GROUP TAB LOCATOR

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INa	Introduction
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5	Brakes
6	Clutch
7	Cooling System
8A	Battery
8B	Starting Systems
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8L	Lamps
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8O	Power Distribution System
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INTRODUCTION

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DESCRIPTION AND OPERATION

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:

- Vehicle Safety Certification Label.
- Frame rail.

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

VEHICLE IDENTIFICATION NUMBER DECODING CHART

POSITION	INTERPRETATION	CODE = DESCRIPTION
1	Country of Origin	1 = United States
2	Make	J = Jeep
3	Vehicle Type	4 = MPV
4	Gross Vehicle Weight Rating	E = 3001-4000 lbs. F = 4001-5000 lbs.
5	Vehicle Line	Y = Wrangler 4X4
6	Series	1 = Sport 2 = SE 4 = Sahara
7	Body Style	9 = Open Body
8	Engine	P = 2.5L Unleaded-Gasoline S = 4.0L Unleaded-Gasoline
9	Check Digit	
10	Model Year	Y=2000
11	Assembly Plant	P = Toledo #2
12 thru 17	Vehicle Build Sequence	

DESCRIPTION AND OPERATION (Continued)



Fig. 1 Vehicle Safety Certification Label—Typical

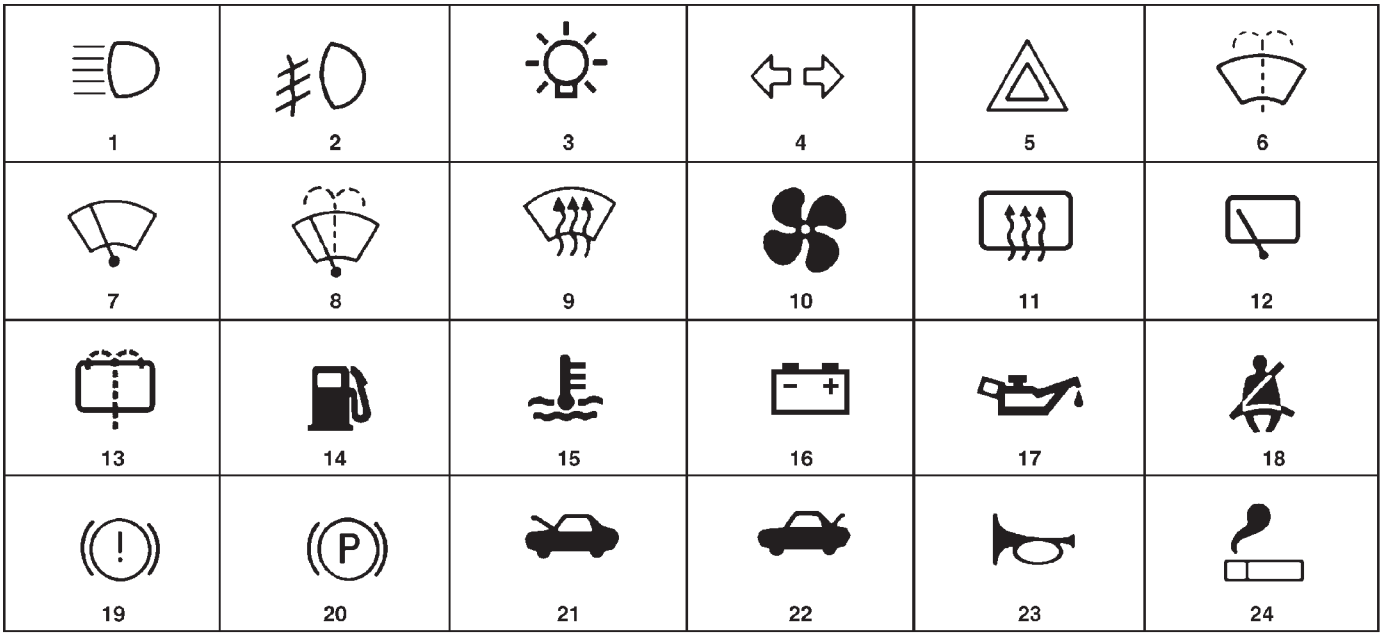
VEHICLE SAFETY CERTIFICATION LABEL

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

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

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

DESCRIPTION AND OPERATION (Continued)



80be4788

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

INTERNATIONAL SYMBOLS

DESCRIPTION

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.

FASTENER IDENTIFICATION

DESCRIPTION

GRADE/CLASS IDENTIFICATION

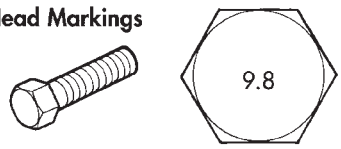
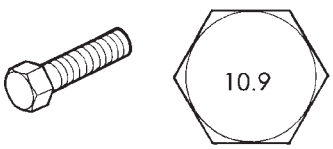
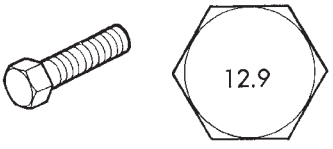
The SAE bolt strength grades range from grade 2 to grade 8. The higher the grade number, the greater the bolt strength. Identification is determined by the line marks on the top of each bolt head. The actual bolt strength grade corresponds to the number of line marks plus 2. The most commonly used metric bolt strength classes are 9.8 and 10.9. The metric strength class identification number is imprinted on the head of the bolt. The higher the class number, the greater the bolt strength. Some metric nuts are imprinted with a single-digit strength class on the nut face. Refer to the Fastener Identification and Fastener Strength Charts.

DESCRIPTION AND OPERATION (Continued)

FASTENER IDENTIFICATION

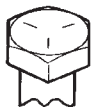
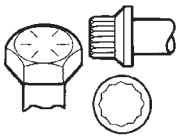
Bolt Markings and Torque - Metric

Commercial Steel Class

	9.8	10.9	12.9
Bolt Head Markings			

Body Size	Torque				Torque				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

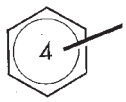
SAE Grade Number	5	8
Bolt Head Markings These are all SAE Grade 5 (3) line	 	

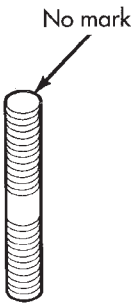
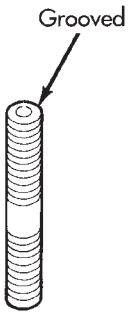
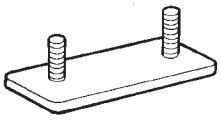
	Bolt Torque - Grade 5 Bolt				Bolt Torque - Grade 8 Bolt			
Body Size	Cast Iron		Aluminum		Cast Iron		Aluminum	
	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
1/4 - 20	9	7	8	6	15	11	12	9
- 28	12	9	9	7	18	13	14	10
5/16 - 18	20	15	16	12	30	22	24	18
- 24	23	17	19	14	33	24	25	19
3/8 - 16	40	30	25	20	55	40	40	30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

DESCRIPTION AND OPERATION (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

	Mark	Class
Stud bolt		4T
		6T
Welded bolt		4T

DESCRIPTION AND OPERATION (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

The metric system is based on quantities of one, ten, one hundred, one thousand and one million (Fig. 2).

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

Fig. 2 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.)

TORQUE REFERENCES

DESCRIPTION

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

CONVERSION FORMULAS AND EQUIVALENT VALUES

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

COMMON METRIC EQUIVALENTS

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

DESCRIPTION AND OPERATION (Continued)

METRIC CONVERSION CHART

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

DESCRIPTION AND OPERATION (Continued)

TORQUE SPECIFICATIONS

SPECIFIED TORQUE FOR STANDARD BOLTS

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

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DESCRIPTION AND OPERATION

VEHICLE IDENTIFICATION NUMBER

DESCRIPTION

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

The Vehicle Identification Number is also imprinted on the:

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

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

VEHICLE IDENTIFICATION NUMBER DECODING CHART

POSITION	INTERPRETATION	CODE = DESCRIPTION
1	Country of Origin	1 = United States
2	Make	J = Jeep
3	Vehicle Type	4 = MPV
4	Gross Vehicle Weight Rating	E = 3001-4000 lbs. F = 4001-5000 lbs.
5	Vehicle Line	A = Wrangler 4X4 Left Hand Drive 4 = Wrangler 4X4 Right Hand Drive
6	Series/Transmission	4 = Sport 5 = Sahara N = 5 SPD. Manual - DDO A = 3 SPD. Auto - DGA
7	Body Style	9 = Open Body
8	Engine	P = 2.5L Gasoline S = 4.0L Gasoline
9	Check Digit	
10	Model Year	Y = 2000
11	Assembly Plant	P = Toledo #2
12 thru 17	Vehicle Build Sequence	

DESCRIPTION AND OPERATION (Continued)



Fig. 1 Vehicle Safety Certification Label—Typical

VEHICLE SAFETY CERTIFICATION LABEL

DESCRIPTION

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

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

BODY CODE PLATE

DESCRIPTION

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

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

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

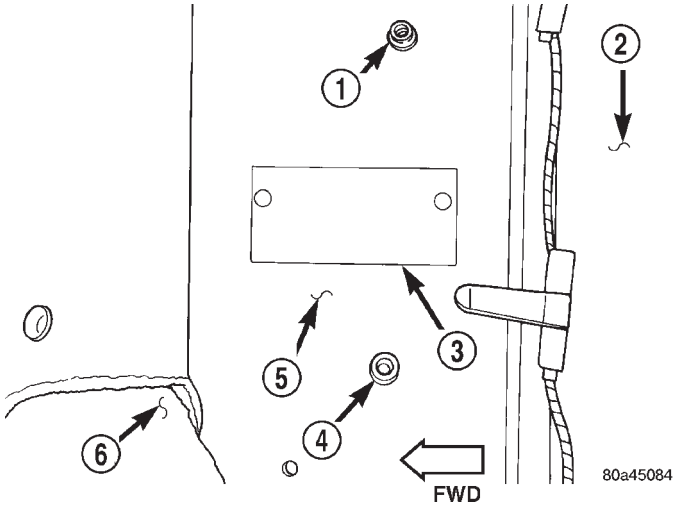


Fig. 2 Body Code Plate Location

1 – SNAP
2 – REAR CARPET
3 – BODY CODE PLATE
4 – SNAP
5 – FLOOR PAN
6 – FRONT CARPET

BODY CODE PLATE—LINE 3

DIGITS 1 THROUGH 12

Vehicle Order Number

DIGITS 13, 14, AND 15

Roof

- VJN = Soft Top White
- VJU = Soft Top Spice
- VJX = Soft Top Black
- VKN = Hard Top White
- VKU = Hard Top Spice
- VKX = Hard Top Black

DIGITS 16, 17, AND 18

Car Line Shell

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

DESCRIPTION AND OPERATION (Continued)

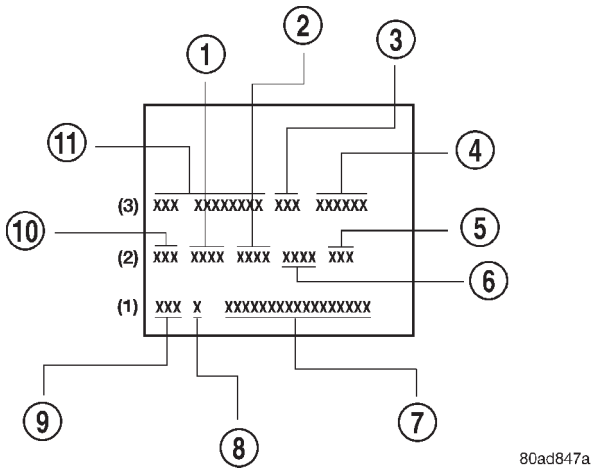


Fig. 3 Body Code Plate Decoding

1 – PRIMARY PAINT
2 – SECONDARY PAINT
3 – ROOF
4 – CAR LINE SHELL
5 – ENGINE
6 – TRIM
7 – VIN
8 – MARKET
9 – TRANSMISSION
10 – PAINT PROCEDURE
11 – VEHICLE ORDER NUMBER

DIGIT 19

Price Class
- L = Wrangler (All)

DIGITS 20 AND 21

Body Type
- 77 = Wheel Base (93.4 in.)

BODY CODE PLATE—LINE 2

DIGITS 1,2, AND 3

Paint Procedure

DIGIT 4

Open Space

DIGITS 5 THROUGH 8

Primary Paint
Refer to Group 23, Body for color codes.

DIGIT 9

Open Space

DIGITS 10 THROUGH 13

Secondary Paint

DIGIT 14

Open Space

DIGITS 15 THROUGH 18

Interior Trim Code

DIGIT 19

Open Space

DIGITS 20, 21, AND 22

Engine Code
- EPE = 2.5 L 4 cyl. MPI Gasoline
- ERH = 4.0L 6 cyl. MPI Gasoline

BODY CODE PLATE—LINE 1

DIGITS 1, 2, AND 3

Transmission Codes
- DDQ = AX5 5–speed Manual
- DDO = AX15 5–speed Manual
- DGD = 30RH 3–speed Automatic
- DGG = 32RH 3–speed Automatic

DIGIT 4

Open Space

DIGIT 5

Market Code
- B = International

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.

DESCRIPTION AND OPERATION (Continued)

INTERNATIONAL VEHICLE CONTROL AND DISPLAY SYMBOLS

DESCRIPTION

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

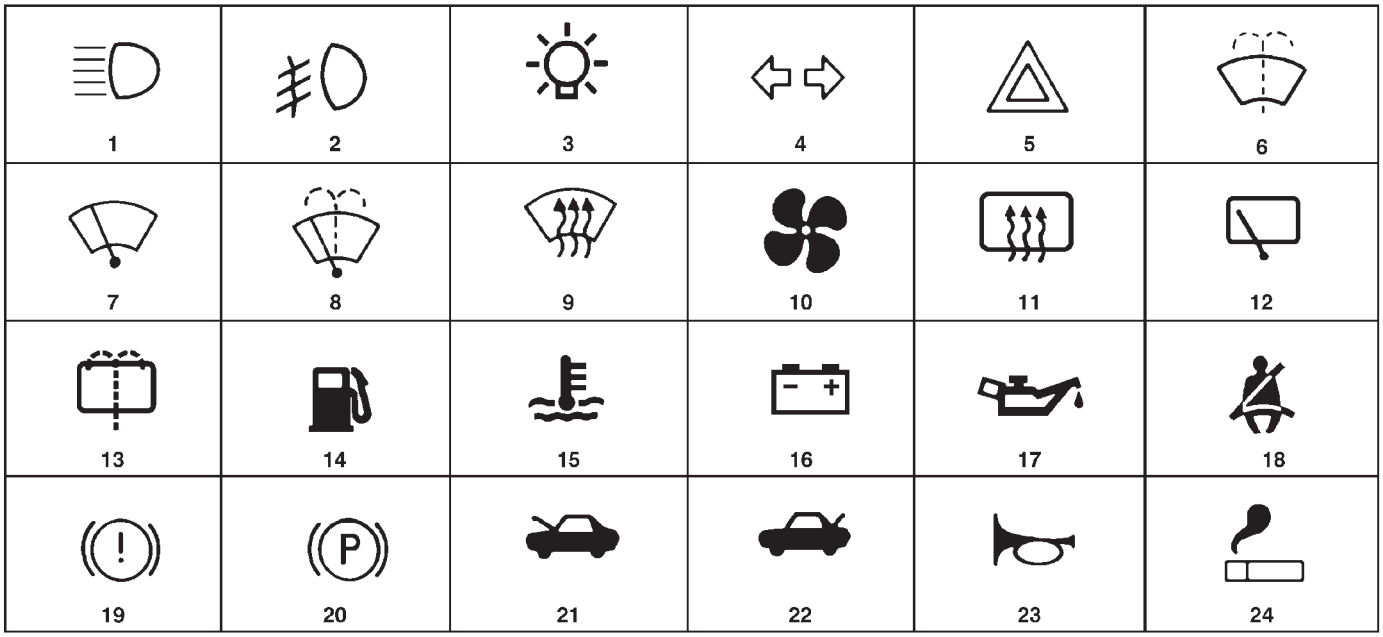


Fig. 4

LUBRICATION AND MAINTENANCE

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LUBRICANTS

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SERVICE PROCEDURES

PARTS AND LUBRICANT RECOMMENDATIONS

RECOMMENDATIONS

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

INTERNATIONAL SYMBOLS

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

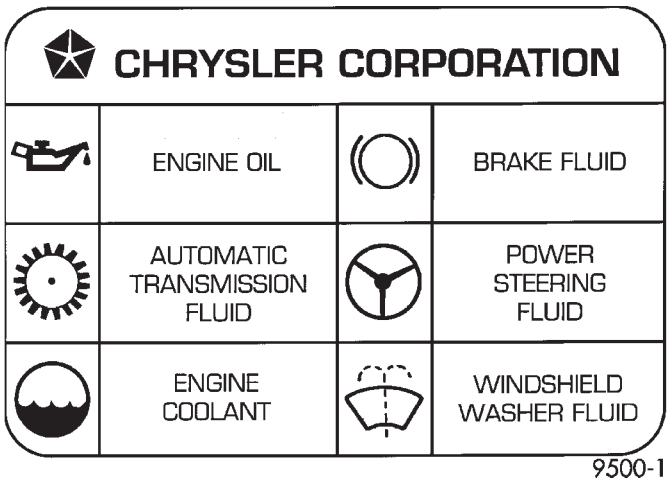


Fig. 1 International Symbols

CLASSIFICATION OF LUBRICANTS

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

DaimlerChrysler 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 DailmlerChrysler Corporation.

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

SERVICE PROCEDURES (Continued)



9400-9

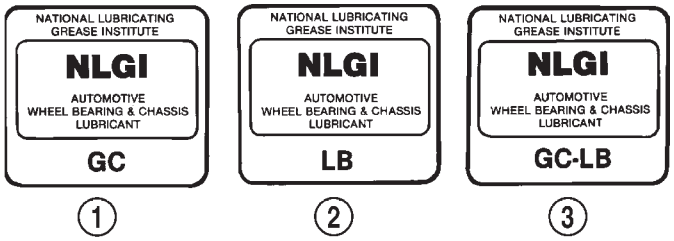
Fig. 2 API Symbol

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.



9200-7

Fig. 3 NLGI Symbol

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

FLUID CAPACITIES

FUEL TANK

Standard . . . . . 71.9 L (19.0 gal.)

ENGINE OILW/FILTER CHANGE

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

COOLING SYSTEM

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

AUTOMATIC TRANSMISSION

Dry fill capacity*

32RH . . . . . 6.31 L (13.33pts.)
30RH . . . . . 4.67 L (9.86 pts.)

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

MANUAL TRANSMISSION

AX5 . . . . . 3.3 L (3.5 qts.)
AX15 . . . . . 3.15 L (3.32 qts.)

TRANSFER CASE

COMMAND-TRAC 231 . . . . . 1.0 L (2.2 pts.)

FRONT AXLE

181–FBI . . . . . 1.2 L (2.5 pts.)

REAR AXLE

194–RBI . . . . . 1.66 L (3.5 pts.*)
216–RBI . . . . . 1.89 L (4.0 pts.*)

* 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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SERVICE PROCEDURES

MAINTENANCE SCHEDULES

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

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 the conditions listed at the beginning of that schedule.

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.

Schedule "A"

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

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

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

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

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

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- Inspect drive belt, adjust tension as necessary (2.5L only).
- Lubricate steering linkage.
- 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 automatic transmission fluid, change filter, and adjust bands.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Flush and replace engine coolant at 36 months, regardless of mileage.
- Lubricate steering and suspension ball joints.

SERVICE PROCEDURES (Continued)

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 (2.5L only).
- Inspect drive belt and replace as needed (4.0L only).
- Lubricate steering linkage.
- 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.
- Inspect drive belt and replace as needed (4.0L only).
- Drain and refill automatic transmission fluid, change filter, and adjust bands.

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 (2.5L only).
- Inspect drive belt and replace as needed (4.0L only).
- Lubricate steering linkage.
- 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.
- Inspect drive belt and replace as needed (4.0L only).

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 automatic transmission fluid, change filter, and adjust bands.

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 (2.5L only).
- Lubricate steering linkage.
- Drain and refill transfer case fluid.
- Inspect drive belt and replace as needed (4.0L only).
- Lubricate steering and suspension ball joints.

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

Schedule "B"

Follow this schedule if the vehicle is operated under one or more of the following conditions:

- Frequent short trips driving less than 5 miles (8 km)
- Frequent driving in dusty conditions

SERVICE PROCEDURES (Continued)

- 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

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, change filter and adjust bands.
- 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 if 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.

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 front and rear axles.‡
- Drain and refill automatic transmission fluid, change filter and adjust bands.
- 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.
- **Inspect engine air cleaner element, replace if necessary.**
- **Replace spark plugs.**
- Inspect drive belt, adjust tension as necessary (2.5L only).
- 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, change filter and adjust bands.
- Drain and refill front and rear axles.‡
- Inspect brake linings.
- Lubricate steering and suspension ball joints.

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 if necessary.**
- Lubricate steering linkage.
- Inspect drive belt and replace as needed (4.0L only).

SERVICE PROCEDURES (Continued)

48,000 Miles (77 000 km)

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid, change filter and adjust bands.
- 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.

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.
- **Inspect engine air cleaner element, replace as necessary.**
- **Replace ignition cables.**
- **Replace spark plugs.**
- Inspect drive belt, adjust tension as necessary (2.5L only).
- Inspect drive belt and replace as needed (4.0L only).
- Lubricate steering linkage.
- Drain and refill transfer case fluid.
- Drain and refill front and rear axles.‡
- Inspect brake linings.
- Lubricate steering and suspension ball joints.
- Drain and refill automatic transmission fluid, change filter and adjust bands.

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, change filter and adjust bands.
- Drain and refill front and rear axles.‡
- Inspect brake linings.
- Lubricate steering and suspension ball joints.

75,000 Miles (120 000 km)

- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air cleaner element, replace as necessary.**
- Lubricate steering linkage.
- Inspect drive belt and replace as needed (4.0L only).

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 3,000 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, change filter and adjust bands.
- 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.
- **Inspect engine air cleaner element, replace as necessary.**

SERVICE PROCEDURES (Continued)

- **Replace spark plugs.**
- Inspect drive belt, adjust tension as necessary (2.5L only).
- Inspect drive belt and replace as needed (4.0L only).
- Lubricate steering linkage.
- Drain and refill transfer case fluid.
- Lubricate steering and suspension ball joints.

93,000 Miles (149 000 km)

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

96,000 Miles (154 000 km)

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid, change filter and adjust bands.
- 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.
- Inspect drive belt and replace as needed (4.0L only).

108,000 Miles (173 000 km)

- Change engine oil.
- Replace engine oil filter.
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid, change filter and adjust bands.
- Drain and refill front and rear axles.‡
- Inspect brake linings.
- Lubricate steering and suspension ball joints.

111,000 Miles (178 000 km)

- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant if it has been 3,000 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.
- **Inspect engine air cleaner element, replace as necessary.**
- **Replace ignition cables.**
- **Replace spark plugs.**
- Inspect drive belt, adjust tension as necessary (2.5L only).
- Inspect drive belt and replace as needed (4.0L only).
- Lubricate steering linkage.
- Drain and refill automatic transmission fluid, change filter and adjust bands.
- 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.

JUMP STARTING, HOISTING AND TOWING

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SERVICE PROCEDURES

JUMP STARTING PROCEDURE

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

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

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

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

DO NOT USE OPEN FLAME NEAR BATTERY.

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

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

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

TO JUMP START A DISABLED VEHICLE:

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

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

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

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

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

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

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

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

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

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

DaimlerChrysler Corporation recommends that a 4WD vehicle be transported on a flat-bed device. A Wheel-lift or front end attached Sling-type device can be used provided all the wheels are lifted off the ground using tow dollies (Fig. 2) and (Fig. 3).

SERVICE PROCEDURES (Continued)

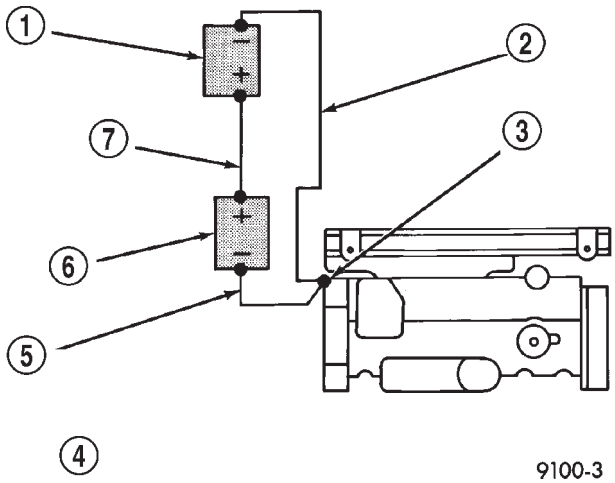


Fig. 1 Jumper Cable Clamp Connections

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

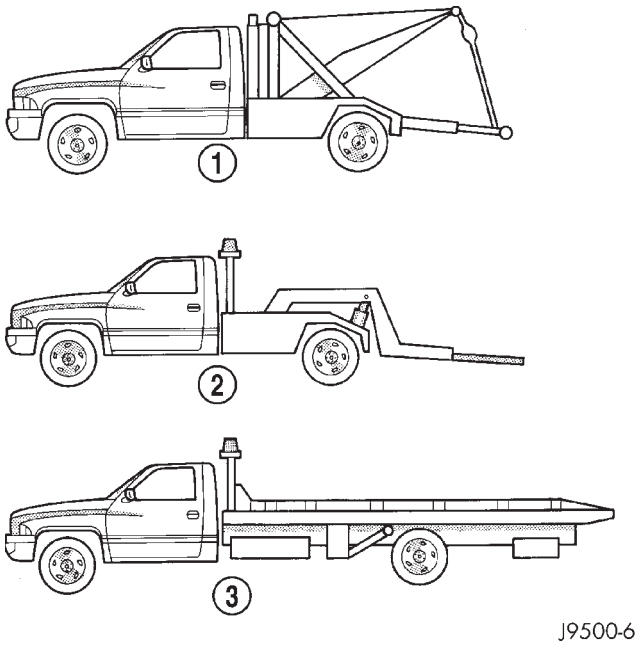


Fig. 2 Tow Vehicles With Approved Equipment

1 – SLING TYPE
2 – WHEEL LIFT
3 – FLAT BED

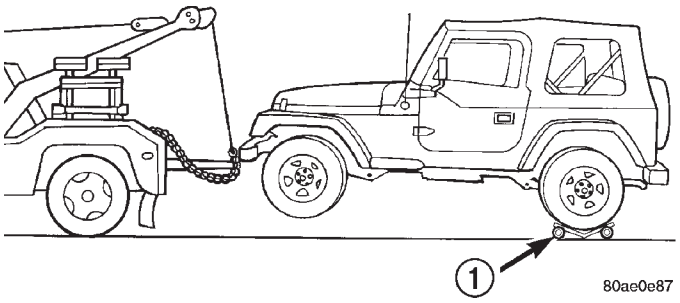


Fig. 3 Towing With Tow Dollies

1 – TOW DOLLY

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.

SERVICE PROCEDURES (Continued)

VEHICLE TOWING

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).

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

TOWING-FRONT END LIFTED (WHEEL LIFT)

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

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

TOWING-REAR END LIFTED (WHEEL LIFT ONLY)

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

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

TOWING-FRONT END LIFTED (SLING-TYPE)

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

(2) Attach T-hooks to the access holes on the outboard side of the frame rails (Fig. 4).

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

(4) Attach the safety chains to the vehicle (Fig. 5).

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

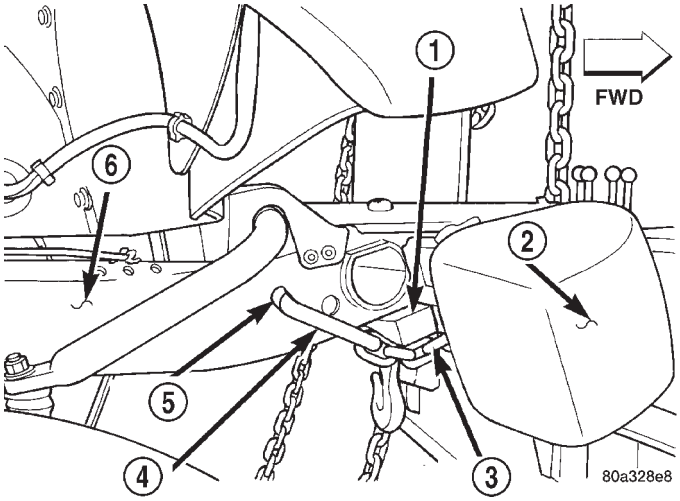


Fig. 4 T-Hook Attachment

1 – PROTECTIVE PAD
2 – BUMPER
3 – CHAIN
4 – T-HOOK
5 – ACCESS HOLE
6 – FRAME

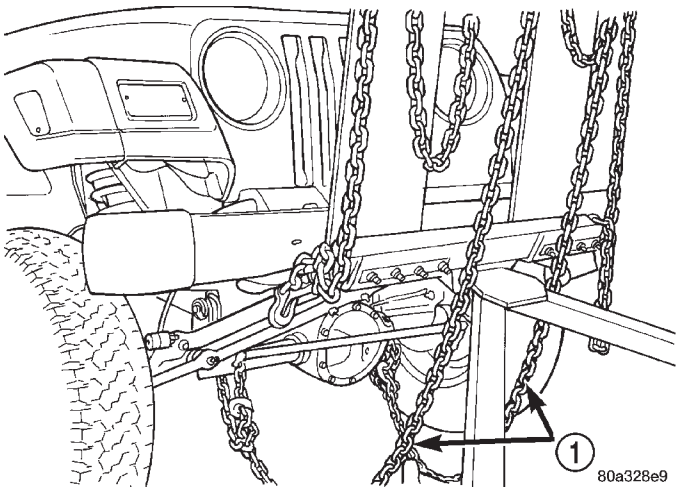


Fig. 5 Safety Chain Attachment

1 – SAFETY CHAIN

RECREATIONAL TOWING

Refer to the Owners Manual for towing procedures.

EMERGENCY TOW HOOKS

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

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

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

HOISTING RECOMMENDATIONS

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

FLOOR JACK

When properly positioned, a floor jack can be used to lift a Jeep vehicle (Fig. 6). 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.
- The engine or transmission oil pan.
- The fuel tank.
- A front suspension arm.
- Transfer case.

SERVICE PROCEDURES (Continued)

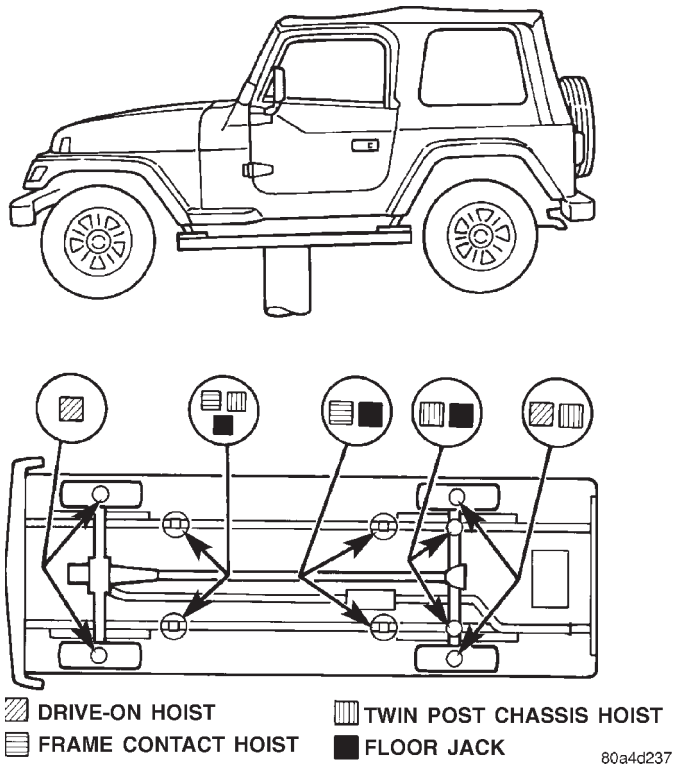


Fig. 6 Vehicle Lifting Locations

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.

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

SUSPENSION

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ALIGNMENT

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DESCRIPTION AND OPERATION

WHEEL ALIGNMENT

DESCRIPTION

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

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

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.

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.

OPERATION

- **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.

DESCRIPTION AND OPERATION (Continued)

- **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.

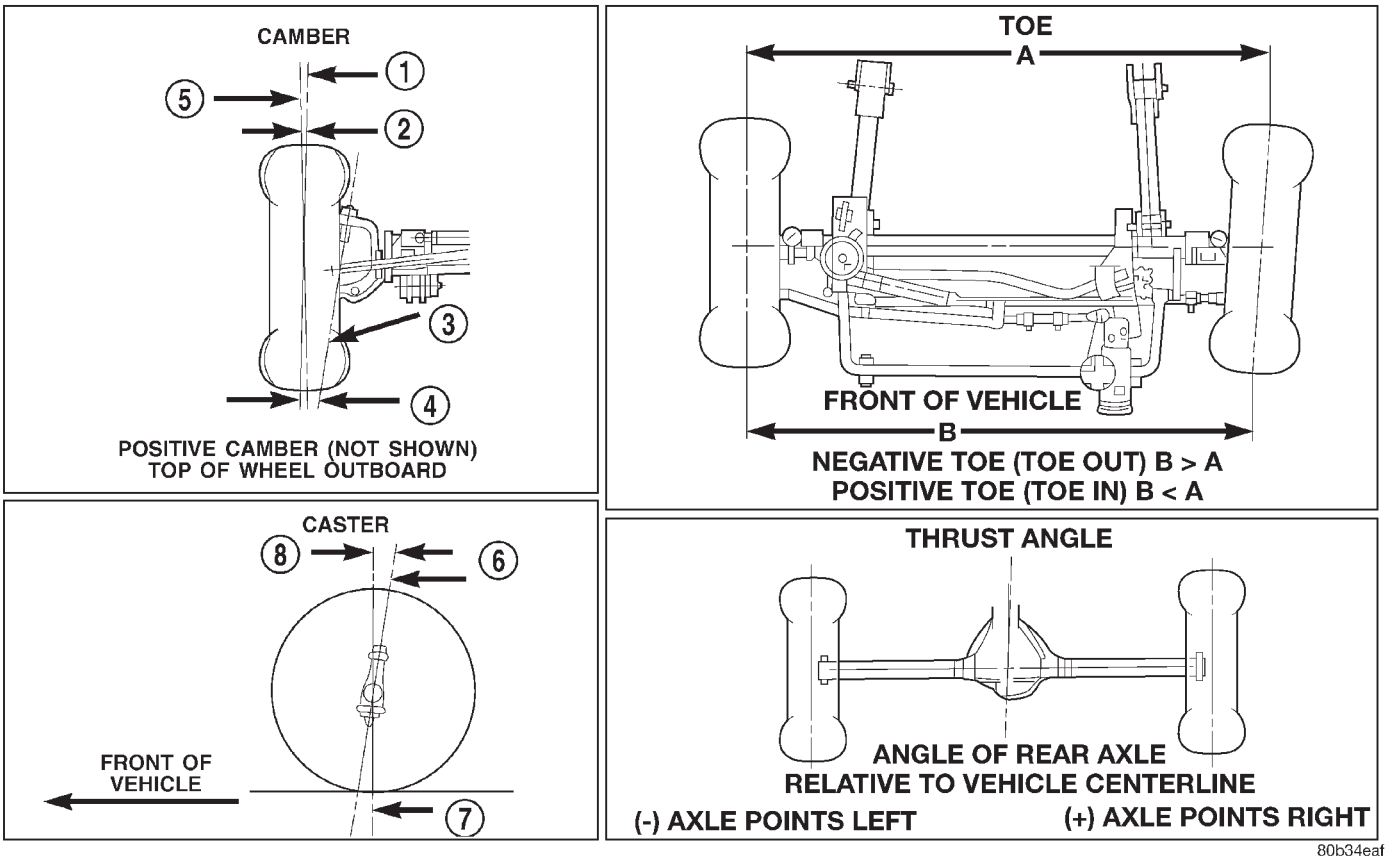


Fig. 1 Wheel Alignment Measurements

1 – WHEEL CENTERLINE
2 – NEGATIVE CAMBER ANGLE
3 – PIVOT CENTERLINE
4 – SCRUB RADIUS
5 – TRUE VERTICAL
6 – KING PIN
7 – VERTICAL
8 – POSITIVE CASTER

DIAGNOSIS AND TESTING

SUSPENSION AND STEERING SYSTEM

CONDITION	POSSIBLE CAUSES	CORRECTION
FRONT END NOISE	1. Loose or worn wheel bearings.	1. Adjust or replace wheel bearings.
	2. Loose or worn steering or suspension components.	2. Tighten or replace components as necessary.
EXCESSIVE PLAY IN STEERING	1. Loose or worn wheel bearings.	1. Adjust or replace wheel bearings.
	2. Loose or worn steering or suspension components.	2. Tighten or replace components as necessary.
	3. Loose or worn steering gear.	3. Adjust or replace steering gear.
FRONT WHEELS SHIMMY	1. Loose or worn wheel bearings.	1. Adjust or replace wheel bearings.
	2. Loose or worn steering or suspension components.	2. Tighten or replace components as necessary.
	3. Tires worn or out of balance.	3. Replace or balance tires.
	4. Alignment.	4. Align vehicle to specifications.
	5. Leaking steering dampener.	5. Replace steering dampener.
VEHICLE INSTABILITY	1. Loose or worn wheel bearings.	1. Adjust or replace wheel bearings.
	2. Loose or worn steering or suspension components.	2. Tighten or replace components as necessary.
	3. Tire pressure.	3. Adjust tire pressure.
	4. Alignment.	4. Align vehicle to specifications.
EXCESSIVE STEERING EFFORT	1. Loose or worn steering gear.	1. Adjust or replace steering gear.
	2. Power steering fluid low.	2. Add fluid and repair leak.
	3. Column coupler binding.	3. Replace coupler.
	4. Tire pressure.	4. Adjust tire pressure.
	5. Alignment.	5. Align vehicle to specifications.
VEHICLE PULLS TO ONE SIDE DURING BRAKING	1. Uneven tire pressure.	1. Adjust tire pressure.
	2. Worn brake components.	2. Repair brakes as necessary.
	3. Air in brake line.	3. Repair as necessary.
VEHICLE LEADS OR DRIFTS FROM STRAIGHT AHEAD DIRECTION ON UNCROWNED ROAD	1. Radial tire lead.	1. Cross front tires.
	2. Brakes dragging.	2. Repair brake as necessary.
	3. Weak or broken spring.	3. Replace spring.
	4. Uneven tire pressure.	4. Adjust tire pressure.
	5. Wheel Alignment.	5. Align vehicle.
	6. Loose or worn steering or suspension components.	6. Repair as necessary.
	7. Cross caster out of spec.	7. Align vehicle.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
KNOCKING, RATTLING OR SQUEAKING	1. Worn shock bushings.	1. Replace shock.
	2. Loose, worn or bent steering/ suspension components.	2. Inspect, tighten or replace components as necessary.
	3. Shock valve.	3. Replace shock.
IMPROPER TRACKING	1. Loose, worn or bent track bar.	1. Inspect, tighten or replace component as necessary.
	2. Loose, worn or bent steering/ suspension components.	2. Inspect, tighten or replace components as necessary.

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.
(7) Road test the vehicle.

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

CAMBER

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

CASTER

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

During the road test, turn the vehicle to both the left and right. If the steering wheel returns to the center position unassisted, the caster angle is correct. However, if steering wheel does not return toward the center position unassisted, a low caster angle is probable.

Caster can be adjusted by installing a cam bolts and rotating the cams on the lower suspension arm (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 and Driveline for additional information.

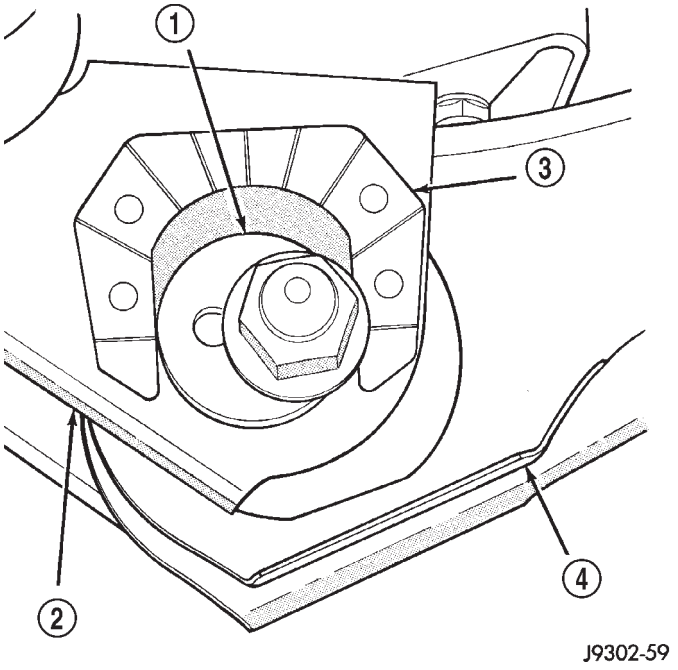


Fig. 2 Cam Adjuster

1 – ADJUSTMENT CAM
2 – AXLE BRACKET
3 – BRACKET REINFORCEMENT
4 – LOWER SUSPENSION ARM

TOE POSITION

NOTE: The wheel toe position adjustment is the final adjustment. This adjustment must be performed with the engine running, if the vehicle is equipped with power steering.

SERVICE PROCEDURES (Continued)

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

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

(3) Adjust the right wheel toe position with the drag link (Fig. 4). Turn the sleeve until the right wheel is at the correct positive TOE-IN position. Position the clamp bolts as shown (Fig. 3) and tighten to 49 N·m (36 ft. lbs.). **Make sure the toe setting does not change during clamp tightening.**

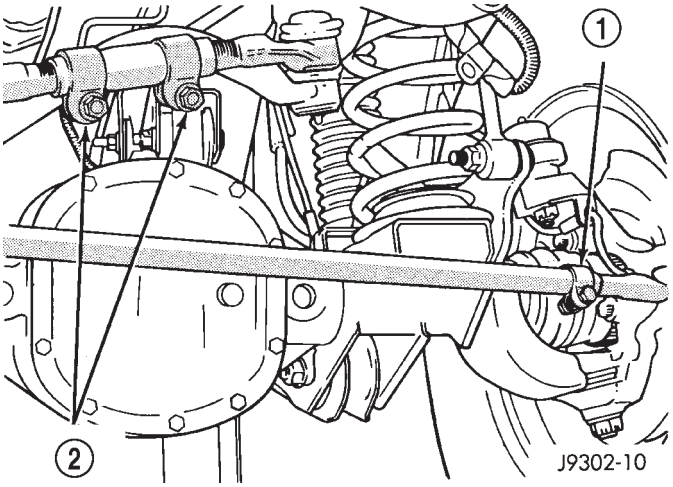


Fig. 3 Drag Link and Tie Rod Clamp

1 – TIE ROD CLAMP
2 – DRAG LINK CLAMPS

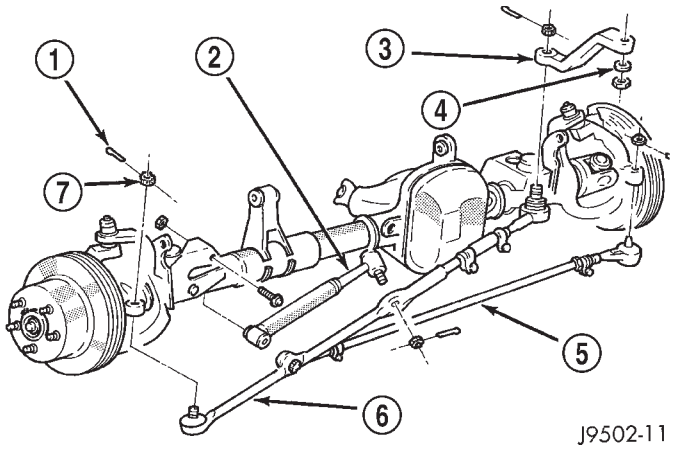


Fig. 4 Steering Linkage

1 – COTTER PIN
2 – DAMPENER
3 – PITMAN ARM
4 – WASHER
5 – TIE ROD
6 – DRAG LINK
7 – NUT

(4) Adjust the left wheel toe position with the tie rod. Turn the sleeve until the left wheel is at the same TOE-IN position as the right wheel. Position the clamp bolts as shown (Fig. 3) and tighten to 27 N·m (20 ft. lbs.). **Make sure the toe setting does not change during clamp tightening.**

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

SPECIFICATIONS

ALIGNMENT SPECIFICATIONS

NOTE: Alignment specifications are in degrees.

ANGLE	PREFERRED	RANGE	MAX RT/LT DIFFERENCE
CASTER	+ 7°	± 1.0°	0.65°
CAMBER (fixed angle)	− 0.25°	± 0.63°	1.0°
TOE-IN (each front wheel)	+ 0.15°	± 0.07°	0.05°
REAR SPECIFICATION			
REAR CAMBER	− 0.25°	± 0.25°	NA
TOTAL TOE-IN	+ O.25°	± 0.25°	NA
THRUST ANGLE 0° ± 0.25°			

FRONT SUSPENSION

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DESCRIPTION AND OPERATION

FRONT SUSPENSION

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

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

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.

SHOCK ABSORBERS

DESCRIPTION

The top of the shock absorbers are bolted to a frame bracket. The bottom of the shocks are bolted to the axle brackets.

OPERATION

The shock absorbers dampen jounce and rebound motion of the vehicle over various road conditions and limit suspension rebound travel.

JOUNCE BUMPER

DESCRIPTION

The jounce bumpers are mounted under the frame rails inside of the coil springs.

OPERATION

The jounce bumpers are used to limit suspension travel in compression.

COIL SPRINGS AND ISOLATORS

DESCRIPTION

The coil springs mount up in the wheelhouse which is part of the unitized body bracket. A rubber doughnut isolator is located between the top of the spring and the bracket. The bottom of the spring seats on a axle pad.

DESCRIPTION AND OPERATION (Continued)

OPERATION

The coil springs control ride quality and maintain proper ride height. The isolators provide road noise isolation.

LOWER SUSPENSION ARMS AND BUSHINGS

DESCRIPTION

The lower suspension arms are steel and use bushings at one end of the arm. The arms mount to the frame rail bracket and the axle brackets.

OPERATION

The lower suspension arm bushings provide isolation from the axle. The arm and bushings provide location and react to loads from the axle. The lower suspension arms can be used to adjust caster and pinion angle by installing a cam bolt service package.

UPPER SUSPENSION ARMS AND BUSHINGS

DESCRIPTION

The upper suspension arms are steel and use rubber bushings at each end of the arm. The arms mount to the frame rail bracket and the axle brackets.

OPERATION

The arm and bushings provide location and react to loads from the axle. The bushings provide isolation from the axle.

STABILIZER BAR

DESCRIPTION

The spring steel bar extends across the top of the chassis frame rails. Links are connected from the bar to the axle brackets. The stabilizer bar and links are isolated by rubber bushings.

OPERATION

The stabilizer bar is used to control vehicle body roll during turns. The bar helps to control the vehicle body in relationship to the suspension.

TRACK BAR

DESCRIPTION

The bar is attached to a frame rail bracket with a ball stud and an axle bracket with a bushing. The bar is forged and has non replaceable isolator bushing and ball stud.

OPERATION

The track bar is used to control front axle lateral movement and provides cross car location of the axle assembly.

HUB/BEARING

DESCRIPTION

The bearing used on the front hub of this vehicle is the combined hub and bearing unit type assembly. This unit assembly combines the front wheel mounting hub (flange) and the front wheel bearing into a one piece unit. The wheel mounting studs are the only replaceable component of the hub/bearing assembly.

OPERATION

The hub/bearing assembly is mounted to the steering knuckle and is retained by three mounting bolts accessible from the back of the steering knuckle. The hub/bearing unit is not serviceable and must be replaced as an assembly if the bearing or the hub is determined to be defective.

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.

SERVICE PROCEDURES

LUBRICATION

Periodic lubrication of the suspension system is required. Refer to Group 0, Lubrication And Maintenance for the recommended maintenance schedule.

The following component must be lubricated:

- Track bar

REMOVAL AND INSTALLATION

SHOCK ABSORBER

REMOVAL

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

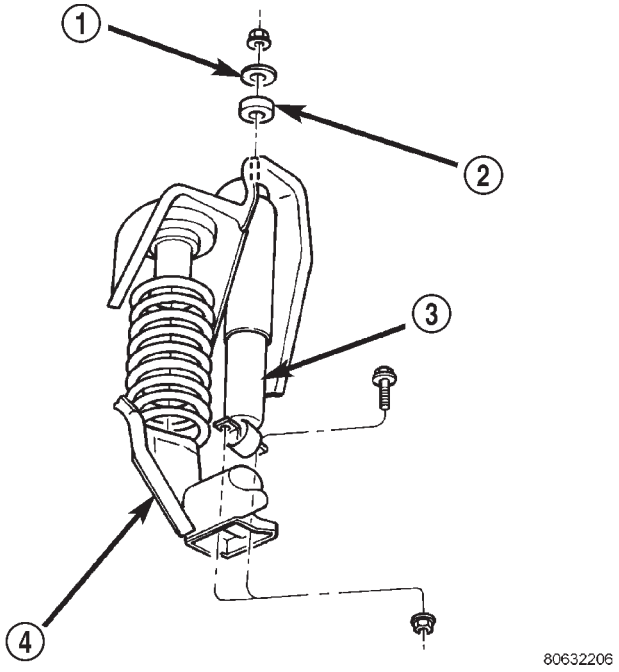


Fig. 1 Coil Spring & Shock Absorber

1 – RETAINER
2 – GROMMET
3 – SHOCK
4 – FRONT AXLE

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

INSTALLATION

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

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

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

COIL SPRING

REMOVAL

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

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

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

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

(5) Disconnect the stabilizer bar links and shock absorbers from the axle.

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

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

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

NOTE: Left coil spring has a retainer and bolt which must be removed from the axle pad.

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

INSTALLATION

(1) Position the coil spring on the axle pad.

NOTE: Install retainer and bolt on the left spring and tighten to 22 N·m (16 ft. lbs.).

(2) Install the jounce bumper.

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

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

(5) Install the lower suspension arm to the axle.

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

(7) Install drag link to pit man arm.

(8) Remove the supports and lower the vehicle.

(9) Tighten all suspension components to proper torque.

STEERING KNUCKLE

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

REMOVAL AND INSTALLATION (Continued)

LOWER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.

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

(3) If the vehicle is equipped with a cam bolt service package paint or scribe alignment marks on the cam adjusters and suspension arm for installation reference (Fig. 2).

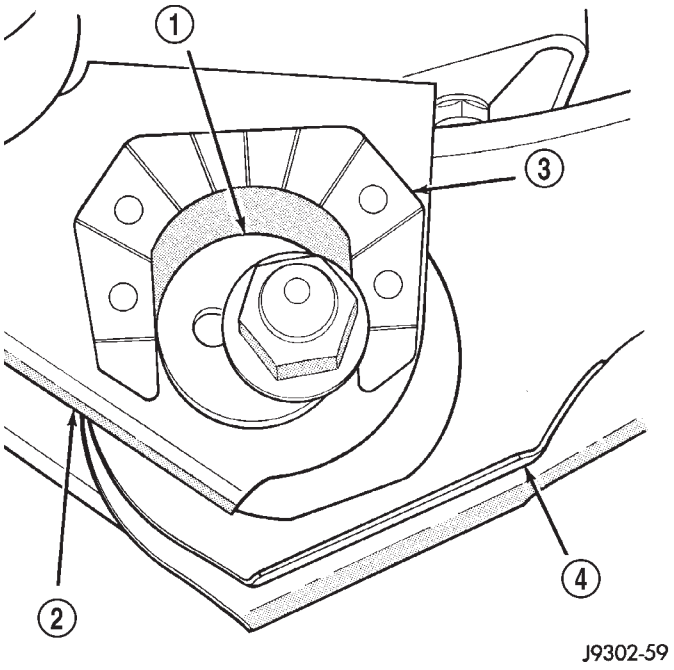


Fig. 2 Cam Bolt Service Package

1 – ADJUSTMENT CAM
2 – AXLE BRACKET
3 – BRACKET REINFORCEMENT
4 – LOWER SUSPENSION ARM

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

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

INSTALLATION

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

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

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

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

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

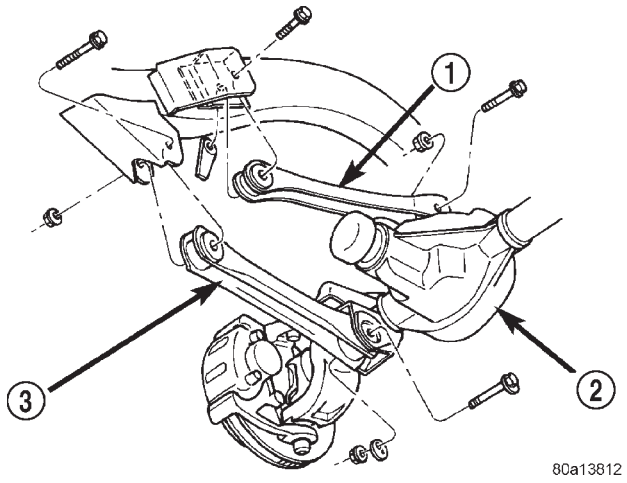


Fig. 3 Upper & Lower Suspension Arms

1 – UPPER SUSPENSION ARM
2 – FRONT AXLE
3 – LOWER SUSPENSION ARM

(5) Lower the vehicle.

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

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

(8) Align vehicle to specifications.

UPPER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.

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

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

INSTALLATION

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

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

(3) Remove the supports and lower the vehicle.

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

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.

REMOVAL AND INSTALLATION (Continued)

(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.

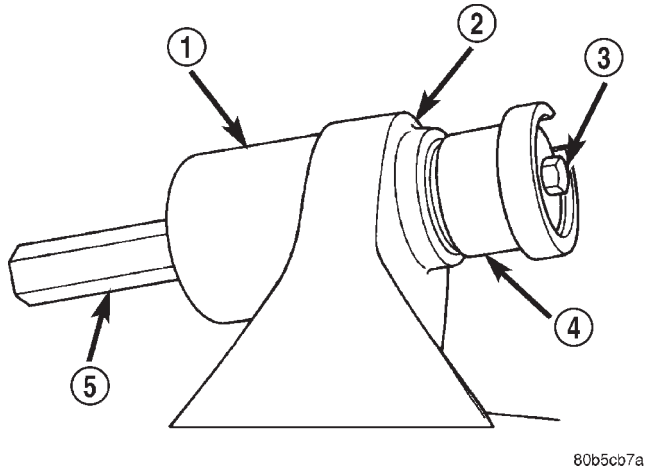


Fig. 4 Bushing Removal

1 – RECEIVER
2 – AXLE BRACKET
3 – BOLT
4 – REMOVER/INSTALLER
5 – LONG NUT

(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 7932-1 on 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.

STABILIZER BAR

REMOVAL

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

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

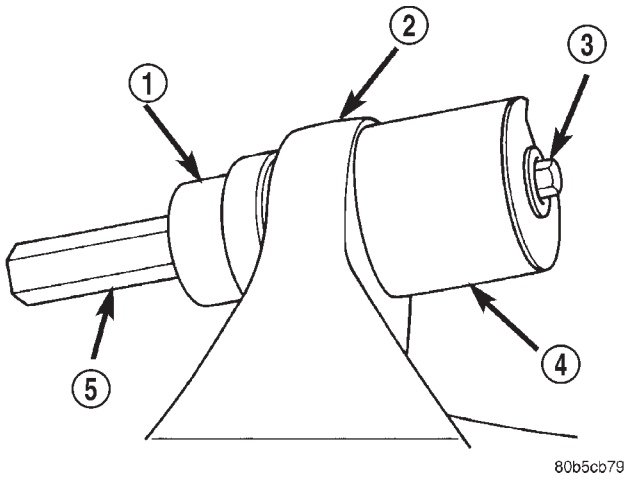


Fig. 5 Bushing Installation

1 – REMOVER/INSTALLER
2 – AXLE BRACKET
3 – BOLT
4 – RECEIVER
5 – LONG NUT

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

(4) Remove stabilizer bar.

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

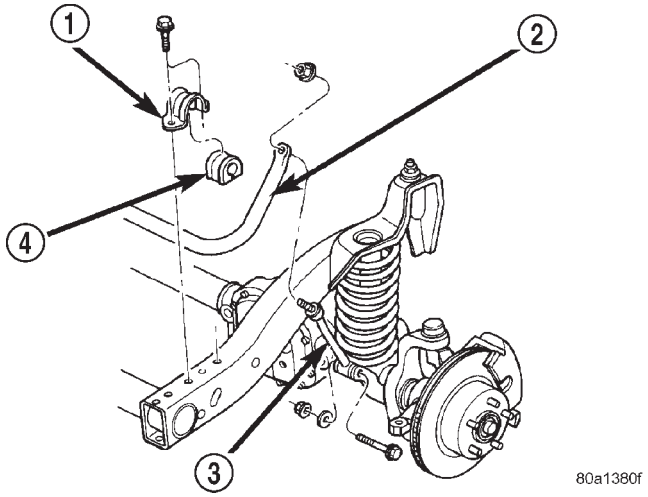


Fig. 6 Stabilizer Bar

1 – RETAINER
2 – STABILIZER BAR
3 – LINK
4 – BUSHING

INSTALLATION

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

REMOVAL AND INSTALLATION (Continued)

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

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

(4) Install bumper valence.

TRACK BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the cotter pin and nut from the ball stud end at the frame rail bracket (Fig. 7).

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

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

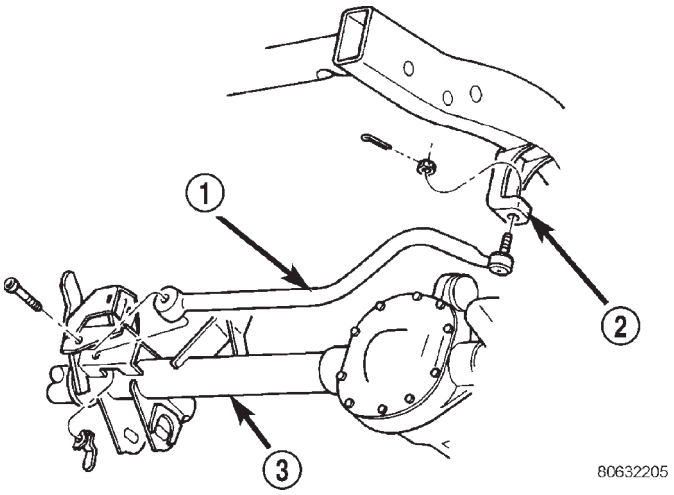


Fig. 7 Track Bar

1 – TRACK BAR
2 – FRAME BRACKET
3 – FRONT AXLE

INSTALLATION

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

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

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

(4) Remove the supports and lower the vehicle.

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

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

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

CAUTION: Do not use a hammer to remove wheel studs.

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove brake caliper, caliper adapter and rotor, refer to Group 5 Brakes for procedure.

(4) Remove stud from hub with Remover C-4150A (Fig. 9).

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.

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

(4) Remove lug nut and washers.

(5) Install the brake rotor, caliper adapter, and caliper, refer to 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.

REMOVAL AND INSTALLATION (Continued)

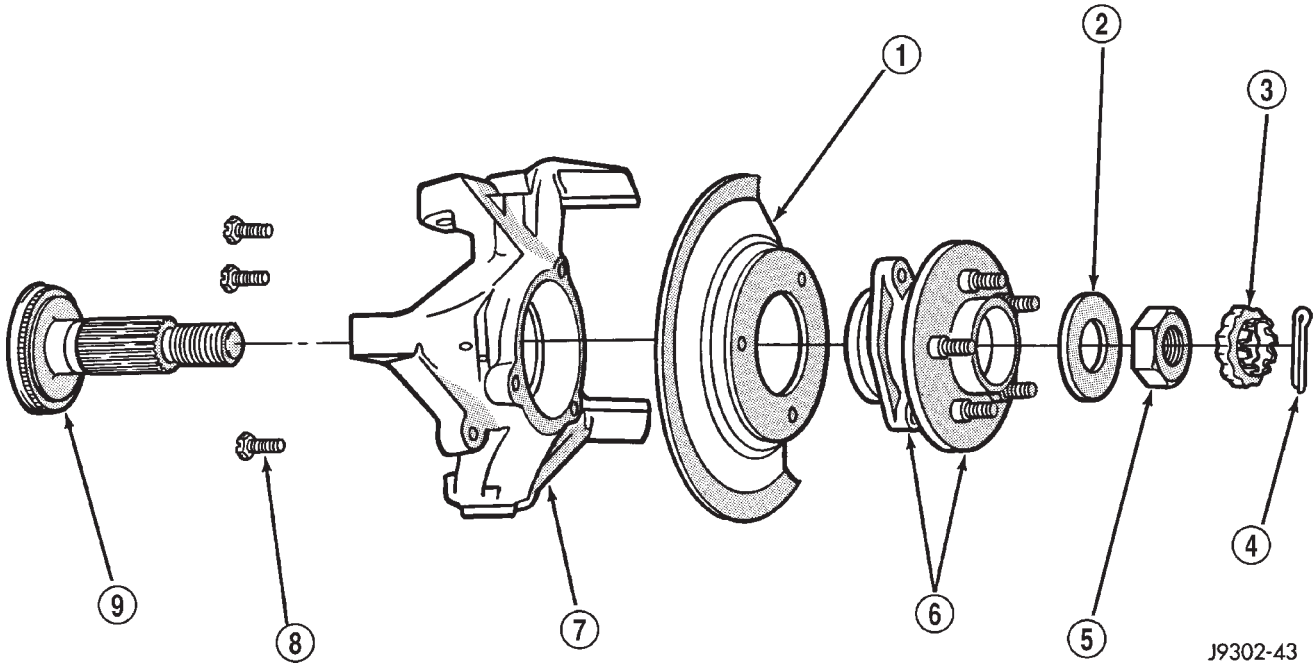


Fig. 8 Hub Bearing & Knuckle

1 – BRAKE SHIELD
2 – WASHER
3 – RETAINER
4 – COTTER PIN
5 – NUT
6 – HUB AND BEARING ASSEMBLY
7 – STEERING KNUCKLE
8 – BOLT
9 – TONE WHEEL (ABS)

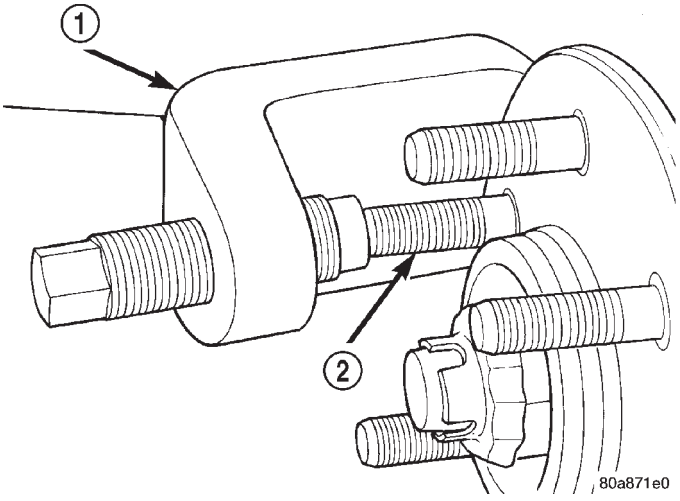


Fig. 9 Wheel Stud Removal

1 – REMOVER
2 – WHEEL STUD

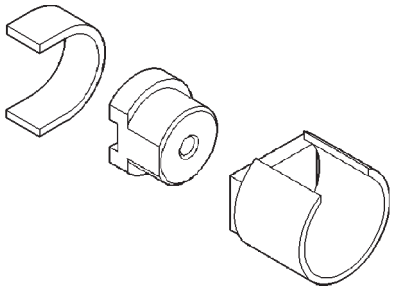
SPECIFICATIONS

TORQUE CHART

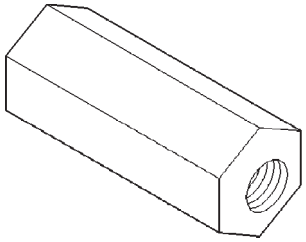
DESCRIPTION	TORQUE
Shock Absorber	
Upper Nut	23 N·m (17 ft. lbs.)
Lower Nut	28 N·m (250 in. lbs.)
Suspension Arm Lower	
Axle Bracket Nut	115 N·m (85 ft. lbs.)
Frame Bracket Nut	176 N·m (130 ft. lbs.)
Suspension Arm Upper	
Axle Bracket Nut	75 N·m (55 ft. lbs.)
Frame Bracket Bolt	75 N·m (55 ft. lbs.)
Stabilizer Bar	
Retainer Bolts	54 N·m (40 ft. lbs.)
Link Upper Nut	61 N·m (45 ft. lbs.)
Link Lower Bolt	95 N·m (70 ft. lbs.)
Track Bar	
Ball Stud Nut	88 N·m (65 ft. lbs.)
Axle Bracket Bolt	75 N·m (55 ft. lbs.)
Hub/Bearing	
Bolts	102 N·m (75 ft. lbs.)
Axle Nut	237 N·m (175 ft. lbs.)

SPECIAL TOOLS

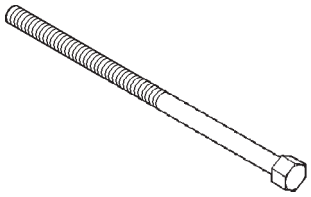
FRONT SUSPENSION



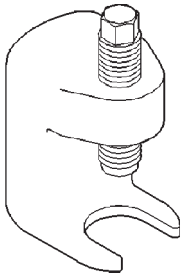
Remover/Installer Suspension Bushing 7932



Nut, Long 7603



Bolt, Special 7604



Remover C-4150A

REAR SUSPENSION

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DESCRIPTION AND OPERATION

REAR SUSPENSION

The rear suspension is link/coil design comprised of:

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

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. This will maintain vehicle ride comfort and prevent premature bushing wear.

SHOCK ABSORBERS

DESCRIPTION

The top of the shock absorbers are bolted to the frame. The bottom of the shocks are bolted to the axle brackets.

OPERATION

The shock absorbers dampen jounce and rebound motion of the vehicle over various road conditions and limit suspension rebound travel.

COIL SPRINGS AND ISOLATORS

DESCRIPTION

The coil springs mount between the bottom of the frame rail and the top of the axle. A rubber doughnut isolator is located between the top of the spring and the frame rail. A plastic isolator is located between the bottom of the spring and the axle.

OPERATION

The coil springs control ride quality and maintain proper ride height. The isolators are used to isolate road noise.

JOUNCE BUMPERS

DESCRIPTION

The jounce bumpers are mounted inside the coil spring to the frame rail.

OPERATION

The jounce bumpers are used to limit suspension travel in compression.

LOWER SUSPENSION ARMS AND BUSHINGS

DESCRIPTION

The lower suspension arms are steel and use bushings at each end of the arm. The arms are mounted from the frame to the axle brackets.

OPERATION

The bushings isolation axle and road noise. The arm and bushings provide location and react to loads from the axle.

STABILIZER BAR

DESCRIPTION

The spring steel bar extends across the axle and mounts to bracket on the axle. Links are connected

DESCRIPTION AND OPERATION (Continued)

from the bar to the side of the frame rail. The stabilizer bar and links are isolated by rubber bushings.

OPERATION

The stabilizer bar is used to control vehicle body roll during turns. The bar helps to control the vehicle body in relationship to the suspension.

TRACK BAR

DESCRIPTION

The bar is attached to a frame rail bracket and axle bracket. The bar has bushings at both ends.

OPERATION

The track bar is used to control rear axle lateral movement.

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) Raise and support the vehicle and the axle.
(2) Remove the upper mounting bolts (Fig. 1).
(3) Remove the lower nut and bolt from the axle bracket. Remove the shock absorber.

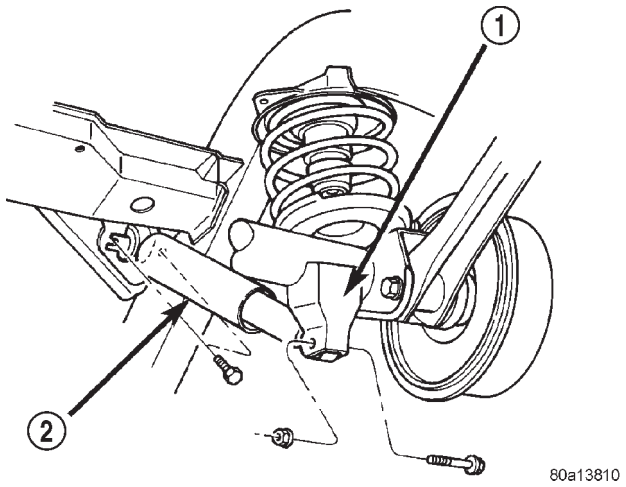


Fig. 1 Shock Absorber

1 – AXLE BRACKET
2 – SHOCK

INSTALLATION

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

COIL SPRING

REMOVAL

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

INSTALLATION

NOTE: Springs can be install with either end up.

(1) Position the coil spring on the axle pad isolator.
(2) Raise the axle into position until the spring seats on the upper isolator.
(3) Connect the stabilizer bar links and shock absorbers to the axle bracket. Connect the track bar to the frame rail bracket.
(4) Remove the supports and lower the vehicle.
(5) Tighten the stabilizer bar links, shock absorbers and track bar to specified torque.

REMOVAL AND INSTALLATION (Continued)

LOWER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.
(2) Remove the lower suspension arm nut and bolt at the axle bracket (Fig. 2).
(3) Remove the nut and bolt at the frame rail mount (Fig. 3) and remove the lower suspension arm.

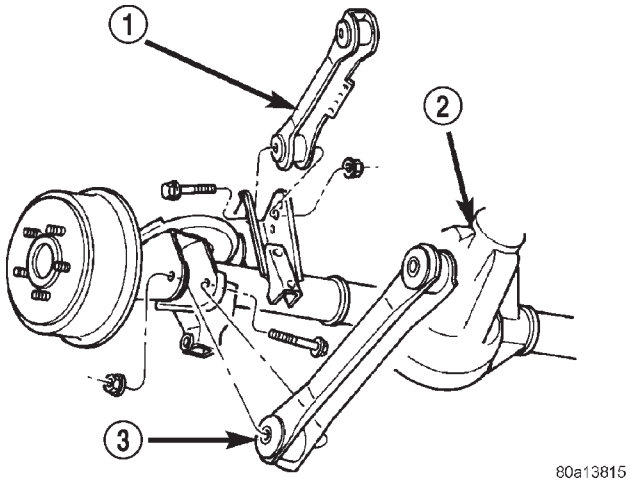


Fig. 2 Upper & Lower Suspension Arms

1 – UPPER SUSPENSION ARM
2 – REAR AXLE
3 – LOWER SUSPENSION ARM

INSTALLATION

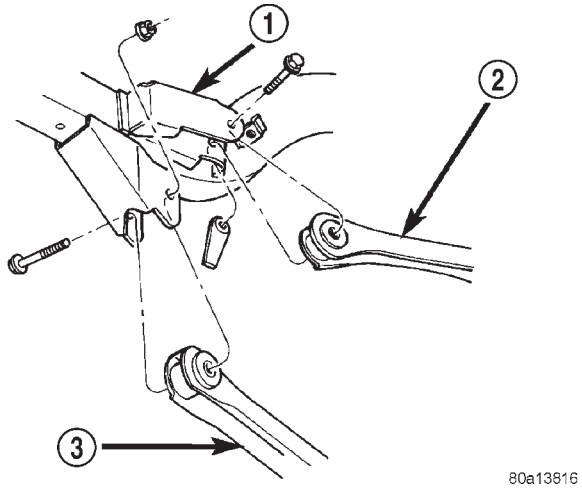


Fig. 3 Upper & Lower Suspension Arms

1 – FRAME MOUNT
2 – UPPER SUSPENSION ARM
3 – LOWER SUSPENSION ARM

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

UPPER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.
(2) Remove the parking brake cable/bracket and ABS wiring bracket from the arm if equipped (Fig. 4).

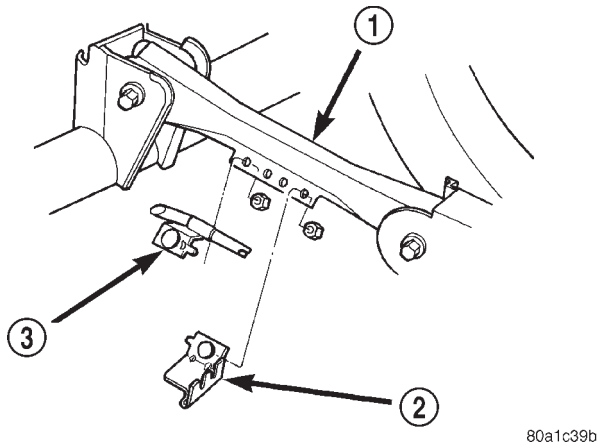


Fig. 4 Parking Brake Cable/Bracket And Wiring Bracket

1 – UPPER SUSPENSION ARM
2 – WIRING BRACKET
3 – PARKING BRAKE CABLE BRACKET

(3) Remove the upper suspension arm nut and bolt from the axle bracket (Fig. 2).
(4) Remove the nut and bolt from the frame rail bracket (Fig. 3) and remove the upper suspension arm.

INSTALLATION

(1) Position the upper suspension arm in the axle bracket and frame rail bracket.
(2) Install the bolts and finger tighten the nuts.
(3) Install the parking brake cable/bracket and ABS wiring bracket on the arm if equipped.
(4) Remove the supports and lower the vehicle.
(5) Tighten the upper suspension arm frame rail bracket bolt to 75 N·m (55 ft. lbs.).
(6) Tighten the upper suspension arm axle bracket nut to 75 N·m (55 ft. lbs.).

STABILIZER BAR

REMOVAL

(1) Raise and support the vehicle.
(2) Remove the stabilizer bar link bolts from the frame mounts (Fig. 5).

REMOVAL AND INSTALLATION (Continued)

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

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

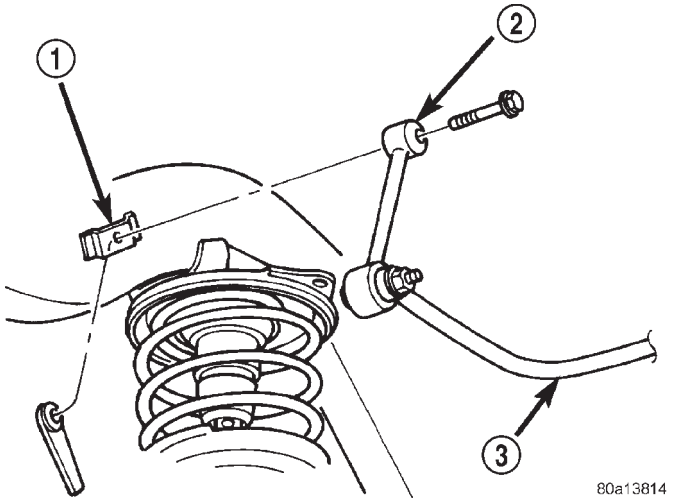


Fig. 5 Stabilizer Bar Link

1 – FRAME MOUNT
2 – LINK
3 – STABILIZER BAR

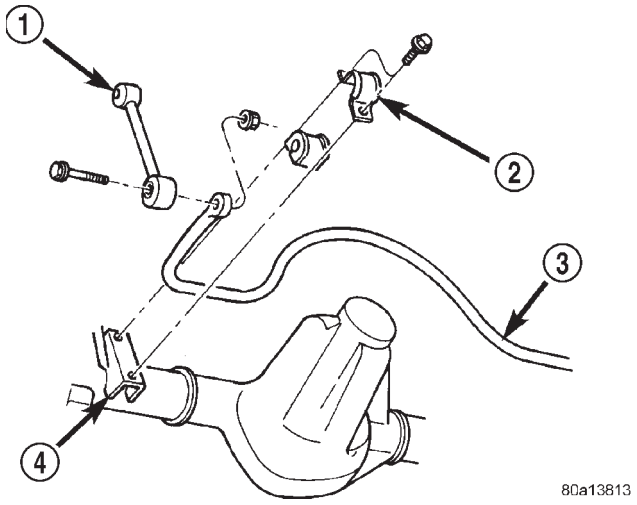


Fig. 6 Stabilizer Bar

1 – LINK
2 – RETAINER
3 – STABILIZER BAR
4 – AXLE MOUNT

INSTALLATION

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

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

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

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

(4) Remove support and lower vehicle.

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

TRACK BAR

REMOVAL

(1) Raise and support the vehicle.

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

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

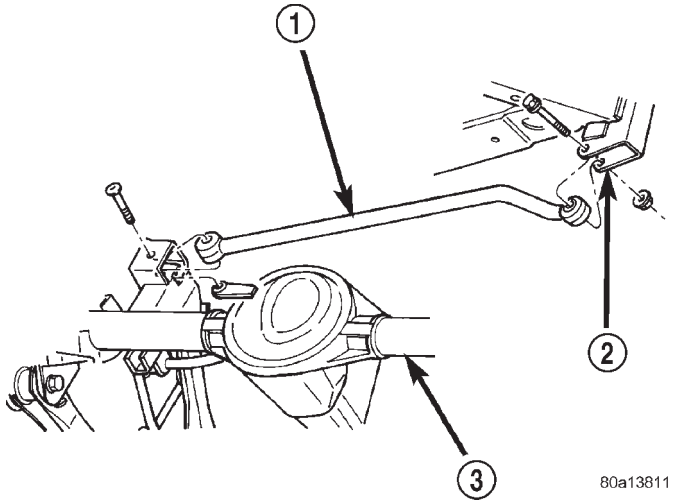


Fig. 7 Rear Track Bar

1 – TRACK BAR
2 – FRAME BRACKET
3 – REAR AXLE

INSTALLATION

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

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

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

(3) Remove supports and lower the vehicle.

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

SPECIFICATIONS

TORQUE CHART

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

DIFFERENTIAL AND DRIVELINE

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PROPELLER SHAFTS

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DESCRIPTION AND OPERATION

PROPELLER SHAFT

DESCRIPTION

A propeller shaft (Fig. 2) is the shaft which connects the transmission/transfer case to the axle differential. This is the link through which the engine power is transmitted to the axle.

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

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

PRECAUTIONS

Use the exact replacement parts when installing the propeller shafts. The use of the correct replacement parts helps to ensure safe operation. All fasteners must be torqued to the specified values for safe operation.

Also make alignment reference marks (Fig. 1) on the propeller shaft yoke and axle, or transmission, yoke prior to servicing. This helps to eliminate possible vibration.

CAUTION: Do not allow the propeller shaft to drop or hang from any propeller shaft joint during removal. Attach the propeller shaft to the vehicle underside with wire to prevent damage to the joints.

DESCRIPTION AND OPERATION (Continued)

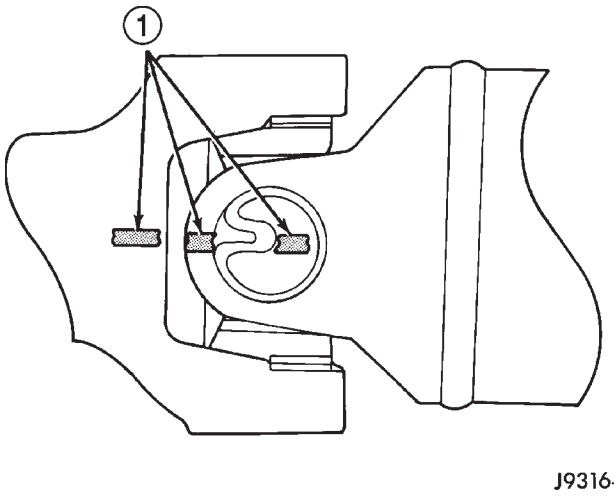


Fig. 1 Reference Marks on Yokes

1 – REFERENCE MARKS

OPERATION

The propeller shaft must operate through constantly changing relative angles between the transmission and axle when going over various road surfaces. It must also be capable of changing length while transmitting torque. The axle rides suspended by springs in a floating motion.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 (Fig. 2).

Before undercoating a vehicle, the propeller shaft and the U-joints should be covered to prevent an out-of-balance condition and driveline vibration.

CAUTION: Use original equipment replacement parts for attaching the propeller shafts. The specified torque must always be applied when tightening the fasteners.

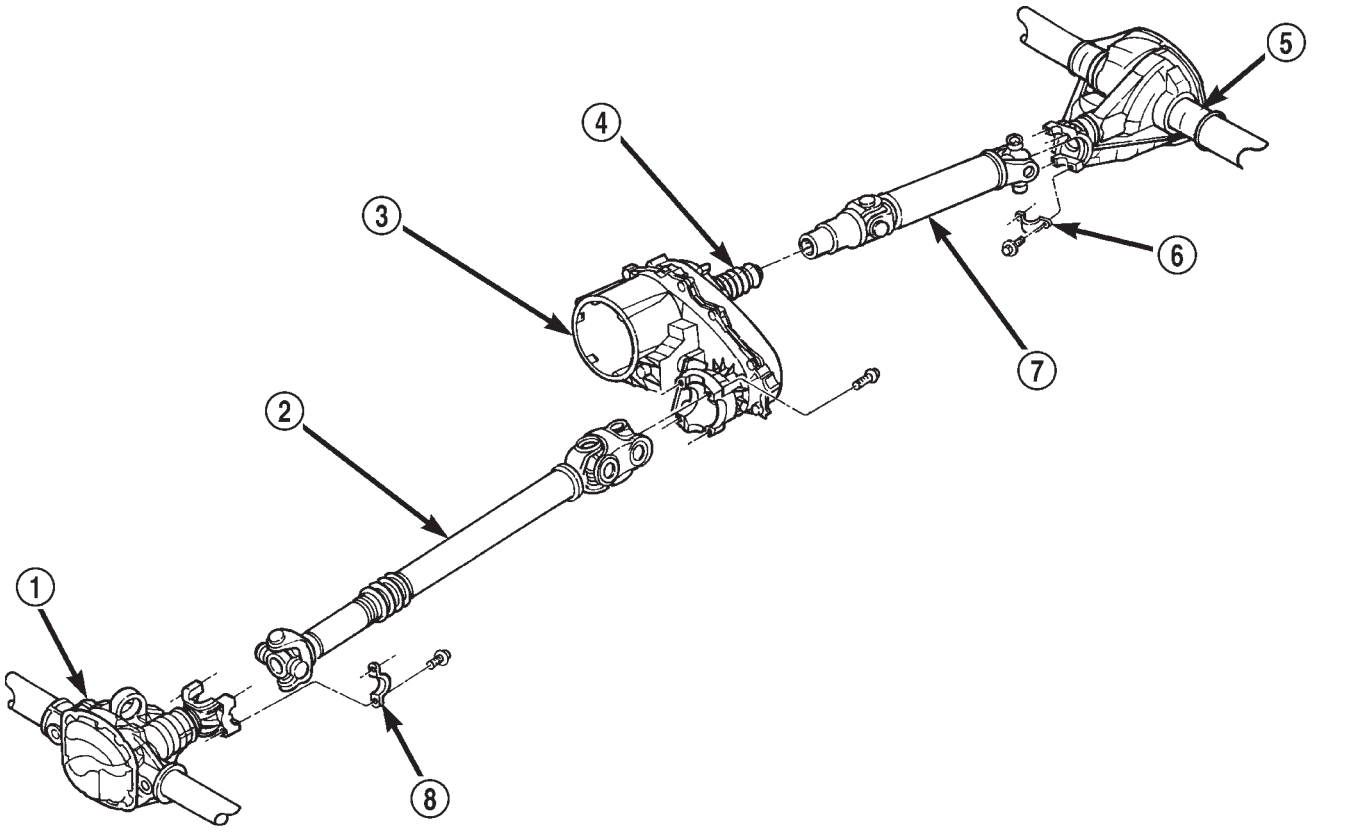


Fig. 2 Propeller Shafts

1 – FRONT AXLE
2 – FRONT PROPELLER SHAFT
3 – TRANSFER CASE
4 – BOOT
5 – REAR AXLE
6 – STRAP
7 – REAR PROPELLER SHAFT
8 – STRAP

DESCRIPTION AND OPERATION (Continued)

PROPELLER SHAFT JOINTS

DESCRIPTION

Two different types of propeller shaft joints are used in TJ vehicles (Fig. 3) and (Fig. 4). None of the joints are serviceable. If worn or damaged, they must be replaced as a complete assembly.

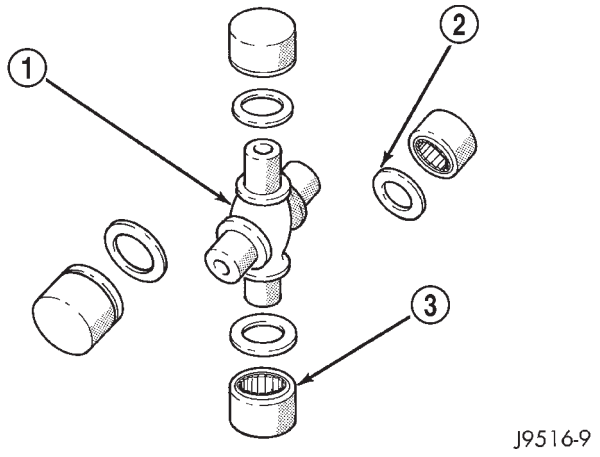


Fig. 3 Single Cardan U-Joint

1 – CROSS
2 – SEAL
3 – CAP AND NEEDLE BEARINGS

LUBRICATION

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.

PROPELLER SHAFT JOINT ANGLE

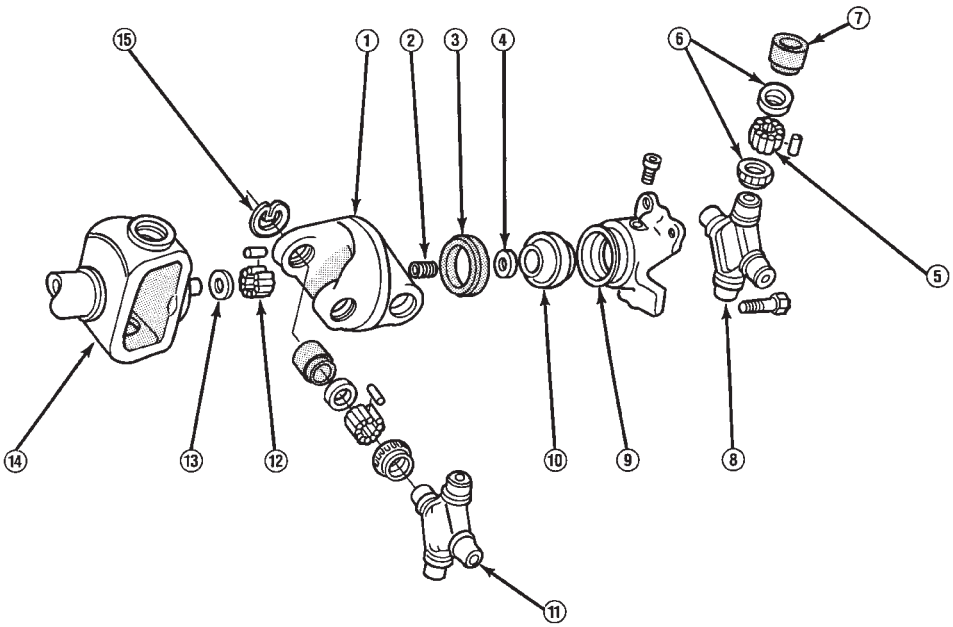
DESCRIPTION

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.

OPERATION

This cancellation 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.



1. LINK YOKE
2. SOCKET SPRING
3. SOCKET BALL RETAINER
4. THRUST WASHER
5. NEEDLE BEARINGS
6. SEAL
7. BEARING CAP
8. REAR SPIDER
9. SOCKET YOKE
10. SOCKET BALL
11. FRONT SPIDER
12. NEEDLE BEARINGS
13. THRUST WASHER
14. DRIVE SHAFT YOKE
15. RETAINING CLIP

Fig. 4 Double Cardan U-Joint

DESCRIPTION AND OPERATION (Continued)

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.

Propeller shaft 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. 5).

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°

Fig. 5 Maximum Angles And Propeller Shaft Speed

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.

DRIVELINE VIBRATION

Drive Condition	Possible Cause	Correction
Propeller Shaft Noise	1) Undercoating or other foreign material on shaft.	1) Clean exterior of shaft and wash with solvent.
	2) Loose U-joint clamp screws.	2) Install new clamps and screws and tighten to proper torque.
	3) Loose or bent U-joint yoke or excessive runout.	3) Install new yoke.
	4) Incorrect driveline angularity.	4) Measure and correct driveline angles.
	5) Rear spring center bolt not in seat.	5) Loosen spring u-bolts and seat center bolt.
	6) Worn U-joint bearings.	6) Install new U-joint.
	7) Propeller shaft damaged or out of balance.	7) Installl new propeller shaft.
	8) Broken rear spring.	8) Install new rear spring.
	9) Excessive runout or unbalanced condition.	9) Re-index propeller shaft, test, and evaluate.
	10) Excessive drive pinion gear shaft runout.	10) Re-index propeller shaft and evaluate.
	11) Excessive axle yoke deflection.	11) Inspect and replace yoke if necessary.
	12) Excessive transfer case runout.	12) Inspect and repair as necessary.
Universal Joint Noise	1) Loose U-joint clamp screws.	1) Install new clamps and screws and tighten to proper torque.
	2) Lack of lubrication.	2) Replace as U-joints as necessary.

DIAGNOSIS AND TESTING (Continued)

UNBALANCE

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

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

(1) Raise the vehicle.

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

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

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

(5) Check the universal joint clamp screws torque.

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

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

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

(9) Install a screw clamp at position 1 (Fig. 6).

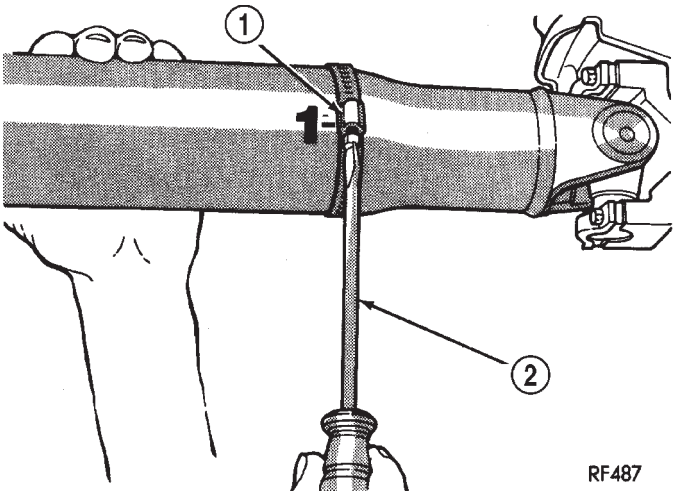


Fig. 6 Clamp Screw At Position 1

1 – CLAMP
2 – SCREWDRIVER

(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. 7) and repeat the test.

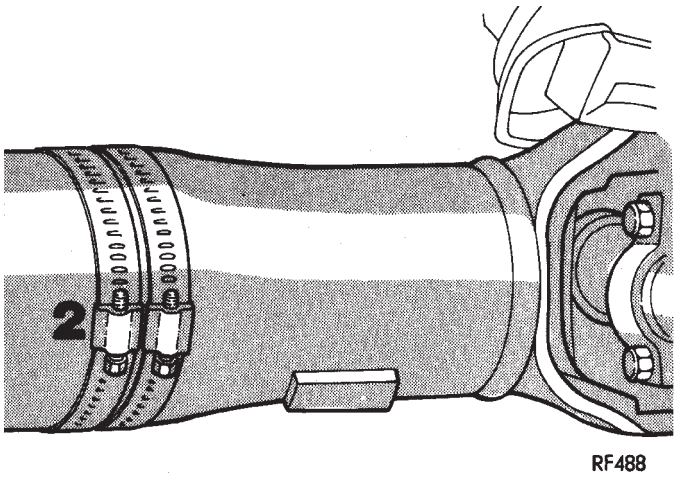


Fig. 7 Two Clamp Screws At The Same Position

(13) If the additional clamp causes an additional vibration, separate the clamps (1/4 inch above and below the mark). Repeat the vibration test (Fig. 8).

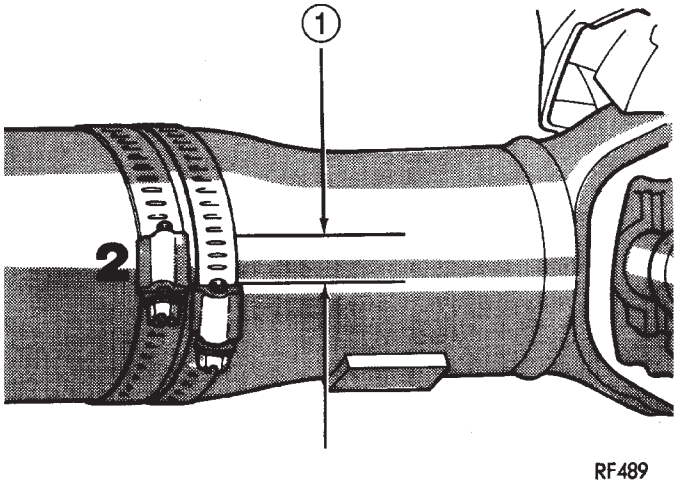


Fig. 8 Clamp Screws Separated

1 – ½ INCH

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

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

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

RUNOUT

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

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

(3) Measure runout at the center and ends of the shaft sufficiently far away from weld areas to ensure

DIAGNOSIS AND TESTING (Continued)

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.

(1) Remove any external bearing snap rings, if equipped, from universal joint so protractor base sits flat.

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

Always make measurements from front to rear. Also, be sure to take all measurements while working from the same side of the vehicle.

(3) Place Inclinometer on yoke bearing (A) parallel to the shaft (Fig. 9). Center bubble in sight glass and record measurement.

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

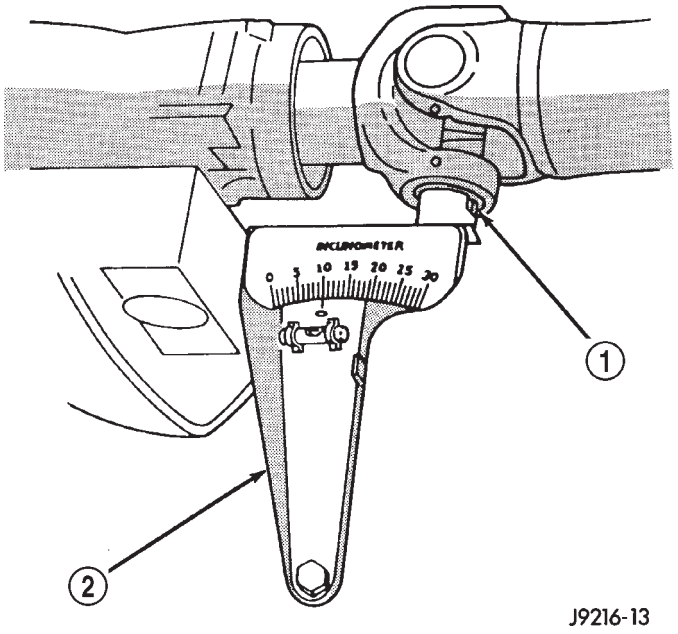


Fig. 9 Front (Output) Angle Measurement (A)

1 – SLIP YOKE BEARING CAP
2 – SPECIAL TOOL 7663 (J-23498A)

(4) Rotate propeller shaft 90 degrees and place Inclinometer on yoke bearing parallel to the shaft (Fig. 10). Center bubble in sight glass and record measurement. This measurement can also be taken at the rear end of the shaft.

This measurement will give you the Propeller Shaft Angle (C).

(5) Subtract smaller figure from larger (C minus A) to obtain Transmission Output Operating Angle.

(6) Rotate propeller shaft 90 degrees and place Inclinometer on pinion yoke bearing parallel to the shaft (Fig. 11). Center bubble in sight glass and record measurement.

This measurement will give you the pinion shaft or Input Yoke Angle (B).

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

Refer to rules given below and the example in (Fig. 12) for additional information.

SERVICE PROCEDURES (Continued)

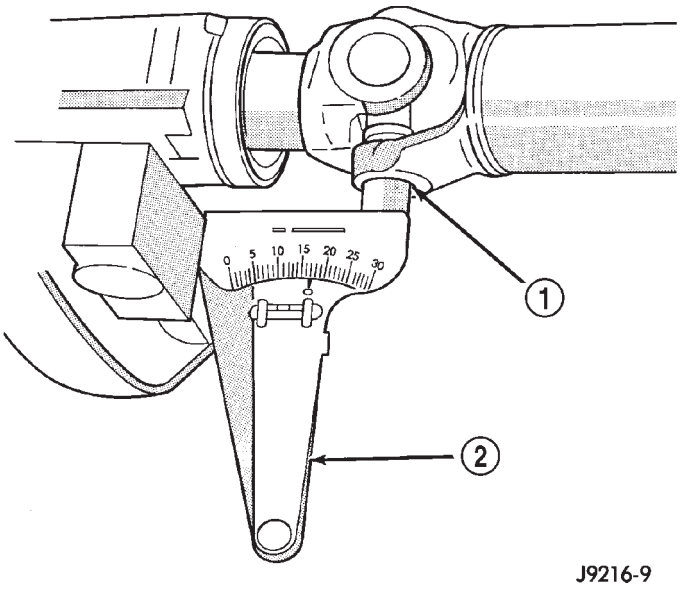


Fig. 10 Propeller Shaft Angle Measurement (C)

1 – SHAFT YOKE BEARING CAP
2 – SPECIAL TOOL 7663 (J23498–A)

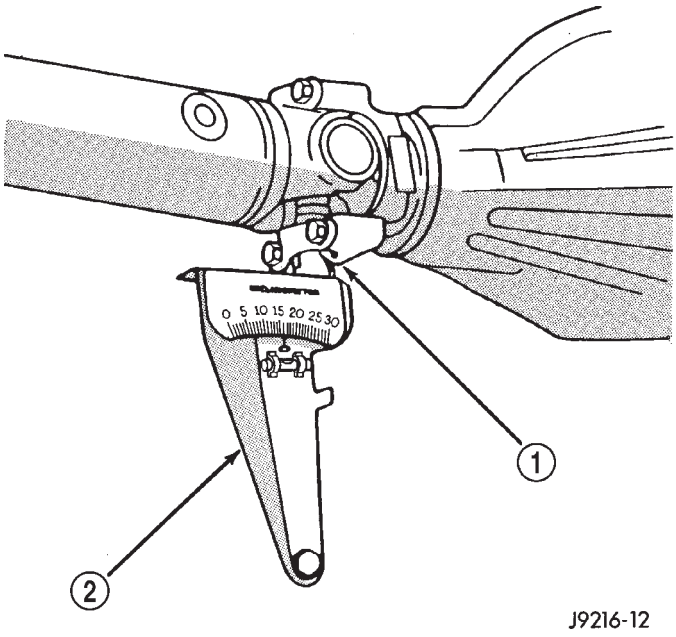
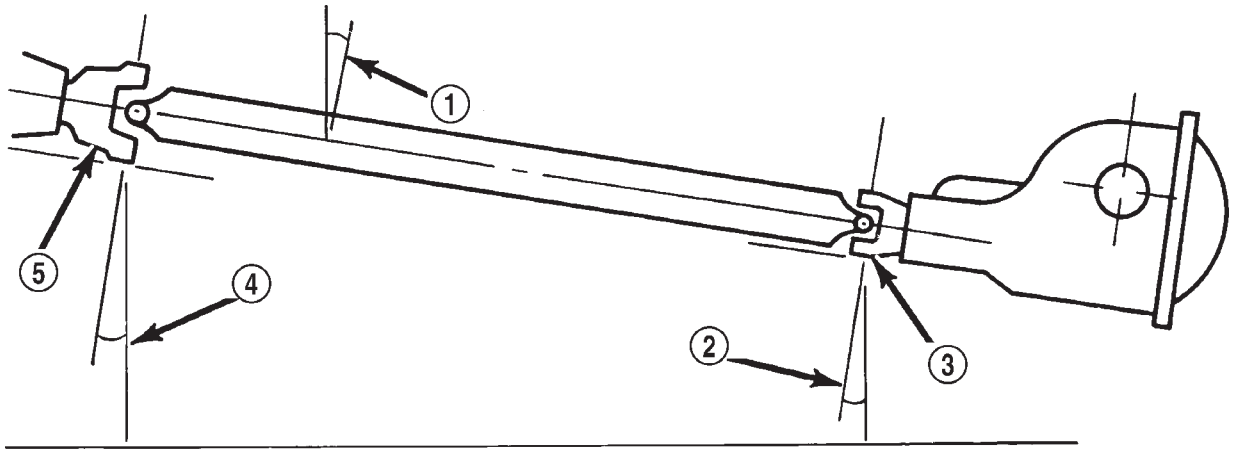


Fig. 11 Rear (Input) Angle Measurement (B)

1 – PINION YOKE BEARING CAP
2 – SPECIAL TOOL 7663 (J-23498A)



(A) Output Yoke = 3.0°	or 4.9°	(B) Axle Input Yoke = 3.2°	or 4.9°
(C) Prop. Shaft = 4.9°	or -3.0°	(C) Prop. Shaft = 4.9°	or -3.2°
Transmission Output Operating Angle	1.9°	Axle Input Operating Angle	1.7°

Trans. Output Operating Angle	1.9°
Axle Input Operating Angle	-1.7°
Amount of U-Joint Cancellation	0.2°

J9316-3

Fig. 12 Universal Joint Angle Example

1 – 4.9° Angle (C)
2 – 3.2° Angle (B)
3 – Input Yoke
4 – 3.0° Angle (A)
5 – Output Yoke

SERVICE PROCEDURES (Continued)

- 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.

REMOVAL AND INSTALLATION

FRONT PROPELLER SHAFT

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove the crossmember/skid plate as necessary to gain access to the propeller shaft.

(3) Shift the transmission and transfer case, if necessary, into the Neutral position.

(4) Using a suitable marker, mark a line across the yoke at the transfer case, the link yoke, and propeller shaft yoke at the rear of the front propeller shaft for installation reference (Fig. 13).

(5) Mark a line across the propeller shaft yoke and the pinion shaft yoke for installation reference.

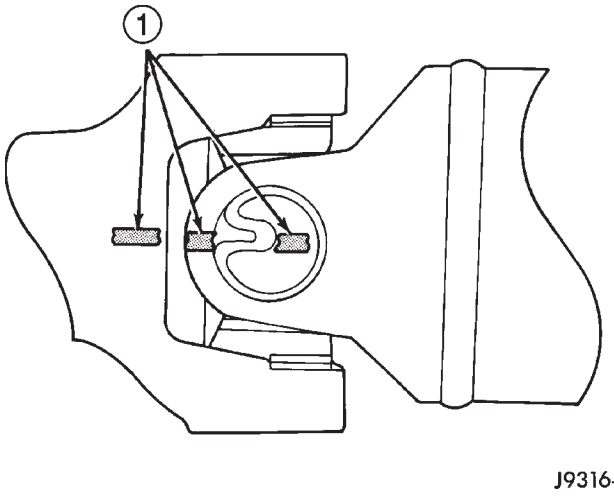


Fig. 13 Reference Marks on Yokes

1 – REFERENCE MARKS

(6) Remove the U-joint strap bolts at the pinion shaft yoke (Fig. 14).

(7) Remove bolts holding rear universal joint to the transfer case yoke.

(8) Separate the rear universal joint from the transfer case yoke.

(9) Push rear of propeller shaft upward to clear transfer case yoke.

(10) Separate front universal joint from front axle.

(11) Separate propeller shaft from vehicle.

INSTALLATION

(1) Position front propeller shaft under vehicle with rear universal joint over the transfer case yoke.

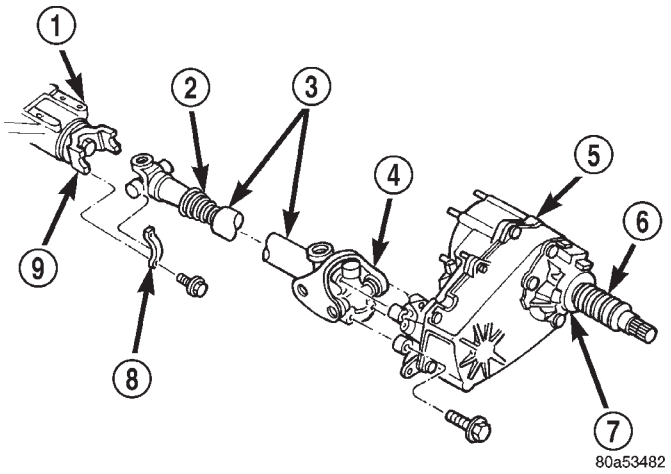


Fig. 14 Front Propeller Shaft

1 – FRONT AXLE
2 – BOOT
3 – PROPELLER SHAFT
4 – CV-JOINT
5 – TRANSFER CASE
6 – BOOT
7 – SLINGER
8 – CLAMP
9 – YOKE

(2) Place front universal joint into the axle pinion yoke.

(3) Align mark on the rear link yoke and universal joint to the mark on the transfer case yoke (Fig. 13).

(4) Loosely install bolts to hold universal joint to transfer case yoke.

(5) Align mark on front universal joint to the mark on the axle pinion yoke.

(6) Tighten the U-joint strap/clamp bolts at the axle yoke to 19 N·m (14 ft. lbs.) torque.

(7) Tighten the universal joint to transfer case bolts to 27 N·m (20 ft. lbs.) torque.

(8) 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 U-joint strap bolts at the pinion shaft yoke.

(5) Pry open clamp holding the dust boot to propeller shaft yoke (Fig. 15).

(6) Slide the slip yoke off of the transmission/transfer case output shaft and remove the propeller shaft (Fig. 16).

REMOVAL AND INSTALLATION (Continued)

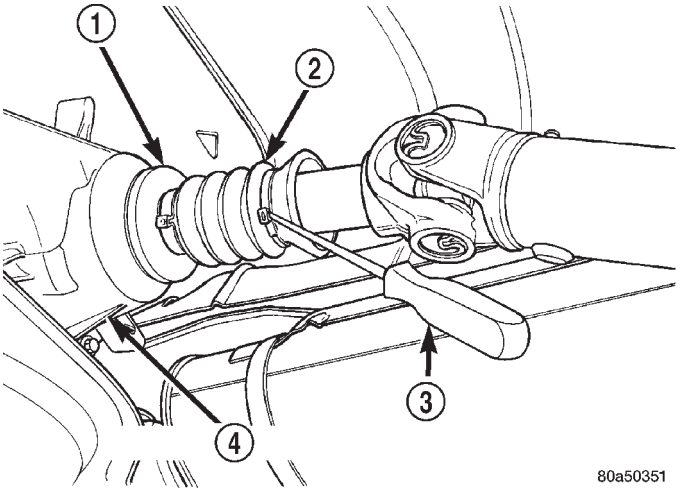


Fig. 15 Dust Boot Clamp

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

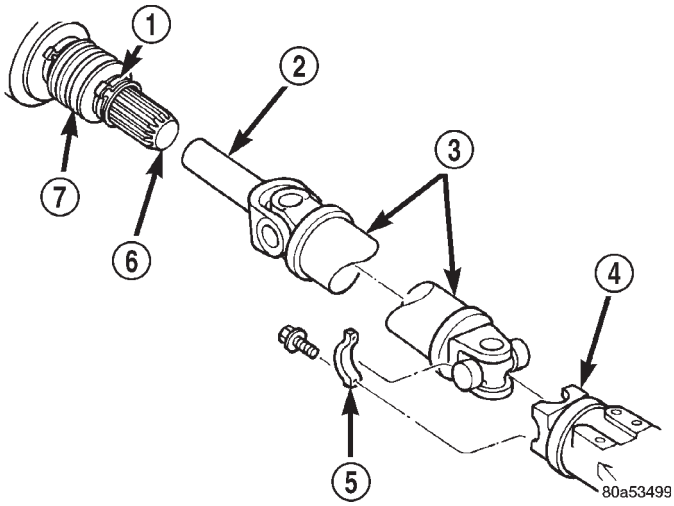


Fig. 16 Rear Propeller Shaft

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

INSTALLATION

(1) Slide the slip yoke on the transmission/transfer case output shaft. Align the installation reference marks at the axle yoke and install the propeller shaft (Fig. 16).

(2) Tighten the U-joint strap/clamp bolts at the axle yoke to 19 N·m (14 ft. lbs.) torque.

(3) Crimp clamp to hold dust boot to propeller shaft yoke (Fig. 17).

(4) Lower the vehicle.

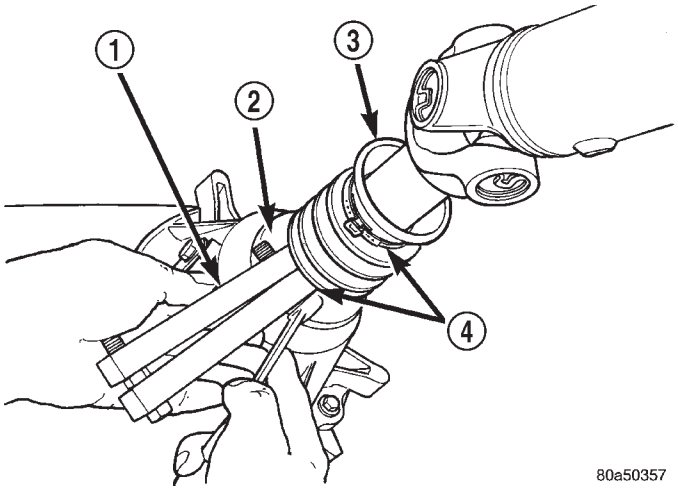


Fig. 17 Crimping Dust Boot Clamp

1 – SPECIAL TOOL C-4975–A
2 – SLINGER
3 – BOOT
4 – CLAMP

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. 18).

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

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

(6) Place a socket with an outside diameter smaller than the upper bearing cap on the upper bearing cap and press the cap through the yoke to release the lower bearing cap (Fig. 19).

(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. 20).

DISASSEMBLY AND ASSEMBLY (Continued)

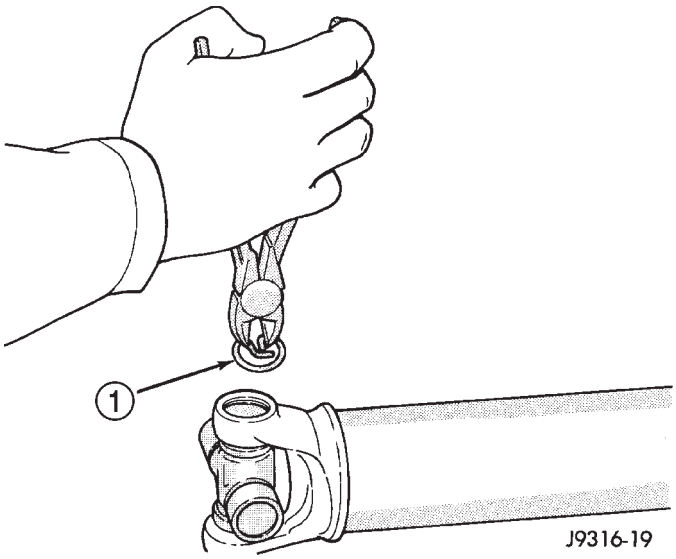


Fig. 18 Remove Snap Ring

1 – SNAP RING

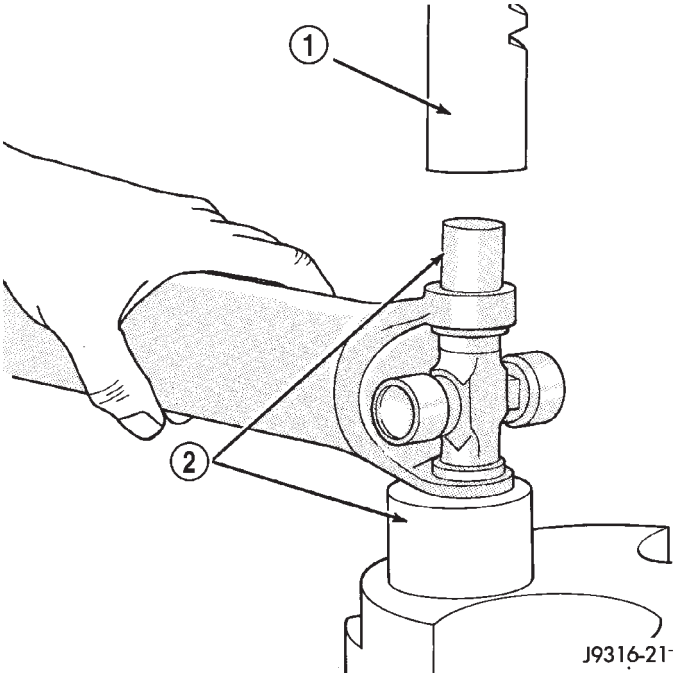


Fig. 19 Press Out Bearing

1 – PRESS
2 – SOCKET

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.

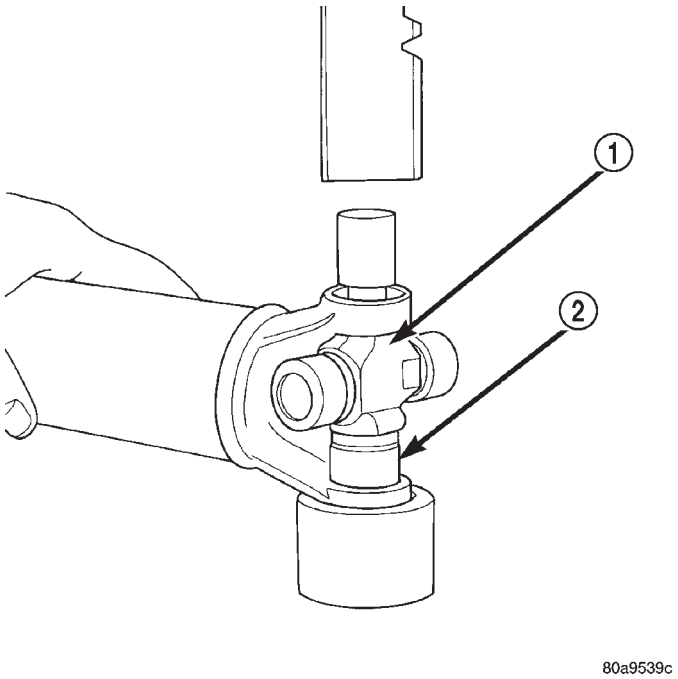


Fig. 20 Press Out Remaining Bearing

1 – CROSS
2 – BEARING CAP

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. 21).

(3) Place a bearing cap over the trunnion and align the cap with the yoke bore (Fig. 22). Keep the needle bearings upright in the bearing assembly. A needle bearing lying at the bottom of the cap will prevent proper assembly.

(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 4to 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.

DISASSEMBLY AND ASSEMBLY (Continued)

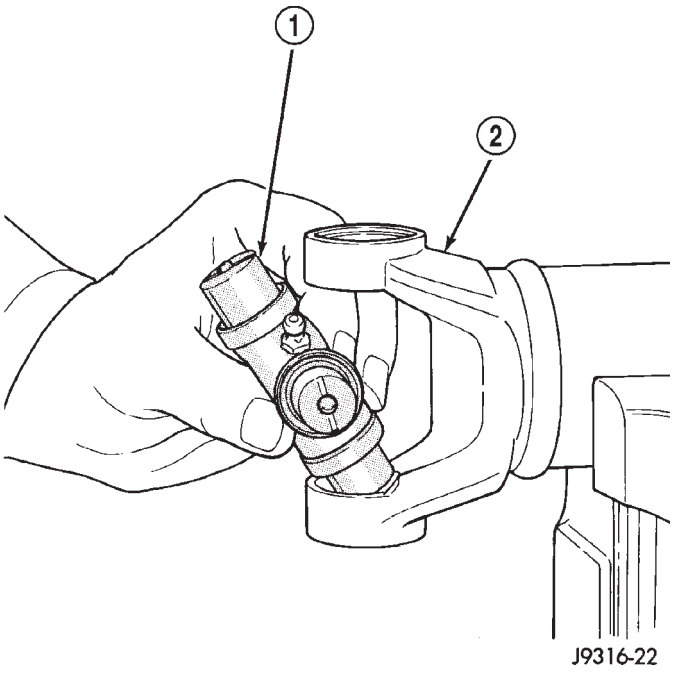


Fig. 21 Install Cross In Yoke

1 – CROSS
2 – YOKE

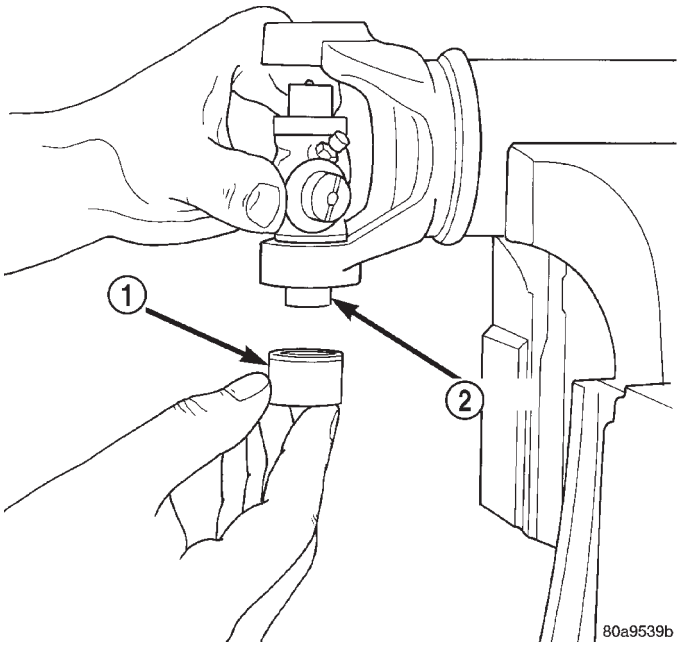


Fig. 22 Install Bearing On Trunnion

1 – BEARING CAP
2 – TRUNNION

(3) Remove all the bearing cap snap rings (Fig. 23).

(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.

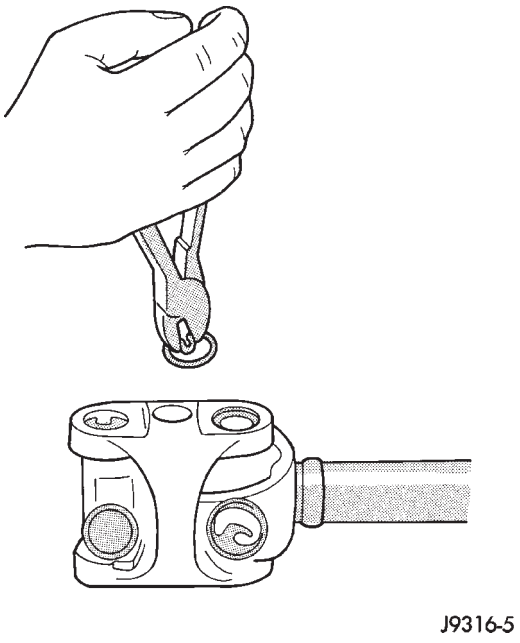


Fig. 23 Remove Snap Rings

(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 the outboard side of the link yoke enough to grasp the bearing cap with vise jaws (Fig. 24). Be sure to remove grease fittings that interfere with removal.

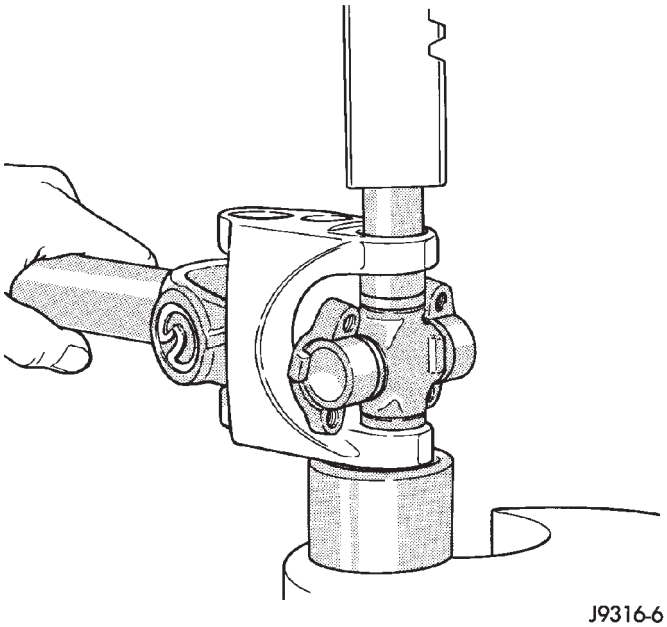


Fig. 24 Press Out Bearing

(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. 25).

DISASSEMBLY AND ASSEMBLY (Continued)

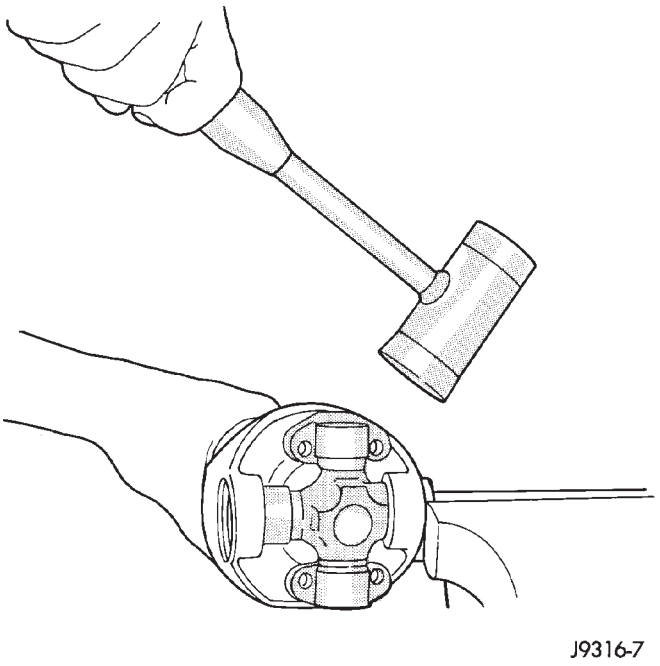


Fig. 25 Remove Bearing From Yoke

(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. 26).

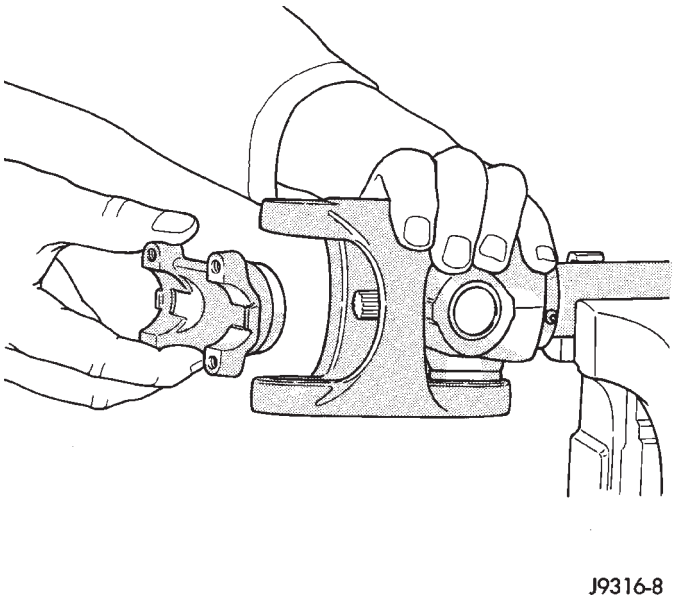


Fig. 26 Remove Centering Kit

(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. 27).

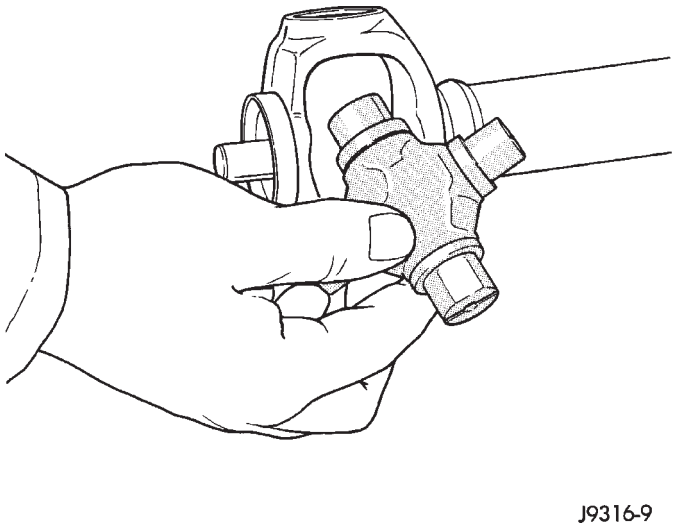


Fig. 27 Install Cross In Yoke

(3) Place a bearing cap over the trunnion and align the cap with the yoke bore (Fig. 28). Keep the needle bearings upright in the bearing assembly. A needle bearing lying at the bottom of the cap will prevent proper assembly.

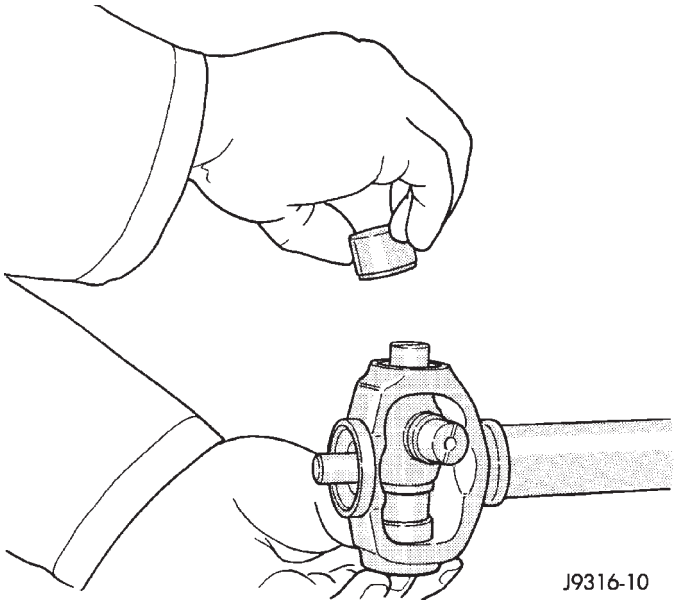


Fig. 28 Install Bearing Cap

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Press the bearing cap into the yoke bore enough to install a snap ring (Fig. 29).

(5) Install a snap ring.

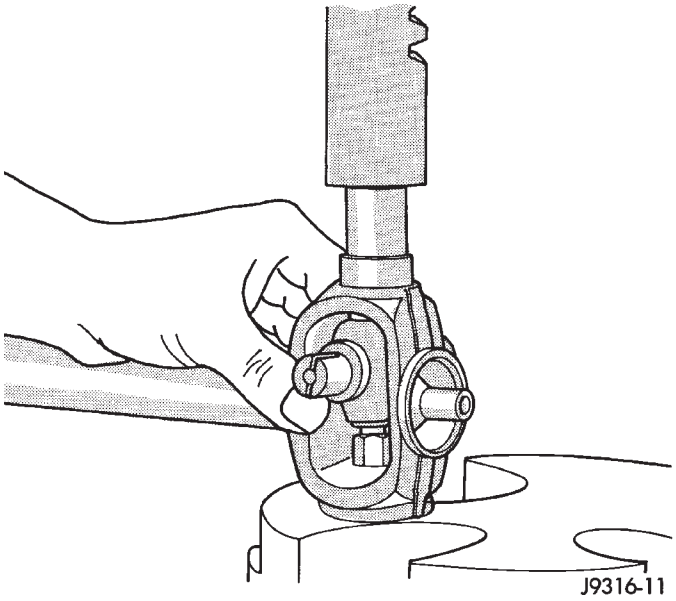


Fig. 29 Press In Bearing Cap

(6) Flip the propeller shaft yoke and install the bearing cap onto the opposite trunnion. Install a snap ring (Fig. 30).

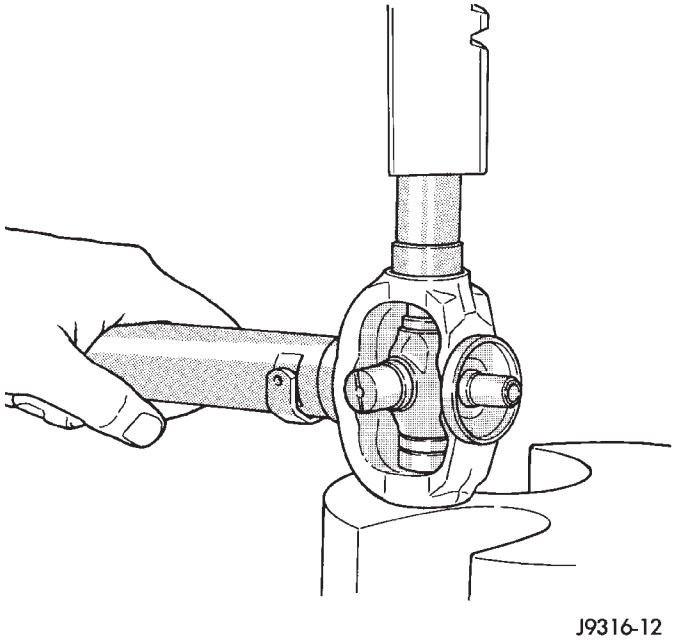


Fig. 30 Press In Bearing Cap

(7) Fit the link yoke on the remaining two trunnions and press both bearing caps into place (Fig. 31).

(8) Install snap rings.

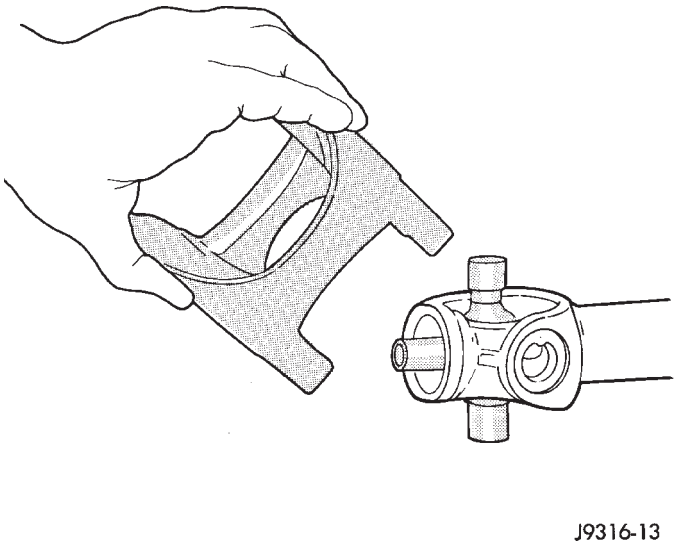


Fig. 31 Install Link Yoke

(9) Install the centering kit assembly inside the link yoke making sure the spring is properly positioned (Fig. 32).

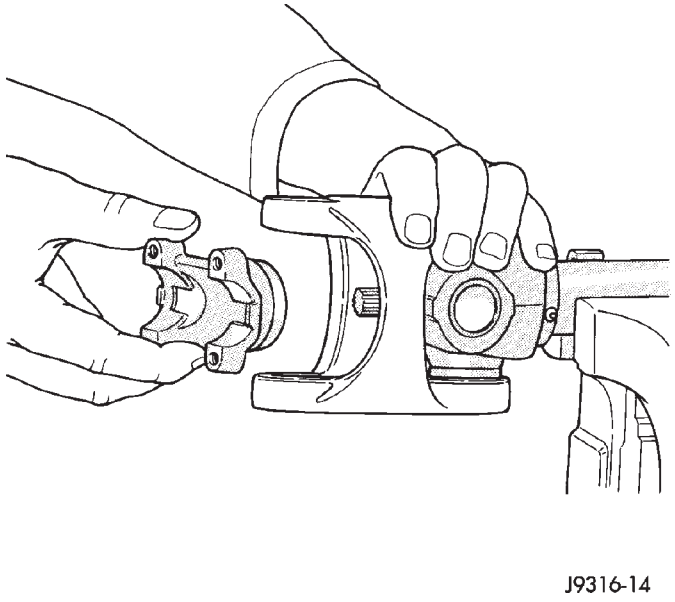


Fig. 32 Install Centering Kit

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. 33).

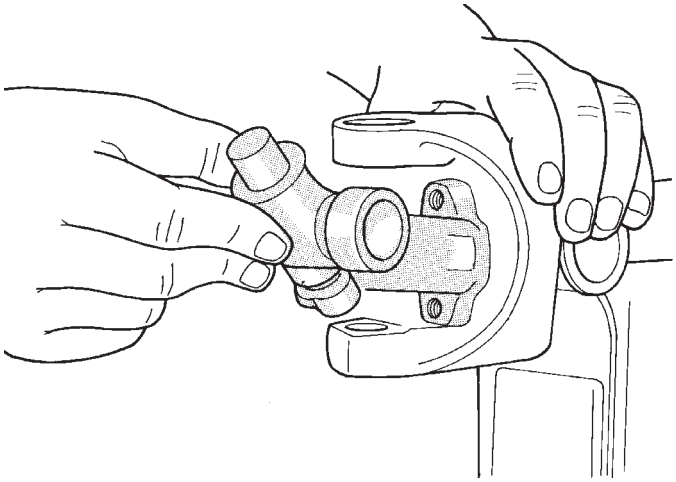


Fig. 33 Install Remaining Cross

(11) Press the remaining two bearing caps into place and install snap rings (Fig. 34).

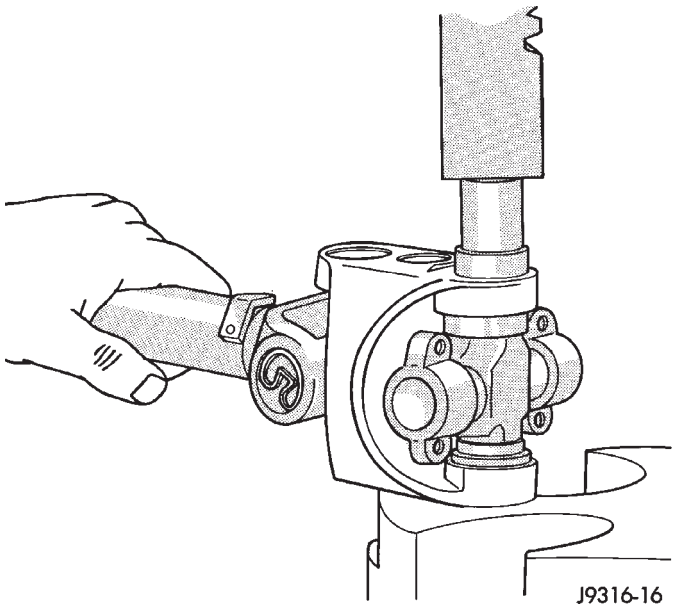


Fig. 34 Press In Bearing Cap

(12) Tap the snap rings to allow them to seat into the grooves (Fig. 35).

(13) Check for proper assembly. Flex the joint beyond center, it should snap over-center in both directions when correctly assembled (Fig. 36).

(14) Install the propeller shaft.

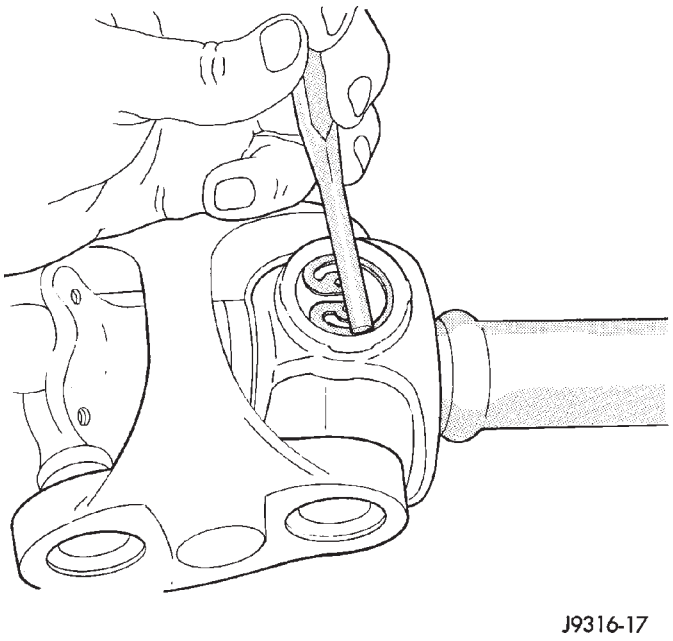


Fig. 35 Seat Snap Rings In Groove

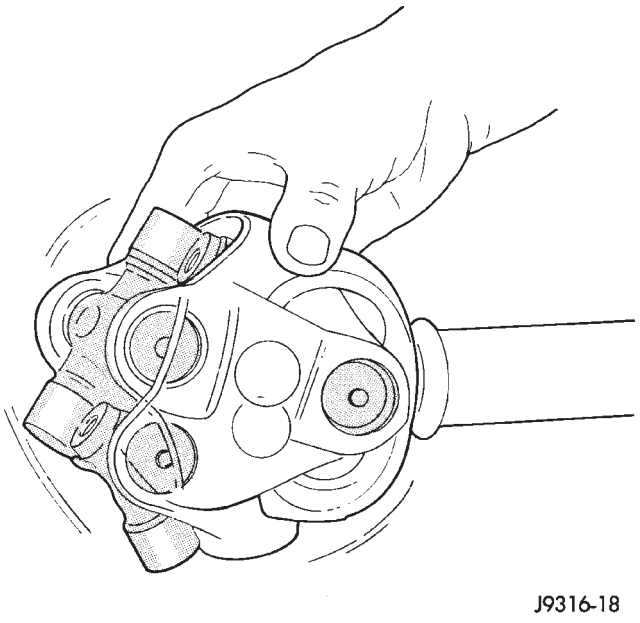


Fig. 36 Check Assembly

CLEANING AND INSPECTION

SINGLE AND DOUBLE CARDAN JOINT

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

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

ADJUSTMENTS

AXLE PINION ANGLE ADJUSTMENT

The pinion angle of the front axle can be adjusted by the use of adjustment cams in the lower suspension arms (Fig. 37). The primary function for the cams is to adjust the caster angle for the alignment of the front suspension. When using the cams to adjust the pinion angle, make sure that both cams are moved equally. After the pinion angle is adjusted, the front suspension alignment should be checked to ensure that side-to-side caster angles variance is with-in the acceptable range. Having the correct pinion angle does have priority over having the preferred caster angle.

A cam kit is available to be installed in the rear axle upper suspension arms in order to provide adjustablity of the pinion angle. Follow the procedures supplied with the kit in order to ensure a safe installation.

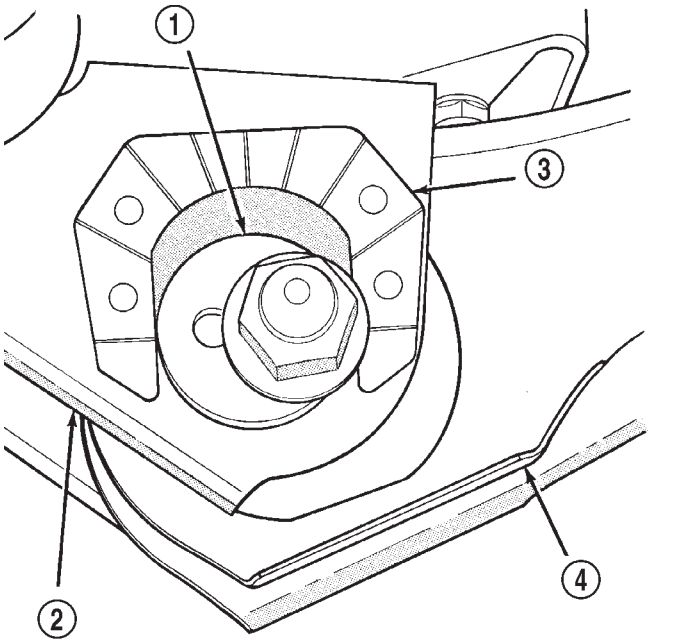


Fig. 37 Adjustment Cam

1 – ADJUSTMENT CAM
2 – AXLE BRACKET
3 – BRACKET REINFORCEMENT
4 – LOWER SUSPENSION ARM

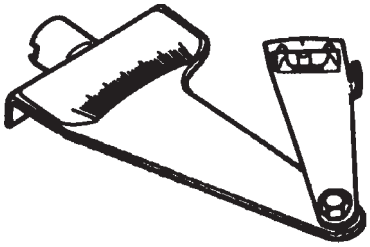
SPECIFICATIONS

TORQUE

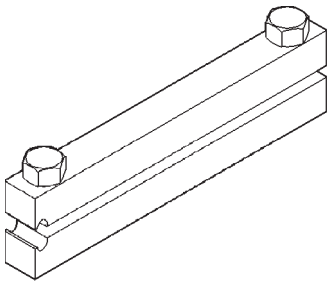
DESCRIPTION	TORQUE
Front Propeller Shaft	
Bolts, Rear Yoke	27 N·m (20 ft. lbs.)
Bolts, Front Yoke	41 N·m (30 ft. lbs.)
Rear Propeller Shaft	
Bolts, Rear Yoke	19 N·m (14 ft. lbs.)

SPECIAL TOOLS

PROPELLER SHAFT



Inclinometer—7663



Boot Clamp Installer—C-4975-A

181 FBI AXLE

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DESCRIPTION AND OPERATION

181 FBI AXLE

DESCRIPTION

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 below the centerline of the ring gear.

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

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

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 a collapsible spacer.

OPERATION

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

DESCRIPTION AND OPERATION (Continued)

LUBRICANT

DESCRIPTION

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.

The 181 FBI axle lubricant capacity is 1.2 L (2.5 pts.).

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

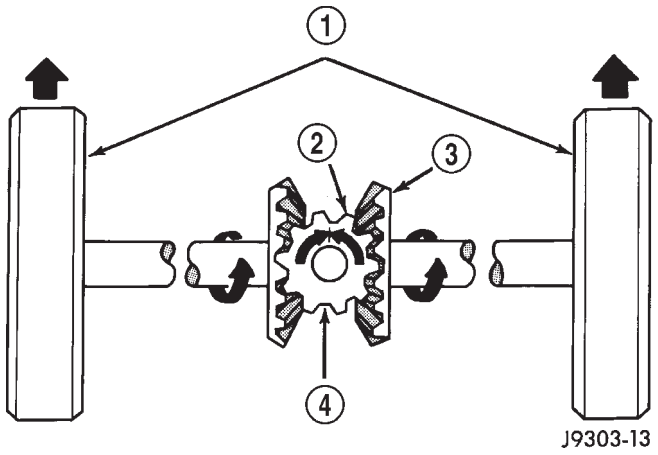


Fig. 1 Differential Operation—Straight Ahead Driving

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

STANDARD DIFFERENTIAL

DESCRIPTION

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.

OPERATION

In operation, power flow occurs as follows:

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

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

When turning corners, the outside wheel must travel a greater distance than the inside wheel 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.

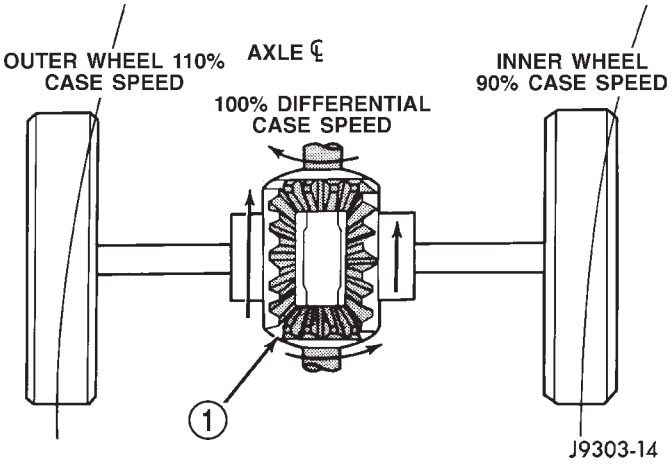


Fig. 2 Differential Operation—On Turns

1 – PINION GEARS ROTATE ON PINION SHAFT

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.
- Differential housing bores not square to each other.

DIAGNOSTIC CHART

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

DIAGNOSIS AND TESTING (Continued)

Condition	Possible Causes	Correction
Differential Cracked	1. Improper adjustment of the differential bearings.	1. Replace case and inspect gears and bearings for further damage. Set differential bearing pre-load properly.
	2. Excessive ring gear backlash.	2. Replace case and inspect gears and bearings for further damage. Set ring gear backlash properly.
	3. Vehicle overloaded.	3. Replace case and inspect gears and bearings for further damage. Avoid excessive vehicle weight.
	4. Erratic clutch operation.	4. Replace case and inspect gears and bearings for further damage. Avoid erratic use of clutch.
Differential Gears Scored	1. Insufficient lubrication.	1. Replace scored gears. Fill differential with the correct fluid type and quantity.
	2. Improper grade of lubricant.	2. Replace scored gears. Fill differential with the correct fluid type and quantity.
	3. Excessive spinning of one wheel/tire.	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 lubricant to the correct level.
	2. Worn axle shaft seals.	2. Replace seals.
	3. Cracked differential housing.	3. Repair as necessary.
	4. Worn pinion seal.	4. Replace seal.
	5. Worn/scored yoke.	5. Replace yoke and seal.
	6. Axle cover not properly sealed.	6. Remove, clean, and re-seal cover.
Axle Overheating	1. Lubricant level low.	1. Fill differential to correct level.
	2. Improper grade of lubricant.	2. Fill differential with the correct fluid type and quantity.
	3. Bearing pre-loads too high.	3. Re-adjust bearing pre-loads.
	4. Insufficient ring gear backlash.	4. Re-adjust ring gear backlash.
Gear Teeth Broke	1. Overloading.	1. Replace gears. Examine other gears and bearings for possible damage.
	2. Erratic clutch operation.	2. Replace gears and examine the remaining parts for damage. Avoid erratic clutch operation.
	3. Ice-spotted pavement.	3. Replace gears and examine remaining parts for damage.
	4. Improper adjustments.	4. Replace gears and examine remaining parts for damage. Ensure ring gear backlash is correct.

DIAGNOSIS AND TESTING (Continued)

Condition	Possible Causes	Correction
Axle Noise	1. Insufficient lubricant.	1. Fill differential with the correct fluid type and quantity.
	2. Improper ring gear and pinion adjustment.	2. Check ring gear and pinion contact pattern.
	3. Unmatched ring gear and pinion.	3. Replace gears with a matched ring gear and pinion.
	4. Worn teeth on ring gear and/or pinion.	4. Replace ring gear and pinion.
	5. Loose pinion bearings.	5. Adjust pinion bearing pre-load.
	6. Loose differential bearings.	6. Adjust differential bearing pre-load.
	7. Mis-aligned or sprung ring gear.	7. Measure ring gear run-out. Replace components as necessary.
	8. Loose differential bearing cap bolts.	8. Inspect differential components and replace as necessary. Ensure that the bearing caps are torqued tot he proper specification.
	9. Housing not machined properly.	9. Replace housing.

GEAR NOISE

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

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

When road testing, first warm-up the axle fluid by driving the vehicle at least 5 miles and then accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak–noise range. If the noise stops or changes greatly:

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

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

BEARING NOISE

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

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

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

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

LOW SPEED KNOCK

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

VIBRATION

Vibration at the rear of the vehicle is usually caused by 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).

DIAGNOSIS AND TESTING (Continued)

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.
- Transmission shift operation.
- Loose engine/transmission/transfer case mounts.
- Worn U–joints.
- Loose spring mounts.
- Loose pinion gear nut and yoke.
- Excessive ring gear backlash.
- Excessive side gear to case clearance.

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

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).

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.).

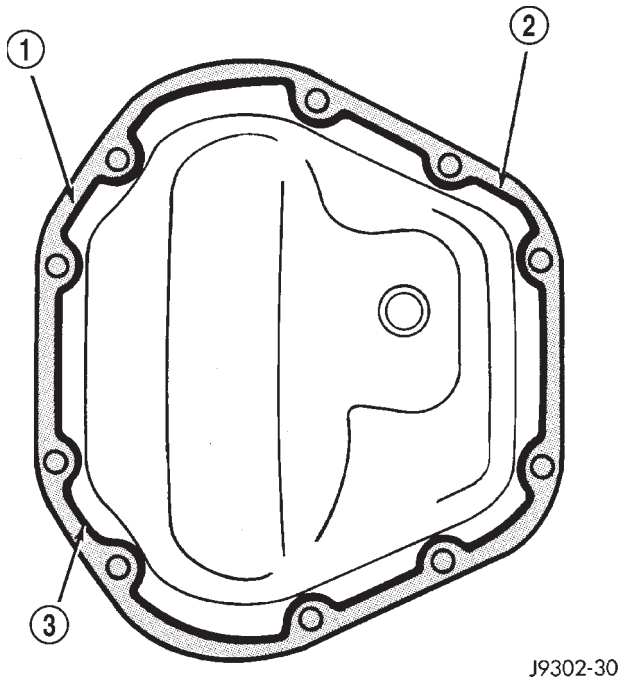


Fig. 3 Typical Housing Cover With Sealant

1 – SEALING SURFACE
2 – CONTOUR OF BEAD
3 – BEAD THICKNESS 6.35MM (1/4")

REMOVAL AND INSTALLATION

FRONT 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 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.

REMOVAL AND INSTALLATION (Continued)

(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.

(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.

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.

(1) Remove axle shaft.

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

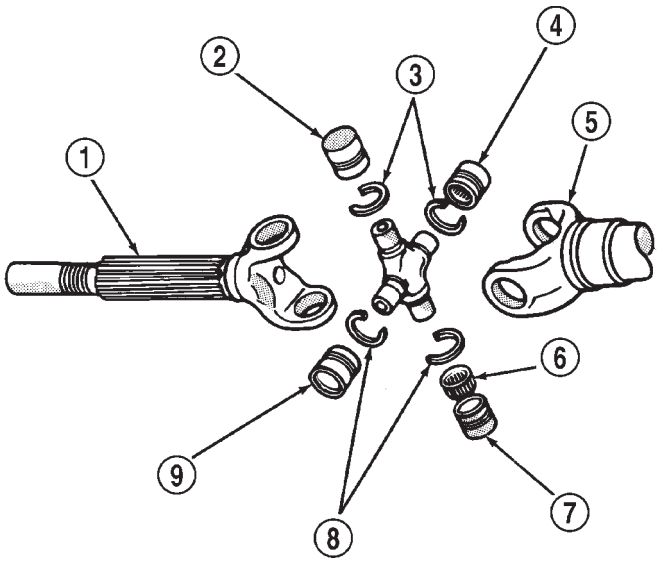


Fig. 4 Axle Shaft Outer U–Joint

1 – SHAFT YOKE
2 – BEARING CAP
3 – SNAP RINGS
4 – BEARING CAP
5 – SPINDLE YOKE
6 – BEARING
7 – BEARING CAP
8 – SNAP RINGS
9 – BEARING CAP

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.

REMOVAL AND INSTALLATION (Continued)

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

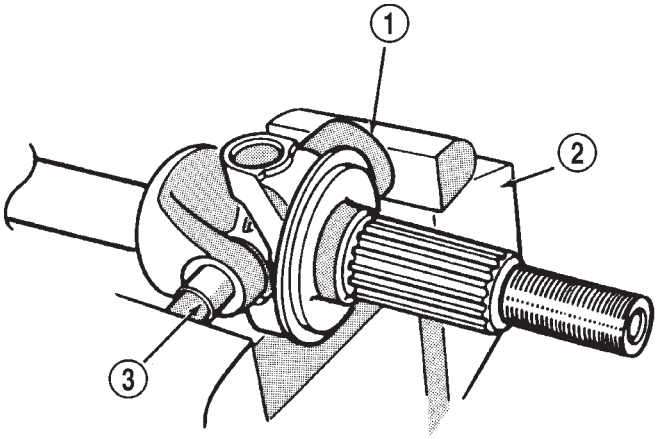


Fig. 5 Yoke Bearing Cap Removal

1 – LARGE-DIAMETER SOCKET WRENCH
2 – VISE
3 – SMALL-DIAMETER SOCKET WRENCH

(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.

(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).

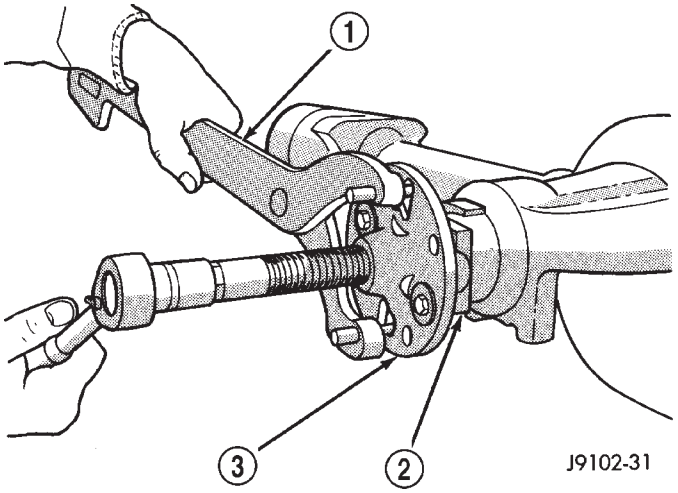


Fig. 6 Pinion Yoke Removal

1 – SPECIAL TOOL C-3281
2 – YOKE
3 – SPECIAL TOOL C-452

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

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.

REMOVAL AND INSTALLATION (Continued)

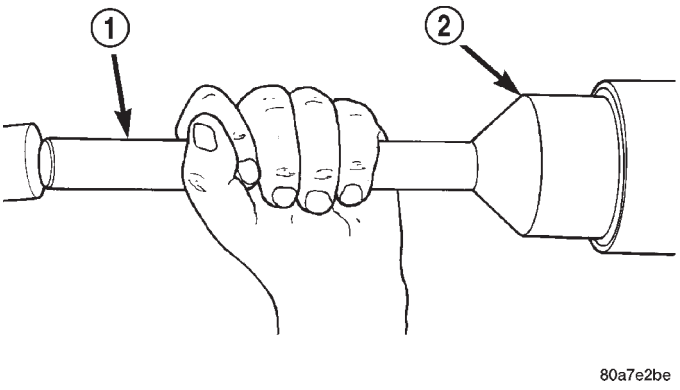


Fig. 7 Pinion Seal Installation

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL C-3972–A

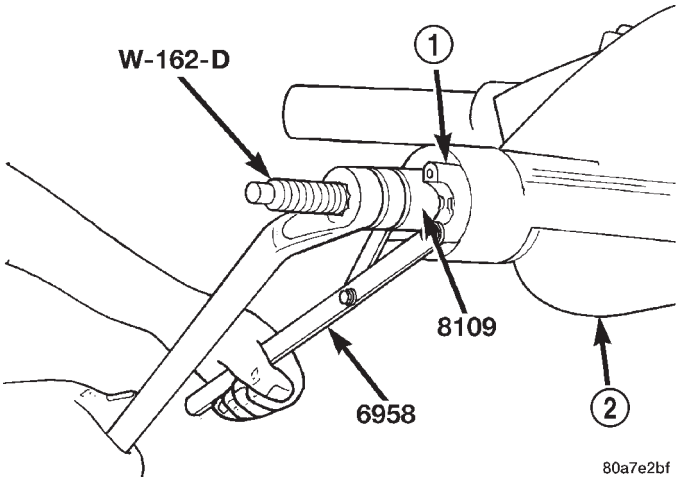


Fig. 8 Pinion Yoke Installation

1 – PINION YOKE
2 – AXLE HOUSING

(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) 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).

(5) If the rotating torque is low, use Holder 6958 to hold the pinion yoke (Fig. 10), and tighten the pinion shaft nut in 6.8 N·m (5 ft. lbs.) increments until proper rotating torque is achieved.

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.

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

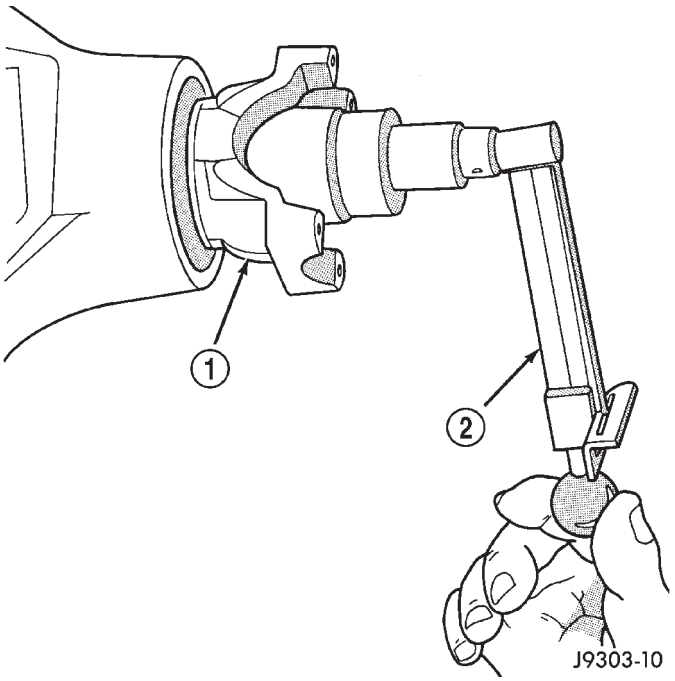


Fig. 9 Check Pinion Rotation Torque

1 – PINION YOKE
2 – INCH POUND TORQUE WRENCH

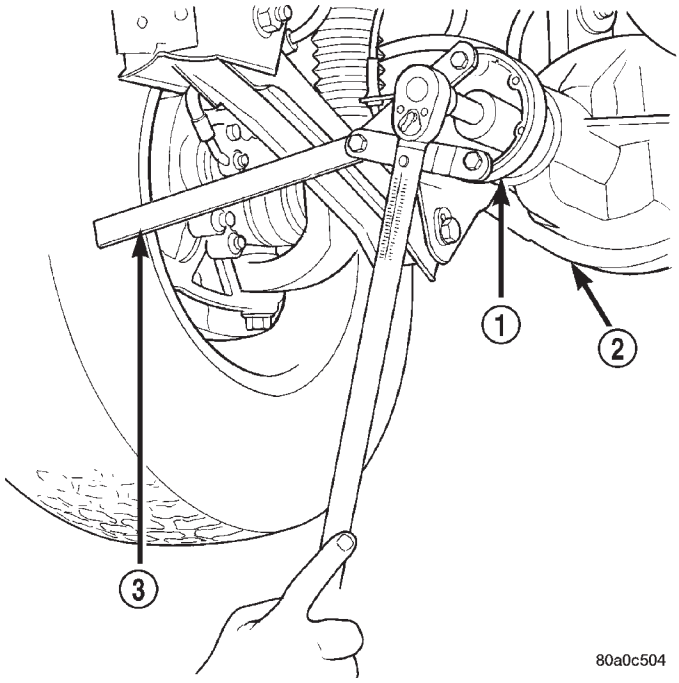


Fig. 10 Tightening Pinion Shaft Nut—Typical

1 – PINION FLANGE
2 – FRONT AXLE
3 – TOOL 6958

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

REMOVAL AND INSTALLATION (Continued)

(8) Install the brake rotors and calipers. Refer to Group 5, Brakes, for proper procedures.
(9) Install wheel and tire assemblies.
(10) Lower the vehicle.

COLLAPSIBLE SPACER

REMOVAL W/PINION INSTALLED

(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. 11).
(10) Use a suitable pry tool or a slide hammer mounted screw, remove the pinion 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.

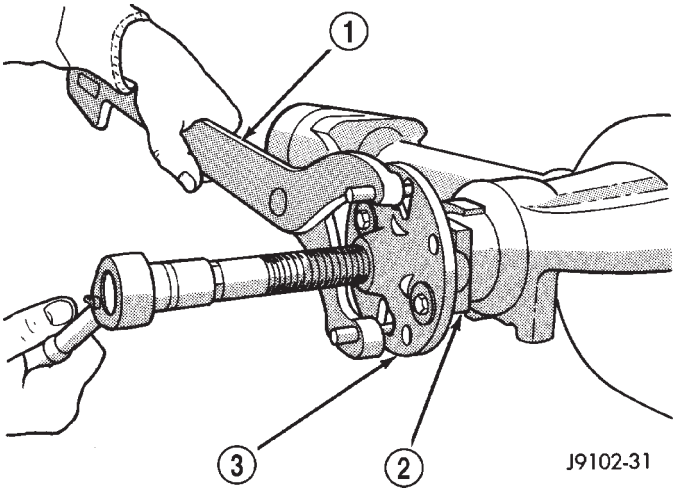


Fig. 11 Pinion Yoke Removal

1 – SPECIAL TOOL C-3281
2 – YOKE
3 – SPECIAL TOOL C-452

REMOVAL W/PINION REMOVED

(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) Remove differential assembly from axle housing.
(9) Using Holder 6958 to hold yoke, remove the pinion nut and washer.
(10) Using Remover C-452 and Wrench C-3281, remove the pinion yoke from pinion shaft (Fig. 11).
(11) Remove the pinion gear from housing (Fig. 12). Catch the pinion with your hand to prevent it from falling and being damaged.
(12) Remove collapsible spacer from pinion shaft.

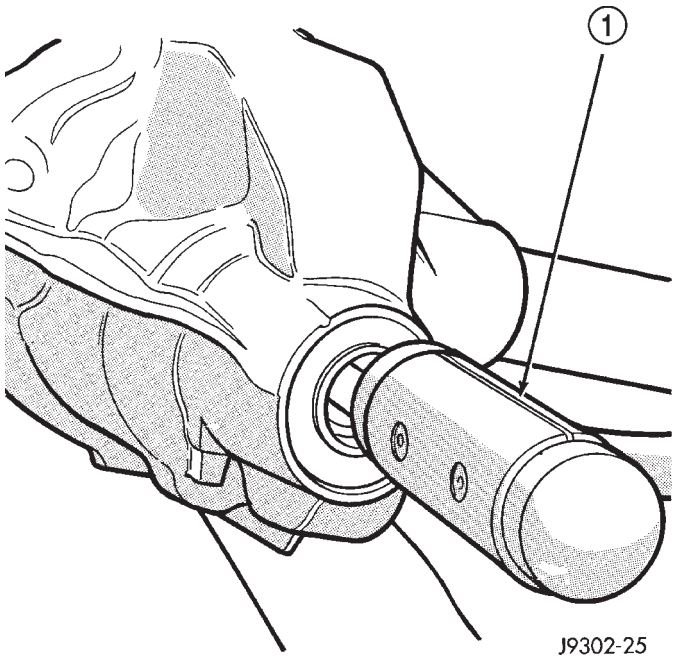


Fig. 12 Remove Pinion Gear

1 – RAWHIDE HAMMER

INSTALLATION

(1) Install a new collapsible preload spacer on pinion shaft (Fig. 13).
(2) If pinion gear was removed, install pinion gear in housing.
(3) Install pinion front bearing, if necessary.

REMOVAL AND INSTALLATION (Continued)

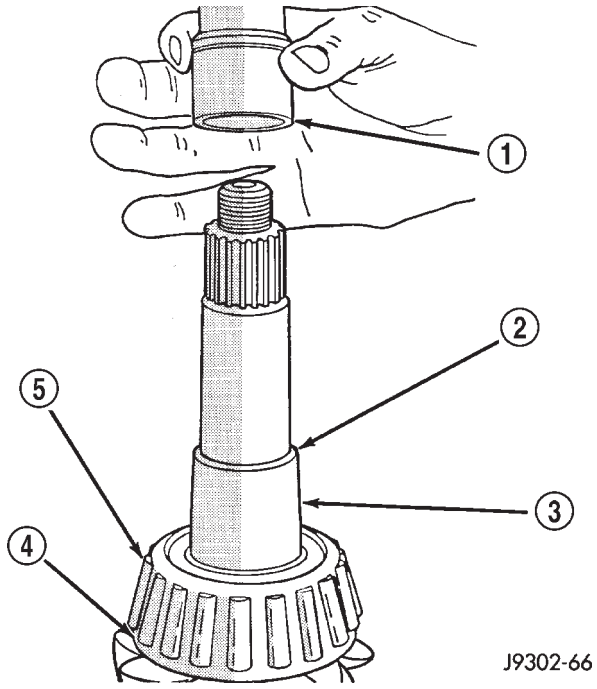


Fig. 13 Collapsible Preload Spacer

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

(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. 14), if necessary.

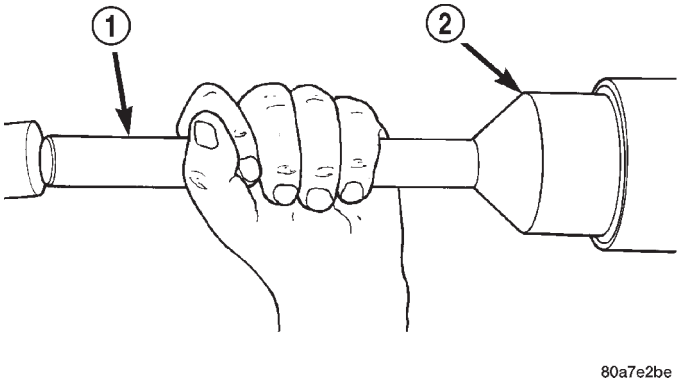


Fig. 14 Pinion Seal Installation

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL C-3972–A

(5) Install yoke with Installer W-162-D, Cup 8109, and holder 6958 (Fig. 15).

(6) If the original pinion bearings are being used, install differential assembly and axle shafts, if necessary.

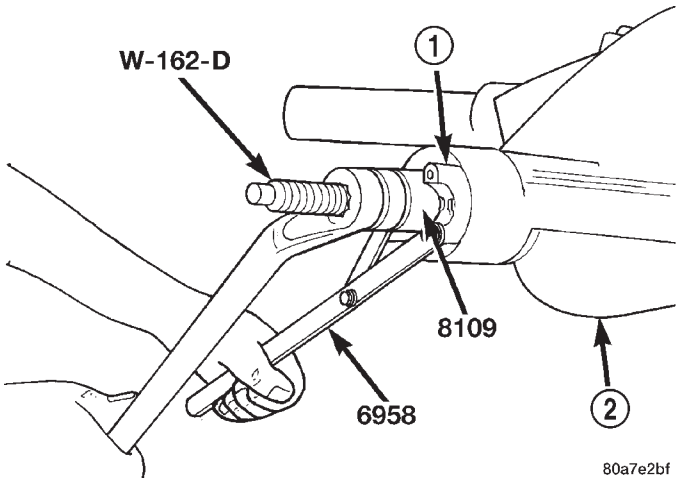


Fig. 15 Pinion Yoke Installation

1 – PINION YOKE
2 – AXLE HOUSING

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 pinion washer and a new nut on the pinion gear. Tighten the nut to 217 N·m (160 ft. lbs.) minimum. **Do not over-tighten.** Maximum torque is 353 N·m (260 ft. lbs.).

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.

(8) Using yoke holder 6958 and a torque wrench set at 353 N·m (260 ft. lbs.), crush collapsible spacer until bearing end play is taken up (Fig. 16). If more than 353 N·m (260 ft. lbs.) is needed to begin to collapse the spacer, the spacer is defective and must be replaced.

(9) 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. 17).

(10) Check rotating torque with an inch pound torque wrench (Fig. 17). 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 — 1.5 to 4 N·m (15 to 35 in. lbs.).

(11) Install differential assembly and axle shafts, if necessary.

(12) Align marks made previously on yoke and propeller shaft and install propeller shaft.

REMOVAL AND INSTALLATION (Continued)

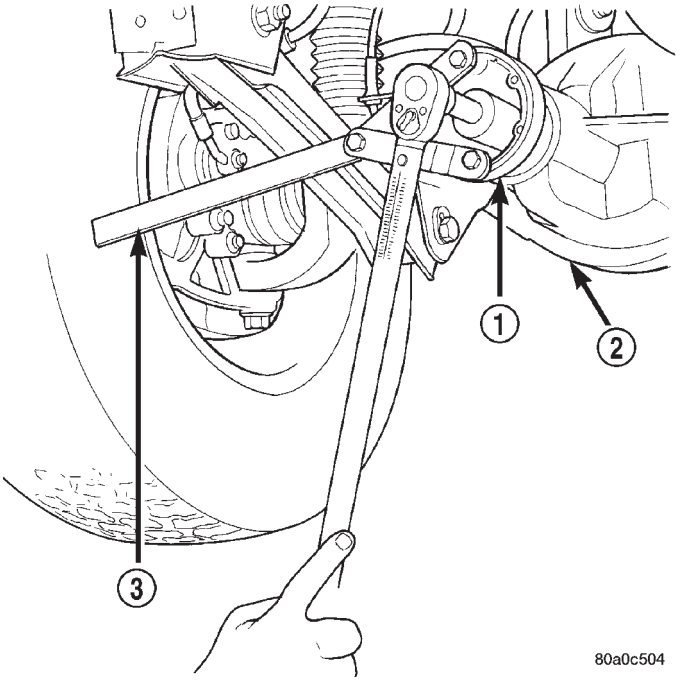


Fig. 16 Tightening Pinion Nut

1 – PINION FLANGE
2 – FRONT AXLE
3 – TOOL 6958

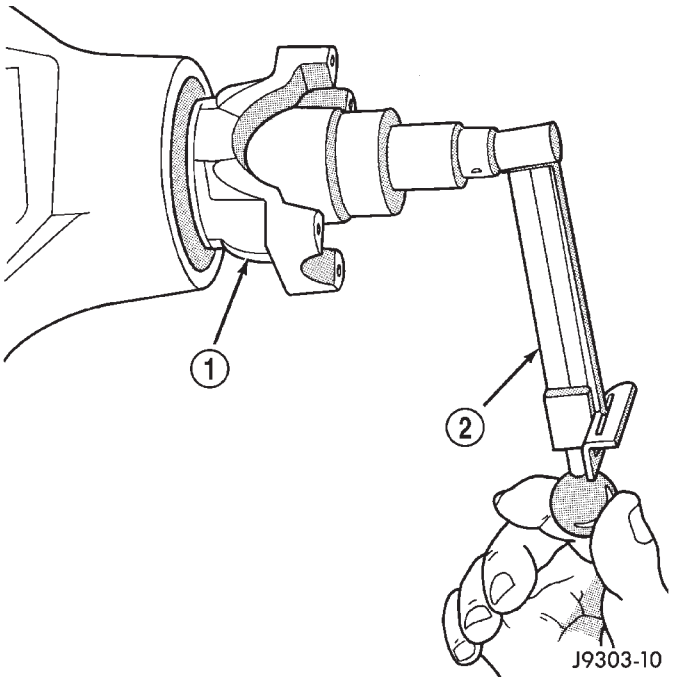


Fig. 17 Check Pinion Gear Rotation Torque—Typical

1 – PINION YOKE
2 – INCH POUND TORQUE WRENCH

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

(14) Add gear lubricant, if necessary. Refer to Lubricant Specifications of this section for lubricant requirements.

(15) Install wheel and tire assemblies.

(16) Lower 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.

(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. 18), if necessary.

(6) Remove the hub to knuckle bolts (Fig. 19).

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

(8) Remove hub bearing and axle shaft assembly (Fig. 20), or axle shaft from axle. **Avoid damaging the axle shaft oil seals in the axle housing.**

(9) Remove the brake rotor shield from the hub bearing or knuckle (Fig. 18).

INSTALLATION

(1) Thoroughly clean the axle shaft (Fig. 18) 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.

(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. 18).

(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.

REMOVAL AND INSTALLATION (Continued)

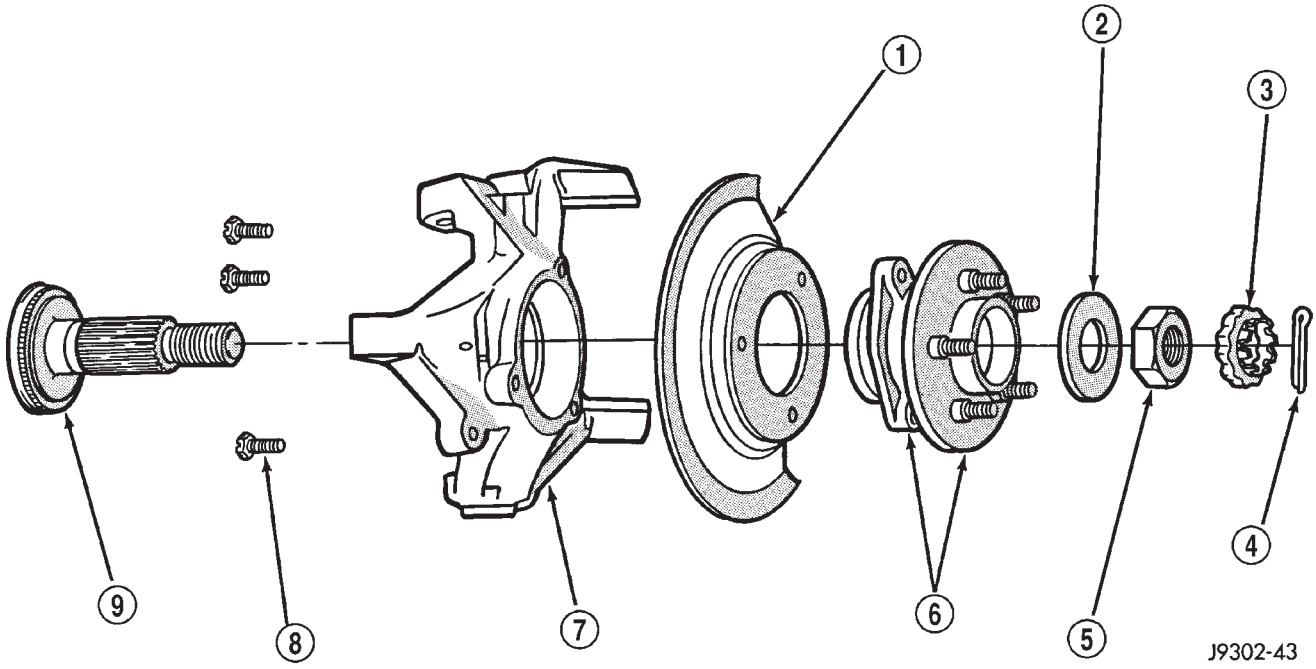


Fig. 18 Hub, Knuckle and Axle Shaft

1 – BRAKE SHIELD
2 – WASHER
3 – RETAINER
4 – COTTER PIN
5 – NUT
6 – HUB AND BEARING ASSEMBLY
7 – STEERING KNUCKLE
8 – BOLT
9 – TONE WHEEL (ABS)

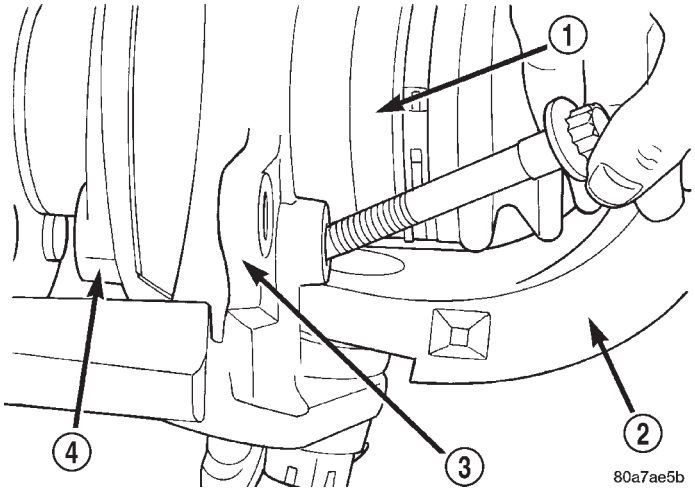


Fig. 19 Hub Bearing Bolts

1 – AXLE SHAFT
2 – AXLE
3 – KNUCKLE
4 – HUB BEARING

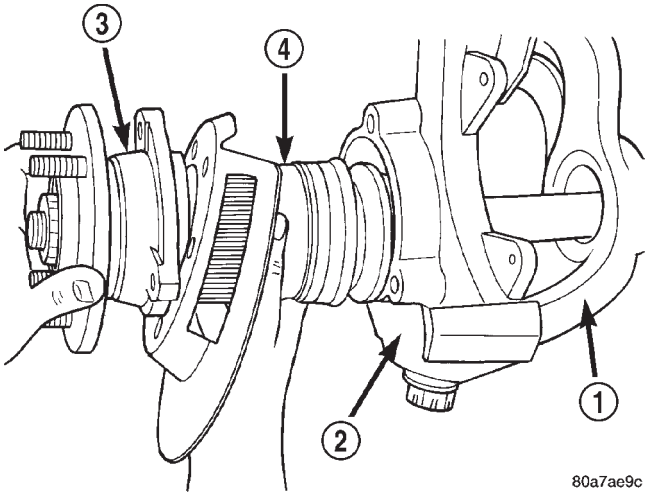


Fig. 20 Hub Bearing and Axle Assembly

1 – AXLE
2 – KNUCKLE
3 – HUB BEARING
4 – AXLE SHAFT

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.

REMOVAL AND INSTALLATION (Continued)

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. 21).

UPPER BALL STUD REPLACEMENT

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

LOWER BALL STUD REPLACEMENT

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

KNUCKLE INSTALLATION

(1) Position the steering knuckle on the ball studs.
(2) Install and tighten the bottom retaining nut to 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.

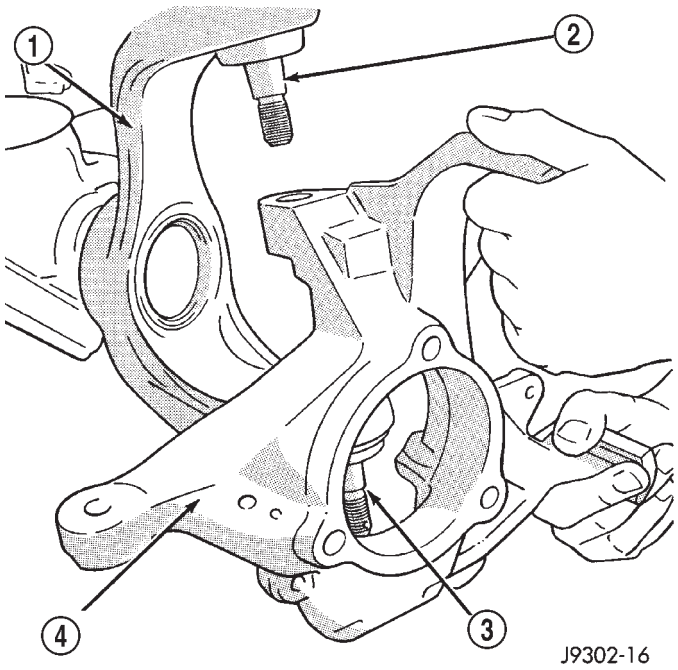


Fig. 21 Steering Knuckle Removal/Installation

1 – AXLE YOKE
2 – UPPER BALL STUD
3 – LOWER BALL STUD
4 – STEERING KNUCKLE

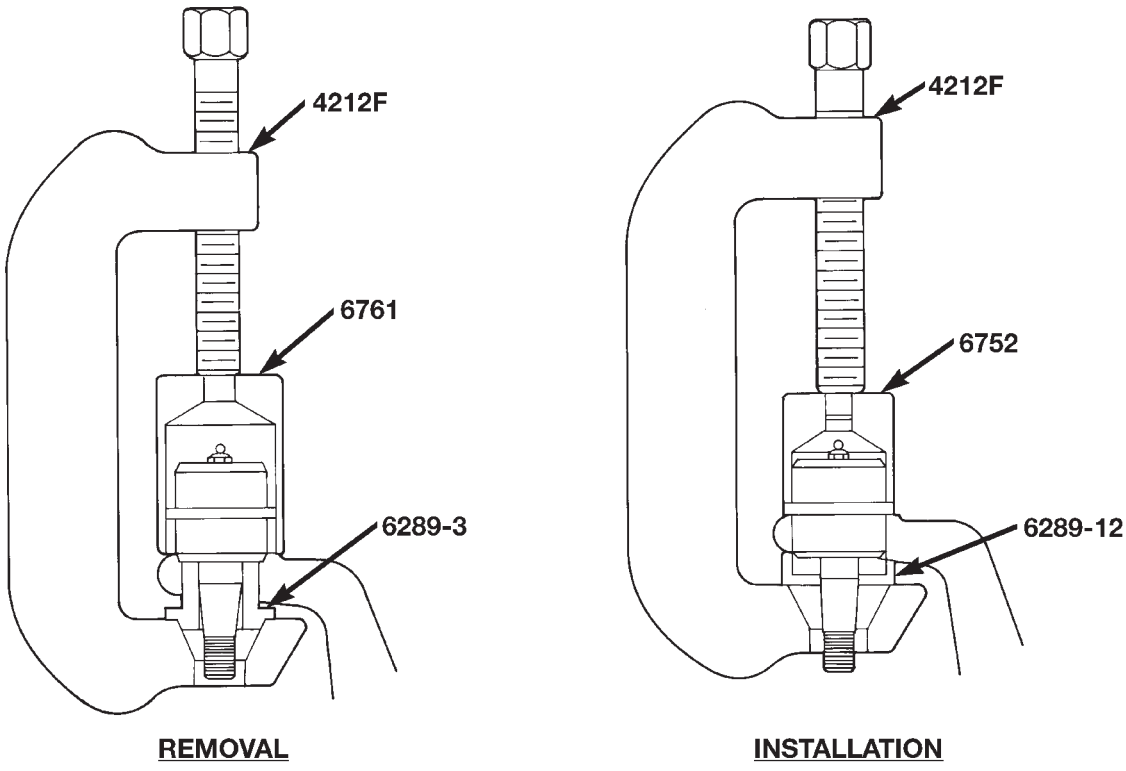


Fig. 22 Upper Ball Stud Remove/Install

REMOVAL AND INSTALLATION (Continued)

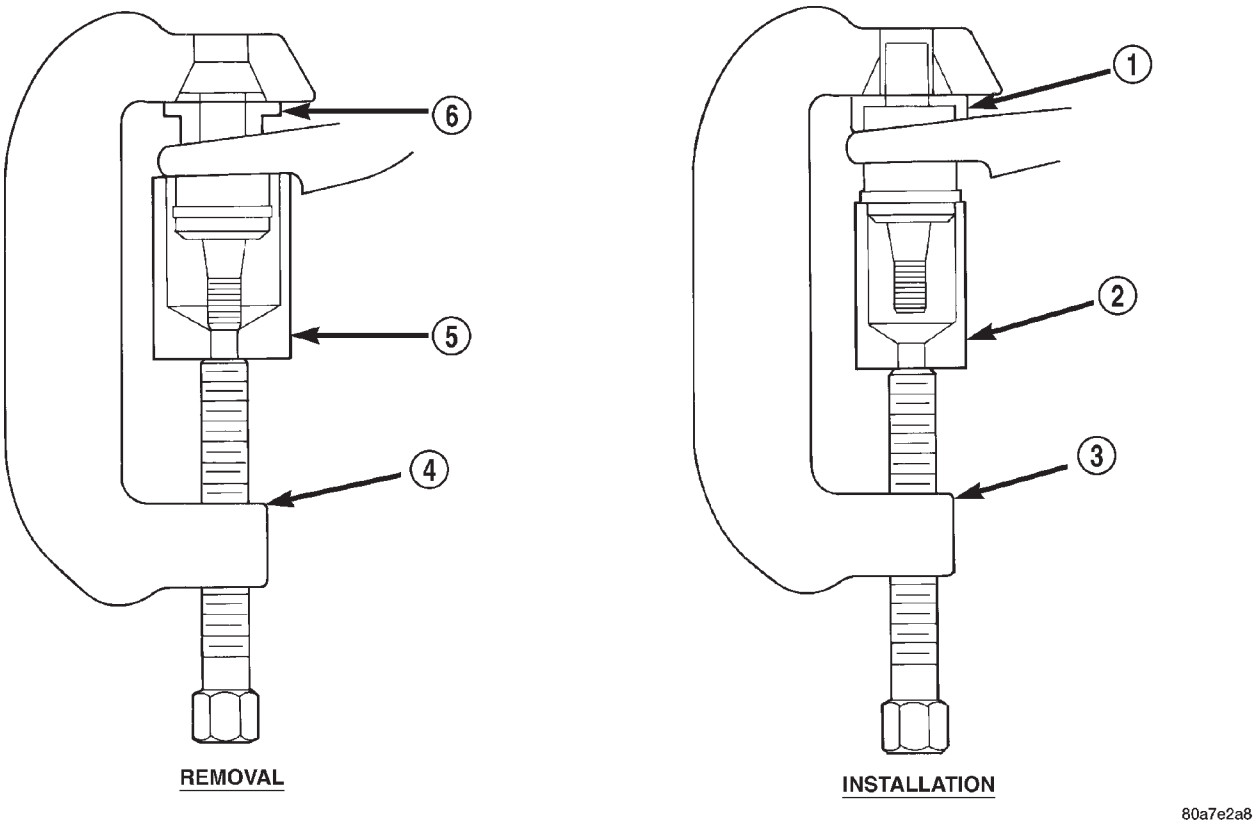


Fig. 23 Lower Ball Stud Remove/Install

1 – SPECIAL TOOL 6289–12
2 – SPECIAL TOOL 6289–4
3 – SPECIAL TOOL 4212F
4 – SPECIAL TOOL 4212F
5 – SPECIAL TOOL 6289–1
6 – SPECIAL TOOL 6289–3

(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. 24).
(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. 25). Install the holddown clamps and tighten the tool turnbuckle finger–tight.

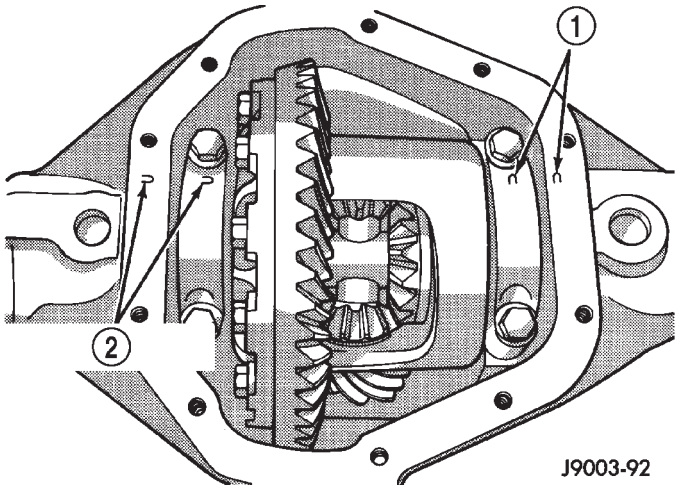


Fig. 24 Bearing Cap Identification

1 – INSTALLATION REFERENCE LETTERS
2 – INSTALLATION REFERENCE LETTERS

REMOVAL AND INSTALLATION (Continued)

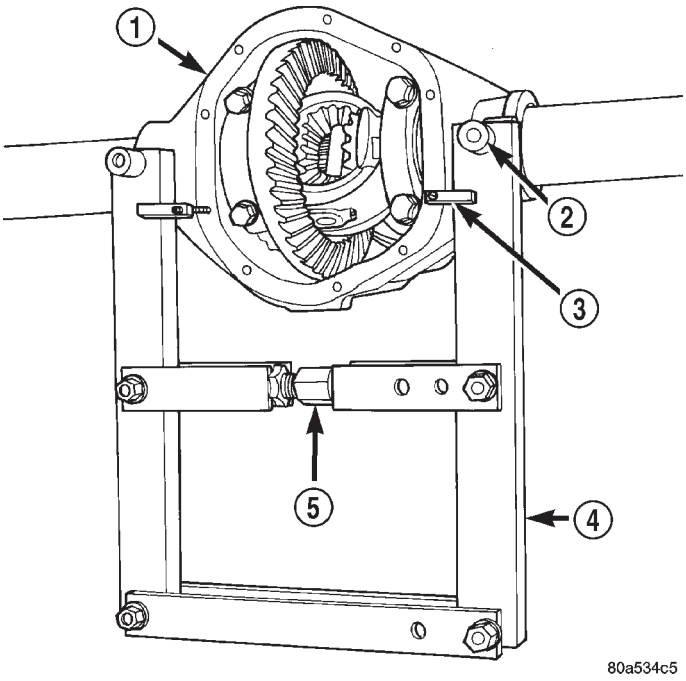


Fig. 25 Install Axle Housing Spreader

1 – AXLE HOUSING
2 – DOWEL
3 – SAFETY HOLD DOWN
4 – SPECIAL TOOL W-129–B
5 – TURNBUCKLE

(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. 26) 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. 27).

(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. 28).

(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 Differential Bearing Preload and Gear Backlash proce-

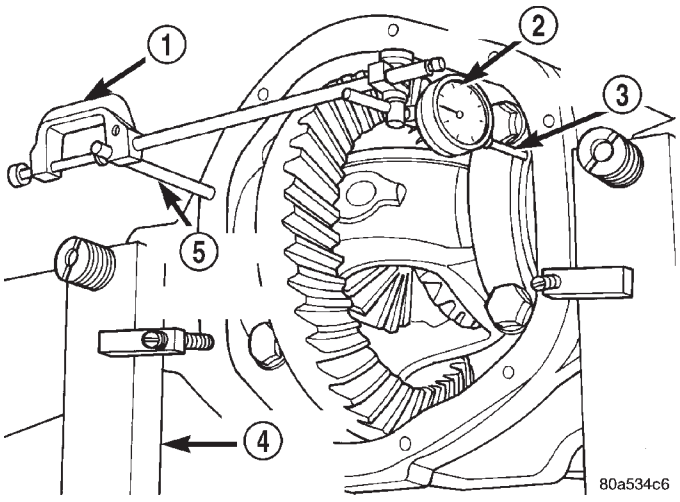


Fig. 26 Install Dial Indicator

1 – SPECIAL TOOL C-3339
2 – DIAL INDICATOR
3 – LEVER ADADPTER
4 – SPECIAL TOOL W-129–B
5 – SPECIAL TOOL C-3288–B

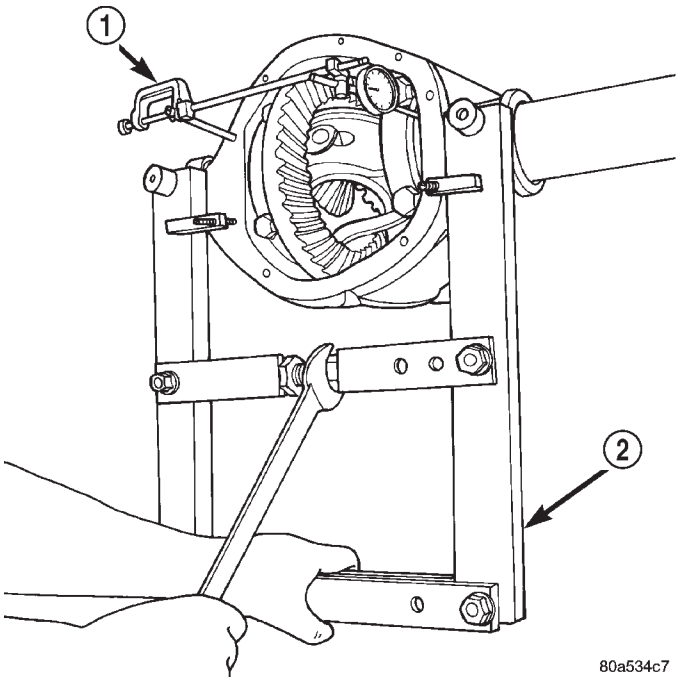


Fig. 27 Spread Axle Housing

1 – SPECIAL TOOL C-3339
2 – SPECIAL TOOL W-129–B

REMOVAL AND INSTALLATION (Continued)

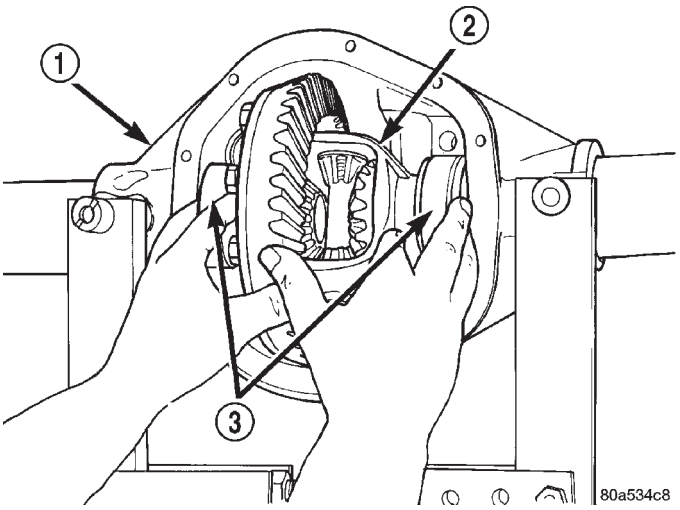


Fig. 28 Differential Case Removal

1 – AXLE HOUSING
2 – DIFFERENTIAL CASE
3 – BEARING CUPS

dures 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. 29). Install the holddown clamps and tighten the tool turnbuckle finger–tight.

(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. 26) 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. 27).

(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. 30).

(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.

(10) Install the hub bearings and axle shafts.

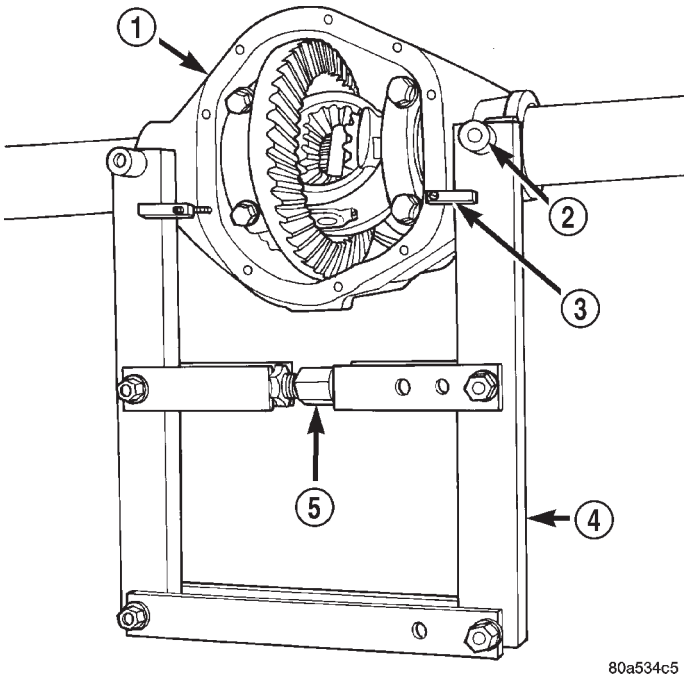


Fig. 29 Install Axle Housing Spreader

1 – AXLE HOUSING
2 – DOWEL
3 – SAFETY HOLD DOWN
4 – SPECIAL TOOL W-129–B
5 – TURNBUCKLE

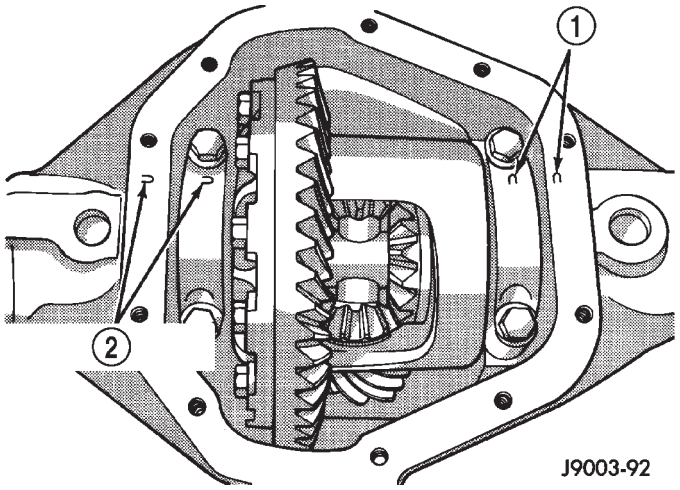


Fig. 30 Differential Bearing Cap Reference Letters

1 – INSTALLATION REFERENCE LETTERS
2 – INSTALLATION REFERENCE LETTERS

REMOVAL AND INSTALLATION (Continued)

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. 31).

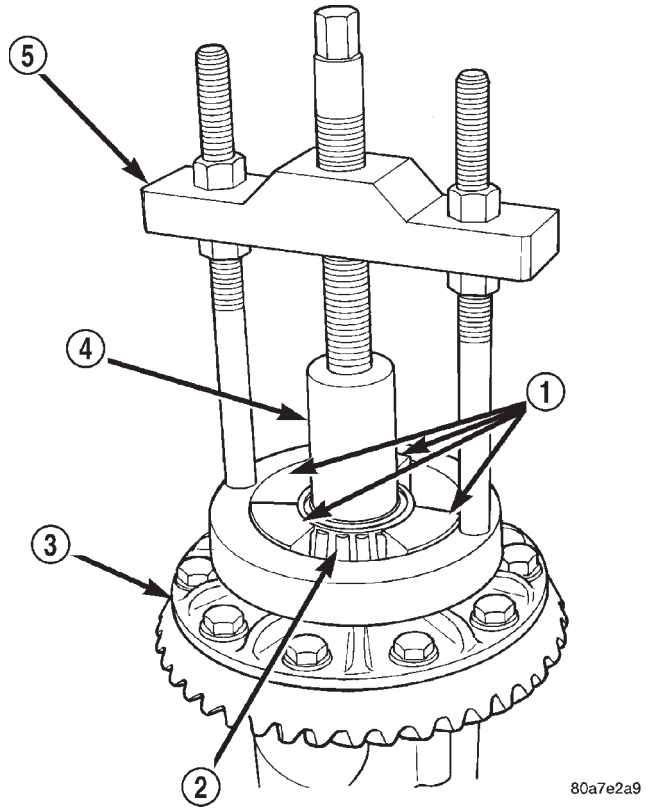


Fig. 31 Differential Bearing Removal

1 – SPECIAL TOOL C–293–39
2 – BEARING
3 – DIFFERENTIAL
4 – SPECIAL TOOL SP–3289
5 – SPECIAL TOOL C–293–PA

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. 32).
(3) Install differential in axle housing.

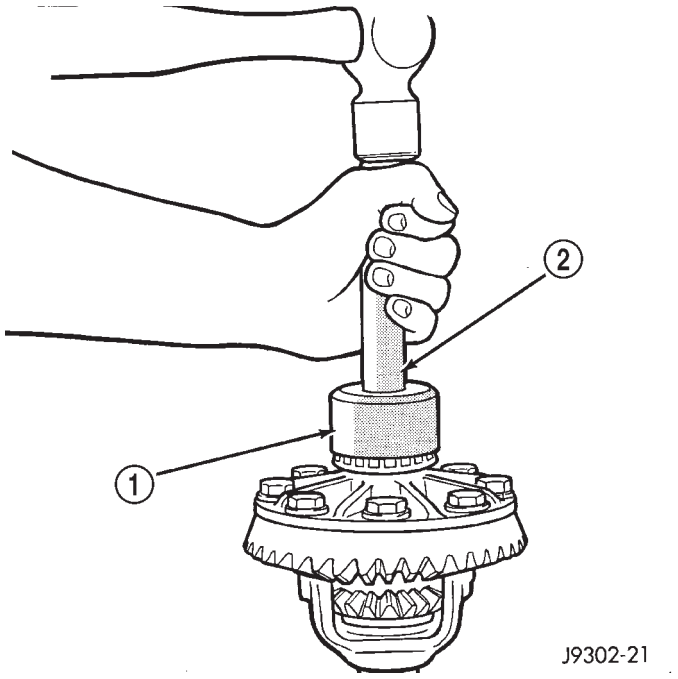


Fig. 32 Differential Side Bearing Installation

1 – SPECIAL TOOL C-3716–A
2 – SPECIAL TOOL C-4171

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. 33). Tighten tool until disc bottoms in housing.
(4) Install differential assembly.

PINION

The ring gear and pinion are serviced as a matched set. Do not replace the pinion 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.

REMOVAL AND INSTALLATION (Continued)

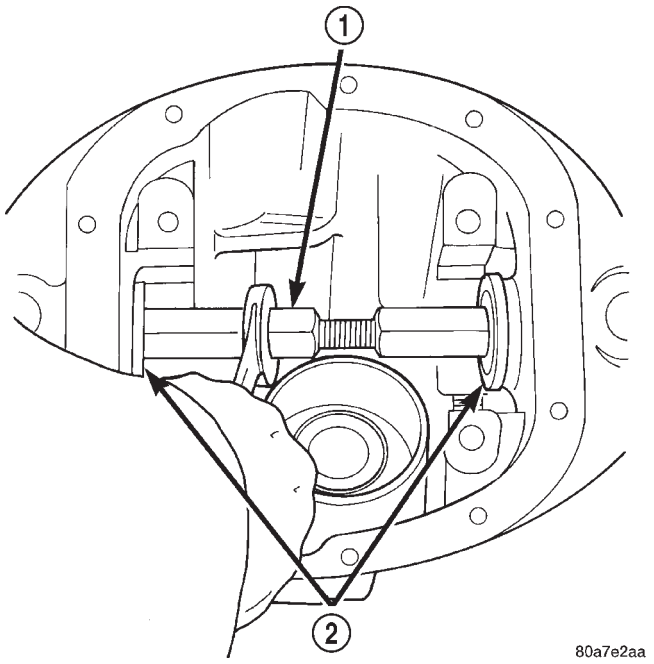


Fig. 33 Axle Seal Installation

1 – TURNBUCKLE 6797
2 – DISCS 8110

(4) Using Holder 6958 to the hold yoke, remove the pinion nut and washer (Fig. 34).

(5) Using Remover C–452 and Holder C-3281, remove the pinion yoke from pinion shaft (Fig. 35).

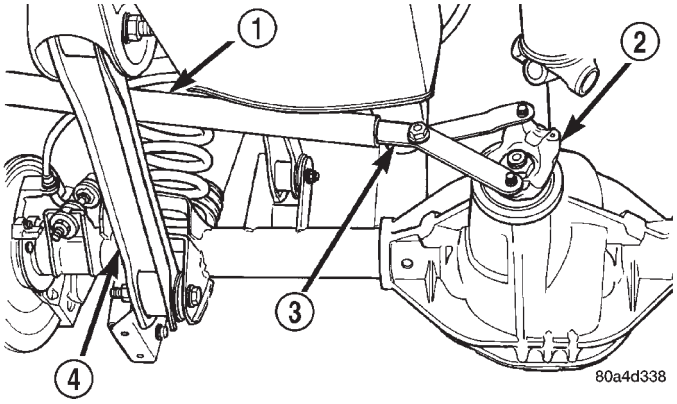


Fig. 34 Pinion Yoke Holder—Typical

1 – 1 in. PIPE
2 – PINION YOKE
3 – SPECIAL TOOL 6958
4 – LOWER CONTROL ARM

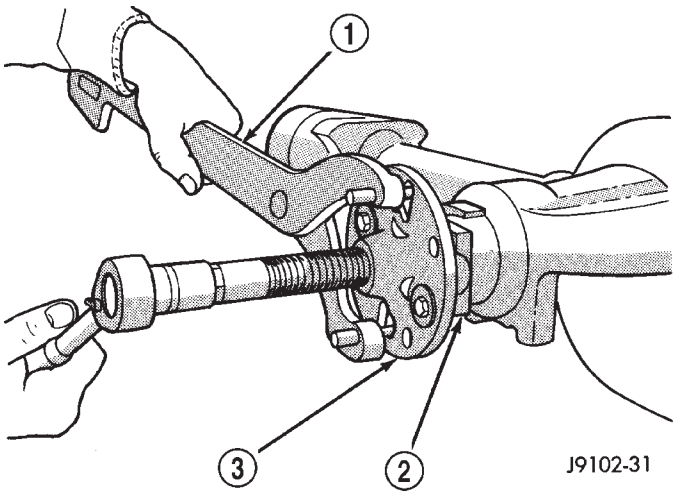


Fig. 35 Pinion Yoke Removal

1 – SPECIAL TOOL C-3281
2 – YOKE
3 – SPECIAL TOOL C-452

(6) Remove the pinion and collapsible spacer from housing (Fig. 36). Catch the pinion with your hand to prevent it from falling and being damaged.

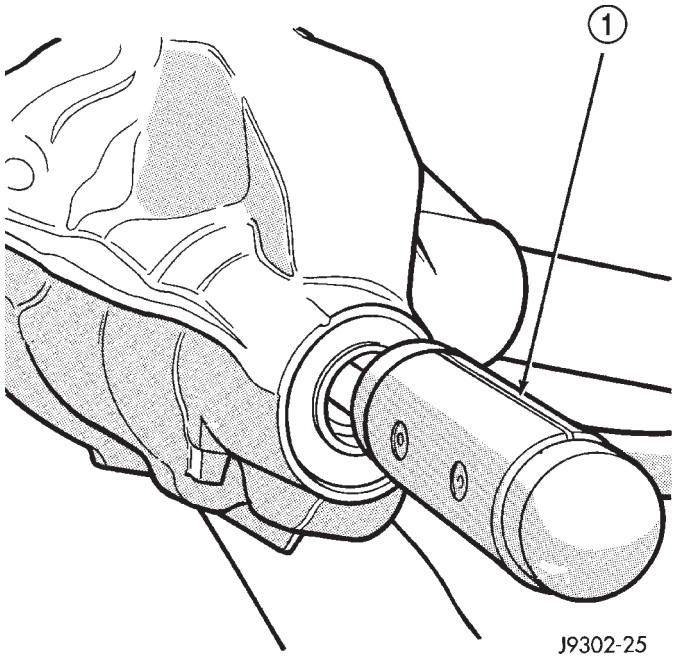


Fig. 36 Remove Pinion

1 – RAWHIDE HAMMER

REMOVAL AND INSTALLATION (Continued)

(7) Remove the front pinion bearing cup, bearing, oil slinger, if equipped, and pinion seal with Remover C-4345 and Handle C–4171 (Fig. 37).

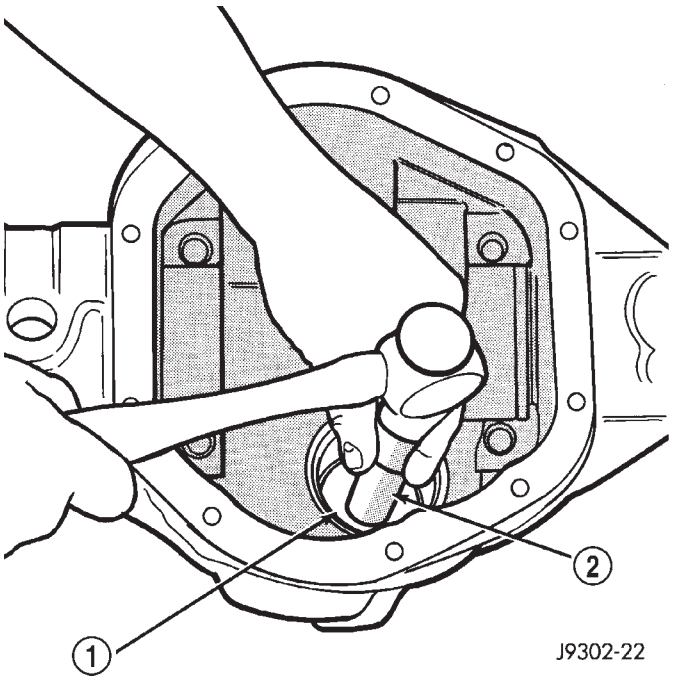


Fig. 37 Front Bearing Cup Removal

1 – REMOVER
2 – HANDLE

(8) Remove the rear pinion bearing cup from axle housing (Fig. 38). Use Remover D-149 and Handle C–4171.

(9) Remove the collapsible preload spacer from pinion gear (Fig. 39).

(10) Remove the rear pinion bearing from the pinion with Puller/Press C–293-PA and Adapters C–293–39 (Fig. 40).

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

(11) Remove the depth shim/oil slinger from the pinion shaft. Record the thickness of the depth shim/oil slinger.

INSTALLATION

NOTE: A pinion depth shim/oil slinger is placed between the rear pinion bearing cone and the pinion head to achieve proper ring gear and pinion mesh. If the factory installed ring gear and pinion are reused, the pinion depth shim/oil slinger should not require replacement. Refer to Pinion Gear Depth to select the proper thickness shim/oil slinger before installing pinion.

(1) 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 Driver Handle C–4171 (Fig. 41). Verify cup is correctly seated.

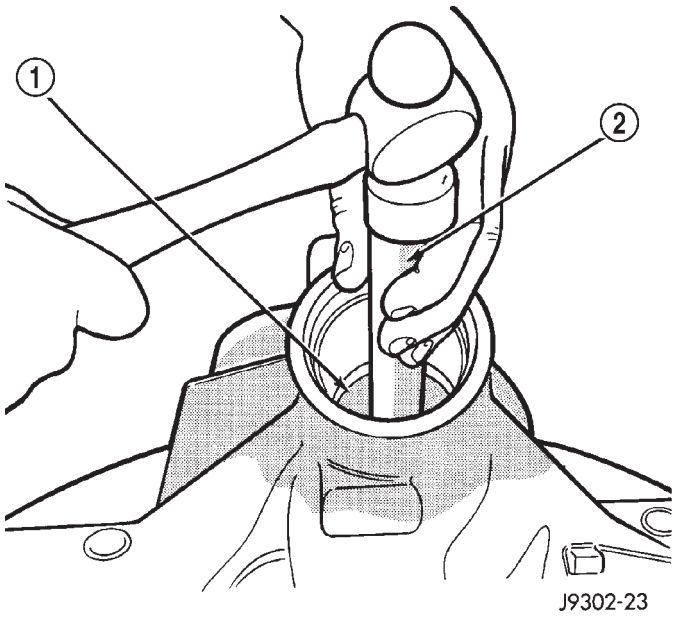


Fig. 38 Rear Bearing Cup Removal

1 – DRIVER
2 – HANDLE

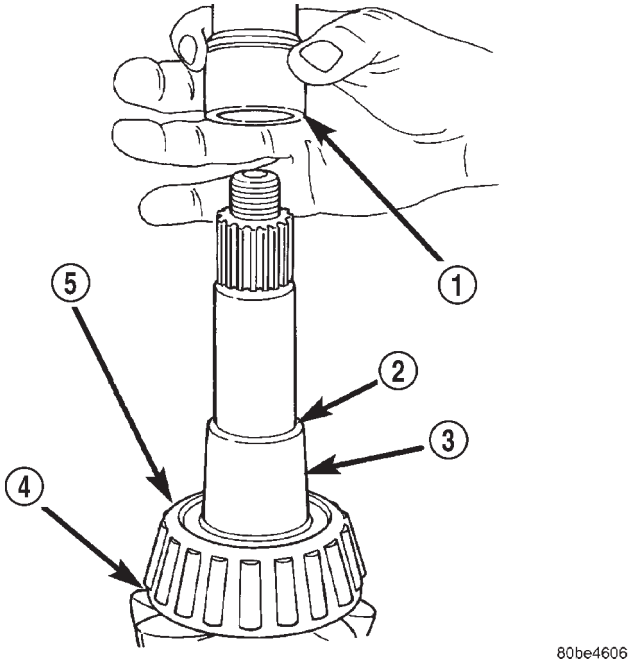


Fig. 39 Collapsible Spacer

1 – COLLAPSIBLE SPACER
2 – SHOULDER
3 – PINION
4 – PINION DEPTH SHIM
5 – REAR BEARING

REMOVAL AND INSTALLATION (Continued)

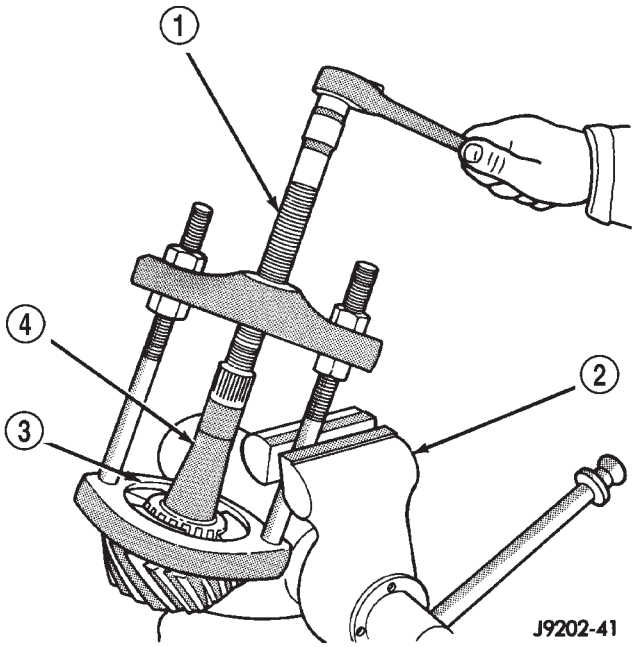


Fig. 40 Inner Bearing Removal

1 – SPECIAL TOOL C-293–PA
2 – VISE
3 – ADAPTERS
4 – DRIVE PINION GEAR SHAFT

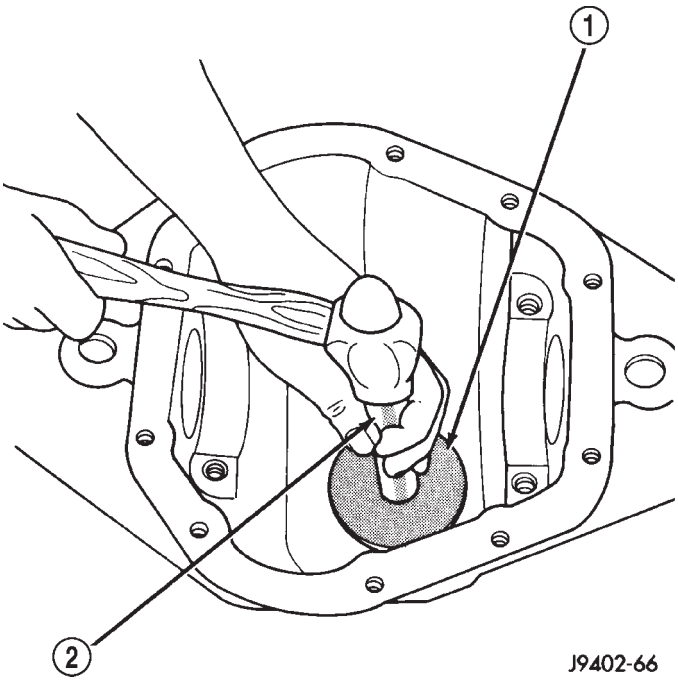


Fig. 41 Rear Pinion Bearing Cup Installation

1 – INSTALLER
2 – HANDLE

(2) Apply Mopar® Door Ease, or equivalent, stick lubricant to outside surface of front pinion bearing cup. Install the bearing cup with Installer D-130 and Handle C–4171 (Fig. 42).

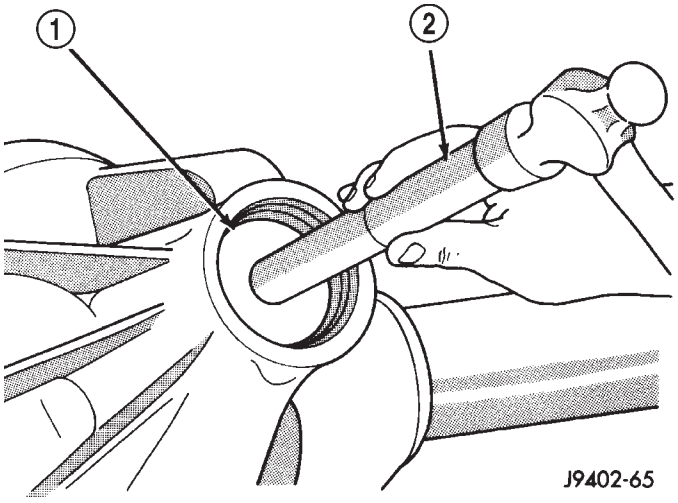


Fig. 42 Pinion Outer Bearing Cup Installation

1 – INSTALLER
2 – HANDLE

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

(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. 43).

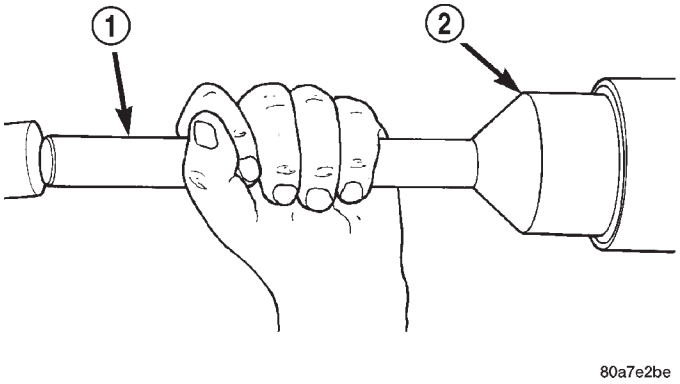


Fig. 43 Pinion Seal Installation

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL C-3972–A

REMOVAL AND INSTALLATION (Continued)

(5) Install the rear pinion bearing and the pinion depth shim/oil slinger onto the pinion with Installer W-262 and a shop press (Fig. 44).

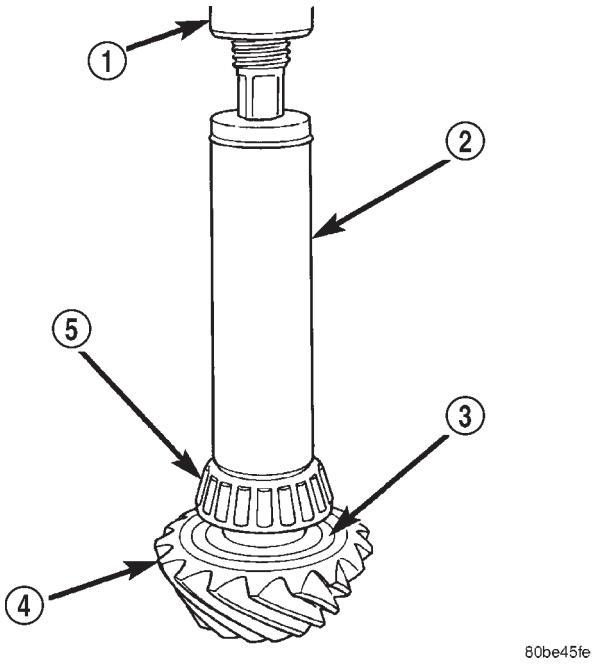


Fig. 44 Rear Pinion Bearing Installation

1 – PRESS
2 – INSTALLATION TOOL
3 – PINION DEPTH SHIM/OIL BAFFLE
4 – DRIVE PINION
5 – DRIVE PINION SHAFT REAR BEARING

(6) Install a new collapsible preload spacer on pinion shaft and install pinion in housing (Fig. 45).

(7) Install yoke with Installer W-162-B, Cup 8109, and Holder 6958 (Fig. 46).

(8) Install the pinion washer and a new nut onto the pinion. Tighten the nut to 216 N·m (160 ft. lbs.) minimum. **Do not over–tighten.** Maximum torque is 352 N·m (260 ft. lbs.).

CAUTION: Never loosen pinion nut to decrease pinion 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.

(9) Using Holder 6958 and torque wrench (set at 352 N·m (260 ft. lbs.)), crush collapsible spacer until bearing end play is taken up (Fig. 47). If more than 353 N·m (260 ft. lbs.) is needed to begin to collapse the spacer, the spacer is defective and must be replaced.

(10) Slowly tighten the nut in 6.8 N·m (5 ft. lb.) increments until the rotating torque is achieved. Measure the rotating torque frequently to avoid over crushing the collapsible spacer (Fig. 48).

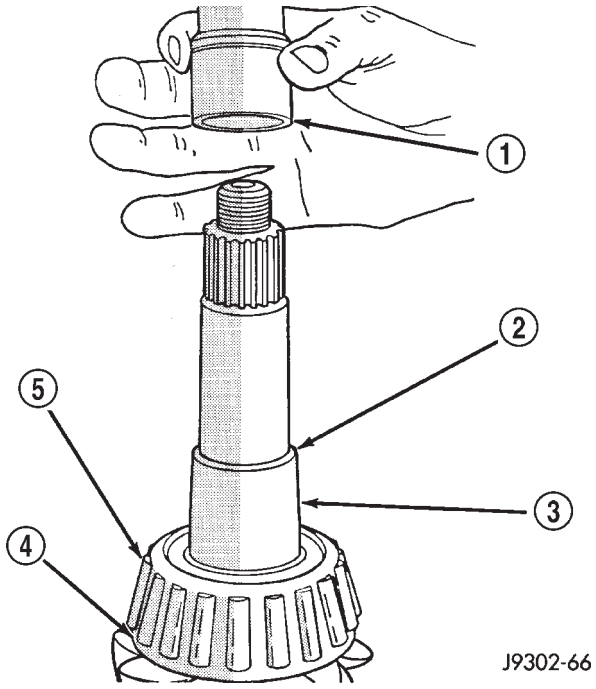


Fig. 45 Collapsible Preload Spacer

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

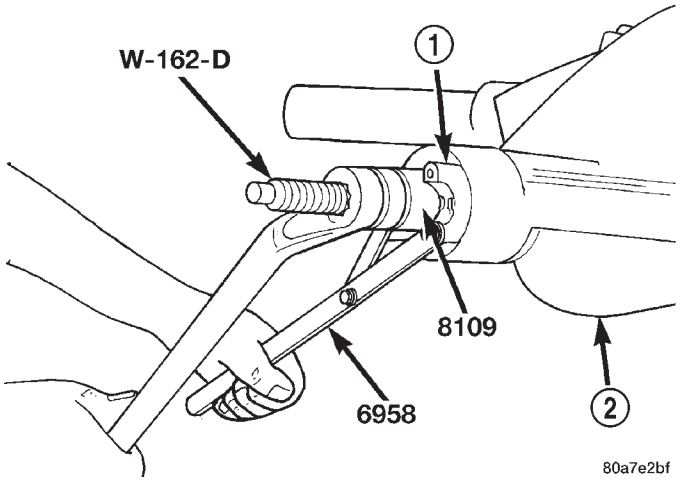


Fig. 46 Pinion Yoke Installation

1 – PINION YOKE
2 – AXLE HOUSING

(11) Check bearing rotating torque with an inch pound torque wrench (Fig. 48). The torque necessary to rotate the pinion should be:

- Original Bearings — 1 to 2 N·m (10 to 20 in. lbs.).
- New Bearings — 1.5 to 4 N·m (15 to 35 in. lbs.).

(12) Install differential assembly.

REMOVAL AND INSTALLATION (Continued)

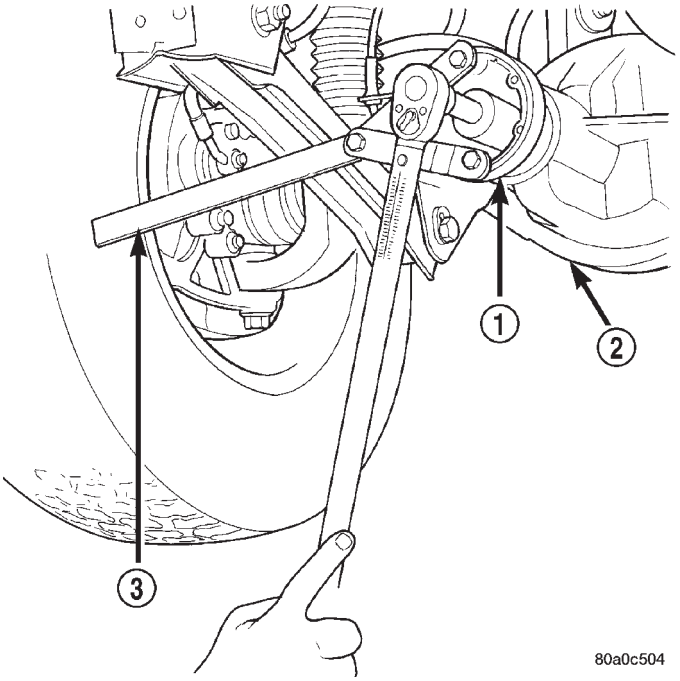


Fig. 47 Tightening Pinion Nut—Typical

1 – PINION FLANGE
2 – FRONT AXLE
3 – TOOL 6958

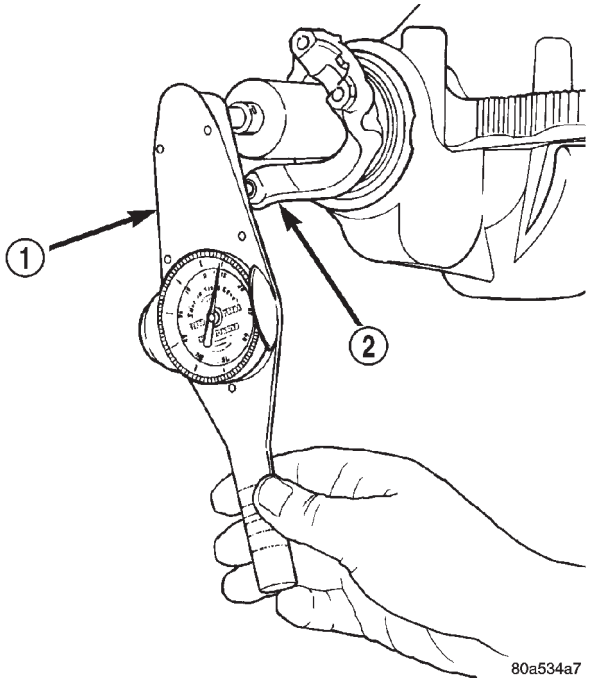


Fig. 48 Check Pinion Rotation Torque

1 – in. lbs. TORQUE WRENCH
2 – PINION YOKE

RING GEAR

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

REMOVAL

(1) Remove differential from axle housing.
(2) Place differential case in a suitable vise with soft metal jaw protectors. (Fig. 49)
(3) Remove bolts holding ring gear to differential case.
(4) Using a soft hammer, drive ring gear from differential case (Fig. 49).

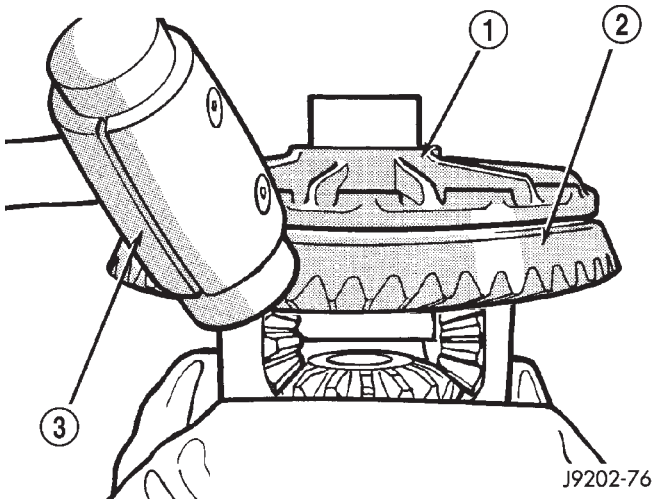


Fig. 49 Ring Gear Removal

1 – CASE
2 – RING GEAR
3 – RAWHIDE HAMMER

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. 50).
(4) Install differential in axle housing and verify gear mesh and contact pattern.

REMOVAL AND INSTALLATION (Continued)

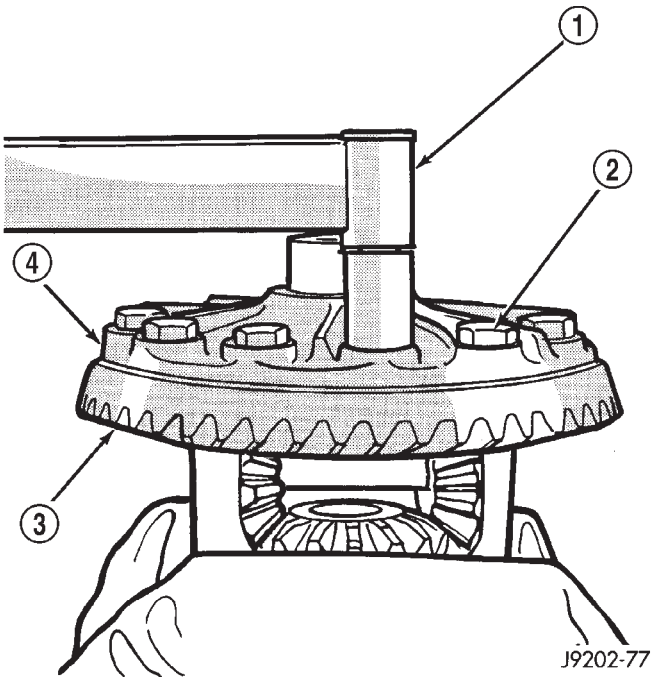


Fig. 50 Ring Gear Bolt Installation

1 – TORQUE WRENCH
2 – RING GEAR BOLT
3 – RING GEAR
4 – CASE

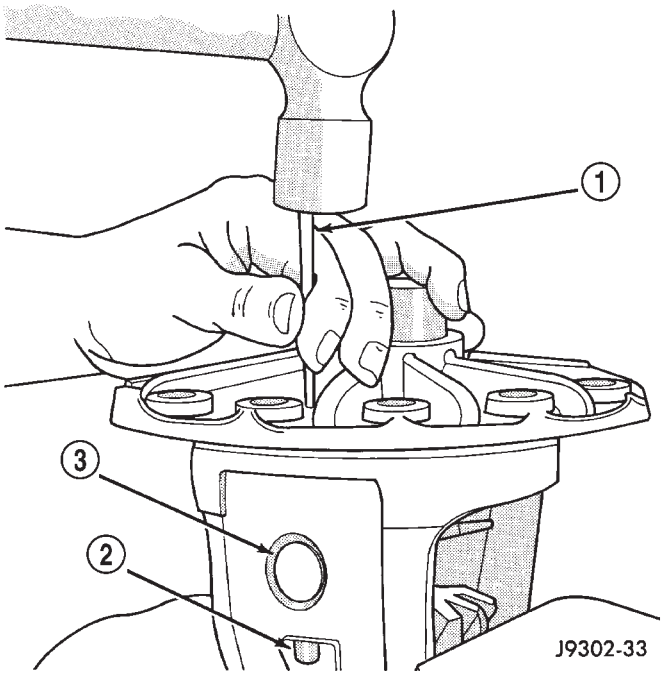


Fig. 51 Mate Shaft Roll Pin Removal

1 – DRIFT
2 – LOCKPIN
3 – MATE SHAFT

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. 51).

(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. 52).

(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. 53).

(5) Install the ring gear.

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

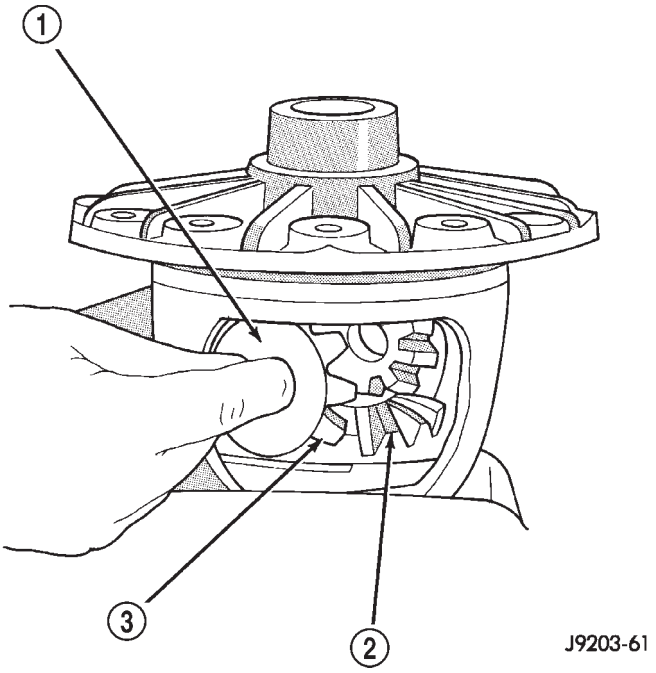


Fig. 52 Pinion Mate Gear Removal

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

DISASSEMBLY AND ASSEMBLY (Continued)

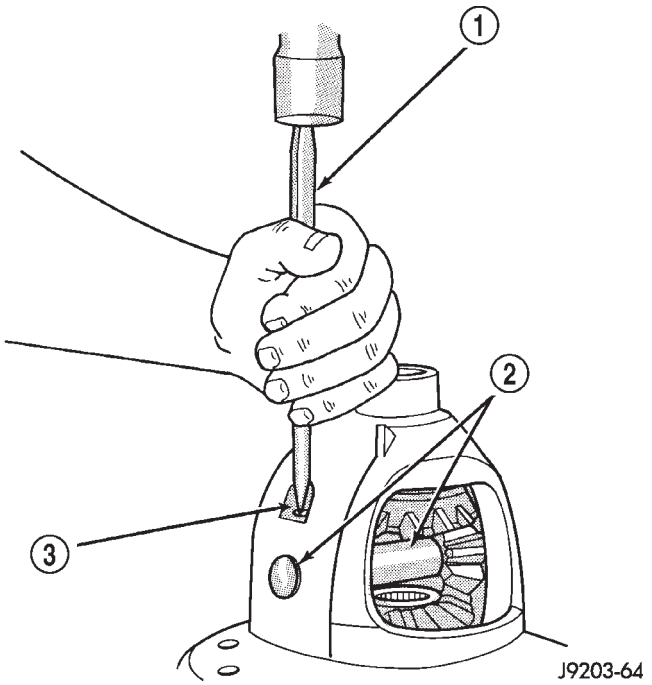


Fig. 53 Mate Shaft Roll Pin Installation

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

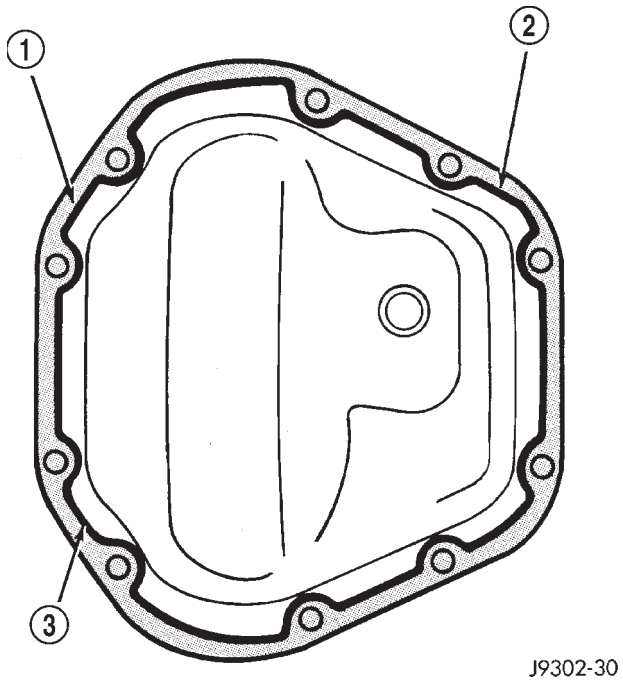


Fig. 54 Typical Housing Cover With Sealant

1 – SEALING SURFACE
2 – CONTOUR OF BEAD
3 – BEAD THICKNESS 6.35MM (1/4")

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. 54).

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.

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.

CLEANING AND INSPECTION (Continued)

- 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 gear and pinion are supplied as matched sets only. The identifying numbers for the ring gear and pinion are etched into the face of each gear (Fig. 55). A plus (+) number, minus (–) number or zero (0) is etched into the face of the pinion gear head. 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.

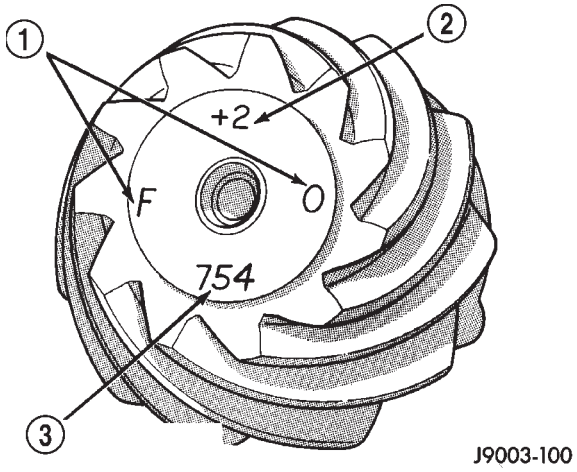


Fig. 55 Pinion Gear ID Numbers

1 – PRODUCTION NUMBERS
2 – DRIVE PINION GEAR DEPTH VARIANCE
3 – GEAR MATCHING NUMBER (SAME AS RING GEAR NUMBER)

Compensation for pinion depth variance is achieved with a select shim/oil slinger. The shim/oil slinger is placed between the rear pinion bearing and the pinion gear head (Fig. 56).

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

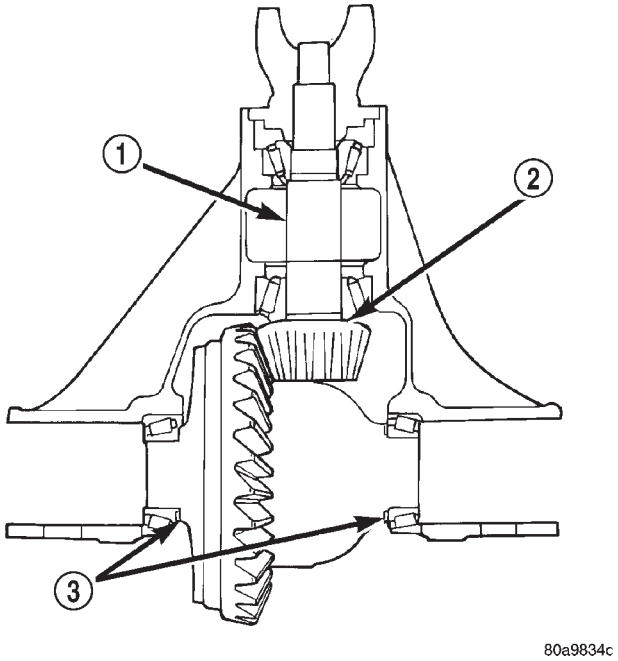


Fig. 56 Shim Locations

1 – COLLAPSIBLE SPACER
2 – DRIVE PINION GEAR DEPTH SHIM
3 – DIFFERENTIAL BEARING SHIM

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 (–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/oil slinger. If the number is positive, subtract that value from the thickness of the depth shim/oil slinger. If the number is 0 no change is necessary.

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Measurements are taken with pinion bearing cups and pinion bearings installed in the axle housing. Take measurements with Pinion Gauge Set 6774 and Dial Indicator C-3339 (Fig. 57).

(1) Assemble Pinion Height Block 6739, Pinion Block 6733, and rear pinion bearing onto Screw 6741 (Fig. 57).

(2) Insert assembled height gauge components, rear bearing and screw into axle housing through pinion bearing cups (Fig. 58).

(3) Install front pinion bearing and Cone-nut 6740 hand tight (Fig. 57).

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in axle housing side bearing cradles (Fig. 59). Install differential bearing caps on Arbor Discs and tighten cap bolts to 41 N·m (30 ft. lbs.).

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

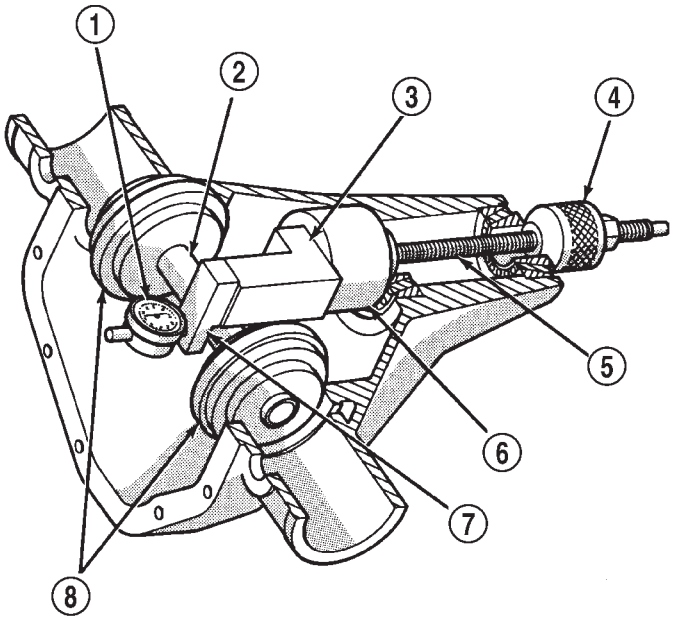


Fig. 57 Pinion Gear Depth Gauge Tools—Typical

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

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

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

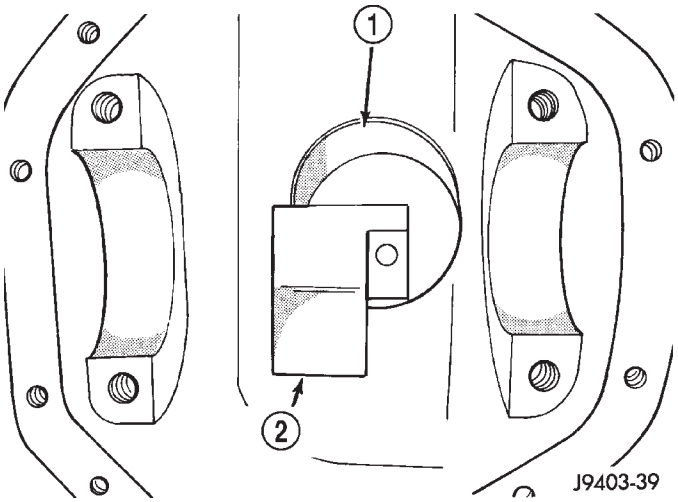


Fig. 58 Pinion Height Block—Typical

1 – PINION BLOCK
2 – PINION HEIGHT BLOCK

(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. 57). 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. 60). 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.

ADJUSTMENTS (Continued)

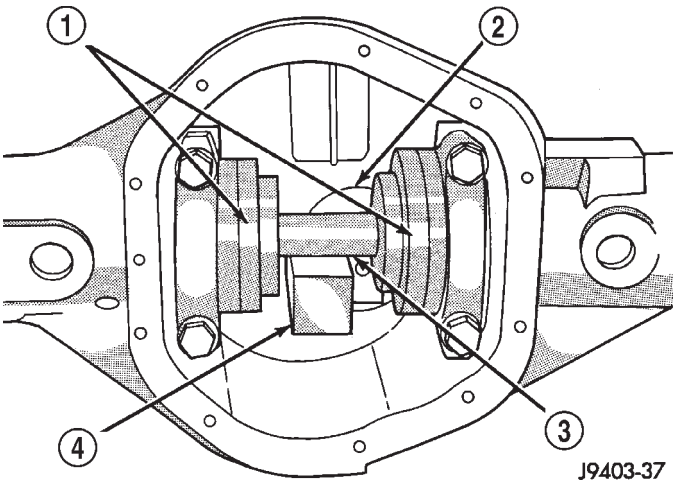


Fig. 59 Gauge Tools In Housing—Typical

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

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/oil slinger equal to the dial indicator reading plus the drive pinion depth variance number etched in the face of the pinion (Fig. 55). For example, if the depth variance is –2, add +0.002 in. to the dial indicator reading.

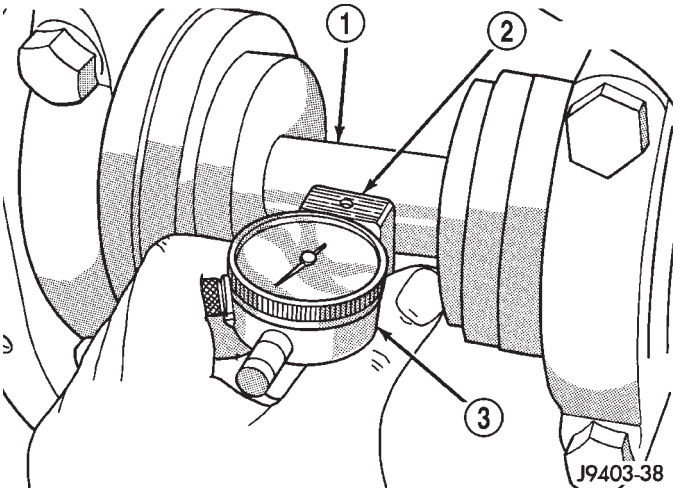


Fig. 60 Pinion Gear Depth Measurement—Typical

1 – ARBOR
2 – SCOOTER BLOCK
3 – DIAL INDICATOR

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 for installation. Establishing proper pinion gear depth is essential to establishing gear backlash and tooth contact patterns. After the overall shim thickness to take up differential side play is measured, the pinion is installed, and the gear backlash 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. 61). Differential shim measurements are performed with axle spreader W-129-B removed.

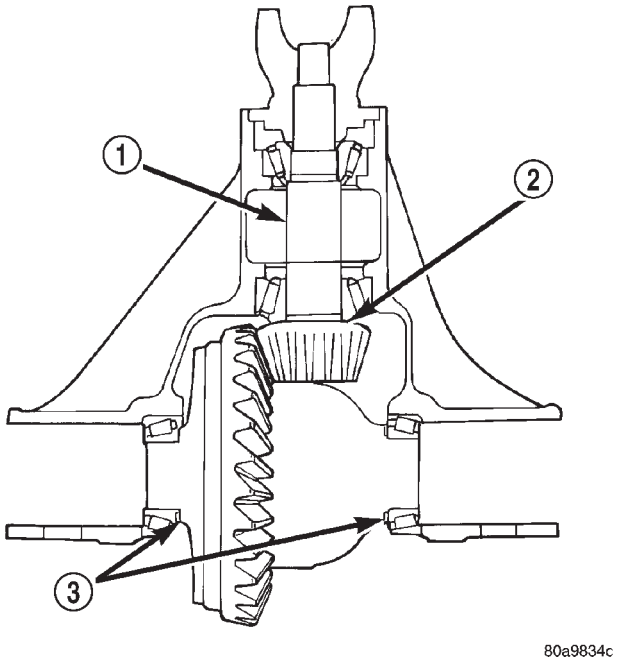


Fig. 61 Axle Adjustment Shim Locations

1 – COLLAPSIBLE SPACER
2 – DRIVE PINION GEAR DEPTH SHIM
3 – DIFFERENTIAL BEARING SHIM

ADJUSTMENTS (Continued)

SHIM SELECTION

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

(1) Remove differential side bearings from differential case.
(2) 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. 62).

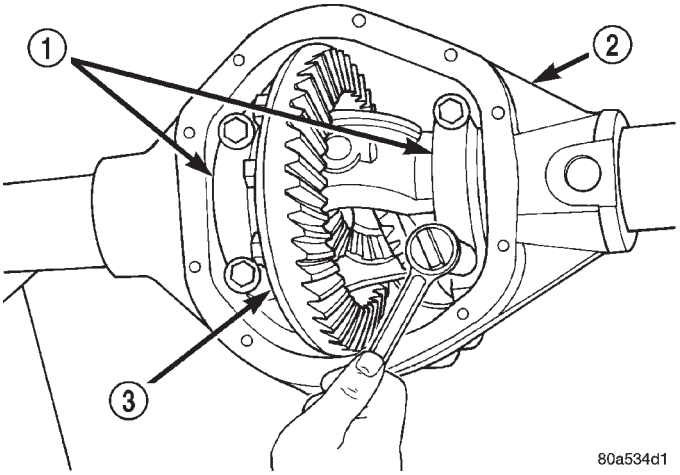


Fig. 62 Tighten Bolts Holding Bearing Caps

1 – BEARING CAP
2 – AXLE HOUSING
3 – DIFFERENTIAL CASE

(7) Using a dead-blow type mallet, seat the differential dummy bearings to each side of the axle housing (Fig. 63) and (Fig. 64).
(8) Thread guide stud C-3288-B into rear cover bolt hole below ring gear (Fig. 65).
(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. 65).
(10) Push and hold differential case to pinion gear side of axle housing (Fig. 66).
(11) Zero dial indicator face to pointer (Fig. 66).
(12) Push and hold differential case to ring gear side of the axle housing (Fig. 67).
(13) Record dial indicator reading (Fig. 67).
(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.

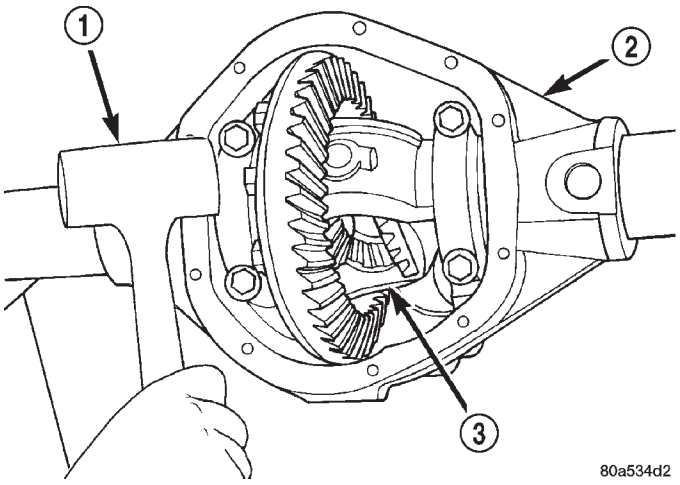


Fig. 63 Seat Pinion Gear Side Differential Dummy Side Bearing

1 – MALLET
2 – AXLE HOUSING
3 – DIFFERENTIAL CASE

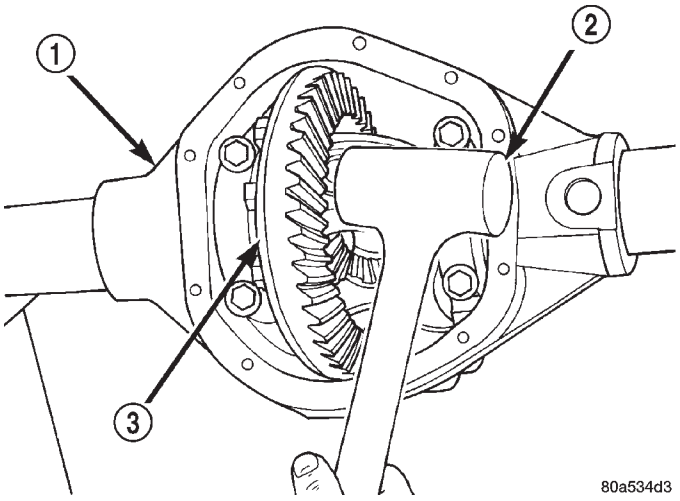


Fig. 64 Seat Ring Gear Side Differential Dummy Side Bearing

1 – AXLE HOUSING
2 – MALLET
3 – DIFFERENTIAL CASE

(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 in the 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. 64).

ADJUSTMENTS (Continued)

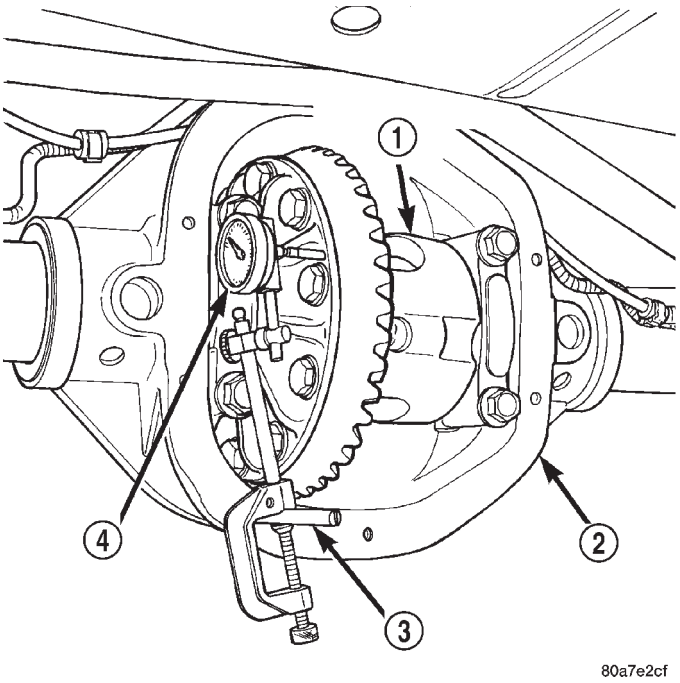


Fig. 65 Differential Side play Measurement

1 – DIFFERENTIAL CASE
2 – AXLE HOUSING
3 – SPECIAL TOOL C-3288–B
4 – SPECIAL TOOL C-3339

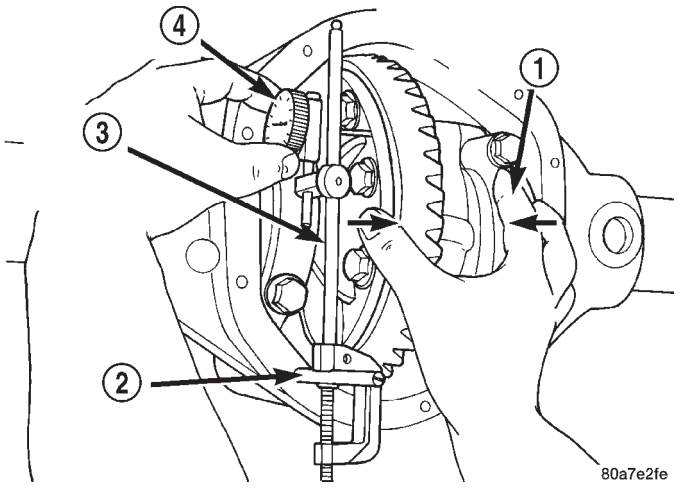


Fig. 66 Hold Differential Case and Zero Dial Indicator

1 – FORCE DIFFERENTIAL CASE TO PINION GEAR SIDE
2 – SPECIAL TOOL C-3288–B
3 – SPECIAL TOOL C-3339
4 – ZERO DIAL INDICATOR FACE

(20) Position the dial indicator plunger on a flat surface between the ring gear bolt heads. (Fig. 65).

(21) Push and hold differential case toward pinion gear (Fig. 68).

(22) Zero dial indicator face to pointer (Fig. 68).

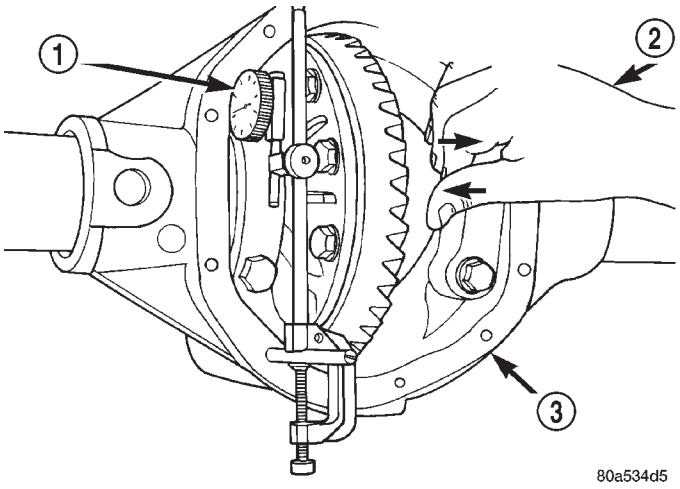


Fig. 67 Hold Differential Case and Read Dial Indicator

1 – READ DIAL INDICATOR
2 – FORCE DIFFERENTIAL CASE TO RING GEAR SIDE
3 – AXLE HOUSING

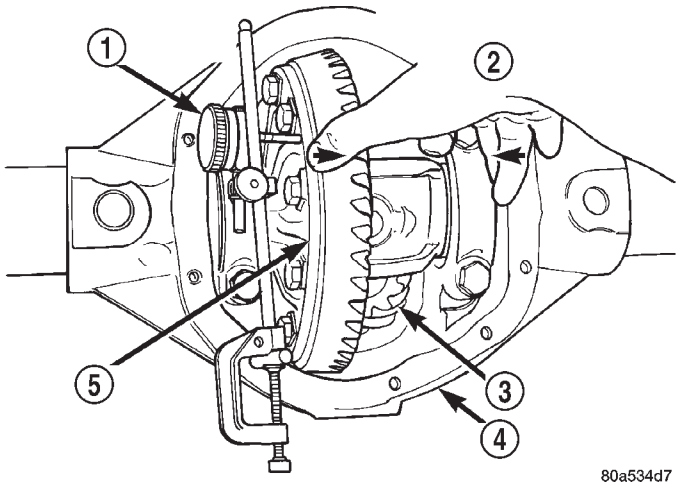


Fig. 68 Hold Differential Case and Zero Dial Indicator

1 – ZERO DIAL INDICATOR FACE
2 – FORCE DIFFERENTIAL CASE TO PINION GEAR SIDE
3 – PINION GEAR
4 – AXLE HOUSING
5 – DIFFERENTIAL CASE

(23) Push and hold differential case to ring gear side of the axle housing (Fig. 69).

(24) Record dial indicator reading (Fig. 69).

(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

ADJUSTMENTS (Continued)

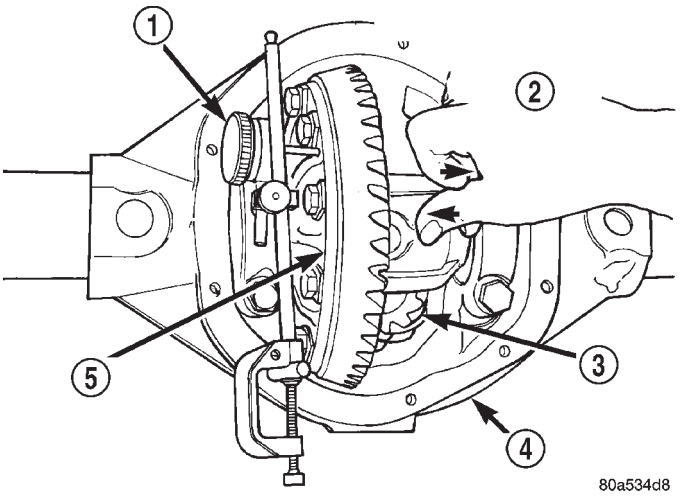


Fig. 69 Hold Differential Case and Read Dial Indicator

1 – READ DIAL INDICATOR
2 – FORCE DIFFERENTIAL CASE TO RING GEAR SIDE
3 – PINION GEAR
4 – AXLE HOUSING
5 – DIFFERENTIAL CASE

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 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. 70).

(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. 71).

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

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

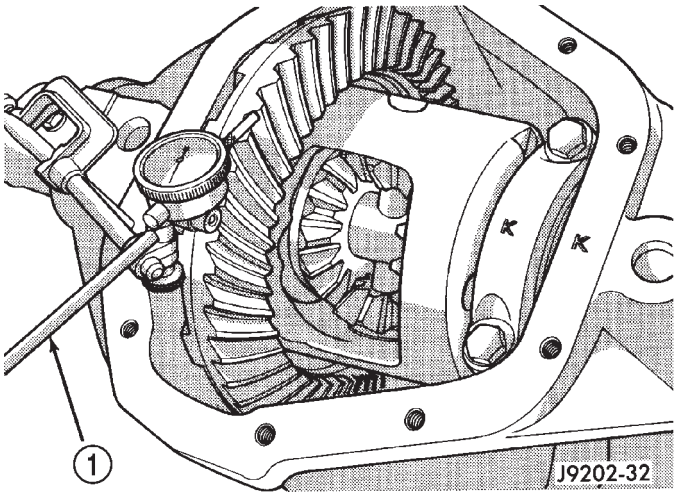


Fig. 70 Ring Gear Backlash Measurement

1 – DIAL INDICATOR

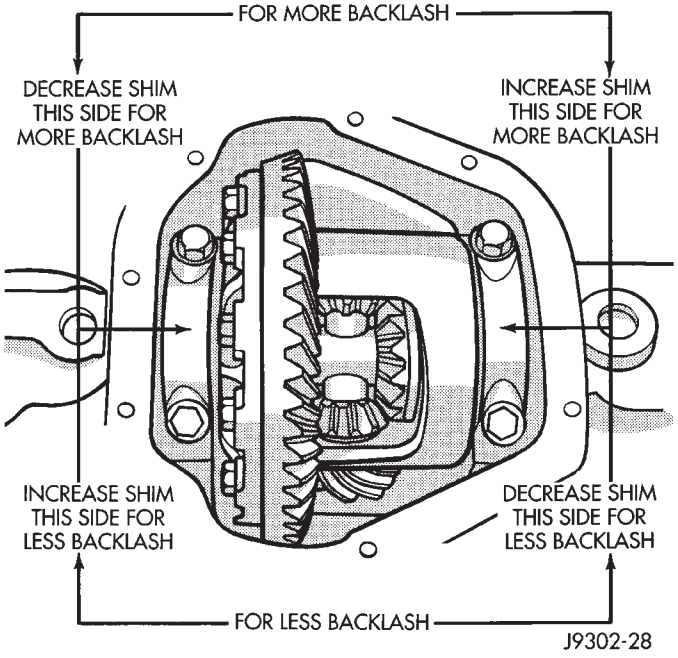


Fig. 71 Backlash Shim Adjustment

ADJUSTMENTS (Continued)

GEAR CONTACT PATTERN ANALYSIS

The ring gear and pinion teeth contact patterns will show if the pinion 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.

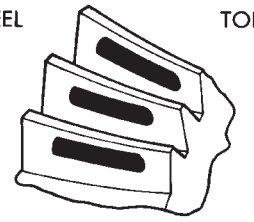
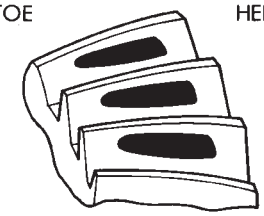
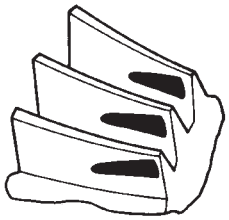
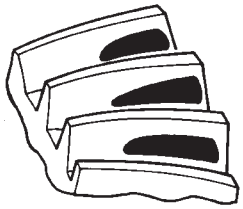
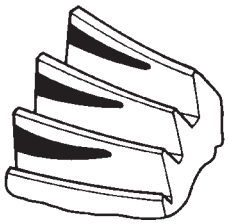
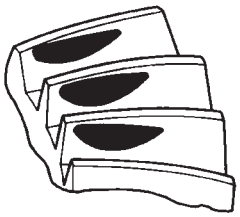
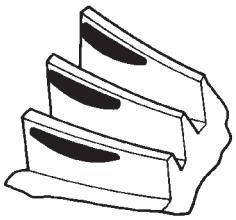
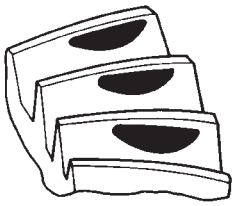
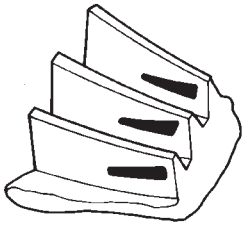
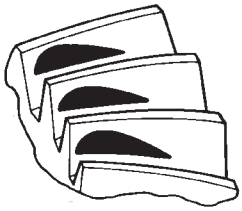
(1) Apply a thin coat of hydrated ferric oxide, or equivalent, to the drive and coast side of the ring gear teeth.

(2) Wrap, twist, and hold a shop towel around the pinion yoke to increase the turning resistance of the pinion. 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 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. 72) and adjust pinion depth and gear backlash as necessary.

ADJUSTMENTS (Continued)

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

J9003-24

Fig. 72 Gear Tooth Contact Patterns

SPECIFICATIONS

181 FBI AXLE

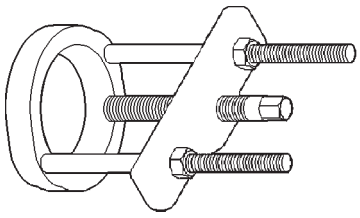
Axle Type	Hypoid
Lubricant	SAE Thermally Stable 80W–90
Lube Capacity	1.2 L (2.5 pts.)
Axle Ratio	3.07, 3.55, 3.73, 4.10
Differential Side Gear Clearance	0.12–0.20 mm (0.005–0.008 in.)
Ring Gear Diameter	18.09 cm (7.125 in.)
Backlash	0–0.15 mm (0.005–0.008 in.)
Pinion Std. Depth	92.1 mm (3.625 in.)
Pinion Bearing Rotating Torque	
Original Bearings	1–2 N·m (10–20 in. lbs.)
New Bearings	1.5–4 N·m (15–35 in. lbs.)

TORQUE

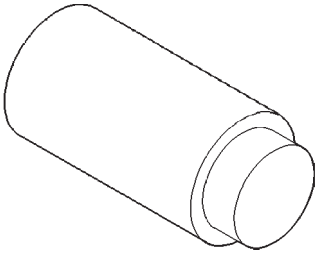
DESCRIPTION	TORQUE
Fill Hole Plug	34 N·m (25 ft. lbs.)
Diff. Cover Bolt	41 N·m (30 ft. lbs.)
Bearing Cap Bolt	61 N·m (45 ft. lbs.)
Ring Gear Bolt	95–122 N·m (70–90 ft. lbs.)
Axle Nut	237 N·m (175 ft. lbs.)
Hub Brg. Bolt	102 N·m (75 ft. lbs.)
Lower Ball Stud	108 N·m (80 ft. lbs.)
Upper Ball Stud	101 N·m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

SPECIAL TOOLS

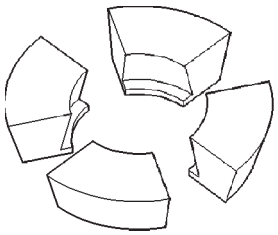
181 FBI AXLE



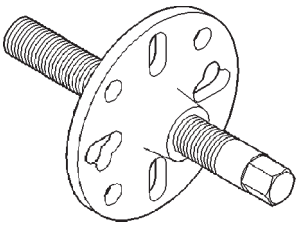
Puller—C-293-PA



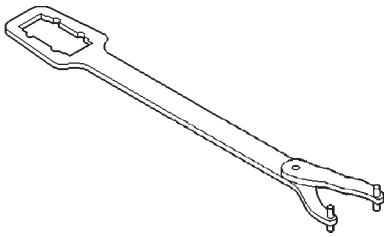
Plug—SP-3289



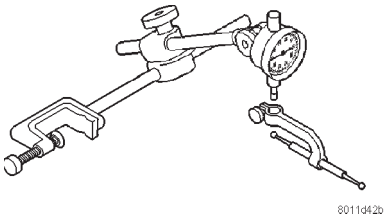
Adapter—C-293-39



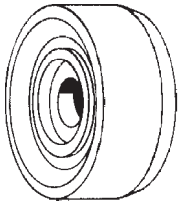
Puller—C-452



Wrench—C-3281

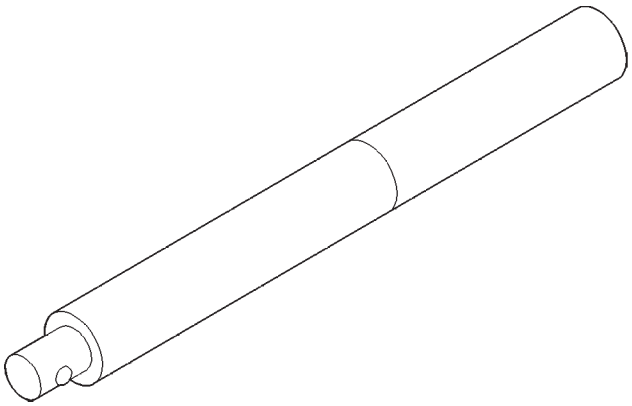


Dial Indicator—C-3339

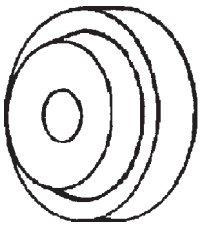


Driver—C-3716-A

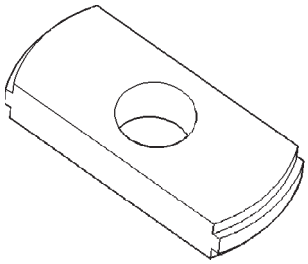
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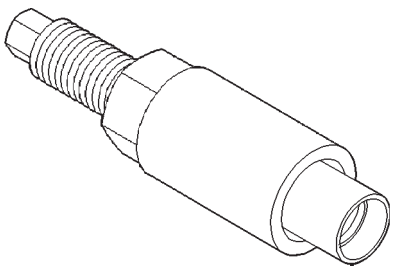
Handle—C-4171



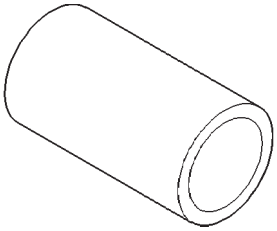
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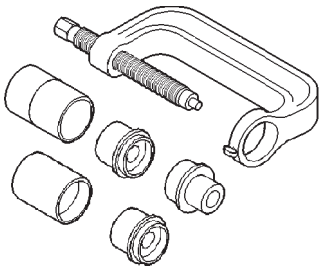
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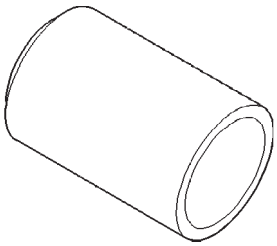
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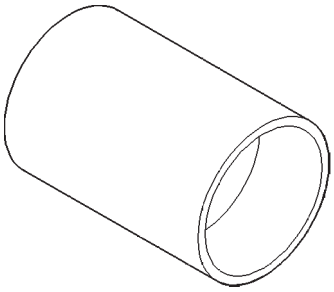
Cup—8109



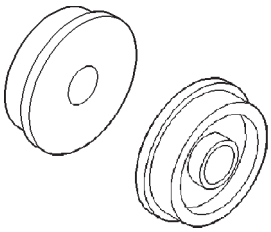
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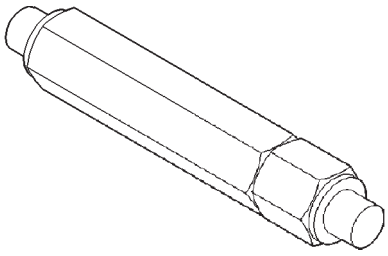
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Installer—6752

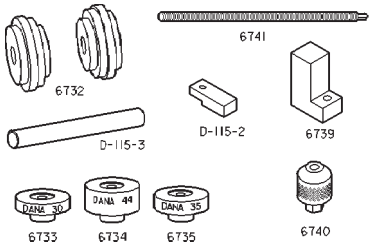


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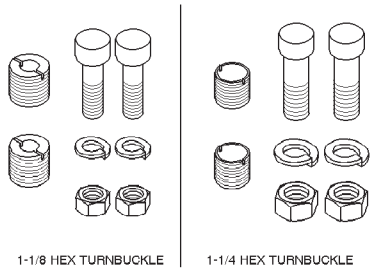


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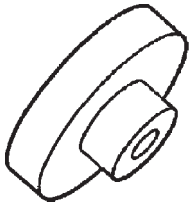
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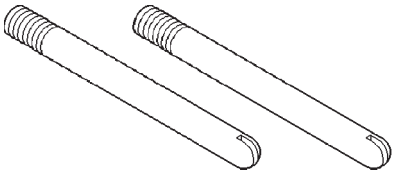
Tool Set, Pinion Depth—6774



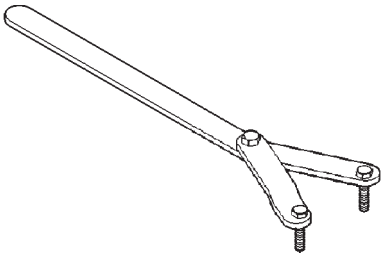
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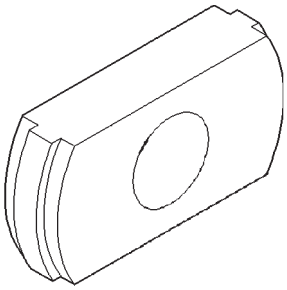
Gauge Block—6733



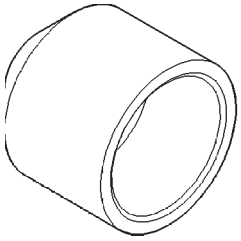
Pilot Stud—C-3288-B



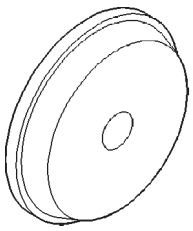
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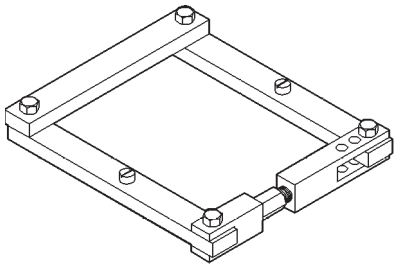
Remover—C-4345



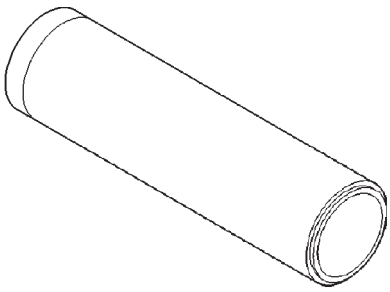
Installer—C-3972-A



Installer—D-130



Spreader—W-129-B



Installer—W-262

194 RBI AXLE

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DESCRIPTION AND OPERATION

194 RBI AXLE

DESCRIPTION

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).

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.

DESCRIPTION AND OPERATION (Continued)

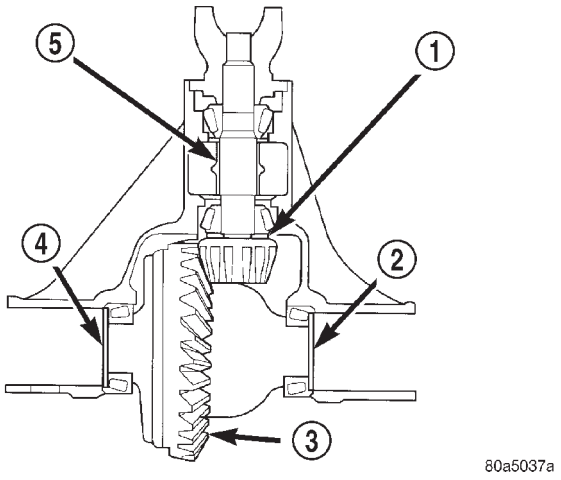


Fig. 1 Shim Locations

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

OPERATION

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

LUBRICANT

DESCRIPTION

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 4 oz. of friction modifier to the axle lubricant. The 194 RBI 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.

STANDARD DIFFERENTIAL

DESCRIPTION

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.

OPERATION

In operation, power flow occurs as follows:

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

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

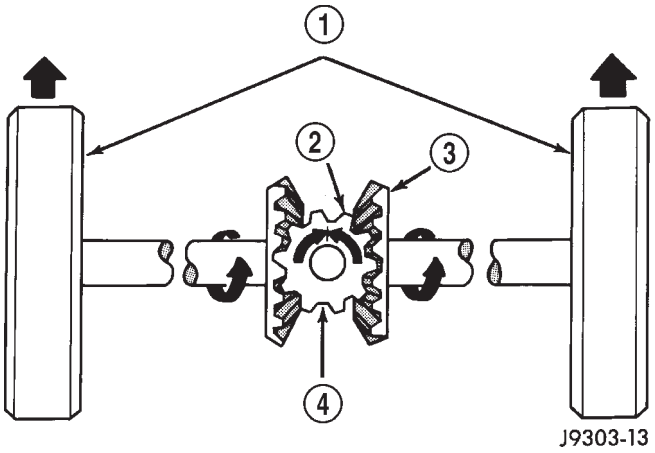


Fig. 2 Differential Operation—Straight Ahead Driving

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

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. The difference must be compensated for to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 3). In this instance, the input torque applied to the

DESCRIPTION AND OPERATION (Continued)

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.

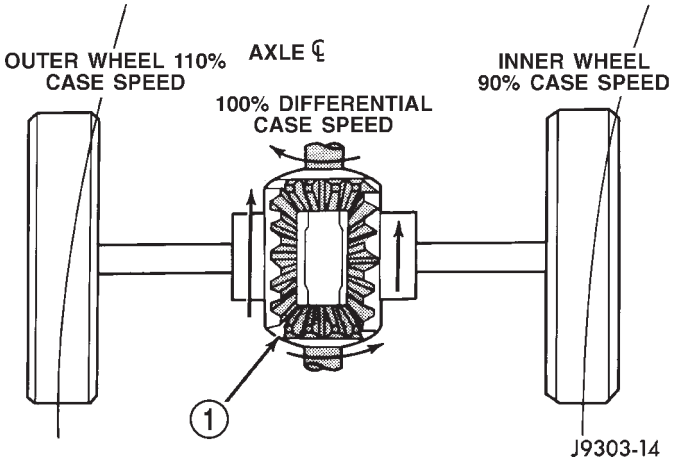


Fig. 3 Differential Operation—On Turns

1 – PINION GEARS ROTATE ON PINION SHAFT

TRAC-LOK™ DIFFERENTIAL

DESCRIPTION

In a standard 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.

OPERATION

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. 4).

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.

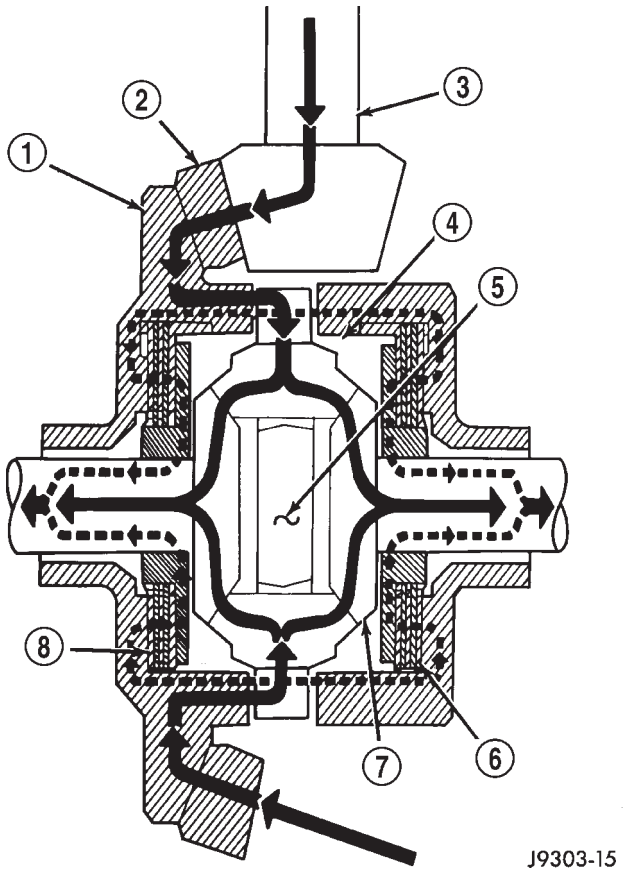


Fig. 4 Trac-lok™ Limited Slip Differential Operation

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

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.

DIAGNOSIS AND TESTING (Continued)

- Incorrect clearance or backlash adjustment.

Axle component breakage is most often the result of:

- Severe overloading.
- Insufficient lubricant.
- Incorrect lubricant.
- Improperly tightened components.
- Differential housing bores not square to each other.

DIAGNOSTIC CHART

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

DIAGNOSIS AND TESTING (Continued)

Condition	Possible Causes	Correction
Differential Gears Scored	1. Insufficient lubrication.	1. Replace scored gears. Fill differential with the correct fluid type and quantity.
	2. Improper grade of lubricant.	2. Replace scored gears. Fill differential with the correct fluid type and quantity.
	3. Excessive spinning of one wheel/tire.	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 lubricant to the correct level.
	2. Worn axle shaft seals.	2. Replace seals.
	3. Cracked differential housing.	3. Repair as necessary.
	4. Worn pinion seal.	4. Replace seal.
	5. Worn/scored yoke.	5. Replace yoke and seal.
	6. Axle cover not properly sealed.	6. Remove, clean, and re-seal cover.
Axle Overheating	1. Lubricant level low.	1. Fill differential to correct level.
	2. Improper grade of lubricant.	2. Fill differential with the correct fluid type and quantity.
	3. Bearing pre-loads too high.	3. Re-adjust bearing pre-loads.
	4. Insufficient ring gear backlash.	4. Re-adjust ring gear backlash.
Gear Teeth Broke	1. Overloading.	1. Replace gears. Examine other gears and bearings for possible damage.
	2. Erratic clutch operation.	2. Replace gears and examine the remaining parts for damage. Avoid erratic clutch operation.
	3. Ice-spotted pavement.	3. Replace gears and examine remaining parts for damage.
	4. Improper adjustments.	4. Replace gears and examine remaining parts for damage. Ensure ring gear backlash is correct.

DIAGNOSIS AND TESTING (Continued)

Condition	Possible Causes	Correction
Axle Noise	1. Insufficient lubricant.	1. Fill differential with the correct fluid type and quantity.
	2. Improper ring gear and pinion adjustment.	2. Check ring gear and pinion contact pattern.
	3. Unmatched ring gear and pinion.	3. Replace gears with a matched ring gear and pinion.
	4. Worn teeth on ring gear and/or pinion.	4. Replace ring gear and pinion.
	5. Loose pinion bearings.	5. Adjust pinion bearing pre-load.
	6. Loose differential bearings.	6. Adjust differential bearing pre-load.
	7. Mis-aligned or sprung ring gear.	7. Measure ring gear run-out. Replace components as necessary.
	8. Loose differential bearing cap bolts.	8. Inspect differential components and replace as necessary. Ensure that the bearing caps are torqued tot he proper specification.
	9. Housing not machined properly.	9. Replace housing.

GEAR NOISE

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

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

When road testing, first warm-up the axle fluid by driving the vehicle at least 5 miles and then accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak–noise range. If the noise stops or changes greatly:

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

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

BEARING NOISE

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

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

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

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

LOW SPEED KNOCK

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

VIBRATION

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

DIAGNOSIS AND TESTING (Continued)

- 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.
- Transmission shift operation.
- Loose engine/transmission/transfer case mounts.
- Worn U–joints.
- Loose spring mounts.
- Loose pinion gear nut and yoke.
- Excessive ring gear backlash.
- Excessive side gear to case clearance.

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

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.

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).

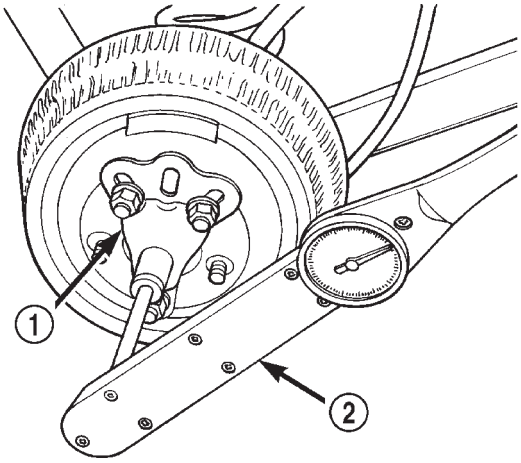


Fig. 5 Trac-lok™ Test —Typical

1 – SPECIAL TOOL 6790 WITH BOLT IN CENTER HOLE
2 – TORQUE WRENCH

(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.

SERVICE PROCEDURES (Continued)

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

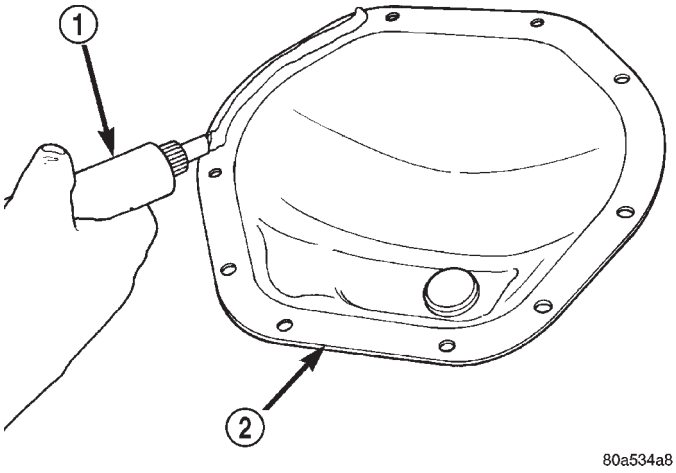


Fig. 6 Apply Sealant

1 – SEALANT
2 – AXLE HOUSING COVER

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) Disconnect track bar.

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

(16) 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 coil springs.

(2) Position the upper and lower suspension arms on the axle brackets. Install nuts and bolts, do not tighten bolts at this time.

(3) Install track bar and attachment bolts, do not tighten bolts at this time.

(4) Install shock absorbers and tighten nuts to 100 N·m (74 ft. lbs.) torque.

(5) Install stabilizer bar links and tighten nuts to 54 N·m (40 ft. lbs.) torque.

(6) Install the wheel speed sensors, if necessary. Refer to Group 5, Brakes, for proper procedures.

(7) Connect parking brake cable to brackets and lever.

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

(9) Connect the brake hose to the axle junction block. Refer to Group 5, Brakes, for proper procedures.

(10) Install axle vent hose.

(11) Align propeller shaft and pinion yoke reference marks. Install U-joint straps and bolts. Tighten to 19 N·m (14 ft. lbs.) torque.

(12) Install the wheels and tires.

REMOVAL AND INSTALLATION (Continued)

(13) Add gear lubricant, if necessary. Refer to Lubricant Specifications in this section for lubricant requirements.

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

(15) Tighten lower suspension arm bolts to 177 N·m (130 ft. lbs.) torque.

(16) Tighten upper suspension arm bolts to 75 N·m (55 ft. lbs.) torque.

(17) Tighten track bar bolts to 100 N·m (74 ft. lbs.) torque.

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).

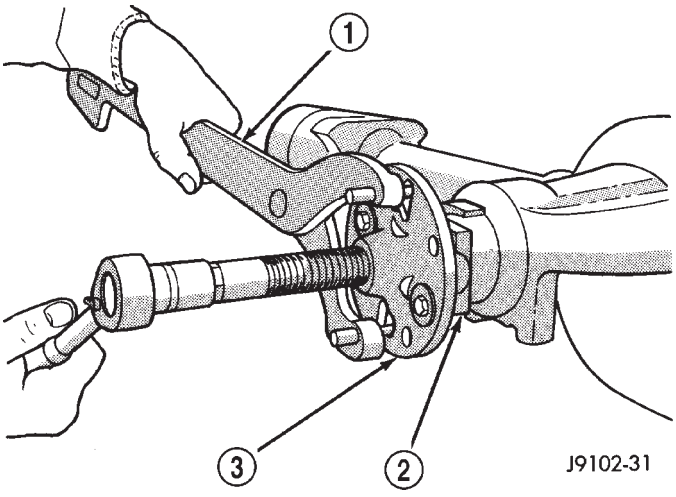


Fig. 7 Pinion Yoke Removal

1 – SPECIAL TOOL C-3281
2 – YOKE
3 – SPECIAL TOOL C-452

(10) Use a suitable pry tool or slide hammer mounted screw to remove the pinion gear 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. 8).

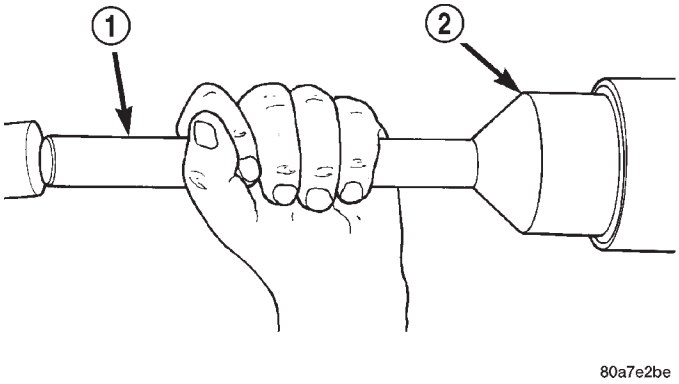


Fig. 8 Pinion Seal Installation

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL C-3972–A

(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.).

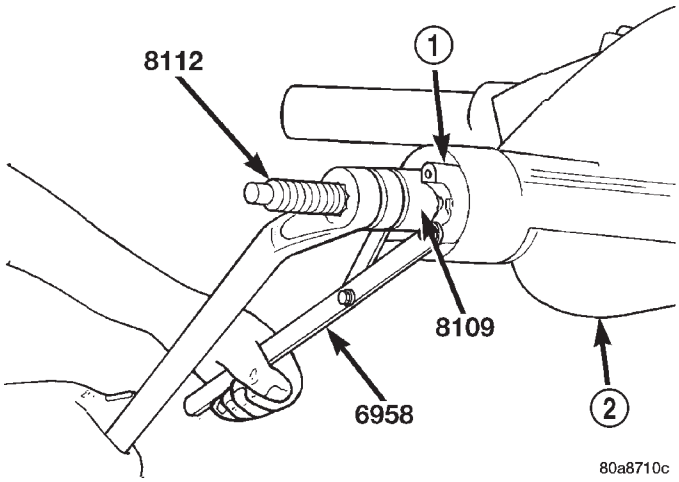


Fig. 9 Pinion Yoke Installation

1 – PINION YOKE
2 – AXLE HOUSING

REMOVAL AND INSTALLATION (Continued)

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).

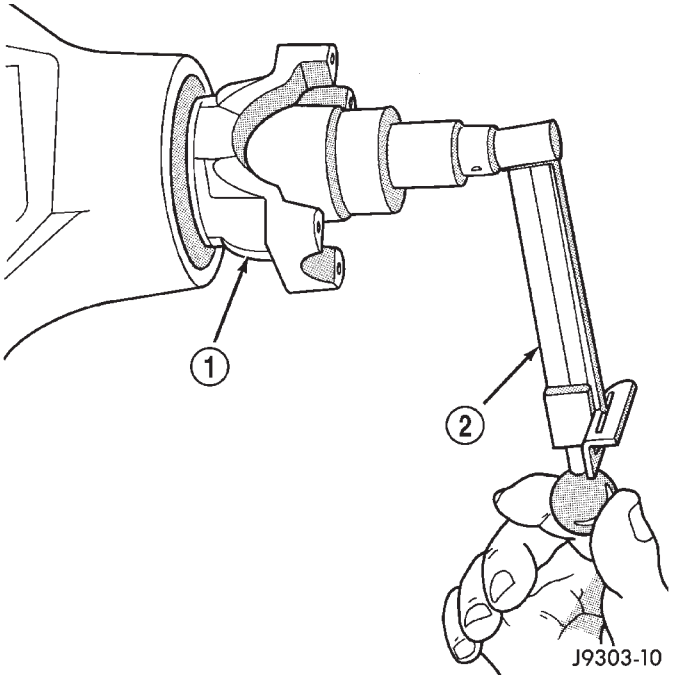


Fig. 10 Check Pinion Rotation Torque

1 – PINION YOKE
2 – INCH POUND TORQUE WRENCH

(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.

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.

(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.

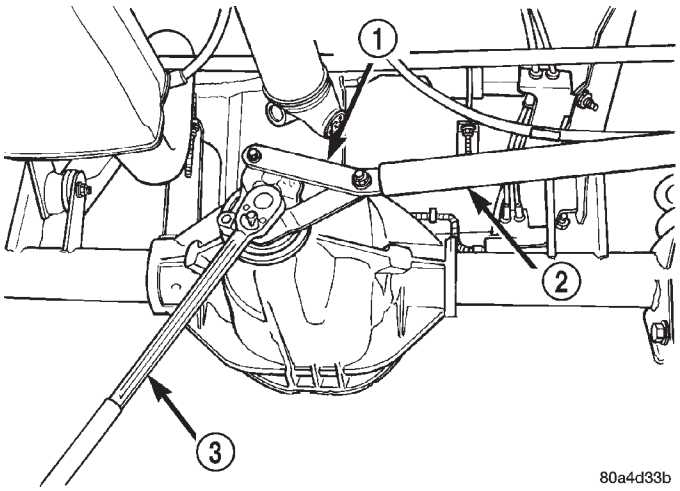


Fig. 11 Tightening Pinion Shaft Nut

1 – SPECIAL TOOL 6958
2 – 1 in. PIPE
3 – 3/4 DRIVE TORQUE WRENCH

(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.

REMOVAL AND INSTALLATION (Continued)

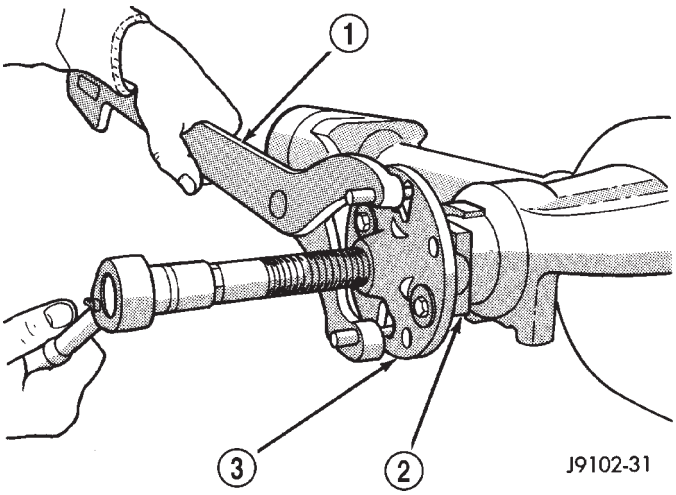


Fig. 12 Pinion Yoke Removal

1 – SPECIAL TOOL C-3281
2 – YOKE
3 – SPECIAL TOOL C-452

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.

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).
(5) Install yoke with Screw 8112, Cup 8109, and Holder 6958 (Fig. 16).

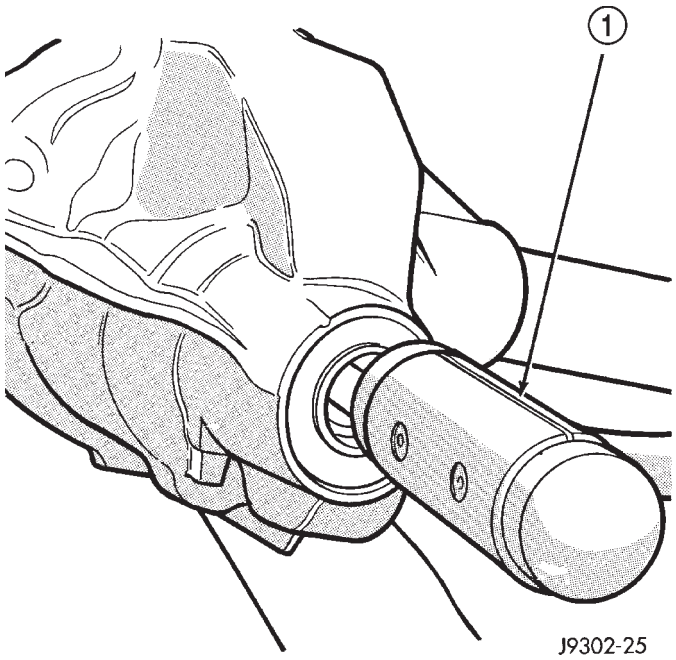


Fig. 13 Remove Pinion Gear

1 – RAWHIDE HAMMER

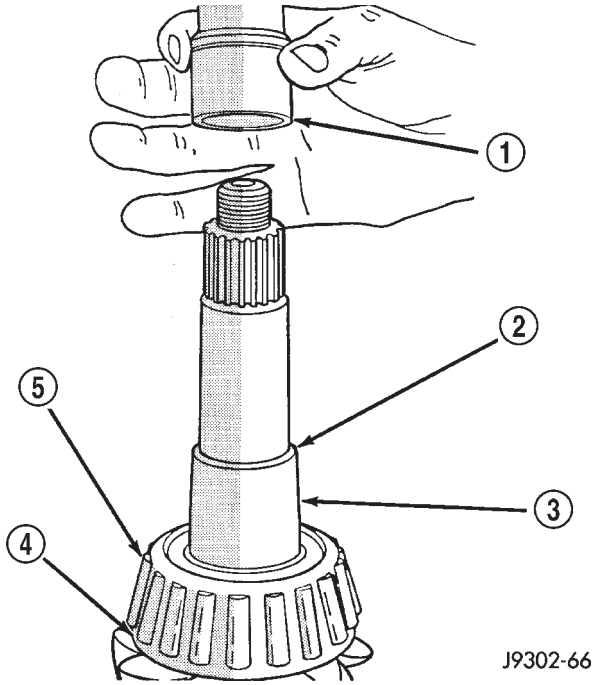


Fig. 14 Collapsible Preload Spacer

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

REMOVAL AND INSTALLATION (Continued)

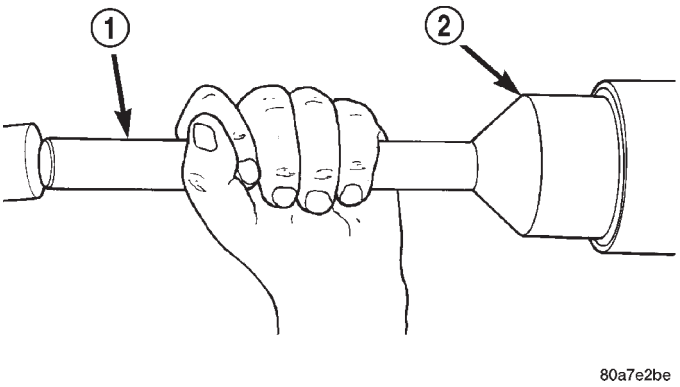


Fig. 15 Pinion Seal Installation

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL C-3972–A

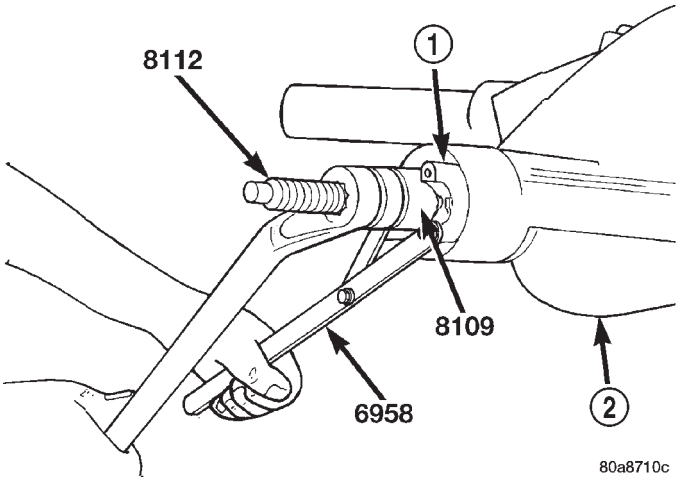


Fig. 16 Pinion Yoke Installation

1 – PINION YOKE
2 – AXLE HOUSING

(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.).

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).

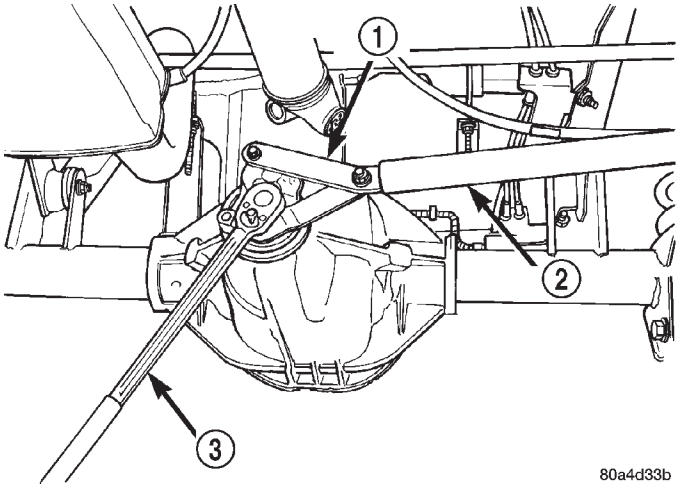


Fig. 17 Tightening Pinion Nut

1 – SPECIAL TOOL 6958
2 – 1 in. PIPE
3 – 3/4 DRIVE TORQUE WRENCH

(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 — 1.5 to 4 N·m (15 to 35 in. lbs.).

(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.

REMOVAL AND INSTALLATION (Continued)

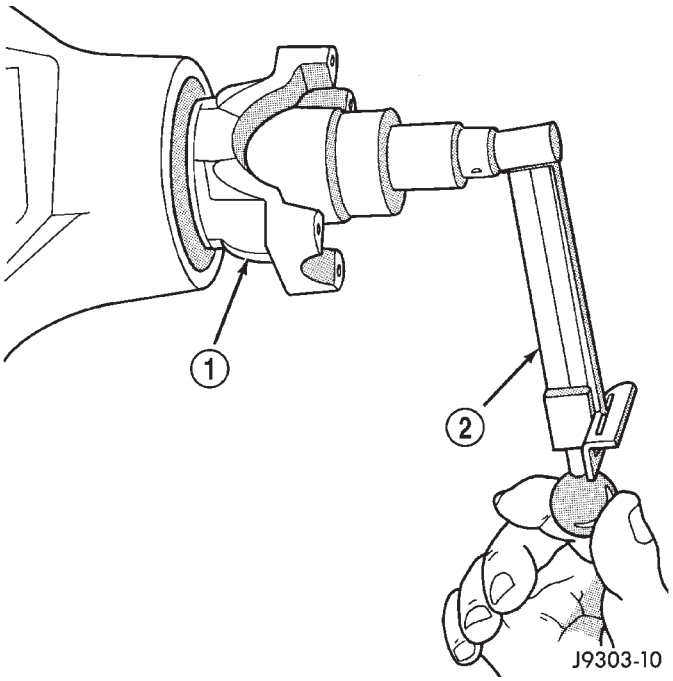


Fig. 18 Check Pinion Gear Rotation Torque

1 – PINION YOKE
2 – INCH POUND TORQUE WRENCH

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).

(7) Push axle shaft inward and remove axle shaft C–clip lock from the axle shaft (Fig. 20).

(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.

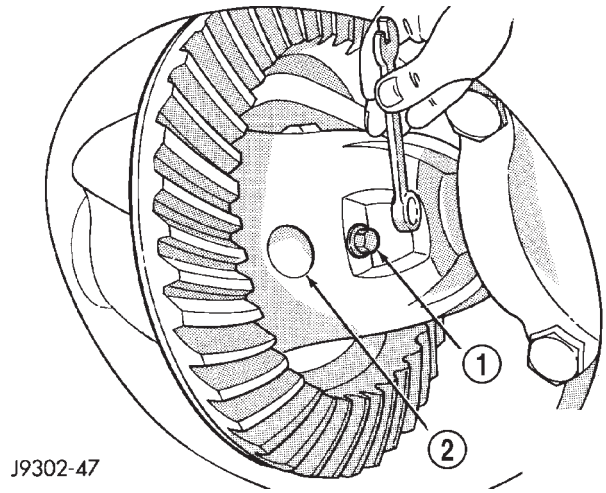


Fig. 19 Mate Shaft Lock Screw

1 – LOCK SCREW
2 – PINION GEAR MATE SHAFT

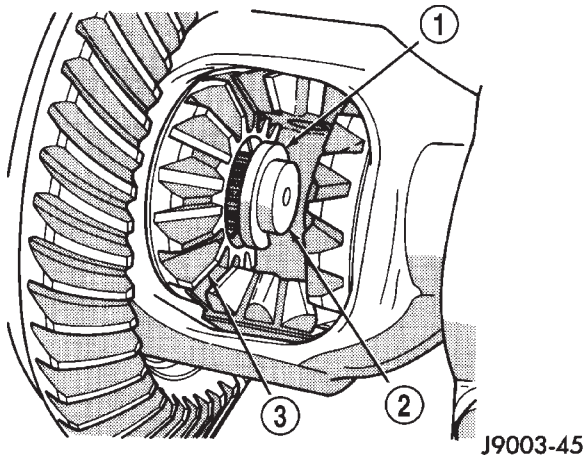


Fig. 20 Axle Shaft C–Clip Lock

1 – C-CLIP LOCK
2 – AXLE SHAFT
3 – SIDE GEAR

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. 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

REMOVAL AND INSTALLATION (Continued)

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).

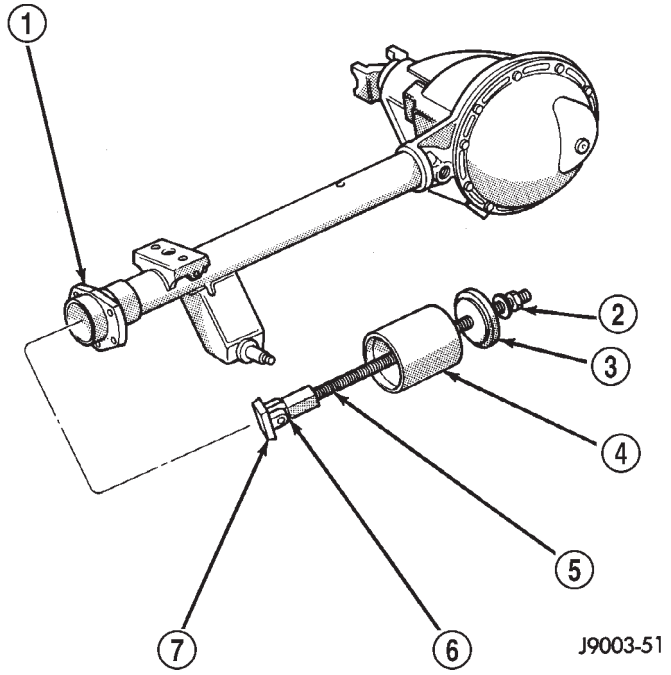


Fig. 21 Axle Shaft Bearing Removal

1 – AXLE SHAFT TUBE
2 – NUT
3 – GUIDE PLATE
4 – GUIDE
5 – THREADED ROD
6 – ADAPTER
7 – FOOT

(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).

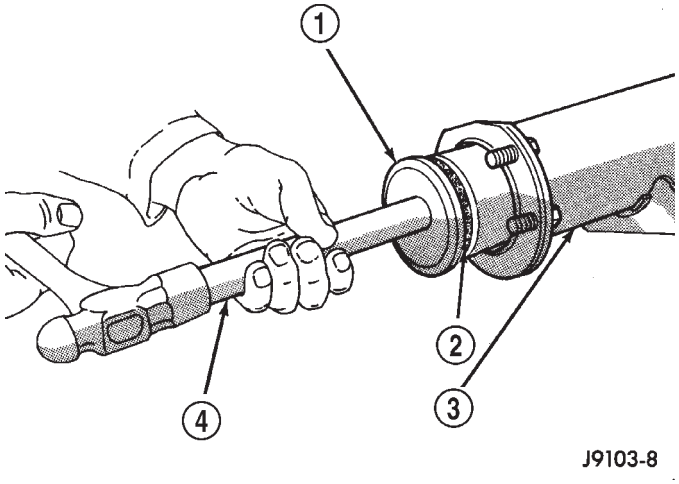


Fig. 22 Axle Shaft Seal Installation

1 – SPECIAL TOOL 6437
2 – SEAL
3 – AXLE SHAFT TUBE
4 – SPECIAL TOOL C-4171

(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.

(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)

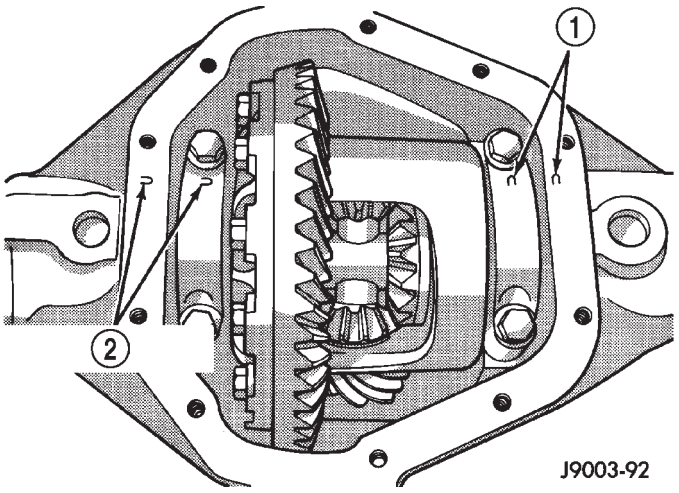


Fig. 23 Bearing Cap Identification

1 – INSTALLATION REFERENCE LETTERS
2 – INSTALLATION REFERENCE LETTERS

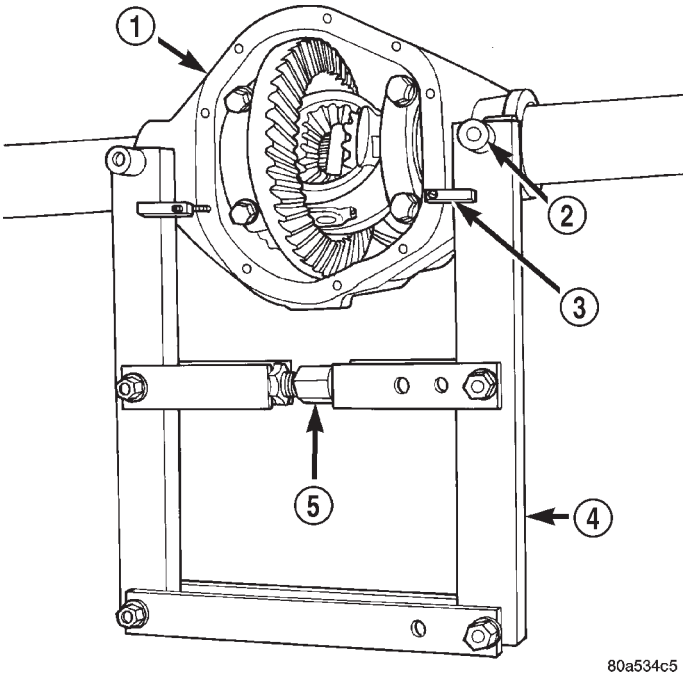


Fig. 24 Install Axle Housing Spreader

1 – AXLE HOUSING
2 – DOWEL
3 – SAFETY HOLD DOWN
4 – SPECIAL TOOL W-129–B
5 – TURNBUCKLE

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).

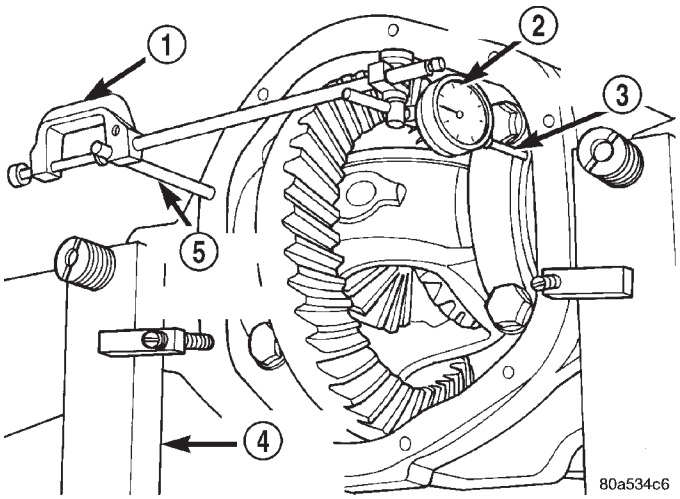


Fig. 25 Install Dial Indicator

1 – SPECIAL TOOL C-3339
2 – DIAL INDICATOR
3 – LEVER ADADPTER
4 – SPECIAL TOOL W-129–B
5 – SPECIAL TOOL C-3288–B

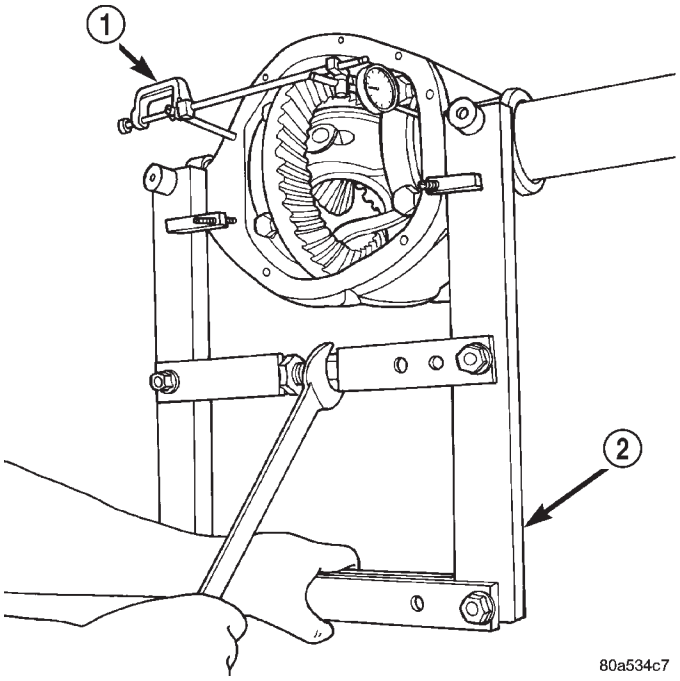


Fig. 26 Spread Axle Housing

1 – SPECIAL TOOL C-3339
2 – SPECIAL TOOL W-129–B

(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).

REMOVAL AND INSTALLATION (Continued)

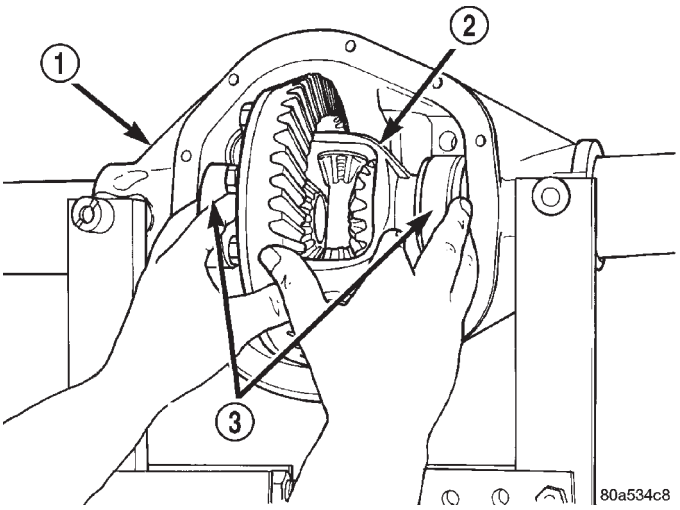


Fig. 27 Differential Case Removal

1 – AXLE HOUSING
2 – DIFFERENTIAL CASE
3 – BEARING CUPS

(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.

(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.

(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.

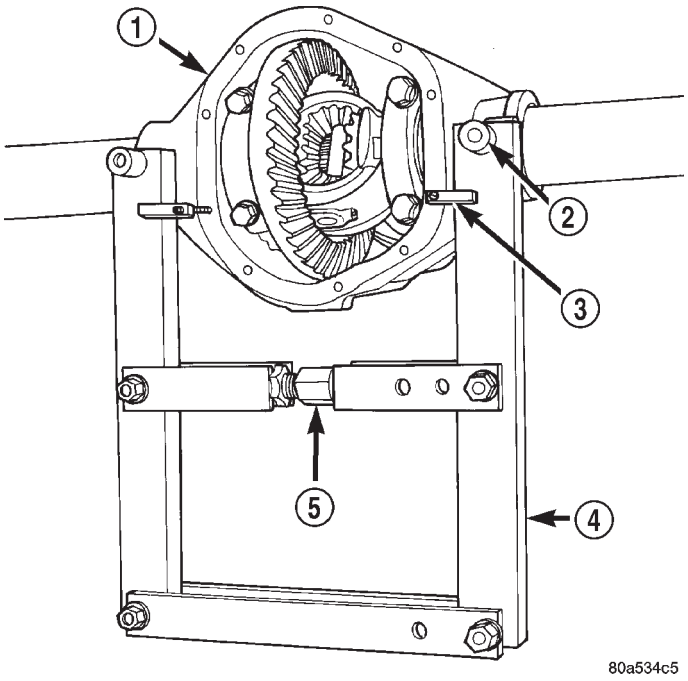


Fig. 28 Install Axle Housing Spreader

1 – AXLE HOUSING
2 – DOWEL
3 – SAFETY HOLD DOWN
4 – SPECIAL TOOL W-129–B
5 – TURNBUCKLE

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).

(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.

REMOVAL AND INSTALLATION (Continued)

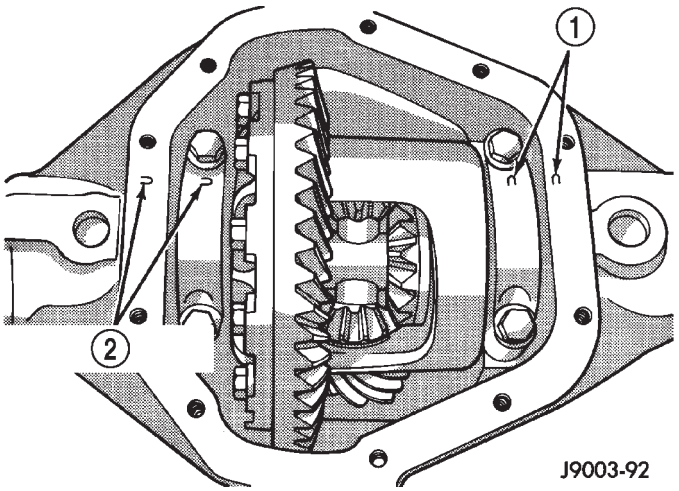


Fig. 29 Differential Bearing Cap Reference Letters

1 – INSTALLATION REFERENCE LETTERS
2 – INSTALLATION REFERENCE LETTERS

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.

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. 32).

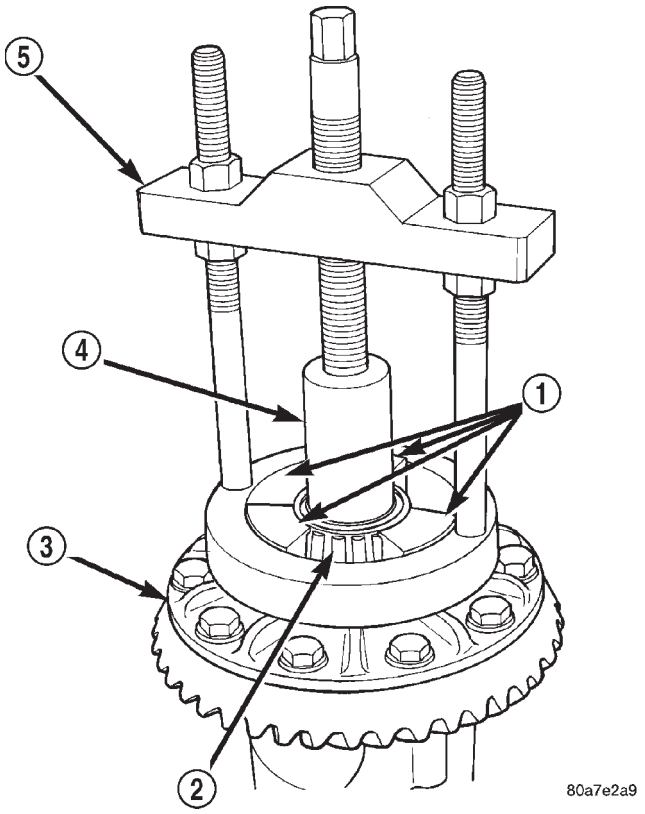


Fig. 30 Differential Bearing Removal

1 – SPECIAL TOOL C–293–39
2 – BEARING
3 – DIFFERENTIAL
4 – SPECIAL TOOL SP–3289
5 – SPECIAL TOOL C–293–PA

(6) Remove the pinion gear from housing (Fig. 33). Catch the pinion with your hand to prevent it from falling and being damaged.

(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. 34).

(10) Remove the rear bearing cup from housing (Fig. 35). Use Remover D-149 and Handle C–4171.

(11) Remove the collapsible preload spacer (Fig. 36).

(12) Remove the rear bearing from the pinion with Puller/Press C-293-PA and Adapters C-293-40 (Fig. 37).

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.

REMOVAL AND INSTALLATION (Continued)

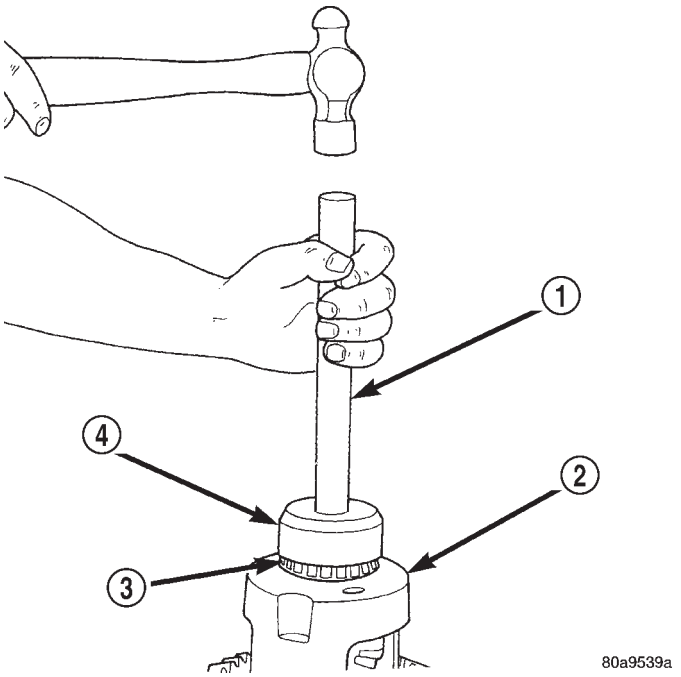


Fig. 31 Install Differential Side Bearings

1 – HANDLE C-4171
2 – DIFFERENTIAL
3 – BEARING
4 – TOOL C-3716–A

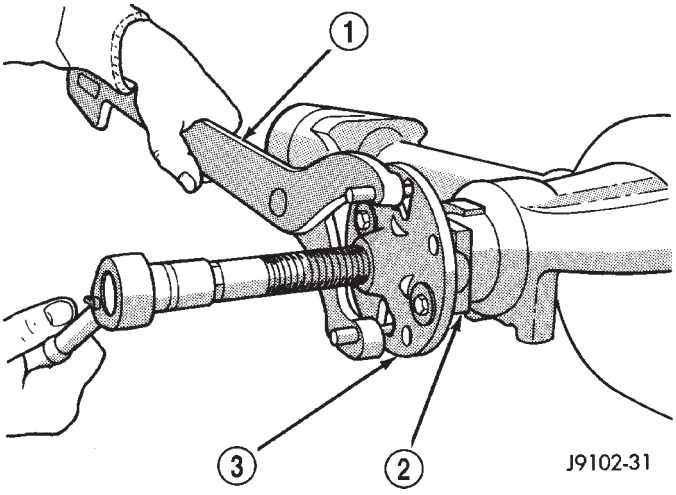


Fig. 32 Pinion Yoke Removal

1 – SPECIAL TOOL C-3281
2 – YOKE
3 – SPECIAL TOOL C-452

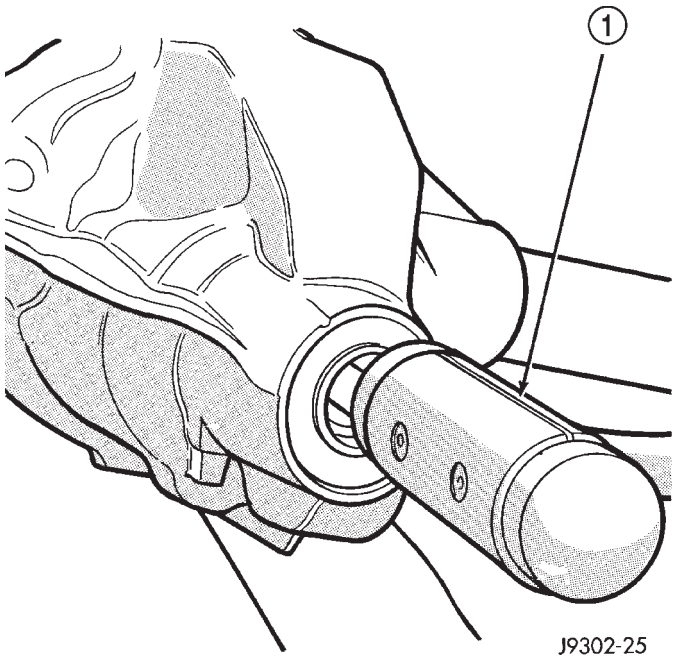


Fig. 33 Remove Pinion Gear

1 – RAWHIDE HAMMER

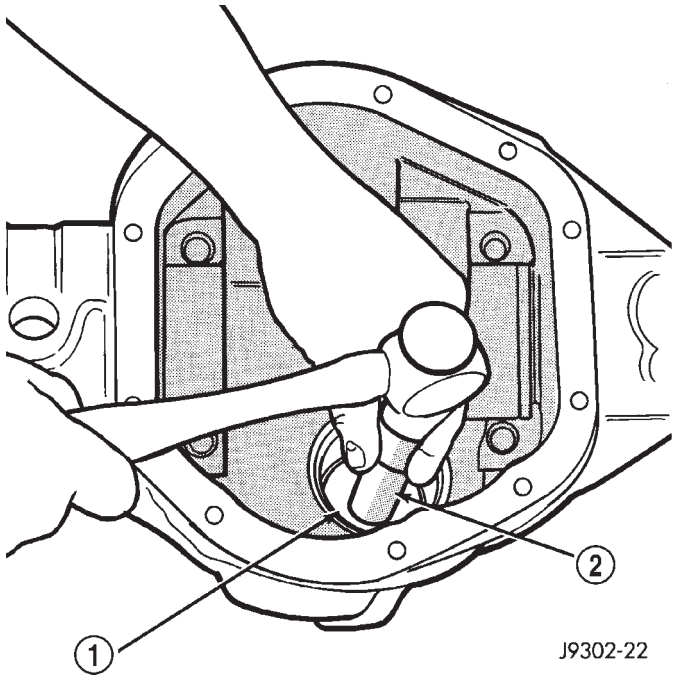


Fig. 34 Front Bearing Cup Removal

1 – REMOVER
2 – HANDLE

REMOVAL AND INSTALLATION (Continued)

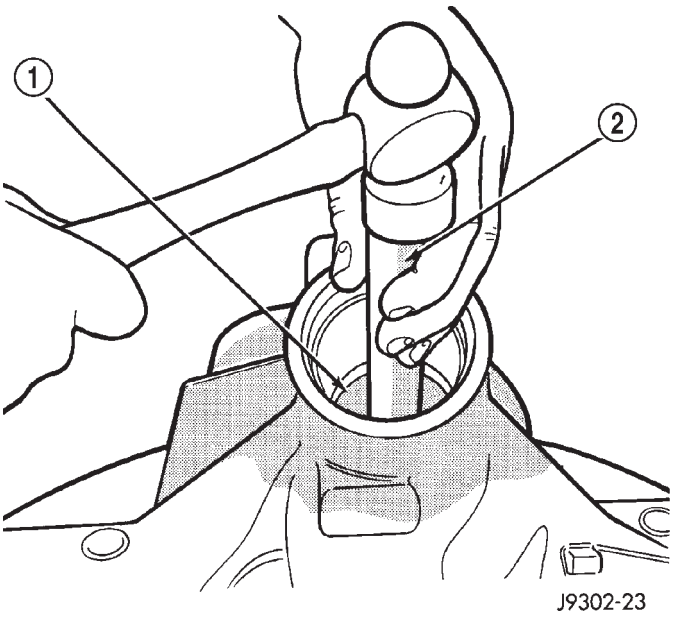


Fig. 35 Rear Bearing Cup Removal

1 – DRIVER
2 – HANDLE

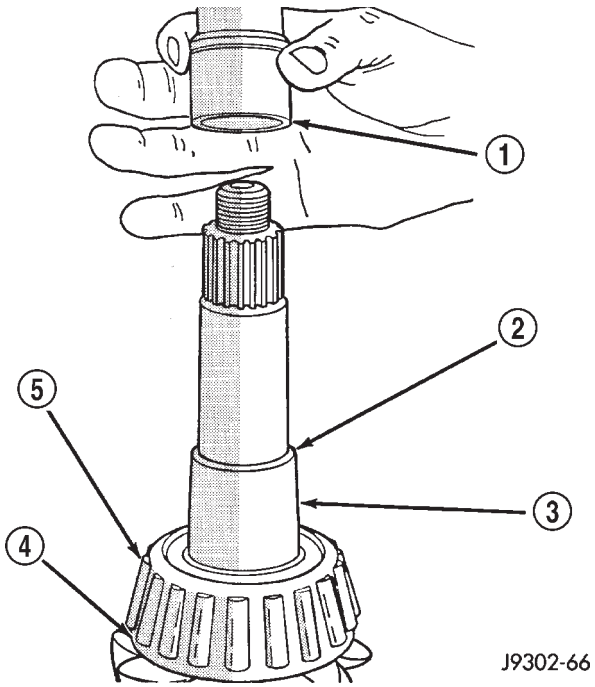


Fig. 36 Collapsible Spacer

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

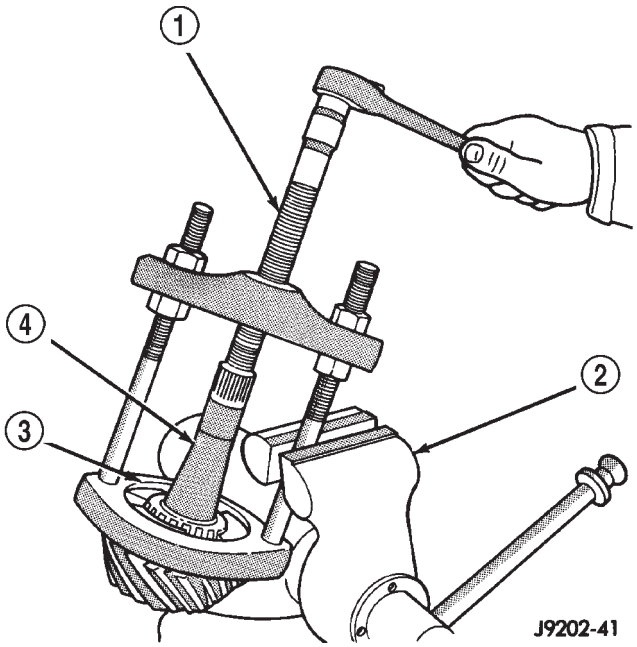


Fig. 37 Rear Bearing Removal

1 – SPECIAL TOOL C-293–PA
2 – VISE
3 – ADAPTERS
4 – DRIVE PINION GEAR SHAFT

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. 38). 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. 39).

(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. 40).

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.

REMOVAL AND INSTALLATION (Continued)

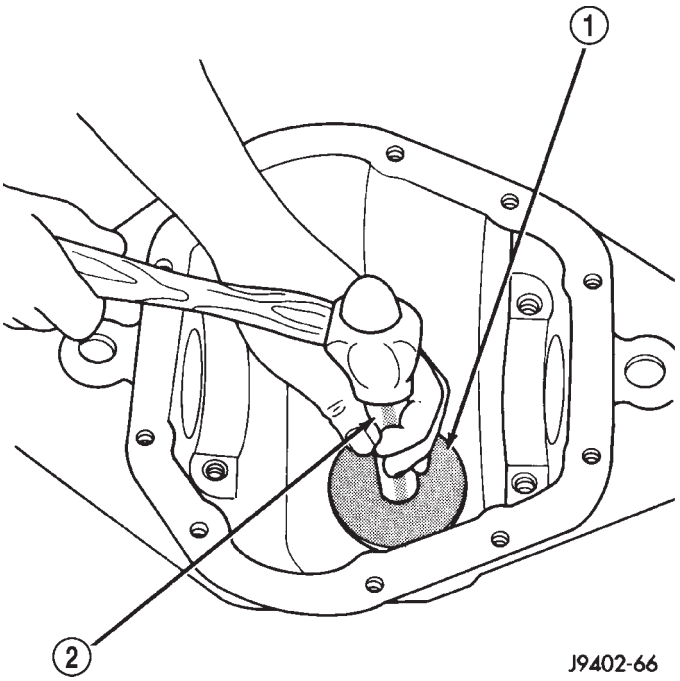


Fig. 38 Pinion Rear Bearing Cup Installation

1 – INSTALLER
2 – HANDLE

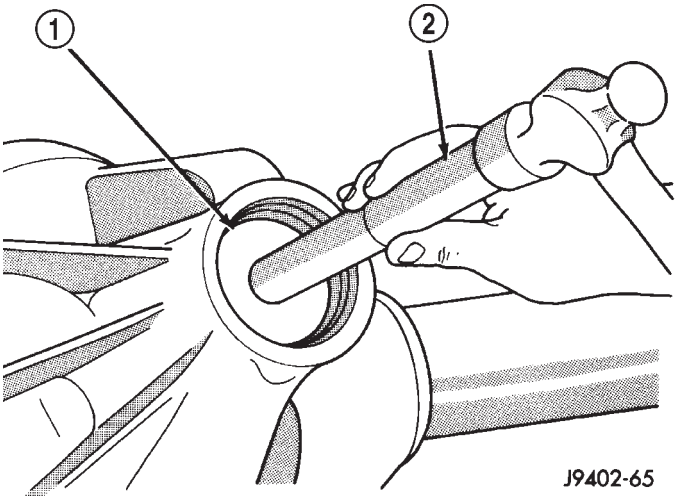


Fig. 39 Pinion Front Bearing Cup Installation

1 – INSTALLER
2 – HANDLE

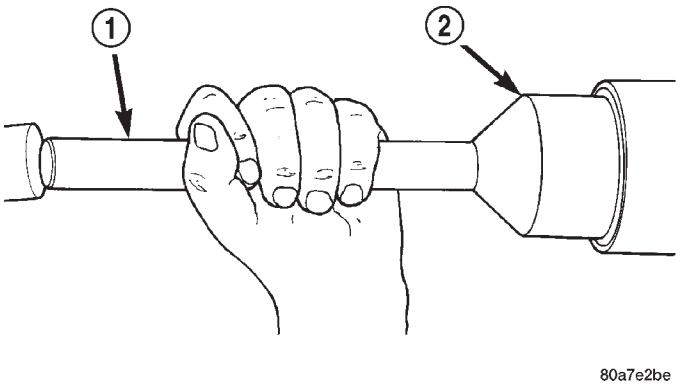


Fig. 40 Pinion Seal Installation

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL C-3972–A

(8) Install the rear bearing and slinger, if equipped, on the pinion gear with Installer W-262 (Fig. 41).

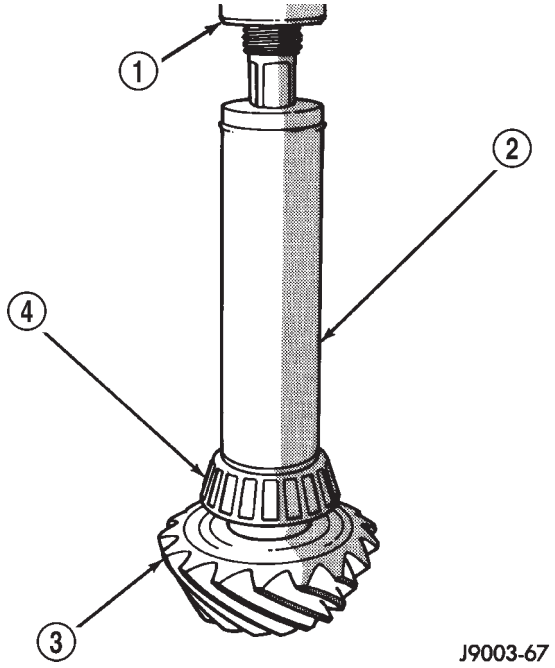


Fig. 41 Shaft Rear Bearing Installation

1 – PRESS
2 – INSTALLATION TOOL
3 – DRIVE PINION GEAR
4 – DRIVE PINION GEAR SHAFT REAR BEARING

REMOVAL AND INSTALLATION (Continued)

(9) Install a new collapsible preload spacer on pinion shaft and install pinion gear in housing (Fig. 42).

(10) Install pinion gear in housing.

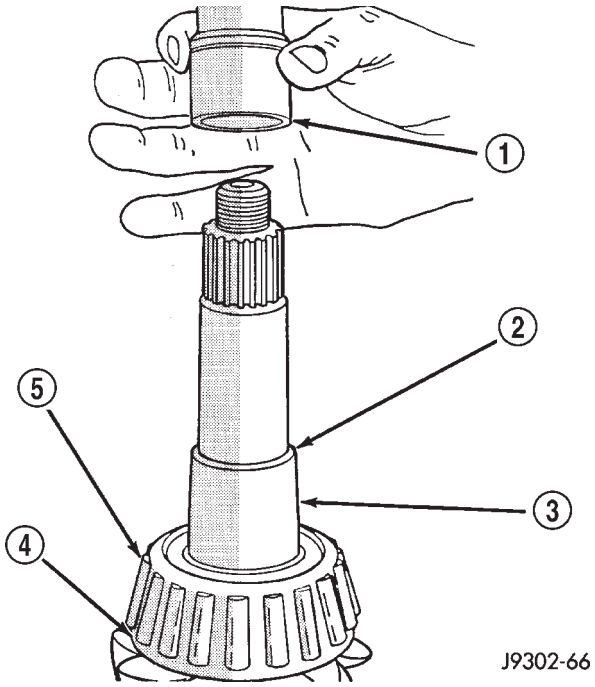


Fig. 42 Collapsible Preload Spacer

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

(11) Install yoke with Installer Screw 8112, Cup 8109, and holder 6958 (Fig. 43).

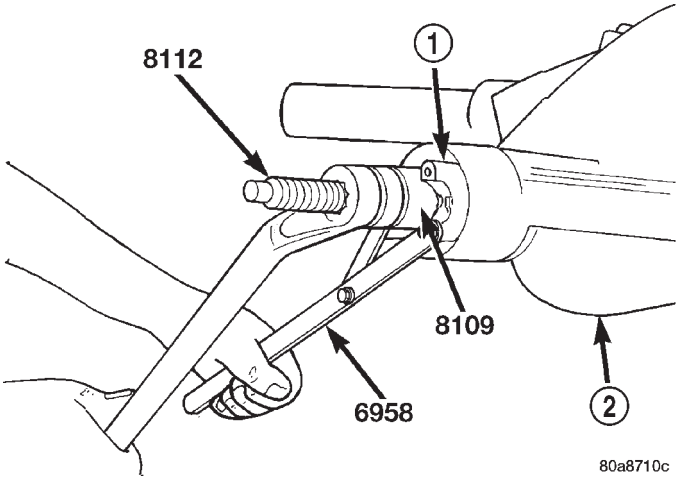


Fig. 43 Pinion Yoke Installation

1 – PINION YOKE
2 – AXLE HOUSING

(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. 44).

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.

(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. 45).

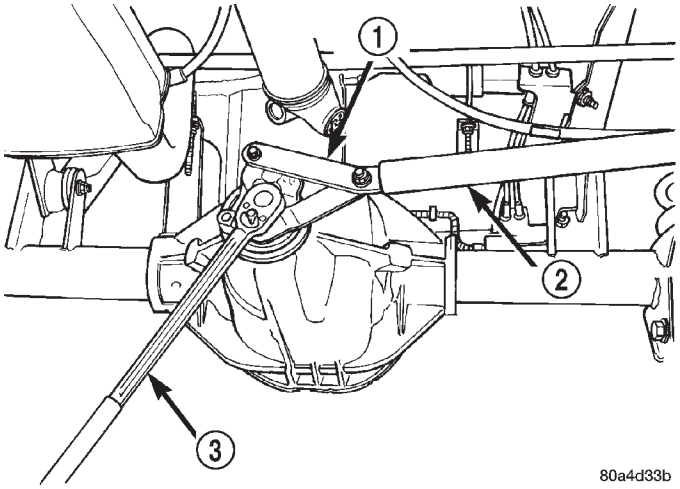


Fig. 44 Tightening Pinion Nut

1 – SPECIAL TOOL 6958
2 – 1 in. PIPE
3 – 3/4 DRIVE TORQUE WRENCH

(16) Check bearing rotating torque with a (in. lbs.) torque wrench (Fig. 45). The torque necessary to rotate the pinion gear should be:

- Original Bearings — 1 to 2 N·m (10 to 20 in. lbs.).
- New Bearings — 1.5 to 4 N·m (15 to 35 in. lbs.).

(17) Install differential in housing.

REMOVAL AND INSTALLATION (Continued)

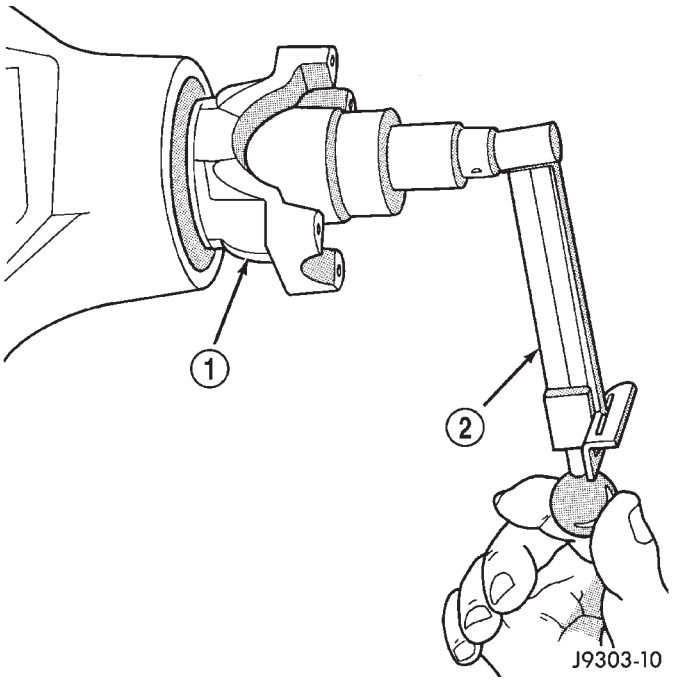


Fig. 45 Check Pinion Gear Rotating Torque

1 – PINION YOKE
2 – INCH POUND TORQUE WRENCH

RING GEAR

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

REMOVAL

(1) Remove differential from axle housing.
(2) Place differential case in a suitable vise with soft metal jaw protectors. (Fig. 46)
(3) Remove bolts holding ring gear to differential case.
(4) Using a soft hammer, drive ring gear from differential case (Fig. 46).

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. 47).

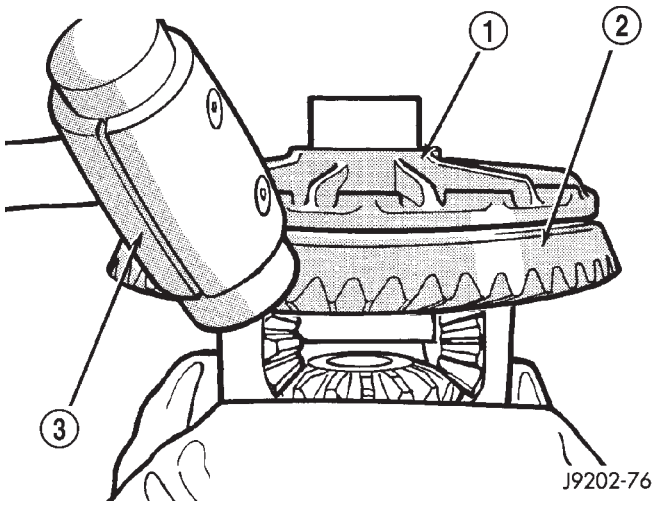


Fig. 46 Ring Gear Removal

1 – CASE
2 – RING GEAR
3 – RAWHIDE HAMMER

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

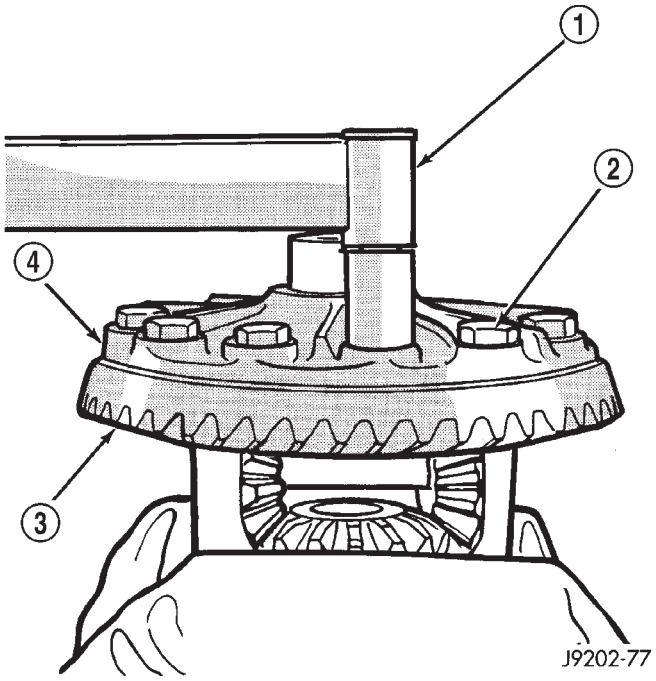


Fig. 47 Ring Gear Bolt Installation

1 – TORQUE WRENCH
2 – RING GEAR BOLT
3 – RING GEAR
4 – CASE

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

REMOVAL AND INSTALLATION (Continued)

Rubber Sealant, or equivalent, on the housing cover (Fig. 48).

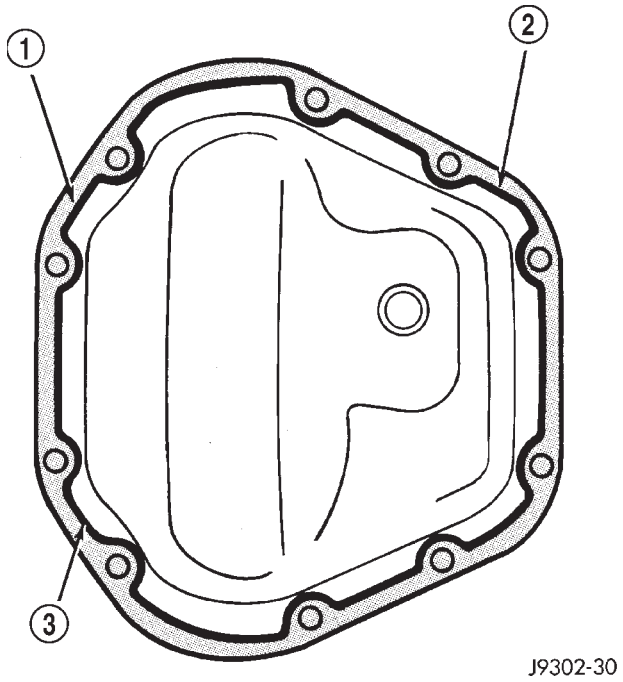


Fig. 48 Typical Housing Cover With Sealant

1 – SEALING SURFACE
2 – CONTOUR OF BEAD
3 – BEAD THICKNESS 6.35MM (1/4")

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.

DISASSEMBLY AND ASSEMBLY

STANDARD DIFFERENTIAL

DISASSEMBLY

(1) Remove pinion mate shaft lock screw (Fig. 49).

(2) Remove pinion mate shaft.

(3) Rotate the differential side gears and remove the differential pinion gears and thrust washers (Fig. 50).

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

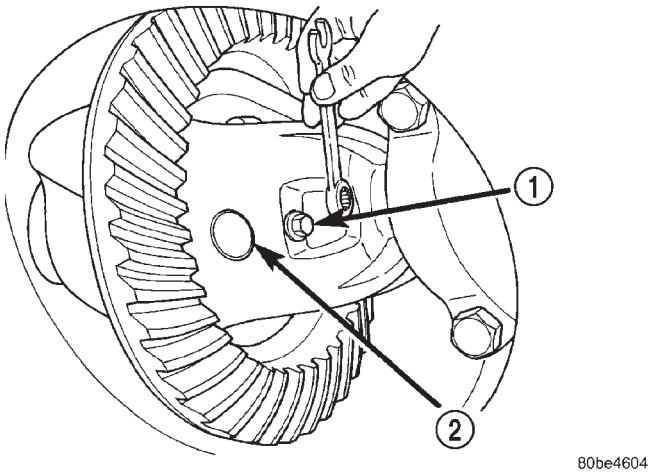


Fig. 49 Pinion Mate Shaft Lock Screw

1 – LOCK SCREW
2 – PINION MATE SHAFT

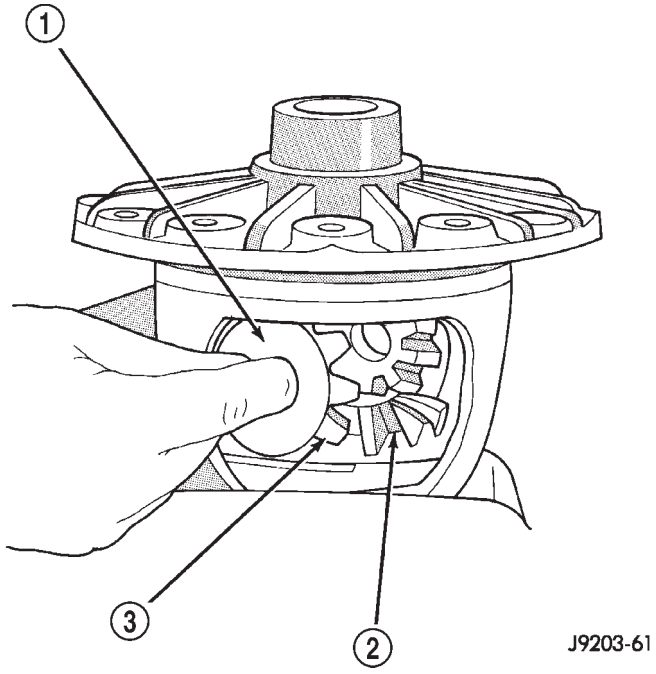


Fig. 50 Pinion Mate Gear Removal

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

ASSEMBLY

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

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

(3) Install the pinion mate shaft.

(4) Align the hole in the pinion mate shaft with the hole in the differential case and install the pinion mate shaft lock screw.

DISASSEMBLY AND ASSEMBLY (Continued)

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

TRAC-LOK™ DIFFERENTIAL

The Trac–lok™ differential components are illustrated in (Fig. 51). Refer to this illustration during repair service.

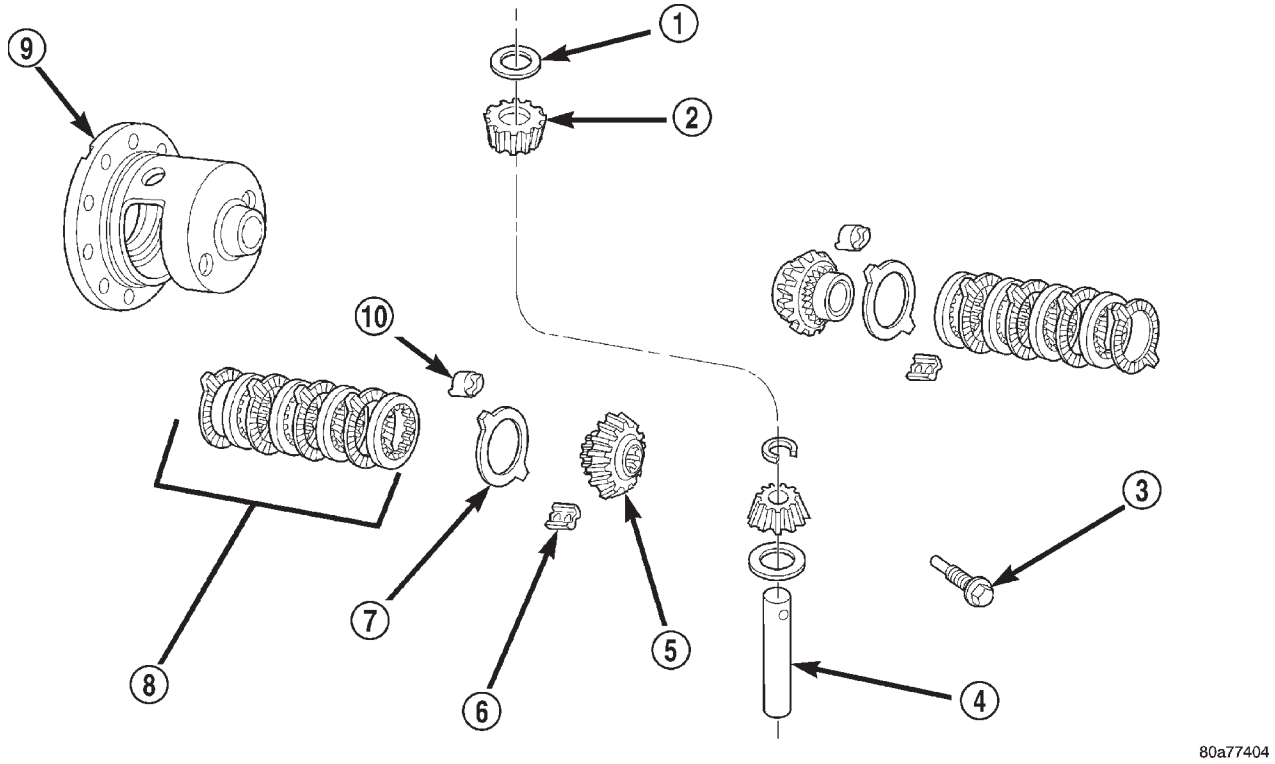


Fig. 51 Trac–lok™ Differential Components

1 – THRUST WASHER
2 – PINION
3 – SHAFT LOCK SCREW
4 – PINION MATE SHAFT
5 – SIDE GEAR
6 – RETAINER
7 – DISC
8 – CLUTCH PACK
9 – DIFFERENTIAL CASE
10 – RETAINER

DISASSEMBLY AND ASSEMBLY (Continued)

DISASSEMBLY

(1) Clamp Side Gear Holding Tool 6965 in a vise.

(2) Position the differential case on Side Gear Holding Tool 6965 (Fig. 52).

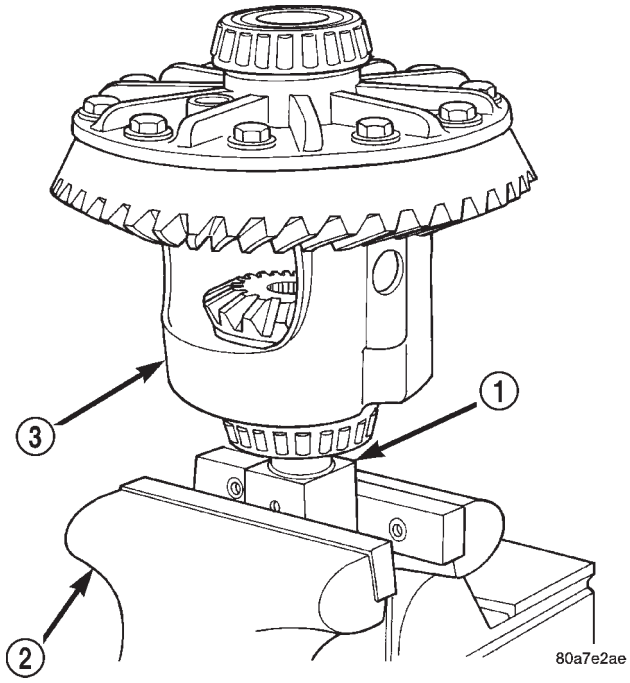


Fig. 52 Differential Case Holding Tool

1 – SPECIAL TOOL 6965
2 – VISE
3 – DIFFERENTIAL

(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).

(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.

(8) Position a small screw driver in slot of Threaded Adapter C-6960-1 (Fig. 56) to prevent adapter from turning.

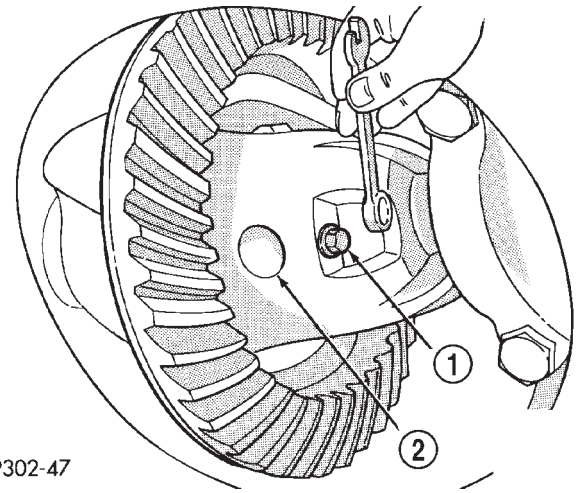


Fig. 53 Mate Shaft Lock Screw

1 – LOCK SCREW
2 – PINION GEAR MATE SHAFT

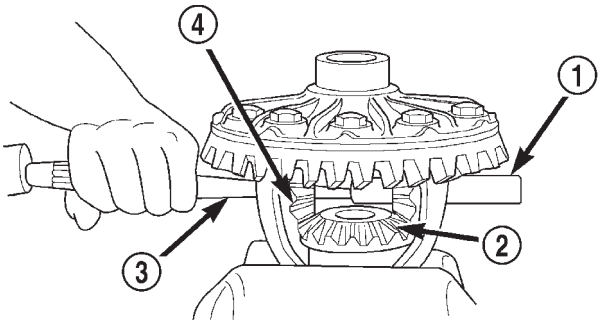


Fig. 54 Mate Shaft Removal

1 – PINION MATE SHAFT
2 – SIDE GEAR
3 – DRIFT
4 – PINION MATE GEAR

(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.

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

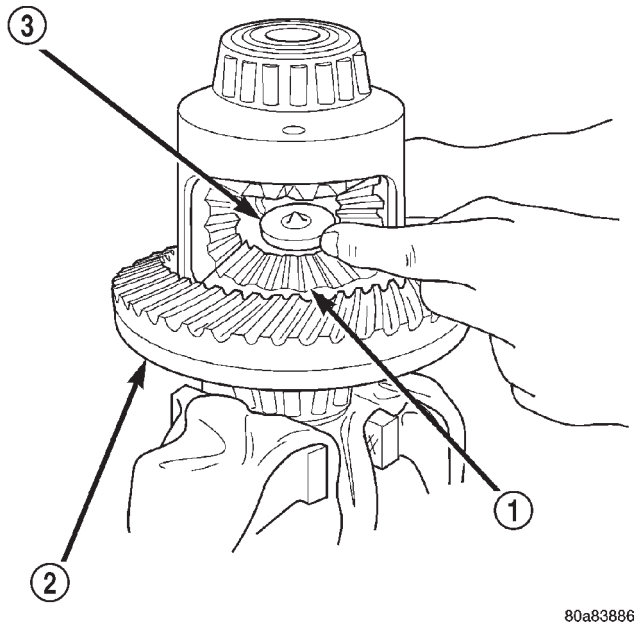


Fig. 55 Step Plate Tool Installation

1 – LOWER SIDE GEAR
2 – DIFFERENTIAL CASE
3 – SPECIAL TOOL C-6960–3

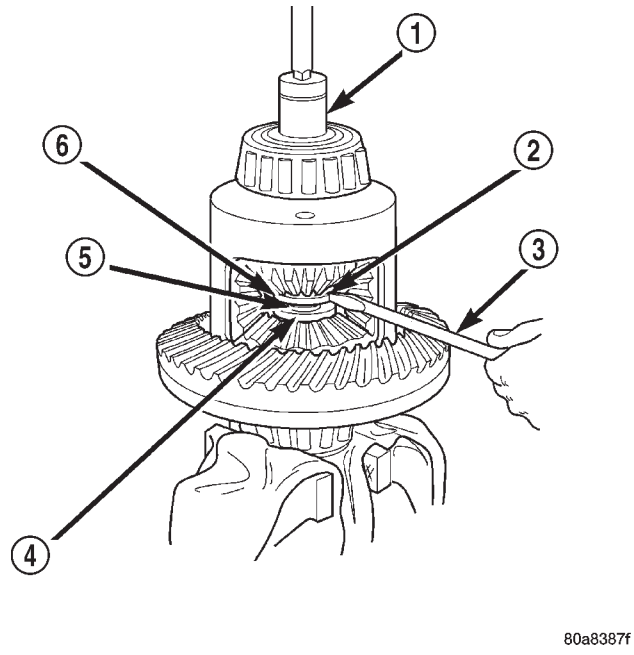


Fig. 56 Threaded Adapter Installation

1 – SOCKET
2 – SLOT IN ADAPTER
3 – SCREWDRIVER
4 – DISC C-6960–3
5 – THREADED ROD C-6960–4
6 – THREADED ADAPTER DISC C–6960–1

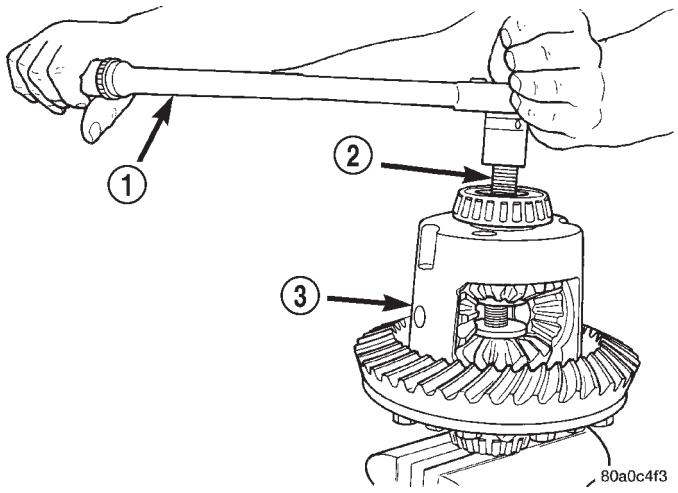


Fig. 57 Tighten Belleville Spring Compressor Tool

1 – TORQUE WRENCH
2 – TOOL ASSEMBLED
3 – DIFFERENTIAL CASE

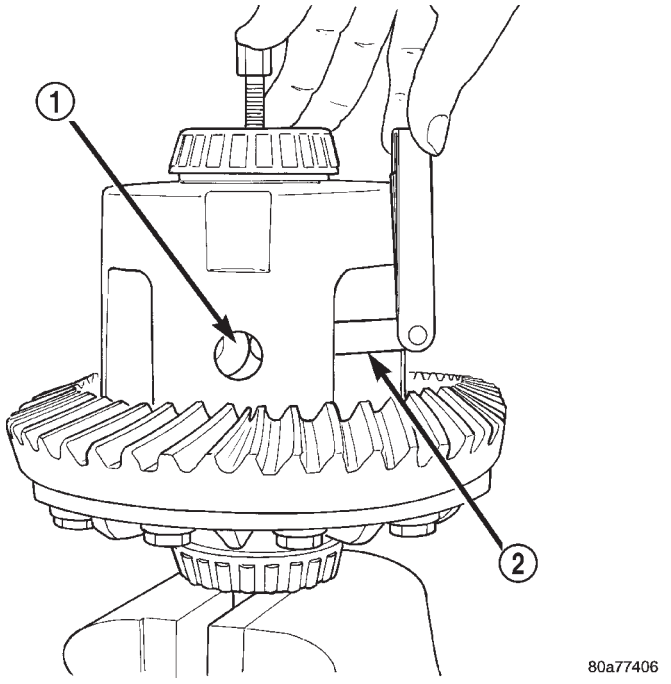


Fig. 58 Remove Pinion Gear Thrust Washer

1 – THRUST WASHER
2 – FEELER GAUGE

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

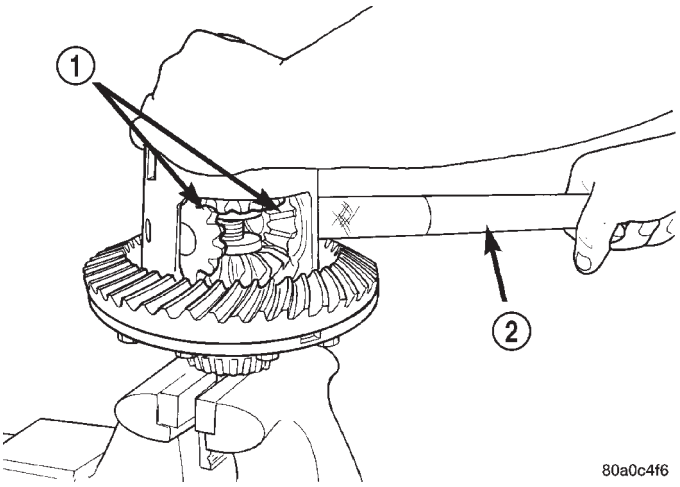


Fig. 59 Pinion Gear Removal

1 – PINION GEARS
2 – TOOL

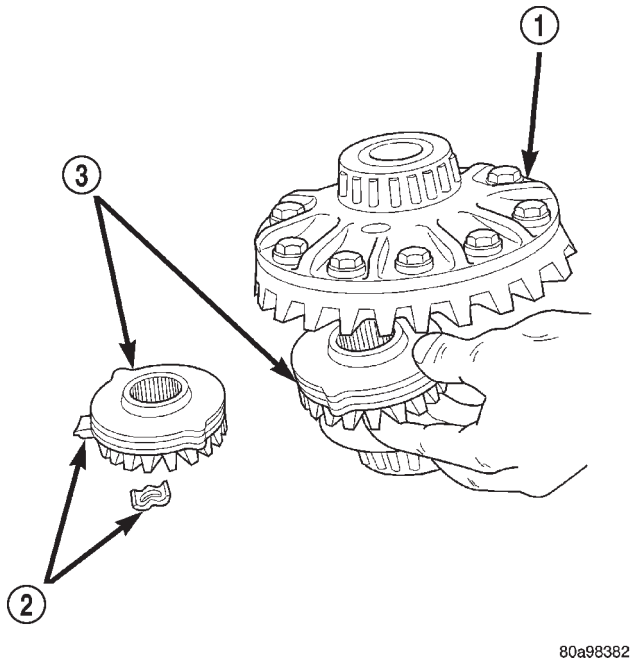


Fig. 60 Side Gear & Clutch Disc Removal

1 – DIFFERENTIAL CASE
2 – RETAINER
3 – SIDE GEAR AND 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. 61).

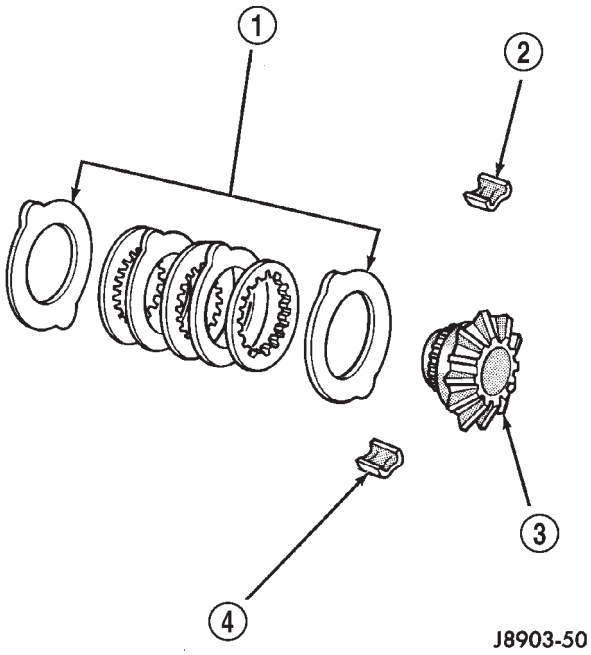


Fig. 61 Clutch Disc Pack

1 – CLUTCH PACK
2 – RETAINER
3 – SIDE GEAR
4 – RETAINER

(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.**

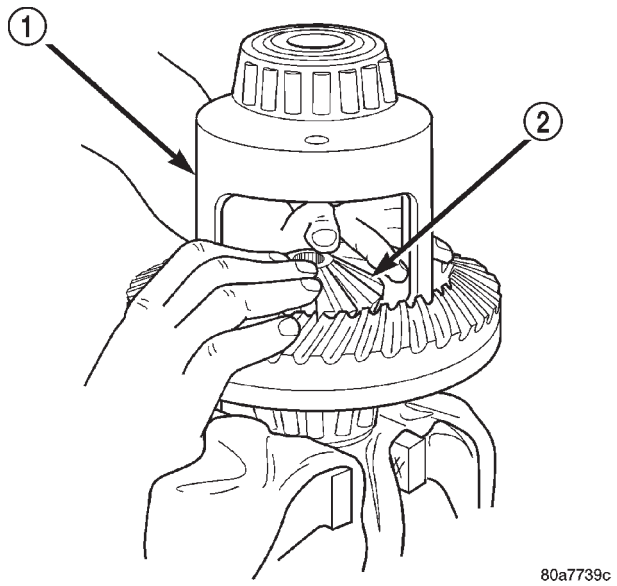


Fig. 62 Clutch Discs & Lower Side Gear Installation

1 – DIFFERENTIAL CASE
2 – LOWER SIDE GEAR AND CLUTCH DISC PACK

DISASSEMBLY AND ASSEMBLY (Continued)

(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).

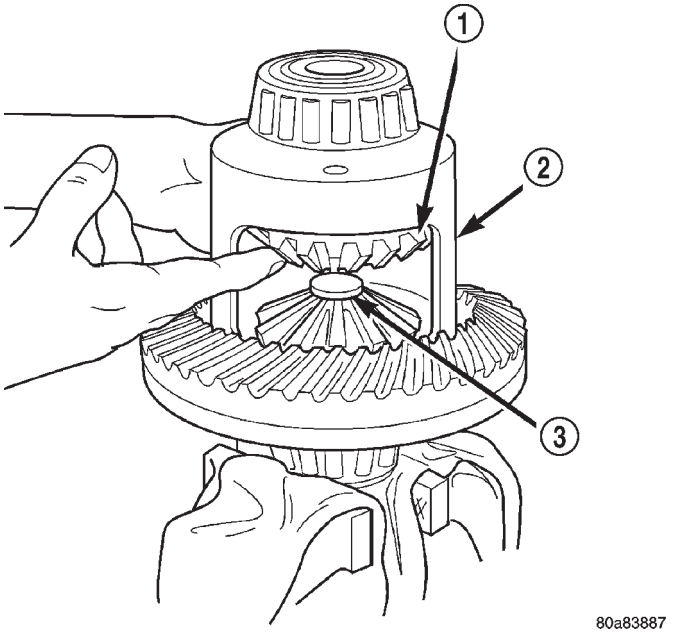


Fig. 63 Upper Side Gear & Clutch Disc Pack Installation

1 – UPPER SIDE GEAR AND CLUTCH DISC PACK
2 – DIFFERENTIAL CASE
3 – SPECIAL TOOL C-6960–3

(6) Install the upper side gear and clutch disc pack (Fig. 63).

(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.

(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 gears and pinions. 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

CLEANING AND INSPECTION (Continued)

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.

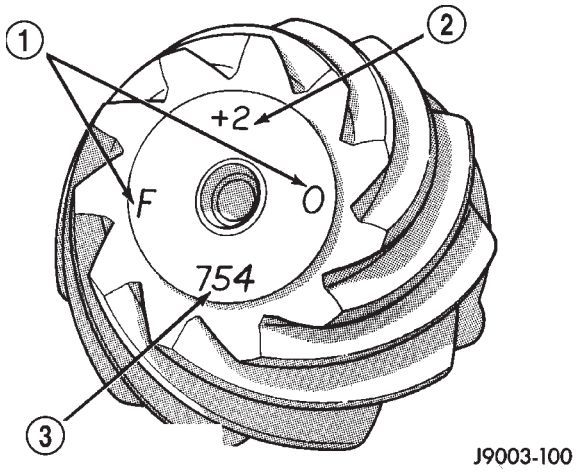


Fig. 64 Pinion Gear ID Numbers

1 – PRODUCTION NUMBERS
2 – DRIVE PINION GEAR DEPTH VARIANCE
3 – GEAR MATCHING NUMBER (SAME AS RING GEAR NUMBER)

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.

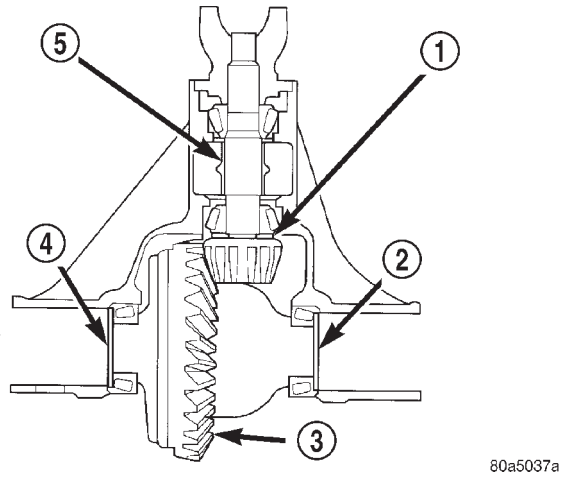


Fig. 65 Shim Locations

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

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).

(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).

(3) Install front pinion bearing and Cone 6740 hand tight (Fig. 66).

(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.

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

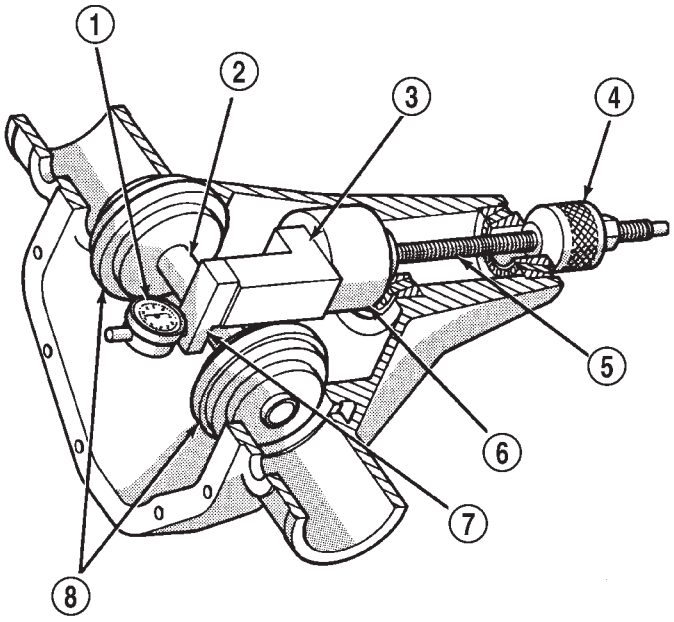


Fig. 66 Pinion Gear Depth Gauge Tools—Typical

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

(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.

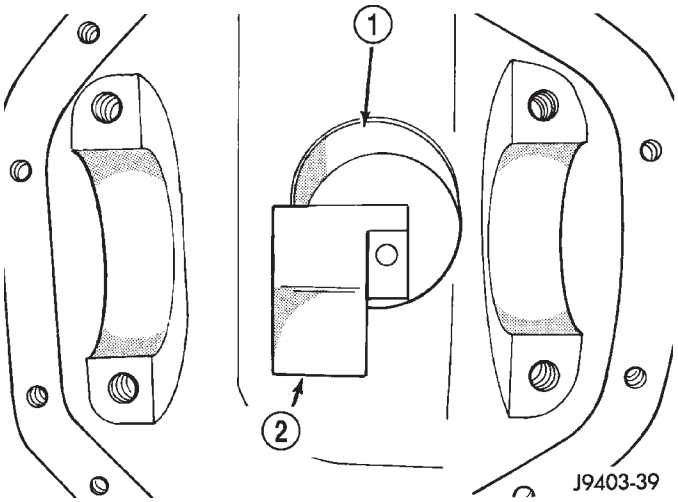


Fig. 67 Pinion Height Block—Typical

1 – PINION BLOCK
2 – PINION HEIGHT BLOCK

(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

ADJUSTMENTS (Continued)

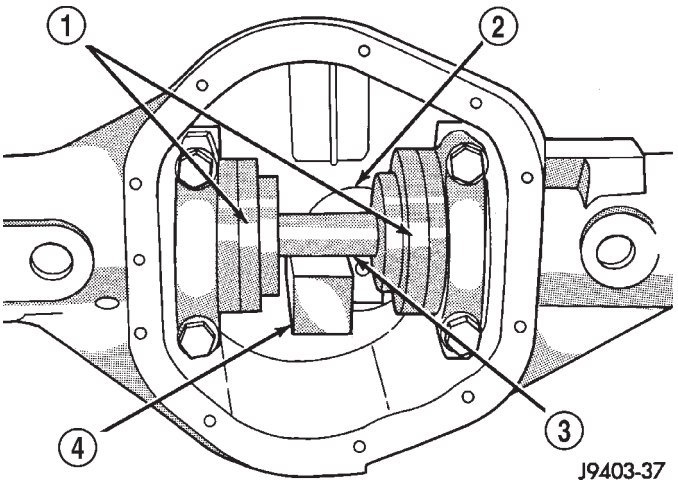


Fig. 68 Gauge Tools In Housing—Typical

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

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.

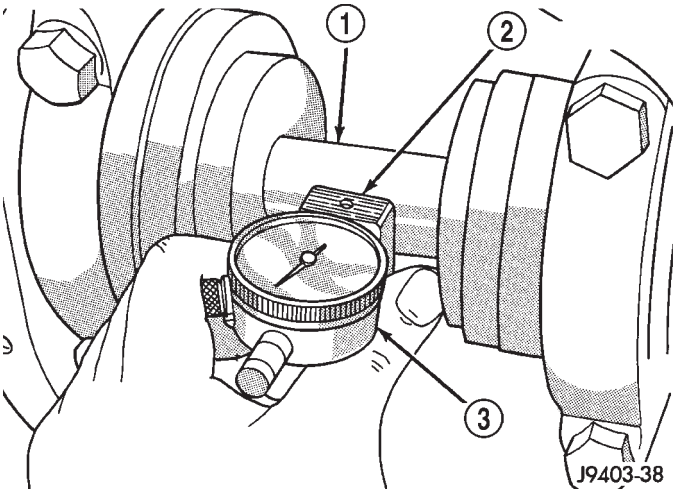


Fig. 69 Pinion Gear Depth Measurement—Typical

1 – ARBOR
2 – SCOOTER BLOCK
3 – DIAL INDICATOR

(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 differential side play is measured, the pinion gear is installed, and the gear backlash shim thickness is measured. The overall shim thickness is the total of the dial indicator reading, starting point shim thickness, and the 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).

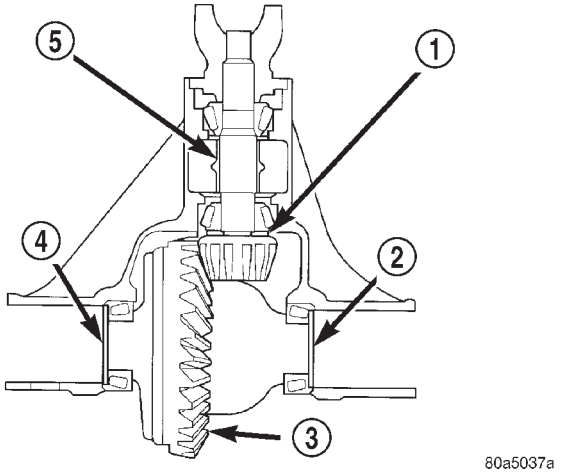


Fig. 70 Axle Adjustment Shim Locations

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

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.

ADJUSTMENTS (Continued)

(5) Insert Dummy Shims 8107 (0.118 in. (3.0 mm)) starting point shims between the dummy bearing and the axle housing (Fig. 71).

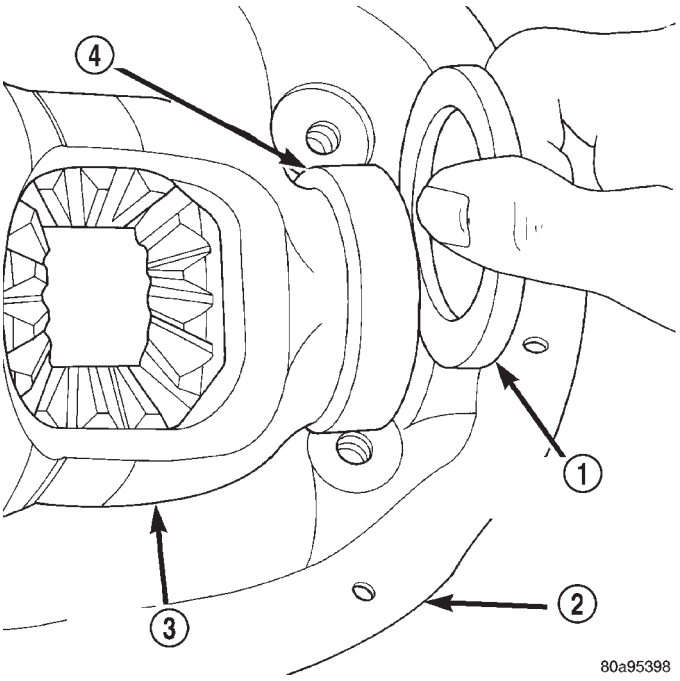


Fig. 71 Insert Starting Point Shims

1 – SPECIAL TOOL 8107
2 – AXLE HOUSING
3 – DIFFERENTIAL CASE
4 – SPECIAL TOOL D-348

(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.

(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.

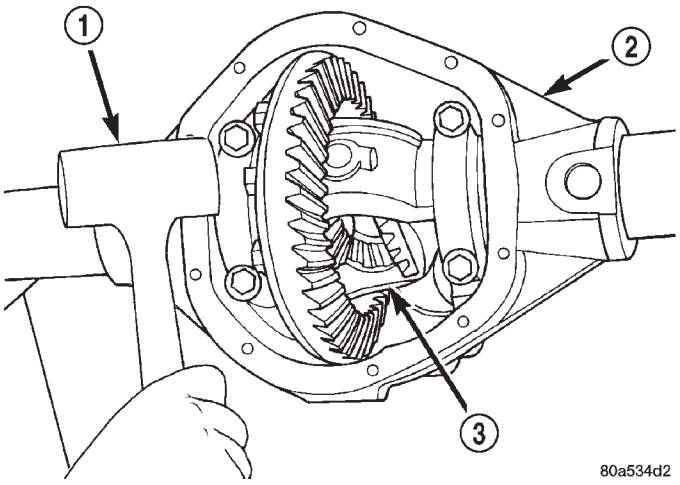


Fig. 72 Seat Pinion Gear Dummy Side Bearing

1 – MALLET
2 – AXLE HOUSING
3 – DIFFERENTIAL CASE

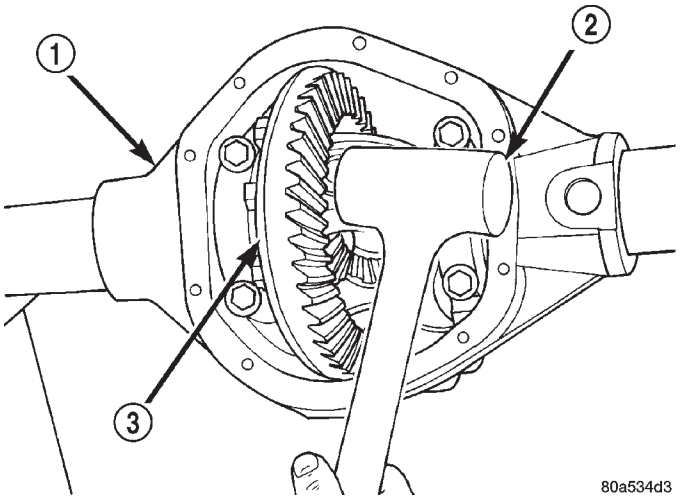


Fig. 73 Seat Ring Gear Side Dummy Bearing

1 – AXLE HOUSING
2 – MALLET
3 – DIFFERENTIAL CASE

(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.

(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.

ADJUSTMENTS (Continued)

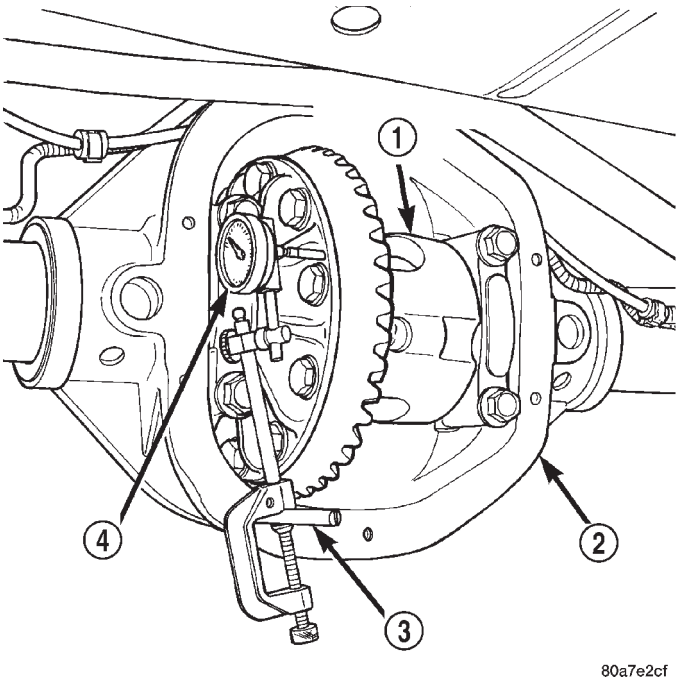


Fig. 74 Differential Side play Measurement

1 – DIFFERENTIAL CASE
2 – AXLE HOUSING
3 – SPECIAL TOOL C-3288–B
4 – SPECIAL TOOL C-3339

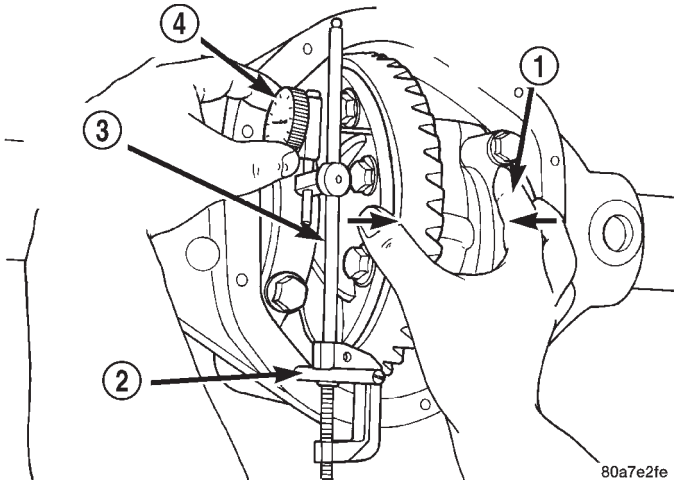


Fig. 75 Hold Differential Case and Zero Dial Indicator

1 – FORCE DIFFERENTIAL CASE TO PINION GEAR SIDE
2 – SPECIAL TOOL C-3288–B
3 – SPECIAL TOOL C-3339
4 – ZERO DIAL INDICATOR FACE

(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.

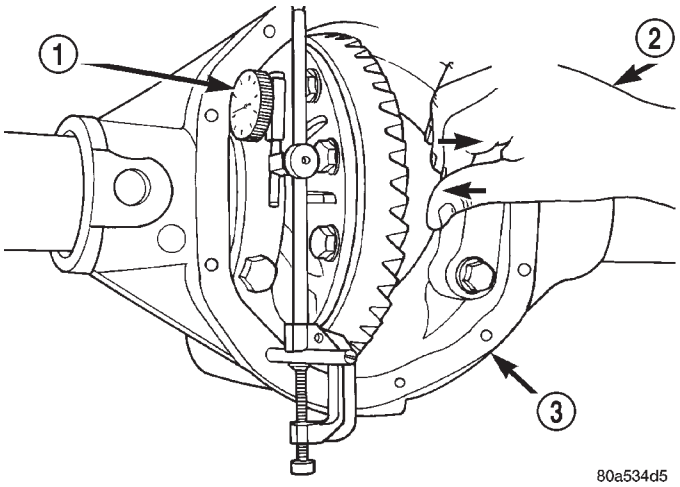


Fig. 76 Hold Differential Case and Read Dial Indicator

1 – READ DIAL INDICATOR
2 – FORCE DIFFERENTIAL CASE TO RING GEAR SIDE
3 – AXLE HOUSING

(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.

(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 eight locations around the ring gear. Readings should not

ADJUSTMENTS (Continued)

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.

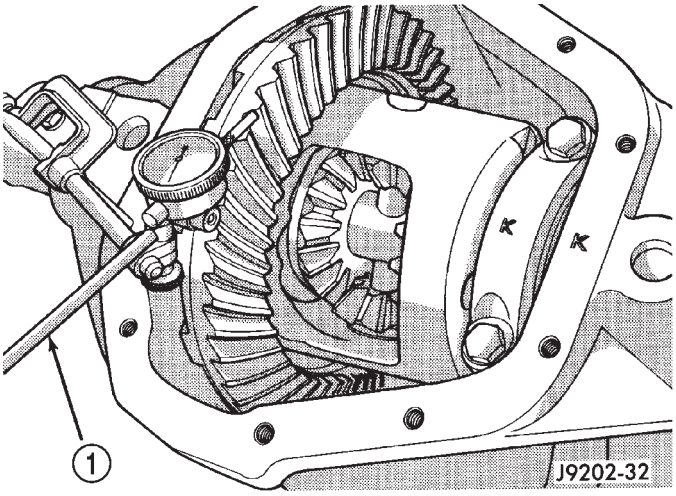


Fig. 77 Ring Gear Backlash Measurement

1 – DIAL INDICATOR

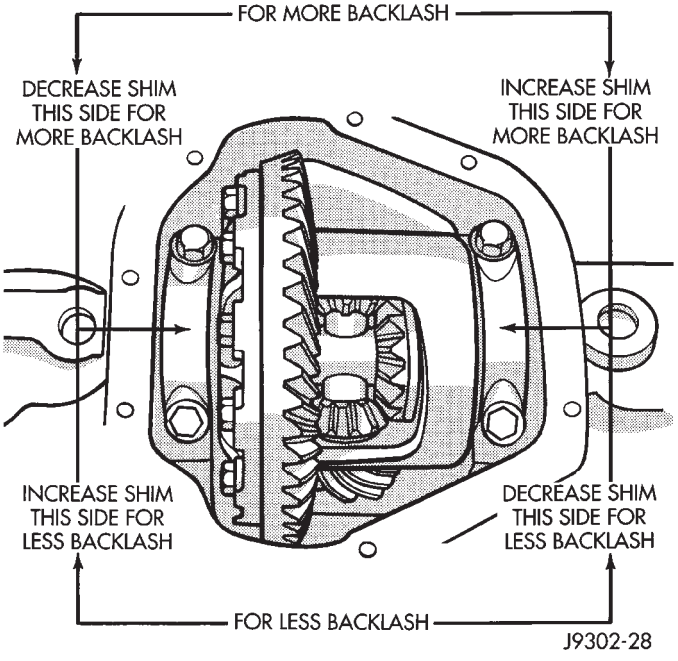


Fig. 78 Backlash Shim Adjustment

GEAR CONTACT PATTERN ANALYSIS

The ring gear and pinion teeth contact patterns will show if the pinion 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. 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 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.

SPECIFICATIONS

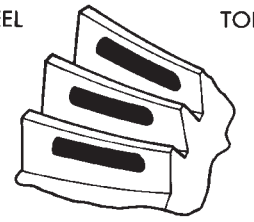
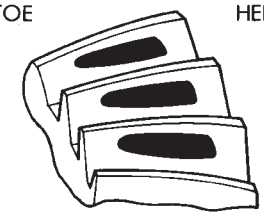
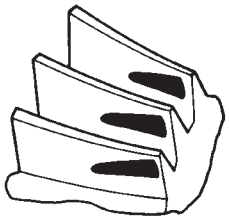
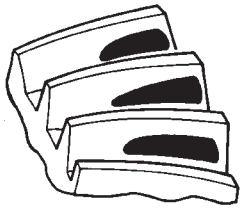
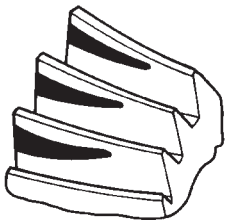
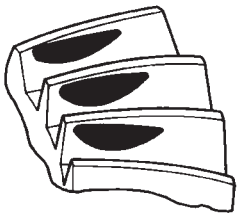
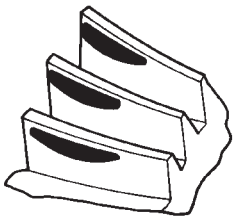
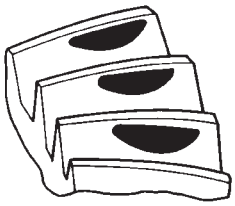
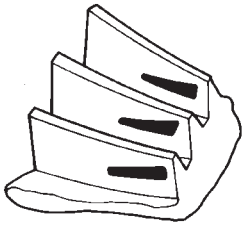
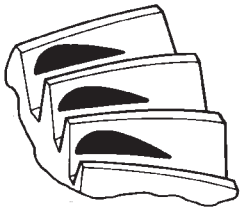
194 RBI AXLE

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, 4.10
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.)
Maximum Carrier Spread	0.51 mm (0.020 in.)

TORQUE

DESCRIPTION	TORQUE
Bolt, Diff. Cover	41 N·m (30 ft. lbs.)
Bolt, 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, ABS Sensor	8 N·m (70 in. lbs.)

SPECIFICATIONS (Continued)

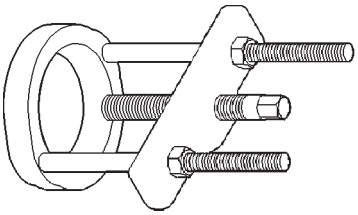
DRIVE SIDE OF RING GEAR TEETH	COAST SIDE OF RING GEAR TEETH	
HEEL TOE 	TOE HEEL 	DESIRABLE CONTACT PATTERN. PATTERN SHOULD BE CENTERED ON THE DRIVE SIDE OF TOOTH. PATTERN SHOULD BE CENTERED ON THE COAST SIDE OF TOOTH, BUT MAY BE SLIGHTLY TOWARD THE TOE. THERE SHOULD ALWAYS BE SOME CLEARANCE BETWEEN CONTACT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

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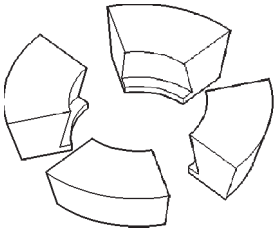
Fig. 79 Gear Tooth Contact Patterns

SPECIAL TOOLS

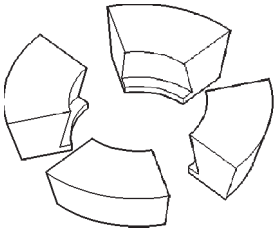
194 RBI AXLE



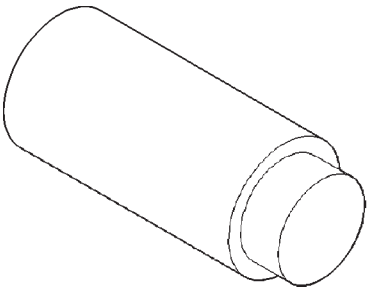
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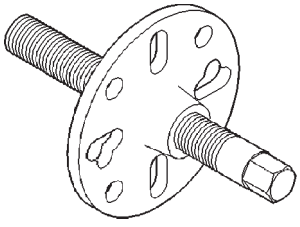
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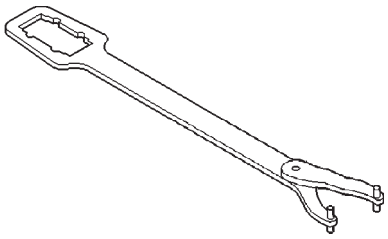
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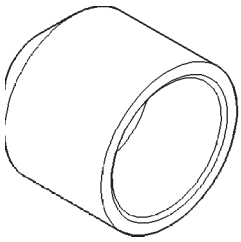
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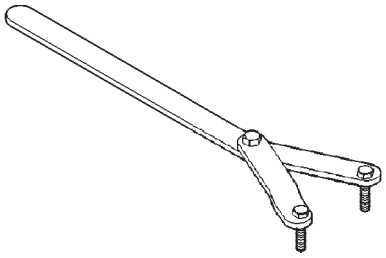
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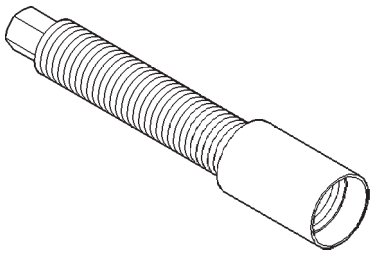
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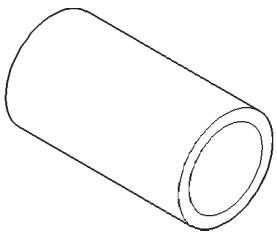
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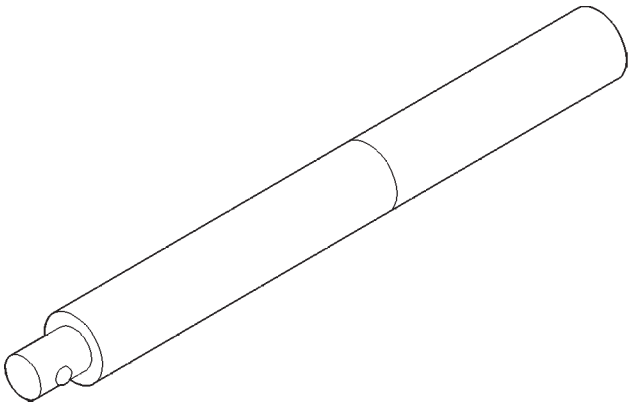


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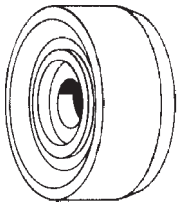


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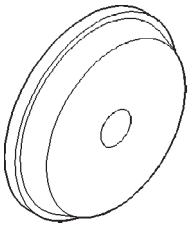
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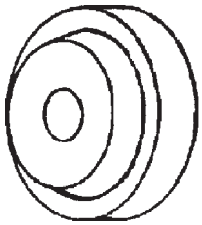
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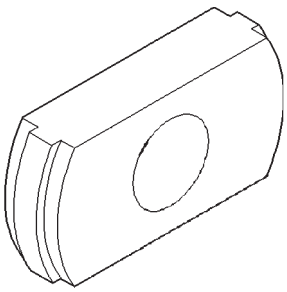
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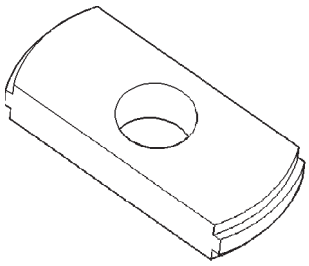
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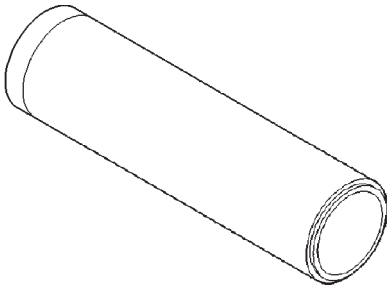
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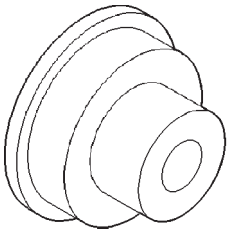
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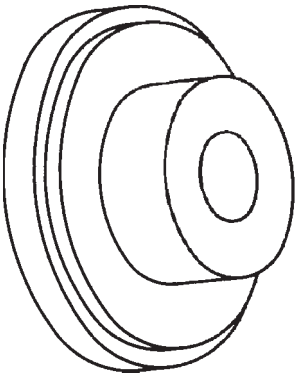
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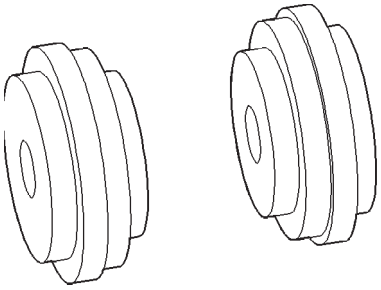


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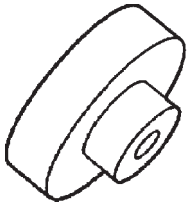


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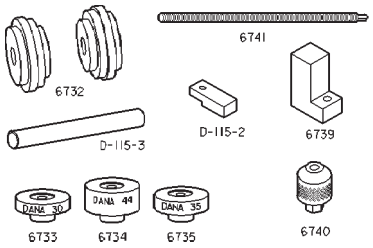
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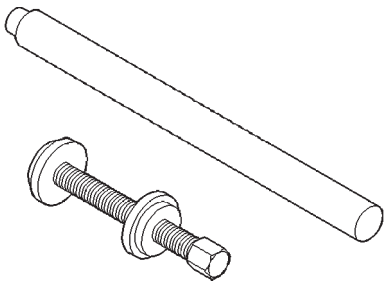
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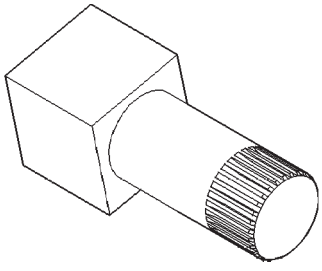
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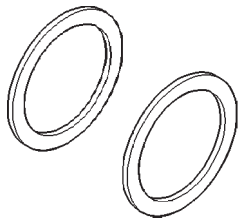
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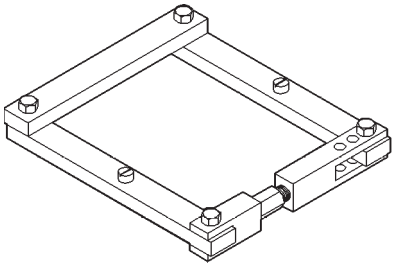
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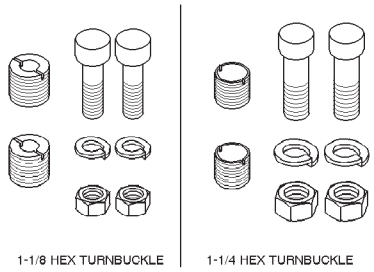
Holder—6965



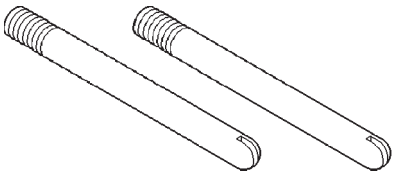
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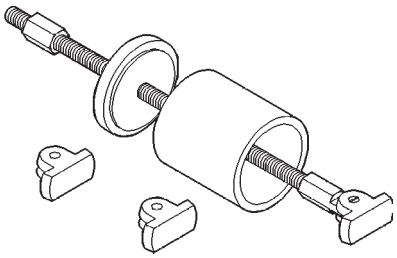
Spreader—W-129-B



Adapter Kit—6987

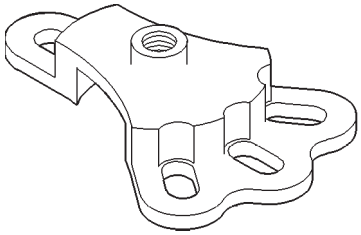


Guide Pin—C-3288-B

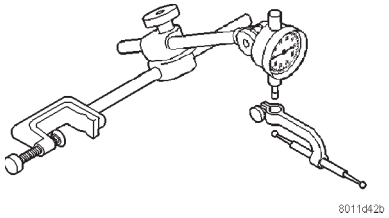


Bearing Remover Tool Set—6310

SPECIAL TOOLS (Continued)



Hub Puller—6790



Dial Indicator—C-3339

216 RBI REAR AXLE

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DESCRIPTION AND OPERATION

216 RBI AXLE

DESCRIPTION

The 216 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 and welded into the differential housing to form a one-piece axle housing.

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

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

The axles are equipped with semi-floating axle shafts. The vehicle weight is supported by the axle shaft and bearings. The axle shafts are retained by plates bolted to the end flanges of the axle tubes.

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

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 ring or the wheel speed sensor are not damaged.

The 216 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 roll-pin. Differential side bearing preload and ring gear backlash is adjusted by shims positioned between the side bearing cone and differential case. Pinion gear depth is adjusted by shims positioned between the axle housing and the inner pinion bearing cup. Pinion bearing preload is maintained by shims positioned between the pinion gear shaft shoulder and the outer bearing cone. (Fig. 1)

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.

OPERATION

The axle receives power from the transmission/transfer case through the rear propeller shaft. The rear propeller shaft is connected to the pinion gear which rotates the differential through the gear mesh with the ring gear bolted to the differential case. The engine power is transmitted to the axle shafts

DESCRIPTION AND OPERATION (Continued)

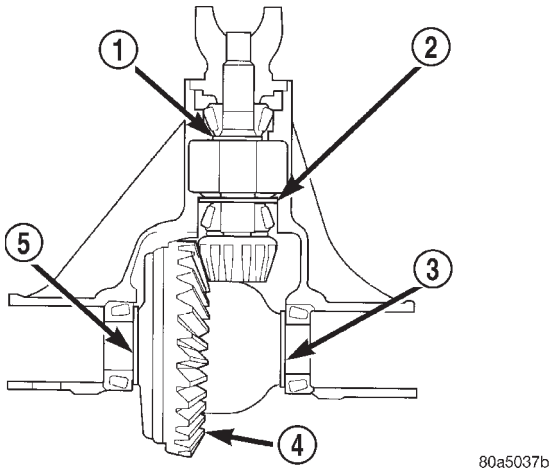


Fig. 1 Axle Adjustment Shims

1 – PINION BEARING PRELOAD SHIM
2 – PINION GEAR DEPTH SHIM
3 – DIFFERENTIAL BEARING SHIM-PINION GEAR SIDE
4 – RING GEAR
5 – DIFFERENTIAL BEARING SHIM-RING GEAR SIDE

through the pinion mate and side gears. The side gears are splined to the axle shafts.

LUBRICANT

DESCRIPTION

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 4 oz. of friction modifier to the axle lubricant. The 216 RBI axle lubricant capacity is 1.89 L (4.0 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.

STANDARD DIFFERENTIAL

DESCRIPTION

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.

OPERATION

In operation, power flow occurs as follows:

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

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

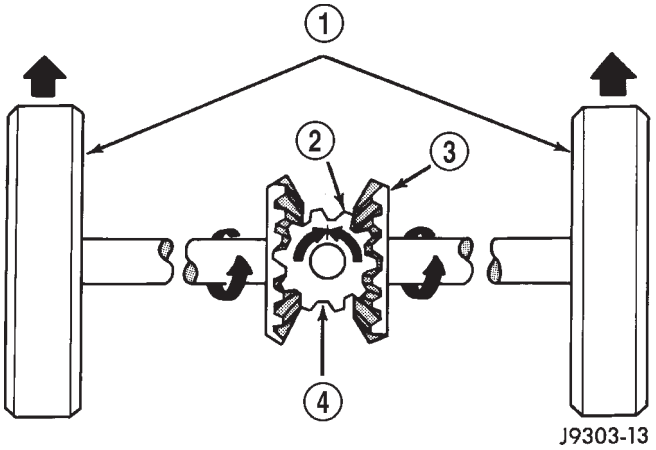


Fig. 2 Differential Operation—Straight Ahead Driving

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

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. The difference must be compensated for to prevent the tires from scuffing and skidding through turns. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 3). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

DESCRIPTION AND OPERATION (Continued)

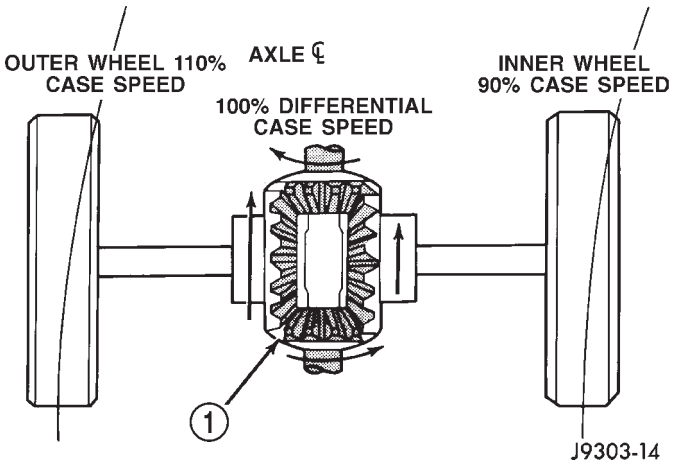


Fig. 3 Differential Operation—On Turns

1 – PINION GEARS ROTATE ON PINION SHAFT

TRAC-LOK™ DIFFERENTIAL

DESCRIPTION

In a standard 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.

OPERATION

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. 4).

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.

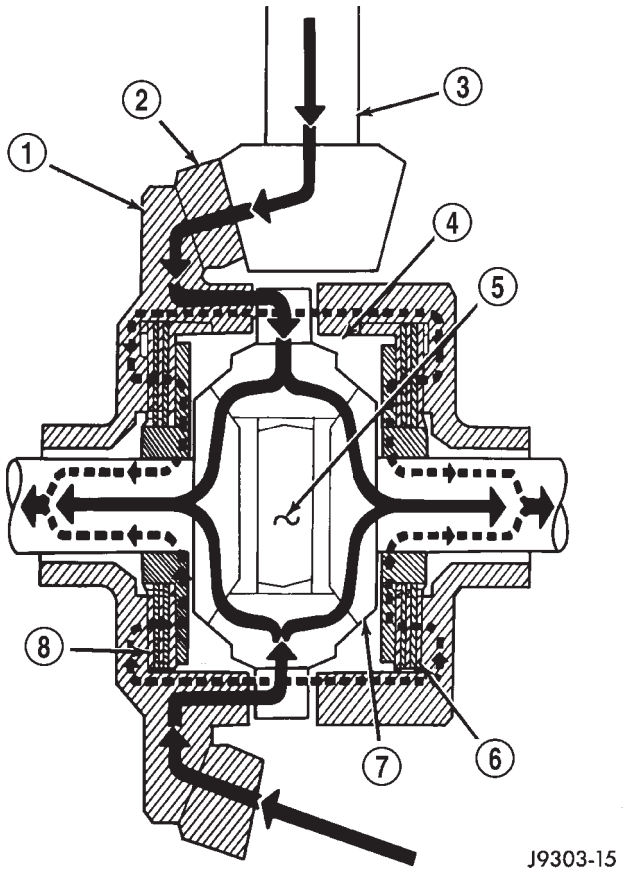


Fig. 4 Trac-lok™ Limited Slip Differential Operation

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

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:

DIAGNOSIS AND TESTING (Continued)

- Severe overloading.
- Insufficient lubricant.
- Incorrect lubricant.
- Improperly tightened components.
- Differential housing bores not square to each other.

DIAGNOSTIC CHART

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

DIAGNOSIS AND TESTING (Continued)

Condition	Possible Causes	Correction
Differential Gears Scored	1. Insufficient lubrication.	1. Replace scored gears. Fill differential with the correct fluid type and quantity.
	2. Improper grade of lubricant.	2. Replace scored gears. Fill differential with the correct fluid type and quantity.
	3. Excessive spinning of one wheel/tire.	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 lubricant to the correct level.
	2. Worn axle shaft seals.	2. Replace seals.
	3. Cracked differential housing.	3. Repair as necessary.
	4. Worn pinion seal.	4. Replace seal.
	5. Worn/scored yoke.	5. Replace yoke and seal.
	6. Axle cover not properly sealed.	6. Remove, clean, and re-seal cover.
Axle Overheating	1. Lubricant level low.	1. Fill differential to correct level.
	2. Improper grade of lubricant.	2. Fill differential with the correct fluid type and quantity.
	3. Bearing pre-loads too high.	3. Re-adjust bearing pre-loads.
	4. Insufficient ring gear backlash.	4. Re-adjust ring gear backlash.
Gear Teeth Broke	1. Overloading.	1. Replace gears. Examine other gears and bearings for possible damage.
	2. Erratic clutch operation.	2. Replace gears and examine the remaining parts for damage. Avoid erratic clutch operation.
	3. Ice-spotted pavement.	3. Replace gears and examine remaining parts for damage.
	4. Improper adjustments.	4. Replace gears and examine remaining parts for damage. Ensure ring gear backlash is correct.

DIAGNOSIS AND TESTING (Continued)

Condition	Possible Causes	Correction
Axle Noise	1. Insufficient lubricant.	1. Fill differential with the correct fluid type and quantity.
	2. Improper ring gear and pinion adjustment.	2. Check ring gear and pinion contact pattern.
	3. Unmatched ring gear and pinion.	3. Replace gears with a matched ring gear and pinion.
	4. Worn teeth on ring gear and/or pinion.	4. Replace ring gear and pinion.
	5. Loose pinion bearings.	5. Adjust pinion bearing pre-load.
	6. Loose differential bearings.	6. Adjust differential bearing pre-load.
	7. Mis-aligned or sprung ring gear.	7. Measure ring gear run-out. Replace components as necessary.
	8. Loose differential bearing cap bolts.	8. Inspect differential components and replace as necessary. Ensure that the bearing caps are torqued tot he proper specification.
	9. Housing not machined properly.	9. Replace housing.

GEAR NOISE

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

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

When road testing, first warm-up the axle fluid by driving the vehicle at least 5 miles and then accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak–noise range. If the noise stops or changes greatly:

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

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

BEARING NOISE

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

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

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

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

LOW SPEED KNOCK

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

VIBRATION

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

DIAGNOSIS AND TESTING (Continued)

- 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.
- Transmission shift operation.
- Loose engine/transmission/transfer case mounts.
- Worn U–joints.
- Loose spring mounts.
- Loose pinion gear nut and yoke.
- Excessive ring gear backlash.
- Excessive side gear to case clearance.

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

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.

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).

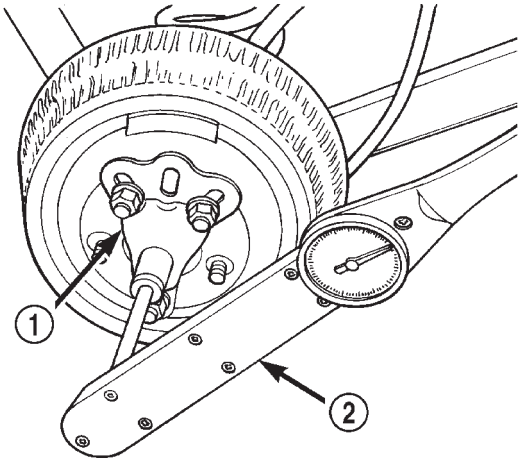


Fig. 5 Trac-lok™ Test —Typical

1 – SPECIAL TOOL 6790 WITH BOLT IN CENTER HOLE
2 – TORQUE WRENCH

(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.

SERVICE PROCEDURES (Continued)

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

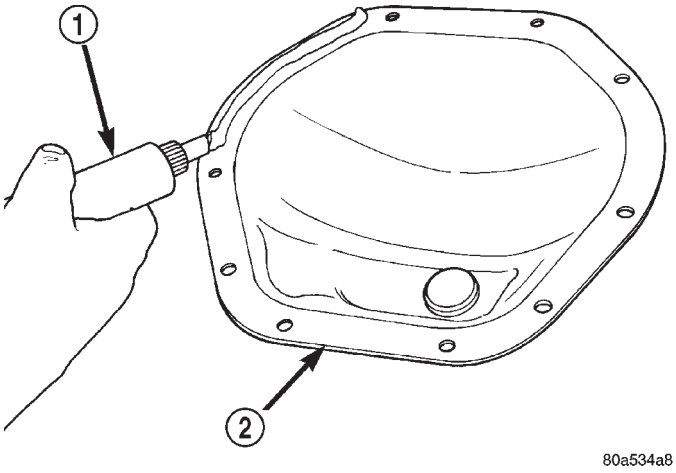


Fig. 6 Apply Sealant

1 – SEALANT
2 – AXLE HOUSING COVER

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) Disconnect track bar.

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

(16) 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 coil springs.

(2) Position the upper and lower suspension arms on the axle brackets. Install nuts and bolts, do not tighten bolts at this time.

(3) Install track bar and attachment bolts, do not tighten bolts at this time.

(4) Install shock absorbers and tighten nuts to 100 N·m (74 ft. lbs.) torque.

(5) Install stabilizer bar links and tighten nuts to 54 N·m (40 ft. lbs.) torque.

(6) Install the wheel speed sensors, if necessary. Refer to Group 5, Brakes, for proper procedures.

(7) Connect parking brake cable to brackets and lever.

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

(9) Connect the brake hose to the axle junction block. Refer to Group 5, Brakes, for proper procedures.

(10) Install axle vent hose.

(11) Align propeller shaft and pinion yoke reference marks. Install U-joint straps and bolts. Tighten to 19 N·m (14 ft. lbs.) torque.

(12) Install the wheels and tires.

REMOVAL AND INSTALLATION (Continued)

(13) Add gear lubricant, if necessary. Refer to Lubricant Specifications in this section for lubricant requirements.

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

(15) Tighten lower suspension arm bolts to 177 N·m (130 ft. lbs.) torque.

(16) Tighten upper suspension arm bolts to 75 N·m (55 ft. lbs.) torque.

(17) Tighten track bar bolts to 100 N·m (74 ft. lbs.) torque.

PINION SHAFT SEAL

REMOVAL

(1) Raise and support the vehicle.

(2) Remove wheel and tire assemblies.

(3) Remove 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. 7).

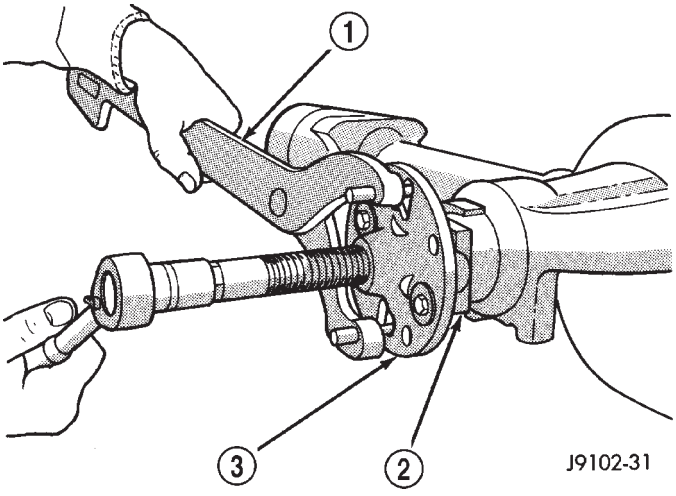


Fig. 7 Pinion Yoke Removal

1 – SPECIAL TOOL C-3281
2 – YOKE
3 – SPECIAL TOOL C-452

(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. 8).

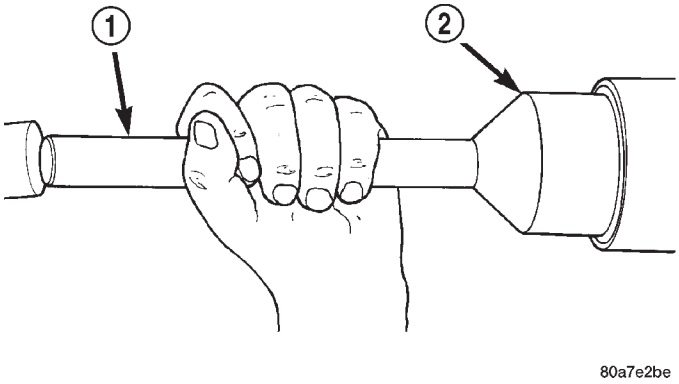


Fig. 8 Pinion Seal Installation

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL C-3972–A

(2) Install yoke on the pinion gear with Installer W-162–D, Cup 8109, and Holder 6958 (Fig. 9).

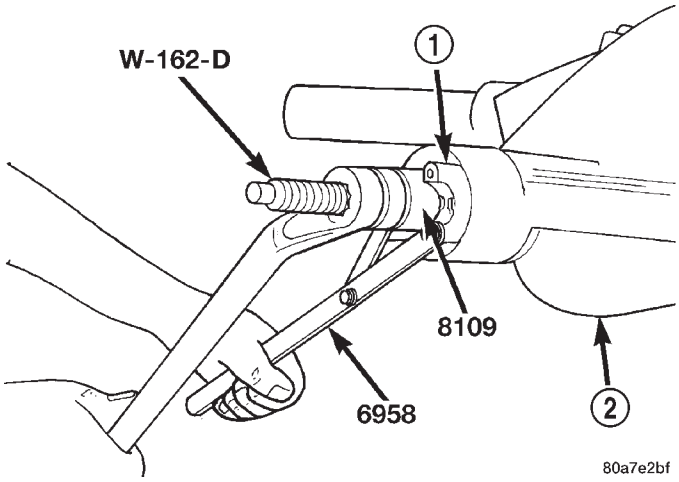


Fig. 9 Pinion Yoke Installation

1 – PINION YOKE
2 – AXLE HOUSING

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. 10).

REMOVAL AND INSTALLATION (Continued)

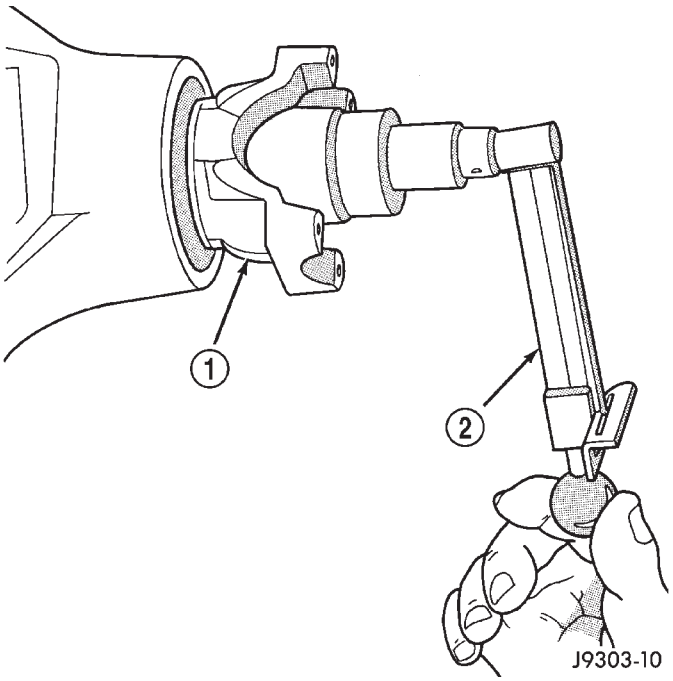


Fig. 10 Check Pinion Rotation Torque

1 – PINION YOKE
2 – INCH POUND TORQUE WRENCH

(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 drums. Refer to Group 5, Brakes, for proper procedures.

(10) Install wheel and tire assemblies.

(11) Lower the vehicle.

AXLE SHAFT

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove wheel from vehicle.

(3) Remove brake drum. Refer to Group 5, Brakes, for proper procedure.

(4) Through access hole in axle flange, remove nuts holding axle retainer plate to axle tube.

(5) Using Slide Hammer 7420, Adapter 6790, and suitable lug nuts, pull axle shaft from vehicle (Fig. 11).

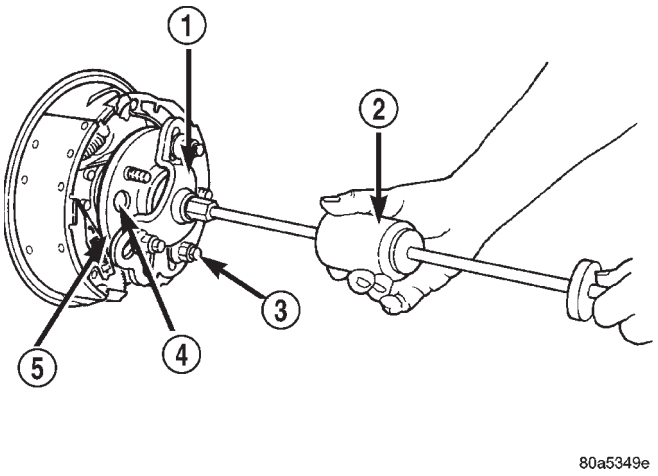


Fig. 11 Axle Shaft, Remove

1 – SPECIAL TOOL 6790
2 – SPECIAL TOOL 7420
3 – LUGNUT
4 – ACCESS HOLE
5 – AXLE SHAFT

INSTALLATION

WARNING: Do not reuse the bolts and nuts that retained the axle shaft to axle tube flange. Used prevailing torque nuts can loosen, causing a dangerous condition.

(1) Insert axle into opening at end of axle tube.

(2) Align flat area on axle shaft retaining plate upward.

(3) Insert the retaining bolts into the axle tube flange and through the holes in the brake backing and axle shaft retaining plates.

(4) Install nuts to hold axle retaining plate to axle tube.

(5) Through access hole in axle flange, tighten nuts to 61 N·m (45 ft. lbs.).

(6) Install brake drum.

(7) Install wheel and tire assembly.

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

(9) Lower vehicle and road test to verify repair.

AXLE BEARING AND SEAL

REMOVAL

(1) Remove axle shaft from vehicle.

(2) Using a 3/8 in. dia. drill bit, drill a shallow hole into soft steel axle bearing retaining ring (Fig. 12). If possible, use a drill depth stop to avoid marking axle.

(3) Using a suitable cold chisel, cut retaining ring across drilled hole. (Fig. 13)

(4) Slide retaining ring from axle shaft.

REMOVAL AND INSTALLATION (Continued)

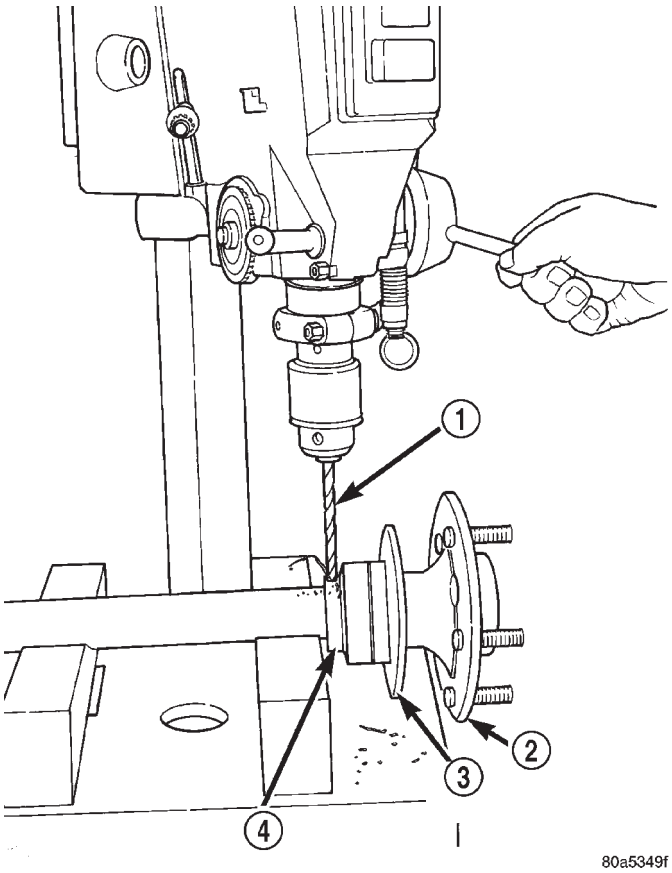


Fig. 12 Drill Retaining Ring

1 – 3/8 in. DIA. DRILL BIT
2 – AXLE
3 – RETAINING PLATE
4 – SOFT METAL RETAINING RING

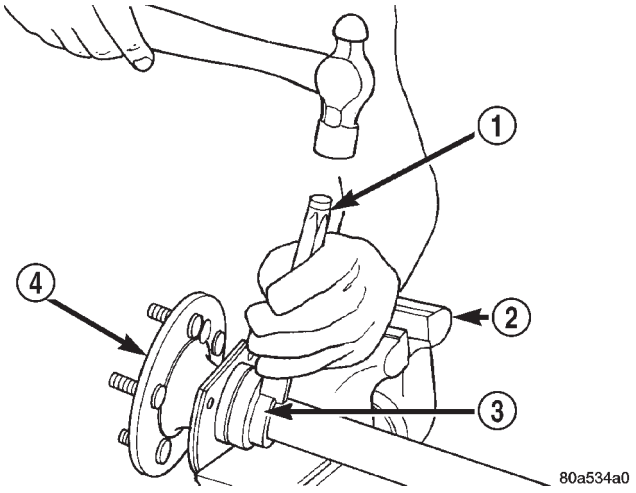


Fig. 13 Cut Retaining Ring

1 – COLD CHISEL
2 – VISE
3 – RETAINING RING
4 – AXLE

(5) Using Splitter 1130 placed between the seal and bearing and a suitable Arbor Press, press unit bearing from axle shaft (Fig. 14).

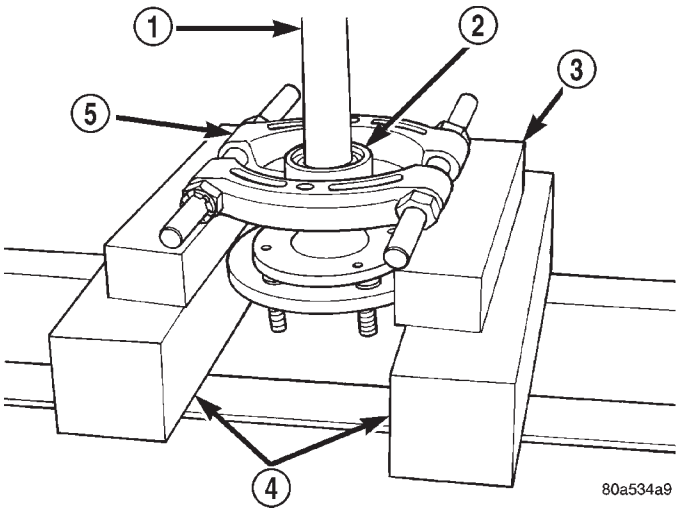


Fig. 14 Axle Bearing and Seal Remove

1 – AXLE
2 – UNIT BEARING
3 – PRESS PLATES
4 – BLOCKS
5 – SPECIAL TOOL 1130

(6) Slide seal from axle.
(7) Slide retaining plate from axle shaft.

INSTALLATION

(1) Using a suitable straight edge, verify flatness of axle shaft retaining plate. Replace plate if warped.
(2) Install retaining plate on axle (Fig. 15).
(3) Apply a coat of multi-purpose grease on sealing surface of axle seal.
(4) Install seal on axle with cavity away from retaining plate (Fig. 15).
(5) Lubricate bearing with Mopar® Wheel Bearing Grease, or equivalent. Wipe excess grease from outside of bearing.
(6) Slide bearing onto axle shaft with groove in outer surface toward seal (Fig. 15).
(7) Using Installer 7913 and shop press, press bearing onto axle shaft (Fig. 16).
(8) Using Installer 7913 and shop press, press soft metal retaining ring onto axle shaft (Fig. 17).
(9) Install axle in vehicle.

REMOVAL AND INSTALLATION (Continued)

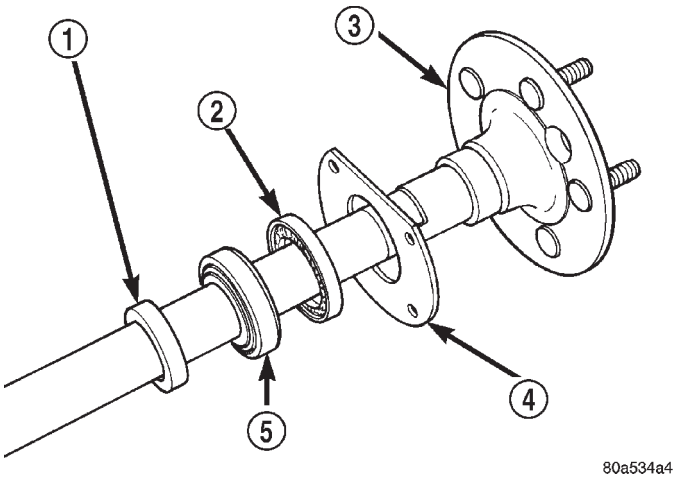


Fig. 15 Axle Bearing and Seal Components

1 – RETAINING RING
2 – SEAL
3 – AXLE
4 – RETAINING PLATE
5 – UNIT BEARING

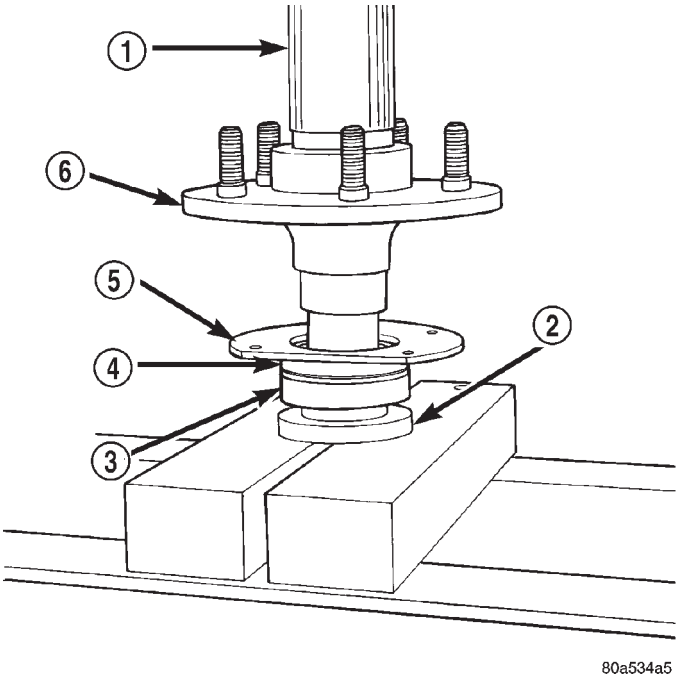


Fig. 16 Press Bearing On Axle

1 – PRESS RAM
2 – SPECIAL TOOL 7913
3 – UNIT BEARING
4 – SEAL
5 – RETAINING PLATE
6 – AXLE

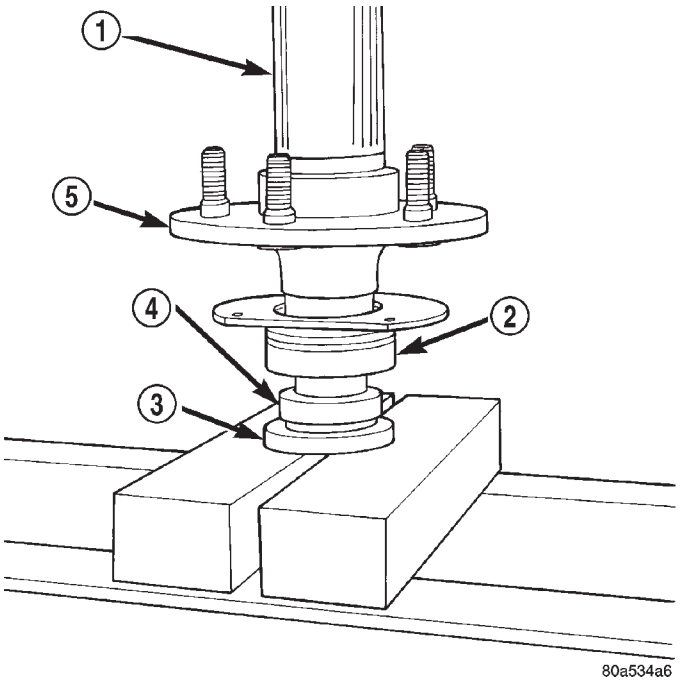


Fig. 17 Press Bearing Retaining Ring On Axle

1 – PRESS RAM
2 – UNIT BEARING
3 – SPECIAL TOOL 7913
4 – SOFT METAL RETAINING RING
5 – AXLE

DIFFERENTIAL

REMOVAL

(1) Remove axle shafts.

(2) Note the orientation of the installation reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 18).

(3) Remove the differential bearing caps.

(4) Position Spreader W–129–B with the tool dowel pins seated in the locating holes (Fig. 19).

(5) Install the hold down clamps and tighten the tool turnbuckle finger–tight.

(6) Install a Guide Pin C-3288-B at the left side of the differential housing. Attach dial indicator to housing pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 19) and zero the indicator.

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

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

(8) Remove the dial indicator.

REMOVAL AND INSTALLATION (Continued)

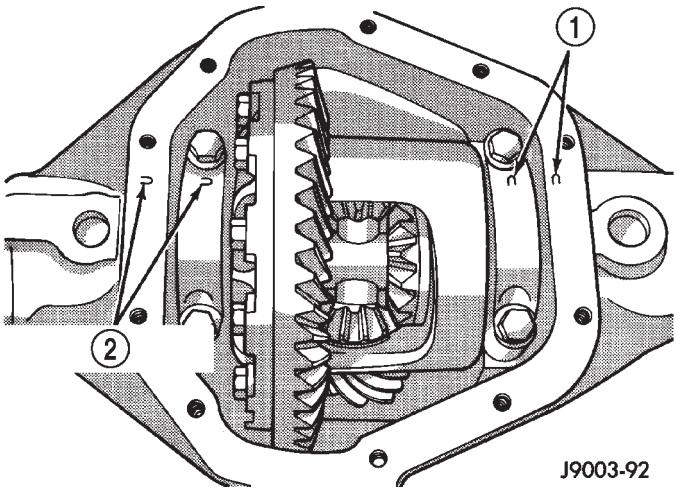


Fig. 18 Bearing Cap Identification

1 – INSTALLATION REFERENCE LETTERS
2 – INSTALLATION REFERENCE LETTERS

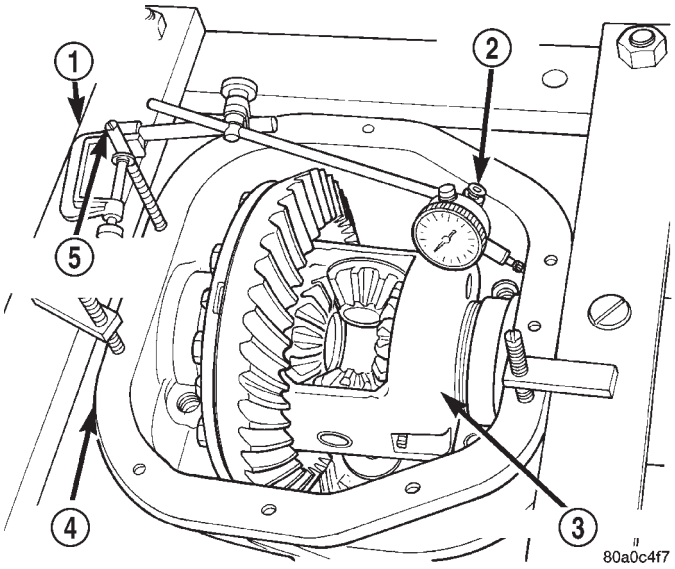


Fig. 19 Spread Differential Housing

1 – HOUSING SPREADER W-129B
2 – DIAL INDICATOR C-3339
3 – DIFFERENTIAL
4 – AXLE HOUSING
5 – GUIDE PIN C-3288–B

(9) Pry the differential case loose from the housing. To prevent damage, pivot on housing with the end of the pry bar against spreader (Fig. 20).

(10) Remove the case from housing. Mark or tag bearing cups to indicate which side they were removed from.

INSTALLATION

(1) Position Spreader W–129–B with the tool dowel pins seated in the locating holes (Fig. 19). Install the hold down clamps and tighten the tool turnbuckle finger–tight.

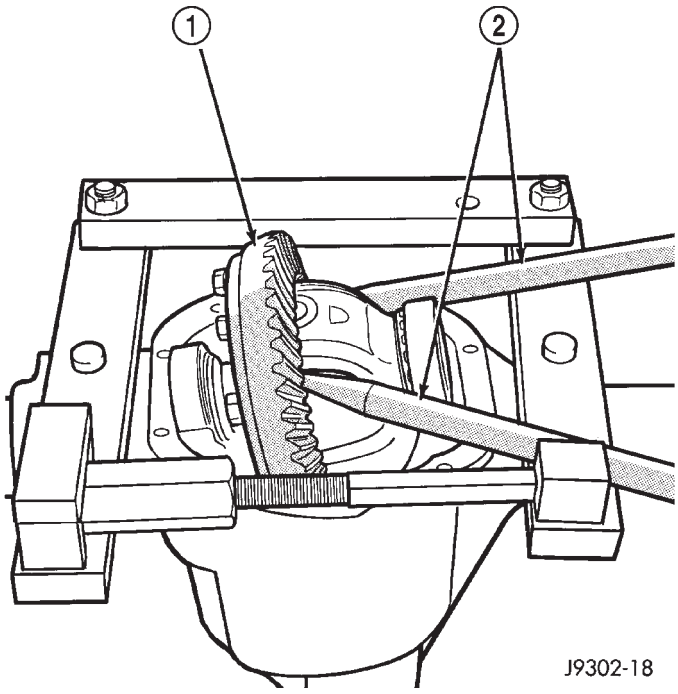


Fig. 20 Differential Removal

1 – DIFFERENTIAL
2 – PRY BAR

(2) Install a Guide Pin C-3288-B at the left side of the differential housing. Attach dial indicator to housing pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 19) and zero the indicator.

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

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

(4) Remove the dial indicator.

(5) Install differential in housing.

(6) Install case in the housing. Tap the differential case with a rawhide or rubber mallet to ensure the bearings are fully seated in the differential housing (Fig. 21).

(7) Remove the spreader.

(8) Install the bearing caps at their original locations (Fig. 22). Tighten the bearing cap bolts to 109 N·m (80 ft. lbs.) torque.

(9) Install axle shafts.

REMOVAL AND INSTALLATION (Continued)

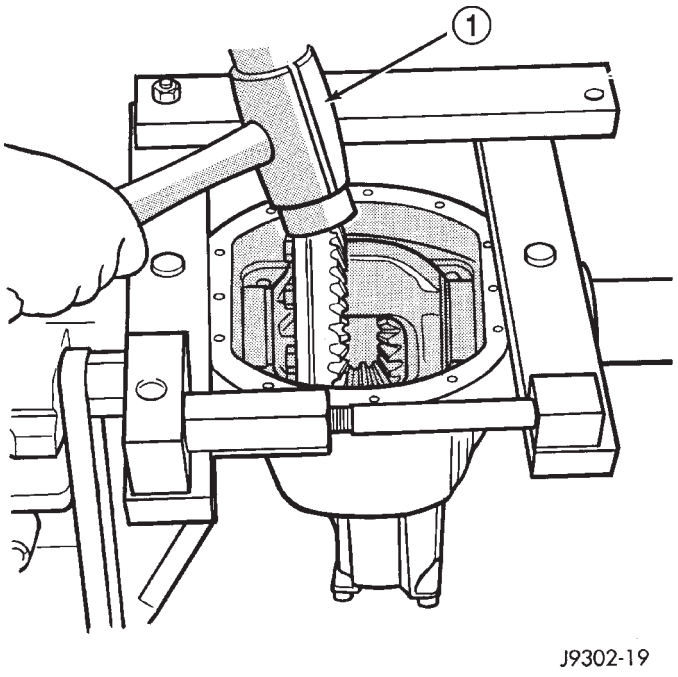


Fig. 21 Differential Installation

1 – RAWHIDE HAMMER

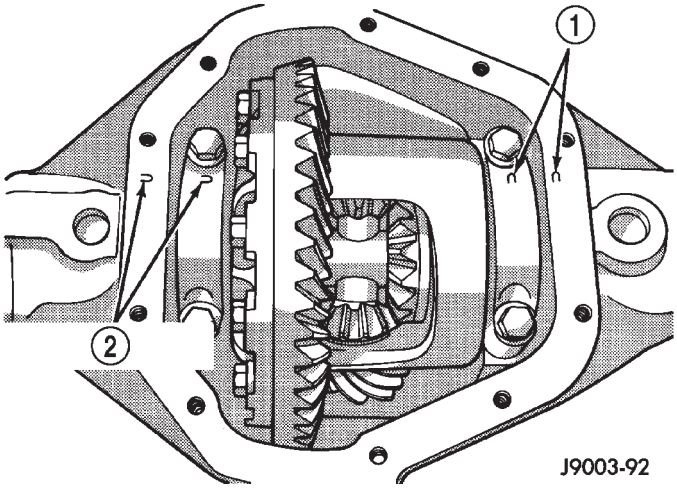


Fig. 22 Differential Bearing Cap Reference Letters

1 – INSTALLATION REFERENCE LETTERS
2 – INSTALLATION REFERENCE LETTERS

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, Adapters C-293-18, and Adapter C-293-3 (Fig. 23).

(3) Remove differential preload shims from differential case hubs. Tag the shims to identify which side of the differential they came from.

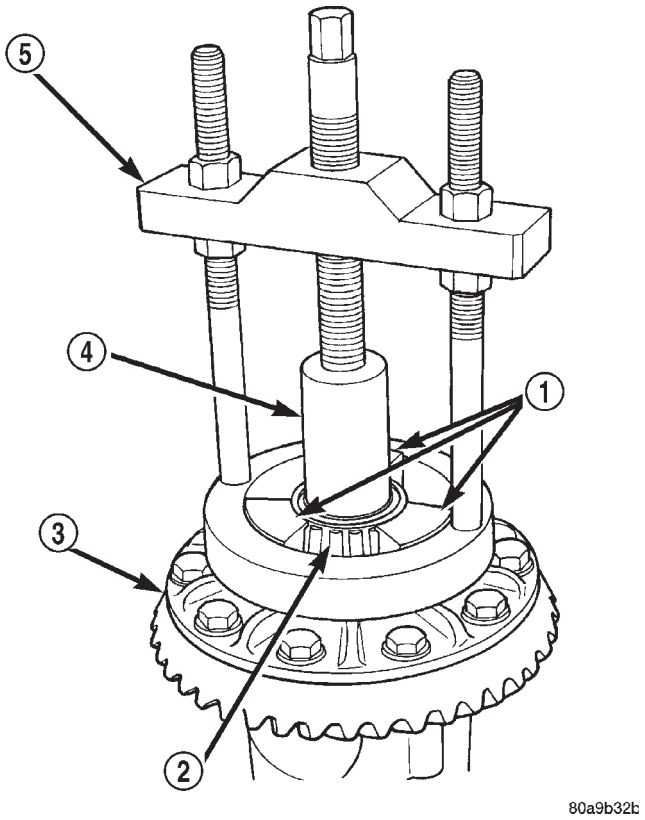


Fig. 23 Differential Bearing Removal

1 – SPECIAL TOOL C-293–18
2 – BEARING
3 – DIFFERENTIAL
4 – SPECIAL TOOL C-293–3
5 – SPECIAL TOOL C-293–PA

INSTALLATION

If ring and pinion gears have been replaced, verify differential side bearing preload and gear mesh backlash.

(1) Install differential preload shims on differential case hubs.

(2) Using tool D-156 with handle C-4171, install differential side bearings (Fig. 24).

(3) Install differential in axle housing.

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.

REMOVAL AND INSTALLATION (Continued)

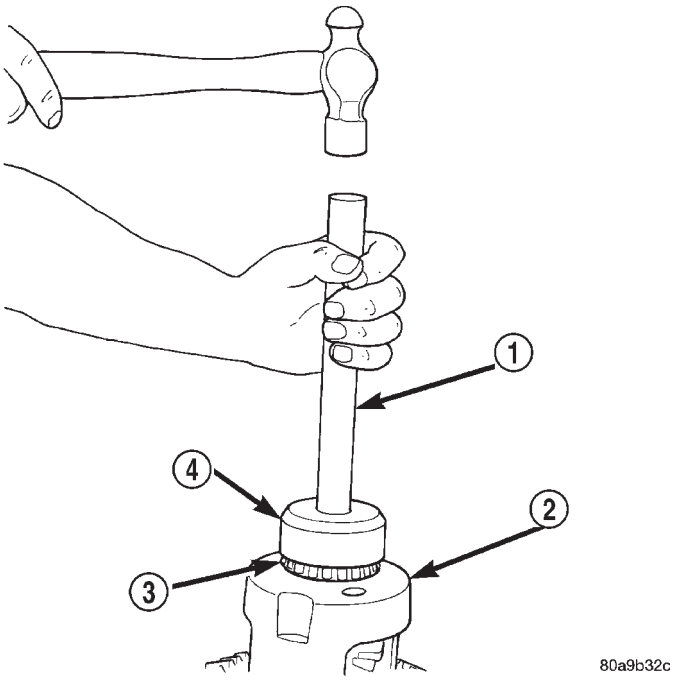


Fig. 24 Install Differential Side Bearings

1 – HANDLE C-4171
2 – DIFFERENTIAL
3 – BEARING
4 – TOOL D-156

(4) Using Holder 6958 to hold yoke, remove the pinion nut and washer (Fig. 25).

(5) Using Remover C-452 and Holder C-3281, remove the pinion yoke from pinion shaft (Fig. 26).

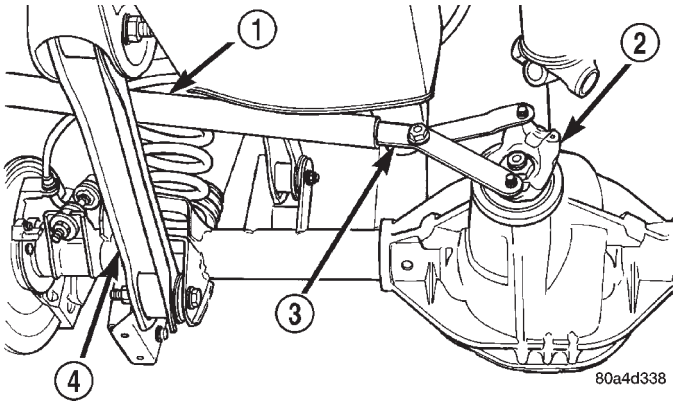


Fig. 25 Pinion Yoke Holder—Typical

1 – 1 in. PIPE
2 – PINION YOKE
3 – SPECIAL TOOL 6958
4 – LOWER CONTROL ARM

(6) Remove the pinion gear and preload shims from housing (Fig. 27). Catch the pinion with your hand to prevent it from falling and being damaged.

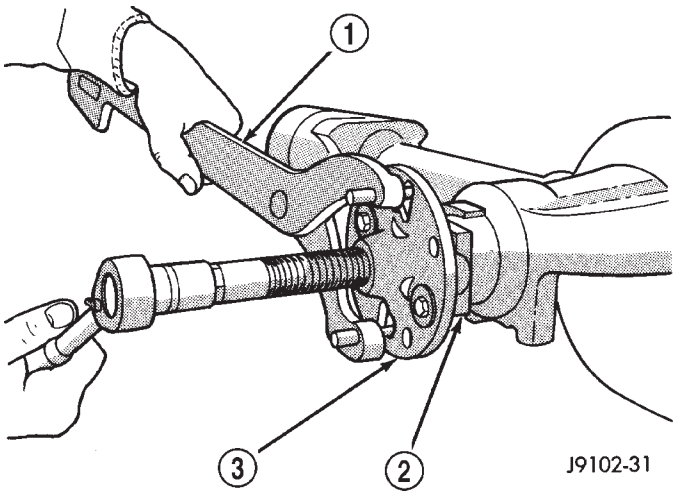


Fig. 26 Pinion Yoke Removal

1 – SPECIAL TOOL C-3281
2 – YOKE
3 – SPECIAL TOOL C-452

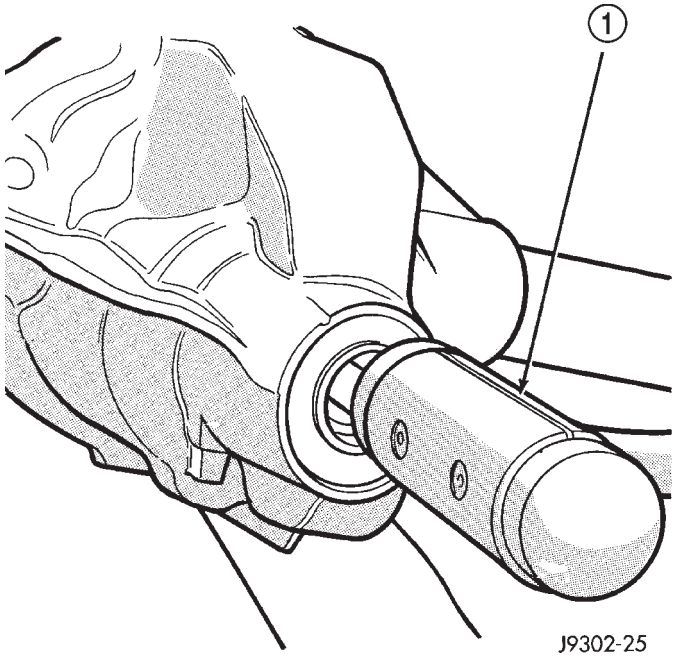


Fig. 27 Remove Pinion Gear

1 – RAWHIDE HAMMER

(7) Remove the front pinion bearing cup, bearing, oil slinger, if equipped, and pinion seal with Remover D-147 and Handle C–4171 (Fig. 28).

(8) Remove the rear pinion bearing cup from axle housing (Fig. 29). Use Remover D-148 and Handle C–4171.

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

REMOVAL AND INSTALLATION (Continued)

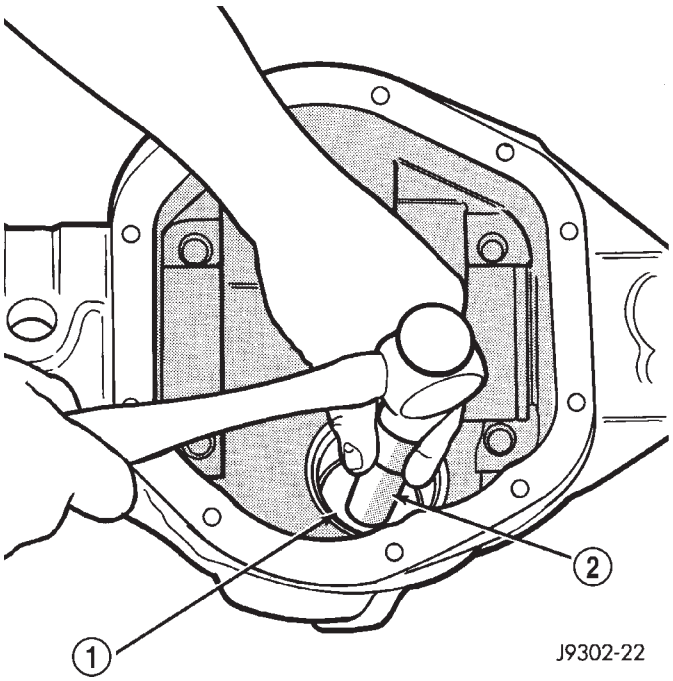


Fig. 28 Front Bearing Cup Removal

1 – REMOVER
2 – HANDLE

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

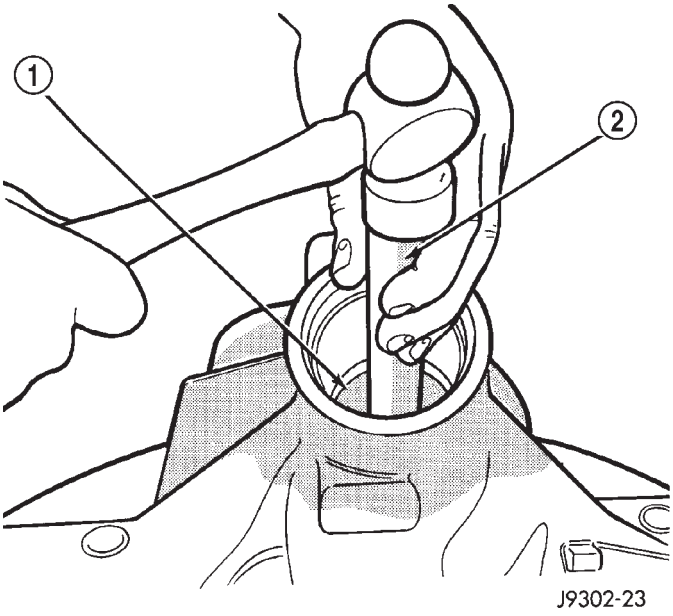


Fig. 29 Rear Bearing Cup Removal

1 – DRIVER
2 – HANDLE

(10) Remove the rear pinion bearing from the pinion with Puller/Press C–293-PA and Adapters C-293-48 (Fig. 30).

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

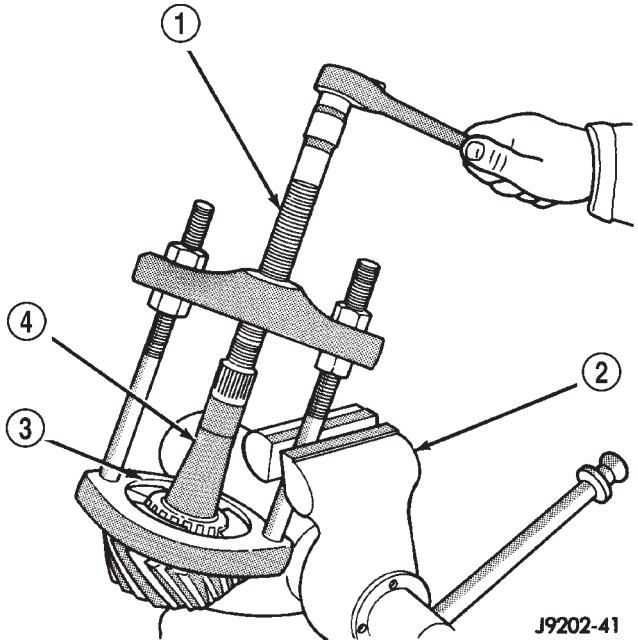


Fig. 30 Inner Bearing Removal

1 – SPECIAL TOOL C-293–PA
2 – VISE
3 – ADAPTERS
4 – DRIVE PINION GEAR SHAFT

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-145 and Handle C–4171 (Fig. 31). 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. 32).

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

REMOVAL AND INSTALLATION (Continued)

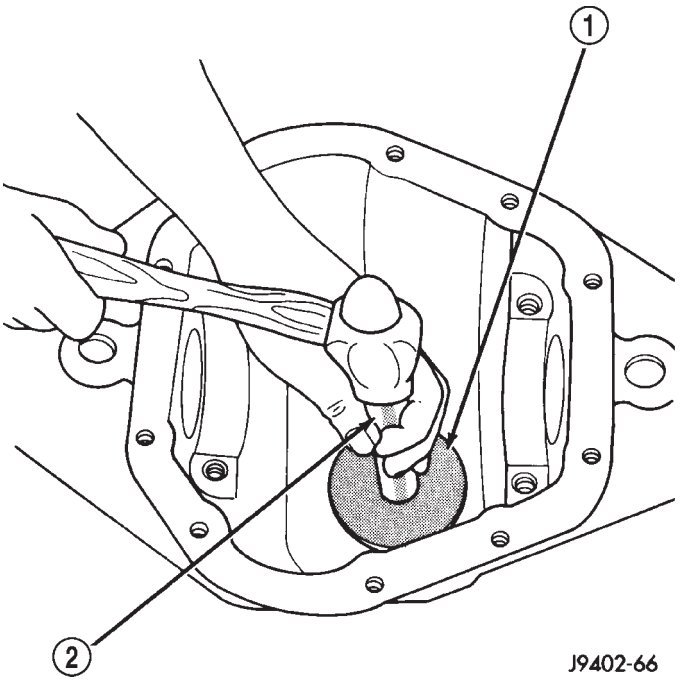


Fig. 31 Rear Pinion Bearing Cup Installation

1 – INSTALLER
2 – HANDLE

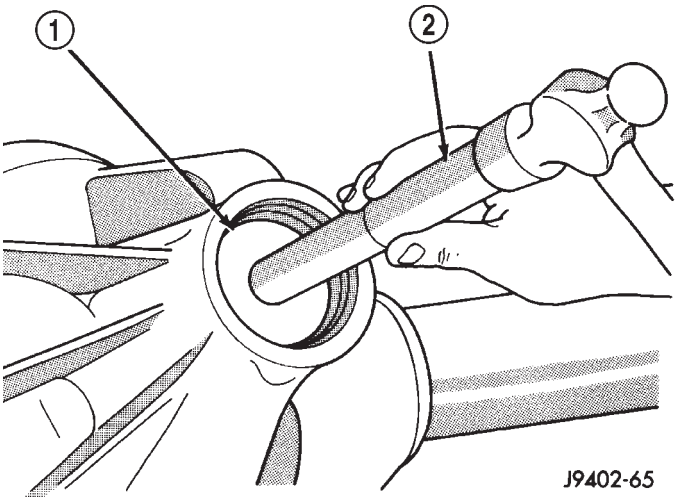


Fig. 32 Pinion Outer Bearing Cup Installation

1 – INSTALLER
2 – HANDLE

(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. 33).

(6) Install the rear pinion bearing and oil slinger, if equipped, on the pinion gear with Installer W-262 and a shop press (Fig. 34).

(7) Install pinion bearing preload shims onto the pinion gear (Fig. 35).

(8) Install pinion gear in housing.

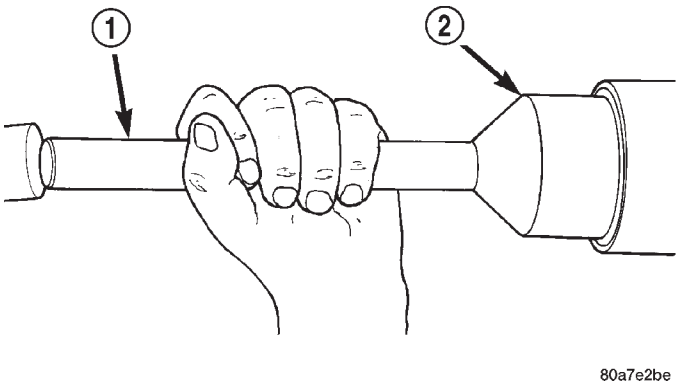


Fig. 33 Pinion Seal Installation

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL C-3972–A

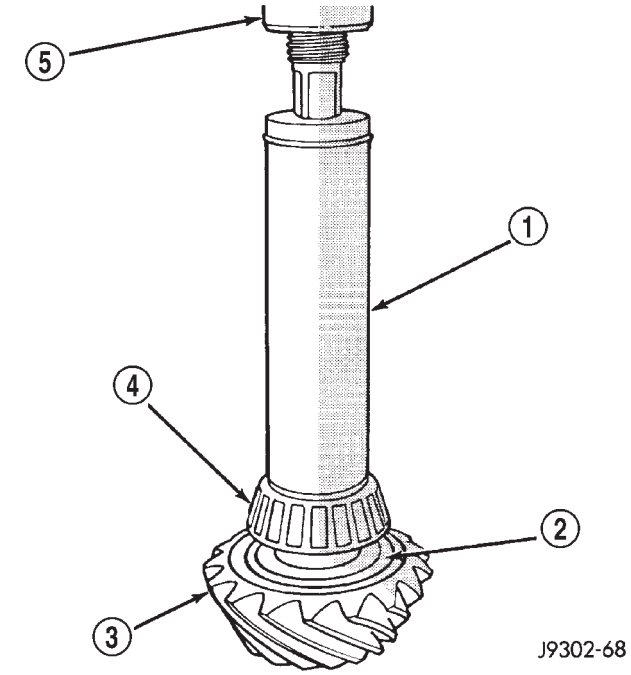


Fig. 34 Rear Pinion Bearing Installation

1 – INSTALLATION TOOL
2 – OIL SLINGER
3 – DRIVE PINION GEAR
4 – DRIVE PINION GEAR SHAFT REAR BEARING
5 – PRESS

(9) Install yoke with Installer W-162-B, Cup 8109, and Holder 6958 (Fig. 36).

(10) Install the pinion washer and a new nut on the pinion gear. Tighten the nut to 217 N·m (160 ft. lbs.) (Fig. 37).

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

REMOVAL AND INSTALLATION (Continued)

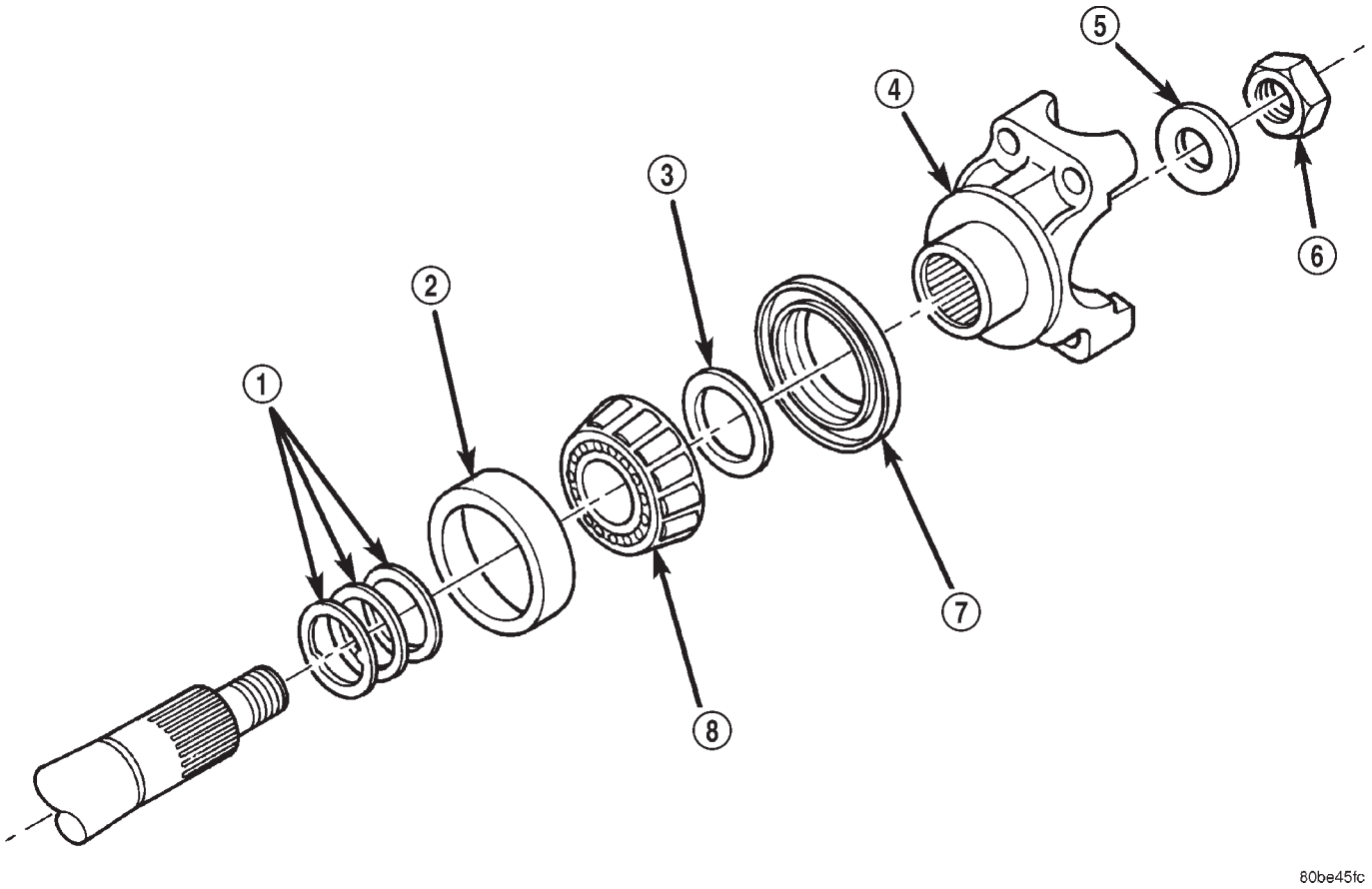


Fig. 35 Pinion Preload Shims–Typical

1 – PINION PRELOAD SHIMS
2 – FRONT BEARING CUP
3 – SLINGER
4 – PINION YOKE
5 – WASHER
6 – PINION NUT
7 – PINION OIL SEAL
8 – FRONT BEARING CONE

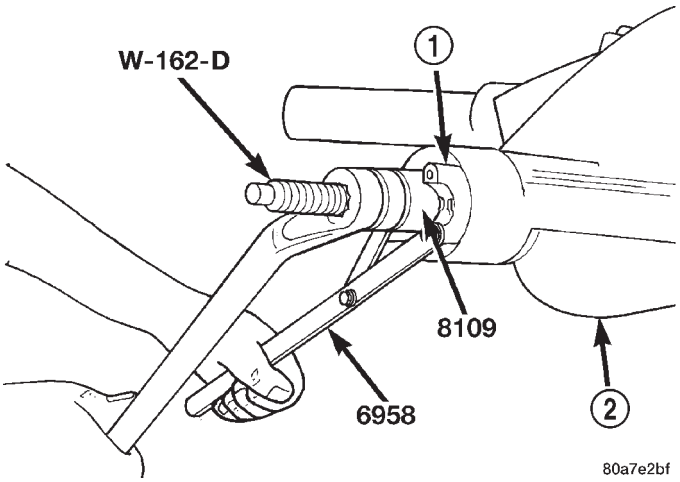


Fig. 36 Pinion Yoke Installation

1 – PINION YOKE
2 – AXLE HOUSING

(11) Check bearing preload torque with an inch pound torque wrench (Fig. 38). The torque necessary to rotate the pinion gear should be:

- Original Bearings—1 to 2.26 N·m (10 to 20 in. lbs.).
- New Bearings—2.26 to 4.52 N·m (20 to 40 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.).

(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.).

REMOVAL AND INSTALLATION (Continued)

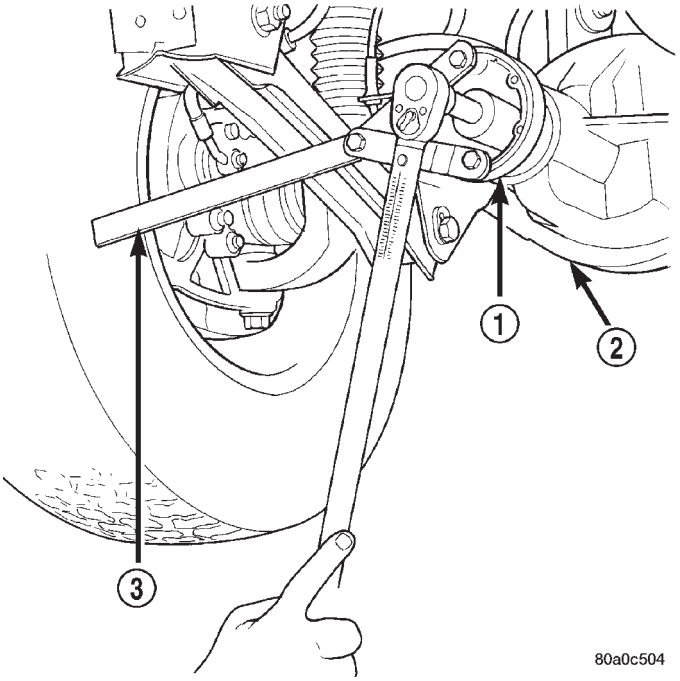


Fig. 37 Tightening Pinion Nut

1 – PINION FLANGE
2 – FRONT AXLE
3 – TOOL 6958

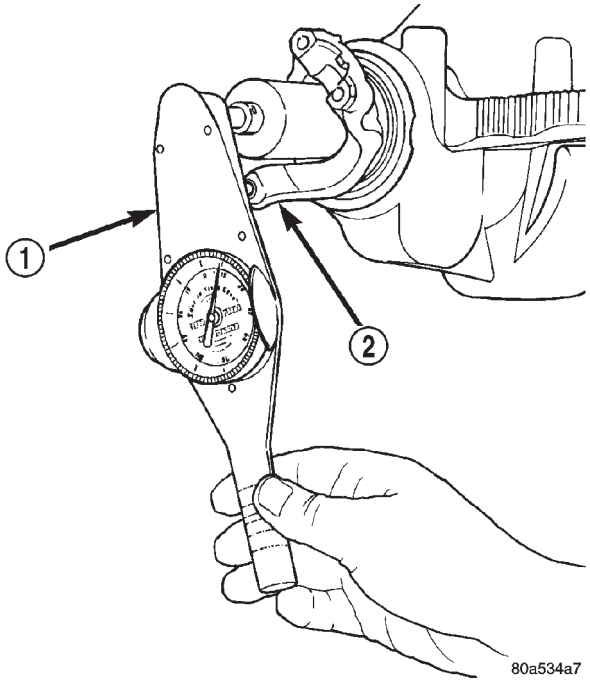


Fig. 38 Check Pinion Gear Rotating Torque

1 – in. lbs. TORQUE WRENCH
2 – PINION YOKE

(15) Install differential assembly.

RING GEAR

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

REMOVAL

(1) Remove differential from axle housing.
(2) Place differential case in a suitable vise with soft metal jaw protectors. (Fig. 39)
(3) Remove bolts holding ring gear to differential case.
(4) Using a soft hammer, drive ring gear from differential case (Fig. 39).

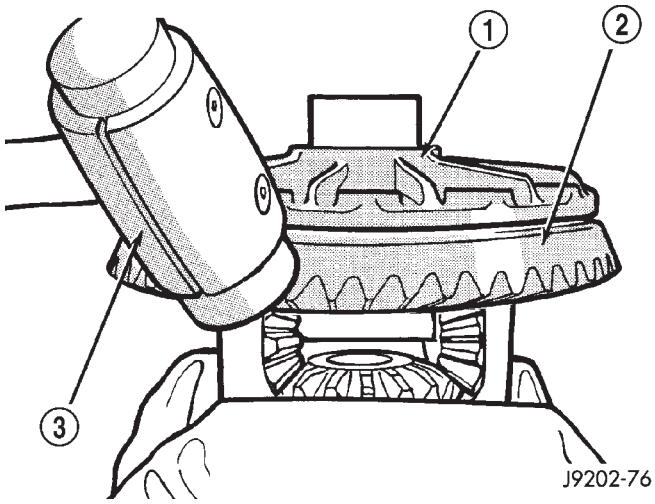


Fig. 39 Ring Gear Removal

1 – CASE
2 – RING GEAR
3 – RAWHIDE HAMMER

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. 40).
(4) Install differential in axle housing and verify gear mesh and contact pattern.

REMOVAL AND INSTALLATION (Continued)

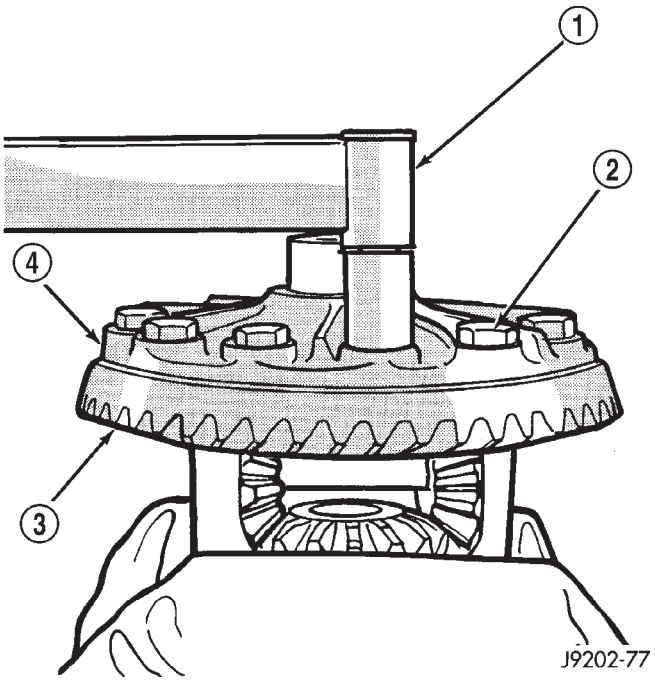


Fig. 40 Ring Gear Bolt Installation

1 – TORQUE WRENCH
2 – RING GEAR BOLT
3 – RING GEAR
4 – CASE

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. 41).

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.

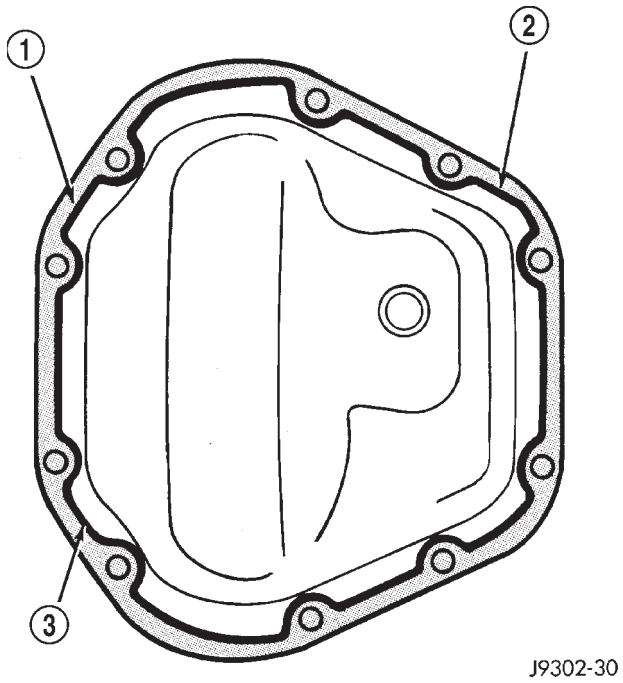


Fig. 41 Typical Housing Cover With Sealant

1 – SEALING SURFACE
2 – CONTOUR OF BEAD
3 – BEAD THICKNESS 6.35MM (1/4")

DISASSEMBLY AND ASSEMBLY

STANDARD DIFFERENTIAL

DISASSEMBLY

(1) Remove pinion mate shaft lock screw (Fig. 42).

(2) Remove pinion mate shaft.

(3) Rotate the differential side gears and remove the differential pinion gears and thrust washers (Fig. 43).

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

ASSEMBLY

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

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

(3) Install the pinion mate shaft.

(4) Align the hole in the pinion mate shaft with the hole in the differential case and install the pinion mate shaft lock screw.

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

DISASSEMBLY AND ASSEMBLY (Continued)

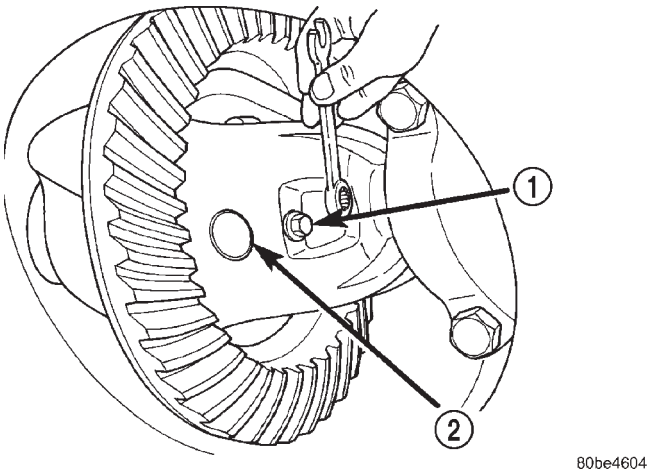


Fig. 42 Pinion Mate Shaft Lock Screw

1 – LOCK SCREW
2 – PINION MATE SHAFT

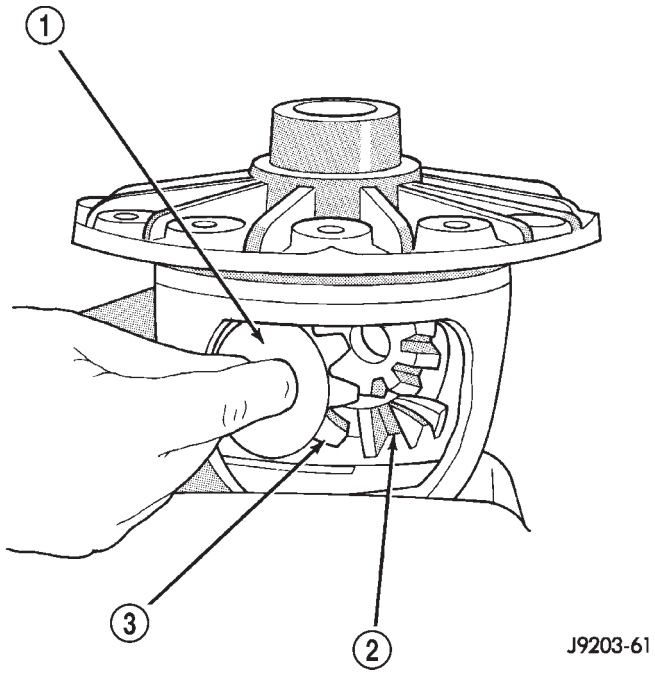


Fig. 43 Pinion Mate Gear Removal

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

TRAC-LOK™ DIFFERENTIAL

The Trac–Lok™ differential components are illustrated in (Fig. 44). Refer to this illustration during repair service.

DISASSEMBLY

(1) Clamp Side Gear Holding Tool 6963–A in a vise.

(2) Position the differential case on Side Gear Holding Tool 6963-A (Fig. 45).

(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. 46).

(5) Remove the pinion gear mate shaft. If necessary, use a drift and hammer (Fig. 47).

(6) Install and lubricate Step Plate C–4487–1 (Fig. 48).

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

(8) Position a small screw driver in slot of Threaded Adapter C–4487–3 (Fig. 49) 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. 50).

(10) Using an appropriate size feeler gauge, remove thrust washers from behind the pinion gears (Fig. 51).

(11) Insert Turning Bar C–4487–4 in case (Fig. 52).

(12) Loosen the Forcing Screw C-4487-2 in small increments until the clutch pack tension is relieved and the differential case can be turned using Turning Bar C-4487-4.

(13) Rotate differential case until the pinion gears can be removed.

(14) Remove pinion gears from differential case.

(15) Remove Forcing Screw C–4487-2, Step Plate C-4487-1, and Threaded Adapter C-4487-3.

(16) Remove top side gear, clutch pack retainer, and clutch pack. Keep plates in correct order during removal (Fig. 53).

(17) Remove differential case from Side Gear Holding Tool 6963-A. Remove side gear, clutch pack retainer, and clutch pack. Keep plates in correct order during removal.

DISASSEMBLY AND ASSEMBLY (Continued)

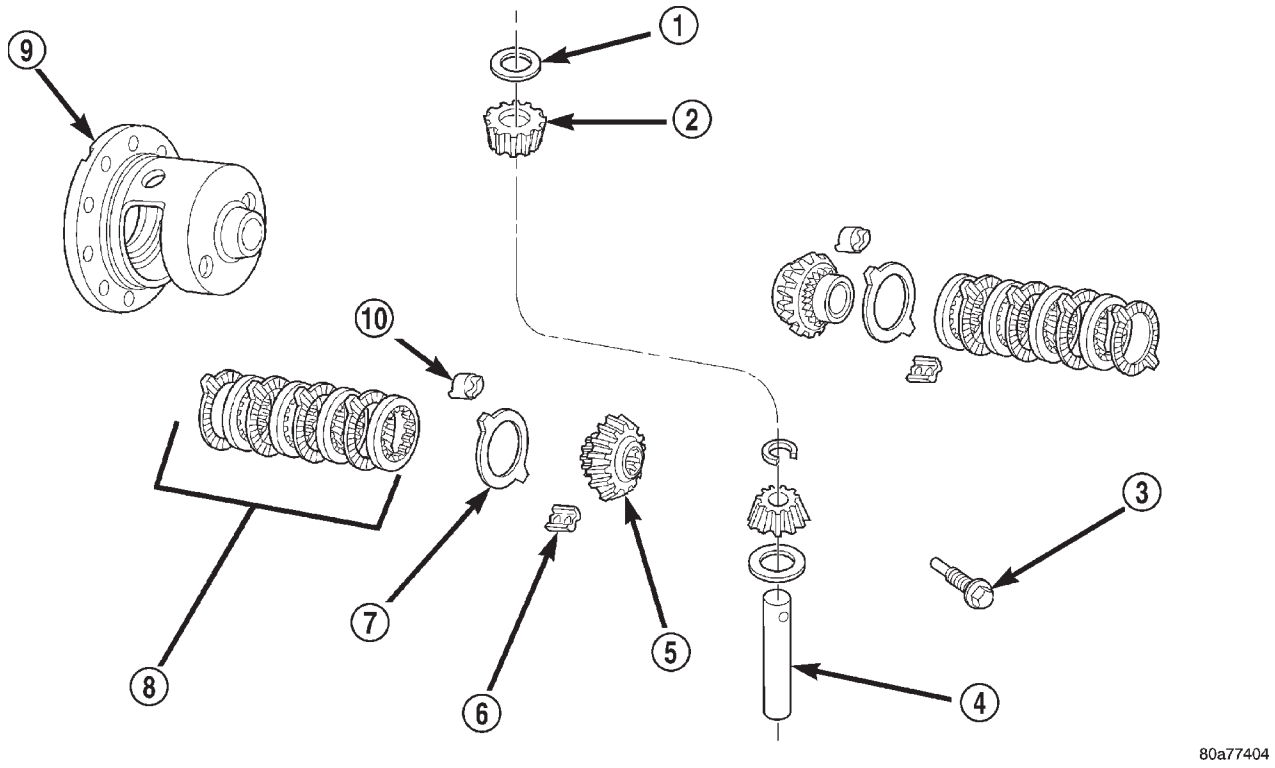


Fig. 44 Trac–Lok™ Differential Components

1 – THRUST WASHER
2 – PINION
3 – SHAFT LOCK SCREW
4 – PINION MATE SHAFT
5 – SIDE GEAR
6 – RETAINER
7 – DISC
8 – CLUTCH PACK
9 – DIFFERENTIAL CASE
10 – RETAINER

DISASSEMBLY AND ASSEMBLY (Continued)

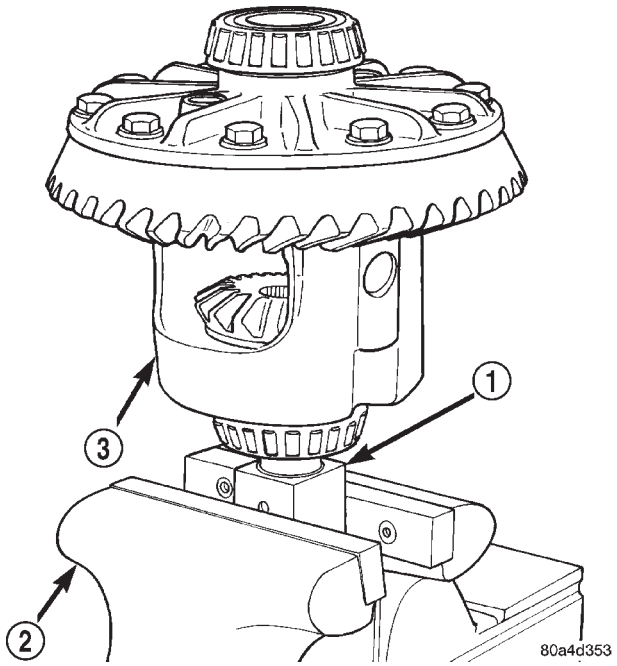


Fig. 45 Differential Case Holding Tool

1 – SPECIAL TOOL 6963–A
2 – VISE
3 – TRAC-LOK DIFFERENTIAL

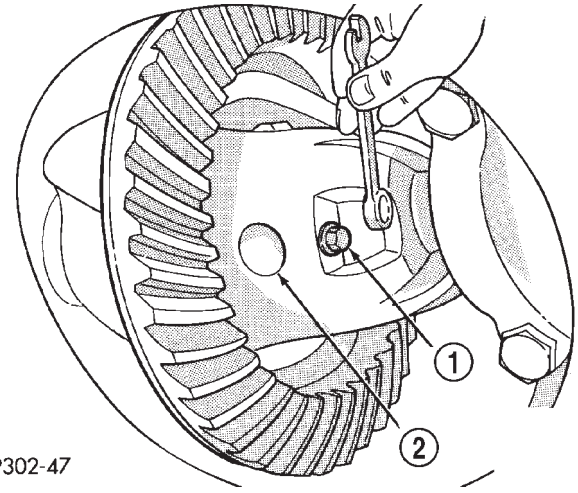


Fig. 46 Mate Shaft Lock Screw

1 – LOCK SCREW
2 – PINION GEAR MATE SHAFT

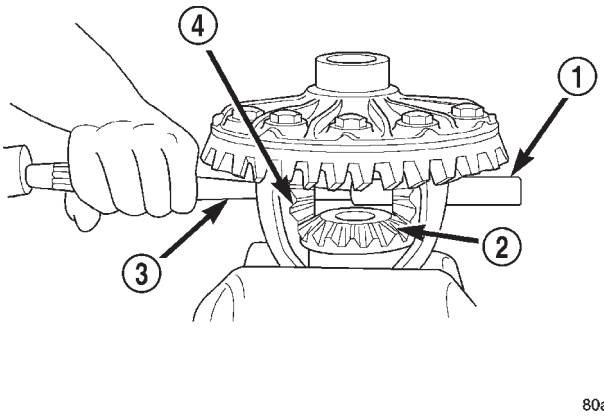


Fig. 47 Mate Shaft Removal

1 – PINION MATE SHAFT
2 – SIDE GEAR
3 – DRIFT
4 – PINION MATE GEAR

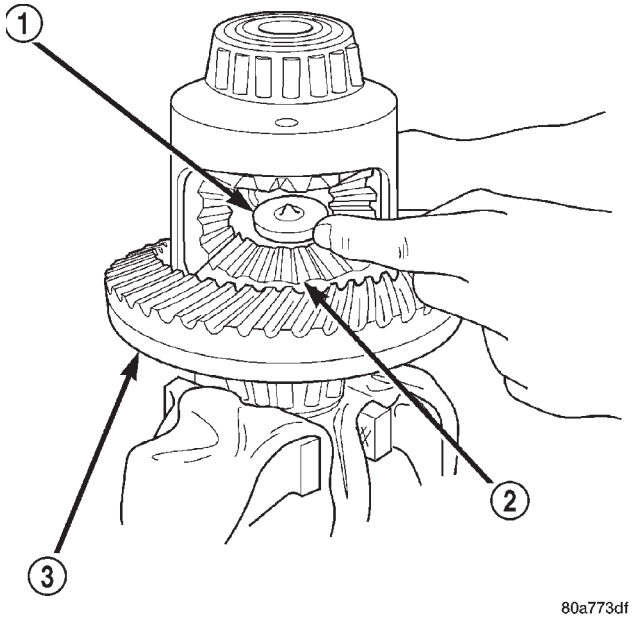


Fig. 48 Step Plate Tool Installation

1 – SPECIAL TOOL C-4487–1
2 – LOWER SIDE GEAR
3 – DIFFERENTIAL CASE

DISASSEMBLY AND ASSEMBLY (Continued)

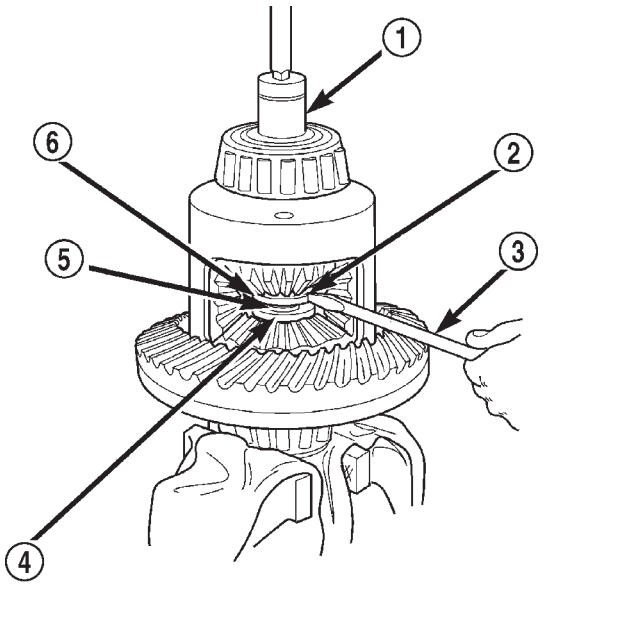


Fig. 49 Threaded Adapter Installation

1 – SOCKET
2 – SLOT IN ADAPTER
3 – SCREWDRIVER
4 – DISC C-4487–1
5 – THREADED ROD C-4487–2
6 – THREADED ADAPTER DISC C-4487–3

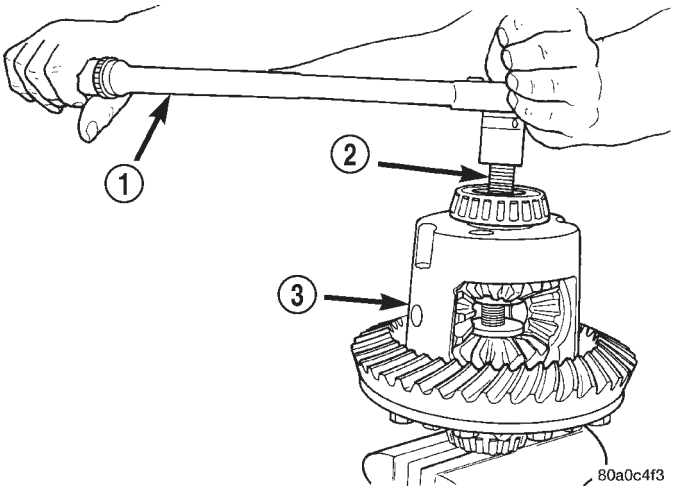


Fig. 50 Tighten Belleville Spring Compressor Tool

1 – TORQUE WRENCH
2 – TOOL ASSEMBLED
3 – DIFFERENTIAL CASE

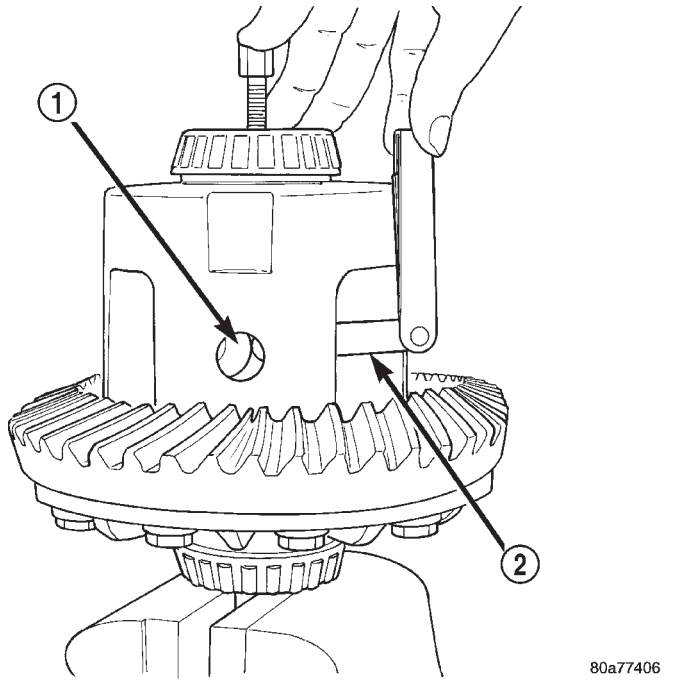


Fig. 51 Remove Pinion Gear Thrust Washer

1 – THRUST WASHER
2 – FEELER GAUGE

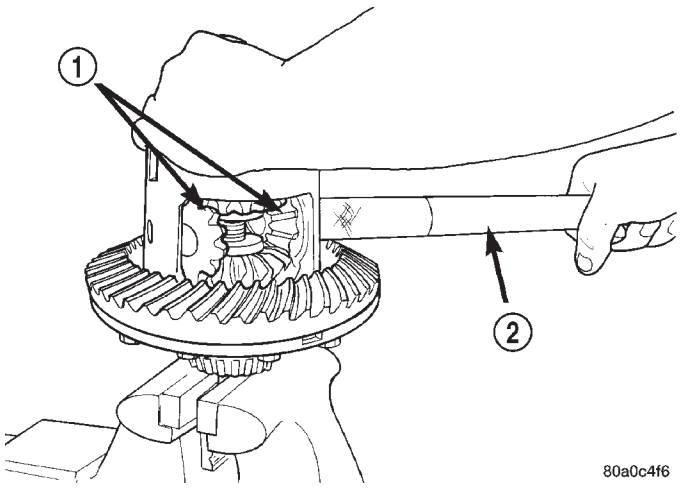


Fig. 52 Pinion Gear Removal

1 – PINION GEARS
2 – TOOL

DISASSEMBLY AND ASSEMBLY (Continued)

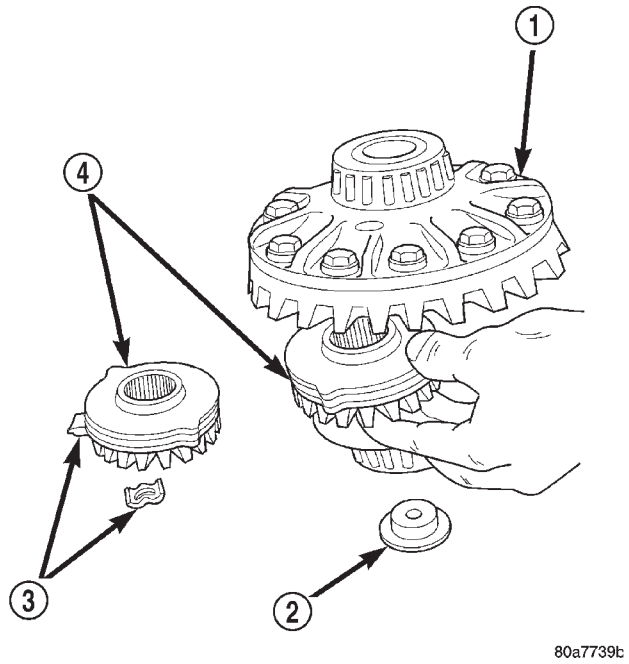


Fig. 53 Side Gear & Clutch Disc Removal

1 – DIFFERENTIAL CASE
2 – SPECIAL TOOL C-4487–1
3 – RETAINER
4 – SIDE GEAR AND CLUTCH DISC PACK

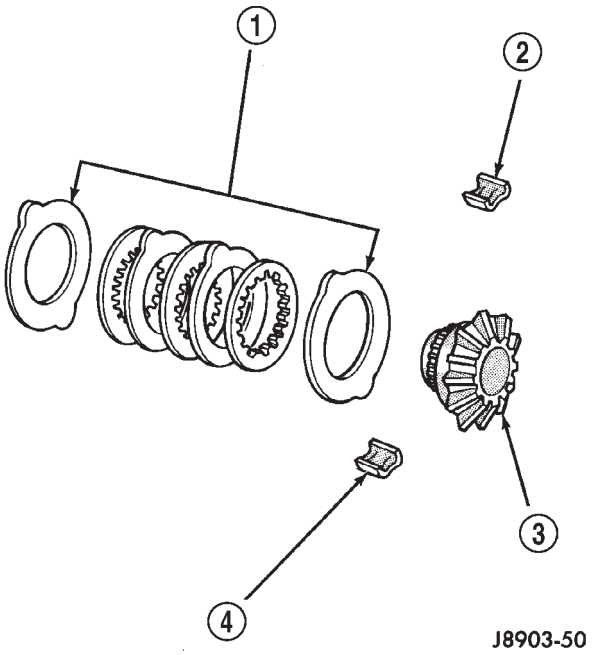


Fig. 54 Clutch Disc Pack

1 – CLUTCH PACK
2 – RETAINER
3 – SIDE GEAR
4 – RETAINER

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. 54).

(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. 55). **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 6963-A.

(5) Install lubricated Step Plate C–4487–1 on side gear (Fig. 56).

(6) Install the upper side gear and clutch disc pack (Fig. 56).

(7) Hold assembly in position. Insert Threaded Adapter C–4487–3 into top side gear.

(8) Insert Forcing Screw C–4487–2.

(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.

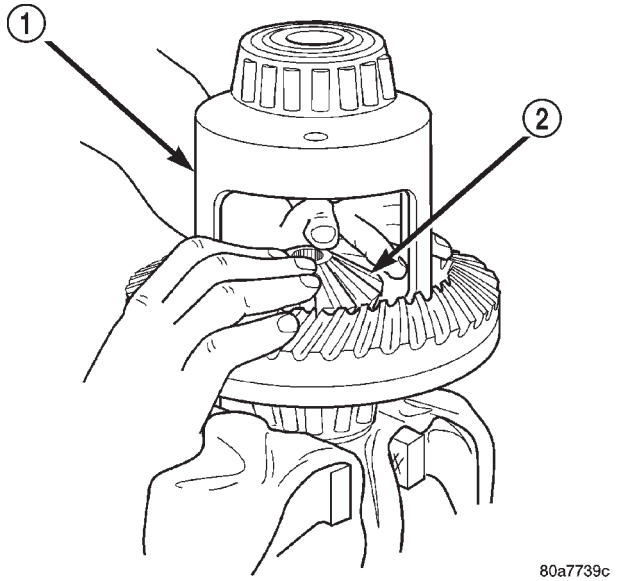


Fig. 55 Clutch Discs & Lower Side Gear Installation

1 – DIFFERENTIAL CASE
2 – LOWER SIDE GEAR AND CLUTCH DISC PACK

(11) Rotate case with Turning Bar C–4487–4 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.

DISASSEMBLY AND ASSEMBLY (Continued)

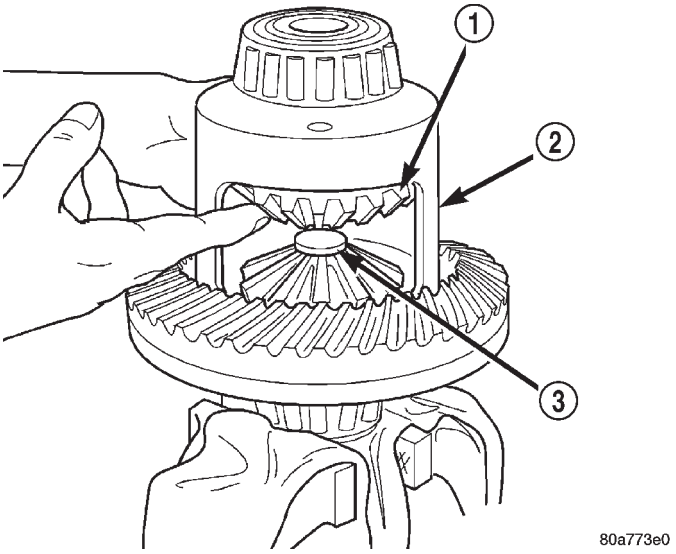


Fig. 56 Upper Side Gear & Clutch Disc Pack Installation

1 – UPPER SIDE GEAR AND CLUTCH DISC PACK
2 – DIFFERENTIAL CASE
3 – SPECIAL TOOL C-4487–1

(12) Tighten forcing screw to 122 N·m (90 ft. lbs.) 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, threaded adapter, and step plate.

(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 side and/or pinion gears and thrust washers were installed, it is not necessary to measure the side 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 gears and pinions. 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. 57). 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 109.52 mm (4.312 in.). The standard depth provides the best teeth contact pattern. Refer to

ADJUSTMENTS (Continued)

Backlash and Contact Pattern Analysis Paragraph in this section for additional information.

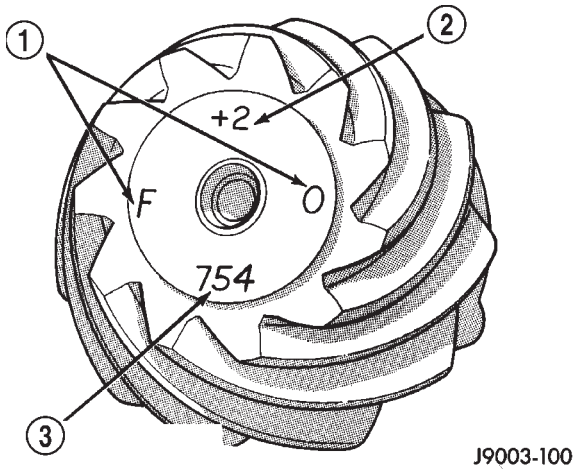


Fig. 57 Pinion Gear ID Numbers

1 – PRODUCTION NUMBERS
2 – DRIVE PINION GEAR DEPTH VARIANCE
3 – GEAR MATCHING NUMBER (SAME AS RING GEAR NUMBER)

Compensation for pinion depth variance is achieved with select shims. The shims are placed under the inner pinion bearing cup in the axle housing bore (Fig. 58).

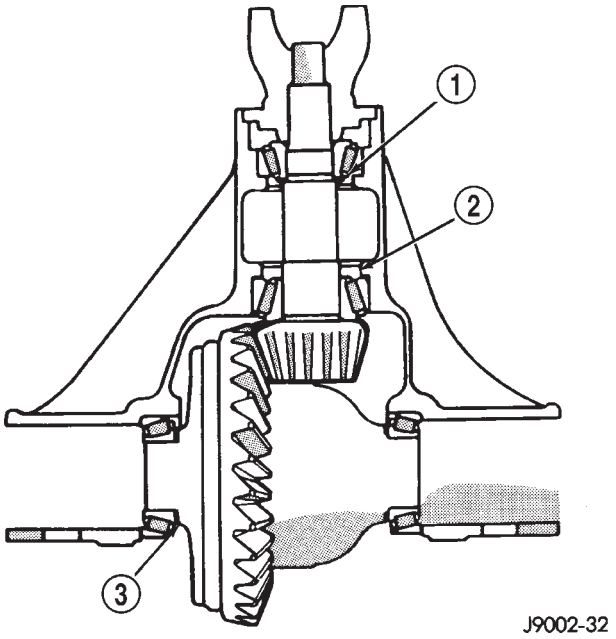


Fig. 58 Shim Locations

1 – DRIVE PINION BEARING PRELOAD SPACER/SHIM
2 – DRIVE PINION GEAR DEPTH SHIM
3 – DIFFERENTIAL BEARING SHIM

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. The 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 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 Pinion Gauge Set 6730 and Dial Indicator C-3339 (Fig. 59).

(1) Assemble Pinion Height Block 6739, Pinion Block 6734, and rear pinion bearing onto Screw 6741 (Fig. 59).

(2) Insert assembled height gauge components, rear bearing and screw into axle housing through pinion bearing cups (Fig. 60).

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

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in axle housing side bearing cradles (Fig. 61). Install differential bearing caps on Arbor Discs and tighten cap bolts to 41 N·m (30 ft. lbs.).

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

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

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are flush against the rearward surface of the pinion height block. 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. 62). When the dial probe contacts the arbor bar,

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

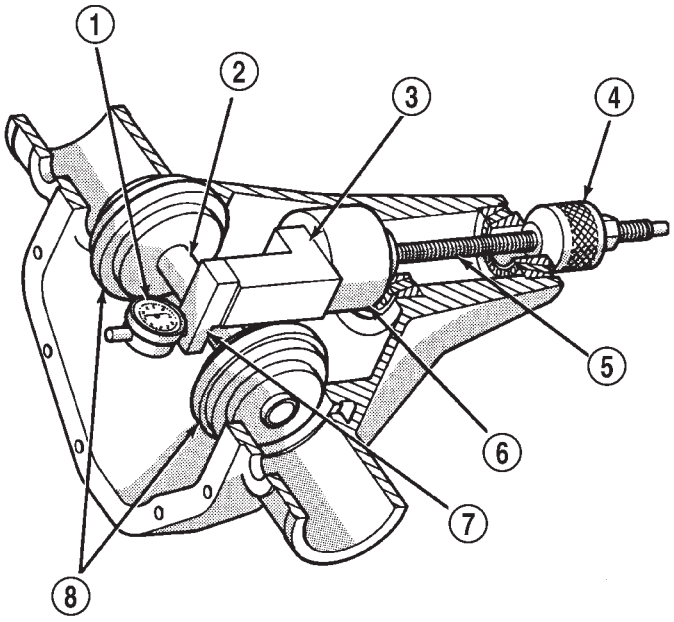


Fig. 59 Pinion Gear Depth Gauge Tools—Typical

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

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

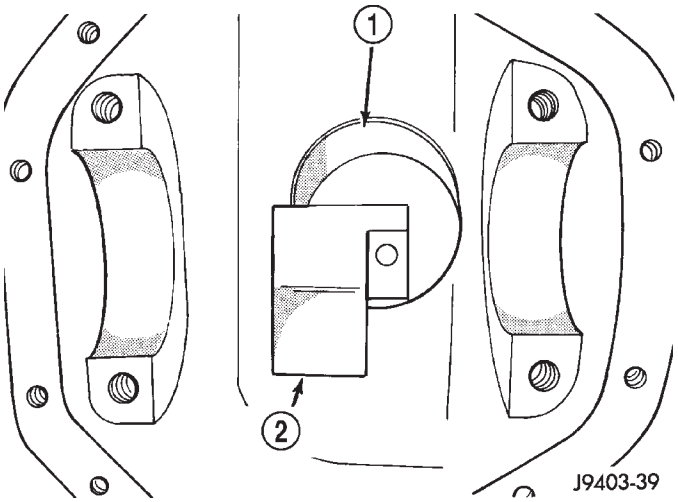


Fig. 60 Pinion Height Block—Typical

1 – PINION BLOCK
2 – PINION HEIGHT BLOCK

(9) Select a shim equal to the thickest dial indicator reading plus or minus the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 57).

(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-345 in place of the differential side bearings and a dial indicator C-3339. Before proceeding with the differential bearing preload and gear backlash measurements, measure the pinion gear depth and prepare the pinion gear for installation. Estab-

ADJUSTMENTS (Continued)

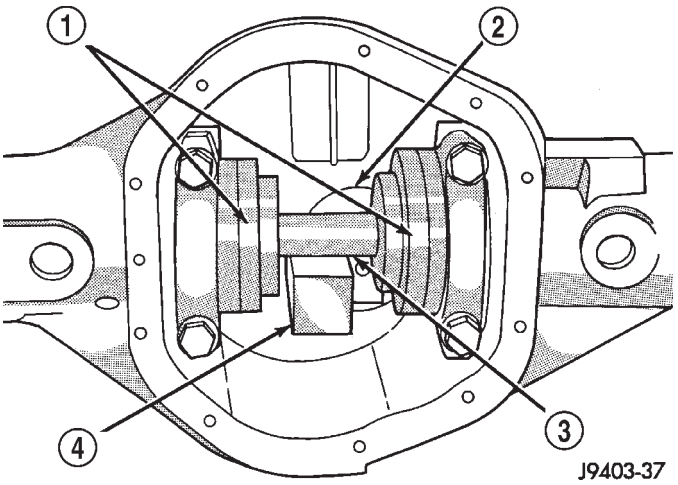


Fig. 61 Gauge Tools In Housing—Typical

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

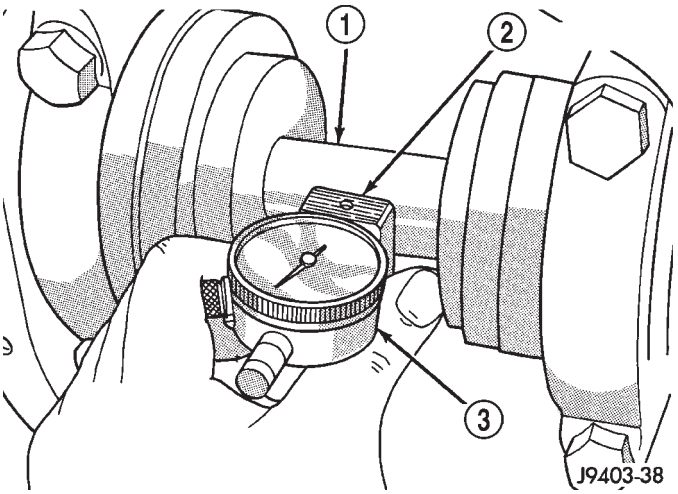


Fig. 62 Pinion Gear Depth Measurement—Typical

1 – ARBOR
2 – SCOOTER BLOCK
3 – DIAL INDICATOR

lishing 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. 63).

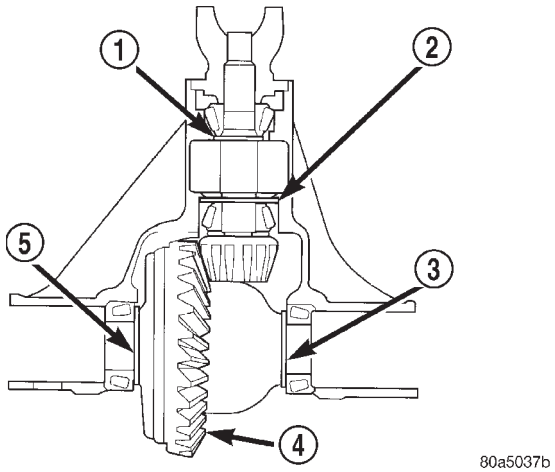


Fig. 63 Axle Adjustment Shim Locations

1 – PINION BEARING PRELOAD SHIM
2 – PINION GEAR DEPTH SHIM
3 – DIFFERENTIAL BEARING SHIM-PINION GEAR SIDE
4 – RING GEAR
5 – DIFFERENTIAL BEARING SHIM-RING GEAR SIDE

DIFFERENTIAL PRELOAD AND GEAR BACHLASH SHIM SELECTION

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

(1) Remove differential side bearings from differential case.

(2) Remove factory installed shims from differential case.

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

(4) Install dummy side bearings D-345 on differential case.

(5) Install differential case in axle housing (Fig. 64).

(6) Install the marked bearing caps in their correct positions. Install and snug the bolts (Fig. 65).

(7) Using a dead-blow type mallet, seat the differential dummy bearings to each side of the axle housing (Fig. 66) and (Fig. 67).

(8) Thread guide stud C-3288-B into rear cover bolt hole below ring gear (Fig. 68).

(9) Attach a dial indicator C-3339 to Guide Stud C-3288-B. Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 68).

(10) Push and hold differential case to pinion gear side of axle housing (Fig. 69).

(11) Zero dial indicator face to pointer (Fig. 69).

(12) Push and hold differential case to ring gear side of the axle housing (Fig. 70).

(13) Record dial indicator reading (Fig. 70).

ADJUSTMENTS (Continued)

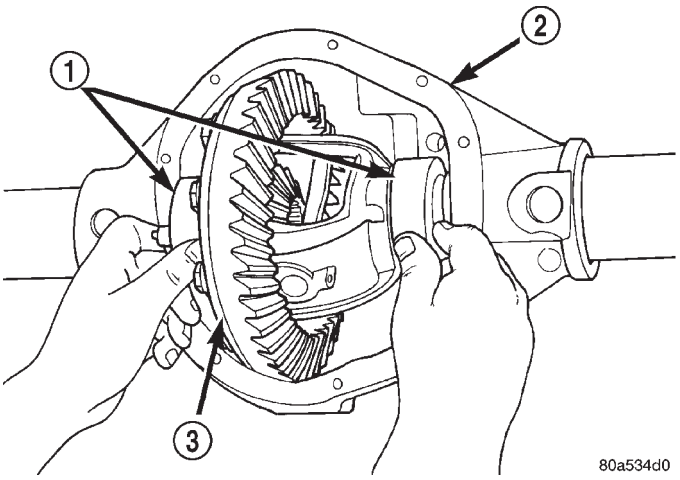


Fig. 64 Install Differential Case W/Dummy Bearings

1 – SPECIAL TOOL D-345
2 – AXLE HOUSING
3 – DIFFERENTIAL CASE

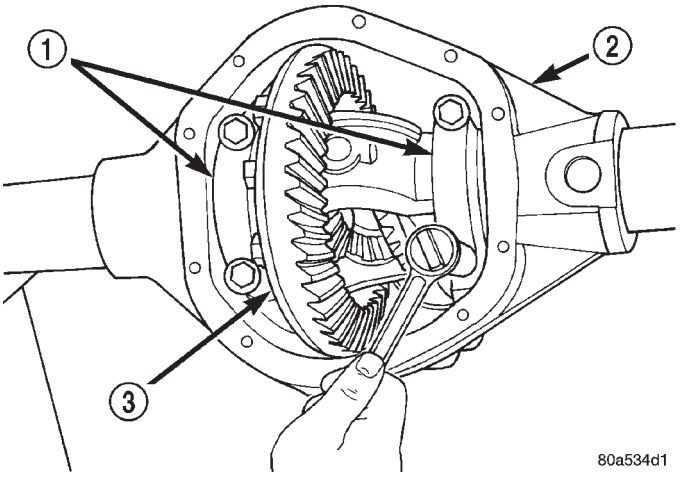


Fig. 65 Tighten Bolts Holding Bearing Caps

1 – BEARING CAP
2 – AXLE HOUSING
3 – DIFFERENTIAL CASE

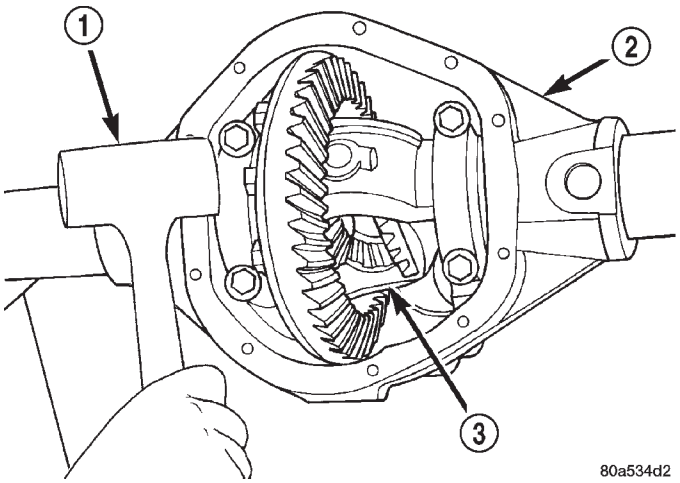


Fig. 66 Seat Pinion Gear Side Differential Dummy Bearing

1 – MALLET
2 – AXLE HOUSING
3 – DIFFERENTIAL CASE

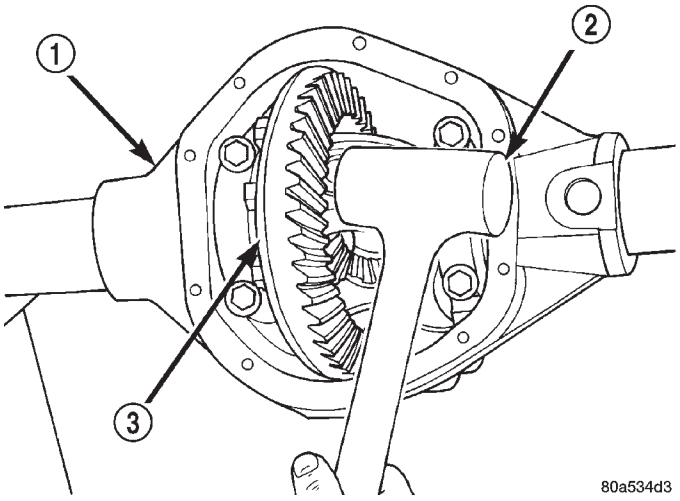


Fig. 67 Seat Ring Gear Side Differential Dummy Bearing

1 – AXLE HOUSING
2 – MALLET
3 – DIFFERENTIAL CASE

ADJUSTMENTS (Continued)

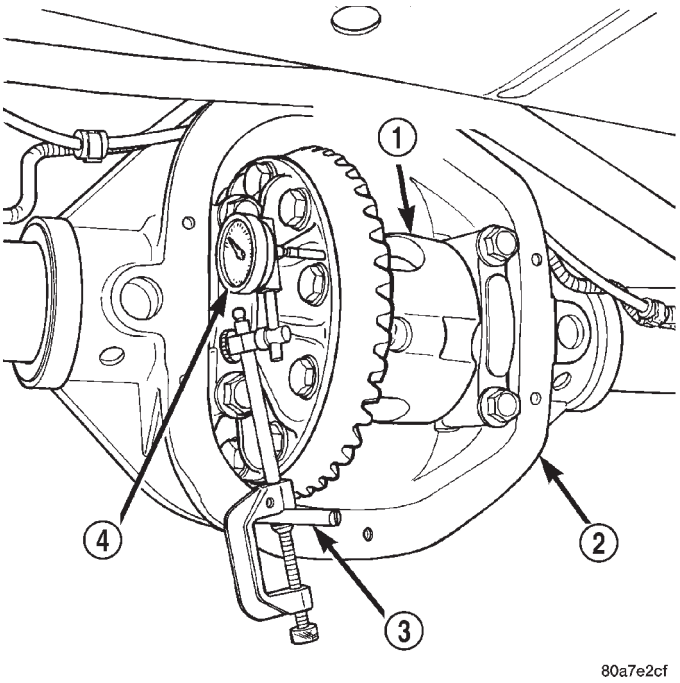


Fig. 68 Differential Side Play Measurement

1 – DIFFERENTIAL CASE
2 – AXLE HOUSING
3 – SPECIAL TOOL C-3288–B
4 – SPECIAL TOOL C-3339

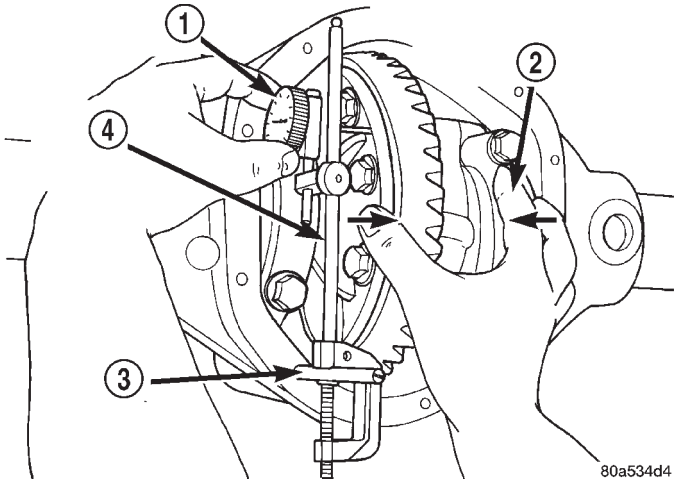


Fig. 69 Hold Differential Case and Zero Dial Indicator

1 – ZERO DIAL INDICATOR FACE
2 – FORCE DIFFERENTIAL CASE TO PINION GEAR SIDE
3 – SPECIAL TOOL C-3288
4 – SPECIAL TOOL C-3339

(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.

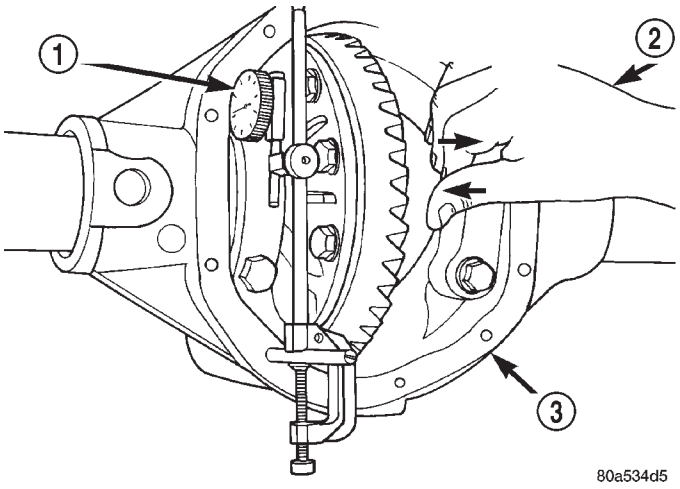


Fig. 70 Hold Differential Case and Read Dial Indicator

1 – READ DIAL INDICATOR
2 – FORCE DIFFERENTIAL CASE TO RING GEAR SIDE
3 – AXLE HOUSING

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

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

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

(19) Install differential case and dummy bearings D-345 in axle housing (without shims), install bearing caps and tighten bolts snug.

(20) Seat ring gear side dummy bearing (Fig. 67).

(21) Position the dial indicator plunger on a flat surface between the ring gear bolt heads. (Fig. 68).

(22) Push and hold differential case toward pinion gear (Fig. 71).

(23) Zero dial indicator face to pointer (Fig. 71).

(24) Push and hold differential case to ring gear side of the axle housing (Fig. 72).

(25) Record dial indicator reading (Fig. 72).

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

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

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

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

ADJUSTMENTS (Continued)

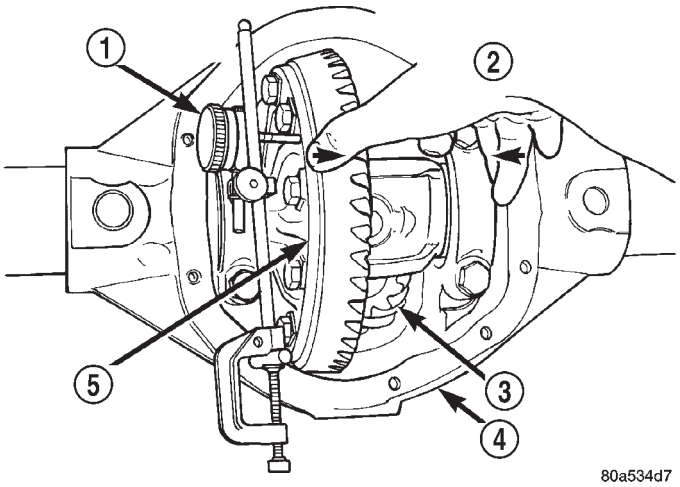


Fig. 71 Hold Differential Case and Zero Dial Indicator

1 – ZERO DIAL INDICATOR FACE
2 – FORCE DIFFERENTIAL CASE TO PINION GEAR SIDE
3 – PINION GEAR
4 – AXLE HOUSING
5 – DIFFERENTIAL CASE

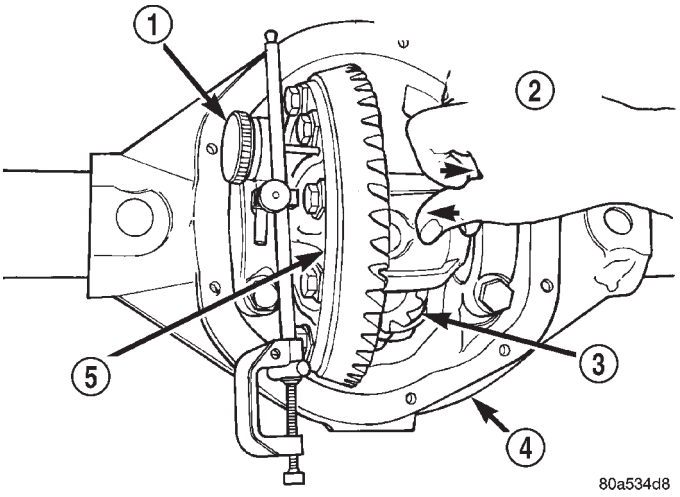


Fig. 72 Hold Differential Case and Read Dial Indicator

1 – READ DIAL INDICATOR
2 – FORCE DIFFERENTIAL CASE TO RING GEAR SIDE
3 – PINION GEAR
4 – AXLE HOUSING
5 – DIFFERENTIAL CASE

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

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

(32) Install spreader W-129-B on axle housing and spread axle opening enough to receive differential case.

(33) Install differential case in axle housing. Refer to Differential Removal and Installation paragraph.

(34) Remove spreader from axle housing.

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

(36) Position the indicator plunger against a ring gear tooth (Fig. 73).

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

(38) Zero dial indicator face to pointer.

(39) 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. 74).

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

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

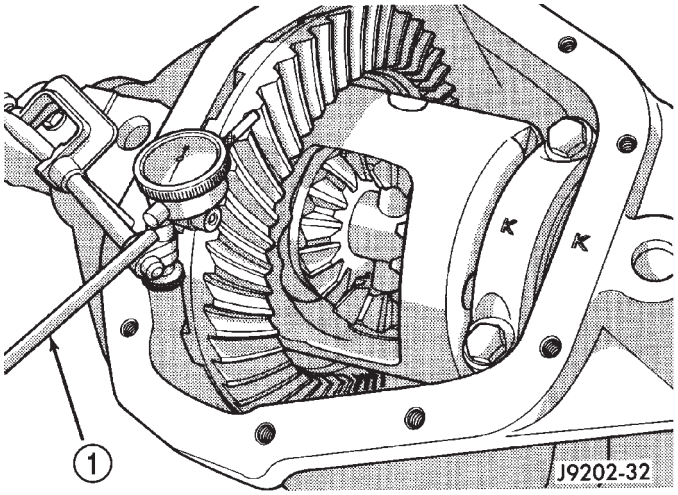


Fig. 73 Ring Gear Backlash Measurement

1 – DIAL INDICATOR

GEAR CONTACT PATTERN ANALYSIS

The ring gear and pinion teeth contact patterns will show if the pinion 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.

ADJUSTMENTS (Continued)

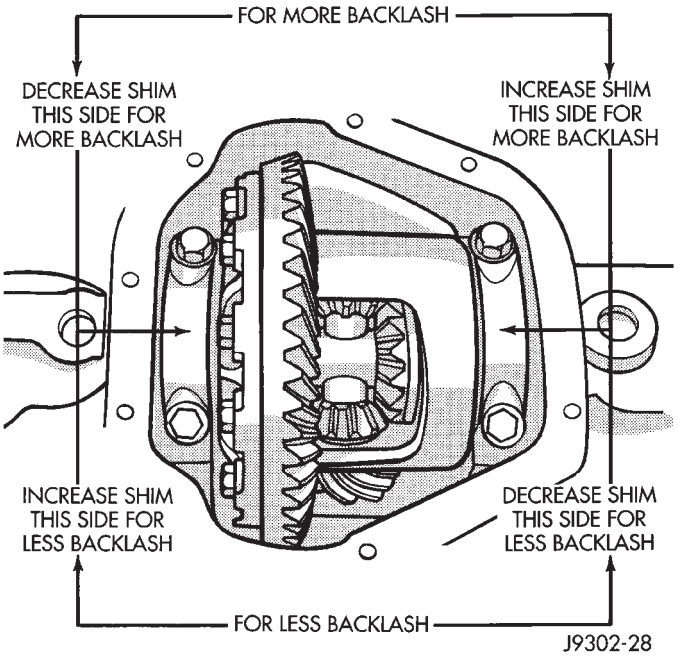


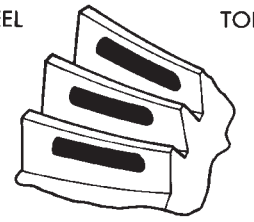
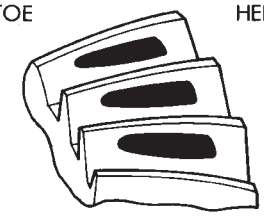
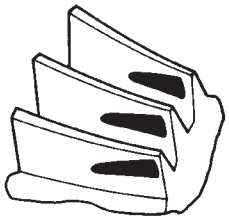
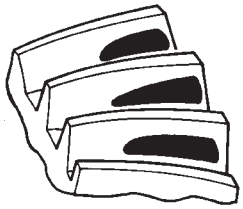
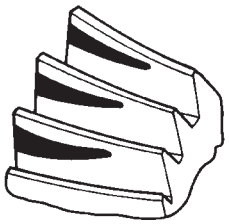
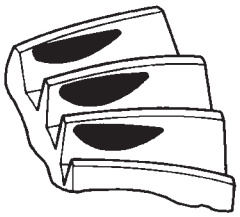
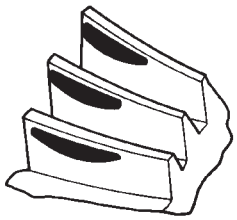
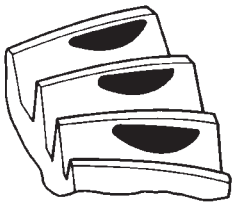
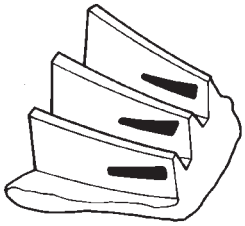
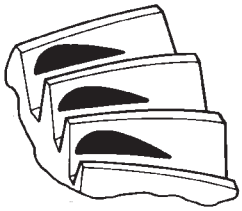
Fig. 74 Backlash Shim Adjustment

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

(3) 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 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. 75) and adjust pinion depth and gear backlash as necessary.

ADJUSTMENTS (Continued)

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

J9003-24

Fig. 75 Gear Tooth Contact Patterns

SPECIFICATIONS

216 RBI AXLE

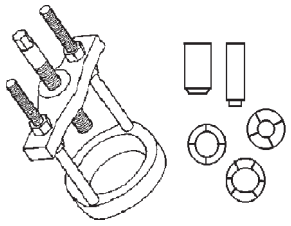
DESCRIPTION	SPECIFICATION
Axle Type	Semi-floating Hypoid
Lubricant	SAE Thermally Stable 80W–90
Lubricant–Trailer Tow	Synthetic 75W–140
Lubricant Capacity	1.89 L (4.0 pts.)
Axle Ratios	3.07, 3.55, 4.10
Differential Bearing Preload	0.1 mm (0.004 in.)
Differential Side Gear Clearance	0–0.15 mm (0–0.006 in.)
Ring Gear Diameter	216 mm (8.5 in.)
Ring Gear Backlash	0.13–0.20 mm (0.005–0.008 in.)
Pinion Depth	109.52 mm (4.312 in.)
Brg. Preload, Pinion (New)	2.26–4.52 N·m (20–40 in. lbs.)
Brg. Preload, Pinion (Original)	1–3 N·m (10–20 in. lbs.)

216 RBI TORQUE

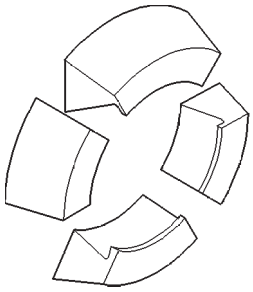
DESCRIPTION	TORQUE
Plug, Fill	34 N·m (25 ft. lbs.)
Bolts, Diff. Cover	41 N·m (30 ft. lbs.)
Bolts, Diff. Bearing Cap	108 N·m (80 ft. lbs.)
Bolts, Ring Gear	108 N·m (80 ft. lbs.)
Nuts, Brake Backing Plate	61 N·m (45 ft. lbs.)
Nut, Pinion Gear—Minimum	217 N·m (160 ft. lbs.)

SPECIAL TOOLS

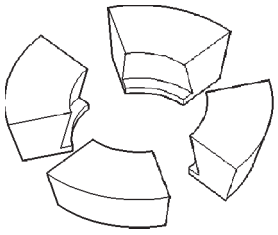
216 RBI AXLE



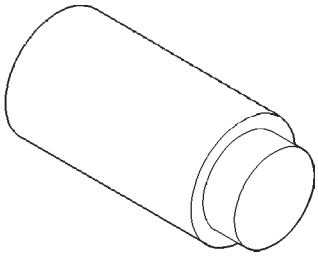
Puller Set—C-293-M



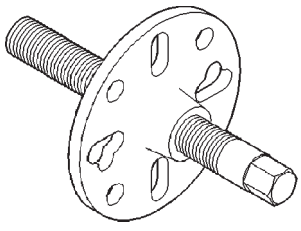
Adapters—C-293-18



Adapters—C-293-48

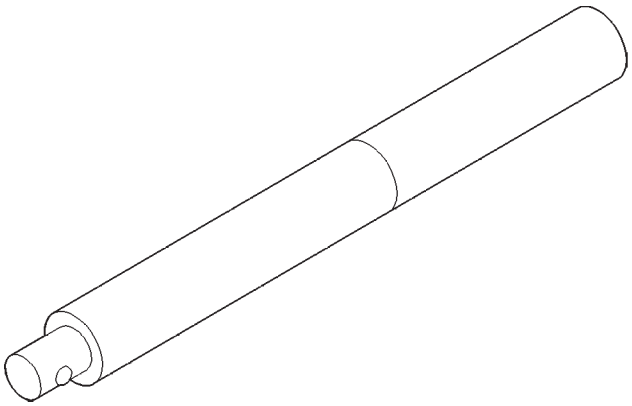


Extension—C-293-3

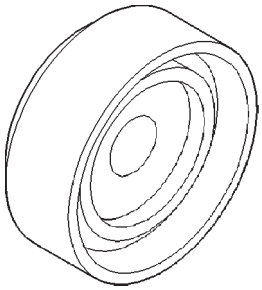


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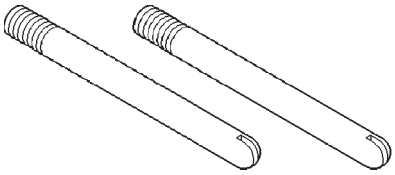
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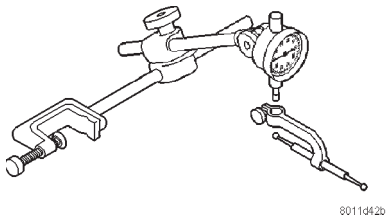
Handle—C-4171



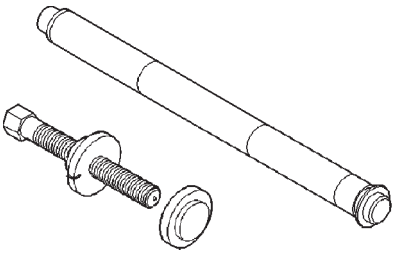
Installer—D-156



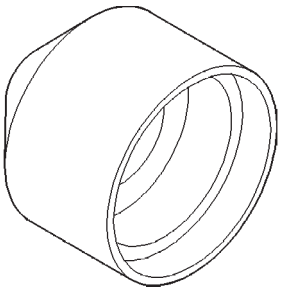
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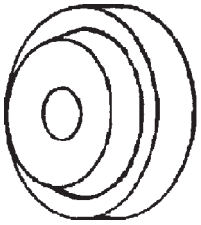
Dial Indicator—C-3339



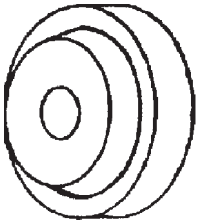
Trac-lok Tool Set—C-4487



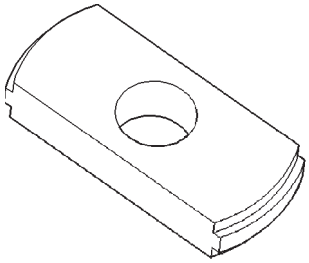
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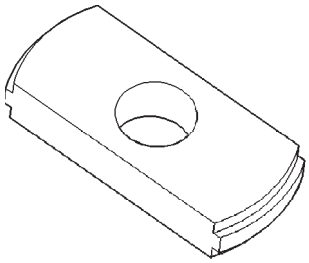
Installer—D-144



Installer—D-145

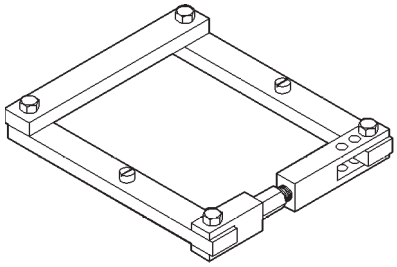


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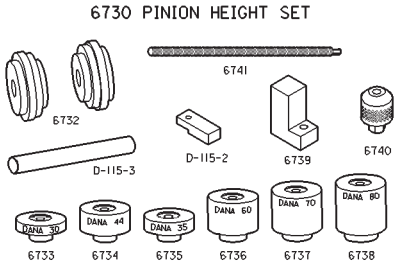


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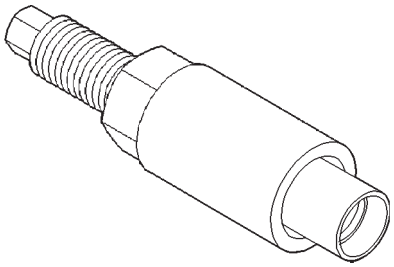
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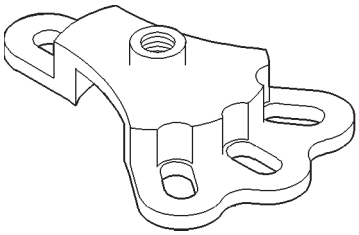
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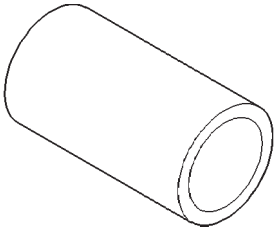
Pinion Depth Set—6730



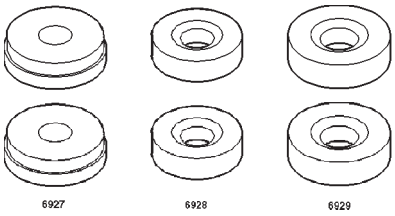
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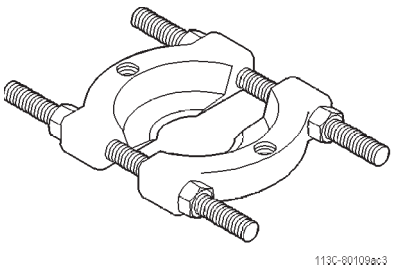
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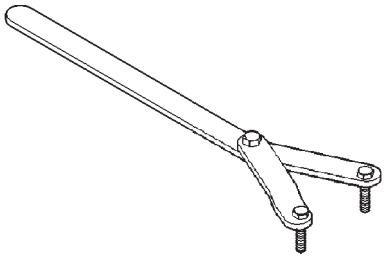
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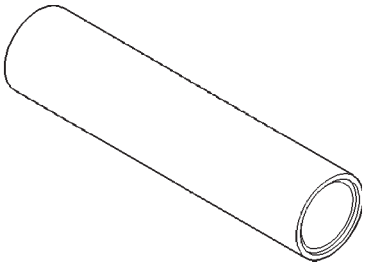
Adapter Set—6956



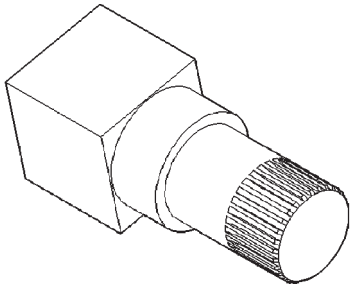
Splitter—1130



Holder—6958

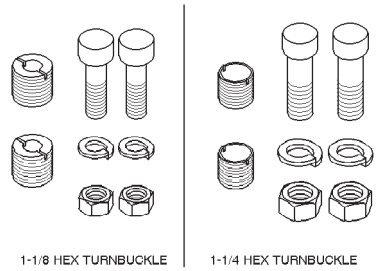


Installer—W-262

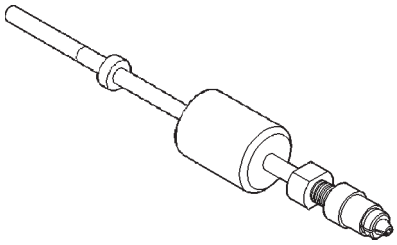


Holder—6963-A

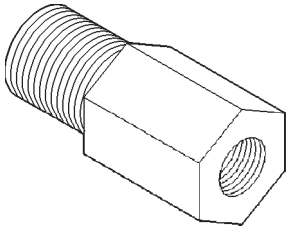
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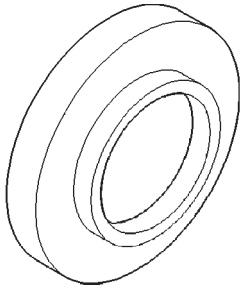
Adapter Set—6987



Slide Hammer—7420



Adapter—7420-8



Installer—7913-A

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BASE BRAKE SYSTEM

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DESCRIPTION AND OPERATION

BRAKE SYSTEM

DESCRIPTION

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

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

A dual diaphragm vacuum power brake booster is used for all applications. All models have an aluminum master cylinder with plastic reservoir.

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

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

SERVICE WARNINGS & CAUTIONS

DESCRIPTION

WARNING: DUST AND DIRT ACCUMULATING ON BRAKE PARTS DURING NORMAL USE MAY CONTAIN ASBESTOS FIBERS FROM PRODUCTION OR 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.

BRAKE PEDAL

DESCRIPTION

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

The brake pedal assembly and pedal pad are the only serviceable component.

OPERATION

The brake pedal is attached to the booster push rod. When the pedal is depressed, the primary booster push rod is depressed which moves the booster secondary rod. The booster secondary rod depresses the master cylinder piston.

BRAKE LAMP SWITCH

DESCRIPTION

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

OPERATION

The brake lamp switch is used to for the brake lamp, speed control and brake sensor circuits.

DESCRIPTION AND OPERATION (Continued)

RED BRAKE WARNING LAMP

DESCRIPTION

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

OPERATION

The red warning light alerts the driver if a pressure differential exists between the front and rear hydraulic systems, the parking brakes are applied or if the brake switch is not functioning properly. 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

DESCRIPTION

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

Two push rods are used in the booster. The primary push rod connects the booster to the brake pedal. The secondary push rod connects the booster to the master cylinder to stroke the cylinder pistons.

OPERATION

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

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

The booster check valve, check valve grommet and booster seals are serviceable.

MASTER CYLINDER

DESCRIPTION

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

OPERATION

The master cylinder bore contains a primary and secondary piston. The primary piston supplies hydraulic pressure to the front brakes. The secondary piston supplies hydraulic pressure to the rear brakes. The master cylinder reservoir stores reserve brake fluid for the hydraulic brake circuits.

COMBINATION VALVE

DESCRIPTION

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.

OPERATION

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.

DESCRIPTION AND OPERATION (Continued)

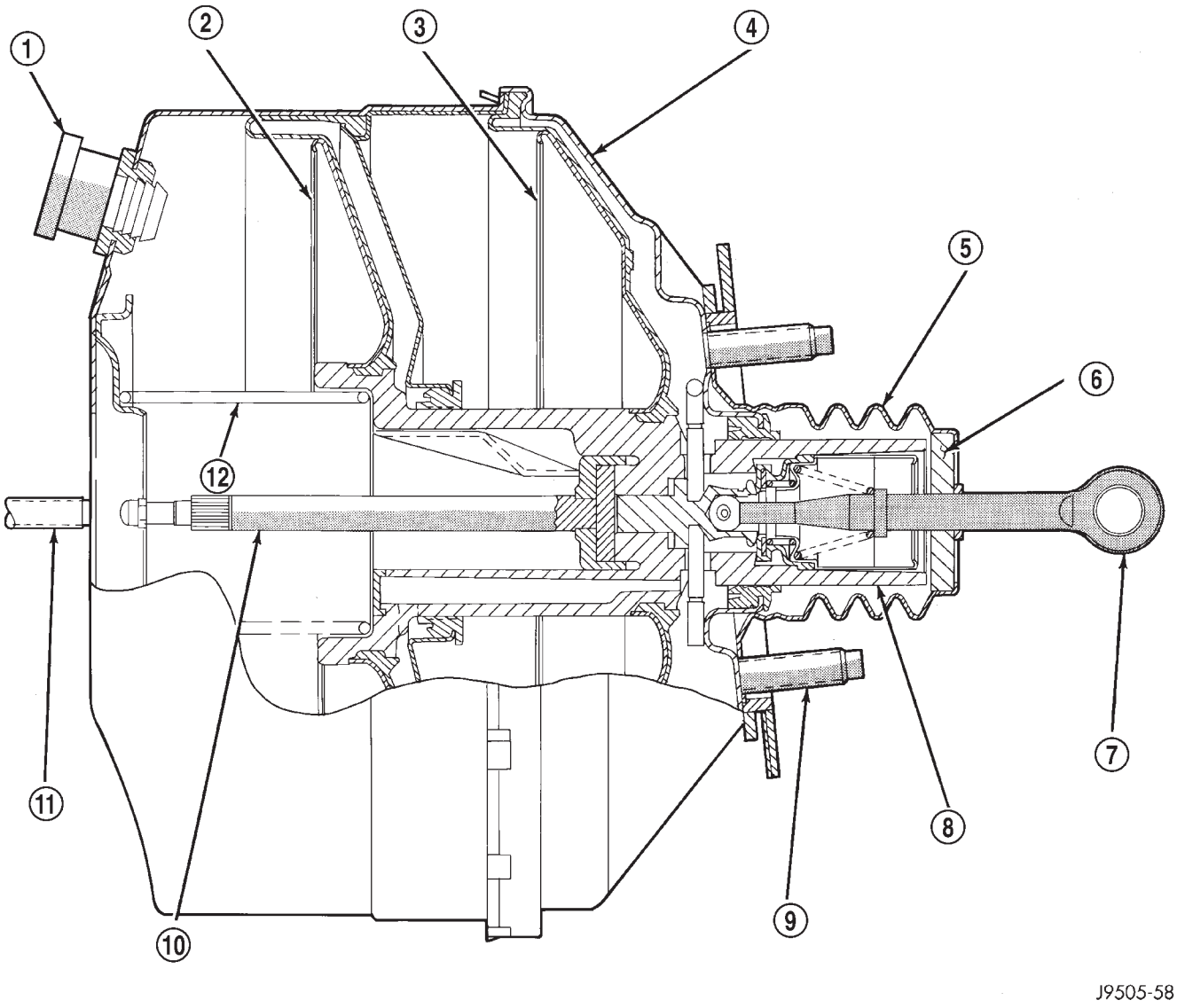


Fig. 1 Power Brake Booster–Typical

1 – VACUUM CHECK VALVE
2 – FRONT DIAPHRAGM
3 – REAR DIAPHRAGM
4 – HOUSING
5 – SEAL
6 – AIR FILTER
7 – PRIMARY PUSH ROD (TO BRAKE PEDAL)
8 – ATMOSPHERIC INLET VALVE ASSEMBLY
9 – BOOSTER MOUNTING STUDS (4)
10 – SECONDARY PUSH ROD (TO MASTER CYLINDER)
11 – MASTER CYLINDER MOUNTING STUD (2)
12 – SPRING

DESCRIPTION AND OPERATION (Continued)

FRONT DISC BRAKES

DESCRIPTION

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

OPERATION

When the brakes are applied fluid pressure is exerted against the caliper piston. The fluid pressure is exerted equally and in all directions. This means pressure exerted against the caliper piston and within the caliper bore will be equal (Fig. 2).

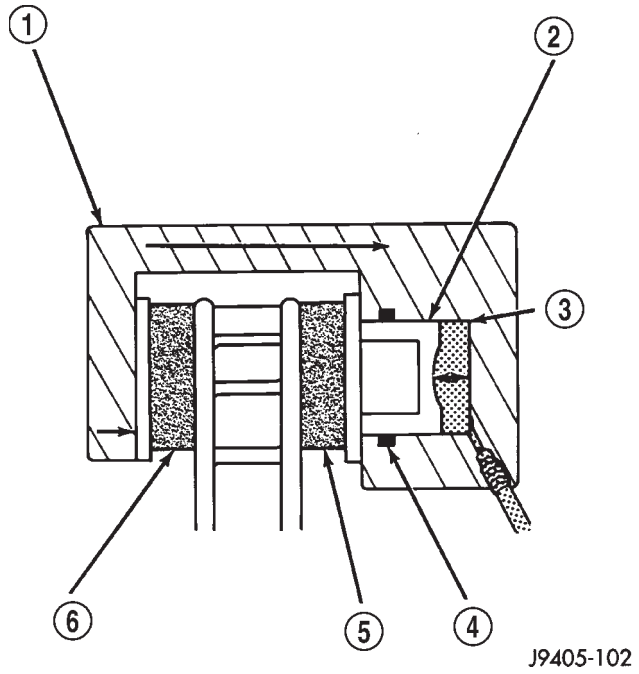


Fig. 2 Brake Caliper Operation

1 – CALIPER
2 – PISTON
3 – PISTON BORE
4 – SEAL
5 – INBOARD SHOE
6 – OUTBOARD SHOE

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

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

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

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

During brake application, the seal is deflected outward by fluid pressure and piston movement (Fig. 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.

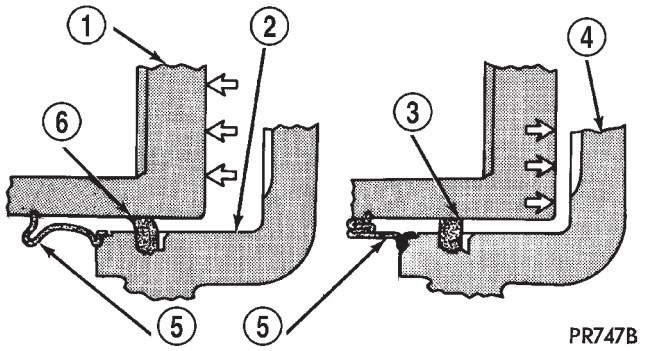


Fig. 3 Lining Wear Compensation By Piston Seal

1 – PISTON
2 – CYLINDER BORE
3 – PISTON SEAL BRAKE PRESSURE OFF
4 – CALIPER HOUSING
5 – DUST BOOT
6 – PISTON SEAL BRAKE PRESSURE ON

REAR DRUM BRAKE

DESCRIPTION

The brake systems use a leading shoe (primary) and trailing shoe (secondary). The mounting hardware is similar but not interchangeable (Fig. 4).

OPERATION

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.

DESCRIPTION AND OPERATION (Continued)

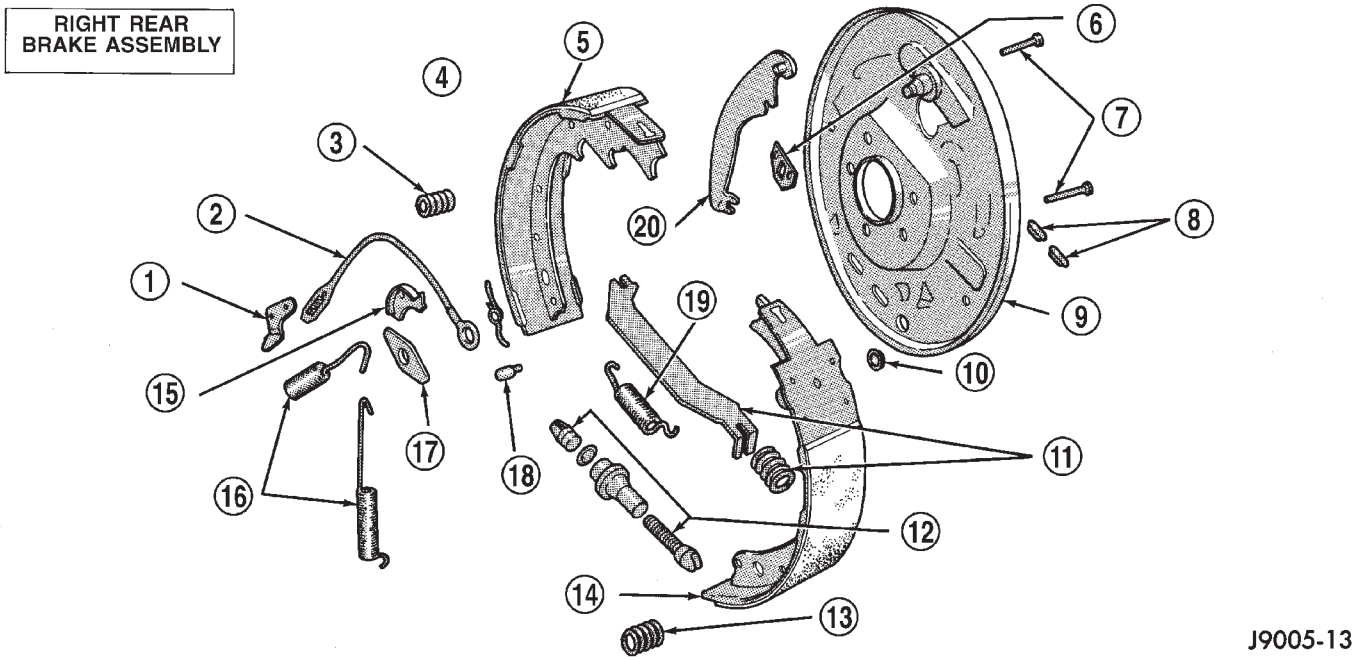


Fig. 4 Brake Components

1 – ADJUSTER LEVER
2 – ADJUSTER CABLE
3 – HOLDDOWN SPRING AND RETAINERS
4 – ADJUSTER LEVER SPRING
5 – TRAILING SHOE
6 – CYLINDER-TO-SUPPORT SEAL
7 – HOLDDOWN PINS
8 – ACCESS PLUGS
9 – SUPPORT PLATE
10 – CABLE HOLE PLUG
11 – PARK BRAKE STRUT AND SPRING
12 – ADJUSTER SCREW ASSEMBLY
13 – HOLDDOWN SPRING AND RETAINERS
14 – LEADING SHOE
15 – CABLE GUIDE
16 – SHOE RETURN SPRINGS
17 – SHOE GUIDE PLATE
18 – PIN
19 – SHOE SPRING
20 – PARK BRAKE LEVER

PARKING BRAKE

DESCRIPTION

The parking bake is a hand lever and cable operated system used to apply the rear brakes.

OPERATION

A hand operated lever in the passenger compartment is the main application device. The front cable is connected between the hand lever and the 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.

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.

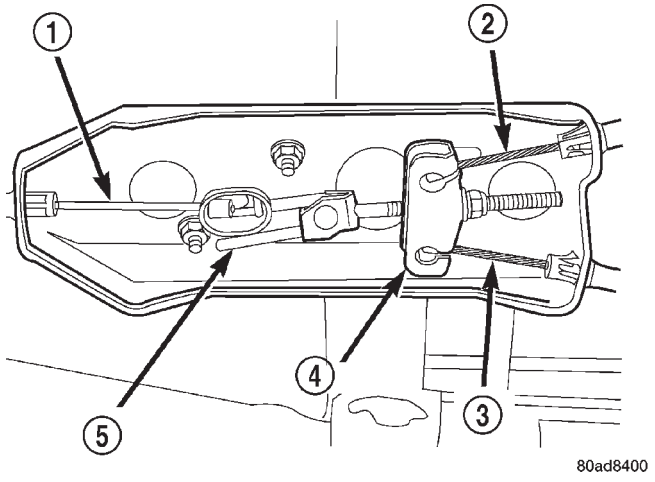


Fig. 5 Parking Brake Components

1 – FRONT CABLE
2 – L. R. CABLE
3 – R. R. CABLE
4 – EQUALIZER
5 – TENSIONER ROD

DESCRIPTION AND OPERATION (Continued)

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.

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

Parking brake 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.

BRAKE HOSES AND LINES

DESCRIPTION

Flexible rubber hose is used at both front brakes and at the rear axle junction block. Double walled steel tubing is used to connect the master cylinder to the major hydraulic braking components and then to the flexible rubber hoses. Double inverted style and ISO style flares are used on the brake lines.

OPERATION

The hoses and lines transmit the brake fluid hydraulic pressure to the calipers and or wheel cylinders.

DIAGNOSIS AND TESTING

BASE BRAKE SYSTEM

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

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

The first diagnosis step is the preliminary check.

PRELIMINARY BRAKE CHECK

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

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

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

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

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

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

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

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

ROAD TESTING

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

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

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

PEDAL FALLS AWAY

A brake pedal that falls away under steady foot pressure is generally the result of a system leak. The leak point could be at a brake line, fitting, hose, or caliper/wheel cylinder. Internal leakage in the master cylinder caused by worn or damaged piston cups, may also be the problem cause.

If leakage is severe, fluid will be evident at or around the leaking component. However, internal leakage in the master cylinder may not be physically evident.

DIAGNOSIS AND TESTING (Continued)

LOW PEDAL

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

SPONGY PEDAL

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

HARD PEDAL OR HIGH PEDAL EFFORT

A hard pedal or high pedal effort may be due to lining that is water soaked, contaminated, glazed, or badly worn. The power booster or check valve could also be faulty.

PEDAL PULSATION

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

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

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

BRAKE DRAG

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

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

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

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

Possible causes for brake drag condition are:

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

Possible causes for front brake pull condition are:

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

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

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

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

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

REAR BRAKE GRAB OR PULL

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

DIAGNOSIS AND TESTING (Continued)

BRAKES DO NOT HOLD AFTER DRIVING THROUGH DEEP WATER PUDDLES

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

BRAKE 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.

BRAKE LINING CONTAMINATION

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

WHEEL AND TIRE PROBLEMS

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

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

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

BRAKE LAMP SWITCH

The brake lamp switch operation can be tested with an ohmmeter. The ohmmeter is used to check continuity between the pin terminals (Fig. 6).

SWITCH CIRCUIT IDENTIFICATION

- Terminals 1 and 2: brake sensor circuit
- Terminals 3 and 4: speed control circuit if equipped
- Terminals 5 and 6: brake lamp circuit

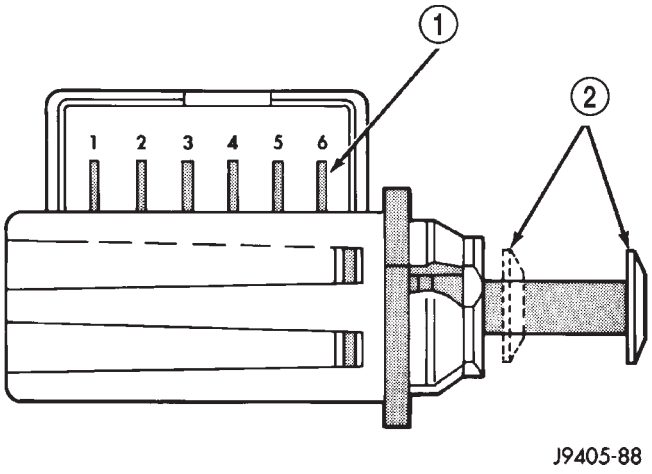


Fig. 6 Brake Lamp Switch Terminal Identification

1 – TERMINAL PINS
2 – PLUNGER TEST POSITIONS

SWITCH CONTINUITY TEST

NOTE: Disconnect switch harness before testing switch continuity.

With the switch plunger retracted, attach test leads to terminal pins 1 and 2. Replace switch if meter indicates no continuity.

With the switch plunger retracted, attach test leads to terminal pins 3 and 4. Replace switch if meter indicates no continuity.

With the switch plunger extended, attach test leads to terminal pins 5 and 6. Replace switch if meter indicates no continuity.

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.

DIAGNOSIS AND TESTING (Continued)

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 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 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.

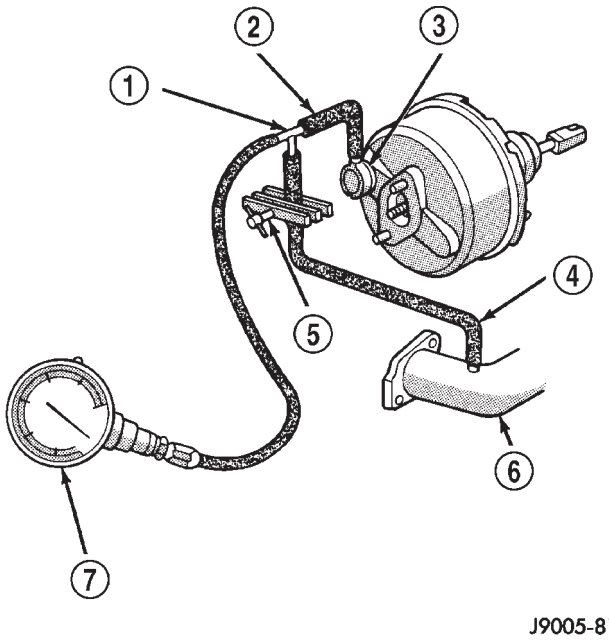


Fig. 7 Typical Booster Vacuum Test Connections

1 – TEE FITTING
2 – SHORT CONNECTING HOSE
3 – CHECK VALVE
4 – CHECK VALVE HOSE
5 – CLAMP TOOL
6 – INTAKE MANIFOLD
7 – VACUUM GAUGE

(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.

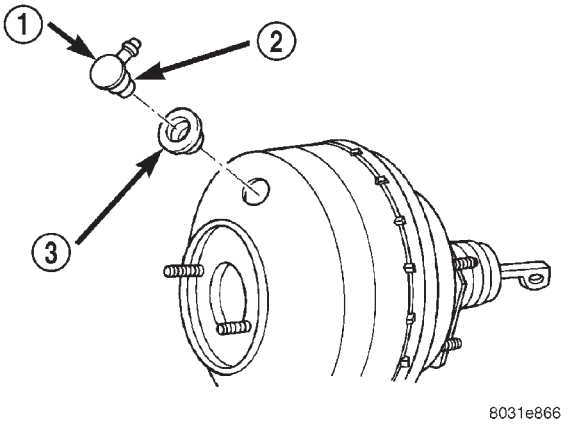


Fig. 8 Vacuum Check Valve And Seal

1 – BOOSTER CHECK VALVE
2 – APPLY TEST VACUUM HERE
3 – VALVE SEAL

DIAGNOSIS AND TESTING (Continued)

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 light bulb and fuse is functional. Repair or replace parts as necessary and test differential pressure switch operation again.

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

DISC BRAKE ROTOR

The rotor braking surfaces should not be refinished unless necessary.

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

Replace the rotor under the following conditions:

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

ROTOR MINIMUM THICKNESS

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

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

ROTOR RUNOUT

Check rotor lateral runout with dial indicator C-3339 (Fig. 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.

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

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

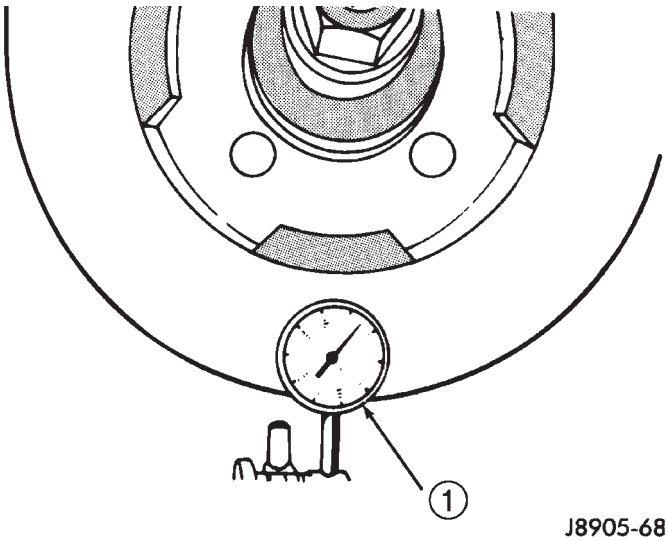


Fig. 9 Checking Rotor Runout And Thickness Variation

1 – DIAL INDICATOR

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.

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 0.069 mm (0.0028 in.). Drum runout should not exceed 0.18 mm (0.007 in.) out of round. Machine the

DIAGNOSIS AND TESTING (Continued)

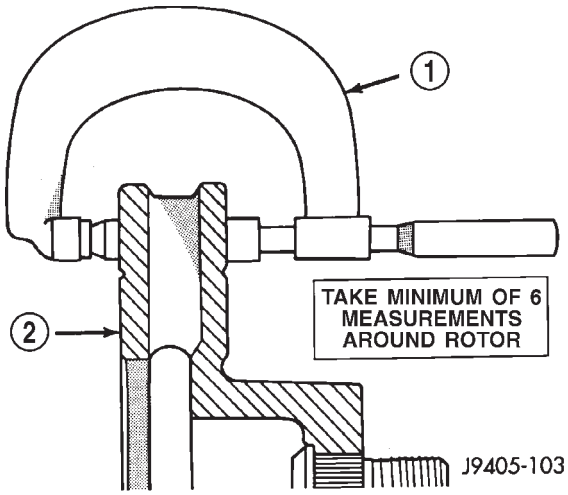


Fig. 10 Measuring Rotor Thickness

1 – MICROMETER
2 – ROTOR

drum if runout or variation exceed these values. Replace the drum if machining causes the drum to exceed the maximum allowable diameter.

PARKING BRAKE

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

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

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

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

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

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

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

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

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

BRAKE LINE AND HOSES

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

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

Also check brake hose installation. Faulty installation can result in kinked, twisted hoses, or contact with the wheels and tires or other chassis components. All of these 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.

DIAGNOSIS AND TESTING (Continued)

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 caps before checking fluid level. If not cleaned, dirt could enter the fluid.

The fluid fill level is indicated on the side of the master cylinder reservoir (Fig. 11).

The correct fluid level is to the FULL indicator on the side of the reservoir. If necessary, add fluid to the proper level.

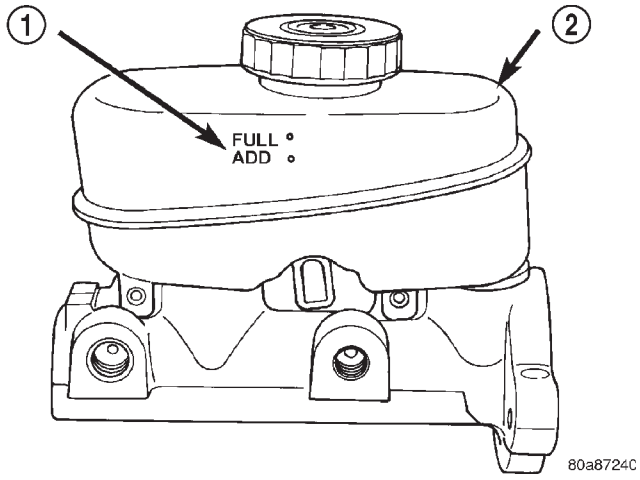


Fig. 11 Master Cylinder Fluid Level - Typical

1 – INDICATOR
2 – RESERVOIR

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 the 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.

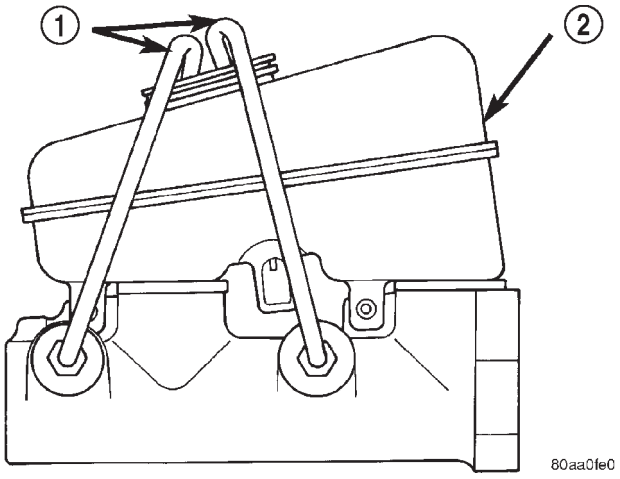


Fig. 12 Master Cylinder Bleeding

1 – BLEEDING TUBES
2 – RESERVOIR

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

SERVICE PROCEDURES (Continued)

filled with brake fluid (Fig. 13). Be sure end of bleed hose is immersed in fluid.

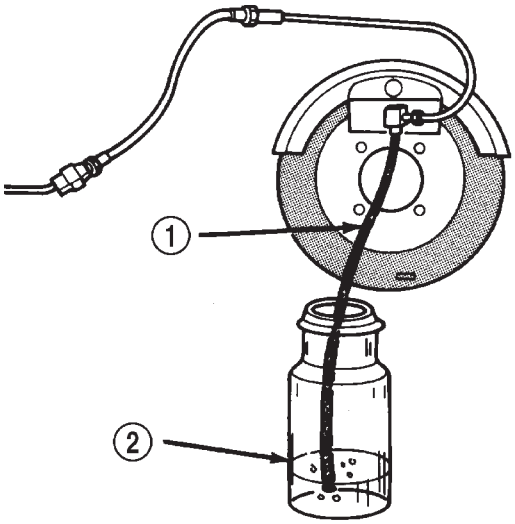


Fig. 13 Bleed Hose Setup

1 – BLEED HOSE
2 – FLUID CONTAINER PARTIALLY FILLED WITH 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.

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. The rotor mounting surface must be clean before placing on the lathe. Equipment capable of machining only one side at a time may produce a tapered rotor.

NOTE: 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.

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 flare or ISO flare (Fig. 14).

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).

SERVICE PROCEDURES (Continued)

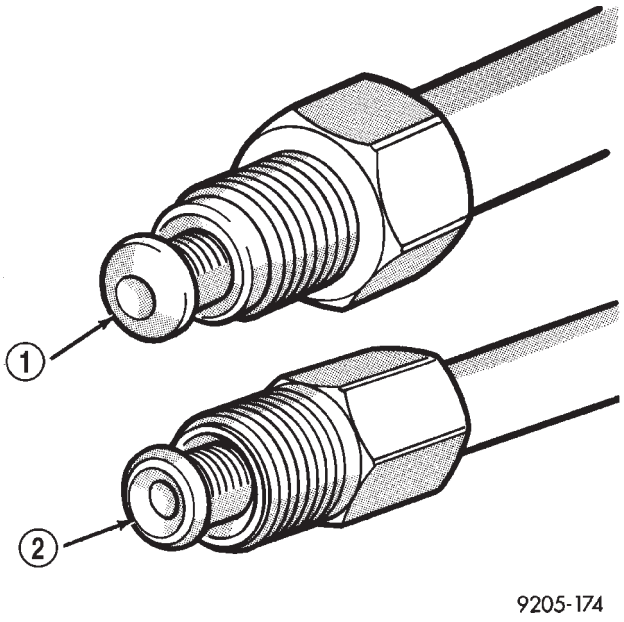


Fig. 14 Inverted Flare And ISO Flare

1 – ISO-STYLE FLARE
2 – DOUBLE INVERTED-STYLE FLARE

(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.

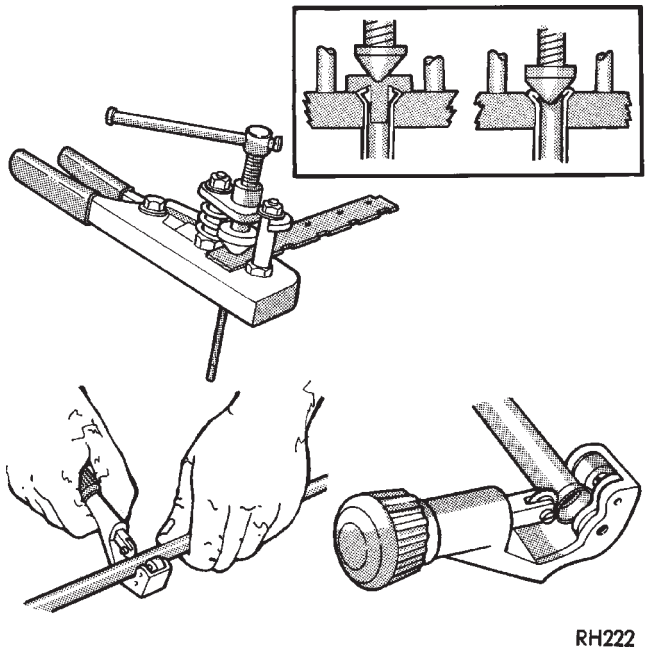


Fig. 15 Inverted Flare Tools

ISO FLARING

To make a ISO flare use Snap-On® Flaring Tool TFM-428 or equivalent.

(1) Cut off damaged tube with Tubing Cutter.

(2) Remove any burrs from the inside of the tube.

(3) Install tube nut on the tube.

(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.

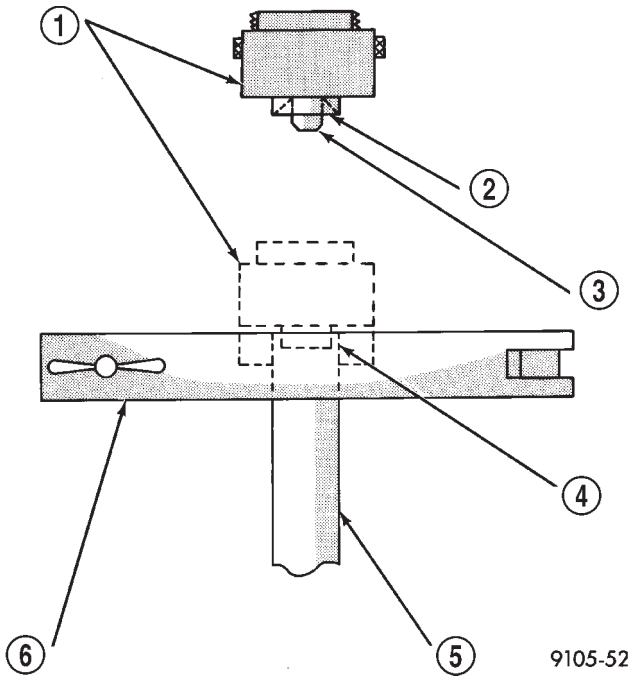


Fig. 16 ISO Flaring

1 – ADAPTER
2 – LUBRICATE HERE
3 – PILOT
4 – FLUSH WITH BAR
5 – TUBING
6 – BAR ASSEMBLY

REMOVAL AND INSTALLATION

BRAKE 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 counter-clockwise direction to unlock switch retainer. Then pull switch rearward and out of bracket.

(4) Disconnect switch harness and remove switch (Fig. 17).

REMOVAL AND INSTALLATION (Continued)

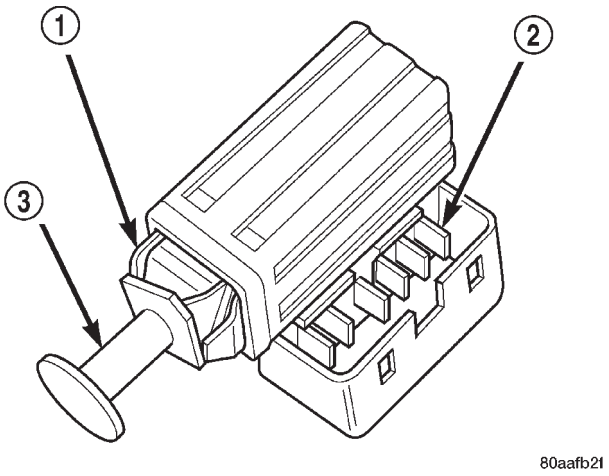


Fig. 17 Brake Lamp Switch

1 – RETAINER
2 – TERMINALS
3 – SWITCH PLUNGER

INSTALLATION

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

(2) Connect harness wires to switch.

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

(4) Install switch as follows: Align tab on switch with notch in switch bracket. Then insert switch in bracket and turn it clockwise about 30° to lock it in place.

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

BRAKE PEDAL

REMOVAL

(1) Remove negative battery cable.

(2) Remove brake lamp switch.

(3) Remove ABS controller if equipped.

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

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

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

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

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

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

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

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

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

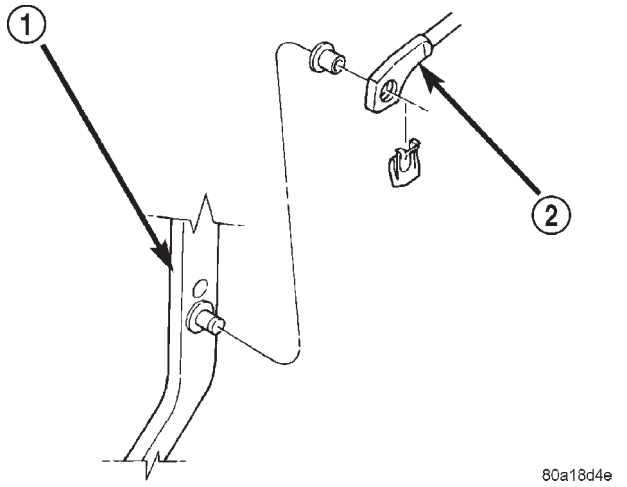


Fig. 18 Push Rod Attachment

1 – BRAKE PEDAL
2 – BOOSTER ROD

INSTALLATION

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

(2) Position pedal in bracket and install shaft.

(3) Install new pivot pin C-clip.

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

(5) Slid the booster/master cylinder assembly into place, install mounting nuts and tighten to 39 N·m (29 ft. lbs.).

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

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

(7) Install ABS controller if equipped.

(8) Install and connect brake lamp switch.

(9) Install negative battery cable.

COMBINATION VALVE

REMOVAL

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

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

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

REMOVAL AND INSTALLATION (Continued)

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

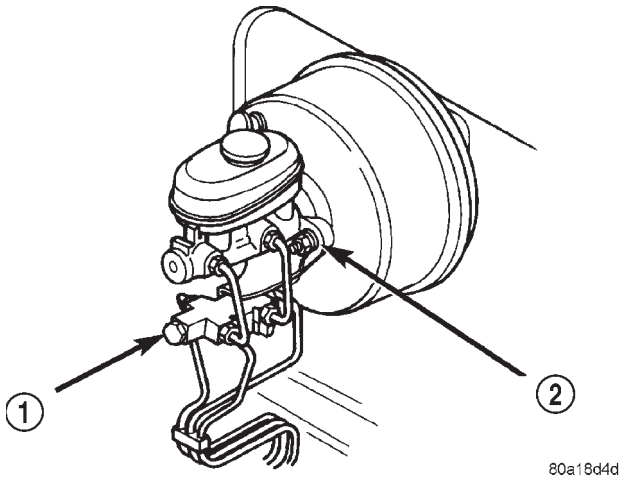


Fig. 19 Combination Valve/Master Cylinder

1 – COMBINATION VALVE
2 – MASTER CYLINDER

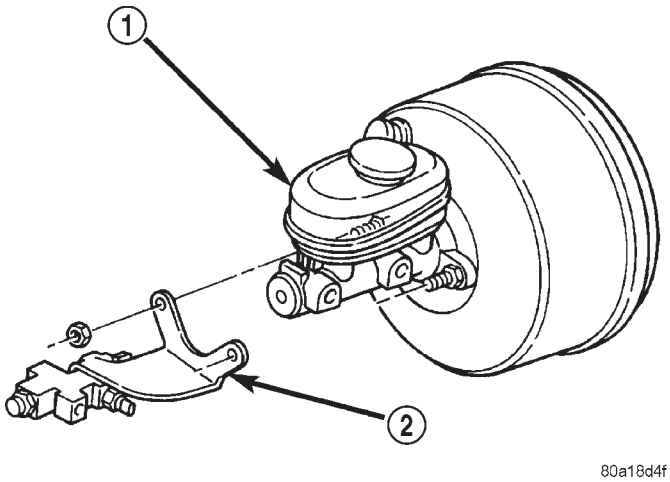


Fig. 20 Combination Valve Bracket

1 – MASTER CYLINDER
2 – COMBINATION VALVE BRACKET

INSTALLATION

(1) Position valve bracket on booster studs and tighten bracket attaching nuts to 20 N·m (15 ft. lbs.).

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

(3) Tighten brake line fittings at combination valve to 19 N·m (14 ft. lbs.).

(4) Tighten brake line fittings at master cylinder to 19 N·m (14 ft. lbs.).

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

(6) Bleed base brake system.

MASTER CYLINDER

REMOVAL

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

(2) Disconnect brake lines to master cylinder and combination valve (Fig. 21).

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

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

(5) Remove cylinder cover and drain fluid.

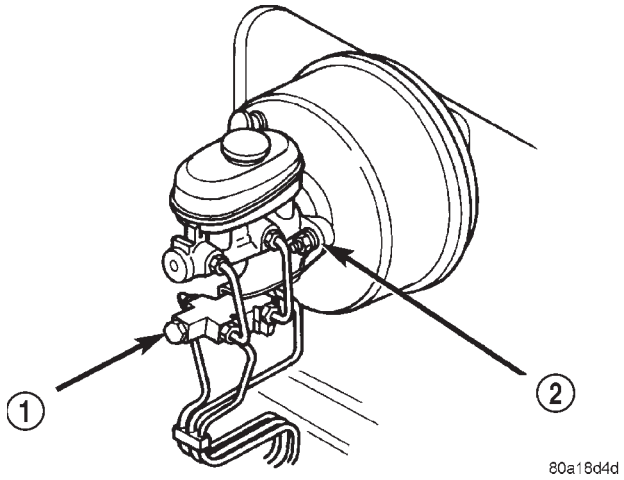


Fig. 21 Master Cylinder/Combination Valve

1 – COMBINATION VALVE
2 – 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) Check condition of seal at rear of cylinder body. Reposition seal if dislodged. Replace seal if cut, or torn.

(3) Install master cylinder onto brake booster studs and tighten mounting nuts to 17 N·m (13 ft. lbs.).

NOTE: Use only original or factory replacement nuts.

(4) Install combination valve onto brake booster studs and tighten mounting nuts to 20 N·m (15 ft. lbs.).

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

(6) Tighten master cylinder brake lines to 19 N·m (14 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

(7) Tighten combination valve brake lines to 19 N·m (14 ft. lbs.).

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

(9) Bleed base brake system.

POWER BRAKE BOOSTER

REMOVAL

(1) Remove combination valve and master cylinder.

(2) Disconnect vacuum hose from booster check valve.

(3) Remove retaining clip that secures booster push rod to brake pedal (Fig. 22) and slide the rod off the pin.

(4) Remove four nuts attaching booster to front cowl panel (Fig. 23).

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

(6) Remove dash seal from booster.

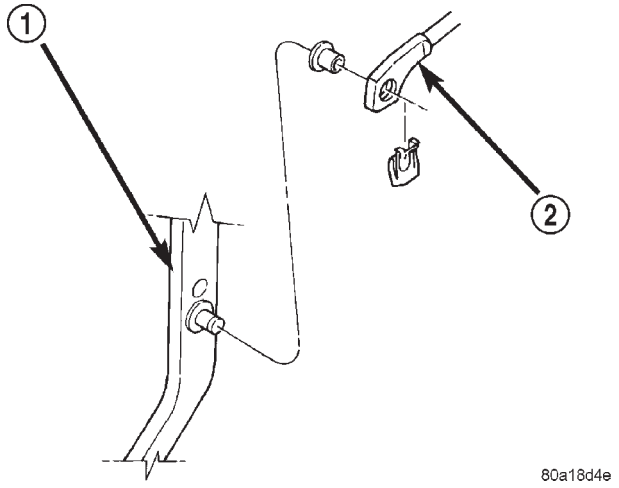


Fig. 22 Push Rod & Clip

1 – BRAKE PEDAL
2 – BOOSTER ROD

INSTALLATION

(1) Clean the booster mounting surface.

(2) Install dash seal on booster.

(3) Align and position booster on the front cowl panel.

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

(5) Lubricate the pedal pin and bushing with Mopar multi-mileage grease. Then slid the booster push rod onto brake pedal pin and secure with retaining clip.

(6) Tighten booster mounting nuts to 39 N·m (29 ft. lbs.).

(7) Connect vacuum hose to booster check valve.

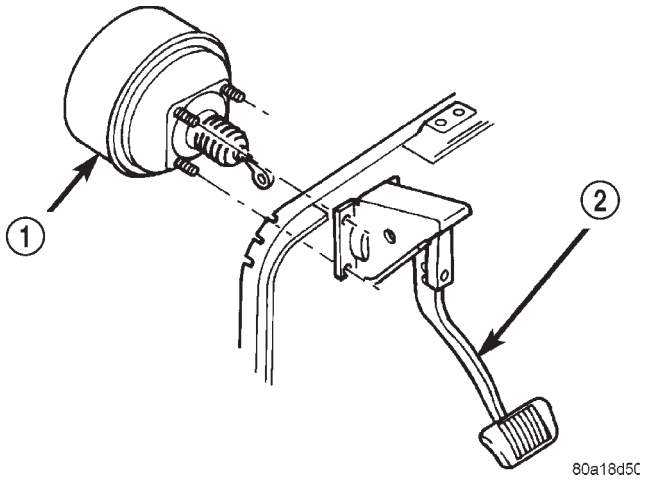


Fig. 23 Booster Mounting Nuts

1 – BOOSTER
2 – BRAKE PEDAL

(8) Install master cylinder and combination valve.

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

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.

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.).

REMOVAL AND INSTALLATION (Continued)

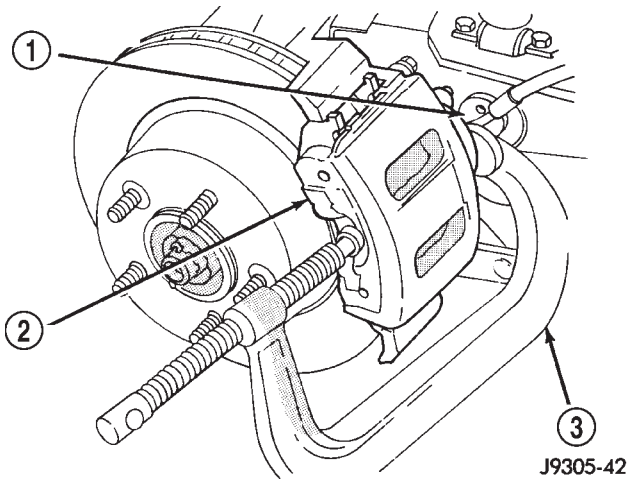


Fig. 24 Bottoming Caliper Piston With C-Clamp

1 – CALIPER BOSS
2 – OUTBOARD BRAKESHOE
3 – C-CLAMP

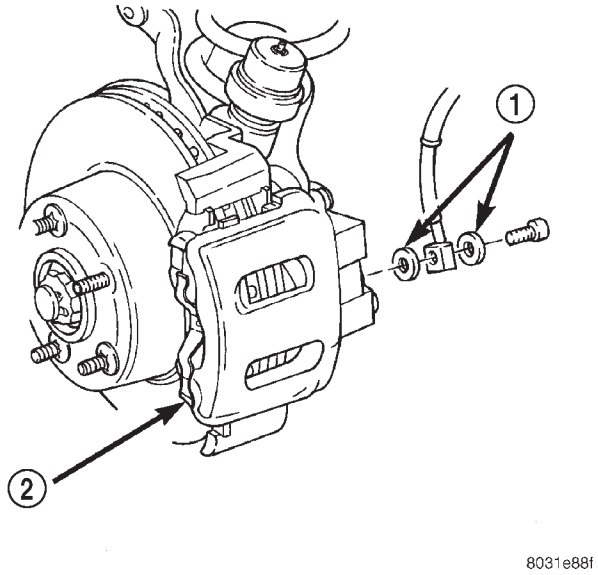


Fig. 25 Brake Hose And Bolt

1 – FITTING WASHERS
2 – CALIPERS

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).

(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.

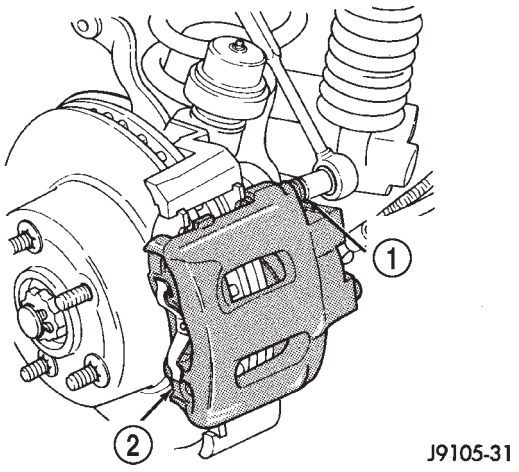


Fig. 26 Caliper Mounting Bolts

1 – CALIPER MOUNTING BOLT (2)
2 – CALIPER

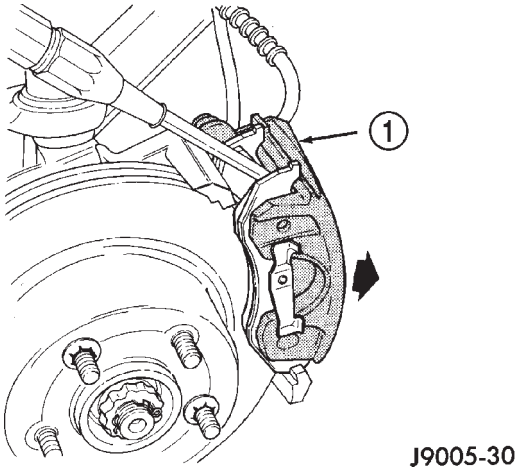


Fig. 27 Caliper Removal

1 – TILT CALIPER OUTBOARD TO REMOVE

(5) Bleed base brake system.
(6) Install wheel and tire assemblies.
(7) Remove supports and lower vehicle.
(8) Verify firm pedal before moving vehicle.

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).

REMOVAL AND INSTALLATION (Continued)

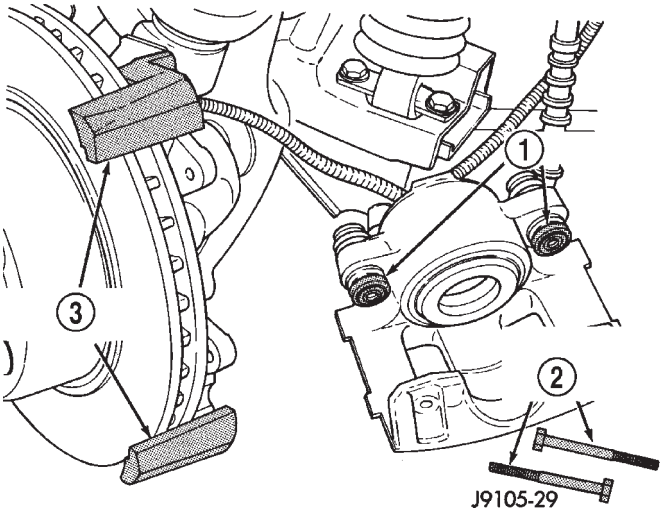


Fig. 28 Caliper Lubrication Points

1 – BUSHINGS
2 – CALIPER MOUNTING BOLTS
3 – MOUNTING LEDGES

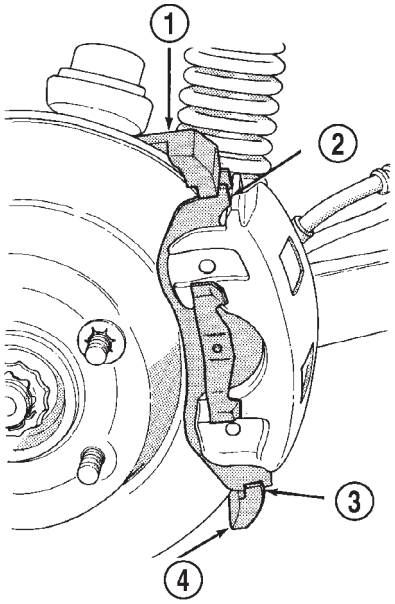


Fig. 29 Caliper Installation

1 – TOP LEDGE
2 – BRAKESHOE TAB ON LEDGE OUTER SURFACE
3 – LEDGE SEATED IN BRAKESHOE NOTCH
4 – BOTTOM LEDGE

(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.

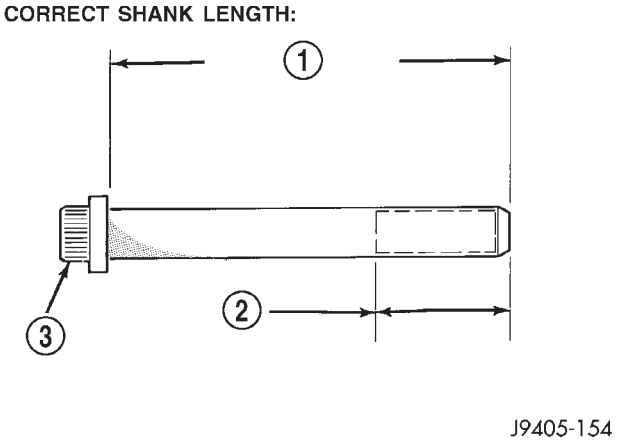


Fig. 30 Mounting Bolt Dimensions

1 – 67 mm (± 0.6 mm) 2.637 in. (± 0.0236 in.)
2 – 22 mm (0.866 in.) THREAD LENGTH
3 – CALIPER BOLT

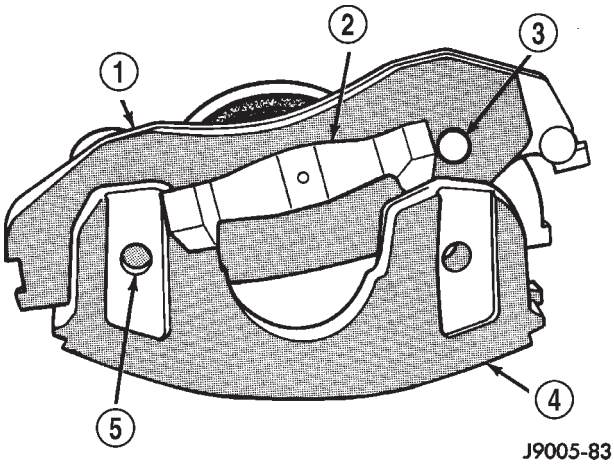


Fig. 31 Outboard Brake Shoe Removal

1 – OUTBOARD BRAKESHOE
2 – SHOE SPRING
3 – LOCATING LUG
4 – CALIPER
5 – LOCATING LUG

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

(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.

REMOVAL AND INSTALLATION (Continued)

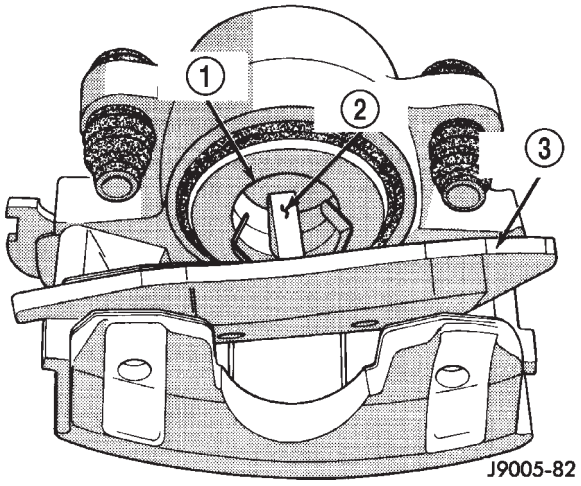


Fig. 32 Inboard Brake Shoe Removal

1 – CALIPER PISTON
2 – SHOE SPRINGS
3 – INBOARD BRAKESHOE

(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.

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.

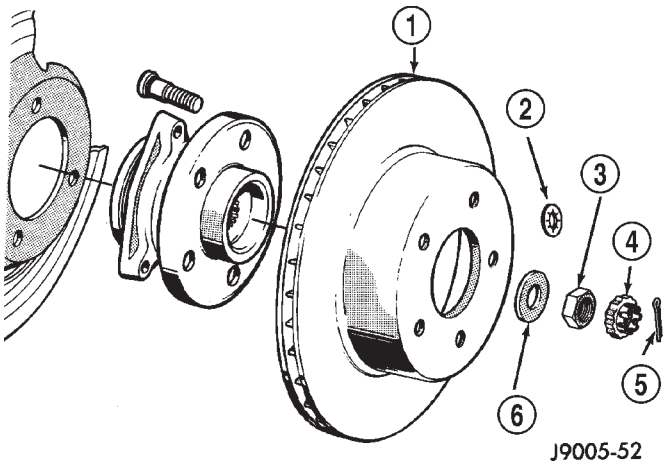


Fig. 33 Rotor & Hub

1 – ROTOR
2 – RETAINER
3 – BEARING NUT
4 – NUT LOCK
5 – COTTER PIN
6 – WASHER

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

(4) Remove U-clip and washer securing adjuster cable to parking brake lever (Fig. 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 or brake cleaner.
(3) Apply multi-purpose grease to brake shoe contact surfaces of support plate (Fig. 35).
(4) Lubricate adjuster screw threads and pivot with spray lube.
(5) Attach parking brake lever to secondary brake shoe. Use new washer and U-clip to secure lever.
(6) Remove wheel cylinder clamps.
(7) Attach parking brake cable to lever.

REMOVAL AND INSTALLATION (Continued)

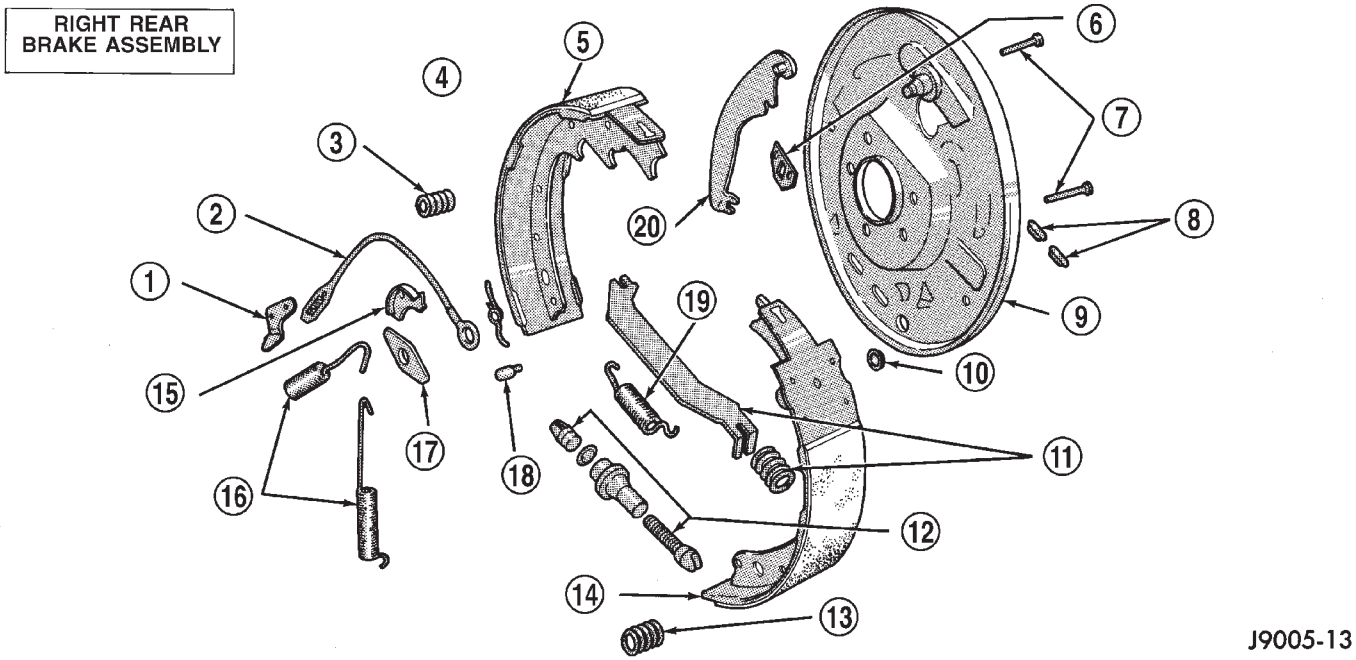


Fig. 34 Drum Brake Components—Typical

1 – ADJUSTER LEVER
2 – ADJUSTER CABLE
3 – HOLDDOWN SPRING AND RETAINERS
4 – ADJUSTER LEVER SPRING
5 – TRAILING SHOE
6 – CYLINDER-TO-SUPPORT SEAL
7 – HOLDDOWN PINS
8 – ACCESS PLUGS
9 – SUPPORT PLATE
10 – CABLE HOLE PLUG
11 – PARK BRAKE STRUT AND SPRING
12 – ADJUSTER SCREW ASSEMBLY
13 – HOLDDOWN SPRING AND RETAINERS
14 – LEADING SHOE
15 – CABLE GUIDE
16 – SHOE RETURN SPRINGS
17 – SHOE GUIDE PLATE
18 – PIN
19 – SHOE SPRING
20 – PARK BRAKE LEVER

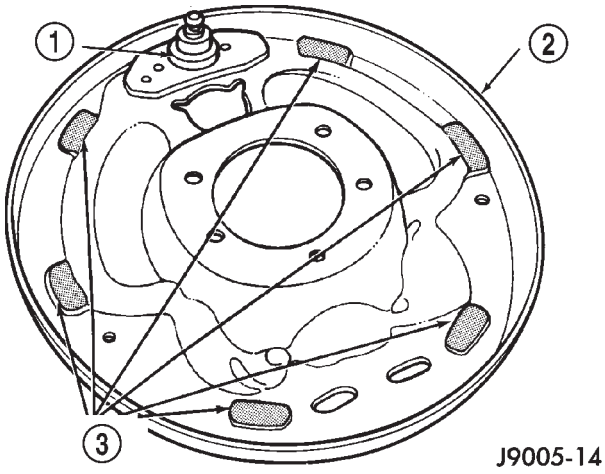


Fig. 35 Shoe Contact Surfaces

1 – ANCHOR PIN
2 – SUPPORT PLATE
3 – SHOE CONTACT SURFACES

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

(9) Install parking brake strut and spring.

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

(11) Install primary and secondary return springs.

(12) Install adjuster cable guide on secondary shoe.

(13) Lubricate and assemble adjuster screw.

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

(15) Adjust shoes to drum.

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

(17) Verify firm brake pedal before moving vehicle.

WHEEL CYLINDER

REMOVAL

(1) Remove wheel and tire assembly.

(2) Remove brake drum.

(3) Remove wheel cylinder brake line.

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

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

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Apply bead of silicone sealer around cylinder mounting surface of support plate.
(2) Install cylinder mounting bolts and tighten to 10 N·m (7 ft. lbs.).
(3) Install brake line to cylinder and tighten to 16 N·m (12 ft. lbs.).
(4) Install brake shoe return spring.
(5) Install brake drum.
(6) Install wheel and tire assembly.
(7) Bleed base brake system.

PARKING BRAKE HAND LEVER

REMOVAL

(1) Release parking brakes.
(2) Raise vehicle on hoist.
(3) Remove front cable adjusting nut and disengage cable tensioner from equalizer. Then remove front cable from tensioner (Fig. 36).
(4) Lower vehicle.
(5) Remove lever cover or center console if equipped. Refer to Group 23 Body for procedures.
(6) Disconnect parking brake switch wiring connectors (Fig. 37).
(7) Remove screws attaching parking brake lever to mount (Fig. 38).
(8) Disengage front cable from parking brake lever and remove lever assembly from vehicle.

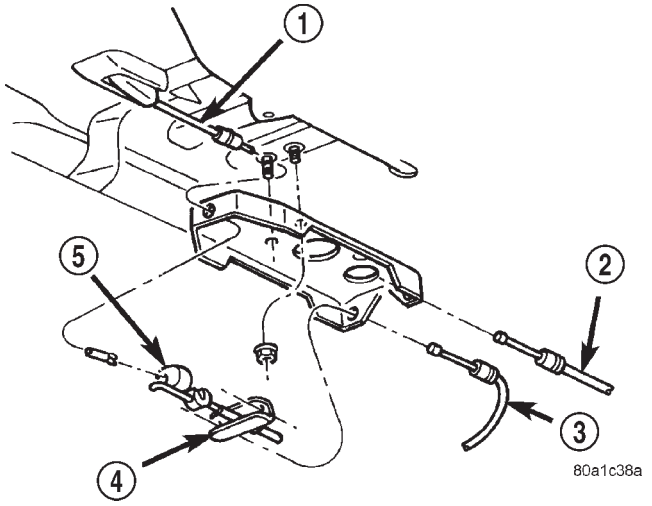


Fig. 36 Parking Brake Cable Attachment

1 – FRONT CABLE
2 – L. R. CABLE
3 – R. R. CABLE
4 – EQUALIZER
5 – TENSIONER

INSTALLATION

(1) Install front cable on lever assembly.

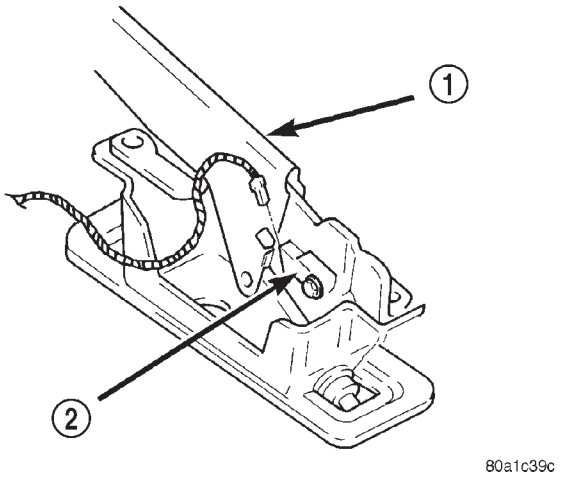


Fig. 37 Parking Brake Lamp Switch

1 – PARK BRAKE LEVER
2 – PARK BRAKE LAMP SWITCH

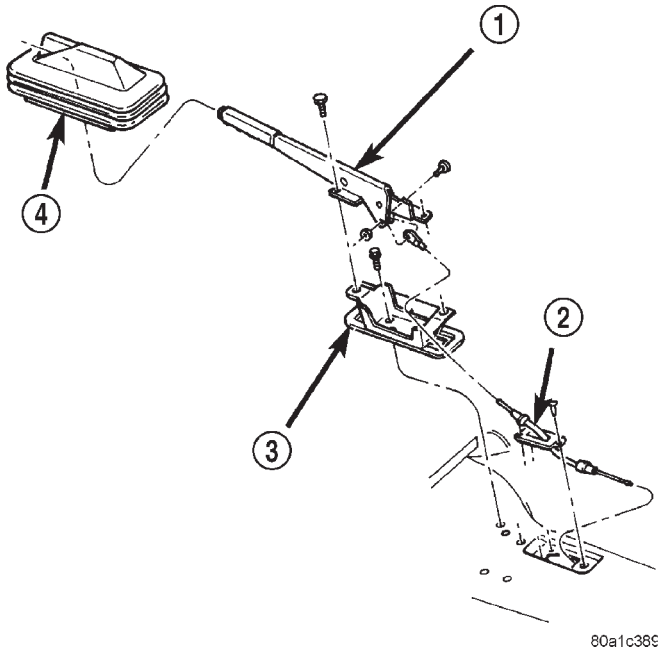


Fig. 38 Parking Brake Lever

1 – PARKING BRAKE LEVER
2 – FRONT CABLE
3 – LEVER MOUNTING BRACKET
4 – COVER

(2) Install lever assembly on mounting bracket and tighten mounting bolts to 12 N·m (9 ft. lbs.).
(3) Connect parking brake switch wire.
(4) Install parking lever cover.
(5) Raise vehicle.
(6) Assemble front cable, cable tensioner and cable bracket.
(7) Adjust parking brake front cable.
(8) Lower vehicle.

REMOVAL AND INSTALLATION (Continued)

REAR PARKING BRAKE CABLE

REMOVAL

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

(2) Disengage cable from equalizer and remove cable (Fig. 36).

(3) Remove cable bracket from upper suspension arm (Fig. 39).

(4) Remove rear wheel and brake drum.

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

(6) Compress cable retainer with worm drive hose clamp (Fig. 40) and remove cable from backing plate.

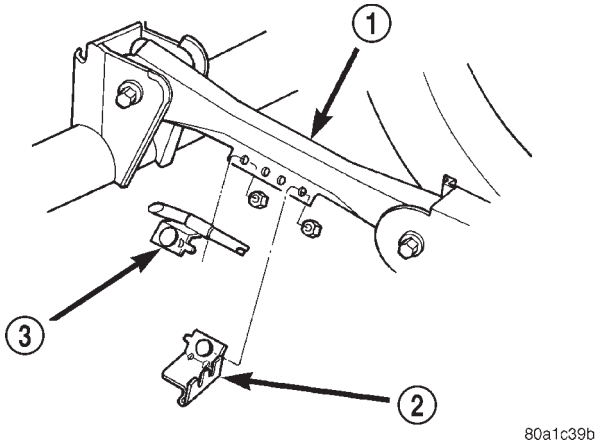


Fig. 39 Parking Brake Cable Bracket

1 – UPPER SUSPENSION ARM
2 – WIRING BRACKET
3 – PARKING BRAKE CABLE BRACKET

INSTALLATION

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

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

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

(4) Install brake drum and wheel.

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

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

(7) Adjust parking brakes.

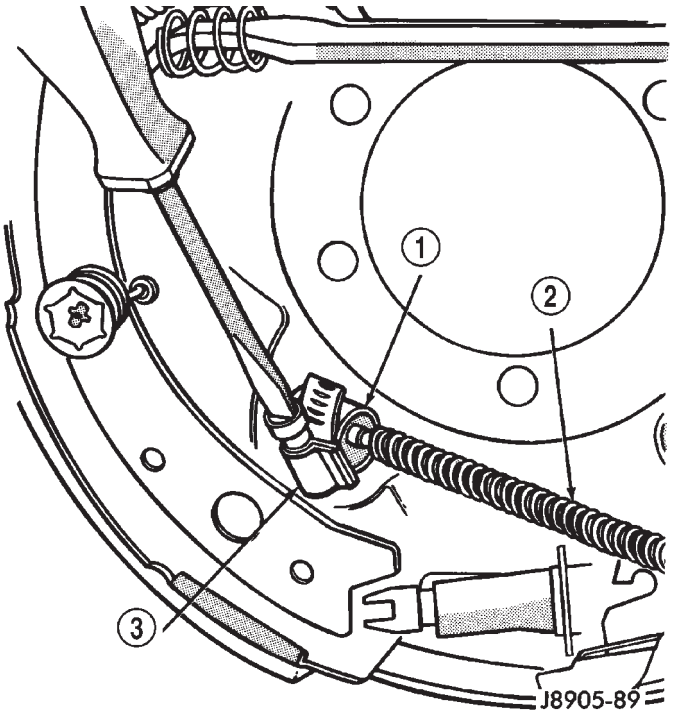


Fig. 40 Cable Retainer

1 – CABLE RETAINER
2 – REAR CABLE
3 – WORM DRIVE HOSE CLAMP

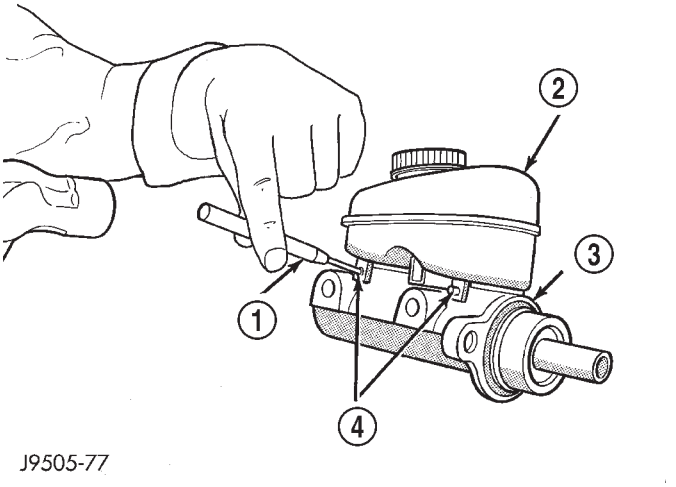


Fig. 41 Reservoir Retaining Pins

1 – PIN PUNCH
2 – RESERVOIR
3 – BODY
4 – ROLL PINS

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. 41).

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

(4) Loosen reservoir from grommets with pry tool (Fig. 42).

(5) Remove reservoir by rocking it to one side and pulling free of grommets (Fig. 43).

DISASSEMBLY AND ASSEMBLY (Continued)

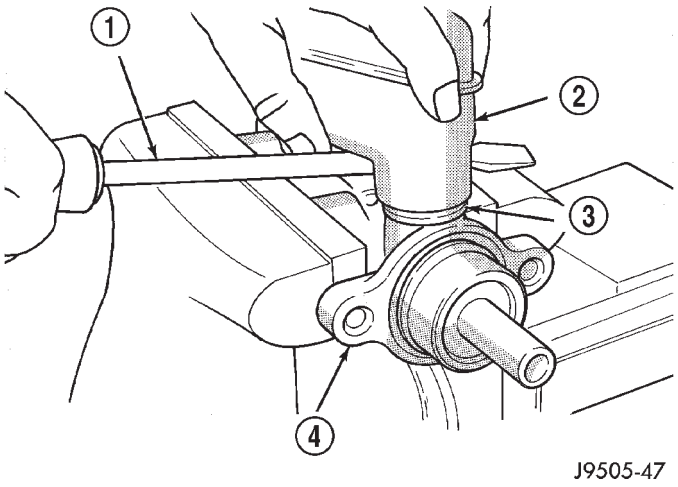


Fig. 42 Loosening Reservoir

1 – PRY TOOL
2 – RESERVOIR
3 – GROMMET
4 – MASTER CYLINDER BODY

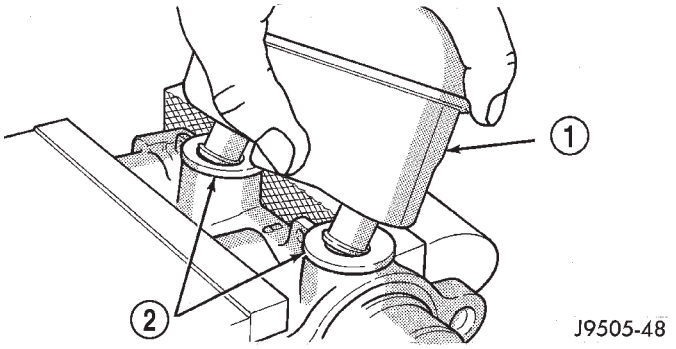


Fig. 43 Reservoir Removal

1 – RESERVOIR
2 – GROMMETS

(6) Remove old grommets from cylinder body (Fig. 44).

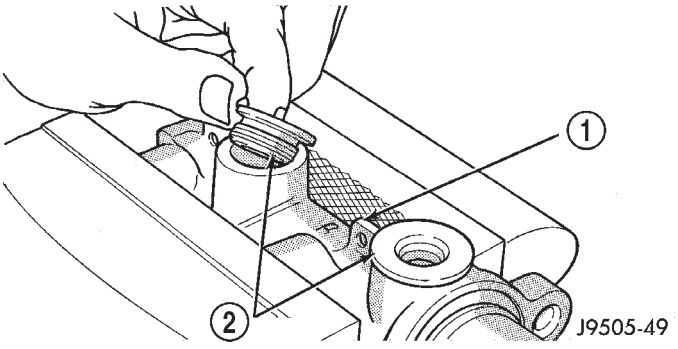


Fig. 44 Grommet Removal

1 – MASTER CYLINDER BODY
2 – GROMMETS

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. 45). Use finger pressure to install and seat grommets.

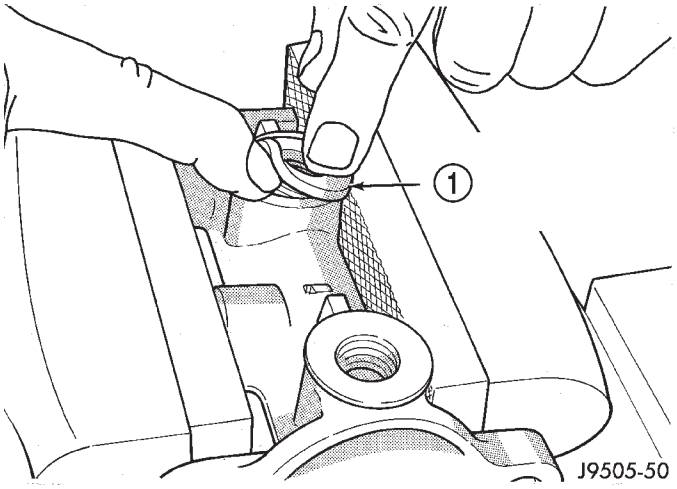


Fig. 45 Grommet Installation

1 – WORK NEW GROMMETS INTO PLACE USING FINGER PRESSURE ONLY

(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. 46).

(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. 47).

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.

DISASSEMBLY AND ASSEMBLY (Continued)

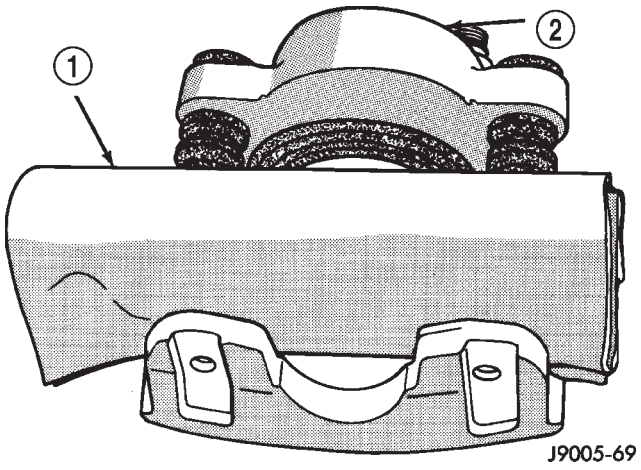


Fig. 46 Padding Caliper Interior

1 – SHOP TOWELS OR CLOTHS
2 – CALIPER

WARNING: NEVER ATTEMPT TO CATCH THE PISTON AS IT LEAVES THE BORE. THIS MAY RESULT IN PERSONAL INJURY.

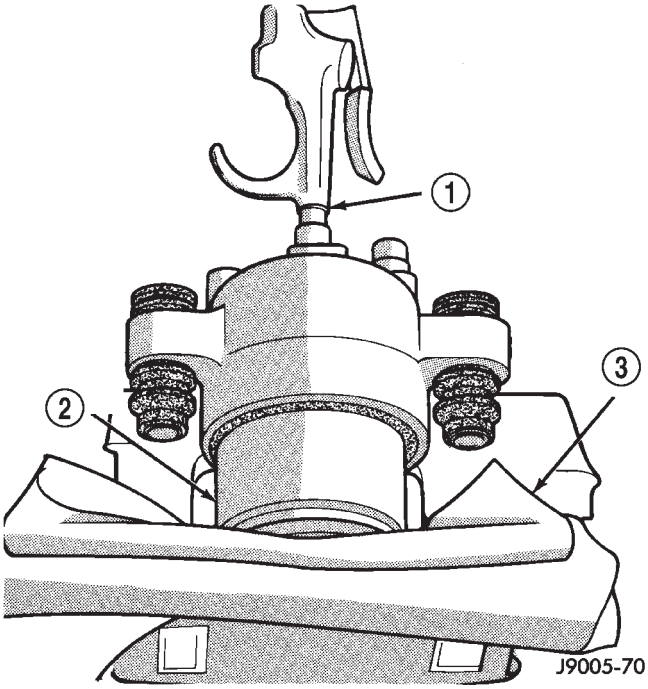


Fig. 47 Caliper Piston Removal

1 – AIR GUN
2 – CALIPER PISTON
3 – PADDING MATERIAL

(5) Remove caliper piston dust boot with suitable pry tool (Fig. 48).

(6) Remove caliper piston seal with wood or plastic tool (Fig. 49). Do not use metal tools as they will scratch piston bore.

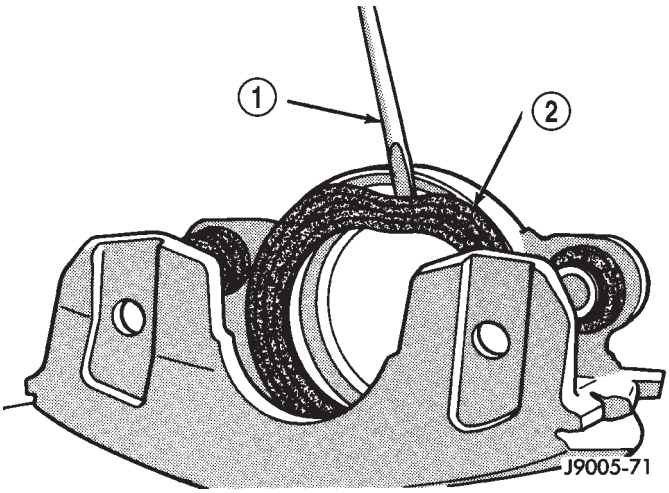


Fig. 48 Caliper Piston Dust Boot Removal

1 – COLLAPSE BOOT WITH PUNCH OR SCREWDRIVER
2 – PISTON DUST BOOT

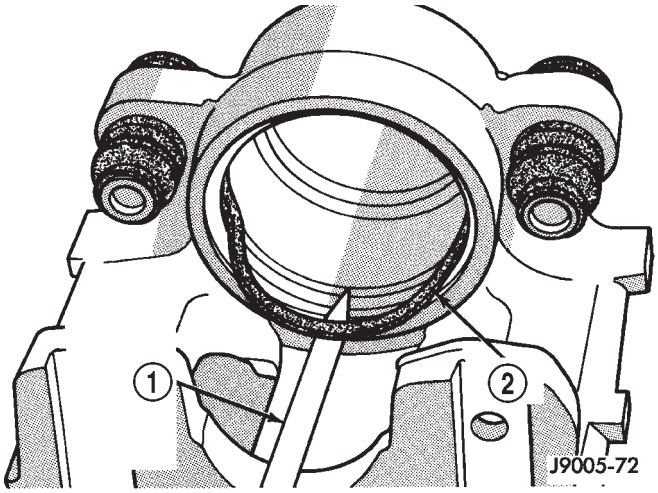


Fig. 49 Piston Seal Removal

1 – REMOVE SEAL WITH WOOD PENCIL OR SIMILAR TOOL
2 – PISTON SEAL

(7) Remove caliper mounting bolt bushings and boots (Fig. 50).

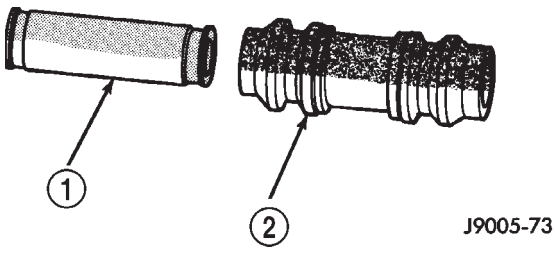


Fig. 50 Mounting Bolt Bushing And Boot

1 – CALIPER SLIDE BUSHING
2 – BOOT

DISASSEMBLY AND ASSEMBLY (Continued)

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. 51).

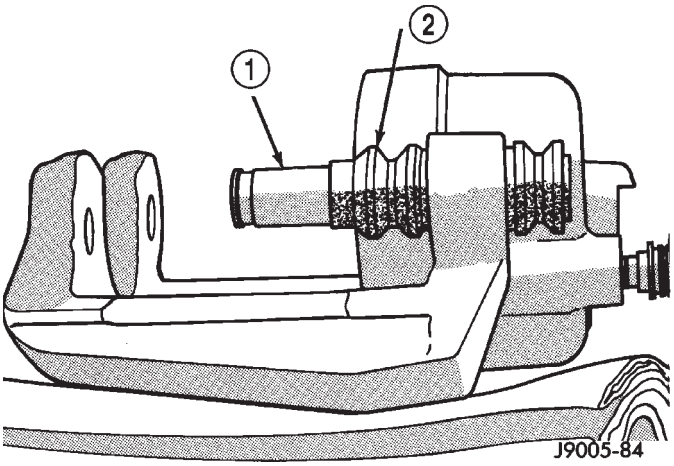


Fig. 51 Bushings And Boots Installation
1 – BUSHING
2 – BOOT

(4) Install new piston seal into seal groove with finger (Fig. 52).

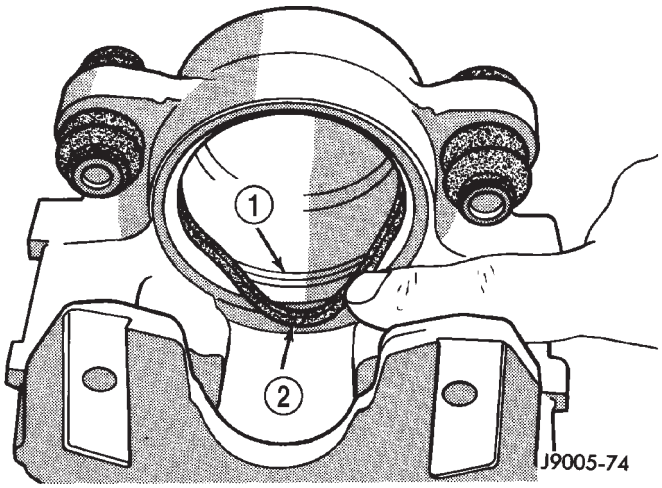


Fig. 52 Piston Seal Installation
1 – SEAL GROOVE
2 – PISTON SEAL

(5) Install new dust boot on caliper piston and seat boot in piston groove (Fig. 53).

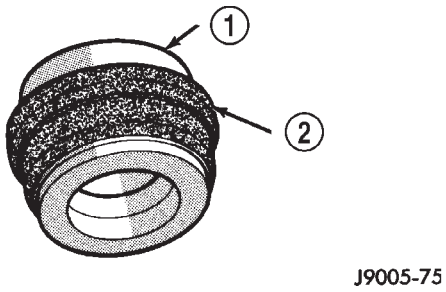


Fig. 53 Dust Boot On Piston
1 – PISTION
2 – DUST BOOT

(6) Press piston into caliper bore by hand, use a turn and push motion to work piston into seal (Fig. 54).

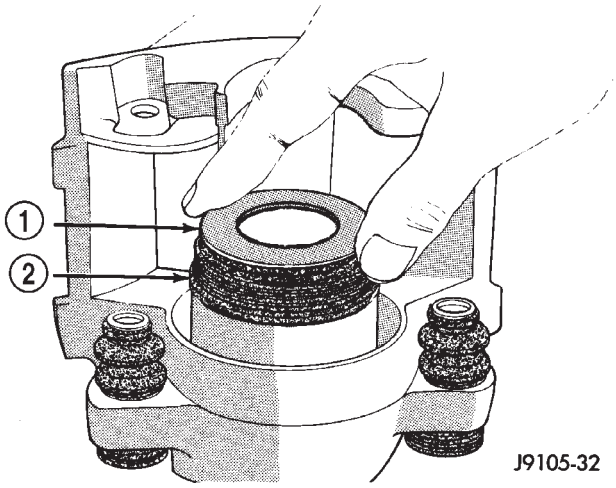


Fig. 54 Caliper Piston Installation
1 – PISTON
2 – BOOT

(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. 55).
(9) Replace caliper bleed screw if removed.

WHEEL CYLINDER

DISASSEMBLY

(1) Remove push rods and boots (Fig. 56).
(2) Press pistons, cups and spring and expander out of cylinder bore.
(3) Remove bleed screw.

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**

DISASSEMBLY AND ASSEMBLY (Continued)

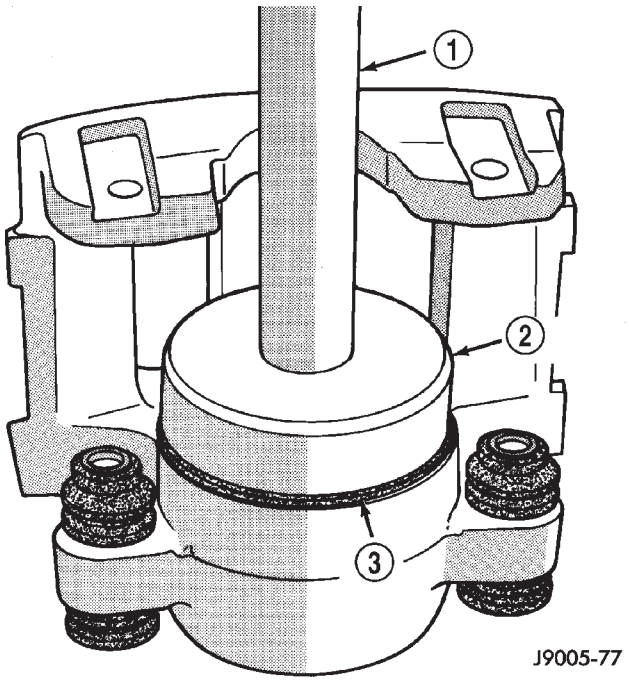


Fig. 55 Piston Dust Boot Installation

1 – HANDLE C-4171
2 – INSTALLER C-4842
3 – DUST BOOT

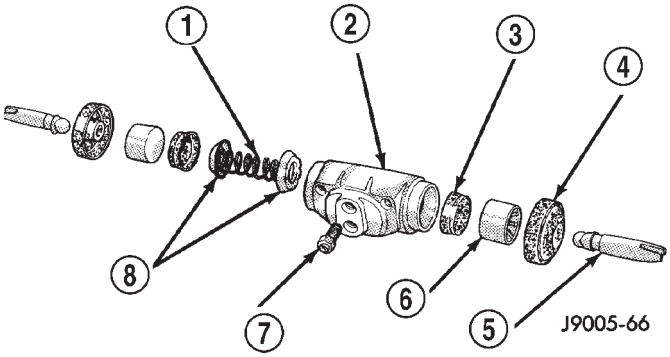


Fig. 56 Wheel Cylinder Components–Typical

1 – SPRING
2 – CYLINDER
3 – PISTON CUP
4 – BOOT
5 – PUSH ROD
6 – PISTON
7 – BLEED SCREW
8 – CUP EXPANDERS

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, paint thinner, or similar solvents. These products may leave a residue that could damage the piston and seal.

INSPECTION

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

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

CAUTION: If the caliper piston is replaced, install the same type of piston in the caliper. Never interchange phenolic resin and steel caliper pistons. The pistons, seals, seal grooves, caliper bore and piston tolerances are different.

The bore can be **lightly** polished with a brake hone to remove very minor surface imperfections (Fig. 57). 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).

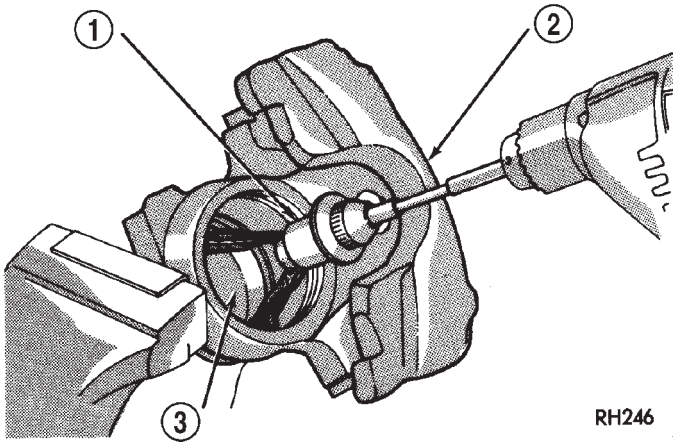


Fig. 57 Polishing Piston Bore

1 – SPECIAL HONE
2 – CALIPER
3 – PISTON BORE

CLEANING AND INSPECTION (Continued)

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. 58).

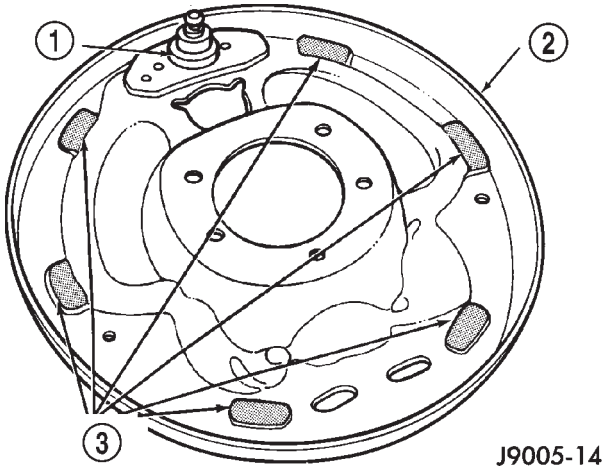


Fig. 58 Shoe Contact Surfaces

1 – ANCHOR PIN
2 – SUPPORT PLATE
3 – 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

BRAKE LAMP SWITCH

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

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

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

CAUTION: Booster damage may occur if the pedal pull exceeds 20 lbs..

PARKING BRAKE CABLE TENSIONER

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

ADJUSTMENTS (Continued)

ADJUSTMENT

(1) Raise vehicle.

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

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

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

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

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

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

(8) Raise vehicle and mark tensioner rod 6.5 mm (1/4 in.) from tensioner bracket (Fig. 59).

(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.

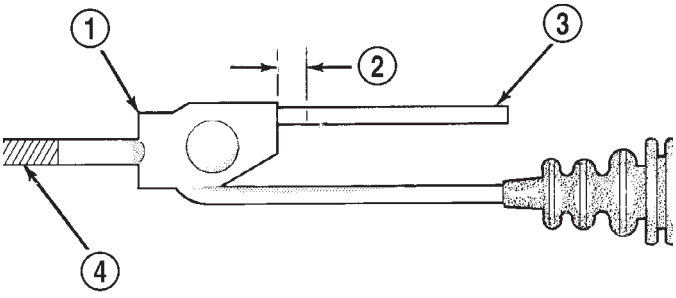


Fig. 59 Tensioner Rod Measurement

1 – TENSIONER BRACKET
2 – 6.5 mm (1/4 in.)
3 – TENSIONER ROD
4 – ROD TO EQUALIZER

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. 60).

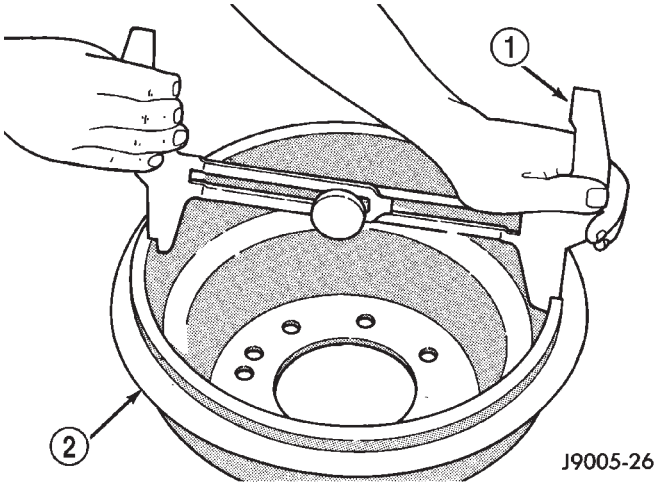


Fig. 60 Adjusting Gauge On Drum

1 – BRAKE GAUGE
2 – BRAKE DRUM

(5) Reverse gauge and install it on brake shoes. Position gauge legs at shoe centers as shown (Fig. 61). 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.

ADJUSTMENTS (Continued)

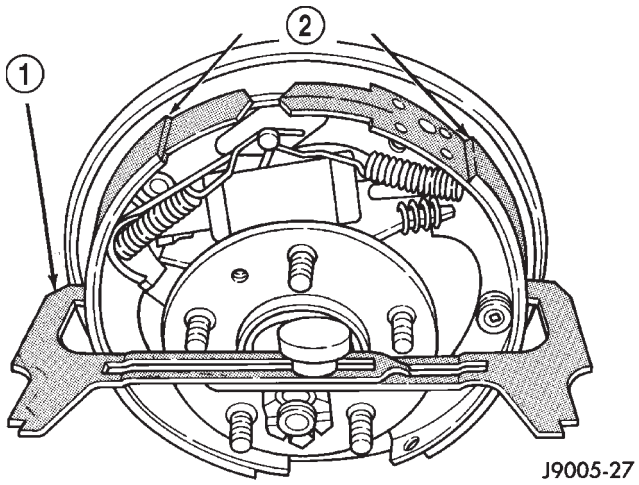


Fig. 61 Adjusting Gauge On Brake Shoes

1 – BRAKE GAUGE
2 – 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. 62).
(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.

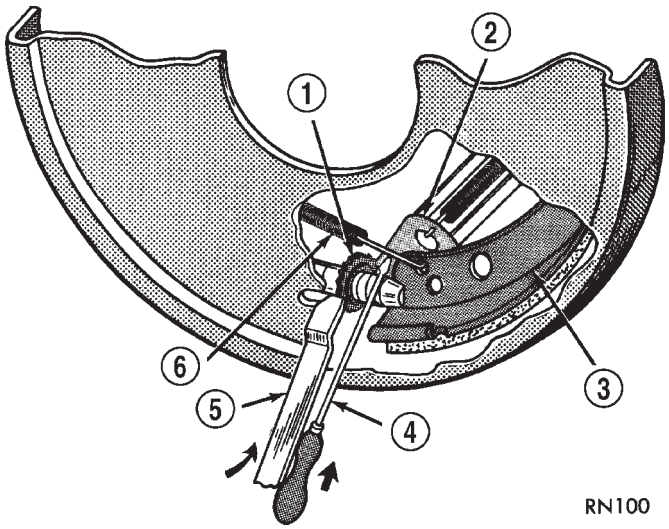


Fig. 62 Brake Adjustment

1 – STAR WHEEL
2 – LEVER
3 – BRAKE SHOE WEB
4 – SCREWDRIVER
5 – ADJUSTING TOOL
6 – ADJUSTER SPRING

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

SPECIFICATIONS

BRAKE FLUID

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

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

CAUTION: Never use any type of a petroleum-based fluid in the brake hydraulic system. Use of such type fluids will result in seal damage of the vehicle brake hydraulic system causing a failure of the vehicle brake system. Petroleum based fluids would be items such as engine oil, transmission fluid, power steering fluid, etc.

SPECIFICATIONS (Continued)

BRAKE COMPONENTS

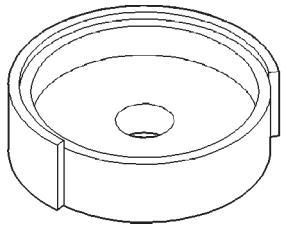
Disc Brake Caliper
Type . . . . . Sliding
Disc Brake Rotor
Type . . . . . Ventilated
Size . . . . . 279.4 x 23.876 mm (11 x 0.94 in.)
Max. Runout . . . . . 0.12 mm (0.005 in.)
Max. Thickness Variation . 0.013 mm (0.0005 in.)
Min. Thickness . . . . . 22.7 mm (0.8937 in.)
Brake Drum
Size . . . . . 228.6 x 63.5 mm (9 x 2.5 in.)
Brake Booster
Type . . . . . Tandem Diaphragm

TORQUE CHART

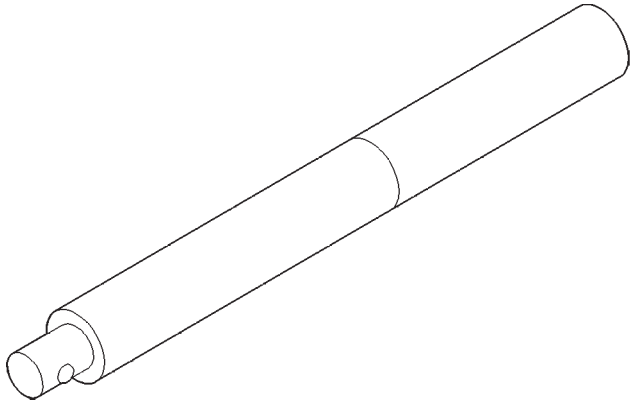
DESCRIPTION	TORQUE
Brake Pedal	
Support Bolt	28 N·m (21 ft. lbs.)
Brake Booster	
Mounting Nuts	39 N·m (29 ft. lbs.)
Master Cylinder	
Mounting Nuts	17 N·m (13 ft. lbs.)
Brake Lines	19 N·m (14 ft. lbs.)
Combination Valve	
Mounting Nuts	20 N·m (15 ft. lbs.)
Brake Lines	19 N·m (14 ft. lbs.)
Caliper	
Mounting Bolts	15 N·m (11 ft. lbs.)
Brake Hose Bolt	31 N·m (23 ft. lbs.)
Wheel Cylinder	
Mounting Bolts	10 N·m (7 ft. lbs.)
Brake Line	16 N·m (12 ft. lbs.)
Parking Brake	
Lever Bolts	12 N·m (9 ft. lbs.)
Lever Bracket Bolts	12 N·m (9 ft. lbs.)
Cable Retainer Nut	1.5 N·m (14 in. lbs.)

SPECIAL TOOLS

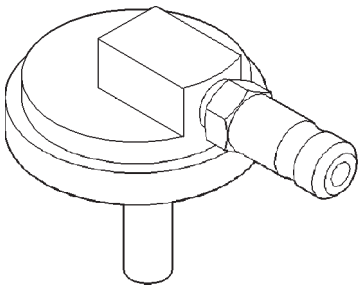
BASE BRAKES



Installer Caliper Dust Boot C-4842



Handle C-4171



Adaptor Cap Pressure Bleeder 6921

ANTILOCK BRAKES

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DESCRIPTION AND OPERATION

ANTILOCK BRAKE SYSTEM

DESCRIPTION

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

The antilock CAB activates the system whenever sensor signals indicate periods of high wheel slip. High wheel slip can be described as the point where wheel rotation begins approaching 20 to 30 percent of actual vehicle speed during braking. Periods of high wheel slip occur when brake stops involve high pedal pressure and rate of vehicle deceleration.

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

The static check occurs after the ignition switch is turned to Run position. The dynamic check occurs when vehicle road speed reaches approximately 30 kph (18 mph). During the dynamic check, the CAB briefly cycles the pump and solenoids to verify operation.

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

OPERATION

During normal braking, the master cylinder, power booster and wheel brake units all function as they would in a vehicle without ABS. The HCU components are not activated.

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

The ABS system has three fluid pressure control channels. The front brakes are controlled separately and the rear brakes in tandem. A speed sensor input signal indicating a high slip condition activates the CAB antilock program. Two solenoid valves are used in each antilock control channel. The valves are all located within the HCU valve body and work in pairs to either increase, hold, or decrease apply pressure as needed in the individual control channels. The solenoid valves are not static during antilock braking. They are cycled continuously to modulate pressure. Solenoid cycle time in antilock mode can be measured in milliseconds.

CONTROLLER ANTILOCK BRAKES

DESCRIPTION

The CAB operates the ABS system (Fig. 1) and is separate from other vehicle electrical circuits. The CAB is located under the instrument panel to the right side of the steering column. It is mounted to bracket with one bolt. The bracket is mounted to the front upper cowl panel.

OPERATION

The 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

DESCRIPTION AND OPERATION (Continued)

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.

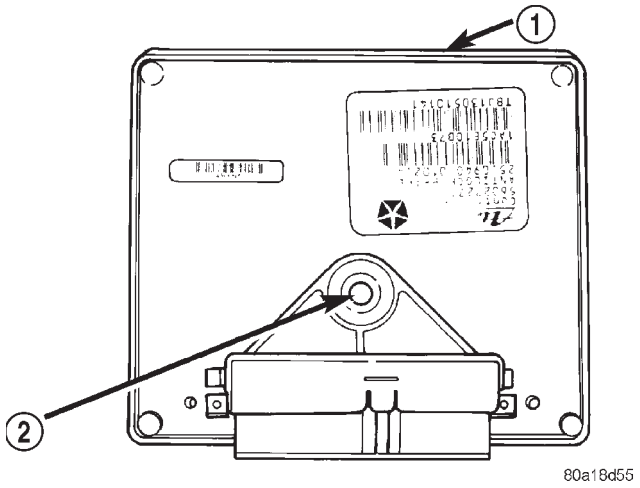


Fig. 1 Controller Antilock Brakes

1 – CAB
2 – MOUNTING HOLE

HYDRAULIC CONTROL UNIT

DESCRIPTION

The hydraulic control unit (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.

OPERATION

The HCU 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.

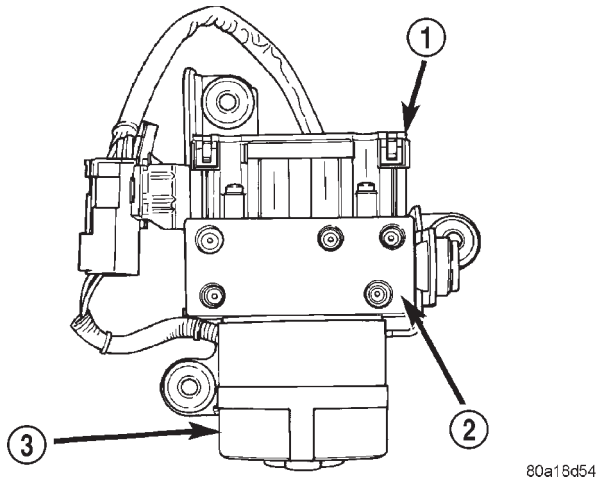


Fig. 2 Hydraulic Controller Unit

1 – SOLENOID BODY
2 – VALVE BODY
3 – PUMP MOTOR

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

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

PRESSURE DECREASE

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

A pressure decrease cycle is initiated when speed sensor signals indicate high wheel slip at one or more wheels. At this point, the CAB 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.

DESCRIPTION AND OPERATION (Continued)

WHEEL SPEED SENSORS AND TONE WHEEL

DESCRIPTION

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

OPERATION

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

A gear type tone ring serves as the trigger mechanism for each sensor. The tone rings are mounted at the outboard ends of the front and rear axle shafts.

Different sensors are used at the front and rear wheels (Fig. 3). The front/rear sensors have the same electrical values but are not interchangeable. The sensors have a resistance between 900 and 1300 ohms.

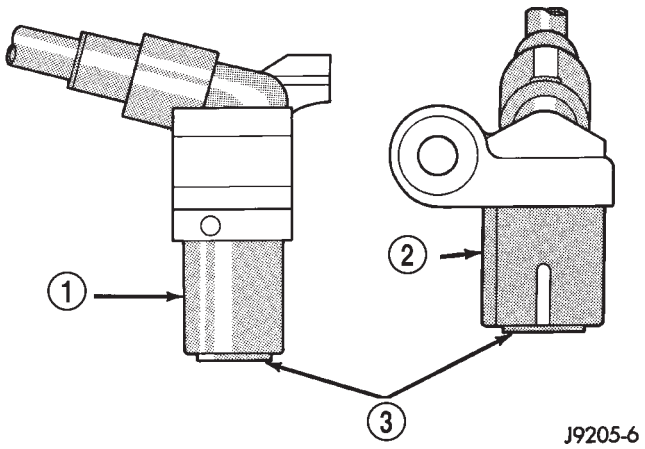


Fig. 3 Typical Wheel Speed Sensors

1 – FRONT SENSOR
2 – REAR SENSOR
3 – PICKUP FACE

FRONT SENSOR AIR GAP

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

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

REAR SENSOR AIR GAP

A rear sensor air gap adjustment is only needed when reinstalling an original sensor. Replacement sensors have an air gap spacer attached to the sensor pickup face. The spacer establishes correct air gap when pressed against the tone ring during installation. As the tone ring rotates, it peels the spacer off the sensor to create the required air gap. Rear sensor air gap is 0.28-1.5 mm (0.011-0.059 in.).

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

COMBINATION VALVE

DESCRIPTION

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.

OPERATION

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.

G-SWITCH

DESCRIPTION

The G-switch is located in front of the console/shifter mounted to a bracket on the floor pan. The switch has directional arrow and must be mounted with the arrow pointing towards the front of the vehicle.

OPERATION

The switch (Fig. 4), provides an additional vehicle deceleration reference during 4-wheel drive operation. The switch is monitored by the CAB at all

DESCRIPTION AND OPERATION (Continued)

times. The switch reference signal is utilized by the CAB when all wheels are decelerating at the same speed.

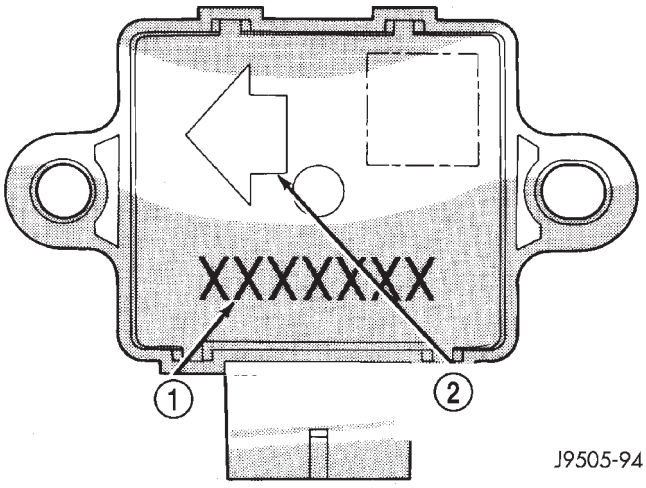


Fig. 4 G-Switch

1 – SWITCH PART NUMBER
2 – ARROW INDICATES FRONT OF SWITCH FOR PROPER MOUNTING

ABS WARNING LAMP

DESCRIPTION

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.

OPERATION

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

CONTROLLER ANTILOCK BRAKES

REMOVAL

(1) Remove negative battery terminal.

(2) Remove the harness connector from the CAB located underneath the instrument panel (Fig. 5).

(3) Remove mounting bolt and remove the CAB.

INSTALLATION

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

(2) Tighten the mounting bolt to 7-9 N·m (60-80 in. lbs.).

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

(4) Install negative battery cable.

HYDRAULIC CONTROL UNIT

REMOVAL

(1) Disconnect and isolate the negative battery terminal.

(2) Disconnect the HCU harness connectors.

REMOVAL AND INSTALLATION (Continued)

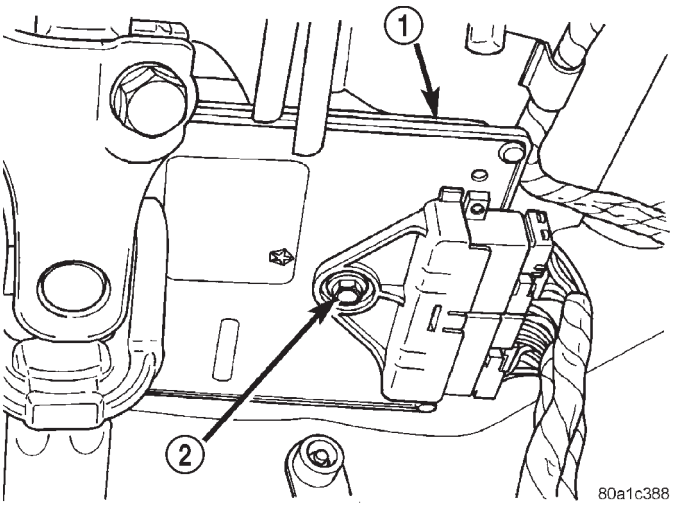


Fig. 5 Controller Antilock Brakes

1 – CAB
2 – MOUNTING BOLT

(3) Remove all the brake lines from the HCU (Fig. 6).

(4) Remove HCU mounting bolts and remove HCU (Fig. 7).

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

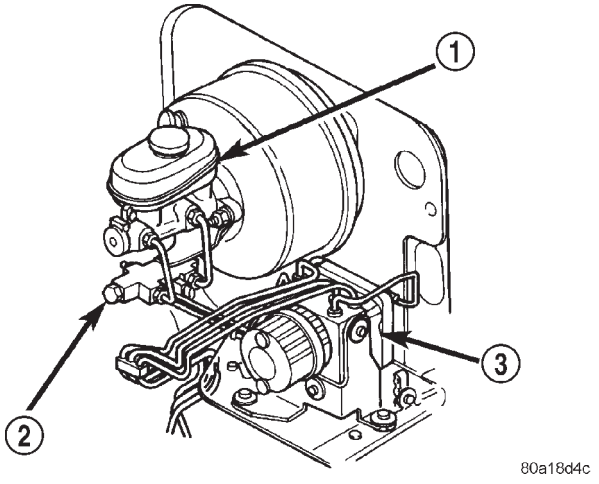


Fig. 6 HCU Brake Lines

1 – MASTER CYLINDER
2 – COMBINATION VALVE
3 – HCU

INSTALLATION

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

(2) Install HCU and tighten mounting bolts to 9-13 N·m (80-115 in. lbs.).

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

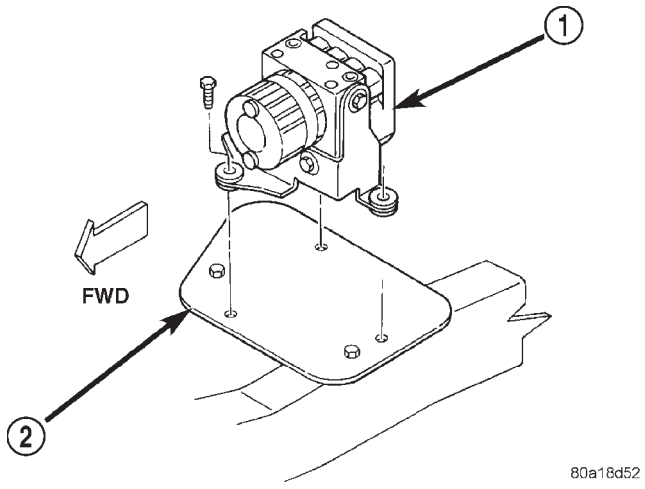


Fig. 7 HCU Mount

1 – HCU
2 – HCU MOUNT

(4) Tighten brake lines to 15-18 N·m (130-160 in. lbs.).

(5) Connect HCU harness.

(6) Connect negative battery terminal.

(7) Bleed complete brake system.

FRONT WHEEL SENSOR

REMOVAL

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

(2) Disconnect sensor wire connector at harness plug.

(3) Remove sensor wire from mounting retainers.

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

(5) Remove bolt attaching sensor to steering knuckle and remove sensor (Fig. 8).

INSTALLATION

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

(2) Apply Mopar Lock N' Seal or Loctite ® 242 on 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 4-6 N·m (34-50 in. lbs.).

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

REMOVAL AND INSTALLATION (Continued)

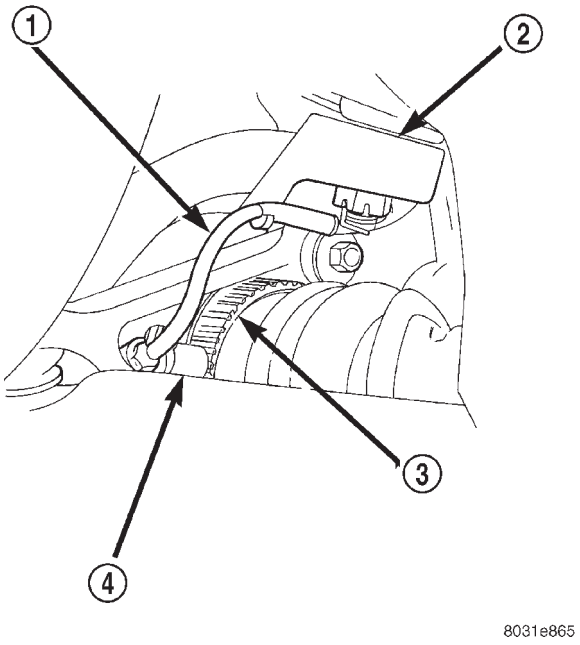


Fig. 8 Front Wheel Speed Sensor

1 – WHEEL SPEED SENSOR PIGTAIL
2 – STEERING KNUCKLE
3 – TONE WHEEL
4 – FRONT WHEEL SPEED SENSOR

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

(7) Connect sensor wire to harness.

REAR WHEEL SPEED SENSOR

REMOVAL

(1) Disconnect sensors at rear harness connectors.

(2) Remove wheel and tire assembly.

(3) Remove brake drum.

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

(5) Unseat sensor wire support plate grommet.

(6) Remove bolt attaching sensor to bracket (Fig. 9) and remove sensor.

INSTALLATION

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

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

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

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

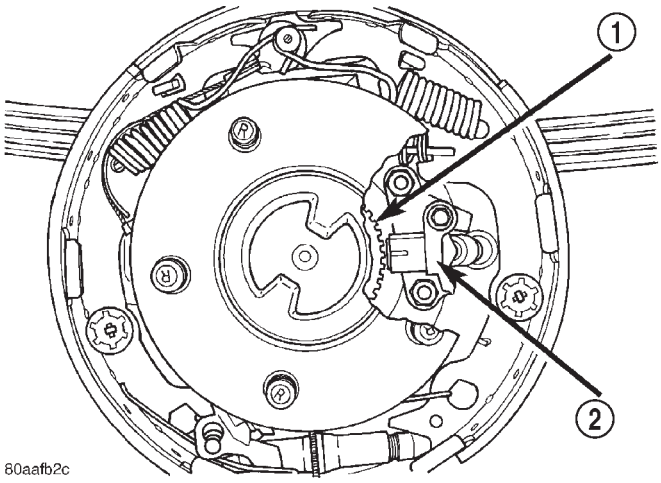


Fig. 9 Wheel Speed Sensor

1 – TONE WHEEL
2 – WHEEL SPEED SENSOR

(5) If **original** rear sensor was installed, adjust sensor air gap to 0.28-1.5 mm (0.011-0.059 in.). Use feeler gauge to measure air gap (Fig. 10). Tighten sensor bolt to 12-14 N·m (106-124 in. lbs.).

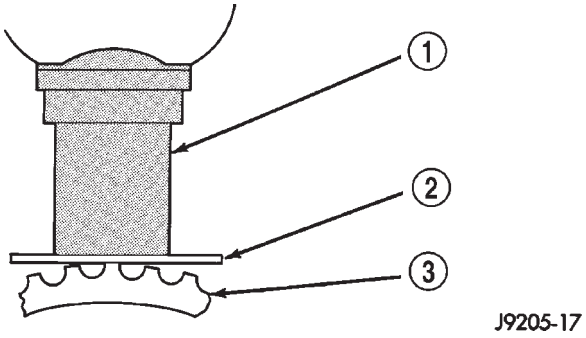


Fig. 10 Setting Air Gap On Original Rear Sensor

1 – WHEEL SPEED SENSOR
2 – BRASS FEELER GAUGE
3 – TONE RING

(6) If **new** sensor was installed, push cardboard spacer on sensor face against tone ring (Fig. 11). Then tighten sensor bolt to 12-14 N·m (106-124 in. lbs.). Correct air gap will be established as tone ring rotates and peels spacer off sensor face.

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

(8) Connect sensor wire to harness connector.

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

(10) Lower vehicle.

(11) Connect sensor wire to harness connector.

REMOVAL AND INSTALLATION (Continued)

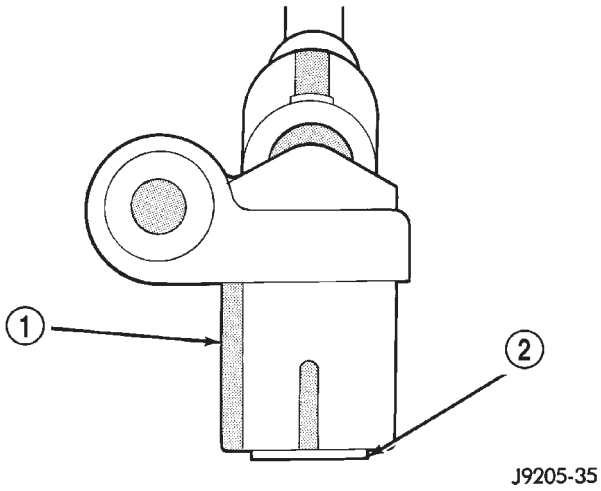


Fig. 11 New Rear Sensor

1 – REAR SENSOR
2 – AIR GAP SPACER ATTACHED TO SENSOR FACE

COMBINATION VALVE

REMOVAL

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

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

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

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

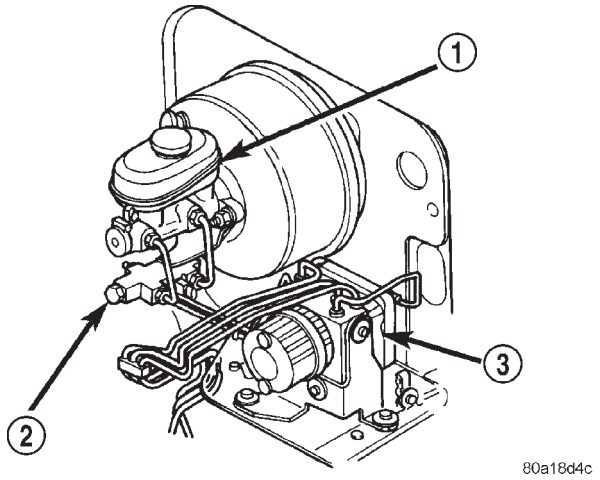


Fig. 12 Combination Valve Brake Lines

1 – MASTER CYLINDER
2 – COMBINATION VALVE
3 – HCU

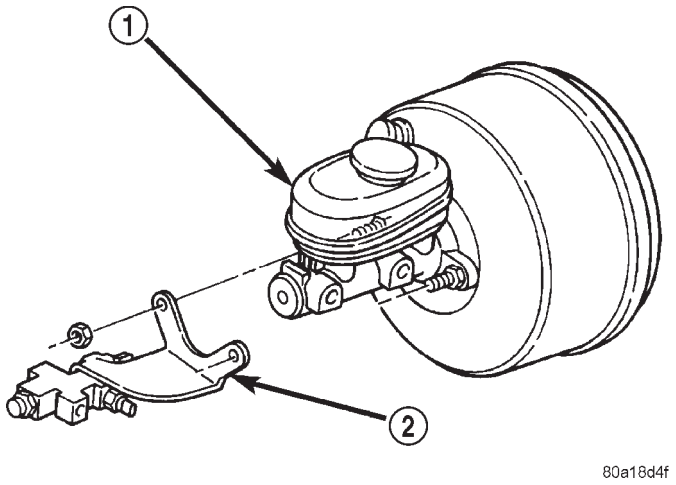


Fig. 13 Combination Valve Bracket

1 – MASTER CYLINDER
2 – COMBINATION VALVE BRACKET

INSTALLATION

(1) Position valve bracket on booster studs and tighten bracket attaching nuts to 17 N·m (13 ft. lbs.).

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

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

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

(5) Tighten brake line fittings at HCU to 16 N·m (12 ft. lbs.).

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

(7) Bleed base brake system.

G-SWITCH

REMOVAL

(1) From the drivers side lift carpet back in front of the console/shifter.

(2) Disconnect harness for switch.

(3) Remove mounting bolts and remove switch (Fig. 14).

INSTALLATION

CAUTION: The mercury switch (inside the G-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. 15).

(1) Position switch on mounting bracket.

(2) Install mounting bolts and tighten to 4-5 N·m (35-45 in. lbs.)

REMOVAL AND INSTALLATION (Continued)

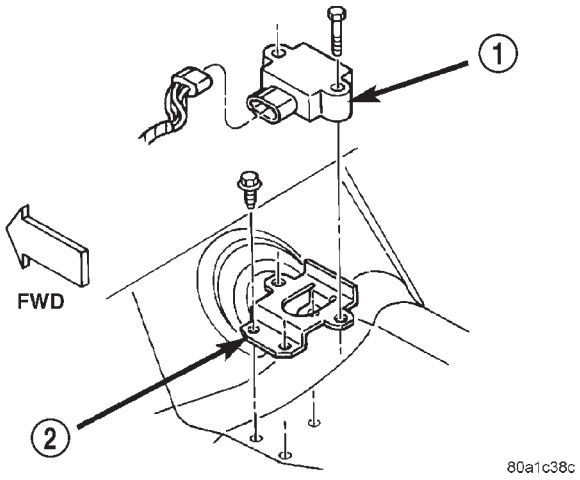


Fig. 14 G-Switch

1 – ACCELERATION SWITCH
2 – MOUNTING BRACKET

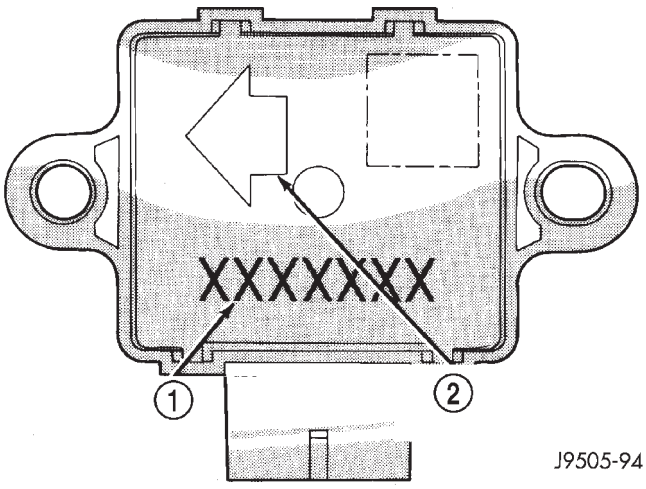


Fig. 15 G-Switch Position Indicator

1 – SWITCH PART NUMBER
2 – ARROW INDICATES FRONT OF SWITCH FOR PROPER MOUNTING

(3) Connect harness to switch.
(4) Place carpet back into position.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
G-Sensor	
Sensor Bolt	4-5 N·m (35-45 in. lbs.)
Bracket Bolt	8-13 N·m (75-115 in. lbs.)
Hydraulic Control Unit	
Bracket to HCU Bolts	6.5 N·m (57 in. lbs.)
Body Bracket Bolts	16-24 N·m (142-212 in. lbs.)
HCU to Body Bracket Bolts	9-13 N·m (80-115 in. lbs.)
Brake Lines	15-18 N·m (130-160 in. lbs.)
Controller Anitlock Brakes	
Mounting Bolt	7-9 N·m (60-80 in. lbs.)
Wheel Speed Sensors	
Front Mounting Bolt	4-6 (34-50 in. lbs.)
Rear Mounting Bolt	12-14 N·m (106-124 in. lbs.)

CLUTCH

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DESCRIPTION AND OPERATION

CLUTCH

DESCRIPTION

The clutch mechanism consists of a flywheel, a single, dry-type disc, and a diaphragm style clutch cover (Fig. 1). A hydraulic linkage is used to operate the clutch release bearing and fork. The flywheel is bolted to the rear flange of the crankshaft. The clutch pressure plate is bolted to the flywheel with the clutch disc located between these two components. The clutch system provides the mechanical, but still easily detachable, link between the engine and the transmission. The system is designed to ensure that the full torque output of the engine is transfered to the transmission while isolating the transmission from the engine firing pulses to minimize concerns such as gear rattle.

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.

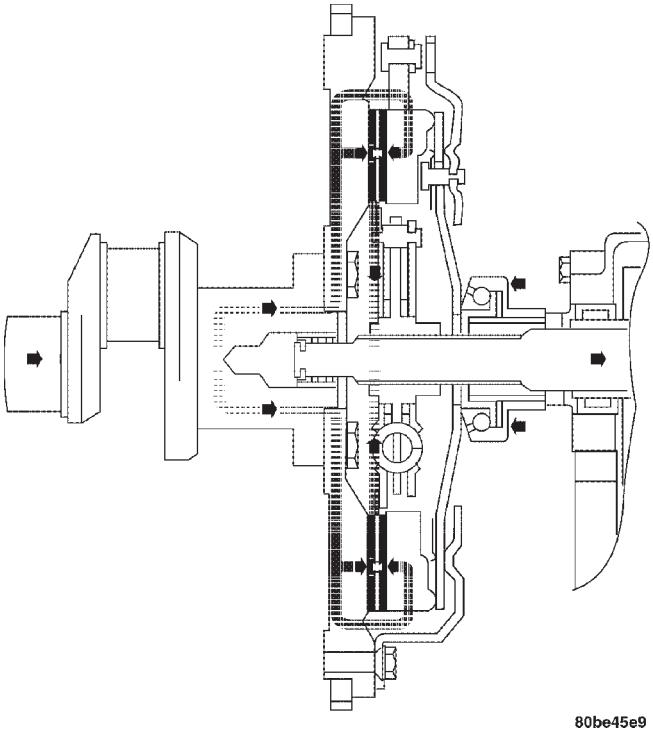


Fig. 1 Engine Powerflow

The clutch master cylinder push rod is connected to the clutch pedal. When the clutch pedal is depressed, the slave cylinder is operated by the

DESCRIPTION AND OPERATION (Continued)

clutch master cylinder mounted on the dash panel. The release fork is actuated by the hydraulic slave cylinder mounted on the transmission housing. The release bearing is operated by a release fork pivoting on a ball stud mounted in the transmission housing. The release bearing then depresses the pressure plate spring fingers, thereby releasing pressure on the clutch disc and allowing the engine crankshaft to spin independently of the transmission input shaft (Fig. 2).

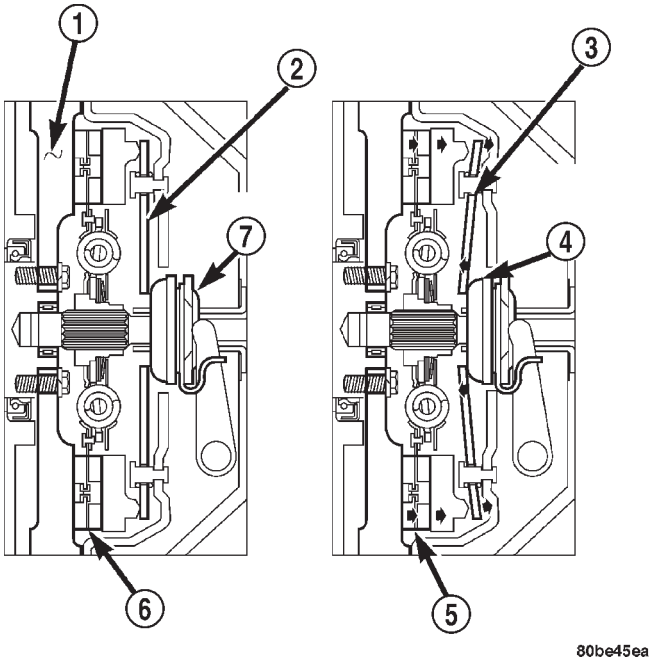


Fig. 2 Clutch Operation

1 – FLYWHEEL
2 – PRESSURE PLATE FINGERS
3 – PIVOT POINT
4 – RELEASE BEARING PUSHED IN
5 – CLUTCH DISC ENGAGED
6 – CLUTCH DISC ENGAGED
7 – RELEASE BEARING

FLYWHEEL

DESCRIPTION

The flywheel (Fig. 3) is a heavy plate bolted to the rear of the crankshaft. The flywheel incorporates the ring gear around the outer circumference to mesh with the starter to permit engine cranking. The rear face of the flywheel serves as the driving member to the clutch disc.

OPERATION

The flywheel serves to dampen the engine firing pulses. The heavy weight of the flywheel relative to the rotating mass of the engine components serves to stabilize the flow of power to the remainder of the drivetrain. The crankshaft has the tendency to attempt to speed up and slow down in response to the cylinder firing pulses. The flywheel dampens these impulses by absorbing energy when the crankshaft speeds and releasing the energy back into the system when the crankshaft slows down.

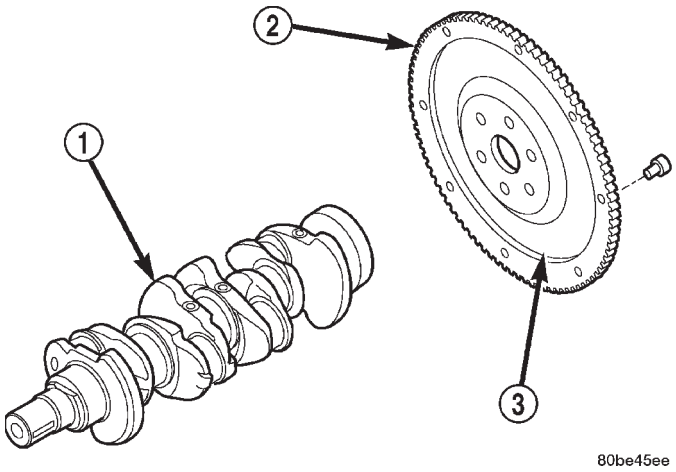


Fig. 3 Flywheel

1 – CRANKSHAFT
2 – RING GEAR
3 – FLYWHEEL

CLUTCH DISC

DESCRIPTION

The clutch disc friction material is riveted to the disc hub (Fig. 4). The hub bore is splined for installation on the transmission input shaft. The clutch disc has cushion springs in the disc hub to dampen disc vibrations during application and release of the clutch.

OPERATION

The clutch disc is held onto the surface of the flywheel by the force exerted by the pressure plate's diaphragm spring. The friction material of the clutch disc then transfers the engine torque from the flywheel and pressure plate to the input shaft of the transmission.

CLUTCH PRESSURE PLATE

DESCRIPTION

The clutch pressure plate assembly is a diaphragm type with a one-piece spring and multiple release fingers (Fig. 5). The pressure plate release fingers are preset during manufacture and are not adjustable. The assembly also contains the cover, pressure plate, and fulcrum components.

OPERATION

The clutch pressure plate assembly clamps the clutch disc against the flywheel. When the release

DESCRIPTION AND OPERATION (Continued)

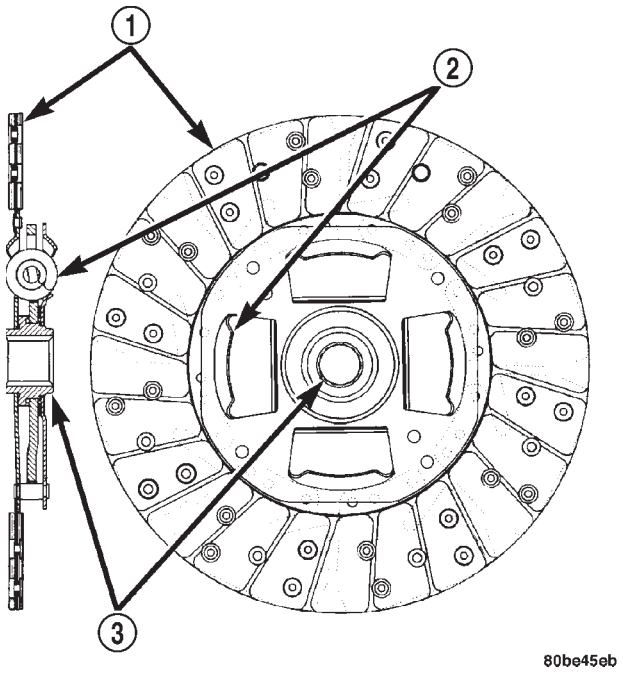


Fig. 4 Clutch Disc-Typical

1 – FACING MATERIAL
2 – DAMPER SPRINGS
3 – HUB

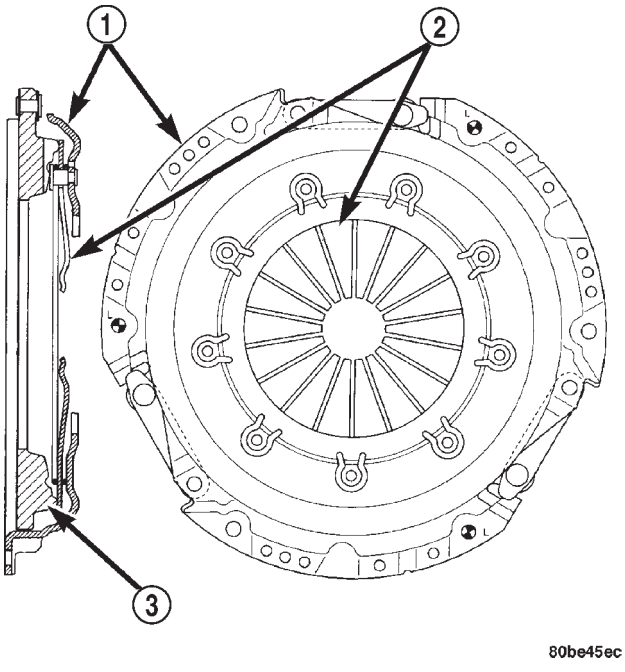


Fig. 5 Clutch Pressure Plate-Typical

1 – COVER
2 – RELEASE FINGERS
3 – PRESSURE PLATE

bearing is depressed by the shift fork, the pressure exerted on the clutch disc by the pressure plate spring is decreased. 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.

CLUTCH RELEASE BEARING

DESCRIPTION

A conventional release bearing (Fig. 6) is used to engage and disengage the clutch pressure plate assembly. The clutch release bearing is mounted on the transmission front bearing retainer. The bearing is attached to the release fork, which moves the bearing into contact with the clutch cover diaphragm spring.

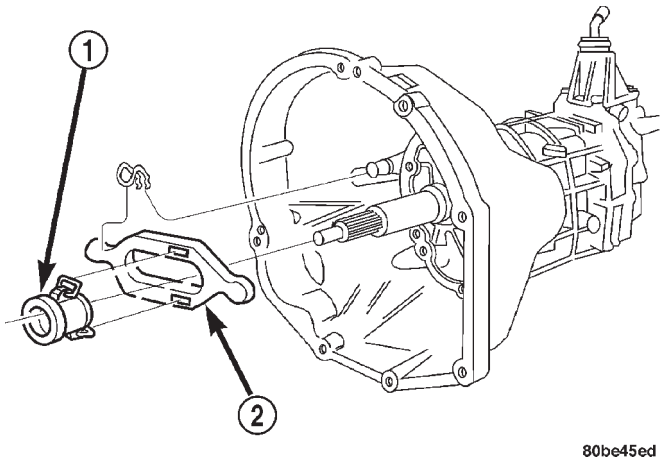


Fig. 6 Clutch Release Bearing

1 – RELEASE BEARING
2 – RELEASE FORK

OPERATION

The release bearing is operated by a release fork in the clutch housing. 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. Releasing pedal pressure removes clutch hydraulic pressure. The release bearing then moves away from the diaphragm spring which allows the pressure plate to exert clamping force on the clutch disc.

HYDRAULIC CLUTCH LINKAGE

DESCRIPTION

The hydraulic linkage consists of a clutch master cylinder with integral reservoir, a clutch slave cylinder and an interconnecting fluid line (Fig. 7).

DESCRIPTION AND OPERATION (Continued)

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.

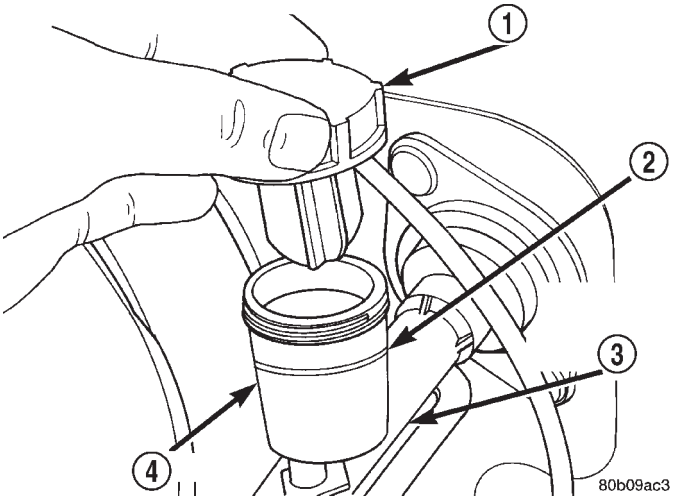


Fig. 7 Clutch Master Cylinder

1 – CAP
2 – FILL LINE
3 – CLUTCH MASTER CYLINDER
4 – RESERVOIR

OPERATION

The clutch linkage uses hydraulic pressure to operate the clutch. Depressing the clutch pedal develops fluid pressure in the clutch master cylinder. This pressure is transmitted to the slave cylinder through a connecting line. In turn, the slave cylinder operates the clutch release lever.

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.

DIAGNOSIS AND TESTING

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.

INSTALLATION METHODS AND PARTS USAGE

Distortion of clutch components during installation and the use of non-standard components are common causes of clutch malfunction.

Improper clutch cover bolt tightening can distort the cover. The usual result is clutch grab, chatter and rapid wear. Tighten the cover bolts as described in Removal and Installation section.

An improperly seated flywheel and/or clutch housing are additional causes of clutch failure. Improper seating will produce misalignment and additional clutch problems.

The use of non-standard or low quality parts will also lead to problems and wear. Use recommended factory quality parts to avoid comebacks.

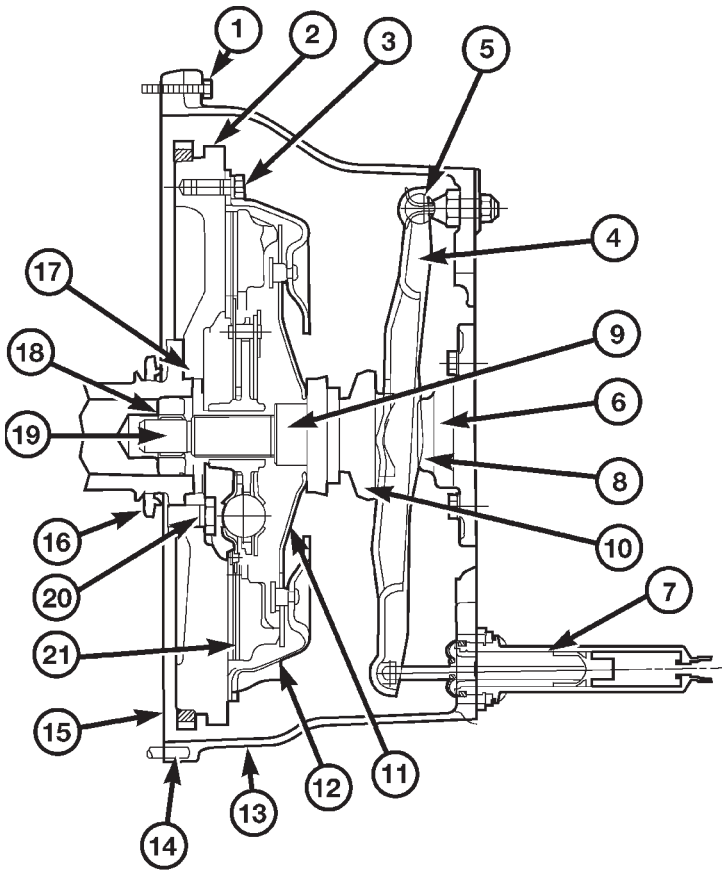
A cocked pilot bearing is another cause of clutch noise, drag, hard shifting, and rapid bearing wear. Always use an alignment tool to install a new bearing. This practice helps avoid cocking the bearing during installation.

CLUTCH DIAGNOSTIC INFORMATION

Unless the cause of a clutch problem is obvious, accurate problem diagnosis will usually require a road test to confirm a problem. Component inspection (Fig. 8) will then be required to determine the actual problem cause.

During a road test, drive the vehicle at normal speeds. Shift the transmission through all gear ranges and observe clutch action. If chatter, grab, slip, or improper release is experienced, remove and inspect the clutch components. However, if the problem is noise or hard shifting, further diagnosis may be needed as the transmission or another driveline component may be at fault. Careful observation during the test will help narrow the problem area.

DIAGNOSIS AND TESTING (Continued)



1 Check clutch housing bolts. Tighten if loose. Be sure housing is fully seated on engine block.

2 Check flywheel. Scuff sand face to remove glaze. Clean surface with wax and grease remover. Replace flywheel if severely scored, worn or cracked. Secure flywheel with new bolts (if removed). Do not reuse old bolts. Use Mopar Lock N'Seal on bolts.

3 Tighten clutch cover bolts 2–3 threads at a time, alternately and evenly (in a star pattern) to specified torque. Failure to do so could warp the cover.

4 Check release fork. Replace fork if bent or worn. Make sure pivot and bearing contact surfaces are lubricated.

5 Check release fork pivot (in housing). Be sure pivot is secure and ball end is lubricated.

6 Transmission input shaft bearing will cause noise, chatter, or improper release if damaged. Check condition before installing transmission.

7 Check slave cylinder. Replace it if leaking. Be sure cylinder is properly secured in housing and cylinder piston is seated in release fork.

8 Check input shaft seal if clutch cover and disc were oil covered. Replace seal if worn, or cut.

9 Inspect release bearing slide surface of trans. front bearing retainer. Surface should be smooth, free of nicks, scores. Replace retainer if necessary. Lubricate slide surface before installing release bearing.

10 Do not replace release bearing unless actually faulty. Replace bearing only if seized, noisy, or damaged.

11 Check clutch cover diaphragm spring and release fingers. Replace cover if spring or fingers are bent, warped, broken, cracked. Do not tamper with factory spring setting as clutch problems will result.

12 Check condition of clutch cover. Replace clutch cover if plate surface is deeply scored, warped, worn, or cracked. Be sure cover is correct size and properly aligned on disc and flywheel.

13 Inspect clutch housing. Be sure bolts are tight. Replace housing if damaged.

14 Verify that housing alignment dowels are in position before installing housing.

15 Clean engine block surface before installing clutch housing. Dirt, grime can produce misalignment.

16 Check rear main seal if clutch disc and cover were oil covered. Replace seal if necessary.

17 Check crankshaft flange (if flywheel is removed). Be sure flange is clean and flywheel bolt threads are in good condition.

18 Check pilot bearing. Replace bearing if damaged. Lube with Mopar high temp. bearing grease before installation.

19 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.

20 Check flywheel bolt torque. If bolts are loose, replace them. Use Mopar Lock N'Seal to secure new bolts.

21 Check clutch disc facing. Replace disc if facing is charred, scored, flaking off, or worn. Also check runout of new disc. Runout should not exceed 0.5 mm (0.02 in.).

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Fig. 8 Clutch Components And Inspection

DIAGNOSIS AND TESTING (Continued)

CLUTCH CONTAMINATION

Fluid contamination is a frequent cause of clutch malfunctions. Oil, water, or clutch fluid on the clutch disc and pressure plate surfaces will cause chatter, slip and grab.

During inspection, note if any components are contaminated with oil, hydraulic fluid, or water/road splash.

Oil contamination indicates a leak at either the rear main seal or transmission input shaft. Oil leakage produces a residue of oil on the housing interior and on the clutch cover and flywheel. Heat buildup caused by slippage between the cover, disc and flywheel, can sometimes bake the oil residue onto the components. The glaze-like residue ranges in color from amber to black.

Road splash contamination means dirt/water is entering the clutch housing due to loose bolts, housing cracks, or through hydraulic line openings. Driving through deep water puddles can force water/road splash into the housing through such openings.

Clutch fluid leaks are usually from damaged slave cylinder push rod seals. This type of leak can only be confirmed by visual inspection.

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 MISALIGNMENT

Clutch components must be in proper alignment with the crankshaft and transmission input shaft. Misalignment caused by excessive runout or warpage of any clutch component will cause grab, chatter and improper clutch release.

CLUTCH HOUSING MISALIGNMENT

Clutch housing alignment is important to proper clutch operation. The housing maintains alignment between the crankshaft and transmission input shaft. Misalignment can cause clutch noise, hard shifting, incomplete release and chatter. It can also result in premature wear of the pilot bearing, cover release fingers and clutch disc. In severe cases, misalignment can also cause premature wear of the transmission input shaft and front bearing.

Housing misalignment is generally caused by incorrect seating on the engine or transmission, loose housing bolts, missing alignment dowels, or housing damage. Infrequently, misalignment may also be caused by housing mounting surfaces that are not completely parallel. Misalignment can be corrected with shims.

CLUTCH FLYWHEEL RUNOUT

Check flywheel runout whenever misalignment is suspected. Flywheel runout should not exceed 0.08 mm (0.003 in.). Measure runout at the outer edge of the flywheel face with a dial indicator. Mount the indicator on a stud installed in place of one of the flywheel bolts.

Common causes of runout are:

- heat warpage
- improper machining
- incorrect bolt tightening
- improper seating on crankshaft flange shoulder
- foreign material on crankshaft flange

Flywheel machining is not recommended. The flywheel clutch surface is machined to a unique contour and machining will negate this feature. However, minor flywheel scoring can be cleaned up by hand with 180 grit emery, or with surface grinding equipment. Remove only enough material to reduce scoring (approximately 0.001 - 0.003 in.). Heavy stock removal is **not recommended.** Replace the flywheel if scoring is severe and deeper than 0.076 mm (0.003 in.). Excessive stock removal can result in flywheel cracking or warpage after installation; it can also weaken the flywheel and interfere with proper clutch release.

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing excessive runout. Use new bolts when remounting a flywheel and secure the bolts with Mopar® Lock And Seal. Tighten flywheel bolts to specified torque only. Overtightening can distort the flywheel hub causing runout.

DIAGNOSIS AND TESTING (Continued)

CLUTCH COVER AND DISC RUNOUT

Check the clutch disc before installation. Axial (face) runout of a **new** disc should not exceed 0.50 mm (0.020 in.). Measure runout about 6 mm (1/4 in.) from the outer edge of the disc facing. Obtain another disc if runout is excessive.

Check condition of the clutch before installation. A warped cover or diaphragm spring will cause grab and incomplete release or engagement. Be careful when handling the cover and disc. Impact can distort the cover, diaphragm spring, release fingers and the hub of the clutch disc.

Use an alignment tool when positioning the disc on the flywheel. The tool prevents accidental misalignment which could result in cover distortion and disc damage.

A frequent cause of clutch cover distortion (and consequent misalignment) is improper bolt tightening.

CLUTCH DIAGNOSIS CHARTS

The clutch inspection chart (Fig. 8) outlines items to be checked before and during clutch installation. Use the chart as a check list to help avoid overlooking potential problem sources during service operations.

The diagnosis charts describe common clutch problems, causes and correction. Fault conditions are listed at the top of each chart. Conditions, causes and corrective action are outlined in the indicated columns.

The charts are provided as a convenient reference when diagnosing faulty clutch operation.

DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
Disc facing worn out	1. Normal wear.	1. Replace cover and disc.
	2. Driver frequently rides (slips) the clutch. Results in rapid overheating and wear.	2. Replace cover and disc.
	3. Insufficient clutch cover diaphragm spring tension.	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.	1. Replace appropriate seal.
	2. Excessive amount of grease applied to the input shaft splines.	2. Remove grease and apply the correct amount of grease.
	3. Road splash, water entering housing.	3. Replace clutch disc. Clean clutch cover and reuse if in good condition.
	4. Slave cylinder leaking.	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.	1. Replace disc or cover as necessary.
	2. Improper bolt tightening procedure.	2. Tighten clutch cover using proper procedure.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
Facing on flywheel side of disc torn, gouged, or worn.	1. Flywheel surface scored or nicked.	2. Correct surface condition if possible. Replace flywheel and disc as necessary.
	2. Clutch disc sticking or binding on transmission input shaft.	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.	1. Correct condition of flywheel and pressure plate surface. Replace clutch cover and disc. Alert driver to problem cause.
	2. Driver frequently rides (slips) clutch. Results in rapid wear and overheating of disc and cover.	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.	1. Clean, smooth, and lubricate hub splines if possible. Replace disc if necessary.
	2. Input shaft splines rough, damaged, or corroded.	2. Clean, smooth, and lubricate shaft splines if possible. Replace input shaft if necessary.
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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
Clutch pedal squeak.	1. Pivot pin loose. 2. Master cylinder bushing not lubricated. 3. Pedal bushings worn out or cracked.	1. Tighten pivot pin if possible. Replace clutch pedal if necessary. 2. Lubricate master cylinder bushing. 3. Replace and lubricate bushings.
Clutch master or slave cylinder plunger dragging andør binding	1. Master or slave cylinder components worn or corroded.	1. Replace clutch hydraulic linkage assembly.
Release bearing is noisy.	1. Release bearing defective or damaged.	1. Replace release bearing.
Contact surface of release bearing damaged.	1. Clutch cover incorrect or release fingers bent or distorted. 2. Release bearing defective or damaged. 3. Release bearing misaligned.	1. Replace clutch cover and release bearing. 2. Replace the release bearing. 3. Check and correct runout of clutch components. Check front bearing sleeve for damage/ alignment. Repair as necessary.
Partial engagement of clutch disc. One side of disc is worn and the other side is glazed and lightly worn.	1. Clutch pressure plate position incorrect. 2. Clutch cover, spring, or release fingers bent or distorted. 3. Clutch disc damaged or distorted. 4. Clutch misalignment.	1. Replace clutch disc and cover. 2. Replace clutch disc and cover. 2. Replace clutch disc. 4. Check alignment and runout of flywheel, disc, pressure plate, andør clutch housing. Correct as necessary.

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.

SERVICE PROCEDURES (Continued)

CLUTCH FLUID LEVEL

The clutch fluid reservoir, master cylinder, slave cylinder and fluid lines are pre-filled with fluid at the factory during assembly operations.

The hydraulic system should not require additional fluid under normal circumstances. **The reservoir fluid level will actually increase as normal clutch wear occurs. Avoid overfilling, or removing fluid from the reservoir.**

Clutch fluid level is checked at the master cylinder reservoir (Fig. 9). An indicator ring is provided on the outside of the reservoir. With the cap and diaphragm removed, fluid level should not be above indicator ring.

To avoid contaminating the hydraulic fluid during inspection, wipe reservoir and cover clean before removing the cap.

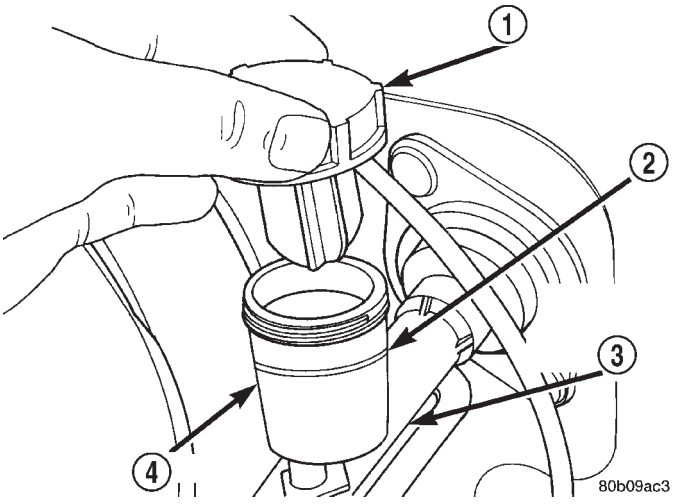


Fig. 9 Clutch Master Cylinder Reservoir And Cap

1 – CAP
2 – FILL LINE
3 – CLUTCH MASTER CYLINDER
4 – RESERVOIR

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
- 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.

SERVICE PROCEDURES (Continued)

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. 10).

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. 10). 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. 10). Replace cover if this surface is worn, heat checked, cracked, or scored.

(6) Insert clutch alignment tool in clutch disc (Fig. 11).

(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. 10). If disc is not marked, place flat side of disc against flywheel.

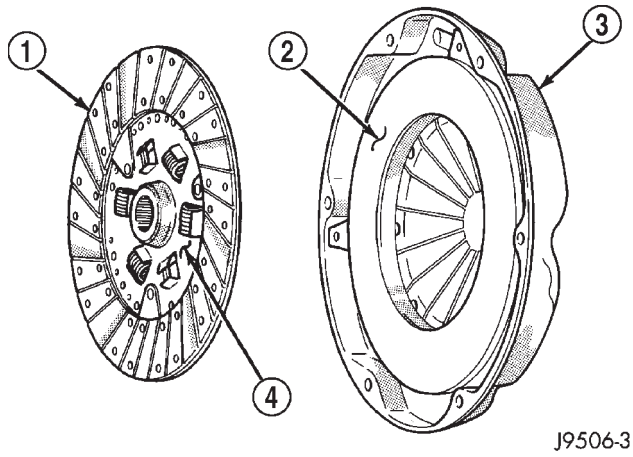


Fig. 10 Clutch Disc And Pressure Plate Inspection

1 – DISC
2 – INSPECT THIS SURFACE
3 – CLUTCH COVER
4 – "FLYWHEEL SIDE" STAMPED ON THIS SURFACE

(8) Position clutch cover over disc and on flywheel (Fig. 11).

(9) Install clutch cover bolts finger tight.

(10) Tighten cover bolts evenly and in rotation a few threads at a time. **Cover bolts must be tightened evenly and to specified torque to avoid distorting cover. Tightening torques are 31 N·m (23 ft. lbs.) on 2.5L engines and 52 N·m (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).

REMOVAL AND INSTALLATION (Continued)

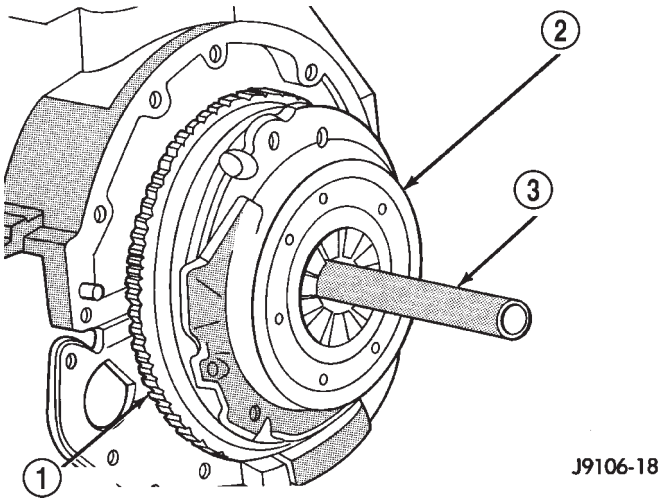


Fig. 11 Typical Method Of Aligning Clutch Disc

1 – FLYWHEEL
2 – CLUTCH COVER AND DISC
3 – CLUTCH DISC ALIGNMENT TOOL

(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. 12).

(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.

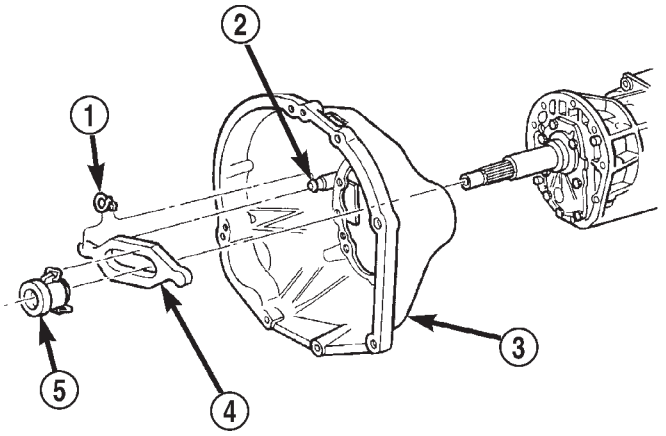


Fig. 12 Release Bearing Attachment

1 – RETURN SPRING
2 – PIVOT BALL STUD
3 – CLUTCH HOUSING
4 – RELEASE FORK
5 – RELEASE BEARING

PILOT BEARING

REMOVAL

(1) Remove transmission.

(2) Remove clutch cover and disc.

(3) Remove pilot bearing. Use internal (blind hole) puller such those as supplied in Snap–On® Tool Set CG40CB to remove bearing.

INSTALLATION

(1) Lubricate new bearing with Mopar® high temperature bearing grease.

(2) Start new bearing into crankshaft by hand. Then seat bearing with clutch alignment tool (Fig. 13).

(3) Lightly scuff sand flywheel surface with 180 grit emery cloth. Then clean surface with wax and grease remover.

(4) Install clutch disc and cover as described in this section.

(5) Install transmission.

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. 14). Recommended tightening torque for the clutch housing-to-transmission bolts is 46 N·m (34 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

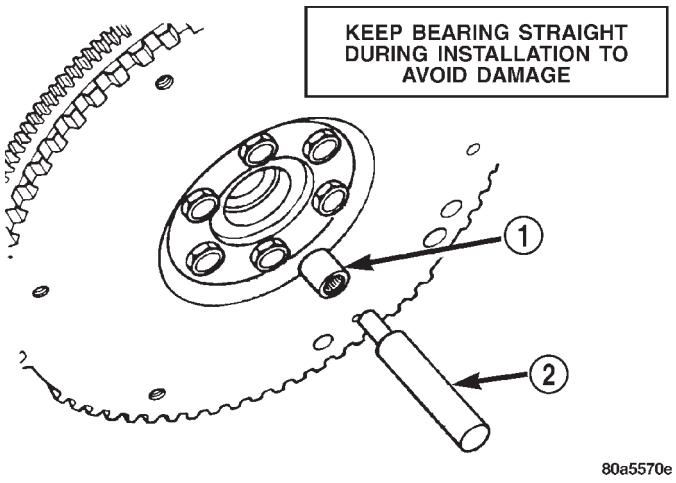


Fig. 13 Pilot Bearing Installation

1 – PILOT BEARING
2 – ALIGNMENT TOOL

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.

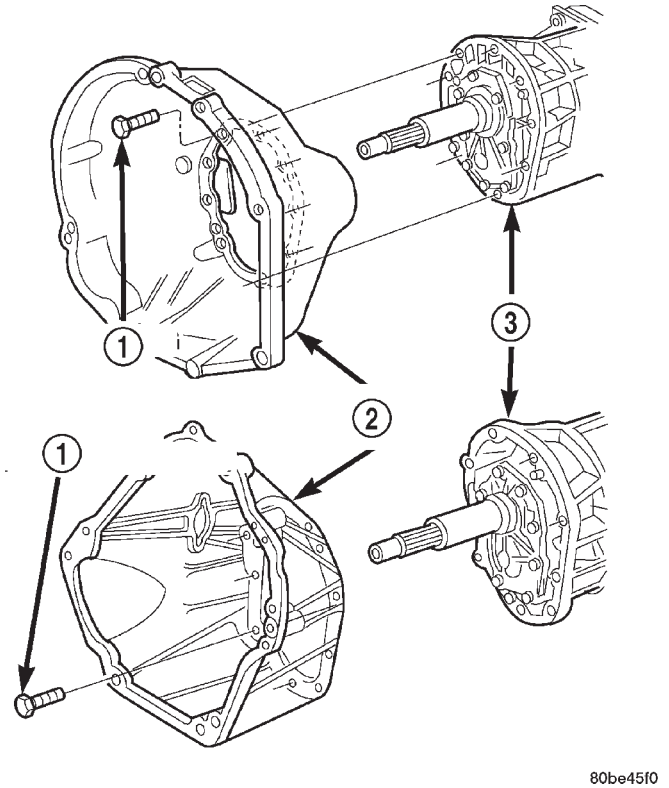


Fig. 14 Clutch Housing Attachment

1 – HOUSING —TO— TRANSMISSION BOLTS (46 N·m/34 ft. lbs.)
2 – CLUTCH HOUSING
3 – TRANSMISSION

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. 15).
(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. 15) or (Fig. 16).
(8) Disengage captured bushing on clutch master cylinder actuator from pivot pin on pedal arm.
(9) Slide actuator off pivot pin.
(10) Disconnect clutch interlock safety switch wires.
(11) Remove clutch hydraulic linkage through engine compartment.

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. 15) or (Fig. 16).
(3) Position clutch master cylinder on dash panel (Fig. 15) or (Fig. 16).
(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.

REMOVAL AND INSTALLATION (Continued)

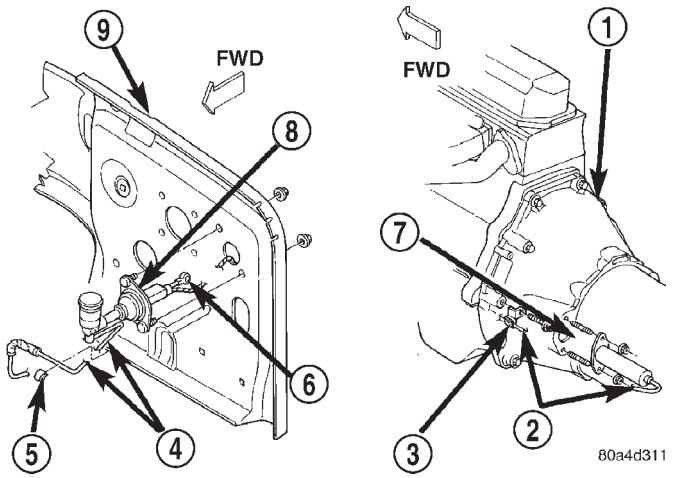


Fig. 15 Slave Cylinder and Left Hand Drive Clutch Master Cylinder

1 – CLUTCH HOUSING
2 – FLUID LINE
3 – BRACKET
4 – FLUID LINE
5 – CLIP
6 – CAPTURED BUSHING
7 – CLUTCH SLAVE CYLINDER
8 – CLUTCH MASTER CYLINDER
9 – DASH PANEL

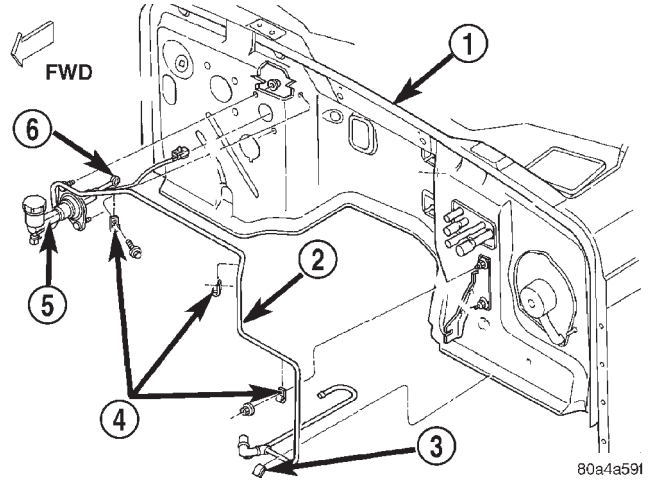


Fig. 16 Right Hand Drive Clutch Master Cylinder

1 – DASH PANEL
2 – FLUID LINE
3 – CLIP
4 – HOLD DOWN STRAP
5 – CLUTCH MASTER CYLINDER
6 – CAPTURED BUSHING

CLUTCH PEDAL

REMOVAL

(1) Remove steering column lower cover and knee blocker for access. Refer to Group 8E, Instrument Panel for procedure.

(2) Disconnect clutch pedal position switch wires.

(3) Disengage captured bushing lock tabs attaching clutch master cylinder actuator to pedal pivot (Fig. 17) or (Fig. 18).

(4) Remove nuts attaching pedal and bracket to dash panel and upper cowl support (Fig. 17) or (Fig. 18).

(5) Separate pedal assemble from vehicle.

INSTALLATION

(1) Place clutch pedal and bracket over studs on dash panel and cowl support (Fig. 17) or (Fig. 18).

(2) Install nuts to attach pedal and bracket to dash panel and upper cowl support (Fig. 17) or (Fig. 18). Tighten nuts to 39 N·m (29 ft. lbs.) torque

(3) Engage captured bushing and actuator on brake pedal pivot (Fig. 17) or (Fig. 18).

(4) Connect clutch pedal position switch wires.

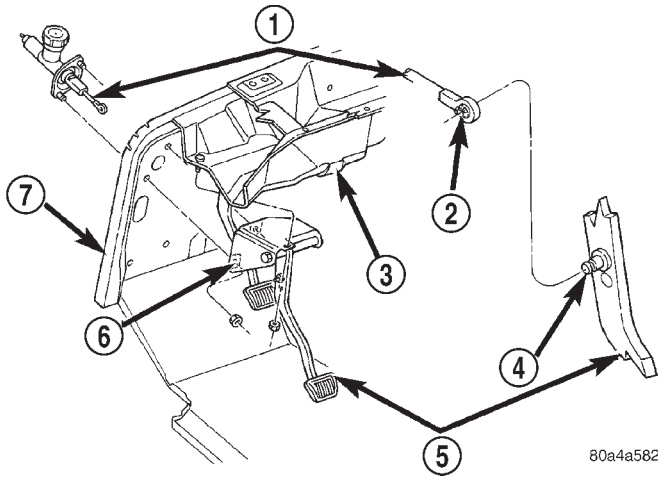


Fig. 17 Clutch Pedal Mounting

1 – CLUTCH CYLINDER ACTUATOR
2 – CAPTURED BUSHING
3 – UPPER COWL SUPPORT
4 – PIVOT
5 – CLUTCH PEDAL
6 – BRACKET
7 – DASH PANEL

REMOVAL AND INSTALLATION (Continued)

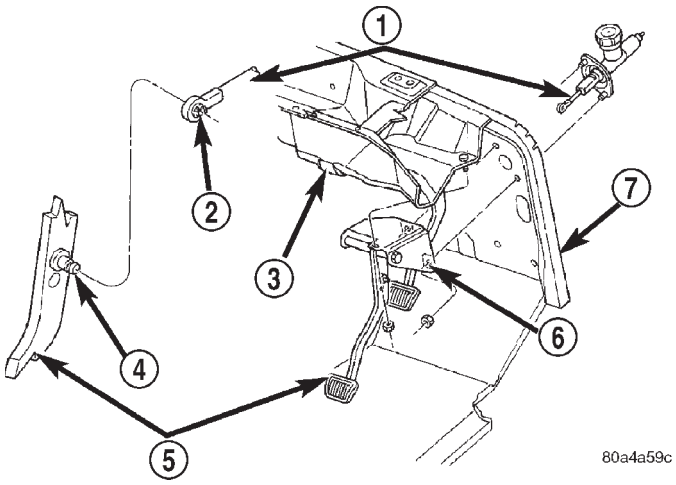


Fig. 18 Clutch Pedal Mounting—Right Hand Drive

1 – CLUTCH CYLINDER ACTUATOR
2 – CAPTURED BUSHING
3 – UPPER COWL SUPPORT
4 – PIVOT
5 – CLUTCH PEDAL
6 – BRACKET
7 – DASH PANEL

SPECIFICATIONS

TORQUE

DESCRIPTION	TORQUE
Bolts, clutch cover 2.5 L	31 N·m (23 ft. lbs)
Bolts, clutch cover 4.0 L	50 N·m (37 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.	46 N·m (34 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	95 N·m (70 ft. lbs)
Bolt, starter motor	45 N·m (33 ft. lbs)
Bolts, U-joints	19 N·m (170 in. lbs.)

COOLING SYSTEM

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DESCRIPTION AND OPERATION

COOLING SYSTEM

DESCRIPTION

The cooling system is designed to maintain engine temperature at an efficient level during all engine operating conditions.

The components of the cooling system are:

- A heavy duty radiator
- Cooling fan (mechanical)
- Thermal viscous fan drive
- Fan shroud
- Radiator pressure cap
- Thermostat
- Coolant reserve/overflow system
- Automatic transmission oil cooler (internal to radiator)
- Coolant
- Water pump
- Coolant hoses and clamps

OPERATION

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible. It also maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid (if equipped). The cooling system is pressurized and uses a centrifugal water

DESCRIPTION AND OPERATION (Continued)

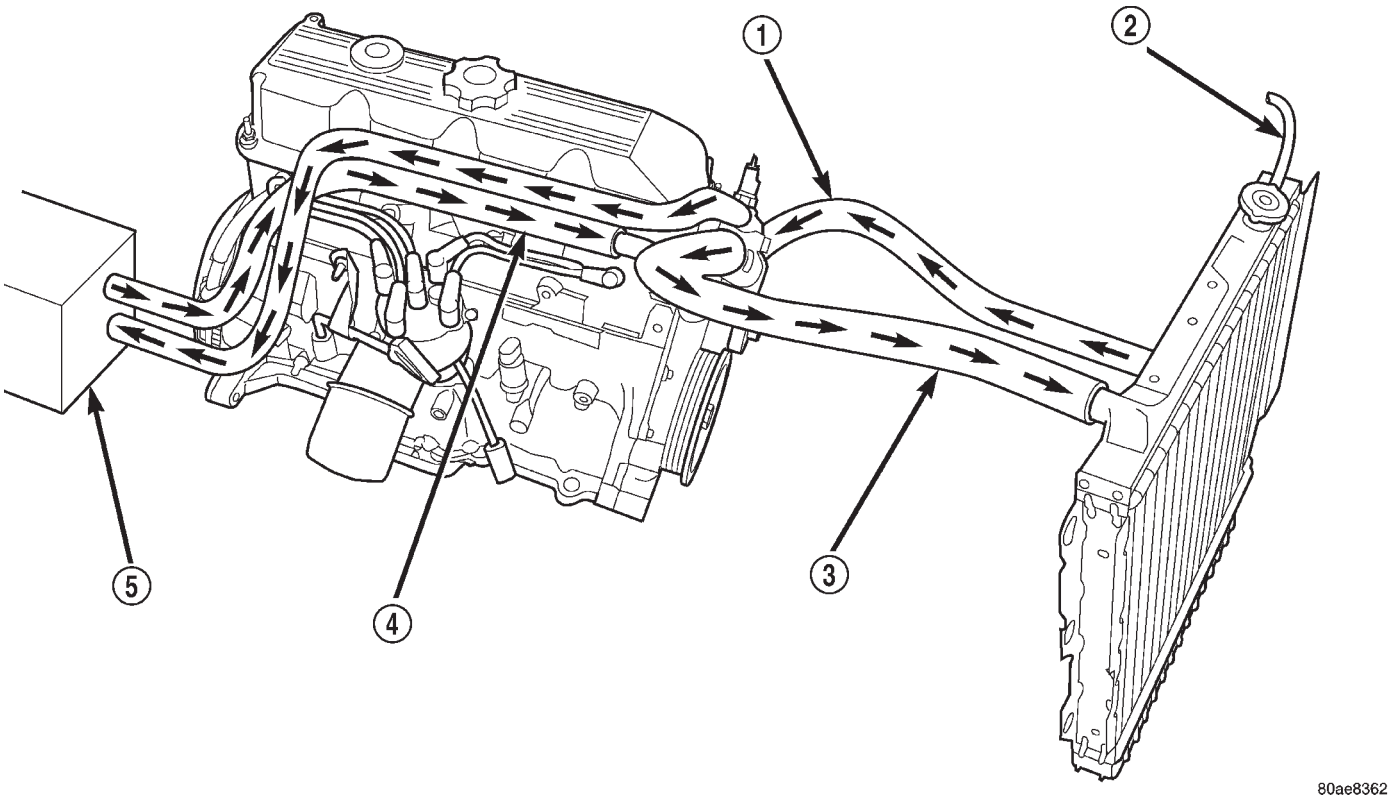


Fig. 1 Coolant Circulation—2.5L Engine

1 – RADIATOR LOWER HOSE
2 – TO COOLANT RECOVERY BOTTLE
3 – RADIATOR UPPER HOSE
4 – TO WATER PUMP
5 – HEATER CORE

pump on all engines to circulate coolant throughout the system.

A “Heavy Duty” Cooling Package is not available. The current package provides sufficient enough cooling capacity for vehicles used under extreme conditions such as trailer towing in high ambient temperatures.

RADIATOR

DESCRIPTION

CAUTION: Plastic tanks, while stronger than brass, are subject to damage by impact, such as wrenches, mishandling, etc.

A heavy duty down-flow aluminum/plastic radiator is used. The radiator consists of an aluminum core and plastic end tanks, which are fastened to the core with clinch tabs and sealed with a high temperature rubber gasket. On automatic transmission equipped vehicles, the lower tank contains a concentric-tube transmission oil cooler.

If the plastic tank has been damaged, individual parts are not available, and the radiator must be replaced.

OPERATION

As air passes through the radiator core, the heat within the coolant is dissipated into the ambient air.

BLOCK HEATER

DESCRIPTION

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE.

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.

DESCRIPTION AND OPERATION (Continued)

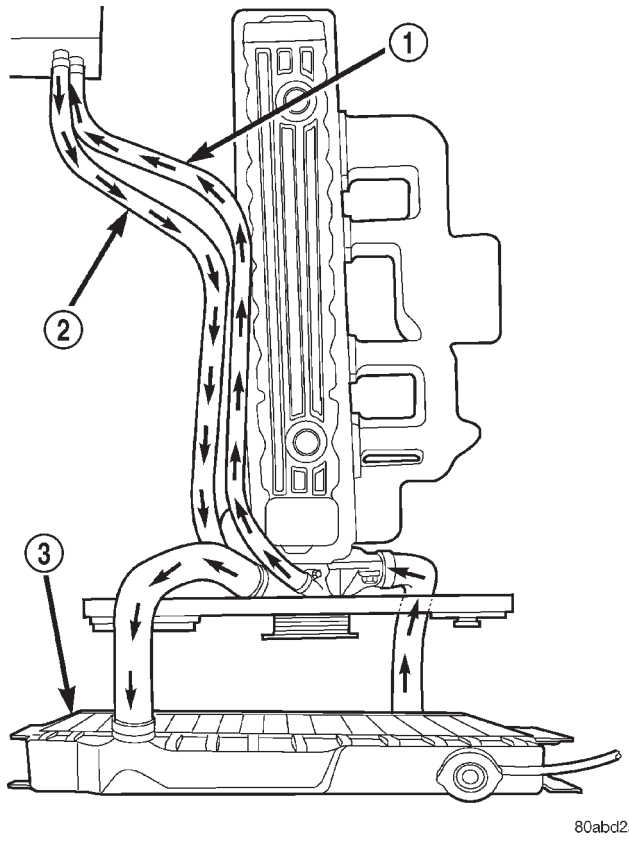


Fig. 2 Coolant Circulation—4.0L Engine

1 – FROM THERMOSTAT
2 – TO WATER PUMP
3 – RADIATOR

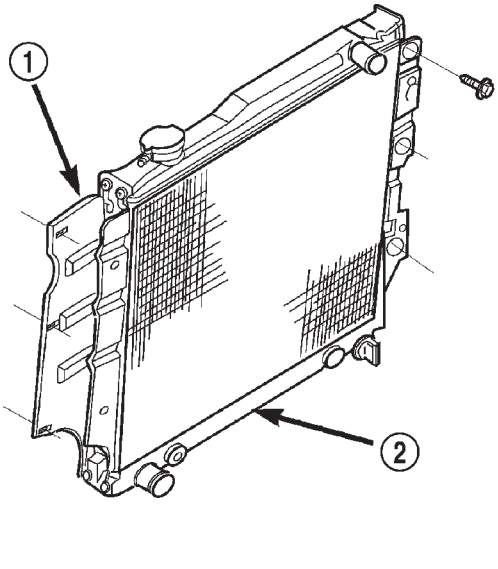


Fig. 3 Downflow Radiator—Typical

1 – DOWNFLOW RADIATOR
2 – INTEGRAL TRANSMISSION OIL COOLER (INTERNAL TO RADIATOR)

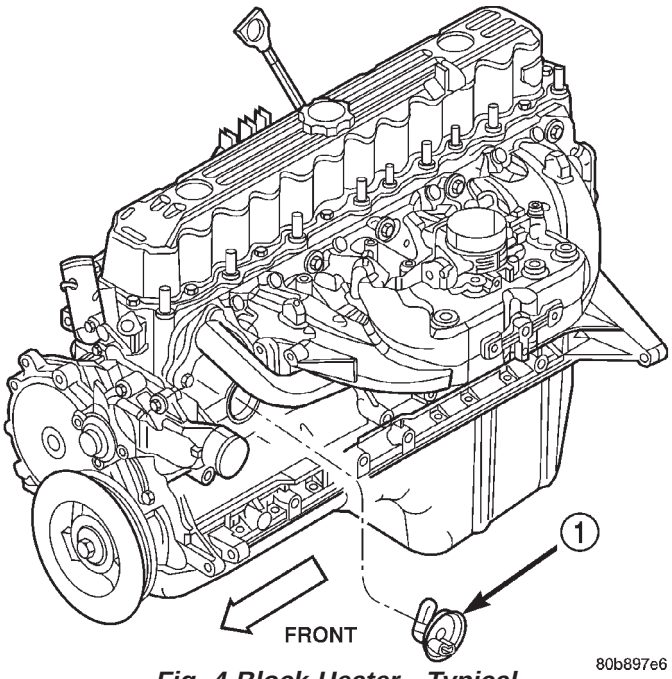


Fig. 4 Block Heater—Typical

1 – ENGINE BLOCK HEATER

OPERATION

Connecting the power cord to a grounded 110-120 volt AC electrical outlet with a grounded, three-wire extension cord, supplies the electricity required to heat the element thus heating the engine coolant.

TRANSMISSION OIL COOLER

DESCRIPTION

All models equipped with an automatic transmission are equipped with a transmission oil cooler (water-to-oil) mounted internally within the radiator tank. This internal cooler is supplied as standard equipment on all models equipped with an automatic transmission.

OPERATION

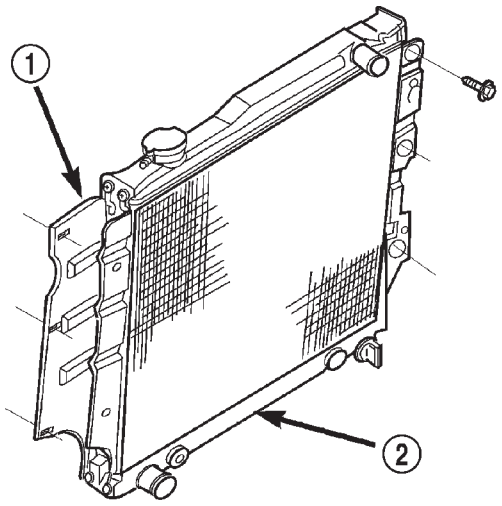
Transmission oil is cooled when it passes through this separate cooler. In case of a leak in the internal radiator mounted transmission oil cooler, engine coolant may become mixed with transmission fluid or transmission fluid may enter the cooling system. Both cooling system and transmission should be drained and inspected if the internal radiator mounted transmission cooler is leaking.

COOLANT RESERVOIR/OVERFLOW SYSTEM

DESCRIPTION

The coolant reserve/overflow system consists of a radiator mounted pressurized cap, a plastic coolant recovery bottle (Fig. 6), a tube (hose) connecting the

DESCRIPTION AND OPERATION (Continued)



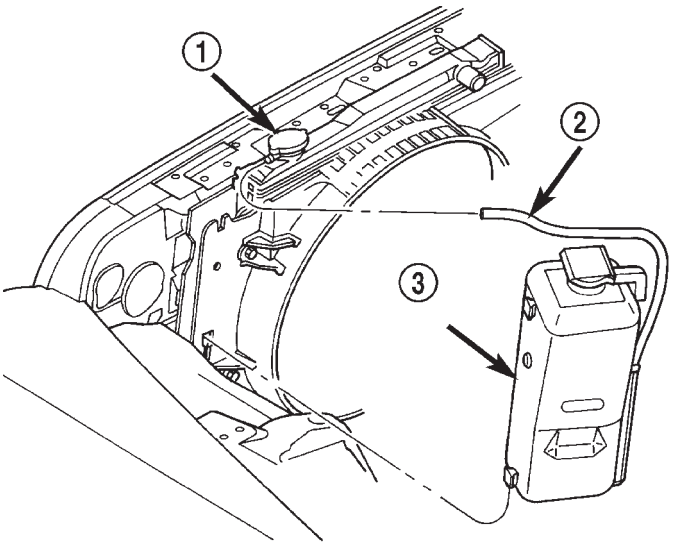
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Fig. 5 Radiator with Integral Transmission Oil Cooler

1 – DOWNFLOW RADIATOR
2 – INTEGRAL TRANSMISSION OIL COOLER (INTERNAL TO RADIATOR)

radiator and recovery bottle, and an overflow tube on the side of the bottle.

The reservoir bottle also has an anti-slosh insert located within the bottle, this insert will aid in reducing coolant loss from splash and spillage.



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Fig. 6 Coolant Recovery Bottle

1 – RADIATOR PRESSURE CAP
2 – HOSE
3 – COOLANT RECOVERY BOTTLE

OPERATION

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.

THERMOSTAT

DESCRIPTION

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

The thermostat on all gas powered engines is located beneath the thermostat housing at the front of the intake manifold.

The thermostat is a wax pellet driven, reverse poppet choke type.

Coolant leakage into the pellet container will cause the thermostat to fail in the open position. Thermostats very rarely stick. Do not attempt to free a thermostat with a prying device.

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 longer engine warmup time, unreliable warmup performance, increased exhaust emissions and crankcase condensation that can result in sludge formation.

OPERATION

The wax pellet is located in a sealed container at the spring end of the thermostat. When heated, the pellet expands, overcoming closing spring tension and water pump pressure to force the valve to open.

RADIATOR PRESSURE CAP

DESCRIPTION

All radiators are equipped with a pressure cap. This cap releases pressure at some point within a range of 83-124 kPa (12-18 psi). The pressure relief point (in pounds) is engraved on top of the cap (Fig. 8).

A rubber gasket seals the radiator filler neck. This is done to maintain vacuum during coolant cool-down and to prevent leakage when system is under pressure.

The cooling system will operate at pressures slightly above atmospheric pressure. This results in a

DESCRIPTION AND OPERATION (Continued)

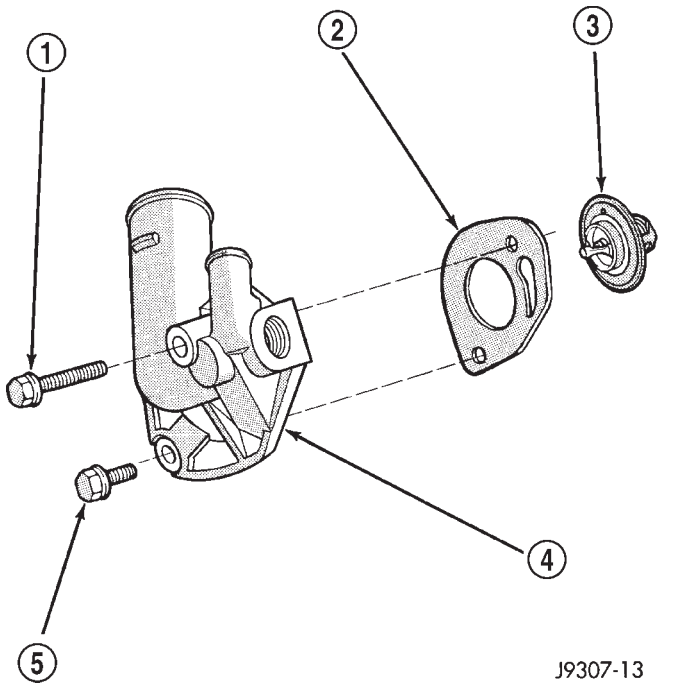


Fig. 7 Thermostat—Typical

1 – LONG BOLT
2 – GASKET
3 – THERMOSTAT
4 – THERMOSTAT HOUSING
5 – SHORT BOLT

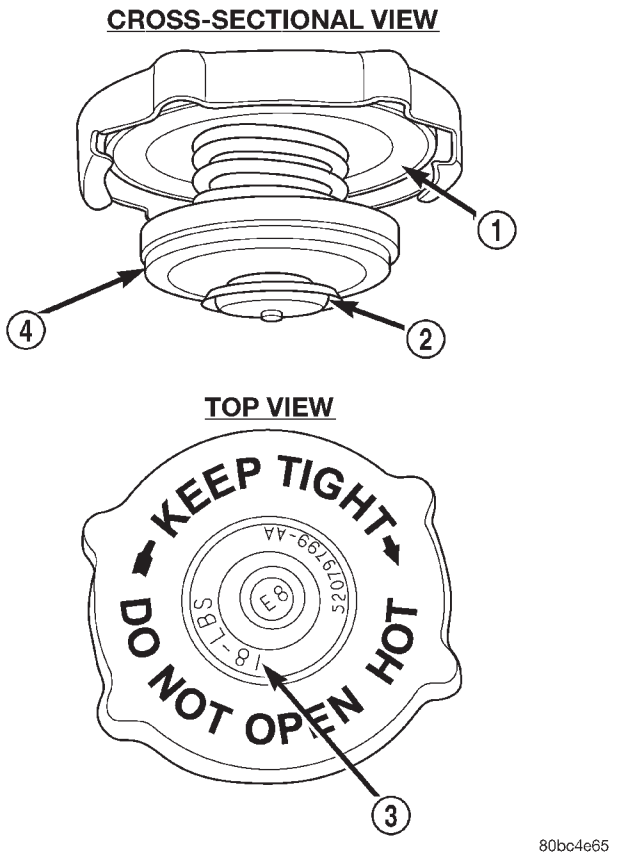


Fig. 8 Radiator Pressure Cap

1 – FILLER NECK SEAL
2 – VACUUM VENT VALVE
3 – PRESSURE RATING
4 – PRESSURE VALVE

higher coolant boiling point allowing increased radiator cooling capacity. The cap contains a spring-loaded pressure relief valve. This valve opens when system pressure reaches the release range of 83-124 kPa (12-18 psi).

OPERATION

A vent valve in the center of the cap allows a small coolant flow through the cap when coolant is below boiling temperature. The valve is completely closed when boiling point is reached. As coolant cools, it contracts and creates a vacuum in the cooling system. This causes the vacuum valve to open and coolant in reserve/overflow tank to be drawn through connecting hose into radiator. If the vacuum valve is stuck shut, radiator hoses will collapse on cool-down.

WATER PUMP

DESCRIPTION

CAUTION: All 4.0L 6-cylinder engines are equipped with a reverse (counterclockwise) rotating water pump and thermal viscous fan drive assembly. REVERSE is stamped or imprinted on the cover of the viscous fan drive and inner side of the fan. The letter R is stamped into the back of the water pump impeller. Engines from previous model years, depending upon application, may have been equipped with a forward (clockwise) rotating water pump. Installation of the wrong water pump or viscous fan drive will cause engine over heating.

This aluminum water pump is the heart of the cooling system. The water pump is located at the front of the cylinder block, above the timing chain cover

The water pump impeller is pressed onto the rear of a shaft that rotates in bearings pressed into the housing. The housing has two small holes to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant mixture. No additional lubrication is necessary.

OPERATION

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core. The pump is driven from the engine crankshaft by a single serpentine drive belt on all engines.

DESCRIPTION AND OPERATION (Continued)

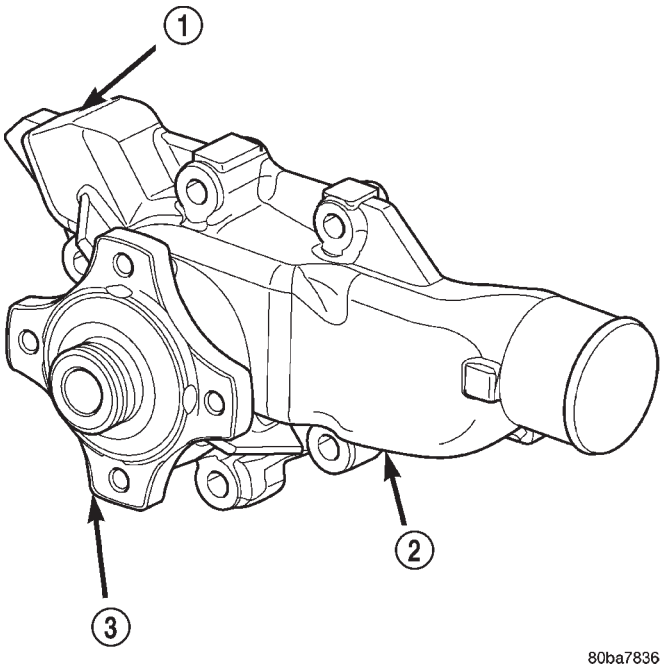


Fig. 9 Water Pump—4.0L

1 – HEATER HOSE FITTING BORE
2 – WATER PUMP
3 – WATER PUMP HUB

VISCOUS FAN DRIVE

DESCRIPTION

CAUTION: Engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

The thermal viscous fan drive (Fig. 10) is a silicone-fluid-filled coupling used to connect the fan blades to the water pump shaft. The coupling allows the fan to be driven in a normal manner. This is done at low engine speeds while limiting the top speed of the fan to a predetermined maximum level at higher engine speeds.

OPERATION

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. 12) (Fig. 13). 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.

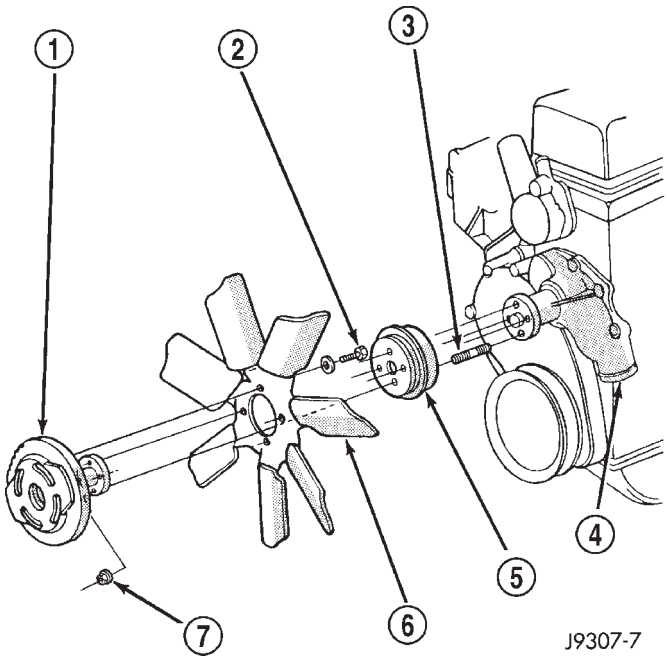


Fig. 10 Water Pump Mounted Fan Drive—2.5L Engine

1 – THERMAL VISCOUS FAN DRIVE
2 – (4) FAN BLADE-TO-VISCOUS DRIVE BOLTS
3 – (4) FAN HUB-TO-PUMP PULLEY STUDS
4 – WATER PUMP
5 – WATER PUMP PULLEY
6 – FAN BLADE
7 – (4) FAN HUB-TO-PUMP PULLEY NUTS

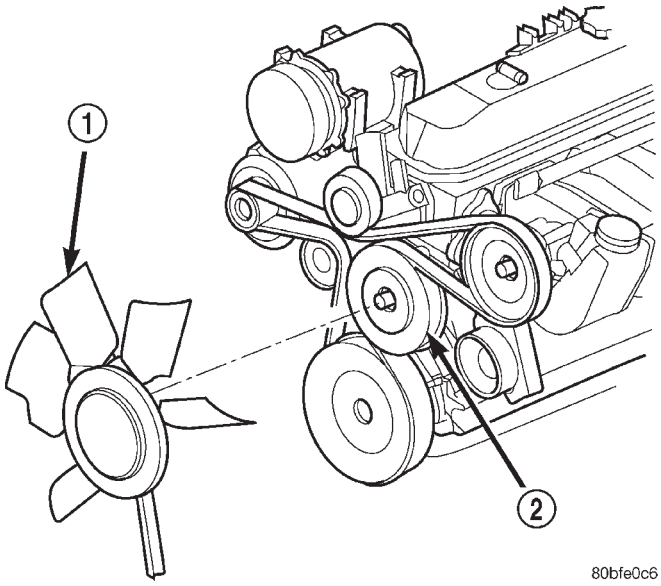


Fig. 11 Water Pump Mounted Fan Drive—4.0L Engine

1 – FAN AND FAN DRIVE
2 – WATER PUMP PULLEY

DESCRIPTION AND OPERATION (Continued)

Only when sufficient heat is present, will the viscous fan drive engage. This is when the air flowing through the radiator core causes a reaction to the bimetallic coil. It then increases fan speed to provide the necessary additional engine cooling.

Once the engine has cooled, the radiator discharge temperature will drop. The bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

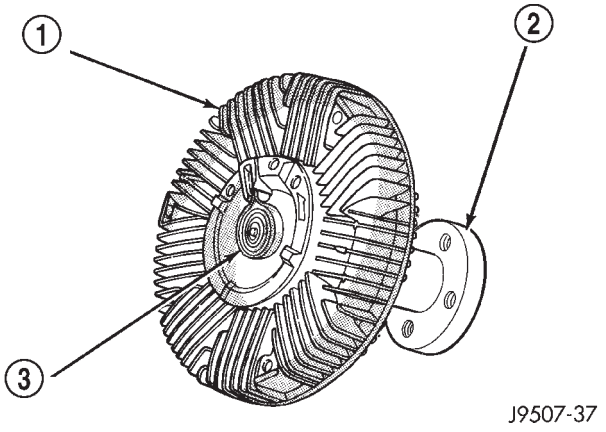


Fig. 12 Viscous Fan Drive—2.5L Engine

1 – VISCOUS FAN DRIVE
2 – MOUNTING HUB
3 – THERMOSTATIC SPRING

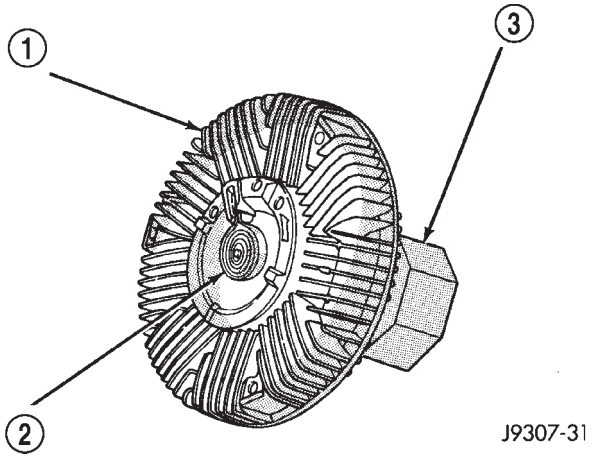


Fig. 13 Viscous Fan Drive—4.0L Engine

1 – VISCOUS FAN DRIVE
2 – THERMOSTATIC SPRING
3 – MOUNTING NUT TO WATER PUMP HUB

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.

ACCESSING DIAGNOSTIC TROUBLE CODES

To read DTC's and to obtain cooling system data, refer to Group 25, Emission Control Systems for proper procedures.

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. 14), are considered normal. These are not a reason to replace the belt. However, cracks running along a rib (not across) are **not** normal. Any belt with cracks running along a rib must be replaced (Fig. 14). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to the Accessory Drive Belt Diagnosis charts for further belt diagnosis.

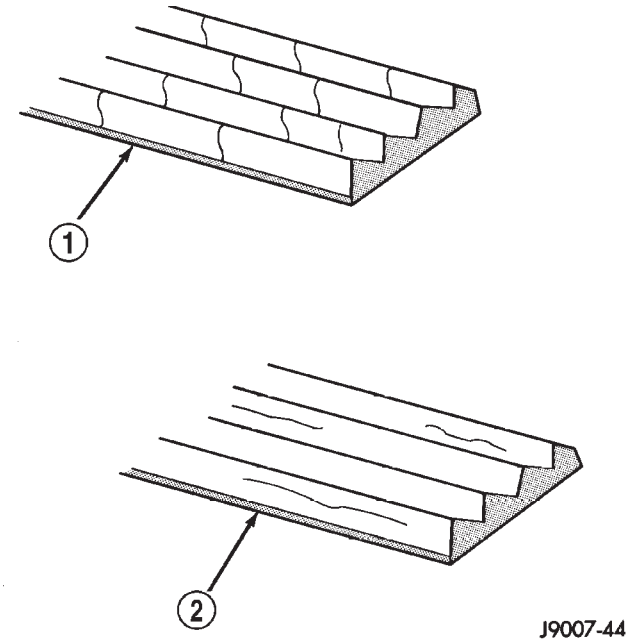


Fig. 14 Belt Wear Patterns

1 – NORMAL CRACKS BELT OK
2 – NOT NORMAL CRACKS REPLACE BELT

DIAGNOSIS AND TESTING (Continued)

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.	1. Remove foreign objects from pulley grooves. Replace belt.
	2. Installation damage	2. Replace belt
RIB OR BELT WEAR	1. Pulley misaligned	1. Align pulley(s)
	2. Abrasive environment	2. Clean pulley(s). Replace belt if necessary
	3. Rusted pulley(s)	3. Clean rust from pulley(s)
	4. Sharp or jagged pulley groove tips	4. Replace pulley. Inspect belt.
	5. Belt rubber deteriorated	5. Replace belt
BELT SLIPS	1. Belt slipping because of insufficient tension	1. Adjust tension (2.5L)
	2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol)	2. Replace belt and clean pulleys
	3. Driven component bearing failure (seizure)	3. Replace faulty component or bearing
	4. Belt glazed or hardened from heat and excessive slippage	4. Replace belt.
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 (2.5L)
	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

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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 tension (2.5L)
	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 (2.5L)
	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

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

These models are equipped with a “heavy duty” cooling system and therefore will accommodate add-on or aftermarket air conditioning. No modifications are necessary to the cooling system.

RECENT SERVICE OR ACCIDENT REPAIR:

Determine if any recent service has been performed on vehicle that may effect cooling system. This may be:

- Engine adjustments (incorrect timing)
- Slipping engine accessory drive belt(s)
- Brakes (possibly dragging)
- Changed parts (incorrect water pump rotating in wrong direction)
- Reconditioned radiator or cooling system refilling (possibly under- filled or air trapped in system).

DIAGNOSIS AND TESTING (Continued)

NOTE: If investigation reveals none of the previous items as a cause for an engine overheating complaint, refer to following Cooling System Diagnosis charts.

COOLING SYSTEM DIAGNOSIS

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 engine thermostat.	1. Refer to group 25, Emission Control Systems. Replace thermostat if necessary. If a Diagnostic Trouble Code (DTC) has not been set, the problem may be with the temperature gauge.
	2. Temperature gauge (if equipped) disconnected from 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. Defective temperature gauge (if equipped)	3. Check gauge operation. Refer to Group 8E. Repair as necessary.
	4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.	4. Check coolant level in the coolant reserve/overflow tank and the radiator. Inspect system for leaks. Repair leaks as necessary. Refer to the Coolant section of the manual text for Warnings and precautions before removing the radiator cap.
	5. Improper operation of internal heater doors or heater controls.	5. Inspect heater and repair as necessary. Refer to Group 24, Heating and Air Conditioning for procedures.
	6. Electric fan functioning when not required.	6. Inspect electric fan for proper operation. Refer to Electric Cooling Fan in this section. Refer to Group 8W for electric cooling fan and relay circuit schematic data.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH OR ENGINE COOLANT WARNING LAMP ILLUMINATES. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM COOLING SYSTEM	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 18).
	2. Defective temperature gauge (if equipped)	2. Check gauge. Refer to Group 8E. Repair as necessary.
	3. Defective temperature warning lamp (if equipped)	3. Check warning lamp operation. Refer to Group 8E. Repair as necessary.
	4. Coolant low in coolant reserve/ overflow tank and radiator?	4. Check for coolant leaks and repair as necessary. Refer to Testing Cooling System for Leaks in this group.
	5. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following step 6.	5. Tighten cap.
	6. Poor seals at radiator cap.	6. (a) Check condition of cap and cap seals. Refer to Radiator Cap. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator.
	7. Coolant level low in radiator but not in coolant reserve/overflow tank. This means the radiator is not drawing coolant from the coolant reserve/overflow tank as the engine cools. As the engine cools, a vacuum is formed in the cooling system of the engine and radiator. If radiator cap seals are defective, or cooling system has leaks, a vacuum can not be formed.	7. (a) Check condition of radiator cap and cap seals. Refer to Radiator Cap in this group. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator. (c) Check the condition of the hose from the radiator to the coolant tank. It should fit tight at both ends without any kinks or tears. Replace hose if necessary. (d) Check coolant reserve/overflow tank and tank hoses for blockage. Repair as necessary
	8. Freeze point of antifreeze not correct. Mixture may be too rich.	8. Check antifreeze. Refer to Coolant section of this group. Adjust antifreeze-to-water ratio as required.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH OR ENGINE COOLANT WARNING LAMP ILLUMINATES. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM COOLING SYSTEM	9. Coolant not flowing through system.	9. Check for coolant flow at radiator filler neck with some coolant removed, engine warm and thermostat open. Coolant should be observed flowing through radiator. If flow is not observed, determine reason for lack of flow and repair as necessary.
	10. Radiator or A/C condenser fins dirty or clogged.	10. Clean insects or debris. Refer to Radiator Cleaning in this group.
	11. Radiator core is corroded or plugged.	11. Have radiator re-cored or replaced.
	12. Fuel or ignition system problems.	12. Refer to Fuel and Ignition System groups for diagnosis. Also refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool.
	13. Dragging brakes.	13. Check and correct as necessary. Refer to Group 5, Brakes in the manual text.
	14. Bug screen is being used reducing airflow.	14. Remove bug screen.
	15. Thermostat partially or completely shut. This is more prevalent of high mileage vehicles.	15. Check thermostat operation and replace as necessary. Refer to Thermostats in this group.
	16. Thermal viscous fan drive not operating properly.	16. Check fan drive operation and replace if necessary. Refer to Viscous Fan Drive in this group.
	17. Cylinder head gasket leaking.	17. Check for cylinder head gasket leaks. Refer to Testing Cooling System for Leaks in this group. For repair, refer to Group 9, Engines.
	18. Heater core leaking.	18. Check heater core for leaks. Refer to Group 24, Heating and Air Conditioning. Repair as necessary.
	19. Electric fan not functioning.	19. Inspect electric fan for proper operation. Refer to Electric Cooling Fan in this section. Refer to Group 8W for electric cooling fan and relay circuit schematic data.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC)	1. During cold weather operation, with the heater blower in the high position, the gauge reading may drop slightly.	1. A normal condition. No correction is necessary.
	2. Temperature gauge or engine mounted gauge sensor defective or shorted. Also, corroded or loose wiring in the circuit.	2. Check operation of gauge and repair if necessary. Refer to Group 8E, Instrument Panel and Gauges.
	3. Gauge reading rises when vehicle is brought to a stop after heavy use (engine still running).	3. A normal condition. No correction is necessary. Gauge reading should return to normal range after vehicle is driven.
	4. Gauge reading high after restarting a warmed-up (hot) engine.	4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.
	5. Coolant level low in radiator (air will build up in the cooling system causing the thermostat to open late).	5. Check and correct coolant leaks. Refer to Testing Cooling System for Leaks in this group.
	6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing thermostat to open late.	6. (a) Check for cylinder head gasket leaks with a commercially available Block Leak Tester. Repair as necessary. (b) Check for coolant in the engine oil. Inspect for white steam emitting from exhaust system. Repair as necessary.
	7. Water pump impeller loose on shaft.	7. Check water pump and replace as necessary. Refer to Water Pumps in this group.
	8. Loose accessory drive belt (water pump slipping).	8. Refer to Engine Accessory Drive Belts in this group. Check and correct as necessary.
	9. Air leak on the suction side of water pump allows air to build up in cooling system causing thermostat to open late.	9. Locate leak and repair as necessary.
PRESSURE CAP IS BLOWING OFF STEAM AND/OR COOLANT TO COOLANT TANK. TEMPERATURE GAUGE READING MAY BE ABOVE NORMAL BUT NOT HIGH. COOLANT LEVEL MAY BE HIGH IN COOLANT RESERVE/ OVERFLOW TANK	1. Pressure relief valve in radiator cap is defective.	1. Check condition of radiator cap and cap seals. Refer to Radiator Caps in this group. Replace cap as necessary.
COOLANT LOSS TO THE GROUND WITHOUT PRESSURE CAP BLOWOFF. GAUGE IS READING HIGH OR HOT	1. Coolant leaks in radiator, cooling system hoses, water pump or engine.	1. Pressure test and repair as necessary. Refer to Testing Cooling System for Leaks in this group.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
DETONATION OR PRE-IGNITION (NOT CAUSED BY IGNITION SYSTEM). GAUGE MAY OR MAY NOT BE READING HIGH	1. Engine overheating.	1. Check reason for overheating and repair as necessary.
	2. Freeze point of antifreeze not correct. Mixture is too rich or too lean.	2. Check antifreeze. Refer to the Coolant section of this group. Adjust antifreeze-to-water ratio as required.
HOSE OR HOSES COLLAPSED WHEN ENGINE IS COOLING	1. Vacuum created in cooling system on engine cool-down is not being relieved through coolant reserve/overflow system.	1. (a) Radiator cap relief valve stuck. Refer to Radiator Cap in this group. Replace if necessary. (b) Hose between coolant reserve/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 interally blocked or plugged. Check for blockage and repair as necessary.
NOISY FAN	1. Fan blades loose.	1. Replace fan blade assembly. Refer to Cooling System Fans in this group.
	2. Fan blades striking a surrounding object.	2. Locate point of fan blade contact and repair as necessary.
	3. Air obstructions at radiator or air conditioning condenser.	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 (roaring) may be evident from the 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 AIR CONDITIONER PERFORMANCE (COOLING SYSTEM SUSPECTED)	1. Radiator and/or A/C condenser is restricted, obstructed or dirty (insects, leaves etc.)	1. Remove restriction and/or clean as necessary. Refer to Radiator Cleaning in this group.
	2. Electric fan not functioning.	2. Inspect electric fan for proper operation. Refer to Electric Cooling Fan in this section.
	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).	3. Correct overheating condition. Refer to text in Group 7, Cooling.
	4. All models with are equipped with air seals at the radiator and/or A/C condenser. If these seals are missing or damaged, not enough air flow will be pulled through the radiator and A/C condenser.	4. Check for missing or damaged air seals and repair as necessary.
INADEQUATE HEATER PERFORMANCE. THERMOSTAT FAILED IN OPEN POSITION	1. Has a diagnostic trouble code (DTC) been set?	1. Refer to group 25, Emission Control System and replace thermostat if necessary.
	2. Coolant level low.	2. Refer to Testing Cooling System for Leaks in the manual text. Repair as necessary.
	3. Obstructions in heater hose fittings at engine.	3. Remove heater hoses at both ends and check for obstructions. Repair as necessary.
	4. Heater hose kinked.	4. Locate kinked area and repair as necessary.
	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.	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.

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.	1. Locate missing shields and replace or repair as necessary.
	2. Engine running hot	2. Preform thermostat, water pump and fan test. Repair or replace as necessary.
	3. Cooling fan malfunctioning.	3. Refer to Cooling System Fan in this group for diagnosis. Repair as necessary
	4. Undercoating or other contaminate applied to cooling or exhaust system.	4. Clean as necessary.
	5. Engine may be running rich causing the catalytic converter to overheat.	5. Refer to the DRB scan tool and the appropriate Powertrain Diagnostic Procedures service manual. Repair as necessary.
POOR DRIVEABILITY (THERMOSTAT POSSIBLY STUCK OPEN). GAUGE MAY BE READING LOW	1. For proper driveability, good vehicle emissions and for preventing build-up of engine oil sludge, the thermostat must be operating properly. Has a diagnostic trouble code (DTC) been set?	1. Refer to group 25, Emission Control System. DTC's may also be checked using the DRB scan tool. Refer to the proper Powertrain Diagnostics Procedures service manual for checking the thermostat using the DRB scan tool. Replace thermostat if necessary.
STEAM IS COMING FROM FRONT OF VEHICLE NEAR GRILL AREA WHEN WEATHER IS WET, ENGINE IS WARMED UP AND RUNNING, AND VEHICLE IS STATIONARY. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. During wet weather, moisture (snow, ice or rain condensation) on the radiator will evaporate when the thermostat opens. This opening allows heated water into the radiator. When the moisture contacts the hot radiator, steam may be emitted. This usually occurs in cold weather with no fan or airflow to blow it away.	1. Occasional steam emitting from this area is normal. No repair is necessary.
COOLANT COLOR	1. Coolant color is not necessarily an indication of adequate corrosion or temperature protection. Do not rely on coolant color for determining condition of coolant.	1. Refer to Coolant in this group for antifreeze tests. Adjust antifreeze-to-water ratio as necessary.
COOLANT LEVEL CHANGES IN COOLANT RESERVE/OVERFLOW TANK. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. Level changes are to be expected as coolant volume fluctuates with engine temperature. If the level in the tank was between the FULL and ADD marks at normal engine operating temperature, the level should return to within that range after operation at elevated temperatures.	1. A normal condition. No repair is necessary.

DIAGNOSIS AND TESTING (Continued)

RADIATOR COOLANT FLOW CHECK

The following procedure will determine if coolant is flowing through the cooling system.

If engine is cold, idle engine until normal operating temperature is reached. Then feel the upper radiator hose. If hose is hot, the thermostat is open and water is circulating through cooling system.

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. 15).

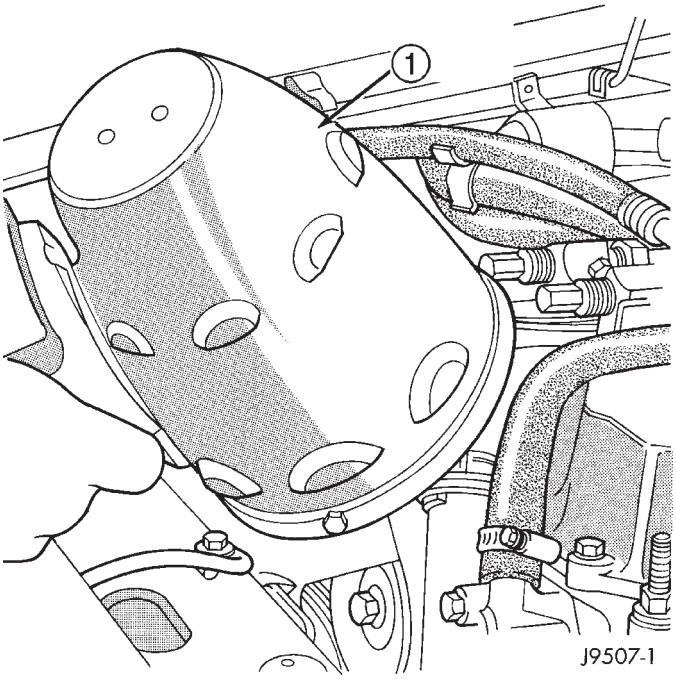


Fig. 15 Leak Detection Using Black Light—Typical

1 – TYPICAL BLACK LIGHT TOOL

PRESSURE TESTER METHOD

The engine should be at the normal operating temperature. Recheck the system cold if the cause of coolant loss is not located during warm engine examination.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING.

Carefully remove the radiator pressure cap from the filler neck and check the coolant level. Push down on the cap to disengage it from the stop tabs. Wipe the inner part of the filler neck and examine the lower inside sealing seat for nicks, cracks, paint, dirt and solder residue. Inspect the reserve/overflow tank tube for internal obstructions. Insert a wire through the tube to be sure it is not obstructed.

Inspect the cams on the outside part of the filler neck. If the cams are bent, seating of pressure cap valve and tester seal will be affected. Replace cap if cams are bent.

Attach pressure tester 7700 (or an equivalent) to the radiator filler neck (Fig. 16).

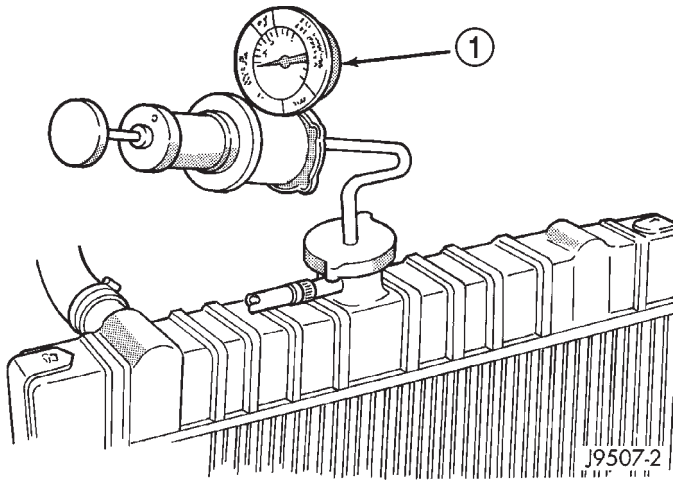


Fig. 16 Pressurizing System—Typical

1 – TYPICAL COOLING SYSTEM PRESSURE TESTER

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

DIAGNOSIS AND TESTING (Continued)

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 engine oil pan drain plug and drain a small amount of engine oil. Coolant, being heavier than engine oil, will drain first. Another way of testing is to operate the engine and check for water globules on the engine oil dipstick. Also inspect the automatic transmission oil dipstick for water globules. Inspect the automatic transmission fluid cooler for leakage. Operate the engine without the pressure cap on the radiator until thermostat opens.

Attach a pressure tester to the filler neck. If pressure builds up quickly, a leak exists as a result of a faulty cylinder head gasket or crack in the engine. Repair as necessary.

WARNING: DO NOT ALLOW PRESSURE TO EXCEED 124 KPA (18 PSI). TURN THE ENGINE OFF. TO RELEASE THE PRESSURE, ROCK THE TESTER FROM SIDE TO SIDE. WHEN REMOVING THE TESTER, DO NOT TURN THE TESTER MORE THAN 1/2 TURN IF THE SYSTEM IS UNDER PRESSURE.

If there is no immediate pressure increase, pump the pressure tester until the indicated pressure is within the system range. Vibration of the gauge pointer indicates compression or combustion leakage into the cooling system.

WARNING: DO NOT DISCONNECT THE SPARK PLUG WIRES WHILE THE ENGINE IS OPERATING.

CAUTION: Do not operate the engine with a spark plug shorted for more than a minute. The catalytic converter may be damaged.

Isolate the compression leak by shorting each spark plug to the cylinder block. The gauge pointer should stop or decrease vibration when spark plug for leaking cylinder is shorted. This happens because of the absence of combustion pressure.

COMBUSTION LEAKAGE TEST (WITHOUT PRESSURE TESTER)

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

Drain sufficient coolant to allow for thermostat removal. Refer to Thermostat Replacement. Disconnect the water pump drive belt.

Disconnect the upper radiator hose from the thermostat housing. Remove the housing and thermostat. Install the thermostat housing.

Add coolant to the radiator to bring the level to within 6.3 mm (1/4 in) of the top of the thermostat housing.

CAUTION: Avoid overheating. Do not operate the engine for an excessive period of time. Open the draincock immediately after the test to eliminate boil over of coolant.

Start the engine and accelerate rapidly three times (to approximately 3000 rpm) while observing the coolant. If internal engine combustion gases are leaking into the cooling system, bubbles will appear in the coolant. If bubbles do not appear, there is no internal combustion gas leakage.

VISCOUS FAN DRIVE

NOISE

NOTE: It is normal for fan noise to be louder (roaring) when:

- The underhood temperature is above the engagement point for the viscous drive coupling. This may occur when ambient (outside air temperature) is very high.
- Engine loads and temperatures are high such as when towing a trailer.
- Cool silicone fluid within the fan drive unit is being redistributed back to its normal disengaged (warm) position. This can occur during the first 15 seconds to one minute after engine start-up on a cold engine.

LEAKS

Viscous fan drive operation is not affected by small oil stains near the drive bearing. If leakage appears excessive, replace the fan drive unit.

TESTING

If the fan assembly free-wheels without drag (the fan blades will revolve more than five turns when spun by hand), replace the fan drive. This spin test must be performed when the engine is cool.

DIAGNOSIS AND TESTING (Continued)

For the following test, the cooling system must be in good condition. It also will ensure against excessively high coolant temperature.

WARNING: BE SURE THAT THERE IS ADEQUATE FAN BLADE CLEARANCE BEFORE DRILLING.

(1) Drill a 3.18-mm (1/8-in) diameter hole in the top center of the fan shroud.
(2) Obtain a dial thermometer with an 8 inch stem (or equivalent). It should have a range of -18°-to-105°C (0°-to-220° F). Insert thermometer through the hole in the shroud. Be sure that there is adequate clearance from the fan blades.
(3) Connect a tachometer and an engine ignition timing light (timing light is to be used as a strobe light).
(4) Block the air flow through the radiator. Secure a sheet of plastic in front of the radiator (or air conditioner condenser). Use tape at the top to secure the plastic and be sure that the air flow is blocked.
(5) Be sure that the air conditioner (if equipped) is turned off.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(6) Start the engine and operate at 2400 rpm. Within ten minutes the air temperature (indicated on the dial thermometer) should be up to 88° C (190° F). Fan drive **engagement** should have started to occur at between 74° to 85° C (165° to 185° F). Engagement is distinguishable by a definite **increase** in fan flow noise (roaring). The timing light also will indicate an increase in the speed of the fan.
(7) When the air temperature reaches 88° C (190° F), remove the plastic sheet. Fan drive **disengagement** should have started to occur at between 57° to 82° C (135° to 180° F). A definite **decrease** of fan flow noise (roaring) should be noticed. If not, replace the defective viscous fan drive unit.

CAUTION: Engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

RADIATOR CAP TO FILLER NECK SEAL— PRESSURE RELIEF CHECK

With radiator cap installed on filler neck, remove coolant reserve/overflow tank hose from nipple on filler neck. Connect a hand operated vacuum pump to nipple. Operate pump until a reading of 47 to 61 kPa (14 to 18 in. Hg) appears on gauge. If the reading stays steady, or drops slightly and then remains steady, the pressure valve seal is good. Replace radiator cap if reading does not hold.

WARNING: THE WARNING WORDS (DO NOT OPEN HOT) ON THE RADIATOR PRESSURE CAP (Fig. 17) ARE A SAFETY PRECAUTION. WHEN HOT, PRESSURE BUILDS UP IN COOLING SYSTEM. TO PREVENT SCALDING OR INJURY, THE RADIATOR CAP SHOULD NOT BE REMOVED WHILE THE SYSTEM IS HOT AND/OR UNDER PRESSURE.

There is no need to remove the radiator cap **except** for the following purposes:
(1) To check and adjust antifreeze freeze point.
(2) To refill system with new antifreeze.
(3) For conducting service procedures.
(4) When checking for vacuum leaks.

WARNING: IF VEHICLE HAS BEEN RUN RECENTLY, WAIT AT LEAST 15 MINUTES BEFORE REMOVING RADIATOR CAP. WITH A RAG, SQUEEZE RADIATOR UPPER HOSE TO CHECK IF SYSTEM IS UNDER PRESSURE. PLACE A RAG OVER THE CAP AND WITHOUT PUSHING DOWN, ROTATE CAP COUNTER-CLOCKWISE TO THE FIRST STOP. ALLOW FLUID TO ESCAPE THROUGH OVERFLOW HOSE INTO COOLANT RESERVE/OVERFLOW TANK. SQUEEZE RADIATOR UPPER HOSE TO DETERMINE WHEN PRESSURE HAS BEEN RELEASED. WHEN COOLANT AND STEAM STOP BEING PUSHED INTO TANK AND SYSTEM PRESSURE DROPS, REMOVE RADIATOR CAP COMPLETELY.

DIAGNOSIS AND TESTING (Continued)

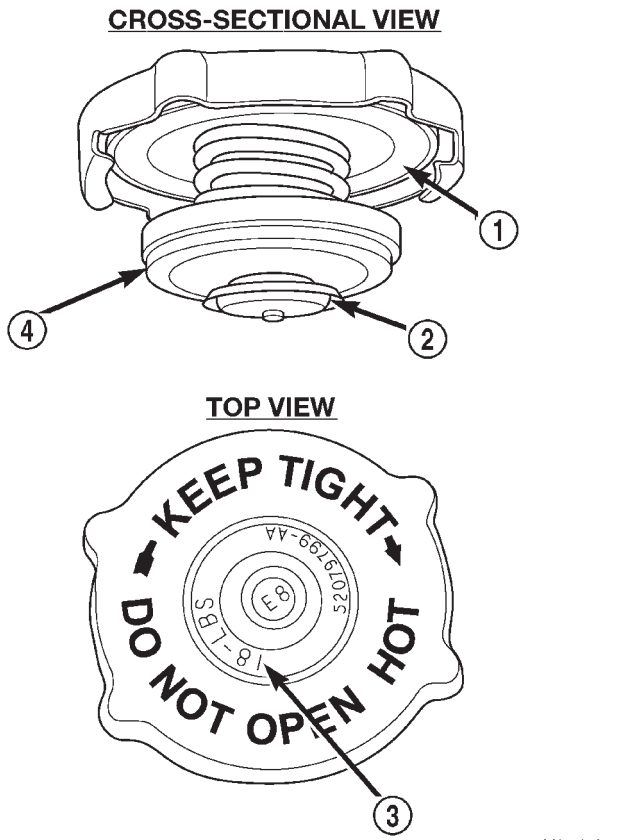


Fig. 17 Radiator Pressure Cap

1 – FILLER NECK SEAL
2 – VACUUM VENT VALVE
3 – PRESSURE RATING
4 – PRESSURE VALVE

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. 18).

Operate the tester pump and observe the gauge pointer at its highest point. The cap release pressure should be 83 to 124 kPa (12 to 18 psi). The cap is satisfactory when the pressure holds steady. It is also good if it holds pressure within the 83 to 124 kPa (12 to 18 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.

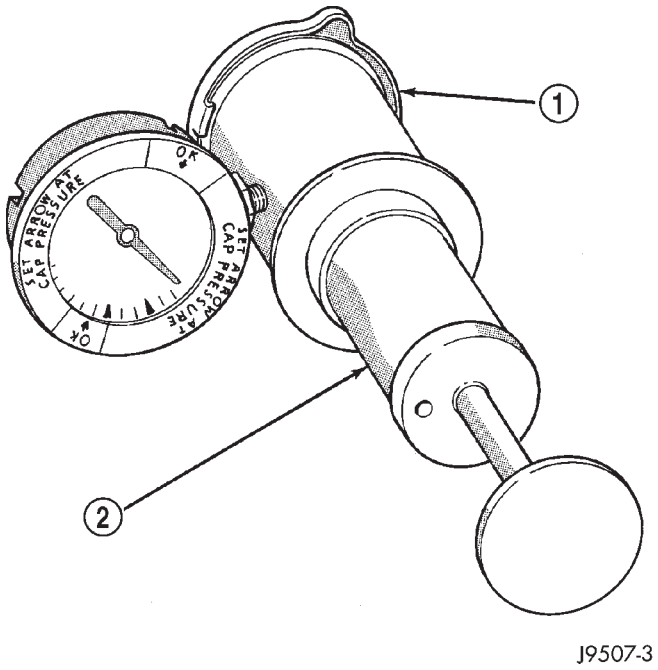


Fig. 18 Pressure Testing Radiator Pressure Cap—Typical

1 – PRESSURE CAP
2 – TYPICAL COOLING SYSTEM PRESSURE TESTER

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.

COOLING SYSTEM 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 LEVEL—ROUTINE CHECK

NOTE: Do not remove radiator cap for routine coolant level inspections. The coolant level can be checked at coolant reserve/overflow tank.

The coolant reserve/overflow system provides a quick visual method for determining coolant level without removing radiator pressure cap. With engine idling and at normal operating temperature, observe coolant level in reserve/overflow tank. The coolant level should be between ADD and FULL marks.

COOLANT—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 low mineral content water. Remove radiator cap only for testing or when refilling system after service. Removing cap unnecessarily can cause loss of coolant and allow air to enter system, which produces corrosion.

SERVICE COOLANT LEVEL

The cooling system is closed and designed to maintain coolant level to top of radiator.

WARNING: DO NOT OPEN RADIATOR DRAINCOCK WITH ENGINE RUNNING OR WHILE ENGINE IS HOT AND COOLING SYSTEM IS UNDER PRESSURE.

When vehicle servicing requires a coolant level check in radiator, drain several ounces of coolant from radiator drain cock. Do this while observing coolant reserve/overflow system tank. The coolant level in reserve/overflow tank should drop slightly. If not, inspect for a leak between radiator and coolant reserve/overflow system connection. Remove radiator cap. The coolant level should be to top of radiator. If not and if coolant level in reserve/overflow tank is at ADD mark, check for:

- An air leak in coolant reserve/overflow tank or its hose
- An air leak in radiator filler neck
- Leak in pressure cap seal to radiator filler neck

COOLING SYSTEM—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.

DO NOT remove the radiator cap when draining the coolant from the reserve/overflow tank. Open the radiator draincock and when the tank is empty, remove the radiator cap. The coolant does not have to be removed from the tank unless the system is being refilled with a fresh mixture.

(1) Drain the coolant from the radiator by loosening the draincock.

(2) Drain coolant from engine block by removing drain plug at left rear side of block (Fig. 19).

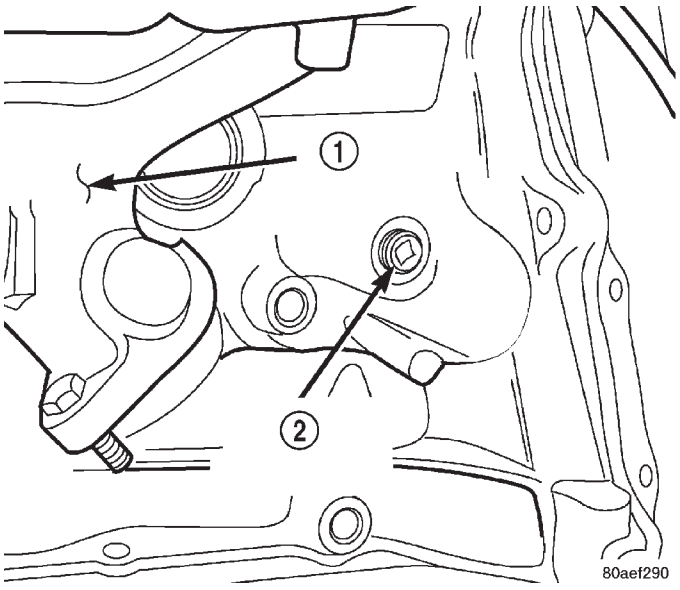


Fig. 19 Draining Coolant From Block—2.5L/4.0L Engines

1 – EXHAUST MANIFOLD
2 – CYLINDER BLOCK COOLANT DRAIN PLUG

COOLING SYSTEM—REFILLING

(1) Tighten the radiator draincock and the cylinder block drain plug(s).

(2) Fill system using a 50/50 mixture of water and antifreeze. This is described in the Coolant section of this group. Fill the radiator to the top and install the radiator cap. Add sufficient coolant to the reserve/overflow tank to raise the level to the FULL mark.

(3) Operate the engine with both the radiator cap and reserve/overflow tank cap in place. After the engine has reached the normal operating temperature, shut the engine off and allow it to cool.

(4) Add coolant to the reserve/overflow tank as necessary. **Only add coolant when the engine is cold. Coolant level in a warm engine will be higher due to thermal expansion.**

SERVICE PROCEDURES (Continued)

COOLING SYSTEM—REVERSE FLUSHING

Reverse flushing of the cooling system is the forcing of water through the cooling system. This is done using air pressure in the opposite direction of normal coolant flow. It is usually only necessary with very dirty systems with evidence of partial plugging.

REVERSE FLUSHING RADIATOR

Disconnect the radiator hoses from the radiator fittings. Attach a section of radiator hose to the radiator bottom outlet fitting and insert the flushing gun. Connect a water supply hose and air supply hose to the flushing gun.

CAUTION: The cooling system normally operates at 97 to 124 kPa (14 to 18 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

Allow the radiator to fill with water. When radiator is filled, apply air in short blasts allowing radiator to refill between blasts. Continue this reverse flushing until clean water flows out through rear of radiator cooling tube passages. For more information, refer to operating instructions supplied with flushing equipment. Have radiator cleaned more extensively by a radiator repair shop.

REVERSE FLUSHING ENGINE

Drain the cooling system. Remove the thermostat housing and thermostat. Install the thermostat housing. Disconnect the radiator upper hose from the radiator and attach the flushing gun to the hose. Disconnect the radiator lower hose from the water pump. Attach a lead away hose to the water pump inlet fitting.

Connect the water supply hose and air supply hose to the flushing gun. Allow the engine to fill with water. When the engine is filled, apply air in short blasts, allowing the system to fill between air blasts. Continue until clean water flows through the lead away hose. For more information, refer to operating instructions supplied with flushing equipment.

Remove the lead away hose, flushing gun, water supply hose and air supply hose. Remove the thermostat housing and install thermostat. Install the thermostat housing with a replacement gasket. Refer to Thermostat Replacement. Connect the radiator hoses. Refill the cooling system with the correct antifreeze/water mixture.

COOLANT PERFORMANCE

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

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

100 percent Ethylene-Glycol- The corrosion inhibiting additives in ethylene-glycol need the presence of water to dissolve. Without water, additives form deposits in system. These act as insulation causing temperature to rise to as high as 149°C (300°F). This temperature is hot enough to melt plastic and soften solder. The increased temperature can result in engine detonation. In addition, 100 percent ethylene-glycol freezes at -22°C (-8°F).

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

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

COOLANT SELECTION AND ADDITIVES

Coolant should be maintained at the specified level with a mixture of ethylene glycol-based antifreeze and low mineral content water.

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

REMOVAL AND INSTALLATION

AUTOMATIC TRANSMISSION OIL COOLER

The internal transmission oil cooler located within the radiator is not serviceable. If it requires service, the radiator must be replaced.

Once the repaired or replacement radiator has been installed, fill the cooling system and inspect for leaks. Refer to the Filling Cooling System and Testing Cooling System For Leaks sections in this group. If the transmission operates properly after repairing the leak, drain the transmission and remove the transmission oil pan. Inspect for sludge. Inspect for a dirty or plugged inlet filter. If none of these condi-

REMOVAL AND INSTALLATION (Continued)

tions are found, the transmission and torque converter may require reconditioning. Refer to Group 21 for automatic transmission servicing.

COOLANT RESERVE/OVERFLOW BOTTLE

REMOVAL/INSTALLATION

(1) Disconnect the hose from radiator filler neck.
(2) Remove coolant recovery bottle (Fig. 20).
(3) Reverse the preceding steps for installation.

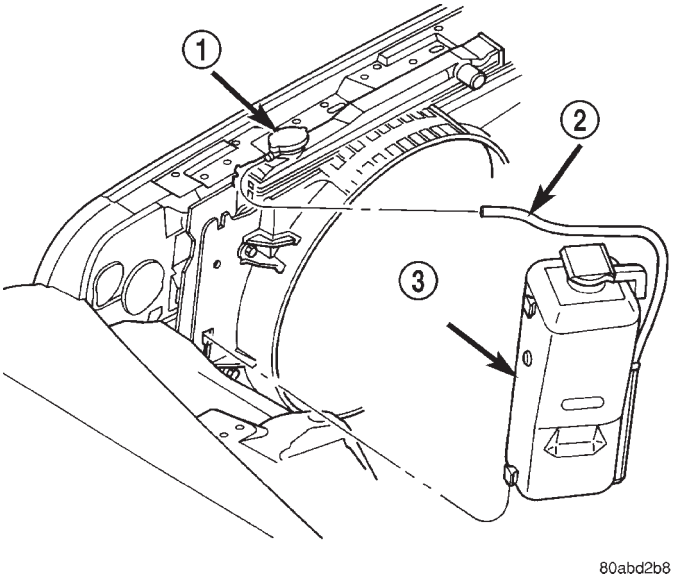


Fig. 20 Coolant Reserve/Overflow Bottle

1 – RADIATOR PRESSURE CAP
2 – HOSE
3 – COOLANT RECOVERY BOTTLE

WATER PUMP

CAUTION: If the water pump is replaced because of mechanical damage, the fan blades and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

REMOVAL

The water pump can be removed without discharging the air conditioning system (if equipped).

CAUTION: All engines have a reverse (counter-clockwise) rotating water pump. The letter R is stamped into the back of the water pump impeller (Fig. 21) 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.

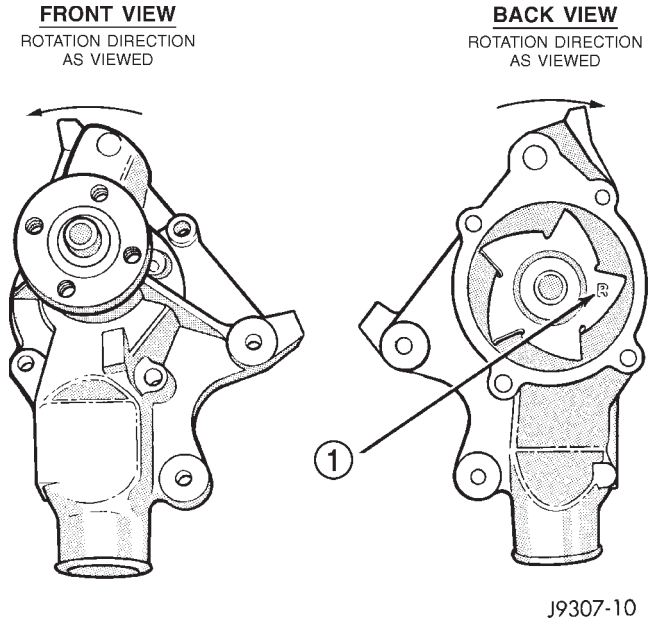


Fig. 21 Reverse Rotating Water Pump—2.5L Engine

1 – R STAMPED INTO IMPELLER

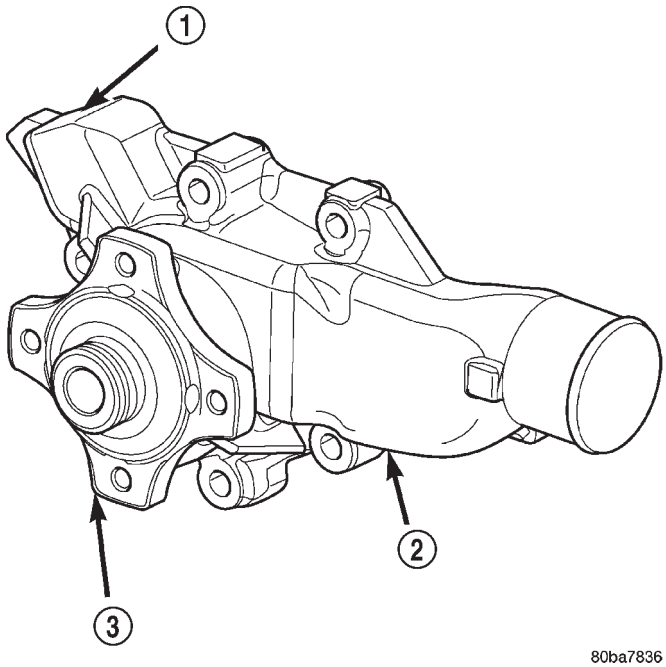


Fig. 22 Water Pump—4.0L Engine

1 – HEATER HOSE FITTING BORE
2 – WATER PUMP
3 – WATER PUMP HUB

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.

REMOVAL AND INSTALLATION (Continued)

WARNING: DO NOT REMOVE THE BLOCK DRAIN PLUG(S) OR LOOSEN RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain coolant into a clean container for reuse.

(1) Disconnect negative battery cable at battery.

(2) Drain the cooling system.

(3) **2.5L Engine** Loosen (but do not remove at this time) the four fan hub-to-water pump pulley mounting nuts (Fig. 23).

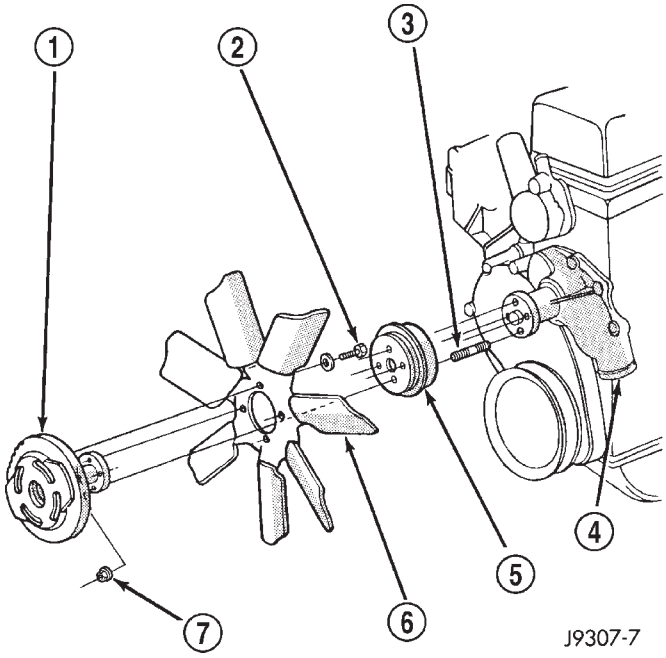


Fig. 23 Fan Mounting Nuts—2.5L Engine

1 – THERMAL VISCOUS FAN DRIVE
2 – (4) FAN BLADE-TO-VISCOUS DRIVE BOLTS
3 – (4) FAN HUB-TO-PUMP PULLEY STUDS
4 – WATER PUMP
5 – WATER PUMP PULLEY
6 – FAN BLADE
7 – (4) FAN HUB-TO-PUMP PULLEY NUTS

NOTE: The engine accessory drive belt must be removed prior to removing the fan.

(4) Remove accessory drive belt.

(5) **4.0L Engine** The thermal viscous fan drive/fan blade assembly is attached (threaded) to water pump hub shaft. Remove fan blade/viscous fan drive assembly from water pump by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT HAND.** Using a suitable fan wrench loosen the fan drive.

(6) Remove power steering pump (Fig. 25). (Refer to Group 19 Steering).

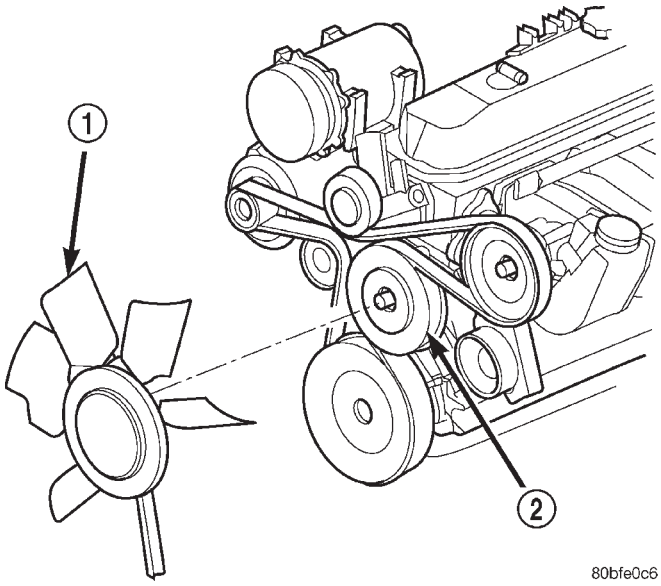


Fig. 24 Fan and Fan Drive Mounting—4.0L Engine

1 – FAN AND FAN DRIVE
2 – WATER PUMP PULLEY

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 26) SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 27). If replacement is necessary, use only an original equipment clamp with matching number or letter.

(7) Remove lower radiator hose from water pump. Remove heater hose from water pump fitting.

(8) **2.5L Engine** Remove four nuts previously loosened and remove the fan blade assembly and pulley.

(9) 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.

(10) Remove the four pump mounting bolts (Fig. 28) and remove pump from vehicle. Discard old gasket. Note that one of the four bolts is longer than the other bolts.

(11) If pump is to be replaced, the heater hose fitting must be removed. Note position of fitting before removal.

REMOVAL AND INSTALLATION (Continued)

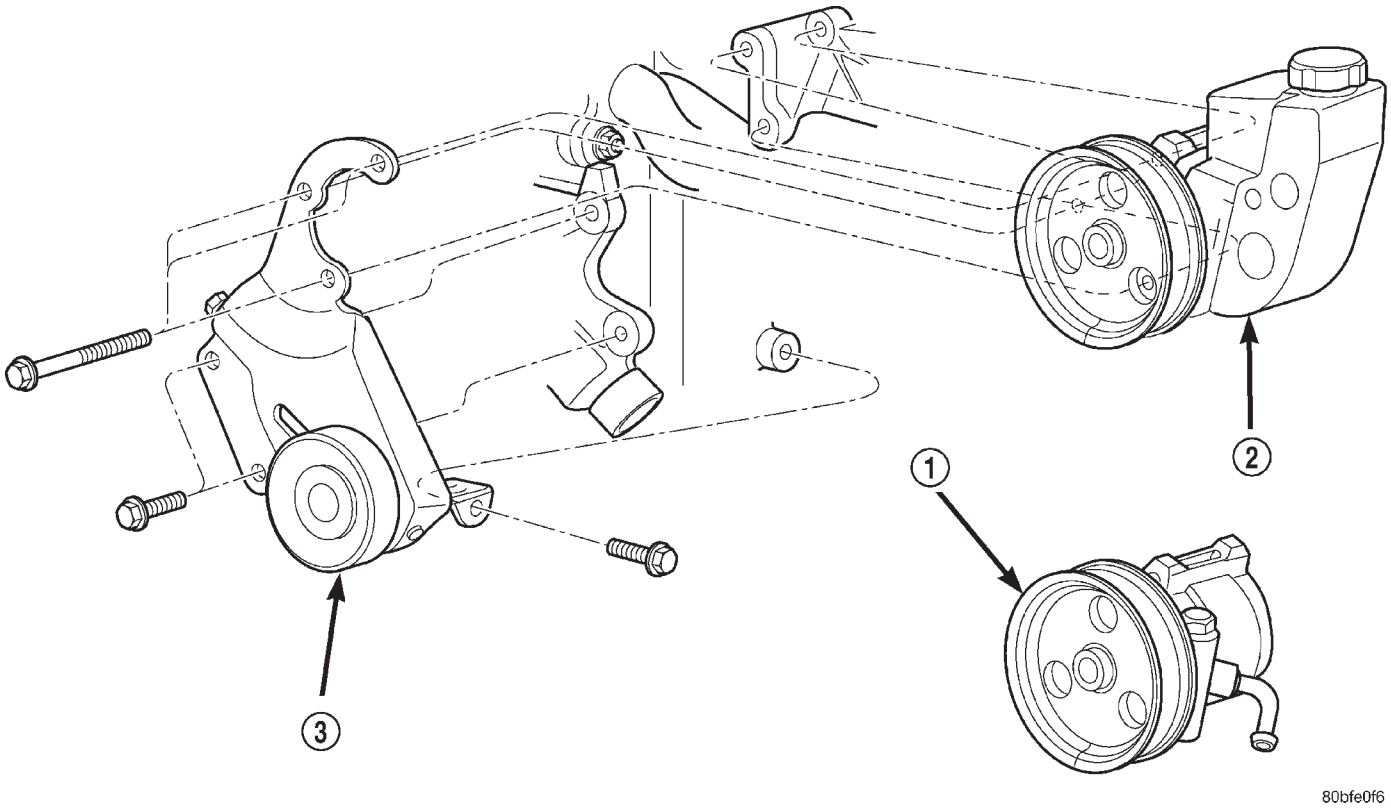


Fig. 25 Power Steering Pump Attachment—2.5L and 4.0L

1 – PUMP ASSEMBLY 2.5L
2 – PUMP ASSEMBLY 4.0L
3 – TENSIONER PULLEY AND BRACKET 2.5L

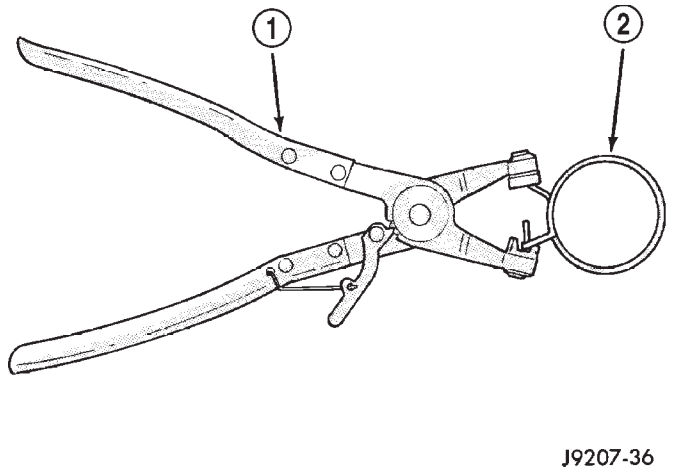


Fig. 26 Hose Clamp Tool–Typical

1 – HOSE CLAMP TOOL 6094
2 – HOSE CLAMP

INSTALLATION

(1) If pump is being replaced, install the heater hose fitting to the pump. Use a sealant on the fitting such as Mopar® Thread Sealant With Teflon. Refer to the directions on the package.

(2) Clean the gasket mating surfaces. If the original pump is used, remove any deposits or other foreign material. Inspect the cylinder block and water pump mating surfaces for erosion or damage from cavitation.

(3) Install the gasket and water pump. The silicone bead on the gasket should be facing the water pump. Also, the gasket is installed dry. Tighten mounting bolts to 23 N·m (200 in. 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) **2.5L Engine** Position water pump pulley to water pump hub.

(6) **2.5L Engine** Install fan and four nuts to water pump hub. Tighten or nuts to 27 N·m (20 ft. lbs.) torque.

(7) Install power steering pump.

(8) **4.0L Engine** Thread the fan and fan hub into the water pump hub shaft.

REMOVAL AND INSTALLATION (Continued)

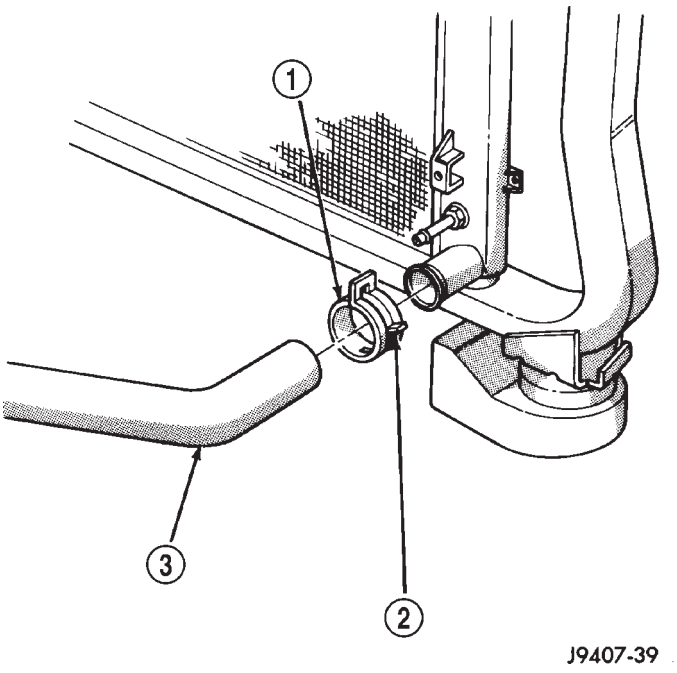


Fig. 27 Clamp Number/Letter Location

1 – TYPICAL CONSTANT TENSION HOSE CLAMP
2 – CLAMP NUMBER/LETTER LOCATION
3 – TYPICAL HOSE

CAUTION: When installing the serpentine engine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to the Belt Removal and Installation in this group for appropriate belt routing. You may also refer to the Belt Routing Label in the vehicle engine compartment.

(9) Install accessory drive belt. **2.5L Engine** Tension drive belts. Refer to Accessory Drive Belt removal and installation in this group.

(10) Fill cooling system with coolant and check for leaks. Refer to Refilling Cooling System in this group.

(11) Connect battery cable to battery.

(12) 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.

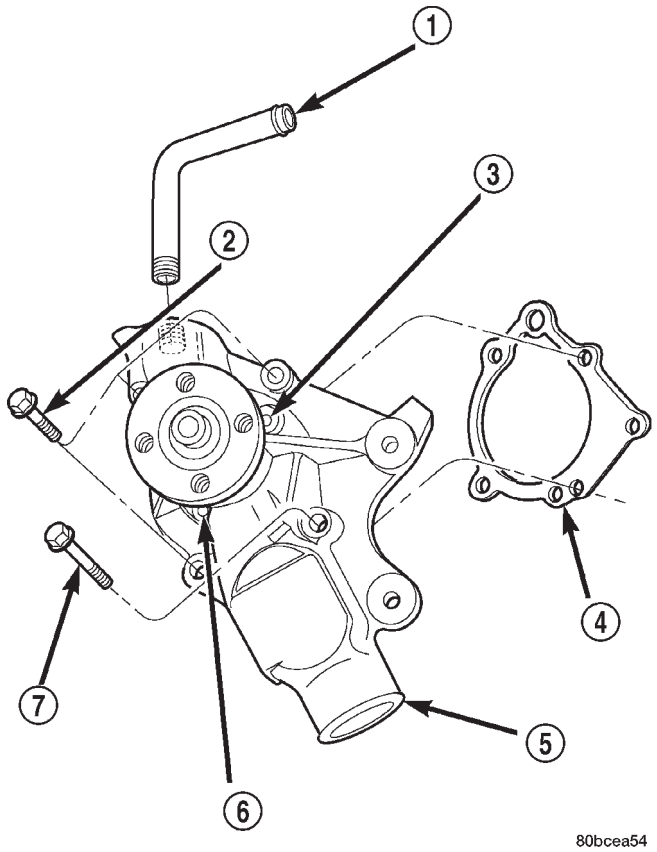


Fig. 28 Water Pump Remove/Install—2.5L Engine

1 – HEATER HOSE FITTING
2 – BOLTS (3) SHORT
3 – UPPER VENT HOLE
4 – PUMP GASKET
5 – WATER PUMP
6 – LOWER VENT HOLE
7 – LONG BOLT

(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. 26). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 27). If replacement is necessary, use only an original equipment clamp with matching number or letter.

REMOVAL AND INSTALLATION (Continued)

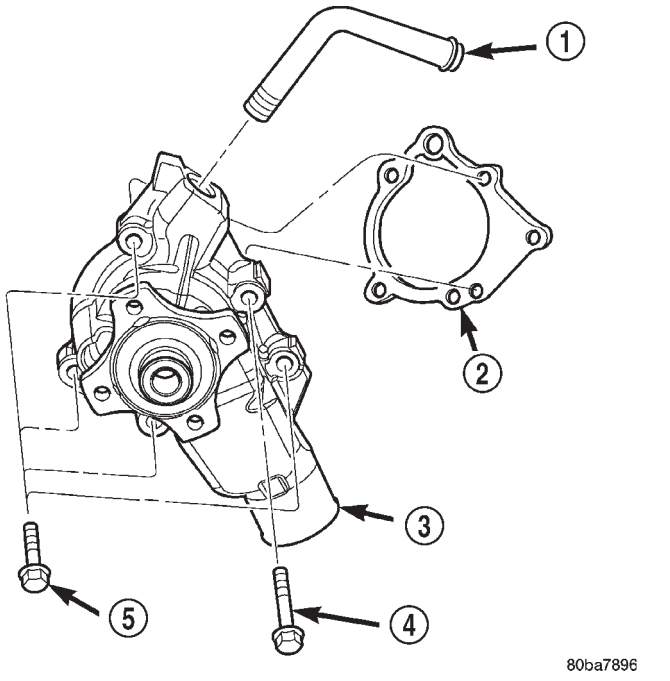


Fig. 29 Water Pump Remove/Install—4.0L Engine

1 – HEATER HOSE FITTING
2 – PUMP GASKET
3 – WATER PUMP
4 – LONG BOLT
5 – BOLTS (4) SHORT

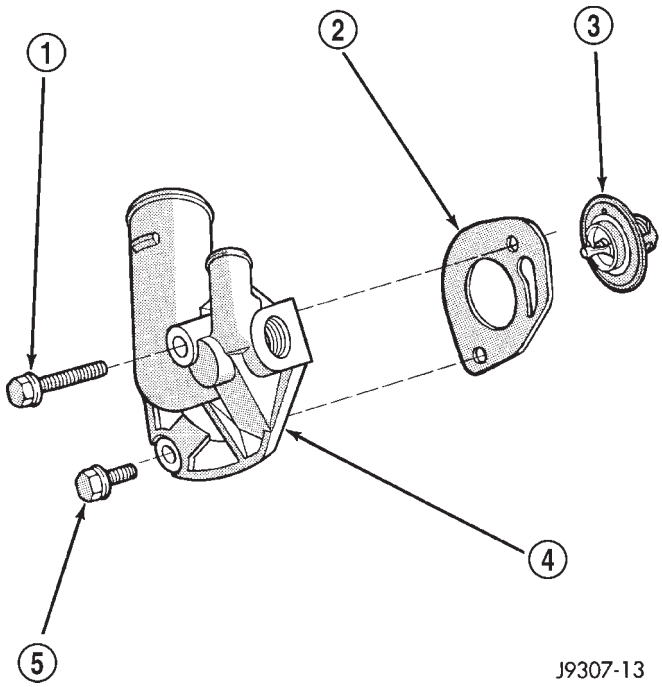


Fig. 30 Thermostat Removal/Installation

1 – LONG BOLT
2 – GASKET
3 – THERMOSTAT
4 – THERMOSTAT HOUSING
5 – SHORT BOLT

(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. 30). Discard old gasket.

(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.

(2) Observe the recess groove in the engine cylinder head (Fig. 31).

(3) Position thermostat into this groove with arrow and air bleed hole on outer flange pointing up.

(4) Install replacement gasket and thermostat housing.

CAUTION: Tightening the thermostat housing unevenly or with the thermostat out of its recess may result in a cracked housing.

(5) Tighten the housing bolts to 20 N·m (15 ft. lbs.) torque.

(6) Install hoses to thermostat housing.

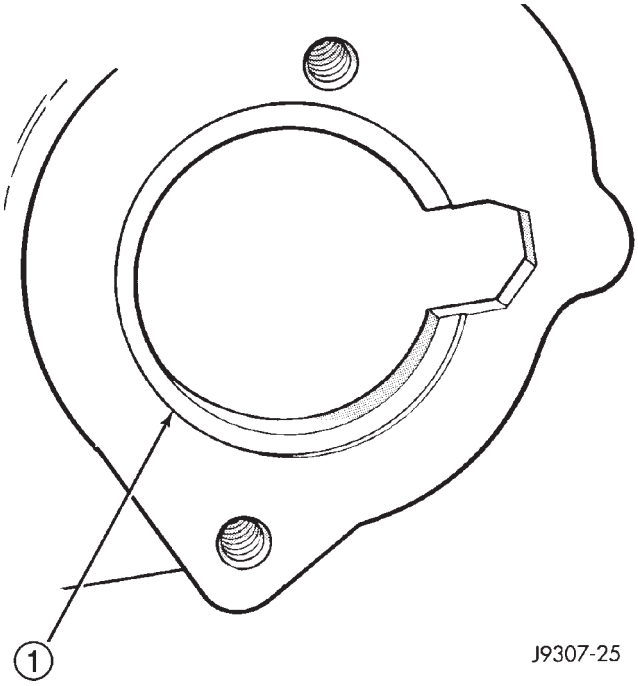


Fig. 31 Thermostat Recess

1 – GROOVE

(7) Install electrical connector to coolant temperature sensor.

REMOVAL AND INSTALLATION (Continued)

(8) Be sure that the radiator draincock is tightly closed. Fill the cooling system to the correct level with the required coolant mixture. Refer to Refilling Cooling System in this group.

(9) Start and warm the engine. Check for leaks.

RADIATOR

REMOVAL

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

(1) Disconnect negative battery cable at battery.

(2) Observe the previous **WARNING.** Remove the radiator cap.

(3) Remove the condenser lower seal from the lower core support (Fig. 32).

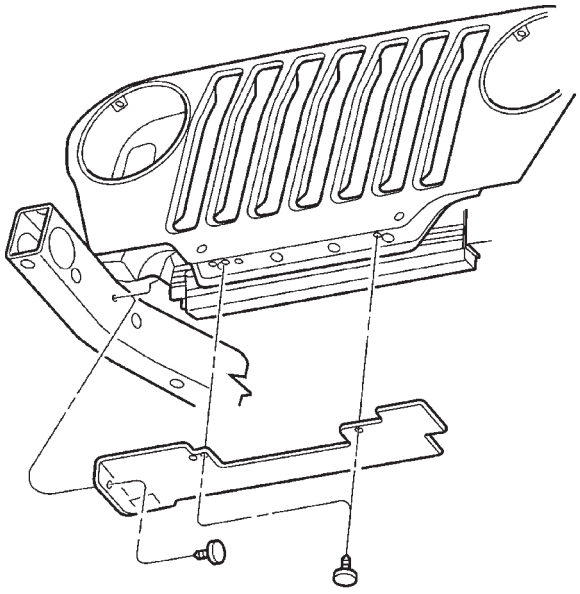


Fig. 32 Condenser Lower Seal

(4) Position drain pan under draincock. Open radiator draincock and drain radiator. DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(5) Remove radiator upper and lower hose clamps. Remove radiator hoses.

(6) Disconnect coolant reserve/overflow tank hose from radiator.

(7) Remove the four fan shroud mounting bolts (Fig. 33). On some models the power steering fluid reservoir tank is attached to the side of the fan shroud. Tie the reservoir back to prevent spillage. Position the fan shroud back over the fan blades.

(8) If equipped, disconnect and plug automatic transmission fluid cooler lines.

(9) Remove six radiator mounting bolts. Position the front axle vent hose (Fig. 33) to the side.

(10) Lift radiator straight up and out of vehicle taking care not to damage radiator fins.

(11) When removing radiator, note position of the rubber seals located on the top and bottom of radiator (on certain models only) (Fig. 33). To prevent possible overheating, these seals must be installed to their original positions.

INSTALLATION

(1) Position the radiator. Install and tighten the six mounting bolts (Fig. 33) to 8 N·m (72 in. lbs.) torque.

(2) Close radiator draincock.

(3) Position fan shroud and power steering reservoir tank (if equipped). Install and tighten four mounting bolts to 8 N·m (72 in. lbs.) torque.

(4) If equipped, remove plugs and connect automatic transmission fluid cooler lines and constant tension clamps.

(5) Connect radiator hoses and install hose clamps.

(6) Position and install the condenser lower seal (Fig. 32).

(7) Connect battery negative cable.

(8) Fill cooling system with correct coolant. Refer to Cooling Sytem Refilling in this group.

(9) Connect coolant recovery bottle hose.

(10) Install radiator cap.

(11) Check and adjust automatic transmission fluid level (if equipped).

(12) Start engine and check for leaks.

BLOCK HEATER

REMOVAL

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(1) Drain coolant from radiator and engine cylinder block.

(2) Unplug power cord from block heater.

(3) Loosen screw in center of block heater (Fig. 34) or (Fig. 35).

(4) Remove block heater from cylinder block.

INSTALLATION

(1) Thoroughly clean the engine core hole and the block heater seat.

REMOVAL AND INSTALLATION (Continued)

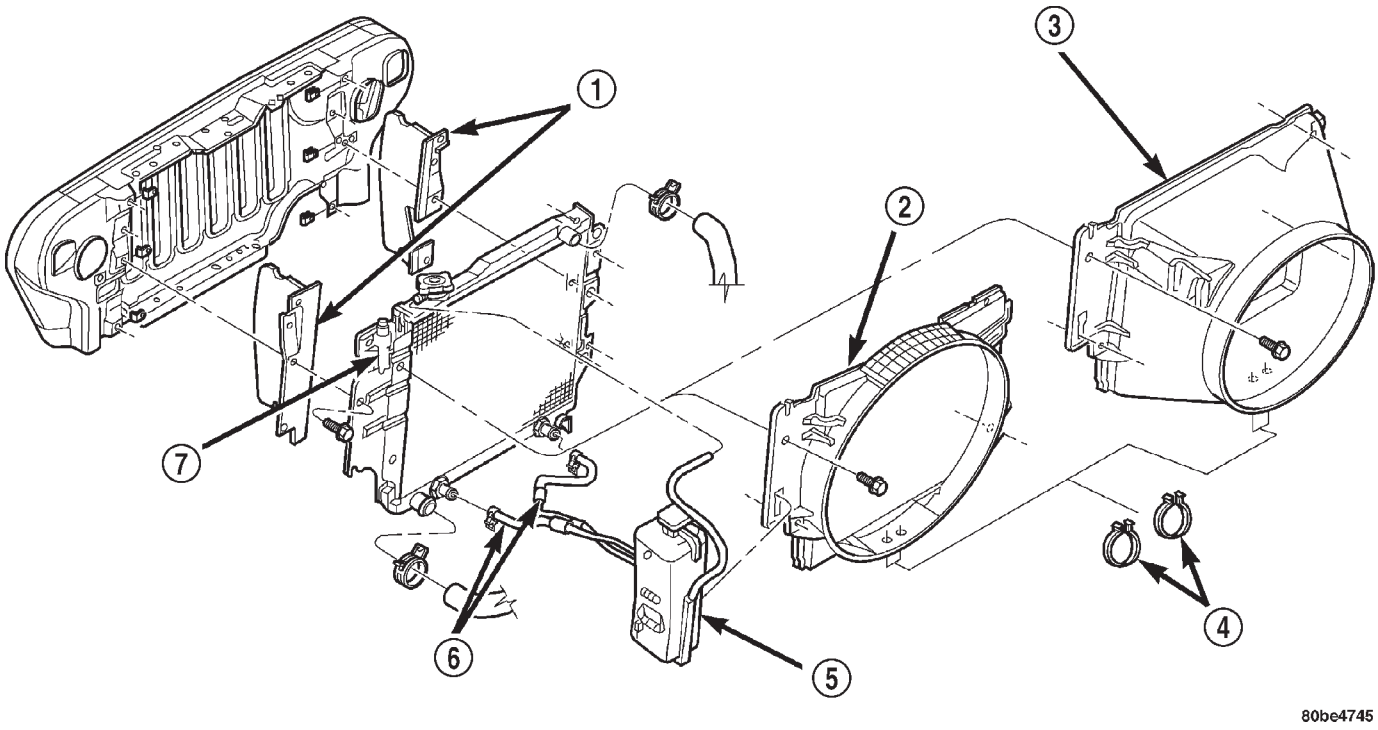


Fig. 33 Radiator—Remove/Install

1 – A/C CONDENSER SEALS
2 – FAN SHROUD (4.0L)
3 – FAN SHROUD (2.5L)
4 – TRANSMISSION OIL COOLER LINES RETAINER CLIPS
5 – COOLANT RECOVERY BOTTLE
6 – TRANSMISSION COOLER LINES (IF EQUIPPED)
7 – FRONT AXLE VENT HOSE

(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 4 N·m (31 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.

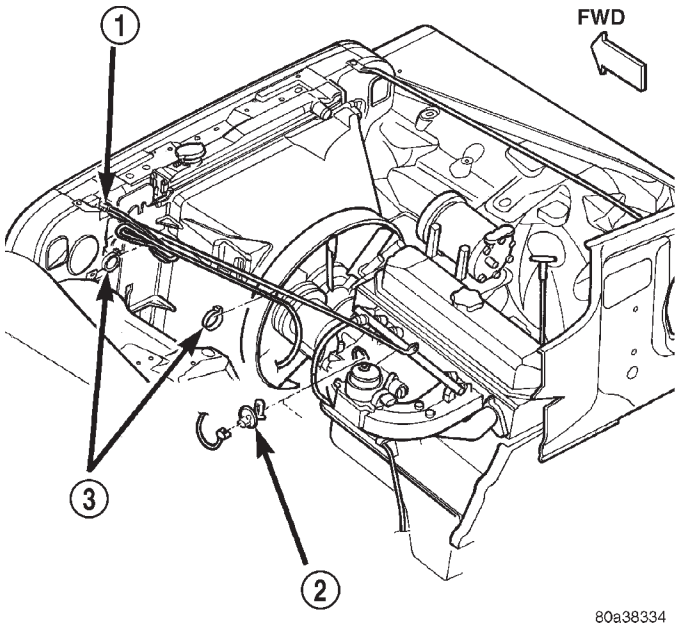


Fig. 34 Block Heater and Cord—2.5L Engine

1 – POWER CORD
2 – BLOCK HEATER
3 – TIE-STRAPS

VISCOUS FAN

REMOVAL

(1) **2.5L Engine** Loosen but do not remove at this time, the four fan hub mounting nuts (Fig. 36).

(2) **4.0L Engine** The thermal viscous fan drive/fan blade assembly is attached (threaded) to water pump hub shaft. Remove fan blade/viscous fan drive assembly from water pump by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT HAND.** Using a suitable fan wrench loosen the fan drive (Fig. 37).

(3) Remove accessory drive belt. Refer to Belt Service in the Engine Accessory Drive Belt section of this group.

REMOVAL AND INSTALLATION (Continued)

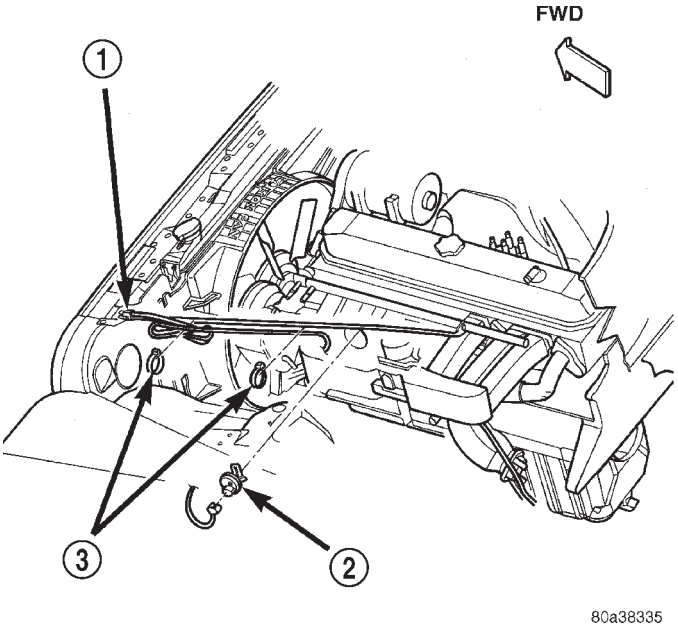


Fig. 35 Block Heater and Cord—4.0L Engine

1 – POWER CORD
2 – FWD
3 – BLOCK HEATER
4 – TIE-STRAPS

(4) 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.

(5) **2.5L Engine** Remove four fan hub mounting nuts (Fig. 36) and remove fan/viscous fan drive assembly from vehicle.

(6) 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) **2.5L Engine** 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.

(3) **4.0L Engine** Thread the fan and fan drive onto the water pump pulley.

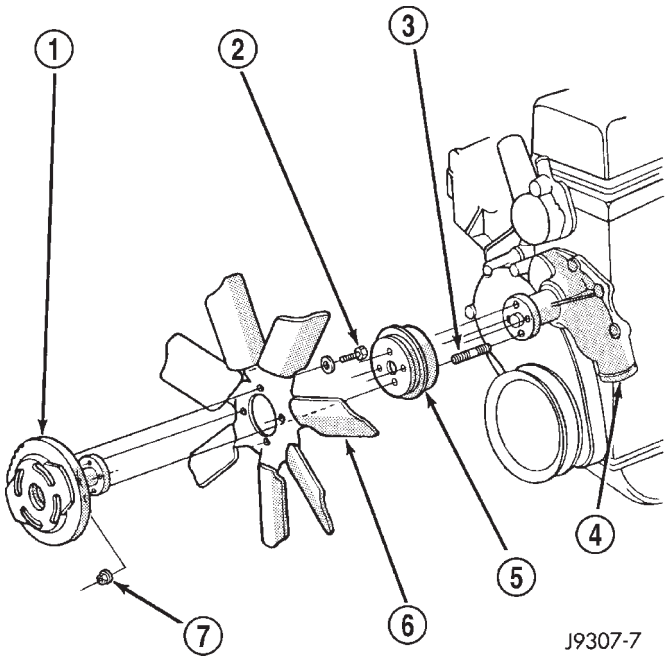


Fig. 36 Fan Mount—2.5L Engine

1 – THERMAL VISCOUS FAN DRIVE
2 – (4) FAN BLADE-TO-VISCOUS DRIVE BOLTS
3 – (4) FAN HUB-TO-PUMP PULLEY STUDS
4 – WATER PUMP
5 – WATER PUMP PULLEY
6 – FAN BLADE
7 – (4) FAN HUB-TO-PUMP PULLEY NUTS

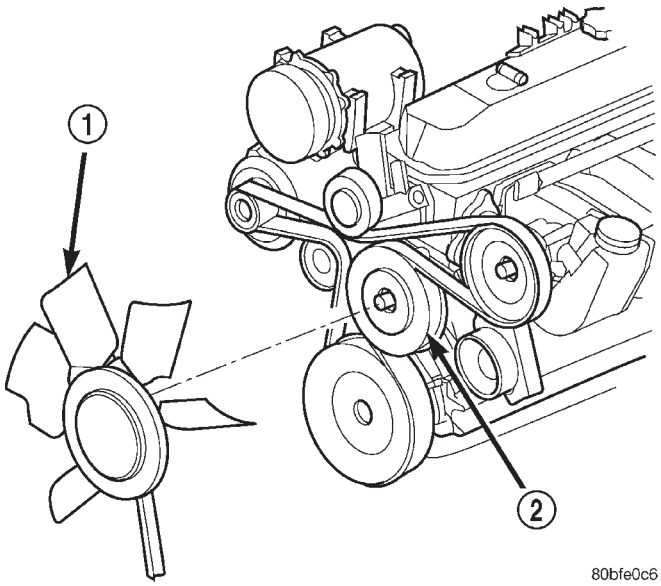


Fig. 37 Fan and Fan Drive—4.0L Engine

1 – FAN AND FAN DRIVE
2 – WATER PUMP PULLEY

REMOVAL AND INSTALLATION (Continued)

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to Serpentine Drive Belt Removal and Installation in this group for correct belt routing.

VISCOUS FAN DRIVE

Refer to Cooling System Fan for removal and installation procedures of the viscous drive unit.

Viscous Fan Drive Fluid Pump Out Requirement: After installing a **new** viscous fan drive, bring the engine speed up to approximately 2000 rpm and hold for approximately two minutes. This will ensure proper fluid distribution within the drive.

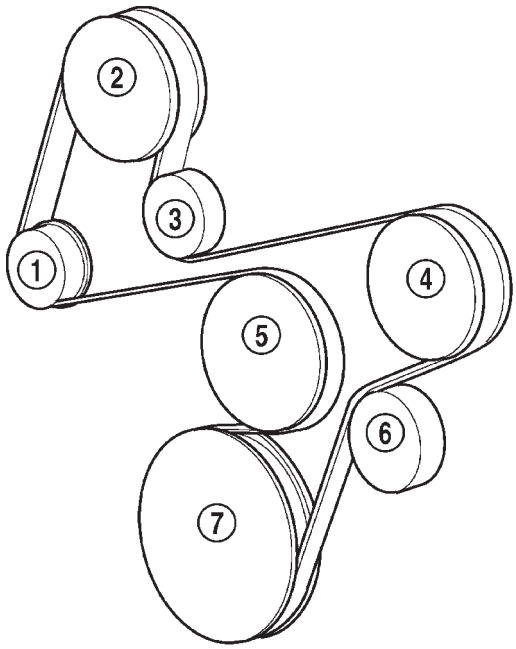
ACCESSORY DRIVE BELT

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 serpentine or a V-type belt. Refer to the instructions supplied with the gauge. Use the correct gauge when checking belt tension. Place gauge in the middle of the section of belt being tested (between two pulleys) to check tension. Do not allow the gauge (or gauge adapter) to contact anything but the belt.

BELT SCHEMATICS

The belt routing schematics are published from the latest information available at the time of publication. Vehicles not equipped with Power Steering have an idler pulley in place of the power steering pump pulley. **If anything differs between these schematics and the Belt Routing Label, use the schematics on Belt Routing Label.** This label is located in the engine compartment.

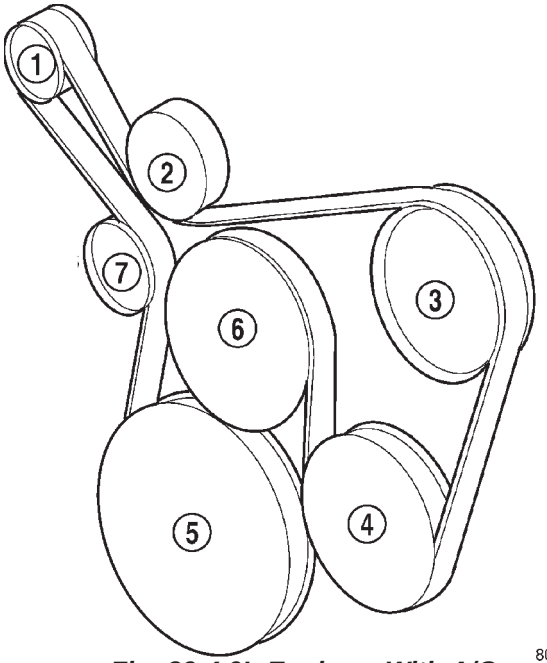
Refer to (Fig. 38) (Fig. 39) (Fig. 40) (Fig. 41) for correct belt routing, or refer to Belt Routing Label located in the vehicle engine compartment.



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Fig. 38 2.5L Engines–With A/C

1 – GENERATOR PULLEY
2 – AIR CONDITIONING COMPRESSOR PULLEY
3 – IDLER PULLEY
4 – POWER STEERING PUMP PULLEY
5 – WATER PUMP PULLEY
6 – IDLER PULLEY
7 – CRANKSHAFT PULLEY



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Fig. 39 4.0L Engines–With A/C

1 – GENERATOR PULLEY
2 – IDLER PULLEY
3 – POWER STEERING PUMP PULLEY
4 – AIR CONDITIONING COMPRESSOR PULLEY
5 – CRANKSHAFT PULLEY
6 – WATER PUMP PULLEY
7 – TENSIONER PULLEY

REMOVAL AND INSTALLATION (Continued)

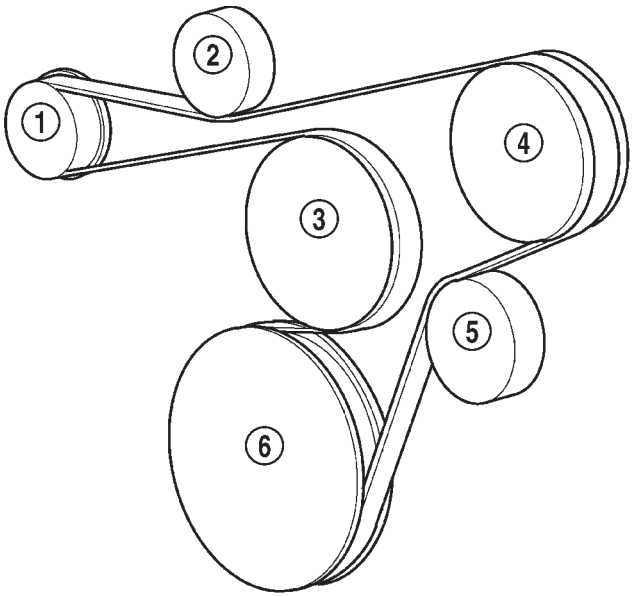


Fig. 40 2.5L Engines—Without A/C

1 – GENERATOR PULLEY
2 – IDLER PULLEY
3 – WATER PUMP PULLEY
4 – POWER STEERING PUMP PULLEY
5 – IDLER PULLEY
6 – CRANKSHAFT PULLEY

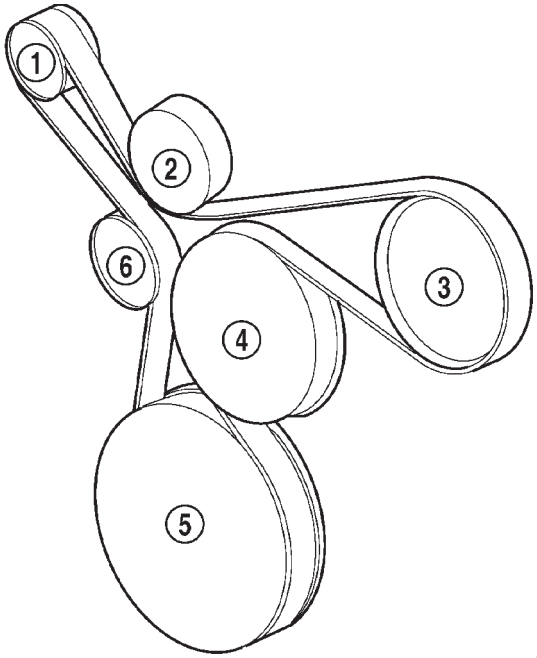


Fig. 41 4.0L Engines—Without A/C

1 – GENERATOR PULLEY
2 – IDLER PULLEY
3 – POWER STEERING PUMP PULLEY
4 – WATER PUMP PULLEY
5 – CRANKSHAFT PULLEY
6 – TENSIONER PULLEY

BELT REPLACEMENT

REMOVAL

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 (Fig. 42).

(3) Loosen tension adjusting bolt (Fig. 42) and remove accessory drive belt.

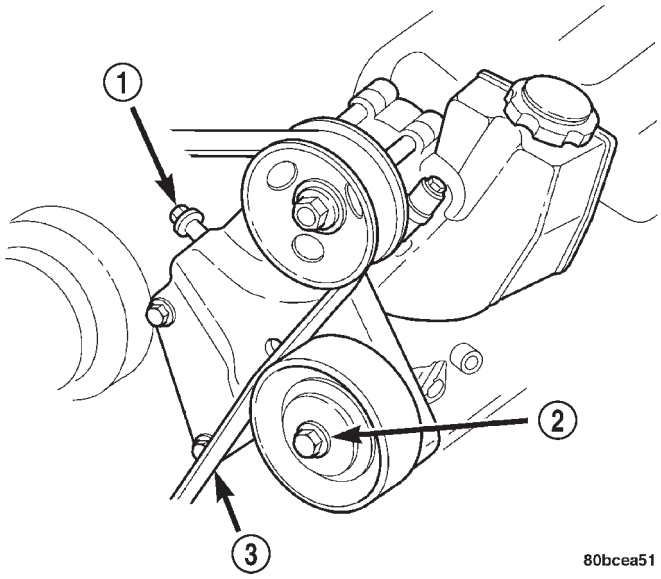


Fig. 42 Power Steering Pump Bracket and Idler Pulley—2.5L

1 – ADJUSTMENT BOLT
2 – IDLER BOLT/ANCHOR BOLT
3 – ACCESSORY DRIVE BELT

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. 38) (Fig. 39) (Fig. 40) (Fig. 41) for correct belt routing.

(2) Install new belt. Install belt tension gauge C-4162 and tighten adjustment bolt (Fig. 42) until belt tension is within specification range. Refer to the end of this group for Drive Belt Tension specifications.

(3) Tighten idler pulley bolt and re-check belt tension. Adjust if necessary.

CLEANING AND INSPECTION

RADIATOR PRESSURE CAP

CLEANING

Use only a mild soap and water to clean the radiator cap. Using any type solvent may cause damage to the seal in the radiator cap.

INSPECTION

Hold cap at eye level, right side up. The vent valve at bottom of cap should open. If rubber gasket has swollen and prevents vent valve from opening, replace cap.

Hold cap at eye level, upside down. If any light can be seen between vent valve and rubber gasket, replace cap. **Do not use a replacement cap that has a spring to hold vent shut.** A replacement cap must be the type designed for a coolant reserve/overflow system with a completely sealed diaphragm spring and a rubber gasket. This gasket is used to seal to radiator filler neck top surface. Use of proper cap will allow coolant return to radiator.

RADIATOR

CLEANING

Clean radiator fins. With the engine cold, apply cold water and compressed air to the back (engine side) of the radiator to flush the radiator and/or A/C condenser of debris.

INSPECTION

The radiator cooling fins should be checked for damage or deterioration. Inspect cooling fins to make sure they are not bent or crushed, these areas result in reduced heat exchange causing the cooling system to operate at higher temperatures. Inspect the plastic end tanks for cracks, damage or leaks.

Inspect the radiator neck for damage or distortion.

FAN BLADE

CLEANING

Clean the fan blades using a mild soap and water. Do not use an abrasive to clean the blades.

INSPECTION

WARNING: DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN BLADES IF FAN IS NOT WITHIN SPECIFICATIONS.

CAUTION: If fan blade assembly is replaced because of mechanical damage, water pump and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

(1) Remove fan blade assembly from viscous fan drive unit (four bolts).

(2) Lay fan on a flat surface with leading edge facing down. With tip of blade touching flat surface, replace fan if clearance between opposite blade and surface is greater than 2.0 mm (.090 inch). Rocking motion of opposite blades should not exceed 2.0 mm (.090 inch). Test all blades in this manner.

(3) Inspect fan assembly for cracks, bends, loose rivets or broken welds. Replace fan if any damage is found.

ADJUSTMENTS

ACCESSORY DRIVE BELT—2.5L 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.

With the engine off (not running), visually inspect accessory drive belt for glazing, cracks or chunks missing. Also inspect pulleys for misalignment or defects. Refer to accessory drive belt diagnosis in this group for the correct belt diagnostic procedures.

ACCESSORY DRIVE BELT TENSION CHART

BELT	TENSION
**NEW SERPENTINE BELT	800-900 N (180-200 lbs.)
USED SERPENTINE BELT	623-712 N (140-160 lbs.)
**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.	

(1) Disconnect battery negative cable.

(2) Install belt tension gauge C-4162 and compare reading with those in the accessory drive belt tension specification chart.

ADJUSTMENTS (Continued)

If tension is within specifications and no adjustment is needed, remove belt tension gauge C-4162 and connect battery negative cable.

If belt tension is out of specification and adjustment is necessary, continue with the following procedure.

(3) Loosen idler pulley bolt (Fig. 43).

(4) Adjust tension adjusting bolt (Fig. 43) until reading is within specification.

(5) Tighten idler pulley bolt and re-check belt tension. Adjust if necessary.

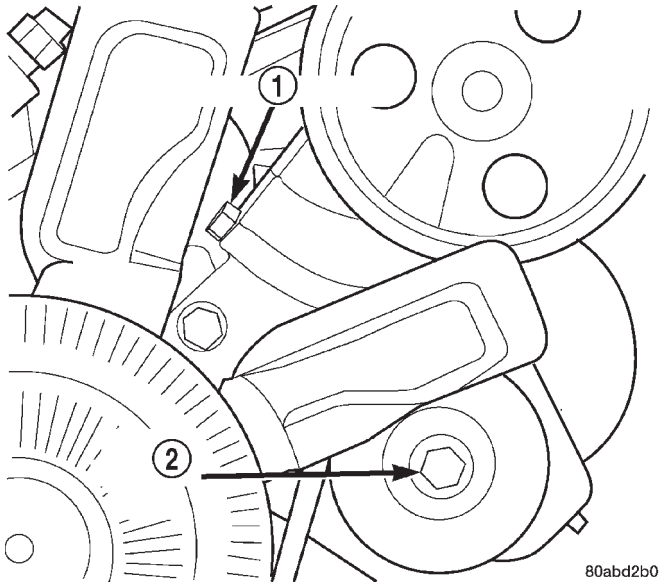


Fig. 43 Power Steering Pump Bracket and Idler Pulley

1 – ADJUSTING BOLT
2 – IDLER PULLEY BOLT

SPECIFICATIONS

COOLING SYSTEM CAPACITIES

ENGINE	CAPACITY
2.5L	8.5L (9.0 Qts.)
4.0L	9.9L (10.5 Qts.)

NOTE: Cooling system capacity does not vary with or without A/C since the components are the same.

ACCESSORY DRIVE BELT TENSION—2.5L

BELT	TENSION
**NEW SERPENTINE BELT	800-900 N (180-200 lbs.)
USED SERPENTINE BELT	623-712 N (140-160 lbs.)
**Belt is considered new if it has been used 15 minutes or less.	
Specifications for use with a belt tension gauge. Refer to operating instructions supplied with gauge.	

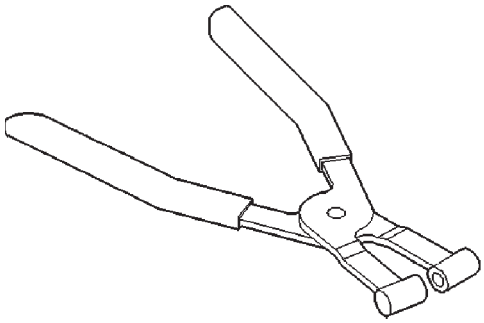
TORQUE

TORQUE CHART

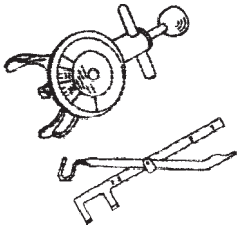
DESCRIPTION	N·m	Ft Lbs	In Lbs
Block Heater—Fastener	4	—	31
Fan Blade–to–Viscous Fan Drive—Bolts	24	18	—
Fan Shroud—Screws	8	—	72
Generator Pivot—Bolt (2.5L)	27	20	—
Radiator Mounting—Bolts	8	—	72
Thermostat Housing—Bolts	20	15	—
Transmission Cooler Lines			
Fittings at Radiator	16	—	140
Pressure Fitting at Trans.	20	—	180
Viscous Fan Drive-to-Water Pump—Nuts (2.5L)	23	—	200
Viscous Fan Drive to Water Pump—Studs (2.5L)	11	—	100
Water Pump—Bolts	23	—	200

SPECIAL TOOLS

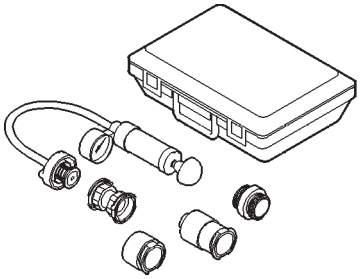
COOLING



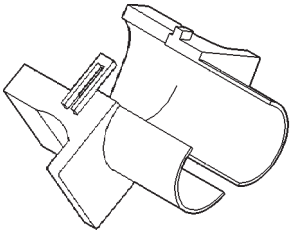
Hose Clamp Pliers—6094



Belt Tension Gauge —C-4162



Cooling System Pressure Tester—7700–A



Quick Disconnect Tool—6935

BATTERY

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DESCRIPTION AND OPERATION

BATTERY

DESCRIPTION

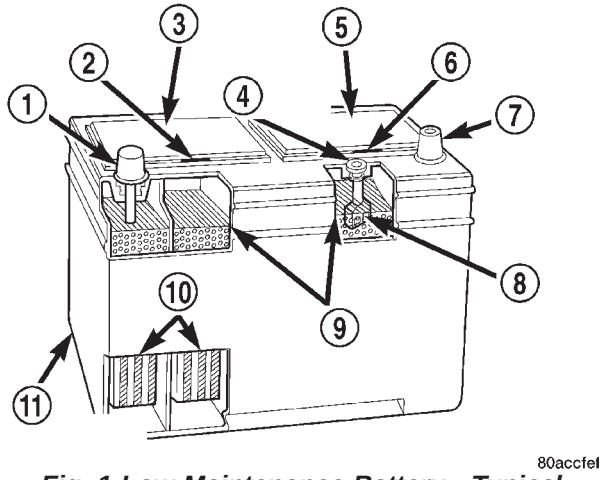


Fig. 1 Low-Maintenance Battery - Typical

1 – POSITIVE POST
2 – VENT
3 – CELL CAP
4 – TEST INDICATOR
5 – CELL CAP
6 – VENT
7 – NEGATIVE POST
8 – GREEN BALL
9 – ELECTROLYTE LEVEL
10 – PLATE GROUPS
11 – LOW-MAINTENANCE BATTERY

A large capacity, low-maintenance storage battery (Fig. 1) is standard factory-installed equipment on this model. Male post type terminals made of a soft lead material protrude from the top of the molded plastic battery case to provide the means for connecting the battery to the vehicle electrical system. The battery positive terminal post is visibly larger in diameter than the negative terminal post, for easy identification. The letters **POS** and **NEG** are also molded into the top of the battery case adjacent to their respective positive and negative terminal posts for additional identification confirmation. Refer to **Battery Cables** in the index of this service manual for the location of more information on the battery cables that connect the battery to the vehicle electrical system.

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 battery is made up of six individual cells that are connected in series. Each cell contains positively charged plate groups that are connected with lead straps to the positive terminal post, and negatively charged plate groups that are connected with lead straps to the negative terminal post. Each plate consists of a stiff mesh framework or grid coated with lead dioxide (positive plate) or sponge lead (negative plate). Insulators or plate separators made of a non-conductive material are inserted between the positive and negative plates to prevent them from contacting or shorting against one another. These dissimilar metal

DESCRIPTION AND OPERATION (Continued)

plates are submerged in a sulfuric acid and water solution called an electrolyte.

The factory-installed battery has a built-in test indicator (hydrometer). The color visible in the sight glass of the indicator will reveal the battery condition. For more information on the use of the built-in test indicator, refer to **Battery** in the index of this service manual for the location of the proper battery diagnosis and testing procedures. **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. The chemical composition of the metal coated plates within the low-maintenance battery reduces battery gassing and water loss, at normal charge and discharge rates. Therefore, the battery should not require additional water in normal service. If the electrolyte level in this battery does become low, water must be added. However, rapid loss of electrolyte can be caused by an overcharging condition. Be certain to diagnose the charging system after replenishing the water in the battery for a low electrolyte condition and before returning the vehicle to service. Refer to **Charging System** in the index of this service manual for the location of the proper charging system diagnosis and testing procedures.

For battery maintenance schedules and jump starting procedures, see the owner's manual in the vehicle glove box. Optionally, refer to **Maintenance Schedules** and **Jump Starting, Towing and Hoisting** in the index of this service manual for the location of the recommended battery maintenance schedules and the proper battery jump starting procedures. While battery charging can be considered a maintenance procedure, the battery charging procedures and information are located in the service procedures section of this service manual. This was done because the battery must be fully-charged before any battery diagnosis or testing procedures can be performed. Refer to **Battery Charging** in the index of this service manual for the location of the proper battery charging procedures.

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** in the index of this service manual for the location of the proper factory-installed battery specifications. Battery sizes and ratings are discussed in more detail below.

- Group Size

The outside dimensions and terminal placement of the battery conform to standards established by the Battery Council International (BCI). Each battery is assigned a BCI Group Size number to help identify a correctly-sized replacement.

- Cold Cranking Amperage

The Cold Cranking Amperage (CCA) rating specifies how much current (in amperes) the battery can deliver for thirty seconds at -18° 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.

OPERATION

When an electrical load is applied to the terminals of the battery, an electrochemical reaction occurs. This reaction causes the battery to discharge electrical current from its terminals. 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 itself, the battery discharging process is reversed. Charging the battery gradually changes the sulfated lead plates back into sponge lead and

DESCRIPTION AND OPERATION (Continued)

lead dioxide, 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.

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, 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.

In addition to producing and storing electrical energy, the battery serves as a capacitor and 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.

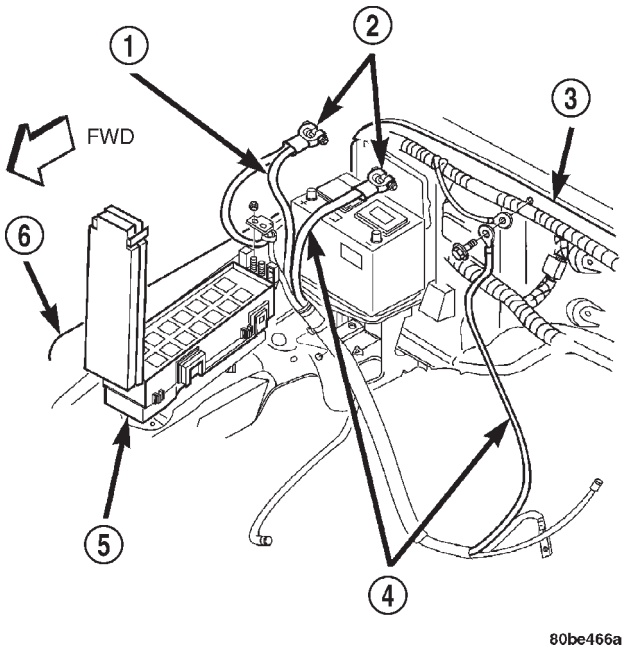


Fig. 2 Battery Cables

1 – POSITIVE CABLE
2 – TERMINAL CLAMPS
3 – DASH PANEL
4 – NEGATIVE CABLE
5 – POWER DISTRIBUTION CENTER
6 – FENDER

BATTERY CABLES

DESCRIPTION

The battery cables (Fig. 2) are large gauge, stranded copper wires sheathed within a heavy plastic or synthetic rubber insulating jacket. The wire used in the battery cables combines excellent flexibility and reliability with high electrical current carrying capacity. Refer to **Wiring Diagrams** in the index of this service manual for the location of the proper battery cable wire gauge information.

A clamping type female battery terminal made of soft lead is die cast onto one end of the battery cable wire. A square headed pinch-bolt and hex nut are installed at the open end of the female battery terminal clamp. Large eyelet type terminals are crimped onto the opposite end of the battery cable wire and then solder-dipped. The battery positive cable wires have a red insulating jacket to provide visual identification and features a larger female battery terminal clamp to allow connection to the larger battery positive terminal post. The battery negative cable wires have a black insulating jacket and a smaller female battery terminal clamp.

The battery cables cannot be repaired and, if damaged or faulty they must be replaced. Both the battery positive and negative cables are available for service replacement only as a unit with the battery wire harness, which may include portions of the wiring circuits for the generator and other components on some models. Refer to **Wiring Diagrams** in the index of this service manual for the location of more information on the various wiring circuits included in the battery wire harness for the vehicle being serviced.

OPERATION

The battery cables connect the battery terminal posts to the vehicle electrical system. These cables also provide a return path for electrical current generated by the charging system for restoring the voltage potential of the battery. The female battery terminal clamps on the ends of the battery cable wires provide a strong and reliable connection of the battery cable to the battery terminal posts. The terminal pinch bolts allow the female terminal clamps to be tightened around the male terminal posts on the top of the battery. The eyelet terminals secured to the ends of the battery cable wires opposite the female battery terminal clamps provide secure and reliable connection of the battery to the vehicle electrical system.

The battery positive cable terminal clamp is die cast onto the ends of two wires. One wire has a two-holed eyelet terminal that connects the battery positive cable to the B(+) terminal studs of the Power

DESCRIPTION AND OPERATION (Continued)

Distribution Center (PDC), and the other wire has an eyelet terminal that connects the battery positive cable to the B(+) terminal stud of the engine starter motor solenoid. The battery negative cable terminal clamp is also die cast onto the ends of two wires. One wire has an eyelet terminal that connects the battery negative cable to the vehicle powertrain through a stud on the right side of the engine block. The other wire has an eyelet terminal that connects the battery negative cable to the vehicle body through a ground screw on the right side of the dash panel, near the battery.

BATTERY HOLD DOWNS

DESCRIPTION

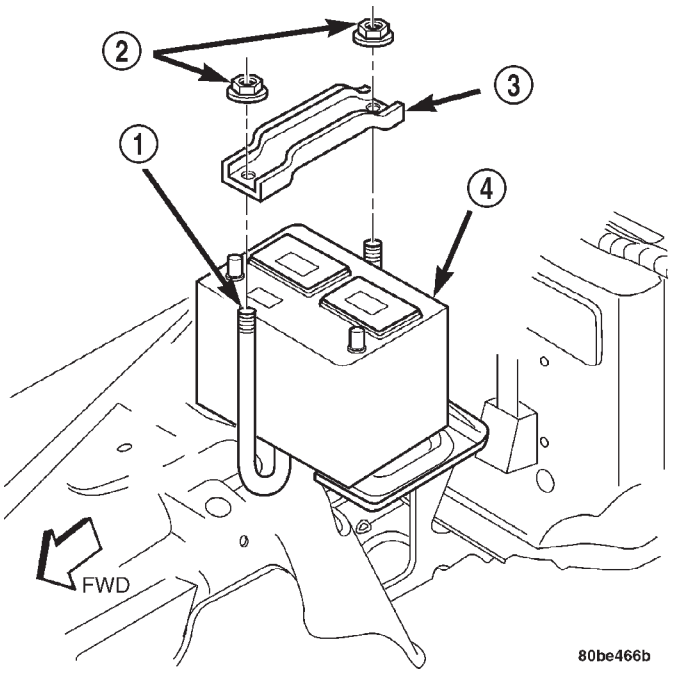


Fig. 3 Battery Hold Downs

1 – J-BOLT (2)
2 – NUT (2)
3 – BRACKET
4 – BATTERY

The battery hold down hardware (Fig. 3) includes two J-bolts, a hold down bracket and two hex nuts with coned washers. The battery hold down bracket consists of a stamped steel bracket that is then plastic-coated for corrosion protection.

When installing a battery into the battery tray, be certain that the hold down hardware is properly installed and that the 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, the vehicle or both. Refer to **Battery Hold Downs** in the index of this service manual for the location of the proper battery hold down installation procedures, including the proper hold down fastener tightness specifications.

OPERATION

The battery hold down hardware secures the battery to the battery tray in the engine compartment. This hardware is designed to prevent battery movement during vehicle operation. Unrestrained battery movement during vehicle operation can result in damage to the vehicle, the battery or both.

The hold down J-bolts are installed a hole in the front and rear flanges of the battery tray from the top, with the threaded ends of the bolts extending upward. The hooked end of each J-bolt is then engaged in a second hole in the front and rear flanges of the battery tray from the bottom. The battery hold down bracket is installed across the top of the battery case and over the two upright threaded ends of the J-bolts. A hex nut with coned washer is then installed and tightened onto each of the J-bolts to securely hold down the battery in the battery tray.

BATTERY THERMOGUARD

DESCRIPTION

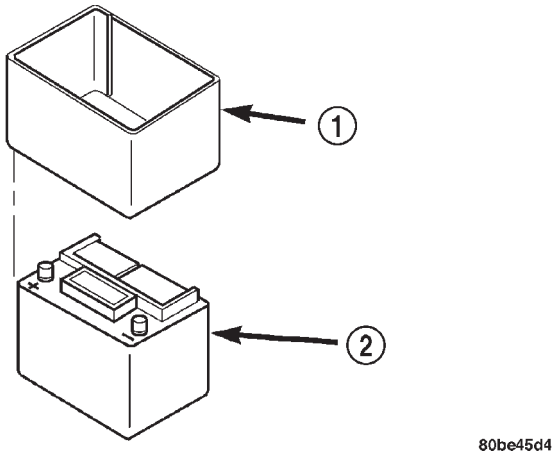


Fig. 4 Battery Thermoguard

1 – THERMOGUARD
2 – BATTERY

A flexible plastic bubble-wrap style thermoguard (Fig. 4) slides over the battery case to enclose the sides of the battery. The thermoguard consists of a heavy black plastic outer skin and two lighter plies of plastic that have been formed into a sheet with hundreds of small air pockets entrapped between them. The resulting material is very similar to the bubble-wrap used to protect items in many parcel packaging and shipping applications.

DESCRIPTION AND OPERATION (Continued)

OPERATION

The thermoguard protects the battery from engine compartment temperature extremes. The air trapped between the plastic plies of the thermoguard create a dead air space, which helps to insulate the sides of the battery case from the surrounding engine compartment air temperature.

BATTERY TRAY

DESCRIPTION

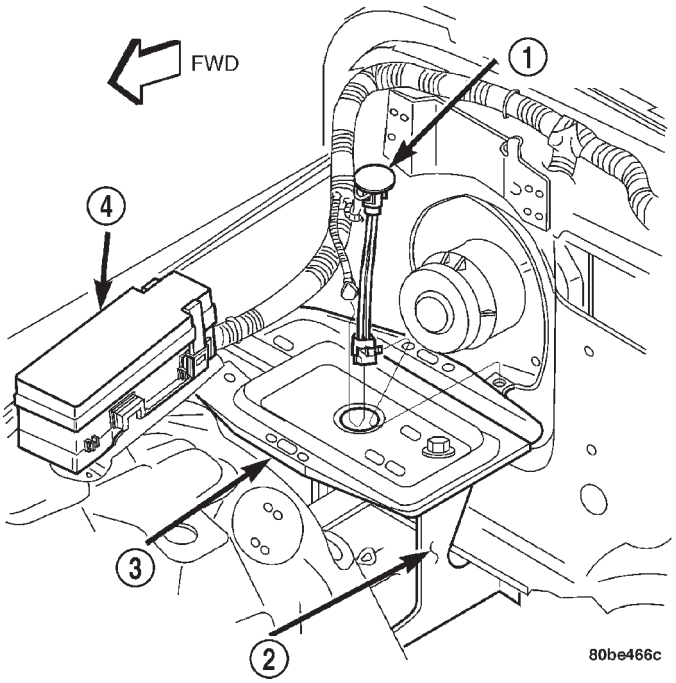


Fig. 5 Battery Tray

1 – BATTERY TEMPERATURE SENSOR
2 – REINFORCEMENT
3 – BATTERY TRAY
4 – POWER DISTRIBUTION CENTER

The battery is mounted in a stamped steel tray (Fig. 5) located in the passenger side rear corner of the engine compartment. The battery tray is secured by four hex screws with washers to the reinforcement located between the engine compartment side of the dash panel and the rear of the front fender wheelhouse inner panel. Refer to **Front Fender** in the index of this service manual for the location of more information on this reinforcement, which serves as the battery tray support.

A hole in the bottom of the battery tray is fitted with a battery temperature sensor. Refer to **Battery Temperature Sensor** in the index of this service manual for the location of more information on the battery temperature sensor. Refer to **Battery Hold Downs** in the index of this service manual for the location of more information on the battery hold down hardware.

OPERATION

The battery tray provides a mounting location and support for the vehicle battery. The battery tray also provides anchor points for the battery hold down hardware. The battery tray and the battery hold down hardware combine to secure and stabilize the battery in the engine compartment, which prevents battery movement during vehicle operation. Unrestrained battery movement during vehicle operation can result in damage to the vehicle, the battery or both.

DIAGNOSIS AND TESTING

BATTERY

DIAGNOSIS

The battery, starting system and charging system in the vehicle operate with one another, and must be tested as a complete system. In order for the engine to start and the battery to charge properly, all of the components that are used in these systems must perform within specifications. It is important that the battery, starting system and charging system 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 and before a vehicle is returned to service. The service information for these systems has been separated within this service manual to make it easier to locate the specific information you are seeking. However, when attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used for the battery, starting system and charging system include the most basic conventional diagnostic methods, to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of an induction-type milliampere ammeter, a volt/ohmmeter, a battery charger, a carbon pile rheostat (load tester) and a 12-volt test lamp may be required. All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. Refer to **Charging System, On-Board Diagnostic Test** in the index of this service manual for the location of the proper on-board diagnostic test procedures.

The battery must be completely charged and the top, posts and terminal clamps should be properly cleaned and inspected before diagnostic procedures

DIAGNOSIS AND TESTING (Continued)

are performed. Refer to **Battery** in the index of this service manual for the location of the proper battery cleaning and inspection procedures. Refer to **Battery Charging** in the index of this service manual for the location of the proper battery charging procedures.

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 does have removable cell caps, perform the hydrometer test to determine the state-of-charge. If the battery cell caps are not removable, or a hydrometer is not available, perform the open-circuit voltage test to determine the state-of-charge.

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 in the index of this service manual for the location of the proper battery charging procedures.

A battery is fully-charged when:

- All battery cells are gassing freely during charging.
- A green color is visible in the sight glass of the battery built-in test indicator.
- Three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in the specific gravity of the battery electrolyte.
- Open-circuit voltage of the battery is 12.4 volts or greater.

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 index of this service manual for the location of the proper battery specifications. Replace an incorrect battery, as required. 2. Inspect the battery for loose terminal posts or a cracked and leaking case. Replace the damaged battery, as required. 3. Refer to Battery Cables in the index of this service manual for the location of the proper battery cable diagnosis and testing procedures. Clean and tighten the battery terminal connections, as required. 4. Determine the battery state-of-charge. Refer to Built-In Test Indicator, Hydrometer Test, or Open-Circuit Voltage Test in this section for the proper test procedures. Charge the faulty battery, as required. 5. Refer to Ignition-Off Draw Test in this section for the proper test procedures. Repair the faulty electrical system, as required. 6. Determine the battery cranking capacity. Refer to Load Test in this section for the proper test procedures. Replace the faulty battery, as required. 7. Determine if the starting system is performing to specifications. Refer to Starting System in the index of this service manual for the location of the proper starting system diagnosis and testing procedures. Repair the faulty starting system, as required. 8. Determine if the charging system is performing to specifications. Refer to Charging System in the index of this service manual for the location of the proper charging system diagnosis and testing procedures. Repair the faulty charging system, as 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 index of this service manual for the location of the proper battery specifications. Replace an incorrect battery, as required. 2. Refer to Battery Cables in the index of this service manual for the location of the proper battery cable diagnosis and testing procedures. Clean and tighten the battery terminal connections, as required. 3. Refer to Accessory Drive Belt Diagnosis in the index of this service manual for the location of the proper accessory drive belt diagnosis and testing procedures. Replace or adjust the faulty generator drive belt, as required. 4. Refer to Ignition-Off Draw Test in this section for the proper test procedures. Repair the faulty electrical system, as required. 5. Determine the battery cranking capacity. Refer to Load Test in this section for the proper test procedures. Replace the faulty battery, as required. 6. Determine if the starting system is performing to specifications. Refer to Starting System in the index of this service manual for the location of the proper starting system diagnosis and testing procedures. Repair the faulty starting system, as required. 7. Determine if the charging system is performing to specifications. Refer to Charging System in the index of this service manual for the location of the proper charging system diagnosis and testing procedures. Repair the faulty charging system, as 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 index of this service manual for the location of the proper battery charging procedures. Charge or replace the faulty battery, as 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.
6. A faulty or incorrect charging system component. Refer to **Charging System** in the index of this service manual for the location of the proper charging system diagnosis and testing procedures.
7. A faulty or incorrect starting system component. Refer to **Starting System** in the index of this ser-

DIAGNOSIS AND TESTING (Continued)

vice manual for the location of the proper starting system diagnosis and testing procedures.

8. 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. 6). Like a hydrometer, the built-in test indicator measures the specific gravity of the battery 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. Refer to **Load Test** in this section for the proper battery load testing procedures.

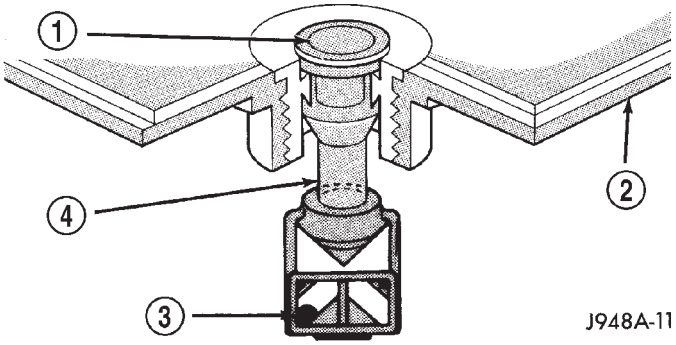


Fig. 6 Built-In Test Indicator

1 – SIGHT GLASS
2 – PLASTIC ROD
3 – BATTERY TOP
4 – GREEN BALL

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. 7). The battery condition that each color indicates is described in the following list:

- Green

Indicates 75% to 100% battery state-of-charge. The battery is adequately charged for further testing or return to service. If the starter will not crank for a minimum of fifteen seconds with a fully-charged battery, the battery must be load tested. Refer to **Load Test** in this section for the proper battery load testing procedures.

- Black or Dark

Indicates 0% to 75% battery state-of-charge. The battery is inadequately charged and must be charged until a green indication is visible in the sight glass (12.4 volts or more), before the battery is tested further or returned to service. Refer to **Battery Charging** in the index of this service manual for the location of the proper battery charging procedures. Also refer to **Abnormal Battery Discharging** in this section for the possible causes of the discharged battery condition.

- Clear or Bright

Indicates a low battery electrolyte level. The electrolyte level in the battery is below the 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 index of this service manual for the location of the proper battery charging procedures. A low electrolyte level may be caused by an overcharging condition. Refer to **Charging System** in the index of this service manual for the location of the proper charging system diagnosis and testing procedures.

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**

DIAGNOSIS AND TESTING (Continued)

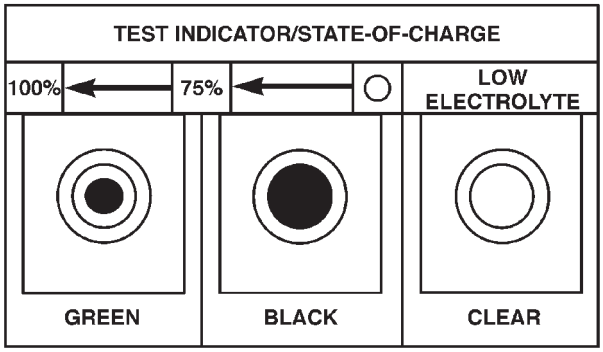


Fig. 7 Built-In Test Indicator Sight Glass

Voltage Test in this section for the proper procedures for performing these alternate tests of the battery state-of-charge.

Specific gravity is a comparison of the density of the battery 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 battery electrolyte by weight, or 24% by volume. In a fully-charged battery the electrolyte will have a temperature-corrected specific gravity of 1.260 to 1.290. However, a specific gravity of 1.235 or above is satisfactory for 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.

• 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. Then remove the battery cell caps and check the electrolyte level. Add distilled water if the electrolyte level is below the top of the battery plates.

See the instructions provided by the manufacturer of the hydrometer for recommendations on the correct use of the hydrometer that you are using. Remove only enough electrolyte from the battery cell so that the float is off the bottom of the hydrometer barrel with pressure on the bulb released. To read the hydrometer correctly, hold it with the top surface of the electrolyte at eye level (Fig. 8).

CAUTION: Exercise care when inserting the tip of the hydrometer into a battery cell to avoid damaging the plate separators. Damaged plate separators can cause early battery failure.

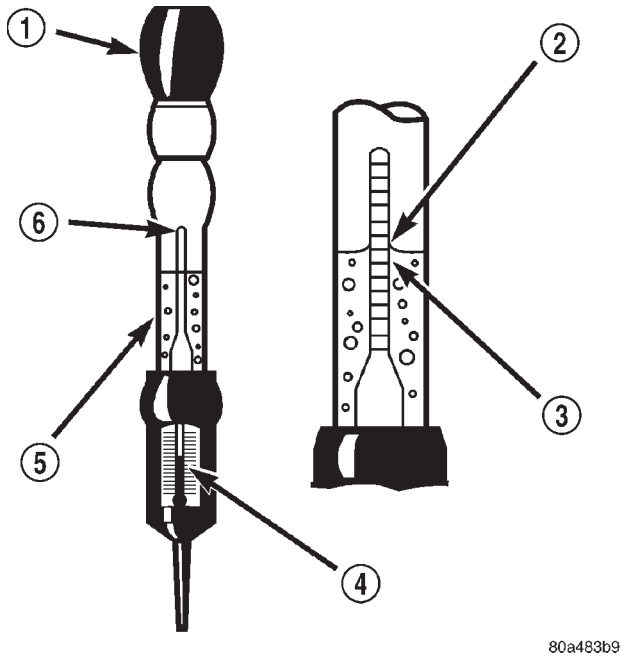


Fig. 8 Hydrometer - Typical

1 – BULB
2 – SURFACE COHESION
3 – SPECIFIC GRAVITY READING
4 – TEMPERATURE READING
5 – HYDROMETER BARREL
6 – FLOAT

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 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.

DIAGNOSIS AND TESTING (Continued)

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° C (10° F): **38.8° C ÷ 5.5° C = 7 (70° F ÷ 10° F = 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**

(5) The corrected specific gravity of the battery cell in this example is 1.212.

Test the specific gravity of the electrolyte in each battery cell. If the specific gravity of all cells is above 1.235, but the variation between cells is more than fifty points (0.050), the battery should be replaced. If the specific gravity of one or more cells is less than 1.235, charge the battery at a rate of approximately five amperes. Continue charging the battery until three consecutive specific gravity tests, taken at one-hour intervals, are constant. If the cell specific gravity variation is more than fifty points (0.050) at the end of the charge period, replace the battery.

When the specific gravity of all cells is above 1.235, and the cell variation is less than fifty points (0.050), the battery may be load tested to determine its cranking capacity. Refer to **Load Test** in this section for the proper battery load testing procedures.

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 index of this service manual for the location of the proper battery charging procedures.

(1) Before measuring the open-circuit voltage, the surface charge must be removed from the battery. Turn on the headlamps for fifteen seconds, then allow up to five minutes for the battery voltage to stabilize.

(2) Disconnect and isolate both battery cables, negative cable first.

(3) Using a voltmeter connected to the battery posts (see the instructions provided by the manufacturer of the voltmeter), measure the open-circuit voltage (Fig. 9).

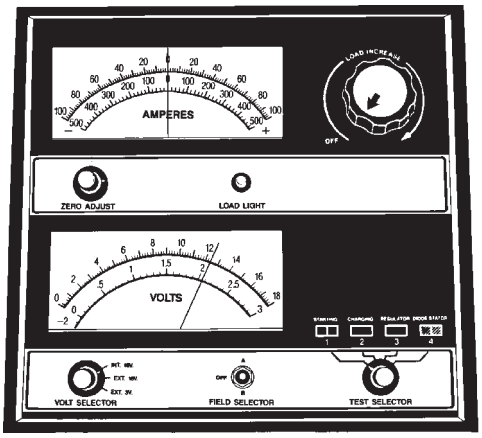


Fig. 9 Testing Open-Circuit Voltage - Typical

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 this section for the proper battery load testing procedures.

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%

DIAGNOSIS AND TESTING (Continued)

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** in the index of this service manual for the location of the proper factory-installed battery specifications to determine the battery CCA rating.

WARNING:

• IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

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Before proceeding with this test, completely charge the battery. Refer to **Battery Charging** in the index of this service manual for the location of 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. 10) to the battery posts (Fig. 11). 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 this section for the proper battery open-circuit voltage test procedures. The battery open-circuit voltage must be 12.4 volts or greater.

(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. 12). This will remove the surface charge from the battery.

(4) Allow the battery to stabilize to open-circuit voltage. It may take up to five minutes for the battery voltage to stabilize.

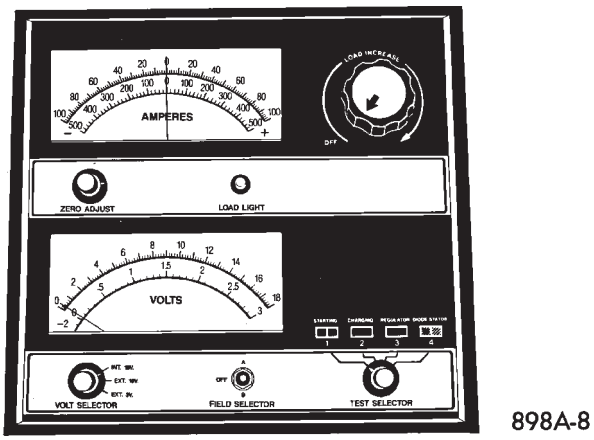


Fig. 10 Volt-Ammeter-Load Tester - Typical

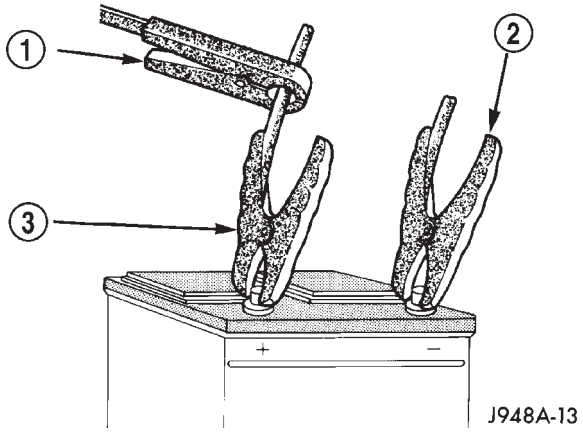


Fig. 11 Volt-Ammeter-Load Tester Connections - Typical

1 – INDUCTION AMMETER CLAMP
2 – NEGATIVE CLAMP
3 – POSITIVE CLAMP

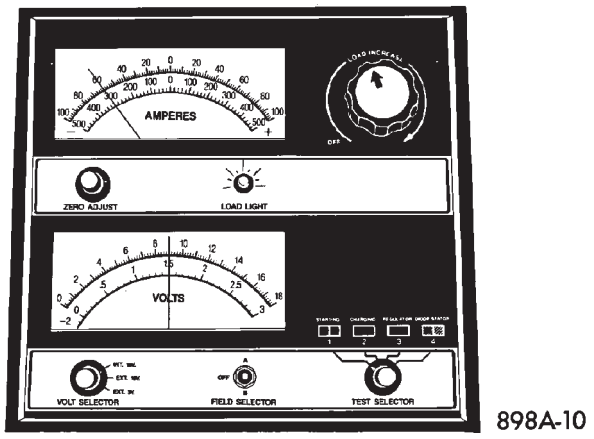


Fig. 12 Remove Surface Charge from Battery - Typical

(5) Rotate the load control knob to maintain a load equal to 50% of the CCA rating of the battery (Fig. 13). After fifteen seconds, record the loaded voltage

DIAGNOSIS AND TESTING (Continued)

reading, then return the load control knob to the Off position.

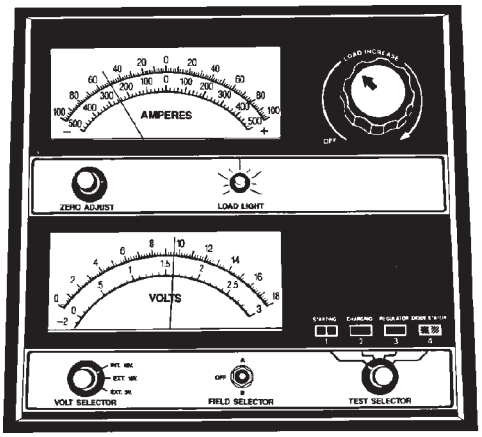


Fig. 13 Load 50% CCA Rating - Note Voltage - Typical

(6) The voltage drop will vary with the battery temperature at the time of the load test. The battery temperature can be estimated by using the ambient temperature during the past several hours. If the battery has been charged, boosted, or loaded a few minutes prior to the test, the battery will be somewhat warmer. See the Load Test Temperature chart for the proper loaded voltage reading.

Load Test Temperature		
Minimum Voltage	Temperature	
	°F	°C
9.6 volts	70° and above	21° and above
9.5 volts	60°	16°
9.4 volts	50°	10°
9.3 volts	40°	4°
9.1 volts	30°	-1°
8.9 volts	20°	-7°
8.7 volts	10°	-12°
8.5 volts	0°	-18°

(7) If the voltmeter reading falls below 9.6 volts, at a minimum battery temperature of 21° C (70° F), the battery is faulty and must be replaced.

IGNITION-OFF DRAW TEST

The term Ignition-Off Draw (IOD) identifies a normal condition where power is being drained from the battery with the ignition switch in the Off position. A normal vehicle electrical system will draw from five to 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 replacing a battery. In most cases, the battery can be charged and returned to service after the excessive IOD condition has been corrected.

(1) Verify that all electrical accessories are off. Turn off all lamps, remove the ignition key, and close all doors. If the vehicle is equipped with an illuminated entry system or an electronically tuned radio, allow the electronic timer function of these systems to automatically shut off (time out). This may take up to three minutes. See the Electronic Module Ignition-Off Draw table for more information.

Electronic Module Ignition-Off Draw (IOD)			
Module	Time Out? (If Yes, Interval and Wake-Up Input)	IOD	IOD After Time Out
Radio	No	1 to 3 milliamperes	N/A
Audio Power Amplifier	No	up to 1 milliampere	N/A
Powertrain Control Module (PCM)	No	0.95 milliampere	N/A

DIAGNOSIS AND TESTING (Continued)

Electronic Module Ignition-Off Draw (IOD)			
Module	Time Out? (If Yes, Interval and Wake-Up Input)	IOD	IOD After Time Out
ElectroMechanical Instrument Cluster (EMIC)	No	0.44 milliampere	N/A
Combination Flasher	No	0.08 milliampere	N/A

(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 terminal clamp and the battery negative terminal post. Make sure that the doors remain closed so that the illuminated entry system is not activated. The multi-meter amperage reading may remain high for up to three minutes, or may not give any reading at all while set in the highest amperage scale, depending upon the electrical equipment in the vehicle. The multi-meter leads must be securely clamped to the battery negative cable terminal clamp and the battery negative terminal post. If continuity between the battery negative terminal post and the negative cable terminal clamp is lost during any part of the IOD test, the electronic timer function will be activated and all of the tests will have to be repeated.

(5) After about three minutes, the high-amperage IOD reading on the multi-meter should become very low or nonexistent, depending upon the electrical equipment in the vehicle. If the amperage reading remains high, remove and replace each fuse or circuit breaker in the Power Distribution Center (PDC) and then in the fuseblock module one at a time (refer to **Power Distribution Center** and **Fuse/Fuse Block** in the index of this service manual for the location of complete PDC and fuseblock module fuse and circuit breaker identification contained in the wiring diagrams) until the amperage reading becomes very low, or nonexistent. This will isolate each circuit and identify the circuit that is the source of the high-amperage IOD. If the amperage reading remains high after removing and replacing each fuse and circuit breaker, disconnect the wire harness from the generator. If the amperage reading now becomes very low or nonexistent, refer to **Charging System** in the index of this service manual for the location of the proper charging system diagnosis and testing procedures. After the high-amperage IOD has been corrected, switch the multi-meter to progressively lower amperage scales and, if necessary, repeat the fuse and circuit breaker remove-and-replace process to identify and correct all sources of excessive IOD. It is now safe to select the lowest 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 current draw exceeds twenty-five milliamperes, isolate each circuit using the fuse and circuit breaker remove-and-replace process in Step 5. The multi-meter reading will drop to within the acceptable limit when the source of the excessive current draw is disconnected. Repair this circuit as required; whether a wiring short, incorrect switch adjustment, or a component failure is at fault.

BATTERY CABLES

DIAGNOSIS

A voltage drop test will determine if there is excessive resistance in the battery cable terminal connections or the battery cables. If excessive resistance is found in the battery cable connections, the connection point should be disassembled, cleaned of all corrosion or foreign material, then reassembled. Following reassembly, check the voltage drop for the battery cable connection and the battery cable again to confirm repair.

When performing the voltage drop test, it is important to remember that the voltage drop is giving an indication of the resistance between the two points at which the voltmeter probes are attached. **EXAMPLE:** When testing the resistance of the battery positive cable, touch the voltmeter leads to the battery positive cable terminal clamp and to the battery positive cable eyelet terminal at the starter solenoid B(+) terminal stud. If you probe the battery positive terminal post and the battery positive cable eyelet terminal at the starter solenoid B(+) terminal stud, you are reading the combined voltage drop in the battery positive cable terminal clamp-to-terminal post connection and the battery positive cable.

DIAGNOSIS AND TESTING (Continued)

TESTING

VOLTAGE DROP TEST

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 this test, be certain that the following procedures are accomplished:

• The battery is fully-charged and load tested. Refer to **Battery Charging** in the index of this service manual for the location of the proper battery charging procedures. Refer to **Battery** in the index of this service manual for the location of the battery diagnosis and testing procedures, including the proper battery load test procedures.

• Fully engage the parking brake.

• If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position. If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and block the clutch pedal in the fully depressed position.

• Verify that all lamps and accessories are turned off.

• To prevent the engine from starting, remove the Automatic ShutDown (ASD) relay. The ASD relay is located in the Power Distribution Center (PDC), in the engine compartment. See the fuse and relay layout label affixed to the underside of the PDC cover for ASD relay identification and location.

(1) Connect the positive lead of the voltmeter to the battery negative terminal post. Connect the negative lead of the voltmeter to the battery negative cable terminal clamp (Fig. 14). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor connection between the battery negative cable terminal clamp and the battery negative terminal post.

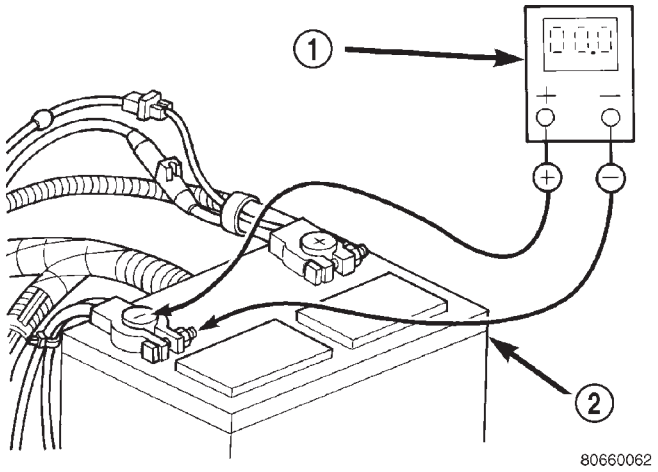


Fig. 14 Test Battery Negative Connection Resistance - Typical

1 – VOLTMETER
2 – BATTERY

(2) Connect the positive lead of the voltmeter to the battery positive terminal post. Connect the negative lead of the voltmeter to the battery positive cable terminal clamp (Fig. 15). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor connection between the battery positive cable terminal clamp and the battery positive terminal post.

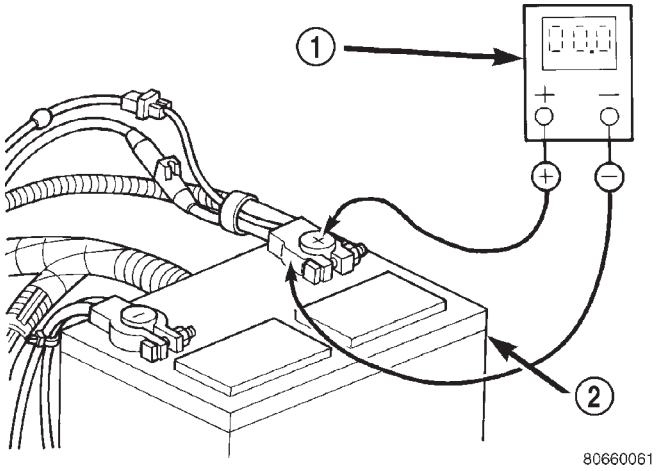


Fig. 15 Test Battery Positive Connection Resistance - Typical

1 – VOLTMETER
2 – BATTERY

DIAGNOSIS AND TESTING (Continued)

(3) Connect the voltmeter to measure between the battery positive cable terminal clamp and the starter solenoid B(+) terminal stud (Fig. 16). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery positive cable eyelet terminal connection at the starter solenoid B(+) terminal stud. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery positive cable.

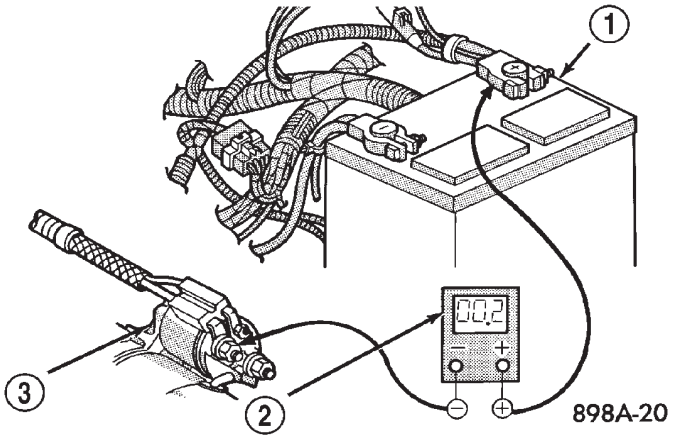


Fig. 16 Test Battery Positive Cable Resistance - Typical

1 – BATTERY
2 – VOLTMETER
3 – STARTER MOTOR

(4) Connect the voltmeter to measure between the battery negative cable terminal clamp and a good clean ground on the engine block (Fig. 17). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery negative cable eyelet terminal connection to the engine block. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery negative cable.

SERVICE PROCEDURES

BATTERY CHARGING

Battery charging is the means by which the battery can be restored to its full voltage potential. A battery is fully-charged when:

- All of the battery cells are gassing freely during battery charging.
- A green color is visible in the sight glass of the battery built-in test indicator.

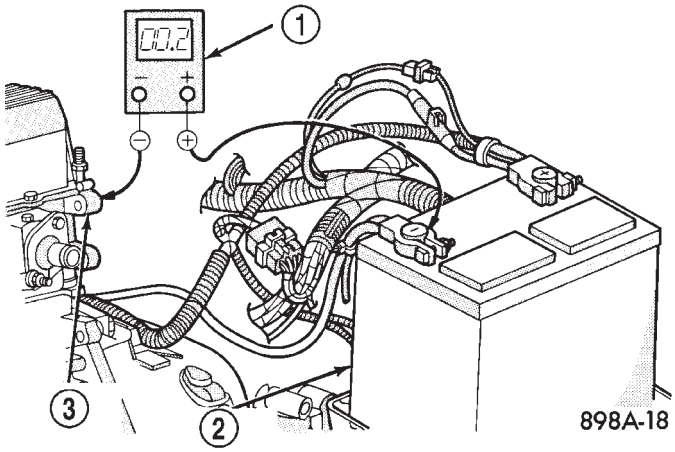


Fig. 17 Test Ground Circuit Resistance - Typical

1 – VOLTMETER
2 – ENGINE GROUND
3 – BATTERY

- Three hydrometer tests, taken at one-hour intervals, indicate no increase in the temperature-corrected specific gravity of the battery electrolyte.
- Open-circuit voltage of the battery is 12.4 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 battery charger and the battery from being damaged if they are improperly connected. If the battery state-of-charge is too low for the polarity-sensing circuitry to detect, the battery charger will not operate. This makes it appear that the battery will not accept charging current. See the instructions provided by the manufacturer of the battery charger for details on how to bypass the polarity-sensing circuitry.

After the battery has been charged to 12.4 volts or greater, perform a load test to determine the battery cranking capacity. Refer to **Battery** in the index of this service manual for the location of the battery diagnosis and testing procedures for more information on the proper battery load testing procedures. If the battery will endure a load test, return the battery to service. If the battery will not endure a load test, it is faulty and must be replaced.

Clean and inspect the battery hold downs, tray, terminals, posts, and top before completing battery service. Refer to **Battery** in the index of this service manual for the location of the proper battery 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. 18). If the reading is below ten volts, the battery charging current will be low. It could take some time before the battery accepts a current greater than a few milliamperes. Such low current may not be detectable on the ammeters built into many battery chargers.

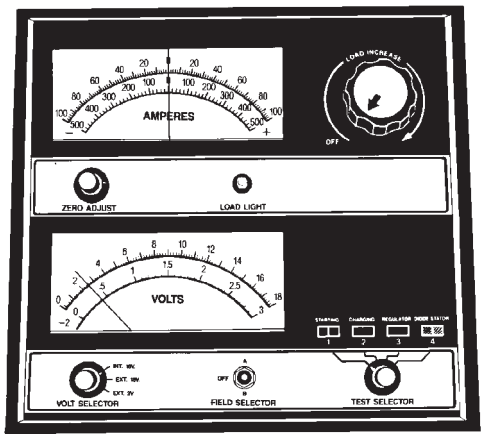


Fig. 18 Voltmeter Accurate to 1/10 Volt Connected - Typical

(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 battery charger and the battery from being damaged if they are improperly connected. If the battery state-of-charge is too low for the polarity-sensing circuitry to detect, the battery charger will not operate. This makes it appear that the battery will not accept charging current. See the instructions provided by the manufacturer of the battery charger for details on how to bypass the polarity-sensing circuitry.

(3) Battery chargers vary in the amount of voltage and current they provide. The amount of time required for a battery to accept measurable charging current at various voltages is shown in the Charge Rate chart. If the charging current is still not measurable at the end of the charging time, the battery is faulty and must be replaced. If the charging current is measurable during the charging time, the battery may be good and the charging should be completed in the normal manner.

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.

SERVICE PROCEDURES (Continued)

- 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 battery charger is connected to a cold battery, the current accepted by the battery will be very low at first. As the battery warms, it will accept a higher charging current rate (amperage).

- Charger Capacity

A battery charger that supplies only five amperes will require a longer charging time. A battery charger that supplies twenty amperes or more will require a shorter charging time.

- State-Of-Charge

A completely discharged battery requires more charging time than a partially discharged battery. Electrolyte is nearly pure water in a completely discharged battery. At first, the charging current (amperage) will be low. As the battery charges, the specific gravity of the electrolyte will gradually rise.

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 CABLES

Both the battery negative cable and the battery positive cable are serviced in the battery wire harness. If either battery cable is damaged or faulty, the battery wire harness unit must be replaced.

REMOVAL

(1) Turn the ignition switch to the Off position. Be certain that all electrical accessories are turned off.

(2) Loosen the battery negative cable terminal clamp pinch-bolt hex nut.

(3) Disconnect the battery negative cable terminal clamp from the battery negative terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post.

(4) Loosen the battery positive cable terminal clamp pinch-bolt hex nut.

(5) Disconnect the battery positive cable terminal clamp from the battery positive terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post.

(6) Unlatch and remove the B(+) terminal stud cover from the rear of the Power Distribution Center (PDC).

(7) Remove the two nuts that secure the battery positive cable and the generator output cable eyelet terminal to the two B(+) terminal studs on the PDC.

(8) Remove the battery positive cable and the generator output eyelet terminal from the two B(+) terminal studs on the PDC.

(9) Remove the screw that secures the battery negative cable eyelet terminal to the dash panel near the battery.

(10) Unlatch and remove the cover from the generator output terminal stud housing on the back of the generator.

(11) Remove the nut that secures the generator output cable eyelet terminal to the generator output terminal stud.

(12) Remove the generator output cable eyelet terminal from the generator output terminal stud.

(13) Remove the nut that secures the battery negative cable ground eyelet terminal to the stud on the right side of the engine block.

(14) Remove the battery negative cable ground eyelet terminal from the engine block stud.

(15) Remove the nut that secures the battery positive cable eyelet terminal to the B(+) terminal stud on the starter solenoid.

(16) Remove the battery positive cable eyelet terminal from the B(+) terminal stud on the starter solenoid.

(17) Remove the battery wire harness from the engine compartment.

INSTALLATION

(1) Clean and inspect the battery cable terminal clamps and the battery terminal posts. Refer to **Battery** in the index of this service manual for the location of the proper battery cable terminal clamp and battery terminal post cleaning and inspection procedures.

(2) Position the battery wire harness into the engine compartment.

REMOVAL AND INSTALLATION (Continued)

(3) Install the battery positive cable eyelet terminal onto the B(+) terminal stud on the starter solenoid.

(4) Install and tighten the nut that secures the battery positive cable eyelet terminal to the B(+) terminal stud on the starter solenoid. Tighten the nut to 10 N·m (90 in. lbs.).

(5) Install the battery negative cable ground eyelet terminal onto the stud on the right side of the engine block.

(6) Install and tighten the nut that secures the battery negative cable ground eyelet terminal to the stud on the right side of the engine block. Tighten the nut to 16.9 N·m (150 in. lbs.).

(7) Install the generator output cable eyelet terminal onto the generator output terminal stud.

(8) Install and tighten the nut that secures the generator output cable eyelet terminal to the generator output terminal stud. Tighten the nut to 8.4 N·m (75 in. lbs.).

(9) Position the cover for the generator output terminal stud housing onto the back of the generator and snap it into place.

(10) Install and tighten the screw that secures the battery negative cable eyelet terminal to the dash panel near the battery. Tighten the screw to 48.7 N·m (36 ft. lbs.).

(11) Install the battery positive cable and the generator output cable eyelet terminal onto the PDC B(+) terminal studs.

(12) Install and tighten the two nuts that secure the battery positive cable and the generator output cable eyelet terminal to the PDC B(+) terminal studs. Tighten the nuts to 11.3 N·m (100 in. lbs.).

(13) Engage the tabs on the lower edge of the B(+) terminal stud cover in the slots on the rear of the PDC housing, then engage the latch on the top of the cover with the latch tabs on the PDC housing.

(14) Reconnect the battery positive cable terminal clamp to the battery positive terminal post. Tighten the terminal clamp pinch-bolt hex nut to 8.4 N·m (75 in. lbs.).

(15) Reconnect the battery negative cable terminal clamp to the battery negative terminal post. Tighten the terminal clamp pinch-bolt hex nut to 8.4 N·m (75 in. lbs.).

(16) Apply a thin coating of petroleum jelly or chassis grease to the exposed surfaces of the battery cable terminal clamps and the battery terminal posts.

BATTERY HOLD DOWNS

All of the battery hold down hardware can be serviced without removal of the battery or the battery tray.

REMOVAL

(1) Turn the ignition switch to the Off position. Be certain that all electrical accessories are turned off.

(2) Loosen the battery negative cable terminal clamp pinch-bolt hex nut.

(3) Disconnect the battery negative cable terminal clamp from the battery negative terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post.

(4) Remove the nut with washer from the threaded end of each of the two J-bolts (Fig. 19).

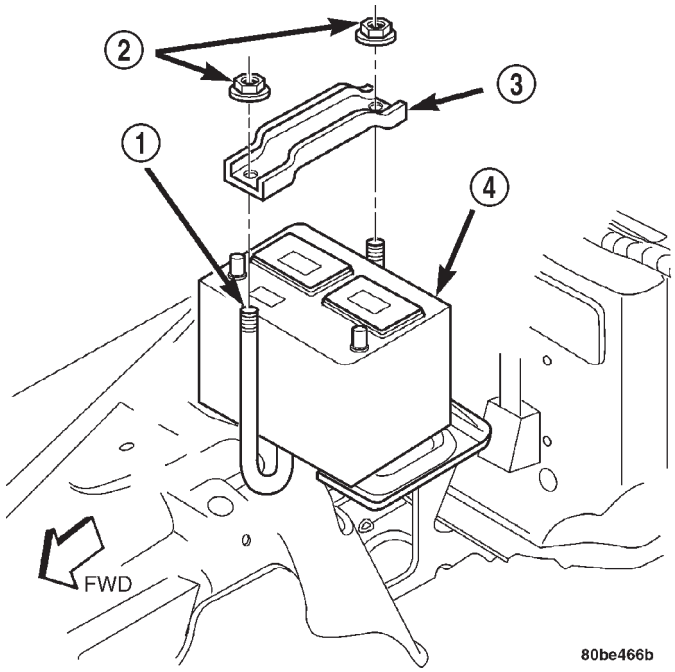


Fig. 19 Battery Hold Downs Remove/Install

1 – J-BOLT (2)
2 – NUT (2)
3 – BRACKET
4 – BATTERY

(5) Remove the battery hold down bracket from the threaded ends of the two J-bolts and the top of the battery case.

(6) Disengage the hooked end of each J-bolt from the holes in the front or rear flange of the battery tray and remove the two J-bolts.

INSTALLATION

(1) Clean and inspect the battery hold down hardware. Refer to **Battery** in the index of this service manual for the location of the proper battery hold down hardware cleaning and inspection procedures.

(2) Engage the hooked end of each J-bolt into the holes in the front or rear flange of the battery tray and position the two J-bolts.

REMOVAL AND INSTALLATION (Continued)

(3) Position the battery hold down bracket onto the threaded ends of the two J-bolts and across the top of the battery case.

(4) Install and tighten the nut with washer onto the threaded end of each of the two J-bolts. Tighten the nuts to 4.7 N·m (42 in. lbs.).

(5) Reconnect the battery negative cable terminal clamp to the battery negative terminal post. Tighten the terminal clamp pinch-bolt hex nut to 8.4 N·m (75 in. lbs.).

BATTERY

REMOVAL

(1) Turn the ignition switch to the Off position. Be certain that all electrical accessories are turned off.

(2) Loosen the battery negative cable terminal clamp pinch-bolt hex nut.

(3) Disconnect the battery negative cable terminal clamp from the battery negative terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post (Fig. 20).

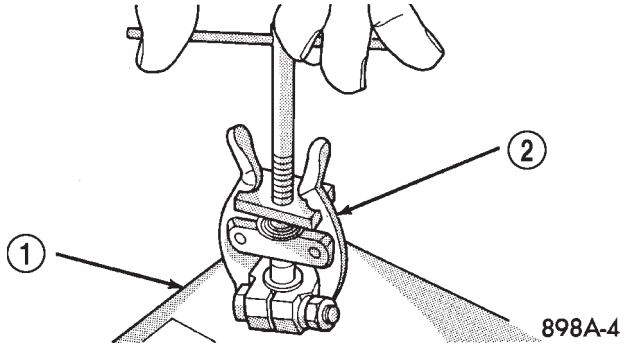


Fig. 20 Remove Battery Cable Terminal Clamp - Typical

1 – BATTERY
2 – BATTERY TERMINAL PULLER

(4) Loosen the battery positive cable terminal clamp pinch-bolt hex nut.

(5) Disconnect the battery positive cable terminal clamp from the battery positive terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post.

(6) Remove the battery hold downs from the battery. Refer to **Battery Hold Downs** in the index of this service manual for the location of the proper battery hold down removal procedures.

WARNING: WEAR A SUITABLE PAIR OF RUBBER GLOVES (NOT THE HOUSEHOLD TYPE) WHEN REMOVING A BATTERY BY HAND. SAFETY GLASSES SHOULD ALSO BE WORN. IF THE BATTERY IS CRACKED OR LEAKING, THE ELECTROLYTE CAN BURN THE SKIN AND EYES.

(7) Remove the battery and the battery thermoguard from the battery tray as a unit.

(8) Remove the battery thermoguard from the battery case. Refer to **Battery Thermoguard** in the index of this service manual for the location of the proper battery thermoguard removal procedures.

INSTALLATION

(1) Clean and inspect the battery. Refer to **Battery** in the index of this service manual for the location of the proper battery cleaning and inspection procedures.

(2) Reinstall the battery thermoguard onto the battery case. Refer to **Battery Thermoguard** in the index of this service manual for the location of the proper battery thermoguard installation procedures.

(3) Position the battery and the battery thermoguard onto the battery tray as a unit. Ensure that the battery positive and negative terminal posts are correctly positioned. The battery cable terminal clamps must reach the correct battery terminal post without stretching the cables (Fig. 21).

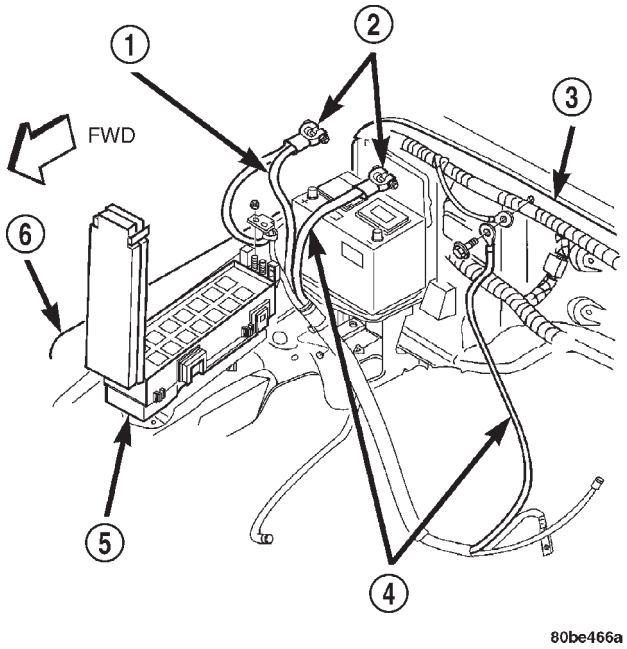


Fig. 21 Battery Cables

1 – POSITIVE CABLE
2 – TERMINAL CLAMPS
3 – DASH PANEL
4 – NEGATIVE CABLE
5 – POWER DISTRIBUTION CENTER
6 – FENDER

(4) Reinstall the battery hold downs onto the battery. Refer to **Battery Hold Downs** in the index of this service manual for the location of the proper battery hold down installation procedures.

REMOVAL AND INSTALLATION (Continued)

CAUTION: Be certain that the battery cable terminal clamps are connected to the correct battery terminal posts. Reversed battery polarity may damage electrical components of the vehicle.

(5) Clean the battery cable terminal clamps and the battery terminal posts. Refer to **Battery** in the index of this service manual for the location of the proper battery cleaning and inspection procedures.

(6) Reconnect the battery positive cable terminal clamp to the battery positive terminal post. Tighten the terminal clamp pinch-bolt hex nut to 8.4 N·m (75 in. lbs.).

(7) Reconnect the battery negative cable terminal clamp to the battery negative terminal post. Tighten the terminal clamp pinch-bolt hex nut to 8.4 N·m (75 in. lbs.).

(8) Apply a thin coating of petroleum jelly or chassis grease to the exposed surfaces of the battery cable terminal clamps and the battery terminal posts.

BATTERY THERMOGUARD

REMOVAL

(1) Remove the battery and the battery thermoguard from the battery tray as a unit. Refer to **Battery** in the index of this service manual for the location of the proper battery removal procedures.

(2) Carefully and evenly slide the battery thermoguard up off of the battery case (Fig. 22).

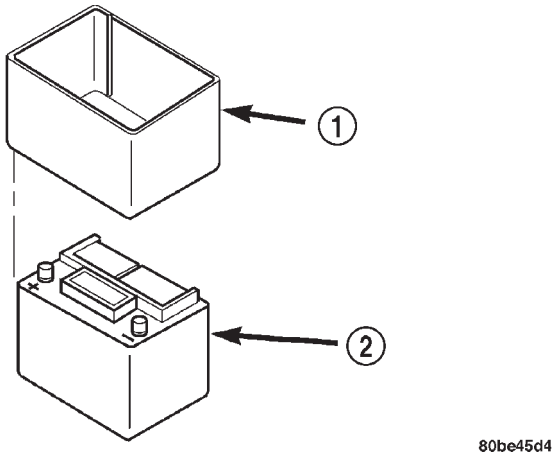


Fig. 22 Battery Thermoguard Remove/Install

1 – THERMOGUARD
2 – BATTERY

INSTALLATION

(1) Clean and inspect the battery thermoguard. Refer to **Battery** in the index of this service manual for the location of the proper battery thermoguard cleaning and inspection procedures.

(2) Carefully and evenly slide the battery thermoguard down over the battery case.

(3) Install the battery and the battery thermoguard into the battery tray as a unit. Refer to **Battery** in the index of this service manual for the location of the proper battery installation procedures.

BATTERY TRAY

REMOVAL

(1) Remove the battery from the battery tray. Refer to **Battery** in the index of this service manual for the location of the proper battery removal procedures.

(2) Remove the battery temperature sensor from the battery tray. Refer to **Battery Temperature Sensor** in the index of this service manual for the location of the proper battery temperature sensor removal procedures.

(3) Remove the four screws with washers that secure the battery tray to the reinforcement located between the dash panel and the rear of the front wheelhouse inner panel in the engine compartment (Fig. 23).

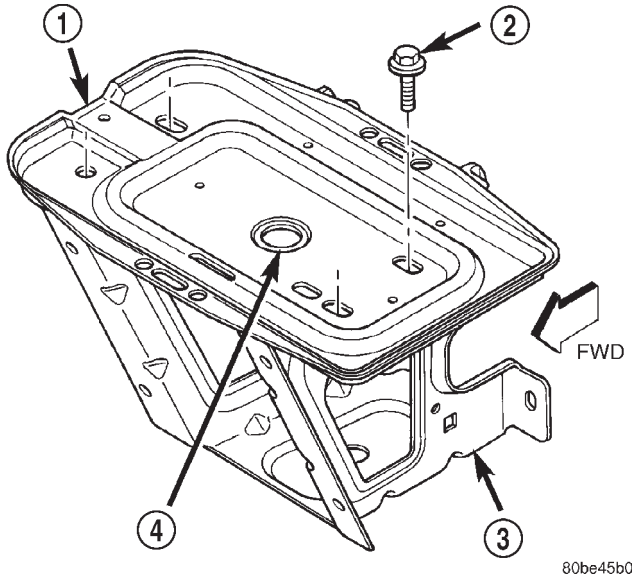


Fig. 23 Battery Tray Remove/Install

1 – BATTERY TRAY
2 – SCREW (4)
3 – REINFORCEMENT
4 – BATTERY TEMPERATURE SENSOR MOUNTING HOLE

(4) Remove the battery tray from the reinforcement in the engine compartment.

INSTALLATION

(1) Clean and inspect the battery tray. Refer to **Battery** in the index of this service manual for the location of the proper battery tray cleaning and inspection procedures.

REMOVAL AND INSTALLATION (Continued)

(2) Position the battery tray onto the reinforcement in the engine compartment.

(3) Install and tighten the four screws with washers that secure the battery tray to the reinforcement located between the dash panel and the rear of the front wheelhouse inner panel in the engine compartment. Tighten the screws to 22.6 N·m (200 in. lbs.).

(4) Install the battery temperature sensor onto the battery tray. Refer to **Battery Temperature Sensor** in the index of this service manual for the location of the proper battery temperature sensor installation procedures.

(5) Install the battery onto the battery tray. Refer to **Battery** in the index of this service manual for the location of the proper battery installation procedures.

CLEANING AND INSPECTION

BATTERY

The following information details the recommended cleaning and inspection procedures for the battery and related components. In addition to the maintenance schedules found in this service manual and the owner's manual, it is recommended that these procedures be performed any time the battery or related components must be removed for vehicle service.

CLEANING

(1) Clean the battery cable terminal clamps of all corrosion. Remove any corrosion using a wire brush or a post and terminal cleaning tool, and a sodium bicarbonate (baking soda) and warm water cleaning solution (Fig. 24).

(2) Clean the battery tray and battery hold down hardware of all corrosion. Remove any corrosion using a wire brush and a sodium bicarbonate (baking soda) and warm water cleaning solution. Paint any exposed bare metal.

(3) If the removed battery is to be reinstalled, clean the outside of the battery case and the top cover with a sodium bicarbonate (baking soda) and warm water cleaning solution using a stiff bristle parts cleaning brush to remove any acid film (Fig. 25). 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** in the index of this service manual for the location of the factory-installed battery specifications. Confirm that the replacement battery is the correct size and has the correct ratings for the vehicle.

(4) Clean the battery thermoguard with a sodium bicarbonate (baking soda) and warm water cleaning solution using a stiff bristle parts cleaning brush to remove any acid film.

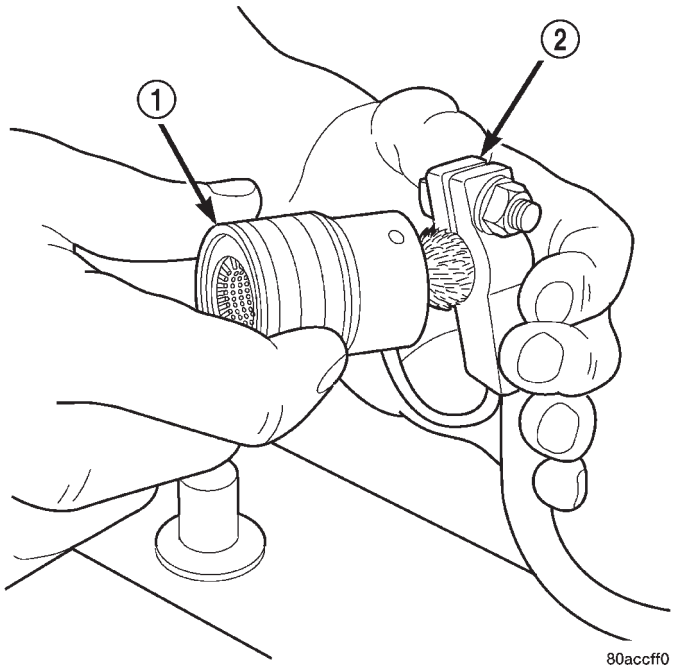


Fig. 24 Clean Battery Cable Terminal Clamp - Typical

1 – TERMINAL BRUSH
2 – BATTERY CABLE

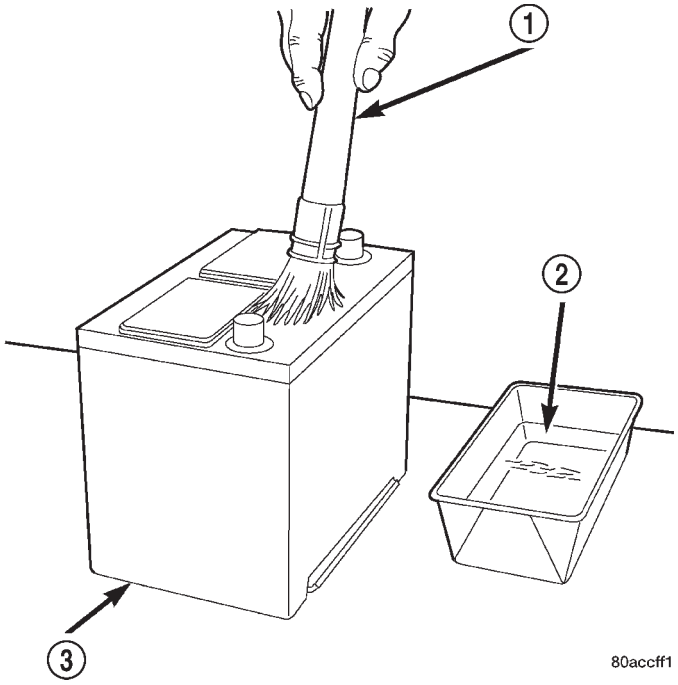


Fig. 25 Clean Battery - Typical

1 – CLEANING BRUSH
2 – WARM WATER AND BAKING SODA SOLUTION
3 – BATTERY

(5) Clean any corrosion from the battery terminal posts with a wire brush or a post and terminal

CLEANING AND INSPECTION (Continued)

cleaner, and a sodium bicarbonate (baking soda) and warm water cleaning solution (Fig. 26).

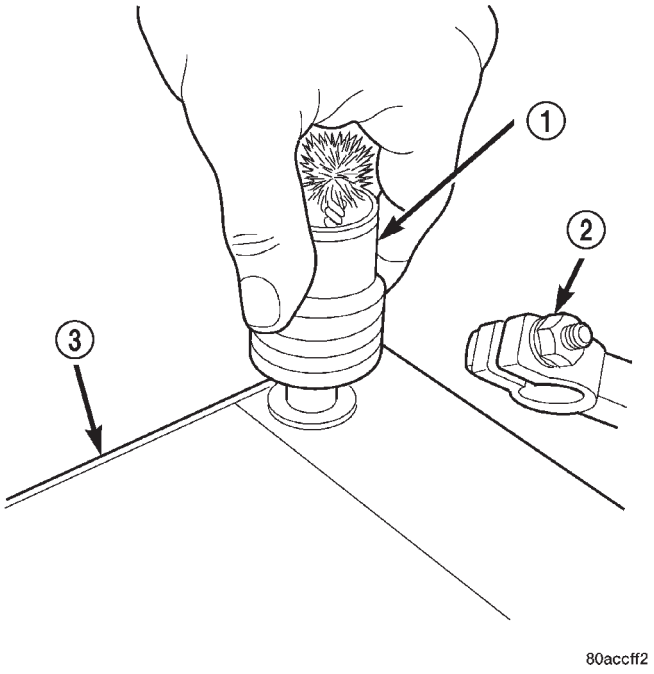


Fig. 26 Clean Battery Terminal Post - Typical

1 – TERMINAL BRUSH
2 – BATTERY CABLE
3 – BATTERY

INSPECTION

(1) Inspect the battery cable terminal clamps for damage. Replace any battery cable that has a damaged or deformed terminal clamp.

(2) Inspect the battery tray and battery hold down hardware for damage. Replace any damaged parts.

(3) Slide the thermoguard off of the battery case. Inspect the battery case for cracks or other damage that could result in electrolyte leaks. Also, check the battery terminal posts for looseness. Batteries with damaged cases or loose terminal posts must be replaced.

(4) Inspect the battery thermoguard for tears, cracks, deformation or other damage. Replace any battery thermoguard that has been damaged.

(5) Inspect the electrolyte level in the battery. Use a putty knife or another suitable wide flat-bladed tool to pry the cell caps off (Fig. 27). Do not use a screwdriver. Add distilled water to each cell until the liquid reaches the bottom of the vent well. **DO NOT OVERFILL.**

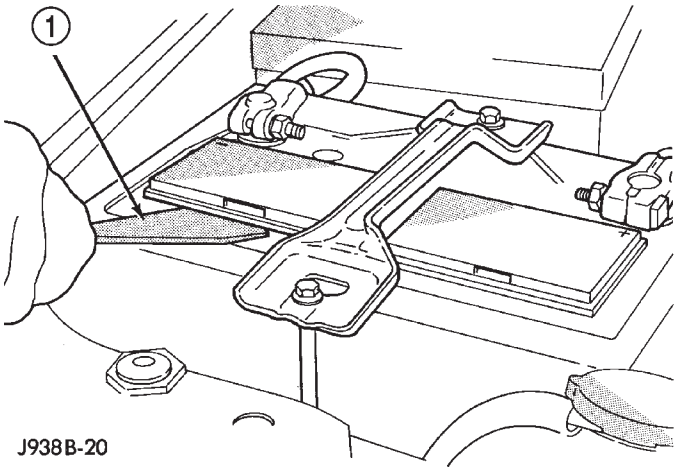


Fig. 27 Removing Battery Cell Caps - Typical

1 – PUTTY KNIFE

(6) 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 **Battery** in the index of this service manual for the location of the proper battery diagnosis and testing procedures for more information on the use of the battery built-in test indicator. Also refer to **Battery Charging** in the index of this service manual for the location of the proper battery charging procedures.

SPECIFICATIONS

BATTERY

Battery Classifications and Ratings					
Part Number	BCI Group Size Classification	Cold Cranking Amperage	Reserve Capacity	Ampere-Hours	Load Test Amperage
56027960	34	500	110 Minutes	60	250
56041003	34	600	120 Minutes	66	300

STARTING SYSTEMS

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DESCRIPTION AND OPERATION

STARTING SYSTEM

DESCRIPTION

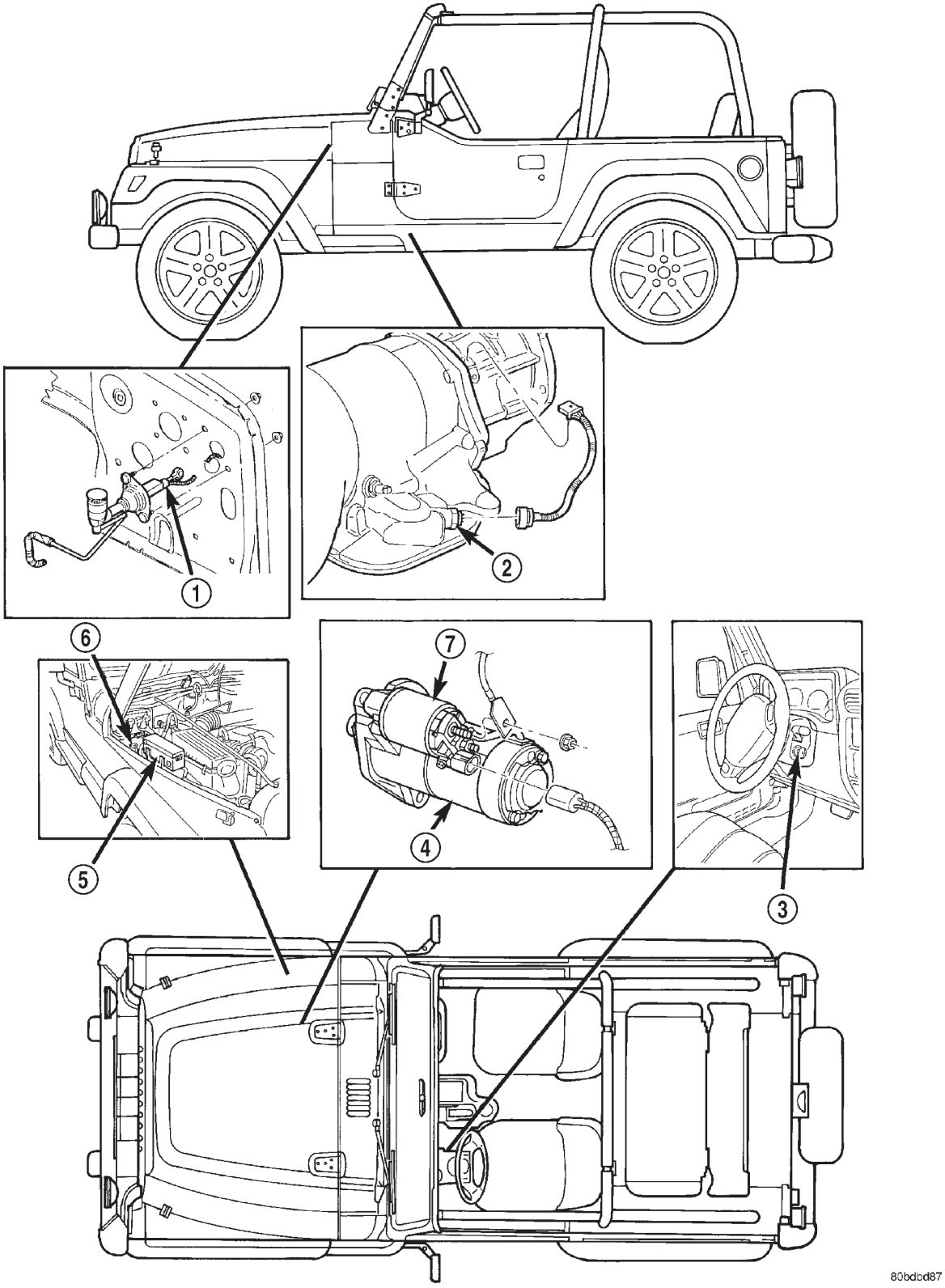


Fig. 1 Starting System

DESCRIPTION AND OPERATION (Continued)

1 – CLUTCH PEDAL POSITION SWITCH
2 – PARK/NEUTRAL POSITION SWITCH
3 – IGNITION SWITCH
4 – STARTER MOTOR
5 – STARTER RELAY (IN POWER DISTRIBUTION CENTER)
6 – BATTERY
7 – STARTER SOLENOID

An electrically operated engine starting system (Fig. 1) 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. The starting system includes the following major components:

- Battery
- Battery cables
- Clutch pedal position switch (manual transmission)
- Ignition switch
- Park/neutral position switch (automatic transmission)
- Starter motor (including the integral starter solenoid)
- Starter relay.

The starting system consists of two separate circuits. A high-amperage feed circuit that feeds the starter motor between 150 and 350 amperes of battery current, and a low-amperage control circuit that operates on less than 20 amperes of battery current. The starting system high-amperage feed circuit includes the battery, the battery cables, the contact disc portion of the starter solenoid, and the starter motor. The following starting system feed circuit components are covered in more detail in other areas of this service manual:

- The battery is located in the passenger side rear corner of the engine compartment, near the dash panel and provides the electrical current needed to operate the starting system. Refer to **Battery** in the index of this service manual for the location of more information on the battery.
- The battery cables connect the battery to the electrical system of the vehicle and to the starting system. Refer to **Battery Cables** in the index of this service manual for the location of more information on the battery cables.

The starting system low-amperage control circuit includes 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 wire harnesses that connect these components. The following starting system control circuit components are covered in more detail in other areas of this service manual:

- The ignition switch is mounted on the bottom of the steering column and actuates the starting system when a properly coded ignition key is inserted in the ignition lock cylinder on the right side of the steering column and turned to the spring-loaded momentary Start position. Refer to **Ignition Switch and Key Lock Cylinder** in the index of this service manual for the location of more information on the ignition switch.
- The clutch pedal position switch is integral to the master cylinder of the clutch hydraulic linkage assembly on models equipped with a manual transmission. Refer to **Clutch Hydraulic Linkage** in the index of this service manual for the location of more information on the clutch pedal position switch.
- The park/neutral position switch is threaded into the left side of the automatic transmission case and has a spring-loaded plunger that is actuated by a cam integral to the gearshift mechanism within the transmission. The back up lamp switch is also integral to the park/neutral position switch. Refer to **Park/Neutral Position Switch** in the index of this service manual for the location of more information on the park/neutral position switch.

Following are general descriptions of the starter relay and the starter motor. See the owner's manual in the vehicle glove box for more information on the features, use and operation of the starting system. Refer to **Starting System** in the index of this service manual for the location of complete wiring diagrams for the starting system.

OPERATION

If the vehicle is equipped with a manual transmission, the clutch pedal position switch is 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 fully 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/

DESCRIPTION AND OPERATION (Continued)

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 windings are energized, the relay directs battery current to the starter solenoid coil windings. When the starter solenoid coil windings are energized, the solenoid directs battery current to the starter motor, which cranks the engine by engaging the starter pinion gear with the starter ring gear. Once the engine starts, the ignition switch key is released by the vehicle operator. When the ignition switch key is released, the switch automatically returns to the On position, which de-energizes the starting system.

STARTER MOTOR

DESCRIPTION

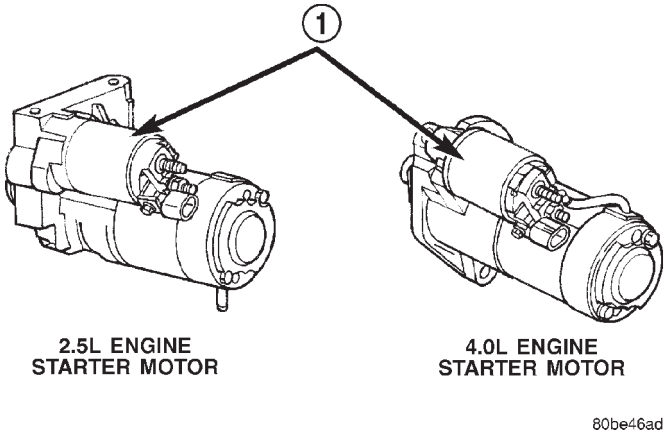


Fig. 2 Starter Motors

1 – STARTER SOLENOID

The starter motors used for both the 2.5L and the 4.0L engines available in this model are not interchangeable (Fig. 2). However, each of these starter motors incorporates several of the same features to create a reliable, efficient, compact, lightweight and powerful unit. Both starters feature high torque direct current electric motors. Inside both starter motors the commutator of the rotating motor armature is contacted by four brushes. The starter motor for the 2.5L engine is driven by four permanent magnet field poles, while the starter motor for the 4.0L engine is driven by 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 motor is rated at 1.4 kilowatts (about 1.9 horsepower) output at 12 volts.

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 fits on a spline on 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. Both starter motors use an overrunning clutch and starter pinion gear unit to engage and drive the starter ring gear, which 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.

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 current to the starter motor through a movable contact on one end of the solenoid core or plunger. At the same time, the solenoid plunger actuates a shift fork that engages and disengages the starter pinion gear with a starter ring gear. The starter solenoid has two electromagnetic windings or coils, a pull-in coil and a hold-in coil. The pull-in coil requires more battery current and produces a stronger electromagnetic field than the hold-in coil.

Both 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

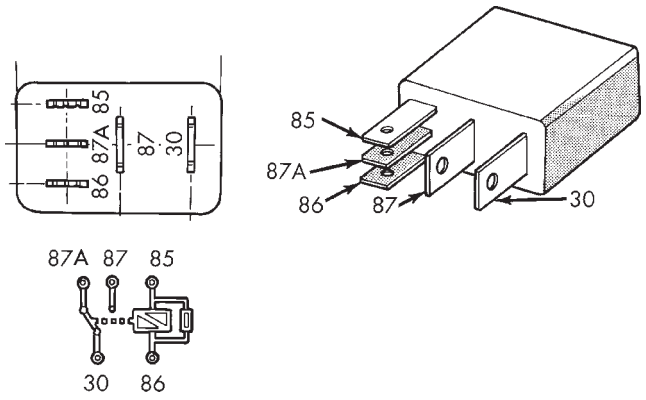
When the starter solenoid pull-in coil windings are energized the solenoid plunger is drawn into the electromagnetic coil. The solenoid plunger pulls the shift lever in the starter motor. This engages the starter overrunning clutch and pinion gear with the starter ring gear on the manual transmission flywheel or on the automatic transmission torque converter drive plate. As the solenoid plunger reaches the end of its travel, it moves the solenoid contact disc to complete the high-amperage starter feed circuit and energizes the solenoid hold-in coil windings. Battery current now flows between the solenoid battery terminal and the starter field terminal, energizing the starter and cranking the engine.

DESCRIPTION AND OPERATION (Continued)

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 solenoid plunger hold-in coil is de-energized, the solenoid plunger return spring returns the plunger to its relaxed position. This causes the solenoid contact disc to open the starter feed circuit, and the shift lever to disengage the overrunning clutch and pinion gear unit from the starter ring gear.

STARTER RELAY

DESCRIPTION



TERMINAL LEGEND	
NUMBER	**IDENTIFICATION**
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 3 Starter Relay

The starter relay (Fig. 3) 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) micro-relay. Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The ISO micro-relay terminal functions are the same as a conventional ISO relay. However, the ISO micro-relay terminal pattern (or footprint) is different, the current capacity is lower, and the physical dimensions are smaller than those of the conventional ISO relay.

The 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 system and charging system in the vehicle operate with one another, and must be tested as a complete system. In order for the engine to start and the battery to charge properly, all of the components that are used in these systems must perform within specifications. The service information for these systems has been separated within this service manual to make it easier to locate the specific information you are seeking. However, when attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used for the battery, starting system and charging system include the most basic conventional diagnostic methods, to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of an induction-type milliampere ammeter, a volt/ohmmeter, a battery charger, a carbon pile rheostat (load tester) and a 12-volt test lamp may be required. All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. Refer to **Charging System, On-Board Diagnostic Test** in the index of this service manual for the location of the proper on-board diagnostic test procedures.

DIAGNOSIS AND TESTING (Continued)

Starting System Diagnosis		
Condition	Possible Cause	Correction
Starter fails to operate.	1. Battery discharged or faulty. 2. On models with an automatic transmission, the clutch interlock ignition fuse is faulty or missing. 3. Starting circuit wiring faulty. 4. Starter relay faulty. 5. Ignition switch faulty. 6. Clutch pedal position switch faulty. 7. Park/Neutral position switch faulty or misadjusted. 8. Starter solenoid faulty. 9. Starter motor faulty.	1. Refer to Battery in the index of this service manual for the location of the proper battery diagnosis and testing procedures. Replace the faulty battery, as required. 2. Check the fuse in cavity 20 of the fuseblock module. Replace the faulty or missing fuse, as required. 3. Refer to Starting System in the index of this service manual for the location of complete starting system wiring diagrams. Test and repair the faulty starter feed and/or control circuits, as required. 4. Refer to Starter Relay in the index of this service manual for the location ofr the proper starter relay diagnosis and testing procedures. Replace the faulty starter relay, as required. 5. Refer to Ignition Switch and Key Lock Cylinder in the index of this service manual for the location of the proper ignition switch diagnosis and testing procedures. Replace the faulty ignition switch, as required. 6. Refer to Clutch Pedal Position Switch in the index of this service manual for the location of the proper clutch pedal position switch diagnosis and testing procedures. Replace the faulty clutch hydraulic linkage unit, as required. 7. Refer to Park/Neutral Position Switch in the index of this service manual for the location of the proper park/neutral position switch diagnosis and testing procedures. Replace the faulty park/neutral position switch, as required. 8. Refer to Starter Motor in the index of this service manual for the location of the proper starter solenoid diagnosis and testing procedures. Replace the faulty starter motor, as required. 9. Refer to Starter Motor in the index of this service manual for the location of the proper starter motor diagnosis and testing procedures. Replace the faulty starter motor, as required.
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 index of this service manual for the location of the proper battery diagnosis and testing procedures. Replace the faulty battery, as required. 2. Refer to Starting System in the index of this service manual for the location of complete starting system wiring diagrams. Test and repair the faulty starter feed and/or control circuits, as required. 3. Refer to Starter Motor in the index of this service manual for the location of the proper starter motor diagnosis and testing procedures. Replace the faulty starter motor, as required. 4. Refer to Engine Diagnosis in the index of this service manual for the location of the proper engine diagnosis and testing procedures. Repair or replace the faulty engine, as required.

DIAGNOSIS AND TESTING (Continued)

Starting System Diagnosis		
Condition	Possible Cause	Correction
Starter engages, spins out before engine starts.	1. Starter ring gear faulty. 2. Starter motor faulty.	1. Refer to Starter Motor in the index of this service manual for the location of the proper starter motor removal and installation procedures. Remove the starter motor to inspect the starter ring gear. Replace the faulty starter ring gear, as required. 2. Refer to Starter Motor in the index of this service manual for the location of the proper starter motor diagnosis and testing procedures. Replace the faulty starter motor, as required.
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 index of this service manual for the location of the proper starter motor installation procedures. Tighten the starter motor mounting hardware to the correct tightness specifications, as required. 2. Refer to Starter Relay in the index of this service manual for the location of the proper starter relay diagnosis and testing procedures. Replace the faulty starter relay, as required. 3. Refer to Ignition Switch and Key Lock Cylinder in the index of this service manual for the location of the proper ignition switch diagnosis and testing procedures. Replace the faulty ignition switch, as required. 4. Refer to Starter Motor in the index of this service manual for the location of the proper starter motor diagnosis and testing procedures. Replace the faulty starter motor, as required.

TESTING

Before testing the starting system perform a visual inspection of the starting system components and connections. Refer to **Starting System** in the index of this service manual for the location of the proper starting system cleaning and inspection procedures.

COLD CRANKING TEST

Refer to **Starting System** in the index of this service manual for the location of complete starting system wiring diagrams. Before performing this test, be certain that the following procedures are accomplished:

- The battery is fully-charged and load tested. Refer to **Battery Charging** in the index of this service manual for the location of the proper battery charging procedures. Refer to **Battery** in the index of this service manual for the location of the battery diagnosis and testing procedures, including the proper battery load test procedures.
- Fully engage the parking brake.
- If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position. If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and block the clutch pedal in the fully depressed position.
- Verify that all lamps and accessories are turned off.
- To prevent the engine from starting, remove the Automatic ShutDown (ASD) relay. The ASD relay is located in the Power Distribution Center (PDC), in the engine compartment. See the fuse and relay layout label affixed to the underside of the PDC cover for ASD relay identification and location.

(1) Connect a suitable volt-ampere tester to the battery terminals (Fig. 4). See the instructions provided by the manufacturer of the volt-ampere tester being used.

(2) 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 index of this service manual for the location of the proper starter motor diagnosis and testing procedures. If the starter motor tests OK, refer to **Engine Diagnosis** in the index of this service manual for the location of the proper engine diagnosis and testing procedures. If the

DIAGNOSIS AND TESTING (Continued)

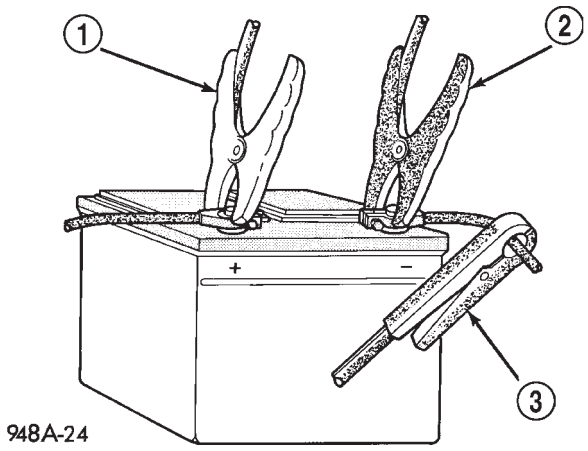


Fig. 4 Volts-Amps Tester Connections - Typical

1 – POSITIVE CLAMP
2 – NEGATIVE CLAMP
3 – INDUCTION AMMETER CLAMP

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 the **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 the **Control Circuit Test** in this section.

(d) If the voltage reads 12.5 volts or greater and the starter motor turns very slowly, refer to the **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 starter feed circuit. Refer to **Starting System** in the index of this service manual for the location of complete starting system wiring diagrams.

When performing the voltage drop test, it is important to remember that the voltage drop is giving an indication of the resistance between the two points at which the voltmeter probes are attached. **EXAMPLE:** When testing the resistance of the battery positive cable, touch the voltmeter leads to the battery positive cable terminal clamp and to the battery positive cable eyelet terminal at the starter solenoid B(+) terminal stud. If you probe the battery positive terminal post and the battery positive cable eyelet terminal at the starter solenoid B(+) terminal stud, you are reading the combined voltage drop in the battery positive cable terminal clamp-to-terminal post connection and the battery positive cable.

The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing this test, be certain that the following procedures are accomplished:

- The battery is fully-charged and load tested. Refer to **Battery Charging** in the index of this service manual for the location of the proper battery charging procedures. Refer to **Battery** in the index of this service manual for the location of the battery diagnosis and testing procedures, including the proper battery load test procedures.
- Fully engage the parking brake.
- If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position. If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and block the clutch pedal in the fully depressed position.
- Verify that all lamps and accessories are turned off.
- To prevent the engine from starting, remove the Automatic ShutDown (ASD) relay. The ASD relay is located in the Power Distribution Center (PDC), in the engine compartment. See the fuse and relay layout label affixed to the underside of the PDC cover for ASD relay identification and location.

(1) Connect the positive lead of the voltmeter to the battery negative terminal post. Connect the negative lead of the voltmeter to the battery negative cable terminal clamp (Fig. 5). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor contact between the battery negative cable terminal clamp and the battery negative terminal post.

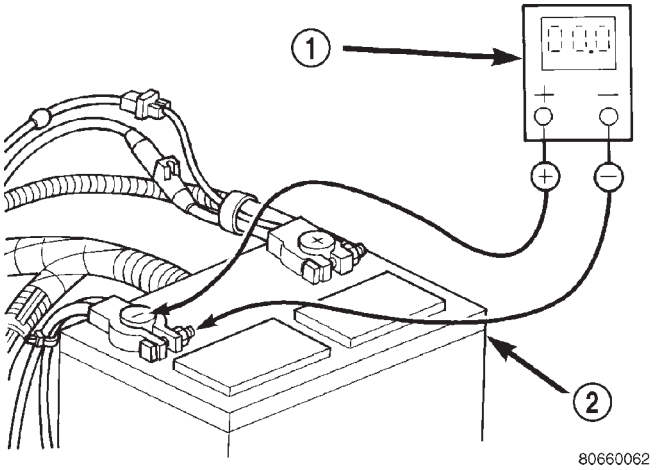


Fig. 5 Test Battery Negative Connection Resistance - Typical

1 – VOLTMETER
2 – BATTERY

DIAGNOSIS AND TESTING (Continued)

(2) Connect the positive lead of the voltmeter to the battery positive terminal post. Connect the negative lead of the voltmeter to the battery positive cable terminal clamp (Fig. 6). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor connection between the battery positive cable terminal clamp and the battery positive terminal post.

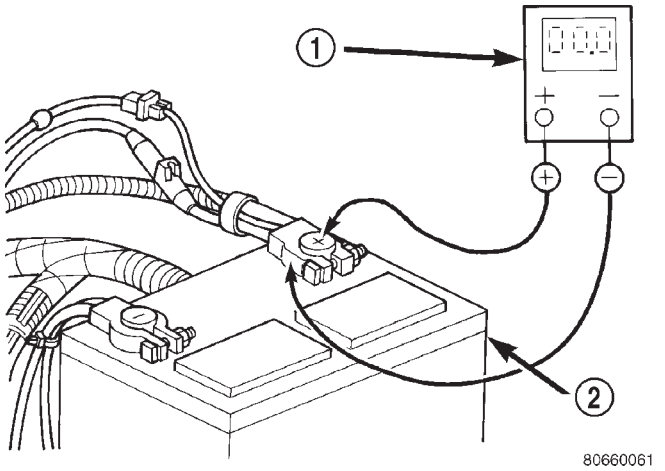


Fig. 6 Test Battery Positive Connection Resistance - Typical

1 – VOLTMETER
2 – BATTERY

(3) Connect the voltmeter to measure between the battery positive cable terminal clamp and the starter solenoid B(+) terminal stud (Fig. 7). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery positive cable eyelet terminal connection at the starter solenoid B(+) terminal stud. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery positive cable.

(4) Connect the voltmeter to measure between the battery negative cable terminal clamp and a good clean ground on the engine block (Fig. 8). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery negative cable eyelet terminal connection to the engine block. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery negative cable.

(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. 9). 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.

If the resistance tests detect no feed circuit problems, refer to **Starter Motor** in the index of this service manual for the location of the proper starter motor diagnosis and testing procedures.

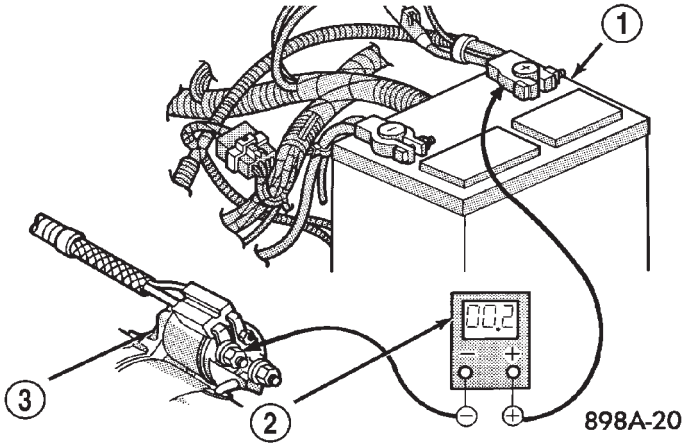


Fig. 7 Test Battery Positive Cable Resistance - Typical

1 – BATTERY
2 – VOLTMETER
3 – STARTER MOTOR

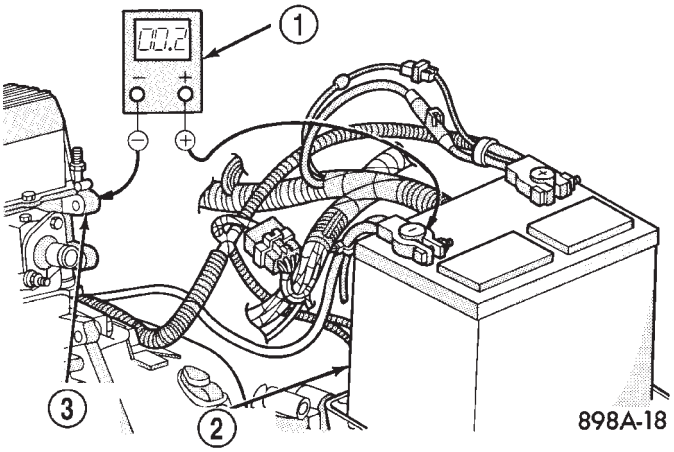


Fig. 8 Test Ground Circuit Resistance - Typical

1 – VOLTMETER
2 – BATTERY
3 – ENGINE GROUND

CONTROL CIRCUIT TEST

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 index of this service manual for the location of the proper starter relay diagnosis and testing procedures.
- Starter Solenoid Refer to **Starter Motor** in the index of this service manual for the location of the proper starter solenoid diagnosis and testing procedures.

DIAGNOSIS AND TESTING (Continued)

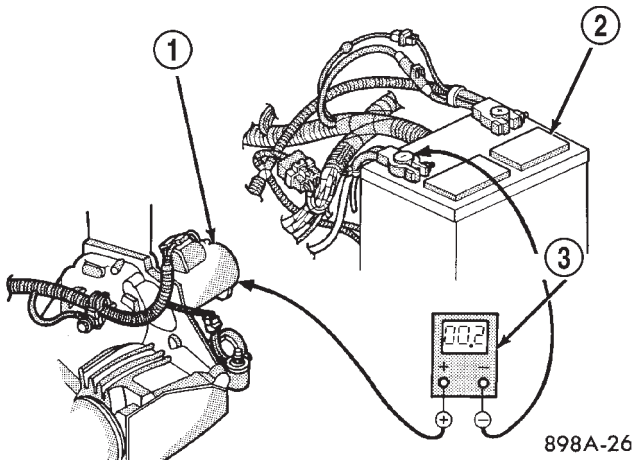


Fig. 9 Test Starter Ground - Typical

1 – STARTER MOTOR
2 – BATTERY
3 – VOLTMETER

- Ignition Switch Refer to **Ignition Switch and Key Lock Cylinder** in the index of this service manual for the location of the proper ignition switch diagnosis and testing procedures.
- Clutch Pedal Position Switch If the vehicle is equipped with a manual transmission, refer to **Clutch Pedal Position Switch** in the index of this service manual for the location of the proper clutch pedal position switch diagnosis and testing procedures.
- Park/Neutral Position Switch If the vehicle is equipped with an automatic transmission, refer to **Park/Neutral Position Switch** in the index of this service manual for the location of the proper park/neutral position switch diagnosis and testing procedures.

STARTER MOTOR NOISE - 2.5L ENGINE

See the Starter Motor Noise Diagnosis chart (Fig. 10). 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:

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.

FIG. 10 STARTER MOTOR NOISE DIAGNOSIS

(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. 11). Refer to **Starter Motor** in the index of this service manual for the location of the proper starter motor removal and installation 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 index of this service manual for the location of the proper removal and installation procedures.

DIAGNOSIS AND TESTING (Continued)

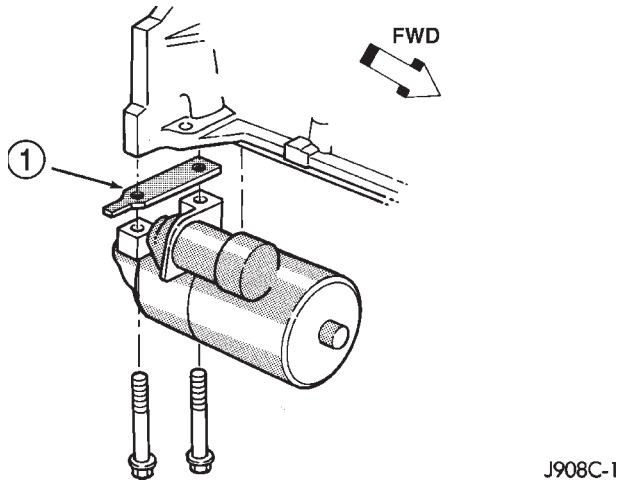


Fig. 11 Starter Motor Shim

1 – STARTER MOTOR SHIM

NOTE: This is a condition that will generally cause broken starter (flywheel/torque converter drive plate) ring gear teeth or broken starter motor housings.

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 index of this service manual for the location of the proper starter motor specifications.

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.

STARTER MOTOR

(1) Remove the starter motor from the vehicle. Refer to **Starter Motor** in the index of this service manual for the location of the proper starter motor removal and installation 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 B(+) terminal stud. The starter motor should operate. If the starter motor fails to operate, replace the faulty starter motor.

(5) Adjust the carbon pile load of the tester to obtain the free running test voltage. Refer to **Starting System** in the index of this service manual for the location of the proper 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 index of this service manual for the location of the proper 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.

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 index of this service manual for the location of the proper starter motor removal and installation 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. 12). There should be continuity. If OK, go to Step 4. If not OK, replace the faulty starter motor.

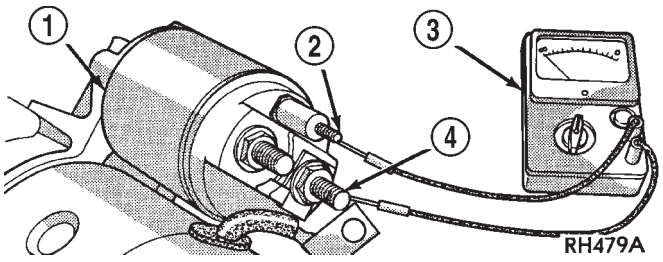


Fig. 12 Continuity Test Between Solenoid Terminal and Field Coil Terminal - Typical

1 – SOLENOID
2 – SOLENOID TERMINAL
3 – OHMMETER
4 – FIELD COIL TERMINAL

(4) Check for continuity between the solenoid terminal and the solenoid case (Fig. 13). There should be continuity. If not OK, replace the faulty starter motor.

DIAGNOSIS AND TESTING (Continued)

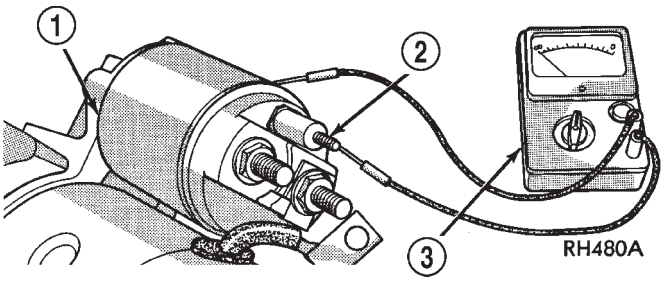


Fig. 13 Continuity Test Between Solenoid Terminal and Solenoid Case - Typical

1 – SOLENOID
2 – SOLENOID TERMINAL
3 – OHMMETER

STARTER RELAY

The starter relay (Fig. 14) 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. Refer to **Starting System** in the index of this service manual for the location of complete starting system wiring diagrams.

RELAY TEST

(1) Remove the starter relay from the PDC. Refer to **Starter Relay** in the index of this service manual for the location of the proper starter relay removal and installation 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.

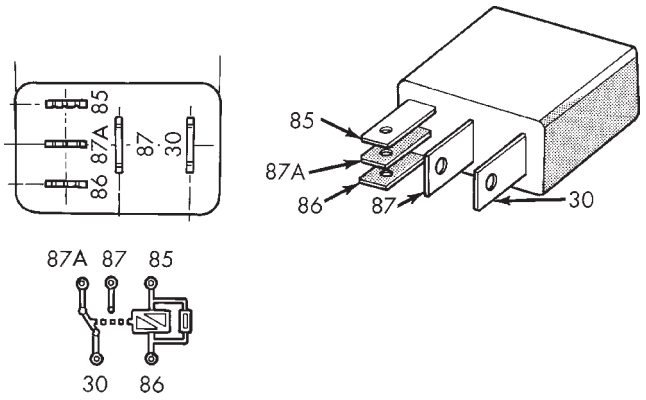
(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, perform the Relay Circuit Test that follows. If not OK, replace the faulty relay.

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 fused B(+) 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 coil. 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 engine starter motor relay output circuit to the starter solenoid as required.



TERMINAL LEGEND	
NUMBER	**IDENTIFICATION**
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 14 Starter Relay

(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 blocked in the fully depressed position 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 a manual transmission, disconnect the clutch pedal position switch wire harness connector and install a jumper wire between the two cavities in the body half of the connector and check for battery voltage again at the cavity for relay terminal 86. If now OK, replace the faulty clutch pedal position switch. If still not OK with a manual transmission or if not OK with an automatic transmission, check for an open or shorted fused ignition switch output (start) circuit to the ignition switch and repair, as required. If the fused ignition switch output (start) circuit is OK, refer to **Ignition Switch and Key Lock Cylinder** in the index of this service manual for the location of the proper ignition switch diagnosis and testing procedures.

(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

DIAGNOSIS AND TESTING (Continued)

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 open park/neutral position switch sense circuit to ground as required. If not OK with an automatic transmission, check for an open or shorted park/neutral position switch sense circuit to the park/neutral position switch and repair, as required. If the park/neutral position switch sense circuit checks OK, refer to **Park/Neutral Position Switch** in the index of this service manual for the location of the proper park/neutral position switch diagnosis and testing procedures.

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. 15).

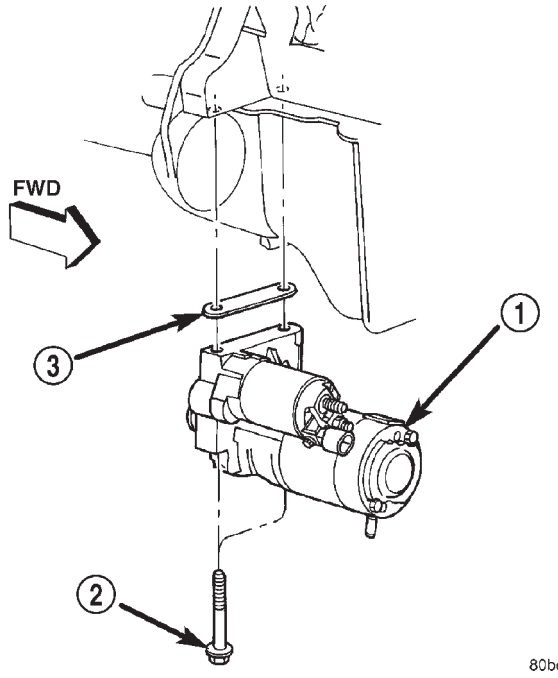


Fig. 15 Starter Motor Remove/Install - 2.5L Engine

1 – STARTER MOTOR
2 – SCREW (2)
3 – SHIM

(4) Lower the starter motor from the engine block far enough to access and remove the nut that secures the battery positive cable eyelet terminal to the starter solenoid B(+) terminal stud (Fig. 16). Always support the starter motor during this process. Do not let the starter motor hang from the wire harness.

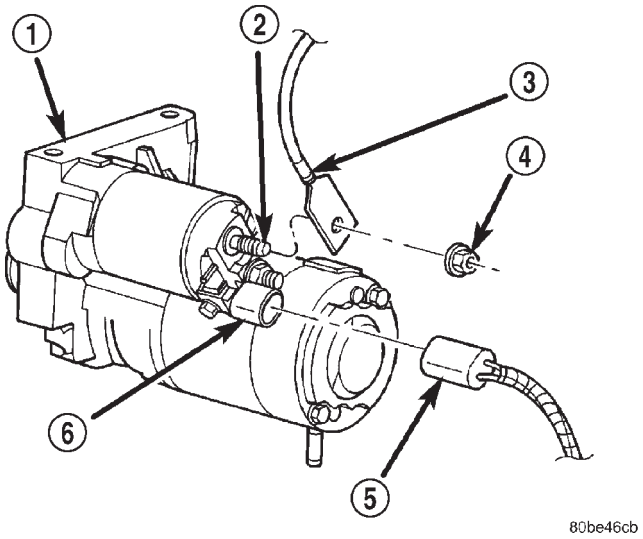


Fig. 16 Starter Connections Remove/Install - Typical

1 – STARTER MOTOR
2 – SOLENOID B(+) TERMINAL STUD
3 – BATTERY POSITIVE CABLE EYELET TERMINAL
4 – NUT
5 – SOLENOID TERMINAL WIRE HARNESS CONNECTOR
6 – SOLENOID TERMINAL CONNECTOR RECEPTACLE

(5) Remove the battery positive cable eyelet terminal from the starter solenoid B(+) terminal stud. 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 and any starter motor shims (if used) from the engine block.

4.0L ENGINE

(1) Disconnect and isolate the battery negative cable.

(2) Raise and support the vehicle.

(3) Remove the lower screw (forward facing) that secures the starter motor to the manual transmission clutch housing or the automatic transmission torque converter housing (Fig. 17).

(4) While supporting the starter motor with one hand, use the other hand to remove the upper screw (rearward facing) that secures the starter motor to

REMOVAL AND INSTALLATION (Continued)

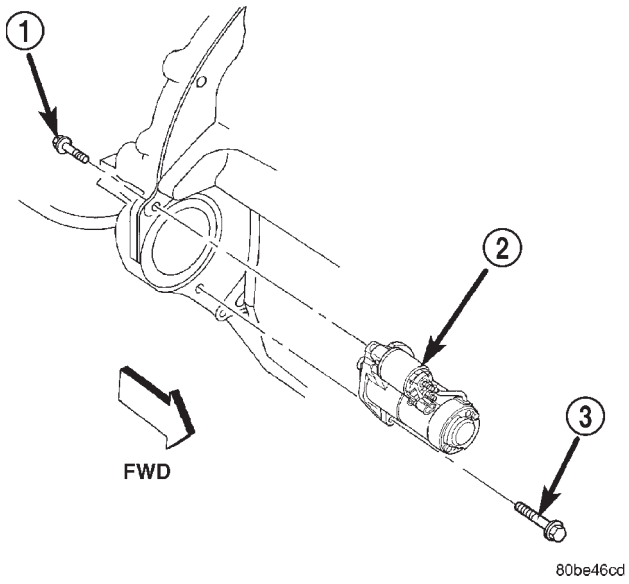


Fig. 17 Starter Motor Remove/Install - 4.0L Engine

1 – SCREW
2 – STARTER MOTOR
3 – SCREW

the manual transmission clutch housing or the automatic transmission torque converter housing.

(5) Lower the starter motor from the front of the manual transmission clutch housing or automatic transmission torque converter housing far enough to access and remove the nut that secures the battery positive cable eyelet terminal to the starter solenoid B(+) terminal stud (Fig. 16). Always support the starter motor during this process. Do not let the starter motor hang from the wire harness.

(6) Remove the battery positive cable eyelet terminal from the solenoid B(+) terminal stud. Always support the starter motor during this process. Do not let the starter motor hang from the wire harness.

(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 manual transmission clutch housing or automatic transmission torque converter housing.

INSTALLATION

2.5L ENGINE

(1) Position the starter motor to the engine block.

(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 positive cable eyelet terminal onto the starter solenoid B(+) terminal stud. 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 positive cable eyelet terminal to the starter solenoid B(+) terminal stud. Tighten the nut to 11.3 N·m (100 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 during the starter motor removal procedure to the engine block. Loosely install the two starter motor mounting screws to secure the starter motor and shims to the engine block.

NOTE: Shim thickness available is 0.381 mm (0.015 in.). Refer to Starter Motor Noise - 2.5L Engine in the index of this service manual for the location of the proper starter motor noise diagnosis and testing procedures.

(6) Tighten the two screws that secure the starter motor and shims to the engine block. Tighten the screws to 44.7 N·m (33 ft. lbs.).

(7) Lower the vehicle.

(8) Reconnect the battery negative cable.

4.0L ENGINE

(1) Position the starter motor to the manual transmission clutch housing or automatic transmission torque converter housing.

(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 positive cable eyelet terminal onto the starter solenoid B(+) terminal stud. 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 positive cable eyelet terminal to the starter solenoid B(+) terminal stud. Tighten the nut to 11.3 N·m (100 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 manual transmission clutch housing or automatic transmission torque converter housing. Loosely install the two starter motor mounting screws to secure the starter motor to the manual transmission clutch housing or automatic transmission torque converter housing.

REMOVAL AND INSTALLATION (Continued)

(6) Tighten the lower (forward facing) screw that secures the starter motor to the manual transmission clutch housing or automatic transmission torque converter housing. Tighten the screw to 40.7 N·m (30 ft. lbs.).

(7) Tighten the upper (rearward facing) screw that secures the starter motor to the manual transmission clutch housing or automatic transmission torque converter housing. Tighten the screw to 47.5 N·m (35 ft. lbs.).

(8) Lower the vehicle.

(9) Reconnect the battery negative cable.

STARTER RELAY

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unlatch and open the cover on the Power Distribution Center (PDC) (Fig. 18).

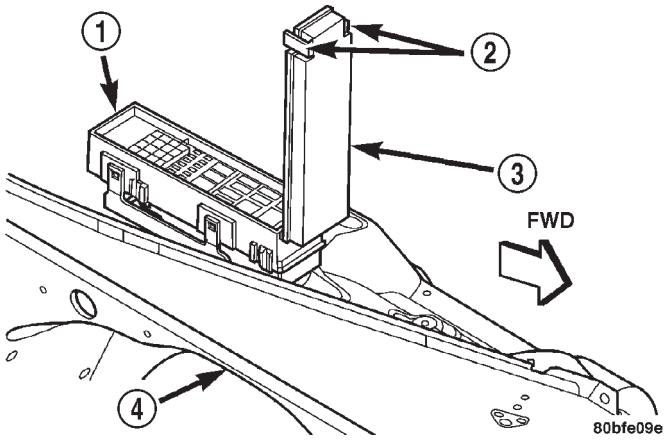


Fig. 18 Power Distribution Center

1 – POWER DISTRIBUTION CENTER
2 – LATCHES
3 – PDC COVER
4 – RIGHT FRONT FENDER

(3) See 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) See 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) Close and latch the PDC cover.

(6) Reconnect the battery negative cable.

CLEANING AND INSPECTION

STARTING SYSTEM

The following components of the starting system should be carefully inspected whenever any starting system problem is encountered.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

- 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 index of this service manual for the location of the proper battery cleaning and inspection procedures.
- Ignition Switch Visually inspect the ignition switch for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Wiring Diagrams** in the index of this service manual for the location of the proper wiring repair or connector and terminal service procedures. Refer to **Ignition Switch and Key Lock Cylinder** in the index of this service manual for the location of the proper ignition switch service procedures.
- 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. Clean corroded connections as required. Refer to **Wiring Diagrams** in the index of this service manual for the location of the proper wiring repair or connector and terminal service procedures. Refer to **Clutch Hydraulic Linkage** in the index of this service manual for the location of the

CLEANING AND INSPECTION (Continued)

proper clutch pedal position switch service procedures.

- 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. Clean corroded connections as required. Refer to **Wiring Diagrams** in the index of this service manual for the location of the proper wiring repair or connector and terminal service procedures. Refer to **Park/Neutral Position Switch** in the index of this service manual for the location of the proper park/neutral position switch service procedures.
- Starter Relay Visually inspect the starter relay for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Wiring Diagrams** in the index of this service manual for the location of the proper wiring repair or connector and terminal service procedures. Refer to **Starter Relay** in the index of this service manual for the location of the proper starter relay service procedures.
- Starter Motor Visually inspect the starter motor for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Wiring Diagrams** in the index of this service manual for the location of the proper wiring repair or connector and terminal service procedures. If the problem being diagnosed involves improper starter engagement, disengagement or noise complaints the starter motor should be removed. With the starter motor removed, inspect the starter pinion and ring gears for damaged or missing teeth. Replace faulty components as required. Refer to **Starter Motor** in the index of this service manual for the location of the proper starter motor removal and installation procedures.
- Starter Solenoid Visually inspect the starter solenoid for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Wiring Diagrams** in the index of this service manual for the location of the proper wiring repair or connector and terminal service procedures. Refer to **Starter Motor** in the index of this service manual for the location of the proper starter solenoid service procedures.
- Wiring Visually inspect the starting system wire harnesses for indications of physical damage. Repair or replace any faulty wiring, as required. Refer to **Starting System** in the index of this service manual for the location of complete starting system wiring diagrams. Refer to **Wiring Diagrams** in the index of this service manual for the location of the proper wiring repair or connector and terminal service procedures.

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.	

CHARGING SYSTEM

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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

DESCRIPTION AND OPERATION (Continued)

generator begins producing sufficient current, it also provides the current needed to energize the rotor.

The Y type stator winding connections deliver the induced AC current to 3 positive and 3 negative diodes for rectification. From the diodes, rectified DC current is delivered to the vehicle electrical system through the generator battery 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 (BTS) is attached to the battery tray located under the battery.

OPERATION

The BTS is used to determine the battery temperature and control battery charging rate. This temperature data, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. System voltage will be higher at colder temperatures and is gradually reduced at warmer temperatures.

The PCM sends 5 volts to the sensor and is grounded through the sensor return line. As temperature increases, resistance in the sensor decreases and the detection voltage at the PCM increases.

The BTS is also used for OBD II diagnostics. Certain faults and OBD II monitors are either enabled or disabled, depending upon BTS input (for example, disable purge and enable Leak Detection Pump (LDP) and O2 sensor heater tests). Most OBD II monitors are disabled below 20°F.

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 (B+) and battery temperature (refer to Battery Temperature Sensor for more information). It then determines a target charging voltage. If sensed battery voltage is 0.5 volts or lower than the target voltage, the PCM grounds the field winding until sensed battery voltage is 0.5 volts above target voltage. A circuit in the PCM cycles the ground side of the generator field up to 100 times per second (100Hz), but has the capability to ground the field control wire 100% of the time (full field) to achieve the target voltage. If the charging rate cannot be monitored (limp-in), a duty cycle of 25% is used by the PCM in order to have some generator output. Also refer to Charging 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.

DIAGNOSIS AND TESTING (Continued)

(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.

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 procedure.

(3) Remove generator pivot and mounting bolts/nut (Fig. 1) or (Fig. 2). Position generator for access to wire connectors.

(4) If equipped, unsnap plastic cover from B+ terminal.

(5) Remove B+ cable output terminal mounting nut at rear of generator (Fig. 3) or (Fig. 4). Disconnect terminal from generator.

(6) Disconnect field wire connector at rear of generator by pushing on connector tab.

(7) Remove generator from vehicle.

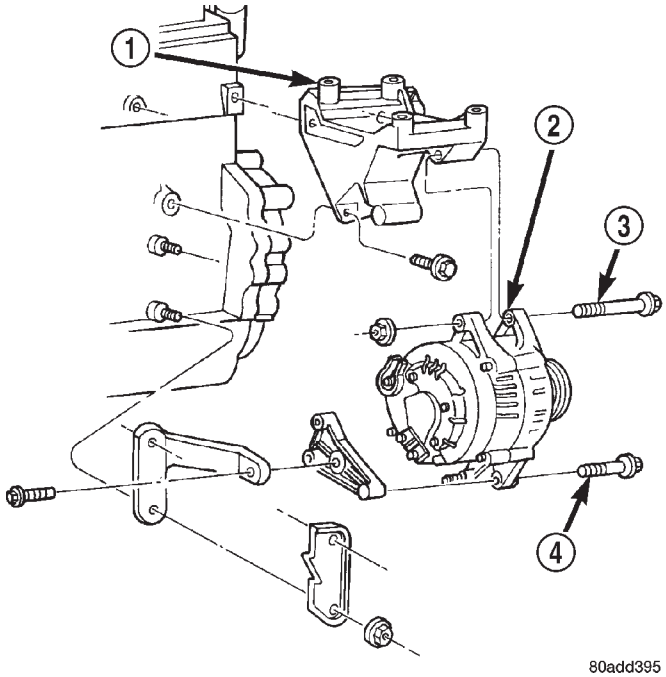


Fig. 1 Generator Remove/Install—2.5L Engine

1 – UPPER MOUNTING BRACKET
2 – GENERATOR
3 – UPPER BOLT
4 – LOWER BOLT

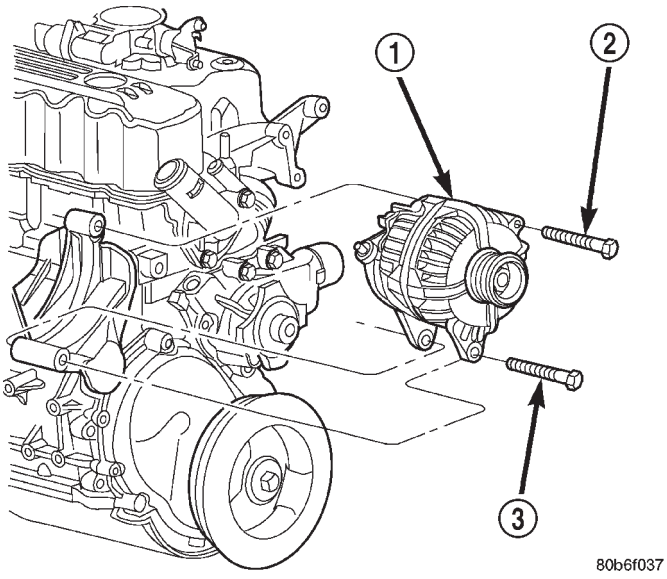


Fig. 2 Generator Remove/Install—4.0L Engine

1 – GENERATOR
2 – UPPER BOLT
3 – LOWER BOLT

REMOVAL AND INSTALLATION (Continued)

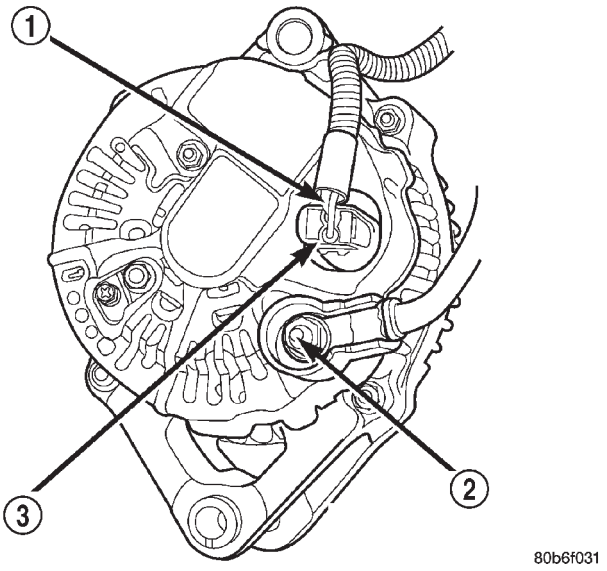


Fig. 3 Generator Connectors—2.5L Engine—Typical Denso

1 – FIELD WIRES
2 – B+ (OUTPUT TERMINAL)
3 – FIELD WIRE CONNECTOR

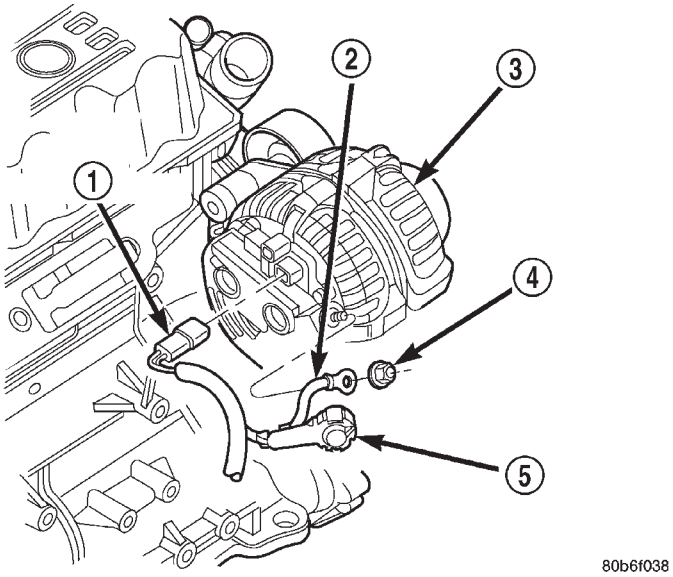


Fig. 4 Generator Connectors—4.0L Engine

1 – FIELD WIRE CONNECTOR
2 – B+ CABLE
3 – GENERATOR
4 – B+ CABLE MOUNTING NUT
5 – CABLE PROTECTOR

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) Install generator mounting fasteners and tighten as follows:

- Generator mounting bolt—55 N·m (41 ft. lbs.) torque.
- Generator 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.

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) Install generator drive belt. Refer to Group 7, Cooling System for procedure.

(6) Install negative battery cable to battery.

BATTERY TEMPERATURE SENSOR

The battery temperature sensor is located under the vehicle battery and is attached to a mounting hole on battery tray.

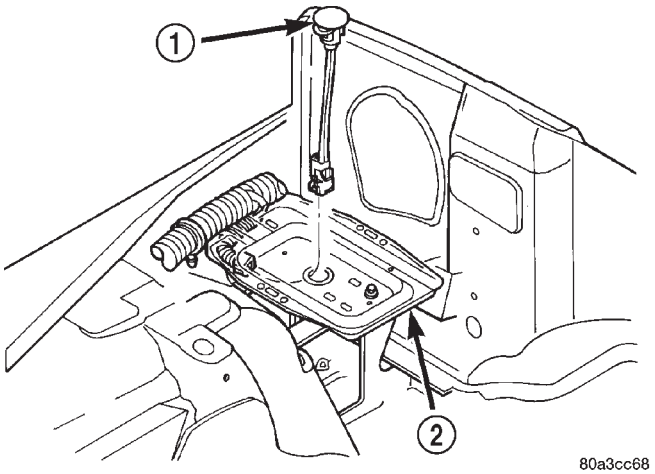


Fig. 5 Battery Temperature Sensor Remove/Install

1 – BATTERY TEMPERATURE SENSOR
2 – BATTERY TRAY

REMOVAL AND INSTALLATION (Continued)

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	56041685AA	117	4.0L	88
DENSO	56041565AA	81	4.0L	57
DENSO	56005684AB	81	2.5L	57
DENSO	56005685AC	117	2.5L	88
DENSO	56041822AA	124	2.5L/4.0L	90

TORQUE CHART

Description	Torque
Generator Upper Mounting Bolt/Nut—	
2.5L/4.0L Engine	55 N·m (41 ft. lbs.)
Generator Lower Mounting Bolt—	
2.5L/4.0L Engine	55 N·m (41 ft. lbs.)
Battery Terminal Nut	8.5 N·m (75 in. lbs.)
Ground Terminal Nut	8.5 N·m (75 in. lbs.)
Harness Hold-down Nut	8.5 N·m (75 in. lbs.)
Field Terminal Nuts	2.8 N·m (25 in. lbs.)

IGNITION SYSTEM

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DESCRIPTION AND OPERATION

IGNITION SYSTEM

DESCRIPTION

Two different ignition systems are used. One type is used for the 2.5L 4–cylinder engine. The other is used for the 4.0L 6–cylinder engine.

OPERATION

2.5L 4–Cylinder Engine:

The ignition system is controlled by the Powertrain Control Module (PCM).

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

4.0L 6–Cylinder Engine:

The 4.0L 6–cylinder engine uses a one-piece coil rail containing three independent coils. Although cylinder firing order is the same as 4.0L engines of previous years, spark plug firing is not. The 3 coils dual-fire the spark plugs on cylinders 1–6, 2–5 and/or 3–4. When one cylinder is being fired (on compression stroke), the spark to the opposite cylinder is being wasted (on exhaust stroke). The one-piece coil bolts directly to the cylinder head. Rubber boots seal the secondary terminal ends of the coils to the top of all 6 spark plugs. One electrical connector (located at the rear end of the coil rail) is used for all three coils.

Because of coil design, spark plug cables (secondary cables) are not used on either engine. A **distributor is not used** with the 4.0L engine.

The ignition system is controlled by the Powertrain Control Module (PCM).

The ignition system consists of:

- Spark Plugs
- Ignition Coil(s)
- Powertrain Control Module (PCM)

DESCRIPTION AND OPERATION (Continued)

- Crankshaft Position Sensor
- Camshaft Position Sensor
- The MAP, TPS, IAC and ECT also have an effect on the control of the ignition system.

DISTRIBUTOR-2.5L ENGINE

DESCRIPTION

The 2.5L engine is equipped with a camshaft driven mechanical distributor (Fig. 1) containing a shaft driven distributor rotor. The distributor is also equipped with an internal camshaft position (fuel sync) sensor (Fig. 1).

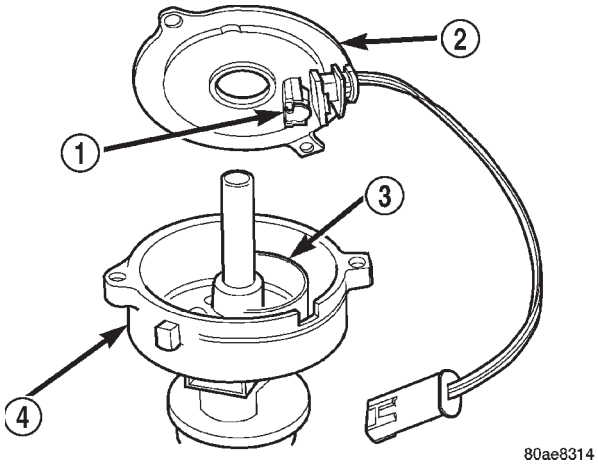


Fig. 1 Distributor and Camshaft Position Sensor-2.5L Engine

1 – SYNC SIGNAL GENERATOR
2 – CAMSHAFT POSITION SENSOR
3 – PULSE RING
4 – DISTRIBUTOR ASSEMBLY

OPERATION

The distributor does 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.**

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

DESCRIPTION

Resistor type spark plugs are used.

Spark plug resistance values range from 6,000 to 20,000 ohms (when checked with at least a 1000 volt spark plug tester). **Do not use an ohmmeter to check the resistance values of the spark plugs. Inaccurate readings will result.**

OPERATION

To prevent possible pre-ignition and/or mechanical engine damage, the correct type/heat range/number spark plug must be used.

Always use the recommended torque when tightening spark plugs. Incorrect torque can distort the spark plug and change plug gap. It can also pull the plug threads and do possible damage to both the spark plug and the cylinder head.

Remove the spark plugs and examine them for burned electrodes and fouled, cracked or broken porcelain insulators. Keep plugs arranged in the order in which they were removed from the engine. A 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 mileage may be cleaned and reused if not otherwise defective, carbon or oil fouled. Also refer to Spark Plug Conditions.

CAUTION: Never use a motorized wire wheel brush to clean the spark plugs. Metallic deposits will remain on the spark plug insulator and will cause plug misfire.

SPARK PLUG CABLES-2.5L ENGINE

DESCRIPTION

Spark plug cables are used only on the 2.5L engine. They are sometimes referred to as secondary ignition wires.

OPERATION

The spark plug 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.

DESCRIPTION AND OPERATION (Continued)

IGNITION COIL-2.5L ENGINE

DESCRIPTION

A single ignition coil is used with the 2.5L 4–cylinder engine. The coil is not oil filled. The coil windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the coil to be mounted on the engine.

OPERATION

The Powertrain Control Module (PCM) opens and closes the ignition coil ground circuit for ignition coil operation.

Battery voltage is supplied to the ignition coil positive terminal from the ASD relay. If the PCM does not see a signal from the crankshaft and camshaft sensors (indicating the ignition key is ON but the engine is not running), it will shut down the ASD circuit.

Base ignition timing is not adjustable. By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

IGNITION COIL—4.0L ENGINE

DESCRIPTION

A one-piece coil rail assembly containing three individual coils is used on the 4.0L 6–cylinder engine (Fig. 2). The coil rail must be replaced as one assembly. The bottom of the coil is equipped with 6 individual rubber boots (Fig. 2) to seal the 6 spark plugs to the coil. Inside each rubber boot is a spring. The spring is used for a mechanical contact between the coil and the top of the spark plug. These rubber boots and springs are a permanent part of the coil and are not serviced separately.

(1) The coil is bolted directly to the cylinder head (Fig. 3). One electrical connector (located at rear of coil) is used for all three coils.

OPERATION

Although cylinder firing order is the same as 4.0L Jeep engines of previous years, spark plug firing is not. The 3 coils dual-fire the spark plugs on cylinders 1–6, 2–5 and/or 3–4. When one cylinder is being fired (on compression stroke), the spark to the opposite cylinder is being wasted (on exhaust stroke).

Battery voltage is supplied to the three ignition coils from the ASD relay. The Powertrain Control Module (PCM) opens and closes the ignition coil ground circuit for ignition coil operation.

Base ignition timing is not adjustable. By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

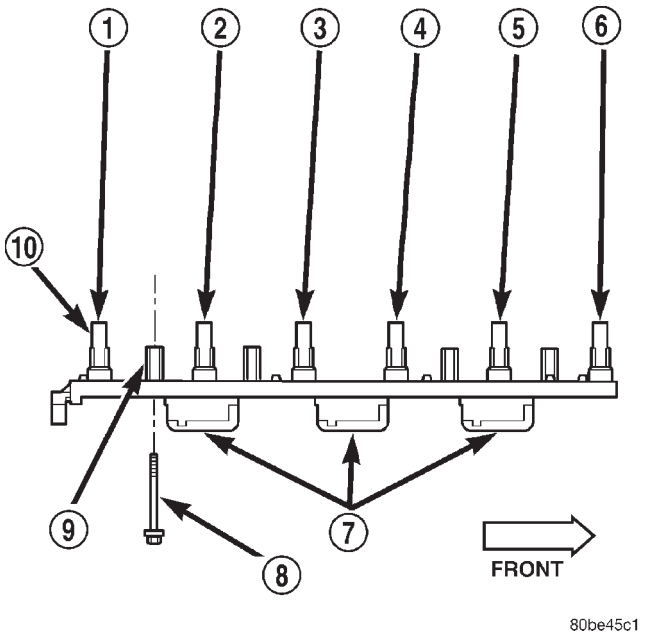


Fig. 2 Ignition Coil Assembly—4.0L 6–Cylinder Engine

1 – CYL. #6
2 – CYL. #5
3 – CYL. #4
4 – CYL. #3
5 – CYL. #2
6 – CYL. #1
7 – COILS (3)
8 – MOUNTING BOLTS (4)
9 – BOLT BASES (4)
10 – RUBBER BOOTS (6)

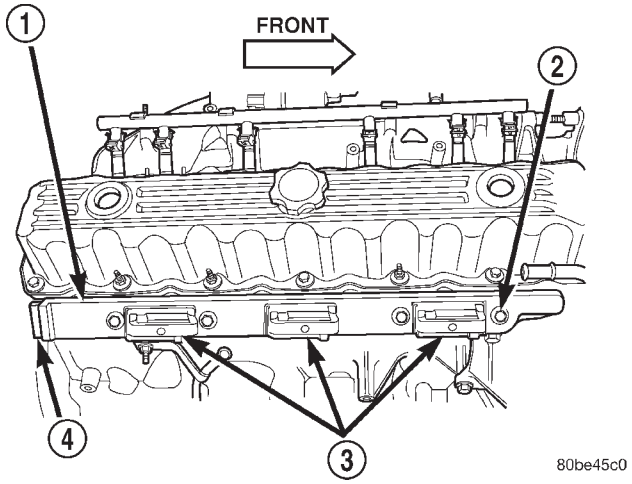


Fig. 3 Coil Location—4.0L Engine

1 – COIL RAIL
2 – COIL MOUNTING BOLTS (4)
3 – COIL
4 – COIL ELECTRICAL CONNECTION

DESCRIPTION AND OPERATION (Continued)

The ignition coil is not oil filled. The windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the ignition coil to be mounted on the engine.

Because of coil design, spark plug cables (secondary cables) are not used. The cables are integral within the coil rail.

CRANKSHAFT POSITION SENSOR

DESCRIPTION

The Crankshaft Position (CKP) sensor is located near the outer edge of the flywheel (starter ringear).

OPERATION

Engine speed and crankshaft position are provided through the CKP sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

The flywheel/drive plate has groups of four notches at its outer edge. On 2.5L 4-cylinder engines there are two sets of notches (Fig. 4). On 4.0L 6-cylinder engines there are three sets of notches (Fig. 5).

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 CKP sensor input.

CAMSHAFT POSITION SENSOR-2.5L ENGINE

DESCRIPTION

On the 2.5L 4–cylinder engine the Camshaft Position (CMP) sensor is located in the distributor.

OPERATION

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 (CKP) sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

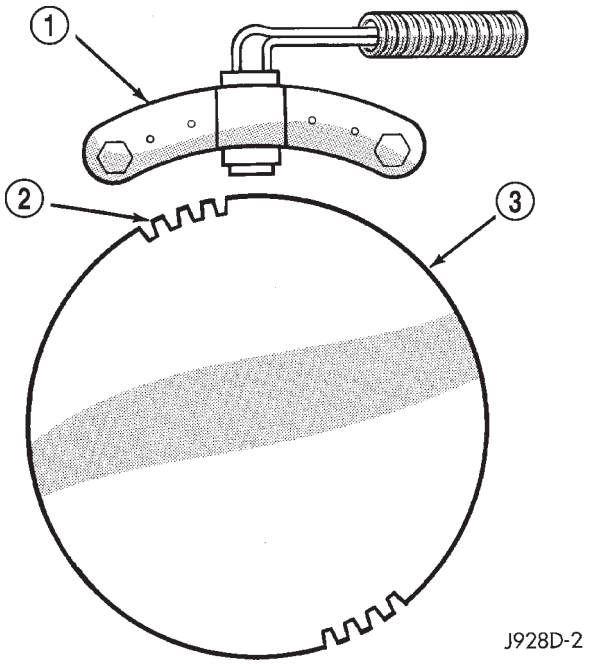


Fig. 4 Sensor Operation—2.5L 4-Cyl. Engine

1 – CRANKSHAFT POSITION SENSOR
2 – NOTCHES
3 – FLYWHEEL

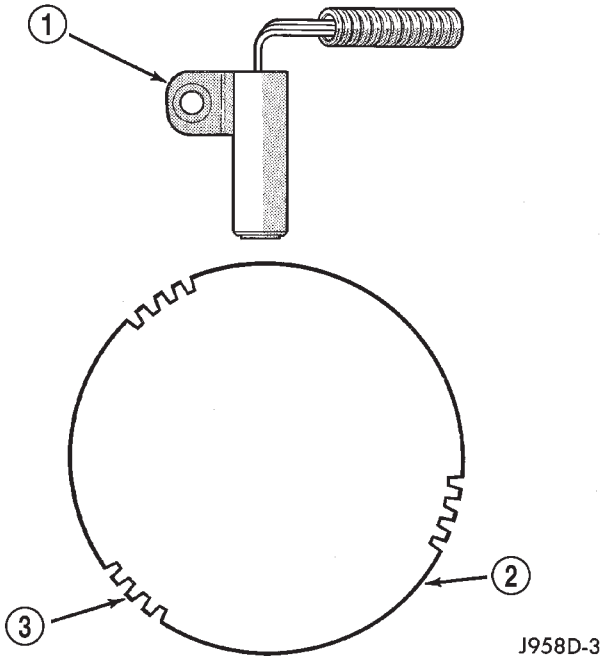


Fig. 5 Sensor Operation—4.0L 6-Cyl. Engine

1 – CRANKSHAFT POSITION SENSOR
2 – FLYWHEEL
3 – FLYWHEEL NOTCHES

DESCRIPTION AND OPERATION (Continued)

When the leading edge of the pulse ring (shutter) enters the sync signal generator, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a sync signal of approximately 5 volts.

When the trailing edge of the pulse ring (shutter) leaves the sync signal generator, the following occurs: The change of the magnetic field causes the sync signal voltage to switch low to 0 volts.

CAMSHAFT POSITION SENSOR—4.0L ENGINE

DESCRIPTION

The Camshaft Position Sensor (CMP) on the 4.0L 6–cylinder engine is bolted to the top of the oil pump drive shaft assembly (Fig. 6). The sensor and drive shaft assembly is located on the right side of the engine near the oil filter (Fig. 7).

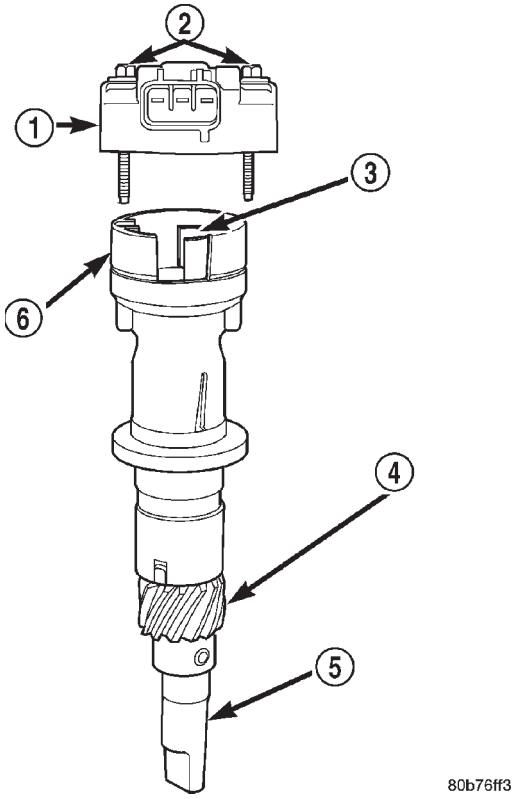


Fig. 6 CMP and Oil Pump Drive Shaft—4.0L Engine

1 – CAMSHAFT POSITION SENSOR
2 – MOUNTING BOLTS (2)
3 – PULSE RING
4 – DRIVE GEAR (TO CAMSHAFT)
5 – OIL PUMP DRIVESHAFT
6 – SENSOR BASE (OIL PUMP DRIVESHAFT ASSEMBLY)

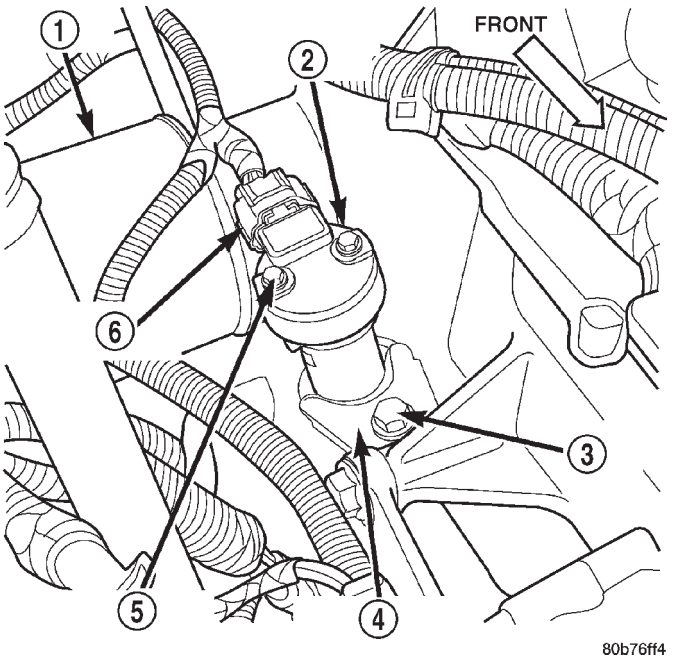


Fig. 7 CMP Location—4.0L Engine

1 – OIL FILTER
2 – CAMSHAFT POSITION SENSOR
3 – CLAMP BOLT
4 – HOLD-DOWN CLAMP
5 – MOUNTING BOLTS (2)
6 – ELEC. CONNECTOR

OPERATION

The CMP 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 oil pump drive shaft (Fig. 6). The pulse ring rotates 180 degrees through the sync signal generator. Its signal is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

When the leading edge of the pulse ring (shutter) enters the sync signal generator, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a sync signal of approximately 5 volts.

When the trailing edge of the pulse ring (shutter) leaves the sync signal generator, the following occurs: The change of the magnetic field causes the sync signal voltage to switch low to 0 volts.

DESCRIPTION AND OPERATION (Continued)

IGNITION SWITCH AND KEY LOCK CYLINDER

DESCRIPTION

The electrical ignition switch is located on the steering column. It is used as the main on/off switching device for most electrical components. The mechanical key lock cylinder is used to engage/disengage the electrical ignition switch.

OPERATION

Vehicles equipped with an automatic transmission and a floor mounted shifter: a cable is used to connect the interlock device in the steering column assembly, to the transmission floor shift lever. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is rotated to the LOCKED or ACCESSORY position. The interlock device within the steering column is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

If the ignition key is difficult to rotate to or from the LOCK or ACCESSORY position, it may not be the fault of the key cylinder or the steering column components. The brake transmission shift interlock cable may be out of adjustment. Refer to Brake Transmission Shift Interlock Cable Adjustment in Group 21, Transmissions for adjustment procedures.

Vehicles equipped with an automatic transmission and a steering column mounted shifter: an interlock device is located within the steering column. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is in the LOCKED or ACCESSORY position. If it is difficult to rotate the key to or from the LOCK or ACCESSORY position, the interlock device within the steering column may be defective. This device is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

Vehicles equipped with a manual transmission and a floor mounted shifter: on certain models, a lever is located on the steering column behind the ignition key lock cylinder. The lever must be manually operated to allow rotation of the ignition key lock cylinder to the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lever mechanism may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

On other models, the ignition key cylinder must be depressed to allow it to be rotated into the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lock mechanism within the steering column may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

DIAGNOSIS AND TESTING

DISTRIBUTOR CAP-2.5L ENGINE

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.

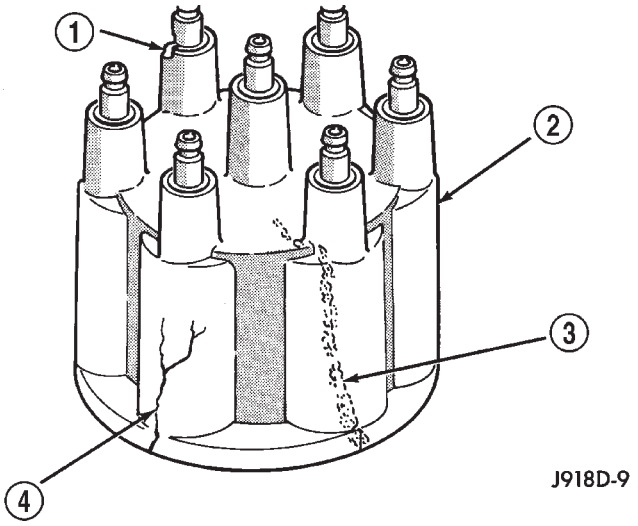


Fig. 8 Cap Inspection—External—Typical

1 – BROKEN TOWER
2 – DISTRIBUTOR CAP
3 – CARBON PATH
4 – CRACK

DISTRIBUTOR ROTOR-2.5L ENGINE

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.

DIAGNOSIS AND TESTING (Continued)

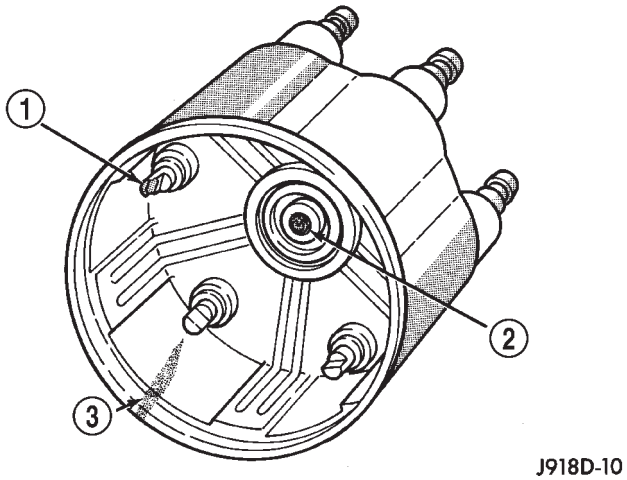


Fig. 9 Cap Inspection—Internal—Typical

1 – CHARRED OR ERODED TERMINALS
2 – WORN OR DAMAGED ROTOR BUTTON
3 – CARBON PATH

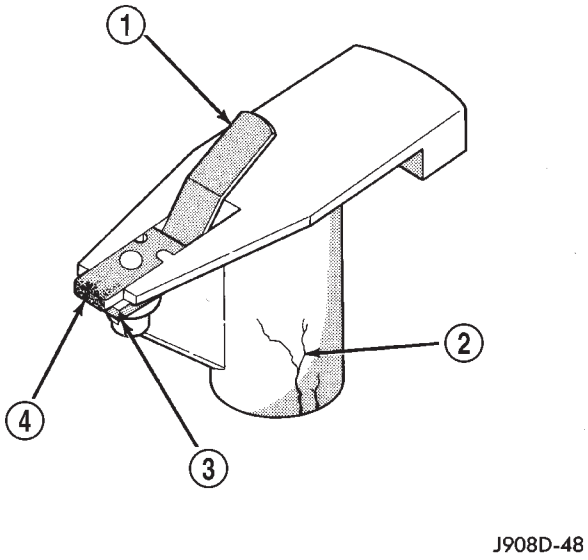


Fig. 10 Rotor Inspection—Typical

1 – INSUFFICIENT SPRING TENSION
2 – CRACKS
3 – EVIDENCE OF PHYSICAL CONTACT WITH CAP
4 – ROTOR TIP CORRODED

SPARK PLUG CABLES

TESTING

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.

When testing secondary cables for damage with an oscilloscope, follow the instructions of the equipment manufacturer.

If an oscilloscope is not available, spark plug cables may be tested as follows:

CAUTION: Do not leave any one spark plug cable disconnected for longer than necessary during testing. This may cause possible heat damage to the catalytic converter. Total test time must not exceed ten minutes.

With the engine running, remove spark plug cable from spark plug (one at a time) and hold next to a good engine ground. If the cable and spark plug are in good condition, the engine rpm should drop and the engine will run poorly. If engine rpm does not drop, the cable and/or spark plug may not be operating properly and should be replaced. Also check engine cylinder compression.

With the engine not running, connect one end of a test probe to a good ground. Start the engine and run the other end of the test probe along the entire length of all spark plug cables. If cables are cracked or punctured, there will be a noticeable spark jump from the damaged area to the test probe. The cable running from the ignition coil to the distributor cap can be checked in the same manner. Cracked, damaged or faulty cables should be replaced with resistance type cable. This can be identified by the words ELECTRONIC SUPPRESSION printed on the cable jacket.

Use an ohmmeter to test for open circuits, excessive resistance or loose terminals. Remove the distributor cap from the distributor. **Do not remove cables from cap.** Remove cable from spark plug. Connect ohmmeter to spark plug terminal end of cable and to 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

DIAGNOSIS AND TESTING (Continued)

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.

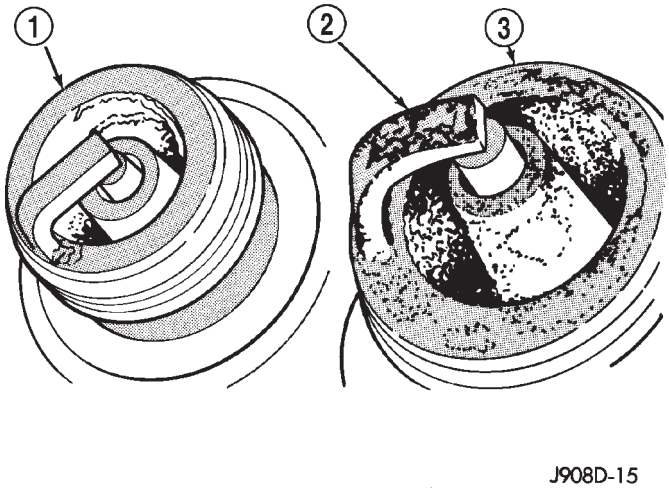


Fig. 11 Normal Operation and Cold (Carbon) Fouling

1 – NORMAL
2 – DRY BLACK DEPOSITS
3 – COLD (CARBON) FOULING

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT causes the entire tip of the spark plug to be coated with a rust colored deposit. This rust color can be misdiagnosed as being caused by coolant in the 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).

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.

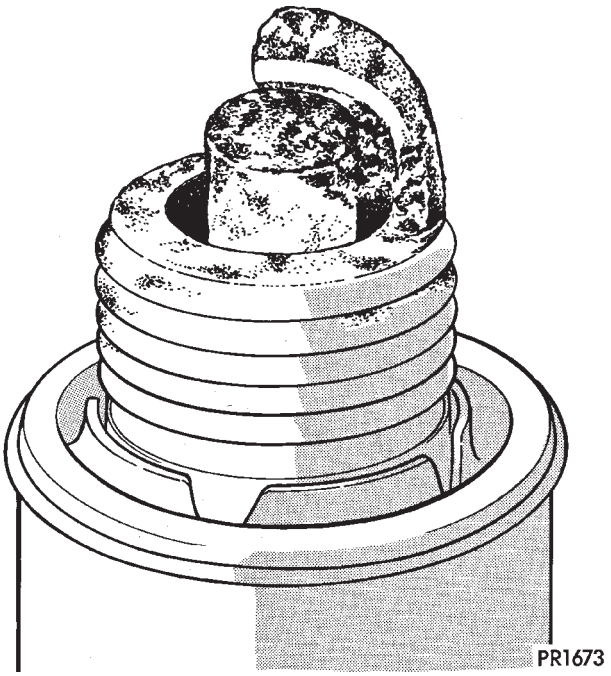


Fig. 12 Oil or Ash Encrusted

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).

DIAGNOSIS AND TESTING (Continued)

This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

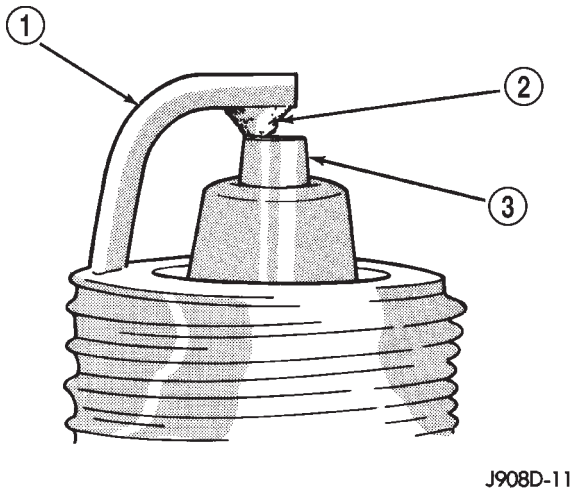


Fig. 13 Electrode Gap Bridging

1 – GROUND ELECTRODE
2 – DEPOSITS
3 – CENTER ELECTRODE

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.

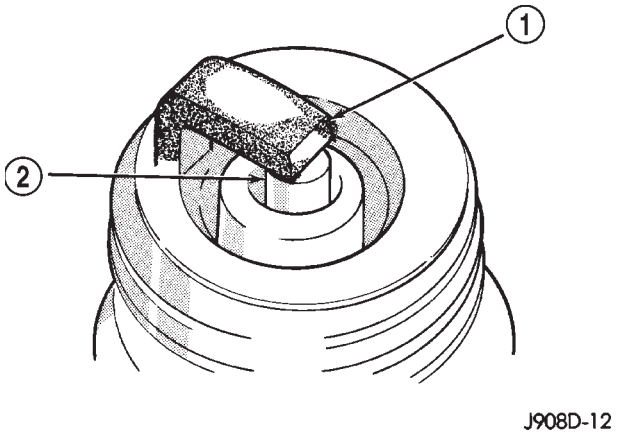


Fig. 14 Scavenger Deposits

1 – GROUND ELECTRODE COVERED WITH WHITE OR YELLOW DEPOSITS
2 – CENTER ELECTRODE

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.

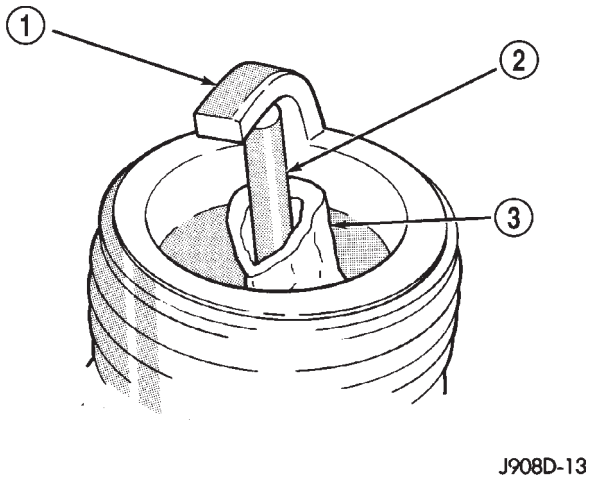


Fig. 15 Chipped Electrode Insulator

1 – GROUND ELECTRODE
2 – CENTER ELECTRODE
3 – CHIPPED INSULATOR

PREIGNITION DAMAGE

Preignition damage is usually caused by excessive combustion chamber temperature. The center electrode dissolves first and the ground electrode dissolves somewhat latter (Fig. 16). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine. Determine if ignition timing is over advanced or if other operating conditions are causing engine overheating. (The heat range rating refers to the operating temperature of a particular type spark plug. Spark plugs are designed to operate within specific temperature ranges. This depends upon the thickness and length of the center electrodes porcelain insulator.)

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.

DIAGNOSIS AND TESTING (Continued)

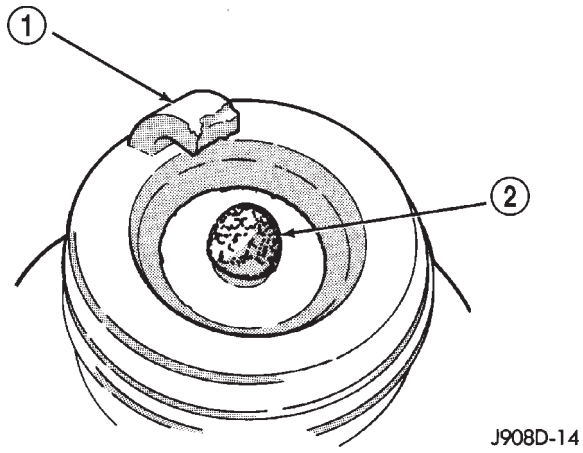


Fig. 16 Preignition Damage

1 – GROUND ELECTRODE STARTING TO DISSOLVE
2 – CENTER ELECTRODE DISSOLVED

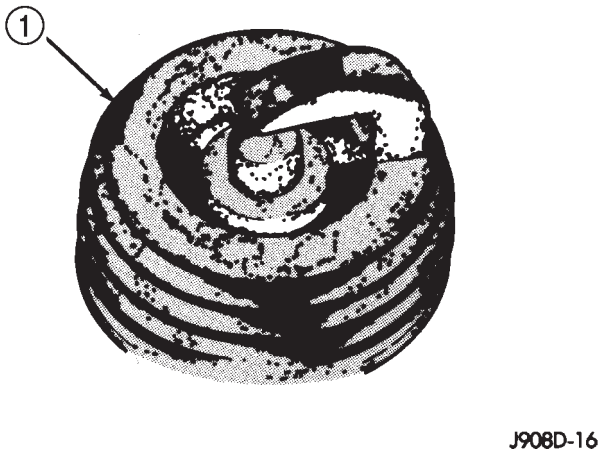


Fig. 17 Spark Plug Overheating

1 – BLISTERED WHITE OR GRAY COLORED INSULATOR

IGNITION SWITCH AND KEY LOCK CYLINDER

ELECTRICAL DIAGNOSIS

For ignition switch electrical schematics, refer to Ignition Switch in Group 8W, Wiring Diagrams.

MECHANICAL DIAGNOSIS (KEY DIFFICULT TO ROTATE)

Vehicles equipped with an automatic transmission and a floor mounted shifter: a cable is used to connect the interlock device in the steering column assembly, to the transmission floor shift lever. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is rotated to the LOCKED or ACCESSORY position. The interlock device within the steering column is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

If the ignition key is difficult to rotate to or from the LOCK or ACCESSORY position, it may not be the fault of the key cylinder or the steering column components. The brake transmission shift interlock cable may be out of adjustment. Refer to Brake Transmission Shift Interlock Cable Adjustment in Group 21, Transmissions for adjustment procedures.

Vehicles equipped with an automatic transmission and a steering column mounted shifter: an interlock device is located within the steering column. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is in the LOCKED or ACCESSORY position. If it is difficult to rotate the key to or from the LOCK or ACCESSORY position, the interlock device within the steering column may be defective. This device is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

Vehicles equipped with a manual transmission and a floor mounted shifter: on certain models, a lever is located on the steering column behind the ignition key lock cylinder. The lever must be manually operated to allow rotation of the ignition key lock cylinder to the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lever mechanism may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

On other models, the ignition key cylinder must be depressed to allow it to be rotated into the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lock mechanism within the steering column may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

REMOVAL AND INSTALLATION

SPARK PLUG CABLES

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.

REMOVAL AND INSTALLATION (Continued)

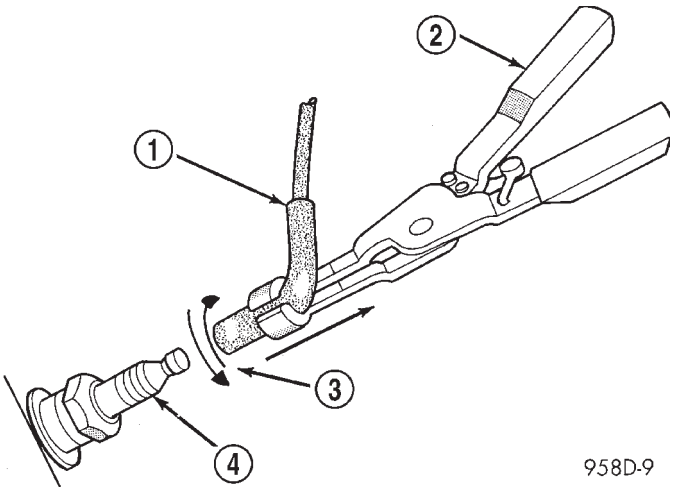


Fig. 18 Cable Removal

1 – SPARK PLUG CABLE AND BOOT
2 – SPARK PLUG BOOT PULLER
3 – TWIST AND PULL
4 – SPARK PLUG

INSTALLATION

Push the cable firmly onto the sparkplug.

SPARK PLUGS

PLUG REMOVAL

On the 4.0L 6–cylinder engine the spark plugs are located below the coil rail assembly. To gain access to any/all spark plug(s), refer to Ignition Coil-4.0L Engine Removal/Installation.

(1) 2.5L 4–Cylinder Engine: 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 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 Conditions.

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.**

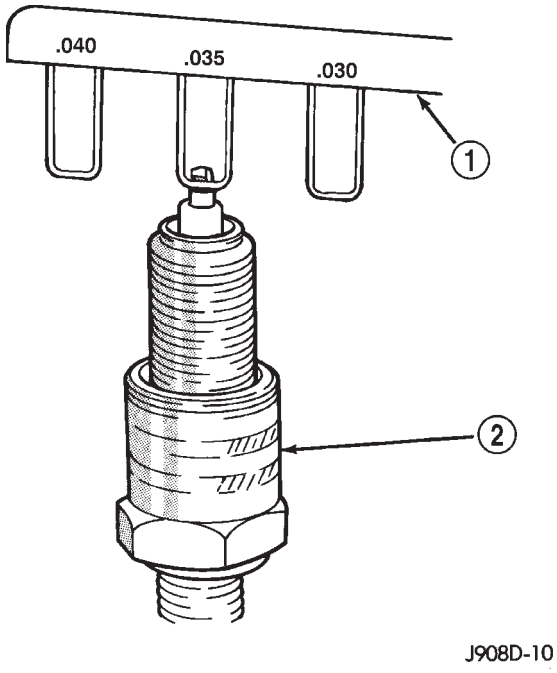


Fig. 19 Setting Spark Plug Gap—Typical

1 – GAUGE
2 – SPARK PLUG

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) 2.5L 4–Cylinder Engine: Install spark plug cables over spark plugs.

(4) 4.0L 6–Cylinder Engine: Install coil rail. Refer to Ignition Coil-4.0L Engine Removal/Installation.

REMOVAL AND INSTALLATION (Continued)

IGNITION COIL—2.5L ENGINE

REMOVAL

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

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).

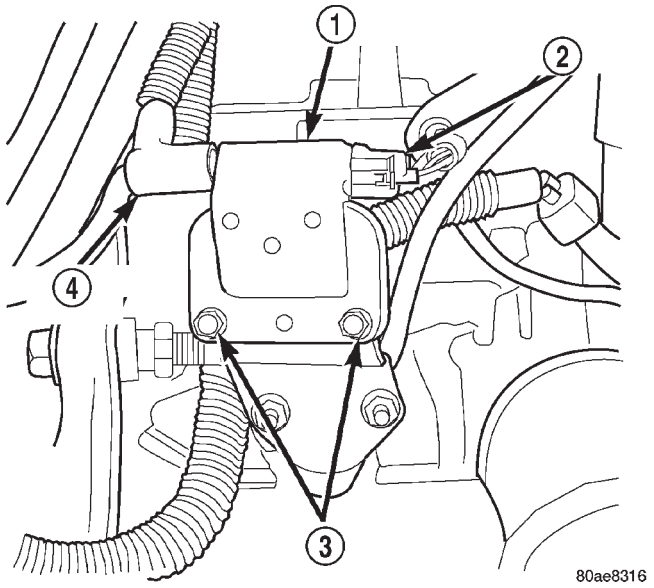


Fig. 20 Ignition Coil—2.5L Engine

1 – IGNITION COIL
2 – ELECTRICAL CONNECTOR
3 – MOUNTING BOLTS (2)
4 – SECONDARY CABLE

(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.

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.

IGNITION COIL—4.0L ENGINE

REMOVAL

A one-piece coil rail assembly containing three individual coils is used on the 4.0L engine (Fig. 21). The coil rail must be replaced as one assembly. The bottom of the coil is equipped with 6 individual rubber boots (Fig. 21) to seal the 6 spark plugs to the coil. Inside each rubber boot is a spring. The spring is used for an electrical contact between the coil and the top of the spark plug. These rubber boots and springs are a permanent part of the coil and are not serviced separately.

(1) Disconnect negative battery cable at battery.

(2) The coil is bolted directly to the cylinder head. Remove 4 coil mounting bolts (Fig. 22).

(3) Carefully pry up coil assembly from spark plugs. Do this by prying alternately at each end of coil until rubber boots have disengaged from all spark plugs. If boots will not release from spark plugs, use a commercially available spark plug boot removal tool. Twist and loosen a few boots from a few spark plugs to help remove coil.

(4) After coil has cleared spark plugs, position coil for access to primary electrical connector. Disconnect connector from coil by pushing slide tab outwards to right side of vehicle (Fig. 23). After slide tab has been positioned outwards, push in on secondary release lock (Fig. 23) on side of connector and pull connector from coil.

(5) Remove coil from vehicle.

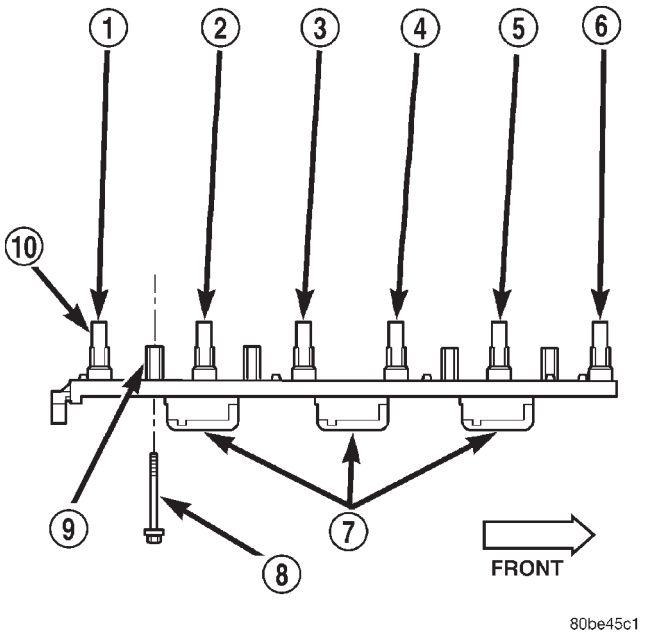


Fig. 21 Ignition Coil Assembly—4.0L 6–Cylinder Engine

1 – CYL. #6
2 – CYL. #5
3 – CYL. #4
4 – CYL. #3
5 – CYL. #2
6 – CYL. #1
7 – COILS (3)
8 – MOUNTING BOLTS (4)
9 – BOLT BASES (4)
10 – RUBBER BOOTS (6)

REMOVAL AND INSTALLATION (Continued)

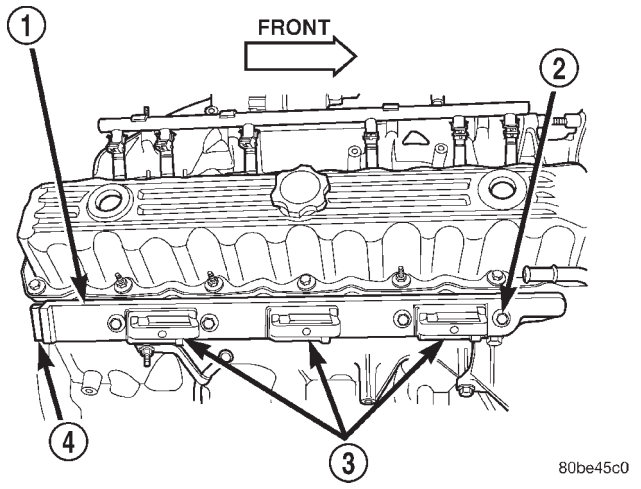


Fig. 22 Ignition Coil Rail Location—4.0L 6–Cylinder Engine

1 – COIL RAIL
2 – COIL MOUNTING BOLTS (4)
3 – COIL
4 – COIL ELECTRICAL CONNECTION

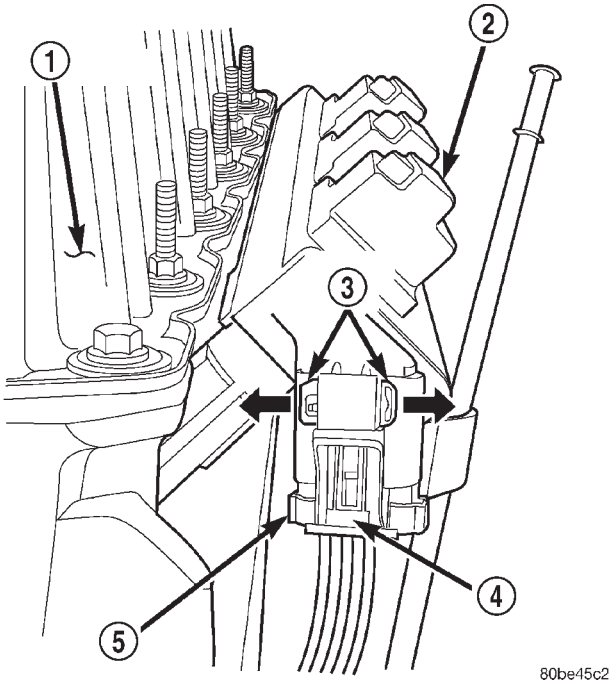


Fig. 23 Ignition Coil Electrical Connector—4.0L 6–Cylinder Engine

1 – REAR OF VALVE COVER
2 – COIL RAIL
3 – SLIDE TAB
4 – RELEASE LOCK
5 – COIL CONNECTOR

INSTALLATION

(1) Position ignition coil rubber boots to all spark plugs. Push down on coil assembly until bolt bases have contacted cylinder head

(2) Install 4 coil mounting bolts. Loosely tighten 4 bolts just enough to allow bolt bases to contact cylinder head. Do a final tightening of each bolt in steps down to 29 N·m (250 in. lbs.) torque. Do not apply full torque to any bolt first.

(3) Connect engine harness connector to coil by snapping into position. Move slide tab towards engine (Fig. 23) for a positive lock.

(4) Connect negative battery cable to battery.

CRANKSHAFT POSITION (CKP) SENSOR

REMOVAL

The crankshaft position (CKP) sensor is mounted to the transmission bellhousing at the left/rear side of the engine block.

The sensor may be mounted to the transmission with one of the following three different configurations:

- with one bolt (Fig. 24). If sensor is equipped with one mounting bolt, **it is adjustable.**.
- with two nuts (Fig. 25).
- with two bolts (Fig. 26).

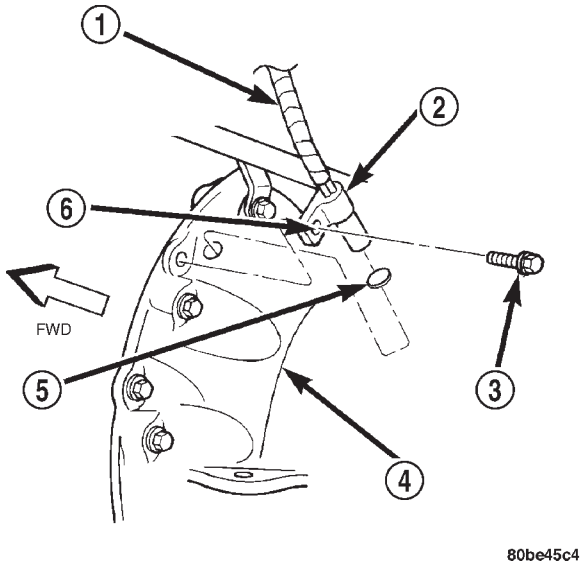


Fig. 24 Crankshaft Position Sensor—One-Bolt Mounting

1 – SENSOR PIGTAIL
2 – CRANKSHAFT POSITION SENSOR
3 – MOUNTING BOLT
4 – TRANSMISSION HOUSING
5 – PAPER SPACER
6 – SLOTTED HOLE

REMOVAL AND INSTALLATION (Continued)

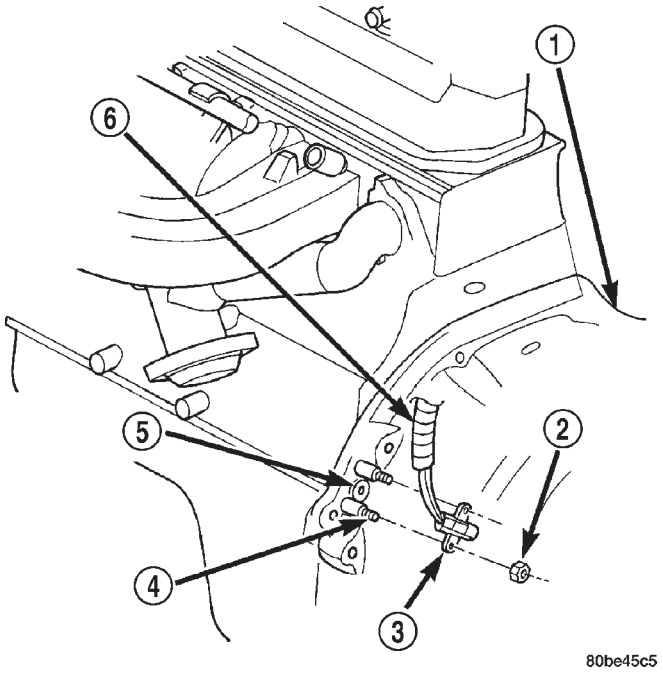


Fig. 25 Crankshaft Position Sensor—Two-Nut Mounting

1 – TRANSMISSION BELLHOUSING
2 – MOUNTING NUTS (2)
3 – CRANKSHAFT POSITION SENSOR
4 – MOUNTING STUDS (2)
5 – RUBBER GROMMET
6 – SENSOR PIGTAIL

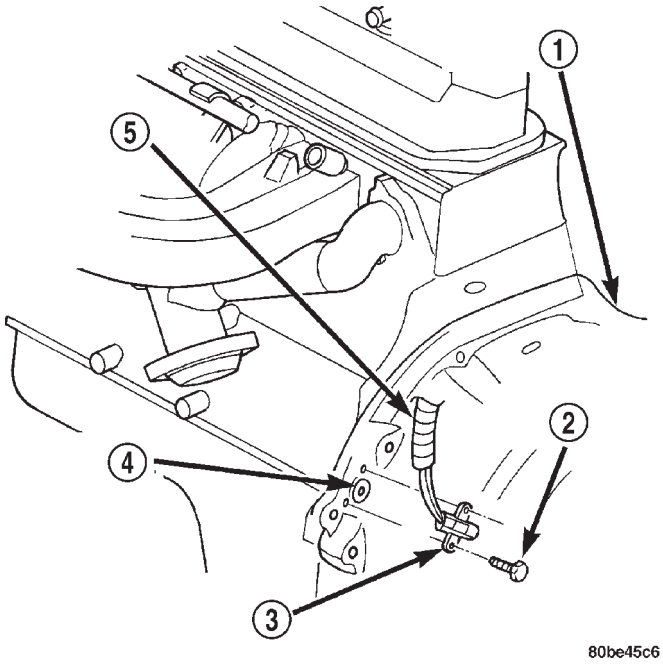


Fig. 26 Crankshaft Position Sensor—Two-Bolt Mounting

1 – TRANSMISSION BELLHOUSING
2 – MOUNTING BOLTS (2)
3 – CRANKSHAFT POSITION SENSOR
4 – RUBBER GROMMET
5 – SENSOR PIGTAIL

(1) Near right-rear side of engine, disconnect sensor pigtail harness (electrical connector) from main electrical harness.

(2) Depending upon application, remove either sensor mounting bolt(s) or nuts.

(3) Remove sensor from engine.

INSTALLATION

Sensor With 2–Bolt Mounting:

(1) Install sensor flush against opening in transmission housing.

(2) Install and tighten two sensor mounting bolts to 19 N·m (14 ft. lbs.) torque. The two sensor mounting bolts are specially machined to correctly space unit to flywheel. Do not attempt to install any other bolts.

Sensor With 2–Nut Mounting:

(3) Install and tighten two sensor mounting nuts to 19 N·m (14 ft. lbs.) torque.

Sensor With One-Bolt Mounting:

New replacement sensors will be equipped with a paper spacer glued to bottom of sensor. If installing (returning) a **used** sensor to vehicle, a new paper spacer must be installed to bottom of sensor. This spacer will be ground off the first time engine is started. If spacer is not used, sensor will be broken the first time engine is started.

(4) New Sensors: Be sure paper spacer is installed to bottom of sensor. If not, obtain spacer PN05252229.

(5) Used Sensors: Clean bottom of sensor and install spacer PN05252229.

(6) Install sensor into transmission bellhousing hole.

(7) Push sensor against flywheel/drive plate. With sensor pushed against flywheel/drive plate, tighten mounting bolt to 7 N·m (60 in. lbs.) torque.

(8) Connect sensor pigtail harness electrical connector to main wiring harness.

CAMSHAFT POSITION SENSOR—2.5L ENGINE

On 2.5L engines, the camshaft position sensor is located in the distributor (Fig. 27).

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.

REMOVAL AND INSTALLATION (Continued)

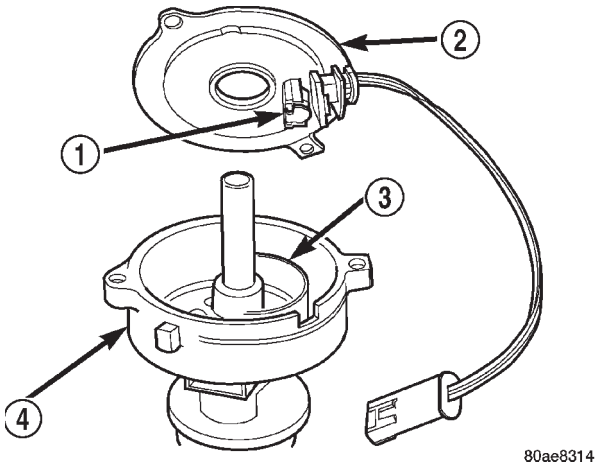


Fig. 27 Camshaft Position Sensor—2.5L Engine

1 – SYNC SIGNAL GENERATOR
2 – CAMSHAFT POSITION SENSOR
3 – PULSE RING
4 – DISTRIBUTOR ASSEMBLY

(4) Remove distributor rotor from distributor shaft.
(5) Lift camshaft position sensor assembly from distributor housing (Fig. 27).

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.

CAMSHAFT POSITION SENSOR—4.0L ENGINE

The Camshaft Position Sensor (CMP) on the 4.0L 6–cylinder engine is bolted to the top of the oil pump drive shaft assembly (Fig. 28). The sensor and drive shaft assembly is located on the right side of the engine near the oil filter (Fig. 29).

The rotational position of oil pump drive determines fuel synchronization only. It does not determine ignition timing.

NOTE: Do not attempt to rotate the oil pump drive to modify ignition timing.

Two different procedures are needed for removal and installation. The first procedure will detail removal and installation of the sensor only. The second procedure will detail removal and installation of the sensor and oil pump drive shaft assembly. The second procedure is to be used if the engine has been disassembled.

An internal oil seal is used in the drive shaft housing that prevents engine oil at the bottom of the sensor. The seal is not serviceable.

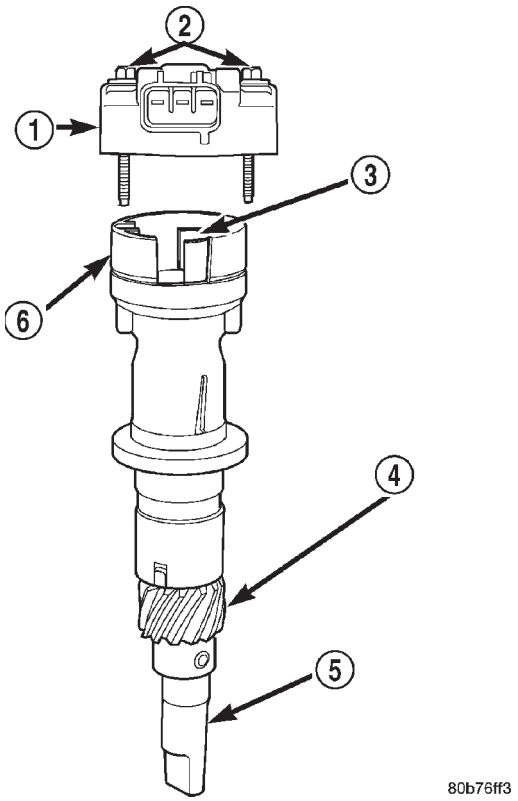


Fig. 28 CMP and Oil Pump Drive Shaft—4.0L Engine

1 – CAMSHAFT POSITION SENSOR
2 – MOUNTING BOLTS (2)
3 – PULSE RING
4 – DRIVE GEAR (TO CAMSHAFT)
5 – OIL PUMP DRIVESHAFT
6 – SENSOR BASE (OIL PUMP DRIVESHAFT ASSEMBLY)

REMOVAL—SENSOR ONLY

(1) Disconnect electrical connector at CMP sensor (Fig. 29).
(2) Remove 2 sensor mounting bolts (Fig. 28) or (Fig. 29).
(3) Remove sensor from oil pump drive.

INSTALLATION—SENSOR ONLY

(1) Install sensor to oil pump drive.
(2) Install 2 sensor mounting bolts and tighten to 2 N·m (15 in. lbs.) torque.
(3) Connect electrical connector to CMP sensor.

REMOVAL—OIL PUMP DRIVE AND SENSOR

If the CMP and oil pump drive are to be removed and installed, do not allow engine crankshaft or camshaft to rotate. CMP sensor relationship will be lost.

(1) Disconnect electrical connector at CMP sensor (Fig. 29).
(2) Remove 2 sensor mounting bolts (Fig. 28) or (Fig. 29).
(3) Remove sensor from oil pump drive.

REMOVAL AND INSTALLATION (Continued)

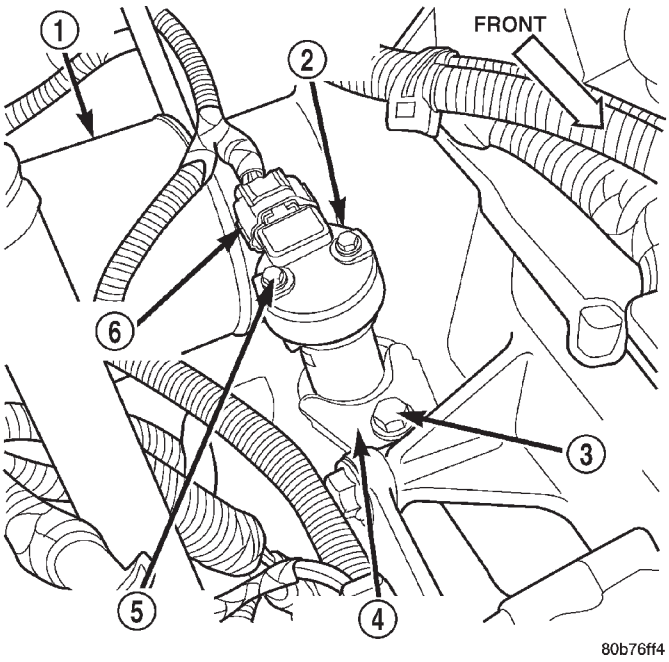


Fig. 29 CMP Location—4.0L Engine

1 – OIL FILTER
2 – CAMSHAFT POSITION SENSOR
3 – CLAMP BOLT
4 – HOLD-DOWN CLAMP
5 – MOUNTING BOLTS (2)
6 – ELEC. CONNECTOR

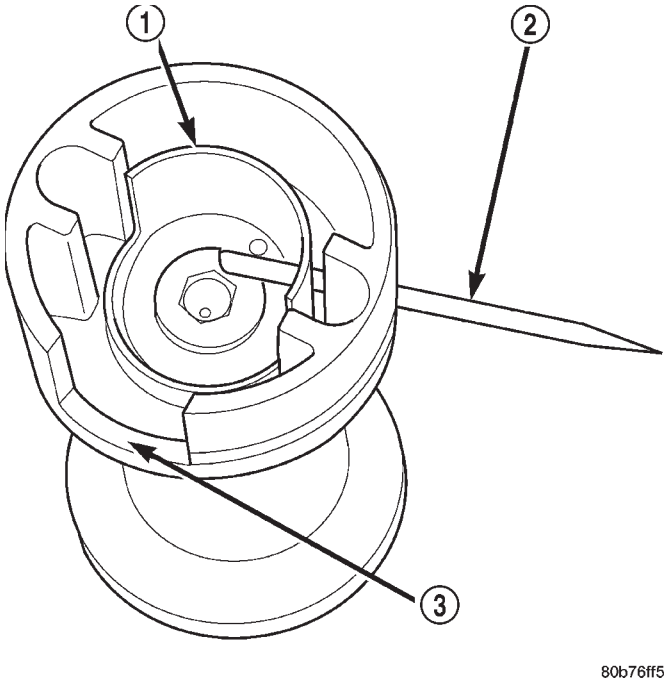


Fig. 30 CMP Pulse Ring Alignment—4.0L Engine

1 – PULSE RING (SHUTTER)
2 – TOOTHPICK
3 – SENSOR BASE (OIL PUMP DRIVESHAFT ASSEMBLY)

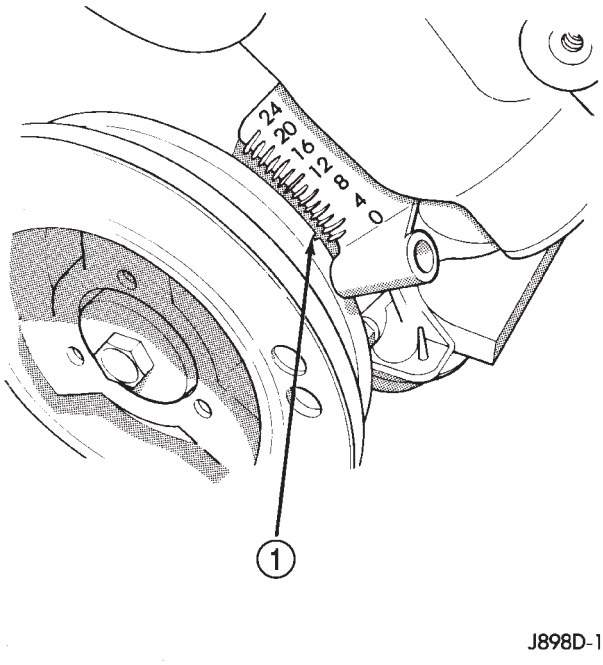


Fig. 31 Align Timing Marks—4.0L Engine

1 – CRANKSHAFT VIBRATION DAMPER TIMING MARK

(4) Before proceeding to next step, mark and note rotational position of oil pump drive in relationship to engine block. After installation, the CMP sensor should face rear of engine 0°.

(5) Remove hold-down bolt and clamp (Fig. 29).

(6) While pulling assembly from engine, note direction and position of pulse ring (Fig. 28). After removal, look down into top of oil pump and note direction and position of slot at top of oil pump gear.

(7) Remove and discard old oil pump drive-to-engine block gasket.

INSTALLATION—OIL PUMP DRIVE AND SENSOR

(1) Clean oil pump drive mounting hole area of engine block.

(2) Install new oil pump drive-to-engine block gasket.

(3) Temporarily install a toothpick or similar tool through access hole at side of oil pump drive housing. Align toothpick into mating hole on pulse ring (Fig. 30).

(4) Install oil pump drive into engine while aligning into slot on oil pump. Rotate oil pump drive back to its original position and install hold-down clamp and bolt. Finger tighten bolt. Do not do a final tightening of bolt at this time.

(5) If engine crankshaft or camshaft has been rotated, such as during engine tear-down, CMP sensor relationship must be reestablished.

(a) Remove ignition coil rail assembly. Refer to Ignition Coil Removal/Installation.

REMOVAL AND INSTALLATION (Continued)

(b) Remove cylinder number 1 spark plug.

(c) Hold a finger over the open spark plug hole. Rotate engine at vibration dampener bolt until compression (pressure) is felt.

(d) 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. 31). Always rotate engine in direction of normal rotation. Do not rotate engine backward to align timing marks.

(e) Install oil pump drive into engine while aligning into slot on oil pump. If pump drive will not drop down flush to engine block, the oil pump slot is not aligned. Remove oil pump drive and align slot in oil pump to shaft at bottom of drive. Install into engine. Rotate oil pump drive back to its original position and install hold-down clamp and bolt. Finger tighten bolt. Do not do a final tightening of bolt at this time.

(f) Remove toothpick from housing.

(6) Install sensor to oil pump drive. After installation, the CMP sensor should face rear of engine 0°.

(7) Install 2 sensor mounting bolts and tighten to 2 N·m (15 in. lbs.) torque.

(8) Connect electrical connector to CMP sensor.

(9) If removed, install spark plug and ignition coil rail.

To verify correct rotational position of oil pump drive, the DRB scan tool must be used.

WARNING: WHEN PERFORMING THE FOLLOWING TEST, THE ENGINE WILL BE RUNNING. BE CAREFUL NOT TO STAND IN LINE WITH THE FAN BLADES OR FAN BELT. DO NOT WEAR LOOSE CLOTHING.

(10) Connect DRB scan tool to data link connector. The data link connector is located in passenger compartment, below and to left of steering column.

(11) Gain access to SET SYNC screen on DRB.

(12) Follow directions on DRB screen and start engine. Bring to operating temperature (engine must be in “closed loop” mode).

(13) With engine running at **idle speed**, the words IN RANGE should appear on screen along with 0°. This indicates correct position of oil pump drive.

(14) If a plus (+) or a minus (-) is displayed next to degree number, and/or the degree displayed is not zero, loosen but do not remove hold-down clamp bolt. Rotate oil pump drive until IN RANGE appears on screen. Continue to rotate oil pump drive until achieving as close to 0° as possible.

The degree scale on SET SYNC screen of DRB is referring to fuel synchronization only. **It is not referring to ignition timing.** Because of this, do not attempt to adjust ignition timing using this method. Rotating oil pump drive will have no effect on ignition timing. All ignition timing values are controlled by powertrain control module (PCM).

(15) Tighten hold-down clamp bolt to 23 N·m (17 ft. lbs.) torque.

DISTRIBUTOR—2.5L ENGINE

The distributor contains 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. 32). 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.

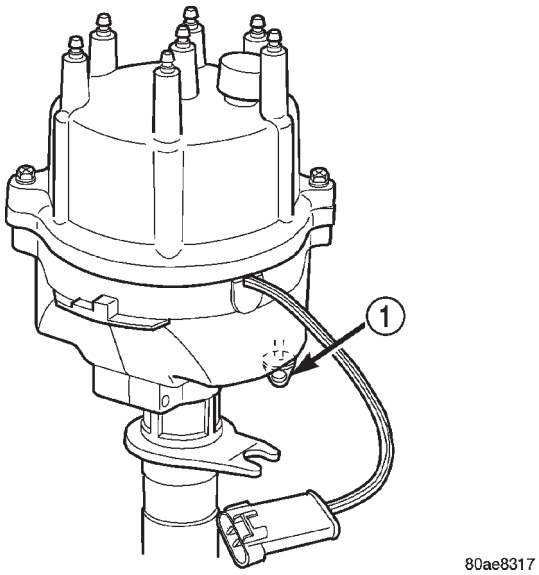


Fig. 32 Plastic Alignment Pin—2.5L Engine

1 – PLASTIC ALIGNMENT PIN

The camshaft position sensor is located in the distributor (Fig. 33). For removal/installation procedures, refer to Camshaft Position Sensor. Distributor removal is not necessary for sensor removal.

Refer to (Fig. 33) 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. 33). 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.

REMOVAL AND INSTALLATION (Continued)

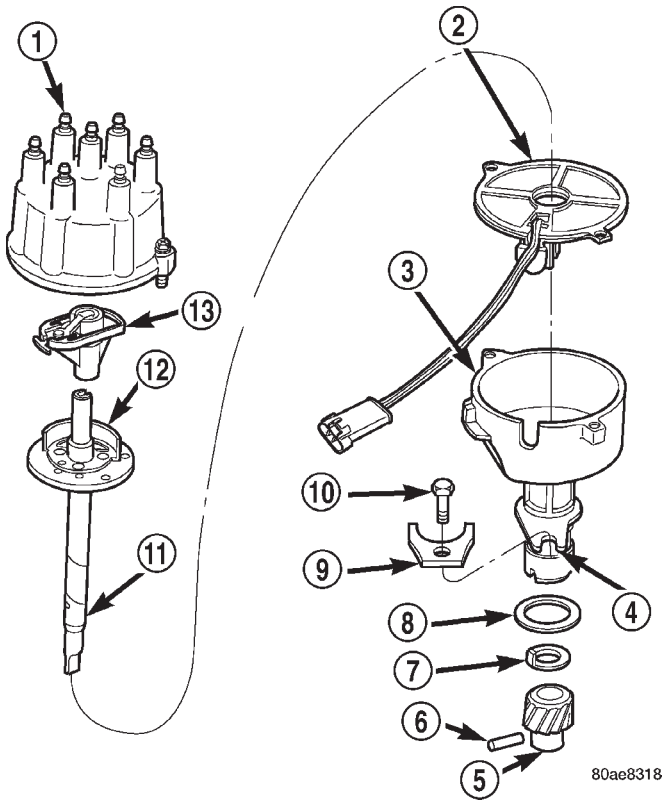


Fig. 33 Distributor—2.5L Engine—Typical

1 – CAP
2 – CAMSHAFT POSITION SENSOR
3 – HOUSING
4 – FORK WITH SLOT
5 – DRIVE GEAR
6 – ROLL PIN
7 – WASHER
8 – GASKET
9 – HOLDDOWN CLAMP
10 – HOLDDOWN BOLT
11 – SHAFT
12 – PULSE RING
13 – ROTOR

NOTE: Do not attempt to modify this fork to attain ignition timing.

REMOVAL

(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.

(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. 34). 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.

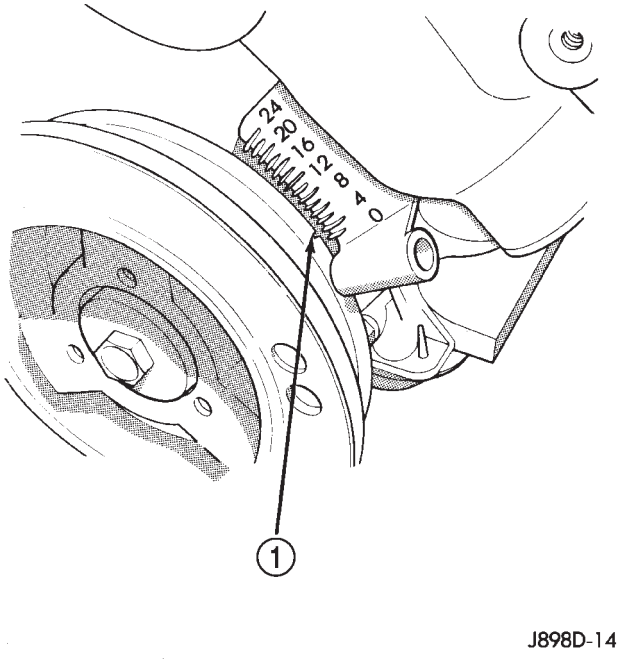


Fig. 34 Align Timing Marks—2.5L Engine

1 – CRANKSHAFT VIBRATION DAMPER TIMING MARK

(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) Observe slot in oil pump gear through hole on side of engine. It should be slightly before (counterclockwise of) 10 o'clock position (Fig. 35).

(15) Remove and discard the old distributor-to-engine block gasket.

REMOVAL AND INSTALLATION (Continued)

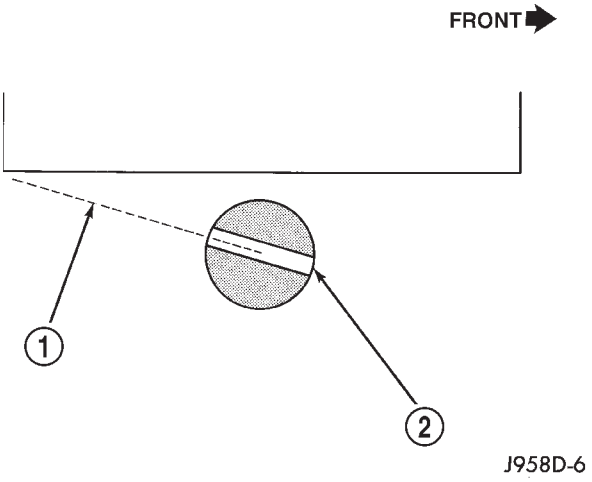


Fig. 35 Slot At 10 O'clock Position—2.5L Engine

1 – 10 0'CLOCK POSITION
2 – OIL PUMP SLOT

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.

(2) Check position of slot on oil pump gear. On the 2.5L engine, it should be just slightly before (counterclockwise of) 10 o'clock position (Fig. 35). 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. 32). 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. 36). **Note that 2.5L and 4.0L engines have different alignment holes (Fig. 36).**

(7) Rotate distributor shaft and install pin punch tool through proper alignment hole in plastic ring (Fig. 36) 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. 33).

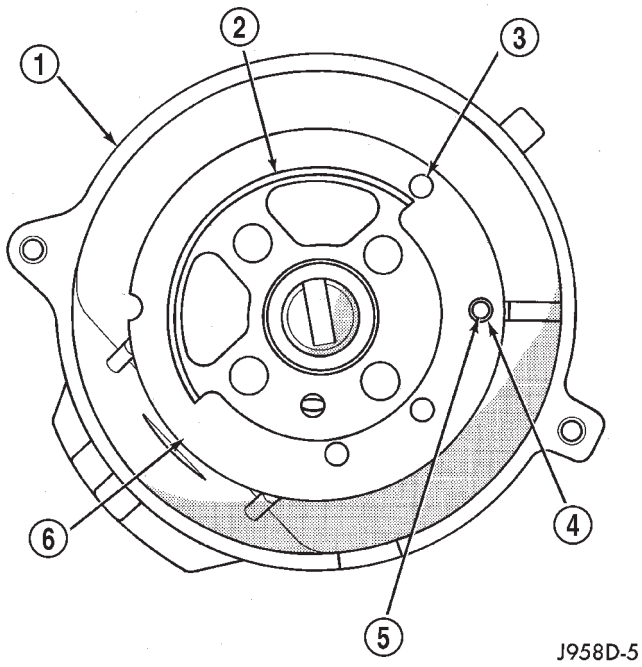


Fig. 36 Pin Alignment Holes—2.5L Engine

1 – DISTRIBUTOR HOUSING (TOP VIEW)
2 – PULSE RING
3 – 4.0L 6–CYLINDER ENGINE ALIGN. HOLE
4 – 2.5L 4–CYLINDER ENGINE ALIGN. HOLE
5 – MATING ACCESS HOLE IN DISTRIBUTOR HOUSING
6 – PLASTIC RING

(10) Install rotor to distributor shaft.

(11) Pre-position distributor into engine while holding centerline of base slot in 1 o'clock position (Fig. 37). 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. 38). The rotor should also be pointed slightly past (clockwise of) 3 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.
- 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)

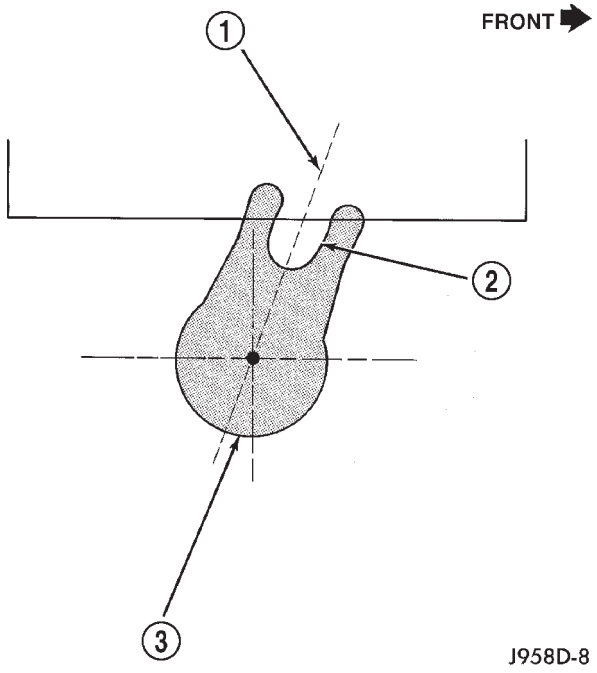


Fig. 37 Distributor Pre-position—2.5L Engine

1 – 1 O'CLOCK POSITION
2 – BASE SLOT
3 – DISTRIBUTOR BASE

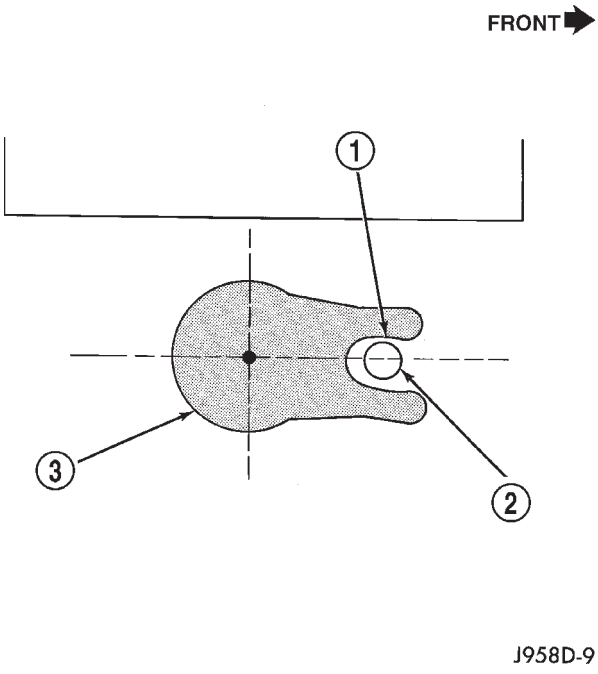


Fig. 38 Distributor Engaged Position—2.5L Engine

1 – DISTRIBUTOR BASE SLOT
2 – CLAMP BOLT MOUNTING HOLE (ON ENGINE)
3 – DISTRIBUTOR BASE

(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.

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 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. 39).

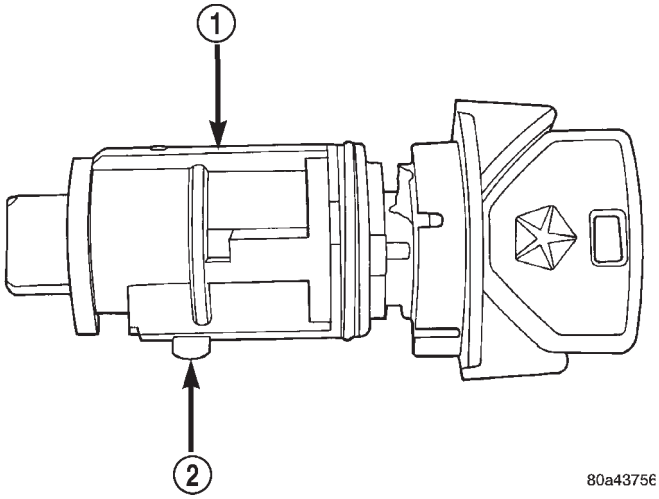


Fig. 39 Key Cylinder Release Tang

1 – KEY CYLINDER
2 – RELEASE TANG

REMOVAL AND INSTALLATION (Continued)

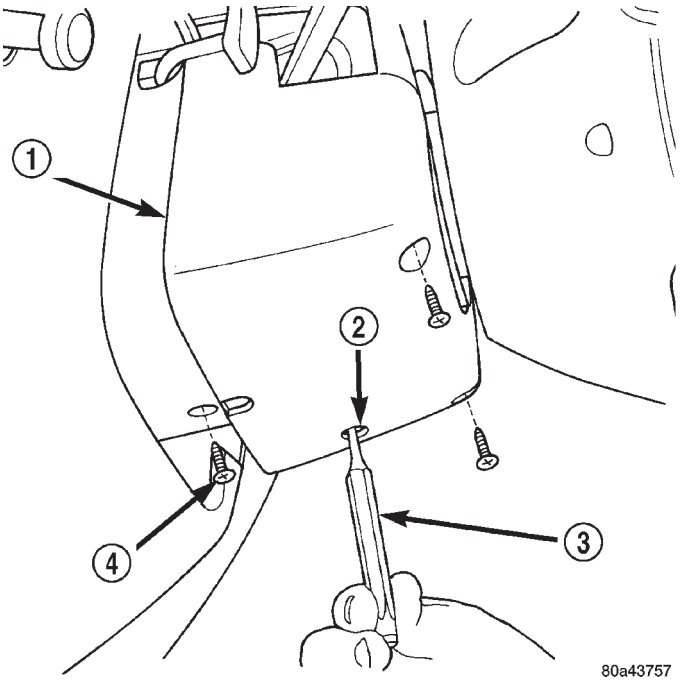


Fig. 40 Key Cylinder and Cover Removal

1 – LOWER COVER
2 – ACCESS HOLE
3 – PIN PUNCH
4 – COVER SCREWS (3)

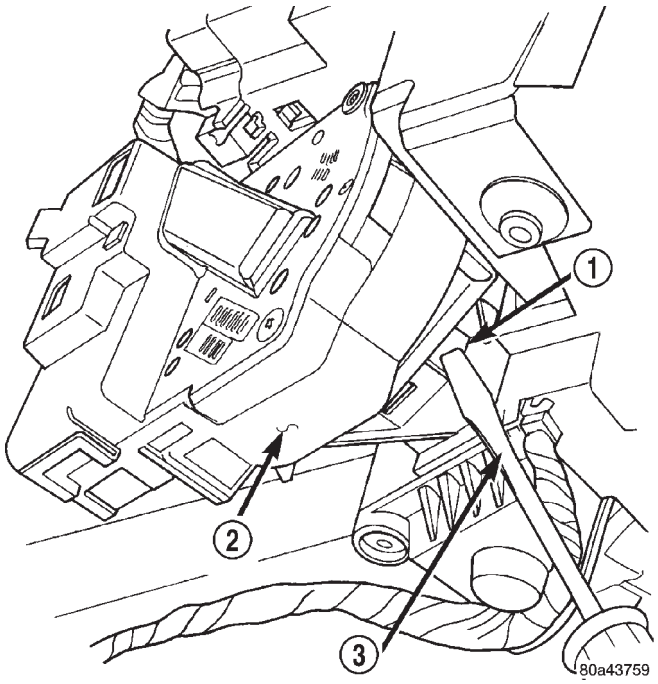


Fig. 41 Ignition Switch Lock Tab

1 – LOCK TAB
2 – IGNITION SWITCH
3 – SCREWDRIVER

(5) Position a small screwdriver or pin punch into tang access hole on bottom of steering column lower cover (Fig. 40).

(6) Push the pin punch up while pulling key cylinder from steering column.

IGNITION SWITCH REMOVAL

(1) Remove key cylinder. Refer to previous steps.

(2) Remove lower steering column cover screws and remove cover (Fig. 40).

(3) Remove ignition switch mounting screw (Fig. 43). Use tamper proof torx bit (Snap-On® SDMTR10 or equivalent) to remove the screw.

(4) Using a small screwdriver, push on locking tab (Fig. 41) and remove switch from steering column.

(5) Disconnect two electrical connectors at rear of ignition switch (Fig. 43).

IGNITION SWITCH INSTALLATION

(1) Before installing ignition switch, rotate the slot in the switch to the ON position (Fig. 42).

(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.

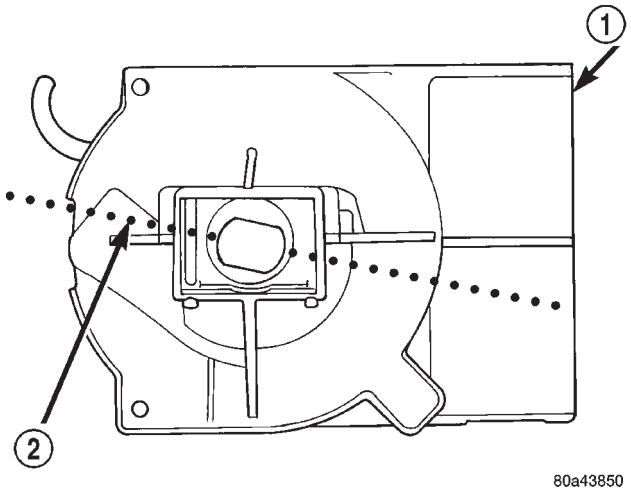


Fig. 42 Switch In ON Position

1 – IGNITION SWITCH
2 – ROTATE TO ON POSITION

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.

REMOVAL AND INSTALLATION (Continued)

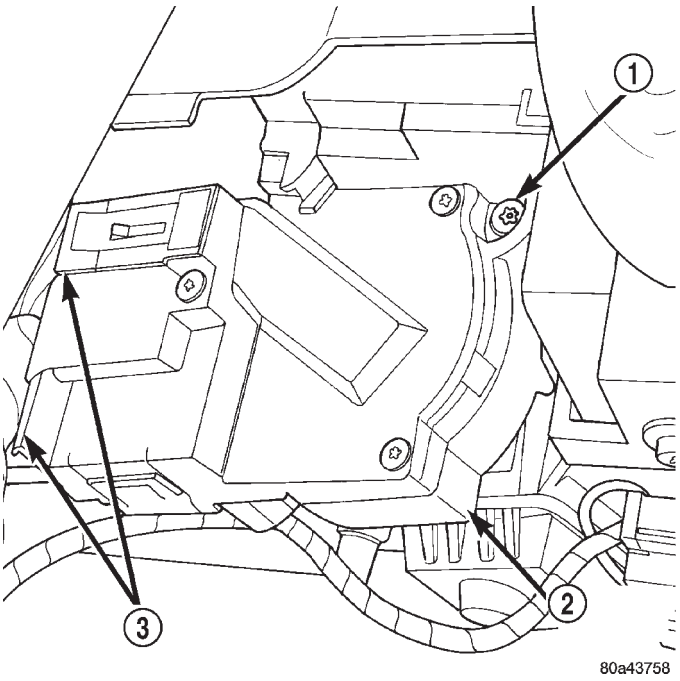


Fig. 43 Ignition Switch Removal/Installation

1 – TAMPER PROOF SCREW
2 – IGNITION SWITCH
3 – ELECTRICAL CONNECTORS

(4) Check mechanical operation of switch. **Automatic Transmission:** Be sure transmission lever is locked in PARK position after key removal. If key is difficult to rotate or is difficult to remove, the shift 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

REMOVAL/INSTALLATION

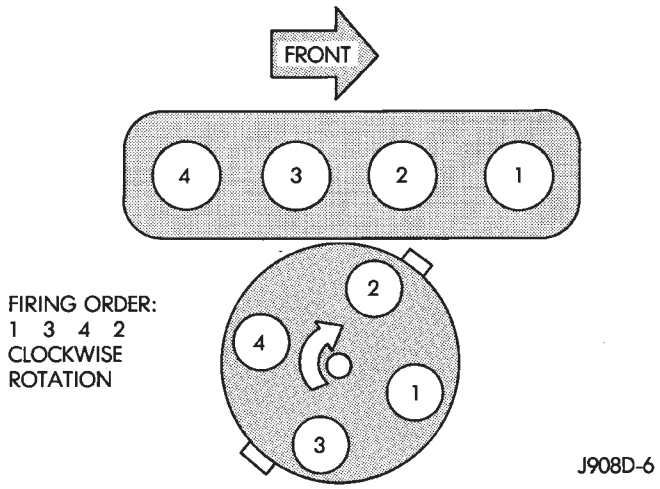
On models equipped with an automatic transmission, a cable connects the ignition switch with the floor shift lever. The shifter will be locked in the PARK position when the ignition key is in the LOCK or ACCESSORY positions. The cable can be adjusted or replaced. Refer to Group 21, Transmissions for 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

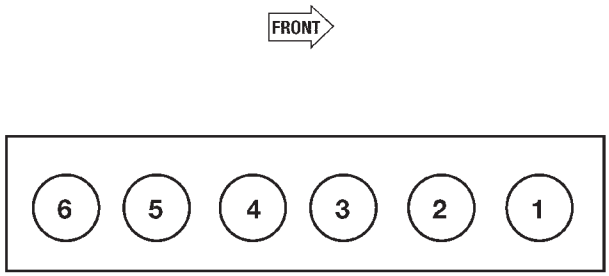
IGNITION TIMING

Ignition timing is not adjustable on any engine.

ENGINE FIRING ORDER—2.5L 4-CYLINDER ENGINE



ENGINE FIRING ORDER—4.0L 6-CYLINDER ENGINE



FIRING ORDER
1-5-3-6-2-4

COILS PAIRED:
CYLINDERS 1-6
CYLINDERS 2-5
CYLINDERS 3-4

80b6f045

SPECIFICATIONS (Continued)

SPARK PLUGS

ENGINE	PLUG TYPE	ELECTRODE GAP
2.5L	RC12ECC	0.89 mm (0.035 in.)
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

IGNITION COIL RESISTANCE—2.5L ENGINE

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

IGNITION COIL RESISTANCE—4.0L ENGINE

PRIMARY RESISTANCE 21-27°C (70-80°F)
0.71 - 0.88 Ohms

TORQUE CHART

DESCRIPTION	TORQUE
Camshaft Position Sensor–to–base bolts—4.0L	28 N·m (15 in. lbs.)
Crankshaft Position Sensor Bolts—with manual transmission	19 N·m (14 ft. lbs.)
Crankshaft Position Sensor Nuts—2.5L with auto.trans.	19 N·m (14 ft. lbs.)
Crankshaft Position Sensor Bolt—4.0L with auto. trans.	7 N·m (60 in. lbs.)
Distributor Hold Down Bolt—2.5L	23 N·m (17 ft. lbs.)
Distributor Cap Screws—2.5L	3 N·m (26 in. lbs.)
Ignition Coil Mounting (if tapped bolts are used)—2.5L	5 N·m (50 in. lbs.)
Ignition Coil Mounting (if nuts/bolts are used)—2.5L	11 N·m (100 in. lbs.)
Ignition Coil Rail Mounting Bolts—4.0L	29 N·m (250 in. lbs.)
Oil Pump Drive Hold-down Bolt—4.0L	23 N·m (17 ft. lbs.)
Spark Plugs (all engines)	41 N·m (30 ft. lbs.)

INSTRUMENT PANEL SYSTEMS

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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.

INSTRUMENT PANEL

DESCRIPTION

Modular instrument panel construction allows all of the gauges and controls to be serviced from the front of the panel. In addition, most of the instrument panel electrical or heating and air conditioning components can be accessed without complete instrument panel removal. If necessary, the instrument panel can be removed from the vehicle as an assembly.

Removal of the steering column opening cover and the knee blocker provides access to the steering column mounts, the steering column wiring, the gearshift interlock mechanism, the headlamp switch, and much of the instrument panel wiring. Removal of the glove box provides access to the fuseblock module, additional instrument panel wiring, and many of the heating and air conditioning components.

Removal of the instrument cluster bezel allows access to the cluster assembly. Removal of the cluster assembly allows access to the cluster illumination

DESCRIPTION AND OPERATION (Continued)

and indicator lamp bulbs, and more of the instrument panel wiring.

Removal of the instrument panel center bezel allows access to the radio, the heating and air conditioning controls, the power outlet or cigar lighter, and the accessory switches. The power outlet/cigar lighter is serviced only as a unit with the accessory switch bezel.

A bezel on each outboard end of the lower instrument panel is removed to service the instrument panel speakers. Removal of the complete instrument panel is required for service of the passenger side airbag module and most internal components of the heating and air conditioning system housing.

INSTRUMENT CLUSTER

DESCRIPTION

A single instrument cluster is offered on this model. This cluster is an electromechanical unit that utilizes integrated circuitry and information carried on the Chrysler Collision Detection (CCD) data bus network for control of all gauges and many of the indicator lamps. This cluster also incorporates a digital Vacuum Fluorescent Display (VFD) for the odometer/trip odometer display functions. Some variations of this cluster exist due to optional equipment and regulatory requirements.

The cluster includes the following analog gauges:

- Coolant temperature gauge
- Fuel gauge
- Oil pressure gauge
- Speedometer
- Tachometer
- Voltmeter.

This cluster also includes provisions for the following indicator lamps:

- Airbag indicator lamp
- Anti-lock Brake System (ABS) lamp
- Brake warning lamp
- Check gauges lamp
- Cruise-on indicator lamp
- Four-wheel drive indicator lamp
- Headlamp high beam indicator lamp
- Low fuel warning lamp
- Malfunction Indicator Lamp (MIL)
- Seat belt reminder lamp
- Sentry Key Immobilizer System (SKIS) indicator lamp
- Turn signal indicator lamps
- Upshift indicator lamp (manual transmission).

The instrument cluster circuitry has a self-diagnostic actuator test capability, which will test each of the 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 - Electrically Heated Systems for more information on the timer function of the instrument cluster.

The instrument cluster for this model is serviced only as a complete unit. If a cluster gauge or the cluster circuit board are faulty, the entire cluster must be replaced. The cluster lens, 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 respec-

DESCRIPTION AND OPERATION (Continued)

tive 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 lamp, headlamp high beam indicator lamp, and turn signal indicator lamps are hard wired. The seat belt reminder lamp is controlled by the instrument cluster programming. The Malfunction Indicator Lamp (MIL) is normally controlled by CCD data bus messages from the Powertrain Control Module (PCM); however, if the instrument cluster detects a loss of CCD data bus communication, the cluster will automatically turn the MIL on and display the message “NO BUS” in the odometer VFD until CCD data bus communication is restored. The instrument cluster circuitry uses CCD data bus messages from the 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). 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

An instrument panel cigar lighter is standard factory-installed 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, next to the ash receiver.

The cigar lighter base is serviced only as a part of the accessory switch bezel unit. If the 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.

OPERATION

The cigar lighter base or 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 Power Distribution Center (PDC) through the accessory relay only when the ignition switch is in the Accessory or On positions. Refer to **Accessory 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 of the cigar lighter 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

DESCRIPTION AND OPERATION (Continued)

the heating element is recessed and shielded around its circumference for safety.

ACCESSORY RELAY

DESCRIPTION

The accessory relay is an electromechanical device that switches fused battery current to the standard factory-installed cigar lighter when the ignition switch is turned to the Accessory or On positions. The accessory relay is located in a wire harness connector that is secured to the 100-way connector bracket under the driver side of the instrument panel, near the cowl side inner panel in the passenger compartment.

The accessory 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 accessory 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

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 CCD 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 fuseblock module. If OK, go to Step 6. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(6) Turn the ignition switch to the On position and check for battery voltage at the fused ignition switch output (run/start) fuse in the fuseblock module. 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.

DIAGNOSIS AND TESTING (Continued)

(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 fuseblock module 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).

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 Immobilizer 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).

(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.

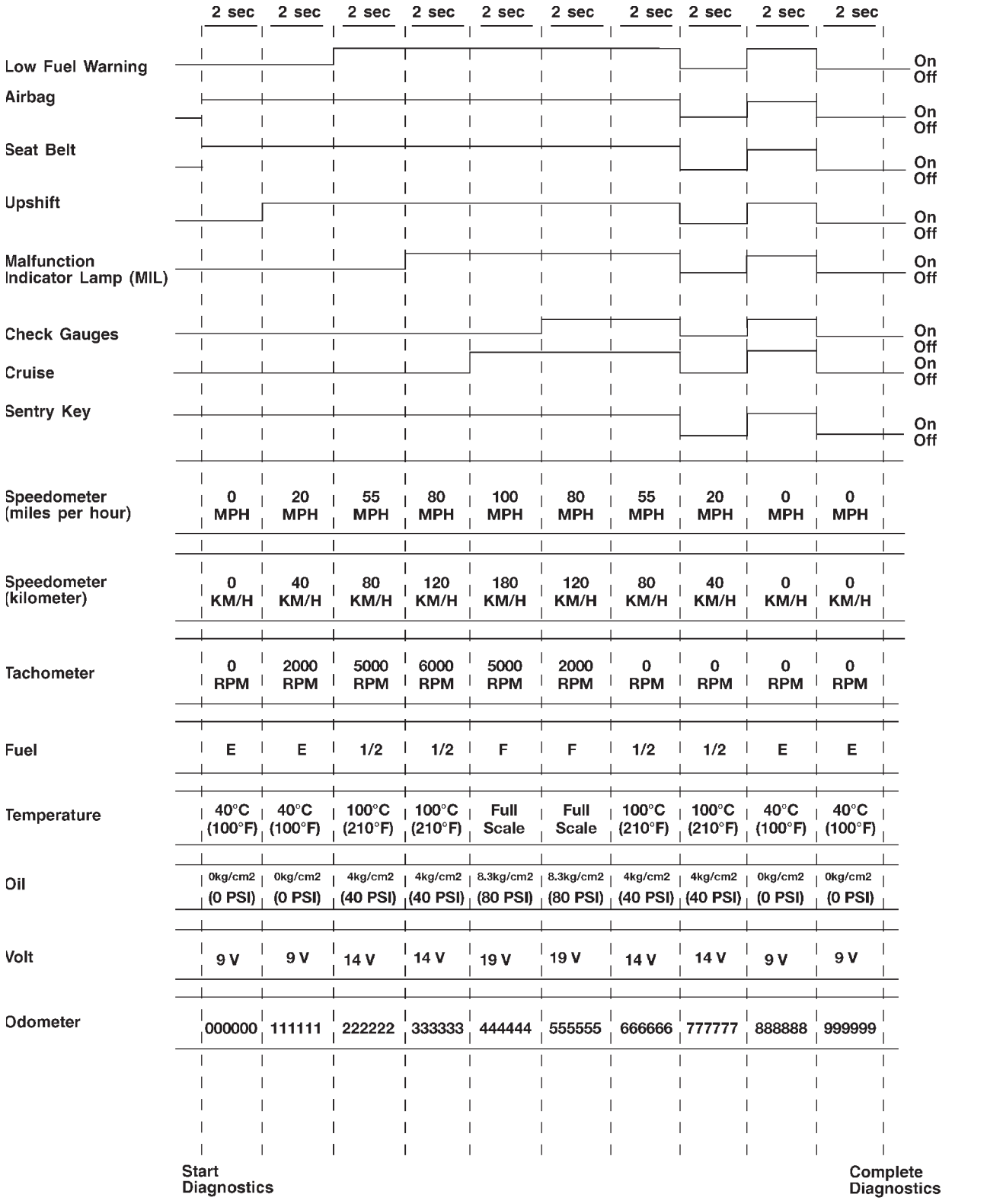
WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL 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 fuseblock module. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

DIAGNOSIS AND TESTING (Continued)



Note: 1.5 seconds after completing test, all pointers should return to pointer stops and odometer should be turned off.

80bdbd90

Fig. 1 Instrument Cluster Actuator Test

DIAGNOSIS AND TESTING (Continued)

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) fuse in the fuseblock module. 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 while driving, refer to **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 fuseblock module. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) fuse in the fuseblock module. 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.

DIAGNOSIS AND TESTING (Continued)

CLUSTER ILLUMINATION LAMP

The diagnosis found here addresses an inoperative instrument cluster illumination lamp condition. If the problem being diagnosed includes inoperative exterior lighting controlled by the headlamp switch, that system needs to be repaired first. If the exterior lamps controlled by the headlamp switch are inoperative, refer to **Headlamp Diagnosis** in the Diagnosis and Testing section of Group 8L - Lamps for diagnosis. If no exterior lighting system problems are found, the following procedure will help locate a short or open in the cluster illumination lamp circuit. If the problem being diagnosed involves a lack of dimming control for the odometer/trip odometer Vacuum Fluorescent Display (VFD), but all of the other cluster illumination lamps can be dimmed, repair the open headlamp switch output circuit input to the instrument cluster. For complete circuit diagrams, refer to **Instrument Cluster** in the Contents of Group 8W - Wiring Diagrams.

(1) Check the panel lamps dimmer fuse in the fuseblock module. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the park lamps on with the headlamp switch. Rotate the headlamp switch knob counterclockwise to just before the interior lamps detent. Check for battery voltage at the panel lamps dimmer fuse in the fuseblock module. Rotate the headlamp switch knob clockwise while observing the test voltmeter. The reading should go from battery voltage to zero volts. If OK, go to Step 3. If not OK, repair the open panel lamps dimmer switch signal circuit to the headlamp switch as required. If the circuit tests OK, refer to **Headlamp Diagnosis** in the Diagnosis and Testing section of Group 8L - Lamps to diagnose the headlamp switch.

(3) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Turn the headlamp switch off. Remove the panel lamps dimmer fuse from the fuseblock module. Probe the fused panel lamps dimmer switch signal circuit cavity of the instrument cluster wire harness connector A. Check for continuity to a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the shorted fused panel lamps dimmer switch signal circuit as required.

(4) Install the panel lamps dimmer fuse in the fuseblock module. Connect the battery negative cable. Turn the park lamps on with the headlamp switch. Rotate the headlamp switch knob counterclockwise to just before the interior lamps detent. Check for battery voltage at the fused panel lamps dimmer switch signal circuit cavity of the instrument cluster wire harness connector A. If OK, replace the faulty cluster illumination lamp bulb(s) and bulb holder(s). If not OK, repair the open fused panel lamps dimmer switch signal circuit as required.

FOUR-WHEEL DRIVE INDICATOR LAMP

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** 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 Group 8W - Wiring Diagrams.

(1) Check the fused ignition switch output (run/start) fuse in the fuseblock module. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) fuse in the fuseblock module. 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 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

DIAGNOSIS AND TESTING (Continued)

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.

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.

ACCESSORY RELAY

The accessory relay (Fig. 2) is located in a wire harness connector that is secured to the 100-way connector bracket under the driver side of the instrument panel, near the cowl side inner 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 accessory relay from its wire harness connector. Refer to **Accessory 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.

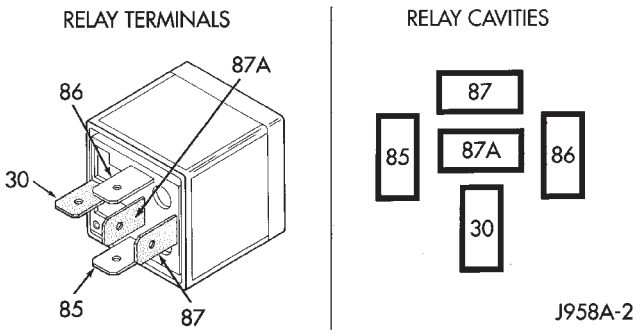
RELAY CIRCUIT TEST

(1) The relay common feed terminal (30) 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 Power Distribution Center (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 cigar lighter when the relay is energized by the ignition switch. There should be continuity between the accessory relay wire harness connector cavity for relay terminal 87 and the accessory relay output circuit cavity in the cigar lighter wire harness connector at all times. If OK, go to Step 4. If not OK,

DIAGNOSIS AND TESTING (Continued)



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 2 Accessory Relay

repair the open accessory 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. The accessory relay wire harness connector cavity for this terminal should have continuity to ground at all times. If OK, go to Step 5. If not OK, repair the open ground circuit to ground as required.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. It receives battery feed to energize the accessory 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 of the accessory relay wire harness connector. If not OK, repair the open fused ignition switch output (acc/run) circuit to the ignition 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 accessory relay output circuit cavity of the cigar lighter wire harness connector. If OK, replace the faulty accessory switch bezel unit. If not OK, refer to **Accessory Relay** in the Diagnosis and Testing section of this group for further diagnosis.

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 knob and shaft from the headlamp switch. Refer to **Headlamp Switch** in the Removal and Installation section of this group for the procedures.

(4) Remove the two screws that secure the steering column opening cover to the instrument panel (Fig. 3).

REMOVAL AND INSTALLATION (Continued)

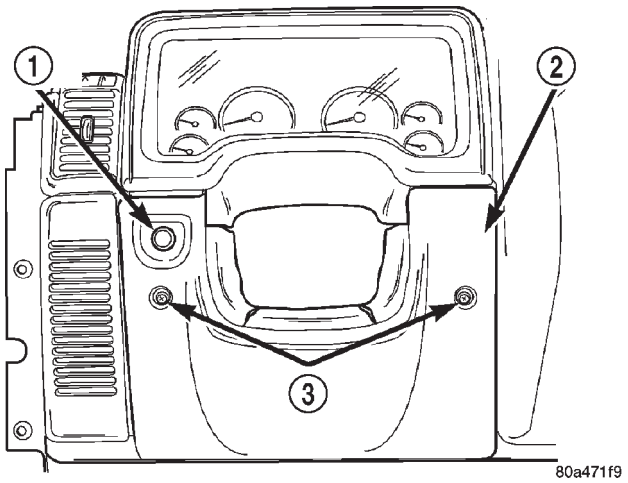


Fig. 3 Steering Column Opening Cover Remove/ Install

1 – HEADLAMP SWITCH KNOB
2 – STEERING COLUMN COVER
3 – MOUNTING SCREWS

(5) Pull the upper edge of the steering column opening cover straight back and down away from the instrument panel as far as possible.

(6) Rock the lower edge of the steering column opening cover rearward to disengage the hinge hook formations on the lower edge of the cover from the hinge pins on the lower edge of the instrument panel.

(7) Remove the steering column opening cover from the instrument panel.

INSTALLATION

(1) Position the steering column opening cover to the instrument panel.

(2) Engage the hinge hook formations on the lower edge of the steering column opening cover with the hinge pins on the lower edge of the instrument panel.

(3) Tilt the upper edge of the steering column opening cover up into position onto the instrument panel.

(4) Install and tighten the two screws that secure the steering column opening cover to the instrument panel. 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.

REMOVAL

(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 four screws that secure the knee blocker to the instrument panel (Fig. 4).

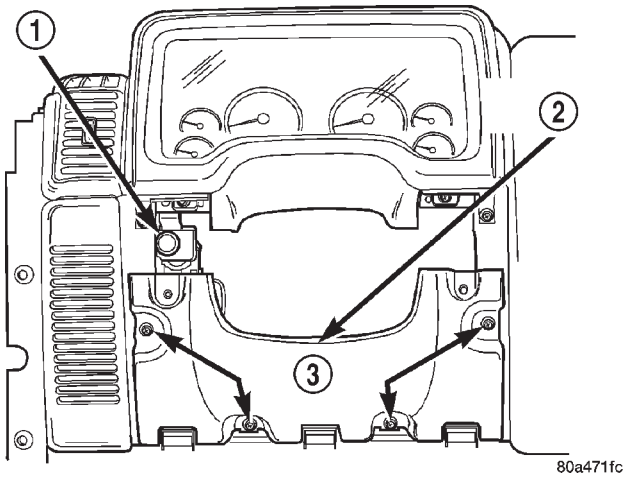


Fig. 4 Knee Blocker Remove/Install

1 – HEADLAMP SWITCH
2 – KNEE BLOCKER
3 – MOUNTING SCREWS

(4) 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.).

(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.

REMOVAL AND INSTALLATION (Continued)

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) Pull the headlamp switch control knob out to the On position stop.

(3) Reach up under the instrument panel outboard of the steering column to access and depress the headlamp switch control knob and shaft release button on the top of the switch body (Fig. 5).

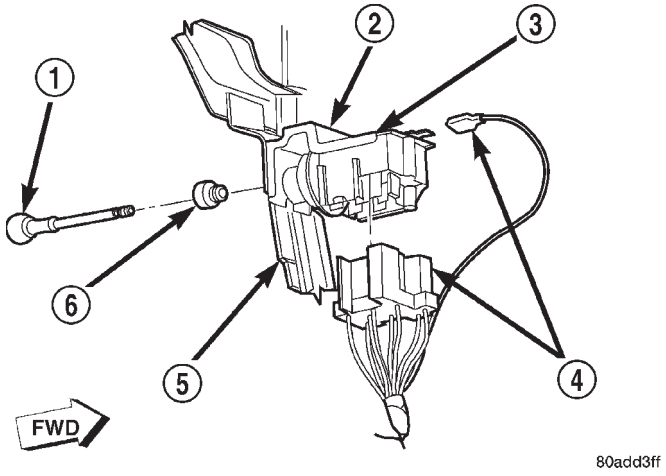


Fig. 5 Headlamp Switch Remove/Install

1 – KNOB AND SHAFT
2 – HEADLAMP SWITCH
3 – RELEASE BUTTON
4 – WIRE HARNESS CONNECTORS
5 – BRACKET
6 – SPANNER NUT

(4) While holding the release button depressed, pull the headlamp switch control knob and shaft unit out of the headlamp switch.

(5) Remove the knee blocker from the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of this group for the procedures.

(6) Remove the spanner nut that secures the headlamp switch to the instrument panel mounting bracket.

(7) Pull the headlamp switch away from the instrument panel mounting bracket 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.

(2) Reconnect the two instrument panel wire harness connectors to the headlamp switch.

(3) Position the headlamp switch behind the mounting bracket on the instrument panel.

(4) Install and tighten the spanner nut that secures the headlamp switch to the instrument panel mounting bracket. Tighten the nut to 2.7 N·m (24 in. lbs.).

(5) Install the knee blocker onto the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of this group for the procedures.

(6) Insert the shaft of the headlamp switch control knob and shaft unit through the opening in the steering column opening cover and into the headlamp switch.

(7) Push the headlamp switch control knob and shaft unit all the way into the headlamp switch body.

(8) Reconnect the battery negative cable.

INSTRUMENT PANEL TOP COVER

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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 top cover up and away from the instrument panel far enough to disengage the five snap clip retainers from their receptacles in the instrument panel (Fig. 6).

REMOVAL AND INSTALLATION (Continued)

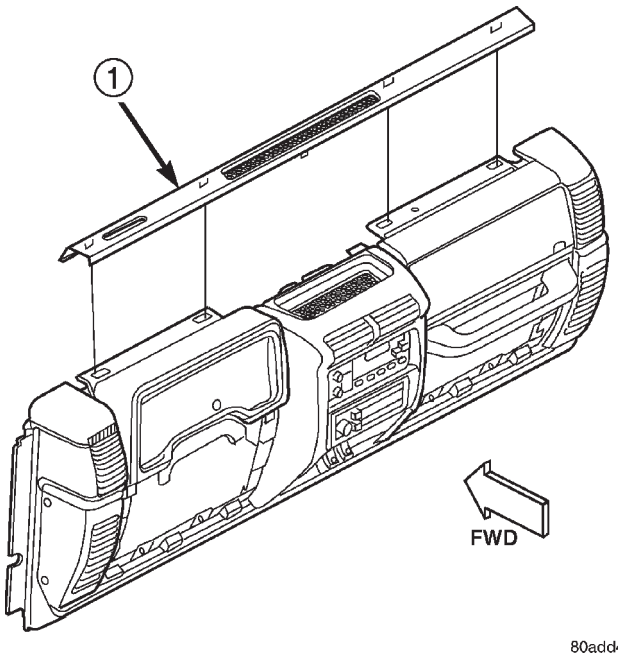


Fig. 6 Instrument Panel Top Cover Remove/Install
1 – INSTRUMENT PANEL TOP COVER

(3) Remove the top cover from the instrument panel.

INSTALLATION

(1) Position the top cover onto the instrument panel.

(2) Align the snap clips on the top cover with the snap clip receptacles in the instrument panel.

(3) Press firmly downward on the top cover over each of the snap clip locations until each of the snap clips is fully seated in their receptacles in the instrument panel.

(4) 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 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 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 two screws that secure the lower mounting tabs of the cluster bezel to the instrument panel (Fig. 7).

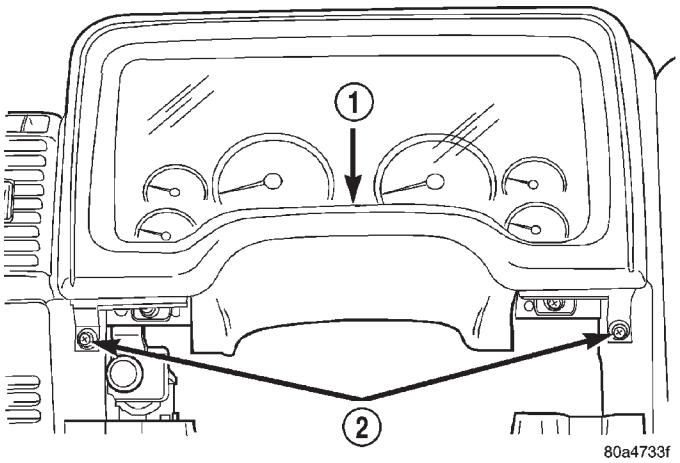


Fig. 7 Cluster Bezel Lower Screws Remove/Install
1 – CLUSTER BEZEL
2 – LOWER MOUNTING SCREWS

(5) Remove the three screws that secure the upper mounting flange of the cluster bezel to the instrument panel (Fig. 8).

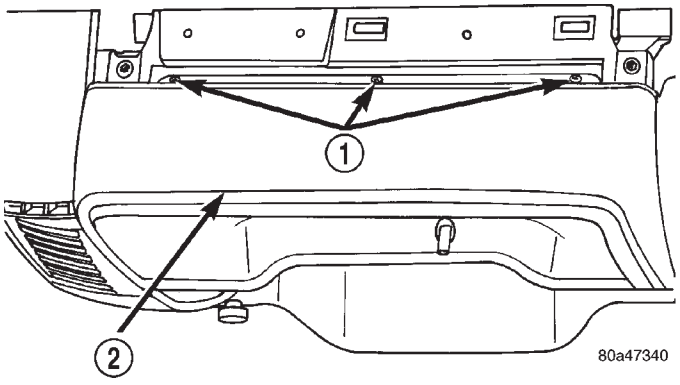


Fig. 8 Cluster Bezel Upper Screws Remove/Install
1 – UPPER MOUNTING SCREWS
2 – CLUSTER BEZEL

(6) Remove the cluster bezel from the instrument panel.

INSTALLATION

(1) Position the cluster bezel to the instrument panel.

REMOVAL AND INSTALLATION (Continued)

(2) Install and tighten the three screws that secure the upper mounting flange of the cluster bezel to the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install and tighten the two screws that secure the lower mounting tabs of the cluster bezel to the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(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) 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.

(6) Reconnect the battery negative cable.

INSTRUMENT CLUSTER

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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) Remove the four screws that secure the instrument cluster to the instrument panel (Fig. 9).

(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.

(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.

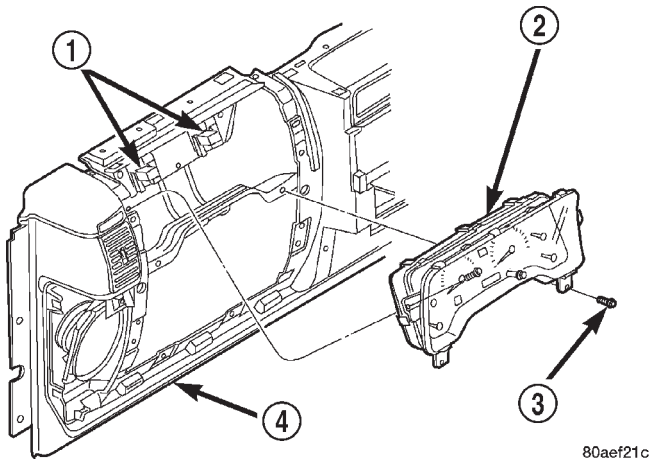


Fig. 9 Instrument Cluster Remove/Install

1 – SELF-DOCKING WIRE HARNESS CONNECTORS
2 – INSTRUMENT CLUSTER
3 – SCREW
4 – 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, and the instrument cluster housing rear cover. Following are the service procedures for the instrument cluster components.

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REMOVAL

CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp or indicator lamp bulb and

REMOVAL AND INSTALLATION (Continued)

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.

(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. 10).

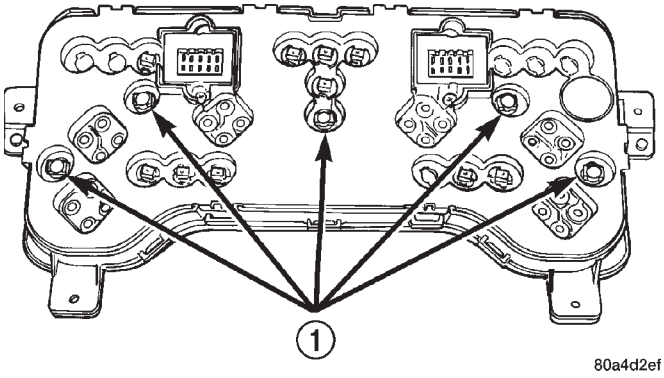


Fig. 10 Cluster Bulb Locations

1 – CLUSTER ILLUMINATION BULBS

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. 11).

(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.

(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. 11).

(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. 11).

(4) Gently pull the rear cover away from the back of the cluster housing.

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.

REMOVAL AND INSTALLATION (Continued)

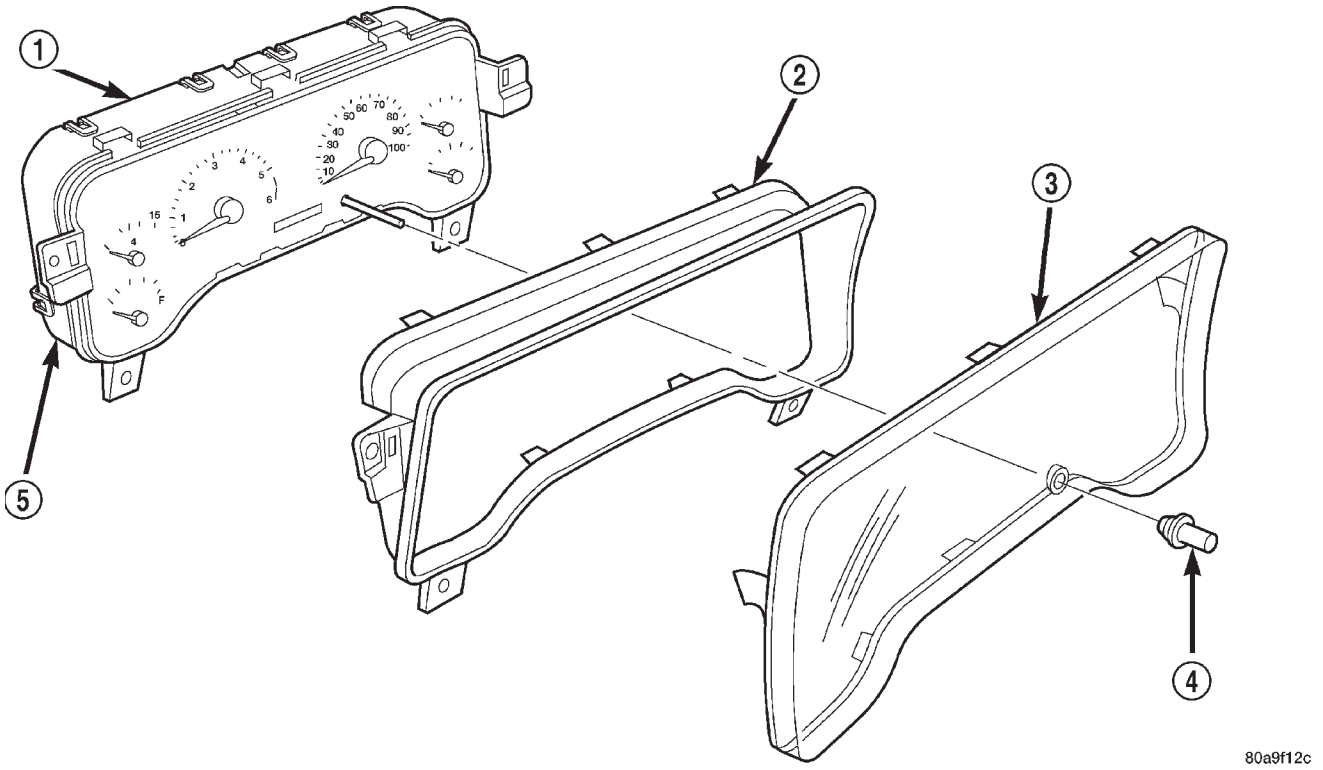


Fig. 11 Instrument Cluster Components

1 – CLUSTER REAR COVER
2 – CLUSTER HOOD AND MASK
3 – CLUSTER LENS
4 – ODOMETER RESET KNOB BOOT
5 – INSTRUMENT CLUSTER HOUSING

(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.

INSTRUMENT PANEL CENTER BEZEL

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REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) 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.

(3) Remove the ash receiver from the ash receiver housing in the lower portion of the instrument panel center bezel.

(4) Remove the one screw from the back of the ash receiver housing that secures the lower portion of the center bezel to the instrument panel (Fig. 12).

(5) Remove the two screws that secure the top of the center bezel to the top of the instrument panel.

(6) Using a trim stick or another suitable wide flat-bladed tool, gently pry the lower edge of the center bezel away from the instrument panel.

(7) Pull the lower edge of the center bezel away from the instrument panel far enough to disengage the four snap clip retainers that secure it from the receptacles in the instrument panel.

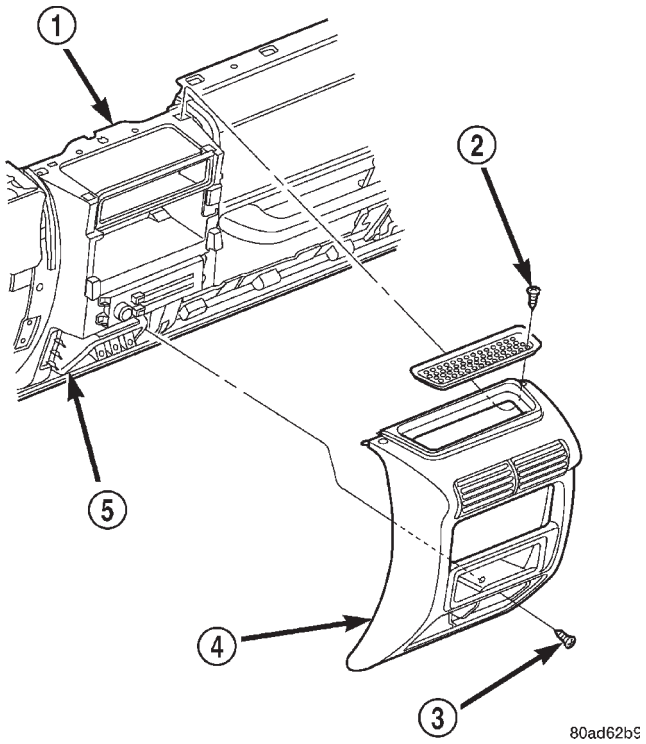


Fig. 12 Instrument Panel Center Bezel Remove/ Install

1 – INSTRUMENT PANEL
2 – SCREW
3 – SCREW
4 – CENTER BEZEL
5 – ACCESSORY SWITCH BEZEL

(8) 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 snap clips is fully engaged in its receptacle on the instrument panel.

(4) Install and tighten the two screws that secure the top of the center bezel to the top of the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

Install and tighten the one screw into the back of the ash receiver housing that secures the lower portion of the center bezel to the instrument panel. Tighten the screw to 2.2 N·m (20 in. lbs.).

(5) Install the ash receiver into the ash receiver housing in the lower portion of the instrument panel center bezel.

REMOVAL AND INSTALLATION (Continued)

(6) 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.

(7) Reconnect the battery negative cable.

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 four screws that secure the accessory switch bezel to the instrument panel (Fig. 13).

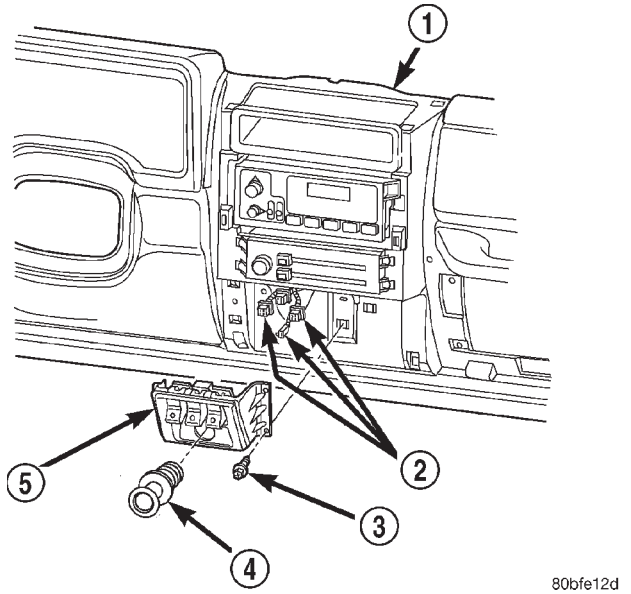


Fig. 13 Instrument Panel Accessory Switch Bezel Remove/Install

1 – INSTRUMENT PANEL
2 – WIRE HARNESS CONNECTORS
3 – SCREW
4 – CIGAR LIGHTER
5 – ACCESSORY SWITCH BEZEL

(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 and the cigar lighter/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 and the cigar lighter/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 four 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.

ACCESSORY 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) Reach up under the instrument panel outboard of the steering column to access the accessory relay and the accessory relay wire harness connector, which is secured to the 100-way wire harness connector mounting bracket (Fig. 14).

(3) Disconnect the accessory relay from the accessory relay wire harness connector.

(4) Remove the accessory relay from under the instrument panel.

REMOVAL AND INSTALLATION (Continued)

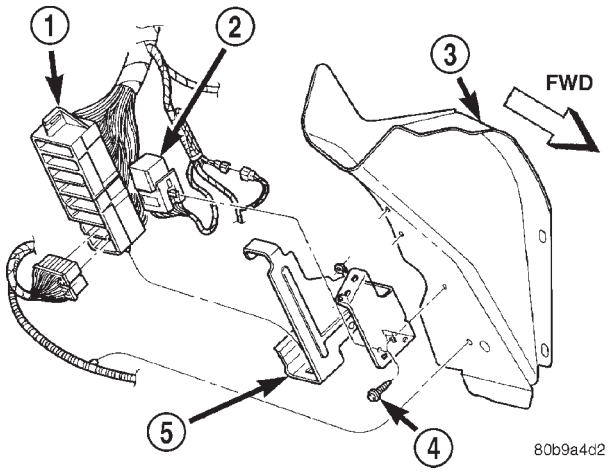


Fig. 14 Accessory Relay Remove/Install

1 – 100–WAY CONNECTOR
2 – ACCESSORY RELAY
3 – LEFT STEERING COLUMN SUPPORT
4 – SCREW
5 – MOUNTING BRACKET

INSTALLATION

(1) Position the accessory relay to the accessory relay wire harness connector under the instrument panel.

(2) Align the terminals of the accessory relay with the cavities in the accessory relay wire harness connector.

(3) Push on the accessory relay case firmly and evenly until all of the relay terminals are fully seated within the cavities of the accessory relay wire harness connector.

(4) 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.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Release the glove box latch and open the glove box door.

(3) While supporting the glove box door with one hand, grasp the check strap as close to the glove box door as possible and slide the rolled end of the check strap out of the slot in the edge of the door (Fig. 15).

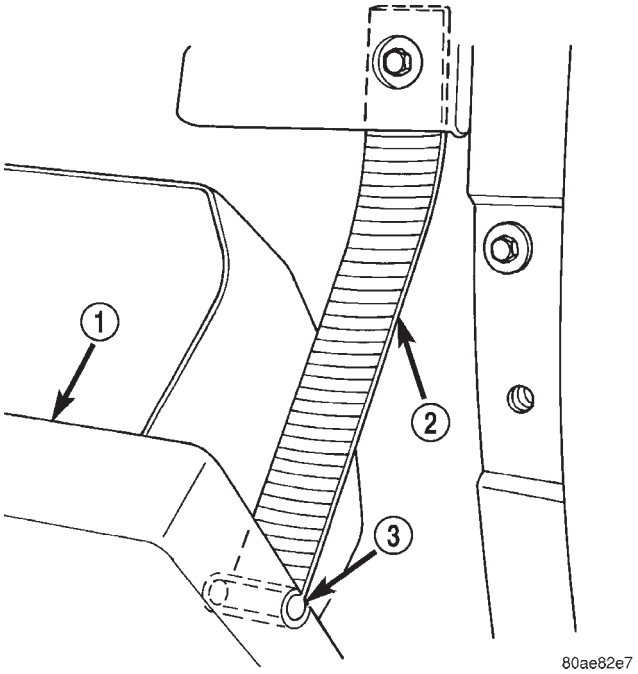


Fig. 15 Glove Box Remove/Install

1 – GLOVE BOX DOOR
2 – CHECK STRAP
3 – SLOT

(4) Lower the glove box door far enough to disengage the hinge hook formations on the lower edge of the door from the hinge pins on the lower edge of the instrument panel.

(5) Remove the glove box from the instrument panel.

INSTALLATION

(1) Position the glove box to the instrument panel.

(2) Engage the hinge hook formations on the lower edge of the glove box door with the hinge pins on the lower edge of the instrument panel.

(3) Tilt the upper edge of the glove box door up toward the instrument panel far enough to engage the check strap with the door.

(4) While supporting the glove box door with one hand, grasp the check strap as close to the glove box door as possible and slide the rolled end of the check strap into the slot in the edge of the door.

(5) Close the glove box door.

(6) Reconnect the battery negative cable.

GLOVE BOX COMPONENTS

Service of all of the glove box components (Fig. 16) must be performed with the glove box removed from the instrument panel.

REMOVAL AND INSTALLATION (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.

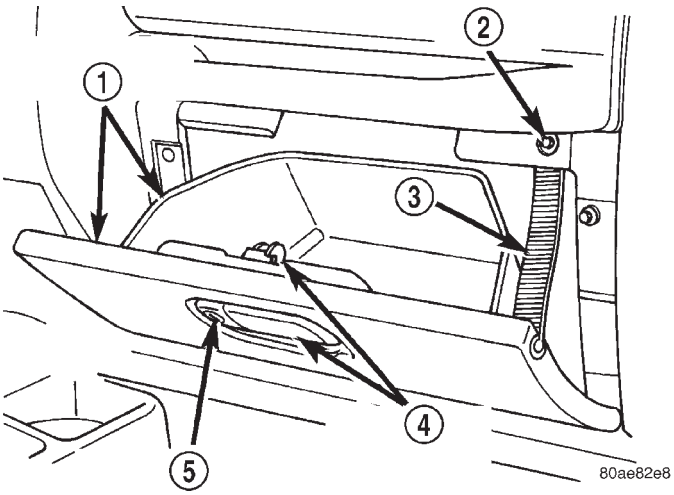


Fig. 16 Glove Box Components

1 – GLOVE BOX DOOR AND BIN
2 – SCREW
3 – CHECK STRAP
4 – LATCH AND HANDLE
5 – LOCK CYLINDER

REMOVAL

GLOVE BOX DOOR AND BIN

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(3) Remove the screws that secure the glove box latch and handle to the glove box door.

(4) Remove the screws that secure the inner door and bin unit to the outer glove box door.

(5) Remove the inner door and bin unit from the outer glove box door.

GLOVE BOX CHECK STRAP

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(3) Remove the screw that secures the glove box check strap to the instrument panel above the glove box opening.

(4) Remove the check strap from the instrument panel.

GLOVE BOX LATCH AND HANDLE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(3) Remove the four screws that secure the glove box latch and handle to the glove box door from the inside of the glove box.

(4) Remove the latch and handle from the glove box door.

GLOVE BOX LOCK CYLINDER

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(3) Remove the glove box latch and handle from the glove box. Refer to **Glove Box Components - Glove Box Latch and Handle** in the Removal and Installation section of this group for the procedures.

(4) Insert the key into the glove box lock cylinder.

(5) Insert a small screwdriver into the retaining tumbler release slot and depress the retaining tumbler (Fig. 17).

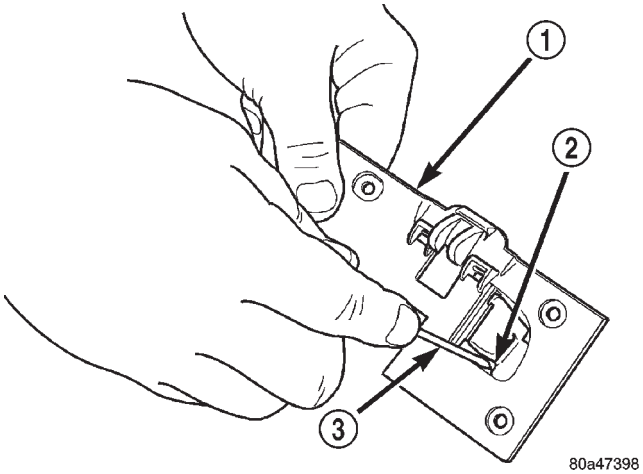


Fig. 17 Glove Box Lock Cylinder Remove/Install

1 – GLOVE BOX LATCH
2 – RELEASE SLOT
3 – SMALL SCREWDRIVER

(6) Pull the lock cylinder out of the glove box latch handle by using a gentle twisting and pulling action on the key.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

GLOVE BOX DOOR AND BIN

(1) Position the inner door and bin unit onto the outer glove box door.

(2) Install and tighten the screws that secure the inner door and bin unit to the outer glove box door. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install and tighten the screws that secure the glove box latch and handle to the glove box door. Tighten the screws to 2.2 N·m (20 in. lbs.).

(4) Install the glove box onto the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(5) Reconnect and isolate the battery negative cable.

GLOVE BOX CHECK STRAP

(1) Position the check strap to the instrument panel.

(2) Install and tighten the screw that secures the glove box check strap to the instrument panel above the glove box opening. Tighten the screw to 2.2 N·m (20 in. lbs.).

(3) Install the glove box onto the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(4) Reconnect the battery negative cable.

GLOVE BOX LATCH AND HANDLE

(1) Position the latch and handle onto the glove box door.

(2) Install and tighten the four screws that secure the glove box latch and handle to the glove box door from the inside of the glove box. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the glove box onto the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(4) Reconnect the battery negative cable.

GLOVE BOX LOCK CYLINDER

(1) Insert the key into the glove box lock cylinder.

(2) Push the lock cylinder into the glove box latch handle by using a gentle twisting and pushing action on the key.

(3) Install the glove box latch and handle onto the glove box. Refer to **Glove Box Components - Glove Box Latch and Handle** in the Removal and Installation section of this group for the procedures.

(4) Install the glove box onto the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(5) Reconnect the battery negative cable.

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) Remove the glove box from the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(3) Remove the two screws that secure the latch striker to the grab handle bezel at the top of the instrument panel glove box opening (Fig. 18).

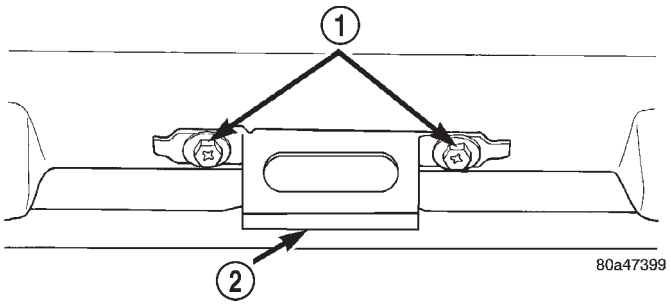


Fig. 18 Glove Box Latch Striker Remove/Install

1 – MOUNTING SCREWS
2 – STRIKER

(4) Remove the latch striker from the instrument panel.

INSTALLATION

(1) Position the latch striker onto the instrument panel.

(2) Install and tighten the two screws that secure the latch striker to the grab handle bezel at the top of the instrument panel glove box opening. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the glove box onto the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(4) Reconnect the battery negative cable.

REMOVAL AND INSTALLATION (Continued)

INSTRUMENT PANEL GRAB HANDLE

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 glove box from the instrument panel. Refer to **Glove Box** in Removal and Installation section of this group for the procedures.

(3) Reach through and above the glove box opening to access and remove the two nuts that secure the stud on each end of the grab handle to the instrument panel (Fig. 19). Discard the used grab handle mounting nuts.

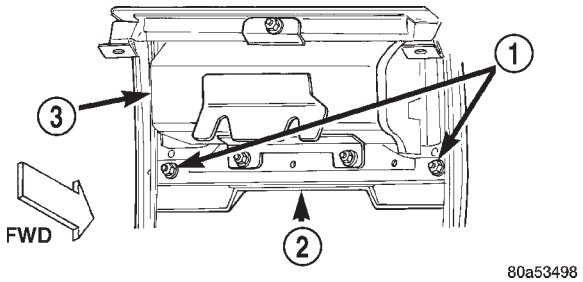


Fig. 19 Instrument Panel Grab Handle Remove/Install

1 – NUTS
2 – GLOVE BOX OPENING
3 – PASSENGER'S AIRBAG MODULE

(4) Remove the grab handle from the instrument panel.

INSTALLATION

(1) Position the grab handle onto the instrument panel.

(2) Reach through and above the glove box opening to install and tighten the two nuts that secure the stud on each end of the grab handle to the instrument panel. Tighten the nuts to 5.6 N·m (50 in. lbs.).

(3) Install the glove box onto the instrument panel. Refer to **Glove Box** in Removal and Installation section of this group for the procedures.

(4) Reconnect the battery negative cable.

INSTRUMENT PANEL GRAB HANDLE 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 grab handle from the instrument panel. Refer to **Instrument Panel Grab Handle** in the Removal and Installation section of this group for the procedures.

(3) Remove the glove box latch striker from the instrument panel. Refer to **Glove Box Latch Striker** in the Removal and Installation section of this group for the procedures.

(4) Remove the two screws that secure the grab handle bezel to the instrument panel (Fig. 20).

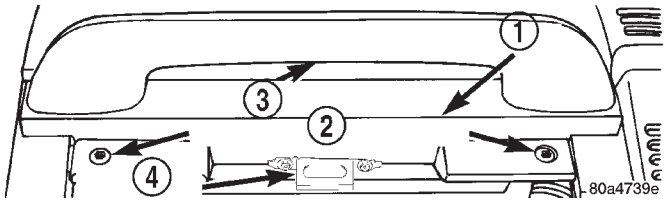


Fig. 20 Instrument Panel Grab Handle Bezel Remove/Install

1 – BEZEL
2 – MOUNTING SCREWS
3 – GRAB HANDLE
4 – STRIKER

(5) Remove the grab handle bezel from the instrument panel.

INSTALLATION

(1) Position the grab handle bezel onto the instrument panel.

(2) Install and tighten the two screws that secure the grab handle bezel to the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the glove box latch striker onto the instrument panel. Refer to **Glove Box Latch Striker** in the Removal and Installation section of this group for the procedures.

(4) Install the grab handle onto the instrument panel. Refer to **Instrument Panel Grab Handle** in

REMOVAL AND INSTALLATION (Continued)

the Removal and Installation section of this group for the procedures.

(5) 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 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 steering column from the vehicle, but do not remove the driver side airbag module, the steering wheel, or the switches from the steering column. Be certain that the steering wheel is locked and secured from rotation to prevent the loss of clockspring centering. Refer to **Steering Column** in the Removal and Installation section of Group 19 - Steering for the procedures.

(4) From under the driver side of the instrument panel, perform the following:

(a) Disconnect the instrument panel wire harness connectors from the 100-way wire harness connector near the left cowl side inner panel.

(b) Disconnect the side window demister hose at the heater-A/C housing demister/defroster duct (driver side).

(5) Remove the glove box from the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(6) Reach through the instrument panel glove box opening to perform the following:

(a) Disconnect the two halves of the heater-A/C system vacuum harness connector.

(b) Disconnect the instrument panel wire harness connector from the heater-A/C system wire harness connector.

(c) Disconnect the instrument panel wire harness connector from the passenger side airbag module wire harness connector.

(d) Disconnect the side window demister hose at the heater-A/C housing demister/defroster duct (passenger side).

(e) Disconnect the two halves of the radio antenna coaxial cable connector.

(f) Disconnect the two instrument panel wire harness connectors from the passenger airbag on/off switch wire harness connectors.

(g) Disengage the passenger side airbag on/off switch wire harness from the retainer clip on the plenum bracket that supports the heater-A/C housing just inboard of the fuseblock module.

(h) Remove the two nuts that secure the lower passenger side airbag module bracket to the studs on the dash panel (Fig. 21).

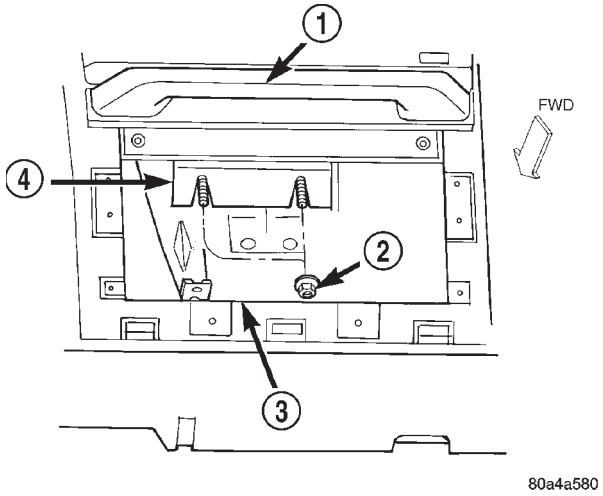


Fig. 21 Passenger Airbag Module Lower Bracket Nuts Remove/Install

1 – GRAB HANDLE
2 – NUT
3 – GLOVE BOX OPENING
4 – LOWER AIRBAG BRACKET

(7) 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.

(8) Remove the three screws that secure each end of the instrument panel to the door hinge pillars (Fig. 22).

(9) Remove the four nuts that secure the top of the instrument panel to the studs on the top of the dash panel.

(10) With the aid of an assistant, lift the instrument panel assembly off of the dash panel studs and remove it from the vehicle.

INSTALLATION

(1) With the aid of an assistant, install the instrument panel assembly onto the dash panel studs in the vehicle.

REMOVAL AND INSTALLATION (Continued)

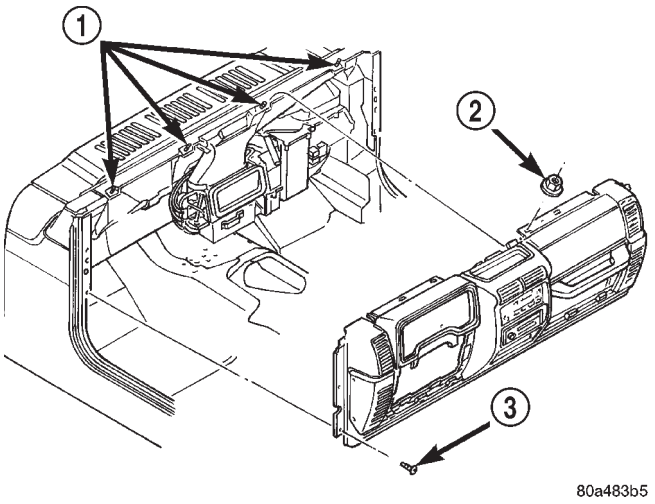


Fig. 22 Instrument Panel Assembly Remove/Install

1 – STUDS
2 – NUT
3 – SCREW

(2) Install and tighten the four nuts that secure the top of the instrument panel to the studs on the top of the dash panel. Tighten the nuts to 12 N·m (105 in. lbs.).

(3) Install and tighten the three screws that secure each end of the instrument panel to the door hinge pillars. Tighten the screws to 12 N·m (105 in. lbs.).

(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) Reach through the instrument panel glove box opening to perform the following:

(a) Install and tighten the two nuts that secure the lower passenger side airbag module bracket to the studs on the dash panel. Tighten the nuts to 28 N·m (250 in. lbs.).

(b) Engage the passenger side airbag on/off switch wire harness in the retainer clip on the plenum bracket that supports the heater-A/C housing just inboard of the fuseblock module.

(c) Reconnect the two instrument panel wire harness connectors to the passenger airbag on/off switch wire harness connectors.

(d) Reconnect the two halves of the radio antenna coaxial cable connector.

(e) Reconnect the side window demister hose to the heater-A/C housing demister/defroster duct (passenger side).

(f) Reconnect the instrument panel wire harness connector to the passenger side airbag module wire harness connector.

(g) Reconnect the instrument panel wire harness connector to the heater-A/C system wire harness connector.

(h) Reconnect the two halves of the heater-A/C system vacuum harness connector.

(6) Install the glove box onto the instrument panel. Refer to **Glove Box** in the Removal and Installation section of this group for the procedures.

(7) From under the driver side of the instrument panel, perform the following:

(a) Reconnect the side window demister hose to the heater-A/C housing demister/defroster duct (driver side).

(b) Reconnect the instrument panel wire harness connectors to the 100-way wire harness connector near the left cowl side inner panel.

(8) Install the steering column into the vehicle. Be certain that the steering wheel is locked and secured from rotation to prevent the loss of clockspring centering. Refer to **Steering Column** in the Removal and Installation section of Group 19 - Steering for the procedures.

(9) Install the knee blocker onto the instrument panel. Refer to **Knee Blocker** in the Removal and Installation section of this group for the procedures.

(10) Reconnect the battery negative cable.

INSTRUMENT PANEL BASE TRIM

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 cluster from the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(3) Remove the accessory switch bezel from the instrument panel. Refer to **Instrument Panel Accessory Switch Bezel** in the Removal and Installation section of this group for the procedures.

(4) Remove the grab handle bezel from the instrument panel. Refer to **Instrument Panel Grab Handle Bezel** in the Removal and Installation section of this group for the procedures.

(5) Remove the speaker bezels from the instrument panel. Refer to **Instrument Panel Speakers** in the Removal and Installation section of Group 8F - Audio Systems for the procedures.

REMOVAL AND INSTALLATION (Continued)

(6) Remove the radio from the instrument panel. Refer to **Radio** in the Removal and Installation section of Group 8F - Audio Systems for the procedures.

(7) Remove the heater-A/C control from the instrument panel. Refer to **Heater-A/C Control** in the Removal and Installation section of Group 24 - Heating and Air Conditioning Systems for the procedures.

(8) Remove the outboard heater-A/C panel outlets from the instrument panel. Refer to **Ducts and Outlets** in the Removal and Installation section of Group 24 - Heating and Air Conditioning Systems for the procedures.

(9) Remove the instrument panel assembly from the vehicle. Refer to **Instrument Panel Assembly** in the Removal and Installation section of this group for the procedures.

(10) Place the instrument panel on a suitable work surface. Be certain to take the proper precautions to protect the instrument panel from any possible cosmetic damage.

(11) Remove the passenger side airbag door from the instrument panel. Refer to **Passenger Side Airbag Door** in the Removal and Installation section of Group 8M - Passive Restraint Systems for the procedures.

(12) Remove the two screws that secure the 16-way data link wire harness connector to the instrument panel.

(13) Remove the screws around the perimeter that secure the base trim to the instrument panel.

(14) Remove the base trim from the instrument panel.

INSTALLATION

(1) Position the base trim onto the instrument panel.

(2) Install and tighten the screws around the perimeter that secure the base trim to the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install and tighten the two screws that secure the 16-way data link wire harness connector to the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(4) Install the passenger side airbag door onto the instrument panel. Refer to **Passenger Side Airbag Door** in the Removal and Installation section of Group 8M - Passive Restraint Systems for the procedures.

(5) Install the instrument panel assembly into the vehicle. Refer to **Instrument Panel Assembly** in the Removal and Installation section of this group for the procedures.

(6) Install the outboard heater-A/C panel outlets onto the instrument panel. Refer to **Ducts and Outlets** in the Removal and Installation section of Group 24 - Heating and Air Conditioning Systems for the procedures.

(7) Install the heater-A/C control onto the instrument panel. Refer to **Heater-A/C Control** in the Removal and Installation section of Group 24 - Heating and Air Conditioning Systems for the procedures.

(8) Install the radio onto the instrument panel. Refer to **Radio** in the Removal and Installation section of Group 8F - Audio Systems for the procedures.

(9) Install the speaker bezels onto the instrument panel. Refer to **Instrument Panel Speakers** in the Removal and Installation section of Group 8F - Audio Systems for the procedures.

(10) Install the grab handle bezel onto the instrument panel. Refer to **Instrument Panel Grab Handle Bezel** in the Removal and Installation section of this group for the procedures.

(11) Install the accessory switch bezel onto the instrument panel. Refer to **Instrument Panel Accessory Switch Bezel** in the Removal and Installation section of this group for the procedures.

(12) Install the instrument cluster onto the instrument panel. Refer to **Instrument Cluster** in the Removal and Installation section of this group for the procedures.

(13) Reconnect the battery negative cable.

INSTRUMENT PANEL SYSTEMS

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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.

REMOVAL

(1) Using a flat blade screwdriver or similar tool between the headlamp leveling switch and the steering column cover (Fig. 1). Gently pry the headlamp leveling switch out of the steering column cover.

(2) Disconnect the headlamp leveling switch electrical connector (Fig. 2) and remove the headlamp leveling switch.

INSTALLATION

(1) Connect the headlamp leveling switch electrical connector.

(2) Install the headlamp leveling switch into the steering column cover.

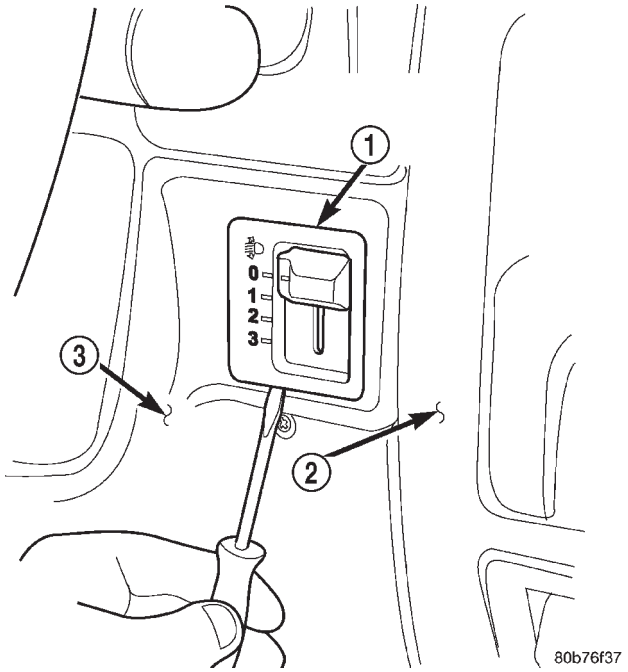


Fig. 1 Headlamp Leveling Switch

1 – HEADLAMP LEVELING SWITCH
2 – I/P CENTER BEZEL
3 – STEERING COLUMN COVER

REMOVAL AND INSTALLATION (Continued)

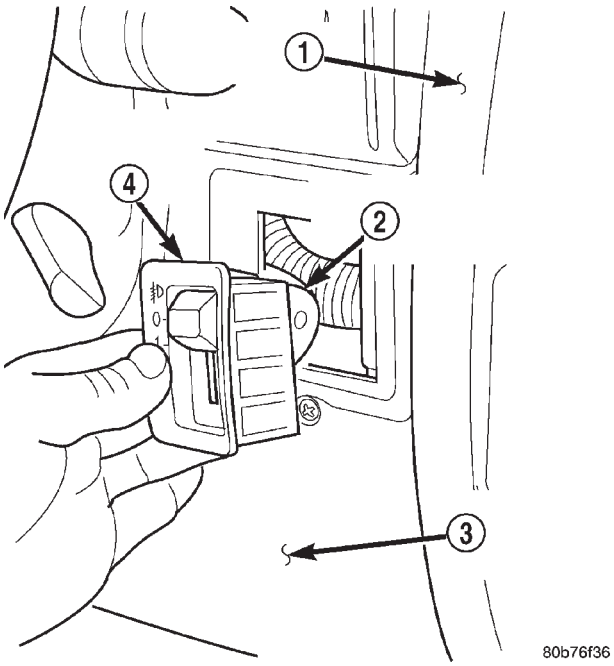


Fig. 2 Headlamp Leveling Switch Electrical Connector

1 – I/P CENTER BEZEL
2 – HEADLAMP LEVELING SWITCH ELECTRICAL CONNECTOR
3 – STEERING COLUMN COVER
4 – HEADLAMP LEVELING SWITCH

REAR FOG LAMP SWITCH

REMOVAL

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) Using a flat blade screwdriver or similar flat-bladed tool, gently pry the instrument panel top cover up and away from the instrument panel to release the snap clip retainers (Fig. 3).
(2) Remove the instrument panel top cover from the vehicle.
(3) Remove the ash receiver from the center bezel.
(4) Remove the screw located in back of the ash receiver housing that secures the center bezel to the lower instrument panel (Fig. 4).
(5) Remove the screws that secure the center bezel to the top of the instrument panel (Fig. 5).
(6) Remove the instrument panel center bezel.

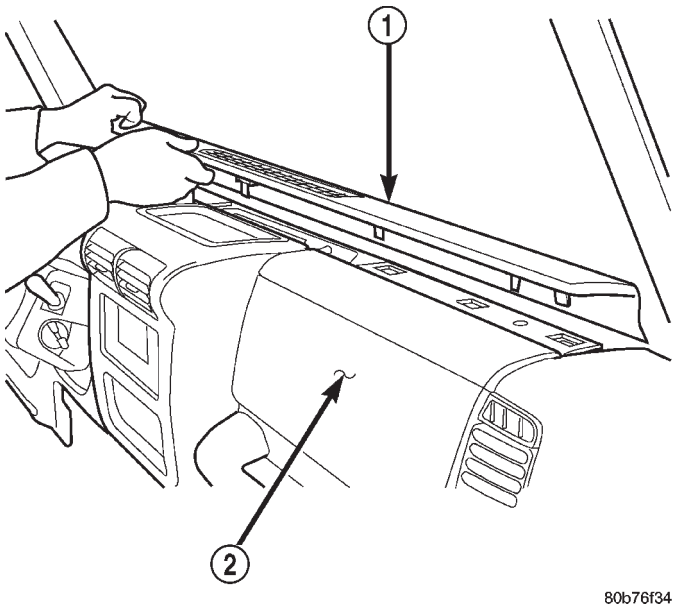


Fig. 3 Instrument Panel Top Cover

1 – INSTRUMENT PANEL TOP COVER
2 – INSTRUMENT PANEL

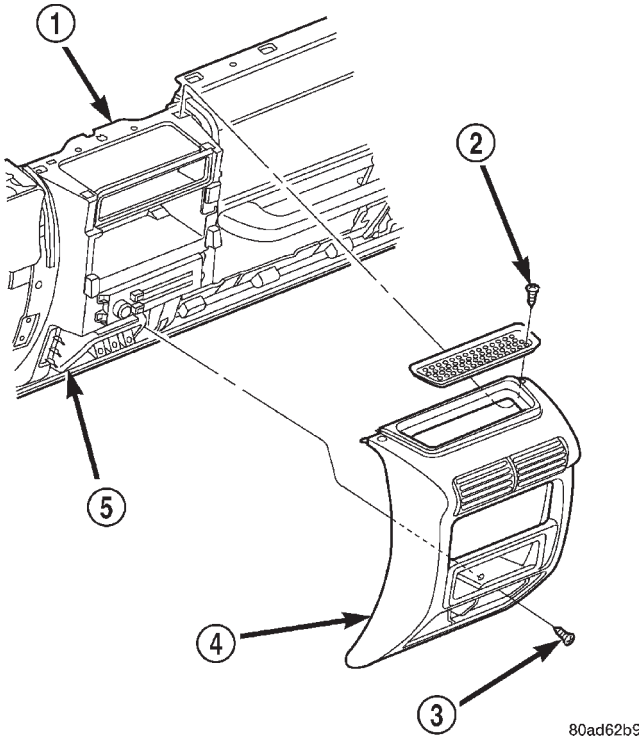


Fig. 4 Center Bezel Lower Screw

1 – INSTRUMENT PANEL
2 – SCREW
3 – SCREW
4 – CENTER BEZEL
5 – ACCESSORY SWITCH BEZEL

REMOVAL AND INSTALLATION (Continued)

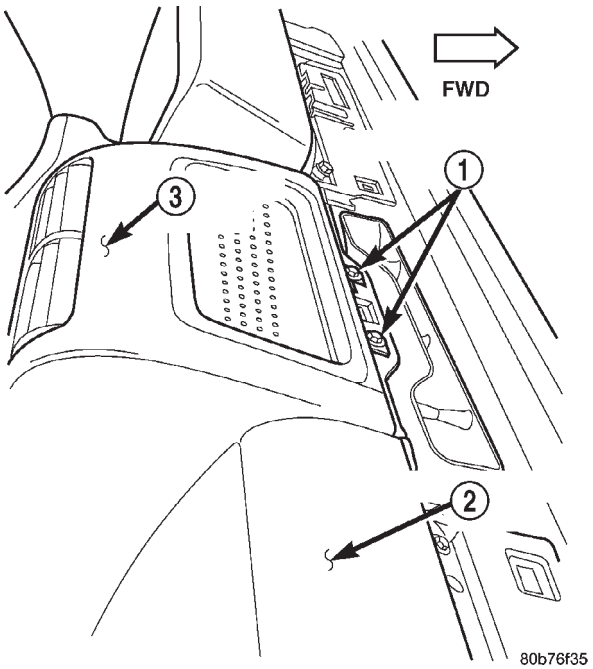


Fig. 5 Center Bezel Mounting Screws

1 – I/P CENTER BEZEL MOUNTING SCREWS
2 – INSTRUMENT PANEL
3 – I/P CENTER BEZEL

(7) Remove the screws attaching the accessory switch bezel to the instrument panel.
(8) Disconnect the rear fog lamp switch electrical connector.
(9) Remove the rear fog lamp switch from the accessory switch bezel.

INSTALLATION

(1) Install the rear fog lamp switch to the accessory switch bezel.
(2) Connect the rear fog lamp switch electrical connector to the switch.
(3) Install the screws attaching the accessory switch bezel to the instrument panel.
(4) Install the instrument panel center bezel and attaching screws.
(5) Install the ash receiver.
(6) Install the instrument panel top cover.

2000 JEEP WRANGLER

AUDIO SYSTEMS

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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.

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.

Models equipped with the RAZ sales code radio receiver also include a CD radio bracket, which provides additional support to the radio to reduce CD skipping. The two ends of this formed wire bracket fit over the top of two of the weld-studs that secure the instrument panel to the dash panel below the windshield. The radio ground strap screw is then installed through a tab welded to the center of the CD bracket, through the radio ground strap and into the back of the radio receiver chassis to securely anchor the back of the radio receiver.

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 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 four full-range speakers. The two front speakers are mounted behind a removable bezel located on each outboard end of the lower instrument panel. The two rear speakers are mounted behind a grille located on each outboard end of the sound bar, which is attached from side-to-side to the sport bar above the rear seating area of the vehicle.

DESCRIPTION AND OPERATION (Continued)

ANTENNA

All models use a black painted fixed-length stainless steel rod-type antenna mast, installed on the right front cowl side panel of the vehicle. The antenna mast is connected to the center wire of the coaxial antenna cable, and is not grounded to any part of the vehicle.

To eliminate static, the antenna base must have a good ground. The antenna coaxial cable shield (the outer wire mesh of the cable) is grounded to the antenna base and the radio chassis.

The antenna coaxial cable has an additional disconnect, located behind the right end of the instrument panel between the radio and the right cowl side 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
- Engine-to-frame 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.	1. Check radio fuse and Ignition-Off Draw fuse in Power Distribution Center. Replace fuses, if required. 2. Check for loose or corroded radio connector. Repair, if required. 3. Check for battery voltage at radio connector. Repair wiring, if required. 4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 5. Exchange or replace radio, if required. 6. See speaker diagnosis, in this group.
NO DISPLAY.	1. Fuse faulty. 2. Radio connector faulty. 3. Wiring faulty. 4. Ground faulty. 5. Radio faulty.	1. Check radio fuse and Ignition-Off Draw fuse in Power Distribution Center. Replace fuses, if required. 2. Check for loose or corroded radio connector. Repair, if required. 3. Check for battery voltage at radio connector. Repair wiring, if required. 4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required. 5. Exchange or replace radio, if required.
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. Exchange or replace radio, if required.
POOR RADIO RECEPTION.	1. Antenna faulty. 2. Ground faulty. 3. Radio faulty.	1. See antenna diagnosis, in this group. Repair or replace antenna, if required. 2. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.. 3. Exchange or replace radio, if required.
NO/POOR TAPE OPERATION.	1. Faulty tape. 2. Foreign objects behind tape door. 3. Dirty cassette tape head. 4. Faulty tape deck.	1. Insert known good tape and test operation. 2. Remove foreign objects and test operation. 3. Clean head with Mopar Cassette Head Cleaner. 4. Exchange or replace radio, if required.
NO COMPACT DISC OPERATION	1. Faulty CD. 2. Foreign material on CD. 3. Condensation on CD or optics. 4. Faulty CD player.	1. Insert known good CD and test operation. 2. Clean CD and test operation. 3. Allow temperature of vehicle interior to stabilize and test operation. 4. Exchange or replace radio, if required.

DIAGNOSIS AND TESTING (Continued)

RADIO

For circuit descriptions and diagrams, refer to 8W-47 - Audio System in Group 8W - Wiring Diagrams.

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 radio fuse and the Ignition-Off Draw (IOD) 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(s).

(2) Check for battery voltage at the radio fuse and the IOD fuse in the PDC. If OK, go to Step 3. If not OK, repair the open circuit to the battery and/or the ignition switch as required.

(3) 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 4. If not OK, repair the open radio chassis ground circuit as required.

(4) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (accessory/run) circuit cavity of the left (gray) radio wire harness connector. If OK, go to Step 5. If not OK, repair the open circuit as required.

(5) 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. Disconnect and isolate the battery negative cable. Remove the radio. Unplug the wire harness connectors at the radio. 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 4. If not OK, go to Step 3.

(3) Leave the radio wire harness connectors unplugged. Unplug the wire harness connector at the inoperative speaker. Check both the speaker feed (+) circuit and return (–) circuit cavities of the speaker wire harness connector for continuity to ground. In each case, there should be no continuity. If OK, replace the shorted speaker. If not OK, repair the shorted circuit as required.

(4) Plug in the speaker wire harness connector. 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 3 and 8 ohms (speaker resistance). If OK, go to Step 5. If not OK, go to Step 6.

(5) Install a known good radio. Connect the battery negative cable. Turn 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, replace the faulty speaker.

(6) Turn the radio off. Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the test radio. Unplug the speaker wire harness connector at the inoperative speaker. Check the resistance between the speaker

DIAGNOSIS AND TESTING (Continued)

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 no measurable resistance. If OK, replace the faulty speaker. If not OK, repair the speaker wire harness circuit(s) 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).

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.

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.

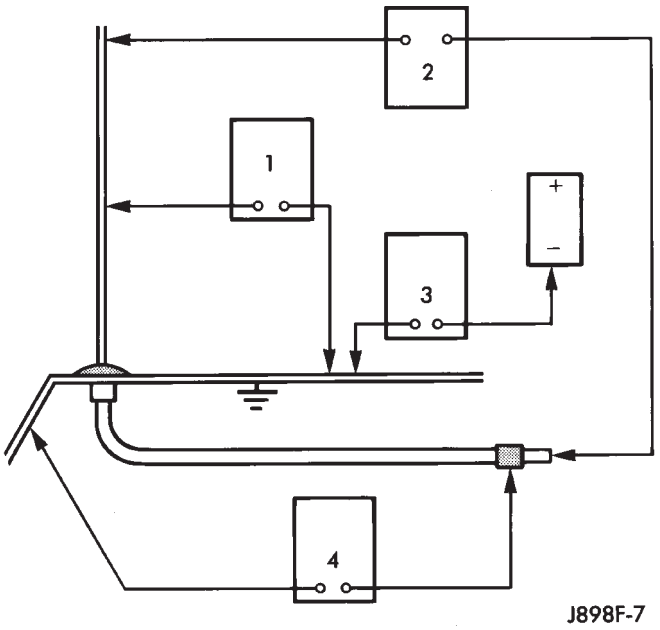


Fig. 1 Antenna Tests

(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.

DIAGNOSIS AND TESTING (Continued)

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
- Engine-to-frame 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 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) Remove the instrument panel top cover from the instrument panel. Refer to Instrument Panel Top Cover in Group 8E - Instrument Panel Systems for the procedures.

(3) Remove the ash receiver from the ash receiver housing in the lower instrument panel center bezel.

(4) Remove the one screw located in the back of the ash receiver housing that secures the center bezel to the lower instrument panel (Fig. 2).

REMOVAL AND INSTALLATION (Continued)

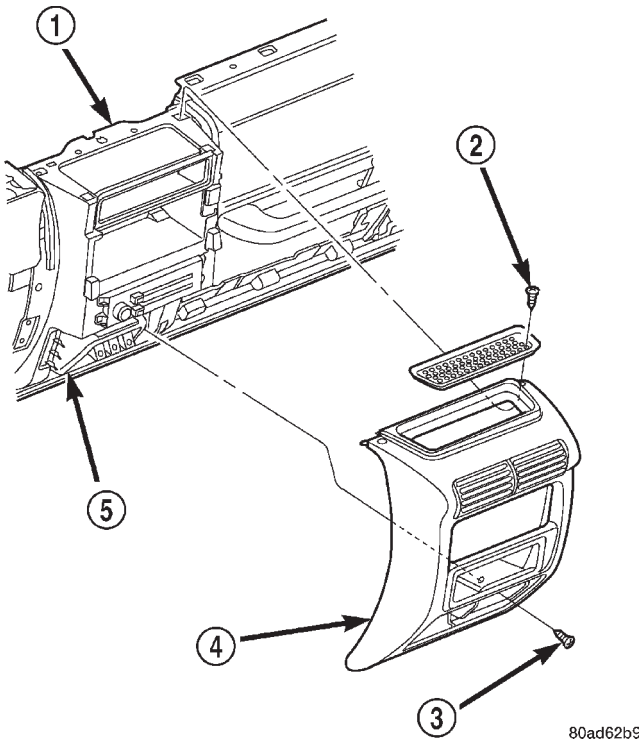


Fig. 2 Center Bezel Remove/Install

1 – INSTRUMENT PANEL
2 – SCREW
3 – SCREW
4 – CENTER BEZEL
5 – ACCESSORY SWITCH BEZEL

(5) Remove the two screws that secure the center bezel to the top of the instrument panel.

(6) Using a trim stick or another suitable wide flat-bladed tool, gently pry the lower edge of the center bezel away from the instrument panel.

(7) Lift the lower edge of the center bezel upwards to release the four snap clip retainers that secure it to the instrument panel.

(8) Remove the center bezel from the instrument panel.

(9) Remove the two screws that secure the radio to the instrument panel (Fig. 3).

(10) If the vehicle is equipped with the CD radio receiver, go to Step 11. If the vehicle is not equipped with the CD radio receiver, go to Step 13.

(11) Remove the glove box from the instrument panel. Refer to **Glove Box** in the index of this service manual for the location of the proper glove box removal and installation procedures.

(12) Reach through the instrument panel glove box opening to access and remove the screw that secures the CD radio bracket and the ground strap to the back of the radio receiver chassis (Fig. 4).

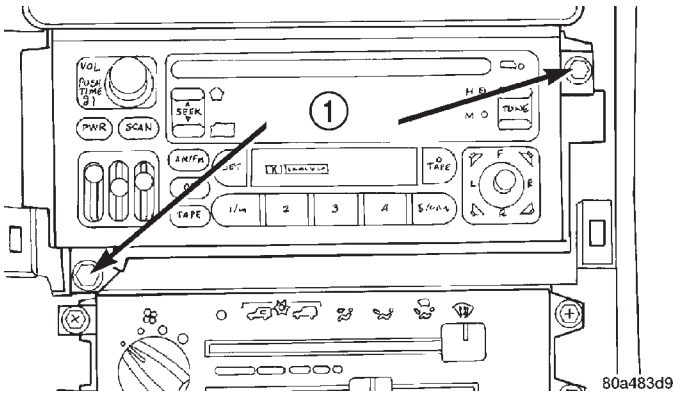


Fig. 3 Radio Remove/Install

1 – MOUNTING SCREWS

(13) Pull the radio out from the instrument panel far enough to access the wire harness connectors and the antenna coaxial cable connector (Fig. 4).

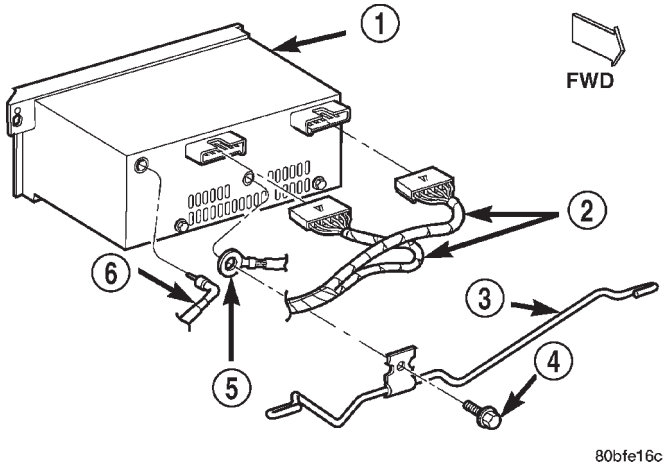


Fig. 4 Radio Connections - Typical

1 – RADIO RECEIVER
2 – INSTRUMENT PANEL WIRE HARNESS
3 – CD RADIO BRACKET
4 – SCREW
5 – GROUND STRAP
6 – ANTENNA CABLE

(14) Unplug the wire harness connectors and the antenna coaxial cable connector from the rear of the radio.

(15) If the vehicle is not equipped with the CD radio receiver, remove the screw that secures the ground strap to the back of the radio receiver chassis.

(16) Remove the radio from the instrument panel.

(17) Reverse the removal procedures to install. Tighten the radio mounting screws to 5 N·m (45 in. lbs.). Tighten the radio receiver ground strap screw to 5.6 N·m (50 in. lbs.). Tighten the instrument panel center bezel mounting screws to 2.2 N·m (20 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

SPEAKER

INSTRUMENT PANEL SPEAKER

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the two screws that secure the outboard end of the speaker bezel to the instrument panel (Fig. 5).

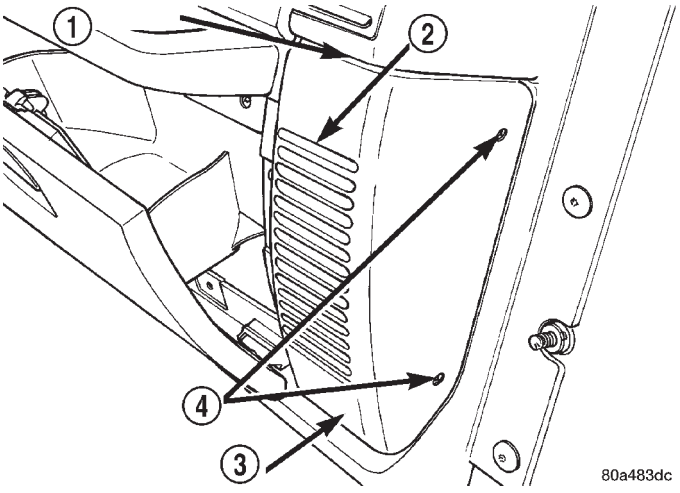


Fig. 5 Instrument Panel Speaker Bezel Remove/Install

1 – PRY HERE
2 – SPEAKER BEZEL
3 – PRY HERE
4 – MOUNTING SCREWS

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry at the top and bottom edges of the speaker bezel to release the two snap clip retainers that secure the bezel to the instrument panel.

(4) Remove the speaker bezel from the instrument panel.

(5) Remove the four screws that secure the speaker to the instrument panel armature (Fig. 6).

(6) Pull the speaker away from the instrument panel far enough to access the speaker wire harness connector.

(7) Unplug the wire harness connector from the speaker.

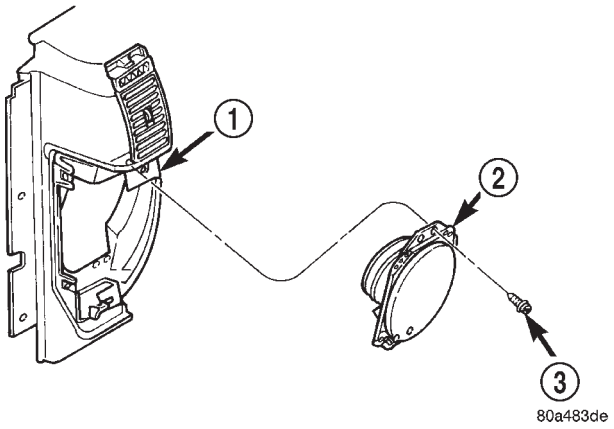


Fig. 6 Instrument Panel Speaker Remove/Install

1 – INSTRUMENT PANEL
2 – SPEAKER
3 – SCREW

(8) Remove the speaker from the instrument panel.

(9) Reverse the removal procedures to install. Tighten the speaker mounting screws to 1.1 N·m (10 in. lbs.). Tighten the speaker bezel mounting screws to 2.2 N·m (20 in. lbs.).

SOUND BAR SPEAKER

(1) Disconnect and isolate the battery negative cable.

(2) Remove the four screws that secure the speaker grille and speaker to the sound bar.

(3) Lower the speaker and grille from the sound bar far enough to access the speaker wire harness connector.

(4) Unplug the wire harness connector from the speaker.

(5) Remove the speaker and grille from the sound bar as a unit.

(6) Remove the speaker grille from the speaker.

(7) Reverse the removal procedures to install. Tighten the mounting screws to 1.1 N·m (10 in. lbs.).

SOUND BAR

(1) Disconnect and isolate the battery negative cable.

(2) If the vehicle is equipped with the optional hard top, remove the hard top from the vehicle. Refer to Hard Top in Group 23 - Body for the procedures.

(3) If the vehicle is equipped with the standard soft top, lower the soft top. Refer to Folding Down the Fabric Top in the Owner's Manual for the procedures.

(4) Release the hook and loop closure on each outboard end flap of the sound bar trim cover.

REMOVAL AND INSTALLATION (Continued)

(5) Lift the left outboard end flap of the sound bar trim cover over the top of the sport bar far enough to access the wire harness connector (Fig. 7).

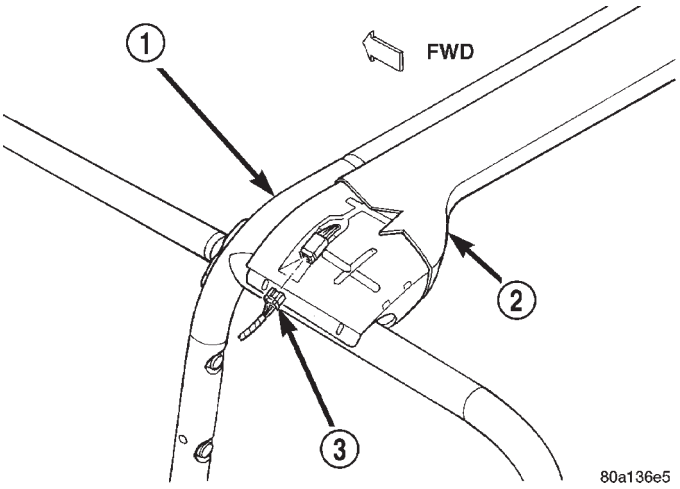


Fig. 7 Sound Bar Wire Harness Connector Remove/Install

1 – SPORT BAR
2 – SOUND BAR
3 – CONNECTOR

(6) Unplug the sound bar wire harness connector.

(7) Lift each outboard end flap of the sound bar cover over the top of the sport bar far enough to access the mounting screws (Fig. 8).

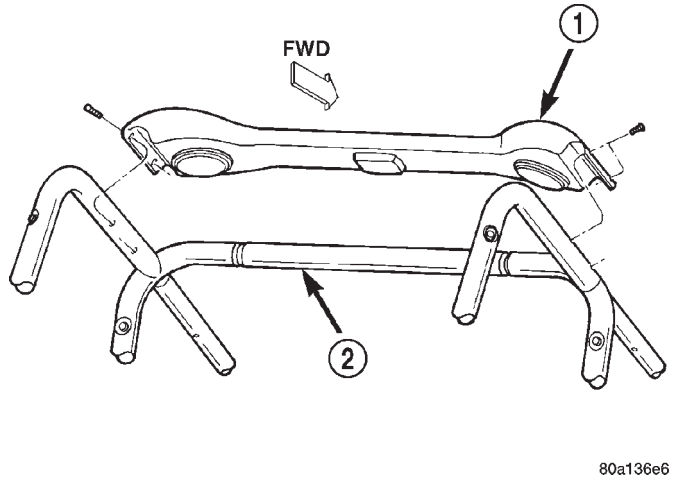


Fig. 8 Sound Bar Remove/Install

1 – SOUND BAR
2 – SPORT BAR

(8) Remove the two screws that secure each end of the sound bar to the sport bar.

(9) Lift the sound bar up off of the sport bar to remove it from the vehicle.

(10) Reverse the removal procedures to install. Tighten the sound bar mounting screws to 11 N·m (100 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 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 unplug the antenna coaxial cable connector. Unplug the connector by pulling it apart while twisting the metal connector halves. Do not pull on the cable.

(4) Unscrew the antenna mast from the antenna body base on the right outer cowl side panel (Fig. 9).

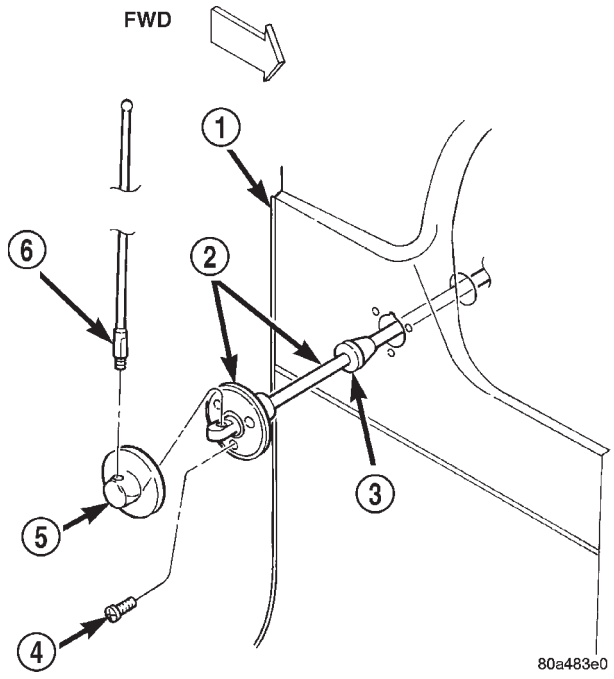


Fig. 9 Antenna Remove/Install

1 – RIGHT COWL SIDE PANEL
2 – BASE & CABLE
3 – GROMMET
4 – SCREW
5 – COVER
6 – MAST

REMOVAL AND INSTALLATION (Continued)

(5) Using a trim stick or another suitable wide flat-bladed tool, gently pry the edge of the antenna base trim cover to unsnap it from the antenna body base.

(6) Remove the three screws that secure the antenna body base to the right outer cowl side panel.

(7) From inside the passenger compartment, push the coaxial cable grommet on the antenna body half of the coaxial cable out through the hole in the right inner cowl side panel.

(8) From the outside of the vehicle, pull the antenna body base and cable assembly out through the hole in the right outer cowl side panel.

(9) Reverse the removal procedures to install. Tighten the antenna body base mounting screws to 2 N·m (17 in. lbs.). Tighten the antenna mast to 3.3 N·m (30 in. lbs.).

RADIO NOISE SUPPRESSION COMPONENTS

WARNING: ON VEHICLES EQUIPPED WITH AIR-BAGS, 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 PRE-CAUTIONS COULD RESULT IN ACCIDENTAL AIR-BAG 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 hood panel center reinforcement (Fig. 10).

(2) Remove the screw that secures the engine-to-body ground strap eyelet to the dash panel.

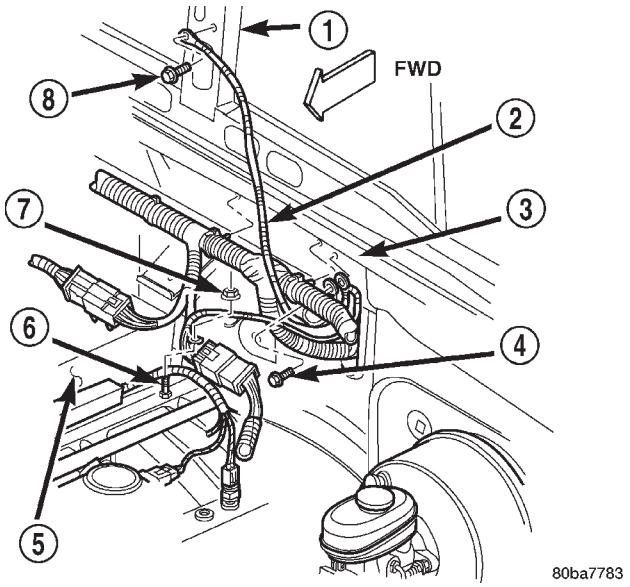


Fig. 10 Engine-To-Body Ground Strap Remove/ Install

1 – HOOD PANEL
2 – GROUND STRAP
3 – DASH PANEL
4 – SCREW
5 – ENGINE
6 – STUD
7 – NUT
8 – SCREW

(3) 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.

(4) Remove the engine-to-body ground strap eyelet from the stud on the left upper rear corner of the engine cylinder head.

(5) Remove the engine-to-body ground strap from the engine compartment.

REMOVAL AND INSTALLATION (Continued)

ENGINE-TO-FRAME GROUND STRAP

(1) Remove the nut that secures the engine-to-frame ground strap eyelet to the forward ignition coil mounting stud on the right side of the engine (Fig. 11) or (Fig. 12).

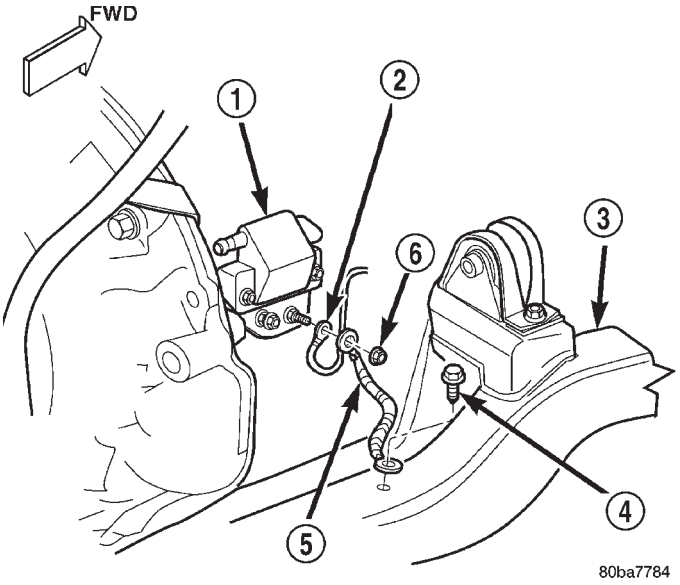


Fig. 11 Engine-To-Frame Ground Strap Remove/ Install - 2.5L Engine

1 – IGNITION COIL
2 – GENERATOR GROUND EYELET
3 – RIGHT FRAME RAIL
4 – SCREW
5 – GROUND STRAP
6 – NUT

(2) Remove the engine-to-frame ground strap eyelet from the forward ignition coil mounting stud on the right side of the engine.

(3) Remove the screw that secures the engine-to-frame ground strap eyelet to the top of the right frame rail.

(4) Remove the engine-to-frame 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.

(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 5.6 N·m (50 in. lbs.).

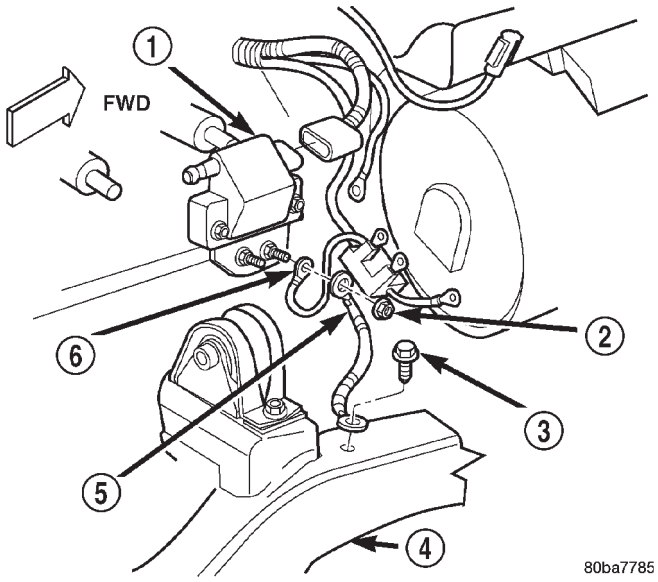


Fig. 12 Engine-To-Frame Ground Strap Remove/ Install - 4.0L Engine

1 – IGNITION COIL
2 – NUT
3 – SCREW
4 – RIGHT FRAME RAIL
5 – GROUND STRAP
6 – GENERATOR GROUND EYELET

(4) Install and tighten the screw that secures the engine-to-body ground strap eyelet to the dash panel. Tighten the screw to 48.5 N·m (430 in. lbs.).

(5) Install and tighten the screw that secures the engine-to-body ground strap eyelet to the hood panel center reinforcement. Tighten the screw to 1.9 N·m (17 in. lbs.).

ENGINE-TO-FRAME GROUND STRAP

(1) Position the engine-to-frame ground strap into the engine compartment. The ground strap eyelet with a 45 degree bend in it is to be mounted on the right frame rail.

(2) Install and tighten the screw that secures the engine-to-frame ground strap eyelet to the top of the right frame rail. Tighten the screw to 22.6 N·m (200 in. lbs.).

(3) Install the engine-to-frame ground strap eyelet over the forward ignition coil mounting stud on the right side of the engine.

(4) Install and tighten the nut that secures the engine-to-frame ground strap eyelet to the forward ignition coil mounting stud on the right side of the engine. Tighten the nut to 22.6 N·m (200 in. lbs.).

HORN SYSTEMS

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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 a 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
- Horn(s)
- Horn relay
- Horn switch

Refer to **Clockspring** in the Description and Operation section of Group 8M - Passive Restraint 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.

HORN

DESCRIPTION

The dual electromagnetic diaphragm-type horns are standard equipment on this model. Each horn is secured with a bracket to the left front inner fender shield just ahead of the left front wheel house in the engine compartment. The two horn brackets are mounted in the same location, one on top of the other. The high-note horn for the optional dual-note horn system is connected in parallel with and secured with a bracket just forward of the low-note horn.

The two horns are connected in parallel. Each horn is grounded through its wire harness connector and circuit to an eyelet secured to the engine compartment side of the grille/headlamp mounting panel near the left headlamp, and receives battery feed through the closed contacts of the horn relay.

The horns cannot be repaired or adjusted and, if faulty or damaged, they must be individually replaced.

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

DESCRIPTION AND OPERATION (Continued)

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 Power Distribution Center (PDC) in the engine compartment. If a problem is encountered with a continuously sounding horn, it can usually be quickly resolved by removing the horn relay from the PDC until further diagnosis is completed. See the fuse and relay layout label affixed to the inside surface of the PDC cover for horn relay identification and location.

The horn relay is a International Standards Organization (ISO) micro-relay. Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The ISO micro-relay terminal functions are the same as a conventional ISO relay. However, the ISO micro-relay terminal pattern (or footprint) is different, the current capacity is lower, and the physical dimensions are smaller than those of the conventional ISO relay.

The 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.

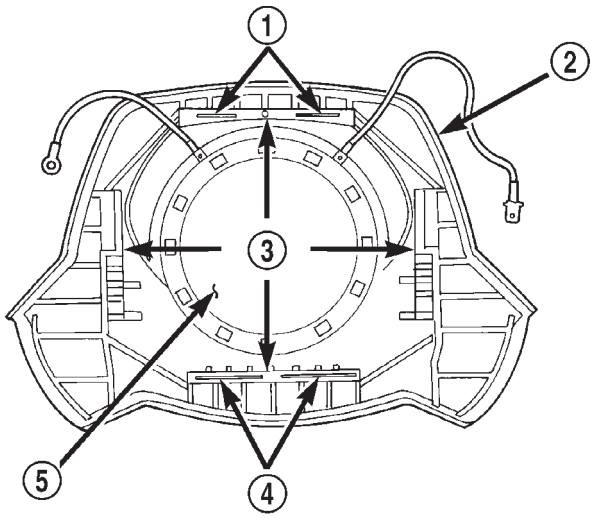


Fig. 1 Driver Side Airbag Module Trim Cover and Horn Switch - Typical

1 – RETAINER SLOTS
2 – TRIM COVER
3 – LOCKING BLOCKS
4 – RETAINER SLOTS
5 – 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 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

DESCRIPTION AND OPERATION (Continued)

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 Power Distribution Center (PDC) behind the battery on the driver side of the engine compartment. If a problem is encountered with a continuously sounding horn, it can usually be quickly resolved by removing the horn relay from the PDC until further diagnosis is completed. See the fuse and relay layout label affixed to the inside surface of the PDC cover 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 PDC. 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.

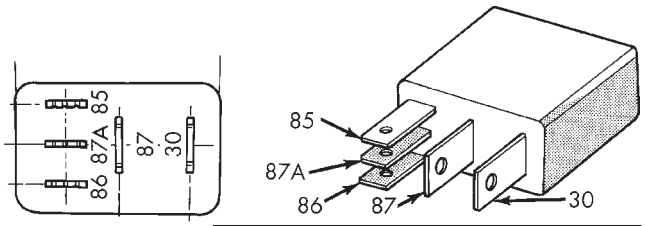
(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, perform the Relay Circuit Test that follows. If not OK, replace the faulty relay.

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 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



TERMINAL LEGEND	
NUMBER	**IDENTIFICATION**
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 2 Horn Relay

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 PDC as required.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. It is grounded through the horn switch when the horn switch is depressed. Check for continuity to ground at the cavity for relay terminal 85. There should be continuity with the horn switch depressed, and no continuity with the horn switch released. If not OK, 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.

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.

DIAGNOSIS AND TESTING (Continued)

(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 Power Distribution Center (PDC). 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 PDC 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 PDC. 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 PDC 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 diagrams, refer to **Horn/Cigar Lighter** in the Contents of Group 8W - Wiring Diagrams.

(1) Disconnect the wire harness connectors from the horn connector receptacles. Measure the resistance between the ground circuit cavity of the horns wire harness connectors and a good ground. There should be no measurable resistance. If OK, go to Step 2. If not OK, repair the open ground circuit to ground as required.

(2) Check for battery voltage at the horn relay output circuit cavity of the horns wire harness connectors. 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 horns wire harness connectors. If OK, replace the faulty horns. 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) Unlatch and open the cover on the Power Distribution Center (PDC) (Fig. 3).

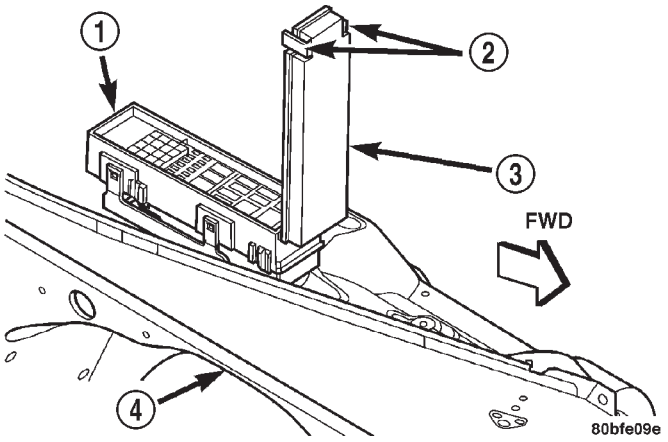


Fig. 3 Power Distribution Center

1 – POWER DISTRIBUTION CENTER
2 – LATCHES
3 – PDC COVER
4 – RIGHT FRONT FENDER

(3) See the fuse and relay layout label on the underside of the PDC cover for horn relay identification and location.

(4) Remove the horn relay from the PDC.

INSTALLATION

(1) Position the horn relay in the proper receptacle in the PDC.

(2) Align the horn relay terminals with the terminal cavities in the PDC receptacle.

(3) Push down firmly on the horn relay until the terminals are fully seated in the terminal cavities in the PDC receptacle.

(4) Close and latch the cover onto the PDC.

(5) Reconnect the battery negative cable.

HORN

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the wire harness connectors from the horn connector receptacles (Fig. 4).

(3) Remove the two screws that secure the horn and mounting bracket units to the left front inner fender shield.

REMOVAL AND INSTALLATION (Continued)

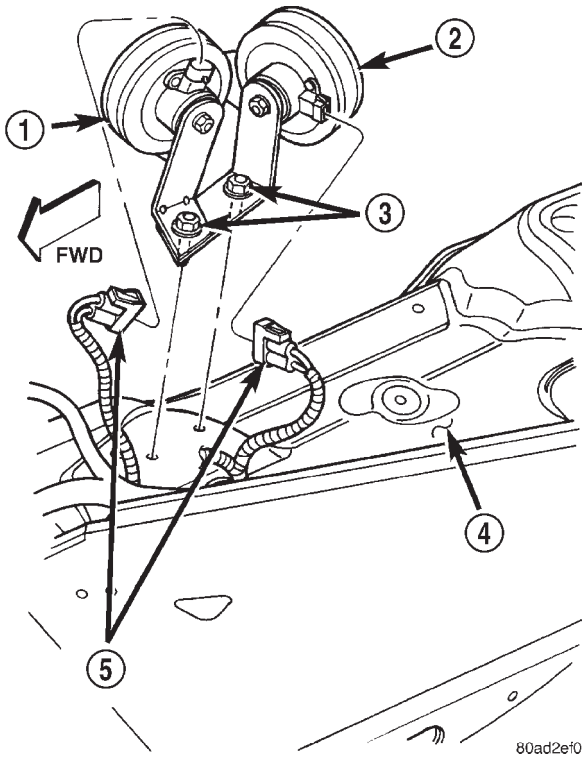


Fig. 4 Horns Remove/Install

1 – HIGH NOTE HORN AND BRACKET
2 – LOW NOTE HORN AND BRACKET
3 – SCREWS
4 – INNER FENDER
5 – HORN CONNECTORS

(4) Remove the horn and mounting bracket units from the left front inner fender shield.

INSTALLATION

(1) Position the horn and mounting bracket units onto the left front inner fender shield.

(2) Install and tighten the screw that secures the horn and mounting bracket units to the left front inner fender shield. Tighten the screw to 6.8 N·m (5 ft. lbs.).

(3) Reconnect the wire harness connectors to the horn connector receptacles.

(4) Reconnect the battery negative cable.

SPEED CONTROL SYSTEM

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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, RES/ACCEL, SET, COAST, and CANCEL.

The system is designed to operate at speeds above 30 mph (50 km/h).

WARNING: THE USE OF SPEED CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS IN HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED, OR SLIPPERY.

OPERATION

When speed control is selected by depressing the ON switch, the PCM allows a set speed to be stored in PCM RAM for speed control. To store a set speed, depress the SET switch while the vehicle is moving at a speed between 35 and 85 mph. In order for the speed control to engage, the brakes cannot be applied, nor can the gear selector be indicating the transmission is in Park or Neutral.

The speed control can be disengaged manually by:

- Stepping on the brake pedal
- Depressing the OFF switch
- Depressing the CANCEL switch.
- Depressing the clutch pedal (if equipped).

NOTE: Depressing the OFF switch or turning off the ignition switch will erase the set speed stored in the PCM.

For added safety, the speed control system is programmed to disengage for any of the following conditions:

- An indication of Park or Neutral
- A rapid increase rpm (indicates that the clutch has been disengaged)
- Excessive engine rpm (indicates that the transmission may be in a low gear)
- The speed signal increases at a rate of 10 mph per second (indicates that the coefficient of friction between the road surface and tires is extremely low)
- The speed signal decreases at a rate of 10 mph per second (indicates that the vehicle may have decelerated at an extremely high rate)

Once the speed control has been disengaged, depressing the RES/ACCEL switch (when speed is greater than 30 mph) restores the vehicle to the target speed that was stored in the PCM.

While the speed control is engaged, the driver can increase the vehicle speed by depressing the RES/ACCEL switch. The new target speed is stored in the PCM when the RES/ACCEL is released. The PCM also has a “tap-up” feature in which vehicle speed increases at a rate of approximately 2 mph for each momentary switch activation of the RES/ACCEL switch.

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.

DESCRIPTION AND OPERATION (Continued)

SPEED CONTROL SERVO

DESCRIPTION

The servo unit consists of a solenoid valve body, and a vacuum chamber. The solenoid valve body contains three solenoids:

- Vacuum
- Vent
- Dump

The vacuum chamber contains a diaphragm with a cable attached to control the throttle linkage.

OPERATION

The Powertrain Control Module (PCM) controls the solenoid valve body. The solenoid valve body controls the application and release of vacuum to the diaphragm of the vacuum servo. The servo unit cannot be repaired and is serviced only as a complete assembly.

Power is supplied to the servo's by the PCM through the brake switch. The PCM controls the ground path for the vacuum and vent solenoids.

The dump solenoid is energized anytime it receives power. If power to the dump solenoid is interrupted, the solenoid dumps vacuum in the servo. This provides a safety backup to the vent and vacuum solenoids.

The vacuum and vent solenoids must be grounded at the PCM to operate. When the PCM grounds the vacuum servo solenoid, the solenoid allows vacuum to enter the servo and pull open the throttle plate using the cable. When the PCM breaks the ground, the solenoid closes and no more vacuum is allowed to enter the servo. The PCM also operates the vent solenoid via ground. The vent solenoid opens and closes a passage to bleed or hold vacuum in the servo as required.

The PCM duty cycles the vacuum and vent solenoids to maintain the set speed, or to accelerate and decelerate the vehicle. To increase throttle opening, the PCM grounds the vacuum and vent solenoids. To decrease throttle opening, the PCM removes the grounds from the vacuum and vent solenoids. When the brake is released, if vehicle speed exceeds 30 mph to resume, 35 mph to set, and the RES/ACCEL switch has been depressed, ground for the vent and vacuum circuits is restored.

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

There are two separate switch pods that operate the speed control system. The steering-wheel-mounted switches use multiplexed circuits to provide inputs to the PCM for ON, OFF, RESUME, ACCELERATE, SET, DECEL and CANCEL modes. Refer to the owner's manual for more information on speed control switch functions and setting procedures.

The individual switches cannot be repaired. If one switch fails, the entire switch module must be replaced.

OPERATION

When speed control is selected by depressing the ON, OFF switch, the PCM allows a set speed to be stored in its RAM for speed control. To store a set speed, depress the SET switch while the vehicle is moving at a speed between approximately 35 and 85 mph. In order for the speed control to engage, the brakes cannot be applied, nor can the gear selector be indicating the transmission is in Park or Neutral.

The speed control can be disengaged manually by:

- Stepping on the brake pedal
- Depressing the OFF switch
- Depressing the CANCEL switch.

The speed control can be disengaged also by any of the following conditions:

- An indication of Park or Neutral
- The VSS signal increases at a rate of 10 mph per second (indicates that the co-efficient of friction between the road surface and tires is extremely low)
- Depressing the clutch pedal.
- Excessive engine rpm (indicates that the transmission may be in a low gear)
- The VSS signal decreases at a rate of 10 mph per second (indicates that the vehicle may have decelerated at an extremely high rate)
- If the actual speed is not within 20 mph of the set speed

The previous disengagement conditions are programmed for added safety.

Once the speed control has been disengaged, depressing the ACCEL switch restores the vehicle to the target speed that was stored in the PCM's RAM.

NOTE: Depressing the OFF switch will erase the set speed stored in the PCM's RAM.

DESCRIPTION AND OPERATION (Continued)

If, while the speed control is engaged, the driver wishes to increase vehicle speed, the PCM is programmed for an acceleration feature. With the ACCEL switch held closed, the vehicle accelerates slowly to the desired speed. The new target speed is stored in the PCM's RAM when the ACCEL switch is released. The PCM also has a "tap-up" feature in which vehicle speed increases at a rate of approximately 2 mph for each momentary switch activation of the ACCEL switch.

The PCM also provides a means to decelerate without disengaging speed control. To decelerate from an existing recorded target speed, depress and hold the COAST switch until the desired speed is reached. Then release the switch. The ON, OFF switch operates two components: the PCM's ON, OFF input, and the battery voltage to the brake switch, which powers the speed control servo.

Multiplexing

The PCM sends out 5 volts through a fixed resistor and monitors the voltage change between the fixed resistor and the switches. If none of the switches are depressed, the PCM will measure 5 volts at the sensor point (open circuit). If a switch with no resistor is closed, the PCM will measure 0 volts (grounded circuit). Now, if a resistor is added to a switch, then the PCM will measure some voltage proportional to the size of the resistor. By adding a different resistor to each switch, the PCM will see a different voltage depending on which switch is pushed.

Another resistor has been added to the 'at rest circuit' causing the PCM to never see 5 volts. This was done for diagnostic purposes. If the switch circuit should open (bad connection), then the PCM will see the 5 volts and know the circuit is bad. The PCM will then set an open circuit fault.

BRAKE 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 brake lamp switch. The PCM monitors the state of the dual function brake lamp switch. Refer to the Brake section for more information on brake lamp switch service and adjustment procedures.

The brake switch is equipped with three sets of contacts, one normally open and the other two normally closed (brakes disengaged). The PCM sends a 12 volt signal to one of the normally closed contacts in the brake switch, which is returned to the PCM as a brake switch state signal. With the contacts closed, the 12 volt signal is pulled to ground causing the signal to go low. The low voltage signal, monitored by the PCM, indicates that the brakes are not applied. When the brakes are applied, the contacts open, causing the PCM's output brake signal to go high, disengaging the speed control, cutting off PCM power to the speed control solenoids.

The second set of normally closed contacts supplies 12 volts from the PCM any time speed control is turned on. Through the brake switch, current is routed to the speed control servo solenoids. The speed control solenoids (vacuum, vent and dump) are provided this current any time the speed control is ON and the brakes are disengaged.

When the driver applies the brakes, the contacts open and current is interrupted to the solenoids. The normally open contacts are fed battery voltage. When the brakes are applied, battery voltage is supplied to the brake lamps.

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.

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.

DESCRIPTION AND OPERATION (Continued)

VEHICLE SPEED SENSOR (SPEED CONTROL OPERATION)

DESCRIPTION

The Vehicle Speed Sensor (VSS) is mounted to an adapter near the transmission output shaft. The sensor is driven through the adapter by a speedometer pinion gear.

OPERATION

The VSS is a pulse generator. 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.

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 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.

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.

(5) Remove 2 mounting nuts holding servo cable sleeve to bracket (Fig. 1) or (Fig. 2).

REMOVAL AND INSTALLATION (Continued)

(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.

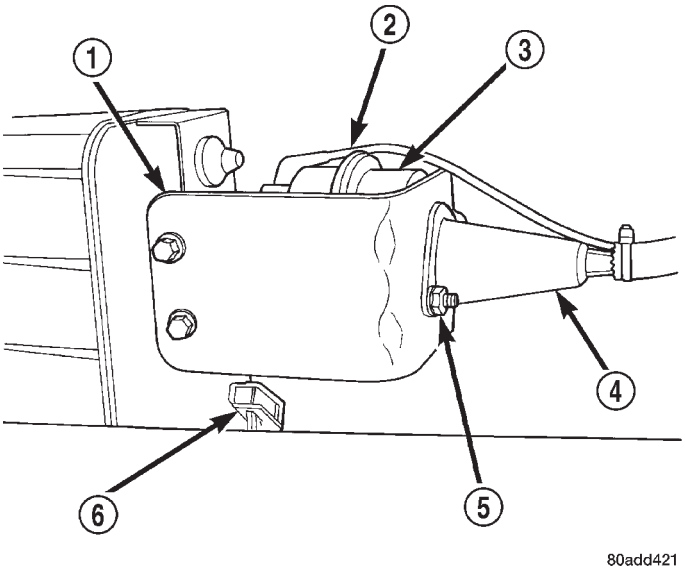


Fig. 1 Speed Control Servo Location

1 – SERVO MOUNTING BRACKET
2 – VACUUM LINE
3 – SPEED CONTROL SERVO
4 – CABLE SLEEVE
5 – SERVO MOUNTING NUTS (2)
6 – ELECTRICAL CONNECTOR

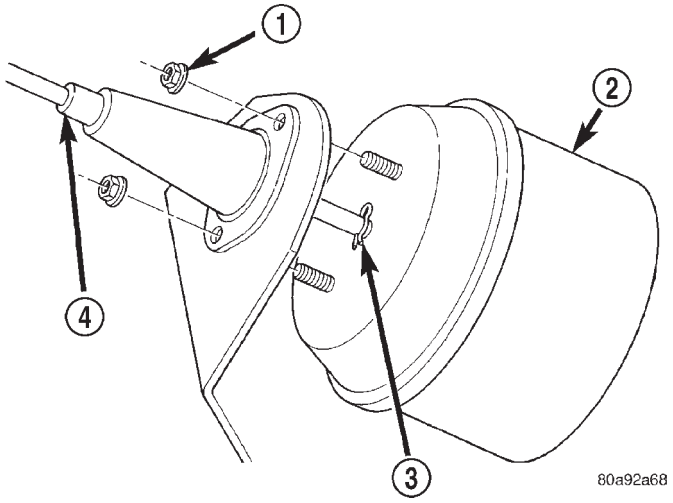


Fig. 2 Servo Cable Clip Remove/Install—Typical

1 – SERVO MOUNTING NUTS (2)
2 – SERVO
3 – CABLE RETAINING CLIP
4 – SERVO CABLE AND SLEEVE

(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.
(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.
(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.
(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.
(4) Install airbag module. Refer to Group 8M, Passive Restraint Systems.
(5) Connect negative battery cable to battery.

REMOVAL AND INSTALLATION (Continued)

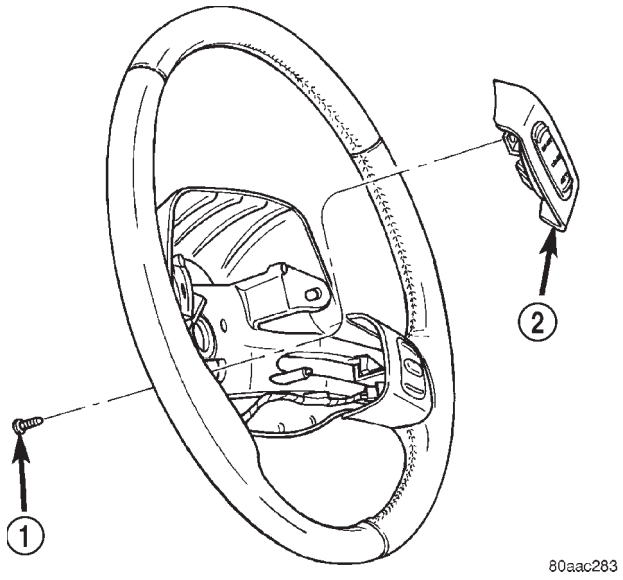


Fig. 3 Speed Control Switch Remove/Install

1 – MOUNTING SCREW
2 – SPEED CONTROL SWITCH

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 release tabs are located on sides of speed control cable at cable bracket (Fig. 4). Squeeze tabs together and push cable out of bracket.

(4) Unclip cable from cable guide at valve cover.

(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 bracket (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.

VACUUM RESERVOIR

The vacuum reservoir is located under the vehicle battery tray (Fig. 5).

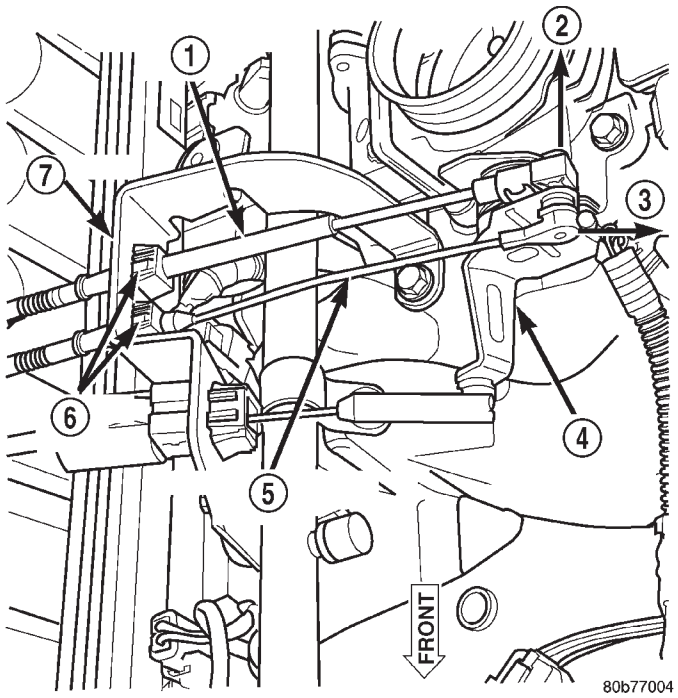


Fig. 4 Speed Control Servo Cable at Throttle Body

1 – ACCELERATOR CABLE
2 – OFF
3 – OFF
4 – THROTTLE BODY BELLCRANK
5 – SPEED CONTROL CABLE
6 – RELEASE TABS
7 – BRACKET

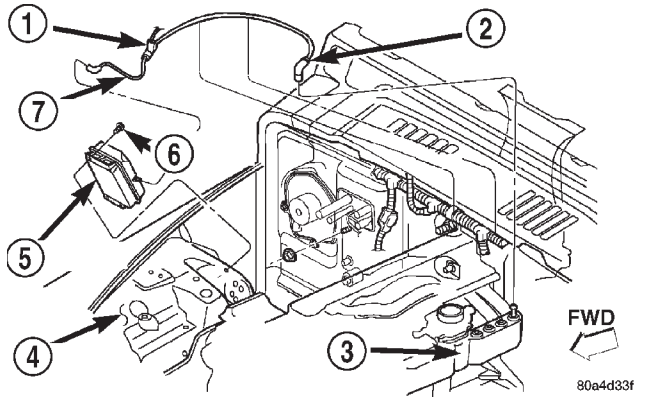


Fig. 5 Vacuum Reservoir Removal/Installation

1 – TEE
2 – VACUUM CHECK VALVE
3 – INTAKE MANIFOLD
4 – INNER FENDER
5 – RESERVOIR
6 – SCREW
7 – VACUUM SUPPLY LINE

REMOVAL AND INSTALLATION (Continued)

REMOVAL

(1) Remove battery and battery tray. Refer to Battery Removal/Installation.

(2) Disconnect vacuum supply line at reservoir (Fig. 5).

(3) Remove screw securing reservoir to inner fender.

(4) Remove reservoir from vehicle.

INSTALLATION

(1) Position reservoir to vehicle and install mounting screw.

(2) Tighten screw to 1.2 N·m (10 in. lbs.) torque.

(3) Connect vacuum line to reservoir.

(4) Install battery and battery tray. Refer to Battery Removal/Installation.

SPECIFICATIONS

TORQUE CHART

Description	Torque
Servo Mounting Bracket-to-Servo Nuts	8.5 N·m (75 in. lbs.)
Speed Control Switch Mounting Screws	1.5 N·m (14 in. lbs.)
Vacuum Reservoir Mounting Screw	1.2 N·m (10 in. lbs.)

TURN SIGNAL AND HAZARD WARNING SYSTEMS

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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.

DESCRIPTION AND OPERATION (Continued)

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.

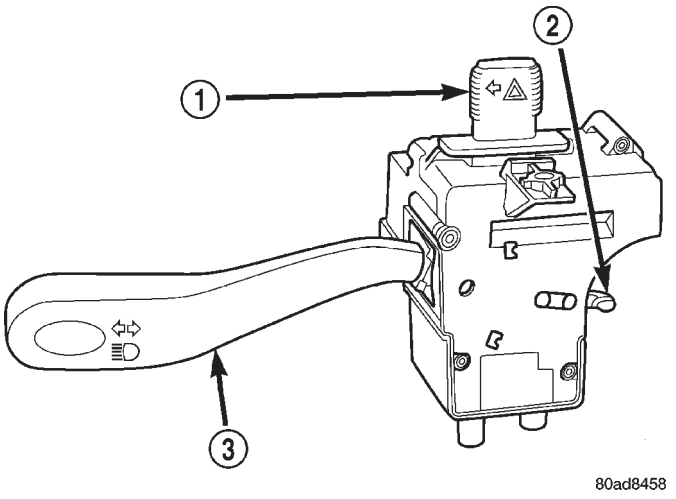


Fig. 1 Multi-Function Switch

1 – HAZARD WARNING BUTTON
2 – CANCEL ACTUATOR
3 – CONTROL STALK

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.

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 bracket secured with a screw to the underside of the upper steering column support bracket, to the right of the steering column under 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)

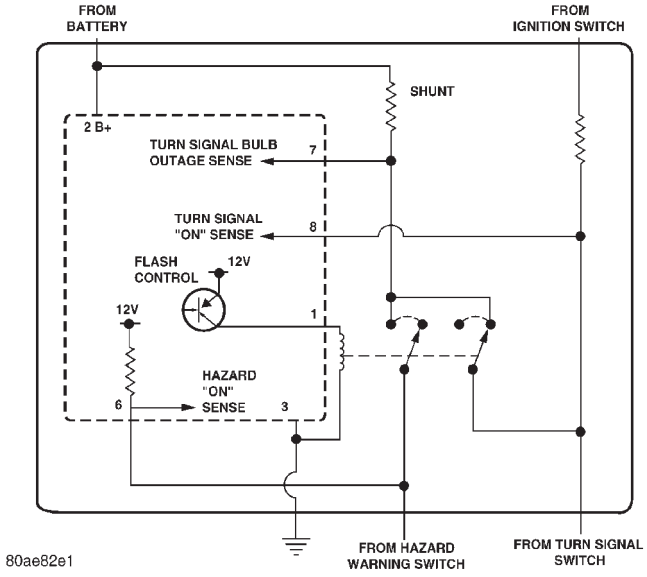


Fig. 2 Combination Flasher - Typical

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 fuseblock module 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 combo flasher input 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 combo flasher input 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 combo flasher input 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 combo flasher input circuit as required.

(10) Check for continuity between the combo flasher 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 combo flasher 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

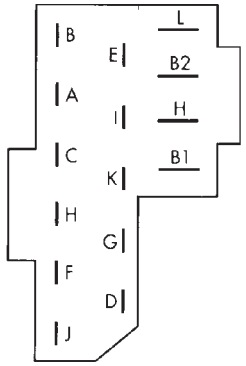


Fig. 3 Multi-Function Switch Continuity

(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)

NOTE: The combination flasher and flasher bracket are serviced only as a unit.

(3) Reach through the inboard side of the instrument panel steering column opening to access and remove the screw that secures the combination flasher bracket to the upper steering column mounting bracket to the right of the steering column (Fig. 4).

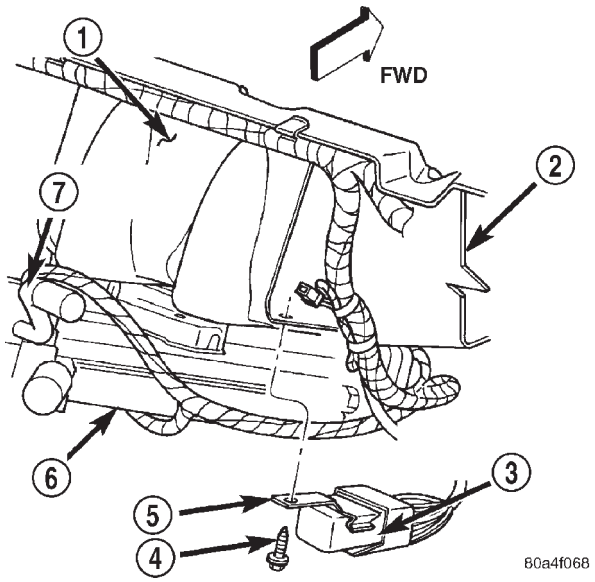


Fig. 4 Combination Flasher Remove/Install

1 – UPPER STEERING COLUMN SUPPORT BRACKET
2 – COWL PANEL
3 – COMBINATION FLASHER
4 – SCREW
5 – BRACKET
6 – STEERING COLUMN
7 – WIPER/WASHER SWITCH LEVER

(4) Lower the combination flasher and bracket far enough to access the wire harness connector.

(5) Remove the combination flasher from the wire harness connector.

(6) Remove the combination flasher and bracket from under the instrument panel as a unit.

INSTALLATION

(1) Position the combination flasher and bracket under the instrument panel as a unit.

(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) Position the combination flasher and bracket to the upper steering column mounting bracket to the right of the steering column under the instrument panel.

(5) Install and tighten the screw that secures the combination flasher and bracket to the upper steering column mounting bracket. Tighten the screw to 4 N·m (35 in. lbs.).

(6) 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.

(7) 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).

(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.

(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).

(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).

(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.

REMOVAL AND INSTALLATION (Continued)

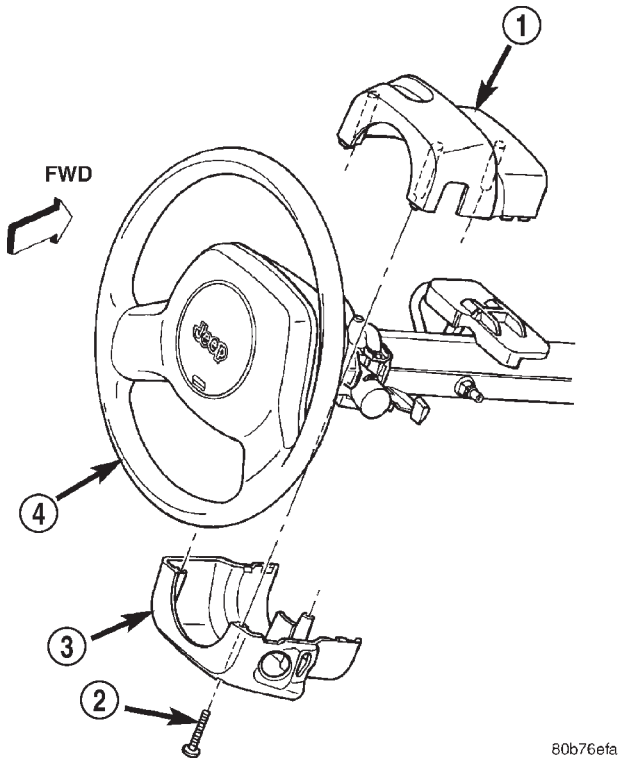


Fig. 5 Steering Column Shrouds Remove/Install

1 – UPPER SHROUD
2 – SCREW (3)
3 – LOWER SHROUD
4 – STEERING WHEEL

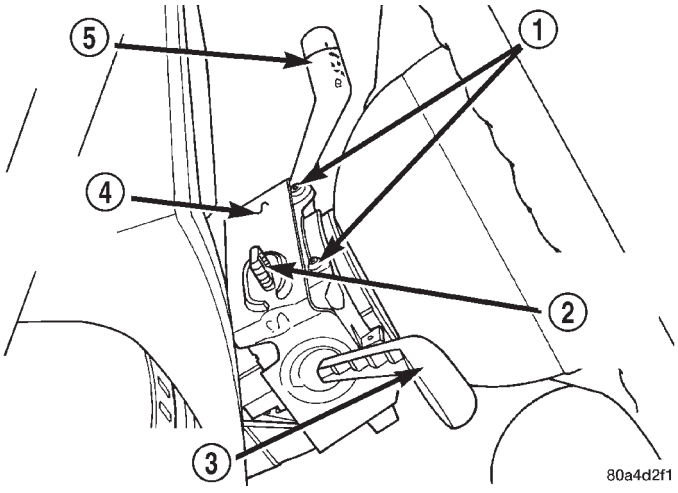


Fig. 6 Water Shield Upper Screws Remove/Install

1 – MOUNTING SCREWS
2 – HAZARD WARNING SWITCH KNOB
3 – MULTI-FUNCTION SWITCH LEVER
4 – WATER SHIELD AND BRACKET
5 – WIPER SWITCH LEVER

(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.

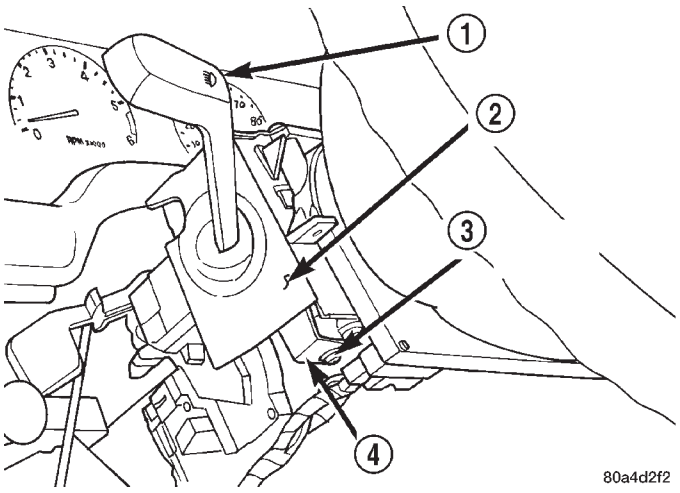


Fig. 7 Water Shield Lower Screw Remove/Install

1 – MULTI-FUNCTION SWITCH LEVER
2 – WATER SHIELD AND BRACKET
3 – LOWER MOUNTING SCREW
4 – LOWER MOUNTING TAB

(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.

REMOVAL AND INSTALLATION (Continued)

(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

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GENERAL INFORMATION

INTRODUCTION

Following are general descriptions of the major components in the wiper and washer systems. Refer to 8W-53 - Wipers in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

DESCRIPTION AND OPERATION

WINDSHIELD WIPER SYSTEM

A two-speed windshield wiper system is standard equipment on this model. An intermittent windshield wiper system is optional. The standard system lets the driver select from two wiper speeds, low or high. The intermittent wiper system adds an intermittent wipe delay feature.

On models equipped with the intermittent wiper system, 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 fuse located in the fuseblock module protects the circuitry of either windshield wiper system. Refer to the owner's manual for more information on the windshield wiper system controls and operation.

WINDSHIELD WASHER SYSTEM

An electrically operated windshield washer system is standard equipment. A washer reservoir in the engine compartment holds the washer fluid, which is pressurized by a pump when the windshield washer switch lever is actuated. The windshield washer pump feeds the pressurized washer fluid through the washer system plumbing to the windshield washer nozzles.

If the vehicle is equipped with the two-speed wiper system and the wipers are not already turned on when the washers are activated, the wiper switch will be turned on to the low speed position automatically. The wipers must be turned off manually following a washer switch activation. If the vehicle is equipped with the intermittent wipe system and the wipers are not turned on when the washers are activated, the wipers will be automatically cycled for one or two wipes, then be turned off.

The washers will operate only when the ignition switch is in the Accessory or On positions. A fuse located in the fuseblock module protects the circuitry of the washer system. Refer to the owner's manual for more information on the windshield washer system controls and operation.

REAR WIPER AND WASHER SYSTEM

A rear wiper and washer system is standard equipment on models equipped with the optional hardtop. The rear wiper system provides the following operating modes:

- Continuous fixed-cycle wipe.
- A rear washer mode.

DESCRIPTION AND OPERATION (Continued)

- A park mode that operates the wiper motor until the blade reaches its park position when the rear wiper switch is placed in the Off position.

A single switch in the instrument panel accessory switch bezel controls both the rear wiper and washer functions. The rear washer system shares the reservoir of the windshield washer system, but has its own dedicated washer pump and plumbing.

The rear wiper and washer systems will operate only when the ignition switch is in the On position. A fuse in the fuseblock module protects the circuitry of both the rear wiper and washer systems.

Refer to the owner's manual for more information on the rear wiper and washer system controls and operation.

WIPER ARM AND BLADE

All models have two 33.02-centimeter (13-inch) windshield wiper blades with non-replaceable rubber elements (squeegees). The rear wiper uses a single 45.72-centimeter (18-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 liftglass 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 an integral latch directly to the rear wiper motor output shaft on the liftglass.

The wiper arms and blades cannot be adjusted or repaired. If faulty or damaged, they must be replaced.

WIPER LINKAGE AND PIVOT

The wiper linkage and pivot module is secured with screws to the cowl plenum 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 driver side wiper pivot crank arm and the wiper motor crank arm each have ball studs on their ends. The passenger side crank arm has two ball studs. A drive link is connected from the motor crank arm ball stud to one ball stud on the passenger side pivot crank arm. A connecting link is connected from the other ball stud on the passenger side pivot crank arm to the driver side pivot crank arm ball stud.

Both the drive link and the connector link have a plastic socket-type bushing on each end. Each of the socket-type bushings are snap-fit over their respective ball studs.

The wiper linkage, pivots, bushings, motor, crank arm, and mounting bracket are only serviced as a complete unit. If any part of this assembly except the motor is faulty or damaged, the entire unit must be replaced. The wiper motor is also available as a separate service item.

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.

Wiper speed is controlled by current flow to the proper set of brushes. The wiper motor completes its 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 motor and boot assembly must be replaced. The wiper linkage and pivots module, which includes the wiper motor, is also available for service.

REAR

The rear wiper motor is secured on the inside of the liftglass with a slotted bracket that fits onto a grommet under the right liftglass hinge mounting nut. The motor output shaft passes through the liftglass, where a rubber gasket and a plastic bezel and nut unit seal and secure the output shaft to the outside of the liftglass. The rear wiper arm is secured directly to the motor output shaft.

The rear wiper motor unit contains an internal park switch. The motor also contains an automatic resetting thermal switch for overload protection.

DESCRIPTION AND OPERATION (Continued)

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. Models with the intermittent wiper system also have a knob on the end of the switch stalk, which is rotated to select the desired delay interval. The windshield wiper and washer switch contains circuitry for the following functions:

- Windshield wipers
- Intermittent wiper delay relay control and logic (if the vehicle is so equipped)
- Intermittent wipe relay (if the vehicle is so equipped)
- 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.

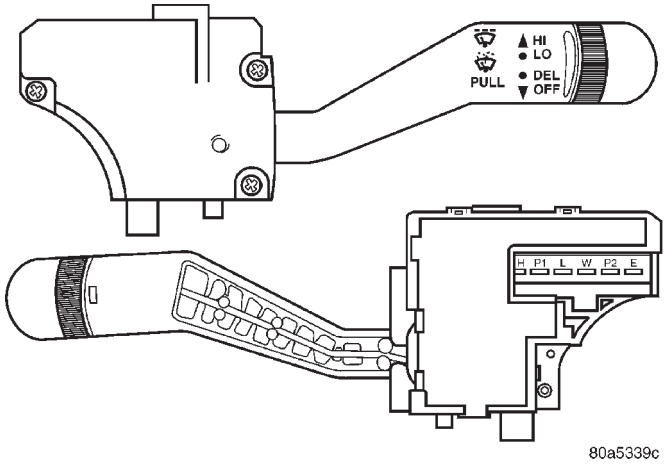


Fig. 1 Windshield Wiper Switch and Washer Switch

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, next to the ash receiver. The rear wiper and washer switch controls the rear wiper and washer functions.

The toggle-type switch features a detent in the On position, and a momentary Wash position. The rear wiper 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 front and rear washer systems. The washer fluid reservoir is secured to the inner fender shield, over the left front wheel house in the engine compartment.

Each washer pump and motor unit has a barbed nipple, which is installed through a rubber grommet seal inserted in a hole near the bottom of the reservoir. The washer pumps are retained by an interference fit between the barbed nipple and the grommet seal, which is a light press fit.

The washer reservoir has a snap-fit filler cap with a rubber gasket. The cap hinges on and is secured to a molded-in hook formation on the reservoir behind the filler neck.

The washer reservoir and filler cap are each available for service.

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.

The washer pump and motor unit cannot be repaired. If faulty, the entire washer pump and motor 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 near the rear inner hood panel reinforcement. Hoses from the tee fitting are routed to the two nozzles.

A check valve is located in the washer supply line near each of the two front nozzles, which prevents washer fluid drain-back or siphoning from occurring.

DESCRIPTION AND OPERATION (Continued)

The nozzles are snapped into openings in the hood panel below the windshield

The two washer nozzles each emit two streams of washer fluid into the wipe pattern (Fig. 2). If the aim of the washer fluid streams is unacceptable, each stream can be adjusted using a pin inserted in the nozzle orifice to rotate the nozzle ball.

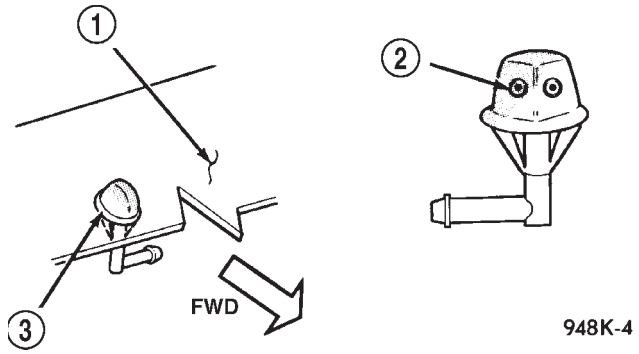


Fig. 2 Windshield Washer Nozzles

1 – HOOD
2 – ADJUST WITH A PIN
3 – NOZZLE

The nozzles, check valves 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 liftglass with the left body wire harness. At the left rear corner of the hardtop, the hose connects to a check valve, which prevents washer fluid drainback or siphoning from occurring.

There is also a washer hose cap attached to the hose below the check valve (Fig. 3). When the hardtop is removed from the vehicle, the body half of the washer hose must be disconnected from the check valve. The washer hose cap is used to plug the body half of the washer hose after it is disconnected from the check valve.

From the check valve, another single hose is routed through the rear liftglass opening reinforcements of the hardtop to the rear wiper motor cover. Behind the rear wiper motor cover, the hose attaches to the rear washer nozzle nipple.

The fluidic rear washer nozzle and a seal are installed from the outside through a hole in the liftglass near the rear wiper motor output shaft. The nozzle is secured on the inside of the glass by a plastic hex nut.

The rear washer nozzle cannot be adjusted. The nozzle, check valve, and hose fittings cannot be repaired and, if faulty or damaged, they must be replaced.

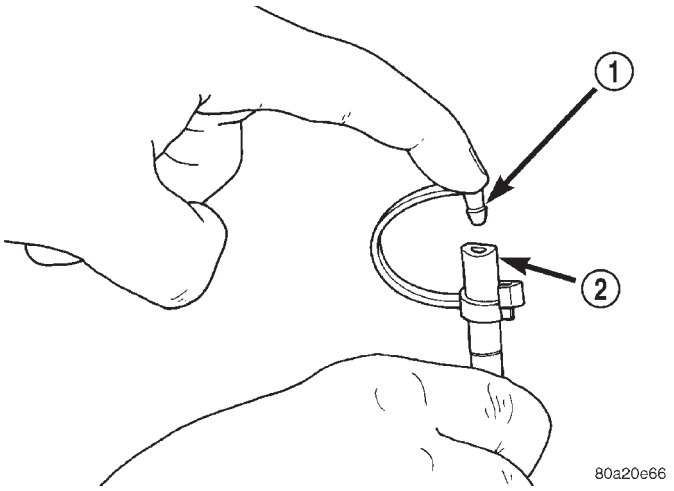


Fig. 3 Rear Washer Hose Cap

1 – CAP
2 – WASHER FLUID TUBE

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 fuse in the fuseblock module. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) 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 fuseblock module as required.

(3) If the vehicle is equipped with the optional intermittent wiper system and the problem being diagnosed involves only the pulse wipe, wipe-after-wash, or intermittent wipe modes, go to Step 4. If not, go to Step 5.

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 fuseblock module 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 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. 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 rear washer 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 fuseblock module 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 rear wiper motor cover 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 fuseblock module 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.

(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.

DIAGNOSIS AND TESTING (Continued)

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.

(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.

DIAGNOSIS AND TESTING (Continued)

WIPER SWITCH AND WASHER SWITCH

FRONT

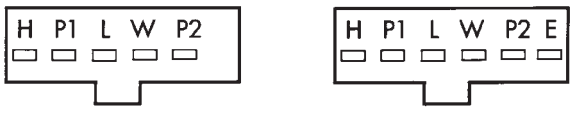
Perform the diagnosis for the front wiper system and/or washer system as described in this group before testing the front wiper and washer switch. For circuit descriptions and diagrams, see 8W-53 - Wipers in Group 8W - Wiring Diagrams.

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. 4).



SWITCH POSITION	CONTINUITY BETWEEN
OFF	PIN P2 AND PIN L
LOW	PIN P1 AND PIN L
HIGH	PIN P1 AND PIN H
WASH	PIN P1 AND PIN W
INTERMITTENT	CANNOT BE CHECKED

948K-38

Fig. 4 Windshield Wiper Switch and Washer Switch Continuity

(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.

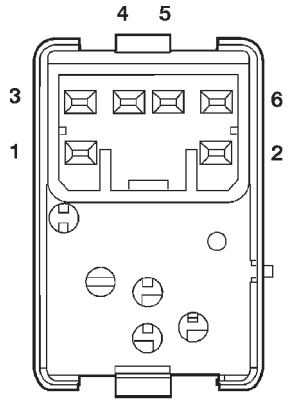
REAR

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.

(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. 5).



SWITCH POSITION	CONTINUITY BETWEEN
OFF	1 AND 4
WIPE	4 AND 5
WASH	2 AND 5, 4 AND 5
ILLUMINATION LAMP	1 AND 3

80a5035e

Fig. 5 Rear Wiper 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. 6).

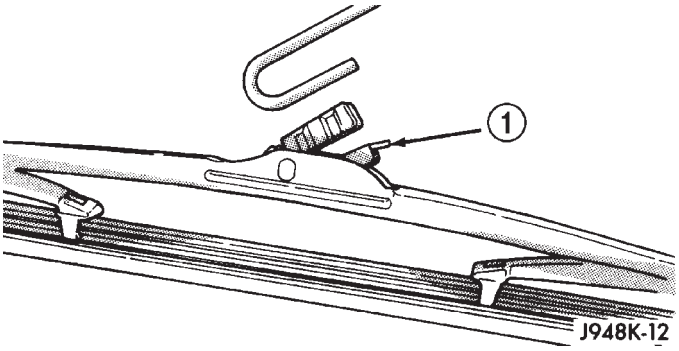


Fig. 6 Wiper Blade Remove/Install - Typical

1 – RELEASE TAB

(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. 6).

(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. 7). The arm will remain off the windshield with the latch in this position.

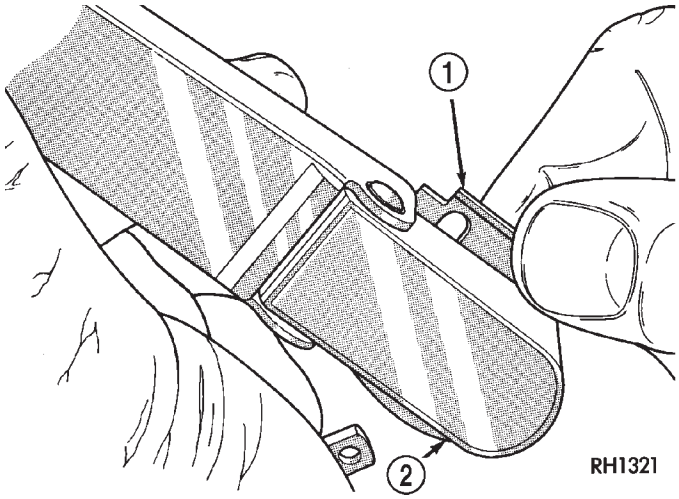


Fig. 7 Wiper Arm Remove/Install

1 – LOCKING LATCH

2 – ARM

(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. 8).

(4) Mount the arms on the pivot shafts so that the tip of the wiper blade is on the upper edge of the lower windshield blackout area, + 15 mm/ – 0 mm (+ 0.59 in./ – 0 in.).

(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.

REMOVAL AND INSTALLATION (Continued)

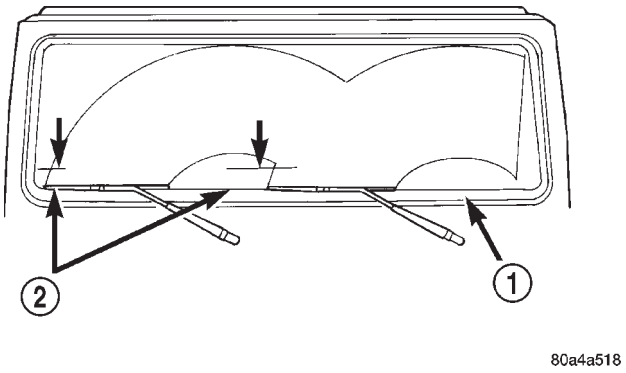


Fig. 8 Front Wiper Arm Installation

1 – WINDSHIELD BLACKOUT AREA
2 – PARK BLADE ON UPPER EDGE OF BLACKOUT AREA +15 mm — 0 mm (+0.59 in. — 0 in.)

REAR

(1) Lift the wiper arm to permit the latch to be pulled out to its holding position, then release the arm (Fig. 7). The arm will remain off the liftglass with the latch in this position.

(2) Remove the wiper arm from the motor output shaft using a rocking motion.

(3) Install the rear wiper arm with the wiper motor in the Park position. Place the rear wiper blade on the liftglass so that it is parallel to or tipped down from the upper edge of the liftglass a maximum of 80 mm (3.14 in.) (Fig. 9).

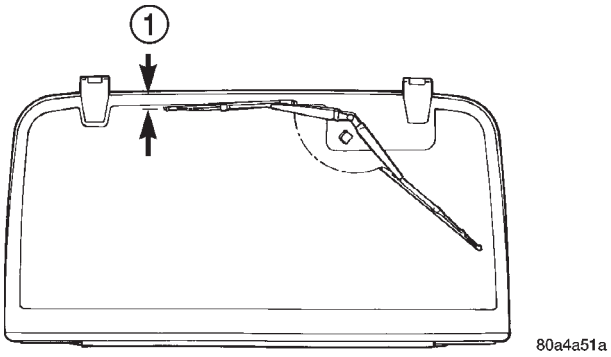


Fig. 9 Rear Wiper Arm Installation

1 – TIP OF BLADE PARALLEL TO OR TIPPED DOWN FROM EDGE OF GLASS MAXIMUM 80 mm (3.14 in.)

(4) Lift the wiper arm away from the liftglass 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 liftglass.

(5) Operate the wiper with the liftglass wet, then turn the wiper switch to the Off position. Check for the correct wiper arm positioning and readjust if required.

WIPER LINKAGE AND 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 one screw that secures the center of the cowl plenum cover/grille panel to the cowl plenum panel.

(4) Remove the four screws that secure the cowl plenum cover/grille panel to the cowl panel near the base of the windshield.

(5) Open and support the hood

(6) Pull each end of the cowl to hood seal away from the metal flange where the dash panel and cowl plenum panel meet far enough to access the one screw that secures each outboard end of the cowl plenum cover/grille panel to the cowl plenum panel (Fig. 10).

(7) Remove the one screw that secures each outboard end of the cowl plenum cover/grille panel to the cowl plenum panel.

(8) Carefully remove the cowl plenum cover/grille panel from the vehicle, so as not to damage the paint around the pivot openings of the panel.

(9) Reach into the cowl plenum and unplug the wiper motor wire harness connector.

(10) Remove the three screws that secure the wiper module mounting bracket to the cowl plenum panel (Fig. 11).

(11) Remove the wiper module from the cowl plenum as a unit.

(12) Release the retainer that secures the wiper motor wire harness connector to the wiper module bracket.

(13) Turn the wiper module over and remove the nut that secures the wiper linkage crank arm to the wiper motor output shaft.

(14) Remove the three screws that secure the wiper motor to the wiper module mounting bracket.

(15) Remove the wiper motor from the wiper module bracket.

(16) Reverse the removal procedures to install. Tighten the mounting hardware as follows:

- Wiper motor screws - 6 N·m (53 in. lbs.)
- Crank arm nut - 11.5 N·m (101 in. lbs.)
- Wiper module bracket screws - 7.9 N·m (70 in. lbs.)

REMOVAL AND INSTALLATION (Continued)

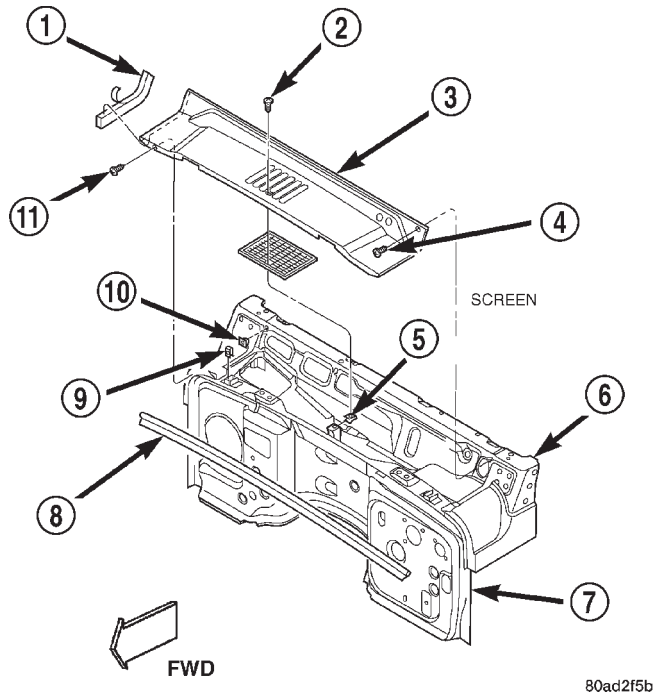


Fig. 10 Cowl Plenum Cover/Grille Panel Remove/Install

1 – SEAL
2 – SCREW
3 – COWL PLENUM COVER/GRILLE PANEL
4 – SCREW
5 – U–NUT
6 – COWL PLENUM PANEL
7 – DASH PANEL
8 – COWL TO HOOD SEAL
9 – U–NUT
10 – PLASTIC NUT
11 – SCREW

- Cowl plenum cover/grille panel screws - 1.7 N·m (15 in. lbs.).

REAR

(1) Disconnect and isolate the battery negative cable.

(2) From the outside of the liftglass, 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 liftglass, remove the rear wiper motor output shaft nut and bezel unit (Fig. 12).

(4) From the outside of the liftglass, remove the rear wiper motor output shaft rubber gasket.

(5) From the inside of the liftglass, remove the three screws that secure the rear wiper motor cover to the motor.

(6) Unplug the rear wiper motor wire harness connector.

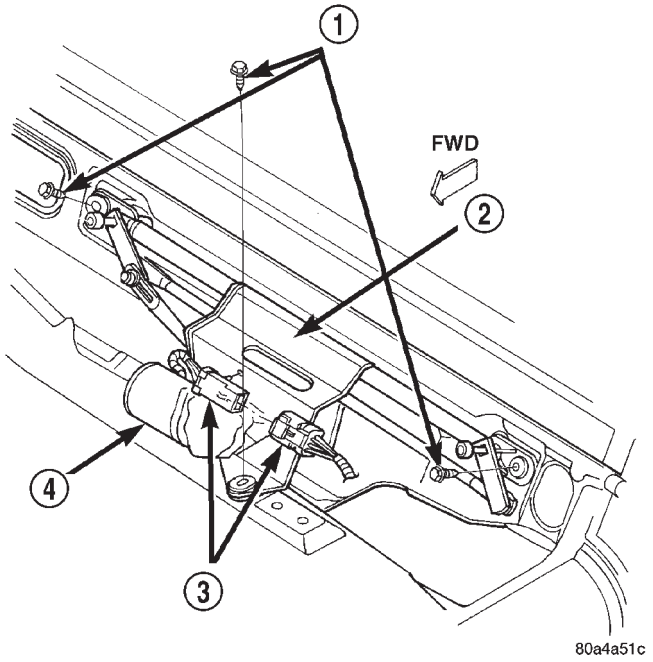


Fig. 11 Wiper Module Assembly Remove/Install

1 – SCREW
2 – LINKAGE ASSEMBLY
3 – CONNECTOR
4 – WIPER MOTOR

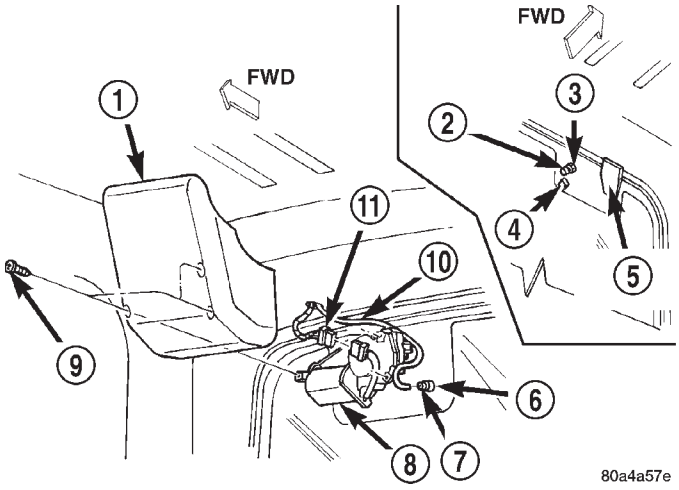


Fig. 12 Rear Wiper and Washer System

1 – COVER
2 – OUTPUT SHAFT
3 – NUT
4 – NOZZLE
5 – HINGE COVER
6 – NUT
7 – NOZZLE
8 – MOTOR
9 – SCREW
10 – HOSE
11 – CONNECTOR

REMOVAL AND INSTALLATION (Continued)

(7) Loosen, but do not remove, the right liftglass hinge nut.

(8) From the inside of the liftglass, gently pull the rear wiper motor away from the liftglass until the output shaft clears the hole in the liftglass.

(9) Move the motor towards the right side of the vehicle until the slotted hole in the motor mounting bracket clears the grommet under the right liftglass hinge nut.

(10) Remove the rear wiper motor from the vehicle.

(11) Reverse the removal procedures to install. Tighten the mounting hardware as follows:

- Wiper motor output shaft nut - 3.3 N·m (30 in. lbs.)
- Liftglass hinge nut - 6 N·m (53 in. lbs.)
- Wiper motor cover screws - 1.1 N·m (10 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.

(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) Remove the three screws that secure the lower steering column shroud to the upper shroud (Fig. 13).

(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.

(5) Remove both the upper and lower shrouds from the steering column.

(6) Remove the two screws that secure the switch water shield and bracket to the top of the steering column (Fig. 14).

(7) Remove the one screw located below the multi-function switch lever that secures the switch water shield and bracket to the steering column (Fig. 15).

(8) Gently pull the lower mounting tab of the switch water shield bracket away from the steering column far enough to clear the screw boss below the multi-function switch lever.

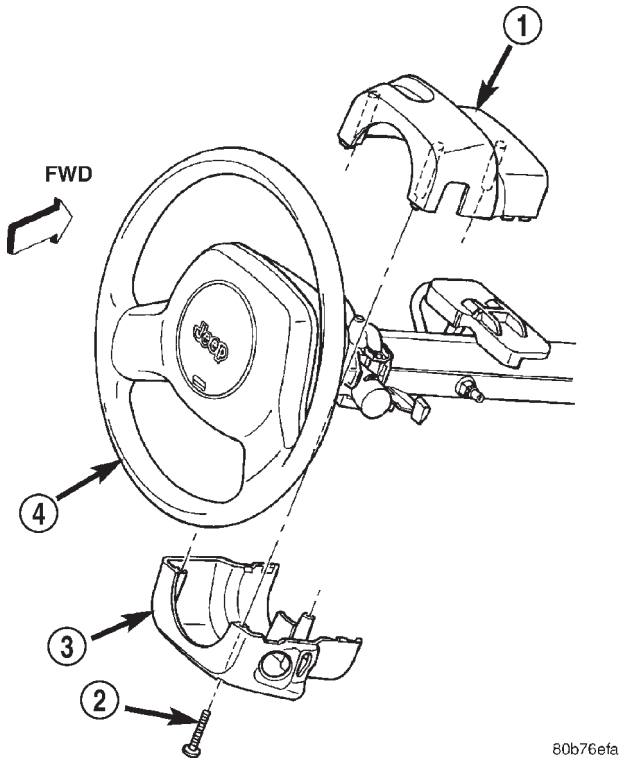


Fig. 13 Steering Column Shrouds Remove/Install

1 – UPPER SHROUD
2 – SCREW (3)
3 – LOWER SHROUD
4 – STEERING WHEEL

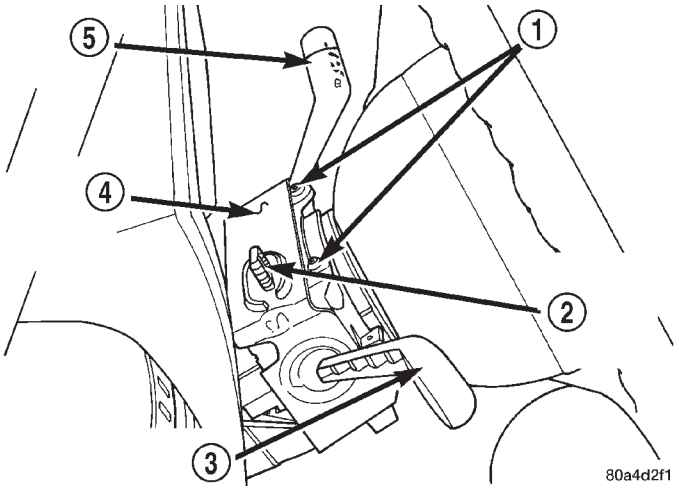


Fig. 14 Water Shield Upper Screws Remove/Install

1 – MOUNTING SCREWS
2 – HAZARD WARNING SWITCH KNOB
3 – MULTI-FUNCTION SWITCH LEVER
4 – WATER SHIELD AND BRACKET
5 – WIPER SWITCH LEVER

REMOVAL AND INSTALLATION (Continued)

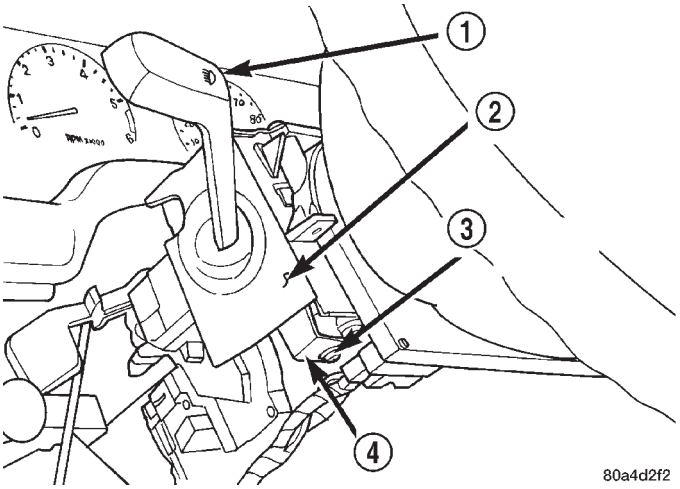


Fig. 15 Water Shield Lower Screw Remove/Install

1 – MULTI-FUNCTION SWITCH LEVER
2 – WATER SHIELD AND BRACKET
3 – LOWER MOUNTING SCREW
4 – LOWER MOUNTING TAB

(9) 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.

(10) 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.

(11) Unplug the wire harness connector from the windshield wiper and washer switch.

(12) Remove the windshield wiper and washer switch from the steering column.

(13) 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 four screws that secure the accessory switch bezel to the instrument panel (Fig. 16).

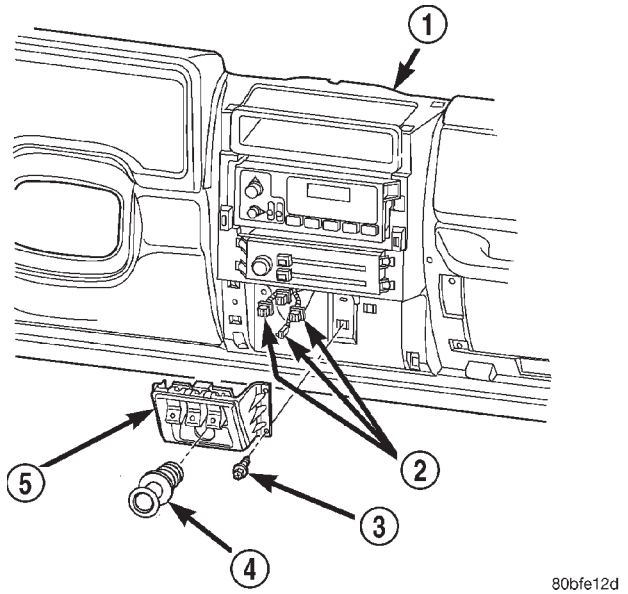


Fig. 16 Accessory Switch Bezel Remove/Install

1 – INSTRUMENT PANEL
2 – WIRE HARNESS CONNECTORS
3 – SCREW
4 – CIGAR LIGHTER
5 – ACCESSORY SWITCH BEZEL

(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.

(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.).

REMOVAL AND INSTALLATION (Continued)

WASHER SYSTEM

WASHER RESERVOIR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the three screws that secure the washer reservoir to the inner fender (Fig. 17).

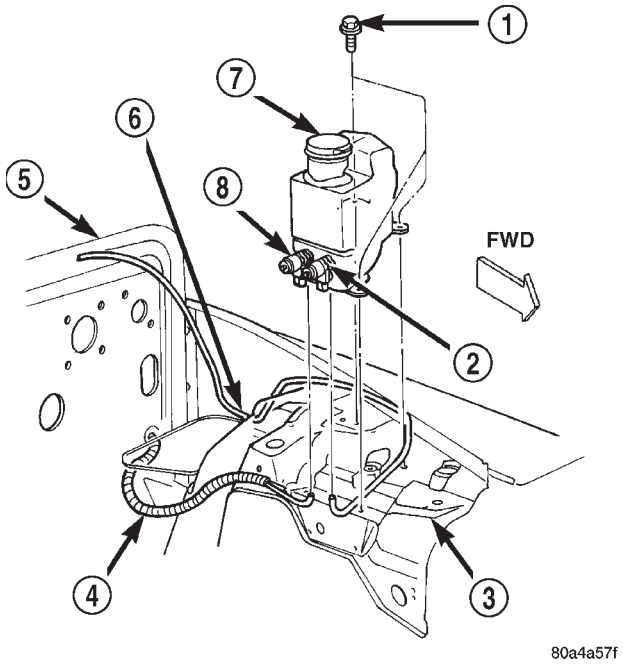


Fig. 17 Washer Reservoir Remove/Install

1 – SCREW
2 – FRONT PUMP
3 – INNER FENDER
4 – REAR WASHER HOSE
5 – DASH PANEL
6 – FRONT WASHER HOSE
7 – RESERVOIR
8 – REAR PUMP

(3) Lift the reservoir far enough to access the washer pump(s).

(4) 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.

(5) Unplug the wire harness connector(s) from the washer pump(s).

(6) Remove the washer reservoir from the vehicle.

(7) Reverse the removal procedures to install. Tighten the reservoir mounting screws to 4 N·m (35 in. lbs.).

WASHER PUMP

(1) Disconnect and isolate the battery negative cable.

(2) 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.

(3) Unplug the wire harness connector(s) from the washer pump(s).

(4) 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.

(5) Remove the rubber grommet seal from the reservoir and discard.

(6) Reverse the removal procedures to install. Always use a new rubber grommet seal on the reservoir.

WASHER NOZZLE

FRONT

(1) Open and support the hood.

(2) From under the rear of the hood, disconnect the washer supply hose from the barbed nipple of the washer nozzle (Fig. 18).

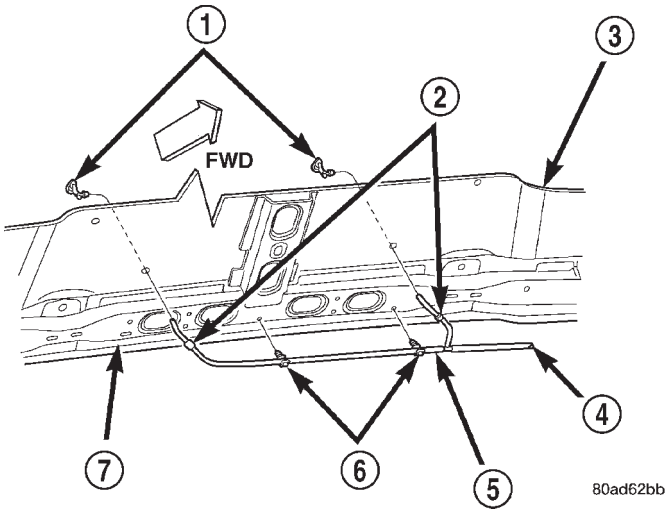


Fig. 18 Front Washer Nozzles Remove/Install

1 – NOZZLES
2 – CHECK VALVES
3 – HOOD
4 – TO RESERVOIR
5 – HOSE
6 – CLIPS
7 – REAR HOOD REINFORCEMENT

(3) From under the rear of the hood, gently squeeze the nozzle retainers and push the nozzle out through the top of the hood panel.

(4) Reverse the removal procedures to install. See Washer Nozzles and Plumbing in this group for the nozzle adjustment procedures.

REMOVAL AND INSTALLATION (Continued)

REAR

(1) Disconnect and isolate the battery negative cable.

(2) From the inside of the liftglass, remove the three screws that secure the rear wiper motor cover to the motor (Fig. 19).

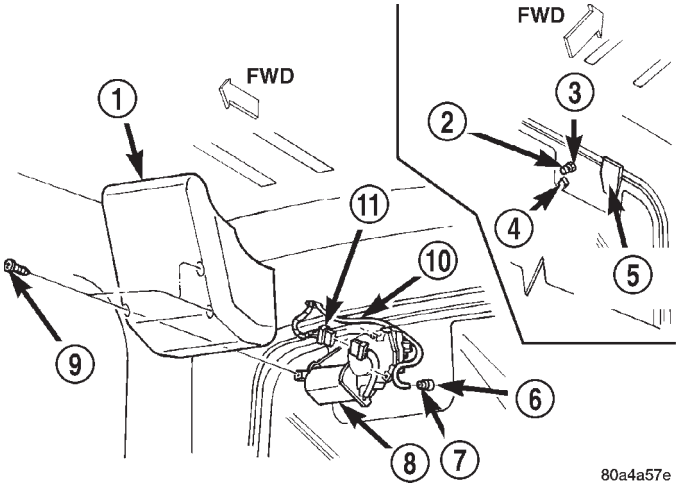


Fig. 19 Rear Washer Nozzle Remove/Install

1 – COVER
2 – OUTPUT SHAFT
3 – NUT
4 – NOZZLE
5 – HINGE COVER
6 – NUT
7 – NOZZLE
8 – MOTOR
9 – SCREW
10 – HOSE
11 – CONNECTOR

(3) Remove the rear wiper motor cover.

(4) Disconnect the washer supply hose from the barbed rear washer nozzle nipple.

(5) While holding the nozzle securely from the outside of the liftglass, remove the plastic nut that secures the threaded nozzle nipple from the inside of the liftglass.

(6) Push the nozzle and seal out through the liftglass from the inside.

(7) Reverse the removal procedures to install. Tighten the washer nozzle nut to 0.9 N·m (8 in. lbs.).

CHECK VALVE

A check valve is located under the hood in the washer supply line near each of the front washer nozzles. Models with the optional rear washer system also have a check valve in the washer supply line in the left rear pillar of the hardtop, near where the hardtop joins the vehicle body.

(1) Disconnect the washer supply hoses from the barbed nipples on each end of the front or rear washer system check valve.

(2) Remove the check valve from the vehicle.

(3) When reinstalling the check valve, be certain the valve is properly oriented within the system flow (Fig. 20).

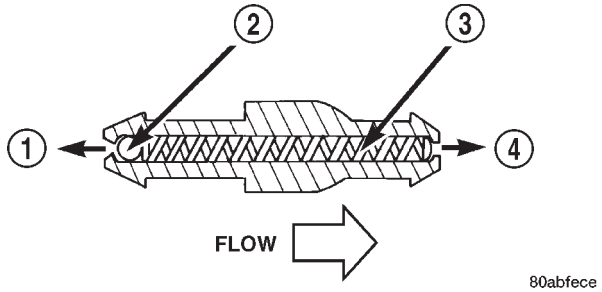


Fig. 20 Washer System Check Valve

1 – TO RESERVOIR
2 – CHECKBALL
3 – SPRING
4 – TO NOZZLE

(4) Reverse the remaining removal procedures to complete the installation.

LAMPS

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LAMP SYSTEMS

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DESCRIPTION AND OPERATION

LAMP SYSTEMS

Each vehicle is equipped with various lamp assemblies. A good ground is necessary for proper lighting operation. Grounding is provided through a separate ground wire.

HEADLAMPS

DESCRIPTION

Headlamps on the Wrangler are sealed beam units. Each unit contains a high and low beam.

OPERATION

The headlamps are controlled by the headlamp switch and the multifunction switch. Each headlamp unit can be serviced individually.

HEADLAMP SWITCH

DESCRIPTION

The headlamp switch is located on the instrument panel. The headlamp switch controls the parking lamps, the headlamps, the interior lamps, and instrument cluster illumination. The headlamp switch also contains a rheostat for controlling the illumination level of the instrument cluster lamps.

OPERATION

The headlamp switch has an off position, a parking lamp position, and a headlamp on position. High beams are controlled by the multifunction switch on the steering column. The headlamp switch cannot be repaired, it must be replaced. Refer to Group 8E for removal and installation procedures, and Group 8W for circuit information.

TAIL/TURN SIGNAL/STOP/BACK-UP LAMP

DESCRIPTION

The rear tail lamp modules are mounted on rear of the vehicle, outboard of the tailgate. Each module contains two bulbs, a lens, and a housing. One bulb is a two filament bulb used for tail, stop, and turn signal functions. The other bulb is a single filament bulb used for back-up light illumination.

OPERATION

Each tail lamp module can be serviced separately. Each bulb can also be serviced separately. The headlamp switch controls tail lamp operation. The multifunction switch controls turn signal operation, and the back-up light switch controls the back-up light operation. The brake lamp switch controls the stop lamp function.

DESCRIPTION AND OPERATION (Continued)

FRONT TURN SIGNAL/PARKING LAMP

DESCRIPTION

The front turn signal/parking lamp is a separate module. Each module contains a housing, a lens, and bulb. The components are serviceable separately.

OPERATION

The parking light function is controlled by the headlamp switch located on the instrument panel. The turn signal function is controlled by the multi-function switch located on the steering column. Each front turn signal/parking lamp module can be serviced separately.

CHMSL LAMP (CENTER HIGH MOUNTED STOP LAMP)

DESCRIPTION

The center high mounted stop lamp (CHMSL) is mounted on a bracket above the spare tire carrier.

OPERATION

CHMSL operation is controlled by the brake lamp switch through button contacts on the tailgate hinge.

DAYTIME RUNNING LAMPS

DESCRIPTION

The Daytime Running Lights (Headlamps) System is installed on vehicles manufactured for sale in Canada only. A separate module, mounted on the cowl, controls the DRL.

OPERATION

The headlamps are illuminated when the engine is running and the parking brake is OFF. The lamps are illuminated at less than normal intensity.

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.

LAMP DIAGNOSIS

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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.

HEADLAMP

HEADLAMP DIAGNOSIS

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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	3. Faulty headlamps switch circuit breaker.	3. Replace headlamp switch. Refer to Goup 8E.
	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. Refer to Group 8E.
	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.
	6. Both headlamp bulbs defective.	6. Replace both headlamp bulbs.
*Canada vehicles must have lamps ON.		

FOG LAMP

FOG LAMP DIAGNOSIS

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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	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.

DAYTIME RUNNING LAMP

DAYTIME RUNNING LAMP DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
DAYTIME RUNNING LAMPS DO NOT WORK	1. Poor connection at DRL module. 2. Parking brake engaged. 3. Parking brake circuit shorted to ground. 4. Headlamp circuit shorted to ground. 5. Defective DRL module.	1. Secure connector on DRL module. 2. Disengage parking brake. 3. Check voltage on pin 3 of module, refer to Group 8W. 4. Check L3 circuit, refer to Group 8W. 5. Replace DRL module.

HEADLAMP ALIGNMENT

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SERVICE PROCEDURES

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.

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.

(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

(1) Place headlamps on LOW beam.

(2) Cover front of the headlamp that is not being adjusted.

(3) Turn the upper, outboard (up/down) adjustment screw (Fig. 2) until the headlamp beam pattern on screen/wall is similar to the pattern depicted in (Fig. 1).

NOTE: When using a headlamp aiming screen:

- Adjust the headlamps so that the beam horizontal position is at 0.
- Adjust the beam vertical position is 25 mm (1 in) downward from the lamp horizontal centerline.

(4) Rotate the lower, inboard (left/right) adjustment screw (Fig. 2) until the headlamp beam pattern on the aiming screen/wall similar to the pattern in (Fig. 1).

(5) Cover front of the headlamp that has been adjusted and adjust the other headlamp beam as instructed above.

SERVICE PROCEDURES (Continued)

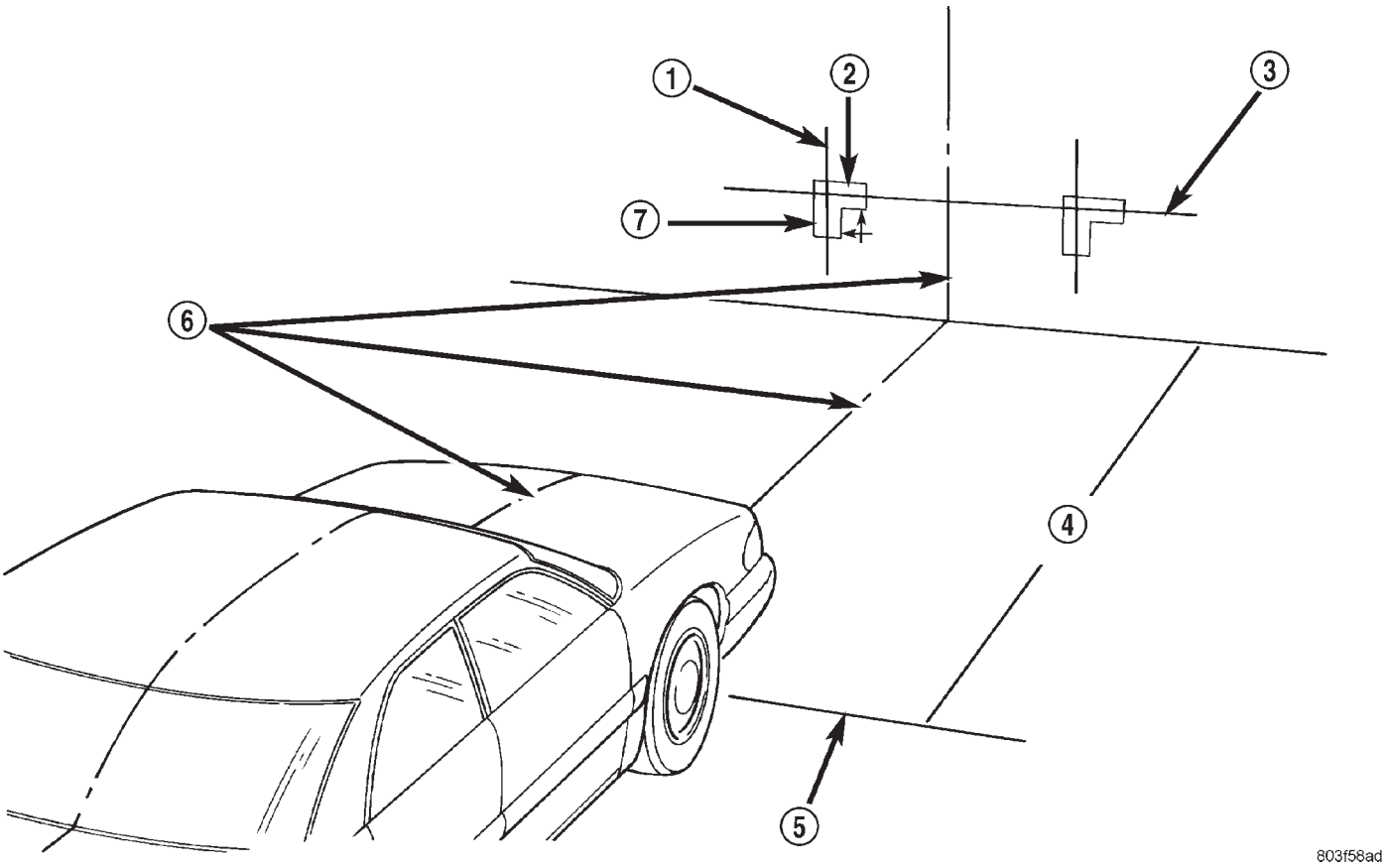


Fig. 1 Headlamp Alignment Screen—Typical

1 – CENTER OF VEHICLE TO CENTER OF HEADLAMP LENS
2 – TOP EDGE OF HIGH INTENSITY ZONE
3 – FLOOR TO CENTER OF HEADLAMP LENS
4 – 7.62 METERS (25 FEET)
5 – FRONT OF HEADLAMP
6 – VEHICLE CENTERLINE
7 – LEFT EDGE OF HIGH INTENSITY ZONE

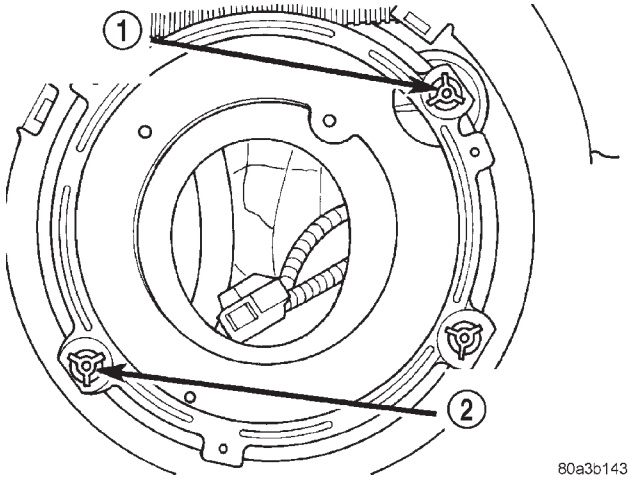


Fig. 2 Headlamp Adjustment Screws

1 – UP/DOWN ADJUSTMENT SCREW
2 – LEFT/RIGHT ADJUSTMENT SCREW

FOG LAMP ADJUSTMENT

Prepare an alignment screen. A properly aligned fog lamp will project a pattern on the alignment screen 100 mm (4 in.) below the fog lamp centerline and straight ahead (Fig. 3).

(1) Loosen the nut attaching the fog lamp to the mounting bracket (Fig. 4).

(2) Move the fog lamp to adjust beam height.

(3) Tighten the nut attaching the fog lamp to the mounting bracket.

SERVICE PROCEDURES (Continued)

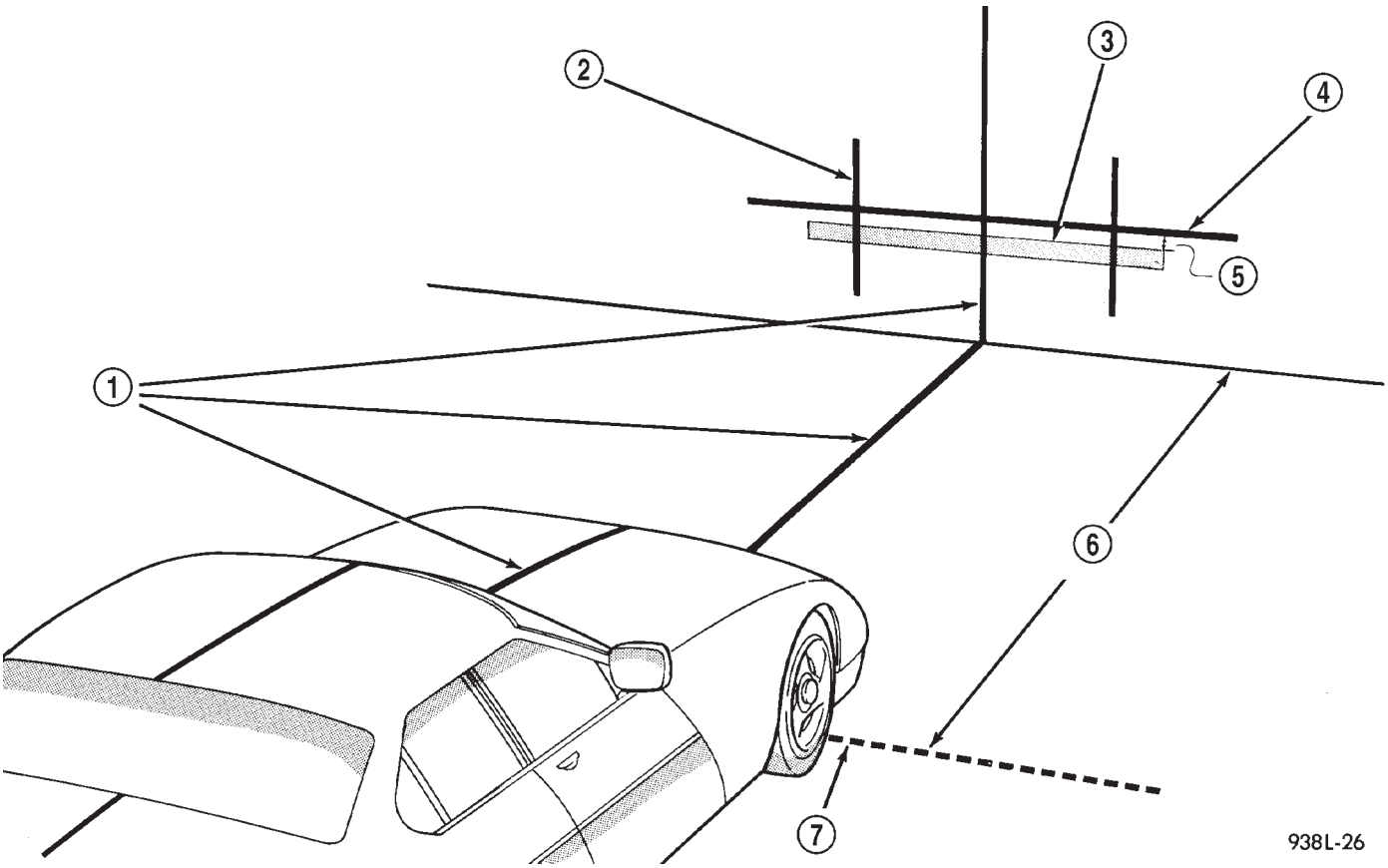


Fig. 3 Fog Lamp Alignment —Typical

1 – VEHICLE CENTERLINE
2 – CENTER OF VEHICLE TO CENTER OF FOG LAMP LENS
3 – HIGH-INTENSITY AREA
4 – FLOOR TO CENTER OF FOG LAMP LENS
5 – 100 mm (4 in.)
6 – 7.62 METERS (25 FEET)
7 – FRONT OF FOG LAMP

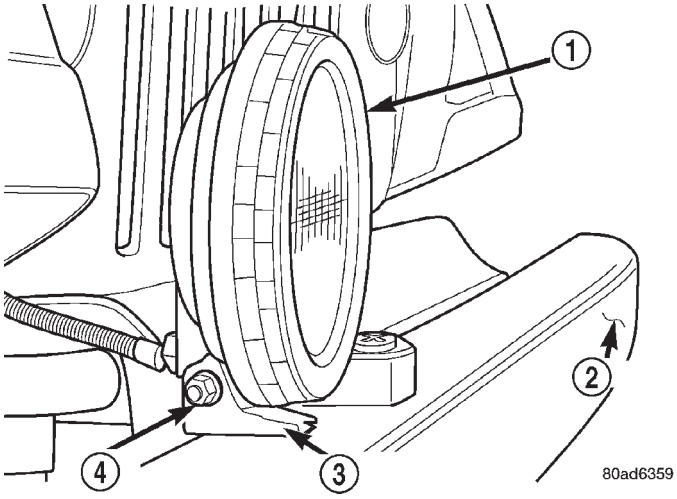
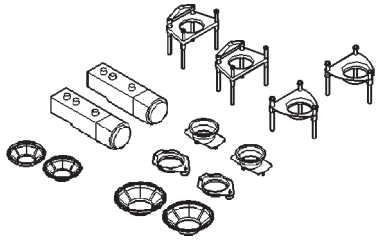


Fig. 4 Fog Lamp Adjustment

1 – FOG LAMP
2 – BUMPER
3 – MOUNTING BRACKET
4 – NUT

SPECIAL TOOLS

HEADLAMP ALIGNMENT



Headlamp Aiming Kit C-4466–A

LAMP BULB SERVICE

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REMOVAL AND INSTALLATION

HEADLAMP BULB

The headlamp is a sealed unit. Refer to the Headlamp Removal/Installation procedure located in the Lamp Service section of this group.

FOG LAMP BULB

REMOVAL

(1) Remove the screws that attach the reflector to the lamp housing.
(2) Separate the reflector from the lamp housing.
(3) Squeeze the bulb retainer together to disengage it from the reflector.
(4) Remove the bulb/element from the reflector (Fig. 1).
(5) Disconnect the electrical connector.

INSTALLATION

CAUTION: Do not touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Connect the electrical connector.
(2) Position the bulb/element in the reflector.
(3) Engage the bulb retainer.
(4) Position the reflector in the lamp housing.
(5) Install the screws that attach the reflector to the lamp housing.

FRONT PARK/TURN SIGNAL LAMP BULB

REMOVAL

(1) Remove the park/turn signal lamp bulb socket via the underside of the fender.
(2) Rotate the bulb socket one-third turn counterclockwise and separate it from the lamp housing.
(3) Pull the bulb straight out of the socket.

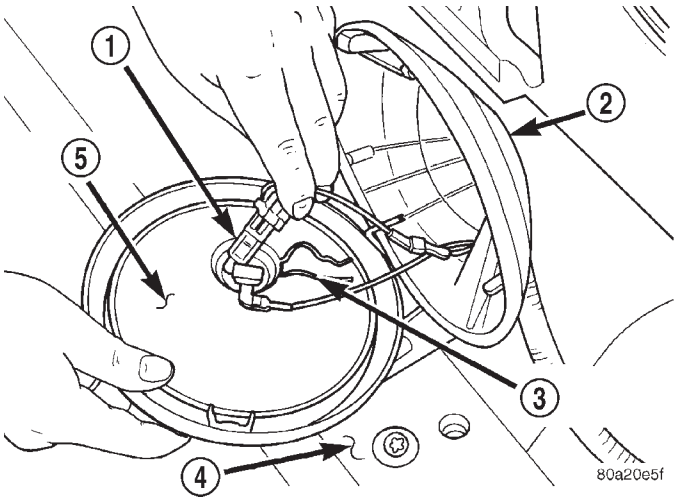


Fig. 1 Fog Lamp Bulb

1 – BULB
2 – FOG LAMP HOUSING
3 – BULB RETAINER
4 – FRONT BUMPER
5 – REFLECTOR HOUSING

INSTALLATION

(1) Install the bulb in the socket.
(2) Install the bulb and socket in the lamp housing.

SIDE MARKER LAMP BULB

REMOVAL

(1) Remove side marker bulb socket via the underside of the fender. Rotate it one-third turn counterclockwise and separate it from the side marker lamp housing.
(2) Remove the bulb from the socket by pulling it straight outward.

INSTALLATION

(1) Install a replacement bulb in the socket.

REMOVAL AND INSTALLATION (Continued)

(2) Install the bulb and socket in the side marker lamp housing.

TAIL/BRAKE/TURN SIGNAL/BACK-UP LAMP BULB

REMOVAL

(1) Remove the screws attaching the lens to the tail lamp housing (Fig. 2).

(2) Separate the lens from the tail lamp housing.

(3) Push the bulb inward and rotate counter-clockwise.

(4) Remove the bulb from the lamp socket.

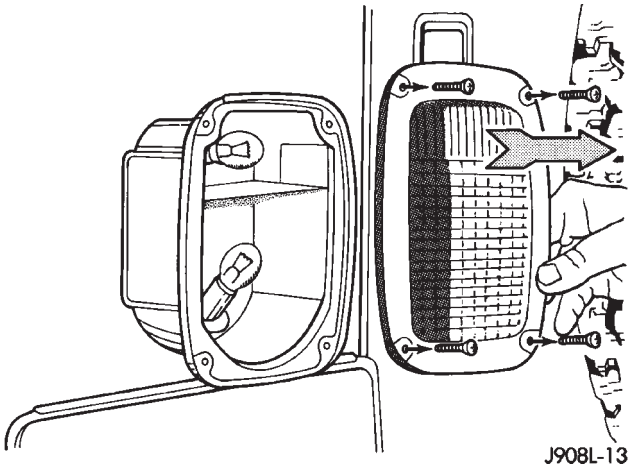


Fig. 2 Lens Removal

INSTALLATION

(1) Install a replacement bulb in the lamp socket.

(2) Position the lens on the lamp housing.

(3) Install the screws. Tighten the screws securely.

BACK-UP LAMP BULB

The back-up lamp bulb is located with-in the tail lamp. Refer to the Tail Lamp Bulb Removal/Installation procedure.

CENTER HIGH MOUNTED STOP LAMP (CHMSL) BULB

REMOVAL

(1) Remove the screws attaching the CHMSL lens to the CHMSL (Fig. 3).

(2) Rotate the bulb socket one third turn counter-clockwise and separate from lamp housing.

(3) Pull the bulb straight out of the socket.

INSTALLATION

(1) Install the bulb.

(2) Position the lens on the CHMSL and install the screws.

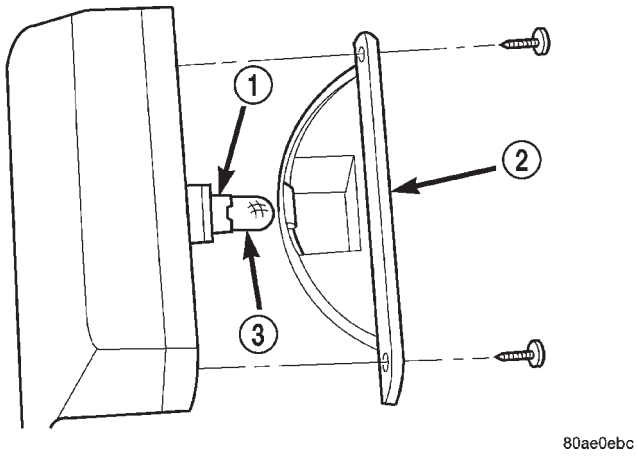


Fig. 3 CHMSL Bulb

1 – SOCKET
2 – CHMSL
3 – BULB

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. 4).

(3) Depress the bulb terminal inward (Fig. 5) to release the bulb.

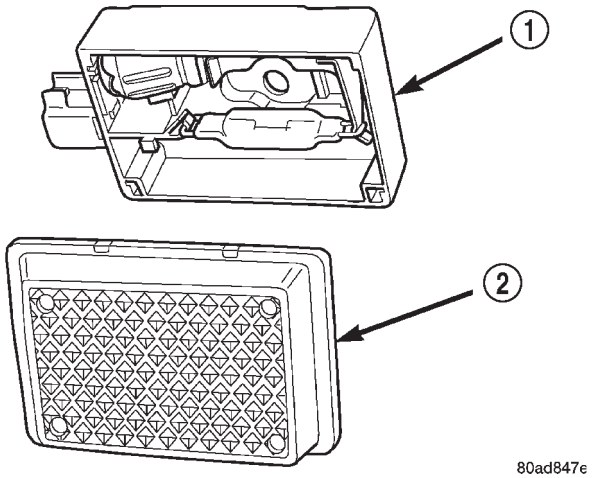


Fig. 4 Underhood Lamp Lens

1 – LAMP
2 – LAMP LENS

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.

REMOVAL AND INSTALLATION (Continued)

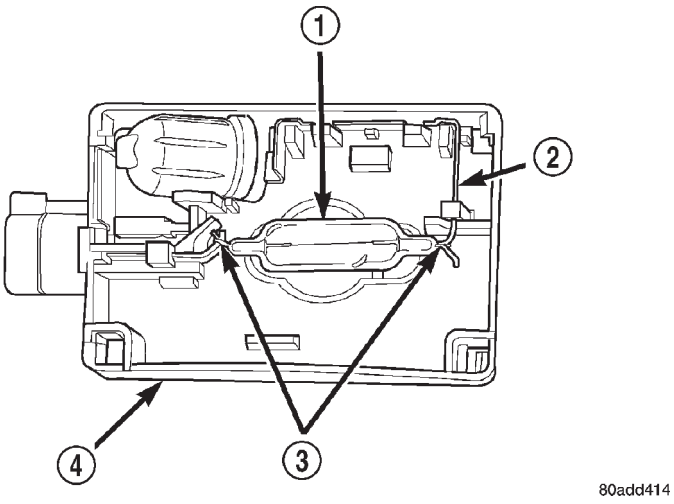


Fig. 5 Underhood Lamp Bulb

1 – BULB
2 – DEPRESS TERMINAL INWARD
3 – BULB WIRE LOOP
4 – LAMP BASE

DOME LAMP

SOUND BAR DOME LAMP BULB REMOVAL

(1) Insert a small flat blade between the lamp housing and lamp lens. Carefully pry lamp lens to disengage lens retaining tabs.
(2) Separate lens from lamp housing.
(3) Grasp bulb and pull from lamp.

SOUND BAR DOME LAMP BULB INSTALLATION

(1) Position bulb in lamp socket and press into place.
(2) Position lamp lens on lamp housing and press into place.

CARGO AREA DOME LAMP BULB REMOVAL

(1) Remove the dome/cargo lamp lens by squeezing it at the lens at the top and bottom (Fig. 6). This will separate the lens retaining tabs from the lamp housing shoulders.
(2) Remove the lens from the lamp housing.
(3) Pull the bulb straight out to remove from the bulb holder.

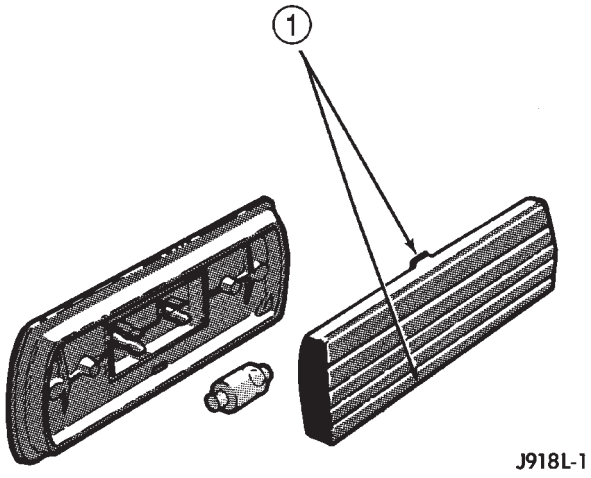


Fig. 6 Cargo Area Dome Lamp

1 – SQUEEZE THE LENS

CARGO AREA DOME LAMP BULB INSTALLATION

(1) Insert the replacement bulb in the bulb holder.
(2) Position lens at the lamp housing and press into the housing until the retainer tabs are seated.

LAMP SERVICE

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REMOVAL AND INSTALLATION

HEADLAMP

REMOVAL

(1) Remove the screws that attach the headlamp bezel (Fig. 1).

(2) Remove the screws that attach the headlamp retaining ring (Fig. 2).

(3) Disconnect the headlamp wire harness connector and remove the bulb from the bucket (Fig. 3).

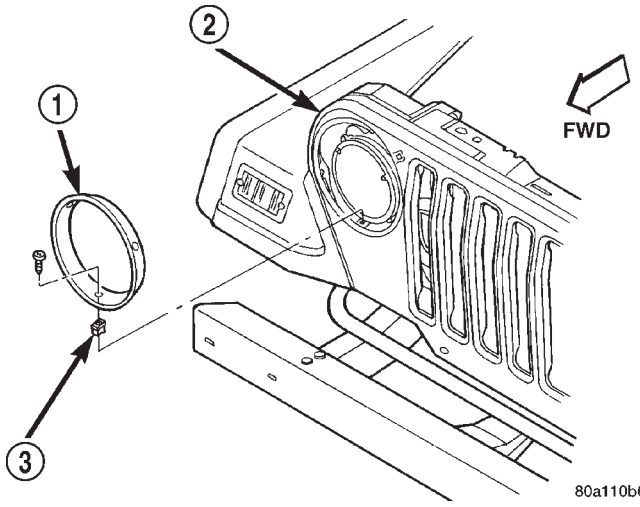


Fig. 1 Headlamp Bezel

1 – HEADLAMP BEZEL
2 – GRILLE
3 – NUT

INSTALLATION

(1) Connect the wire harness connector and position the bulb in the bucket.

(2) Position retaining ring on the headlamp bulb and install screws.

(3) Install the headlamp bezel. Tighten the screws securely.

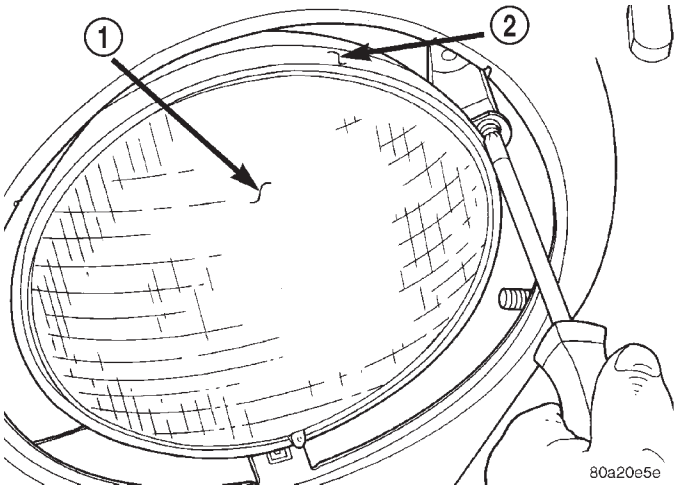


Fig. 2 Headlamp Retaining Ring

1 – HEADLAMP
2 – HEADLAMP RETAINER

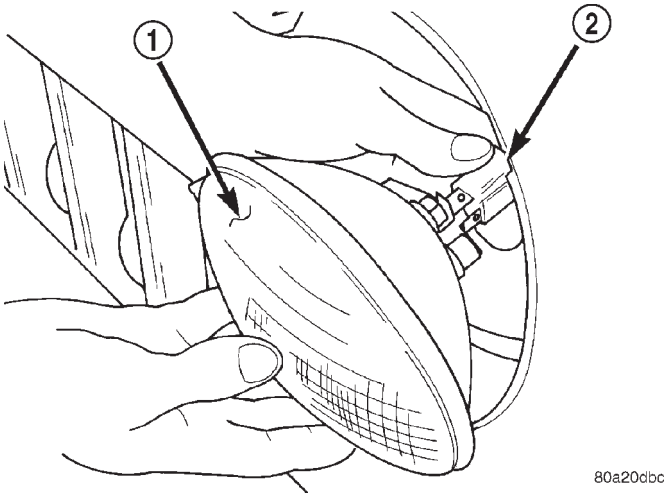


Fig. 3 Headlamp Connector

1 – HEADLAMP
2 – CONNECTOR

REMOVAL AND INSTALLATION (Continued)

FOG LAMP

REMOVAL

(1) Disconnect the fog lamp wire harness connector.
(2) Remove the nut attaching the fog lamp to the front bumper.
(3) Separate the fog lamp from the bumper.

INSTALLATION

(1) Position the fog lamp on the bumper.
(2) Install the nut attaching the fog lamp to the front bumper.
(3) Connect the fog lamp wire harness connector.

FRONT PARK/TURN SIGNAL LAMP

REMOVAL

(1) Remove the park/turn signal lamp housing screws (Fig. 4).
(2) Separate the park/turn signal lamp housing from the fender.
(3) Rotate bulb socket one third turn counter-clockwise and separate bulb socket from lamp.

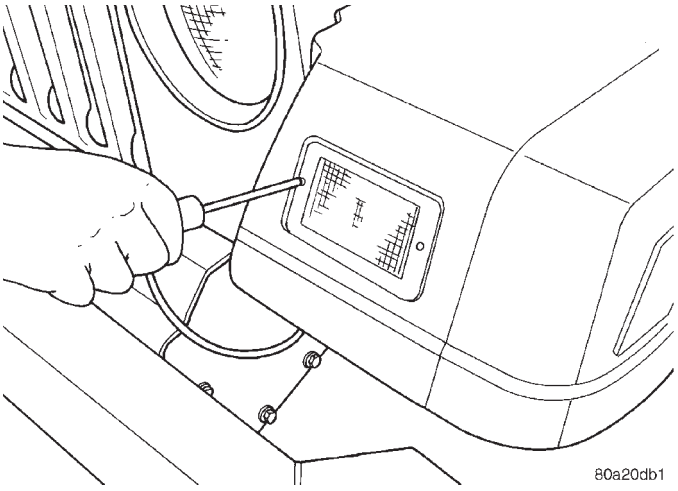


Fig. 4 Park/Turn Signal Lamp

INSTALLATION

(1) Install the bulb socket in the lamp housing.
(2) Position the park/turn signal lamp housing in the fender.
(3) Install the park/turn signal lamp housing screws.

SIDE MARKER LAMP

REMOVAL

(1) From underside of the fender, remove nut attaching marker lamp to fender.
(2) Separate lamp from fender.
(3) Rotate bulb socket one-third turn counter-clockwise and separate socket from lamp housing.

INSTALLATION

(1) Position bulb socket in lamp housing and rotate bulb socket one-third turn clockwise.
(2) Position lamp in fender.
(3) Install nut attaching marker lamp to fender.

TAIL/BRAKE/TURN SIGNAL/BACK-UP LAMP

REMOVAL

(1) From the underside of the vehicle, remove the push-in fastener attaching the bottom rear edge of the rear wheelhouse splash shield to the body.
(2) Pull the rear of the wheelhouse splash shield away from the body and reach upward to disengage the tail lamp electrical connector.
(3) Remove the screws attaching the lens to the tail lamp housing.
(4) Remove the bolts attaching the tail lamp housing to the body (Fig. 5).
(5) Separate the lamp housing from the body.

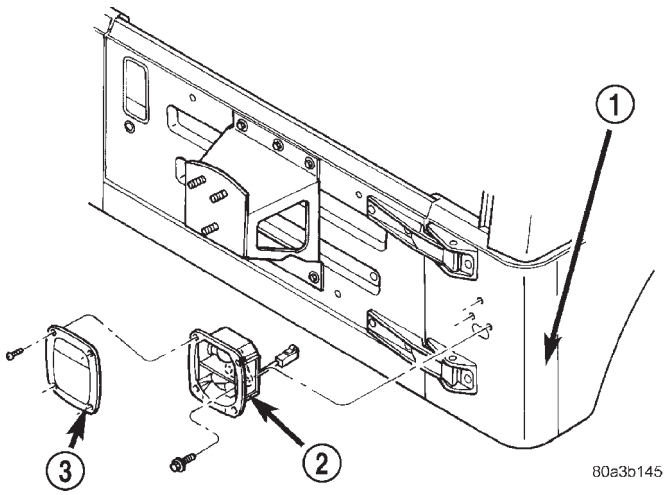


Fig. 5 Tail Lamp Housing

1 – BODY
2 – TAIL LAMP
3 – LAMP LENS

INSTALLATION

(1) Engage the electrical connector.
(2) Install the push-in fastener attaching the bottom rear edge of the rear wheelhouse splash shield to the body.
(3) Position the lamp housing on the body.
(4) Install the bolts attaching the tail lamp housing to the body.
(5) Install the screws attaching the lens to the tail lamp housing.

REMOVAL AND INSTALLATION (Continued)

CENTER HIGH MOUNTED STOP LAMP (CHMSL)

REMOVAL

NOTE: It may be necessary to remove spare tire.

(1) Remove screws attaching CHMSL lamp/bracket to spare tire carrier bracket.
(2) Disengage CHMSL wire harness from retaining clips.
(3) Remove cover from CHMSL contact buttons.
(4) Carefully pull wire harness terminal ends from contact buttons (Fig. 6).
(5) Route wire harness through tailgate and separate CHMSL from vehicle.

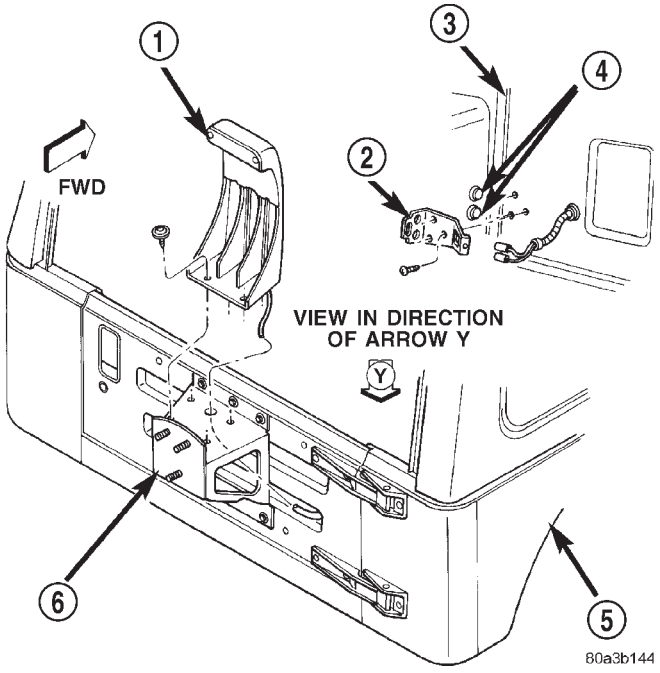


Fig. 6 CHMSL Contact Buttons

1 – CHMSL MOUNTING BRACKET
2 – CHMSL CONTACT BUTTON TAILGATE CLAMP
3 – BODY
4 – CONTACT BUTTONS
5 – BODY
6 – SPARE TIRE MOUNTING BRACKET

INSTALLATION

(1) Position CHMSL lamp/bracket on spare tire carrier bracket and install screws.
(2) Route wire harness through tailgate.
(3) Install wire harness terminal ends onto contact buttons.
(4) Install cover over CHMSL contact buttons.
(5) Position CHMSL wire harness into CHMSL bracket retaining clips and engage clips.

UNDERHOOD LAMP

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.

INSTALLATION

(1) Install bulb.
(2) Install lamp lens.
(3) Position the underhood lamp flange on the hood inner panel.
(4) Install the attaching screw through the lamp flange and into the hood panel (Fig. 7). Tighten the screw securely.
(5) Fold lamp housing over and firmly press onto base to snap into place.
(6) Connect the wire harness connector to the lamp.

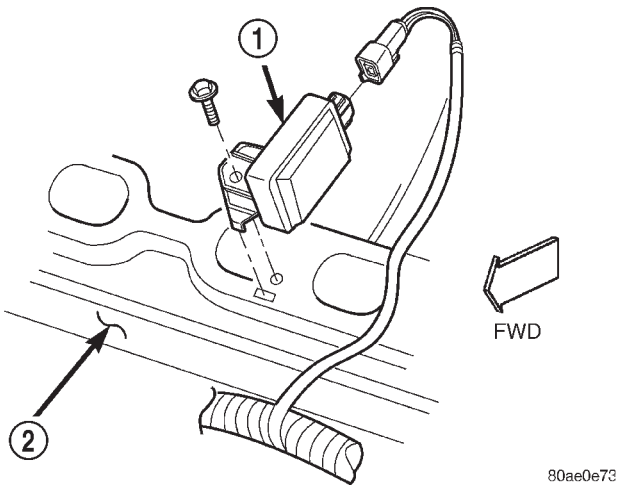


Fig. 7 Underhood Lamp

1 – UNDER HOOD LAMP
2 – HOOD

DOME LAMP

SOUND BAR DOME LAMP REMOVAL

(1) Insert a small flat blade between the lamp housing and lamp lens. Carefully pry lamp lens from the lamp housing.
(2) Separate lens from lamp.
(3) Remove the screws attaching the lamp to the sound bar (Fig. 8).
(4) Disengage lamp electrical connector.

REMOVAL AND INSTALLATION (Continued)

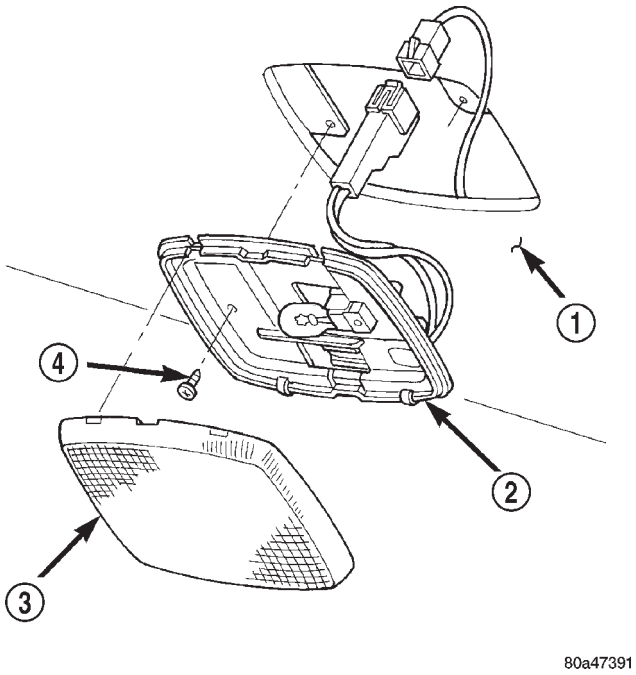


Fig. 8 Sound Bar Dome Lamp

1 – SOUND BAR
2 – DOME LAMP HOUSING
3 – DOME LAMP LENS
4 – SCREW

SOUND BAR DOME LAMP INSTALLATION

(1) Engage lamp electrical connector.
(2) Position lamp in sound bar.
(3) Install the screws attaching the lamp to the sound bar.
(4) Position lamp lens on lamp housing and press into place.

CARGO AREA DOME LAMP REMOVAL

Vehicles equipped with a hardtop have a dome lamp located above the rear window lift glass.

(1) Remove the dome/cargo lamp lens by squeezing it at the top and bottom. This will separate the lens retaining tabs from the lamp housing shoulders.
(2) Remove the lens from the lamp housing.
(3) Remove the bulb.
(4) Remove the screws that attach the lamp to the hardtop.
(5) Separate the lamp from the hardtop.
(6) Disconnect the lamp wire connector.

CARGO AREA DOME LAMP INSTALLATION

(1) Connect the lamp wire connector.
(2) Position the lamp in the hardtop.
(3) Install the screws that attach the lamp to the hardtop.
(4) Install the bulb.
(5) Position the lens on the lamp housing and press into place.

LAMP SYSTEMS

REMOVAL AND INSTALLATION

DAYTIME RUNNING LAMP (DRL) MODULE

REMOVAL

(1) Disconnect the wire harness connector from the module.

(2) Remove the screws that attach the module to the cowl (Fig. 1).

(3) Separate the module from the vehicle.

INSTALLATION

(1) Position the DRL module on the cowl.

(2) Install the screws.

(3) Connect the wire harness connector to the module.

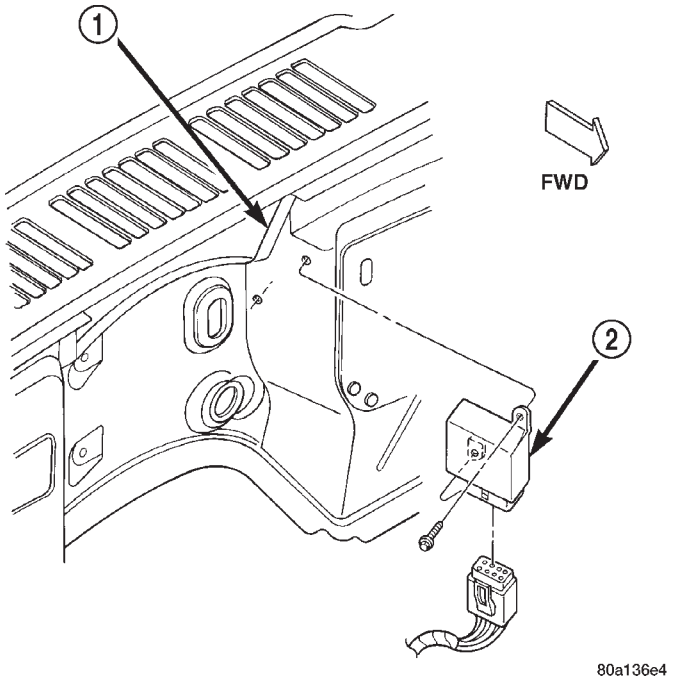


Fig. 1 DRL Module

1 – COWL
2 – DAYTIME RUNNING LAMP MODULE

BULB APPLICATION

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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	1156
Center High Mounted Stoplamp	921 or W16W
Fog lamp	H3
Front Side Marker	168 or W3W
Headlamp/Sealed Beam	H6024
Park/Turn Signal	3157
Tail/Brake	1157

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 Table lists the lamp title on the left side of the column and trade number or part number on the right.

LAMP	BULB
Dome/Cargo (Hard Top)	212–2
Dome (Sound Bar)	912
Under Hood	561
Underpanel Courtesy	906
Instrument Cluster Illumination	103
Instrument Cluster Warning	74
Automatic Transmission Indicator	658

LAMPS

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LAMP DIAGNOSIS

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DESCRIPTION AND OPERATION

HEADLAMP LEVELING MOTOR

This vehicle is equipped with a remote headlamp leveling system. This system allows the driver to adjust the vertical headlamp aim from the interior of the vehicle to compensate for passenger or cargo load. A headlamp leveling switch is located in the instrument panel and controls the headlamp leveling motor found on the back of the head lamp assembly.

DIAGNOSIS AND TESTING

GENERAL INFORMATION

Each vehicle is equipped with varies 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 sockets 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 surfaces, reduced bulb life can result.

Do not use bulbs with higher candle power than indicated in the Bulb Application Table at the end of this group. Damage to lamp can result.

Do not use fuses, circuit breakers or relays having greater amperage value than indicated on the fuse panel or in the Owners Manual.

When it 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.

DIAGNOSTIC PROCEDURES

When a vehicle experiences problems with the headlamp system, verify the condition of the battery connections, charging system, headlamp bulbs, wire connectors, relay, high beam dimmer switch and headlamp switch. Refer to Group 8W, Wiring Diagrams, for component locations and circuit information.

DIAGNOSIS AND TESTING (Continued)

HEADLAMP DIAGNOSIS

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 alternator drive belt.	2. Adjust or replace alternator 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.
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.
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.
	3. Loose or corroded terminals or splices in circuit.	3. 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.
	6. Defective or burned out bulb.	6. Replace bulb.
	7. Body controller malfunction.	7. Refer to appropriate body controller diagnostics.

DIAGNOSIS AND TESTING (Continued)

FOG LAMP DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
FOG LAMPS ARE DIM WITH ENGINE IDLING OR IGNITION TURNED OFF.	1. Loose or corroded battery cables.	1. Clean and secure battery cable clamps and posts.
	2. Loose or worn alternator drive belt.	2. Adjust or replace alternator 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 LEVELING MOTOR DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
ONE MOTOR DOES NOT OPERATE	1. Poor connection at motor.	1. Secure connector on motor.
	2. No voltage at motor.	2. Repair circuit. Refer to Group 8W, Wiring.
	3. Defective motor.	3. Replace motor.
BOTH MOTORS DO NOT OPERATE	1. No voltage at headlamp leveling switch.	1. Repair circuit or replace fuse. Refer to Group 8W, Wiring.
	2. No voltage at both motors.	2. Repair circuit or replace fuse. Refer to Group 8W, Wiring.
	3. Poor connection at motors.	3. Secure connectors on motors.
	4. Both motors defective.	4. Replace motors.

LAMP BULB SERVICE

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REMOVAL AND INSTALLATION

HEADLAMP BULB

REMOVAL

(1) Release the hood latches and open hood.
(2) Disconnect the headlamp wire harness connectors.
(3) Remove the headlamp bezel retaining screws and bezel (Fig. 1).
(4) Remove the headlamp retaining ring screws and retaining ring (Fig. 2).
(5) Remove the headlamp from vehicle.
(6) Remove rubber seal boot (Fig. 3).
(7) Disengage wire retaining ring from headlamp (Fig. 4).
(8) Pull the headlamp bulb from back of headlamp assembly (Fig. 5).

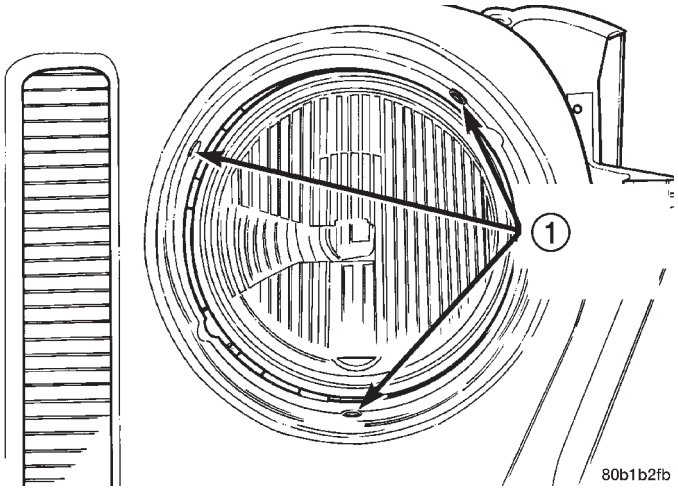


Fig. 1 Headlamp Bezel
1 – HEADLAMP BEZEL ATTACHING SCREWS

INSTALLATION

(1) Perform the removal procedure in reverse order.

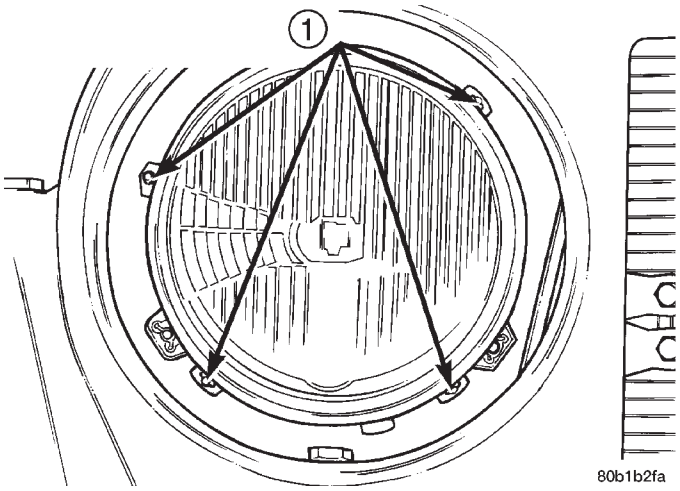


Fig. 2 Headlamp Retaining Ring
1 – HEADLAMP RETAINER ATTACHING SCREWS

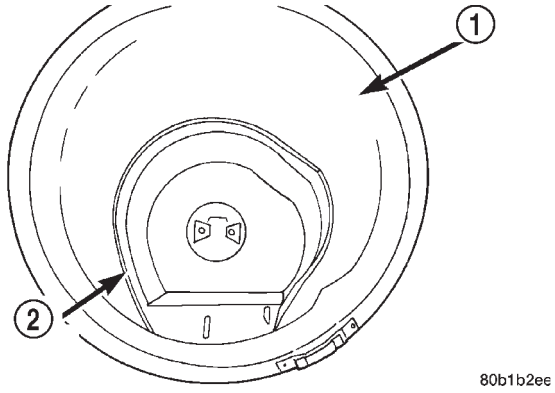


Fig. 3 Headlamp Rubber Seal Boot
1 – HEADLAMP
2 – HEADLAMP RUBBER SEAL BOOT

FRONT POSITION LAMP BULB

REMOVAL

(1) Remove the headlamp from the vehicle. Refer to the headlamp Removal/Installation procedure located in this group.
(2) Remove rubber boot seal.

REMOVAL AND INSTALLATION (Continued)

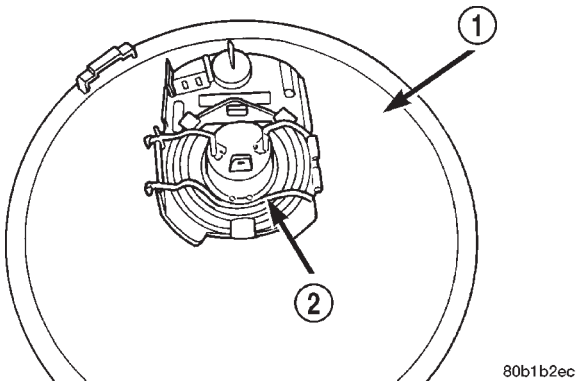


Fig. 4 Headlamp Bulb Retaining Ring

1 – HEADLAMP
2 – HEADLAMP WIRE RETAINING RING

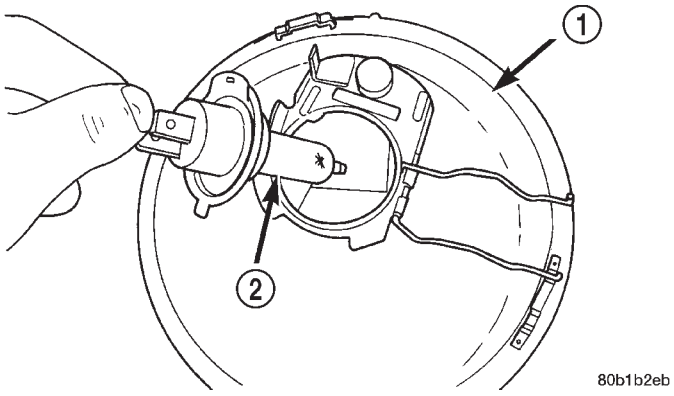


Fig. 5 Headlamp Bulb

1 – HEADLAMP
2 – HEADLAMP BULB

(3) Remove front position lamp bulb socket from the headlamp (Fig. 6).

(4) Remove front position bulb from its socket by rotating counter clockwise and pulling straight out.

INSTALLATION

(1) Install the front position lamp bulb in its socket.

(2) Verify lamp operation

(3) Install the position lamp in the headlamp assembly.

(4) Install the rubber boot seal.

(5) Install the headlamp in the vehicle. Refer to the headlamp Removal/Installation procedure located in this group.

TAIL LAMP BULB

REMOVAL

(1) Remove the tail lamp lense retaining screws (Fig. 8).

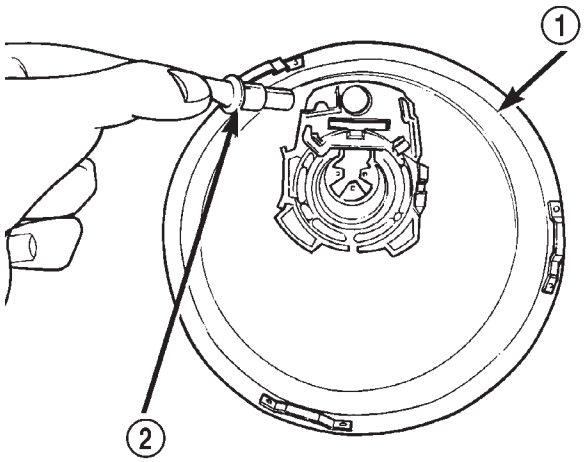


Fig. 6 Front Position Lamp Location

1 – HEADLAMP
2 – FRONT POSITION LAMP SOCKET AND BULB

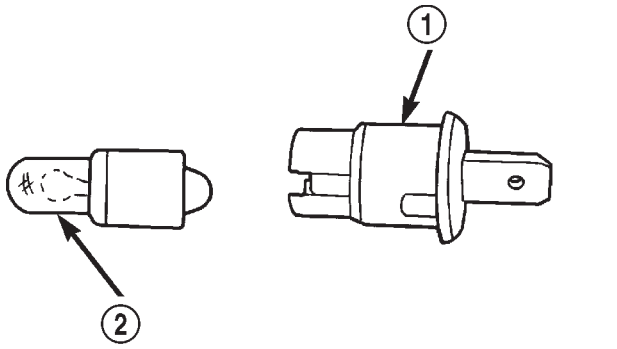


Fig. 7 Front Position Lamp

1 – FRONT POSITION LAMP SOCKET
2 – FRONT POSITION LAMP BULB

(2) Separate the tail lamp lense from the tail lamp housing.

(3) Remove the tail lamp bulb from the bulb socket (Fig. 9).

INSTALLATION

(1) Perform the removal procedure in reverse order.

REAR FOG LAMP BULB

REMOVAL

(1) Remove the rear fog lamp lense attaching screws and lense (Fig. 10).

REMOVAL AND INSTALLATION (Continued)

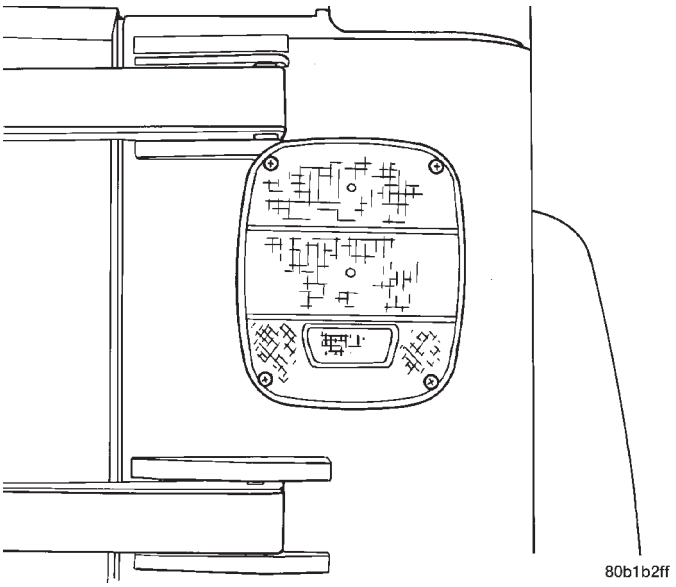


Fig. 8 Tail Lamp Lense

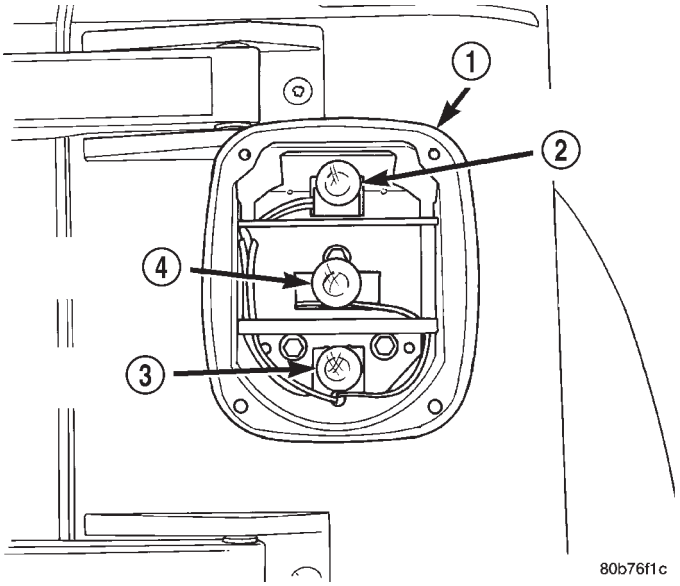


Fig. 9 Tail Lamp Bulbs

1 – TAILLAMP ASSEMBLY
2 – STOP LAMP BULB
3 – REVERSE LAMP BULB
4 – TURN SIGNAL LAMP BULB

(2) Remove the bulb from the fog lamp socket (Fig. 11).

INSTALLATION

(1) Install the bulb in the fog lamp socket (Fig. 11).
(2) Verify lamp operation.
(3) Install the rear fog lamp lense and attaching screws (Fig. 10).

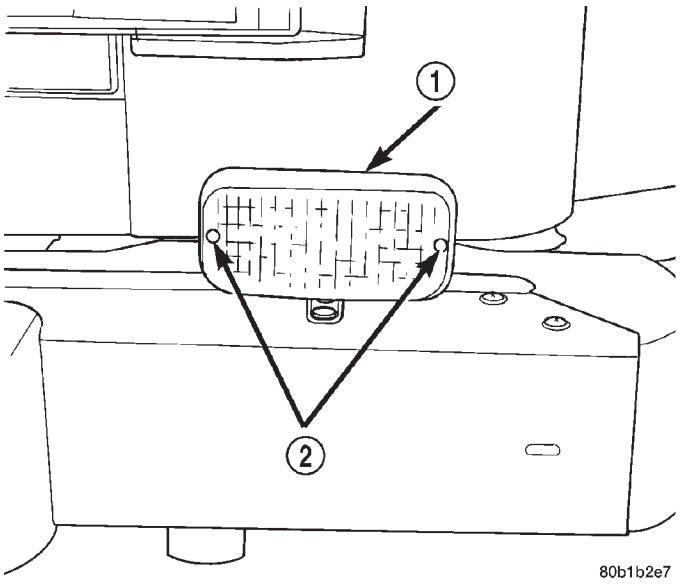


Fig. 10 Rear Fog Lamp Lense

1 – REAR FOG LAMP
2 – FOG LAMP LENSE ATTACHING SCREWS

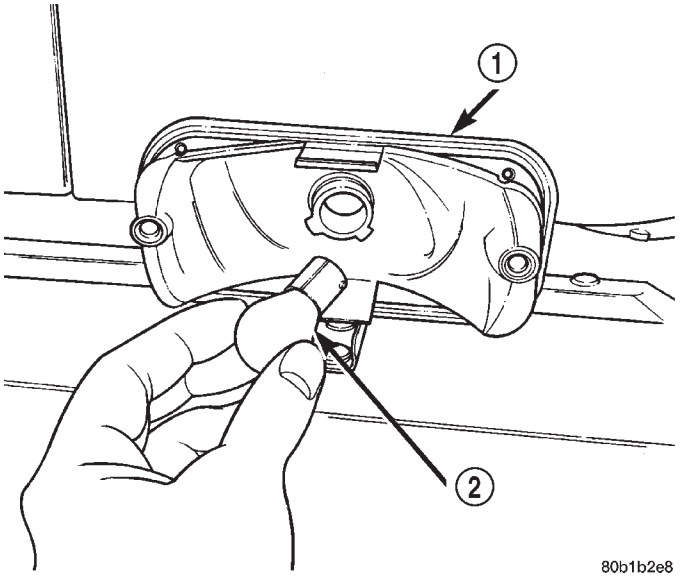


Fig. 11 Rear Fog Lamp Bulb

1 – REAR FOG LAMP HOUSING
2 – REAR FOG LAMP BULB

LICENSE PLATE LAMP BULB

REMOVAL

(1) Remove the license plate lamp lense attaching screws and lense.
(2) Remove the bulb from the socket.

INSTALLATION

(1) Perform the removal procedure in reverse order.

REMOVAL AND INSTALLATION (Continued)

CENTER HIGH MOUNTED STOP LAMP (CHMSL) BULB

REMOVAL

(1) Remove the screws attaching the center high mounted stop lamp (CHMSL) lense assembly to the housing.

(2) Separate the CHMSL lense assembly from the housing.

INSTALLATION

(1) Perform the removal procedure in reverse order.

LAMP SERVICE

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REMOVAL AND INSTALLATION

HEADLAMP ASSEMBLY

REMOVAL

(1) Remove the headlamp bezel attaching screws (Fig. 1).

(2) Remove the headlamp assembly retaining ring attaching screws (Fig. 2).

(3) Disconnect the headlamp assembly electrical connectors and remove the headlamp assembly from the bucket.

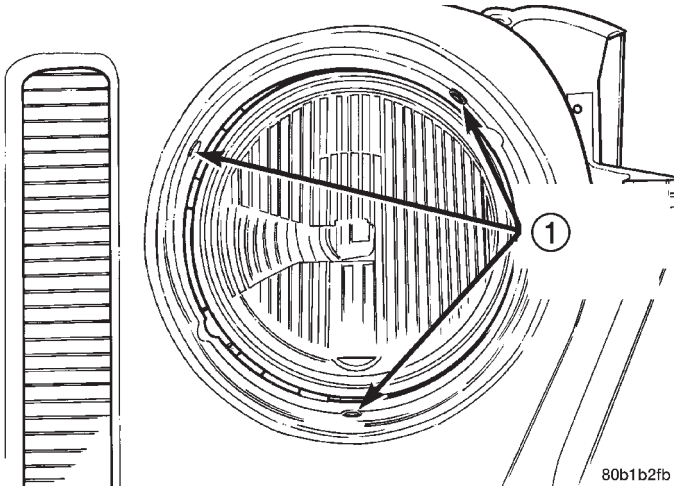


Fig. 1 Headlamp Bezel
1 – HEADLAMP BEZEL ATTACHING SCREWS

Installation

(1) Perform the removal procedure in reverse order.

HEADLAMP LEVELING MOTOR

REMOVAL

(1) Remove the headlamp bezel attaching screws and bezel (Fig. 3).

(2) Disconnect the headlamp and headlamp leveling motor electrical connectors.

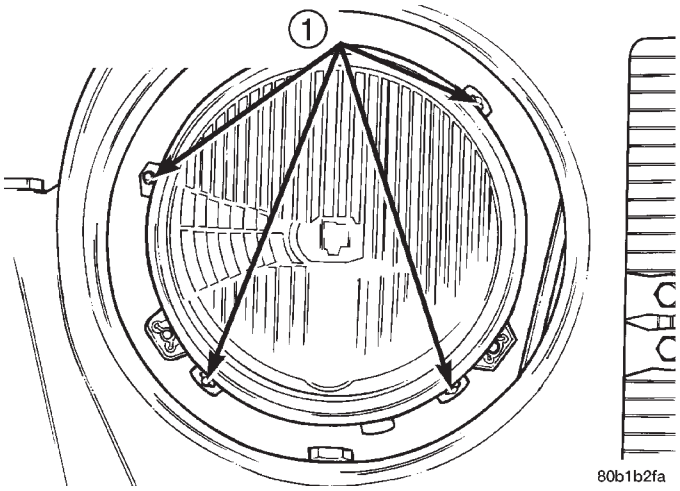


Fig. 2 Headlamp Retaining Ring
1 – HEADLAMP RETAINER ATTACHING SCREWS

(3) Remove the headlamp housing attaching screws (Fig. 4).

(4) Rotate leveling motor one quarter turn counterclockwise.

(5) Pull the leveling motor from the headlamp housing.

(6) Separate the leveling motor from the headlamp housing (Fig. 5).

NOTE: The headlamp leveling motor arm is snapped into the headlamp housing very securely. Use a firm, steady pull to disengage motor arm from the headlamp housing.

INSTALLATION

(1) Perform the removal procedure in reverse order.

TAIL LAMP

REMOVAL

(1) Remove the tail lamp lense attaching screws and lense (Fig. 6).

REMOVAL AND INSTALLATION (Continued)

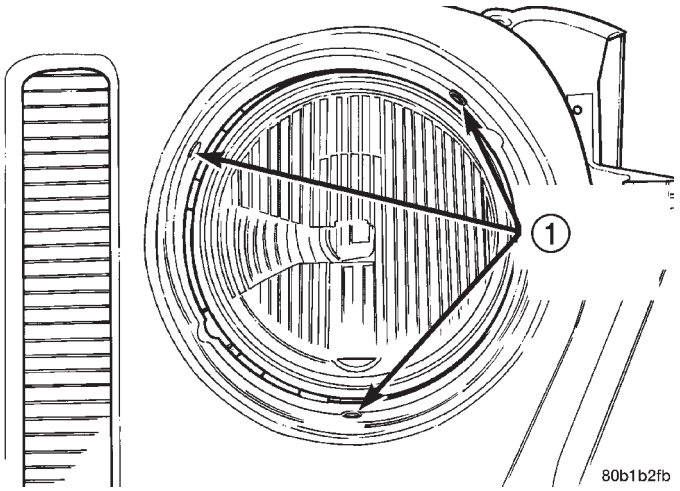


Fig. 3 Headlamp Bezel

1 – HEADLAMP BEZEL ATTACHING SCREWS

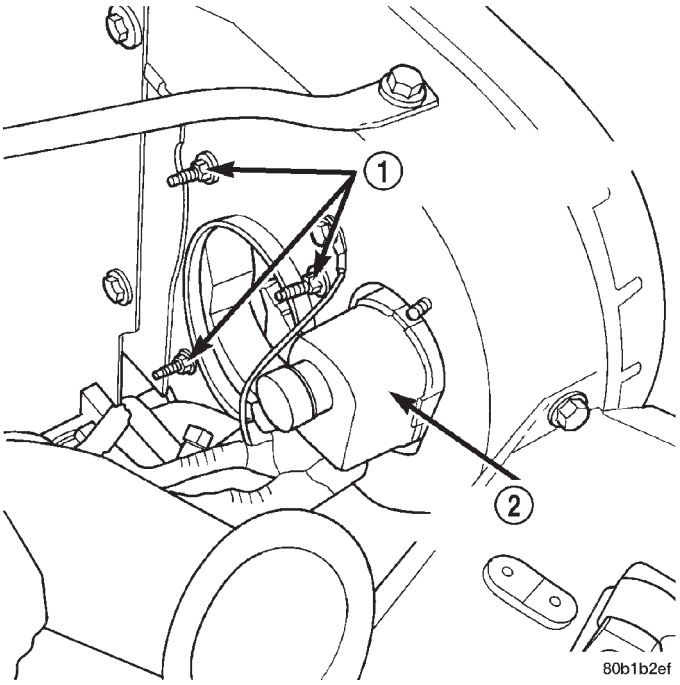


Fig. 4 Headlamp Housing

1 – HEADLAMP HOUSING ATTACHING NUTS
2 – HEADLAMP LEVELING MOTOR

(2) Remove the tail lamp housing attaching bolts (Fig. 7).

(3) Separate the lamp housing from the body.

(4) Disconnect the tail lamp electrical connector and remove tail lamp housing.

INSTALLATION

(1) Perform the removal procedure in reverse order.

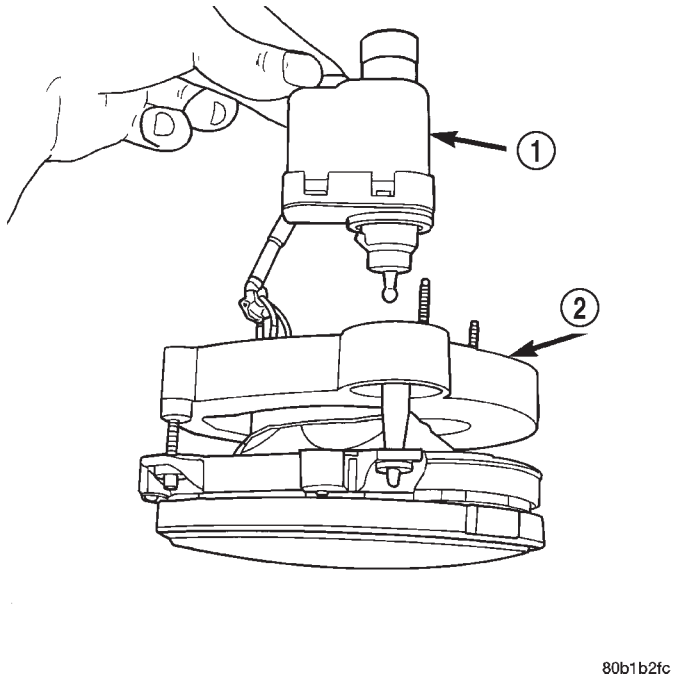


Fig. 5 Headlamp Leveling Motor

1 – HEADLAMP LEVELING MOTOR
2 – HEADLAMP HOUSING

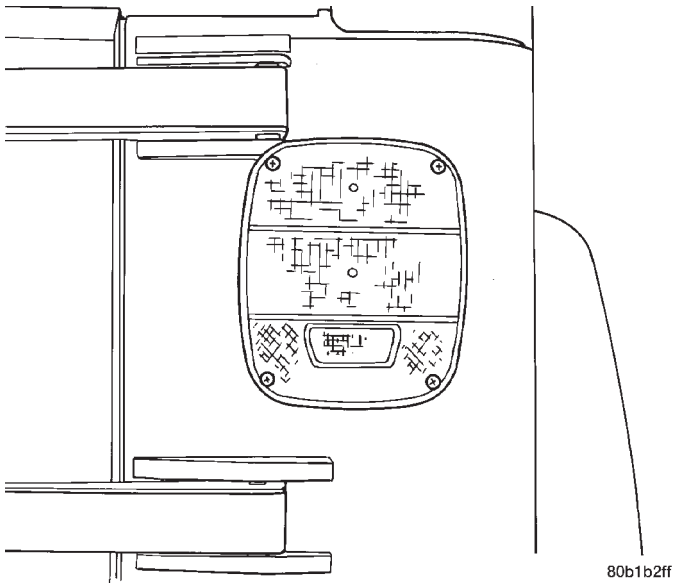


Fig. 6 Tail Lamp Lense

CENTER HIGH MOUNTED STOP LAMP (CHMSL)

REMOVAL

NOTE: It may be necessary to remove the spare tire.

(1) Remove the CHMSL housing to CHMSL bracket attaching screws.

REMOVAL AND INSTALLATION (Continued)

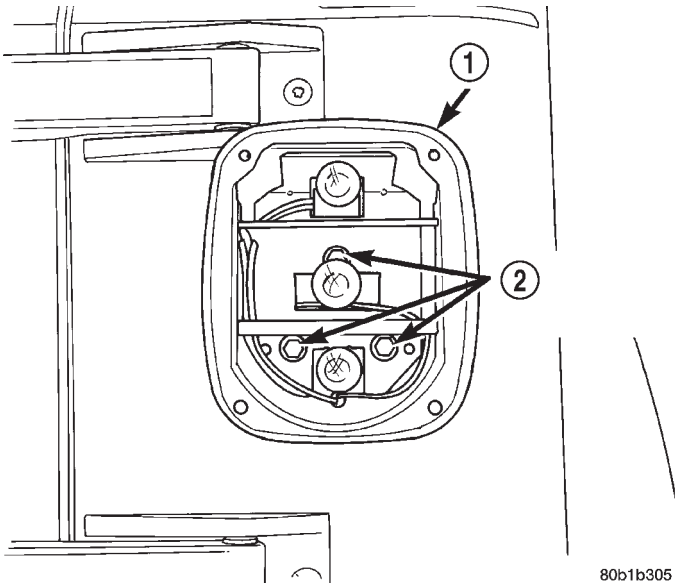


Fig. 7 Tail Lamp Housing

1 – TAILLAMP ASSEMBLY
2 – ATTACHING SCREWS

(2) Disconnect the CHMSL wire harness from the retaining clips.
(3) Remove the cover from the CHMSL contact buttons.
(4) Carefully pull the wire harness terminal ends from the contact buttons (Fig. 8).
(5) Route wire harness through tailgate and separate CHMSL from vehicle.

INSTALLATION

(1) Perform the removal procedure in reverse order.

REAR FOG LAMP

REMOVAL

(1) Remove the rear fog lamp attaching screws (Fig. 9).
(2) Disconnect the rear fog lamp electrical connector.

INSTALLATION

(1) Connect the rear fog lamp electrical connector.
(2) Install the rear fog lamp attaching screws (Fig. 9).

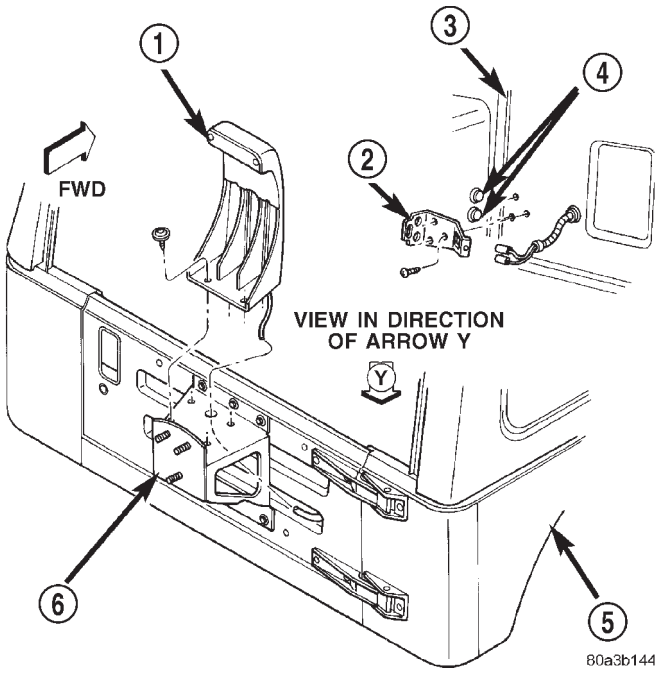


Fig. 8 CHMSL Assembly

1 – CHMSL MOUNTING BRACKET
2 – CHMSL CONTACT BUTTON TAILGATE CLAMP
3 – BODY
4 – CONTACT BUTTONS
5 – BODY
6 – SPARE TIRE MOUNTING BRACKET

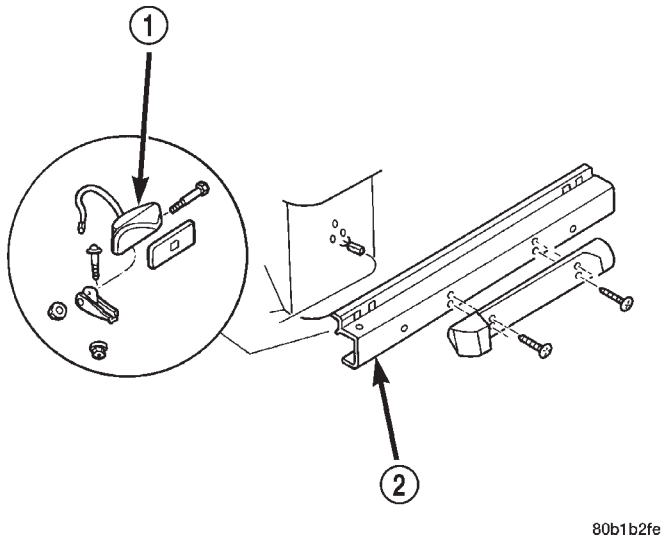


Fig. 9 Rear Fog Lamp

1 – REAR FOG LAMP ASSEMBLY
2 – REAR BUMPER ASSEMBLY

BULB APPLICATION

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DESCRIPTION AND OPERATION

BULB INFORMATION

(1) The following bulb Application tables lists the lamp title on the left side of the column and trade number on the right.

CAUTION: Do not use bulbs that have a higher candle power the bulb listed in the Bulb Application Table. Damage to lamp can result. Do not touch halogen bulbs with fingers or other oily surfaces. Bulb life will be reduced.

SPECIFICATIONS

EXTERIOR LAMPS

LAMP	BULB
Back-up	P21W
Center High Mounted Stop	W16W
Headlamp	H-4
License Plate	W5W
Front Turn Signal	P27/7W
Tail/Stop	P21/5W
Rear Turn Signal	P21W
Rear Fog Lamp	P21W
Citylight	T4W
Side Repeater	W5W

INTERIOR LAMPS

Service procedures for most of the lamps in the instrument panel, Instrument cluster and switches are located in Group 8E, Instrument panel and Gauges. Some components have lamps than can only be serviced by an Authorized Service Center (ASC) after the component is removed from the vehicle. Contact a local dealer for location of nearest ASC.

LAMP	BULB
ABS	PC74
Airbag	PC74
Brake Warning System Indicator	PC74
Climate Controls	203
Console Gear Selector	658
Dome Light	912
High Beam Indicator	PC74
Rear Cargo	212-2
Seat Belt Indicator	PC74
Service Engine Soon	PC74
Turn Signal Indicator	PC74
Underhood	561
Under Dash Courtesy Lamps	906
I. P. Rocker Switches	See Dealer

PASSIVE RESTRAINT SYSTEMS

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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.

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
- Passenger side airbag on/off switch
- Wire harness and connections.

This group provides complete service information for the ACM, both airbag modules, the clockspring, and the passenger side airbag on/off switch. 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 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.

DESCRIPTION AND OPERATION (Continued)

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 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

DESCRIPTION AND OPERATION (Continued)

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 a stamped metal housing within which the cushion and inflator are mounted and sealed. The airbag housing has three stamped metal mounting brackets spot welded to it. The mounting brackets at the top and at the lower rear of the airbag module secure the module to the instrument panel armature. The stamped metal mounting bracket at the lower front of the housing secures the passenger side airbag module to two studs on the dash panel, behind the glove box. A plastic end bracket encloses the inboard end of the housing and retains the wire harness connector for the inflator.

Following a passenger side airbag deployment, the passenger side airbag module, the passenger side airbag door and the instrument panel assembly 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 the instrument panel at the upper and lower flanges with screws. A stamped metal bracket located on the back side of the airbag door is secured to the instrument panel armature with one screw on each end, and serves as the hinge for the door upon an airbag deployment. 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.

PASSENGER SIDE AIRBAG ON/OFF SWITCH

DESCRIPTION

A passenger side airbag on/off switch, which is located on the forward end of the floor console (both full and mini versions), allows the passenger side airbag system to be disabled when certain child restraint devices are being used in the right front seating position. The passenger side airbag on/off switch is equipped with a key actuator that is designed so that the switch position can be changed using an ignition key. The key is inserted into the actuator far enough to fully depress a spring-loaded locking plunger, then rotated to the desired position. The key will not insert all the way into the actuator, and the spring-loaded locking plunger prevents the user from leaving a key in the actuator. When the ignition switch is in the On position and the passenger side airbag system is disabled, a Light-Emitting Diode (LED) illuminates an **Off** indicator lamp on the face plate of the switch.

The passenger side airbag on/off switch cannot be adjusted or repaired and, if faulty or damaged, the switch assembly must be replaced. The switch bezel is available for service replacement.

OPERATION

To actuate the passenger side airbag on/off switch, insert the ignition key in the switch key actuator far enough to fully depress the spring-loaded locking plunger. The switch key actuator is then rotated with the ignition key to its clockwise stop (the key actuator slot will be aligned with the Off indicator lamp) to disable the passenger side airbag system. When the switch key actuator is rotated with the ignition key to its counterclockwise stop (the key actuator slot will be in a vertical position), the Off indicator lamp will be extinguished and the passenger side airbag system will be enabled.

DESCRIPTION AND OPERATION (Continued)

AIRBAG CONTROL MODULE

DESCRIPTION

The Airbag Control Module (ACM) is secured with screws to a mounting bracket that is secured with four screws onto the floor panel transmission tunnel below the instrument panel and forward of the center floor console in the passenger compartment of the vehicle. The ACM contains an electronic microprocessor, an electronic impact sensor, an electromechanical safing sensor, and an energy storage capacitor.

The ACM is serviced as a unit with the mounting bracket. The ACM cannot be repaired or adjusted and, if damaged or faulty, the ACM and mounting bracket unit 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 specific 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 precentered 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).

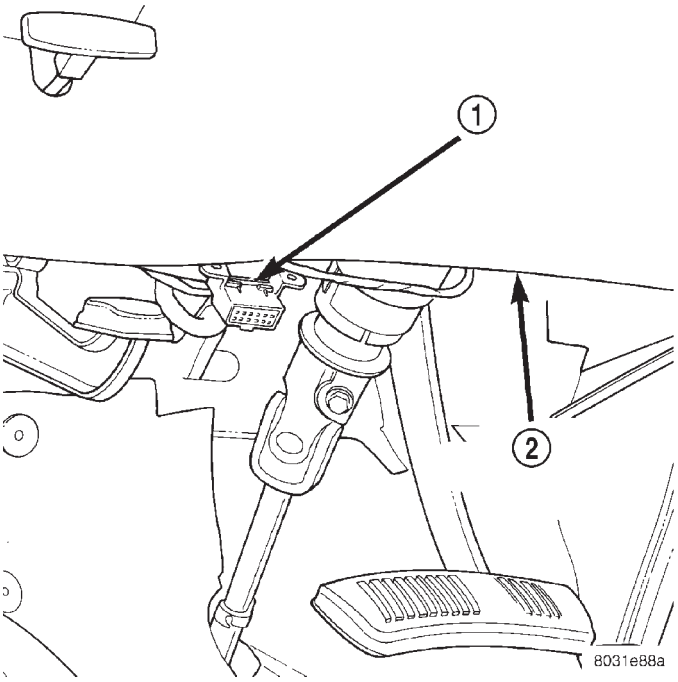


Fig. 1 16-Way Data Link Connector - Typical

1 – 16–WAY DATA LINK CONNECTOR
2 – BOTTOM OF INSTRUMENT PANEL

(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.

(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 instrument panel assembly, 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.

SERVICE PROCEDURES (Continued)

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).

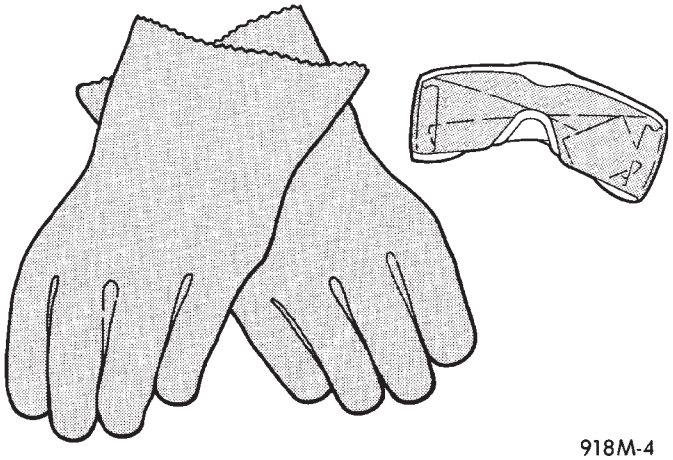


Fig. 2 Wear Safety Glasses and Rubber Gloves - Typical

WARNING: IF YOU EXPERIENCE SKIN IRRITATION DURING CLEANUP, RUN COOL WATER OVER THE AFFECTED AREA. ALSO, IF YOU EXPERIENCE IRRITATION OF THE NOSE OR THROAT, EXIT THE VEHICLE FOR FRESH AIR UNTIL THE IRRITATION CEASES. IF IRRITATION CONTINUES, SEE A PHYSICIAN.

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 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.

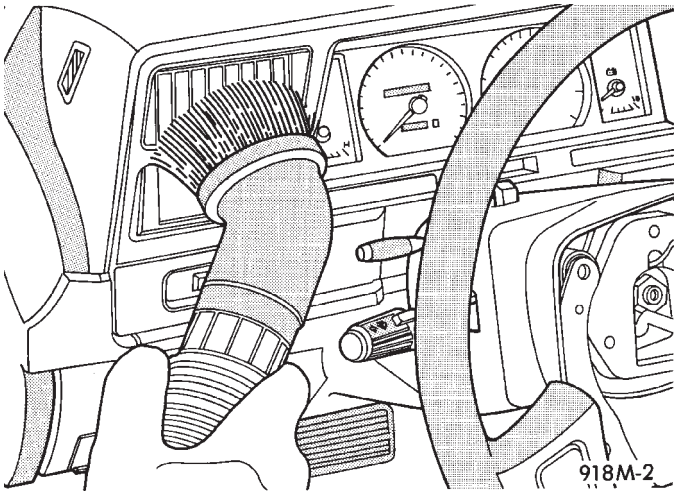


Fig. 3 Vacuum Heater and A/C Outlets - Typical

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.

REMOVAL AND INSTALLATION (Continued)

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).

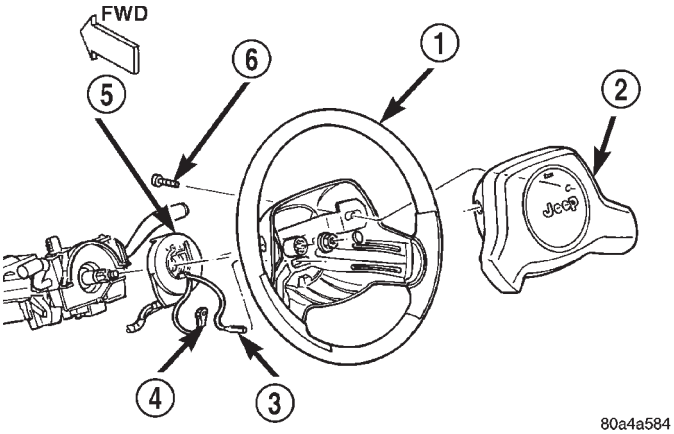


Fig. 4 Driver Side Airbag Module Remove/Install

1 – STEERING WHEEL
2 – DRIVER'S AIRBAG MODULE
3 – HORN SWITCH WIRE
4 – AIRBAG WIRE
5 – CLOCKSPRING
6 – SCREW

(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.

(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 clock-

REMOVAL AND INSTALLATION (Continued)

spring 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(s) from the stud(s) on the back of the driver side airbag housing (Fig. 5) or (Fig. 6).

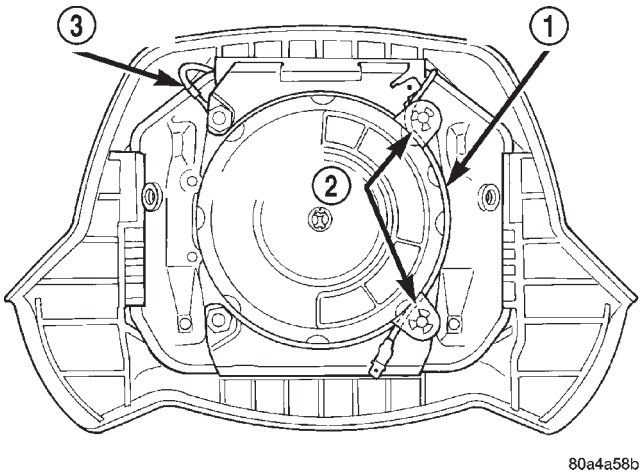


Fig. 5 Horn Switch Feed Wire Remove/Install - w/o Speed Control

1 – HORN SWITCH FEED WIRE
2 – WIRE RETAINERS
3 – HORN SWITCH GROUND WIRE

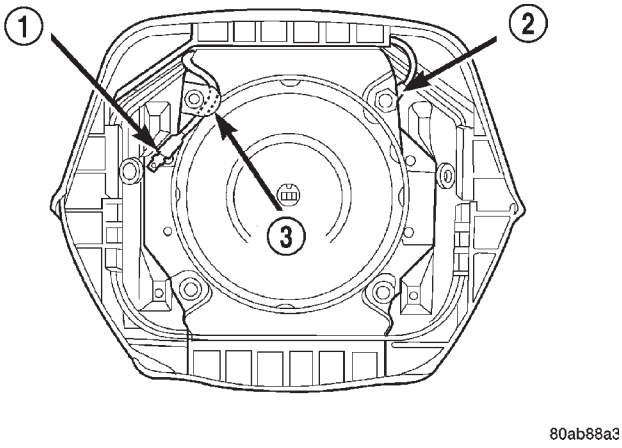


Fig. 6 Horn Switch Feed Wire Remove/Install - w/Speed Control

1 – HORN SWITCH FEED WIRE
2 – HORN SWITCH GROUND WIRE
3 – WIRE RETAINER

(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. 7) or (Fig. 8).

(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. 9) or (Fig. 10).

REMOVAL AND INSTALLATION (Continued)

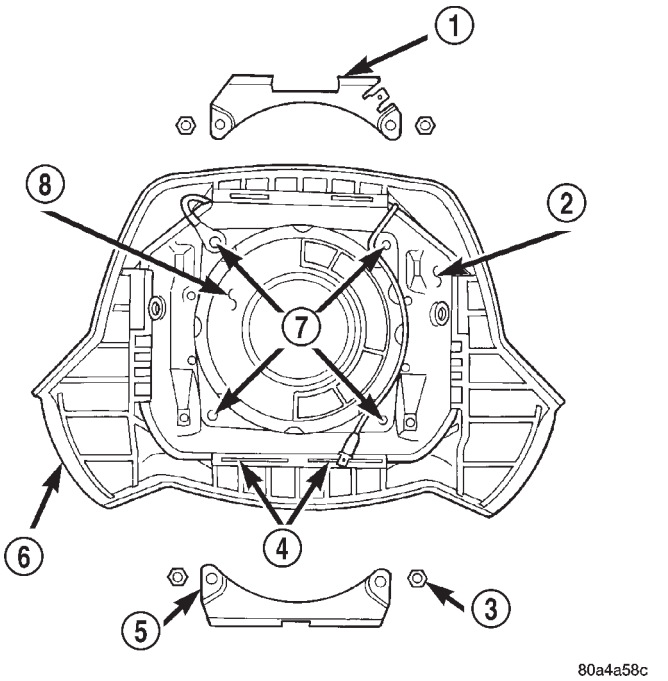


Fig. 7 Driver Side Airbag Trim Cover Retainers Remove/Install - w/o Speed Control

1 – UPPER RETAINER
2 – AIRBAG HOUSING
3 – NUT (4)
4 – RETAINER SLOTS
5 – LOWER RETAINER
6 – TRIM COVER
7 – STUDS
8 – INFLATOR

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) 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.

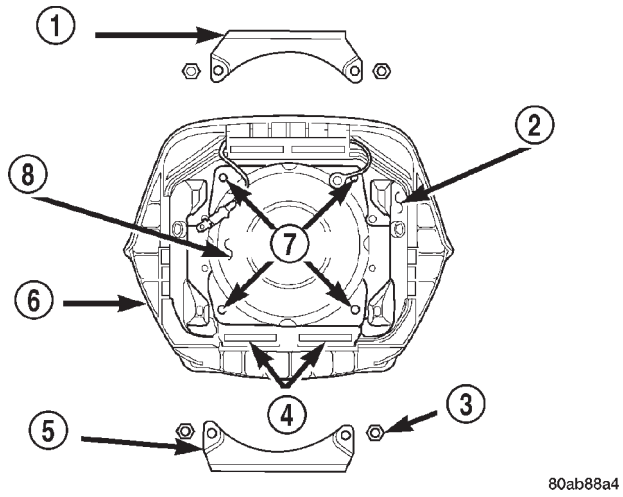


Fig. 8 Driver Side Airbag Trim Cover Retainers Remove/Install - w/Speed Control

1 – UPPER RETAINER
2 – AIRBAG HOUSING
3 – NUT (4)
4 – RETAINER SLOTS
5 – LOWER RETAINER
6 – TRIM COVER
7 – STUDS
8 – INFLATOR

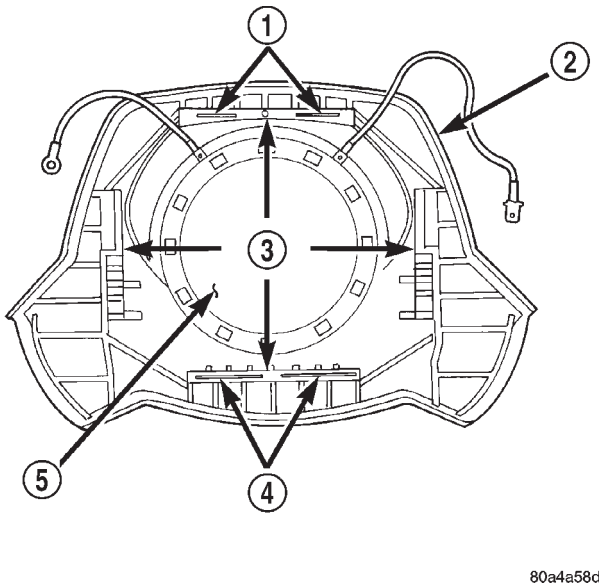


Fig. 9 Driver Side Airbag Trim Cover Remove/Install - w/o Speed Control

1 – RETAINER SLOTS
2 – TRIM COVER
3 – LOCKING BLOCKS
4 – RETAINER SLOTS
5 – HORN SWITCH

REMOVAL AND INSTALLATION (Continued)

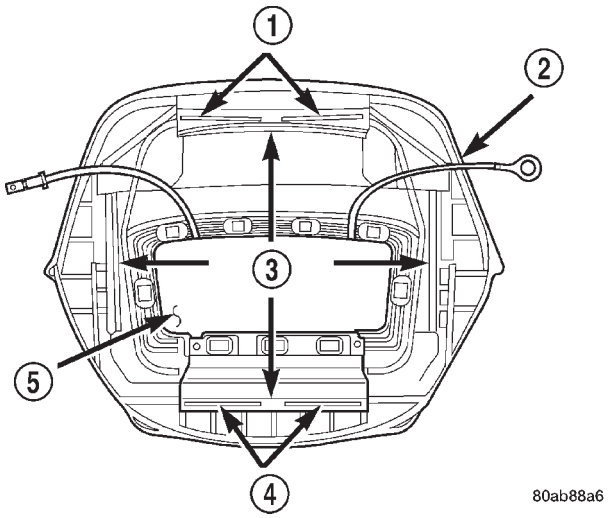


Fig. 10 Driver Side Airbag Trim Cover Remove/ Install - w/Speed Control

1 – RETAINER SLOTS
2 – TRIM COVER
3 – LOCKING BLOCKS
4 – RETAINER SLOTS
5 – HORN SWITCH

(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. 11).

(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. 9) or (Fig. 10).

(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, the instrument panel assembly must be replaced. The instrument panel assembly includes the passenger side airbag module and the passenger side airbag door. Refer to **Instrument Panel Assembly** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the instrument panel assembly service procedures.

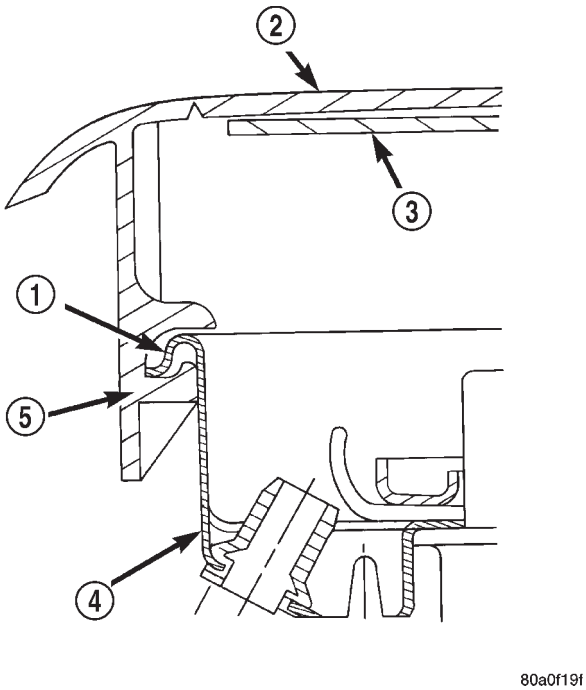


Fig. 11 Driver Side Airbag Trim Cover Locking Blocks Engaged

1 – LIP
2 – TRIM COVER
3 – HORN SWITCH
4 – AIRBAG HOUSING
5 – LOCKING BLOCK

WARNING:

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• 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 AND INSTALLATION (Continued)

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 instrument panel assembly from the passenger compartment of the vehicle. Refer to **Instrument Panel Assembly** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(3) Place the instrument panel on a suitable work surface. Be certain to take the proper precautions to protect the instrument panel from any possible cosmetic damage.

(4) Remove the three nuts that secure the passenger side airbag module to the studs on the instrument panel armature (Fig. 12).

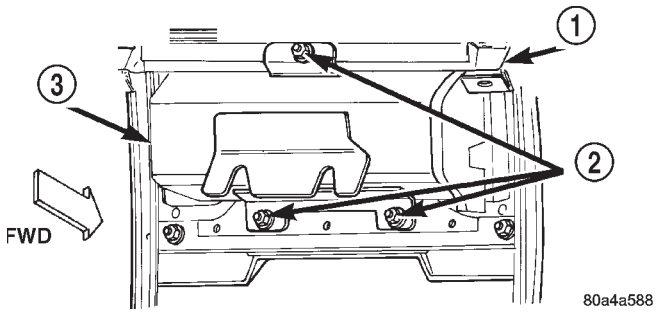


Fig. 12 Passenger Side Airbag Module Remove/ Install

1 – INSTRUMENT PANEL ARMATURE
2 – NUTS (3)
3 – PASSENGER'S AIRBAG MODULE

(5) Remove the passenger side airbag module from the instrument panel.

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) Carefully position the passenger side airbag module in the instrument panel.

(2) Install and tighten the three nuts that secure the passenger side airbag module upper and lower mounting brackets to the studs on the instrument panel armature. Tighten the nuts to 12 N·m (105 in. lbs.).

(3) Install the instrument panel assembly into the passenger compartment of the vehicle. Refer to **Instrument Panel Assembly** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures. When installing the instrument panel, be certain to reconnect the passenger side airbag module wire harness to the cross-body wire harness, and that the connector is fully engaged and latched.

(4) 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.

(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) Remove the five screws that secure the passenger side airbag door upper flange to the top of the instrument panel (Fig. 13).

(4) Remove the grab handle bezel from the instrument panel. Refer to **Instrument Panel Grab Handle Bezel** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

REMOVAL AND INSTALLATION (Continued)

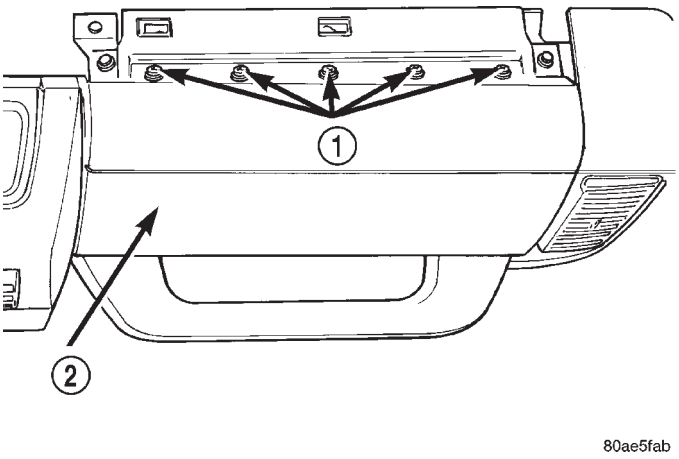


Fig. 13 Passenger Side Airbag Door Upper Screws Remove/Install

1 – MOUNTING SCREWS
2 – AIRBAG DOOR

(5) Remove the five screws that secure the passenger side airbag door lower flange to the instrument panel above the glove box opening.

(6) Remove the two screws that secure the ends of the passenger side airbag door bracket to the instrument panel armature (Fig. 14).

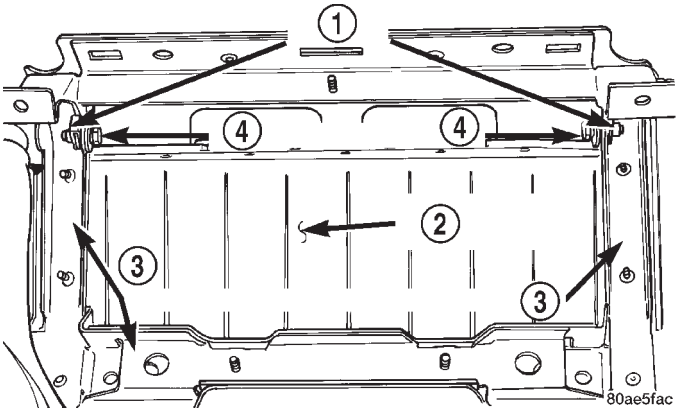


Fig. 14 Passenger Side Airbag Door Remove/Install

1 – J-NUTS
2 – PASSENGER AIRBAG DOOR
3 – INSTRUMENT PANEL ARMATURE
4 – MOUNTING SCREWS

(7) Remove and discard the two passenger side airbag door bracket J-nuts from the instrument panel armature. These J-nuts must be replaced with new parts whenever the passenger side airbag door bracket screws are removed.

(8) Remove the passenger side airbag door from the instrument panel.

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) Install two new passenger airbag door bracket J-nuts onto the instrument panel armature. These J-nuts must be replaced with new parts whenever the passenger side airbag door bracket screws are removed.

(2) Position the passenger side airbag door to the instrument panel and align the mounting holes in each end of the airbag door bracket with the J-nuts on the instrument panel armature.

(3) Install and tighten the two screws that secure the passenger side airbag door bracket to the instrument panel armature. Tighten the screws to 12 N·m (105 in. lbs.).

(4) Install and tighten the five screws that secure the passenger side airbag door lower flange to the instrument panel above the glove box opening. Tighten the screws to 2.2 N·m (20 in. lbs.).

(5) Install the grab handle bezel onto the instrument panel. Refer to **Instrument Panel Grab Handle Bezel** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(6) Install and tighten the five screws that secure the passenger side airbag door upper flange to the top of the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(7) 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.

REMOVAL AND INSTALLATION (Continued)

PASSENGER SIDE AIRBAG ON/OFF SWITCH

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

PASSENGER SIDE AIRBAG ON/OFF SWITCH

(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 glove box from the instrument panel. Refer to **Glove Box** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(3) Reach through the glove box opening to access and disconnect the two passenger side airbag on/off switch wire harness connectors from the instrument panel wire harness. These connectors are retained on a bracket located on the outboard glove box opening reinforcement (Fig. 15).

(4) Still reaching through the glove box opening, disengage the passenger side airbag on/off switch wire harness from the retainer clip on the plenum bracket that supports the heater-A/C housing just inboard of the fuseblock module.

(5) Remove the full floor console or mini-floor console from the floor panel transmission tunnel. Refer to **Full Floor Console** or **Mini Floor Console** in the Removal and Installation section of Group 23 - Body for the procedures.

(6) From the underside of the console, remove the three screws that secure the passenger side airbag on/off switch to the back of the switch bezel (Fig. 16).

(7) Remove the passenger side airbag on/off switch from the switch bezel.

PASSENGER SIDE AIRBAG ON/OFF SWITCH BEZEL

The passenger side airbag on/off switch can be serviced without removing the switch bezel from the floor console. If the passenger side airbag on/off switch bezel is removed from the floor console, it must be replaced. The latch tabs that secure the bezel to the console will be damaged during the removal process.

(1) Disconnect and isolate the battery negative cable. If either of the airbags has not been deployed,

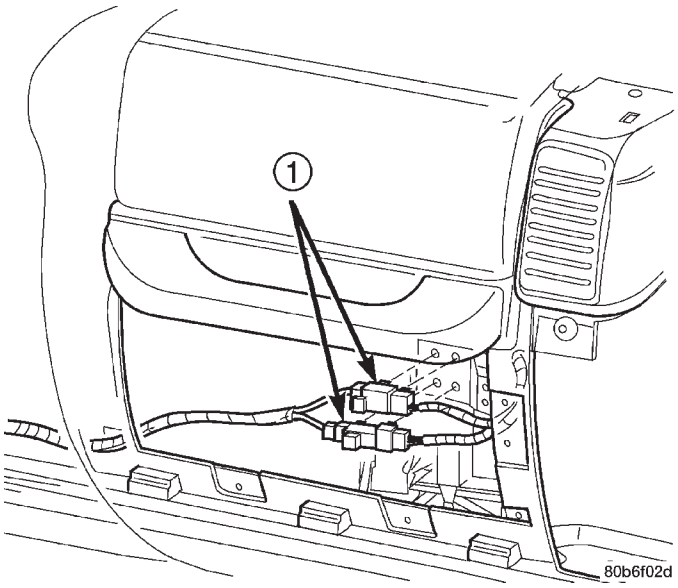


Fig. 15 Passenger Side Airbag On/Off Switch Wire Harness Connectors

1 – PASSENGER AIRBAG ON/OFF SWITCH CONNECTORS

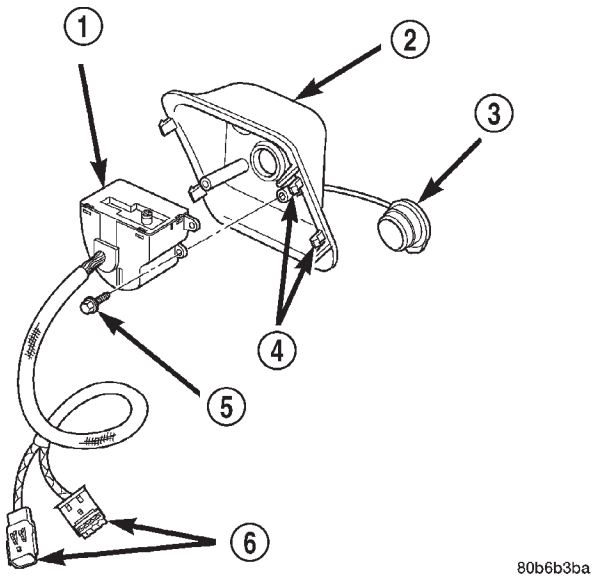


Fig. 16 Passenger Side Airbag On/Off Switch Remove/Install

1 – PASSENGER SIDE AIRBAG ON/OFF SWITCH
2 – BEZEL
3 – CAP
4 – LATCH TABS (4)
5 – SCREW (3)
6 – WIRE HARNESS CONNECTORS

REMOVAL AND INSTALLATION (Continued)

wait two minutes for the system capacitor to discharge before further service.

(2) Remove the passenger side airbag on/off switch from the bezel. Refer to **Passenger Side Airbag On/Off Switch** in the Removal and Installation section of this group for the procedures.

(3) From the underside of the console, release the four latch tabs that secure the passenger side airbag on/off switch bezel to the mounting hole in the front of the full floor console or mini floor console.

(4) Remove the passenger side airbag on/off switch bezel from the top of the full floor console or mini floor console.

INSTALLATION

PASSENGER SIDE AIRBAG ON/OFF SWITCH

(1) From the underside of the console, position the passenger side airbag on/off switch to the back of the switch bezel.

(2) Install and tighten the three screws that secure the passenger side airbag on/off switch to the switch bezel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the full floor console or mini floor console onto the floor panel transmission tunnel. Refer to **Full Floor Console** or **Mini Floor Console** in the Removal and Installation section of Group 23 - Body for the procedures.

(4) Reach through the glove box opening to engage the passenger side airbag on/off switch wire harness in the retainer clip on the plenum bracket that supports the heater-A/C housing just inboard of the fuseblock module.

(5) Still reaching through the glove box opening, access and reconnect the two passenger side airbag on/off switch wire harness connectors to the instrument panel wire harness. These connectors are retained on a bracket located on the outboard glove box opening reinforcement. Be certain that both connectors are fully engaged and latched.

(6) Install the glove box onto the instrument panel. Refer to **Glove Box** in the Removal and Installation section of Group 8E - Instrument Panel Systems for the procedures.

(7) 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 ON/OFF SWITCH BEZEL

(1) Position the passenger side airbag on/off switch bezel to the mounting hole at the front of the full floor console or mini floor console.

(2) Press down firmly and evenly on the passenger side airbag on/off switch bezel until each of the four latch tabs on the bezel is fully engaged with the mounting hole of the full floor console or mini floor console.

(3) Install the passenger side airbag on/off switch onto the bezel. Refer to **Passenger Side Airbag On/Off Switch** in the Removal and Installation section of this group for the procedures.

(4) 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.

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. 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) Pull back the carpet from the floor panel transmission tunnel area under the heater-A/C housing floor duct and forward of the full floor console or mini floor console.

(3) If the vehicle is equipped with the optional Anti-lock Brake System (ABS), remove the acceleration switch and mounting bracket from the floor panel transmission tunnel (Fig. 17). Refer to **Acceleration Switch** in the Removal and Installation section of Group 5 - Brakes for the procedures.

REMOVAL AND INSTALLATION (Continued)

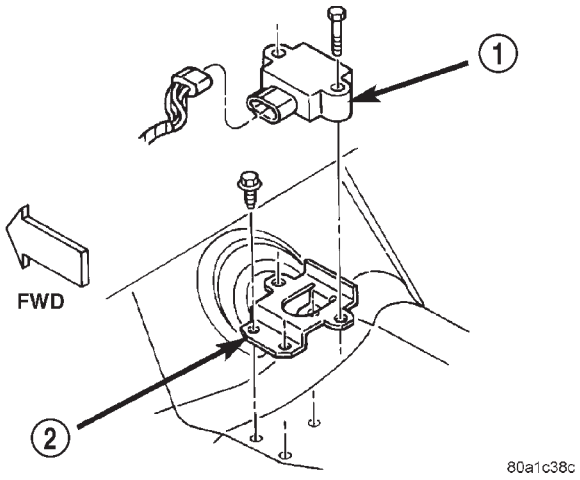


Fig. 17 Acceleration Switch Remove/Install

1 – ACCELERATION SWITCH
2 – MOUNTING BRACKET

NOTE: Always remove and replace the airbag control module and its mounting bracket as a unit. Replacement modules include a replacement mounting bracket. Do not transfer the module to another mounting bracket.

(4) Remove the four screws that secure the Airbag Control Module (ACM) mounting bracket to the floor panel transmission tunnel (Fig. 18).

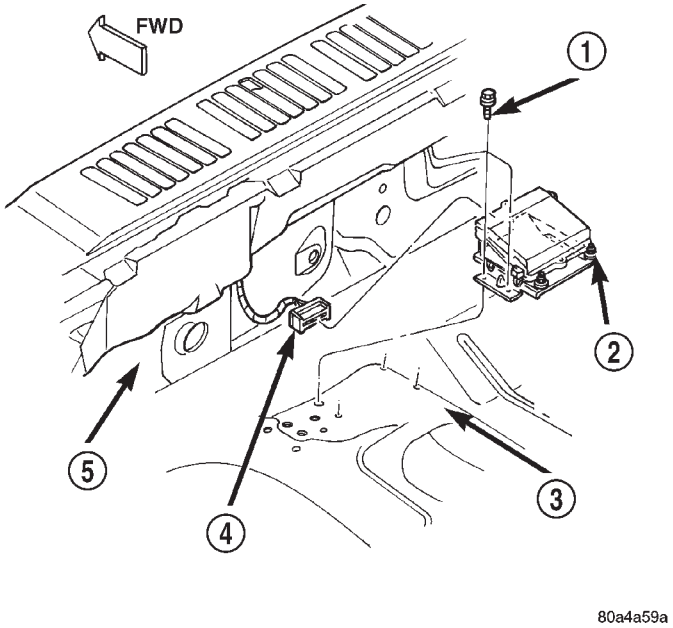


Fig. 18 Airbag Control Module Remove/Install

1 – SCREW
2 – AIRBAG CONTROL MODULE
3 – FLOOR TRANSMISSION TUNNEL
4 – CONNECTOR
5 – DASH PANEL

(5) Slide the ACM and mounting bracket out from under the heater-A/C housing floor duct far enough to access the ACM wire harness connector.

(6) Disconnect the cross-body wire harness connector from the ACM. To disconnect the cross-body wire harness connector from the ACM (Fig. 19) :

(a) Pull the two white locks out about 3 millimeters (0.125 in.) from each side of the connector.

(b) Squeeze the two connector latch tabs between the thumb and forefinger and pull the connector straight away from the ACM connector receptacle.

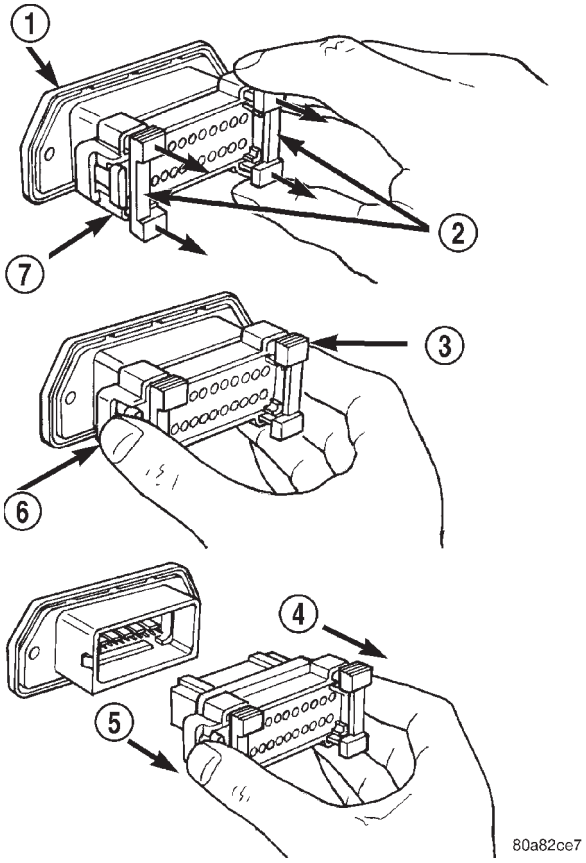


Fig. 19 Airbag Control Module Connector Removal

1 – AIRBAG CONTROL MODULE
2 – PULL TWO LOCKS OUT
3 – SQUEEZE LATCHES
4 – PULL
5 – PULL
6 – SQUEEZE LATCHES
7 – MALE CONNECTOR

(7) Remove the ACM and mounting bracket from the floor panel transmission tunnel as a unit.

INSTALLATION

(1) Reconnect the cross-body wire harness connector to the ACM connector receptacle. Be certain that

REMOVAL AND INSTALLATION (Continued)

the connector latches are fully engaged and that the white connector locks are pushed in.

(2) Carefully position the ACM and mounting bracket unit to the floor panel transmission tunnel. When the ACM is correctly positioned the arrow on the ACM label will be pointed forward in the vehicle.

(3) Install and tighten the four screws that secure the ACM mounting bracket to the floor panel transmission tunnel. Tighten the screws to 10.7 N·m (95 in. lbs.).

(4) If the vehicle is equipped with the optional ABS brakes, install the acceleration switch and mounting bracket onto the floor panel transmission tunnel. Refer to **Acceleration Switch** in the Removal and Installation section of Group 5 - Brakes for the procedures.

(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.

CLOCKSPRING

The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver side airbag has been deployed.

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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).

(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. 20).

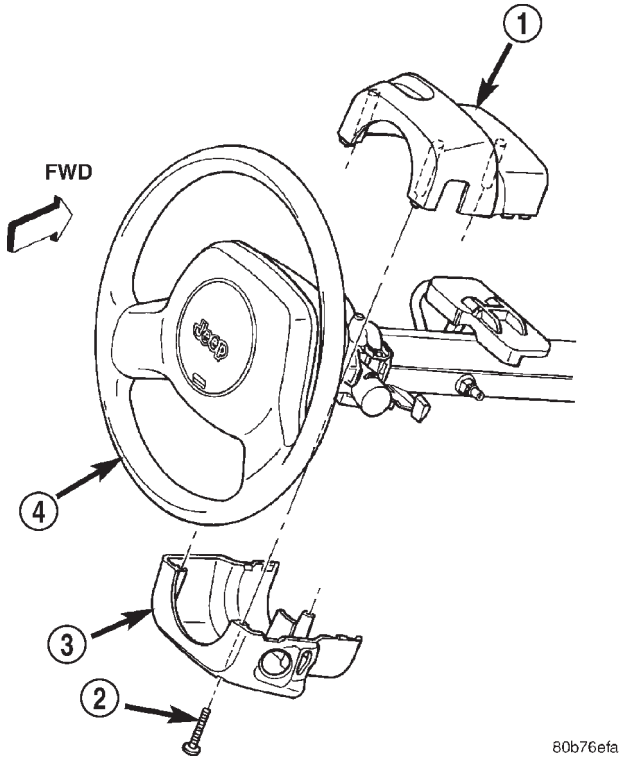


Fig. 20 Steering Column Shrouds Remove/Install

1 – UPPER SHROUD
2 – SCREW (3)
3 – LOWER SHROUD
4 – STEERING WHEEL

(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.

REMOVAL AND INSTALLATION (Continued)

(11) Disconnect the two instrument panel wire harness connectors from the lower clockspring connector receptacles (Fig. 21).

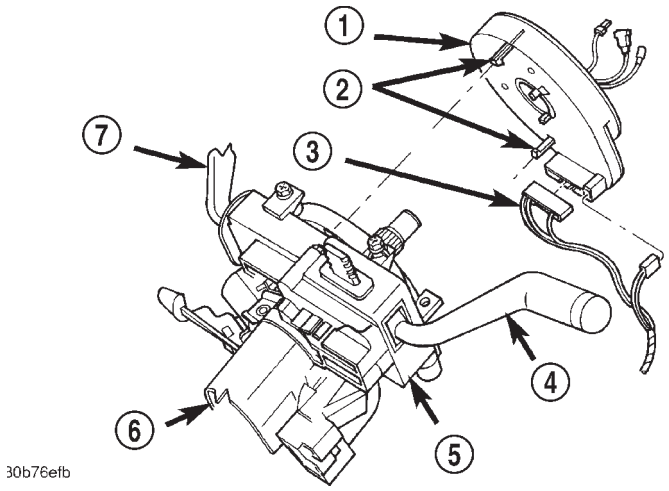


Fig. 21 Clockspring Remove/Install

1 – CLOCKSPRING
2 – LATCHES
3 – WIRE HARNESS
4 – TURN SIGNAL SWITCH LEVER
5 – WATER SHIELD BRACKET
6 – STEERING COLUMN
7 – WIPER SWITCH LEVER

(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. 22). 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.

(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.

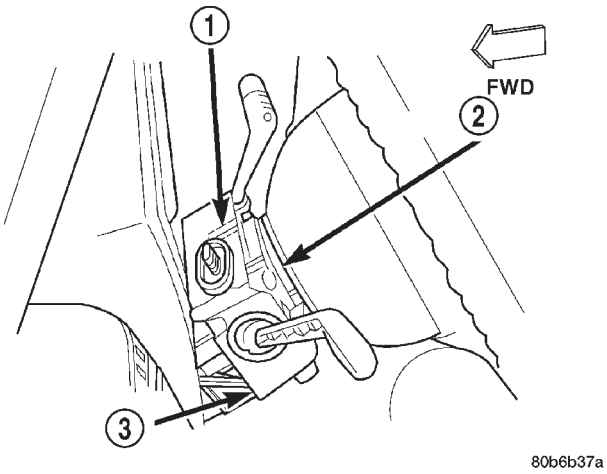


Fig. 22 Upper Clockspring Latch Access Window

1 – UPPER CLOCKSPRING LATCH ACCESS WINDOW
2 – CLOCKSPRING
3 – WATER SHIELD AND BRACKET

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.

Service replacement clocksprings are shipped precentered 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 control 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.

REMOVAL AND INSTALLATION (Continued)

(5) Position both the upper and lower shrouds onto 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 precentered 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.

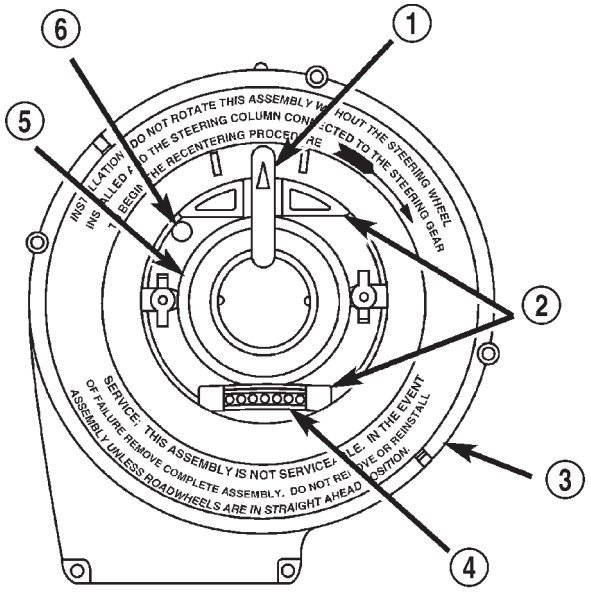
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NOTE: Before starting this procedure, be certain to turn the steering wheel until the front wheels are in the straight-ahead position.

(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. 23).



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Fig. 23 Clockspring

1 – LOCKING PIN
2 – ROTOR FLATS
3 – CASE
4 – UPPER CLOCKSPRING WIRE HARNESSES (WIRES NOT SHOWN)
5 – ROTOR
6 – INDEX HOLE

ADJUSTMENTS (Continued)

(4) Use your other hand to rotate the clockspring rotor clockwise to the end of its travel. **Do not apply excessive torque.**

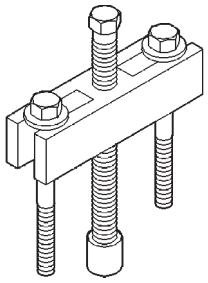
(5) From the end of the clockwise travel, rotate the rotor about two and one-half turns counterclockwise, until the rotor flats are horizontal. If the upper clockspring wire harnesses are not oriented towards the bottom of the clockspring, rotate the rotor another one-half turn in the counterclockwise 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

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GENERAL INFORMATION

INTRODUCTION

An electrically heated rear window defogger is available as factory-installed equipment on models equipped with the hardtop option. The defogger will only operate when the ignition switch is in the On position. When the defogger switch is in the On position, an electric heater grid on the rear window glass is energized. This grid produces heat to help clear the rear window glass of ice, snow, or fog.

The defogger system is controlled by a switch located in the accessory switch bezel, which is near the bottom of the instrument panel center bezel and next to the ash receiver. An amber indicator lamp in the switch button will light to indicate when the defogger system is turned on. The instrument cluster circuitry, which contains the defogger system timer logic, monitors the state of the defogger switch through a hard-wired input. The instrument cluster circuitry controls the defogger system through a hard-wired control output to the defogger relay.

The defogger system will be automatically turned off after a programmed time interval of about ten minutes. After the initial time interval has expired, if the defogger switch is turned on again during the same ignition cycle, the defogger system will automatically turn off after about five minutes.

The defogger system will automatically shut off if the ignition switch is turned to the Off position, or it can be turned off manually by depressing the instrument panel switch. Refer to the owner's manual for more information on the defogger system controls and operation.

Following are general descriptions of the major components in the defogger system. Refer to 8W-48 - Rear Window Defogger in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

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.

DESCRIPTION AND OPERATION (Continued)

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, next to the ash receiver. 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. 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 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 heating grid 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 Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for relay identification and location.

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 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 glass. A distinct difference in temperature between the grid lines and the adjacent clear glass can be detected within three to four minutes of operation.

3. Using a 12-volt DC voltmeter, contact the rear glass heating grid terminal A (right side) with the negative lead, and terminal B (left side) with the positive lead (Fig. 1). The voltmeter should read battery voltage.

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.

DIAGNOSIS AND TESTING (Continued)

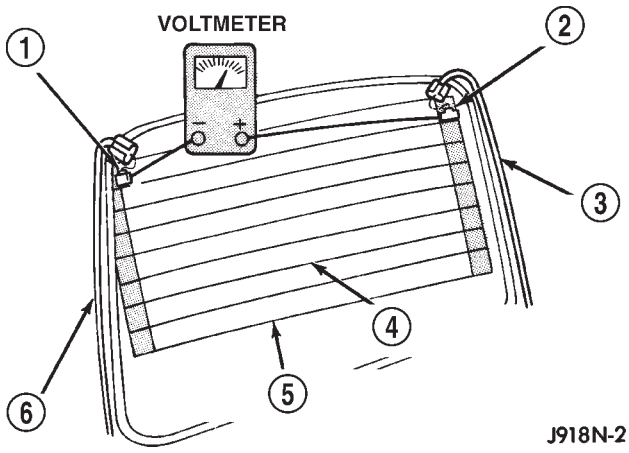


Fig. 1 Rear Window Glass Grid Test

1 – TERMINAL "A"
2 – TERMINAL "B"
3 – FEED WIRE
4 – MID-POINT "C" (TYPICAL)
5 – HEATED REAR WINDOW DEFOGGER GRID
6 – GROUND WIRE

(3) Check the fuses in the Power Distribution Center (PDC) and in the fuseblock module. 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 heating grid is still inoperative, one or more of the following is faulty:

- Defogger switch
- Defogger relay
- Instrument cluster circuitry
- Rear window grid lines (all grid lines would have to be broken or one of the feed wires disconnected for the entire system to be inoperative).

If setting the defogger switch to the On position produces a severe voltmeter deflection, check for a short circuit between the defogger relay output and the rear glass heating grid.

REAR GLASS HEATING GRID

For circuit descriptions and diagrams, refer to 8W-48 - Rear Window Defogger in Group 8W - Wiring Diagrams. To detect breaks in the grid lines, the following procedure is required:

(1) Turn the ignition switch to the On position. Set the 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.

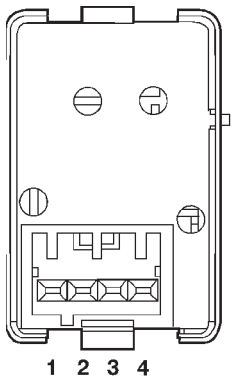
WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL 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.

DIAGNOSIS AND TESTING (Continued)



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 Power Distribution Center (PDC), in the engine compartment. Remove the defogger relay from the PDC to perform the following tests:

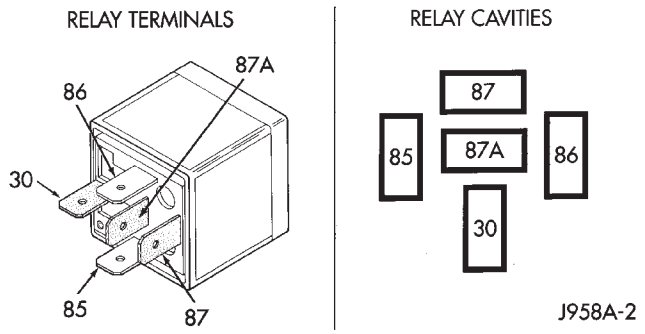
(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 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.

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.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 3 Defogger Relay

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the rear glass heating grid and the defogger switch indicator lamp. There should be continuity between the cavity for relay terminal 87 and the rear window defogger relay output circuit cavities of the rear glass heating grid and defogger switch connectors at all times. If OK, go to Step 4. If not OK, repair the open circuit(s) as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. This terminal is provided with ground by the instrument cluster rear window defogger timer and logic circuitry to energize the defogger relay. There should be continuity to ground at the cavity for relay terminal 86 when the defogger switch is turned On. However, with the defogger relay removed, the defogger switch indicator lamp will not light to show that the defogger system is turned On. Be certain that you depress the defogger switch at least twice to confirm that the system is turned on during this test. If OK, go to Step 5. If not OK, repair the open circuit to the instrument cluster as required.

DIAGNOSIS AND TESTING (Continued)

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. It is connected to fused ignition switch output voltage and should be hot when the ignition switch is in the On position. Check for battery voltage at the cavity for relay terminal 85 with the ignition switch in the On position. If OK, see the diagnosis for Instrument Cluster in this group. If not OK, repair the open circuit to the fuse in the fuseblock module as required.

INSTRUMENT CLUSTER

Before performing this test, complete the Defogger Switch and the Defogger Relay tests as described in this group. For circuit descriptions and diagrams, refer to 8W-48 - Rear Window Defogger in Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING 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 Power Distribution Center (PDC) 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 86) in the PDC. There should be continuity. If OK, replace the faulty instrument cluster. If not OK, repair the open circuit as required.

SERVICE PROCEDURES

REAR GLASS HEATING GRID 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).

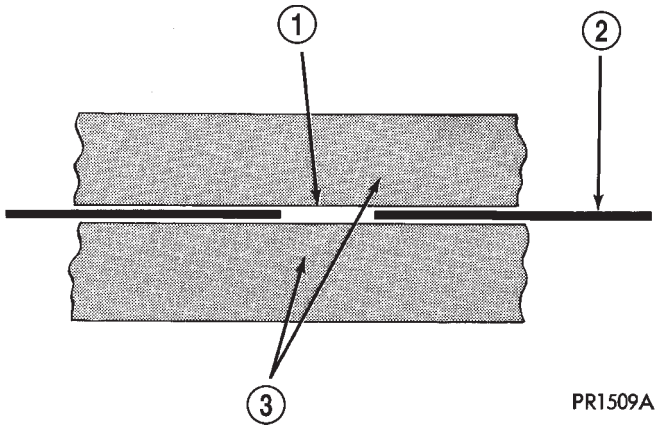


Fig. 4 Grid Line Repair - Typical

1 – BREAK
2 – GRID LINE
3 – MASKING TAPE

(2) Follow the instructions in the repair kit for preparing the damaged area.

(3) Remove the package separator clamp and mix the two conductive epoxy components thoroughly within the packaging. Fold the package in half and cut the center corner to dispense the epoxy.

SERVICE PROCEDURES (Continued)

(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 four screws that secure the accessory switch bezel to the instrument panel (Fig. 5).

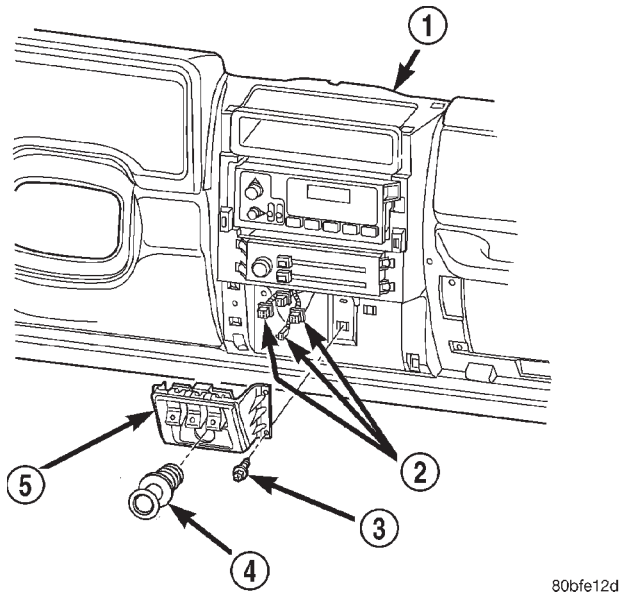


Fig. 5 Accessory Switch Bezel Remove/Install

1 – INSTRUMENT PANEL
2 – WIRE HARNESS CONNECTORS
3 – SCREW
4 – CIGAR LIGHTER
5 – ACCESSORY SWITCH BEZEL

(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.

(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 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.).

REAR WINDOW DEFOGGER RELAY

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unlatch and open the cover on the Power Distribution Center (PDC) (Fig. 6).

(3) See the fuse and relay layout label on the underside of the PDC cover for rear window defogger relay identification and location.

REMOVAL AND INSTALLATION (Continued)

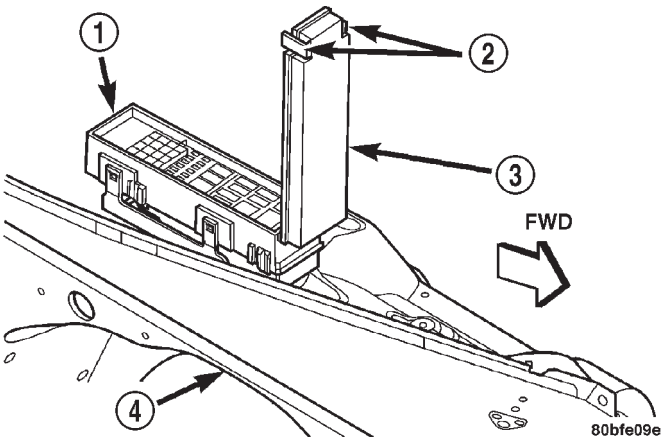


Fig. 6 Power Distribution Center

1 – POWER DISTRIBUTION CENTER
2 – LATCHES
3 – PDC COVER
4 – RIGHT FRONT FENDER

(4) Remove the rear window defogger relay from the PDC.

INSTALLATION

(1) Position the rear window defogger relay in the proper receptacle in the PDC.

(2) Align the rear window defogger relay terminals with the terminal cavities in the PDC receptacle.

(3) Push down firmly on the rear window defogger relay until the terminals are fully seated in the terminal cavities in the PDC receptacle.

(4) Close and latch the cover onto the PDC.

(5) Reconnect the battery negative cable.

POWER DISTRIBUTION SYSTEMS

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DESCRIPTION AND OPERATION

POWER DISTRIBUTION SYSTEM

DESCRIPTION

This group covers the various standard and optional power distribution components used on this model. The power distribution system for this vehicle consists of the following components:

- Power Distribution Center (PDC)
- Fuseblock Module.

The power distribution system also incorporates various types of circuit control and protection features, including:

- Blade-type fuses
- Cartridge fuses
- Relays.

Following are general descriptions of the major components in the power distribution system. See the owner's manual in the vehicle glove box for more information on the features and use of all of the power distribution system components. Refer to the index in this service manual for the location of complete circuit diagrams for the various power distribution system components.

OPERATION

The power distribution system for this vehicle is designed to provide safe, reliable, and centralized distribution points for the electrical current required to operate all of the many standard and optional factory-installed electrical and electronic powertrain, chassis, safety, security, comfort and convenience systems. At the same time, the power distribution system was designed to provide ready access to these electrical distribution points for the vehicle technician to use when conducting diagnosis and repair of faulty circuits. The power distribution system can also prove useful for the sourcing of additional electrical circuits that may be required to provide the electrical current needed to operate many accessories that the vehicle owner may choose to have installed in the aftermarket.

POWER DISTRIBUTION CENTER

DESCRIPTION

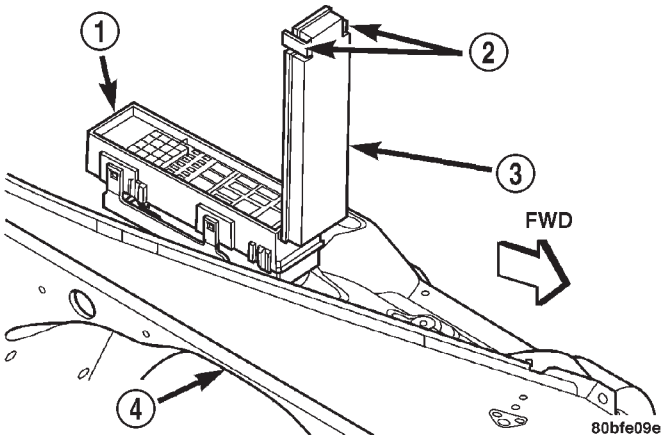


Fig. 1 Power Distribution Center Location

1 – POWER DISTRIBUTION CENTER
2 – LATCHES
3 – PDC COVER
4 – RIGHT FRONT FENDER

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, forward of the battery on the top of the right front inner fender shield. The PDC houses up to fifteen maxi-type cartridge fuses, which replace all in-line fusible links. The PDC also houses up to thirteen blade-type mini fuses, and up to twelve International Standards Organization

DESCRIPTION AND OPERATION (Continued)

(ISO) relays (four standard-type and eight micro-type).

The PDC housing is secured in the engine compartment at four points. Integral mounts on both sides of the PDC housing engage and latch to stanchions that are integral to the stamped steel PDC bracket. The PDC bracket is secured to the top of the right front inner fender shield with three screws, two at the front of the bracket and one at the rear. The PDC is integral to the dash wire harness, which exits from the bottom of the PDC housing. The PDC housing has a molded plastic cover that includes two integral latches at the rear and pivot hooks at the front that snap over a hinge pin on the front of the PDC housing. The PDC cover is easily opened or 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. A fuse puller is also stored on the inside of the PDC cover.

The PDC cover, the PDC housing lower cover, the PDC relay wedges, the PDC relay cassettes and the PDC B(+) terminal stud module are available for service replacement. The PDC main housing unit, the fuse wedges and the bus bars cannot be repaired and are only serviced as a unit with the dash wire harness. If the PDC main housing unit, fuse wedges or the bus bars are faulty or damaged, the dash wire harness unit must be replaced.

OPERATION

All of the current from the battery and the generator output enters the PDC through two cables and a single two-holed eyelet that is secured with nuts to the two PDC B(+) terminal studs near the back of the PDC housing. The molded plastic PDC cover is unlatched and opened to access the battery and generator output connection B(+) terminal studs. 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 index of this service manual for the location of complete PDC wiring diagrams.

IGNITION-OFF DRAW FUSE

DESCRIPTION

All vehicles are equipped with an Ignition-Off Draw (IOD) fuse (Fig. 2) that is removed from its cavity in the Power Distribution Center (PDC) when the vehicle is shipped from the factory. Dealer personnel are to remove the IOD fuse from the storage location and install it into PDC fuse cavity 25 as part of the preparation procedures performed just prior to new vehicle delivery.

The PDC has a molded plastic cover that can be unlatched and opened to provide service access to all of the fuses and relays in the PDC. An integral latch and hinge tabs are molded into the PDC cover for easy removal. A fuse layout map is integral to the underside of the PDC cover to ensure proper fuse and relay identification. The IOD fuse is a 10 ampere mini blade-type fuse and, when removed, it is stored in the empty fuse cavity 27 of the PDC.

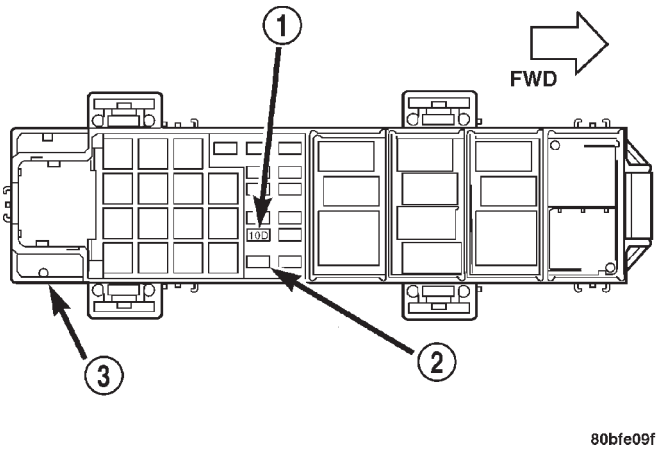


Fig. 2 Ignition-Off Draw Fuse

1 – IGNITION-OFF DRAW FUSE
2 – IGNITION-OFF DRAW FUSE STORAGE LOCATION
3 – POWER DISTRIBUTION CENTER

OPERATION

The term ignition-off draw identifies a normal condition where power is being drained from the battery with the ignition switch in the Off position. The IOD fuse feeds the memory and sleep mode functions for many of the electronic modules in the vehicle as well as various other accessories that require battery current when the ignition switch is in the Off position, including the clock. The only reason the IOD fuse is removed is to reduce the normal IOD of the vehicle electrical system during new vehicle transportation and pre-delivery storage to reduce battery depletion, while still allowing vehicle operation so that the vehicle can be loaded, unloaded and moved as needed by both vehicle transportation company and dealer personnel.

The IOD fuse is removed from PDC fuse cavity 25 when the vehicle is shipped from the assembly plant. Dealer personnel must install the IOD fuse when the vehicle is being prepared for delivery in order to restore full electrical system operation. Once the vehicle is prepared for delivery, the IOD function of this fuse becomes transparent and the fuse that has been assigned the IOD designation becomes only another Fused B(+) circuit fuse. The IOD fuse serves no useful purpose to the dealer technician in the service or diagnosis of any vehicle system or condition,

DESCRIPTION AND OPERATION (Continued)

other than the same purpose as that of any other standard circuit protection device.

The IOD fuse can be used by the vehicle owner as a convenient means of reducing battery depletion when a vehicle is to be stored for periods not to exceed about thirty days. However, it must be remembered that removing the IOD fuse will not eliminate IOD, but only reduce this normal condition. If a vehicle will be stored for more than about thirty days, the battery negative cable should be disconnected to eliminate normal IOD; and, the battery should be tested and recharged at regular intervals during the vehicle storage period to prevent the battery from becoming discharged or damaged. Refer to **Battery** in the index of this service manual for the location of additional service information covering the battery.

FUSEBLOCK MODULE

DESCRIPTION

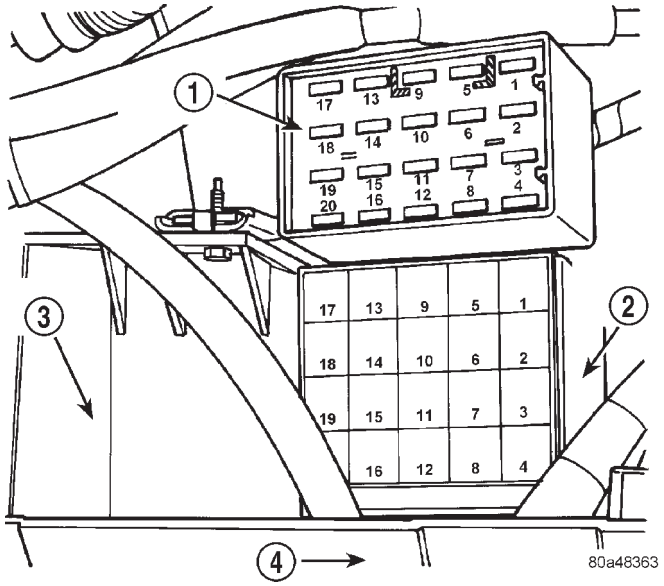


Fig. 3 Fuseblock Module Location

1 – FUSE BLOCK
2 – FUSE BLOCK LABEL
3 – HEATER CASE
4 – GLOVE BOX OPENING

An electrical fuseblock module is mounted on the dash panel in the passenger compartment of the vehicle (Fig. 3). The fuseblock module serves to distribute electrical current to many of the accessory systems in the vehicle. The fuseblock module houses up to twenty blade-type mini fuses.

The molded plastic fuseblock module housing has an integral mounting bracket that is secured with two screws to a bracket welded on the dash panel just above the heater and air conditioner housing. The glove box is rolled down from the instrument panel for service access of the fuseblock module fuses. An adhesive-backed fuse layout map is located on the heater and air conditioner housing below the fuseblock module to ensure proper fuse identification.

The fuseblock module is integral to the cross body wire harness. If any internal circuit or the fuseblock module housing is faulty or damaged, the entire fuseblock module and cross body harness unit must be replaced.

OPERATION

All of the circuits entering and leaving the fuseblock module do so through the cross body wire harness. Internal connection of all of the fuseblock module circuits is accomplished by an intricate combination of hard wiring and bus bars. Refer to **Fuse/ Fuse Block** in the index of this service manual for the location of complete fuseblock module circuit diagrams.

REMOVAL AND INSTALLATION

POWER DISTRIBUTION CENTER

The Power Distribution Center (PDC) main housing unit, the PDC fuse wedges and the PDC bus bars cannot be repaired and are only serviced as a unit with the dash wire harness. If the PDC main housing unit, the fuse wedges or the bus bars are faulty or damaged, the entire PDC and dash wire harness unit must be replaced.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect each of the dash wire harness connectors. Refer to **Connector Locations** in the index of this service manual for the location of more information on the dash wire harness connector locations.

(3) Remove all of the fasteners that secure each of the dash wire harness ground eyelets to the vehicle body and chassis components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the ground eyelet locations.

(4) Disengage each of the retainers that secure the dash wire harness to the vehicle body and chassis components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the dash wire harness retainer locations.

(5) Unlatch and open the PDC cover (Fig. 4).

(6) Remove the two nuts that secure the eyelet terminal of the battery positive cable take out and the engine wire harness generator output take out to the PDC B(+) terminal studs.

REMOVAL AND INSTALLATION (Continued)

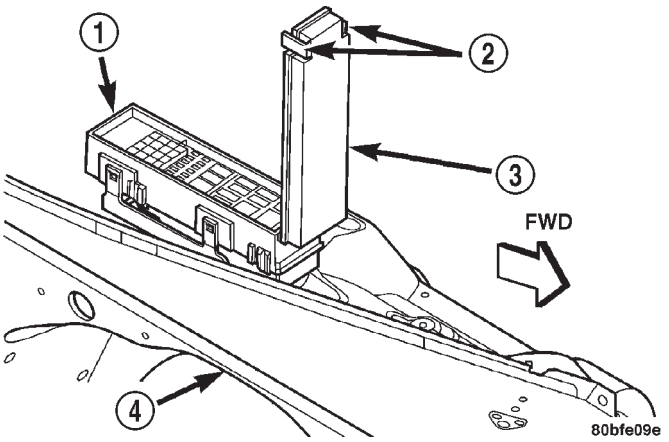


Fig. 4 Power Distribution Center

1 – POWER DISTRIBUTION CENTER
2 – LATCHES
3 – PDC COVER
4 – RIGHT FRONT FENDER

(7) Remove the battery positive cable take out and the engine wire harness generator output take out eyelet terminal from the B(+) terminal studs.

(8) Disengage the latches on the PDC housing mounts from the tabs on the PDC bracket stanchions, and pull the PDC housing upward to disengage the mounts from the stanchions of the bracket.

(9) Remove the PDC and the dash wire harness from the engine compartment as a unit.

INSTALLATION

NOTE: If the PDC is being replaced with a new unit, be certain to transfer each of the fuses and relays that have not been included with the replacement PDC from the faulty PDC to the proper cavities of the replacement unit. Refer to Power Distribution in the index of this service manual for the location of complete PDC wiring diagrams and cavity assignments.

(1) Position the PDC and the dash wire harness unit in the engine compartment.

(2) Engage the mounts on the PDC housing with the stanchions of the PDC bracket and push the unit downward until the mount latches engage the mounting tabs on the PDC bracket.

(3) Install the eyelet terminal of the battery positive cable take out and the engine wire harness generator output take out onto the PDC B(+) terminal studs.

(4) Install and tighten the two nuts that secure the eyelet terminal of the battery positive cable take out and the engine wire harness generator output take out to the B(+) terminal studs. Tighten the nuts to 11.3 N·m (100 in. lbs.).

(5) Engage the tabs on the lower edge of the B(+) terminal stud cover in the slots on the back of the PDC housing, then engage the latch on the top of the cover with the latch receptacle on the PDC housing.

(6) Engage each of the retainers that secure the dash wire harness to the vehicle body and chassis components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the dash wire harness retainer locations.

(7) Install all of the fasteners that secure each of the dash wire harness ground eyelets to the vehicle body and chassis components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the ground eyelet locations.

(8) Reconnect each of the dash wire harness connectors. Refer to **Connector Locations** in the index of this service manual for the location of more information on the dash wire harness connector locations.

(9) Reconnect the battery negative cable.

POWER DISTRIBUTION CENTER BRACKET

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the Power Distribution Center (PDC) from the PDC bracket. Refer to **Power Distribution Center** in the index of this service manual for the location of the proper PDC removal procedures.

(3) Remove the three screws that secure the PDC bracket to the right front inner fender (Fig. 5).

(4) Remove the PDC bracket from the right front inner fender.

INSTALLATION

(1) Position the PDC bracket onto the right front inner fender.

(2) Install and tighten the three screws that secure the PDC mounting bracket to the right front inner fender. Tighten the screws to 3.9 N·m (35 in. lbs.).

(3) Install the PDC onto the PDC bracket. Refer to **Power Distribution Center** in the index of this service manual for the location of the proper PDC installation procedures.

(4) Reconnect the battery negative cable.

IGNITION-OFF DRAW FUSE

The Ignition-Off Draw (IOD) fuse is removed from Power Distribution Center (PDC) fuse cavity 25 (Fig. 6) when the vehicle is shipped from the assembly plant. Dealer personnel must install the IOD fuse when the vehicle is being prepared for delivery in order to restore full electrical system operation.

REMOVAL AND INSTALLATION (Continued)

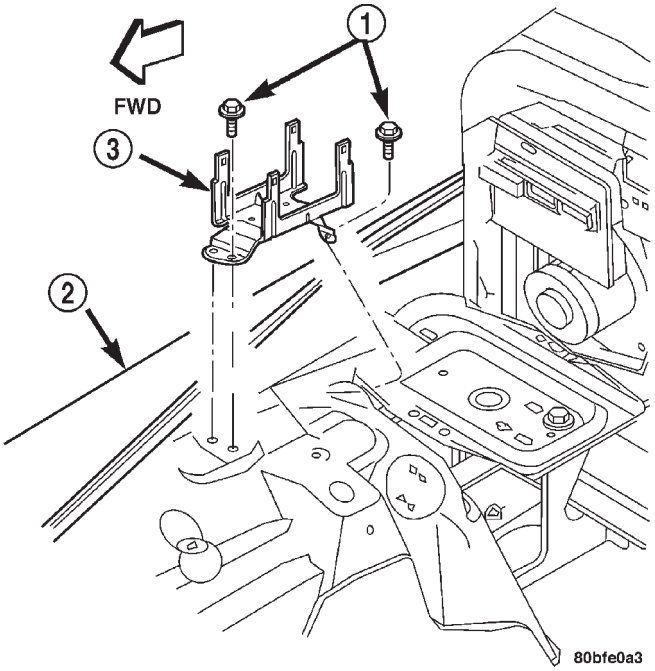


Fig. 5 PDC Bracket Remove/Install

1 – SCREW (3)
2 – RIGHT FRONT FENDER
3 – PDC BRACKET

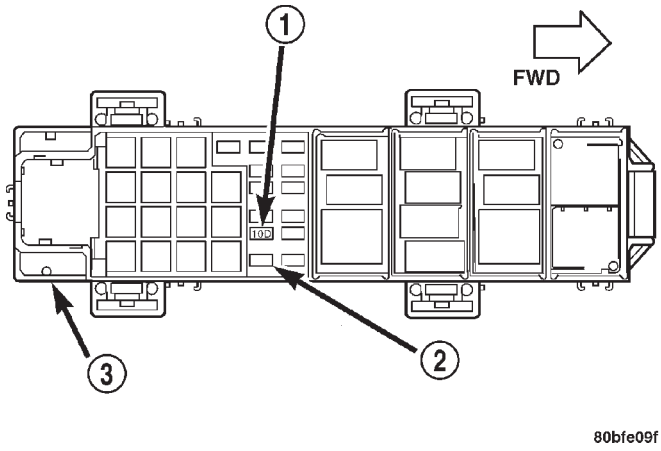


Fig. 6 Ignition-Off Draw Fuse

1 – IGNITION-OFF DRAW FUSE
2 – IGNITION-OFF DRAW FUSE STORAGE LOCATION
3 – POWER DISTRIBUTION CENTER

NOTE: 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 installed. Removing and installing the IOD fuse again with the ignition switch in the Off position will usually correct the scrambled radio display condition.

REMOVAL

(1) Turn the ignition switch to the Off position.
(2) Unlatch and open the cover from the PDC.
(3) Remove the IOD fuse from fuse cavity 25 of the PDC.
(4) Store the removed IOD fuse by inserting the terminal blades of the fuse into the empty fuse cavity 27 of the PDC.
(5) Close and latch the cover onto the PDC.

INSTALLATION

(1) Turn the ignition switch to the Off position.
(2) Unlatch and open the cover from the PDC.
(3) Remove the stored IOD fuse from fuse cavity 27 of the PDC.
(4) Align the terminal blades of the IOD fuse with the terminal receptacles in fuse cavity 25 of the PDC.
(5) Use a thumb to press the IOD fuse firmly down into PDC fuse cavity 25.
(6) Close and latch the cover onto the PDC.

FUSEBLOCK MODULE

The fuseblock module is serviced as a unit with the cross body wire harness. If any internal circuit of the fuseblock module or if the fuseblock module housing is faulty or damaged, the entire fuseblock module and the cross body wire harness unit must be replaced.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Remove the instrument panel assembly from the dash panel. Refer to **Instrument Panel Assembly** in the index of this service manual for the location of the instrument panel removal procedures.
(3) Disconnect each of the cross body wire harness connectors. Refer to **Connector Locations** in the index of this service manual for the location of more

REMOVAL AND INSTALLATION (Continued)

information on the cross body wire harness connector locations.

(4) Remove all of the fasteners that secure each of the cross body wire harness ground eyelets to the vehicle body and chassis components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the ground eyelet locations.

(5) Disengage each of the retainers that secure the cross body wire harness to the vehicle body and chassis components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the cross body wire harness retainer locations.

(6) Remove the two screws that secure the fuseblock module to the bracket on the dash panel (Fig. 7).

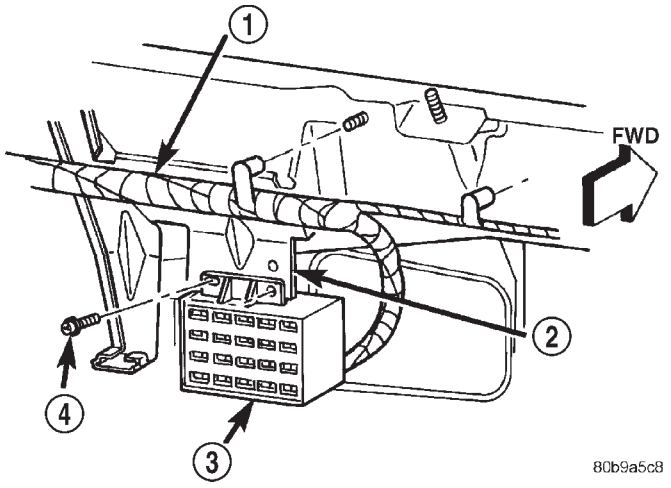


Fig. 7 Fuseblock Module Remove/Install

1 – CROSS BODY WIRE HARNESS
2 – BRACKET
3 – FUSEBLOCK MODULE
4 – SCREWS (2)

(7) Remove the fuseblock module and the cross body wire harness from the dash panel as a unit.

INSTALLATION

NOTE: If the fuseblock module is being replaced with a new unit, be certain to transfer each of the fuses from the faulty fuseblock module to the proper cavities of the replacement fuseblock module. Refer to Fuse/Fuse Block in the index of this service manual for the location of complete fuseblock module circuit diagrams and cavity assignments.

(1) Position the fuseblock module and the cross body wire harness onto the dash panel as a unit.

(2) Install and tighten the two screws that secure the fuseblock module to the bracket on the dash panel. Tighten the screws to 3.3 N·m (30 in. lbs.).

(3) Engage each of the retainers that secure the cross body wire harness to the vehicle body and chassis components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the cross body wire harness retainer locations.

(4) Install all of the fasteners that secure each of the cross body wire harness ground eyelets to the vehicle body and chassis components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the ground eyelet locations.

(5) Reconnect each of the cross body wire harness connectors. Refer to **Connector Locations** in the index of this service manual for the location of more information on the cross body wire harness connector locations.

(6) Install the instrument panel assembly onto the dash panel. Refer to **Instrument Panel Assembly** in the index of this service manual for the location of the instrument panel installation procedures.

(7) Reconnect the battery negative cable.

DISASSEMBLY AND ASSEMBLY

POWER DISTRIBUTION CENTER

The Power Distribution Center (PDC) cover, the PDC housing lower cover, the PDC relay wedges, the PDC relay cassettes and the PDC B(+) terminal stud module are available for service replacement (Fig. 8). The PDC cover can be simply unlatched and removed from the PDC housing without the PDC being removed or disassembled. Service of the remaining PDC components requires that the PDC be removed from its mounting and disassembled. Refer to **Wiring Repair** in the index of this service manual for the location of the proper wiring repair procedures.

DISASSEMBLY

PDC HOUSING LOWER COVER

(1) Disconnect and isolate the battery negative cable.

(2) Unlatch and remove the cover from the PDC.

(3) Unlatch and remove the B(+) terminal stud cover from the PDC.

(4) Remove the two nuts that secure the eyelet terminal to the two B(+) terminal studs of the PDC.

(5) Remove the eyelet terminal from the PDC B(+) terminal studs.

(6) Disengage the latches on the PDC mounts from the tabs on the PDC bracket stanchions, and pull the

DISASSEMBLY AND ASSEMBLY (Continued)

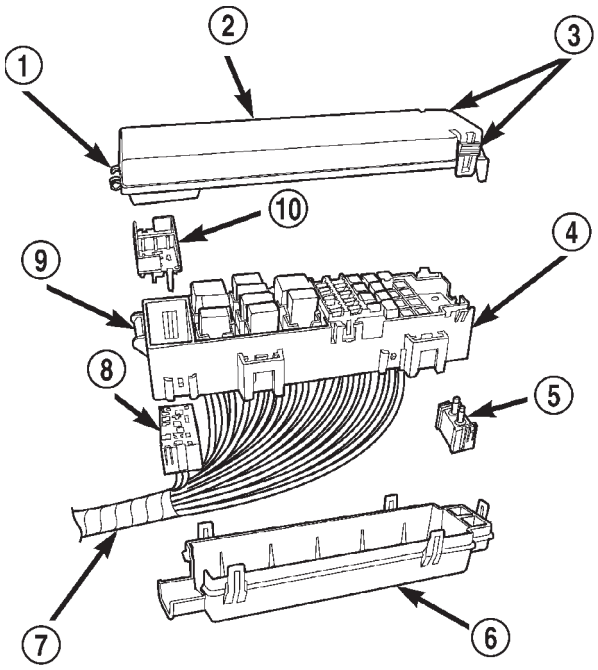


Fig. 8 Power Distribution Center Components - Typical

1 – PIVOT HOOKS
2 – COVER
3 – LATCHES
4 – PDC HOUSING
5 – B(+) TERMINAL STUD MODULE
6 – HOUSING LOWER COVER
7 – WIRE HARNESS
8 – RELAY CASSETTE (TYPICAL)
9 – HINGE PIN
10 – RELAY WEDGE (TYPICAL)

PDC housing upward to disengage the mounts from the stanchions of the bracket.

(7) Using a trim stick or another suitable wide flat-bladed tool, gently pry the latches on each side and one end of the PDC housing that secure the housing lower cover to the PDC and remove the housing lower cover (Fig. 9).

PDC B(+) TERMINAL MODULE

(1) Remove the PDC housing lower cover.

(2) From the top of the PDC housing, use a small screwdriver or a terminal pick tool (Special Tool Kit 6680) to release the two latches that secure the B(+) terminal module in the PDC (Fig. 10).

(3) Gently and evenly press the two B(+) terminal studs down through the bus bar in the PDC.

(4) From the bottom of the PDC housing, remove the B(+) terminal module from the PDC (Fig. 11).

PDC RELAY WEDGE

(1) Remove the PDC housing lower cover.

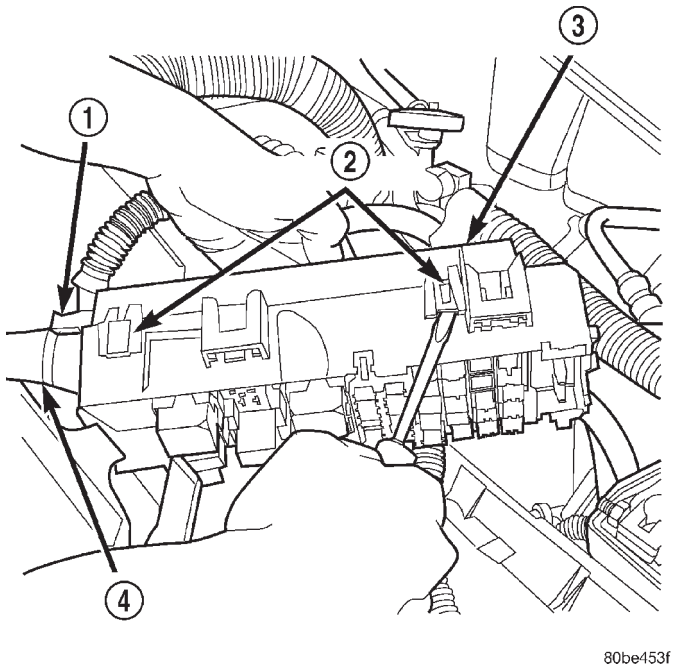


Fig. 9 PDC Housing Lower Cover Remove/Install - Typical

1 – TROUGH FORMATION
2 – LATCHES (5)
3 – PDC HOUSING LOWER COVER
4 – WIRE HARNESS

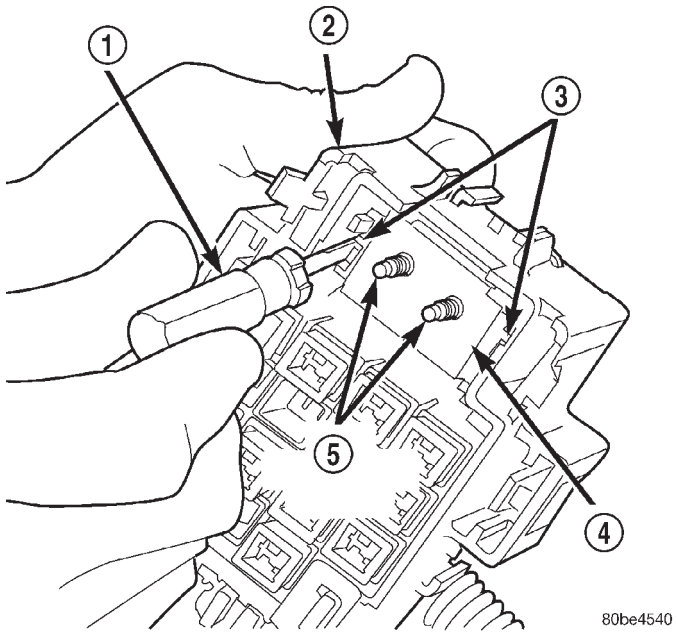


Fig. 10 PDC B(+) Terminal Module Latches

1 – FROM SPECIAL TOOL KIT 6680
2 – PDC HOUSING
3 – LATCHES
4 – BUS BAR
5 – B(+) TERMINAL STUDS

DISASSEMBLY AND ASSEMBLY (Continued)

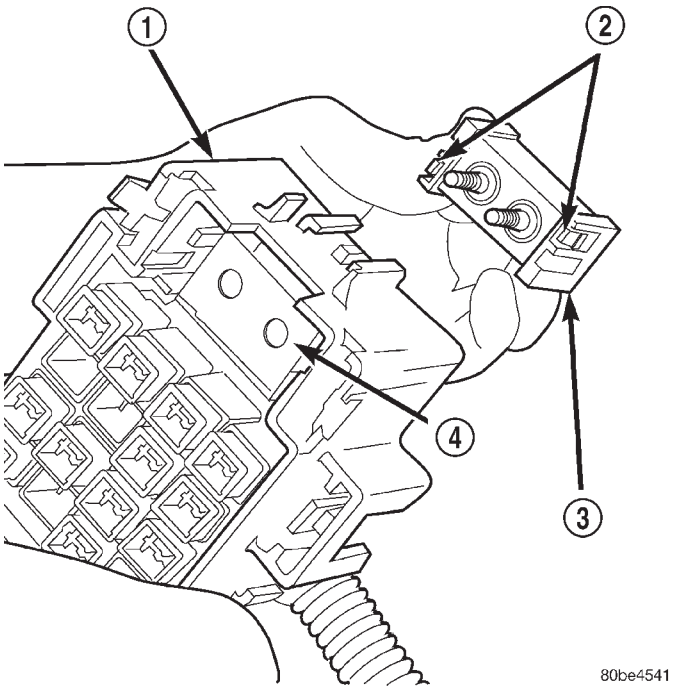


Fig. 11 PDC B(+) Terminal Module Remove/Install

1 – PDC HOUSING
2 – LATCHES
3 – B(+) TERMINAL MODULE
4 – BUS BAR

(2) Remove each of the relays from the PDC relay wedge to be removed.

(3) From the bottom of the PDC housing, use a small screwdriver or a terminal pick tool (Special Tool Kit 6680) to release the two latches (yellow) that secure the relay wedge to the PDC relay cassette.

(4) From the top of the PDC housing, remove the relay wedge from the PDC relay cassette (Fig. 12).

PDC RELAY CASSETTE

(1) Remove the relay wedge from the PDC relay cassette to be removed.

NOTE: It may be necessary to remove relay cassettes that are not being serviced from the PDC housing in order to obtain sufficient clearance to service the faulty relay cassette. The same service procedure is repeated as necessary to remove each of the interfering relay wedges and relay cassettes from the PDC housing.

(2) From the top of the PDC housing, use a small screwdriver or a terminal pick tool (Special Tool Kit 6680) to release the two latches that secure the relay cassette in the PDC (Fig. 13).

(3) Gently and evenly press the relay cassette down through the PDC housing.

(4) From the bottom of the PDC housing, remove the relay cassette from the PDC (Fig. 14).

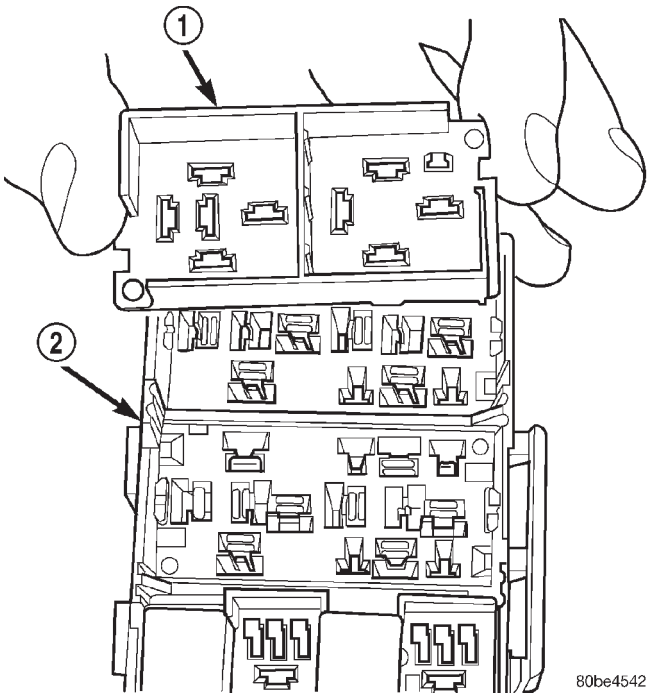


Fig. 12 PDC Relay Wedge Remove/Install - Typical

1 – RELAY WEDGE (TYPICAL)
2 – PDC HOUSING

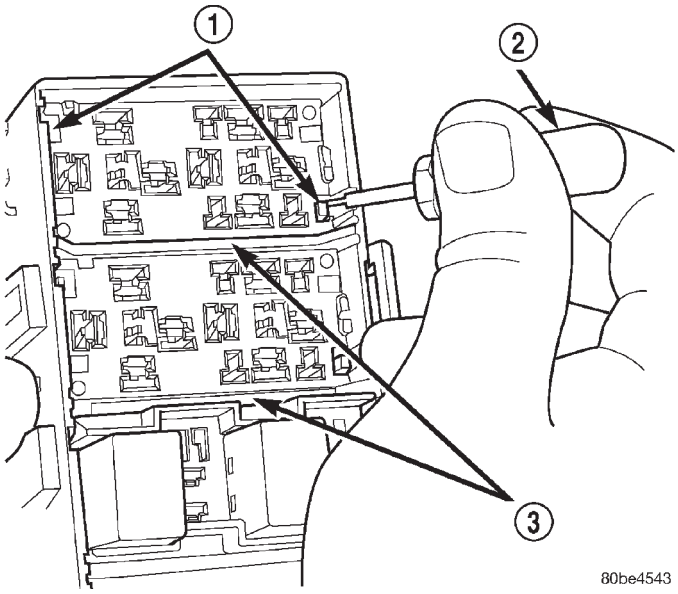


Fig. 13 PDC Relay Cassette Latches - Typical

1 – LATCHES
2 – FROM SPECIAL TOOL KIT 6680
3 – PDC RELAY CASSETTES (TYPICAL)

CAUTION: Do not remove the wiring and terminals from the terminal cavities of the faulty PDC relay cassette at this time. Refer to the Assembly procedure that follows for the proper procedures for transferring the wiring and terminals to the replacement PDC relay cassette.

DISASSEMBLY AND ASSEMBLY (Continued)

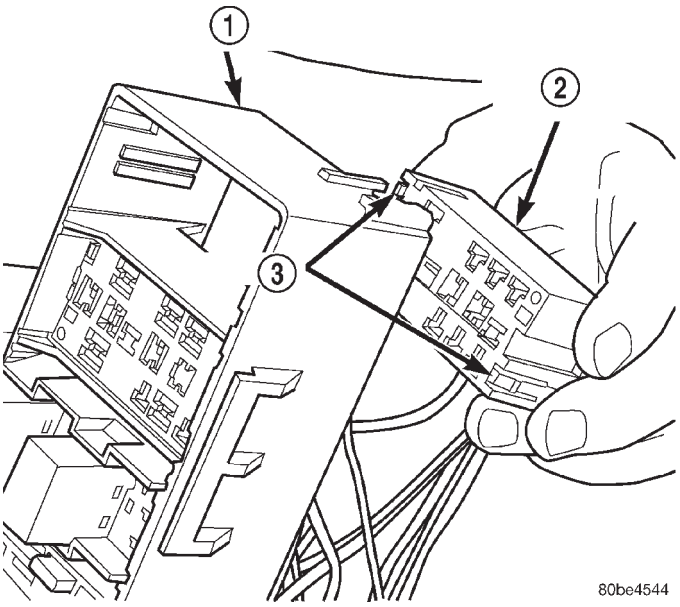


Fig. 14 PDC Relay Cassette Remove/Install - Typical

1 – PDC HOUSING
2 – PDC RELAY CASSETTE (TYPICAL)
3 – LATCHES

ASSEMBLY

PDC RELAY CASSETTE

(1) Move the faulty PDC relay cassette with its wiring away from the bottom of the PDC housing far enough to allow the replacement relay cassette to be installed into the PDC.

(2) Using the faulty relay cassette as a guide, be certain that the replacement relay cassette is correctly oriented before installing it into the PDC housing.

(3) From the bottom of the PDC housing, align and insert the replacement relay cassette into the PDC. Press the relay cassette up into the PDC until both of the latches are fully engaged.

CAUTION: Proper care must be taken to be certain that the wiring and terminals from the faulty PDC relay cassette are installed in the correct terminal cavities of the replacement relay cassette. To prevent mistakes it is recommended that the wiring and terminals be removed from the faulty relay cassette one cavity at a time, repaired or spliced as necessary, then installed securely into the correct cavity of the replacement relay cassette. If you are not absolutely certain into which cavity a terminal should be installed, refer to Power Distribution in the index of this service manual for the location of complete PDC wiring diagrams.

(4) While pulling gently on the wire from the bottom of the faulty PDC relay cassette, use a terminal pick tool (Special Tool Kit 6680) from the top of the relay cassette to release the latch that secures the terminal in the relay cassette terminal cavity (Fig. 15).

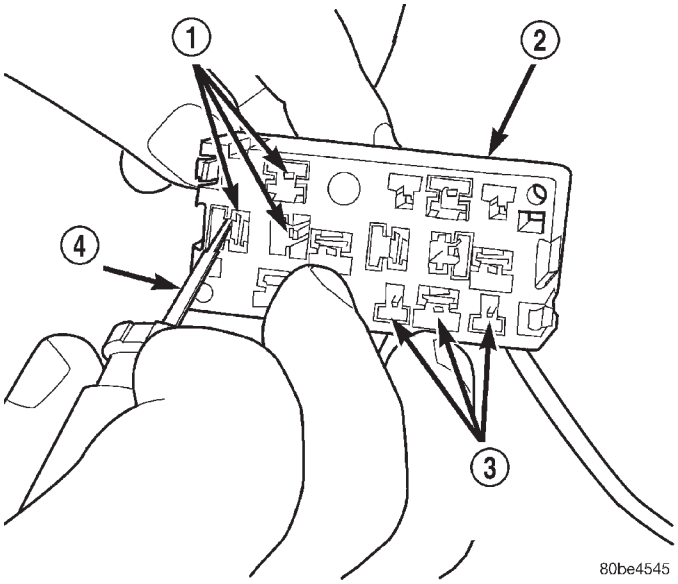


Fig. 15 PDC Relay Cassette Terminal Remove/Install

1 – TERMINAL CAVITIES (TYPICAL)
2 – PDC RELAY CASSETTE (TYPICAL)
3 – TERMINAL LATCHES (TYPICAL)
4 – FROM SPECIAL TOOL KIT 6680

(5) From the bottom of the faulty PDC relay cassette, remove the wire and terminal from the relay cassette terminal cavity.

(6) Make all necessary repairs and splices to the wire for the removed terminal. Refer to **Wiring Repair** in the index of this service manual for the location of the proper wiring repair procedures.

(7) From the bottom of the PDC housing, align and insert the removed wire and terminal into the correct terminal cavity of the replacement relay cassette. Push the wire and terminal up into the relay cassette terminal cavity until it is fully engaged by the latch.

(8) Repeat Step 4, Step 5, Step 6 and Step 7 one wire and terminal at a time until each of the wires and terminals have been transferred from the faulty PDC relay cassette into the replacement relay cassette.

(9) Install the PDC relay wedge into the replacement PDC relay cassette.

PDC RELAY WEDGE

(1) From the top of the PDC housing, align and insert the PDC relay wedge latch arms into the correct cavities in the relay cassette.

(2) Gently and evenly press the PDC relay wedge down into the relay cassette until both of the latches are fully engaged.

DISASSEMBLY AND ASSEMBLY (Continued)

(3) Install each of the removed relays into the proper cavities of the PDC relay wedge.

(4) Install the PDC housing lower cover.

PDC B(+) TERMINAL MODULE

(1) From the bottom of the PDC housing, align and insert the B(+) terminal module into the PDC.

(2) From the bottom of the PDC housing, align and insert the two studs of the PDC B(+) terminal module through the bus bar in the PDC.

(3) From the bottom of the PDC housing, press the B(+) terminal module gently and evenly into the PDC until both of the latches are fully engaged.

(4) Install the PDC housing lower cover.

PDC HOUSING LOWER COVER

(1) Align the PDC housing lower cover to the bottom of the PDC.

(2) Press the PDC housing lower cover gently and evenly onto the PDC until each of the latches that secure the cover to the PDC is fully engaged.

(3) Engage the mounts on the PDC housing with the stanchions of the PDC bracket and push the unit downward until the mount latches fully engage the mounting tabs on the PDC bracket.

(4) Install the eyelet terminal over the two PDC B(+) terminal studs.

(5) Install and tighten the two nuts that secure the eyelet terminal to the B(+) terminal studs. Tighten the nuts to 11.3 N·m (100 in. lbs.).

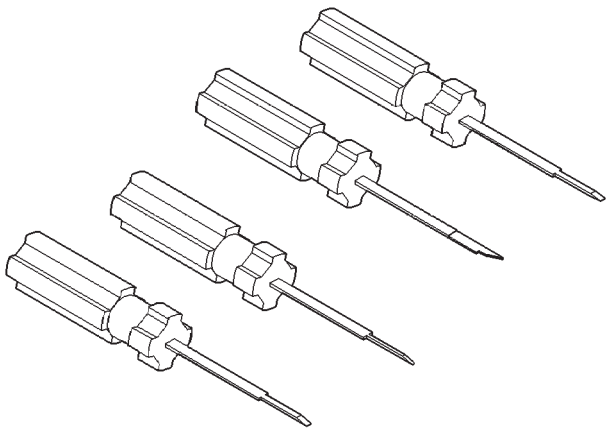
(6) Install the B(+) terminal stud cover onto the PDC.

(7) Install the cover onto the PDC.

(8) Reconnect the battery negative cable.

SPECIAL TOOLS

POWER DISTRIBUTION SYSTEMS



Terminal Pick Kit 6680

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 using the Customer Learn programming procedure or a DRBIII® scan tool. 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 DRBIII® 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 one, 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 DRBIII® 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 (PIN). The SKIM keeps the "Secret Key" code in memory. This "Secret Key" code must be transferred to the PCM memory during the initialization/programming of the SKIS when the vehicle is manufactured, and each time the PCM is replaced

DESCRIPTION AND OPERATION (Continued)

during vehicle service by the dealer technician. The SKIM also transfers the "Secret Key" code to the memory of each of the Sentry Key transponders during new key programming. 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 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 DRBIII® 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).

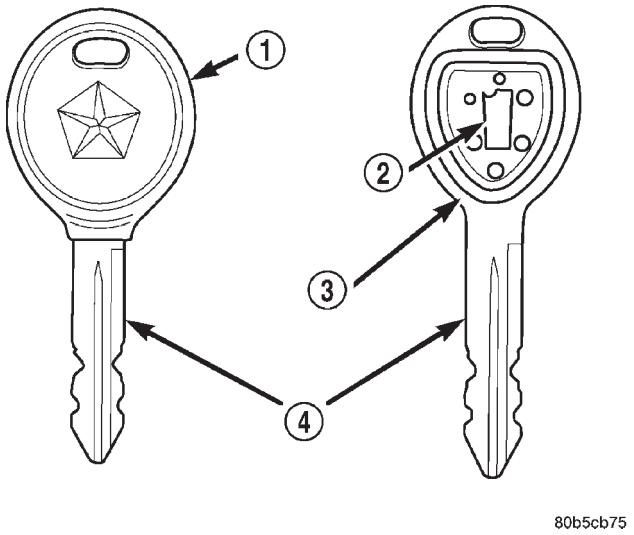


Fig. 1 Sentry Key Immobilizer Transponder

1 – MOLDED CAP
2 – TRANSPONDER
3 – MOLDED CAP REMOVED
4 – SENTRY KEY

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. Each time a new Sentry Key transponder is programmed, 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 and their transponder identification codes must be learned by and stored in the SKIM memory, 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.

DESCRIPTION AND OPERATION (Continued)

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.

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.

(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) Remove the three screws that secure the lower steering column shroud to the upper shroud (Fig. 2).

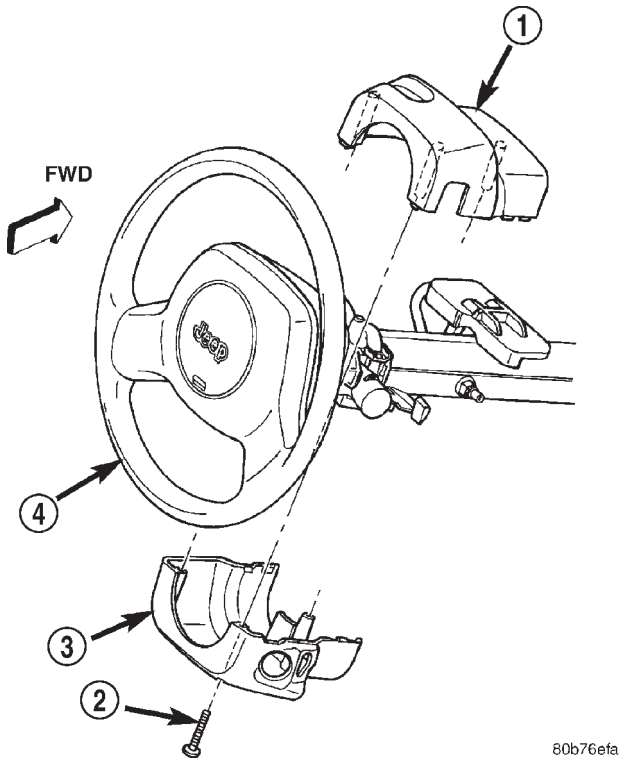


Fig. 2 Steering Column Shrouds Remove/Install

1 – UPPER SHROUD
2 – SCREW (3)
3 – LOWER SHROUD
4 – STEERING WHEEL

REMOVAL AND INSTALLATION (Continued)

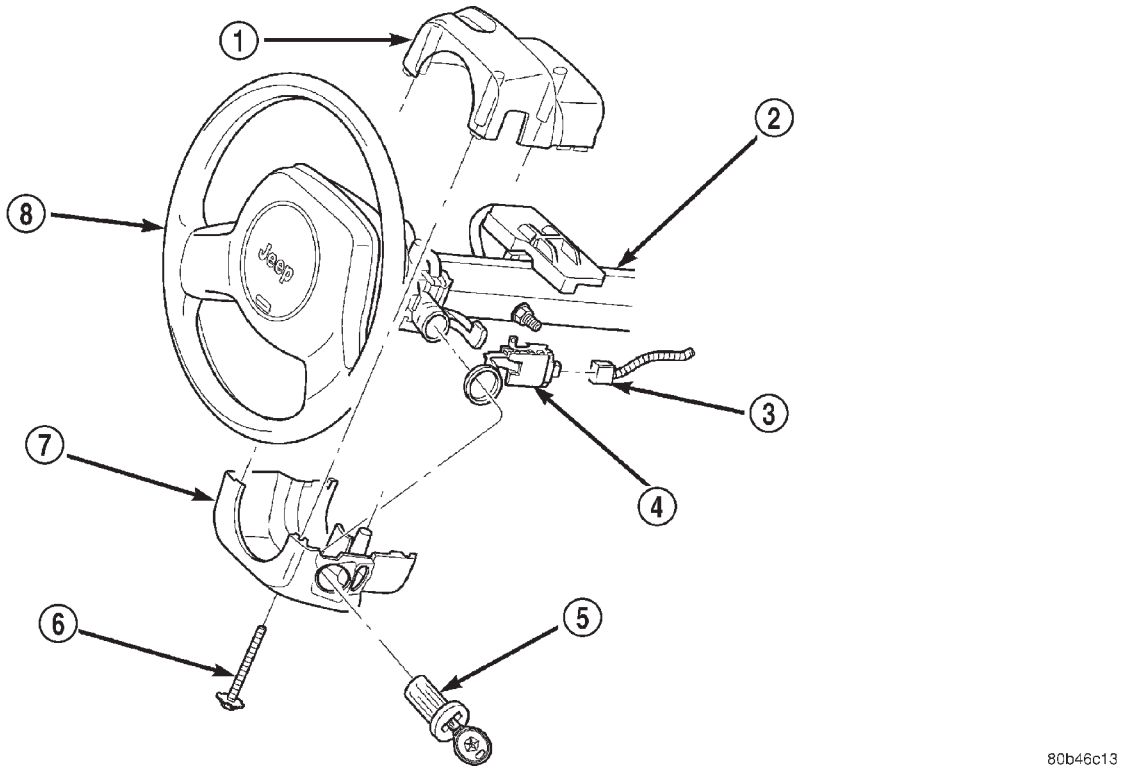


Fig. 3 Sentry Key Immobilizer Module Remove/Install

1 – UPPER SHROUD
2 – STEERING COLUMN
3 – WIRE HARNESS CONNECTOR
4 – SENTRY KEY IMMOBILIZER MODULE
5 – IGNITION LOCK CYLINDER
6 – SCREW
7 – LOWER SHROUD
8 – STEERING WHEEL

(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.

(5) Remove both the upper and lower shrouds from the steering column.

(6) Disengage the steering column wire harness retainer from the tab on the top of the Sentry Key Immobilizer Module (SKIM) mounting bracket (Fig. 3).

(7) Unplug the wire harness connector from the SKIM receptacle.

(8) 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.

(9) 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.

(10) Remove the SKIM from the vehicle.

(11) 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.).

NOTE: If the SKIM is replaced with a new unit, a DRBIII® 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.

CHIME/BUZZER WARNING SYSTEMS

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GENERAL INFORMATION

INTRODUCTION

This group covers the chime warning system, which is standard factory-installed equipment on this model. The chime warning system provides an audible warning to the driver under the following conditions:

- Check gauges lamp illumination
- Driver side seat belt is not fastened with the ignition switch in the On position
- 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
- 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 8W-40 Instrument Cluster or 8W-44 - Interior Lighting in Group 8W - Wiring Diagrams for complete circuit descriptions and diagrams.

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 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 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.

DESCRIPTION AND OPERATION (Continued)

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 AIR-BAGS, 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 AIR-BAG 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 door jamb switch output 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 output 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 AIR-BAGS, 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 AIR-BAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(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.

DIAGNOSIS AND TESTING (Continued)

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 no continuity with the driver door closed, and 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 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

DIAGNOSIS AND TESTING (Continued)

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.

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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.

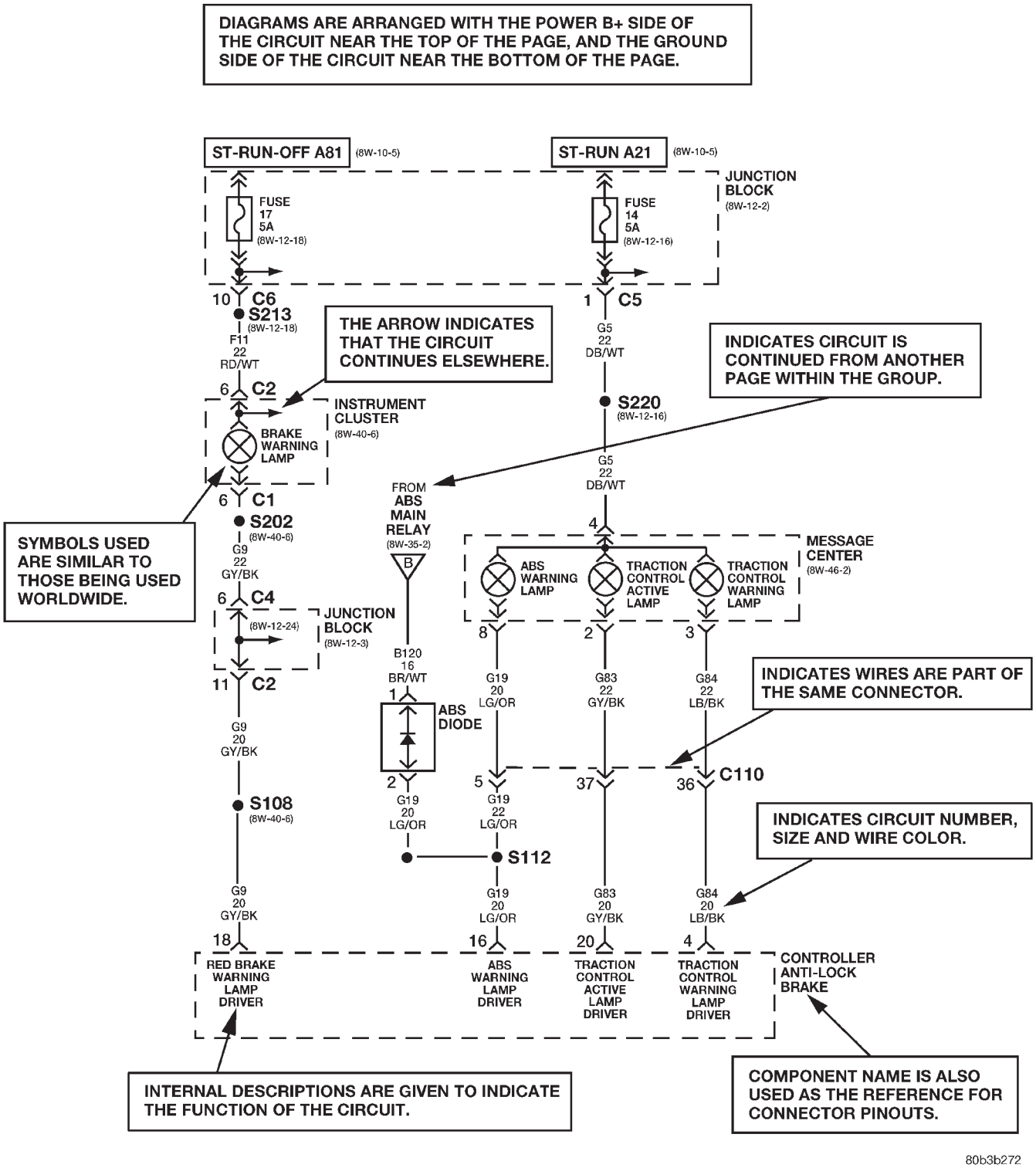
Diagrams are arranged such that the power (B+) side of the circuit is placed near the top of the page, and the ground (B-) side of the circuit is placed near the bottom of the page.

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.

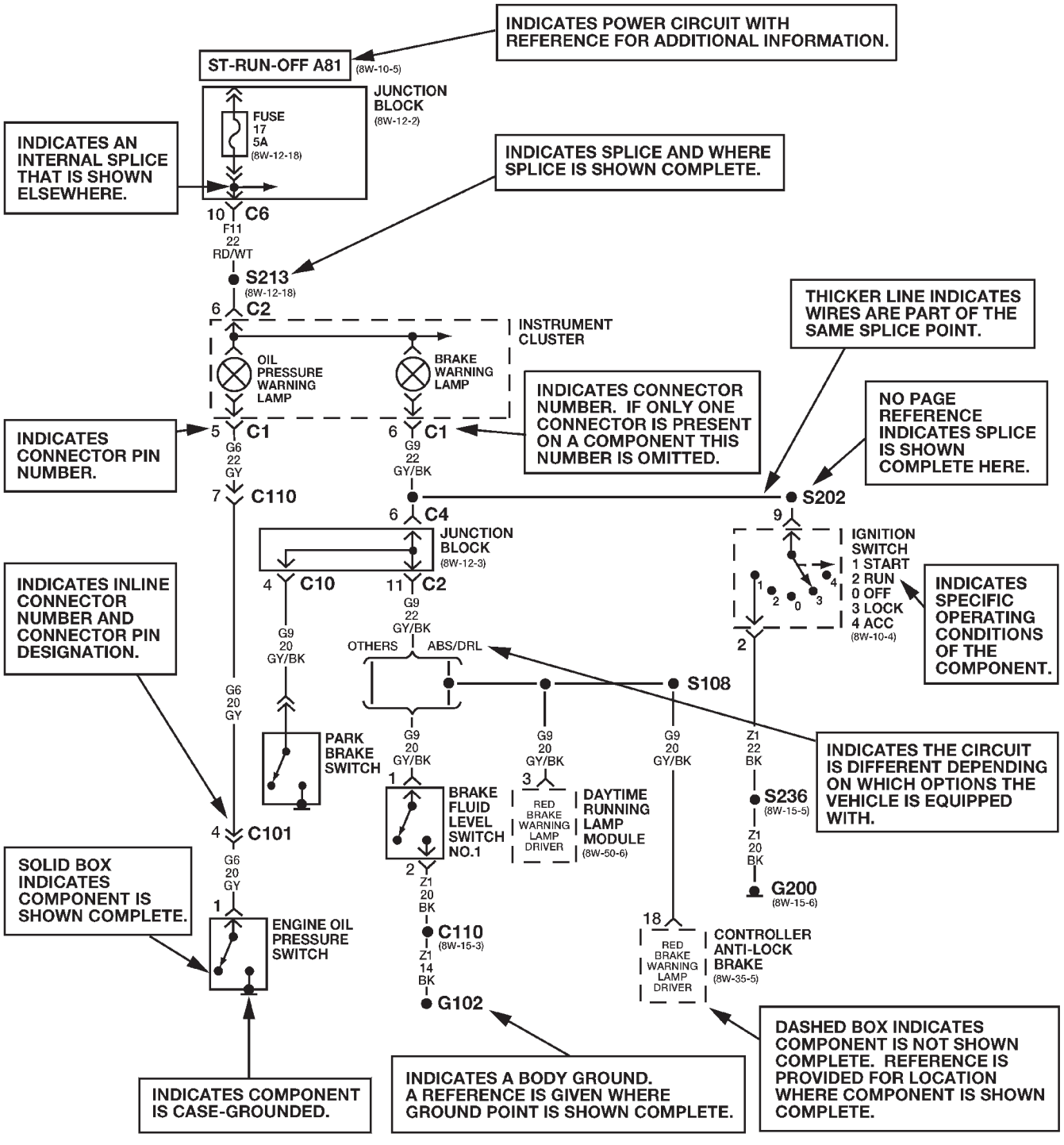
It is important to realize that no attempt is made on the diagrams to represent components and wiring as they appear on the vehicle. For example, a short piece of wire is treated the same as a long one. In addition, switches and other components are shown as simply as possible, with regard to function 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).

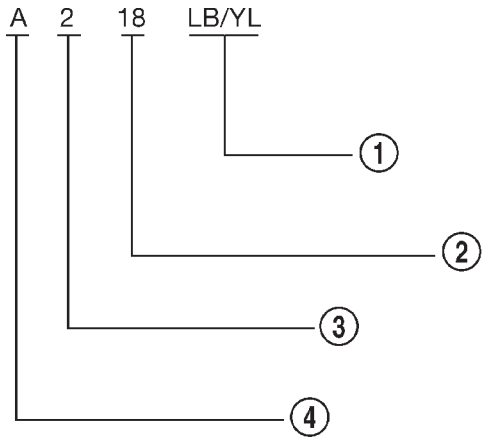


Fig. 1 Wire Code Identification

1 – COLOR OF WIRE (LIGHT BLUE WITH YELLOW TRACER)
2 – GAUGE OF WIRE (18 GAUGE)
3 – PART OF MAIN CIRCUIT (VARIES DEPENDING ON EQUIPMENT)
4 – MAIN CIRCUIT 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

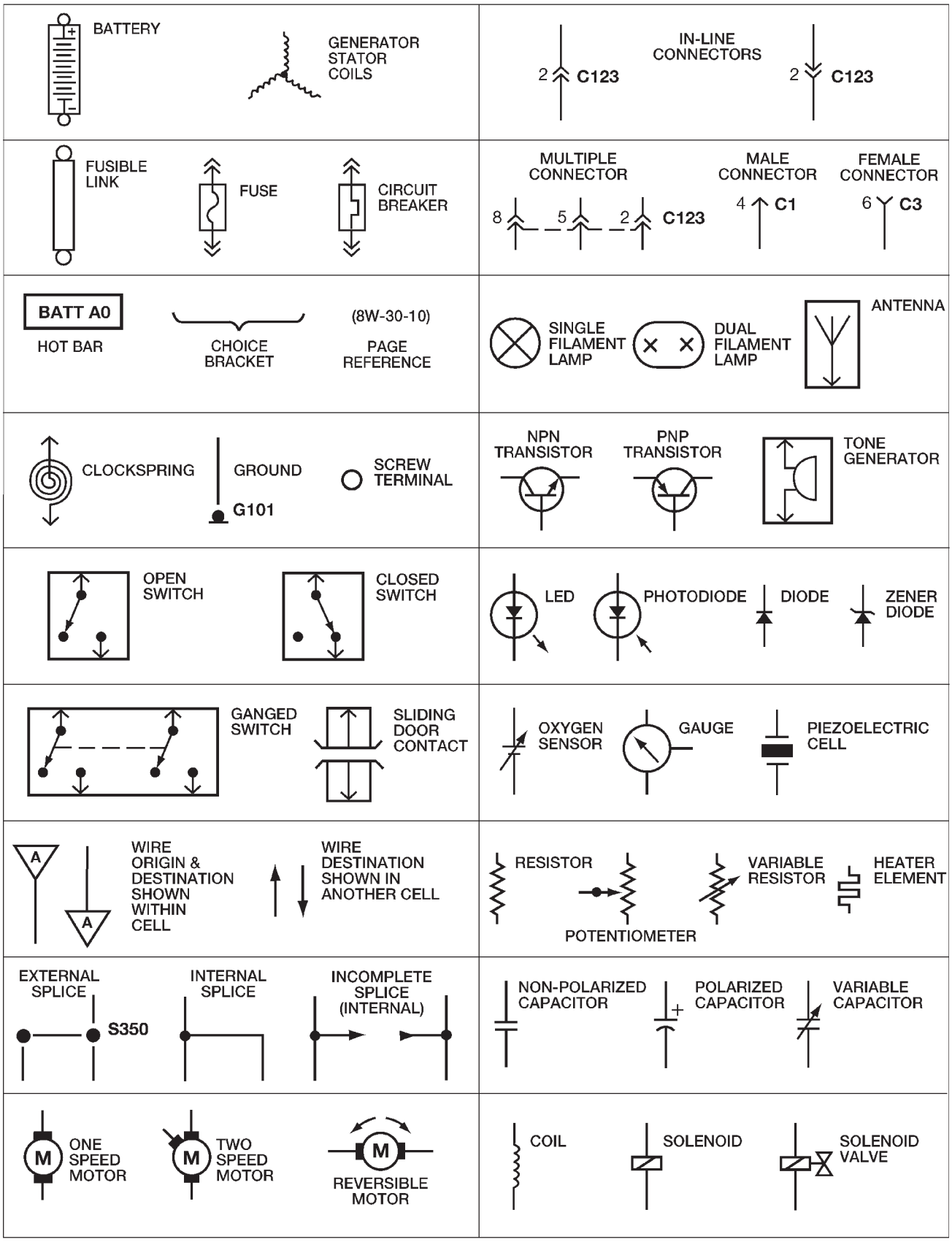
The wiring diagrams are grouped into individual sections. If a component is most likely found in a particular group, it will be shown complete (all wires, connectors, and pins) within that group. For example, the Auto Shutdown Relay is most likely to be found in Group 30, so it is shown there complete. It can, however, be shown partially in another group if it contains some associated wiring.

SYMBOLS

International symbols are used throughout the wiring diagrams. These symbols are consistent with those being used around the world

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

DESCRIPTION AND OPERATION (Continued)



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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
EATX . . . Electronic Automatic Transmission-Front Wheel Drive
ATX . . Automatic Transmission-Front Wheel Drive
MTX . . . . Manual Transmission-Front Wheel Drive
A/T . . . . Automatic Transmission-Rear Wheel Drive
M/T . . . . . 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. Multiple connectors on a component use a C1, C2, etc. identifier.

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.

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.

DESCRIPTION AND OPERATION (Continued)

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. 2) 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. 2 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.

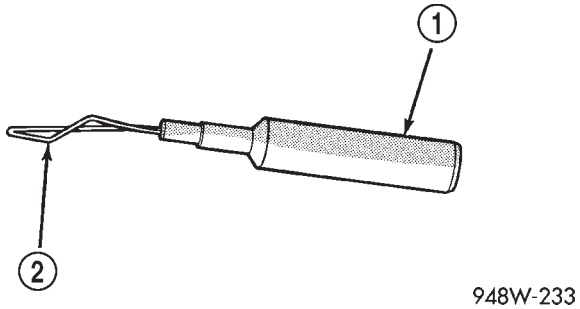
- Voltmeter - Used to check for voltage on a circuit. Always connect the black lead to a known good ground and the red lead to the positive side of the circuit.

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.

- Probing Tools - These tools are used for probing terminals in connectors (Fig. 3). Select the proper size tool from Special Tool Package 6807, and insert it into the terminal being tested. Use the other end of the tool to insert the meter probe.



948W-233

Fig. 3 Probing Tool

1 – SPECIAL TOOL 6801
2 – PROBING END

DIAGNOSIS AND TESTING (Continued)

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. 4).

(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.

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. 5).

(3) Connect the other lead to the other end of the circuit being tested. Low or no resistance means good continuity.

TESTING FOR A SHORT TO GROUND

(1) Remove the fuse and disconnect all items involved with the fuse.

(2) Connect a test light or a voltmeter across the terminals of the fuse.

(3) Starting at the fuse block, wiggle the wiring harness about six to eight inches apart and watch the voltmeter/test lamp.

(4) If the voltmeter registers voltage or the test lamp glows, there is a short to ground in that general area of the wiring harness.

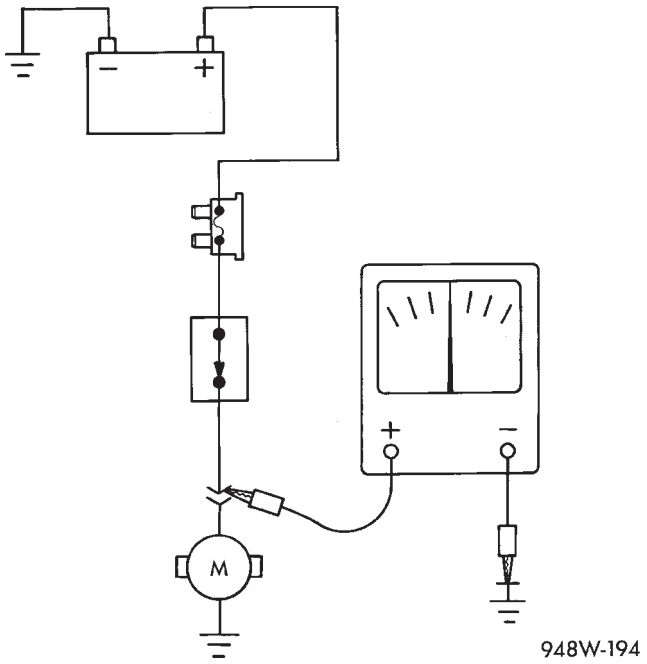


Fig. 4 Testing for Voltage Potential

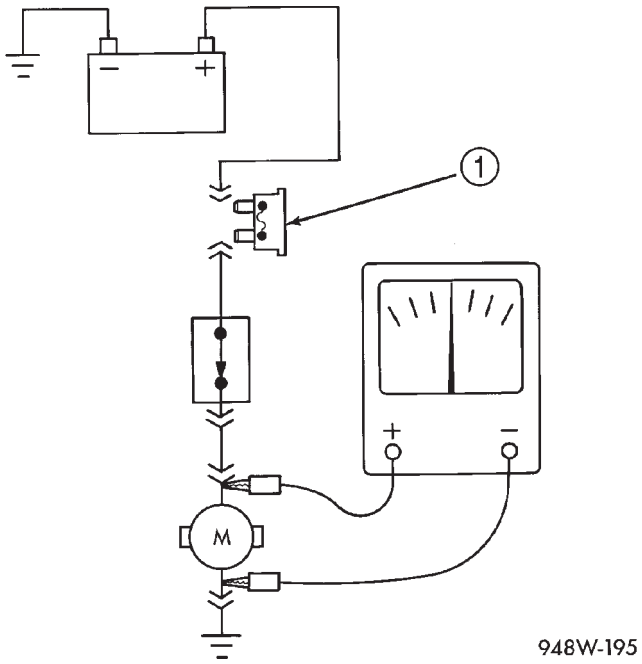


Fig. 5 Testing for Continuity

1 – FUSE REMOVED FROM CIRCUIT

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.

DIAGNOSIS AND TESTING (Continued)

(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. 6).

(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.

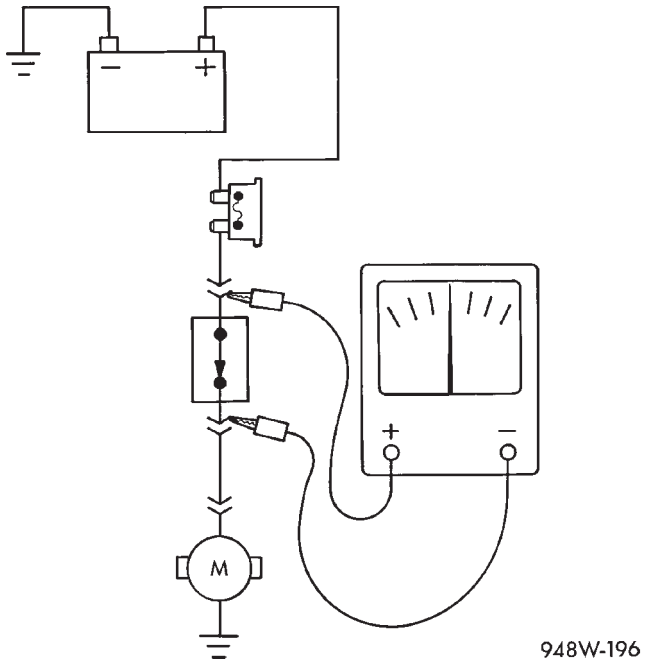


Fig. 6 Testing for Voltage Drop

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. 7)

(5) Push the two ends of wire together until the strands of wire are close to the insulation (example 2) (Fig. 7)

(6) Twist the wires together (example 3) (Fig. 7)

(7) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(8) Center the heat shrink tubing over the joint, and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing.

(9) Secure the wire to the existing ones to prevent chafing or damage to the insulation

(10) Connect battery and test all affected systems.

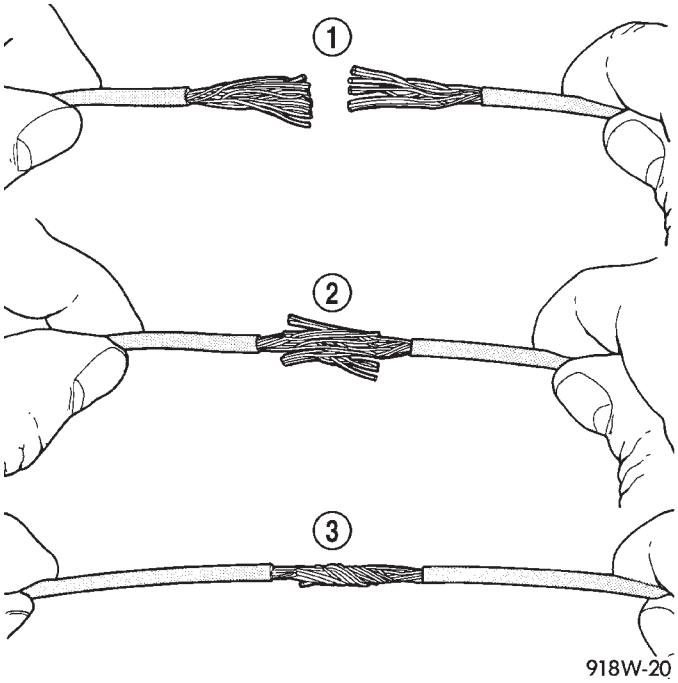


Fig. 7 Wire Repair

1 – EXAMPLE 1
2 – EXAMPLE 2
3 – EXAMPLE 3

SERVICE PROCEDURES (Continued)

TERMINAL/CONNECTOR REPAIR-MOLEX CONNECTORS

(1) Disconnect battery.
(2) Disconnect the connector from its mating half/component.
(3) Insert the terminal releasing special tool 6742 into the terminal end of the connector (Fig. 8).

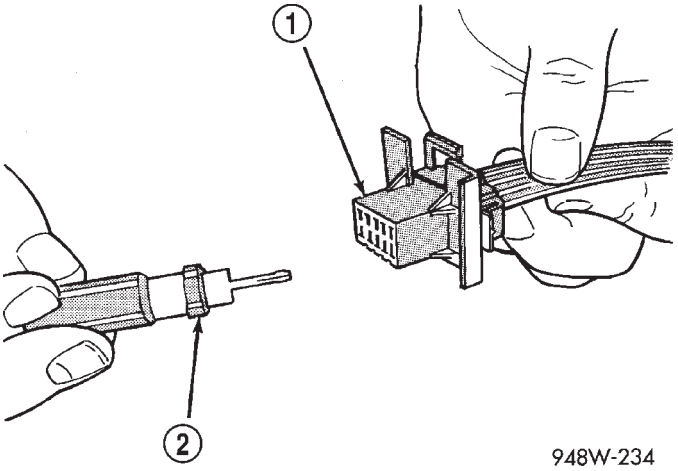


Fig. 8 Molex Connector Repair

1 – CONNECTOR
2 – SPECIAL TOOL 6742

(4) Using special tool 6742 release the locking fingers on the terminal (Fig. 9).
(5) Pull on the wire to remove it from the connector.
(6) Repair or replace the connector or terminal, as necessary.

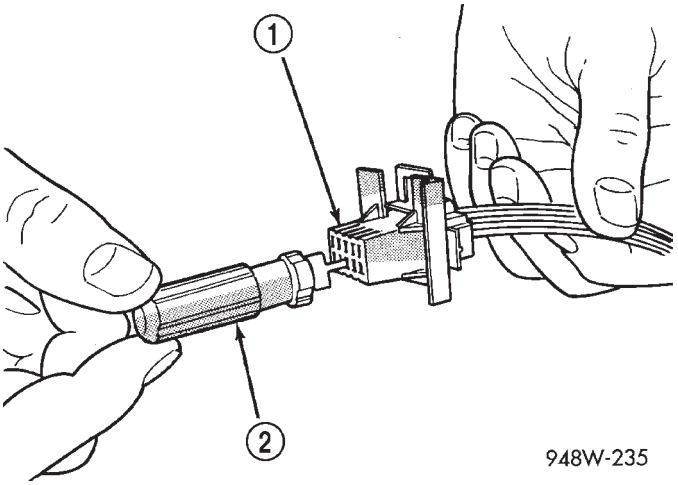


Fig. 9 Using Special Tool 6742

1 – CONNECTOR
2 – SPECIAL TOOL 6742

TERMINAL/CONNECTOR REPAIR—THOMAS AND BETTS CONNECTORS

(1) Disconnect battery.
(2) Disconnect the connector from its mating half/component.
(3) Push in the two lock tabs on the side of the connector (Fig. 10).

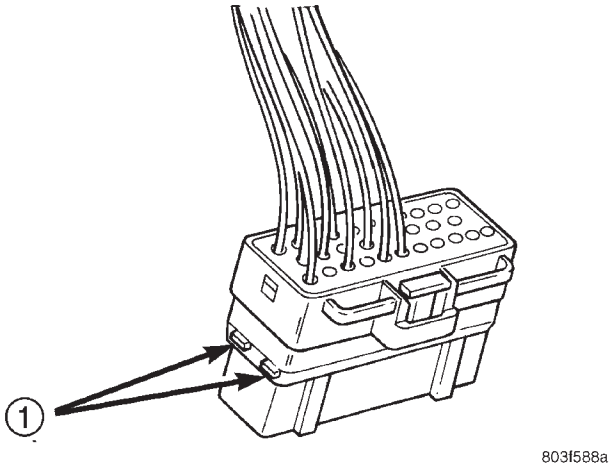


Fig. 10 Thomas and Betts Connector Lock Release Tabs

1 – LOCK TABS

(4) Insert the probe end of special tool 6934 into the back of the connector cavity (Fig. 11).
(5) Grasp the wire and tool 6934 and slowly remove the wire and terminal from the connector.

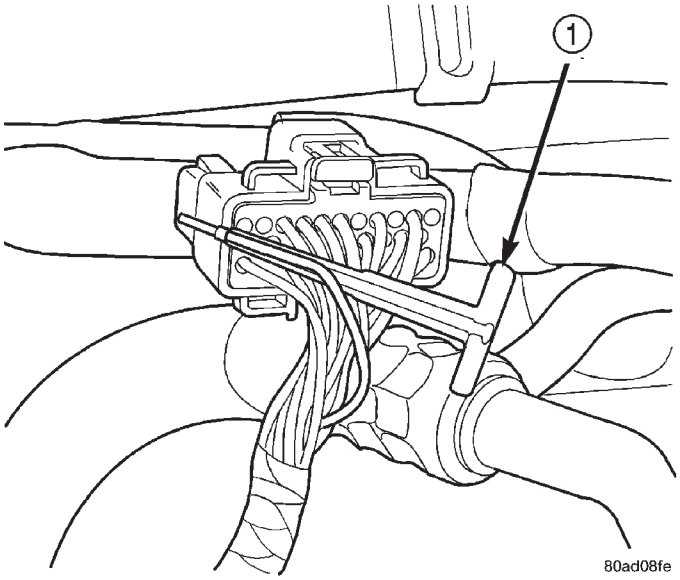


Fig. 11 Removing Wire Terminal

1 – SPECIAL TOOL 6934

SERVICE PROCEDURES (Continued)

(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. 12).

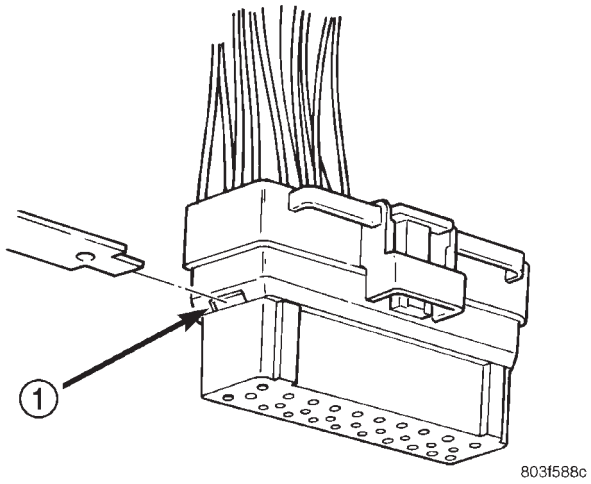


Fig. 12 Single Lock Tab

1 – SINGLE LOCK TAB

TERMINAL/CONNECTOR REPAIR- AUGAT CONNECTORS

(1) Disconnect battery.

(2) Disconnect the connector from its mating half/component.

(3) Push down on the yellow connector locking tab to release the terminals (Fig. 13).

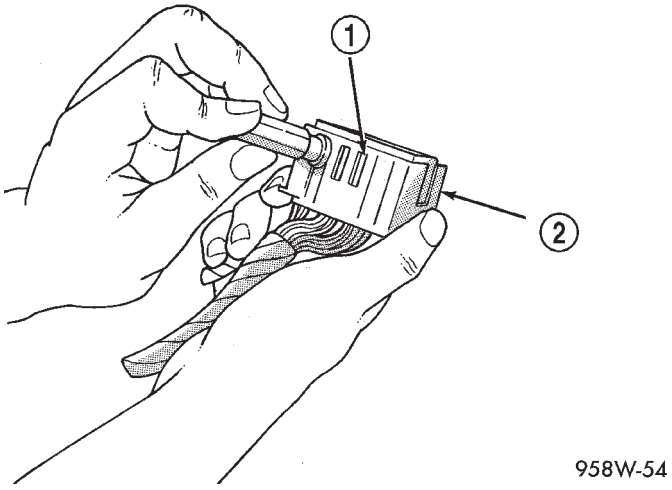


Fig. 13 Augat Connector Repair

1 – LOCKING TAB
2 – CONNECTOR

(4) Using special tool 6932, push the terminal to remove it from the connector (Fig. 14).

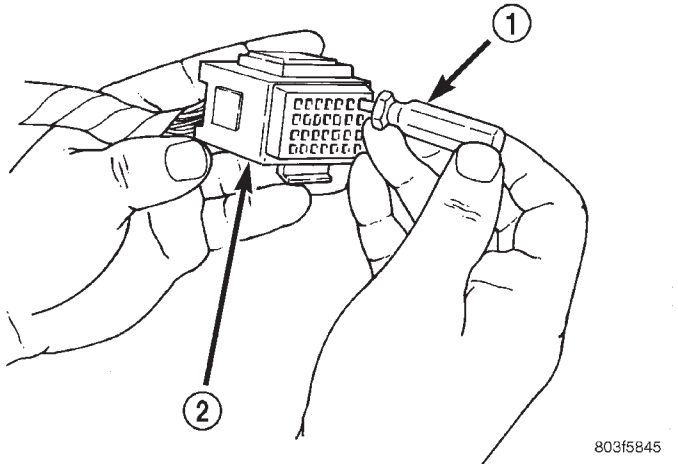


Fig. 14 Using Special Tool 6932

1 – SPECIAL TOOL 6932
2 – CONNECTOR

(5) Repair or replace the connector or terminal as necessary.

(6) When re-assembling the connector, the locking wedge must be placed in the locked position to prevent terminal push out.

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)

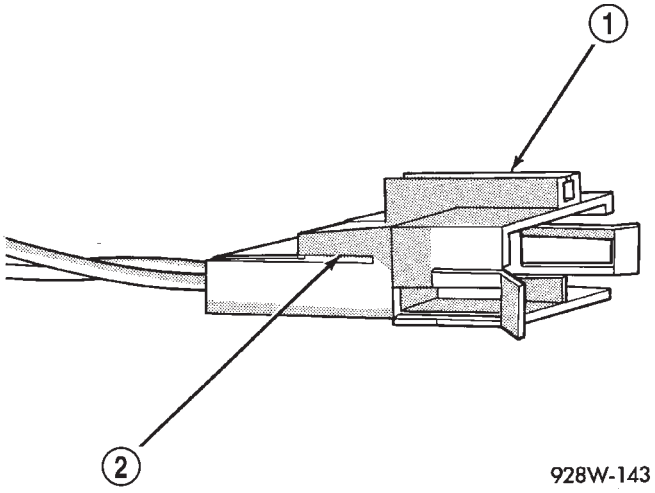


Fig. 15 Connector Locking Wedge

1 – CONNECTOR
2 – CONNECTOR LOCKING WEDGE TAB

SERVICE PROCEDURES (Continued)

(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.

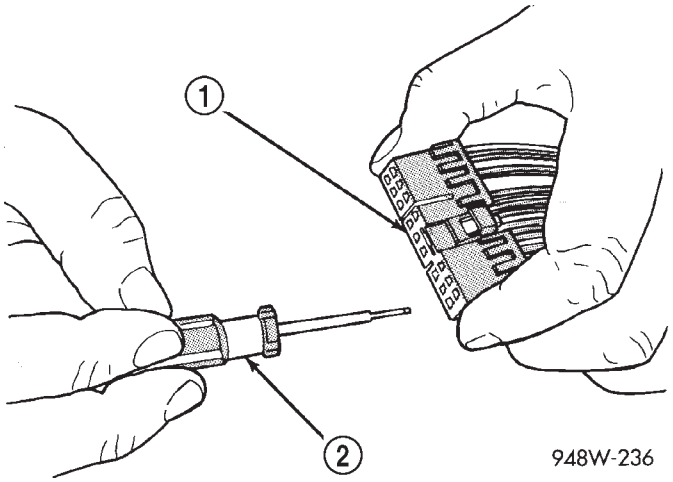


Fig. 16 Terminal Removal

1 – CONNECTOR
2 – FROM SPECIAL TOOL KIT 6680

CONNECTOR AND TERMINAL REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector (that is to be repaired) from its mating half/component.

(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).

(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.

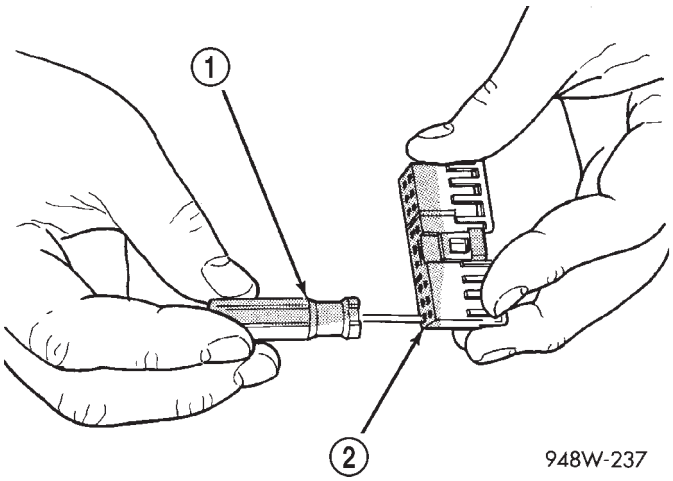


Fig. 17 Terminal Removal Using Special Tool

1 – FROM SPECIAL TOOL KIT 6680
2 – CONNECTOR

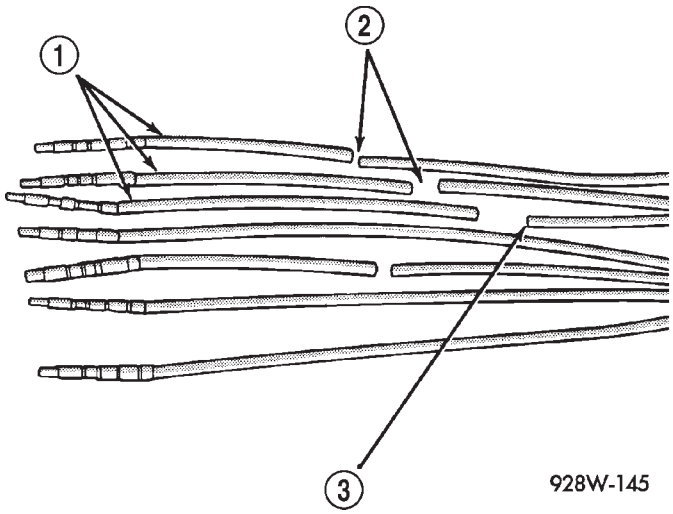


Fig. 18 Stagger Cutting Wires

1 – REPAIR SIDE WIRES
2 – STAGER CUTS
3 – HARNESS WIRES

(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.

SERVICE PROCEDURES (Continued)

(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).

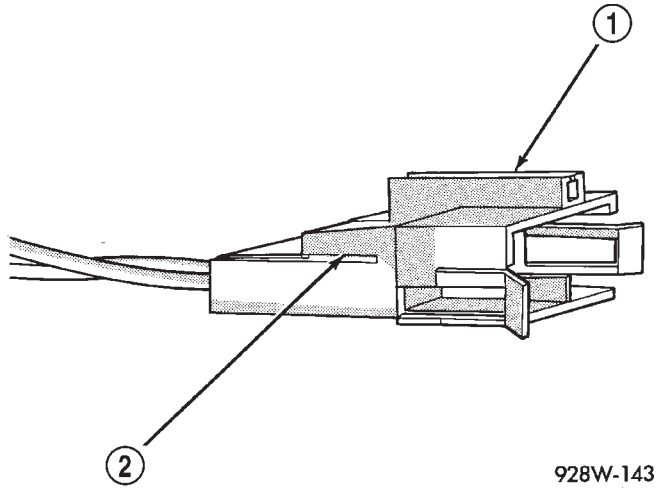


Fig. 19 Connector Locking Wedge Tab (Typical)
1 – CONNECTOR
2 – CONNECTOR LOCKING WEDGE TAB

(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).

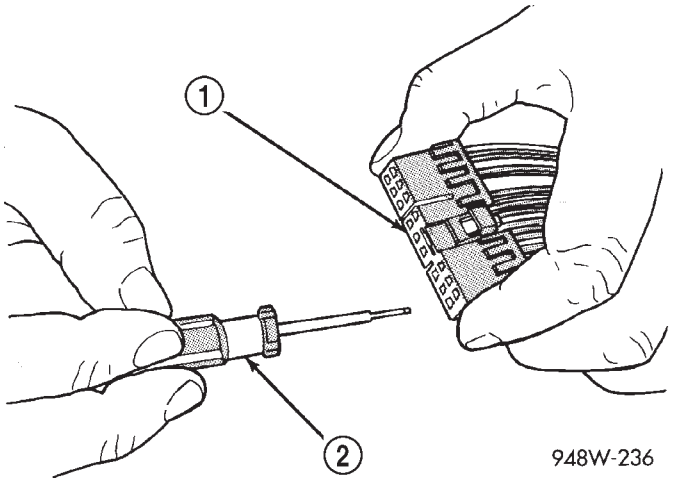


Fig. 20 Terminal Removal
1 – CONNECTOR
2 – FROM SPECIAL TOOL KIT 6680

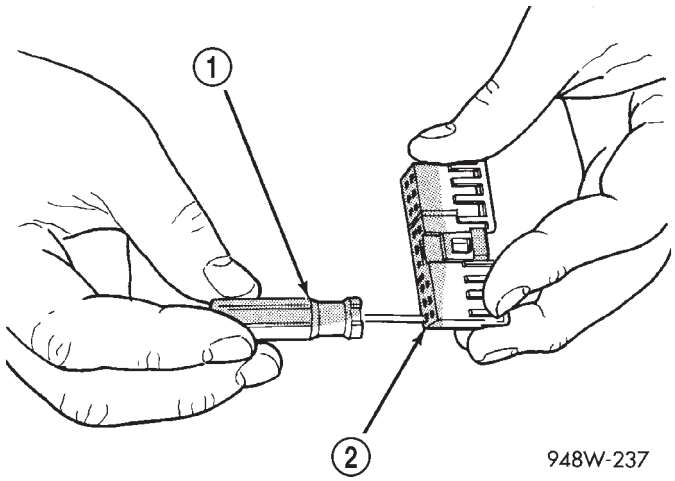


Fig. 21 Terminal Removal Using Special Tool
1 – FROM SPECIAL TOOL KIT 6680
2 – CONNECTOR

(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.
(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).

SERVICE PROCEDURES (Continued)

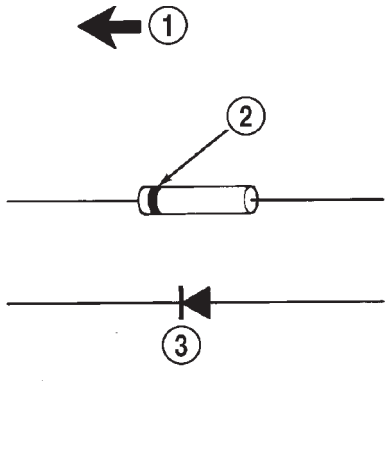


Fig. 22 Diode Identification

1 – CURRENT FLOW
2 – BAND AROUND DIODE INDICATES CURRENT FLOW
3 – DIODE AS SHOWN IN THE DIAGRAMS

(4) Remove the insulation from the wires in the harness. Only remove enough insulation to solder in the new diode.

(5) Install the new diode in the harness, making sure current flow is correct. If necessary refer to the appropriate wiring diagram for current flow.

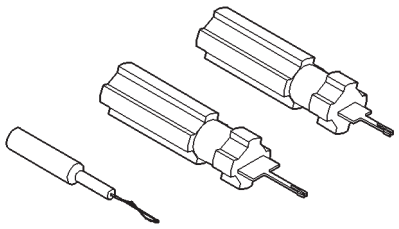
(6) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(7) Tape the diode to the harness using electrical tape making, sure the diode is completely sealed from the elements.

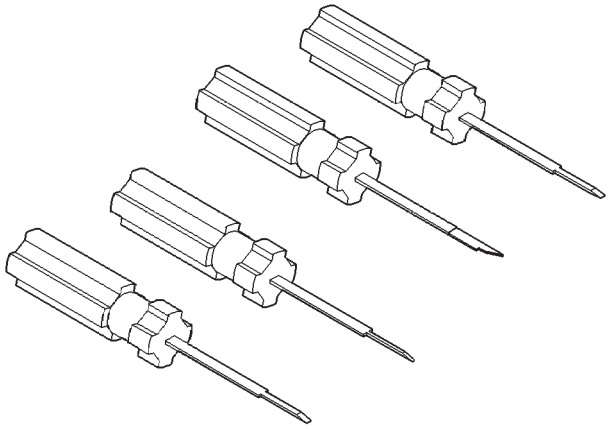
(8) Re-connect the battery, and test affected systems.

SPECIAL TOOLS

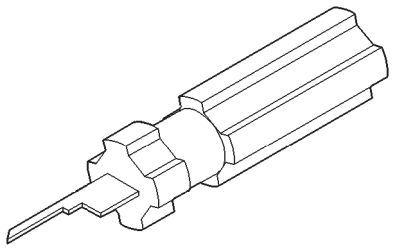
WIRING/TERMINAL



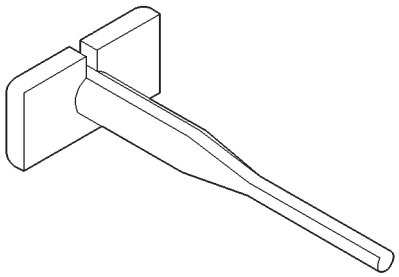
Probing Tool Package 6807



Terminal Pick 6680



Terminal Removing Tool 6932



Terminal Removing Tool 6934

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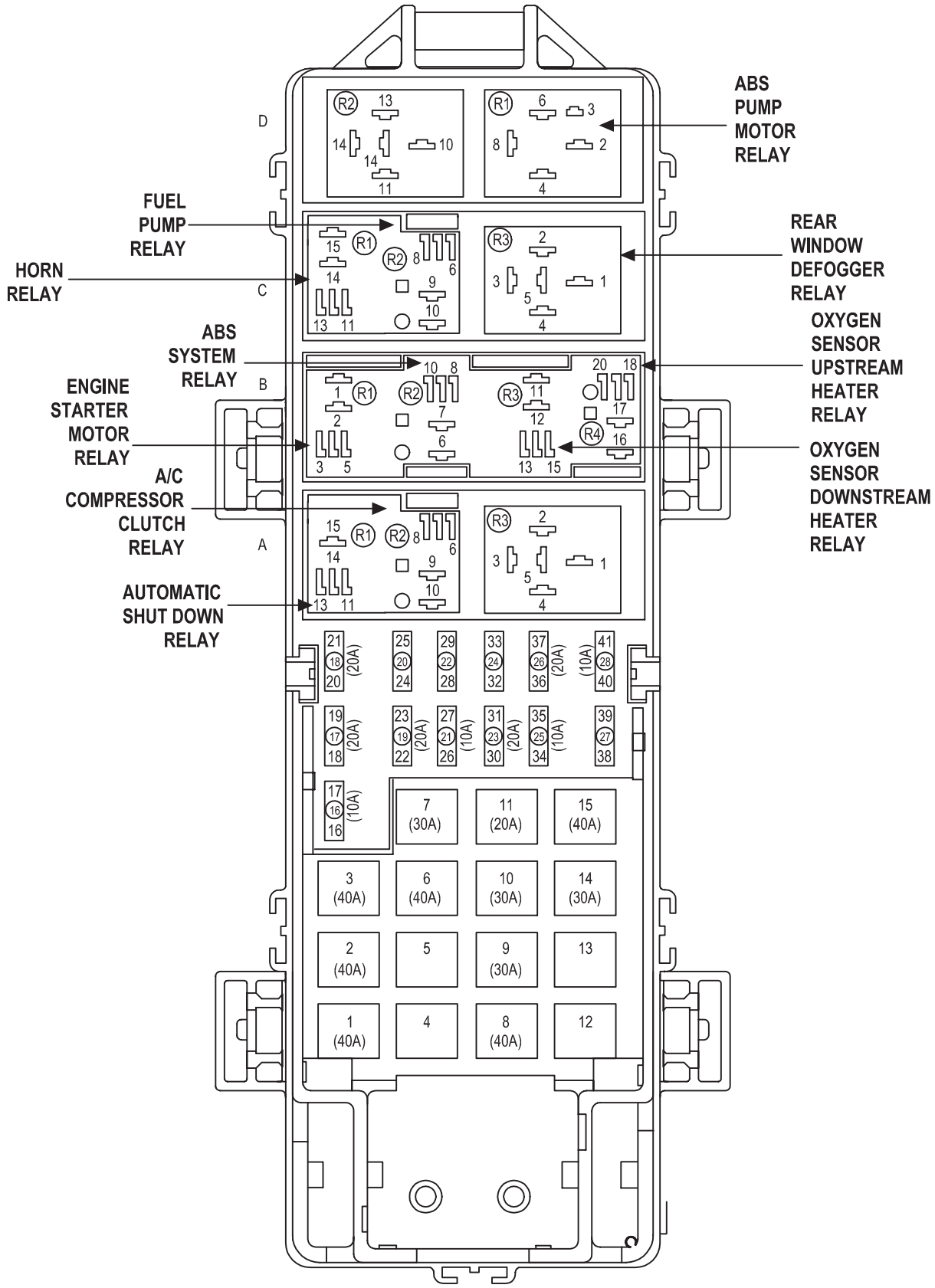
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POWER DISTRIBUTION CENTER



FUSES

FUSE NO.	AMPS	FUSED CIRCUIT	FEED CIRCUIT
1	40A	A111 12RD/LB	A0 6RD
2	40A	A4 12BK/PK	A0 6RD
3	40A	A6 12RD/BK	A0 6RD
4	-	-	-
5	-	-	-
6	40A	A10 12RD/DG	A0 6RD
7	30A	A20 14RD/DB	A0 6RD
8	40A	A2 12PK/BK	A0 6RD
9	30A	A14 14RD/WT A14 14RD/WT	A0 6RD
10	30A	A3 14RD/WT	A0 6RD
11	20A	L9 16BK/WT	A0 6RD
12	-	-	-
13	-	-	-
14	30A	A1 14RD	A0 6RD
15	40A	F30 12RD/PK	A0 6RD
16 ■■	10A	F142 20OR/DG	A142 14DG/PK
17 ■	20A	A114 18DG/OR	A0 6RD
18	20A	F31 18VT F31 18VT	A0 6RD
19 ●	20A	F61 18WT/OR	A0 6RD
20	-	-	-
21	10A	A17 20RD/GY	A0 6RD
22	-	-	-
23	20A	A61 18DG/BK	A0 6RD
24	-	-	-
25	10A	M1 20PK/WT	A0 6RD
26	20A	F42 18DG/LG	A142 14DG/PK
27	-	-	-
28	10A	B48 20RD/YL	B47 14RD/LB

● FRONT FOG LAMPS

■ CALIFORNIA/EUROPEAN III

■■ EXCEPT CALIFORNIA/EUROPEAN III

ABS PUMP MOTOR RELAY

CAVITY	CIRCUIT	FUNCTION
D2	A10 12RD/DG	FUSED B(+)
D3	Z1 14BK	GROUND
D4	B47 14RD/LB	ABS SYSTEM RELAY OUTPUT
	B47 14RD/LB	ABS SYSTEM RELAY OUTPUT
D6	B116 20GY	ABS PUMP MOTOR RELAY CONTROL
D8	B120 12BR/WT	ABS PUMP MOTOR RELAY OUTPUT

ABS SYSTEM RELAY

CAVITY	CIRCUIT	FUNCTION
B6	B47 14RD/LB	ABS SYSTEM RELAY OUTPUT
B7	A20 14RD/DB	FUSED B(+)
B8	F20 20VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
B9	Z1 14BK	GROUND
B10	B58 20GY/LB	ABS SYSTEM RELAY CONTROL

A/C COMPRESSOR CLUTCH RELAY

CAVITY	CIRCUIT	FUNCTION
A6	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
A7	-	-
A8	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
A9	C3 20DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
A10	A17 20RD/GY	FUSED B(+)

AUTOMATIC SHUT DOWN RELAY

CAVITY	CIRCUIT	FUNCTION
A11	K51 18DB/YL	AUTOMATIC SHUT DOWN RELAY CONTROL
A12	-	-
A13	F15 20DB	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
A14	A142 14DG/PK	AUTOMATIC SHUT DOWN RELAY OUTPUT
A15	A14 14RD/WT	FUSED B(+)

ENGINE STARTER MOTOR RELAY

CAVITY	CIRCUIT	FUNCTION
B1	A2 12PK/BK	FUSED B(+)
B2	T40 12BR	ENGINE STARTER MOTOR RELAY OUTPUT
B3	T41 20BR/LB	PARK/NEUTRAL POSITION SWITCH SENSE
B4	-	-
B5	T141 14YL/RD	FUSED IGNITION SWITCH OUTPUT (ST)

FUEL PUMP RELAY

CAVITY	CIRCUIT	FUNCTION
C6	F15 20DB	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
C7	-	-
C8	K31 18BR	FUEL PUMP RELAY CONTROL
C9	A141 18DG/WT	FUEL PUMP RELAY OUTPUT
C10	A61 18DG/BK	FUSED B(+)

HORN RELAY

CAVITY	CIRCUIT	FUNCTION
C11	F31 18VT	FUSED B(+)
C12	-	-
C13	X3 20RD/YL	HORN RELAY CONTROL
C14	X2 18WT/RD	HORN RELAY OUTPUT
C15	F31 18VT	FUSED B(+)

OXYGEN SENSOR DOWNSTREAM HEATER RELAY

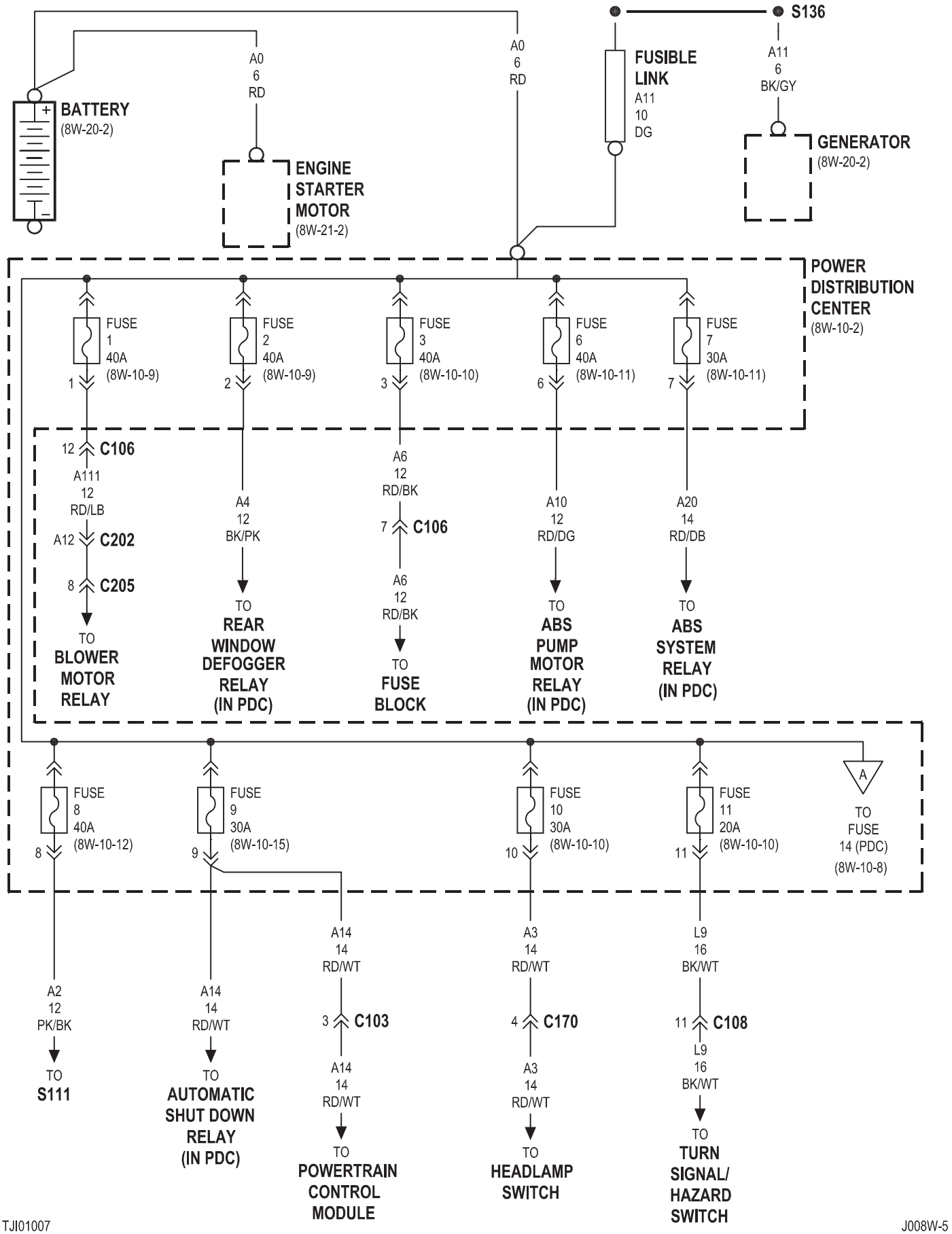
CAVITY	CIRCUIT	FUNCTION
B11	A114 18DG/OR	FUSED B(+)
B12	A242 18VT/OR	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
B13	F15 20DB	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
B14	-	-
B15	K74 18BR/VT	OXYGEN SENSOR DOWNSTREAM HEATER RELAY CONTROL

OXYGEN SENSOR UPSTREAM HEATER RELAY

CAVITY	CIRCUIT	FUNCTION
B16	A114 18DG/OR	FUSED B(+)
	A114 18DG/OR	FUSED B(+)
B17	A42 18DG	OXYGEN SENSOR UPSTREAM HEATER RELAY OUTPUT
B18	F15 20DB	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
B19	-	-
B20	K73 18BR/OR	OXYGEN SENSOR UPSTREAM HEATER RELAY CONTROL

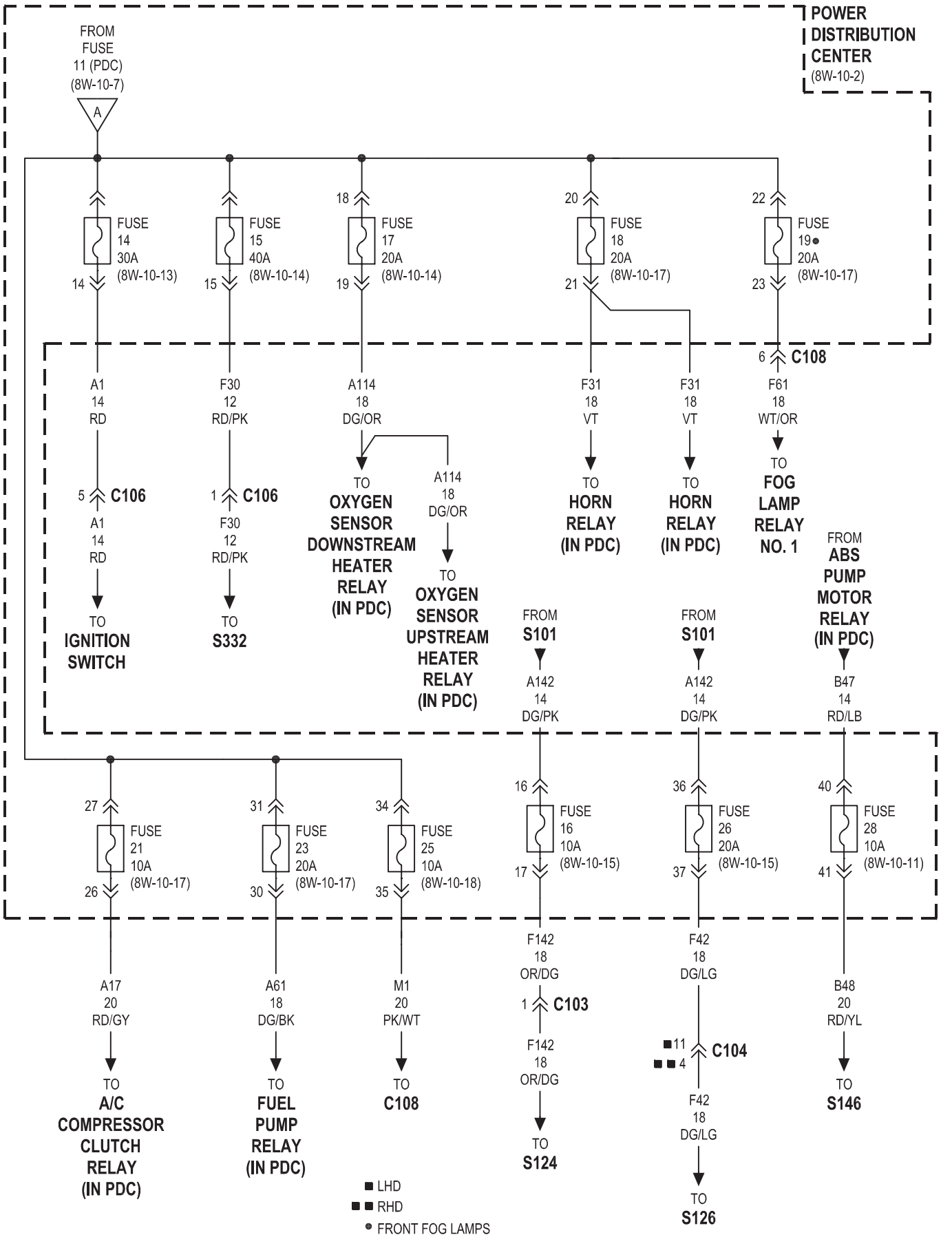
REAR WINDOW DEFOGGER RELAY

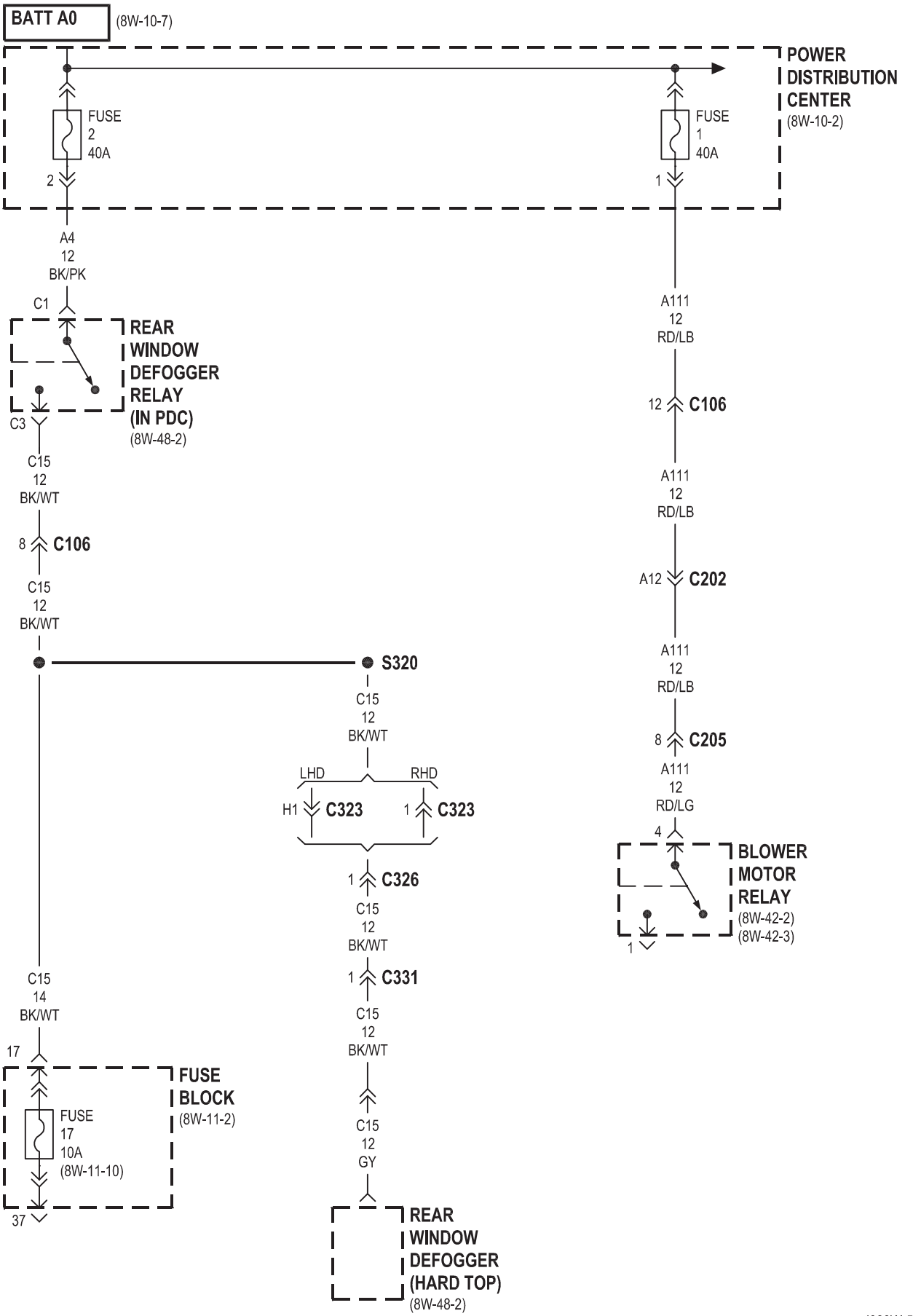
CAVITY	CIRCUIT	FUNCTION
C1	A4 12BK/PK	FUSED B(+)
C2	C81 20LB/WT	REAR WINDOW DEFOGGER RELAY CONTROL
C3	C15 12BK/WT	REAR WINDOW DEFOGGER RELAY OUTPUT
C4	F20 20VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
C5	-	-

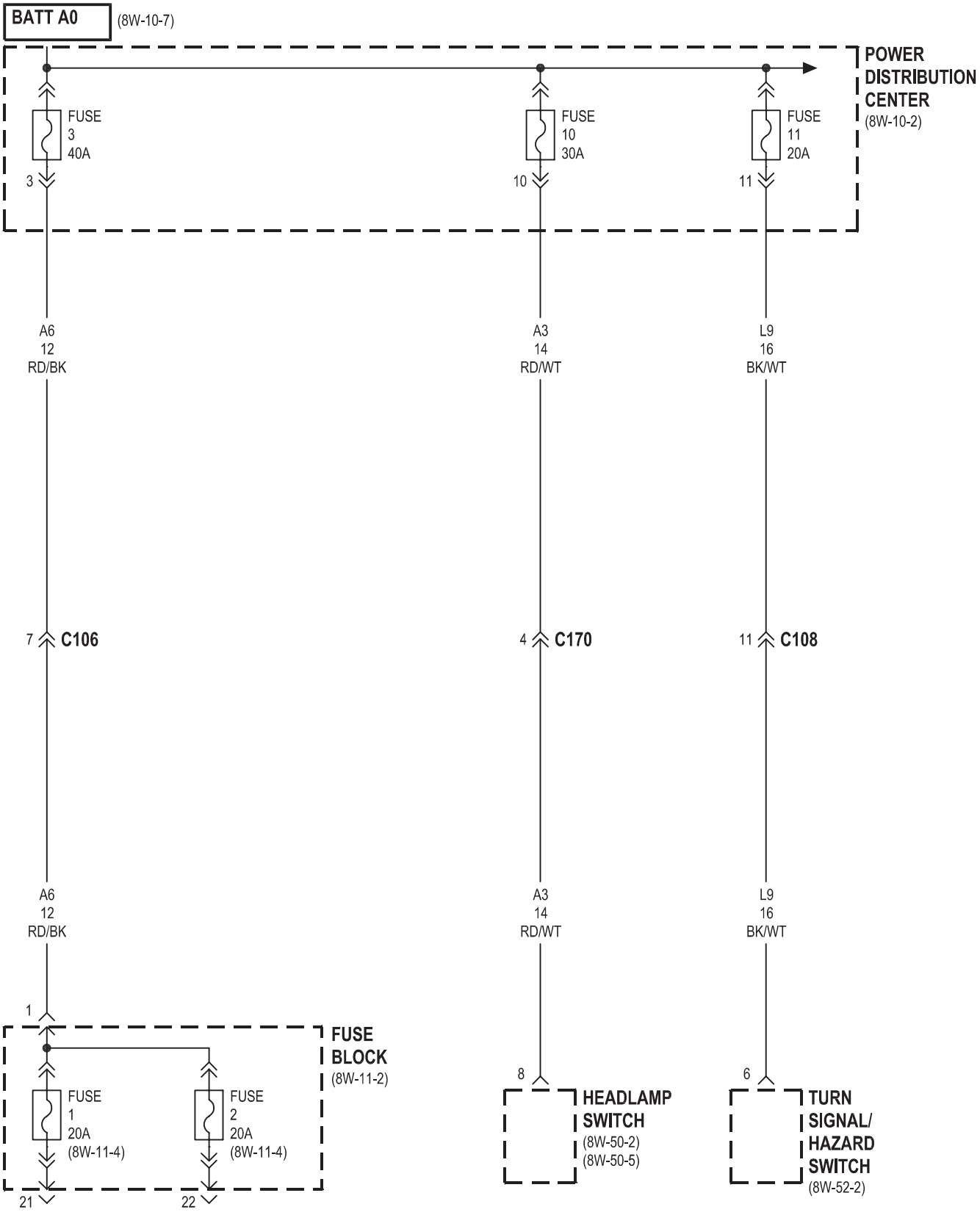


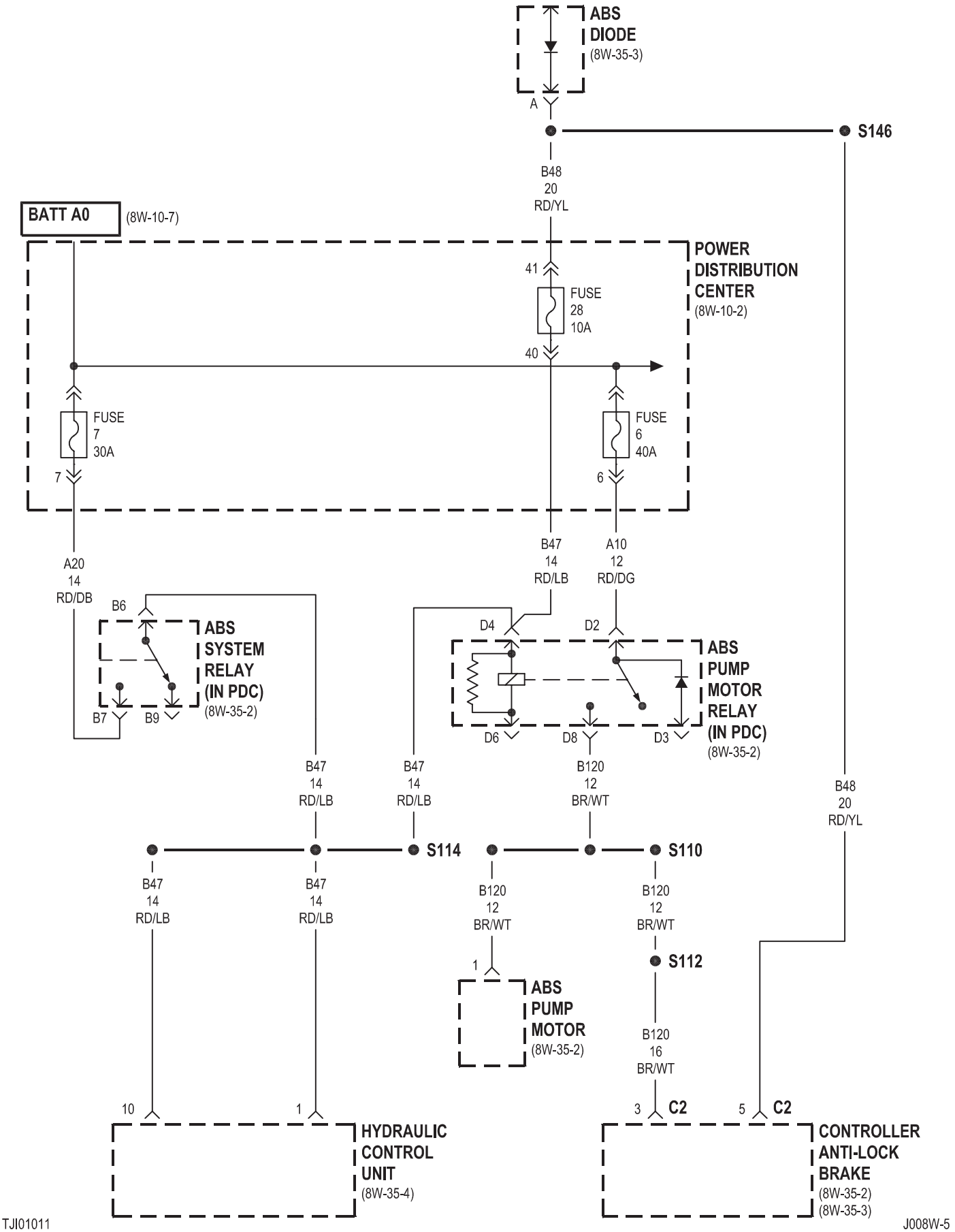
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J008W-5


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FUSE 15 40A (8W-10-14)
FUSE 17 20A (8W-10-14)
FUSE 18 20A (8W-10-17)
FUSE 19● 20A (8W-10-17)
A1 14 RD
F30 12 RD/PK
A114 18 DG/OR
F31 18 VT
F31 18 VT
F61 18 WT/OR
C108
C106
C106
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TO S332
TO OXYGEN SENSOR DOWNSTREAM HEATER RELAY (IN PDC)
A114 18 DG/OR
TO OXYGEN SENSOR UPSTREAM HEATER RELAY (IN PDC)
TO HORN RELAY (IN PDC)
TO HORN RELAY (IN PDC)
TO FOG LAMP RELAY NO. 1
FROM S101
FROM S101
FROM ABS PUMP MOTOR RELAY (IN PDC)
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A142 14 DG/PK
B47 14 RD/LB
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FUSE 25 10A (8W-10-18)
FUSE 16 10A (8W-10-15)
FUSE 26 20A (8W-10-15)
FUSE 28 10A (8W-10-11)
A17 20 RD/GY
A61 18 DG/BK
M1 20 PK/WT
F142 18 OR/DG
C103
F142 18 OR/DG
F42 18 DG/LG
C104
F42 18 DG/LG
B48 20 RD/YL
TO A/C COMPRESSOR CLUTCH RELAY (IN PDC)
TO FUEL PUMP RELAY (IN PDC)
TO C108
TO S124
TO S126
TO S146
■ LHD
■■ RHD
● FRONT FOG LAMPS

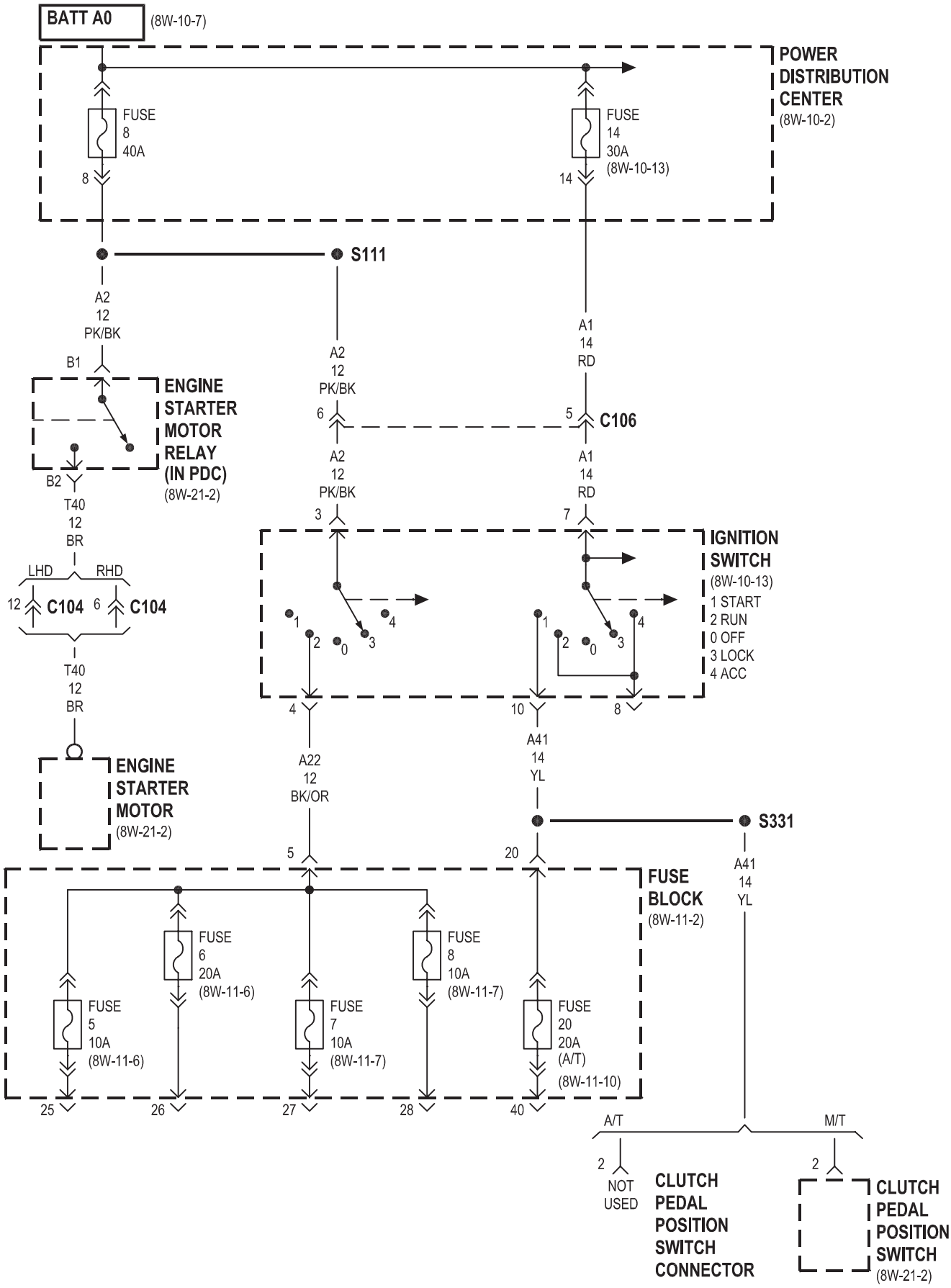

BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 2 40A
FUSE 1 40A
2
1
A4 12 BK/PK
C1
REAR WINDOW DEFOGGER RELAY (IN PDC)
(8W-48-2)
C3
C15 12 BK/WT
8 C106
C15 12 BK/WT
S320
C15 12 BK/WT
LHD
RHD
H1 C323
1 C323
1 C326
C15 12 BK/WT
1 C331
C15 12 BK/WT
C15 12 GY
REAR WINDOW DEFOGGER (HARD TOP)
(8W-48-2)
C15 14 BK/WT
17
FUSE BLOCK
(8W-11-2)
FUSE 17 10A
(8W-11-10)
37
A111 12 RD/LB
12 C106
A111 12 RD/LB
A12 C202
A111 12 RD/LB
8 C205
A111 12 RD/LG
4
BLOWER MOTOR RELAY
(8W-42-2)
(8W-42-3)
1

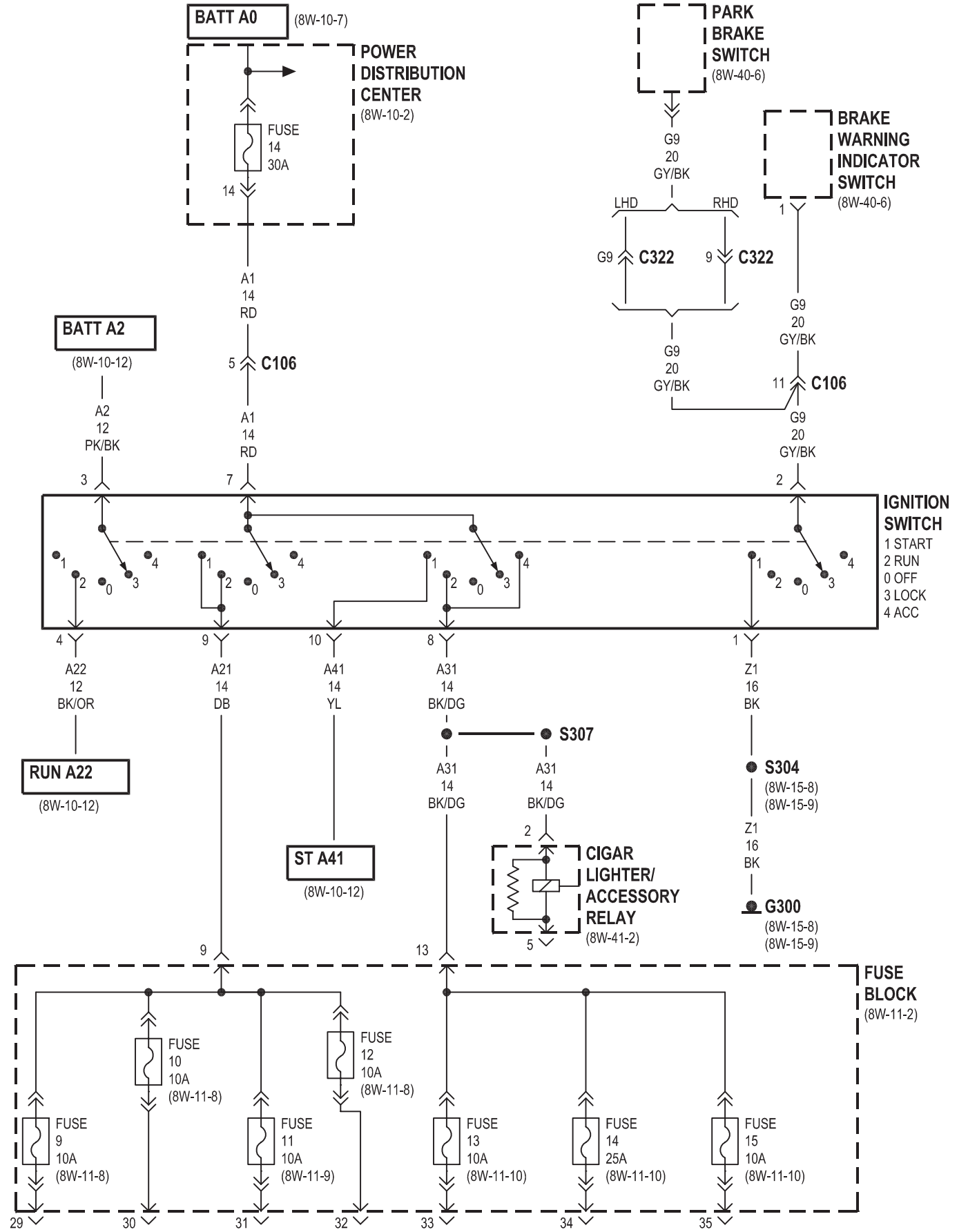

BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 3 40A
FUSE 10 30A
FUSE 11 20A
3
10
11
A6 12 RD/BK
A3 14 RD/WT
L9 16 BK/WT
7 C106
4 C170
11 C108
A6 12 RD/BK
A3 14 RD/WT
L9 16 BK/WT
1
FUSE BLOCK
(8W-11-2)
FUSE 1 20A
(8W-11-4)
FUSE 2 20A
(8W-11-4)
21
22
8
HEADLAMP SWITCH
(8W-50-2)
(8W-50-5)
6
TURN SIGNAL/ HAZARD SWITCH
(8W-52-2)



TJI01011

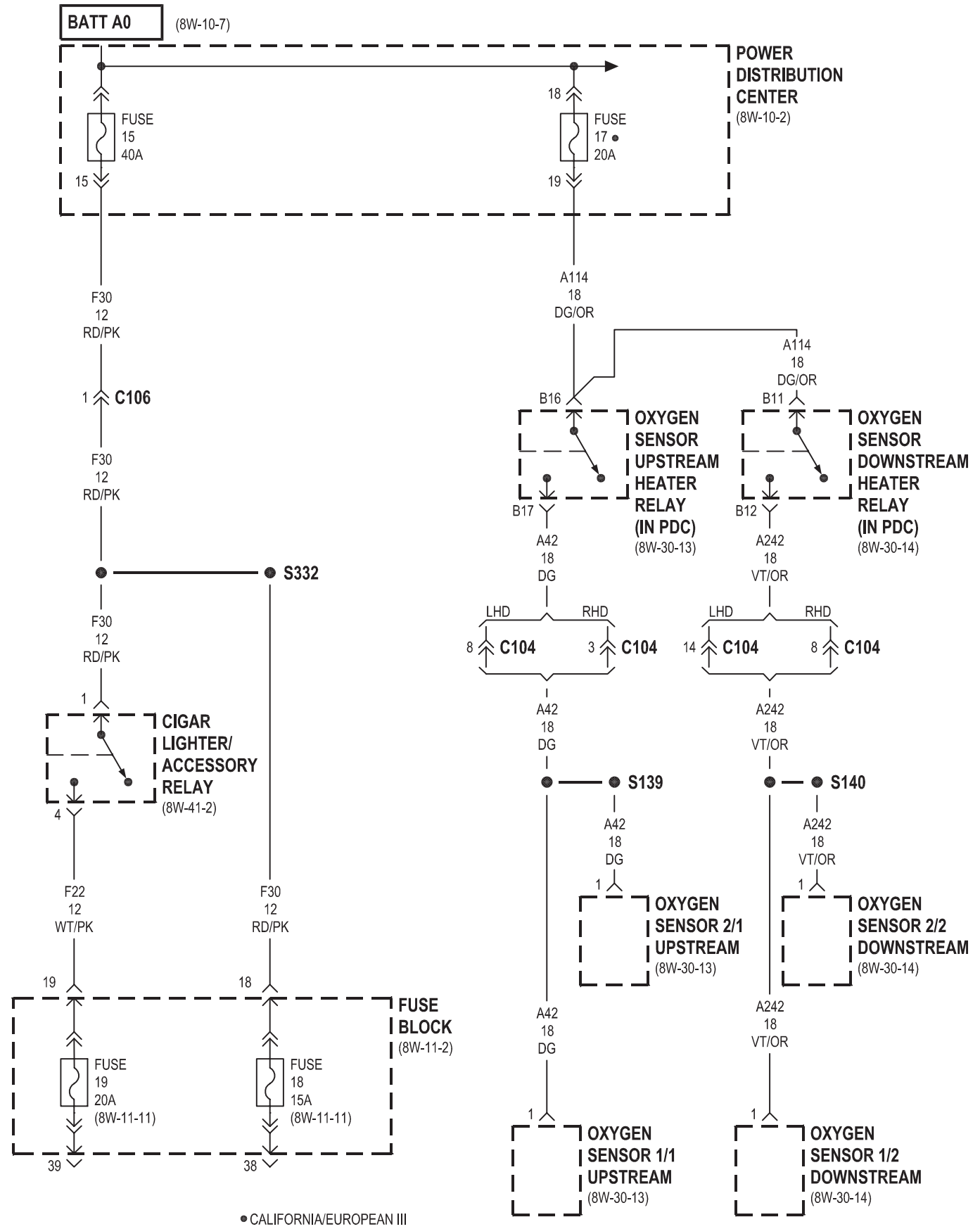
J008W-5

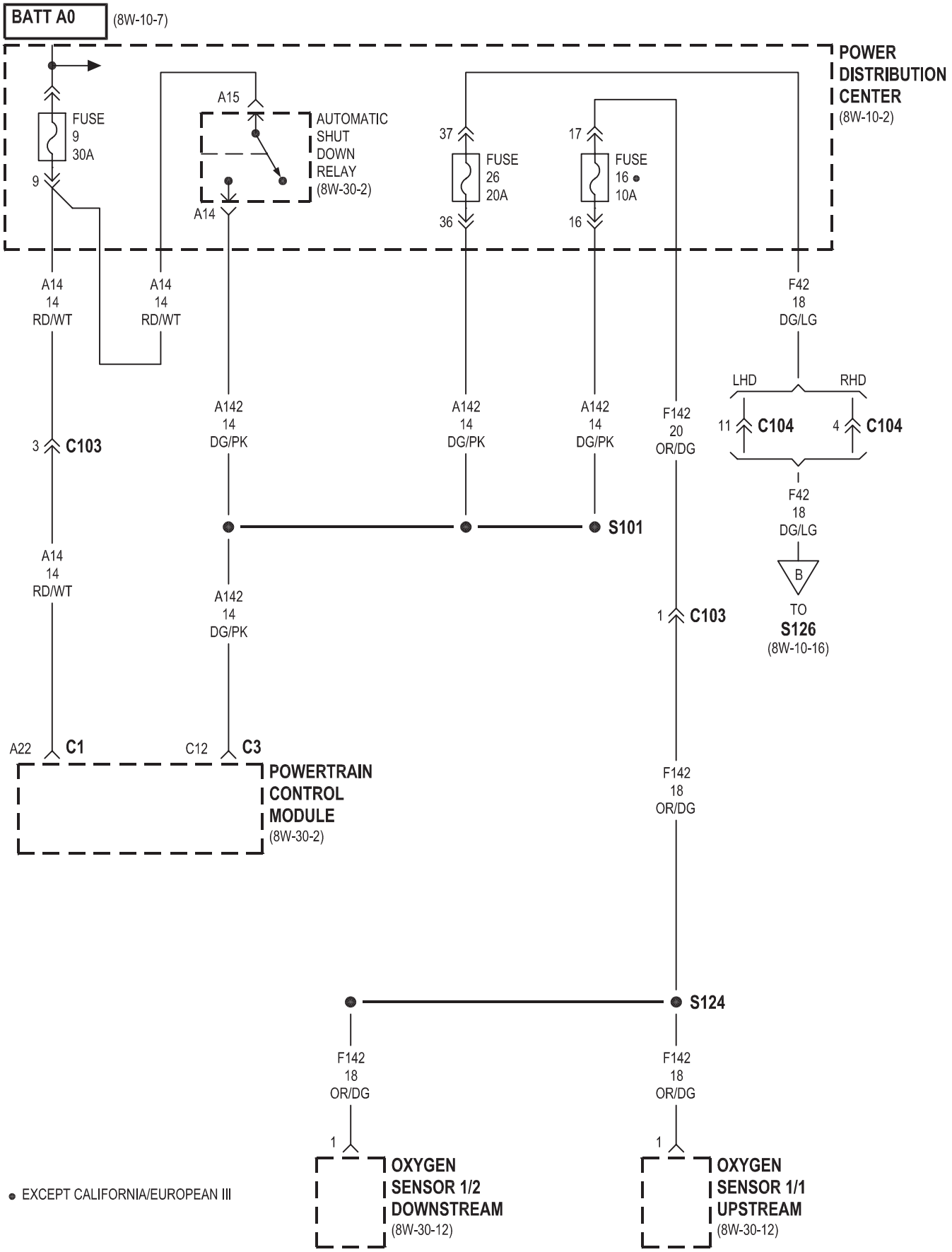

BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 8 40A
FUSE 14 30A
(8W-10-13)
S111
A2 12 PK/BK
A1 14 RD
C106
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-2)
T40 12 BR
LHD
RHD
C104
IGNITION SWITCH
(8W-10-13)
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
A22 12 BK/OR
A41 14 YL
S331
ENGINE STARTER MOTOR
(8W-21-2)
FUSE BLOCK
(8W-11-2)
FUSE 5 10A (8W-11-6)
FUSE 6 20A (8W-11-6)
FUSE 7 10A (8W-11-7)
FUSE 8 10A (8W-11-7)
FUSE 20 20A (A/T)
(8W-11-10)
A/T
M/T
NOT USED
CLUTCH PEDAL POSITION SWITCH CONNECTOR
CLUTCH PEDAL POSITION SWITCH
(8W-21-2)

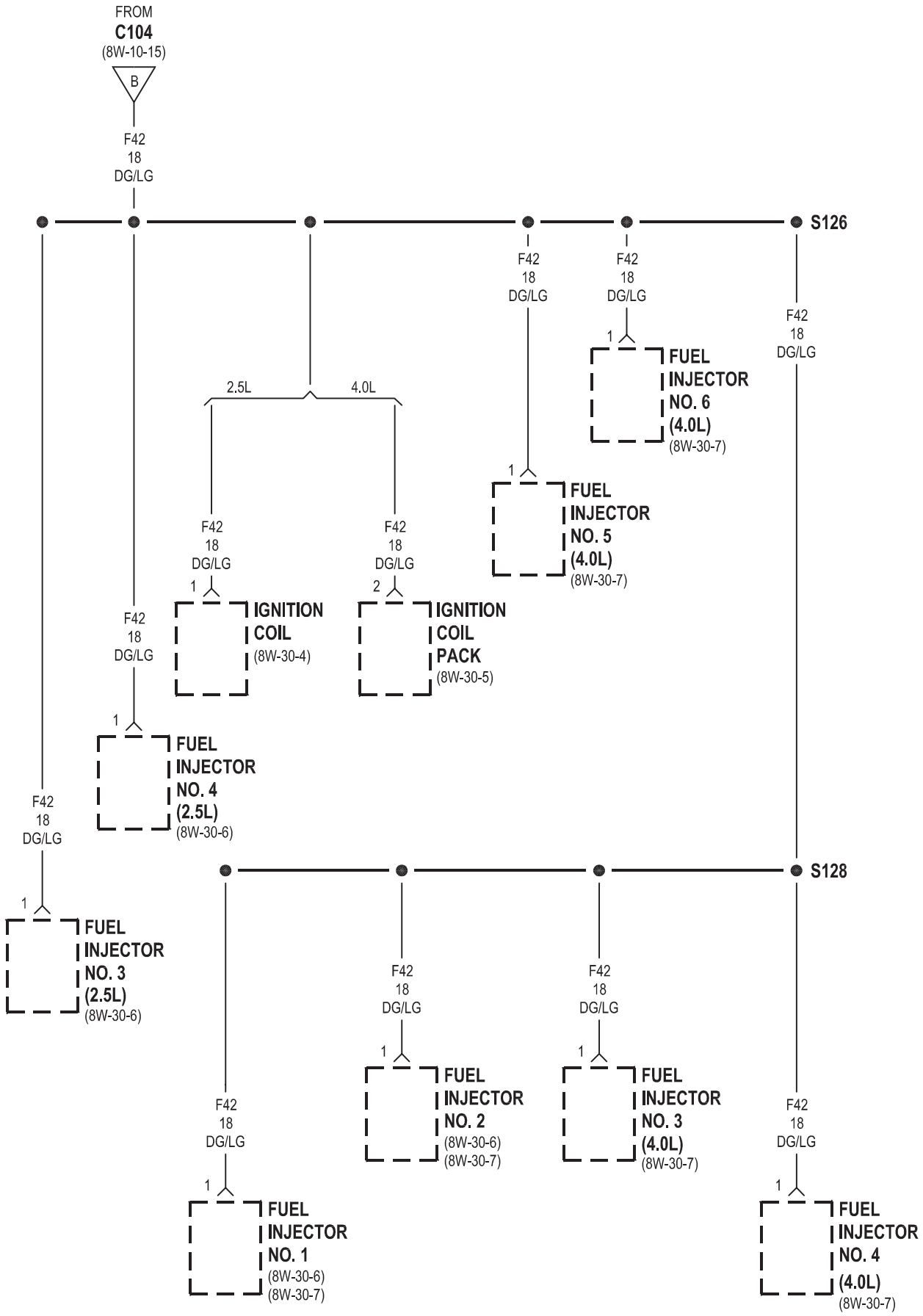


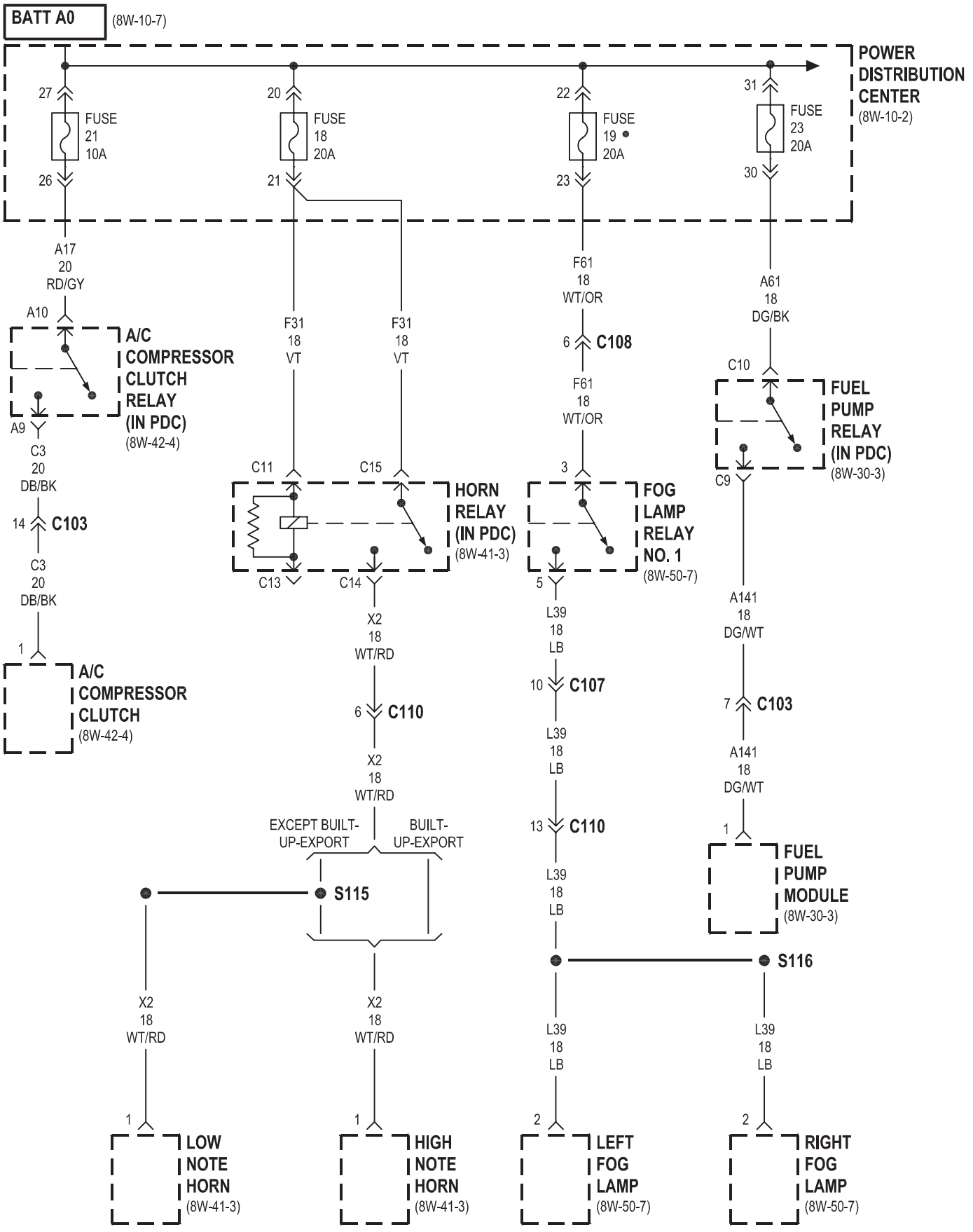
TJI01013

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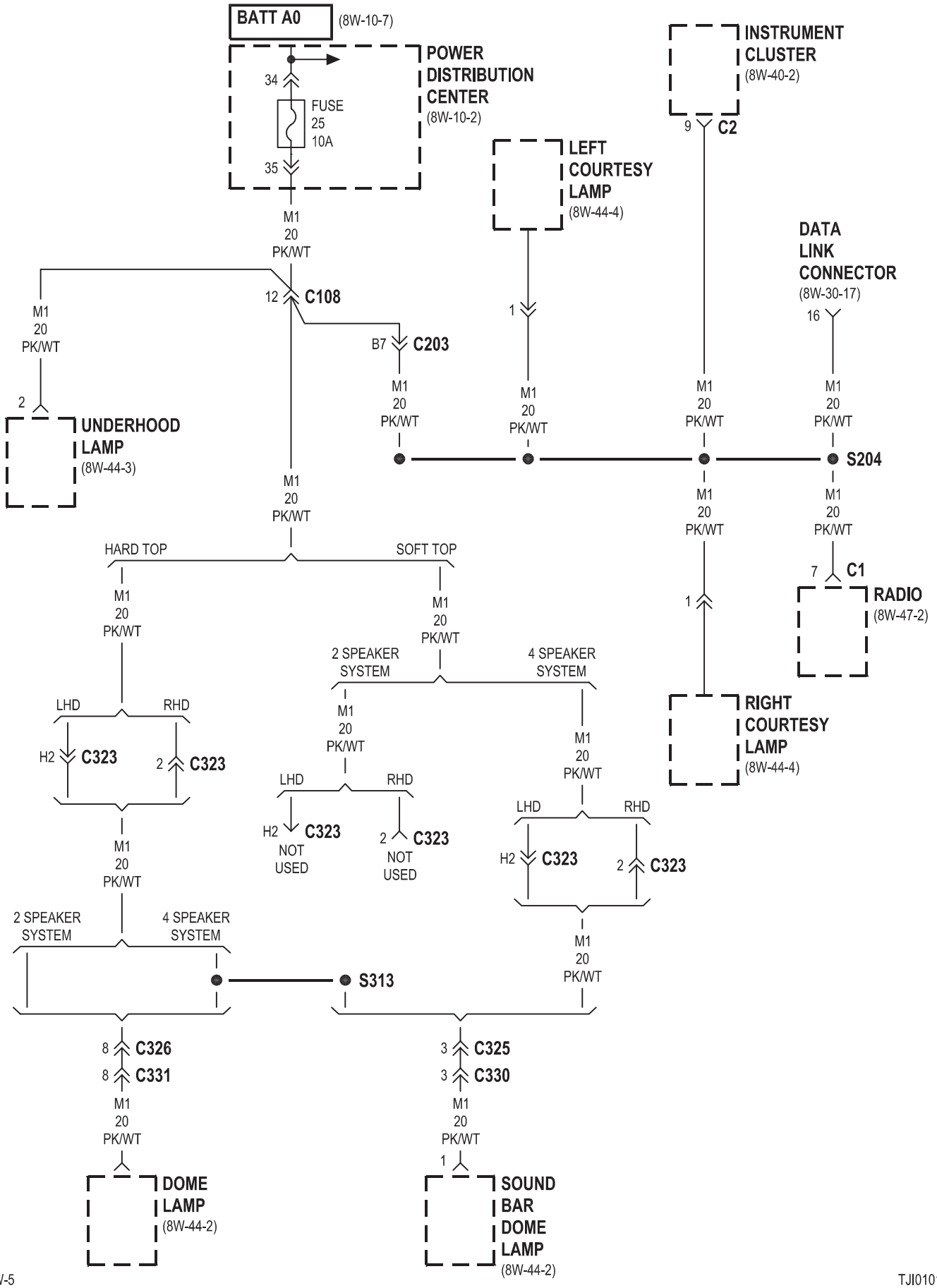

BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 15 40A
FUSE 17 20A
F30 12 RD/PK
A114 18 DG/OR
C106
S332
OXYGEN SENSOR UPSTREAM HEATER RELAY (IN PDC)
(8W-30-13)
OXYGEN SENSOR DOWNSTREAM HEATER RELAY (IN PDC)
(8W-30-14)
A42 18 DG
A242 18 VT/OR
LHD
RHD
C104
CIGAR LIGHTER/ ACCESSORY RELAY
(8W-41-2)
F22 12 WT/PK
S139
S140
OXYGEN SENSOR 2/1 UPSTREAM
(8W-30-13)
OXYGEN SENSOR 2/2 DOWNSTREAM
(8W-30-14)
FUSE BLOCK
(8W-11-2)
FUSE 19 20A
(8W-11-11)
FUSE 18 15A
(8W-11-11)
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-13)
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-14)
• CALIFORNIA/EUROPEAN III


BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 9 30A
FUSE 26 20A
FUSE 16 10A
AUTOMATIC SHUT DOWN RELAY
(8W-30-2)
A15
A14
9
37
36
17
16
A14 14 RD/WT
A14 14 RD/WT
A142 14 DG/PK
A142 14 DG/PK
A142 14 DG/PK
F142 20 OR/DG
F42 18 DG/LG
LHD
RHD
11 C104
4 C104
3 C103
1 C103
S101
S124
B
TO S126
(8W-10-16)
A22 C1
C12 C3
POWERTRAIN CONTROL MODULE
(8W-30-2)
F142 18 OR/DG
F142 18 OR/DG
F142 18 OR/DG
1
1
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-12)
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-12)
• EXCEPT CALIFORNIA/EUROPEAN III


FROM
C104
(8W-10-15)
B
F42
18
DG/LG
S126
2.5L
4.0L
1
FUEL
INJECTOR
NO. 6
(4.0L)
(8W-30-7)
1
FUEL
INJECTOR
NO. 5
(4.0L)
(8W-30-7)
1
IGNITION
COIL
(8W-30-4)
2
IGNITION
COIL
PACK
(8W-30-5)
1
FUEL
INJECTOR
NO. 4
(2.5L)
(8W-30-6)
1
FUEL
INJECTOR
NO. 3
(2.5L)
(8W-30-6)
S128
1
FUEL
INJECTOR
NO. 2
(8W-30-6)
(8W-30-7)
1
FUEL
INJECTOR
NO. 3
(4.0L)
(8W-30-7)
1
FUEL
INJECTOR
NO. 1
(8W-30-6)
(8W-30-7)
1
FUEL
INJECTOR
NO. 4
(4.0L)
(8W-30-7)



• FRONT FOG LAMPS

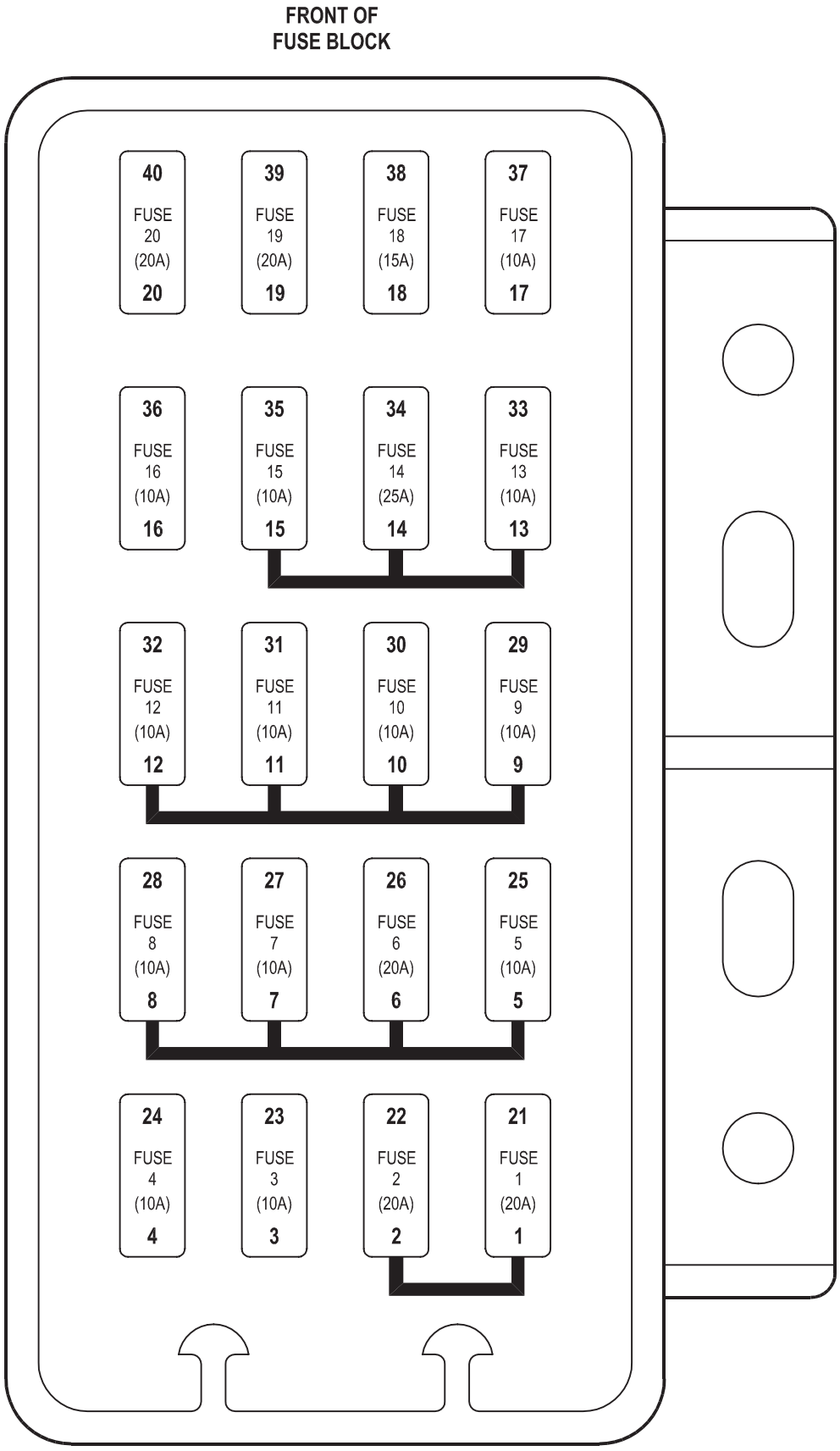


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TJI01018

8W-11 FUSE/FUSE BLOCK

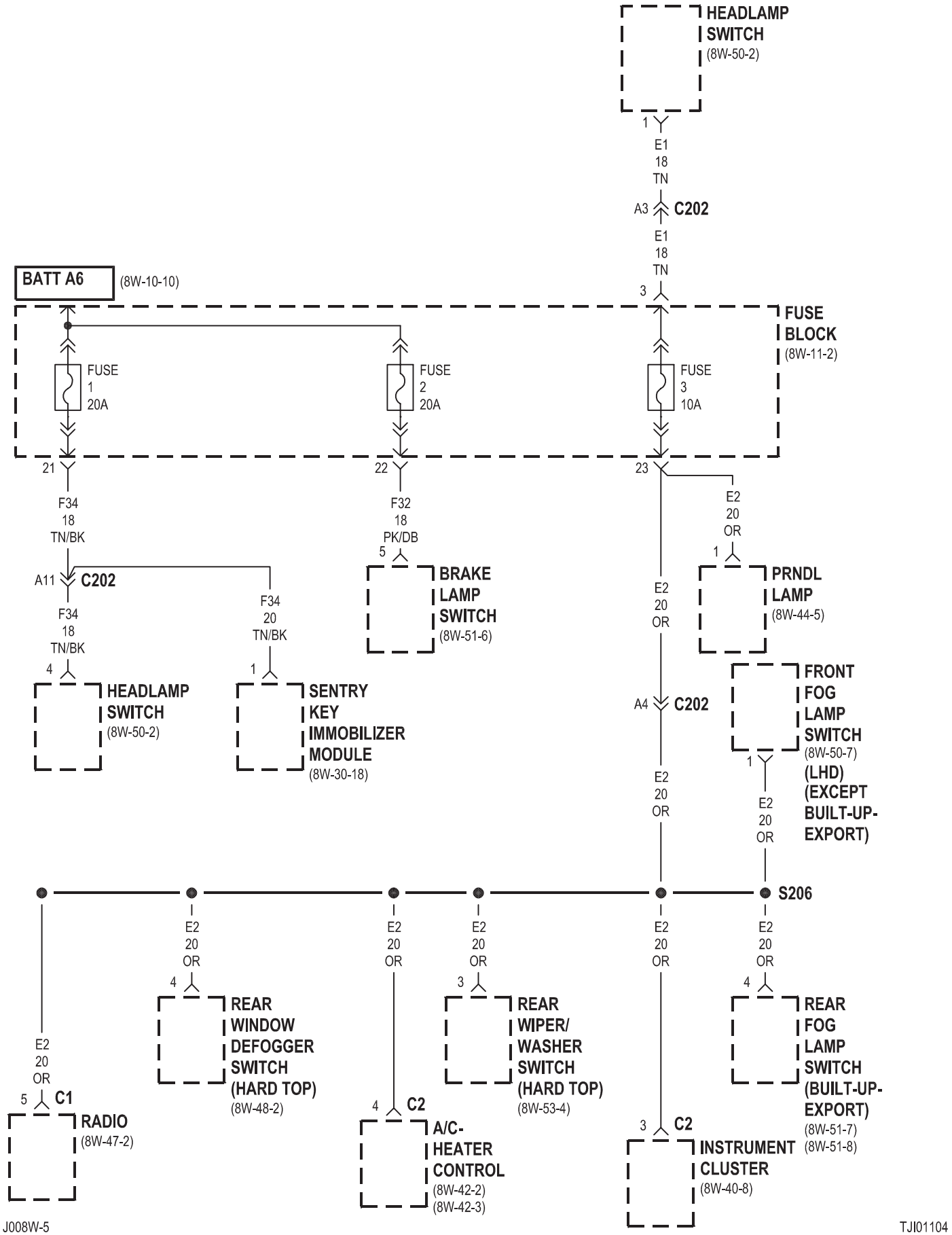
Component	Page
A/C Compressor Clutch Relay	8W-11-9
A/C- Heater Control	8W-11-4, 7
ABS System Relay	8W-11-7
Airbag Control Module	8W-11-6, 8
Automatic Shut Down Relay	8W-11-8
Back-Up Lamp Switch	8W-11-7
Blend Door Actuator	8W-11-7
Blower Motor Relay	8W-11-7
Brake Lamp Switch	8W-11-4
Brake Shift Interlock Solenoid	8W-11-8
Cigar Lighter/Accessory Relay	8W-11-11
Cigar Lighter/Power Outlet	8W-11-11
Clutch Pedal Position Switch	8W-11-10
Clutch Pedal Position Switch Connector	8W-11-10
Controller Anti-Lock Brake	8W-11-7
Daytime Running Lamp Module	8W-11-9
Driver Door Ajar Switch	8W-11-5
Duty Cycle Evap/Purge Solenoid	8W-11-9
Engine Starter Motor Relay	8W-11-10
Fog Lamp Relay No. 1	8W-11-5
Fog Lamp Relay No. 2	8W-11-5
Front Fog Lamp Switch	8W-11-4
Fuel Pump Relay	8W-11-8
Fuse 1 (FB)	8W-11-4
Fuse 2 (FB)	8W-11-4
Fuse 3 (FB)	8W-11-4
Fuse 4 (FB)	8W-11-5
Fuse 5 (FB)	8W-11-6
Fuse 6 (FB)	8W-11-6
Fuse 7 (FB)	8W-11-7
Fuse 8 (FB)	8W-11-7
Fuse 9 (FB)	8W-11-8
Fuse 10 (FB)	8W-11-8
Fuse 11 (FB)	8W-11-9
Fuse 12 (FB)	8W-11-8
Fuse 13 (FB)	8W-11-10
Fuse 14 (FB)	8W-11-10
Fuse 15 (FB)	8W-11-10
Fuse 16 (FB)	8W-11-11
Fuse 17 (FB)	8W-11-10
Fuse 18 (FB)	8W-11-11
Fuse 19 (FB)	8W-11-11
Fuse 20 (FB)	8W-11-10
Fuse Block	8W-11-2, 4, 5, 6, 7, 8, 9, 10, 11
G300	8W-11-5
Headlamp Dimmer Switch	8W-11-11
Headlamp Leveling Switch	8W-11-11
Headlamp Switch	8W-11-4, 11
Instrument Cluster	8W-11-4, 8
Left Headlamp Leveling Motor	8W-11-11
Oxygen Sensor Downstream Heater Relay	8W-11-8
Oxygen Sensor Upstream Heater Relay	8W-11-8
Park/Neutral Position Switch	8W-11-7
Passenger Airbag On/Off Switch	8W-11-8
Passenger Door Ajar Switch	8W-11-5
Powertrain Control Module	8W-11-8
PRNDL Lamp	8W-11-4
Radio	8W-11-4, 10
Rear Fog Lamp Relay	8W-11-5, 11
Rear Fog Lamp Switch	8W-11-4
Rear Window Defogger Relay	8W-11-7, 10
Rear Window Defogger Switch	8W-11-4, 10
Rear Wiper Motor	8W-11-6
Rear Wiper/Washer Switch	8W-11-4, 6
Right Headlamp Leveling Motor	8W-11-11
Sentry Key Immobilizer Module	8W-11-4, 8
Torque Converter Clutch Solenoid	8W-11-9
Turn Signal/Hazard Switch	8W-11-10
Windshield Wiper Motor	8W-11-10
Windshield Wiper Switch	8W-11-10


FRONT OF
FUSE BLOCK
40
FUSE
20
(20A)
20
39
FUSE
19
(20A)
19
38
FUSE
18
(15A)
18
37
FUSE
17
(10A)
17
36
FUSE
16
(10A)
16
35
FUSE
15
(10A)
15
34
FUSE
14
(25A)
14
33
FUSE
13
(10A)
13
32
FUSE
12
(10A)
12
31
FUSE
11
(10A)
11
30
FUSE
10
(10A)
10
29
FUSE
9
(10A)
9
28
FUSE
8
(10A)
8
27
FUSE
7
(10A)
7
26
FUSE
6
(20A)
6
25
FUSE
5
(10A)
5
24
FUSE
4
(10A)
4
23
FUSE
3
(10A)
3
22
FUSE
2
(20A)
2
21
FUSE
1
(20A)
1

FUSES

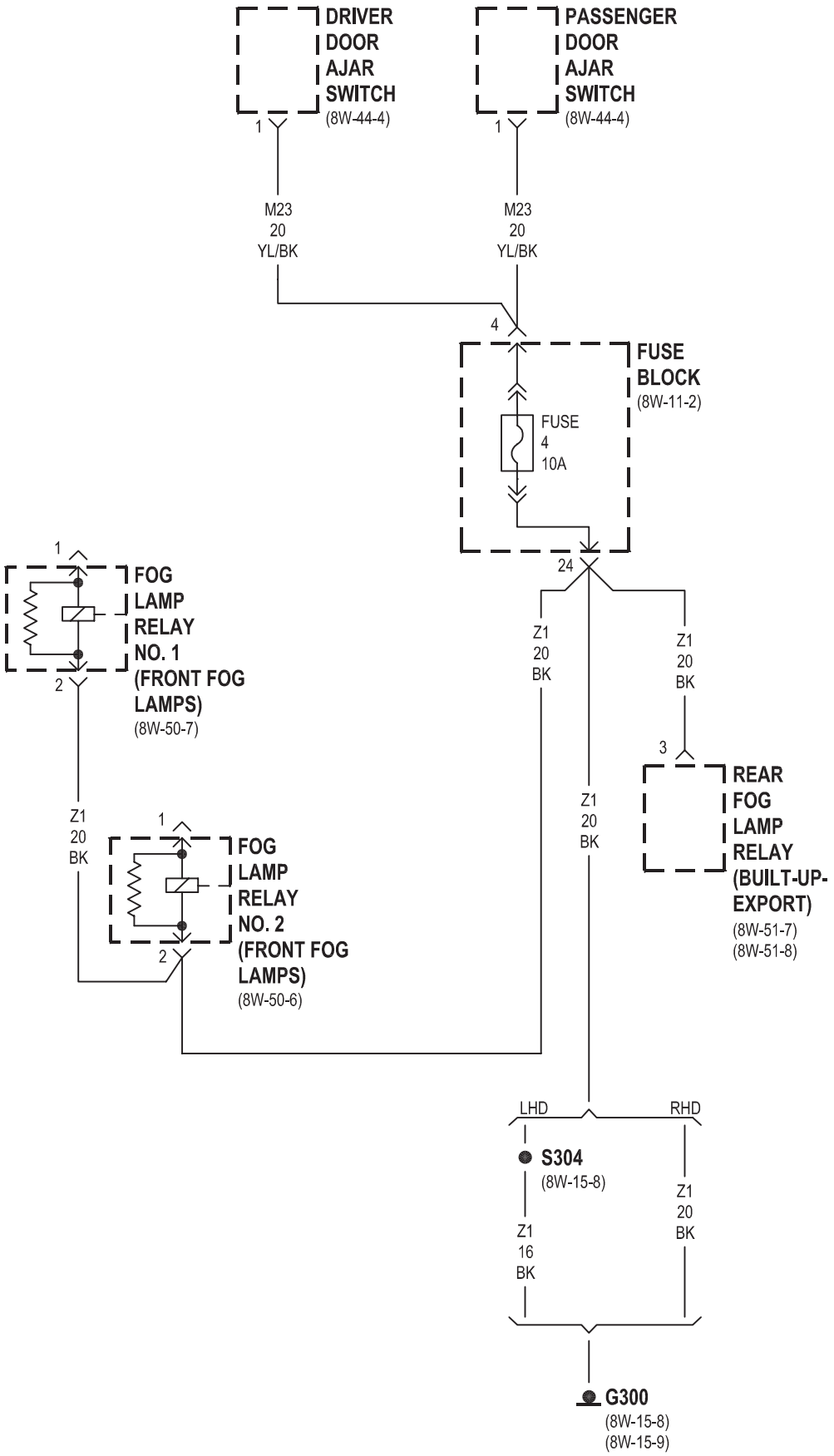
FUSE NO.	AMPS	FUSED CIRCUIT	FEED CIRCUIT
1	20A	F34 18TN/BK	A6 12RD/BK
2	20A	F32 18PK/DB	
3	10A	E2 20OR	E1 18TN
		E2 20OR	
4	10A	Z1 20BK	M23 20YL/BK
		Z1 20BK ● ■	M23 20YL/BK
5	10A	F23 18DB/YL	A22 12BK/OR
6	20A	V23 18BR/PK	
7	10A	F20 20VT/WT	
8	10A	F24 20RD/DG	
9	10A	F14 18LG/YL	A21 14DB
		F14 18LG/YL	
10	10A	G5 20DB/WT	
		G5 20DB/WT	
11	10A	F12 20RD/LG	
12	10A	F15 20DB	
		F15 20DB	
13	10A	L5 20BK/GY	A31 14BK/DG
14	25A	V6 16PK/BK	
15	10A	X12 20PK	
16 ●	10A	L22 20LG/DG	L2 16LG
17	10A	F81 20DB/RD	C15 14BK/WT
18	15A	A18 16RD/BK	F30 12RD/PK
19	20A	F38 16LB	F22 12WT/PK
		F38 16LB	
20 ▲	20A	T141 14YL/RD	A41 14YL

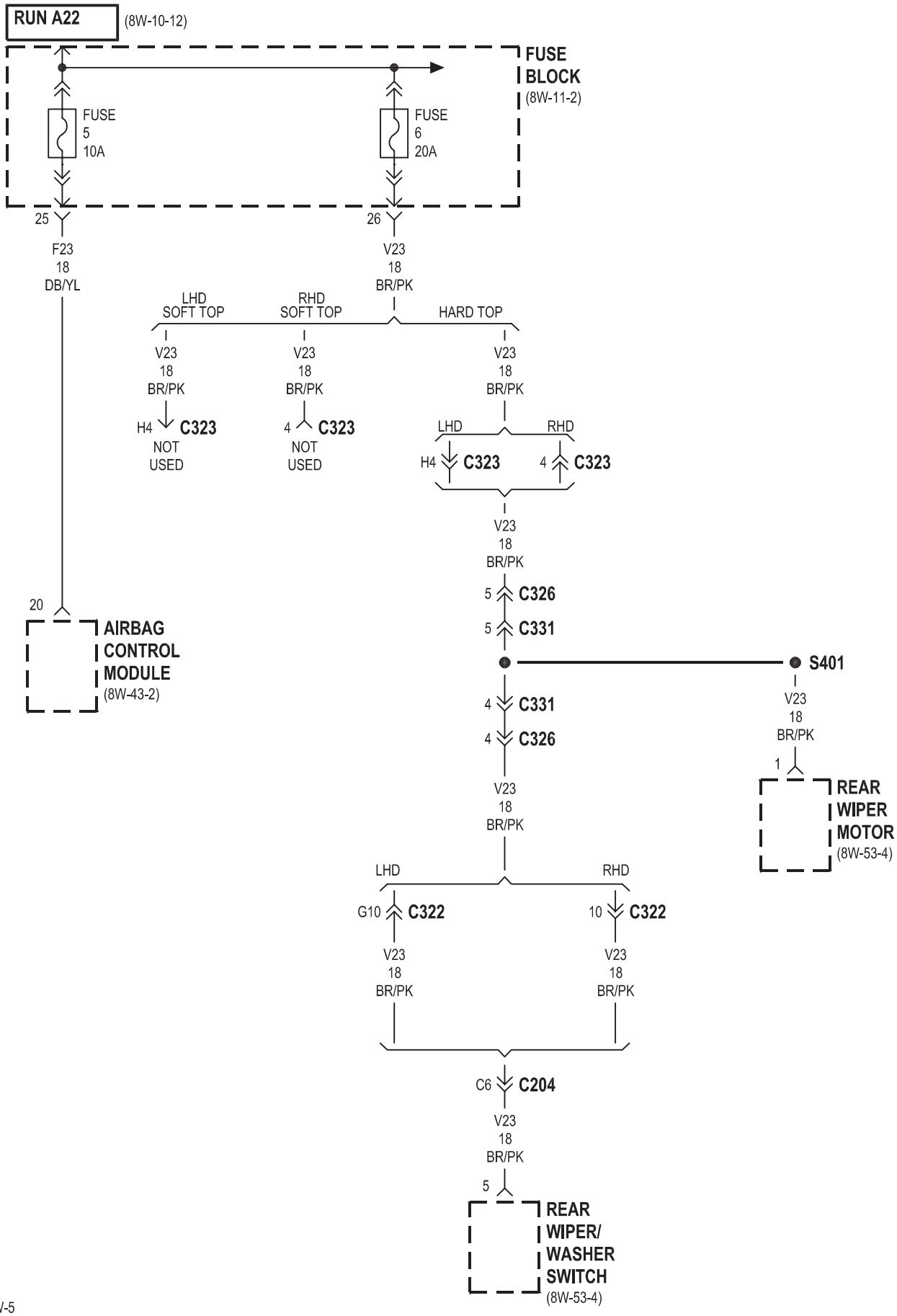
■ FRONT FOG LAMPS
● REAR FOG LAMPS
▲ A/T

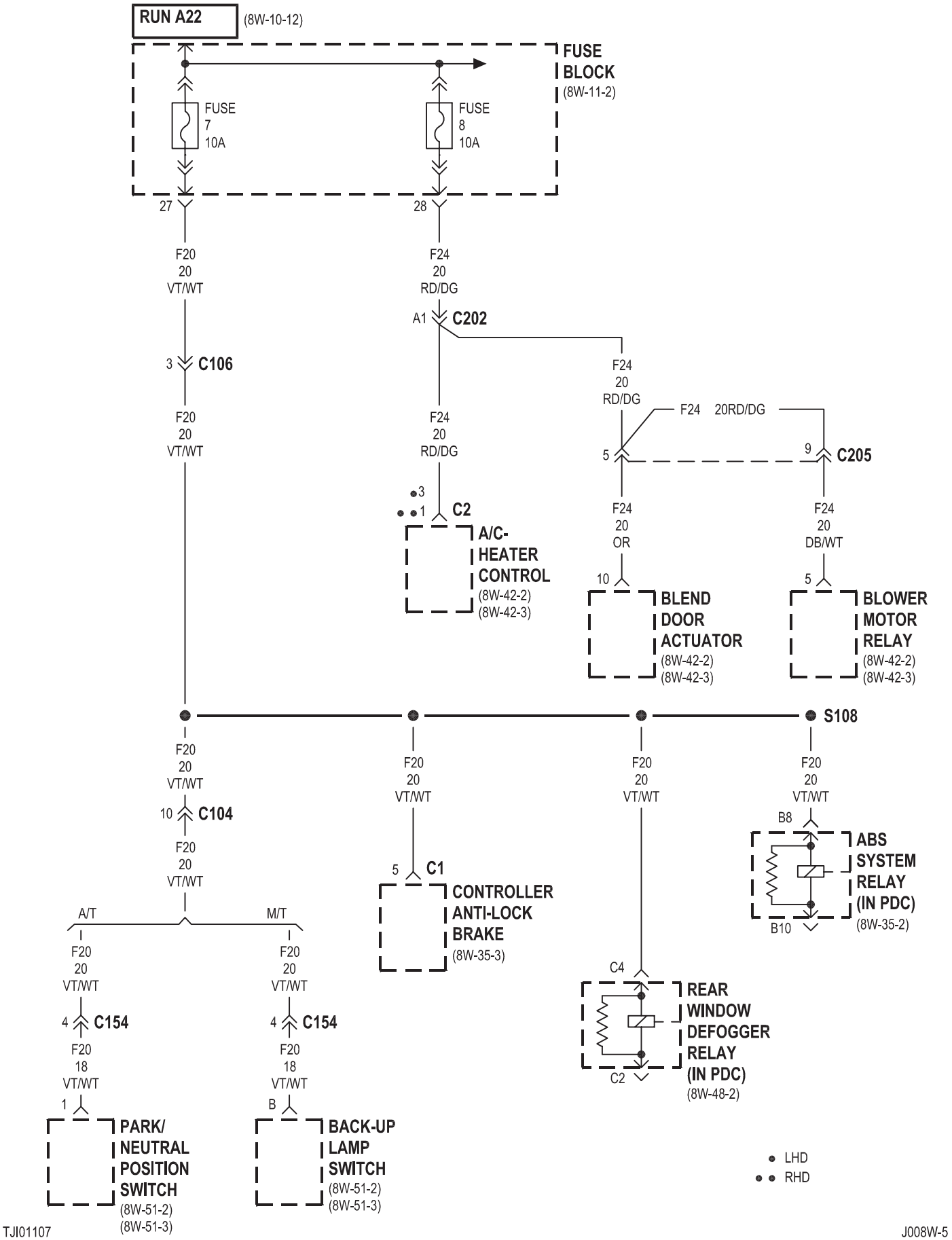


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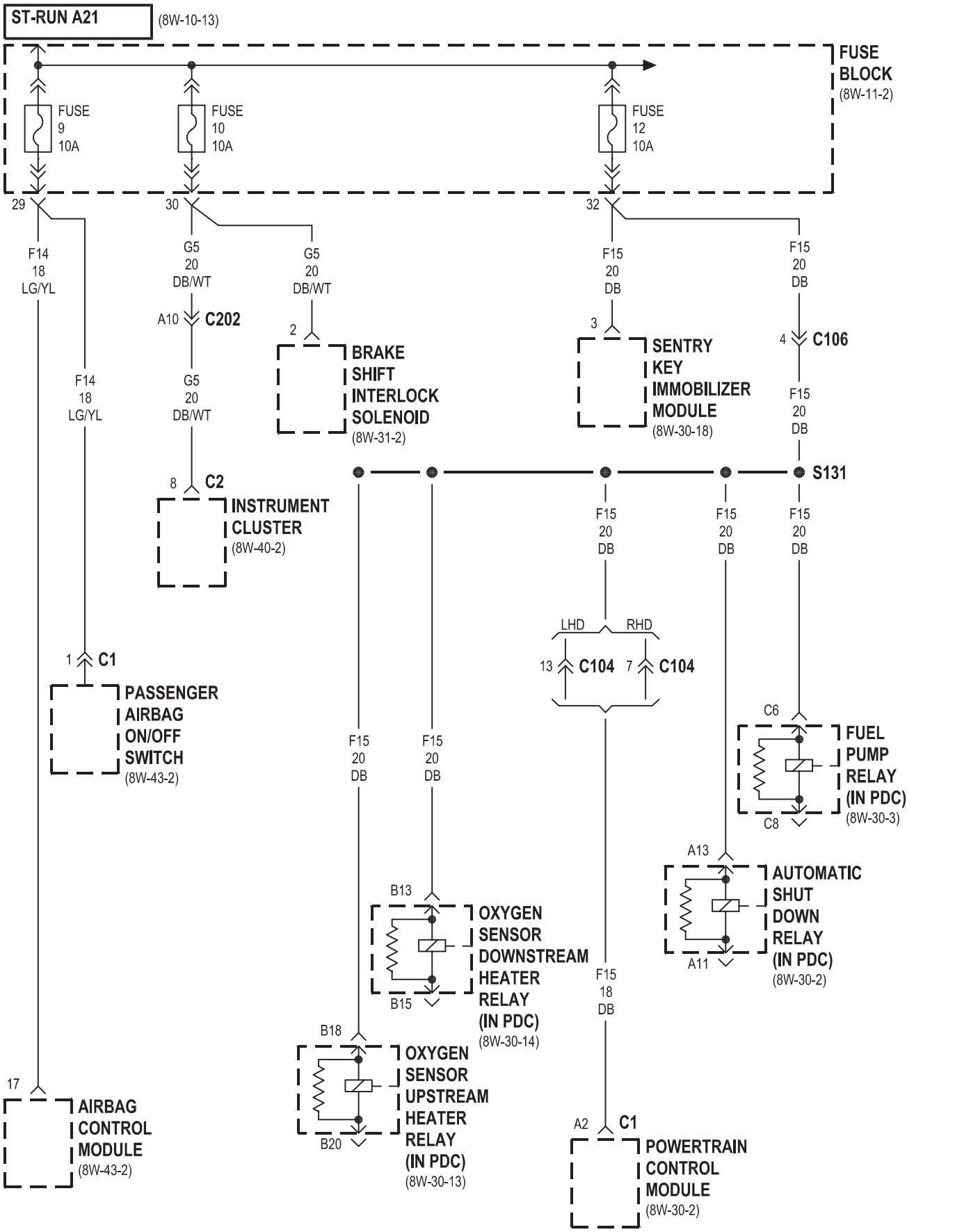

DRIVER DOOR AJAR SWITCH
(8W-44-4)
1
PASSENGER DOOR AJAR SWITCH
(8W-44-4)
1
M23
20
YL/BK
M23
20
YL/BK
4
FUSE BLOCK
(8W-11-2)
FUSE
4
10A
24
1
FOG LAMP RELAY NO. 1 (FRONT FOG LAMPS)
(8W-50-7)
2
Z1
20
BK
Z1
20
BK
Z1
20
BK
3
REAR FOG LAMP RELAY (BUILT-UP-EXPORT)
(8W-51-7)
(8W-51-8)
Z1
20
BK
1
FOG LAMP RELAY NO. 2 (FRONT FOG LAMPS)
(8W-50-6)
2
LHD
RHD
S304
(8W-15-8)
Z1
16
BK
Z1
20
BK
G300
(8W-15-8)
(8W-15-9)

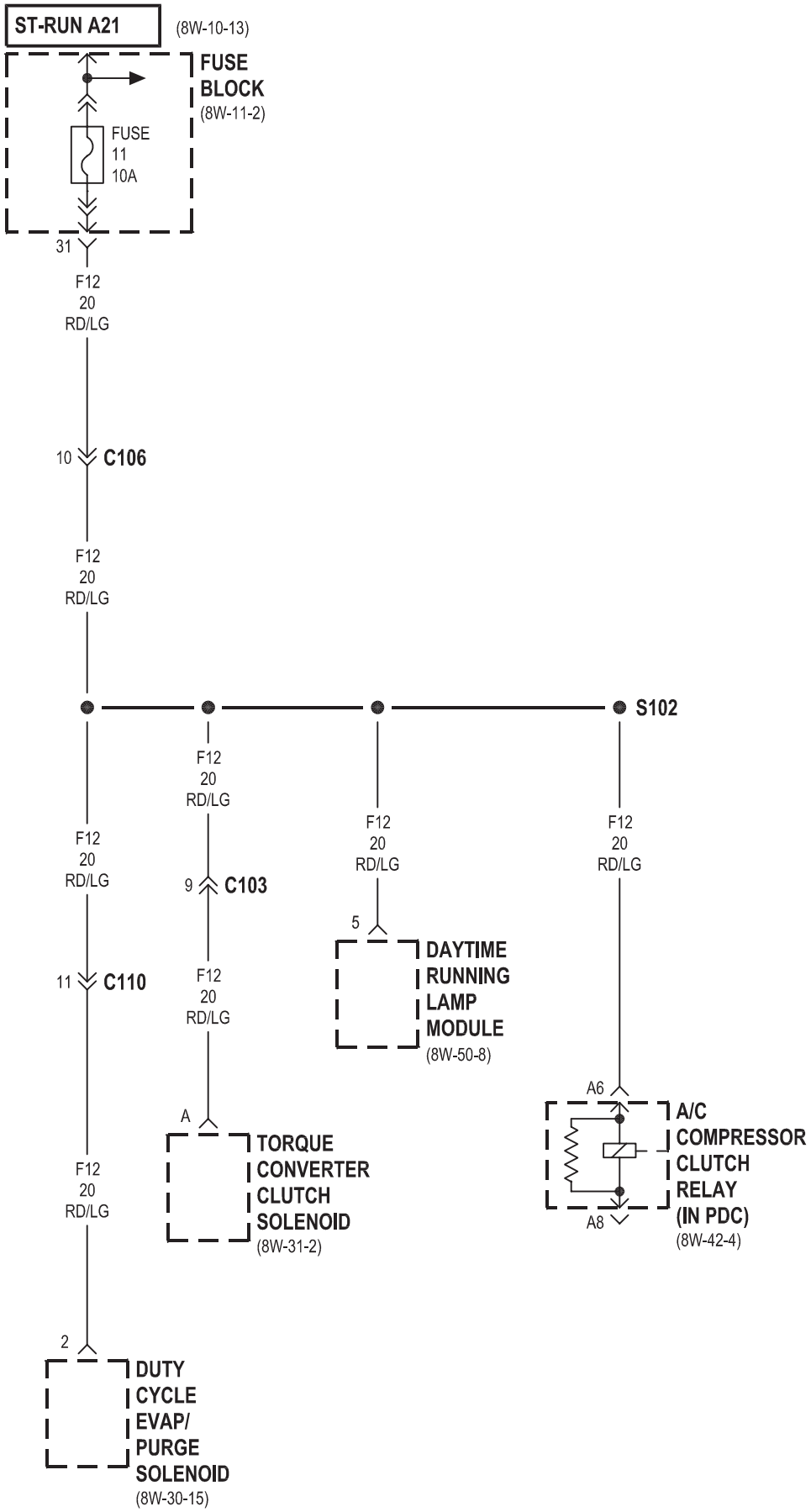

RUN A22
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 5 10A
FUSE 6 20A
25
26
F23 18 DB/YL
V23 18 BR/PK
LHD SOFT TOP
RHD SOFT TOP
HARD TOP
V23 18 BR/PK
H4 C323
NOT USED
4 C323
NOT USED
LHD
RHD
H4 C323
4 C323
V23 18 BR/PK
5 C326
5 C331
S401
4 C331
4 C326
V23 18 BR/PK
1
REAR WIPER MOTOR
(8W-53-4)
20
AIRBAG CONTROL MODULE
(8W-43-2)
LHD
RHD
G10 C322
10 C322
V23 18 BR/PK
V23 18 BR/PK
C6 C204
V23 18 BR/PK
5
REAR WIPER/ WASHER SWITCH
(8W-53-4)



TJI01107

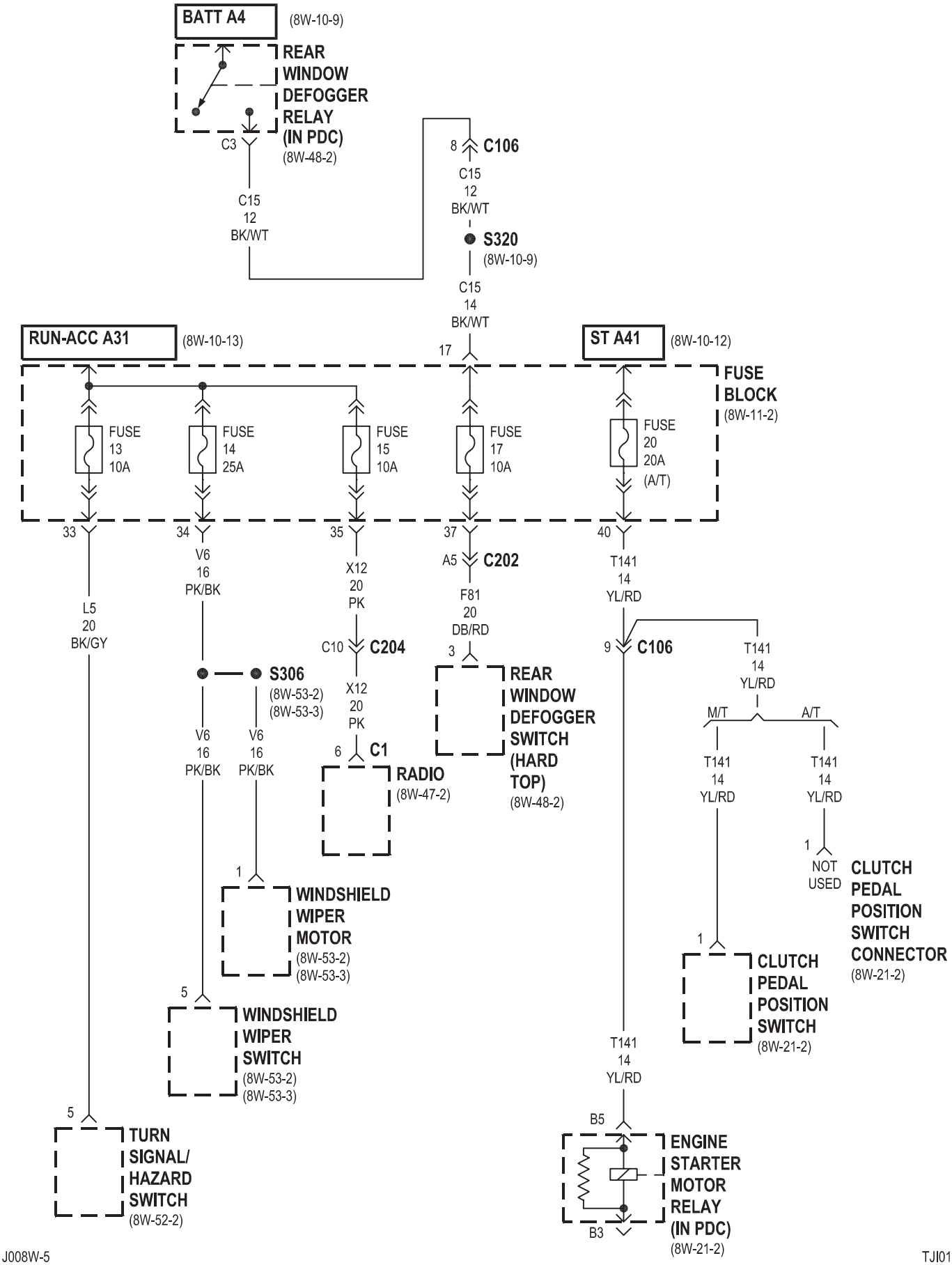
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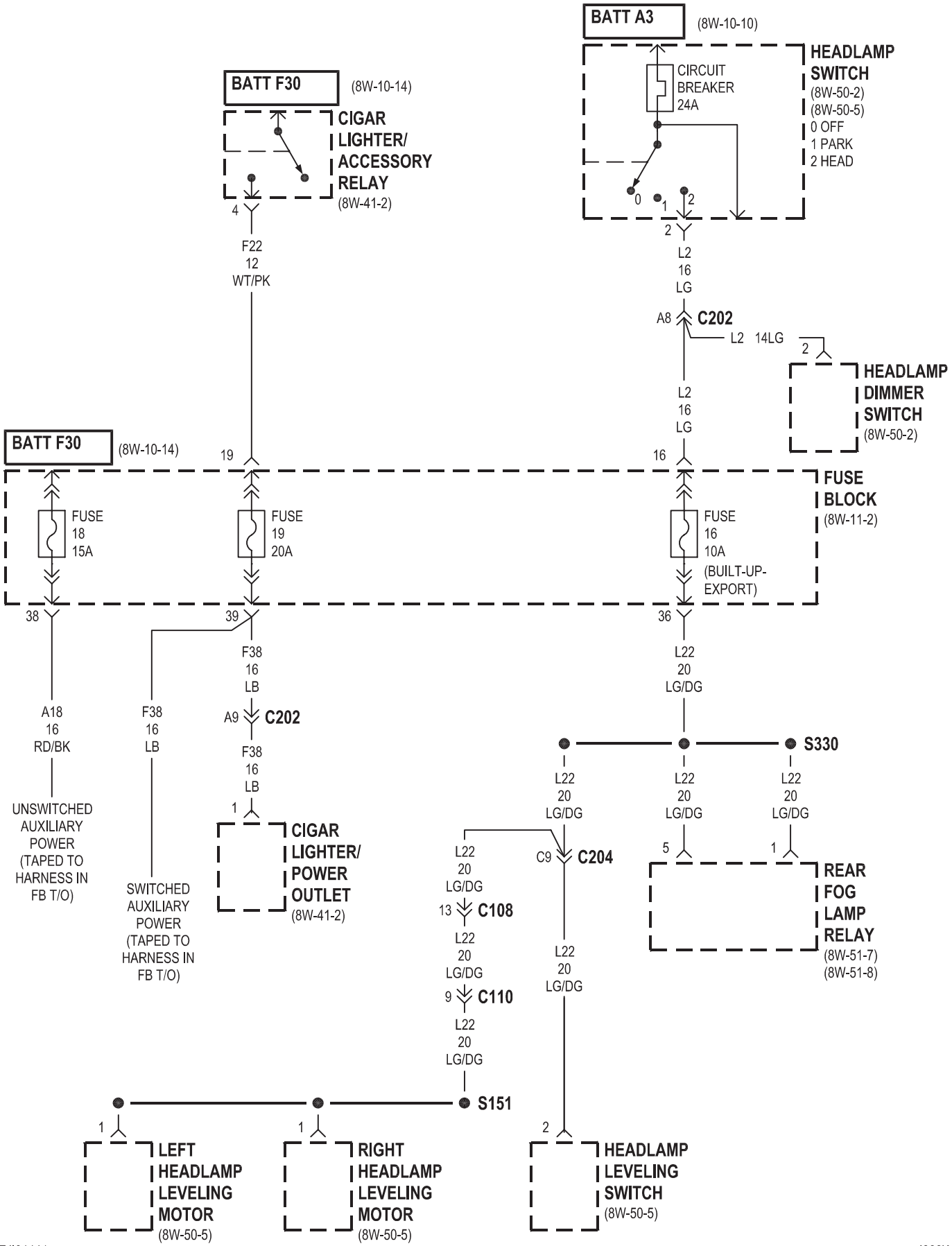

ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 9 10A
FUSE 10 10A
FUSE 12 10A
29
30
32
F14 18 LG/YL
F14 18 LG/YL
G5 20 DB/WT
G5 20 DB/WT
G5 20 DB/WT
F15 20 DB
F15 20 DB
A10 C202
2
3
4 C106
BRAKE SHIFT INTERLOCK SOLENOID
(8W-31-2)
SENTRY KEY IMMOBILIZER MODULE
(8W-30-18)
F15 20 DB
8 C2
INSTRUMENT CLUSTER
(8W-40-2)
S131
F15 20 DB
F15 20 DB
F15 20 DB
LHD
RHD
13 C104
7 C104
1 C1
PASSENGER AIRBAG ON/OFF SWITCH
(8W-43-2)
C6
FUEL PUMP RELAY (IN PDC)
(8W-30-3)
C8
F15 20 DB
F15 20 DB
A13
AUTOMATIC SHUT DOWN RELAY (IN PDC)
(8W-30-2)
A11
B13
OXYGEN SENSOR DOWNSTREAM HEATER RELAY (IN PDC)
(8W-30-14)
B15
F15 18 DB
B18
OXYGEN SENSOR UPSTREAM HEATER RELAY (IN PDC)
(8W-30-13)
B20
17
AIRBAG CONTROL MODULE
(8W-43-2)
A2 C1
POWERTRAIN CONTROL MODULE
(8W-30-2)



TJI01109

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BATT A4
(8W-10-9)
REAR WINDOW DEFOGGER RELAY (IN PDC)
(8W-48-2)
C3
C15 12 BK/WT
8 C106
C15 12 BK/WT
S320
(8W-10-9)
C15 14 BK/WT
17
RUN-ACC A31
(8W-10-13)
ST A41
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 13 10A
FUSE 14 25A
FUSE 15 10A
FUSE 17 10A
FUSE 20 20A (A/T)
33
34
35
37
40
L5 20 BK/GY
V6 16 PK/BK
X12 20 PK
C10 C204
X12 20 PK
6 C1
RADIO
(8W-47-2)
A5 C202
F81 20 DB/RD
3
REAR WINDOW DEFOGGER SWITCH (HARD TOP)
(8W-48-2)
T141 14 YL/RD
9 C106
T141 14 YL/RD
M/T
A/T
T141 14 YL/RD
T141 14 YL/RD
1
NOT USED
CLUTCH PEDAL POSITION SWITCH CONNECTOR
(8W-21-2)
S306
(8W-53-2)
(8W-53-3)
V6 16 PK/BK
V6 16 PK/BK
1
WINDSHIELD WIPER MOTOR
(8W-53-2)
(8W-53-3)
5
WINDSHIELD WIPER SWITCH
(8W-53-2)
(8W-53-3)
1
CLUTCH PEDAL POSITION SWITCH
(8W-21-2)
T141 14 YL/RD
5
TURN SIGNAL/ HAZARD SWITCH
(8W-52-2)
B5
B3
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-2)

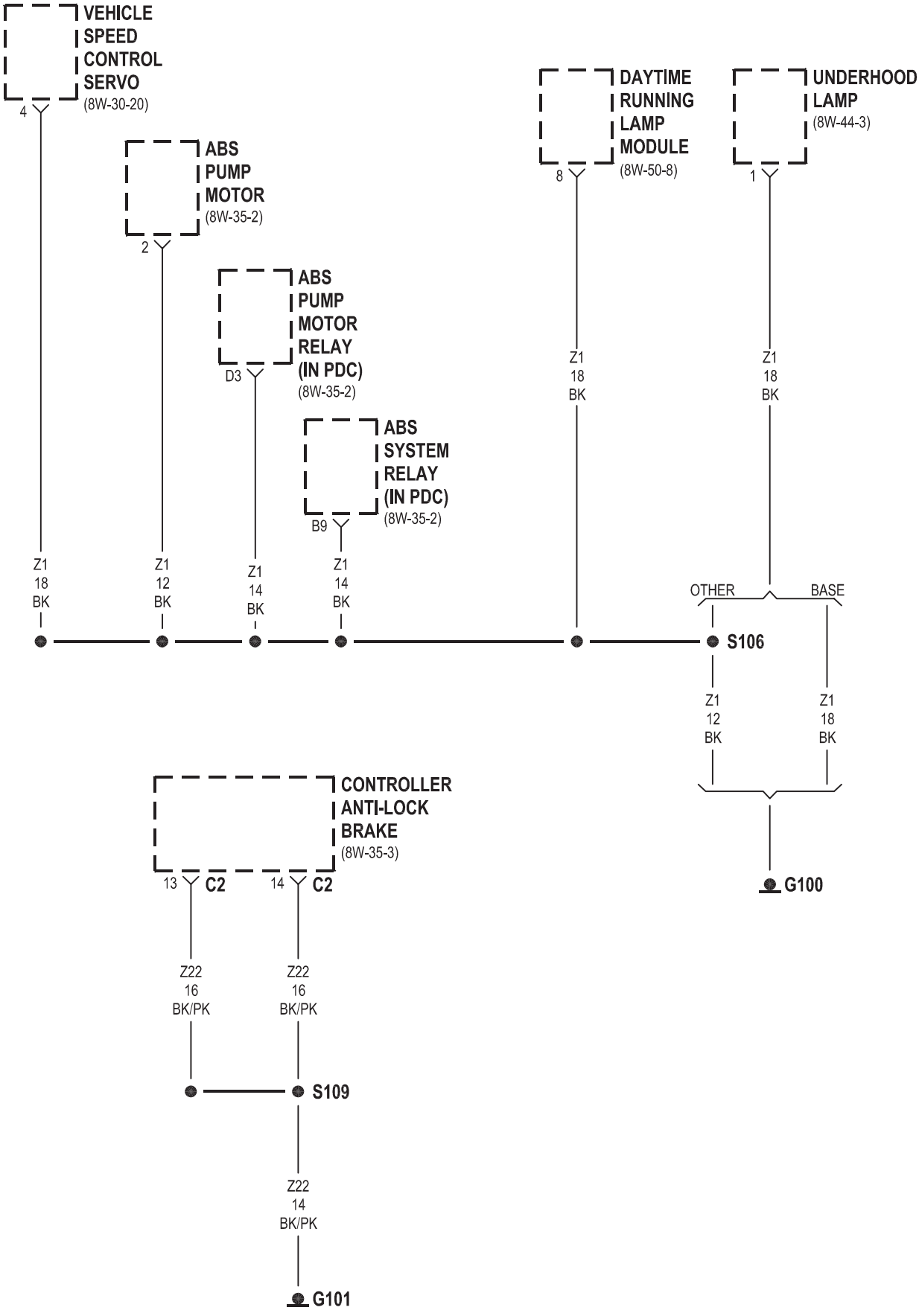


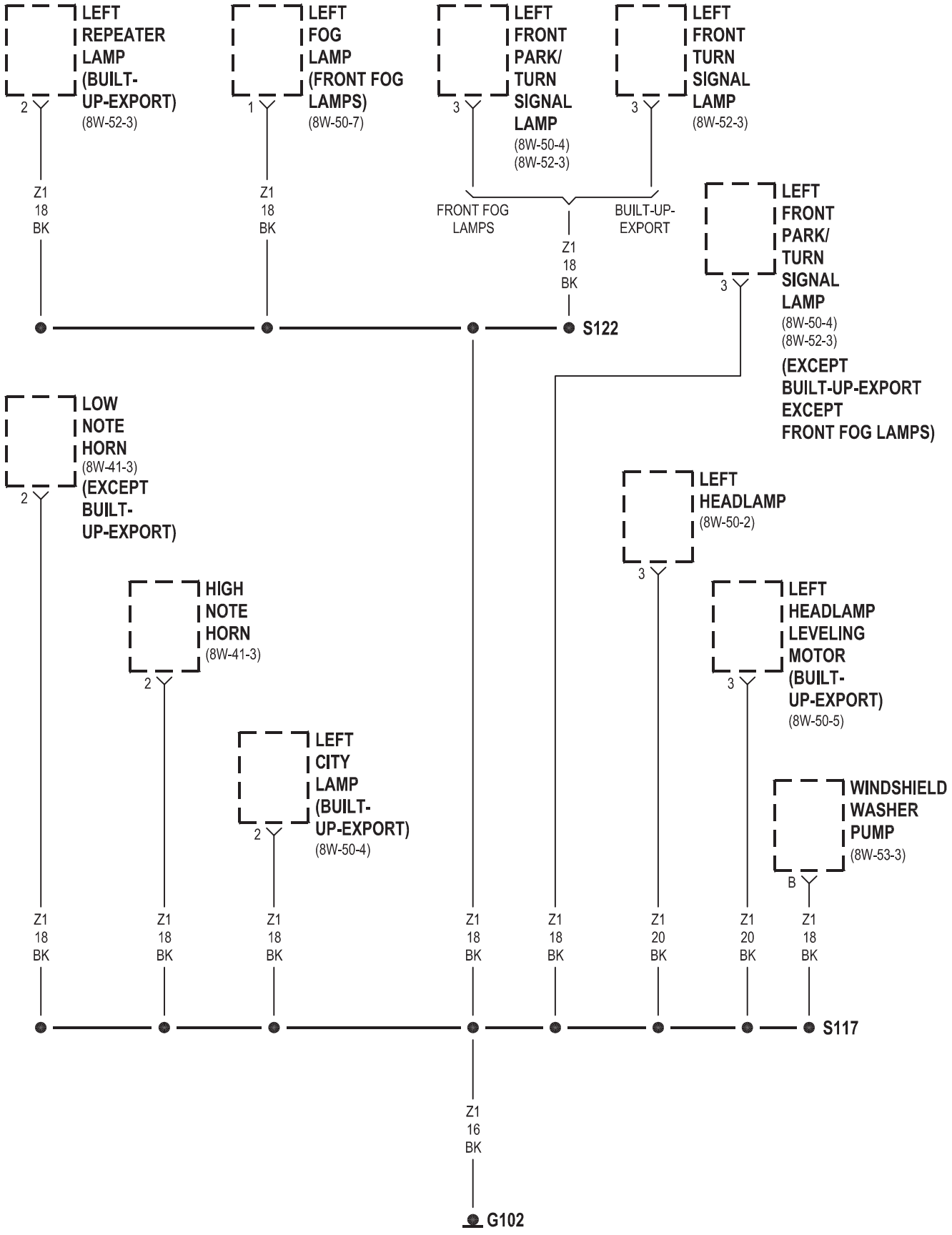
TJI01111

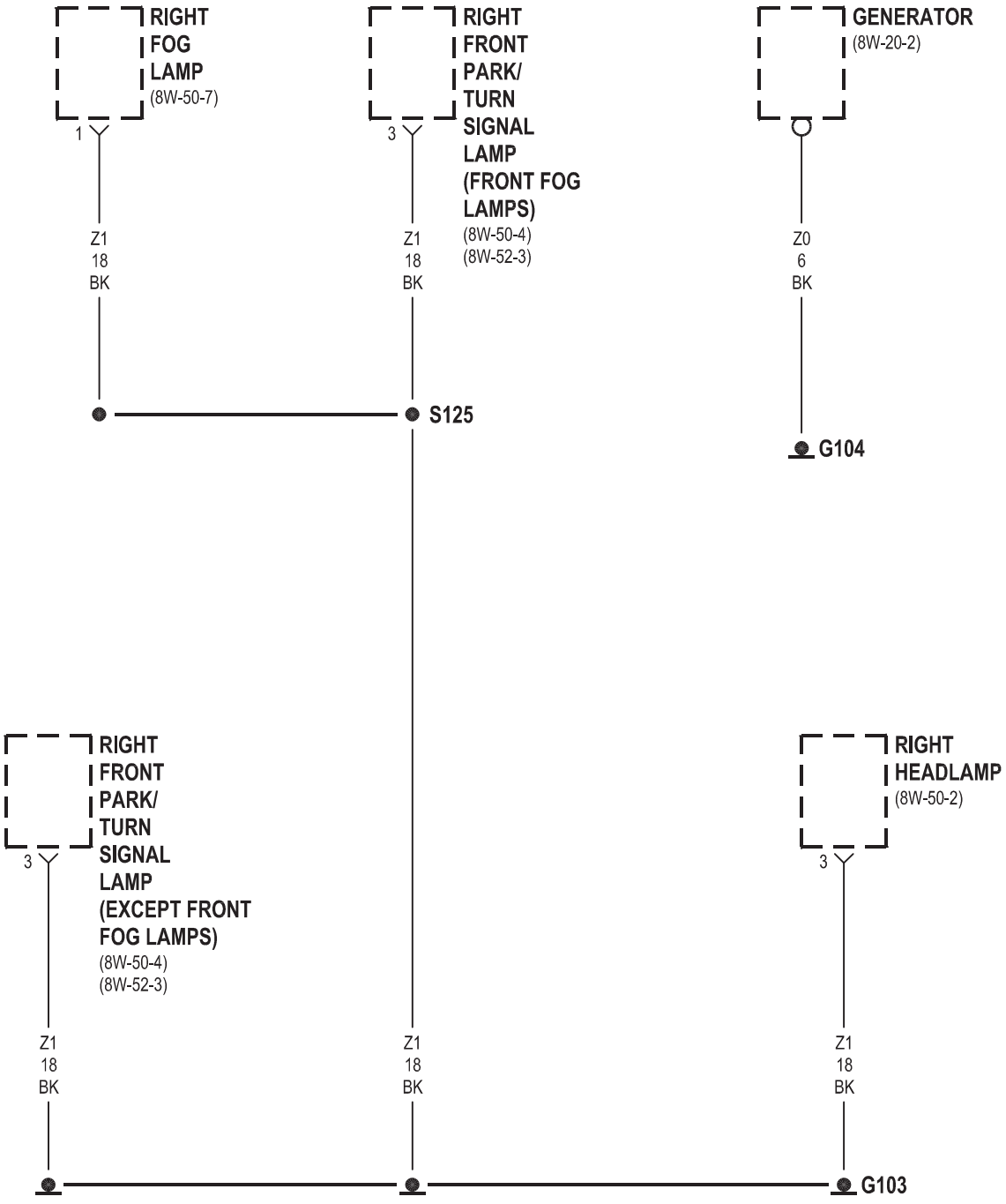
J008W-5

8W-15 GROUND DISTRIBUTION

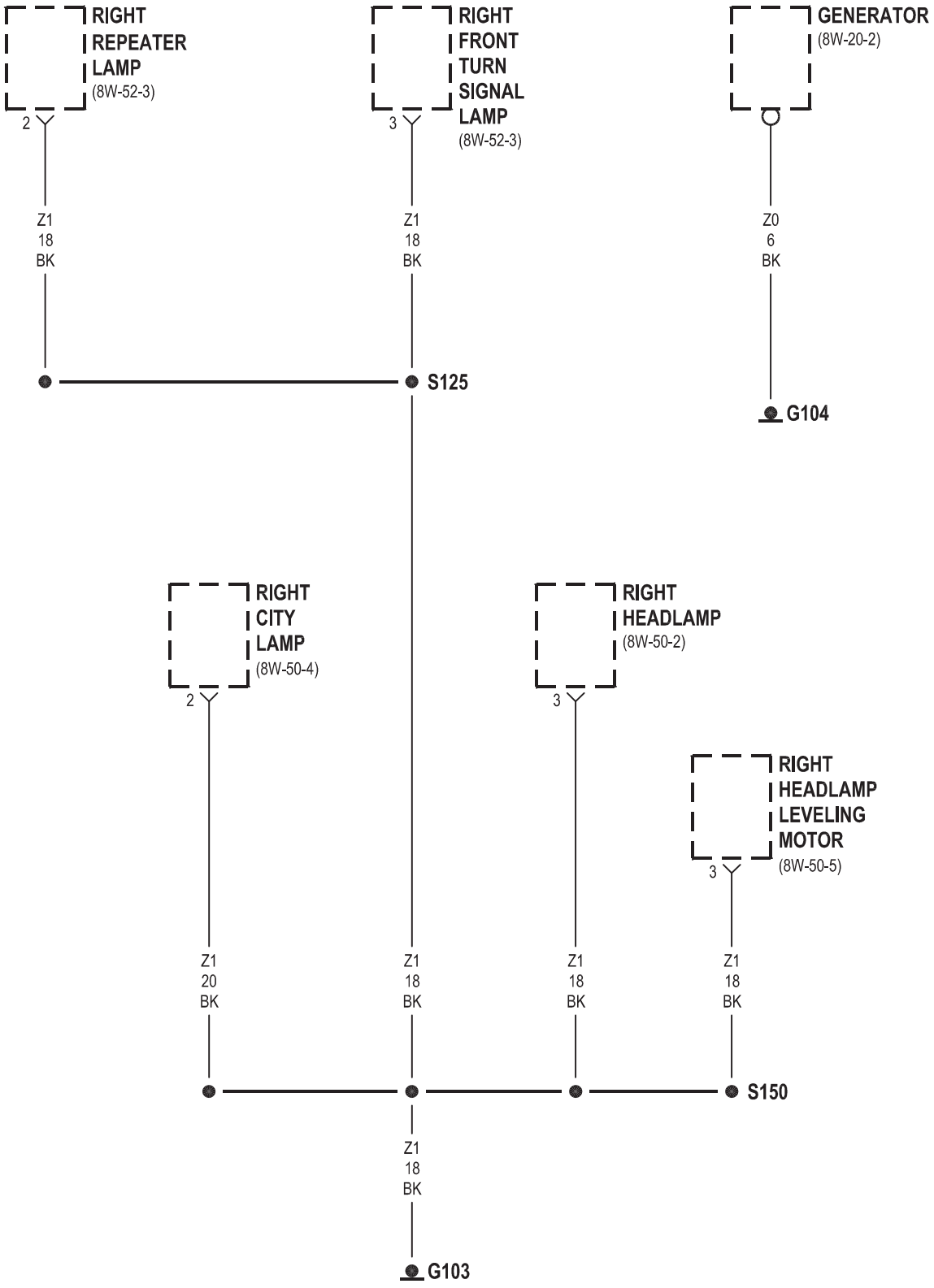
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ABS Pump Motor Relay	8W-15-2
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G104	8W-15-4, 5
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Left Headlamp	8W-15-3
Left Headlamp Leveling Motor	8W-15-3
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Right Fog Lamp	8W-15-4
Right Front Park/Turn Signal Lamp	8W-15-4
Right Front Turn Signal Lamp	8W-15-5
Right Headlamp	8W-15-4, 5
Right Headlamp Leveling Motor	8W-15-5
Right License Lamp	8W-15-10
Right Repeater Lamp	8W-15-5
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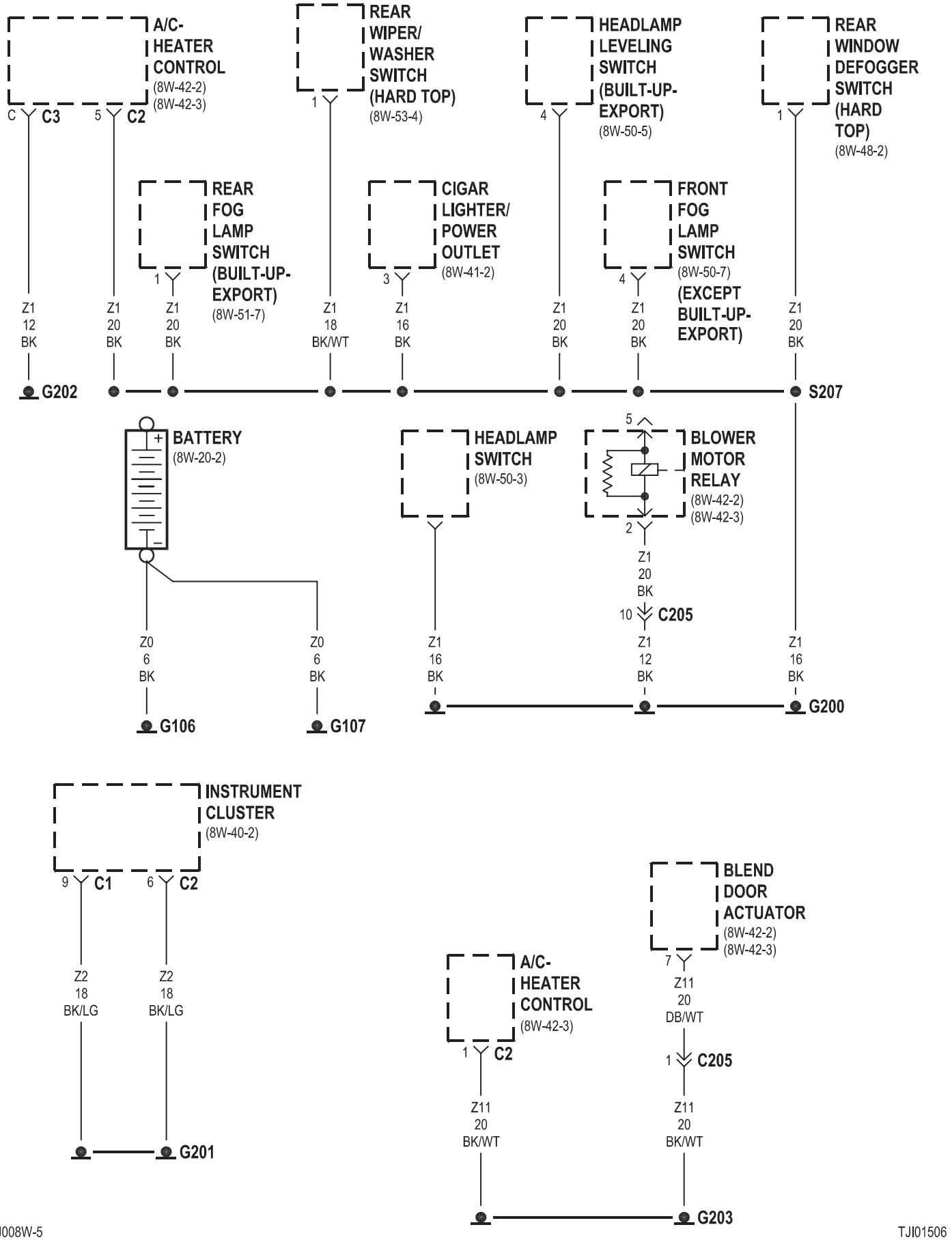

VEHICLE SPEED CONTROL SERVO
(8W-30-20)
4
ABS PUMP MOTOR
(8W-35-2)
2
ABS PUMP MOTOR RELAY (IN PDC)
(8W-35-2)
D3
ABS SYSTEM RELAY (IN PDC)
(8W-35-2)
B9
DAYTIME RUNNING LAMP MODULE
(8W-50-8)
8
UNDERHOOD LAMP
(8W-44-3)
1
Z1 18 BK
Z1 12 BK
Z1 14 BK
Z1 14 BK
Z1 18 BK
Z1 18 BK
OTHER
BASE
S106
Z1 12 BK
Z1 18 BK
G100
CONTROLLER ANTI-LOCK BRAKE
(8W-35-3)
13 C2
14 C2
Z22 16 BK/PK
Z22 16 BK/PK
S109
Z22 14 BK/PK
G101


LEFT REPEATER LAMP (BUILT-UP-EXPORT)
(8W-52-3)
2
Z1 18 BK
LEFT FOG LAMP (FRONT FOG LAMPS)
(8W-50-7)
1
Z1 18 BK
LEFT FRONT PARK/ TURN SIGNAL LAMP
(8W-50-4)
(8W-52-3)
3
FRONT FOG LAMPS
LEFT FRONT TURN SIGNAL LAMP
(8W-52-3)
3
BUILT-UP-EXPORT
Z1 18 BK
S122
LEFT FRONT PARK/ TURN SIGNAL LAMP
(8W-50-4)
(8W-52-3)
(EXCEPT BUILT-UP-EXPORT EXCEPT FRONT FOG LAMPS)
3
LOW NOTE HORN
(8W-41-3)
(EXCEPT BUILT-UP-EXPORT)
2
LEFT HEADLAMP
(8W-50-2)
3
HIGH NOTE HORN
(8W-41-3)
2
LEFT HEADLAMP LEVELING MOTOR (BUILT-UP-EXPORT)
(8W-50-5)
3
LEFT CITY LAMP (BUILT-UP-EXPORT)
(8W-50-4)
2
WINDSHIELD WASHER PUMP
(8W-53-3)
B
Z1 18 BK
Z1 18 BK
Z1 18 BK
Z1 18 BK
Z1 18 BK
Z1 20 BK
Z1 20 BK
Z1 18 BK
S117
Z1 16 BK
G102

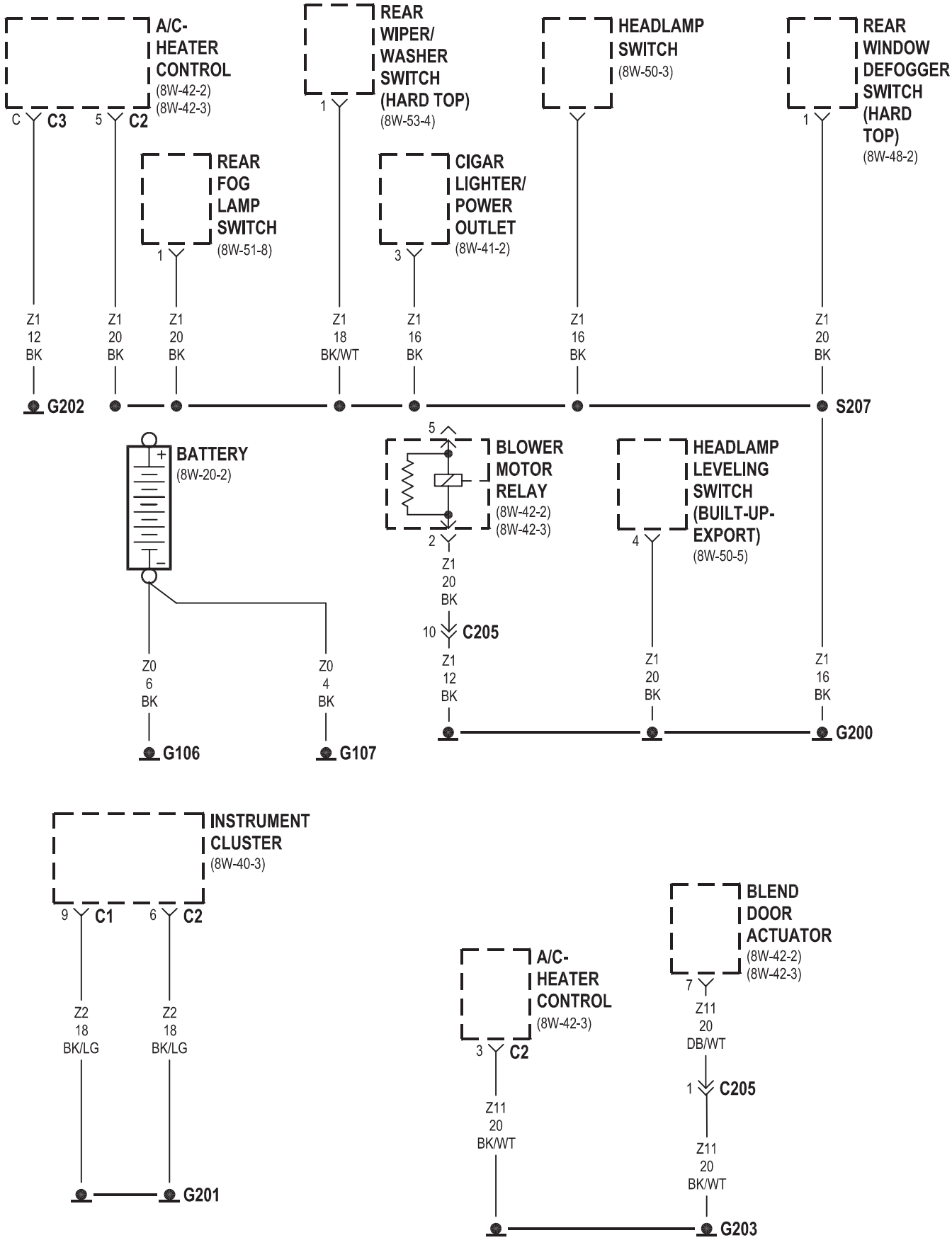

RIGHT FOG LAMP
(8W-50-7)
1
Z1
18
BK
RIGHT FRONT PARK/ TURN SIGNAL LAMP (FRONT FOG LAMPS)
(8W-50-4)
(8W-52-3)
3
Z1
18
BK
GENERATOR
(8W-20-2)
Z0
6
BK
G104
S125
RIGHT FRONT PARK/ TURN SIGNAL LAMP (EXCEPT FRONT FOG LAMPS)
(8W-50-4)
(8W-52-3)
3
Z1
18
BK
RIGHT HEADLAMP
(8W-50-2)
3
Z1
18
BK
Z1
18
BK
G103

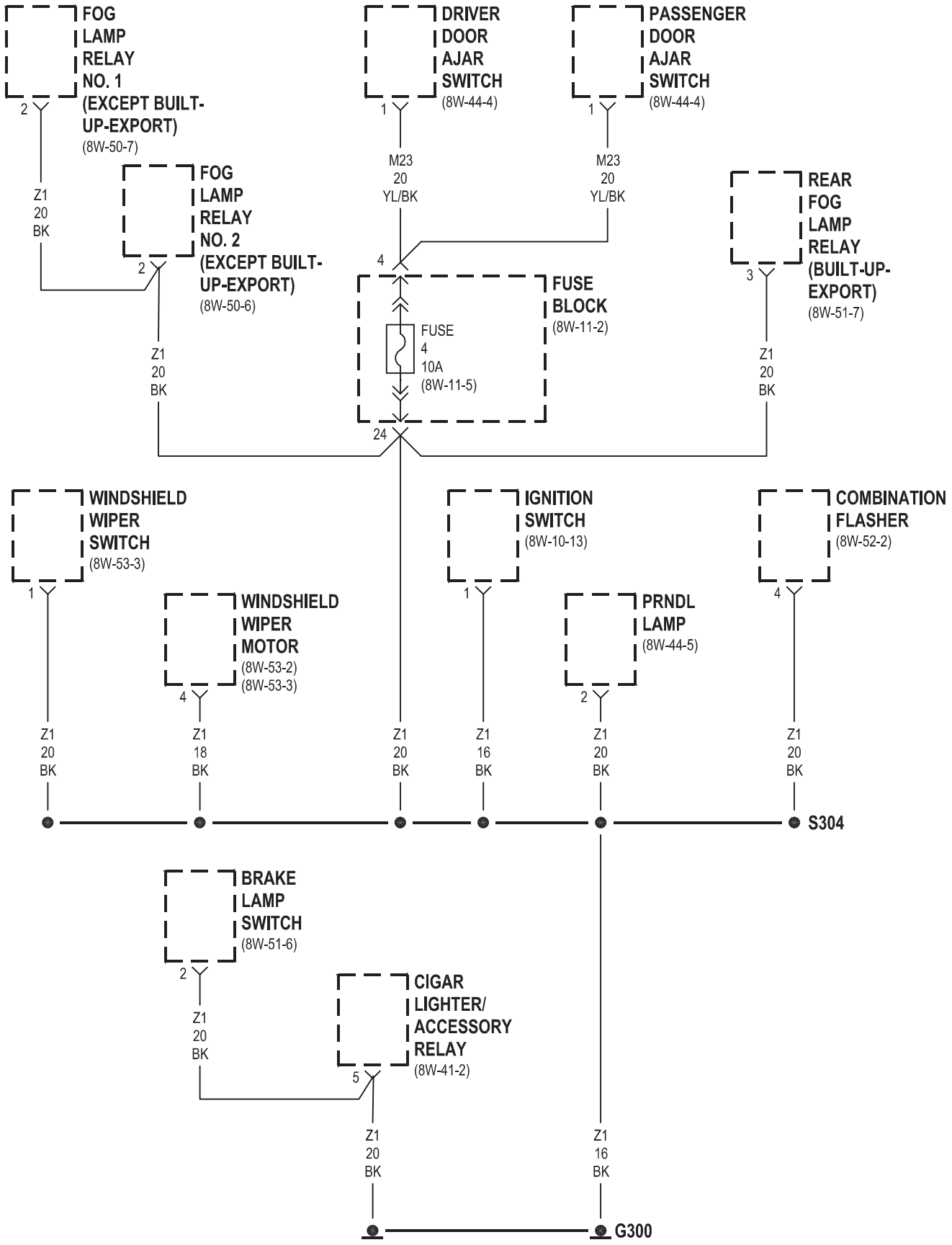
BUILT-UP-EXPORT



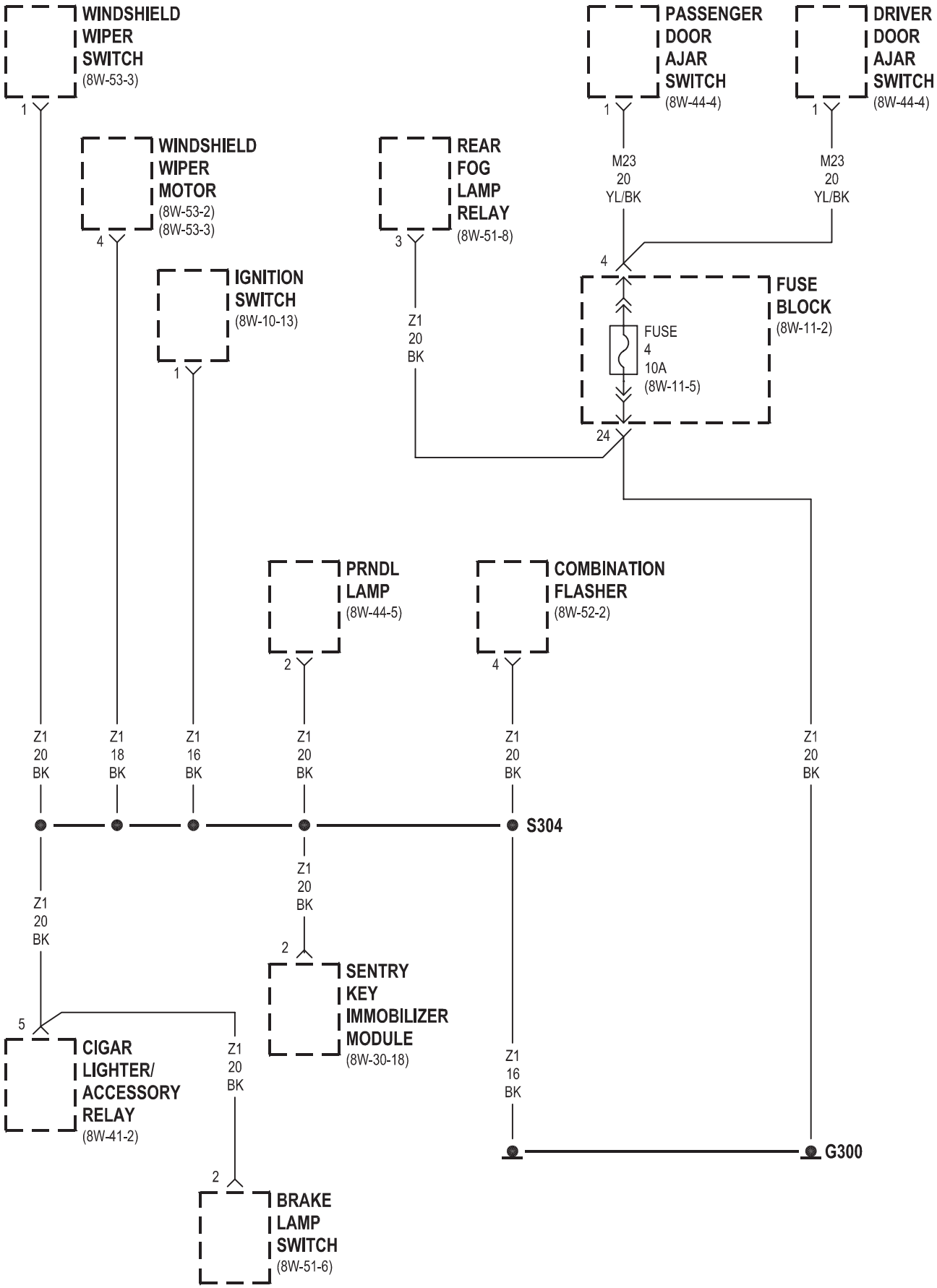

A/C-
HEATER
CONTROL
(8W-42-2)
(8W-42-3)
C
C3
5
C2
REAR
WIPER/
WASHER
SWITCH
(HARD TOP)
(8W-53-4)
1
HEADLAMP
LEVELING
SWITCH
(BUILT-UP-
EXPORT)
(8W-50-5)
4
REAR
WINDOW
DEFOGGER
SWITCH
(HARD
TOP)
(8W-48-2)
1
REAR
FOG
LAMP
SWITCH
(BUILT-UP-
EXPORT)
(8W-51-7)
1
CIGAR
LIGHTER/
POWER
OUTLET
(8W-41-2)
3
FRONT
FOG
LAMP
SWITCH
(8W-50-7)
(EXCEPT
BUILT-UP-
EXPORT)
4
Z1
12
BK
Z1
20
BK
Z1
20
BK
Z1
18
BK/WT
Z1
16
BK
Z1
20
BK
Z1
20
BK
Z1
20
BK
G202
S207
BATTERY
(8W-20-2)
HEADLAMP
SWITCH
(8W-50-3)
BLOWER
MOTOR
RELAY
(8W-42-2)
(8W-42-3)
5
2
Z1
20
BK
10
C205
Z0
6
BK
Z0
6
BK
Z1
16
BK
Z1
12
BK
Z1
16
BK
G106
G107
G200
INSTRUMENT
CLUSTER
(8W-40-2)
9
C1
6
C2
Z2
18
BK/LG
Z2
18
BK/LG
G201
BLEND
DOOR
ACTUATOR
(8W-42-2)
(8W-42-3)
7
Z11
20
DB/WT
1
C205
A/C-
HEATER
CONTROL
(8W-42-3)
1
C2
Z11
20
BK/WT
Z11
20
BK/WT
G203

RHD


A/C-
HEATER
CONTROL
(8W-42-2)
(8W-42-3)
C
C3
5
C2
REAR
WIPER/
WASHER
SWITCH
(HARD TOP)
(8W-53-4)
1
HEADLAMP
SWITCH
(8W-50-3)
REAR
WINDOW
DEFOGGER
SWITCH
(HARD
TOP)
(8W-48-2)
1
REAR
FOG
LAMP
SWITCH
(8W-51-8)
1
CIGAR
LIGHTER/
POWER
OUTLET
(8W-41-2)
3
Z1
12
BK
Z1
20
BK
Z1
20
BK
Z1
18
BK/WT
Z1
16
BK
Z1
16
BK
Z1
20
BK
G202
S207
BATTERY
(8W-20-2)
5
BLOWER
MOTOR
RELAY
(8W-42-2)
(8W-42-3)
2
HEADLAMP
LEVELING
SWITCH
(BUILT-UP-
EXPORT)
(8W-50-5)
4
Z1
20
BK
10
C205
Z1
12
BK
Z1
20
BK
Z1
16
BK
Z0
6
BK
Z0
4
BK
G106
G107
G200
INSTRUMENT
CLUSTER
(8W-40-3)
9
C1
6
C2
Z2
18
BK/LG
Z2
18
BK/LG
G201
A/C-
HEATER
CONTROL
(8W-42-3)
3
C2
Z11
20
BK/WT
BLEND
DOOR
ACTUATOR
(8W-42-2)
(8W-42-3)
7
Z11
20
DB/WT
1
C205
Z11
20
BK/WT
G203

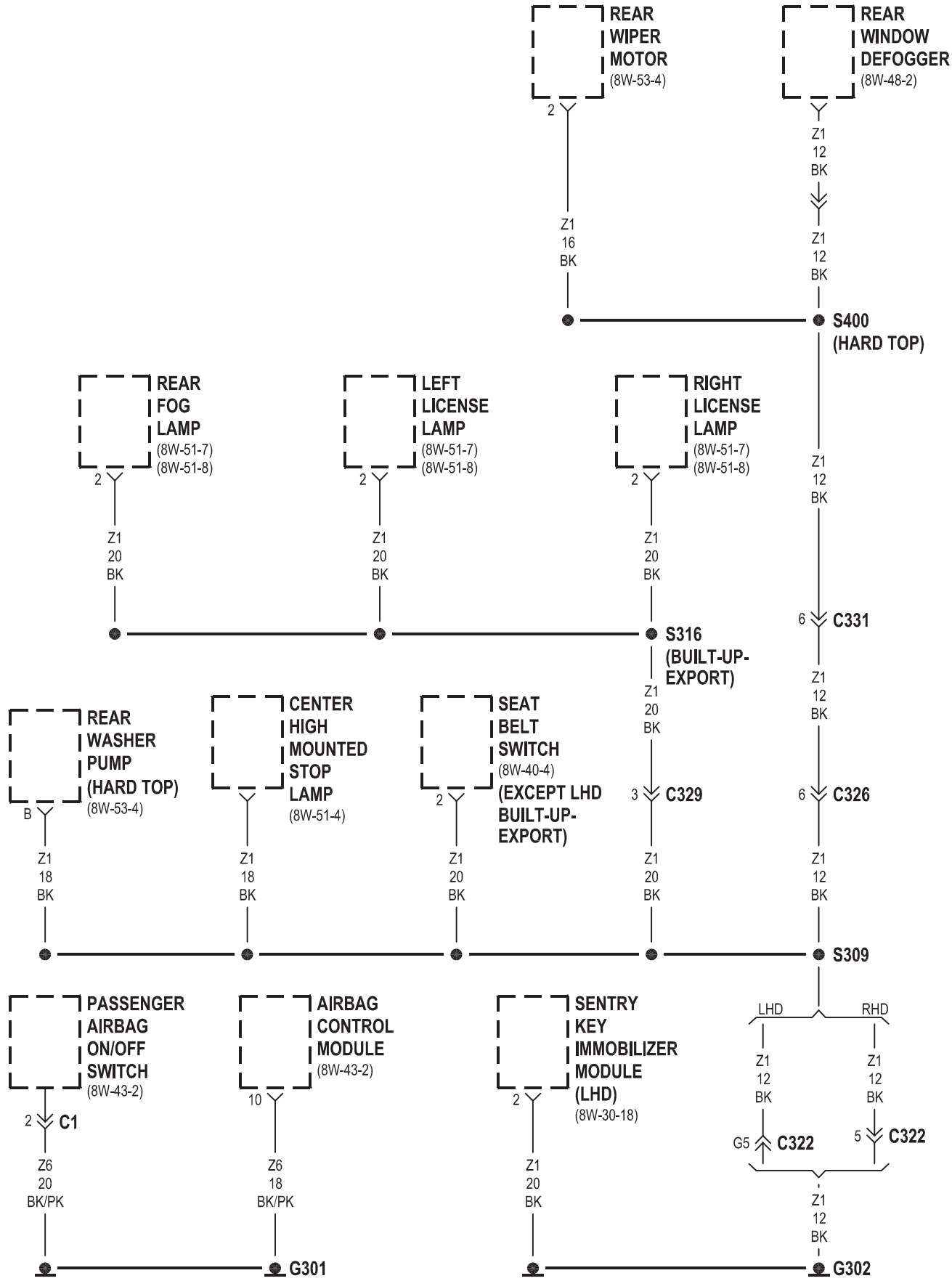

FOG LAMP RELAY NO. 1 (EXCEPT BUILT-UP-EXPORT) (8W-50-7)
2
Z1 20 BK
FOG LAMP RELAY NO. 2 (EXCEPT BUILT-UP-EXPORT) (8W-50-6)
2
Z1 20 BK
DRIVER DOOR AJAR SWITCH (8W-44-4)
1
M23 20 YL/BK
PASSENGER DOOR AJAR SWITCH (8W-44-4)
1
M23 20 YL/BK
4
FUSE BLOCK (8W-11-2)
FUSE 4 10A (8W-11-5)
24
REAR FOG LAMP RELAY (BUILT-UP-EXPORT) (8W-51-7)
3
Z1 20 BK
WINDSHIELD WIPER SWITCH (8W-53-3)
1
Z1 20 BK
WINDSHIELD WIPER MOTOR (8W-53-2) (8W-53-3)
4
Z1 18 BK
Z1 20 BK
IGNITION SWITCH (8W-10-13)
1
Z1 16 BK
PRNDL LAMP (8W-44-5)
2
Z1 20 BK
COMBINATION FLASHER (8W-52-2)
4
Z1 20 BK
S304
BRAKE LAMP SWITCH (8W-51-6)
2
Z1 20 BK
CIGAR LIGHTER/ ACCESSORY RELAY (8W-41-2)
5
Z1 20 BK
Z1 16 BK
G300

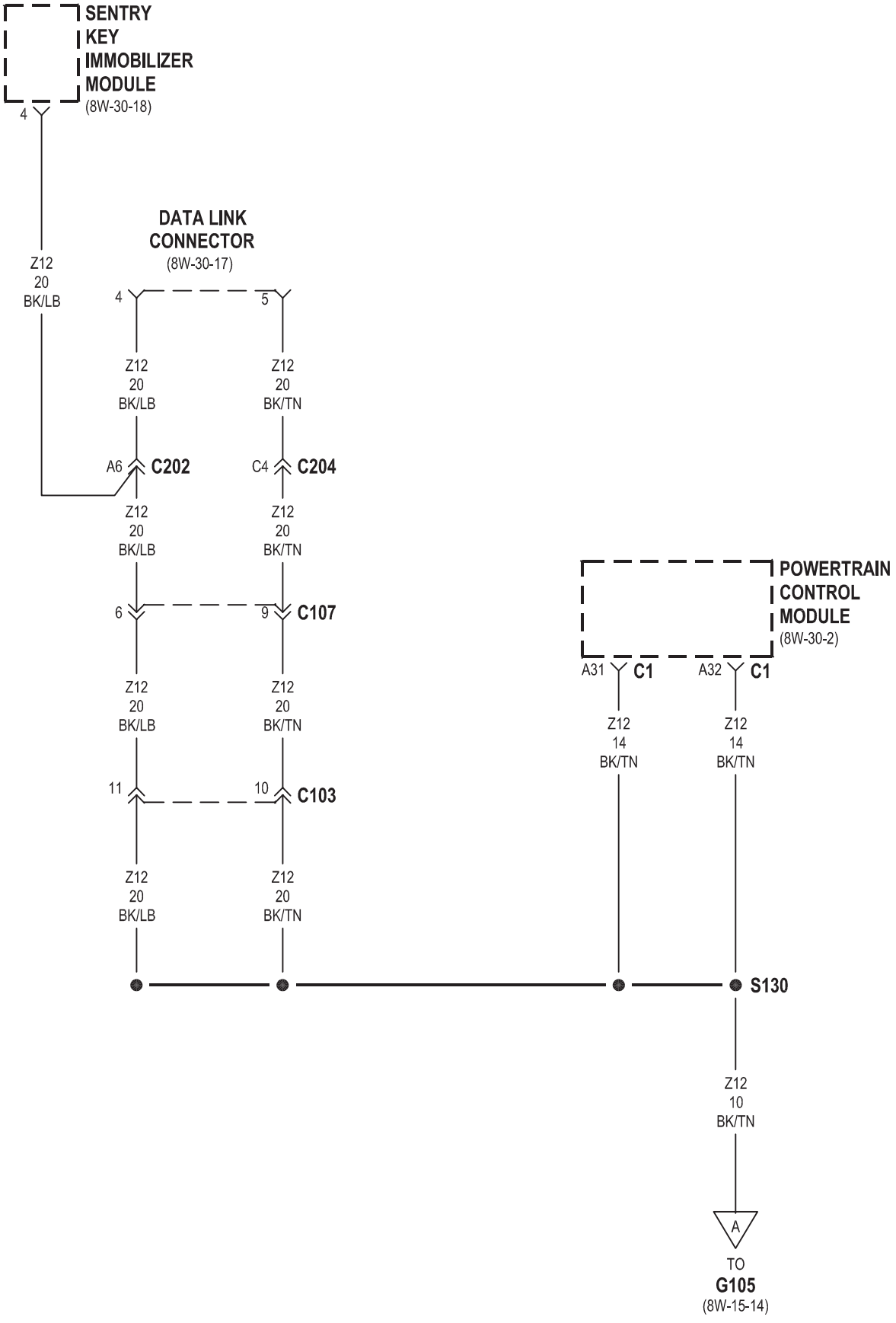
RHD



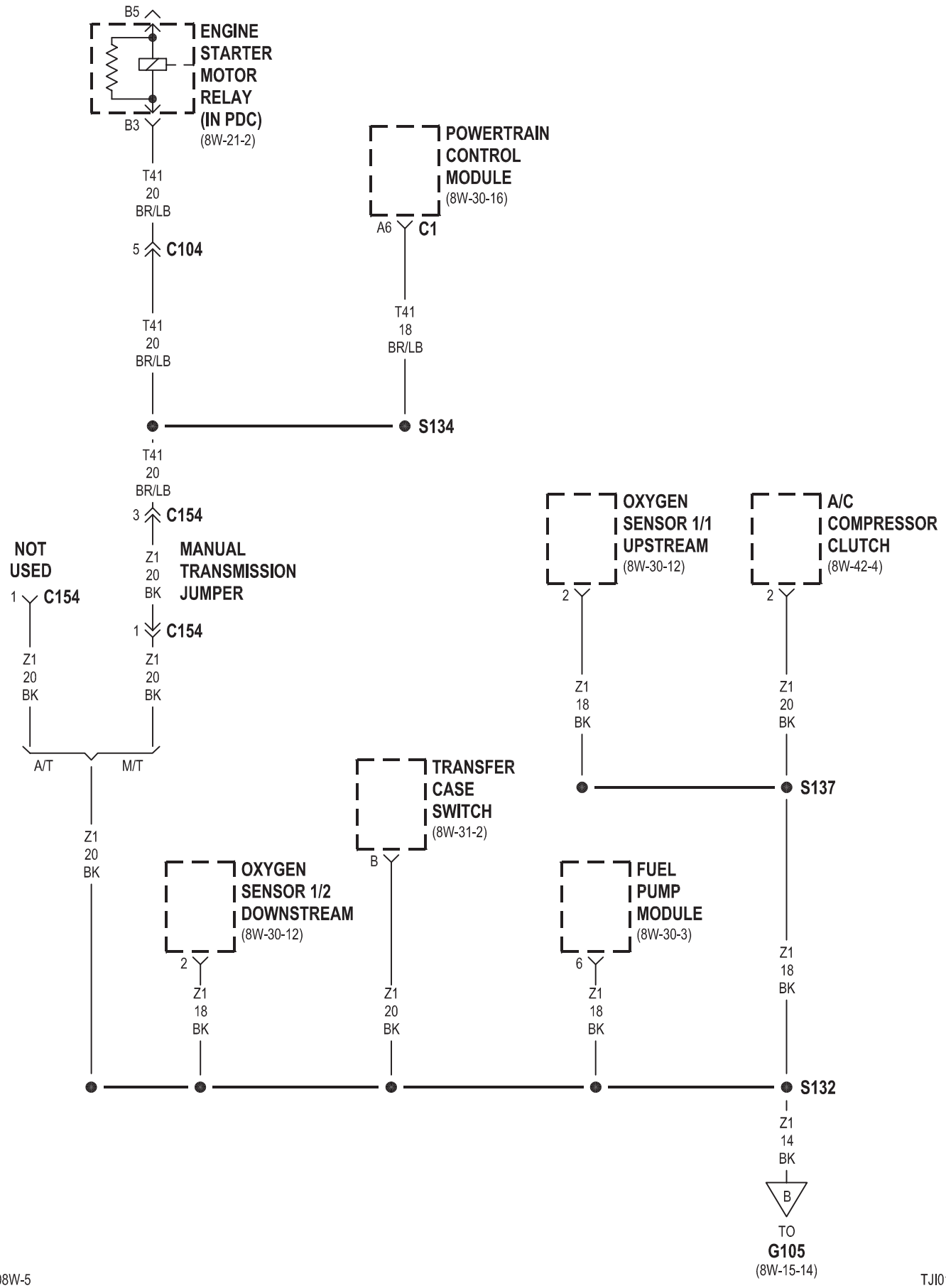
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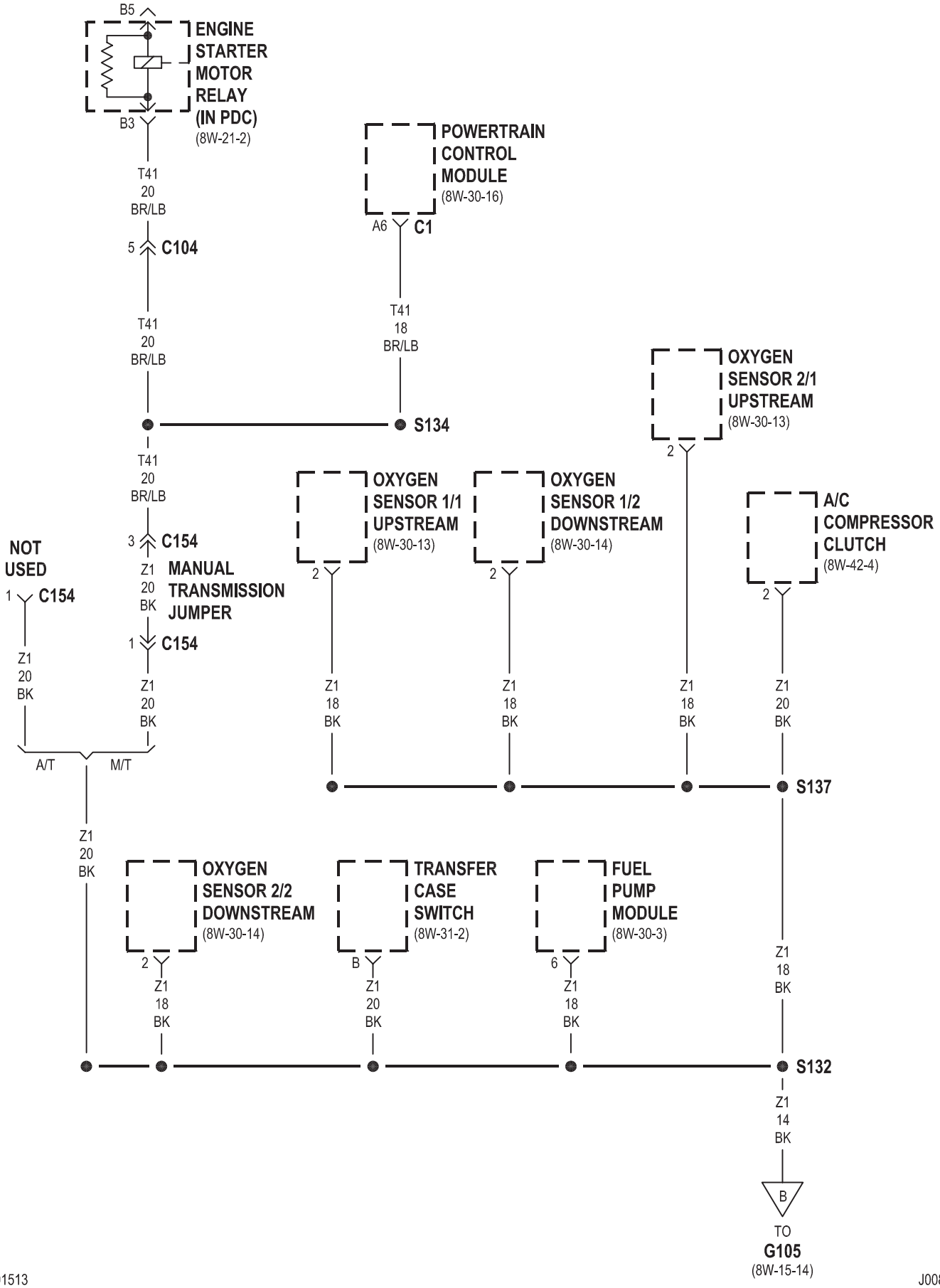
J008W-5

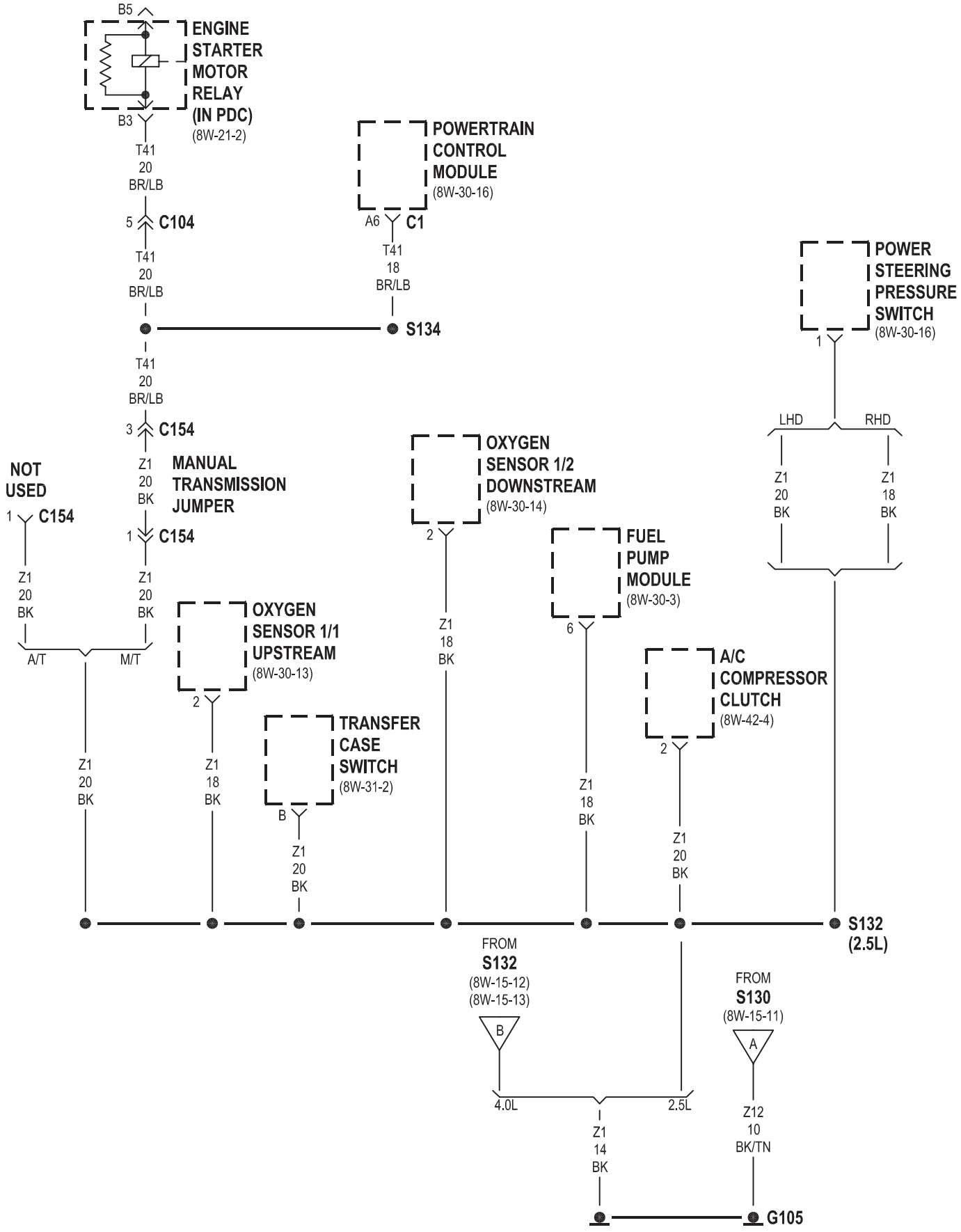

REAR WIPER MOTOR (8W-53-4)
2
Z1 16 BK
REAR WINDOW DEFOGGER (8W-48-2)
Z1 12 BK
Z1 12 BK
S400 (HARD TOP)
REAR FOG LAMP (8W-51-7) (8W-51-8)
2
Z1 20 BK
LEFT LICENSE LAMP (8W-51-7) (8W-51-8)
2
Z1 20 BK
RIGHT LICENSE LAMP (8W-51-7) (8W-51-8)
2
Z1 20 BK
Z1 12 BK
6 C331
S316 (BUILT-UP-EXPORT)
Z1 20 BK
3 C329
Z1 12 BK
6 C326
REAR WASHER PUMP (HARD TOP) (8W-53-4)
B
Z1 18 BK
CENTER HIGH MOUNTED STOP LAMP (8W-51-4)
Z1 18 BK
SEAT BELT SWITCH (8W-40-4) (EXCEPT LHD BUILT-UP-EXPORT)
2
Z1 20 BK
Z1 20 BK
Z1 12 BK
S309
PASSENGER AIRBAG ON/OFF SWITCH (8W-43-2)
2 C1
Z6 20 BK/PK
AIRBAG CONTROL MODULE (8W-43-2)
10
Z6 18 BK/PK
SENTRY KEY IMMOBILIZER MODULE (LHD) (8W-30-18)
2
Z1 20 BK
LHD
RHD
Z1 12 BK
G5 C322
Z1 12 BK
5 C322
Z1 12 BK
G301
G302


SENTRY
KEY
IMMOBILIZER
MODULE
(8W-30-18)
4
Z12
20
BK/LB
DATA LINK
CONNECTOR
(8W-30-17)
4
5
Z12
20
BK/LB
Z12
20
BK/TN
A6
C202
C4
C204
Z12
20
BK/LB
Z12
20
BK/TN
6
9
C107
Z12
20
BK/LB
Z12
20
BK/TN
11
10
C103
Z12
20
BK/LB
Z12
20
BK/TN
POWERTRAIN
CONTROL
MODULE
(8W-30-2)
A31
C1
A32
C1
Z12
14
BK/TN
Z12
14
BK/TN
S130
Z12
10
BK/TN
A
TO
G105
(8W-15-14)

4.0L EXCEPT CALIFORNIA/EUROPEAN III

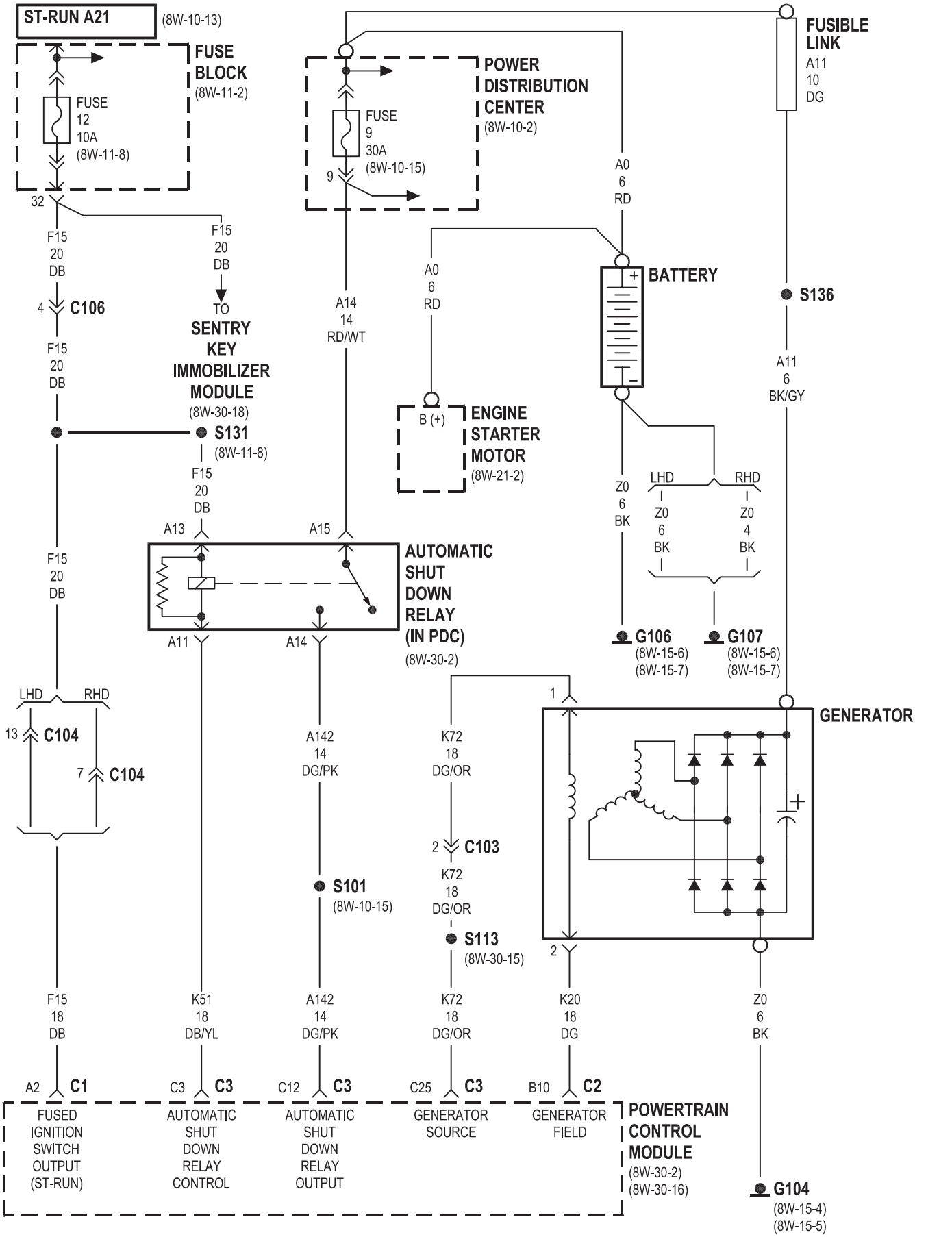


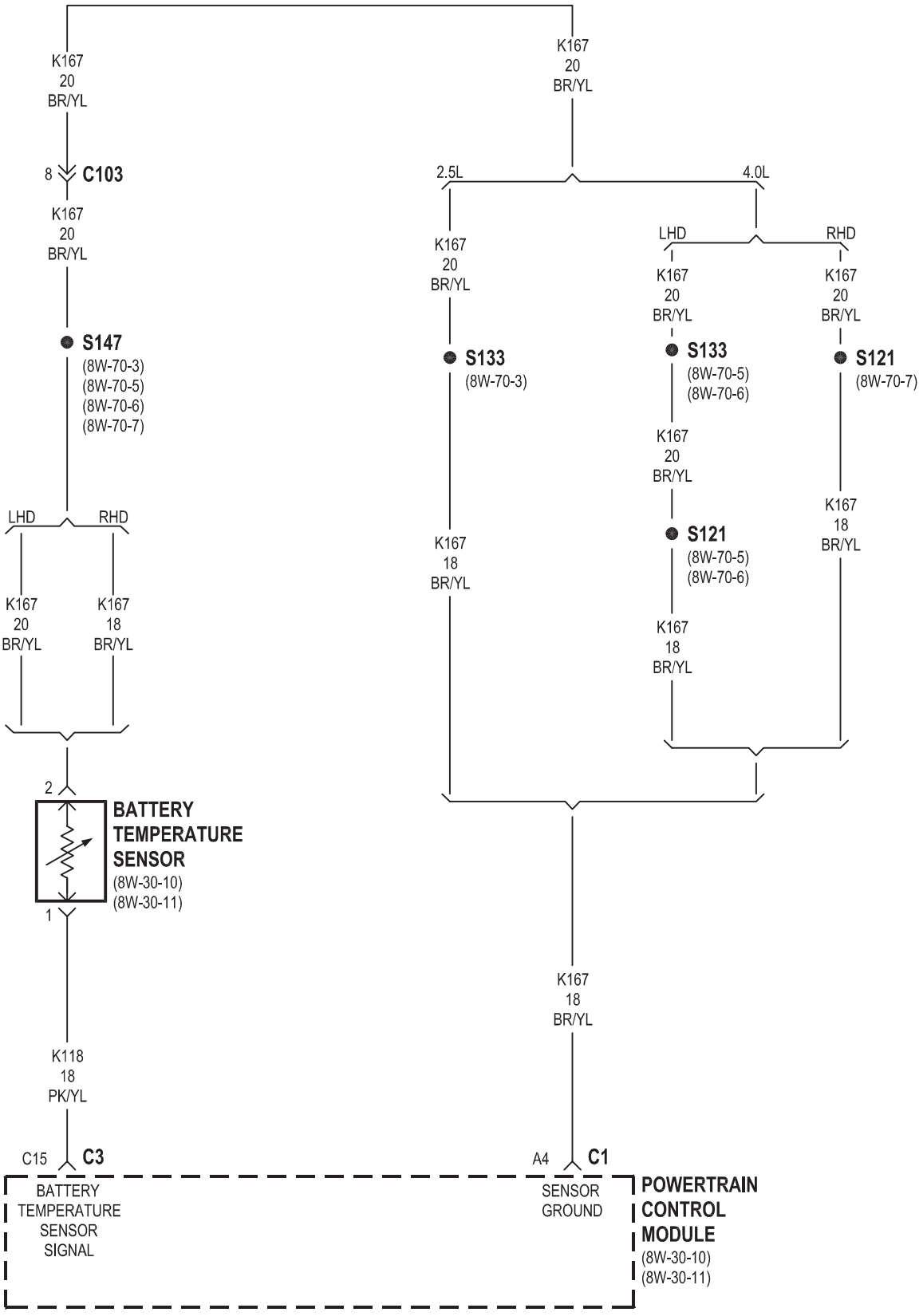

B5
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-2)
B3
T41
20
BR/LB
5
C104
T41
20
BR/LB
POWERTRAIN CONTROL MODULE
(8W-30-16)
A6
C1
T41
18
BR/LB
S134
T41
20
BR/LB
OXYGEN SENSOR 2/1 UPSTREAM
(8W-30-13)
2
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-13)
2
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-14)
2
A/C COMPRESSOR CLUTCH
(8W-42-4)
2
NOT USED
1
C154
Z1
20
BK
3
C154
Z1
20
BK
MANUAL TRANSMISSION JUMPER
1
C154
Z1
20
BK
A/T
M/T
Z1
18
BK
Z1
18
BK
Z1
18
BK
Z1
20
BK
S137
Z1
20
BK
OXYGEN SENSOR 2/2 DOWNSTREAM
(8W-30-14)
2
Z1
18
BK
TRANSFER CASE SWITCH
(8W-31-2)
B
Z1
20
BK
FUEL PUMP MODULE
(8W-30-3)
6
Z1
18
BK
Z1
18
BK
S132
Z1
14
BK
B
TO
G105
(8W-15-14)


B5
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-2)
B3
T41
20
BR/LB
5
C104
T41
20
BR/LB
POWERTRAIN CONTROL MODULE
(8W-30-16)
A6
C1
T41
18
BR/LB
S134
T41
20
BR/LB
3
C154
Z1
20
BK
MANUAL TRANSMISSION JUMPER
NOT USED
1
C154
Z1
20
BK
A/T
1
C154
Z1
20
BK
M/T
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-13)
2
Z1
18
BK
TRANSFER CASE SWITCH
(8W-31-2)
B
Z1
20
BK
Z1
20
BK
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-14)
2
Z1
18
BK
FUEL PUMP MODULE
(8W-30-3)
6
Z1
18
BK
A/C COMPRESSOR CLUTCH
(8W-42-4)
2
Z1
20
BK
POWER STEERING PRESSURE SWITCH
(8W-30-16)
1
LHD
RHD
Z1
20
BK
Z1
18
BK
S132
(2.5L)
FROM
S132
(8W-15-12)
(8W-15-13)
B
4.0L
2.5L
Z1
14
BK
FROM
S130
(8W-15-11)
A
Z12
10
BK/TN
G105

8W-20 CHARGING SYSTEM

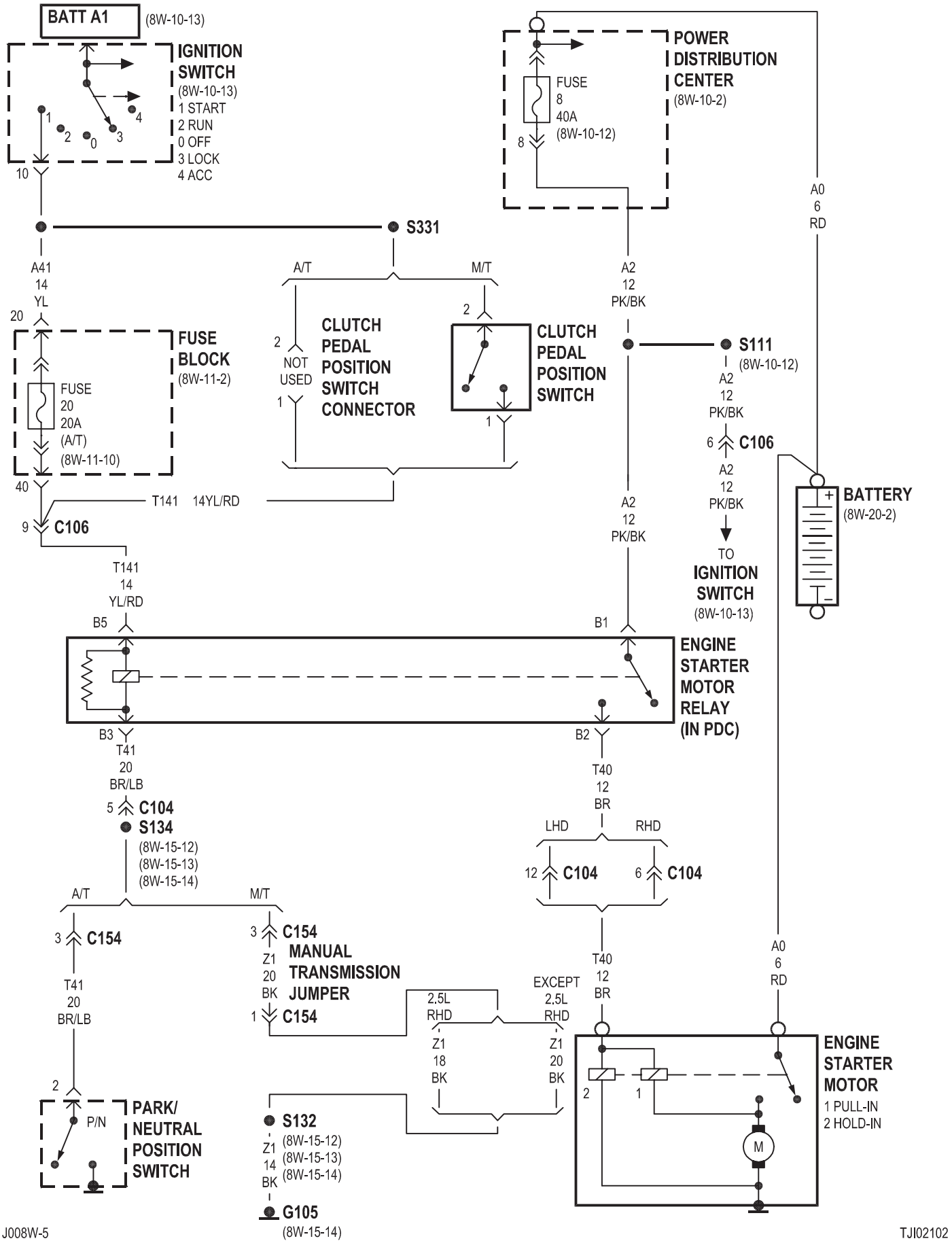
Component	Page
Automatic Shut Down Relay	8W-20-2
Battery	8W-20-2, 3
Battery Temperature Sensor	8W-20-3
Engine Starter Motor	8W-20-2
Fuse 9 (PDC)	8W-20-2
Fuse 12 (FB)	8W-20-2
Fuse Block	8W-20-2
Fusible Link	8W-20-2
G104	8W-20-2
G106	8W-20-2
G107	8W-20-2
Generator	8W-20-2
Power Distribution Center	8W-20-2
Powertrain Control Module	8W-20-2, 3
Sentry Key Immobilizer Module	8W-20-2


ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 12 10A
(8W-11-8)
32
F15 20 DB
4 C106
F15 20 DB
F15 20 DB
TO SENTRY KEY IMMOBILIZER MODULE
(8W-30-18)
S131
(8W-11-8)
F15 20 DB
F15 20 DB
LHD RHD
13 C104
7 C104
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 9 30A
(8W-10-15)
9
A14 14 RD/WT
A13
A15
AUTOMATIC SHUT DOWN RELAY (IN PDC)
(8W-30-2)
A11
A14
A142 14 DG/PK
S101
(8W-10-15)
A0 6 RD
A0 6 RD
B (+)
ENGINE STARTER MOTOR
(8W-21-2)
FUSIBLE LINK
A11 10 DG
BATTERY
S136
A11 6 BK/GY
Z0 6 BK
LHD
RHD
Z0 6 BK
Z0 4 BK
G106
(8W-15-6)
(8W-15-7)
G107
(8W-15-6)
(8W-15-7)
1
GENERATOR
2
K72 18 DG/OR
2 C103
K72 18 DG/OR
S113
(8W-30-15)
F15 18 DB
K51 18 DB/YL
A142 14 DG/PK
K72 18 DG/OR
K20 18 DG
Z0 6 BK
A2 C1
C3 C3
C12 C3
C25 C3
B10 C2
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
AUTOMATIC SHUT DOWN RELAY CONTROL
AUTOMATIC SHUT DOWN RELAY OUTPUT
GENERATOR SOURCE
GENERATOR FIELD
POWERTRAIN CONTROL MODULE
(8W-30-2)
(8W-30-16)
G104
(8W-15-4)
(8W-15-5)


K167
20
BR/YL
8
C103
K167
20
BR/YL
S147
(8W-70-3)
(8W-70-5)
(8W-70-6)
(8W-70-7)
LHD
RHD
K167
20
BR/YL
K167
18
BR/YL
2
BATTERY
TEMPERATURE
SENSOR
(8W-30-10)
(8W-30-11)
1
K118
18
PK/YL
C15
C3
BATTERY
TEMPERATURE
SENSOR
SIGNAL
K167
20
BR/YL
2.5L
4.0L
K167
20
BR/YL
S133
(8W-70-3)
K167
18
BR/YL
LHD
RHD
K167
20
BR/YL
K167
20
BR/YL
S133
(8W-70-5)
(8W-70-6)
K167
20
BR/YL
S121
(8W-70-5)
(8W-70-6)
K167
18
BR/YL
S121
(8W-70-7)
K167
18
BR/YL
K167
18
BR/YL
A4
C1
SENSOR
GROUND
POWERTRAIN
CONTROL
MODULE
(8W-30-10)
(8W-30-11)

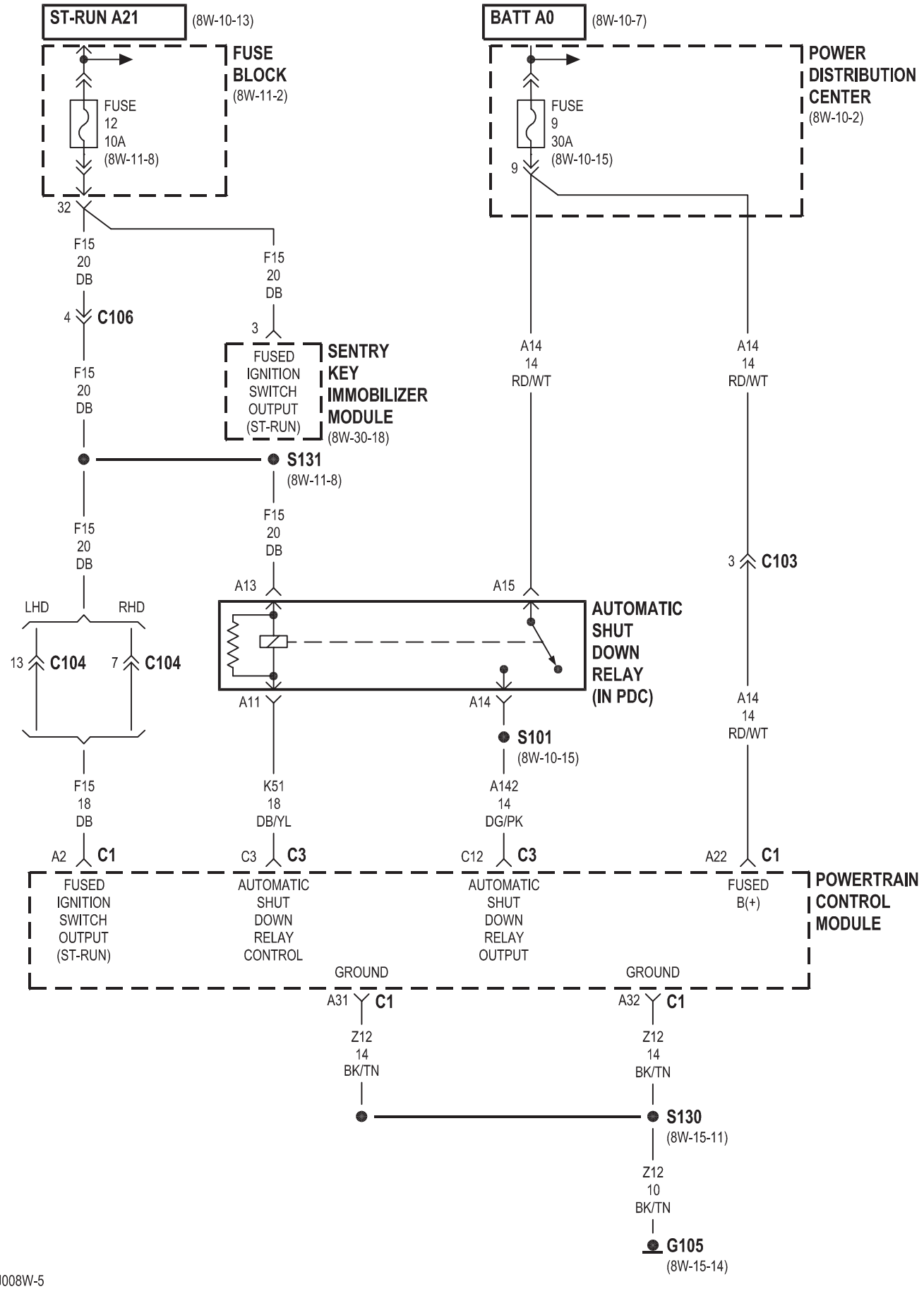
8W-21 STARTING SYSTEM

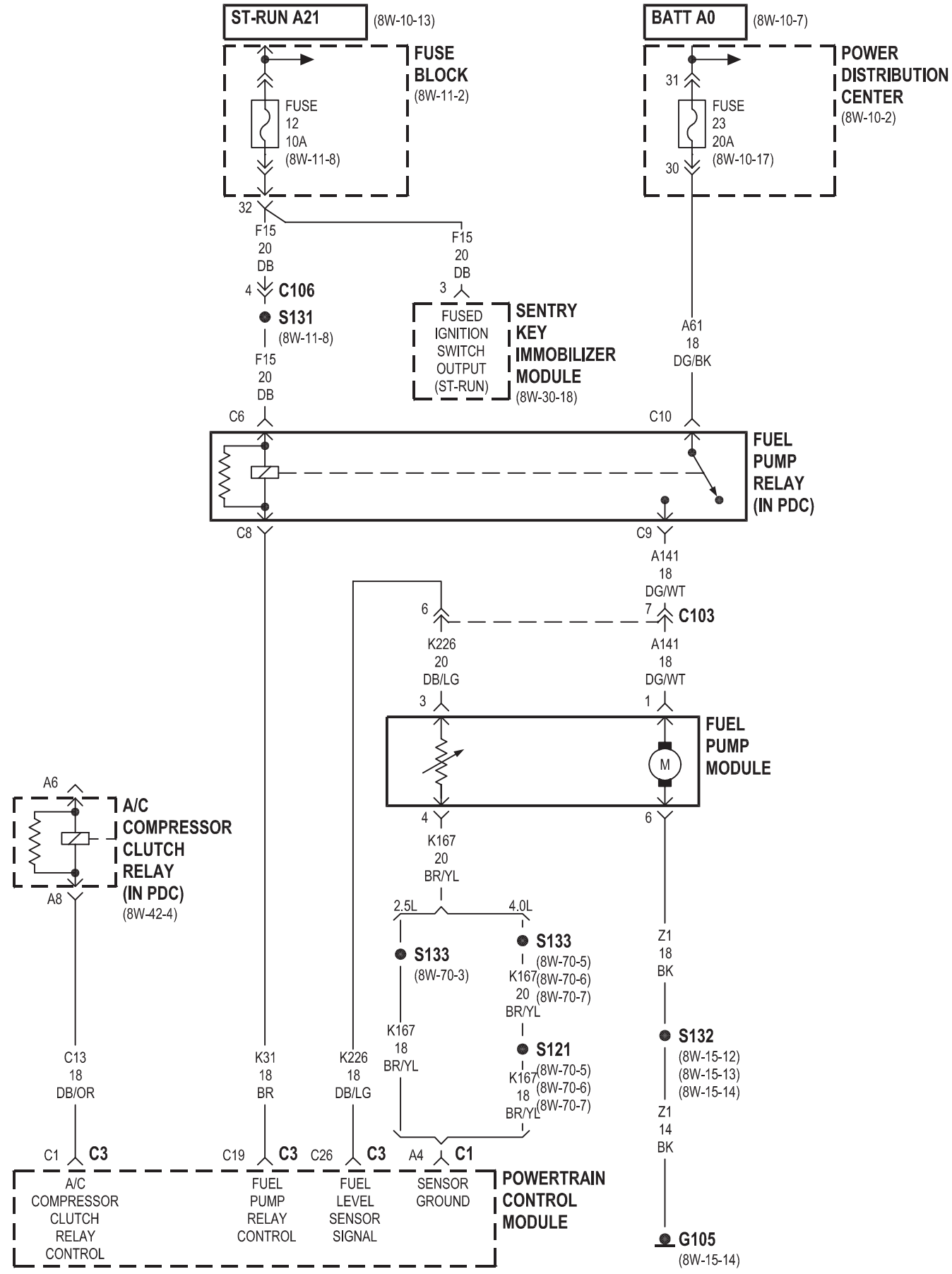
Component	Page
Battery	8W-21-2
Clutch Pedal Position Switch	8W-21-2
Clutch Pedal Position Switch Connector	8W-21-2
Engine Starter Motor	8W-21-2
Engine Starter Motor Relay	8W-21-2
Fuse 8 (PDC)	8W-21-2
Fuse 20 (FB)	8W-21-2
Fuse Block	8W-21-2
G105	8W-21-2
Ignition Switch	8W-21-2
Manual Transmission Jumper	8W-21-2
Park/Neutral Position Switch	8W-21-2
Power Distribution Center	8W-21-2


BATT A1
(8W-10-13)
IGNITION SWITCH
(8W-10-13)
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
8
40A
(8W-10-12)
A0
6
RD
S331
A41
14
YL
20
FUSE BLOCK
(8W-11-2)
FUSE
20
20A
(A/T)
(8W-11-10)
40
T141 14YL/RD
9 C106
A/T
M/T
2
NOT USED
1
CLUTCH PEDAL POSITION SWITCH CONNECTOR
CLUTCH PEDAL POSITION SWITCH
A2
12
PK/BK
S111
(8W-10-12)
6 C106
TO IGNITION SWITCH
(8W-10-13)
BATTERY
(8W-20-2)
T141
14
YL/RD
B5
B1
ENGINE STARTER MOTOR RELAY (IN PDC)
B3
T41
20
BR/LB
B2
T40
12
BR
5 C104
S134
(8W-15-12)
(8W-15-13)
(8W-15-14)
LHD
RHD
12 C104
6 C104
3 C154
3 C154
Z1
20
BK
MANUAL TRANSMISSION JUMPER
1 C154
2.5L RHD
EXCEPT 2.5L RHD
Z1
18
BK
Z1
20
BK
2
P/N
PARK/ NEUTRAL POSITION SWITCH
S132
Z1
14
BK
(8W-15-12)
(8W-15-13)
(8W-15-14)
G105
(8W-15-14)
ENGINE STARTER MOTOR
1 PULL-IN
2 HOLD-IN
M

8W-30 FUEL/IGNITION SYSTEM

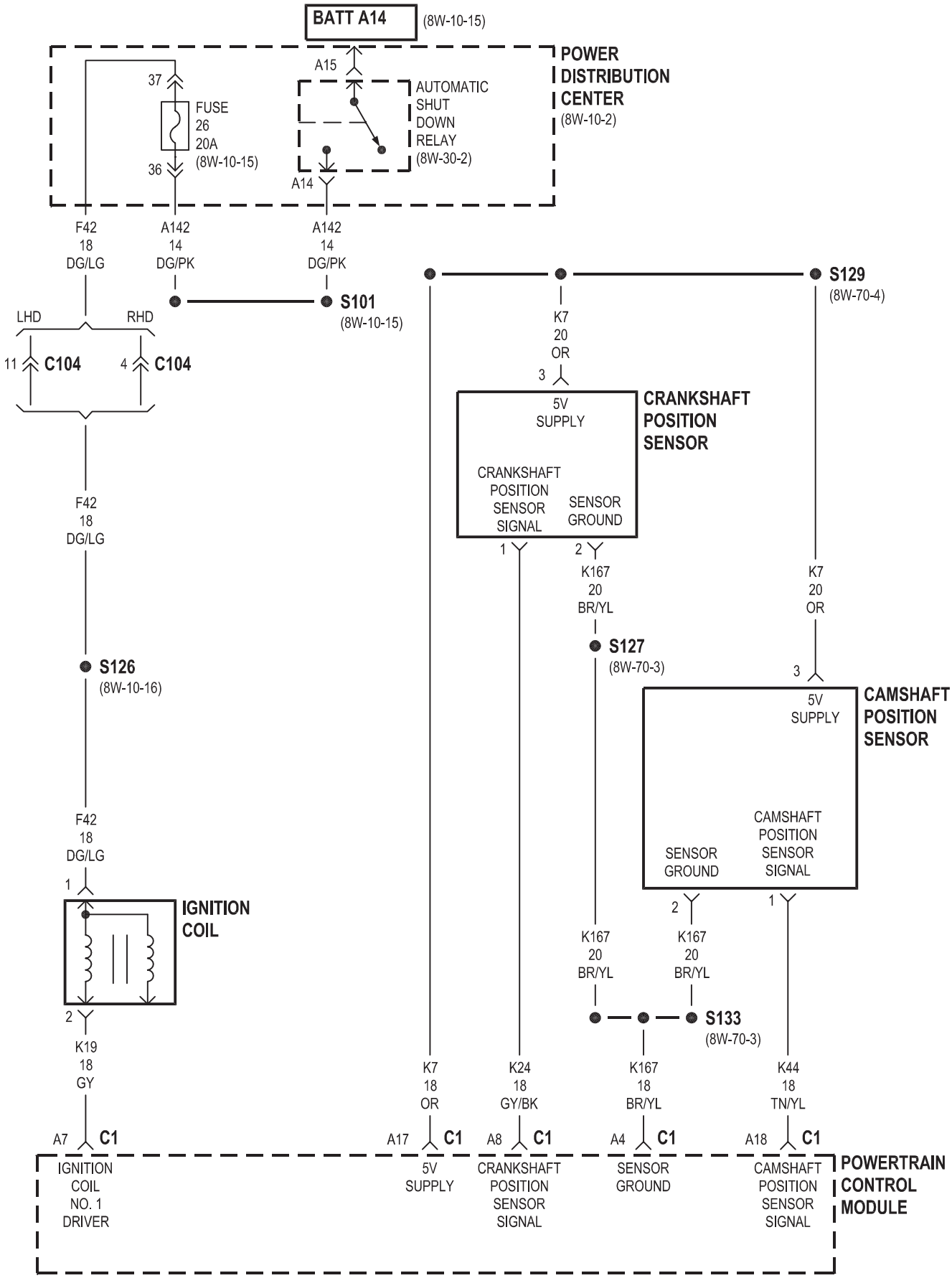
Component	Page
A/C Compressor Clutch Relay	8W-30-3
A/C High Pressure Switch	8W-30-16
A/C Low Pressure Switch	8W-30-16
A/C- Heater Control	8W-30-16
Airbag Control Module	8W-30-18
Automatic Shut Down Relay	8W-30-2, 4, 5, 6, 7, 12
Battery	8W-30-11
Battery Temperature Sensor	8W-30-10, 11, 19
Brake Lamp Switch	8W-30-16, 20
Brake Shift Interlock Solenoid	8W-30-16, 20
Camshaft Position Sensor	8W-30-4, 5
Cigar Lighter/Accessory Relay	8W-30-16, 20
Clockspring	8W-30-19
Controller Anti-Lock Brake	8W-30-17
Crankshaft Position Sensor	8W-30-4, 5
Data Link Connector	8W-30-17, 18
Daytime Running Lamp Module	8W-30-10, 11
Dome Lamp	8W-30-17
Duty Cycle Evap/Purge Solenoid	8W-30-15
Engine Coolant Temperature Sensor	8W-30-8, 9
Engine Oil Pressure Sensor	8W-30-8, 9, 10, 11
Fuel Injector No. 1	8W-30-6, 7
Fuel Injector No. 2	8W-30-6, 7
Fuel Injector No. 3	8W-30-6, 7
Fuel Injector No. 4	8W-30-6, 7
Fuel Injector No. 5	8W-30-7
Fuel Injector No. 6	8W-30-7
Fuel Pump Module	8W-30-3
Fuel Pump Relay	8W-30-3
Fuse 1 (FB)	8W-30-18
Fuse 9 (PDC)	8W-30-2
Fuse 11 (FB)	8W-30-15
Fuse 12 (FB)	8W-30-2, 3, 13, 14, 18
Fuse 16 (PDC)	8W-30-12
Fuse 17 (PDC)	8W-30-13
Fuse 23 (PDC)	8W-30-3
Fuse 25 (PDC)	8W-30-17
Fuse 26 (PDC)	8W-30-4, 5, 6, 7
Fuse Block	8W-30-2, 3, 13, 14, 15, 18
G100	8W-30-20
G105	8W-30-2, 3, 12, 13, 14, 16, 17, 18
G300	8W-30-16, 18, 20
G302	8W-30-18
Generator	8W-30-15, 16
Headlamp Switch	8W-30-18
Horn Relay	8W-30-19
Horn Switch	8W-30-19
Idle Air Control Motor	8W-30-15
Ignition Coil	8W-30-4
Ignition Coil Pack	8W-30-5
Instrument Cluster	8W-30-18
Intake Air Temperature Sensor	8W-30-8, 9
Leak Detection Pump	8W-30-15
Left Speed Control Switch Pod	8W-30-19
Manifold Absolute Pressure Sensor	8W-30-8, 9
Manual Transmission Jumper	8W-30-16
Oxygen Sensor 1/1 Upstream	8W-30-12, 13
Oxygen Sensor 1/2 Downstream	8W-30-12, 14
Oxygen Sensor 2/1 Upstream	8W-30-13
Oxygen Sensor 2/2 Downstream	8W-30-14
Oxygen Sensor Downstream Heater Relay	8W-30-13, 14
Oxygen Sensor Upstream Heater Relay	8W-30-13, 14
Park/Neutral Position Switch	8W-30-16
Power Distribution Center	8W-30-2, 3, 4, 5, 6, 7, 12, 13, 17, 19
Power Steering Pressure Switch	8W-30-16
Powertrain Control Module	8W-30-2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
Powertrain Control Module	8W-30-20
Right Speed Control Switch Pod	8W-30-19
Sentry Key Immobilizer Module	8W-30-2, 3, 17, 18
Sound Bar Dome Lamp	8W-30-17
Throttle Position Sensor	8W-30-10, 11
Torque Converter Clutch Solenoid	8W-30-15
Underhood Lamp	8W-30-17
Vehicle Speed Control Servo	8W-30-20
Vehicle Speed Sensor	8W-30-10, 11
Vehicle Speed Sensor Signal	8W-30-11


ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 12 10A
(8W-11-8)
32
F15 20 DB
4 C106
F15 20 DB
F15 20 DB
3
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
SENTRY KEY IMMOBILIZER MODULE
(8W-30-18)
S131
(8W-11-8)
F15 20 DB
F15 20 DB
LHD
RHD
13 C104
7 C104
A13
A15
AUTOMATIC SHUT DOWN RELAY (IN PDC)
A11
A14
S101
(8W-10-15)
F15 18 DB
K51 18 DB/YL
A142 14 DG/PK
A2 C1
C3 C3
C12 C3
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
AUTOMATIC SHUT DOWN RELAY CONTROL
AUTOMATIC SHUT DOWN RELAY OUTPUT
BATT A0
(8W-10-7)
FUSE 9 30A
(8W-10-15)
9
POWER DISTRIBUTION CENTER
(8W-10-2)
A14 14 RD/WT
A14 14 RD/WT
3 C103
A14 14 RD/WT
A22 C1
FUSED B(+)
POWERTRAIN CONTROL MODULE
GROUND
A31 C1
GROUND
A32 C1
Z12 14 BK/TN
Z12 14 BK/TN
S130
(8W-15-11)
Z12 10 BK/TN
G105
(8W-15-14)

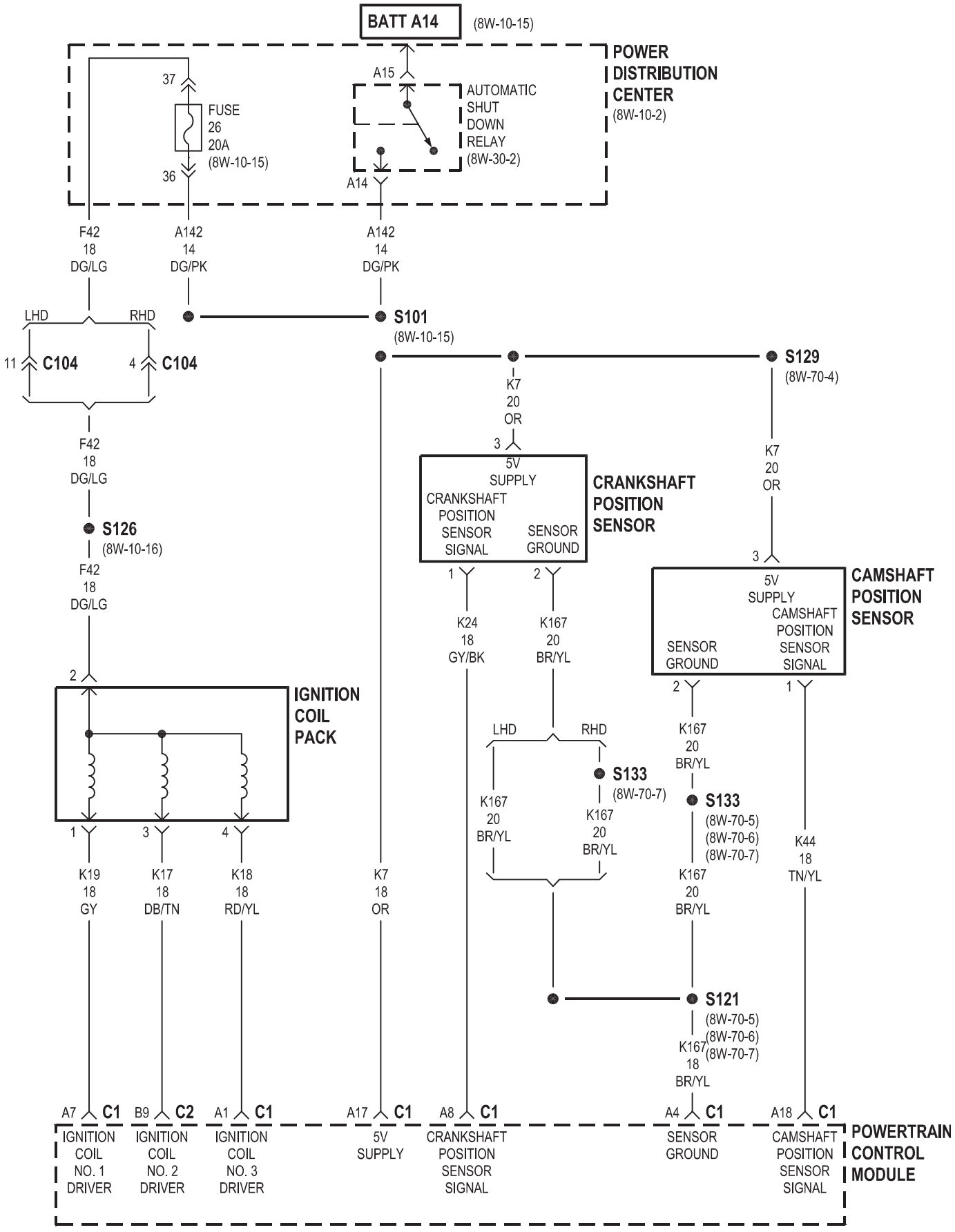


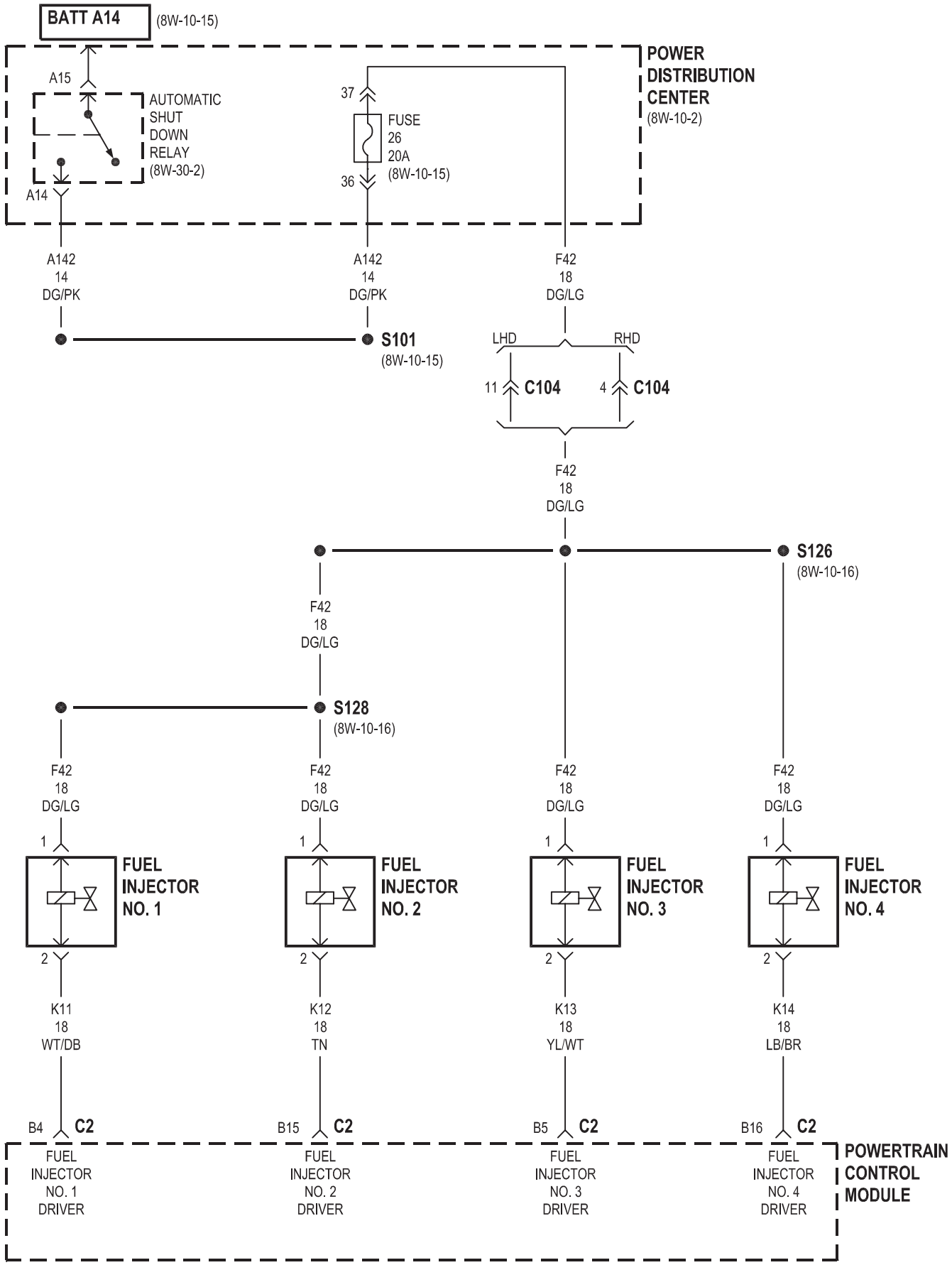
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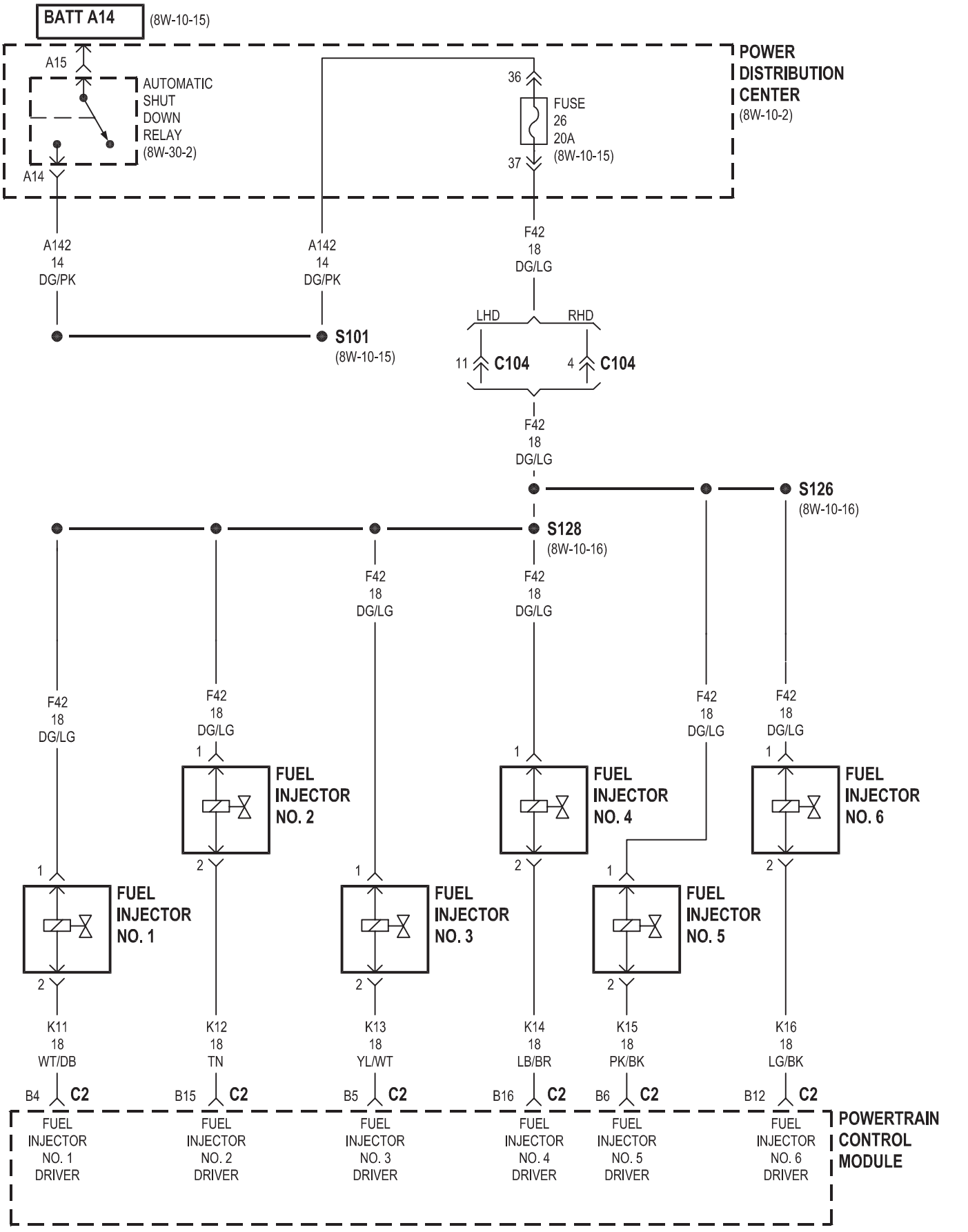
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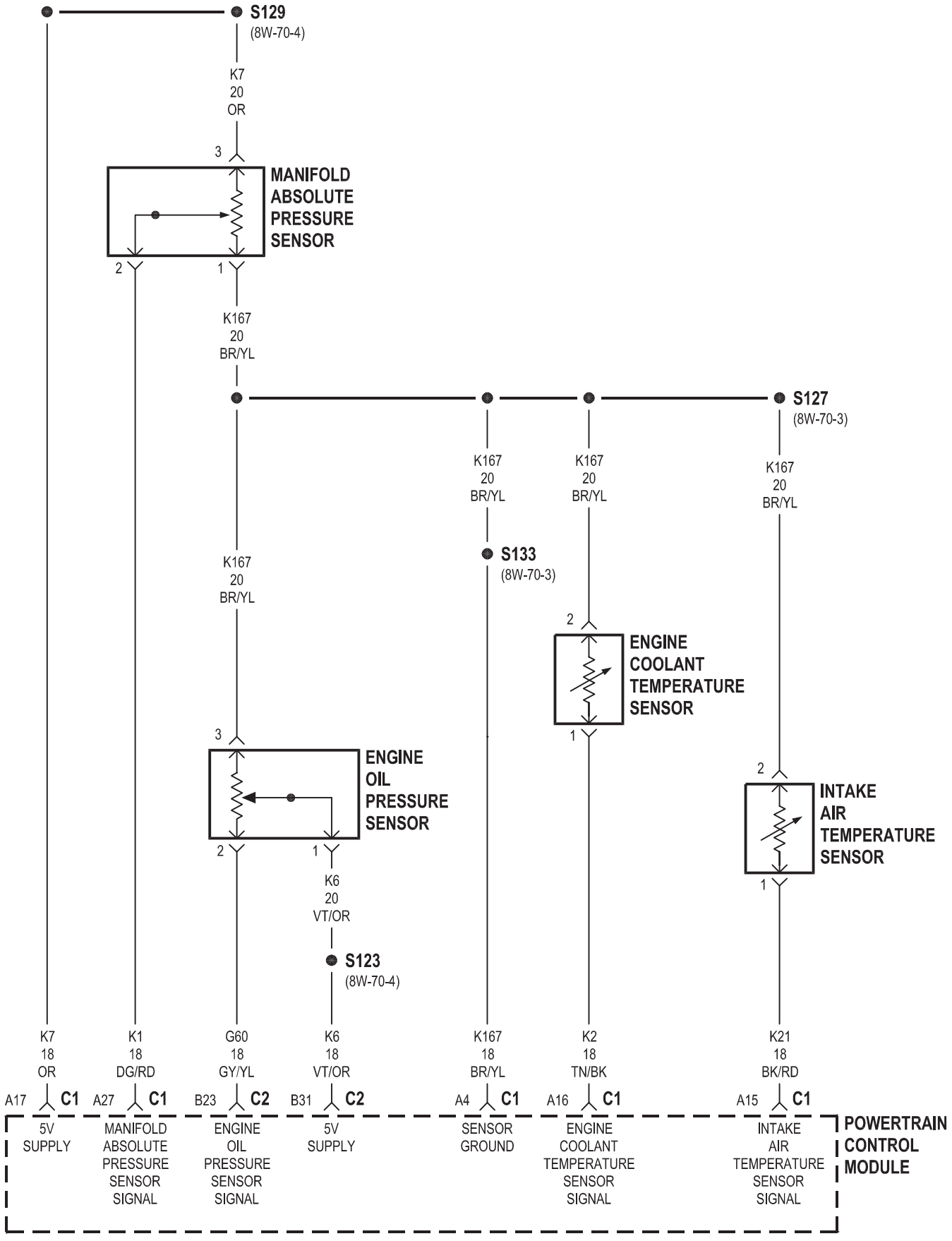

BATT A14
(8W-10-15)
POWER DISTRIBUTION CENTER
(8W-10-2)
A15
37
FUSE 26 20A
(8W-10-15)
36
AUTOMATIC SHUT DOWN RELAY
(8W-30-2)
A14
F42 18 DG/LG
A142 14 DG/PK
A142 14 DG/PK
S101
(8W-10-15)
S129
(8W-70-4)
LHD
RHD
11 C104
4 C104
K7 20 OR
3
5V SUPPLY
CRANKSHAFT POSITION SENSOR
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
1
2
K167 20 BR/YL
S127
(8W-70-3)
K7 20 OR
3
5V SUPPLY
CAMSHAFT POSITION SENSOR
SENSOR GROUND
CAMSHAFT POSITION SENSOR SIGNAL
2
1
S126
(8W-10-16)
F42 18 DG/LG
F42 18 DG/LG
1
IGNITION COIL
2
K19 18 GY
K167 20 BR/YL
K167 20 BR/YL
S133
(8W-70-3)
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

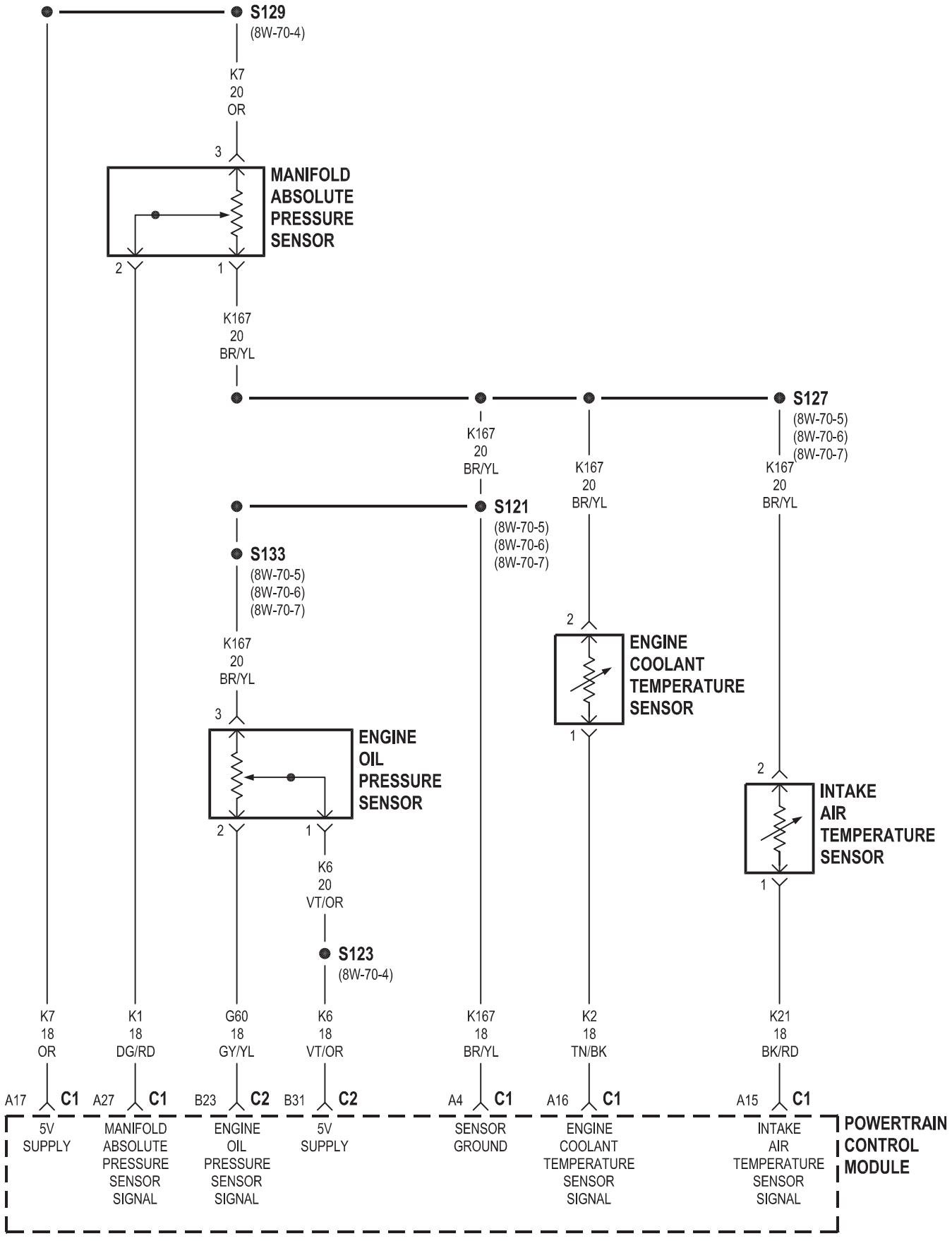
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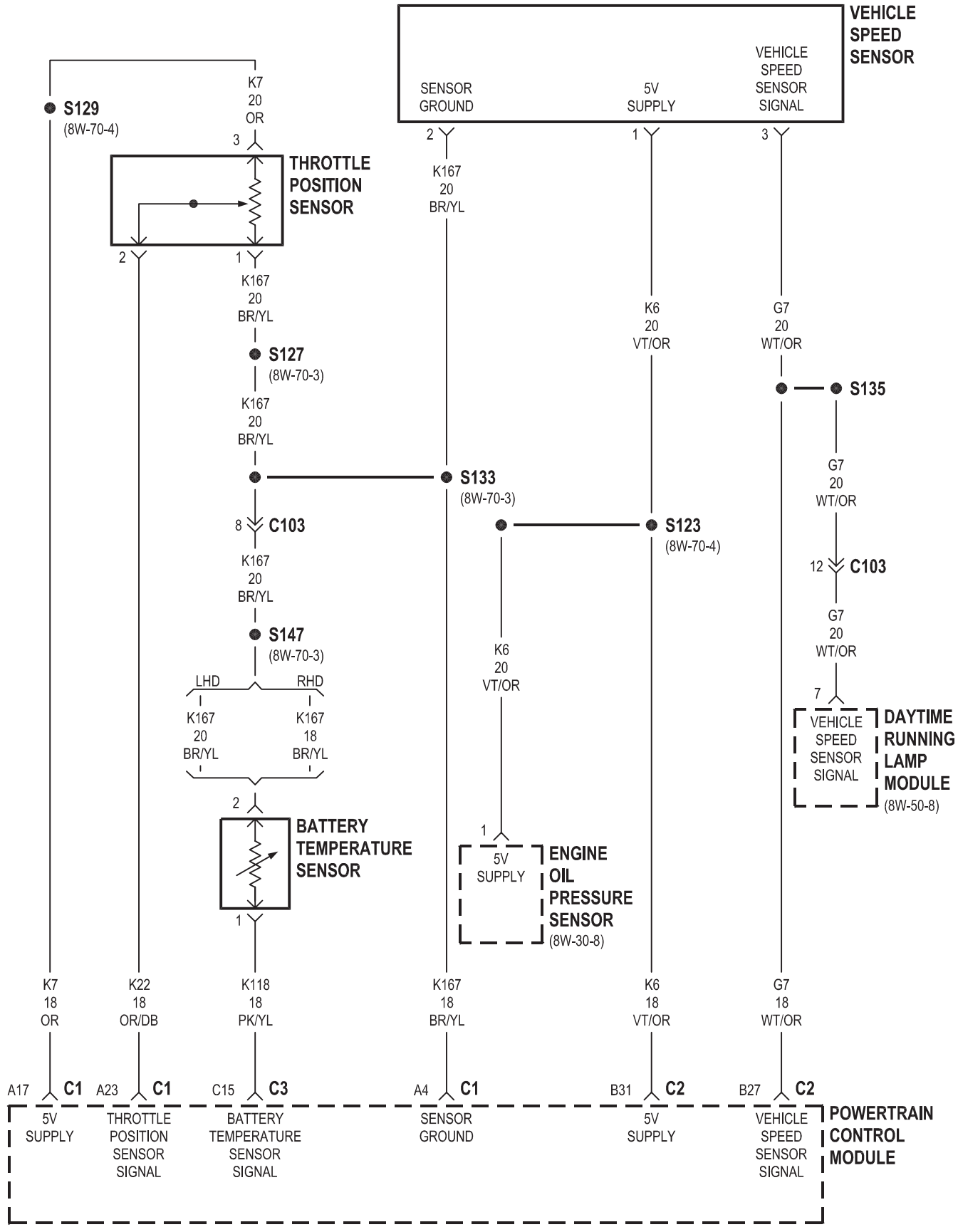

BATT A14
(8W-10-15)
POWER DISTRIBUTION CENTER
(8W-10-2)
37
FUSE 26 20A
(8W-10-15)
36
A15
AUTOMATIC SHUT DOWN RELAY
(8W-30-2)
A14
F42 18 DG/LG
A142 14 DG/PK
A142 14 DG/PK
LHD
RHD
11 C104
4 C104
S101
(8W-10-15)
S129
(8W-70-4)
K7 20 OR
3
5V SUPPLY
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
CRANKSHAFT POSITION SENSOR
K7 20 OR
3
F42 18 DG/LG
S126
(8W-10-16)
F42 18 DG/LG
1
2
K24 18 GY/BK
K167 20 BR/YL
3
5V SUPPLY
CAMSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
CAMSHAFT POSITION SENSOR
2
IGNITION COIL PACK
1
3
4
K19 18 GY
K17 18 DB/TN
K18 18 RD/YL
K7 18 OR
LHD
RHD
K167 20 BR/YL
S133
(8W-70-7)
K167 20 BR/YL
2
1
K167 20 BR/YL
S133
(8W-70-5)
(8W-70-6)
(8W-70-7)
K44 18 TN/YL
K167 20 BR/YL
S121
(8W-70-5)
(8W-70-6)
(8W-70-7)
K167 18 BR/YL
A7 C1
B9 C2
A1 C1
A17 C1
A8 C1
A4 C1
A18 C1
IGNITION COIL NO. 1 DRIVER
IGNITION COIL NO. 2 DRIVER
IGNITION COIL NO. 3 DRIVER
5V SUPPLY
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
CAMSHAFT POSITION SENSOR SIGNAL
POWERTRAIN CONTROL MODULE

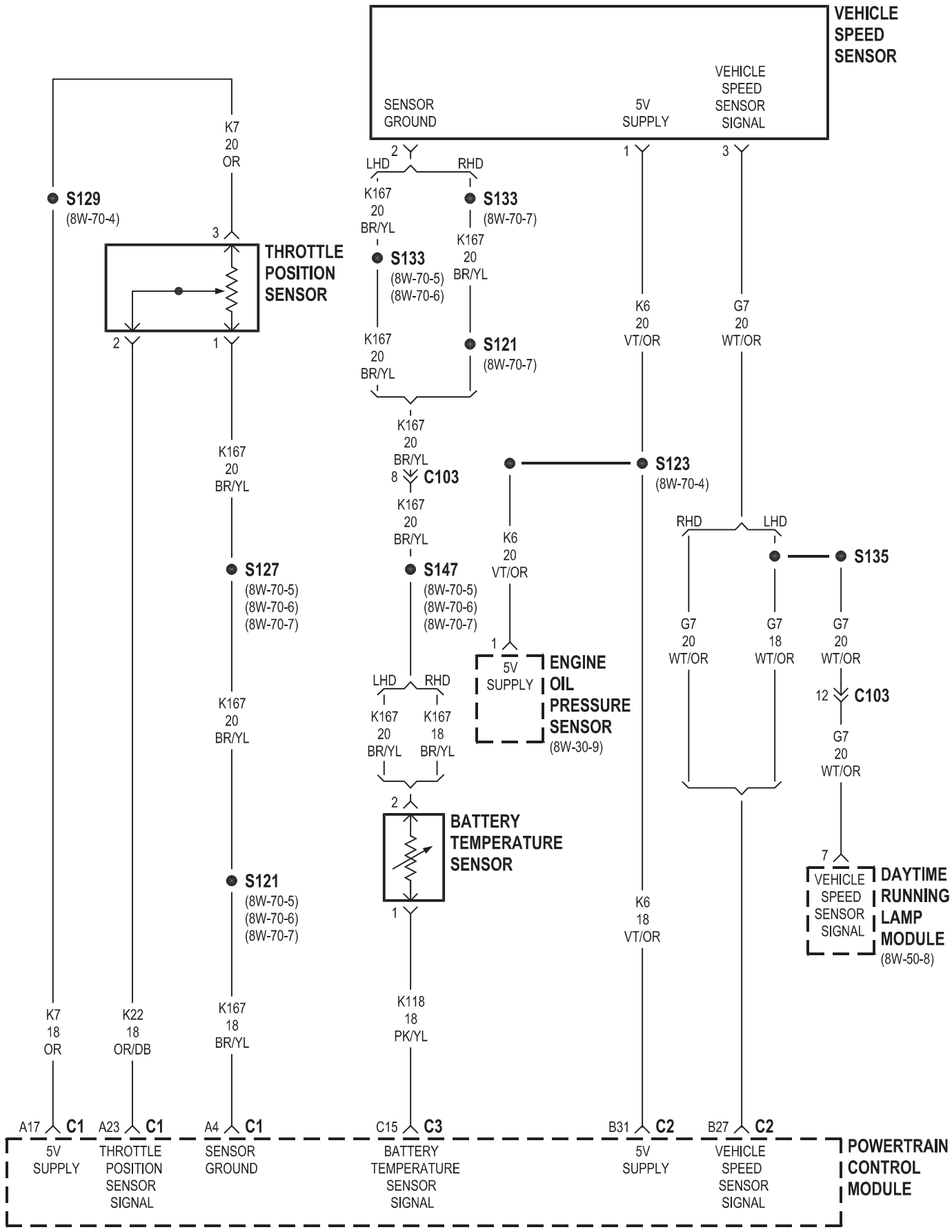

BATT A14
(8W-10-15)
POWER DISTRIBUTION CENTER
(8W-10-2)
A15
AUTOMATIC SHUT DOWN RELAY
(8W-30-2)
A14
37
FUSE 26 20A
(8W-10-15)
36
A142 14 DG/PK
A142 14 DG/PK
F42 18 DG/LG
S101
(8W-10-15)
LHD
RHD
11 C104
4 C104
F42 18 DG/LG
S126
(8W-10-16)
F42 18 DG/LG
S128
(8W-10-16)
F42 18 DG/LG
F42 18 DG/LG
F42 18 DG/LG
F42 18 DG/LG
1
2
FUEL INJECTOR NO. 1
FUEL INJECTOR NO. 2
FUEL INJECTOR NO. 3
FUEL INJECTOR NO. 4
K11 18 WT/DB
K12 18 TN
K13 18 YL/WT
K14 18 LB/BR
B4 C2
B15 C2
B5 C2
B16 C2
FUEL INJECTOR NO. 1 DRIVER
FUEL INJECTOR NO. 2 DRIVER
FUEL INJECTOR NO. 3 DRIVER
FUEL INJECTOR NO. 4 DRIVER
POWERTRAIN CONTROL MODULE


BATT A14
(8W-10-15)
A15
AUTOMATIC SHUT DOWN RELAY
(8W-30-2)
A14
36
FUSE 26 20A
(8W-10-15)
37
POWER DISTRIBUTION CENTER
(8W-10-2)
A142 14 DG/PK
A142 14 DG/PK
F42 18 DG/LG
S101
(8W-10-15)
LHD
RHD
11 C104
4 C104
F42 18 DG/LG
S126
(8W-10-16)
S128
(8W-10-16)
F42 18 DG/LG
F42 18 DG/LG
F42 18 DG/LG
F42 18 DG/LG
F42 18 DG/LG
F42 18 DG/LG
1
FUEL INJECTOR NO. 2
1
FUEL INJECTOR NO. 4
1
FUEL INJECTOR NO. 6
1
FUEL INJECTOR NO. 1
1
FUEL INJECTOR NO. 3
1
FUEL INJECTOR NO. 5
2
2
2
2
2
2
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


S129
(8W-70-4)
K7
20
OR
3
MANIFOLD
ABSOLUTE
PRESSURE
SENSOR
2
1
K167
20
BR/YL
S127
(8W-70-3)
K167
20
BR/YL
K167
20
BR/YL
K167
20
BR/YL
S133
(8W-70-3)
2
ENGINE
COOLANT
TEMPERATURE
SENSOR
1
K167
20
BR/YL
3
ENGINE
OIL
PRESSURE
SENSOR
2
1
2
INTAKE
AIR
TEMPERATURE
SENSOR
1
K6
20
VT/OR
S123
(8W-70-4)
K7
18
OR
K1
18
DG/RD
G60
18
GY/YL
K6
18
VT/OR
K167
18
BR/YL
K2
18
TN/BK
K21
18
BK/RD
A17 C1
A27 C1
B23 C2
B31 C2
A4 C1
A16 C1
A15 C1
5V
SUPPLY
MANIFOLD
ABSOLUTE
PRESSURE
SENSOR
SIGNAL
ENGINE
OIL
PRESSURE
SENSOR
SIGNAL
5V
SUPPLY
SENSOR
GROUND
ENGINE
COOLANT
TEMPERATURE
SENSOR
SIGNAL
INTAKE
AIR
TEMPERATURE
SENSOR
SIGNAL
POWERTRAIN
CONTROL
MODULE


S129
(8W-70-4)
K7
20
OR
3
MANIFOLD
ABSOLUTE
PRESSURE
SENSOR
2
1
K167
20
BR/YL
S127
(8W-70-5)
(8W-70-6)
(8W-70-7)
K167
20
BR/YL
K167
20
BR/YL
K167
20
BR/YL
S121
(8W-70-5)
(8W-70-6)
(8W-70-7)
S133
(8W-70-5)
(8W-70-6)
(8W-70-7)
2
ENGINE
COOLANT
TEMPERATURE
SENSOR
1
K167
20
BR/YL
3
ENGINE
OIL
PRESSURE
SENSOR
2
1
2
INTAKE
AIR
TEMPERATURE
SENSOR
1
K6
20
VT/OR
S123
(8W-70-4)
K7
18
OR
K1
18
DG/RD
G60
18
GY/YL
K6
18
VT/OR
K167
18
BR/YL
K2
18
TN/BK
K21
18
BK/RD
A17 C1
A27 C1
B23 C2
B31 C2
A4 C1
A16 C1
A15 C1
5V
SUPPLY
MANIFOLD
ABSOLUTE
PRESSURE
SENSOR
SIGNAL
ENGINE
OIL
PRESSURE
SENSOR
SIGNAL
5V
SUPPLY
SENSOR
GROUND
ENGINE
COOLANT
TEMPERATURE
SENSOR
SIGNAL
INTAKE
AIR
TEMPERATURE
SENSOR
SIGNAL
POWERTRAIN
CONTROL
MODULE

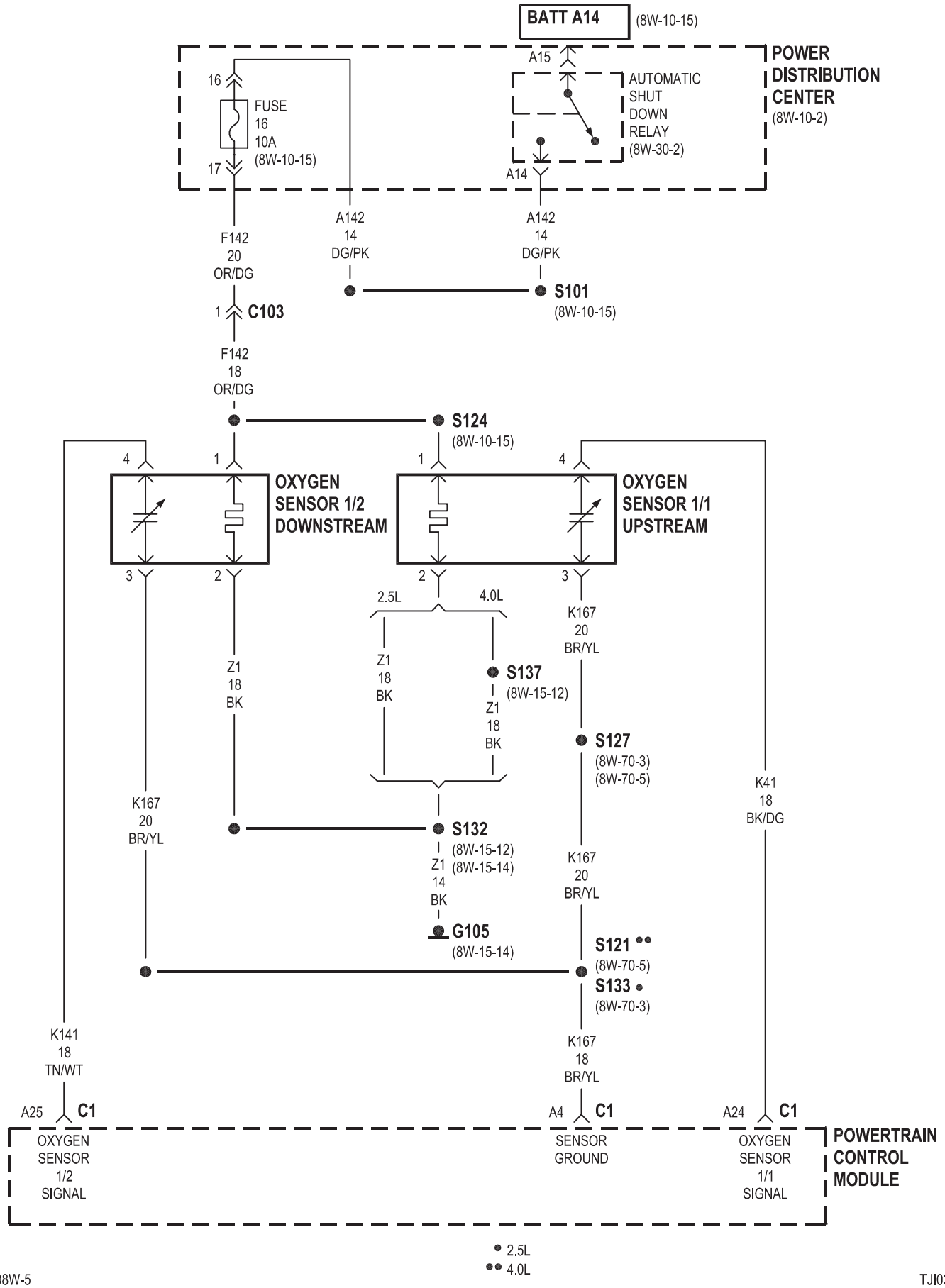

VEHICLE SPEED SENSOR
SENSOR GROUND
5V SUPPLY
VEHICLE SPEED SENSOR SIGNAL
S129
(8W-70-4)
K7 20 OR
THROTTLE POSITION SENSOR
K167 20 BR/YL
K6 20 VT/OR
G7 20 WT/OR
S127
(8W-70-3)
S135
S133
(8W-70-3)
S123
(8W-70-4)
C103
S147
(8W-70-3)
LHD
RHD
K167 20 BR/YL
K167 18 BR/YL
BATTERY TEMPERATURE SENSOR
ENGINE OIL PRESSURE SENSOR
(8W-30-8)
DAYTIME RUNNING LAMP MODULE
(8W-50-8)
K7 18 OR
K22 18 OR/DB
K118 18 PK/YL
K167 18 BR/YL
K6 18 VT/OR
G7 18 WT/OR
A17 C1
A23 C1
C15 C3
A4 C1
B31 C2
B27 C2
5V SUPPLY
THROTTLE POSITION SENSOR SIGNAL
BATTERY TEMPERATURE SENSOR SIGNAL
SENSOR GROUND
5V SUPPLY
VEHICLE SPEED SENSOR SIGNAL
POWERTRAIN CONTROL MODULE

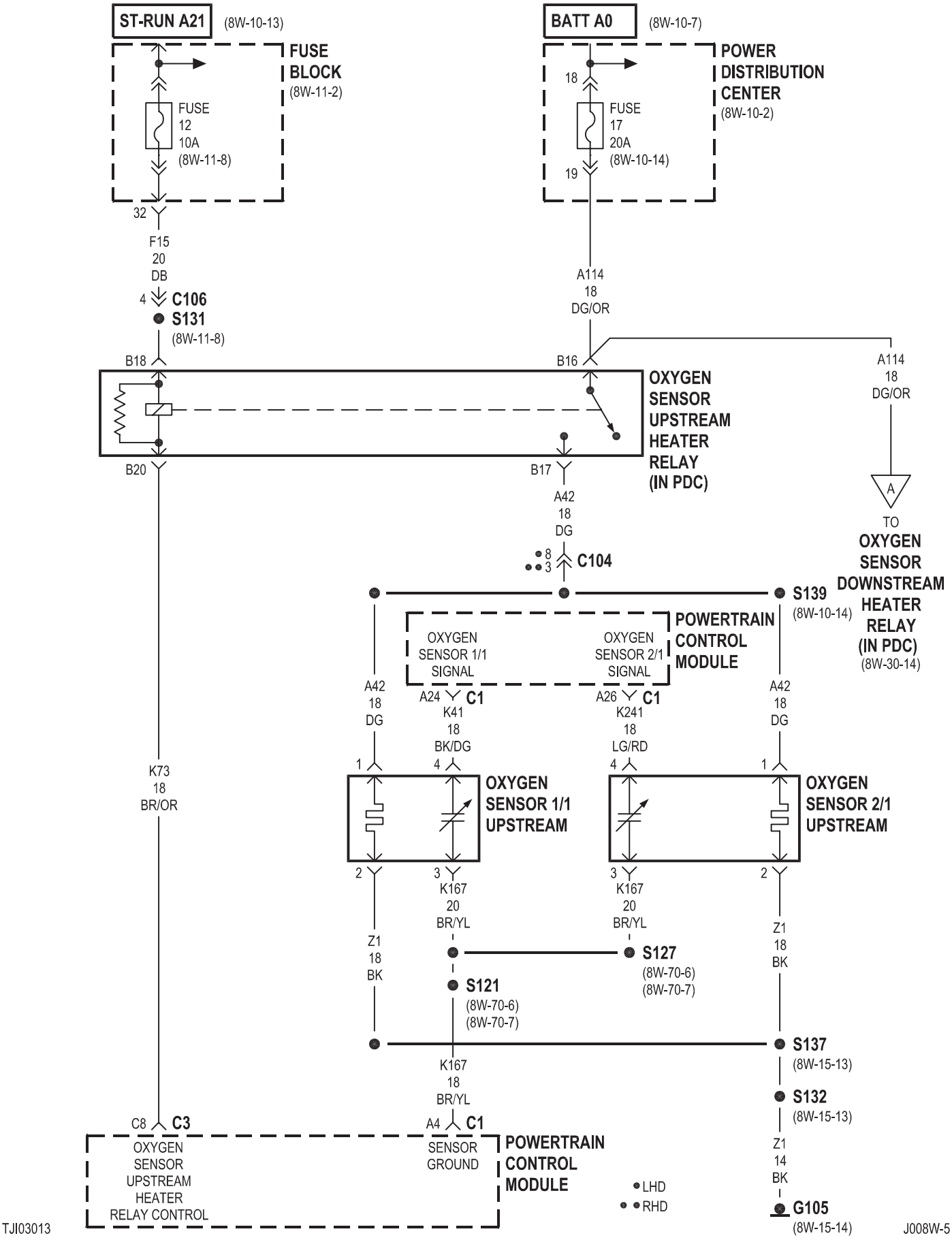


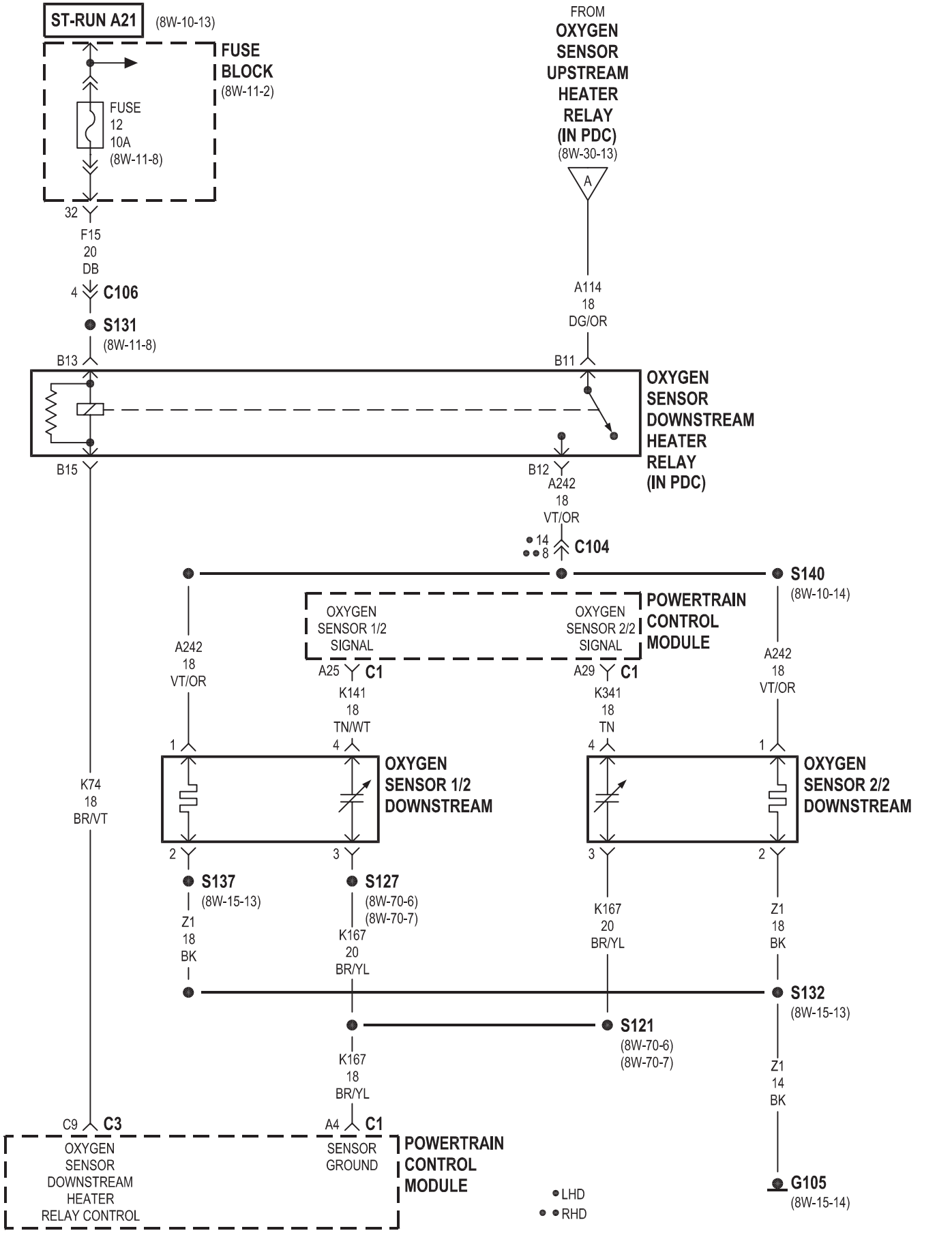
TJI03011

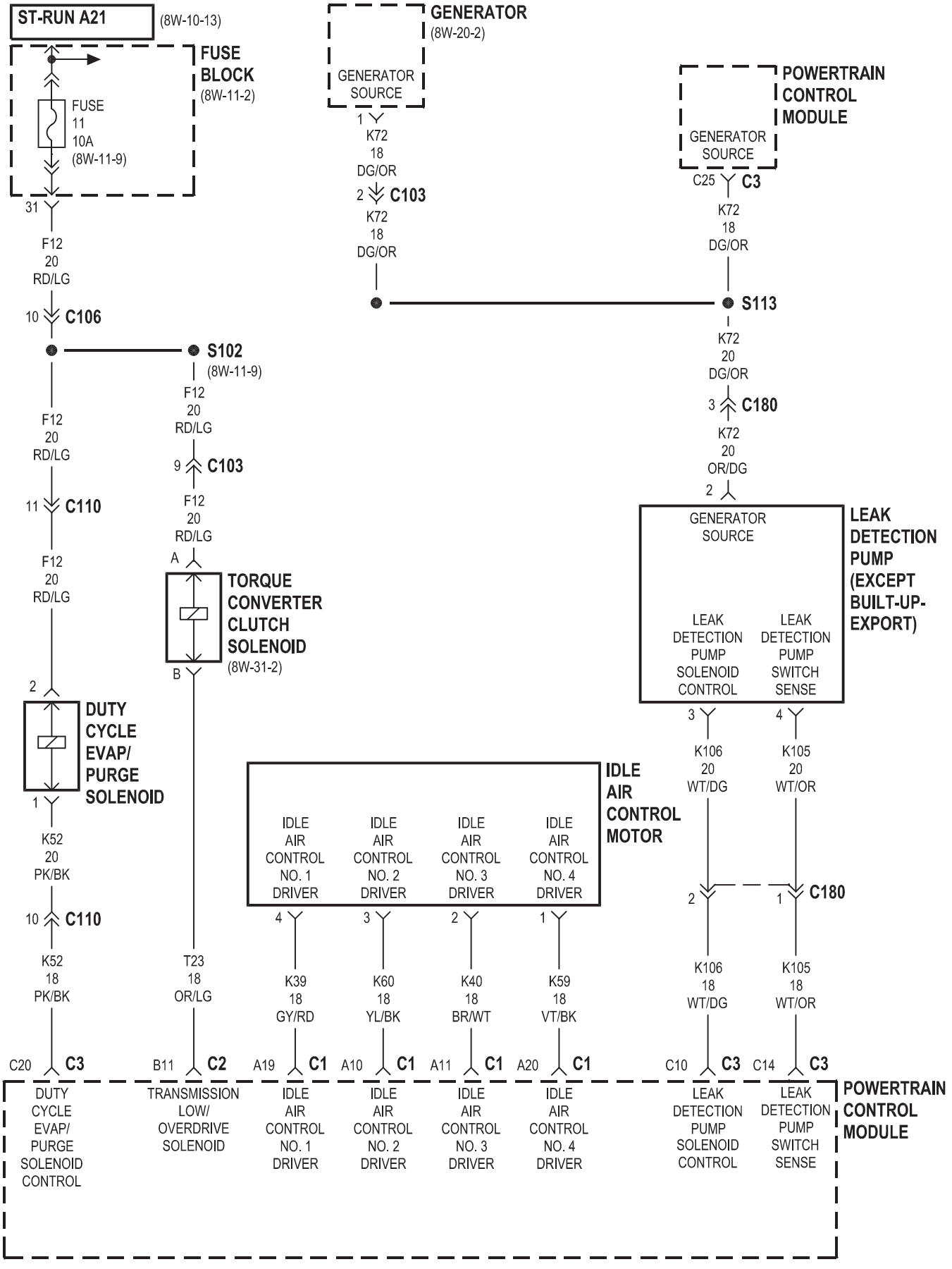
J008W-5

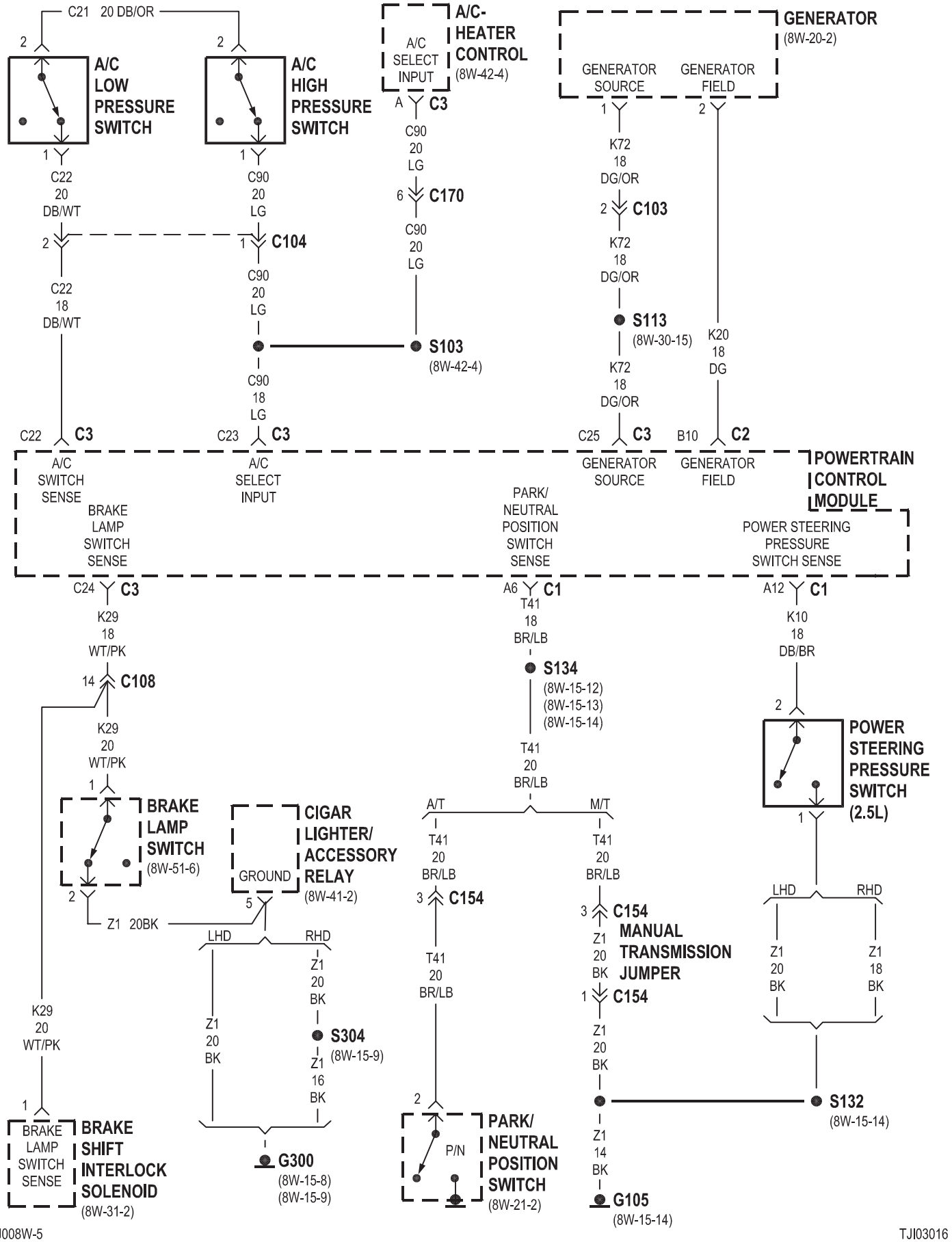
EXCEPT CALIFORNIA/EUROPEAN III

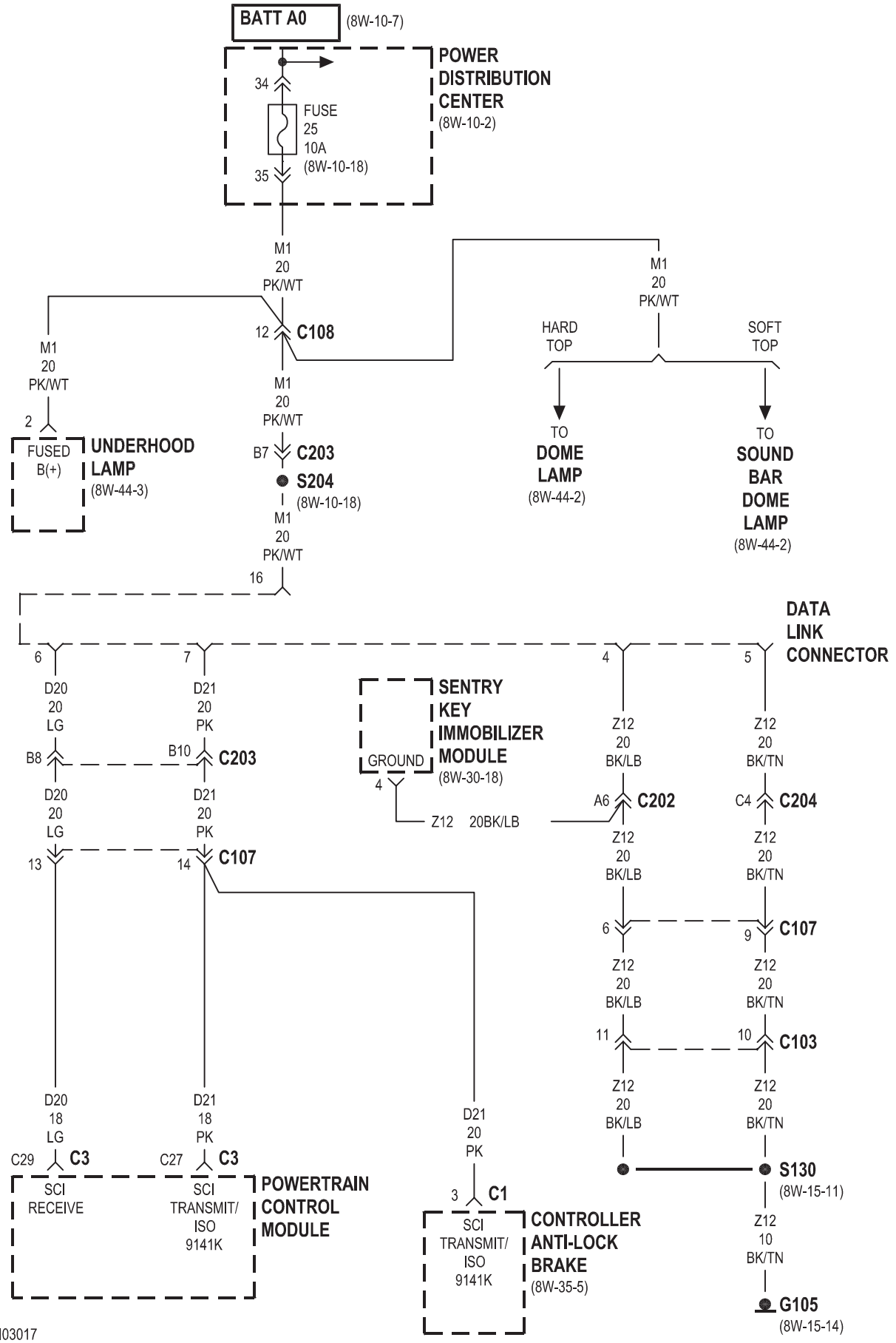



ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 12 10A
(8W-11-8)
32
F15 20 DB
4
C106
S131
(8W-11-8)
B18
B20
BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
18
FUSE 17 20A
(8W-10-14)
19
A114 18 DG/OR
B16
B17
OXYGEN SENSOR UPSTREAM HEATER RELAY (IN PDC)
A114 18 DG/OR
A
TO OXYGEN SENSOR DOWNSTREAM HEATER RELAY (IN PDC)
(8W-30-14)
A42 18 DG
8
3
C104
S139
(8W-10-14)
POWERTRAIN CONTROL MODULE
OXYGEN SENSOR 1/1 SIGNAL
OXYGEN SENSOR 2/1 SIGNAL
A24
C1
K41 18 BK/DG
A26
C1
K241 18 LG/RD
A42 18 DG
A42 18 DG
K73 18 BR/OR
1
4
OXYGEN SENSOR 1/1 UPSTREAM
4
1
OXYGEN SENSOR 2/1 UPSTREAM
2
3
K167 20 BR/YL
3
K167 20 BR/YL
2
Z1 18 BK
S127
(8W-70-6)
(8W-70-7)
Z1 18 BK
S121
(8W-70-6)
(8W-70-7)
S137
(8W-15-13)
K167 18 BR/YL
S132
(8W-15-13)
C8
C3
A4
C1
OXYGEN SENSOR UPSTREAM HEATER RELAY CONTROL
SENSOR GROUND
POWERTRAIN CONTROL MODULE
Z1 14 BK
LHD
RHD
G105
(8W-15-14)
TJI03013
J008W-5


ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 12 10A
(8W-11-8)
32
F15 20 DB
4
C106
S131
(8W-11-8)
B13
B15
FROM OXYGEN SENSOR UPSTREAM HEATER RELAY (IN PDC)
(8W-30-13)
A
A114 18 DG/OR
B11
OXYGEN SENSOR DOWNSTREAM HEATER RELAY (IN PDC)
B12
A242 18 VT/OR
14
8
C104
S140
(8W-10-14)
POWERTRAIN CONTROL MODULE
OXYGEN SENSOR 1/2 SIGNAL
OXYGEN SENSOR 2/2 SIGNAL
A25
C1
A29
C1
K141 18 TN/WT
K341 18 TN
A242 18 VT/OR
A242 18 VT/OR
1
4
4
1
OXYGEN SENSOR 1/2 DOWNSTREAM
OXYGEN SENSOR 2/2 DOWNSTREAM
K74 18 BR/VT
2
3
3
2
S137
(8W-15-13)
S127
(8W-70-6)
(8W-70-7)
Z1 18 BK
K167 20 BR/YL
K167 20 BR/YL
Z1 18 BK
S132
(8W-15-13)
S121
(8W-70-6)
(8W-70-7)
K167 18 BR/YL
Z1 14 BK
C9
C3
A4
C1
OXYGEN SENSOR DOWNSTREAM HEATER RELAY CONTROL
SENSOR GROUND
POWERTRAIN CONTROL MODULE
LHD
RHD
G105
(8W-15-14)

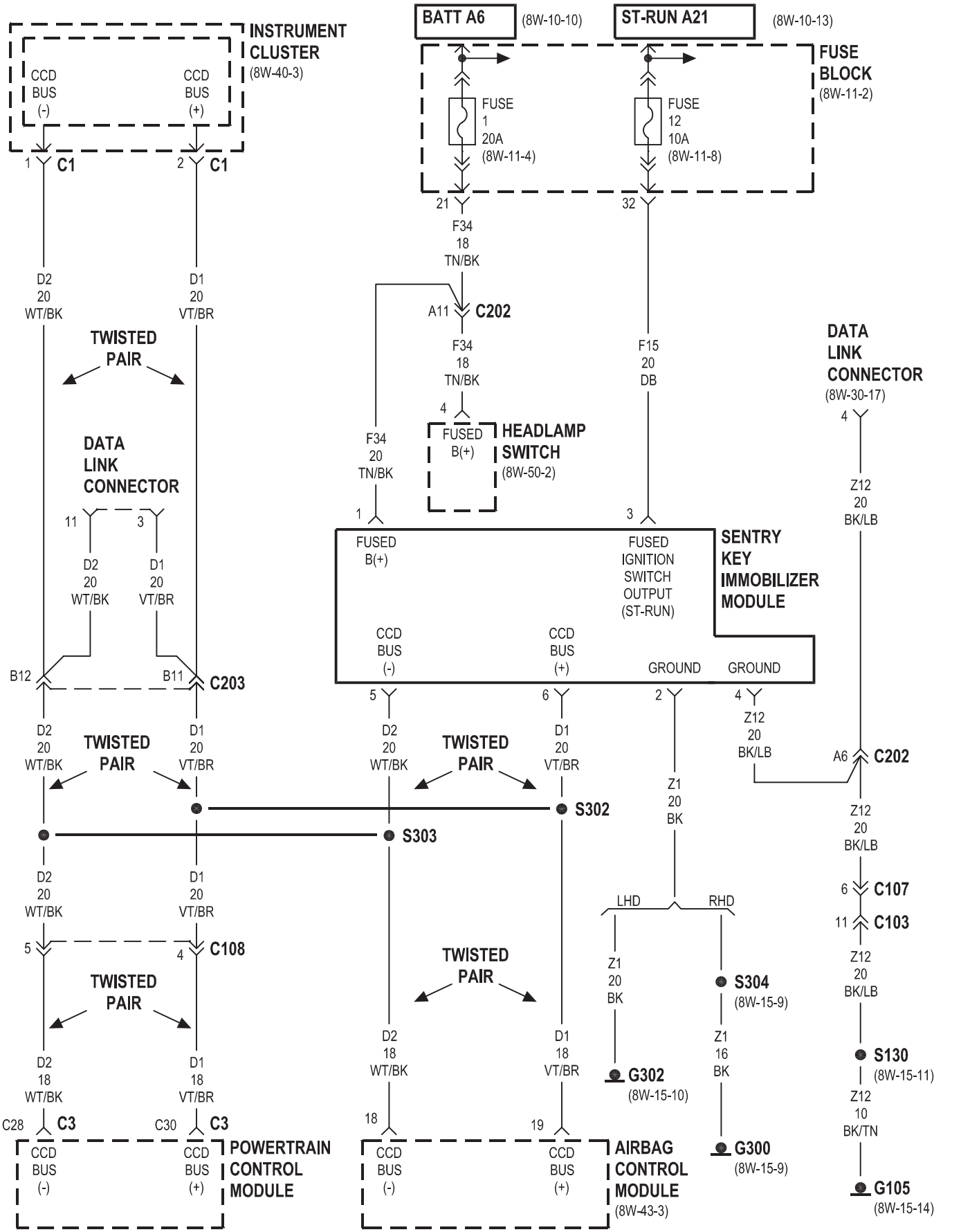

ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 11 10A
(8W-11-9)
31
F12 20 RD/LG
10 C106
F12 20 RD/LG
11 C110
F12 20 RD/LG
2
DUTY CYCLE EVAP/ PURGE SOLENOID
1
K52 20 PK/BK
10 C110
K52 18 PK/BK
C20 C3
DUTY CYCLE EVAP/ PURGE SOLENOID CONTROL
S102
(8W-11-9)
F12 20 RD/LG
9 C103
F12 20 RD/LG
A
TORQUE CONVERTER CLUTCH SOLENOID
(8W-31-2)
B
T23 18 OR/LG
B11 C2
TRANSMISSION LOW/ OVERDRIVE SOLENOID
GENERATOR
(8W-20-2)
GENERATOR SOURCE
1
K72 18 DG/OR
2 C103
K72 18 DG/OR
S113
K72 20 DG/OR
3 C180
K72 20 OR/DG
2
POWERTRAIN CONTROL MODULE
GENERATOR SOURCE
C25 C3
K72 18 DG/OR
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL NO. 1 DRIVER
IDLE AIR CONTROL NO. 2 DRIVER
IDLE AIR CONTROL NO. 3 DRIVER
IDLE AIR CONTROL NO. 4 DRIVER
4
3
2
1
K39 18 GY/RD
K60 18 YL/BK
K40 18 BR/WT
K59 18 VT/BK
A19 C1
A10 C1
A11 C1
A20 C1
IDLE AIR CONTROL NO. 1 DRIVER
IDLE AIR CONTROL NO. 2 DRIVER
IDLE AIR CONTROL NO. 3 DRIVER
IDLE AIR CONTROL NO. 4 DRIVER
LEAK DETECTION PUMP (EXCEPT BUILT-UP-EXPORT)
GENERATOR SOURCE
LEAK DETECTION PUMP SOLENOID CONTROL
LEAK DETECTION PUMP SWITCH SENSE
3
4
K106 20 WT/DG
K105 20 WT/OR
2
1 C180
K106 18 WT/DG
K105 18 WT/OR
C10 C3
C14 C3
LEAK DETECTION PUMP SOLENOID CONTROL
LEAK DETECTION PUMP SWITCH SENSE
POWERTRAIN CONTROL MODULE

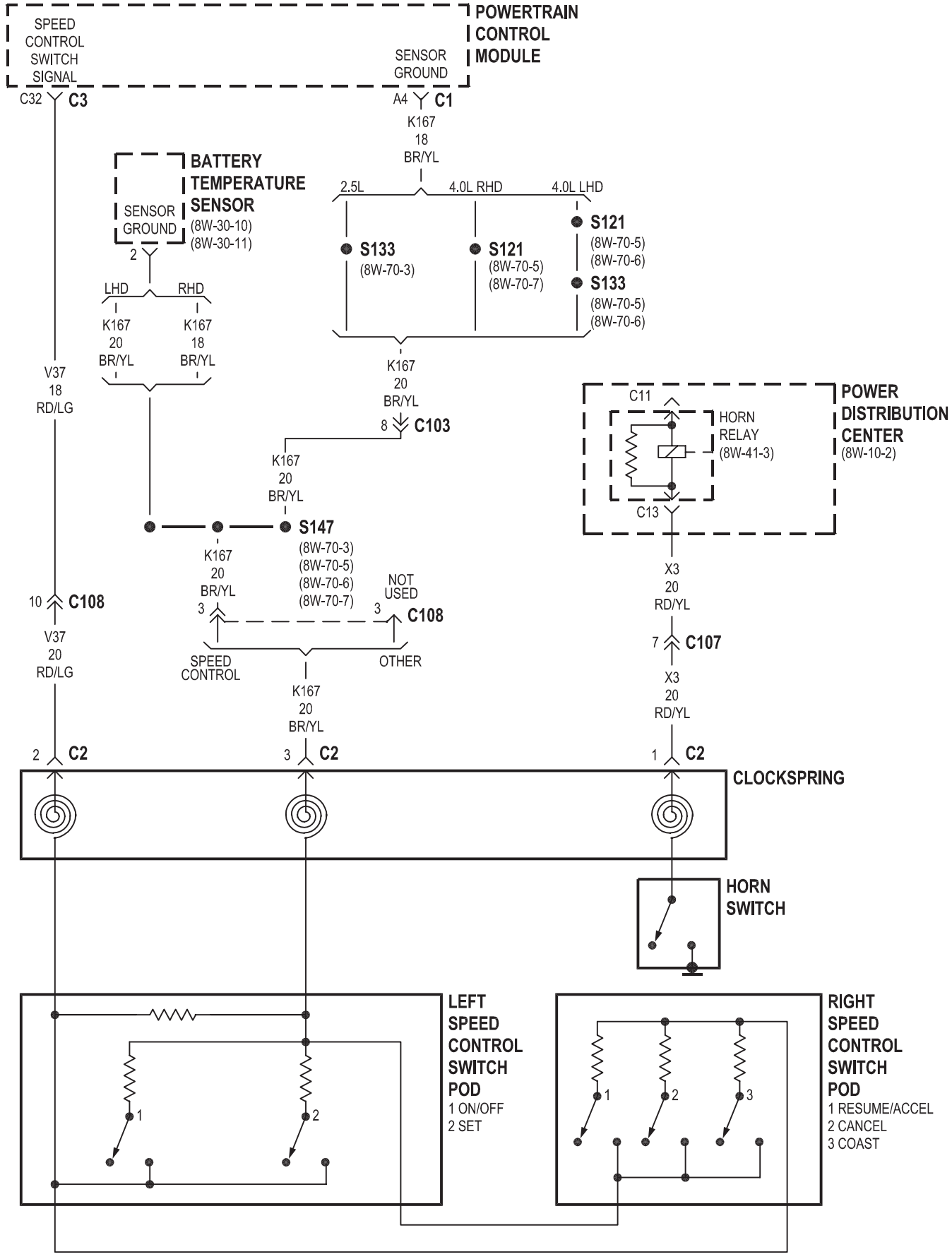

C21 20 DB/OR
A/C LOW PRESSURE SWITCH
A/C HIGH PRESSURE SWITCH
A/C- HEATER CONTROL (8W-42-4)
A/C SELECT INPUT
GENERATOR (8W-20-2)
GENERATOR SOURCE
GENERATOR FIELD
C22 20 DB/WT
C90 20 LG
C104
C170
K72 18 DG/OR
C103
S113 (8W-30-15)
K20 18 DG
S103 (8W-42-4)
C22 18 DB/WT
C90 18 LG
C22 C3
C23 C3
C25 C3
B10 C2
A/C SWITCH SENSE
A/C SELECT INPUT
GENERATOR SOURCE
GENERATOR FIELD
POWERTRAIN CONTROL MODULE
BRAKE LAMP SWITCH SENSE
PARK/ NEUTRAL POSITION SWITCH SENSE
POWER STEERING PRESSURE SWITCH SENSE
C24 C3
A6 C1
A12 C1
K29 18 WT/PK
C108
T41 18 BR/LB
S134 (8W-15-12) (8W-15-13) (8W-15-14)
K10 18 DB/BR
K29 20 WT/PK
T41 20 BR/LB
POWER STEERING PRESSURE SWITCH (2.5L)
BRAKE LAMP SWITCH (8W-51-6)
CIGAR LIGHTER/ ACCESSORY RELAY (8W-41-2)
GROUND
A/T
M/T
LHD
RHD
Z1 20BK
C154
MANUAL TRANSMISSION JUMPER
Z1 20 BK
Z1 16 BK
Z1 18 BK
S304 (8W-15-9)
S132 (8W-15-14)
K29 20 WT/PK
BRAKE LAMP SWITCH SENSE
BRAKE SHIFT INTERLOCK SOLENOID (8W-31-2)
G300 (8W-15-8) (8W-15-9)
P/N
PARK/ NEUTRAL POSITION SWITCH (8W-21-2)
Z1 14 BK
G105 (8W-15-14)

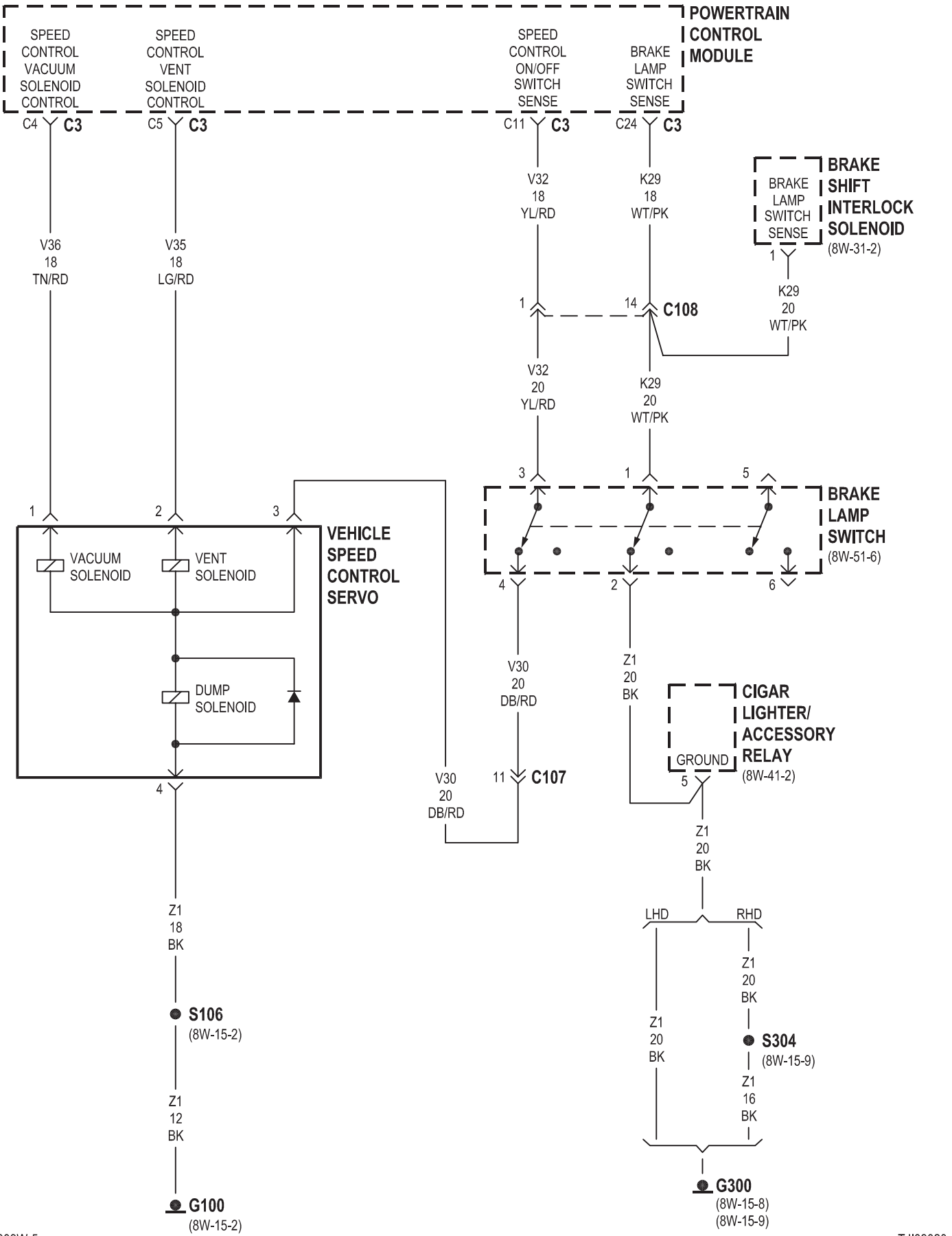


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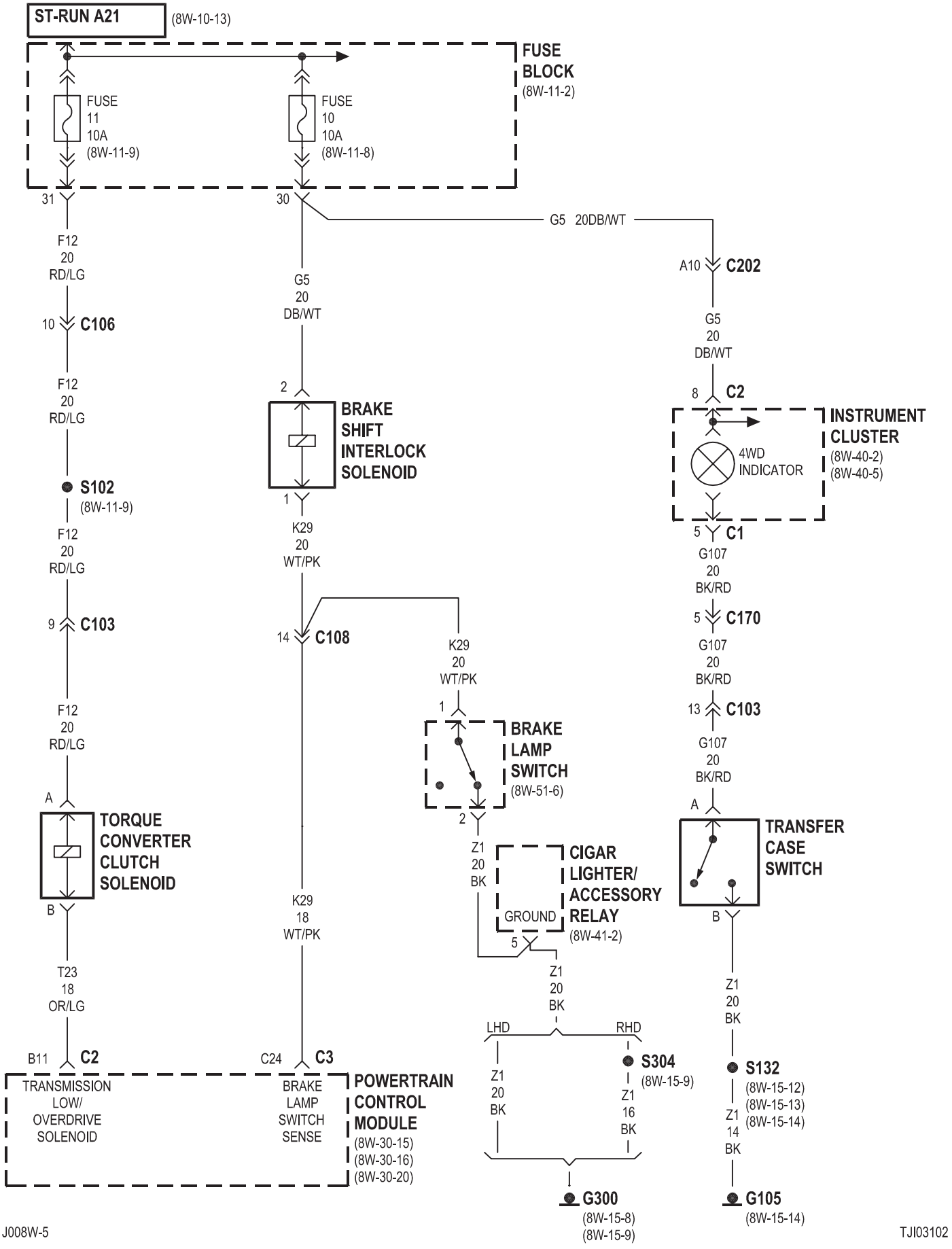

INSTRUMENT CLUSTER
(8W-40-3)
CCD BUS (-)
CCD BUS (+)
1 C1
2 C1
BATT A6
(8W-10-10)
ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 1 20A
(8W-11-4)
FUSE 12 10A
(8W-11-8)
21
32
F34 18 TN/BK
A11 C202
F34 18 TN/BK
4
FUSED B(+)
HEADLAMP SWITCH
(8W-50-2)
F34 20 TN/BK
1
F15 20 DB
3
D2 20 WT/BK
D1 20 VT/BR
TWISTED PAIR
DATA LINK CONNECTOR
11
3
D2 20 WT/BK
D1 20 VT/BR
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
SENTRY KEY IMMOBILIZER MODULE
CCD BUS (-)
CCD BUS (+)
GROUND
GROUND
5
6
2
4
Z12 20 BK/LB
DATA LINK CONNECTOR
(8W-30-17)
4
Z12 20 BK/LB
A6 C202
B12
B11 C203
D2 20 WT/BK
TWISTED PAIR
D1 20 VT/BR
D2 20 WT/BK
TWISTED PAIR
D1 20 VT/BR
S302
S303
Z1 20 BK
Z12 20 BK/LB
6 C107
11 C103
Z12 20 BK/LB
D2 20 WT/BK
D1 20 VT/BR
LHD
RHD
5
4 C108
TWISTED PAIR
TWISTED PAIR
Z1 20 BK
S304
(8W-15-9)
S130
(8W-15-11)
Z12 10 BK/TN
D2 18 WT/BK
D1 18 VT/BR
D2 18 WT/BK
D1 18 VT/BR
G302
(8W-15-10)
Z1 16 BK
C28 C3
C30 C3
18
19
CCD BUS (-)
CCD BUS (+)
POWERTRAIN CONTROL MODULE
CCD BUS (-)
CCD BUS (+)
AIRBAG CONTROL MODULE
(8W-43-3)
G300
(8W-15-9)
G105
(8W-15-14)


POWERTRAIN CONTROL MODULE
SPEED CONTROL SWITCH SIGNAL
C32
C3
SENSOR GROUND
A4
C1
K167 18 BR/YL
BATTERY TEMPERATURE SENSOR
(8W-30-10)
(8W-30-11)
SENSOR GROUND
2
LHD
RHD
K167 20 BR/YL
K167 18 BR/YL
2.5L
4.0L RHD
4.0L LHD
S133
(8W-70-3)
S121
(8W-70-5)
(8W-70-7)
S121
(8W-70-5)
(8W-70-6)
S133
(8W-70-5)
(8W-70-6)
K167 20 BR/YL
8
C103
K167 20 BR/YL
S147
(8W-70-3)
(8W-70-5)
(8W-70-6)
(8W-70-7)
V37 18 RD/LG
10
C108
V37 20 RD/LG
K167 20 BR/YL
3
NOT USED
3
C108
SPEED CONTROL
OTHER
K167 20 BR/YL
POWER DISTRIBUTION CENTER
(8W-10-2)
C11
HORN RELAY
(8W-41-3)
C13
X3 20 RD/YL
7
C107
X3 20 RD/YL
2
C2
3
C2
1
C2
CLOCKSPRING
HORN SWITCH
LEFT SPEED CONTROL SWITCH POD
1 ON/OFF
2 SET
RIGHT SPEED CONTROL SWITCH POD
1 RESUME/ACCEL
2 CANCEL
3 COAST


POWERTRAIN CONTROL MODULE
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL
SPEED CONTROL ON/OFF SWITCH SENSE
BRAKE LAMP SWITCH SENSE
C4 C3
C5 C3
C11 C3
C24 C3
V36 18 TN/RD
V35 18 LG/RD
V32 18 YL/RD
K29 18 WT/PK
BRAKE SHIFT INTERLOCK SOLENOID
(8W-31-2)
BRAKE LAMP SWITCH SENSE
K29 20 WT/PK
C108
V32 20 YL/RD
K29 20 WT/PK
BRAKE LAMP SWITCH
(8W-51-6)
VEHICLE SPEED CONTROL SERVO
VACUUM SOLENOID
VENT SOLENOID
DUMP SOLENOID
V30 20 DB/RD
C107
Z1 20 BK
CIGAR LIGHTER/ ACCESSORY RELAY
(8W-41-2)
GROUND
LHD
RHD
Z1 18 BK
S106
(8W-15-2)
Z1 12 BK
G100
(8W-15-2)
S304
(8W-15-9)
Z1 16 BK
G300
(8W-15-8)
(8W-15-9)

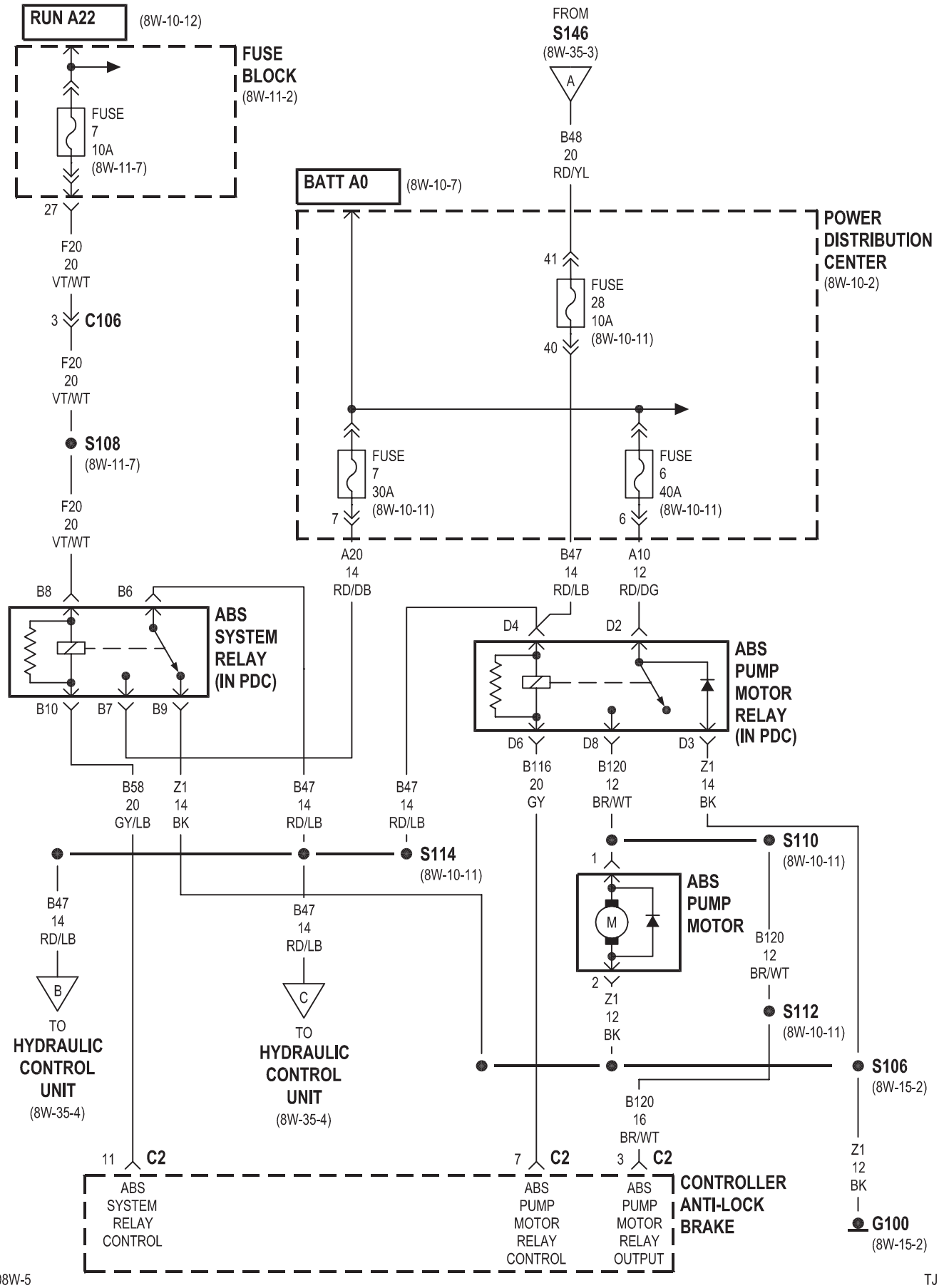
8W-31 TRANSMISSION CONTROL SYSTEM

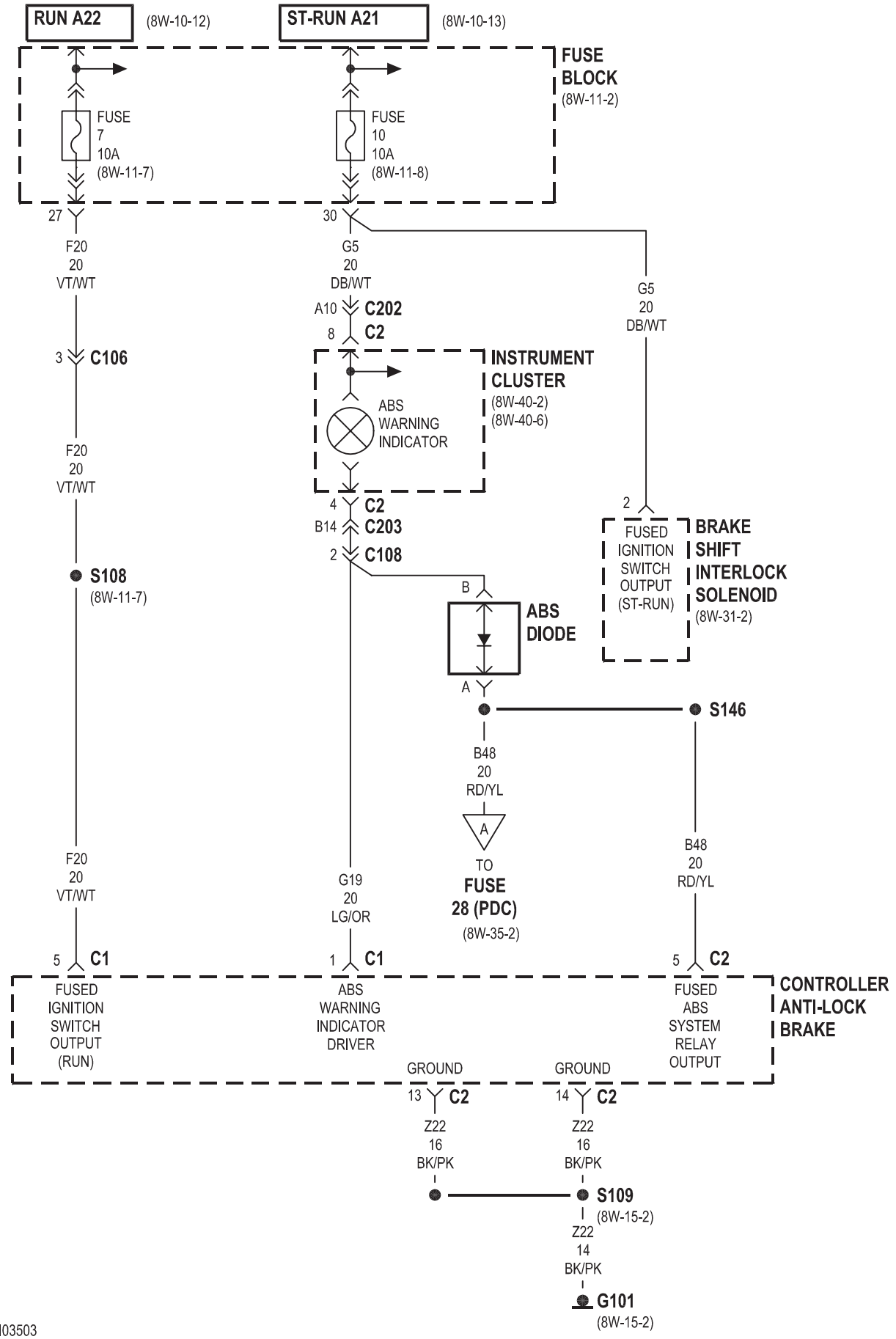
Component	Page
Brake Lamp Switch	8W-31-2
Brake Shift Interlock Solenoid	8W-31-2
Cigar Lighter/Accessory Relay	8W-31-2
Fuse 10 (FB)	8W-31-2
Fuse 11 (FB)	8W-31-2
Fuse Block	8W-31-2
G105	8W-31-2
G107	8W-31-2
G300	8W-31-2
Instrument Cluster	8W-31-2
Powertrain Control Module	8W-31-2
Torque Converter Clutch Solenoid	8W-31-2
Transfer Case Switch	8W-31-2

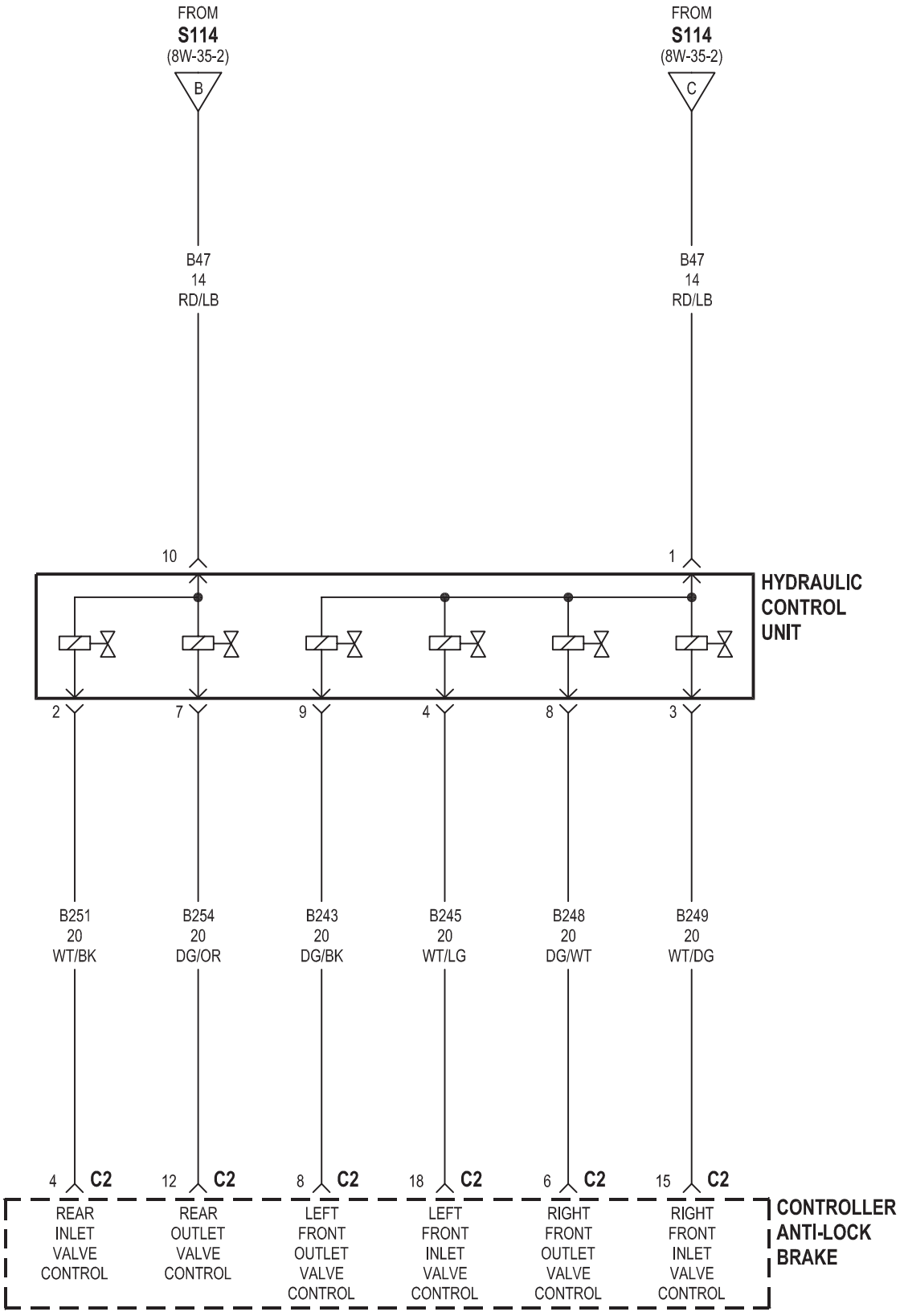

ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 11 10A
(8W-11-9)
FUSE 10 10A
(8W-11-8)
31
30
G5 20DB/WT
F12 20 RD/LG
10 C106
F12 20 RD/LG
S102
(8W-11-9)
F12 20 RD/LG
9 C103
F12 20 RD/LG
A
TORQUE CONVERTER CLUTCH SOLENOID
B
T23 18 OR/LG
B11 C2
TRANSMISSION LOW/ OVERDRIVE SOLENOID
G5 20 DB/WT
2
BRAKE SHIFT INTERLOCK SOLENOID
1
K29 20 WT/PK
14 C108
K29 18 WT/PK
C24 C3
BRAKE LAMP SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-15)
(8W-30-16)
(8W-30-20)
K29 20 WT/PK
1
BRAKE LAMP SWITCH
(8W-51-6)
2
Z1 20 BK
CIGAR LIGHTER/ ACCESSORY RELAY
GROUND
(8W-41-2)
5
Z1 20 BK
LHD
RHD
Z1 20 BK
S304
(8W-15-9)
Z1 16 BK
G300
(8W-15-8)
(8W-15-9)
A10 C202
G5 20 DB/WT
8 C2
INSTRUMENT CLUSTER
4WD INDICATOR
(8W-40-2)
(8W-40-5)
5 C1
G107 20 BK/RD
5 C170
G107 20 BK/RD
13 C103
G107 20 BK/RD
A
TRANSFER CASE SWITCH
B
Z1 20 BK
S132
(8W-15-12)
(8W-15-13)
(8W-15-14)
Z1 14 BK
G105
(8W-15-14)

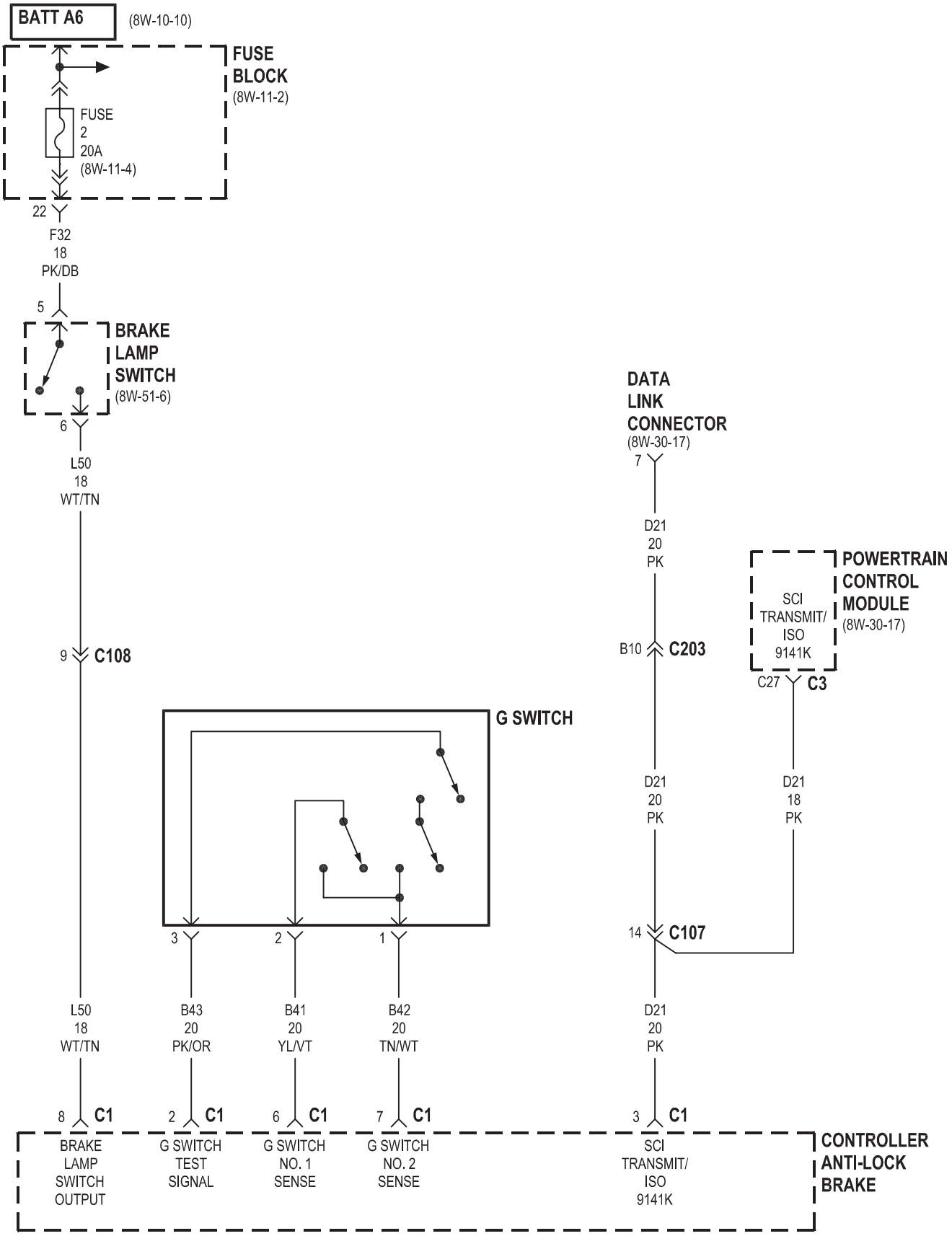
8W-35 ANTI-LOCK BRAKES

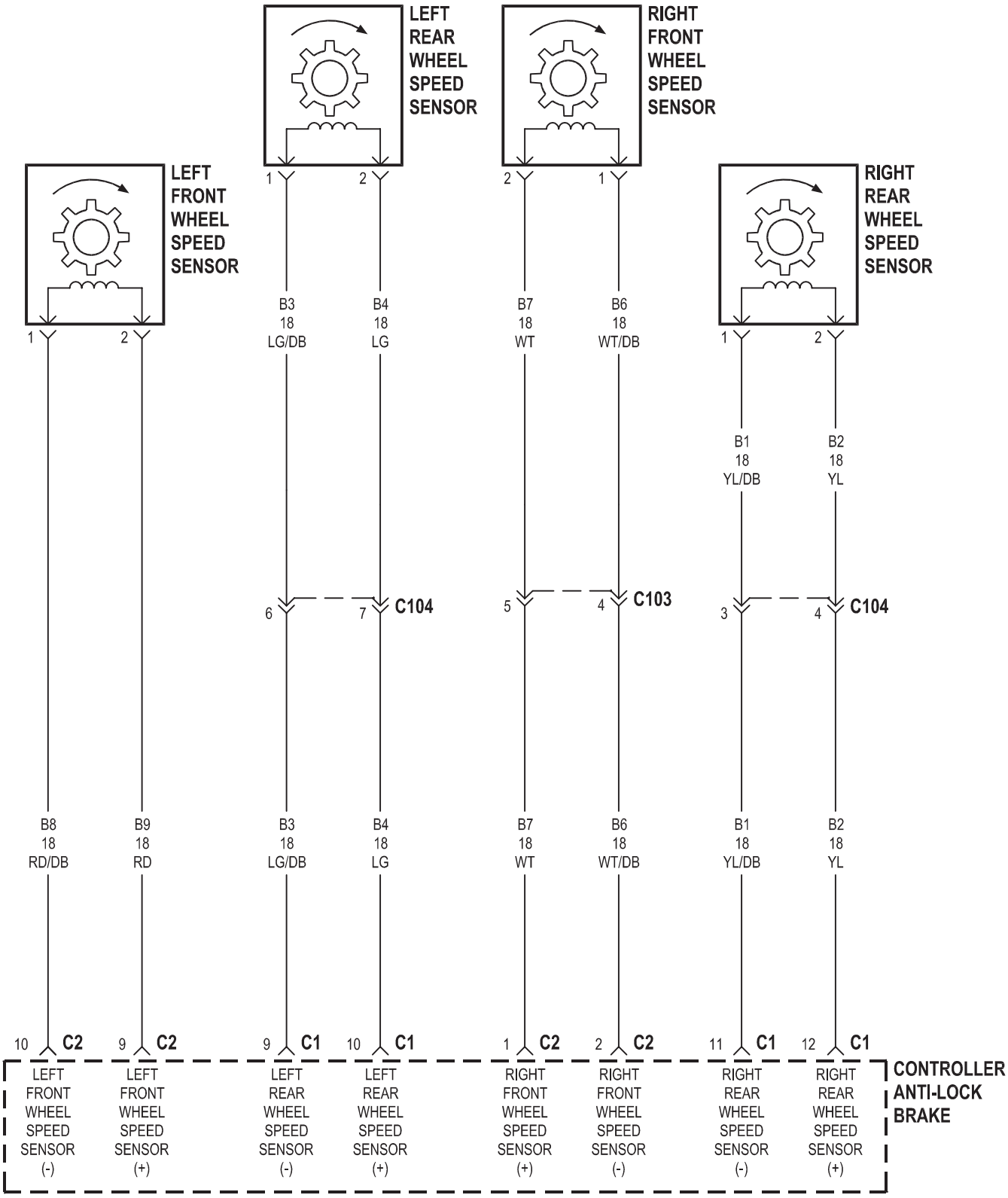
Component	Page
ABS Diode	8W-35-3
ABS Pump Motor	8W-35-2
ABS Pump Motor Relay	8W-35-2
ABS System Relay	8W-35-2
ABS Warning Indicator	8W-35-3
Brake Lamp Switch	8W-35-5
Brake Shift Interlock Solenoid	8W-35-3
Controller Anti-Lock Brake	8W-35-2, 3, 4, 5, 6
Data Link Connector	8W-35-5
Fuse 2 (FB)	8W-35-5
Fuse 6 (PDC)	8W-35-2
Fuse 7 (FB)	8W-35-2, 3
Fuse 7 (PDC)	8W-35-2
Fuse 10 (FB)	8W-35-3
Fuse 28 (PDC)	8W-35-2
Fuse Block	8W-35-2, 3, 5
G Switch	8W-35-5
G100	8W-35-2
G101	8W-35-3
Hydraulic Control Unit	8W-35-4
Instrument Cluster	8W-35-3
Left Front Wheel Speed Sensor	8W-35-6
Left Rear Wheel Speed Sensor	8W-35-6
Power Distribution Center	8W-35-2
Powertrain Control Module	8W-35-5
Right Front Wheel Speed Sensor	8W-35-6
Right Rear Wheel Speed Sensor	8W-35-6


RUN A22
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 7 10A
(8W-11-7)
27
F20 20 VT/WT
3 C106
F20 20 VT/WT
S108
(8W-11-7)
F20 20 VT/WT
FROM S146
(8W-35-3)
A
B48 20 RD/YL
BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
41
FUSE 28 10A
(8W-10-11)
40
FUSE 7 30A
(8W-10-11)
7
FUSE 6 40A
(8W-10-11)
6
A20 14 RD/DB
B47 14 RD/LB
A10 12 RD/DG
B8
B6
ABS SYSTEM RELAY (IN PDC)
B10
B7
B9
D4
D2
ABS PUMP MOTOR RELAY (IN PDC)
D6
D8
D3
B58 20 GY/LB
Z1 14 BK
B47 14 RD/LB
B47 14 RD/LB
B116 20 GY
B120 12 BR/WT
Z1 14 BK
S114
(8W-10-11)
S110
(8W-10-11)
1
ABS PUMP MOTOR
M
2
Z1 12 BK
B120 12 BR/WT
S112
(8W-10-11)
B47 14 RD/LB
B
TO HYDRAULIC CONTROL UNIT
(8W-35-4)
B47 14 RD/LB
C
TO HYDRAULIC CONTROL UNIT
(8W-35-4)
S106
(8W-15-2)
B120 16 BR/WT
Z1 12 BK
11 C2
7 C2
3 C2
ABS SYSTEM RELAY CONTROL
ABS PUMP MOTOR RELAY CONTROL
ABS PUMP MOTOR RELAY OUTPUT
CONTROLLER ANTI-LOCK BRAKE
G100
(8W-15-2)


RUN A22
(8W-10-12)
ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 7 10A
(8W-11-7)
FUSE 10 10A
(8W-11-8)
27
F20 20 VT/WT
3 C106
F20 20 VT/WT
S108
(8W-11-7)
F20 20 VT/WT
5 C1
FUSED IGNITION SWITCH OUTPUT (RUN)
30
G5 20 DB/WT
A10 C202
8 C2
INSTRUMENT CLUSTER
(8W-40-2)
(8W-40-6)
ABS WARNING INDICATOR
4 C2
B14 C203
2 C108
G19 20 LG/OR
1 C1
ABS WARNING INDICATOR DRIVER
B
ABS DIODE
A
B48 20 RD/YL
A
TO FUSE 28 (PDC)
(8W-35-2)
G5 20 DB/WT
2
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
BRAKE SHIFT INTERLOCK SOLENOID
(8W-31-2)
S146
B48 20 RD/YL
5 C2
FUSED ABS SYSTEM RELAY OUTPUT
CONTROLLER ANTI-LOCK BRAKE
GROUND
13 C2
Z22 16 BK/PK
GROUND
14 C2
Z22 16 BK/PK
S109
(8W-15-2)
Z22 14 BK/PK
G101
(8W-15-2)

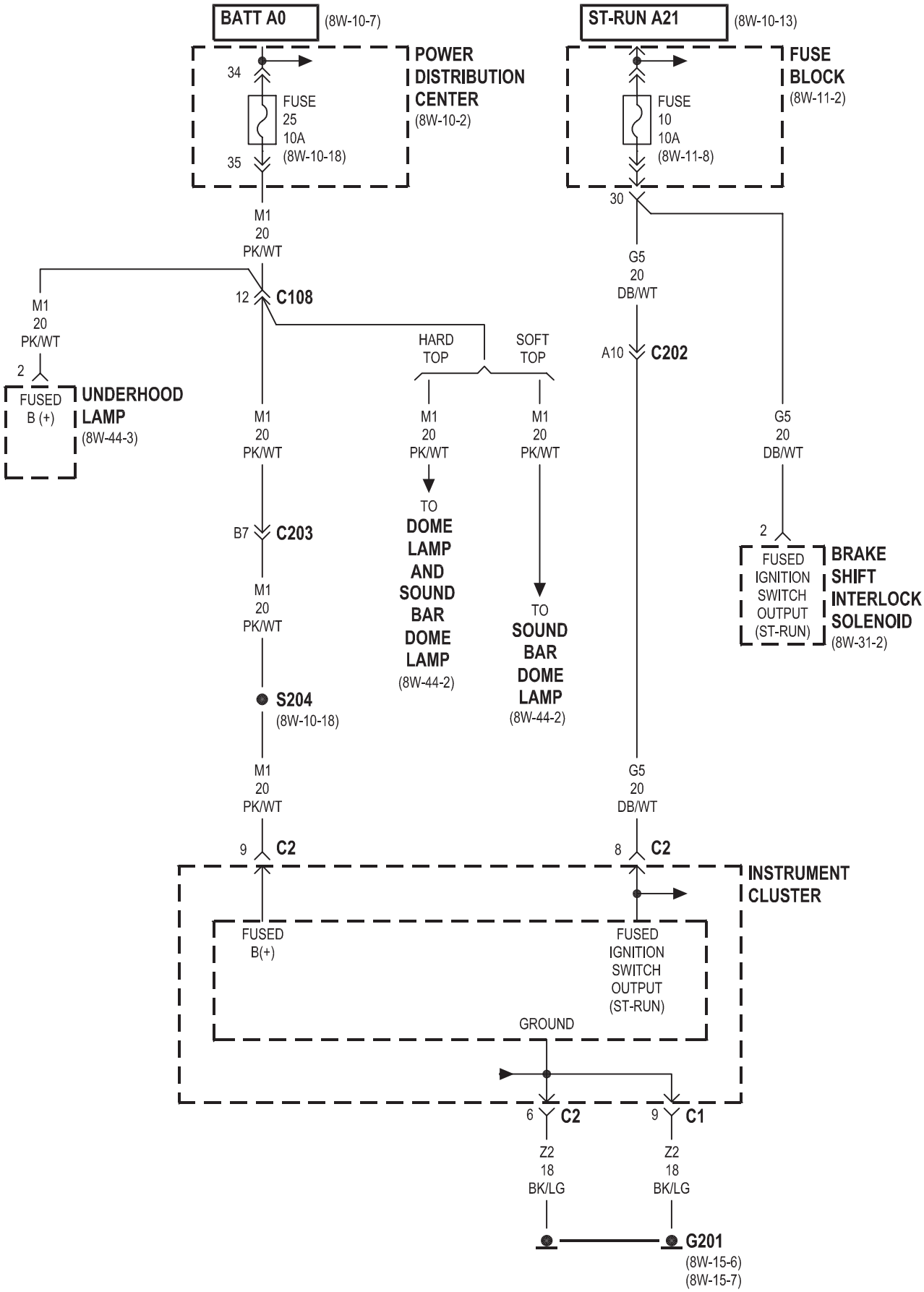

FROM
S114
(8W-35-2)
B
FROM
S114
(8W-35-2)
C
B47
14
RD/LB
B47
14
RD/LB
10
1
HYDRAULIC
CONTROL
UNIT
2
7
9
4
8
3
B251
20
WT/BK
B254
20
DG/OR
B243
20
DG/BK
B245
20
WT/LG
B248
20
DG/WT
B249
20
WT/DG
4 C2
12 C2
8 C2
18 C2
6 C2
15 C2
REAR
INLET
VALVE
CONTROL
REAR
OUTLET
VALVE
CONTROL
LEFT
FRONT
OUTLET
VALVE
CONTROL
LEFT
FRONT
INLET
VALVE
CONTROL
RIGHT
FRONT
OUTLET
VALVE
CONTROL
RIGHT
FRONT
INLET
VALVE
CONTROL
CONTROLLER
ANTI-LOCK
BRAKE

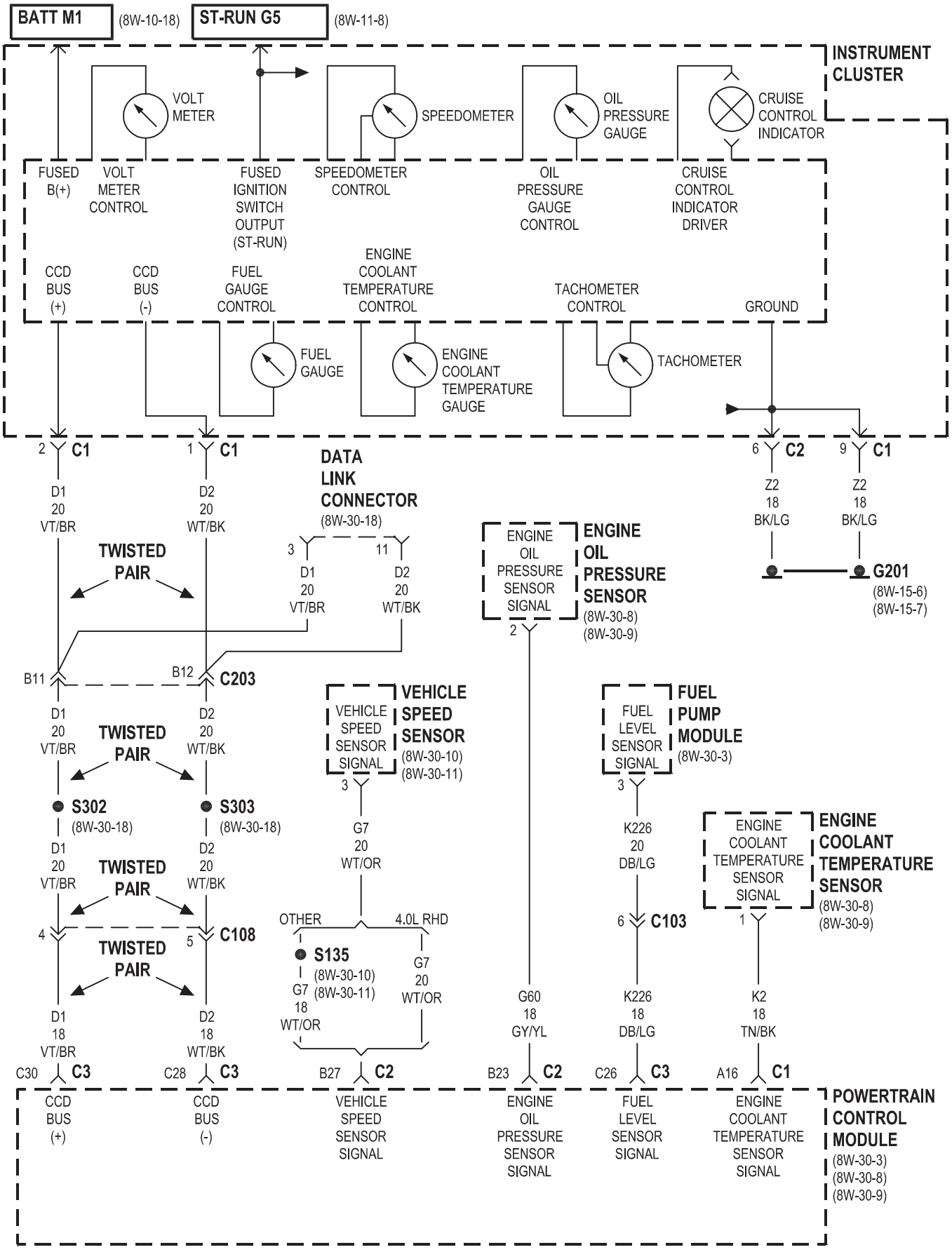

BATT A6
(8W-10-10)
FUSE BLOCK
(8W-11-2)
FUSE
2
20A
(8W-11-4)
22
F32
18
PK/DB
5
BRAKE LAMP SWITCH
(8W-51-6)
6
L50
18
WT/TN
9
C108
DATA LINK CONNECTOR
(8W-30-17)
7
D21
20
PK
B10
C203
POWERTRAIN CONTROL MODULE
(8W-30-17)
SCI TRANSMIT/ ISO 9141K
C27
C3
D21
18
PK
G SWITCH
3
2
1
D21
20
PK
14
C107
L50
18
WT/TN
B43
20
PK/OR
B41
20
YL/VT
B42
20
TN/WT
D21
20
PK
8
C1
2
C1
6
C1
7
C1
3
C1
BRAKE LAMP SWITCH OUTPUT
G SWITCH TEST SIGNAL
G SWITCH NO. 1 SENSE
G SWITCH NO. 2 SENSE
SCI TRANSMIT/ ISO 9141K
CONTROLLER ANTI-LOCK BRAKE

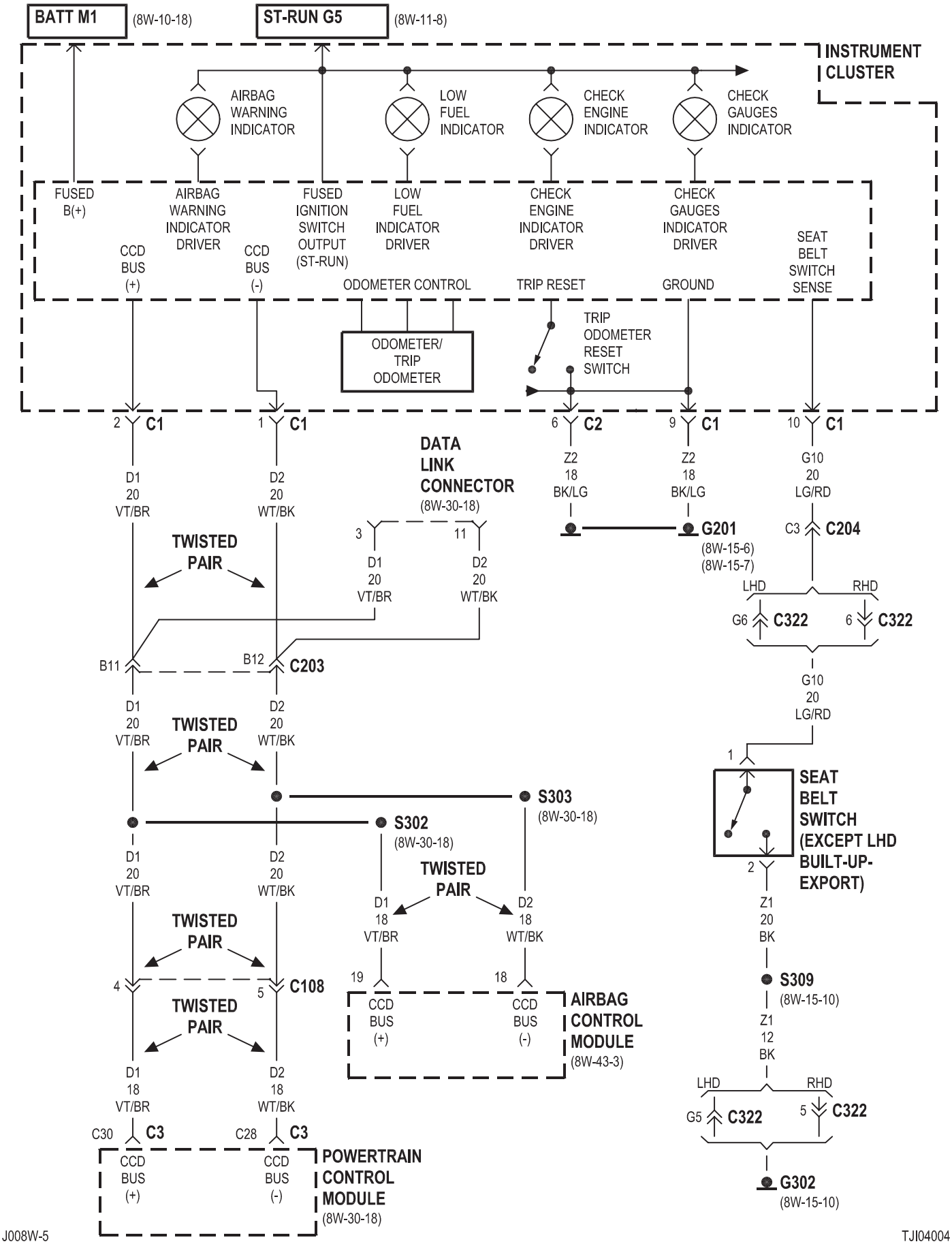

LEFT FRONT WHEEL SPEED SENSOR
LEFT REAR WHEEL SPEED SENSOR
RIGHT FRONT WHEEL SPEED SENSOR
RIGHT REAR WHEEL SPEED SENSOR
1
2
B8 18 RD/DB
B9 18 RD
B3 18 LG/DB
B4 18 LG
B7 18 WT
B6 18 WT/DB
B1 18 YL/DB
B2 18 YL
C104
C103
C104
6
7
5
4
3
4
10 C2
9 C2
9 C1
10 C1
1 C2
2 C2
11 C1
12 C1
LEFT FRONT WHEEL SPEED 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

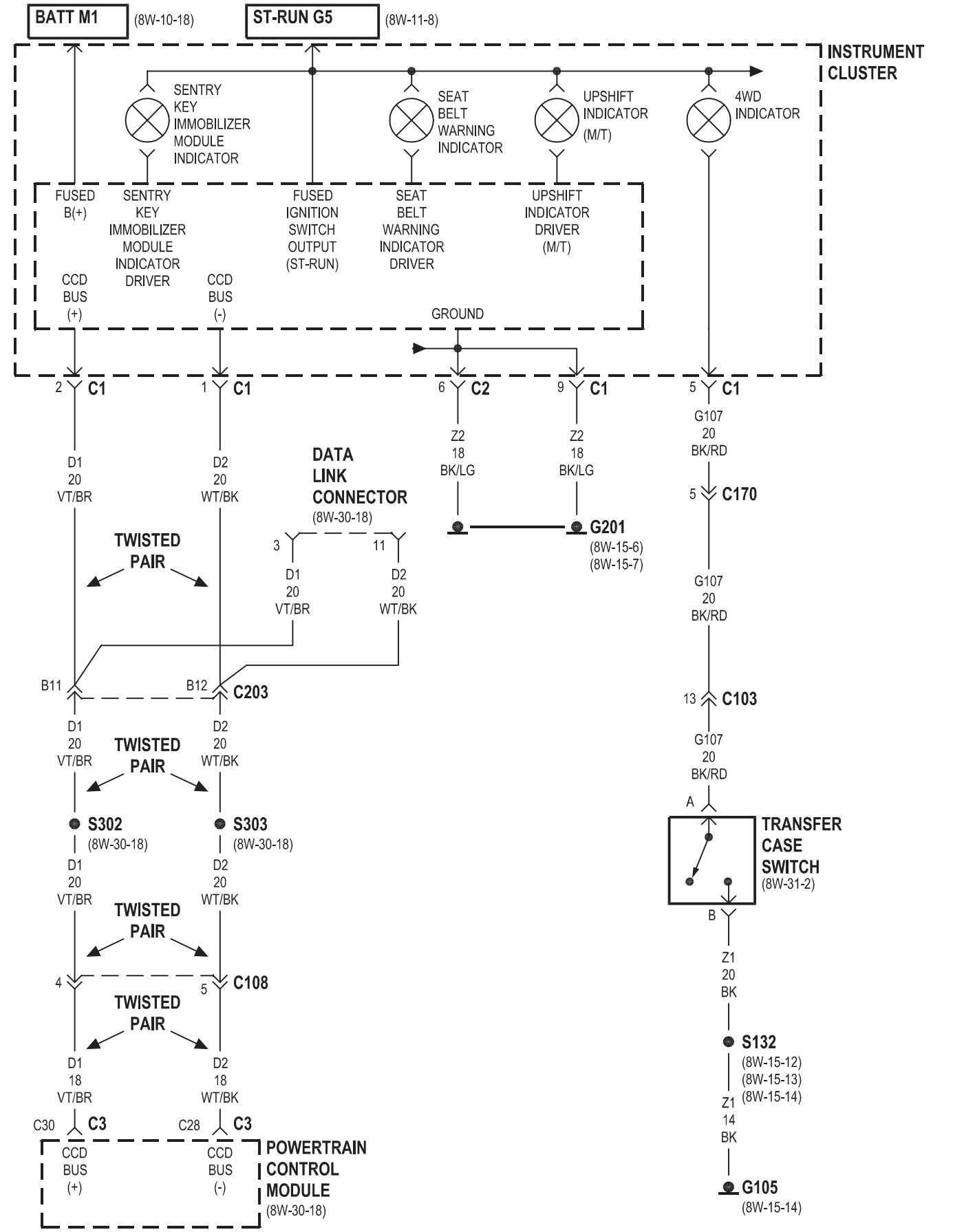
8W-40 INSTRUMENT CLUSTER

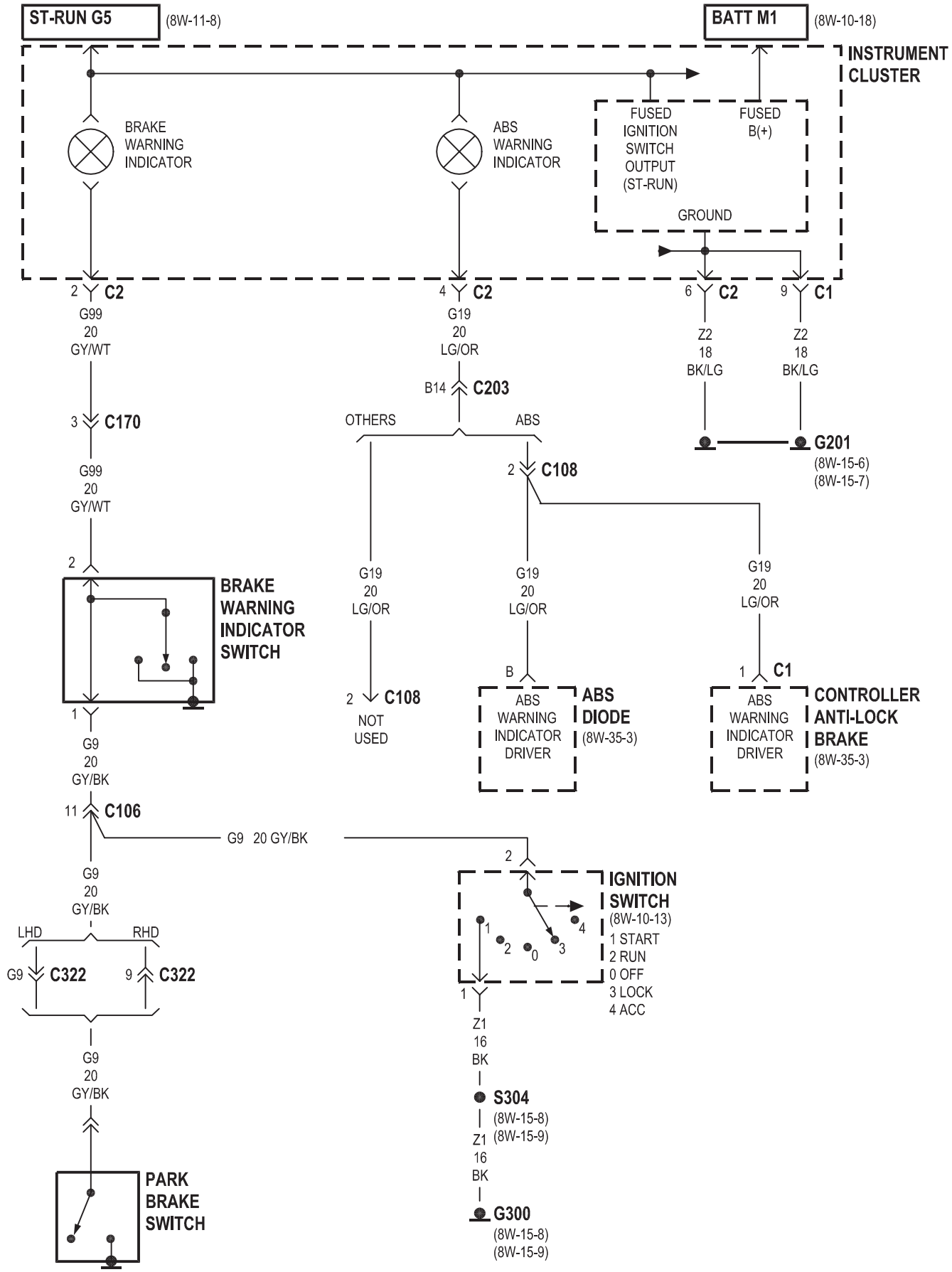
Component	Page
ABS Diode	8W-40-6
ABS Warning Indicator	8W-40-6
Airbag Control Module	8W-40-4
Airbag Warning Indicator	8W-40-4
Brake Shift Interlock Solenoid	8W-40-2
Brake Warning Indicator	8W-40-6
Brake Warning Indicator Switch	8W-40-6
Check Engine Indicator	8W-40-4
Check Gauges Indicator	8W-40-4
Cluster Illumination Lamps	8W-40-8
Controller Anti-Lock Brake	8W-40-6
Cruise Control Indicator	8W-40-3
Data Link Connector	8W-40-3, 4, 6, 7
Daytime Running Lamp Module	8W-40-9
Dome Lamp And Sound Bar Dome Lamp	8W-40-2
Driver Door Ajar Switch	8W-40-7
Engine Coolant Temperature Gauge	8W-40-3
Engine Coolant Temperature Sensor	8W-40-3
Engine Oil Pressure Sensor	8W-40-3
Fog Lamp Relay No. 2	8W-40-9
Fuel Gauge	8W-40-3
Fuel Pump Module	8W-40-3
Fuse 3 (FB)	8W-40-8
Fuse 4 (FB)	8W-40-7
Fuse 10 (FB)	8W-40-2
Fuse 25 (PDC)	8W-40-2
Fuse Block	8W-40-2, 7, 8
G105	8W-40-5
G107	8W-40-5
G201	8W-40-2, 3, 4, 5, 6, 7, 8, 9
G300	8W-40-6, 7
G302	8W-40-4
Headlamp Dimmer Switch	8W-40-9
Headlamp Switch	8W-40-7, 8
High Beam Indicator	8W-40-9
Ignition Switch	8W-40-6
Instrument Cluster	8W-40-2, 3, 4, 5, 6, 7, 8, 9
Key-In Switch	8W-40-7
Left Turn Signal Indicator	8W-40-9
Low Fuel Indicator	8W-40-4
Odometer/Trip Odometer	8W-40-4
Oil Pressure Gauge	8W-40-3
Park Brake Switch	8W-40-6
Passenger Door Ajar Switch	8W-40-7
Power Distribution Center	8W-40-2
Powertrain Control Module	8W-40-3, 4, 5, 7
PRNDL Lamp	8W-40-8
Rear Window Defogger Relay	8W-40-8
Rear Window Defogger Switch	8W-40-8
Right Turn Signal Indicator	8W-40-9
Seat Belt Switch	8W-40-4
Seat Belt Warning Indicator	8W-40-5
Sentry Key Immobilizer Module Indicator	8W-40-5
Sound Bar Dome Lamp	8W-40-2
Speedometer	8W-40-3
Tachometer	8W-40-3
Transfer Case Switch	8W-40-5
Trip Odometer Reset Switch	8W-40-4
Turn Signal/Hazard Switch	8W-40-9
Underhood Lamp	8W-40-2
Upshift Indicator	8W-40-5
Vehicle Speed Sensor	8W-40-3
Volt Meter	8W-40-3

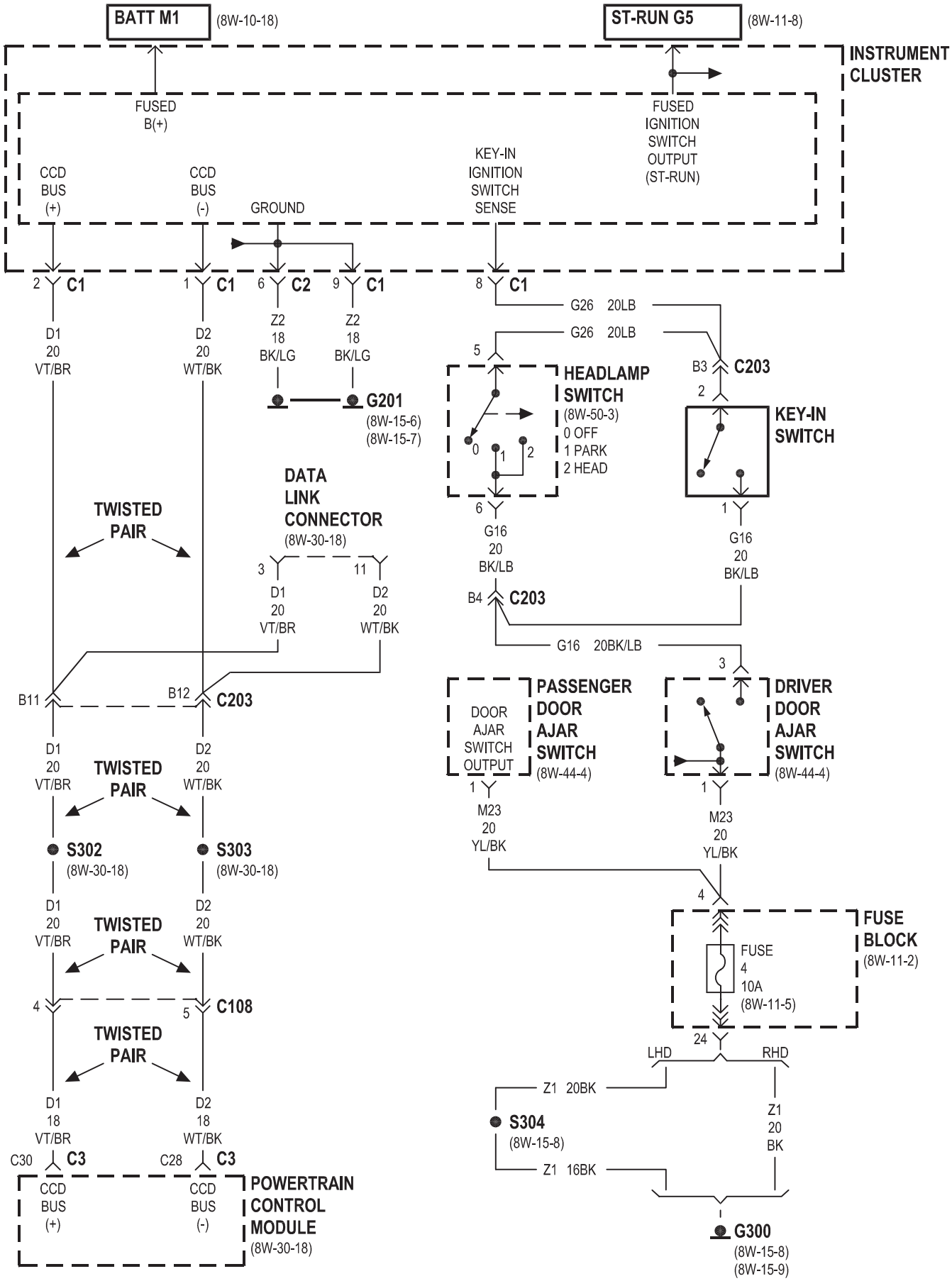

BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
34
FUSE 25 10A
(8W-10-18)
35
M1 20 PK/WT
12 C108
M1 20 PK/WT
2
FUSED B (+)
UNDERHOOD LAMP
(8W-44-3)
M1 20 PK/WT
B7 C203
M1 20 PK/WT
S204
(8W-10-18)
M1 20 PK/WT
9 C2
FUSED B(+)
HARD TOP
SOFT TOP
M1 20 PK/WT
TO DOME LAMP AND SOUND BAR DOME LAMP
(8W-44-2)
M1 20 PK/WT
TO SOUND BAR DOME LAMP
(8W-44-2)
ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 10 10A
(8W-11-8)
30
G5 20 DB/WT
A10 C202
G5 20 DB/WT
8 C2
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
G5 20 DB/WT
2
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
BRAKE SHIFT INTERLOCK SOLENOID
(8W-31-2)
INSTRUMENT CLUSTER
GROUND
6 C2
9 C1
Z2 18 BK/LG
Z2 18 BK/LG
G201
(8W-15-6)
(8W-15-7)


BATT M1
(8W-10-18)
ST-RUN G5
(8W-11-8)
INSTRUMENT CLUSTER
VOLT METER
SPEEDOMETER
OIL PRESSURE GAUGE
CRUISE CONTROL INDICATOR
FUSED B(+)
VOLT METER CONTROL
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
SPEEDOMETER CONTROL
OIL PRESSURE GAUGE CONTROL
CRUISE CONTROL INDICATOR DRIVER
CCD BUS (+)
CCD BUS (-)
FUEL GAUGE CONTROL
ENGINE COOLANT TEMPERATURE CONTROL
TACHOMETER CONTROL
GROUND
FUEL GAUGE
ENGINE COOLANT TEMPERATURE GAUGE
TACHOMETER
2 C1
1 C1
6 C2
9 C1
D1 20 VT/BR
D2 20 WT/BK
Z2 18 BK/LG
DATA LINK CONNECTOR
(8W-30-18)
TWISTED PAIR
ENGINE OIL PRESSURE SENSOR SIGNAL
ENGINE OIL PRESSURE SENSOR
(8W-30-8)
(8W-30-9)
G201
(8W-15-6)
(8W-15-7)
B11
B12
C203
VEHICLE SPEED SENSOR SIGNAL
VEHICLE SPEED SENSOR
(8W-30-10)
(8W-30-11)
FUEL LEVEL SENSOR SIGNAL
FUEL PUMP MODULE
(8W-30-3)
S302
(8W-30-18)
S303
(8W-30-18)
G7 20 WT/OR
K226 20 DB/LG
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
ENGINE COOLANT TEMPERATURE SENSOR
(8W-30-8)
(8W-30-9)
4
5
C108
OTHER
4.0L RHD
S135
(8W-30-10)
(8W-30-11)
G7 18 WT/OR
G60 18 GY/YL
K226 18 DB/LG
K2 18 TN/BK
D1 18 VT/BR
D2 18 WT/BK
C30 C3
C28 C3
B27 C2
B23 C2
C26 C3
A16 C1
CCD BUS (+)
CCD BUS (-)
VEHICLE SPEED SENSOR SIGNAL
ENGINE OIL PRESSURE SENSOR SIGNAL
FUEL LEVEL SENSOR SIGNAL
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
POWERTRAIN CONTROL MODULE
(8W-30-3)
(8W-30-8)
(8W-30-9)


BATT M1
(8W-10-18)
ST-RUN G5
(8W-11-8)
INSTRUMENT CLUSTER
AIRBAG WARNING INDICATOR
LOW FUEL INDICATOR
CHECK ENGINE INDICATOR
CHECK GAUGES INDICATOR
FUSED B(+)
AIRBAG WARNING INDICATOR DRIVER
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
LOW FUEL INDICATOR DRIVER
CHECK ENGINE INDICATOR DRIVER
CHECK GAUGES INDICATOR DRIVER
SEAT BELT SWITCH SENSE
CCD BUS (+)
CCD BUS (-)
ODOMETER CONTROL
TRIP RESET
GROUND
ODOMETER/ TRIP ODOMETER
TRIP ODOMETER RESET SWITCH
2 C1
1 C1
6 C2
9 C1
10 C1
DATA LINK CONNECTOR
(8W-30-18)
D1 20 VT/BR
D2 20 WT/BK
Z2 18 BK/LG
G10 20 LG/RD
G201
(8W-15-6)
(8W-15-7)
C3 C204
LHD
RHD
G6 C322
6 C322
TWISTED PAIR
B11
B12 C203
S303
(8W-30-18)
S302
(8W-30-18)
D1 18 VT/BR
D2 18 WT/BK
4
5 C108
19
18
CCD BUS (+)
CCD BUS (-)
AIRBAG CONTROL MODULE
(8W-43-3)
SEAT BELT SWITCH (EXCEPT LHD BUILT-UP-EXPORT)
Z1 20 BK
S309
(8W-15-10)
Z1 12 BK
G5 C322
5 C322
G302
(8W-15-10)
C30 C3
C28 C3
POWERTRAIN CONTROL MODULE
(8W-30-18)

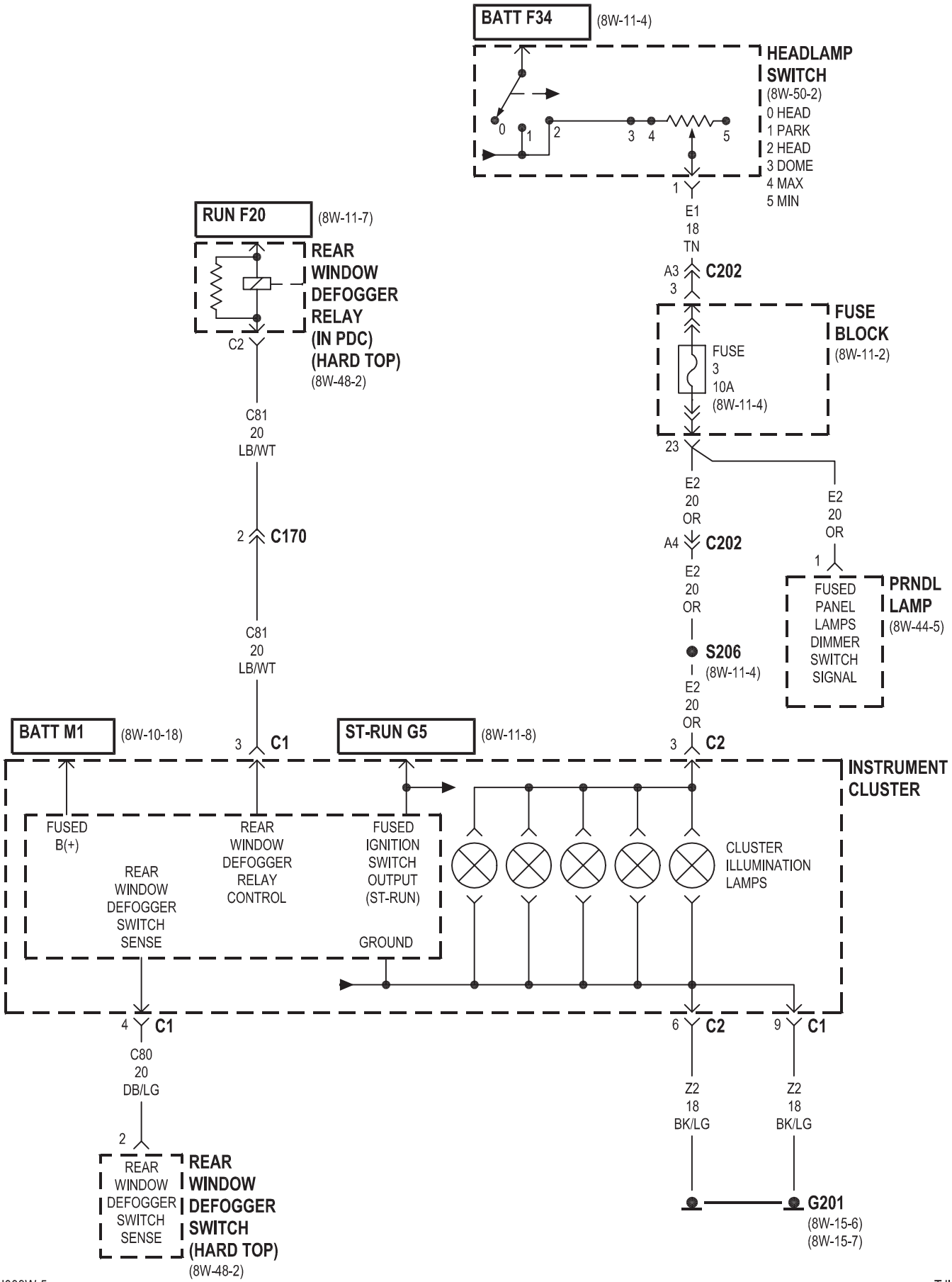

BATT M1
(8W-10-18)
ST-RUN G5
(8W-11-8)
INSTRUMENT CLUSTER
SENTRY KEY IMMOBILIZER MODULE INDICATOR
SEAT BELT WARNING INDICATOR
UPSHIFT INDICATOR (M/T)
4WD INDICATOR
FUSED B(+)
SENTRY KEY IMMOBILIZER MODULE INDICATOR DRIVER
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
SEAT BELT WARNING INDICATOR DRIVER
UPSHIFT INDICATOR DRIVER (M/T)
CCD BUS (+)
CCD BUS (-)
GROUND
2 C1
1 C1
6 C2
9 C1
5 C1
D1 20 VT/BR
D2 20 WT/BK
Z2 18 BK/LG
Z2 18 BK/LG
G107 20 BK/RD
5 C170
G107 20 BK/RD
13 C103
G107 20 BK/RD
A
TRANSFER CASE SWITCH
(8W-31-2)
B
Z1 20 BK
S132
(8W-15-12)
(8W-15-13)
(8W-15-14)
Z1 14 BK
G105
(8W-15-14)
DATA LINK CONNECTOR
(8W-30-18)
3
11
G201
(8W-15-6)
(8W-15-7)
TWISTED PAIR
B11
B12
C203
S302
(8W-30-18)
S303
(8W-30-18)
4
5
C108
D1 18 VT/BR
D2 18 WT/BK
C30 C3
C28 C3
POWERTRAIN CONTROL MODULE
(8W-30-18)

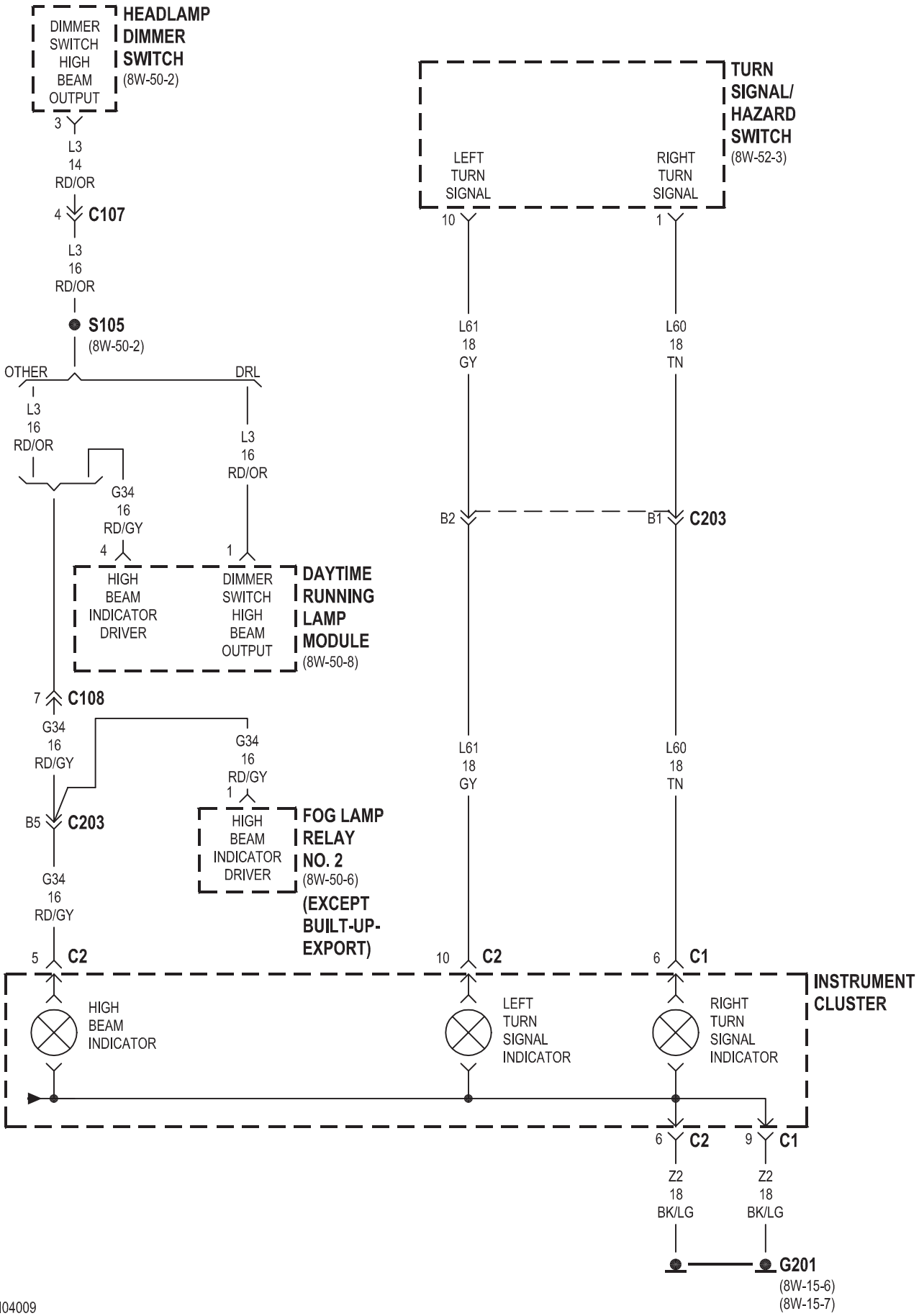

ST-RUN G5
(8W-11-8)
BATT M1
(8W-10-18)
INSTRUMENT CLUSTER
BRAKE WARNING INDICATOR
ABS WARNING INDICATOR
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
FUSED B(+)
GROUND
2 C2
G99 20 GY/WT
4 C2
G19 20 LG/OR
6 C2
9 C1
Z2 18 BK/LG
Z2 18 BK/LG
G201
(8W-15-6)
(8W-15-7)
B14 C203
OTHERS
ABS
2 C108
3 C170
G99 20 GY/WT
2
BRAKE WARNING INDICATOR SWITCH
1
G9 20 GY/BK
11 C106
G19 20 LG/OR
G19 20 LG/OR
G19 20 LG/OR
2 C108
NOT USED
B
ABS WARNING INDICATOR DRIVER
ABS DIODE
(8W-35-3)
1 C1
ABS WARNING INDICATOR DRIVER
CONTROLLER ANTI-LOCK BRAKE
(8W-35-3)
G9 20 GY/BK
2
IGNITION SWITCH
(8W-10-13)
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
1
Z1 16 BK
S304
(8W-15-8)
(8W-15-9)
Z1 16 BK
G300
(8W-15-8)
(8W-15-9)
LHD
RHD
G9 C322
9 C322
G9 20 GY/BK
G9 20 GY/BK
PARK BRAKE SWITCH



TJI04007

J008W-5


BATT F34
(8W-11-4)
HEADLAMP SWITCH
(8W-50-2)
0 HEAD
1 PARK
2 HEAD
3 DOME
4 MAX
5 MIN
0 1 2 3 4 5
1
E1
18
TN
A3
3
C202
RUN F20
(8W-11-7)
REAR WINDOW DEFOGGER RELAY (IN PDC) (HARD TOP)
(8W-48-2)
C2
FUSE BLOCK
(8W-11-2)
FUSE
3
10A
(8W-11-4)
23
C81
20
LB/WT
2
C170
C81
20
LB/WT
E2
20
OR
A4
C202
E2
20
OR
S206
(8W-11-4)
E2
20
OR
E2
20
OR
1
FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
PRNDL LAMP
(8W-44-5)
BATT M1
(8W-10-18)
3
C1
ST-RUN G5
(8W-11-8)
3
C2
INSTRUMENT CLUSTER
FUSED B(+)
REAR WINDOW DEFOGGER SWITCH SENSE
REAR WINDOW DEFOGGER RELAY CONTROL
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
GROUND
CLUSTER ILLUMINATION LAMPS
4
C1
6
C2
9
C1
C80
20
DB/LG
Z2
18
BK/LG
Z2
18
BK/LG
2
REAR WINDOW DEFOGGER SWITCH SENSE
REAR WINDOW DEFOGGER SWITCH (HARD TOP)
(8W-48-2)
G201
(8W-15-6)
(8W-15-7)

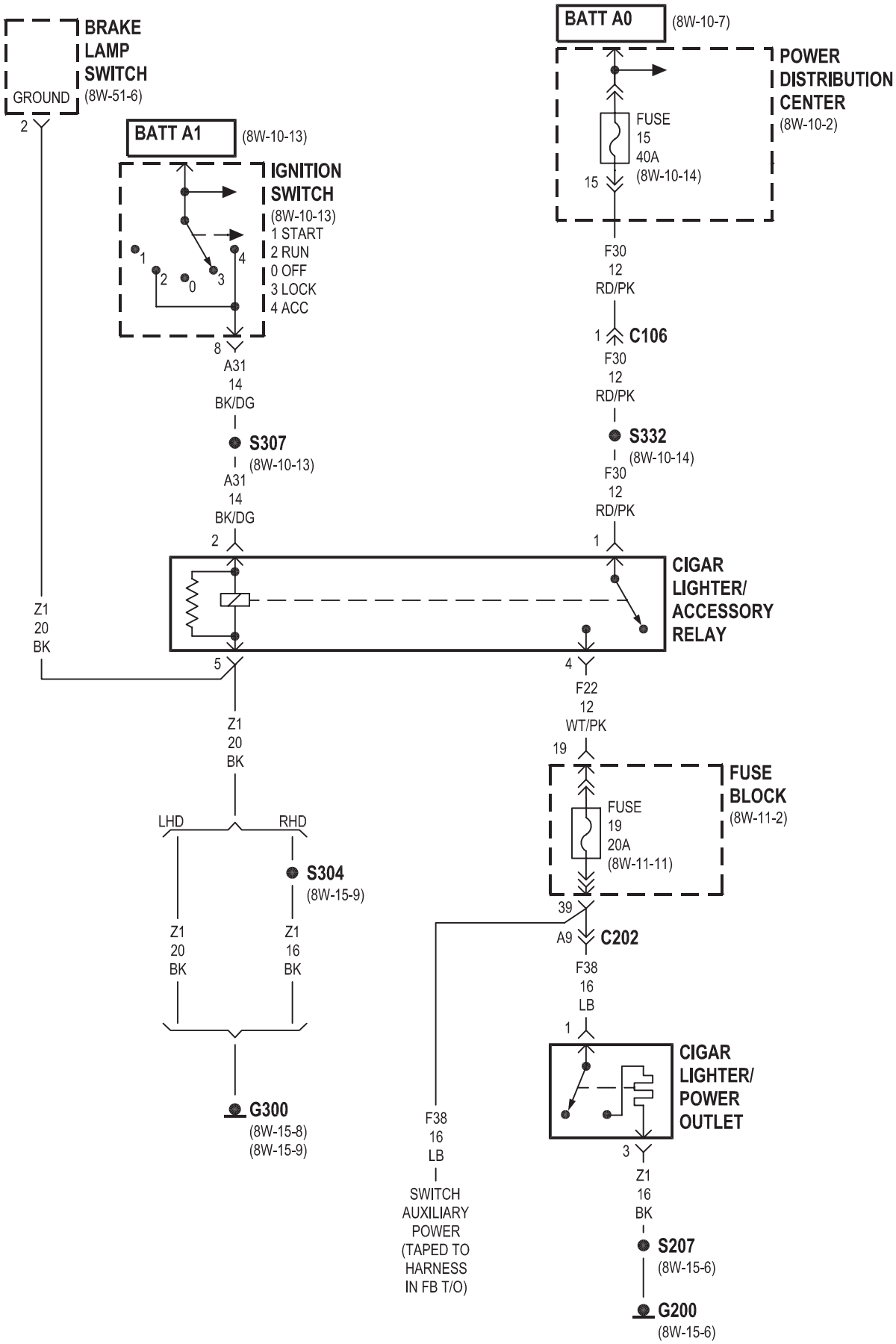


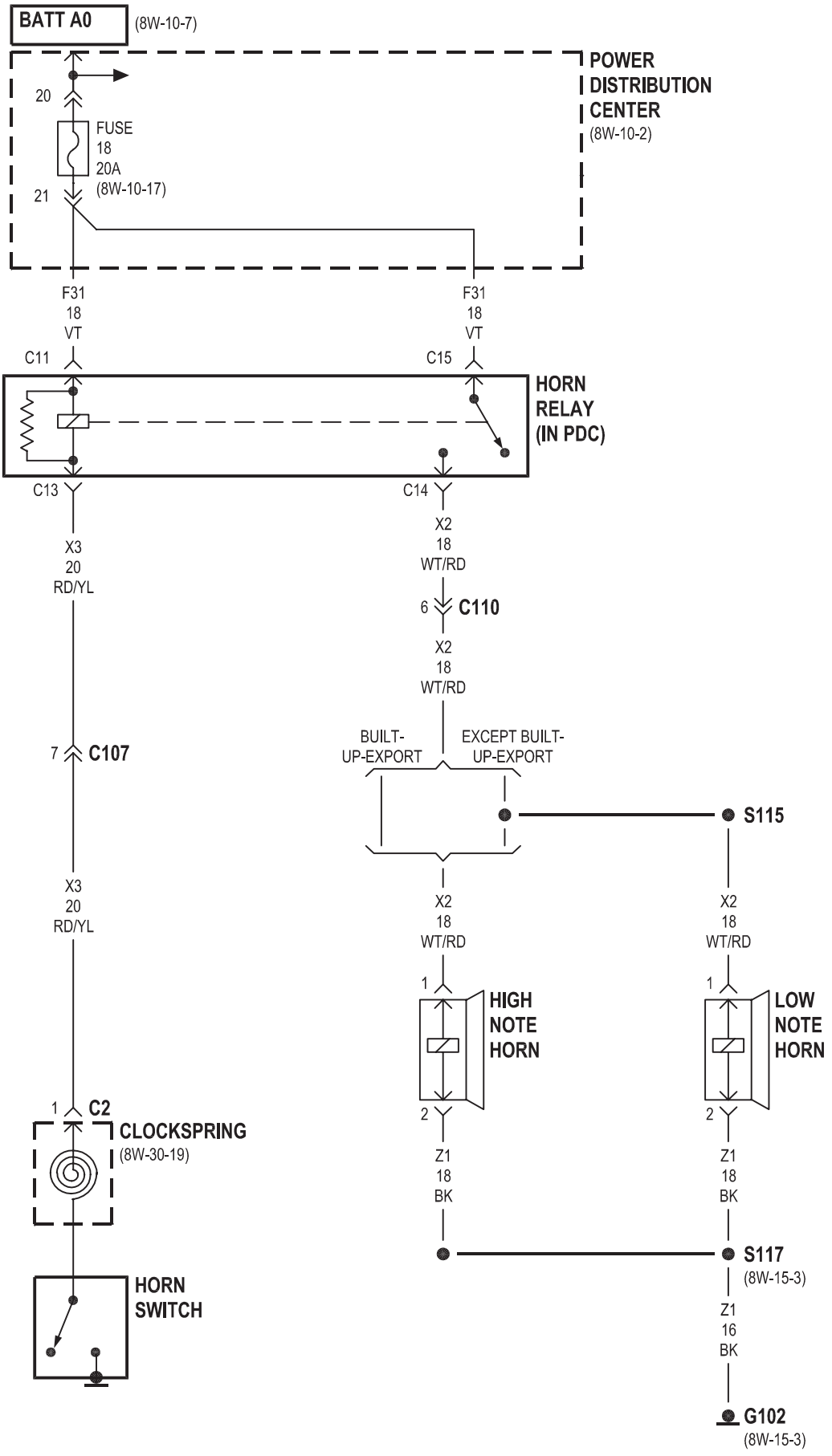
TJI04009

J008W-5

8W-41 HORN/CIGAR LIGHTER/POWER OUTLET

Component	Page
Brake Lamp Switch	8W-41-2
Cigar Lighter/Accessory Relay	8W-41-2
Cigar Lighter/Power Outlet	8W-41-2
Clockspring	8W-41-3
Fuse 15 (PDC)	8W-41-2
Fuse 18 (PDC)	8W-41-3
Fuse 19 (FB)	8W-41-2
Fuse Block	8W-41-2
G102	8W-41-3
G200	8W-41-2
G300	8W-41-2
High Note Horn	8W-41-3
Horn Relay	8W-41-3
Horn Switch	8W-41-3
Ignition Switch	8W-41-2
Low Note Horn	8W-41-3
Power Distribution Center	8W-41-2, 3

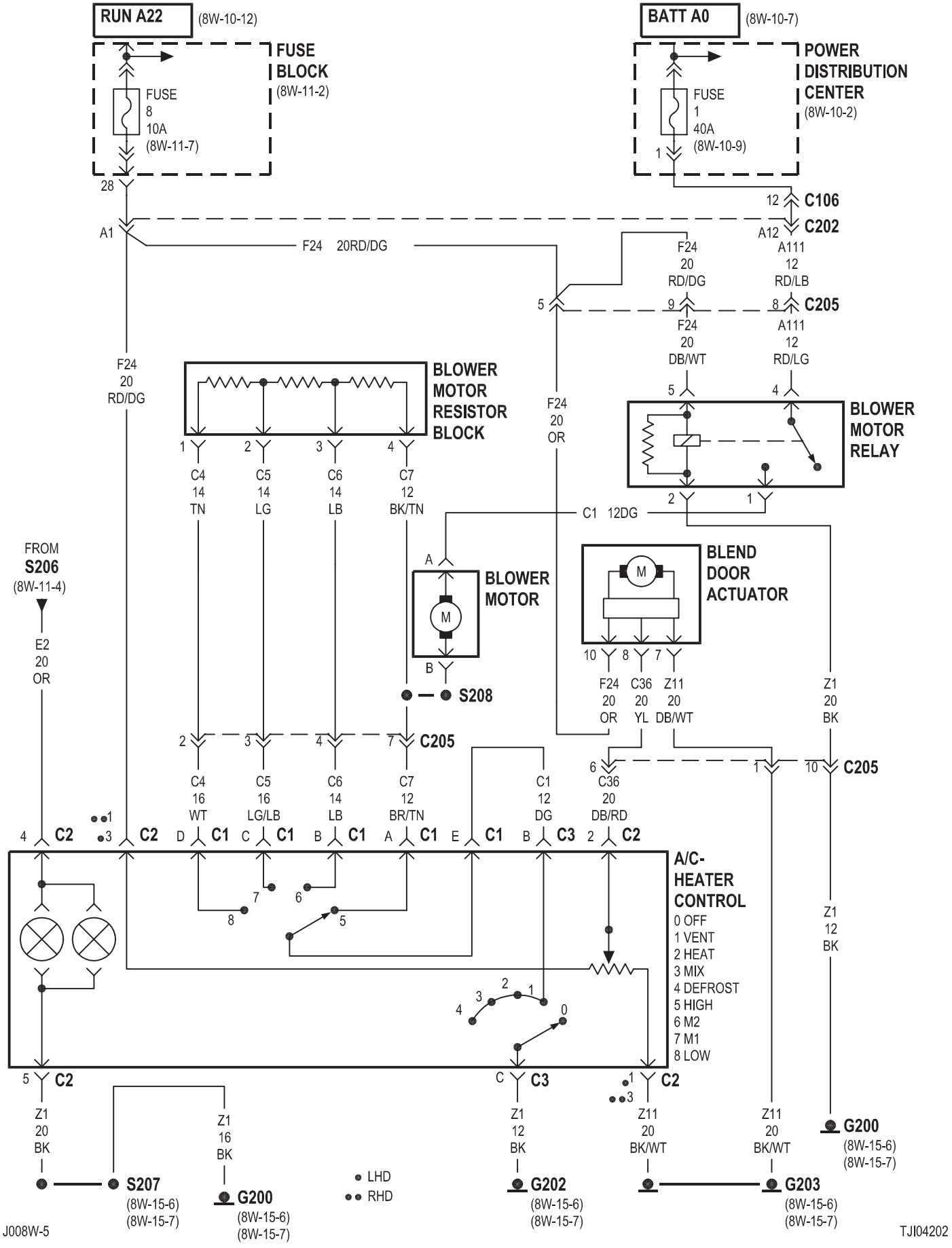

BRAKE
LAMP
SWITCH
GROUND
(8W-51-6)
2
BATT A1
(8W-10-13)
IGNITION
SWITCH
(8W-10-13)
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
8
A31
14
BK/DG
S307
(8W-10-13)
A31
14
BK/DG
2
Z1
20
BK
5
Z1
20
BK
LHD
RHD
S304
(8W-15-9)
Z1
20
BK
Z1
16
BK
G300
(8W-15-8)
(8W-15-9)
BATT A0
(8W-10-7)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
15
40A
(8W-10-14)
15
F30
12
RD/PK
1
C106
F30
12
RD/PK
S332
(8W-10-14)
F30
12
RD/PK
1
CIGAR
LIGHTER/
ACCESSORY
RELAY
4
F22
12
WT/PK
19
FUSE
BLOCK
(8W-11-2)
FUSE
19
20A
(8W-11-11)
39
A9
C202
F38
16
LB
1
CIGAR
LIGHTER/
POWER
OUTLET
3
Z1
16
BK
S207
(8W-15-6)
G200
(8W-15-6)
F38
16
LB
SWITCH
AUXILIARY
POWER
(TAPED TO
HARNESS
IN FB T/O)

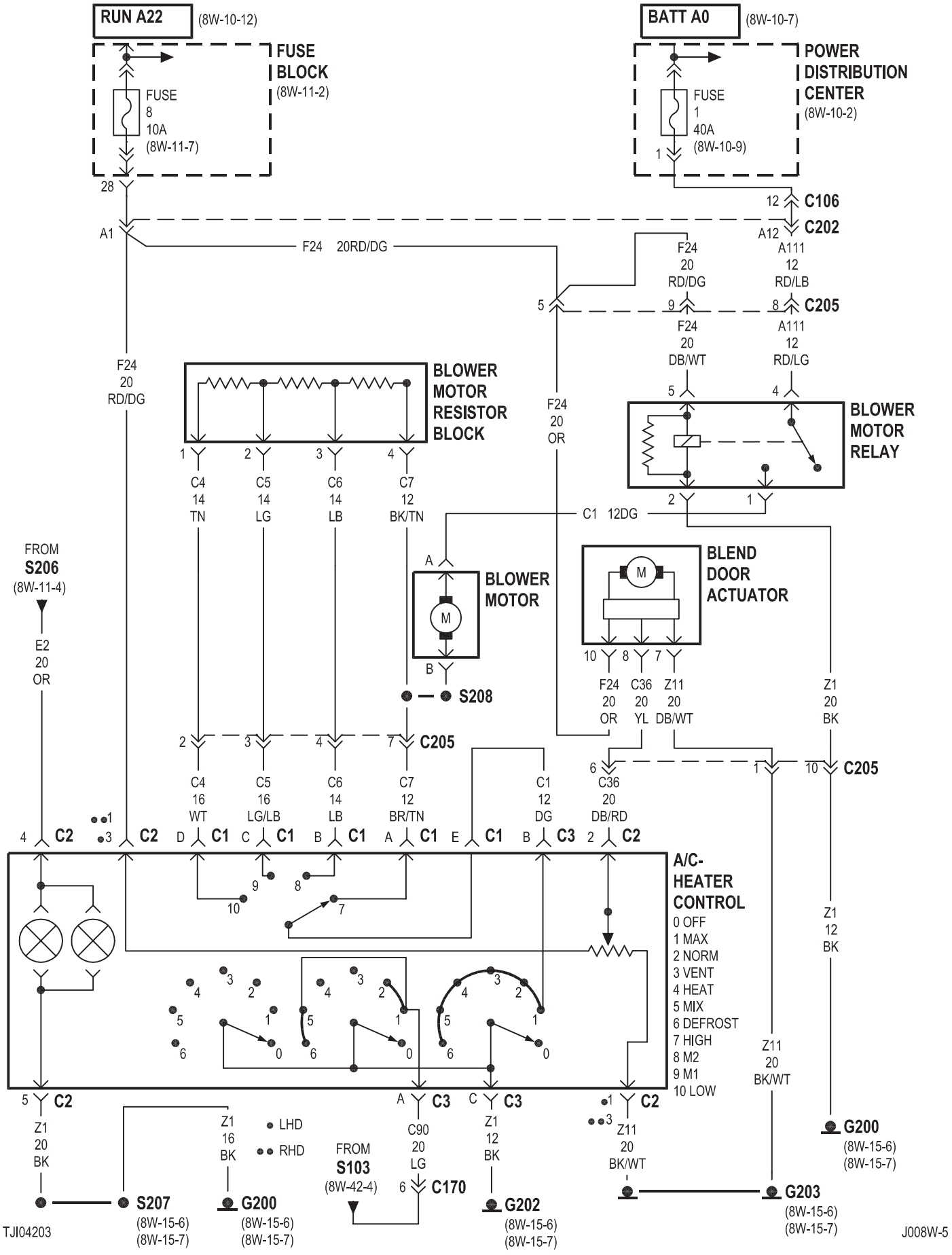

BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
20
FUSE 18 20A
(8W-10-17)
21
F31 18 VT
C11
C15
F31 18 VT
HORN RELAY (IN PDC)
C13
C14
X3 20 RD/YL
X2 18 WT/RD
6 C110
X2 18 WT/RD
BUILT-UP-EXPORT
EXCEPT BUILT-UP-EXPORT
S115
7 C107
X3 20 RD/YL
X2 18 WT/RD
X2 18 WT/RD
1
HIGH NOTE HORN
LOW NOTE HORN
2
Z1 18 BK
Z1 18 BK
1 C2
CLOCKSPRING
(8W-30-19)
S117
(8W-15-3)
Z1 16 BK
HORN SWITCH
G102
(8W-15-3)

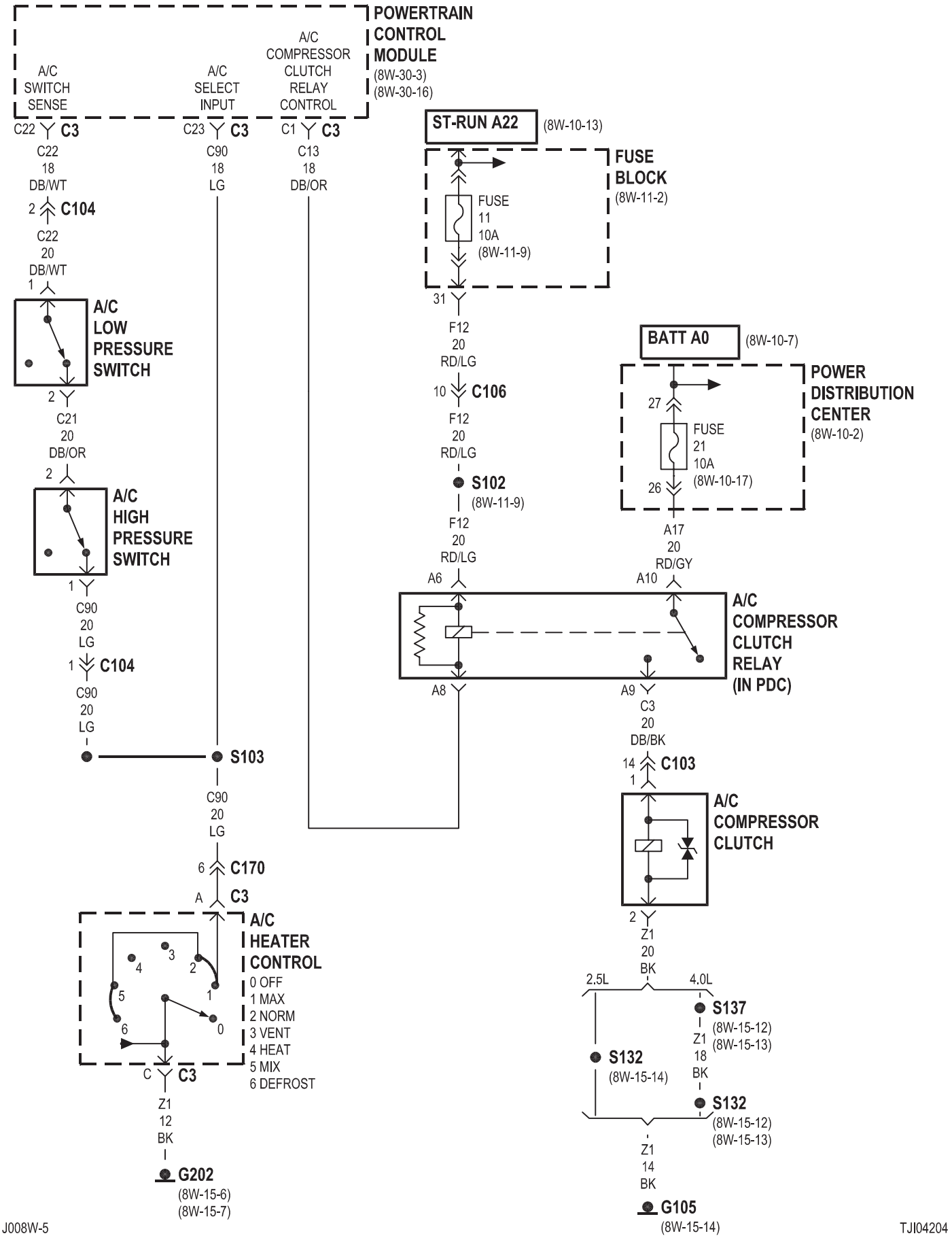
8W-42 AIR CONDITIONING-HEATER

Component	Page
A/C Compressor Clutch	8W-42-4
A/C Compressor Clutch Relay	8W-42-4
A/C Heater Control	8W-42-4
A/C High Pressure Switch	8W-42-4
A/C Low Pressure Switch	8W-42-4
A/C- Heater Control	8W-42-2, 3
Blend Door Actuator	8W-42-2, 3
Blower Motor	8W-42-2, 3
Blower Motor Relay	8W-42-2, 3
Blower Motor Resistor Block	8W-42-2, 3
Fuse 1 (PDC)	8W-42-2, 3
Fuse 8 (FB)	8W-42-2, 3
Fuse 11 (FB)	8W-42-4
Fuse 21 (PDC)	8W-42-4
Fuse Block	8W-42-2, 3, 4
G105	8W-42-4
G200	8W-42-2, 3
G202	8W-42-2, 3, 4
G203	8W-42-2, 3
Power Distribution Center	8W-42-2, 3, 4
Powertrain Control Module	8W-42-4

HEATER ONLY

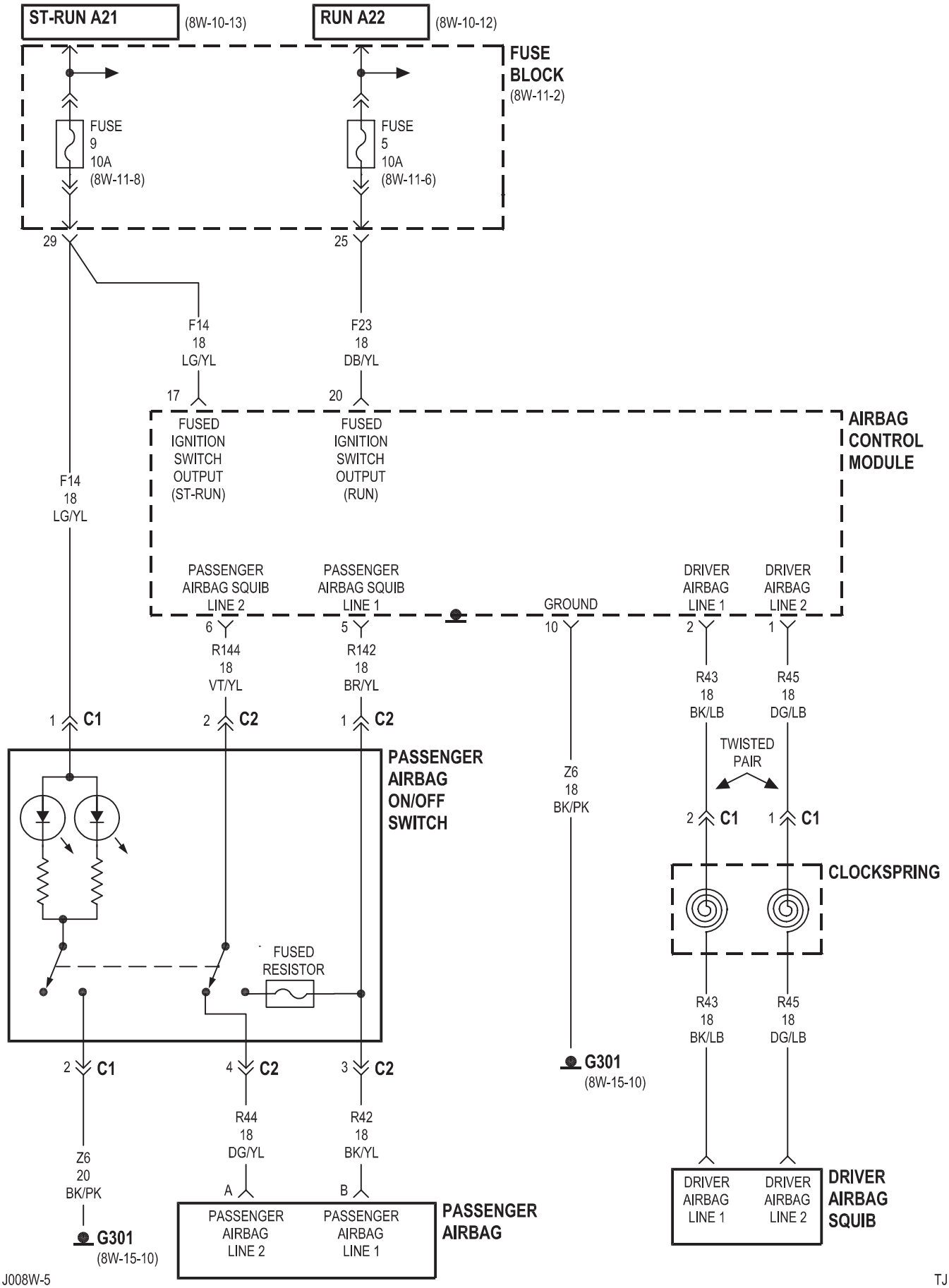

RUN A22
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 8 10A
(8W-11-7)
BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 1 40A
(8W-10-9)
C106
C202
F24 20RD/DG
F24 20 RD/DG
A111 12 RD/LB
C205
F24 20 DB/WT
A111 12 RD/LG
BLOWER MOTOR RESISTOR BLOCK
C4 14 TN
C5 14 LG
C6 14 LB
C7 12 BK/TN
F24 20 OR
BLOWER MOTOR RELAY
C1 12DG
FROM S206
(8W-11-4)
E2 20 OR
BLOWER MOTOR
S208
BLEND DOOR ACTUATOR
F24 20 OR
C36 20 YL
Z11 20 DB/WT
Z1 20 BK
C4 16 WT
C5 16 LG/LB
C6 14 LB
C7 12 BR/TN
C1 12 DG
C36 20 DB/RD
A/C-HEATER CONTROL
0 OFF
1 VENT
2 HEAT
3 MIX
4 DEFROST
5 HIGH
6 M2
7 M1
8 LOW
Z1 12 BK
Z1 20 BK
Z1 16 BK
Z1 12 BK
Z11 20 BK/WT
Z11 20 BK/WT
S207
(8W-15-6)
(8W-15-7)
G200
(8W-15-6)
(8W-15-7)
LHD
RHD
G202
(8W-15-6)
(8W-15-7)
G203
(8W-15-6)
(8W-15-7)
G200
(8W-15-6)
(8W-15-7)
J008W-5
TJI04202

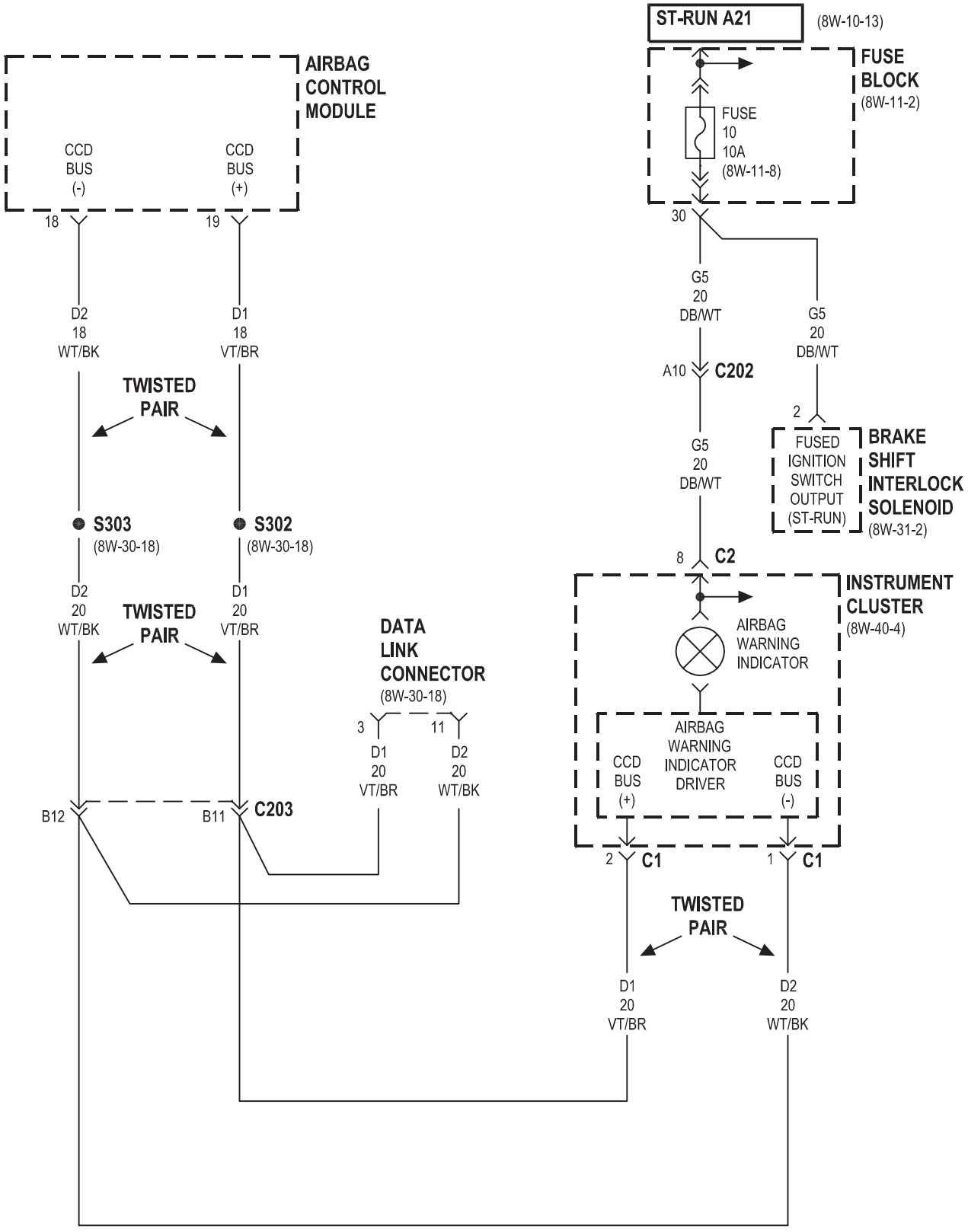

RUN A22
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 8 10A
(8W-11-7)
BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 1 40A
(8W-10-9)
28
A1
F24 20RD/DG
12 C106
A12 C202
F24 20 RD/DG
A111 12 RD/LB
9 C205
8 C205
F24 20 DB/WT
A111 12 RD/LG
5
4
BLOWER MOTOR RELAY
2
1
C1 12DG
F24 20 RD/DG
F24 20 OR
BLOWER MOTOR RESISTOR BLOCK
1 2 3 4
C4 14 TN
C5 14 LG
C6 14 LB
C7 12 BK/TN
FROM S206
(8W-11-4)
E2 20 OR
A
BLOWER MOTOR
M
B
S208
BLEND DOOR ACTUATOR
10 8 7
F24 20 OR
C36 20 YL
Z11 20 DB/WT
Z1 20 BK
2 3 4 7 C205
6 1 10 C205
C4 16 WT
C5 16 LG/LB
C6 14 LB
C7 12 BR/TN
C1 12 DG
C36 20 DB/RD
4 C2
1
3 C2
D C1
C C1
B C1
A C1
E C1
B C3
2 C2
A/C-HEATER CONTROL
0 OFF
1 MAX
2 NORM
3 VENT
4 HEAT
5 MIX
6 DEFROST
7 HIGH
8 M2
9 M1
10 LOW
Z1 12 BK
Z11 20 BK/WT
5 C2
A C3
C C3
1
3 C2
Z1 20 BK
Z1 16 BK
LHD
RHD
FROM S103
(8W-42-4)
C90 20 LG
6 C170
Z1 12 BK
Z11 20 BK/WT
G200
(8W-15-6)
(8W-15-7)
S207
(8W-15-6)
(8W-15-7)
G200
(8W-15-6)
(8W-15-7)
G202
(8W-15-6)
(8W-15-7)
G203
(8W-15-6)
(8W-15-7)
TJI04203
J008W-5


POWERTRAIN CONTROL MODULE
(8W-30-3)
(8W-30-16)
A/C SWITCH SENSE
A/C SELECT INPUT
A/C COMPRESSOR CLUTCH RELAY CONTROL
C22 C3
C23 C3
C1 C3
C22 18 DB/WT
C90 18 LG
C13 18 DB/OR
2 C104
C22 20 DB/WT
1
A/C LOW PRESSURE SWITCH
2
C21 20 DB/OR
2
A/C HIGH PRESSURE SWITCH
1
C90 20 LG
1 C104
C90 20 LG
S103
C90 20 LG
6 C170
A C3
A/C HEATER CONTROL
0 OFF
1 MAX
2 NORM
3 VENT
4 HEAT
5 MIX
6 DEFROST
C C3
Z1 12 BK
G202
(8W-15-6)
(8W-15-7)
ST-RUN A22 (8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 11 10A
(8W-11-9)
31
F12 20 RD/LG
10 C106
F12 20 RD/LG
S102
(8W-11-9)
F12 20 RD/LG
A6
A8
BATT A0 (8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
27
FUSE 21 10A
(8W-10-17)
26
A17 20 RD/GY
A10
A9
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
C3 20 DB/BK
14 C103
1
A/C COMPRESSOR CLUTCH
2
Z1 20 BK
2.5L
4.0L
S137
(8W-15-12)
(8W-15-13)
Z1 18 BK
S132
(8W-15-14)
S132
(8W-15-12)
(8W-15-13)
Z1 14 BK
G105
(8W-15-14)

8W-43 AIRBAG SYSTEM

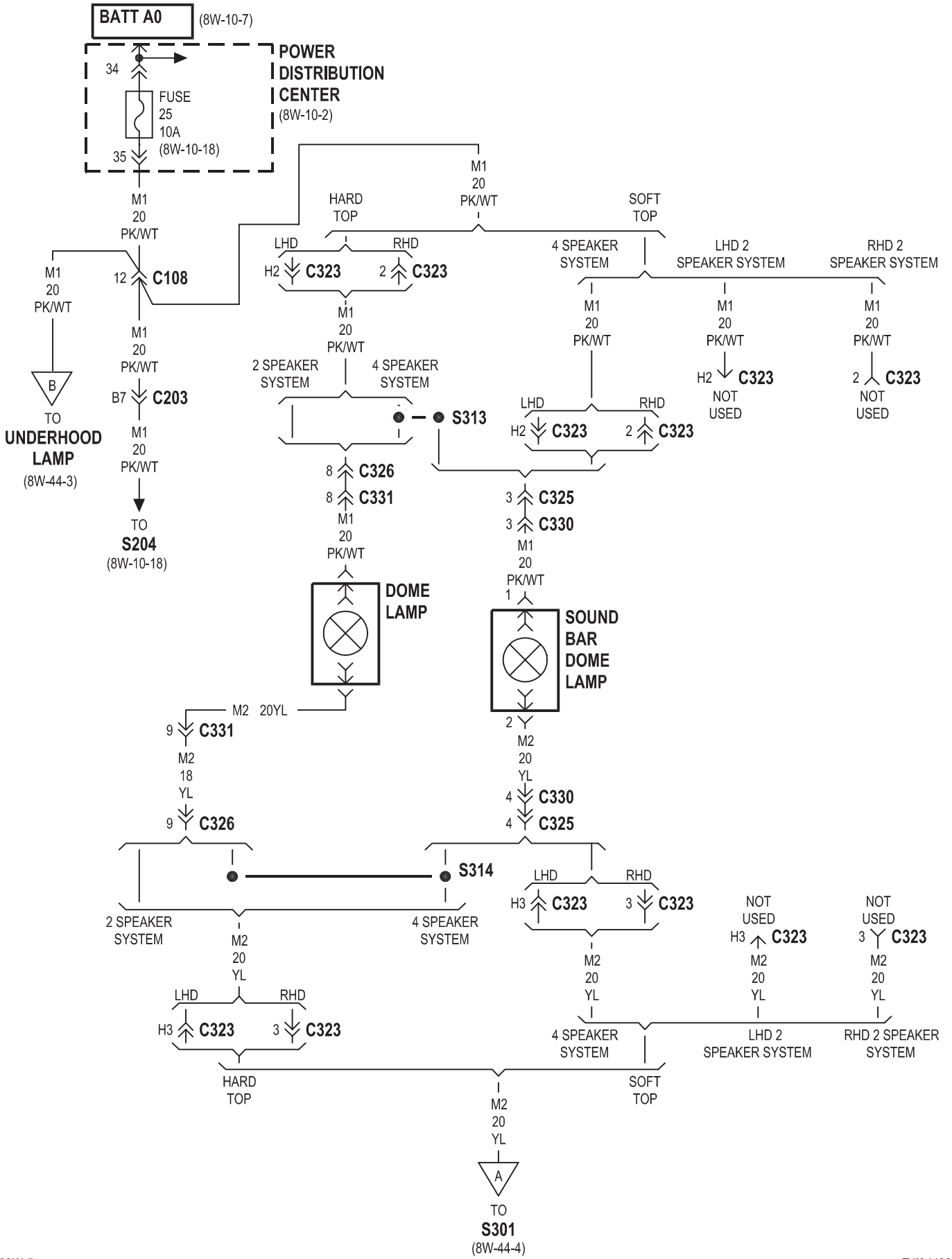
Component	Page
Airbag Control Module	8W-43-2, 3
Airbag Warning Indicator	8W-43-3
Brake Shift Interlock Solenoid	8W-43-3
Clockspring	8W-43-2
Data Link Connector	8W-43-3
Driver Airbag Squib	8W-43-2
Fuse 5 (FB)	8W-43-2
Fuse 9 (FB)	8W-43-2
Fuse 10 (FB)	8W-43-3
Fuse Block	8W-43-2, 3
G301	8W-43-2
Instrument Cluster	8W-43-3
Passenger Airbag	8W-43-2
Passenger Airbag On/Off Switch	8W-43-2

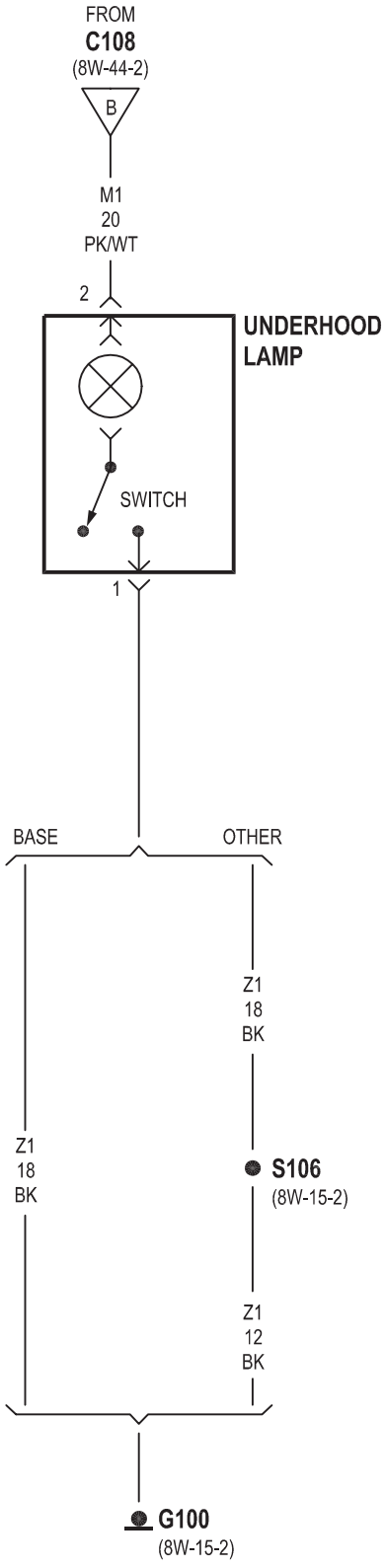

ST-RUN A21
(8W-10-13)
RUN A22
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 9 10A
(8W-11-8)
FUSE 5 10A
(8W-11-6)
29
25
F14 18 LG/YL
F23 18 DB/YL
17
20
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
FUSED IGNITION SWITCH OUTPUT (RUN)
AIRBAG CONTROL MODULE
F14 18 LG/YL
PASSENGER AIRBAG SQUIB LINE 2
PASSENGER AIRBAG SQUIB LINE 1
GROUND
DRIVER AIRBAG LINE 1
DRIVER AIRBAG LINE 2
6
5
10
2
1
R144 18 VT/YL
R142 18 BR/YL
R43 18 BK/LB
R45 18 DG/LB
1 C1
2 C2
1 C2
TWISTED PAIR
Z6 18 BK/PK
2 C1
1 C1
PASSENGER AIRBAG ON/OFF SWITCH
CLOCKSPRING
FUSED RESISTOR
R43 18 BK/LB
R45 18 DG/LB
2 C1
4 C2
3 C2
G301
(8W-15-10)
R44 18 DG/YL
R42 18 BK/YL
Z6 20 BK/PK
A
B
DRIVER AIRBAG LINE 1
DRIVER AIRBAG LINE 2
DRIVER AIRBAG SQUIB
PASSENGER AIRBAG LINE 2
PASSENGER AIRBAG LINE 1
PASSENGER AIRBAG
G301
(8W-15-10)

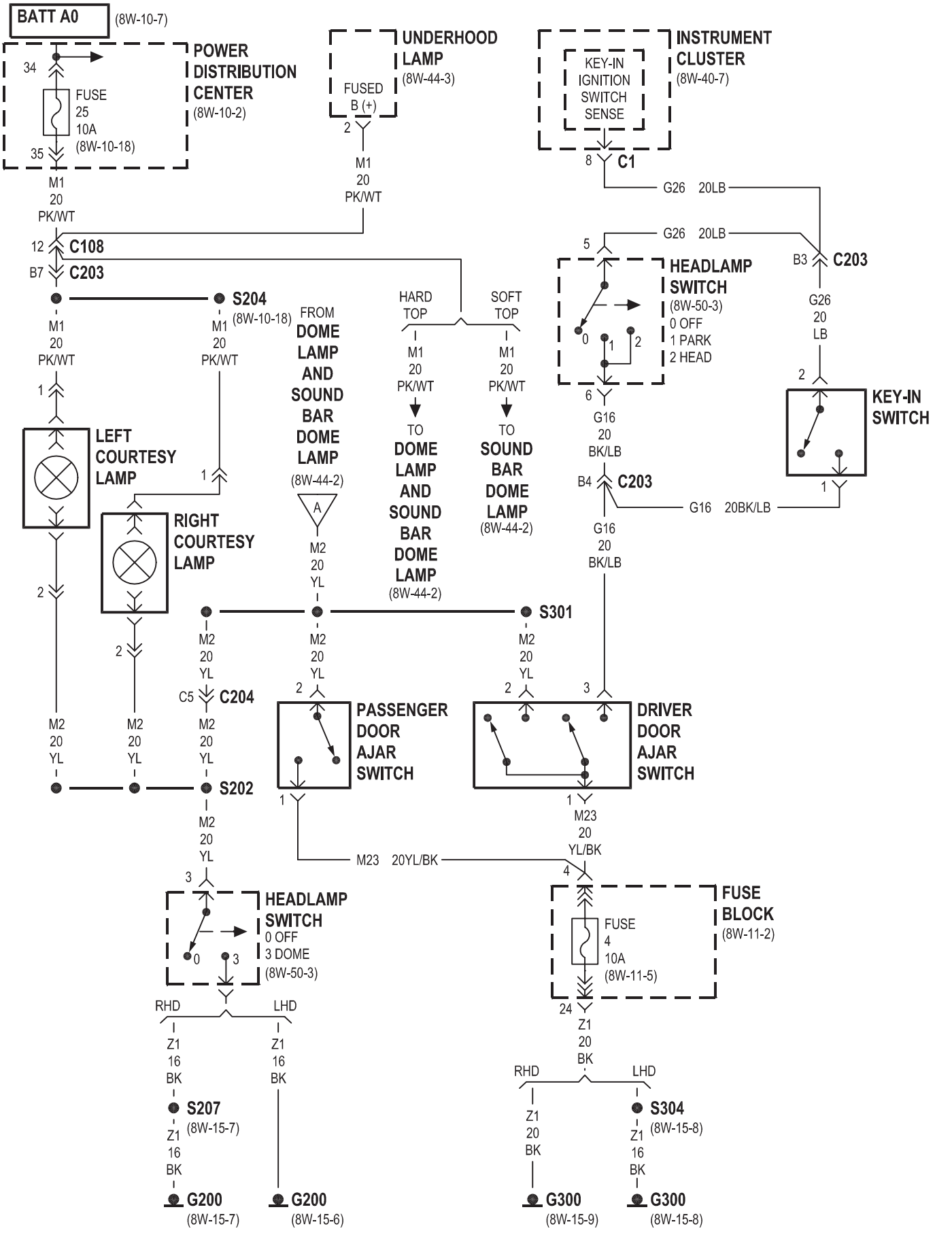

ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 10 10A
(8W-11-8)
30
AIRBAG CONTROL MODULE
CCD BUS (-)
CCD BUS (+)
18
19
G5 20 DB/WT
G5 20 DB/WT
A10 C202
2
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
BRAKE SHIFT INTERLOCK SOLENOID
(8W-31-2)
D2 18 WT/BK
D1 18 VT/BR
TWISTED PAIR
S303
(8W-30-18)
S302
(8W-30-18)
8
C2
INSTRUMENT CLUSTER
(8W-40-4)
AIRBAG WARNING INDICATOR
D2 20 WT/BK
TWISTED PAIR
D1 20 VT/BR
DATA LINK CONNECTOR
(8W-30-18)
3
11
D1 20 VT/BR
D2 20 WT/BK
AIRBAG WARNING INDICATOR DRIVER
CCD BUS (+)
CCD BUS (-)
B12
B11
C203
2 C1
1 C1
TWISTED PAIR
D1 20 VT/BR
D2 20 WT/BK

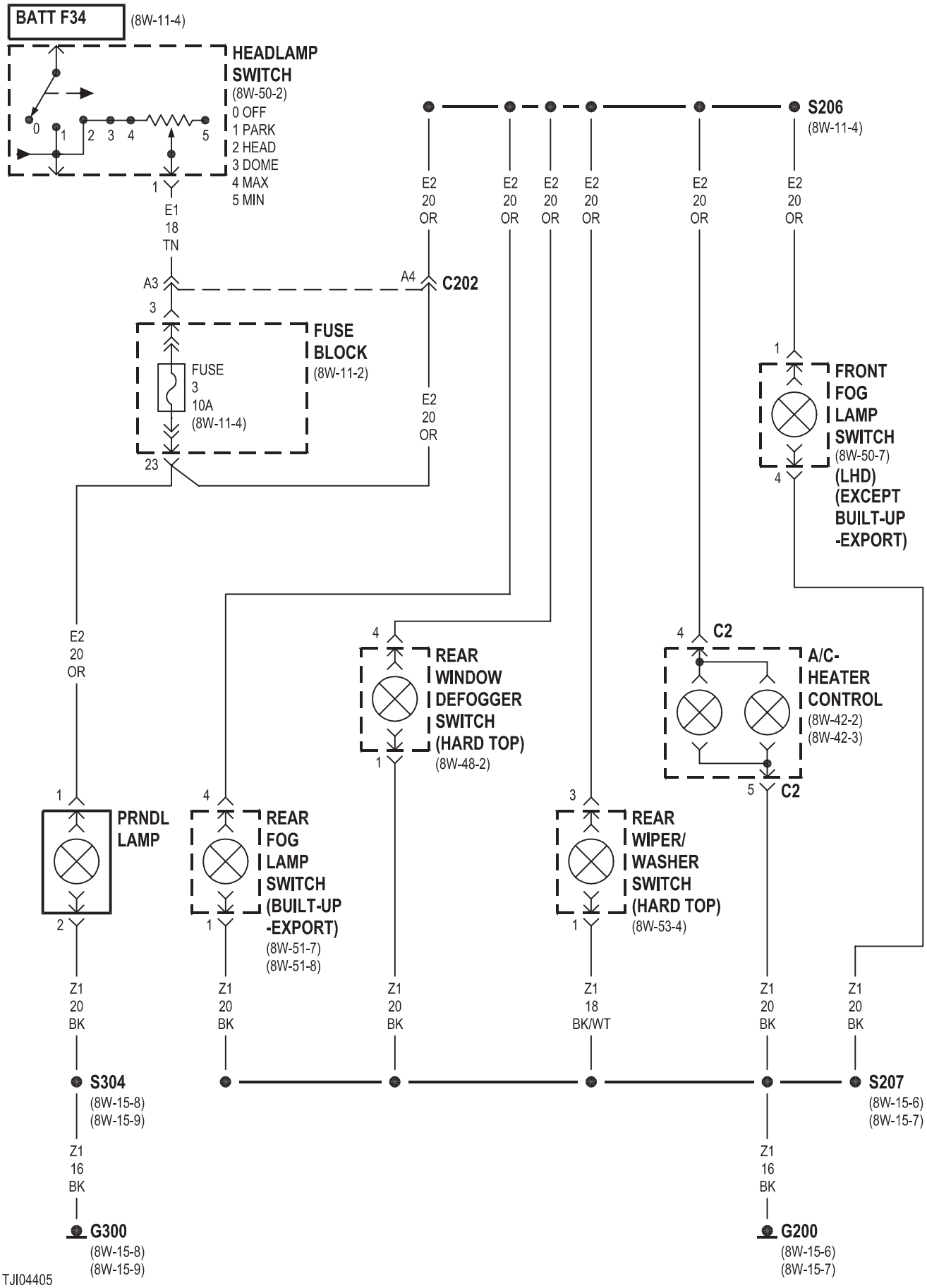
8W-44 INTERIOR LIGHTING

Component	Page
A/C- Heater Control	8W-44-5
Dome Lamp	8W-44-2
Dome Lamp And Sound Bar Dome Lamp	8W-44-4
Driver Door Ajar Switch	8W-44-4
Front Fog Lamp Switch	8W-44-5
Fuse 3 (FB)	8W-44-5, 6
Fuse 4 (FB)	8W-44-4
Fuse 25 (PDC)	8W-44-2, 4
Fuse Block	8W-44-4, 5, 6
G100	8W-44-3
G200	8W-44-4, 5
G201	8W-44-6
G300	8W-44-4, 5
Headlamp Switch	8W-44-4, 5, 6
Instrument Cluster	8W-44-4, 6
Key-In Switch	8W-44-4
Left Courtesy Lamp	8W-44-4
Passenger Door Ajar Switch	8W-44-4
Power Distribution Center	8W-44-2, 4
PRNDL Lamp	8W-44-5, 6
Radio	8W-44-6
Rear Fog Lamp Switch	8W-44-5
Rear Window Defogger Switch	8W-44-5
Rear Wiper/Washer Switch	8W-44-5
Right Courtesy Lamp	8W-44-4
Sound Bar Dome Lamp	8W-44-2, 4
Underhood Lamp	8W-44-3, 4


BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
34
FUSE 25 10A
(8W-10-18)
35
M1 20 PK/WT
12 C108
B7 C203
TO UNDERHOOD LAMP
(8W-44-3)
TO S204
(8W-10-18)
HARD TOP
SOFT TOP
LHD
RHD
H2 C323
2 C323
4 SPEAKER SYSTEM
LHD 2 SPEAKER SYSTEM
RHD 2 SPEAKER SYSTEM
NOT USED
2 SPEAKER SYSTEM
S313
8 C326
8 C331
3 C325
3 C330
DOME LAMP
SOUND BAR DOME LAMP
M2 20YL
9 C331
M2 18 YL
9 C326
M2 20 YL
4 C330
4 C325
S314
H3 C323
3 C323
TO S301
(8W-44-4)

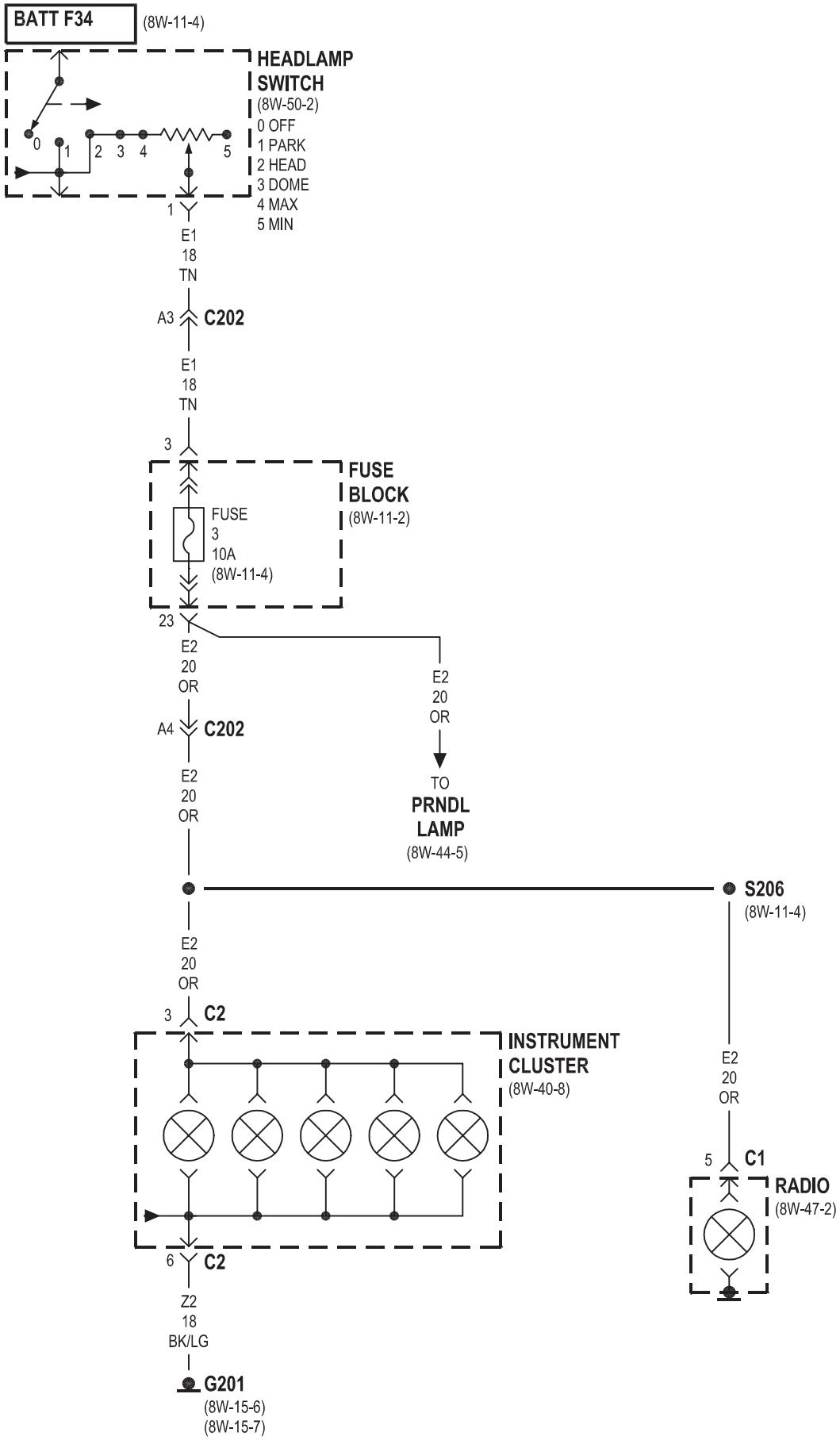

FROM
C108
(8W-44-2)
B
M1
20
PK/WT
2
UNDERHOOD
LAMP
SWITCH
1
BASE
OTHER
Z1
18
BK
Z1
18
BK
S106
(8W-15-2)
Z1
12
BK
G100
(8W-15-2)


BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
34
FUSE 25 10A
(8W-10-18)
35
M1 20 PK/WT
UNDERHOOD LAMP
(8W-44-3)
FUSED B (+)
2
M1 20 PK/WT
INSTRUMENT CLUSTER
(8W-40-7)
KEY-IN IGNITION SWITCH SENSE
8
C1
G26 20LB
12
C108
B7
C203
S204
(8W-10-18)
FROM DOME LAMP AND SOUND BAR DOME LAMP
(8W-44-2)
A
HARD TOP
SOFT TOP
TO DOME LAMP AND SOUND BAR DOME LAMP
(8W-44-2)
TO SOUND BAR DOME LAMP
(8W-44-2)
HEADLAMP SWITCH
(8W-50-3)
0 OFF
1 PARK
2 HEAD
5
6
G16 20 BK/LB
B3
C203
G26 20 LB
2
KEY-IN SWITCH
1
B4
C203
G16 20BK/LB
LEFT COURTESY LAMP
RIGHT COURTESY LAMP
M2 20 YL
S301
C5
C204
S202
PASSENGER DOOR AJAR SWITCH
DRIVER DOOR AJAR SWITCH
M23 20 YL/BK
M23 20YL/BK
HEADLAMP SWITCH
0 OFF
3 DOME
(8W-50-3)
RHD
LHD
Z1 16 BK
S207
(8W-15-7)
G200
(8W-15-7)
G200
(8W-15-6)
FUSE BLOCK
(8W-11-2)
FUSE 4 10A
(8W-11-5)
24
Z1 20 BK
S304
(8W-15-8)
G300
(8W-15-9)
G300
(8W-15-8)



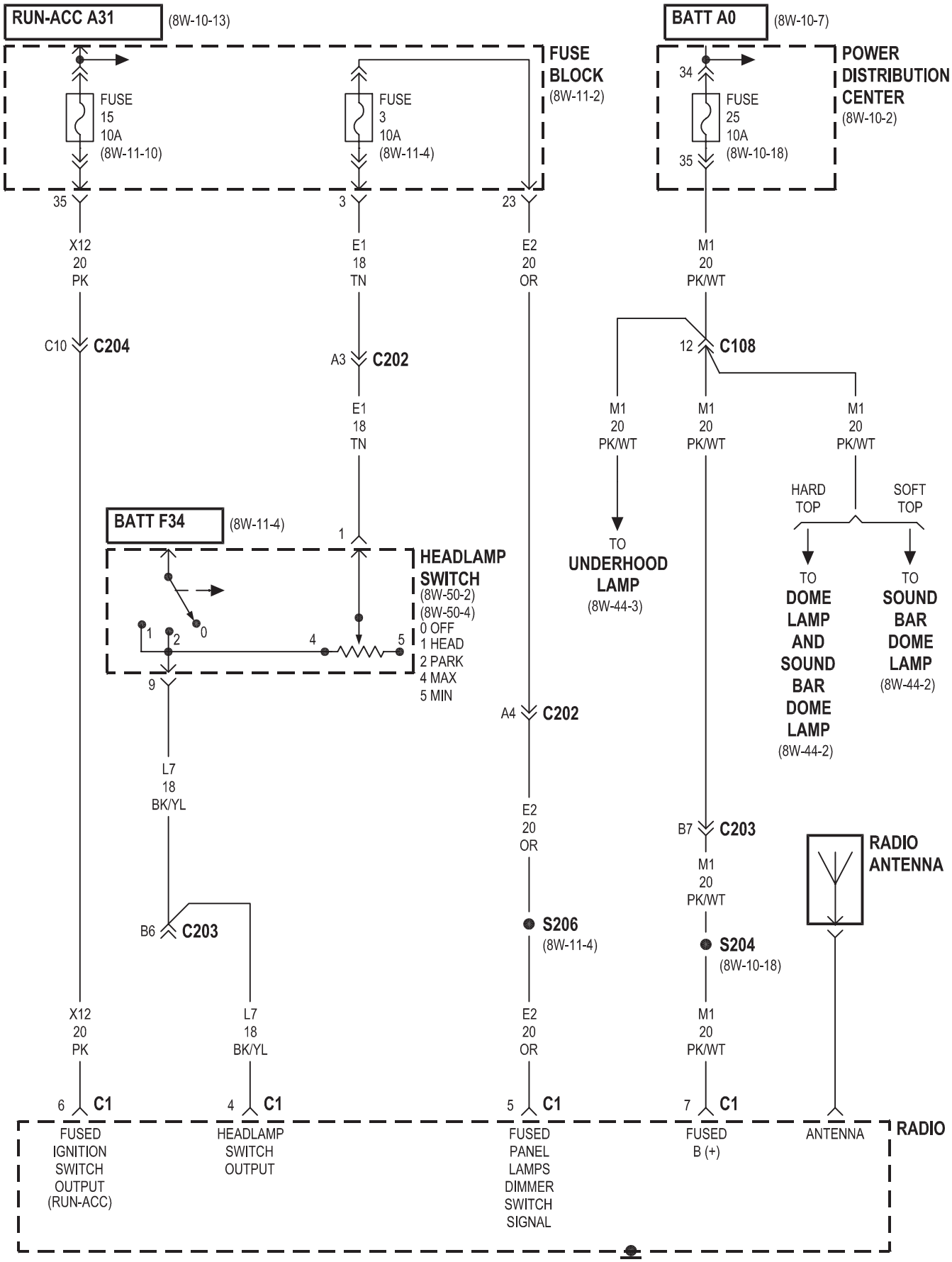
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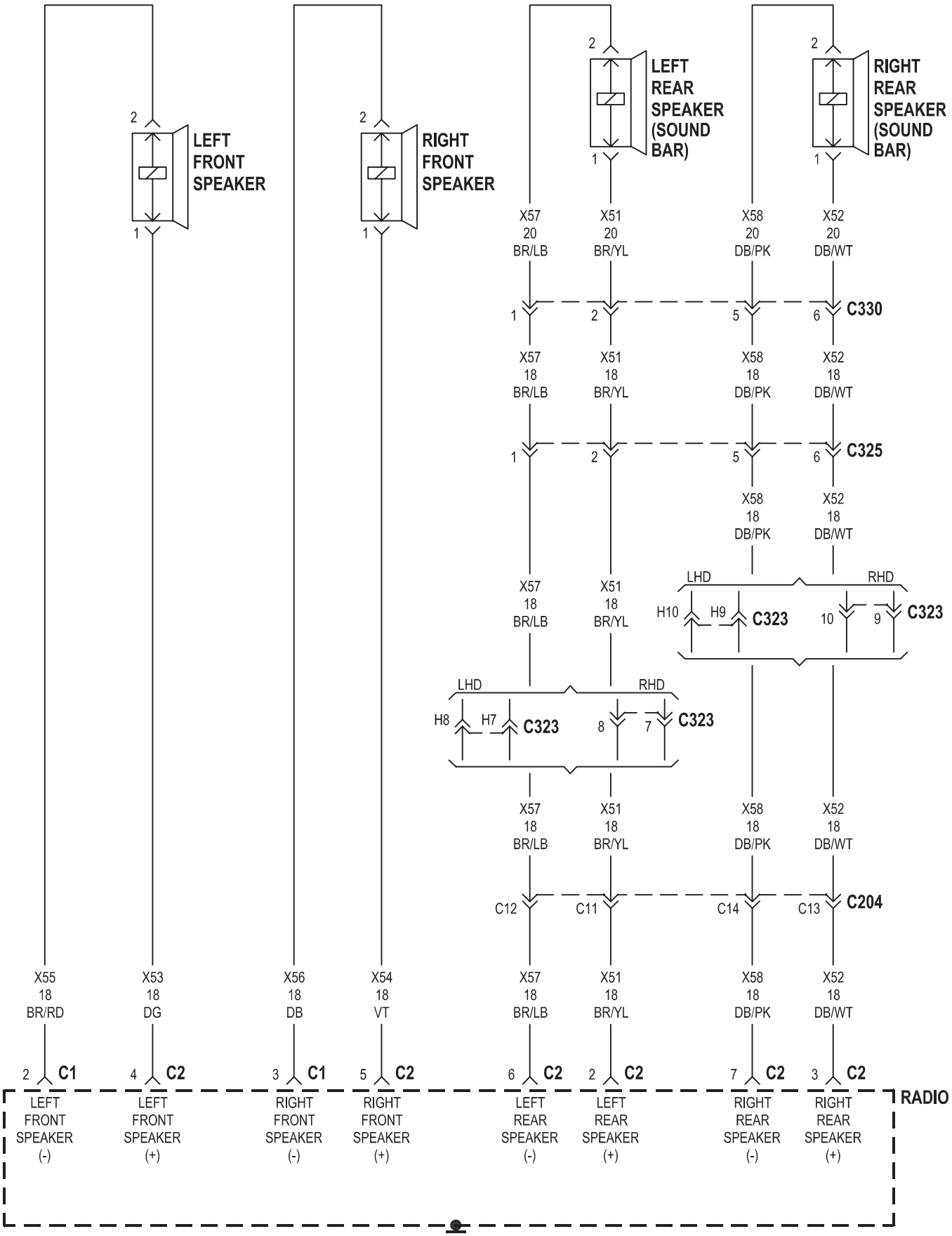
J008W-5


BATT F34
(8W-11-4)
HEADLAMP SWITCH
(8W-50-2)
0 OFF
1 PARK
2 HEAD
3 DOME
4 MAX
5 MIN
0 1 2 3 4 5
1
E1
18
TN
A3 C202
E1
18
TN
3
FUSE BLOCK
(8W-11-2)
FUSE
3
10A
(8W-11-4)
23
E2
20
OR
A4 C202
E2
20
OR
E2
20
OR
TO
PRNDL
LAMP
(8W-44-5)
S206
(8W-11-4)
E2
20
OR
3 C2
INSTRUMENT
CLUSTER
(8W-40-8)
E2
20
OR
5 C1
RADIO
(8W-47-2)
6 C2
Z2
18
BK/LG
G201
(8W-15-6)
(8W-15-7)

8W-47 AUDIO SYSTEM

Component	Page
Dome Lamp And Sound Bar Dome Lamp	8W-47-2
Fuse 3 (FB)	8W-47-2
Fuse 15 (FB)	8W-47-2
Fuse 25 (PDC)	8W-47-2
Fuse Block	8W-47-2
Headlamp Switch	8W-47-2
Left Front Speaker	8W-47-3
Left Rear Speaker	8W-47-3
Power Distribution Center	8W-47-2
Radio	8W-47-2, 3
Radio Antenna	8W-47-2
Right Front Speaker	8W-47-3
Right Rear Speaker	8W-47-3
Sound Bar Dome Lamp	8W-47-2
Underhood Lamp	8W-47-2


RUN-ACC A31
(8W-10-13)
BATT A0
(8W-10-7)
FUSE BLOCK
(8W-11-2)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 15 10A (8W-11-10)
FUSE 3 10A (8W-11-4)
FUSE 25 10A (8W-10-18)
35
3
23
34
35
X12 20 PK
E1 18 TN
E2 20 OR
M1 20 PK/WT
C10 C204
A3 C202
12 C108
M1 20 PK/WT
M1 20 PK/WT
M1 20 PK/WT
HARD TOP
SOFT TOP
BATT F34
(8W-11-4)
HEADLAMP SWITCH
(8W-50-2)
(8W-50-4)
0 OFF
1 HEAD
2 PARK
4 MAX
5 MIN
TO UNDERHOOD LAMP
(8W-44-3)
TO DOME LAMP AND SOUND BAR DOME LAMP
(8W-44-2)
TO SOUND BAR DOME LAMP
(8W-44-2)
L7 18 BK/YL
A4 C202
E2 20 OR
B7 C203
M1 20 PK/WT
RADIO ANTENNA
B6 C203
S206
(8W-11-4)
S204
(8W-10-18)
X12 20 PK
L7 18 BK/YL
E2 20 OR
M1 20 PK/WT
6 C1
4 C1
5 C1
7 C1
FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
HEADLAMP SWITCH OUTPUT
FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
FUSED B (+)
ANTENNA
RADIO

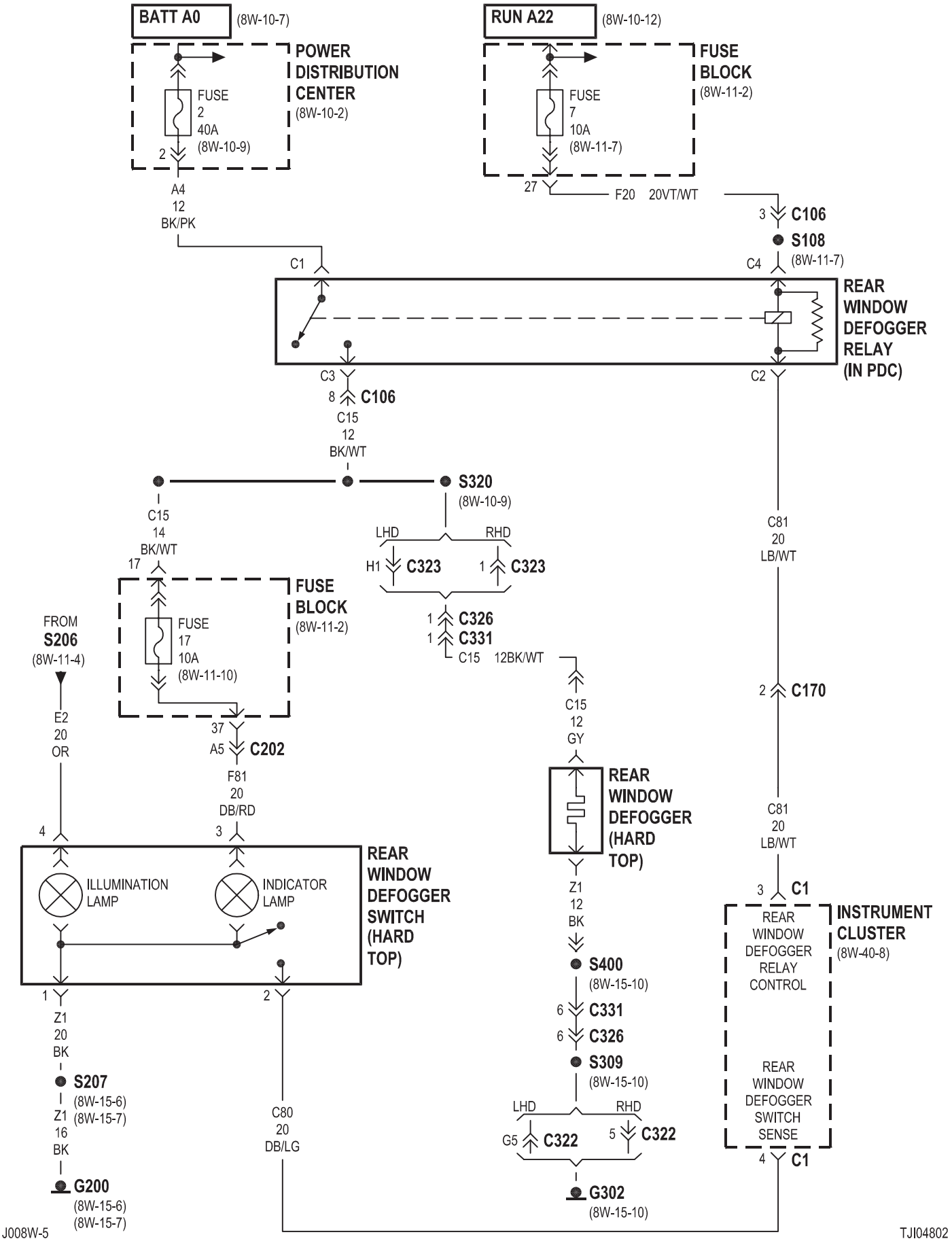


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J008W-5

8W-48 REAR WINDOW DEFOGGER

Component	Page	Component	Page
Fuse 2 (PDC)	8W-48-2	Instrument Cluster	8W-48-2
Fuse 7 (FB)	8W-48-2	Power Distribution Center	8W-48-2
Fuse 17 (FB)	8W-48-2	Rear Window Defogger	8W-48-2
Fuse Block	8W-48-2	Rear Window Defogger Relay	8W-48-2
G200	8W-48-2	Rear Window Defogger Switch	8W-48-2
G302	8W-48-2		

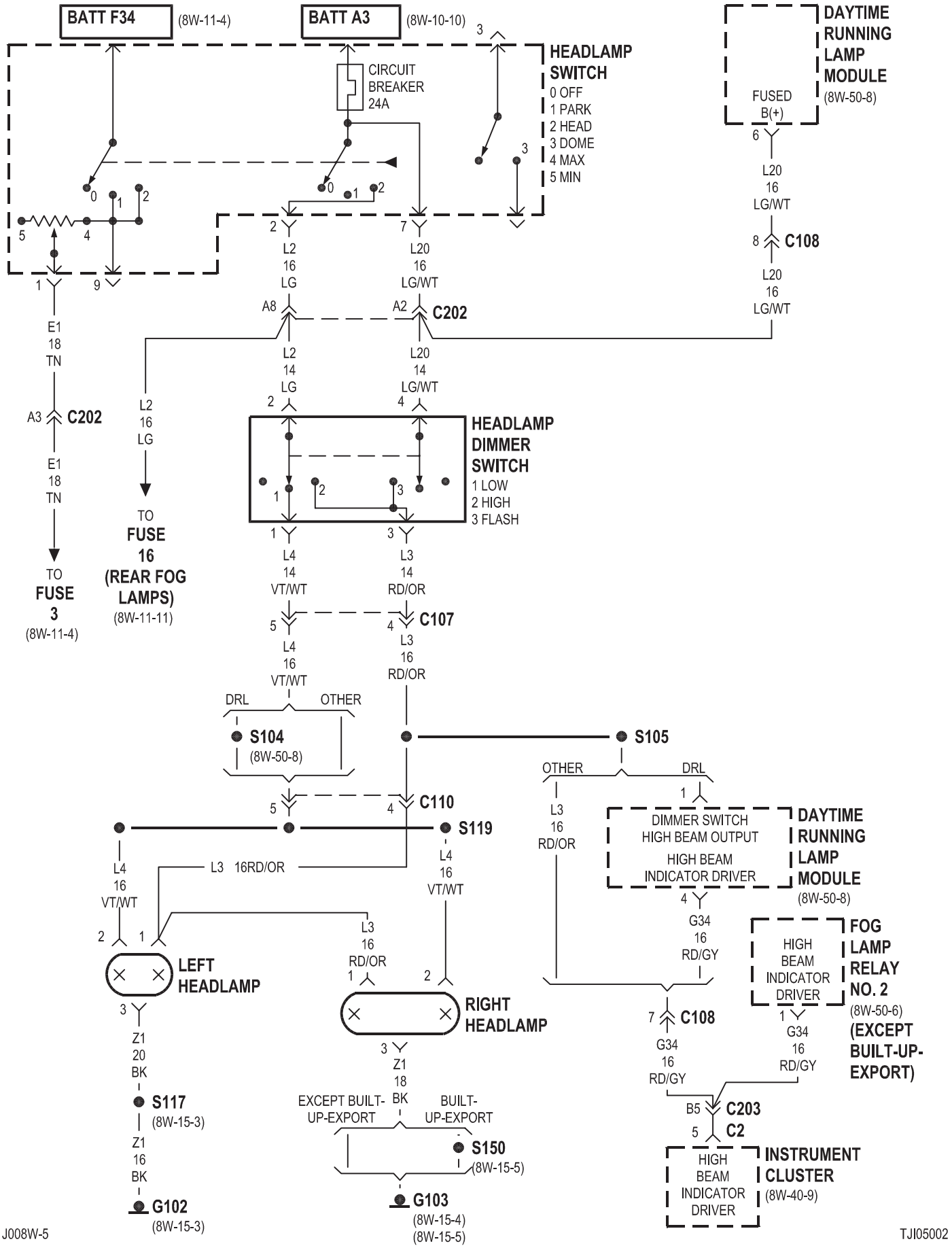


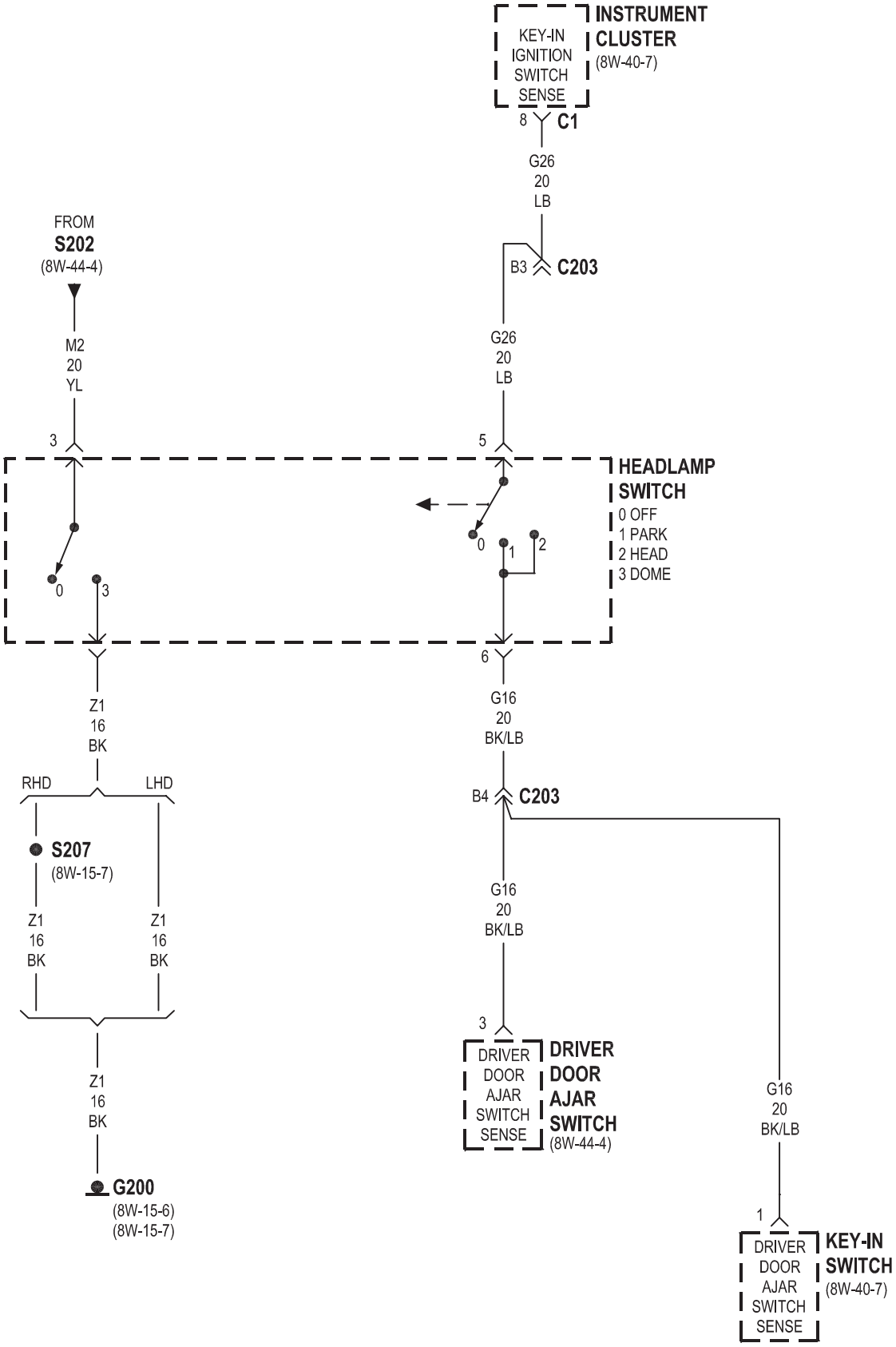
J008W-5

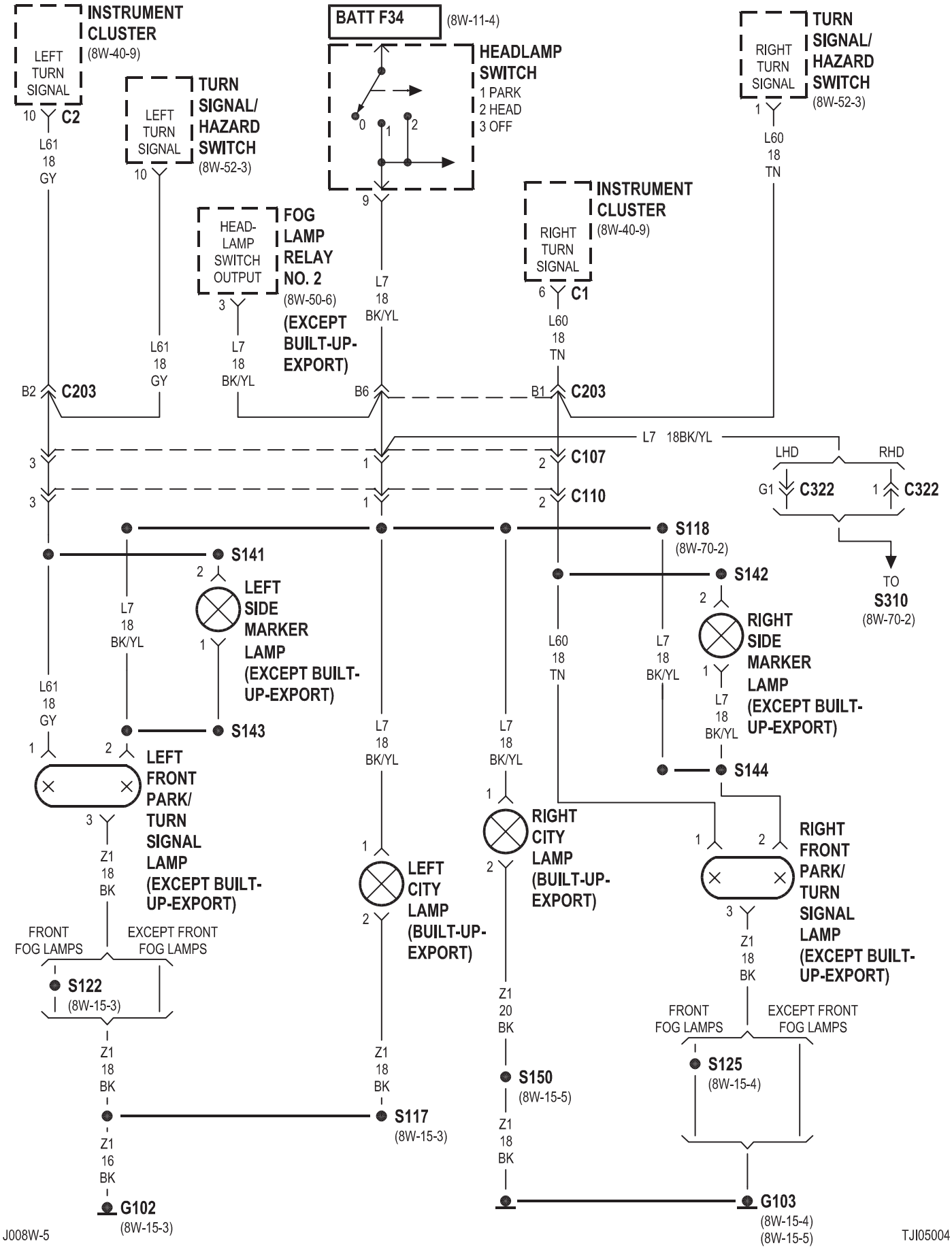
TJI04802

8W-50 FRONT LIGHTING

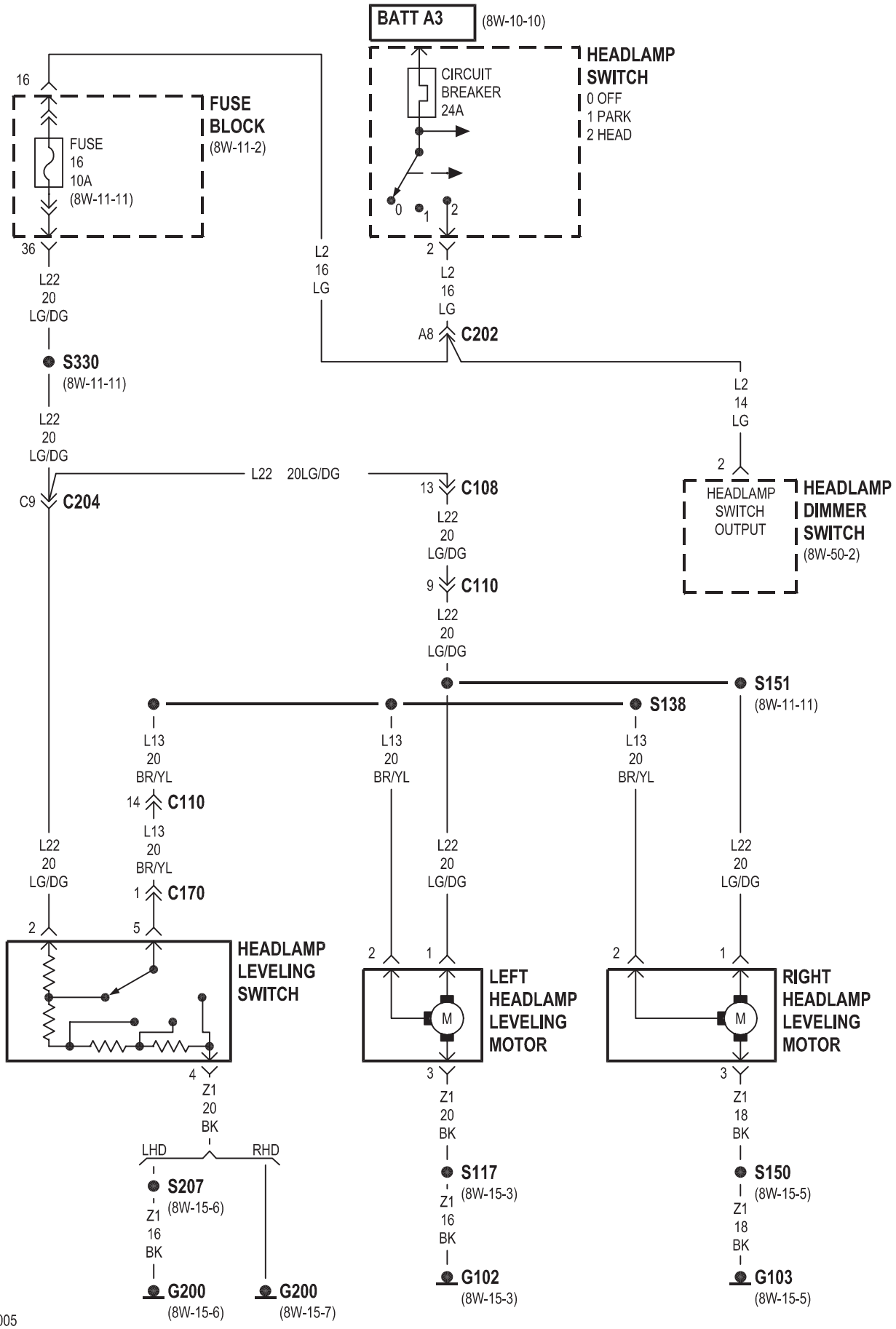
Component	Page
Circuit Breaker	8W-50-2, 5
Daytime Running Lamp Module	8W-50-2, 8
Driver Door Ajar Switch	8W-50-3
Fog Lamp Relay No. 1	8W-50-7
Fog Lamp Relay No. 2	8W-50-2, 4, 6, 8
Front Fog Lamp Switch	8W-50-7
Fuse 3 (FB)	8W-50-2, 6
Fuse 4 (FB)	8W-50-6
Fuse 11 (FB)	8W-50-8
Fuse 16 (FB)	8W-50-2, 5
Fuse 19 (PDC)	8W-50-7
Fuse Block	8W-50-5, 6, 8
G100	8W-50-8
G102	8W-50-2, 4, 5, 7
G103	8W-50-2, 4, 5, 7
G200	8W-50-3, 5, 7
G300	8W-50-6
Headlamp Dimmer Switch	8W-50-2, 5, 6, 8
Headlamp Leveling Switch	8W-50-5
Headlamp Switch	8W-50-2, 3, 4, 5, 6, 8
Instrument Cluster	8W-50-2, 3, 4, 6, 8
Key-In Switch	8W-50-3
Left City Lamp	8W-50-4
Left Fog Lamp	8W-50-7
Left Front Park/Turn Signal Lamp	8W-50-4
Left Headlamp	8W-50-2, 8
Left Headlamp Leveling Motor	8W-50-5
Left Side Marker Lamp	8W-50-4
Power Distribution Center	8W-50-7
Powertrain Control Module	8W-50-8
PRNDL Lamp	8W-50-6
Right City Lamp	8W-50-4
Right Fog Lamp	8W-50-7
Right Front Park/Turn Signal Lamp	8W-50-4
Right Headlamp	8W-50-2, 8
Right Headlamp Leveling Motor	8W-50-5
Right Side Marker Lamp	8W-50-4
Turn Signal/Hazard Switch	8W-50-4
Vehicle Speed Sensor	8W-50-8


BATT F34
(8W-11-4)
BATT A3
(8W-10-10)
CIRCUIT BREAKER 24A
HEADLAMP SWITCH
0 OFF
1 PARK
2 HEAD
3 DOME
4 MAX
5 MIN
DAYTIME RUNNING LAMP MODULE
(8W-50-8)
FUSED B(+)
L20 16 LG/WT
C108
L2 16 LG
L20 16 LG/WT
C202
E1 18 TN
TO FUSE 3
(8W-11-4)
TO FUSE 16 (REAR FOG LAMPS)
(8W-11-11)
HEADLAMP DIMMER SWITCH
1 LOW
2 HIGH
3 FLASH
L4 14 VT/WT
L3 14 RD/OR
C107
L4 16 VT/WT
L3 16 RD/OR
DRL
OTHER
S104
(8W-50-8)
S105
C110
S119
L4 16 VT/WT
L3 16RD/OR
LEFT HEADLAMP
RIGHT HEADLAMP
Z1 20 BK
S117
(8W-15-3)
Z1 16 BK
G102
(8W-15-3)
L3 16 RD/OR
Z1 18 BK
EXCEPT BUILT-UP-EXPORT
BUILT-UP-EXPORT
S150
(8W-15-5)
G103
(8W-15-4)
(8W-15-5)
DIMMER SWITCH HIGH BEAM OUTPUT
HIGH BEAM INDICATOR DRIVER
DAYTIME RUNNING LAMP MODULE
(8W-50-8)
G34 16 RD/GY
C108
HIGH BEAM INDICATOR DRIVER
FOG LAMP RELAY NO. 2
(8W-50-6)
(EXCEPT BUILT-UP-EXPORT)
C203
C2
INSTRUMENT CLUSTER
(8W-40-9)


INSTRUMENT CLUSTER
(8W-40-7)
KEY-IN IGNITION SWITCH SENSE
8
C1
G26
20
LB
B3
C203
FROM
S202
(8W-44-4)
M2
20
YL
3
5
HEADLAMP SWITCH
0 OFF
1 PARK
2 HEAD
3 DOME
0
1
2
0
3
6
Z1
16
BK
G16
20
BK/LB
RHD
LHD
B4
C203
S207
(8W-15-7)
Z1
16
BK
Z1
16
BK
G16
20
BK/LB
3
DRIVER DOOR AJAR SWITCH SENSE
DRIVER DOOR AJAR SWITCH
(8W-44-4)
Z1
16
BK
G200
(8W-15-6)
(8W-15-7)
G16
20
BK/LB
1
DRIVER DOOR AJAR SWITCH SENSE
KEY-IN SWITCH
(8W-40-7)


INSTRUMENT CLUSTER
(8W-40-9)
LEFT TURN SIGNAL
10
C2
L61 18 GY
TURN SIGNAL/ HAZARD SWITCH
(8W-52-3)
LEFT TURN SIGNAL
10
BATT F34
(8W-11-4)
HEADLAMP SWITCH
1 PARK
2 HEAD
3 OFF
0
1
2
9
TURN SIGNAL/ HAZARD SWITCH
(8W-52-3)
RIGHT TURN SIGNAL
1
L60 18 TN
INSTRUMENT CLUSTER
(8W-40-9)
RIGHT TURN SIGNAL
6
C1
L60 18 TN
FOG LAMP RELAY NO. 2
(8W-50-6)
(EXCEPT BUILT-UP-EXPORT)
HEAD-LAMP SWITCH OUTPUT
3
L7 18 BK/YL
L61 18 GY
L7 18 BK/YL
B2
C203
B6
B1
C203
L7 18BK/YL
3
3
1
2
C107
C110
LHD
RHD
G1
C322
1
C322
TO S310
(8W-70-2)
S118
(8W-70-2)
S141
S142
2
LEFT SIDE MARKER LAMP
(EXCEPT BUILT-UP-EXPORT)
1
L7 18 BK/YL
L60 18 TN
L7 18 BK/YL
RIGHT SIDE MARKER LAMP
(EXCEPT BUILT-UP-EXPORT)
L61 18 GY
S143
S144
LEFT FRONT PARK/ TURN SIGNAL LAMP
(EXCEPT BUILT-UP-EXPORT)
L7 18 BK/YL
L7 18 BK/YL
RIGHT CITY LAMP
(BUILT-UP-EXPORT)
RIGHT FRONT PARK/ TURN SIGNAL LAMP
(EXCEPT BUILT-UP-EXPORT)
Z1 18 BK
Z1 18 BK
Z1 20 BK
Z1 18 BK
FRONT FOG LAMPS
EXCEPT FRONT FOG LAMPS
LEFT CITY LAMP
(BUILT-UP-EXPORT)
S122
(8W-15-3)
S150
(8W-15-5)
S125
(8W-15-4)
Z1 18 BK
Z1 18 BK
Z1 18 BK
Z1 16 BK
S117
(8W-15-3)
G102
(8W-15-3)
G103
(8W-15-4)
(8W-15-5)
J008W-5
TJI05004

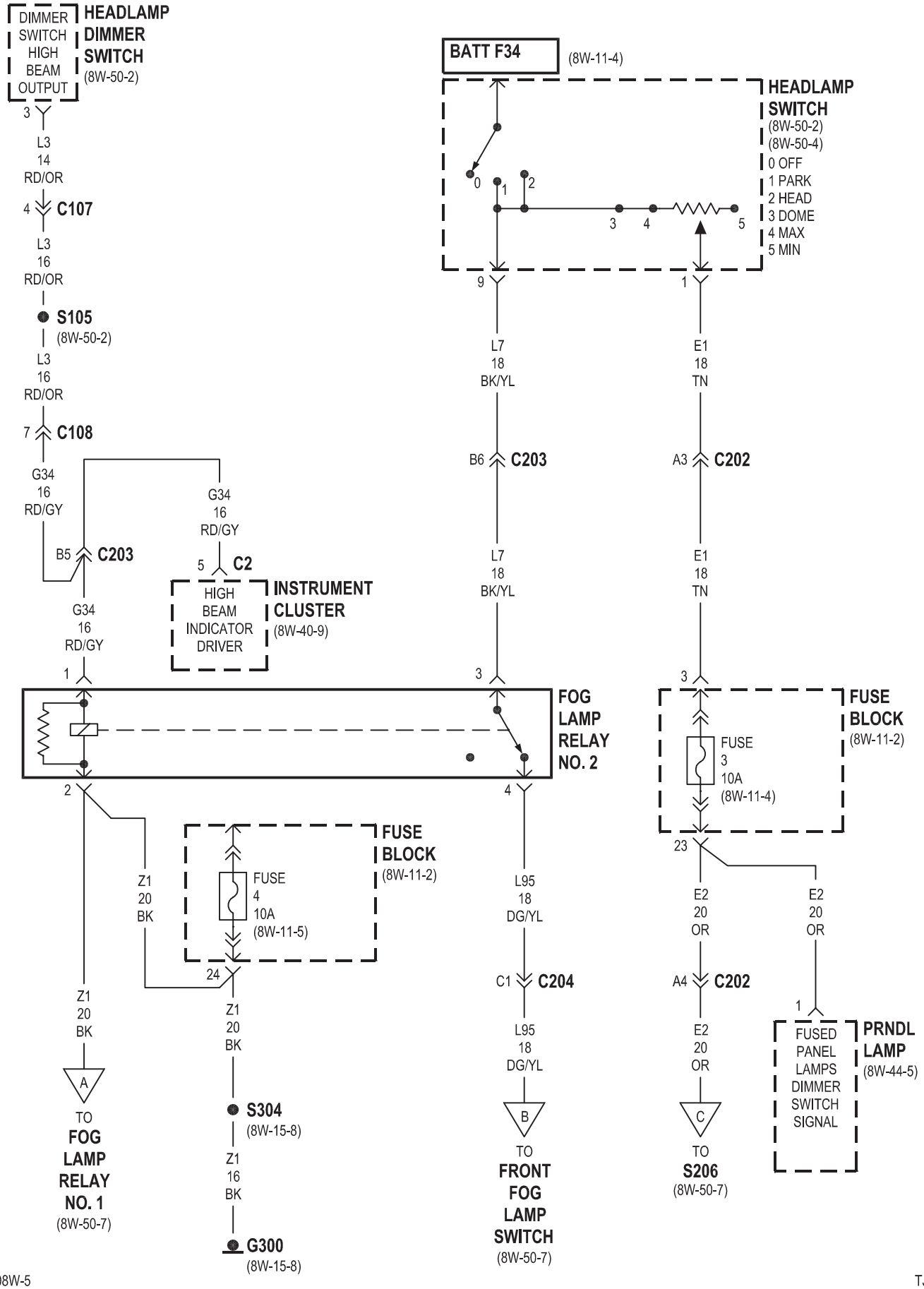
BUILT-UP-EXPORT



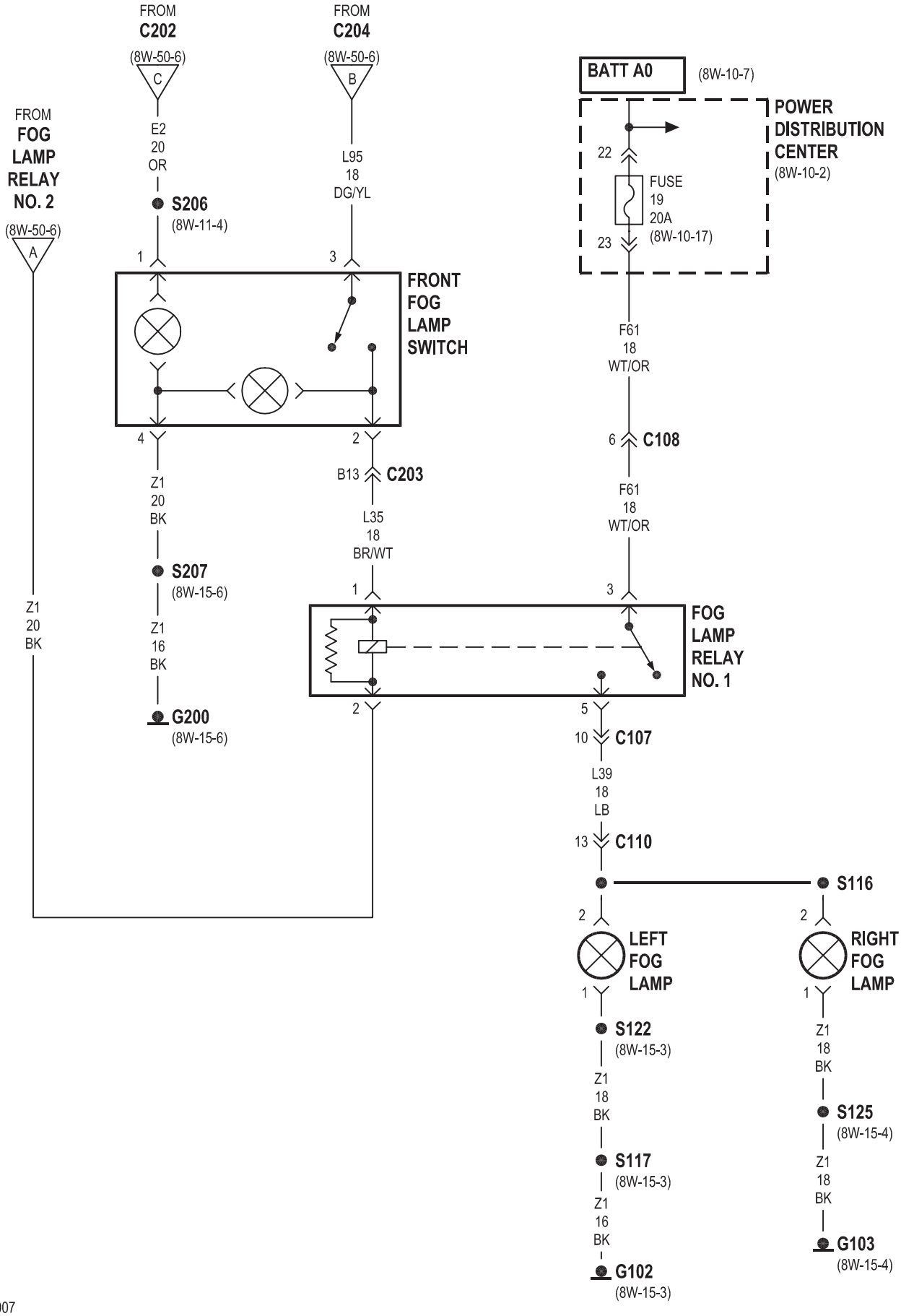
TJI05005

J008W-5

FOG LAMPS


DIMMER SWITCH HIGH BEAM OUTPUT
HEADLAMP DIMMER SWITCH
(8W-50-2)
3
L3
14
RD/OR
4
C107
L3
16
RD/OR
S105
(8W-50-2)
L3
16
RD/OR
7
C108
G34
16
RD/GY
B5
C203
G34
16
RD/GY
5
C2
HIGH BEAM INDICATOR DRIVER
INSTRUMENT CLUSTER
(8W-40-9)
G34
16
RD/GY
1
2
Z1
20
BK
A
TO FOG LAMP RELAY NO. 1
(8W-50-7)
FUSE BLOCK
(8W-11-2)
FUSE
4
10A
(8W-11-5)
24
Z1
20
BK
S304
(8W-15-8)
Z1
16
BK
G300
(8W-15-8)
BATT F34
(8W-11-4)
HEADLAMP SWITCH
(8W-50-2)
(8W-50-4)
0 OFF
1 PARK
2 HEAD
3 DOME
4 MAX
5 MIN
0
1
2
3
4
5
9
1
L7
18
BK/YL
B6
C203
L7
18
BK/YL
3
4
FOG LAMP RELAY NO. 2
L95
18
DG/YL
C1
C204
L95
18
DG/YL
B
TO FRONT FOG LAMP SWITCH
(8W-50-7)
E1
18
TN
A3
C202
E1
18
TN
3
FUSE BLOCK
(8W-11-2)
FUSE
3
10A
(8W-11-4)
23
E2
20
OR
A4
C202
E2
20
OR
C
TO S206
(8W-50-7)
E2
20
OR
1
FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
PRNDL LAMP
(8W-44-5)

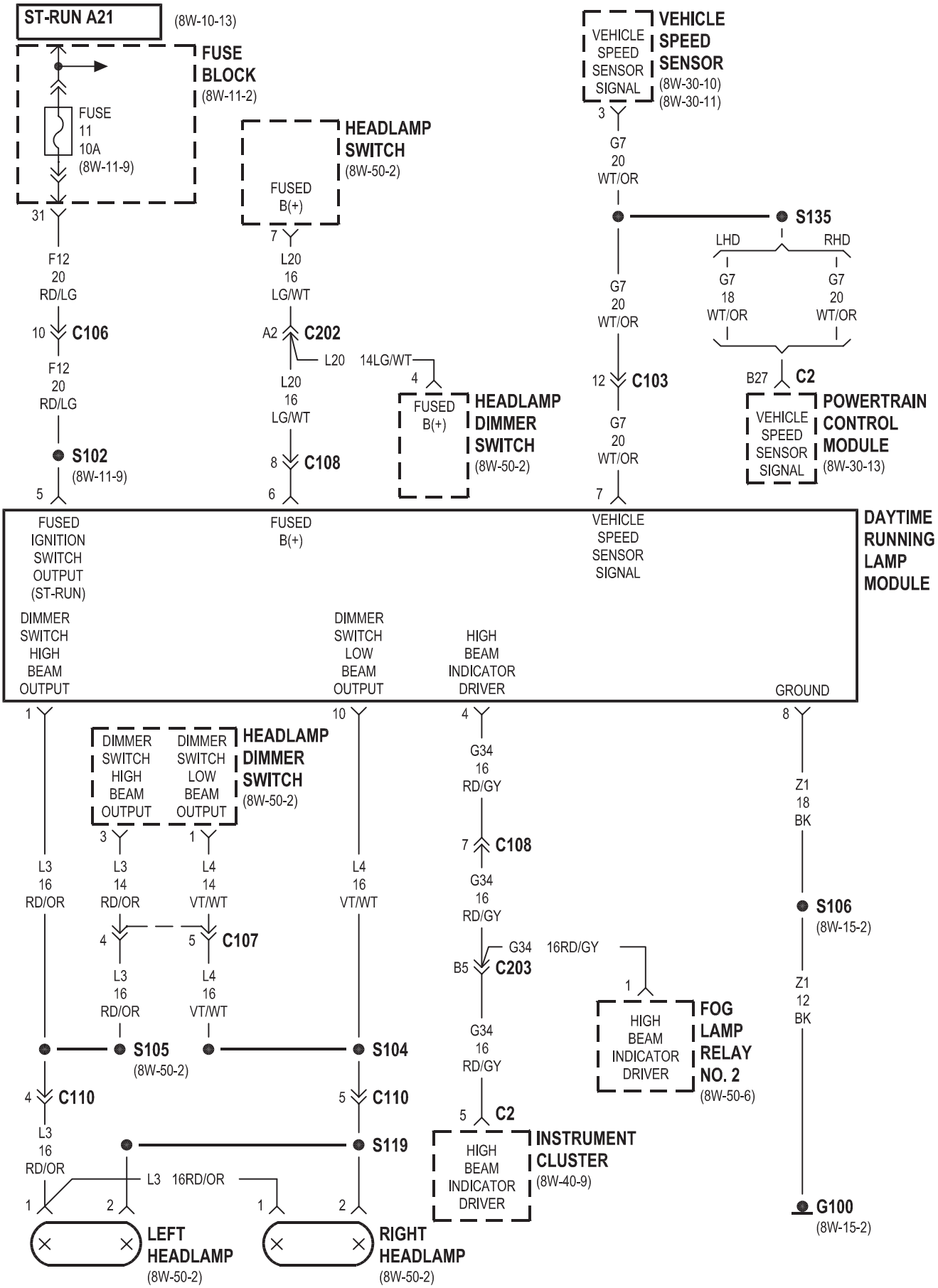
FOG LAMPS



TJI05007

J008W-5

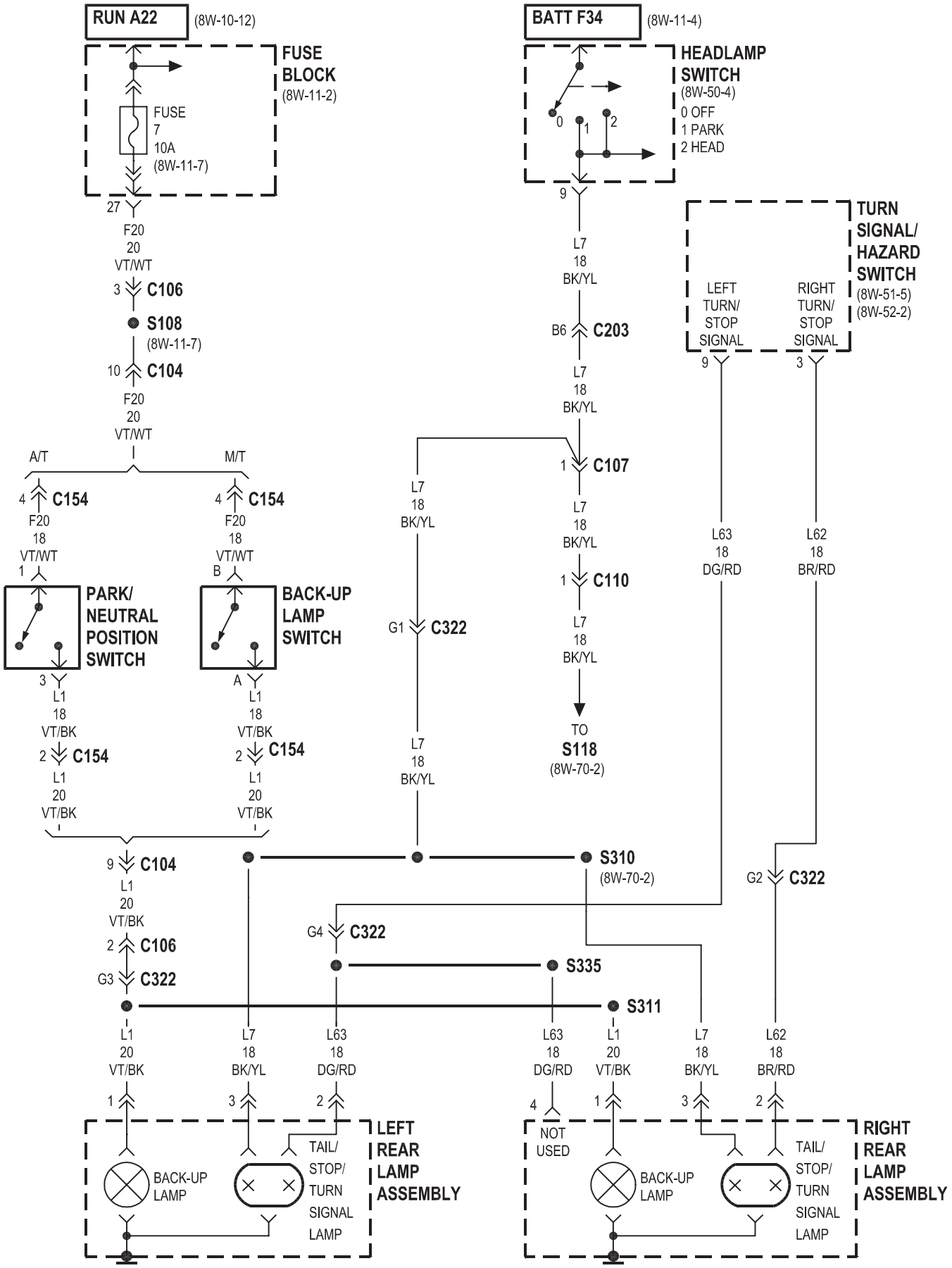
DRL


ST-RUN A21
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE 11 10A
(8W-11-9)
31
F12 20 RD/LG
10 C106
F12 20 RD/LG
S102
(8W-11-9)
5
HEADLAMP SWITCH
(8W-50-2)
FUSED B(+)
7
L20 16 LG/WT
A2 C202
L20
L20 16 LG/WT
8 C108
6
14LG/WT
4
FUSED B(+)
HEADLAMP DIMMER SWITCH
(8W-50-2)
VEHICLE SPEED SENSOR SIGNAL
VEHICLE SPEED SENSOR
(8W-30-10)
(8W-30-11)
3
G7 20 WT/OR
S135
G7 20 WT/OR
12 C103
G7 20 WT/OR
7
LHD
RHD
G7 18 WT/OR
G7 20 WT/OR
B27 C2
VEHICLE SPEED SENSOR SIGNAL
POWERTRAIN CONTROL MODULE
(8W-30-13)
FUSED IGNITION SWITCH OUTPUT (ST-RUN)
FUSED B(+)
VEHICLE SPEED SENSOR SIGNAL
DAYTIME RUNNING LAMP MODULE
DIMMER SWITCH HIGH BEAM OUTPUT
DIMMER SWITCH LOW BEAM OUTPUT
HIGH BEAM INDICATOR DRIVER
GROUND
1
10
4
8
DIMMER SWITCH HIGH BEAM OUTPUT
DIMMER SWITCH LOW BEAM OUTPUT
HEADLAMP DIMMER SWITCH
(8W-50-2)
3
1
L3 16 RD/OR
L3 14 RD/OR
L4 14 VT/WT
L4 16 VT/WT
4
5 C107
L3 16 RD/OR
L4 16 VT/WT
G34 16 RD/GY
7 C108
G34 16 RD/GY
G34 16RD/GY
B5 C203
G34 16 RD/GY
5 C2
HIGH BEAM INDICATOR DRIVER
INSTRUMENT CLUSTER
(8W-40-9)
1
HIGH BEAM INDICATOR DRIVER
FOG LAMP RELAY NO. 2
(8W-50-6)
Z1 18 BK
S106
(8W-15-2)
Z1 12 BK
G100
(8W-15-2)
S105
(8W-50-2)
S104
4 C110
5 C110
L3 16 RD/OR
S119
L3 16RD/OR
1
2
1
2
LEFT HEADLAMP
(8W-50-2)
RIGHT HEADLAMP
(8W-50-2)

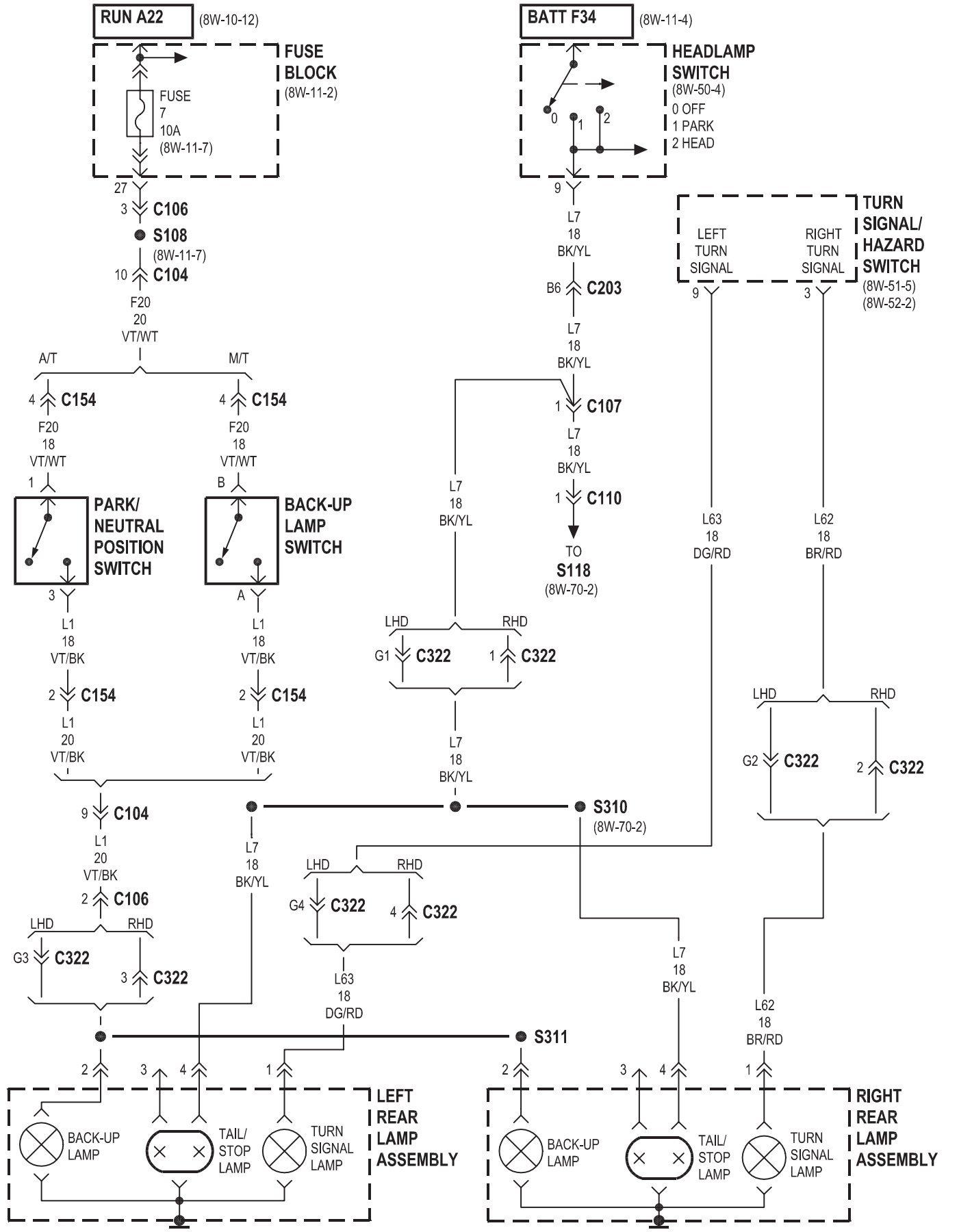
8W-51 REAR LIGHTING

Component	Page
Back-Up Lamp	8W-51-2, 3
Back-Up Lamp Switch	8W-51-2, 3
Brake Lamp Switch	8W-51-4, 6
Brake Shift Interlock Solenoid	8W-51-6
Center High Mounted Stop Lamp	8W-51-4, 6
Cigar Lighter/Accessory Relay	8W-51-6
Circuit Breaker	8W-51-7, 8
Controller Anti-Lock Brake	8W-51-4, 6
Fog Lamp Illumination	8W-51-7, 8
Fog Lamp Indicator	8W-51-7, 8
Fuse 2 (FB)	8W-51-4, 6
Fuse 3 (FB)	8W-51-7, 8
Fuse 4 (FB)	8W-51-7, 8
Fuse 7 (FB)	8W-51-2, 3
Fuse 16 (FB)	8W-51-7, 8
Fuse Block	8W-51-2, 3, 4, 6, 7, 8
G200	8W-51-7, 8
G300	8W-51-6, 7, 8
G302	8W-51-4, 7, 8
Headlamp Dimmer Switch	8W-51-7, 8
Headlamp Switch	8W-51-2, 3, 7, 8
Left License Lamp	8W-51-7, 8
Left Rear Lamp Assembly	8W-51-2, 3, 4, 5, 6
Park/Neutral Position Switch	8W-51-2, 3
Powertrain Control Module	8W-51-6
PRNDL Lamp	8W-51-7, 8
Rear Fog Lamp	8W-51-7, 8
Rear Fog Lamp Relay	8W-51-7, 8
Rear Fog Lamp Switch	8W-51-7, 8
Right License Lamp	8W-51-7, 8
Right Rear Lamp Assembly	8W-51-2, 3, 4, 5, 6
Tail/Stop Lamp	8W-51-3, 4
Tail/Stop/Turn Signal Lamp	8W-51-2, 5
Turn Signal Lamp	8W-51-3, 5
Turn Signal/Hazard Switch	8W-51-2, 3, 5, 6
Vehicle Speed Control Servo	8W-51-6

EXCEPT BUILT-UP-EXPORT

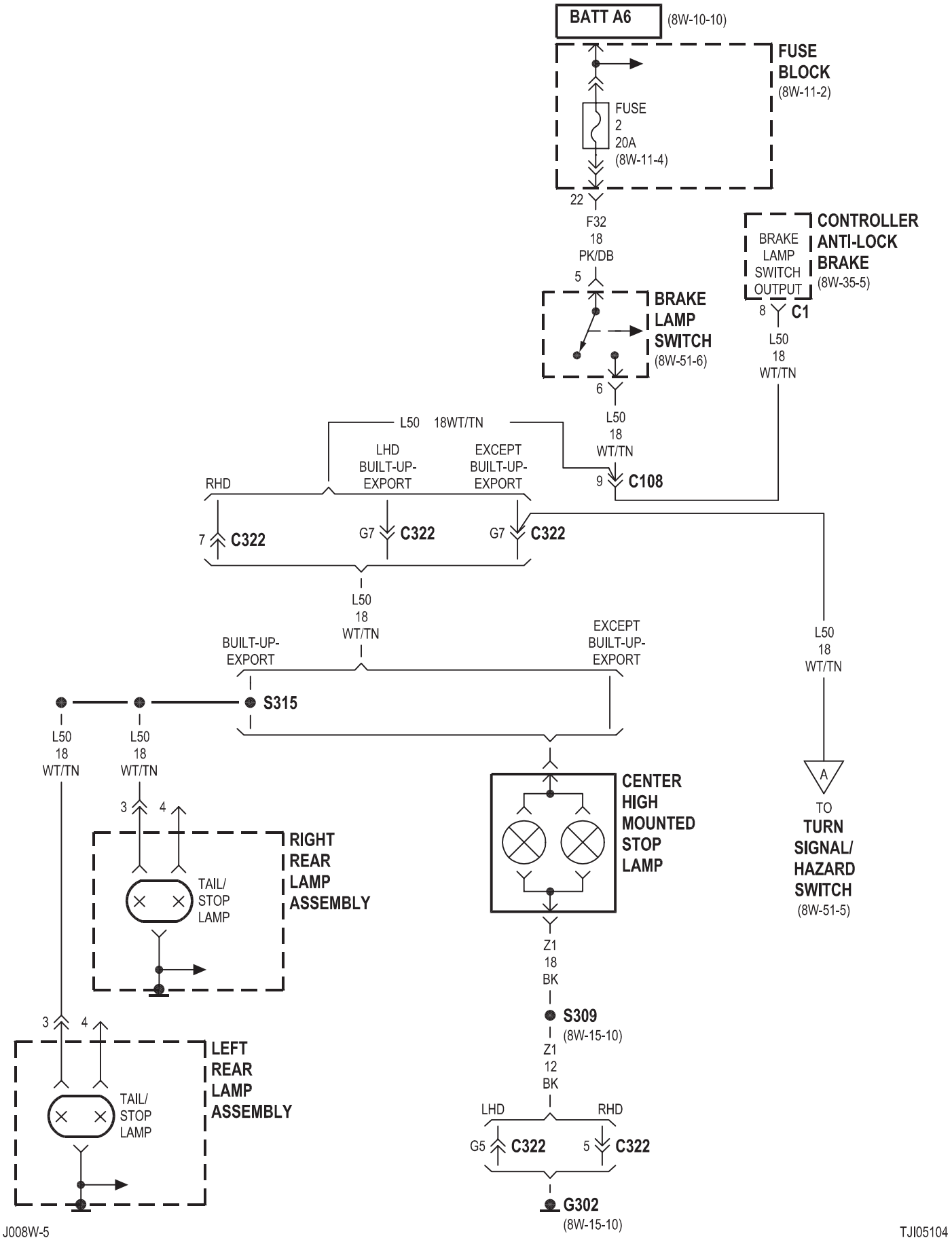


BUILT-UP-EXPORT



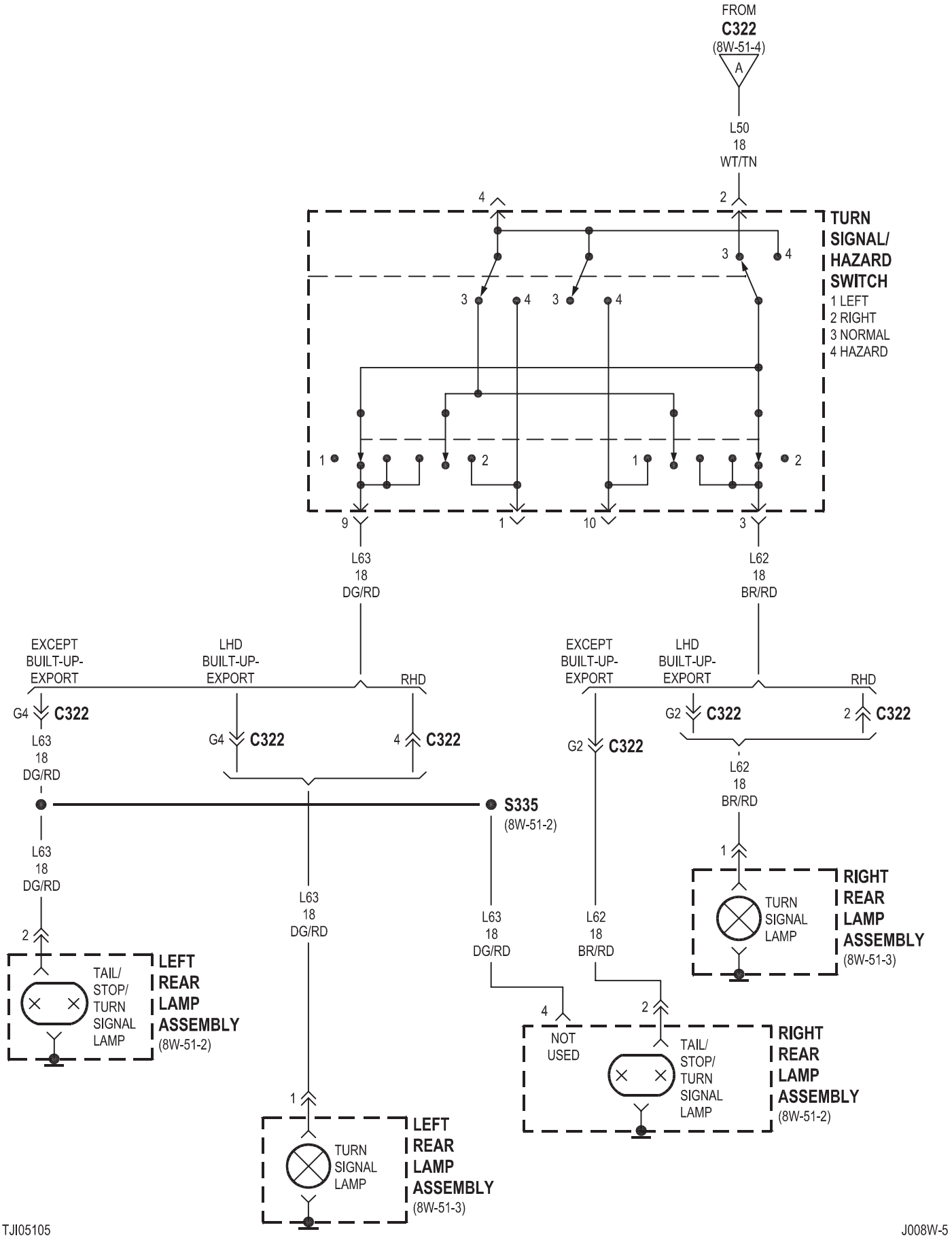
TJI05103

J008W-5



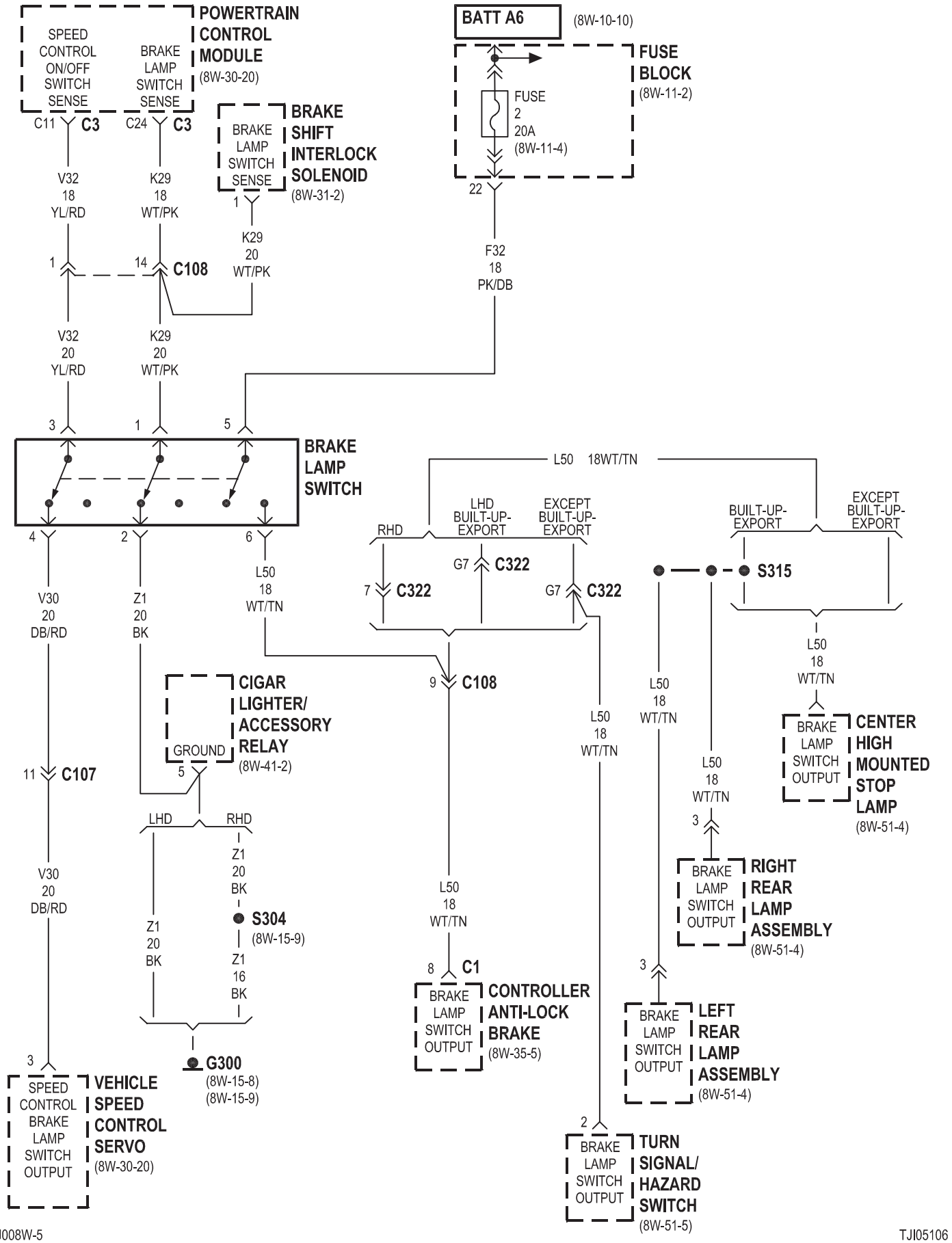
J008W-5

TJI05104



TJI05105

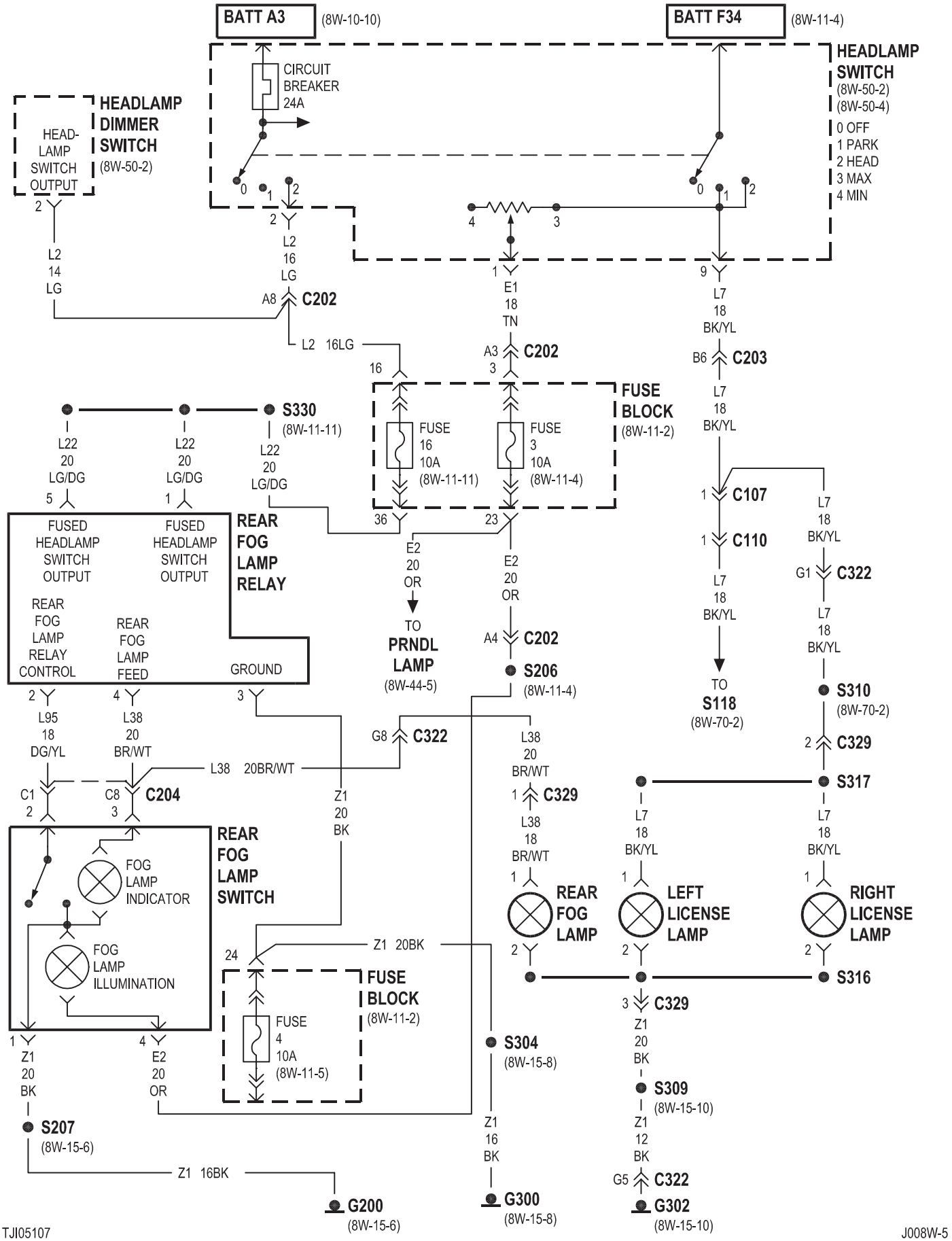
J008W-5



J008W-5

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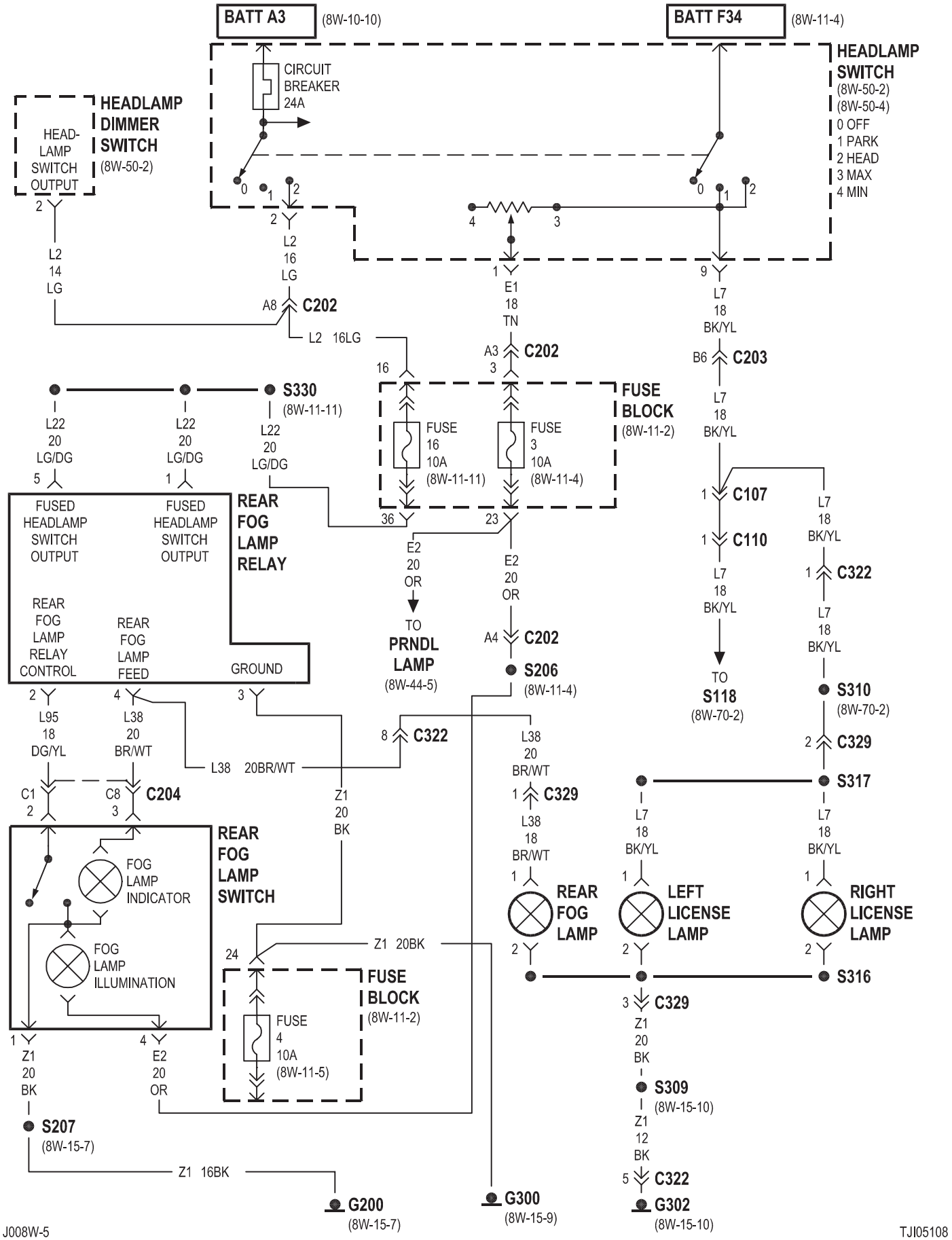
LHD BUILT-UP-EXPORT



TJI05107

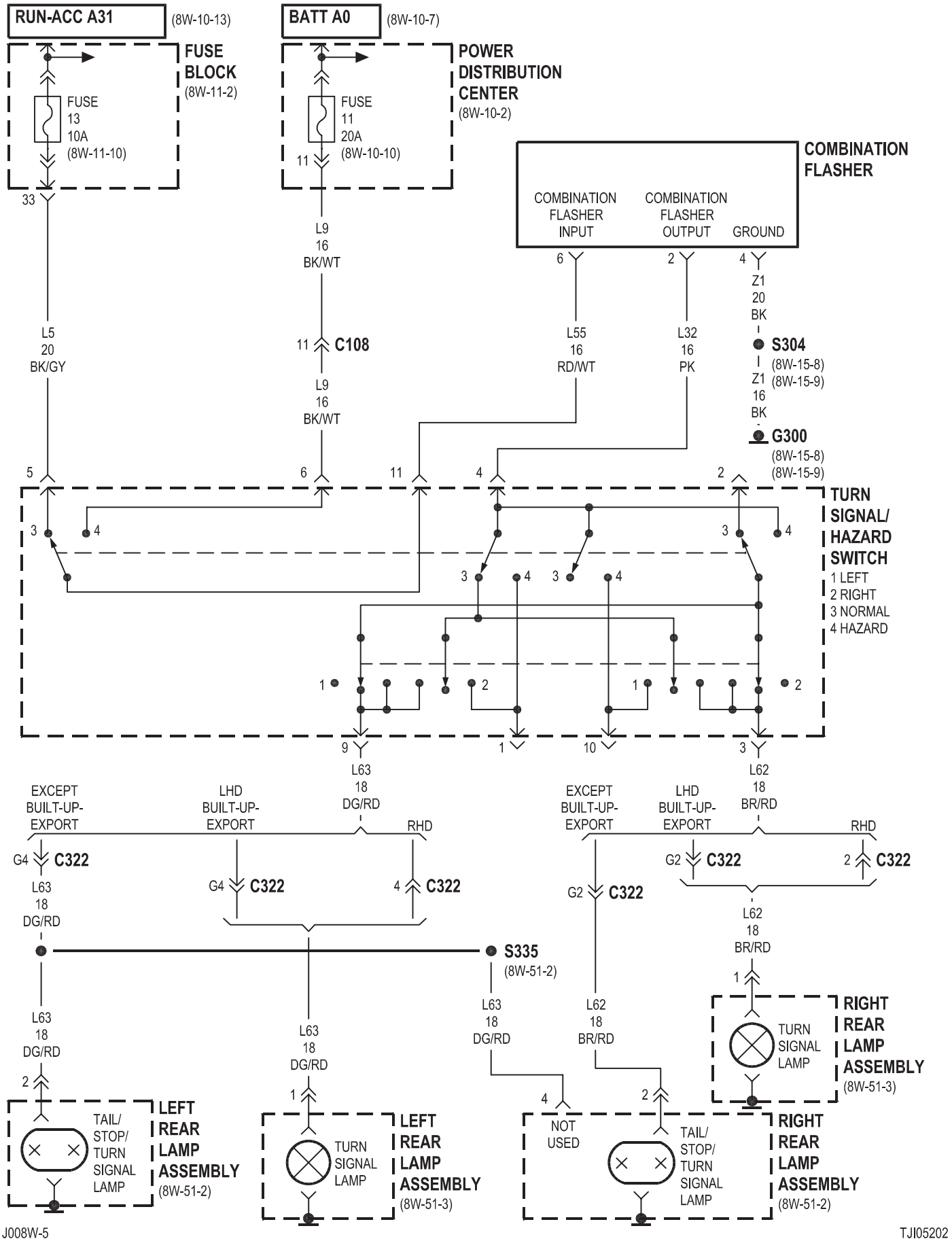
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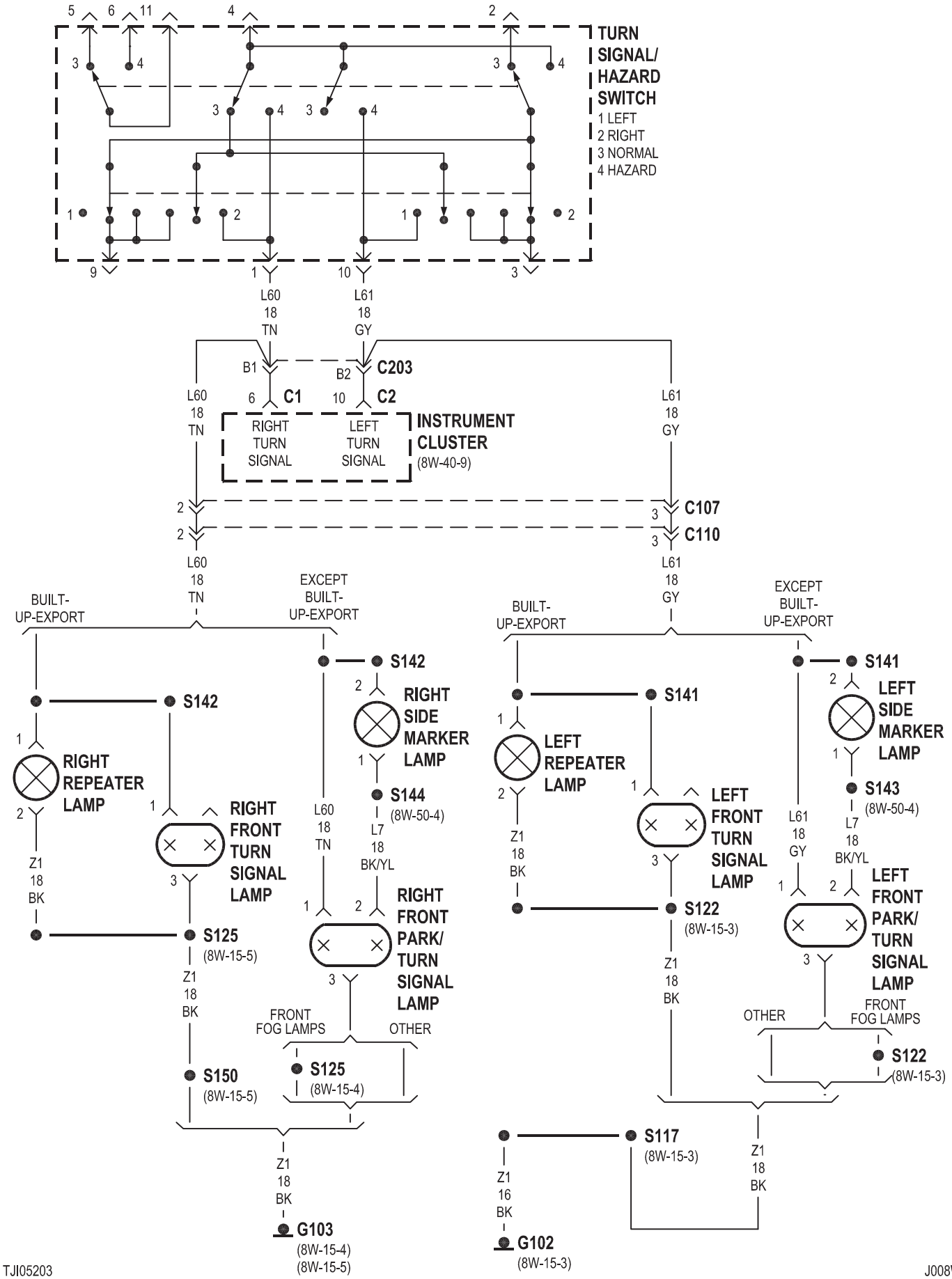
RHD BUILT-UP-EXPORT



8W-52 TURN SIGNALS

Component	Page
Combination Flasher	8W-52-2
Fuse 11 (PDC)	8W-52-2
Fuse 13 (FB)	8W-52-2
Fuse Block	8W-52-2
G102	8W-52-3
G103	8W-52-3
G300	8W-52-2
Instrument Cluster	8W-52-3
Left Front Park/Turn Signal Lamp	8W-52-3
Left Front Turn Signal Lamp	8W-52-3
Left Rear Lamp Assembly	8W-52-2
Left Repeater Lamp	8W-52-3
Left Side Marker Lamp	8W-52-3
Power Distribution Center	8W-52-2
Right Front Park/Turn Signal Lamp	8W-52-3
Right Front Turn Signal Lamp	8W-52-3
Right Rear Lamp Assembly	8W-52-2
Right Repeater Lamp	8W-52-3
Right Side Marker Lamp	8W-52-3
Tail/Stop/Turn Signal Lamp	8W-52-2
Turn Signal Lamp	8W-52-2
Turn Signal/Hazard Switch	8W-52-2, 3


RUN-ACC A31
(8W-10-13)
BATT A0
(8W-10-7)
FUSE BLOCK
(8W-11-2)
FUSE 13 10A
(8W-11-10)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 11 20A
(8W-10-10)
COMBINATION FLASHER
COMBINATION FLASHER INPUT
COMBINATION FLASHER OUTPUT
GROUND
33
11
L9 16 BK/WT
6
2
4
Z1 20 BK
L5 20 BK/GY
C108
L55 16 RD/WT
L32 16 PK
S304
(8W-15-8)
(8W-15-9)
Z1 16 BK
G300
(8W-15-8)
(8W-15-9)
5
6
11
4
2
TURN SIGNAL/ HAZARD SWITCH
1 LEFT
2 RIGHT
3 NORMAL
4 HAZARD
3
4
1
9
10
L63 18 DG/RD
L62 18 BR/RD
EXCEPT BUILT-UP-EXPORT
LHD BUILT-UP-EXPORT
RHD
G4
G2
C322
S335
(8W-51-2)
TURN SIGNAL LAMP
RIGHT REAR LAMP ASSEMBLY
(8W-51-3)
TAIL/ STOP/ TURN SIGNAL LAMP
LEFT REAR LAMP ASSEMBLY
(8W-51-2)
LEFT REAR LAMP ASSEMBLY
(8W-51-3)
NOT USED
RIGHT REAR LAMP ASSEMBLY
(8W-51-2)

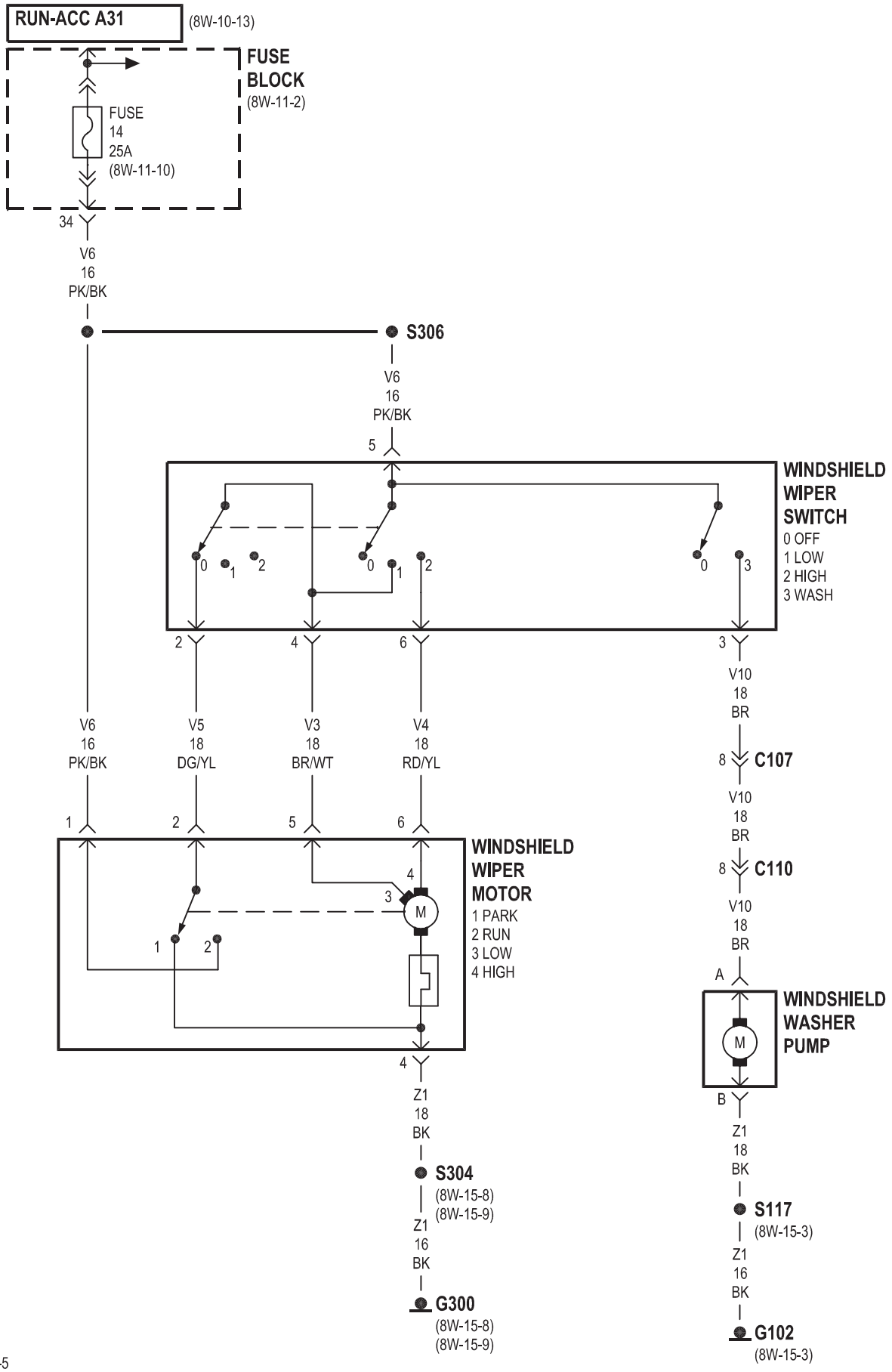


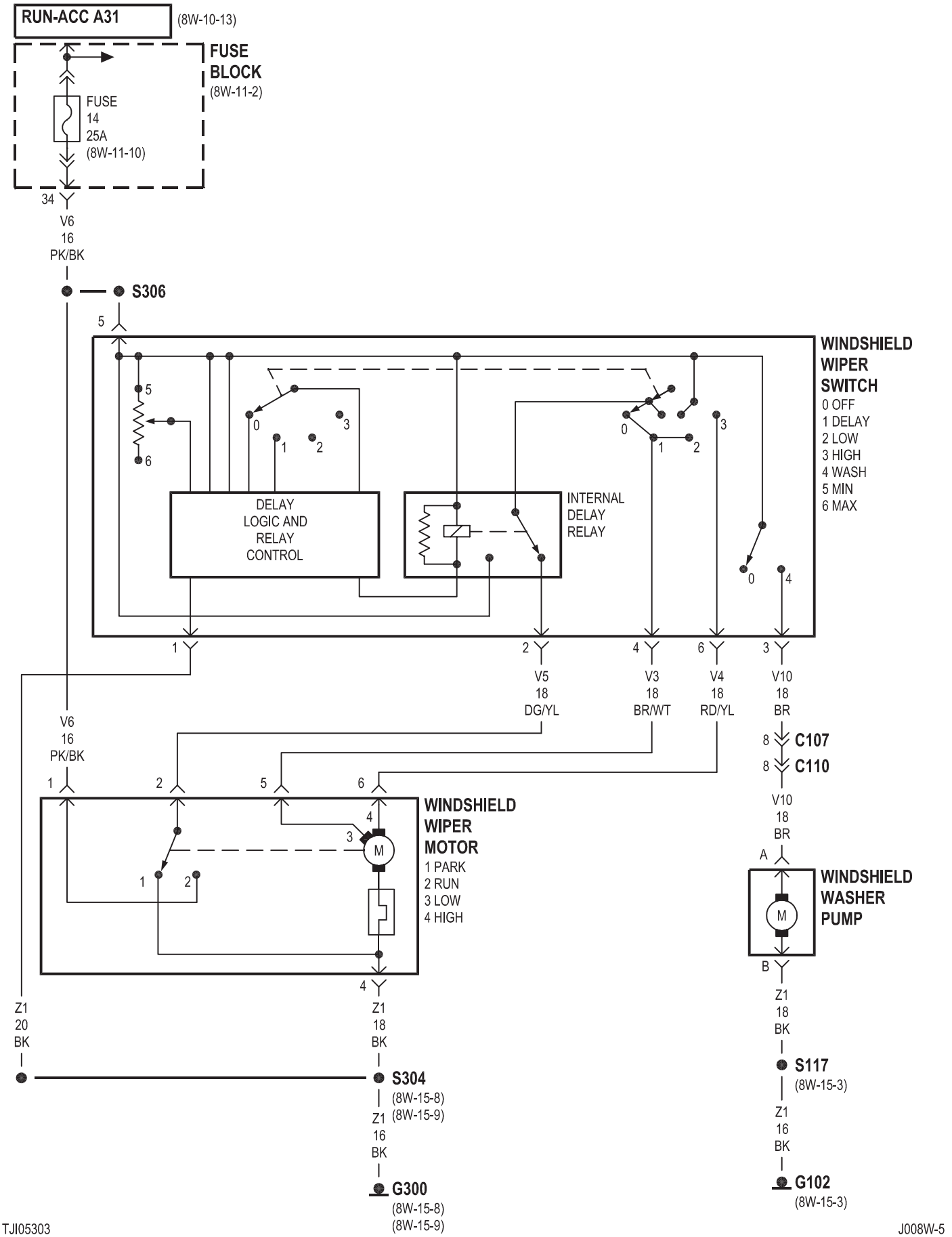
TJI05203

J008W-5

8W-53 WIPERS

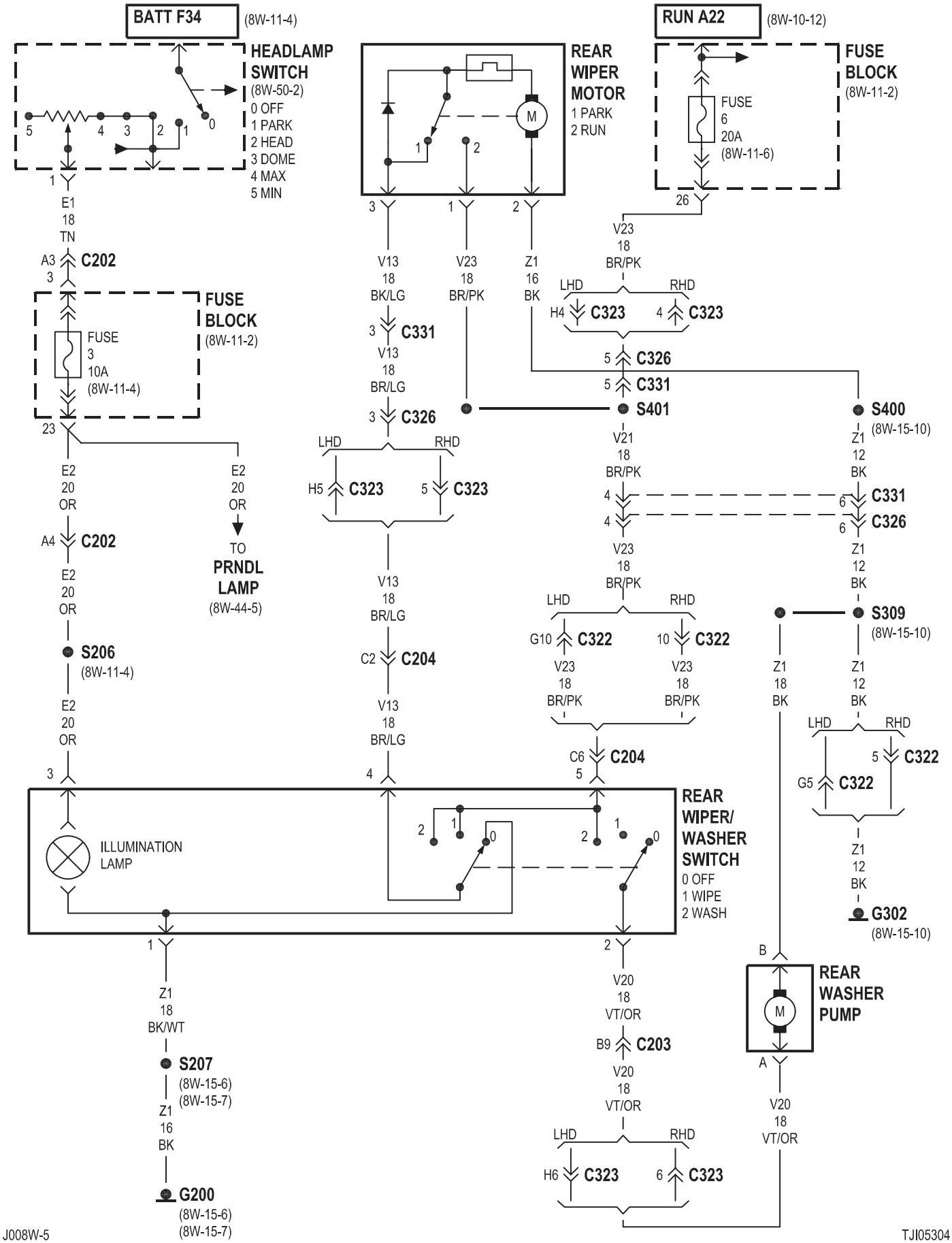
Component	Page
Fuse 3 (FB)	8W-53-4
Fuse 6 (FB)	8W-53-4
Fuse 14 (FB)	8W-53-2, 3
Fuse Block	8W-53-2, 3, 4
G102	8W-53-2, 3
G200	8W-53-4
G300	8W-53-2, 3
G302	8W-53-4
Headlamp Switch	8W-53-4
Internal Delay Relay	8W-53-3
PRNDL Lamp	8W-53-4
Rear Washer Pump	8W-53-4
Rear Wiper Motor	8W-53-4
Rear Wiper/Washer Switch	8W-53-4
Windshield Washer Pump	8W-53-2, 3
Windshield Wiper Motor	8W-53-2, 3
Windshield Wiper Switch	8W-53-2, 3


RUN-ACC A31
(8W-10-13)
FUSE BLOCK
(8W-11-2)
FUSE
14
25A
(8W-11-10)
34
V6
16
PK/BK
S306
V6
16
PK/BK
5
WINDSHIELD WIPER SWITCH
0 OFF
1 LOW
2 HIGH
3 WASH
0
1
2
0
1
2
0
3
2
4
6
3
V6
16
PK/BK
V5
18
DG/YL
V3
18
BR/WT
V4
18
RD/YL
V10
18
BR
8
C107
V10
18
BR
8
C110
V10
18
BR
A
1
2
5
6
WINDSHIELD WIPER MOTOR
1 PARK
2 RUN
3 LOW
4 HIGH
4
3
M
1
2
4
Z1
18
BK
S304
(8W-15-8)
(8W-15-9)
Z1
16
BK
G300
(8W-15-8)
(8W-15-9)
WINDSHIELD WASHER PUMP
M
B
Z1
18
BK
S117
(8W-15-3)
Z1
16
BK
G102
(8W-15-3)



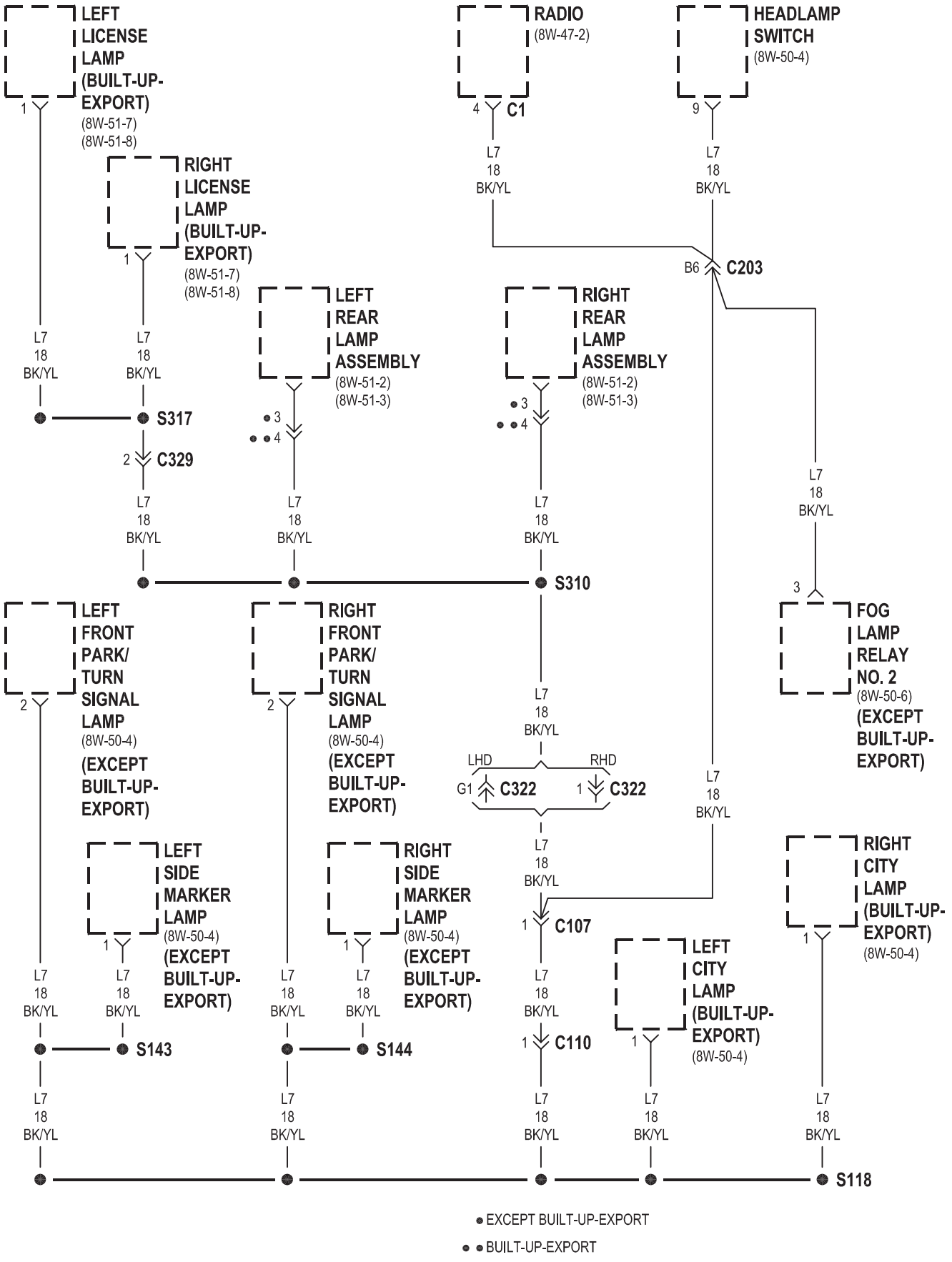
TJI05303

J008W-5

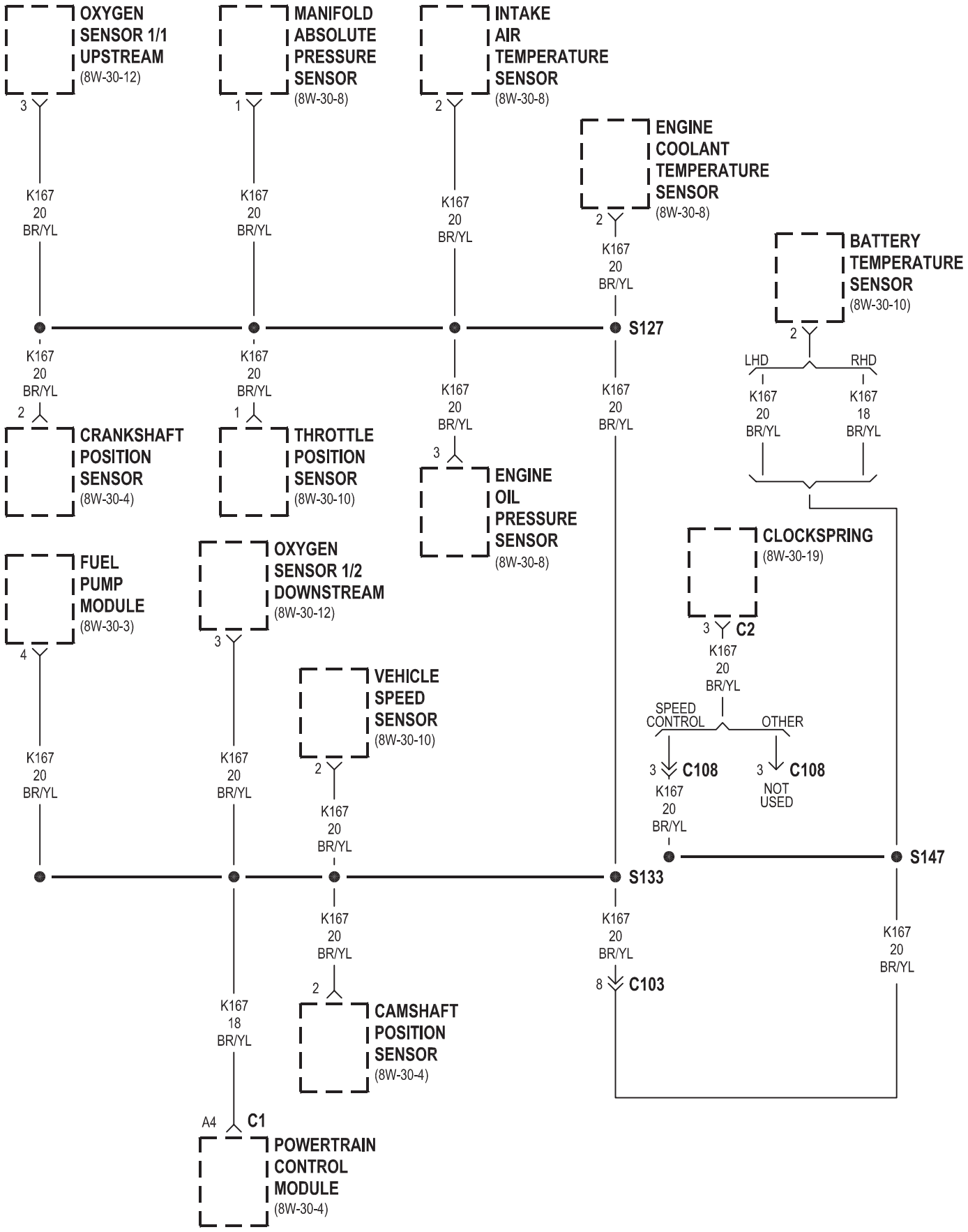

BATT F34
(8W-11-4)
HEADLAMP SWITCH
(8W-50-2)
0 OFF
1 PARK
2 HEAD
3 DOME
4 MAX
5 MIN
REAR WIPER MOTOR
1 PARK
2 RUN
RUN A22
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 6 20A
(8W-11-6)
E1 18 TN
A3 3
C202
FUSE BLOCK
(8W-11-2)
FUSE 3 10A
(8W-11-4)
V13 18 BK/LG
V23 18 BR/PK
Z1 16 BK
V23 18 BR/PK
LHD
RHD
H4 C323
4 C323
3 C331
V13 18 BR/LG
3 C326
5 C326
5 C331
S401
S400
(8W-15-10)
LHD
RHD
H5 C323
5 C323
V21 18 BR/PK
Z1 12 BK
4 C331
6 C331
4 C326
6 C326
V23 18 BR/PK
Z1 12 BK
E2 20 OR
A4 C202
TO PRNDL LAMP
(8W-44-5)
V13 18 BR/LG
C2 C204
LHD
RHD
G10 C322
10 C322
S309
(8W-15-10)
V23 18 BR/PK
V23 18 BR/PK
Z1 18 BK
Z1 12 BK
S206
(8W-11-4)
C6 C204
5
LHD
RHD
5 C322
G5 C322
V13 18 BR/LG
4
Z1 12 BK
G302
(8W-15-10)
ILLUMINATION LAMP
REAR WIPER/ WASHER SWITCH
0 OFF
1 WIPE
2 WASH
B
REAR WASHER PUMP
A
Z1 18 BK/WT
S207
(8W-15-6)
(8W-15-7)
Z1 16 BK
G200
(8W-15-6)
(8W-15-7)
V20 18 VT/OR
B9 C203
V20 18 VT/OR
V20 18 VT/OR
LHD
RHD
H6 C323
6 C323

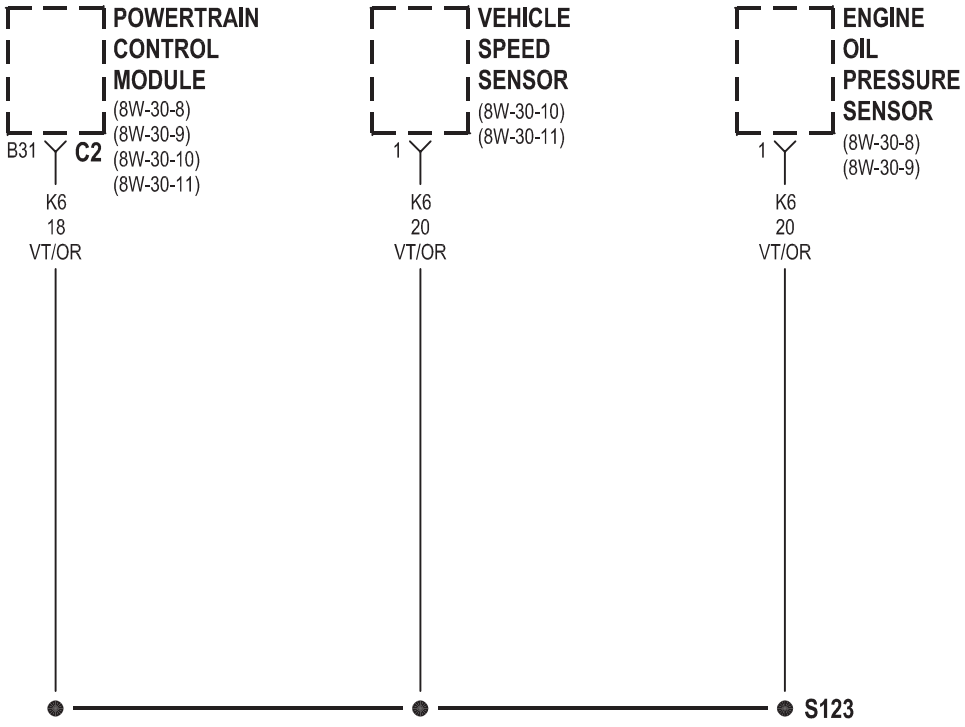
8W-70 SPLICE INFORMATION

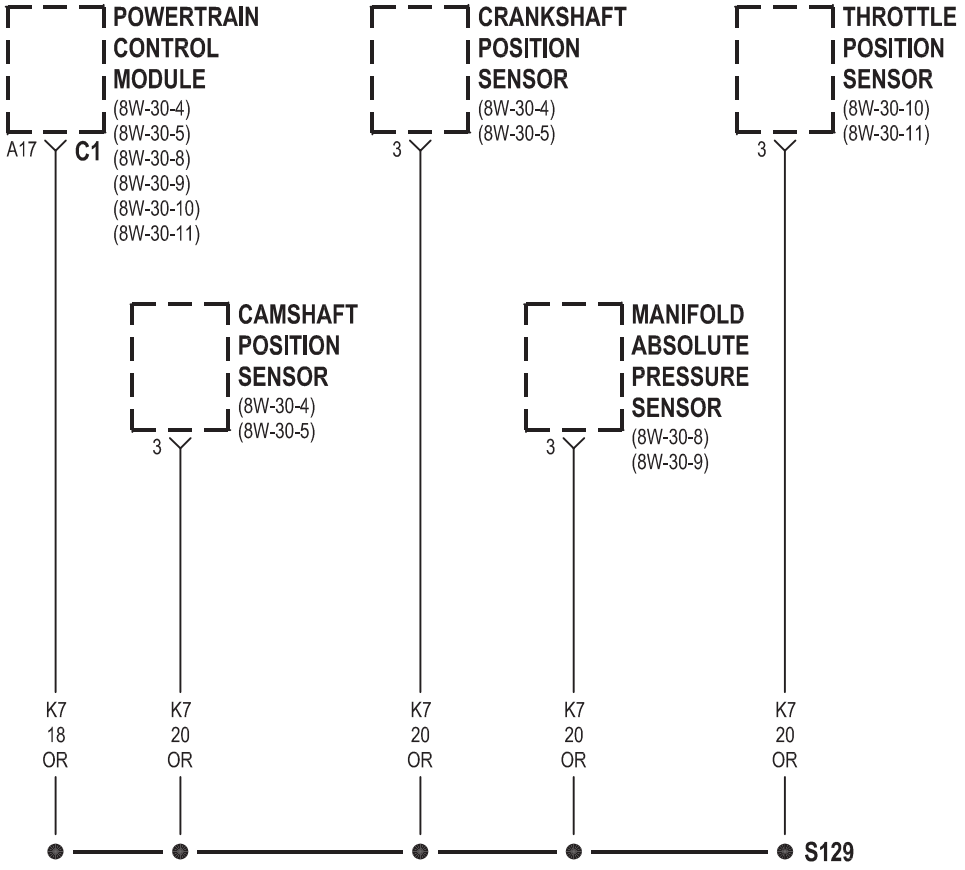
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S105	8W-50-2
S106	8W-15-2
S108	8W-11-7
S109	8W-15-2
S110	8W-10-11
S111	8W-10-12
S112	8W-10-11
S113	8W-30-15
S114	8W-10-11
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S139	8W-10-14
S140	8W-10-14
S141	8W-50-4
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S143	8W-70-2
S144	8W-70-2
S146	8W-10-11
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S151	8W-11-11
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S330	8W-11-11
S331	8W-10-12
S332	8W-10-14
S335	8W-51-2
S400	8W-15-10
S401	8W-11-6


LEFT LICENSE LAMP (BUILT-UP-EXPORT)
(8W-51-7)
(8W-51-8)
RIGHT LICENSE LAMP (BUILT-UP-EXPORT)
(8W-51-7)
(8W-51-8)
RADIO
(8W-47-2)
HEADLAMP SWITCH
(8W-50-4)
LEFT REAR LAMP ASSEMBLY
(8W-51-2)
(8W-51-3)
RIGHT REAR LAMP ASSEMBLY
(8W-51-2)
(8W-51-3)
C1
C203
S317
C329
S310
LEFT FRONT PARK/ TURN SIGNAL LAMP
(8W-50-4)
(EXCEPT BUILT-UP-EXPORT)
RIGHT FRONT PARK/ TURN SIGNAL LAMP
(8W-50-4)
(EXCEPT BUILT-UP-EXPORT)
FOG LAMP RELAY NO. 2
(8W-50-6)
(EXCEPT BUILT-UP-EXPORT)
LHD
RHD
C322
C322
LEFT SIDE MARKER LAMP
(8W-50-4)
(EXCEPT BUILT-UP-EXPORT)
RIGHT SIDE MARKER LAMP
(8W-50-4)
(EXCEPT BUILT-UP-EXPORT)
C107
C110
LEFT CITY LAMP (BUILT-UP-EXPORT)
(8W-50-4)
RIGHT CITY LAMP (BUILT-UP-EXPORT)
(8W-50-4)
S143
S144
S118
L7
18
BK/YL
● EXCEPT BUILT-UP-EXPORT
● ● BUILT-UP-EXPORT

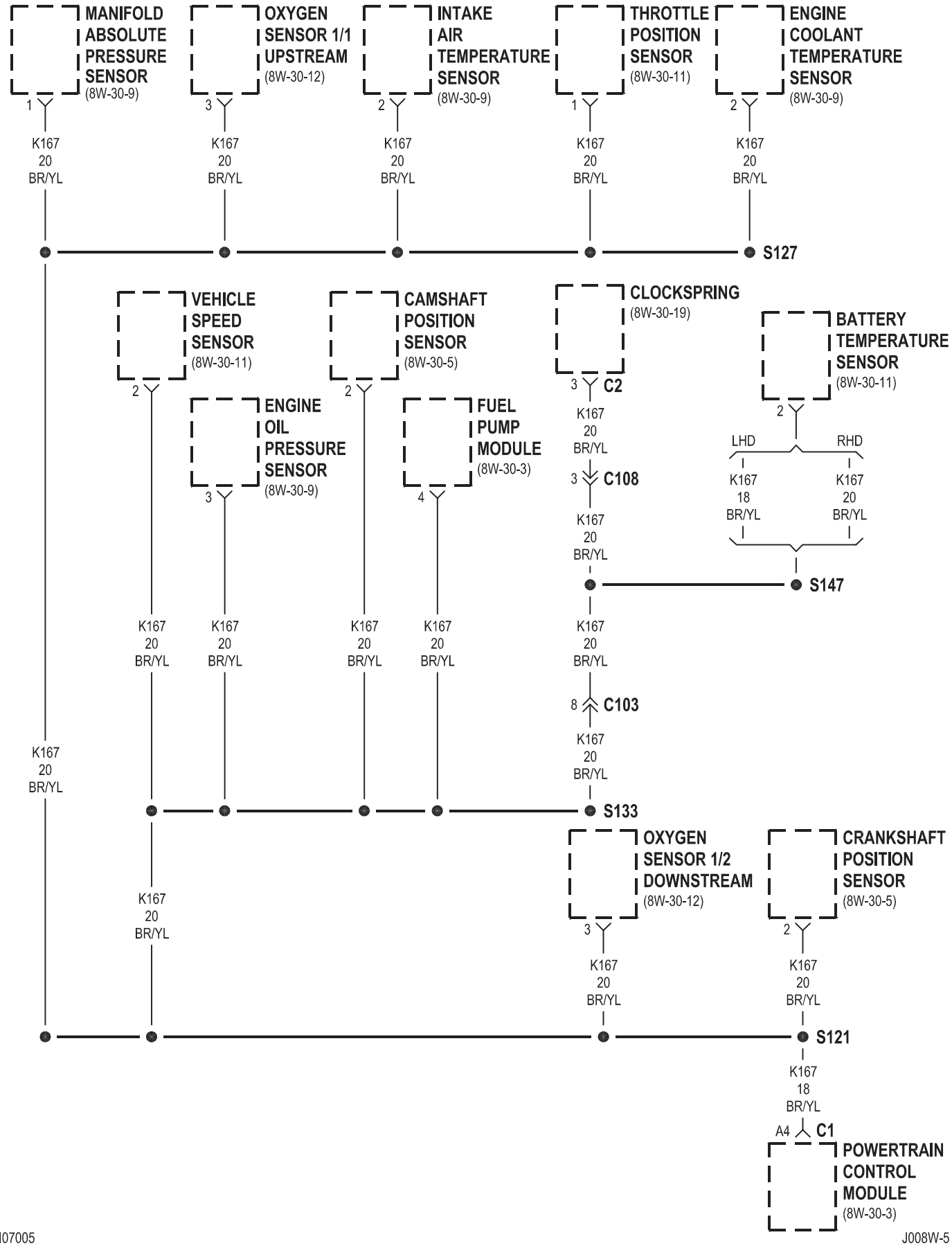
2.5L


OXYGEN SENSOR 1/1 UPSTREAM (8W-30-12)
MANIFOLD ABSOLUTE PRESSURE SENSOR (8W-30-8)
INTAKE AIR TEMPERATURE SENSOR (8W-30-8)
ENGINE COOLANT TEMPERATURE SENSOR (8W-30-8)
BATTERY TEMPERATURE SENSOR (8W-30-10)
CRANKSHAFT POSITION SENSOR (8W-30-4)
THROTTLE POSITION SENSOR (8W-30-10)
ENGINE OIL PRESSURE SENSOR (8W-30-8)
FUEL PUMP MODULE (8W-30-3)
OXYGEN SENSOR 1/2 DOWNSTREAM (8W-30-12)
VEHICLE SPEED SENSOR (8W-30-10)
CLOCKSPRING (8W-30-19)
CAMSHAFT POSITION SENSOR (8W-30-4)
POWERTRAIN CONTROL MODULE (8W-30-4)
S127
S133
S147
C1
C2
C103
C108
LHD
RHD
SPEED CONTROL
OTHER
NOT USED
K167 20 BR/YL
K167 18 BR/YL


POWERTRAIN CONTROL MODULE
(8W-30-8)
(8W-30-9)
(8W-30-10)
(8W-30-11)
B31
C2
K6
18
VT/OR
VEHICLE SPEED SENSOR
(8W-30-10)
(8W-30-11)
1
K6
20
VT/OR
ENGINE OIL PRESSURE SENSOR
(8W-30-8)
(8W-30-9)
1
K6
20
VT/OR
S123


POWERTRAIN CONTROL MODULE
(8W-30-4)
(8W-30-5)
(8W-30-8)
(8W-30-9)
(8W-30-10)
(8W-30-11)
A17
C1
CRANKSHAFT POSITION SENSOR
(8W-30-4)
(8W-30-5)
3
THROTTLE POSITION SENSOR
(8W-30-10)
(8W-30-11)
3
CAMSHAFT POSITION SENSOR
(8W-30-4)
(8W-30-5)
3
MANIFOLD ABSOLUTE PRESSURE SENSOR
(8W-30-8)
(8W-30-9)
3
K7
18
OR
K7
20
OR
K7
20
OR
K7
20
OR
K7
20
OR
S129

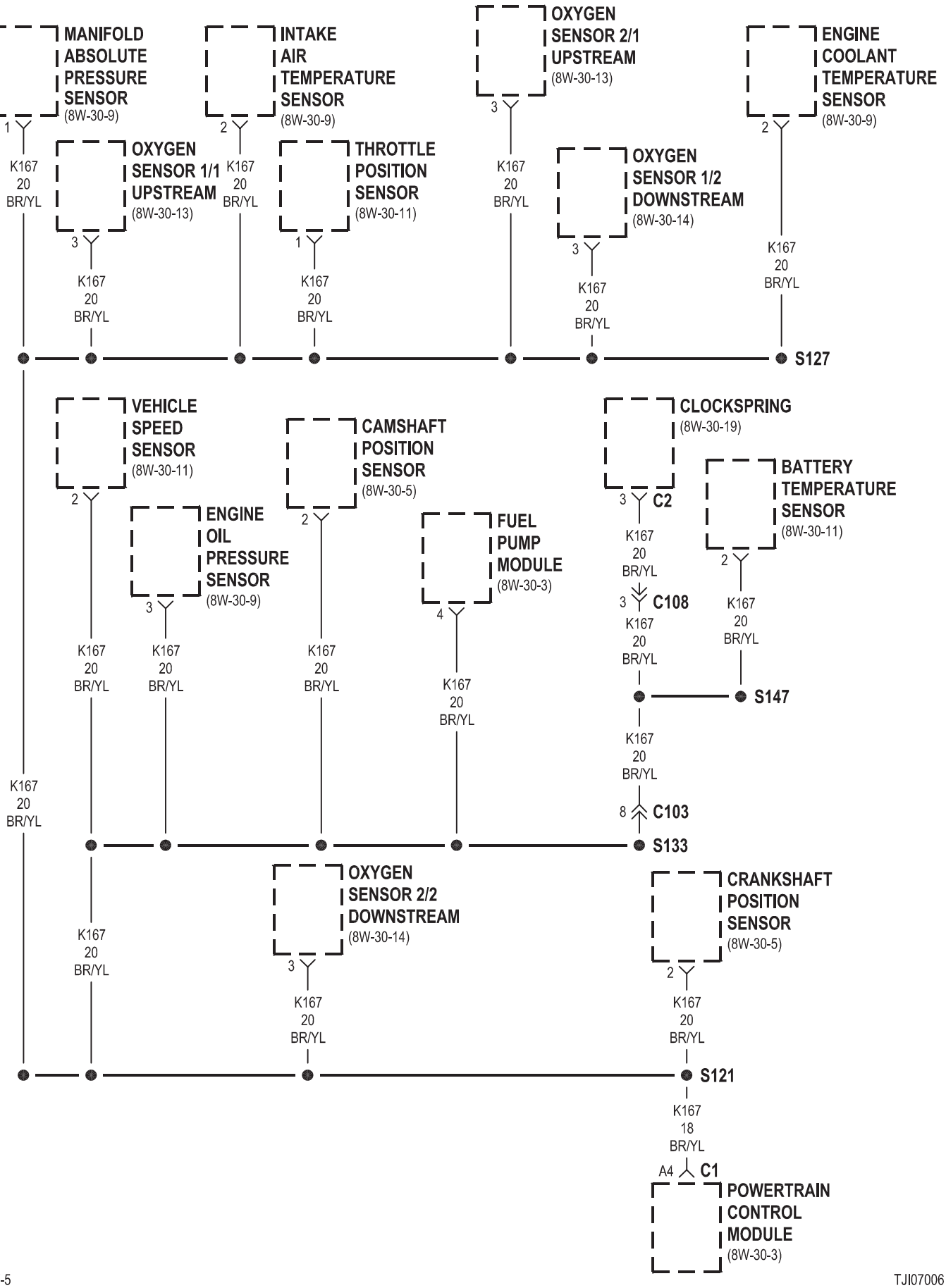
4.0L EXCEPT CALIFORNIA/EUROPEAN III



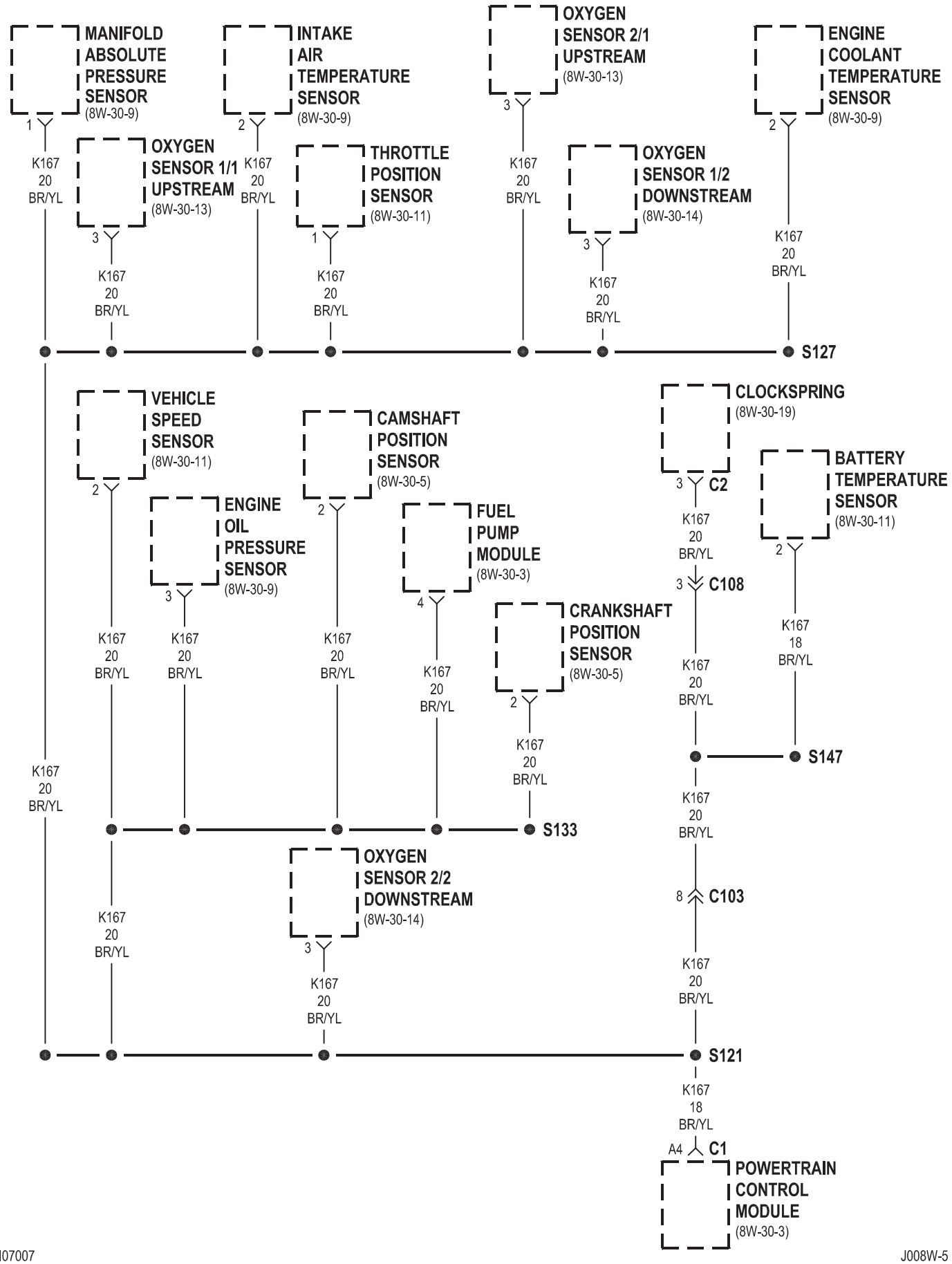
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LHD 4.0L CALIFORNIA/EUROPEAN III



RHD 4.0L CALIFORNIA/EUROPEAN III

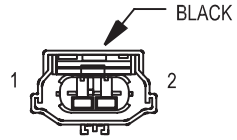


8W-80 CONNECTOR PIN-OUTS

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A/C Low Pressure Switch	8W-80-5
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ABS Pump Motor	8W-80-5
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C104	8W-80-8
C106	8W-80-8
C107	8W-80-9
C108	8W-80-9
C110	8W-80-10
C154	8W-80-10
C170	8W-80-11
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C203	8W-80-12
C204	8W-80-12
C205	8W-80-13
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C325	8W-80-15
C326	8W-80-15
C329	8W-80-16
C330	8W-80-16
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Engine Oil Pressure Sensor	8W-80-20
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Fuel Injector No. 6	8W-80-23
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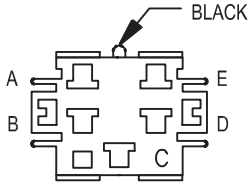
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Component	Page
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Right Headlamp Leveling Motor	8W-80-39
Right License Lamp	8W-80-39
Right Rear Lamp Assemby	8W-80-39
Right Rear Speaker	8W-80-39
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Vehicle Speed Sensor	8W-80-42
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Windshield Wiper Motor	8W-80-42
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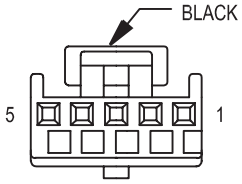
A/C COMPRESSOR CLUTCH

CAV	CIRCUIT	FUNCTION
1	C3 20DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
2	Z1 20BK	GROUND



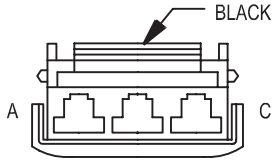
A/C-HEATER CONTROL - C1

CAV	CIRCUIT	FUNCTION
A	C7 12BR/TN	BLOWER MOTOR HIGH SPEED
B	C6 14LB	BLOWER MOTOR M2 SPEED
C	C5 16LG/LB	BLOWER MOTOR M1 SPEED
D	C4 16WT	BLOWER MOTOR LOW SPEED
E	C1 12DG	BLOWER MOTOR FEED



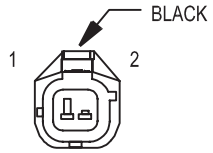
A/C-HEATER CONTROL - C2

CAV	CIRCUIT		FUNCTION
1	Z11 20BK/WT	•	GROUND
1	F24 20RD/DG	••	FUSED IGNITION SWITCH OUTPUT (RUN)
2	C36 20DB/RD		BLEND DOOR FEEDBACK SIGNAL
3	F24 20RD/DG	•	FUSED IGNITION SWITCH OUTPUT (RUN)
3	Z11 20BK/WT	••	GROUND
4	E2 20OR		FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
5	Z1 20BK		GROUND



A/C-HEATER CONTROL - C3

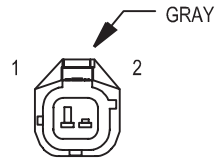
CAV	CIRCUIT	FUNCTION
A	C90 20LG	A/C SELECT INPUT
B	C1 12DG	BLOWER MOTOR FEED
C	Z1 12BK	GROUND



A/C HIGH PRESSURE SWITCH

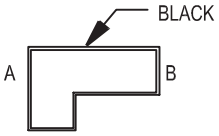
CAV	CIRCUIT	FUNCTION
1	C90 20LG	A/C SELECT INPUT
2	C21 20DB/OR	A/C SWITCH SENSE

• LHD
•• RHD



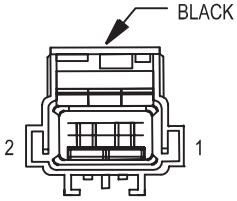
A/C LOW PRESSURE SWITCH

CAV	CIRCUIT	FUNCTION
1	C22 20DB/WT	A/C SWITCH SENSE
2	C21 20DB/OR	A/C SWITCH SENSE



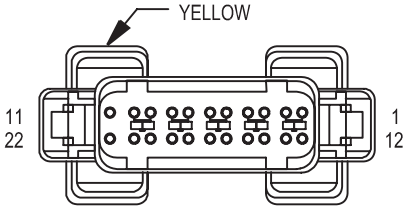
ABS DIODE

CAV	CIRCUIT	FUNCTION
A	B48 20RD/YL	FUSED ABS SYSTEM RELAY OUTPUT
B	G19 20LG/OR	ABS WARNING INDICATOR DRIVER



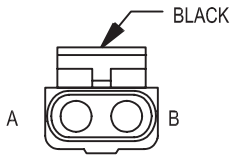
ABS PUMP MOTOR

CAV	CIRCUIT	FUNCTION
1	B120 12BR/WT	ABS PUMP MOTOR RELAY OUTPUT
2	Z1 12BK	GROUND



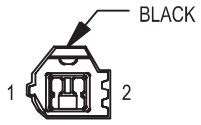
AIRBAG CONTROL MODULE

CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER AIRBAG LINE 2
2	R43 18BK/LB	DRIVER AIRBAG LINE 1
3	-	-
4	-	-
5	R142 18BR/YL	PASSENGER AIRBAG SQUIB LINE 1
6	R144 18VT/YL	PASSENGER AIRBAG SQUIB LINE 2
7	-	-
8	-	-
9	-	-
10	Z6 18BK/PK	GROUND
11	-	-
12	-	-
13	-	-
14	-	-
15	-	-
16	-	-
17	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
18	D2 18WT/BK	CCD BUS(-)
19	D1 18VT/BR	CCD BUS(+)
20	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
21	-	-
22	-	-



BACK-UP LAMP SWITCH (M/T)

CAV	CIRCUIT	FUNCTION
A	L1 18VT/BK	BACK-UP LAMP FEED
B	F20 18VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)



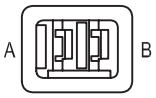
BATTERY TEMPERATURE SENSOR

CAV	CIRCUIT	FUNCTION
1	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
2	K167 20BR/YL ●	SENSOR GROUND
2	K167 18BR/YL ●●	SENSOR GROUND



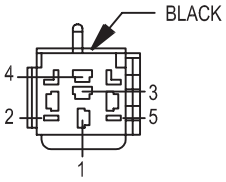
BLEND DOOR ACTUATOR

CAV	CIRCUIT	FUNCTION
5	-	-
6	-	-
7	Z11 20DB/WT	GROUND
8	C36 20YL	BLEND DOOR FEEDBACK SIGNAL
9	-	-
10	F24 20OR	FUSED IGNITION SWITCH OUTPUT (RUN)



BLOWER MOTOR

CAV	CIRCUIT	FUNCTION
A	C1 12DG	BLOWER MOTOR RELAY OUTPUT
B	C7 12BK/TN	BLOWER MOTOR HIGH DRIVER



BLOWER MOTOR RELAY

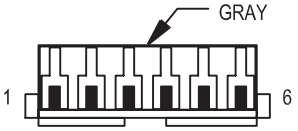
CAV	CIRCUIT	FUNCTION
1	C1 12DG	BLOWER MOTOR RELAY OUTPUT
2	Z1 20BK	GROUND
3	-	-
4	A111 12RD/LG	FUSED B (+)
5	F24 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)



BLOWER MOTOR RESISTOR BLOCK

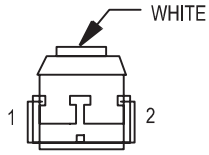
CAV	CIRCUIT	FUNCTION
1	C4 14TN	BLOWER MOTOR LOW DRIVER
2	C5 14LG	BLOWER MOTOR M1 DRIVER
3	C6 14LB	BLOWER MOTOR M2 DRIVER
4	C7 12BK/TN	BLOWER MOTOR HIGH DRIVER

● LHD
●● RHD



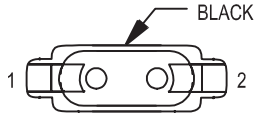
BRAKE LAMP SWITCH

CAV	CIRCUIT	FUNCTION
1	K29 20WT/PK	BRAKE LAMP SWITCH SENSE
2	Z1 20BK	GROUND
3	V32 20YL/RD	SPEED CONTROL ON/OFF SWITCH SENSE
4	V30 20DB/RD	SPEED CONTROL BRAKE LAMP SWITCH OUTPUT
5	F32 18PK/DB	FUSED B(+)
6	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT



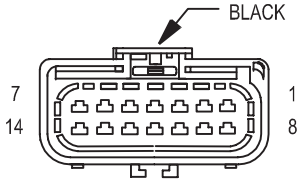
BRAKE SHIFT INTERLOCK SOLENOID

CAV	CIRCUIT	FUNCTION
1	K29 20WT/PK	BRAKE LAMP SWITCH SENSE
2	G5 20DB/WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)



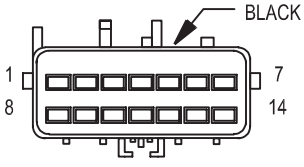
BRAKE WARNING INDICATOR SWITCH

CAV	CIRCUIT	FUNCTION
1	G9 20GY/BK	RED BRAKE WARNING INDICATOR DRIVER
2	G99 20GY/WT	RED BRAKE WARNING INDICATOR DRIVER



C103

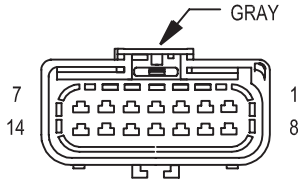
CAV	CIRCUIT
1	F142 20OR/DG
2	K72 18DG/OR
3	A14 14RD/WT
4	B6 18WT/DB ▲
5	B7 18WT ▲
6	K226 18DB/LG
7	A141 18DG/WT
8	K167 20BR/YL
9	F12 20RD/LG
10	Z12 20BK/TN
11	Z12 20BK/LB
12	G7 20WT/OR ▲▲
13	G107 20BK/RD
14	C3 20DB/BK



C103

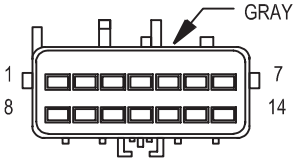
CAV	CIRCUIT
1	F142 18OR/DG ■
2	K72 18DG/OR
3	A14 14RD/WT
4	B6 18WT/DB ▲
5	B7 18WT ▲
6	K226 20DB/LG
7	A141 18DG/WT
8	K167 20BR/YL
9	F12 20RD/LG
10	Z12 20BK/TN
11	Z12 20BK/LB
12	G7 20WT/OR ■
13	G107 20BK/RD
14	C3 20DB/BK

▲ ABS
▲▲ DRL
● LHD
●● RHD
■ EXCEPT 4.0L CALIFORNIA/EUROPEAN III



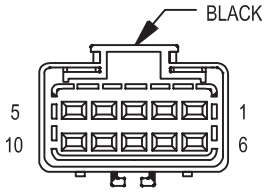
C104
(LHD)

CAV	CIRCUIT
1	C90 20LG
2	C22 18DB/WT
3	B1 18YL/DB ●
4	B2 18YL ●
5	T41 20BR/LB
6	B3 18LG/DB ●
7	B4 18LG ●
8	A42 18DG ■
9	L1 20VT/BK
10	F20 20VT/WT
11	F42 18DG/LG
12	T40 12BR
13	F15 20DB
14	A242 18VT/OR ■



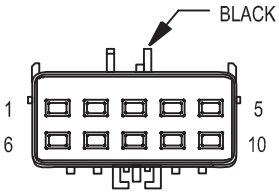
C104
(LHD)

CAV	CIRCUIT
1	C90 20LG
2	C22 20DB/WT
3	B1 18YL/DB ●
4	B2 18YL ●
5	T41 20BR/LB
6	B3 18LG/DB ●
7	B4 18LG ●
8	A42 18DG ■
9	L1 20VT/BK
10	F20 20VT/WT
11	F42 18DG/LG
12	T40 12BR
13	F15 18DB
14	A242 18VT/OR ■



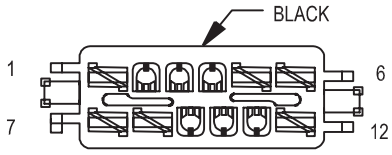
C104
(RHD)

CAV	CIRCUIT
1	C90 20LG
2	C22 18DB/WT
3	A42 18DG ■
4	F42 18DG/LG
5	T41 20BR/LB
6	T40 12BR
7	F15 20DB
8	A242 18VT/OR ■
9	L1 20VT/BK
10	F20 20VT/WT



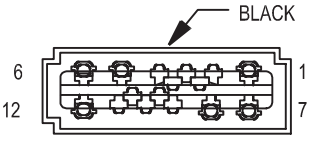
C104
(RHD)

CAV	CIRCUIT
1	C90 20LG
2	C22 20DB/WT
3	A42 18DG ■
4	F42 18DG/LG
5	T41 20BR/LB
6	T40 12BR
7	F15 18DB
8	A242 18VT/OR ■
9	L1 20VT/BK
10	F20 20VT/WT



C106

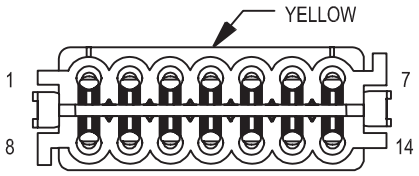
CAV	CIRCUIT
1	F30 12RD/PK
2	L1 20VT/BK
3	F20 20VT/WT
4	F15 20DB
5	A1 14RD
6	A2 12PK/BK
7	A6 12RD/BK
8	C15 12BK/WT
9	T141 14YL/RD
10	F12 20RD/LG
11	G9 20GY/BK
12	A111 12RD/LB



C106

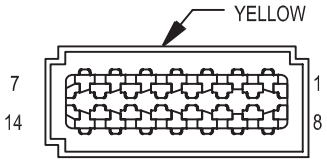
CAV	CIRCUIT
1	F30 12RD/PK
2	L1 20VT/BK
3	F20 20VT/WT
4	F15 20DB
5	A1 14RD
6	A2 12PK/BK
7	A6 12RD/BK
8	C15 12BK/WT
9	T141 14YL/RD T141 14YL/RD
10	F12 20RD/LG
11	G9 20GY/BK G9 20GY/BK
12	A111 12RD/LB

■ 4.0L CALIFORNIA/EUROPEAN III
● ABS



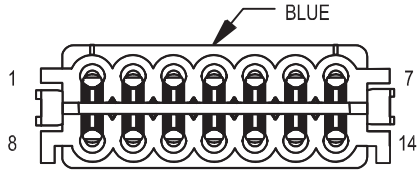
C107

CAV	CIRCUIT
1	L7 18BK/YL
2	L60 18TN
3	L61 18GY
4	L3 16RD/OR
5	L4 16VT/WT
6	Z12 20BK/LB
7	X3 20RD/YL
8	V10 18BR
9	Z12 20BK/TN
10	L39 18LB ▲
11	V30 20DB/RD ■■
12	-
13	D20 18LG
14	D21 18PK
	D21 20PK ◄►



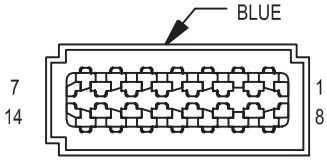
C107

CAV	CIRCUIT
1	L7 18BK/YL
	L7 18BK/YL
2	L60 18TN
3	L61 18GY
4	L3 14RD/OR
5	L4 14VT/WT
6	Z12 20BK/LB
7	X3 20RD/YL
8	V10 18BR
9	Z12 20BK/TN
10	L39 18LB ▲
11	V30 20DB/RD
12	-
13	D20 20LG
14	D21 20PK



C108

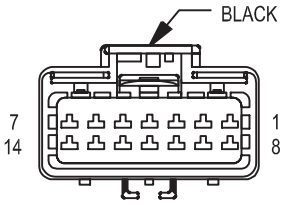
CAV	CIRCUIT
1	V32 18YL/RD
2	G19 20LG/OR ◄►
	G19 20LG/OR ◄►
3	K167 20BR/YL ■■
4	D1 18VT/BR
5	D2 18WT/BK
6	F61 18WT/OR ▲
7	G34 16RD/GY ●
	L3 16RD/OR ●●
8	L20 16LG/WT ●
9	L50 18WT/TN ◄►
10	V37 18RD/LG ■■
11	L9 16BK/WT
12	M1 20PK/WT
	M1 20PK/WT
13	L22 20LG/DG ▲▲
14	K29 18WT/PK



C108

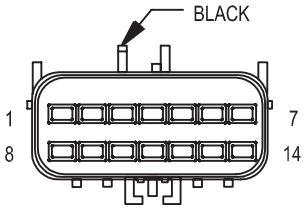
CAV	CIRCUIT
1	V32 20YL/RD
2	G19 20LG/OR
3	K167 20BR/YL
4	D1 20VT/BR
5	D2 20WT/BK
6	F61 18WT/OR ▲
7	G34 16RD/GY
8	L20 16LG/WT ●
9	L50 18WT/TN
	L50 18WT/TN
10	V37 20RD/LG
11	L9 16BK/WT
12	M1 20PK/WT
	M1 20PK/WT
13	L22 20LG/DG ▲▲
14	K29 20WT/PK
	K29 20WT/PK

● DRL
●● EXCEPT DRL
■ LHD
■■ SPEED CONTROL
▲ FRONT FOG LAMPS
▲▲ BUILT-UP-EXPORT
◄► ABS



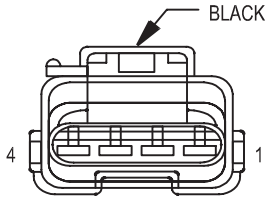
C110

CAV	CIRCUIT
1	L7 18BK/YL
2	L60 18TN
3	L61 18GY
4	L3 16RD/OR
5	L4 16VT/WT
6	X2 18WT/RD
7	-
8	V10 18BR
9	L22 20LG/DG ■
10	K52 20PK/BK
11	F12 20RD/LG
12	-
13	L39 18LB ■■
14	L13 20BR/YL ■



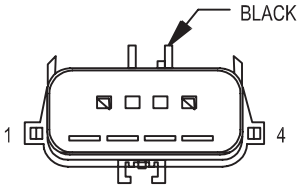
C110

CAV	CIRCUIT
1	L7 18BK/YL
2	L60 18TN
3	L61 18GY
4	L3 16RD/OR
5	L4 16VT/WT
6	X2 18WT/RD
7	-
8	V10 18BR
9	L22 20LG/DG ■
10	K52 18PK/BK
11	F12 20RD/LG
12	-
13	L39 18LB ■■
14	L13 20BR/YL ■



C154

CAV	CIRCUIT
1	Z1 20BK
2	L1 20VT/BK
3	T41 20BR/LB
4	F20 20VT/WT



C154

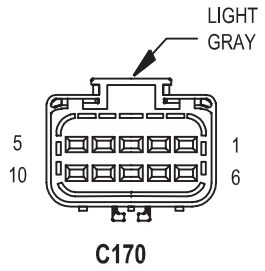
CAV	CIRCUIT
1	Z1 20BK ▲
2	L1 18VT/BK
3	T41 20BR/LB ▲▲
3	Z1 20BK ▲
4	F20 18VT/WT

▲ M/T

▲▲ A/T

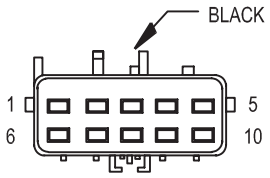
■ BUILT-UP-EXPORT

■■ FRONT FOG LAMPS



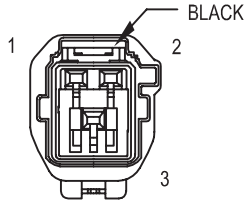
C170

CAV	CIRCUIT
1	L13 20BR/YL ■
2	C81 20LB/WT
3	G99 20GY/WT
4	A3 14RD/WT
5	G107 20BK/RD
6	C90 20LG
7	-
8	-
9	-
10	-



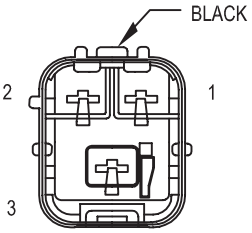
C170

CAV	CIRCUIT
1	L13 20BR/YL ■
2	C81 20LB/WT ■■
3	G99 20GY/WT
4	A3 14RD/WT
5	G107 20BK/RD
6	C90 20LG
7	-
8	-
9	-
10	-



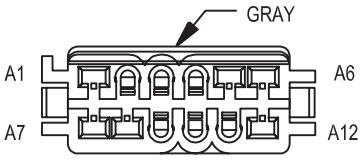
C180

CAV	CIRCUIT
1	K105 18WT/OR
2	K106 18WT/DG
3	K72 20DG/OR



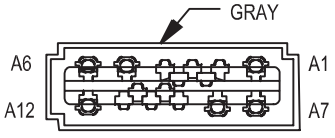
C180

CAV	CIRCUIT
1	K105 20WT/OR
2	K106 20WT/DG
3	K72 20OR/DG



C202

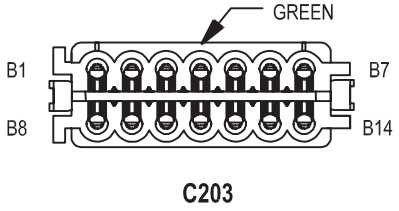
CAV	CIRCUIT
A1	F24 20RD/DG
	F24 20RD/DG
A2	L20 16LG/WT
A3	E1 18TN
A4	E2 20OR
A5	F81 20DB/RD ■■
A6	Z12 20BK/LB
A7	-
A8	L2 16LG
A9	F38 16LB
A10	G5 20DB/WT
A11	F34 18TN/BK
A12	A111 12RD/LB



C202

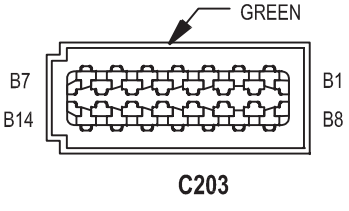
CAV	CIRCUIT
A1	F24 20RD/DG
A2	L20 16LG/WT ●●
	L20 14LG/WT
A3	E1 18TN
A4	E2 20OR
A5	F81 20DB/RD
A6	Z12 20BK/LB
	Z12 20BK/LB
A7	-
A8	L2 14LG
	L2 16LG ●
A9	F38 16LB
A10	G5 20DB/WT
A11	F34 18TN/BK
	F34 20TN/BK
A12	A111 12RD/LB

▲ EXCEPT DRL
● REAR FOG LAMP
●● DRL
■ BUILT-UP-EXPORT
■■ HARDTOP



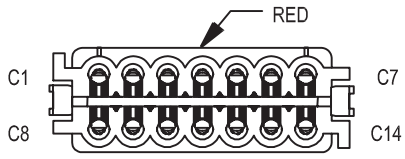
C203

CAV	CIRCUIT
B1	L60 18TN
B2	L61 18GY
B3	G26 20LB
	G26 20LB
B4	G16 20BK/LB
B5	G34 16RD/GY
B6	L7 18BK/YL
	L7 18BK/YL
B7	M1 20PK/WT
B8	D20 20LG
B9	V20 18VT/OR ▲
B10	D21 20PK
B11	D1 20VT/BR
	D1 20VT/BR
B12	D2 20WT/BK
	D2 20WT/BK
B13	L35 18BR/WT ▲▲
B14	G19 20LG/OR



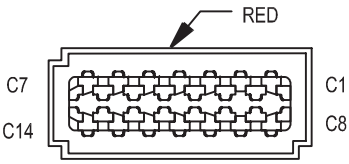
C203

CAV	CIRCUIT
B1	L60 18TN
	L60 18TN
B2	L61 18GY
	L61 18GY
B3	G26 20LB
B4	G16 20BK/LB
	G16 20BK/LB
B5	G34 16RD/GY
	G34 16RD/GY ▲▲
B6	L7 18BK/YL
	L7 18BK/YL ●●▲▲
B7	M1 20PK/WT
B8	D20 20LG
B9	V20 18VT/OR
B10	D21 20PK
B11	D1 20VT/BR
B12	D2 20WT/BK
B13	L35 18BR/WT ▲▲
B14	G19 20LG/OR



C204

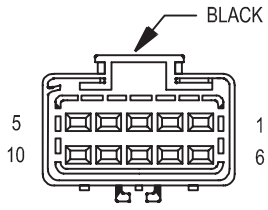
CAV	CIRCUIT
C1	L95 18DG/YL
C2	V13 18BR/LG ▲
C3	G10 20LG/RD
C4	Z12 20BK/TN
C5	M2 20YL
C6	V23 18BR/PK
C7	-
C8	L38 20BR/WT ■
C9	L22 20LG/DG ●
C10	X12 20PK
C11	X51 18BR/YL
C12	X57 18BR/LB
C13	X52 18DB/WT
C14	X58 18DB/PK



C204

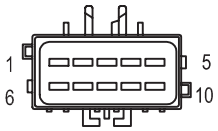
CAV	CIRCUIT
C1	L95 18DG/YL
C2	V13 18BR/LG
C3	G10 20LG/RD
C4	Z12 20BK/TN
C5	M2 20YL
C6	V23 18BR/PK
C7	-
C8	L38 20BR/WT ■
	L38 20BR/WT ■ ▼
C9	L22 20LG/DG ●
	L22 20LG/DG ●
C10	X12 20PK
C11	X51 18BR/YL
C12	X57 18BR/LB
C13	X52 18DB/WT
C14	X58 18DB/PK

■ REAR FOG LAMPS
▲ HARD TOP
▲▲ FRONT FOG LAMPS
● BUILT-UP-EXPORT
●● EXCEPT BUILT-UP-EXPORT
▼ LHD BUILT-UP-EXPORT



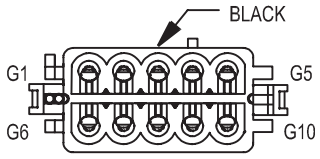
C205

CAV	CIRCUIT
1	Z11 16BK/WT
2	C4 16TN
3	C5 16LG/LB
4	C6 14LB
5	F24 20RD/DG
	F24 20RD/DG
6	C36 20DB/RD
7	C7 12BR/TN
8	A111 12RD/LB
9	F24 20RD/DG
10	Z1 20BK



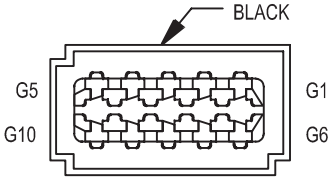
C205

CAV	CIRCUIT
1	Z11 20DB/WT
2	C4 14TN
3	C5 14LG
4	C6 14LB
5	F24 20OR
6	C36 20YL
7	C7 12BK/TN
8	A111 12RD/LG
9	F24 20DB/WT
10	Z1 20BK



C322
(LHD)

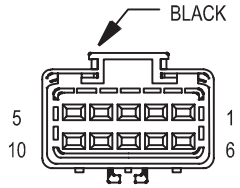
CAV	CIRCUIT
G1	L7 18BK/YL
G2	L62 18BR/RD
G3	L1 20VT/BK
G4	L63 18DG/RD
G5	Z1 12BK
G6	G10 20LG/RD ▲▲
G7	L50 18WT/TN
G8	L38 20BR/WT ●
G9	G9 20GY/BK
G10	V23 18BR/PK ▲



C322
(LHD)

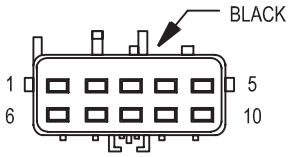
CAV	CIRCUIT
G1	L7 18BK/YL
G2	L62 18BR/RD
G3	L1 20VT/BK
G4	L63 18DG/RD
G5	Z1 12BK
G6	G10 20LG/RD ▲▲
G7	L50 18WT/TN
	L50 18WT/TN ▲▲
G8	L38 20BR/WT ●
G9	G9 20GY/BK
G10	V23 18BR/PK

▲ HARD TOP
▲▲ EXCEPT BUILT-UP-EXPORT
● REAR FOG LAMP
■ 4 SPEAKER SYSTEM



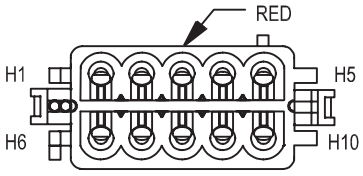
C322
(RHD)

CAV	CIRCUIT
1	L7 18BK/YL
2	L62 18BR/RD
3	L1 20VT/BK
4	L63 18DG/RD
5	Z1 12BK
6	G10 20LG/RD
7	L50 18WT/TN
8	L38 20BR/WT
9	G9 20GY/BK
10	V23 18BR/PK



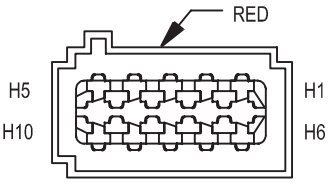
C322
(RHD)

CAV	CIRCUIT
1	L7 18BK/YL
2	L62 18BR/RD
3	L1 20VT/BK
4	L63 18DG/RD
5	Z1 12BK
6	G10 20LG/RD
7	L50 18WT/TN
8	L38 20BR/WT
9	G9 20GY/BK
10	V23 18BR/PK ▲



C323 ■■
(LHD)

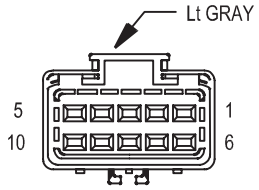
CAV	CIRCUIT
H1	C15 12BK/WT ▲
H2	M1 20PK/WT
H3	M2 20YL
H4	V23 18BR/PK ▲
H5	V13 18BR/LG ▲
H6	V20 18VT/OR ▲
H7	X51 18BR/YL ■
H8	X57 18BR/LB ■
H9	X52 18DB/WT ■
H10	X58 18DB/PK ■



C323
(LHD)

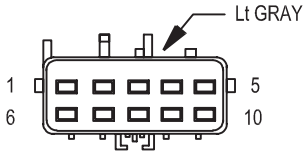
CAV	CIRCUIT
H1	C15 12BK/WT
H2	M1 20PK/WT
H3	M2 20YL
H4	V23 18BR/PK
H5	V13 18BR/LG
H6	V20 18VT/OR
H7	X51 18BR/YL
H8	X57 18BR/LB
H9	X52 18DB/WT
H10	X58 18DB/PK

▲ HARD TOP
■ 4 SPEAKER SYSTEM
■■ THE FEMALE SIDE OF C323 IS NOT PRESENT IN SOFT-TOP 2 - SPEAKER SYSTEM VEHICLES



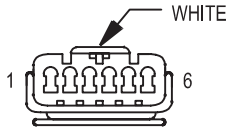
C323
(RHD)

CAV	CIRCUIT
1	C15 12BK/WT ■■
2	M1 20PK/WT
3	M2 20YL
4	V23 18BR/PK ■■
5	V13 18BR/LG ■■
6	V20 18VT/OR ■■
7	X51 18BR/YL ■
8	X57 18BR/LB ■
9	X52 18DB/WT ■
10	X58 18DB/PK ■



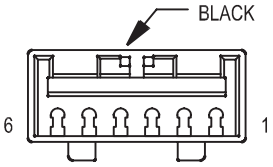
C323 ●
(RHD)

CAV	CIRCUIT
1	C15 12BK/WT
2	M1 20PK/WT
3	M2 20YL
4	V23 18BR/PK
5	V13 18BR/LG
6	V20 18VT/OR
7	X51 18BR/YL
8	X57 18BR/LB
9	X52 18DB/WT
10	X58 18DB/PK



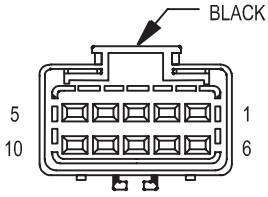
C325
(4 SPKR SYS)

CAV	CIRCUIT
1	X57 18BR/LB
2	X51 18BR/YL
3	M1 20PK/WT
4	M2 20YL
5	X58 18DB/PK
6	X52 18DB/WT



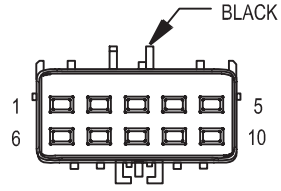
C325
(4 SPKR SYS)

CAV	CIRCUIT
1	X57 18BR/LB
2	X51 18BR/YL
3	M1 20PK/WT
4	M2 20YL
5	X58 18DB/PK
6	X52 18DB/WT



C326
(HARD TOP)

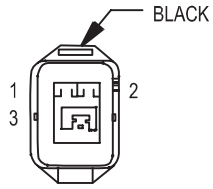
CAV	CIRCUIT
1	C15 12BK/WT
2	-
3	V13 18BR/LG
4	V23 18BR/PK
5	V23 18BR/PK
6	Z1 12BK
7	-
8	M1 20PK/WT
9	M2 20YL
10	-



C326
(HARD TOP)

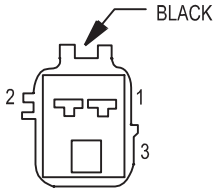
CAV	CIRCUIT
1	C15 12BK/WT
2	-
3	V13 18BR/LG
4	V23 18BR/PK
5	V23 18BR/PK
6	Z1 12BK
7	-
8	M1 20PK/WT
9	M2 18YL
10	-

■ 4 SPEAKER SYSTEM
■ ■ HARD TOP
● THE MALE SIDE OF C323 IS NOT PRESENT IN SOFT-TOP 2 - SPEAKER SYSTEM VEHICLES



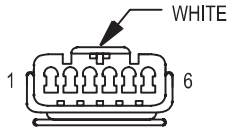
C329

CAV	CIRCUIT
1	L38 20BR/WT
2	L7 18BK/YL
3	Z1 20BK



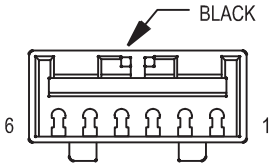
C329

CAV	CIRCUIT
1	L38 18BR/WT
2	L7 18BK/YL
3	Z1 20BK



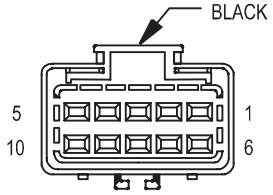
C330
(4 SPKR SYS)

CAV	CIRCUIT
1	X57 18BR/LB
2	X51 18BR/YL
3	M1 20PK/WT
4	M2 20YL
5	X58 18DB/PK
6	X52 18DB/WT



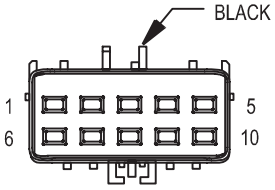
C330
(4 SPKR SYS)

CAV	CIRCUIT
1	X57 20BR/LB
2	X51 20BR/YL
3	M1 20PK/WT
4	M2 20YL
5	X58 20DB/PK
6	X52 20DB/WT



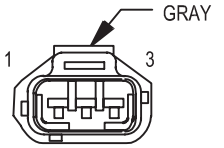
C331
(HARD TOP)

CAV	CIRCUIT
1	C15 12BK/WT
2	-
3	V13 18BR/LG
4	V23 18BR/PK
5	V23 18BR/PK
6	Z1 12BK
7	-
8	M1 20PK/WT
9	M2 18YL
10	-



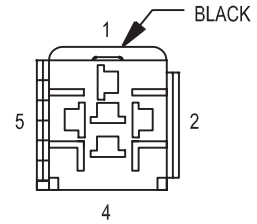
C331
(HARD TOP)

CAV	CIRCUIT
1	C15 12BK/WT
2	-
3	V13 18BK/LG
4	V23 18BR/PK
5	V23 18BR/PK
6	Z1 12BK
7	-
8	M1 20PK/WT
9	M2 20YL
10	-



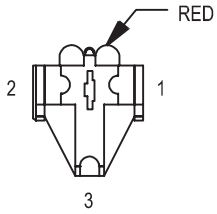
CAMSHAFT POSITION
SENSOR

CAV	CIRCUIT	FUNCTION
1	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
2	K167 20BR/YL	SENSOR GROUND
3	K7 20OR	5V SUPPLY



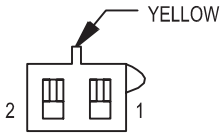
CIGAR LIGHTER/ ACCESSORY RELAY

CAV	CIRCUIT	FUNCTION
1	F30 12RD/PK	FUSED B(+)
2	A31 14BK/DG	IGNITION SWITCH OUTPUT (RUN-ACC)
3	-	-
4	F22 12WT/PK	CIGAR LIGHTER/ACCESSORY RELAY OUTPUT
5	Z1 20BK	GROUND
	Z1 20BK	GROUND



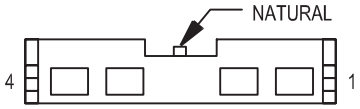
CIGAR LIGHTER/ POWER OUTLET

CAV	CIRCUIT	FUNCTION
1	F38 16LB	FUSED CIGAR LIGHTER/ACCESSORY RELAY OUTPUT
2	-	-
3	Z1 16BK	GROUND



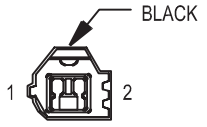
CLOCKSPRING - C1

CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER AIRBAG LINE 2
2	R43 18BK/LB	DRIVER AIRBAG LINE 1



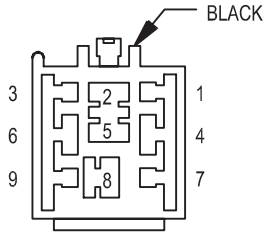
CLOCKSPRING - C2

CAV	CIRCUIT	FUNCTION
1	X3 20RD/YL	HORN RELAY CONTROL
2	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL
3	K167 20BR/YL	SENSOR GROUND
4	-	-



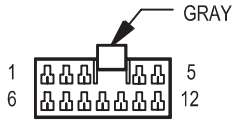
CLUTCH PEDAL POSITION SWITCH (M/T)

CAV	CIRCUIT	FUNCTION
1	T141 14YL/RD	FUSED IGNITION SWITCH OUTPUT (ST)
2	A41 14YL	FUSED IGNITION SWITCH OUTPUT (ST)



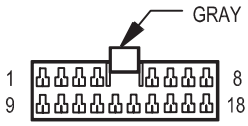
COMBINATION FLASHER

CAV	CIRCUIT	FUNCTION
1	-	-
2	L32 16PK	COMBINATION FLASHER OUTPUT
3	-	-
4	Z1 20BK	GROUND
5	-	-
6	L55 16RD/WT	COMBINATION FLASHER INPUT
7	-	-
8	-	-
9	-	-



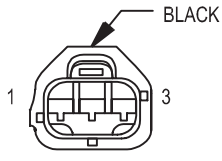
CONTROLLER ANTI-LOCK BRAKE - C1

CAV	CIRCUIT	FUNCTION
1	G19 20LG/OR	ABS WARNING INDICATOR DRIVER
2	B43 20PK/OR	G SWITCH TEST SIGNAL
3	D21 20PK	SCI TRANSMIT/ISO 9141K
4	-	-
5	F20 20VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
6	B41 20YL/VT	G SWITCH NO. 1 SENSE
7	B42 20TN/WT	G SWITCH NO. 2 SENSE
8	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
9	B3 18LG/DB	LEFT REAR WHEEL SPEED SENSOR (-)
10	B4 18LG	LEFT REAR WHEEL SPEED SENSOR (+)
11	B1 18YL/DB	RIGHT REAR WHEEL SPEED SENSOR (-)
12	B2 18YL	RIGHT REAR WHEEL SPEED SENSOR (+)



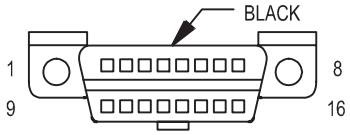
CONTROLLER ANTI-LOCK BRAKE - C2

CAV	CIRCUIT	FUNCTION
1	B7 18WT	RIGHT FRONT WHEEL SPEED SENSOR (+)
2	B6 18WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
3	B120 16BR/WT	ABS PUMP MOTOR RELAY OUTPUT
4	B251 20WT/BK	REAR INLET VALVE CONTROL
5	B48 20RD/YL	FUSED ABS SYSTEM RELAY OUTPUT
6	B248 20DG/WT	RIGHT FRONT OUTLET VALVE CONTROL
7	B116 20GY	ABS PUMP MOTOR RELAY CONTROL
8	B243 20DG/BK	LEFT FRONT OUTLET VALVE CONTROL
9	B9 18RD	LEFT FRONT WHEEL SPEED SENSOR (+)
10	B8 18RD/DB	LEFT FRONT WHEEL SPEED SENSOR (-)
11	B58 20GY/LB	ABS SYSTEM RELAY CONTROL
12	B254 20DG/OR	REAR OUTLET VALVE CONTROL
13	Z22 16BK/PK	GROUND
14	Z22 16BK/PK	GROUND
15	B249 20WT/DG	RIGHT FRONT INLET VALVE CONTROL
16	-	-
17	-	-
18	B245 20WT/LG	LEFT FRONT INLET VALVE CONTROL



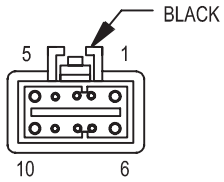
CRANKSHAFT POSITION SENSOR

CAV	CIRCUIT	FUNCTION
1	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
2	K167 20BR/YL	SENSOR GROUND
3	K7 20OR	5V SUPPLY



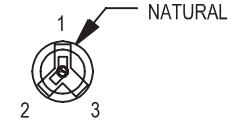
DATA LINK CONNECTOR

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	D1 20VT/BR	CCD BUS(+)
4	Z12 20BK/LB	GROUND
5	Z12 20BK/TN	GROUND
6	D20 20LG	SCI RECEIVE
7	D21 20PK	SCI TRANSMIT/ISO 9141K
8	-	-
9	-	-
10	-	-
11	D2 20WT/BK	CCD BUS(-)
12	-	-
13	-	-
14	-	-
15	-	-
16	M1 20PK/WT	FUSED B(+)



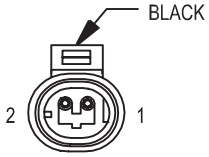
DAYTIME RUNNING LAMP MODULE (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
2	-	-
3	-	-
4	G34 16RD/GY	HIGH BEAM INDICATOR DRIVER
5	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
6	L20 16LG/WT	FUSED B(+)
7	G7 20WT/OR	VEHICLE SPEED SENSOR SIGNAL
8	Z1 18BK	GROUND
9	-	-
10	L4 16VT/WT	DIMMER SWITCH LOW BEAM OUTPUT



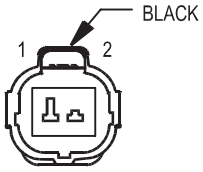
DRIVER DOOR AJAR SWITCH

CAV	CIRCUIT	FUNCTION
1	M23 20YL/BK	DOOR AJAR SWITCH OUTPUT
2	M2 20YL	COURTESY LAMPS DRIVER
3	G16 20BK/LB	DRIVER DOOR AJAR SWITCH SENSE



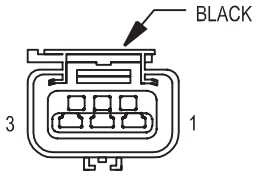
DUTY CYCLE EVAP/PURGE SOLENOID

CAV	CIRCUIT	FUNCTION
1	K52 20PK/BK	DUTY CYCLE EVAP/PURGE SOLENOID CONTROL
2	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (ST-RUN)



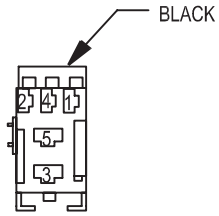
ENGINE COOLANT TEMPERATURE SENSOR

CAV	CIRCUIT	FUNCTION
1	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
2	K167 20BR/YL	SENSOR GROUND



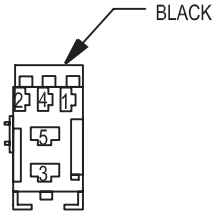
ENGINE OIL PRESSURE SENSOR

CAV	CIRCUIT	FUNCTION
1	K6 20VT/OR	5V SUPPLY
2	G60 18GY/YL	ENGINE OIL PRESSURE SENSOR SIGNAL
3	K167 20BR/YL	SENSOR GROUND



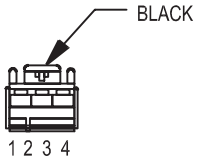
FOG LAMP RELAY NO. 1 (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L35 18BR/WT	FOG LAMP SWITCH OUTPUT
2	Z1 20BK	GROUND
3	F61 18WT/OR	FUSED B(+)
4	-	-
5	L39 18LB	FOG LAMP RELAY NO. 1 OUTPUT



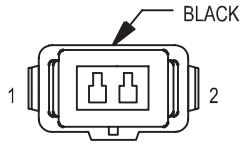
FOG LAMP RELAY NO. 2 (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	G34 16RD/GY	HIGH BEAM INDICATOR DRIVER
2	Z1 20BK	GROUND
	Z1 20BK	GROUND
3	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
4	L95 18DG/YL	FOG LAMP RELAY NO. 2 OUTPUT
5	-	-



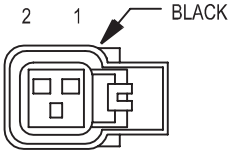
FRONT FOG LAMP SWITCH (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
2	L35 18BR/WT	FOG LAMP SWITCH OUTPUT
3	L95 18DG/YL	FOG LAMP RELAY NO. 2 OUTPUT
4	Z1 20BK	GROUND



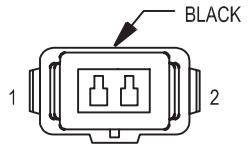
FUEL INJECTOR NO. 1 (2.5L)

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER



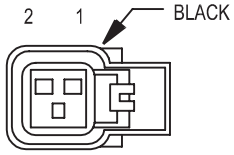
FUEL INJECTOR NO. 1 (4.0L)

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER



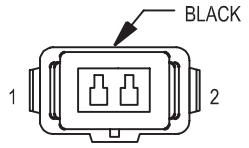
FUEL INJECTOR NO. 2
(2.5L)

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K12 18TN	FUEL INJECTOR NO. 2 DRIVER



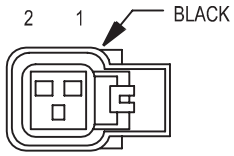
FUEL INJECTOR NO. 2
(4.0L)

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K12 18TN	FUEL INJECTOR NO. 2 DRIVER



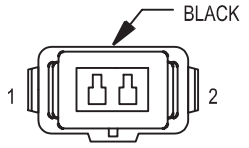
FUEL INJECTOR NO. 3
(2.5L)

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER



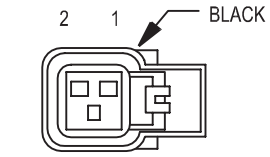
FUEL INJECTOR NO. 3
(4.0L)

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER



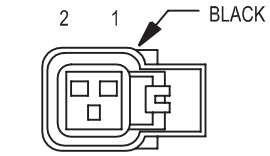
FUEL INJECTOR NO. 4
(2.5L)

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER



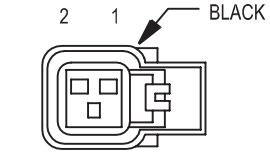
FUEL INJECTOR NO. 4 (4.0L)

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER



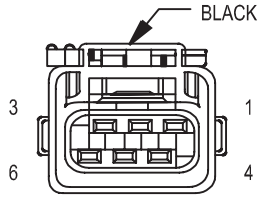
FUEL INJECTOR NO. 5 (4.0L)

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K15 18PK/BK	FUEL INJECTOR NO. 5 DRIVER



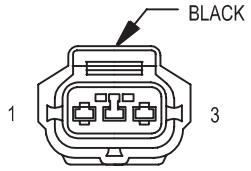
FUEL INJECTOR NO. 6 (4.0L)

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K16 18LG/BK	FUEL INJECTOR NO. 6 DRIVER



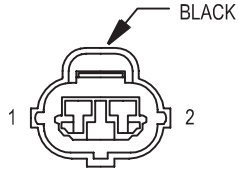
FUEL PUMP MODULE

CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT	FUEL PUMP RELAY OUTPUT
2	-	-
3	K226 20DB/LG	FUEL LEVEL SENSOR SIGNAL
4	K167 20BR/YL	SENSOR GROUND
5	-	-
6	Z1 18BK	GROUND



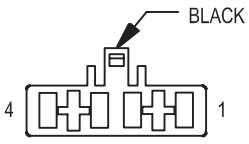
G SWITCH

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



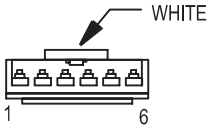
GENERATOR

CAV	CIRCUIT	FUNCTION
1	K72 18DG/OR	GENERATOR SOURCE
2	K20 18DG	GENERATOR FIELD



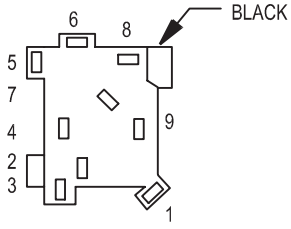
HEADLAMP DIMMER SWITCH

CAV	CIRCUIT	FUNCTION
1	L4 14VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
2	L2 14LG	HEADLAMP SWITCH OUTPUT
3	L3 14RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
4	L20 14LG/WT	FUSED B(+)



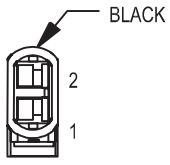
HEADLAMP LEVELING SWITCH (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	-	-
2	L22 20LG/DG	FUSED HEADLAMP SWITCH OUTPUT
3	-	-
4	Z1 20BK	GROUND
5	L13 20BR/YL	HEADLAMP ADJUST SIGNAL
6	-	-



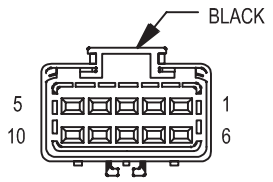
HEADLAMP SWITCH

CAV	CIRCUIT	FUNCTION
1	E1 18TN	PANEL LAMPS DIMMER SWITCH SIGNAL
2	L2 16LG	HEADLAMP SWITCH OUTPUT
3	M2 20YL	COURTESY LAMPS DRIVER
4	F34 18TN/BK	FUSED B(+)
5	G26 20LB	KEY-IN IGNITION SWITCH SENSE
6	G16 20BK/LB	DRIVER DOOR AJAR SWITCH SENSE
7	L20 16LG/WT	FUSED B(+)
8	A3 14RD/WT	FUSED B(+)
9	L7 18BK/YL	HEADLAMP SWITCH OUTPUT



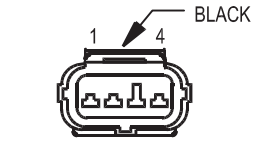
HIGH NOTE HORN

CAV	CIRCUIT	FUNCTION
1	X2 18WT/RD	HORN RELAY OUTPUT
2	Z1 18BK	GROUND



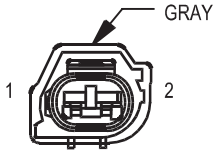
HYDRAULIC CONTROL UNIT

CAV	CIRCUIT	FUNCTION
1	B47 14RD/LB	ABS SYSTEM RELAY OUTPUT
2	B251 20WT/BK	REAR INLET VALVE CONTROL
3	B249 20WT/DG	RIGHT FRONT INLET VALVE CONTROL
4	B245 20WT/LG	LEFT FRONT INLET VALVE CONTROL
5	-	-
6	-	-
7	B254 20DG/OR	REAR OUTLET VALVE CONTROL
8	B248 20DG/WT	RIGHT FRONT OUTLET VALVE CONTROL
9	B243 20DG/BK	LEFT FRONT OUTLET VALVE CONTROL
10	B47 14RD/LB	ABS SYSTEM RELAY OUTPUT



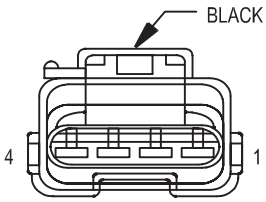
IDLE AIR CONTROL MOTOR

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



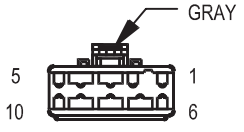
IGNITION COIL (2.5L)

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K19 18GY	IGNITION COIL NO. 1 DRIVER



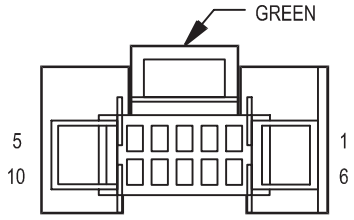
IGNITION COIL PACK (4.0L)

CAV	CIRCUIT	FUNCTION
1	K19 18GY	IGNITION COIL NO. 1 DRIVER
2	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
3	K17 18DB/TN	IGNITION COIL NO. 2 DRIVER
4	K18 18RD/YL	IGNITION COIL NO. 3 DRIVER



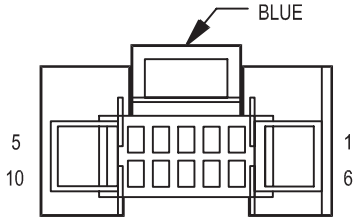
IGNITION SWITCH

CAV	CIRCUIT	FUNCTION
1	Z1 16BK	GROUND
2	G9 20GY/BK	RED BRAKE WARNING INDICATOR DRIVER
3	A2 12PK/BK	FUSED B(+)
4	A22 12BK/OR	IGNITION SWITCH OUTPUT (RUN)
5	-	-
6	-	-
7	A1 14RD	FUSED B(+)
8	A31 14BK/DG	IGNITION SWITCH OUTPUT (RUN-ACC)
9	A21 14DB	IGNITION SWITCH OUTPUT (ST-RUN)
10	A41 14YL	IGNITION SWITCH OUTPUT (ST)



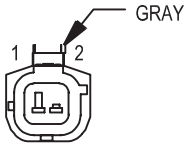
INSTRUMENT CLUSTER - C1

CAV	CIRCUIT	FUNCTION
1	D2 20WT/BK	CCD BUS(-)
2	D1 20VT/BR	CCD BUS(+)
3	C81 20LB/WT •	REAR WINDOW DEFOGGER RELAY CONTROL
4	C80 20DB/LG •	REAR WINDOW DEFOGGER SWITCH SENSE
5	G107 20BK/RD	4WD SENSE
6	L60 18TN	RIGHT TURN SIGNAL
7	-	-
8	G26 20LB	KEY-IN IGNITION SWITCH SENSE
9	Z2 18BK/LG	GROUND
10	G10 20LG/RD	SEAT BELT SWITCH SENSE



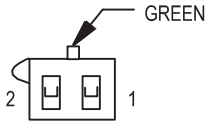
INSTRUMENT CLUSTER - C2

CAV	CIRCUIT	FUNCTION
1	-	-
2	G99 20GY/WT	RED BRAKE WARNING INDICATOR DRIVER
3	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
4	G19 20LG/OR	ABS WARNING INDICATOR DRIVER
5	G34 16RD/GY	HIGH BEAM INDICATOR DRIVER
6	Z2 18BK/LG	GROUND
7	-	-
8	G5 20DB/WT	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
9	M1 20PK/WT	FUSED B(+)
10	L61 18GY	LEFT TURN SIGNAL



INTAKE AIR TEMPERATURE SENSOR

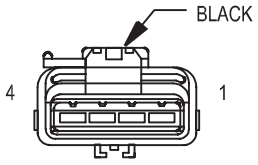
CAV	CIRCUIT	FUNCTION
1	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
2	K167 20BR/YL	SENSOR GROUND



KEY-IN SWITCH

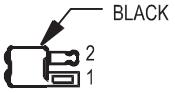
CAV	CIRCUIT	FUNCTION
1	G16 20BK/LB	DRIVER DOOR AJAR SWITCH SENSE
2	G26 20LB	KEY-IN IGNITION SWITCH SENSE

•HARD TOP



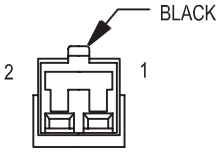
LEAK DETECTION PUMP (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	-	-
2	K72 20OR/DG	GENERATOR SOURCE
3	K106 20WT/DG	LEAK DETECTION PUMP SOLENOID CONTROL
4	K105 20WT/OR	LEAK DETECTION PUMP SWITCH SENSE



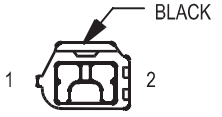
LEFT CITY LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	Z1 18BK	GROUND



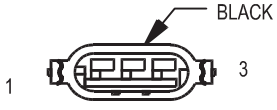
LEFT COURTESY LAMP

CAV	CIRCUIT	FUNCTION
1	M1 20PK/WT	FUSED B(+)
2	M2 20YL	COURTESY LAMPS DRIVER



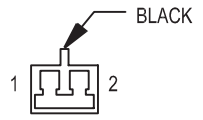
LEFT FOG LAMP (EXCEPT BUILT-UP -EXPORT)

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L39 18LB	FOG LAMP RELAY NO. 1 OUTPUT



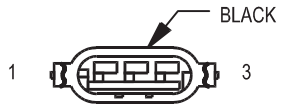
LEFT FRONT PARK/ TURN SIGNAL LAMP (EXCEPT BUILT-UP -EXPORT)

CAV	CIRCUIT	FUNCTION
1	L61 18GY	LEFT TURN SIGNAL
2	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
3	Z1 18BK	GROUND



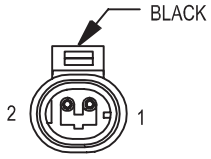
LEFT FRONT SPEAKER

CAV	CIRCUIT	FUNCTION
1	X53 18DG	LEFT FRONT SPEAKER (+)
2	X55 18BR/RD	LEFT FRONT SPEAKER (-)



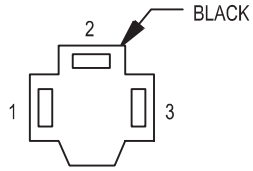
LEFT FRONT TURN SIGNAL LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L61 18GY	LEFT TURN SIGNAL
2	-	-
3	Z1 18BK	GROUND



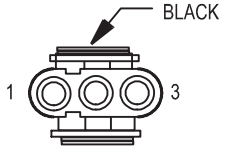
LEFT FRONT WHEEL SPEED SENSOR

CAV	CIRCUIT	FUNCTION
1	B8 18RD/DB	LEFT FRONT WHEEL SPEED SENSOR (-)
2	B9 18RD	LEFT FRONT WHEEL SPEED SENSOR (+)



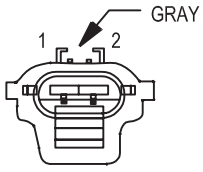
LEFT HEADLAMP

CAV	CIRCUIT	FUNCTION
1	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
2	L4 16VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
3	Z1 20BK	GROUND



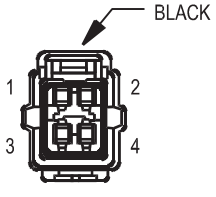
LEFT HEADLAMP LEVELING MOTOR (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L22 20LG/DG	FUSED HEADLAMP SWITCH OUTPUT
2	L13 20BR/YL	HEADLAMP ADJUST SIGNAL
3	Z1 20BK	GROUND



LEFT LICENSE LAMP (BUILT-UP-EXPORT)

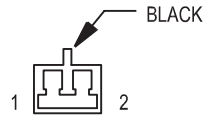
CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	Z1 20BK	GROUND



LEFT REAR LAMP ASSEMBLY

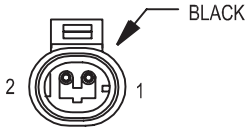
CAV	CIRCUIT		FUNCTION
1	L1 20VT/BK	●	BACK-UP LAMP FEED
	L63 18DG/RD	●●	LEFT TURN SIGNAL
2	L63 18DG/RD	●	LEFT TURN/STOP SIGNAL
	L1 20VT/BK	●●	BACK-UP LAMP FEED
3	L7 18BK/YL	●	HEADLAMP SWITCH OUTPUT
	L50 18WT/TN	●●	BRAKE LAMP SWITCH OUTPUT
4	L7 18BK/YL	●●	HEADLAMP SWITCH OUTPUT

● EXCEPT BUILT-UP-EXPORT
●● BUILT-UP-EXPORT



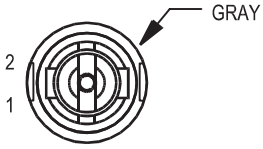
LEFT REAR SPEAKER (SOUND BAR)

CAV	CIRCUIT	FUNCTION
1	X51 20BR/YL	LEFT REAR SPEAKER (+)
2	X57 20BR/LB	LEFT REAR SPEAKER (-)



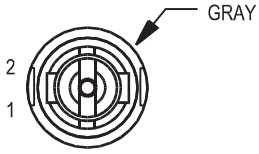
LEFT REAR WHEEL SPEED SENSOR

CAV	CIRCUIT	FUNCTION
1	B3 18LG/DB	LEFT REAR WHEEL SPEED SENSOR (-)
2	B4 18LG	LEFT REAR WHEEL SPEED SENSOR (+)



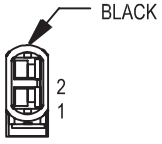
LEFT REPEATER LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L61 18GY	LEFT TURN SIGNAL
2	Z1 18BK	GROUND



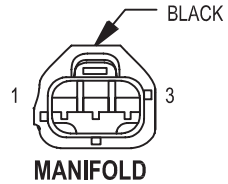
LEFT SIDE MARKER LAMP (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	L61 18GY	LEFT TURN SIGNAL



LOW NOTE HORN (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	X2 18WT/RD	HORN RELAY OUTPUT
2	Z1 18BK	GROUND

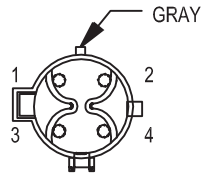


MANIFOLD ABSOLUTE PRESSURE SENSOR

CAV	CIRCUIT	FUNCTION
1	K167 20BR/YL	SENSOR GROUND
2	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
3	K7 20OR	5V SUPPLY

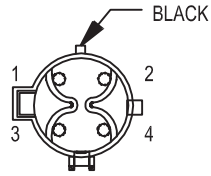
● EXCEPT BUILT-UP-EXPORT

●● BUILT-UP-EXPORT



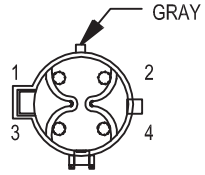
OXYGEN SENSOR 1/1 UPSTREAM

CAV	CIRCUIT	FUNCTION
1	F142 18OR/DG ●	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
1	A42 18DG ●●	OXYGEN SENSOR UPSTREAM HEATER 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

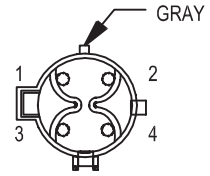
CAV	CIRCUIT	FUNCTION
1	F142 18OR/DG ●	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
1	A242 18VT/OR ●●	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
2	Z1 18BK	GROUND
3	K167 20BR/YL	SENSOR GROUND
4	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL



OXYGEN SENSOR 2/1 UPSTREAM (4.0L CALIFORNIA/EUROPEAN III)

CAV	CIRCUIT	FUNCTION
1	A42 18DG	OXYGEN SENSOR UPSTREAM HEATER RELAY OUTPUT
2	Z1 18BK	GROUND
3	K167 20BR/YL	SENSOR GROUND
4	K241 18LG/RD	OXYGEN SENSOR 2/1 SIGNAL

● EXCEPT 4.0L CALIFORNIA/EUROPEAN III
●● 4.0L CALIFORNIA/EUROPEAN III



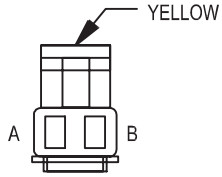
OXYGEN SENSOR 2/2 DOWNSTREAM (4.0L CALIFORNIA/EUROPEAN III)

CAV	CIRCUIT	FUNCTION
1	A242 18VT/OR	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
2	Z1 18BK	GROUND
3	K167 20BR/YL	SENSOR GROUND
4	K341 18TN	OXYGEN SENSOR 2/2 SIGNAL



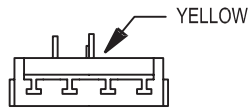
PARK/NEUTRAL POSITION SWITCH (A/T)

CAV	CIRCUIT	FUNCTION
1	F20 18VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
2	T41 20BR/LB	PARK/NEUTRAL POSITION SWITCH SENSE
3	L1 18VT/BK	BACK-UP LAMP FEED



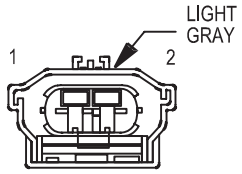
PASSENGER AIRBAG

CAV	CIRCUIT	FUNCTION
A	R44 18DG/YL	PASSENGER AIRBAG LINE 2
B	R42 18BK/YL	PASSENGER AIRBAG LINE 1



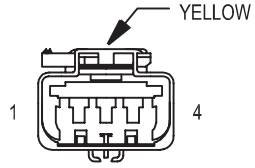
PASSENGER AIRBAG DISCONNECT BYPASS JUMPER

CAV	CIRCUIT	FUNCTION
1	R142 18BR/YL	PASSENGER AIRBAG SQUIB LINE 1
2	R144 18VT/YL	PASSENGER AIRBAG SQUIB LINE 2
3	R142 18BK/YL	PASSENGER AIRBAG SQUIB LINE 1
4	R144 18DG/YL	PASSENGER AIRBAG SQUIB LINE 2



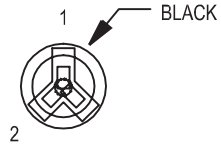
PASSENGER AIRBAG ON/OFF SWITCH - C1

CAV	CIRCUIT	FUNCTION
1	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
2	Z6 20BK/PK	GROUND



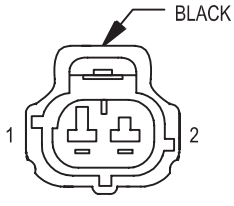
PASSENGER AIRBAG ON/OFF SWITCH - C2

CAV	CIRCUIT	FUNCTION
1	R142 18BR/YL	PASSENGER AIRBAG SQUIB LINE 1
2	R144 18VT/YL	PASSENGER AIRBAG SQUIB LINE 2
3	R42 18BK/YL	PASSENGER AIRBAG LINE 1
4	R44 18DG/YL	PASSENGER AIRBAG LINE 2



PASSENGER DOOR AJAR SWITCH

CAV	CIRCUIT	FUNCTION
1	M23 20YL/BK	DOOR AJAR SWITCH OUTPUT
2	M2 20YL	COURTESY LAMPS DRIVER

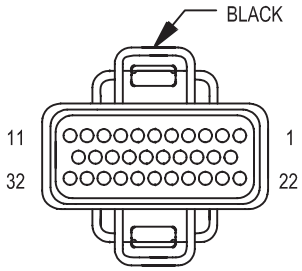


POWER STEERING PRESSURE SWITCH (2.5L)

CAV	CIRCUIT	FUNCTION
1	Z1 20BK ●	GROUND
1	Z1 18BK ● ●	GROUND
2	K10 18DB/BR	POWER STEERING PRESSURE SWITCH SENSE

● LHD

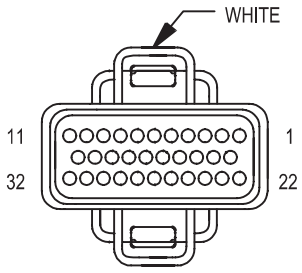
● ● RHD



POWERTRAIN CONTROL MODULE - C1

CAV	CIRCUIT	FUNCTION
A1	K18 18RD/YL ▲	IGNITION COIL NO. 3 DRIVER
A2	F15 18DB	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
A3	-	-
A4	K167 18BR/YL	SENSOR GROUND
A5	-	-
A6	T41 18BR/LB	PARK/NEUTRAL POSITION 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 PRESSURE SWITCH SENSE
A13	-	-
A14	-	-
A15	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
A16	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
A17	K7 18OR	5V SUPPLY
A18	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
A19	K39 18GY/RD	IDLE AIR CONTROL NO. 1 DRIVER
A20	K59 18VT/BK	IDLE AIR CONTROL NO. 4 DRIVER
A21	-	-
A22	A14 14RD/WT	FUSED B(+)
A23	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
A24	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL
A25	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL
A26	K241 18LG/RD ●●	OXYGEN SENSOR 2/1 SIGNAL
A27	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
A28	-	-
A29	K341 18TN ●●	OXYGEN SENSOR 2/2 SIGNAL
A30	-	-
A31	Z12 14BK/TN	GROUND
A32	Z12 14BK/TN	GROUND

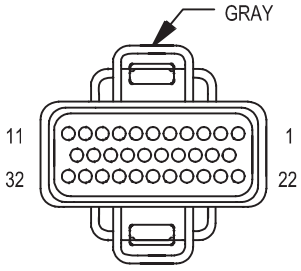
● 2.5L
●● 4.0L CALIFORNIA/EUROPEAN III
▲ 4.0L



POWERTRAIN CONTROL MODULE - C2

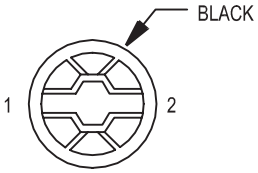
CAV	CIRCUIT	FUNCTION
B1	-	-
B2	-	-
B3	-	-
B4	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER
B5	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER
B6	K15 18PK/BK ●	FUEL INJECTOR NO. 5 DRIVER
B7	-	-
B8	-	-
B9	K17 18DB/TN ●	IGNITION COIL NO. 2 DRIVER
B10	K20 18DG	GENERATOR FIELD
B11	T23 18OR/LG	TRANSMISSION LOW/OVERDRIVE SOLENOID
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 20WT/OR ■	VEHICLE SPEED SENSOR SIGNAL
B27	G7 18WT/OR ■■	VEHICLE SPEED SENSOR SIGNAL
B28	-	-
B29	-	-
B30	-	-
B31	K6 18VT/OR	5V SUPPLY
B32	-	-

● 4.0L
■ 4.0L RHD
■■ EXCEPT 4.0L RHD



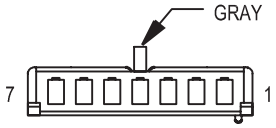
POWERTRAIN CONTROL MODULE - C3

CAV	CIRCUIT	FUNCTION
C1	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
C2	-	-
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	K73 18BR/OR ●●	OXYGEN SENSOR UPSTREAM HEATER RELAY CONTROL
C9	K74 18BR/VT ●●	OXYGEN SENSOR DOWNSTREAM HEATER RELAY CONTROL
C10	K106 18WT/DG ▼	LEAK DETECTION PUMP SOLENOID CONTROL
C11	V32 18YL/RD ●	SPEED CONTROL ON/OFF SWITCH SENSE
C12	A142 14DG/PK	AUTOMATIC SHUT DOWN RELAY OUTPUT
C13	-	-
C14	K105 18WT/OR ▼	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 SOURCE
C26	K226 18DB/LG	FUEL LEVEL SENSOR SIGNAL
C27	D21 18PK	SCI TRANSMIT/ISO 9141K
C28	D2 18WT/BK	CCD BUS(-)
C29	D20 18LG	SCI RECEIVE
C30	D1 18VT/BR	CCD BUS(+)
C31	-	-
C32	V37 18RD/LG ●	SPEED CONTROL SWITCH SIGNAL



PRNDL LAMP

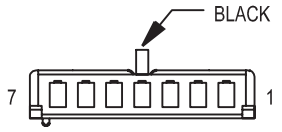
CAV	CIRCUIT	FUNCTION
1	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
2	Z1 20BK	GROUND



RADIO - C1

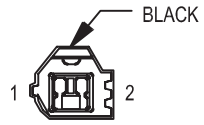
CAV	CIRCUIT	FUNCTION
1	-	-
2	X55 18BR/RD	LEFT FRONT SPEAKER(-)
3	X56 18DB	RIGHT FRONT SPEAKER(-)
4	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
5	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
6	X12 20PK	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
7	M1 20PK/WT	FUSED B(+)

● SPEED CONTROL
●● 4.0L CALIFORNIA/EUROPEAN III
▼ LEAK DETECTION



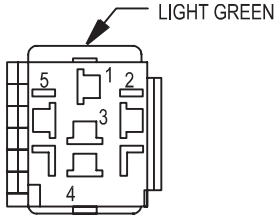
RADIO - C2

CAV	CIRCUIT	FUNCTION
1	-	-
2	X51 18BR/YL	LEFT REAR SPEAKER(+)
3	X52 18DB/WT	RIGHT REAR SPEAKER(+)
4	X53 18DG	LEFT FRONT SPEAKER(+)
5	X54 18VT	RIGHT FRONT SPEAKER(+)
6	X57 18BR/LB	LEFT REAR SPEAKER(-)
7	X58 18DB/PK	RIGHT REAR SPEAKER(-)



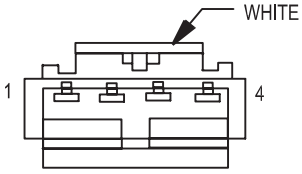
REAR FOG LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L38 18BR/WT	REAR FOG LAMP FEED
2	Z1 20BK	GROUND



REAR FOG LAMP RELAY (BUILT-UP-EXPORT)

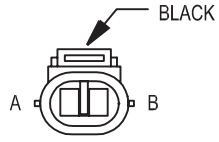
CAV	CIRCUIT	FUNCTION
1	L22 20LG/DG	FUSED HEADLAMP SWITCH OUTPUT
2	L95 18DG/YL	REAR FOG LAMP RELAY CONTROL
3	Z1 20BK	GROUND
4	L38 20BR/WT	REAR FOG LAMP FEED
	L38 20BR/WT ●	REAR FOG LAMP FEED
5	L22 20LG/DG	FUSED HEADLAMP SWITCH OUTPUT



REAR FOG LAMP SWITCH (BUILT-UP-EXPORT)

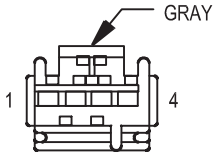
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	L95 18DG/YL	REAR FOG LAMP RELAY CONTROL
3	L38 20BR/WT	REAR FOG LAMP FEED
4	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL

● RHD



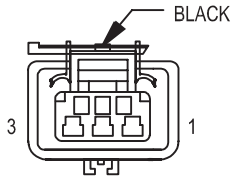
REAR WASHER PUMP (HARD TOP)

CAV	CIRCUIT	FUNCTION
A	V20 18VT/OR	REAR WASHER MOTOR CONTROL
B	Z1 18BK	GROUND



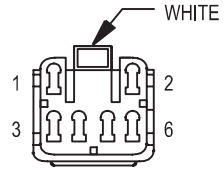
REAR WINDOW DEFOGGER SWITCH (HARD TOP)

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	C80 20DB/LG	REAR WINDOW DEFOGGER SWITCH SENSE
3	F81 20DB/RD	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
4	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL



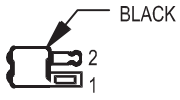
REAR WIPER MOTOR (HARD TOP)

CAV	CIRCUIT	FUNCTION
1	V23 18BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
2	Z1 16BK	GROUND
3	V13 18BK/LG	REAR WIPER MOTOR CONTROL



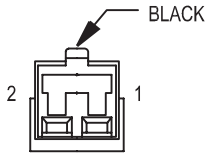
REAR WIPER/ WASHER SWITCH (HARD TOP)

CAV	CIRCUIT	FUNCTION
1	Z1 18BK/WT	GROUND
2	V20 18VT/OR	REAR WASHER MOTOR CONTROL
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	-	-



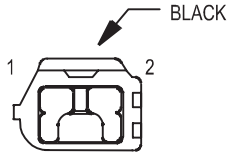
RIGHT CITY LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	Z1 20BK	GROUND



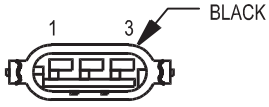
RIGHT COURTESY LAMP

CAV	CIRCUIT	FUNCTION
1	M1 20PK/WT	FUSED B(+)
2	M2 20YL	COURTESY LAMPS DRIVER



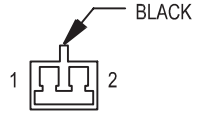
RIGHT FOG LAMP (EXCEPT BUILT-UP -EXPORT)

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L39 18LB	FOG LAMP RELAY NO. 1 OUTPUT



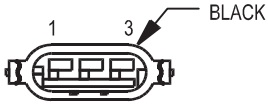
RIGHT FRONT PARK/ TURN SIGNAL LAMP (EXCEPT BUILT-UP -EXPORT)

CAV	CIRCUIT	FUNCTION
1	L60 18TN	RIGHT TURN SIGNAL
2	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
3	Z1 18BK	GROUND



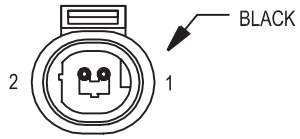
RIGHT FRONT SPEAKER

CAV	CIRCUIT	FUNCTION
1	X54 18VT	RIGHT FRONT SPEAKER (+)
2	X56 18DB	RIGHT FRONT SPEAKER (-)



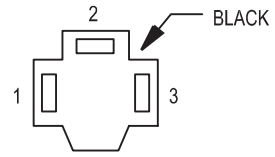
RIGHT FRONT TURN SIGNAL LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L60 18TN	RIGHT TURN SIGNAL
2	-	-
3	Z1 18BK	GROUND



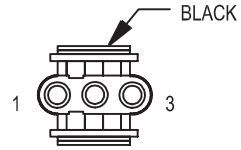
RIGHT FRONT WHEEL SPEED SENSOR

CAV	CIRCUIT	FUNCTION
1	B6 18WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
2	B7 18WT	RIGHT FRONT WHEEL SPEED SENSOR (+)



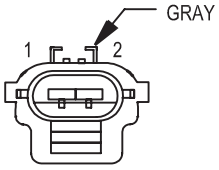
RIGHT HEADLAMP

CAV	CIRCUIT	FUNCTION
1	L3 16RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
2	L4 16VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
3	Z1 18BK	GROUND



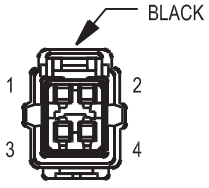
RIGHT HEADLAMP LEVELING MOTOR (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L22 20LG/DG	FUSED HEADLAMP SWITCH OUTPUT
2	L13 20BR/YL	HEADLAMP ADJUST SIGNAL
3	Z1 18BK	GROUND



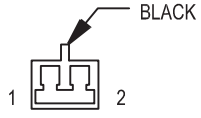
RIGHT LICENSE LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	Z1 20BK	GROUND



RIGHT REAR LAMP ASSEMBLY

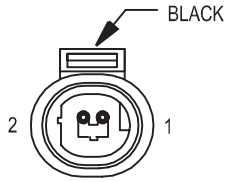
CAV	CIRCUIT		FUNCTION
1	L1 20VT/BK	●	BACK-UP LAMP FEED
	L62 18BR/RD	●●	RIGHT TURN SIGNAL
2	L62 18BR/RD	●	RIGHT TURN/STOP SIGNAL
	L1 20VT/BK	●●	BACK-UP LAMP FEED
3	L7 18BK/YL	●	HEADLAMP SWITCH OUTPUT
	L50 18WT/TN	●●	BRAKE LAMP SWITCH OUTPUT
4	L63 18DG/RD	●	LEFT TURN/STOP SIGNAL
	L7 18BK/YL	●●	HEADLAMP SWITCH OUTPUT



RIGHT REAR SPEAKER (SOUND BAR)

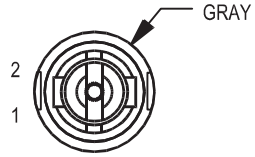
CAV	CIRCUIT	FUNCTION
1	X52 20DB/WT	RIGHT REAR SPEAKER (+)
2	X58 20DB/PK	RIGHT REAR SPEAKER (-)

● EXCEPT BUILT-UP-EXPORT
●● BUILT-UP-EXPORT



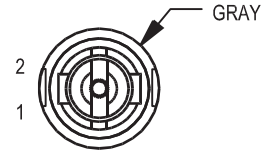
RIGHT REAR WHEEL SPEED SENSOR

CAV	CIRCUIT	FUNCTION
1	B1 18YL/DB	RIGHT REAR WHEEL SPEED SENSOR (-)
2	B2 18YL	RIGHT REAR WHEEL SPEED SENSOR (+)



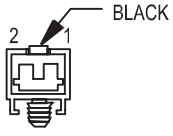
RIGHT REPEATER LAMP (BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L60 18TN	RIGHT TURN SIGNAL
2	Z1 18BK	GROUND



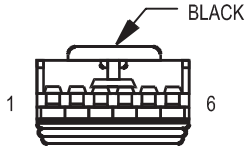
RIGHT SIDE MARKER LAMP (EXCEPT BUILT-UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	L60 18TN	RIGHT TURN SIGNAL



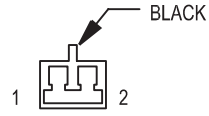
SEAT BELT SWITCH (EXCEPT LHD BUILT--UP-EXPORT)

CAV	CIRCUIT	FUNCTION
1	G10 20LG/RD	SEAT BELT SWITCH SENSE
2	Z1 20BK	GROUND



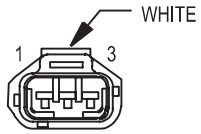
SENTRY KEY IMMOBILIZER MODULE

CAV	CIRCUIT	FUNCTION
1	F34 20TN/BK	FUSED B(+)
2	Z1 20BK	GROUND
3	F15 20DB	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
4	Z12 20BK/LB	GROUND
5	D2 20WT/BK	CCD BUS(-)
6	D1 20VT/BR	CCD BUS(+)



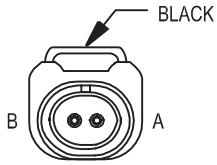
SOUND BAR DOME LAMP

CAV	CIRCUIT	FUNCTION
1	M1 20PK/WT	FUSED B(+)
2	M2 20YL	COURTESY LAMPS DRIVER



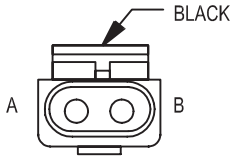
THROTTLE POSITION SENSOR

CAV	CIRCUIT	FUNCTION
1	K167 20BR/YL	SENSOR GROUND
2	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
3	K7 20OR	5V SUPPLY



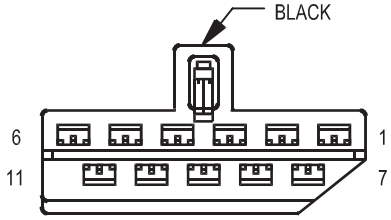
TORQUE CONVERTER CLUTCH SOLENOID

CAV	CIRCUIT	FUNCTION
A	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (ST-RUN)
B	T23 18OR/LG	TRANSMISSION LOW/OVERDRIVE SOLENOID



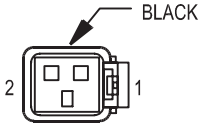
TRANSFER CASE SWITCH

CAV	CIRCUIT	FUNCTION
A	G107 20BK/RD	4WD SENSE
B	Z1 20BK	GROUND



TURN SIGNAL/ HAZARD SWITCH

CAV	CIRCUIT	FUNCTION
1	L60 18TN	RIGHT TURN SIGNAL
2	L50 18WT/TN ▼	BRAKE LAMP SWITCH OUTPUT
3	L62 18BR/RD ▼	RIGHT TURN/STOP SIGNAL
3	L62 18BR/RD ▼▼	RIGHT TURN SIGNAL
4	L32 16PK	COMBINATION FLASHER OUTPUT
5	L5 20BK/GY	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
6	L9 16BK/WT	FUSED FLASHER FEED
7	-	-
8	-	-
9	L63 18DG/RD ▼	LEFT TURN/STOP SIGNAL
9	L63 18DG/RD ▼▼	LEFT TURN SIGNAL
10	L61 18GY	LEFT TURN SIGNAL
11	L55 16RD/WT	COMBINATION FLASHER INPUT

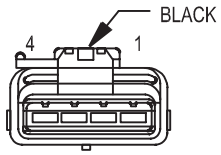


UNDERHOOD LAMP

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	M1 20PK/WT	FUSED B(+)

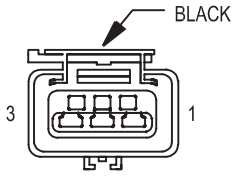
▼ EXCEPT BUILT-UP-EXPORT

▼▼ BUILT-UP-EXPORT



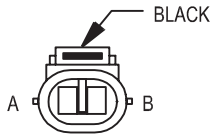
VEHICLE SPEED CONTROL SERVO

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 BRAKE LAMP SWITCH OUTPUT
4	Z1 18BK	GROUND



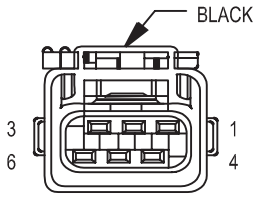
VEHICLE SPEED SENSOR

CAV	CIRCUIT	FUNCTION
1	K6 20VT/OR	5V SUPPLY
2	K167 20BR/YL	SENSOR GROUND
3	G7 20WT/OR	VEHICLE SPEED SENSOR SIGNAL



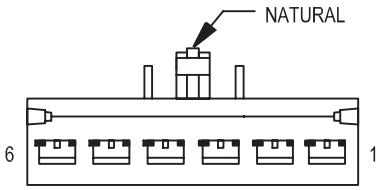
WINDSHIELD WASHER PUMP

CAV	CIRCUIT	FUNCTION
A	V10 18BR	WASHER PUMP CONTROL SWITCH OUTPUT
B	Z1 18BK	GROUND



WINDSHIELD WIPER MOTOR

CAV	CIRCUIT	FUNCTION
1	V6 16PK/BK	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	V5 18DG/YL	WIPER PARK SWITCH SENSE
3	-	-
4	Z1 18BK	GROUND
5	V3 18BR/WT	LOW SPEED WIPER SWITCH OUTPUT
6	V4 18RD/YL	WIPER SWITCH HIGH SPEED OUTPUT



WINDSHIELD WIPER SWITCH

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	V5 18DG/YL	WIPER PARK SWITCH SENSE
3	V10 18BR	WASHER PUMP CONTROL SWITCH OUTPUT
4	V3 18BR/WT	LOW SPEED WIPER SWITCH OUTPUT
5	V6 16PK/BK	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
6	V4 18RD/YL	WIPER SWITCH HIGH SPEED OUTPUT

8W-90 CONNECTOR/GROUND 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 a N/S is placed in the Fig. column.

Connector Name/Number	Color	Location	Fig.
A/C Compressor Clutch	BK	At A/C Compressor Clutch	12
A/C Heater Control - C1	BK	Rear of Blower Motor Switch	18, 19
A/C Heater Control - C2	BK	Rear of Lamp	18, 19
A/C Heater Control - C3	BK	Rear of A/C Heater Control Switch	18, 19
A/C High Pressure Switch (2.5L)	BK	On A/C Compressor	N/S
A/C High Pressure Switch (4.0L)	BK	T/O at A/C Compressor Clutch T/O or Intake Air Temperature Sensor T/O	N/S
A/C Low Pressure Switch	GY	Near T/O for Powertrain Control Module	N/S
ABS Diode	BK	Near T/O for Controller Anti-Lock Brake	2
ABS Pump Motor	BK	Left Side of Engine Compartment Near Grommet	6
Airbag Control Module	YL	Front of Floor Pan Tunnel	16, 17, 20
Back-up Lamp Switch (M/T)	BK	Right Side of Transmission	14
Battery Temperature Sensor	BK	Under Battery Tray	3, 4
Blend Door Actuator		On HVAC Harness	N/S

Connector Name/Number	Color	Location	Fig.
Blower Motor		On HVAC Harness	N/S
Blower Motor Relay	BK	On HVAC Harness	N/S
Blowe Motor Resistor Block		On HVAC Harness	N/S
Brake Lamp Switch	GY	Top of Brake Pedal Bracket	16, 17
Brake Shift Interlock Solenoid	WT	Near Steering Column	21
Brake Warning Indicator Switch	BK	On Brake Master Cylinder	2, 3
C103 (2.5L)	BK	Near T/O for Fuel Injector NO. 4	2, 3
C103 (4.0L)	BK	Near T/O for Fuel Injector NO. 6	2, 3
C104 (LHD)	GY	Rear of Engine	2
C104 (RHD)	BK	Rear of Engine	3
C106 (LHD)	BK	Left Kick Panel	2, 16
C106 (RHD)	BK	Right Kick Panel	17
C107 (LHD)	YL	Left Kick Panel	2, 16
C107 (RHD)	YL	Right Kick Panel	17
C108 (LHD)	BL	Left Kick Panel	2, 16
C108 (RHD)	BL	Right Kick Panel	17
C110	BK	Left Fender Side Shield	3, 5
C154	BK	Top Right Side of Transmission	11, 14

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
C170 (LHD)	LT GY/ BK	Left Kick Panel	2, 18
C170 (RHD)	LT GY/ BK	Right Kick Panel	19
C180	BK	Engine Compartment Left Side	N/S
C202 (LHD)	GY	Left Kick Panel	16, 18
C202 (RHD)	GY	Right Kick Panel	17, 19
C203 (LHD)	GN	Left Kick Panel	16, 18
C203 (RHD)	GN	Right Kick Panel	17, 19
C204 (LHD)	RD	Left Kick Panel	16, 18
C204 (RHD)	RD	Right Kick Panel	17, 19
C205 (LHD)	BK	Bottom Right of Instrument Panel	22
C205 (RHD)	BK	Bottom Left of Instrument Panel	19
C322	BK	Left Kick Panel	16, 17, 23
C323 (LHD)	RD	Left Kick Panel	16, 23
C323 (RHD)	LT GY	Left Kick Panel	17, 24
C325 (4 Spkr Sys)	WT/ BK	Left Side of Sound Bar	23, 24
C326 (Hard Top)	BK	Left Rear Quarter Panel	23, 24
C329 (LHD)	BK	Left Side of Rear Bumper	25
C329 (RHD)	BK	Right Side of Rear Bumper	26
C330 (4 Spkr Sys)	WT/ BK	Left Side of Sound Bar	23, 24
C331 (Hard Top)	BK	Left Rear Quarter Panel	23, 24
Camshaft Position Sensor (2.5L)	GY	Below Distributor	11
Camshaft Position Sensor (4.0L)	GY	T/O at Generator T/O	N/S
Cigar Lighter/ Accessory Relay (LHD)	BK	Bottom of Instrument Panel Near Steering Column	16, 23
Cigar Lighter/ Accessory Relay (RHD)	BK	Bottom of Instrument Panel Near Steering Column	N/S
Cigar Lighter/ Power Outlet	RD	Rear of Cigar Lighter	18, 19
Clockspring - C1	YL	Rear of Clockspring	21
Clockspring - C2	NAT	Rear of Clockspring	21
Clutch Pedal Position Switch (M/T)	BK	Top of Clutch Pedal Bracket	16, 17
Combination Flasher	BK	Bottom of Instrument Panel Near Steering Column	21
Controller Anti-Lock Brake - C1	GY	Near Grommet Rear Left Side of Dash Panel	2
Controller Anti-Lock Brake - C2	GY	Near Grommet Rear Left Side of Dash Panel	2
Crankshaft Position Sensor	BK	At Rear of Intake Manifold	9, 13
Data Link Connector (LHD)	BK	Bottom Left of Instrument Panel	18
Data Link Connector (RHD)	BK	Bottom Right of Instrument Panel	19
Daytime Running Lamp Module (Except Built-Up-Export)	BK	Left Side of Engine Compartment	4
Driver Door Ajar Switch	NAT	At “A” Pillar	16, 17
Duty Cycle Evap/Purge solenoid	BK	Left Fender Side Shield	5

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Engine Coolant Temperature Sensor	BK	On Thermostat Housing	9, 10
Engine Oil Pressure Sensor (2.5L)	BK	Right Side of Engine Block	11
Engine Oil Pressure Sensor (4.0L)	BK	Right Side of Engine Block	N/S
Fog Lamp Relay NO.1 (Except Built-Up-Export)	BK	Near Fuse Block T/O	16
Fog Lamp Relay NO.2 (Except Built-Up-Export)	BK	Near Fuse Block T/O	16
Front Fog Lamp Switch (Except Built-Up-Export)	BK	At Switch	18
Fuel Injector NO.1	BK	At Injector	9, 10
Fuel Injector NO.2	BK	At Injector	9, 10
Fuel Injector NO.3	BK	At Injector	9, 10
Fuel Injector NO.4	BK	At Injector	9, 10
Fuel Injector NO.5	BK	At Injector	10
Fuel Injector NO.6	BK	At Injector	10
Fuel Pump Module	BK	Above Fuel Tank	27
G100		Rear Center of Engine Compartment	2, 3
G101		Rear Center of Engine Compartment	2
G102		Left Radiator Closure Panel	5
G103		Right Radiator Closure Panel	1
G105 (2.5L)		Right Rear of Engine Block	12
G105 (4.0L)		Right Rear of Engine Block	N/S
G106		Right Rear of Engine Block	12
G107		Right Rear of Engine Block	12
G200 (LHD)		Left Rear of Instrument Panel	18
G200 (RHD)		Right Rear of Instrument Panel	19
G201 (LHD)		Left Rear of Instrument Panel	18
G201 (RHD)		Right Rear of Instrument Panel	19
G202 (LHD)		Right Rear of Instrument Panel	22
G202 (RHD)		Left Rear of Instrument Panel	19
G203 (LHD)		Right Rear of Instrument Panel	22
G203 (RHD)		Left Rear of Instrument Panel	19
G300 (LHD)		Left Kick Panel	16
G300 (RHD)		Right Kick Panel	17
G301 (LHD)		Right Kick Panel	16
G301 (RHD)		Left Kick Panel	17
G302 (LHD)		Left Kick Panel	16
G302 (RHD)		Right Kick Panel	17
G Switch	BK	Near T/O for Controller Anti-Lock Brake	20
Generator	BK	Rear of Generator	12
Headlamp Dimmer Switch	BK	At Steering Column Part of Multifunction Switch	21

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Headlamp Leveling Switch (Built-Up-Export)	WT	At Switch	18, 19
Headlamp Switch	BK	Rear of Switch	18, 19
High Note Horn	BK	Left Front Fender Side Shield	5
Hydraulic Control Unit	BK	Left Side of Engine Compartment	6
Idle Air Control Motor	BK	Side of Throttle Body	9, 10
Ignition Coil (2.5L)	GY	T/O near G105 T/O	N/S
Ignition Coil Pack (4.0L)	BK	Near T/O for Crankshaft Position Sensor	N/S
Ignition Switch	GY	Rear of Ignition Switch	21
Instrument Cluster - C1	GN	Rear of Cluster	18, 19
Instrument Cluster - C2	BL	Rear of Cluster	18, 19
Intake Air Temperature Sensor	GY	Rear of Intake Manifold	9, 10
Key-In Switch	GN	At Key-In Switch	21
Leak Detection Pump (Except Built-Up-Export)	BK	Engine Compartment Left Side	N/S
Left City Lamp (Built-Up-Export)	BK	At Lamp	5
Left Courtesy Lamp	BK	Left Side of Instrument Panel	18, 19
Left Fog Lamp (Except Built-Up-Export)	BK	At Lamp	N/S
Left Front Park/Turn Signal Lamp (Except Built-Up-Export)	BK	At Lamp	N/S

Connector Name/Number	Color	Location	Fig.
Left Front Speaker	BK	At Speaker	18, 19
Left Front Turn Signal Lamp (Built-Up-Export)	BK	At Lamp	N/S
Left Front Wheel Speed Sensor	BK	Left Side of Engine Compartment Near Hydraulic Control Unit	6
Left Headlamp	BK	Rear of Lamp	5
Left Headlamp Leveling Motor (Built-Up-Export)	BK	Near Headlamp at Motor	5
Left License Lamp (Built-Up-Export)	GY	At Lamp	25, 26
Left Rear Lamp Assembly	BK	At Lamp	25, 26
Left Rear Speaker (Sound Bar)	BK	At Sound Bar	N/S
Left Rear Wheel Speed Sensor	BK	Near Vehicle Speed Sensor T/O	27
Left Repeater Lamp (Built-Up-Export)	GY	At Lamp	N/S
Left Side Marker Lamp (Except Built-Up-Export)	GY	At Lamp	N/S
Low Note Horn (Except Built-Up-Export)	BK	Left Front Fender Side Shield	5
Manifold Absolute Pressure Sensor	BK	Side of Throttle Body	9, 10
Oxygen Sensor 1/1 Upstream	GY	On Front Exhaust Pipe	9, 15
Oxygen Sensor 1/2 Downstream	BK	Rear of Catalytic Converter	15

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Oxygen Sensor 1/1 Upstream (4.0L California/ European III)	GY	Near T/O for Engine Coolant Temperature Sensor	15
Oxygen Sensor 1/2 Downstream (4.0L California/ European III)	BK	Near T/O for Oxygen Sensor 1/1 Front Bank Up	15
Oxygen Sensor 2/1 Upstream (4.0L California/ European III)	GY	Near Idle Air Control Motor T/O	15
Oxygen Sensor 2/2 Downstream (4.0L California/ European III)	GY	T/O near Ignition Coil Pack T/O	15
Park/Neutral Position Switch (A/T)		Left Side of Transmission	11
Passenger Airbag	YL	Rear of Airbag	16, 17, 19, 22
Passenger Airbag Disconnect Bypass Jumper	YL	Near Fuse Block T/O	N/S
Passenger Airbag On/Off Switch - C1	LT GY	Near Fuse Block T/O	16, 17
Passenger Airbag On/Off Switch - C2	YL	Near Fuse Block T/O	16, 17
Passenger Door Ajar Switch	BK	Near T/O for G301	16, 17
Power Steering Pressure Switch (2.5L)	BK	Near Power Steering Pump	9
Powertrain Control Module - C1 (LHD)	BK	Right Rear of Engine Compartment	4
Powertrain Control Module - C1 (RHD)	BK	Left Rear of Engine Compartment	3
Powertrain Control Module - C2 (LHD)	WT	Right Rear of Engine Compartment	4
Powertrain Control Module - C2 (RHD)	WT	Left Rear of Engine Compartment	3

Connector Name/Number	Color	Location	Fig.
Powertrain Control Module - C3 (LHD)	GY	Right Rear of Engine Compartment	4
Powertrain Control Module - C3 (RHD)	GY	Left Rear of Engine Compartment	3
PRNDL Lamp	BK	Rear of Lamp	16, 17
Radio - C1	GY	Rear of Radio	18, 19
Radio - C2	BK	Rear of Radio	18, 19
Rear Fog Lamp (Built-Up-Export)	BK	At Lamp	25, 26
Rear Fog Lamp Relay (Built-Up-Export) (LHD)	LT GN	Near Fuse Block T/O	16
Rear Fog Lamp Relay (Built-Up-Export) (RHD)	LT GN	Near Fuse Block T/O	17
Rear Fog Lamp Switch (Built-Up-Export)	WT	At Switch	18, 19
Rear Washer Pump (Hard Top)	BK	Under Washer Fluid Reservoir	5
Rear Window Defogger Switch (Hard Top)	GY	Behind Rear Window Defogger Switch	18, 19
Rear Wiper Motor (Hard Top)	BK	At Rear Wiper Motor	N/S
Rear Wiper/ Washer Switch (Hard Top)	WT	Behind Rear Wiper/Washer Switch	18, 19
Right City Lamp (Built-Up-Export)	BK	At Lamp	1
Right Courtesy Lamp	BK	Right Side of Instrument Panel	19, 22
Right Fog Lamp (Except Built-Up-Export)	BK	At Lamp	1

DESCRIPTION AND OPERATION (Continued)

Connector Name/Number	Color	Location	Fig.
Right Front Park/Turn Signal Lamp (Except Built-Up-Export)	BK	At Lamp	1
Right Front Speaker	BK	At Speaker	19, 22
Right Front Turn Signal Lamp (Built-Up-Export)	BK	At Lamp	1
Right Front Wheel Speed Sensor	BK	Rear of Engine	13
Right Headlamp	BK	Rear of Lamp	1
Right Headlamp Leveling Motor (Built-Up-Export)	BK	Near Headlamp at Motor	1
Right License Lamp (Built-Up-Export)	GY	At Lamp	25, 26
Right Rear Lamp Assembly	BK	At Lamp	24, 25
Right Rear Speaker (Sound Bar)	BK	At Sound Bar	N/S
Right Rear Wheel Speed Sensor	BK	Near Vehicle Speed Sensor T/O	27
Right Repeater Lamp (Built-Up-Export)	GY	At Lamp	1
Right Side Marker Lamp (Except Built-Up-Export)	GY	At Lamp	1
Seat Belt Switch (Except LHD Built-Up-Export)	BK	Near Park Brake Switch T/O	23, 24
Sentry Key Immobilizer Module	BK	At Immobilizer	16, 17
Sound Bar Dome Lamp	BK	At Sound Bar	N/S
Throttle Position Sensor	WT	Side of Throttle Body	9, 10
Torque Converter Clutch Solenoid	BK	Left Side of Transmission	14
Transfer Case Switch	BK	Left Side of Transfer Case	14
Turn Signal/ Hazard Switch	BK	At Steering Column Part of Multifunction Switch	21
Underhood Lamp	BK	Under Hood	2, 3
Vehicle Speed Control Servo (LHD)	BK	Left Side of Engine Compartment	N/S
Vehicle Speed Control Servo (RHD)	BK	Right Side of Engine Compartment	N/S
Vehicle Speed Sensor	BK	Left Rear of Transfer Case	14
Windshield Washer Pump	BK	Under Washer Fluid Reservoir	5
Windshield Wiper Motor	BK	Center of Cowl Panel	7, 8
Windshield Wiper Switch	NAT	At Steering Column	21

DESCRIPTION AND OPERATION (Continued)

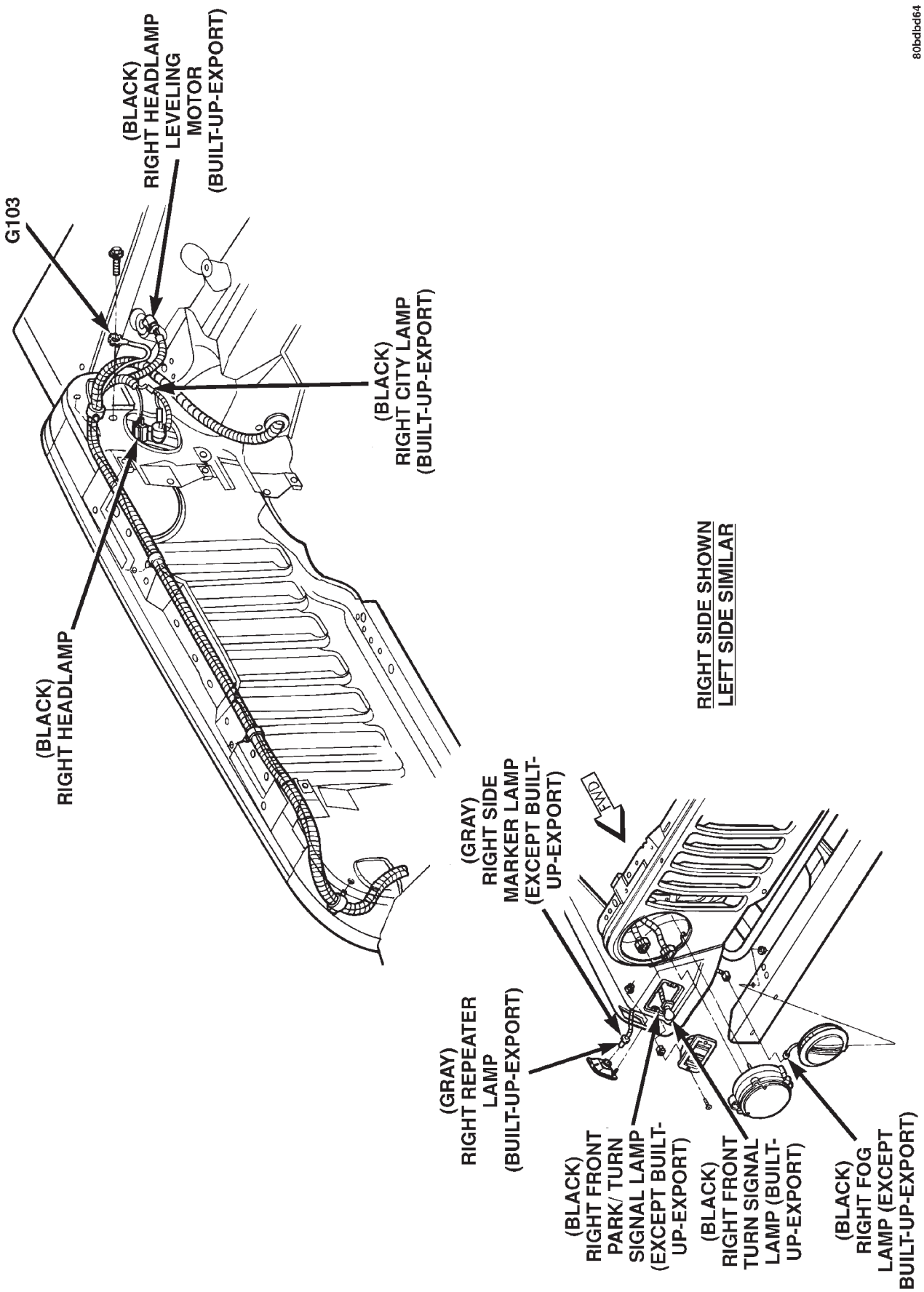


Fig. 1 Front End Wiring Connectors

DESCRIPTION AND OPERATION (Continued)

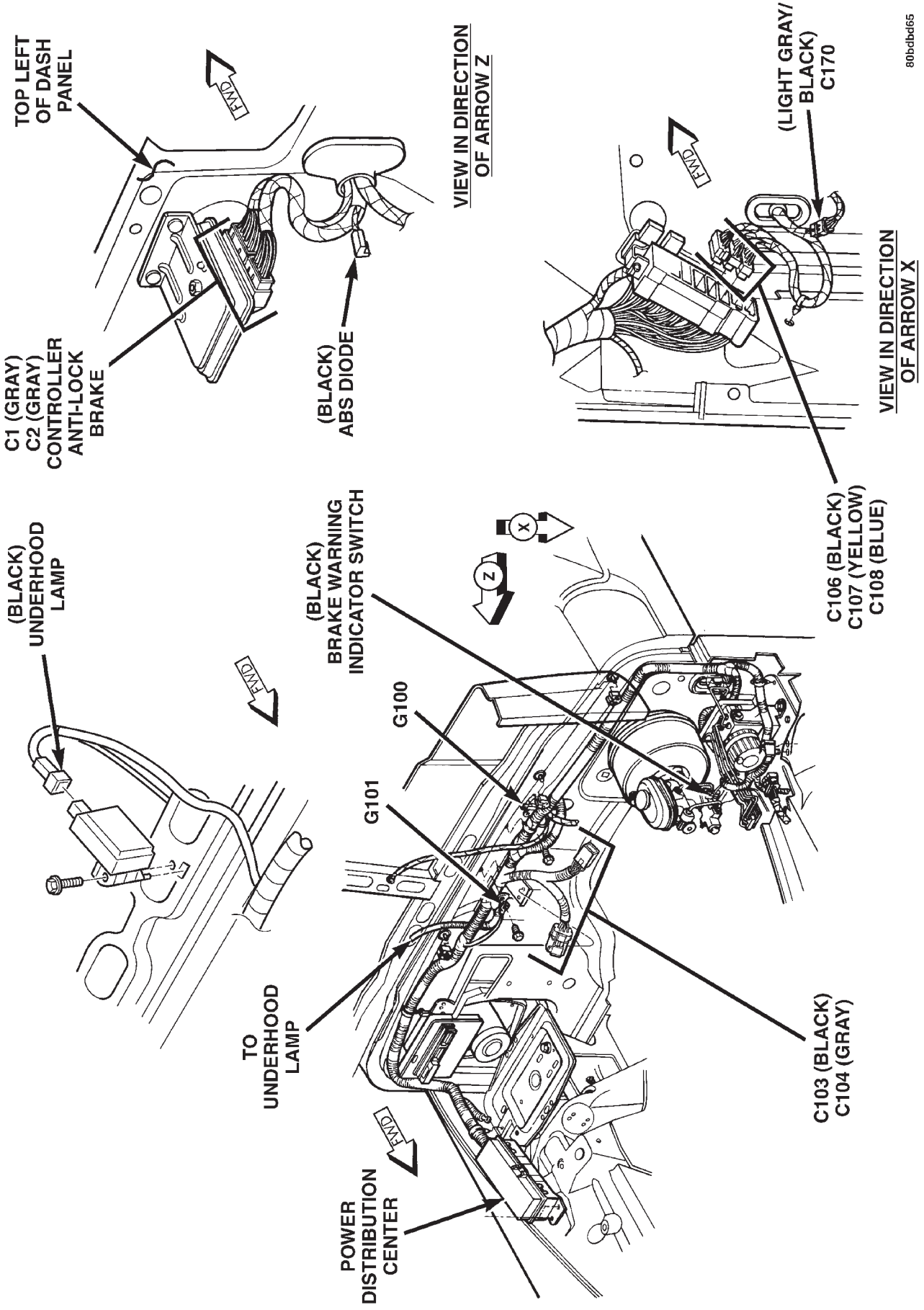


Fig. 2 Engine Compartment Connectors — Rear, LHD

DESCRIPTION AND OPERATION (Continued)

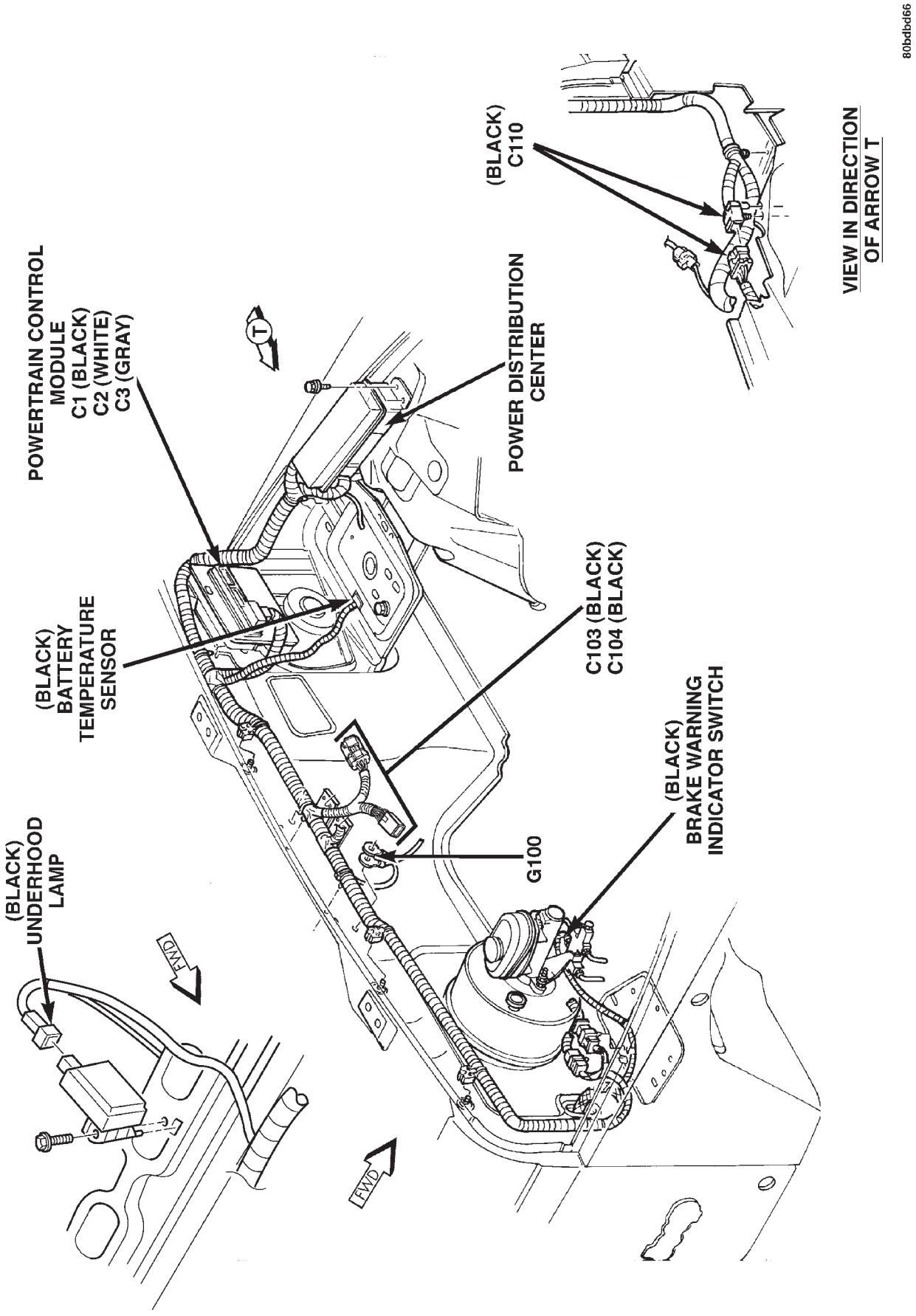


Fig. 3 Engine Compartment Connectors — Rear, RHD

DESCRIPTION AND OPERATION (Continued)

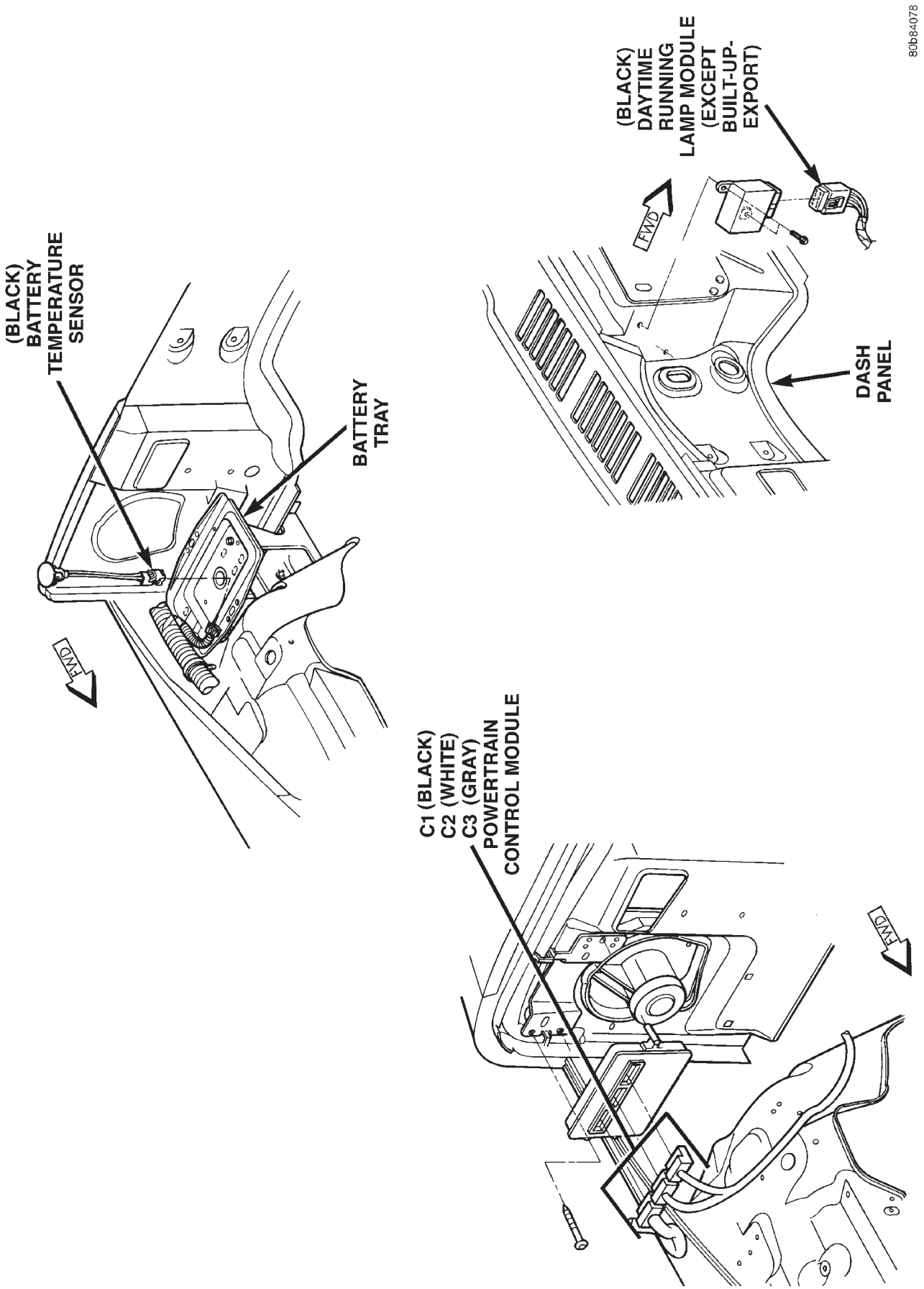


Fig. 4 Engine Compartment Connectors—LHD

DESCRIPTION AND OPERATION (Continued)

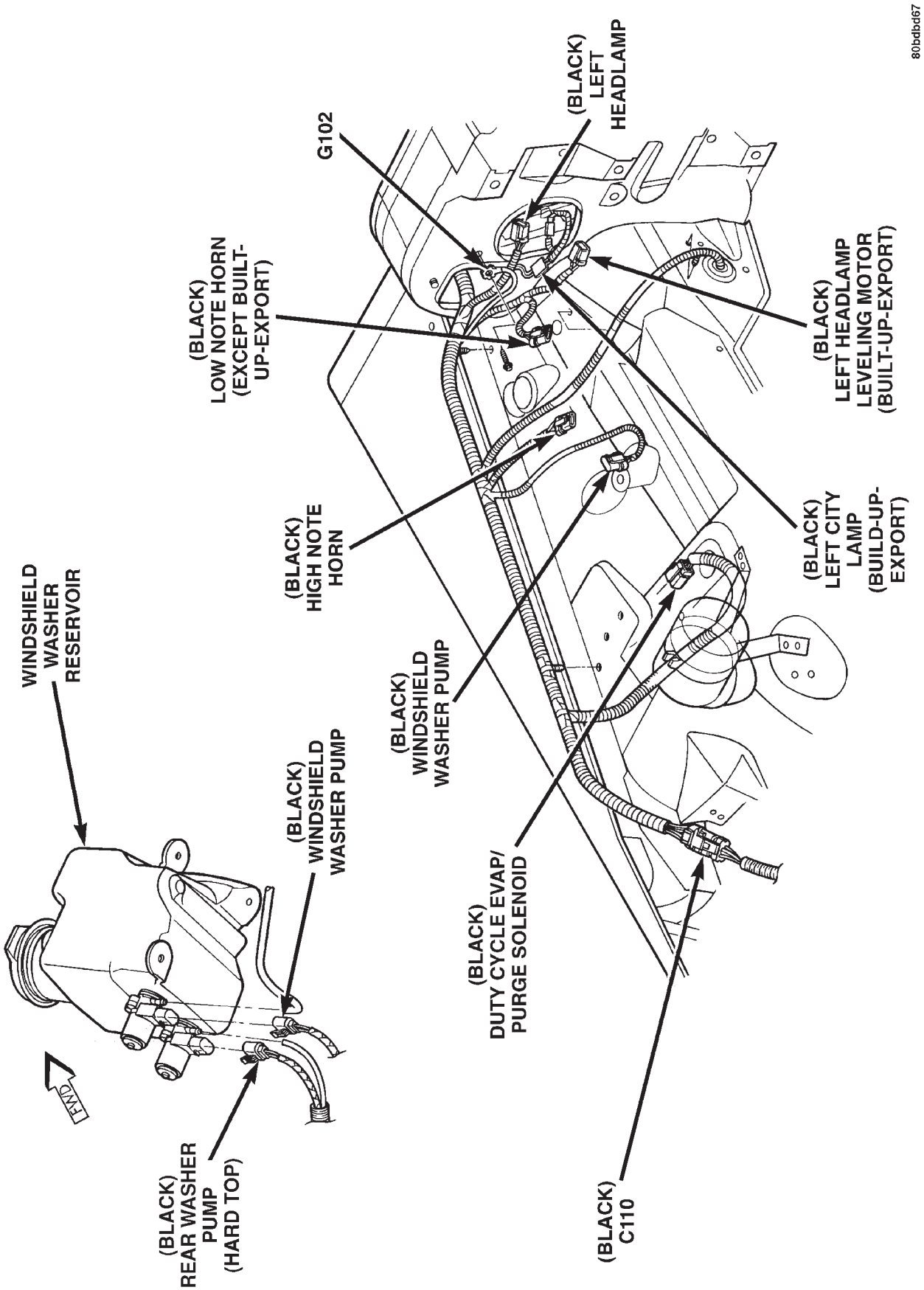


Fig. 5 Engine Compartment Connectors—Left Side

DESCRIPTION AND OPERATION (Continued)

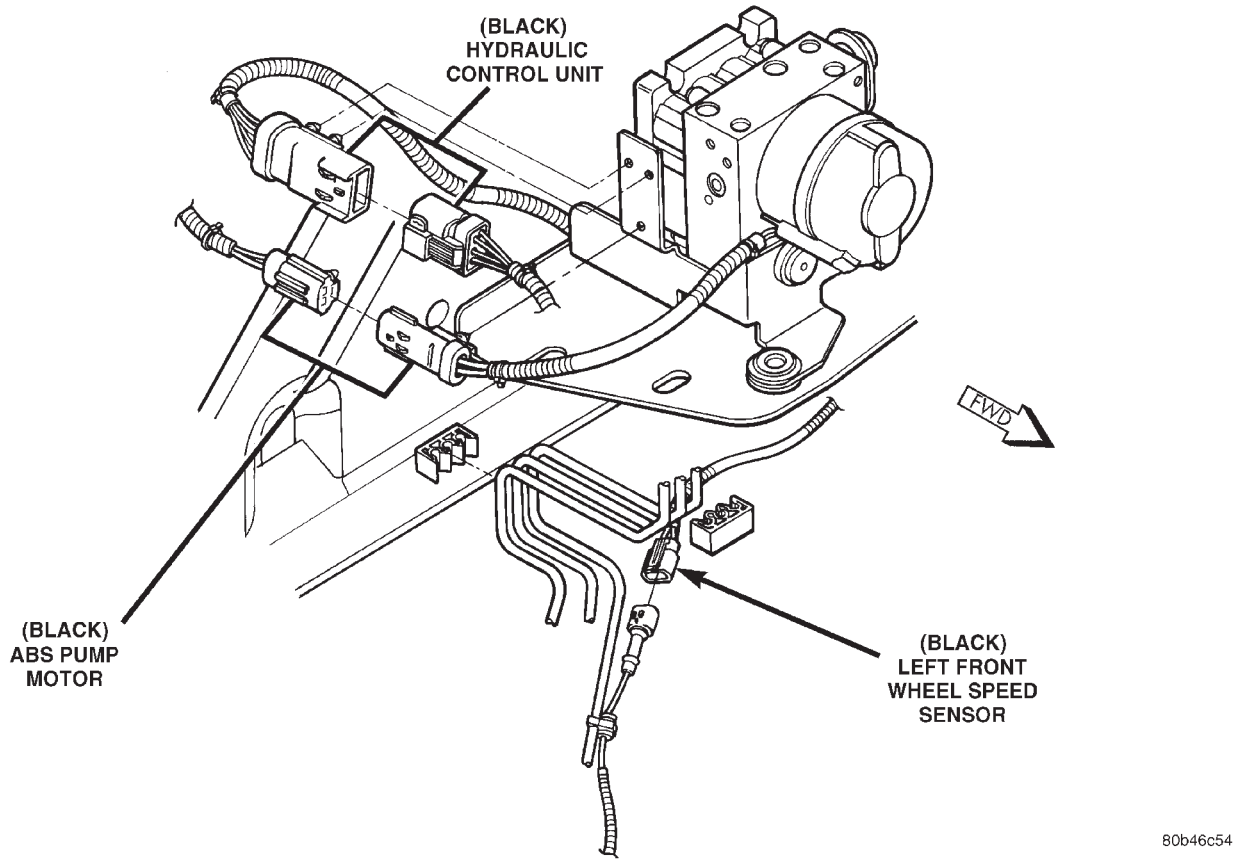


Fig. 6 ABS Hydraulic Control Unit

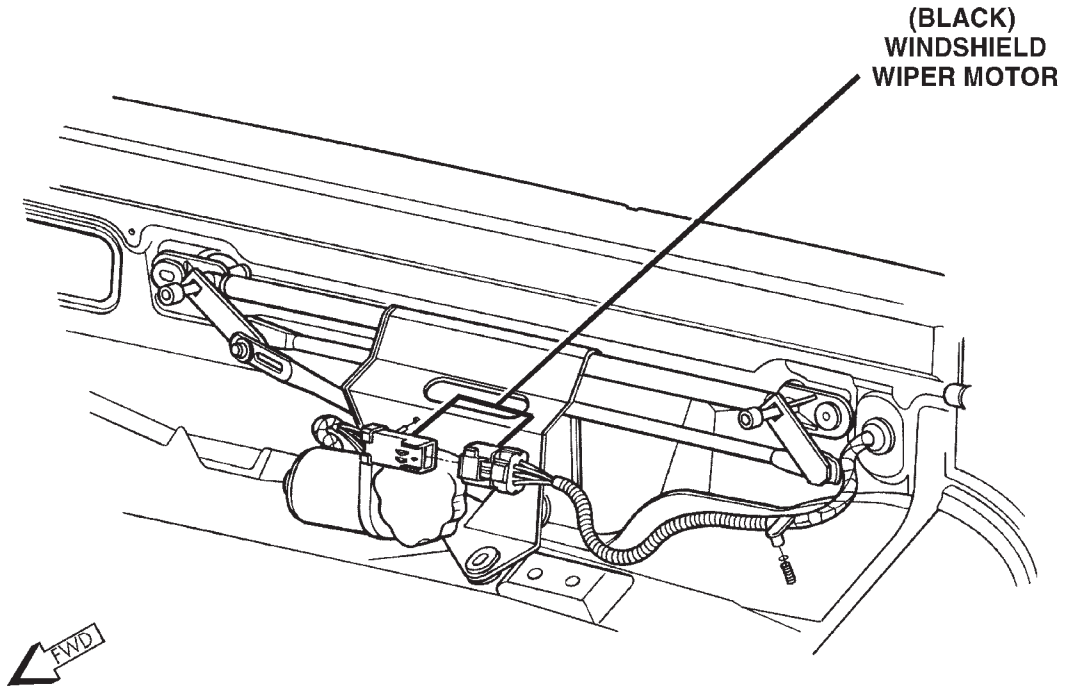


Fig. 7 Windshield Wiper Motor—LHD

DESCRIPTION AND OPERATION (Continued)

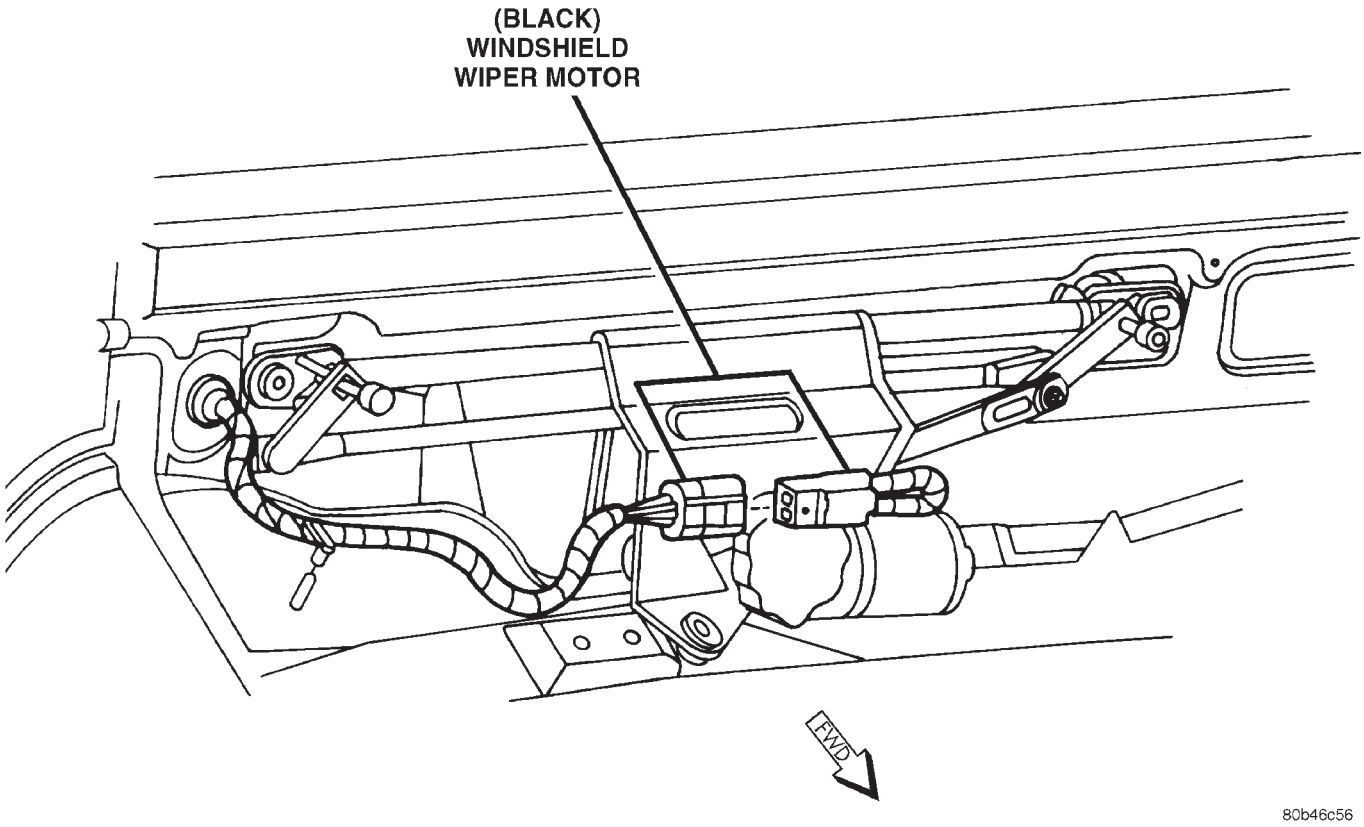


Fig. 8 Windshield Wiper Motor—RHD

DESCRIPTION AND OPERATION (Continued)

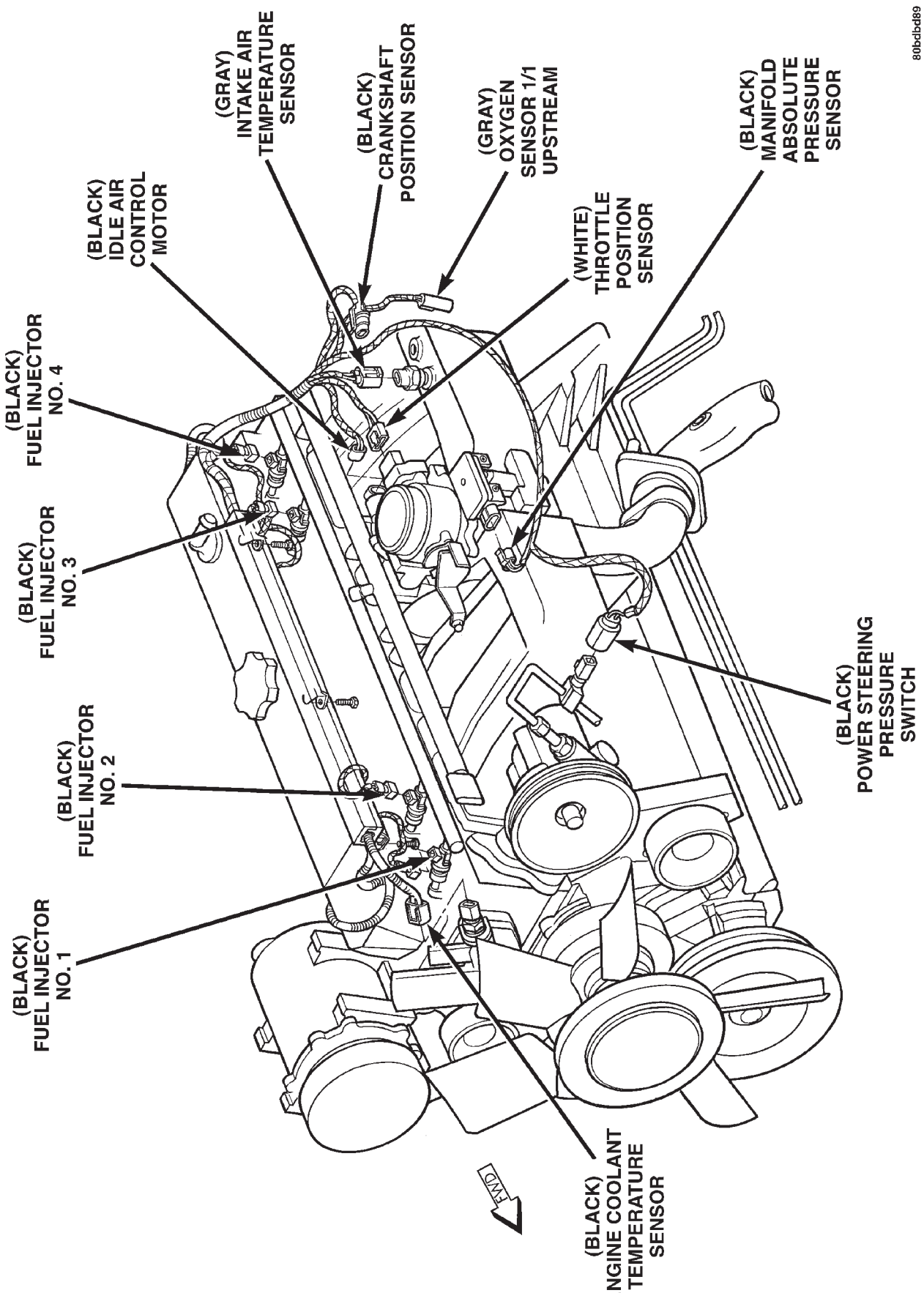


Fig. 9 Engine Harness Connectors—2.5L Engine

DESCRIPTION AND OPERATION (Continued)

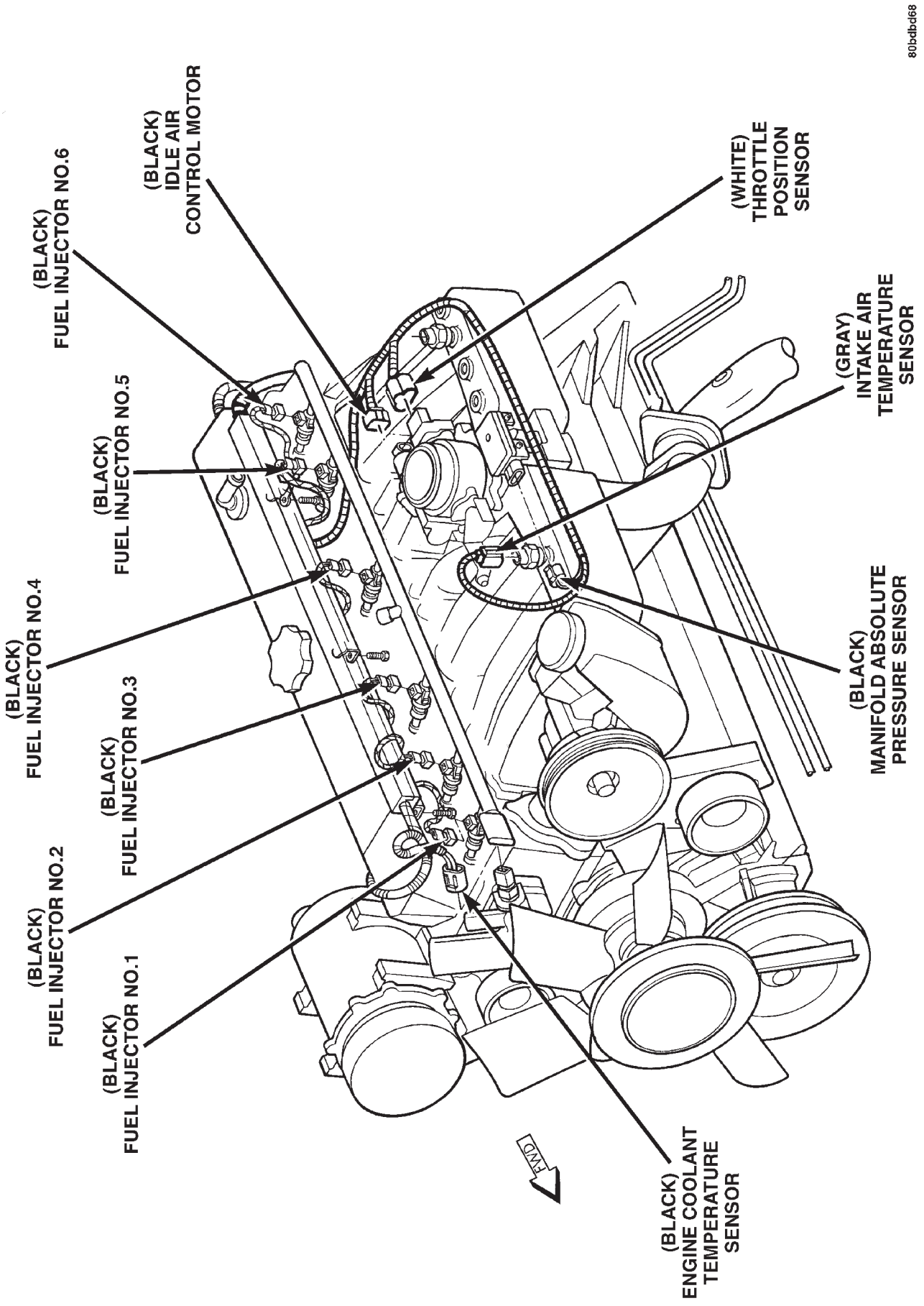


Fig. 10 Engine Harness Connectors—4.0L Engine

DESCRIPTION AND OPERATION (Continued)

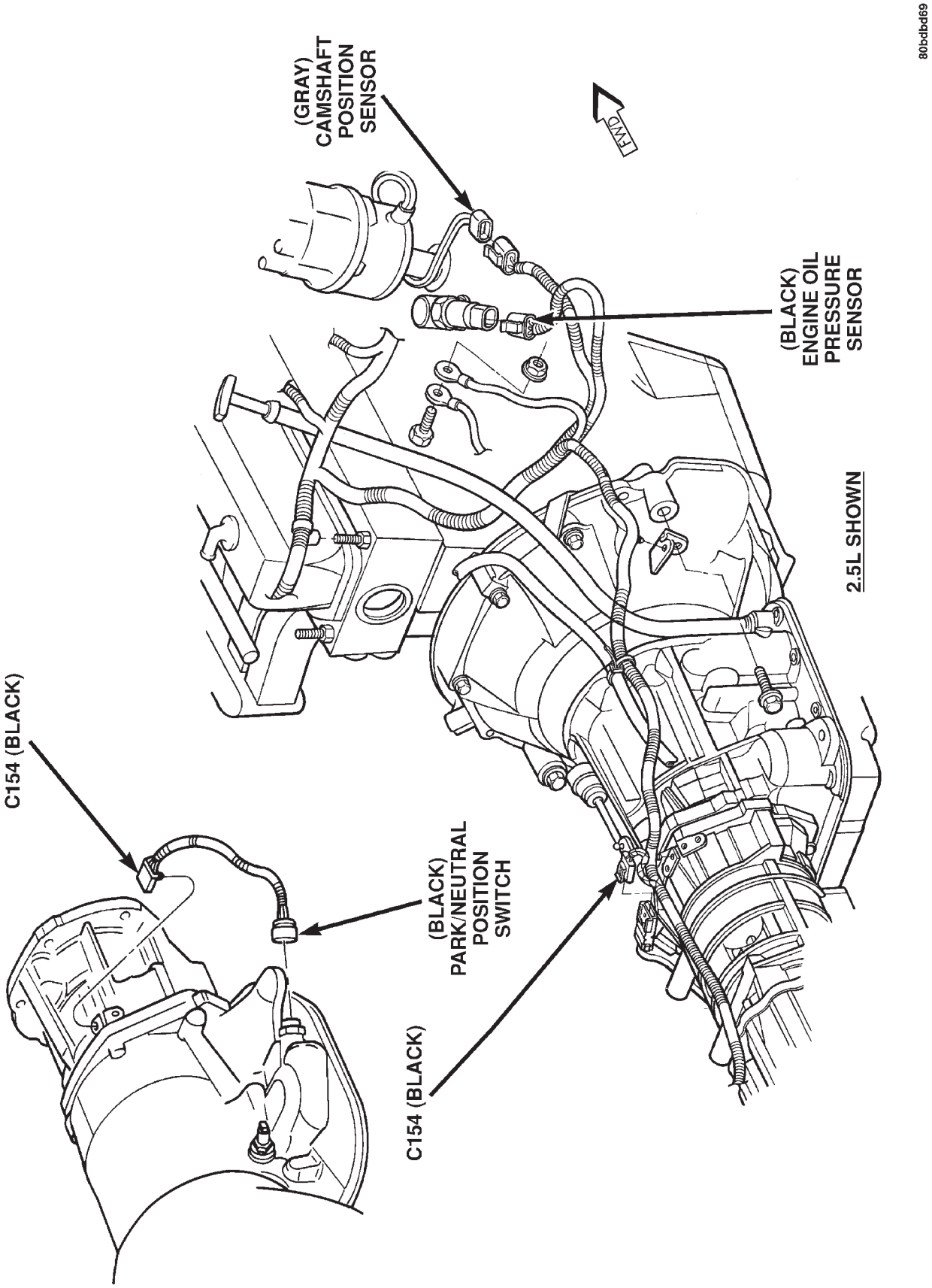


Fig. 11 Engine and Automatic Transmission Connectors

DESCRIPTION AND OPERATION (Continued)

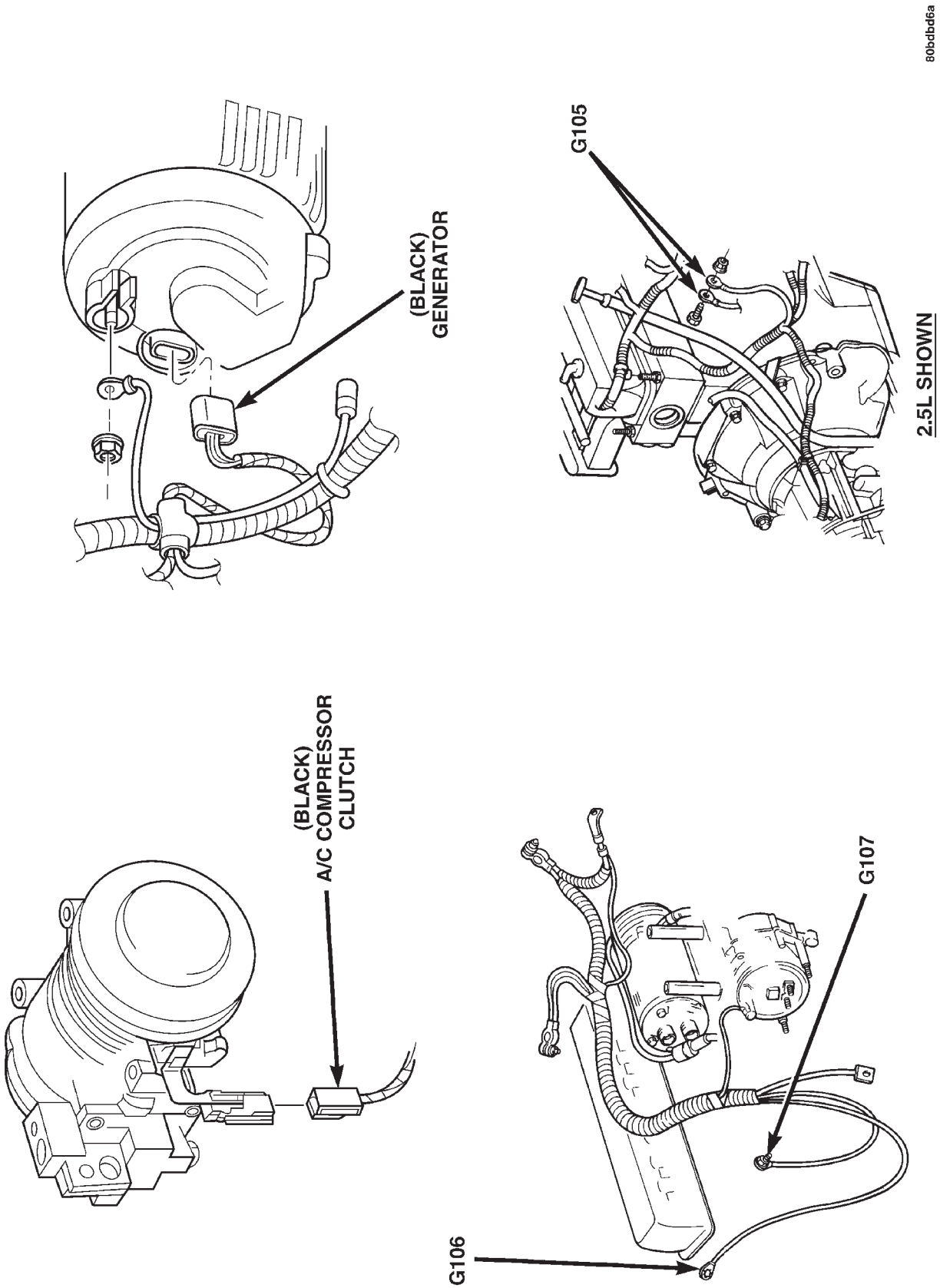


Fig. 12 Engine and Transmission Connectors

DESCRIPTION AND OPERATION (Continued)

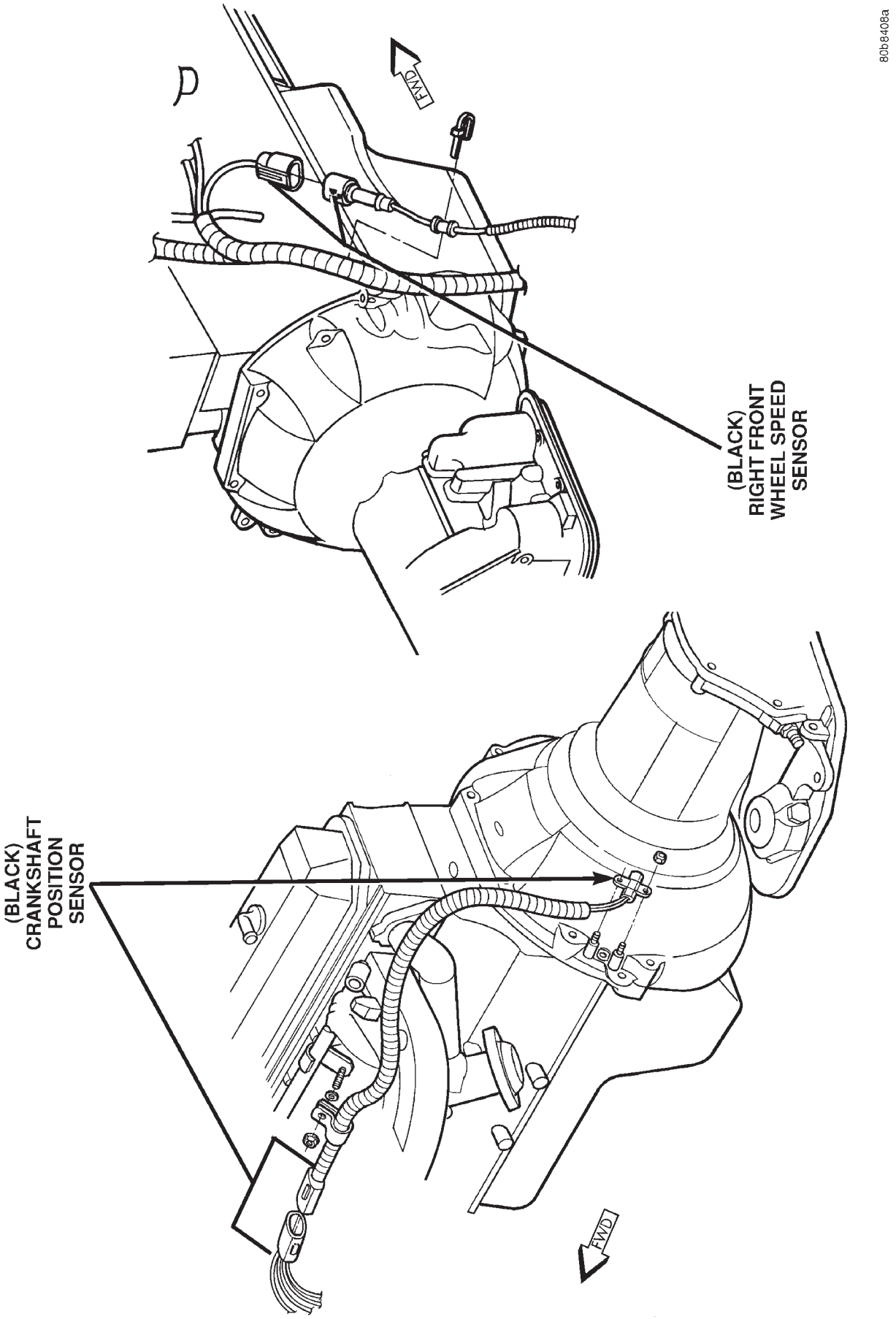


Fig. 13 Crankshaft Position Sensor and Right Front Wheel Speed Sensor

DESCRIPTION AND OPERATION (Continued)

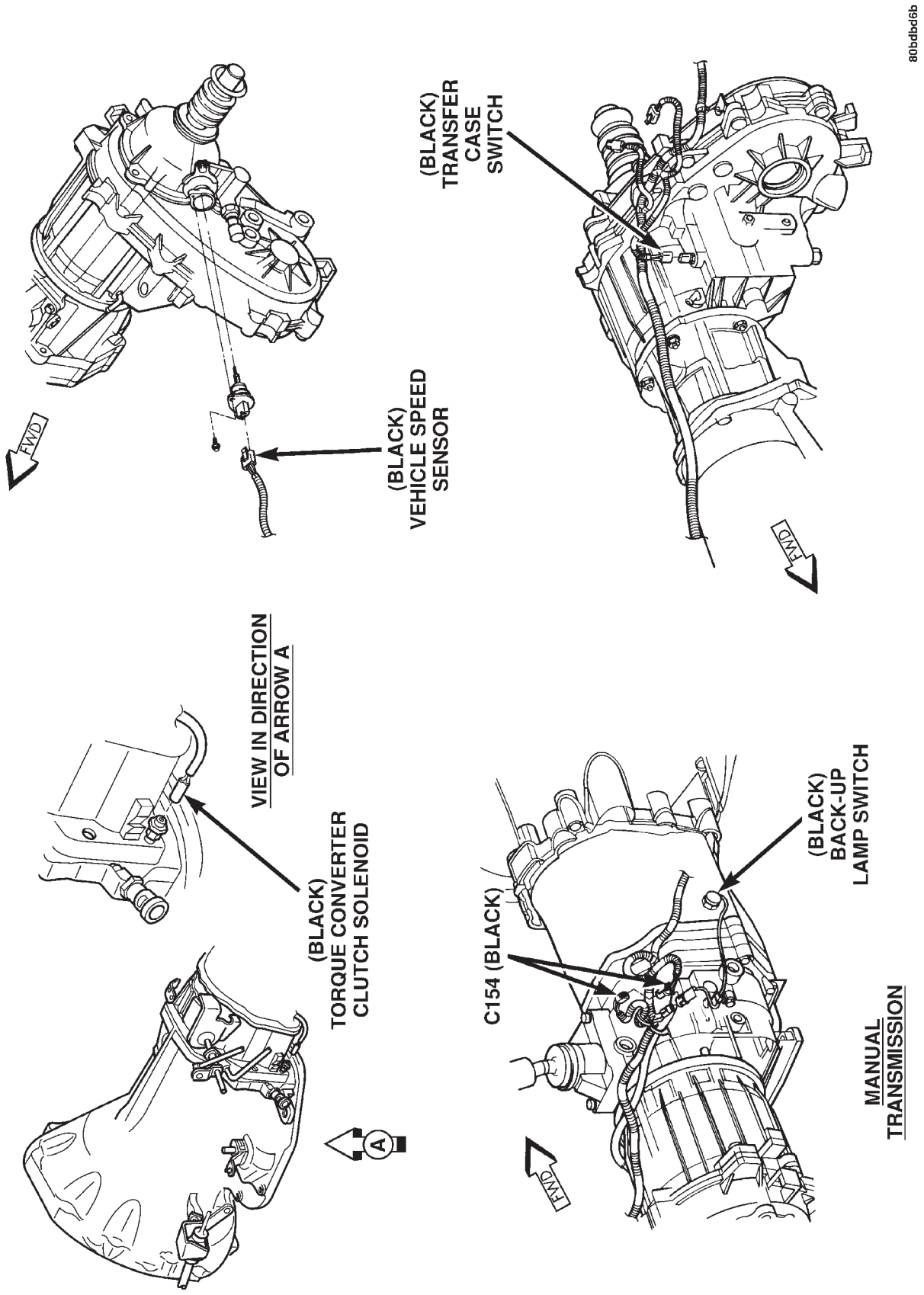


Fig. 14 Transmission and Transfer Case Connectors

DESCRIPTION AND OPERATION (Continued)

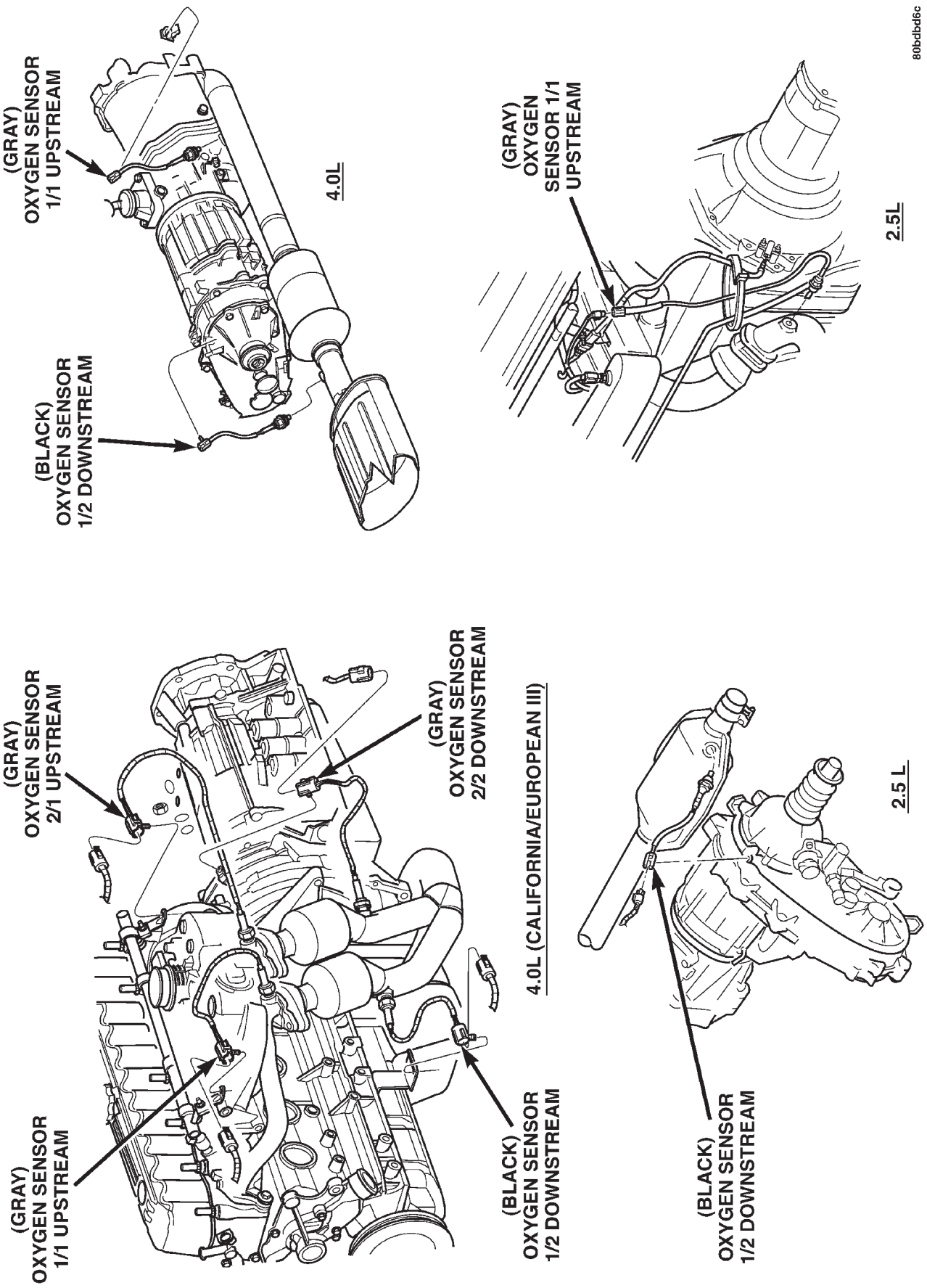


Fig. 15 Oxygen Sensor Connectors

DESCRIPTION AND OPERATION (Continued)

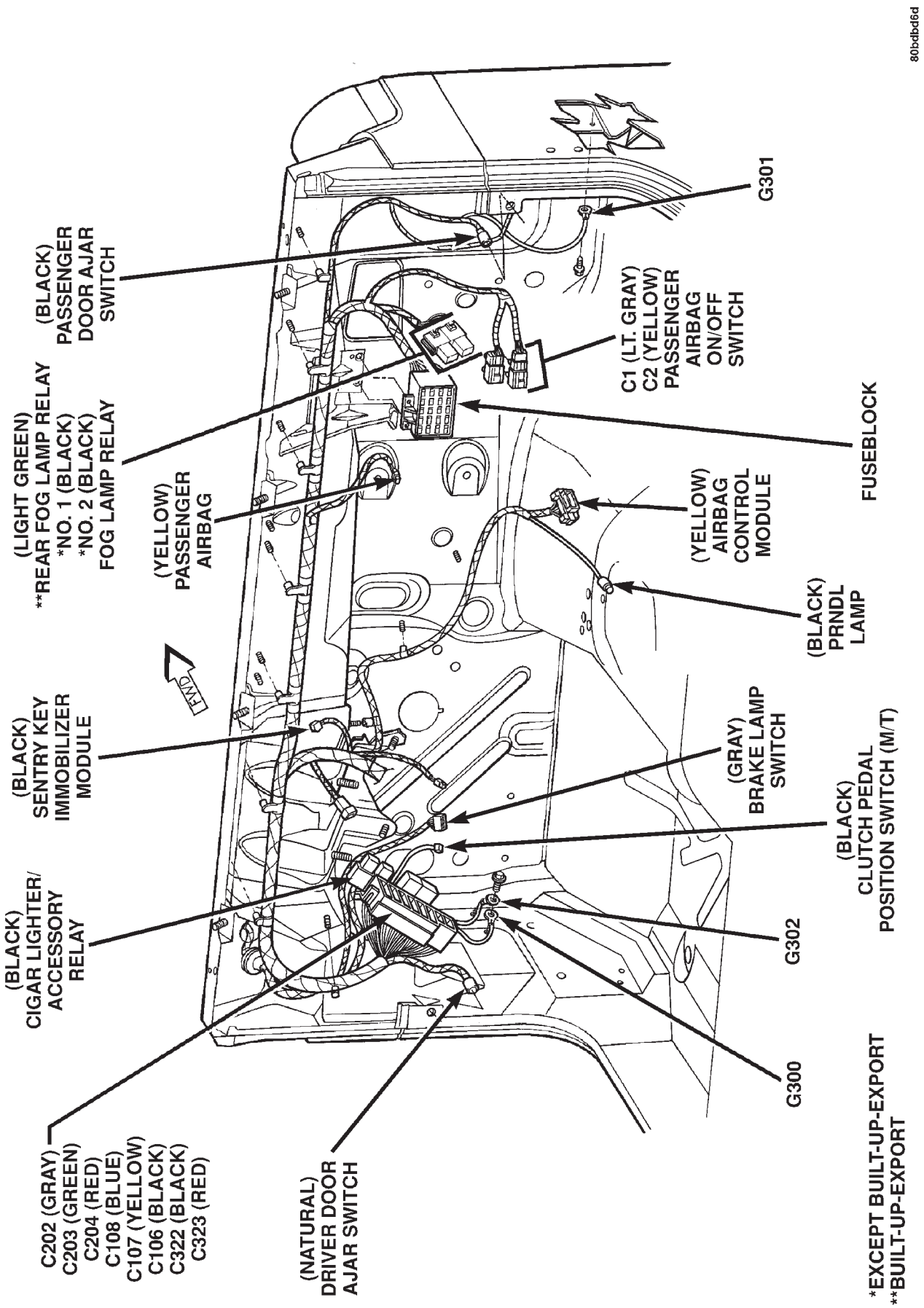


Fig. 16 Dash Panel Connectors—LHD

DESCRIPTION AND OPERATION (Continued)

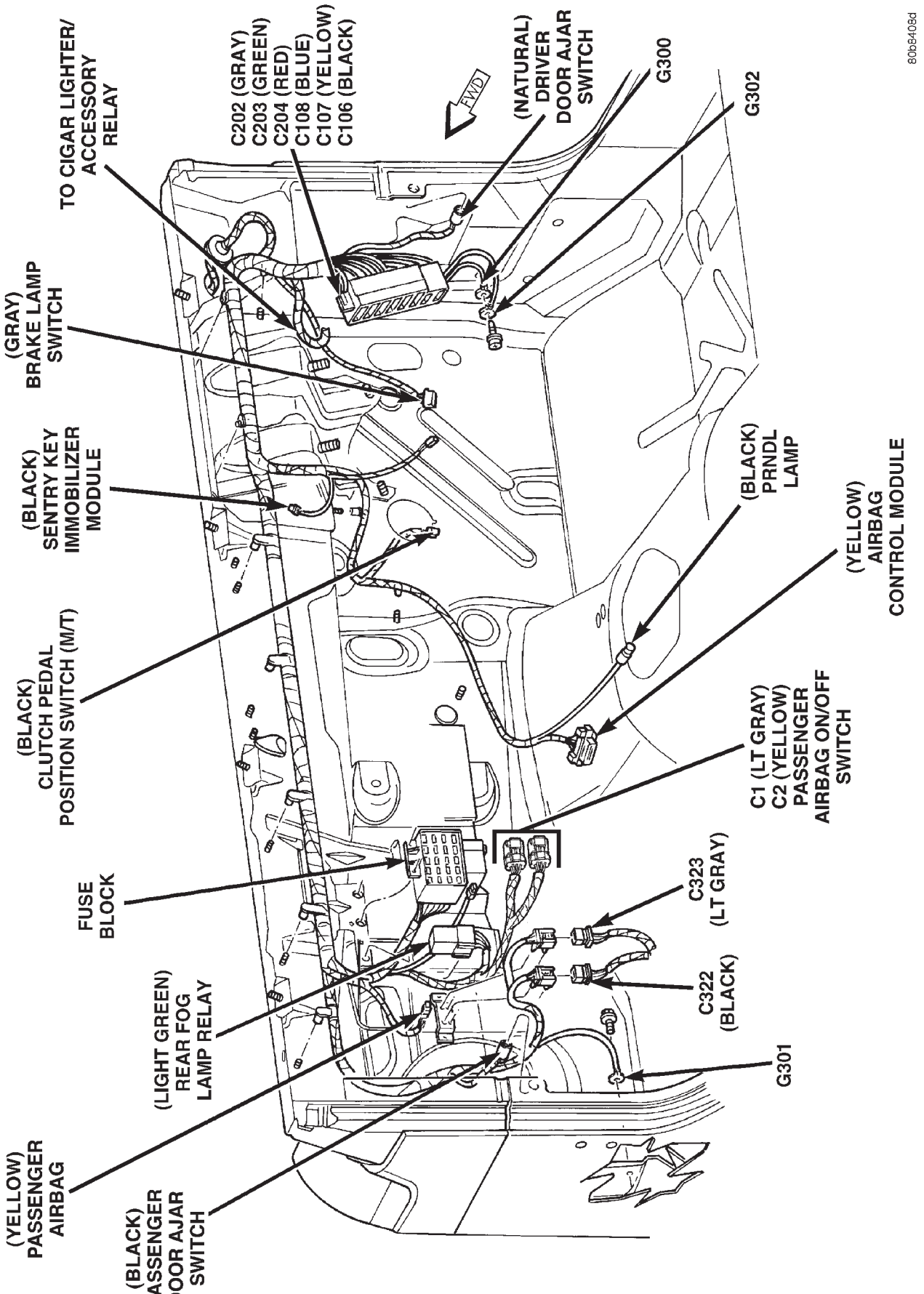


Fig. 17 Dash Panel Connectors—RHD

DESCRIPTION AND OPERATION (Continued)

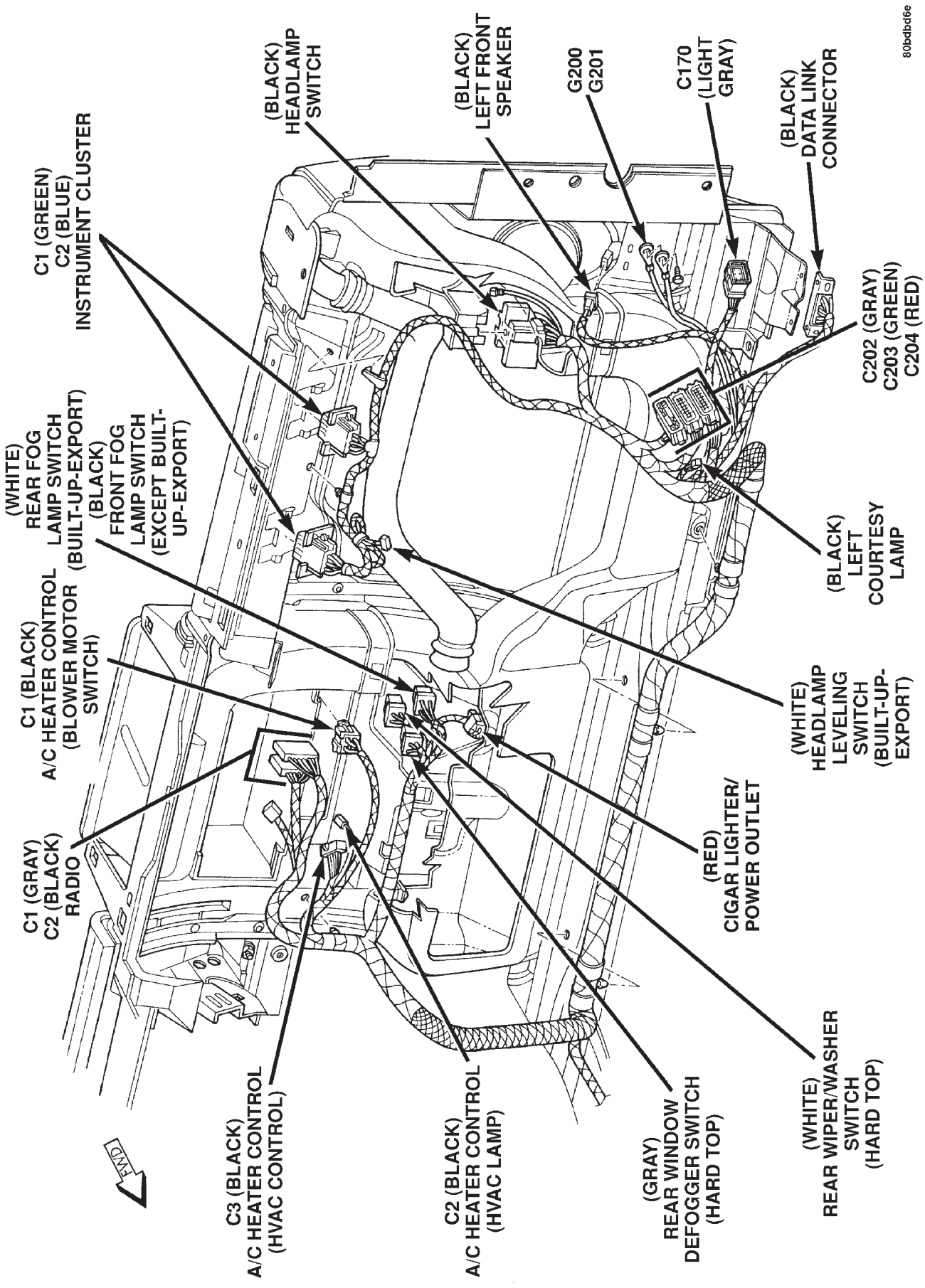


Fig. 18 Instrument Panel Wiring Connectors—LHD

DESCRIPTION AND OPERATION (Continued)

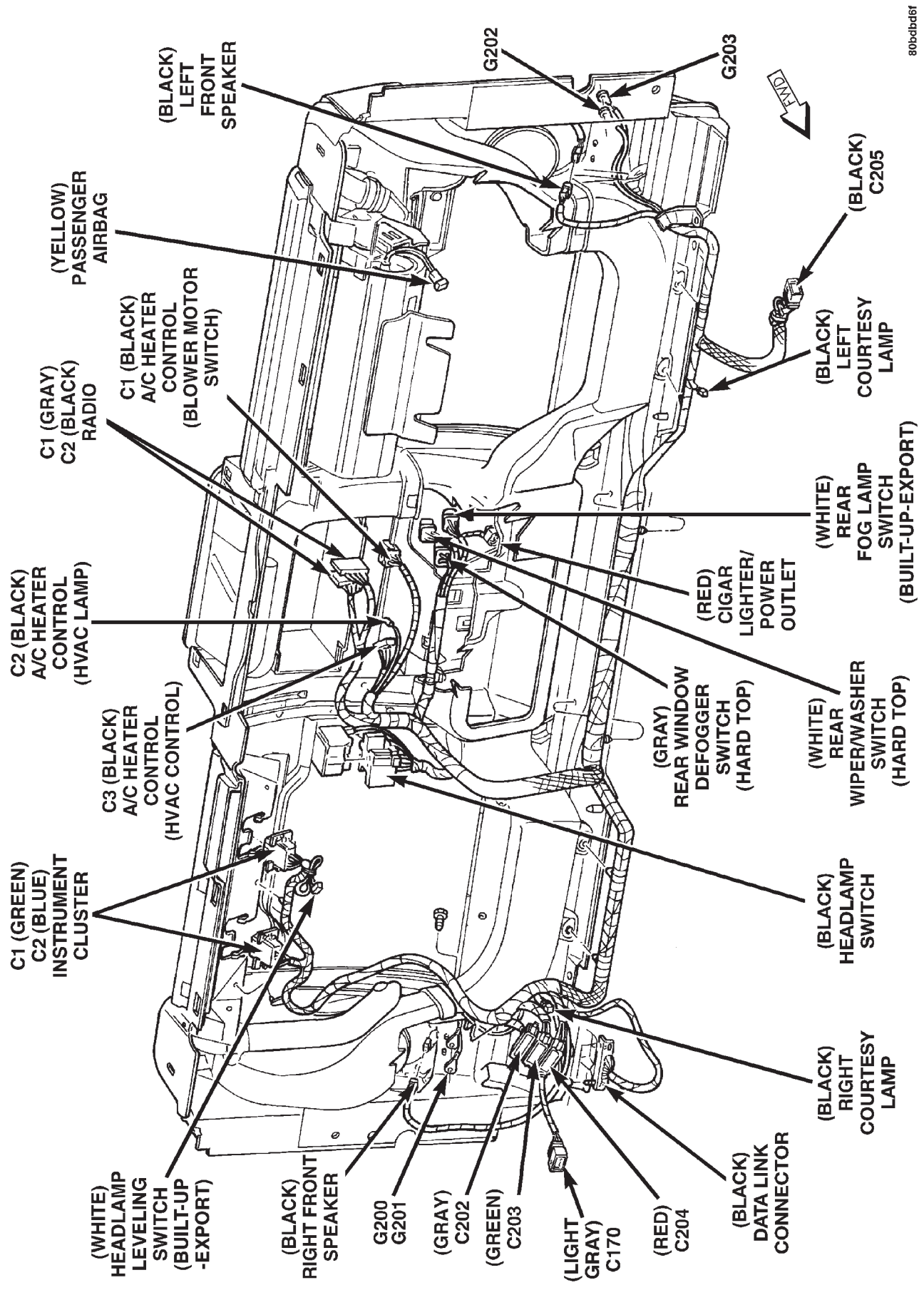


Fig. 19 Instrument Panel Wiring Connectors—RHD

DESCRIPTION AND OPERATION (Continued)

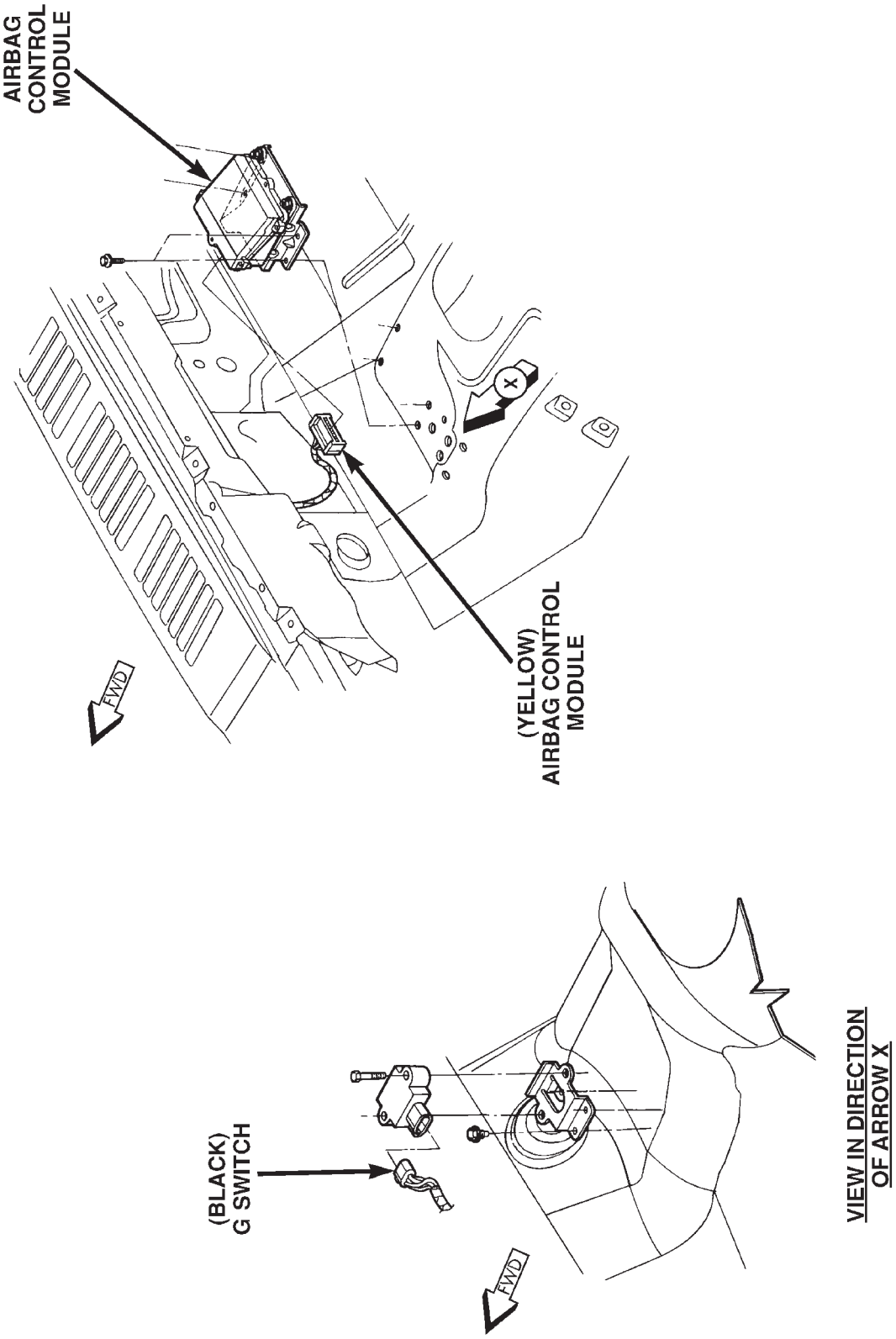


Fig. 20 Airbag Control Module and G Switch

DESCRIPTION AND OPERATION (Continued)

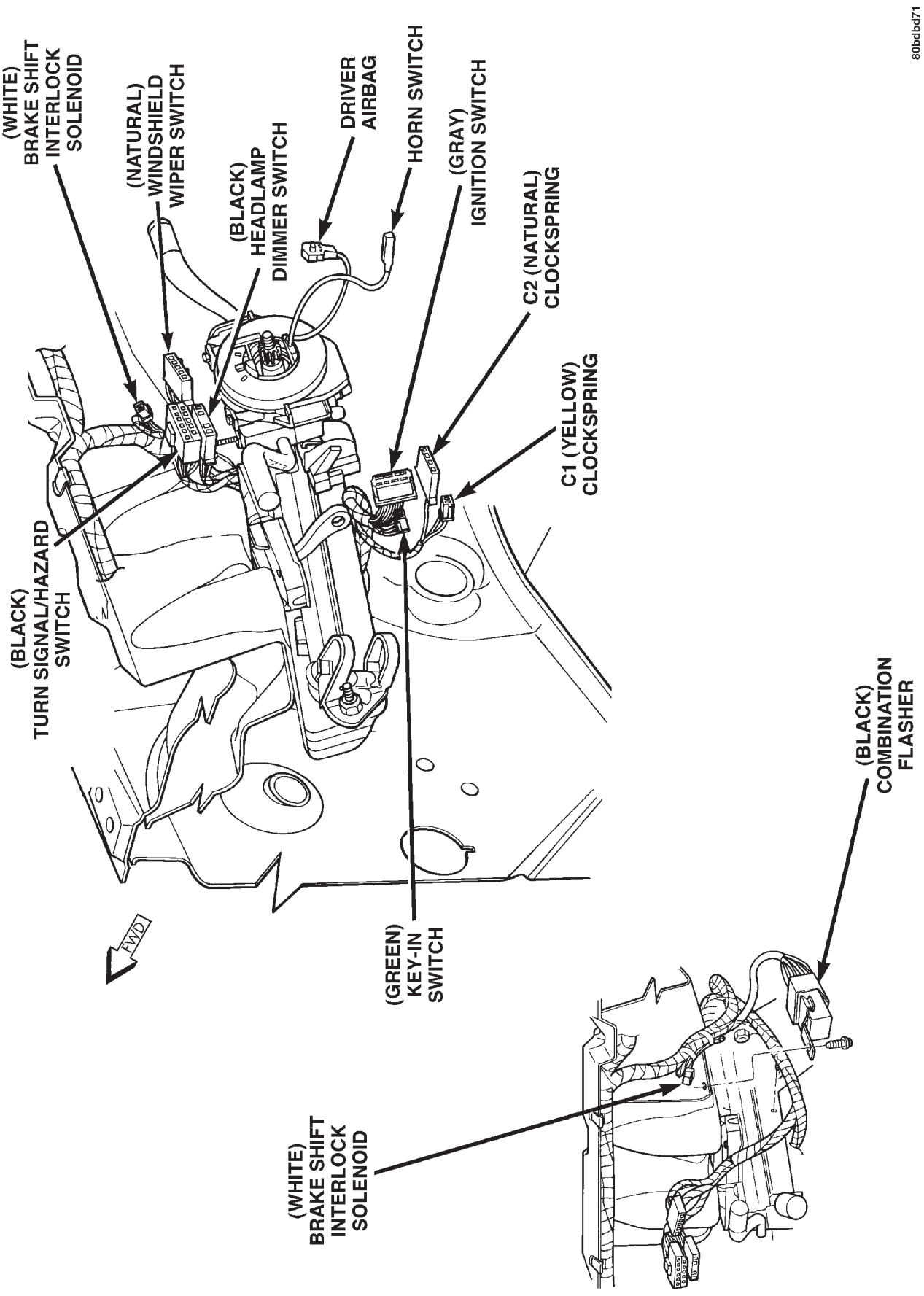


Fig. 21 Steering Column Connectors

DESCRIPTION AND OPERATION (Continued)

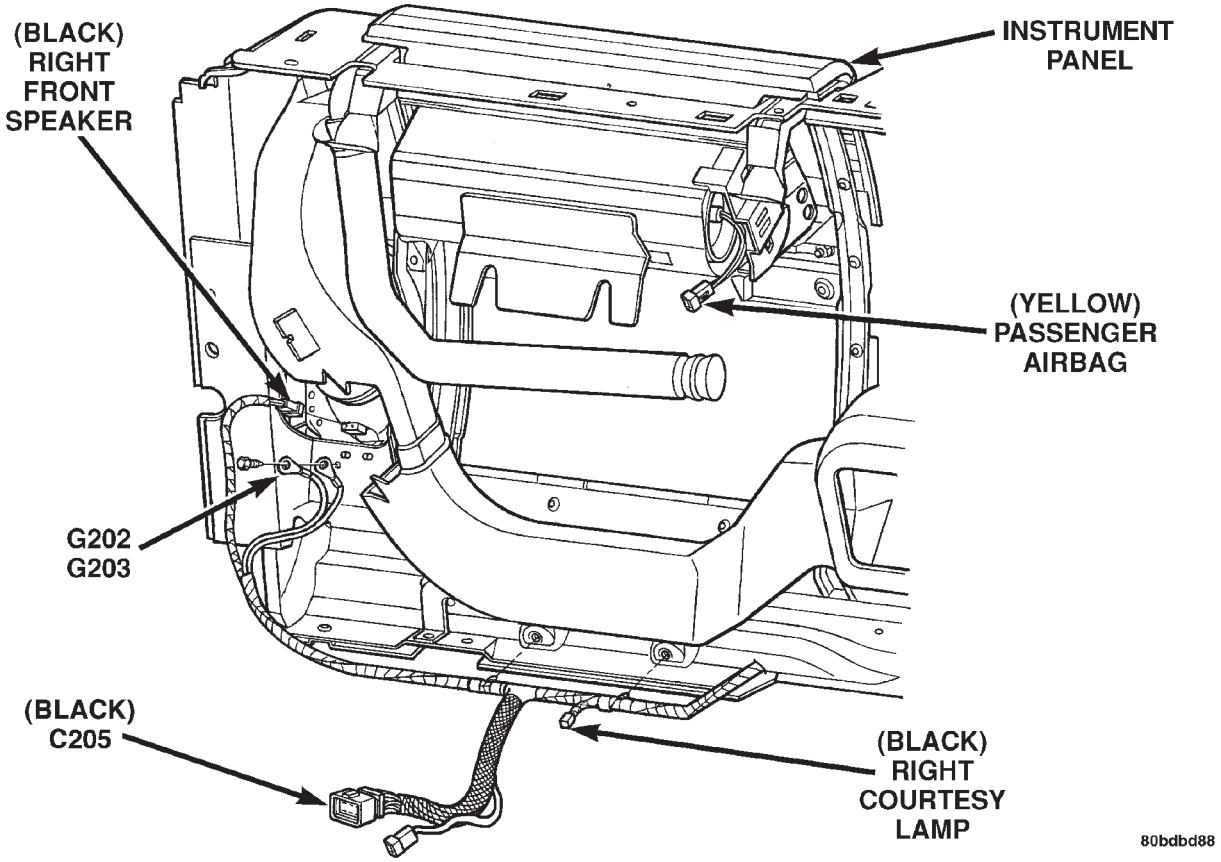


Fig. 22 Instrument Panel Connectors—Right Side, LHD

DESCRIPTION AND OPERATION (Continued)

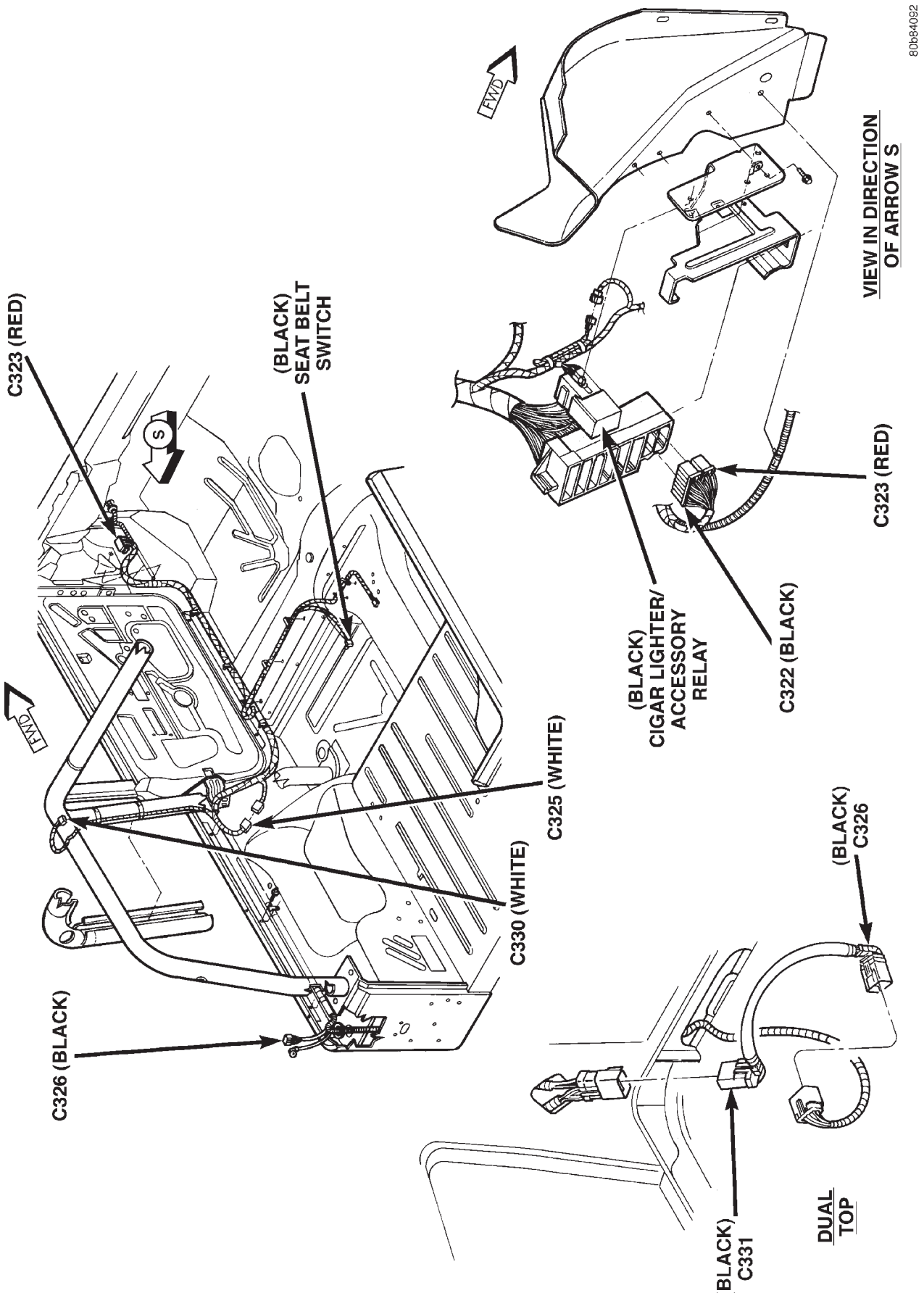


Fig. 23 Body Connectors—LHD

DESCRIPTION AND OPERATION (Continued)

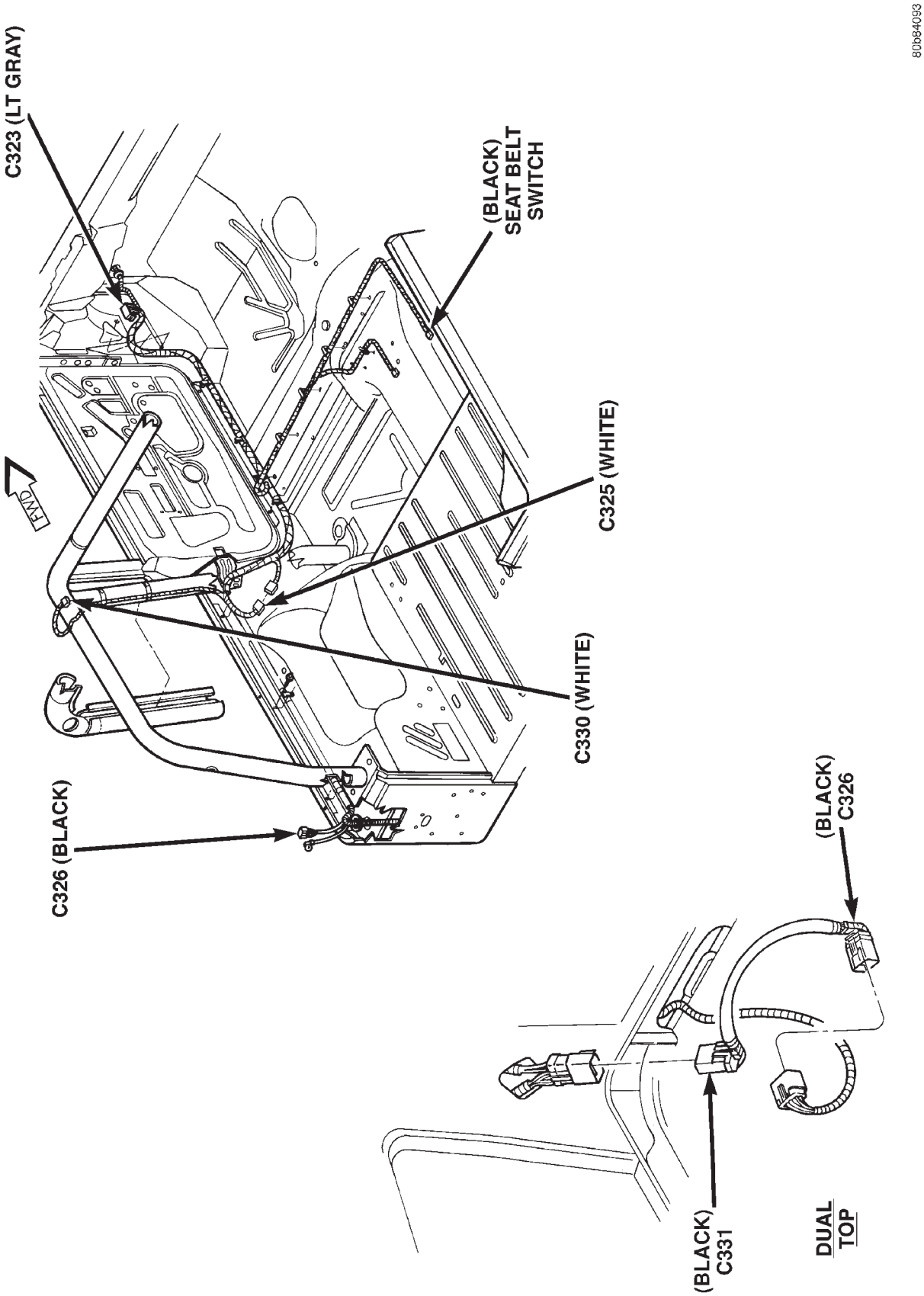


Fig. 24 Rear Body Wiring Connectors—RHD

DESCRIPTION AND OPERATION (Continued)

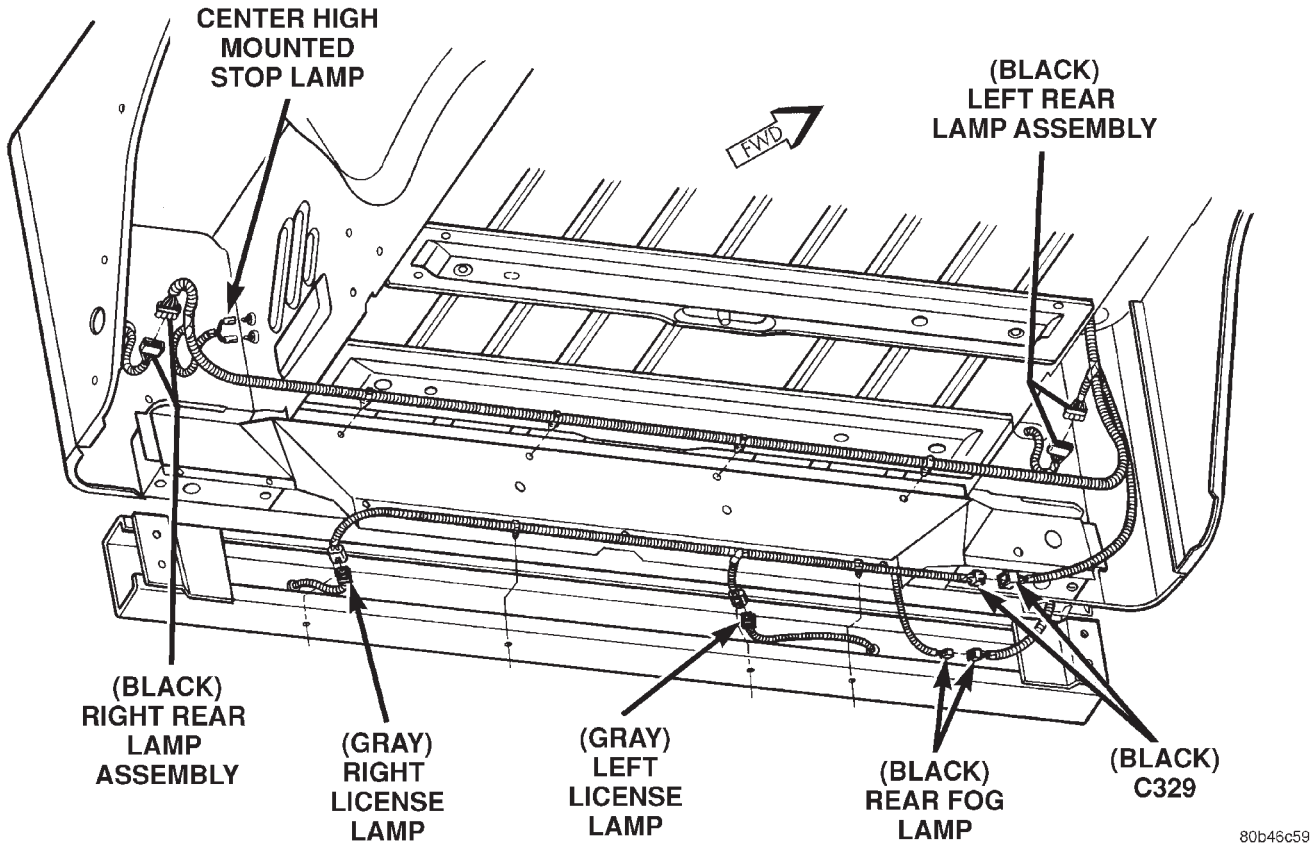


Fig. 25 Rear Under Body Wiring Connectors—LHD

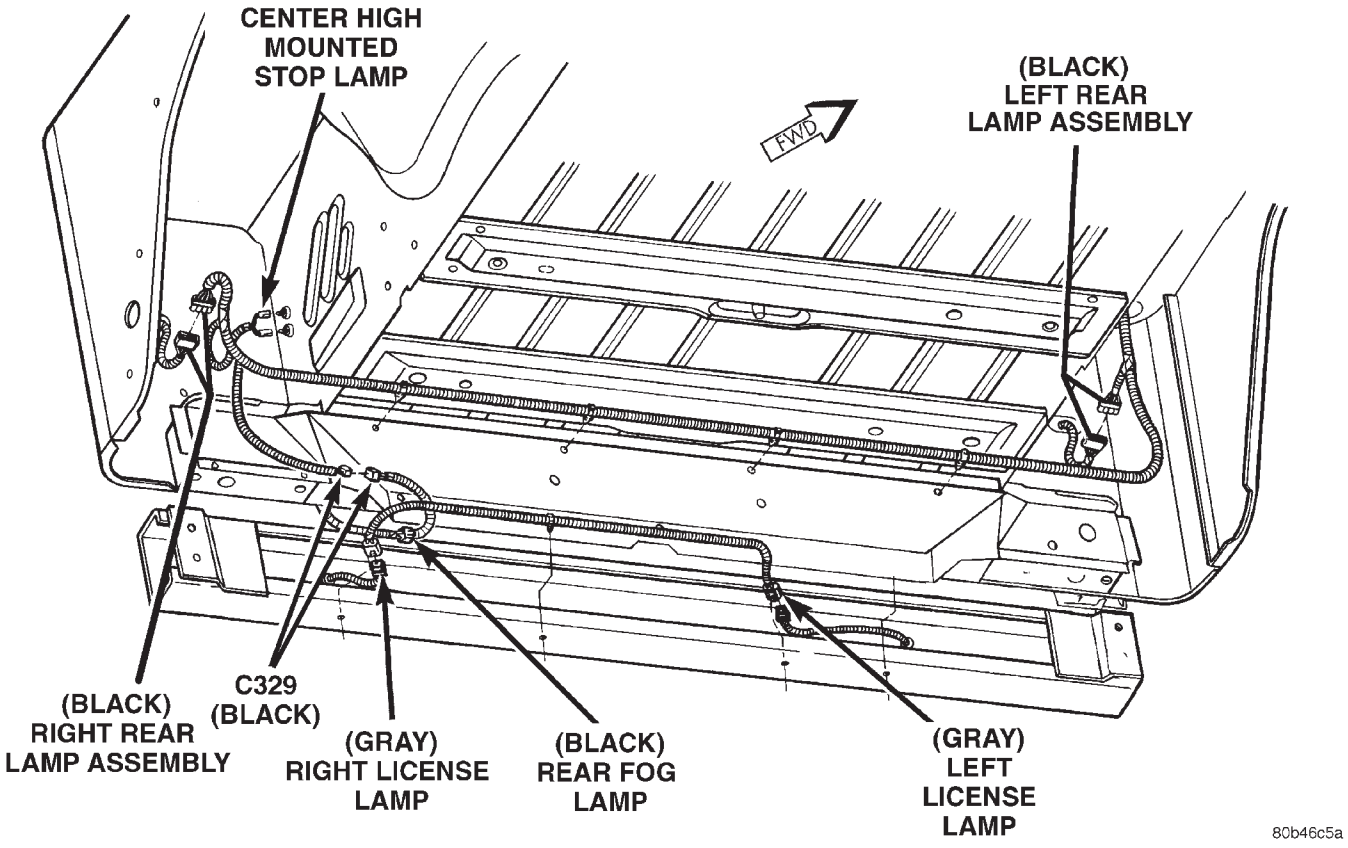


Fig. 26 Rear Under Body Wiring Connectors—RHD

DESCRIPTION AND OPERATION (Continued)

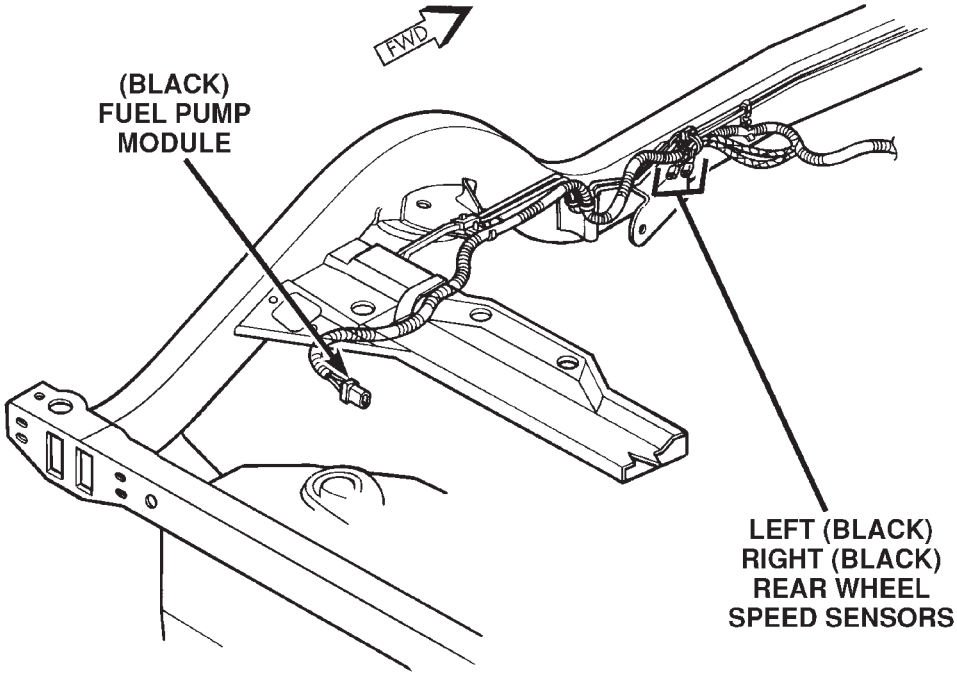


Fig. 27 Rear Engine Harness Connectors

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, an N/S is placed in the Fig. column.

Splice Number	Location	Fig.
S101 (LHD)	Near T/O for Power Distribution Center	2
S101 (RHD)	Near T/O for Power Distribution Center	3
S102	Near T/O for G100 or Daytime Running Lamp Module	2, 3
S103 (LHD)	Near T/O for G101 or Powertrain Control Module - C3	2
S103 (RHD)	Near T/O for Battery Temperature Sensor	3
S104	Near T/O for C110	2
S105 (LHD)	Near T/O for C110	2
S105 (LHD) (DRL)	Near T/O for ABS Pump Motor	2
S105 (RHD)	Near T/O for C110	3
S106	Near T/O for Ground G100	2
S106 (DRL)	Near T/O for Daytime Running Lamp Module	2
S108 (LHD)	Near T/O for Underhood Lamp	2
S108 (RHD)	Near T/O for C110	3
S109	Near T/O for C103 and C104	2
S110	Near T/O for C103 and C104	2
S111	Near T/O for Battery Temperature Sensor or Power Distribution Center	2, 3
S112	In T/O for Controller Antilock Brake - C2	2
S113	Near T/O for G100	2
S114	Near ABS Pump Motor T/O	2
S115 (Except Built-Up-Export)	Near T/O for Duty Cycle Evap/Purge Solenoid	1
S116 (Except Built-Up-Export)	Near T/O for High Note Horn	1
S117	Near T/O for High Note Horn	1
S118	Near Left Headlamp T/O	1
S119	Left Side Radiator Closure Panel	1
S121 (LHD)	Near T/O for Powertrain Control Module - C1	N/S
S121 (RHD)	Near T/O for Powertrain Control Module - C2	N/S
S122 (Built-Up-Export)	Near Grommet for Left Front Turn Signal Lamp	N/S
S122 (Except Built-Up-Export)	Near Grommet for Left Front Park/Turn Signal Lamp	N/S
S123 (LHD)	Near T/O for C104	6
S123 (RHD) (2.5L)	Near T/O for A/C Low Pressure Switch	7
S123 (RHD) (4.0L)	Near T/O for Fuel Injector NO. 6	7
S124 (LHD) (ABS)	Near T/O for G105	6
S124 (LHD) (All 2.5L)	Near T/O for C104	6
S124 (LHD) (Except ABS)	Near T/O for C154	6
S124 (RHD) (2.5L)	Near T/O for C103	7
S124 (RHD) (4.0L)	Near T/O for G105	7
S125 (Built-Up-Export)	Near Grommet for Right Front Turn Signal Lamp	N/S
S125 (Fog Lamps) (Except Built-Up-Export)	Near Grommet for Right Front Park/Turn Signal Lamp and Right Side Marker Lamp	N/S
S126 (LHD)	Near T/O for C104	6

DESCRIPTION AND OPERATION (Continued)

Splice Number	Location	Fig.
S126 (2.5L) (RHD)	Near T/O for Fuel Injector NO. 4	7
S126 (4.0L) (RHD)	Near T/O for Fuel Injector NO. 6	7
S127 (LHD)	Near T/O for Idle Air Control Motor	4
S127 (RHD) (2.5L)	Between Fuel Injector NO. 2 and Fuel Injector NO. 3	5
S127 (RHD) (4.0L)	Near T/O for Idle Air Control Motor	5
S128 (LHD)	Between Fuel Injector NO. 2 and Fuel Injector NO. 3	4
S128 (RHD) (2.5L)	Near T/O for Fuel Injector NO. 1	5
S128 (RHD) (4.0L)	Between Fuel Injector NO. 2 and Fuel Injector NO. 3	5
S129 (LHD)	Near T/O for C104	6
S129 (RHD)	Near T/O for C104	7
S130 (LHD) (ABS) (All 2.5L)	Near T/O for C104	6
S130 (LHD) (Except ABS) (All California/ European III)	Near A/C Low Pressure Switch T/O	6
S130 (RHD)	Near T/O for C103	7
S131 (LHD)	Near T/O for Power Distribution Center	2
S131 (RHD)	Near T/O for C110	3
S132 (LHD)	Near T/O for G105	6
S132 (LHD) (All 2.5L)	Near T/O for C154	6
S132 (RHD) (2.5L)	Near T/O for C154	7
S132 (RHD) (4.0L)	Near T/O for Crankshaft Position Sensor	7
S133 (LHD)	Near T/O for G105	6
S133 (RHD)	Near T/O For C104	7
S134 (LHD) (ABS) (All 2.5L)	Near T/O for C154	6
S134 (LHD) (Except ABS) (All California/ European III)	Near A/C Low Pressure Switch T/O	6
S134 (RHD) (2.5L)	Near T/O for C154	7
S134 (RHD) (4.0L)	Near T/O for Crankshaft Position Sensor	7
S135 (LHD) (ABS) (All 2.5L)	Near T/O for Oxygen Sensor 1/2 Downstream	6
S135 (LHD) (Except ABS) (All California/ European III)	Near T/O for C104	6
S135 (RHD) (2.5L)	Near T/O for Oxygen Sensor 1/2 Downstream	7
S136	In Battery Harness Near PDC	N/S
S137 (LHD)	Near T/O for Engine Coolant Temperature Sensor	4
S137 (RHD)	Near T/O for Engine Coolant Temperature Sensor	5
S138 (Built-Up-Export)	Near T/O for Right Headlamp Leveling Motor	1
S139	Near T/O for Fuel Injector NO. 5	4
S140 (LHD)	Near T/O for C104	N/S
S140 (RHD) (4.0L)	In T/O for Oxygen Sensor 2/2 Right Bank Down	N/S
S141 (Built-Up-Export)	Near T/O for Left Front Turn Signal Lamp	N/S
S141 (Except Built-Up-Export)	Near T/O for Left Front Park/Turn Signal Lamp	N/S
S142 (Built-Up-Export)	Near Grommet for Right Front Turn Signal Lamp	N/S
S142 (Fog Lamps) (Except Built-Up-Export)	Near T/O for Right Front Park/Turn Signal Lamp	N/S
S142 (Except Fog Lamps) (Except Built-Up-Export)	Near Grommet for Right Front Park/Turn Signal Lamp and Right Side Marker Lamp	N/S
S143	Near T/O for Left Front Park/Turn Signal Lamp	N/S
S144	Near T/O for Right Front Park/Turn Signal Lamp	N/S
S144 (Fog Lamps)	Near T/O for Right Fog Lamp	N/S

DESCRIPTION AND OPERATION (Continued)

Splice Number	Location	Fig.
S145	Near T/O for Crankshaft Position Sensor	N/S
S146	Near T/O for Powertrain Control Module - C3	2
S147 (LHD)	Between T/O's for Underhood Lamp and C103, C104	2
S147 (RHD)	Right Side of Engine Compartment Near Grommet	3
S150 (Built-Up-Export)	Near T/O for Right Headlamp Leveling Motor	1
S151 (Built-Up-Export)	Near T/O for Left Headlamp Ground	1
S202	Center Rear of Instrument Panel	10, 11
S204	Center Rear of Instrument Panel	10, 11
S206	Center Rear of Instrument Panel	10, 11
S207	Near Cigar Lighter T/O	10, 11
S301 (LHD)	Near Grommet for Windshield Wiper Motor	8
S301 (RHD)	Near T/O for Passenger Airbag	9
S302	Near Grommet for Windshield Wiper Motor	8, 9
S303	Near Grommet for Windshield Wiper Motor	8, 9
S304 (LHD)	Near Grommet for Windshield Wiper Motor	8
S304 (RHD)	Near T/O for 100 Way Connector	9
S306	Near T/O for Airbag Control Module	8, 9
S307	Near T/O for Airbag Control Module	8, 9
S309	Front of Left Rear Wheel Well	12, 13
S310	Left Rear Quarter Panel, Near Body Grommet	12, 13
S311	Near Left Rear Lamp Assembly Connector	12, 13
S313	Front of Left Rear Wheel Well	12, 13
S314	Front of Left Rear Wheel Well	12, 13
S314 (Built-Up-Export) (Hardtop)	Top of Left Rear Wheel Well	12
S315	Near Right Rear Lamp Assembly Connector	12, 13
S316	In T/O for Rear Fog Lamp	12, 13
S317	Near T/O for Left License Lamp	12, 13
S320 (LHD)	Near T/O for 100 way Connector	8
S320 (RHD)	Near Passenger Airbag T/O	9
S330 (LHD)	In T/O for Fuse Block	8
S330 (RHD)	Near Passenger Airbag T/O	9
S331	Near T/O for Airbag Control Module	8, 9
S332	Near T/O for Cigar Lighter/ Accessory Relay	8, 9
S335	Near Left Rear Lamp Assembly Connector	12
S400	Near T/O for Rear Window Defogger Feed	N/S
S401	Near T/O for Rear Window Defogger Feed	N/S

DESCRIPTION AND OPERATION (Continued)

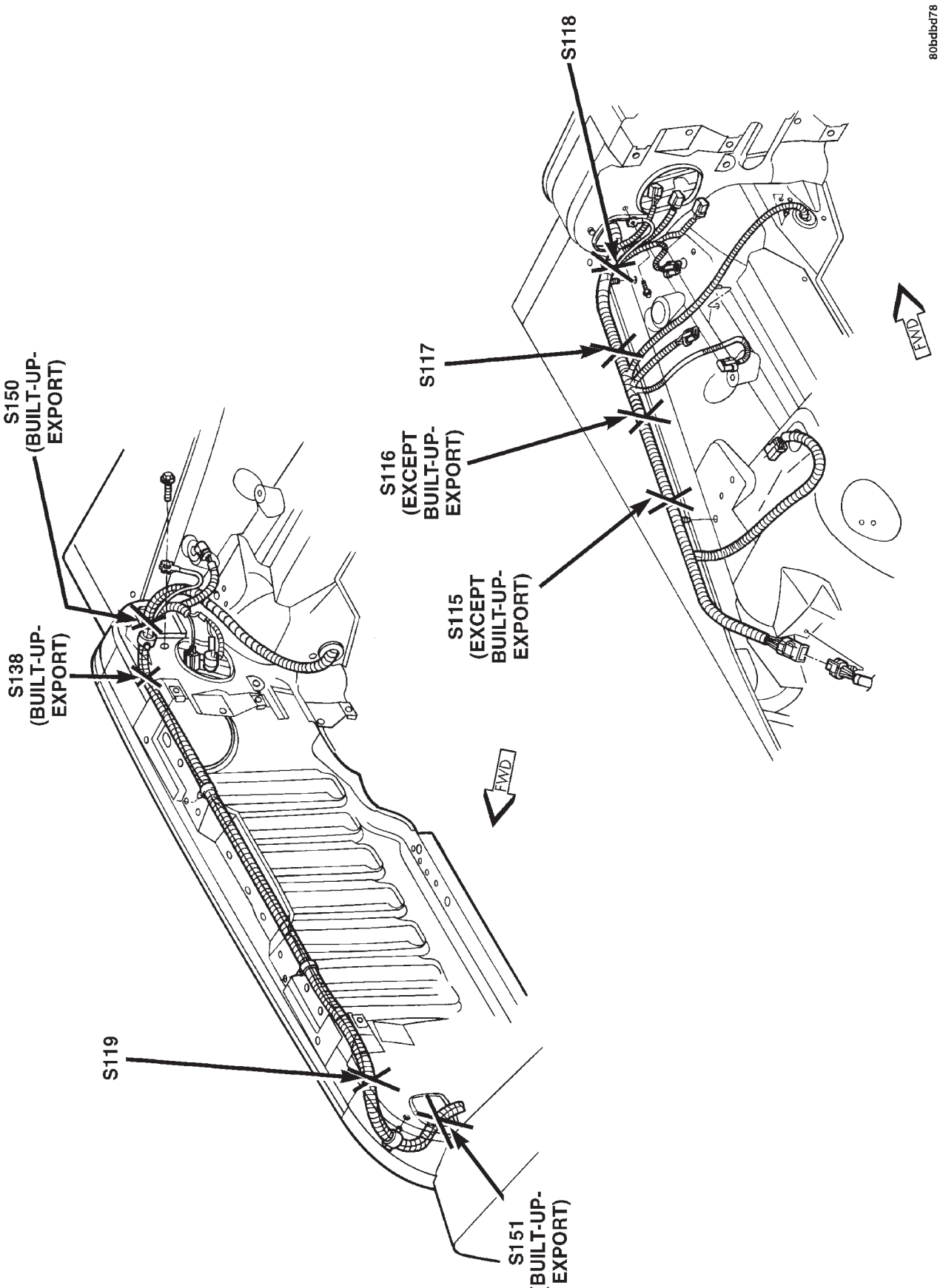


Fig. 1 Engine Compartment Splices—Front

DESCRIPTION AND OPERATION (Continued)

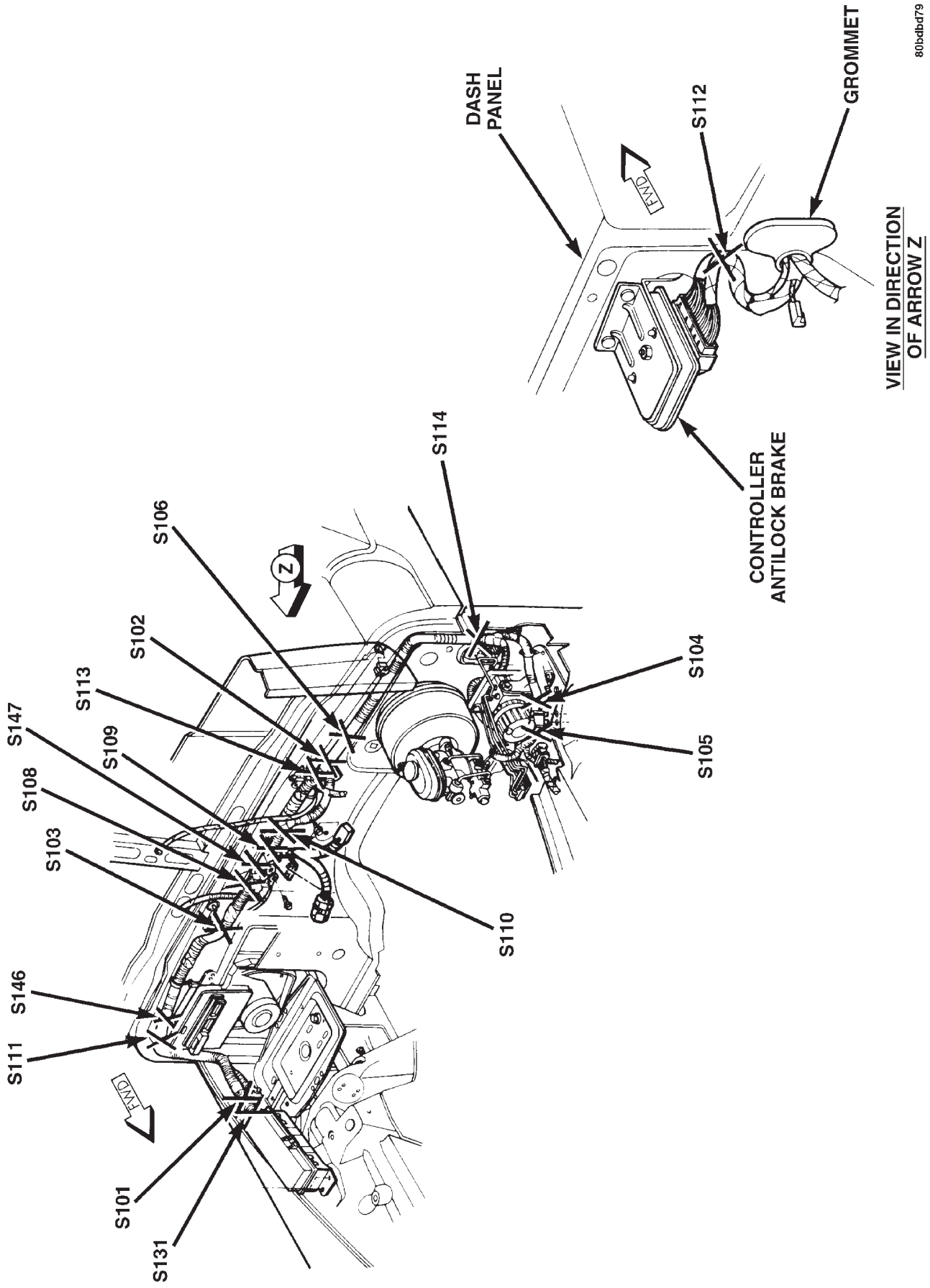


Fig. 2 Engine Compartment Splices—Rear,LHD

DESCRIPTION AND OPERATION (Continued)

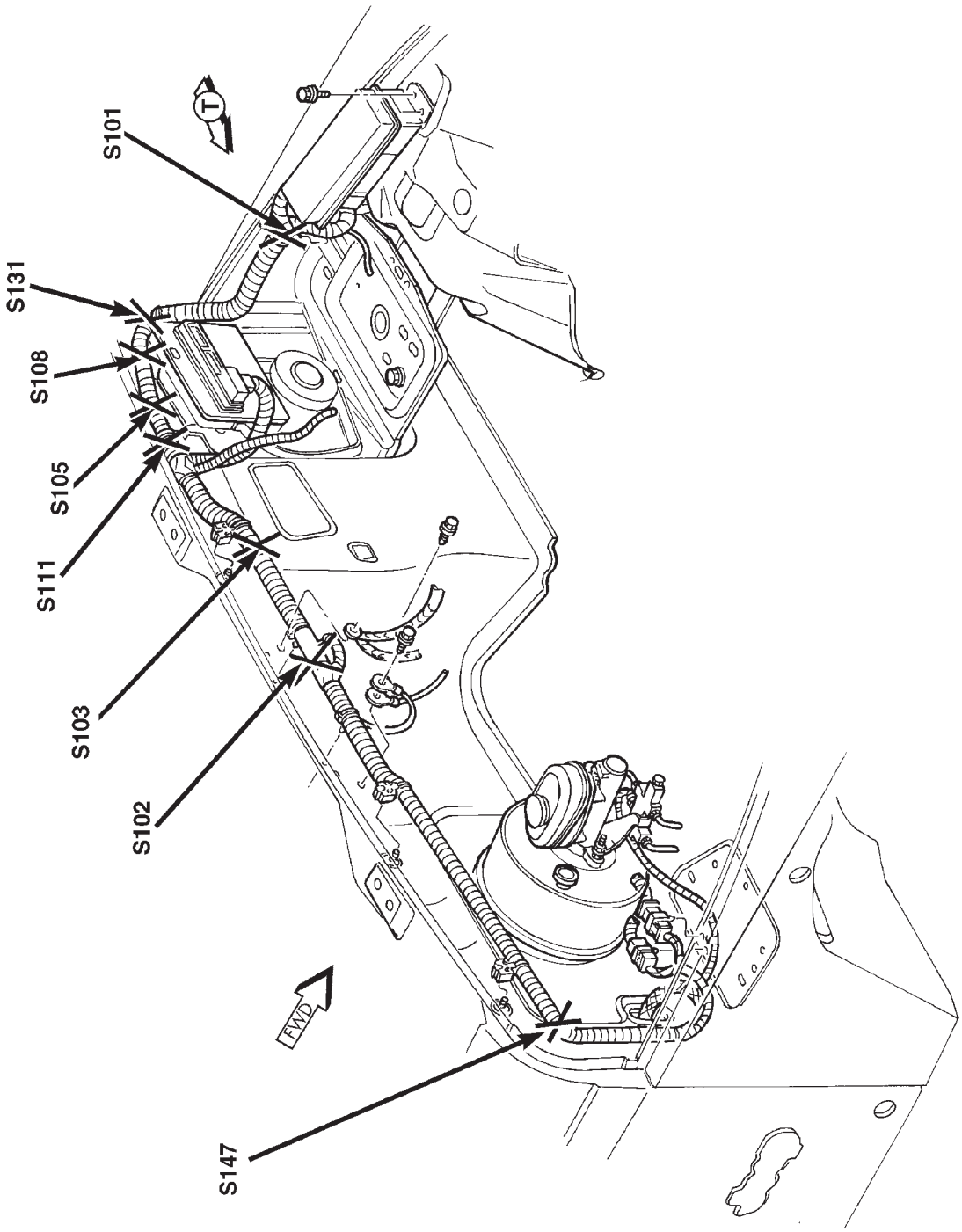


Fig. 3 Engine Compartment Splices—Rear,RHD

DESCRIPTION AND OPERATION (Continued)

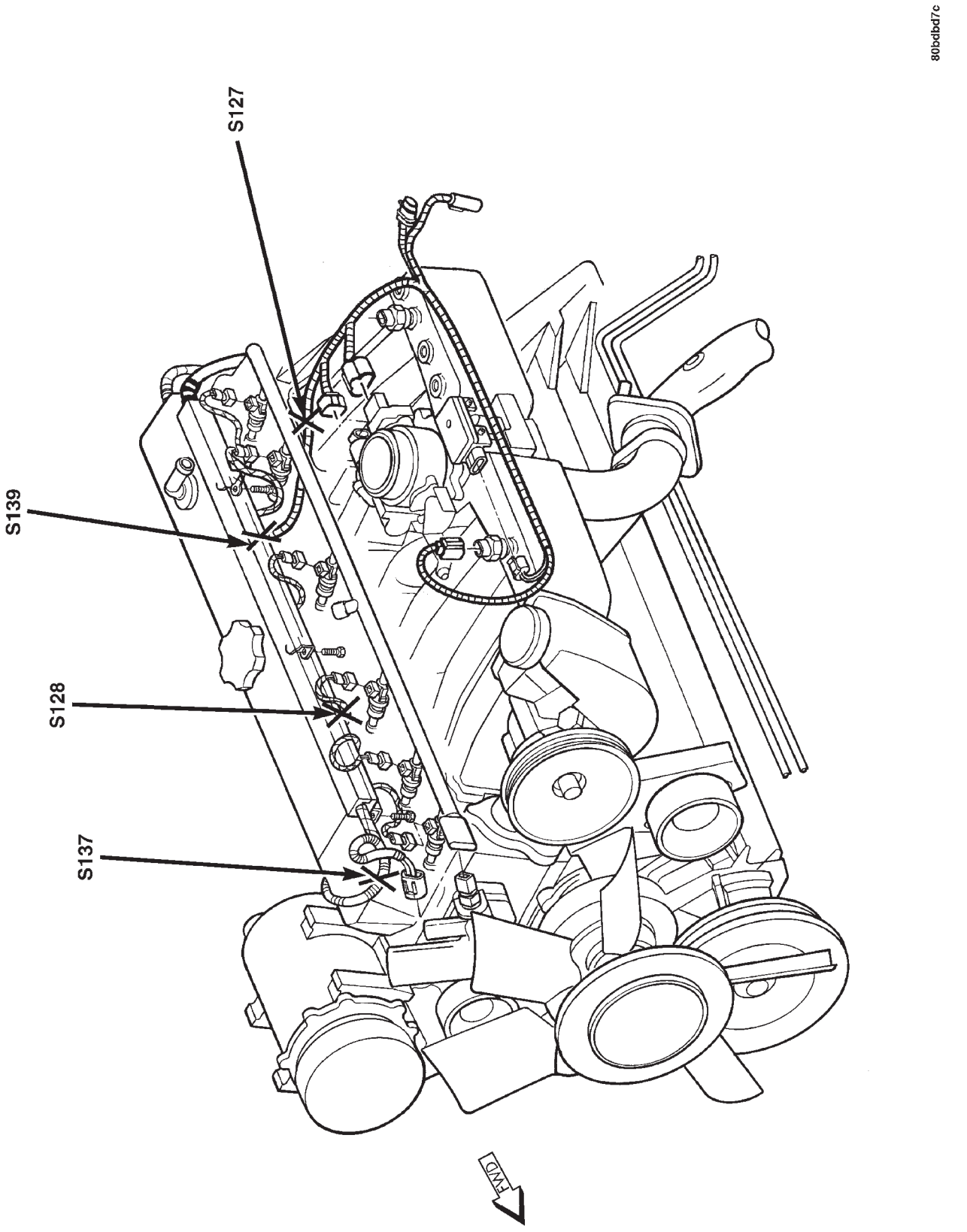


Fig. 4 Engine Wiring Splices—LHD

DESCRIPTION AND OPERATION (Continued)

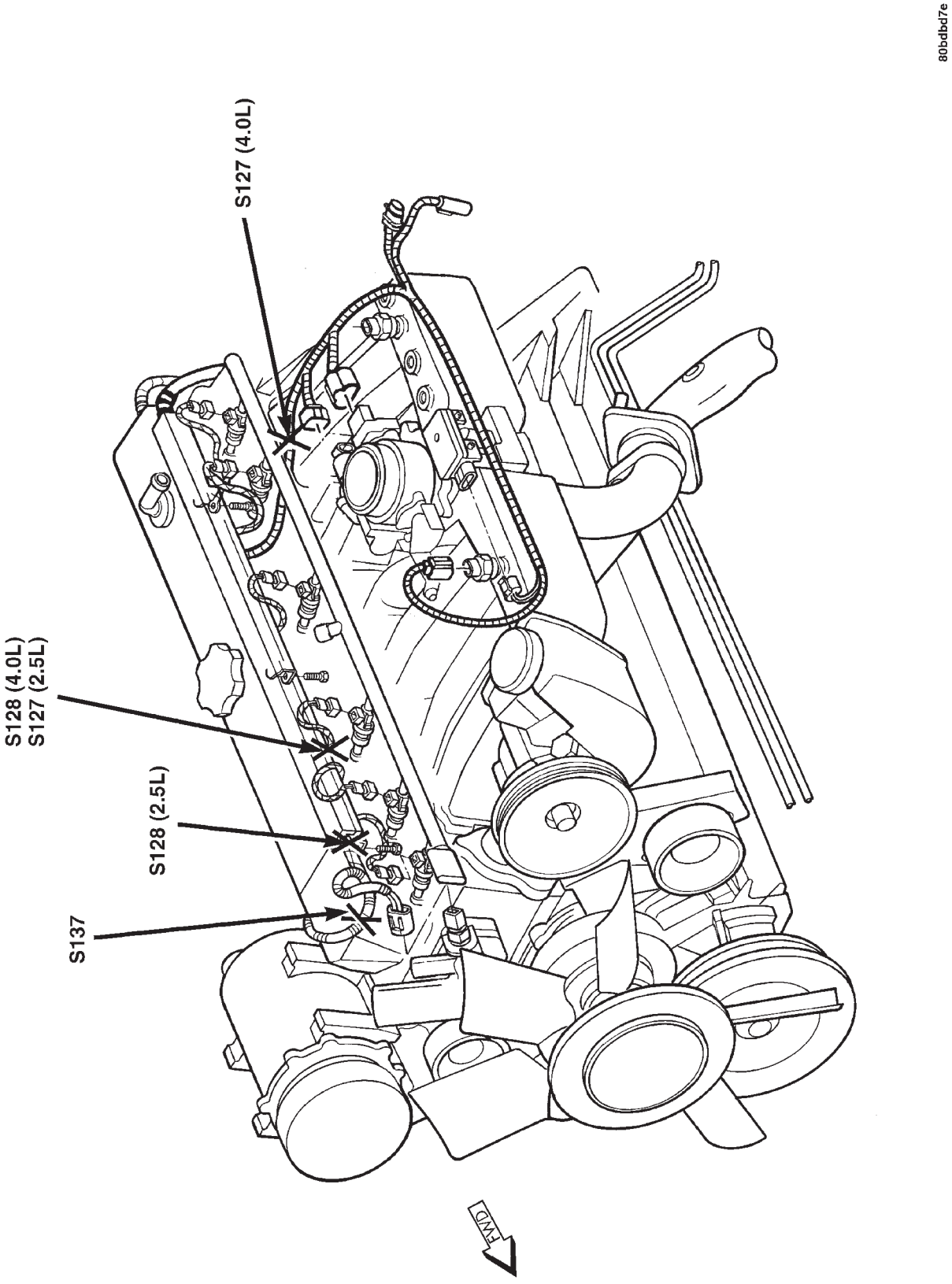


Fig. 5 Engine Wiring Splices—RHD

DESCRIPTION AND OPERATION (Continued)

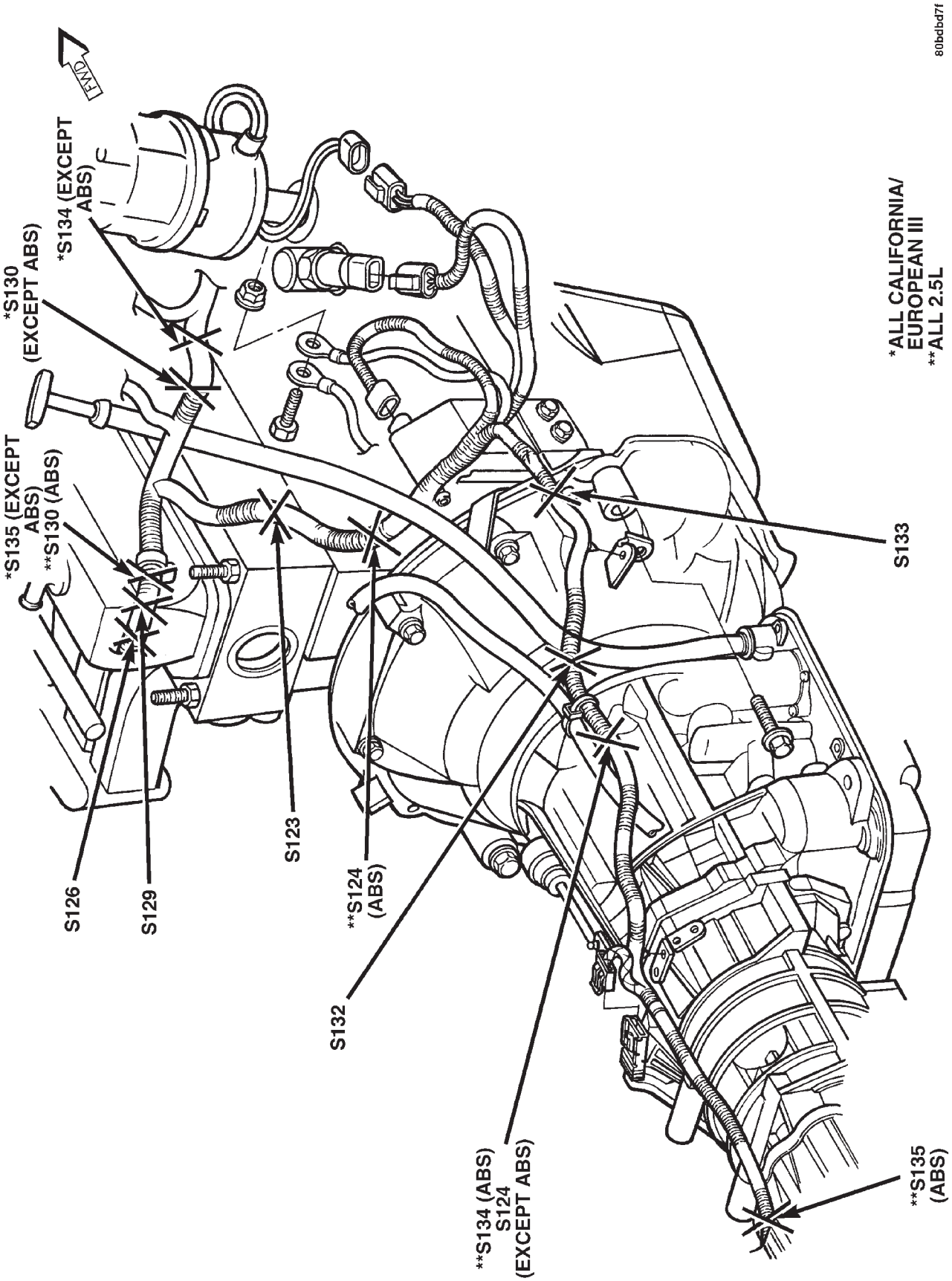


Fig. 6 Engine Wiring Splices—LHD

DESCRIPTION AND OPERATION (Continued)

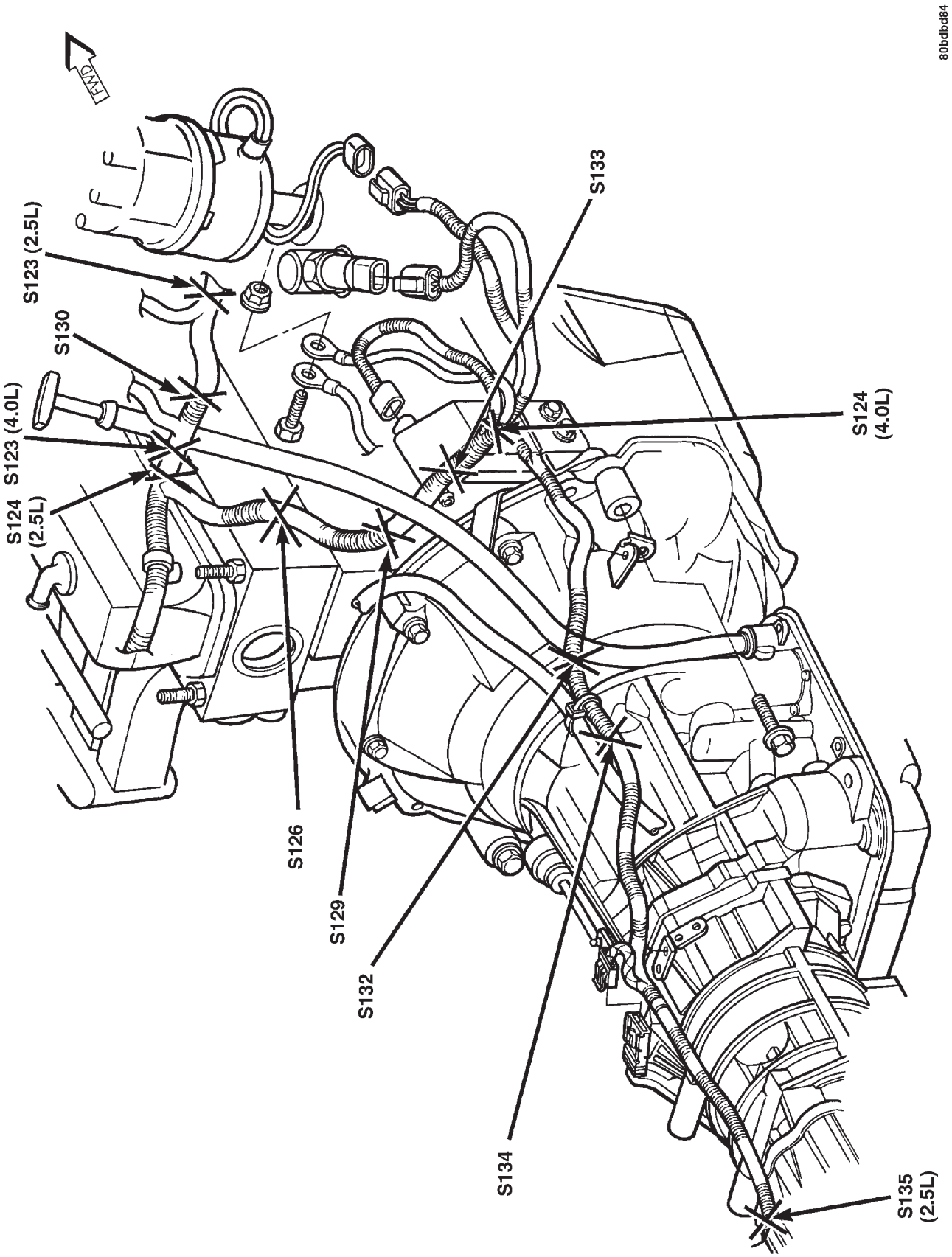


Fig. 7 Engine Wiring Splices—RHD

DESCRIPTION AND OPERATION (Continued)

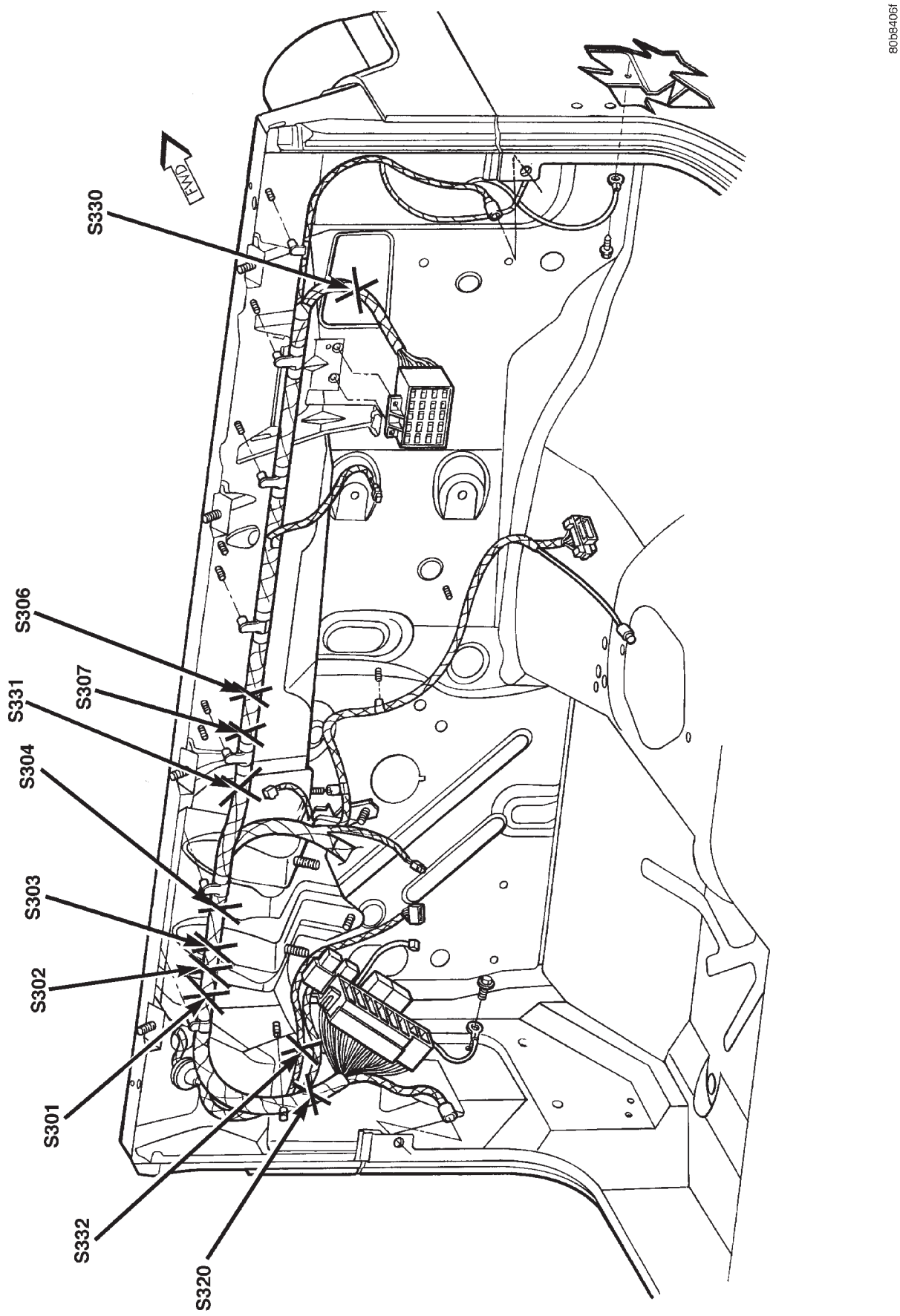


Fig. 8 Dash Panel Wiring Splices—LHD

DESCRIPTION AND OPERATION (Continued)

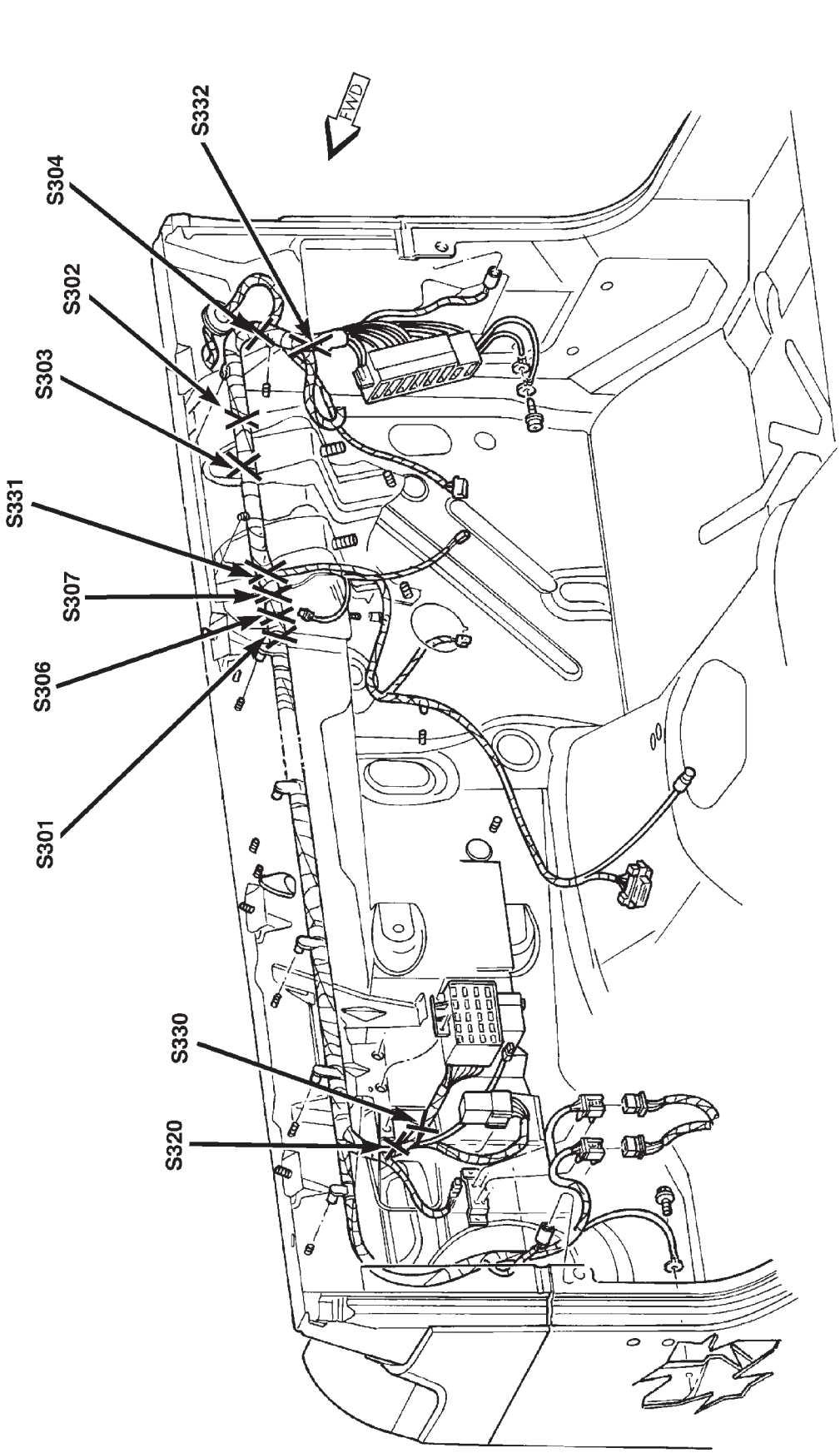


Fig. 9 Dash Panel Wiring Splices—RHD

DESCRIPTION AND OPERATION (Continued)

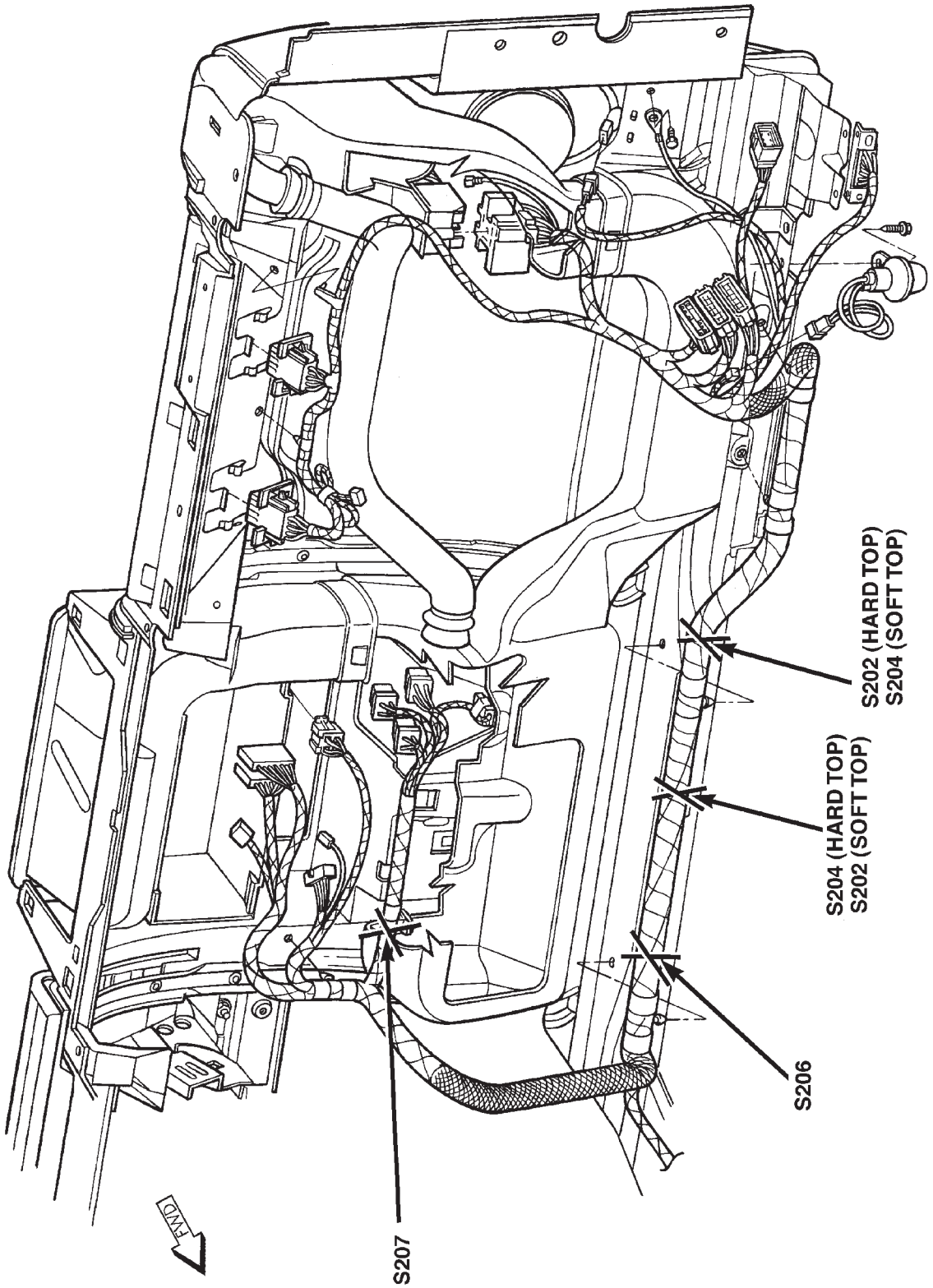


Fig. 10 Instrument Panel Wiring Splices—LHD

DESCRIPTION AND OPERATION (Continued)

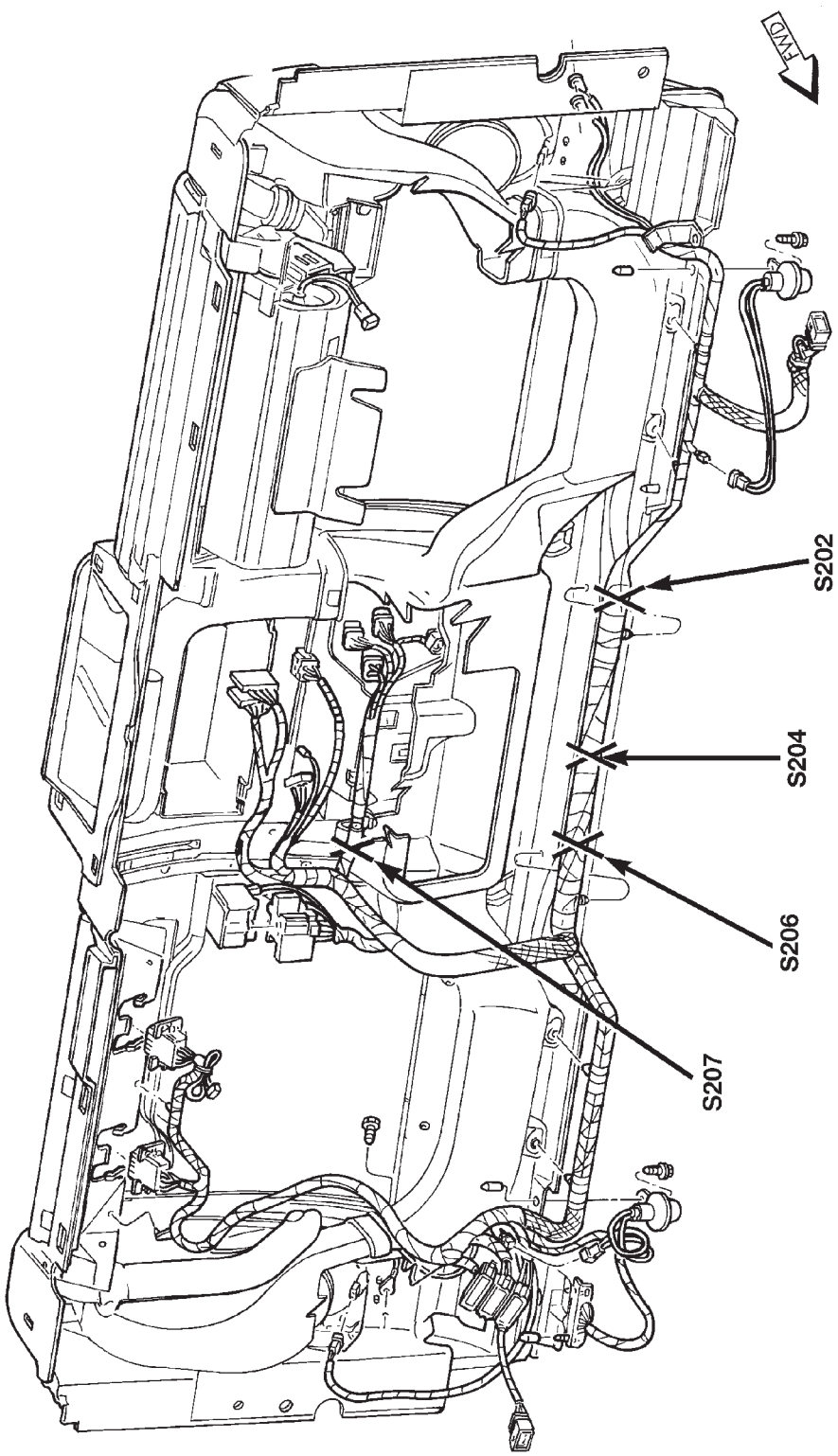


Fig. 11 Instrument Panel Wiring Splices—RHD

DESCRIPTION AND OPERATION (Continued)

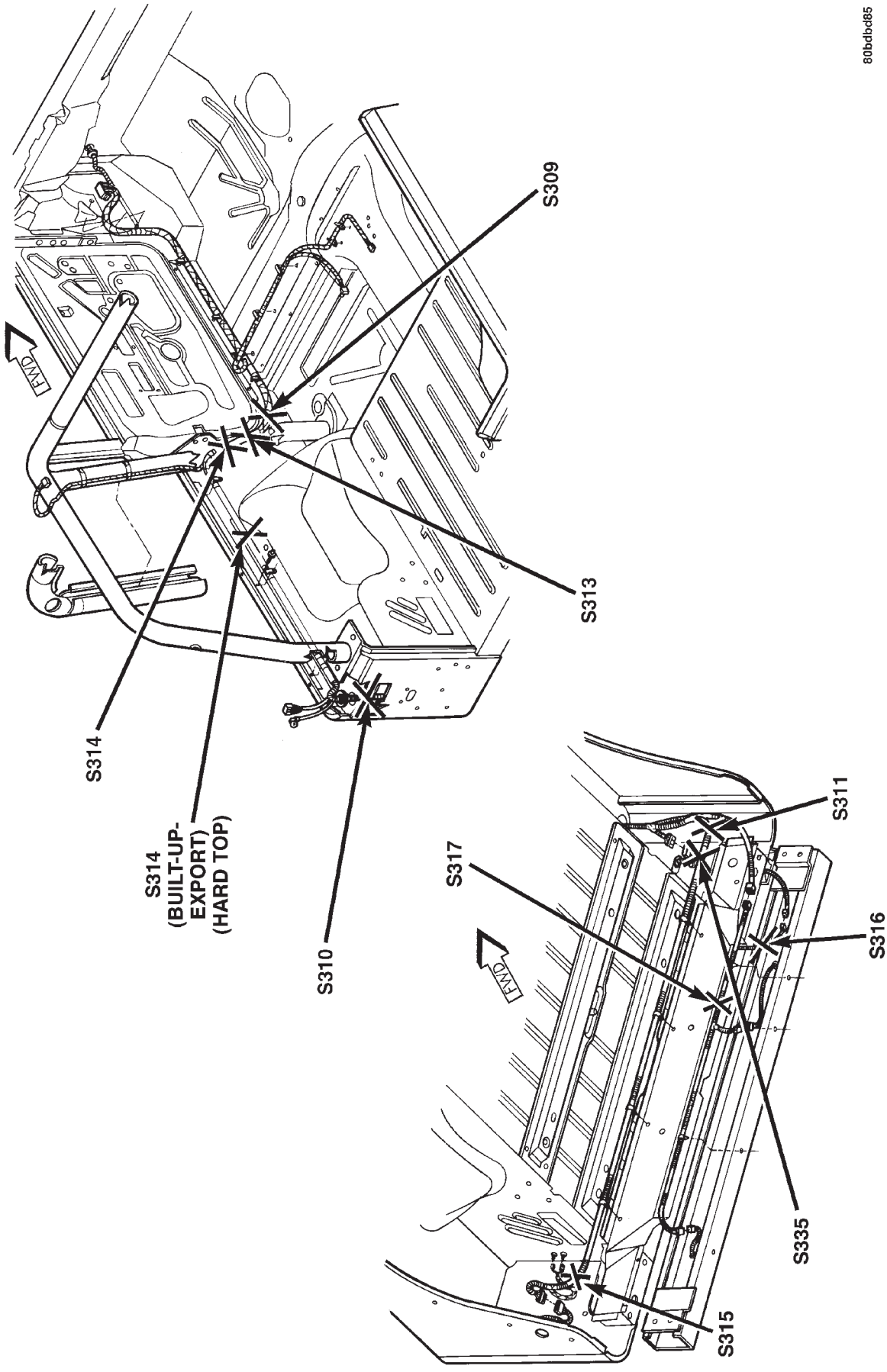


Fig. 12 Body Wiring Splices—LHD

DESCRIPTION AND OPERATION (Continued)

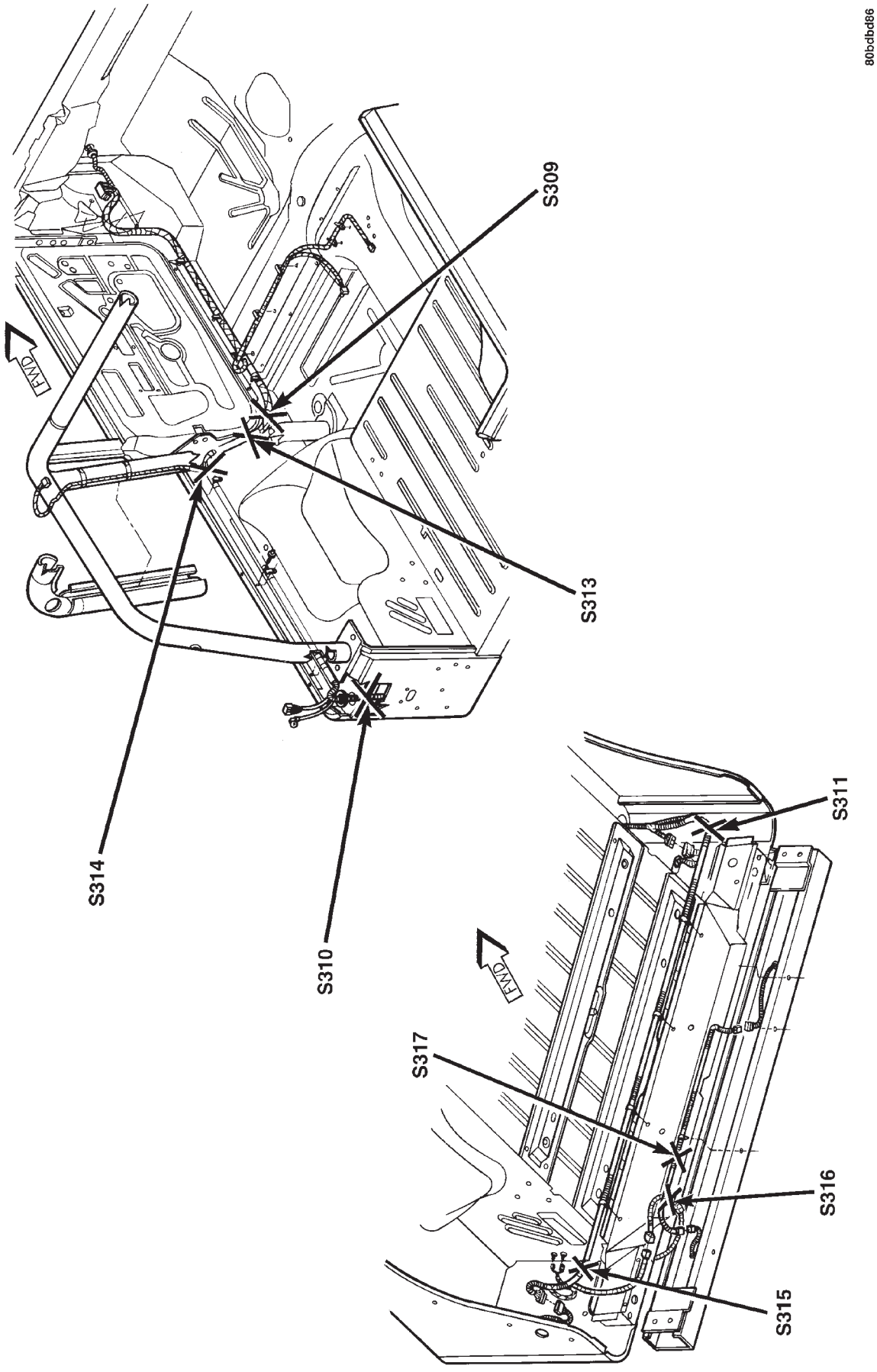


Fig. 13 Body Wiring Splices—RHD

ENGINE

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2.5L ENGINE

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DESCRIPTION AND OPERATION

ENGINE DESCRIPTION

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).

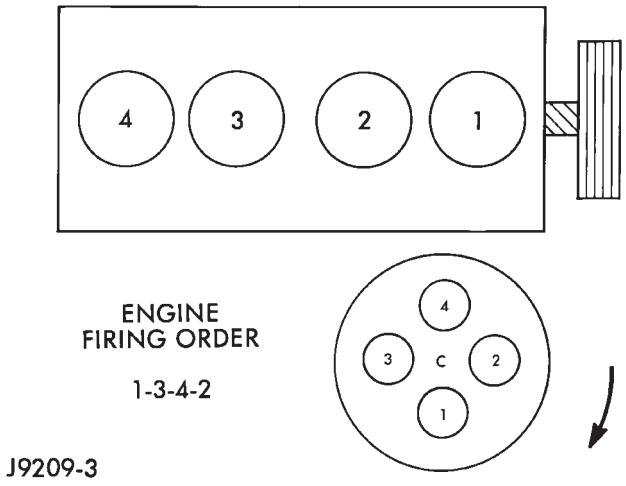


Fig. 1 Engine Firing Order

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.

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).

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

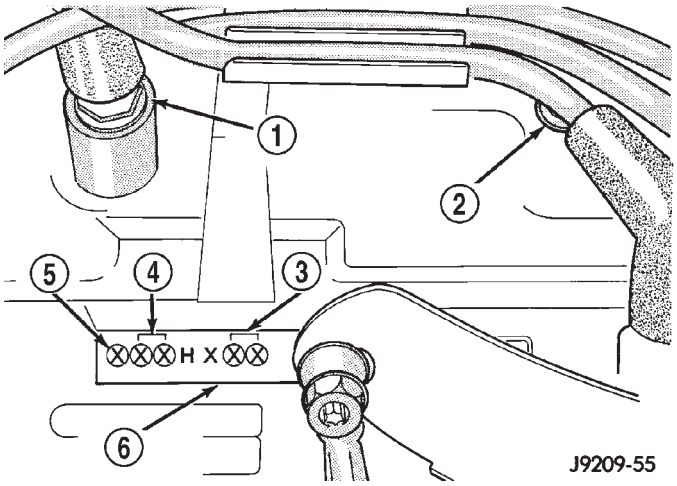


Fig. 2 Build Date Code Location

1 – NO. 4 CYLINDER
2 – NO. 3 CYLINDER
3 – DAY
4 – MONTH
5 – YEAR
6 – MACHINED SURFACE

LUBRICATION SYSTEM

DESCRIPTION

A gear—type positive displacement pump is mounted at the underside of the block opposite the No. 4 main bearing.

OPERATION

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 con-

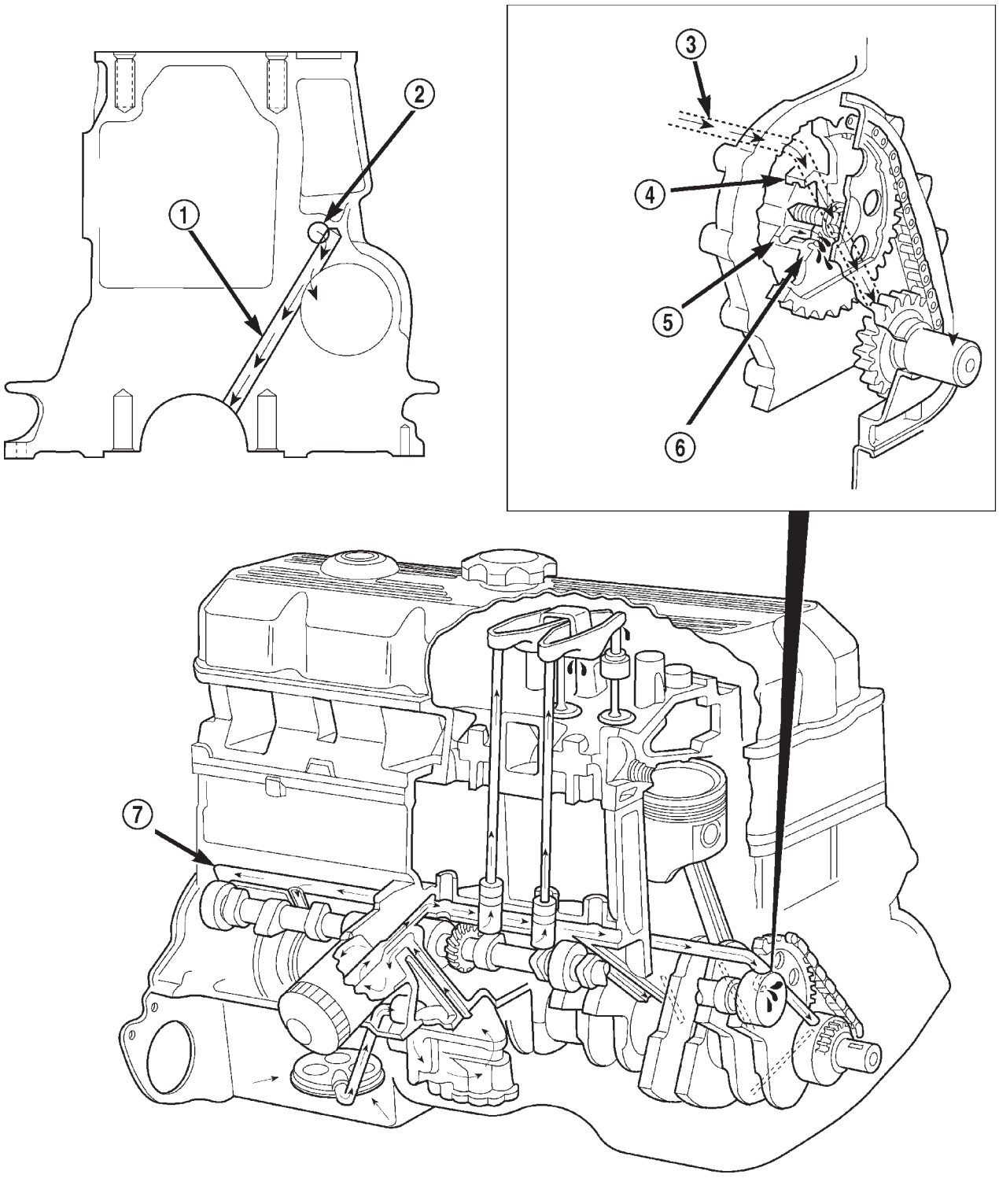
DESCRIPTION AND OPERATION (Continued)

necting 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

1 – CAM/CRANK MAIN GALLERY (5)
2 – TAPPET GALLERY
3 – TAPPET GALLERY
4 – CAMSHAFT BEARING
5 – NUMBER 1 CAMSHAFT BEARING JOURNAL
6 – CAMSHAFT SPROCKET
7 – TAPPET GALLERY

DESCRIPTION AND OPERATION (Continued)

CYLINDER BLOCK

DESCRIPTION

The cylinder block is a cast iron inline four cylinder design. The cylinder block is drilled forming galleries for both oil and coolant.

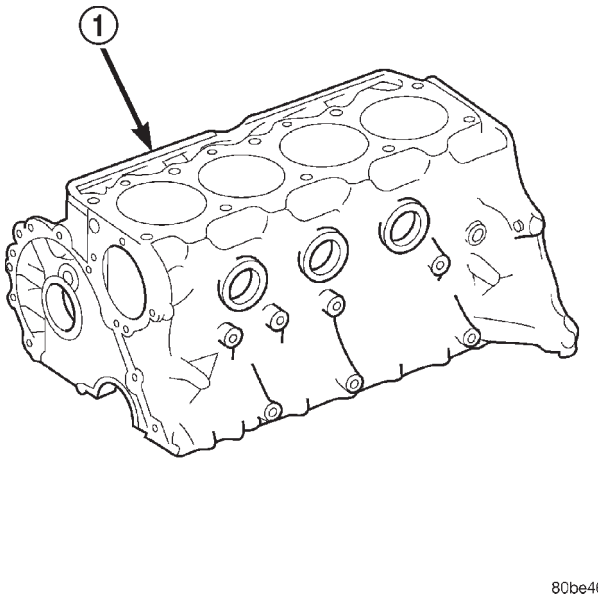


Fig. 3 Cylinder Block—2.5L

1 – CYLINDER BLOCK

CYLINDER HEAD

DESCRIPTION

The cylinder head is made of cast iron containing eight valves made of chrome plated heat resistant steel, valve stem seals, springs, retainers and keepers. The cylinder head, valve seats and guides can be resurfaced for service purposes.

The cylinder head uses dual quench-type design combustion chambers which cause turbulence in the cylinders allowing faster burning of the air/fuel mixture, resulting in better fuel economy.

The valve guides are integral to the cylinder head, They are not replaceable. However, they are serviceable.

CRANKSHAFT

DESCRIPTION

The crankshaft is constructed of nodular cast iron.

PISTON AND CONNECTING ROD

DESCRIPTION

The pistons are made of a high strength aluminum alloy, the piston skirts are coated with a solid lubricant (Molykote) to reduce friction and provide scuff resistance. The connecting rods are made of cast iron.

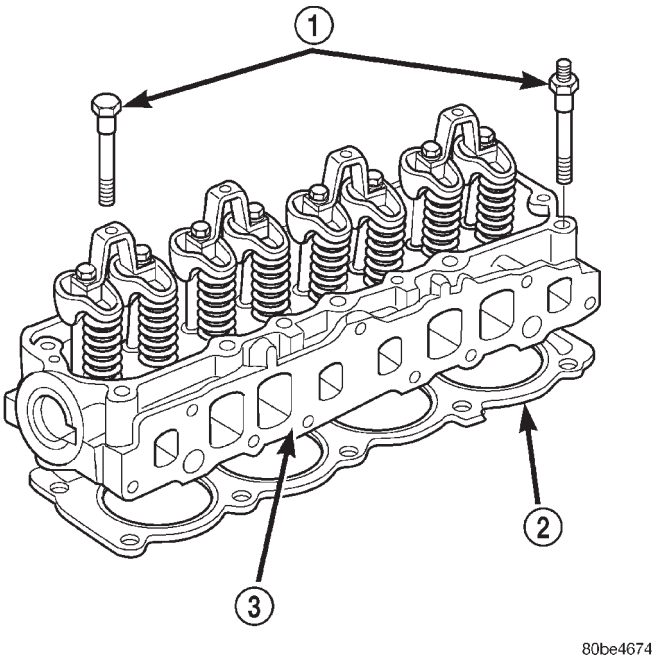


Fig. 4 Cylinder Head

1 – CYLINDER HEAD BOLTS
2 – CYLINDER HEAD GASKET
3 – CYLINDER HEAD

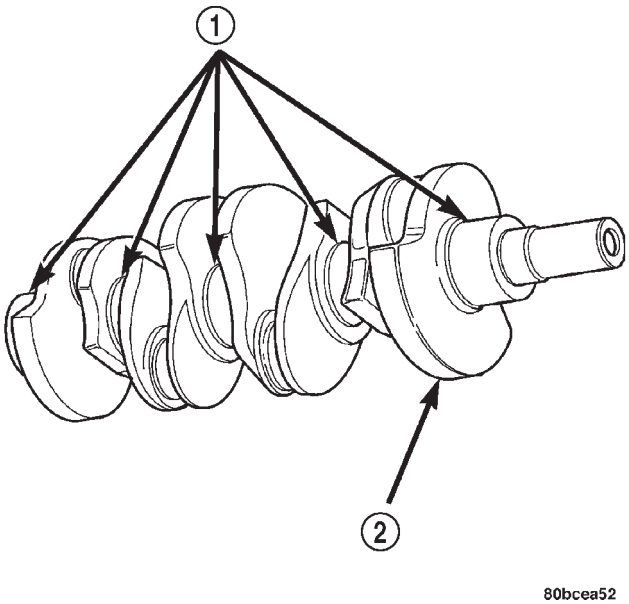


Fig. 5 Crankshaft—Typical

1 – MAIN BEARING JOURNALS
2 – COUNTER BALANCE WEIGHTS

DESCRIPTION AND OPERATION (Continued)

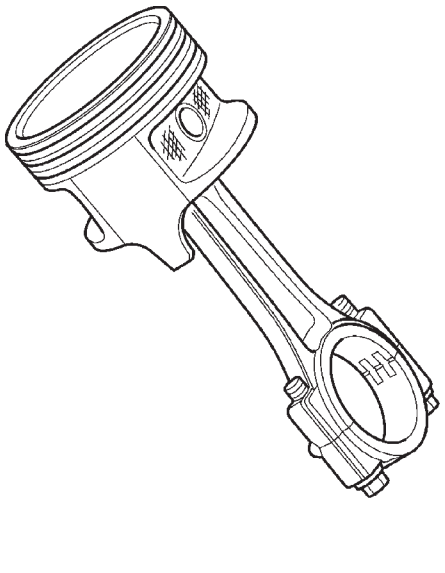


Fig. 6 Piston and Connecting Rod Assembly

CAMSHAFT

DESCRIPTION

The camshaft is made of cast iron with eight machined lobes and four bearing journals.

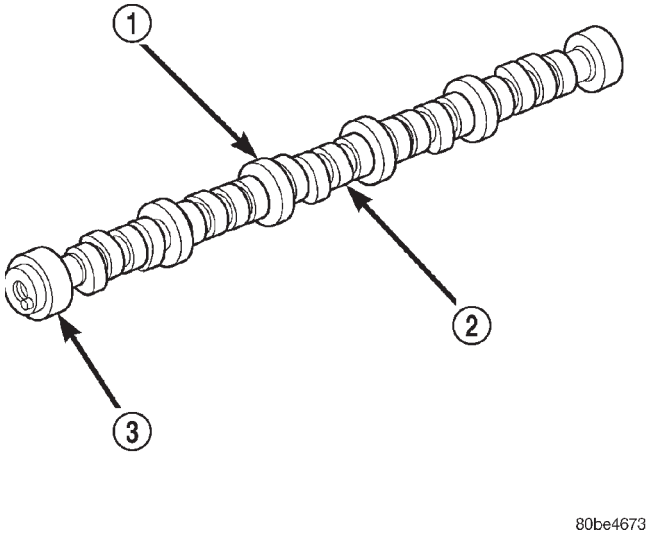


Fig. 7 Camshaft—Typical

1 – **CAMSHAFT**
2 – **LOBES**
3 – **BEARING JOURNAL**

OPERATION

When the camshaft rotates, the lobes actuate the tappets and push rods forcing upward on the rocker arms which applies downward force on the valves.

ROCKER ARM

DESCRIPTION

The rocker arms are made of stamped steel and have a operational ratio of 1.6:1.

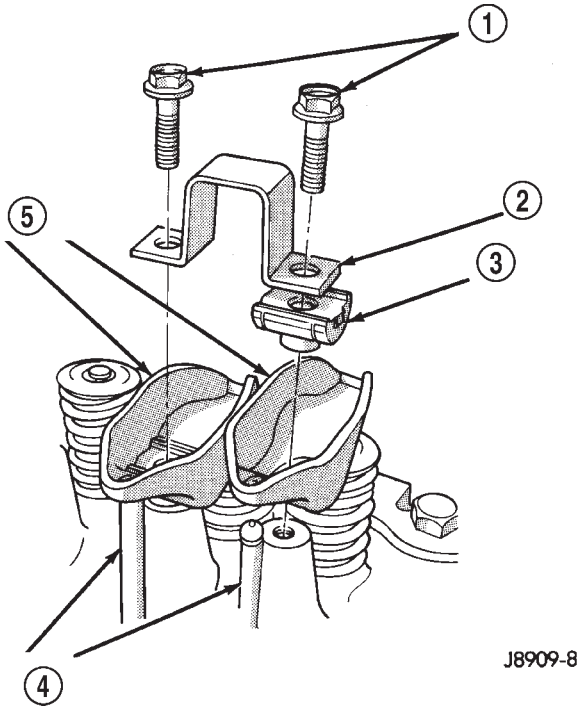


Fig. 8 Rocker Arms—Typical

1 – CAPSCREWS
2 – BRIDGE
3 – PIVOT ASSEMBLY
4 – PUSH RODS
5 – ROCKER ARMS

OPERATION

When the push rods are forced upward by the camshaft lobes the push rod presses upward on the rocker arms, the rocker arms pivot, forcing downward pressure on the valves forcing the valves to move downward and off from their seats.

VALVES

DESCRIPTION

The valves are made of heat resistant steel and have chrome plated stems to prevent scuffing. All valves use three bead lock keepers to retain the valve spring and promote valve rotation (Fig. 9).

DESCRIPTION AND OPERATION (Continued)

VALVE SPRING

DESCRIPTION

The valve springs are made of high strength chrome silicon steel. The springs are common for both intake and exhaust valves.

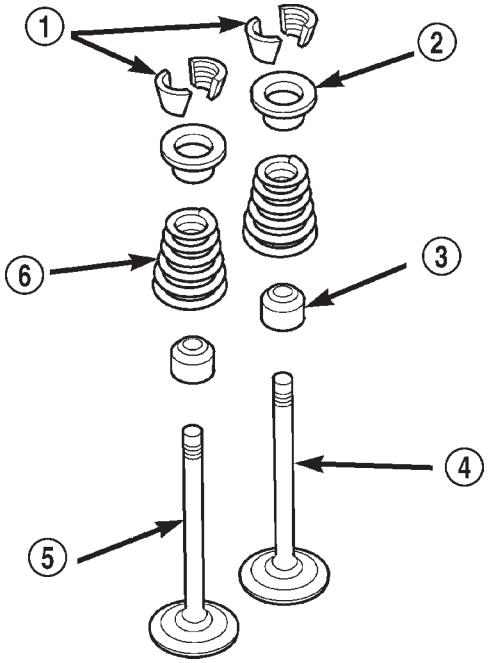


Fig. 9 Valve and Keeper Configuration 2.5L Engine

1 – VALVE LOCKS (3–BEAD)
2 – RETAINER
3 – VALVE STEM OIL SEAL
4 – INTAKE VALVE
5 – EXHAUST VALVE
6 – VALVE SPRING

CYLINDER HEAD COVER

DESCRIPTION

The cylinder head cover is made of die cast aluminum and incorporates the Crankcase Ventilation (CCV) Hoses and the oil fill opening.

HYDRAULIC TAPPET

DESCRIPTION

Valve lash is controlled by hydraulic tappets located inside the cylinder block, in tappet bores above the camshaft.

OIL PAN

DESCRIPTION

The oil pan is made of stamped steel. The oil pan gasket is a one piece steel backbone silicone coated gasket.

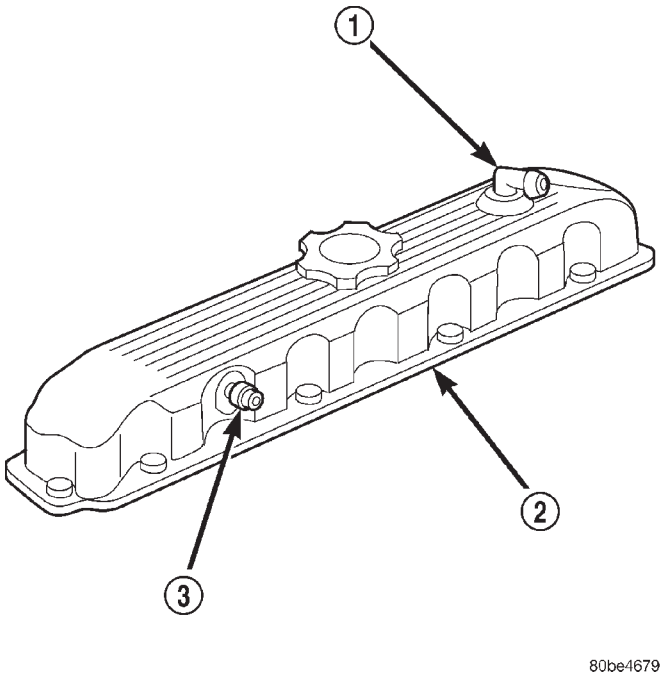


Fig. 10 Cylinder Head Cover

1 – **AIR INLET FITTING**
2 – **CYLINDER HEAD COVER**
3 – **FIXED ORIFICE FITTING**

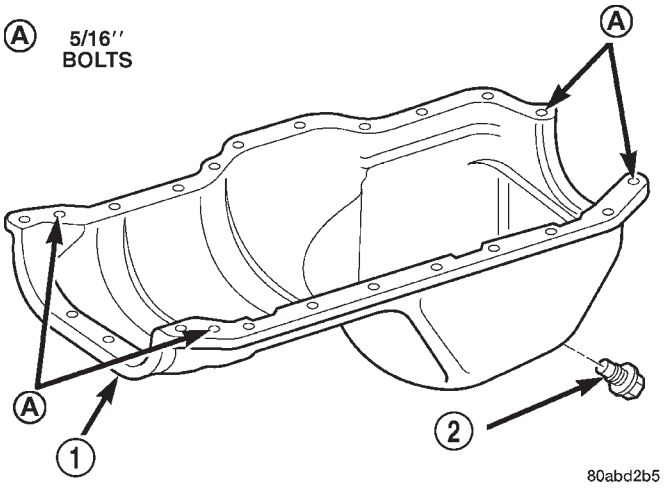


Fig. 11 Oil Pan

1 – OIL PAN
2 – OIL PAN DRAIN PLUG

VALVE STEM SEAL

DESCRIPTION

The valve stem seals are made of rubber and incorporate a garter spring to maintain consistent lubrication control (Fig. 9).

DESCRIPTION AND OPERATION (Continued)

INTAKE MANIFOLD

DESCRIPTION

The intake manifold is made of cast aluminum and uses seven bolts to mount to the cylinder head. This mounting style improves sealing and reduces the chance of leaks.

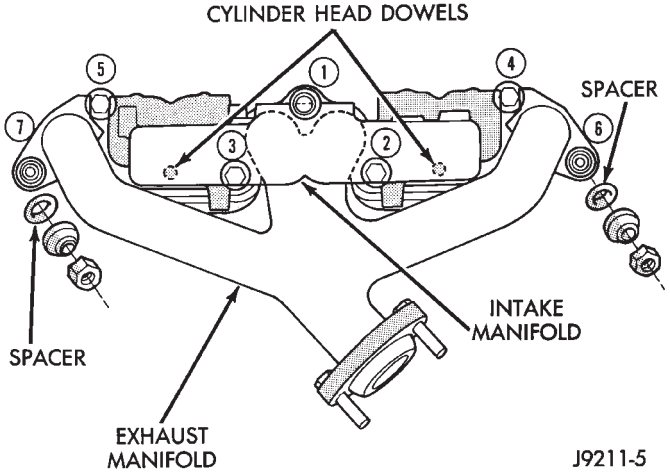


Fig. 12 Intake and Exhaust Manifold

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifold is log style and is made of high silicon molybdenum cast iron. The exhaust manifold shares a common gasket with the intake manifold. The exhaust manifold also incorporates a ball flange outlet for improved sealing and strain free connections (Fig. 12).

DIAGNOSIS AND TESTING

ENGINE DIAGNOSIS—INTRODUCTION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either performance (e.g., engine idles rough and stalls) or mechanical (e.g., a strange noise).

Refer to 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.

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

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to Group 8D, ignition system)
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)

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

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	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	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
	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

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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

HYDRAULIC TAPPETS

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 13).

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.

DIAGNOSIS AND TESTING (Continued)

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

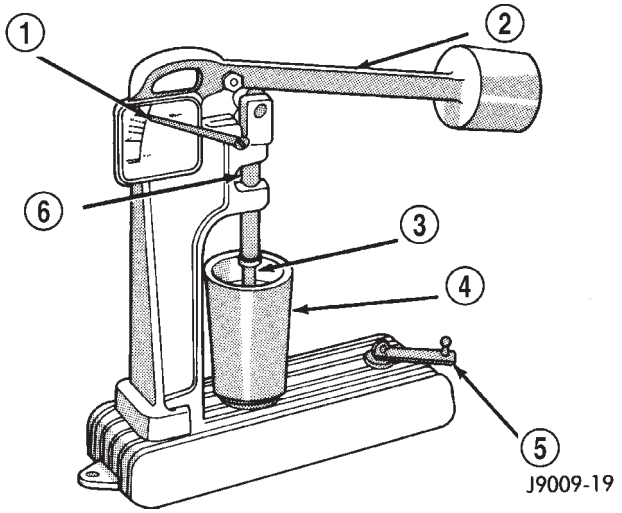


Fig. 13 Leak-Down Tester

1 – POINTER
2 – WEIGHTED ARM
3 – RAM
4 – CUP
5 – HANDLE
6 – PUSH ROD

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.

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

DIAGNOSIS AND TESTING (Continued)

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

DIAGNOSIS AND TESTING (Continued)

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.

(4) **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.

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.

SERVICE PROCEDURES (Continued)

- Set the dial indicator pointer at zero.
- 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. 15).

(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. 14). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

(5) Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

PISTON 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.

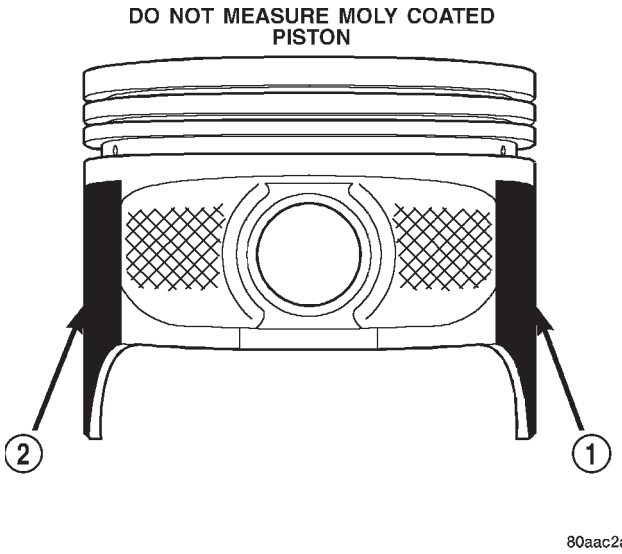


Fig. 14 Moly Coated Piston

1 – MOLY COATED
2 – MOLY COATED

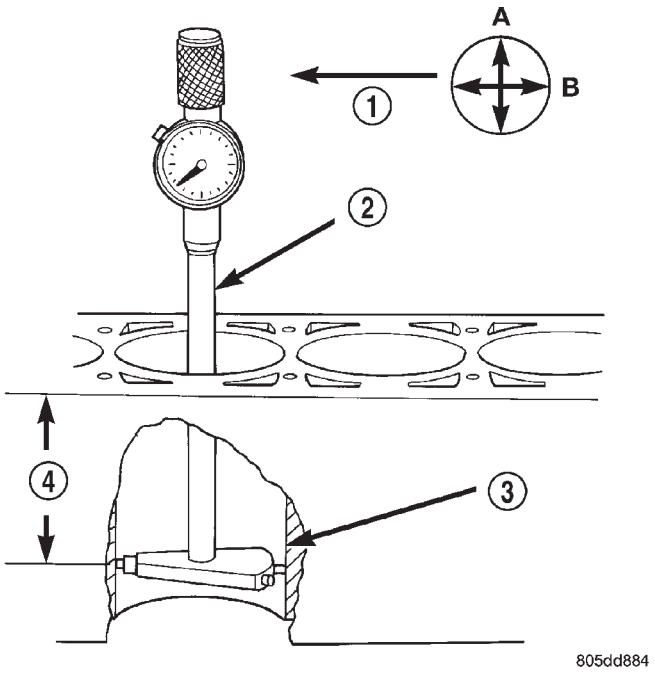


Fig. 15 Bore Gauge

1 – FRONT
2 – BORE GAUGE
3 – CYLINDER BORE
4 – 49.5 MM (1–15/16 in)

SERVICE PROCEDURES (Continued)

PISTON SIZE CHART

CYLINDER BORE SIZE	PISTON LETTER SIZE
98.438 - 98.448 mm (3.8755 - 3.8759 in.)	A
98.448 - 98.458 mm (3.8759 - 3.8763 in.)	B
98.458 - 98.468 mm (3.8763 - 3.8767 in.)	C
98.468 - 98.478 mm (3.8767 - 3.8771 in.)	D
98.478 - 98.488 mm (3.8771 - 3.8775 in.)	E
98.488 - 98.498 mm (3.8775 - 3.8779 in.)	F

(3) Measure the ring side clearance with a feeler gauge fitted snugly between the ring land and ring (Fig. 16) (Fig. 17). Rotate the ring in the groove. It must move freely around circumference of the groove.

GROOVE HEIGHT

A 1.530-1.555 mm (0.0602-0.0612 in)
B 4.035-4.060 mm (0.1589-0.1598 in)

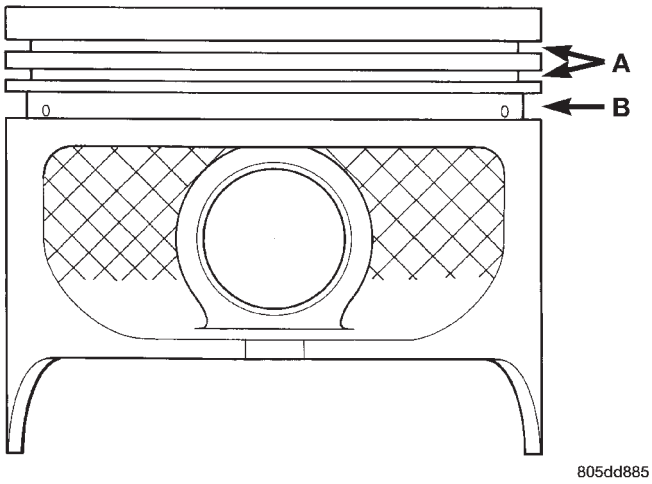


Fig. 16 Piston Dimensions

(4) Place ring in the cylinder bore and push down with inverted piston to position near lower end of the ring travel. Measure ring gap with a feeler gauge fitting snugly between ring ends (Fig. 18).

(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. 19).

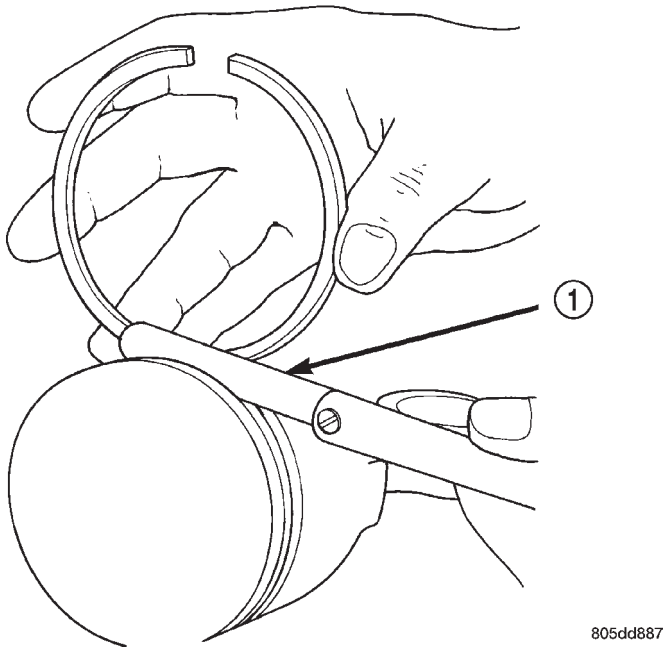


Fig. 17 Ring Side Clearance Measurement

1 – FEELER GAUGE

RING SIDE CLEARANCE CHART

ITEM	SPECIFICATION
Top Compression Ring	0.042 - 0.084 mm (0.0017 - 0.0033 in.)
Second Compression Ring	0.042 - 0.084 mm (0.0017 - 0.0033 in.)
Oil Control Ring	0.06 - 0.21 mm (0.0024 - 0.0083 in.)

(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. 20).

(8) Using a ring installer, install the second compression ring with the dot facing up (Fig. 20) (Fig. 22).

(9) Using a ring installer, install the top compression ring (either side up).

Ring Gap Orientation

- Position the gaps on the piston as shown (Fig. 23).
- Oil spacer - Gap on center line of piston skirt.

SERVICE PROCEDURES (Continued)

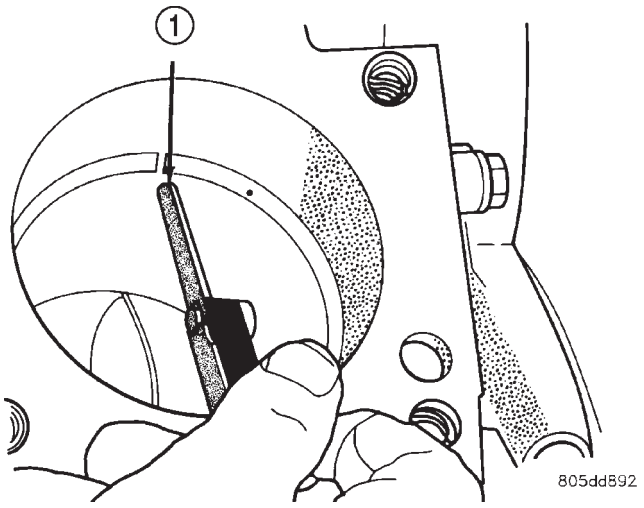


Fig. 18 Gap Measurement

1 – FEELER GAUGE

RING GAP MEASUREMENT CHART

ITEM	SPECIFICATION
Top Compression Ring	0.229 - 0.610 mm (0.0090 - 0.0240 in.)
Second Compression Ring	0.483 - 0.965 mm (0.0190 - 0.080 in.)
Oil Control Ring	0.254 - 1.500 mm (0.010 - 0.060 in.)

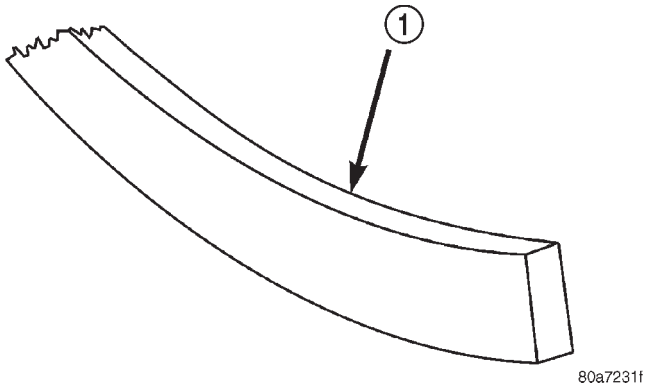


Fig. 19 Top Compression ring identification

1 – TOP COMPRESSION RING

- 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.

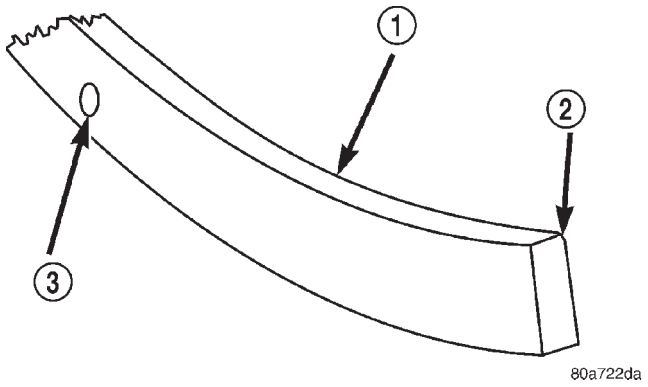


Fig. 20 Second Compression Ring Identification

1 – SECOND COMPRESSION RING
2 – CHAMFER
3 – ONE DOT

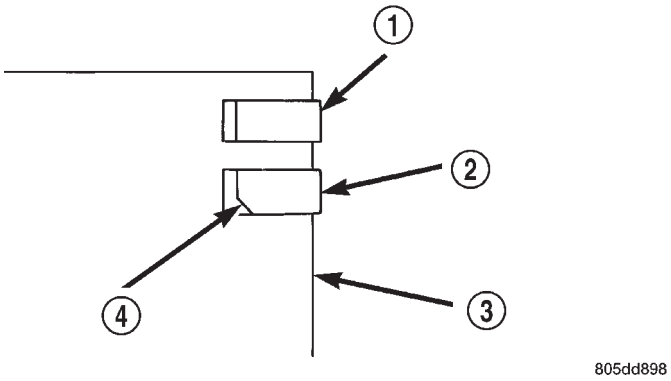


Fig. 21 Compression Ring Chamfer Location

1 – TOP COMPRESSION RING
2 – SECOND COMPRESSION RING
3 – PISTON
4 – CHAMFER

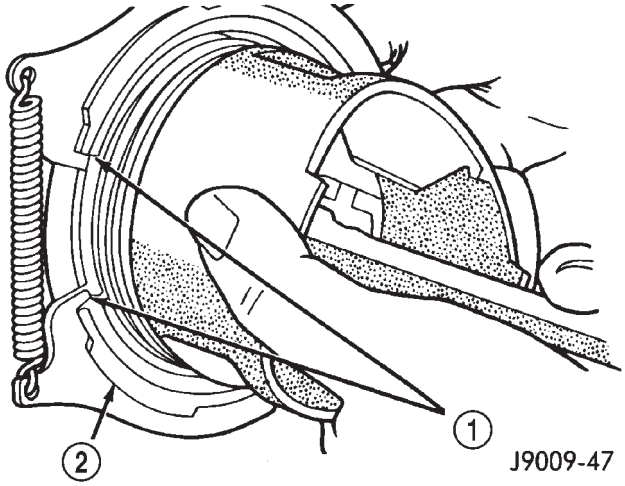


Fig. 22 Compression Ring Installation

1 – COMPRESSION RING
2 – RING EXPANDER RECOMMENDED

SERVICE PROCEDURES (Continued)

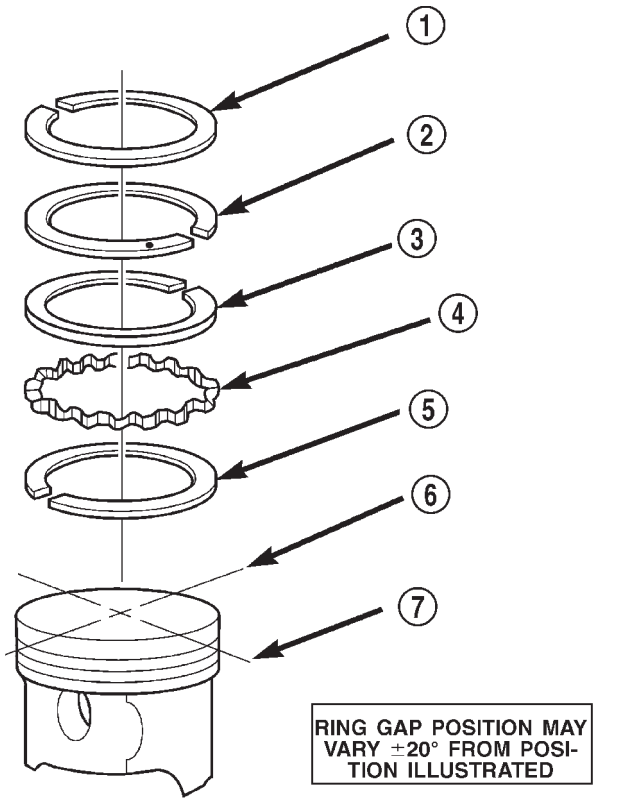


Fig. 23 Ring Gap Orientation

1 – TOP COMPRESSION RING
2 – BOTTOM COMPRESSION RING
3 – TOP OIL CONTROL RAIL
4 – OIL RAIL SPACER
5 – BOTTOM OIL CONTROL RAIL
6 – IMAGINARY LINE PARALLEL TO PISTON PIN
7 – IMAGINARY LINE THROUGH CENTER OF PISTON SKIRT

CONNECTING ROD BEARINGS—FITTING

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 24) (Fig. 25). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 26). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

(1) Wipe the oil from the connecting rod journal.

(2) Use short rubber hose sections over rod bolts during installation.

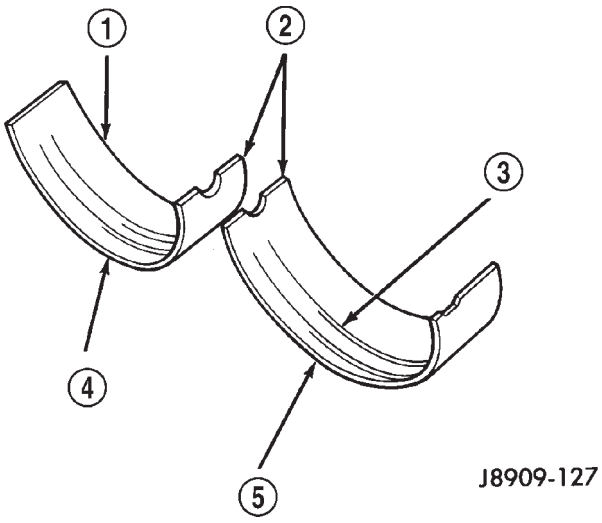


Fig. 24 Connecting Rod Bearing Inspection

1 – UPPER
2 – MATING EDGES
3 – GROOVES CAUSED BY ROD BOLTS SCRATCHING JOURNAL DURING INSTALLATION
4 – WEAR PATTERN — ALWAYS GREATER ON UPPER BEARING
5 – LOWER

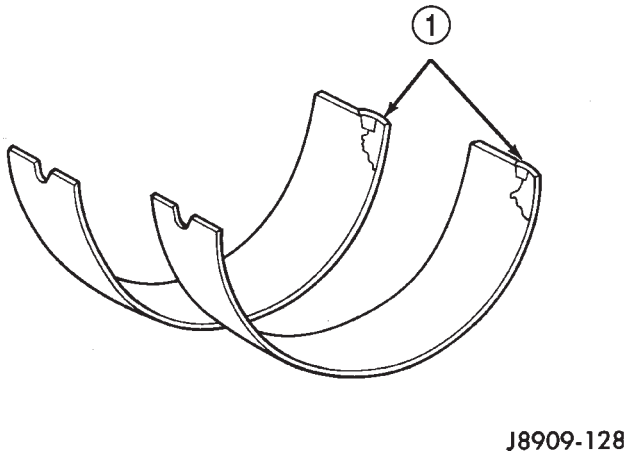


Fig. 25 Locking Tab Inspection

1 – ABNORMAL CONTACT AREA CAUSED BY LOCKING TABS NOT FULLY SEATED OR BEING BENT

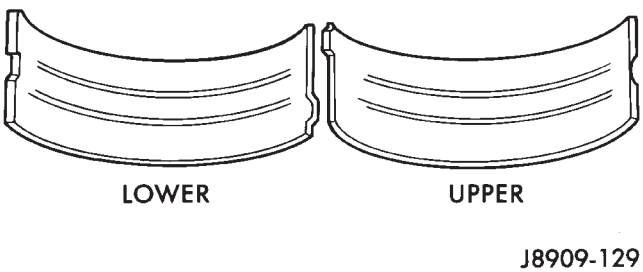


Fig. 26 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

SERVICE PROCEDURES (Continued)

(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. 27). 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.

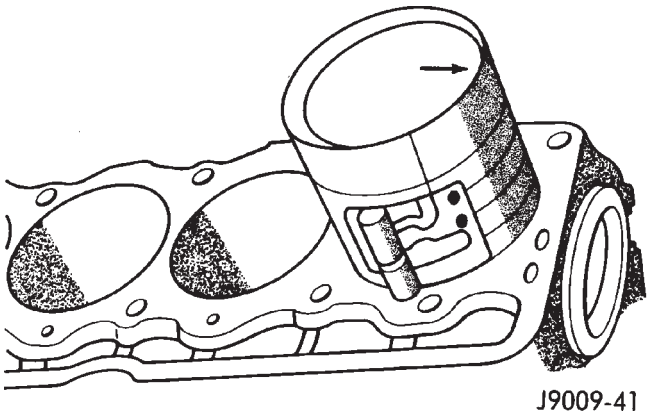


Fig. 27 Rod and Piston Assembly Installation

(5) Install the lower bearing insert in the bearing cap. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.

(6) Install bearing cap and connecting rod on the journal and tighten nuts to 45 N·m (33 ft. lbs.) torque. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(7) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 28). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

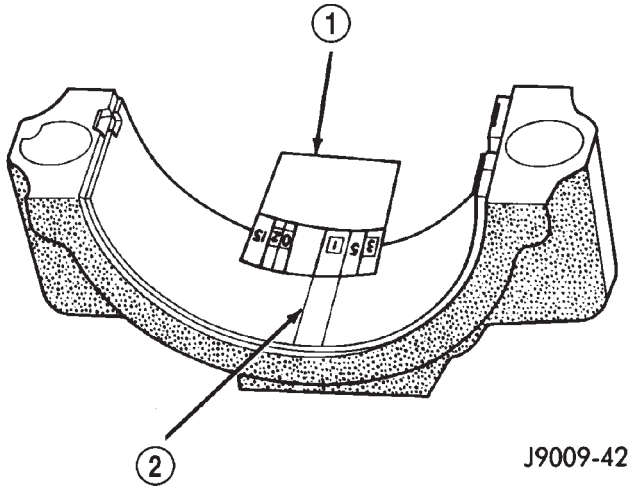


Fig. 28 Measuring Bearing Clearance with Plastigage

1 – PLASTIGAGE SCALE
2 – COMPRESSED PLASTIGAGE

(8) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(9) If bearing-to-journal clearance exceeds the specification, install a pair of 0.0254 mm (0.001 inch) undersize bearing inserts. All the odd size inserts must be on the bottom. The sizes of the service replacement bearing inserts are stamped on the backs of the inserts. Measure the clearance as described in the previous steps.

(10) The clearance is measured with a pair of 0.0254 mm (0.001 inch) undersize bearing inserts installed. This will determine if two 0.0254 mm (0.001 inch) undersize inserts or another combination is needed to provide the correct clearance (refer to Connecting Rod Bearing Fitting Chart).

SERVICE PROCEDURES (Continued)

CONNECTING ROD BEARING FITTING CHART

CRANKSHAFT JOURNAL		CORRESPONDING CONNECTING ROD BEARING INSERT	
Color Code	**Diameter**	**Upper Insert Size**	**Lower Insert Size**
Yellow	53.2257-53.2079 mm (2.0955-2.0948 in.)	Yellow - Standard	Yellow - Standard
Orange	53.2079 - 53.1901 mm (2.0948 - 2.0941 in.) 0.0178 mm (0.0007 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	53.1901 - 53.1724 mm (2.0941 - 2.0934 in.) 0.0356 mm (0.0014 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Red	52.9717 - 52.9539 mm (2.0855 - 2.0848 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

(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.

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 29). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

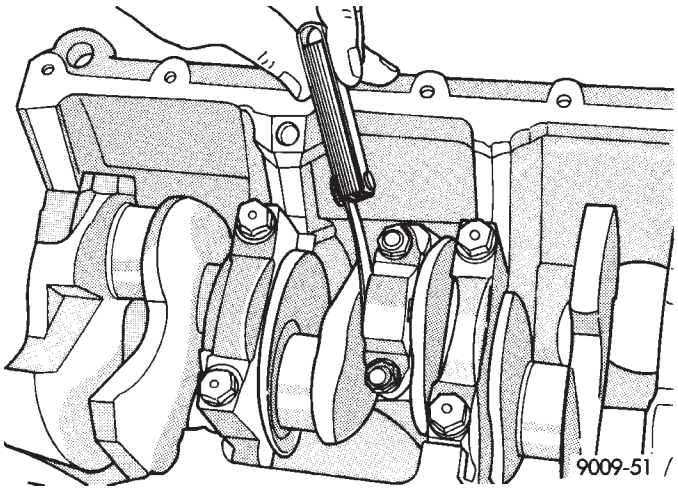


Fig. 29 Checking Connecting Rod Side Clearace—Typical

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. 30). In general the lower bearing half will have a heavier wear pattern.

NOTE: If any of the crankshaft journals are scored, remove the engine for crankshaft repair.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

FITTING BEARINGS (CRANKSHAFT INSTALLED)

The main bearing caps, numbered (front to rear) from 1 through 5 have an arrow to indicate the for-

SERVICE PROCEDURES (Continued)

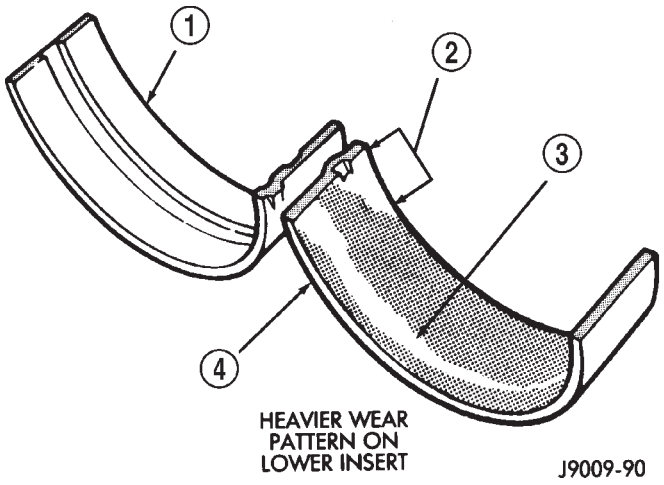


Fig. 30 Main Bearing Wear Patterns

1 – UPPER INSERT
2 – NO WEAR IN THIS AREA
3 – LOW AREA IN BEARING LINING
4 – LOWER INSERT

ward 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. Refer to the Bearing Insert Pair Chart.**

BEARING INSERT PAIR CHART

INSERT	CORRECT	INCORRECT
UPPER	STANDARD	STANDARD
LOWER	0.025 mm (0.001 in.) UNDERSIZE	0.051 mm (0.002 in.) UNDERSIZE

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. 31). Refer to Engine Specifications for the proper clearance.

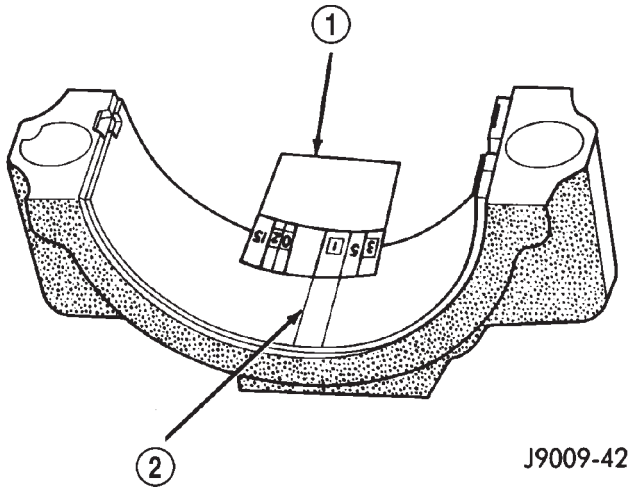


Fig. 31 Measuring Bearing Clearance with Plastigage

1 – PLASTIGAGE SCALE
2 – COMPRESSED 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.

SERVICE PROCEDURES (Continued)

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.

MAIN BEARING FITTING CHART

CRANKSHAFT JOURNALS		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.)

SERVICE PROCEDURES (Continued)

CRANKSHAFT JOURNALS		CORRESPONDING CRANKSHAFT BEARING INSERT	
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.)

FORM-IN-PLACE GASKETS

There are several places where form-in-place gaskets are used on the engine. **DO NOT use form-in-place gasket material unless specified.** Care must be taken when applying form-in-place gaskets. Bead size, continuity and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over. A continuous bead of the proper width is essential to obtain a leak-free joint.

Two types of form-in-place gasket materials are used in the engine area (Mopar Silicone Rubber Adhesive Sealant and Mopar Gasket Maker). Each have different properties and cannot be used interchangeably.

MOPAR SILICONE RUBBER ADHESIVE SEALANT

Mopar Silicone Rubber Adhesive Sealant, normally black in color, is available in 3 ounce tubes. Moisture in the air causes the sealant material to cure. This material is normally used on flexible metal flanges. It has a shelf life of a year and will not properly cure if over aged. Always inspect the package for the expiration date before use.

MOPAR GASKET MAKER

Mopar Gasket Maker, normally red in color, is available in 6 cc tubes. This anaerobic type gasket material cures in the absence of air when squeezed between smooth machined metallic surfaces. It will not cure if left in the uncovered tube. DO NOT use on flexible metal flanges.

SURFACE PREPARATION

Parts assembled with form-in-place gaskets may be disassembled without unusual effort. In some instances, it may be necessary to lightly tap the part with a mallet or other suitable tool to break the seal between the mating surfaces. A flat gasket scraper may also be lightly tapped into the joint but care must be taken not to damage the mating surfaces.

Scrape or wire brush all gasket surfaces to remove all loose material. Inspect stamped parts to ensure gasket rails are flat. Flatten rails with a hammer on a flat plate, if required. Gasket surfaces must be free of oil and dirt. Make sure the old gasket material is removed from blind attaching holes.

GASKET APPLICATION

Assembling parts using a form-in-place gasket requires care.

Mopar Silicone Rubber Adhesive Sealant should be applied in a continuous bead approximately 3 mm (0.12 inch) in diameter. All mounting holes must be circled. For corner sealing, a 3 or 6 mm (1/8 or 1/4 inch) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The use of a locating dowel is recommended during assembly to prevent smearing the material off location.

Mopar Gasket Maker should be applied sparingly to one gasket surface. The sealant diameter should be 1.00 mm (0.04 inch) or less. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing the material off location.

ENGINE PERFORMANCE

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.

SERVICE PROCEDURES (Continued)

(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. 32).

(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.

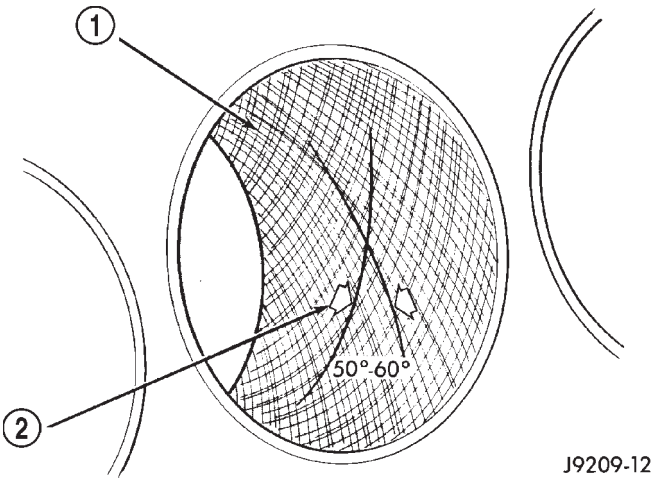


Fig. 32 Cylinder Bore Crosshatch Pattern

1 – CROSSHATCH PATTERN
2 – INTERSECT ANGLE

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.

SERVICE PROCEDURES (Continued)

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. 33). 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.**

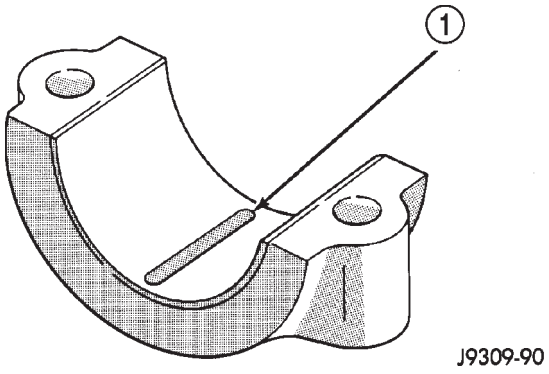


Fig. 33 Placement of Plastigage in Bearing Shell

1 – PLASTIGAGE

(2) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 34). 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).

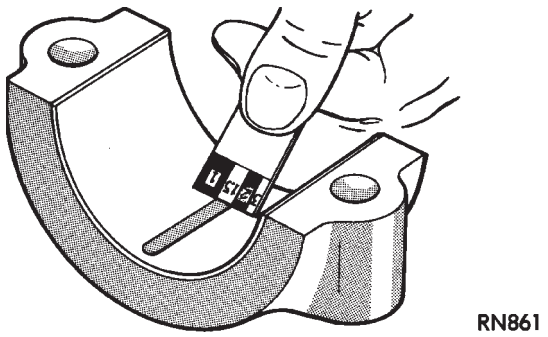


Fig. 34 Clearance Measurement

(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. 33). Position the Plastigage approximately 6.35 mm (1/4 inch) off center and away from the oil holes. In addition, suspect areas can be checked by placing the Plastigage in the suspect area.

(3) The crankshaft must be turned until the connecting rod to be checked starts moving toward the top of the engine. Only then should the rod cap with Plastigage in place be assembled. Tighten the rod cap 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. 34). 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

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- 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.

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

SERVICE PROCEDURES (Continued)

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.

API SERVICE GRADE CERTIFIED

In gasoline engines. use an engine oil that is API Service Grade Certified (Fig. 35).

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. 35).



9400-9

Fig. 35 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.

When choosing an engine oil, consider the range of temperatures the vehicle will be operated in before the next oil change. Select an engine oil that is best suited to your area's particular ambient temperature range and variation (Fig. 36).

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.

SERVICE PROCEDURES (Continued)

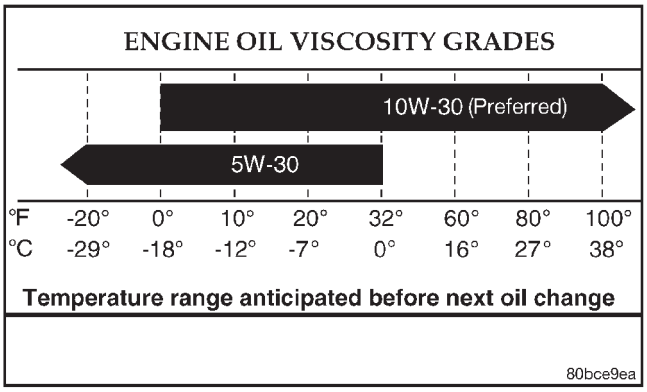


Fig. 36 Temperature/Engine Oil Viscosity

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 the 2.5L engine. 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. 37).

(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, note oil level reading (Fig. 37).

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules.

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.

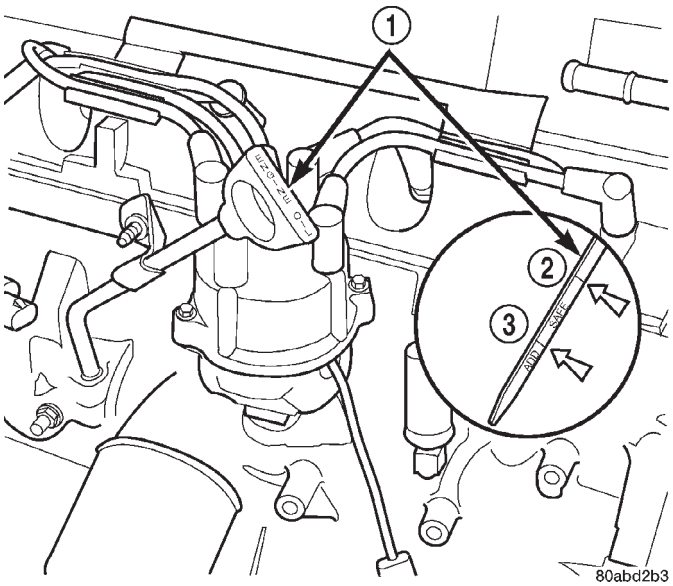


Fig. 37 Engine Oil Dipstick—2.5L Engine

1 – DIPSTICK
2 – SAFE
3 – ADD

(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 (Fig. 38).

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

SERVICE PROCEDURES (Continued)

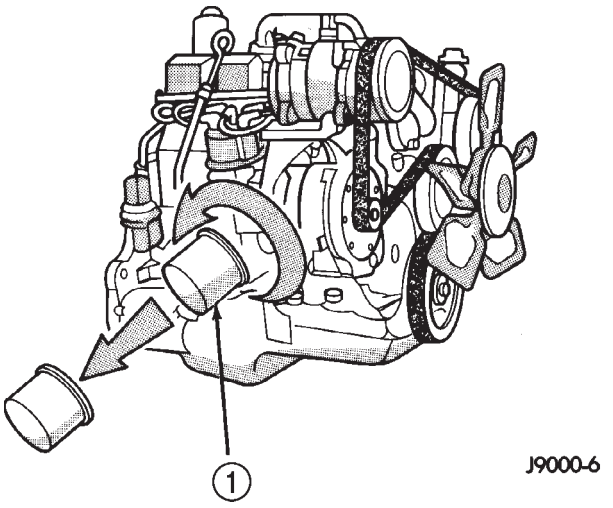


Fig. 38 Oil Filter—2.5L Engine

1 – OIL FILTER

(5) With a wiping cloth, clean the gasket sealing surface (Fig. 39) of oil and grime.

OIL FILTER INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil or chassis grease.

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 39) hand tighten filter one full turn, do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

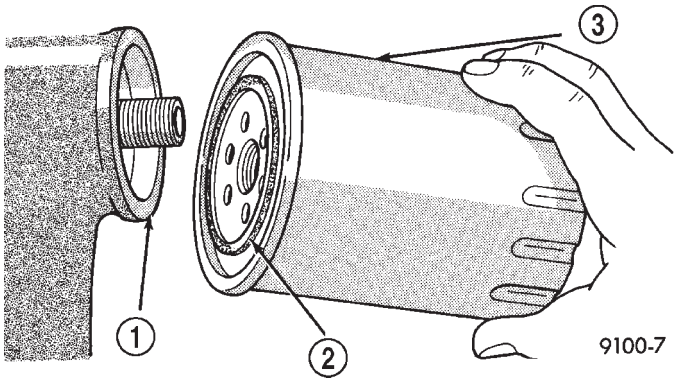


Fig. 39 Oil Filter Sealing Surface—Typical

1 – SEALING SURFACE
2 – RUBBER GASKET
3 – OIL FILTER

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.

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

The front mounts support the engine at each side. These supports are made of resilient rubber.

REMOVAL

(1) Disconnect negative cable from battery.
(2) Raise the vehicle.
(3) Support the engine.

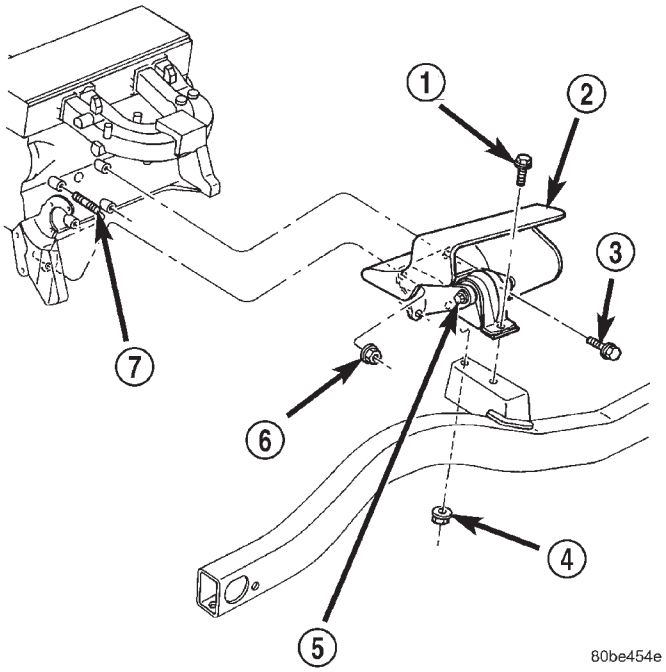


Fig. 40 Left Front Mount—2.5L Engine

1 – **BOLT (2)**
2 – **LEFT HAND ENGINE MOUNT ASSEMBLY**
3 – **BOLT (3)**
4 – **NUT (2)**
5 – **THROUGH BOLT**
6 – **LOCKNUT**
7 – **STUD**

(4) Remove through bolt nut (Fig. 40) (Fig. 41). DO NOT remove the through bolt.

(5) Remove the retaining bolts and nuts from the support cushions.

(6) Remove the through bolt.

(7) Remove the engine mount insulator.

INSTALLATION

(1) If the engine support bracket was removed, position the bracket onto the block and install the attaching bolts. Tighten the bolts to 50 N·m (37 ft. lbs.) and the nuts to 34 N·m (25 ft. lbs.) torque.

(2) Place the insulator on the support bracket. Install the insulator retaining bolts and nuts.

REMOVAL AND INSTALLATION (Continued)

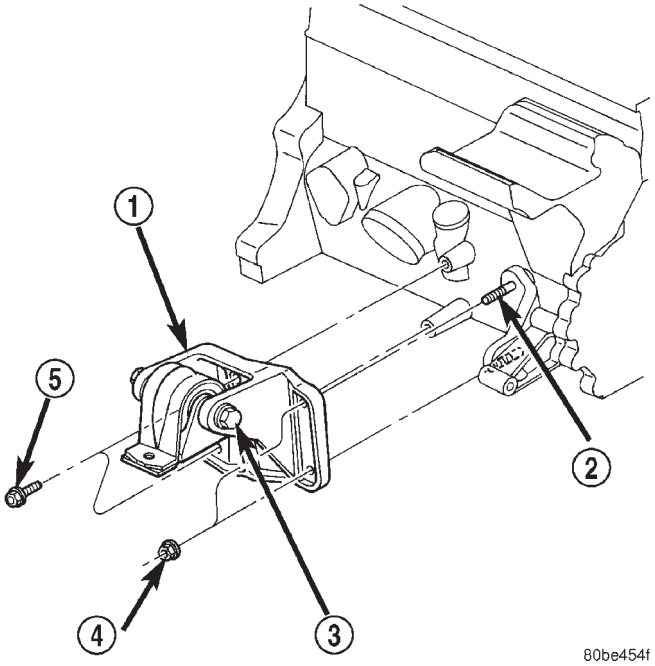


Fig. 41 Right Front Mount—2.5L Engine

1 – **RIGHT HAND ENGINE MOUNT ASSEMBLY**
2 – **STUD (2)**
3 – **THROUGH BOLT**
4 – **LOCKNUT (2)**
5 – **BOLT (2)**

Tighten the bolts and nuts to 40 N·m (30 ft. lbs.) torque.

(3) Install the through bolt and the retaining nut. Tighten the through bolt nut to 48 N·m (35 ft. lbs.) torque.

(4) Remove the engine support.

(5) Lower the vehicle.

(6) Connect negative cable to battery.

ENGINE MOUNT—REAR

A resilient rubber cushion supports the transmission at the rear between the transmission extension housing and the rear support crossmember or skid plate.

REMOVAL

ALL TRANSMISSIONS

(1) Disconnect negative cable from battery.

(2) Raise the vehicle and support the transmission.

(3) Remove the nuts holding the support cushion to the skid plate (Fig. 42) (Fig. 43).

(4) Remove the skid plate bolts and the skid plate.

MANUAL TRANSMISSIONS

(1) Remove nuts holding support cushion to transmission support bracket.

(2) Remove the support cushion.

(3) Remove bolts holding transmission support bracket to transmission.

(4) Remove the transmission support bracket.

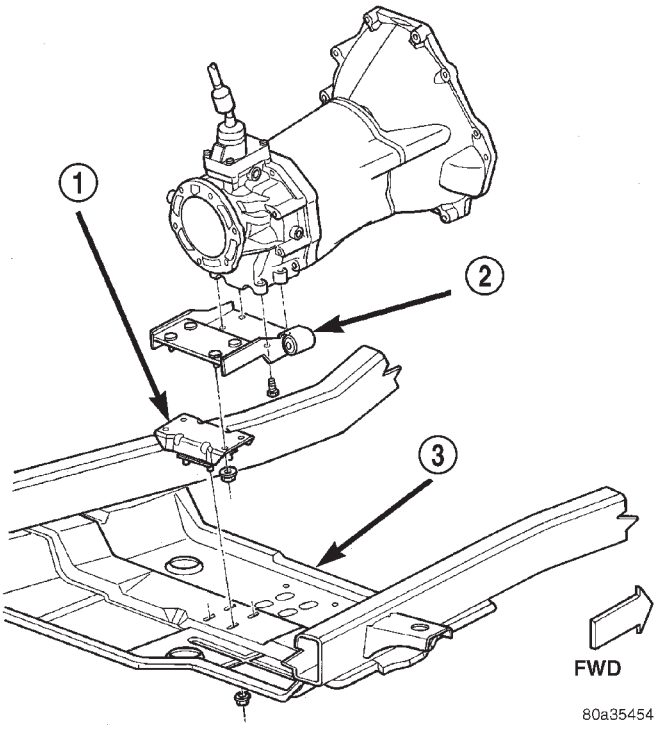


Fig. 42 Rear Mount (Manual Transmission)

1 – CUSHION
2 – BRACKET
3 – SKID PLATE

AUTOMATIC TRANSMISSIONS

(1) Remove nuts holding support cushion to transmission support bracket (Fig. 43). Remove the support cushion.

(2) Remove the bolts holding the transmission support bracket to transmission.

(3) Remove the transmission support bracket.

INSTALLATION

MANUAL TRANSMISSION:

(1) Position the transmission mount bracket to the transmission and install the bolts (Fig. 42).

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

(3) Position the support cushion to the transmission mount bracket and install nuts (Fig. 42).

(4) Tighten the nuts to 41 N·m (30 ft. lbs.) torque.

AUTOMATIC TRANSMISSION:

(1) Position the transmission mount bracket to the transmission and install the bolts. Tighten the bolts to 54 N·m (40 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

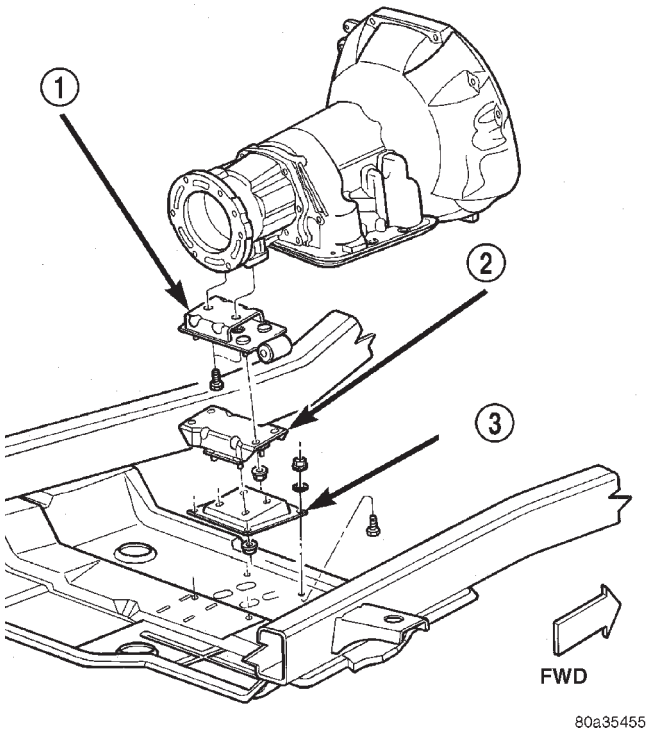


Fig. 43 Rear Mount (AutomaticTransmission)

1 – BRACKET
2 – CUSHION
3 – BRACKET

(2) Position the support cushion to the transmission mount bracket and install nuts. Tighten the nuts to 41 N·m (30 ft. lbs.) torque (Fig. 43).

(3) If the support cushion bracket was removed from the skid plate, position the bracket on the skid plate and install the nuts and bolts. Tighten the nuts to 28 N·m (21 ft. lbs.) torque.

ALL TRANSMISSIONS

(1) Position the skid plate to the studs of the support cushion and install the nuts (Fig. 42) (Fig. 43). Tighten the nuts to 28 N·m (21 ft. lbs.) torque.

(2) Install the skid plate bolts to the sill and tighten to 75 N·m (55 ft. lbs.) torque.

(3) Remove the transmission support.

(4) Lower the vehicle.

(5) Connect negative cable to battery.

ENGINE ASSEMBLY

REMOVAL

(1) Place a protective cloth over the windshield frame. Raise the hood and rest it on the windshield frame.

(2) Disconnect the battery negative cable.

(3) Remove the air cleaner resonator and related duct work. (Fig. 44)

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.

(4) Remove the radiator drain cock and radiator cap to drain the coolant. DO NOT waste usable coolant. If the solution is clean, drain the coolant into a clean container for reuse. Close drain cock when draining is complete.

(5) Discharge A/C system and disconnect compressor suction/discharge hose assembly (if A/C equipped). Refer to Group 24, Heating and Air Conditioning for correct procedures.

(6) Remove upper radiator hose.

(7) Remove the viscous fan/drive assembly.

(8) Remove accessory drive belt. (Refer to Group 7, Cooling for the correct procedures.)

(9) Disconnect the transmission cooler lines (if equipped) from the radiator.

(10) Disconnect lower radiator hose at radiator.

(11) Remove the fan shroud screws.

(12) Remove the radiator attaching bolts.

(13) Remove the radiator and fan shroud.

(14) Disconnect the wires at the starter motor solenoid.

(15) Disconnect the wire connectors from the generator. Secure the harness out of the way.

(16) If equipped with A/C, disconnect the compressor clutch connector and the A/C hi-pressure switch connector.

(17) Disconnect the ignition coil and distributor wire connectors.

(18) Disconnect the oil pressure sender wire connector.

(19) Disconnect harness ground at the engine oil dipstick tube mounting stud. Secure the harness out of the way.

(20) Disconnect the heater hoses from the thermostat housing and water pump inlet tube.

(21) Disconnect CCV hoses from the cylinder head cover and intake manifold (Fig. 44).

(22) Disconnect the accelerator, transmission line pressure (if equipped), and speed control (if equipped) cables from the throttle body.

(23) Remove cable(s) from the bracket and secure out of the way.

(24) Disconnect the body ground at the engine.

(25) Disconnect the following connectors and secure their harness out of the way:

- Power steering pressure switch (if equipped)
- Coolant temperature sensor at the thermostat housing
- Four (4) fuel injector connectors
- Intake air temperature sensor
- Idle air control motor

REMOVAL AND INSTALLATION (Continued)

- Throttle position sensor
- MAP sensor
- Crankshaft position sensor
- Oxygen sensor

(26) Disconnect the CCV, hvac supply, brake booster supply, and canister purge hoses from the intake manifold.

(27) Relieve fuel pressure. (Refer to Group 14, Fuel Pressure Release Procedure for correct procedure)

(28) Disconnect the fuel supply line at the fuel rail. (Refer to Group 14, Quick Connect Fittings for correct procedure)

(29) If equipped with power steering:

(a) Disconnect the hoses from the fittings at the steering gear.

(b) Drain the pump reservoir.

(c) Cap the fittings on the hoses and steering gear to prevent foreign objects from entering the system.

(30) Lift the vehicle and support it with support stands.

(31) Remove the oil filter.

(32) Remove the starter motor.

(33) Remove the engine support cushion-to-bracket through bolts.

(34) Disconnect the exhaust pipe from the manifold.

Manual Transmission models: (Fig. 46)

(35) Remove two (2) clutch housing inspection cover bolts and the two (2) clutch housing inspection cover bolts/nuts.

(36) Remove shield.

(37) Remove six (6) clutch housing to engine block bolts.

Proceed to step Step 41

Automatic Transmission models: (Fig. 45)

(38) Remove two (2) torque converter housing inspection cover bolts and the two (2) torque convertor housing inspection cover bolts/nuts.

(39) Remove four (4) torque converter to flexplate bolts.

(40) Remove six (6) transmission to engine block bolts.

(41) Drain the engine oil.

(42) Lower the vehicle.

(43) Attach a lifting device to the engine.

(44) Raise the engine off the front supports.

(45) Place a floor jack or support stand under the flywheel/converter housing.

(46) Separate the engine from the transmission, lift the engine out of the engine compartment and install on an engine stand.

(47) Install the oil filter to keep foreign material out of the engine.

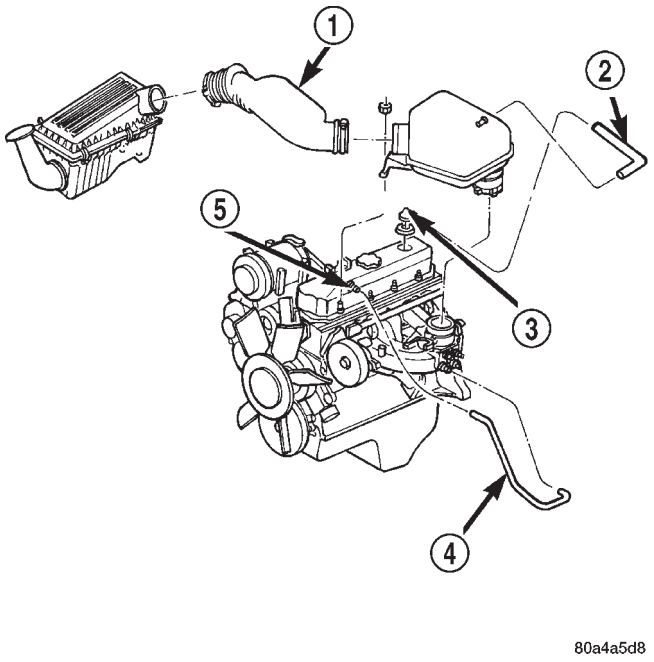


Fig. 44 Air Cleaner Resonator and Duct Work

1 – AIR TUBE
2 – CCV TUBE
3 – AIR INLET FITTING
4 – CCV TUBE
5 – FIXED ORIFICE FITTING

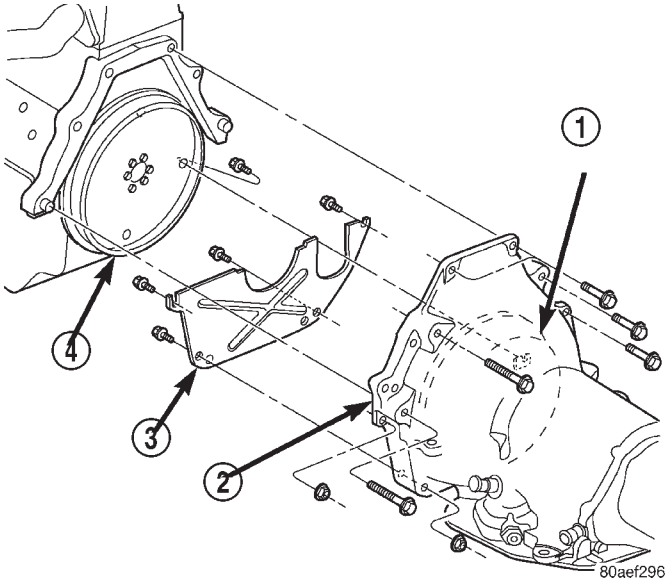


Fig. 45 Automatic Transmission to Engine—2.5L

1 – TORQUE CONVERTER
2 – TORQUE CONVERTER HOUSING
3 – COVER
4 – FLEXPLATE

INSTALLATION

(1) Remove the oil filter.

REMOVAL AND INSTALLATION (Continued)

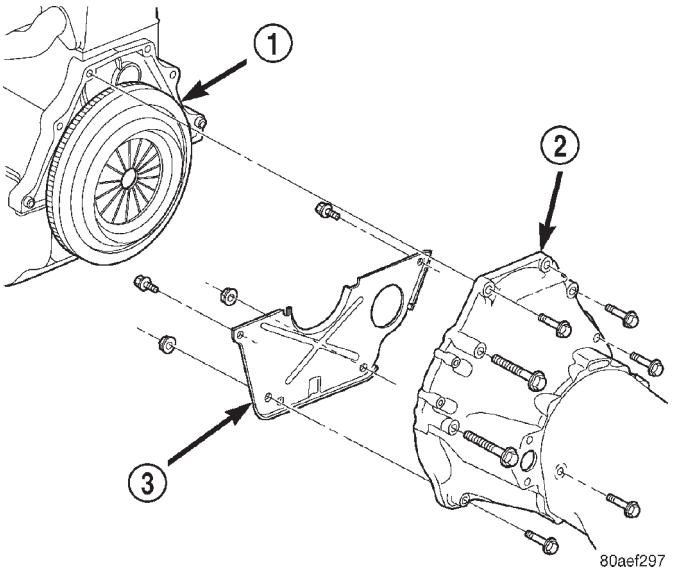


Fig. 46 Manual Transmission to Engine—2.5L

1 – FLYWHEEL/CLUTCH
2 – CLUTCH HOUSING
3 – COVER

(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.

Manual Transmission models: (Fig. 46)

(3) Lower engine into compartment.

(4) Insert the transmission shaft into the clutch spline.

(5) Align the flywheel housing with the engine.

(6) Install and tighten the flywheel housing bolts to 38 N·m (28 ft. lbs.).

Proceed to Step 10

Automatic Transmission models: (Fig. 45)

(7) Align converter housing with engine.

(8) Install and tighten the converter housing bolts to 38 N·m (28 ft. lbs.).

(9) Install and tighten the torque converter to flexplate bolts to 68 N·m (50 ft. lbs.).

(10) Remove the floorjack or support stand from beneath the flywheel/converter housing.

(11) Lower the engine and engine support cushions onto the engine compartment brackets. Ensure that the bolt holes are aligned. Install the thru-bolts and nuts and tighten to 81 N·m (60 ft. lbs.).

(12) Remove the engine lifting device.

(13) Raise the vehicle.

(14) Install inspection cover and tighten bolts/nuts to 16 N·m (138 in. lbs.)

(15) Attach the exhaust pipe to the manifold. Install and tighten the nuts to 31 N·m (23 ft. lbs.) torque.

(16) Install the starter motor and bolts. Tighten the bolts to 45 N·m (33 ft. lbs.).

(17) Install the oil filter.

(18) Lower the vehicle.

(19) If equipped with power steering:

(a) Remove the protective caps

(b) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.

(c) Fill the pump reservoir with fluid.

(20) Inspect the fuel supply line o-rings and replace if necessary. Install fuel supply line to fuel rail. Push until a “click” is heard. Verify the connection by pulling outward on line. Install latch clip.

(21) Attach fuel supply line bracket to intake manifold.

(22) Connect the brake booster, hvac, canister purge, and CCV vacuum hoses to the intake manifold.

(23) Connect the following electrical connectors:

- Power steering pressure switch (if equipped)
- Coolant temperature sensor at the thermostat housing
- Four (4) fuel injector connectors
- Intake air temperature sensor
- Idle air control motor
- Throttle position sensor
- MAP sensor
- Crankshaft position sensor
- Oxygen sensor

(24) Install the engine ground strap.

(25) Connect heater hoses to thermostat housing and water pump inlet tube.

(26) Connect accelerator cable, transmission line pressure cable (if equipped), and speed control cable (if equipped) to bracket and throttle body.

(27) Install the fan shroud and radiator. Tighten fan shroud and radiator fasteners to 8 N·m (75 in. lbs.).

(28) Connect transmission cooler lines (if equipped). Tighten fittings to 15 N·m (135 in. lbs.).

(29) Install the viscous fan/drive assembly. Tighten nuts to 27 N·m (20 ft. lbs.)

(30) Install and tension the accessory drive belt. Refer to Group 7, Cooling System for correct procedure/specifications.

(31) Install the radiator hoses.

(32) Connect the following electrical connectors:

- Ignition coil
- Distributor
- Starter motor
- A/C compressor clutch (if equipped)
- A/C Hi-pressure switch (if equipped)
- Generator
- Oil pressure sender
- Harness ground at dipstick tube bracket

REMOVAL AND INSTALLATION (Continued)

(33) Remove the coolant temperature sending unit to permit air to escape from the block. Fill the cooling system with coolant. Install the coolant temperature sending unit when the system is filled.

(34) Connect A/C suction/discharge hose and recharge A/C system. Refer to Group 24, Heating and Air Conditioning for correct procedures.

(35) Install air cleaner resonator and duct work.

(36) Lower the hood and secure in place.

(37) Start the engine and inspect for leaks.

(38) Stop the engine and check all fluid levels. Add fluid, as required.

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 the intake manifold. (Refer to procedure in this section).

(6) Remove fasteners 2 through 5 and remove the intake manifold (Fig. 47).

(7) Remove fasteners 1, 6 and 7 and remove the engine exhaust manifold (Fig. 47).

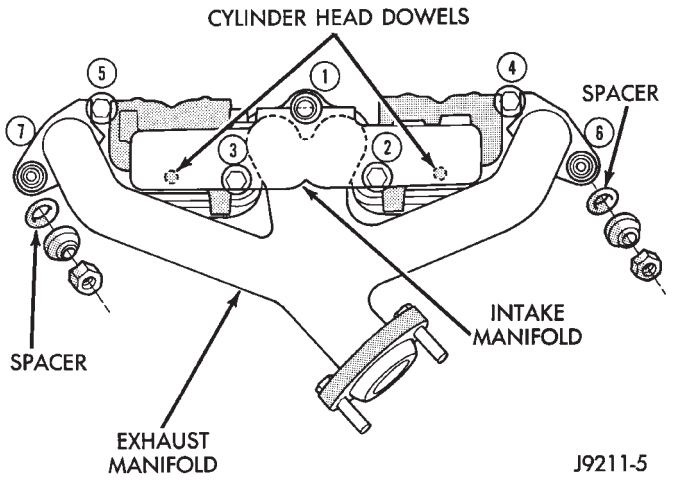


Fig. 47 Intake/Engine Exhaust Manifold Installation—2.5L Engine

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. 47).**

(4) Tighten bolt No. 1 to 41 N·m (30 ft. lbs.) torque (Fig. 47).

(5) Install the intake manifold on the cylinder head dowels (Fig. 47).

(6) Install bolts 2 through 5 (Fig. 47). 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. 47).

(8) Tighten nuts 6 and 7 to 14 N·m (126 in. lbs.) torque (Fig. 47).

(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.

INTAKE MANIFOLD—2.5L ENGINE

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove the air inlet hose and resonator from the throttle body and air cleaner housing (Fig. 48).

(3) Loosen the accessory drive belt tension and remove the belt from the power steering pump. (Refer to Group 7, Cooling for correct procedure).

(4) Remove the power steering pump and brackets from the water pump and intake manifold. Support power steering pump and bracket with mechanics wire attached to the radiator upper crossmember.

(5) Perform the fuel pressure release procedure. (Refer to Group 14, Fuel System for correct procedure)

(6) Disconnect fuel supply tube from the fuel rail. (Refer to Group 14, Fuel System - Quick Connect Fittings)

(7) Disconnect the accelerator cable from the throttle body and cable bracket.

(8) Disconnect the speed control and transmission line pressure cable from the throttle body and cable bracket (if equipped).

CAUTION: When disconnecting the speed control connector at the throttle body, DO NOT pry the connector off with pliers or screwdriver. Use finger pressure only. Prying the connector off could break it.

(9) Disconnect the electrical connectors. Pull the harnesses away from the manifold.

- The throttle position sensor.
- The idle air control motor.
- The coolant temperature sensor at the thermostat housing.

REMOVAL AND INSTALLATION (Continued)

- The manifold air temperature sensor at the intake manifold.
- The fuel injectors.
- The oxygen sensor.

(10) Disconnect the crankcase ventilation (CCV) vacuum hose and manifold absolute pressure (MAP) sensor vacuum hose connector at the intake manifold.

(11) Disconnect HVAC supply vacuum hose from intake manifold.

(12) Disconnect CCV hose at the cylinder head cover (Fig. 48).

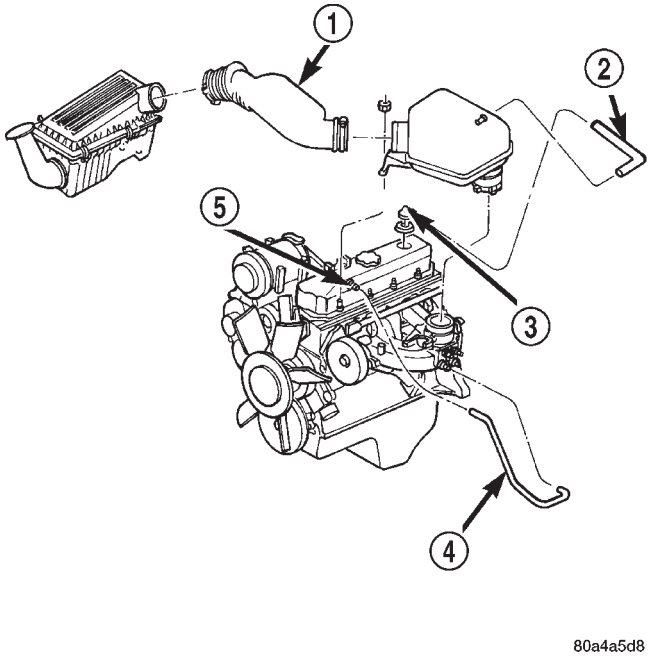


Fig. 48 Air Inlet/CCV System—2.5L Engine

1 – AIR TUBE
2 – CCV TUBE
3 – AIR INLET FITTING
4 – CCV TUBE
5 – FIXED ORIFICE FITTING

(13) Remove the molded vacuum harness.

(14) Disconnect the vacuum brake booster hose at the intake manifold.

(15) Remove bolts 2 through 5 securing the intake manifold to the cylinder head (Fig. 49). LOOSEN BUT DO NOT REMOVE exhaust manifold bolt No. 1 and nuts 6 and 7.

(16) Remove the intake manifold and gaskets. Drain the coolant from the manifold.

INSTALLATION

(1) Clean the intake manifold and cylinder head mating surfaces. **DO NOT allow foreign material to enter either the intake manifold or the ports in the cylinder head.**

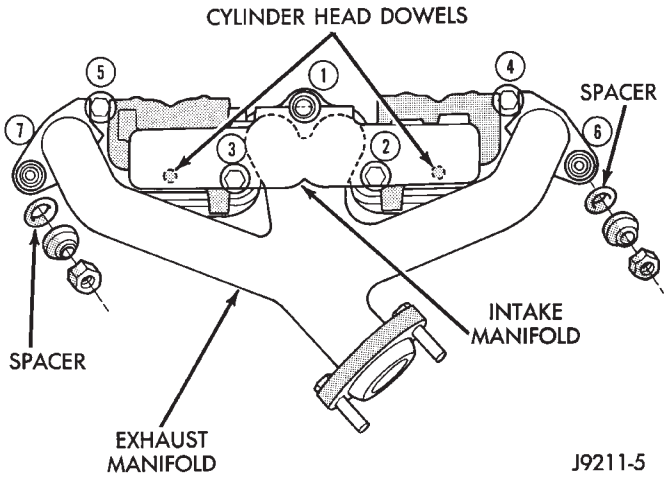


Fig. 49 Intake/Exhaust Manifold—2.5L Engine

(2) Install the new intake manifold gasket over the locating dowels.

(3) Position the manifold in place and finger tighten the mounting bolts.

(4) Tighten the fasteners in sequence and to the specified torque (Fig. 49).

- Fastener No. 1—Tighten to 41 N·m (30 ft. lbs.) torque.
- Fasteners Nos. 2 through 5—Tighten to 31 N·m (23 ft. lbs.) torque.
- Fasteners Nos. 6 and 7—Tighten to 23 N·m (17 ft. lbs.) torque.

(5) **Before connecting the fuel line to the fuel rail inspect the fuel line O-rings and replace them if necessary.** Connect the fuel supply tube to the fuel rail inlet. Push tube until a click is heard.

(6) Pull out on fuel supply line to verify that it is properly connected. Install latch clip.

(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 manifold air temperature sensor at the intake manifold.
- The fuel injectors.
- The oxygen sensor.

(9) Connect the brake booster vacuum supply hose.

(10) Connect the CCV hose and MAP sensor vacuum hose connectors to the throttle body.

(11) Install the power steering pump and bracket assembly to the water pump and intake manifold. Torque power steering pump bolts to 28 N·m (21 ft. lbs.). Torque bracket to water pump bolts to 47 N·m (35 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

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.

(12) Install and tension the accessory drive belt. (Refer to Group 7, Cooling System for the correct procedure)

(13) Connect the accelerator cable to the bracket and the throttle lever.

(14) Connect the speed control and transmission line pressure cable (if equipped) to the bracket and throttle lever.

(15) Install the air inlet hose and resonator to the throttle body and the air cleaner.

(16) Connect the battery negative cable.

(17) 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. 50).

(3) Remove the air inlet hose and resonator from the air cleaner and throttle body.

(4) Remove the engine cylinder head cover mounting bolts.

(5) Remove the engine cylinder head cover (Fig. 50).

(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.

(2) If a replacement cover is installed, transfer the CCV valve grommet the oil filler cap from the original cover to the replacement cover.

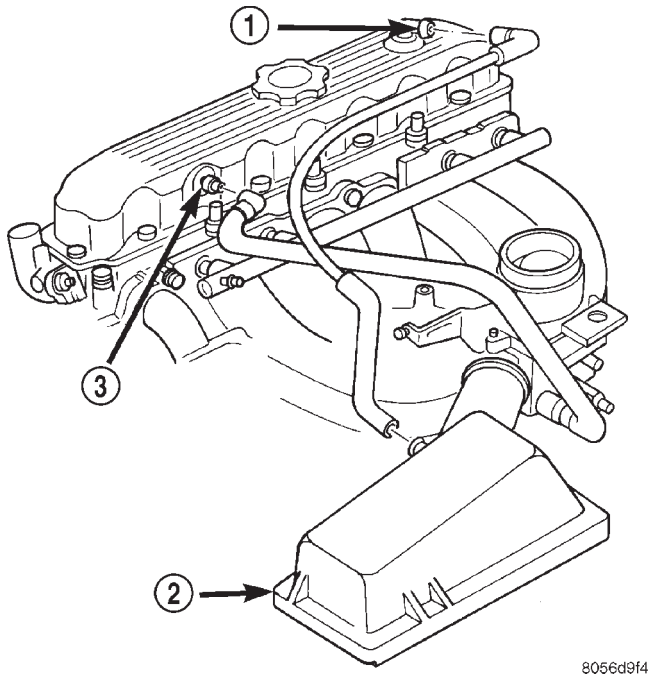


Fig. 50 Engine Cylinder Head Cover

1 – AIR INLET FITTING
2 – AIR FILTER COVER
3 – FIXED ORIFICE FITTING

(3) Install engine cylinder head cover. Tighten the mounting bolts to 13 N·m (115 in. lbs.) torque.

(4) Connect the CCV hoses (Fig. 50).

(5) Connect negative cable to battery.

(6) Install the air inlet hose and resonator.

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. 51). 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. 51). 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.

(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.

REMOVAL AND INSTALLATION (Continued)

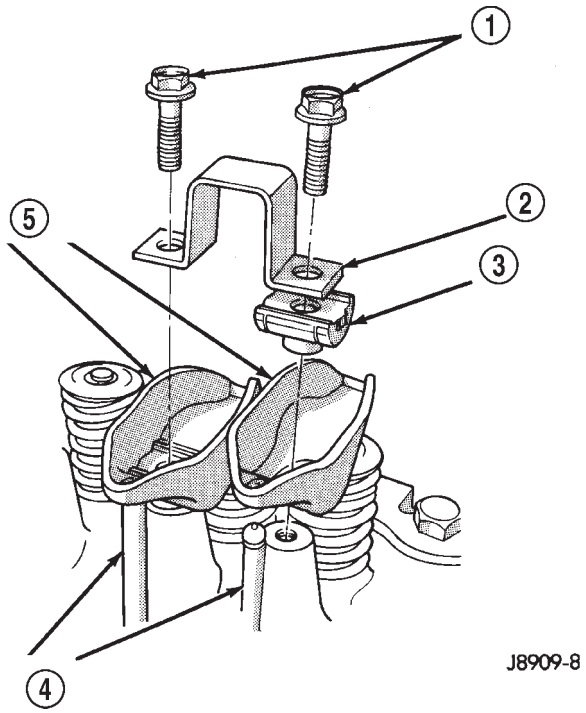


Fig. 51 Rocker Arm Assembly

1 – CAPSCREWS
2 – BRIDGE
3 – PIVOT ASSEMBLY
4 – PUSH RODS
5 – ROCKER ARMS

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 SPRING AND SEAL

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. 52).

(9) Remove valve spring and retainer (Fig. 52).

(10) Remove valve stem oil seals (Fig. 52). 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.

INSTALLATION

Inspect the valve stems, especially the grooves. An Arkansas smooth stone should be used to remove nicks and high spots.

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.

REMOVAL AND INSTALLATION (Continued)

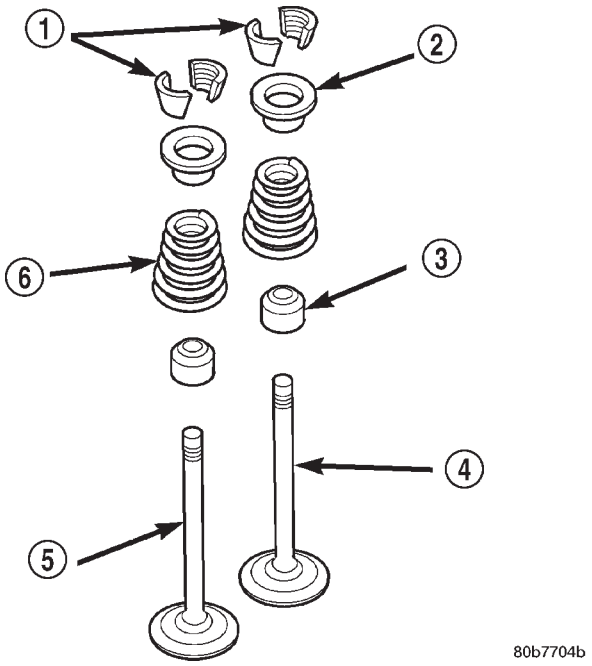


Fig. 52 Valve and Valve Components

1 – VALVE LOCKS (3–BEAD)
2 – RETAINER
3 – VALVE STEM OIL SEAL
4 – INTAKE VALVE
5 – EXHAUST VALVE
6 – VALVE SPRING

(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. 53).

(6) Remove the push rods (Fig. 53). **Retain the push rods, bridges, pivots and rocker arms in the same order as removed.**

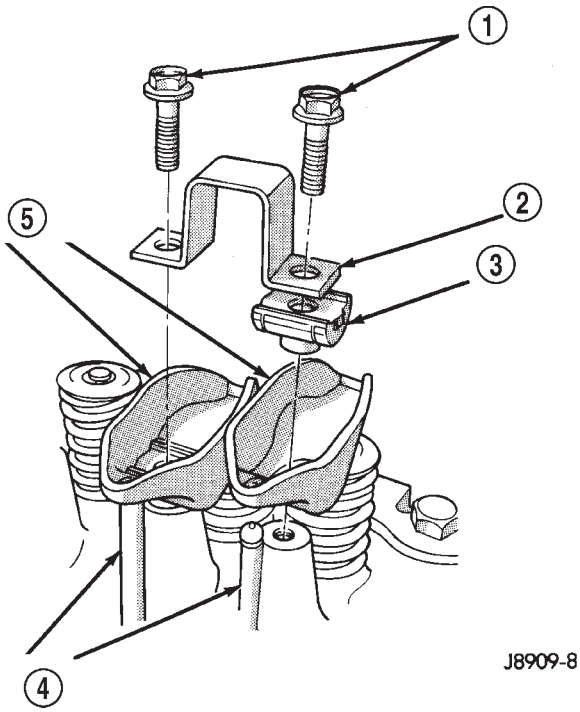


Fig. 53 Rocker Arm Assembly

1 – CAPSCREWS
2 – BRIDGE
3 – PIVOT ASSEMBLY
4 – PUSH RODS
5 – ROCKER ARMS

(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).

(8) If equipped with air conditioning, perform the following:

(a) Remove the bolts from the A/C compressor mounting bracket and set the compressor aside.

(b) Remove the air conditioner compressor bracket bolts from the engine cylinder head.

(c) Loosen the through bolt at the bottom of the bracket.

(9) If equipped, disconnect the power steering pump bracket. Set the pump and bracket aside. DO NOT disconnect the hoses.

REMOVAL AND INSTALLATION (Continued)

(10) 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. 54).

(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.

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 inspection procedures.

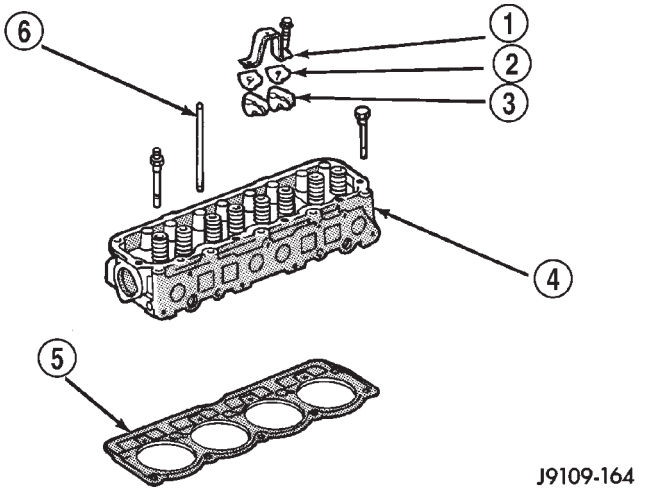


Fig. 54 Engine Cylinder Head Assembly

1 – BRIDGE
2 – PIVOT ASM.
3 – ROCKER ARM
4 – CYLINDER HEAD
5 – HEAD GASKET
6 – PUSH ROD

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. 55). 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.

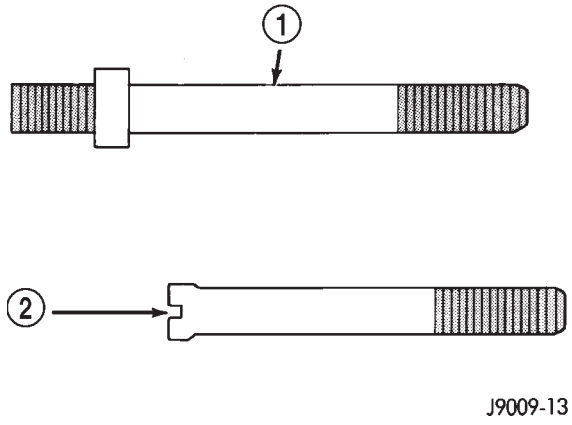


Fig. 55 Fabricate Alignment Dowels

1 – USED CYLINDER HEAD BOLT
2 – SLOT

(2) Install one dowel in bolt hole No.10 and the other dowel in bolt hole No.8 (Fig. 56).

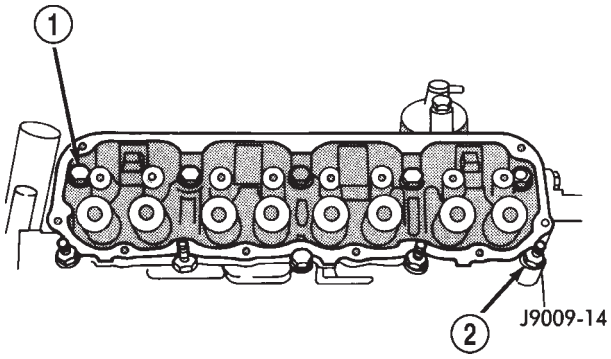


Fig. 56 Alignment Dowel Locations

1 – ALIGNMENT DOWEL
2 – ALIGNMENT DOWEL

(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.

REMOVAL AND INSTALLATION (Continued)

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. 57) :

(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.

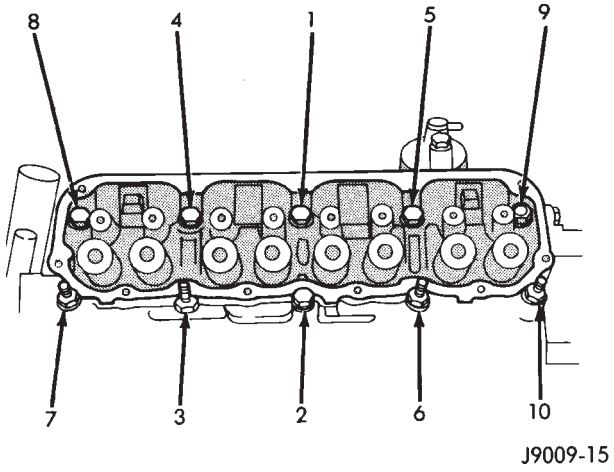


Fig. 57 Engine cylinder head Bolt Tightening Sequence

(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 assembly.
(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.

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

REMOVAL AND INSTALLATION (Continued)

bridge. Alternately loosen each capscrew, one turn at a time, to avoid damaging the bridges.

(3) Remove the push rods.

(4) Remove the tappets through the push rod openings in the cylinder head with a Hydraulic Valve Tappet Removal/Installation Tool (Fig. 58).

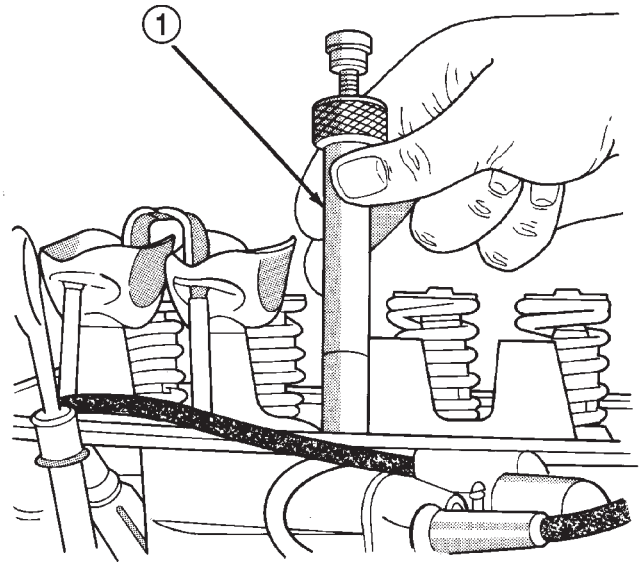


Fig. 58 Hydraulic Valve Tappet Removal/Installation Tool

1 – 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. 59).

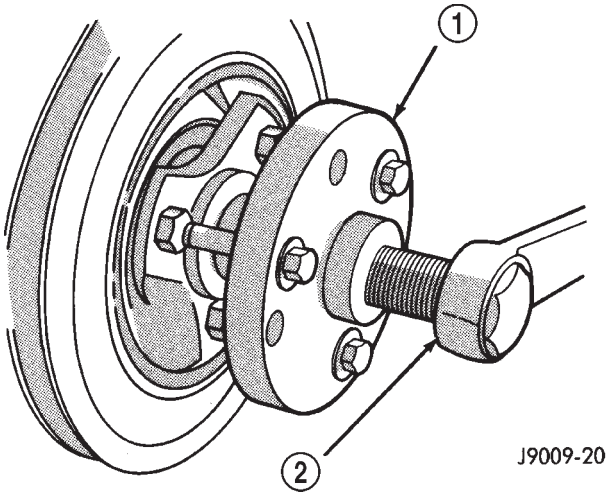


Fig. 59 Vibration Damper Removal Tool 7697

1 – VIBRATION DAMPER REMOVAL TOOL
2 – WRENCH

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.

REMOVAL AND INSTALLATION (Continued)

(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.

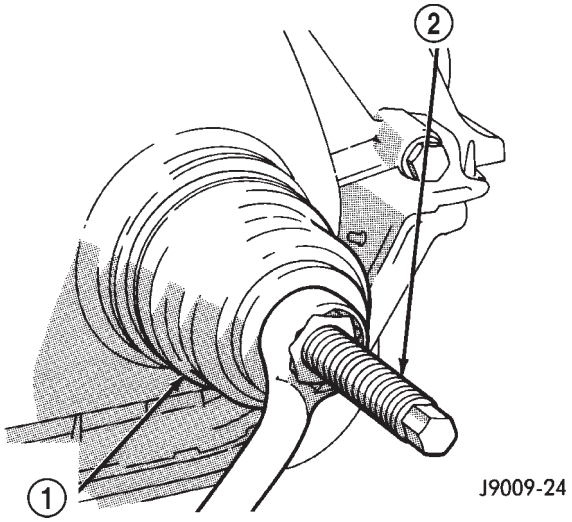


Fig. 60 Timing Case Cover Oil Seal Installation

1 – SEAL INSTALLATION TOOL
2 – DRAW SCREW TOOL

(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. 61).

(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. 61).

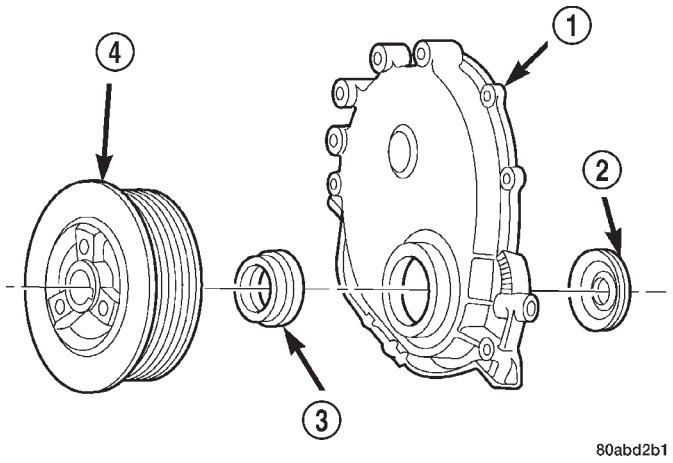


Fig. 61 Timing Case Cover Components

1 – TIMING CASE COVER
2 – OIL SLINGER
3 – CRANKSHAFT OIL SEAL
4 – VIBRATION DAMPER PULLEY

INSTALLATION

(1) Clean the timing case cover, oil pan and cylinder block gasket surfaces.

(2) Install a new crankshaft oil seal in the timing case cover. The open end of the seal should be toward the inside of the cover. Support the cover at the seal area while installing the seal. Force it into position with Seal Installation Tool 6139.

(3) Position the gasket on the cylinder block.

(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. 62).

(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.

(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.

REMOVAL AND INSTALLATION (Continued)

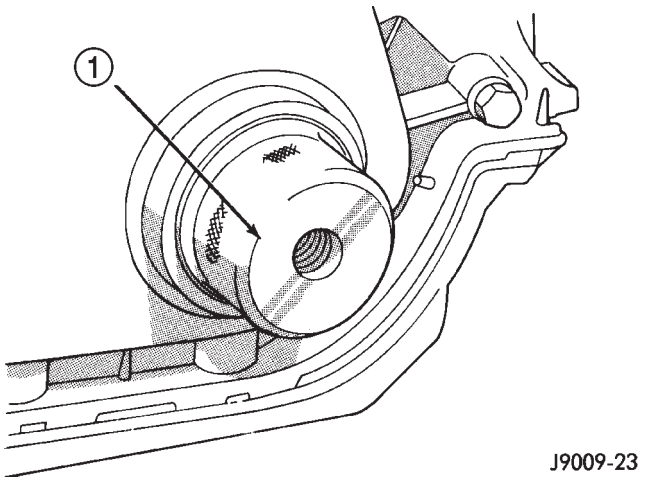


Fig. 62 Timing Case Cover Alignment and Seal Installation Tool 6139

1 – TIMING CASE COVER ALIGNMENT AND SEAL INSTALLATION TOOL

(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 chain drive system is equipped with a timing chain tensioner which reduces noise and prolongs timing chain life. In addition, it compensates for wear and temperature changes on the valve train for proper engine operation.

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. 63).

(7) Remove the oil slinger from the crankshaft.

(8) Remove the camshaft retaining bolt and remove the sprockets and chain as an assembly (Fig. 64).

(9) To replace the timing chain tensioner, the oil pan must be removed.

INSTALLATION

(1) Turn the tensioner lever to the unlocked (down) position (Fig. 65).

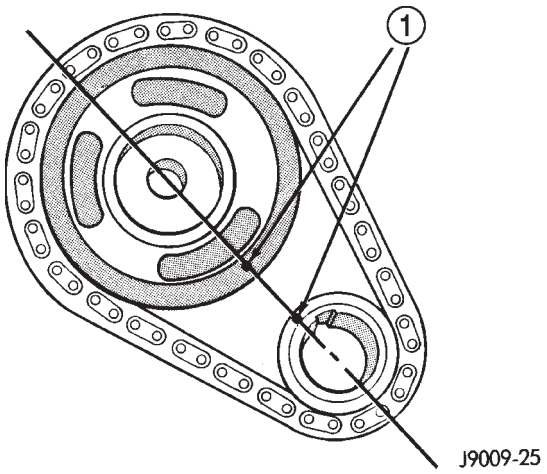


Fig. 63 Crankshaft—Camshaft Alignment

1 – TIMING MARKS

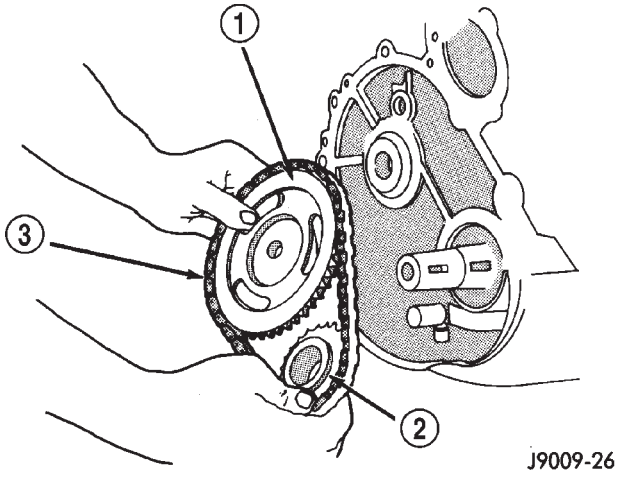


Fig. 64 Camshaft and Crankshaft Sprockets and Chain

1 – CAMSHAFT SPROCKET
2 – CRANKSHAFT SPROCKET
3 – CHAIN

(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. 65).

(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. 63).

(4) Install the camshaft sprocket retaining bolt and washer. Tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(5) Turn the chain tensioner lever to the unlocked (down) position (Fig. 65).

(6) Install the oil slinger.

(7) Replace the oil seal in the timing case cover.

REMOVAL AND INSTALLATION (Continued)

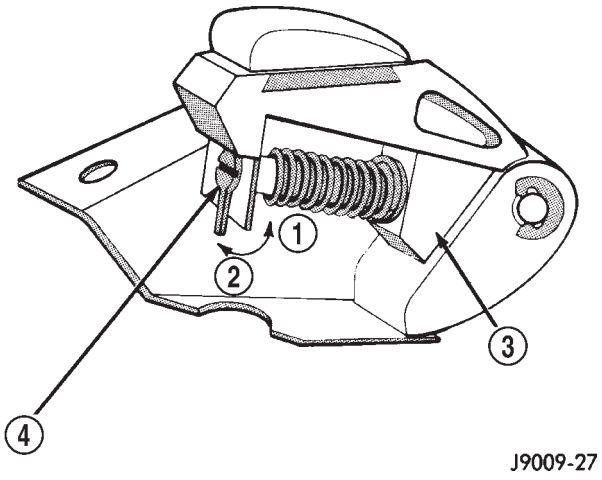


Fig. 65 Loading Timing Chain Tensioner

1 – LOCK
2 – UNLOCK
3 – TENSIONER BLOCK
4 – TENSIONER LEVER

(8) Install the timing case cover and gasket.
(9) With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.
(10) Install the fan and shroud.
(11) Connect negative cable to battery.

CAMSHAFT

REMOVAL

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. RELEASE THE PRESSURE BEFORE REMOVING THE DRAIN COCK, CAP AND DRAIN PLUGS.

(1) Disconnect negative cable from battery.
(2) Drain the cooling system. DO NOT waste reusable coolant. If the solution is clean, drain it into a clean container for reuse.
(3) Remove the radiator or radiator and condenser, if equipped with A/C.
(4) Scribe a mark on the distributor housing in line with the lip of the rotor.
(5) Scribe a mark on the distributor housing near the clamp and continue the scribe mark on the cylinder block in line with the distributor mark.
(6) For ease of installation, note the position of the rotor and distributor housing in relation to adjacent engine components.
(7) Remove the distributor and ignition wires.
(8) Remove the engine cylinder head cover.
(9) Remove the rocker arms, bridges and pivots.
(10) Remove the push rods.
(11) Remove the hydraulic valve tappets from the engine cylinder head.
(12) Remove the vibration damper.
(13) Remove the timing case cover.
(14) Remove the timing chain and sprockets.
(15) Remove the camshaft (Fig. 66).

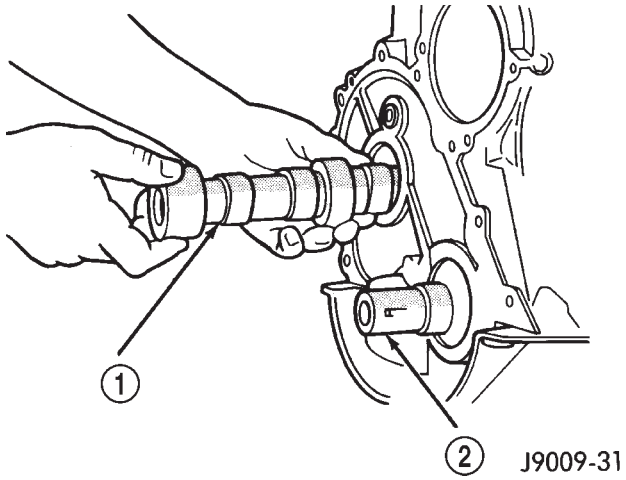


Fig. 66 Camshaft

1 – CAMSHAFT
2 – CRANKSHAFT

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. 66).
(8) Turn the tensioner lever to the unlocked (down) position (Fig. 67).
(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. 67).
(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.
(12) Release the timing chain tensioner by moving the lever to the unlock position (Fig. 67).
(13) Install the timing case cover with a replacement oil seal (Fig. 68). Refer to Timing Case Cover Installation.

REMOVAL AND INSTALLATION (Continued)

(14) Install the vibration damper.

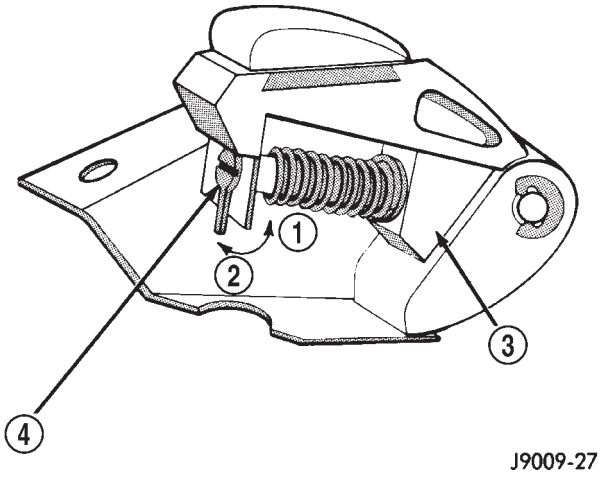


Fig. 67 Loading Timing Chain Tensioner

1 – LOCK
2 – UNLOCK
3 – TENSIONER BLOCK
4 – TENSIONER LEVER

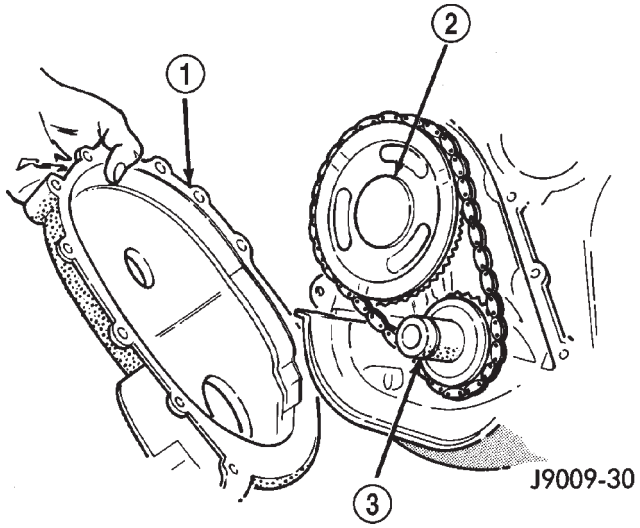


Fig. 68 Timing Case Cover

1 – TIMING CASE COVER
2 – CAMSHAFT
3 – CRANKSHAFT

(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) Remove the accessory drive belt.
(5) Disconnect the radiator overflow tube, radiator hoses, automatic transmission fluid cooler pipes (if equipped).
(6) Remove the radiator.

CAUTION: DO NOT loosen or disconnect any air conditioner system fittings. Move the condenser and receiver/drier aside as a complete assembly.

(7) If equipped with air conditioning, Remove the A/C condenser attaching bolts and move the condenser and receiver/drier assembly up and out of the way.
(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. 69).
(11) Remove camshaft sprocket retaining bolt.
(12) Remove the crankshaft oil slinger.
(13) Remove the sprockets and chain as an assembly (Fig. 70).

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.

REMOVAL AND INSTALLATION (Continued)

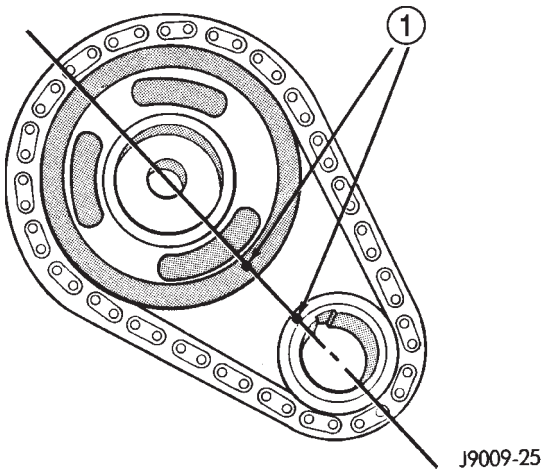


Fig. 69 Timing Chain Alignment

1 – TIMING MARKS

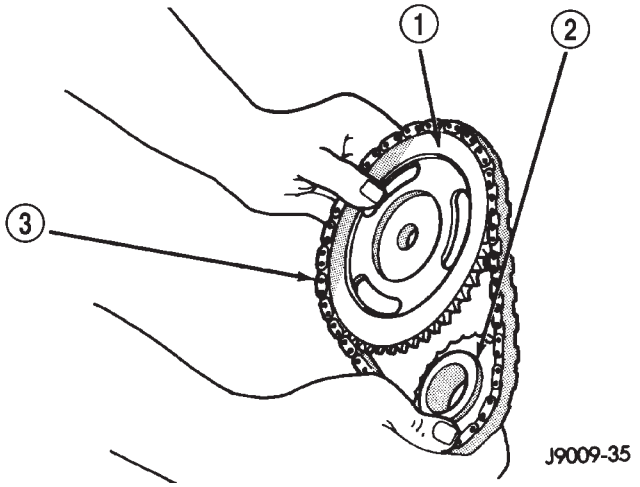


Fig. 70 Camshaft and Crankshaft Sprocket and Chain

1 – CAMSHAFT SPROCKET
2 – CRANKSHAFT SPROCKET
3 – CHAIN

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. 69).

(5) Install the crankshaft oil slinger.

(6) Tighten the camshaft sprocket bolt to 108 N·m (80 ft. lbs.) torque.

(7) Check the valve timing.

(8) Coat both sides of the replacement timing case cover gasket with gasket sealer. Apply a 3 mm (1/8 inch) bead of Mopar Silicone Rubber Adhesive Sealant, or equivalent to the joint formed at the timing case cover and cylinder block.

(9) Position the timing case cover on the oil pan gasket and the cylinder block.

(10) Place Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening of the cover (Fig. 71).

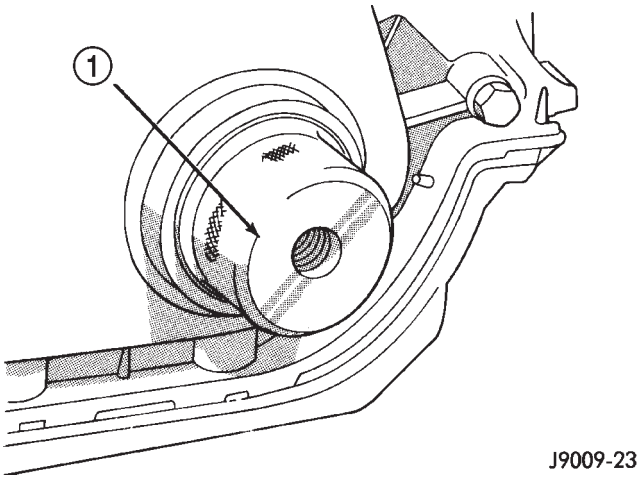


Fig. 71 Timing Case Cover Alignment and Seal Installation Tool 6139

1 – TIMING CASE COVER ALIGNMENT AND SEAL INSTALLATION TOOL

(11) Install the timing case cover-to-cylinder block bolts. Install the oil pan-to-timing case cover bolts.

(12) Tighten the 1/4 inch cover-to-block bolts to 7 N·m (60 in. lbs.) torque. Tighten the 5/16 inch front cover-to-block bolts to 22 N·m (192 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 14 N·m (120 in. lbs.) torque. Tighten the oil pan-to-cover 5/16 inch bolts to 18 N·m (156 in. lbs.) torque.

(13) Remove the cover alignment tool and install a replacement oil seal into the cover.

(14) Install the vibration damper on the crankshaft.

(15) Lubricate and tighten the damper bolt to 108 N·m (80 ft. lbs.) torque.

(16) If equipped with air conditioning, install the A/C condenser and receiver/drier assembly.

REMOVAL AND INSTALLATION (Continued)

(17) Install the accessroy drive belt on the pulleys and tighten (refer to Group 7, Cooling System for the specifications and procedures).

(18) Install the radiator. Connect the radiator hoses and automatic transmission fluid cooler pipes, if equipped. Fill the cooling system.

(19) Install the fan and shroud.

(20) Connect negative cable to battery.

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, such as recommended tool 8544 Camshaft Bushing Remover Installer.

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. 72).

(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. 73). 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. 73). 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.

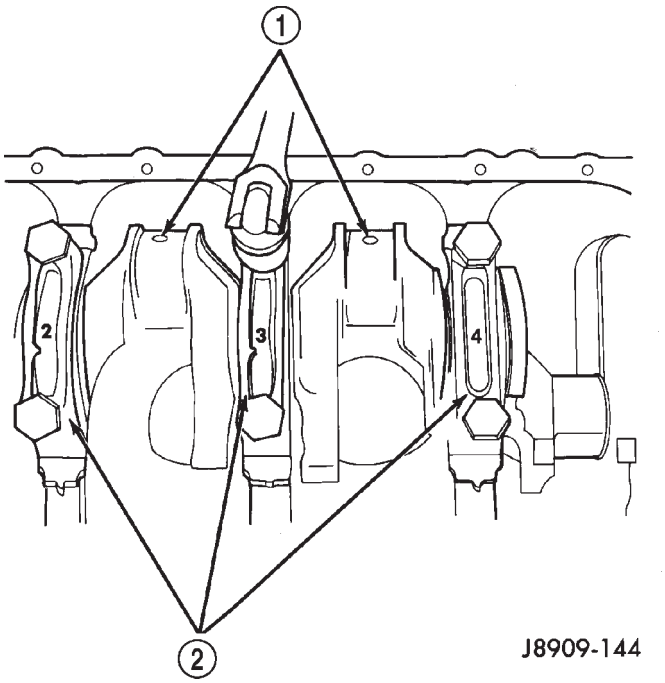


Fig. 72 Removing Main Bearing Caps and Lower Inserts

1 – CONNECTING ROD JOURNAL
2 – MAIN BEARING CAPS

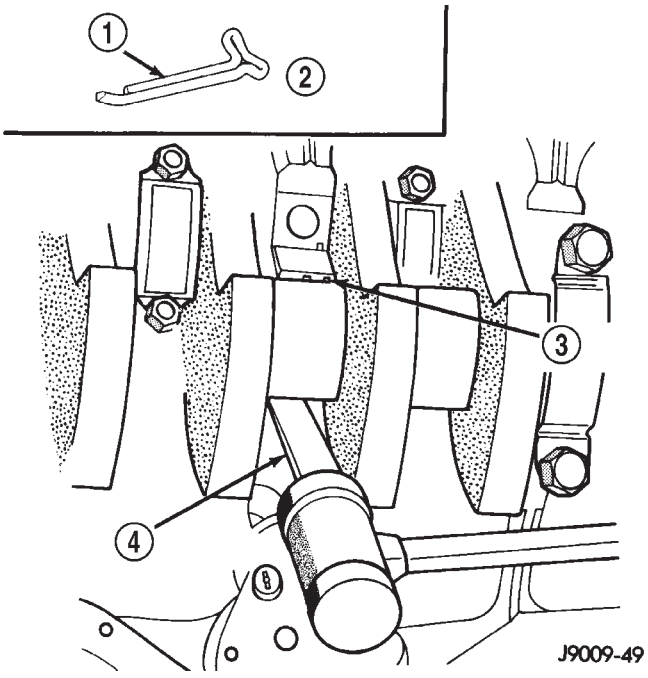


Fig. 73 Removing Upper Inserts

1 – COTTER PIN
2 – FABRICATED TOOL
3 – BEARING INSERT
4 – TONGUE DEPRESSOR

REMOVAL AND INSTALLATION (Continued)

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. 74). The bead should be 3 mm (0.125 in) thick. DO NOT apply Mopar® Gasket Maker, or equivalent to the lip of the seal.

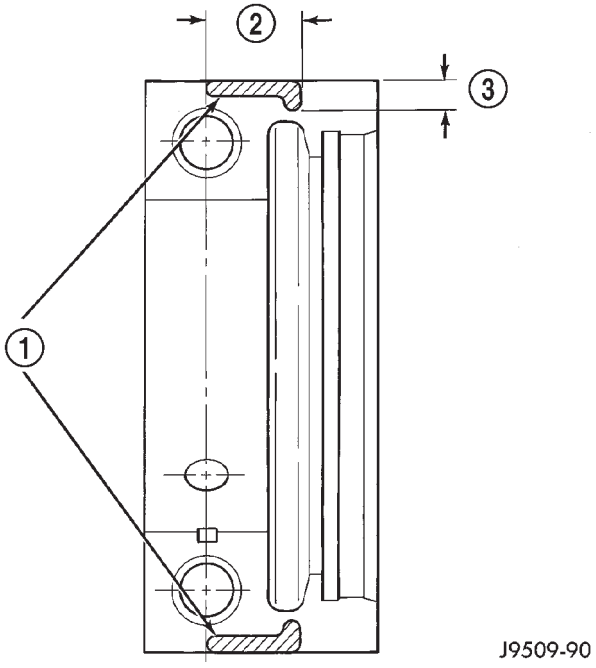


Fig. 74 Location of Mopar® Gasket Maker

1 – MOPAR® GASKET MAKER (OR EQUIVALENT)
2 – 19 mm (.75 IN)
3 – 6 mm (0.025 IN)

(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. 75). 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.

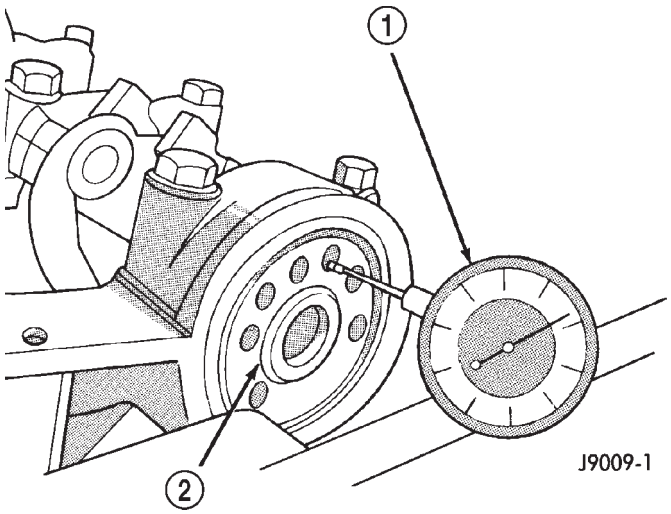


Fig. 75 Crankshaft End Play Measurement

1 – DIAL INDICATOR
2 – 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.

REMOVAL AND INSTALLATION (Continued)

(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.

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

(3) Remove the oil pan drain plug and drain the engine oil.

(4) Remove the engine starter motor.

(5) Remove the flywheel/torque converter housing access cover.

(6) Position a jack stand directly under the engine vibration damper.

(7) Place a piece of wood (2 x 2) between the jack stand and the engine vibration damper.

(8) Remove the engine mount through bolts.

(9) Using the jack stand, raise the engine until adequate clearance is obtained to remove the oil pan.

(10) Remove transmission oil cooling lines (if equipped) and oxygen sensor wiring supports that are attached to the oil pan studs.

(11) Remove the oil pan fasteners. 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. 76).

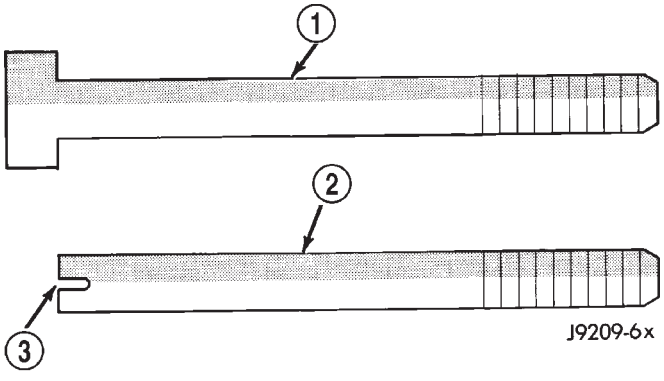


Fig. 76 Fabrication of Alignment Dowels

1 – 1/4'' × 1 1/2'' BOLT
2 – DOWEL
3 – SLOT

(3) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 77).

(4) Apply Mopar® Silicone Rubber Adhesive Sealant on cylinder block to rear main bearing cap corners and cylinder block to front cover joints (four places).

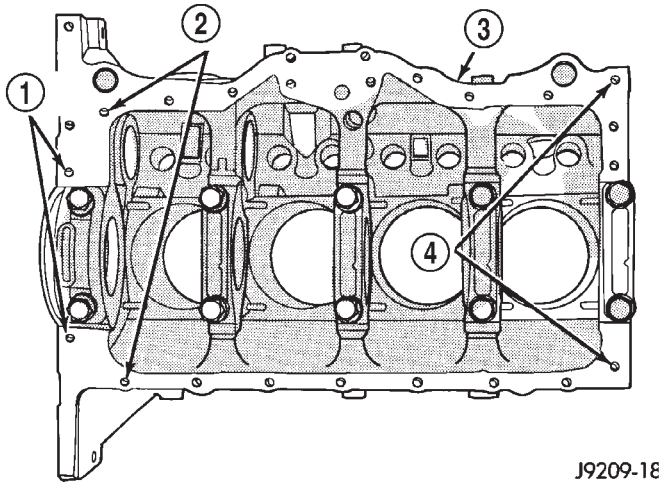


Fig. 77 Position of Dowels in Cylinder Block

1 – 5/16'' HOLES
2 – DOWEL HOLES
3 – CYLINDER BLOCK
4 – 5/16'' HOLES

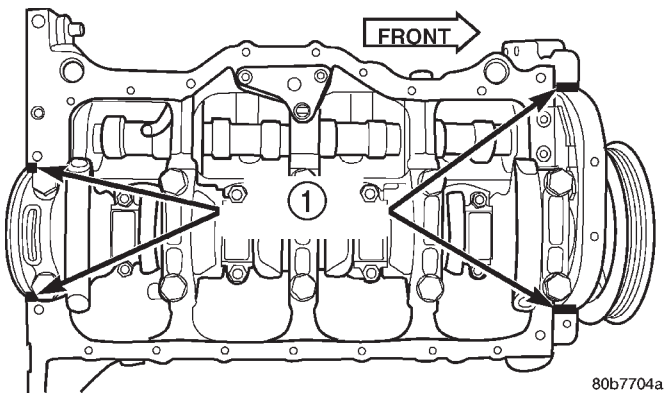


Fig. 78 Oil Pan Sealer Locations

1 – SEALER LOCATIONS

(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 fasteners. Tighten these fasteners to 9.5 N·m (84 in. lbs.) torque. Install the 5/16 inch oil pan fasteners (Fig. 79). Tighten these fasteners to 15 N·m (132 in. lbs.) torque.

(8) Remove the dowels. Install the remaining 1/4 inch oil pan fasteners and tighten to 9.5 N·m (84 in. lbs.).

(9) Lower the engine until it is properly located on the engine mounts.

REMOVAL AND INSTALLATION (Continued)

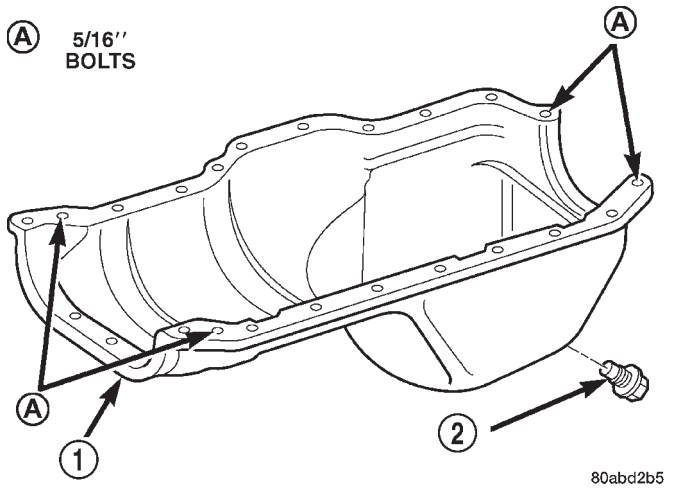


Fig. 79 Position of 5/16 inch Oil Pan Bolts

1 – OIL PAN
2 – OIL PAN DRAIN PLUG

(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 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. 79). 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.

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. 80).

CAUTION: If the oil pump is not to be serviced, DO NOT disturb position of oil inlet tube and strainer assembly in pump body. If the tube is moved within the pump body, a replacement tube and strainer assembly must be installed to assure an airtight seal.

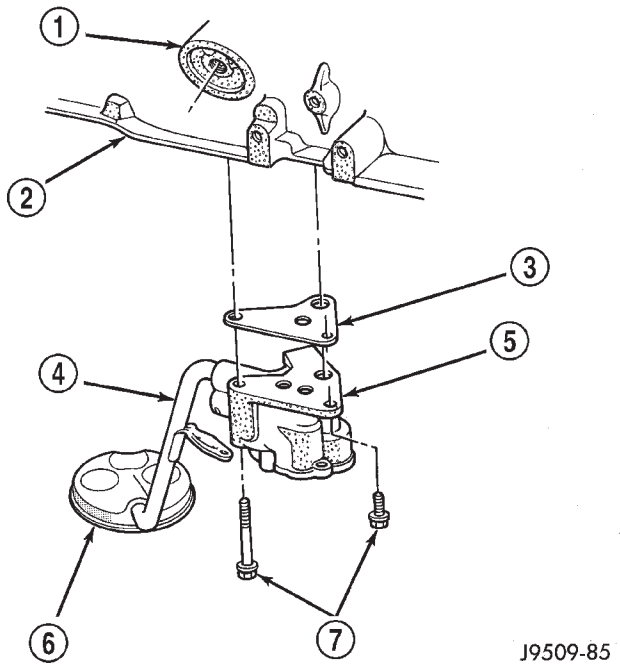


Fig. 80 Oil Pump Assembly

1 – OIL FILTER ADAPTOR
2 – BLOCK
3 – GASKET
4 – OIL INLET TUBE
5 – OIL PUMP
6 – STRAINER ASSEMBLY
7 – ATTACHING BOLTS

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.

REMOVAL AND INSTALLATION (Continued)

PISTON AND CONNECTING ROD

REMOVAL

(1) Remove the engine cylinder head cover.
(2) Remove the rocker arms, bridges and pivots.
(3) Remove the push rods.
(4) Remove the engine cylinder head.
(5) Position the pistons one at a time near the bottom of the stroke. Use a ridge reamer to remove the ridge from the top end of the cylinder walls. Use a protective cloth to collect the cuttings.
(6) Raise the vehicle.
(7) Drain the engine oil.
(8) Remove the oil pan and gasket.
(9) Remove the connecting rod bearing caps and inserts. Mark the caps and rods with the cylinder bore location. The connecting rods and caps are stamped with a two letter combination (Fig. 81).

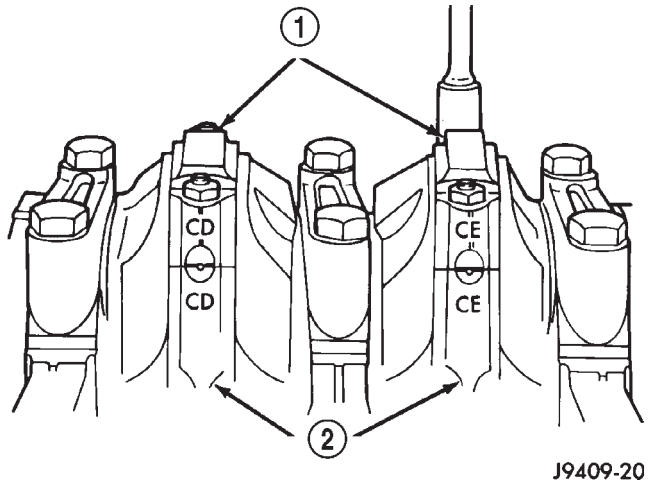


Fig. 81 Stamped Connecting Rods and Caps
1 – CONNECTING ROD CAP
2 – CONNECTING ROD

(10) Lower the vehicle until it is about 2 feet from the floor.

CAUTION: Ensure that the connecting rod bolts DO NOT scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose, slipped over the rod bolts will provide protection during removal.

(11) Have an assistant push the piston and connecting rod assemblies up and through the top of the cylinder bores (Fig. 82).

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.

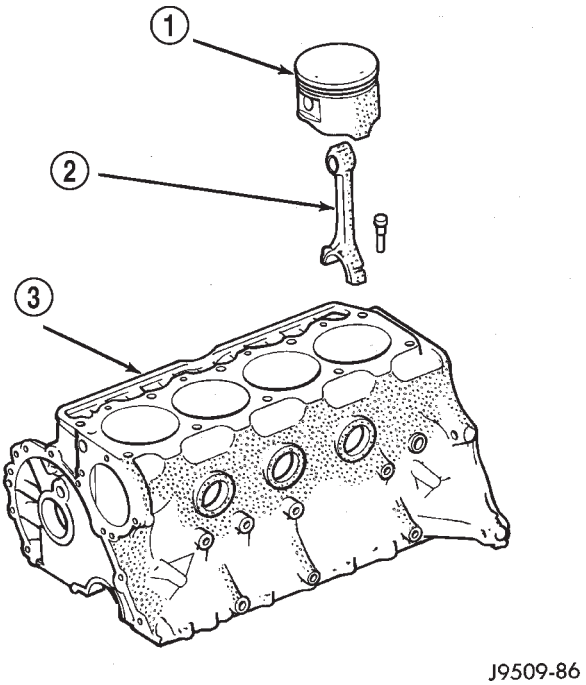


Fig. 82 Removal of Connecting Rod and Piston Assembly
1 – PISTON
2 – CONNECTING ROD
3 – CYLINDER BLOCK

(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.

(5) Use a piston ring compressor to install the connecting rod and piston assemblies through the top of the cylinder bores (Fig. 83).
(6) Ensure the arrow on the piston top points to the front of the engine (Fig. 83).
(7) Raise the vehicle.
(8) 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.
(9) 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 indi-

REMOVAL AND INSTALLATION (Continued)

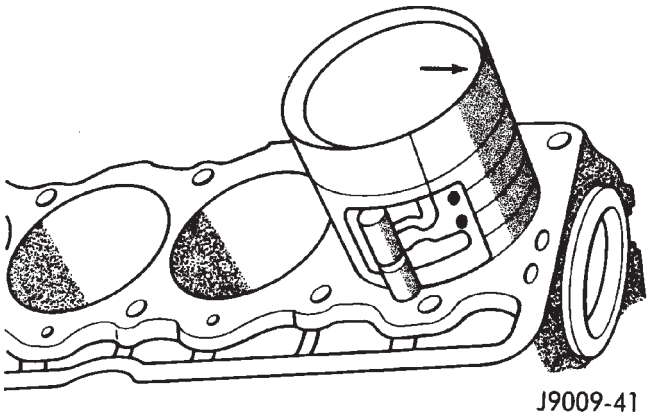


Fig. 83 Rod and Piston Assembly Installation

cate journal sizes are listed in the Connecting Rod Bearing Fitting Chart.

(10) 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.

(11) 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.

(13) Install the oil pan and gaskets as outlined in the installation procedure.

(14) Lower the vehicle.

(15) Install the engine cylinder head, push rods, rocker arms, bridges, pivots and engine cylinder head cover.

(16) Fill the crankcase with engine oil.

REAR MAIN OIL SEAL

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. 84).

INSTALLATION

(1) Wipe the seal surface area of the crankshaft until it is clean.

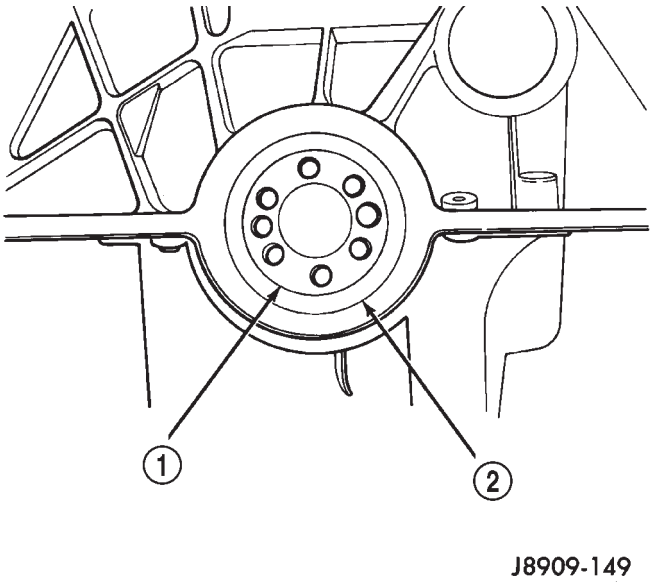


Fig. 84 Replacement of Rear Crankshaft Oil Seal

1 – CRANKSHAFT
2 – CRANKSHAFT OIL SEAL

(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

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.

DISASSEMBLY AND ASSEMBLY (Continued)

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.

VALVE, GUIDE AND SEAL

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. 85). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

VALVE SEAT REFACING

(1) Install a pilot of the correct size in the valve guide bore. Reface the valve seat to the specified angle with a good dressing stone. Remove only enough metal to provide a smooth finish.

(2) Use tapered stones to obtain the specified seat width when required.

(3) Control valve seat runout to a maximum of 0.0635 mm (0.0025 in.)— (Fig. 86).

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.

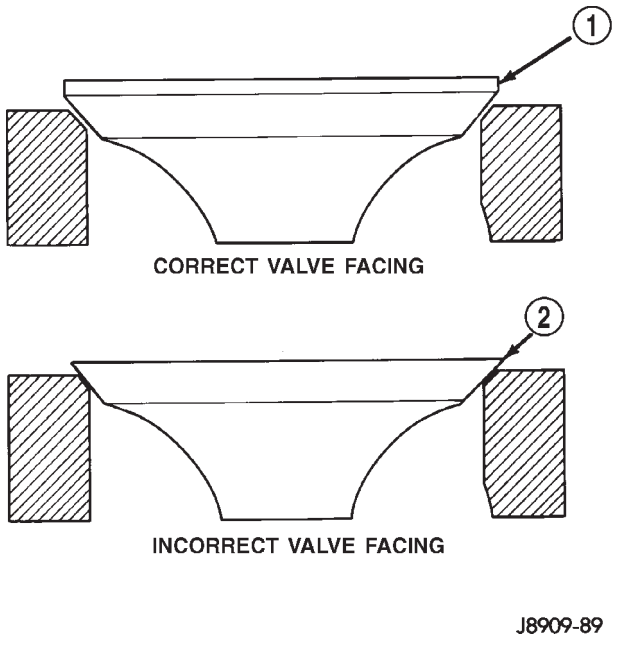


Fig. 85 Valve Facing Margin

1 – 0.787 MM (1/32 INCH) VALVE MARGIN
2 – NO MARGIN

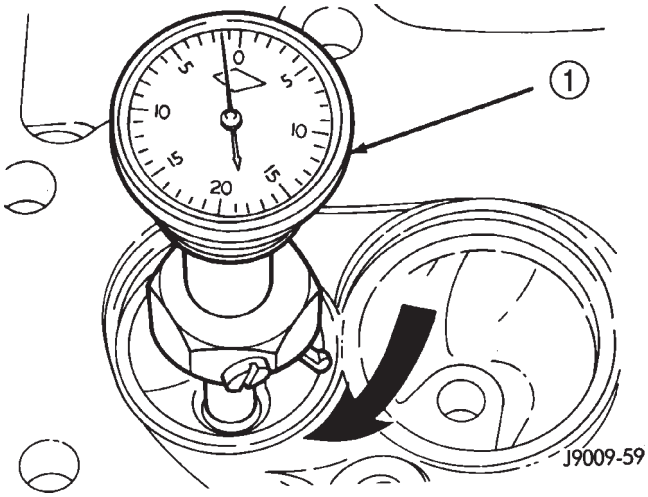


Fig. 86 Measurement of Valve Seat Runout

1 – DIAL INDICATOR

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

DISASSEMBLY AND ASSEMBLY (Continued)

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. 87).

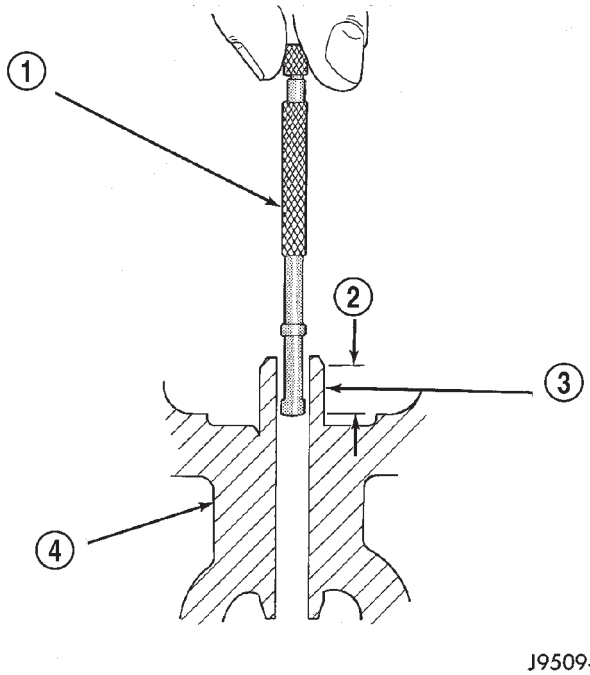


Fig. 87 Measurement of Valve Guide Bore Diameter

1 – GAUGE
2 – 9.525 MM (3/8 INCH)
3 – VALVE STEM GUIDE
4 – CYLINDER HEAD

(4) Remove and measure telescoping gauge with a micrometer.

(5) Repeat the measurement with contacts lengthwise to engine cylinder head.

(6) Compare the crosswise to lengthwise measurements to determine out-of-roundness. If the measurements differ by more than 0.0635 mm (0.0025 in.), ream the guide bore to accommodate an oversize valve stem.

(7) Compare the measured valve guide bore diameter with specifications (7.95-7.97 mm or 0.313-0.314 inch). If the measurement differs from specification by more than 0.076 mm (0.003 inch), ream the guide bore to accommodate an oversize valve stem.

ALTERNATIVE METHOD:

(1) Use a dial indicator to measure the lateral movement of the valve stem (stem-to-guide clearance). This must be done with the valve installed in its guide and just off the valve seat (Fig. 88).

(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.

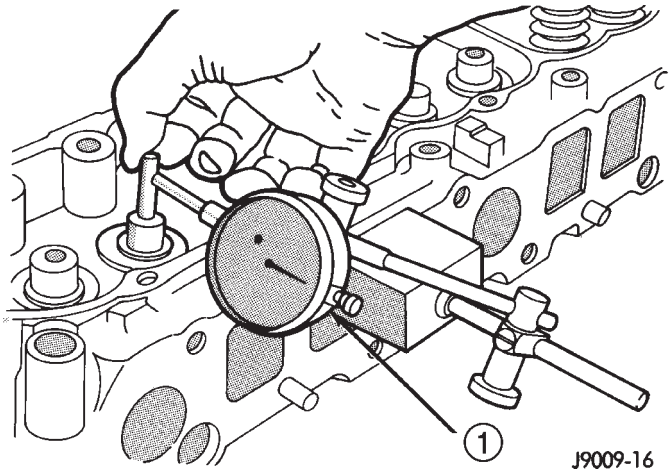


Fig. 88 Measurement of Lateral Movement Of Valve Stem

1 – DIAL INDICATOR

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. 89).

Replace valve springs that are not within specifications.

CYLINDER BLOCK

DISASSEMBLY

(1) Drain the engine oil. Remove and discard the oil filter.

DISASSEMBLY AND ASSEMBLY (Continued)

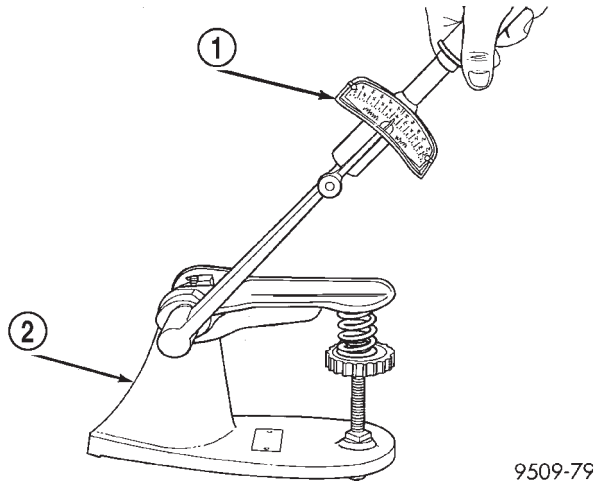


Fig. 89 Valve Spring Tester

1 – TORQUE WRENCH
2 – VALVE SPRING TESTER

(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.

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.

CLEANING AND INSPECTION (Continued)

ENGINE CYLINDER HEAD

CLEANING

Thoroughly clean the engine cylinder head and cylinder block mating surfaces. Clean the intake and exhaust manifold and engine cylinder head mating surfaces. Remove all gasket material and carbon.

Check to ensure that no coolant or foreign material has fallen into the tappet bore area.

Remove the carbon deposits from the combustion chambers and top of the pistons.

INSPECTION

Use a straightedge and feeler gauge to check the flatness of the engine cylinder head and block mating surfaces.

CYLINDER BLOCK

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

- The galley at the oil filter adaptor hole, the filter bypass hole (Fig. 90).

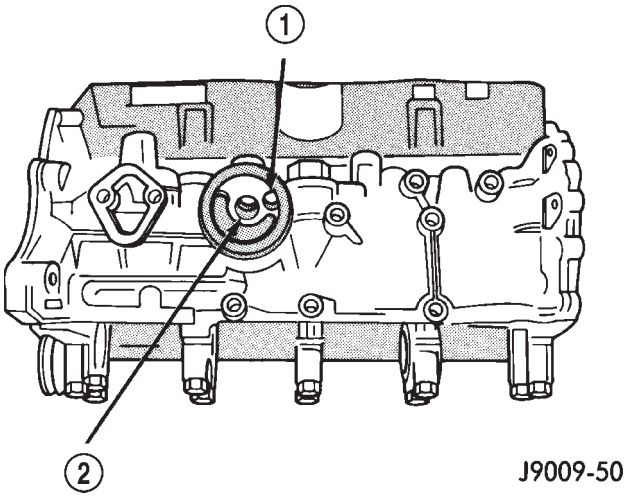


Fig. 90 Oil Filter Adaptor Hole

1 – FILTER BYPASS HOLE
2 – OIL FILTER ADAPTOR HOLE

- The front and rear oil galley holes (Fig. 91) (Fig. 92).
- The feed holes for the crankshaft main bearings.

Once the block has been completely cleaned, apply Mopar® Thread Sealant with Teflon to the threads of the front and rear oil galley plugs. Tighten the plugs to 41 N·m (30 ft. lbs.) torque.

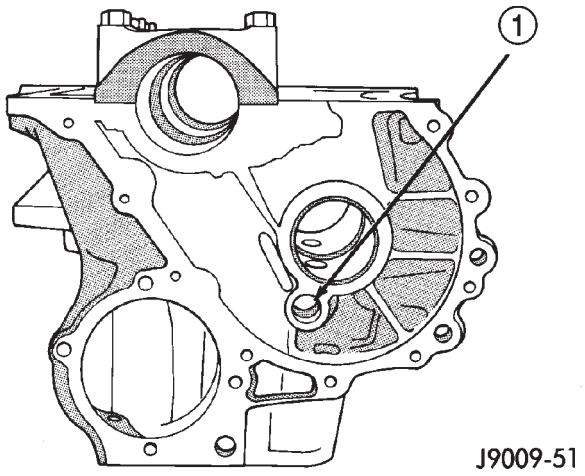


Fig. 91 Front Oil Galley Hole

1 – FRONT OIL GALLEY HOLE

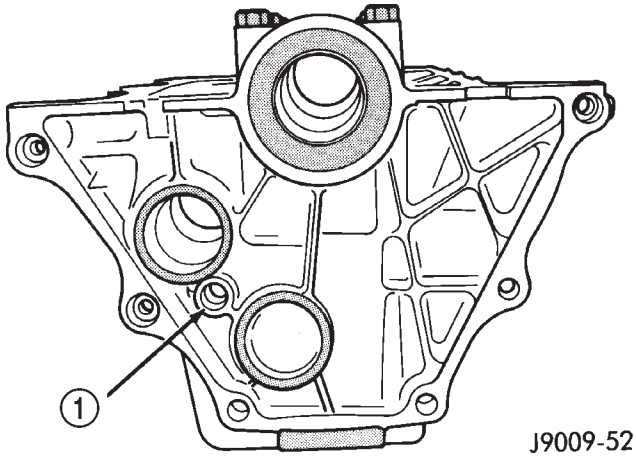


Fig. 92 Rear Oil Galley Hole

1 – REAR OIL GALLEY HOLE

INSPECTION

Inspect the cylinder bores for signs of scorring, pitting or cracks. If the cylinder bores are scorred or pitted the cylinder bores will require boreing or honing to clean them up. Refer to Honing Cylinder Bores in this Section. If the cylinder bore(s) are cracked the cylinder block must be replaced.

Inspect the cylinder block to cylinder head mating surface for flatness and/or pitting.

SPECIFICATIONS

ENGINE SPECIFICATIONS

ENGINE DESCRIPTION

DESCRIPTION	SPECIFICATION
Engine Type	In-line 4 Cylinder
Bore and Stroke	98.4 x 81.0 mm (3.88 x 3.19 in.)
Displacement	2.5L (150 cu. in.)
Compression Ratio	9.1:1
Compression Pressure Range	827 to 1,034 kPa (120 to 150 psi)
Max. Variation Between Cylinders	206 kPa (30 psi)
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 Iron
CAMSHAFT	
Hydraulic Tappet Clearance	Zero Lash
Bearing Clearance	0.025 - 0.076 mm (0.001 - 0.003 in.)
Bearing Journal Diameter	
No. 1	51.54 - 51.56 mm (2.029 - 2.030 in.)
No. 2	51.28 - 51.31 mm (2.019 - 2.020 in.)
No. 3	51.03 - 51.05 mm (2.009 - 2.010 in.)
No. 4	50.78 - 50.80 mm (1.999 - 2.000 in.)
Base Circle Runout (Max)	0.03 mm (0.001 in.)
Camshaft Lobe Lift	
Exhaust	6.579 mm (0.259 in.)
Intake	6.477 mm (0.255 in.)
Camshaft Duration	
Intake	253.3°
Exhaust	259°
VALVES	
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)
Duration	253.3°
Exhaust Valve Timing	
Opens	52.8° (BBDC)
Closes	26.2° (ATDC)
Duration	259°
Valve Overlap	41.6°
Valve Lenght (Overall)	
Intake	124.435 - 125.070 mm (4.899 - 4.924 in.)
Exhaust	125.120 - 125.755 mm (4.927 - 4.952 in.)
Valve Stem Diameter	7.899 - 7.925 mm (0.311 - 0.312 in.)
Stem to Guide Clearance	0.025 - 0.076 mm (0.001 - 0.003 in.)
ValveFace Angle	
Intake	46.5°
Exhaust	46.5°

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Valve Head Diameter	
Intake	48.387 - 48.641 mm (1.905 - 1.915 in.)
Exhaust	37.973 - 38.227 mm (1.495 - 1.505 in.)
Tip Refinishing (Max Alowable)	0.25 mm (0.010 in.)
VALVE SPRINGS	
Free Length (Approx.)	47.65 mm (1.876 in.)
Spring Load	
Valve Closed	316 to 351 N @ 41.656 mm (71 to 79 Lbs. @ 1.64 in.)
Valve Open	898.6 to 969.7 N @ 30.89 mm (202 to 218 Lbs. @ 1.216 in.)
Inside Diameter (Top)	21.0 mm to 21.51 mm (0.827 to 0.847 in.)
Installed Height	41.656 mm (1.640 in.)
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.)
No. 2	32.28 to 32.33 mm (1.271 to 1.273 in.)
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.)

DESCRIPTION	SPECIFICATION
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	0.013 mm (0.0005 in.)
Taper - Max	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.)
Out of Round (Max)	0.025 mm (0.001 in.)
Tappet Bore Diameter	23.000 to 23.025 mm (0.9055 to 0.9065 in.)
Flatness	0.03 mm per 25 mm (0.001 in. per 1 in.) 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)	663 to 671 grams (23.39 to 23.67 oz.)
Length (Center to Center)	155.52 to 155.62 mm (6.123 to 6.127 in.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
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)	0.002 mm per mm (0.002 in. per in.)
Bend (Max)	0.006 mm per mm (0.006 in. per inch.)
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 Seat Angle	
Intake	44.5°
Exhaust	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.) 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)

DESCRIPTION	SPECIFICATION
ROCKER ARMS, PUSH RODS & TAPPETS	
Rocker Arm Ratio	1.6:1
Push Rod Length (Blue)	241.300 to 241.808 mm (9.500 to 9.520 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.)
PISTON	
Weight (Less Pin)	417 to 429 grams (14.7 to 15.1 oz.)
Compression Height	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 1.555 mm (0.0602 to 0.0612 in.)
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.)
Compression Ring #2	87.63 to 87.88 mm (89.66 to 89.92 in.)
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.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
PISTON RINGS	
Ring Gap Clearance	
Top Compression Ring	0.229 to 0.610 mm (0.0090 to 0.0240 in.)
2nd Compression Ring	0.483 to 0.965 mm (0.0190 to 0.0380 in.)
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.)
Oil Control Rings	0.06 to 0.21 mm (0.0024 to 0.0083 in.)
OIL PUMP AND OIL PRESSURE	
Gear to Body Clearance	
(Radial)	0.051 to 0.102 mm (0.002 to 0.004 in.)
(Radial Preferred)	0.051 mm (0.002 in.)
Gear End Clearance—	
Plastigage	0.051 to 0.152 mm (0.002 to 0.006 in.)
Plastigage Preferred	0.051 mm (0.002 in.)
Feeler Gauge	0.1016 to 0.2032 mm (0.004 to 0.008 in.)
Feeler Gauge Preferred	0.1778 mm (0.007 in.)
Min. Pressure (600 rpm)	89.6 kPa (13 psi)
Min. Pressure at Idle (800 rpm)	172 to 241 kPa (25 to 35 psi)
Min. Pressure at 1600 rpm and Higher	255 to 517 kPa (37 to 75 psi)
Oil Pressure Relief	517 kPa (75 psi)

SPECIFICATIONS—TORQUE

TORQUE CHART 2.5L ENGINE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs
A/C Compressor Bracket to Engine—Bolts	47	35	—
A/C Compressor Mounting Bolts	28	—	250
Block Heater Nut	1.8	—	16
Camshaft Sprocket Bolt	108	80	—
Clutch Cover to Flywheel Bolts	31	23	—
Connecting Rod Cap Nuts	45	33	—
Cylinder Block Drain Plugs	41	30	—
Cylinder Head Bolts #1–10 & #12–14	149	110	—
Cylinder Head Bolt #11	135	100	—
Cylinder Head Cover Bolts	13	—	115
Dipstick Tube Bracket to Cylinder Block—Bolt	19	—	168
Distributor Hold-Down Clamp Bolt	23	—	204
Engine Front Insulator Bracket— Bolts	81	60	—
Insulator Bracket—Nuts	47	35	—
Insulator—Through Bolt	81	60	—
Engine Rear Support Cushion /Crossmember—Nuts	22	—	192
Support Cushion/Bracket Nuts	46	34	—
Transmission Support Bracket— Bolts	43	32	—
Transmission Support Bracket /Cushion—Bolt	75	55	—
Transmission Support Adaptor Bracket—Bolts	75	55	—
Exhaust Manifold/Pipe Nuts	27	20	—

SPECIFICATIONS (Continued)

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs
Exhaust Manifold			
Bolt #1	41	30	—
Bolts #2-5	31	23	—
Nuts 6 and 7	14	—	126
Flywheel/Converter Housing Bolts	38	28	—
Flywheel to Crankshaft Bolts	143	105	—
Front Cover to Block Bolts 1/4-20	7	—	60
Front Cover to Block 5/16-18	22	—	192
Generator Mounting—Bolts	57	42	—
Generator Mounting Bracket to Engine—Bolts	47	35	—
Main Bearing Cap Bolts	108	80	—
Oil Filter Adaptor Bolt	102	75	—
Oil Filter Connector	68	50	—
Oil Filter	18	13	—
Oil Galley Plug	41	30	—
Oil Pan 1/4-20 Bolts	9.5	—	84
Oil Pan 5/16-18 Bolts	15	—	132
Oil Pan Drain Plug	34	25	—
Oil Pressure Sending Unit	15	—	130
Oil Pump Short Attaching Bolts	23	—	204
Oil Pump Long Attaching Bolts	23	—	204
Oil Pump Cover Bolts	8	—	70
Rocker Arm—Bolts	28	21	—
Spark Plugs	37	27	—
Starter Motor Mounting Bolts	45	33	—
Thermostat Housing Bolts	18	—	156
Throttle Body Bolts	10	—	90
Vibration Damper Bolt	108	80	—
Water Pump to Block Bolts	31	23	—

SPECIAL TOOLS

ENGINE

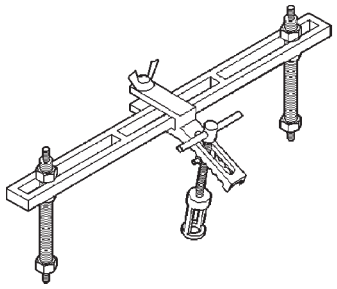


Fig. 93 Valve Spring Compressor Tool MD-998772A

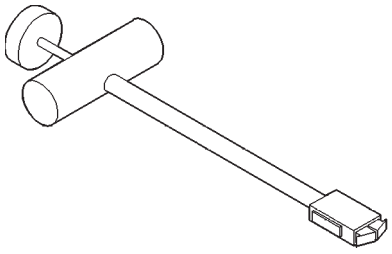


Fig. 94 Hydraulic Valve Tappet Removal Tool C-4129–A

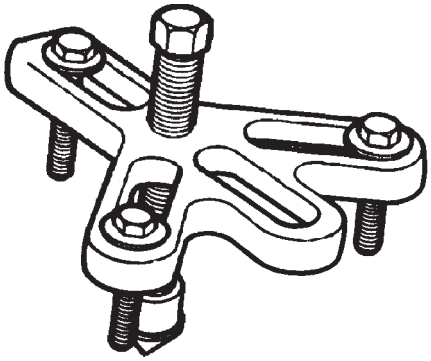


Fig. 95 Vibration Damper Removal Tool 7697

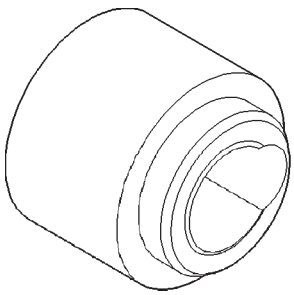


Fig. 96 Timing Case Cover Alignment and Seal Tool 6139

4.0L ENGINE

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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 better 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.

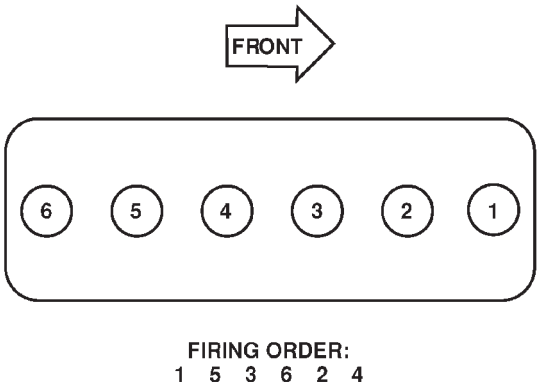


Fig. 1 Engine Firing Order

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).
- 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).

(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.

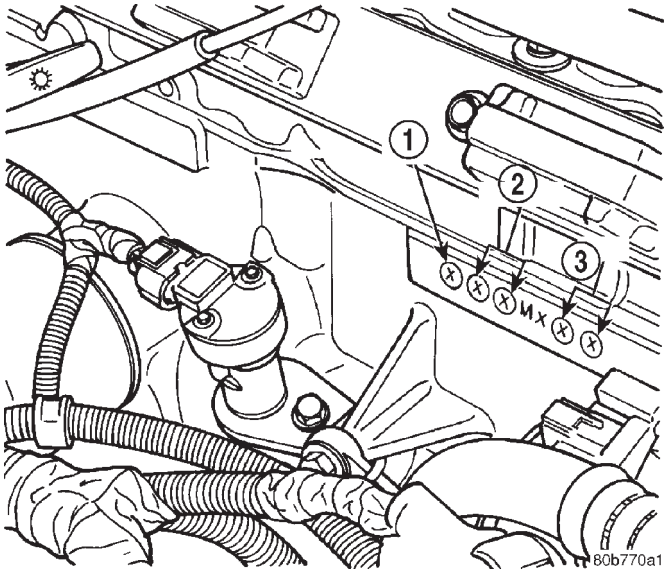


Fig. 2 Build Date Code Location

1 – YEAR
2 – MONTH
3 – DAY

LUBRICATION SYSTEM

DESCRIPTION

A gear—type positive displacement pump is mounted at the underside of the block opposite the No. 4 main bearing.

OPERATION

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, camshaft position sensor 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

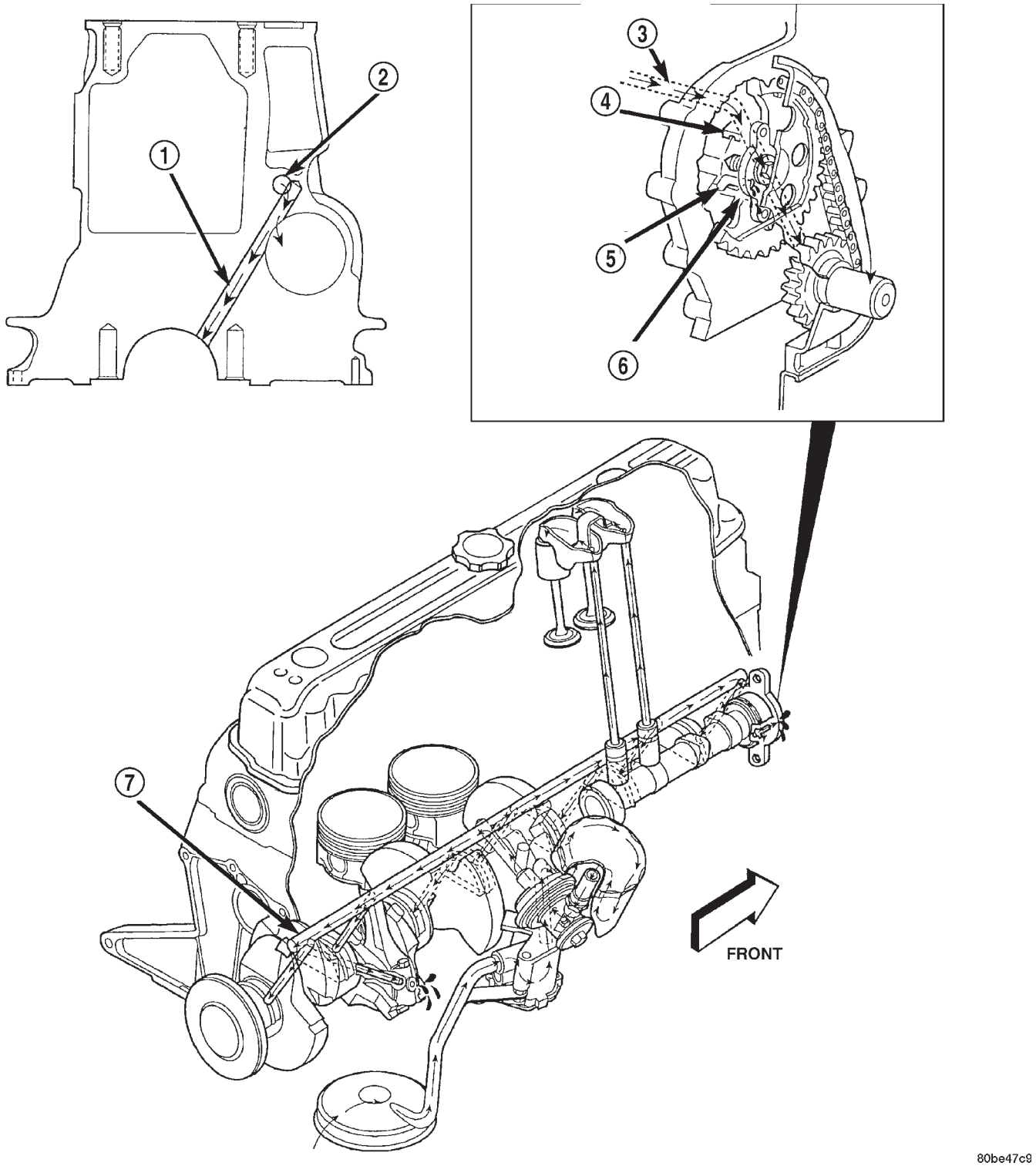
DESCRIPTION AND OPERATION (Continued)

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)

CYLINDER BLOCK



Oil Lubrication System—4.0L Engine

1 – CAM/CRANK MAIN GALLERY (7)
2 – TAPPET GALLERY
3 – TAPPET GALLERY
4 – CAMSHAFT BEARING
5 – NUMBER 1 CAMSHAFT BEARING JOURNAL
6 – CAMSHAFT SPROCKET
7 – TAPPET GALLERY

DESCRIPTION AND OPERATION (Continued)

DESCRIPTION

The cylinder block is a cast iron inline six cylinder design. The cylinder block is drilled forming galleries for both oil and coolant (Fig. 3).

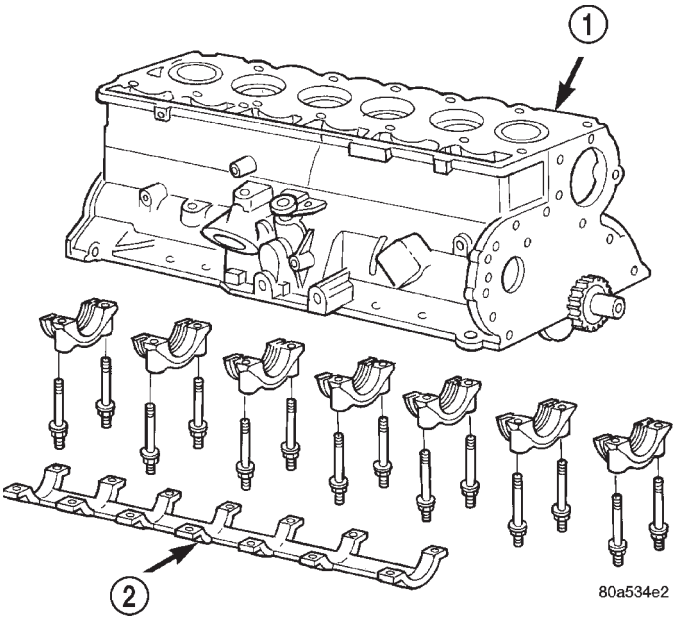


Fig. 3 4.0L Cylinder Block with Main Bearing Caps and Cap Brace

1 – BLOCK
2 – MAIN BEARING CAP BRACE

CYLINDER HEAD

DESCRIPTION

The cylinder head is made of cast iron containing twelve valves made of chrome plated heat resistant steel, valve stem seals, springs, retainers and keepers. The cylinder head and valve seats can be resurfaced for service purposes.

The valve guides are integral to the cylinder head, They are not replaceable. However, they are serviceable.

The cylinder head uses dual quench-type design combustion chambers which cause turbulence in the cylinders allowing faster burning of the air/fuel mixture, resulting in better fuel economy (Fig. 4).

CRANKSHAFT

DESCRIPTION

The crankshaft is constructed of nodular cast iron. The crankshaft is a crosshaped four throw design with eight counterweights for balancing purposes. The crankshaft is supported by seven select main bearings with the number three serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication.

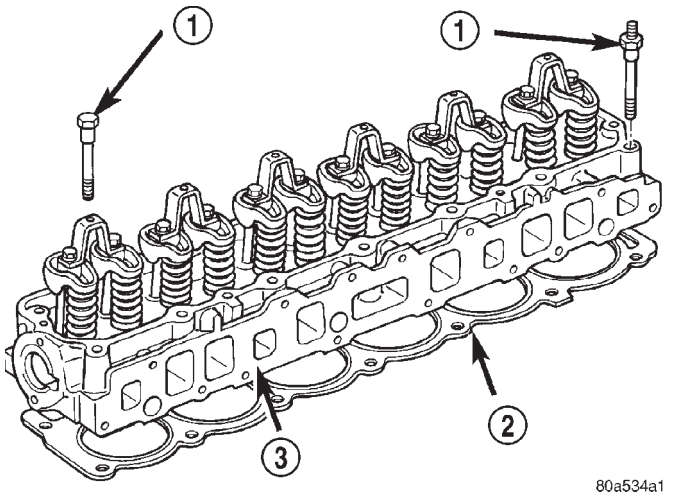


Fig. 4 Cylinder Head 4.0L Engine

1 – CYLINDER HEAD BOLTS
2 – CYLINDER HEAD GASKET
3 – CYLINDER HEAD

The select fit main bearing markings are located on the crankshaft counter weights. The crankshaft rear oil seal is a two piece design. The front oil seal is a one piece design retained in the timing chain cover (Fig. 5).

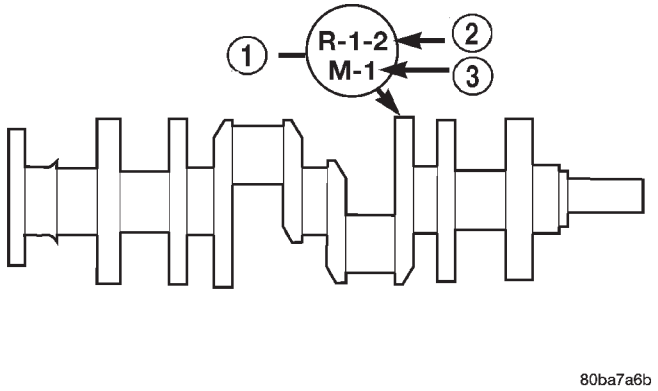


Fig. 5 Crankshaft with Select Fit Marking Location

1 – **1/4" LETTERS**
2 – **(ROD)**
3 – **(MAIN)**

PISTON AND CONNECTING ROD

DESCRIPTION

The pistons are made of a high strength aluminum alloy with an anodized top ring groove and crown. Piston skirts are coated with a solid lubricant (Molykote) to reduce friction and provide scuff resistance. The connecting rods are made of ductile iron. A pressed fit piston pin is used to attach the piston and connecting rod.

DESCRIPTION AND OPERATION (Continued)

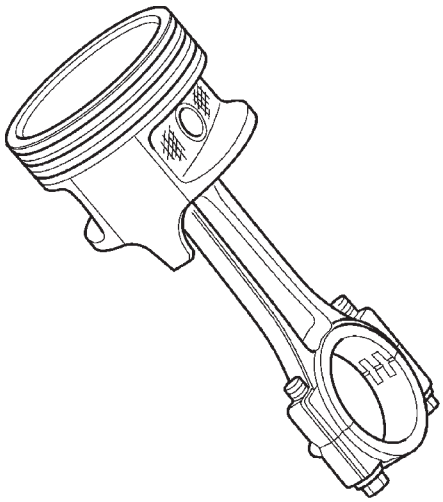


Fig. 6 Piston and Connecting Rod Assembly

CAMSHAFT

DESCRIPTION

The camshaft is made of gray cast iron with twelve machined lobes and four bearing journals. When the camshaft rotates the lobes actuate the tappets and push rods, forcing upward on the rocker arms which applies downward force on the valves.

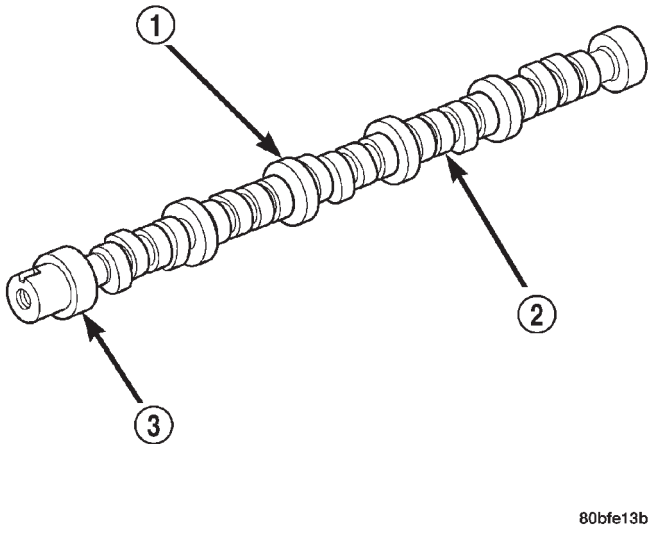


Fig. 7 Camshaft—Typical

1 – **CAMSHAFT**
2 – **LOBES**
3 – **BEARING JOURNAL**

ROCKER ARM

DESCRIPTION

The rocker arms are made of stamped steel and have a operational ratio of 1.6:1. When the push rods are forced upward by the camshaft lobes the push rod presses upward on the rocker arms, the rocker arms pivot, forcing downward pressure on the valves forcing the valves to move downward and off from their seats (Fig. 8).

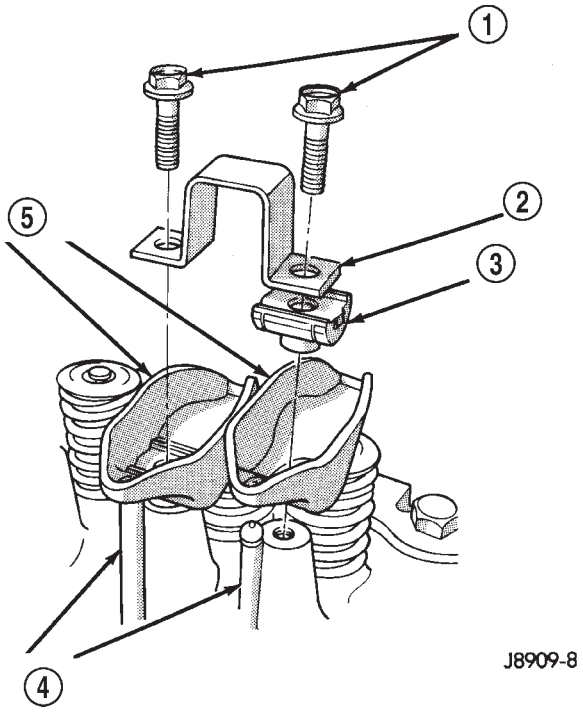


Fig. 8 Rocker Arms 4.0L Engine

1 – CAPSCREWS
2 – BRIDGE
3 – PIVOT ASSEMBLY
4 – PUSH RODS
5 – ROCKER ARMS

VALVES

DESCRIPTION

The valves are made of heat resistant steel and have chrome plated stems to prevent scuffing. All valves use three bead locks to promote valve rotation (Fig. 9).

VALVE SPRING

DESCRIPTION

The valve springs are made of high strength silicon chrome spring steel. The springs are common for both intake and exhaust valves. (Fig. 9).

DESCRIPTION AND OPERATION (Continued)

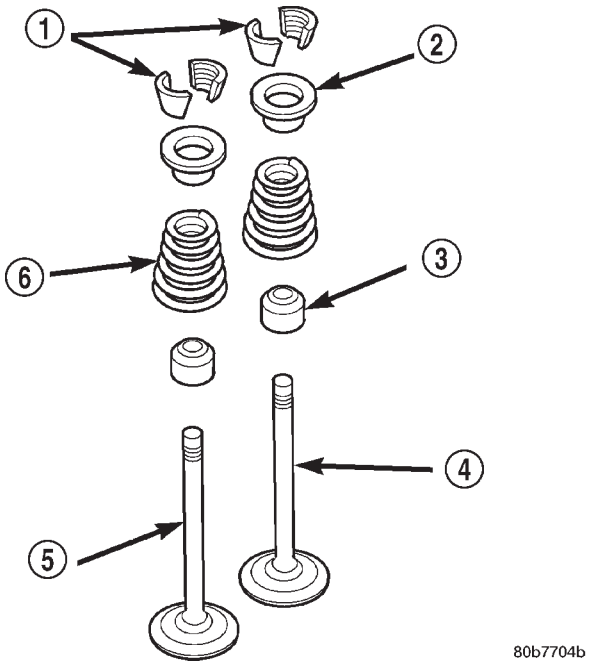


Fig. 9 Valve and Keeper Configuration 4.0L Engine

1 – VALVE LOCKS (3–BEAD)
2 – RETAINER
3 – VALVE STEM OIL SEAL
4 – INTAKE VALVE
5 – EXHAUST VALVE
6 – VALVE SPRING

VALVE STEM SEAL

DESCRIPTION

The valve stem seals are made of rubber and incorporate a garter spring to maintain consistent lubrication control (Fig. 9).

CYLINDER HEAD COVER

DESCRIPTION

The cylinder head cover (Fig. 10) is made of stamped steel and incorporates the Crankcase Ventilation (CCV) Hoses and the oil fill opening.

HYDRAULIC TAPPET

DESCRIPTION

Valve lash is controlled by hydraulic tappets located inside the cylinder block, in tappet bores above the camshaft.

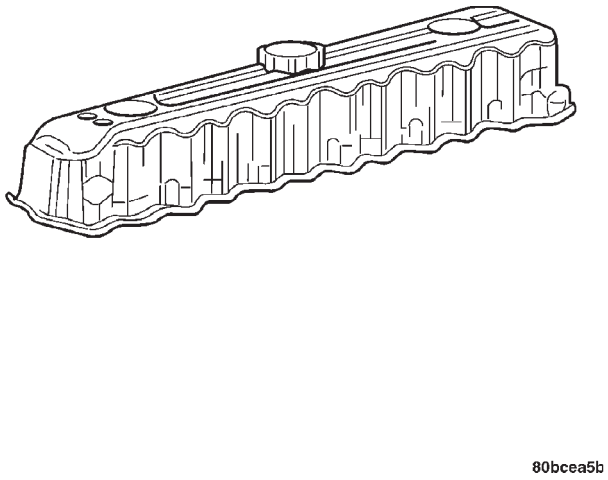


Fig. 10 Cylinder Head Cover

OIL PAN

DESCRIPTION

The oil pan is made of stamped steel. The oil pan gasket is a one piece steel backbone silicone coated gasket.

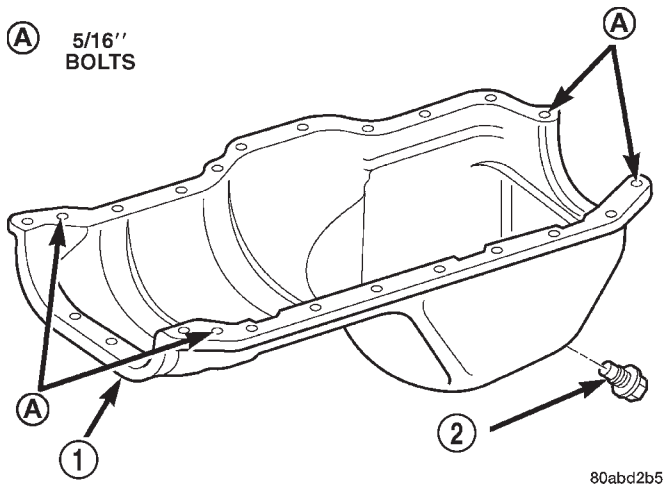


Fig. 11 Oil Pan

1 – OIL PAN
2 – OIL PAN DRAIN PLUG

INTAKE MANIFOLD

DESCRIPTION

The intake manifold is made of cast aluminum and uses eleven bolts to mount to the cylinder head. This mounting style improves sealing and reduces the chance of leaks.

DESCRIPTION AND OPERATION (Continued)

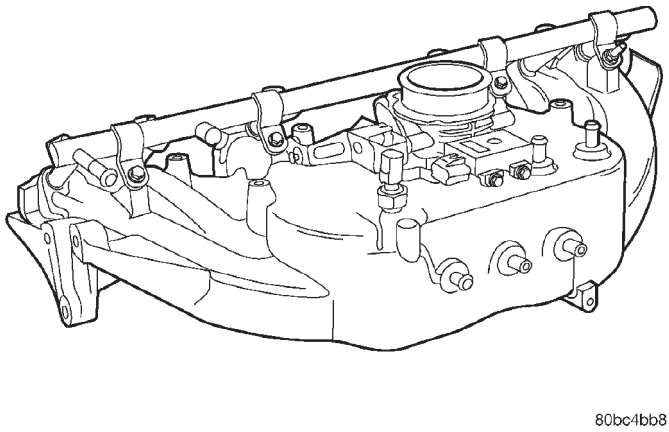


Fig. 12 Intake Manifold 4.0L Engine

EXHAUST MANIFOLD

DESCRIPTION

The two exhaust manifolds are log style and are made of high silicon molybdenum cast iron. The exhaust manifolds share a common gasket with the intake manifold. The exhaust manifolds also incorporate ball flange outlets for improved sealing and strain free connections.

DIAGNOSIS AND TESTING

ENGINE DIAGNOSIS—INTRODUCTION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either performance (e.g., engine idles rough and stalls) or mechanical (e.g., a strange noise).

Refer to 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.

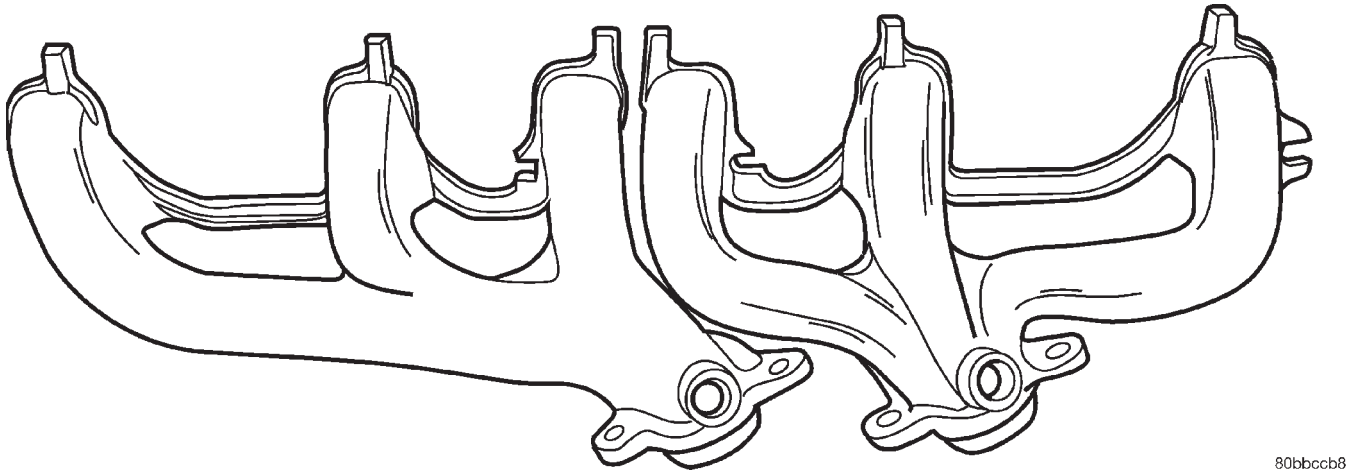


Fig. 13 Exhaust Manifolds 4.0L Engine

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

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to Group 8D, ignition system)
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)

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

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	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	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
	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

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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

HYDRAULIC TAPPETS

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 14).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Leak-Down Tester.

(1) Place a 7.925-7.950 mm (0.312-0.313 inch) diameter ball bearing on the plunger cap of the tappet.

DIAGNOSIS AND TESTING (Continued)

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

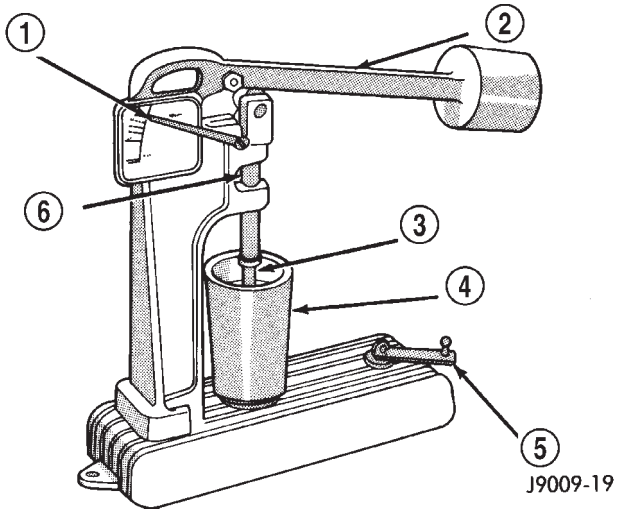


Fig. 14 Leak-Down Tester

1 – POINTER
2 – WEIGHTED ARM
3 – RAM
4 – CUP
5 – HANDLE
6 – PUSH ROD

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.

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

DIAGNOSIS AND TESTING (Continued)

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

DIAGNOSIS AND TESTING (Continued)

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.

(4) **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.

SERVICE PROCEDURES

VALVE TIMING

Disconnect the coil rail and remove from engine.

Remove 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.

SERVICE PROCEDURES (Continued)

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. 16).

(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. 15). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

(5) Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

PISTON 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

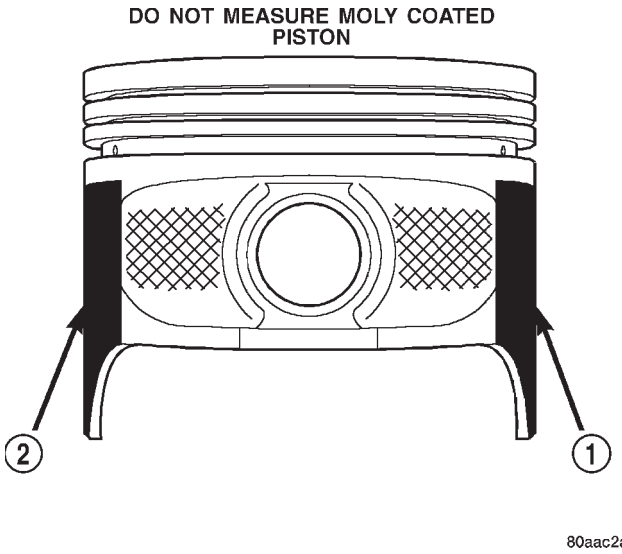


Fig. 15 Moly Coated Piston

1 – MOLY COATED
2 – MOLY COATED

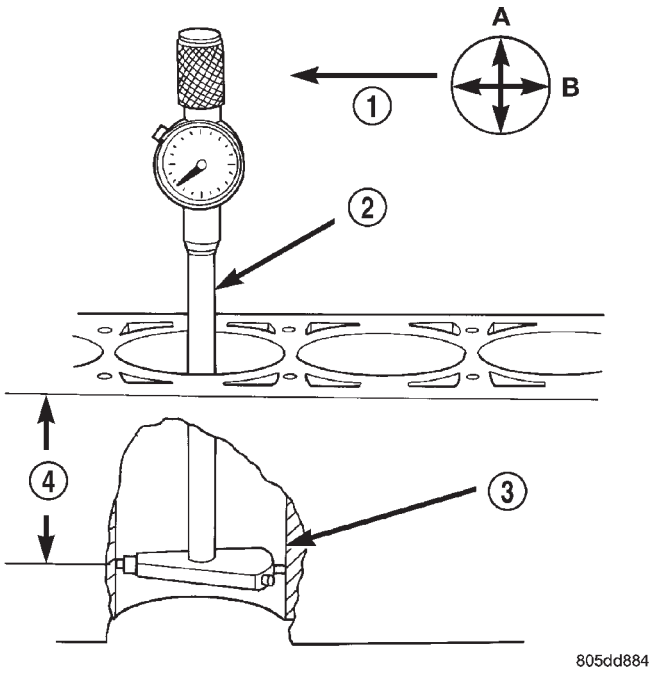


Fig. 16 Bore Gauge

1 – FRONT
2 – BORE GAUGE
3 – CYLINDER BORE
4 – 49.5 MM (1–15/16 in)

SERVICE PROCEDURES (Continued)

PISTON SIZE CHART

CYLINDER BORE SIZE	PISTON LETTER SIZE
98.438 - 98.448 mm (3.8755 - 3.8759 in.)	A
98.448 - 98.458 mm (3.8759 - 3.8763 in.)	B
98.458 - 98.468 mm (3.8763 - 3.8767 in.)	C
98.468 - 98.478 mm (3.8767 - 3.8771 in.)	D
98.478 - 98.488 mm (3.8771 - 3.8775 in.)	E
98.488 - 98.498 mm (3.8775 - 3.8779 in.)	F

(Fig. 17) (Fig. 18). Rotate the ring in the groove. It must move freely around circumference of the groove.

GROOVE HEIGHT

A 1.530-1.555 mm (0.0602-0.0612 in)
B 4.035-4.060 mm (0.1589-0.1598 in)

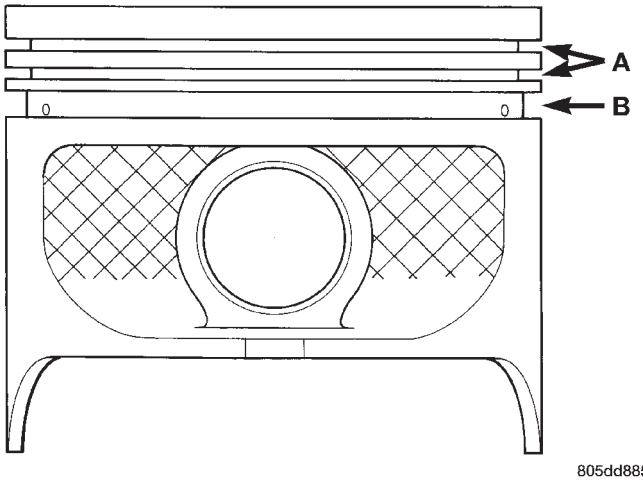


Fig. 17 Piston Dimensions

(4) Place ring in the cylinder bore and push down with inverted piston to position near lower end of the ring travel. Measure ring gap with a feeler gauge fitting snugly between ring ends (Fig. 19).

(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. 20).

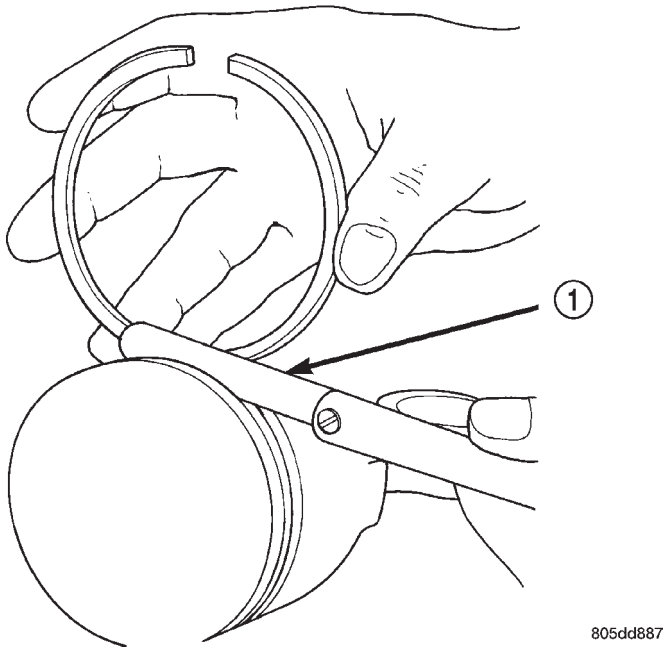


Fig. 18 Ring Side Clearance Measurement

1 – FEELER GAUGE

RING SIDE CLEARANCE CHART

ITEM	SPECIFICATION
Top Compression Ring	0.042 - 0.084 mm (0.0017 - 0.0033 in.)
Second Compression Ring	0.042 - 0.084 mm (0.0017 - 0.0033 in.)
Oil Control Ring	0.06 - 0.21 mm (0.0024 - 0.0083 in.)

(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. 21).

(8) Using a ring installer, install the second compression ring with the dot facing up (Fig. 21) (Fig. 23).

(9) Using a ring installer, install the top compression ring (either side up).

Ring Gap Orientation

- Position the gaps on the piston as shown (Fig. 24).
- Oil spacer - Gap on center line of piston skirt.
- Oil rails - gap 180° apart on centerline of piston pin bore.

SERVICE PROCEDURES (Continued)

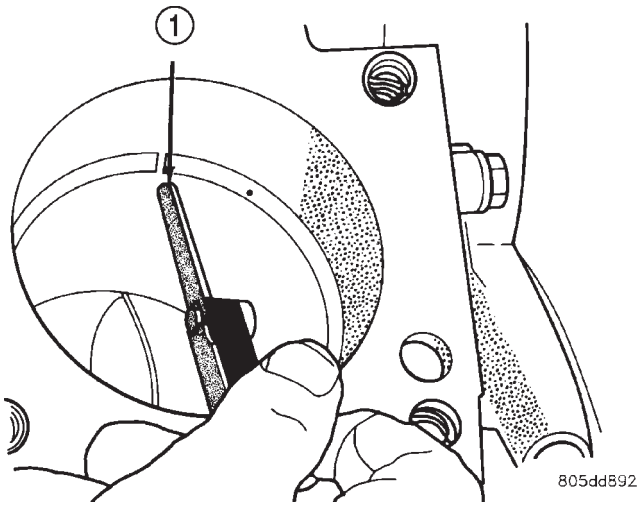


Fig. 19 Gap Measurement

1 – FEELER GAUGE

RING GAP MEASUREMENT CHART

ITEM	SPECIFICATION
Top Compression Ring	0.229 - 0.610 mm (0.0090 - 0.0240 in.)
Second Compression Ring	0.483 - 0.965 mm (0.0190 - 0.080 in.)
Oil Control Ring	0.254 - 1.500 mm (0.010 - 0.060 in.)

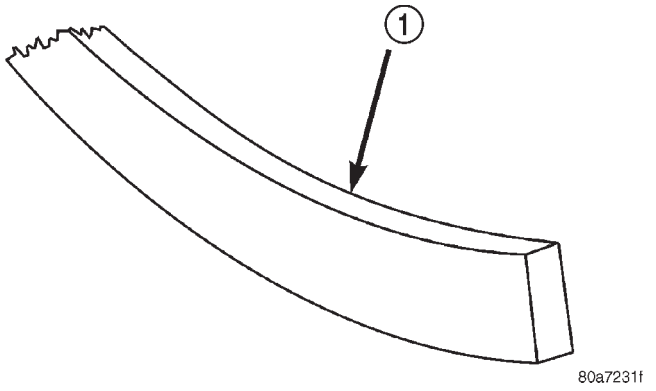


Fig. 20 Top Compression ring identification

1 – TOP COMPRESSION RING

- No. 2 Compression ring - Gap 180° from top oil rail gap.
- No. 1 Compression ring - Gap 180° from No. 2 compression ring gap.

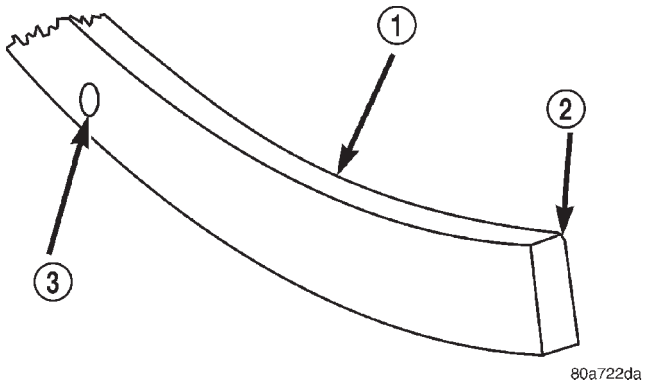


Fig. 21 Second Compression Ring Identification

1 – SECOND COMPRESSION RING
2 – CHAMFER
3 – ONE DOT

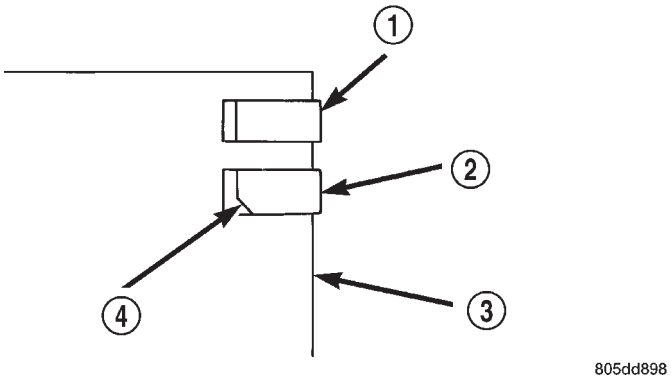


Fig. 22 Compression Ring Chamfer Location

1 – TOP COMPRESSION RING
2 – SECOND COMPRESSION RING
3 – PISTON
4 – CHAMFER

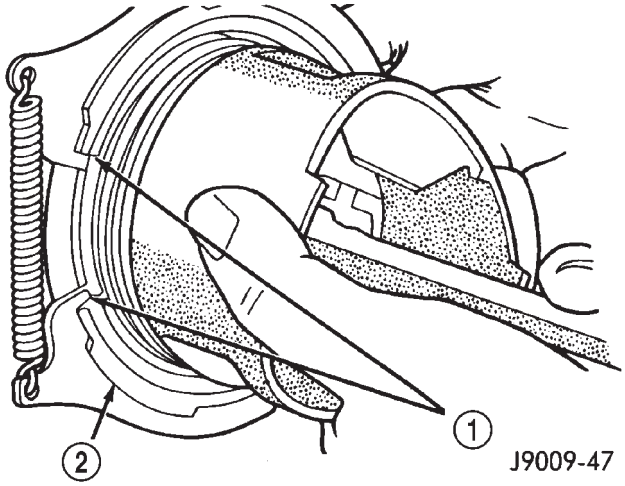


Fig. 23 Compression Ring Installation

1 – COMPRESSION RING
2 – RING EXPANDER RECOMMENDED

SERVICE PROCEDURES (Continued)

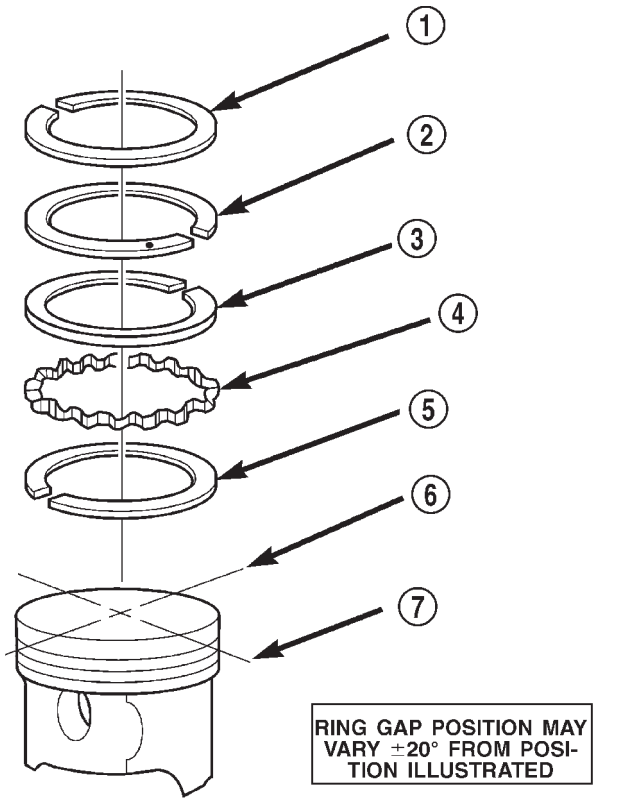


Fig. 24 Ring Gap Orientation

1 – TOP COMPRESSION RING
2 – BOTTOM COMPRESSION RING
3 – TOP OIL CONTROL RAIL
4 – OIL RAIL SPACER
5 – BOTTOM OIL CONTROL RAIL
6 – IMAGINARY LINE PARALLEL TO PISTON PIN
7 – IMAGINARY LINE THROUGH CENTER OF PISTON SKIRT

FITTING CONNECTING ROD BEARINGS

INSPECTION

BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 25) (Fig. 26). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 27). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

CONNECTING RODS

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod

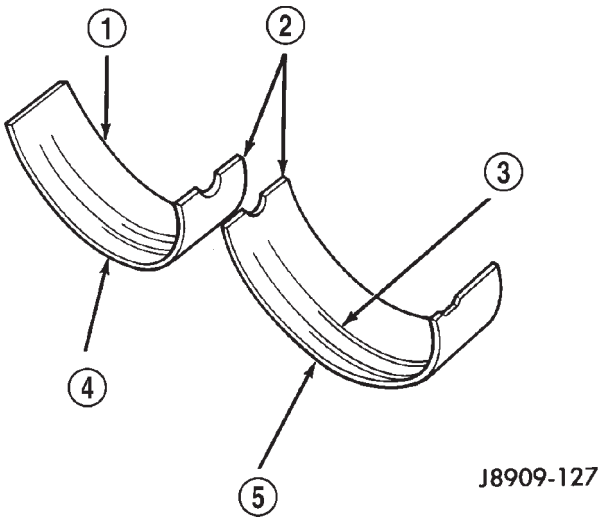


Fig. 25 Connecting Rod Bearing Inspection

1 – UPPER BEARING HALF
2 – MATING EDGES
3 – GROOVES CAUSED BY ROD BOLTS SCRATCHING JOURNAL DURING INSTALLATION
4 – WEAR PATTERN — ALWAYS GREATER ON UPPER BEARING
5 – LOWER BEARING HALF

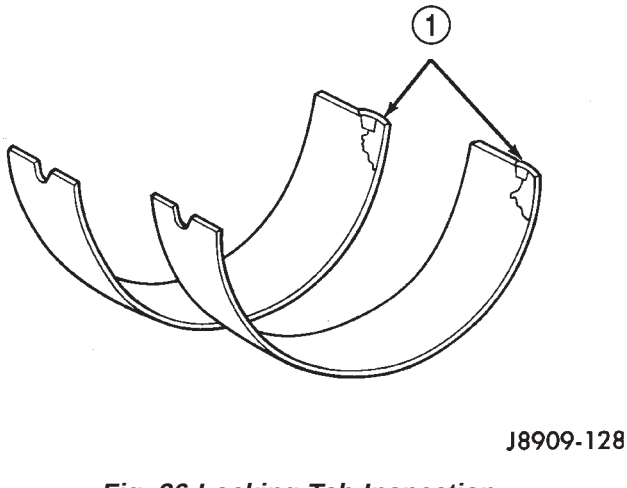


Fig. 26 Locking Tab Inspection

1 – ABNORMAL CONTACT AREA CAUSED BY LOCKING TABS NOT FULLY SEATED OR BEING BENT

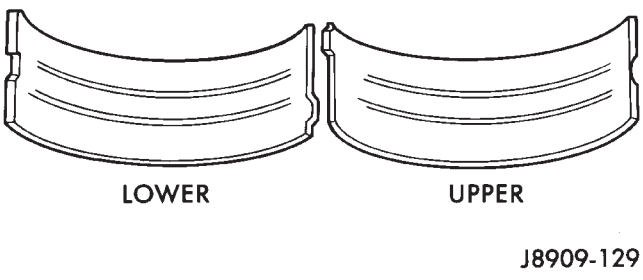


Fig. 27 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

SERVICE PROCEDURES (Continued)

alignment. Replace misaligned, bent or twisted connecting rods.

BEARING-TO-JOURNAL CLEARANCE

(1) Wipe the oil from the connecting rod journal.

(2) Use short rubber hose sections over rod bolts during installation.

(3) Lubricate the upper bearing insert and install in connecting rod.

(4) Use piston ring compressor to install the rod and piston assemblies. The oil squirt holes in the rods must face the camshaft. The arrow on the piston crown should point to the front of the engine (Fig. 28). 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.

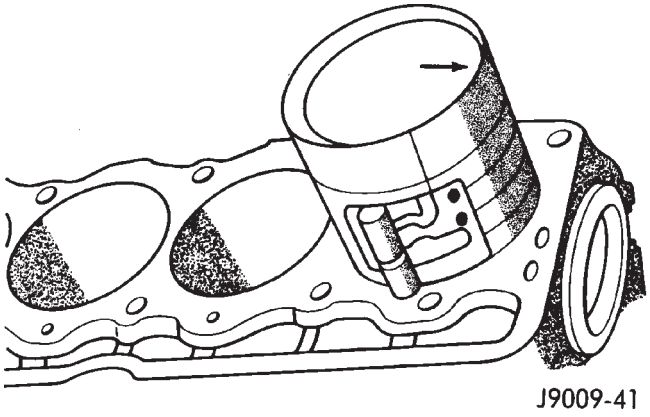


Fig. 28 Rod and Piston Assembly Installation

(5) Install the lower bearing insert in the bearing cap. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.

(6) Install bearing cap and connecting rod on the journal and tighten nuts to 45 N·m (33 ft. lbs.) torque. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(7) Remove the bearing cap and determine amount of bearing-to- journal clearance by measuring the width of compressed Plastigage (Fig. 29). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

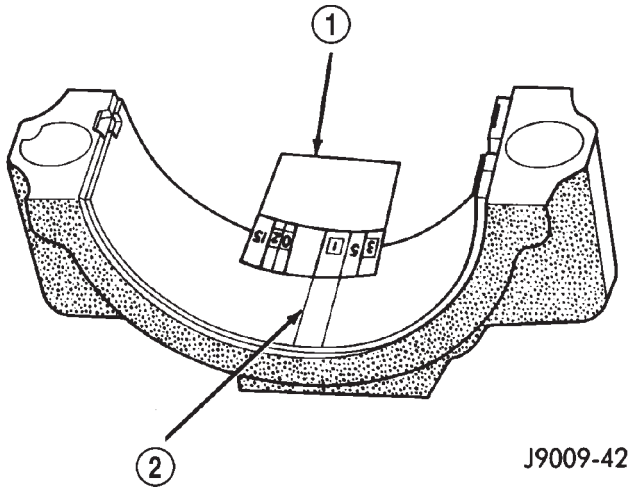


Fig. 29 Measuring Bearing Clearance with Plastigage

1 – PLASTIGAGE SCALE
2 – COMPRESSED PLASTIGAGE

(8) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(9) If bearing-to-journal clearance exceeds the specification, install a pair of 0.0254 mm (0.001 inch) undersize bearing inserts. All the odd size inserts must be on the bottom. The sizes of the service replacement bearing inserts are stamped on the backs of the inserts. Measure the clearance as described in the previous steps.

(10) The clearance is measured with a pair of 0.0254 mm (0.001 inch) undersize bearing inserts installed. This will determine if two 0.0254 mm (0.001 inch) undersize inserts or another combination is needed to provide the correct clearance (refer to Connecting Rod Bearing Fitting Chart).

SERVICE PROCEDURES (Continued)

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.)

(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. 30). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

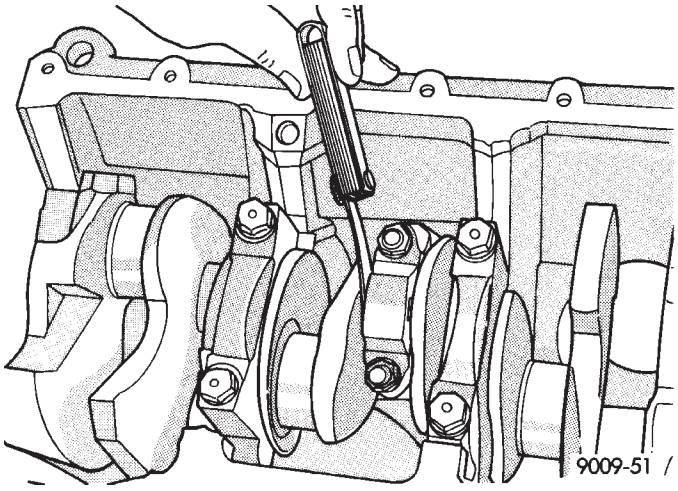


Fig. 30 Checking Connecting Rod Side Clearance—Typical

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. 31). In general the lower bearing half will have a heavier wear pattern.

NOTE: If any of the crankshaft journals are scored, remove the engine for crankshaft repair.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

FITTING BEARINGS (CRANKSHAFT INSTALLED)

The main bearing caps, numbered (front to rear) from 1 through 7 have an arrow to indicate the forward position. The upper main bearing inserts are

SERVICE PROCEDURES (Continued)

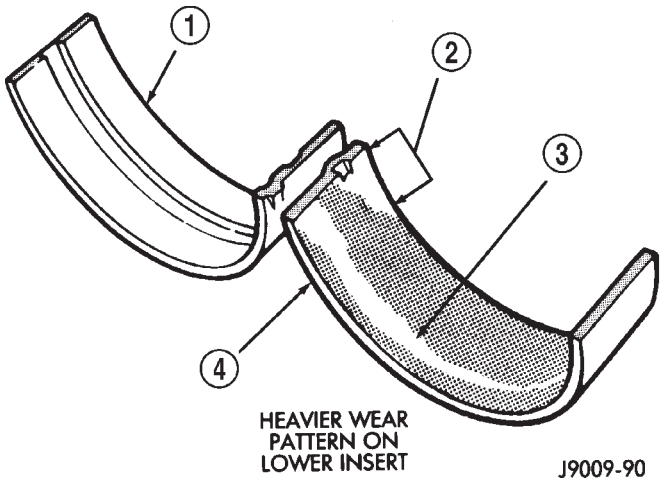


Fig. 31 Main Bearing Wear Patterns

1 – UPPER INSERT
2 – NO WEAR IN THIS AREA
3 – LOW AREA IN BEARING LINING
4 – LOWER INSERT

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. 32) 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. Refer to the Bearing Insert Pair Chart.**

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. 33). Refer to Engine Specifications for the proper clearance.

Plastigage should indicate the same clearance across the entire width of the insert. If clearance varies, it may indicate a tapered journal or foreign material trapped behind the insert.

If the specified clearance is indicated and there are no abnormal wear patterns, replacement of the bearing inserts is not necessary. Remove the Plastigage from the crankshaft journal and bearing insert. Proceed to Crankshaft Main Bearing—Installation.

If the clearance exceeds specification, install a pair of 0.025 mm (0.001 inch) undersize bearing inserts 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 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.

SERVICE PROCEDURES (Continued)

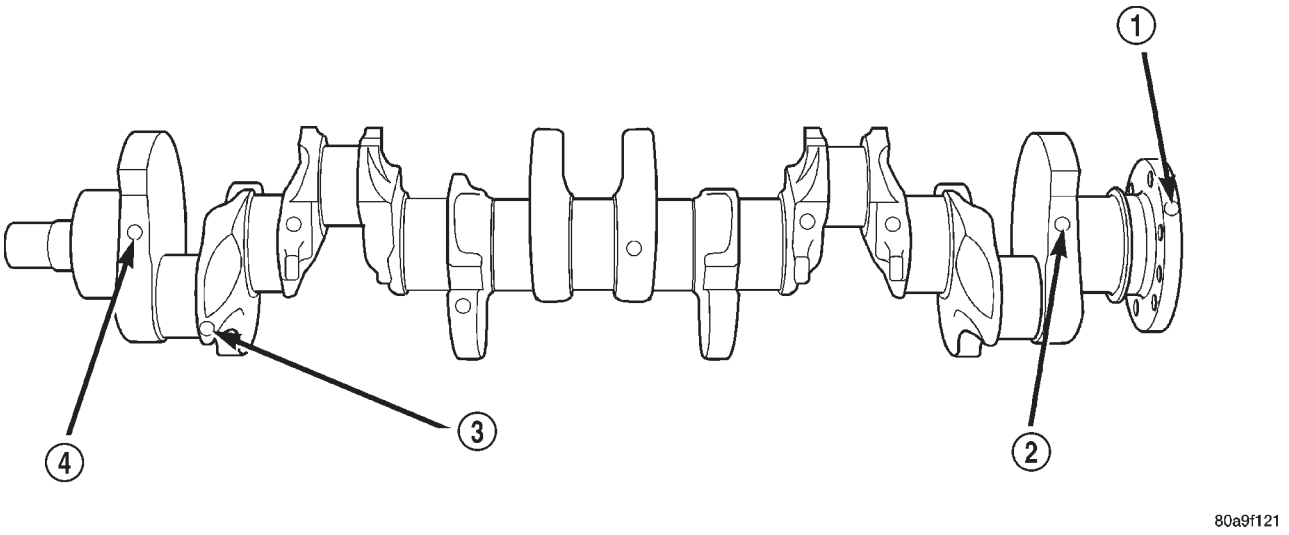


Fig. 32 Crankshaft Journal Size Paint I. D. Location

1 – NO. 7 MAIN JOURNAL SIZE PAINT MARK
2 – NO. 6 CONNECTING ROD JOURNAL SIZE PAINT MARK
3 – NO. 1 CONNECTING ROD JOURNAL SIZE PAINT MARK
4 – NO. 1 MAIN JOURNAL SIZE PAINT MARK

BEARING INSERT PAIRS CHART

INSERT	CORRECT	INCORRECT
UPPER	STANDARD	STANDARD
LOWER	0.025 mm (0.001 in.) UNDERSIZE	0.051 mm (0.002 in.) UNDERSIZE

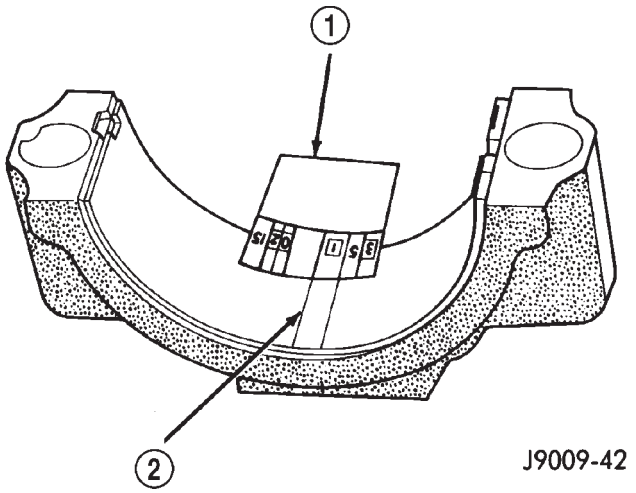


Fig. 33 Measuring Bearing Clearance with Plastigage

1 – PLASTIGAGE SCALE
2 – COMPRESSED PLASTIGAGE

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 (0.0005 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 #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.)

SERVICE PROCEDURES (Continued)

FORM-IN-PLACE GASKETS

There are several places where form-in-place gaskets are used on the engine. **DO NOT use form-in-place gasket material unless specified.** Care must be taken when applying form-in-place gaskets. Bead size, continuity and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over. A continuous bead of the proper width is essential to obtain a leak-free joint.

Two types of form-in-place gasket materials are used in the engine area (Mopar Silicone Rubber Adhesive Sealant and Mopar Gasket Maker). Each have different properties and cannot be used interchangeably.

MOPAR SILICONE RUBBER ADHESIVE SEALANT

Mopar Silicone Rubber Adhesive Sealant, normally black in color, is available in 3 ounce tubes. Moisture in the air causes the sealant material to cure. This material is normally used on flexible metal flanges. It has a shelf life of a year and will not properly cure if over aged. Always inspect the package for the expiration date before use.

MOPAR GASKET MAKER

Mopar Gasket Maker, normally red in color, is available in 6 cc tubes. This anaerobic type gasket material cures in the absence of air when squeezed between smooth machined metallic surfaces. It will not cure if left in the uncovered tube. DO NOT use on flexible metal flanges.

SURFACE PREPARATION

Parts assembled with form-in-place gaskets may be disassembled without unusual effort. In some instances, it may be necessary to lightly tap the part with a mallet or other suitable tool to break the seal between the mating surfaces. A flat gasket scraper may also be lightly tapped into the joint but care must be taken not to damage the mating surfaces.

Scrape or wire brush all gasket surfaces to remove all loose material. Inspect stamped parts to ensure gasket rails are flat. Flatten rails with a hammer on a flat plate, if required. Gasket surfaces must be free of oil and dirt. Make sure the old gasket material is removed from blind attaching holes.

GASKET APPLICATION

Assembling parts using a form-in-place gasket requires care.

Mopar Silicone Rubber Adhesive Sealant should be applied in a continuous bead approximately 3 mm (0.12 inch) in diameter. All mounting holes must be circled. For corner sealing, a 3 or 6 mm (1/8 or 1/4 inch) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The use of a locating dowel is recommended during assembly to prevent smearing the material off location.

Mopar Gasket Maker should be applied sparingly to one gasket surface. The sealant diameter should be 1.00 mm (0.04 inch) or less. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing the material off location.

ENGINE PERFORMANCE

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

SERVICE PROCEDURES (Continued)

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. 34).

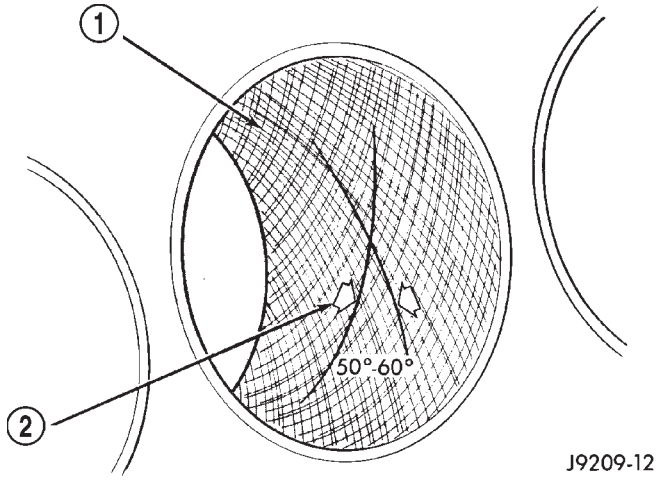


Fig. 34 Cylinder Bore Crosshatch Pattern

1 – CROSSHATCH PATTERN
2 – INTERSECT ANGLE

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

MEASURING WITH PLASTIGAGE

CRANKSHAFT MAIN BEARING CLEARANCE

Engine crankshaft bearing clearances can be determined by use of Plastigage, or equivalent. The following is the recommended procedures for the use of Plastigage:

(1) Remove oil film from surface to be checked. Plastigage is soluble in oil.

(2) The total clearance of the main bearings can only be determined by removing the weight of the crankshaft. This can be accomplished by either of two methods:

METHOD - 1 (PREFERRED)

Shim the bearings adjacent to the bearing to be checked. This will remove the clearance between upper bearing shell and the crankshaft. Place a minimum of 0.254 mm (0.010 inch) shim between the bearing shell and the adjacent bearing cap. Tighten the bolts to 18 N·m (13 ft. lbs.) torque.

- **ALL ENGINES** —When checking No.1 main bearing; shim No.2 main bearing.
- **ALL ENGINES** —When checking No.2 main bearing; shim No.1 and No.3 main bearing.
- **ALL ENGINES** —When checking No.3 main bearing; shim No.2 and No.4 main bearing.
- **ALL ENGINES** —When checking No.4 main bearing; shim No.3 and No.5 main bearing.
- **2.5L ENGINE** —When checking No.5 main bearing; shim No.4 main bearing.
- **4.0L ENGINE** —When checking No.5 main bearing; shim No.4 and No.6 main bearing.
- **4.0L ENGINE** —When checking No.6 main bearing; shim No.5 and No.7 main bearing.
- **4.0L ENGINE** —When checking No.7 main bearing; shim No.6 main bearing.

NOTE: Remove all shims before assembling engine.

METHOD - 2 (ALTERNATIVE)

The weight of the crankshaft is supported by a jack under the counterweight adjacent to the bearing being checked.

(1) Place a piece of Plastigage across the entire width of the bearing cap shell (Fig. 35). 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.**

SERVICE PROCEDURES (Continued)

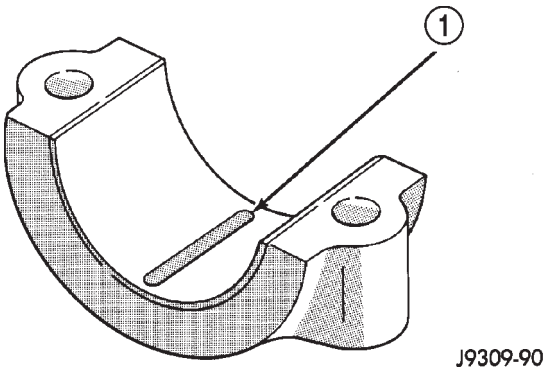


Fig. 35 Placement of Plastigage in Bearing Shell

1 – PLASTIGAGE

(2) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 36). 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).

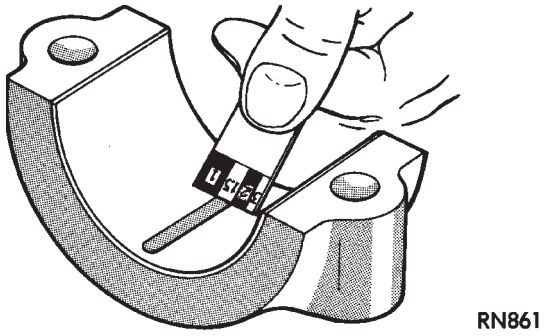


Fig. 36 Clearance Measurement

(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. 35). Position the Plastigage approximately 6.35 mm (1/4 inch) off center and away from the oil holes. In addition, suspect areas can be checked by placing the Plastigage in the suspect area.

(3) The crankshaft must be turned until the connecting rod to be checked starts moving toward the top of the engine. Only then should the rod cap with Plastigage in place be assembled. Tighten the rod cap 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. 36). 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

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- 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.

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.

SERVICE PROCEDURES (Continued)

(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.

API SERVICE GRADE CERTIFIED

In gasoline engines. use an engine oil that is API Service Grade Certified (Fig. 37).

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. 37).



9400-9

Fig. 37 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.

When choosing an engine oil, consider the range of temperatures the vehicle will be operated in before the next oil change. Select an engine oil that is best suited to your area's particular ambient temperature range and variation (Fig. 38).

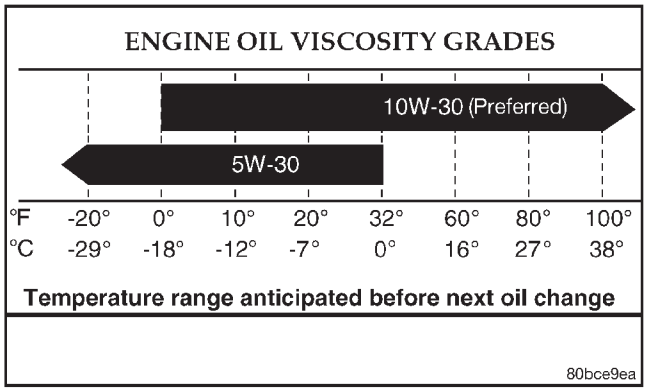


Fig. 38 Temperature/Engine Oil Viscosity

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

SERVICE PROCEDURES (Continued)

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. 39).

(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, note oil level reading (Fig. 39).

(6) Add oil only if level is below the ADD mark on dipstick.

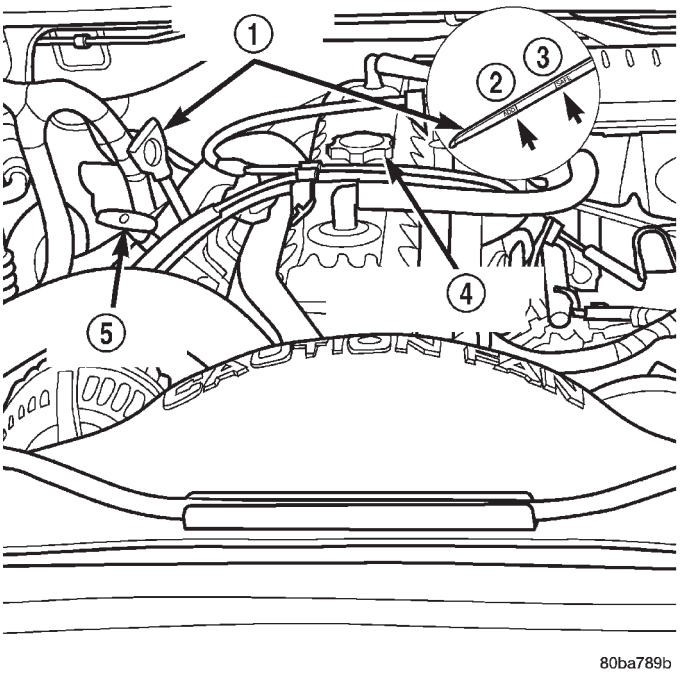


Fig. 39 Engine Oil Dipstick—4.0L Engine Typical

1 – ENGINE OIL DIPSTICK
2 – ADD
3 – SAFE
4 – ENGINE OIL FILL CAP
5 – TRANSMISSION DIPSTICK

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules.

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for 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.

(4) When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) With a wiping cloth, clean the gasket sealing surface (Fig. 40) of oil and grime.

OIL FILTER INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil or chassis grease.

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 40) hand tighten filter one full turn, do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

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.

REMOVAL AND INSTALLATION (Continued)

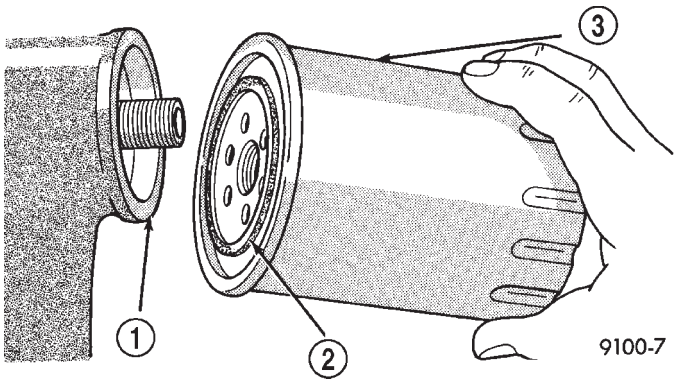


Fig. 40 Oil Filter Sealing Surface—Typical

1 – SEALING SURFACE
2 – RUBBER GASKET
3 – OIL FILTER

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. 41) (Fig. 42). DO NOT remove the through bolt.
(5) Remove the retaining bolts and nuts from the insulator.
(6) Remove the through bolt.
(7) Remove the insulator.

INSTALLATION

(1) If the engine support bracket was removed, position the bracket onto the block and install the attaching bolts (Fig. 41) (Fig. 42). Tighten the bolts to 50 N·m (37 ft. lbs.) torque.
(2) Place the insulator on the support bracket. Install the insulator retaining bolts and nuts. Tighten the bolts and nuts to 40 N·m (30 ft. lbs) torque.
(3) Install the through bolt and the retaining nut. Tighten the through bolt nut to 48 N·m (35 ft. lbs.) torque.
(4) Remove the engine support.
(5) Lower the vehicle.
(6) Connect negative cable to battery.

ENGINE MOUNT—REAR

A resilient rubber cushion bracket assembly supports the transmission at the rear. This bracket is attached to the crossmember.

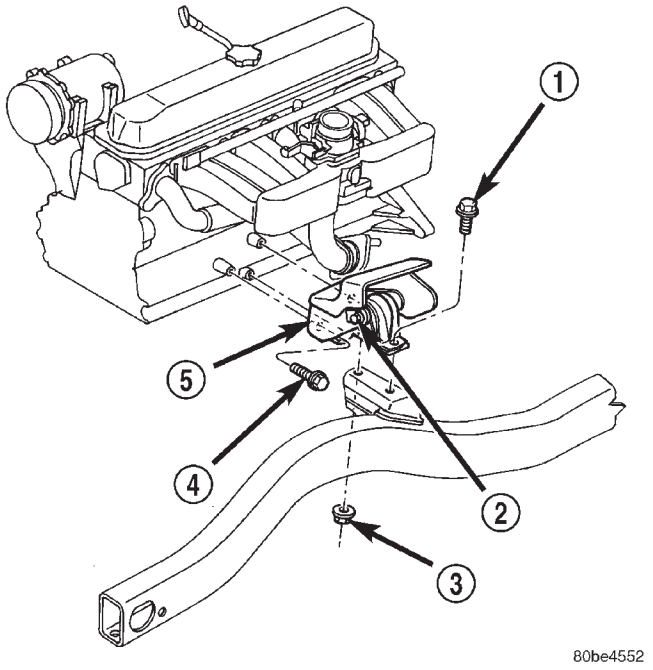


Fig. 41 Left Front Engine Mount

1 – **BOLT (2)**
2 – **THROUGH BOLT**
3 – **NUT (2)**
4 – **BOLT (3)**
5 – **LEFT HAND ENGINE MOUNT ASSEMBLY**

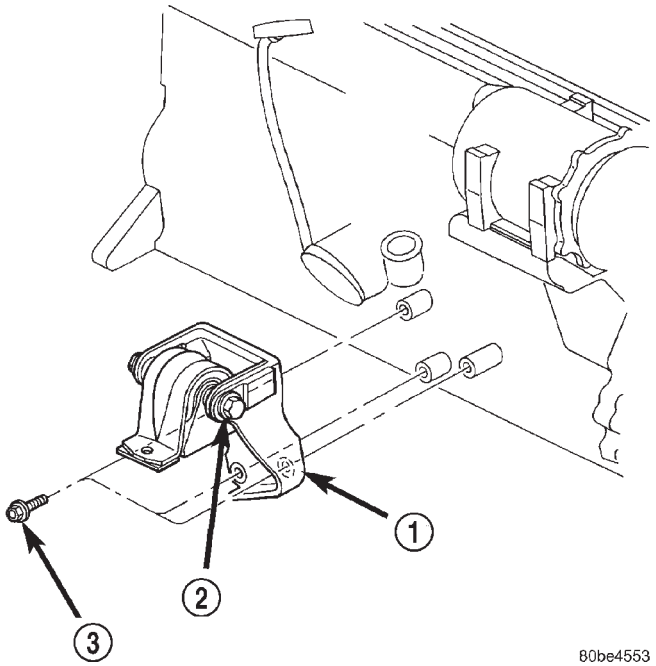


Fig. 42 Right Front Engine Mount

1 – **RIGHT HAND ENGINE MOUNT ASSEMBLY**
2 – **THROUGH BOLT**
3 – BOLT (3)

REMOVAL AND INSTALLATION (Continued)

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle and support the transmission.
(3) Remove the bolts holding the isolator mount assembly to the transmission (Fig. 43) (Fig. 44).
(4) Raise the transmission SLIGHTLY.
(5) Remove the through bolt and nut. Remove the rear isolator mount assembly.
(6) If necessary, remove the bolts holding the rear mount bracket to the crossmember.

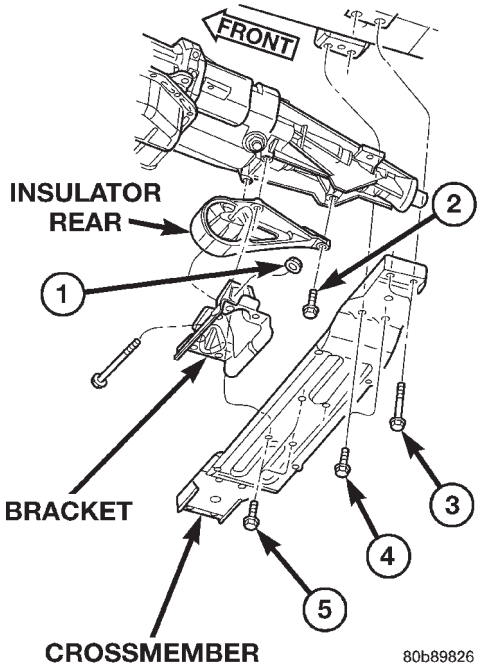


Fig. 43 Rear Engine Mount—(4X2)

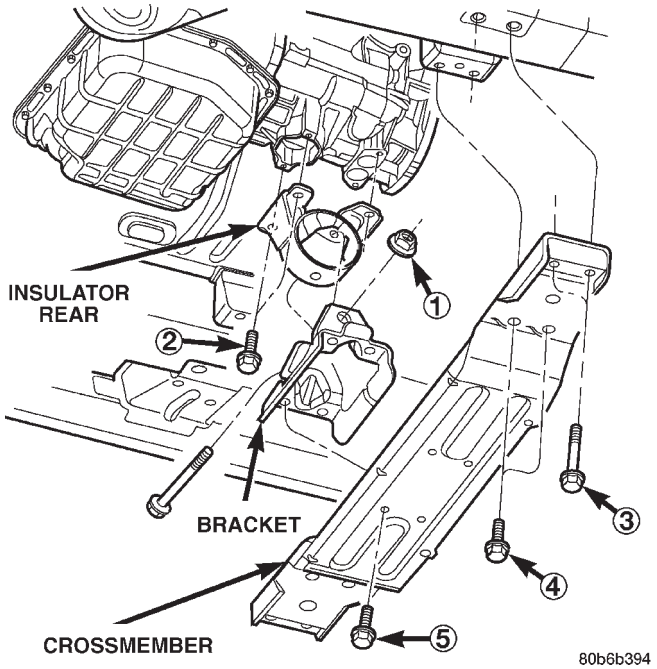


Fig. 44 Rear Engine Mount—(4X4)

ITEM	DESCRIPTON	TORQUE
1	NUT (Qty 1)	45 N·m (33 ft. lbs.)
2	BOLT (Qty 4)	46 N·m (34 ft. lbs.)
3	BOLT (Qty 2 Per Side)	68 N·m (50 ft. lbs.)
4	BOLT (Qty 2 Per Side)	46 N·m (34 ft. lbs.)
5	BOLT (Qty 4)	46 N·m (34 ft. lbs.)

INSTALLATION

(1) Position the rear mount bracket assembly onto the crossmember and install the bolts. Tighten the bolts to 46 N·m (34 ft. lbs.)
(2) Position isolator mount into mount bracket and install through bolt and nut. DO NOT tighten the bolt at this time.
(3) Lower the transmission.
(4) Remove the transmission support.
(5) Install the mount fastening bolts and tighten to 54 N·m (40 ft. lbs.) torque.
(6) Tighten the through bolt nut to 50 N·m (37 ft. lbs.).
(7) Lower the vehicle.
(8) Connect the negative cable to the battery.

ENGINE BENDING BRACES

REMOVAL

The engine bending braces are used to add strength to the powertrain and to address some minor NVH concerns.

NOTE: Before the engine or the transmission can be removed the engine bending braces must be removed.

(1) Raise and support vehicle.

NOTE: Both left and right side bending braces are removed the sameway. Only the right side is shown.

NOTE: The exhaust does not require removal to preform this procedure.

(2) Remove the exhaust hanger bracket retaining bolt.
(3) Remove locknut and transmission bending brace bar.
(4) Remove engine-to-bending brace retaining bolt, bending brace bar and cross bar.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

NOTE: DO NOT tighten the retaining hardware until all bending braces are in place.

(1) Position the cross brace into the engine-to-transmission brace, then position the engine-to-transmission brace and install retaining bolt.

(2) Position the transmission bending brace onto through brace and install new locknut.

(3) Position exhaust hanger and transmission brace, install retaining bolt (Fig. 46).

(4) Tighten engine-to-transmission brace retaining bolt (Fig. 45) to 40 N·m (30 ft. lbs.).

(5) Tighten transmission brace retaining bolts (Fig. 46) to 40 N·m (30 ft. lbs.), then tighten transmission brace retaining lock nuts (Fig. 46) to 108 N·m (80 ft. lbs.).

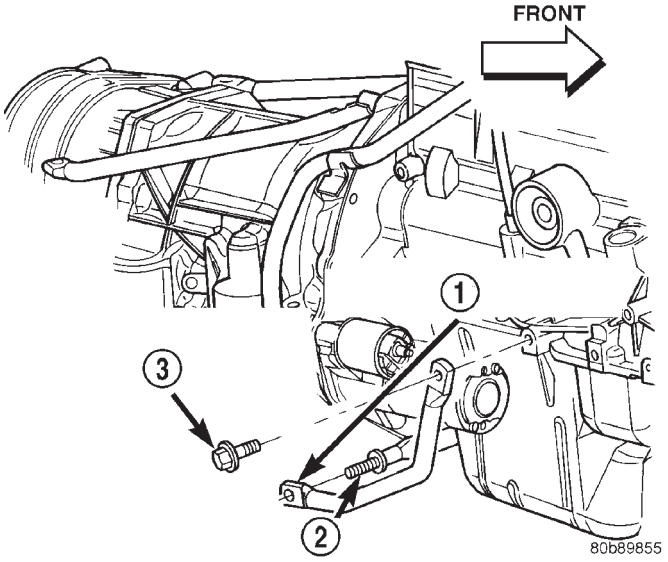


Fig. 45 Engine-to-Transmission Bending Braces

1 – ENGINE-TO-TRANSMISSION BENDING BRACE
2 – CROSS BRACE
3 – ENGINE-TO-TRANSMISSION BENDING BRACE RETAINING BOLT

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect the battery negative cable.

(2) Mark the hinge locations on the hood panel for alignment reference during installation. Remove the engine compartment lamp. Remove the hood.

(3) Remove the radiator drain cock and radiator cap to drain the coolant. DO NOT waste usable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(4) Remove the upper radiator hose and coolant recovery hose (Fig. 47).

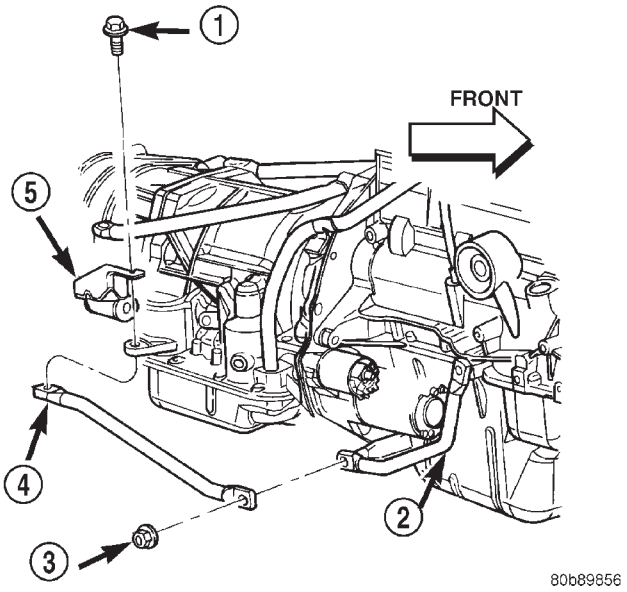


Fig. 46 Transmission Bending Braces and Exhaust Hanger

1 – TRANSMISSION BENDING BRACE RETAINING BOLT
2 – ENGINE-TO-TRANSMISSION BENDING BRACE
3 – LOCKNUT
4 – TRANSMISSION BRACE
5 – EXHAUST HANGER

(5) Remove the lower radiator hose.

(6) Remove upper radiator support retaining bolts and remove radiator support.

(7) Remove the fan assembly from the water pump.

(8) Remove the fan shroud (Fig. 47).

(9) Disconnect the transmission fluid cooler lines (automatic transmission).

(10) Discharge the A/C system. (Refer to Group 24, Heating and Air Conditioning)

(11) Remove the service valves and cap the compressor ports.

(12) Remove the radiator or radiator/condenser (if equipped with A/C).

(13) Disconnect the heater hoses at the engine thermostat housing and water pump (Fig. 47).

(14) Disconnect the accelerator cable, transmission line pressure cable and speed control cable (if equipped) from the throttle body (Fig. 48).

(15) Remove cables from the bracket and secure out of the way.

(16) Disconnect the body ground at the engine.

(17) Disconnect the following connectors and secure their harness out of the way.

- Power steering pressure switch
- Coolant temperature sensor
- Six (6) fuel injector connectors
- Intake air temperature sensor
- Throttle position sensor

REMOVAL AND INSTALLATION (Continued)

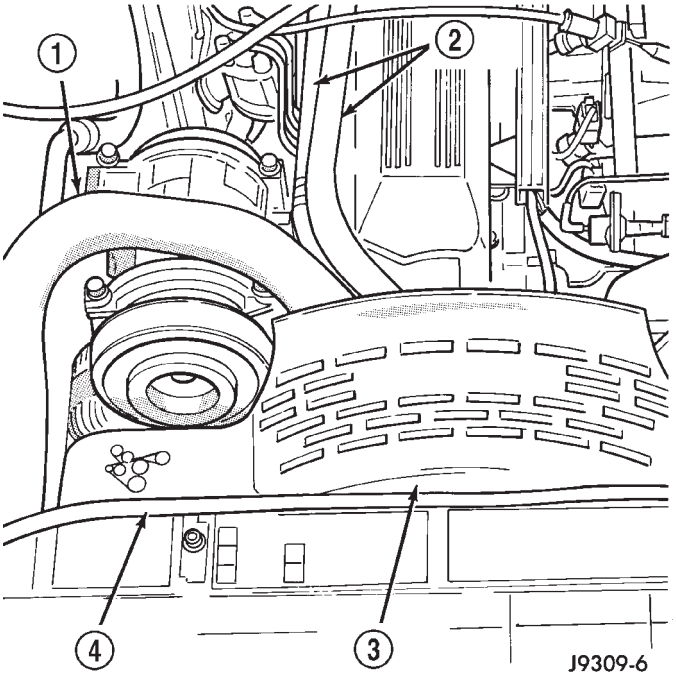


Fig. 47 Upper Radiator Hose, Coolant Recovery Hose, Fan Shroud & Heater hoses

1 – UPPER RADIATOR HOSE
2 – HEATER HOSES
3 – FAN SHROUD
4 – COOLANT RECOVERY HOSE

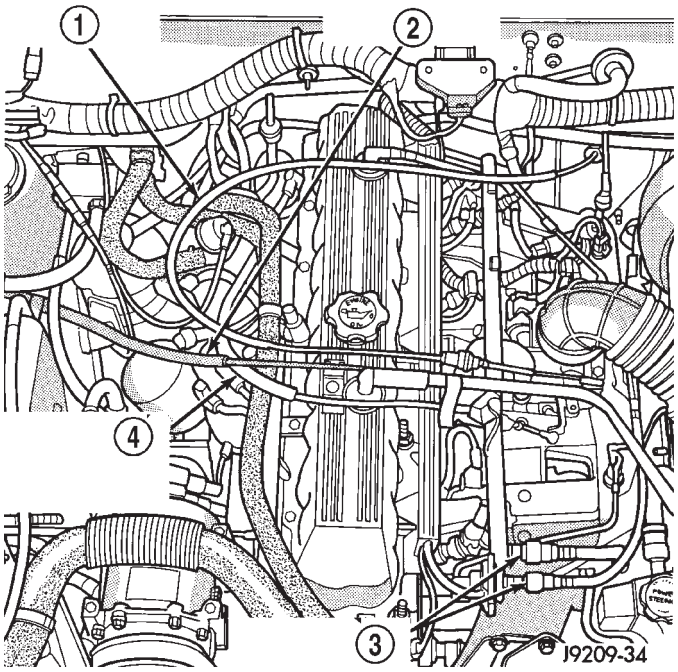


Fig. 48 Accelerator Cable, Vehicle Speed Control Cable, Automatic Transmission Control Cable & Quick-Connect Fuel Lines

1 – ACCELERATOR CABLE
2 – SPEED CONTROL CABLE
3 – QUICK-CONNECT FUEL LINES
4 – AUTOMATIC TRANSMISSION CONTROL CABLE

- Map sensor
- Crankshaft position sensor
- Oxygen sensor
- Camshaft position sensor
- Generator connector and B+ terminal wire

(18) Disconnect the coil rail electrical connections and the oil pressure switch connector.

(19) Perform the fuel pressure release procedure. (Refer to Group 14, Fuel System for correct procedure)

(20) Disconnect the fuel supply line at the injector rail. (Refer to Group 14, Quick-Connect Fittings for the correct procedure)

(21) Remove the fuel line bracket from the intake manifold.

(22) Remove the air cleaner assembly (Fig. 49).

(23) Disconnect the hoses from the fittings at the steering gear.

(24) Drain the pump reservoir.

(25) Cap the fittings on the hoses and steering gear to prevent foreign objects from entering the system.

(26) Raise and support the vehicle.

(27) Disconnect the wires from the engine starter motor solenoid.

(28) Remove the engine starter motor.

(29) Disconnect the oxygen sensor from the exhaust pipe.

(30) Disconnect the exhaust pipe from the manifold.

(31) Remove the exhaust pipe support.

(32) Remove the bending brace. Refer to Engine Bending Brace in this section for procedure.

(33) Remove the engine flywheel/converter housing access cover.

(34) Mark the converter and drive plate location.

(35) Remove the converter-to-drive plate bolts.

(36) Remove the upper engine flywheel/converter housing bolts and loosen the bottom bolts.

(37) Remove the engine mount cushion-to-engine compartment bracket bolts.

(38) Lower the vehicle.

(39) Attach a lifting device to the engine.

(40) Raise the engine off the front supports.

(41) Place a support or floor jack under the converter (or engine flywheel) housing.

(42) Remove the remaining converter (or engine flywheel) housing bolts.

(43) Lift the engine out of the engine compartment.

REMOVAL AND INSTALLATION (Continued)

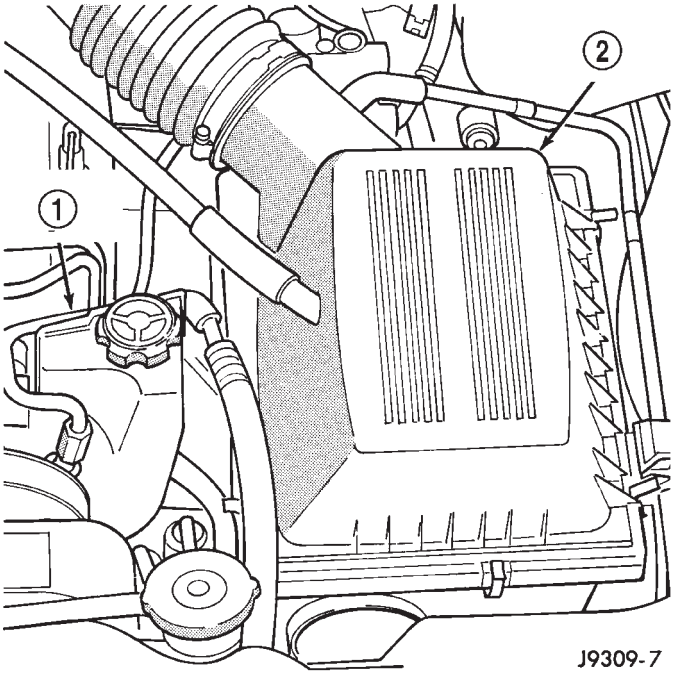


Fig. 49 Air Cleaner Assembly & Power Steering Pump

1 – POWER STEERING PUMP
2 – AIR CLEANER ASSEMBLY

INSTALLATION

CAUTION: When installing the engine into a vehicle equipped with an automatic transmission, be careful not to damage the trigger wheel on the engine flywheel.

(1) Attach a lifting device to the engine and lower the engine into the engine compartment. For easier installation, it may be necessary to remove the engine mount bracket as an aid in alignment of the engine to the transmission.

(2) Align the transmission torque converter housing with the engine.

(3) Loosely install the converter housing lower bolts and install the next higher bolt and nut on each side.

(4) Tighten all 4 bolts finger tight.

(5) Install the engine mount brackets (if removed).

(6) Lower the engine and engine mount brackets onto the engine compartment cushions. Install the bolts and finger tighten the nuts.

(7) Remove the engine lifting device.

(8) Raise and support the vehicle.

(9) Install the remaining engine flywheel/converter housing bolts. Tighten all bolts to 38 N·m (28 ft. lbs.) torque.

(10) Install the converter-to-drive plate bolts.

(11) Ensure the installation reference marks are aligned.

(12) Install the engine flywheel/converter housing access cover.

(13) Install the exhaust pipe support and tighten the screw.

(14) Install the engine bending brace.

(15) Tighten the engine mount-to-bracket bolts.

(16) Connect the vehicle speed sensor wire connections and tighten the screws.

(17) Connect the exhaust pipe to the manifold.

(18) Install the engine starter motor and connect the cable.

(19) Connect the wires to the engine starter motor solenoid.

(20) Lower the vehicle.

(21) Connect all the vacuum hoses and wire connectors identified during engine removal.

(22) Remove protective caps from the power steering hoses.

(23) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.

(24) Fill the pump reservoir with fluid.

(25) Inspect the fuel supply line o-ring(s) and replace if necessary. Connect fuel supply line to injectior rail and verify connection by pulling outward on the line.

(26) Install the fuel line bracket to the intake manifold.

(27) Connect the coil rail electrical connectors and oil pressure switch connector.

(28) Connect the following electrical connectors:

- Power steering pressure switch
- Coolant temperature sensor
- Six (6) fuel injector connectors
- Intake air temperature sensor
- Throttle position sensor
- Map sensor
- Crankshaft position sensor
- Oxygen sensor
- Camshaft position sensor
- Generator connector and B+ terminal wire

(29) Connect all previously removed vacuum hoses.

(30) Connect the body ground strap.

(31) Install the throttle, transmission line pressure, and speed control cables to their mounting bracket and connect them to the throttle body.

(32) Connect the heater hoses at the engine thermostat housing and water pump.

(33) Install the fan assembly to the water pump.

(34) Place the fan shroud in position over the fan.

(35) Install the radiator or radiator/condenser.

(36) Connect the service valves to the A/C compressor ports, if equipped with A/C.

REMOVAL AND INSTALLATION (Continued)

(37) Charge the air conditioner system (refer to Group 24, Heating and Air Conditioning).
(38) Connect the radiator hoses and automatic transmission fluid cooler pipes, if equipped.
(39) Install the fan shroud to the radiator or radiator/condenser (if equipped with A/C).
(40) Install upper radiator support.
(41) Connect the upper radiator hose and tighten the clamp.
(42) Connect the lower radiator hose and tighten the clamp.
(43) Fill crankcase with engine oil. (Refer to Group 0, Lubrication and Maintenance for correct capacities.)
(44) Fill the cooling system with reusable coolant or new coolant (refer to Group 7, Cooling System).
(45) Align the hood to the scribe marks. Install the hood.
(46) Install the air cleaner assembly.
(47) Install the battery and connect the battery cable.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(48) Start the engine, inspect for leaks and correct the fluid levels, as necessary.

INTAKE AND EXHAUST MANIFOLD

REMOVAL

NOTE: THE ENGINE INTAKE AND EXHAUST MANIFOLD MUST BE REMOVED AND INSTALLED TOGETHER. THE MANIFOLDS USE A COMMON GASKET AT THE CYLINDER HEAD.

(1) Disconnect the battery negative cable.
(2) Remove air cleaner inlet hose from throttle body assembly.
(3) Remove the air cleaner assembly.
(4) Remove the throttle cable, vehicle speed control cable (if equipped) and the transmission line pressure cable.
(5) Disconnect the following electrical connections and secure their harness out of the way:
- Throttle Position Sensor
- Idle Air Control Motor
- Coolant Temperature Sensor (at thermostat housing)
- Intake Air Temperature Sensor
- Oxygen Sensor
- Crank Position Sensor
- Six (6) Fuel Injector Connectors

(6) Disconnect the Map Sensor, HVAC, and Brake Booster vacuum supply hoses at the intake manifold.
(7) Perform the fuel pressure release procedure. (Refer to Group 14, Fuel Systems for correct procedure)
(8) Disconnect and remove the fuel system supply line from the fuel rail assembly. (Refer to Group 14, Quick Connect Fittings for correct procedures)
(9) Remove the accessory drive belt (refer to Group 7, Cooling System). Loosen the tensioner.
(10) Remove the power steering pump and bracket from the intake manifold and set aside.
(11) Raise the vehicle.
(12) Disconnect the exhaust pipes from the engine exhaust manifolds.
(13) Lower the vehicle.
(14) Remove the intake manifold and engine exhaust manifolds.

INSTALLATION

If the manifold is being replaced, ensure all the fitting, etc. are transferred to the replacement manifold.
(1) Install a new engine exhaust/intake manifold gasket over the alignment dowels on the cylinder head.
(2) Position the engine exhaust manifolds to the cylinder head. Install fastener Number 3 and finger tighten at this time (Fig. 50).
(3) Install intake manifold on the cylinder head dowels.
(4) Install washer and fastener Numbers 1, 2, 4, 5, 8, 9, 10 and 11 (Fig. 50).
(5) Install washer and fastener Numbers 6 and 7 (Fig. 50).
(6) Tighten the fasteners in sequence and to the specified torque (Fig. 50).
- Fastener Numbers 1 through 5—Tighten to 33 N·m (24 ft. lbs.) torque.
- Fastener Numbers 6 and 7—Tighten to 14 N·m (126 in. lbs.) torque.
- Fastener Numbers 8 through 11—Tighten to 33 N·m (24 ft. lbs.) torque.

(7) Install the power steering pump and bracket to the intake manifold. Tighten the belt to specification. (Refer to Group 7, Cooling System for the correct procedures)
(8) Install the fuel system supply line to the fuel rail assembly. **Before connecting the fuel supply line to the fuel rail inspect the O-rings and replace if necessary. Refer to Group 14, Fuel System for the correct procedure.**
(9) Connect all electrical connections on the intake manifold.
(10) Connect the vacuum hoses previously removed.

REMOVAL AND INSTALLATION (Continued)

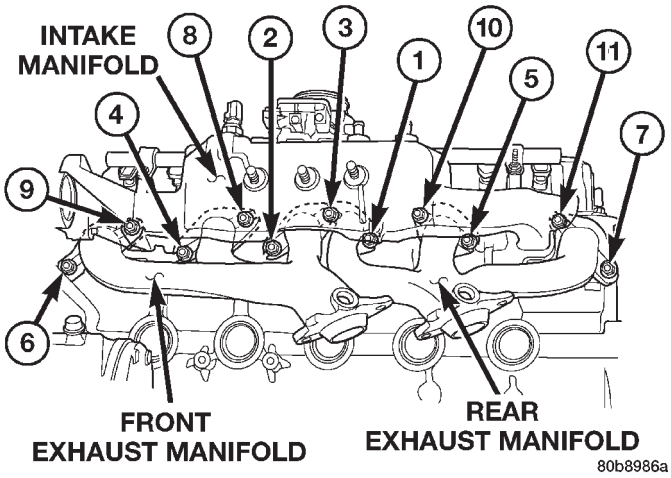


Fig. 50 Intake and Exhaust Manifolds—4.0L

(11) Install throttle cable, vehicle speed control cable (if equipped).

(12) Install the transmission line pressure cable (if equipped). Refer to Group 21, Transmission for the adjustment procedures.

(13) Install air cleaner assembly.

(14) Connect air inlet hose to the throttle body assembly.

(15) Raise the vehicle.

(16) Connect the exhaust pipes to the engine exhaust manifolds. Tighten the bolts to 31 N·m (23 ft. lbs.)

(17) Lower the vehicle.

(18) Connect the battery negative cable.

(19) Start the engine and check for leaks.

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. 52)

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. 51).

(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.

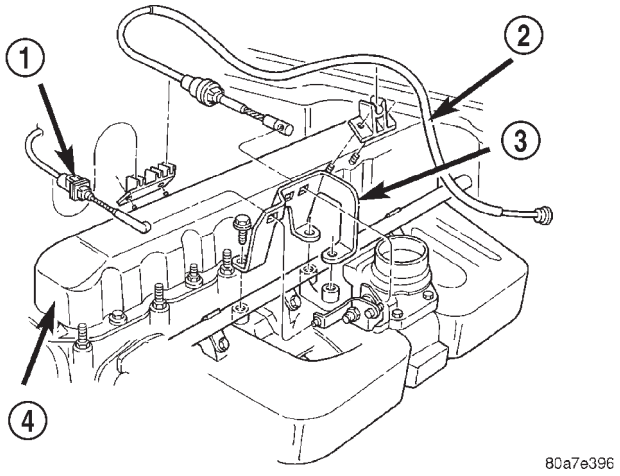


Fig. 51 Engine Cylinder Head Cover

1 – TRANS CONTROL CABLE
2 – ACCELERATOR CABLE
3 – CONTROL CABLE BRACKET
4 – CYLINDER HEAD COVER

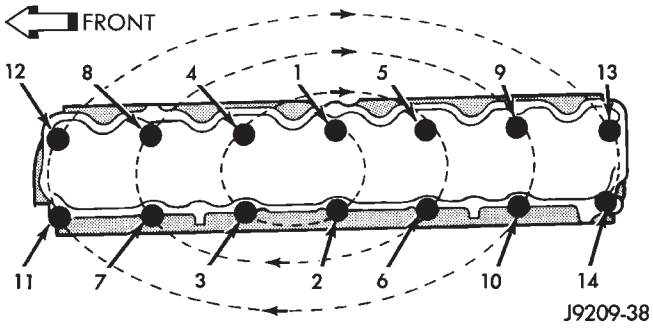


Fig. 52 Cylinder Head Cover Gasket Locator Pins at #8 & #9

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.

REMOVAL AND INSTALLATION (Continued)

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. 53). 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. 53). 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.

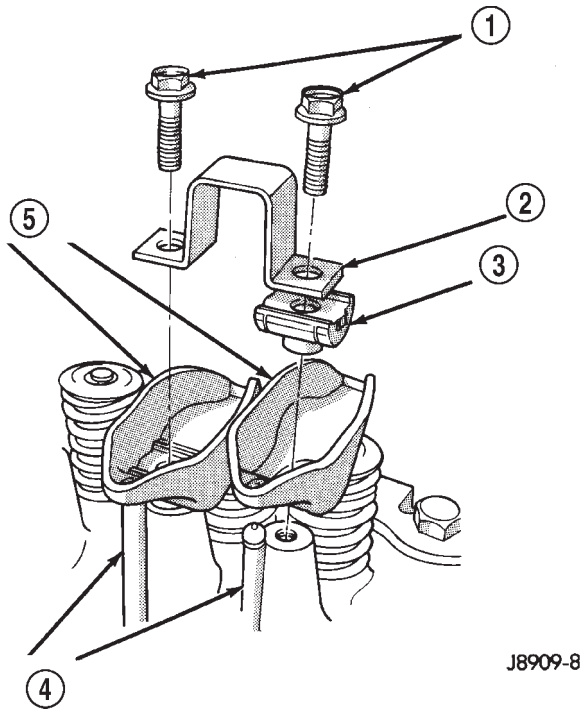


Fig. 53 Rocker Arm Assembly

1 – CAPSCREWS
2 – BRIDGE
3 – PIVOT ASSEMBLY
4 – PUSH RODS
5 – ROCKER ARMS

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 STEM SEAL AND SPRING

This procedure can be done with the engine cylinder head installed on the block.

REMOVAL

Inspect the valve stems, especially the grooves for nicks, and high spots. If excessive nicks or high spots are found the valve or valves should be replaced.

Each valve spring is held in place by a retainer and a set of conical valve locks. The locks can be removed only by compressing the valve spring.

(1) Remove the engine cylinder head cover.

(2) Remove capscrews, bridge and pivot assemblies and rocker arms for access to each valve spring to be removed.

(3) Remove push rods. **Retain the push rods, bridges, pivots and rocker arms in the same order and position as removed.**

(4) Inspect the springs and retainer for cracks and possible signs of weakening.

(5) Remove the spark plug(s) adjacent to the cylinder(s) below the valve springs to be removed.

(6) Connect an air hose to the adapter and apply air pressure slowly. Maintain at least 621 kPa (90 psi) of air pressure in the cylinder to hold the valves against their seats. For vehicles equipped with an air conditioner, use a flexible air adaptor when servicing the No.1 cylinder.

(7) Tap the retainer or tip with a rawhide hammer to loosen the lock from the retainer. Use Valve Spring Compressor Tool MD-998772A to compress the spring and remove the locks (Fig. 54).

(8) Remove valve spring and retainer (Fig. 54).

(9) Remove valve stem oil seals (Fig. 54). Note the valve seals are different for intake and exhaust valves. The top of each seal is marked either INT (Intake) or EXH (Exhaust). DO NOT mix the seals.

NOTE: If valves, valve springs or seals are to be inspected / replaced at this time, refer to Valves and Valve Springs in this section for proper inspection procedures.

INSTALLATION

CAUTION: Install oil seals carefully to prevent damage from the sharp edges of the valve spring lock grove.

REMOVAL AND INSTALLATION (Continued)

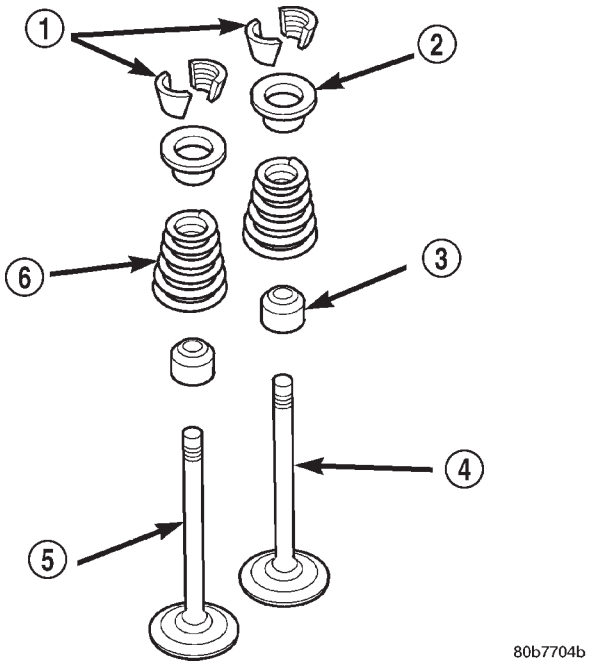


Fig. 54 Valve and Valve Components

1 – VALVE LOCKS (3–BEAD)
2 – RETAINER
3 – VALVE STEM OIL SEAL
4 – INTAKE VALVE
5 – EXHAUST VALVE
6 – VALVE SPRING

(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 capscrews alternately, one at a time, to avoid damaging the bridge. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(9) Install the engine cylinder head cover.

CYLINDER HEAD

This procedure can be done with the engine in or out of the vehicle.

REMOVAL

(1) Disconnect the battery negative 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 coolant and disconnect the hoses at the engine thermostat housing and the water pump inlet. DO NOT waste reusable coolant. If the solution is clean and is being drained only to service the engine or cooling system, drain the coolant into a clean container for reuse.

(3) Remove the air cleaner assembly.

(4) Remove the engine cylinder head cover.

(5) Remove the capscrews, bridge and pivot assemblies and rocker arms.

(6) Remove the push rods. **Retain the push rods, bridges, pivots and rocker arms in the same order as removed.**

(7) Loosen the accessory drive belt at the power steering pump. (Refer to Group 7, Cooling System for the correct procedure). Slip the belt off of the power steering pulley.

(8) Remove the A/C compressor mounting bolts and secure the compressor to the side.

(9) Remove the power steering pump and bracket from the intake manifold and water pump. 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) Disconnect the fuel supply line at the fuel rail. (Refer to Group 14, Quick-Connect Fittings for the correct procedures)

(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 coil rail electrical connectors and remove the coil rail.

(14) Remove spark plugs.

(15) Disconnect the temperature sending unit wire connector.

(16) Remove the engine cylinder head bolts. Bolt No.14 cannot be removed until the head is moved forward (Fig. 55). Pull bolt No.14 out as far as it will go and then suspend the bolt in this position (tape around the bolt).

REMOVAL AND INSTALLATION (Continued)

(17) Remove the engine cylinder head and gasket (Fig. 55).

(18) If this was the first time the bolts were removed, put a paint dab on the top of the bolt. If the bolts have a paint dab on the top of the bolt or it isn't known if they were used before, discard the bolts.

(19) Stuff clean lint free shop towels into the cylinder bores.

NOTE: If the valves, springs, or seals are to be inspected/replaced at this time, refer to Valves and Valve Springs in this section for proper inspection procedures.

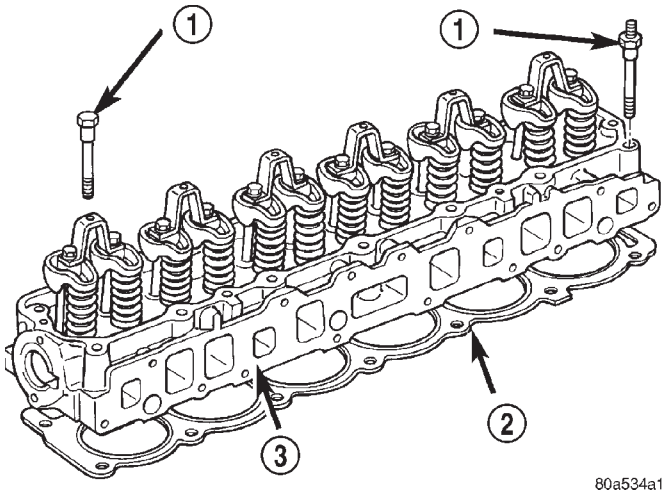


Fig. 55 Engine Cylinder Head Assembly

1 – CYLINDER HEAD BOLTS
2 – CYLINDER HEAD GASKET
3 – CYLINDER HEAD

INSTALLATION

The engine cylinder head gasket is a composition gasket. The gasket is to be installed DRY. **DO NOT use a gasket sealing compound on the gasket.**

If the engine cylinder head is to be replaced and the original valves used, measure the valve stem diameter. Only standard size valves can be used with a service replacement engine cylinder head unless the replacement head valve stem guide bores are reamed to accommodate oversize valve stems. Remove all carbon buildup and reface the valves.

(1) Remove the shop towels from the cylinder bores. Coat the bores with clean engine oil.

(2) Position the engine cylinder head gasket (with the numbers facing up) using the alignment dowels in the cylinder block, to position the gasket.

CAUTION: Engine cylinder head bolts should be reused only once. Replace the head bolts if they were used before or if they have a paint dab on the top of the bolt.

(3) With bolt No.14 held in place (tape around bolt), install the engine cylinder head over the same dowels used to locate the gasket. Remove the tape from bolt No.14.

(4) Coat the threads of stud bolt No.11 with Loctite 592 sealant, or equivalent.

(5) Tighten the engine cylinder head bolts in sequence according to the following procedure (Fig. 56).

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 135 N·m (100 ft. lbs.) torque.
- Bolts 12 through 14 to 149 N·m (110 ft. lbs.) torque.

CYLINDER HEAD BOLTS

POSITION	DESCRIPTION
1,4,5,12,13	1/2 in.-13 BOLT
8,9	1/2 in.-13 BOLT WITH DOWEL POINT
2,3,6,7,10,11,14	1/2 in.-13 WITH 7/16 in.-14 STUD END
All bolts are 12 point drives for rocker cover clearance	

(e) Check all bolts in sequence to verify the correct torque.

(f) If not already done, clean and mark each bolt with a dab of paint after tightening. Should you encounter bolts which were painted in an earlier service operation, replace them.

(6) Install the spark plugs and tighten to 37 N·m (27 ft. lbs.) torque.

(7) Connect the temperature sending unit wire connector.

(8) Install the ignition coil rail and coil rail electrical connectors.

(9) Install the intake and engine exhaust manifolds (refer to procedures in this section).

(10) Install the fuel line and the vacuum advance hose.

(11) Attach the power steering pump and bracket.

REMOVAL AND INSTALLATION (Continued)

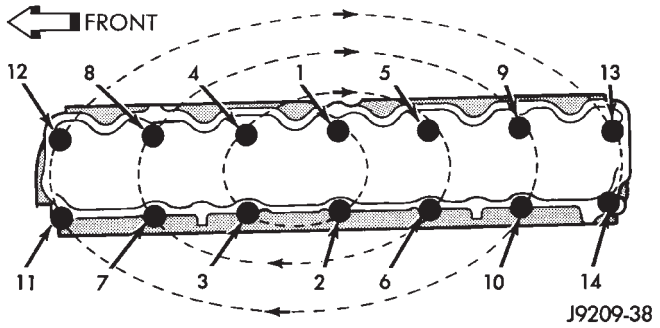


Fig. 56 Engine Cylinder Head Bolt Tightening Sequence

(12) Install the push rods, rocker arms, pivots and bridges in the order they were removed (refer to Rocker Arms and Push Rods in this section).

(13) Install the engine cylinder head cover.

(14) Attach the air conditioner compressor mounting bracket to the engine cylinder head and block. Tighten the bolts to 40 N·m (30 ft. lbs.) torque.

(15) Attach the air conditioning compressor to the bracket. Tighten the bolts to 27 N·m (20 ft. lbs.) torque.

CAUTION: The serpentine drive belt must be routed correctly. Incorrect routing can cause the water pump to turn in the opposite direction causing the engine to overheat.

(16) Install the serpentine drive belt. (refer to Group 7, Cooling System for the proper procedure).

(17) Install the air cleaner and ducting.

(18) 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).

(19) 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).

(20) Install the temperature sending unit and connect the wire connector.

(21) If equipped with air conditioning, install A/C compressor and charge A/C system (refer to Group 24 Heating and Air Conditioning).

(22) Connect negative cable to battery.

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.

(23) 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. 57).

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.

REMOVAL AND INSTALLATION (Continued)

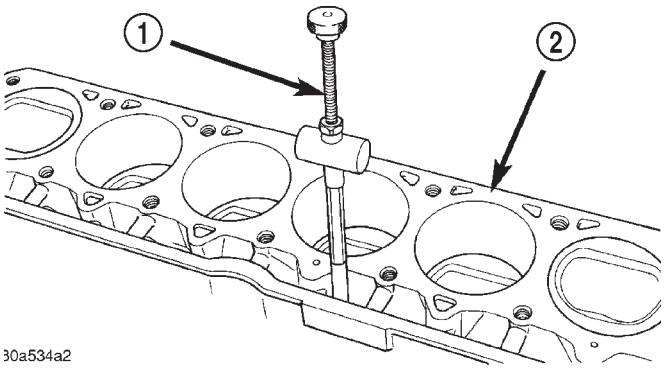


Fig. 57 Hydraulic Valve Tappet Removal—Installation Tool

1 – HYDRAULIC TAPPET REMOVAL TOOL
2 – CYLINDER BLOCK

(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. Refer to Group 7, Cooling Systems for the procedures.

(3) Remove the vibration damper retaining bolt and washer.

(4) Use Vibration Damper Removal Tool 7697 to remove the damper from the crankshaft (Fig. 58).

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.

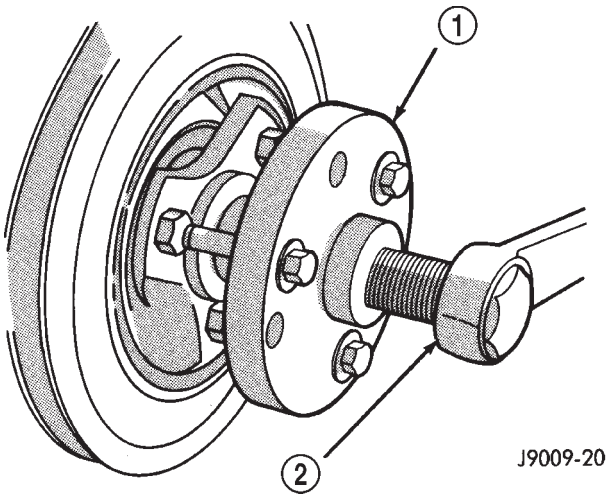


Fig. 58 Vibration Damper Removal Tool 7697

1 – VIBRATION DAMPER REMOVAL TOOL
2 – WRENCH

(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. (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. 59).

INSTALLATION

Clean the timing case cover, oil pan and cylinder block gasket surfaces.

(1) Install a new crankshaft oil seal in the timing case cover. The open end of the seal should be toward the inside of the cover. Support the cover at the seal area while installing the seal. Force it into position with Seal Installation Tool 6139.

REMOVAL AND INSTALLATION (Continued)

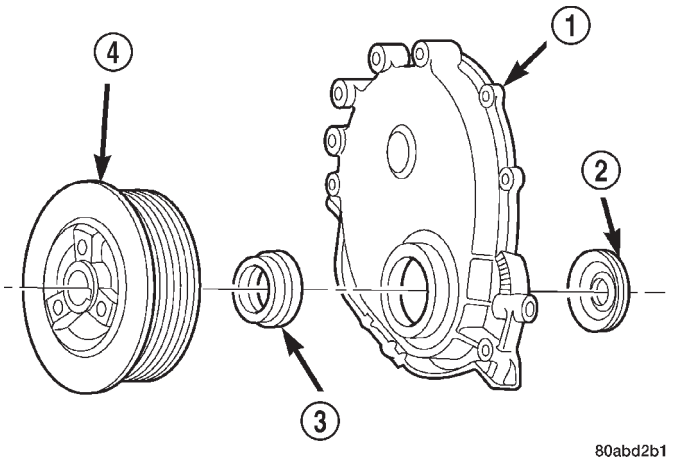


Fig. 59 Timing Case Cover Components

1 – TIMING CASE COVER
2 – OIL SLINGER
3 – CRANKSHAFT OIL SEAL
4 – VIBRATION DAMPER PULLEY

(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. 60).

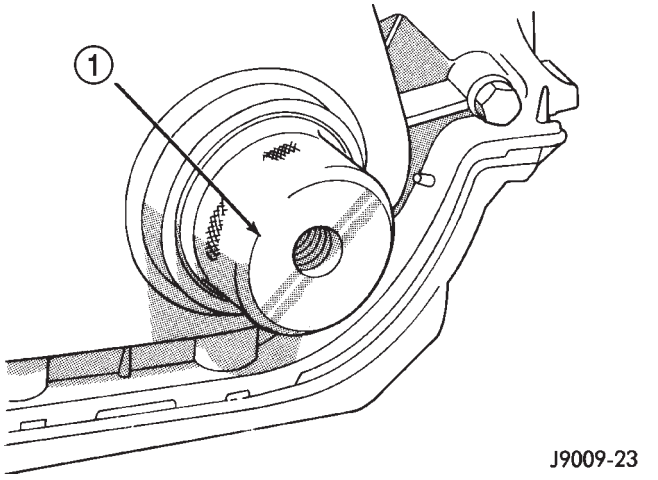


Fig. 60 Timing Case Cover Alignment and Seal Installation Tool 6139

1 – TIMING CASE COVER ALIGNMENT AND SEAL INSTALLATION TOOL

(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.

(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. 61).

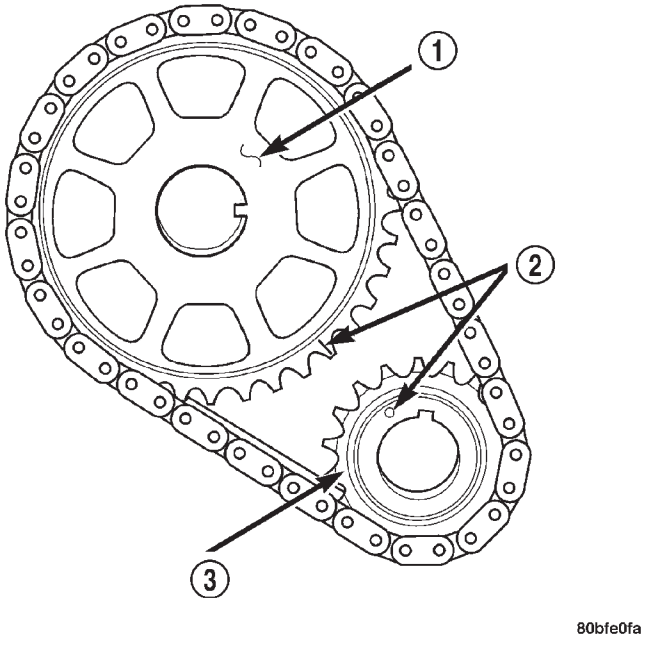


Fig. 61 Crankshaft—Camshaft Alignment

1 – **CAMSHAFT SPROCKET**
2 – **TIMING MARKS**
3 – **CRANKSHAFT SPROCKET**

(7) Remove the oil slinger from the crankshaft.

(8) Remove the camshaft sprocket bolt and washer (Fig. 62).

REMOVAL AND INSTALLATION (Continued)

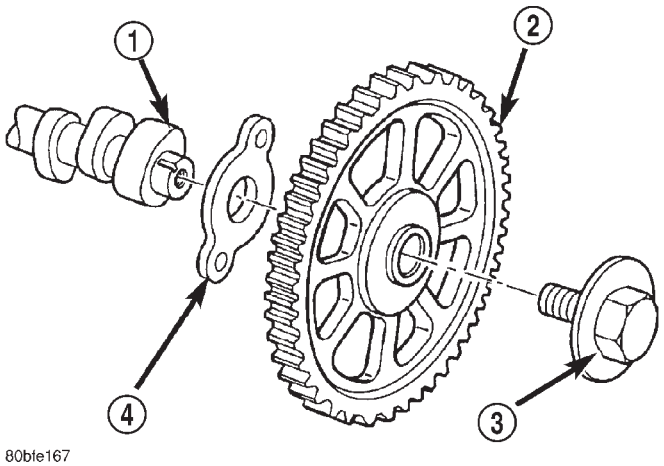


Fig. 62 Camshaft Sprocket and Thrust Plate

1 – CAMSHAFT
2 – CAMSHAFT SPROCKET W/ INTEGRAL KEY
3 – BOLT & CUP WASHER
4 – 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 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. 61).

(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. 62). 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. 61).

(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. (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 engine cylinder head cover.

(5) Remove the rocker arms, bridges and pivots.

(6) Remove the push rods.

(7) Remove the engine cylinder head and gasket.

(8) Remove the hydraulic valve tappets from the engine cylinder block.

(9) Remove the vibration damper.

(10) Remove the timing case cover.

(11) Rotate the crankshaft until the crankshaft sprocket timing mark is aligned on centerline with the camshaft sprocket timing mark (Fig. 64).

(12) Remove the timing chain and sprockets.

(13) Remove the front bumper and/or grille, as required.

(14) Remove the two thrust plate retaining screws, thrust plate and camshaft (Fig. 63).

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. 63).

(8) Position thrust plate and install 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.).

REMOVAL AND INSTALLATION (Continued)

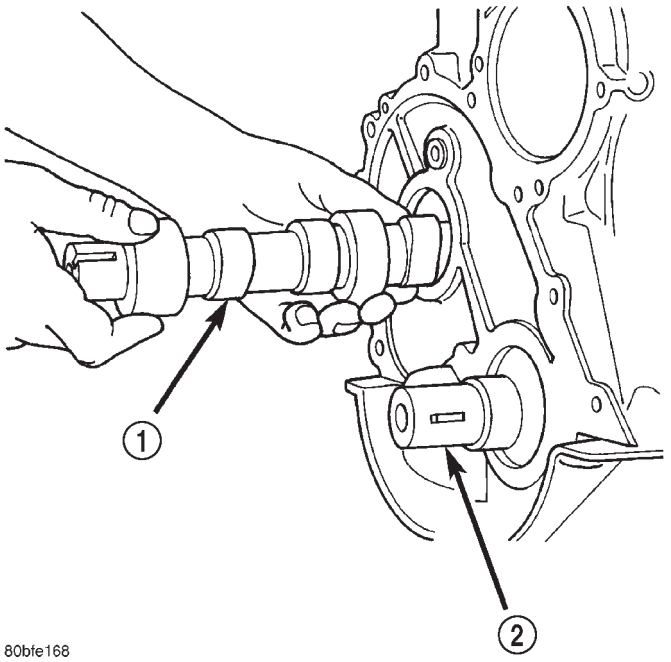


Fig. 63 Camshaft

1 – CAMSHAFT
2 – CRANKSHAFT

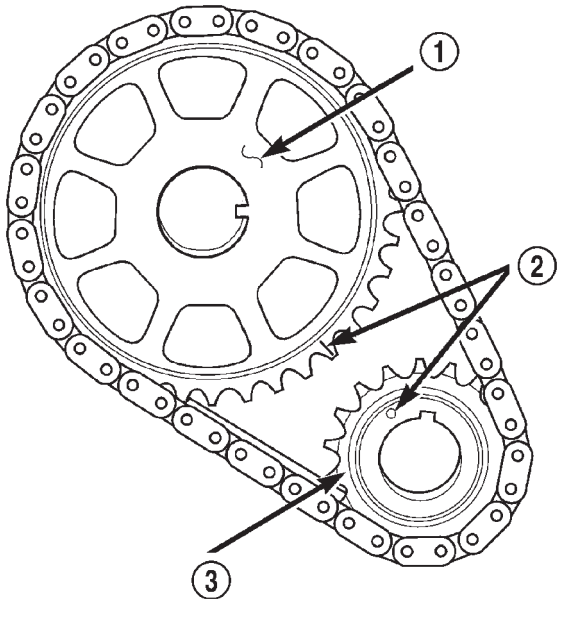


Fig. 64 Crankshaft / Camshaft Sprocket Timing Mark Alignment

1 – **CAMSHAFT SPROCKET**
2 – **TIMING MARKS**
3 – **CRANKSHAFT SPROCKET**

(11) Install the timing case cover with a replacement oil seal (Fig. 65). Refer to Timing Case Cover Installation.

(12) Install the vibration damper (Fig. 65).

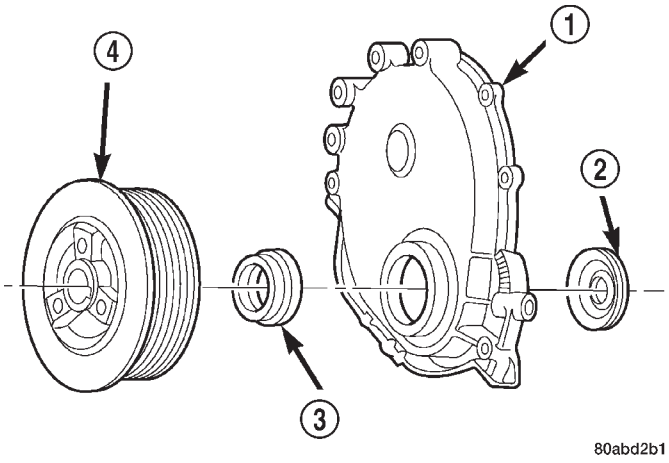


Fig. 65 Timing Case Cover Components

1 – TIMING CASE COVER
2 – OIL SLINGER
3 – CRANKSHAFT OIL SEAL
4 – VIBRATION DAMPER PULLEY

(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).

(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) Install the serpentine drive belt. (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.

(20) 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).

(21) Check the ignition timing and adjust as necessary.

(22) Install the grille and bumper, if removed.

(23) Connect negative cable to battery.

REMOVAL AND INSTALLATION (Continued)

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, such as recommended tool 8544 Camshaft Bushing Remover Installer.

(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 in (Fig. 66).

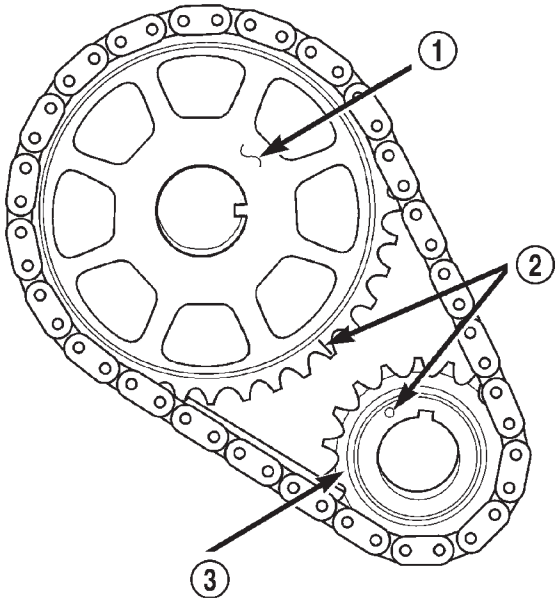


Fig. 66 Crankshaft / Camshaft Chain Drive Installation—Typical

1 – **CAMSHAFT SPROCKET**
2 – **TIMING MARKS**
3 – **CRANKSHAFT SPROCKET**

(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 main bearing cap brace (Fig. 67).

(6) Remove only one main bearing cap and lower insert at a time (Fig. 68).

(7) Remove the lower insert from the bearing cap.

(8) Remove the upper insert by LOOSENING (DO NOT REMOVE) all of the other bearing caps. Now insert a small cotter pin tool in the crankshaft journal oil hole. Bend the cotter pin as illustrated to fabricate the tool (Fig. 69). 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. 69). After moving

REMOVAL AND INSTALLATION (Continued)

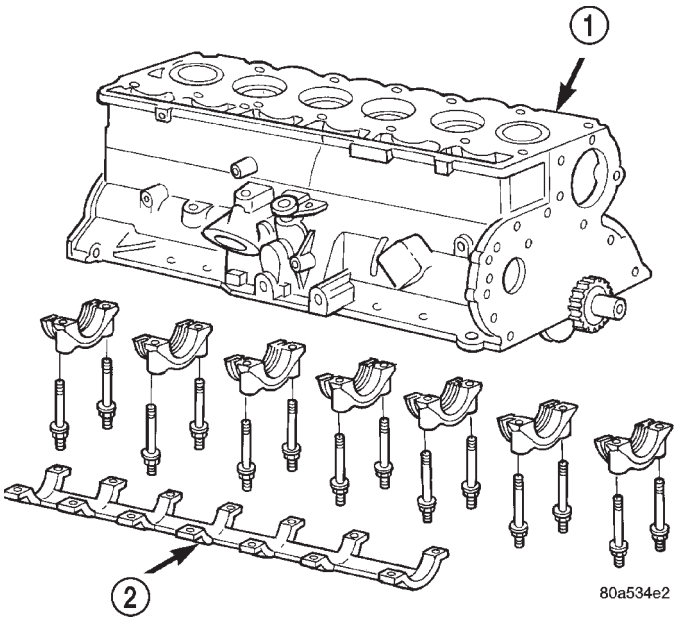


Fig. 67 Main Bearing Caps and Brace.

1 – BLOCK
2 – MAIN BEARING CAP BRACE

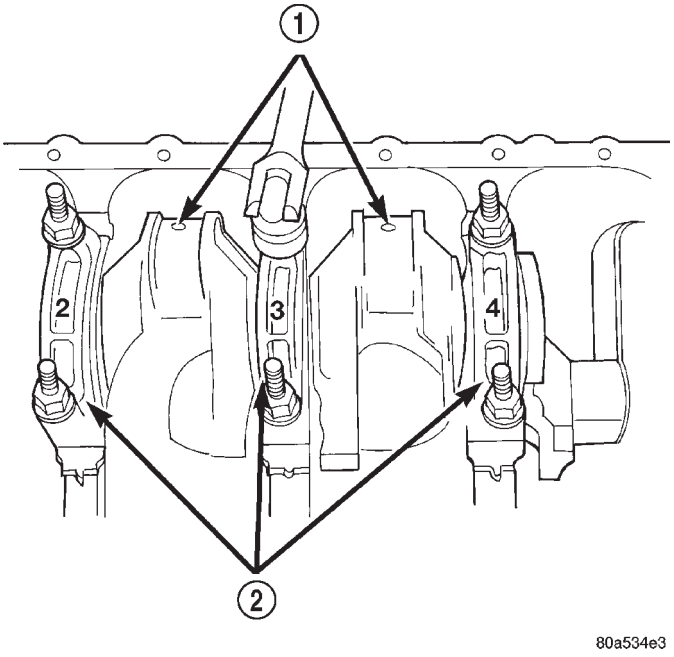


Fig. 68 Removing Main Bearing Caps and Lower Inserts

1 – CONNECTING ROD JOURNAL
2 – MAIN BEARING CAPS

the insert approximately 25 mm (1 inch), it can be removed by applying pressure under the tab.

(9) Using the same procedure described above, remove the remaining bearing inserts one at a time for inspection.

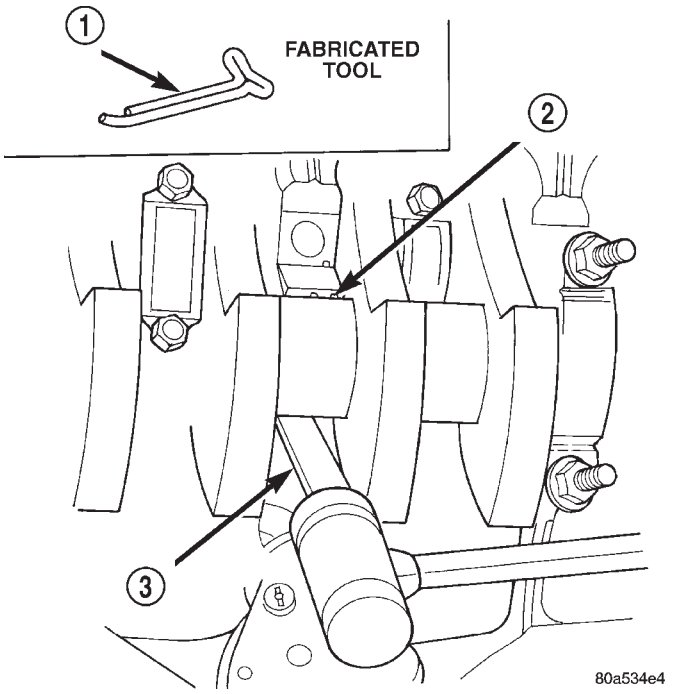


Fig. 69 Removing Upper Inserts

1 – COTTER PIN
2 – BEARING INSERT
3 – TONGUE DEPRESSOR

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) On the rear main cap, apply Mopar® Gasket Maker sealer on both sides of cylinder block as shown in (Fig. 70). The dab of sealer should be 3 mm (0.125 in.) in diameter.

(5) Apply Mopar® Gasket Maker on the rear bearing cap. The bead should be 2.3 mm (0.09 in.) in diameter. DO NOT apply sealer to the lip of the seal.

(6) Install the main bearing cap(s) and lower insert(s).

(7) 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.

(8) 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.

(9) Rotate the crankshaft after tightening each main bearing cap to ensure the crankshaft rotates freely.

REMOVAL AND INSTALLATION (Continued)

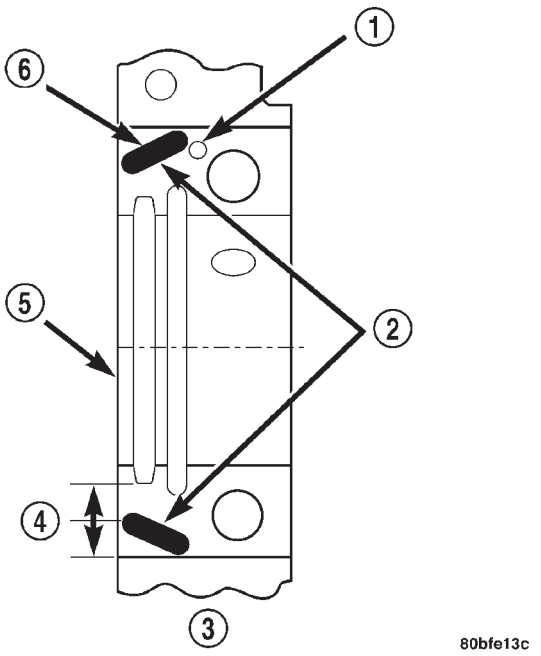


Fig. 70 Location of Sealer

1 – **DOWEL**
2 – **SEALER LOCATIONS**
3 – **CYLINDER BLOCK**
4 – **HALFWAY BETWEEN**
5 – **REAR FACE OF CYLINDER BLOCK**
6 – **3mm (0.125 in.)**

(10) 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. 71). 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.

(11) If the crankshaft was removed, install the crankshaft into the cylinder block (refer to Cylinder Block - Assemble).

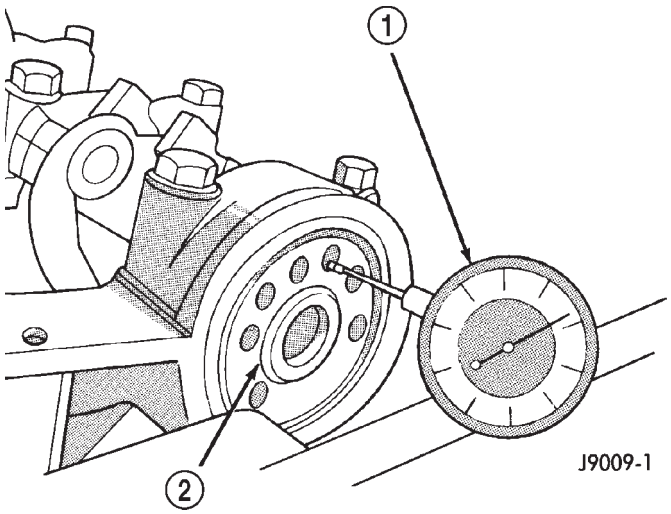


Fig. 71 Crankshaft End Play Measurement

1 – DIAL INDICATOR
2 – CRANKSHAFT

(12) Install main bearing cap brace tighten nuts to 47 N·m (35 ft. lbs.) torque.

(13) Install oil pump assy. and tighten attaching bolts to 23 N·m (17 ft. lbs.)

(14) Install the oil pan.

(15) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(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 full mark on the dipstick level.

(19) 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.

REMOVAL AND INSTALLATION (Continued)

(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. 72).

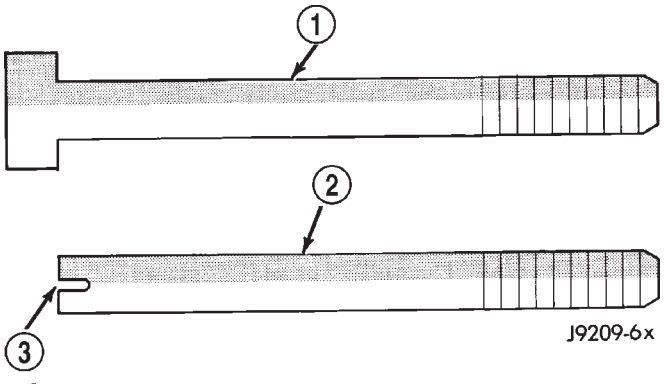


Fig. 72 Fabrication of Alignment Dowels

1 – 1/4'' × 1 1/2'' BOLT
2 – DOWEL
3 – SLOT

(3) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 73).

(4) Apply Mopar® Silicone Rubber Adhesive Sealant on cylinder block to rear main bearing cap corners and cylinder block to front cover joints (four places) (Fig. 74).

(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. 75). Tighten these bolts to 15 N·m (132 in. lbs.) torque.

(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.

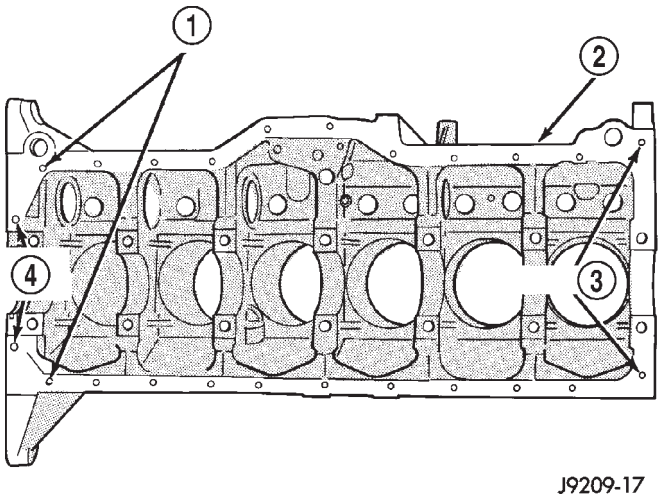


Fig. 73 Position of Dowels in Cylinder Block

1 – DOWEL HOLES
2 – CYLINDER BLOCK
3 – 5/16'' HOLES
4 – 5/16'' HOLES

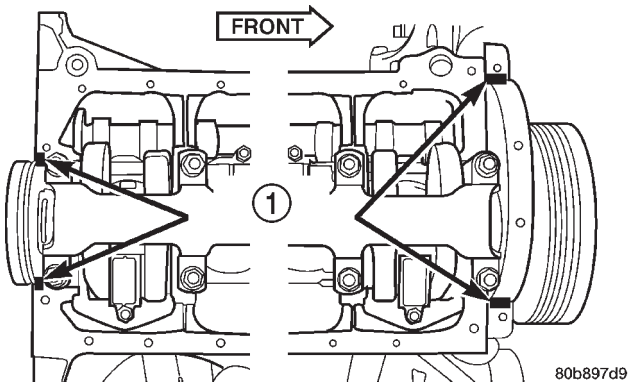


Fig. 74 Oil Pan Sealer Location

1 – SEALER LOCATIONS

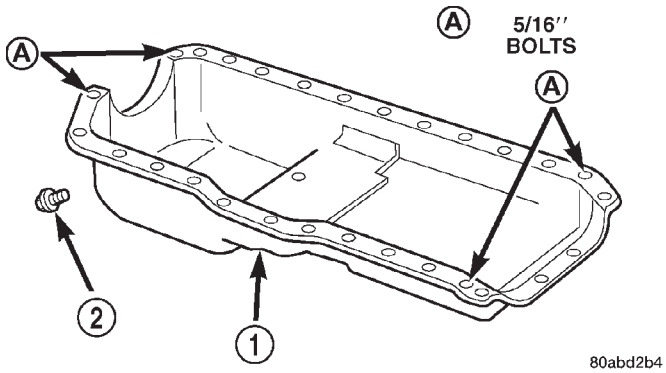


Fig. 75 Position of 5/16 inch Oil Pan Bolts

1 – OIL PAN
2 – OIL PAN DRAIN PLUG

REMOVAL AND INSTALLATION (Continued)

(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. 75). 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.

(6) Raise the vehicle.

(7) Drain the engine oil.

(8) Remove the oil pan and gasket.

(9) Remove main bearing cap brace (Fig. 76).

(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. 77).

(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. 78).

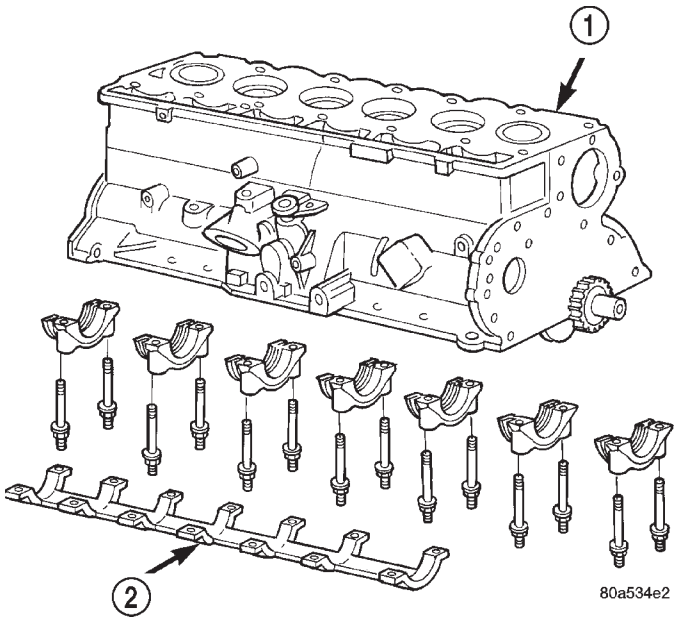


Fig. 76 Main Bearings Caps and Brace

1 – BLOCK
2 – MAIN BEARING CAP BRACE

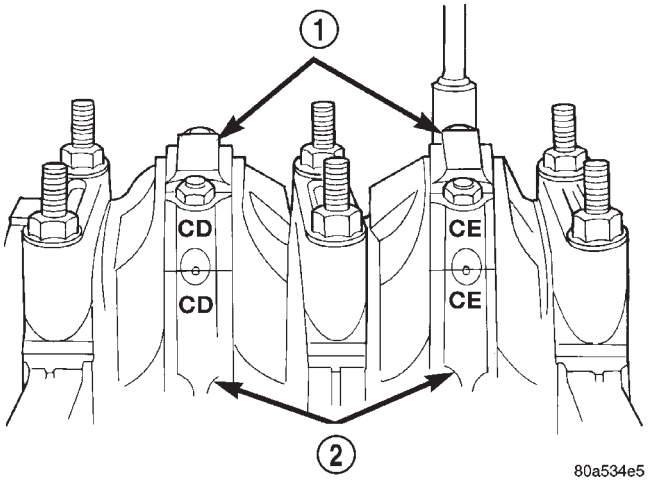


Fig. 77 Stamped Connecting Rods and Caps

1 – CONNECTING ROD CAP
2 – CONNECTING ROD

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.

REMOVAL AND INSTALLATION (Continued)

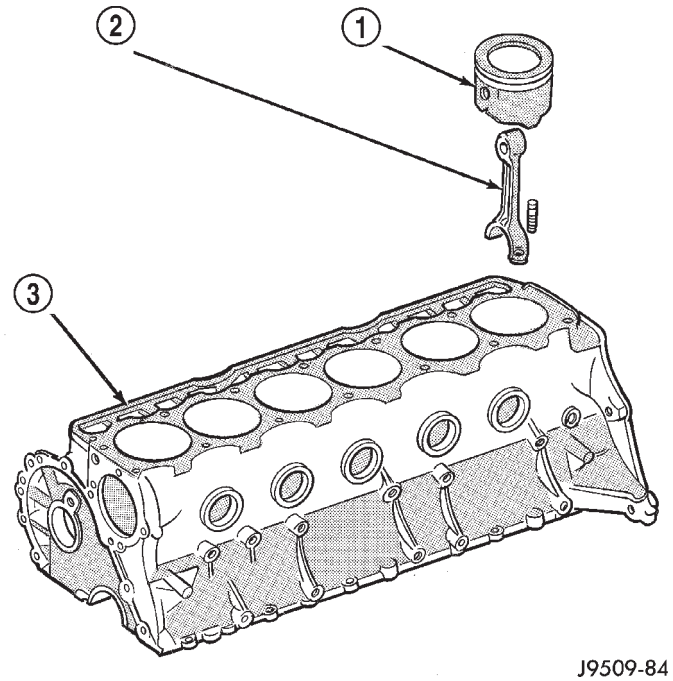


Fig. 78 Removal of Connecting Rod and Piston Assembly

1 – PISTON
2 – CONNECTING ROD
3 – BLOCK

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. 79).

(5) Ensure the arrow on the piston top points to the front of the engine (Fig. 79).

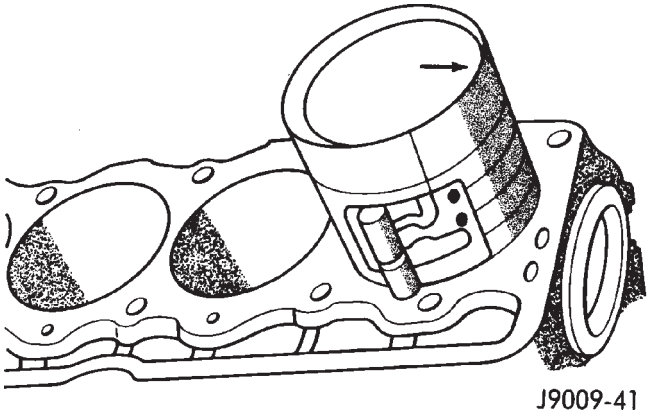


Fig. 79 Rod and Piston Assembly Installation

(6) Raise the vehicle.

(7) Each bearing insert is fitted to its respective journal to obtain the specified clearance between the bearing and the journal. In production, the select fit is obtained by using various-sized, color-coded bearing inserts as listed in the Connecting Rod Bearing Fitting Chart. The color code appears on the edge of the bearing insert. The size is not stamped on inserts used for production of engines.

(8) The rod journal is identified during the engine production by a color-coded paint mark on the adjacent cheek or counterweight toward the flange (rear) end of the crankshaft. The color codes used to indicate journal sizes are listed in the Connecting Rod Bearing Fitting Chart.

(9) When required, upper and lower bearing inserts of different sizes may be used as a pair (refer to Connecting Rod Bearing Fitting Chart). A standard size insert is sometimes used in combination with a 0.025 mm (0.001 inch) undersize insert to reduce clearance 0.013 mm (0.0005 inch).

CAUTION: DO NOT intermix bearing caps. Each connecting rod and bearing cap are stamped with the cylinder number. The stamp is located on a machined surface adjacent to the oil squirt hole that faces the camshaft side of the cylinder block.

(10) Install the connecting rod bearing caps and inserts in the same positions as removed.

CAUTION: Verify that the oil squirt holes in the rods face the camshaft and that the arrows on the pistons face the front of the engine.

(11) Install main bearing cap brace (Fig. 76). 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.

REMOVAL AND INSTALLATION (Continued)

(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) Apply Mopar® Gasket Maker sealer on both sides of cylinder block as shown in (Fig. 80). The dab of sealer should be 3 mm (0.125 in.) in diameter.

(6) Apply Mopar® Gasket Maker on the rear bearing cap (Fig. 80). The bead should be 2.3 mm (0.09 in.) in diameter. DO NOT apply sealer to the lip of the seal.

(7) Position the lower seal into the bearing cap recess and seat it firmly. Be sure the seal is flush with the cylinder block pan rail.

(8) Coat the outer curved surface of the lower seal with soap and the lip of the seal with engine oil.

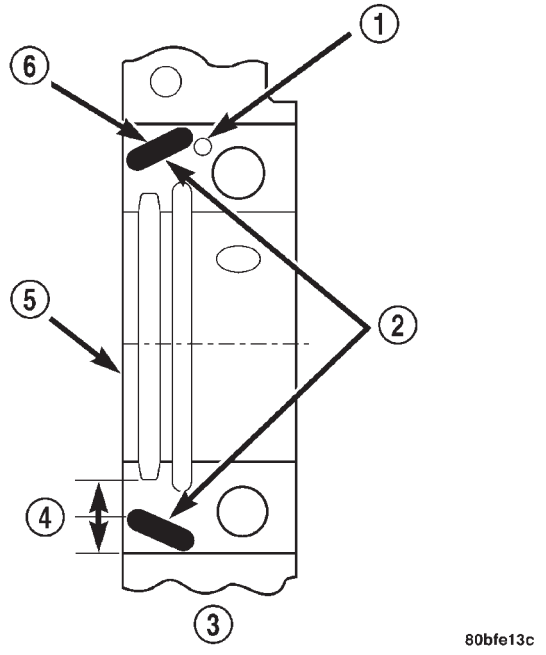


Fig. 80 Location of Sealer

1 – **DOWEL**
2 – **SEALER LOCATIONS**
3 – **CYLINDER BLOCK**
4 – **HALFWAY BETWEEN**
5 – **REAR FACE OF CYLINDER BLOCK**
6 – **3mm (0.125 in.)**

(9) Install the rear main bearing cap. DO NOT strike the cap more than twice for proper engagement.

(10) Tighten all main bearing bolts to 108 N·m (80 ft. lbs.) torque.

(11) Install the main bearing cap brace. Tighten nuts to 47 N·m (35 ft. lbs.).

(12) 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.)

(13) Apply Mopar® Silicone Rubber Adhesive Sealant on cylinder block to rear main bearing cap corners and cylinder block to front cover joints (four places) (Fig. 81)

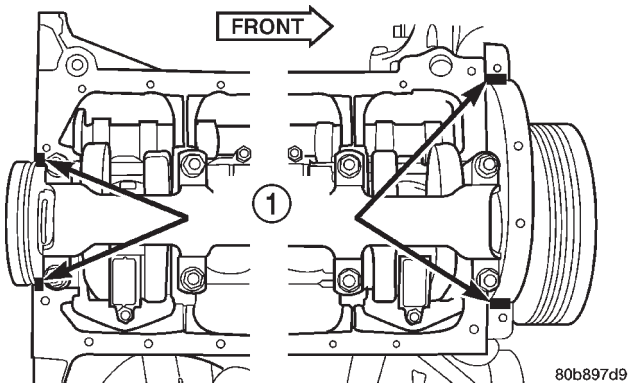


Fig. 81 Oil Pan Sealer Location

1 – SEALER LOCATIONS

(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. 82).

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)

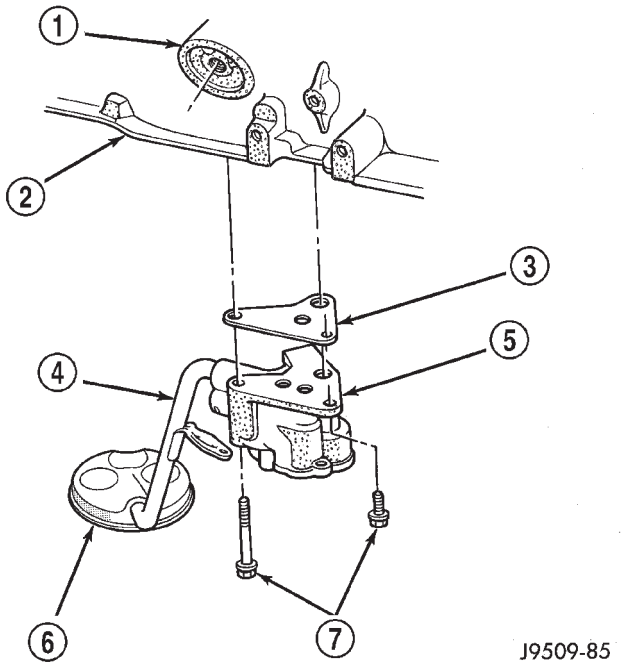


Fig. 82 Oil Pump Assembly

1 – OIL FILTER ADAPTOR
2 – BLOCK
3 – GASKET
4 – OIL INLET TUBE
5 – OIL PUMP
6 – STRAINER ASSEMBLY
7 – ATTACHING BOLTS

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. 83). Tighten the nut against the tool until it contacts the cover.

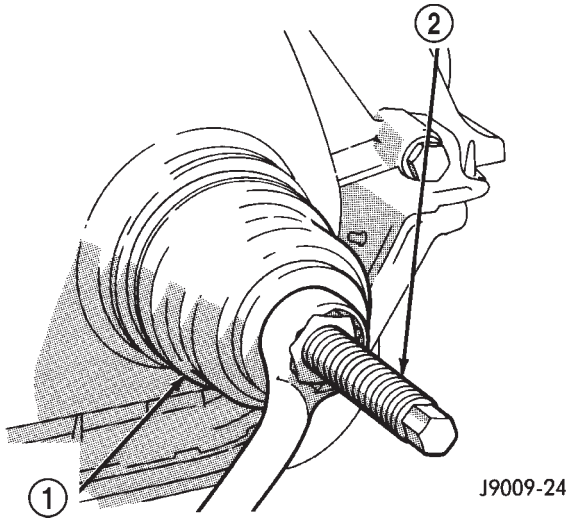


Fig. 83 Timing Case Cover Oil Seal Installation

1 – SEAL INSTALLATION TOOL
2 – DRAW SCREW TOOL

(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.

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.

DISASSEMBLY AND ASSEMBLY (Continued)

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. 84). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

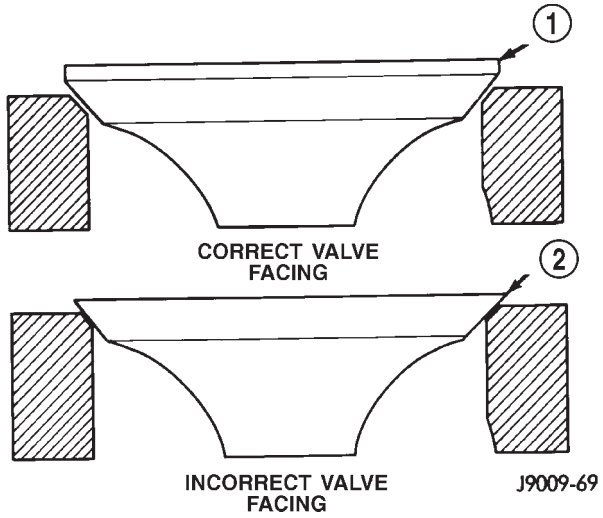


Fig. 84 Valve Facing Margin

1 – VALVE MARGIN
2 – NO 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. 85).

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.

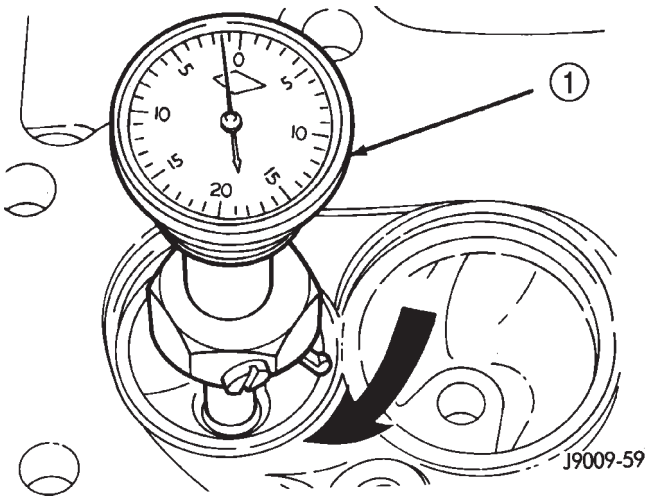


Fig. 85 Measurement of Valve Seat Runout

1 – DIAL INDICATOR

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. 86).

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

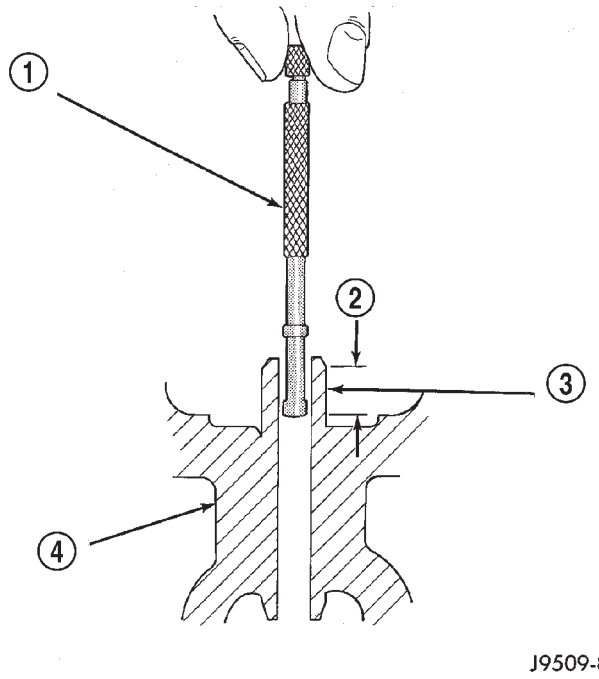


Fig. 86 Measurement of Valve Guide Bore Diameter

1 – GAUGE
2 – 9.525 MM (3/8 INCH)
3 – VALVE STEM GUIDE
4 – CYLINDER HEAD

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. 87).

(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.

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. 88).

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.

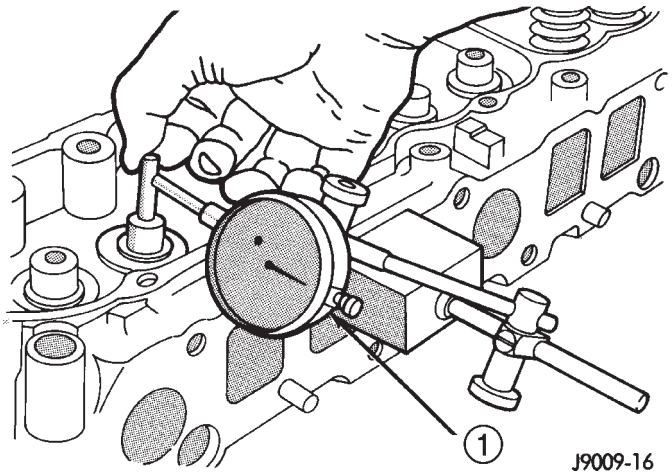


Fig. 87 Measurement of Lateral Movement of Valve Stem

1 – DIAL INDICATOR

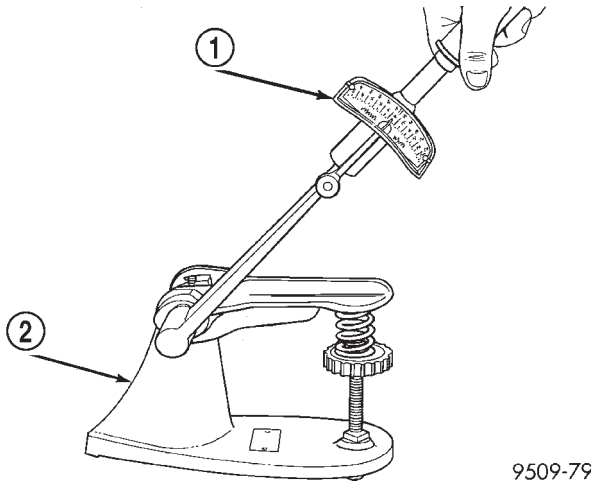


Fig. 88 Valve Spring Tester

1 – TORQUE WRENCH
2 – 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.

DISASSEMBLY AND ASSEMBLY (Continued)

(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.

(14) Fill the engine with clean lubrication oil (refer to Group 0, Lubrication and Maintenance).

(15) Fill the cooling system.

CLEANING AND INSPECTION

INTAKE AND EXHAUST MANIFOLD

Clean the mating surfaces of the cylinder head and the manifold if the original manifold is to be installed.

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.

CLEANING AND INSPECTION (Continued)

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.

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 89).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Leak-Down Tester.

(1) Place a 7.925-7.950 mm (0.312-0.313 inch) diameter ball bearing on the plunger cap of the tappet.

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

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.

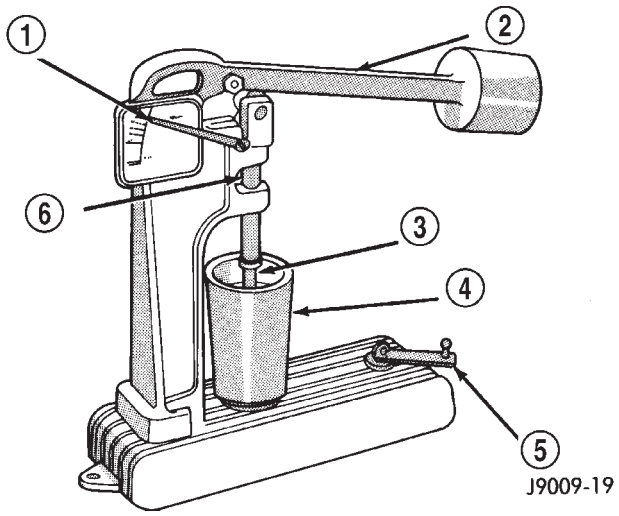


Fig. 89 Leak-Down Tester

1 – POINTER
2 – WEIGHTED ARM
3 – RAM
4 – CUP
5 – HANDLE
6 – PUSH ROD

INSPECTION

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter (Fig. 90). To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

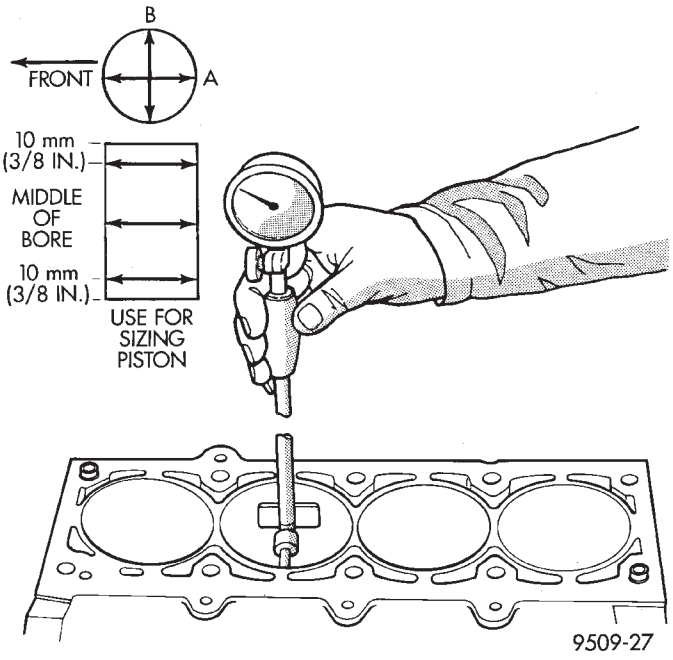


Fig. 90 Cylinder Bore Measurement

CLEANING AND INSPECTION (Continued)

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

(3) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.

(4) Determine taper by subtracting the smaller diameter from the larger diameter.

(5) Rotate measuring device 90° and repeat steps above.

(6) Determine out-of-roundness by comparing the difference between each measurement.

(7) If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out- of-round condition exceeds these maximum limits, the cylinder must be bored and then honed to accept an oversize piston. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

SPECIFICATIONS

SPECIFICATIONS

4.0L ENGINE

DESCRIPTION	SPECIFICATION
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
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 (MAX)	0.03 mm (0.001 in.)
Valve Lift	
Intake	10.350 mm (0.4075 in.)
Exhaust	10.528 mm (0.4145 in.)
Valve Timing	
Intake	
Opens	12.4° BTDC
Closes	60.9° ABDC
Exhaust	
Opens	49.8 BBDC
Closes	29.2° ATDC
Valve Overlap	41.6°
Intake Duration	253.3°
Exhaust Duration	259.°

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
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.)
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.)
No. 3	32.28 to 32.33 mm (1.271 to 1.273 in.)
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.)
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)	0.013 mm (0.0005 in.)
Taper (MAX)	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.)
Taper	0.025 mm (0.001 in.)
Out-ofRound	0.025 mm (0.001 in.)

DESCRIPTION	SPECIFICATION
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.) 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 ROD	
Total Weight (Less Bearing)	663 to 671 grams (23.39 to 23.67 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.)
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.)	0.002 mm per mm (0.002 in. per inch)
Bend (Max.)	0.002 mm per mm (0.002 in. per inch.)
CYLINDER COMPRESSION PRESSURE	
Pressure Range	827 to 1,034 kPa (120 to 150 psi)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Max. Variation Between Cylinders	206 kPa (30 psi)
CYLINDER HEAD	
Combustion Chamber	55.22 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.)
Valve Seat Angle	
Intake	44.5°
Exhaust	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.) 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 (Pink)	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.)

DESCRIPTION	SPECIFICATION
VALVES	
Valve Length (Overall)	
Intake	122.479 to 122.860 mm (4.822 to 4.837 in.)
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.)
Exhaust	37.973 to 38.227 mm (1.495 to 1.505 in.)
Valve Face Angle	
Intake	46.5°
Exhaust	46.5°
Tip Refinishing (Max. Allowable)	0.25 mm (0.010 in.)
VALVE SPRINGS	
Free Length (Approx.)	47.65 mm (1.876 in.)
Spring Load	
Valve Closed	316 to 351 N @ 41.656 mm (71 to 79 lbf. @ 1.64 in.)
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 (1.64 in.)
PISTONS	
Weight (Less Pin)	417 to 429 grams (14.7 to 15.1 oz.)
Piston Pin Bore (Centerline	40.61 to 40.72 mm

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
to Piston Top)	(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.)
2nd Compression Ring	0.483 to 0.965 mm (0.0190 to 0.0380 in.)
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.)
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.)
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.)
No.2 Compression Ring	87.63 to 87.88 mm (3.45 to 3.46 in.)
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.)

DESCRIPTION	SPECIFICATION
OIL PUMP	
Gear-to-Body Clearance	0.051 to 0.102 mm
(Radial)	(0.002 to 0.004 in.)
Gear-to-Body Clearance (Radial) Preferred	0.051 mm (0.002 in.)
Gear End Clearance Plastigage	0.051 to 0.152 mm (0.002 to 0.006 in.)
Gear End Clearance Plastigage (Preferred)	0.051 mm (0.002 in.)
Gear End Clearance Feeler Gauge	0.1016 to 0.2032 mm (0.004 to 0.008 in.)
Gear End Clearance Feeler Gauge (Preferred)	0.1778 mm (0.007 in.)
Oil Pressure	
At Idle Speed	89.6 kPa (13 psi)
At 1600 rpm & Higher	255 to 517 kPa (37 to 75 psi)
Oil Pressure Relief	517 kPa (75 psi)

TORQUE SPECIFICATIONS

4.0L ENGINE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
A/C Compressor—Bolts	28	—	250
Block Heater—Nut	2	—	16
Camshaft Sprocket—Bolt	68	50	—
Camshaft Thrust Plate to Cylinder Block—Screws	24	18	—
Clutch Cover to Flywheel—Bolts	54	40	—
Coil Bracket to Block—Bolts	22	—	192
Connecting Rod—Nuts	45	33	—
Cylinder Block—Drain Plugs	34	25	—
Cylinder Head—Bolts	135	100	—
Cylinder Head Cover—Bolts	10	—	85
Distributor Clamp—Bolts	23	—	204

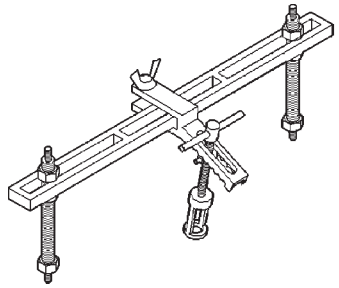
SPECIFICATIONS (Continued)

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Engine Mounts—Front			
Support Bracket Bolts	61	45	—
Support Cushion Bolts/Nuts	41	30	—
Support Cushion Bracket Bolts	54	40	—
Support Cushion Bracket Stud Nuts	41	30	—
Support Cushion Thru-Bolt	65	48	—
Engine Mounts—Rear Crossmember to Sill Bolts—(Automatic)	41	30	—
Insulator Stud Assembly—Nut	41	30	—
Support Cushion/Crossmember—Nuts	22	—	192
Support Cushion/Bracket—Nuts (Manual)	75	55	—
Transmission Support Bracket—Bolt (Manual)	46	34	—
Transmission Support Bracket/Cushion—Bolt (4WD Auto)	75	55	—
Transmission Support Adaptor Bracket—Bolts (2WD Auto)	75	55	—
Exhaust Manifold/Pipe—Nuts	27	20	—
Intake/Exhaust Manifold			
Fasteners #1-5	33	24	—
Fasteners #6 and 7	14	—	126
Fasteners #8-11	33	24	—
Flywheel to Converter Housing—Bolts	38	28	—
Flywheel to Crankshaft—Bolts	143	105	—
Front Cover to Block—Bolts			
1/4-20	7	—	60
5/16-18	22	—	192
Fuel Rail—Bolts/Stud	12	—	108
Generator—Bolts	57	42	—
Generator Bracket to Engine—Bolts	47	35	—
Main Bearing Cap—Bolts	108	80	—

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Oil Filter	18	—	156
Oil Filter Connector to			
Adaptor	47	35	—
Block	68	50	—
Adaptor Bolts	102	50	—
Oil Galley—Plug	41	30	—
Oil Pan—Bolts			
1/4-20	9.5	—	84
5/16-18	15	—	132
Oil Pan—Drain Plug	34	25	—
Oil Pump			
Mounting Bolts	23	—	204
Cover Bolts	8	—	70
Rocker Arm Assembly to Cylinder Head—Capscrews	30	21	—
Spark Plugs	37	27	—
Starter Motor—Mounting Bolts	45	33	—
Thermostat Housing—Bolts	18	—	156
Throttle Body—Bolts	10	—	90
Vibration Damper—Bolt	108	80	—
Water Pump to Block—Bolts	23	17	—

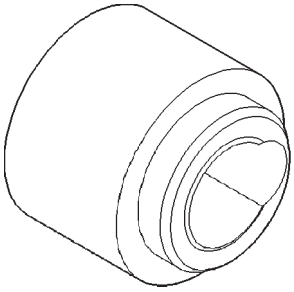
SPECIAL TOOLS

4.0L ENGINE

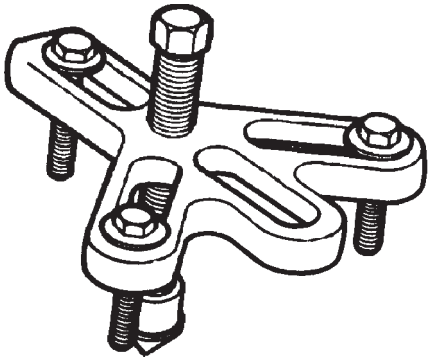


Valve Spring Compressor Tool MD-998772A

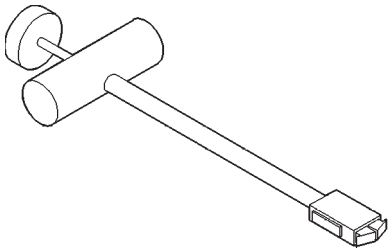
SPECIAL TOOLS (Continued)



Timing Case Cover Alignment and Seal installation Tool 6139



Vibration Damper Removal Tool 7697



Hydraulic Valve Tappet Removal/Installation Tool C-4129–A

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EXHAUST SYSTEM

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DESCRIPTION AND OPERATION

EXHAUST SYSTEM

DESCRIPTION

WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER WORK AROUND OR ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.

The basic exhaust system consists of exhaust manifold(s), exhaust pipe with oxygen sensors, catalytic converter(s), heat shield(s), muffler and tailpipe

The 2.5L and 4.0L Federal Emissions vheicles use a single catalytic converter, while the California models use additional mini catalytic converters inline with the exhaust pipe below the exhaust manifolds.

CATALYTIC CONVERTER

DESCRIPTION

California emissions vehicles incorporate two mini catalytic converters as well as the under floor catalytic converter, into the exhaust system. These catalytic converters are made of stainless steel designed to operate at extremely high temperatures. Federal vehicles use a single under floor catalytic converter only (Fig. 1) (Fig. 2) (Fig. 3).

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.

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DESCRIPTION AND OPERATION (Continued)

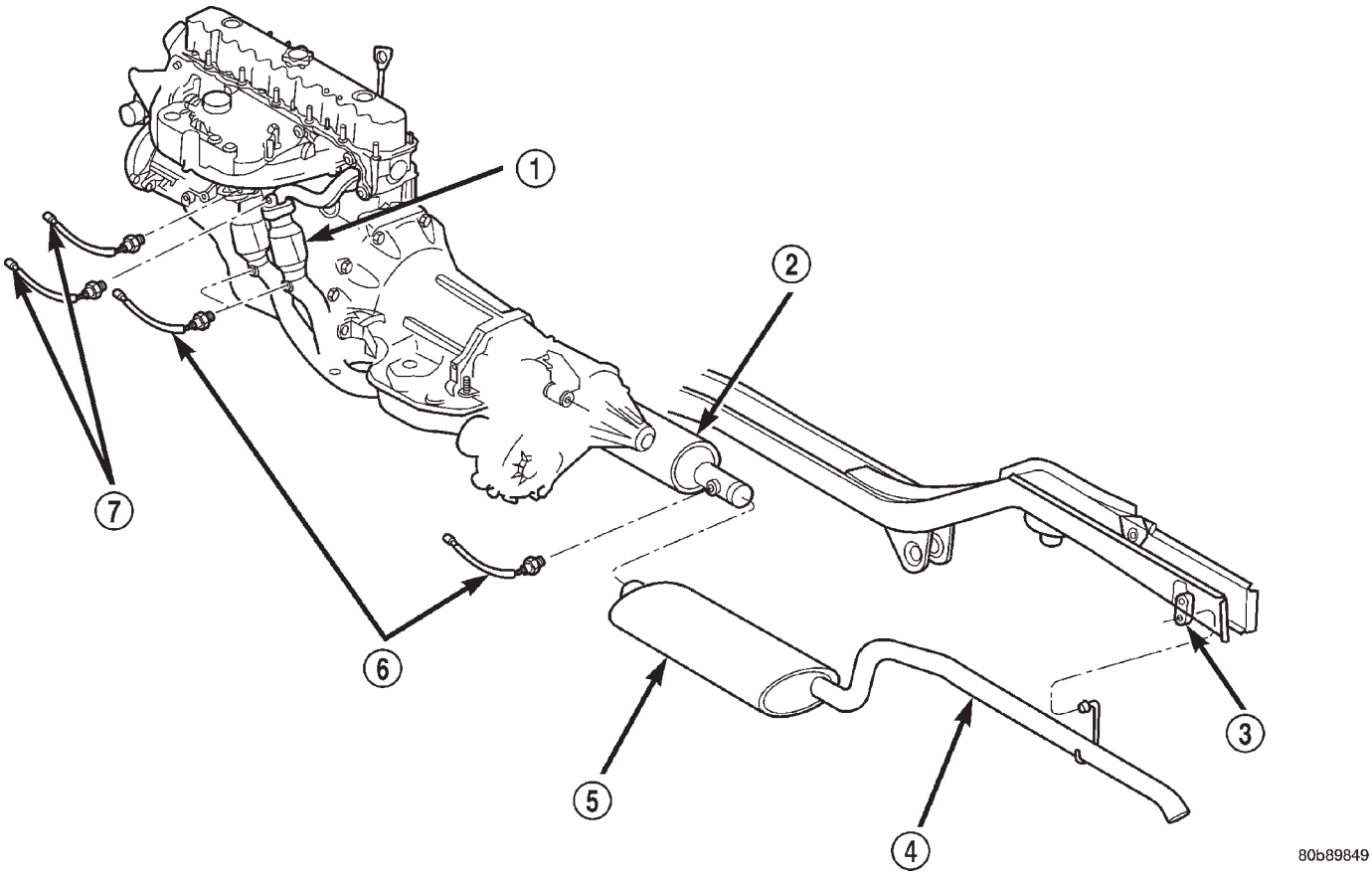


Fig. 1 Exhaust System—4.0L Early Build Typical

1 – MINI CONVERTERS (2)
2 – CATALYTIC CONVERTER
3 – TAIL PIPE HANGER REAR MOUNT INSULATOR
4 – TAIL PIPE
5 – MUFFLER
6 – OXYGEN SENSORS (ALL)
7 – OXYGEN SENSORS (CALIFORNIA ONLY)

DESCRIPTION AND OPERATION (Continued)

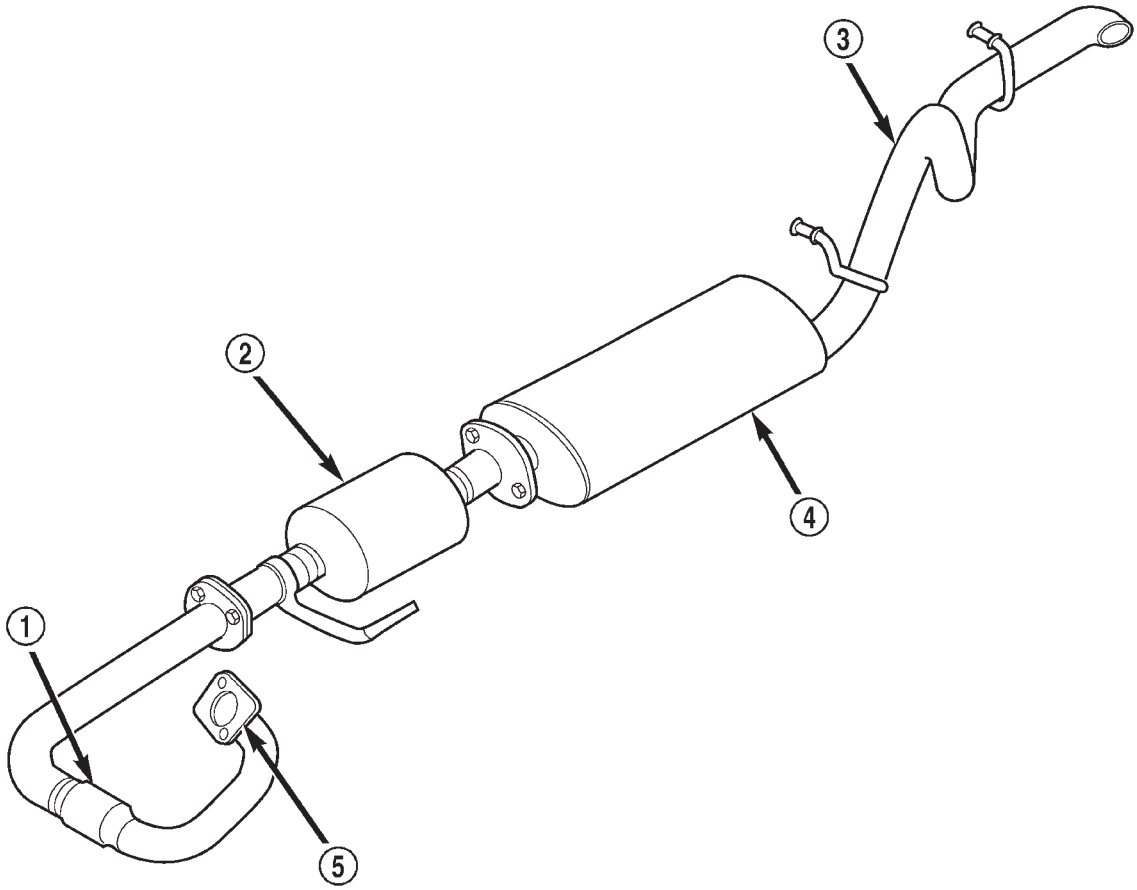


Fig. 2 Exhaust System—2.5L Late Build Typical

1 – MINI CATALYTIC CONVERTER
2 – CATALYTIC CONVERTER
3 – TAILPIPE
4 – MUFFLER
5 – EXHAUST PIPE TO EXHAUST MANIFOLD FLANGE

DESCRIPTION AND OPERATION (Continued)

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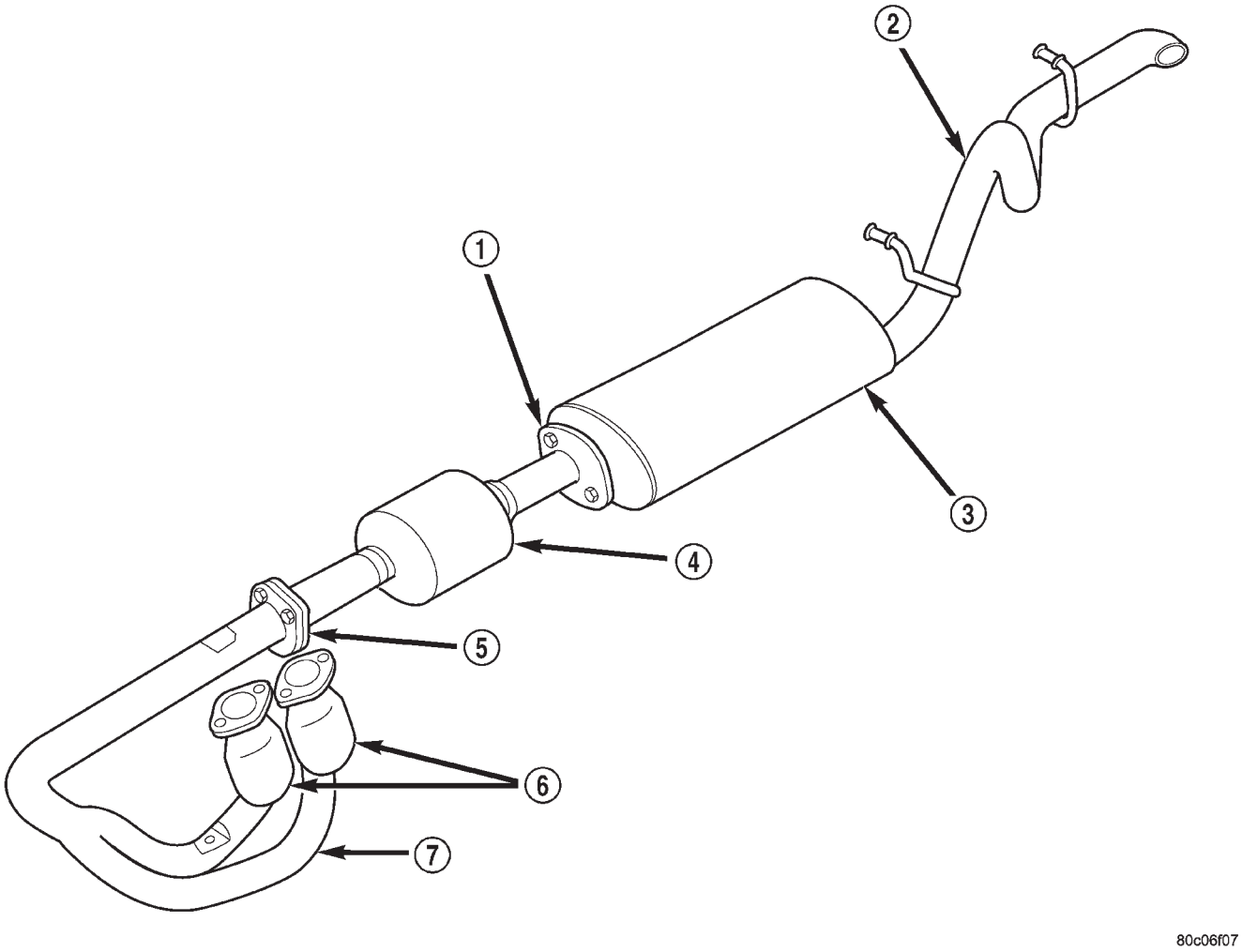


Fig. 3 Exhaust System—4.0L Late Build Typical

1 – MUFFLER TO CATALYTIC CONVERTER FLANGE
2 – TAILPIPE
3 – MUFFLER
4 – CATALYTIC CONVERTER
5 – EXHAUST PIPE TO CATALYTIC CONVERTER FLANGE
6 – MINI CATALYTIC CONVERTER
7 – EXHAUST PIPE

DESCRIPTION AND OPERATION (Continued)

EXHAUST HEAT SHIELDS

DESCRIPTION

Heat shields are made of stamped/formed steel, or metal foil.

Exhaust heat shields are needed to protect both the vehicle and the environment from the high temperatures developed by the catalytic converter. The catalytic converter releases additional heat into the exhaust system. Under severe operating conditions, the temperature increases in the area of the converter. Such conditions can exist when the engine misfires or otherwise does not operate at peak efficiency.

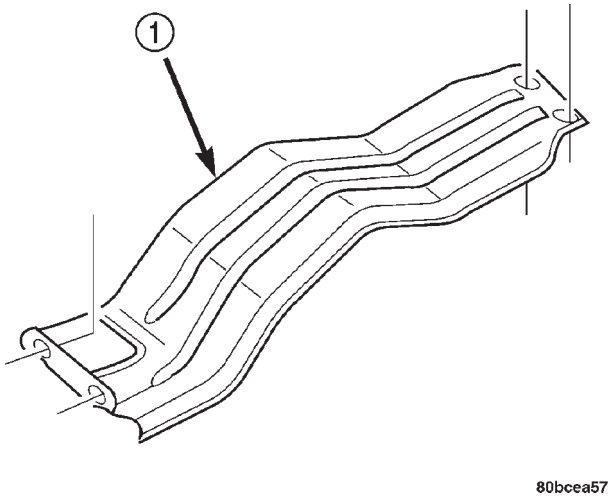


Fig. 4 Exhaust Heat Shield—Typical

1 – HEAT SHIELD

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 to specified torque 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.		

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REMOVAL AND INSTALLATION

CATALYTIC CONVERTER/EXHAUST PIPE—EARLY BUILD

WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.

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(s). 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 studs and nuts with a Mopar® rust penetrant. Allow 5 minutes for penetration (Fig. 5).

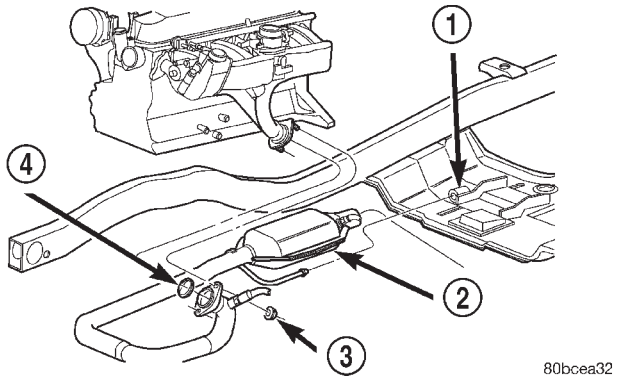


Fig. 5 Exhaust Pipe with Catalytic Converter

1 – EXHAUST PIPE MOUNTING BRACKET
2 – CATALYTIC CONVERTER
3 – NUT
4 – SEAL RING (4.0L ONLY)

(3) Remove the oxygen sensors from the exhaust pipe and the catalytic converter (Fig. 5).

(4) Disconnect the exhaust pipe from the engine exhaust manifold.

(5) Support the transmission and remove the rear crossmember.

(6) Remove the clamp from the catalytic converter and muffler connection.

(7) Heat the catalytic converter and muffler connection with an oxyacetylene torch until the metal becomes cherry red.

(8) While the metal is still cherry red, twist the muffler assembly back and forth to separate it from the catalytic converter.

INSTALLATION

(1) Assemble catalytic converter and muffler loosely to permit proper alignment of all parts.

(2) Use a new clamp and tighten the nut to 48 N·m (35 ft. lbs.) torque.

(3) Connect the exhaust pipe to the engine exhaust manifold. Tighten the nuts to 31 N·m (23 ft. lbs.) torque.

(4) Install the rear crossmember. Tighten the crossmember-to-sill bolts to 41 N·m (30 ft. lbs.) torque. Remove the support from the transmission.

(5) Coat the oxygen sensors with anti-seize compound. Install the sensors and tighten the nut to 30 N·m (22 ft. lbs.) torque.

(6) Lower the vehicle.

(7) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

CATALYTIC CONVERTER/EXHAUST PIPE—LATE BUILD

WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.

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(s). 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 studs and nuts with a Mopar® rust penetrant. Allow 5 minutes for penetration.

(3) Remove the oxygen sensors from the exhaust pipe and the catalytic converter.

(4) Disconnect the exhaust pipe from the engine exhaust manifold (Fig. 6) (Fig. 7).

(5) Remove catalytic converter to muffler flange retaining nuts (Fig. 6) (Fig. 7).

(6) Slide exhaust pipe foward until exhaust pipe hanger disengages from transmission support. Remove exhaust pipe and catalytic converter from vehicle.

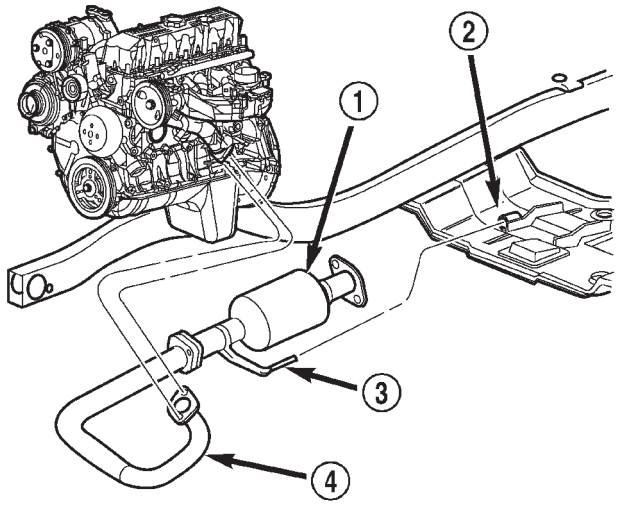


Fig. 6 Exhaust Pipe and Catalytic Converter Removal/Installation 2.5L Engine Late Build

1 – CATALYTIC CONVERTER
2 – TRANSMISSION SUPPORT
3 – EXHAUST HANGER
4 – EXHAUST PIPE

INSTALLATION

(1) Position exhaust pipe and catalytic converter into vehicle.

(2) Insert exhaust pipe hanger into transmission support (Fig. 6) (Fig. 7).

(3) Install exhaust pipe onto exhaust manifold **DO NOT** tighten bolts at this time.

(4) Position muffler flange onto catalytic converter flange and install retaining bolts and nuts. **DO NOT** tighten nuts at this time (Fig. 6) (Fig. 7).

(5) Make sure the exhaust system is aligned and has the proper clearance. The minimum clearance is 25mm (1 inch).

(6) Tighten muffler to catalytic converter flange retaining nuts to 28.5 N·m (21 ft. lbs.).

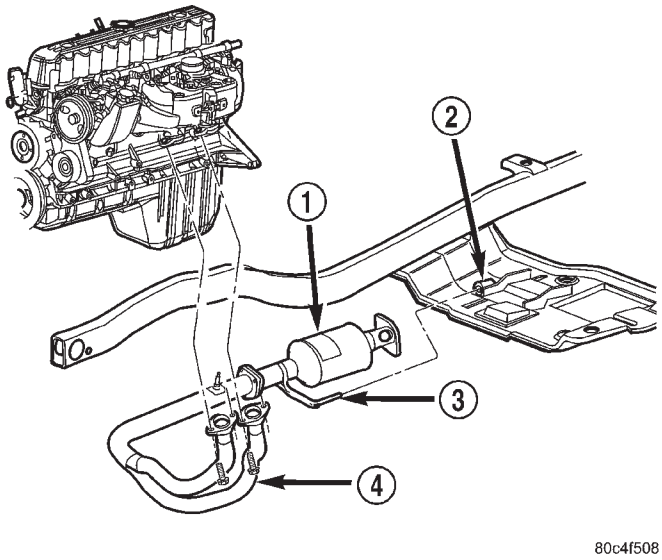


Fig. 7 Exhaust Pipe and Catalytic Converter Removal/Installation 4.0L Engine Late Build

1 – CATALYTIC CONVERTER
2 – TRANSMISSION SUPPORT
3 – EXHAUST HANGER
4 – EXHAUST PIPE

(7) Tighten exhaust pipe to exhaust manifold mounting bolts to 31 N·m (23 ft. lbs.).

(8) Install the oxygen sensors in the exhaust pipe and catalytic converter.

(9) Lower vehicle.

(10) Start engine check for leaks.

MUFFLER AND TAILPIPE ASSEMBLY—EARLY BUILD

WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

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REMOVAL AND INSTALLATION (Continued)

CAUTION: When servicing exhaust system components, disconnect the oxygen sensor connector(s). Allowing the exhaust system to hang by the oxygen sensor harness will damage the wiring and/or sensor.

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.

REMOVAL

(1) Raise the vehicle and support the rear of the vehicle by the side rails and allow the axle to hang free.

(2) Remove the clamp from the catalytic converter and muffler connection (Fig. 8).

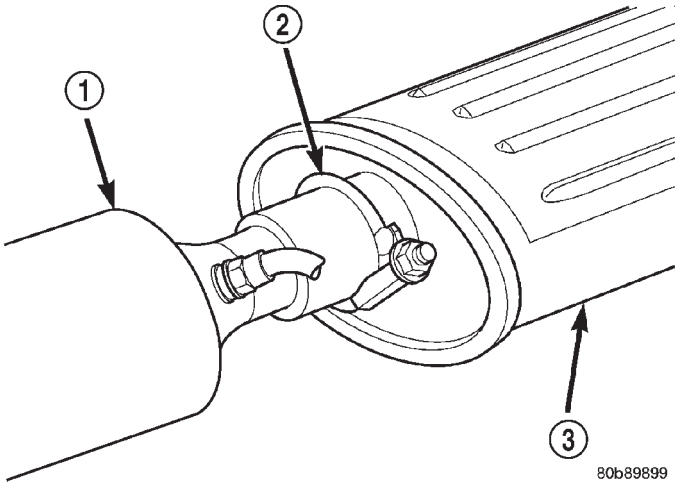


Fig. 8 Catalytic Converter to Muffler Connection Early Build

1 – CATALYTIC CONVERTER
2 – CLAMP
3 – MUFFLER

(3) Remove the tailpipe hangers from the insulators (Fig. 9).

(4) Heat the catalytic converter-to-muffler connection with an oxyacetylene torch until the metal becomes cherry red.

(5) While the metal is still cherry red, twist the exhaust tailpipe/muffler assembly back and forth to separate it from the catalytic converter.

- To separate an original equipment exhaust tailpipe/muffler combination, cut the exhaust tailpipe close to the muffler. Collapse the part remaining in the muffler and remove.
- To remove a service exhaust tailpipe/muffler combination, apply heat until the metal becomes cherry red. Remove the exhaust tailpipe/muffler clamp and twist the exhaust tailpipe out of the muffler.

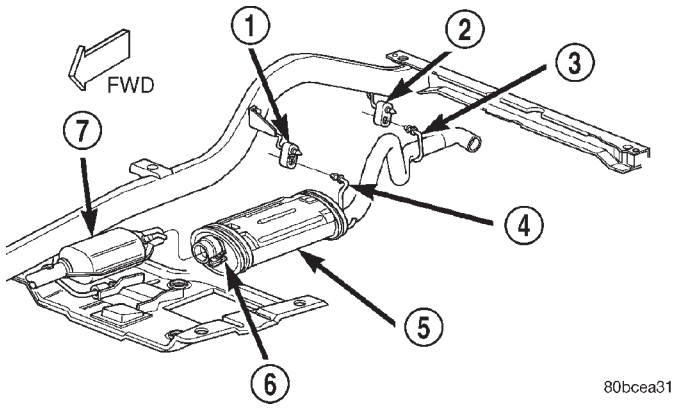


Fig. 9 Muffler and Tailpipe Assembly Early Build

1 – ISOLATOR
2 – ISOLATOR
3 – TAIL PIPE HANGER
4 – MUFFLER HANGER
5 – MUFFLER AND TAILPIPE ASSEMBLY
6 – CLAMP
7 – CATALYTIC CONVERTER

INSTALLATION

(1) Assemble catalytic converter and muffler loosely to permit proper alignment of all parts.

(2) Install the exhaust tailpipe into the rear of the muffler.

(3) Install the exhaust tailpipe/muffler assembly on the rear exhaust tailpipe hanger. Make sure that the exhaust tailpipe has sufficient clearance from the floor pan.

(4) Tighten the nut on the muffler-to-catalytic converter clamp to 48 N·m (35 ft. lbs.) torque.

(5) Insert rods into isolators.

(6) Lower the vehicle.

(7) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

MUFFLER AND TAILPIPE ASSEMBLY—LATE BUILD

WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.

REMOVAL AND INSTALLATION (Continued)

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(s). Allowing the exhaust system to hang by the oxygen sensor harness will damage the wiring and/or sensor.

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.

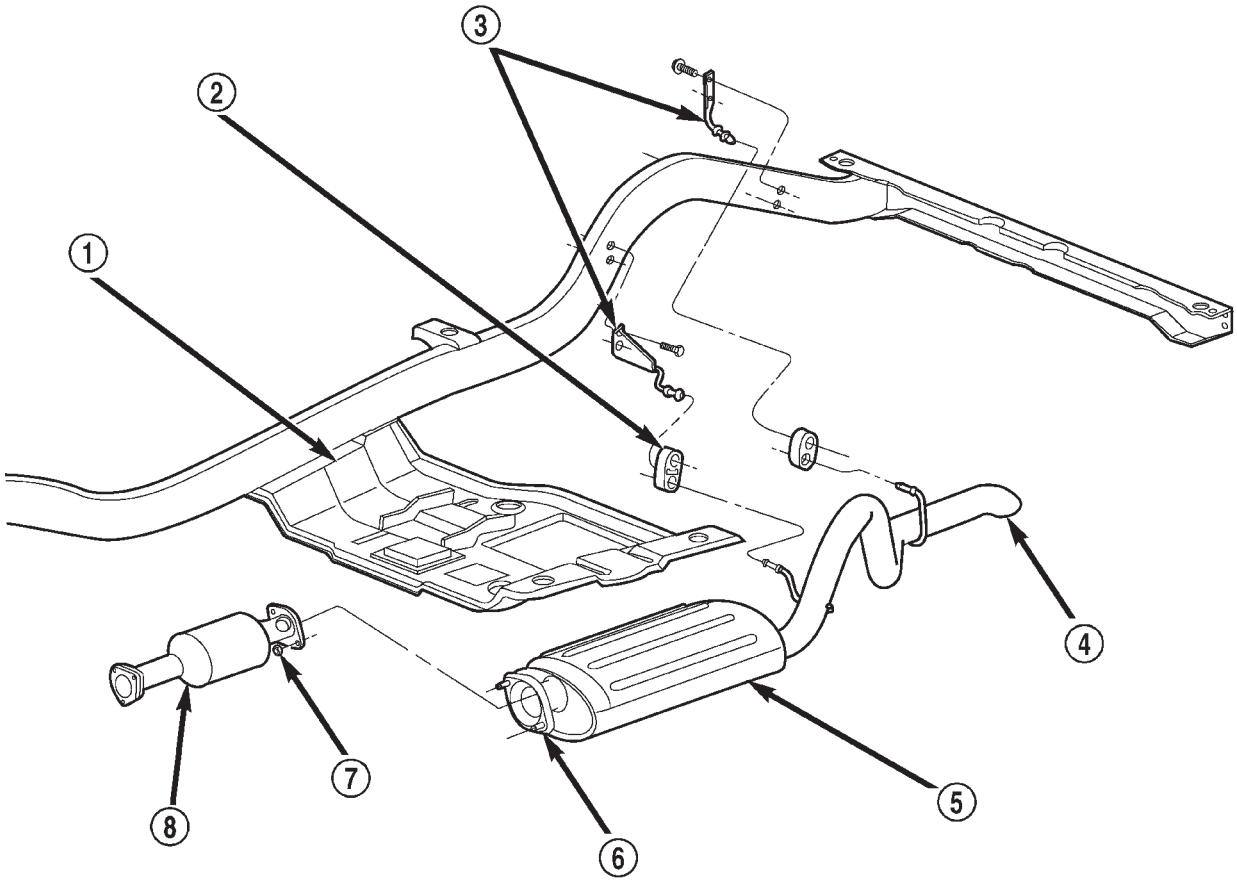
REMOVAL

(1) Raise the vehicle and support the rear of the vehicle by the side rails and allow the axle to hang free.

(2) Remove the tailpipe hangers from the insulators (Fig. 10).

(3) Remove muffler to catalytic converter flange retaining nuts (Fig. 10).

(4) Remove muffler and tailpipe assembly from vehicle.



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Fig. 10 Muffler and Tailpipe Removal/Installation—Late Build

1 – TRANSMISSION SUPPORT
2 – TAILPIPE HANGER INSULATORS
3 – TAILPIPE HANGERS
4 – TAILPIPE
5 – MUFFLER
6 – MUFFLER TO CATALYTIC CONVERTER FLANGE
7 – NUTS
8 – CATALYTIC CONVERTER

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INSTALLATION

(1) Position muffler and tailpipe assembly into vehicle.

(2) Position muffler and catalytic converter flanges togather and install nuts (Fig. 10). **DO NOT** tighten nuts at this time.

(3) Install tailpipe hangers into the insulators (Fig. 10).

(4) Make sure the muffler and tailpipe are correctly positioned and the proper alignment. The minimum clearance between components is 25mm (1 inch).

(5) Tighten muffler to catalytic converter flange nuts to 28.5 N·m (21 ft. lbs.).

(6) Lower vehicle.

(7) Start engine check for leaks.

HEAT SHIELDS

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the screws and/or nuts holding the heat shields to the frame and/or floor pan (Fig. 11) (Fig. 12).

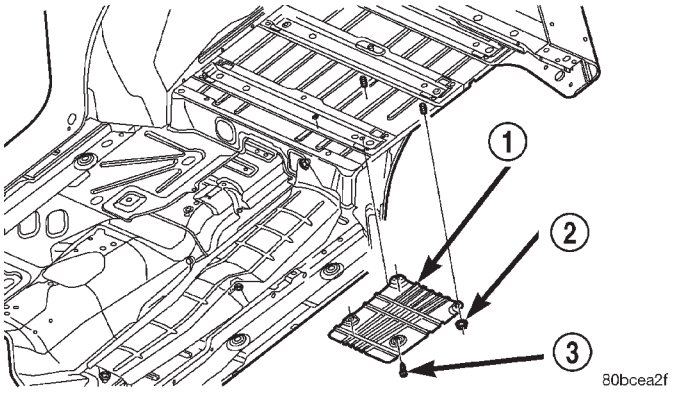


Fig. 11 Muffler Rear Heat Shield Removal/ Installation

1 – REAR MUFFLER HEAT SHIELD
2 – NUT
3 – SELF TAPPING SCREW

(3) When removing muffler heat shield, the muffler front support bracket must be removed first.

(4) Slide the shields out around the exhaust system.

INSTALLATION

(1) Position the heat shields to the floor pan or the frame and install the screws and/or nuts.

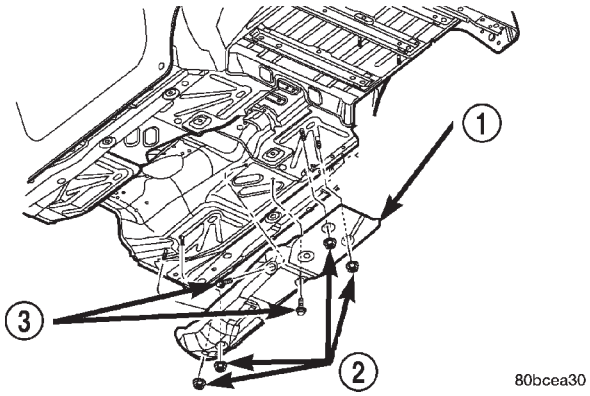


Fig. 12 Muffler Middle Heat Shield Removal/ Installation

1 – MIDDLE MUFFLER HEAT SHIELD
2 – NUTS
3 – SELF TAPPING SCREWS

(2) Tighten the nuts and/or screws to 45 N·m (33 ft. lbs.) (Fig. 11).

(3) Lower the vehicle.

SPECIFICATIONS

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Crossmember to Sill—Bolts	41	30	—
Exhaust Pipe to Manifold—Nuts	31	23	—
Muffler to Catalytic Converter— Clamps	48	35	—
Muffler to Catalytic Converter Flange—Nuts			
Late Build	28.5	21	—
Catalytic Converter to Exhaust Pipe Flange			
—Nuts Late Build	28.5	21	—
Oxygen Sensors	30	22	—
Power Steering Pump/ Tensioner Bracket—			
Bolts to Intake Manifold	28	21	—
Bolts to Water Pump	48	35	—

FRAME AND BUMPERS

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FRAME DESCRIPTION 1

DESCRIPTION AND OPERATION

FRAME DESCRIPTION

The Jeep TJ frame is the structural center of the vehicle. In addition to supporting the body and payload, the frame provides a station for the engine. The vehicle body is attached to the frame with holddowns (Fig. 1). The torque specification for the holddown bolts are: Radiator to frame, tighten to 47 N·m (35 ft. lbs.) torque. Main floor to frame, tighten to 67 N·m (50 ft. lbs.) torque. Rear floor to frame, tighten to 47 N·m (35 ft. lbs.) torque.

The frame is constructed of mild-strength rectangular tubing and crossmembers. The crossmembers join the siderails and retain them in alignment in relation to each other. This provides resistance to frame twists and strains.

BUMPERS

DESCRIPTION

Bumpers are used at the front and rear of the vehicle. Bumpers are made up of a center section and two extensions.

OPERATION

The bumpers are attached to the frame and provide mounting points for some optional accessories such as fog lights and tow hooks.

DESCRIPTION AND OPERATION (Continued)

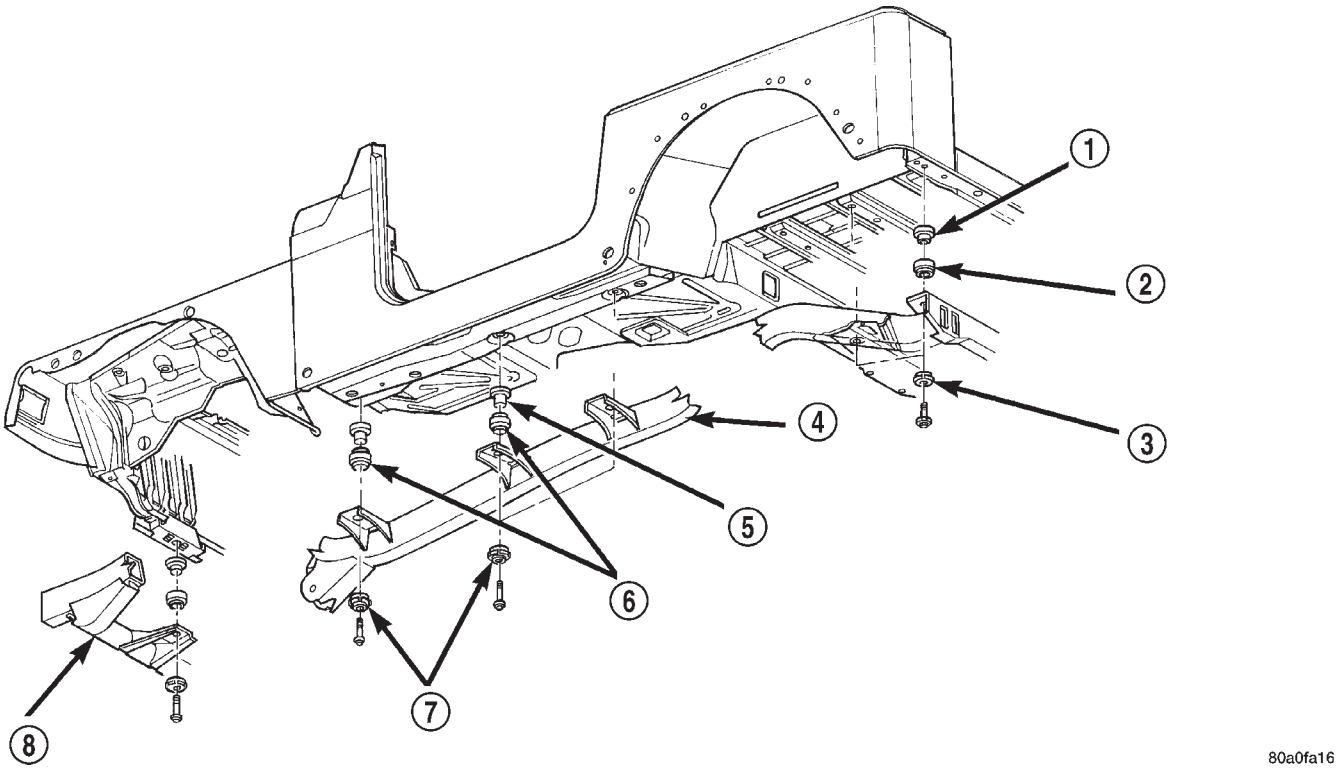


Fig. 1 Body to Frame Holddowns

1 – UPPER BODY MOUNT RETAINER
2 – UPPER BODY MOUNT INSULATOR
3 – LOWER BODY MOUNT INSULATOR
4 – FRAME
5 – UPPER BODY MOUNT RETAINER
6 – UPPER BODY MOUNT INSULATOR
7 – LOWER BODY MOUNT INSULATOR
8 – FRAME

BUMPERS

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REAR BUMPER 4

REMOVAL AND INSTALLATION

TOW HOOKS

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

FRONT TOW HOOK REMOVAL

(1) Remove the torx bolts that attach the tow hook to the bumper (Fig. 1).
(2) Separate the tow hook from the bumper.

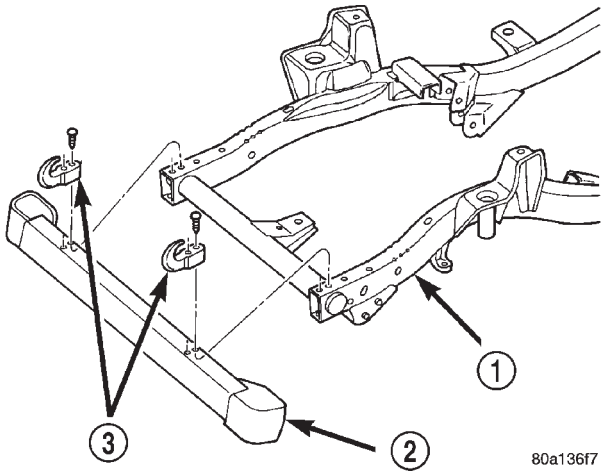


Fig. 1 Front Tow Hook

1 – FRAME
2 – BUMPER
3 – TOW HOOK

FRONT TOW HOOK INSTALLATION

(1) Position the tow hook on the bumper.
(2) Install the torx bolts that attach the tow hook to the bumper. Tighten the bolts to 108 N·m (80 ft. lbs.) torque.

REAR TOW HOOK REMOVAL

(1) Remove the fasteners that attach the rear tow hook to the frame (Fig. 2).
(2) Separate the tow hook from the frame.

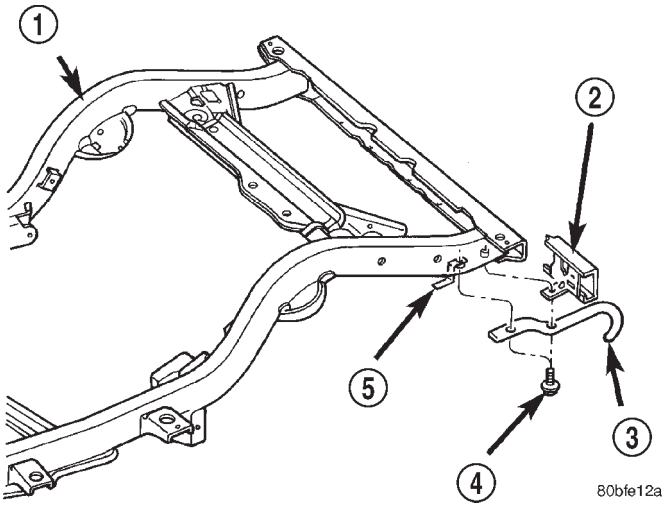


Fig. 2 Rear Tow Hook

1 – FRAME
2 – REAR BUMPER
3 – TOW HOOK
4 – BOLT
5 – NUT

REAR TOW HOOK INSTALLATION

(1) Position the tow hook on the frame.
(2) Install the fasteners that attach the rear tow hook to the frame. Tighten the bolts to 67 N·m (50 ft.lbs.).

FRONT BUMPER EXTENSION

REMOVAL

(1) Remove the screws attaching the bumper extension to the bumper (Fig. 3).
(2) Separate the extension from the bumper.

INSTALLATION

(1) Position the extension on the bumper.
(2) Install the screws attaching the bumper extension to the bumper.

REMOVAL AND INSTALLATION (Continued)

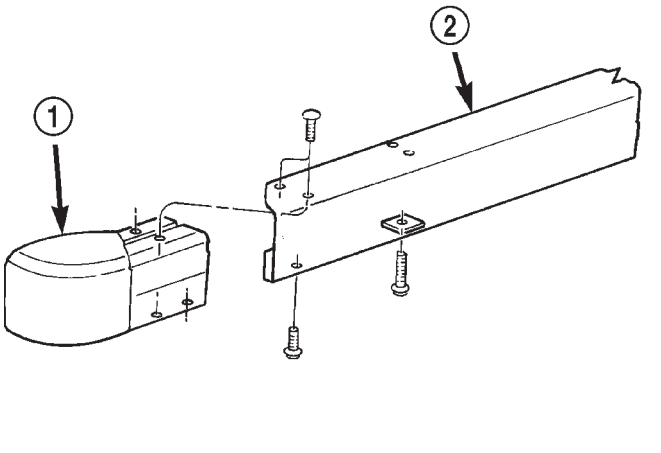


Fig. 3 Bumper Extension

1 – BUMPER EXTENSION
2 – FRONT BUMPER

FRONT BUMPER

REMOVAL

(1) If equipped, disconnect the fog lamp harness connector.

(2) Remove the screws that attach the bumper to the frame rail (Fig. 4).

(3) If equipped, remove the tow hook.

(4) Separate the bumper from the vehicle.

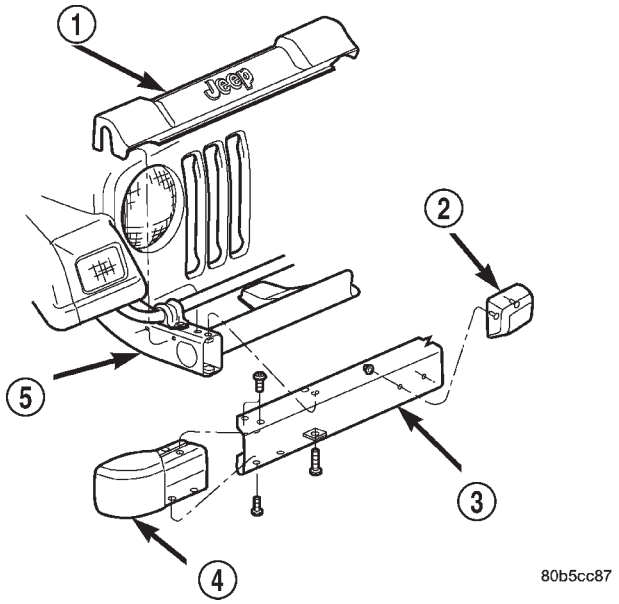


Fig. 4 Front Bumper Components

1 – VALANCE
2 – BUMPER GUARD
3 – FRONT BUMPER
4 – BUMPER EXTENSION
5 – FRAME

INSTALLATION

(1) Position the bumper on the vehicle.

(2) If equipped, install the tow hook.

(3) Install the screws that attach the bumper to the frame rail. Tighten the screws to 104 N·m (77 ft. lbs.) torque.

(4) If equipped, Connect the fog lamp harness connector.

REAR BUMPER EXTENSION

REMOVAL

(1) Remove the screws attaching the bumper extension to the bumper (Fig. 5).

(2) Separate the extension from the bumper.

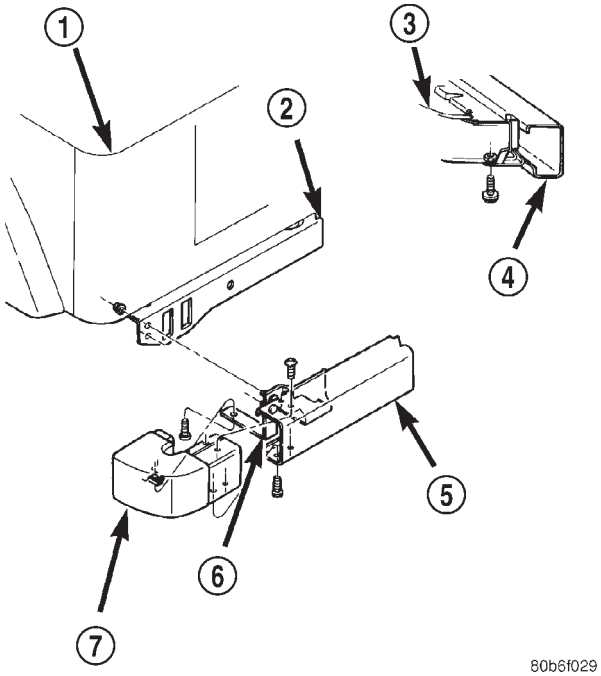


Fig. 5 Rear Bumper Components

1 – BODY
2 – CROSSMEMBER
3 – FRAME
4 – REAR BUMPER
5 – REAR BUMPER
6 – BRACE
7 – REAR BUMPER EXTENSION

INSTALLATION

(1) Position the extension on the bumper.

(2) Install the screws attaching the bumper extension to the bumper.

REAR BUMPER

REMOVAL

(1) Remove the bolt attaching the bumper to frame rail (Fig. 5).

REMOVAL AND INSTALLATION (Continued)

(2) If equipped, separate the rear tow eye from the bumper.

(3) Remove the nuts attaching the bumper to the rear frame crossmember.

(4) Separate the bumper from the vehicle.

INSTALLATION

(1) Position the bumper on the vehicle.

(2) Install the nuts attaching the bumper to the rear frame crossmember. Tighten the nuts to 67 N·m (50 ft.lbs.) torque.

(3) If equipped, position the rear tow eye on the bumper.

(4) Install the bolt attaching the bumper to frame rail. Tighten the bolts to 67 N·m (50 ft.lbs.) torque.

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FRAME SERVICE

SAFETY PRECAUTIONS AND WARNINGS

WARNING: USE EYE PROTECTION WHEN GRINDING OR WELDING METAL, SERIOUS EYE INJURY CAN RESULT. BEFORE PROCEEDING WITH FRAME REPAIR INVOLVING GRINDING OR WELDING, VERIFY THAT VEHICLE FUEL SYSTEM IS NOT LEAKING OR IN CONTACT WITH REPAIR AREA, PERSONAL INJURY CAN RESULT. DO NOT ALLOW OPEN FLAME TO CONTACT PLASTIC BODY PANELS. FIRE OR EXPLOSION CAN RESULT. WHEN WELDED FRAME COMPONENTS ARE REPLACED, 100% PENETRATION WELD MUST BE ACHIEVED DURING INSTALLATION. IF NOT, DANGEROUS OPERATING CONDITIONS CAN RESULT. STAND CLEAR OF CABLES OR CHAINS ON PULLING EQUIPMENT DURING FRAME STRAIGHTENING OPERATIONS, PERSONAL INJURY CAN RESULT. DO NOT VENTURE UNDER A HOISTED VEHICLE THAT IS NOT SUPPORTED ON SAFETY STANDS, PERSONAL INJURY CAN RESULT.

CAUTION: Do not reuse damaged fasteners, quality of repair would be suspect. Do not drill holes in top or bottom frame rail flanges, frame rail failure can result. Do Not use softer than Grade 3 bolts to replace production fasteners, loosening or failure can result. When using heat to straighten frame components do not exceed 566°C (1050°F), metal fatigue can result. Welding the joints around riveted cross members and frame side rails can weaken frame.

FRAME STRAIGHTENING

When necessary, a conventional frame that is bent or twisted can be straightened by application of heat. The temperature must not exceed 566°C (1050°F). The metal will have a dull red glow at the desired temperature. Excessive heat will decrease the strength of the metal and result in a weakened frame.

Welding the joints around riveted cross members and frame side rails is not recommended.

A straightening repair process should be limited to frame members that are not severely damaged. The replacement bolts, nuts and rivets that are used to join the frame members should conform to the same specifications as the original bolts, nuts and rivets.

FRAME REPAIRS

DRILLING HOLES

Do not drill holes in the top and bottom of frame rail, metal fatigue can result causing frame failure. Holes drilled in the side of the frame rail must be at least 38 mm (1.5 in.) from the top and bottom flanges.

Additional drill holes should be located away from existing holes.

WELDING

Use MIG, TIG or arc welding equipment to repair welded frame components.

Frame components that have been damaged should be inspected for cracks before returning the vehicle to use. If cracks are found in accessible frame components perform the following procedures.

(1) Drill a hole at each end of the crack with a 3 mm (O.125 in.) diameter drill bit.

(2) Using a suitable die grinder with 3 inch cut off wheel, V-groove the crack to allow 100% weld penetration.

(3) Weld the crack.

(4) If necessary when a side rail is repaired, grind the weld smooth and install a reinforcement channel (Fig. 1) over the repaired area.

CAUTION: A reinforcement should never be used on the front section of the frame. The frame section forward of the suspension mounts contains energy management holes (Fig. 2). Reinforcing this area may effect energy management.

SERVICE PROCEDURES (Continued)

NOTE: If a reinforcement is required, it should completely cover the repaired area. The reinforcement should also overlap the top and bottom of the frame by more than 50% of its width. Weld as indicated (Fig. 1).

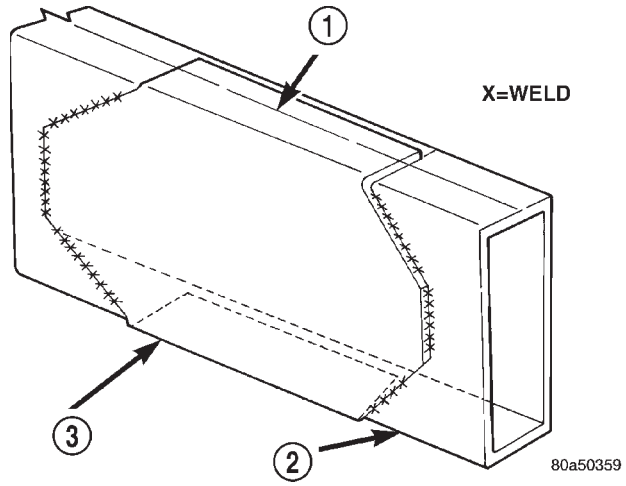


Fig. 1 Frame Reinforcement

1 – FRAME CENTER LINE
2 – FRAME
3 – FRAME REPAR REINFORCEMENT

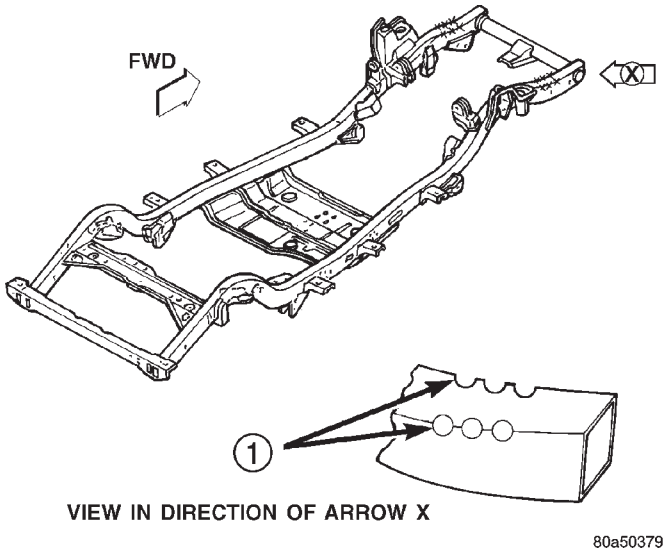


Fig. 2 Energy Management Holes

1 – ENERGY MANAGEMENT HOLES

FRAME FASTENERS

Bolts and nuts and can be used to repair frames or to install a reinforcement section on the frame.

Conical-type washers are preferred over the split-ring type lock washers. Normally, grade-5 bolts are adequate for frame repair. **Grade-3 bolts or softer should not be used.** Tightening bolts/nuts with the correct torque, refer to the Introduction Group at the front of this manual for tightening information.

REMOVAL AND INSTALLATION

TRANSFER CASE SKID PLATE

The transmission and transfer case crossmember is integrated with the transfer case skid plate.

REMOVAL

WARNING: THE TRANSFER CASE AND TRANSMISSION ARE SUPPORTED BY THE TRANSFER CASE SKID PLATE. BEFORE REMOVING THE TRANSFER CASE SKID PLATE, ENSURE THAT THE TRANSMISSION IS PROPERLY SUPPORTED.

(1) Raise and support the vehicle.
(2) Place a support under the transmission.
(3) Remove the nuts attaching the transmission mount to the skid plate (Fig. 3) and (Fig. 4).
(4) Remove the bolts attaching the skid plate to the frame (Fig. 5).
(5) Separate the skid plate from the vehicle.

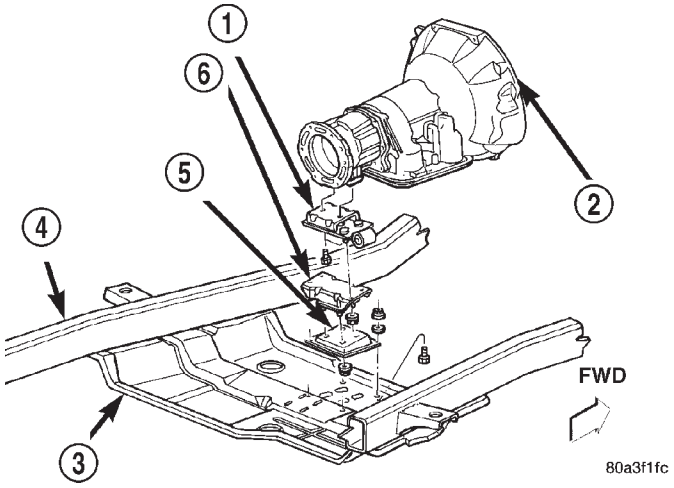


Fig. 3 Transmission Mount—Automatic Transmission

1 – TRANSMISSION SUPPORT BRACKET
2 – AUTOMATIC TRANSMISSION
3 – SKID PLATE
4 – FRAME
5 – TRANSMISSION MOUNT SUPPORT BRACKET
6 – CUSHION

INSTALLATION

(1) Position the skid plate on the vehicle.
(2) Install the bolts attaching the skid plate to the frame. Tighten the bolts to 74 N·m (55 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

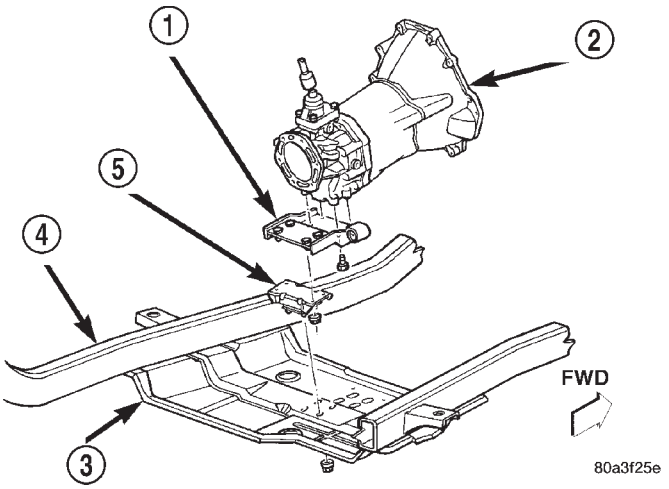


Fig. 4 Transmission Mount—Manual Transmission

1 – TRANSMISSION SUPPORT BRACKET
2 – MANUAL TRANSMISSION
3 – SKID PLATE
4 – FRAME
5 – CUSHION

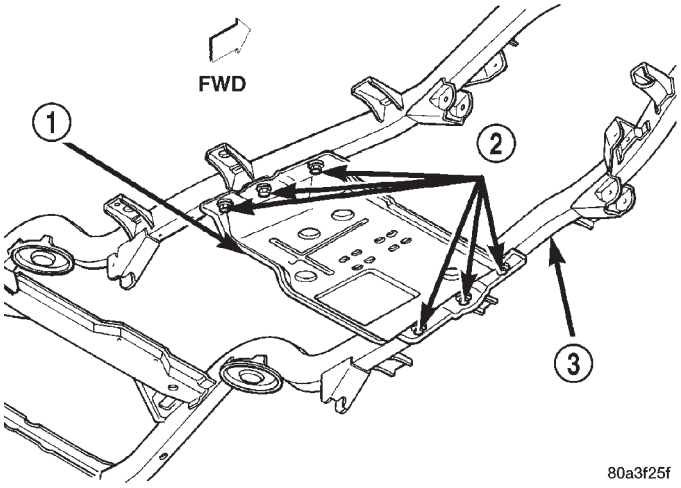


Fig. 5 Transfer Case Skid Plate

1 – SKID PLATE
2 – BOLTS
3 – FRAME

(3) Install the nuts attaching the transmission mount to the skid plate. Tighten the nuts to 28 N·m (21 ft. lbs.) torque.

(4) Remove the support under the transmission.

(5) Remove the support from under the vehicle and lower the vehicle.

FUEL TANK SKID PLATE

REMOVAL

(1) Position a support under the fuel tank skid plate.

(2) Remove the protective caps from the end of the strap studs.

(3) Remove the nuts that attach the skid plate to the straps and to the crossmembers (Fig. 6).

(4) Separate the fuel tank strap from the skid plate.

(5) Support the fuel tank and remove the skid plate from the vehicle.

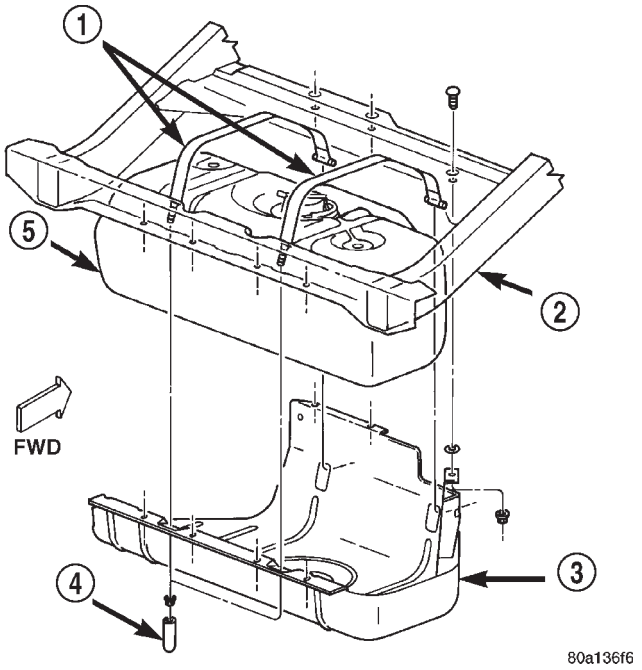


Fig. 6 Fuel Tank Skid Plate

1 – STRAP
2 – FRAME
3 – SKID PLATE
4 – PROTECTIVE CAP
5 – FUEL TANK

INSTALLATION

(1) Attach the skid plate to the fuel tank strap.

(2) Position and support the skid plate under the fuel tank.

(3) Install the nuts to attach the skid plate to the straps and to the frame crossmembers. Tighten the fuel tank strap nuts to 5 N·m (40 in. lbs.) torque. Tighten the skid plate-to-crossmember nuts with 16 N·m (138 in. lbs.) torque.

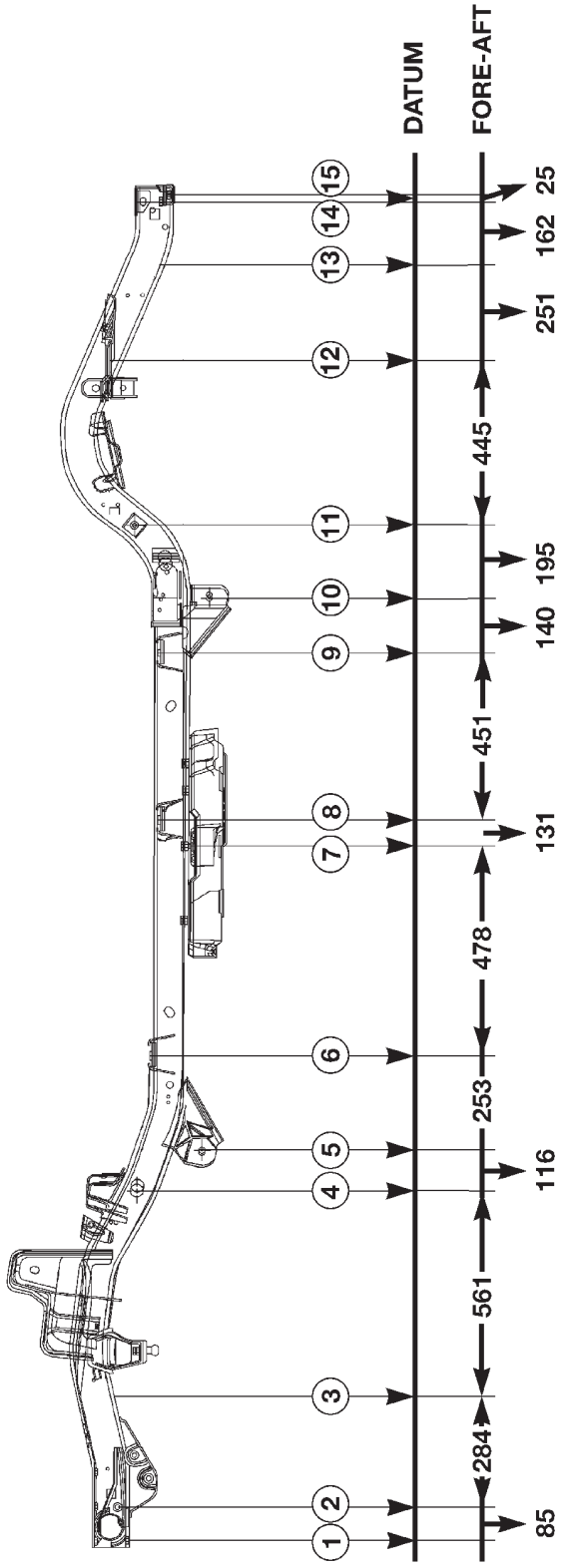
(4) Install the protective caps on the end of the strap studs.

(5) Remove the support from under the skid plate.

SPECIFICATIONS

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FRAME SIDE VIEW

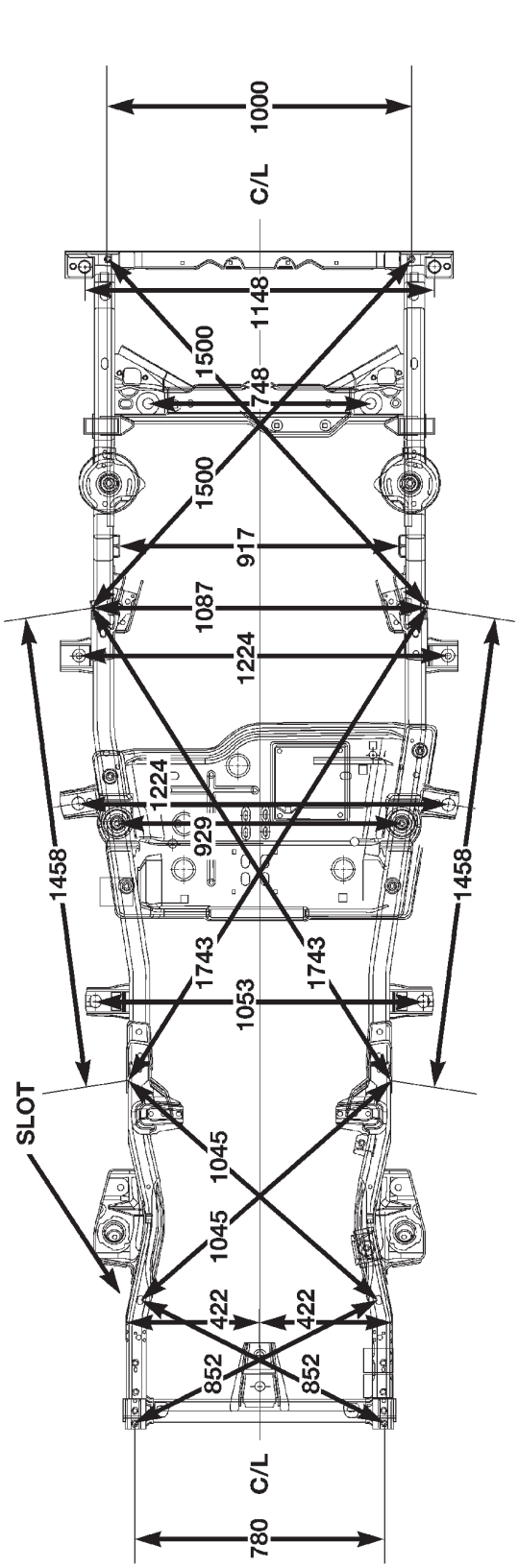


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POINT #	DISTANCE TO DATUM (mm)	
1.	500	BOTTOM OF SIDERAIL
2.	534	CENTER OF HOLE
3.	543	BOTTOM OF SIDERAIL, CENTER OF SLOT
4.	494	CENTER OF HOLE, OUTBOARD
5.	317	CENTER OF HOLE, OUTBOARD
6.	460	BOTTOM OF BRACKET
7.	359	BOTTOM OF SIDERAIL
8.	445	BOTTOM OF BRACKET
9.	445	BOTTOM OF BRACKET
10.	309	CENTER OF HOLE, OUTBOARD
11.	512	CENTER OF HOLE, INBOARD
12.	577	BOTTOM OF CROSSMEMBER
13.	474	CENTER OF HOLE, OUTBOARD
14.	505	BOTTOM OF BRACKET
15.	406	BOTTOM OF FRAME

SPECIFICATIONS (Continued)

FRAME TOP VIEW



SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Front Bumper Screw	104 N·m (77 ft. lbs.)
Front Tow Hook Screw	108 N·m (80 ft. lbs.)
Fuel Tank Skid Plate Nuts	16 N·m (138 in. lbs.)
Fuel Tank Strap Nuts	5 N·m (40 in. lbs.)
Main Floor holdown Bolt	47 N·m (35 ft. lbs.)
Radiator Holdown Bolt	47 N·m (35 ft. lbs.)
Rear Bumper Bolt	67 N·m (50 ft. lbs.)
Rear Bumper Nut	67 N·m (50 ft. lbs.)
Rear Floor holdown Bolt	47 N·m (35 ft. lbs.)
Transfer Case Skid Plate Bolts	74 N·m (55 ft. lbs.)
Transmission Mount Nuts	28 N·m (21 ft. lbs.)

FRAME AND BUMPERS

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BUMPERS

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REAR LICENSE PLATE BRACKET. 2

REMOVAL AND INSTALLATION

EMERGENCY TOE EYE

REMOVAL

(1) Remove the emergency toe eye cover.
(2) Remove the emergency toe eye attaching bolts (Fig. 1).

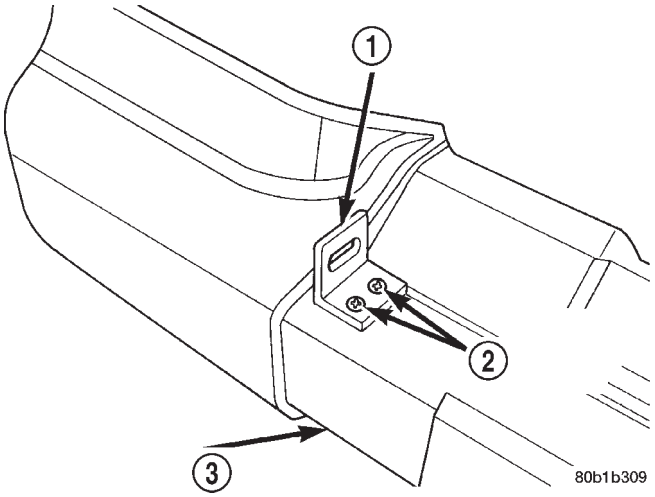


Fig. 1 Emergency Toe Eye

1 – FRONT TOW EYELET
2 – EYELET MOUNTING SCREWS
3 – FRONT BUMPER

INSTALLATION

(1) Perform the removal procedure in reverse order.

FRONT BUMPER EXTENSIONS

REMOVAL

(1) Remove the front bumper extension attaching screws (Fig. 2).
(2) Remove the front bumper extension.

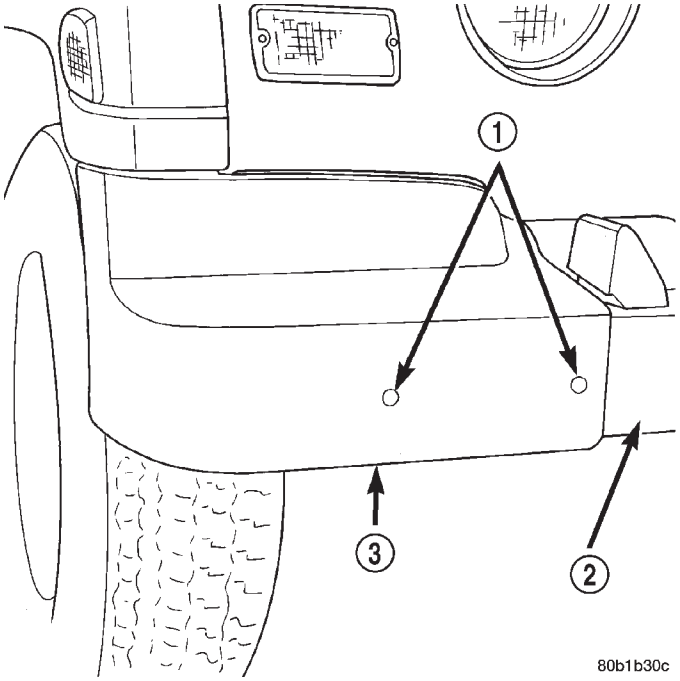


Fig. 2 Front Bumper Extension

1 – BUMPER EXTENSION FASTENERS
2 – FRONT BUMPER
3 – BUMPER EXTENSION

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Perform the removal procedure in reverse order.

FRONT LICENSE PLATE BRACKET

REMOVAL

(1) Remove the front license plate bracket attaching bolts and bracket (Fig. 3).

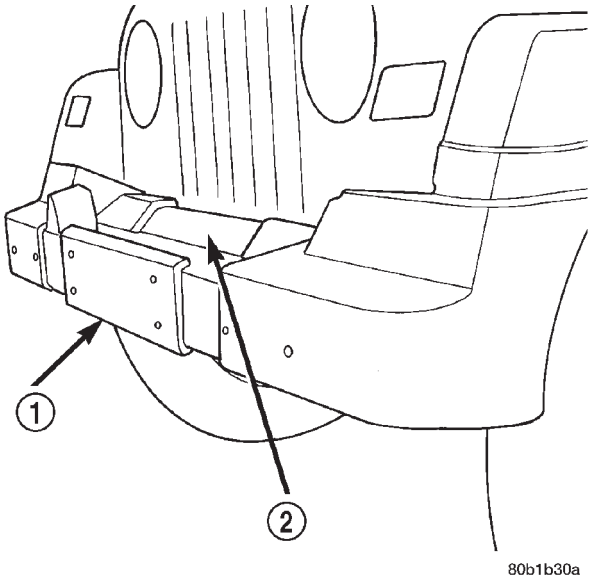


Fig. 3 Front License Plate Bracket

1 – FRONT LICENSE PLATE BRACKET
2 – FRONT BUMPER

INSTALLATION

(1) Perform the removal procedure in reverse order.

REAR LICENSE PLATE BRACKET

REMOVAL

(1) Remove the rear license plate bracket attaching screws (Fig. 4).

(2) Disconnect the license plate lamp electrical connectors.

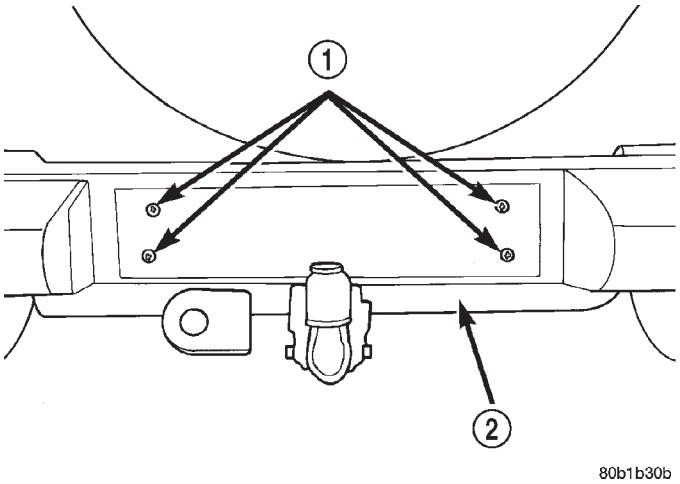


Fig. 4 Rear License Plate Bracket

1 – REAR LICENSE PLATE MOUNTING SCREWS
2 – REAR LICENSE PLATE BRACKET

INSTALLATION

(1) Perform the removal procedure in reverse order.

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FUEL DELIVERY SYSTEM

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DESCRIPTION AND OPERATION

PCM VIN REPROGRAMMING

OPERATION

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 DELIVERY SYSTEM

DESCRIPTION

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

DESCRIPTION AND OPERATION (Continued)

- 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
- rollover valve
- accelerator pedal
- throttle cable

OPERATION

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 flap door located below the fuel fill cap.

Also to be considered part of the fuel system is the evaporation control system. This is designed to reduce the emission of fuel vapors into the atmosphere. The description and function of the Evaporative Control System is found in Group 25, Emission Control Systems.

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

DESCRIPTION

The fuel pump module on all models is installed into the top of the fuel tank (Fig. 1). The fuel pump module contains the following components (Fig. 1) or (Fig. 2):

- A combination fuel filter/fuel pressure regulator
- A separate fuel pick-up filter (strainer)
- An electric fuel pump
- A threaded locknut to retain module to tank
- 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.

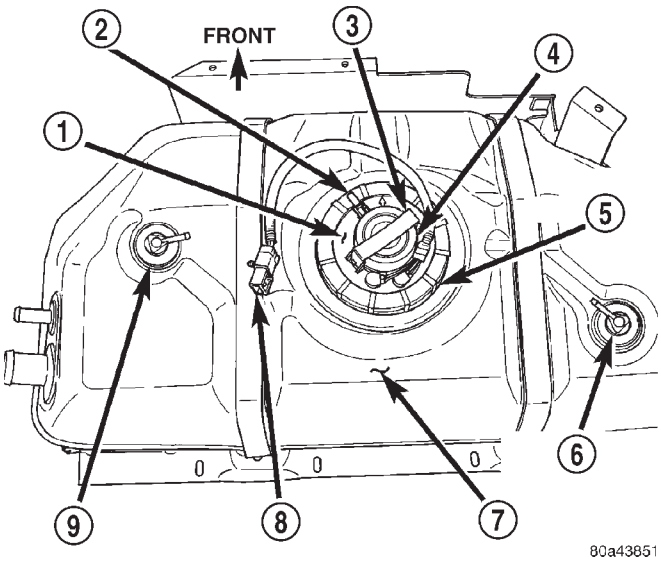


Fig. 1 Fuel Tank/Fuel Pump Module (Top View)

1 – FUEL PUMP MODULE
2 – FUEL SUPPLY TUBE
3 – RETAINER CLAMP
4 – FUEL FILTER/FUEL PRESSURE REGULATOR
5 – LOCKNUT
6 – ROLLOVER VALVE
7 – TOP OF FUEL TANK
8 – ELECTRICAL CONNECTOR
9 – ROLLOVER VALVE

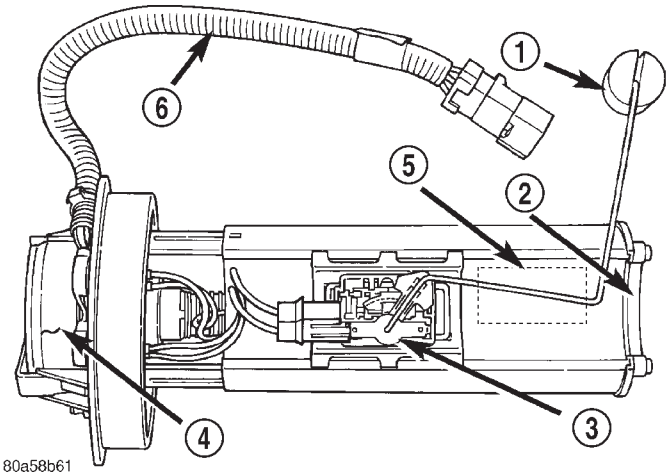


Fig. 2 Fuel Pump Module Components

1 – FUEL GAUGE FLOAT
2 – PICK-UP FILTER
3 – FUEL GAUGE SENDING UNIT
4 – FUEL FILTER/FUEL PRESSURE REGULATOR
5 – ELECTRIC FUEL PUMP
6 – PIGTAIL WIRING HARNESS

DESCRIPTION AND OPERATION (Continued)

OPERATION

Refer to Fuel Pump, Fuel Filter/Fuel Pressure Regulator and Fuel Gauge Sending Unit.

FUEL PUMP

DESCRIPTION

The fuel pump is located inside of the fuel pump module. A 12 volt, permanent magnet, electric motor powers the fuel pump.

OPERATION

Voltage to operate the electric pump is supplied through the fuel pump relay.

Fuel is drawn in through a filter at the bottom of the module and pushed through the electric motor gearset to the pump outlet.

Check Valve Operation: The 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.

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 (card).

OPERATION

The fuel pump module has 4 different circuits (wires). Two of these circuits are used for the fuel gauge sending unit for fuel gauge operation, and for certain OBD II emission requirements. The other 2 wires are used for electric fuel pump operation.

For Fuel Gauge Operation: A constant input voltage source of about 12 volts (battery voltage) is supplied to the resistor track on the fuel gauge sending unit. This is fed directly from the Powertrain Control Module (PCM). **NOTE: For diagnostic purposes, this 12V power source can only be verified with the circuit opened (fuel pump module electrical connector unplugged). With the connectors plugged, output voltages will vary from about.6 volts at FULL, to about 8.6 volts at EMPTY (about 8.6 volts at EMPTY for Jeep models, and about 7.0 volts at EMPTY for Dodge Truck models).** The resistor track is used to vary the voltage (resistance) depending on fuel tank float level. As fuel level increases, the float and arm move up, which decreases voltage. As fuel level decreases, the float and arm move down, which increases voltage. The varied voltage signal is returned back to the PCM through the sensor return circuit.

Both of the electrical circuits between the fuel gauge sending unit and the PCM are hard-wired (not multi-plexed). After the voltage signal is sent from the resistor track, and back to the PCM, the PCM will interpret the resistance (voltage) data and send a message across the multi-plex bus circuits to the instrument panel cluster. Here it is translated into the appropriate fuel gauge level reading. Refer to Instrument Panel for additional information.

For OBD II Emission Monitor Requirements: The PCM will monitor the voltage output sent from the resistor track on the sending unit to indicate fuel level. The purpose of this feature is to prevent the OBD II system from recording/setting false misfire and fuel system monitor diagnostic trouble codes. The feature is activated if the fuel level in the tank is less than approximately 15 percent of its rated capacity. If equipped with a Leak Detection Pump (EVAP system monitor), this feature will also be activated if the fuel level in the tank is more than approximately 85 percent of its rated capacity.

FUEL FILTER/FUEL PRESSURE REGULATOR

DESCRIPTION

The combination fuel filter and fuel pressure regulator is located on the top of fuel pump module (Fig. 1).

OPERATION

A combination fuel filter and fuel pressure regulator is used on all engines. 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 ± 34 kPa (49.2 ± 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.

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.

DESCRIPTION AND OPERATION (Continued)

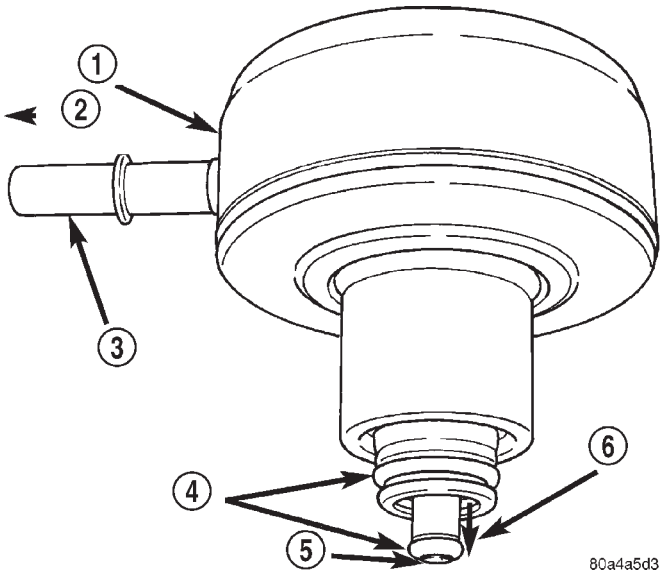


Fig. 3 Fuel Filter/Fuel Pressure Regulator

1 – FUEL FILTER/FUEL PRESSURE REGULATOR
2 – TO FUEL INJECTORS
3 – FUEL SUPPLY TUBE
4 – O-RINGS
5 – FUEL INLET FROM PUMP
6 – FUEL RETURN TO TANK

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 pressure is routed back into the tank through the pressure regulator. A separate fuel return line is not used with any engine.

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.

FUEL INJECTORS

DESCRIPTION

An individual fuel injector (Fig. 4) is used for each individual cylinder.

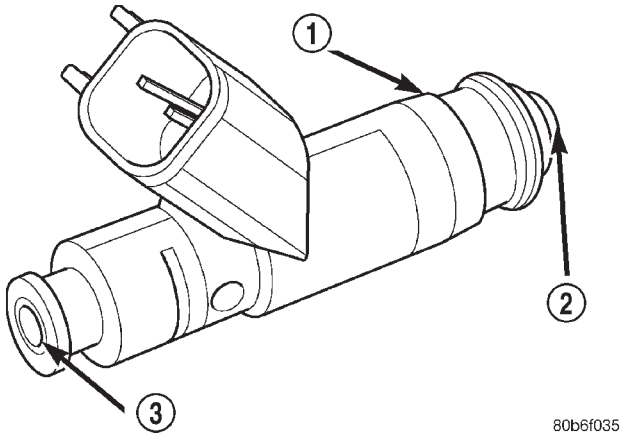


Fig. 4 Fuel Injector—Typical

1 – FUEL INJECTOR
2 – NOZZLE
3 – TOP (FUEL ENTRY)

OPERATION

The top (fuel entry) end of the injector (Fig. 4) is attached into an opening on the fuel rail.

The fuel injectors are electrical solenoids. The injector contains a pintle that closes off an orifice at the nozzle end. When electric current is supplied to the injector, the armature and needle move a short distance against a spring, allowing fuel to flow out the orifice. Because the fuel is under high pressure, a fine spray is developed in the shape of a pencil stream. The spraying action atomizes the fuel, adding it to the air entering the combustion chamber.

The nozzle (outlet) ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector.

The injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector

DESCRIPTION AND OPERATION (Continued)

on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

Battery voltage is supplied to the injectors through the ASD relay.

The PCM determines injector pulse width based on various inputs.

FUEL INJECTOR RAIL/FUEL DAMPER—2.5L ENGINE

DESCRIPTION

The fuel injector rail is used to mount the fuel injectors to the engine (Fig. 5). On the 2.5L 4–cylinder engine, a **fuel damper** is located at the front of the fuel rail (Fig. 5).

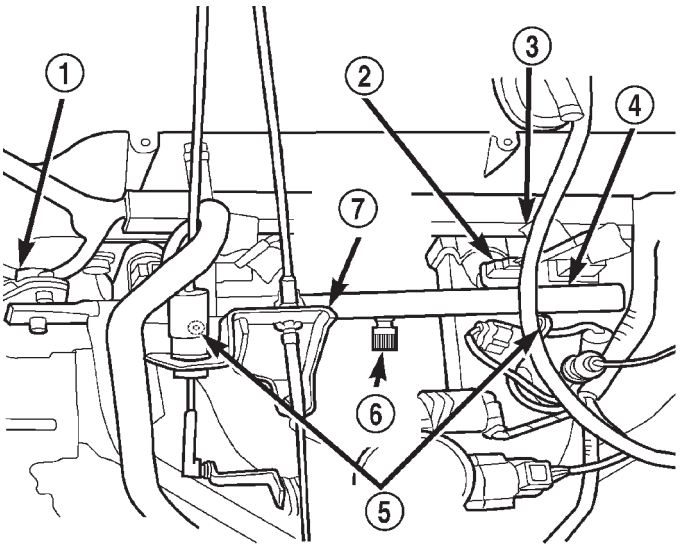


Fig. 5 Fuel Injector Rail/Fuel Damper—2.5L Engine

1 – FUEL DAMPER
2 – FUEL INJECTOR
3 – NUMBERED TAG
4 – FUEL RAIL
5 – FUEL RAIL MOUNTING BOLTS/NUTS
6 – TEST PORT
7 – CABLE BRACKET

OPERATION

The fuel injector rail supplies the necessary fuel to each individual fuel injector.

The fuel 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.

The fuel rail is not repairable.

FUEL RAIL/FUEL DAMPER—4.0L ENGINE

DESCRIPTION

The fuel rail is mounted to the intake manifold (Fig. 6). It is used to mount the fuel injectors to the engine. On the 4.0L 6–cylinder engine, a **fuel damper** is located near the center of the fuel rail (Fig. 6).

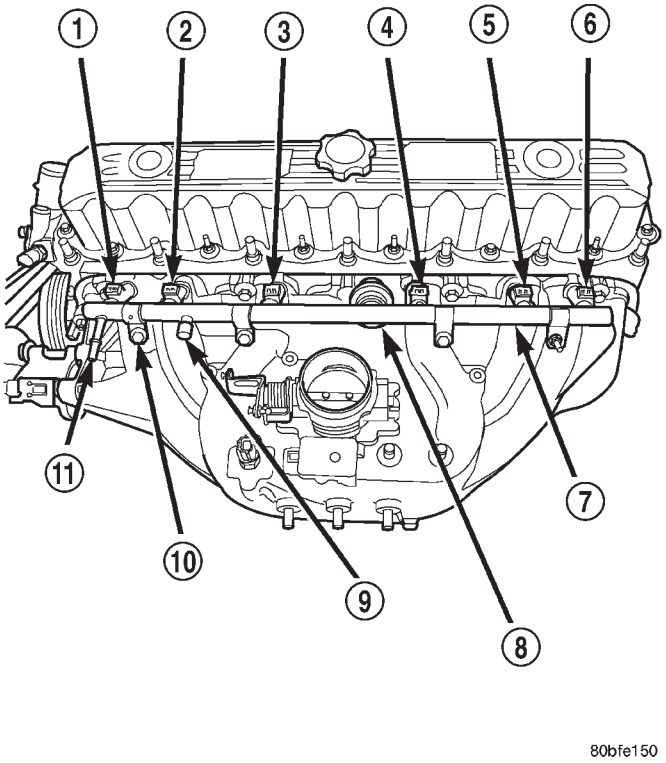


Fig. 6 Fuel Rail/Fuel Damper—4.0L Engine

1 – INJ. #1
2 – INJ. #2
3 – INJ. #3
4 – INJ. #4
5 – INJ. #5
6 – INJ. #6
7 – FUEL INJECTOR RAIL
8 – FUEL DAMPER
9 – PRESSURE TEST PORT CAP
10 – MOUNTING BOLTS (4)
11 – QUICK-CONNECT FITTING

OPERATION

The fuel injector rail supplies the necessary fuel to each individual fuel injector.

The fuel 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.

DESCRIPTION AND OPERATION (Continued)

Refer to Fuel Filter/Fuel Pressure Regulator in this group for information.

The fuel rail is not repairable.

FUEL TANK FILLER TUBE CAP

DESCRIPTION

The plastic fuel tank filler tube cap is threaded onto the end of the fuel fill tube. Certain models are equipped with a 1/4 turn cap.

OPERATION

The loss of any fuel or vapor out of fuel filler tube is prevented by the use of a pressure-vacuum fuel fill cap. Relief valves inside the cap will release fuel tank pressure at predetermined pressures. Fuel tank vacuum will also be released at predetermined values. This cap must be replaced by a similar unit if replacement is necessary. This is in order for the system to remain effective.

CAUTION: Remove fill cap before servicing any fuel system component to relieve tank pressure. If equipped with a California emissions package and a Leak Detection Pump (LDP), the cap must be tightened securely. If cap is left loose, a Diagnostic Trouble Code (DTC) may be set.

FUEL TUBES/LINES/HOSES AND CLAMPS

DESCRIPTION

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.

The lines/tubes/hoses used on fuel injected vehicles are of a special construction. This is due to the higher fuel pressures and the possibility of contaminated fuel in this system. If it is necessary to replace these lines/tubes/hoses, only those marked EFM/EFI may be used.

If equipped: The hose clamps used to secure rubber hoses on fuel injected vehicles are of a special rolled edge construction. This construction is used to prevent the edge of the clamp from cutting into the hose. Only these rolled edge type clamps may be used in this system. All other types of clamps may cut into the hoses and cause high-pressure fuel leaks.

Use new original equipment type hose clamps.

QUICK-CONNECT FITTINGS

DESCRIPTION

Different types of quick-connect fittings are used to attach various fuel system components, lines and tubes. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Some are equipped with safety latch clips. Some may require the use of a special tool for disconnection and removal. Refer to Quick-Connect Fittings Removal/Installation for more information.

CAUTION: The interior components (o-rings, clips) of quick-connect fittings are not serviced separately, but new plastic spacers are available for some types. If service parts are not available, do not attempt to repair the damaged fitting or fuel line (tube). If repair is necessary, replace the complete fuel line (tube) assembly.

DIAGNOSIS AND TESTING

FUEL PUMP PRESSURE TEST

Use this test in conjunction with the Fuel Pump Capacity Test, Fuel Pressure Leak Down Test and Fuel Pump Amperage Test found elsewhere in this group.

Check Valve Operation: The 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). **The DRB III Scan Tool along with the PEP module, the 500 psi pressure transducer, and the transducer-to-test port adapter may also be used in place of the fuel pressure gauge.**

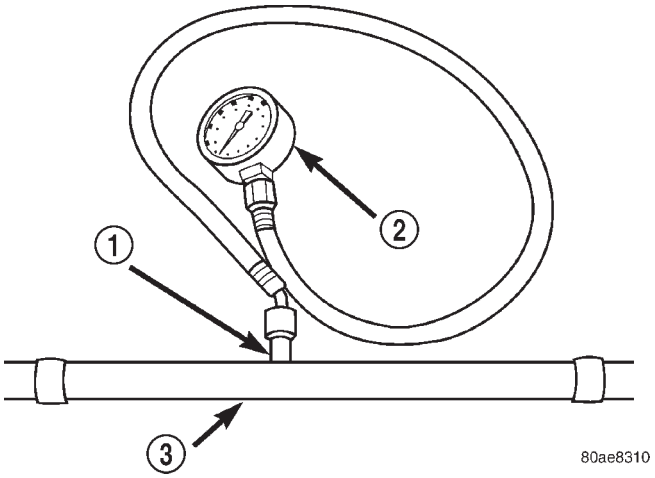


Fig. 7 Fuel Pressure Test Gauge (Typical Gauge Installation at Test Port)

1 – SERVICE (TEST) PORT
2 – FUEL PRESSURE TEST GAUGE
3 – FUEL RAIL

(2) Start and warm engine and note pressure gauge reading. Fuel pressure should be 339 kPa ± 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

DIAGNOSIS AND TESTING (Continued)

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).

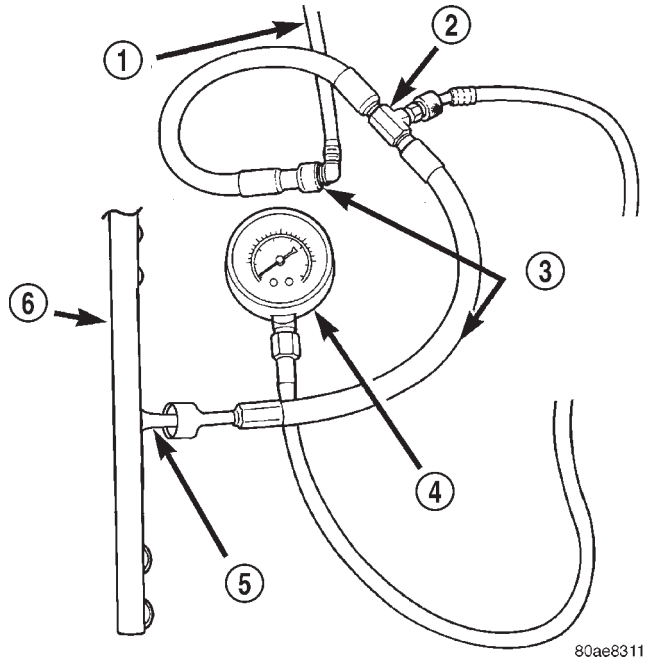


Fig. 8 Connecting Adapter Tool—Typical

1 – VEHICLE FUEL LINE
2 – TEST PORT "T"
3 – SPECIAL TOOL 6923, 6631, 6541 OR 6539
4 – FUEL PRESSURE TEST GAUGE
5 – FUEL LINE CONNECTION AT RAIL
6 – FUEL RAIL

(4) Connect the 0-414 kPa (0-60 psi) fuel pressure test gauge (from Gauge Set 5069) to the test port on the appropriate Adaptor Tool. **The DRB III Scan Tool along with the PEP module, the 500 psi pressure transducer, and the transducer-to-test port adapter may also be used in place of the fuel pressure gauge.**

The fittings on both tools must be in good condition and free from any small leaks before performing the proceeding test.

(5) Start engine and bring to normal operating temperature.

(6) Observe test gauge. Normal operating pressure should be 339 kPa ± 34 kPa (49.2 psi ± 5 psi).

(7) Shut engine off.

(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.

(1) Be sure fuel tank contains fuel before starting test. If tank is empty or near empty, amperage readings will be incorrect.

(2) Obtain LCS adapter.

(3) Plug cable from LCS adapter into DRB scan tool at SET 1 receptacle.

(4) Plug DRB into vehicle 16–way connector (data link connector).

(5) Connect (-) and (+) test cable leads into LCS adapter receptacles. Use **10 amp (10A +)** receptacle and common (-) receptacles.

(6) Gain access to MAIN MENU on DRB screen.

(7) Press DVOM button on DRB.

DIAGNOSIS AND TESTING (Continued)

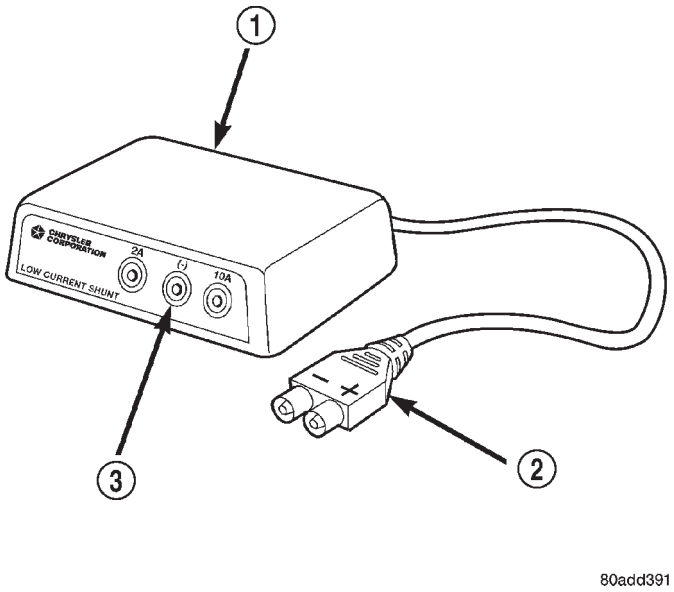


Fig. 9 Low Current Shunt Adapter

1 – LOW CURRENT SHUNT ADAPTER
2 – PLUG TO DRB
3 – TEST LEAD RECEPTACLES

(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.

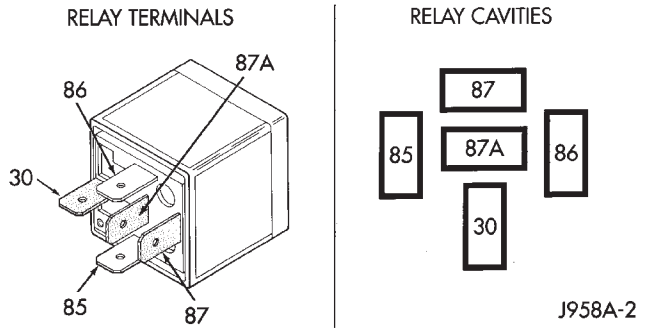
CAUTION: TO PREVENT POSSIBLE DAMAGE TO THE VEHICLE ELECTRICAL SYSTEM AND LCS ADAPTER, THE TEST LEADS MUST BE CONNECTED INTO RELAY CAVITIES EXACTLY AS SHOWN IN FOLLOWING STEPS.

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).

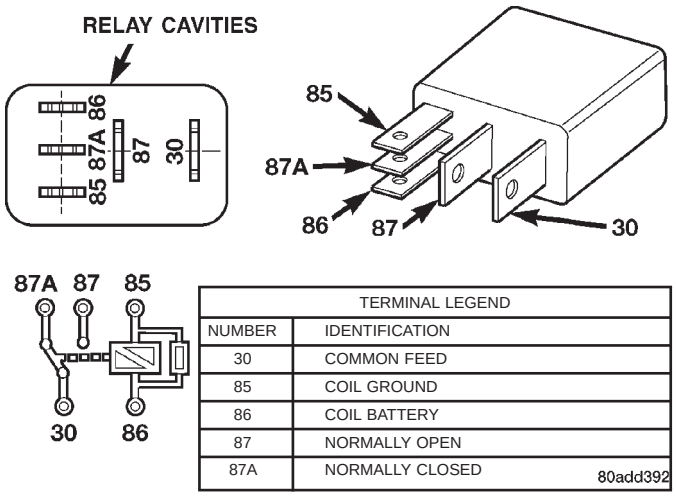
(16) If equipped with **type–3 relay** (Fig. 12), attach test leads from LCS adapter into PDC relay cavities number 3 and 5. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 12).



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 10 Type–1 Relay

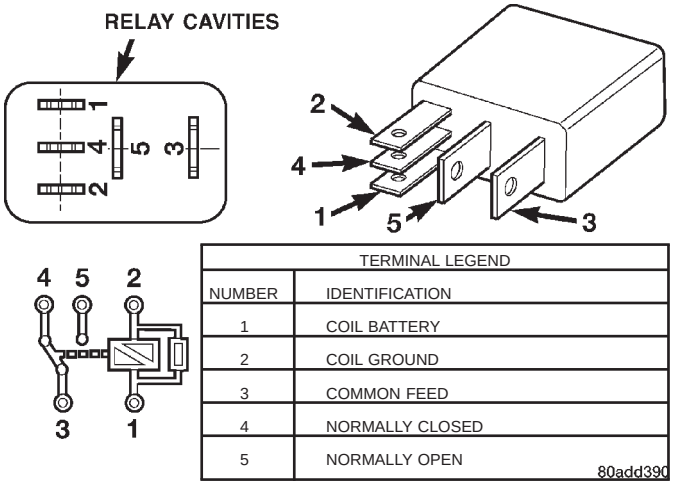
DIAGNOSIS AND TESTING (Continued)



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

80add392

Fig. 11 Type–2 Relay



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
1	COIL BATTERY
2	COIL GROUND
3	COMMON FEED
4	NORMALLY CLOSED
5	NORMALLY OPEN

80add390

Fig. 12 Type–3 Relay

(17) When LCS adapter test leads are attached into relay cavities, fuel pump **will be activated.** Determine fuel pump amperage on DRB screen. Amperage should be below 10.0 amps. If amperage is below 10.0 amps, and specifications for the Fuel Pump Pressure, Fuel Pump Capacity and Fuel Pressure Leak Down tests were met, the fuel pump module is OK.

(18) If amperage is more than 10.0 amps, replace fuel pump module assembly. The electric fuel pump is not serviced separately.

(19) Disconnect test leads from relay cavities immediately after testing.

FUEL 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 the fuel injector rail is, or is not equipped with a fuel pressure test port.

(1) Remove fuel fill cap.

(2) Remove fuel pump relay from Power Distribution Center (PDC). For location of relay, refer to label on underside of PDC cover.

(3) Start and run engine until it stalls.

(4) Attempt restarting engine until it will no longer run.

(5) Turn ignition key to OFF position.

CAUTION: Steps 1, 2, 3 and 4 must be performed to relieve high pressure fuel from within fuel rail. Do not attempt to use following steps to relieve this pressure as excessive fuel will be forced into a cylinder chamber.

(6) Unplug connector from any fuel injector.

(7) Attach one end of a jumper wire with alligator clips (18 gauge or smaller) to either injector terminal.

(8) Connect other end of jumper wire to positive side of battery.

(9) Connect one end of a second jumper wire to remaining injector terminal.

CAUTION: Powering an injector for more than a few seconds will permanently damage the injector.

(10) Momentarily touch other end of jumper wire to negative terminal of battery for no more than a few seconds.

SERVICE PROCEDURES (Continued)

(11) Place a rag or towel below fuel line quick-connect fitting at fuel rail.

(12) Disconnect quick-connect fitting at fuel rail. Refer to Quick-Connect Fittings.

(13) Return fuel pump relay to PDC.

(14) One or more Diagnostic Trouble Codes (DTC's) may have been stored in PCM memory due to fuel pump relay removal. The DRB scan tool must be used to erase a DTC.

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.

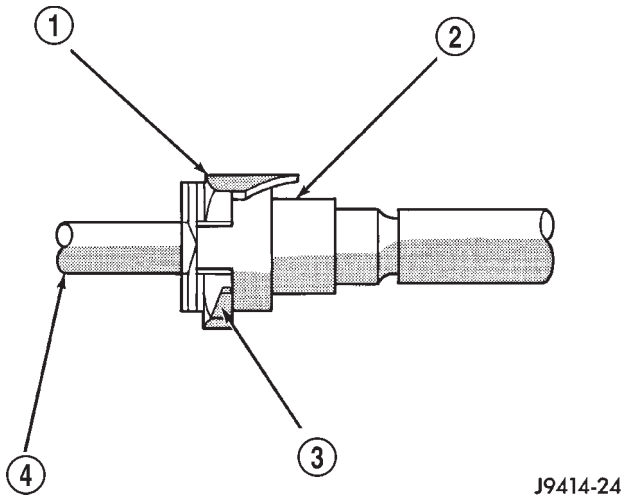


Fig. 13 Single-Tab Type Fitting

1 – PULL TAB
2 – QUICK-CONNECT FITTING
3 – PRESS HERE TO REMOVE PULL TAB
4 – INSERTED TUBE END

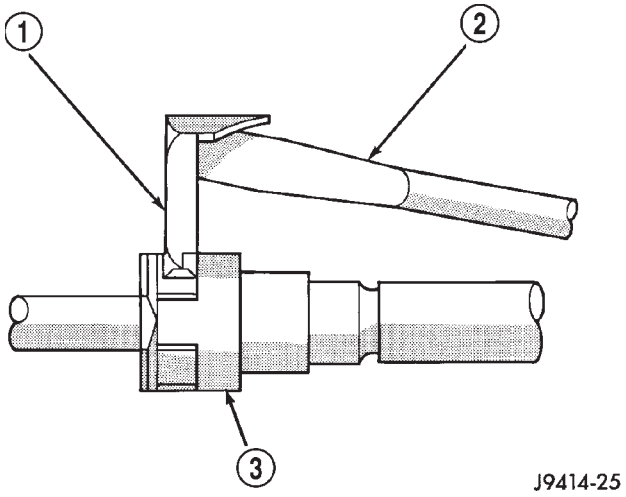


Fig. 14 Disconnecting Single-Tab Type Fitting

1 – PULL TAB
2 – SCREWDRIVER
3 – QUICK-CONNECT FITTING

SERVICE PROCEDURES (Continued)

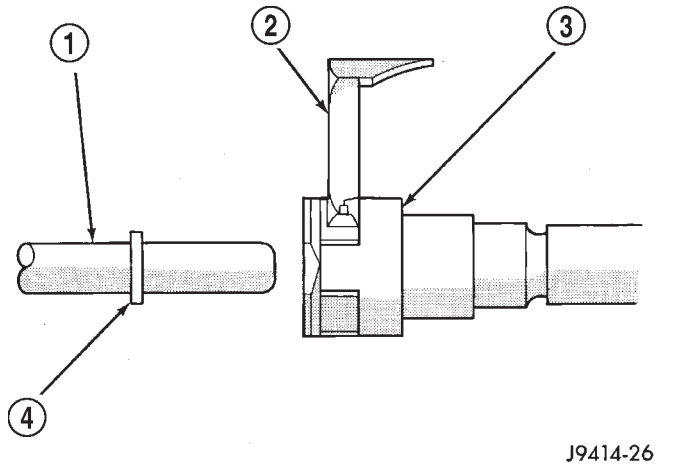


Fig. 15 Removing Pull Tab

1 – FUEL TUBE OR FUEL SYSTEM COMPONENT
2 – PULL TAB
3 – QUICK-CONNECT FITTING
4 – FUEL TUBE STOP

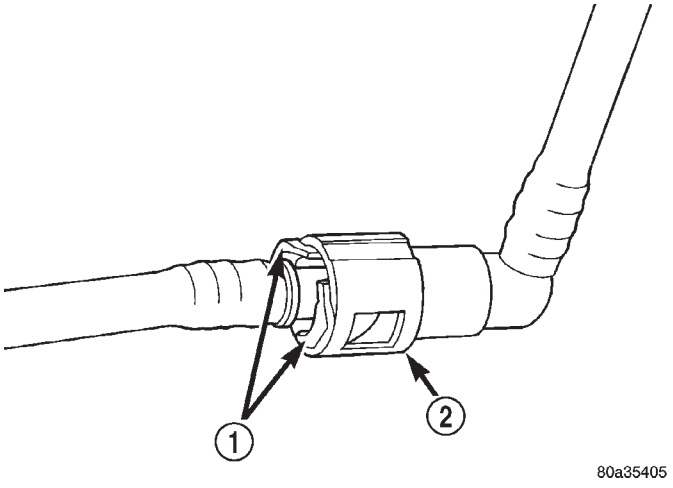


Fig. 16 Typical Two-Tab Type Quick-Connect Fitting

1 – TAB(S)
2 – QUICK-CONNECT 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.

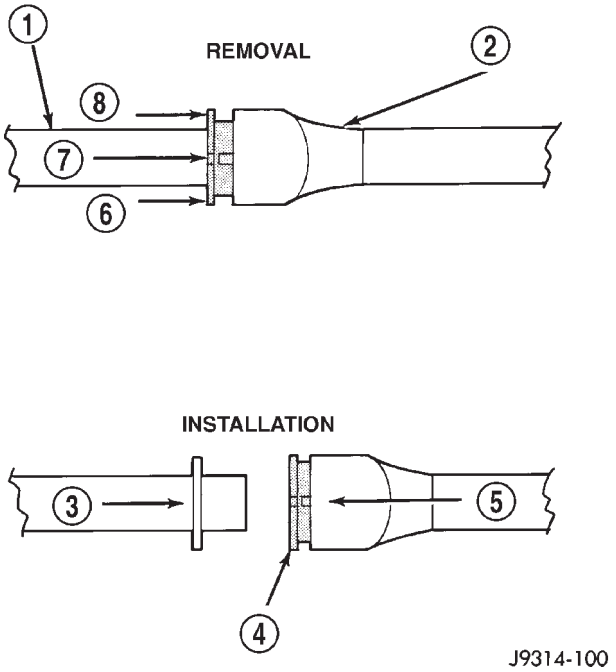


Fig. 17 Plastic Retainer Ring Type Fitting

1 – FUEL TUBE
2 – QUICK CONNECT FITTING
3 – PUSH
4 – PLASTIC RETAINER
5 – PUSH
6 – PUSH
7 – PUSH
8 – PUSH

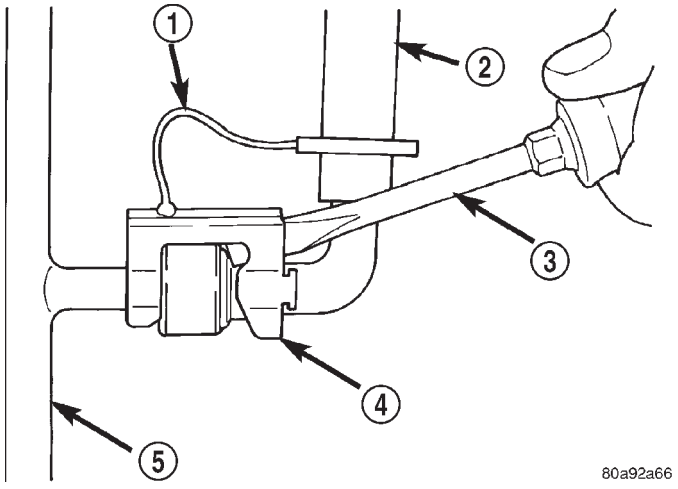


Fig. 18 Latch Clip—Type 1

1 – TETHER STRAP
2 – FUEL LINE
3 – SCREWDRIVER
4 – LATCH CLIP
5 – FUEL RAIL

SERVICE PROCEDURES (Continued)

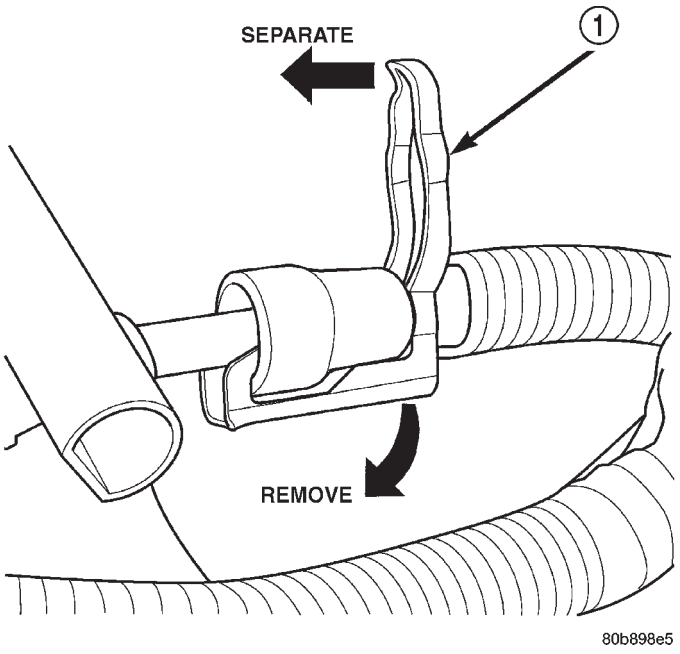


Fig. 19 Latch Clip—Type 2

1 – LATCH CLIP

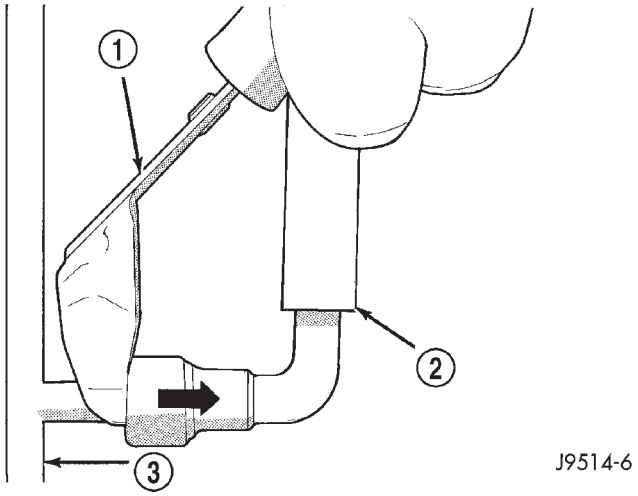


Fig. 20 Fuel Line Disconnection Using Special Tool

1 – SPECIAL FUEL LINE TOOL
2 – FUEL LINE
3 – FUEL RAIL

(a) To release fuel system component from quick-connect fitting, firmly push fitting towards component being serviced while firmly pushing plastic retainer ring into fitting (Fig. 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.

(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.

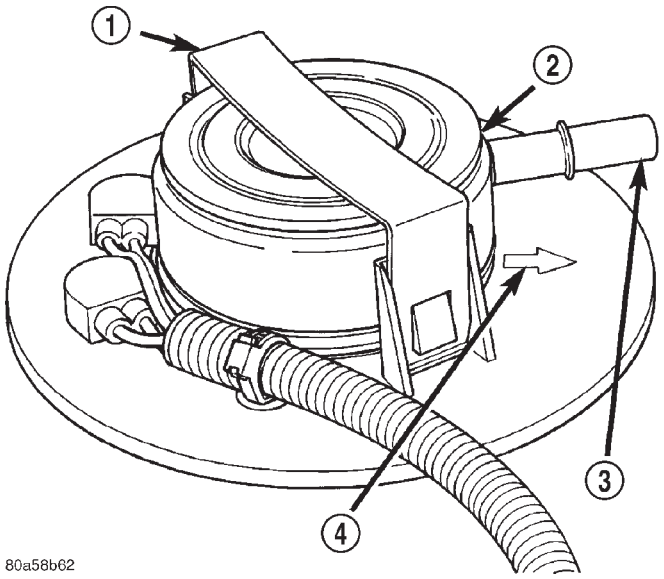


Fig. 21 Fuel Filter/Fuel Pressure Regulator

1 – RETAINER CLAMP
2 – FUEL FILTER/FUEL PRESSURE REGULATOR
3 – FUEL SUPPLY TUBE
4 – ALIGNMENT ARROW

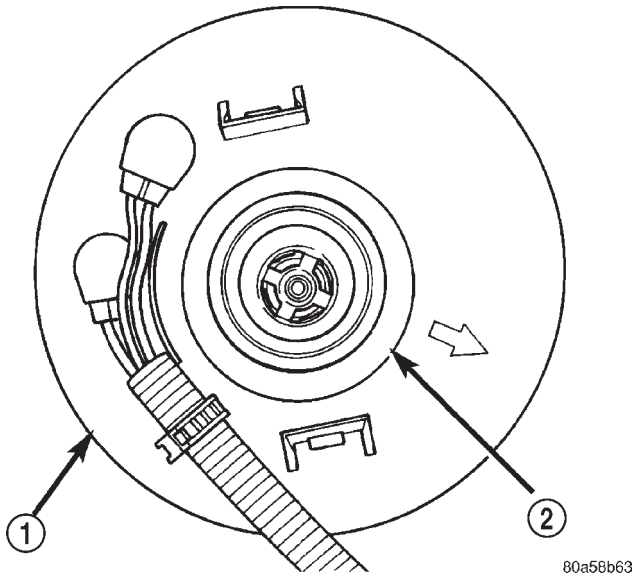


Fig. 22 Fuel Filter/Fuel Pressure Regulator Gasket

1 – TOP OF MODULE
2 – GASKET

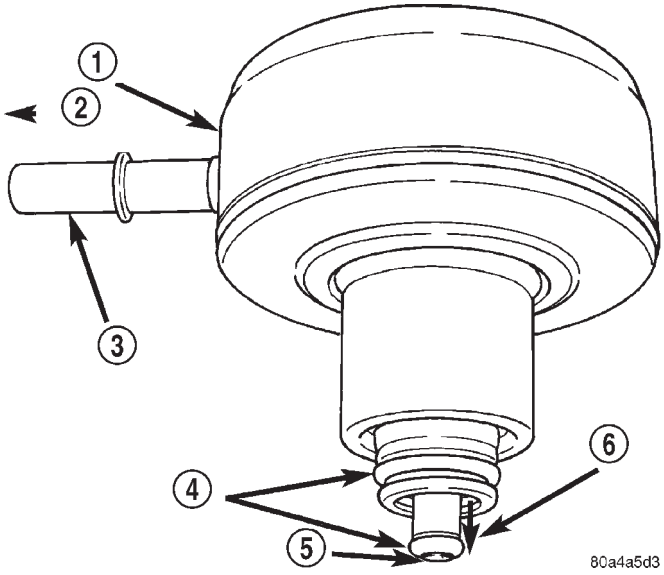


Fig. 23 Fuel Filter/Fuel Pressure Regulator O-Rings

1 – FUEL FILTER/FUEL PRESSURE REGULATOR
2 – TO FUEL INJECTORS
3 – FUEL SUPPLY TUBE
4 – O-RINGS
5 – FUEL INLET FROM PUMP
6 – FUEL RETURN TO TANK
7 – FUEL RETURN TO TANK

REMOVAL AND INSTALLATION (Continued)

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).

(6) The molded arrow (Fig. 21) on 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 to 10 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.

FUEL PUMP MODULE

Fuel tank removal will be necessary for fuel pump module removal.

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING THE FUEL PUMP MODULE, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

(1) Drain fuel tank and remove tank. Refer to the Fuel Tank Removal/Installation section of this group.

(2) Thoroughly wash and clean area around pump module to prevent contaminants from entering tank.

(3) 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.

(4) Remove module from fuel tank.

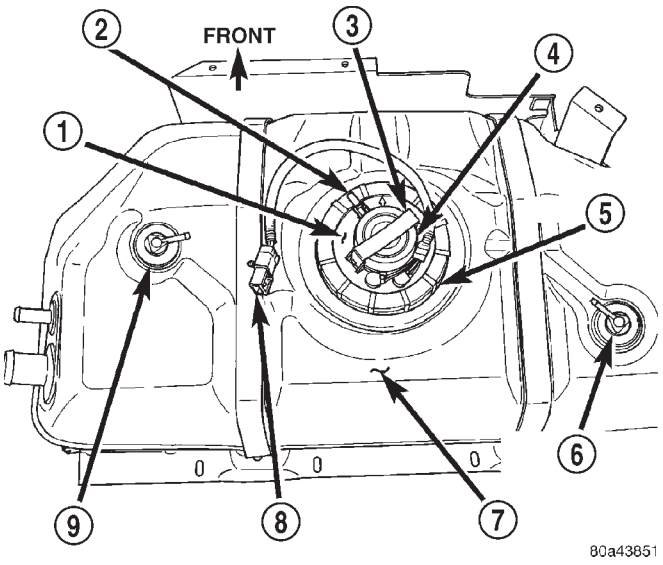


Fig. 24 Top View of Fuel Tank and Fuel Pump Module

1 – FUEL PUMP MODULE
2 – FUEL SUPPLY TUBE
3 – RETAINER CLAMP
4 – FUEL FILTER/FUEL PRESSURE REGULATOR
5 – LOCKNUT
6 – ROLLOVER VALVE
7 – TOP OF FUEL TANK
8 – ELECTRICAL CONNECTOR
9 – ROLLOVER VALVE

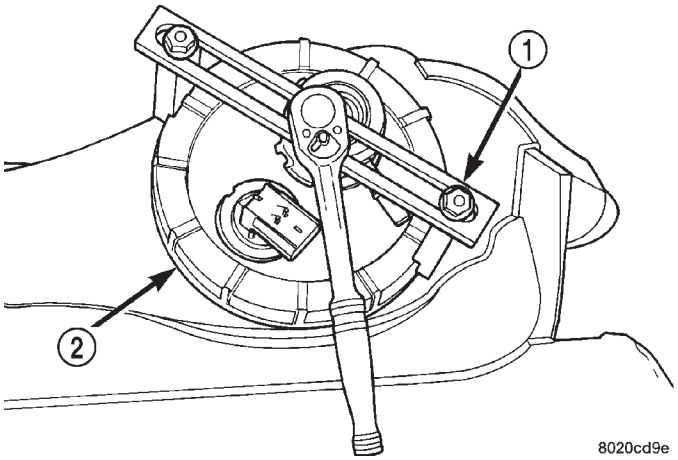


Fig. 25 Locknut Removal/Installation—Typical

1 – SPECIAL TOOL 6856
2 – LOCKNUT

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

CAUTION: Whenever the fuel pump module is serviced, the 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 new gasket, position fuel pump module into opening in fuel tank.
(3) Apply clean water to locknut threads.
(4) Position locknut over top of fuel pump module.
(5) Rotate module until arrow (Fig. 21) 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 to 10 o'clock position.
(9) 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.

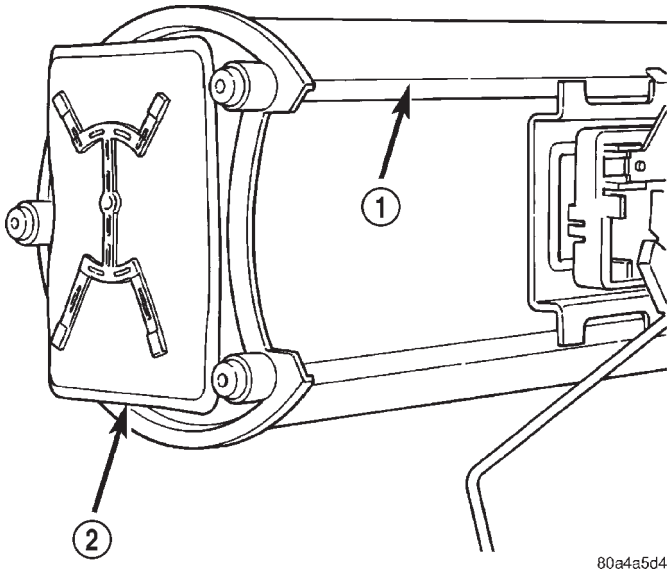


Fig. 26 Fuel Pump Inlet Filter

1 – FUEL PUMP MODULE
2 – 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.

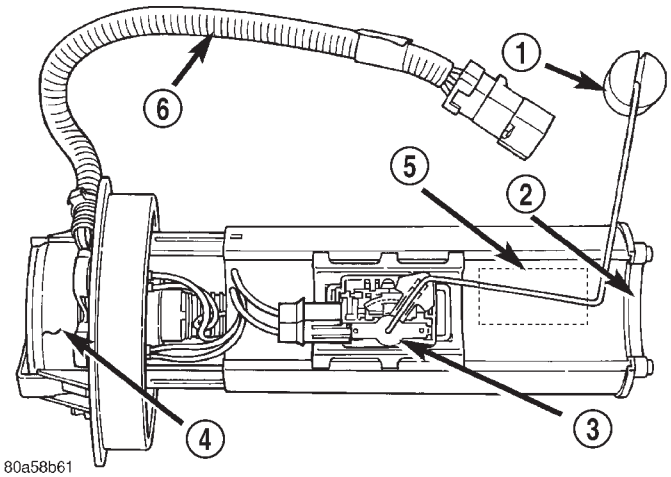


Fig. 27 Fuel Gauge Sending Unit Location

1 – FUEL GAUGE FLOAT
2 – PICK-UP FILTER
3 – FUEL GAUGE SENDING UNIT
4 – FUEL FILTER/FUEL PRESSURE REGULATOR
5 – ELECTRIC FUEL PUMP
6 – PIGTAIL WIRING HARNESS

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.

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.

REMOVAL AND INSTALLATION (Continued)

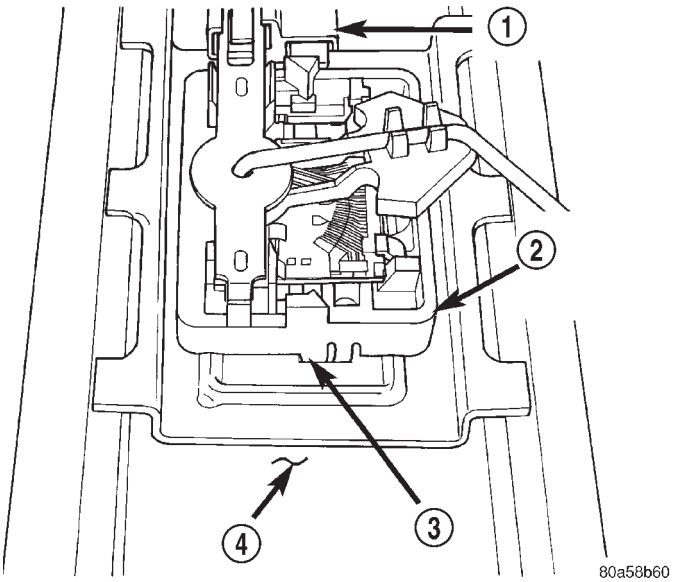


Fig. 28 Fuel Gauge Sending Unit Release Tab

1 – ELECTRICAL CONNECTOR
2 – FUEL GAUGE SENDING UNIT
3 – RELEASE TAB
4 – FUEL PUMP MODULE

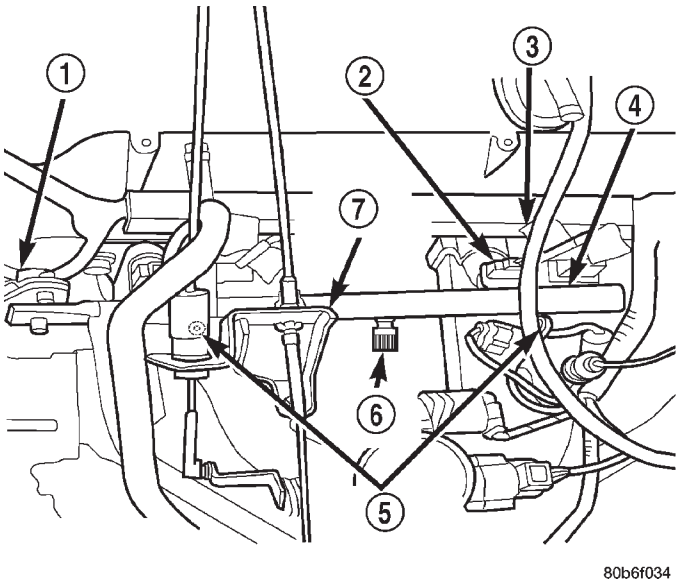


Fig. 29 Fuel Rail Mounting—2.5L Engine

1 – FUEL DAMPER
2 – FUEL INJECTOR
3 – NUMBERED TAG
4 – FUEL RAIL
5 – FUEL RAIL MOUNTING BOLTS/NUTS
6 – TEST PORT
7 – CABLE BRACKET

(4) Install fuel tank. Refer to Fuel Tank Removal/Installation.

FUEL INJECTOR RAIL/FUEL DAMPER—2.5L ENGINE

REMOVAL

The fuel damper is not serviced separately.

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.
(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.

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.

REMOVAL AND INSTALLATION (Continued)

(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/FUEL DAMPER—4.0L ENGINE

REMOVAL

The fuel damper is not serviced separately.

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.

(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) Disconnect electrical connectors at all 6 fuel injectors. To remove connector refer to (Fig. 30). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification. If harness is not tagged, note wiring location before removal.

(6) Disconnect fuel supply line latch clip and fuel line at fuel rail. Refer to Quick-Connect Fittings.

(7) Disconnect throttle cable at throttle body. Refer to Throttle Cable Removal/Installation.

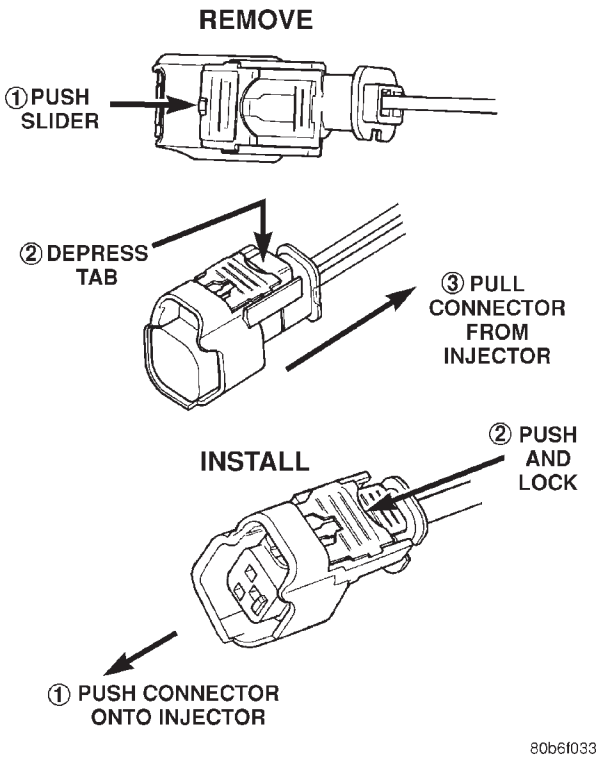


Fig. 30 Remove/Install Fuel Injector Connector—2.5L/4.0L Engine

(8) Disconnect speed control cable at throttle body (if equipped). Refer to Speed Control Cable in Group 8H, Speed Control System.

(9) Disconnect automatic transmission cable at throttle body (if equipped).

(10) Remove cable routing bracket at intake manifold.

(11) If equipped, remove wiring harnesses at injection rail studs by removing nuts.

(12) Clean dirt/debris from each fuel injector at intake manifold.

(13) Remove fuel rail mounting nuts/bolts (Fig. 31).

(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) If equipped, connect wiring harnesses to injection rail studs.

REMOVAL AND INSTALLATION (Continued)

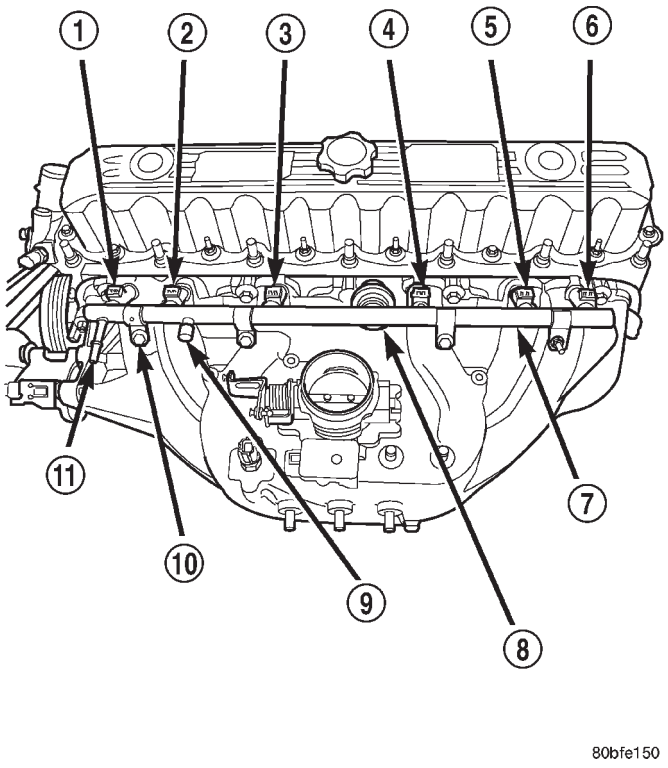


Fig. 31 Fuel Rail Mounting—4.0L Engine

1 – INJ. #1
2 – INJ. #2
3 – INJ. #3
4 – INJ. #4
5 – INJ. #5
6 – INJ. #6
7 – FUEL INJECTOR RAIL
8 – FUEL DAMPER
9 – PRESSURE TEST PORT CAP
10 – MOUNTING BOLTS (4)
11 – QUICK-CONNECT FITTING

(6) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 30). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector.

(7) Connect fuel line and fuel line latch clip to fuel rail. Refer Quick-Connect Fittings..

(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) Disconnect clip(s) that retain fuel injector(s) to fuel rail (Fig. 32).

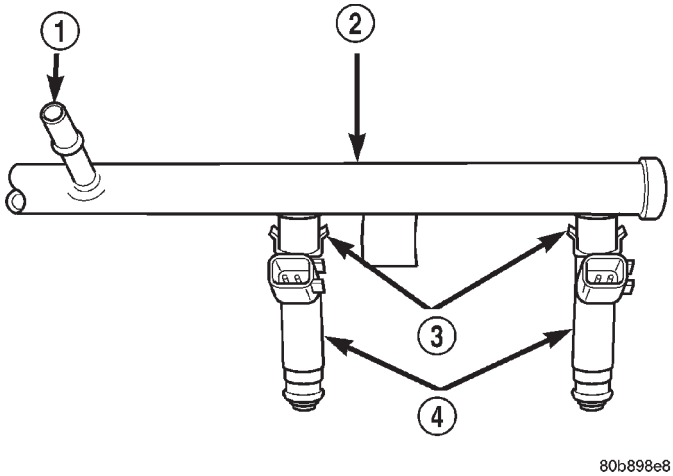


Fig. 32 Fuel Injector Mounting

1 – INLET FITTING
2 – FUEL INJECTOR RAIL
3 – CLIP
4 – FUEL INJECTOR

INSTALLATION

(1) Install fuel injector(s) into fuel rail assembly and install retaining clip(s).

(2) If same injector(s) is being reinstalled, install new o-ring(s).

(3) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.

(4) Install fuel rail. Refer to Fuel Rail Installation.

(5) Start engine and check for fuel leaks.

FUEL 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

REMOVAL AND INSTALLATION (Continued)

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

On this model, the fuel tank is mounted to vehicle skid plate. The skid plate is mounted to vehicle body.

(1) Remove fuel filler cap.

(2) Perform the Fuel System Pressure Release Procedure as described elsewhere in this group.

(3) Disconnect negative battery cable.

(4) Remove 8 screws retaining plastic fuel filler bezel to body (Fig. 33). Remove fuel filler bezel.

(5) To prevent contaminants from entering tank, temporarily install fuel cap to fill hoses.

(6) Cut plastic tie wrap securing rear axle vent hose to fuel filler hoses.

(7) Disconnect electrical connector at front of fuel tank (Fig. 34).

(8) Disconnect EVAP hose from EVAP line at front of fuel tank (Fig. 34).

(9) Disconnect quick-connect fitting from fuel line at front of fuel tank (Fig. 34). Refer to Quick-Connect Fittings in this group for procedures.

(10) The fuel tank and skid plate are removed as an assembly. Centrally position a transmission jack (or equivalent lifting device) under skid plate/fuel tank assembly. Secure tank assembly to jack.

(11) Remove three skid plate-to-body nuts at front of tank (Fig. 36). Remove one of the nuts through access hole on skid plate (Fig. 36).

(12) Remove four skid plate-to-body nuts at rear of tank (Fig. 35). **Do not loosen tank strap nuts (Fig. 35).**

(13) Lower the tank assembly.

(14) If fuel pump module is to be removed, refer to Fuel Pump Module Removal/Installation.

(15) Disconnect fuel filler hoses at tank. Before disconnecting, mark and note the hose rotational position in relation to tank fittings.

(16) Using an approved portable gasoline siphon/storage tank, drain fuel from tank. To drain fuel, position drain hose into vent fitting (smallest of 2) on side of tank.

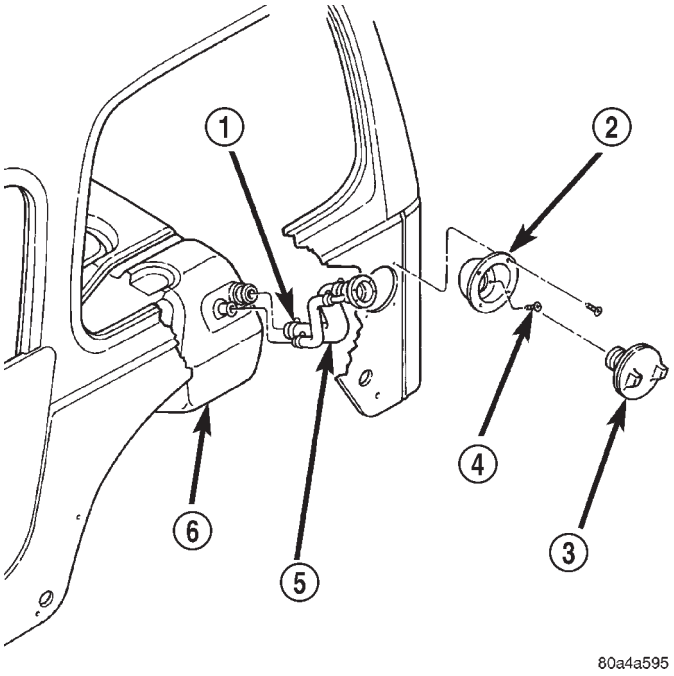


Fig. 33 Fuel Filler Hoses/Fuel Fill Cap

1 – FILLER HOSE CLAMPS (4)
2 – BEZEL
3 – BEZEL SCREWS (8)
4 – FUEL FILLER CAP
5 – FUEL FILLER HOSES
6 – FUEL TANK

REMOVAL AND INSTALLATION (Continued)

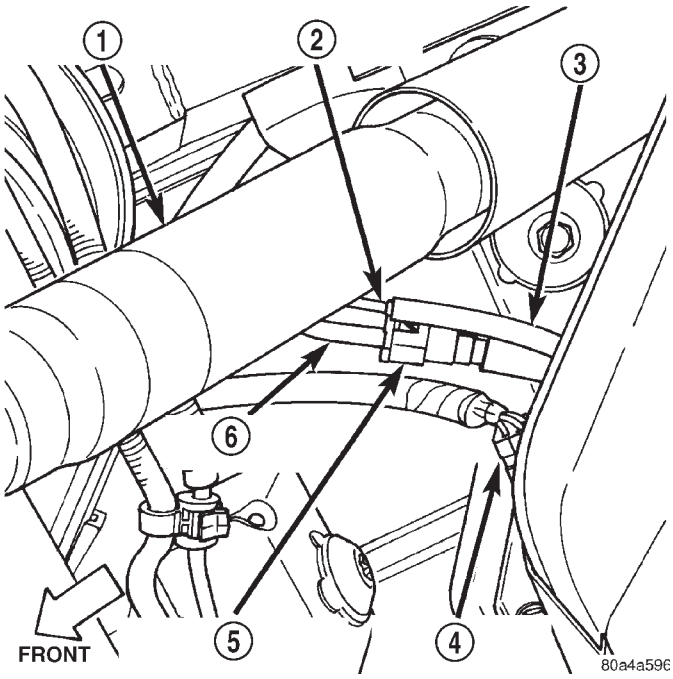


Fig. 34 Fuel Tank Connections

1 – L. R. SHOCK ABSORBER
2 – EVAP LINE (TO CANISTER)
3 – EVAP HOSE
4 – ELECTRICAL CONNECTOR
5 – QUICK-CONNECT FITTING
6 – FUEL LINE (TO ENGINE)

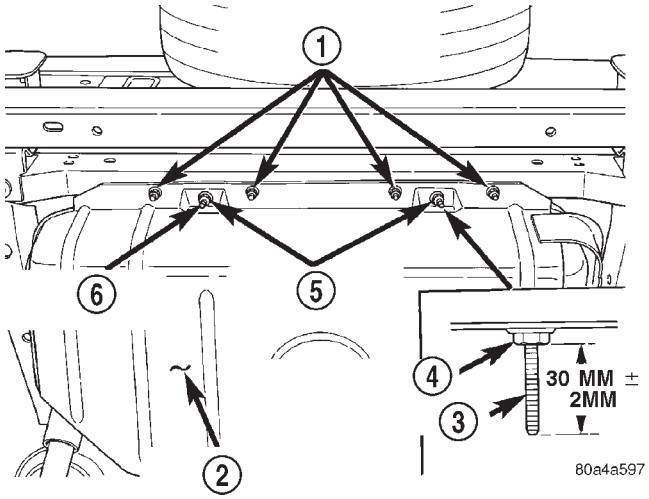


Fig. 35 Fuel Tank Mounting Nuts—Rear

1 – REAR SKID PLATE NUTS (4)
2 – SKID PLATE
3 – TANK STRAP STUD
4 – TANK STRAP NUT
5 – TANK STRAP NUTS (2)
6 – PROTECTIVE CAPS (2)

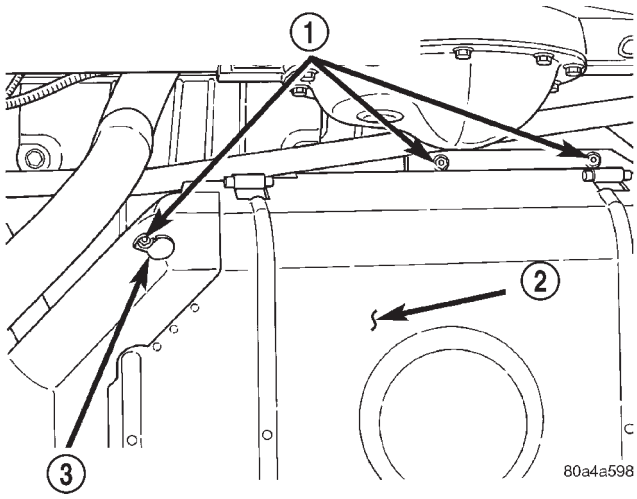


Fig. 36 Fuel Tank Mounting Nuts—Front

1 – FRONT SKID PLATE NUTS (3)
2 – SKID PLATE
3 – ACCESS HOLE

(17) To separate tank from skid plate, remove two protective caps at tank strap studs (Fig. 35) and remove tank strap nuts.

(18) Remove both straps and remove tank from skid plate.

INSTALLATION

(1) Place fuel tank into skid plate. Wrap straps around tank with strap studs inserted through holes in skid plate. Tighten strap nuts to attain 30 mm (±2 mm) between bottom of nut to end of strap stud (Fig. 35). **Do not over tighten nuts.**

(2) Install two protective caps to tank strap studs.

(3) Connect fuel filler hoses at tank. Tighten hose clamps.

(4) Raise skid plate/fuel tank assembly into position on body while guiding filler hoses.

(5) Install 7 skid plate mounting nuts. Tighten to 16 N·m (141 in. lbs.) torque.

(6) Remove tank jacking device.

(7) Connect electrical connector at front of fuel tank.

(8) Connect EVAP hose to EVAP line at front of fuel tank.

(9) Connect quick-connect fitting to fuel line at front of fuel tank. Refer to Quick-Connect Fittings in this group for procedures.

(10) Use a new plastic tie wrap to secure rear axle vent hose to fuel filler hoses.

(11) Position fuel filler bezel to body. Install 8 screws and tighten.

(12) Fill fuel tank. Install filler cap.

(13) Connect negative battery cable to battery.

(14) Start vehicle and inspect for leaks.

REMOVAL AND INSTALLATION (Continued)

FUEL TANK FILLER TUBE CAP

REMOVAL/INSTALLATION

If replacement of the 1/4 turn 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

REMOVAL

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. 37). This retainer (clip) snaps into the top of the accelerator pedal arm. Retainer tabs (built into the cable sheathing) (Fig. 37) fasten the cable to the dash panel.

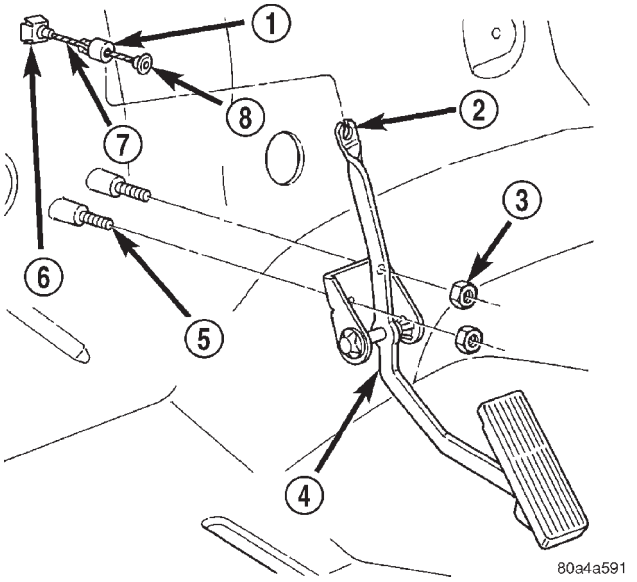


Fig. 37 Accelerator Pedal Mounting

1 – CABLE RETAINER
2 – SLOT
3 – MOUNTING STUDS (2)
4 – PEDAL/BRACKET ASSEMBLY
5 – MOUNTING STUDS
6 – RETAINER TABS
7 – CABLE
8 – CABLE STOP

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing the accelerator pedal or throttle cable.

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of accelerator pedal arm (Fig. 37). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove accelerator pedal mounting bracket nuts.

(3) Remove accelerator pedal assembly.

INSTALLATION

(1) Place accelerator pedal assembly over mounting studs protruding from floor pan. Tighten mounting nuts to 8.5 N·m (75 in. lbs.) torque.

(2) Slide throttle cable into opening (slot) in top of pedal arm. An index tab is located on pedal arm. Rotate and push plastic cable retainer (clip) into accelerator pedal arm opening until it snaps into place on index tab.

(3) Before starting engine, operate accelerator pedal to check for any binding.

THROTTLE CABLE

REMOVAL

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of accelerator pedal arm (Fig. 37). 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. 37) at dash panel. Remove cable housing from dash panel and pull into engine compartment.

(4) Remove cable from clip guides on engine cylinder head (valve) cover (Fig. 38).

(5) Remove throttle cable ball socket at throttle body by pushing ball socket towards rear of vehicle (ball snaps off of throttle body pin) (Fig. 39).

(5)

(6) Remove throttle cable from throttle body mounting bracket by compressing release tabs (Fig. 39) and pushing cable through hole in bracket.

(7) Remove throttle cable from vehicle.

INSTALLATION

(1) Slide throttle cable through hole in throttle body bracket until retainer tabs lock into bracket. Connect cable ball end to throttle body linkage ball (snaps on).

(2) Snap cable into clip guides on engine cylinder head (valve) cover.

REMOVAL AND INSTALLATION (Continued)

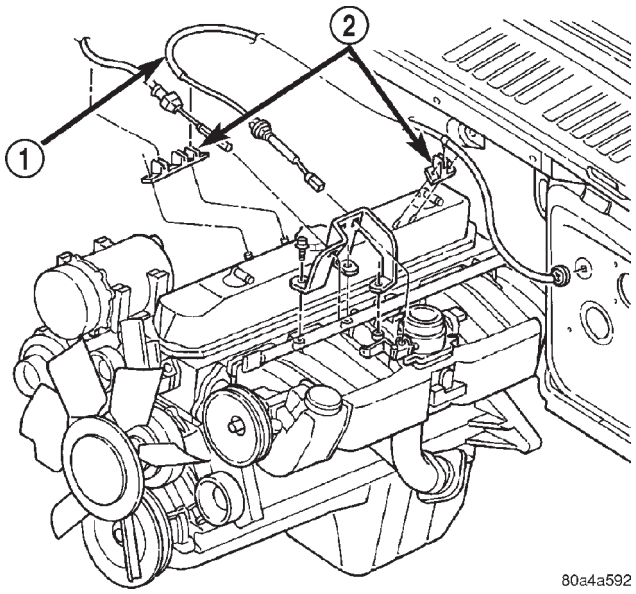


Fig. 38 Throttle Cable Routing

1 – THROTTLE CABLE
2 – GUIDE

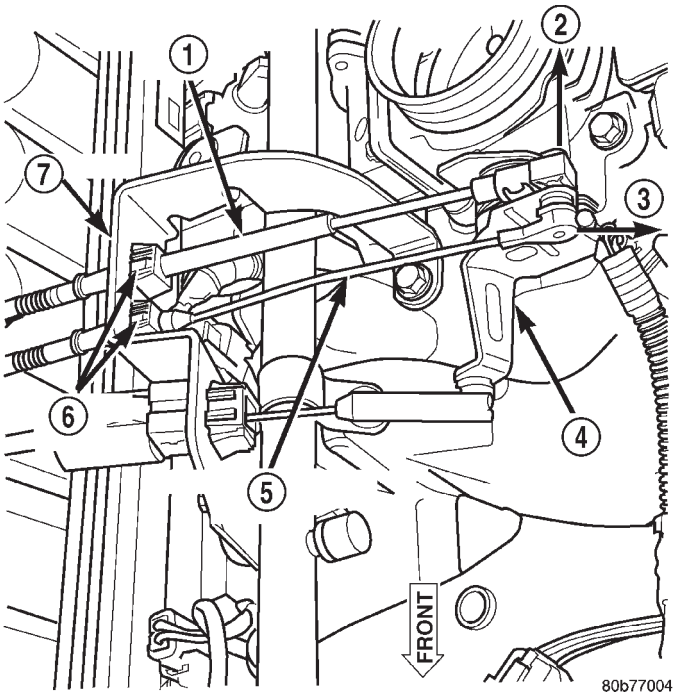


Fig. 39 Throttle Cable at Throttle Body—Typical

1 – ACCELERATOR CABLE
2 – OFF
3 – OFF
4 – THROTTLE BODY BELLCRANK
5 – SPEED CONTROL CABLE
6 – RELEASE TABS
7 – BRACKET

(3) Push other end of cable through opening in dash panel until retaining tabs lock into panel.

(4) From inside drivers compartment, slide throttle cable core wire into opening in top of accelerator pedal arm. An index tab is located on pedal arm. Rotate and push cable retainer (clip) into pedal arm opening until it snaps in place on index tab.

(5) Before starting engine, operate accelerator pedal to check for any binding.

SPECIFICATIONS

FUEL TANK CAPACITY

Models	Liters	U. S. Gallons
All	72L	19
Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.		

FUEL SYSTEM PRESSURE

339 kPa ± 34 kPa (49.2 psi ± 2 psi).

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.

Over 40 auto manufacturers world-wide have issued and endorsed consistent gasoline specifications (the Worldwide Fuel Charter, WWFC) to define fuel properties necessary to deliver enhanced emissions, performance and durability for your vehicle. We recommend the use of gasolines that meet the WWFC specifications if they are available.

SPECIFICATIONS (Continued)

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.

We 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 IN GASOLINE

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. We recommend that gasolines free of 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 Cleaner-Burning California reformulated gasoline with low sulfur. If such fuels are not available in states adopting California emission standards, your vehicles will operate satisfactorily on fuels meeting federal specifications, but emission control system performance may be adversely affected. 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 Malfunction Indicator Lamp (MIL), Check Engine or Service Engine Soon light to illuminate. We recommend 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 Malfunction Indicator Lamp (MIL), 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 Daimler-Chrysler Corporation and may not be covered under the new vehicle warranty.

NOTE: Intentional tampering with emissions control systems can result in civil penalties being assessed against you.

SPECIFICATIONS (Continued)

TORQUE CHART

DESCRIPTION	TORQUE
Accelerator Pedal Bracket Mounting Nuts	8.5 N·m (75 in. lbs.)
Fuel Hose Clamps	3 N·m (25 in. lbs.)
Fuel Pump Module Locknut	74 N·m (55 ft. lbs.)
Fuel Rail Mounting Bolts or Nuts	11 N·m (100 in. lbs.)
Fuel Tank Skidplate Bolts	16 N·m (141 in. lbs.)
Fuel Tank Mounting Strap Bolts	Refer to manual text

FUEL INJECTION SYSTEM

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DESCRIPTION AND OPERATION

POWERTRAIN CONTROL MODULE (PCM)

DESCRIPTION

The PCM is located in the engine compartment (Fig. 1). The PCM is referred to as JTEC.

OPERATION

The PCM operates the fuel system. The PCM is a pre-programmed, triple microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, speed control (if equipped), air conditioning compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as PCM Outputs. The sensors and switches that provide inputs to the PCM are considered PCM Inputs.

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, engine coolant temperature, throttle position, transmission gear selection (automatic transmission), vehicle speed, power steering pump pressure (2.5L only), and the brake switch.

DESCRIPTION AND OPERATION (Continued)

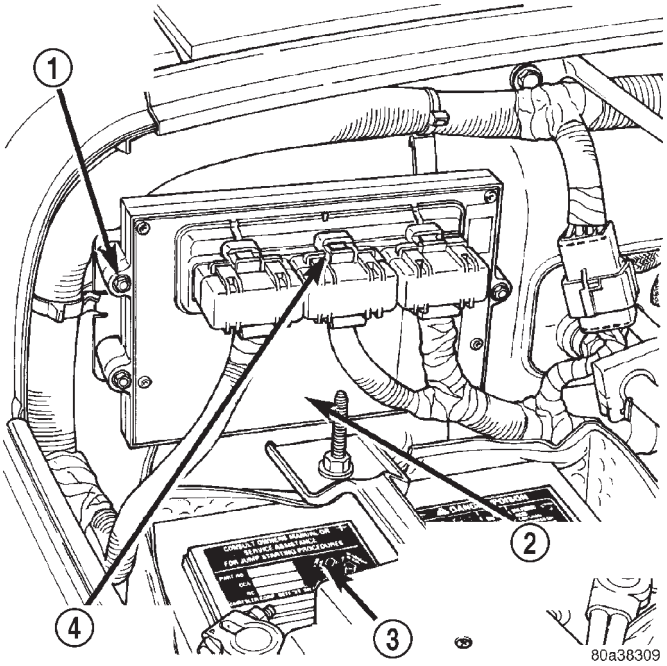


Fig. 1 PCM Location

1 – PCM MOUNTING BOLTS (3)
2 – POWERTRAIN CONTROL MODULE (PCM)
3 – BATTERY
4 – (3) 32–WAY CONNECTOR

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: Powertrain Control Module (PCM) Inputs:

- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shutdown (ASD) sense
- Battery temperature
- Battery voltage
- Brake switch
- CCD bus (+) circuits
- CCD bus (-) circuits
- Camshaft position sensor signal
- Crankshaft position sensor
- Data link connector for DRB scan tool
- Engine coolant temperature sensor
- Fuel level
- Generator (battery voltage) output
- Ignition circuit sense (ignition switch in run position)
- Intake manifold air temperature sensor
- Leak detection pump (if equipped)
- Manifold Absolute Pressure (MAP) sensor
- Oil pressure sensor
- Oxygen sensors
- Park/neutral switch (auto. trans. only)
- Power ground
- Power steering pressure switch (2.5L only)
- SCI receive (DRB scan tool 16–way connection)
- Sensor return
- Signal ground
- Speed control multiplexed single wire input
- Throttle position sensor
- Vehicle speed sensor

NOTE: Powertrain Control Module (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
- Duty cycle EVAP canister purge solenoid
- Five volt sensor supply (primary)
- Five volt sensor supply (secondary)
- Fuel injectors
- Fuel pump relay
- Generator field driver (-)
- Generator field source (+)
- Idle Air Control (IAC) motor
- Ignition coil
- Leak detection pump (if equipped)
- Malfunction indicator lamp (Check engine lamp). Driven through CCD circuits.
- SCI transmit (DRB scan tool 16–way connection)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (if equipped). Driven through CCD circuits.
- Transmission convertor clutch solenoid

MODES OF OPERATION

OPERATION

As input signals to the Powertrain Control Module (PCM) change, the PCM adjusts its response to the output devices. For example, the PCM must calculate different injector pulse width and ignition timing for idle than it does for wide open throttle (WOT).

The PCM will operate in two different modes: **Open Loop and Closed Loop**.

During Open Loop modes, the PCM receives input signals and responds only according to preset PCM programming. Input from the oxygen (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

DESCRIPTION AND OPERATION (Continued)

pulse width results in the ideal air-fuel ratio. This ratio is 14.7 parts air-to-1 part fuel. By monitoring the exhaust oxygen content through the O2S sensor, the PCM can fine tune the injector pulse width. This is done to achieve optimum fuel economy combined with low emission engine performance.

The fuel injection system has the following modes of operation:

- Ignition switch ON
- Engine start-up (crank)
- Engine warm-up
- Idle
- Cruise
- Acceleration
- Deceleration
- Wide open throttle (WOT)
- Ignition switch OFF

The ignition switch On, engine start-up (crank), engine warm-up, acceleration, deceleration and wide open throttle modes are Open Loop modes. The idle and cruise modes, (with the engine at operating temperature) are Closed Loop modes.

IGNITION SWITCH (KEY-ON) MODE

This is an Open Loop mode. When the fuel system is activated by the ignition switch, the following actions occur:

- The PCM pre-positions the Idle Air Control (IAC) motor.
- The PCM determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The PCM monitors the engine coolant temperature sensor input. The PCM modifies fuel strategy based on this input.
- Intake manifold air temperature sensor input is monitored.
- Throttle position sensor (TPS) is monitored.
- The auto shutdown (ASD) relay is energized by the PCM for approximately three seconds.
- The fuel pump is energized through the fuel pump relay by the PCM. The fuel pump will operate for approximately three seconds unless the engine is operating or the starter motor is engaged.
- The O2S sensor heater element is energized via the ASD relay. The O2S sensor input is not used by the PCM to calibrate air-fuel ratio during this mode of operation.
- The Up-shift Indicator Lamp is illuminated (manual transmission only).

ENGINE START-UP MODE

This is an Open Loop mode. The following actions occur when the starter motor is engaged.

The PCM receives inputs from:

- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal

The PCM monitors the crankshaft position sensor. If the PCM does not receive a crankshaft position sensor signal within 3 seconds of cranking the engine, it will shut down the fuel injection system.

The fuel pump is activated by the PCM through the fuel pump relay.

Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.

The PCM determines the proper ignition timing according to input received from the crankshaft position sensor.

ENGINE WARM-UP MODE

This is an Open Loop mode. During engine warm-up, the PCM receives inputs from:

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (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.

DESCRIPTION AND OPERATION (Continued)

IDLE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At idle speed, the PCM) receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Battery voltage
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen 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.

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 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:

- 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.
- The Up-shift Indicator Lamp is operated (manual transmission only).

ACCELERATION MODE

This is an Open Loop mode. The PCM recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased throttle opening.

DECELERATION MODE

When the engine is at operating temperature, this is an Open Loop mode. During hard deceleration, the PCM receives the following inputs.

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (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.

DESCRIPTION AND OPERATION (Continued)

Based on the above inputs, the PCM will adjust engine idle speed through the idle air control (IAC) motor.

The PCM adjusts ignition timing by turning the ground path to the coil on and off.

WIDE OPEN THROTTLE MODE

This is an Open Loop mode. During wide open throttle operation, the PCM receives the following inputs.

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (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.
- The Up-shift Indicator Lamp is operated (manual transmission only).

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.

AUTOMATIC SHUTDOWN (ASD) RELAY SENSE—PCM INPUT

DESCRIPTION

The ASD relay is located in the Power Distribution Center (PDC). The PDC is located in the engine compartment. Refer to label on PDC cover for relay location.

OPERATION

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The relay is used to connect the oxygen sensor heater element, ignition coil and fuel injectors to 12 volt + power supply.

This input is used only to sense that the ASD relay is energized. If the powertrain control module (PCM) does not see 12 volts at this input when the ASD should be activated, it will set a diagnostic trouble code (DTC).

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 SUPPLIES—PRIMARY AND SECONDARY

DESCRIPTION

Two different Powertrain Control Module (PCM) five volt supply circuits are used; primary and secondary.

OPERATION

These 2 circuits will:

- supply the required 5 volt power source to the Crankshaft Position (CKP) sensor.
- supply the required 5 volt power source to the Camshaft Position (CMP) sensor.
- supply a reference voltage for the Manifold Absolute Pressure (MAP) sensor.
- supply a reference voltage for the Throttle Position Sensor (TPS) sensor.
- supply the required 5 volt power source to the oil pressure sensor.
- supply the required 5 volt power source for the Vehicle Speed Sensor (VSS) (if equipped).
- supply the 5 volt power source to the transmission pressure sensor (if equipped with an RE automatic transmission).

DESCRIPTION AND OPERATION (Continued)

FUEL LEVEL SENSOR—PCM INPUT

DESCRIPTION

The fuel level sensor (fuel gauge sending unit) is located on the fuel pump module.

OPERATION

Refer to Fuel Gauge Sending Unit in the Fuel Delivery section for information.

ENGINE COOLANT TEMPERATURE SENSOR—PCM INPUT

DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to sense engine coolant temperature. The sensor protrudes into an engine water jacket.

The ECT sensor is a two-wire Negative Thermal Coefficient (NTC) sensor. Meaning, as engine coolant temperature increases, resistance (voltage) in the sensor decreases. As temperature decreases, resistance (voltage) in the sensor increases.

OPERATION

At key-on, the Powertrain Control Module (PCM) sends out a regulated 5 volt signal to the ECT sensor. The PCM then monitors the signal as it passes through the ECT sensor to the sensor ground (sensor return).

When the engine is cold, the PCM will operate in Open Loop cycle. It will demand slightly richer air-fuel mixtures and higher idle speeds. This is done until normal operating temperatures are reached.

The PCM uses inputs from the ECT sensor for the following calculations:

- for engine coolant temperature gauge operation through CCD or PCI (J1850) communications
- Injector pulse-width
- Spark-advance curves
- ASD relay shut-down times
- Idle Air Control (IAC) motor key-on steps
- Pulse-width prime-shot during cranking
- O2 sensor closed loop times
- Purge solenoid on/off times
- EGR solenoid on/off times (if equipped)
- Leak Detection Pump operation (if equipped)
- Radiator fan relay on/off times (if equipped)
- Target idle speed

OXYGEN SENSOR—PCM INPUT

DESCRIPTION

The Oxygen Sensors (O2S) are attached to, and protrude into the vehicle exhaust system. Depending on the emission package, the vehicle may contain either 2 or 4 sensors. On non-California emissions packages, 2 sensors are used: upstream (referred to as 1/1) and downstream (referred to as 1/2). On California emissions packages, 4 sensors are used: 2 upstream (referred to as 1/1 and 2/1) and 2 downstream (referred to as 1/2 and 2/2).

OPERATION

An O2 sensor is a galvanic battery that provides the PCM with a voltage signal (0-1 volt) inversely proportional to the amount of oxygen in the exhaust. In other words, if the oxygen content is low, the voltage output is high; if the oxygen content is high the output voltage is low. The PCM uses this information to adjust injector pulse-width to achieve the 14.7–to–1 air/fuel ratio necessary for proper engine operation and to control emissions.

An O2 sensor must have a source of oxygen from outside of the exhaust stream for comparison. Current O2 sensors receive their fresh oxygen (outside air) supply through the wire harness. This is why it is important to never solder an O2 sensor connector, or pack the connector with grease.

Four wires (circuits) are used on each O2 sensor: a 12–volt feed circuit for the sensor heating element; a ground circuit for the heater element; a low-noise sensor return circuit to the PCM, and an input circuit from the sensor back to the PCM to detect sensor operation.

Oxygen Sensor Heaters/Heater Relays: On a certain non-California emission package, the heaters on both sensors are fed battery voltage from the ASD relay which is controlled by the PCM. Refer to ASD relay for more information. On another non-California emission package, the heaters on both sensors are fed battery voltage from the two O2S heater relays. The O2S relays are also controlled by the PCM. On the California emission package, the heaters on all 4 sensors are fed battery voltage from the two O2S Heater Relays.

The O2 sensor uses a Positive Thermal Co-efficient (PTC) heater element. As temperature increases, resistance increases. At ambient temperatures around 70°F, the resistance of the heating element is approximately 6 ohms. As the sensor's temperature increases, resistance in the heater element increases. This allows the heater to maintain the optimum operating temperature of approximately 930°-1100°F (500°-600° C). Although the sensors operate the same, there are physical differences, due to the environment that they operate in, that keep them from being interchangeable.

Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation sooner. Also, it allows the system to remain in closed loop operation during periods of extended idle.

DESCRIPTION AND OPERATION (Continued)

In Closed Loop operation, the PCM monitors certain O2 sensor input(s) along with other inputs, and adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O2 sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

Upstream Sensor (Non-California Emissions): The upstream O2S sensor (1/1 sensor) is located in the exhaust downpipe before the catalytic convertor. 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 fuel delivery to maintain the correct oxygen content at the downstream oxygen sensor. The PCM will change the air/fuel ratio until the upstream sensor inputs a voltage that the PCM has determined will make the downstream sensor output (oxygen content) correct.

The upstream oxygen sensor also provides an input to determine catalyst efficiency.

Downstream Sensor (Non-California Emissions): The downstream heated oxygen sensor (1/2 sensor) is located near the outlet end of the catalytic convertor. The downstream sensor is also used to determine the correct air fuel ratio. As the oxygen content changes at the downstream the PCM calculates how much air fuel ratio change is required. The PCM then looks at the upstream oxygen sensor voltage and changes fuel delivery until the upstream sensor voltage changes enough to correct the downstream sensor voltage (oxygen content).

The downstream oxygen sensor also provides an input to determine catalyst efficiency.

Upstream Sensors (California Emissions): Two upstream sensors are used (1/1 and 2/1). The 1/1 sensor is the first sensor to receive exhaust gases from the #1 cylinder. Both of the upstream O2S sensors are located in the exhaust manifold just before the mini-catalytic convertors. They provide an input voltage to the PCM. The input tells the PCM the oxygen content of the exhaust gas. The PCM uses this information to fine tune fuel delivery to maintain the correct oxygen content at the downstream oxygen sensors. The PCM will change the air/fuel ratio until the upstream sensors input a voltage that the PCM has determined will make the downstream sensors output (oxygen content) correct.

The upstream oxygen sensors also provide an input to determine mini-catalyst efficiency.

Downstream Sensors (California Emissions): Two downstream sensors are used (1/2 and 2/2). The downstream sensors are located in the exhaust downpipes just after the mini-catalytic convertors. The downstream is also used to determine the correct air fuel ratio. As the oxygen content changes at the downstream the PCM calculates how much air fuel ratio change is required. The PCM then looks at the upstream oxygen sensor voltage and changes fuel delivery until the upstream sensor voltage changes enough to correct the downstream sensor voltage (oxygen content).

The downstream oxygen sensors also provide an input to determine mini-catalyst efficiency.

IGNITION CIRCUIT SENSE—PCM INPUT

DESCRIPTION

This circuit ties the ignition switch to the Powertrain Control Module (PCM).

OPERATION

The ignition circuit sense input tells the PCM the ignition switch has energized the ignition circuit.

Battery voltage is also supplied to the PCM through the ignition switch when the ignition is in the RUN or START position. This is referred to as the “ignition sense” circuit and is used to “wake up” the PCM. Voltage on the ignition input can be as low as 6 volts and the PCM will still function. Voltage is supplied to this circuit to power the PCM's 8-volt regulator and to allow the PCM to perform fuel, ignition and emissions control functions. The battery voltage on this line is supplied to the 8-volt regulator which then passes on a power-up supply to the 5-volt regulator.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—PCM INPUT

DESCRIPTION

The 2–wire Intake Manifold Air Temperature (IAT) sensor is installed in the intake manifold with the sensor element extending into the air stream.

The IAT sensor is a two-wire Negative Thermal Coefficient (NTC) sensor. Meaning, as intake manifold temperature increases, resistance (voltage) in the sensor decreases. As temperature decreases, resistance (voltage) in the sensor increases.

OPERATION

The IAT sensor provides an input voltage to the Powertrain Control Module (PCM) indicating the density of the air entering the intake manifold based upon intake manifold temperature. At key-on, a 5–volt power circuit is supplied to the sensor from the PCM. The sensor is grounded at the PCM through a low-noise, sensor-return circuit.

The PCM uses this input to calculate the following:

- Injector pulse-width
- Adjustment of spark timing (to help prevent spark knock with high intake manifold air-charge temperatures)

DESCRIPTION AND OPERATION (Continued)

The resistance values of the IAT sensor is the same as for the Engine Coolant Temperature (ECT) sensor.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—PCM INPUT

DESCRIPTION

The Manifold Absolute Pressure (MAP) sensor is attached to the side of the engine throttle body with 2 screws. The sensor is connected to the throttle body with a rubber L-shaped fitting.

OPERATION

The MAP sensor is used as an input to the Powertrain Control Module (PCM). It contains a silicon based sensing unit to provide data on the manifold vacuum that draws the air/fuel mixture into the combustion chamber. The PCM requires this information to determine injector pulse width and spark advance. When manifold absolute pressure (MAP) equals Barometric pressure, the pulse width will be at maximum.

A 5 volt reference is supplied from the PCM and returns a voltage signal to the PCM that reflects manifold pressure. The zero pressure reading is 0.5V and full scale is 4.5V. For a pressure swing of 0–15 psi, the voltage changes 4.0V. To operate the sensor, it is supplied a regulated 4.8 to 5.1 volts. Ground is provided through the low-noise, sensor return circuit at the PCM.

The MAP sensor input is the number one contributor to fuel injector pulse width. The most important function of the MAP sensor is to determine barometric pressure. The PCM needs to know if the vehicle is at sea level or at a higher altitude, because the air density changes with altitude. It will also help to correct for varying barometric pressure. Barometric pressure and altitude have a direct inverse correlation; as altitude goes up, barometric goes down. At key-on, the PCM powers up and looks at MAP voltage, and based upon the voltage it sees, it knows the current barometric pressure (relative to altitude). Once the engine starts, the PCM looks at the voltage again, continuously every 12 milliseconds, and compares the current voltage to what it was at key-on. The difference between current voltage and what it was at key-on, is manifold vacuum.

During key-on (engine not running) the sensor reads (updates) barometric pressure. A normal range can be obtained by monitoring a known good sensor.

As the altitude increases, the air becomes thinner (less oxygen). If a vehicle is started and driven to a very different altitude than where it was at key-on, the barometric pressure needs to be updated. Any time the PCM sees Wide Open Throttle (WOT), based upon Throttle Position Sensor (TPS) angle and RPM, it will update barometric pressure in the MAP memory cell. With periodic updates, the PCM can make its calculations more effectively.

The PCM uses the MAP sensor input to aid in calculating the following:

- Manifold pressure
- Barometric pressure
- Engine load
- Injector pulse-width
- Spark-advance programs
- Shift-point strategies (certain automatic transmissions only)
- Idle speed
- Decel fuel shutoff

The MAP sensor signal is provided from a single piezoresistive element located in the center of a diaphragm. The element and diaphragm are both made of silicone. As manifold pressure changes, the diaphragm moves causing the element to deflect, which stresses the silicone. When silicone is exposed to stress, its resistance changes. As manifold vacuum increases, the MAP sensor input voltage decreases proportionally. The sensor also contains electronics that condition the signal and provide temperature compensation.

The PCM recognizes a decrease in manifold pressure by monitoring a decrease in voltage from the reading stored in the barometric pressure memory cell. The MAP sensor is a linear sensor; meaning as pressure changes, voltage changes proportionately. The range of voltage output from the sensor is usually between 4.6 volts at sea level to as low as 0.3 volts at 26 in. of Hg. Barometric pressure is the pressure exerted by the atmosphere upon an object. At sea level on a standard day, no storm, barometric pressure is approximately 29.92 in Hg. For every 100 feet of altitude, barometric pressure drops.10 in. Hg. If a storm goes through it can change barometric pressure from what should be present for that altitude. You should know what the average pressure and corresponding barometric pressure is for your area.

OIL PRESSURE SENSOR—PCM INPUT

DESCRIPTION

The 3–wire, solid-state engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

OPERATION

The oil pressure sensor uses three circuits. They are:

- A 5–volt power supply from the Powertrain Control Module (PCM)

DESCRIPTION AND OPERATION (Continued)

• A sensor ground through the PCM's sensor return
• A signal to the PCM relating to engine oil pressure

The oil pressure sensor has a 3–wire electrical function very much like the Manifold Absolute Pressure (MAP) sensor. Meaning different pressures relate to different output voltages.

A 5–volt supply is sent to the sensor from the PCM to power up the sensor. The sensor returns a voltage signal back to the PCM relating to engine oil pressure. This signal is then transferred (bussed) to the instrument panel on either a CCD or PCI bus circuit (depending on vehicle line) to operate the oil pressure gauge and the check gauges lamp. Ground for the sensor is provided by the PCM through a low-noise sensor return.

POWER GROUNDS

OPERATION

The Powertrain Control Module (PCM) has 2 main grounds. Both of these grounds are referred to as power grounds. All of the high-current, noisy, electrical devices are connected to these grounds as well as all of the sensor returns. The sensor return comes into the sensor return circuit, passes through noise suppression, and is then connected to the power ground.

The power ground is used to control ground circuits for the following PCM loads:

- Generator field winding
- Fuel injectors
- Ignition coil(s)
- Certain relays/solenoids
- Certain sensors

POWER STEERING PRESSURE SWITCH—PCM INPUT

DESCRIPTION

A pressure sensing switch (Fig. 2) 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.

OPERATION

The power steering pressure switch 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.

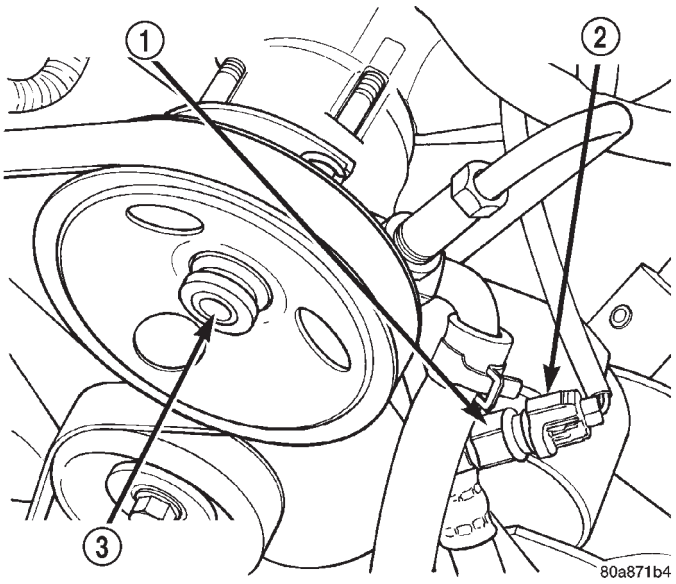


Fig. 2 Power Steering Pump Pressure Switch—2.5L Engine

1 – POWER STEERING PRESSURE SWITCH
2 – ELECTRICAL CONNECTOR
3 – POWER STEERING PUMP

When steering pump pressure exceeds 3275 kPa ± 690 kPa (475 psi ± 100 psi), the normally closed 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.

SENSOR RETURN—PCM INPUT

OPERATION

The Sensor Return circuits are internal to the Powertrain Control Module (PCM).

Sensor Return provides a low–noise ground reference for all engine control system sensors. Refer to Power Grounds for more information.

THROTTLE POSITION SENSOR (TPS)—PCM INPUT

DESCRIPTION

The 3–wire Throttle Position Sensor (TPS) is mounted on the throttle body and is connected to the throttle blade.

OPERATION

The TPS is a 3–wire variable resistor that provides the Powertrain Control Module (PCM) with an input signal (voltage) that represents the throttle blade position of the throttle body. The sensor is connected

DESCRIPTION AND OPERATION (Continued)

to the throttle blade shaft. As the position of the throttle blade changes, the resistance (output voltage) of the TPS changes.

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the PCM) represents the throttle blade position. The PCM receives an input signal voltage from the TPS. This will vary in an approximate range of from.26 volts at minimum throttle opening (idle), to 4.49 volts at wide open throttle. Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions. In response to engine operating conditions, the PCM will adjust fuel injector pulse width and ignition timing.

The PCM needs to identify the actions and position of the throttle blade at all times. This information is needed to assist in performing the following calculations:

- Ignition timing advance
- Fuel injection pulse-width
- Idle (learned value or minimum TPS)
- Off-idle (0.06 volt)
- Wide Open Throttle (WOT) open loop (2.608 volts above learned idle voltage)
- Deceleration fuel lean out
- Fuel cutoff during cranking at WOT (2.608 volts above learned idle voltage)
- A/C WOT cutoff (certain automatic transmissions only)

VEHICLE SPEED AND DISTANCE SENSOR—PCM INPUT

DESCRIPTION

The 3–wire Vehicle Speed Sensor (VSS) is located on the speedometer pinion gear adapter. If equipped with 4WD, this adapter is located on the extension housing of the transfer case (drivers side). If equipped with 2WD, this adapter is located on the left side of the transmission extension housing.

OPERATION

The VSS is a 3–circuit (3–wire), magnetic, hall-effect sensor.

The 3 circuits are:

- A 5–volt power supply from the Powertrain Control Module (PCM).
- A ground is provided for the sensor though a low-noise sensor return circuit in the PCM.
- An input to the PCM is used 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.

AUTO SHUTDOWN (ASD) RELAY—PCM OUTPUT

DESCRIPTION

The 5–pin, 12–volt, Automatic Shutdown (ASD) relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

OPERATION

The ASD relay supplies battery voltage (12+ volts) to the fuel injectors and ignition coil(s). With certain emissions packages it also supplies 12–volts to the oxygen sensor heating elements.

The ground circuit for the coil within the ASD relay is controlled by the Powertrain Control Module (PCM). The PCM operates the ASD relay by switching its ground circuit on and off.

The ASD relay will be shut–down, meaning the 12–volt power supply to the ASD relay will be de-activated by the PCM if:

- the ignition key is left in the ON position. This is if the engine has not been running for approximately 1.8 seconds.
- there is a crankshaft position sensor signal to the PCM that is lower than pre-determined values.

The PCM will sense if or when the ASD relay has been activated through a “sense circuit”. Refer to Automatic Shut-Down (ASD) Relay Sense-PCM Input for additional information.

CCD BUS (+/-) CIRCUITS-PCM OUTPUTS

OPERATION

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

DESCRIPTION

The data link connector is located at the lower edge of the instrument panel near the steering column.

DESCRIPTION AND OPERATION (Continued)

OPERATION

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).

FUEL INJECTORS—PCM OUTPUT

DESCRIPTION

The fuel injectors are connected to the engine with the fuel injector rail.

OPERATION

The nozzle ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector with its respective cylinder number.

The injectors are energized individually in a sequential order by the Powertrain Control Module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

Battery voltage (12 volts +) is supplied to the injectors through the ASD relay. The ASD relay will shutdown the 12 volt power source to the fuel injectors if the PCM senses the ignition is on, but the engine is not running. This occurs after the engine has not been running for approximately 1.8 seconds.

The PCM determines injector on-time (pulse width) based on various inputs.

FUEL PUMP RELAY-PCM OUTPUT

DESCRIPTION

The 5–pin, 12–volt, fuel pump relay is located in the Power Distribution Center (PDC). Refer to the label on the PDC cover for relay location.

OPERATION

The Powertrain Control Module (PCM) energizes the electric fuel pump through the fuel pump relay. The fuel pump relay is energized by first applying battery voltage to it when the ignition key is turned ON, and then applying a ground signal to the relay from the PCM.

Whenever the ignition key is turned ON, the electric fuel pump will operate. But, the PCM will shutdown the ground circuit to the fuel pump relay in approximately 1–3 seconds unless the engine is operating or the starter motor is engaged.

IDLE AIR CONTROL (IAC) MOTOR—PCM OUTPUT

DESCRIPTION

The IAC stepper motor is mounted to the throttle body, and regulates the amount of air bypassing the control of the throttle plate. As engine loads and ambient temperatures change, engine rpm changes. A pintle on the IAC stepper motor protrudes into a passage in the throttle body, controlling air flow through the passage. The IAC is controlled by the Powertrain Control Module (PCM) to maintain the target engine idle speed.

OPERATION

At idle, engine speed can be increased by retracting the IAC motor pintle and allowing more air to pass through the port, or it can be decreased by restricting the passage with the pintle and diminishing the amount of air bypassing the throttle plate.

The IAC is called a stepper motor because it is moved (rotated) in steps, or increments. Opening the IAC opens an air passage around the throttle blade which increases RPM.

The PCM uses the IAC motor to control idle speed (along with timing) and to reach a desired MAP during decel (keep engine from stalling).

The IAC motor has 4 wires with 4 circuits. Two of the wires are for 12 volts and ground to supply electrical current to the motor windings to operate the stepper motor in one direction. The other 2 wires are also for 12 volts and ground to supply electrical current to operate the stepper motor in the opposite direction.

To make the IAC go in the opposite direction, the PCM just reverses polarity on both windings. If only 1 wire is open, the IAC can only be moved 1 step (increment) in either direction. To keep the IAC motor in position when no movement is needed, the PCM will energize both windings at the same time. This locks the IAC motor in place.

In the IAC motor system, the PCM will count every step that the motor is moved. This allows the PCM to determine the motor pintle position. If the memory is cleared, the PCM no longer knows the position of the pintle. So at the first key ON, the PCM drives the IAC motor closed, regardless of where it was before. This zeros the counter. From this point the PCM will back out the IAC motor and keep track of its position again.

When engine rpm is above idle speed, the IAC is used for the following:

- Off-idle dashpot (throttle blade will close quickly but idle speed will not stop quickly)
- Deceleration air flow control

DESCRIPTION AND OPERATION (Continued)

- A/C compressor load control (also opens the passage slightly before the compressor is engaged so that the engine rpm does not dip down when the compressor engages)
- Power steering load control

The PCM can control polarity of the circuit to control direction of the stepper motor.

IAC Stepper Motor Program: The PCM is also equipped with a memory program that records the number of steps the IAC stepper motor most recently advanced to during a certain set of parameters. For example: The PCM was attempting to maintain a 1000 rpm target during a cold start-up cycle. The last recorded number of steps for that may have been 125. That value would be recorded in the memory cell so that the next time the PCM recognizes the identical conditions, the PCM recalls that 125 steps were required to maintain the target. This program allows for greater customer satisfaction due to greater control of engine idle.

Another function of the memory program, which occurs when the power steering switch (if equipped), or the A/C request circuit, requires that the IAC stepper motor control engine rpm, is the recording of the last targeted steps into the memory cell. The PCM can anticipate A/C compressor loads. This is accomplished by delaying compressor operation for approximately 0.5 seconds until the PCM moves the IAC stepper motor to the recorded steps that were loaded into the memory cell. Using this program helps eliminate idle-quality changes as loads change. Finally, the PCM incorporates a "No-Load" engine speed limiter of approximately 1800 - 2000 rpm, when it recognizes that the TPS is indicating an idle signal and IAC motor cannot maintain engine idle.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the IAC motor through the PCM.

THROTTLE BODY

DESCRIPTION

The throttle body is located on the intake manifold. Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors.

OPERATION

Filtered air from the air cleaner enters the intake manifold through the throttle body. The throttle body contains an air control passage controlled by an Idle Air Control (IAC) motor. The air control passage is used to supply air for idle conditions. A throttle valve (plate) is used to supply air for above idle conditions.

Certain sensors are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle body linkage arm.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

DIAGNOSIS AND TESTING

VISUAL INSPECTION

A visual inspection for loose, disconnected or incorrectly routed wires and hoses should be made. This should be done before attempting to diagnose or service the fuel injection system. A visual check will help spot these faults and save unnecessary test and diagnostic time. A thorough visual inspection will include the following checks:

(1) Verify that the three 32–way electrical connectors are fully inserted into connector of Powertrain Control Module (PCM) (Fig. 3).

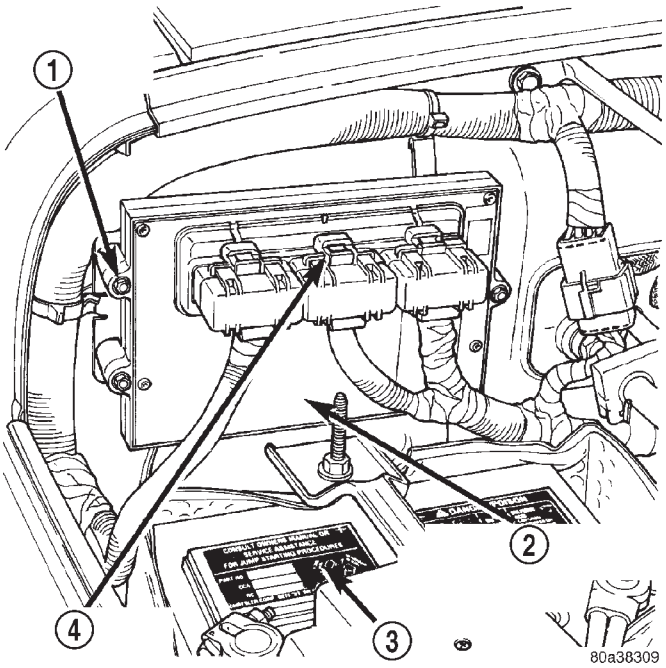


Fig. 3 Powertrain Control Module (PCM)

1 – PCM MOUNTING BOLTS (3)
2 – POWERTRAIN CONTROL MODULE (PCM)
3 – BATTERY
4 – (3) 32–WAY CONNECTOR

(2) Inspect battery cable connections. Be sure that they are clean and tight.

(3) Inspect fuel pump relay and ASD relay connections. Inspect starter motor relay connections.

DIAGNOSIS AND TESTING (Continued)

Inspect relays for signs of physical damage and corrosion. The relays are located in Power Distribution Center (PDC) (Fig. 4). Refer to label on PDC cover for relay location.

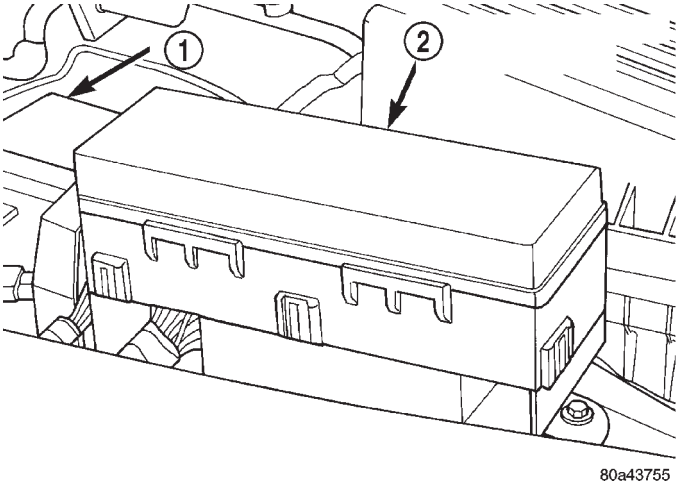


Fig. 4 Power Distribution Center (PDC)

1 – BATTERY
2 – POWER DISTRIBUTION CENTER (PDC)

(4) 2.5L Engine: Inspect ignition coil primary connection. Verify coil secondary cable is firmly connected to coil (Fig. 5).

(5) 4.0L Engine: Inspect ignition coil connection (Fig. 6).

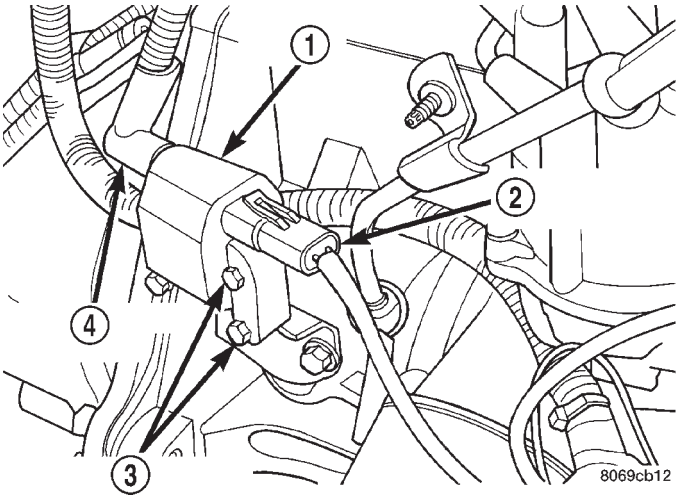


Fig. 5 Ignition Coil—2.5L Engine

1 – IGNITION COIL
2 – ELECTRICAL CONNECTOR
3 – MOUNTING BOLTS
4 – SECONDARY CABLE

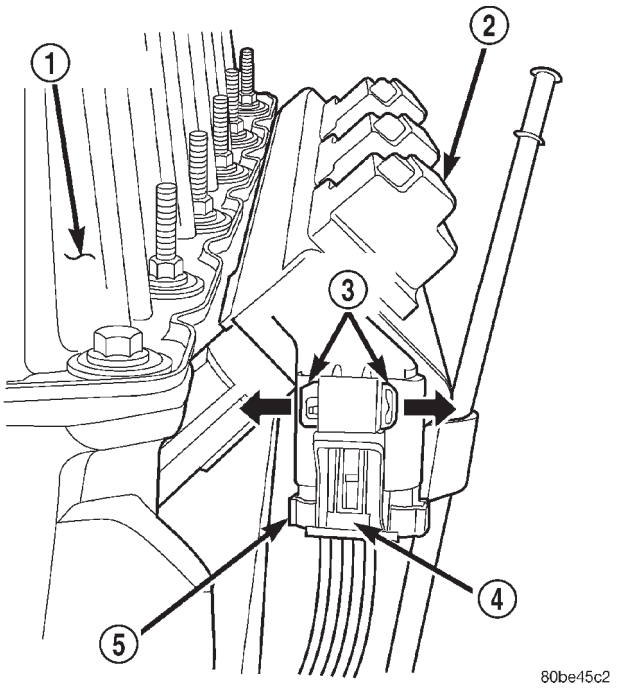


Fig. 6 Ignition Coil—4.0L Engine

1 – REAR OF VALVE COVER
2 – COIL RAIL
3 – SLIDE TAB
4 – RELEASE LOCK
5 – COIL CONNECTOR

(6) 2.5L Engine: Verify that distributor cap is correctly attached to distributor. Be sure that spark plug cables are firmly connected to the distributor cap and spark plugs are in their correct firing order. Be sure that coil cable is firmly connected to distributor cap and coil.

(7) Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables.

(8) Verify that generator output wire, generator connector and ground wire are firmly connected to the generator.

(9) Inspect system body grounds for loose or dirty connections. Refer to Group 8, Wiring for ground locations.

(10) Verify Crankcase Ventilation (CCV) operation. Refer to Group 25, Emission Control System for additional information.

(11) Inspect fuel tube quick-connect fitting-to-fuel rail connections.

(12) Verify that hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

DIAGNOSIS AND TESTING (Continued)

(13) Inspect accelerator cable and transmission throttle cable (if equipped). Check their connections to throttle arm of throttle body for any binding or restrictions.

(14) If equipped with vacuum brake booster, verify that vacuum booster hose is firmly connected to fitting on intake manifold. Also check connection to brake vacuum booster.

(15) Inspect air cleaner inlet and air cleaner element for dirt or restrictions.

(16) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

(17) Verify intake manifold air temperature sensor wire connector is firmly connected to harness connector (Fig. 7) or (Fig. 8).

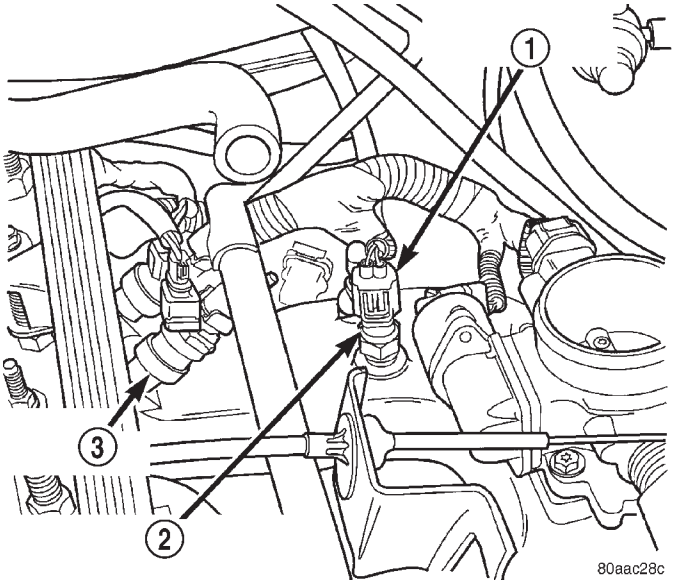


Fig. 7 Intake Manifold Air Temp. Sensor Location—2.5L Engine

1 – ELECTRICAL CONNECTOR
2 – INTAKE MANIFOLD TEMPERATURE SENSOR
3 – FUEL INJECTOR

(18) Verify MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 8). Also verify rubber L-shaped fitting from MAP sensor to throttle body is firmly connected (Fig. 9).

(19) Verify that fuel injector wire harness connectors are firmly connected to injectors in the correct order. Each harness connector is numerically tagged with injector number (INJ 1, INJ 2 etc.) of its corresponding fuel injector and cylinder number.

(20) Verify harness connectors are firmly connected to Idle Air Control (IAC) motor and Throttle Position Sensor (TPS) (Fig. 8).

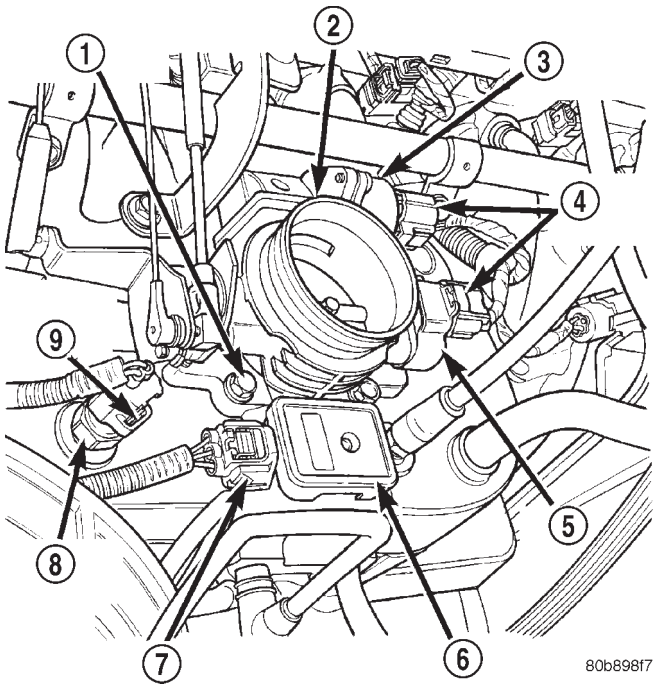


Fig. 8 Sensor Locations—4.0L Engine

1 – MOUNTING BOLTS (4)
2 – THROTTLE BODY
3 – IAC MOTOR
4 – ELEC. CONN.
5 – TPS
6 – MAP SENSOR
7 – ELEC. CONN.
8 – IAT SENSOR
9 – ELEC. CONN.

(21) Verify wire harness connector is firmly connected to engine coolant temperature sensor (Fig. 10).

(22) Raise and support vehicle.

(23) Verify that all oxygen sensor wire connectors are firmly connected to sensors. Inspect sensors and connectors for damage (Fig. 11), (Fig. 12), (Fig. 13) or (Fig. 14).

(24) Inspect for pinched or leaking fuel tubes. Inspect for pinched, cracked or leaking fuel hoses.

(25) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(26) If equipped with automatic transmission, verify that electrical harness is firmly connected to park/neutral switch. Refer to Automatic Transmission section of Group 21.

(27) Verify that electrical harness connector is firmly connected to the vehicle speed sensor (Fig. 15).

(28) Verify that fuel pump/gauge sender unit wire connector is firmly connected to harness connector.

(29) Inspect fuel hoses at fuel pump/gauge sender unit for cracks or leaks.

DIAGNOSIS AND TESTING (Continued)

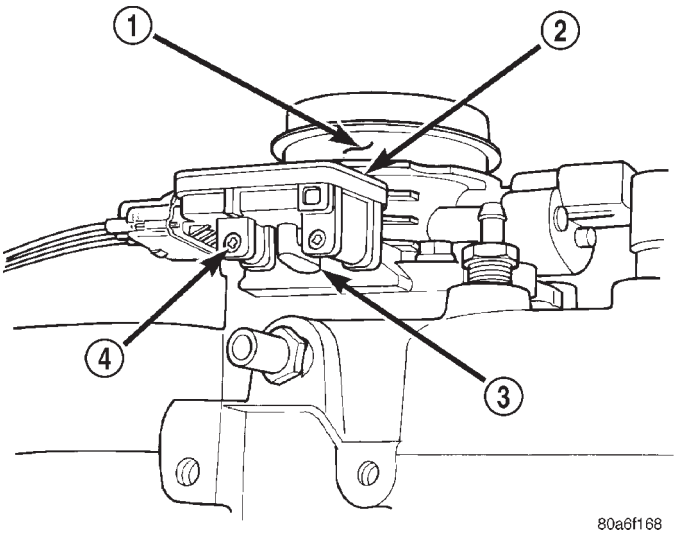


Fig. 9 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

1 – THROTTLE BODY
2 – MAP SENSOR
3 – RUBBER FITTING
4 – MOUNTING SCREWS (2)

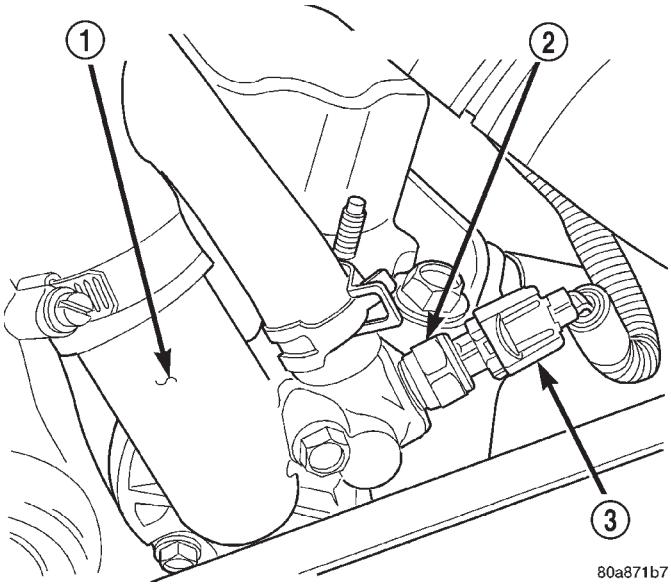


Fig. 10 Engine Coolant Temperature Sensor—Typical

1 – THERMOSTAT HOUSING
2 – ENGINE COOLANT TEMPERATURE SENSOR
3 – ELECTRICAL CONNECTOR

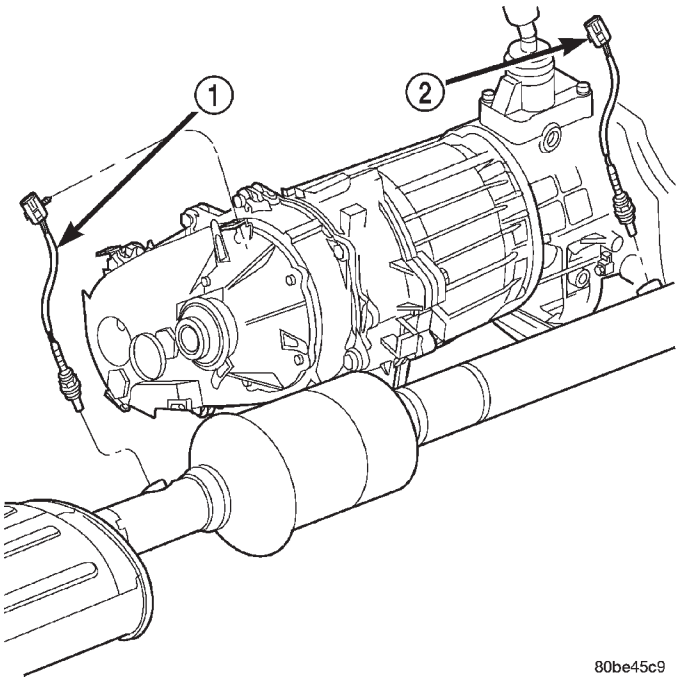


Fig. 11 Oxygen Sensors—4.0L—Federal Emissions

1 – 1/2 O2S
2 – 1/1 02S

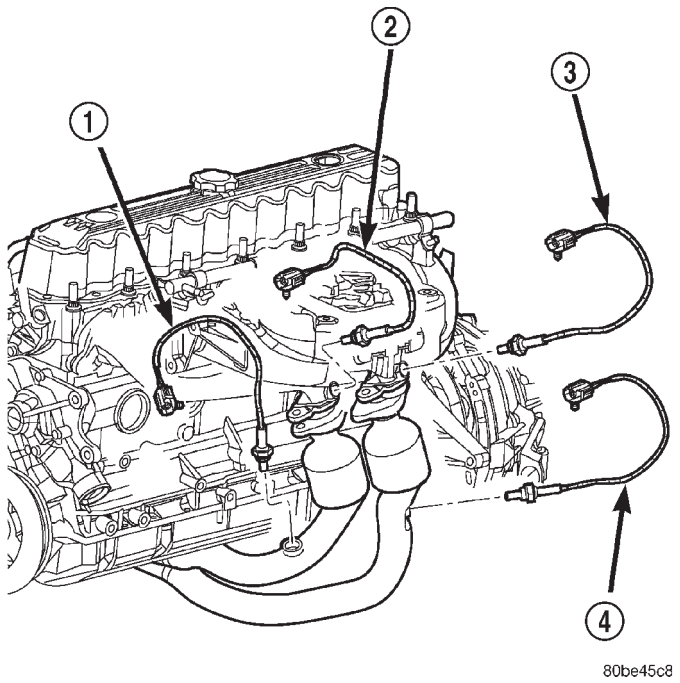


Fig. 12 Oxygen Sensors—4.0L—California Emissions

1 – 1/2 O2S
2 – 1/1 O2S
3 – 2/1 O2S
4 – 2/2 O2S

DIAGNOSIS AND TESTING (Continued)

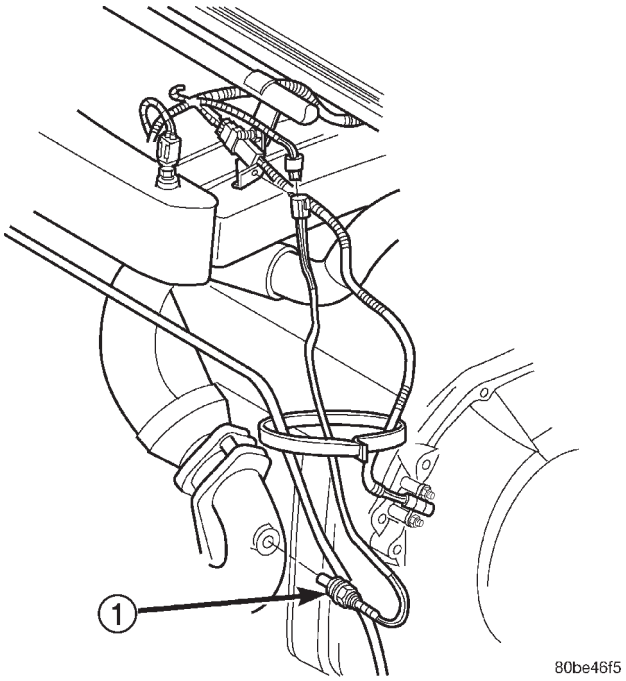


Fig. 13 Front Oxygen Sensor—2.5L—Federal Emissions

1 – 1/1 O2S

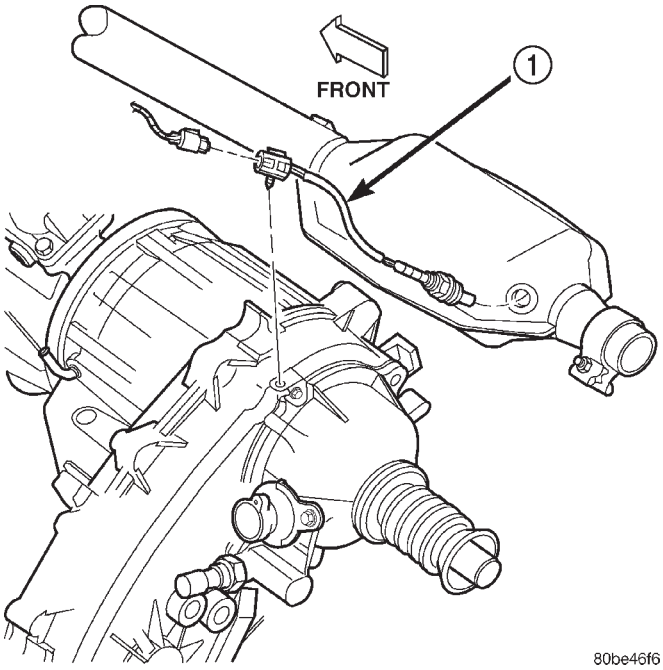


Fig. 14 Rear Oxygen Sensor—2.5L—Federal Emissions

1 – 1/2 O2S

(30) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

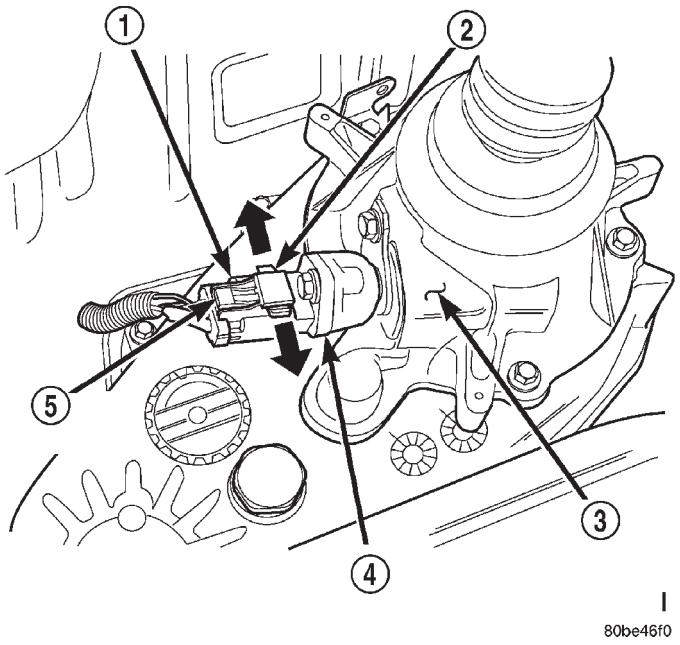


Fig. 15 Vehicle Speed Sensor—Typical—4WD Shown

1 – SENSOR ELECTRICAL CONNECTOR
2 – SLIDE TAB
3 – 4WD TRANSFER CASE EXTENSION
4 – VEHICLE SPEED SENSOR
5 – RELEASE LOCK

(31) Verify that 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.

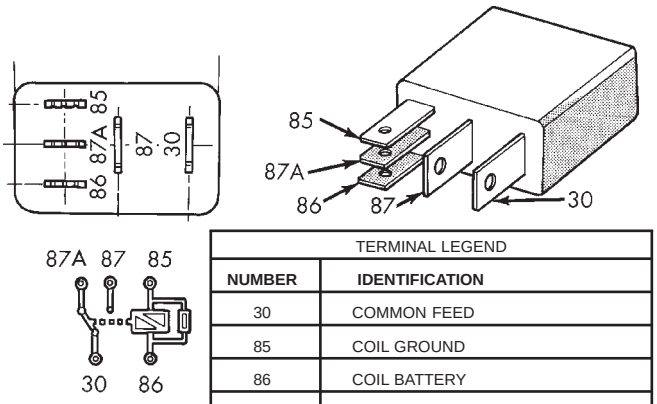
ASD AND FUEL PUMP RELAYS

The following description of operation and tests apply only to the Automatic Shutdown (ASD) and fuel pump relays. The terminals on the bottom of each relay are numbered. Two different types of relays may be used, (Fig. 16) or (Fig. 17).

OPERATION

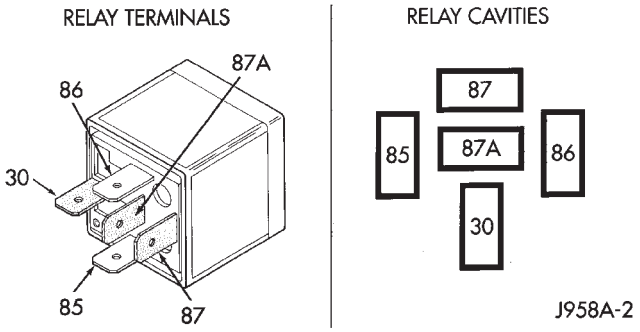
- Terminal number 30 is connected to battery voltage. For both the ASD and fuel pump relays, terminal 30 is connected to battery voltage at all times.
- The PCM grounds the coil side of the relay through terminal number 85.
- Terminal number 86 supplies voltage to the coil side of the relay.
- When the 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.
- When the PCM energizes the ASD and fuel pump relays, terminal 87 connects to terminal 30.

DIAGNOSIS AND TESTING (Continued)



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 16 ASD and Fuel Pump Relay Terminals—Type 1



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 17 ASD and Fuel Pump Relay Terminals—Type 2

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.

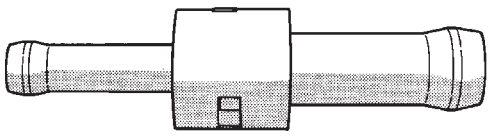
(9) Replace the relay if it did not pass the continuity and resistance tests. If the relay passed the tests, it operates properly. Check the remainder of the ASD and fuel pump relay circuits. Refer to the Wiring Diagrams.

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. 18) must be used for the following test. This tool has a fixed internal diameter of 0.185”.

SPECIAL TOOL 6714



J9414-7

Fig. 18 6714 Fixed Orifice Tool

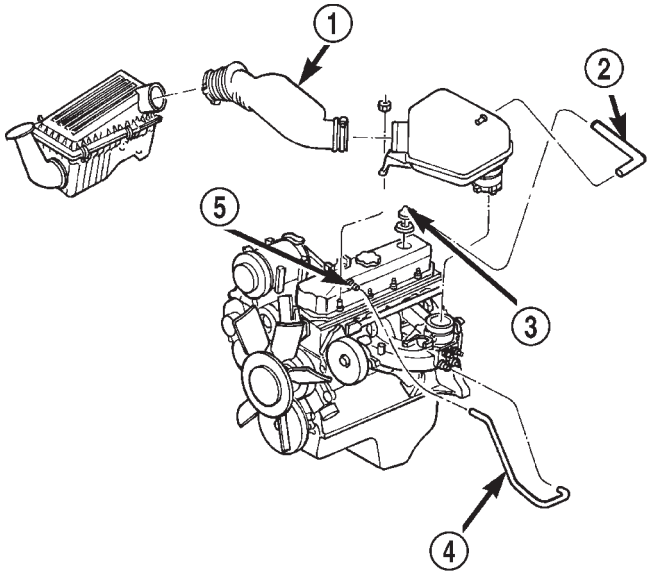
DIAGNOSIS AND TESTING (Continued)

(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. 19). 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. 20) 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.



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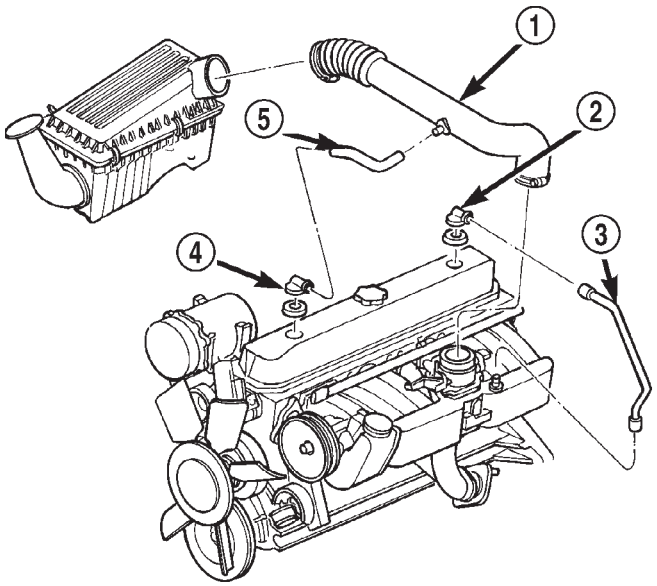
Fig. 19 Install Orifice Tool 2.5L 4–Cylinder Engine

1 – AIR TUBE
2 – CCV TUBE
3 – AIR INLET FITTING
4 – CCV TUBE
5 – FIXED ORIFICE FITTING

(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 the year 2000 Diagnostics, select—Engine, select—System Test, select—Minimum Air Flow.



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Fig. 20 Install Orifice Tool 4.0L 6–Cylinder Engine

1 – AIR TUBE
2 – FIXED ORIFICE FITTING
3 – CCV TUBE
4 – AIR INLET FITTING
5 – CCV TUBE

(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.

(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. 21). 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.

REMOVAL AND INSTALLATION (Continued)

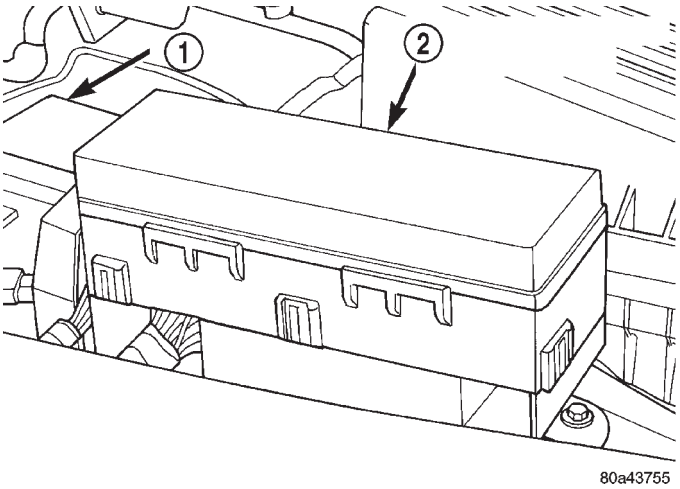


Fig. 21 Power Distribution Center (PDC)

1 – BATTERY
2 – POWER DISTRIBUTION CENTER (PDC)

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. 21). 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.

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. 22) or (Fig. 23).

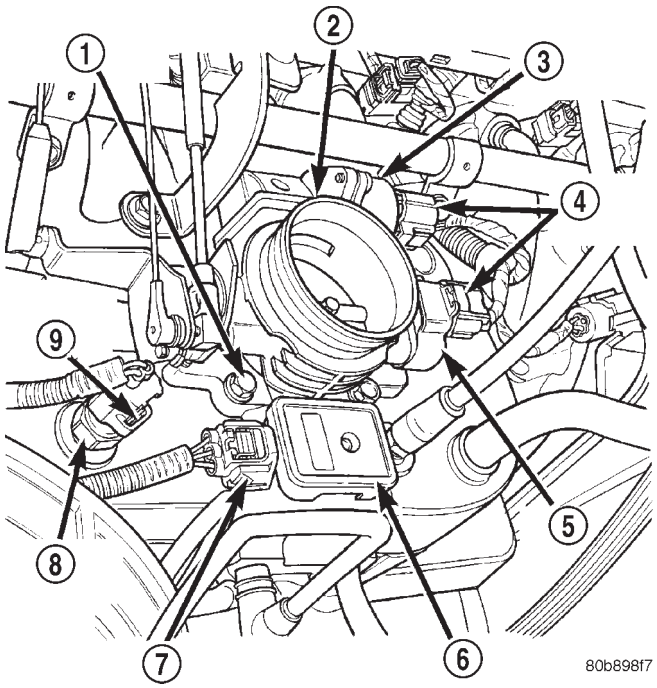


Fig. 22 Throttle Body and Sensor Locations—4.0L Engine

1 – MOUNTING BOLTS (4)
2 – THROTTLE BODY
3 – IAC MOTOR
4 – ELEC. CONN.
5 – TPS
6 – MAP SENSOR
7 – ELEC. CONN.
8 – IAT SENSOR
9 – ELEC. CONN.

(3) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section of this group for additional information.
(4) Remove four throttle body mounting bolts.
(5) Remove throttle body from intake manifold.
(6) Discard old throttle body-to-intake manifold gasket.

INSTALLATION

(1) Clean mating surfaces of throttle body and intake manifold.
(2) Install new throttle body-to-intake manifold gasket.
(3) Install throttle body to intake manifold.
(4) Install four mounting bolts. Tighten bolts to 11 N·m (100 in. lbs.) torque.
(5) Install control cables.
(6) Install electrical connectors.
(7) Install air cleaner at throttle body.

REMOVAL AND INSTALLATION (Continued)

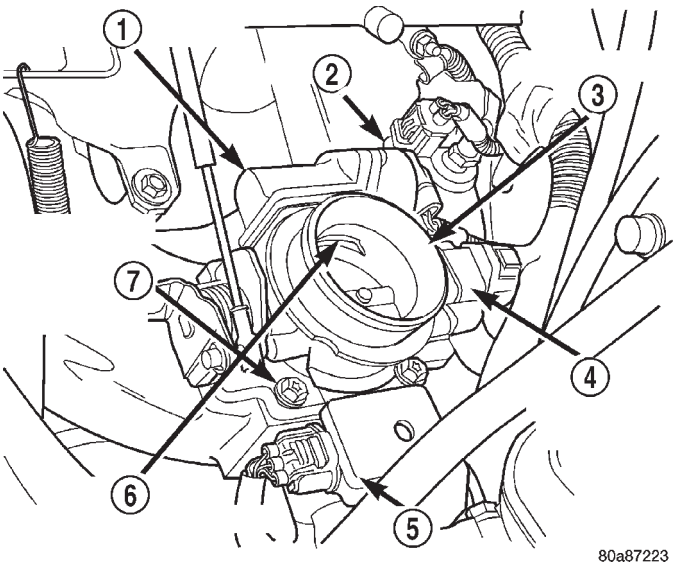


Fig. 23 Throttle Body and Sensor Locations—2.5L Engine

1 – IDLE AIR CONTROL MOTOR
2 – IAT SENSOR
3 – THROTTLE BODY
4 – THROTTLE POSITION SENSOR
5 – MAP SENSOR
6 – IDLE AIR CONTROL PASSAGE INLET
7 – THROTTLE BODY MOUNTING BOLTS (4)

THROTTLE POSITION SENSOR (TPS)

The TPS is mounted to the throttle body (Fig. 22) or (Fig. 23).

REMOVAL

(1) Remove air cleaner tube at throttle body.
(2) Disconnect TPS electrical connector.
(3) Remove TPS mounting screws (Fig. 24).
(4) Remove TPS.

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 25). The TPS must be installed so that it can be rotated a few degrees. (If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs). The TPS will be under slight tension when rotated.

(1) Install TPS and retaining screws.
(2) Tighten screws to 7 N·m (60 in. lbs.) torque.
(3) Connect TPS electrical connector to TPS.
(4) Manually operate throttle (by hand) to check for any TPS binding before starting engine.
(5) Install air cleaner tube to throttle body.

IDLE AIR CONTROL (IAC) MOTOR

The IAC motor is located on the side of the throttle body (Fig. 22) or (Fig. 23).

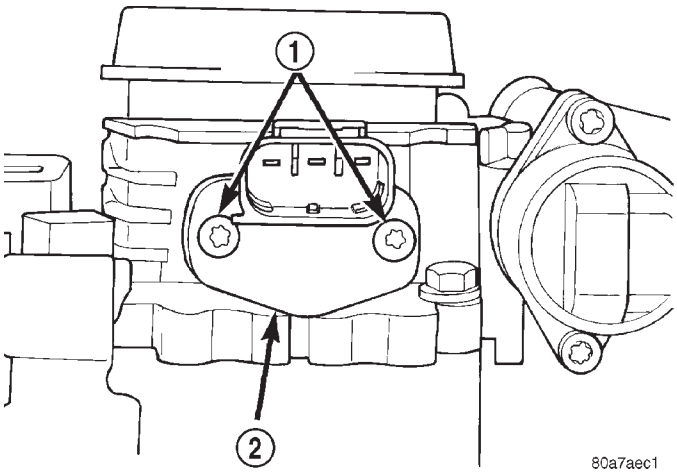


Fig. 24 TPS Mounting Screws

1 – MOUNTING SCREWS
2 – TPS

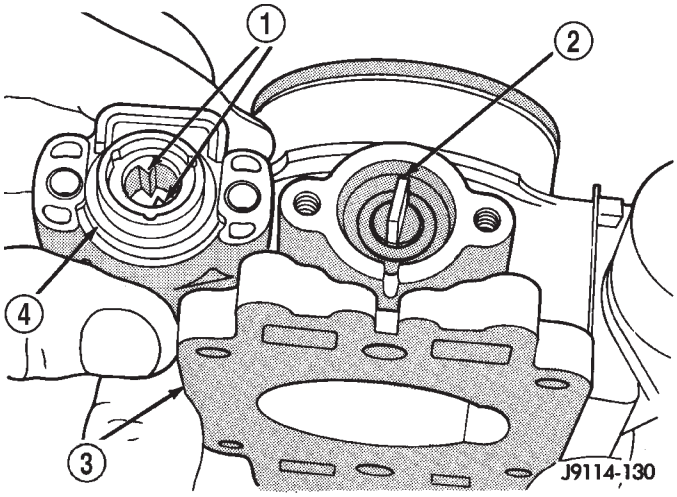


Fig. 25 Throttle Position Sensor—Installation

1 – TANGS
2 – THROTTLE SHAFT
3 – THROTTLE BODY
4 – TPS

REMOVAL

(1) Remove air cleaner tube at throttle body.
(2) Disconnect electrical connector from IAC motor.
(3) Remove two mounting bolts (screws) (Fig. 26).
(4) Remove IAC motor from throttle body.

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.

REMOVAL AND INSTALLATION (Continued)

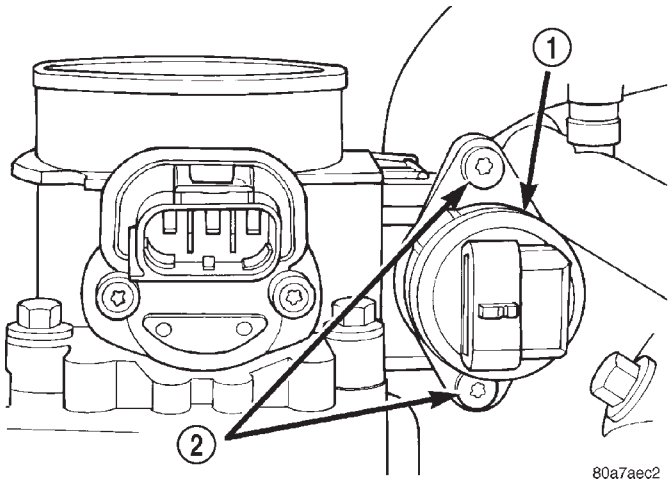


Fig. 26 Mounting Bolts (Screws)—IAC Motor

1 – IDLE AIR CONTROL MOTOR
2 – MOUNTING SCREWS

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The MAP sensor is mounted to the side of the throttle body (Fig. 22) or (Fig. 23). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 27).

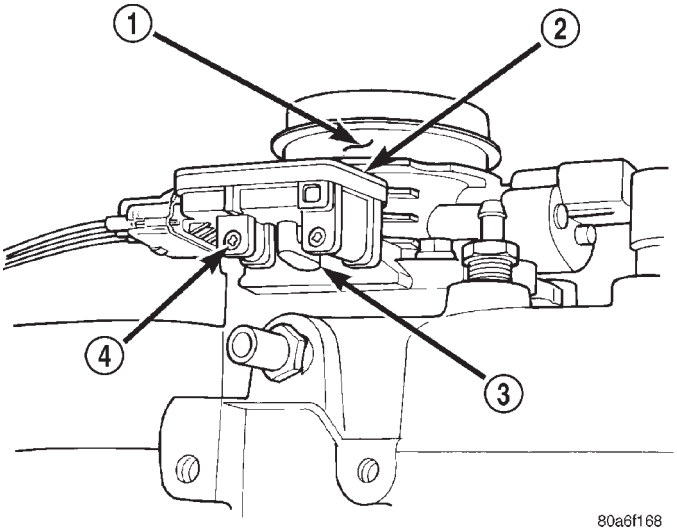


Fig. 27 MAP Sensor Mounting

1 – THROTTLE BODY
2 – MAP SENSOR
3 – RUBBER FITTING
4 – MOUNTING SCREWS (2)

REMOVAL

(1) Remove air cleaner intake tube at throttle body.

(2) Remove two MAP sensor mounting bolts (screws) (Fig. 27).

(3) While removing MAP sensor, slide the rubber L-shaped fitting (Fig. 27) from throttle body.

(4) Remove rubber L-shaped fitting from MAP sensor.

INSTALLATION

(1) Install rubber L-shaped fitting to MAP sensor.

(2) Position sensor to throttle body while guiding rubber fitting over throttle body vacuum nipple.

(3) Install MAP sensor mounting bolts (screws). Tighten screws to 3 N·m (25 in. lbs.) torque.

(4) Install air cleaner intake tube.

POWERTRAIN CONTROL MODULE (PCM)

The PCM is located in the engine compartment (Fig. 28).

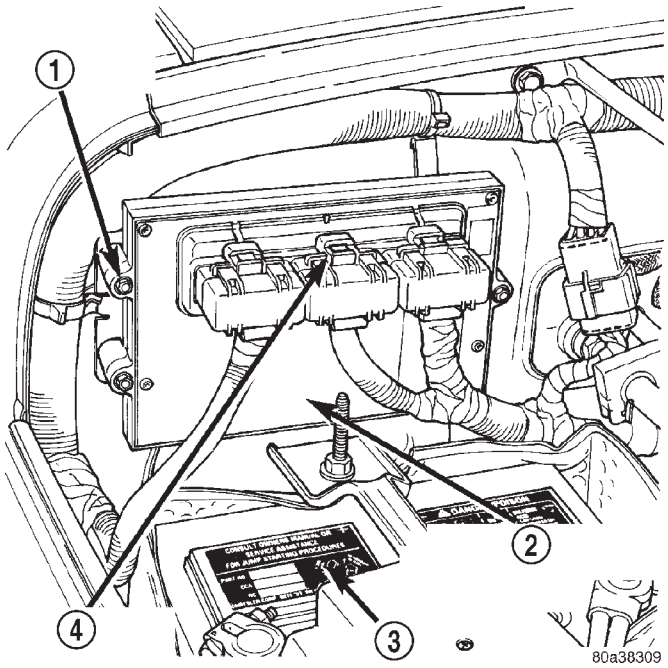


Fig. 28 PCM Location

1 – PCM MOUNTING BOLTS (3)
2 – POWERTRAIN CONTROL MODULE (PCM)
3 – BATTERY
4 – (3) 32–WAY CONNECTOR

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.

(2) Remove plastic shield from over 32–way connectors. Shield snaps to connectors.

(3) Carefully unplug three 32–way connectors (Fig. 28) from PCM.

(4) Remove three PCM mounting bolts and remove PCM from vehicle.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Install PCM and mounting bolts to vehicle.
(2) Tighten bolts to 4 N·m (35 in. lbs.).
(3) Check pin connectors in PCM and three 32–way connectors for corrosion or damage. Also check pin heights in connectors. Pin heights should all be the same. Repair as necessary before installing 32–way connectors.
(4) Install three 32–way connectors.
(5) Install plastic shield to 32–way connectors. Shield snaps to connectors.
(6) Install battery cable.
(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. 29).

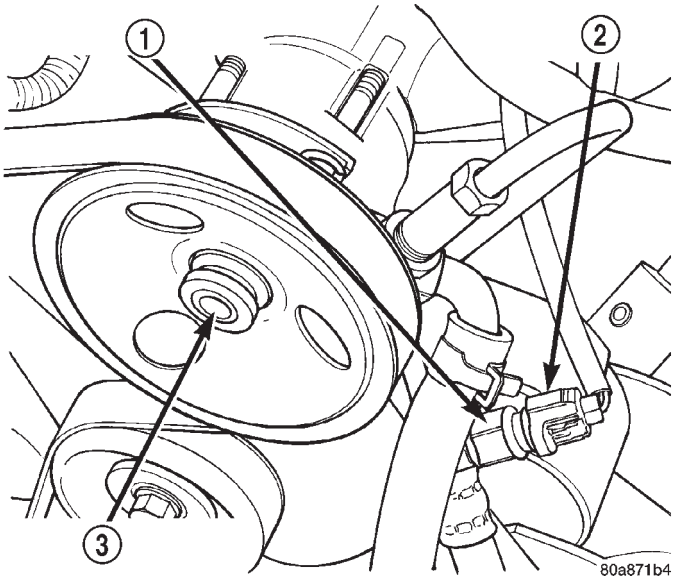


Fig. 29 Power Steering Pressure Switch

1 – POWER STEERING PRESSURE SWITCH
2 – ELECTRICAL CONNECTOR
3 – POWER STEERING PUMP

REMOVAL

(1) Disconnect electrical connector from power steering pressure switch.
(2) Place a small container or shop towel beneath switch to collect any excess fluid.
(3) Remove switch. Use 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

REMOVAL

Never apply any type of grease to the oxygen sensor electrical connector, or attempt any soldering of the sensor wiring harness. For sensor operation, it must have a comparison source of oxygen from outside the exhaust system. This fresh air is supplied to the sensor through its pigtail wiring harness.

Refer to (Fig. 30), (Fig. 31), (Fig. 32) or (Fig. 33) for O2S (oxygen sensor) location.

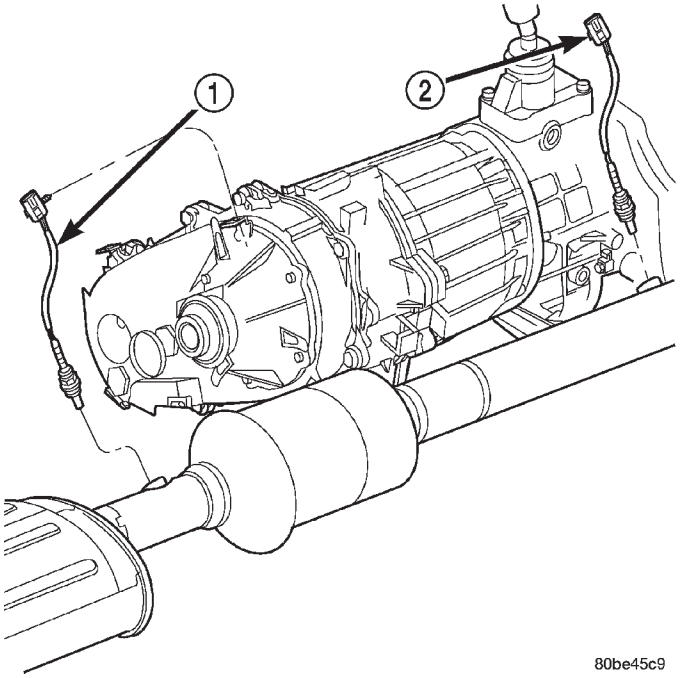


Fig. 30 Oxygen Sensors—4.0L—Federal Emissions

1 – 1/2 O2S
2 – 1/1 O2S

REMOVAL AND INSTALLATION (Continued)

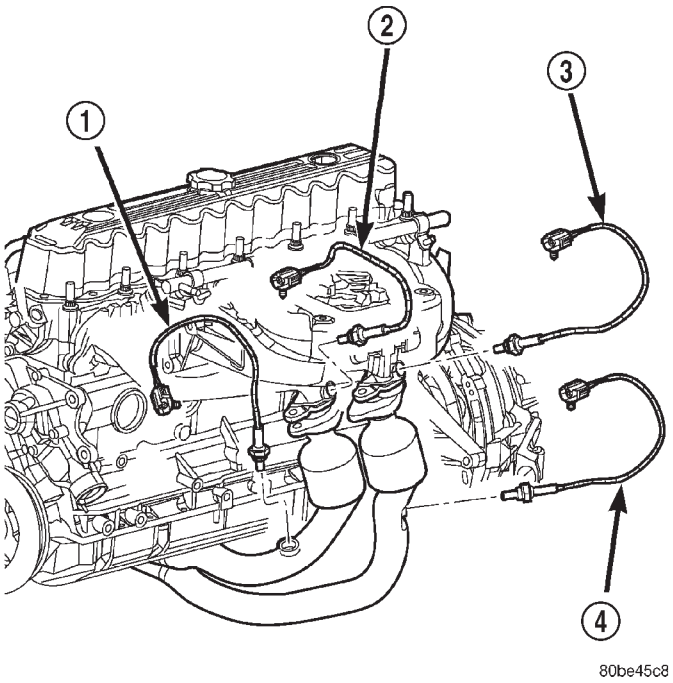


Fig. 31 Oxygen Sensors—4.0L—California Emissions

1 – 1/2 O2S
2 – 1/1 O2S
3 – 2/1 O2S
4 – 2/2 O2S

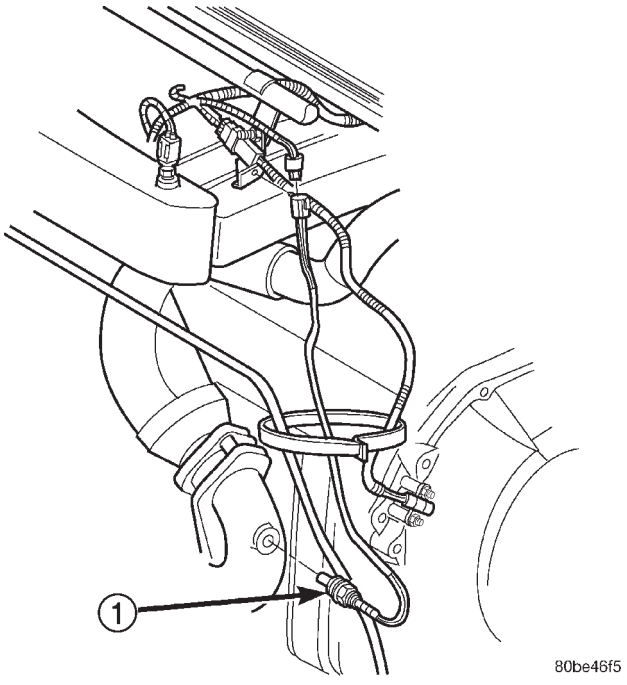


Fig. 32 Front Oxygen Sensor—2.5L—Federal Emissions

1 – 1/1 O2S

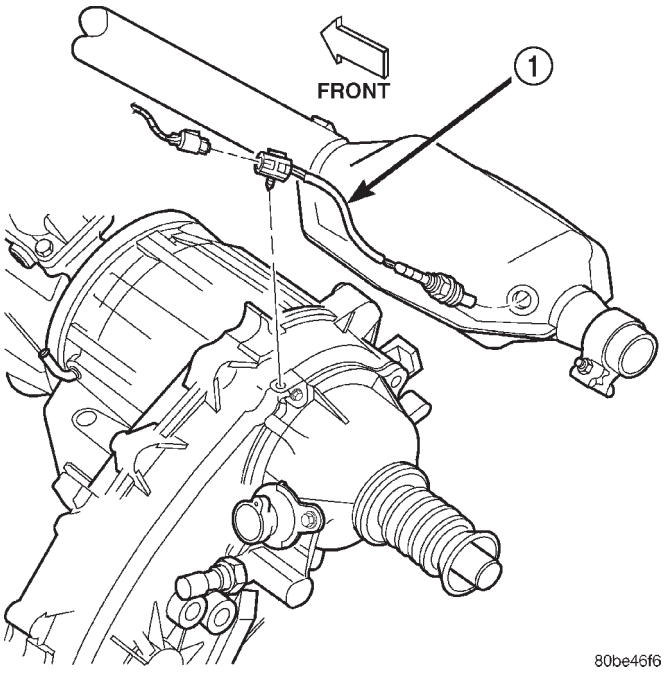


Fig. 33 Rear Oxygen Sensor—2.5L—Federal Emissions

1 – 1/2 O2S

WARNING: THE EXHAUST MANIFOLD, EXHAUST PIPES AND CATALYTIC CONVERTER BECOME VERY HOT DURING ENGINE OPERATION. ALLOW ENGINE TO COOL BEFORE REMOVING OXYGEN SENSOR.

(1) Raise and support vehicle.
(2) Disconnect wire connector from O2S sensor.

CAUTION: When disconnecting sensor electrical connector, do not pull directly on wire going into sensor.

(3) Remove O2S sensor with an oxygen sensor removal and installation tool.
(4) Clean threads in exhaust pipe using appropriate size tap.

INSTALLATION

Threads of new oxygen sensors are factory coated with anti-seize compound to aid in removal. **DO NOT add any additional anti-seize compound to the threads of a new oxygen sensor.**

(1) Install O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.
(2) Connect O2S sensor wire connector.
(3) Lower vehicle.

REMOVAL AND INSTALLATION (Continued)

AIR CLEANER ELEMENT

REMOVAL

(1) Loosen air tube clamp at housing cover (Fig. 34).
(2) Disconnect air tube at cover.
(3) Pry back the clips retaining air cleaner cover to air cleaner housing.
(4) Lift cover up to expose air cleaner element.
(5) Remove air cleaner element.
(6) Clean inside of air cleaner housing and its cover before installing new element.

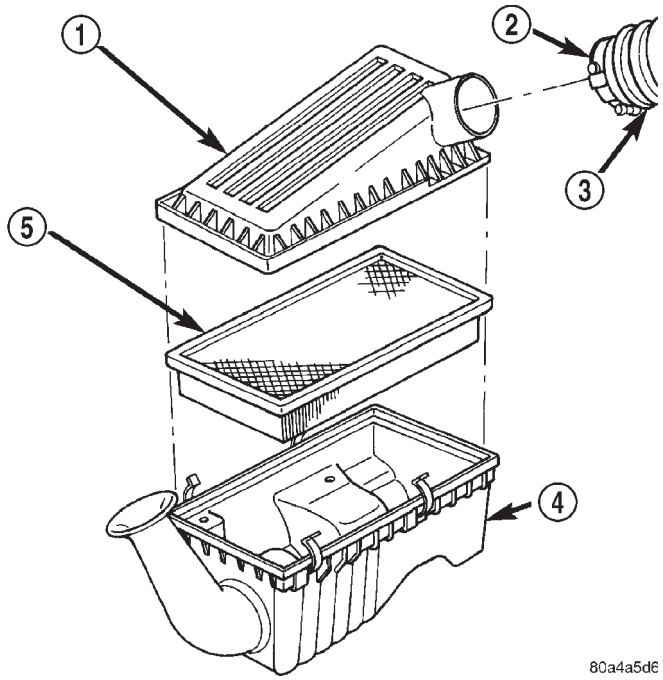


Fig. 34 Air Cleaner Element

1 – COVER
2 – CLAMP
3 – AIR TUBE
4 – HOUSING
5 – FILTER

INSTALLATION

(1) Install air cleaner element into housing.
(2) Install housing cover to housing. Be sure cover is properly seated to air cleaner housing.
(3) Connect air tube at cover.

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. 35).

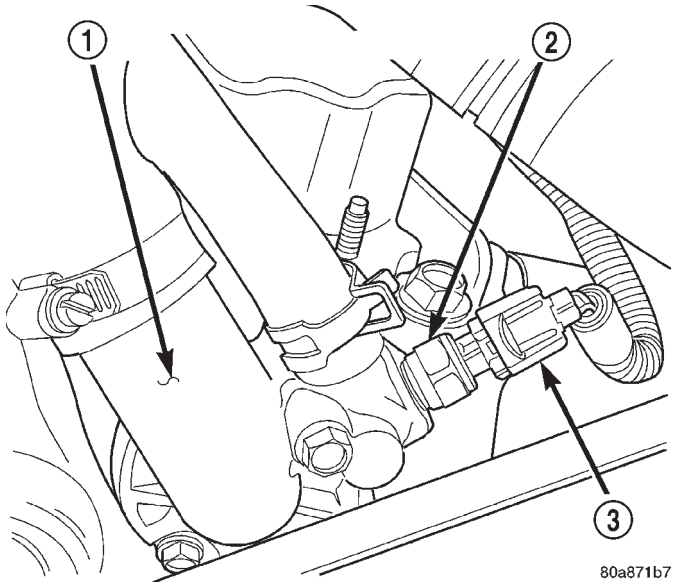


Fig. 35 Engine Coolant Temperature Sensor— Typical

1 – THERMOSTAT HOUSING
2 – ENGINE COOLANT TEMPERATURE SENSOR
3 – ELECTRICAL CONNECTOR

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. 36) or (Fig. 37).

REMOVAL

(1) Disconnect electrical connector from IAT sensor.
(2) Remove sensor from intake manifold.

REMOVAL AND INSTALLATION (Continued)

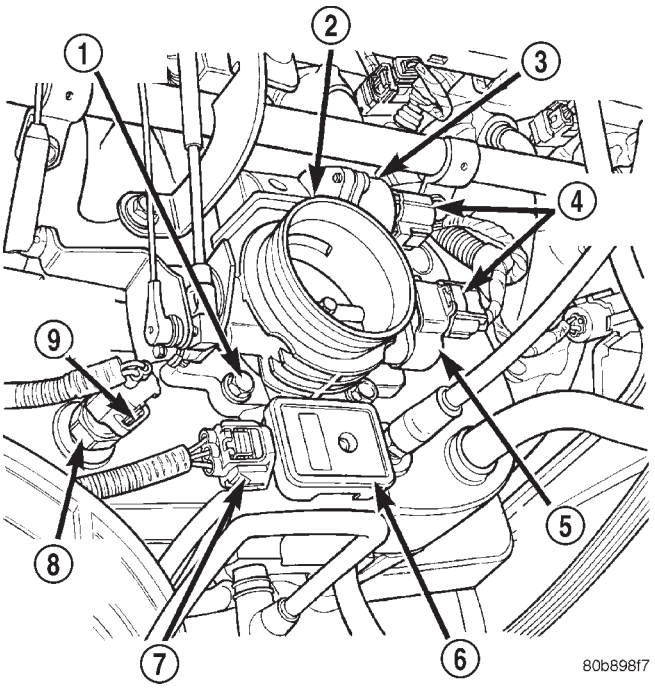


Fig. 36 IAT Sensor Location—4.0L Engine

1 – MOUNTING BOLTS (4)
2 – THROTTLE BODY
3 – IAC MOTOR
4 – ELEC. CONN.
5 – TPS
6 – MAP SENSOR
7 – ELEC. CONN.
8 – IAT SENSOR
9 – ELEC. CONN.

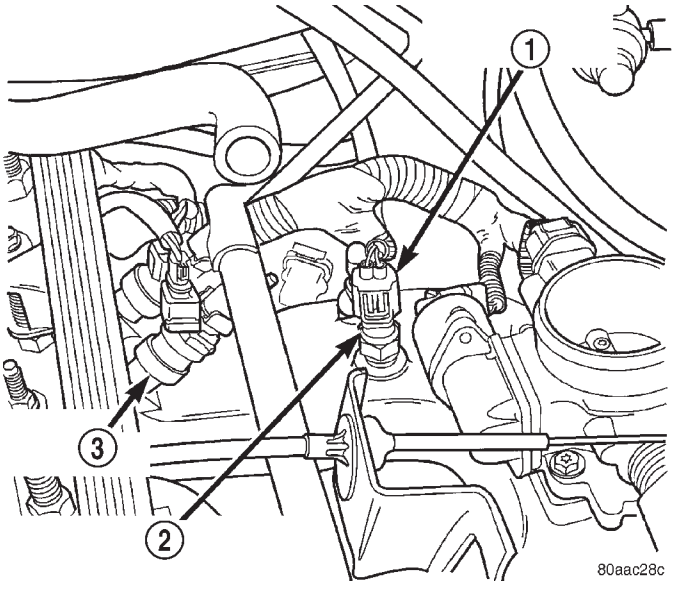


Fig. 37 IAT Sensor Location—2.5L Engine

1 – ELECTRICAL CONNECTOR
2 – INTAKE MANIFOLD TEMPERATURE SENSOR
3 – FUEL INJECTOR

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 (VSS) is located on the speedometer pinion gear adapter. If equipped with 4WD, this adapter is located on the transfer case extension (left side) (Fig. 38). If equipped with 2WD, this adapter is located on the extension housing of the transmission (left side).

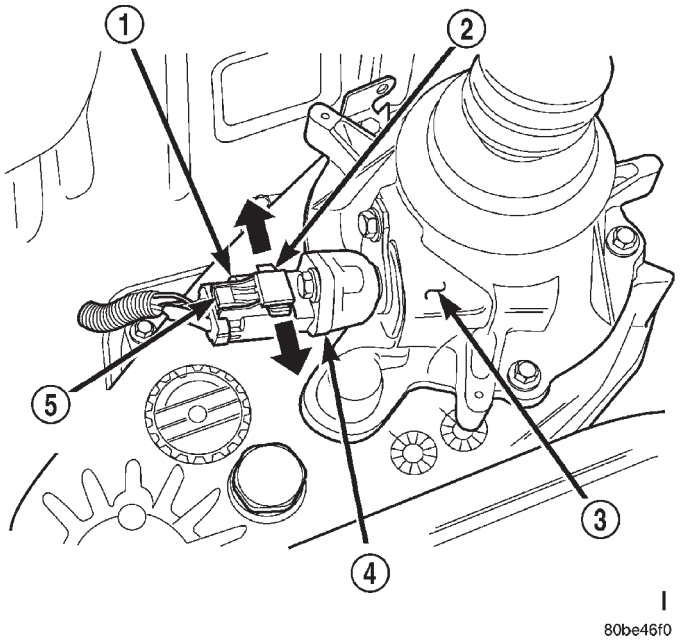


Fig. 38 VSS Location—4WD Shown

1 – SENSOR ELECTRICAL CONNECTOR
2 – SLIDE TAB
3 – 4WD TRANSFER CASE EXTENSION
4 – VEHICLE SPEED SENSOR
5 – RELEASE LOCK

REMOVAL

(1) Raise and support vehicle.

(2) Disconnect electrical connector from sensor by pushing slide tab (Fig. 38). After slide tab has been positioned, push in on secondary release lock (Fig. 38) on side of connector and pull connector from sensor.

(3) Remove sensor mounting bolt (Fig. 39).

(4) Remove sensor (pull straight out) from speedometer pinion gear adapter (Fig. 39). Do not remove gear adapter from transmission.

REMOVAL AND INSTALLATION (Continued)

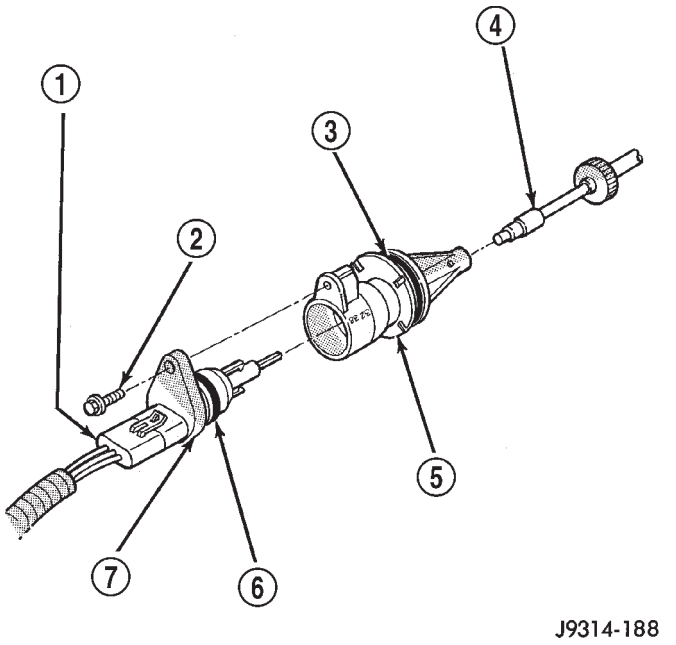


Fig. 39 VSS Removal/Installation

1 – ELECTRICAL CONNECTOR
2 – SENSOR MOUNTING BOLT
3 – O-RING
4 – SPEEDOMETER PINION GEAR
5 – SPEEDOMETER PINION GEAR ADAPTER
6 – O-RING
7 – VEHICLE SPEED SENSOR

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.

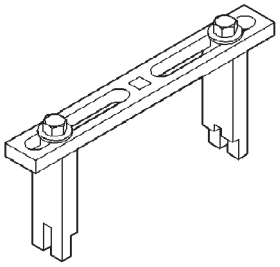
SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Accelerator Pedal Bracket Mounting Nuts	8.5 N·m (75 in. lbs.)
Engine Coolant Temperature Sensor	11 N·m (96 in. lbs.)
Fuel Tank Mounting Nuts	Refer to manual text
Fuel Hose Clamps	1 N·m (10 in. lbs.)
IAC Motor-To-Throttle Body Bolts	7 N·m (60 in. lbs.)
Intake Manifold Air Temp. Sensor	28 N·m (20 ft. lbs.)
MAP Sensor Mounting Screws	3 N·m (25 in. lbs.)
Oxygen Sensor	30 N·m (22 ft. lbs.)
PCM Mounting Screws	4 N·m (35 in. lbs.)
Power Steering Pressure Switch	14–22 N·m (124–195 in. lbs.)
Throttle Body Mounting Bolts	12 N·m (108 in. lbs.)
Throttle Position Sensor Mounting Screws	7 N·m (60 in. lbs.)
Vehicle Speed Sensor Mounting Bolt	2.2 N·m (20 in. lbs.)

SPECIAL TOOLS

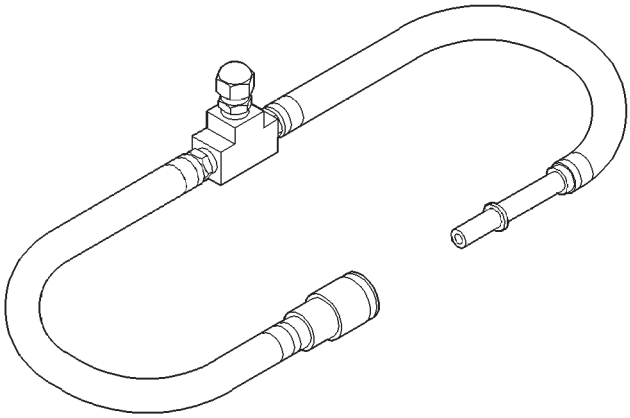
FUEL SYSTEM



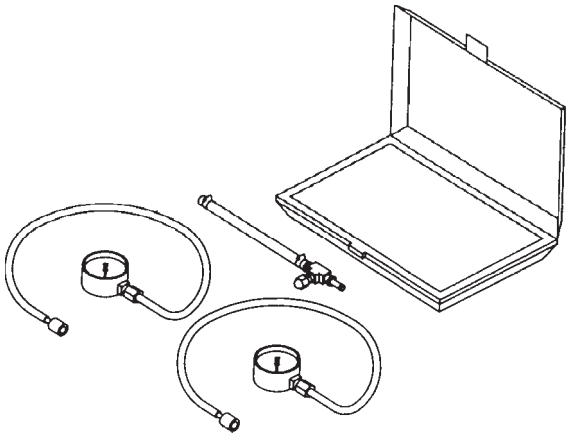
Spanner Wrench—6856



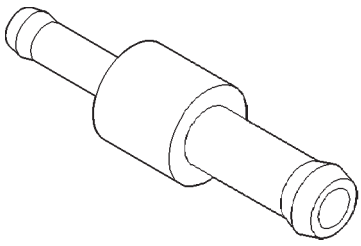
O2S (Oxygen Sensor) Remover/Installer—C-4907



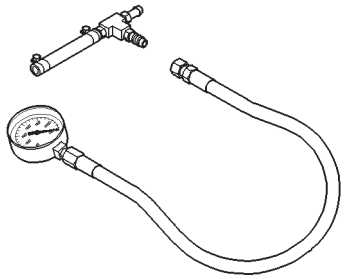
Adapters, Fuel Pressure Test—6539 and/or 6631



Test Kit, Fuel Pressure—5069



Fitting, Air Metering—6714



Test Kit, Fuel Pressure—C-4799-B



Fuel Line Removal Tool—6782

FUEL SYSTEM

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DESCRIPTION AND OPERATION

FUEL REQUIREMENTS—LEADED FUEL VEHICLES

DESCRIPTION

Your vehicle is designed to meet all emission regulations and provide excellent fuel economy when using high quality leaded gasoline with a minimum octane rating of 91.

The vehicle will operate on fuels ranging from regular leaded having a minimum research octane of 91 to super unleaded with a minimum research octane of 98.

Light spark knock at low engine speeds is not harmful to your engine. However, continued heavy spark knock at high speeds can cause damage and should be reported to your dealer immediately. Engine damage resulting from operating with a heavy spark knock may not be covered by the new vehicle warranty.

Besides using leaded gasoline with the proper octane rating, gasolines that contain detergents, corrosion and stability additives are recommended. Using gasolines that have these additives will help improve fuel economy, reduce emissions, and maintain vehicle performance.

Poor quality gasoline can cause problems such as hard starting, stalling and stumble. If you experience these problems, try another brand of gasoline before considering service for the vehicle.

2000 JEEP WRANGLER

STEERING

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POWER STEERING

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DESCRIPTION AND OPERATION

STEERING SYSTEM

DESCRIPTION

The power steering system has a hydraulic pump. The pump is a constant flow rate and displacement vane-type pump. The pump reservoir on the 4.0L engine is mounted to the pump body (Fig. 1). The 2.5L engine has a remote pump reservoir mounted to the fan shroud (Fig. 2).

The steering gear used is a variable ratio recirculating ball type gear. A tilt and non-tilt column provide steering input.

OPERATION

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 from input from the steering column the rack piston moves. The rack piston teeth mesh with the pitman shaft. Turning the worm shaft turns the pitman shaft, which turns the steering linkage.

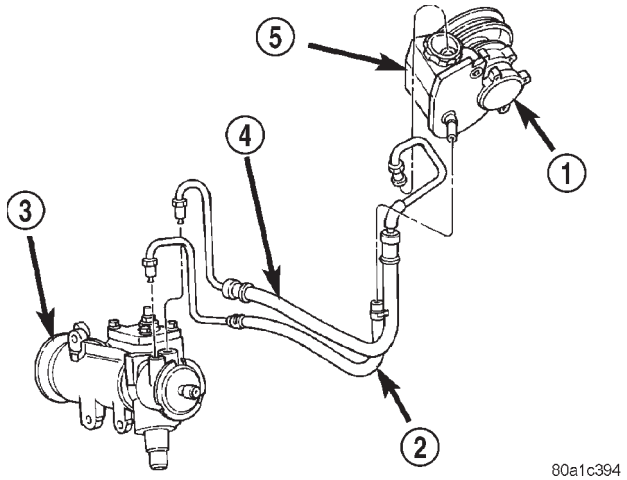


Fig. 1 Power Steering Gear & Pump – 4.0L

1 – 4.0 L PUMP
2 – RETURN HOSE
3 – STEERING GEAR
4 – PRESSURE HOSE
5 – RESERVOIR

DESCRIPTION AND OPERATION (Continued)

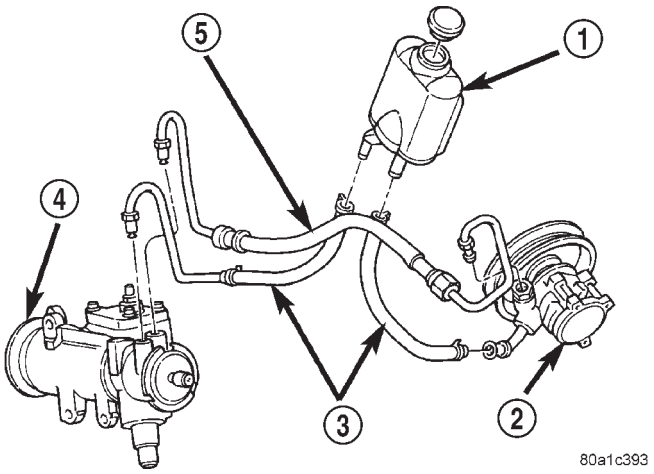


Fig. 2 Power Steering Gear & Pump – 2.5L

1 – REMOTE RESERVOIR
2 – 2.5 L PUMP
3 – RETURN HOSES
4 – STEERING GEAR
5 – PRESSURE HOSE

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.	1. Check and repair seal at dash panel.
	2. Noisy valve in power steering gear.	2. Replace steering gear.
RATTLE OR CLUNK	1. Gear mounting bolts loose.	1. Tighten bolts to specification.
	2. Loose or damaged suspension components/track bar.	2. Inspect and repair suspension.
	3. Loose or damaged steering linkage.	3. Inspect and repair steering linkage.
	4. Internal gear noise.	4. Replace gear.
	5. Pressure hose in contact with other components.	5. Reposition hose.
CHIRP OR SQUEAL	1. Loose belt.	1. Adjust or replace.
WHINE OR GROWL	1. Low fluid level.	1. Fill to proper level.
	2. Pressure hose in contact with other components.	2. Reposition hose.
	3. Internal pump noise.	3. Replace pump.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SUCKING AIR SOUND	4. Air in the system. 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.	4. Perform pump initial operation. 1. Replace clamp. 2. Replace o-ring. 3. Fill to proper level. 4. Repair as necessary.
SCRUBBING OR KNOCKING	1. Wrong tire size. 2. Wrong gear.	1. Verify tire size. 2. Verify gear.

BINDING AND STICKING

CONDITION	POSSIBLE CAUSE	CORRECTION
DIFFICULT TO TURN WHEEL STICKS OR BINDS	1. Low fluid level. 2. Tire pressure. 3. Steering component. 4. Loose belt. 5. Low pump pressure. 6. Column shaft coupler binding. 7. Steering gear worn or out of adjustment. 8. Ball joints binding.	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. 8. Inspect and repair as necessary.

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. 5. Ball joints binding.	1. Adjust tire pressure. 2. Align front end. 3. Inspect and lubricate steering and suspension compnents. 4. Test and adjust as necessary. 5. Inspect and repair as necessary.

Some roads will cause a vehicle to drift, due to the crown in the road.

DIAGNOSIS AND TESTING (Continued)

LOOSE STEERING AND VEHICLE LEADS/DRIFTS

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 TO ONE SIDE DURING BRAKING	1. Tire Pressure.	1. Adjust tire pressure.
	2. Air in brake hydrauliics system.	2. Bleed brake system.
	3. Worn brake components.	3. Repair as necessary.
VEHICLE LEADS OR DRIFTS FROM STRAIGHT AHEAD DIRECTION ON UNCROWNED ROAD.	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/ suspension components.	6. Repair as necessary.
	7. Cross caster out of spec.	7. Adjust or replace axle as necessary.

POWER STEERING FLOW AND PRESSURE

The following procedure is used to test the operation of the power steering system on the vehicle. This test will provide the gallons per minute (GPM) or flow rate of the power steering pump along with the maximum relief pressure. Perform test any time a power steering system problem is present. This test will determine if the power steering pump or power steering gear is not functioning properly. The following pressure and flow test is performed using Power Steering Analyzer Tool 6815 (Fig. 3) 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 the high pressure hose from the power steering pump.

(5) Connect Tube 6865 to the pump hose fitting.

(6) Connect the power steering hose from the steering gear to Adapter 6826.

(7) Open the test valve completely.

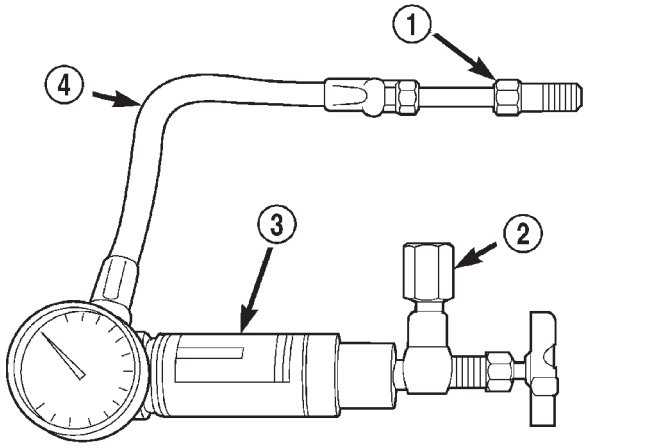


Fig. 3 Power Steering Analyzer

1 – TUBE
2 – ADAPTER FITTINGS
3 – ANALYZER
4 – GAUGE HOSE

(8) Start engine and let idle long enough to circulate power steering fluid through flow/pressure test gauge.

DIAGNOSIS AND TESTING (Continued)

(9) Shut off the engine and check the 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: This next step involves testing maximum pump pressure output and flow control valve operation. Do not leave test valve closed for more than three seconds as the pump could be damaged.

(12) Close valve fully three times for three seconds and record highest pressure indicated each time. **All three readings must be above pump relief pressure 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 and turn the steering wheel to the extreme left and right positions against the stops. Record the highest pressure reading at each position. Compare readings to pump specifications chart. If pressure readings are not within 50 psi. of each other, 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 4 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)	

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DESCRIPTION AND OPERATION

POWER STEERING PUMP

DESCRIPTION

Hydraulic pressure for the power steering system is provided by a belt driven power steering pump (Fig. 1). The pump shaft has a pressed-on high strength plastic drive pulley that is belt driven by the crankshaft pulley. The reservoir is attached to the pump body with spring clips on the 4.0L engine. A remote pump reservoir is used on the 2.5L engine mounted to the fan shroud. The power steering pump is connected to the steering gear by the pressure and return hoses.

OPERATION

The power steering pump is a constant flow rate and displacement, vane-type pump. The pump internal parts operate submerged in fluid. The flow control orifice is part of the high pressure line fitting. The pressure relief valve inside the flow control valve limits the pump pressure.

NOTE: Power steering pumps have different pressure rates and are not interchangeable with other pumps.

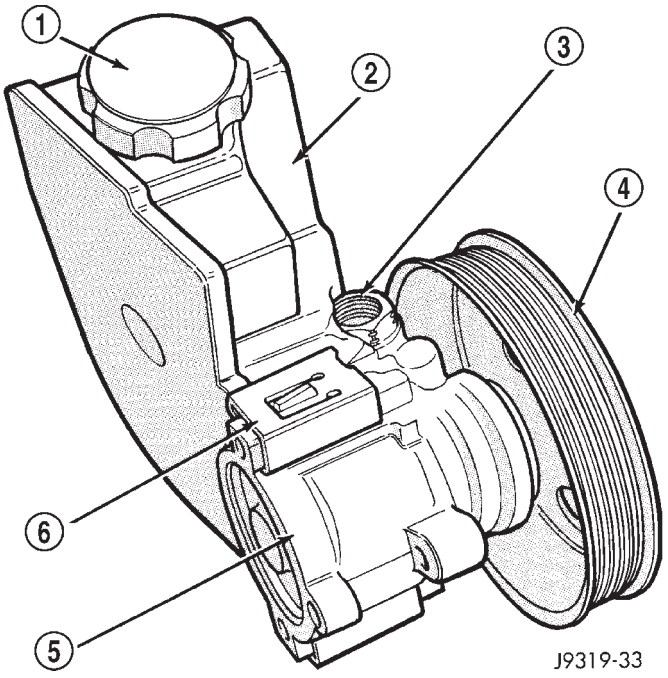


Fig. 1 Pump With Integral Reservoir

1 – CAP
2 – FLUID RESERVOIR (TYPICAL)
3 – HIGH-PRESSURE FITTING
4 – DRIVE PULLEY
5 – PUMP BODY
6 – RESERVOIR CLIP

POWER STEERING PRESSURE LINE

DESCRIPTION

The hose consists of two metal ends and rubber center section that contains a tuning cable.

OPERATION

Power steering pressure line, is used to transfer high pressure power steering fluid, from the power steering pump to the power steering gear.

DESCRIPTION AND OPERATION (Continued)

POWER STEERING RETURN LINE

DESCRIPTION

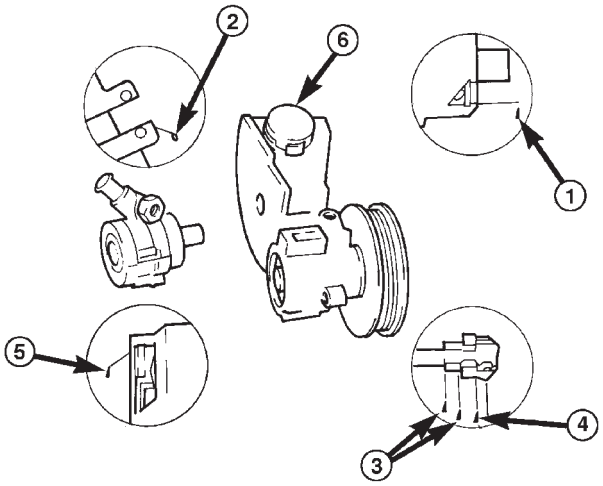
Power steering return line is a hose which is clamped at the pump and the gear.

OPERATION

Power steering return line, is used to transfer low pressure power steering fluid, from the power steering gear to the power steering pump.

DIAGNOSIS AND TESTING

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.

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 – 4.0L

REMOVAL

(1) Remove serpentine drive belt, refer to Group 7 Cooling.

(2) Remove pressure and return hoses from pump and drain the pump.

(3) Loosen the pump bracket bolt at the engine block.

(4) Remove 3 pump mounting bolts (Fig. 2) through pulley access holes.

(5) Tilt pump downward and remove from engine.

(6) Remove pulley from pump.

INSTALLATION

(1) Install pulley on pump.

(2) Install pump on the engine mounting bracket.

(3) Install 3 pump mounting bolts and tighten to 27 N·m (20 ft. lbs.).

(4) Tighten pump bracket bolt to 57 N·m (42 ft. lbs.).

(5) Install the pressure line on the pump and tighten to 28 N·m (21 ft. lbs.).

(6) Install return hoses on pump.

(7) Install drive belt, refer to Group 7 Cooling.

(8) Add power steering fluid, refer to Power Steering Pump Initial Operation.

REMOVAL AND INSTALLATION (Continued)

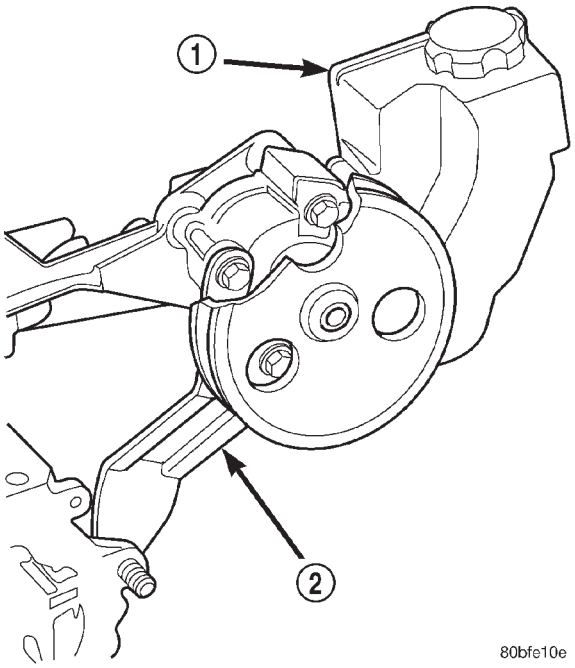


Fig. 2 Pump Mounting – 4.0L

1 – PUMP ASSEMBLY
2 – PUMP BRACKET

POWER STEERING PUMP – 2.5L

REMOVAL

(1) Remove serpentine drive belt, refer to Group 7 Cooling.

(2) Remove pressure and return hoses from pump and drain the pump.

(3) Remove 3 pump mounting bolts (Fig. 3) through pulley access holes.

(4) Loosen the 3 pump bracket bolts.

(5) Tilt pump downward and remove from engine.

(6) Remove pulley from pump.

INSTALLATION

(1) Install pulley on pump.

(2) Install pump on the engine mounting bracket.

(3) Tighten pump bracket bolts to 47 N·m (35 ft. lbs.).

(4) Install 3 pump mounting bolts and tighten to 27 N·m (20 ft. lbs.).

(5) Install the pressure line on the pump and tighten to 28 N·m (21 ft. lbs.).

(6) Install return hoses on pump.

(7) Install drive belt, refer to Group 7 Cooling.

(8) Add power steering fluid, refer to Power Steering Pump Initial Operation.

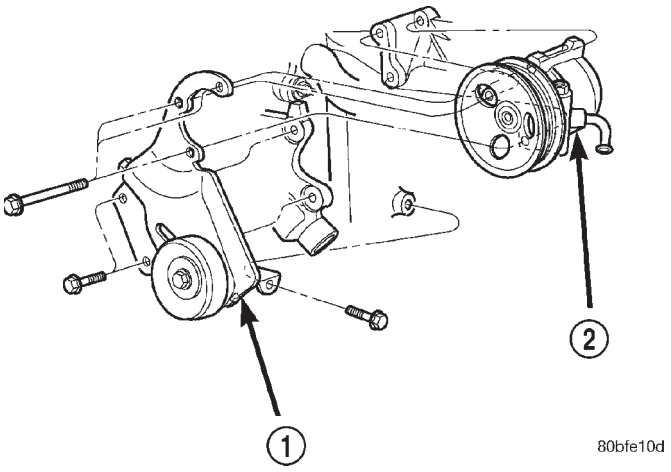


Fig. 3 Pump Mounting – 2.5L

1 – PUMP BRACKET
2 – PUMP ASSEMBLY 2.5L

PUMP REMOTE RESERVOIR – 2.5L

REMOVAL

(1) Remove the pump return hoses from the reservoir and drain the reservoir.

(2) Remove the push-in fastener from the reservoir (Fig. 4).

(3) Slide the reservoir up out of the fan shroud mount.

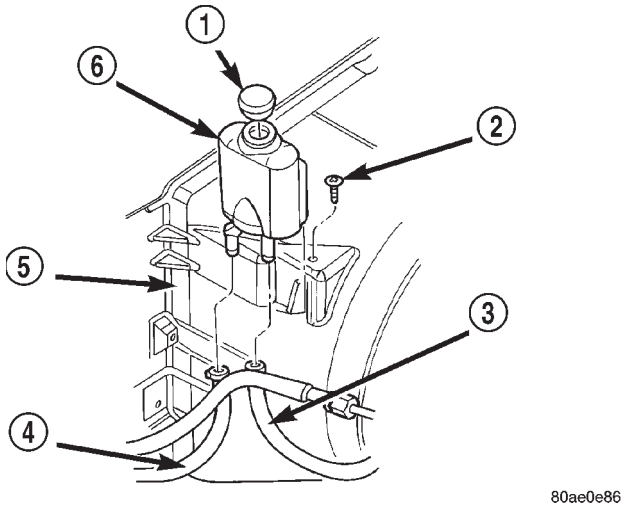


Fig. 4 Pump Reservoir – 2.5L

1 – CAP
2 – FASTENER
3 – PUMP SUPPLY HOSE
4 – RETURN HOSE
5 – FAN SHROUD
6 – RESERVOIR

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Slide reservoir down onto the fan shroud mount until it clicks in place.
(2) Install the push-in fastener.
(3) Install the 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 or equivalent puller (Fig. 5).

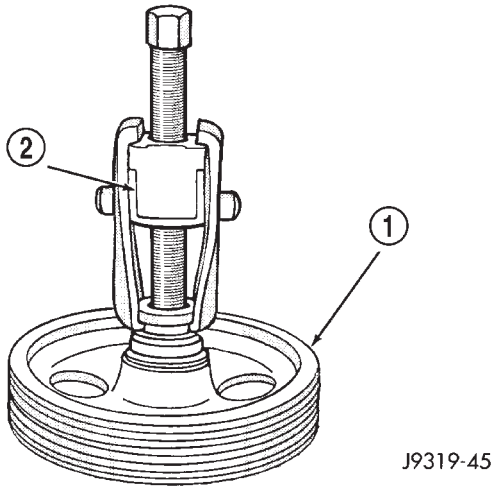


Fig. 5 Pulley Removal

1 – POWER STEERING PUMP DRIVE PULLEY
2 – SPECIAL TOOL C-4333

ASSEMBLY

NOTE: The pulley is marked front for installation.

(1) Replace pulley if bent, cracked, or loose.
(2) Install pulley on pump with Installer C-4063-B or equivalent installer (Fig. 6). The pulley must be flush with the end of the shaft. Ensure the tool and pulley are aligned with the pump shaft.
(3) Install pump assembly.
(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.**

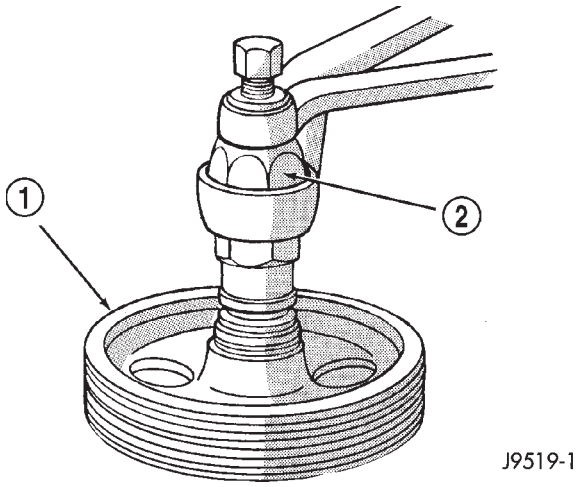


Fig. 6 Pulley Installation

1 – POWER STEERING PUMP DRIVE PULLEY
2 – SPECIAL TOOL C-4063–B

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 installation.

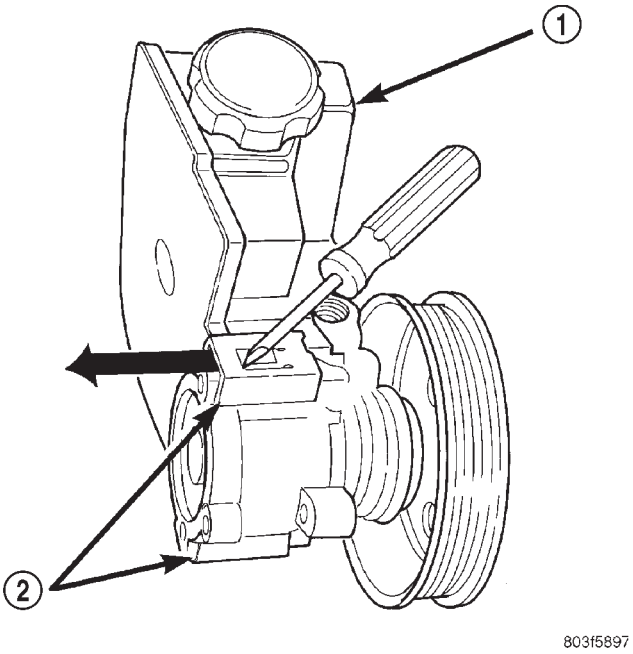


Fig. 7 Pump Reservoir Clips

1 – RESERVOIR
2 – RETAINING CLIPS

DISASSEMBLY AND ASSEMBLY (Continued)

(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.

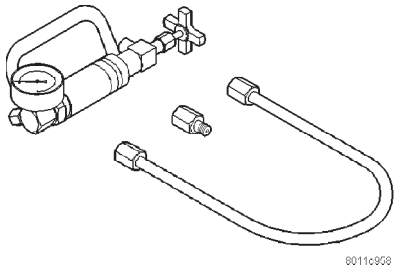
SPECIFICATIONS

TORQUE CHART

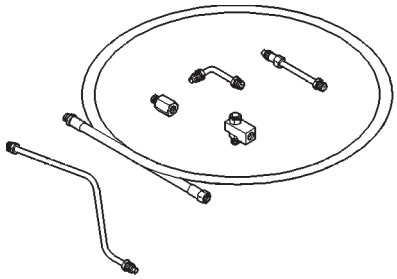
DESCRIPTION	TORQUE
Power Steering Pump	
Bracket to Pump	28 N·m (21 ft. lbs.)
Bracket to 4.0L Engine	57 N·m (42 ft. lbs.)
Bracket to 2.5L Engine	47 N·m (35 ft. lbs.)
Flow Control Valve	75 N·m (55 ft. lbs.)
Pressure Line	28 N·m (21 ft. lbs.)

SPECIAL TOOLS

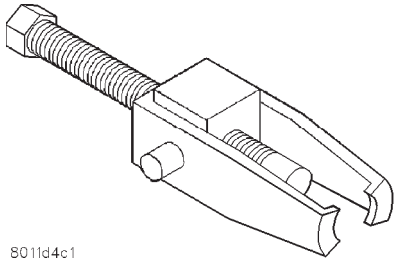
POWER STEERING PUMP



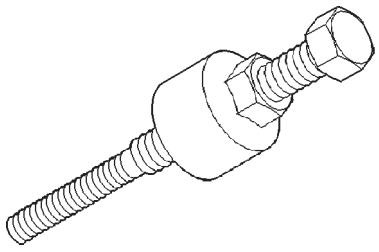
Analyzer Set, Power Steering Flow/Pressure 6815



Adapters, Power Steering Flow/Pressure Tester 6893



Puller C-4333



Installer, Power Steering Pulley C-4063B

POWER STEERING GEAR

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POWER STEERING GEAR 21

DESCRIPTION AND OPERATION

POWER STEERING GEAR

DESCRIPTION

The power steering gear is a variable ratio recirculating ball type gear. The ratio is 15:1 on center, reducing to 13:1 at the end of travel.

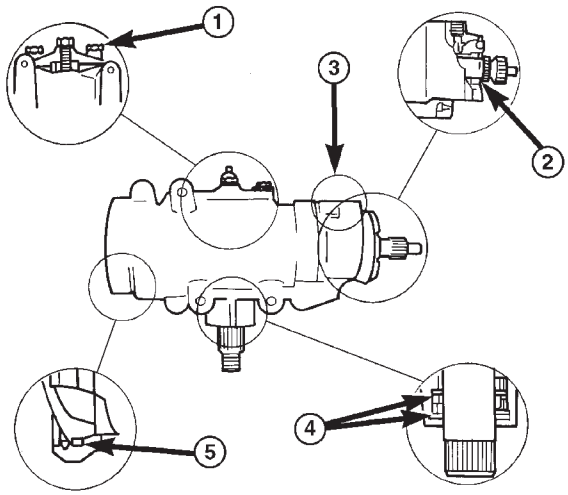
OPERATION

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.

DIAGNOSIS AND TESTING

POWER STEERING GEAR LEAKAGE



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

POWER STEERING GEAR

REMOVAL

(1) Place the front wheels in the straight ahead position with the steering wheel centered.

(2) Disconnect and cap the fluid hoses/tubes from power steering pump.

(3) Remove the column coupler shaft from the gear.

(4) Remove pitman arm from gear.

(5) Remove the steering gear retaining bolts and remove the gear (Fig. 1).

(6) Remove power steering hoses/tubes from steering gear.

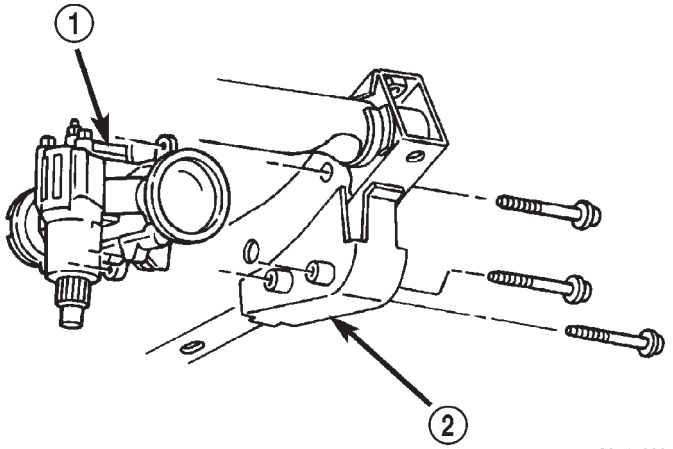


Fig. 1 Steering Gear Mounting

1 – STEERING GEAR
2 – FRAME MOUNT

INSTALLATION

(1) Install power steering hoses/tubes to steering gear and tighten to 28 N·m (21 ft. lbs.).

(2) Install steering gear on the frame rail and tighten bolts to 95 N·m (70 ft. lbs.)

(3) Align the column coupler shaft to steering gear. Install a **new** coupler pinch bolt and tighten to 49 N·m (36 ft. lbs.).

(4) Align and install the pitman arm and tighten nut to 251 N·m (185 ft. lbs.).

(5) Install power steering hoses/tubes to power steering pump.

(6) Fill power steering system to proper level, refer to Steering Pump Initial Operation.

DISASSEMBLY AND ASSEMBLY

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. 2).

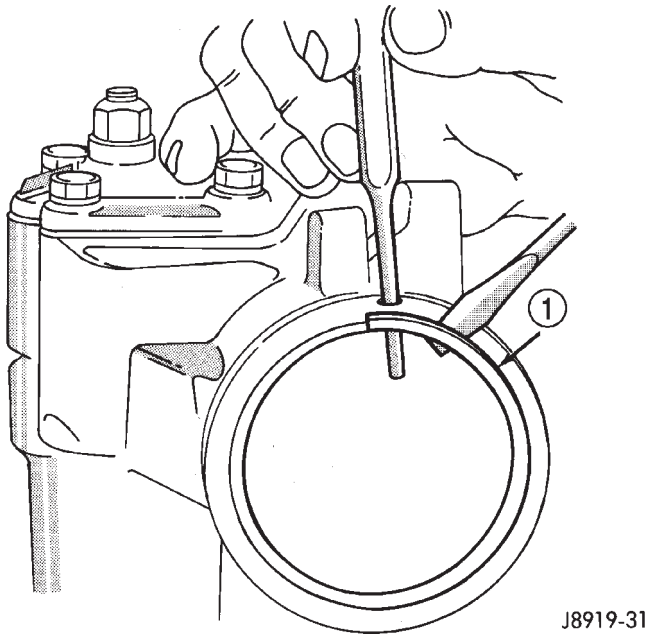


Fig. 2 End Plug Retaining Ring

1 – RETAINING RING

(2) Slowly rotate stub shaft with 12 point socket COUNTER-CLOCKWISE to force the end plug out from housing.

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. 3).

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. 4).

PITMAN SHAFT/SEALS/BEARING

DISASSEMBLY

(1) Clean exposed end of pitman shaft and housing with a wire brush.

(2) Remove preload adjuster nut (Fig. 5).

DISASSEMBLY AND ASSEMBLY (Continued)

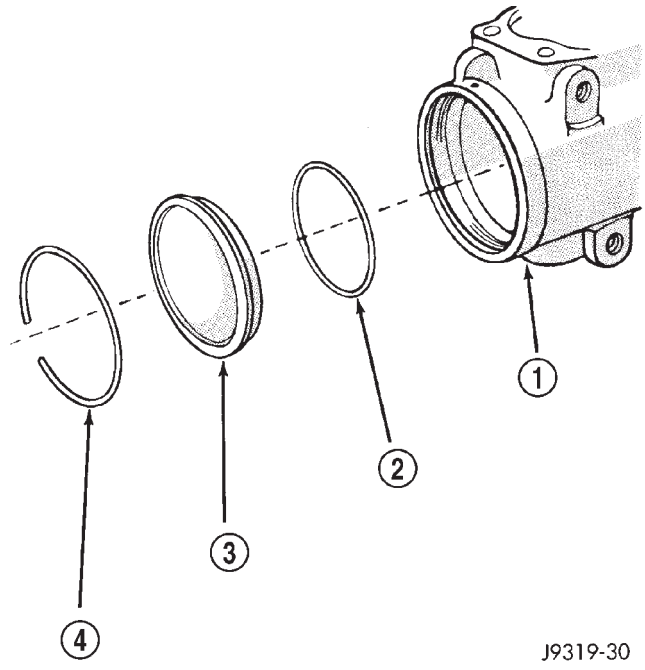


Fig. 3 End Plug Components

1 – HOUSING ASSEMBLY
2 – HOUSING END PLUG O-RING SEAL
3 – HOUSING END PLUG
4 – RETAINING RING

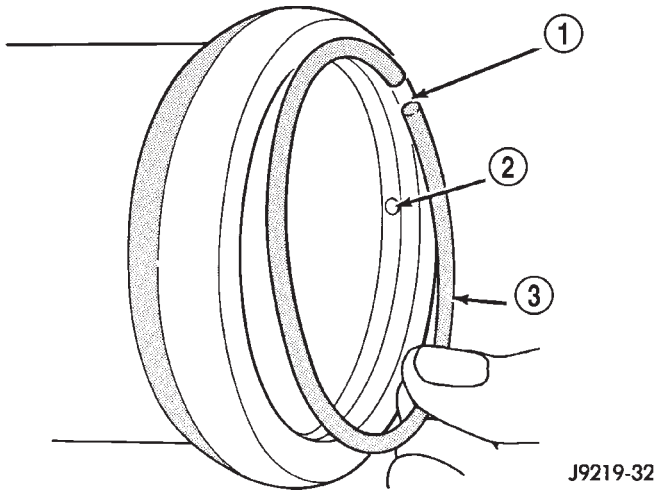


Fig. 4 Installing The Retaining Ring

1 – RING CAP
2 – PUNCH ACCESS HOLE
3 – RETAINER RING

(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. 5).

NOTE: The pitman shaft will not clear the housing if it is not centered.

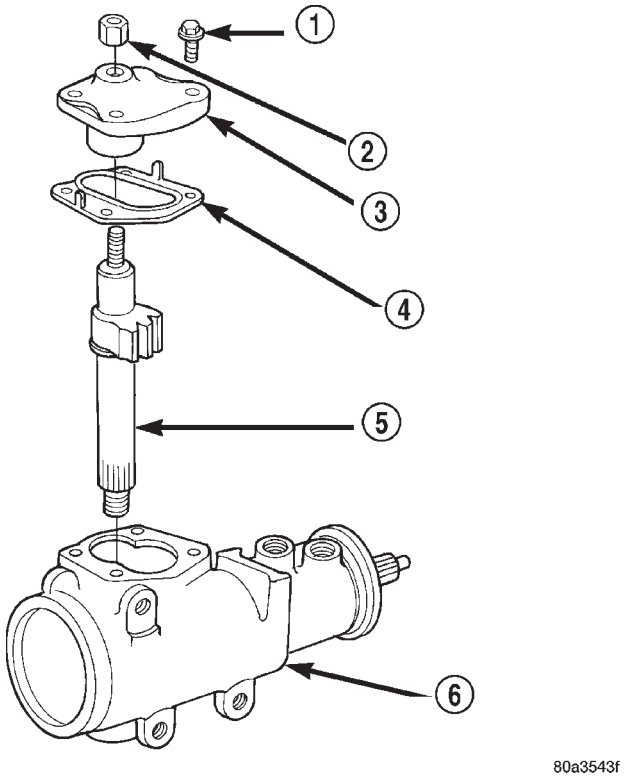


Fig. 5 Side Cover and Pitman Shaft

1 – SIDE COVER BOLTS
2 – PRELOAD ADJUSTER NUT
3 – SIDE COVER
4 – GASKET SEAL
5 – PITMAN SHAFT
6 – HOUSING ASSEMBLY

(6) Remove pitman shaft from the side cover.

(7) Remove dust seal from the housing with a seal pick (Fig. 6).

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. 7).

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.

DISASSEMBLY AND ASSEMBLY (Continued)

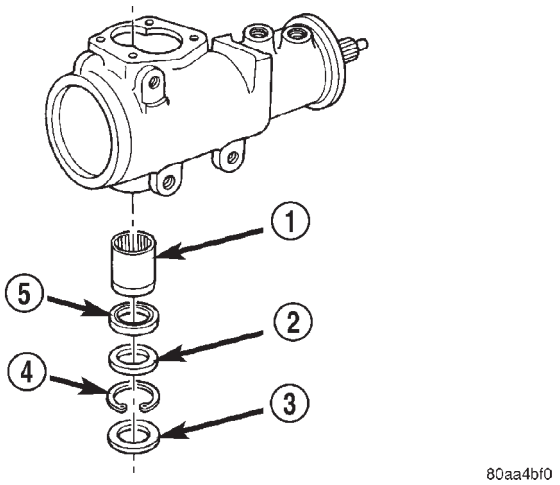


Fig. 6 Pitman Shaft Seals & Bearing

1 – BEARING
2 – WASHER
3 – DUST SEAL
4 – RETAINER
5 – OIL SEAL

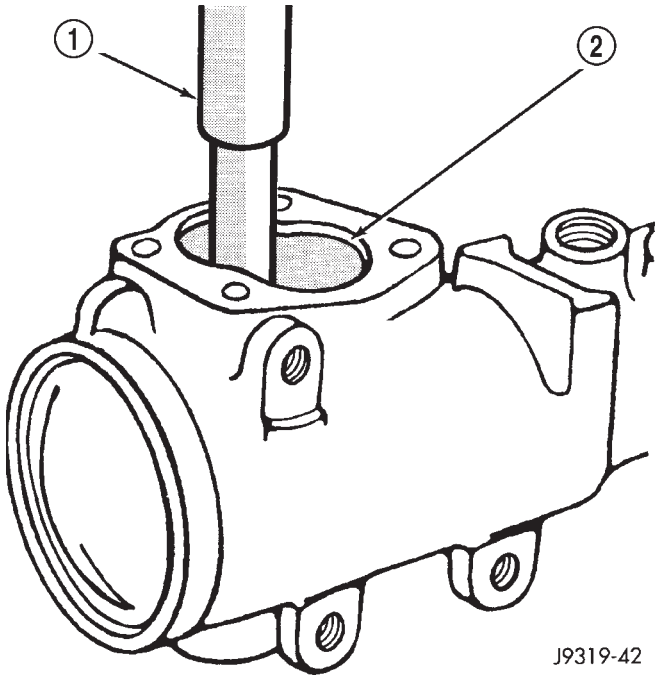


Fig. 7 Needle Bearing Removal

1 – REMOVER
2 – SIDE COVER AREA

(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. 5).

(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. 8).

(2) Remove adjuster nut with Spanner Wrench C-4381.

(3) Remove thrust support assembly out of the housing (Fig. 9).

(4) Pull stub shaft and valve assembly from the housing (Fig. 10).

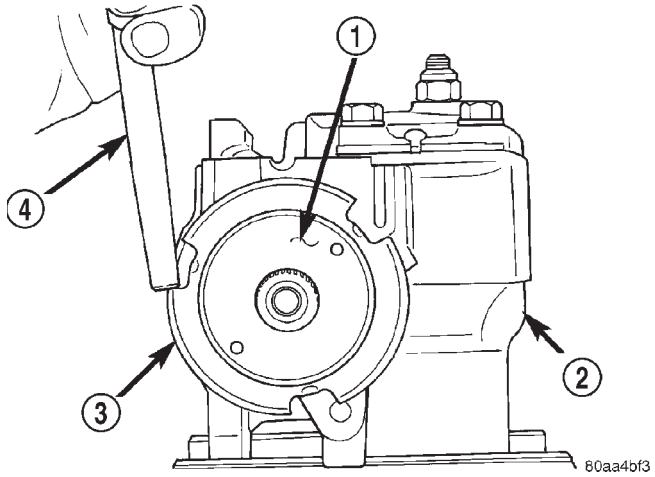


Fig. 8 Lock Nut and Adjuster Nut

1 – ADJUSTER NUT
2 – STEERING GEAR
3 – LOCK NUT
4 – PUNCH

(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. 11).

(6) Remove spool valve from valve body by pulling and rotating the spool valve from the valve body (Fig. 12).

(7) Remove spool valve O-ring and valve body teflon rings and O-rings underneath the teflon rings (Fig. 13).

DISASSEMBLY AND ASSEMBLY (Continued)

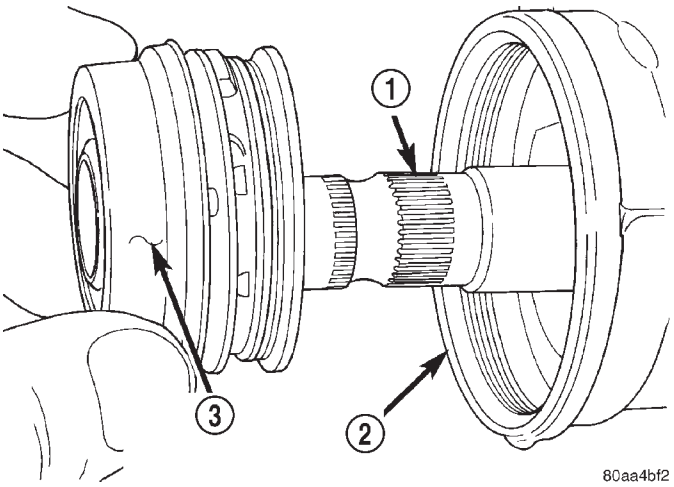


Fig. 9 Thrust Support Assembly

1 – STUB SHAFT
2 – HOUSING
3 – THRUST SUPPORT ASSEMBLY

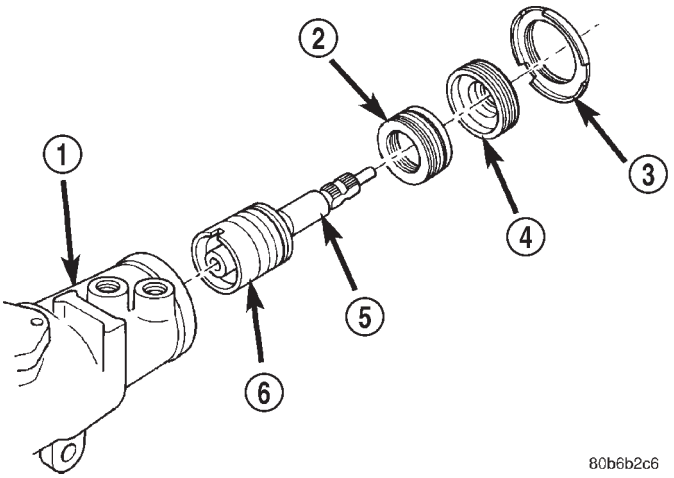


Fig. 10 Valve Assembly With Stub Shaft

1 – GEAR
2 – THRUST SUPPORT
3 – LOCK NUT
4 – ADJUSTER NUT
5 – STUB SHAFT
6 – VALVE ASSEMBLY

(8) Remove the O-ring between the worm shaft and the stub shaft.

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.

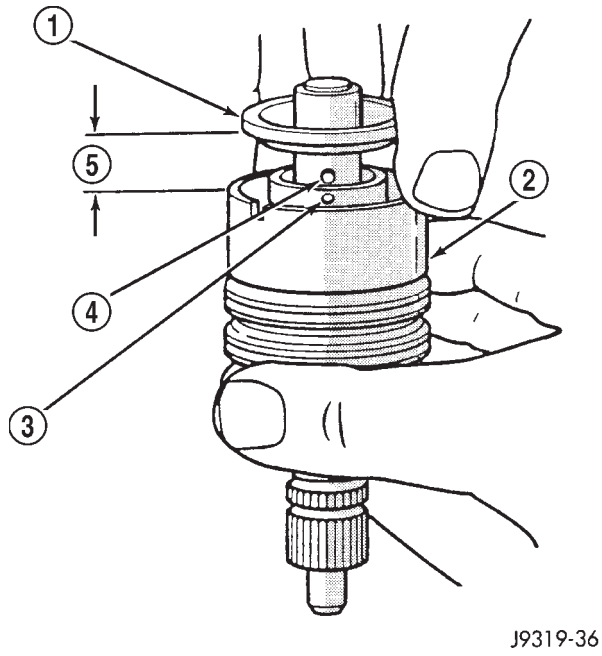


Fig. 11 Stub Shaft

1 – STUB SHAFT
2 – VALVE BODY
3 – HOLE IN SPOOL
4 – SHAFT PIN
5 – 6mm (1/4")

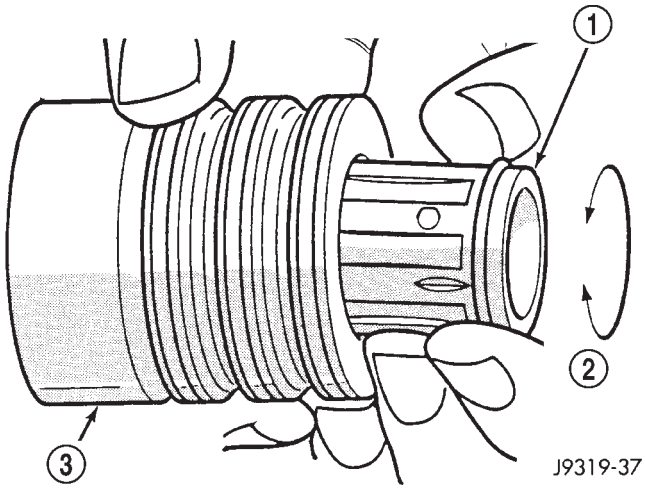


Fig. 12 Spool Valve

1 – SPOOL VALVE
2 – ROTATE VALVE TO REMOVE
3 – VALVE BODY

(3) Install stub shaft in valve spool and engage locating pin on stub shaft into spool valve hole (Fig. 14).

NOTE: Notch in stub shaft cap must fully engage valve body pin and seat against valve body shoulder.

DISASSEMBLY AND ASSEMBLY (Continued)

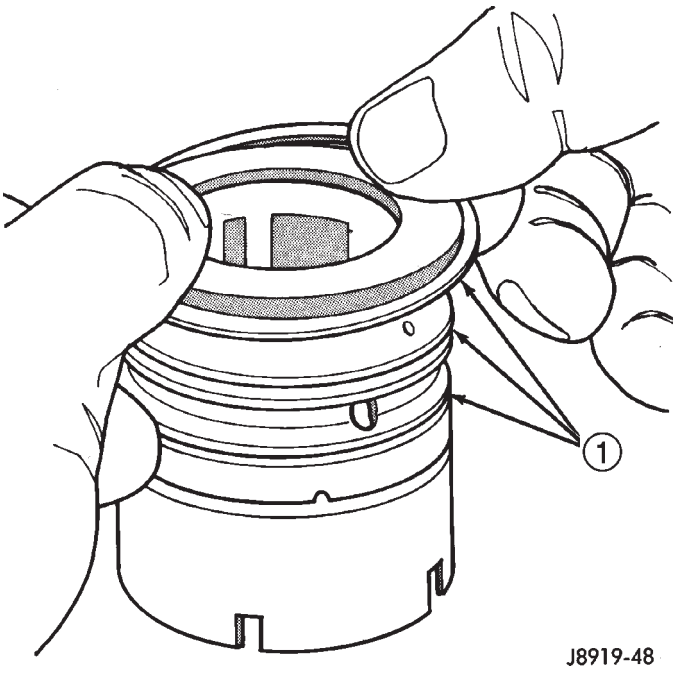


Fig. 13 Valve Seals

1 – O-RING SEALS

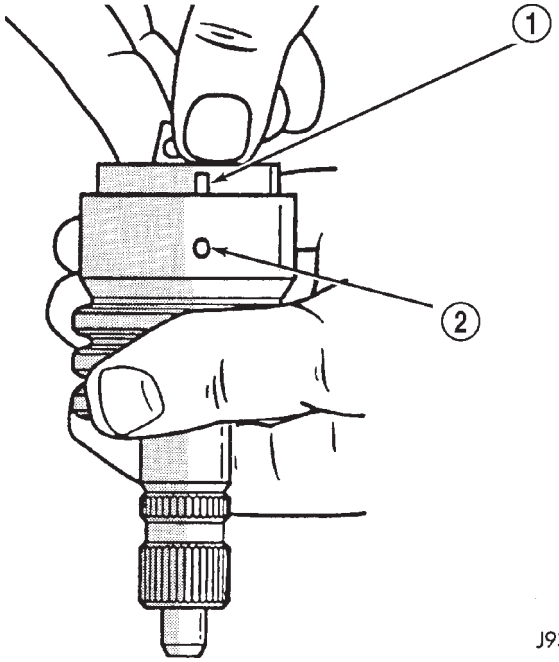


Fig. 14 Stub Shaft Installation

1 – NOTCH IN CAP
2 – VALVE BODY PIN

(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. 15).

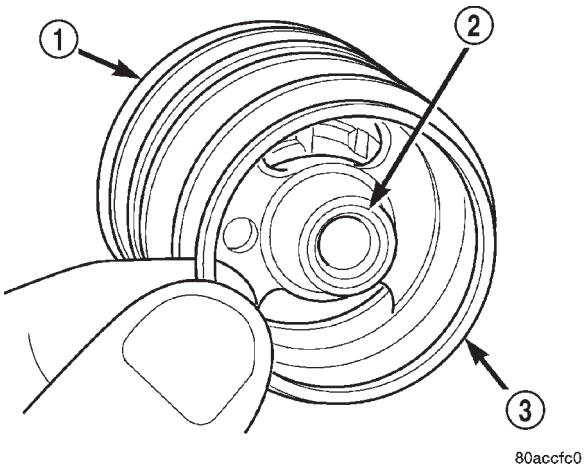


Fig. 15 Stub Shaft Cap O-Ring

1 – VALVE BODY
2 – STUB SHAFT CAP
3 – 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. 16).

(3) Remove side cover and pitman shaft.

(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. 17) 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.

(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. 18).

(11) Remove teflon ring and O-ring from the rack piston (Fig. 19).

DISASSEMBLY AND ASSEMBLY (Continued)

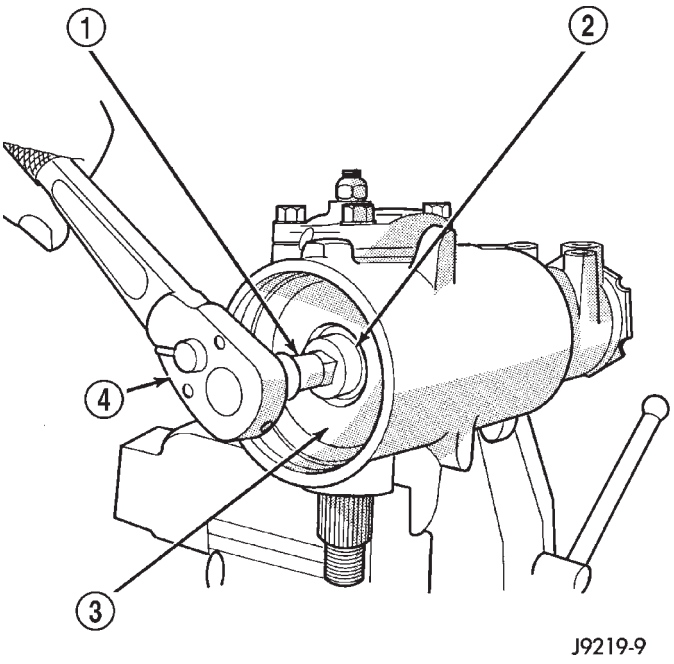


Fig. 16 Rack Piston End Plug

1 – EXTENSION
2 – END PLUG
3 – RACK PISTON
4 – RATCHET

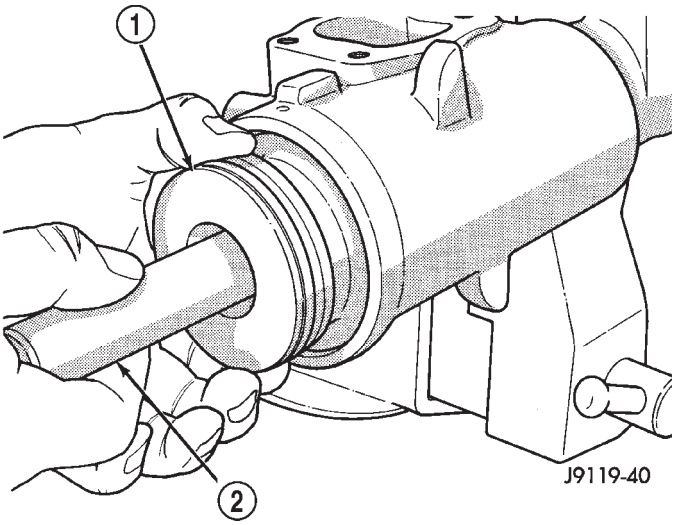


Fig. 17 Rack Piston with Arbor

1 – RACK PISTON
2 – SPECIAL TOOL C-4175

(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. 20).

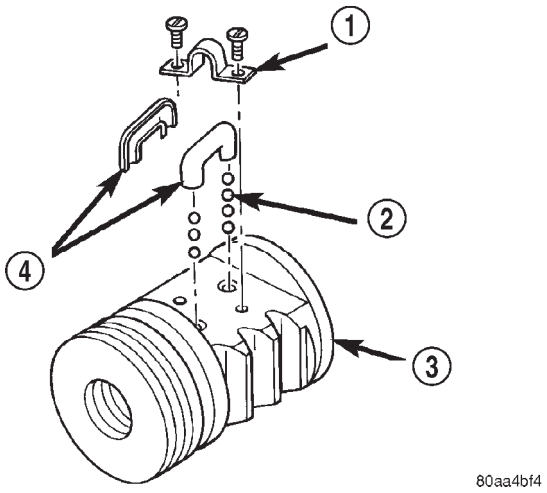


Fig. 18 Rack Piston

1 – CLAMP
2 – BALLS
3 – RACK PISTON
4 – BALL GUIDE

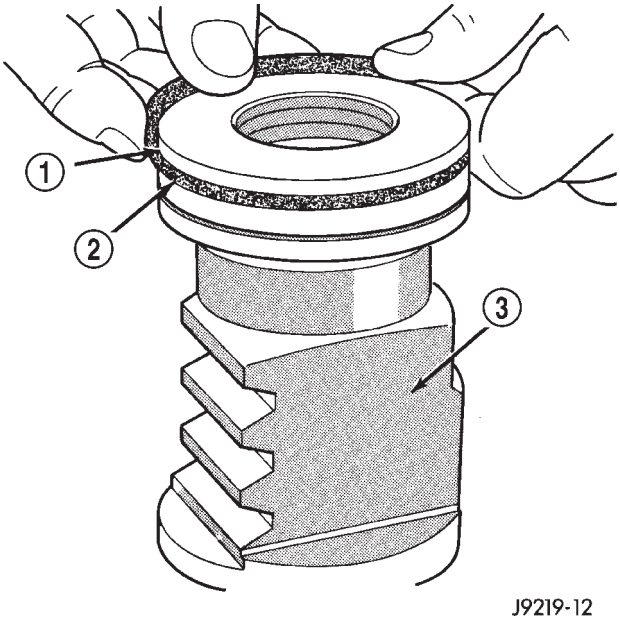


Fig. 19 Rack Piston Teflon Ring and O-Ring

1 – TEFLON SEAL
2 – BACK-UP O-RING MUST BE INSTALLED UNDER PISTON RING
3 – RACK PISTON NUT

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.

DISASSEMBLY AND ASSEMBLY (Continued)

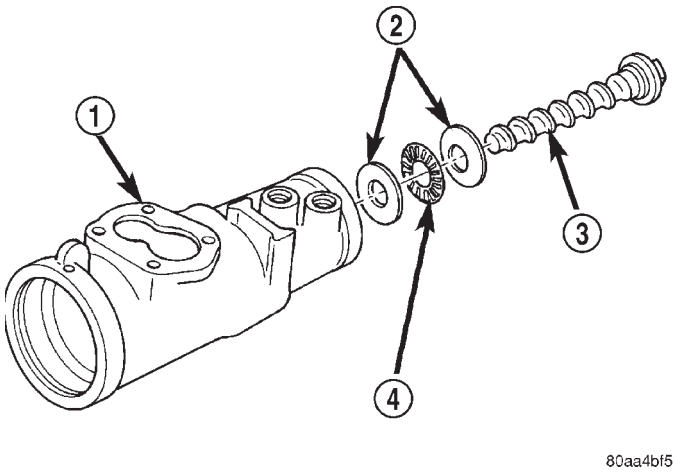


Fig. 20 Worm Shaft

1 – GEAR HOUSING
2 – BEARING RACE
3 – WORM SHAFT
4 – BEARING

(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. 21).

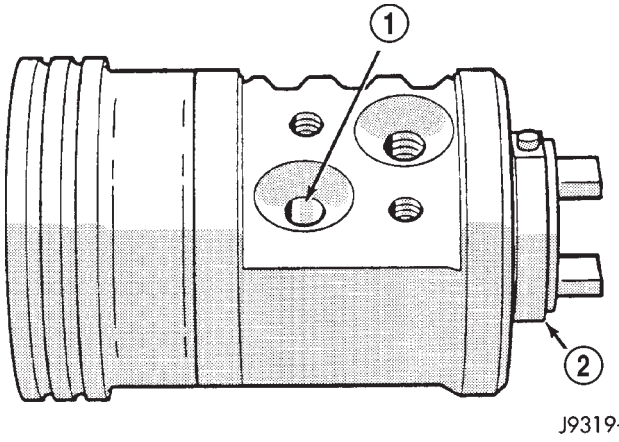


Fig. 21 Installing Balls in Rack Piston

1 – INSTALL BALLS IN THIS HOLE WHILE SLOWLY ROTATING WORM COUNTER CLOCKWISE
2 – WORM FLANGE

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.

(4) Lubricate and install rack piston balls through return guide hole while turning worm shaft COUNTERCLOCKWISE (Fig. 21).

(5) Install remaining balls in guide using grease to hold the balls in place (Fig. 22).

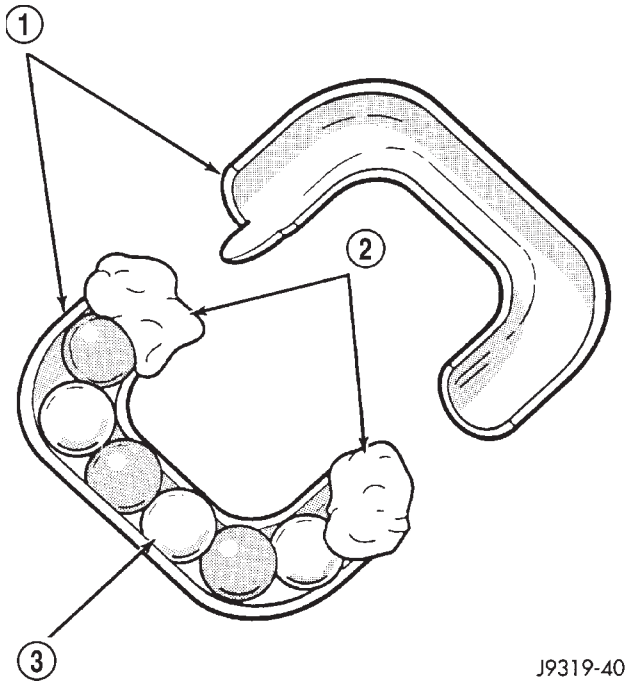


Fig. 22 Balls in the Return Guide

1 – GUIDE
2 – PETROLEUM JELLY
3 – BALLS

(6) Install the guide onto rack piston and install clamp and clamp bolts. Tighten bolts to 4.8 N·m (43 in. 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. 20).

(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. 23).

(3) Rotate the stub shaft back and forth with a 12 point socket to drain the remaining fluid.

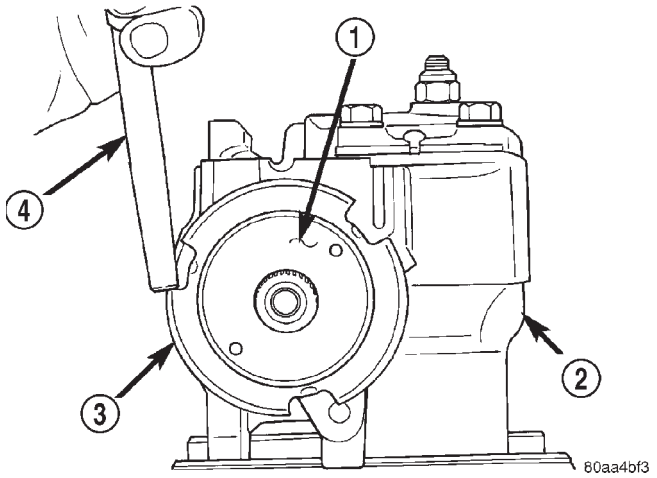


Fig. 23 Adjuster Lock Nut

1 – ADJUSTER NUT
2 – STEERING GEAR
3 – LOCK NUT
4 – PUNCH

(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. 24).

(6) Measure back (counterclockwise) 5.08 mm (0.20 in) and mark housing (Fig. 25).

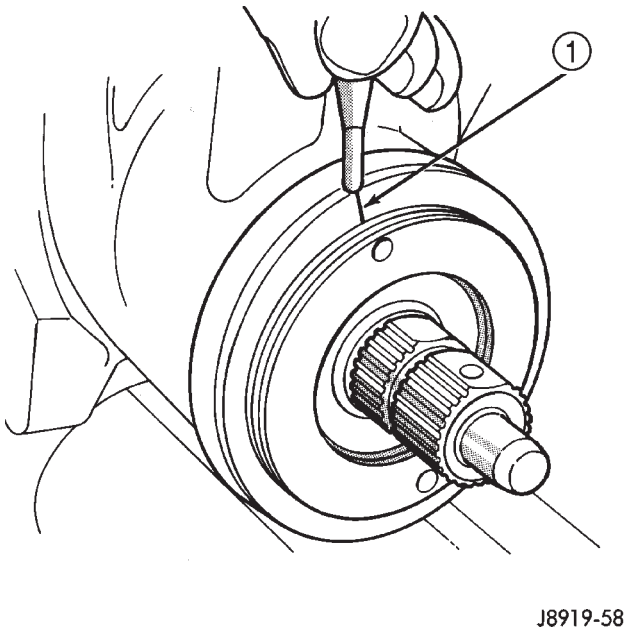


Fig. 24 Alignment Marking On Housing

1 – INDEX

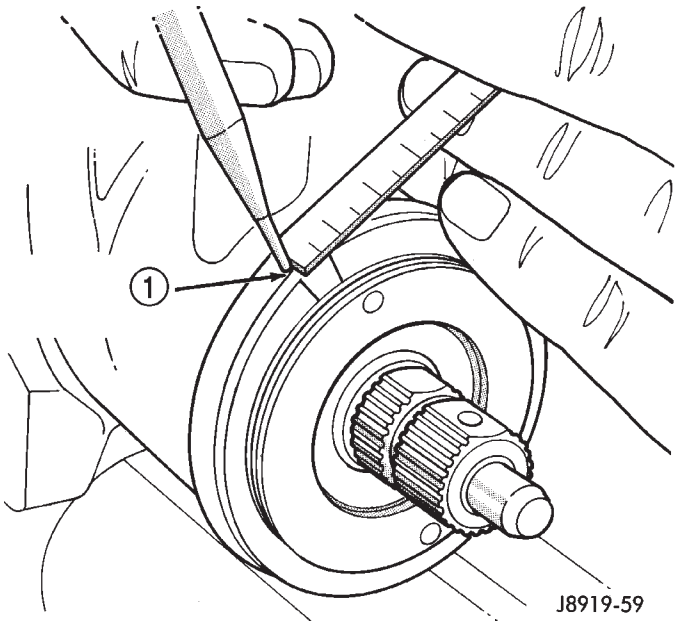


Fig. 25 Second Marking On Housing

1 – REFERENCE MARK

(7) Rotate adjustment cap back (counterclockwise) with spanner wrench until hole is aligned with the second mark (Fig. 26).

(8) Install and tighten locknut to 108 N·m (80 ft. lbs.). Be sure adjustment cap does not turn while tightening the locknut.

ADJUSTMENTS (Continued)

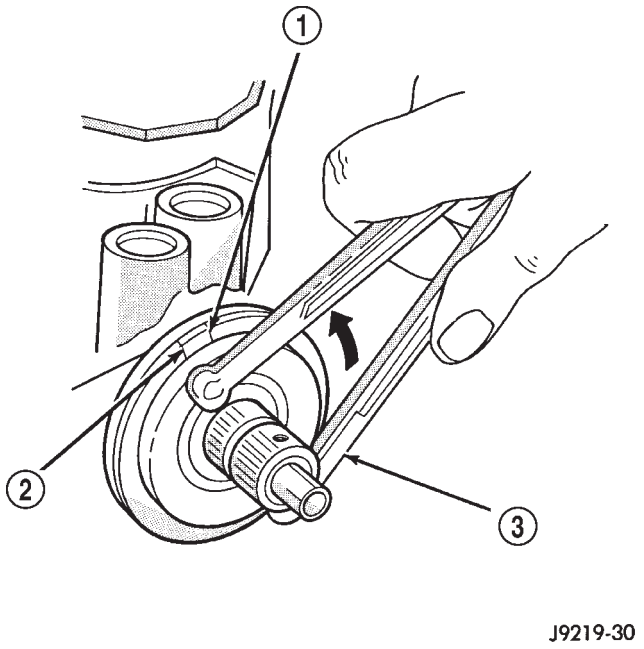


Fig. 26 Aligning To The Second Mark

1 – FIRST MARK
2 – SECOND MARK
3 – SPANNER WRENCH

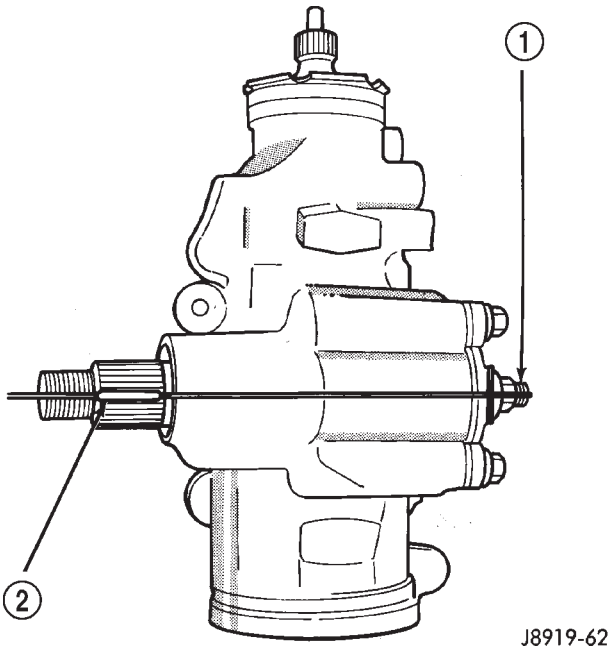


Fig. 27 Steering Gear Centered

1 – ADJUSTMENT SCREW
2 – MASTER SPLINE

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.

(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. 27).

(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. 28). This is the Over-Center Rotating Torque.

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 0.40-0.70 N·m (3-7 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.

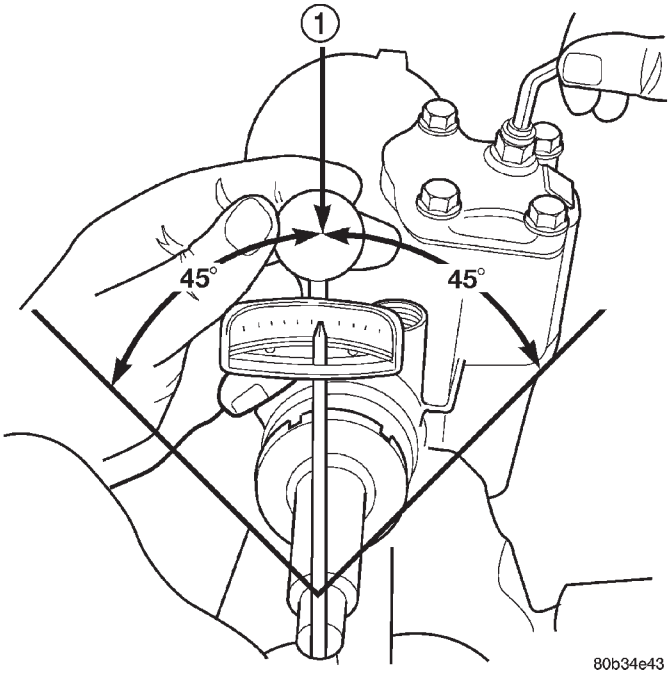


Fig. 28 Checking Over-center Rotation Torque

1 – CENTER

(7) Remeasure Over-Center Rotating Torque. If necessary turn the adjuster screw and repeat mea-

ADJUSTMENTS (Continued)

surement 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 ..... 15 to 13:1
Worm Shaft Bearing
Preload ..... 0.45–1.13 N·m (4–10 in. lbs.)
Pitman Shaft Over-Center Drag
New Gear (under 400 miles) ..... 0.45–0.90 N·m (4–8 in. lbs.) + Worm Shaft Preload
Used Gear (over 400 miles) ..... 0.5–0.6 N·m (4–5 in. lbs.) + Worm Shaft Preload

TORQUE CHART

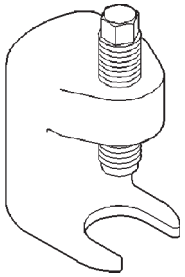
DESCRIPTION	TORQUE
Power Steering Gear	
Adjustment Cap Locknut	108 N·m (80 ft. lbs.)
Adjustment Screw Locknut	49 N·m (36 ft. lbs.)
Gear to Frame Bolts	95 N·m (70 ft. lbs.)
Pitman Shaft Nut	251 N·m (185 ft. lbs.)
Rack Piston Plug	102 N·m (75 ft. lbs.)
Side Cover Bolts	60 N·m (44 ft. lbs.)
Pressure Line	28 N·m (21 ft. lbs.)
Return Line	28 N·m (21 ft. lbs.)

SPECIAL TOOLS

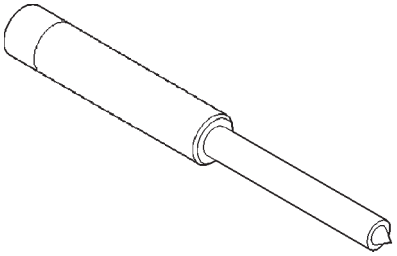
POWER STEERING GEAR



Remover/Installer, Steering Plug C-4381



Remover, Pitman Arm C-4150A



Remover/Installer Steering Rack Piston C-4175

STEERING LINKAGE

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DESCRIPTION AND OPERATION

STEERING LINKAGE

DESCRIPTION

The steering linkage consists of a pitman arm, drag link, tie rod, and steering dampener (Fig. 1). Adjustment sleeves are used on the tie rod and drag link for toe and steering wheel alignment.

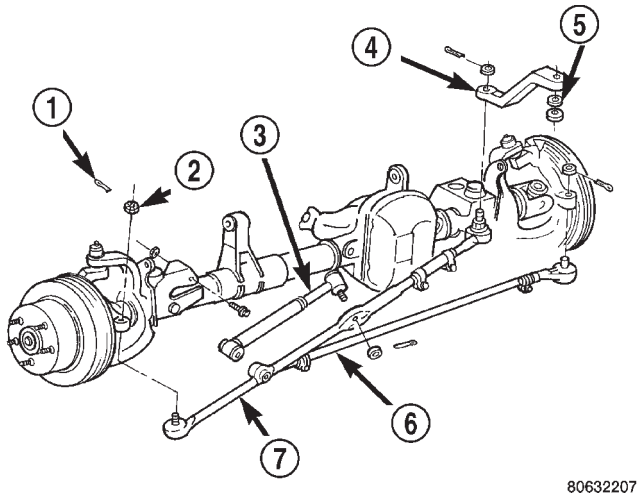


Fig. 1 Steering Linkage

1 – COTTER PIN
2 – NUT
3 – DAMPENER
4 – PITMAN ARM
5 – WASHER
6 – TIE ROD
7 – DRAG LINK

SERVICE PROCEDURES

LUBRICATION

Periodic lubrication of the steering system components is required. Refer to Group 0, Lubrication And Maintenance for the recommended maintenance schedule.

The following components must be lubricated:

- Tie rod ends
- Drag link

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.

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

REMOVAL

(1) Remove the cotter pins and nuts at the steering knuckle and drag link (Fig. 1).

(2) Remove the ball studs with puller tool.

(3) If necessary, loosen the end clamp bolts and remove the tie rod ends from the tube.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) If necessary, install the tie rod ends in the tube. Position the tie rod clamp (Fig. 2) and tighten to 27 N·m (20 ft. lbs.).

(2) Install the tie rod on the drag link and steering knuckle.

(3) Tighten the ball stud nut on the steering knuckle to 47 N·m (35 ft. lbs.). Tighten the ball stud nut to drag link to 47 N·m (35 ft. lbs.) torque. Install new cotter pins.

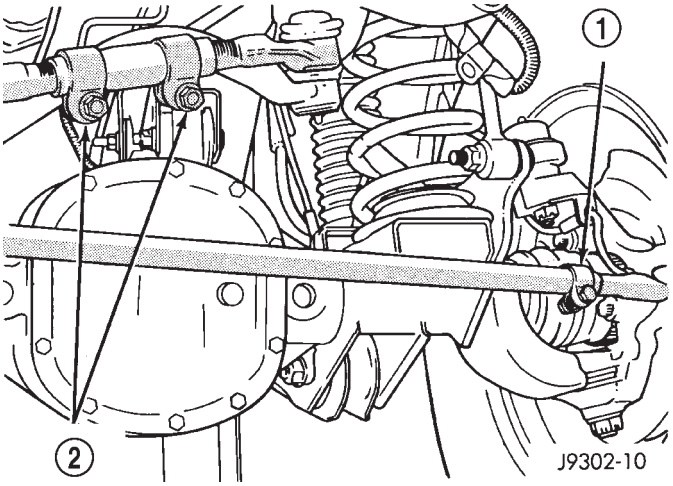


Fig. 2 Tie Rod/Drag Link Clamp Bolt

1 – TIE ROD CLAMP
2 – DRAG LINK CLAMPS

PITMAN ARM

REMOVAL

(1) Remove the cotter pin and nut from the drag link at the pitman arm.

(2) Remove the drag link ball stud from the pitman arm with a puller.

(3) Remove the nut and washer from the steering gear shaft. Mark the pitman shaft and pitman arm for installation reference. Remove the pitman arm from steering gear with Puller C-4150A (Fig. 3).

INSTALLATION

(1) Align and install the pitman arm on steering gear shaft.

(2) Install the washer and nut on the shaft and tighten the nut to 251 N·m (185 ft. lbs.).

(3) Install drag link ball stud to pitman arm. Install nut and tighten to 81 N·m (60 ft. lbs.). Install a new cotter pin.

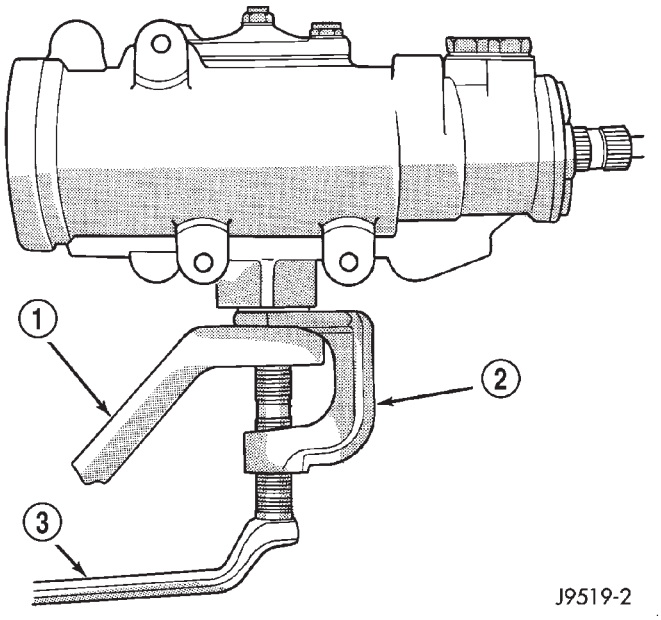


Fig. 3 Pitman Arm Removal

1 – PITMAN ARM
2 – SPECIAL TOOL C-4150–A
3 – WRENCH

DRAG LINK

REMOVAL

(1) Remove the cotter pins and nuts at the steering knuckle and drag link (Fig. 1).

(2) Remove the steering dampener ball stud from the drag link with a puller tool.

(3) Remove the drag link from the steering knuckle with a puller tool. Remove the same for tie rod and pitman arm.

(4) If necessary, loosen the end clamp bolts and remove the tie rod end from the link.

INSTALLATION

(1) Install the drag link adjustment sleeve and tie rod end. Position clamp bolts (Fig. 2).

(2) Position the drag link at the steering linkage. Install the drag link to the steering knuckle nut. Do the same for the tie rod and pitman arm.

(3) Tighten the nut at the steering knuckle to 47 N·m (35 ft. lbs.). Tighten the pitman nut to 81 N·m (60 ft. lbs.) and tie rod ball stud nut to 47 N·m (35 ft. lbs.). Install new cotter pins and bend end 60°.

(4) Install the steering dampener onto the drag link and tighten the nut to 74 N·m (55 ft. lbs.). Install a new cotter pin and bend end 60°.

REMOVAL AND INSTALLATION (Continued)

STEERING DAMPENER

REMOVAL

(1) Place the front wheels in a straight ahead position.

(2) Remove the steering dampener retaining nut and bolt from the axle bracket (Fig. 1).

(3) Remove the cotter pin and nut from the ball stud at the drag link.

(4) Remove the steering dampener ball stud from the drag link using C-3894-A puller.

INSTALLATION

(1) Install the steering dampener to the axle bracket and drag link.

(2) Install the steering dampener bolt in the axle bracket and tighten nut to 74 N·m (55 ft. lbs.).

(3) Install the ball stud nut at the drag link and tighten nut to 74 N·m (55 ft. lbs.). Install a new cotter pin.

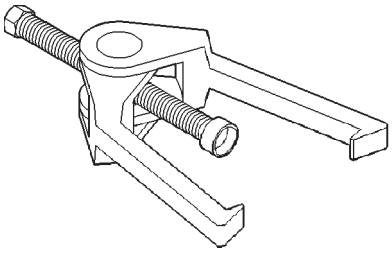
SPECIFICATIONS

TORQUE CHART

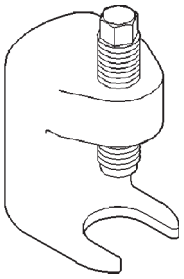
DESCRIPTION	TORQUE
Pitman Arm	
Shaft	251 N·m (185 ft. lbs.)
Drag Link	
Ball Studs	74 N·m (55 ft. lbs.)
Clamp	49 N·m (36 ft. lbs.)
Tie Rod Ends	
Ball Studs	74 N·m (55 ft. lbs.)
Clamp	27 N·m (20 ft. lbs.)
Tie Rod	
Ball Stud	88 N·m (65 ft. lbs.)
Steering Damper	
Frame	74 N·m (55 ft. lbs.)
Drag Link	74 N·m (55 ft. lbs.)

SPECIAL TOOLS

STEERING LINKAGE



Puller C-3894–A



Remover Pitman C-4150A

STEERING COLUMN

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DESCRIPTION AND OPERATION

STEERING COLUMN

DESCRIPTION

The standard non-tilt and tilt steering column has been designed to be serviced as an assembly. The column is connected to the steering gear with an upper and lower shaft. The lower shaft has a support bearing mounted to a bracket. The bracket mounts to the frame rail with two bolts. These shafts and bearing are serviceable. 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.

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.

CAUTION: Keep clock spring from turning during removal and installation. Failure to do so may damage the clock spring.

REMOVAL

(1) Position front wheels **straight ahead.**

(2) Remove and isolate the negative ground cable from the battery.

(3) Remove the airbag, refer to Group 8M Restraint Systems for service procedures.

NOTE: If equipped with cruise control, disconnect clock spring harness from the 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 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 the shroud.

REMOVAL AND INSTALLATION (Continued)

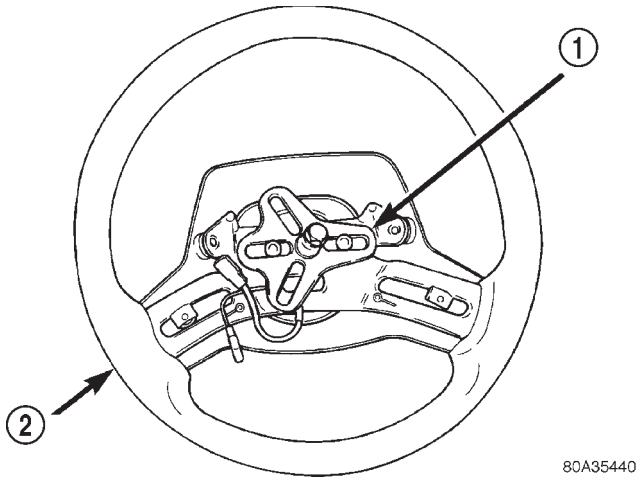


Fig. 1 Steering Wheel

1 – PULLER
2 – STEERING WHEEL

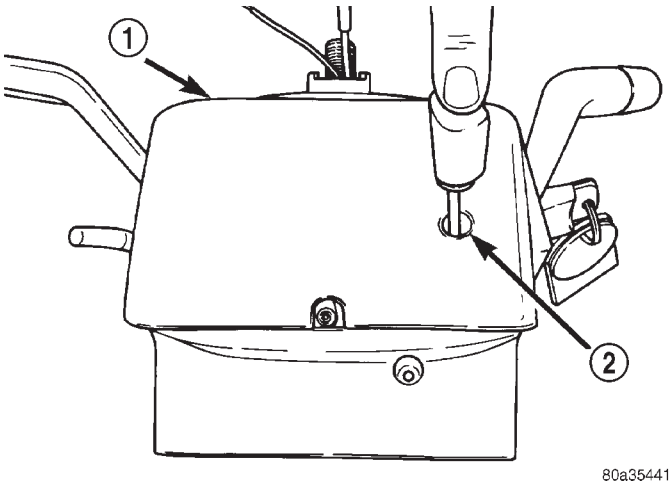


Fig. 2 Key Cylinder Release Access Hole

1 – LOWER SHROUD
2 – RELEASE ACCESS HOLE

(8) Remove the steering coupler bolt and column mounting nuts (Fig. 4) then lower column off the mounting studs.

(9) Remove upper column shroud (Fig. 3).

(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 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

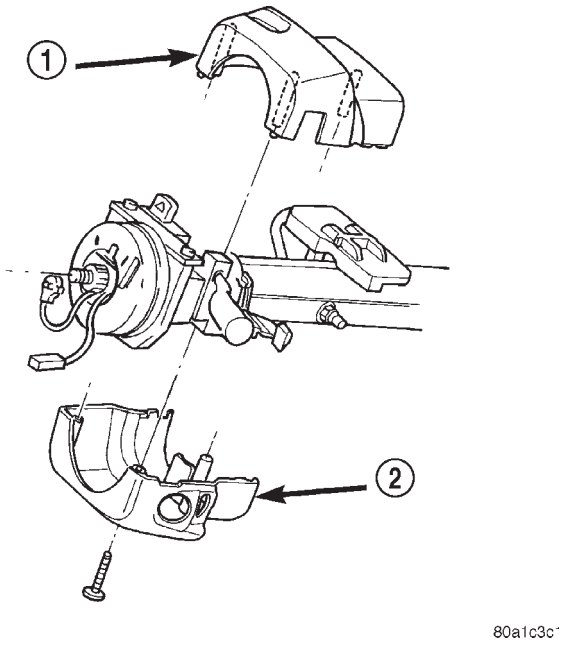


Fig. 3 Column Shrouds

1 – UPPER SHROUD
2 – LOWER SHROUD

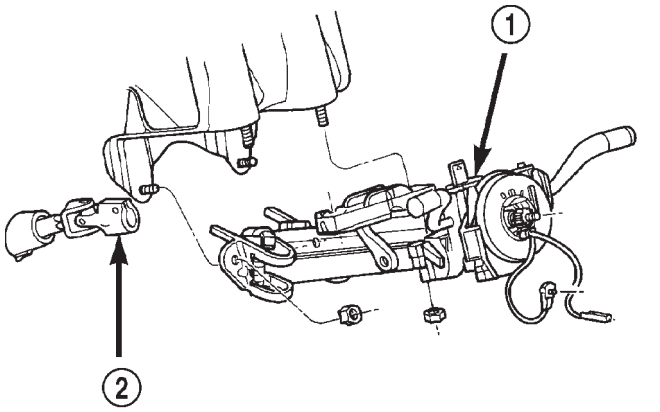


Fig. 4 Steering Column Mounting

1 – STEERING COLUMN
2 – COUPLER

the bracket from the column and **note the mounting location and orientation of the bracket.**

(13) Remove clock spring (Fig. 7), 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.

REMOVAL AND INSTALLATION (Continued)

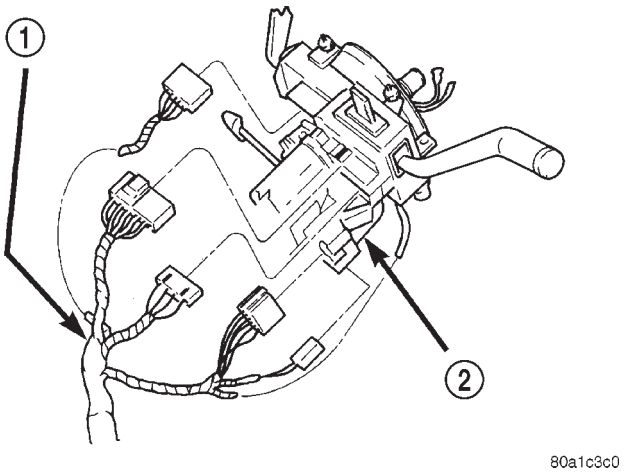


Fig. 5 Steering Column Harness

1 – COLUMN HARNESS
2 – STEERING COLUMN

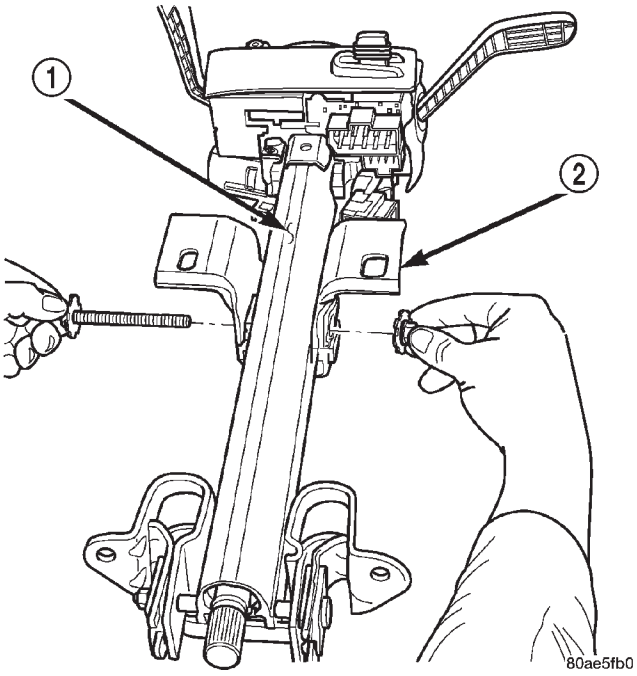


Fig. 6 Non-Tilt Column

1 – NON-TILT COLUMN
2 – UPPER BRACKET

(3) Align and install column into the steering coupler.

(4) Install column harness and connect harness to switches.

NOTE: If vehicle is equipped with automatic transmission, install shifter interlock cable. Refer to Group 21 Transmission and Transfer Case for installation and adjustment.

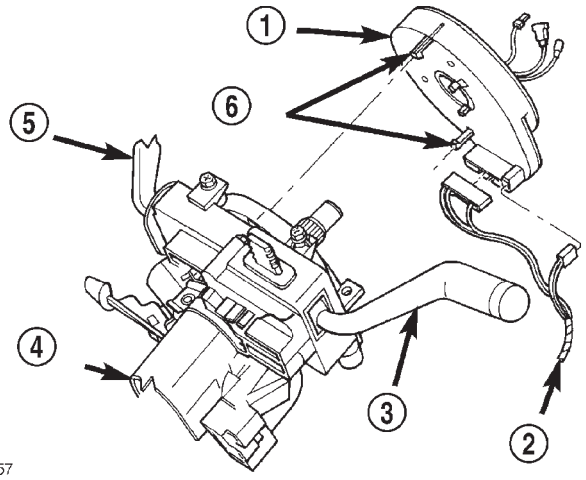


Fig. 7 Clock Spring

1 – CLOCKSPRING
2 – WIRE HARNESS
3 – TURN SIGNAL SWITCH LEVER
4 – STEERING COLUMN
5 – WIPER SWITCH LEVER
6 – LOCATING FINGERS

(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 (if necessary) and install it on the column, refer to Group 8 Electrical for service procedures.

(10) Install lower column shrouds 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.)

TRANSMISSION AND TRANSFER CASE

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AX5 MANUAL TRANSMISSION

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DESCRIPTION AND OPERATION

AX5 MANUAL TRANSMISSION

DESCRIPTION

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).

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

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.

OPERATION

The manual transmission receives power through the clutch assembly from the engine. The clutch disc is splined to the transmission input shaft and is turned at engine speed at all times that the clutch is engaged. The input shaft is connected to the transmission countershaft through the mesh of fourth speed gear on the input shaft and the fourth counter-

DESCRIPTION AND OPERATION (Continued)

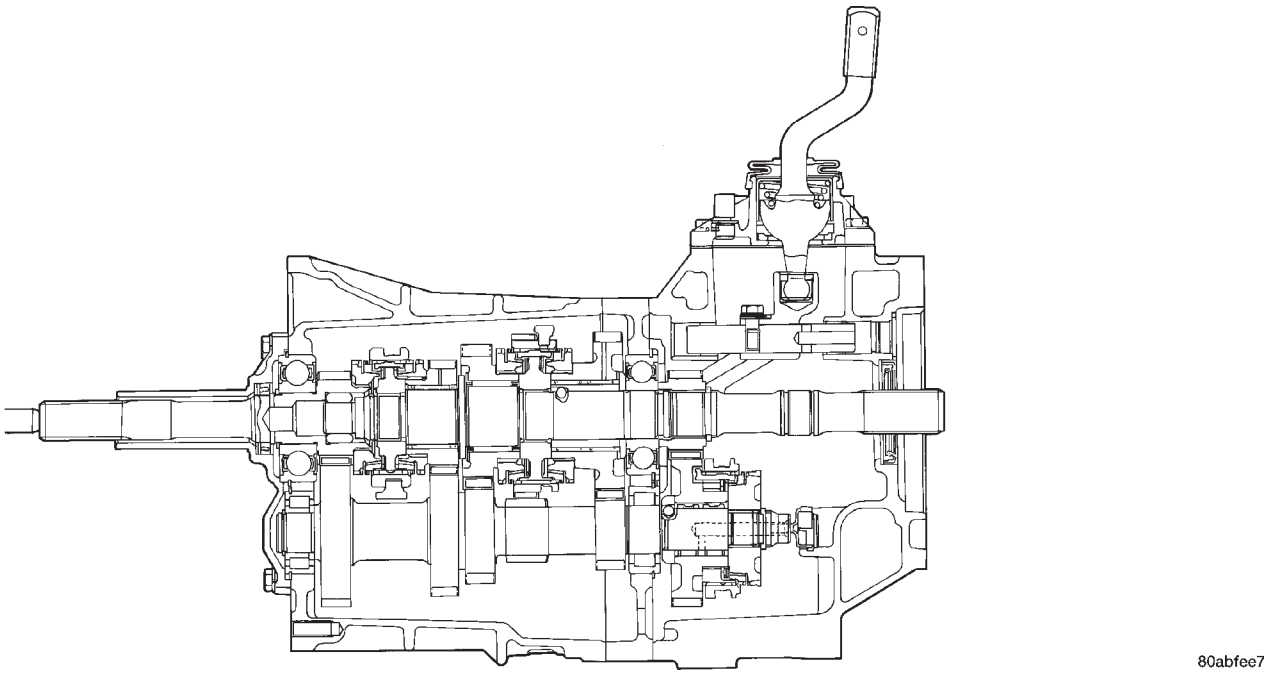


Fig. 1 AX5 Manual Transmission

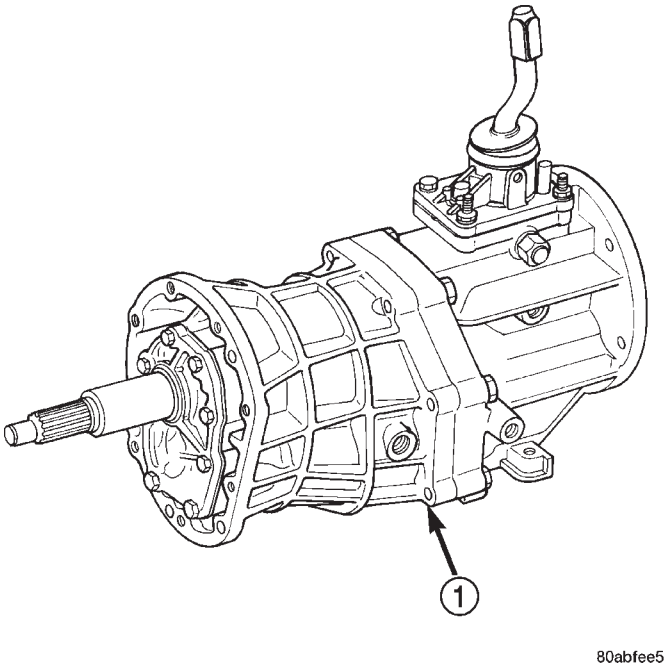


Fig. 2 Transmission Identification

1 – I. D. CODE ON CASE NEAR DRAIN PLUG

shaft gear. At this point, all the transmission gears are spinning.

The driver selects a particular gear by moving the shift lever to the desired gear position. This movement moves the internal transmission shift components to begin the shift sequence. As the shift lever moves the selected shift rail, the shift fork attached to that rail begins to move. The fork is positioned in a groove in the outer circumference of the synchronizer sleeve. As the shift fork moves the synchronizer sleeve, the synchronizer begins to speed-up or slow down the selected gear (depending on whether we are up-shifting or down-shifting). The synchronizer does this by having the synchronizer hub splined to the mainshaft, or the countershaft in some cases, and moving the blocker ring into contact with the gear's friction cone. As the blocker ring and friction cone come together, the gear speed is brought up or down to the speed of the synchronizer. As the two speeds match, the splines on the inside of the synchronizer sleeve become aligned with the teeth on the blocker ring and the friction cone and eventually will slide over the teeth, locking the gear to the mainshaft, or countershaft, through the synchronizer.

LUBRICANT

DESCRIPTION

Recommended lubricant for AX5 transmissions is Mopar® 75W–90, API Grade GL–3 gear lubricant, or equivalent.

Correct lubricant level is from the bottom edge, to no more than 6 mm (1/4 in.) below the bottom edge of the fill plug hole.

The fill plug is on the passenger side of the adapter housing (Fig. 3). The drain plug is on the bottom of the case.

Approximate dry fill lubricant capacity is:

- 3.3 liters (3.49 quarts) for 4–wheel drive applications.

DESCRIPTION AND OPERATION (Continued)

• 3.5 liters (3.70 quarts) for 2–wheel drive applications.

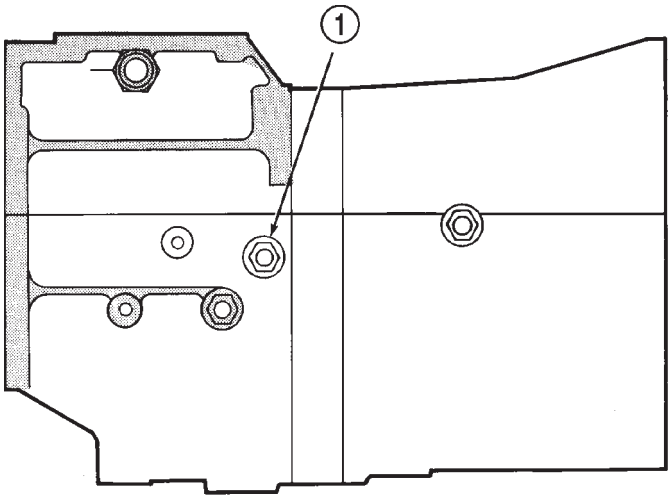


Fig. 3 Fill Plug Location

1 – 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.

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.

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) Support engine with adjustable jack stand. Position wood block between jack and oil pan to avoid damaging pan.

(4) Remove crossmember/skid plate.

(5) Disconnect necessary exhaust system components.

(6) Remove slave cylinder (Fig. 4) from clutch housing.

(7) Mark rear propeller shaft and rear axle yokes for installation alignment (Fig. 5).

(8) Mark front propeller shaft, axle, and transfer case yokes for installation alignment.

(9) Remove propeller shaft(s).

(10) Unclip wire harnesses from transmission and transfer case.

REMOVAL AND INSTALLATION (Continued)

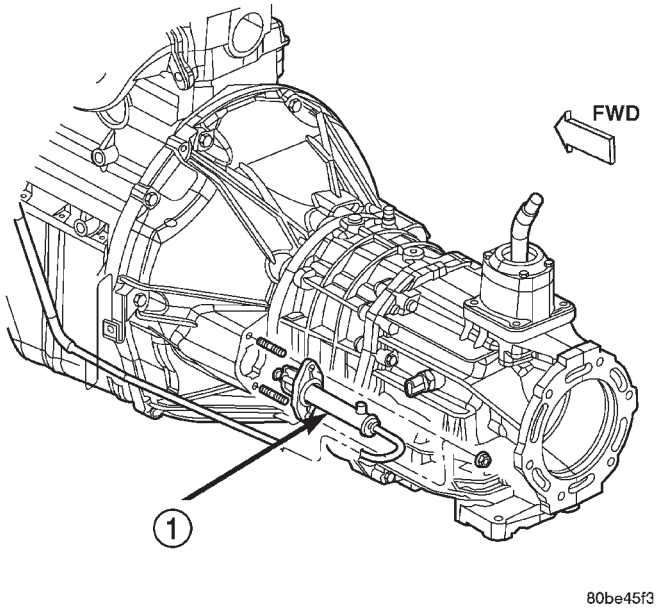


Fig. 4 Slave Cylinder—Typical

1 – CLUTCH SLAVE CYLINDER

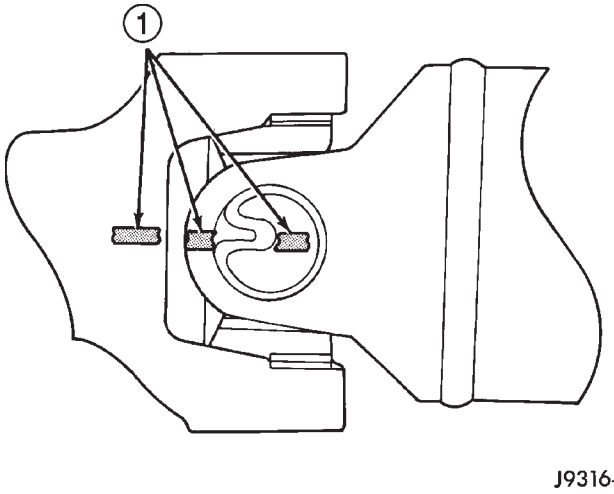


Fig. 5 Marking Propeller Shaft And Axle Yokes

1 – REFERENCE MARKS

(11) Disconnect transfer case vent hose.

(12) Disengage any wire connectors attached to transmission or transfer case components.

(13) Support transfer case with transmission jack.

(14) Secure transfer case to jack with safety chains.

(15) Disconnect transfer case shift linkage at transfer case.

(16) Remove nuts attaching transfer case to transmission.

(17) Remove transfer case.

(18) Remove crankshaft position sensor (Fig. 6).

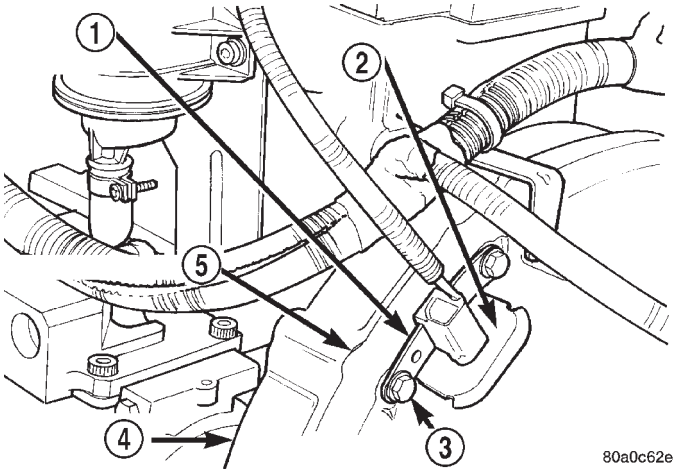


Fig. 6 Crankshaft Position Sensor —2.5 and 4.0L Engine

1 – ENGINE SPEED SENSOR
2 – GROMMET
3 – MOUNTING BOLT(S)
4 – LEFT REAR OF ENGINE
5 – TRANSMISSION

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.

(19) Support transmission with transmission jack.

(20) Secure transmission to jack with safety chains.

(21) Disconnect rear cushion and bracket from transmission.

(22) Disconnect transmission shift lever as follows:

(a) Lower transmission 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. 7). 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. 7). Do not remove the shift lever from the floor console shifter boots. Leave the lever in place for transmission installation.

(23) Remove clutch housing brace rod.

(24) Remove clutch housing-to-engine bolts.

(25) Pull transmission jack rearward until input shaft clears clutch. Then slide transmission out from under vehicle.

(26) Remove clutch release bearing, release fork, and retainer clip.

REMOVAL AND INSTALLATION (Continued)

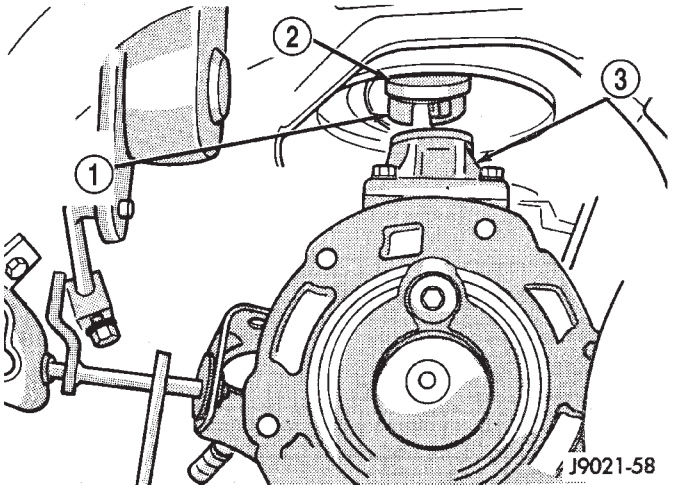


Fig. 7 Removing/Installing Shift Lever

1 – SHIFT LEVER RETAINER
2 – DUST BOOT
3 – SHIFT TOWER

(27) Remove clutch housing from transmission (Fig. 8).

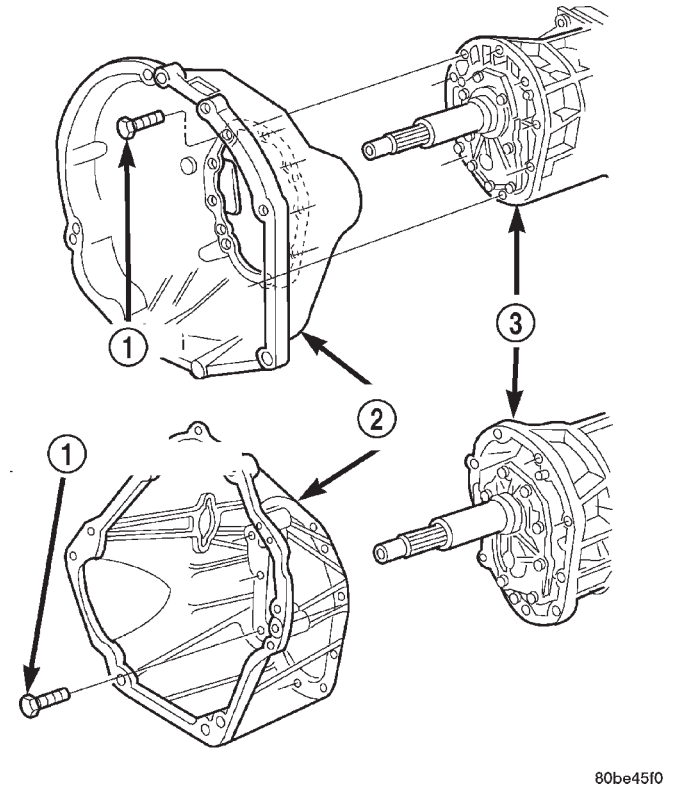


Fig. 8 Clutch Housing

1 – HOUSING-TO-TRANSMISSION BOLTS (46 N·m/34 ft. lbs.)
2 – CLUTCH HOUSING
3 – TRANSMISSION

INSTALLATION

(1) Install clutch housing on transmission. Tighten housing bolts to 46 N·m (34 ft. lbs.) torque (Fig. 8).

(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 the appropriate torque: **Be sure the housing is properly seated on engine block before tightening bolts.**

- Tighten 3/8” diameter bolts to 37 N·m (27 ft.lbs.).
- Tighten 7/16” diameter bolts to 58 N·m (43 ft.lbs.).
- Tighten M12 bolts to 75 N·m (55 ft.lbs.).

(8) Install clutch housing brace rod.

(9) Lower transmission approximately 7–8 cm (3 in.) for access to shift tower. Be sure transmission is in first or third gear.

(10) Reach up and around transmission and insert shift lever in shift tower. Press lever retainer downward and turn it clockwise to lock it in place. Then install lever dust boot on shift tower.

(11) Install fasteners to hold rear cushion and bracket to transmission. Then tighten transmission-to-rear support bolts/nuts to 54 N·m (40 ft. lbs.) torque.

(12) Install rear crossmember. Tighten crossmember-to-frame bolts to 41 N·m (31 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.

(16) Secure transfer case to jack with safety chains.

(17) Raise transfer case and align transfer case input shaft to the transmission output shaft.

(18) Slide transfer case forward until case is seated on transmission.

(19) Install nuts to attach transfer case to transmission. Tighten transfer case-to-transmission nuts to 35 N·m (26 ft. lbs.) torque.

(20) Connect transfer case shift linkage at transfer case.

(21) Connect transfer case vent hose.

(22) Secure wire harnesses in clips/tie straps on transmission and transfer case.

REMOVAL AND INSTALLATION (Continued)

(23) Engage wire connectors attached to all necessary transmission or transfer case components.

(24) Install rear propeller shaft slip yoke to transmission or transfer case output shaft.

(25) Align marks on rear propeller shaft and rear axle yokes (Fig. 9).

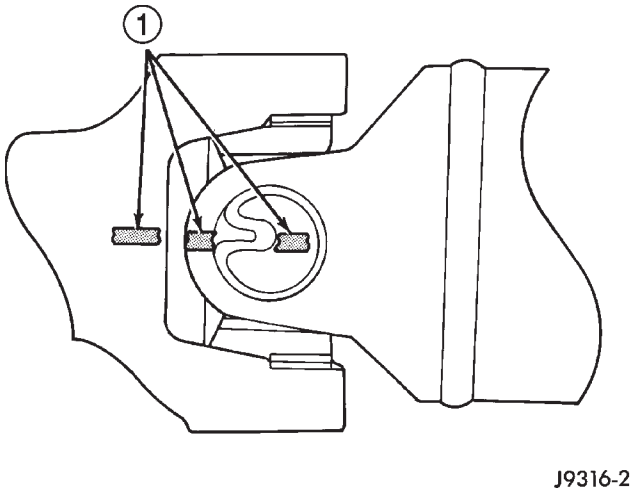


Fig. 9 Align Propeller Shaft And Rear Axle Yokes Alignment Marks

1 – REFERENCE 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.

(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 section 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. 10).

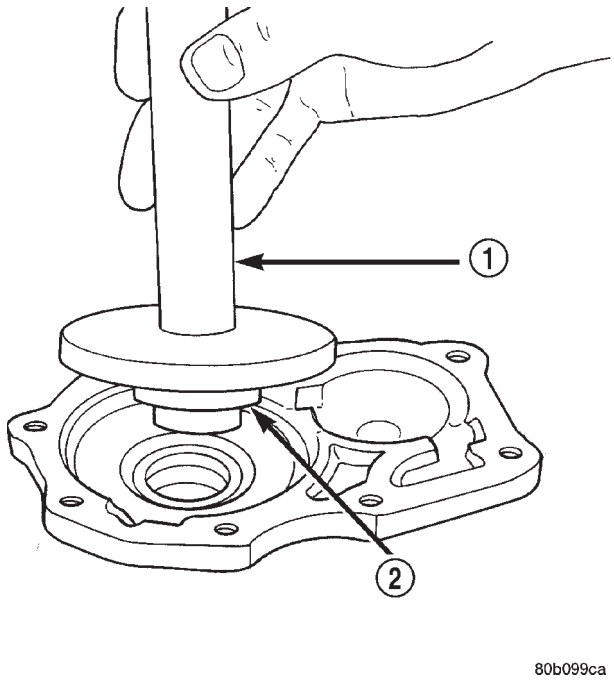


Fig. 10 Install Front Bearing Retainer Seal

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL 8211 (AX5) OR 8209 (AX15)

(2) Remove any residual gasket material from the sealing surfaces of the bearing retainer and the transmission case.

(3) Install new front bearing retainer gasket to the front bearing retainer.

(4) Install the front bearing retainer onto the transmission case.

(5) Install the bolts to hold the bearing retainer onto the transmission case.

(6) Tighten the bolts to 17 N·m (12 ft. lbs.).

(7) Install release bearing and lever onto the transmission.

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. 11).

INSTALLATION

(1) Clean seal bore of adapter housing of any residual sealer material from original seal.

REMOVAL AND INSTALLATION (Continued)

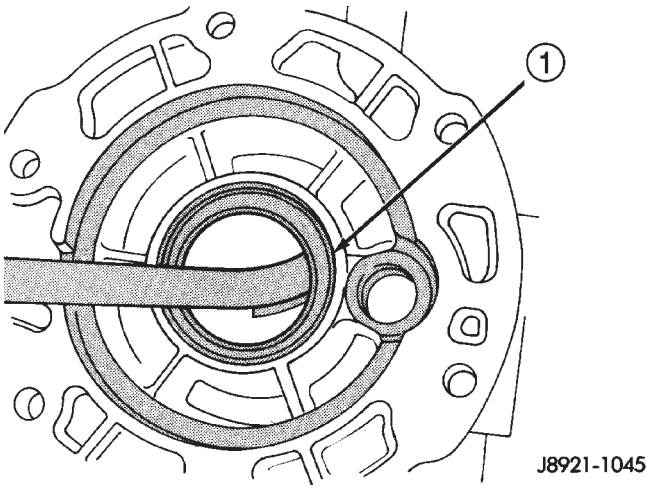


Fig. 11 Remove Adapter Housing Seal

1 – ADAPTER HOUSING OIL 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. 12).

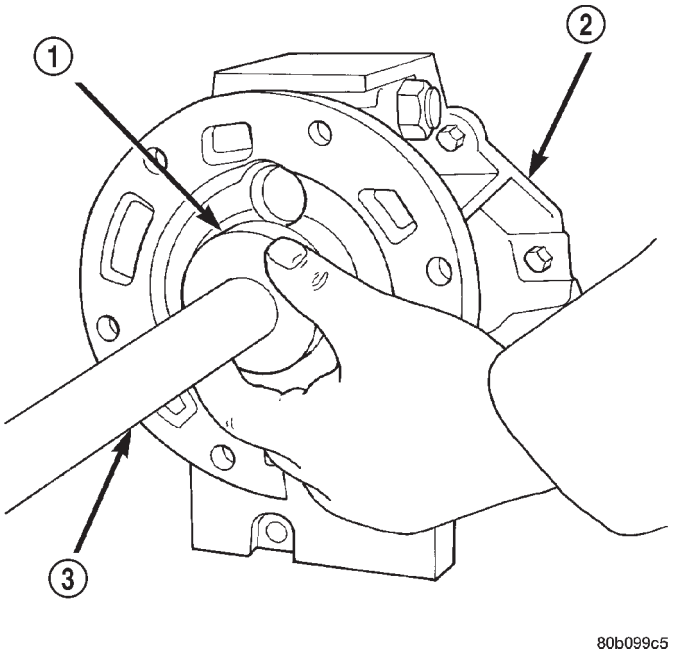


Fig. 12 Install Adapter Housing Seal

1 – SPECIAL TOOL 8208
2 – ADAPTER HOUSING
3 – SPECIAL TOOL C-4171

(3) Install transfer case.

(4) Check and add fluid to transmission as necessary. Refer to the Recommended Lubricant section for proper fluid requirements.

(5) Lower vehicle.

DISASSEMBLY AND ASSEMBLY

ADAPTER/EXTENSION HOUSING AND FRONT BEARING RETAINER

DISASSEMBLY

(1) Drain transmission lubricant, if necessary.

(2) Remove release bearing and lever.

(3) Remove clutch housing bolts and remove housing (Fig. 15).

(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. 13).

(7) Remove shift tower gasket from shift tower or transmission case (Fig. 14).

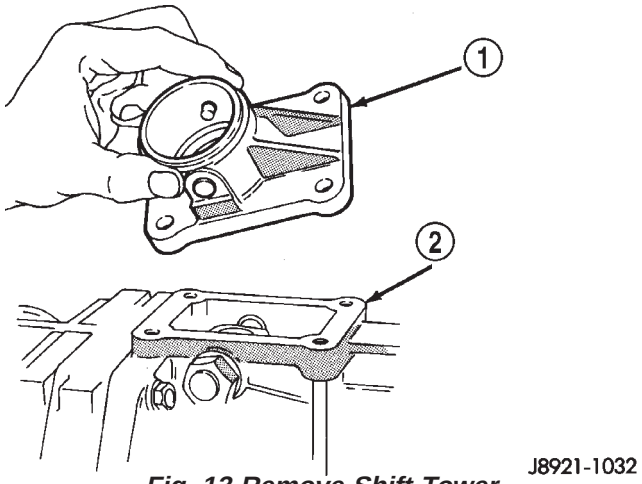


Fig. 13 Remove Shift Tower

1 – SHIFT TOWER
2 – ADAPTER/EXTENSION HOUSING

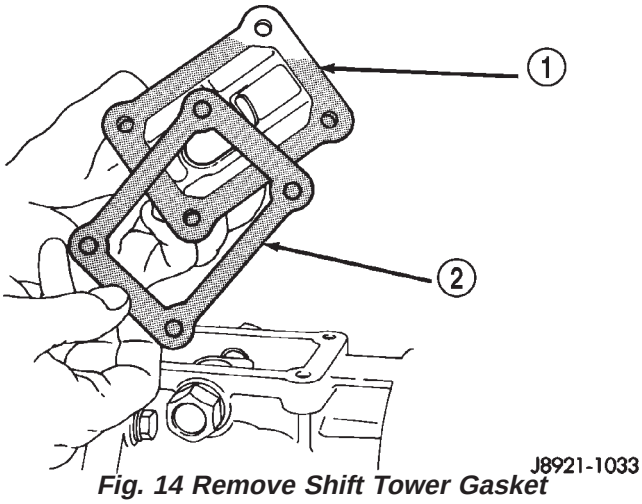


Fig. 14 Remove Shift Tower Gasket

1 – SHIFT TOWER
2 – GASKET

DISASSEMBLY AND ASSEMBLY (Continued)

(8) Remove detent ball plug (Fig. 16).
(9) Remove detent spring and ball with pencil magnet (Fig. 17), (Fig. 18).

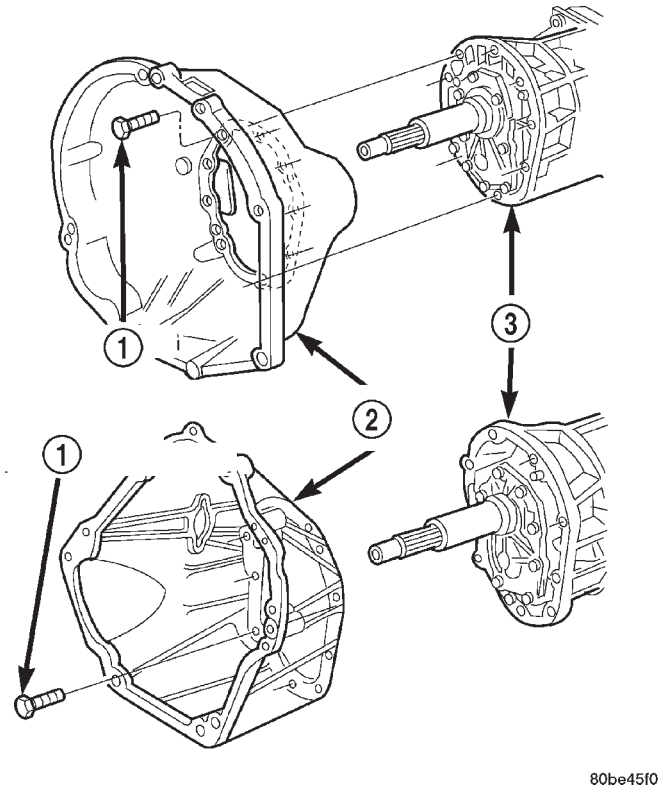


Fig. 15 Clutch Housing

1 – HOUSING-TO-TRANSMISSION BOLTS (46 N·m/34 ft. lbs.)
2 – CLUTCH HOUSING
3 – TRANSMISSION

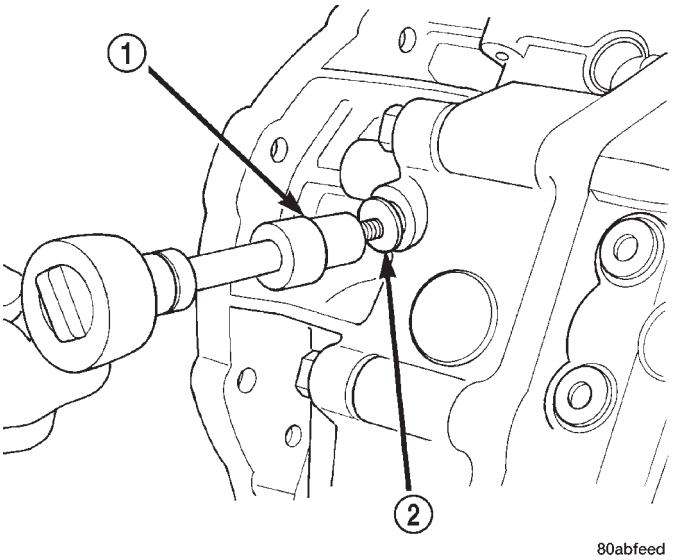


Fig. 16 Remove Detent Ball Plug

1 – TORX BIT
2 – DETENT BALL PLUG

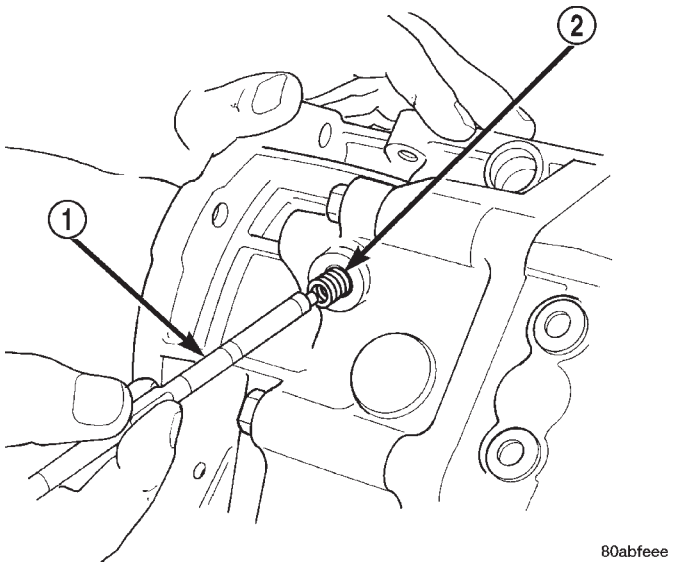


Fig. 17 Remove Detent Spring

1 – PENCIL MAGNET
2 – DETENT BALL SPRING

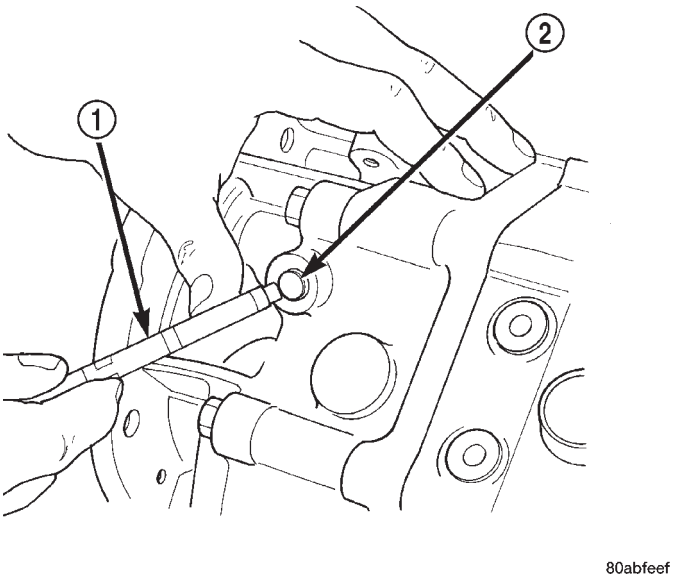


Fig. 18 Remove Detent Ball

1 – PENCIL MAGNET
2 – SHIFT DETENT BALL

(10) Remove shift arm retainer bolt (Fig. 19).
(11) Remove shift arm restrictor pins (Fig. 20).

NOTE: The restrictor pins are not interchangeable and are color coded. Note which color restrictor pin is removed from each side of the transmission and be sure to install it into the same location.

(12) Remove shift lever shaft plug (Fig. 21).
(13) Remove shifter shaft with large magnet (Fig. 22).

DISASSEMBLY AND ASSEMBLY (Continued)

(14) Remove the shift arm from the adapter housing.

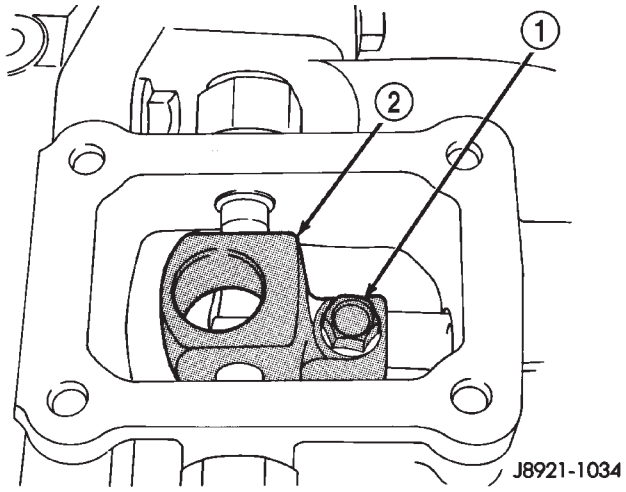


Fig. 19 Shift Arm Retainer Bolt Removal

1 – RETAINER BOLT
2 – SHIFT ARM

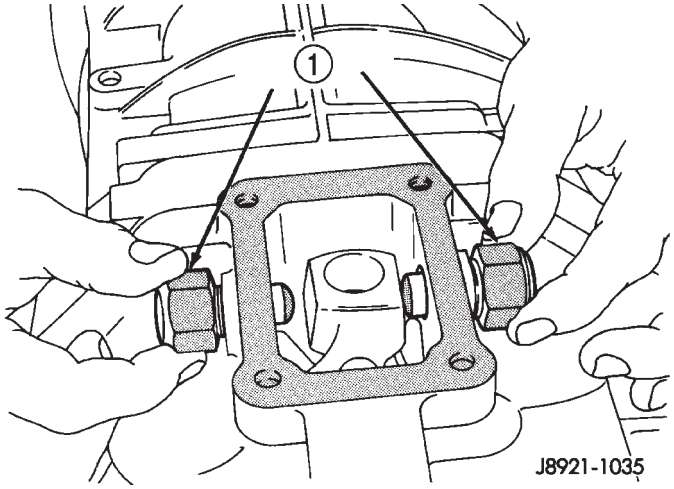


Fig. 20 Shift Arm Restrictor Pins

1 – RESTRICTOR PINS

(15) Remove adapter/extension housing bolts.

(16) Loosen adapter/extension housing by tapping it loose with plastic mallet (Fig. 23).

(17) Remove adapter/extension housing (Fig. 24).

(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. 25).

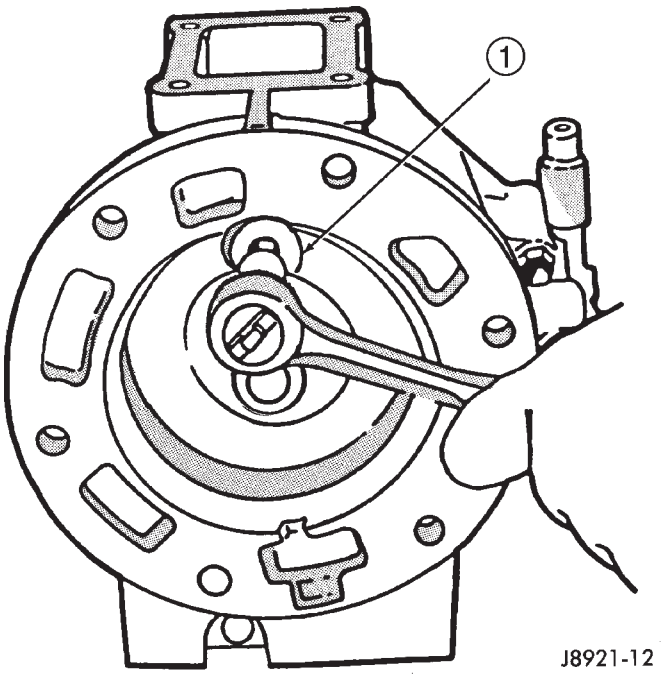


Fig. 21 Removing Shift Lever Shaft Plug

1 – SHIFT LEVER SHAFT PLUG

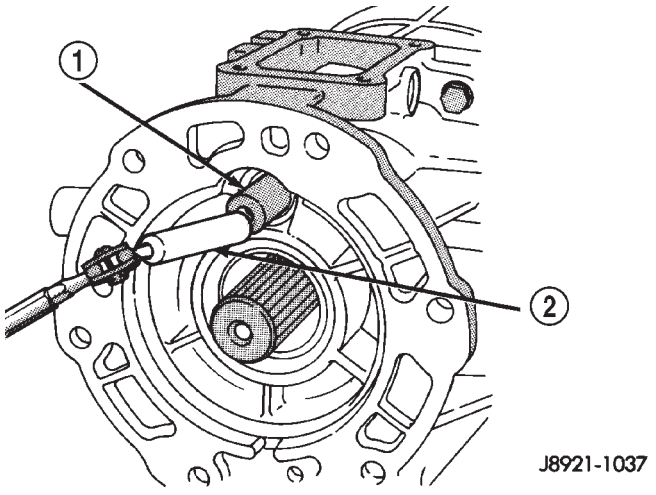


Fig. 22 Remove Shifter Shaft

1 – SHIFT ARM SHAFT
2 – LARGE MAGNET

(19) Remove the bolts holding the front bearing retainer to the transmission case.

(20) Remove the bearing retainer from transmission case (Fig. 26).

(21) Remove input shaft bearing snap-ring (Fig. 27).

(22) Remove countershaft front bearing snap-ring.

DISASSEMBLY AND ASSEMBLY (Continued)

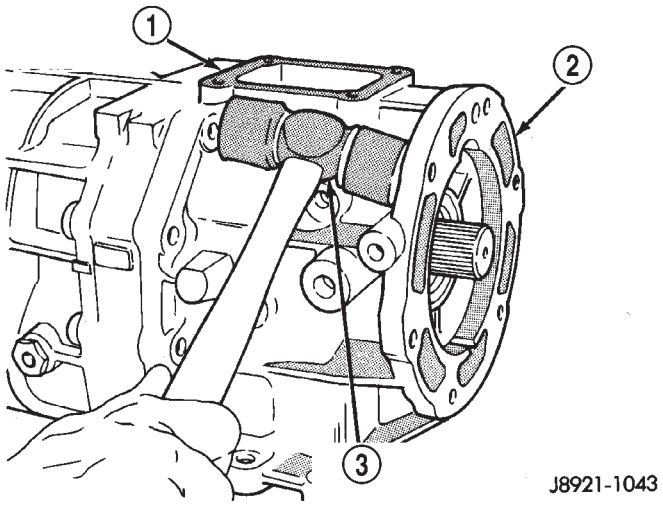


Fig. 23 Loosen Adapter/Extension Housing

1 – INTERMEDIATE PLATE
2 – ADAPTER HOUSING
3 – RUBBER FACED MALLET

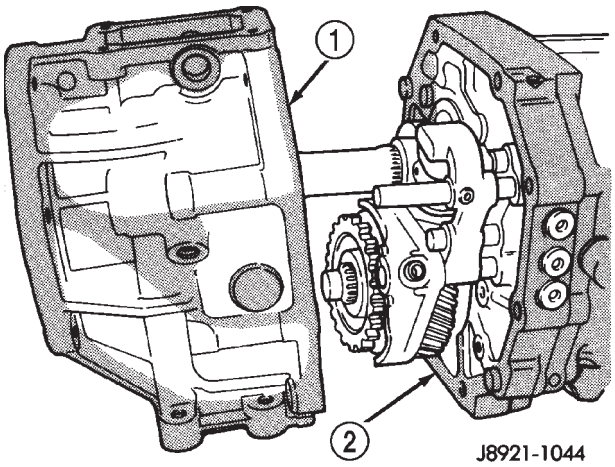


Fig. 24 Remove Adapter/Extension Housing–Typical

1 – ADAPTER HOUSING
2 – INTERMEDIATE PLATE

(23) Separate intermediate plate and transmission case by tapping them loose with plastic mallet (Fig. 28).

(24) Separate the intermediate plate from the transmission case (Fig. 29).

ASSEMBLY

(1) Remove any residual sealer from transmission case, intermediate plate, and adapter/extension housing.

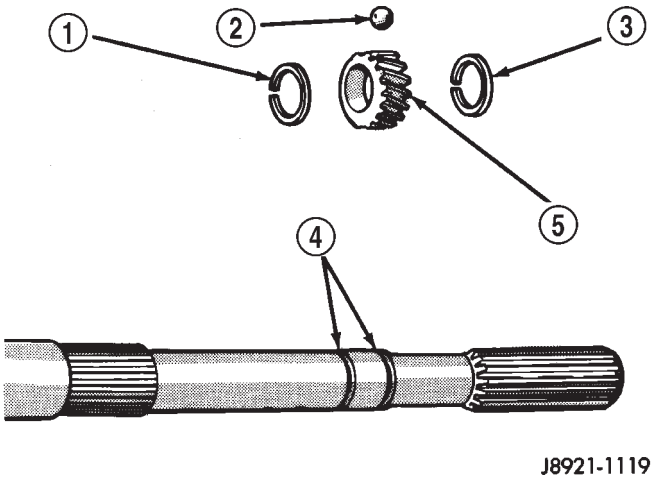


Fig. 25 Speedometer Drive Gear Assembly

1 – SNAP RING
2 – LOCK BALL
3 – SNAP RING
4 – OUTPUT SHAFT GROOVES
5 – SPEEDOMETER GEAR

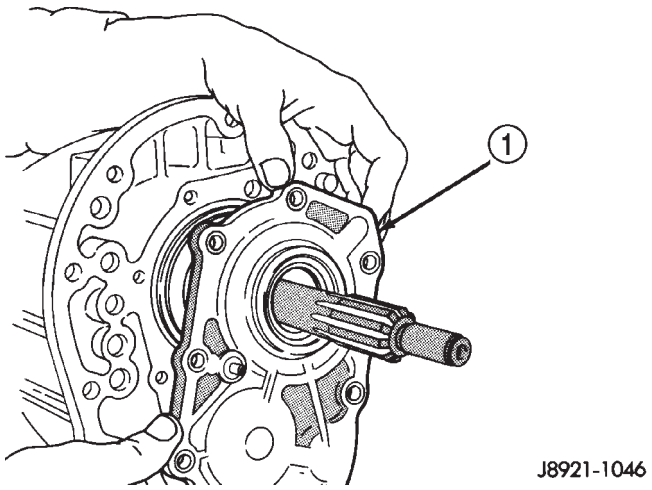


Fig. 26 Remove Front Bearing Retainer

1 – 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. 30).

(3) Align geartrain and shift rails with mating holes in transmission case and install transmission case to the intermediate plate (Fig. 31). Verify that the transmission case is seated on the intermediate plate locating pins.

DISASSEMBLY AND ASSEMBLY (Continued)

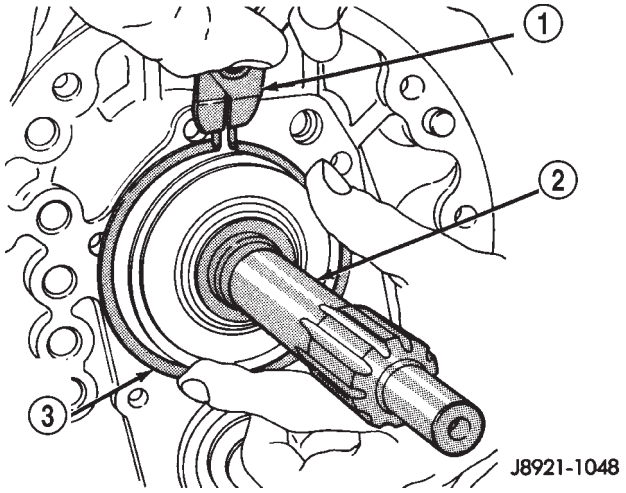


Fig. 27 Remove Input Shaft Bearing Snap-ring

1 – SNAP RING PLIERS
2 – INPUT SHAFT
3 – INPUT SHAFT BEARING SNAP RING

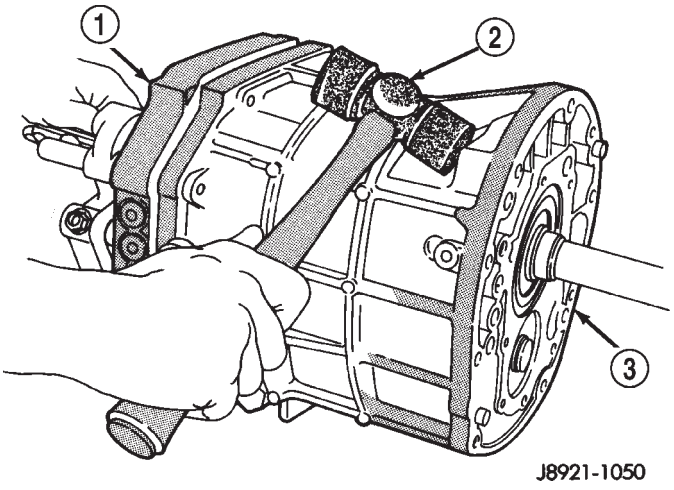


Fig. 28 Separate Intermediate Plate and Transmission Case

1 – INTERMEDIATE PLATE
2 – RUBBER MALLET
3 – GEAR CASE

(4) Install new front bearing snap rings (Fig. 32).

(5) Install front bearing retainer gasket to front bearing retainer.

(6) Install the front bearing retainer (Fig. 33) and tighten bolts to 17 N·m (12 ft. lbs.).

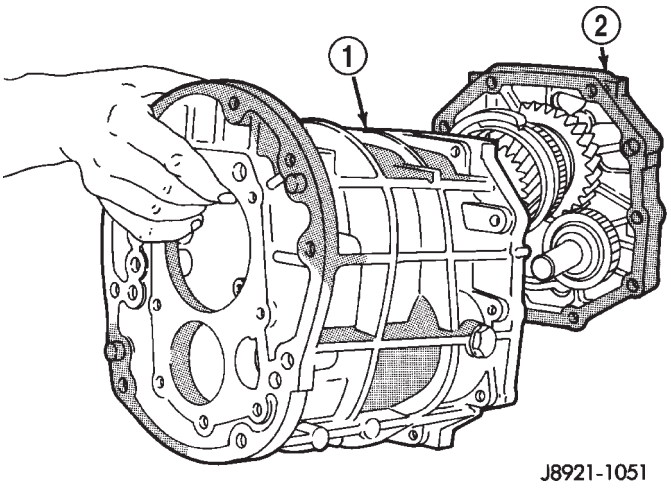


Fig. 29 Remove Intermediate Plate from Transmission Case

1 – GEAR CASE
2 – INTERMEDIATE PLATE

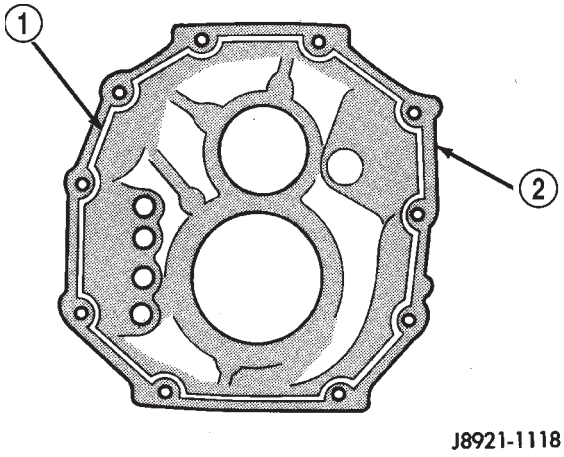


Fig. 30 Apply Sealer to Transmission Gear Case

1 – SEALER BEAD (1/8" - 3/16" WIDE)
2 – GEAR CASE

(7) On 4x2 transmissions;

(a) Install speedometer drive gear locating snap-ring (Fig. 34).

(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)

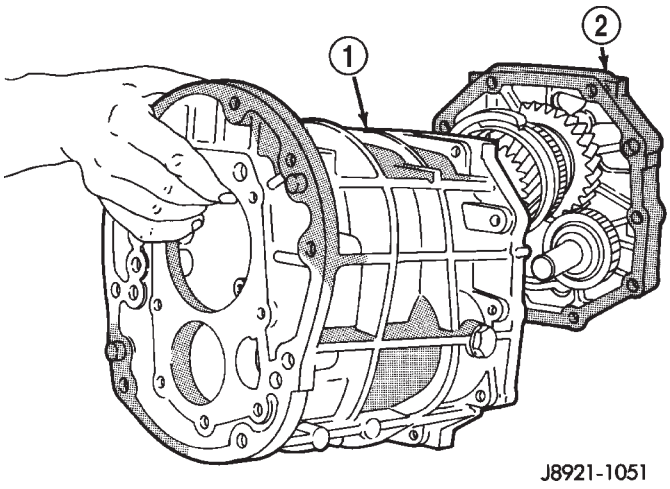


Fig. 31 Install Transmission Gear Case to the Intermediate Plate

1 – GEAR CASE
2 – INTERMEDIATE PLATE

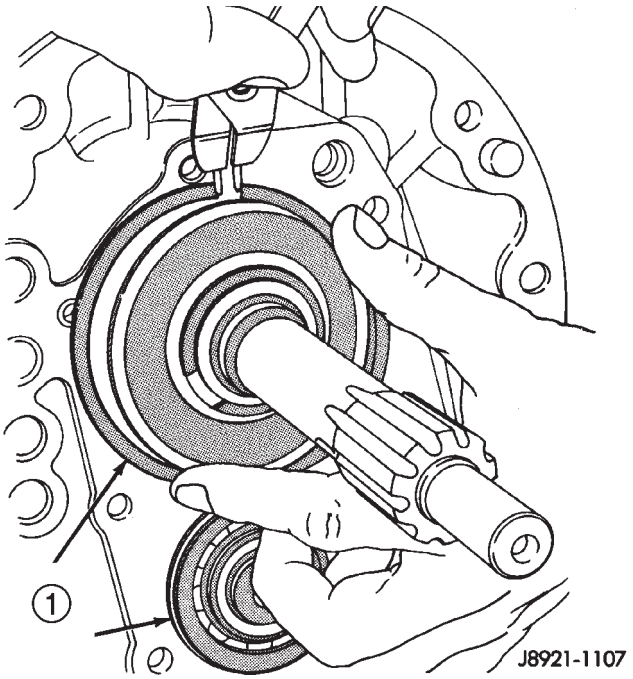


Fig. 32 Install Front Bearing Snap-rings

1 – FRONT BEARING SNAP RINGS

(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. 35). Tighten housing bolts to 34 N·m (25 ft. lbs.) torque.

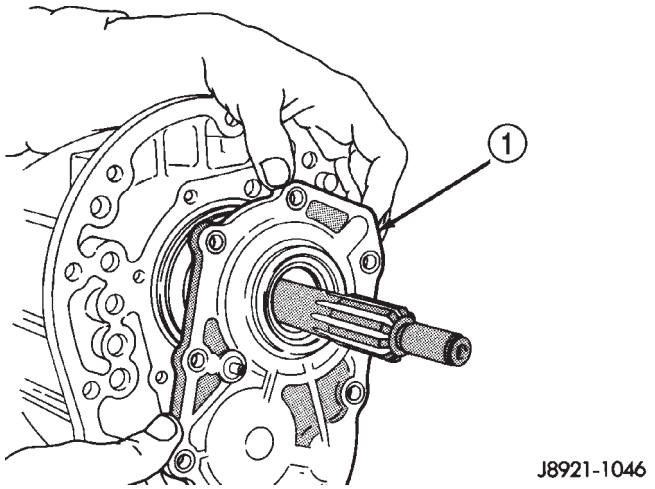


Fig. 33 Install Front Bearing Retainer

1 – FRONT BEARING RETAINER

(10) Position shift arm in shifter tower opening of adapter or extension housing (Fig. 36). Be sure that the shifter arm is engaged into the shift rails.

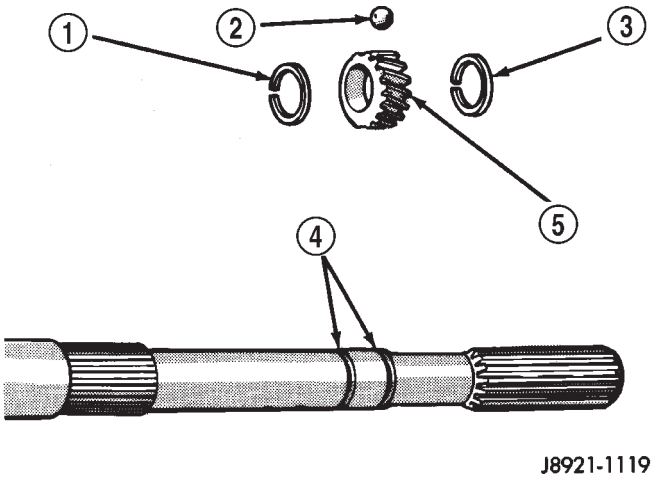


Fig. 34 Speedometer Drive Gear Assembly

1 – SNAP RING
2 – LOCK BALL
3 – SNAP RING
4 – OUTPUT SHAFT GROOVES
5 – SPEEDOMETER GEAR

(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. 37).

DISASSEMBLY AND ASSEMBLY (Continued)

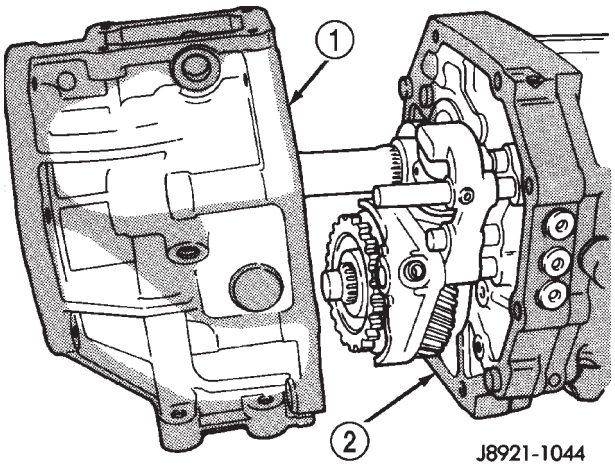


Fig. 35 Install Adapter/Extension Housing–Typical

1 – ADAPTER HOUSING
2 – INTERMEDIATE PLATE

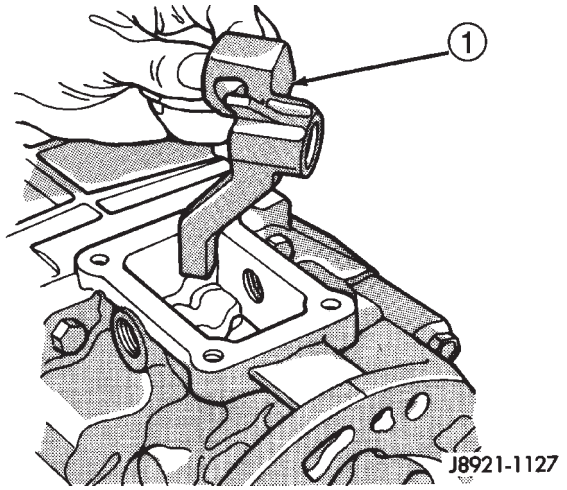


Fig. 36 Position Shift Arm in Adapter or Extension Housing

1 – SHIFT ARM

(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. 38).

(14) Install and tighten shifter arm shaft plug to 18 N·m (13 ft. lbs.) torque (Fig. 39).

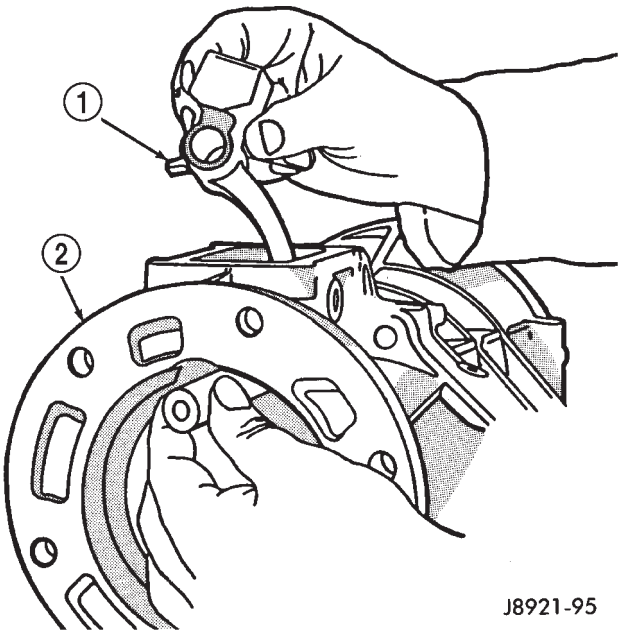


Fig. 37 Install Shifter Arm Shaft

1 – SHIFT ARM
2 – ADAPTER OR EXTENSION HOUSING

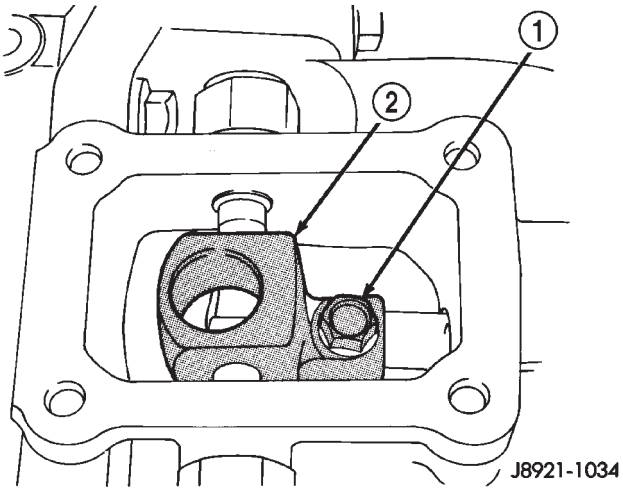


Fig. 38 Install Shift Arm Retainer Bolt

1 – RETAINER BOLT
2 – SHIFT ARM

DISASSEMBLY AND ASSEMBLY (Continued)

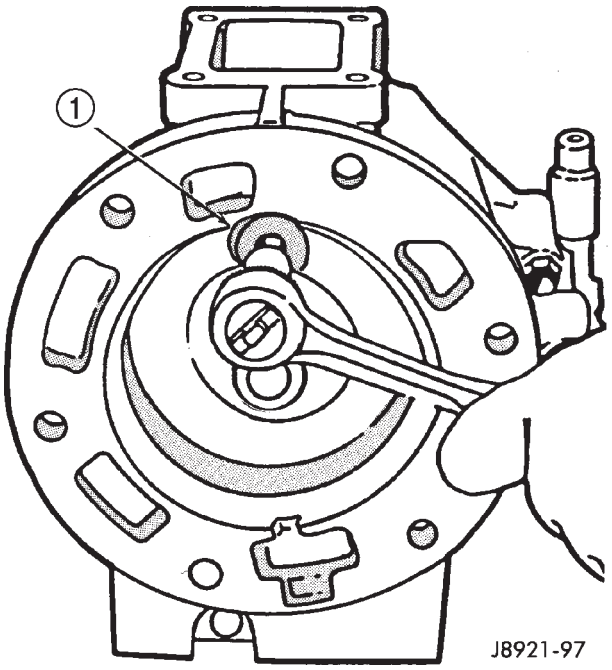


Fig. 39 Shifter Arm Shaft Plug Installation

1 – SHAFT PLUG

(15) Install shift restrictor pins in shift tower and tighten to 27 N·m (20 ft. lbs.) (Fig. 40).

NOTE: The restrictor pins are not interchangeable and are color coded. Be sure to install the pin into the same location from which it was removed.

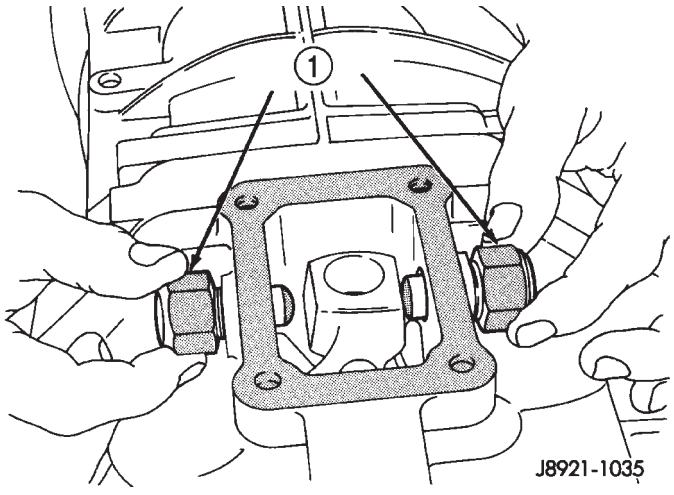


Fig. 40 Install Shifter Restrictor Pins

1 – RESTRICTOR PINS

(16) Install shift detent ball in detent opening of case (Fig. 41).

(17) Install detent spring in case (Fig. 42).

(18) Install detent plug and tighten to 19 N·m (14 ft. lbs.) (Fig. 43).

(19) Install shift tower gasket onto shift tower.

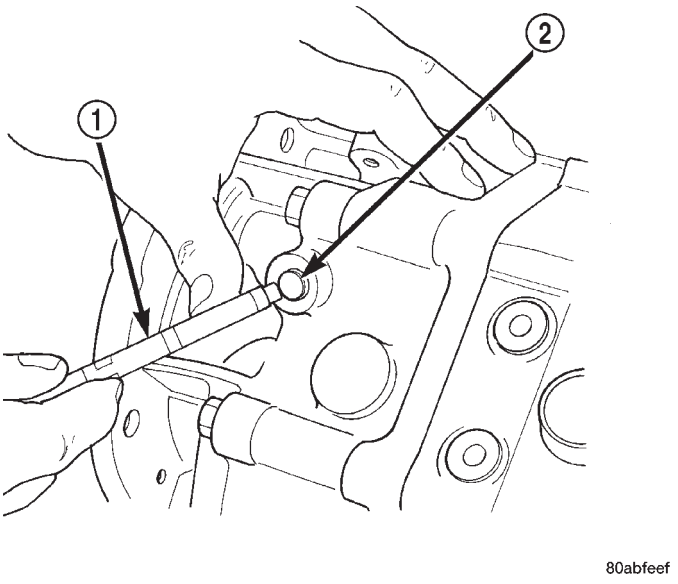


Fig. 41 Install Detent Ball

1 – PENCIL MAGNET
2 – SHIFT DETENT BALL

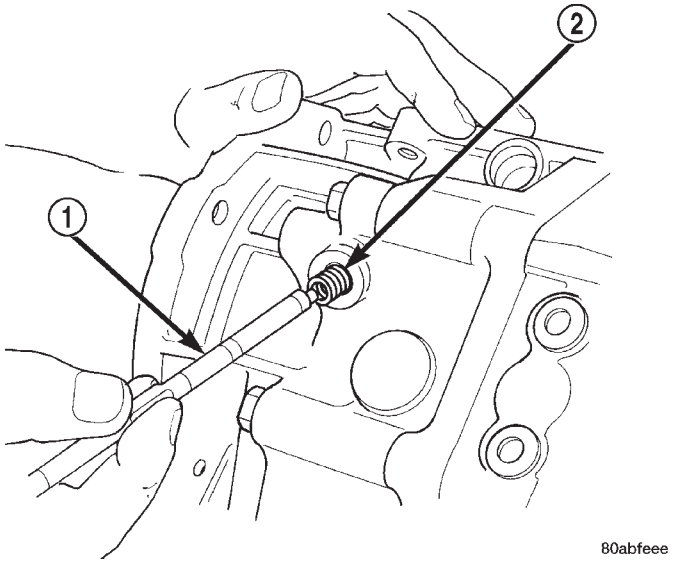


Fig. 42 Install Detent Spring

1 – PENCIL MAGNET
2 – DETENT BALL SPRING

(20) Install the shift tower oil deflector and gasket onto the adapter or extension housing.

(21) Install shift tower onto transmission case (Fig. 44).

(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. 45). Tighten switch to 44 N·m (32.5 ft. lbs.) torque.

DISASSEMBLY AND ASSEMBLY (Continued)

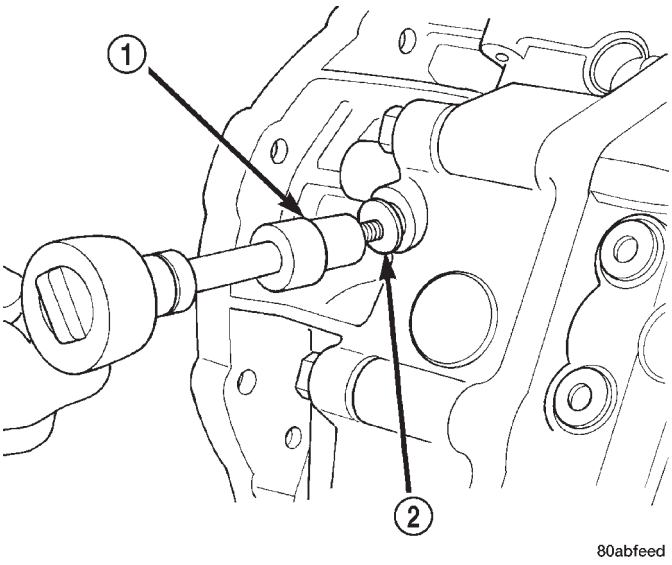


Fig. 43 Install Detent Ball Plug

1 – TORX BIT
2 – DETENT BALL PLUG

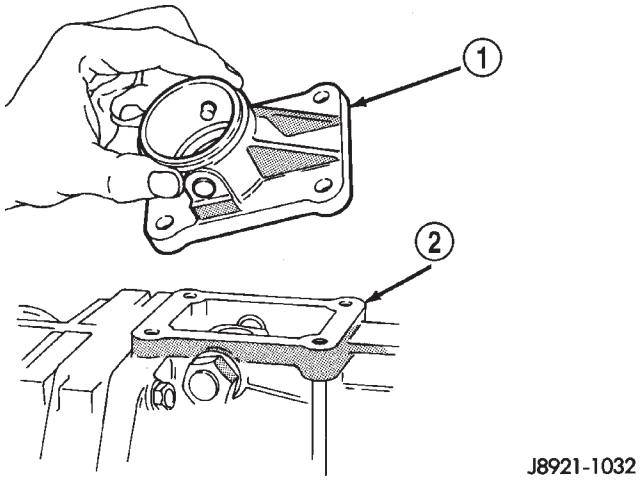


Fig. 44 Install Shift Tower

1 – SHIFT TOWER
2 – ADAPTER/EXTENSION HOUSING

(25) Install new seal in adapter/extension housing.
(26) Install vehicle speed sensor, if necessary.
(27) Install clutch housing, release bearing, release fork and retainer clip.

SHIFT MECHANISM AND GEARTRAIN

DISASSEMBLY

(1) Install suitable bolts and washers in intermediate plate (Fig. 46). 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.

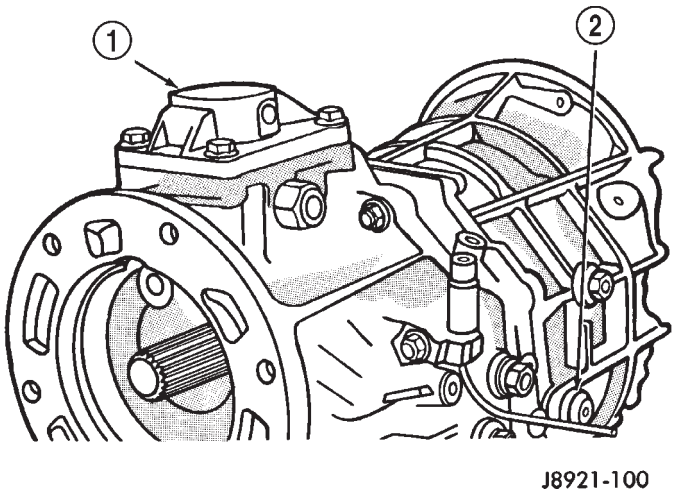


Fig. 45 Install Backup Lamp Switch

1 – SHIFT TOWER
2 – BACKUP LAMP SWITCH

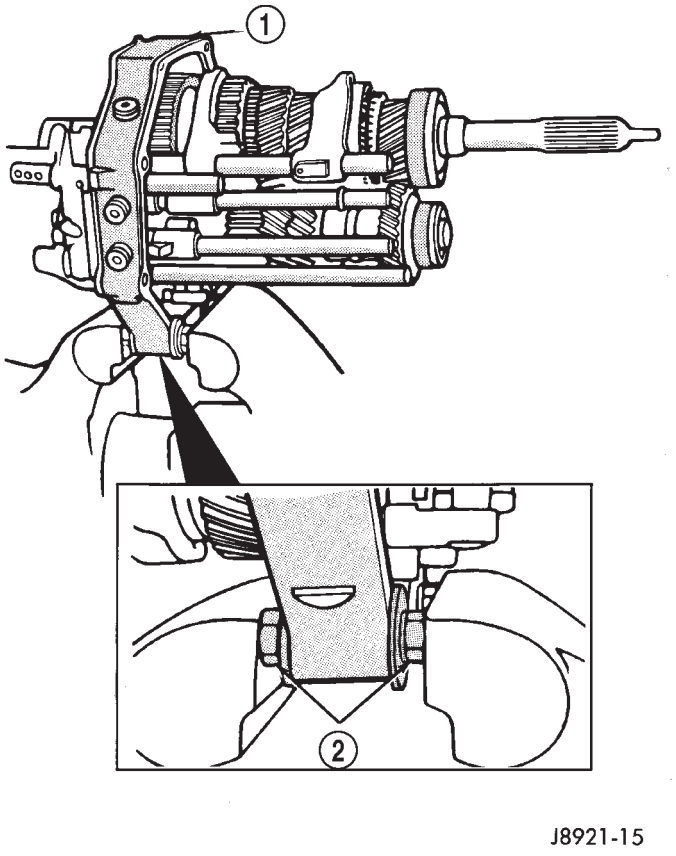


Fig. 46 Positioning Intermediate Plate In Vise

1 – INTERMEDIATE PLATE
2 – BOLTS

(2) Remove countershaft fifth gear retaining snapring (Fig. 47).
(3) Remove bolt holding fifth gear shift fork to shift rail (Fig. 48).

DISASSEMBLY AND ASSEMBLY (Continued)

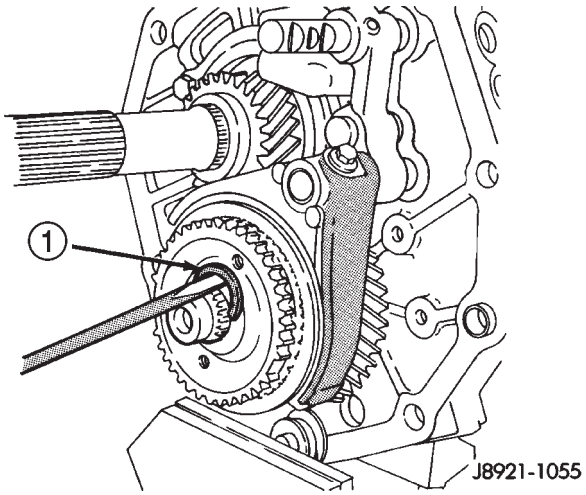


Fig. 47 Remove Fifth Gear Snap-ring

1 – FIFTH GEAR SNAP RING (SELECT FIT)

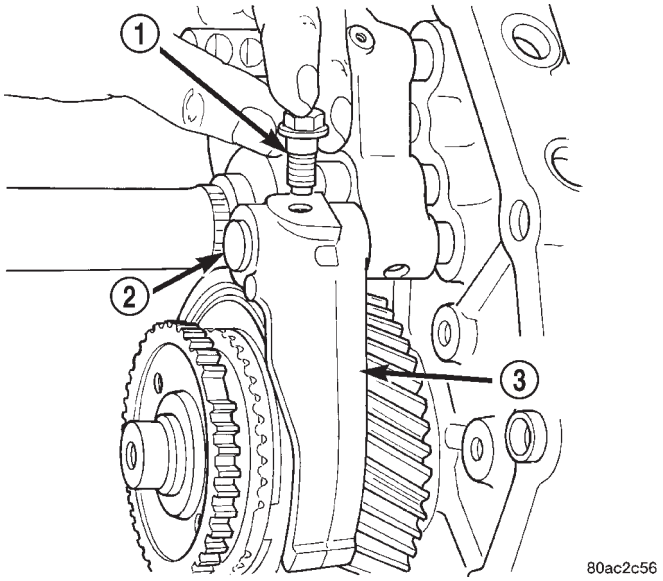


Fig. 48 Remove Shift Fork Retainer Bolt

1 – SHIFT FORK RETAINER BOLT
2 – FIFTH GEAR SHIFT RAIL
3 – FIFTH GEAR SHIFT FORK

(4) Remove fifth gear blocker ring from countershaft assembly with Puller L-4407 (Fig. 49).

(5) Remove fifth gear synchro ring (Fig. 50).

(6) Remove the countershaft fifth gear assembly from countershaft (Fig. 51).

(7) Remove fifth gear thrust ring from countershaft (Fig. 52).

(8) Remove fifth gear thrust ring lock ball from countershaft (Fig. 53).

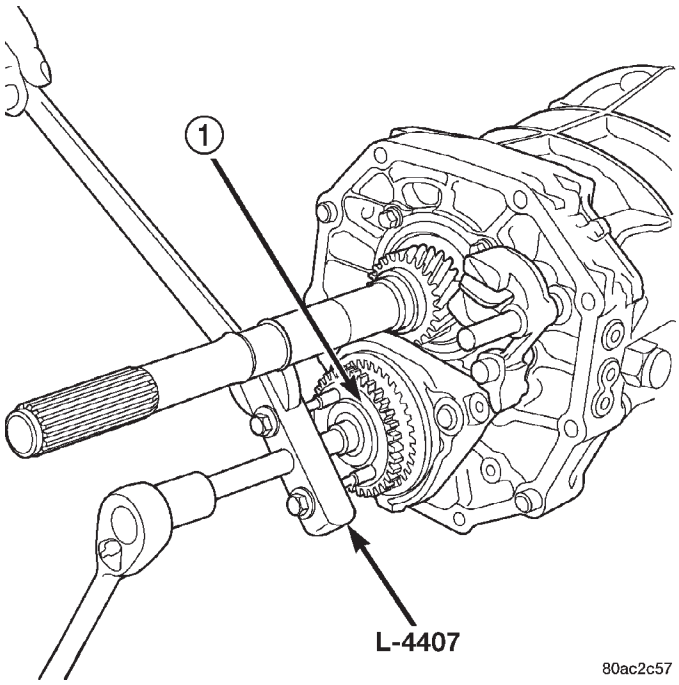


Fig. 49 Remove Fifth Gear Blocker Ring

1 – FIFTH GEAR BLOCKER RING

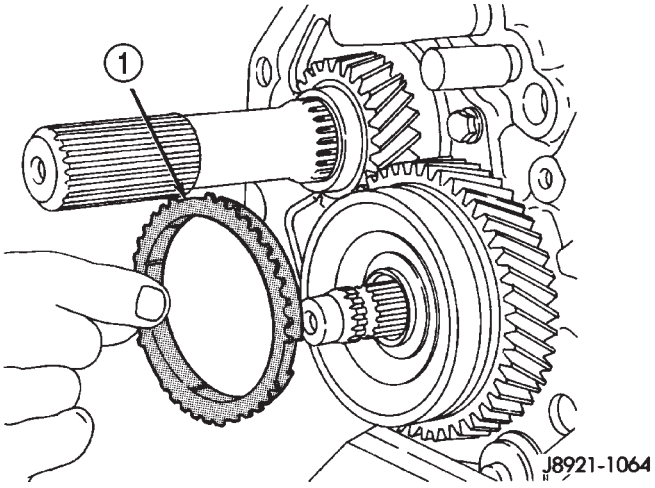


Fig. 50 Remove Fifth Gear Synchro Ring

1 – FIFTH GEAR SYNCHRO RING

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.

DISASSEMBLY AND ASSEMBLY (Continued)

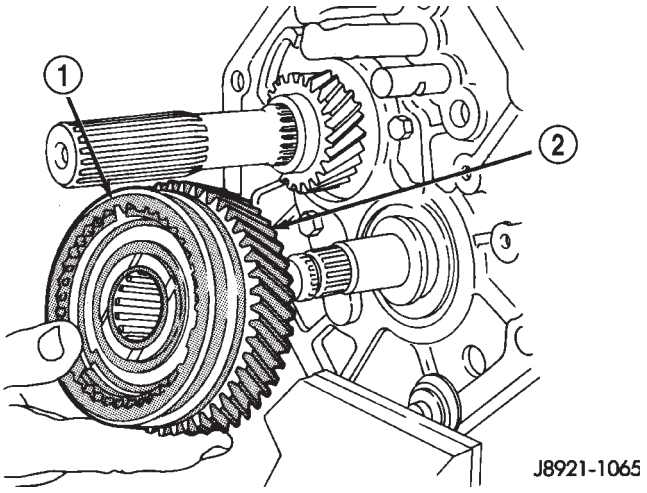


Fig. 51 Remove Fifth Gear and Synchro Assembly

1 – FIFTH GEAR SYNCHRO SLEEVE ASSEMBLY
2 – COUNTER FIFTH GEAR

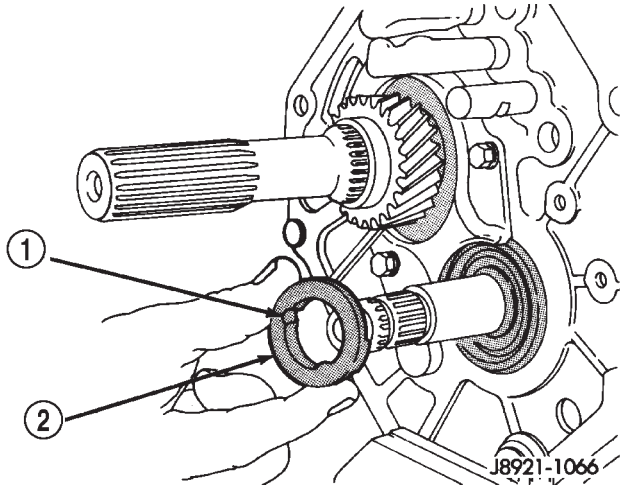


Fig. 52 Remove Fifth Gear Thrust Ring

1 – LOCK BALL NOTCH
2 – FIFTH GEAR THRUST RING

(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. 54).

NOTE: Be sure to retrieve the pin and compression spring from the reverse idler shaft.

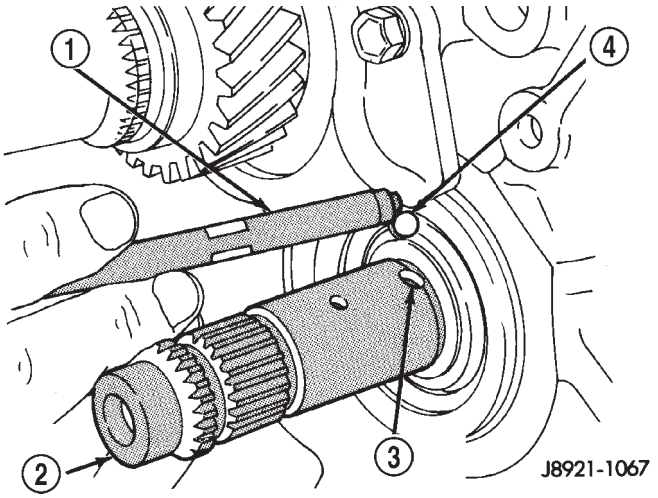


Fig. 53 Remove Fifth Gear Thrust Ring Lock Ball

1 – PENCIL MAGNET
2 – CLUSTER GEAR
3 – LOCK BALL RECESS
4 – THRUST RING LOCK BALL

(11) Remove bolts holding output shaft rear bearing retainer to the intermediate plate and remove retainer (Fig. 55).

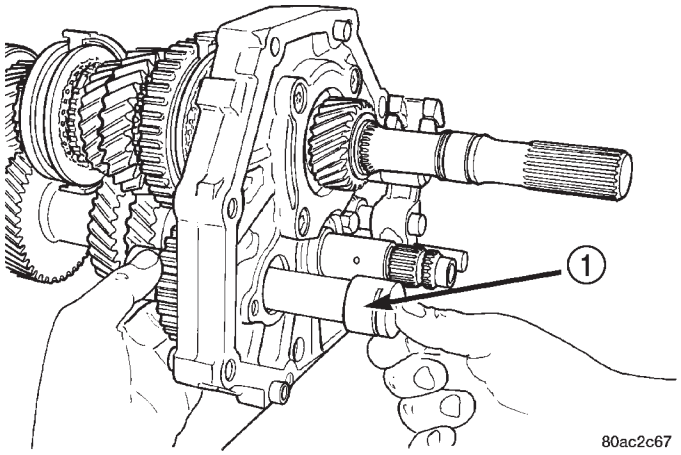


Fig. 54 Remove Reverse Idler Shaft

1 – REVERSE IDLER SHAFT

(12) Remove bolts holding 1–2 and 3–4 shift forks to the shift rails (Fig. 56) and discard bolts.

(13) Remove bolts holding reverse shift arm bracket to intermediate plate (Fig. 57).

DISASSEMBLY AND ASSEMBLY (Continued)

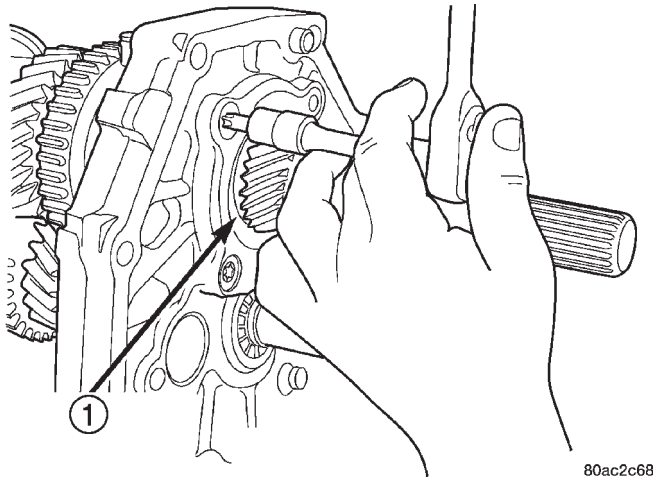


Fig. 55 Remove Output Shaft Rear Bearing Retainer

1 – OUTPUT SHAFT REAR BEARING RETAINER

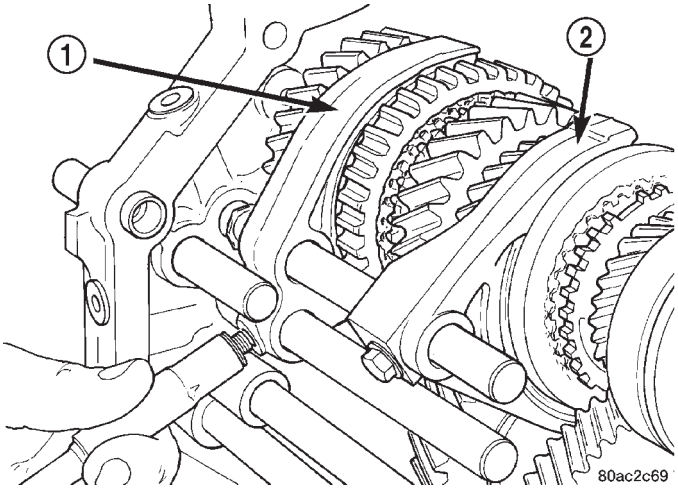


Fig. 56 Remove Shift Fork To Shift Rail Bolts

1 – 1–2 SHIFT FORK
2 – 3–4 SHIFT FORK

(14) Remove snap-ring holding output shaft rear bearing into the intermediate plate (Fig. 58).

(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. 59).

(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. 60).

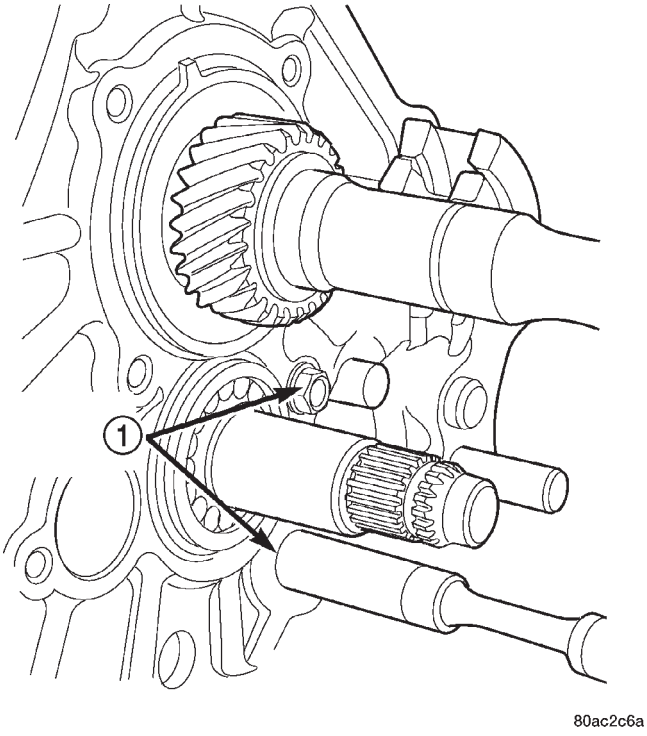


Fig. 57 Remove Reverse Shift Arm Bracket Bolts

1 – REVERSE SHIFT ARM BOLTS

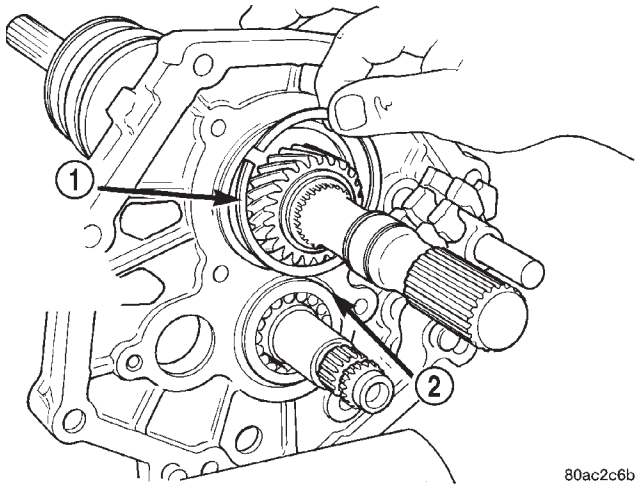


Fig. 58 Remove Output Shaft Rear Bearing Snap-ring

1 – OUTPUT SHAFT REAR BEARING SNAP-RING
2 – COUNTERSHAFT REAR BEARING SNAP-RING

(18) Remove the 3–4 shift fork from the 3–4 shift rail (Fig. 61).

(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. 62).

DISASSEMBLY AND ASSEMBLY (Continued)

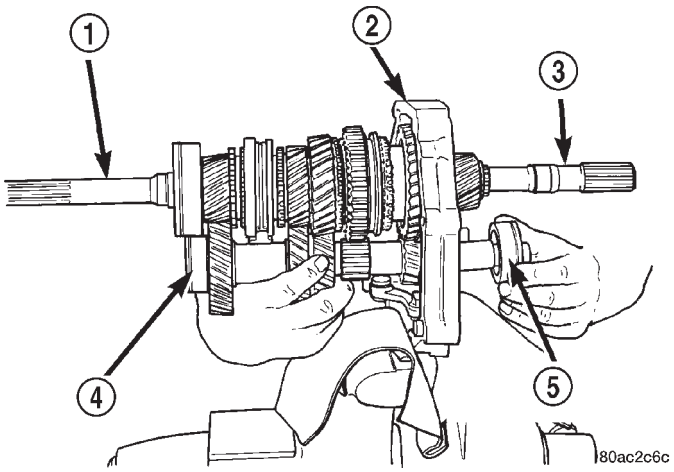


Fig. 59 Remove Countershaft and Countershaft Rear Bearing

1 – INPUT SHAFT
2 – INTERMEDIATE PLATE
3 – OUTPUT SHAFT
4 – COUNTERSHAFT
5 – COUNTERSHAFT REAR BEARING

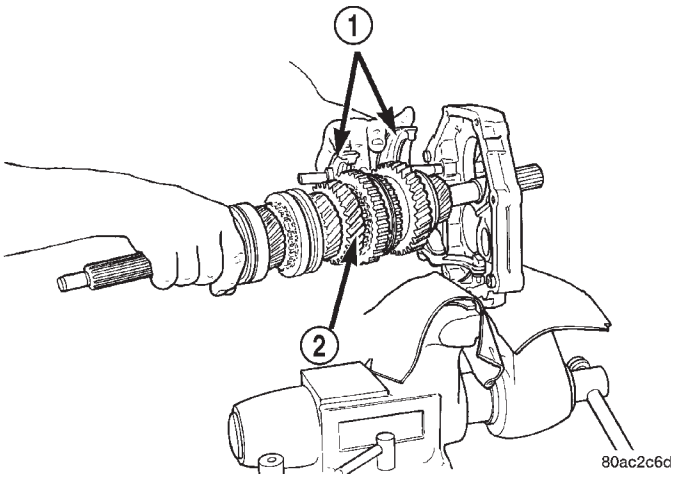


Fig. 60 Remove Mainshaft

1 – SHIFT FORKS
2 – MAINSHAFT

(21) Remove threaded plugs from intermediate plate. Then remove lock ball and spring from plug holes with pencil magnet (Fig. 63). 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.

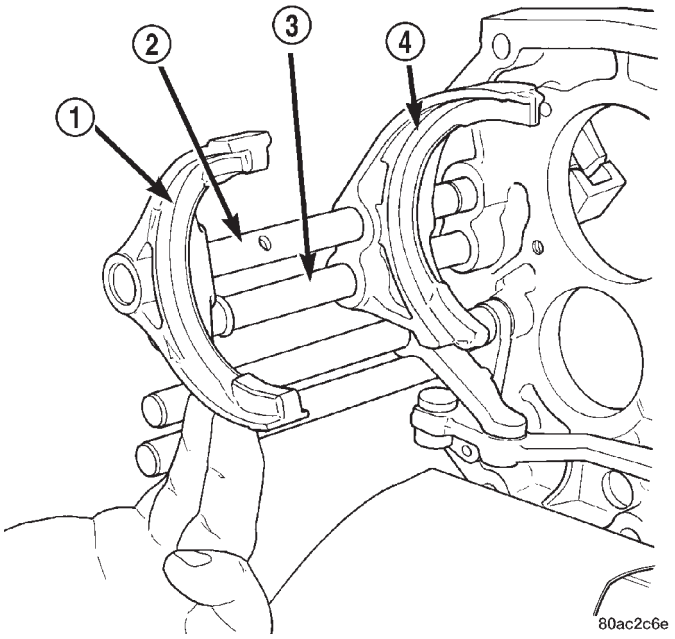


Fig. 61 Remove 3–4 Shift Fork

1 – 3–4 SHIFT FORK
2 – 3–4 SHIFT RAIL
3 – 1–2 SHIFT RAIL
4 – 1–2 SHIFT FORK

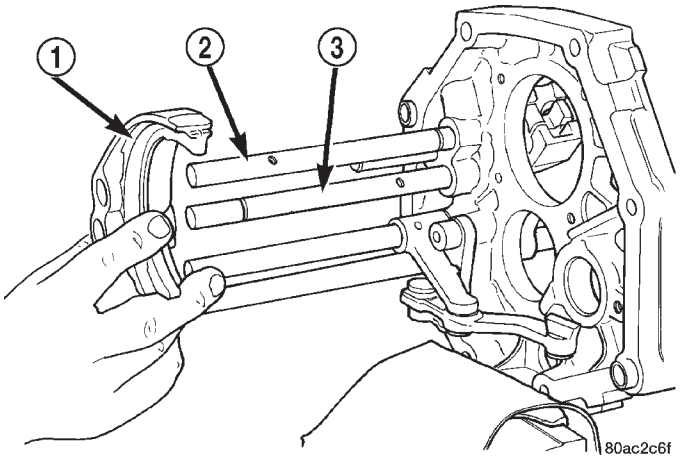


Fig. 62 Remove 1–2 Shift Fork

1 – 1–2 SHIFT FORK
2 – 3–4 SHIFT RAIL
3 – 1–2 SHIFT RAIL

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.

DISASSEMBLY AND ASSEMBLY (Continued)

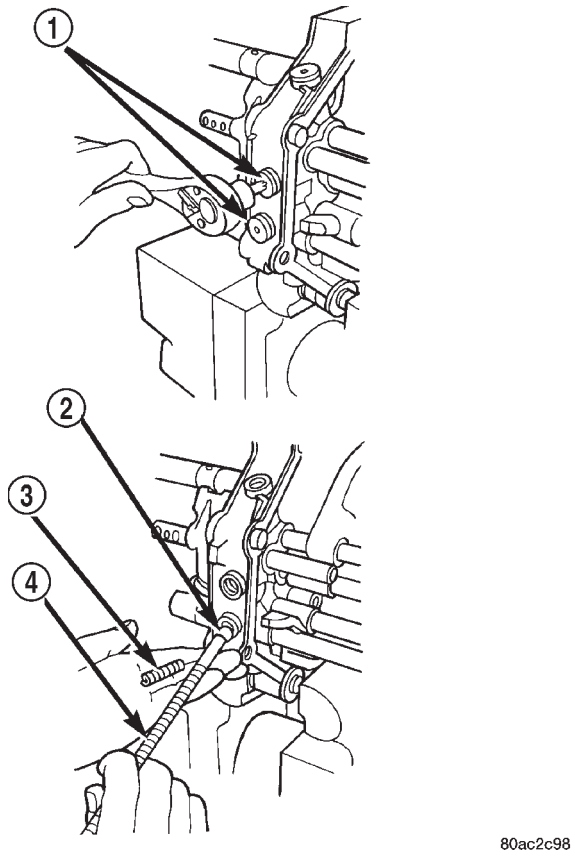


Fig. 63 Remove Lock Ball And Spring

1 – THREADED PLUGS
2 – LOCK BALL
3 – SPRING
4 – PENCIL MAGNET

(23) Remove fifth gear shift rail (Fig. 64).

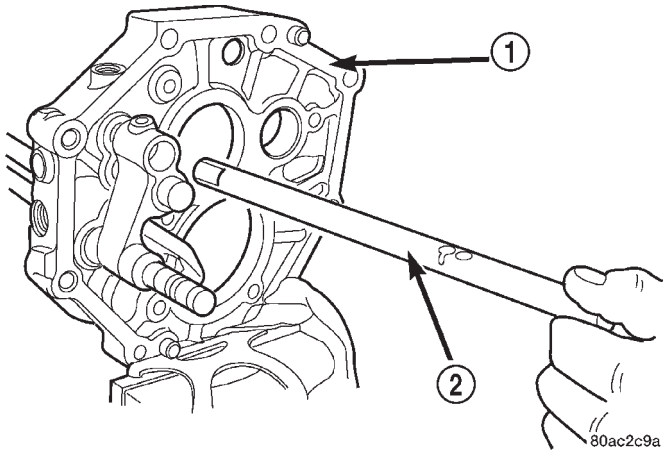


Fig. 64 Remove Fifth Gear Shift Rail

1 – INTERMEDIATE PLATE
2 – FIFTH GEAR SHIFT RAIL

(24) Remove fifth gear check ball (Fig. 65) and interlock pin.

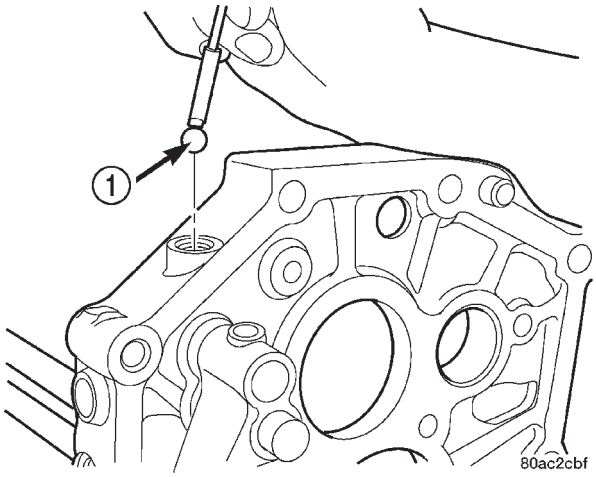


Fig. 65 Remove Fifth Gear Check Ball

1 – FIFTH GEAR CHECK BALL

(25) Remove reverse shift head and rail assembly (Fig. 66).

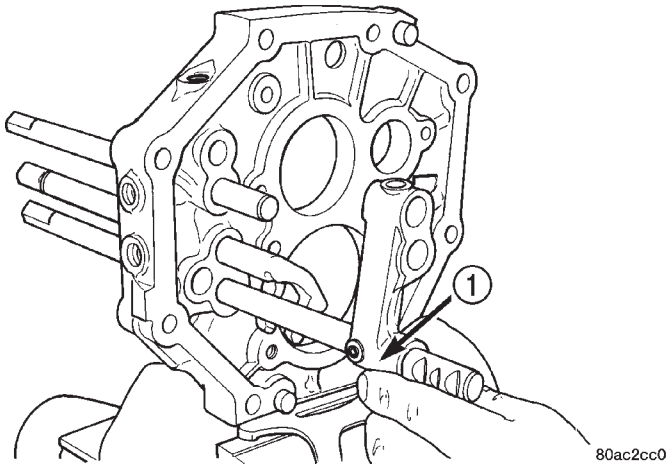


Fig. 66 Remove Reverse Shift Head And Rail Assembly

1 – REVERSE SHIFT HEAD AND RAIL ASSEMBLY

(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. 67).

(28) Remove interlock pin from reverse shift rail (Fig. 68).

(29) Remove reverse elongated check ball (Fig. 69).

(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. 70).

DISASSEMBLY AND ASSEMBLY (Continued)

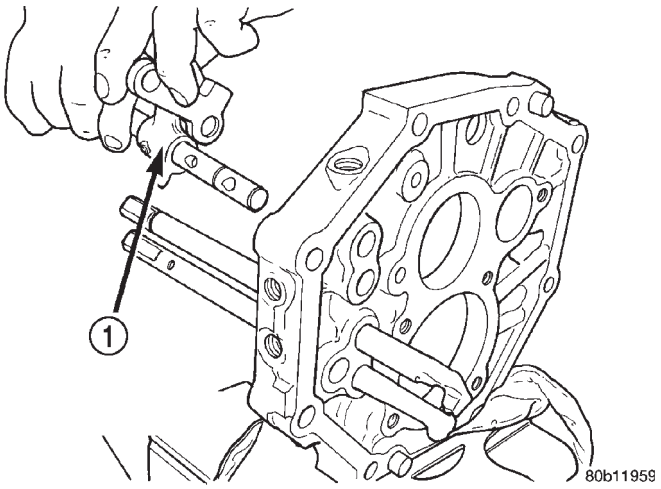


Fig. 67 Remove Reverse Shift Rail

1 – REVERSE SHIFT RAIL AND REVERSE FORK ASSEMBLY

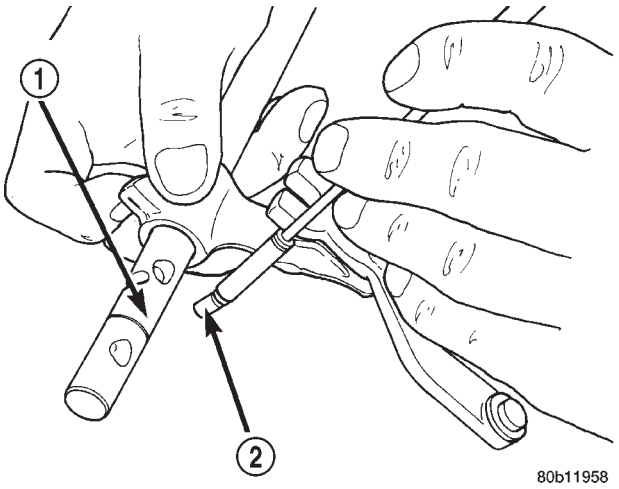


Fig. 68 Remove Interlock Pin From Reverse Shift Rail

1 – REVERSE SHIFT RAIL
2 – INTERLOCK PIN

(33) Remove 1–2 shift rail elongated check ball from intermediate plate (Fig. 71).

(34) Remove 3–4 shift rail from intermediate plate.

ASSEMBLY

Refer to (Fig. 72) 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.

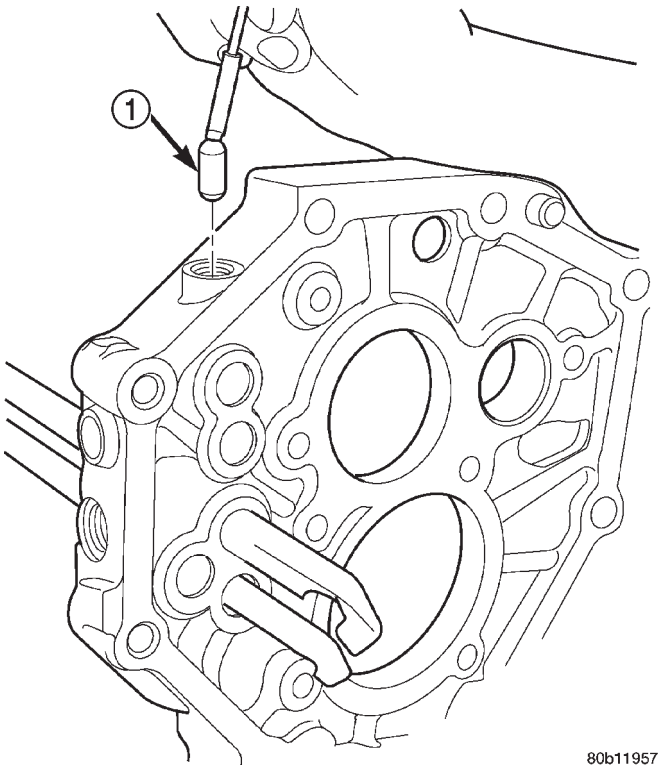


Fig. 69 Remove Reverse Check Ball

1 – REVERSE CHECK BALL

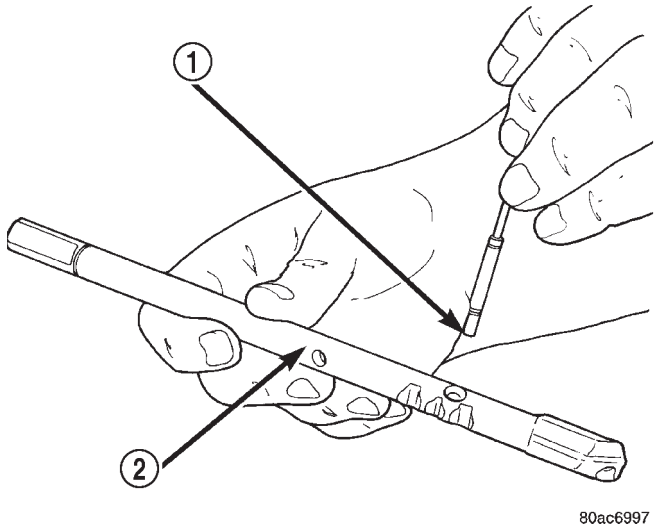


Fig. 70 Remove 1–2 Shift Rail Interlock Pin

1 – INTERLOCK PIN
2 – 1–2 SHIFT RAIL

DISASSEMBLY AND ASSEMBLY (Continued)

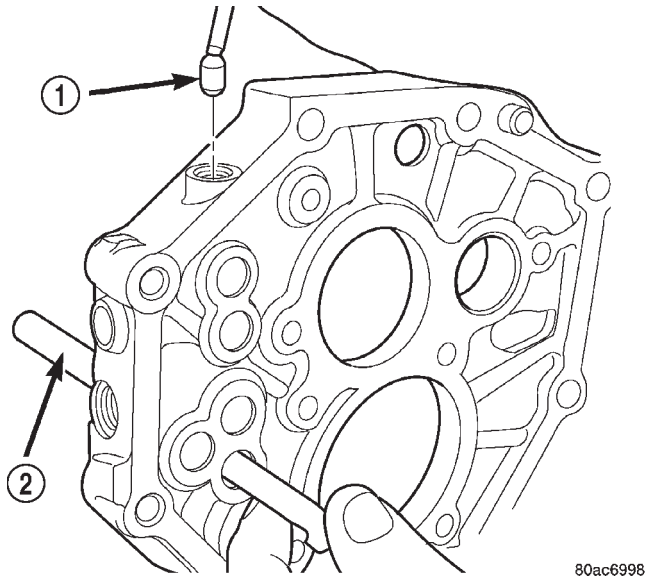


Fig. 71 Remove 1–2 Check Ball

1 – 1–2 CHECK BALL
2 – 3–4 SHIFT RAIL

(1) Install the 3–4 shift rail into the intermediate plate.

(2) Install the 1–2 elongated check ball into the intermediate plate (Fig. 73).

(3) Install the interlock pin into the 1–2 shift rail (Fig. 74).

(4) Install the 1–2 shift rail into the intermediate plate.

(5) Install snap-ring onto 3–4 shift rail.

(6) Install the reverse check ball into the intermediate plate (Fig. 75).

(7) Install the interlock pin into the reverse shift rail (Fig. 76).

(8) Assemble the reverse arm bracket to the reverse fork (Fig. 77).

(9) Install reverse shift rail into intermediate plate and position reverse arm bracket to intermediate plate (Fig. 78).

(10) Install snap-ring onto reverse shift rail (Fig. 79).

(11) Install reverse shift head and rail assembly into the intermediate plate.

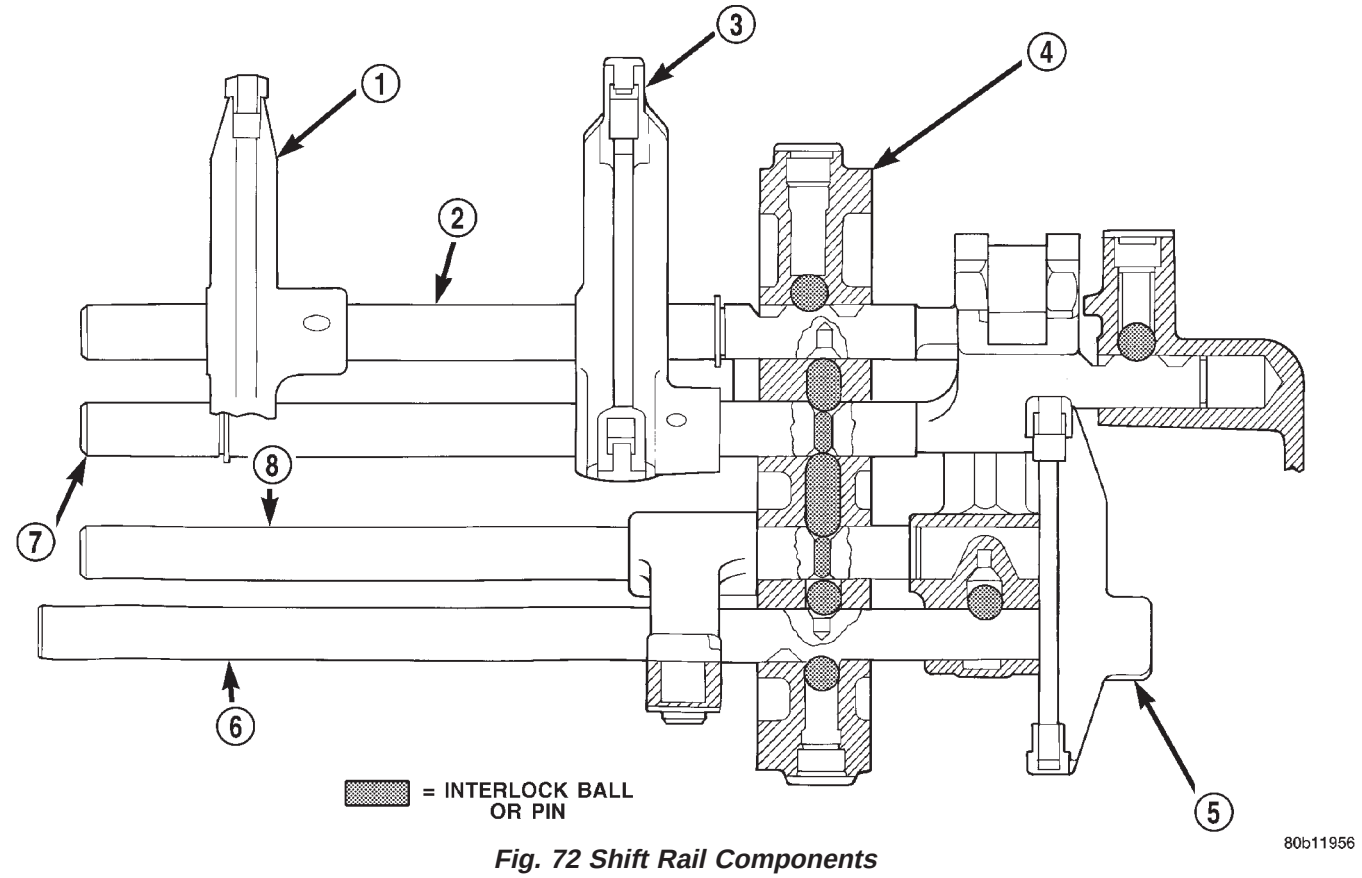


Fig. 72 Shift Rail Components

1 – 3–4 FORK
2 – 3–4 SHIFT RAIL
3 – 1–2 FORK
4 – INTERMEDIATE PLATE
5 – FIFTH GEAR FORK
6 – FIFTH GEAR SHIFT RAIL
7 – 1–2 SHIFT RAIL
8 – REVERSE SHIFT RAIL

DISASSEMBLY AND ASSEMBLY (Continued)

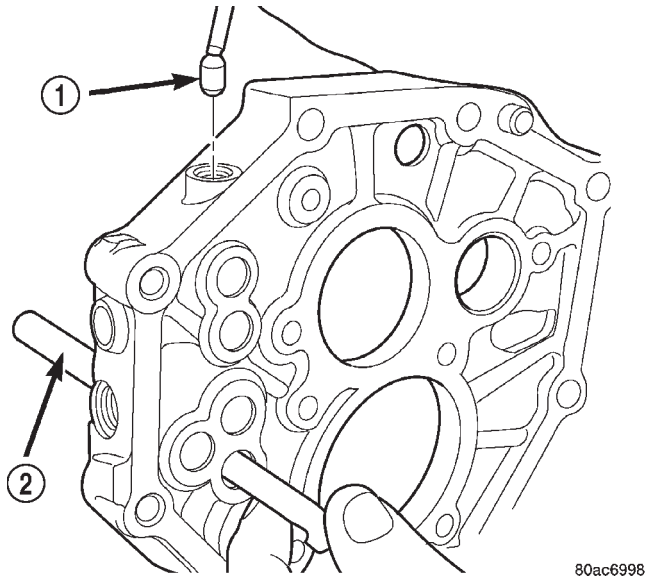


Fig. 73 Install 1–2 Check Ball

1 – 1–2 CHECK BALL
2 – 3–4 SHIFT RAIL

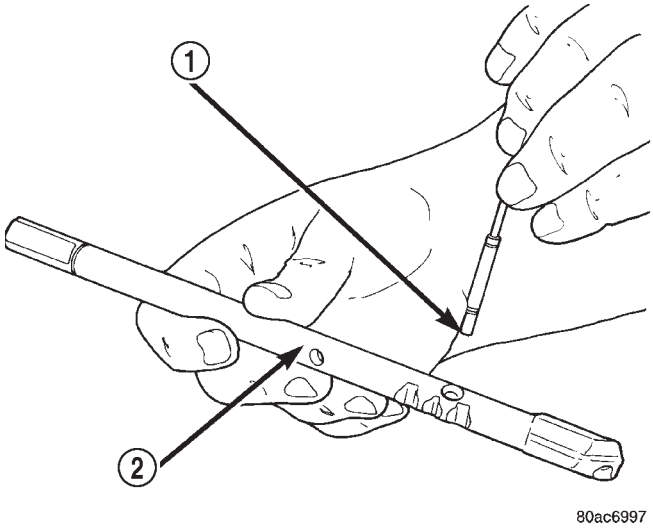


Fig. 74 Install 1–2 Shift Rail Interlock Pin

1 – INTERLOCK PIN
2 – 1–2 SHIFT RAIL

(12) Install the fifth gear interlock ball and check ball (Fig. 80).

(13) Install fifth gear shift rail (Fig. 81).

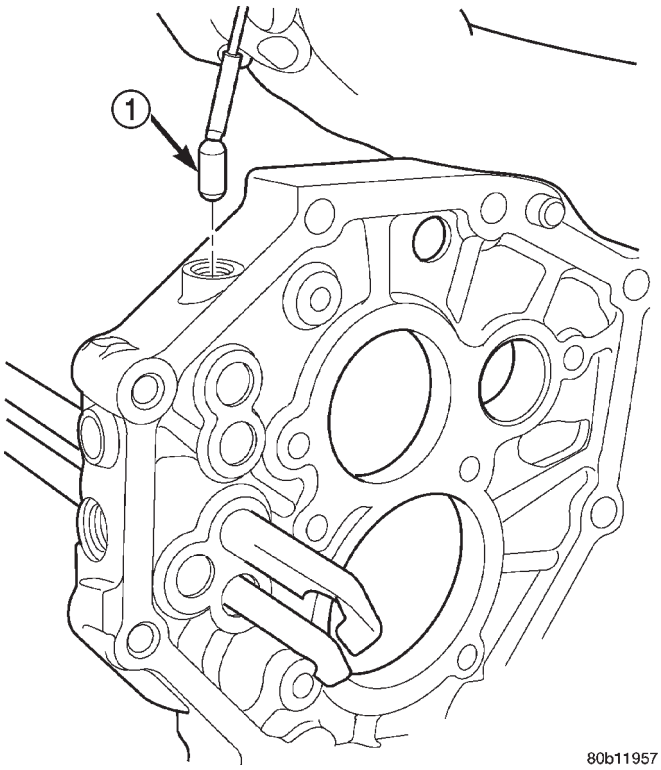


Fig. 75 Install Reverse Check Ball

1 – REVERSE CHECK BALL

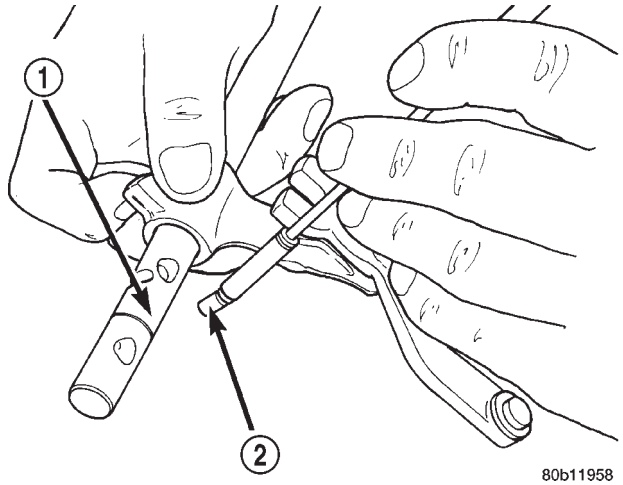


Fig. 76 Install Reverse Interlock Pin

1 – REVERSE SHIFT RAIL
2 – INTERLOCK PIN

DISASSEMBLY AND ASSEMBLY (Continued)

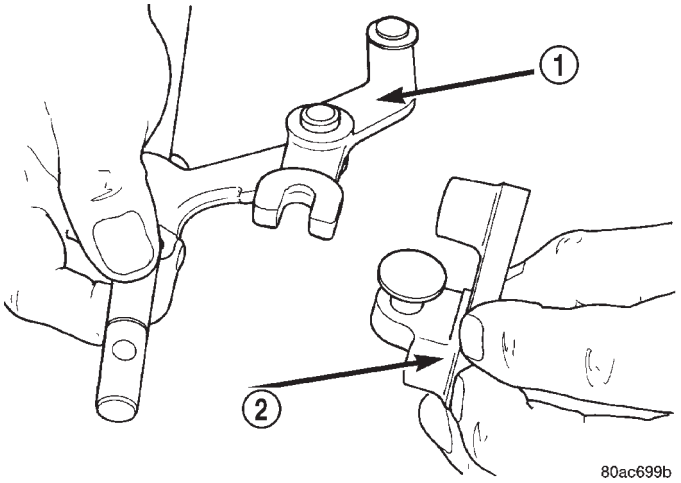


Fig. 77 Install Reverse Arm Bracket to Fork

1 – REVERSE SHIFT FORK
2 – REVERSE ARM BRACKET

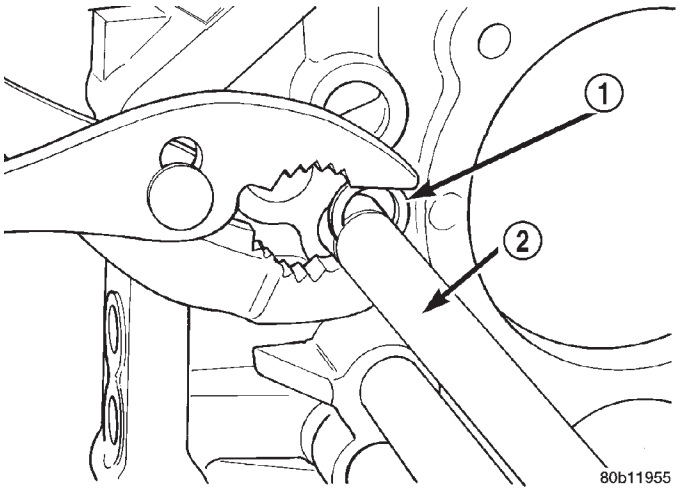


Fig. 79 Install Reverse Snap-ring

1 – SNAP RING
2 – REVERSE SHIFT RAIL

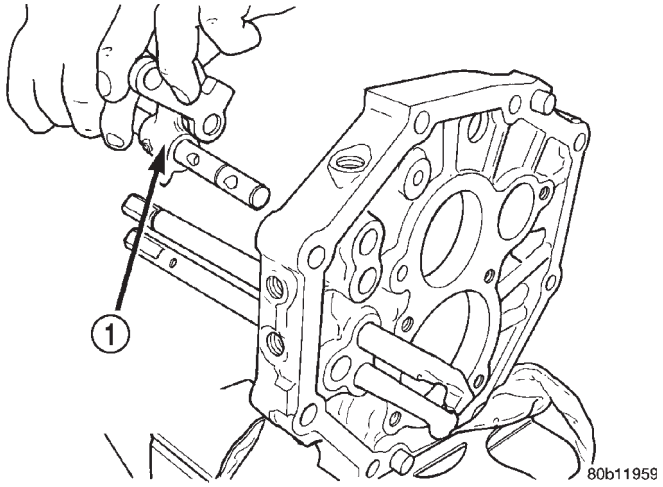


Fig. 78 Install Reverse Shift Rail

1 – REVERSE SHIFT RAIL AND REVERSE FORK ASSEMBLY

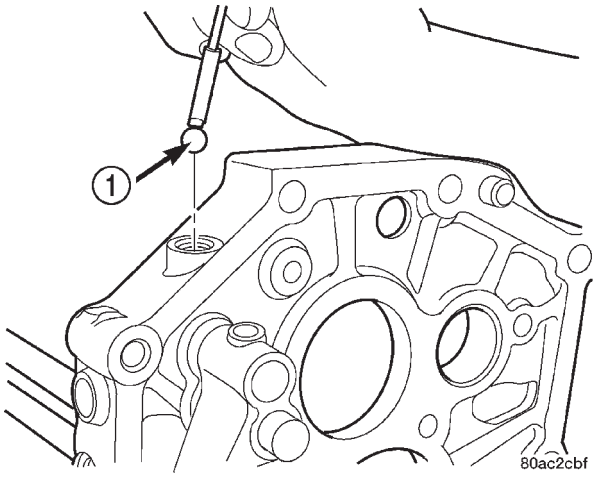


Fig. 80 Install Fifth Gear Check Ball

1 – FIFTH GEAR CHECK BALL

DISASSEMBLY AND ASSEMBLY (Continued)

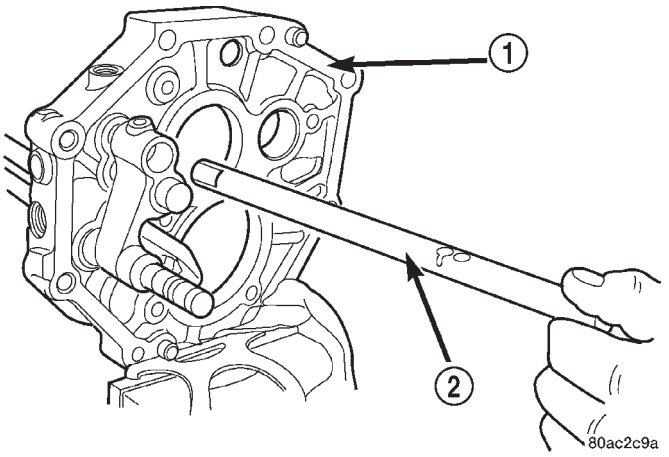


Fig. 81 Install Fifth Gear Shift Rail

1 – INTERMEDIATE PLATE
2 – FIFTH GEAR SHIFT RAIL

(14) Remove the intermediate plate from the vise, rotate the plate 180°, and reinstall the plate in the vise using the same bolt and washer mounting set-up.

(15) Install the shift rail detent balls in the intermediate plate.

(16) Install the shift rail detent springs in the intermediate plate. Note that the bottom detent spring is shorter than the others.

(17) Install the shift rail detent plugs in the intermediate plate.

(18) Install the 1–2 shift fork onto the 1–2 and 3–4 shift rails (Fig. 82).

(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. 83).

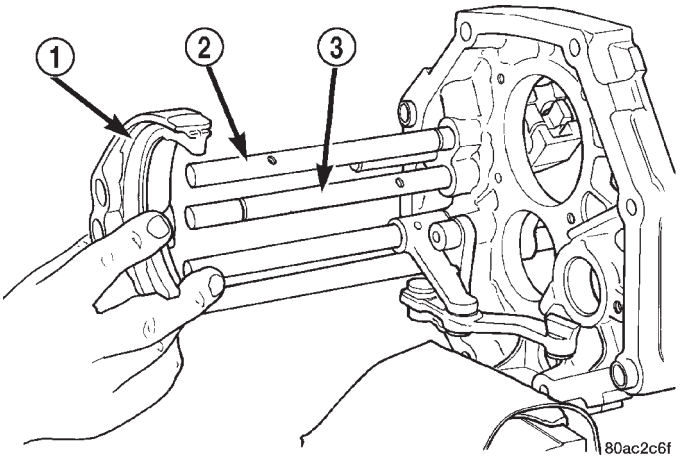


Fig. 82 Install 1–2 Shift Fork

1 – 1–2 SHIFT FORK
2 – 3–4 SHIFT RAIL
3 – 1–2 SHIFT RAIL

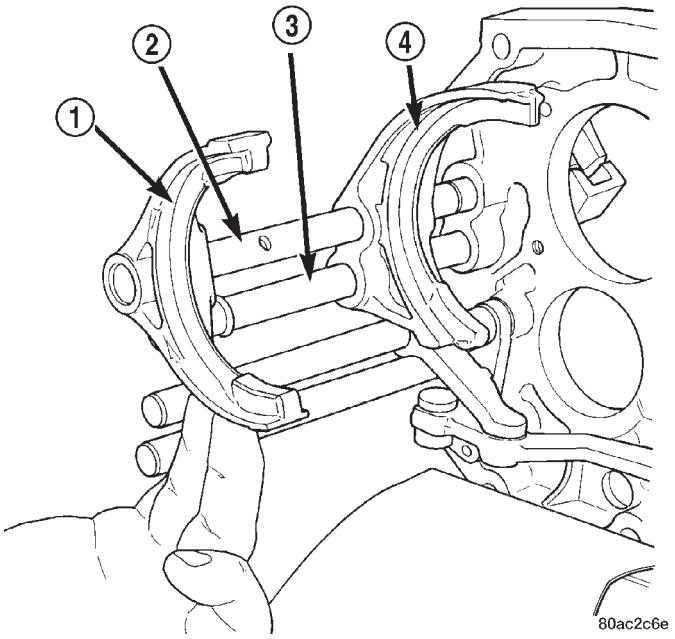


Fig. 83 Install 3–4 Shift Fork

1 – 3–4 SHIFT FORK
2 – 3–4 SHIFT RAIL
3 – 1–2 SHIFT RAIL
4 – 1–2 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. 84).

(28) Position the mainshaft rear bearing retainer over the output shaft and onto the intermediate plate.

DISASSEMBLY AND ASSEMBLY (Continued)

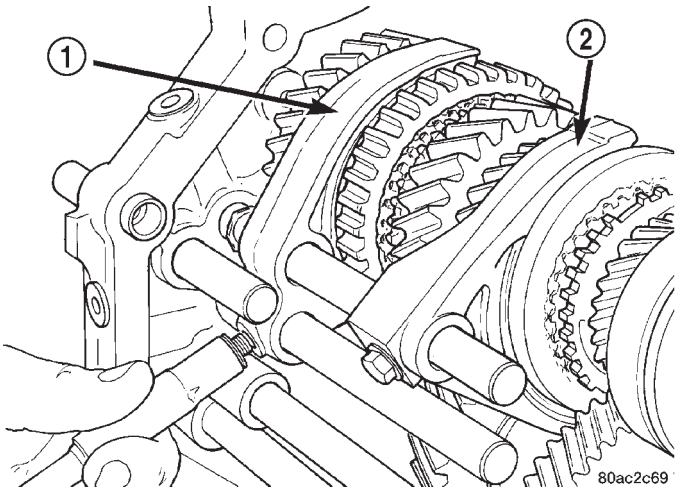


Fig. 84 Install Shift Fork Bolts

1 – 1–2 SHIFT FORK
2 – 3–4 SHIFT FORK

(29) Install new bolts to hold the bearing retainer to the intermediate plate.

(30) Move the reverse shift arm into the reverse gear position. The reverse gear position is with the arm moved away from the intermediate plate (Fig. 85).

(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. 86).

(33) Install the reverse idler shaft through the intermediate plate and reverse idler gear assembly (Fig. 87) 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.

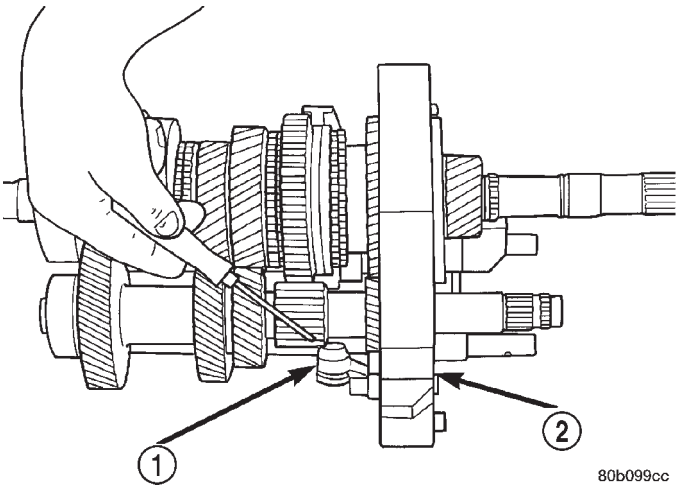


Fig. 85 Reverse Shift Arm Position

1 – REVERSE SHIFT ARM
2 – INTERMEDIATE PLATE

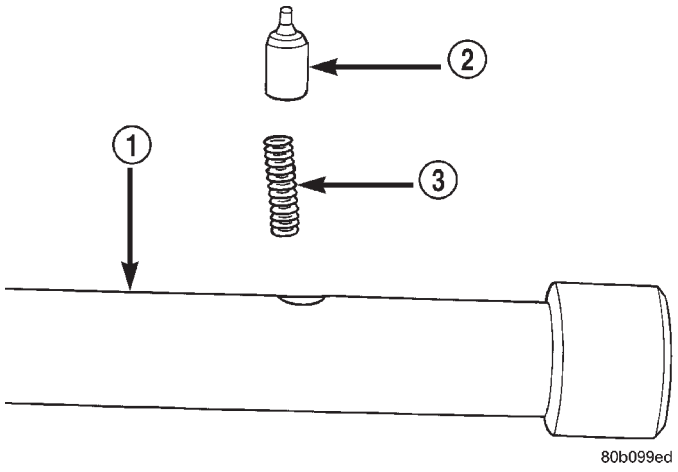


Fig. 86 Install Compression Spring And Pin

1 – REVERSE IDLER GEAR SHAFT
2 – PIN
3 – COMPRESSION SPRING

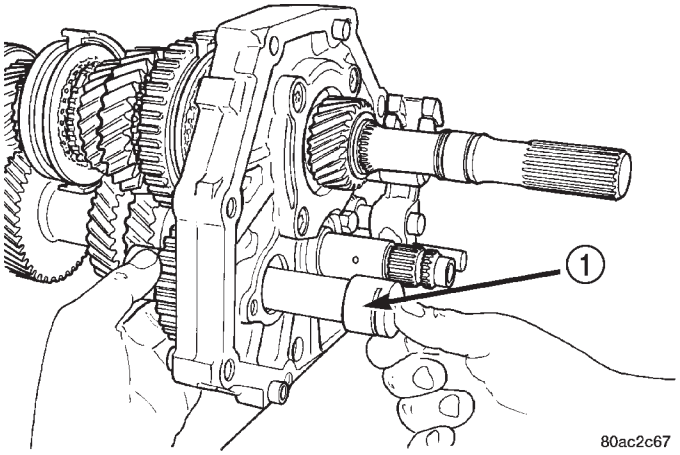


Fig. 87 Install Reverse Idler Shaft

1 – REVERSE IDLER SHAFT

(34) Align the pin with the alignment notch in the reverse idler gear assembly (Fig. 88). The alignment notch in the reverse idler gear race/hub is a small relief cut above one of the main longitudinal slots. Be sure that the pin is aligned with the proper slot, the opposite slot has an oil drain hole which the pin will drop into. The assembly will then be locked onto the shaft and will need to be disassembled in order to be removed.

(35) Depress compression spring and pin in reverse idler gear shaft (Fig. 89).

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

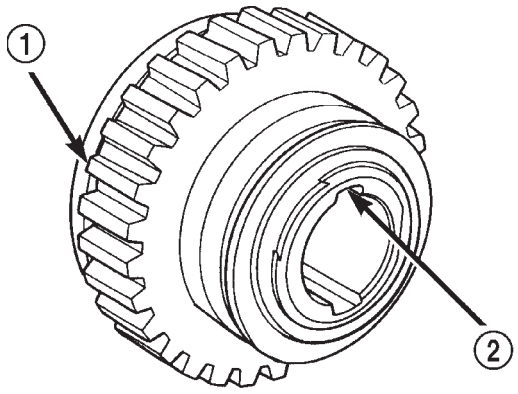


Fig. 88 Align Idler Shaft Pin

1 – REVERSE IDLER GEAR ASSEMBLY
2 – ALIGNMENT NOTCH

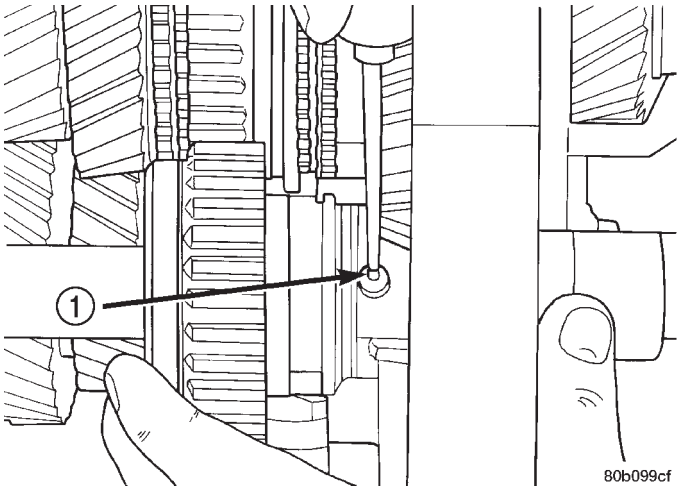


Fig. 89 Depress Pin In Reverse Idler Gear Shaft

1 – DEPRESS PIN

(39) Install the fifth gear thrust ring lock ball to the countershaft (Fig. 90).

(40) Install the fifth gear thrust ring onto the countershaft and over the lock ball (Fig. 91).

(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.

(46) Using a suitable mallet and spacer, tap the fifth gear blocker ring onto the countershaft.

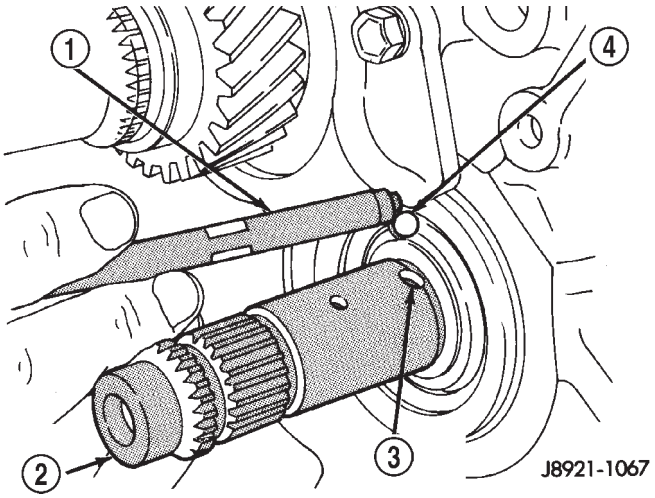


Fig. 90 Install Fifth Gear Thrust Ring Lock Ball

1 – PENCIL MAGNET
2 – CLUSTER GEAR
3 – LOCK BALL RECESS
4 – THRUST RING LOCK BALL

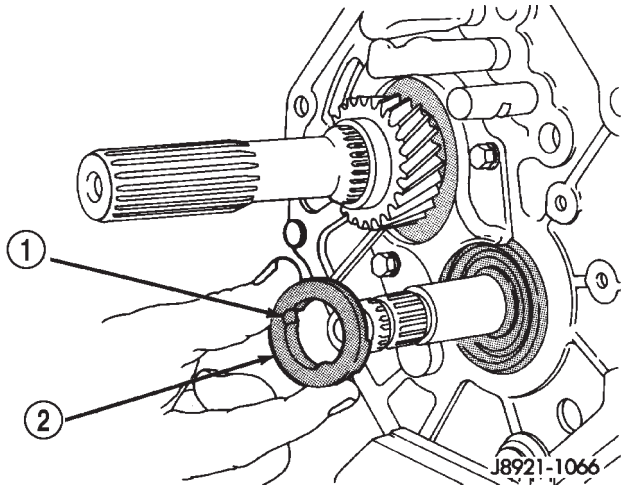


Fig. 91 Install Fifth Gear Thrust Ring

1 – LOCK BALL NOTCH
2 – FIFTH GEAR THRUST RING

(47) Install new bolt to hold fifth gear shift fork to the fifth gear shift rail (Fig. 92).

(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)

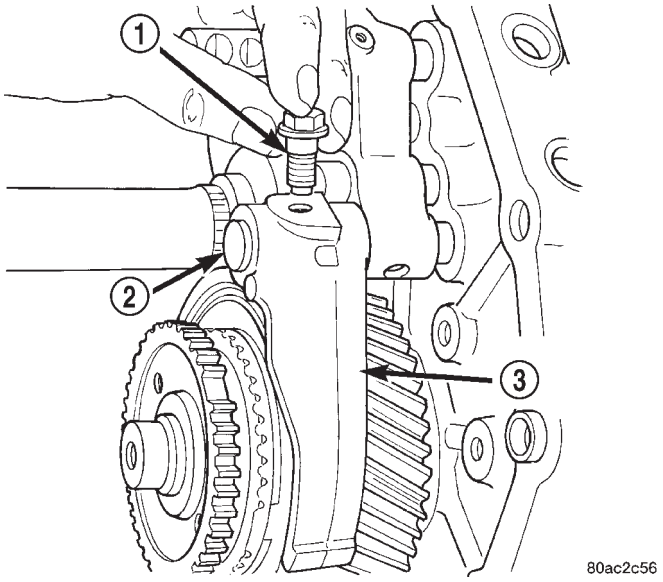


Fig. 92 Install Fifth Gear Retainer Bolt

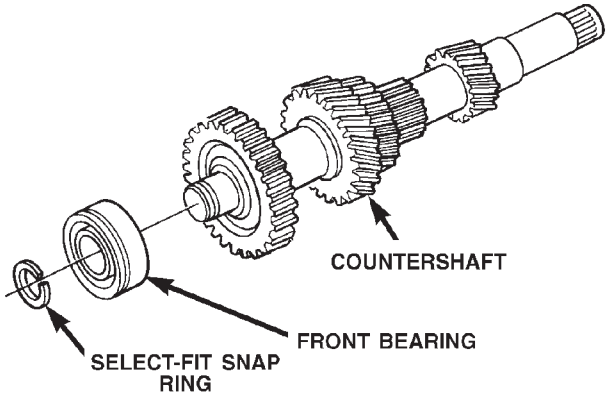
1 – SHIFT FORK RETAINER BOLT
2 – FIFTH GEAR SHIFT RAIL
3 – FIFTH GEAR SHIFT FORK

COUNTERSHAFT

DISASSEMBLY

(1) Remove select fit snap-ring holding the countershaft front bearing onto the countershaft (Fig. 93).

(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. 93 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. 93).

(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. 94). Note that the output shaft pilot bearing is an uncaged roller type bearing.

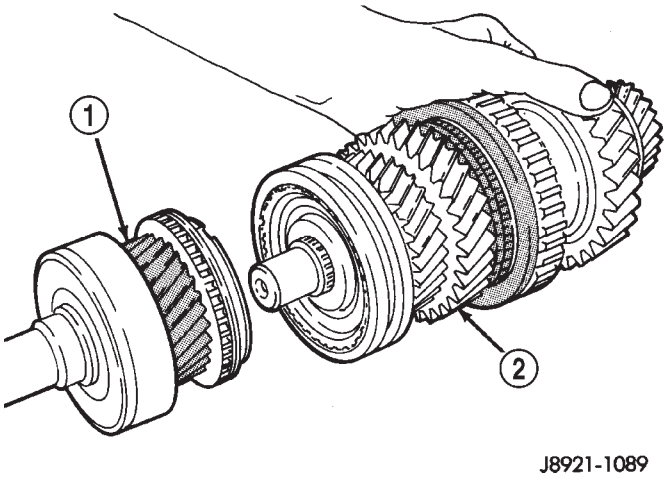


Fig. 94 Separate Input and Output Shafts

1 – INPUT SHAFT ASSEMBLY
2 – OUTPUT SHAFT AND GEAR ASSEMBLY

(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. 95).

DISASSEMBLY AND ASSEMBLY (Continued)

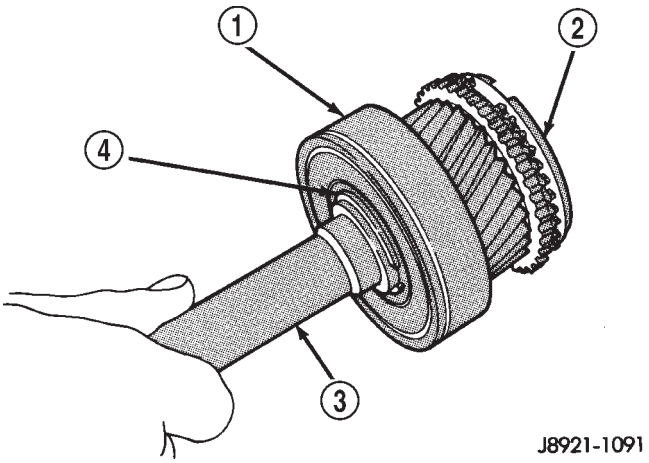


Fig. 95 Input Shaft Components

1 – BEARING
2 – SYNCHRO RING
3 – INPUT SHAFT
4 – BEARING SNAP RING

(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. 96).

(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. 97). 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.

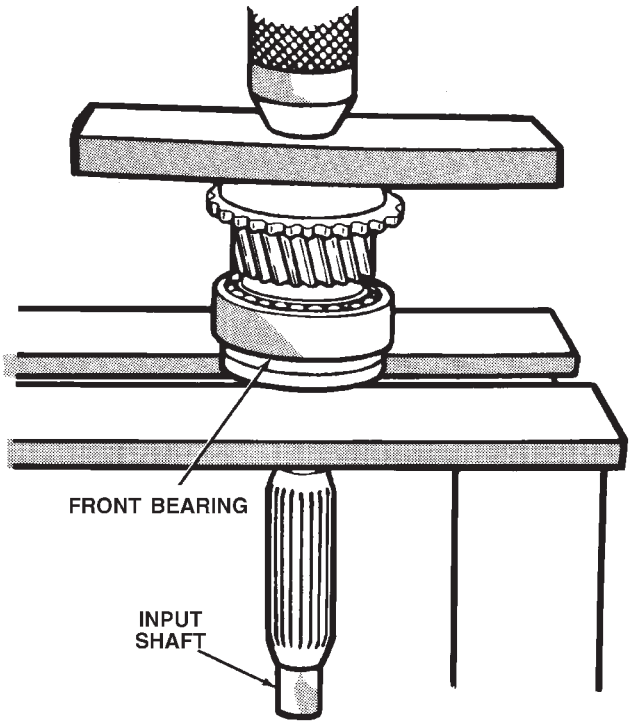
OUTPUT SHAFT

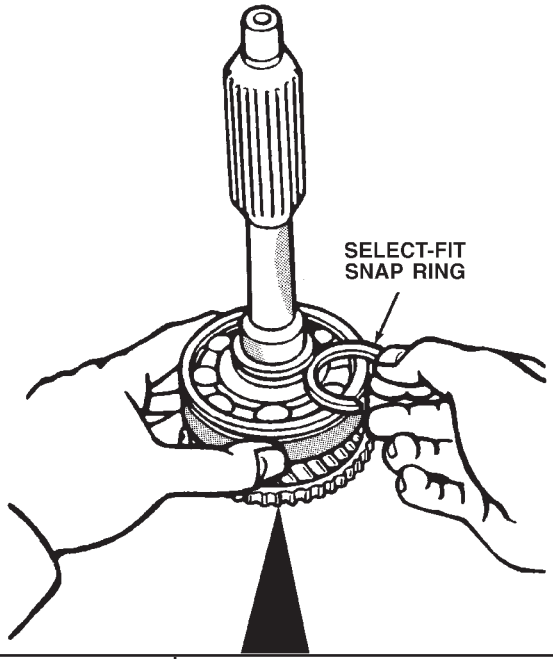
DISASSEMBLY

(1) Remove input shaft and output shaft pilot bearing rollers from output shaft.

(2) Measure and note thrust clearance of output shaft gears (Fig. 98). Clearance should be 0.10 – 0.25 mm (0.004 – 0.010 in.).

(3) Remove output shaft fifth gear snap ring with two screwdrivers (Fig. 99).





I. D. Mark	Snap Ring Thickness mm (in.)
0	2.05-2.10 (0.0807-0.0827)
1	2.10-2.15 (0.0827-0.0846)
2	2.15-2.20 (0.0846-0.0866)
3	2.20-2.25 (0.0866-0.0886)
4	2.25-2.30 (0.0886-0.0906)
5	2.30-2.35 (0.0906-0.0925)

J8921-50

Fig. 96 Select Input Shaft Bearing Snap-ring

DISASSEMBLY AND ASSEMBLY (Continued)

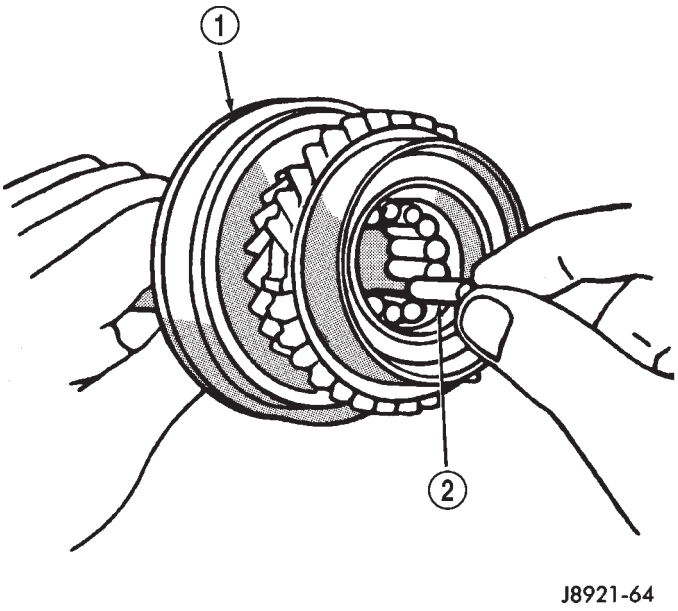


Fig. 97 Install Output Shaft Pilot Bearing Rollers

1 – INPUT SHAFT
2 – BEARING ROLLERS

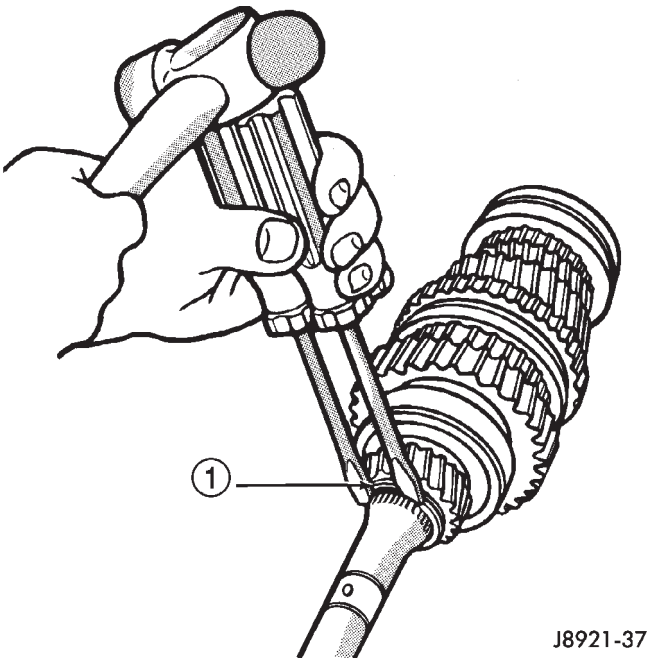


Fig. 99 Remove Fifth Gear Snap-ring

1 – SNAP RING

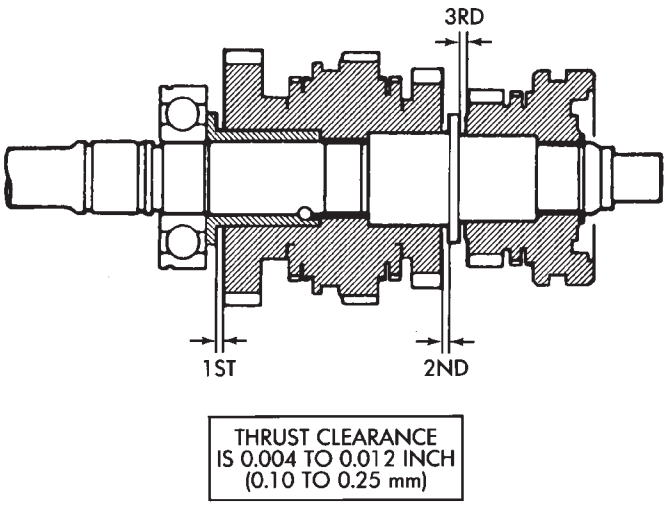


Fig. 98 Check Output Shaft Gear Thrust Clearance

(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. 100).

(5) Remove first gear needle roller bearing from output shaft.

(6) Remove first gear bearing inner race lock ball with pencil magnet (Fig. 101).

(7) Remove first gear synchronizer ring.

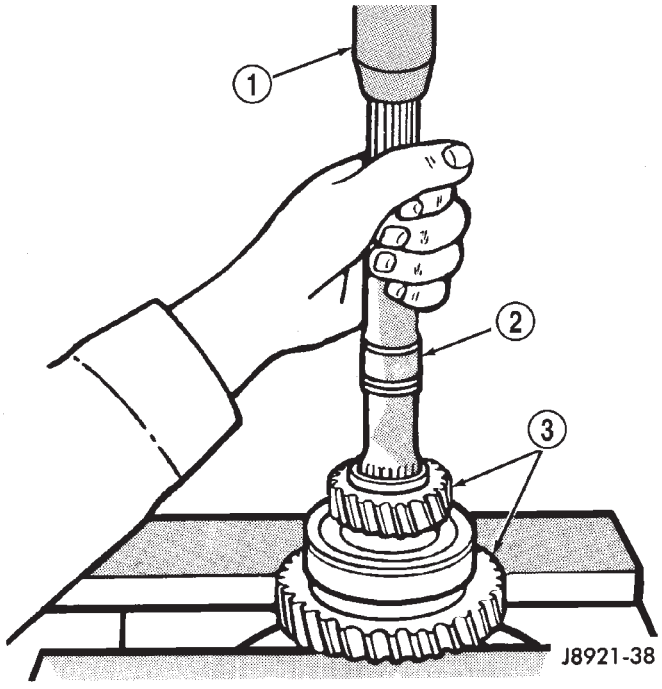


Fig. 100 Remove Fifth Gear, First Gear Bearing, And Race

1 – PRESS RAM
2 – OUTPUT SHAFT
3 – FIRST-FIFTH GEAR-BEARING ASSEMBLY

DISASSEMBLY AND ASSEMBLY (Continued)

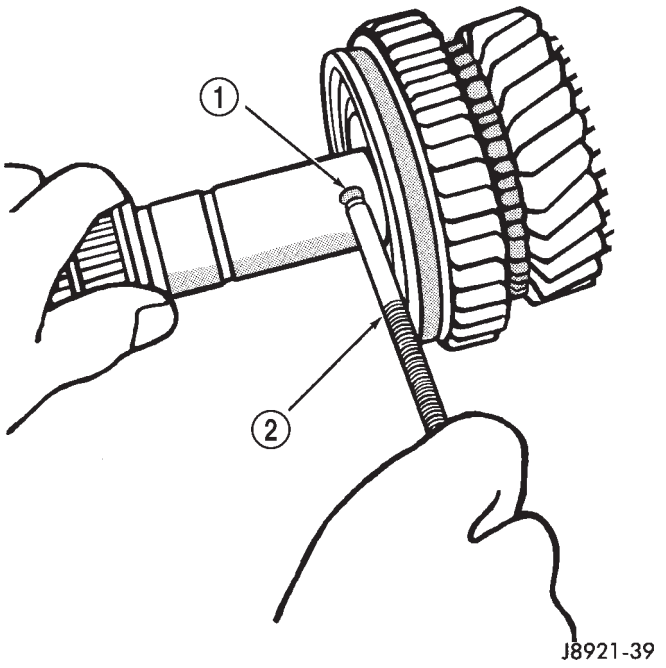


Fig. 101 Remove First Gear Bearing Inner Race Lock Ball

1 – LOCK BALL
2 – PENCIL MAGNET

(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. 102).

(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. 103).

(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. 104).

(12) Remove third gear needle roller bearing from output shaft or gear.

ASSEMBLY

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. 105) during assembly for AX5 gear assembly identification.

(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. 106).

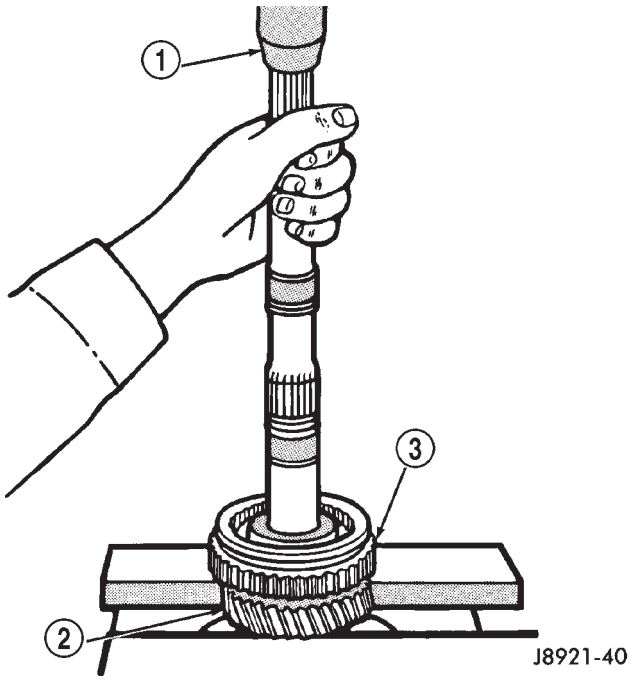


Fig. 102 Remove Second Gear, Reverse Gear, And 1–2 Synchronizer

1 – PRESS RAM
2 – SECOND GEAR
3 – 1–2 SYNCHRONIZER HUB

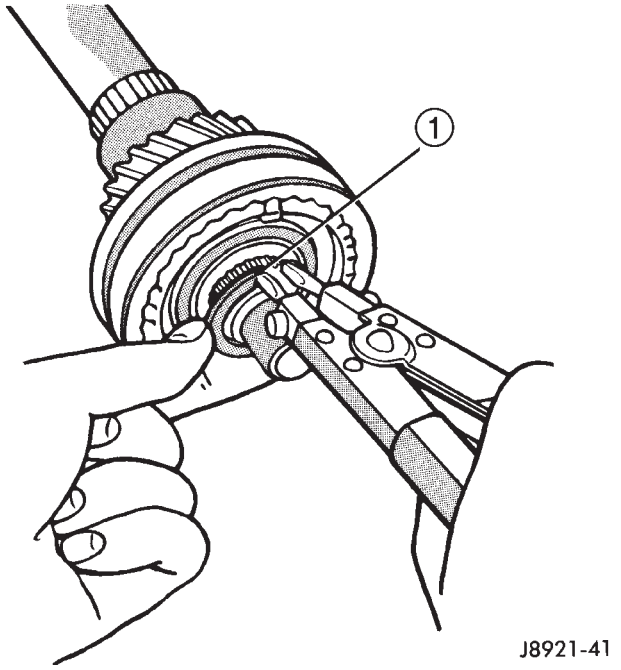


Fig. 103 Remove 3–4 Synchronizer Snap Ring

1 – 3–4 SYNCHRONIZER SNAP RING

(3) Install third gear needle bearing onto the output shaft.

DISASSEMBLY AND ASSEMBLY (Continued)

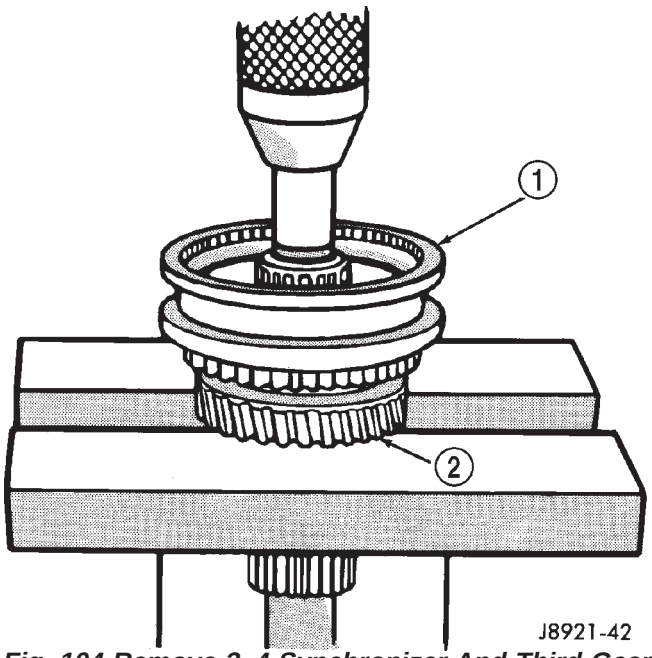


Fig. 104 Remove 3–4 Synchronizer And Third Gear

1 – 3–4 SYNCHRONIZER
2 – THIRD GEAR

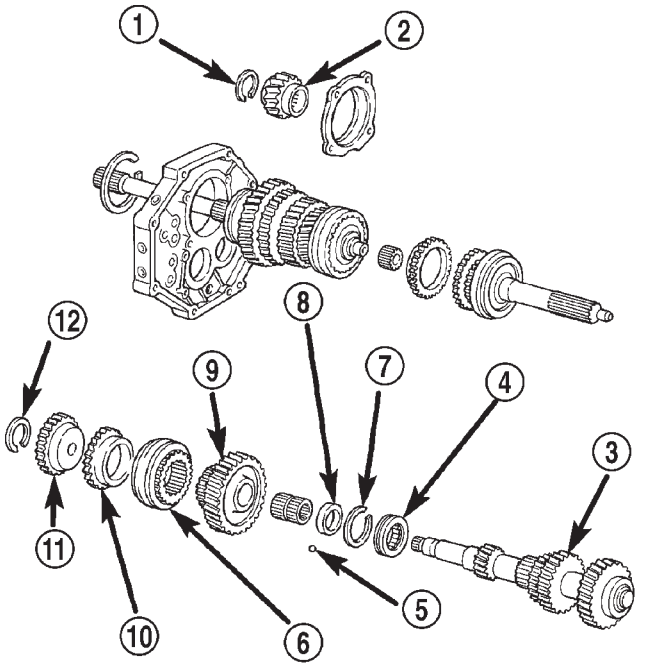


Fig. 105 Geartrain Components

1 – SNAP RING
2 – FIFTH GEAR
3 – COUNTER GEAR
4 – BEARING
5 – LOCK BALL
6 – SYNCHRO HUB/SLEEVE
7 – SNAP RING
8 – SPACER
9 – COUNTER 5TH GEAR
10 – SYNCHRO RING
11 – 5TH SPLINE GEAR
12 – SNAP RING

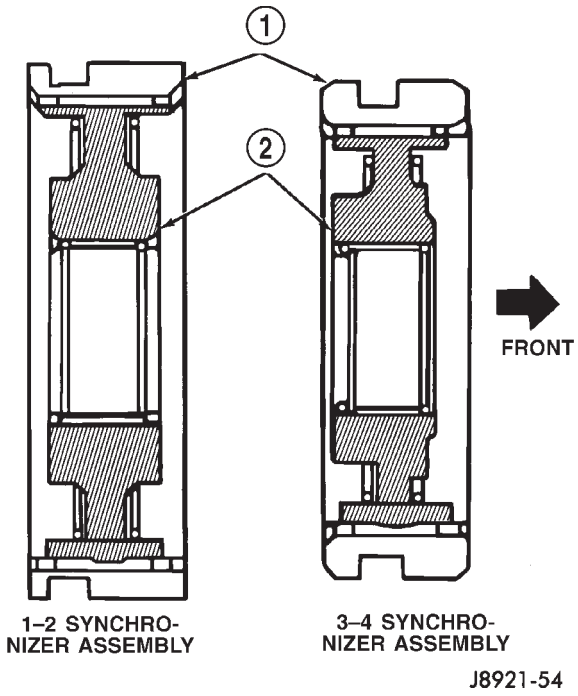


Fig. 106 Synchronizer Identification

1 – SLEEVES
2 – HUBS

(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. 107).

(9) Install snap-ring to hold 3–4 synchronizer onto output shaft.

(10) Verify third gear thrust clearance with feeler gauge (Fig. 108). Clearance should be 0.10 – 0.25 mm (0.004 – 0.010 in.). If clearance is out of specification, refer to Cleaning and Inspection section within this group.

(11) Install second gear needle bearing onto output shaft.

(12) Install second gear over bearing and onto output shaft flange.

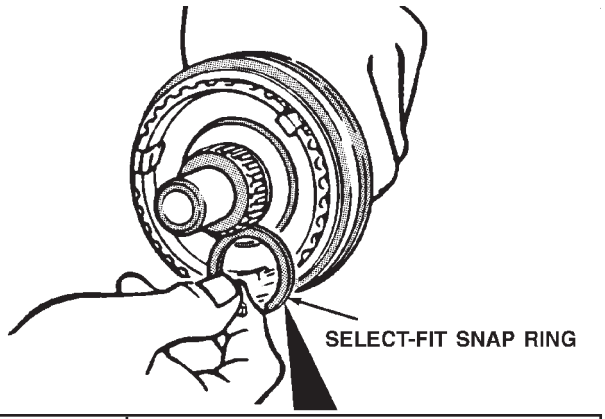
(13) Install second gear synchronizer ring onto second gear.

(14) Position 1–2 synchronizer assembly onto splines of output shaft.

(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.

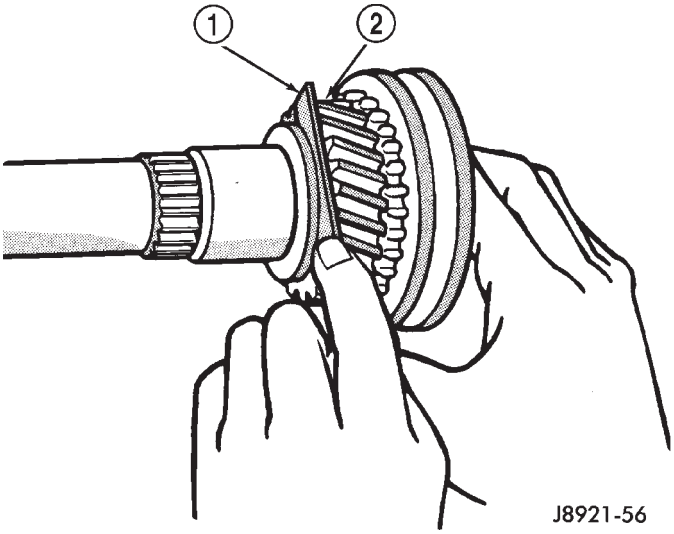
DISASSEMBLY AND ASSEMBLY (Continued)



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. 107 Select 3–4 Synchronizer Snap-ring



J8921-56

Fig. 108 Check Third Gear Clearance

1 – FEELER GAUGE
2 – THIRD GEAR

(17) Install first gear bearing inner race lock ball in output shaft (Fig. 109).

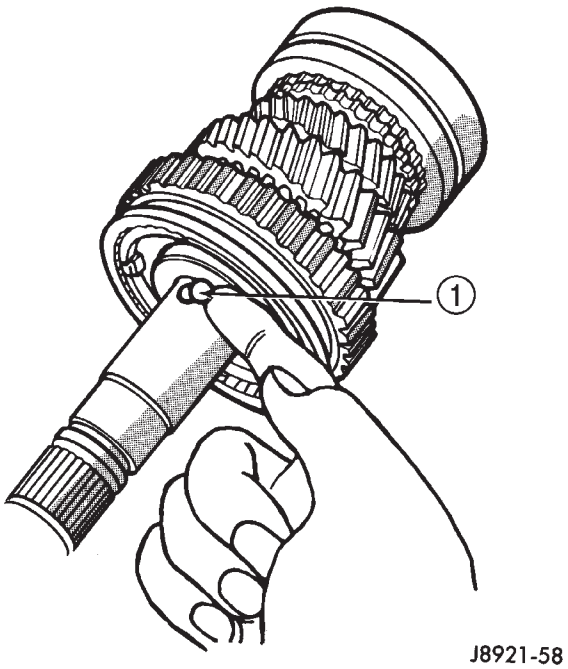
(18) Install first gear needle bearing onto output shaft (Fig. 110).

(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.

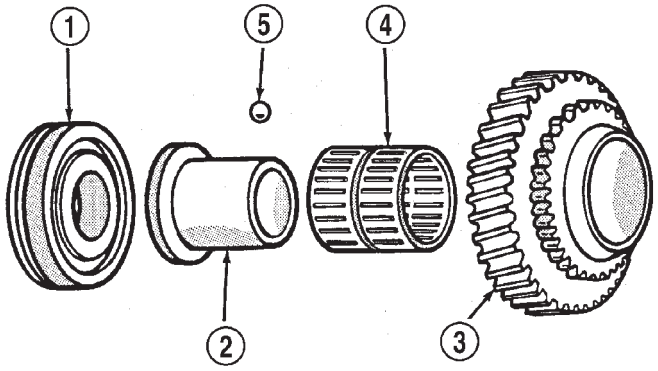


J8921-58

Fig. 109 Install First Gear Bearing Inner Race Lock Ball

1 – FIRST GEAR LOCK BALL

(23) Install snap-ring onto output shaft rear bearing outer race.



J8921-59

Fig. 110 First Gear Components

1 – REAR BEARING
2 – INNER RACE
3 – FIRST GEAR
4 – NEEDLE BEARING
5 – FIRST GEAR LOCK BALL

DISASSEMBLY AND ASSEMBLY (Continued)

(24) Check first–second gear thrust clearance (Fig. 111). 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.

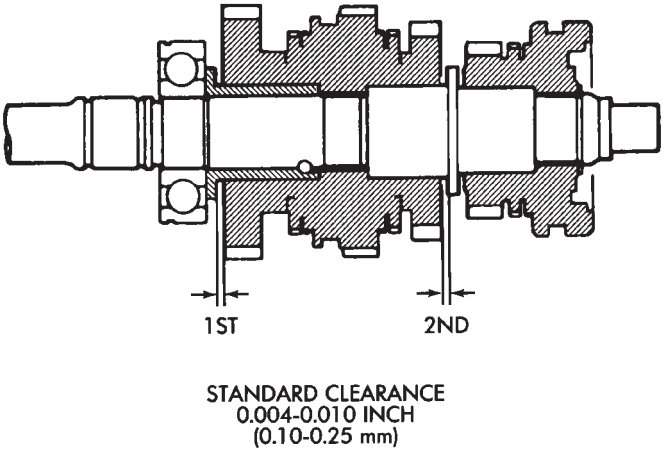


Fig. 111 Check First–Second Gear Thrust Clearance

(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. 112).

(28) Install snap-ring to hold fifth gear onto output shaft.

SEMI-SYNCHRONIZED REVERSE IDLER GEAR

DISASSEMBLY

(1) Remove snap-ring holding the reverse idler gear onto the reverse idler gear hub/race (Fig. 113).

(2) Remove the plate washer from the reverse idler gear hub/race (Fig. 114).

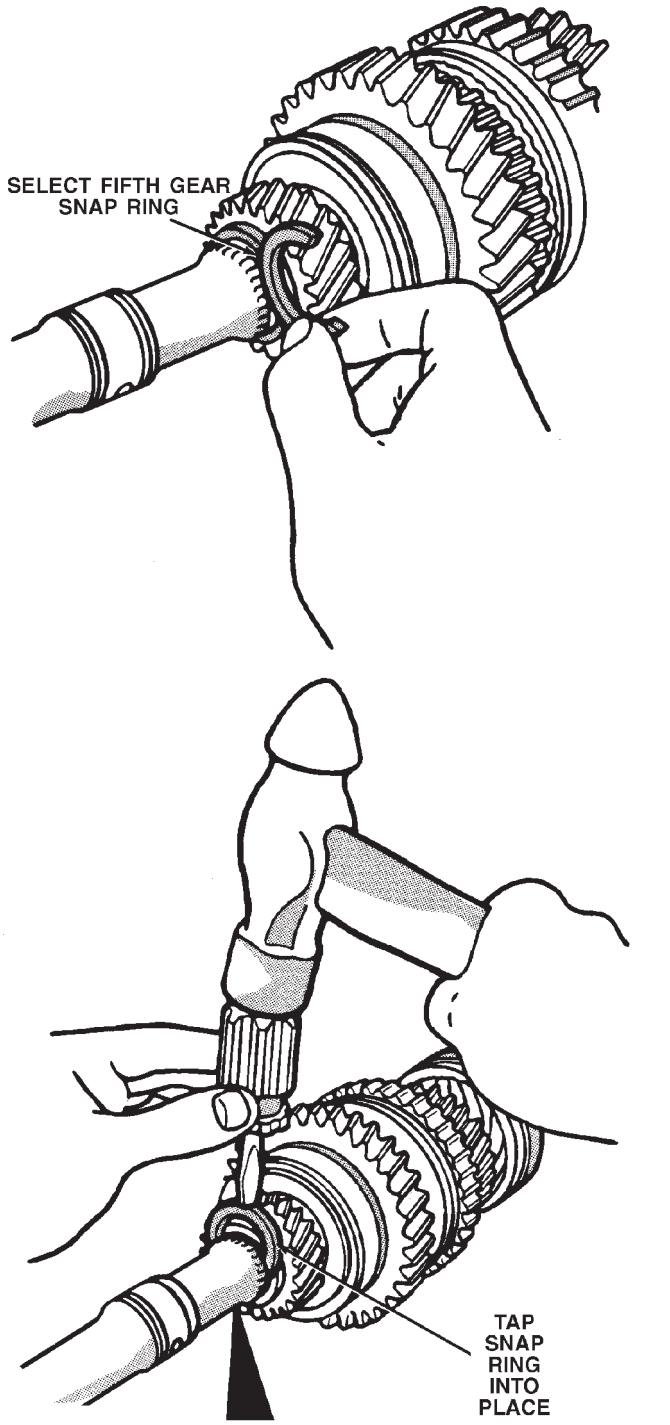
(3) Remove the reverse idler gear from the reverse idler gear hub/race (Fig. 115).

(4) Remove the reverse idler gear synchronizer ring from the reverse idler gear hub/race (Fig. 116).

ASSEMBLY

(1) Install the reverse idler gear synchronizer ring onto the reverse idler gear hub/race. Apply a film of 75W-90 GL-3 transmission oil to the contact surface of the synchronizer ring prior to assembly.

(2) Install the reverse idler gear onto the reverse idler gear hub/race. Apply a film of 75W-90 GL-3 transmission oil to the reverse idler gear bushing prior to assembly. Verify that the teeth on the synchronizer ring are properly engaged into the recesses of the reverse idler gear.



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. 112 Select/Install Fifth Gear Snap Ring

DISASSEMBLY AND ASSEMBLY (Continued)

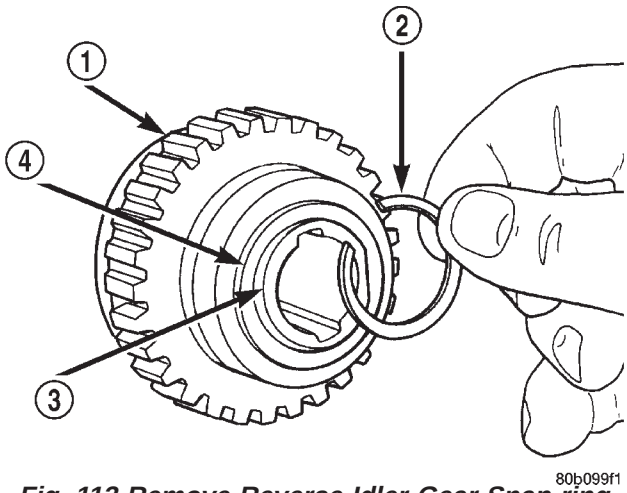


Fig. 113 Remove Reverse Idler Gear Snap-ring

1 – REVERSE IDLER GEAR
2 – SNAP-RING
3 – REVERSE IDLER GEAR HUB
4 – PLATE WASHER

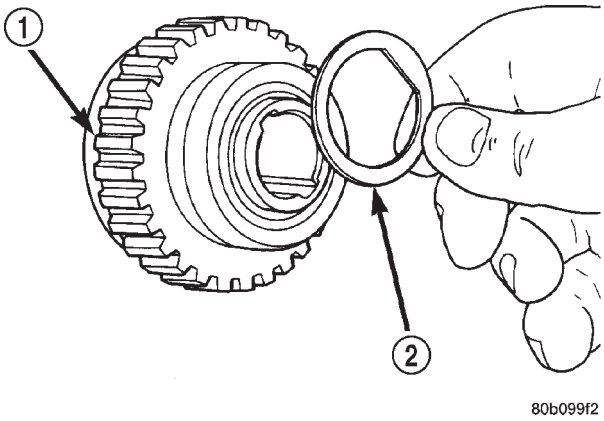


Fig. 114 Remove Reverse Idler Gear Plate Washer

1 – REVERSE IDLER GEAR
2 – PLATE WASHER

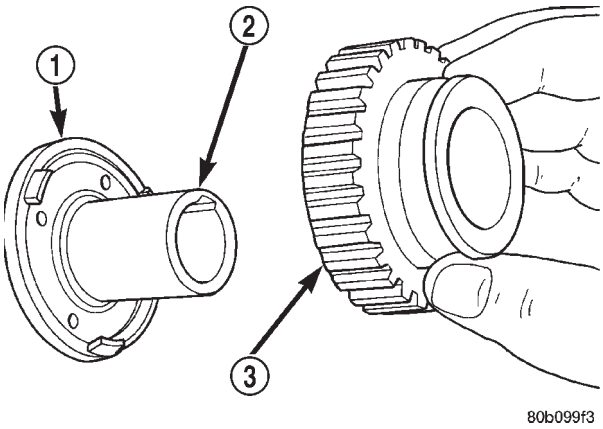


Fig. 115 Remove Reverse Idler Gear

1 – REVERSE SYNCHRONIZER RING
2 – REVERSE IDLER GEAR HUB
3 – REVERSE IDLER GEAR

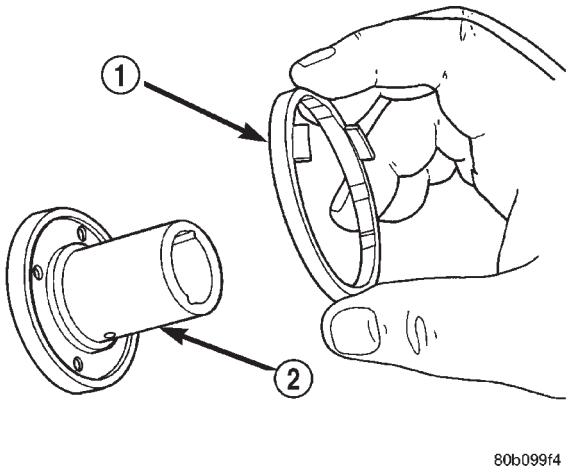


Fig. 116 Remove Reverse Idler Gear Synchronizer Ring

1 – REVERSE SYNCHRONIZER RING
2 – REVERSE IDLER GEAR HUB

(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 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.

CLEANING AND INSPECTION (Continued)

OUTPUT SHAFT

Check thickness of the output shaft and inner bearing race flanges with a micrometer or vernier calipers (Fig. 117).

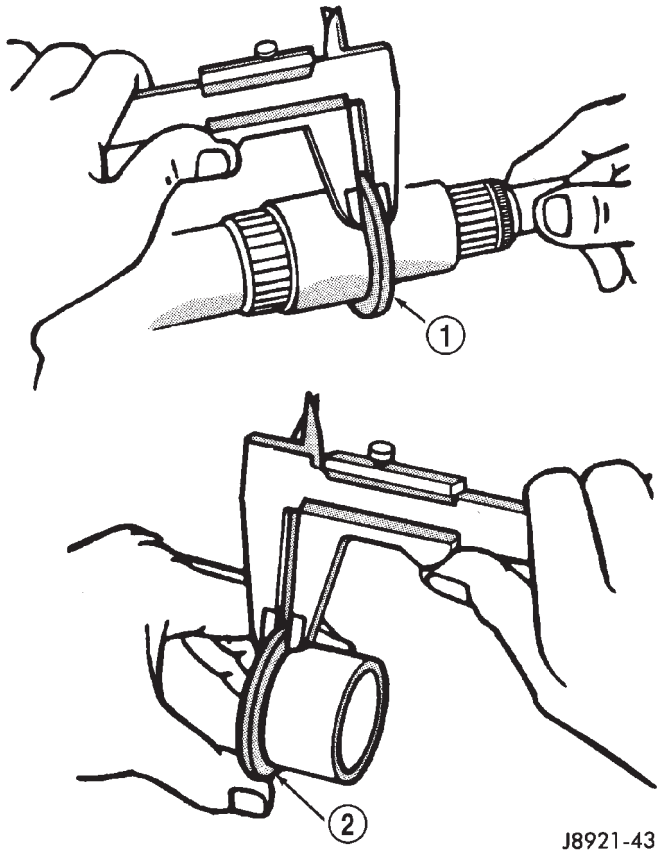


Fig. 117 Check Shaft And Bearing Race Flange Thickness

1 – OUTPUT SHAFT FLANGE
2 – INNER RACE FLANGE

- 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. 118). Runout should not exceed 0.05 mm (0.002 in.).

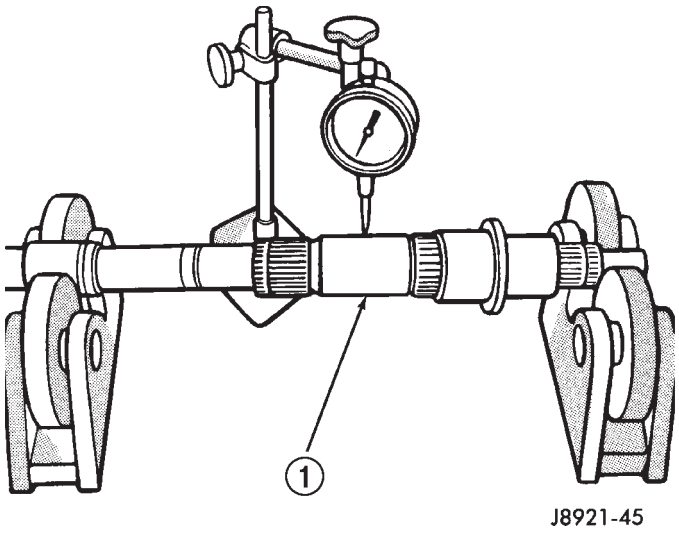


Fig. 118 Check Output Shaft Runout

1 – OUTPUT SHAFT JOURNAL

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. 119). 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. 120). Oil clearance for all three gears is 0.009 – 0.0013 mm (0.0004 – 0.0013 in.).

Check synchronizer ring wear (Fig. 121). Insert each ring in matching gear. Measure clearance between each ring and gear with feeler gauge. Replace ring if clearance exceeds 2.0 mm (0.078 in.).

Check shift fork–to–synchronizer hub clearance with a feeler gauge (Fig. 122). 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.

CLEANING AND INSPECTION (Continued)

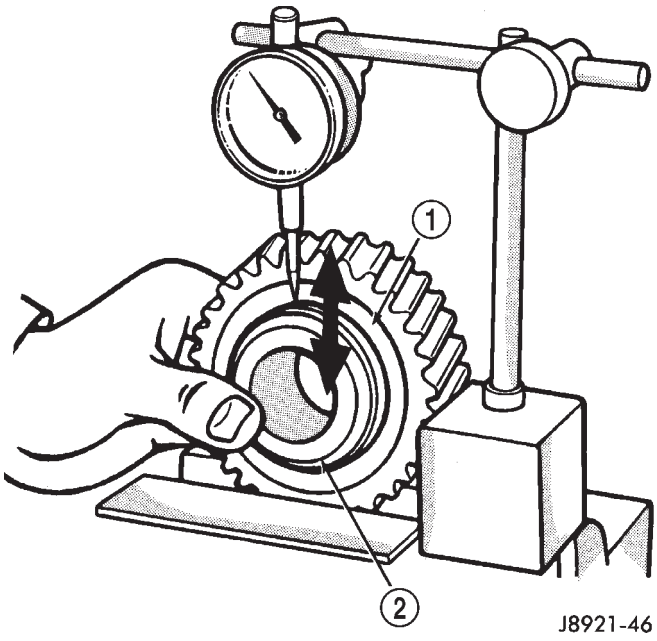


Fig. 119 Check Gear–To–Race Clearance

1 – GEAR
2 – INNER RACE

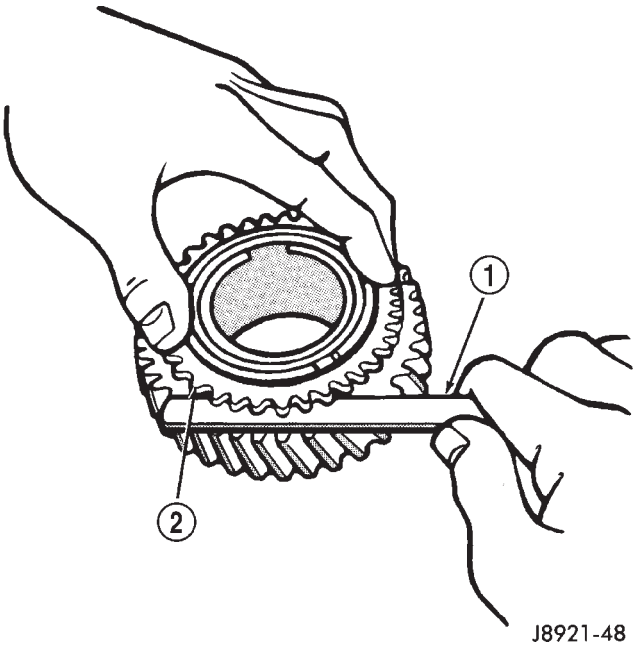


Fig. 121 Check Synchronizer Ring Wear

1 – FEELER GAUGE
2 – SYNCHRONIZER RING

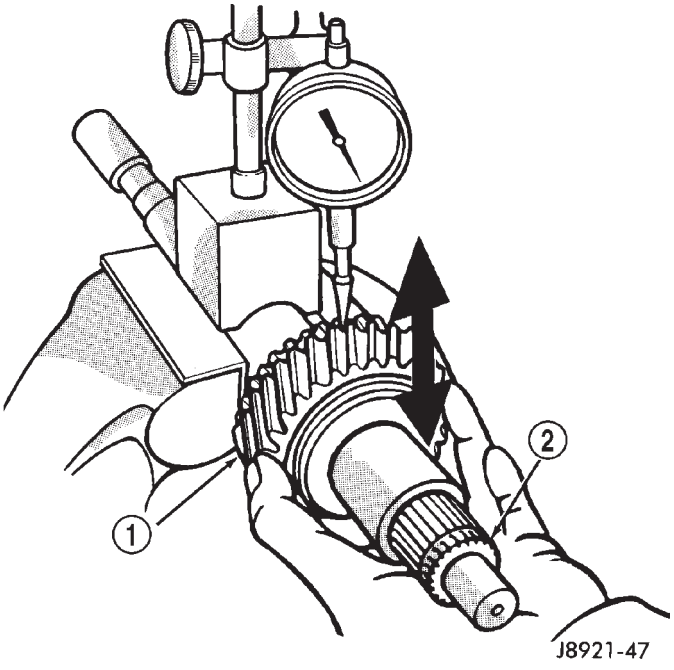


Fig. 120 Check Gear–To–Shaft Oil Clearance

1 – GEAR BEING CHECKED
2 – OUTPUT SHAFT

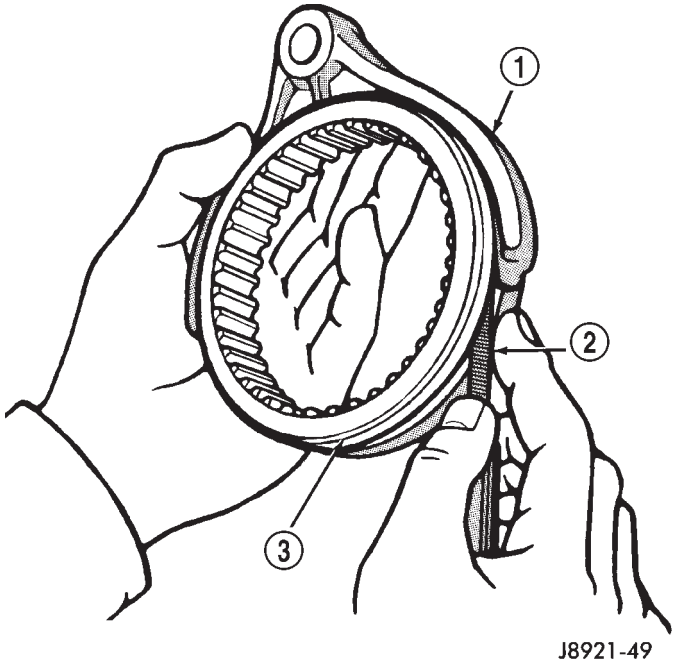


Fig. 122 Check Fork–To–Hub Clearance

1 – SHIFT FORK
2 – FEELER GAUGE
3 – SYNCHRONIZER SLEEVE

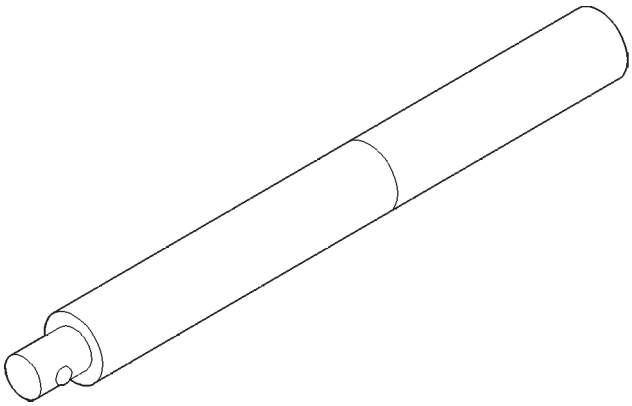
SPECIFICATIONS

TORQUE

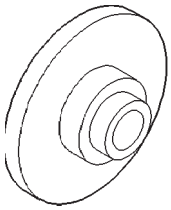
DESCRIPTION	TORQUE
Plugs, Access	19 N·m (14 ft.lbs.)
Bolts, Adapter Housing	34 N·m (25 ft.lbs.)
Switch, Back-up Light	44 N·m (32.5 ft.lbs.)
Plugs, Drain and Fill	44 N·m (32.5 ft.lbs.)
Bolts, Front Bearing Retainer	17 N·m (12 ft.lbs.)
Plugs, Interlock and Detent	19 N·m (14 ft.lbs.)
Screws, Propeller Shaft 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	41–68 N·m (30–50 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

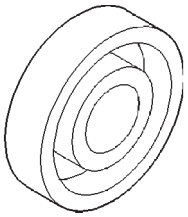
AX5



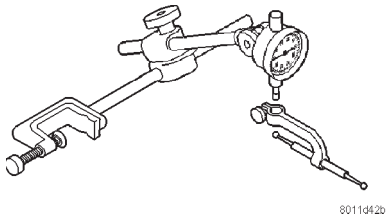
C-4171 Handle, Universal Tool



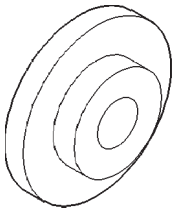
8211 Installer, Seal



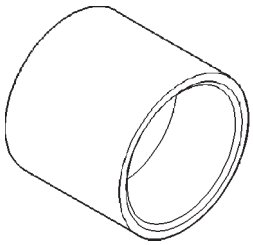
8212 Installer, Seal



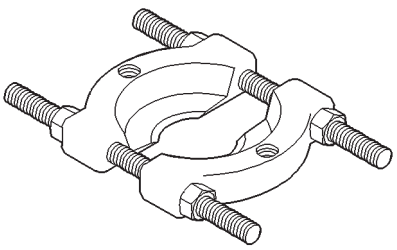
C-3339 Dial Indicator Set



8208 Installer, Seal

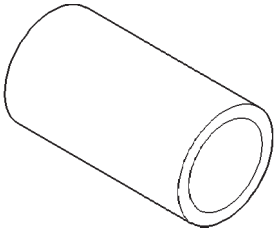


C-3995-A Installer, Extension Housing Seal

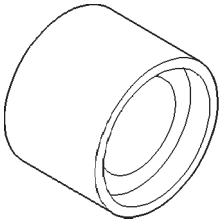


P-334 Splitter, Bearing

SPECIAL TOOLS (Continued)



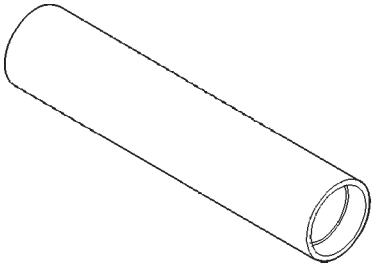
8109 Cup, Installer



6747–1A Adapter, Fixture



L-4507 Tube, Driver



MD-998805 Installer, Seal

NV3550 MANUAL TRANSMISSION

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DESCRIPTION AND OPERATION

NV3550 MANUAL TRANSMISSION

DESCRIPTION

The NV3550 is a medium-duty, 5-speed, constant mesh, fully synchronized manual transmission. Fifth gear is an overdrive range with a ratio of 0.78:1. The NV3550 is available in two and four–wheel drive configurations.

The transmission gear case consists of two aluminum housings. The clutch housing is a removable component. It is not an integral part of the transmission front housing.

A combination of roller and ball bearings are used to support the transmission shafts in the two housings. The transmission gears all rotate on caged type needle bearings. A roller bearing is used between the input and output shaft.

The NV3550 has a single shaft shift mechanism with three shift forks all mounted on the shaft. The shaft is supported in the front and rear housings by bushings and one linear ball bearing. Internal shift components consist of the forks, shaft, shift lever socket, and detent components (Fig. 1).

GEAR RATIOS

Gear ratios for the NV3550 are as follows:

RANGE	RATIO
FIRST	4.01:1
SECOND	2.32:1
THIRD =	1.40:1
FOURTH =	1:1
FIFTH =	0.78:1
REVERSE =	3.55:1

IDENTIFICATION

The NV3550 identification and part number bar code tags (Fig. 2) are located on the top of the transmission, forward of the shift tower.

OPERATION

The manual transmission receives power through the clutch assembly from the engine. The clutch disc is splined to the transmission input shaft and is turned at engine speed at all times that the clutch is engaged. The input shaft is connected to the transmission countershaft through the mesh of fourth speed gear on the input shaft and the fourth countershaft gear. At this point, all the transmission gears are spinning.

The driver selects a particular gear by moving the shift lever to the desired gear position. This movement moves the internal transmission shift components to begin the shift sequence. As the shift lever moves the selected shift rail, the shift fork attached to that rail begins to move. The fork is positioned in a groove in the outer circumference of the synchronizer sleeve. As the shift fork moves the synchronizer sleeve, the synchronizer begins to speed-up or slow down the selected gear (depending on whether we are up-shifting or down-shifting). The synchronizer does this by having the synchronizer hub splined to the mainshaft, or the countershaft in some cases, and moving the blocker ring into contact with the gear's friction cone. As the blocker ring and friction cone come together, the gear speed is brought up or down to the speed of the synchronizer. As the two speeds match, the splines on the inside of the synchronizer sleeve become aligned with the teeth on the blocker ring and the friction cone and eventually will slide over the teeth, locking the gear to the mainshaft, or countershaft, through the synchronizer.

DESCRIPTION AND OPERATION (Continued)

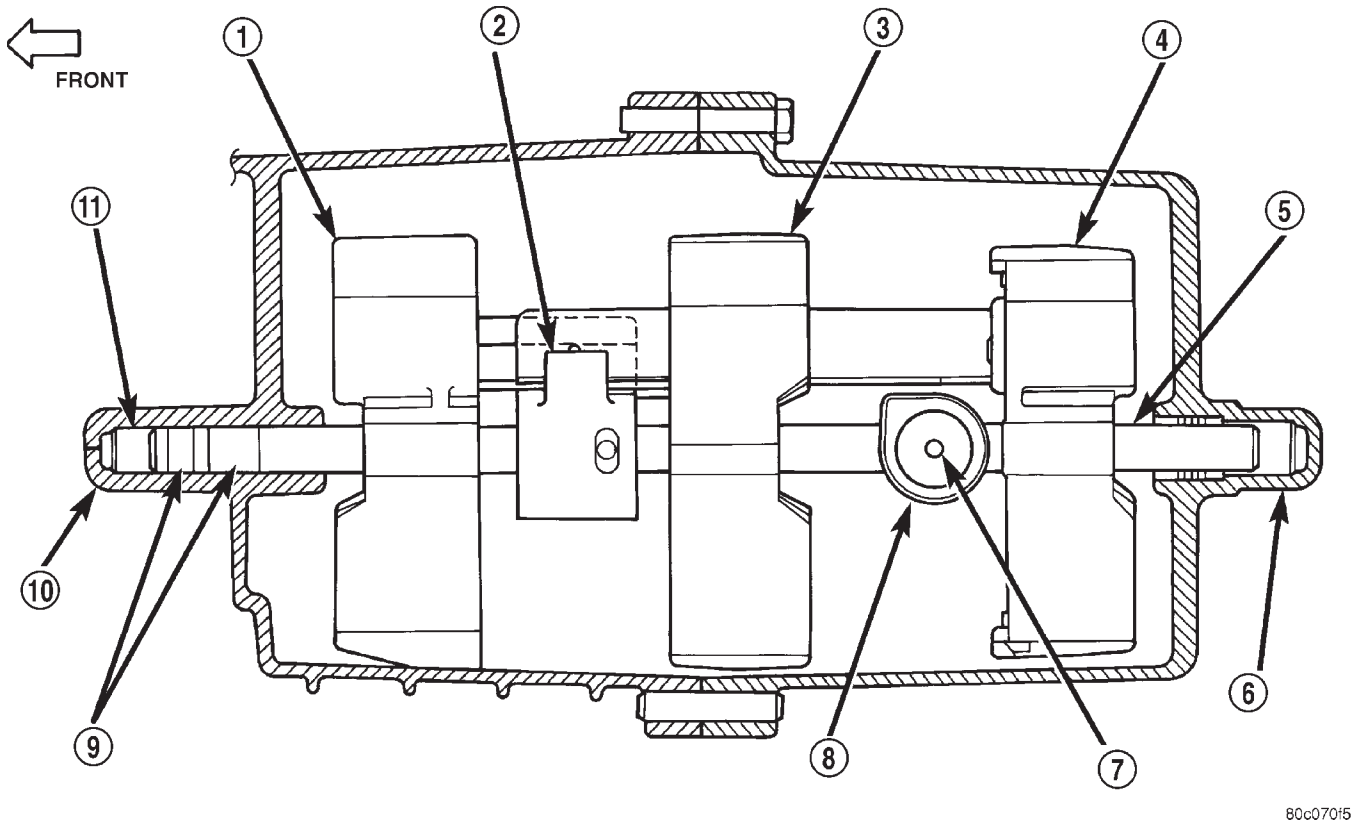


Fig. 1 NV3550 Shift Mechanism

1 – 3–4 FORK
2 – SHIFT SHAFT LEVER AND BUSHING
3 – 1–2 FORK
4 – FIFTH-REVERSE FORK
5 – SHIFT SHAFT
6 – REAR HOUSING
7 – ROLL PIN
8 – SHIFT LEVER SOCKET
9 – SHAFT RAIL DETENTS
10 – FRONT HOUSING
11 – SHIFT SHAFT

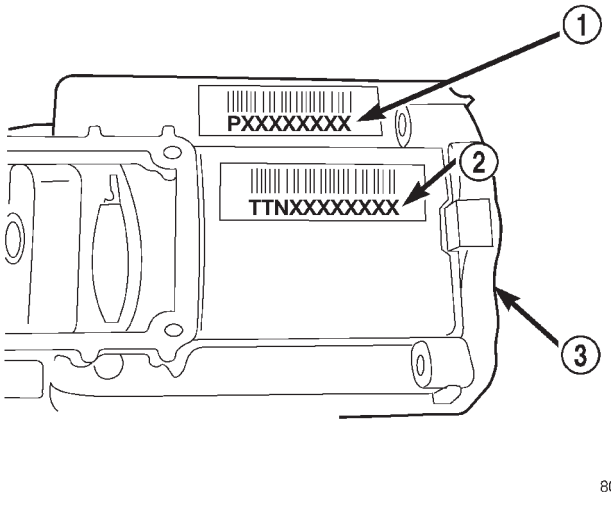


Fig. 2 NV3550 Identification

1 – PART NUMBER TAG
2 – IDENTIFICATION TAG
3 – FRONT OF REAR HOUSING

LUBRICANT

DESCRIPTION

Required lubricant for the NV3550 is Mopar® Manual Transmission Lubricant, P/N 4761526. This is the **only** lubricant to be used in NV3550 transmissions. No other lubricants are acceptable, or recommended.

The correct transmission lubricant level is to the bottom edge of the fill plug hole (Fig. 3).

The transmission must be level to obtain an accurate lubricant level check. A drive–on type of hoist is recommended for this purpose.

Lubricant capacity of the NV3500 is approximately 2.28 liters (4.8 pints). This represents the approximate quantity needed to refill the transmission after a lubricant change or overhaul.

DRAIN AND FILL PLUG LOCATIONS

The NV3550 fill plug is located in the front housing. The drain plug is at the bottom rear of the housing (Fig. 3).

DESCRIPTION AND OPERATION (Continued)

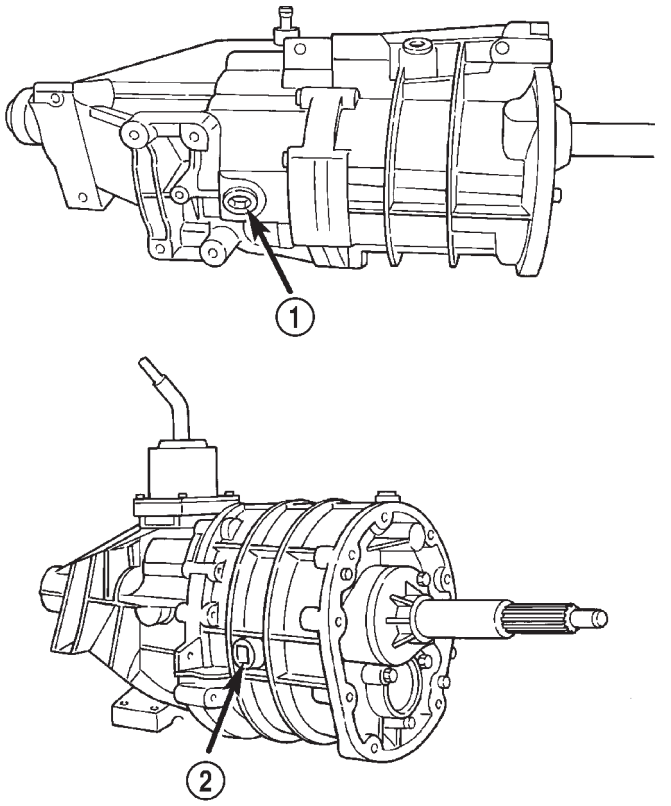


Fig. 3 Drain and Fill Plug Locations

1 – DRAIN PLUG
2 – FILL PLUG

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 housings, or from the front/rear seals. A suspected leak could also be the result of an overfill condition.

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 a loose or damaged, front bearing retainer or retainer seal. Lubricant may also drip from the transmission clutch housing after extended operation. If the leak is severe, it will contaminate the clutch disc causing slip, grab and chatter.

Transmissions filled from air or electrically powered lubricant containers can be under filled. Always check the lubricant level after filling to avoid an under fill condition.

A correct lubricant level check can only be made when the vehicle is level; use a drive–on hoist to ensure this. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an under-or-overfill condition.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper or contaminated lubricants, transmission component damage, clutch linkage malfunction, or by a damaged clutch pressure plate or disc.

Substantial lubricant leaks can result in gear, shift component, 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 stiff and/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) Shift transmission into first or third gear.

(2) Remove the floor console and shift boot as necessary to access the bottom of the shift lever at the shift tower attachment.

REMOVAL AND INSTALLATION (Continued)

(3) Install nuts on two M6X1.0 bolts and thread the bolts into the threaded holes at the base of the shift lever.

(4) Tighten the nuts equally until the shift lever loosens on the shift tower stub shaft.

(5) Remove the shift lever from the shift tower.

(6) Raise and support vehicle on suitable safety stands.

(7) Support engine with adjustable jack stand. Position wood block between jack and oil pan to avoid damaging pan.

(8) Remove crossmember/skid plate.

(9) Disconnect necessary exhaust system components.

(10) Remove slave cylinder (Fig. 4) from clutch housing.

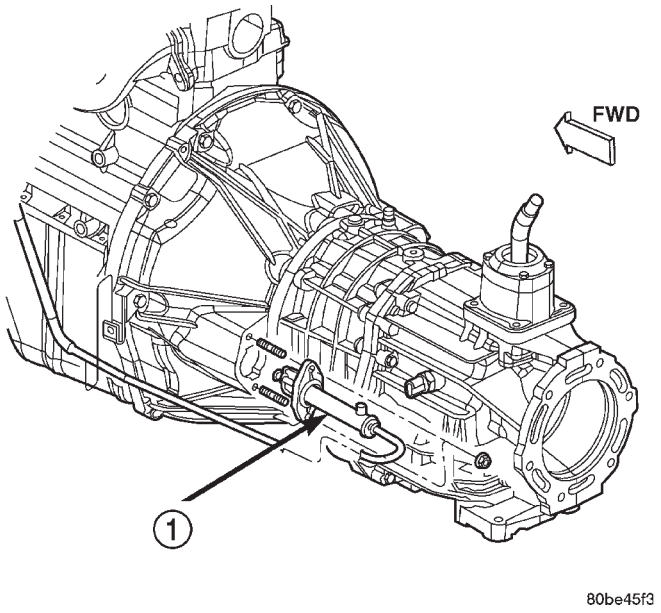


Fig. 4 Slave Cylinder

1 – CLUTCH SLAVE CYLINDER

(11) Mark rear propeller shaft and rear axle yokes for installation alignment (Fig. 5).

(12) Mark front propeller shaft, axle, and transfer case yokes for installation alignment.

(13) Remove propeller shaft(s).

(14) Unclip wire harnesses from transmission and transfer case.

(15) Disconnect transfer case vent hose.

(16) Disengage any wire connectors attached to transmission or transfer case components.

(17) Support transfer case with transmission jack.

(18) Secure transfer case to jack with safety chains.

(19) Disconnect transfer case shift linkage at transfer case.

(20) Remove nuts attaching transfer case to transmission.

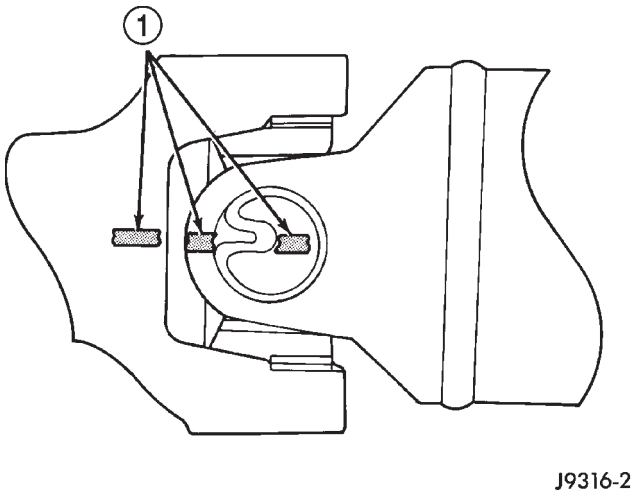


Fig. 5 Marking Propeller Shaft And Axle Yokes

1 – REFERENCE MARKS

(21) Remove transfer case.

(22) Remove crankshaft position sensor (Fig. 6).

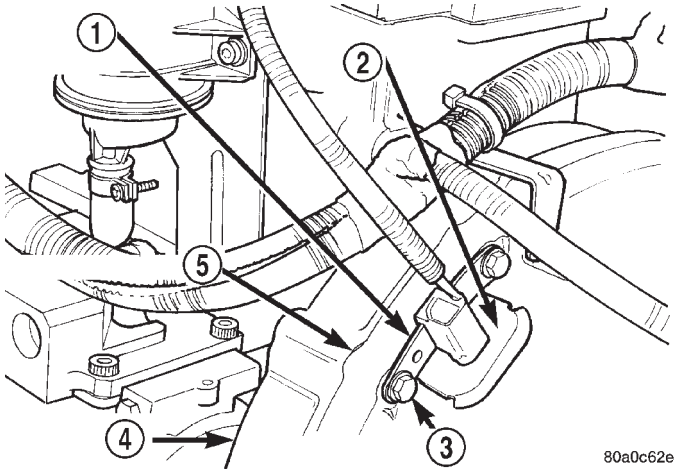


Fig. 6 Crankshaft Position Sensor —2.5 and 4.0L Engine

1 – ENGINE SPEED SENSOR
2 – GROMMET
3 – MOUNTING BOLT(S)
4 – LEFT REAR OF ENGINE
5 – TRANSMISSION

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.

(23) Support transmission with transmission jack.

(24) Secure transmission to jack with safety chains.

(25) Disconnect rear cushion and bracket from transmission.

(26) Remove clutch housing-to-engine bolts.

REMOVAL AND INSTALLATION (Continued)

(27) Pull transmission jack rearward until input shaft clears clutch. Then slide transmission out from under vehicle.

(28) Remove clutch release bearing, release fork, and retainer clip.

(29) Remove clutch housing from transmission (Fig. 7).

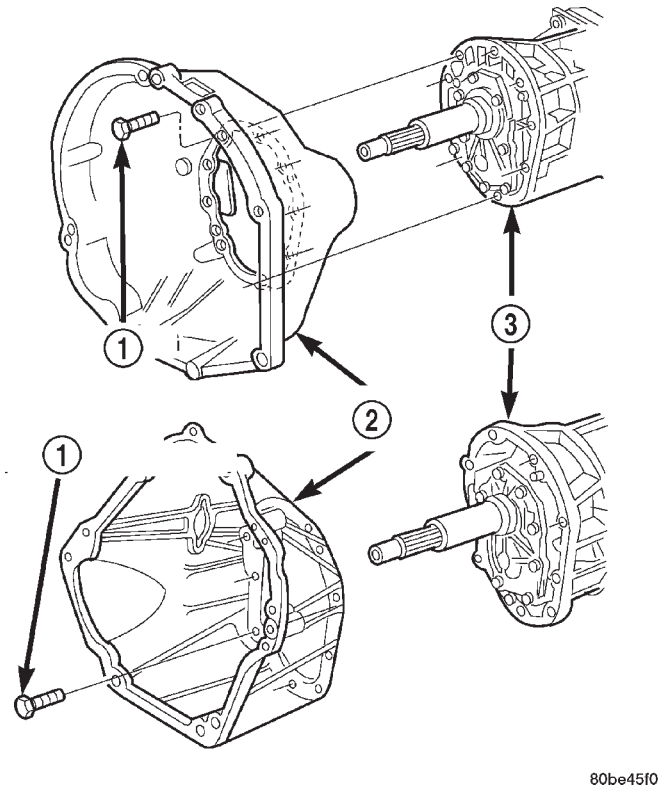


Fig. 7 Clutch Housing

1 – HOUSING-TO-TRANSMISSION BOLTS (46 N·m/34 ft. lbs.)
2 – CLUTCH HOUSING
3 – TRANSMISSION

INSTALLATION

(1) Install clutch housing on transmission. Tighten housing bolts to 46 N·m (34 ft. lbs.) torque (Fig. 7).

(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 the appropriate torque: **Be sure the housing is properly seated on engine block before tightening bolts.**

- Tighten 3/8" diameter bolts to 37 N·m (27 ft.lbs.).
- Tighten 7/16" diameter bolts to 58 N·m (43 ft.lbs.).
- Tighten M12 bolts to 75 N·m (55 ft.lbs.).

(8) Be sure transmission is in first or third gear.

(9) Install fasteners to hold rear cushion and bracket to transmission. Then tighten transmission-to-rear support bolts/nuts to 54 N·m (40 ft. lbs.) torque.

(10) Install rear crossmember. Tighten crossmember-to-frame bolts to 41 N·m (31 ft. lbs.) torque.

(11) Remove support stands from engine and transmission.

(12) Install and connect crankshaft position sensor.

(13) Position transfer case on transmission jack.

(14) Secure transfer case to jack with safety chains.

(15) Raise transfer case and align transfer case input shaft to the transmission output shaft.

(16) Slide transfer case forward until case is seated on transmission.

(17) Install nuts to attach transfer case to transmission. Tighten transfer case-to-transmission nuts to 35 N·m (26 ft. lbs.) torque.

(18) Connect transfer case shift linkage at transfer case.

(19) Connect transfer case vent hose.

(20) Secure wire harnesses in clips/tie straps on transmission and transfer case.

(21) Engage wire connectors attached to all necessary transmission or transfer case components.

(22) Install rear propeller shaft slip yoke to transmission or transfer case output shaft.

(23) Align marks on rear propeller shaft and rear axle yokes (Fig. 8).

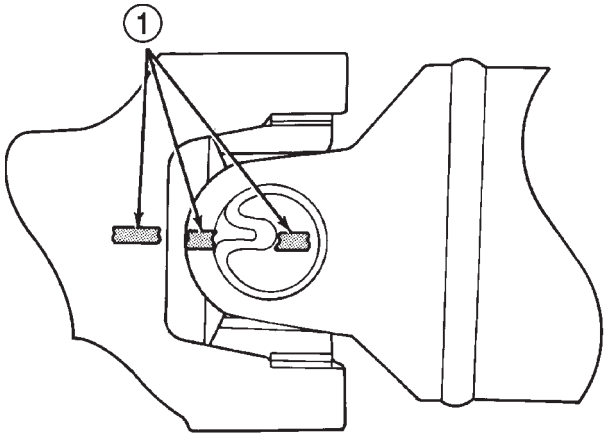


Fig. 8 Align Propeller Shaft And Rear Axle Yokes Alignment Marks

1 – REFERENCE MARKS

REMOVAL AND INSTALLATION (Continued)

(24) Install and tighten propeller shaft U–joint clamp bolts to 19 N·m (170 in. lbs.) torque.

(25) Align marks on front propeller shaft, axle, and transfer case yokes.

(26) Install and tighten propeller shaft U–joint clamp bolts to 19 N·m (170 in. lbs.) torque.

(27) Install slave cylinder in clutch housing.

(28) 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.

(29) Fill transmission and transfer case, if equipped, with recommended lubricants. Refer to the Lubricant section of the appropriate component for correct fluid.

(30) Lower vehicle.

(31) Install nuts on two M6X1.0 bolts and thread the bolts into the threaded holes at the base of the shift lever.

(32) Tighten the nuts equally until the shift lever will slide over the shift tower stub shaft.

(33) Install the floor console and shift boot.

SHIFT TOWER

REMOVAL

(1) Shift transmission into Neutral.

(2) Unscrew and remove the shift lever extension from the shift

(3) Remove any floor console components necessary to access the transmission shift tower.

(4) Remove the bolts holding the shift tower to the isolator plate and transmission gear case.

(5) Remove the shift tower (Fig. 9) from the transmission.

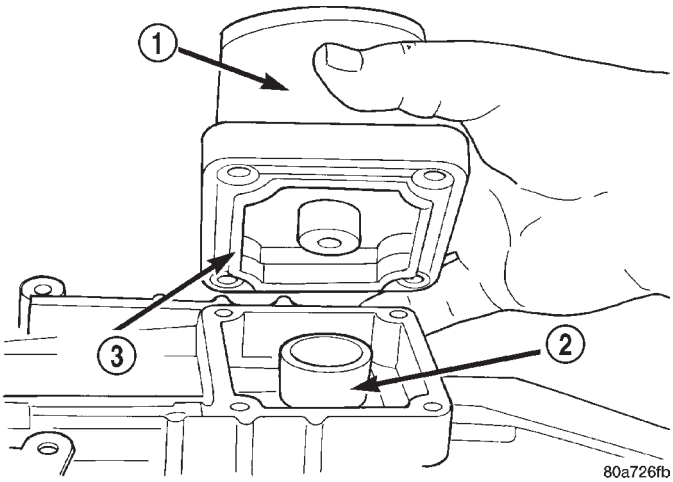


Fig. 9 Remove Shift Tower

1 – SHIFT TOWER AND LEVER ASSEMBLY
2 – SHIFT SOCKET
3 – SEAL

INSTALLATION

(1) Shift transmission into third gear.

(2) Clean the mating surfaces of shift tower and transmission gear case with suitable wax and grease remover.

(3) Install the shift tower onto the transmission case. No sealant is necessary between the shift tower and transmission case.

(4) Install the bolts to hold the shift tower to the isolator plate and the transmission gear case. Tighten the shift tower bolts to 8.5 N·m (6.3 ft. lbs.).

(5) Install the shift lever extension and any floor console components previously removed.

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

DISASSEMBLY

FRONT HOUSING

(1) If necessary, temporarily reinstall shift lever assembly. Shift transmission into Neutral.

(2) If lubricant was not drained out of transmission during removal, remove drain plug and drain lubricant into container at this time.

(3) Inspect drain plug magnet for debris.

(4) Remove backup light switch (Fig. 10). Switch is located on driver side of rear housing.

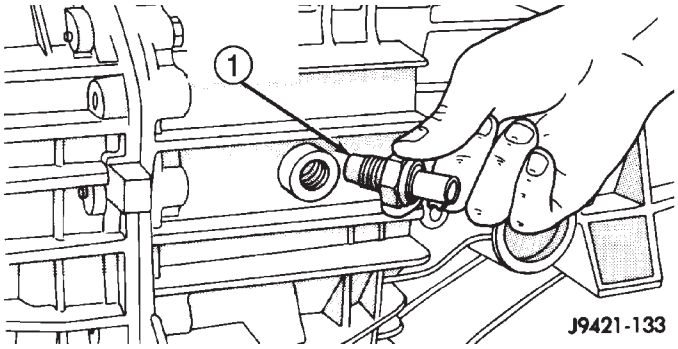


Fig. 10 Installing Backup Light Switch

1 – BACKUP LIGHT SWITCH

(5) If necessary, remove shift tower bolts and remove tower and lever assembly (Fig. 11).

(6) Remove shift shaft lock bolt (Fig. 12). Bolt is located at top of front housing just forward of shift tower. Bolt is a shoulder bolt that secures the shift shaft bushing and lever.

(7) Use Remover 8117 and suitable slide hammer to remove shift shaft detent plug.

(8) Remove shift shaft detent plunger and spring (Fig. 13). Use pencil magnet to remove spring then plunger, if necessary.

DISASSEMBLY AND ASSEMBLY (Continued)

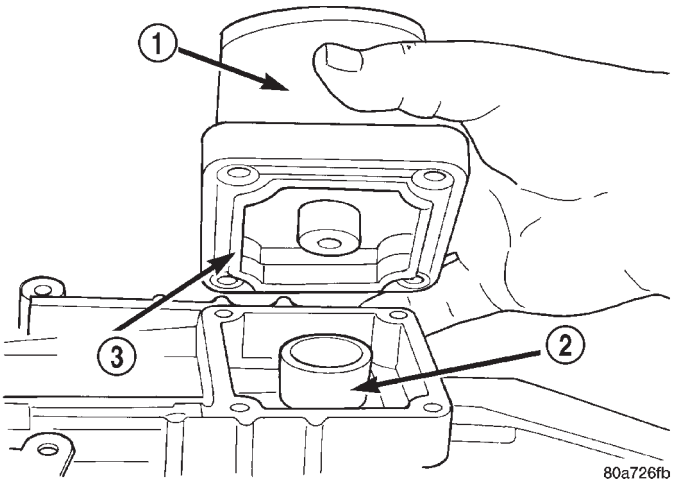


Fig. 11 Shift Tower Removal

1 – SHIFT TOWER AND LEVER ASSEMBLY
2 – SHIFT SOCKET
3 – SEAL

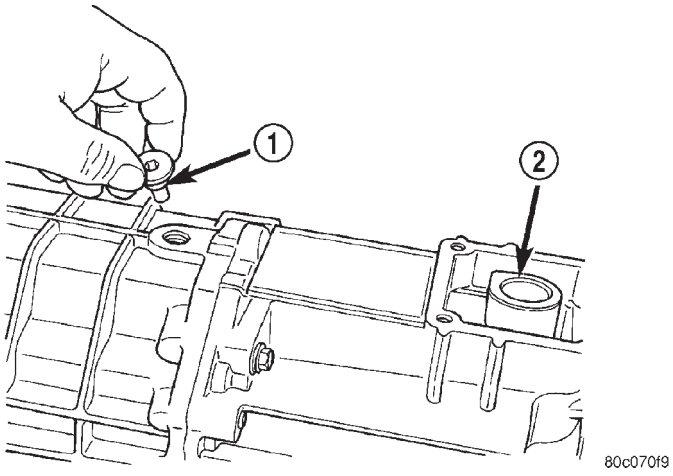


Fig. 12 Shift Shaft Lock Bolt Removal

1 – SHIFT SHAFT LOCK BOLT
2 – SHAFT SOCKET

(9) Remove bolts attaching input shaft bearing retainer to front housing (Fig. 14).

(10) Remove input shaft bearing retainer. Use pry tool to carefully lift retainer and break sealer bead (Fig. 15).

(11) Remove bearing retainer from input shaft (Fig. 16).

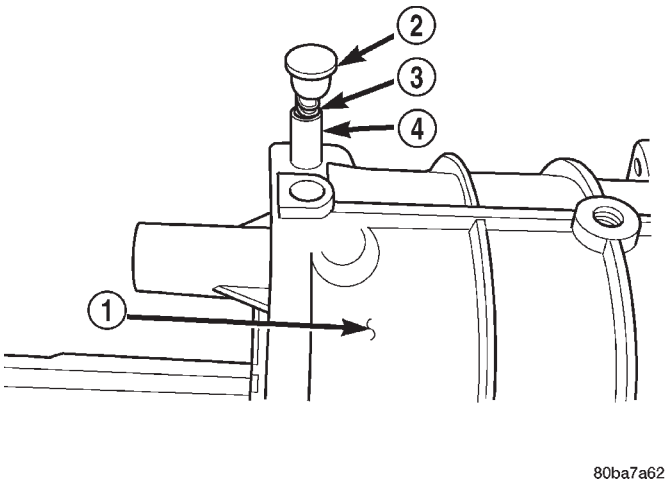


Fig. 13 Detent Plunger And Spring Removal

1 – FRONT HOUSING
2 – PLUG
3 – SPRING
4 – PLUNGER

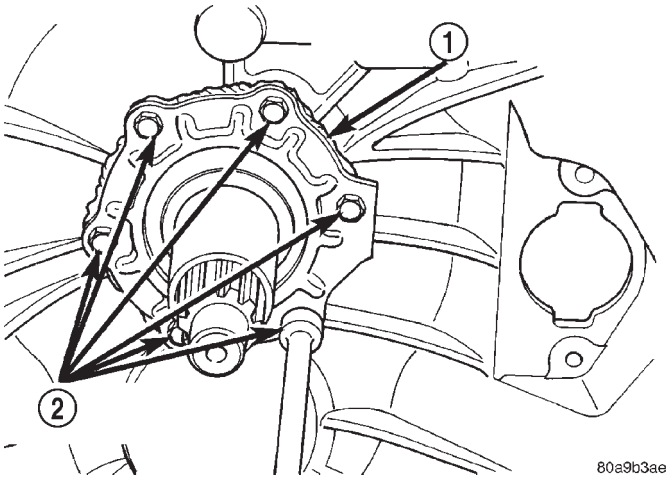


Fig. 14 Input Shaft Bearing Retainer Bolt Removal—Typical

1 – INPUT SHAFT BEARING RETAINER
2 – RETAINER BOLTS

(12) Remove snap ring that secures input shaft in front bearing (Fig. 17).

(13) Remove bolts that attach front housing to rear housing.

DISASSEMBLY AND ASSEMBLY (Continued)

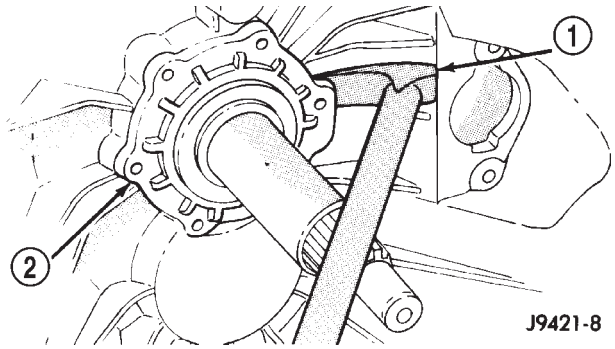


Fig. 15 Loosening Bearing Retainer Sealer Bead—Typical

1 – PRY TOOL
2 – INPUT SHAFT BEARING RETAINER

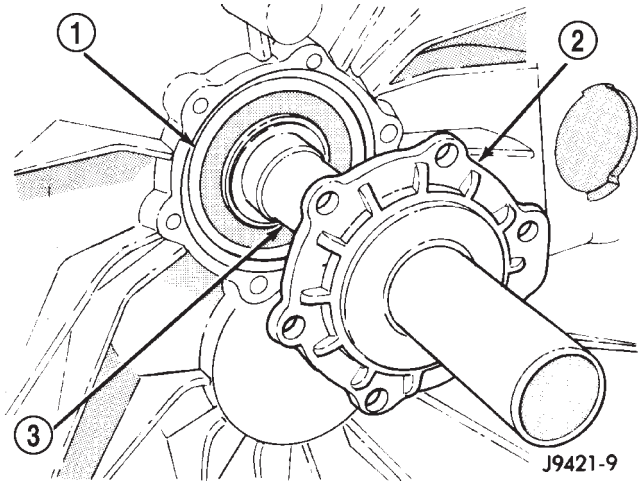


Fig. 16 Input Shaft Bearing Retainer Removal—Typical

1 – SHAFT BEARING
2 – BEARING RETAINER
3 – INPUT SHAFT

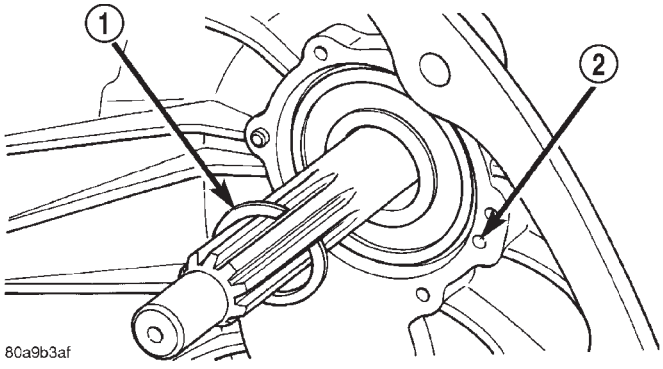


Fig. 17 Input Shaft Snap Ring Removal—Typical

1 – INPUT SHAFT SNAP RING
2 – OIL FEED

(14) Separate front housing from rear housing (Fig. 18). Use plastic mallet to tap front housing off alignment dowels.

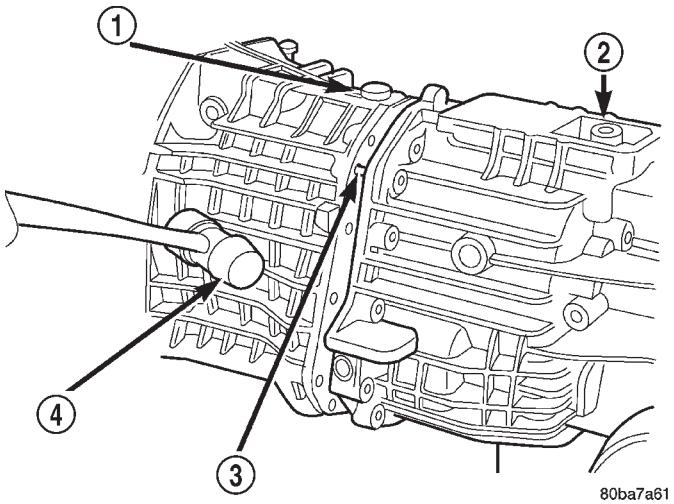


Fig. 18 Front Housing Removal

1 – FRONT HOUSING
2 – REAR HOUSING
3 – DOWELS (2)
4 – PLASTIC MALLET

(15) Remove and inspect input shaft bearing. Inspect countershaft front bearing race (Fig. 19).

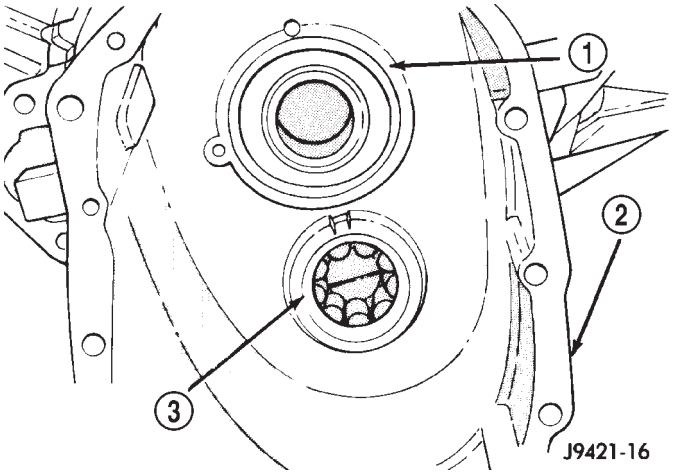


Fig. 19 Input Shaft Bearing and Countershaft Front Bearing Race Location

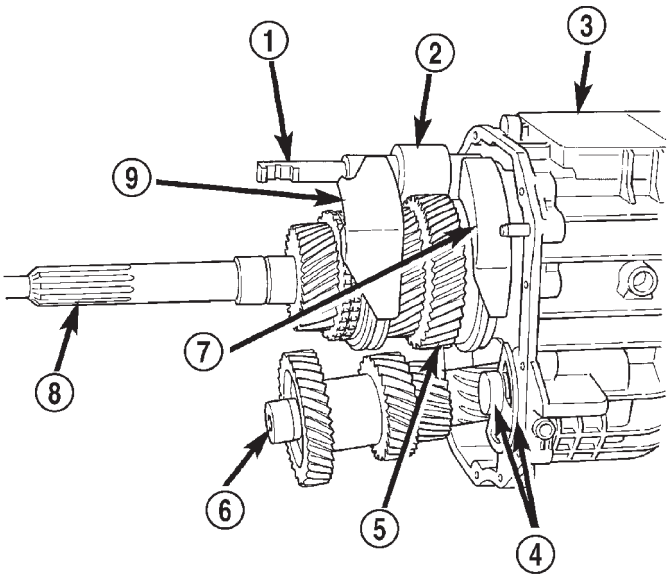
1 – INPUT SHAFT BEARING
2 – FRONT HOUSING
3 – COUNTERSHAFT FRONT BEARING

(16) Note position of input shaft, shift shaft and forks, and geartrain components in housing (Fig. 20).

SHIFT SHAFT, SHIFT FORKS AND REVERSE IDLER SEGMENT

(1) Unseat the roll pin that secures the shift socket tot he shift shaft with Special Tool 6858 as follows:

DISASSEMBLY AND ASSEMBLY (Continued)



80a9b3b2

Fig. 20 Geartrain And Shift Component Identification

1 – SHIFT SHAFT
2 – BUSHING
3 – REAR HOUSING
4 – REVERSE IDLER AND SUPPORT
5 – OUTPUT SHAFT AND GEARS
6 – COUNTERSHAFT
7 – 1–2 FORK
8 – INPUT SHAFT
9 – 3–4 FORK

(a) Position Tool 6858 on the shift shaft. Center the tool over the roll pin and verify that the tool legs are firmly seated on the shift socket (Fig. 21).

(b) Tilt the socket toward the side of the case. This positions the roll pin at a slight angle to avoid trapping the pin between the gear teeth.

(c) Tighten the tool punch to press the roll pin downward and out of the shift socket (Fig. 21). The roll pin does not have to be completely removed from the shift socket. The roll pin must only be clear of the shift shaft. Be careful not to push the pin into the geartrain.

(2) Using a hammer and suitable punch, drive out roll pin that secures shift bushing and lever to shift shaft (Fig. 22).

NOTE: Be sure to use the proper size punch to avoid bending the shift shaft.

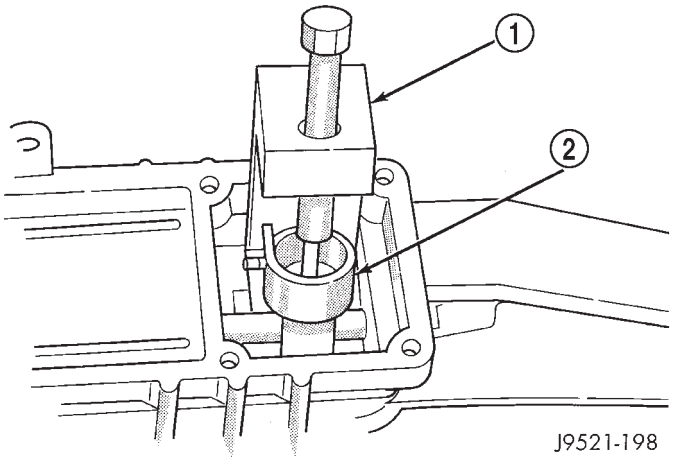


Fig. 21 Removing the Shift Socket Roll Pin

1 – SPECIAL TOOL 6858
2 – SHIFT SOCKET

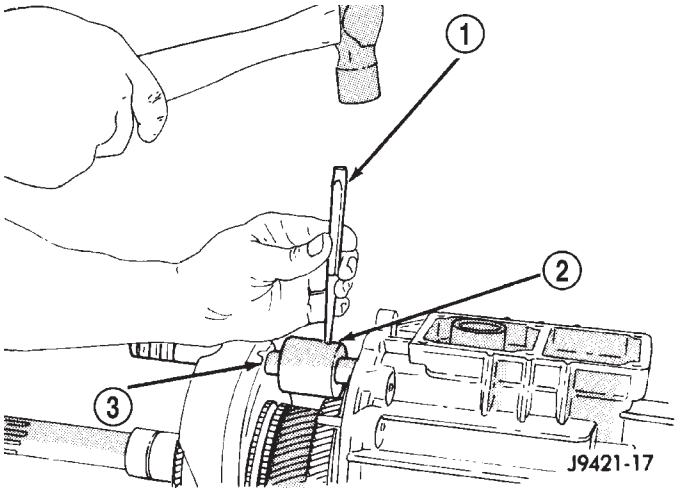


Fig. 22 Removing Shift Shaft Lever And Bushing Roll Pin

1 – PIN PUNCH
2 – BUSHING AND LEVER
3 – SHIFT SHAFT

(3) Pull shift shaft straight out of rear housing, shift socket, fifth-reverse fork, and 1-2 fork (Fig. 23).

(4) Remove shift socket from rear housing (Fig. 24).

(5) Remove lever and bushing (Fig. 25).

DISASSEMBLY AND ASSEMBLY (Continued)

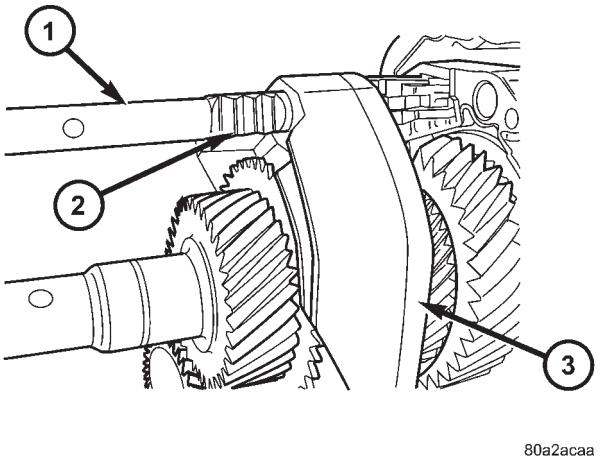


Fig. 23 Shifter Shaft

1 – SHIFTER SHAFT
2 – SHIFTER SHAFT DETENT
3 – 3–4 SHIFT FORK

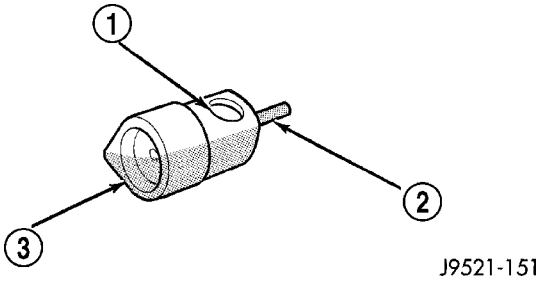


Fig. 24 Shift Socket And Roll Pin

1 – SHAFT BORE
2 – ROLL PIN
3 – SHIFT SOCKET

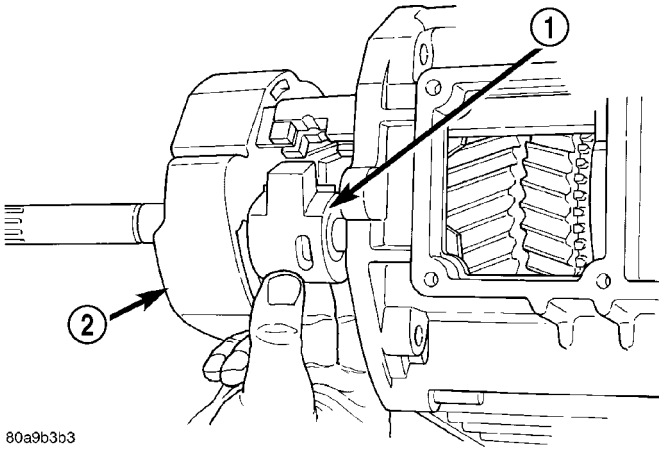


Fig. 25 Removing Shift Shaft Lever And Bushing

1 – SHAFT LEVER AND BUSHING
2 – 3–4 FORK

(6) Remove 3-4 fork. Rotate 3-4 fork around synchro sleeve until fork clears shift arms on 1-2 and fifth-reverse forks. Then remove 3-4 fork (Fig. 26).

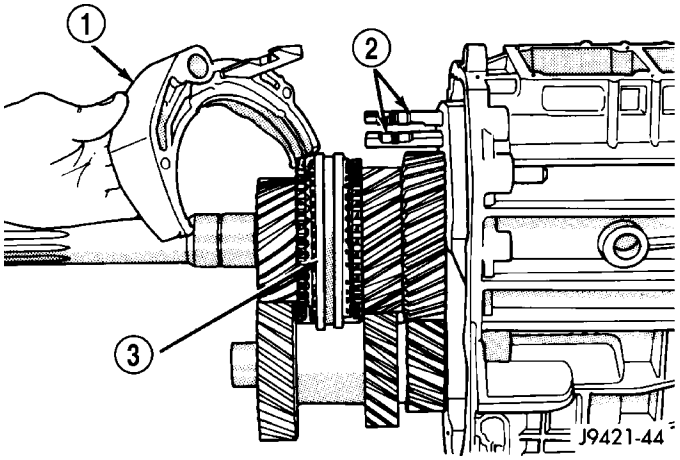


Fig. 26 Removing 3-4 Shift Fork

1 – 3–4 FORK
2 – 1–2 AND 5TH-REVERSE FORK ARMS
3 – 3–4 SYNCHRO SLEEVE

(7) Remove the reverse idler shaft support bolt (front bolt) (Fig. 27).

(8) Loosen rear reverse idler shaft bolt (rear bolt) (Fig. 27).

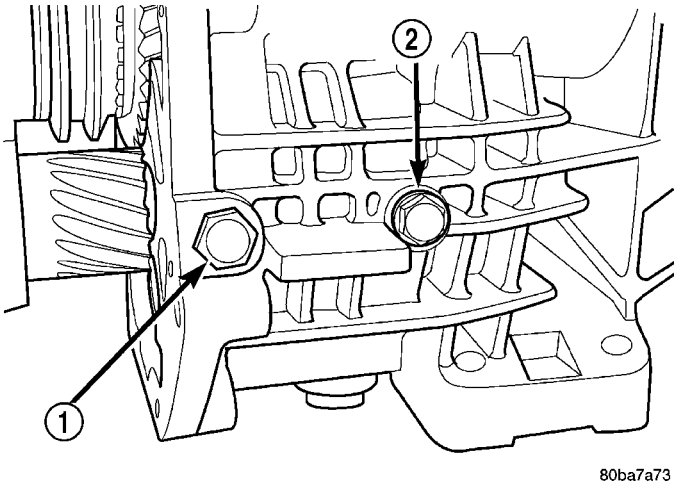


Fig. 27 Reverse Idler Shaft/Support Bolts

1 – SUPPORT BOLT
2 – SHAFT BOLT

(9) Remove reverse idler shaft support segment by sliding it straight out of housing.

(10) Support geartrain and rear housing on Assembly Fixture Tool 6747 as follows:

(a) Adjust height of reverse idler pedestal rod until the reverse idle shaft bottoms in Cup 8115.

(b) Position Adapters 6747-1A and 6747-2A on Assembly Fixture 6747.

(c) Slide fixture tool onto input shaft, countershaft and idler gear (Fig. 28).

DISASSEMBLY AND ASSEMBLY (Continued)

(d) Stand geartrain and rear housing upright on fixture (Fig. 29). Have helper hold fixture tool in place while housing and geartrain is being rotated into upright position.

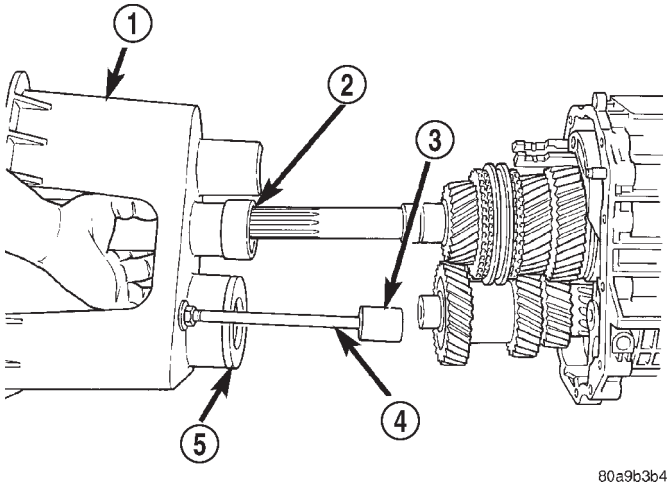


Fig. 28 Installing Assembly Fixture On Geartrain

1 – SPECIAL TOOL 6747
2 – SPECIAL TOOL 6747–1A
3 – SPECIAL TOOL 8115
4 – REVERSE IDLER PEDESTAL
5 – SPECIAL TOOL 6747–2A

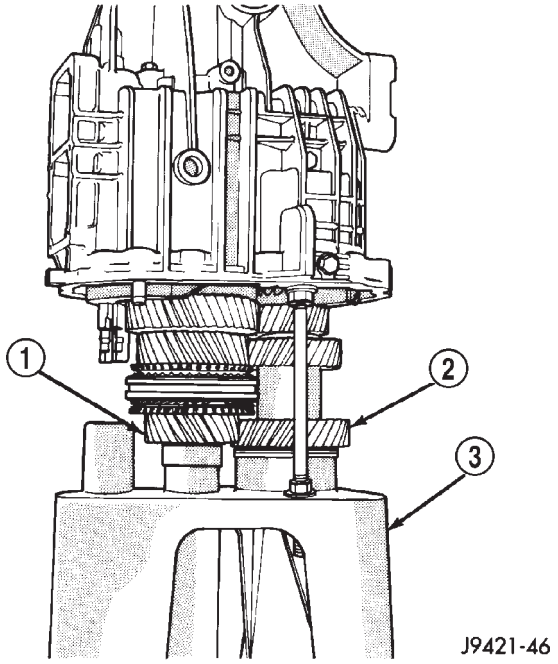


Fig. 29 Geartrain And Housing Mounted On Fixture Tool

1 – INPUT SHAFT
2 – COUNTERSHAFT
3 – SPECIAL TOOL 6747

(11) Remove rear bolt holding reverse idler shaft in housing.

REAR ADAPTER HOUSING REMOVAL

(1) Locate dimples in face of rear seal (Fig. 30). Use a suitable slide hammer mounted screw to remove seal by inserting screw into seal at dimple locations (Fig. 31).

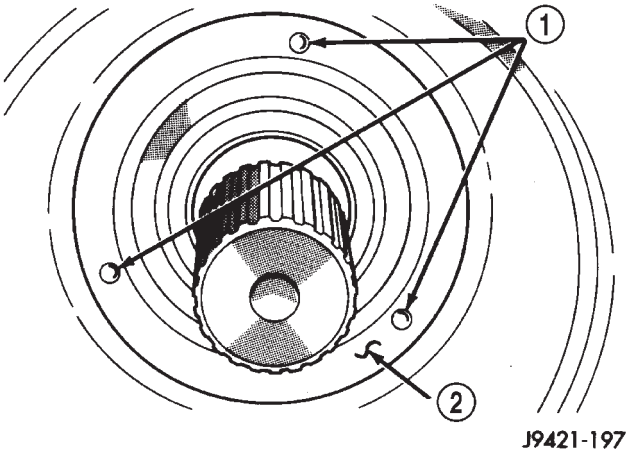


Fig. 30 Location Of Dimples In Seal Face

1 – LOCATION OF DIMPLES
2 – SEAL FACE

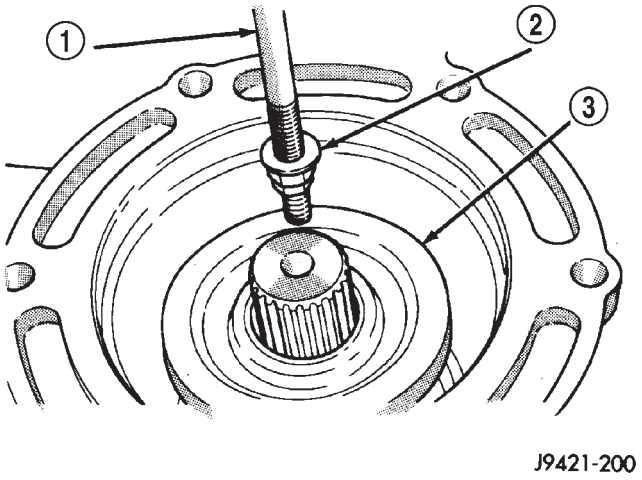


Fig. 31 Rear Seal Removal

1 – SLIDE HAMMER
2 – REMOVER TOOL
3 – REAR SEAL

(2) Remove rear bearing snap ring from output shaft with heavy duty snap ring pliers (Fig. 32).

(3) Lift rear adapter housing upward and off geartrain (Fig. 33).

(4) Remove bearing retainer bolts and remove rear bearing retainer and rear bearing (Fig. 34). Use hammer handle to push or tap bearing out of housing if needed.

(5) Examine condition of bearing bore, countershaft rear bearing race and idler shaft notch in rear

DISASSEMBLY AND ASSEMBLY (Continued)

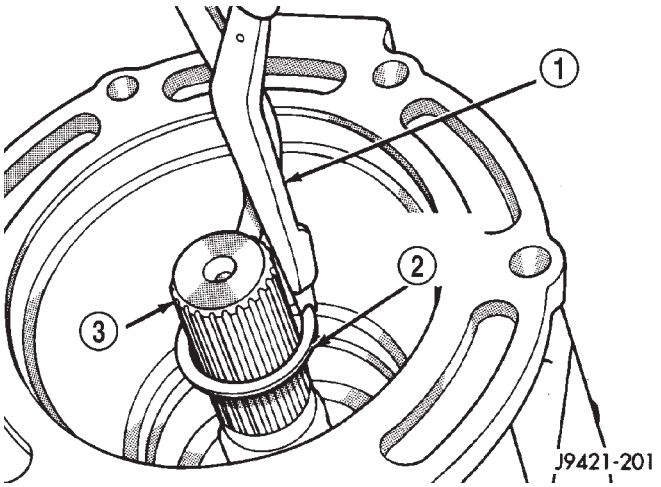


Fig. 32 Rear Bearing Snap Ring Removal

1 – HEAVY DUTY SNAP RING PLIERS
2 – REAR BEARING SNAP RING
3 – OUTPUT SHAFT

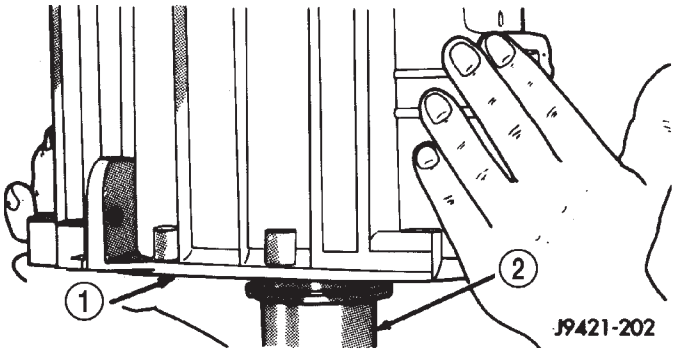


Fig. 33 Rear Adapter Housing Removal

1 – REAR ADAPTER HOUSING
2 – OUTPUT SHAFT

housing. Replace housing if race, bore or notch are worn or damaged.

GEARTRAIN DISASSEMBLY FROM FIXTURE

(1) Remove reverse idler gear assembly from assembly fixture cup.

(2) Remove 1-2 and fifth-reverse forks from synchro sleeves.

(3) Slide countershaft out of fixture tool.

(4) Remove output shaft bearing retainer from rear surface of fifth gear (retainer will drop onto gear after bolts are removed).

(5) Lift and remove output shaft and gears off input shaft.

(6) Lift and remove input shaft, pilot bearing and fourth gear synchro ring from assembly fixture tool.

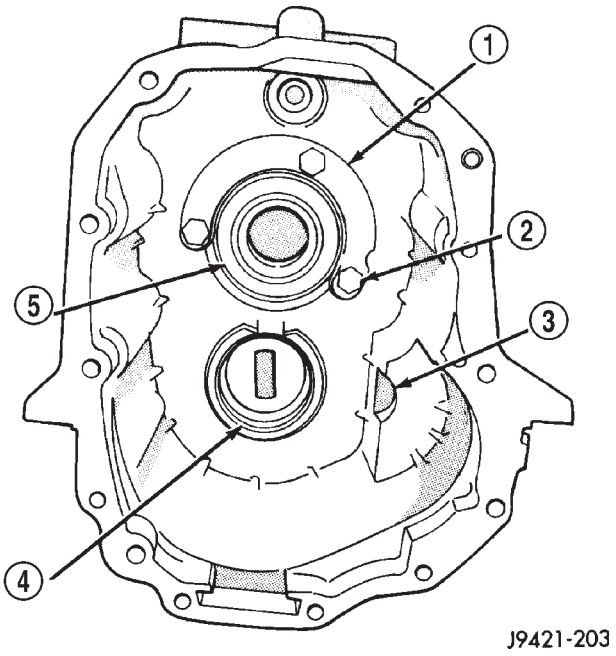


Fig. 34 Rear Adapter Housing Components

1 – BEARING RETAINER
2 – RETAINER BOLTS (3)
3 – IDLER SHAFT NOTCH
4 – COUNTERSHAFT REAR BEARING RACE
5 – REAR BEARING

OUTPUT SHAFT

NOTE: The synchronizer hubs and sleeves are different and must not be intermixed. It is recommended that each synchronizer unit be removed as an assembly to avoid intermixing parts. It is also recommended that each synchro hub and sleeve be marked with a scriber or paint for correct assembly reference.

(1) Remove snap ring that secures 3-4 synchro hub on output shaft.

(2) Remove 3-4 synchro assembly, third gear synchro ring, and third gear with shop press and Remover Tool 1130. Position Tool 1130 between second and third gears.

(3) Remove third gear needle bearing (Fig. 35).

(4) Remove retaining ring that secures two-piece thrust washer on shaft (Fig. 36). Use small pry tool to remove retaining ring.

(5) Remove two-piece thrust washer (Fig. 37). Note position of washer locating lugs in shaft notches for installation reference.

(6) Remove second gear and needle bearing (Fig. 38).

DISASSEMBLY AND ASSEMBLY (Continued)

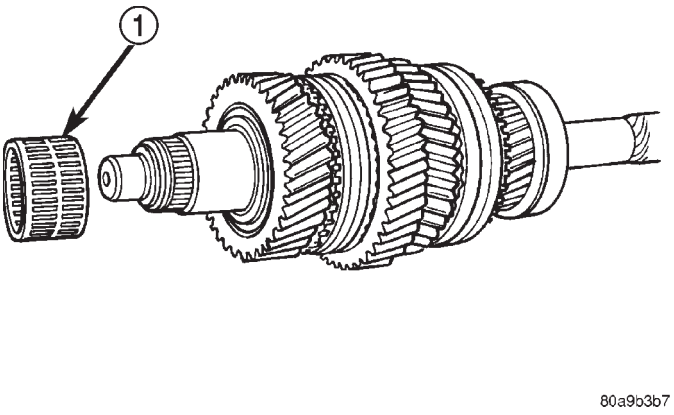


Fig. 35 Third Gear Needle Bearing Removal

1 – THIRD GEAR NEEDLE BEARING

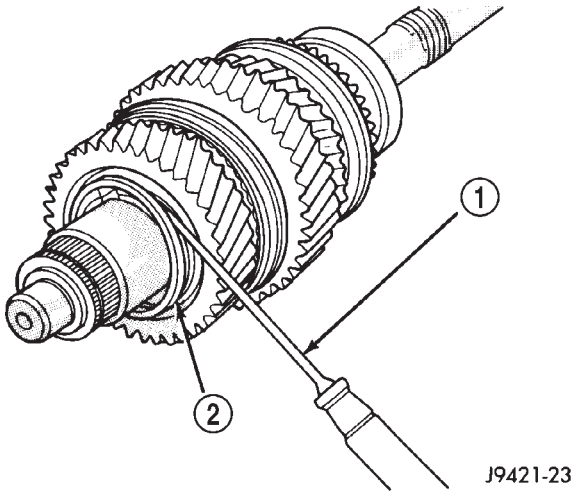


Fig. 36 Thrust Washer Retaining Ring Removal

1 – PRY TOOL
2 – THRUST WASHER RETAINING RING

(7) Remove second gear synchro ring, synchro friction cone, and synchro cone (Fig. 39).

(8) Remove interm ring.

(9) Remove 1-2 synchro hub snap ring.

(10) Remove 1-2 synchro hub and sleeve and first gear from output shaft with shop press and Remover Tool 1130 (Fig. 40). Position Tool 1130 between first and reverse gears.

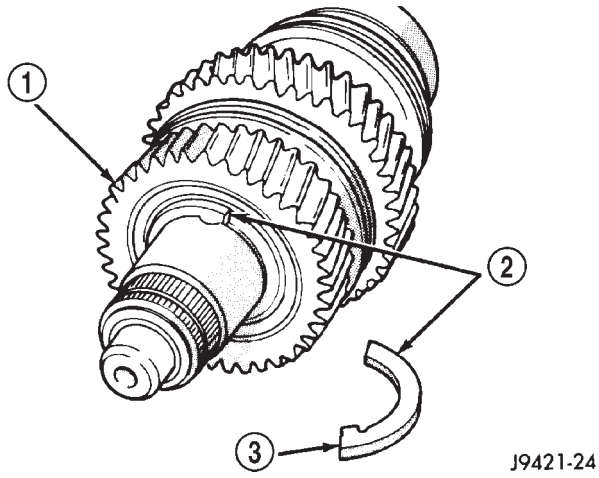


Fig. 37 Two-Piece Thrust Washer Removal

1 – SECOND GEAR
2 – THRUST WASHER (2–PIECE)
3 – WASHER LOCATING LUG

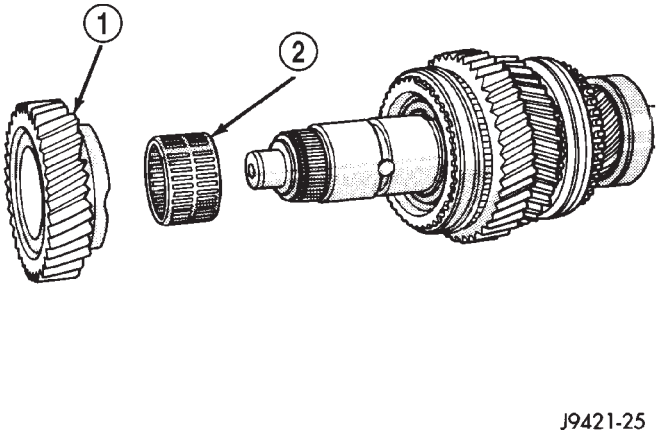


Fig. 38 Second Gear And Needle Bearing Removal

1 – SECOND GEAR
2 – SECOND GEAR NEEDLE BEARING

(11) Remove first gear needle bearing (Fig. 41).

(12) Remove output shaft bearing snap ring (Fig. 42).

(13) On 2-wheel drive models, remove output shaft bearing.

(14) Remove fifth gear (Fig. 43).

DISASSEMBLY AND ASSEMBLY (Continued)

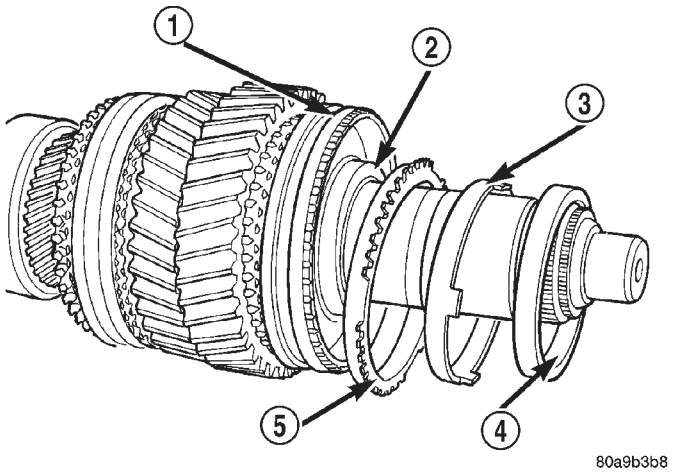


Fig. 39 Second Gear Synchro Ring And Cones Removal

1 – 1–2 SYNCHRO HUB AND SLEEVE
2 – INTERM RING
3 – SYNCHRO FRICTION CONE
4 – SYNCHRO CONE
5 – SYNCHRO RING

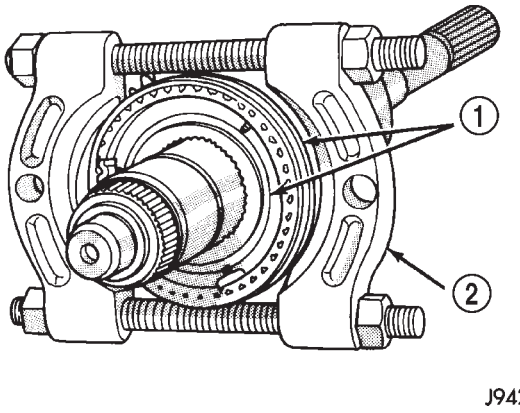


Fig. 40 Hub And Sleeve Removal—1-2 Synchro

1 – 1–2 SYNCHRO HUB AND SLEEVE
2 – SPECIAL TOOL 1130

(15) Remove fifth gear needle bearing. Spread bearing apart just enough to clear shoulder on output shaft (Fig. 44).

(16) Remove fifth-reverse synchro hub snap ring (Fig. 45).

(17) Remove fifth-reverse synchro hub and sleeve with shop press (Fig. 46).

(18) Remove reverse gear and needle bearing (Fig. 47).

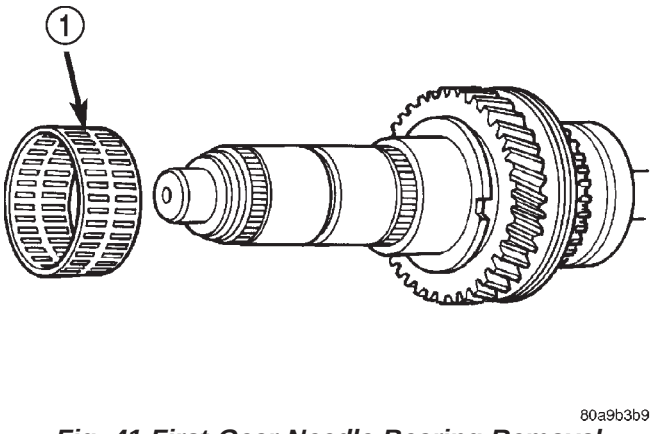


Fig. 41 First Gear Needle Bearing Removal

1 – FIRST GEAR NEEDLE BEARING

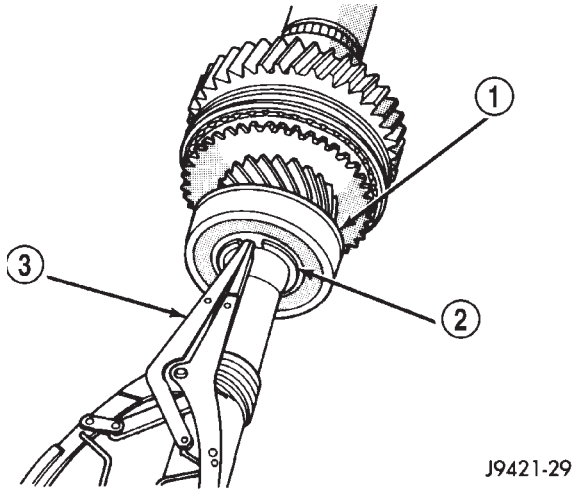


Fig. 42 Output Shaft Bearing Snap Ring Removal

1 – OUTPUT SHAFT BEARING
2 – BEARING SNAP RING
3 – SNAP RING PLIERS

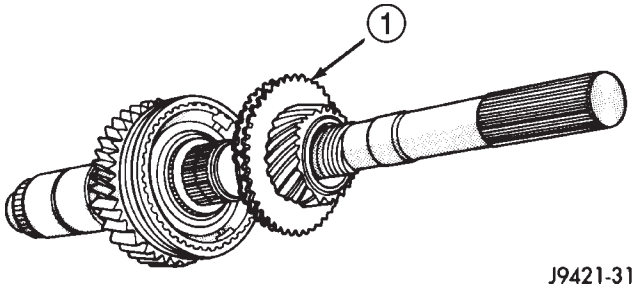


Fig. 43 Fifth Gear Removal

1 – FIFTH GEAR AND SYNCHRO RING

DISASSEMBLY AND ASSEMBLY (Continued)

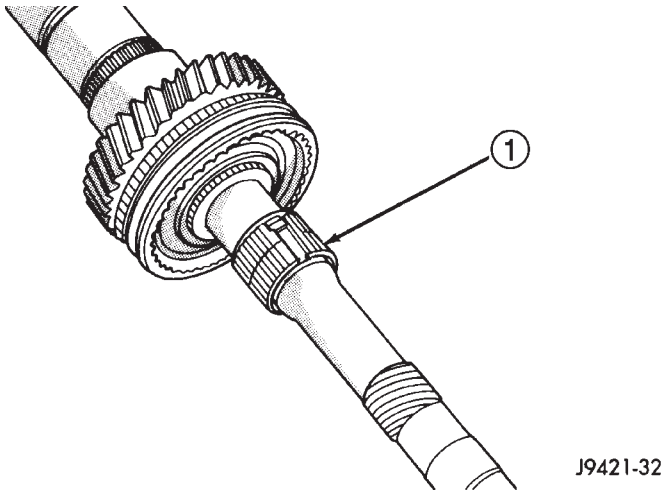


Fig. 44 Fifth Gear Needle Bearing Removal

1 – FIFTH GEAR NEEDLE BEARING (SPREAD BEARING TO CLEAR SHOULDER ON SHAFT)

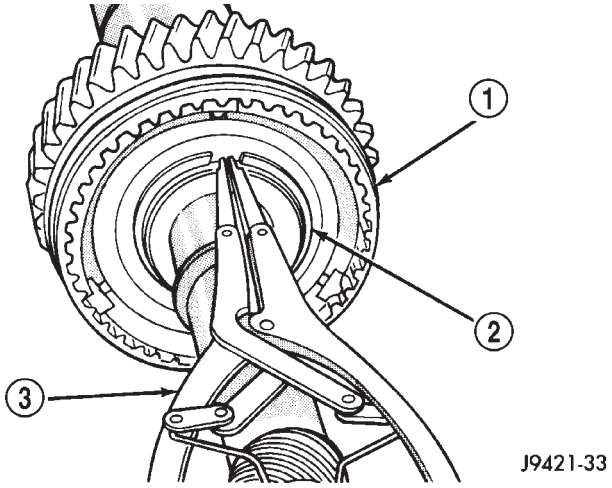


Fig. 45 Fifth-Reverse Synchro Hub Snap Ring Removal

1 – FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
2 – SYNCHRO HUB SNAP RING
3 – SNAP RING PLIERS

REVERSE IDLER DISASSEMBLY

(1) Remove idler gear snap rings (Fig. 48).

(2) Remove thrust washer, wave washer, thrust plate and idler gear from shaft.

(3) Remove idler gear needle bearing from shaft.

ASSEMBLY

Gaskets are not used in the NV3550 transmission. Sealers are used at all case joints. Recommended sealers are Mopar® Gasket Maker for all case joints and Mopar® silicone sealer, or equivalent, for the input shaft bearing retainer. Apply these products as indicated in the assembly procedures.

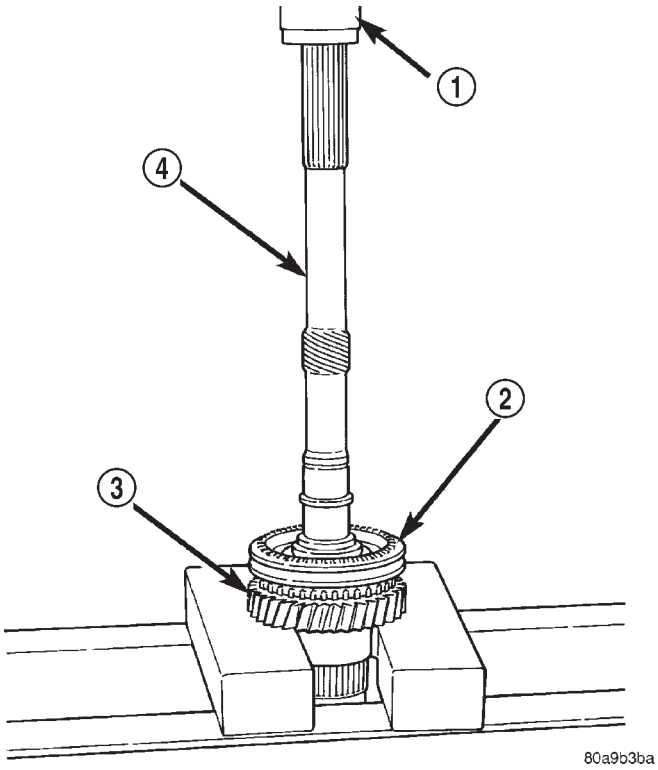


Fig. 46 Fifth-Reverse Synchro Hub And Sleeve Removal

1 – PRESS
2 – FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
3 – REVERSE GEAR
4 – OUTPUT SHAFT

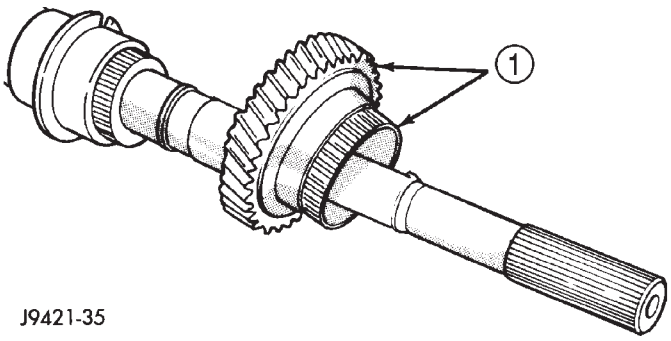


Fig. 47 Reverse Gear And Needle Bearing Removal

1 – REVERSE GEAR AND NEEDLE BEARING

NOTE: It is very important that the transmission shift components be in Neutral position during assembly. This is necessary to prevent damaging synchro and shift components when the housings are installed.

The 3-4, 1-2 and fifth-reverse synchro hub snap rings can be fitted selectively. New snap rings are available in 0.05 mm (0.0019 in.) thickness incre-

DISASSEMBLY AND ASSEMBLY (Continued)

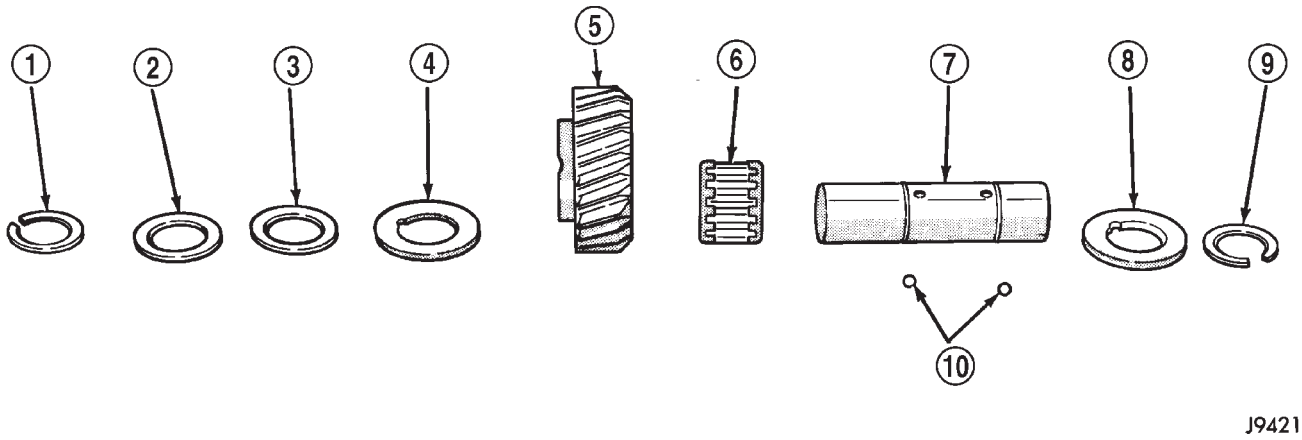


Fig. 48 Reverse Idler Components

1 – SNAP RING
2 – FLAT WASHER
3 – WAVE WASHER
4 – THRUST WASHER
5 – REVERSE IDLER GEAR
6 – IDLER GEAR BEARING
7 – IDLER SHAFT
8 – THRUST WASHER
9 – SNAP RING
10 – THRUST WASHER LOCK BALLS

ments. Use the thickest snap ring that will fit in each snap ring groove.

SYNCHRONIZER

The easiest method of assembling each synchro is to install the springs, struts and detent balls one at a time as follows:

(1) Slide the sleeve part way onto the hub. Leave enough room to install the spring in the hub and the strut in the hub groove.

(2) Install the first spring in the hub. Then install a strut over the spring. Be sure the spring is seated in the spring bore in the strut.

(3) Slide the sleeve onto the hub just far enough to hold the first strut and spring in place.

(4) Place the detent ball in the top of the strut. Then carefully work the sleeve over the ball to hold it in place. A small flat blade screwdriver can be used to press the ball into place while moving the sleeve over it.

(5) Repeat the procedure for the remaining springs, struts and balls. Tape, or a rubber band can be used to temporarily secure each strut and ball as they are installed.

(6) Verify synchro assembly. Be sure the three springs, struts and detent balls are all in place (Fig. 49).

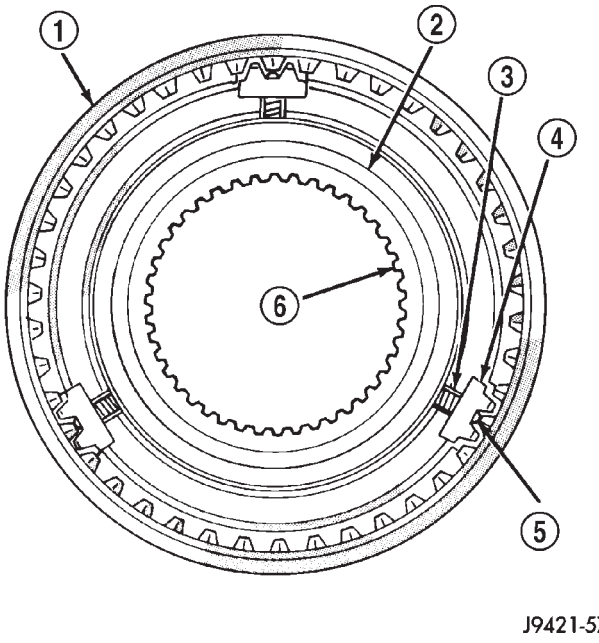


Fig. 49 Assembled View Of Synchro Components

1 – SLEEVE
2 – HUB SHOULDER
3 – SPRING (3)
4 – STRUT (3)
5 – DETENT BALL (3)
6 – HUB

OUTPUT SHAFT

(1) Lubricate shaft, gears and bearings with recommended lubricant during assembly. Petroleum jelly can be used to hold parts in place.

(2) Check bearing surfaces of output shaft for nicks or scratches. Smooth surfaces with 320/400 grit emery cloth if necessary. Apply oil to emery cloth and shaft surface before polishing.

(3) Inspect and replace any synchro ring that exhibits wear or damage. Completely immerse each synchro ring in lubricant before installation.

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Lubricate and install reverse gear needle bearing on shaft (Fig. 50). Slide bearing up against shoulder on output shaft.

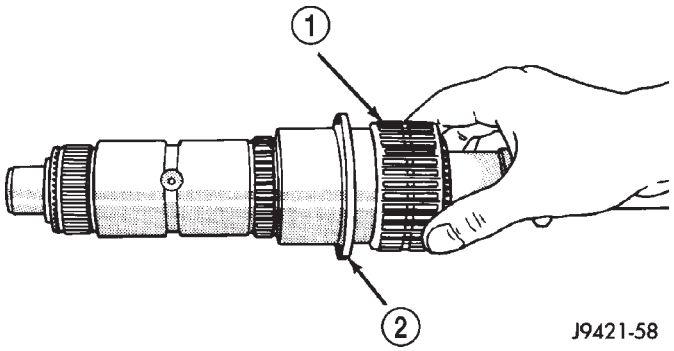


Fig. 50 Reverse Gear Bearing Installation

1 – REVERSE GEAR BEARING
2 – SHOULDER

(5) Install reverse gear over needle bearing (Fig. 51).

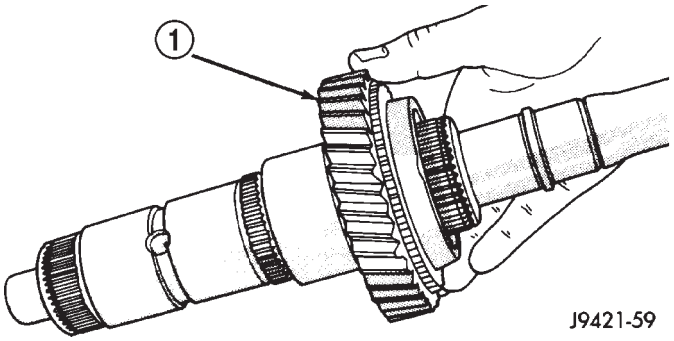


Fig. 51 Reverse Gear Installation

1 – REVERSE GEAR

(6) Install solid brass synchro ring on reverse gear (Fig. 52).

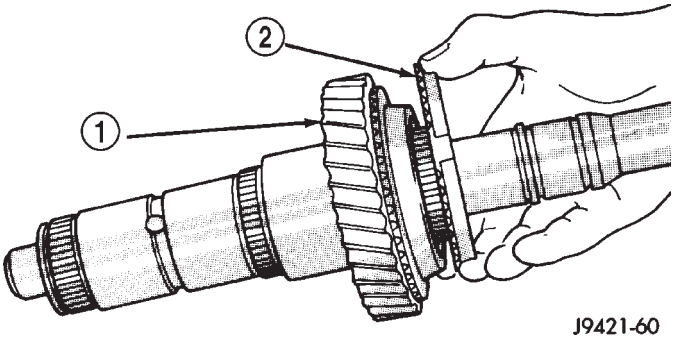


Fig. 52 Reverse Gear Synchro Ring Installation

1 – REVERSE GEAR
2 – SYNCHRO RING (SOLID BRASS)

(7) Assemble fifth-reverse synchro hub, sleeve, struts, springs and detent balls, if not previously done.

CAUTION: The fifth-reverse synchro hub and sleeve can be installed backwards if care is not exercised. One side of the hub has shoulders around the hub bore. Make sure this side of the hub is facing the front of the shaft. In addition, one side of the sleeve is tapered. Be sure the sleeve is installed so the tapered side will be facing the front of the shaft.

(8) Start fifth-reverse synchro assembly on output shaft splines by hand. Then seat synchro onto shaft with shop press and Remover 6310-1 (Fig. 53).

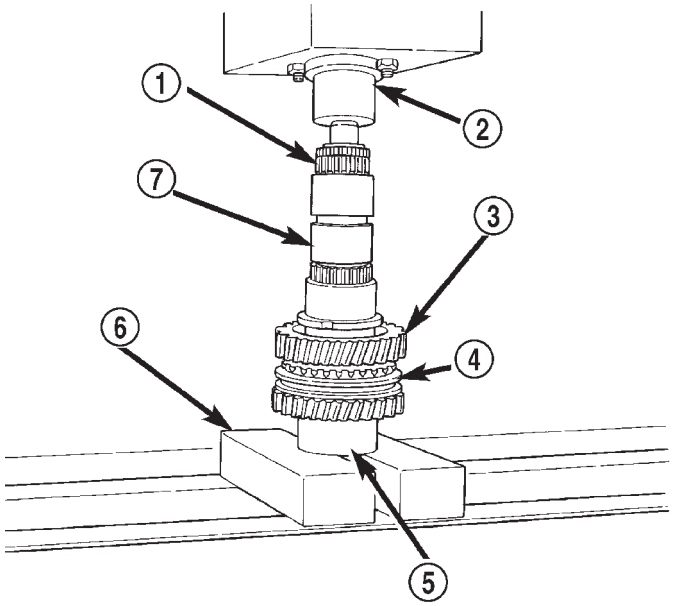


Fig. 53 Fifth-Reverse Synchro Assembly Installation

1 – SPACER
2 – PRESS RAM
3 – REVERSE GEAR
4 – FIFTH-REVERSE SYNCHRO ASSEMBLY
5 – SPECIAL TOOL 6310–1
6 – PRESS BLOCKS
7 – OUTPUT SHAFT

(9) Install new fifth-reverse hub snap ring (Fig. 54) as follows:

(a) Snap rings are available in thicknesses from 2.00 mm to 2.20 mm (0.078 to 0.086 in.).

(b) Install thickest snap ring that will fit in shaft groove.

(c) Verify that snap ring is completely seated in groove before proceeding.

DISASSEMBLY AND ASSEMBLY (Continued)

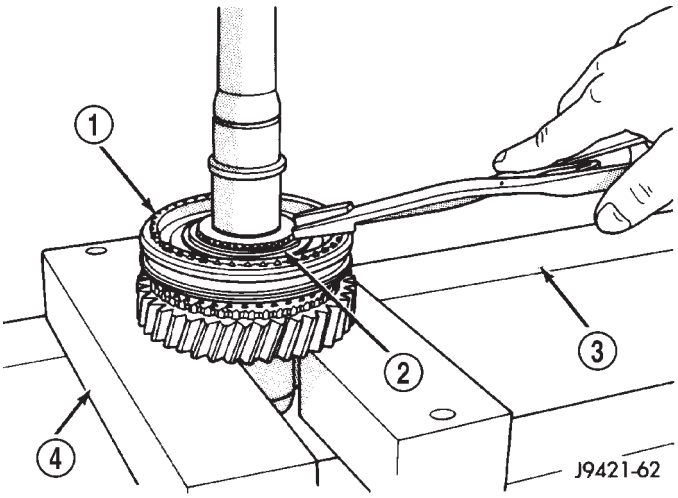


Fig. 54 Installing Fifth-Reverse Synchro Hub Snap Ring

1 – FIFTH-REVERSE SYNCHRO ASSEMBLY
2 – SNAP RING
3 – PRESS BED
4 – PRESS BLOCKS

(10) Install fifth gear synchro ring in synchro hub and sleeve (Fig. 55).

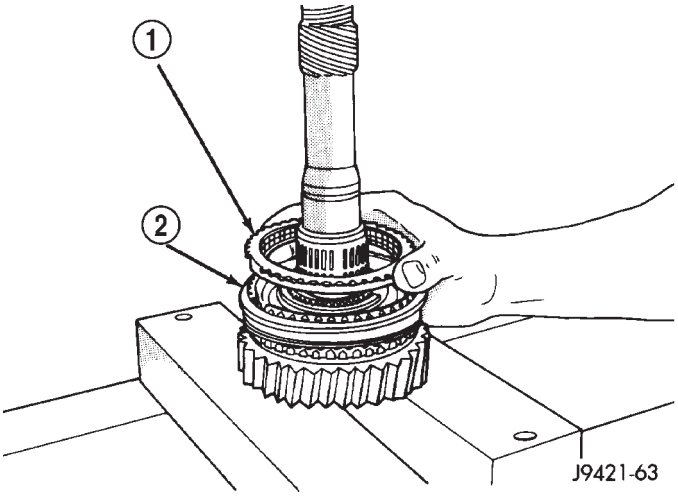


Fig. 55 Installing Fifth Gear Synchro Ring

1 – FIFTH-SPEED SYNCHRO RING
2 – FIFTH-REVERSE SYNCHRO ASSEMBLY

(11) Install fifth gear bearing. Spread bearing only enough to clear shoulder on output shaft (Fig. 56). Be sure bearing is properly seated after installation.

(12) Install fifth gear on shaft and onto bearing (Fig. 57).

(13) Invert output shaft and set the shaft in Remover 6310-1 so that fifth gear is seated on the tool (Fig. 58).

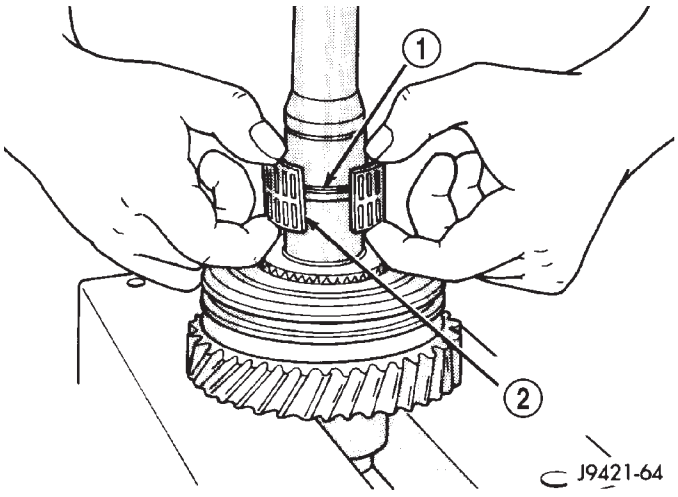


Fig. 56 Installing Fifth Gear Bearing

1 – SHAFT SHOULDER
2 – FIFTH GEAR BEARING

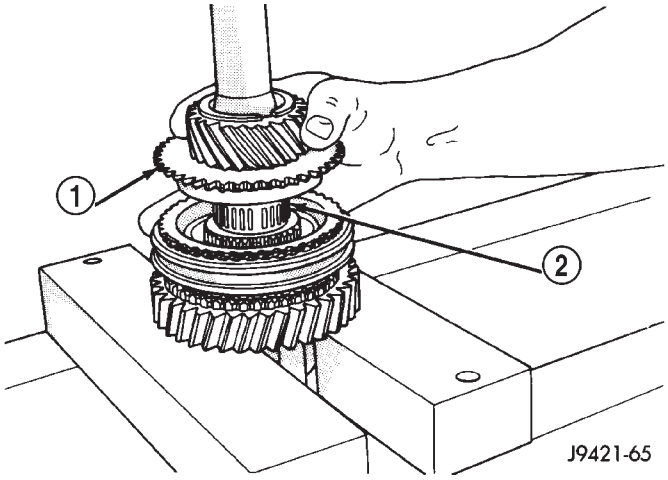


Fig. 57 Fifth Gear Installation

1 – FIFTH GEAR
2 – BEARING

(14) Install first gear bearing on output shaft (Fig. 58). Be sure bearing is seated on shaft shoulder and is properly joined.

(15) Install first gear on shaft and over bearing (Fig. 59). Make sure bearing synchro cone is facing up as shown.

(16) Install first gear synchro ring (Fig. 60).

(17) Assemble 1-2 synchro hub sleeve, springs, struts and detent balls.

CAUTION: The 1-2 synchro hub and sleeve can be installed backwards if care is not exercised. One side of the synchro sleeve is marked First Gear Side. Be sure this side of the sleeve will face first gear after installation.

DISASSEMBLY AND ASSEMBLY (Continued)

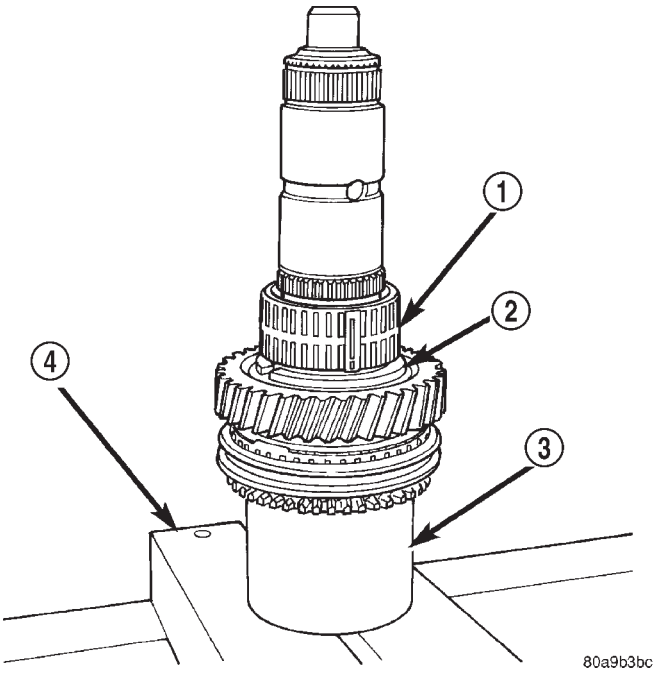


Fig. 58 First Gear Bearing Installation

1 – FIRST GEAR BEARING
2 – SHAFT SHOULDER
3 – SPECIAL TOOL 6310–1
4 – PRESS BLOCKS

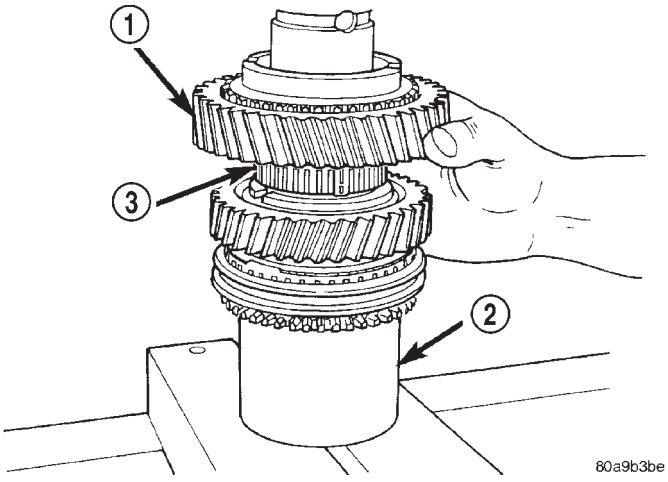


Fig. 59 First Gear Installation

1 – FIRST GEAR
2 – SPECIAL TOOL 6310–1
3 – BEARING

(18) Start 1-2 synchro assembly on shaft by hand (Fig. 61). Be sure synchro sleeve is properly positioned. Side marked first side must be facing first gear.

(19) Press 1-2 synchro onto output shaft using suitable size pipe tool and shop press (Fig. 62).

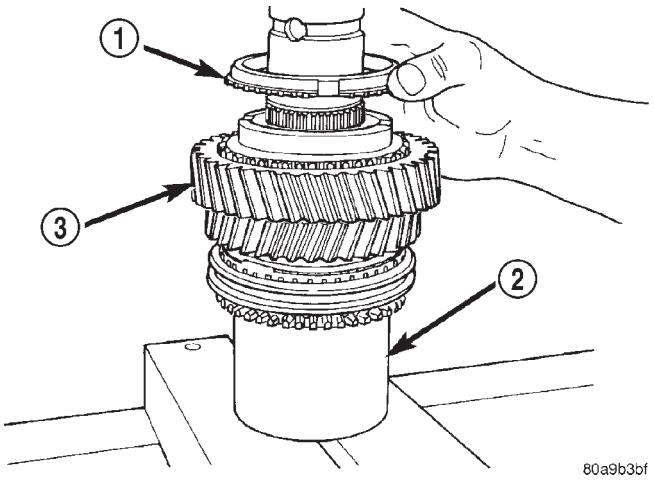


Fig. 60 First Gear Synchro Ring Installation

1 – FIRST GEAR SYNCHRO RING
2 – SPECIAL TOOL 6310–1
3 – FIRST GEAR

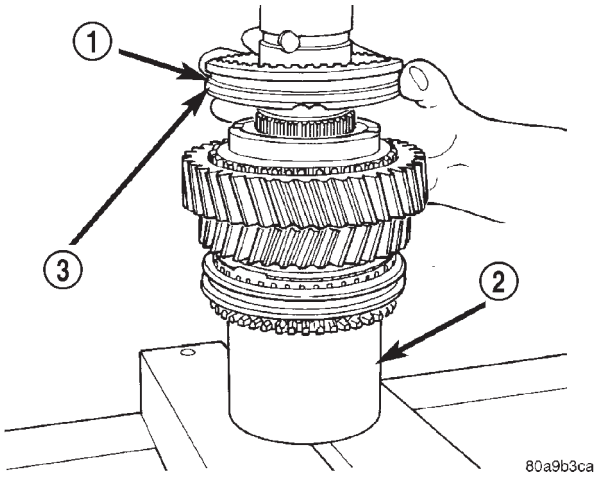


Fig. 61 Starting 1-2 Synchro On Shaft

1 – 1–2 SYNCHRO ASSEMBLY
2 – SPECIAL TOOL 6310–1
3 – BE SURE THIS IS “FIRST GEAR SIDE” OF SYNCHRO SLEEVE

CAUTION: Take time to align the synchro ring and sleeve as hub the is being pressed onto the shaft. The synchro ring can be cracked if it becomes misaligned.

(20) Install interm ring.

(21) Install new 1-2 synchro hub snap ring (Fig. 63) as follows:

(a) Snap rings are available in thicknesses from 1.80 mm to 2.00 mm (0.070 to 0.078 in.).

(b) Install thickest snap ring that will fit in shaft groove.

(c) Verify that snap ring is completely seated in groove before proceeding.

DISASSEMBLY AND ASSEMBLY (Continued)

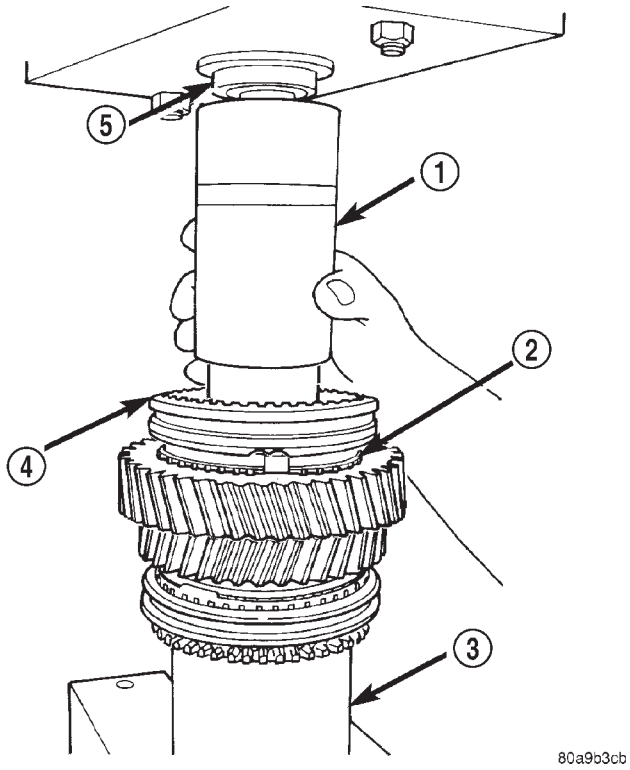


Fig. 62 Pressing 1-2 Synchro Assembly Onto Output Shaft

1 – SUITABLE SIZE PIPE TOOL
2 – SYNCHRO RING
3 – SPECIAL TOOL 6310–1
4 – 1–2 SYNCHRO ASSEMBLY
5 – PRESS RAM

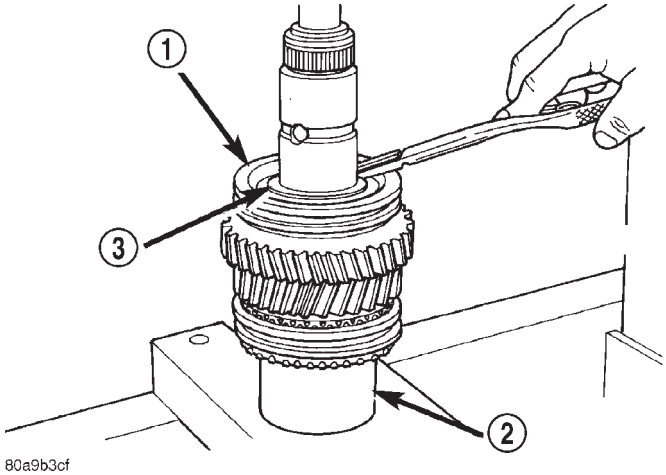


Fig. 63 Installing 1-2 Synchro Hub Snap Ring

1 – 1–2 SYNCHRO
2 – SPECIAL TOOL 6310–1
3 – SYNCHRO SNAP RING

(22) Install second gear synchro ring in 1-2 synchro hub and sleeve (Fig. 64). Be sure synchro ring is properly seated in sleeve.

(23) Install synchro friction cone and synchro cone in synchro ring.

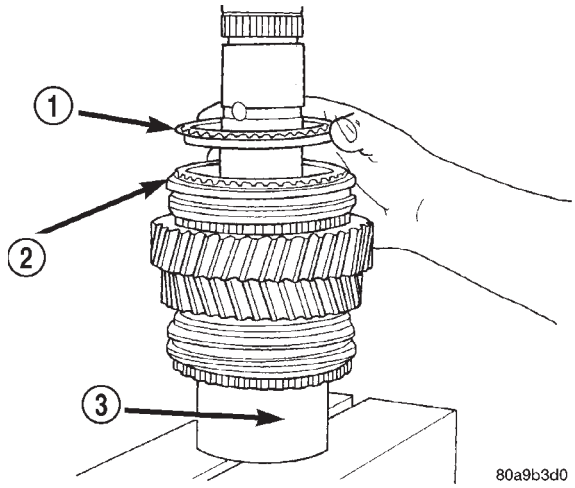


Fig. 64 Second Gear Synchro Ring Installation

1 – SECOND GEAR SYNCHRO RING
2 – 1–2 SYNCHRO
3 – SPECIAL TOOL 6310–1

(24) Install second gear needle bearing on shaft (Fig. 65).

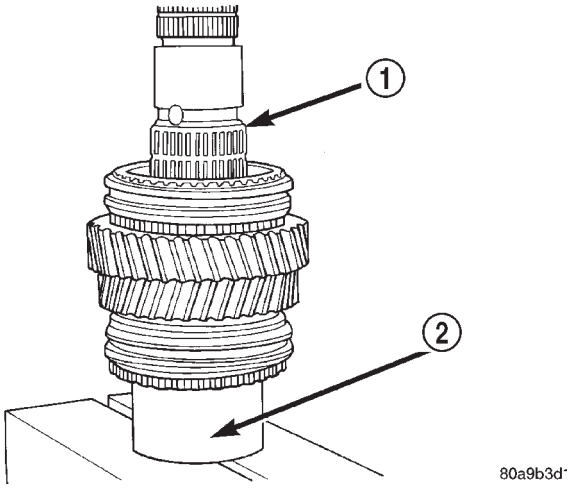


Fig. 65 Second Gear Bearing Installation

1 – SECOND GEAR BEARING
2 – SPECIAL TOOL 6310–1

(25) Install second gear onto shaft and bearing (Fig. 66). Make sure that second gear is fully seated on synchro components.

(26) Install two-piece thrust washer (Fig. 67). Be sure washer halves are seated in shaft groove and that washer lugs are seated in shaft lug bores. Also, ensure that the i.d. grooves and markings noted during removal are facing the correct direction.

DISASSEMBLY AND ASSEMBLY (Continued)

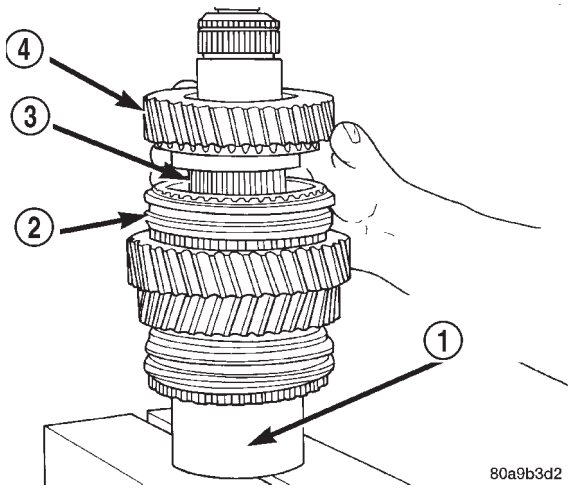


Fig. 66 Second Gear Installation

1 – SPECIAL TOOL 6310–1
2 – 1–2 SYNCHRO ASSEMBLY
3 – BEARING
4 – SECOND GEAR

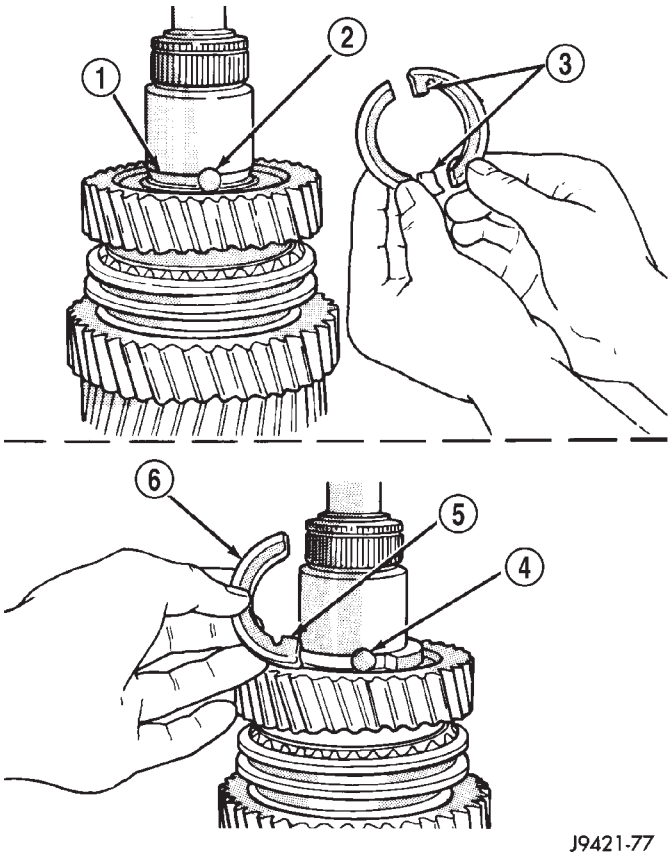


Fig. 67 Installing Two-Piece Thrust Washer

1 – WASHER GROOVE IN SHAFT
2 – LUG BORE
3 – THRUST WASHER LUGS
4 – LUG BORE
5 – LUG
6 – WASHER HALF

(27) Start retaining ring around two-piece thrust washer (Fig. 68). Make sure that the locating dimple is between the thrust washer halves.

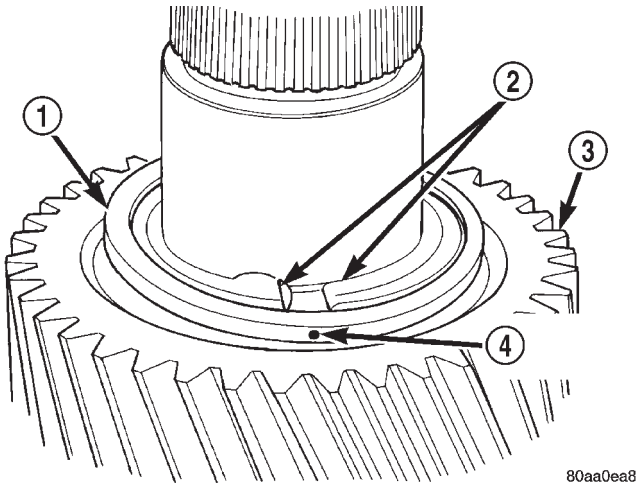


Fig. 68 Starting Retaining Ring Over Two-Piece Thrust Washer

1 – THRUST WASHER RETAINING RING
2 – THRUST WASHER HALVES
3 – SECOND GEAR
4 – LOCATING DIMPLE

(28) Seat thrust washer retaining ring with plastic mallet (Fig. 69).

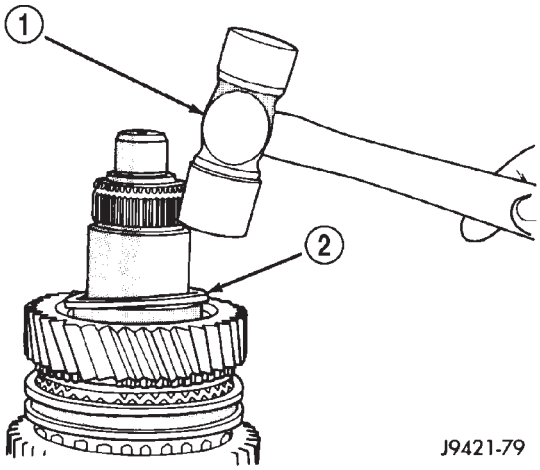


Fig. 69 Seating Thrust Washer Retaining Ring

1 – PLASTIC MALLET
2 – THRUST WASHER RETAINING RING

(29) Install third gear needle bearing on shaft (Fig. 70).

(30) Install third gear on shaft and bearing (Fig. 71).

(31) Install third speed synchro ring on third gear (Fig. 72).

DISASSEMBLY AND ASSEMBLY (Continued)

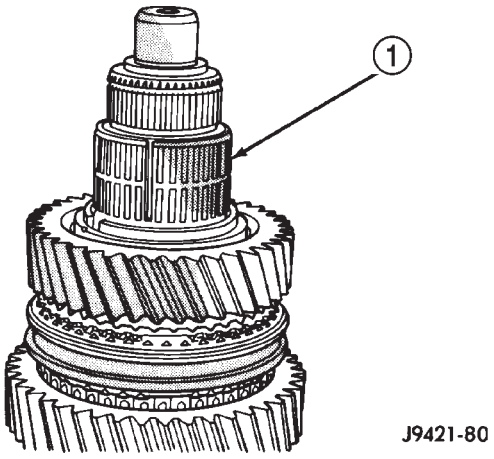


Fig. 70 Third Gear Bearing Installation

1 – THIRD GEAR BEARING

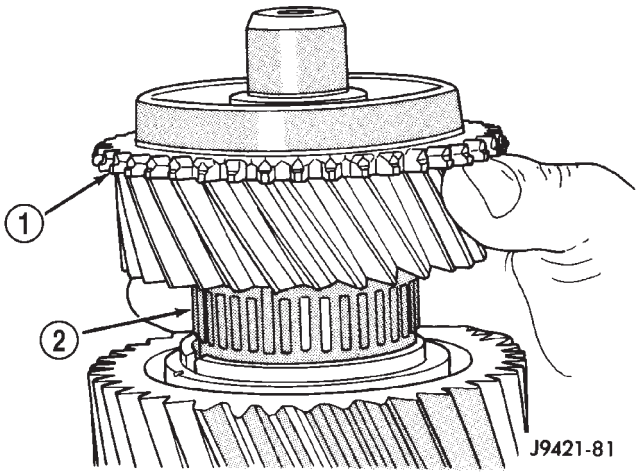


Fig. 71 Installing Third Gear

1 – THIRD GEAR
2 – BEARING

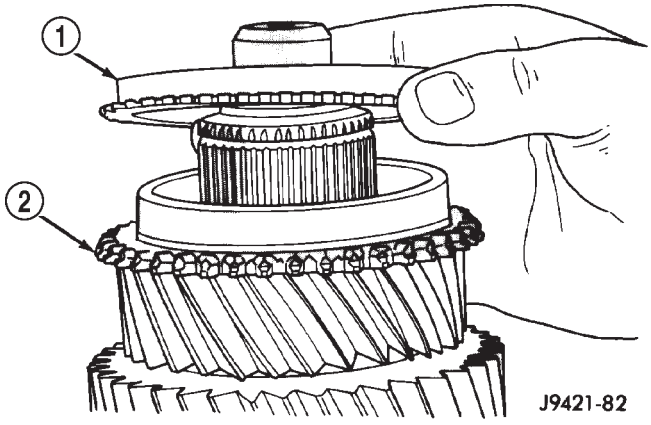


Fig. 72 Third Speed Synchro Ring Installation

1 – THIRD SPEED SYNCHRO RING
2 – THIRD GEAR

(32) Assemble 3-4 synchro hub, sleeve, springs, struts and detent balls.

CAUTION: The 3-4 synchro hub and sleeve can be installed backwards if care is not exercised. One side of the sleeve has grooves in it. Be sure this side of sleeve is also facing the front of the shaft.

(33) Start 3-4 synchro hub on output shaft splines by hand (Fig. 73).

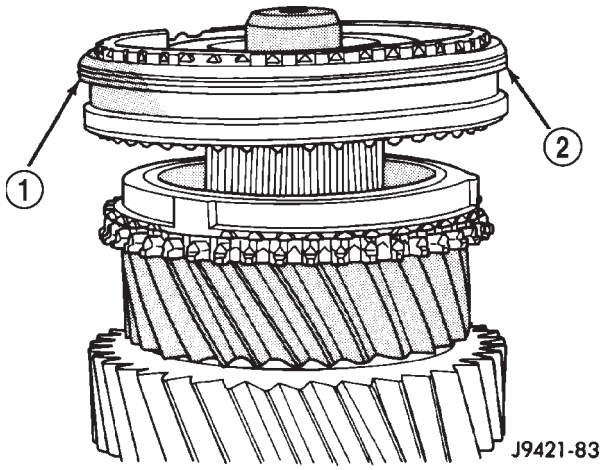


Fig. 73 Starting 3-4 Synchro Hub On Output Shaft

1 – GROOVED SIDE OF SLEEVE (TO FRONT)
2 – 3–4 SYNCHRO ASSEMBLY

(34) Press 3-4 synchro assembly onto output shaft with shop press and suitable size pipe tool (Fig. 74). Make sure that the tool presses on hub as close to output shaft as possible but does not contact the shaft splines.

(35) Install 3-4 synchro hub snap ring (Fig. 75) as follows:

(a) Snap rings are available in thicknesses from 2.00 mm to 2.30 mm (0.078 to 0.090 in.).

(b) Install thickest snap ring that will fit in shaft groove. Use heavy duty snap ring pliers to install new ring.

(c) Verify that snap ring is completely seated in groove before proceeding.

(36) Install output shaft bearing.

(37) Install output shaft bearing snap ring (Fig. 76). Use heavy duty snap ring pliers and spread snap ring only enough to install it. Be sure snap ring is completely seated in shaft groove before proceeding.

(38) Verify correct position of synchro sleeves before proceeding with assembly operations (Fig. 77). Grooved side of 3-4 sleeve should be facing forward. First gear side of 1-2 sleeve should be facing first gear. Tapered side of fifth-reverse sleeve should be facing forward.

DISASSEMBLY AND ASSEMBLY (Continued)

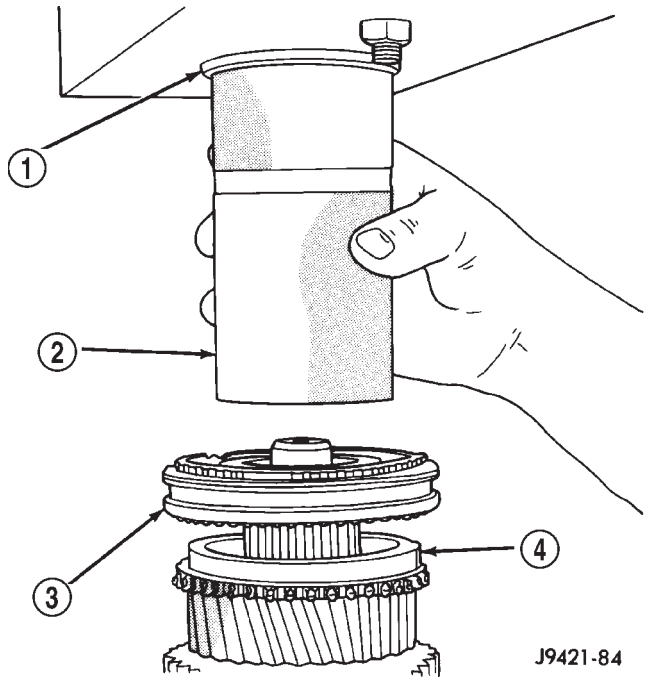


Fig. 74 Pressing 3-4 Synchro Assembly On Output Shaft

1 – PRESS RAM
2 – PIPE TOOL
3 – 3–4 SYNCHRO
4 – THIRD SPEED SYNCHRO RING

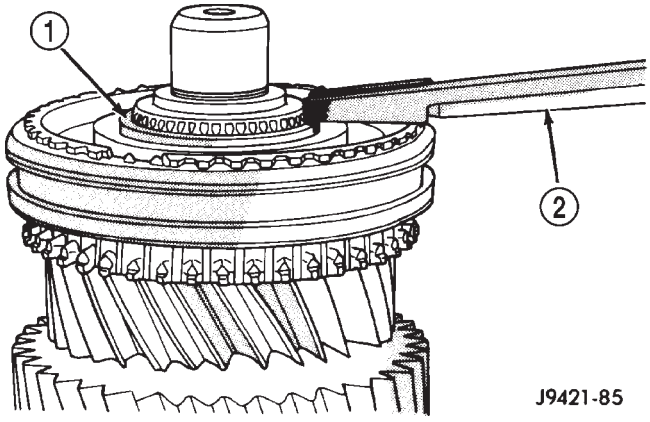


Fig. 75 Installing 3-4 Synchro Hub Snap Ring

1 – 3–4 SYNCHRO HUB SNAP RING
2 – HEAVY DUTY SNAP RING PLIERS

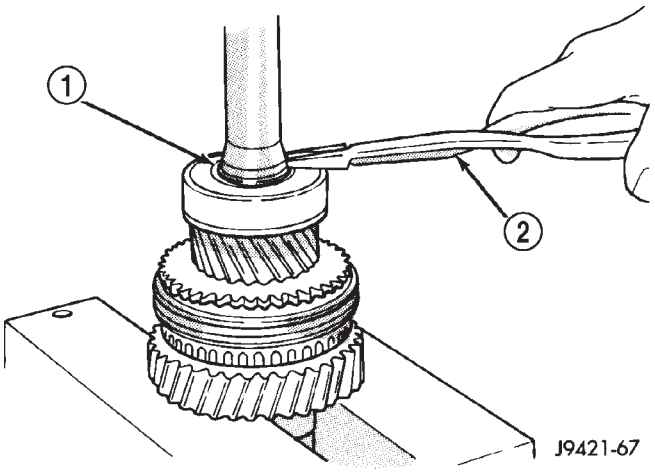


Fig. 76 Installing Output Shaft Bearing Snap Ring

1 – BEARING SNAP RING
2 – HEAVY DUTY SNAP RING PLIERS

REVERSE IDLER ASSEMBLY

(1) Lubricate idler components with gear lube.

(2) Slide idler gear bearing on shaft (Fig. 78). Bearing fits either way on shaft.

(3) Slide gear onto shaft. Side of gear with recess goes to rear (Fig. 78).

(4) Place first lock ball in dimple at rear end of idler shaft (Fig. 78). Petroleum jelly can be used to hold ball in place if desired.

(5) Slide thrust rear thrust washer onto shaft and over lock ball (Fig. 79).

(6) Install snap ring in groove at rear of shaft (Fig. 79).

(7) Install lock ball in dimple at front of shaft. Hold ball in place with petroleum jelly if desired.

(8) Install front thrust washer on shaft and slide washer up against gear and over lock ball (Fig. 80).

(9) Install wave washer, flat washer and remaining snap ring on idler shaft (Fig. 80). Be sure snap ring is fully seated.

SHIFT SHAFT AND DETENT PLUNGER BUSHINGS/BEARINGS

(1) Inspect shift shaft bushing and bearing for damage.

(2) If necessary, the shift shaft bushing can be replaced as follows:

DISASSEMBLY AND ASSEMBLY (Continued)

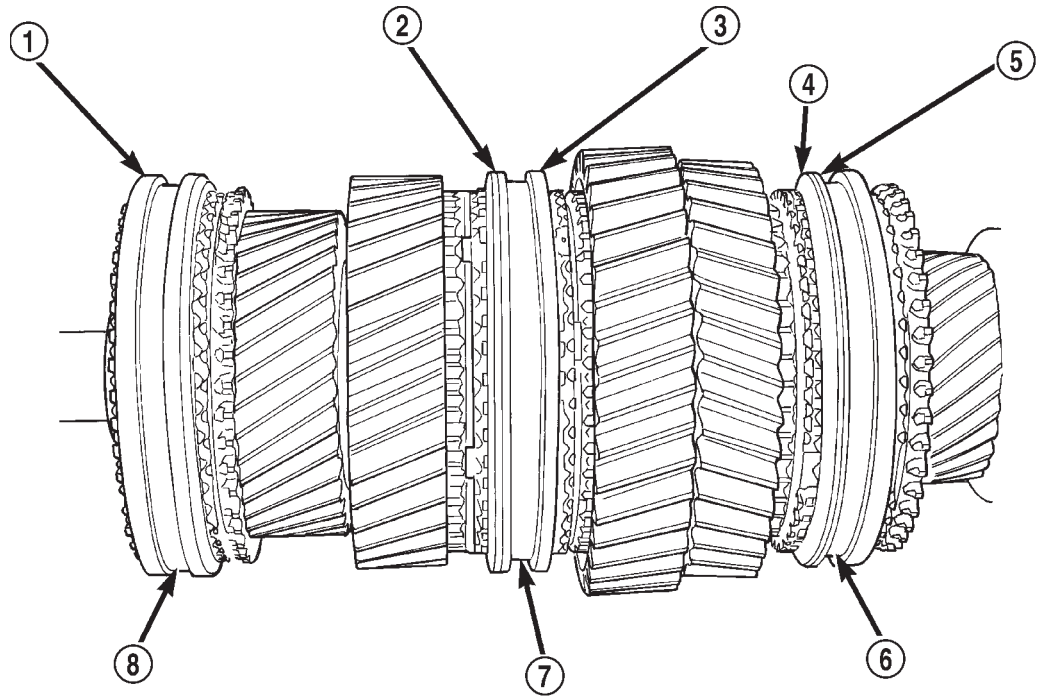


Fig. 77 Correct Synchro Sleeve Position

1 – DOUBLE GROOVE FORWARD
2 – GROOVE FORWARD
3 – FIRST GEAR SIDE MARKING TOWARD FIRST GEAR
4 – TAPER FORWARD
5 – GROOVE FORWARD
6 – 5TH-REV SYNCHRO SLEEVE
7 – 1–2 SYNCHRO SLEEVE
8 – 3–4 SYNCHRO SLEEVE

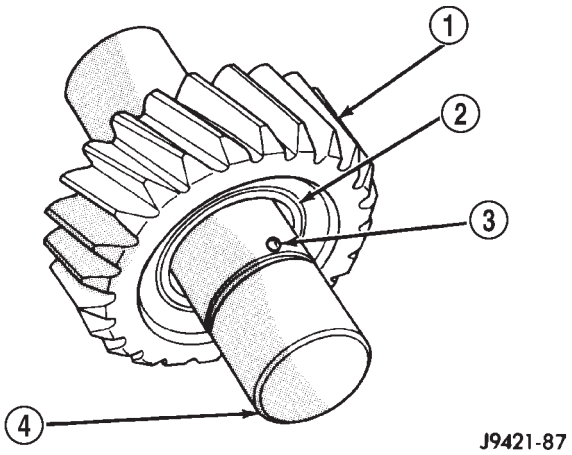


Fig. 78 Idler Gear And Bearing Installation

1 – IDLER GEAR
2 – BEARING
3 – LOCK BALL
4 – REAR OF SHAFT

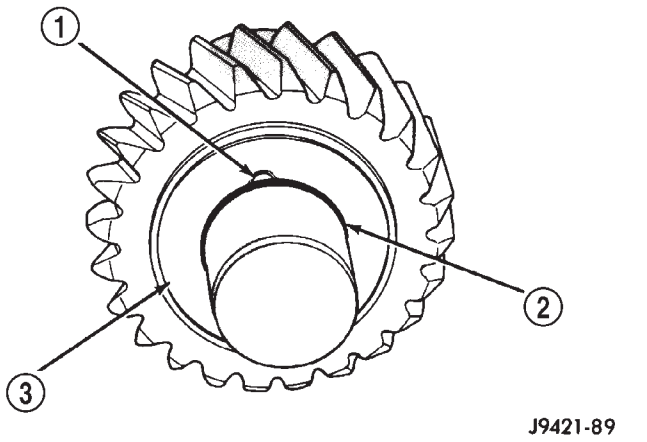


Fig. 79 Idler Gear Rear Thrust Washer Installation

1 – LOCK BALL
2 – SNAP RING GROOVE
3 – THRUST WASHER

(a) Locate a bolt that will thread into the bushing without great effort.

(b) Thread the bolt into the bushing, allowing the bolt to make its own threads in the bushing.

DISASSEMBLY AND ASSEMBLY (Continued)

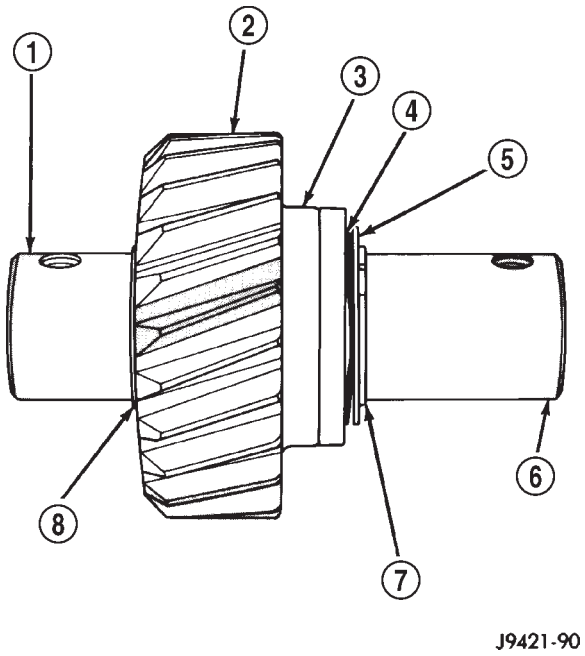


Fig. 80 Idler Gear And Shaft Assembly

1 – REAR OF SHAFT
2 – GEAR
3 – THRUST WASHER AND BALL
4 – WAVE WASHER
5 – FLAT WASHER
6 – FRONT OF SHAFT
7 – SNAP RING
8 – SNAP RING

(c) Attach a slide hammer or suitable puller to the bolt and remove bushing.

(d) Use the short end of Installer 8119 to install the new bushing.

(e) The bushing is correctly installed if the bushing is flush with the transmission case.

(3) If necessary, the shift shaft bearing can be replaced as follows:

(a) Locate a bolt that will thread into the bearing without great effort.

(b) Thread the bolt into the bearing as much as possible.

(c) Attach a slide hammer or suitable puller to the bolt and remove the bearing.

(d) Use the short end of Installer 8119 to install the new bearing.

(e) The bearing is correctly installed if the bearing is flush with the transmission case.

(4) Inspect detent plunger bushings for damage.

NOTE: The detent plunger bushings are installed to a specific depth. The space between the two bushings when correctly installed contain an oil feed hole. Do not attempt to install the bushings with anything other than the specified tool or this oil hole may become restricted.

(5) If necessary, the detent plunger bushings can be replaced as follows:

(a) Using the long end of Installer 8119, drive the detent bushings through the outer case and into the shift shaft bore.

(b) Remove the bushings from the shift shaft bore.

(c) Install a new detent plunger bushing on the long end of Installer 8118.

(d) Start the bushing in the detent plunger bore in the case.

(e) Drive the bushing into the bore until the tool contacts the transmission case.

(f) Install a new detent plunger bushing on the short end of Installer 8118.

(g) Start the bushing in the detent plunger bore in the case.

(h) Drive the bushing into the bore until the tool contacts the transmission case.

GEARTRAIN ASSEMBLY

(1) Install Adapter 6747-1A on input shaft hub of fixture tool (Fig. 81). Then install Adapter 6747-2A on front bearing hub of countershaft. Adapter 6747-2A has a raised shoulder on one side. Be sure the shoulder is seated against the countershaft.

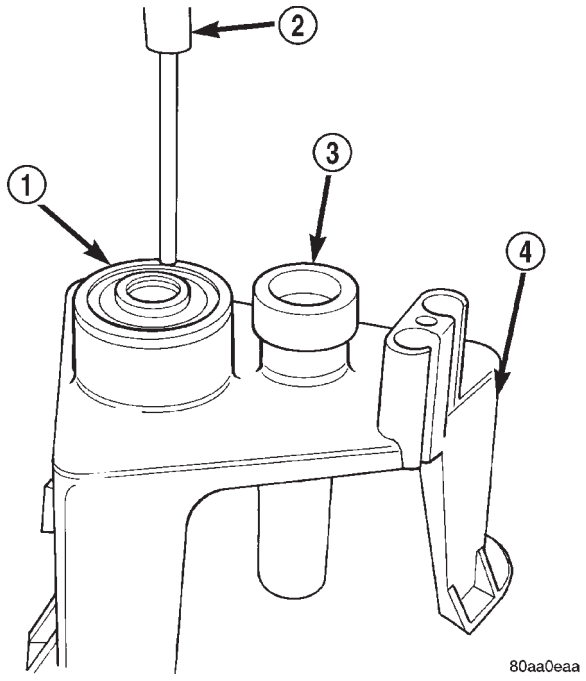


Fig. 81 Preparing Assembly Fixture For Geartrain Build-up

1 – SPECIAL TOOL 6747–2A (INSTALL ON COUNTERSHAFT FRONT HUB)
2 – SPECIAL TOOL 8115
3 – SPECIAL TOOL 6747–1A
4 – SPECIAL TOOL 6747

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Install input shaft in fixture tool. Make sure Adapter Tool 6747-1A is positioned under shaft as shown (Fig. 82).

(3) Install pilot bearing in input shaft (Fig. 82).

NOTE: There is a correct and an incorrect way to install the pilot bearing into the input shaft. The side of the pilot bearing with the small diameter goes toward the input shaft.

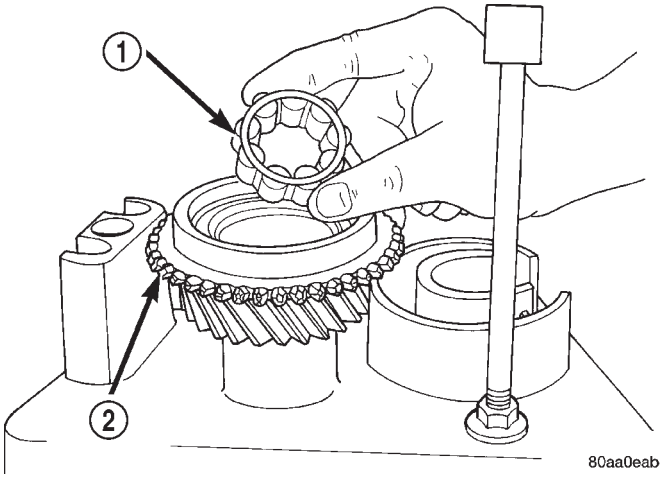


Fig. 82 Installing Pilot Bearing In Input Shaft

1 – PILOT BEARING
2 – INPUT SHAFT

(4) Install fourth gear synchro ring on input shaft (Fig. 83).

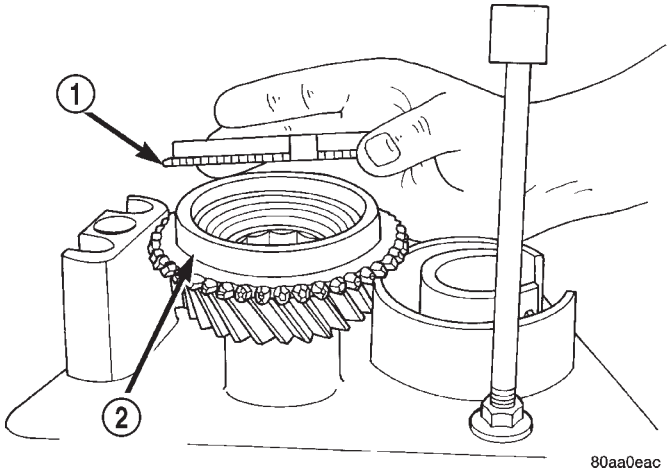


Fig. 83 Installing Fourth Gear Synchro Ring On Input Shaft

1 – FOURTH GEAR SYNCHRO RING
2 – INPUT SHAFT

(5) Adjust height of idler gear pedestal on assembly fixture (Fig. 84). Start with a basic height of 18.4 cm (7-1/4 in.). Final adjustment can be made after gear is positioned on pedestal.

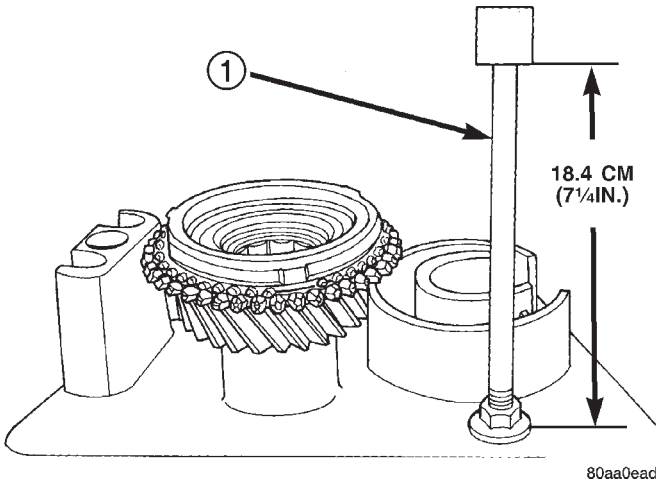


Fig. 84 Idler Pedestal Basic Height Adjustment

1 – REVERSE IDLER PEDESTAL

(6) Install assembled output shaft and geartrain in input shaft (Fig. 85). Carefully rotate output shaft until the 3–4 synchro ring seats in synchro hub and sleeve.

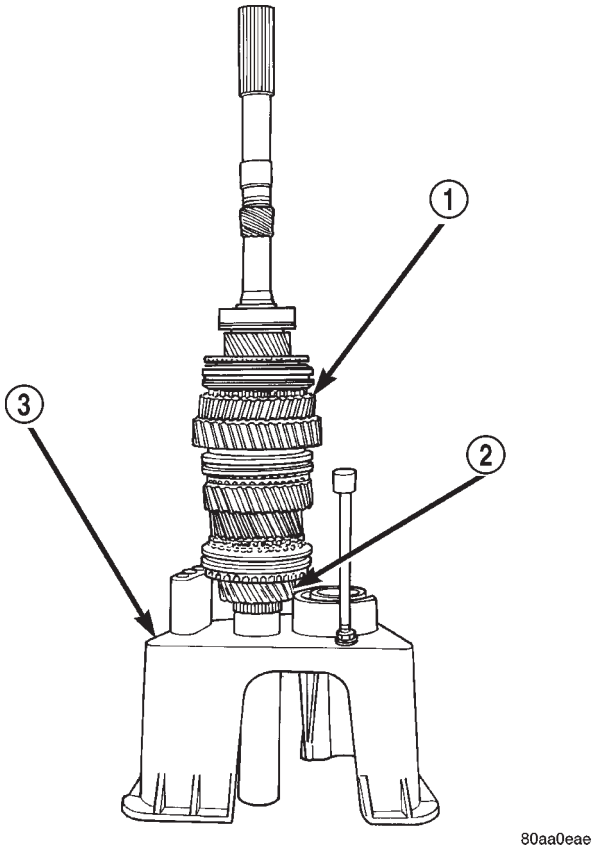


Fig. 85 Output Shaft And Geartrain Installed In Input Shaft

1 – OUTPUT SHAFT AND GEARTRAIN
2 – INPUT SHAFT
3 – SPECIAL TOOL 6747

DISASSEMBLY AND ASSEMBLY (Continued)

(7) Install Adapter 6747-2A on front bearing hub of countershaft, if not previously done. The adapter has a shoulder on one side. The shoulder goes toward the countershaft.

(8) Slide countershaft (and adapter) into fixture slot. Verify that countershaft and output shaft gears are fully meshed with the mainshaft gears before proceeding (Fig. 86).

(9) Check alignment of countershaft and output shaft gear teeth. Note that gears may not align perfectly. A difference in height of 1.57 to 3.18 mm (1/16 to 1/8 in.) will probably exist. This difference will not interfere with assembly. However, if the difference is greater than this, the countershaft adapter tool is probably upside down. Remove countershaft, reverse adapter tool, reinstall countershaft and check alignment again.

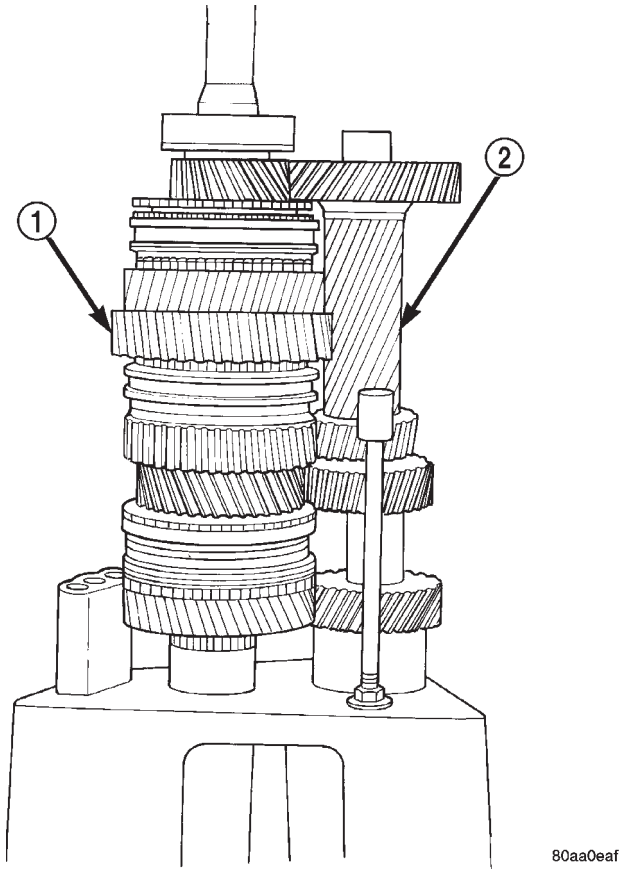


Fig. 86 Countershaft Installed On Fixture Tool

1 – OUTPUT SHAFT AND GEARTRAIN
2 – COUNTERSHAFT (SLIDE INTO PLACE ON FIXTURE TOOL)

(10) Position reverse idler in support cup of assembly fixture (Fig. 87). Be sure idler gear is properly meshed and aligned with shaft gear teeth and that bolt holes are facing out and not toward geartrain. Adjust pedestal up or down if necessary. Also be sure that short end of idler shaft is facing up as shown.

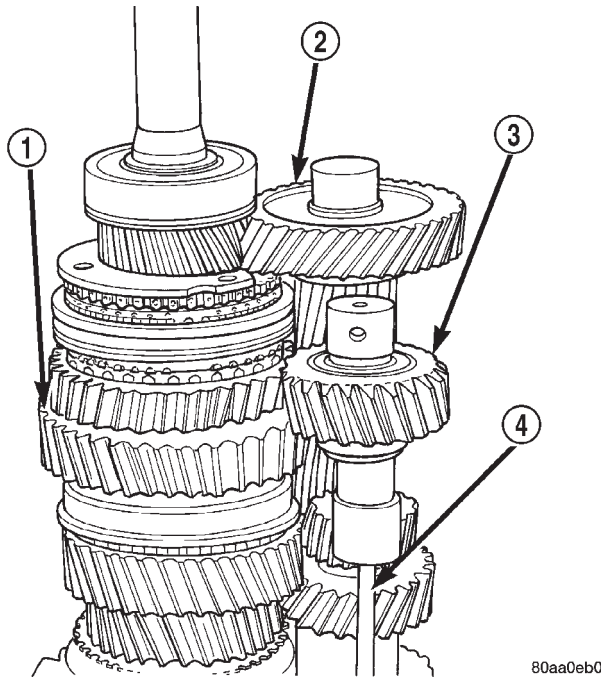


Fig. 87 Reverse Idler Assembly Positioned On Assembly Fixture Pedestal

1 – OUTPUT SHAFT AND GEARTRAIN
2 – COUNTERSHAFT
3 – REVERSE IDLER ASSEMBLY
4 – TOOL PEDESTAL

(11) On 2-wheel drive transmission, thread one Pilot Stud 8120 in center or passenger side hole of output shaft bearing retainer. Then position retainer on fifth gear as shown (Fig. 88).

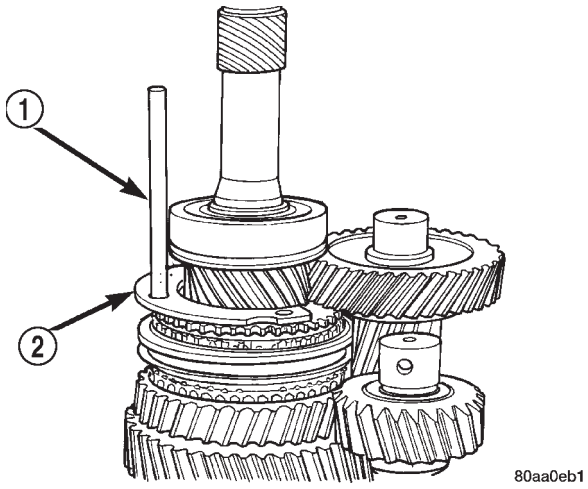


Fig. 88 Positioning Output Shaft Bearing Retainer For Rear Housing Installation

1 – SPECIAL TOOL 8120
2 – OUTPUT SHAFT BEARING RETAINER

DISASSEMBLY AND ASSEMBLY (Continued)

(12) Assemble 1-2 and fifth reverse-shift forks (Fig. 89). Arm of fifth-reverse fork goes through slot in 1-2 fork.

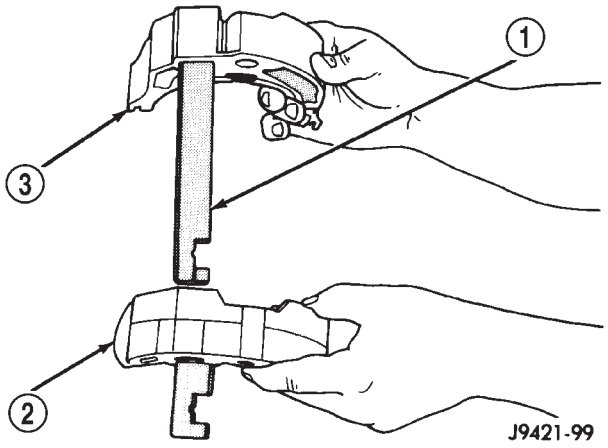


Fig. 89 Assembling 1-2 And Fifth-Reverse Shift Forks

1 – INSERT ARM THROUGH 1–2 FORK
2 – 1–2 FORK
3 – FIFTH-REVERSE FORK

(13) Install assembled shift forks in synchro sleeves (Fig. 90). Be sure forks are properly seated in sleeves.

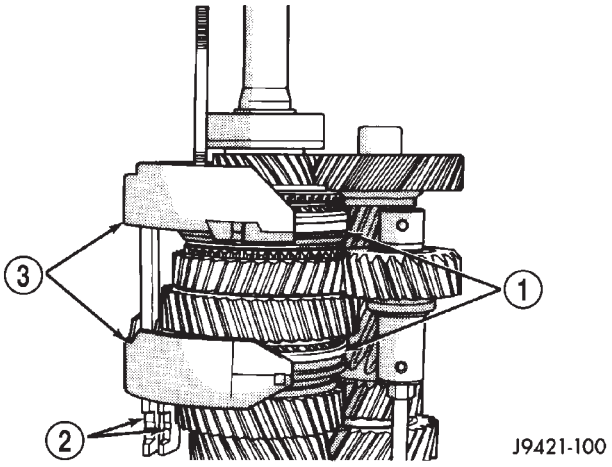


Fig. 90 Shift Forks Installed In Synchro Sleeves

1 – SYNCHRO SLEEVES
2 – FORK ARMS
3 – SHIFT FORKS

ADAPTER HOUSING

(1) Install rear bearing in adapter housing. Use wood hammer handle or wood dowel to tap bearing into place.

(2) Position rear bearing retainer in adapter housing (Fig. 91).

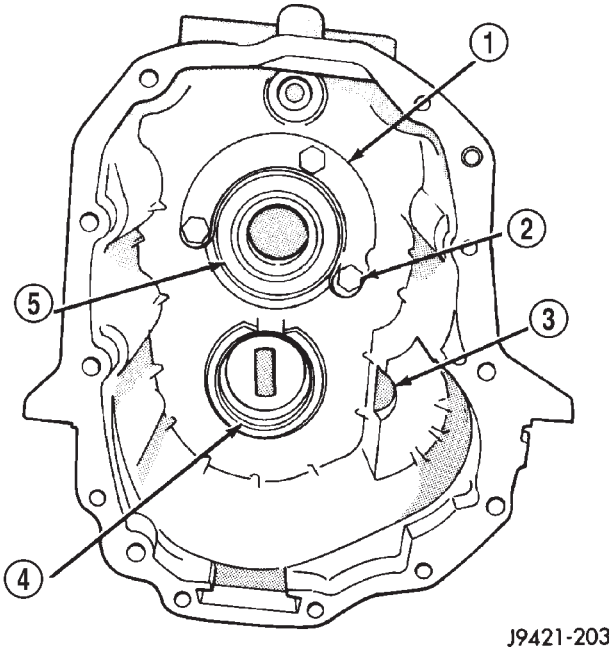


Fig. 91 Preparing Adapter Housing For Installation

1 – BEARING RETAINER
2 – RETAINER BOLTS (3)
3 – IDLER SHAFT NOTCH
4 – COUNTERSHAFT REAR BEARING RACE
5 – REAR BEARING

(3) Apply Mopar® Gasket Maker, or equivalent, to threads, bolt shanks and under hex heads of bearing retainer bolts (Fig. 94).

(4) Apply liberal quantity of petroleum jelly to countershaft rear bearing and bearing race.

(5) Install countershaft rear bearing in bearing race (Fig. 92).

CAUTION: The countershaft bearings can be installed backwards if care is not exercised. Be sure the large diameter side of the roller retainer faces the countershaft and the small diameter side faces the race and housing (Fig. 93).

(6) Apply extra petroleum jelly to hold countershaft rear bearing in place when housing is installed.

DISASSEMBLY AND ASSEMBLY (Continued)

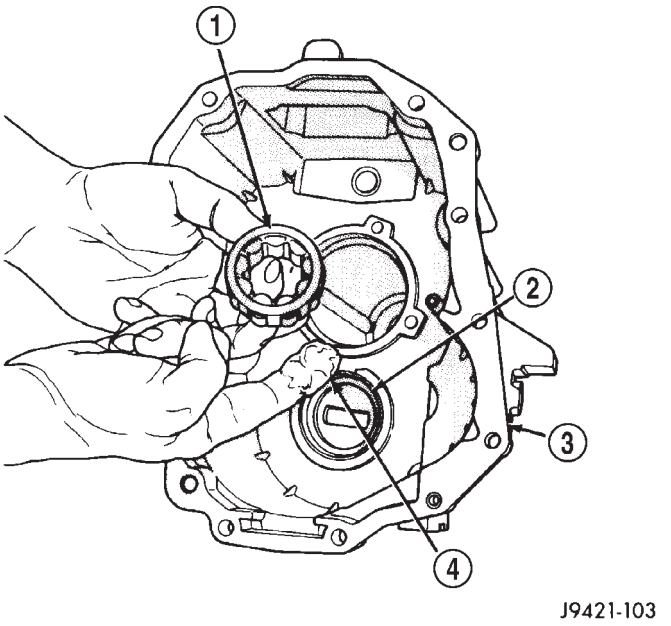


Fig. 92 Lubricating the Countershaft Rear Bearing

1 – COUNTERSHAFT REAR BEARING
2 – REAR BEARING RACE
3 – REAR HOUSING
4 – PETROLEUM JELLY (APPLY TO BEARING AND RACE)

(7) Apply light coat of petroleum jelly to shift shaft bushing/bearing in adapter housing (Fig. 93).

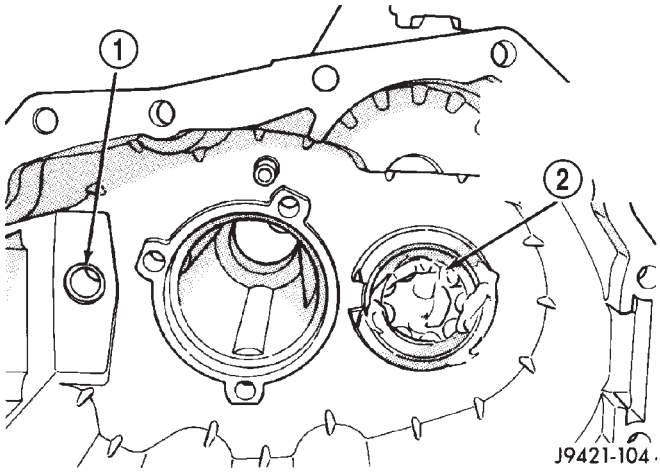


Fig. 93 Countershaft Rear Bearing Installation

1 – SHIFT SHAFT BUSHING/BEARING
2 – COUNTERSHAFT REAR BEARING (SEATED IN RACE)

(8) Install adapter housing on geartrain.

(9) Install rear bearing snap ring on output shaft (Fig. 94).

(10) Lubricate lip of new rear seal (Fig. 95) with Mopar® Door Ease, or transmission fluid.

(11) Install new rear seal in adapter housing bore with Installer C-3860-A. Be sure seal is fully seated in housing bore (Fig. 95).

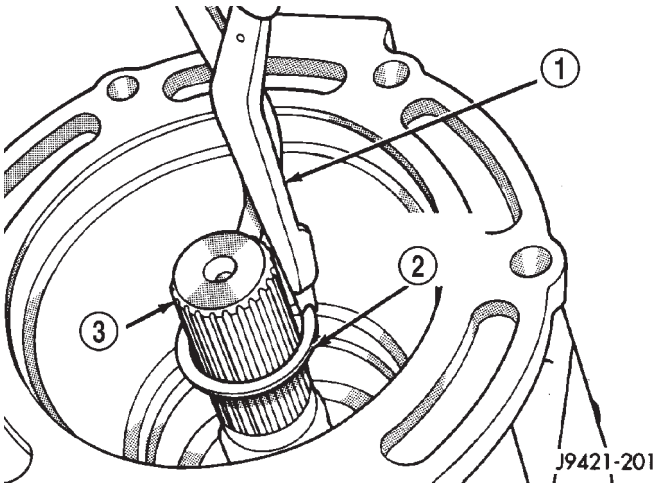


Fig. 94 Installing Rear Bearing Snap Ring

1 – HEAVY DUTY SNAP RING PLIERS
2 – REAR BEARING SNAP RING
3 – OUTPUT SHAFT

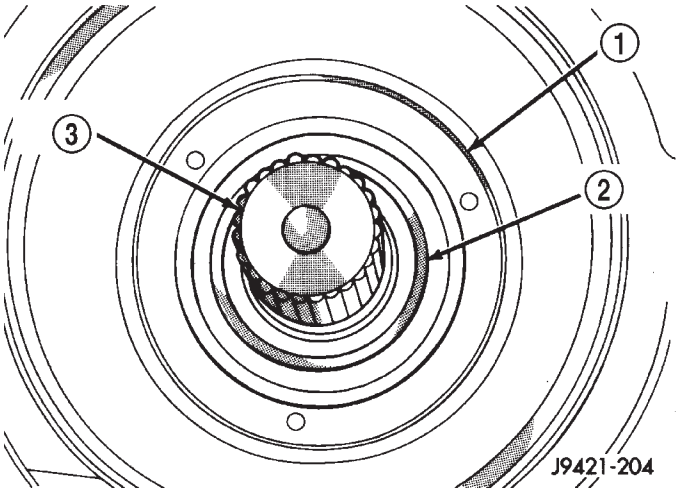


Fig. 95 Rear Seal Installation

1 – REAR SEAL
2 – SEAL LIP
3 – OUTPUT SHAFT

SHIFT SHAFT, SHAFT LEVER AND BUSHING AND SHIFT SOCKET

(1) Before proceeding, verify that all synchro sleeves are in Neutral position (centered on hub). Move sleeves into neutral if necessary.

CAUTION: The transmission synchros must all be in Neutral position for proper reassembly. Otherwise, the housings, shift forks and gears can be damaged during installation of the two housings.

(2) Install 3-4 shift fork in synchro sleeve (Fig. 96). Verify that groove in fork arm is aligned with grooves in 1-2 and fifth-reverse fork arms as shown.

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DISASSEMBLY AND ASSEMBLY (Continued)

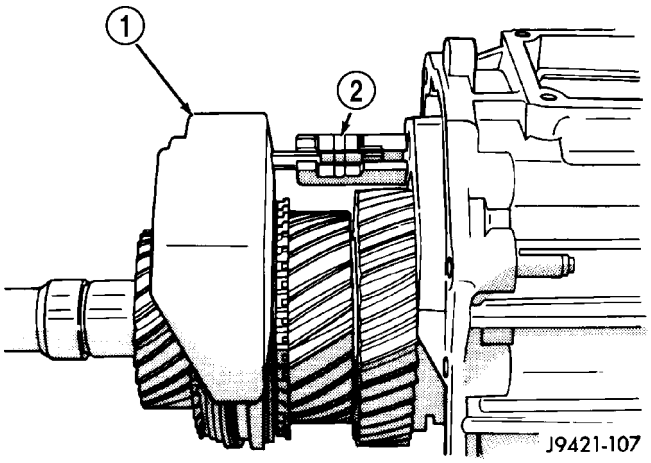


Fig. 96 Installing 3-4 Shift Fork

1 – 3–4 FORK
2 – ALIGN GROOVES IN FORK ARMS

(3) Slide shift shaft through 3-4 shift fork (Fig. 97). Be sure shaft detent notches are to the rear.

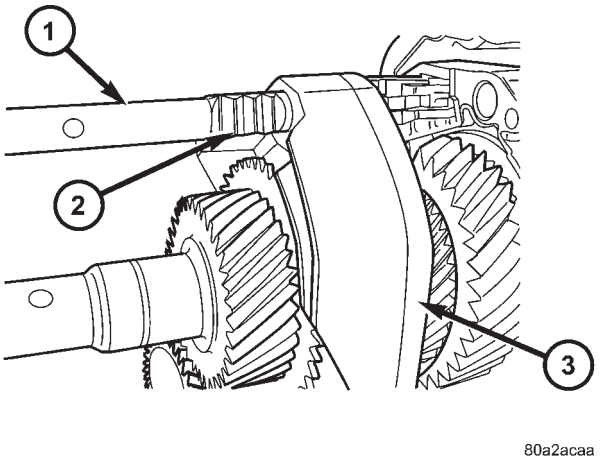


Fig. 97 Shifter Shaft

1 – SHIFTER SHAFT
2 – SHIFTER SHAFT DETENT
3 – 3–4 SHIFT FORK

(4) Assemble shift shaft shift lever and bushing (Fig. 98). Be sure slot in bushing is facing up and roll pin hole for lever is aligned with hole in shaft.

(5) Install assembled lever and bushing on shift shaft (Fig. 99).

(6) Slide shift shaft through 1-2 and fifth-reverse fork and into shift lever opening in rear housing (Fig. 100).

(7) Align shift socket with shaft and slide shaft through socket and into shift shaft bearing in rear housing (Fig. 101).

(8) Rotate shift shaft so detent notches in shaft are facing the TOP of the transmission housing.

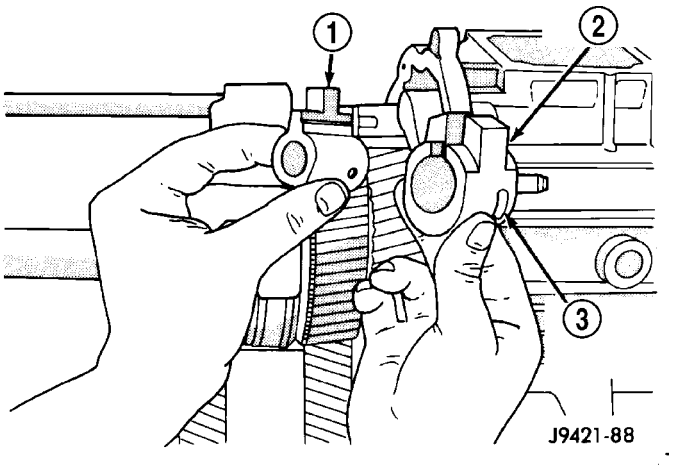


Fig. 98 Assembling Shift Shaft Lever And Bushing

1 – SHAFT LEVER
2 – LEVER BUSHING
3 – BUSHING LOCK PIN SLOT

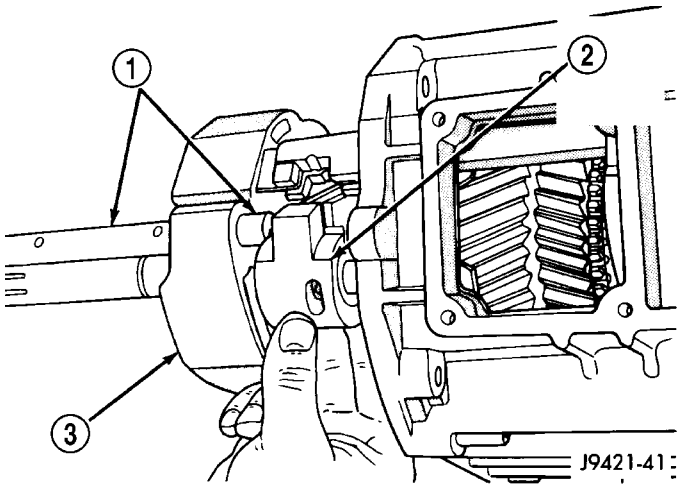


Fig. 99 Installing Shift Shaft Lever And Bushing

1 – SHIFT SHAFT
2 – SHAFT LEVER AND BUSHING
3 – 3–4 FORK

CAUTION: Correct positioning of the shift shaft detent notch is important. Both of the shaft roll pins can be installed even when the shaft is 180° off. If this occurs, the transmission will have to be disassembled again to correct shaft alignment.

(9) Select correct new roll pin for shift shaft lever (Fig. 102). Shaft lever roll pin is approximately 22 mm (7/8 in.) long. Shift socket roll pin is approximately 33 mm (1-1/4 in.) long.

(10) Align roll pin holes in shift shaft, lever and bushing. Then start roll pin into shaft lever by hand (Fig. 103).

(11) Seat shaft lever roll pin with pin punch (Fig. 104).

DISASSEMBLY AND ASSEMBLY (Continued)

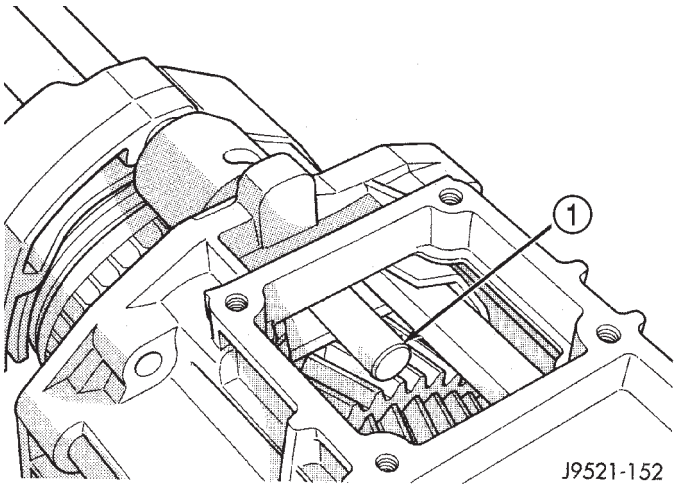


Fig. 100 Inserting Shaft Into Lever Opening In Housing

1 – SHIFT SHAFT

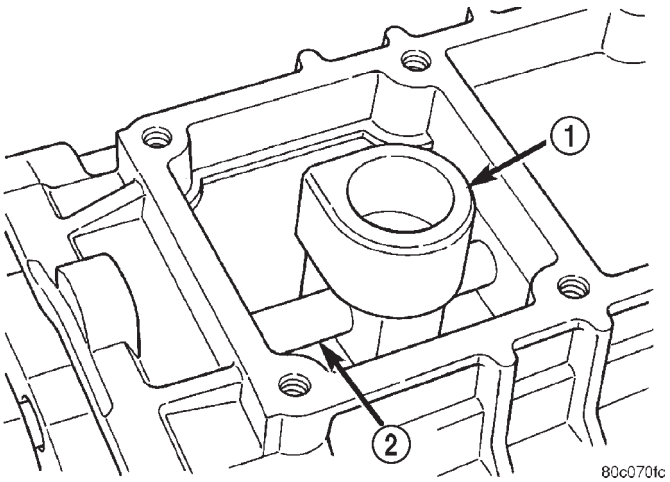


Fig. 101 Shift Socket Installation

1 – SHIFT SOCKET
2 – SHIFT SHAFT

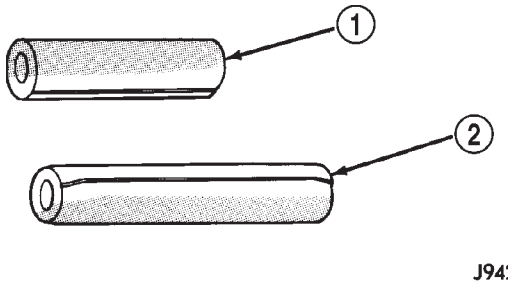


Fig. 102 Roll Pin Identification—Shaft Lever And Shift Socket

1 – SHAFT LEVER ROLL PIN
2 – SHIFT SOCKET ROLL PIN

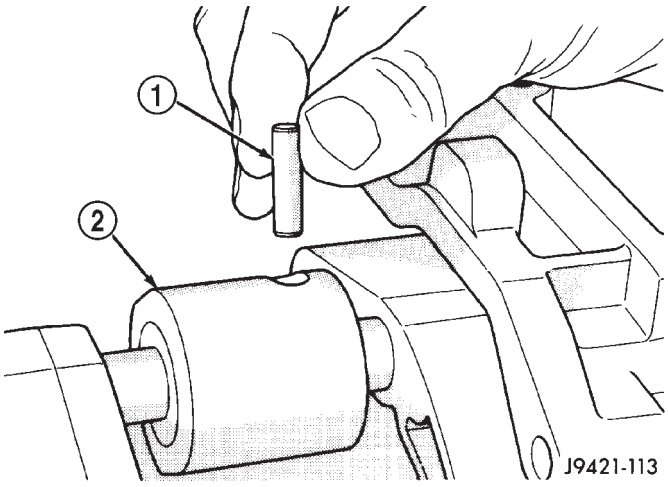


Fig. 103 Starting Roll Pin In Shift Shaft Lever

1 – SHAFT LEVER ROLL PIN (⅞" LONG)
2 – LEVER AND BUSHING

CAUTION: The shaft lever roll pin must be flush with the surface of the lever. The lever bushing will bind on the roll pin if the pin is not seated flush.

(12) Before proceeding, verify that lock pin slot in lever bushing is positioned as shown (Fig. 104).

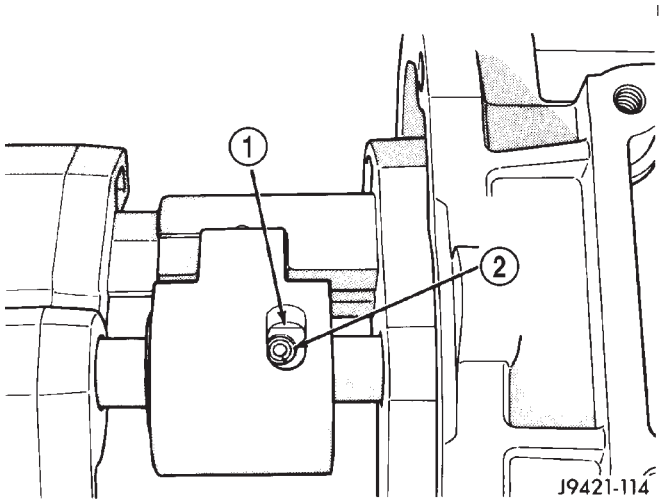


Fig. 104 Correct Seating Of Shift Shaft Lever Roll Pin

1 – BUSHING LOCK PIN SLOT
2 – SEAT ROLL PIN FLUSH WITH LEVER

(13) Align roll pin holes in shift socket and shift shaft. Then start roll pin into shift shaft by hand (Fig. 105).

(14) Seat roll pin in shift socket with pin punch. Roll pin must be flush with socket after installation (Fig. 106).

(15) Verify that notches in shift fork arms are aligned. Realign arms if necessary.

DISASSEMBLY AND ASSEMBLY (Continued)

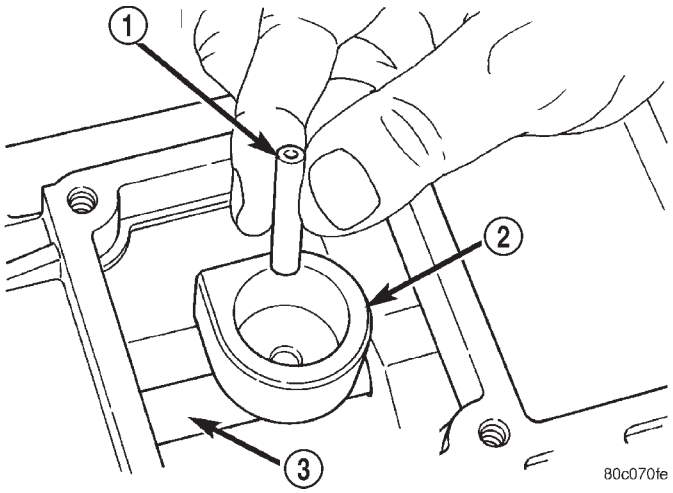


Fig. 105 Starting Roll Pin In Shift Socket

1 – ROLL PIN
2 – SHIFT SOCKET
3 – SHIFT SHAFT

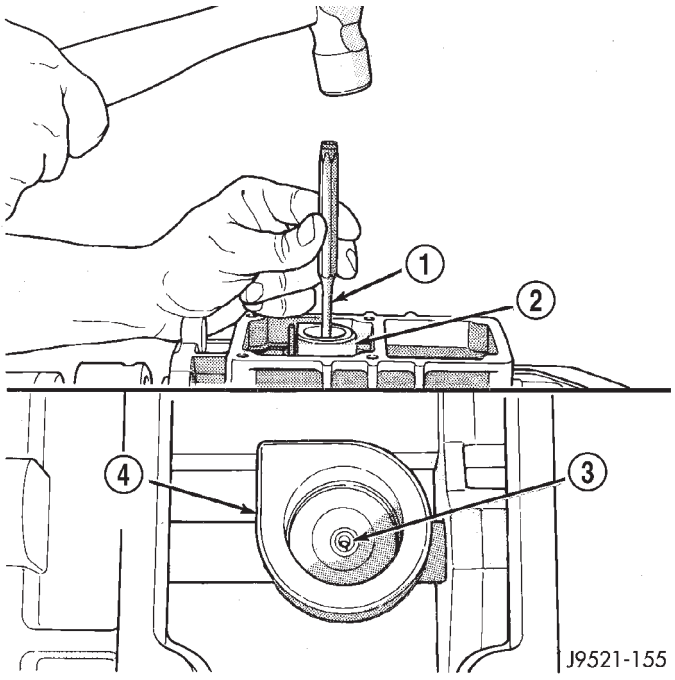


Fig. 106 Seating Shift Socket Roll Pin

1 – PIN PUNCH
2 – SHIFT SOCKET
3 – SEAT ROLL PIN FLUSH
4 – SHIFT SOCKET

FRONT HOUSING AND INPUT SHAFT BEARING RETAINER

(1) If previously removed, install input shaft bearing in front housing bore (Fig. 107). Install snap ring and use plastic mallet to seat bearing. Bearing goes in from front side of housing only.

(2) Apply liberal quantity of petroleum jelly to countershaft front bearing. Then insert bearing in front housing race (Fig. 107). Large diameter side of bearing cage goes toward countershaft (Fig. 108). Small diameter side goes toward bearing race in housing.

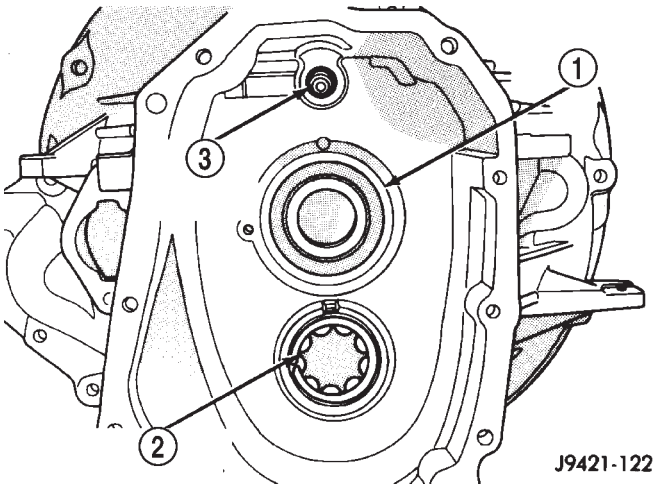


Fig. 107 Input Shaft Bearing And Countershaft Front Bearing

1 – INPUT SHAFT BEARING
2 – COUNTERSHAFT FRONT BEARING
3 – SHIFT SHAFT BUSHING

(3) Reach into countershaft front bearing with finger, and push each bearing roller outward against race. Then apply extra petroleum jelly to hold rollers in place. This avoids having rollers becoming displaced during housing installation. This will result in misalignment between bearing and countershaft bearing hub.

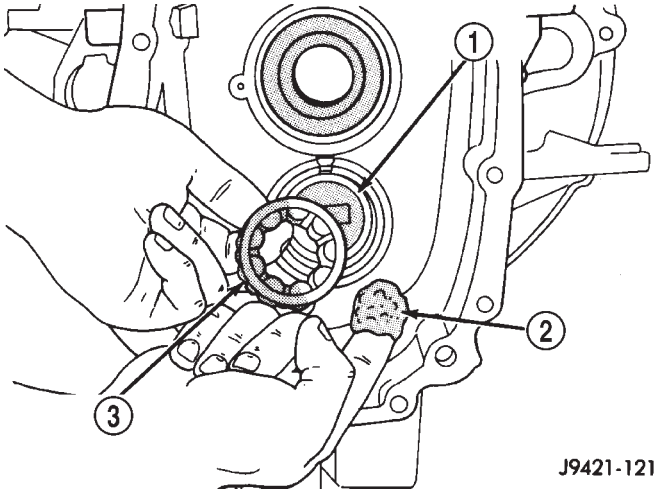


Fig. 108 Lubricating/Positioning Countershaft Front Bearing

1 – BEARING RACE
2 – PETROLEUM JELLY
3 – COUNTERSHAFT FRONT BEARING

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Apply small amount of petroleum jelly to shift shaft bushing in front housing.

(5) Apply 1/8 in. wide bead of Mopar® Gasket Maker, or equivalent, to mating surfaces of front and rear housings (Fig. 109).

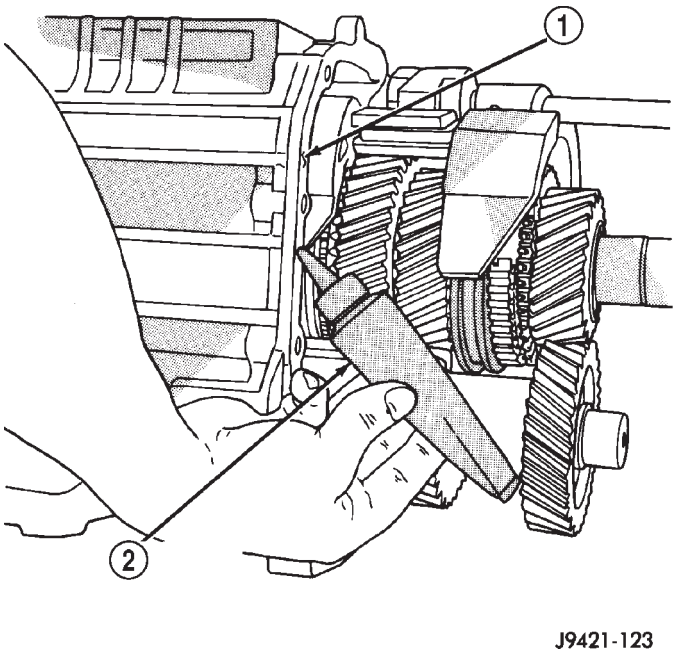


Fig. 109 Applying Sealer To Front/Rear Housings

1 – HOUSING FLANGE SURFACE
2 – MOPAR GASKET MAKER (OR LOCTITE 518)

(6) Have helper hold rear housing and geartrain in upright position. Then install front housing on rear housing and geartrain.

(7) Work front housing downward onto geartrain until seated on rear housing.

CAUTION: If the front housing will not seat on the rear housing, either the shift components are not in Neutral, or one or more components are misaligned. Do not force the front housing into place. This will only result in damaged components.

(8) Tap rear housing alignment dowels back into place with hammer and pin punch. Both dowels should be flush fit in each housing. Have helper hold transmission upright while dowels are tapped back into place.

(9) Place transmission in horizontal position.

(10) Apply Mopar® Gasket Maker, or equivalent, to housing attaching bolts. Apply sealer material sealer to underside of bolt heads and to bolt shanks and threads (Fig. 110).

(11) Install and start housing attaching bolts by hand (Fig. 110). Then tighten bolts to 34 N·m (25 ft. lbs.) torque.

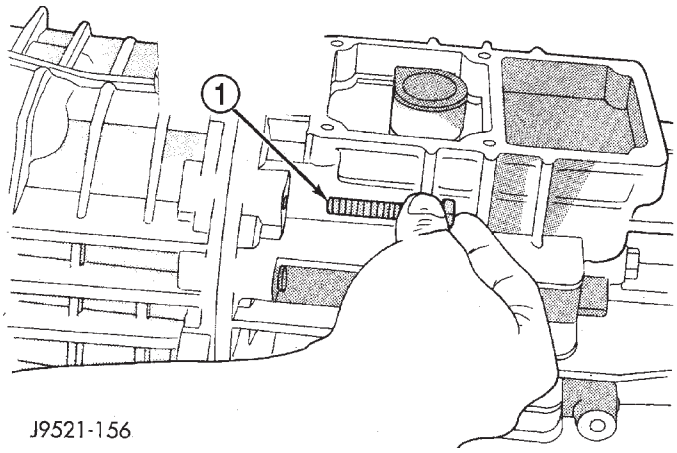


Fig. 110 Installing Housing Attaching Bolts

1 – HOUSING ATTACHING BOLTS (APPLY SEALER BEFOREHAND)

(12) Install shift shaft bushing lock bolt (Fig. 111). Apply Mopar® Gasket Maker, or equivalent, to bolt threads, shank and underside of bolt head before installation.

CAUTION: If the lock bolt cannot be fully installed, do not try to force it into place. Either the shift shaft is not in Neutral, or the shaft bushing (or lever) is misaligned.

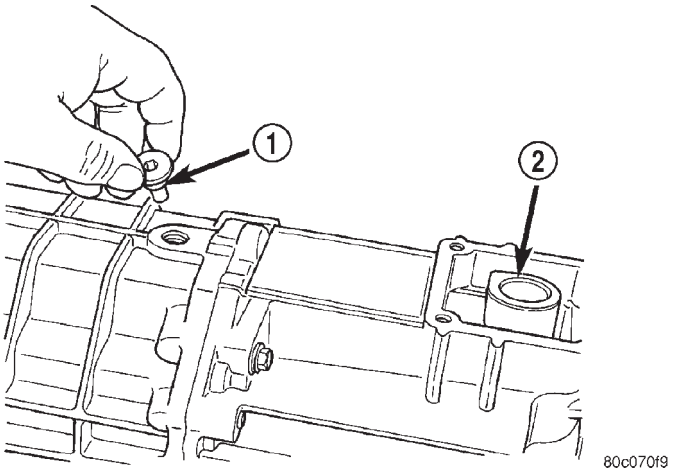


Fig. 111 Installing Shift Shaft Bushing Lock Bolt

1 – SHIFT SHAFT LOCK BOLT
2 – SHAFT SOCKET

(13) Lubricate then install shift shaft detent plunger in housing bore (Fig. 112). Lubricate plunger with petroleum jelly or gear lubricant. **Be sure plunger is fully seated in detent notch in shift shaft.**

(14) Install detent spring inside plunger (Fig. 112).

(15) Install detent plug as follows:

(a) Install detent plug in end of Installer 8123.

DISASSEMBLY AND ASSEMBLY (Continued)

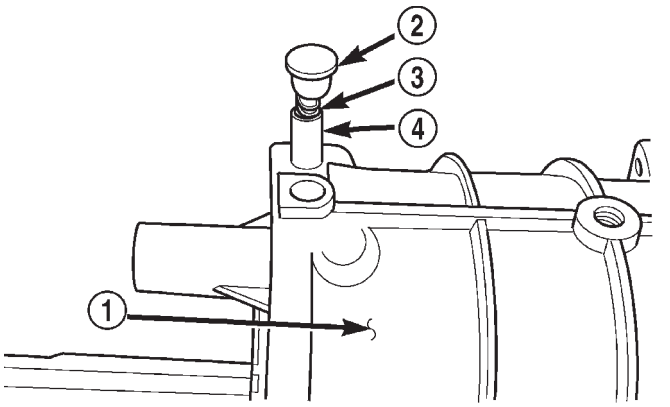


Fig. 112 Installing Shift Shaft Detent Plunger, Spring, and Plug

1 – FRONT HOUSING
2 – PLUG
3 – SPRING
4 – PLUNGER

(b) Position plug on detent spring and compress spring until detent plug pilots in detent plunger bore.

(c) Drive detent plug into transmission case until plug seats.

(16) Install backup light switch (Fig. 113).

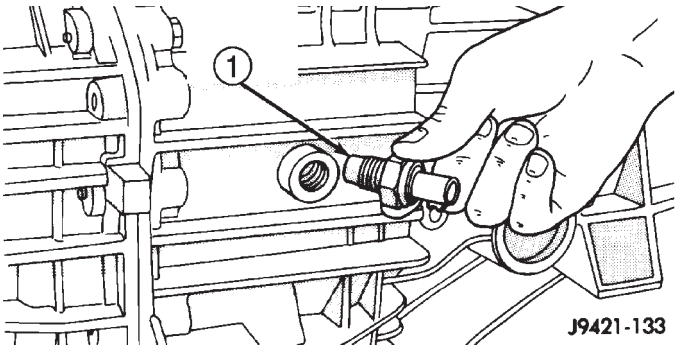


Fig. 113 Installing Backup Light Switch

1 – BACKUP LIGHT SWITCH

(17) Install input shaft snap ring (Fig. 114).

(18) Install new oil seal in front bearing retainer with Installer Tool 6448 (Fig. 115).

(19) Apply bead of Mopar® silicone sealer, or equivalent, to flange surface of front bearing retainer (Fig. 116).

(20) Align and install front bearing retainer over input shaft and onto housing mounting surface (Fig. 117). Although retainer is one-way fit on housing, be sure bolt holes are aligned before seating retainer.

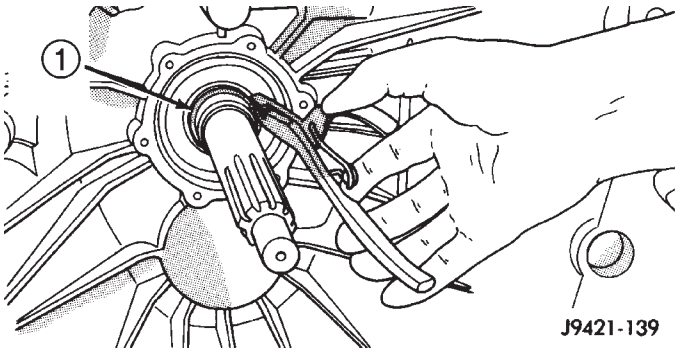


Fig. 114 Installing Input Shaft Snap Ring—Typical

1 – INPUT SHAFT SNAP RING

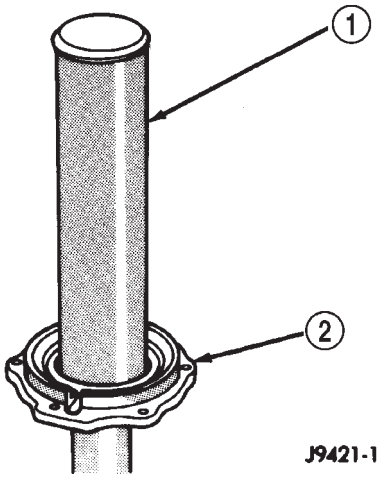


Fig. 115 Installing Oil Seal In Front Bearing Retainer

1 – SPECIAL TOOL 6448
2 – FRONT BEARING RETAINER

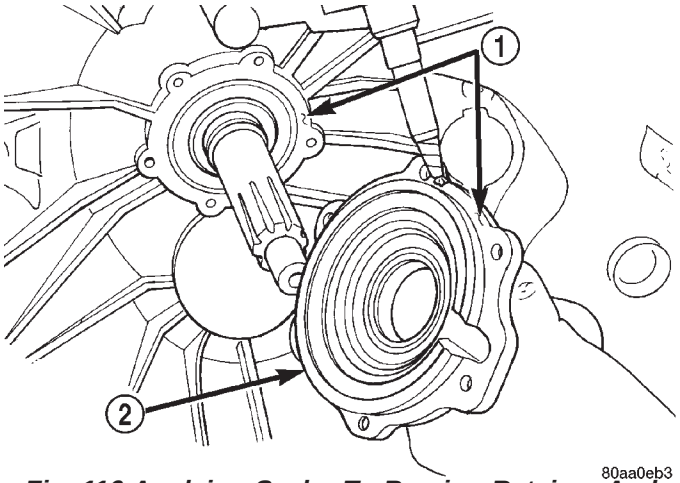


Fig. 116 Applying Sealer To Bearing Retainer And Housing—Typical

1 – APPLY SEALER BEAD
2 – INPUT SHAFT BEARING RETAINER

NOTE: Be sure that no sealer gets into the oil feed hole in the transmission case or bearing retainer.

DISASSEMBLY AND ASSEMBLY (Continued)

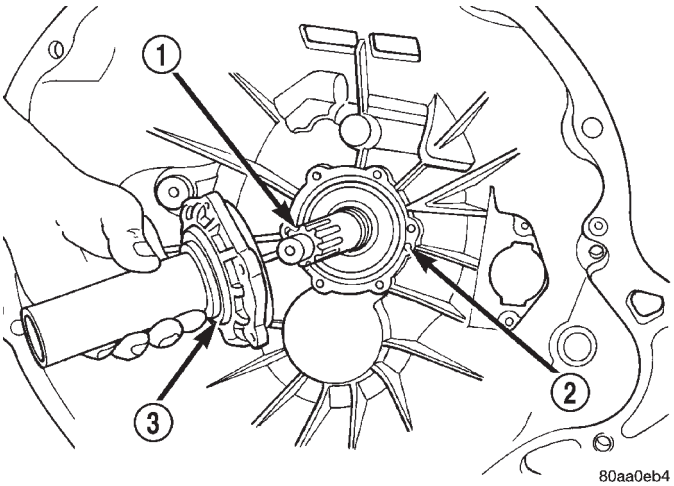


Fig. 117 Installing Input Shaft Bearing Retainer—Typical

1 – INPUT SHAFT
2 – OIL FEED
3 – BEARING RETAINER

(21) Install and tighten bearing retainer bolts to 7-10 N·m (5-7 ft. lbs.) torque (Fig. 118).

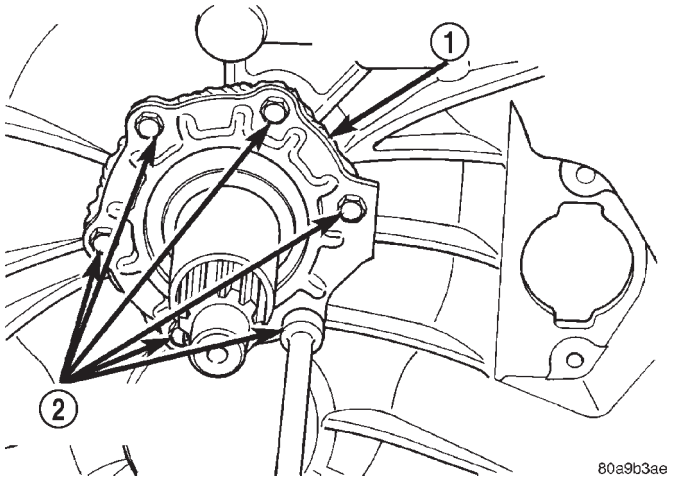


Fig. 118 Installing Input Shaft Bearing Retainer Bolts—Typical

1 – INPUT SHAFT BEARING RETAINER
2 – RETAINER BOLTS

SHIFT TOWER AND LEVER ASSEMBLY

(1) Apply petroleum jelly to ball end of shift lever and interior of shift socket.

(2) Shift the transmission into third gear.

(3) Align and install shift tower and lever assembly (Fig. 119). Be sure shift ball is seated in socket and the offset in the tower is toward the passenger side of the vehicle before installing tower bolts.

(4) Install shift tower bolts (Fig. 120). Tighten bolts to 8.5 N·m (75.2 in. lbs.) torque.

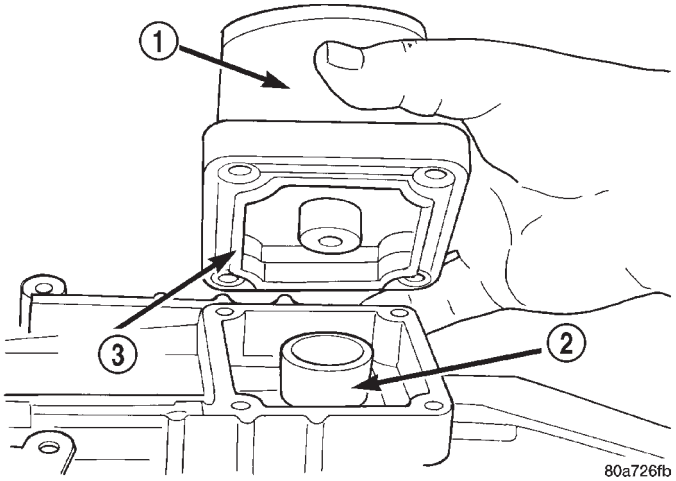


Fig. 119 Shift Tower Installation

1 – SHIFT TOWER AND LEVER ASSEMBLY
2 – SHIFT SOCKET
3 – SEAL

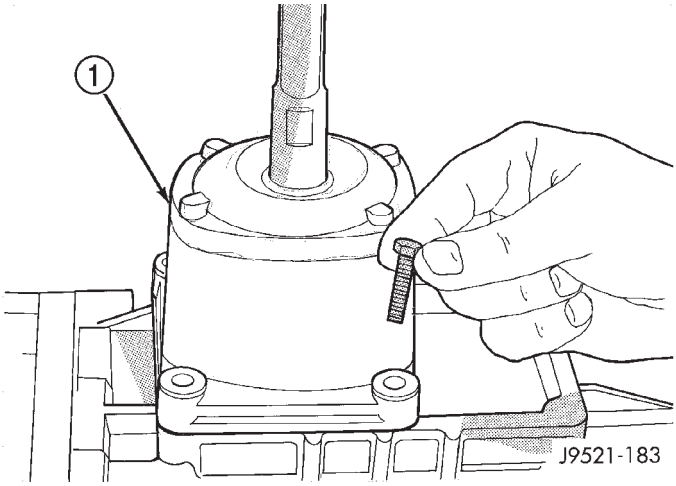


Fig. 120 Shift Tower Bolt Installation

1 – SHIFT TOWER AND LEVER ASSEMBLY

(5) Fill transmission to bottom edge of fill plug hole with Mopar® Transmission Lubricant, P/N 4761526.

(6) Install and tighten fill plug to 34 N·m (25 ft. lbs.) torque.

(7) Check transmission vent. Be sure vent is open and not restricted.

CLEANING AND INSPECTION

TRANSMISSION COMPONENTS

Clean the gears, shafts, shift components and transmission housings with a standard parts cleaning solvent. Do not use acid or corrosive base solvents. Dry all parts except bearings with compressed air.

Clean the shaft bearings with a mild solvent such as Mopar® degreasing solvent, Gunk, or similar solvents. Do not dry the bearings with compressed air. Allow the bearings to either air dry, or wipe them dry with clean shop towels.

SHIFT LEVER ASSEMBLY

The shift lever assembly is not serviceable. Replace the lever and shift tower as an assembly if the tower, lever, lever ball, or internal components are worn, or damaged.

SHIFT SHAFT AND FORKS

Inspect the shift fork interlock arms and synchro sleeve contact surfaces (Fig. 121). Replace any fork exhibiting wear or damage in these areas. Do not attempt to salvage shift forks.

Check condition of the shift shaft detent plunger and spring. The plunger should be smooth and free of nicks, or scores. The plunger spring should be straight and not collapsed, or distorted. Minor scratches, or nicks on the plunger can be smoothed with 320/400 grit emery soaked in oil. Replace the plunger and spring if in doubt about condition. Check condition of detent plunger bushings. Replace if damaged.

Inspect the shift shaft, shift shaft bushing and bearing, the shaft lever, and the lever bushing that fits over the lever. Replace the shaft if bent, cracked, or severely scored. Minor burrs, nicks, or scratches can be smoothed off with 320/400 grit emery cloth followed by polishing with crocus cloth. Replace the shift shaft bushing or bearing if damaged.

Replace the shaft lever and bushing if either part is deformed, or worn. Do not attempt to salvage these parts as shift fork binding will occur. Replace the roll pin that secures the lever to the shaft.

FRONT/REAR HOUSINGS AND BEARING RETAINERS

Inspect the housings carefully. Look for cracks, stripped threads, scored mating surfaces, damaged bearing bores, or worn dowel pin holes. Minor nicks on mating surfaces can be dressed off with a fine file, or emery cloth. Damaged threads can be renewed by either re-tapping or installing Helicoil inserts.

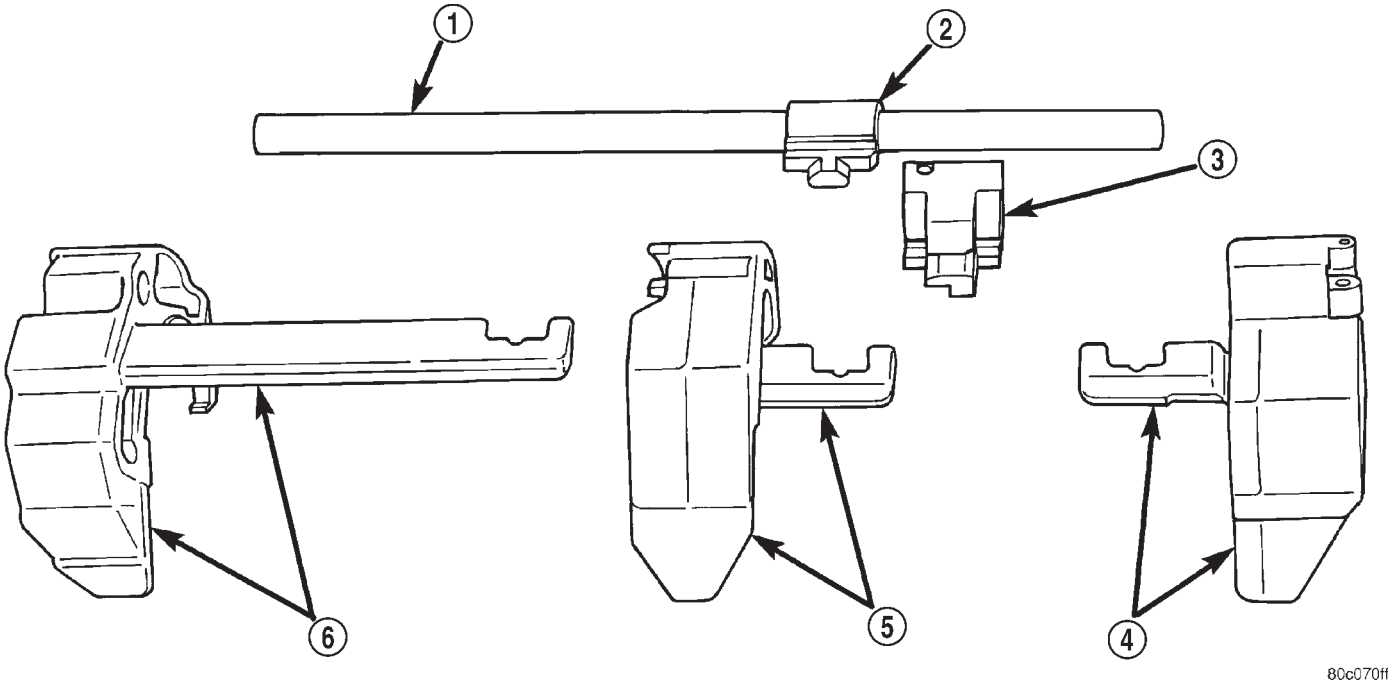


Fig. 121 Shift Forks And Shaft

1 – SHIFT SHAFT
2 – SHAFT LEVER
3 – SHAFT LEVER BUSHING
4 – 3–4 SHIFT FORK
5 – 1–2 SHIFT FORK
6 – FIFTH-REVERSE SHIFT FORK

CLEANING AND INSPECTION (Continued)

NOTE: The front housing contains the countershaft front bearing race. The rear housing contains the countershaft rear bearing race. Be advised that these components are NOT serviceable items. The front housing will have to be replaced if the countershaft bearing race is loose, worn, or damaged. The rear housing will have to be replaced if the countershaft rear bearing race is loose, worn, or damaged.

Inspect the input shaft bearing retainer. Be sure the release bearing slide surface of the retainer is in good condition. Minor nicks on the surface can be smoothed off with 320/420 grit emery cloth and final polished with oil coated crocus cloth. Replace the retainer seal if necessary.

Inspect the output shaft bearing retainer. Be sure the U-shaped retainer is flat and free of distortion. Replace the retainer if the threads are damaged, or if the retainer is bent, or cracked.

COUNTERSHAFT BEARINGS AND RACES

The countershaft bearings and races are machine lapped during manufacture to form matched sets. The bearings and races should not be interchanged.

NOTE: The bearing races are a permanent press fit in the housings and are NOT serviceable. If a bearing race becomes damaged, it will be necessary to replace the front or rear housing as necessary. A new countershaft bearing will be supplied with each new housing for service use.

The countershaft bearings can be installed backwards if care is not exercised. The bearing roller cage is a different diameter on each side. Be sure the bearing is installed so the large diameter side of the cage is facing the countershaft gear (Fig. 122). The small diameter side goes in the bearing race.

REVERSE IDLER COMPONENTS

Inspect the idler gear, bearing, shaft, thrust washer, wave washer and thrust plate. Replace the bearing if any of the needle bearing rollers are worn, chipped, cracked, flat-spotted, or brinnelled. Also replace the bearing if the plastic bearing cage is damaged or distorted.

Replace the thrust washer, wave washer, or thrust plate if cracked, chipped, or worn. Replace the idler gear if the teeth are chipped, cracked or worn thin. Replace the shaft if worn, scored, or the bolt threads are damaged beyond repair. Replace the support segment if cracked, or chipped and replace the idler attaching bolts if the threads are damaged.

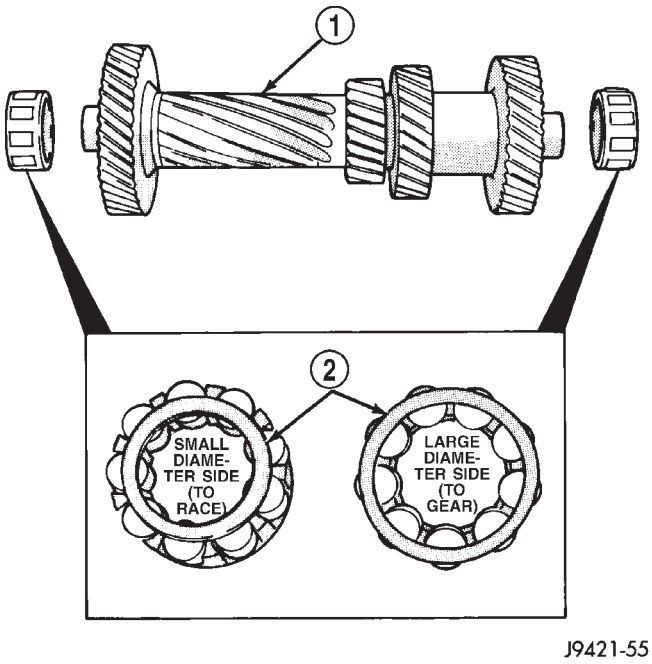


Fig. 122 Correct Countershaft Bearing Installation

1 – COUNTERSHAFT
2 – BEARING CAGE

Shift Socket

Inspect the shift socket for wear or damage. replace the socket if the roll pin, or shift shaft bores are damaged. Minor nicks in the shift lever ball seat in the socket can be smoothed down with 400 grit emery or wet/dry paper. Replace the socket if the ball seat is worn, or cracked. Do not reuse the original shift socket roll pin. Install a new pin during reassembly. The socket roll pin is approximately is approximately 33 mm (1-1/4 in.) long.

Output Shaft And Geartrain

Inspect all of the gears for worn, cracked, chipped, or broken teeth. Also check condition of the bearing bore in each gear. The bores should be smooth and free of surface damage. Discoloration of the gear bores is a normal occurrence and is not a reason for replacement. Replace gears only when tooth damage has occurred, or if the bores are brinnelled or severely scored.

Inspect the shaft splines and bearings surfaces. Minor nicks on the bearing surfaces can be smoothed with 320/420 grit emery and final polished with crocus cloth. Replace the shaft if the splines are damaged or bearing surfaces are deeply scored, worn, or brinnelled.

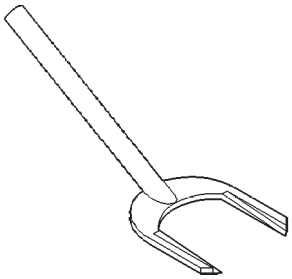
SPECIFICATIONS

TORQUE

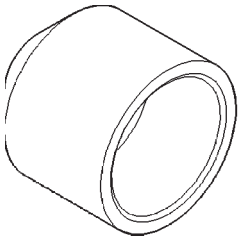
Description	Torque
Clutch Housing Bolts	54–61 N·m (40–45 ft. lbs.)
Crossmember-To-Frame Bolts	61–75 N·m (44–55 ft. lbs.)
Crossmember-To-Insulator Nuts	54–61 N·m (40–45 ft. lbs.)
Drain/Fill Plug	9–27 N·m (14–20 ft. lbs.)
Front-To-Rear Housing Bolts	30–35 N·m (22–26 ft. lbs.)
Front Bearing Retainer Bolts	7–10 N·m (5–7 ft. lbs.)
Idler Shaft Bolts	19–25 N·m (14–18 ft. lbs.)
Rear Bearing Retainer Bolts	30–35 N·m (22–26 ft. lbs.)
Shift Tower Bolts	7–10 N·m (5–7 ft. lbs.)
Slave Cylinder Attaching Nuts	23 N·m (200 in. lbs.)
Transfer Case Attaching Nuts	47 N·m (35 ft. lbs.)
U-Joint Clamp Bolts	19 N·m (170 in. lbs.)

SPECIAL TOOLS

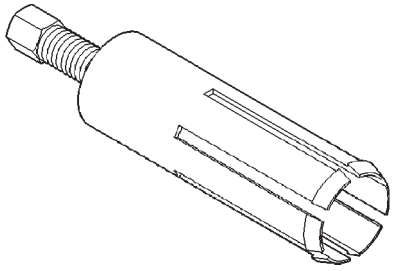
NV3550 MANUAL TRANSMISSION



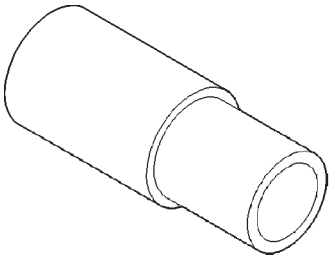
Remover, Seal—C-3985-B



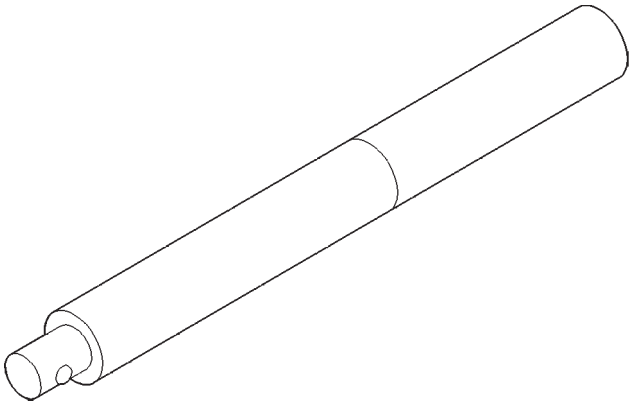
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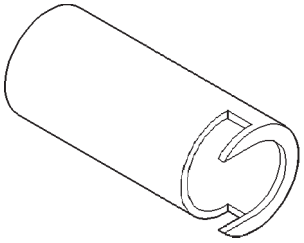
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Installer, Bushing—6951

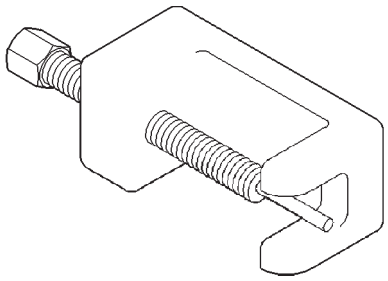


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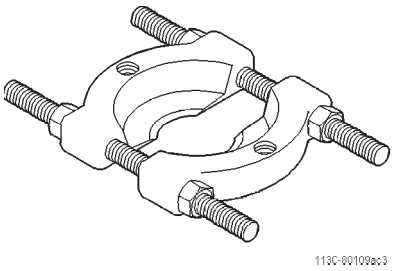


Remover—8117

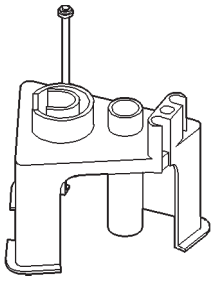
SPECIAL TOOLS (Continued)



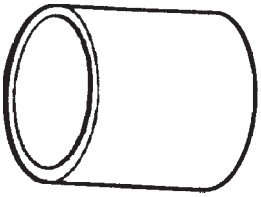
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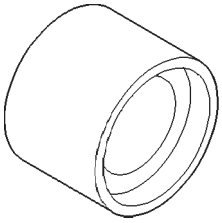
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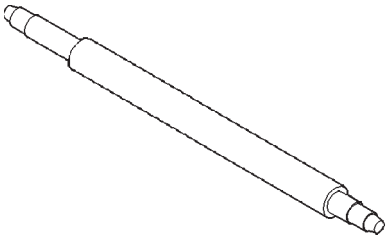
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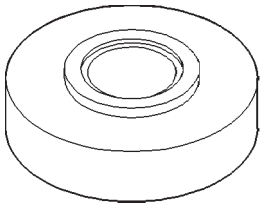
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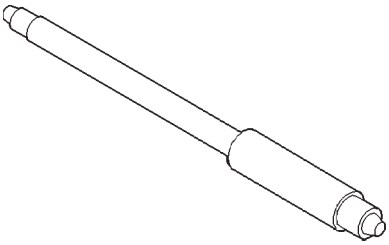
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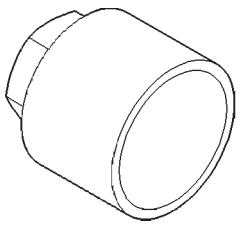
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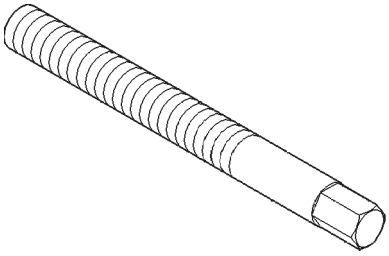
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Remover/Installer—8119

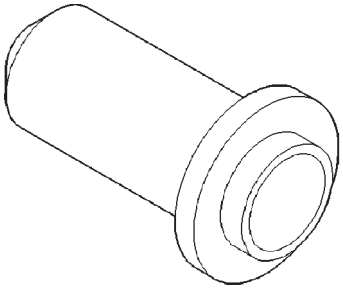


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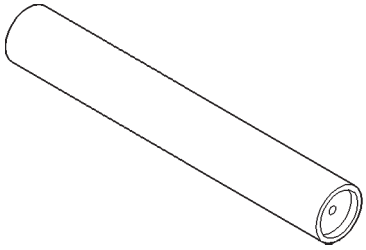


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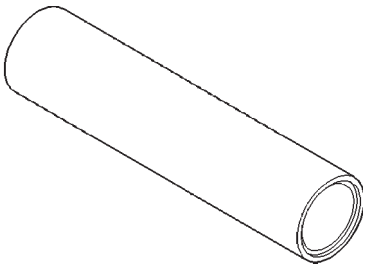
SPECIAL TOOLS (Continued)



Installer, Seal—C-3860-A



Installer—8123



Installer, Bearing Cone—6448

AUTOMATIC TRANSMISSION—30/32RH

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DESCRIPTION AND OPERATION

30/32RH AUTOMATIC TRANSMISSION

DESCRIPTION

The 30RH automatic transmission is used with the 2.5L engine. The 32RH automatic transmission (Fig. 1) is used with the 4.0L engine. The 30/32RH are three speed transmissions with a lock-up clutch in the torque converter. The transmissions contain a front and rear clutch which function as the input driving components. They also contain the kickdown (front) and the low/reverse (rear) bands which, along with the overrunning clutch, serve as the holding components. The driving and holding components combine to select the necessary planetary gear components, in the front and rear planetary gear set, transfer the engine power from the input shaft through to the output shaft. The transmissions contain a governor that is mounted on the output shaft and supplies pressure to the valve body based on the output shaft speed. The valve body is mounted to the lower side of the transmission and contains the valves to control pressure regulation, fluid flow control, and clutch/band application. The oil pump is mounted at the front of the transmission and is driven by the torque converter hub. The pump supplies the oil pressure necessary for clutch/band actuation and transmission lubrication. The 30/32RH 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.

TRANSMISSION GEAR RATIOS

Forward gear ratios are:

- 2.74:1 (first gear)
- 1.54:1 (second gear)
- 1.00:1 (third gear)

OPERATION

The application of each driving or holding component is controlled by the valve body based upon the manual lever position and governor pressure. The governor pressure is a variable pressure input to the valve body and is one of the signals that a shift is necessary. First through third gear are obtained by selectively applying and releasing the different clutches and bands. Engine power is thereby routed to the various planetary gear assemblies which combine with the overrunning clutch assembly to generate the different gear ratios. 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 is controlled by the Powertrain Control Module (PCM). 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 momentarily when an increase in engine load is sensed by the PCM, such as when the vehicle begins to go uphill or the throttle pressure is increased. The torque converter clutch feature increases fuel economy and reduces the transmission fluid temperature.

PARK POWERFLOW

As the engine is running and the crankshaft is rotating, the flexplate and torque converter, which are also bolted to it, are all rotating in a clockwise direction as viewed from the front of the engine. The notched hub of the torque converter is connected to the oil pump's internal gear, supplying the transmission with oil pressure. As the converter turns, it turns the input shaft in a clockwise direction. As the input shaft is rotating, the front clutch hub–rear clutch retainer and all their associated parts are also rotating, all being directly connected to the input shaft. The power flow from the engine through the front–clutch–hub and rear–clutch–retainer stops at the rear–clutch–retainer. Therefore, no power flow to the output shaft, occurs because no clutches are applied. The only mechanism in use at this time is the parking sprag (Fig. 3), which locks the parking gear on the output shaft to the transmission case.

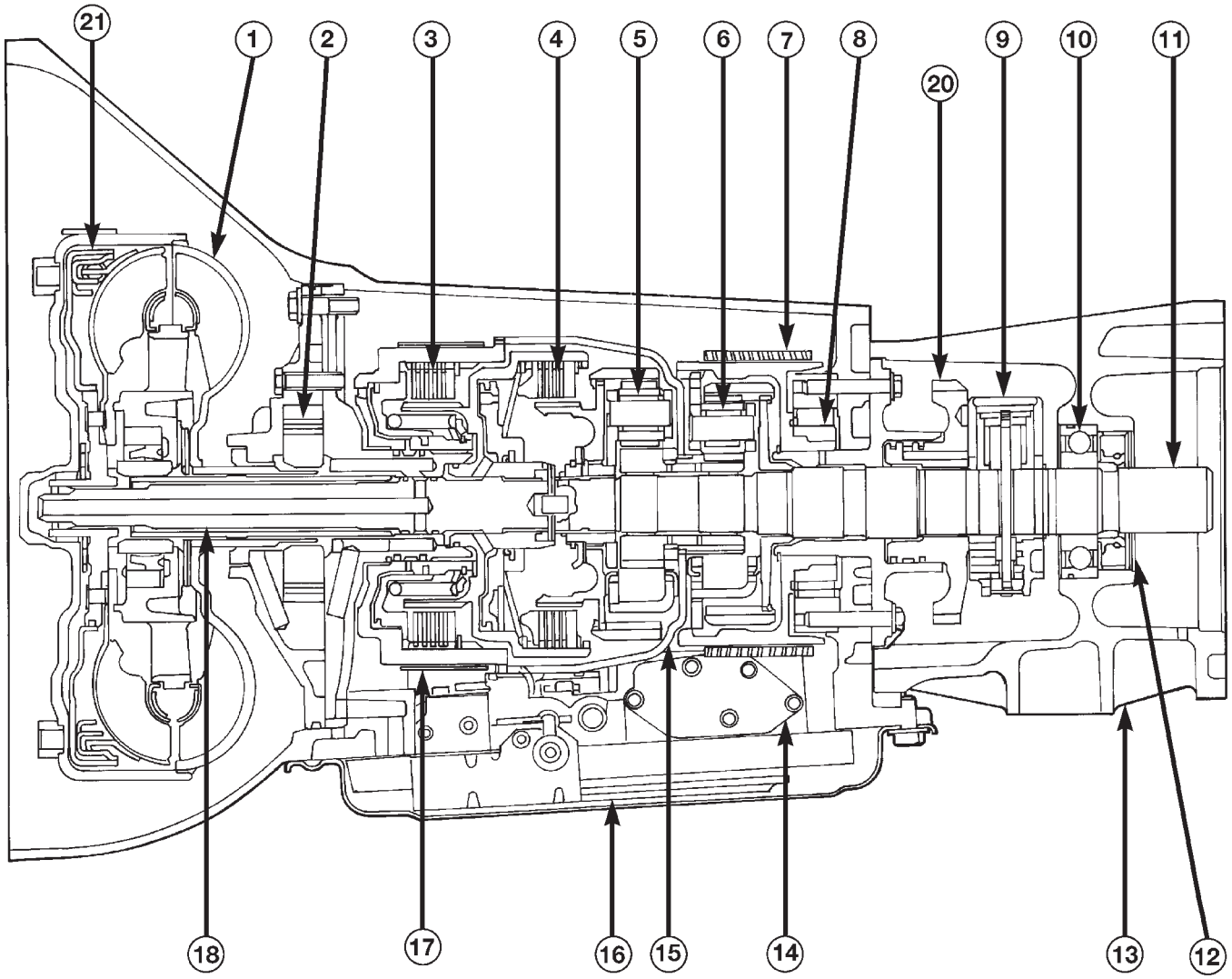
NEUTRAL POWERFLOW

With the gear selector in the neutral position (Fig. 4), the power flow of the transmission is essentially the same as in the park position. The only operational difference is that the parking sprag has been disengaged, unlocking the output shaft from the transmission case and allowing it to move freely.

REVERSE POWERFLOW

When the gear selector is moved into the reverse position (Fig. 5), the front clutch and the rear band are applied. With the application of the front clutch, engine torque is applied to the sun gear, turning it in a clockwise direction. The clockwise rotation of the sun gear causes the rear planet pinions to rotate against engine rotation in a counterclockwise direction. The rear band is holding the low reverse drum, which is splined to the rear carrier. Since the rear carrier is being held, the torque from the planet pinions is transferred to the rear annulus gear, which is splined to the output shaft. The output shaft in turn rotates with the annulus gear in a counterclockwise direction giving a reverse gear output. The entire

DESCRIPTION AND OPERATION (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. VALVE BODY
15. SUN GEAR DRIVING SHELL
16. OIL FILTER
17. KICK DOWN (FRONT) BAND
18. INPUT SHAFT
19. PARK GEAR
20. CONVERTER CLUTCH

80c070a2

Fig. 1 30/32 RH Automatic Transmission

DESCRIPTION AND OPERATION (Continued)

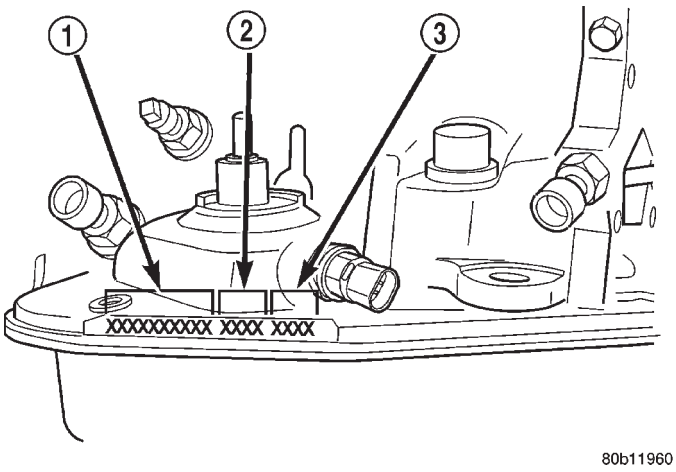


Fig. 2 Transmission Part Number And Serial Number Location

1 – PART NUMBER
2 – BUILD DATE
3 – SERIAL NUMBER

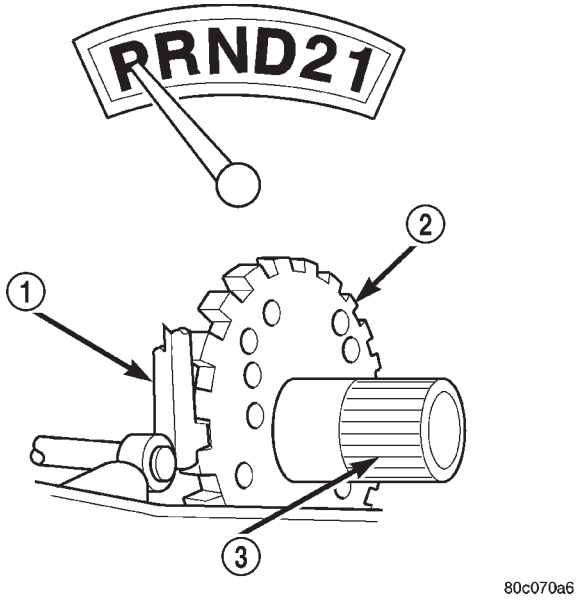


Fig. 3 Park Powerflow

1 – LEVER ENGAGED FOR PARK
2 – PARK SPRAG
3 – OUTPUT SHAFT

transmission of torque is applied to the rear planetary gearset only. Although there is torque input to the front gearset through the sun gear, no other member of the gearset is being held. During the entire reverse stage of operation, the front planetary gears are in an idling condition.

FIRST GEAR POWERFLOW

When the gearshift lever is moved into the drive position the transmission goes into first gear (Fig. 6).

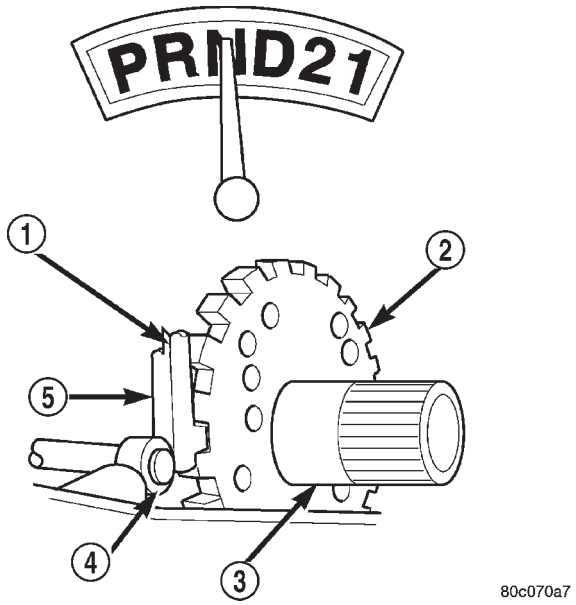


Fig. 4 Neutral Powerflow

1 – LEVER DISENGAGED FOR NEUTRAL
2 – PARK SPRAG
3 – OUTPUT SHAFT
4 – CAM
5 – LEVER

As soon as the transmission is shifted from park or neutral to drive, the rear clutch applies, applying the rear clutch pack to the front annulus gear. Engine torque is now applied to the front annulus gear turning it in a clockwise direction. With the front annulus gear turning in a clockwise direction, it causes the front planets to turn in a clockwise direction. The rotation of the front planets cause the sun to revolve in a counterclockwise direction. The sun gear now transfers its counterclockwise rotation to the rear planets which rotate back in a clockwise direction. With the rear annulus gear stationary, the rear planet rotation on the annulus gear causes the rear planet carrier to revolve in a counterclockwise direction. The rear planet carrier is splined into the low–reverse drum, and the low reverse drum is splined to the inner race of the over–running clutch. With the over–running clutch locked, the planet carrier is held, and the resulting torque provided by the planet pinions is transferred to the rear annulus gear. The rear annulus gear is splined to the output shaft and rotated along with it (clockwise) in an underdrive gear reduction mode.

SECOND GEAR POWERFLOW

In drive–second (Fig. 7), the same elements are applied as in manual–second. Therefore, the power flow will be the same, and both gears will be discussed as one in the same. In drive–second, the transmission has proceeded from first gear to its

DESCRIPTION AND OPERATION (Continued)

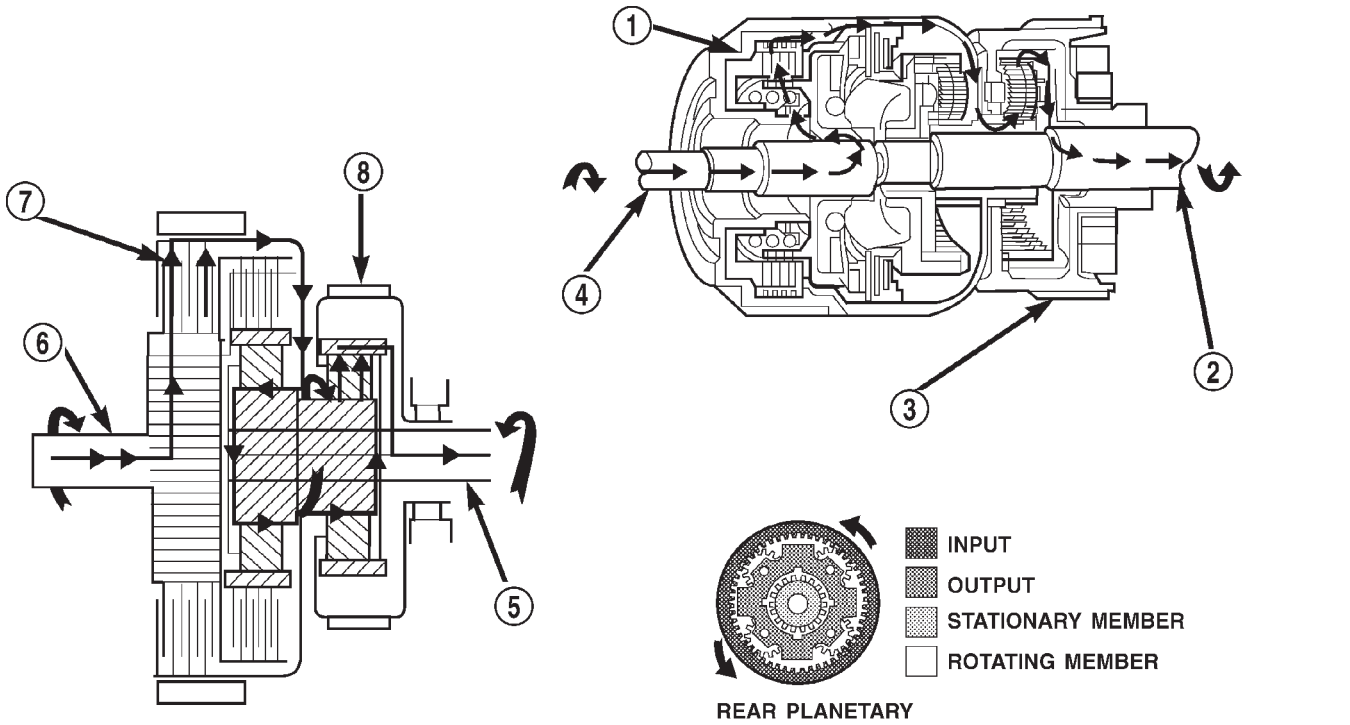


Fig. 5 Reverse Powerflow

1 – FRONT CLUTCH ENGAGED
2 – OUTPUT SHAFT
3 – LOW/REVERSE BAND APPLIED
4 – INPUT SHAFT
5 – OUTPUT SHAFT
6 – INPUT SHAFT
7 – FRONT CLUTCH ENGAGED
8 – LOW/REVERSE BAND APPLIED

shift point, and is shifting from first gear to second. The second gear shift is obtained by keeping the rear clutch applied and applying the front (kickdown) band. The front band holds the front clutch retainer that is locked to the sun gear driving shell. With the rear clutch still applied, the input is still on the front annulus gear turning it clockwise at engine speed. Now that the front band is holding the sun gear stationary, the annulus rotation causes the front planets to rotate in a clockwise direction. The front carrier is then also made to rotate in a clockwise direction but at a reduced speed. This will transmit the torque to the output shaft, which is directly connected to the front planet carrier. The rear planetary annulus gear will also be turning because it is directly splined to the output shaft. All power flow has occurred in the front planetary gear set during the drive–second stage of operation, and now the over–running clutch, in the rear of the transmission, is disengaged and freewheeling on its hub.

DIRECT DRIVE POWERFLOW

The vehicle has accelerated and reached the shift point for the 2–3 upshift into direct drive (Fig. 8). When the shift takes place, the front band is released, and the front clutch is applied. The rear clutch stays applied as it has been in all the forward gears. With the front clutch now applied, engine torque is now on the front clutch retainer, which is locked to the sun gear driving shell. This means that the sun gear is now turning in engine rotation (clockwise) and at engine speed. The rear clutch is still applied so engine torque is also still on the front annulus gear. If two members of the same planetary set are driven, direct drive results. Therefore, when two members are rotating at the same speed and in the same direction, it is the same as being locked up. The rear planetary set is also locked up, given the sun gear is still the input, and the rear annulus gear must turn with the output shaft. Both gears are turning in the same direction and at the same speed. The front and rear planet pinions do not turn at all in direct drive. The only rotation is the input from the engine to the connected parts, which are acting as one common unit, to the output shaft.

FLUID

NOTE: Refer to the maintenance schedules in Group 0, Lubrication and Maintenance for the recommended maintenance (fluid/filter change) intervals for this transmission.

DESCRIPTION AND OPERATION (Continued)

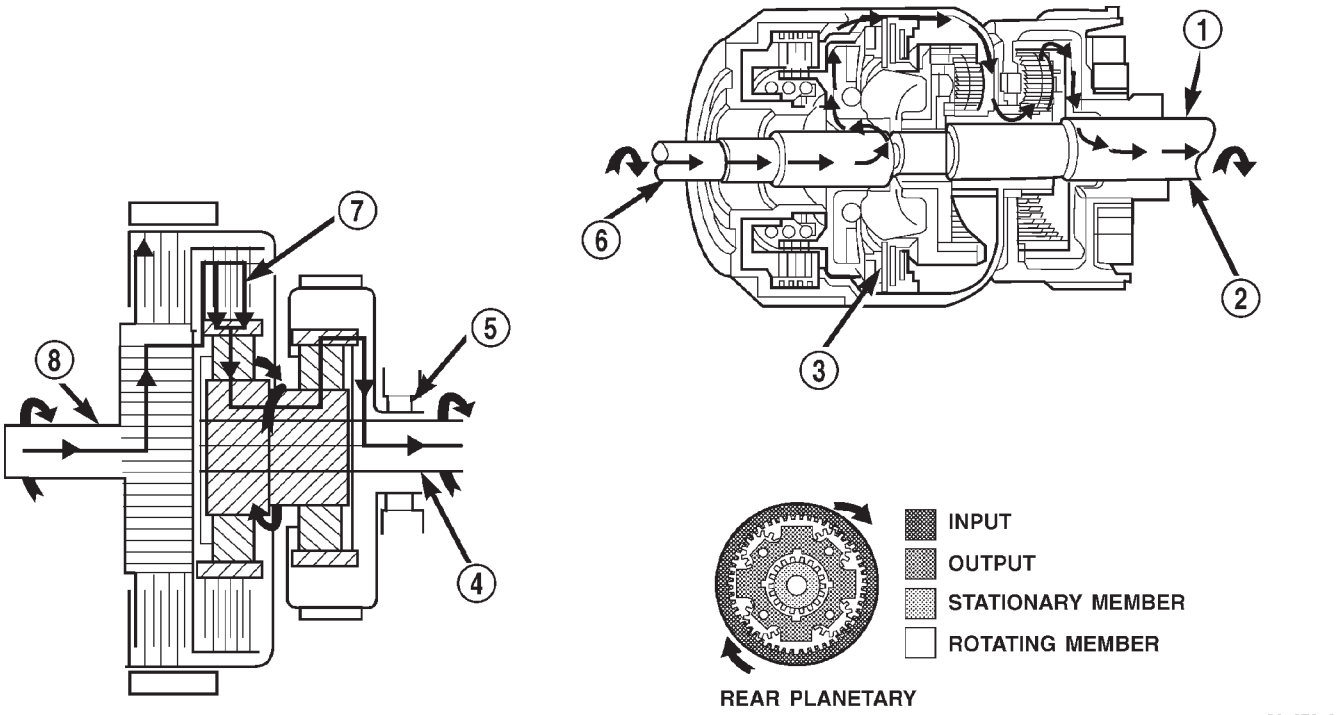


Fig. 6 First Gear Powerflow

1 – OUTPUT SHAFT
2 – OVER-RUNNING CLUTCH HOLDING
3 – REAR CLUTCH APPLIED
4 – OUTPUT SHAFT
5 – OVER-RUNNING CLUTCH HOLDING
6 – INPUT SHAFT
7 – REAR CLUTCH APPLIED
8 – INPUT SHAFT

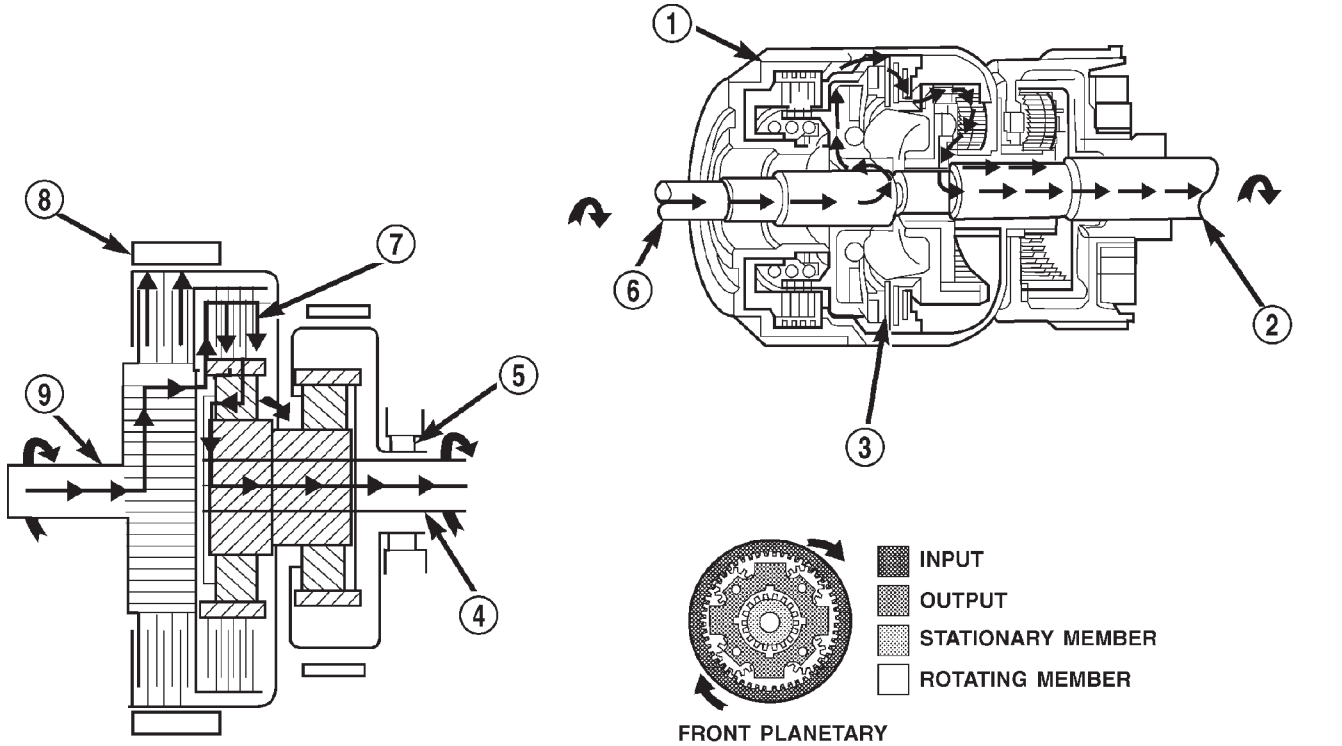


Fig. 7 Second Gear Powerflow

1 – KICKDOWN BAND APPLIED
2 – OUTPUT SHAFT
3 – REAR CLUTCH ENGAGED
4 – OUTPUT SHAFT
5 – OVER-RUNNING CLUTCH FREE-WHEELING
6 – INPUT SHAFT
7 – REAR CLUTCH APPLIED
8 – KICKDOWN BAND APPLIED
9 – INPUT SHAFT

DESCRIPTION AND OPERATION (Continued)

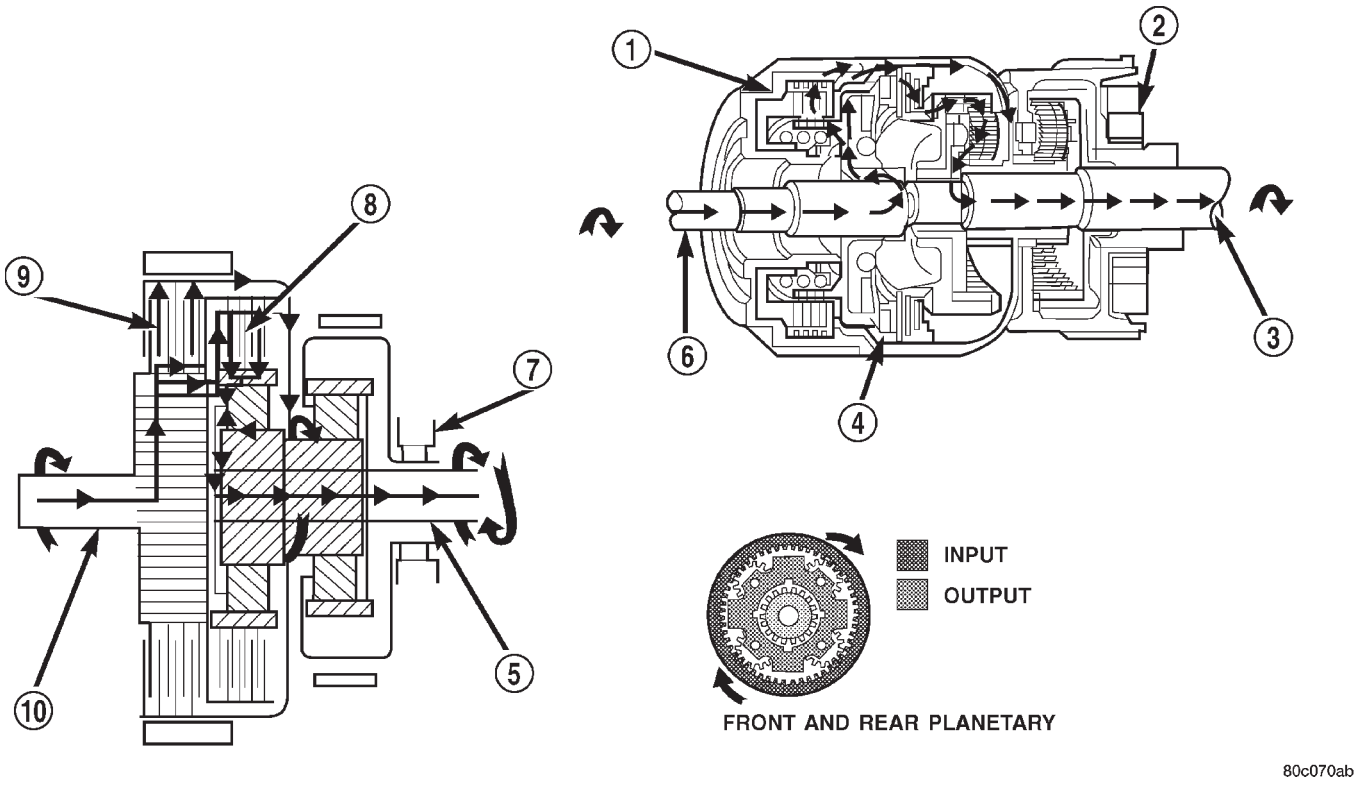


Fig. 8 Direct Drive Powerflow

1 – FRONT CLUTCH APPLIED
2 – OVER-RUNNING CLUTCH FREE-WHEELING
3 – OUTPUT SHAFT
4 – REAR CLUTCH APPLIED
5 – OUTPUT SHAFT
6 – INPUT SHAFT
7 – OVER-RUNNING CLUTCH FREE-WHEELING
8 – REAR CLUTCH APPLIED
9 – FRONT CLUTCH APPLIED
10 – INPUT SHAFT

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

DESCRIPTION

Mopar® ATF Plus 3, Type 7176, automatic transmission fluid is the recommended fluid for DaimlerChrysler automatic transmissions.

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

Mopar® ATF Plus 3, Type 7176, automatic transmission fluid when new is red in color. The ATF is dyed red so it can be identified from other fluids used in the vehicle such as engine oil or antifreeze. The red color is not permanent and is not an indicator of fluid condition. As the vehicle is driven, the ATF will begin to look darker in color and may eventually become brown. **This is normal.** A dark brown/black fluid accompanied with a burnt odor and/or deterioration in shift quality may indicate fluid deterioration or transmission component failure.

FLUID ADDITIVES

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

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

OPERATION

The automatic transmission fluid is selected based upon several qualities. The fluid must provide a high level of protection for the internal components by providing a lubricating film between adjacent metal

DESCRIPTION AND OPERATION (Continued)

components. The fluid must also be thermally stable so that it can maintain a consistent viscosity through a large temperature range. If the viscosity stays constant through the temperature range of operation, transmission operation and shift feel will remain consistent. Transmission fluid must also be a good conductor of heat. The fluid must absorb heat from the internal transmission components and transfer that heat to the transmission case.

TORQUE CONVERTER

DESCRIPTION

The torque converter (Fig. 9) is a hydraulic device that couples the engine crankshaft to the transmission. The torque converter consists of an outer shell with an internal turbine, a stator, an overrunning clutch, an impeller and an electronically applied converter clutch. The converter clutch provides reduced engine speed and greater fuel economy when engaged. Clutch engagement also provides reduced transmission fluid temperatures. The converter clutch engages in third gear. The torque converter hub drives the transmission oil (fluid) pump.

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.

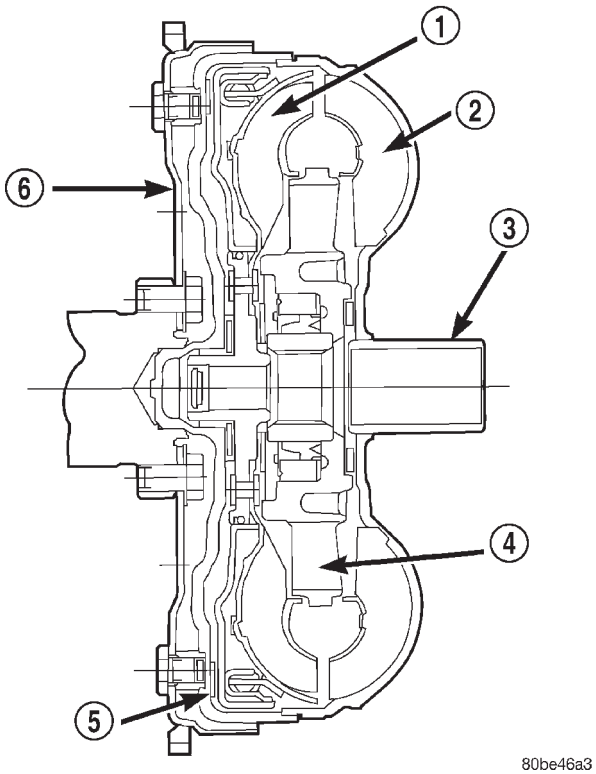


Fig. 9 Torque Converter Assembly

1 – TURBINE
2 – IMPELLER
3 – HUB
4 – STATOR
5 – CONVERTER CLUTCH DISC
6 – DRIVE PLATE

IMPELLER

The impeller (Fig. 10) is an integral part of the converter housing. The impeller consists of curved blades placed radially along the inside of the housing on the transmission side of the converter. As the converter housing is rotated by the engine, so is the impeller, because they are one and the same and are the driving member of the system.

TURBINE

The turbine (Fig. 11) is the output, or driven, member of the converter. The turbine is mounted within the housing opposite the impeller, but is not attached to the housing. The input shaft is inserted through the center of the impeller and splined into the turbine. The design of the turbine is similar to the impeller, except the blades of the turbine are curved in the opposite direction.

DESCRIPTION AND OPERATION (Continued)

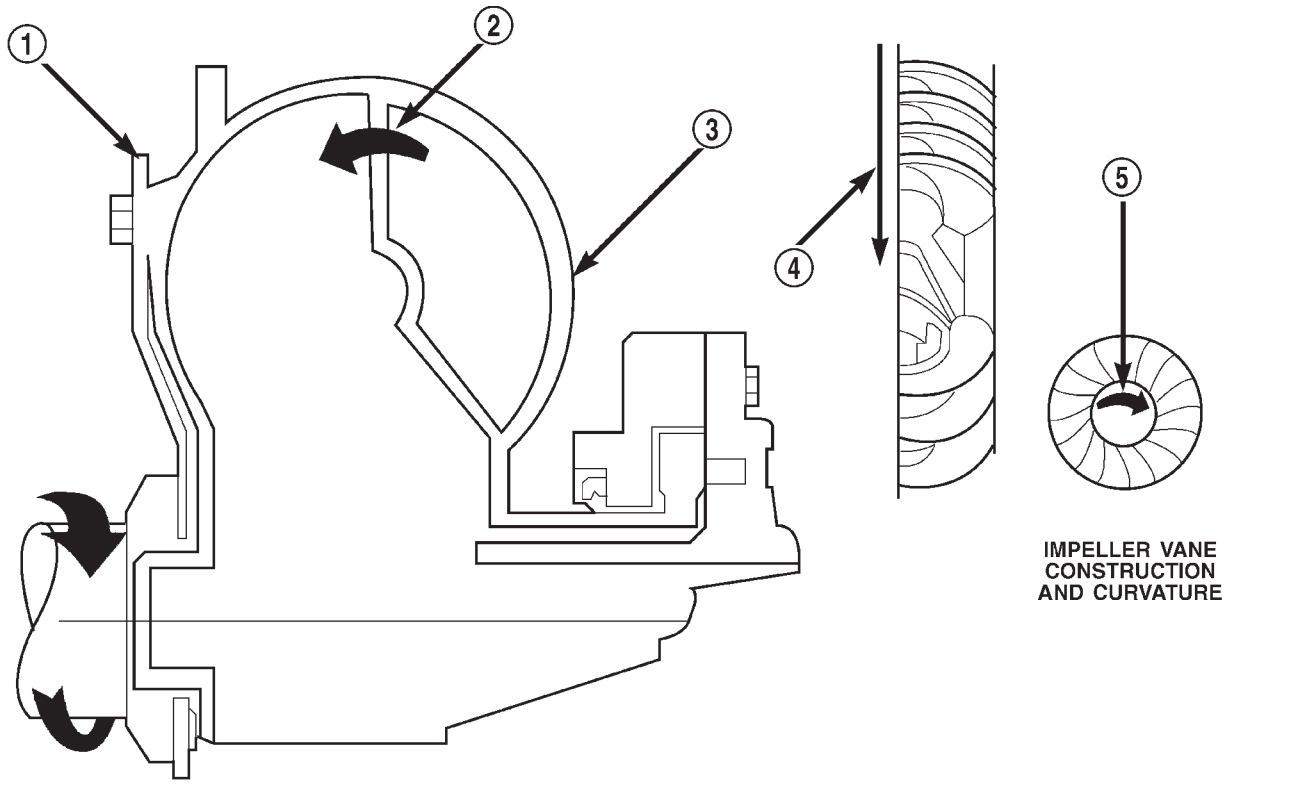


Fig. 10 Impeller

1 – ENGINE FLEXPLATE
2 – OIL FLOW FROM IMPELLER SECTION INTO TURBINE SECTION
3 – IMPELLER VANES AND COVER ARE INTEGRAL
4 – ENGINE ROTATION
5 – ENGINE ROTATION

DESCRIPTION AND OPERATION (Continued)

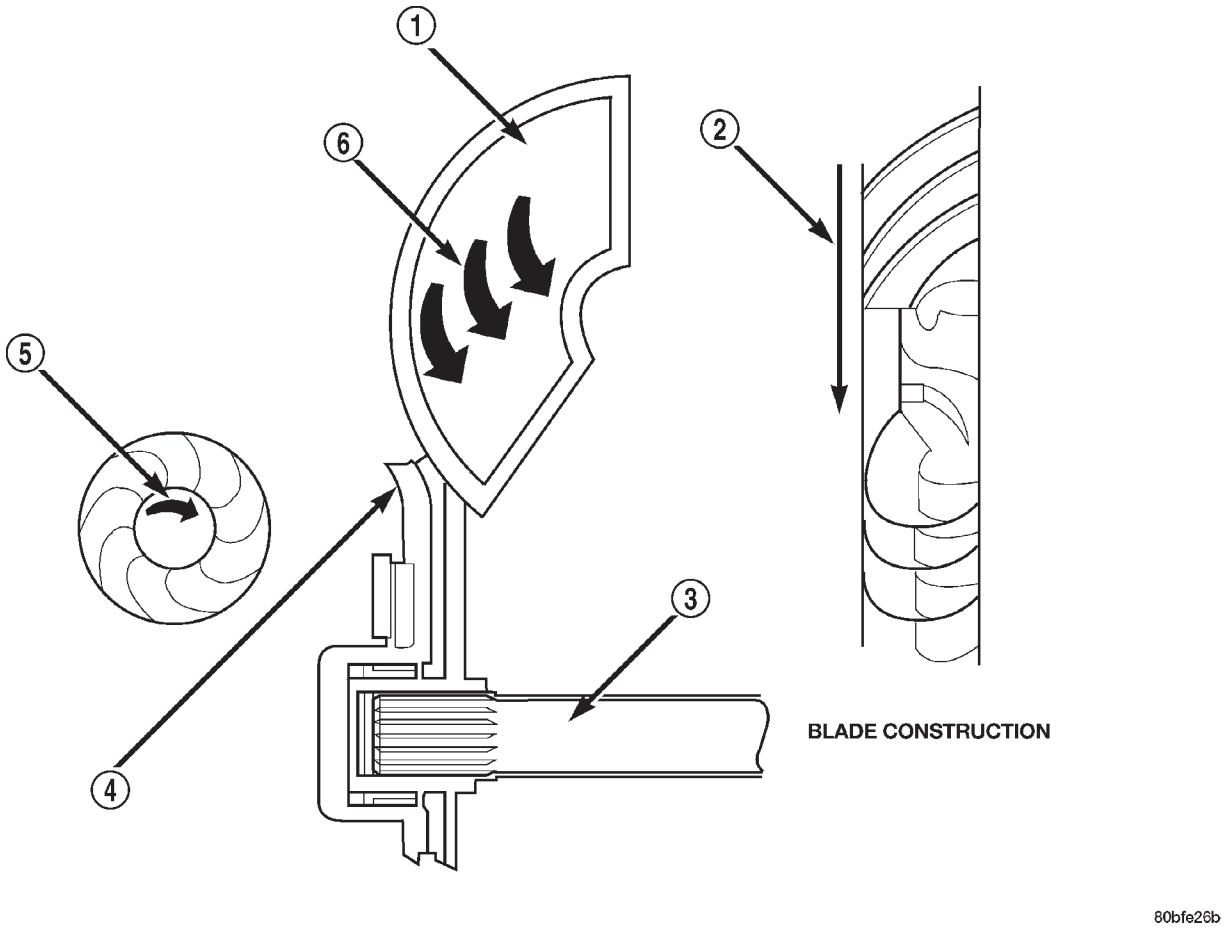


Fig. 11 Turbine

1 – TURBINE VANE
2 – ENGINE ROTATION
3 – INPUT SHAFT
4 – PORTION OF TORQUE CONVERTER COVER
5 – ENGINE ROTATION
6 – OIL FLOW WITHIN TURBINE SECTION

STATOR

The stator assembly (Fig. 12) is mounted on a stationary shaft which is an integral part of the oil pump. The stator is located between the impeller and turbine within the torque converter case (Fig. 13). The stator contains an over-running clutch, which allows the stator to rotate only in a clockwise direction. When the stator is locked against the over-running clutch, the torque multiplication feature of the torque converter is operational.

DESCRIPTION AND OPERATION (Continued)

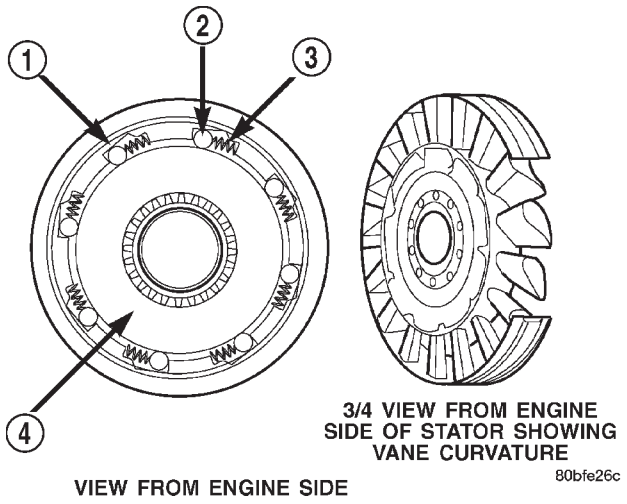


Fig. 12 Stator Components

1 – CAM (OUTER RACE)
2 – ROLLER
3 – SPRING
4 – INNER RACE

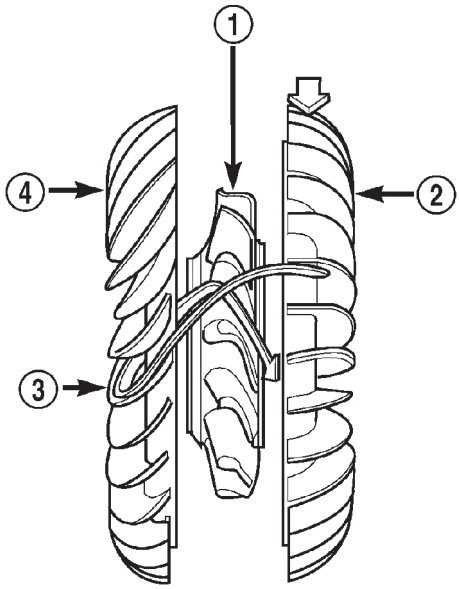


Fig. 13 Stator Location

1 – STATOR
2 – IMPELLER
3 – FLUID FLOW
4 – TURBINE

TORQUE CONVERTER CLUTCH (TCC)

The TCC (Fig. 14) was installed to improve the efficiency of the torque converter that is lost to the slippage of the fluid coupling. Although the fluid coupling provides smooth, shock–free power transfer, it is natural for all fluid couplings to slip. If the impeller and turbine were mechanically locked together, a zero slippage condition could be obtained. A hydraulic piston was added to the turbine, and a friction material was added to the inside of the front cover to provide this mechanical lock-up.

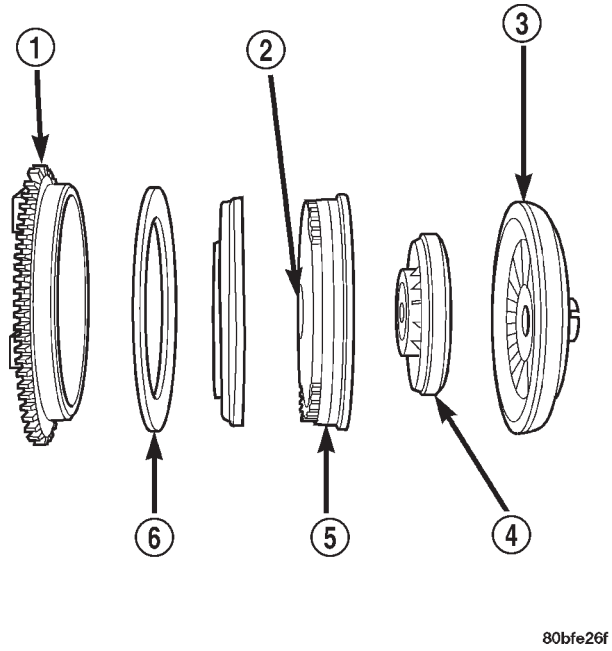


Fig. 14 Torque Converter Clutch (TCC)

1 – IMPELLER FRONT COVER
2 – THRUST WASHER ASSEMBLY
3 – IMPELLER
4 – STATOR
5 – TURBINE
6 – FRICTION DISC

OPERATION

The converter impeller (Fig. 15) (driving member), which is integral to the converter housing and bolted to the engine drive plate, rotates at engine speed. The converter turbine (driven member), which reacts from fluid pressure generated by the impeller, rotates and turns the transmission input shaft.

TURBINE

As the fluid that was put into motion by the impeller blades strikes the blades of the turbine, some of the energy and rotational force is transferred into the turbine and the input shaft. This causes both of them (turbine and input shaft) to rotate in a clockwise direction following the impeller. As the fluid is leaving the trailing edges of the turbine's blades it continues in a "hindering" direction back toward the impeller. If the fluid is not redirected before it strikes the impeller, it will strike the impeller in such a direction that it would tend to slow it down.

DESCRIPTION AND OPERATION (Continued)

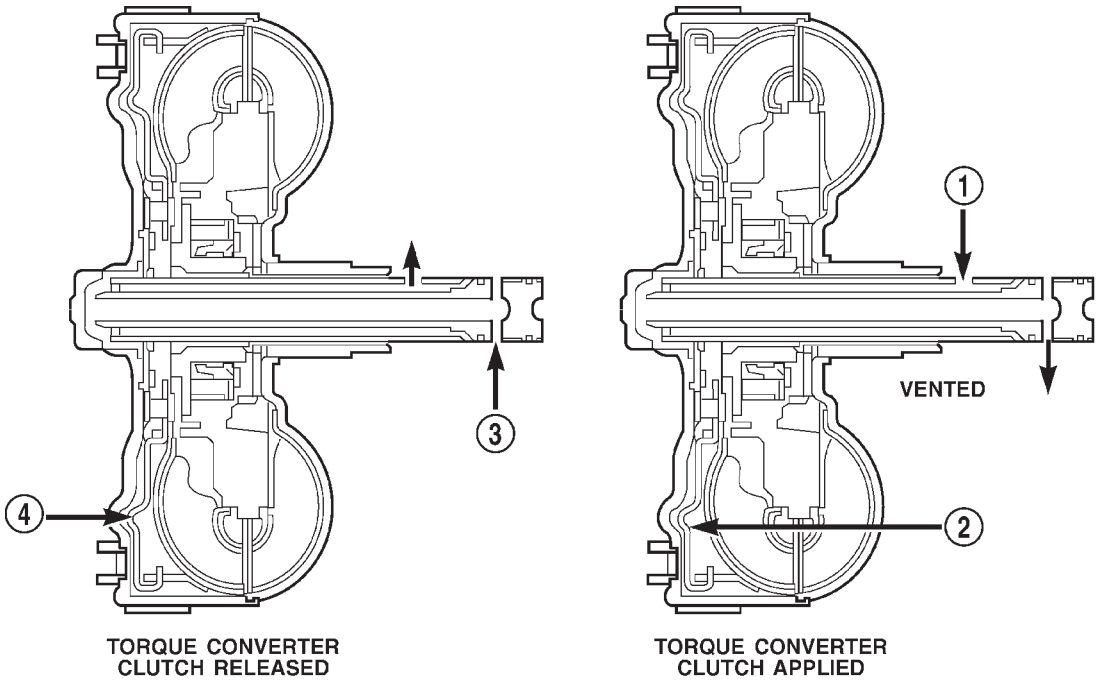


Fig. 15 Torque Converter Fluid Operation

1 – APPLY PRESSURE
2 – THE PISTON MOVES SLIGHTLY FORWARD
3 – RELEASE PRESSURE
4 – THE PISTON MOVES SLIGHTLY REARWARD

STATOR

Torque multiplication is achieved by locking the stator's over-running clutch to its shaft (Fig. 16). Under stall conditions (the turbine is stationary), the oil leaving the turbine blades strikes the face of the stator blades and tries to rotate them in a counter-clockwise direction. When this happens the over–running clutch of the stator locks and holds the stator from rotating. With the stator locked, the oil strikes the stator blades and is redirected into a "helping" direction before it enters the impeller. This circulation of oil from impeller to turbine, turbine to stator, and stator to impeller, can produce a maximum torque multiplication of about 2.4:1. As the turbine begins to match the speed of the impeller, the fluid that was hitting the stator in such as way as to cause it to lock–up is no longer doing so. In this condition of operation, the stator begins to free wheel and the converter acts as a fluid coupling.

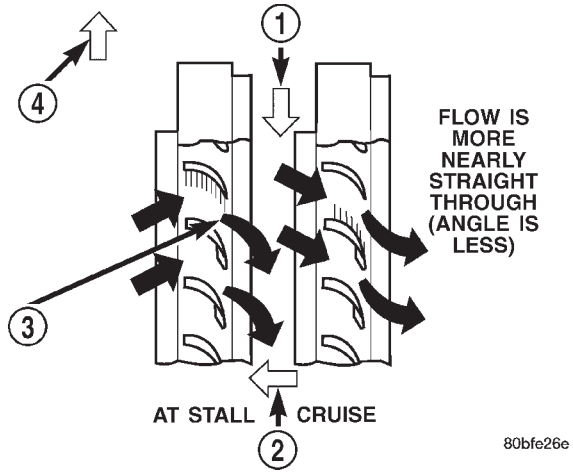


Fig. 16 Stator Operation

1 – DIRECTION STATOR WILL FREE WHEEL DUE TO OIL PUSHING ON BACKSIDE OF VANES
2 – FRONT OF ENGINE
3 – INCREASED ANGLE AS OIL STRIKES VANES
4 – DIRECTION STATOR IS LOCKED UP DUE TO OIL PUSHING AGAINST STATOR VANES

TORQUE CONVERTER CLUTCH (TCC)

In a standard torque converter, the impeller and turbine are rotating at about the same speed and the stator is freewheeling, providing no torque multiplication. By applying the turbine's piston to the front cover's friction material, a total converter engagement can be obtained. The result of this engagement is a direct 1:1 mechanical link between the engine and the transmission.

The engagement and disengagement of the TCC are automatic and controlled by the Powertrain Con-

DESCRIPTION AND OPERATION (Continued)

trol Module (PCM). The engagement cannot be activated in the lower gears because it eliminates the torque multiplication effect of the torque converter necessary for acceleration. 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.

OIL PUMP

DESCRIPTION

The oil pump (Fig. 17) is located in the pump housing inside the bell housing of the transmission case. The oil pump consists of an inner and outer gear, a housing, and a cover that also serves as the reaction shaft support.

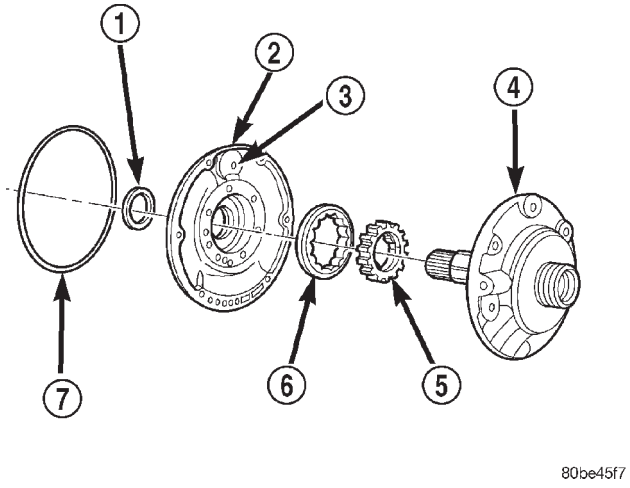


Fig. 17 Oil Pump Assembly

1 – OIL SEAL
2 – OIL PUMP BODY
3 – VENT
4 – REACTION SHAFT SUPPORT
5 – INNER ROTOR
6 – OUTER ROTOR
7 – "O" RING

OPERATION

As the torque converter rotates, the converter hub rotates the inner and outer gears. As the gears rotate, the clearance between the gear teeth increases in the crescent area, and creates a suction at the inlet side of the pump. This suction draws fluid through the pump inlet from the oil pan. As the clearance between the gear teeth in the crescent area decreases, it forces pressurized fluid into the pump outlet and to the valve body.

VALVE BODY

DESCRIPTION

The valve body consists of a cast aluminum valve body, a separator plate, and transfer plate. The valve body contains valves and check balls that control fluid delivery to the torque converter clutch, bands, and frictional clutches. The valve body contains the following components (Fig. 18) and (Fig. 19):

- Regulator valve
- Regulator valve throttle pressure plug
- Line pressure plug and sleeve
- Kickdown valve
- Kickdown limit valve
- 1–2 shift valve
- 1–2 control valve
- 2–3 shift valve
- 2–3 governor plug
- Throttle valve
- Throttle pressure plug
- Switch valve
- Manual valve
- Converter clutch control valve
- Fail-safe valve
- Shuttle valve
- Shuttle valve throttle plug
- 9 check balls

By adjusting the spring pressure acting on the regulator valve, transmission line pressure can be adjusted.

DESCRIPTION AND OPERATION (Continued)

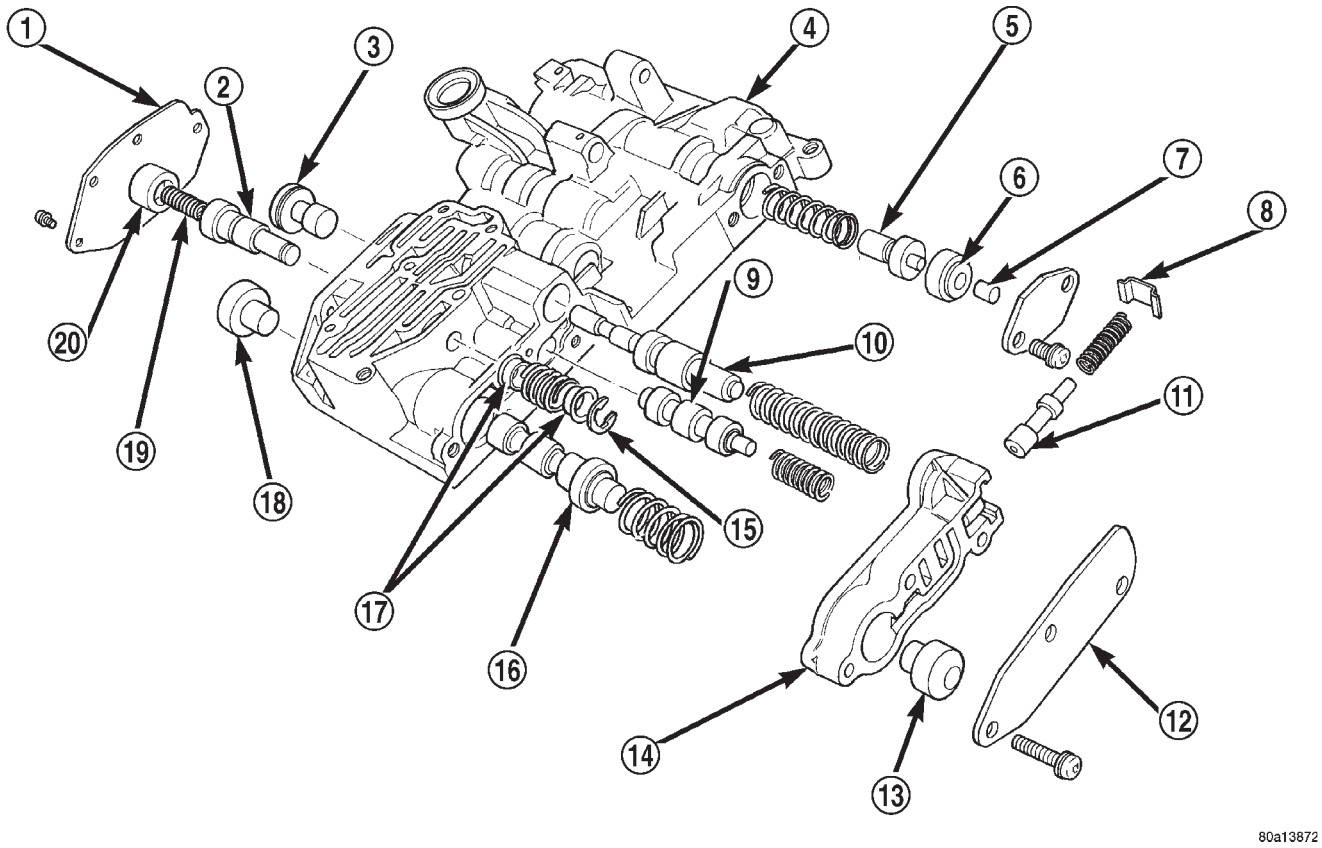


Fig. 18 Valve Body Assembly

1 – GOVERNOR PLUG END PLATE
2 – SHUTTLE VALVE
3 – 1–2 GOVERNOR PLUG
4 – VALVE BODY
5 – REGULATOR VALVE THROTTLE PRESSURE PLUG
6 – SLEEVE
7 – LINE PRESSURE PLUG
8 – RETAINER
9 – 1–2 SHIFT VALVE
10 – 1–2 SHIFT CONTROL VALVE
11 – KICKDOWN LIMIT VALVE
12 – END PLATE
13 – THROTTLE PRESSURE PLUG
14 – KICKDOWN LIMIT VALVE BODY
15 – E-RING
16 – 2–3 SHIFT VALVE
17 – GUIDES
18 – 2–3 GOVERNOR PLUG
19 – PRIMARY SPRING
20 – SHUTTLE VALVE THROTTLE PLUG

OPERATION

NOTE: Refer to the Hydraulic Schematics for a visual aid in determining valve location, operation and design.

REGULATOR VALVE

The pressure regulator valve is needed to control the hydraulic pressure within the system and reduce the amount of heat produced in the fluid. The pressure regulator valve is located in the valve body near the manual valve. The pressure regulator valve train controls the maximum pressure in the lines by metering the dumping of fluid back into the sump. Regulated pressure is referred to as “line pressure.”

The regulator valve (Fig. 20) has a spring on one end that pushes the valve to the left. This closes a dump (vent) that is used to lower pressure. The closing of the dump will cause the oil pressure to increase. Oil pressure on the opposite end of the valve pushes the valve to the right, opening the dump and lowering oil pressure. The result is spring pressure working against oil pressure to maintain the oil at specific pressures. With the engine running, fluid flows from the pump to the pressure regulator valve, manual valve, and the interconnected circuits. As fluid is sent through passages to the regulator valve, the pressure pushes the valve to the right against the large spring. It is also sent to the reaction areas on the left side of the throttle pressure plug and the line pressure plug. With the gear selec-

DESCRIPTION AND OPERATION (Continued)

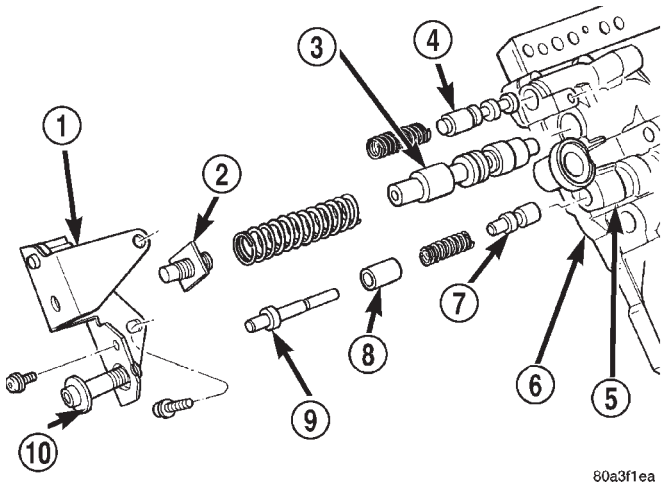


Fig. 19 Valve Body Assembly

1 – ADJUSTER BRACKET
2 – LINE PRESSURE ADJUSTER
3 – PRESSURE REGULATOR VALVE
4 – SWITCH VALVE
5 – VALVE BODY
6 – TRANSFER PLATE
7 – THROTTLE VALVE
8 – SLEEVE
9 – KICKDOWN VALVE
10 – THROTTLE PRESSURE ADJUSTER

tor in the park position, fluid recirculates through the regulator and manual valves back to the sump.

Meanwhile, the torque converter is filled slowly. In all other gear positions (Fig. 21), fluid flows between two right side lands to the switch valve and torque converter. At low pump speeds, the flow is controlled by the pressure valve groove to reduce pressure to the torque converter. After the torque converter and switch valve fill with fluid, the switch valve becomes the controlling metering device for torque converter pressure. The regulator valve then begins to control the line pressure for the other transmission circuits. The balance of the fluid pressure pushing the valve to the right and the spring pressure pushing to the left determines the size of the metering passage at land #2 (land #1 being at the far right of the valve in the diagram). As fluid leaks past the land, it moves into a groove connected to the filter or sump. As the land meters the fluid to the sump, it causes the pressure to reduce and the spring decreases the size of the metering passage. When the size of the metering passage is reduced, the pressure rises again and the size of the land is increased again. Pressure is regulated by this constant balance of hydraulic and spring pressure.

The metering at land #2 establishes the line pressure throughout the transmission. It is varied according to changes in throttle position, engine speed, and transmission condition within a range of 57–94 psi (except in reverse) (Fig. 22). The regulated line pressure in reverse (Fig. 23) is held at much higher pres-

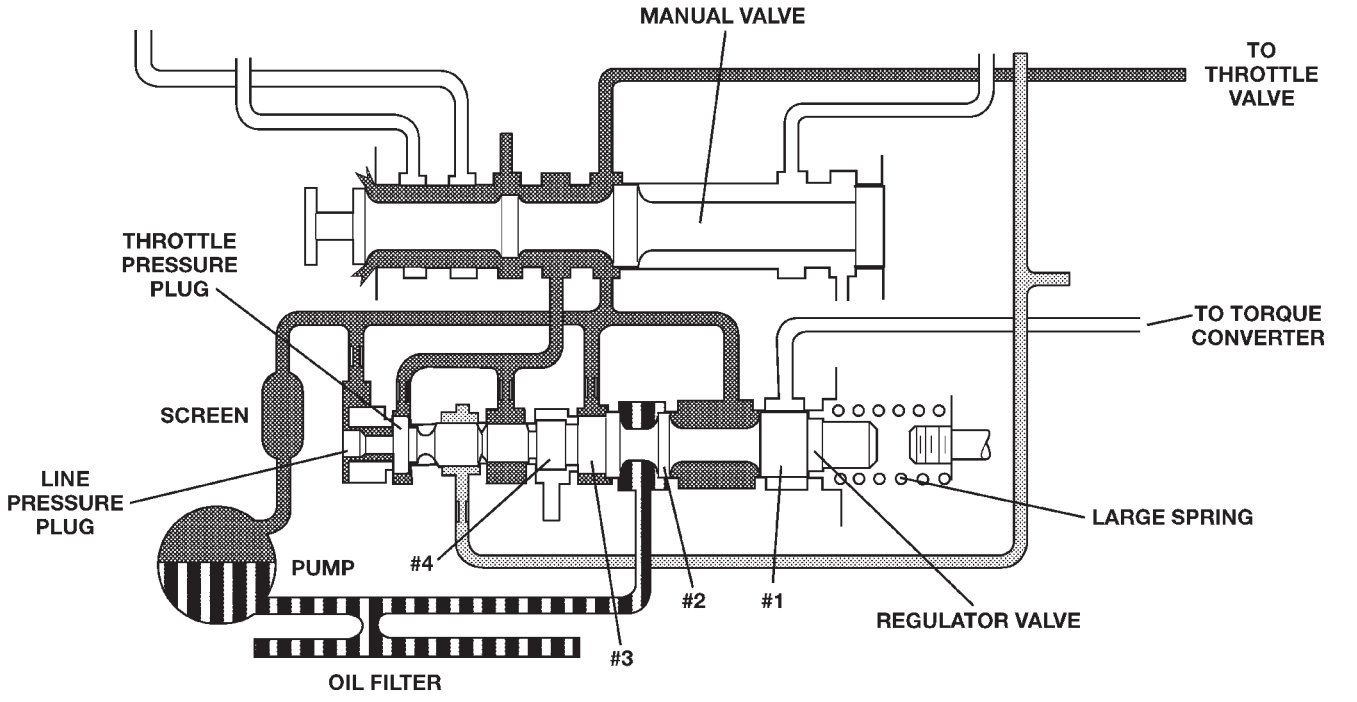


Fig. 20 Regulator Valve in Park Position

DESCRIPTION AND OPERATION (Continued)

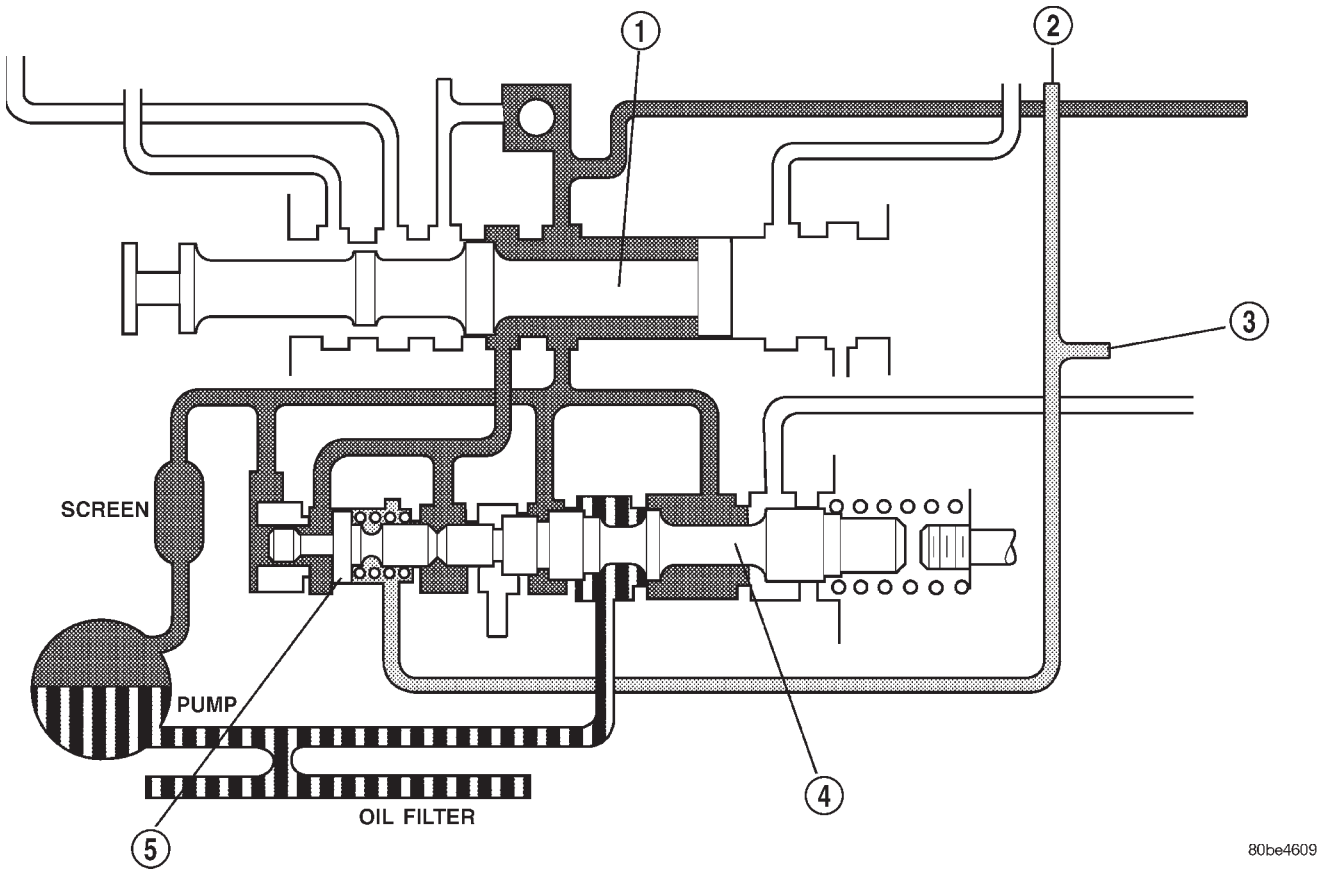


Fig. 21 Regulator Valve in Neutral Position

1 – MANUAL VALVE
2 – TO SHIFT VALVE
3 – FROM THROTTLE VALVE
4 – REGULATOR VALVE
5 – THROTTLE PRESSURE PLUG

sures than in the other gear positions: 145–280 psi. The higher pressure for reverse is achieved by the manual valve blocking the supply of line pressure to the reaction area left of land #4. With this pressure blocked, there is less area for pressure to act on to balance the force of the spring on the right. This allows line pressure to push the valve train to the right, reducing the amount of fluid returned to the pump's inlet, increasing line pressure.

DESCRIPTION AND OPERATION (Continued)

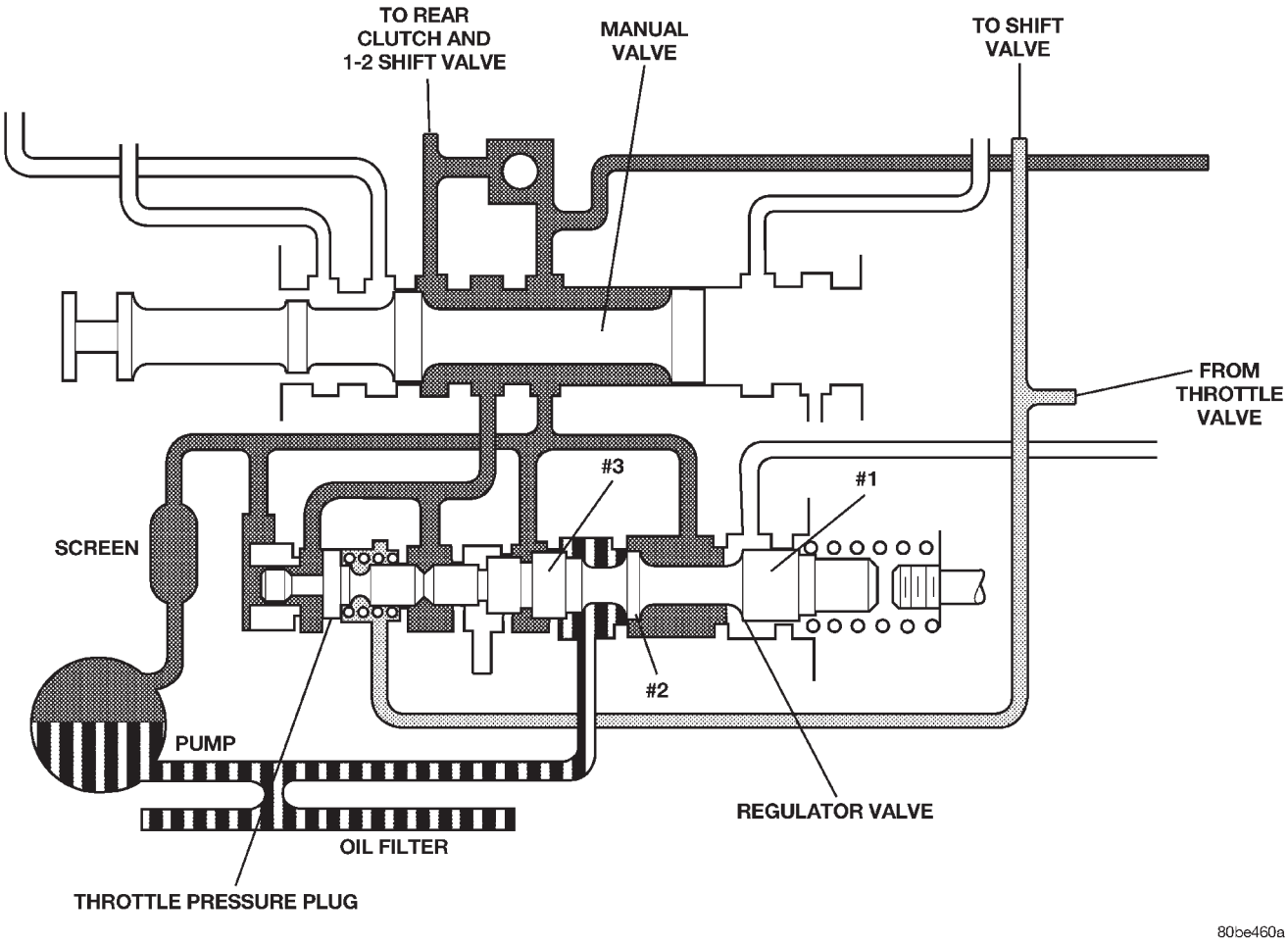


Fig. 22 Regulator Valve in Drive Position

DESCRIPTION AND OPERATION (Continued)

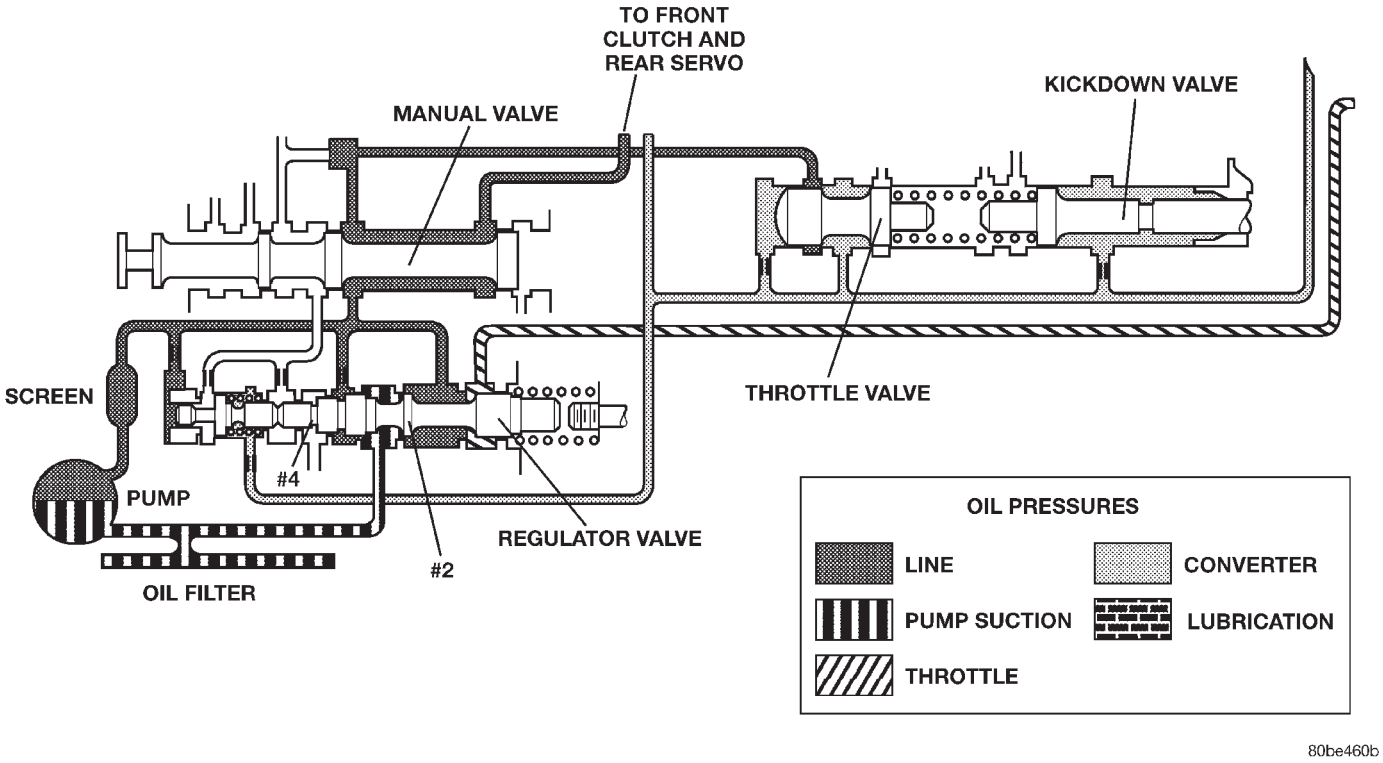


Fig. 23 Regulator Valve in Reverse Position

KICKDOWN VALVE

When the throttle valve is as far over to the left as it can go, the maximum line pressure possible will enter the throttle pressure circuit. In this case, throttle pressure will equal line pressure. With the kickdown valve (Fig. 24) pushed into the bore as far as it will go, fluid initially flows through the annular groove of the 2–3 shift valve (which will be in the direct drive position to the right).

After passing the annular groove, the fluid is routed to the spring end of the 2–3 shift valve. Fluid pressure reacting on the area of land #1 overcomes governor pressure, downshifting the 2–3 shift valve into the kickdown, or second gear stage of operation. The valve is held in the kickdown position by throttle pressure routed from a seated check ball (#2). Again, if vehicle speed is low enough, throttle pressure will also push the 1–2 shift valve left to seat its governor plug, and downshift to drive breakaway.

KICKDOWN LIMIT VALVE

The purpose of the limit valve is to prevent a 3–2 downshift at higher speeds when a part–throttle downshift is not desirable. At these higher speeds only a full throttle 3–2 downshift will occur. At low road speeds (Fig. 25) the limit valve does not come into play and does not affect the downshifts. As the vehicle's speed increases (Fig. 26), the governor pressure also increases. The increased governor pressure acts on the reaction area of the bottom land of the limit valve overcoming the spring force trying to push the valve toward the bottom of its bore. This pushes the valve upward against the spring and bottoms the valve against the top of the housing. With the valve bottomed against the housing, the throttle pressure supplied to the valve will be closed off by the bottom land of the limit valve. When the supply of throttle pressure has been shut off, the 3–2 part throttle downshift plug becomes inoperative, because no pressure is acting on its reaction area.

DESCRIPTION AND OPERATION (Continued)

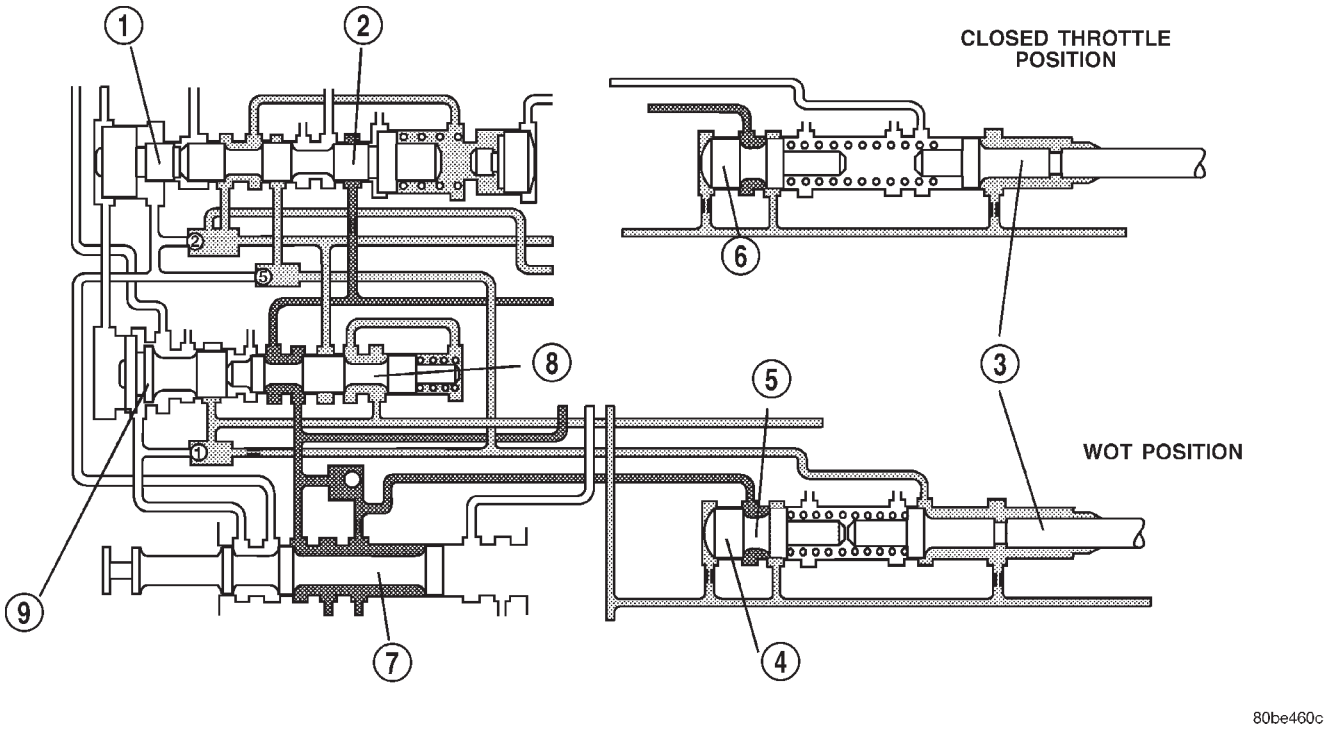


Fig. 24 Kickdown Valve

1 – GOVERNOR PLUG
2 – 2–3 SHIFT VALVE
3 – KICKDOWN VALVE
4 – THROTTLE VALVE
5 – MAXIMUM THROTTLE PRESSURE
6 – THROTTLE VALVE
7 – MANUAL VALVE
8 – 1–2 SHIFT VALVE
9 – GOVERNOR PLUG

DESCRIPTION AND OPERATION (Continued)

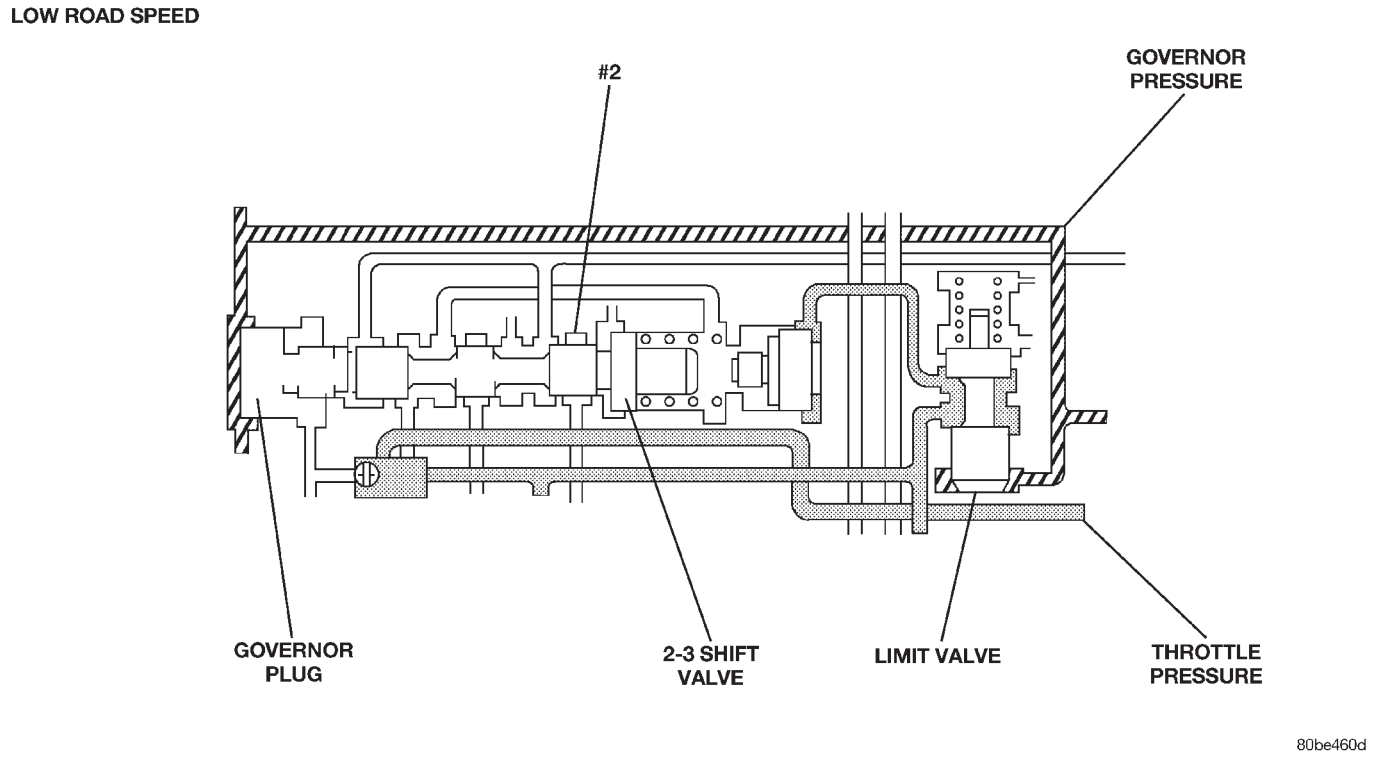


Fig. 25 Kickdown Limit Valve-Low Speeds

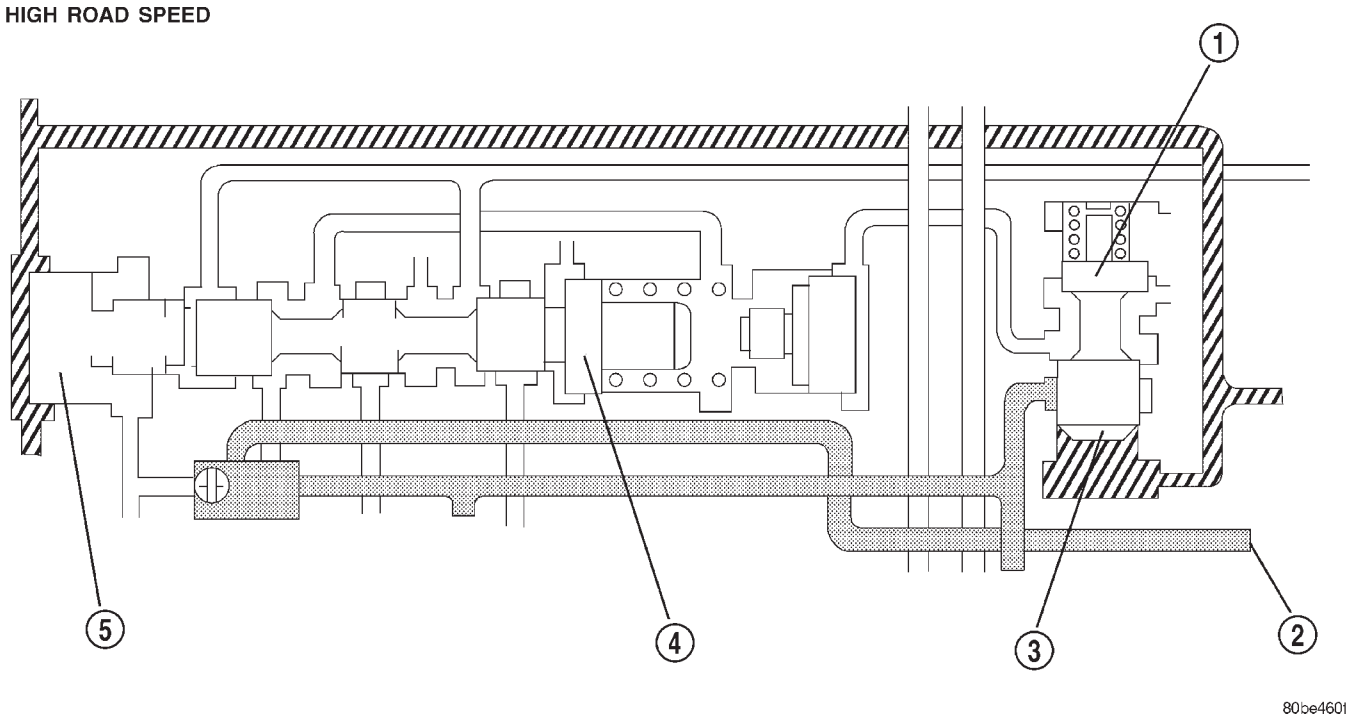


Fig. 26 Kickdown Limit Valve-High Speeds

1 – GOVERNOR PRESSURE CLOSES LIMIT VALVE
2 – THROTTLE PRESSURE
3 – LIMIT VALVE
4 – 2–3 SHIFT VALVE
5 – GOVERNOR PLUG

DESCRIPTION AND OPERATION (Continued)

1–2 SHIFT VALVE

The 1–2 shift valve assembly (Fig. 27), or mechanism, consists of: the 1–2 shift valve, governor plug, and a spring on the end of the valve. After the manual valve has been placed into a forward gear range, line pressure is directed to the 1–2 shift valve. As the throttle is depressed, throttle pressure is applied to the right side of the 1–2 shift valve assembly. With throttle pressure applied to the right side of the valve, there is now both spring pressure and throttle pressure acting on the valve, holding it against the governor plug. As the vehicle begins to move and build speed, governor pressure is created and is applied to the left of the valve at the governor plug.

When governor pressure builds to a point where it can overcome the combined force of the spring and throttle pressure on the other side of the valve, the valve will begin to move over to the right. As the valve moves to the right, the middle land of the valve will close off the circuit supplying the throttle pressure to the right side of the valve. When the throttle pressure is closed off, the valve will move even farther to the right, allowing line pressure to enter another circuit and energize the front servo, applying the front band (Fig. 28).

The governor plug serves a dual purpose: [0001]

- It allows the shift valves to move either left or right, allowing both upshifts and downshifts.
- When in a manual selection position, it will be hydraulically “blocked” into position so no upshift can occur.

The physical blocking of the upshift while in the manual “1” position is accomplished by the directing of line pressure between both lands of the governor plug. The line pressure reacts against the larger land of the plug, pushing the plug back against the end plate overcoming governor pressure. With the combination of the line pressure and spring pressure, the valve cannot move, preventing any upshift.

1–2 SHIFT CONTROL VALVE

It contains a valve with four lands and a spring. It is used as both a “relay” and “balanced” valve.

The valve has two specific operations (Fig. 29):

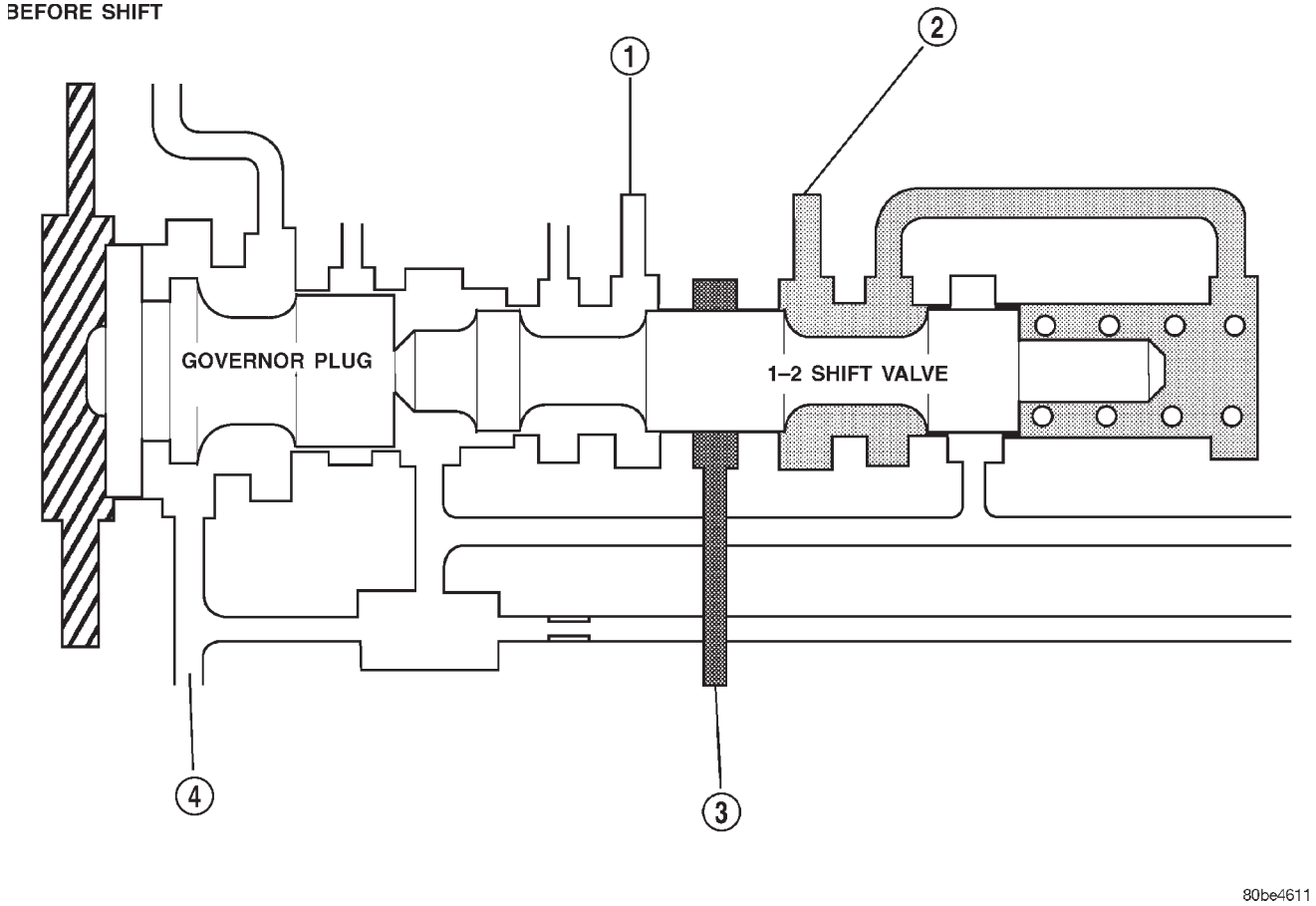


Fig. 27 1–2 Shift Valve-Before Shift

1 – TO FRONT SERVO AND 2–3 SHIFT VALVE
2 – THROTTLE PRESSURE
3 – LINE PRESSURE
4 – LINE PRESSURE PASSAGE FOR MANUAL LOW POSITION

DESCRIPTION AND OPERATION (Continued)

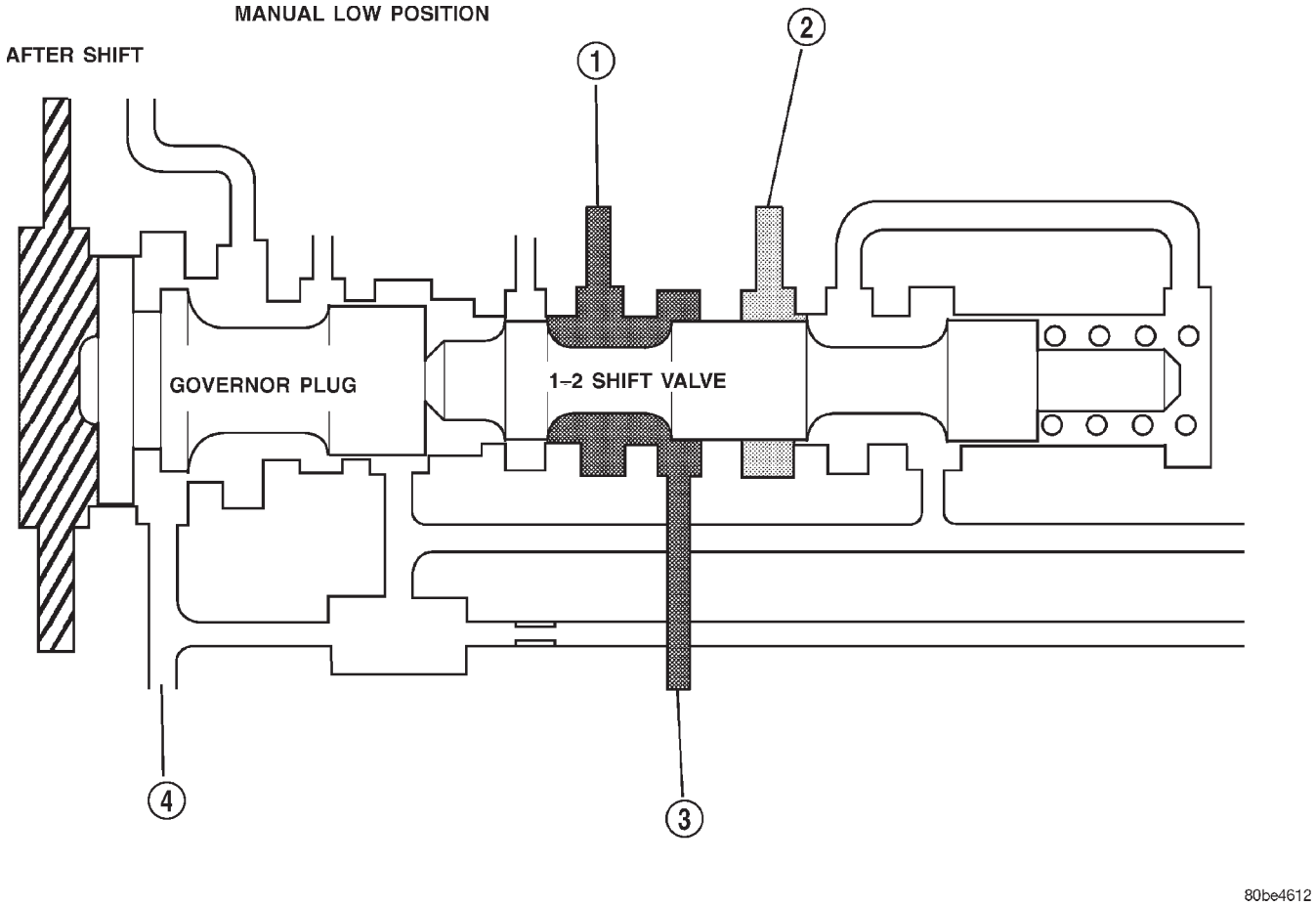


Fig. 28 1–2 Shift Valve-After Shift

1 – TO FRONT SERVO AND 2–3 SHIFT VALVE
2 – THROTTLE PRESSURE
3 – LINE PRESSURE
4 – LINE PRESSURE PASSAGE FOR MANUAL LOW POSITION

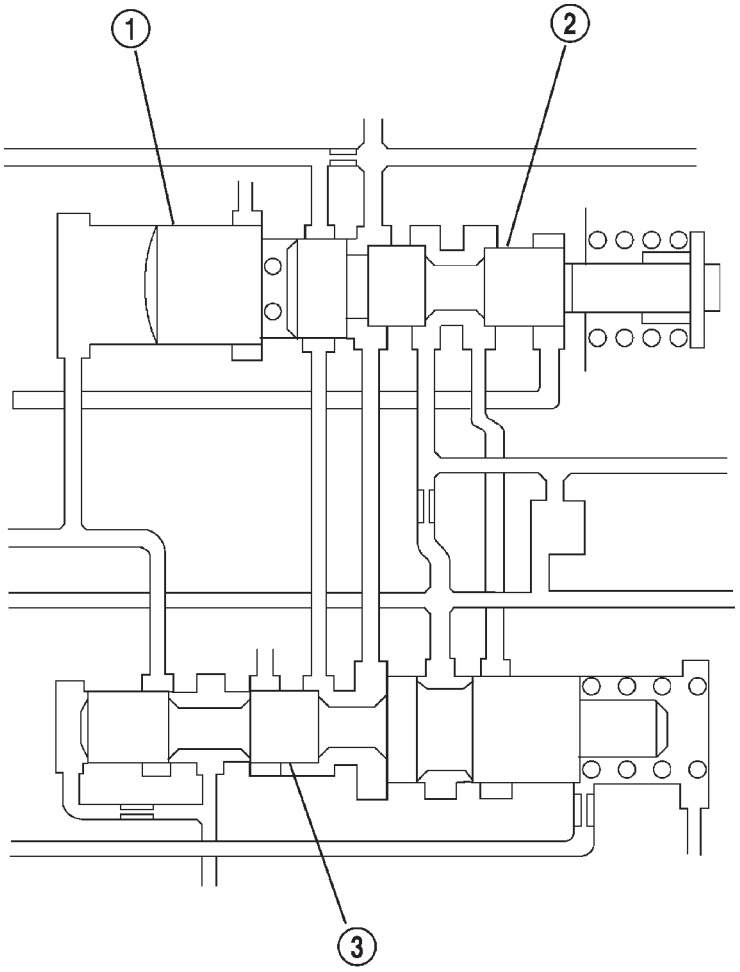
DESCRIPTION AND OPERATION (Continued)

- Aid in quality of the 1–2 upshift.
- Aid in the quality and timing of the 3–2 kickdown ranges.

When the manual valve is set to the Drive position and the transmission is in the first or second gear range, 1–2 shift control or “modulated throttle pressure” is supplied to the middle of the accumulator piston by the 1–2 shift control valve. During the 1–2 upshift, this pressure is used to control the kickdown servo apply pressure that is needed to apply the kickdown and accumulator pistons. Thus, the 1–2 shift point is “cushioned” and the quality is improved. During a WOT kickdown, kickdown pressure is applied between the kickdown valve and the 1–2 shift control valve. This additional pressure is directed to the 1–2 shift control's spring cavity, adding to the spring load on the valve. The result of this increased “modulated” throttle pressure is a firmer WOT upshift.

SHUTTLE VALVE

The assembly is contained in a bore in the valve body above the shift valves. When the manual valve is positioned in the Drive range, throttle pressure acts on the throttle plug of the shuttle valve (Fig. 29) to move it against a spring, increasing the spring force on the shuttle valve. During a part or full throttle 1–2 upshift, the throttle plug is bottomed by throttle pressure, holding the shuttle valve to the right against governor pressure, and opening a by–pass circuit. The shuttle valve controls the quality of the kickdown shift by restricting the rate of fluid discharge from the front clutch and servo release circuits. During a 3–2 kickdown, fluid discharges through the shuttle by–pass circuit. When



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Fig. 29 1–2 Shift Control Valve

1 – THROTTLE PLUG
2 – SHUTTLE VALVE
3 – 1–2 SHIFT CONTROL VALVE

DESCRIPTION AND OPERATION (Continued)

the shuttle valve closes the by–pass circuit, fluid discharge is restricted and controlled for the application of the front band. During a 2–3 “lift foot” upshift, the shuttle valve by–passes the restriction to allow full fluid flow through the by–pass groove for a faster release of the band.

2–3 SHIFT VALVE

The 2–3 shift valve mechanism (Fig. 30) consists of the 2–3 shift valve, governor plug and spring, and a throttle plug. After the 1–2 shift valve has completed its operation and applied the front band, line pressure is directed to the 2–3 shift valve through the connecting passages from the 1–2 shift valve. The line pressure will then dead–end at land #2 until the 2–3 valve is ready to make its shift. Now that the vehicle is in motion and under acceleration, there is throttle pressure being applied to the spring side of the valve and between lands #3 and #4.

As vehicle speed increases, governor pressure increases proportionately, until it becomes great enough to overcome the combined throttle and spring pressure on the right side of the valve. When this happens, the governor plug is forced against the shift valve moving it to the right. The shift valve causes land #4 to close the passage supplying throttle pressure to the 2–3 shift valve. Without throttle pressure present in the circuit now, the governor plug will push the valve over far enough to bottom the valve in its bore. This allows land #2 to direct line pressure to the front clutch.

After the shift (Fig. 31), line pressure is directed to the land between the shift valve and the governor plug, and to the release side of the kickdown servo. This releases the front band and applies the front clutch, shifting into third gear or direct drive. The rear clutch remains applied, as it has been in the other gears. During a manual“1” or manual “2” gear selection, line pressure is sent between the two lands of the 2–3 governor plug. This line pressure at the governor plug locks the shift valve into the second gear position, preventing an upshift into direct drive. The theory for the blocking of the valve is the same as that of the 1–2 shift valve.

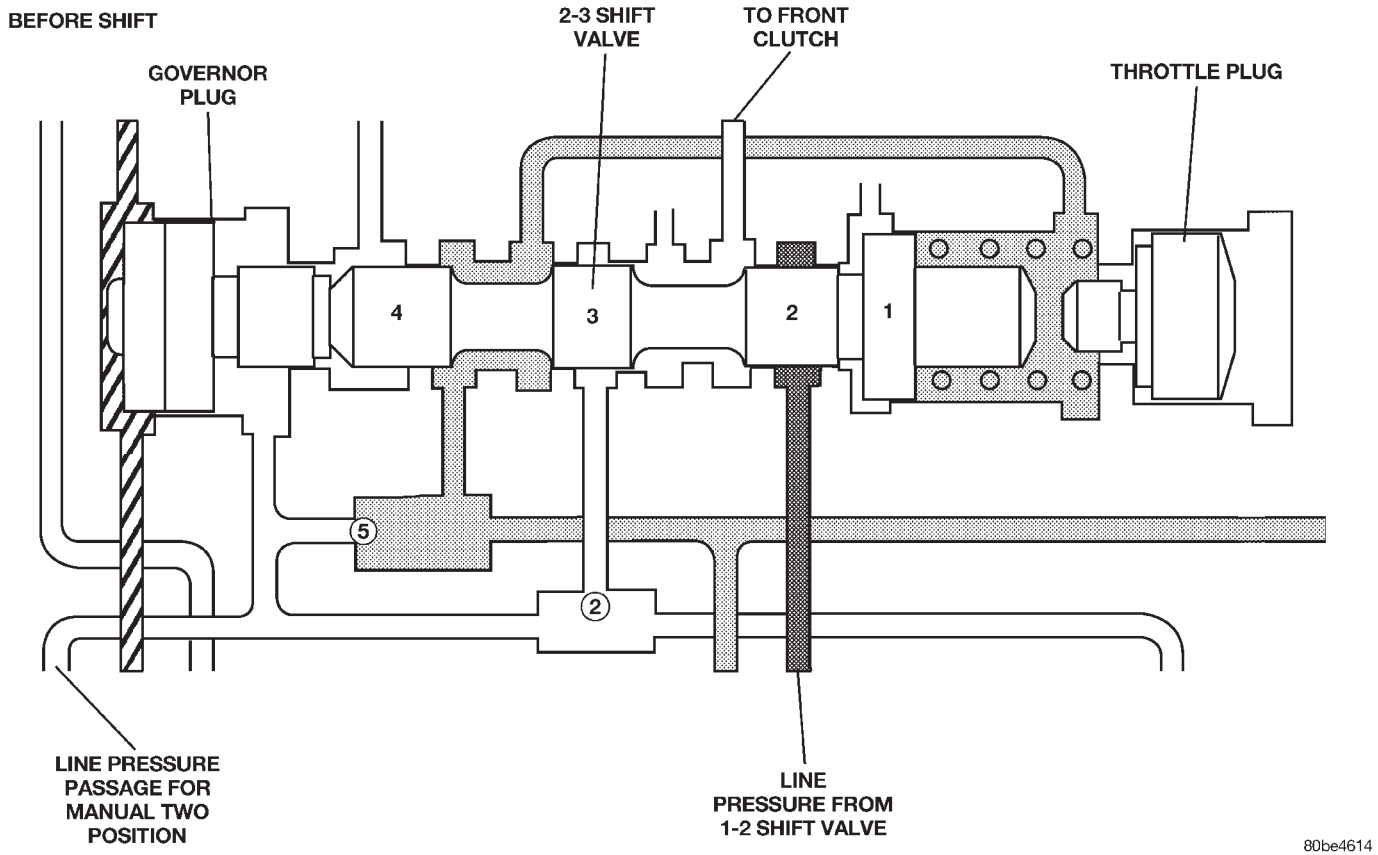


Fig. 30 2–3 Shift Valve-Before Shift

DESCRIPTION AND OPERATION (Continued)

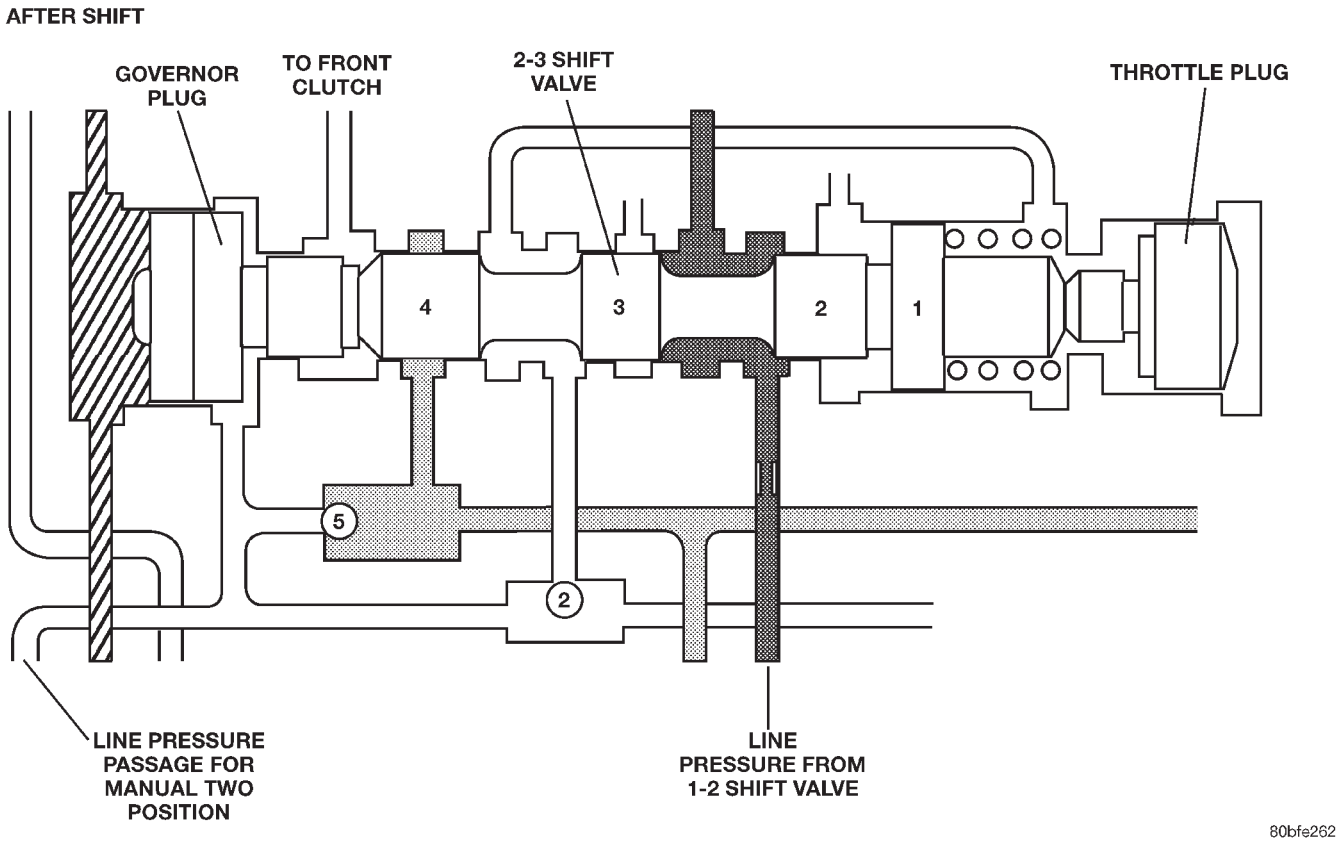


Fig. 31 2–3 Shift Valve-After Shift

THROTTLE VALVE

In all gear positions the throttle valve (Fig. 32) is being supplied with line pressure. The throttle valve meters and reduces the line pressure that now becomes throttle pressure. The throttle valve is moved by a spring and the kickdown valve, which is mechanically connected to the throttle. The larger the throttle opening, the higher the throttle pressure (to a maximum of line pressure). The smaller the throttle opening, the lower the throttle pressure (to a minimum of zero at idle). As engine speed increases, the increase in pump speed increases pump output. The increase in pressure and volume must be regulated to maintain the balance within the transmission. To do this, throttle pressure is routed to the reaction area on the right side of the throttle pressure plug (in the regulator valve).

The higher engine speed and line pressure would open the vent too far and reduce line pressure too much. Throttle pressure, which increases with engine speed (throttle opening), is used to oppose the movement of the pressure valve to help control the metering passage at the vent. The throttle pressure is combined with spring pressure to reduce the force of the throttle pressure plug on the pressure valve. The larger spring at the right closes the regulator valve passage and maintains or increases line pressure. The increased line pressure works against the reaction area of the line pressure plug and the reaction area left of land #3 simultaneously moves the regulator valve train to the right and controls the metering passage.

DESCRIPTION AND OPERATION (Continued)

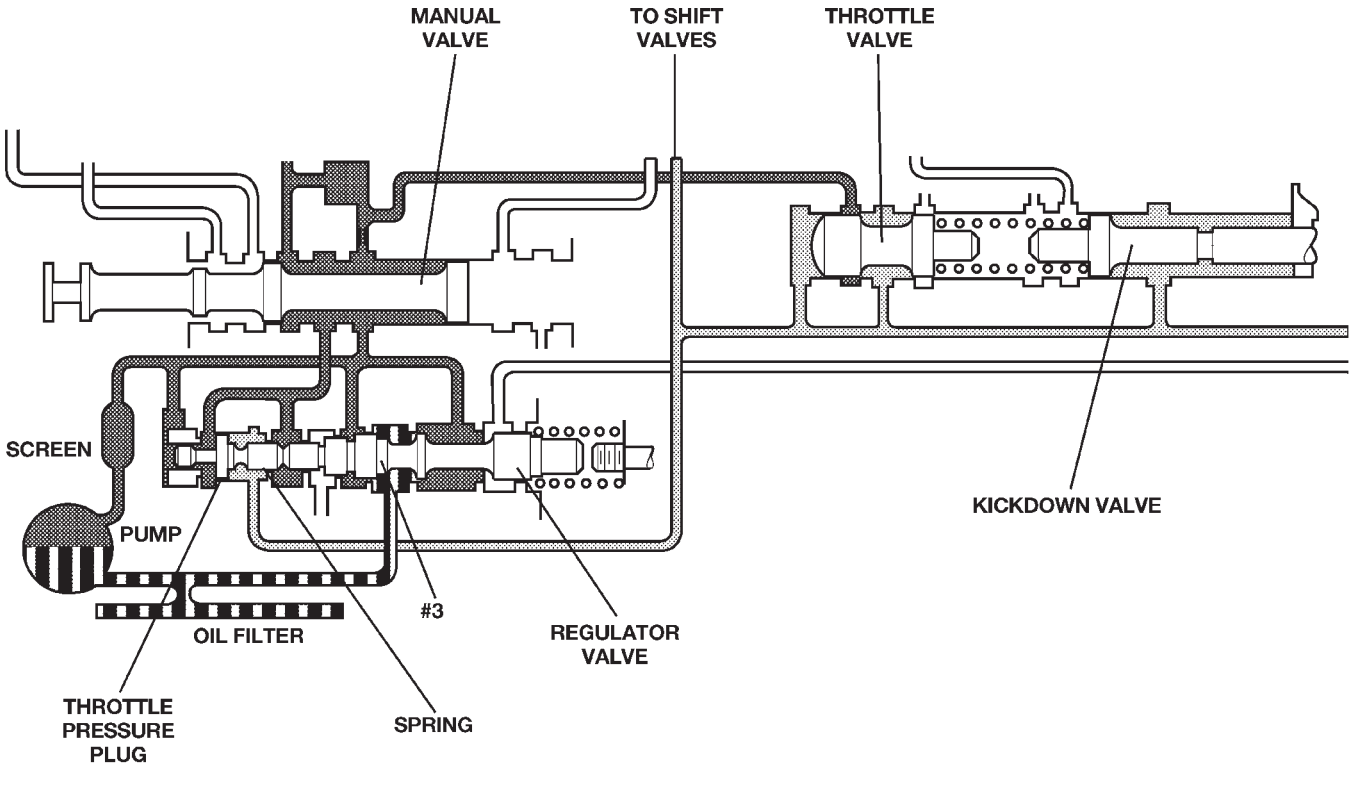


Fig. 32 Throttle Valve

The kickdown valve, along with the throttle valve, serve to delay upshifts until the correct vehicle and engine speed have been reached. It also controls downshifts upon driver demand, or increased engine load. If these valves were not in place, the shift points would be at the same speed for all throttle positions. The kickdown valve is actuated by a cam connected to the throttle. This is accomplished through either a linkage or a cable. The cam forces the kickdown valve toward the throttle valve compressing the spring between them and moving the throttle valve. As the throttle valve land starts to uncover its port, line pressure is "metered" out into the circuits and viewed as throttle pressure. This increased throttle pressure is metered out into the circuits it is applied to: the 1–2 and 2–3 shift valves. When the throttle pressure is high enough, a 3–2 downshift will occur. If the vehicle speed is low enough, a 2–1 downshift will occur.

SWITCH VALVE

When the transmission is in Drive Second just before the TCC application occurs (Fig. 33), the pressure regulator valve is supplying torque converter pressure to the switch valve. The switch valve directs this pressure through the transmission input shaft, into the converter, through the converter, back out between the input shaft and the reaction shaft, and back up to the switch valve. From the switch valve, the fluid pressure is directed to the transmission cooler, and lubrication pressure returns from the cooler to lubricate different portions of the transmission.

Once the TCC control valve has moved to the left (Fig. 34), line pressure is directed to the fail–safe valve, and then to the tip of the switch valve, forcing the valve downward. The switch valve now vents oil from the front of the piston in the torque converter, and supplies line pressure to the (rear) apply side of the torque converter piston. This pressure differential causes the piston to apply against the friction material, cutting off any further flow of line pressure oil. After the switch valve is shuttled downward allowing line pressure to engage the TCC, torque converter pressure is directed past the switch valve into the transmission cooler and lubrication circuits.

DESCRIPTION AND OPERATION (Continued)

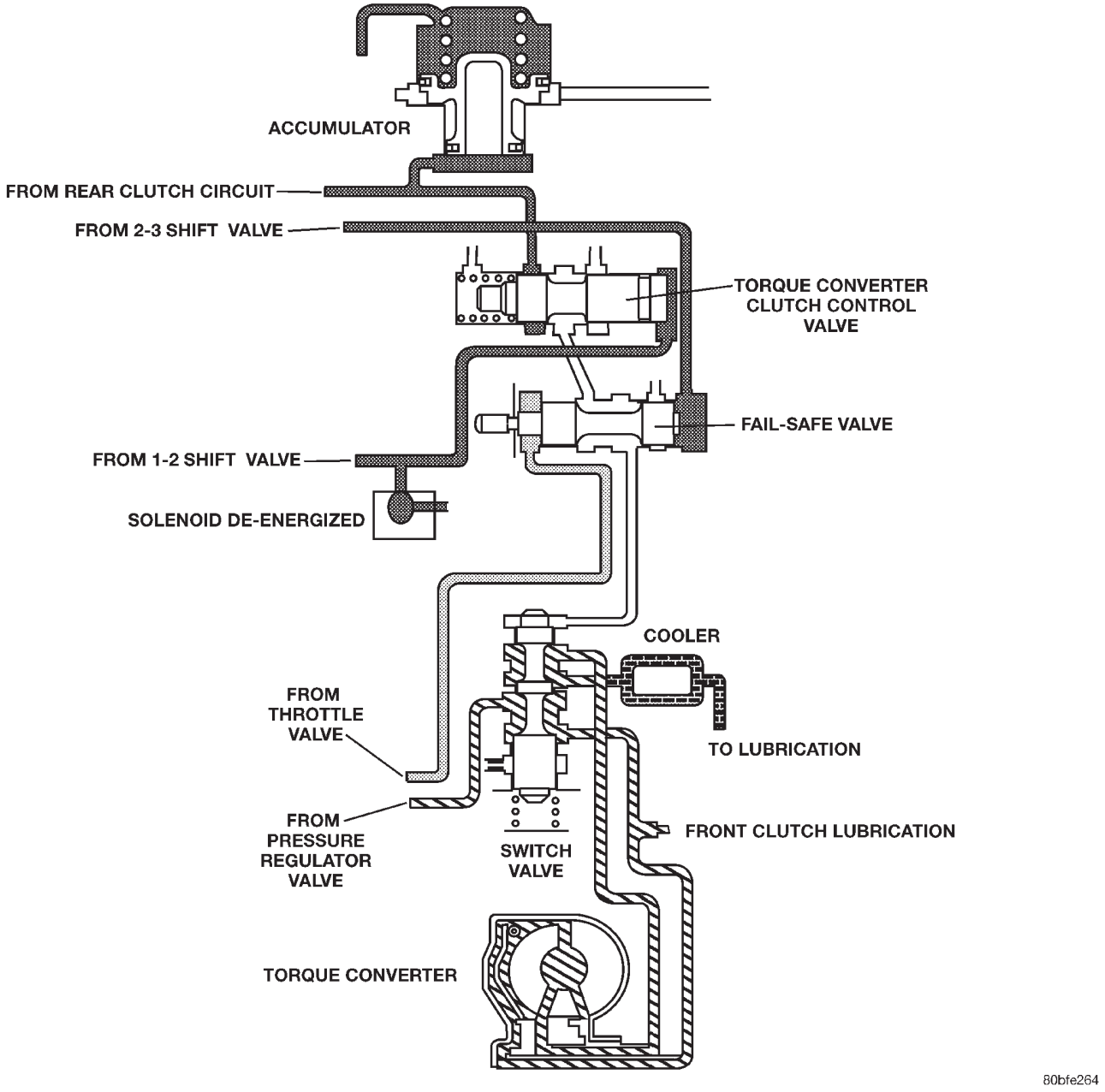


Fig. 33 Switch Valve-Torque Converter Unlocked

DESCRIPTION AND OPERATION (Continued)

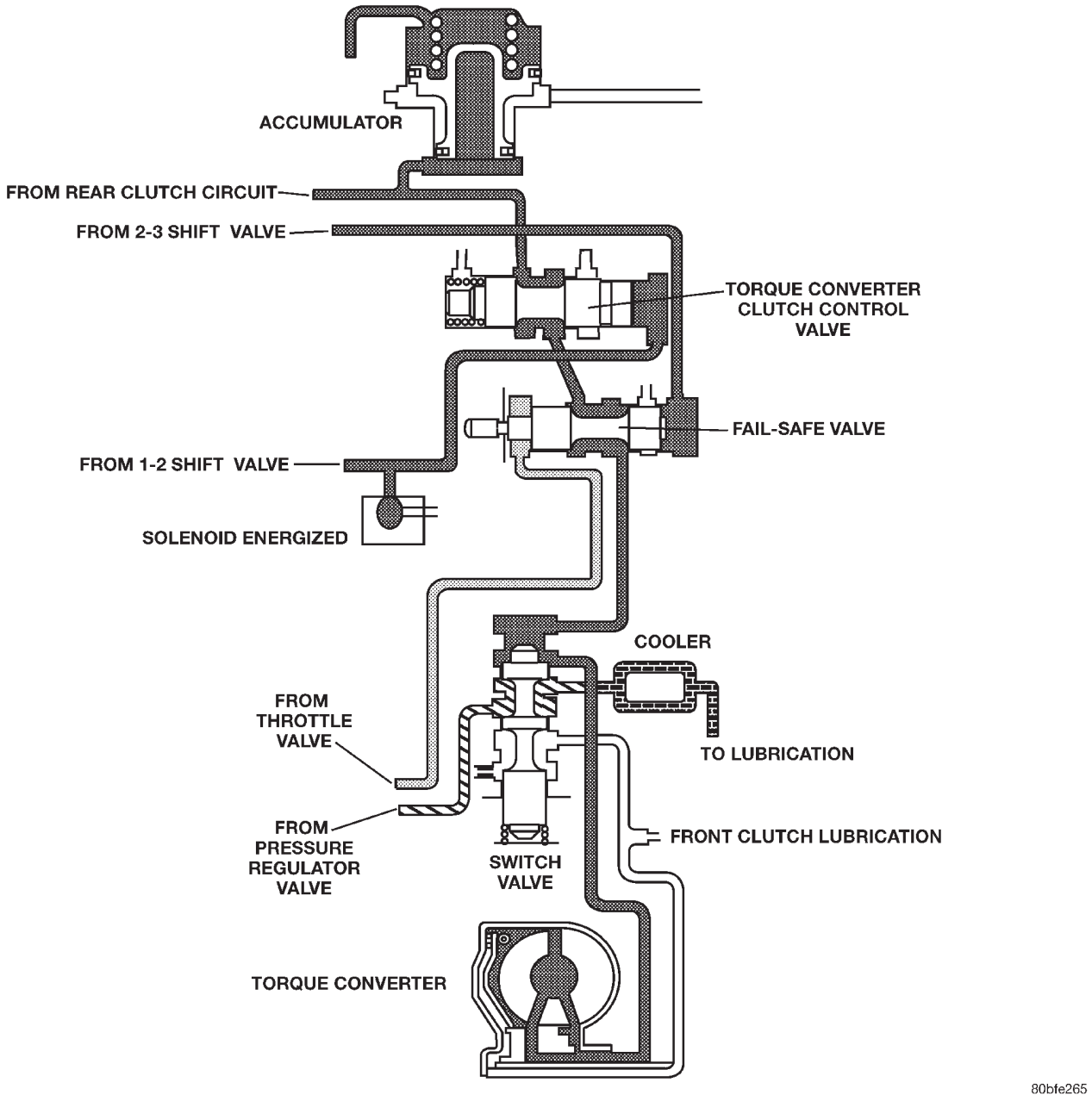


Fig. 34 Switch Valve-Torque Converter Locked

CONVERTER CLUTCH CONTROL VALVE

The torque converter clutch (TCC) control valve controls the back (ON) side of the torque converter clutch. When the PCM energizes the TCC solenoid to engage the converter clutch piston, pressure is applied to the TCC control valve which moves to the left and applies pressure to the fail–safe valve.

FAIL-SAFE VALVE

The pressure coming from the TCC control valve dead–ends at the fail–safe valve until governor pressure on the right side of the valve increases. The pressure must be high enough to overcome the throttle and spring pressure on the left side of the valve and push the valve to the left. The pressure will then flow to the switch valve.

MANUAL VALVE

The manual valve (Fig. 35) is a relay valve. The purpose of the manual valve is to direct fluid to the correct circuit needed for a specific gear or driving range. The manual valve, as the name implies, is manually operated by the driver with a lever located on the side of the valve body. The valve is connected mechanically by either a cable or linkage to the gearshift mechanism. The valve is held in each of its positions by a spring–loaded roller or ball that engages the “roostercomb” of the manual valve.

DESCRIPTION AND OPERATION (Continued)

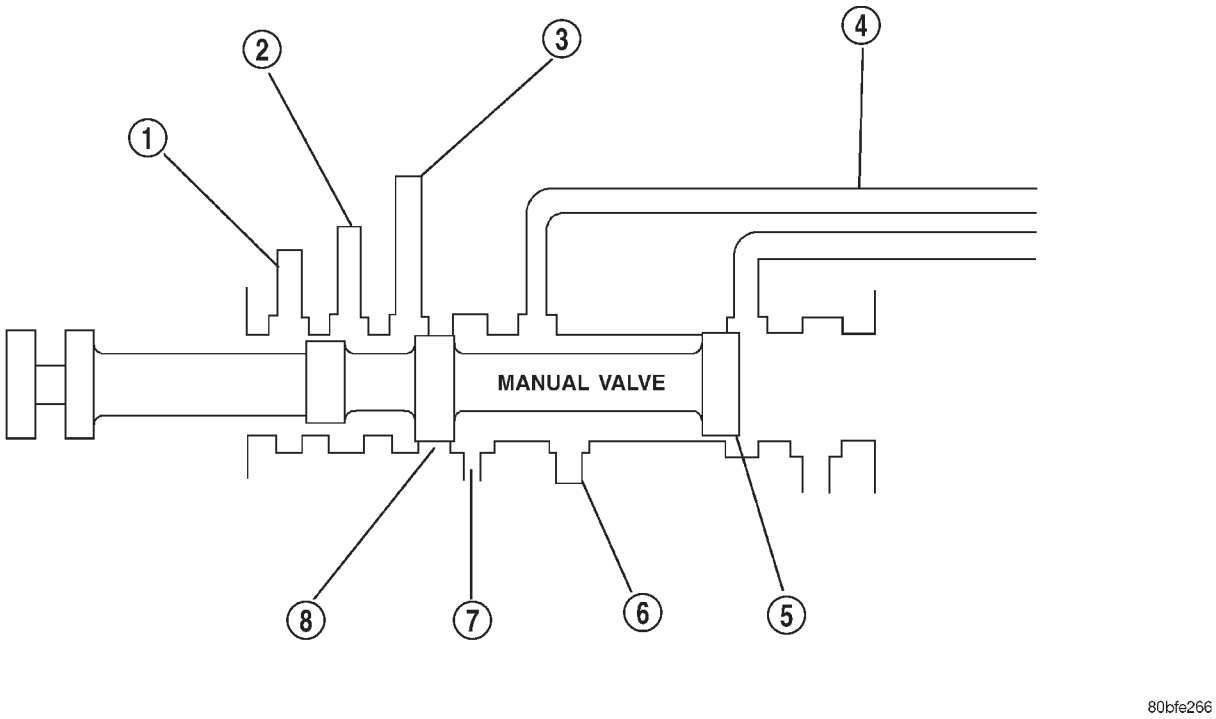


Fig. 35 Manual Valve

1 – 1–2 GOVERNOR PLUG
2 – 2–3 GOVERNOR PLUG
3 – GOVERNOR REAR CLUTCH ACCUMULATOR
4 – THROTTLE VALVE
5 – LAND #1
6 – PUMP
7 – PRESSURE REGULATOR
8 – LAND #2

ACCUMULATOR

DESCRIPTION

The accumulator (Fig. 36) is a hydraulic device that has the sole purpose of cushioning the application of a band or clutch. The accumulator consists of a dual–land piston and a spring located in a bore in the transmission case.

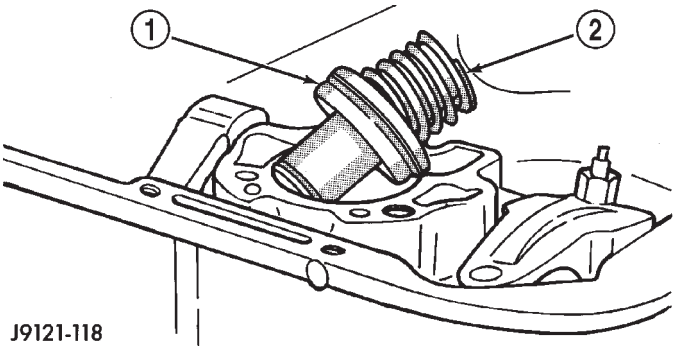


Fig. 36 Accumulator

1 – ACCUMULATOR PISTON
2 – PISTON SPRING

OPERATION

Line pressure is directed between the lands of the piston (Fig. 37), bottoming it against the accumulator plate. The accumulator stays in this position after the transmission is placed into a Drive position. When the 1–2 upshift occurs (Fig. 38), line pressure is directed to the large end of the piston and then to the kickdown servo. As the line pressure reaches the accumulator, the combination of spring pressure and line pressure forces the piston away from the accumulator plate. This causes a balanced pressure situation, which results in a cushioned band application. After the kickdown servo has become immovable, line pressure will finish pushing the accumulator up into its bore. When the large end of the accumulator piston is seated in its bore, the band or clutch is fully applied.

NOTE: The accumulator is shown in the inverted position for illustrative purposes.

DESCRIPTION AND OPERATION (Continued)

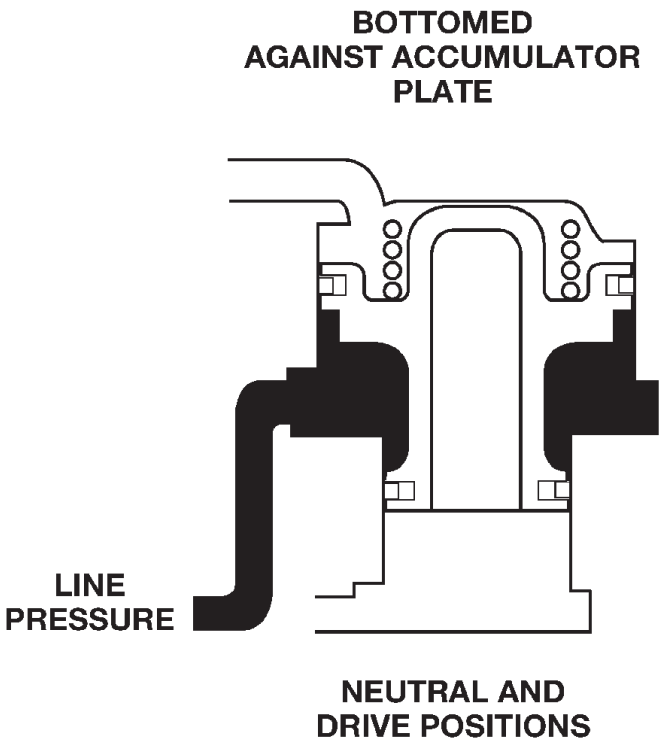


Fig. 37 Accumulator in Neutral and Drive Positions

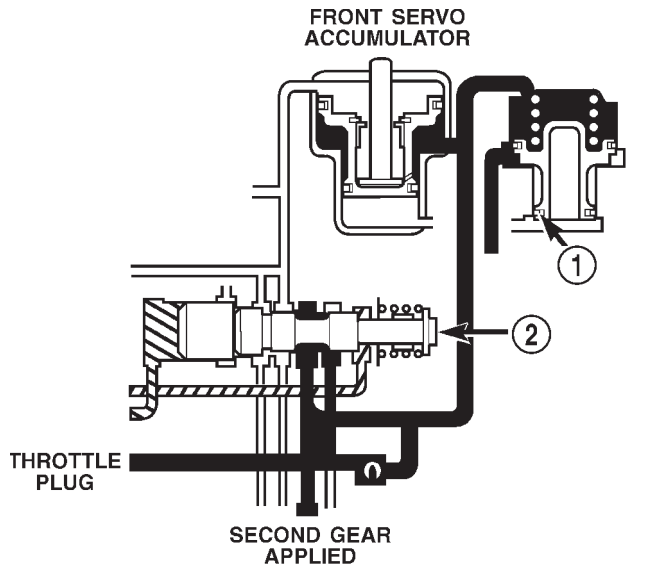


Fig. 38 Accumulator in Second Gear Position

1 – BOTTOM IN BORE
2 – SHUTTLE VALVE

PISTONS

DESCRIPTION

There are several sizes and types of pistons used in an automatic transmission. Some pistons are used to apply clutches, while others are used to apply bands. They all have in common the fact that they are round or circular in shape, located within a smooth walled cylinder, which is closed at one end and converts fluid pressure into mechanical movement. The fluid pressure exerted on the piston is contained within the system through the use of piston rings or seals.

OPERATION

The principal which makes this operation possible is known as Pascal's Law. Pascal's Law can be stated as: "Pressure on a confined fluid is transmitted equally in all directions and acts with equal force on equal areas."

PRESSURE

Pressure (Fig. 39) is nothing more than force (lbs.) divided by area (in or ft.), or force per unit area. Given a 100 lb. block and an area of 100 sq. in. on the floor, the pressure exerted by the block is: 100 lbs. 100 in or 1 pound per square inch, or PSI as it is commonly referred to.

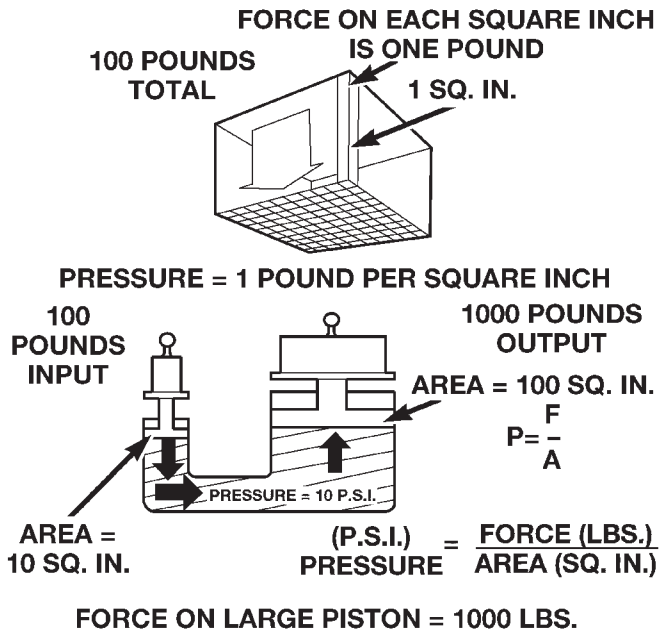


Fig. 39 Force and Pressure Relationship

PRESSURE ON A CONFINED FLUID

Pressure is exerted on a confined fluid (Fig. 40) by applying a force to some given area in contact with the fluid. A good example of this is a cylinder filled with fluid and equipped with a piston that is closely fitted to the cylinder wall. If a force is applied to the piston, pressure will be developed in the fluid. Of course, no pressure will be created if the fluid is not confined. It will simply "leak" past the piston. There must be a resistance to flow in order to create pressure. Piston sealing is extremely important in hydraulic operation. Several kinds of seals are used to accomplish this within a transmission. These include but are not limited to O–rings, D–rings, lip seals, sealing rings, or extremely close tolerances between the piston and the

DESCRIPTION AND OPERATION (Continued)

cylinder wall. The force exerted is downward (gravity), however, the principle remains the same no matter which direction is taken. The pressure created in the fluid is equal to the force applied, divided by the piston area. If the force is 100 lbs., and the piston area is 10 sq. in., then the pressure created equals 10 PSI. Another interpretation of Pascal's Law is that regardless of container shape or size, the pressure will be maintained throughout, as long as the fluid is confined. In other words, the pressure in the fluid is the same everywhere within the container.

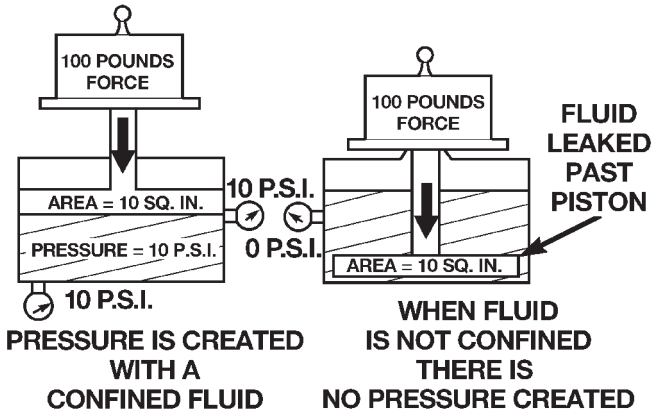


Fig. 40 Pressure on a Confined Fluid

FORCE MULTIPLICATION

Using the 10 PSI example used in the illustration (Fig. 41), a force of 1000 lbs. can be moved with a force of only 100 lbs. The secret of force multiplication in hydraulic systems is the total fluid contact area employed. The illustration, (Fig. 41), shows an area that is ten times larger than the original area. The pressure created with the smaller 100 lb. input is 10 PSI. The concept "pressure is the same everywhere" means that the pressure underneath the larger piston is also 10 PSI. Pressure is equal to the force applied divided by the contact area. Therefore, by means of simple algebra, the output force may be found. This concept is extremely important, as it is also used in the design and operation of all shift valves and limiting valves in the valve body, as well as the pistons, of the transmission, which activate the clutches and bands. It is nothing more than using a difference of area to create a difference in pressure to move an object.

PISTON TRAVEL

The relationship between hydraulic lever and a mechanical lever is the same. With a mechanical lever it's a weight–to–distance output rather than a pressure–to–area output. Using the same forces and areas as in the previous example, the smaller piston (Fig. 42) has to move ten times the distance required

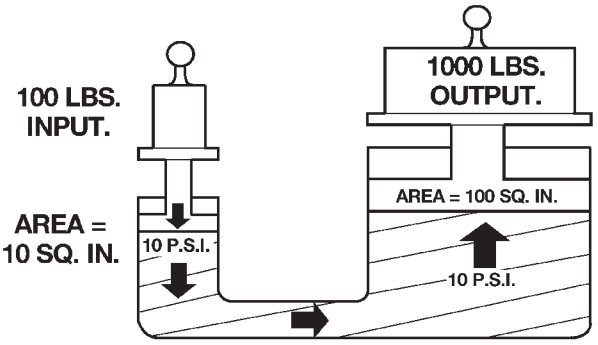


Fig. 41 Force Multiplication

to move the larger piston one inch. Therefore, for every inch the larger piston moves, the smaller piston moves ten inches. This principle is true in other instances also. A common garage floor jack is a good example. To raise a car weighing 2000 lbs., an effort of only 100 lbs. may be required. For every inch the car moves upward, the input piston at the jack handle must move 20 inches downward.

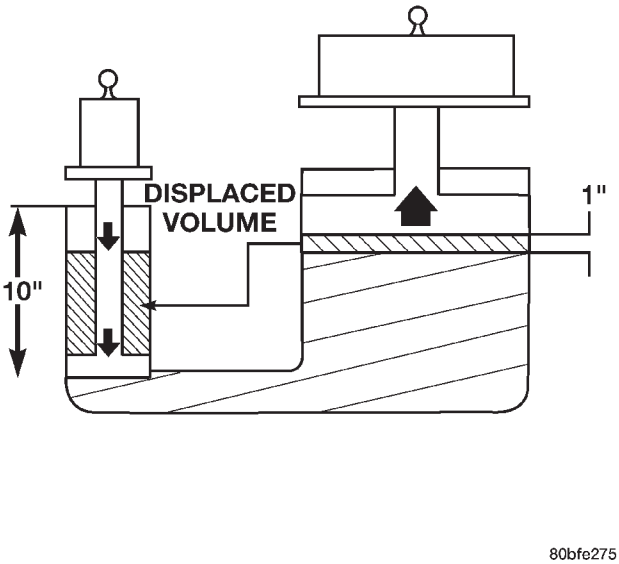


Fig. 42 Piston Travel

FRONT CLUTCH

DESCRIPTION

The front clutch assembly (Fig. 43) is composed of the front clutch retainer, pressure plate, four clutch plates, four driving discs, piston, piston return spring, return spring retainer, and snap rings. The

DESCRIPTION AND OPERATION (Continued)

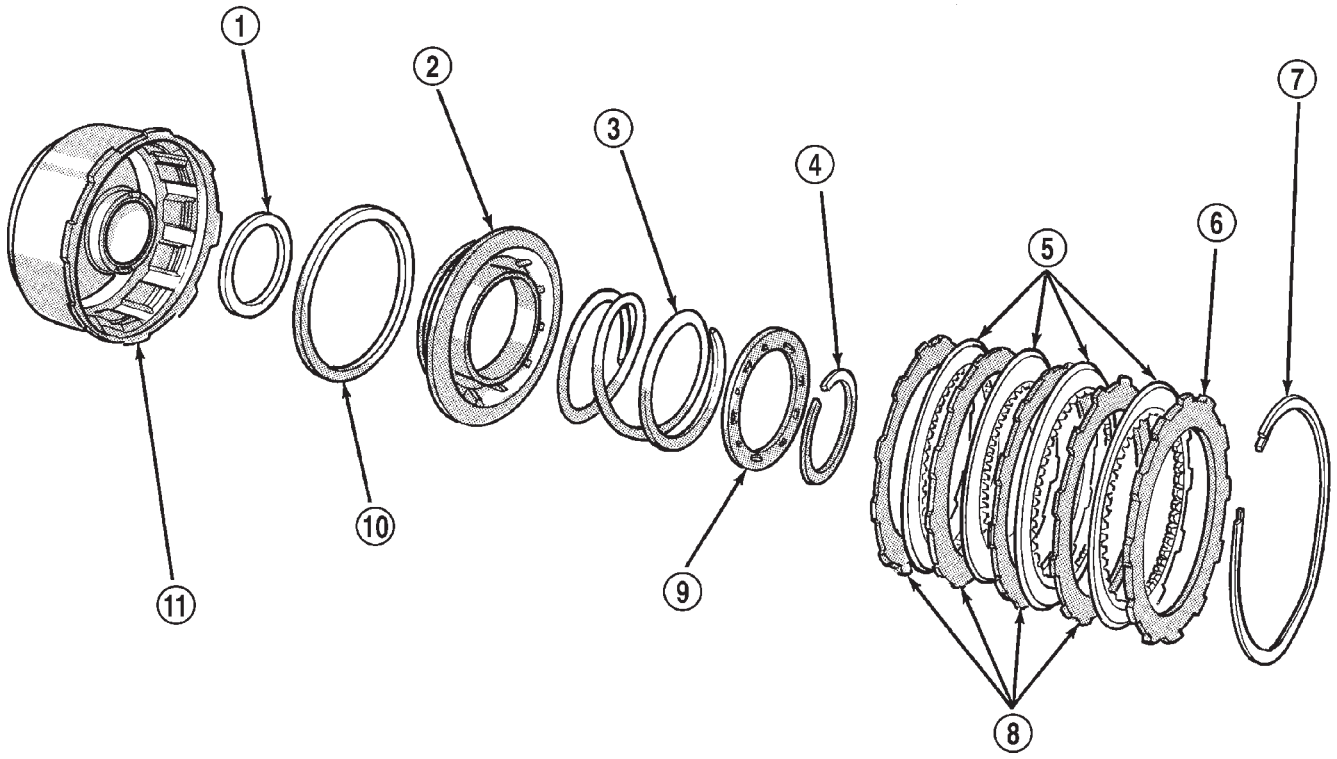


Fig. 43 Front Clutch

1 – RETAINER HUB SEAL
2 – CLUTCH PISTON
3 – PISTON SPRING
4 – SPRING RETAINER SNAP RING
5 – CLUTCH DISCS
6 – PRESSURE PLATE
7 – SNAP RING (WAVED)
8 – CLUTCH PLATES
9 – SPRING RETAINER
10 – PISTON SEAL
11 – FRONT CLUTCH RETAINER

front clutch is the forwardmost component in the transmission geartrain and is directly behind the oil pump and is considered a driving component.

NOTE: The number of discs and plates may vary with each engine and vehicle combination.

OPERATION

To apply the clutch, pressure is applied between the clutch retainer and piston. The fluid pressure is provided by the oil pump, transferred through the control valves and passageways, and enters the clutch through the hub of the reaction shaft support. With pressure applied between the clutch retainer and piston, the piston moves away from the clutch retainer and compresses the clutch pack. This action applies the clutch pack, allowing torque to flow through the input shaft into the driving discs, and into the clutch plates and pressure plate that are lugged to the clutch retainer. The waved snap ring is used to cushion the application of the clutch pack. In some transmissions, the snap ring is selective and used to adjust clutch pack clearance.

When pressure is released from the piston, the spring returns the piston to its fully released position and disengages the clutch. The release spring also helps to cushion the application of the clutch assembly. When the clutch is in the process of being released by the release spring, fluid flows through a vent and one–way ball–check–valve located in the clutch retainer. The check–valve is needed to eliminate the possibility of plate drag caused by centrifugal force acting on the residual fluid trapped in the clutch piston retainer.

REAR CLUTCH

DESCRIPTION

The rear clutch assembly (Fig. 44) is composed of the rear clutch retainer, pressure plate, three clutch plates, four driving discs, piston, Belleville spring,

DESCRIPTION AND OPERATION (Continued)

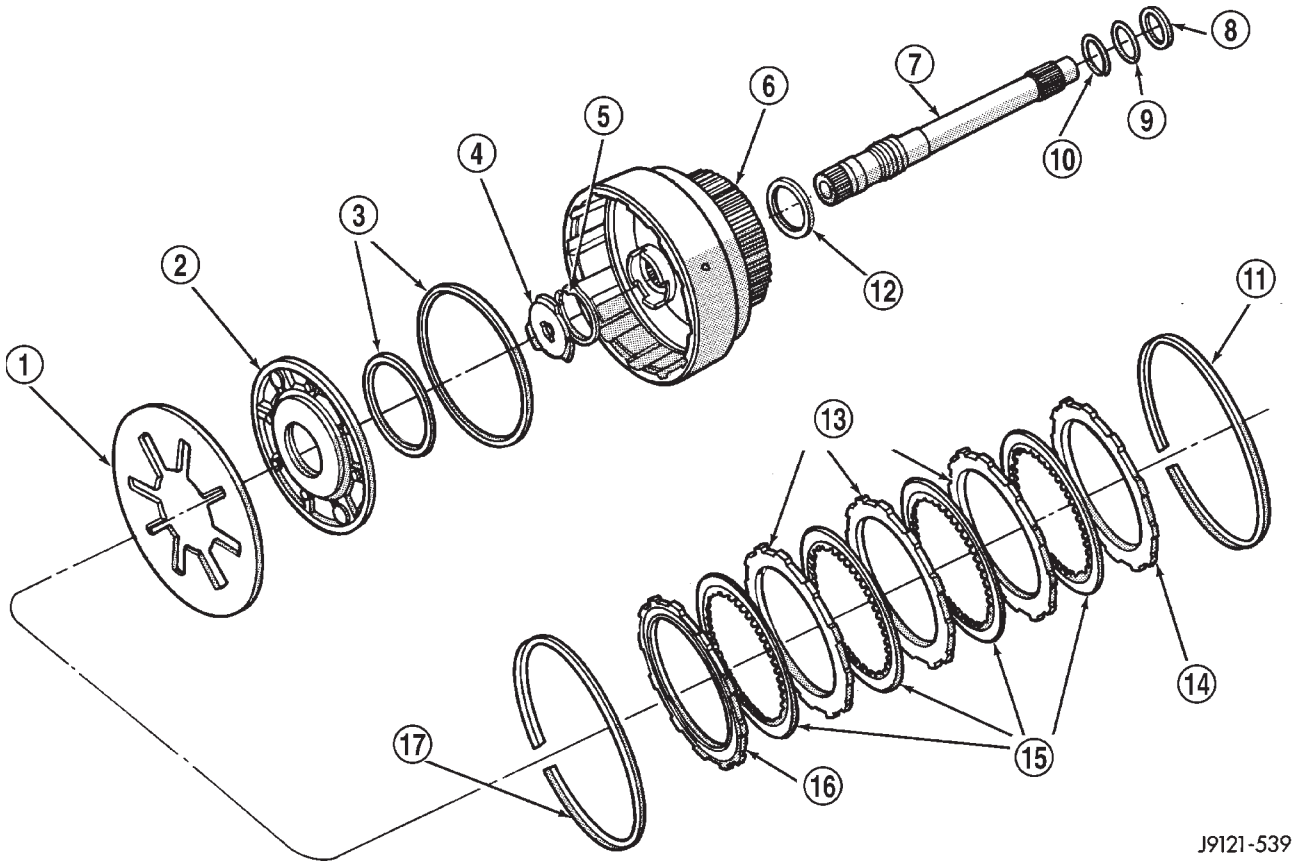


Fig. 44 Rear Clutch

1 – PISTON SPRING
2 – REAR CLUTCH PISTON
3 – CLUTCH PISTON SEALS
4 – OUTPUT SHAFT THRUST WASHER (METAL)
5 – INPUT SHAFT SNAP RING
6 – REAR CLUTCH RETAINER
7 – INPUT SHAFT
8 – REAR CLUTCH THRUST WASHER (FIBER)
9 – SHAFT FRONT SEAL RING (TEFLON)
10 – SHAFT REAR SEAL RING (METAL)
11 – CLUTCH PACK SNAP RING (SELECTIVE)
12 – RETAINER SEAL RING
13 – CLUTCH PLATES (3)
14 – TOP PRESSURE PLATE
15 – CLUTCH DISCS (4)
16 – BOTTOM PRESSURE PLATE
17 – WAVE SPRING

and snap rings. The Belleville spring acts as a lever to multiply the force applied on to it by the apply piston. The increased apply force on the rear clutch pack, in comparison to the front clutch pack, is needed to hold against the greater torque load imposed onto the rear pack. The rear clutch is directly behind the front clutch and is considered a driving component.

NOTE: The number of discs and plates may vary with each engine and vehicle combination.

OPERATION

To apply the clutch, pressure is applied between the clutch retainer and piston. The fluid pressure is provided by the oil pump, transferred through the control valves and passageways, and enters the clutch through the hub of the reaction shaft support. With pressure applied between the clutch retainer and piston, the piston moves away from the clutch retainer and compresses the clutch pack. This action applies the clutch pack, allowing torque to flow through the input shaft into the driving discs, and into the clutch plates and pressure plate that are lugged to the clutch retainer. The waved snap ring is used to cushion the application of the clutch pack. In some transmissions, the snap ring is selective and used to adjust clutch pack clearance.

When pressure is released from the piston, the spring returns the piston to its fully released position and disengages the clutch. The release spring also helps to cushion the application of the clutch assembly. When the clutch is in the process of being

DESCRIPTION AND OPERATION (Continued)

released by the release spring, fluid flows through a vent and one–way ball–check–valve located in the clutch retainer. The check–valve is needed to eliminate the possibility of plate drag caused by centrifugal force acting on the residual fluid trapped in the clutch piston retainer.

OVERRUNNING CLUTCH

DESCRIPTION

The overrunning clutch (Fig. 45) consists of an inner race, an outer race (or cam), rollers and springs, and the spring retainer. The number of rollers and springs depends on what transmission and which overrunning clutch is being dealt with.

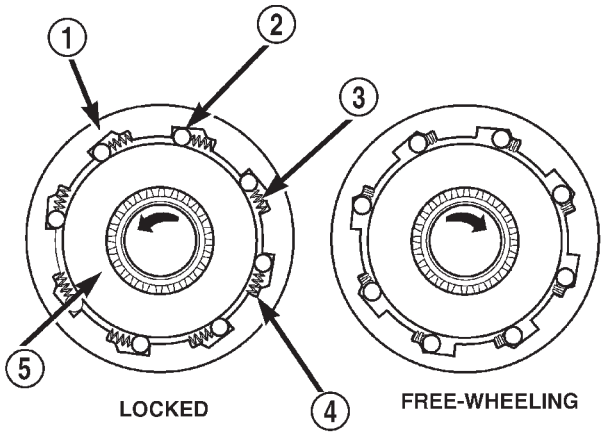


Fig. 45 Overrunning Clutch

1 – OUTER RACE (CAM)
2 – ROLLER
3 – SPRING
4 – SPRING RETAINER
5 – INNER RACE (HUB)

OPERATION

As the inner race is rotated in a clockwise direction (as viewed from the front of the transmission), the race causes the rollers to roll toward the springs, causing them to compress against their retainer. The compression of the springs increases the clearance between the rollers and cam. This increased clearance between the rollers and cam results in a freewheeling condition. When the inner race attempts to rotate counterclockwise, the action causes the rollers to roll in the same direction as the race, aided by the pushing of the springs. As the rollers try to move in the same direction as the inner race, they are wedged between the inner and outer races due to the design of the cam. In this condition, the clutch is locked and acts as one unit.

PLANETARY GEARSET

DESCRIPTION

The planetary gearsets (Fig. 46) are designated as the front and rear planetary gear assemblies and located in such order. A simple planetary gearset consists of three main members:

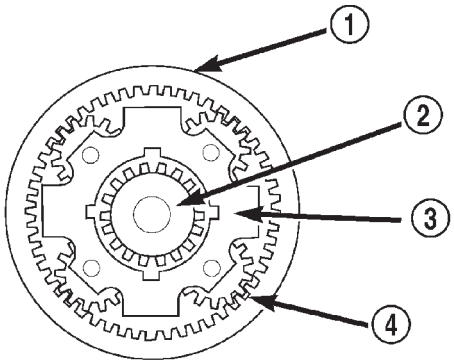


Fig. 46 Planetary Gearset

1 – ANNULUS GEAR
2 – SUN GEAR
3 – PLANET CARRIER
4 – PLANET PINIONS (4)

- The sun gear which is at the center of the system.
- The planet carrier with planet pinion gears which are free to rotate on their own shafts and are in mesh with the sun gear.
- The annulus gear, which rotates around and is in mesh with the planet pinion gears.

NOTE: The number of pinion gears does not affect the gear ratio, only the duty rating.

OPERATION

With any given planetary gearset, several conditions must be met for power to be able to flow:

- One member must be held.
- Another member must be driven or used as an input.
- The third member may be used as an output for power flow.
- For direct drive to occur, two gear members in the front planetary gearset must be driven.

NOTE: Gear ratios are dependent on the number of teeth on the annulus and sun gears.

DESCRIPTION AND OPERATION (Continued)

BANDS

DESCRIPTION

KICKDOWN (FRONT) BAND

The kickdown, or “front”, band (Fig. 47) holds the common sun gear of the planetary gear sets. The front (kickdown) band is made of steel, and faced on its inner circumference with a friction–type lining. One end of the band is anchored to the transmission case, and the other is acted on with a pushing force by a servo piston. The front band is a single–wrap design (the band does not completely encompass/ wrap the drum that it holds).

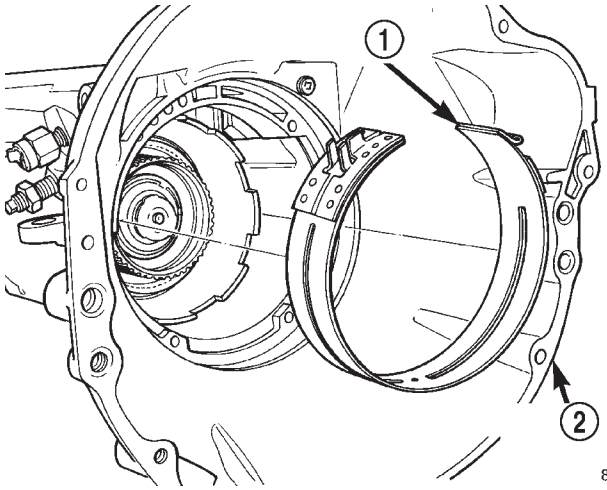


Fig. 47 Front Band

1 – FRONT BAND
2 – TRANSMISSION HOUSING

LOW/REVERSE (REAR) BAND

The low/reverse band, or “rear”, band (Fig. 48) is similar in appearance and operation to the front band. The rear band of the 32RH is slightly different in that it does not use a link bar, but is acted directly on by the apply lever. This is referred to as a double–wrap band design (the drum is completely encompassed/wrapped by the band). The double–wrap band provides a greater holding power in comparison to the single–wrap design.

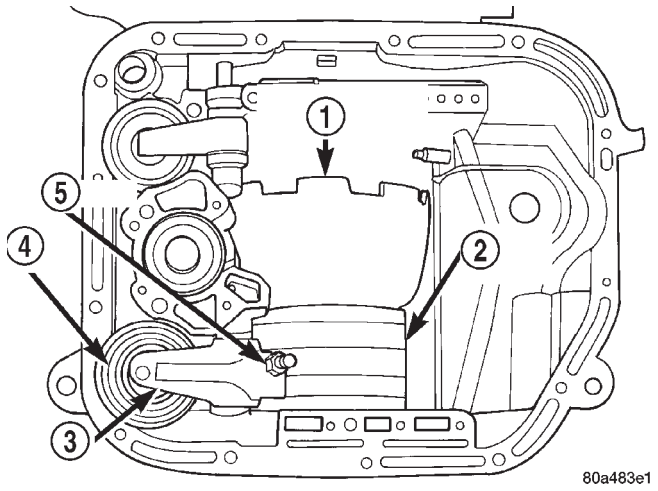


Fig. 48 Rear Band

1 – PLANETARY GEARTRAIN
2 – REAR BAND
3 – LEVER
4 – SERVO
5 – ADJUSTER

OPERATION

KICKDOWN (FRONT) BAND

The kickdown band holds the common sun gear of the planetary gear sets by applying and holding the front clutch retainer, which is splined to the sun gear driving shell, and in turn splined directly to the sun gear. The application of the band by the servo is typically done by an apply lever and link bar.

LOW/REVERSE (REAR) BAND

The rear band holds the rear planet carrier stationary by being mounted around and applied to the low/reverse drum.

SERVOS

DESCRIPTION

KICKDOWN (FRONT) SERVO

The kickdown servo (Fig. 49) consists of a two–land piston with an inner piston, a piston rod and guide, and a return spring. The dual–land piston uses seal rings on its outer diameters and an O–ring for the inner piston.

LOW/REVERSE (REAR) SERVO

The rear (low/reverse) servo consists of a single stage or diameter piston and a spring loaded plug. The spring is used to cushion the application of the rear (low/reverse) band.

DESCRIPTION AND OPERATION (Continued)

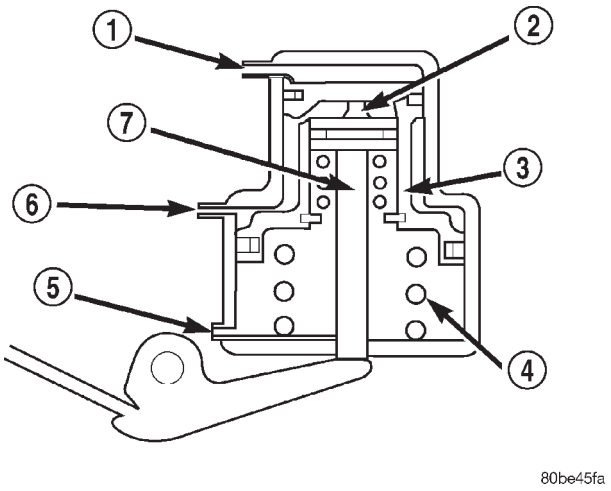


Fig. 49 Front Servo

1 – VENT
2 – INNER PISTON
3 – PISTON
4 – SPRING
5 – RELEASE PRESSURE
6 – APPLY PRESSURE
7 – PISTON ROD

OPERATION

KICKDOWN (FRONT) SERVO

The application of the piston is accomplished by applying pressure between the two lands of the piston. The pressure acts against the larger lower land to push the piston downward, allowing the piston rod to extend though its guide against the apply lever. Release of the servo at the 2–3 upshift is accomplished by a combination of spring and line pressure, acting on the bottom of the larger land of the piston. The small piston is used to cushion the application of the band by bleeding oil through a small orifice in the larger piston. The release timing of the kickdown servo is very important to obtain a smooth but firm shift. The release has to be very quick, just as the front clutch application is taking place. Otherwise, engine runaway or a shift hesitation will occur. To accomplish this, the band retains its holding capacity until the front clutch is applied, giving a small amount of overlap between them.

LOW/REVERSE (REAR) SERVO

While in the de-energized state (no pressure applied), the piston is held up in its bore by the piston spring. The plug is held down in its bore, in the piston, by the plug spring. When pressure is applied to the top of the piston, the plug is forced down in its bore, taking up any clearance. As the piston moves, it causes the plug spring to compress, and the piston moves down over the plug. The piston continues to move down until it hits the shoulder of the plug and fully applies the band. The period of time from the initial application, until the piston is against the shoulder of the plug, represents a reduced shocking of the band that cushions the shift.

GOVERNOR

DESCRIPTION

The governor (Fig. 50) valve body is attached to the output shaft of the transmission.

OPERATION

The governor meters hydraulic pressure (Fig. 51), and this metered pressure is used to signal the transmission when it is time for a shift to occur. It does this by balancing governor pressure on one side of a shift valve, and throttle pressure on the other. When governor pressure increases far enough to overcome the throttle pressure on the valve, a shift occurs.

With the gearshift selector in a forward driving range, line pressure flows from the manual valve and down to the governor valve. When the output shaft starts to rotate with vehicle motion (Fig. 52), the governor weight assembly will start to move outward due to centrifugal force. As the weight is moved outward, it will pull the valve with it until the land of the valve uncovers the line pressure port. As the port begins to become uncovered, governor pressure is metered. As the vehicle's speed continues to increase (Fig. 53), the weight assembly will be at a point at which governor pressure is acting on the left side of the reaction area of the valve. This produces sufficient force to compress the spring and allow the outer weight to move out against the outer governor body retaining ring. At a very high speed, the governor valve will be opened as far as possible. In this condition, it is possible for governor pressure to meet, but not to exceed, line pressure. Generally governor pressure ranges from 0–100 psi from idle to maximum speed, and rises proportionally with the increase in output shaft speed. Governor pressure and throttle pressure are acting upon the shift valves to determine when a shift will occur. Governor pressure is a direct indication of road speed, and throttle pressure is an indication of engine load. When both parameters have been met by the throttle and governor pressures, an upshift or downshift will occur.

DESCRIPTION AND OPERATION (Continued)

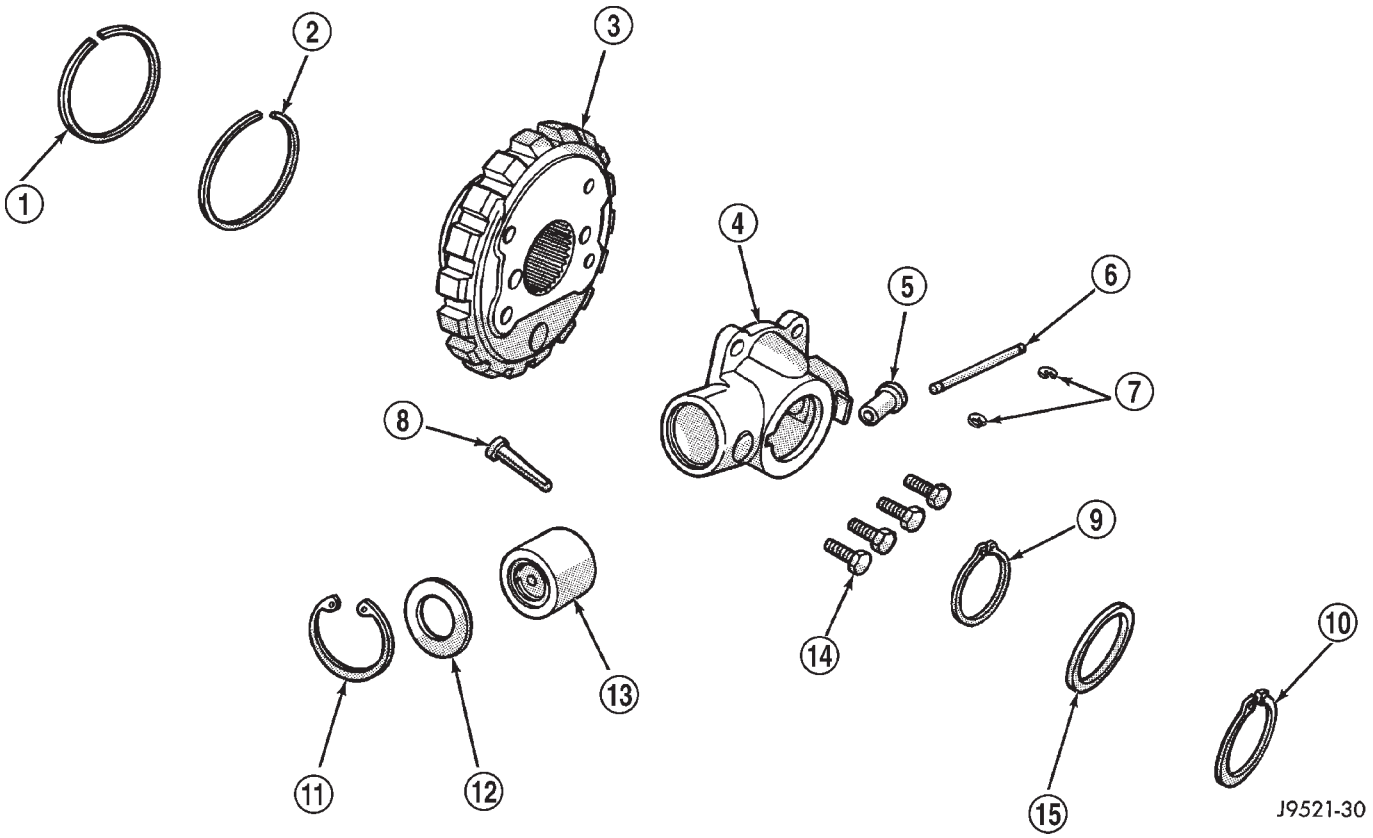


Fig. 50 Governor

1 – SEAL RING (PLAIN END)
2 – SEAL RING (HOOK END)
3 – PARK GEAR
4 – GOVERNOR BODY
5 – GOVERNOR VALVE
6 – VALVE SHAFT
7 – E-CLIPS (2)
8 – FILTER
9 – SNAP RING (THIN)
10 – SNAP RING (THICK)
11 – SNAP RING
12 – RETAINER WASHER
13 – GOVERNOR WEIGHT ASSEMBLY
14 – GOVERNOR BODY BOLTS (4)
15 – WASHER

DESCRIPTION AND OPERATION (Continued)

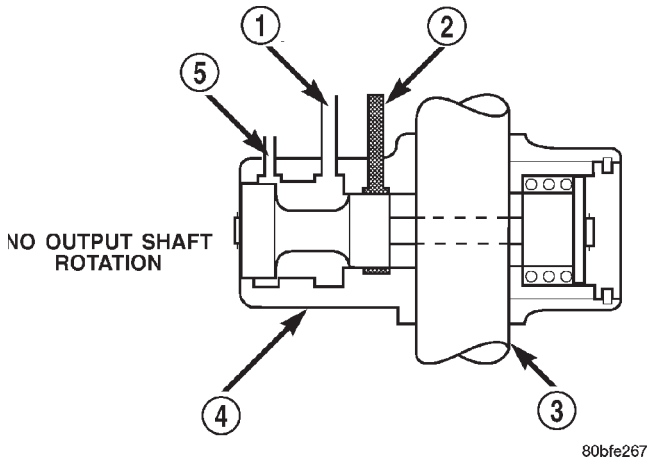


Fig. 51 Governor—No Output Shaft Rotation

1 – GOVERNOR PRESSURE
2 – LINE PRESSURE
3 – OUTPUT SHAFT
4 – GOVERNOR
5 – VENT

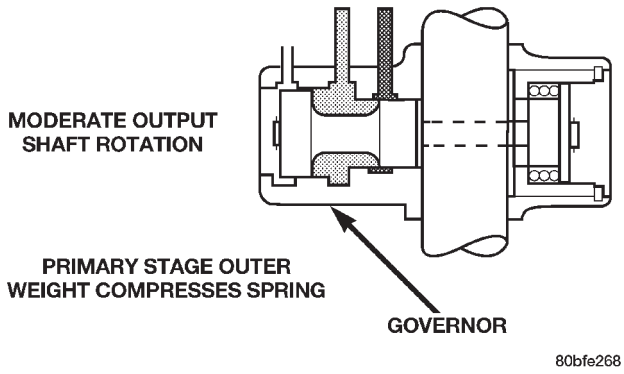


Fig. 52 Governor—Moderate Output Shaft Rotation

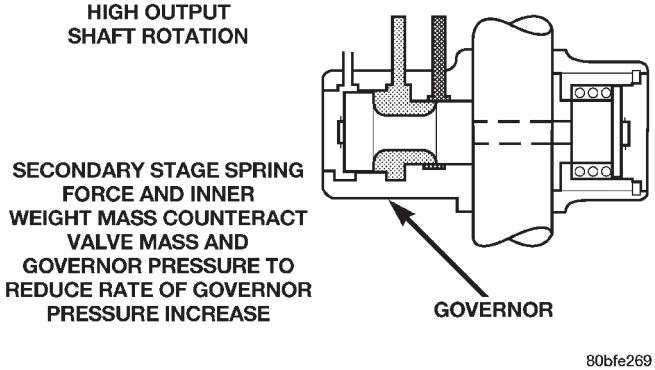


Fig. 53 Governor—High Output Shaft Rotation

GEARSHIFT MECHANISM

DESCRIPTION

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)

OPERATION

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.

CONVERTER DRAINBACK VALVE

DESCRIPTION

The drainback valve is located in the transmission cooler outlet (pressure) line.

OPERATION

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

DESCRIPTION

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. 54).

OPERATION

The system locks the shifter into the PARK position. The Interlock system is engaged whenever the ignition switch is in the LOCK or ACCESSORY position. An additional electrically activated feature will prevent shifting out of the PARK position unless the brake pedal is depressed 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 posi-

DESCRIPTION AND OPERATION (Continued)

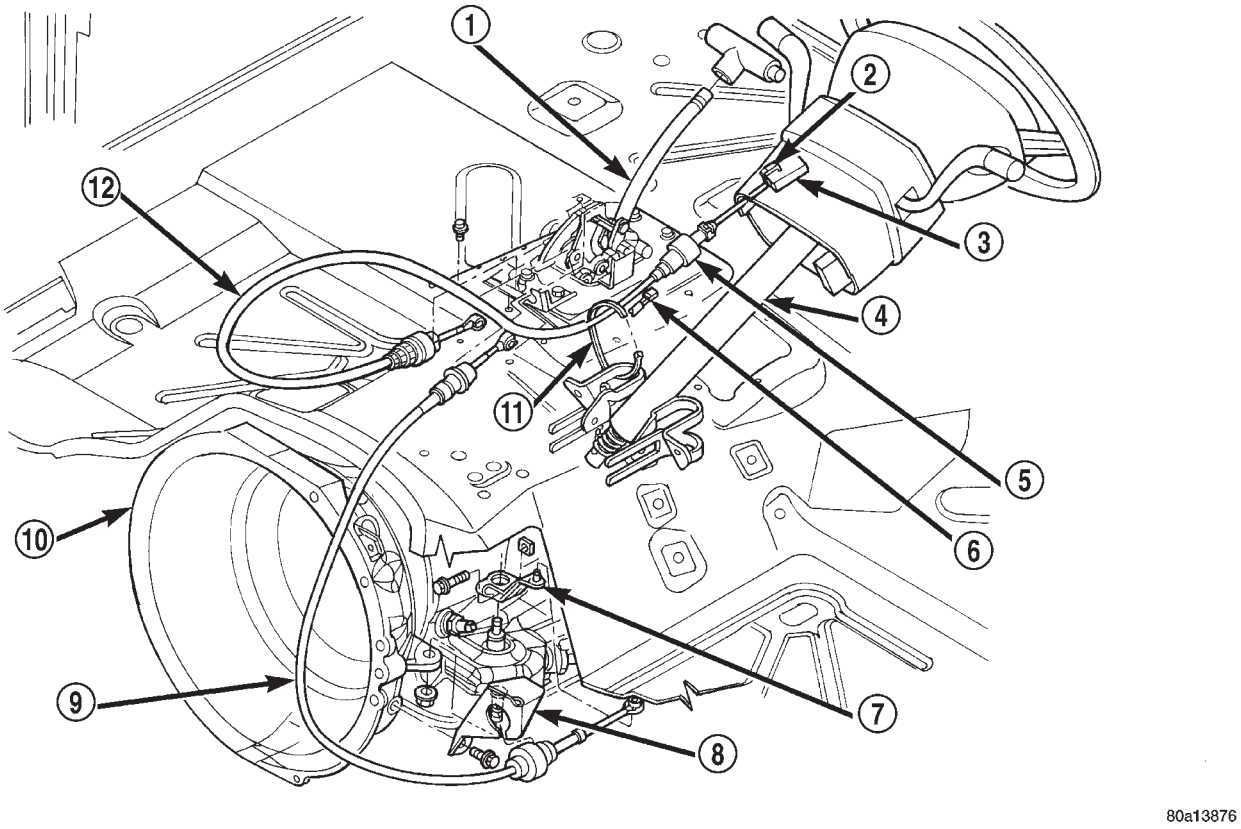


Fig. 54 Ignition Interlock Cable Routing

1 – SHIFT MECHANISM
2 – LOCK-TAB
3 – IGNITION LOCK INTERLOCK
4 – STEERING COLUMN
5 – SOLENOID
6 – WIRE CONNECTOR
7 – LEVER
8 – MOUNT BRACKET
9 – SHIFT CABLE
10 – AUTOMATIC TRANSMISSION
11 – TIE STRAP
12 – PARK/BRAKE INTERLOCK CABLE

tion 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. 55) 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.

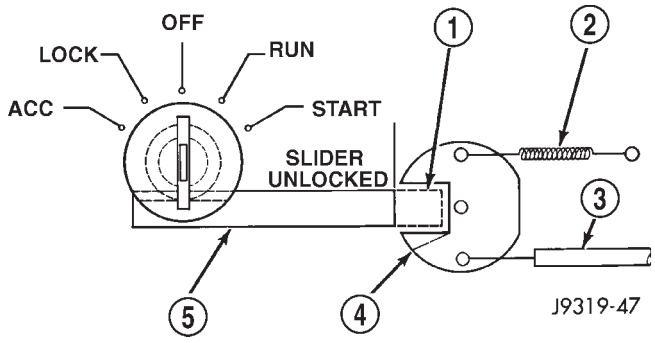


Fig. 55 Ignition Key Cylinder Actuation

1 – SLIDER LOCKED
2 – CAM RETURN SPRING
3 – INTERLOCK CABLE
4 – CAM
5 – SLIDER

DIAGNOSIS AND TESTING (Continued)

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.

PRELIMINARY DIAGNOSIS

Two basic procedures are required. One procedure for vehicles that are drivable and an alternate procedure for disabled vehicles (will not back up or move forward).

VEHICLE IS DRIVEABLE

(1) Check for transmission fault codes using DRB scan tool.

(2) Check fluid level and condition.

(3) Adjust throttle and gearshift linkage if complaint was based on delayed, erratic, or harsh shifts.

(4) Road test and note how transmission upshifts, downshifts, and engages.

(5) Perform stall test if complaint is based on sluggish acceleration. Or, if abnormal throttle opening is needed to maintain normal speeds with a properly tuned engine.

(6) Perform hydraulic pressure test if shift problems were noted during road test.

(7) Perform air-pressure test to check clutch-band operation.

VEHICLE IS DISABLED

(1) Check fluid level and condition.

(2) Check for broken or disconnected gearshift or throttle linkage.

(3) Check for cracked, leaking cooler lines, or loose or missing pressure-port plugs.

(4) Raise and support vehicle on safety stands, start engine, shift transmission into gear, and note following:

(a) If propeller shaft turns but wheels do not, problem is with differential or axle shafts.

DIAGNOSIS AND TESTING (Continued)

(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.

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.

DRIVE ELEMENTS	Gearshift Lever Position								
	P	R	N	D			2		1
				1	2	3	1	2	
FRONT CLUTCH		•				•			
FRONT BAND (KICKDOWN)					•			•	
REAR CLUTCH				•	•	•	•	•	•
REAR BAND (LOW-REV.)		•							•
OVER-RUNNING CLUTCH				•			•		•

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Fig. 56 Clutch And Band Application

DIAGNOSIS AND TESTING (Continued)

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.

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. 57), (Fig. 58) and (Fig. 59).

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.

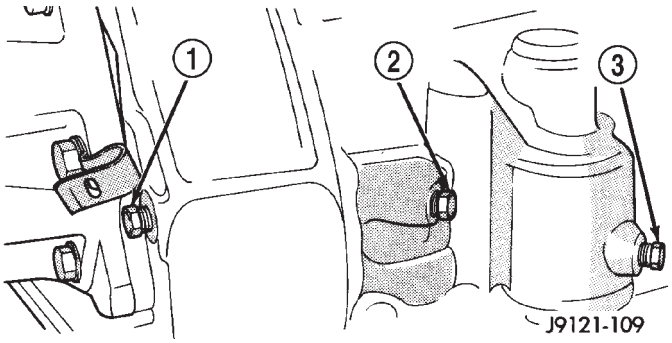


Fig. 57 Pressure Test Ports At Side Of Case

1 – REAR SERVO PORT
2 – LINE PRESSURE PORT
3 – FRONT SERVO PORT

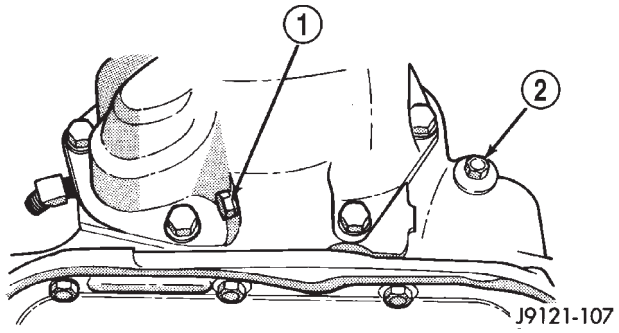


Fig. 58 Pressure Test Ports At Rear Of Case—2WD

1 – GOVERNOR PRESSURE PORT
2 – REAR SERVO PRESSURE PORT

Connect a tachometer to the engine. Position the tachometer so it can be observed from under the vehicle. Raise the vehicle on a hoist that will allow the wheels to rotate freely.

PRESSURE TEST PROCEDURE

Test One - Transmission In 1 Range

This test checks pump output, pressure regulation, and condition of the rear clutch and servo circuit. Test Gauges C-3292 and C-3293-SP are required for this test. Gauge C-3292 has a 100 psi range. Gauge C-3293-SP has a 300 psi range.

(1) Connect 100 psi Gauge C-3292 to accumulator port.

DIAGNOSIS AND TESTING (Continued)

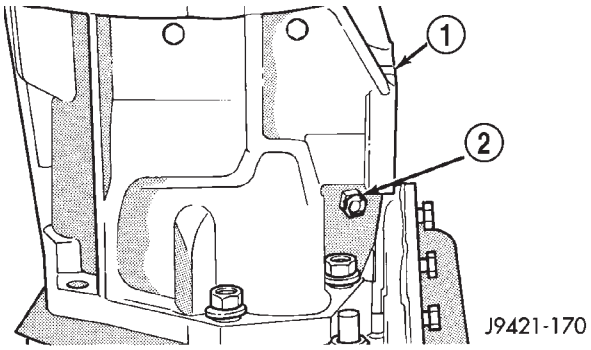


Fig. 59 Pressure Test Ports At Rear Of Case—4WD

1 – ADAPTER HOUSING
2 – GOVERNOR PRESSURE PORT PLUG

(2) Connect 300 psi Gauge C-3293-SP to rear servo port (Fig. 57) and (Fig. 58).

(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. 57) and (Fig. 58).

(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. 57) and (Fig. 58). 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. 57) and (Fig. 58).

(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. 57) and (Fig. 58).

(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. 60).

DIAGNOSIS AND TESTING (Continued)

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 devris, worn bushings in pump or clutch retainer

Fig. 60 Pressure Test Analysis

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. 61).

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.

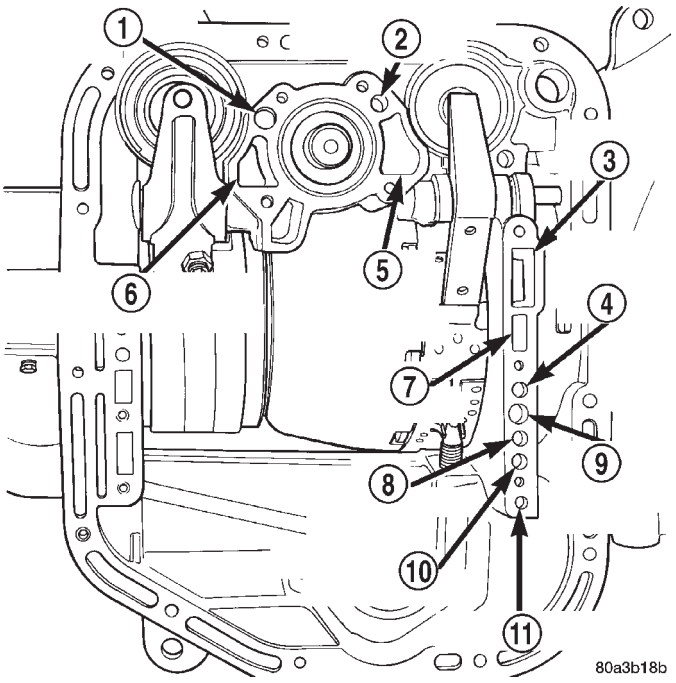


Fig. 61 Air Pressure Test Passages

1 – REAR SERVO APPLY
2 – FRONT SERVO APPLY
3 – PUMP SUCTION
4 – FRONT CLUTCH APPLY
5 – FRONT SERVO RELEASE
6 – LINE PRESSURE TO ACCUMULATOR
7 – PUMP PRESSURE
8 – TO CONVERTER
9 – REAR CLUTCH APPLY
10 – FROM CONVERTER
11 – TO COOLER

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.

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.

DIAGNOSIS AND TESTING (Continued)

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. 62). Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 62). 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.

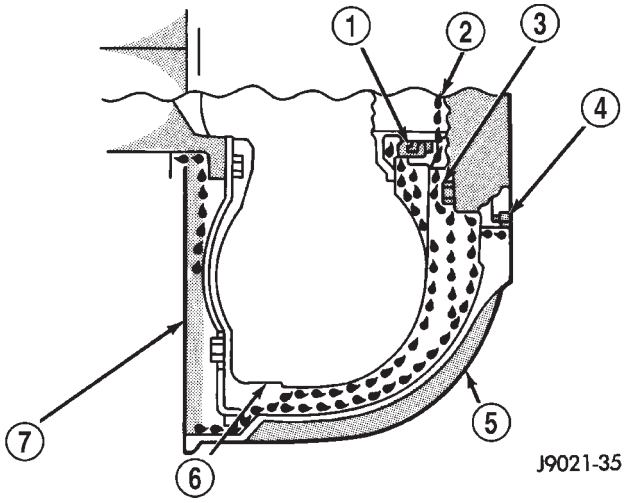


Fig. 62 Converter Housing Leak Paths

1 – PUMP SEAL
2 – PUMP VENT
3 – PUMP BOLT
4 – PUMP GASKET
5 – CONVERTER HOUSING
6 – CONVERTER
7 – REAR MAIN SEAL LEAK

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are:

(1) Leaks at the weld joint around the outside diameter weld (Fig. 63).

(2) Leaks at the converter hub weld (Fig. 63).

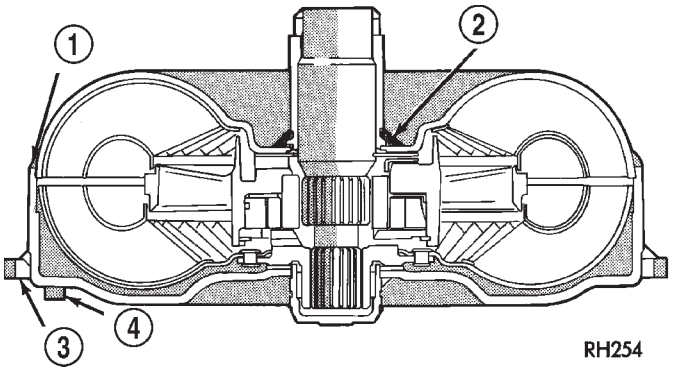


Fig. 63 Converter Leak Points—Typical

1 – OUTSIDE DIAMETER WELD
2 – TORQUE CONVERTER HUB WELD
3 – STARTER RING GEAR
4 – LUG

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

(2) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out when oil pump is removed.

(3) Remove oil pump and remove pump seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter.

(5) Install new pump seal, O-ring, and gasket. Replace oil pump if cracked, porous or damaged in any way. Be sure to loosen the front band before installing the oil pump, damage to the oil pump seal may occur if the band is still tightened to the front clutch retainer.

(6) Loosen kickdown lever pin access plug three turns. Apply Loctite 592, or Permatex No. 2 to plug threads and tighten plug to 17 N·m (150 in. lbs.) torque.

(7) Adjust front band.

(8) Lubricate pump seal and converter hub with transmission fluid or petroleum jelly and install converter.

(9) Install transmission and converter housing dust shield.

(10) Lower vehicle.

DIAGNOSIS AND TESTING (Continued)

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 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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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.
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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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. 64) 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.

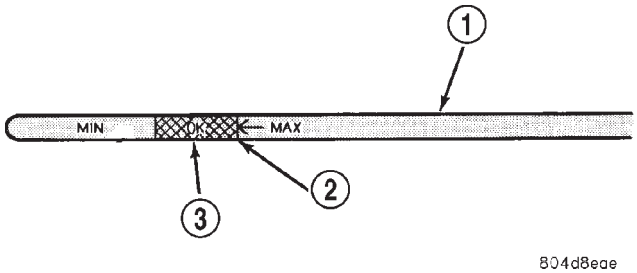


Fig. 64 Dipstick Fluid Level Marks—Typical

1 – DIPSTICK
2 – MAXIMUM CORRECT FLUID LEVEL
3 – ACCEPTABLE FLUID LEVEL

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) Remove the transmission/skip plate as necessary to access the transmission oil pan.
(3) Place a large diameter shallow drain pan beneath the transmission pan.
(4) Remove bolts holding front and sides of pan to transmission (Fig. 65).
(5) Loosen bolts holding rear of pan to transmission.
(6) Slowly separate front of pan away from transmission allowing the fluid to drain into drain pan.
(7) Hold up pan and remove remaining bolts holding pan to transmission.
(8) While holding pan level, lower pan away from transmission.
(9) Pour remaining fluid in pan into drain pan.
(10) Remove screws holding filter to valve body (Fig. 66).
(11) Separate filter from valve body and pour fluid in filter into drain pan.
(12) Dispose used trans fluid and filter properly.

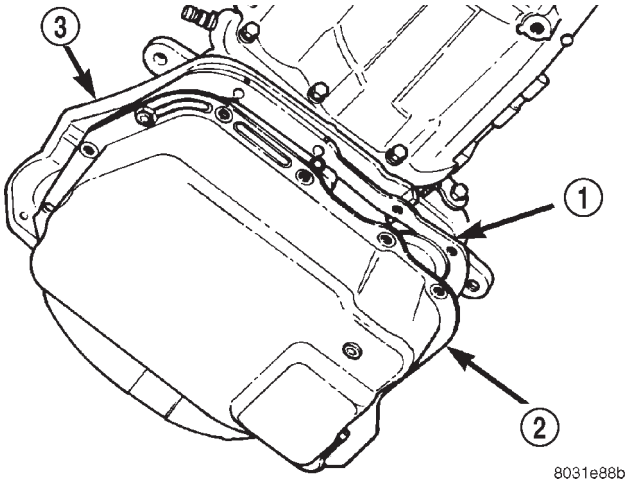


Fig. 65 Transmission Pan–Typical

1 – GASKET
2 – PAN
3 – TRANSMISSION

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

SERVICE PROCEDURES (Continued)

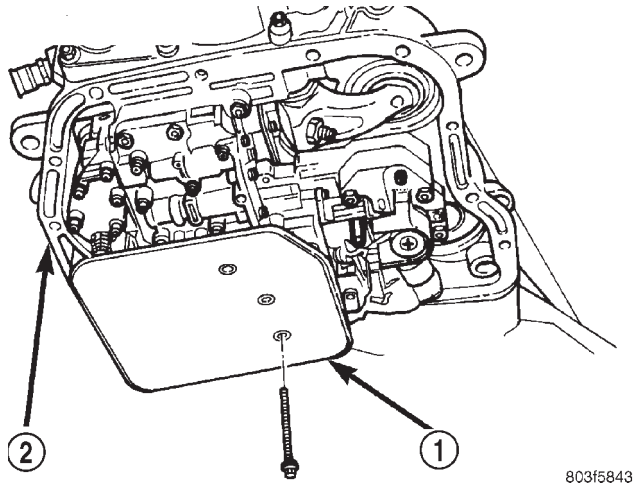


Fig. 66 Transmission Filter–Typical

1 – FILTER
2 – TRANSMISSION

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. 66). 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. 65). Tighten bolts to 17 N·m (150 in. lbs.) torque.

(6) Install the transmission/skip plate.

(7) 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.

SERVICE PROCEDURES (Continued)

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

Measuring the oil pump output volume will determine if sufficient oil flow to the transmission oil cooler exists, and whether or not an internal transmission failure is present.

Verify that the transmission fluid is at the proper level. Refer to the Fluid Level Check procedure in this section. If necessary, fill the transmission to the proper level with Mopar® ATF+3, type 7176, Automatic Transmission Fluid.

(1) Disconnect the **To cooler** line at the cooler inlet and place a collecting container under the disconnected line.

CAUTION: With the fluid set at the proper level, fluid collection should not exceed (1) quart or internal damage to the transmission may occur.

(2) Run the engine **at curb idle speed**, with the shift selector in neutral.

(3) If one quart of transmission fluid is collected in the container in 20 seconds or less, oil pump flow volume is within acceptable limits. If fluid flow is intermittent, or it takes more than 20 seconds to collect one quart of fluid, refer to the Hydraulic Pressure tests in this section for further diagnosis.

(4) Re-connect the **To cooler** line to the transmission cooler inlet.

(5) Refill the transmission to proper level.

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 6906A Cooler Flusher.

CAUTION: The transmission oil cooler requires a two stage flushing procedure due to an internally mounted thermostat. Failure to follow the procedure can result in severe transmission damage.

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 6906A

(1) Remove cover plate filler plug on Tool 6906A. 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 6906A.

(3) Verify pump power switch is turned OFF. Connect red alligator clip to positive (+) battery post. Connect black (-) alligator clip to a good ground.

(4) Disconnect the cooler lines at the transmission.

NOTE: When flushing transmission cooler and lines, ALWAYS reverse flush.

NOTE: The converter drainback valve must be removed and an appropriate replacement hose installed to bridge the space between the transmission cooler line and the cooler fitting. Failure to remove the drainback valve will prevent reverse flushing the system. A suitable replacement hose can be found in the adapter kit supplied with the flushing tool.

(5) Connect the BLUE pressure line to the OUTLET (From) cooler line.

(6) Connect the CLEAR return line to the INLET (To) cooler line

(7) Remove the transmission oil cooler from the vehicle. Refer to the Group 7, Cooling System, for the proper procedures.

(8) Remove the transmission oil cooler thermostat. Refer to the Group 7, Cooling System, for the proper procedures.

(9) Re-install the thermostat cover onto the oil cooler and install the snap ring.

SERVICE PROCEDURES (Continued)

(10) Re-connect the oil cooler to the transmission cooler lines.

(11) Turn pump ON for two to three minutes to flush cooler(s) and lines.

NOTE: This flushes the bypass circuit of the cooler only.

(12) Turn pump OFF.

(13) Remove the thermostat cover from the oil cooler.

(14) Install Special Tool Cooler Plug 8414 into the transmission oil cooler.

(15) Turn pump ON for two to three minutes to flush cooler(s) and lines.

NOTE: This flushes the main oil cooler core passages only.

(16) Turn pump OFF.

(17) Remove the thermostat cover from the oil cooler.

(18) Remove Special Tool Cooler Plug 8414 from the transmission oil cooler.

(19) Install a new thermostat spring, thermostat, cover, and snap-ring into the transmission oil cooler.

(20) Install the transmission oil cooler onto the vehicle.

(21) Disconnect CLEAR suction line from reservoir at cover plate. Disconnect CLEAR return line at cover plate, and place it in a drain pan.

(22) Turn pump ON for 30 seconds to purge flushing solution from cooler and lines. Turn pump OFF.

(23) Place CLEAR suction line into a one quart container of Mopar® ATF Plus 3, type 7176 automatic transmission fluid.

(24) 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.

(25) 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.

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 left in place. To avoid damage, remove the sensor before removing the transmission.

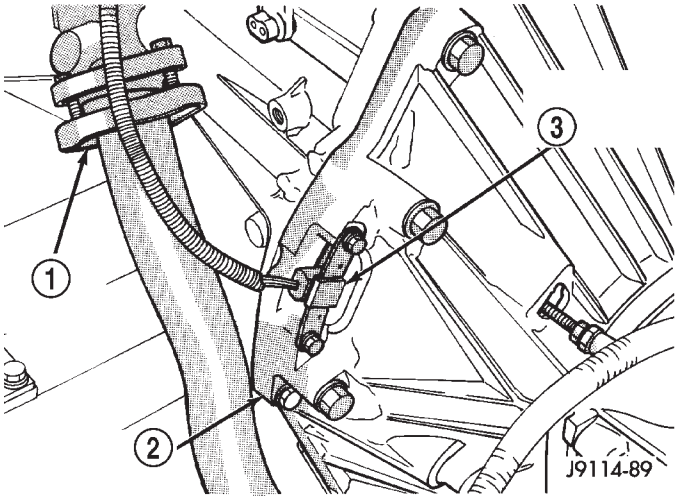


Fig. 67 Crankshaft Position Sensor—2.5L Engine

1 – EXHAUST DOWN PIPE
2 – TRANSMISSION HOUSING
3 – CRANKSHAFT POSITION SENSOR

(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.

(10) Remove fill tube bracket bolts and pull tube out of transmission. Retain fill tube seal. Remove the

REMOVAL AND INSTALLATION (Continued)

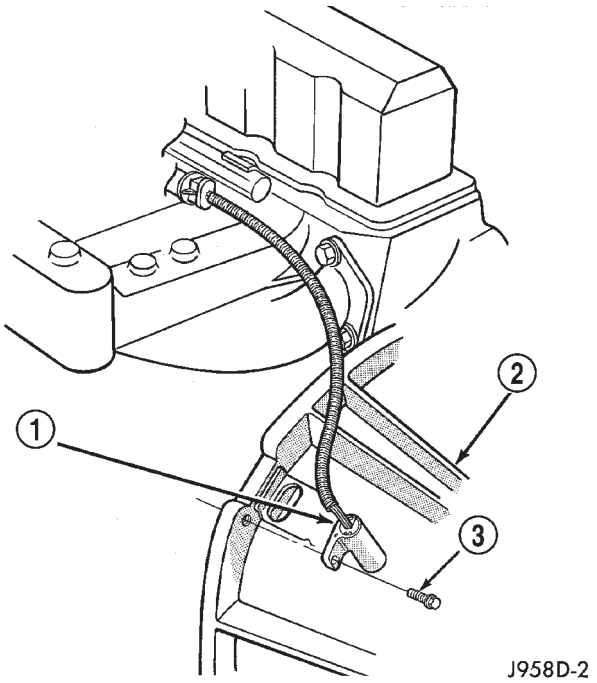


Fig. 68 Crankshaft Position Sensor—4.0L Engine

1 – CRANKSHAFT POSITION SENSOR
2 – TRANSMISSION BELLHOUSING
3 – MOUNTING BOLT

bolt attaching transfer case vent tube to converter housing.

(11) 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.

(12) Mark propeller shaft and axle yokes for assembly alignment. Then disconnect and remove propeller shafts.

(13) Disconnect wires from park/neutral position switch and vehicle speed sensor.

(14) Disconnect gearshift cable from transmission manual valve lever.

(15) Disconnect throttle valve cable from transmission bracket and throttle valve lever.

(16) Disconnect shift rod from transfer case shift lever or remove shift lever from transfer case.

(17) Support rear of engine with safety stand or jack.

(18) Raise transmission slightly with service jack to relieve load on crossmember and supports.

(19) Remove bolts securing rear support and cushion to transmission and crossmember. Raise transmission slightly, slide exhaust hanger arm from bracket and remove rear support.

(20) Remove bolts attaching crossmember to frame and remove crossmember.

(21) Disconnect transfer case vent hose. Then disconnect vacuum switch harness.

(22) Remove transfer case.

(23) Remove all converter housing bolts.

(24) Carefully work transmission and torque converter assembly rearward off engine block dowels.

(25) Hold torque converter in place during transmission removal.

(26) Lower transmission and remove assembly from under the vehicle.

(27) 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) Align converter and oil pump.

(4) Carefully insert converter in oil pump. Then rotate converter back and forth until fully seated in pump gears.

(5) Check converter seating with steel scale and straightedge (Fig. 69). Surface of converter lugs should be 1/2 in. to rear of straightedge when converter is fully seated.

(6) Temporarily secure converter with C-clamp.

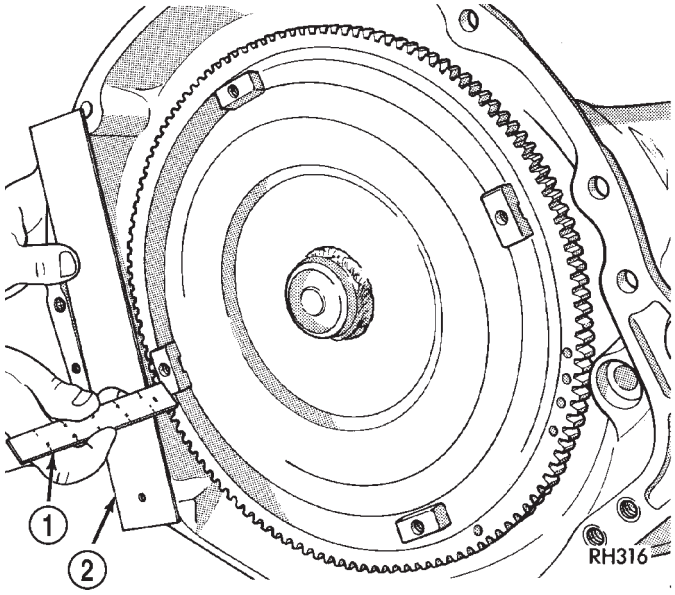


Fig. 69 Typical Method Of Checking Converter Seating

1 – SCALE
2 – STRAIGHTEDGE

(7) Lightly grease crankshaft flange hole.

(8) Position transmission on jack and secure it with safety chains.

REMOVAL AND INSTALLATION (Continued)

(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) Carefully work transmission forward and over engine block dowels until converter hub is seated in crankshaft.

(13) Install and tighten bolts that attach transmission converter housing to engine block (Fig. 70).

CAUTION: Be sure the converter housing is fully seated on the engine block dowels before tightening any bolts.

(14) 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

(15) Install crankshaft position sensor.

(16) Install transmission fill tube and seal. Install new fill tube seal in transmission before installation.

(17) Connect transmission cooler lines to transmission.

(18) Install transfer case onto transmission.

(19) Install rear crossmember and attach transmission rear support to crossmember.

(20) Remove engine support fixture.

(21) Remove transmission jack.

(22) Connect vehicle speed sensor wires.

(23) Connect wires to park/neutral position switch.

(24) Install crankshaft position sensor.

(25) Install converter housing access cover.

(26) Install exhaust pipes and support brackets, if removed.

(27) Install starter motor and cooler line bracket.

(28) 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.

(29) Connect gearshift and linkage and throttle cable.

(30) Connect transfer case shift linkage.

(31) Adjust gearshift linkage and throttle valve cable if necessary.

(32) Align and connect propeller shaft(s).

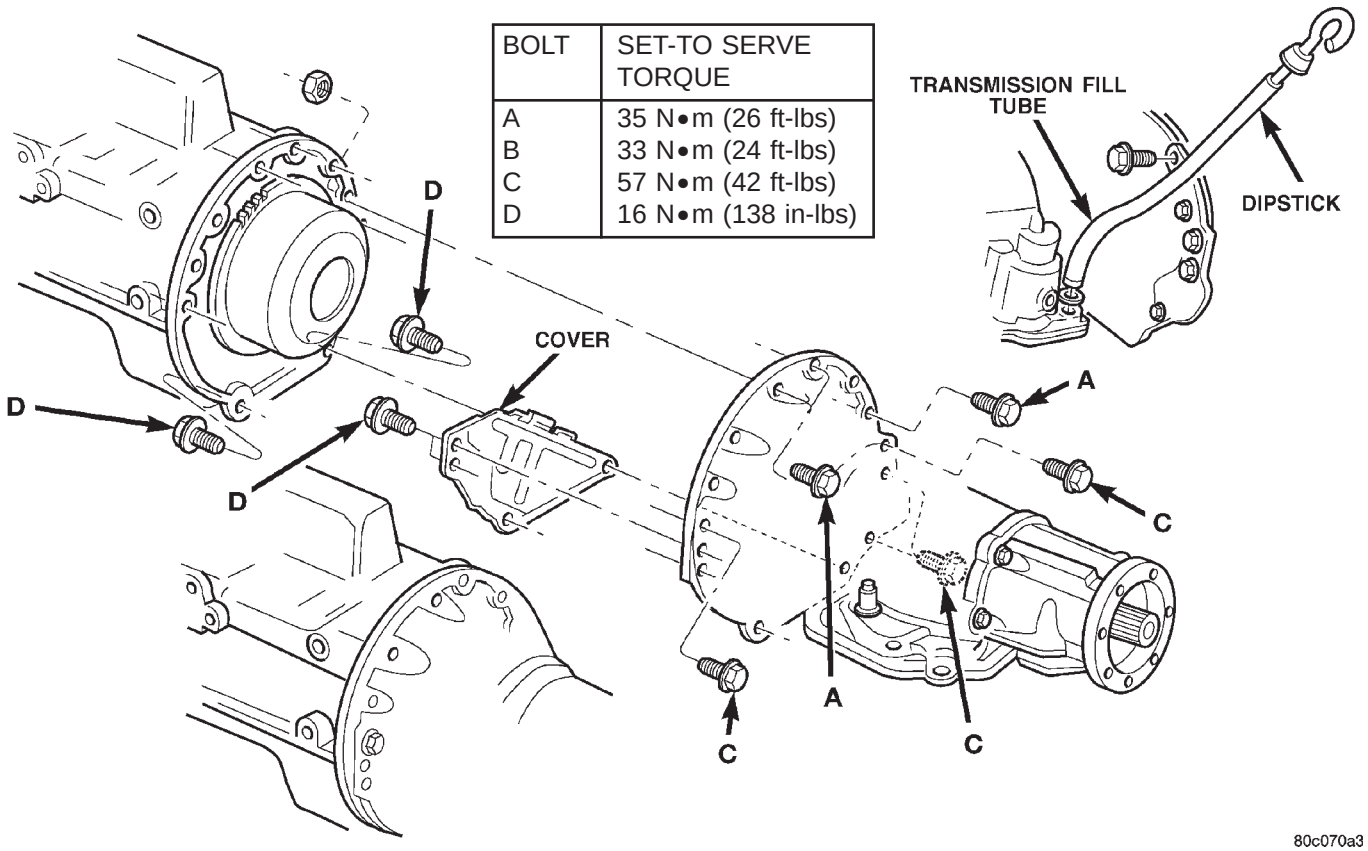


Fig. 70 Transmission Attachment

REMOVAL AND INSTALLATION (Continued)

(33) Install skid plate, rear cushion and bracket, if removed.

(34) Fill transfer case to bottom edge of fill plug hole.

(35) 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.

(6) Check converter seating with a scale and straightedge (Fig. 71). 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.

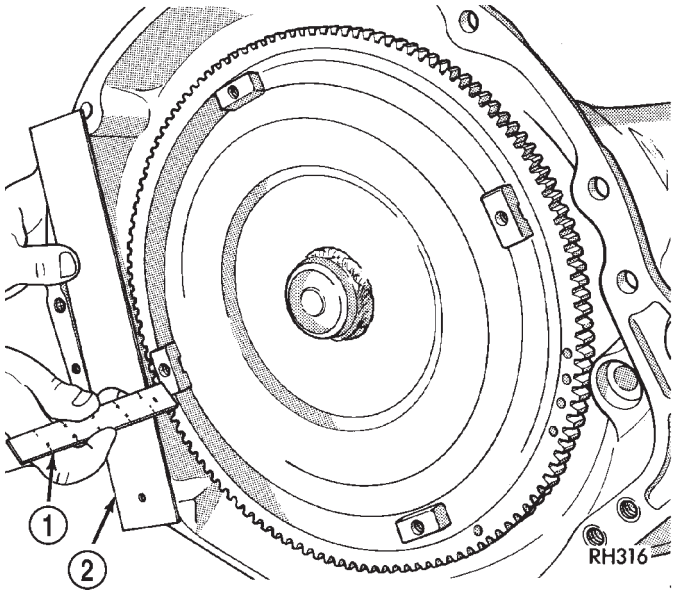


Fig. 71 Checking Torque Converter Seating

1 – SCALE
2 – STRAIGHTEDGE

ADAPTER 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 adapter housing to transmission case (Fig. 72).

(7) Separate adapter housing from transmission.

(8) Slide adapter housing rearward and off output shaft (Fig. 72).

INSTALLATION

Clear gasket material from sealing surfaces on adapter housing and rear of transmission. Replace output shaft bearing, if necessary.

(1) Install new rear seal in adapter housing. Use Tool Handle C-4171 and Seal Installer C-3860-A to install seal.

(2) Place adapter housing gasket in position on rear of transmission.

(3) Slide adapter housing forward and over output shaft (Fig. 72).

(4) Guide park shaft into park sprag and push adapter housing forward until rod passes through

REMOVAL AND INSTALLATION (Continued)

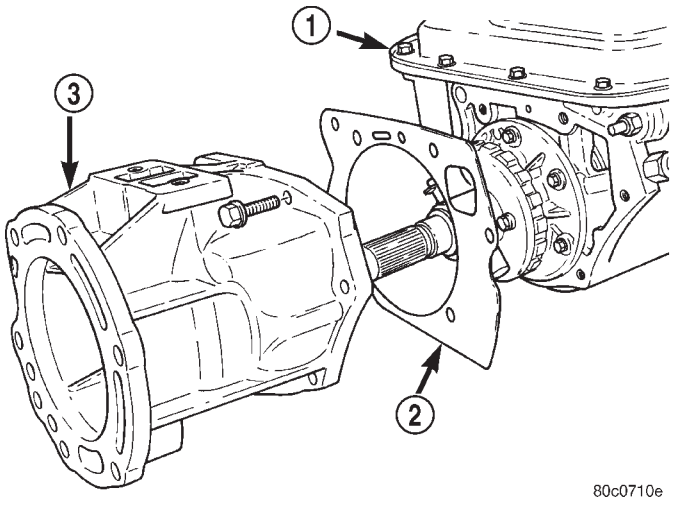


Fig. 72 Adapter Housing

1 – TRANSMISSION
2 – GASKET
3 – ADAPTER HOUSING

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 adapter 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. 73).

(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. 73). 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. 73).

ITEM	TORQUE
A	2-3 N·m (15-27 in. lbs.)
B	10-12 N·m (90-110 in. lbs.)

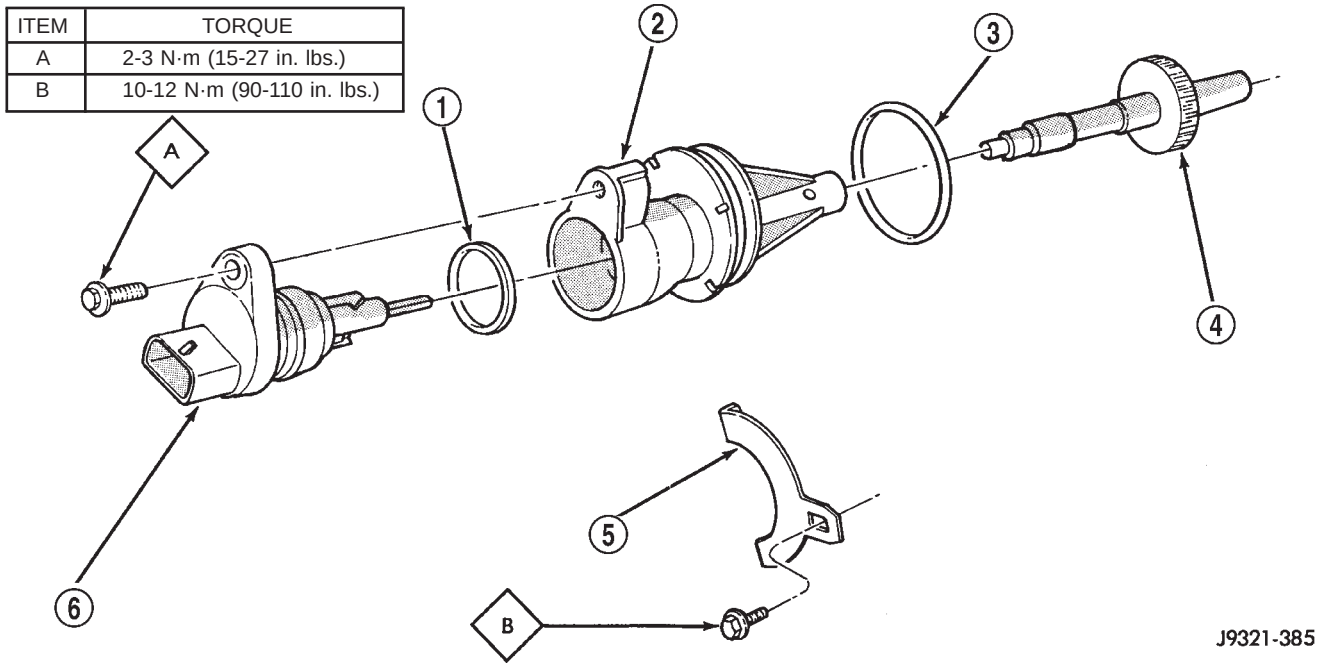


Fig. 73 Speedometer Pinion Adapter Components

1 – SENSOR O-RING
2 – SPEEDOMETER ADAPTER
3 – ADAPTER O-RING
4 – SPEEDOMETER PINION
5 – ADAPTER CLAMP
6 – VEHICLE SPEED SENSOR

REMOVAL AND INSTALLATION (Continued)

(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. 74). 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.

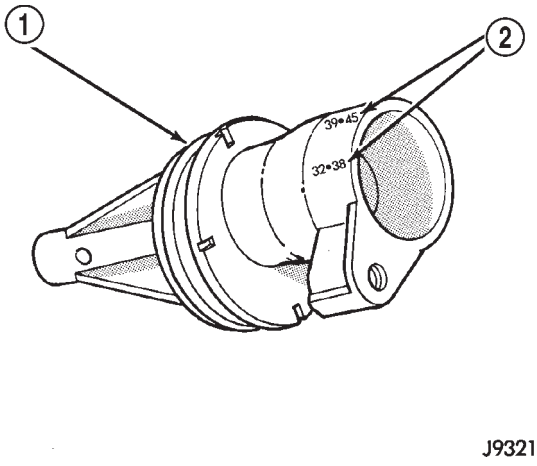


Fig. 74 Index Numbers On Speedometer Pinion Adapter

1 – SPEEDOMETER ADAPTER
2 – INDEX NUMBER LOCATION

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. 75).

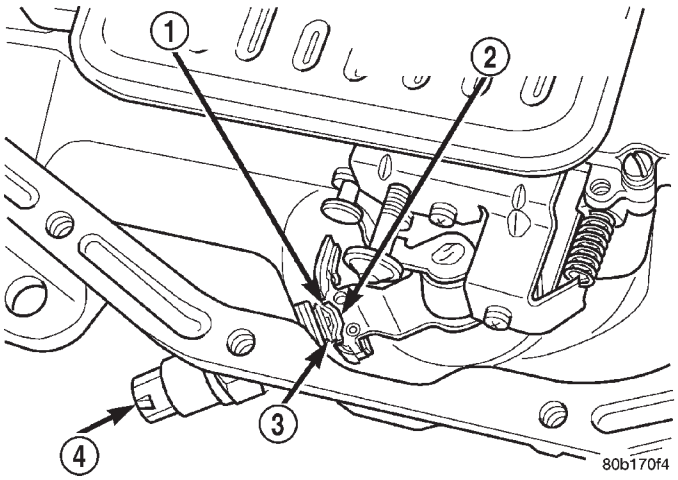


Fig. 75 Park/Neutral Position Switch

1 – NEUTRAL CONTACT
2 – MANUAL LEVER AND SWITCH PLUNGER IN REVERSE POSITION
3 – PARK CONTACT
4 – SWITCH

(2) Install new seal on switch and install switch in case. Tighten switch to 34 N·m (25 ft. lbs.) torque.

(3) Test continuity of new switch with 12V test lamp.

(4) Connect switch wires and lower vehicle.

(5) Top off transmission fluid level.

GEARSHIFT CABLE

REMOVAL

(1) Shift transmission into Park.

(2) Remove shift lever bezel and necessary console parts for access to shift lever assembly.

(3) Disconnect cable at shift lever and feed cable through dash panel opening to underside of vehicle.

(4) Raise vehicle.

(5) Disengage cable eyelet at transmission shift lever and pull cable adjuster out of mounting bracket. Then remove old cable from vehicle.

INSTALLATION

(1) Route cable through hole in dash panel. Fully seat cable grommet into dash panel.

(2) Place the auto transmission manual shift control lever in "Park" detent (rearmost) position and rotate prop shaft to ensure transmission is in park.

(3) Connect shift cable to shifter mechanism by snapping cable retaining ears into shifter bracket and press cable end fitting onto lever ball stud.

(4) Place the floor shifter lever in park position. Ensure that the pawl is seated within the confines of the adjustment gauge clip.

REMOVAL AND INSTALLATION (Continued)

(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. 76).

(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. 77).

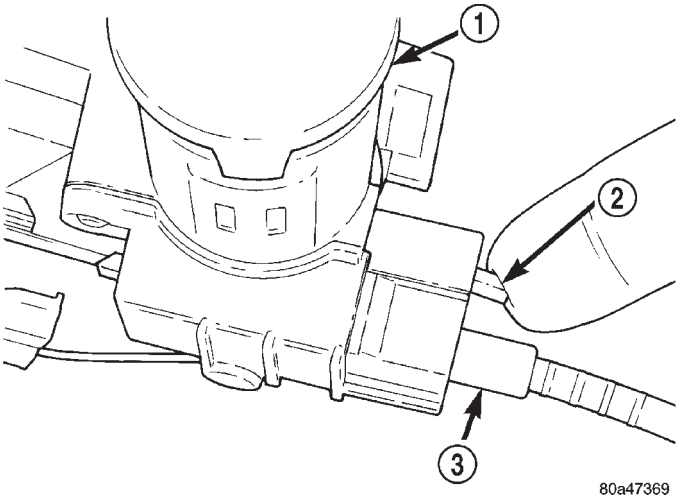


Fig. 76 Brake/Park Interlock Cable

1 – IGNITION LOCK
2 – LOCK TAB
3 – CABLE END

(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. 77).

(2) Insert cable end into opening in steering column hub under ignition lock. Push cable inward until lock tab engages.

(3) Connect the cable end eyelet onto shifter bellcrank pin.

(4) Place gear selector in PARK.

(5) Push the spring-loaded cable adjuster forward and snap cable into bracket.

(6) Adjust the brake transmission shifter interlock cable. Refer to the Adjustment portion of this section for proper procedures.

(7) Verify that the cable adjuster lock clamp is pushed downward to the locked position.

(8) Test the park-lock cable operation.

(9) Install the floor console and related trim.

(10) Install tie strap to hold cable to base of steering column.

(11) Install lower steering column shroud and ignition lock.

(12) Install lower steering column cover.

VALVE BODY

REMOVAL

(1) Raise vehicle.

(2) Remove oil pan and drain fluid.

(3) Loosen clamp bolts and remove throttle and manual valve levers from manual lever shaft.

(4) Remove park/neutral position switch.

(5) Remove filter from valve body.

(6) Depress retaining clip and pull solenoid wire from case connector (Fig. 78).

(7) Remove valve body attaching screws.

(8) Lower valve body enough to remove accumulator piston and piston spring (Fig. 79).

(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. 80).

INSTALLATION

(1) Verify that park/neutral position switch is **NOT** installed. Valve body cannot be installed with switch in place. Remove switch if necessary.

(2) Install new seals on accumulator piston if necessary, and install piston in case. Use small amount of petroleum jelly to hold piston in place.

(3) Place valve body manual lever in low (1 position) to ease inserting park rod into sprag.

(4) Use screwdriver to push park sprag into engagement with park gear. This makes clearance for knob on lock rod to move past sprag when valve body is installed. Rotate output shaft to verify sprag engagement.

REMOVAL AND INSTALLATION (Continued)

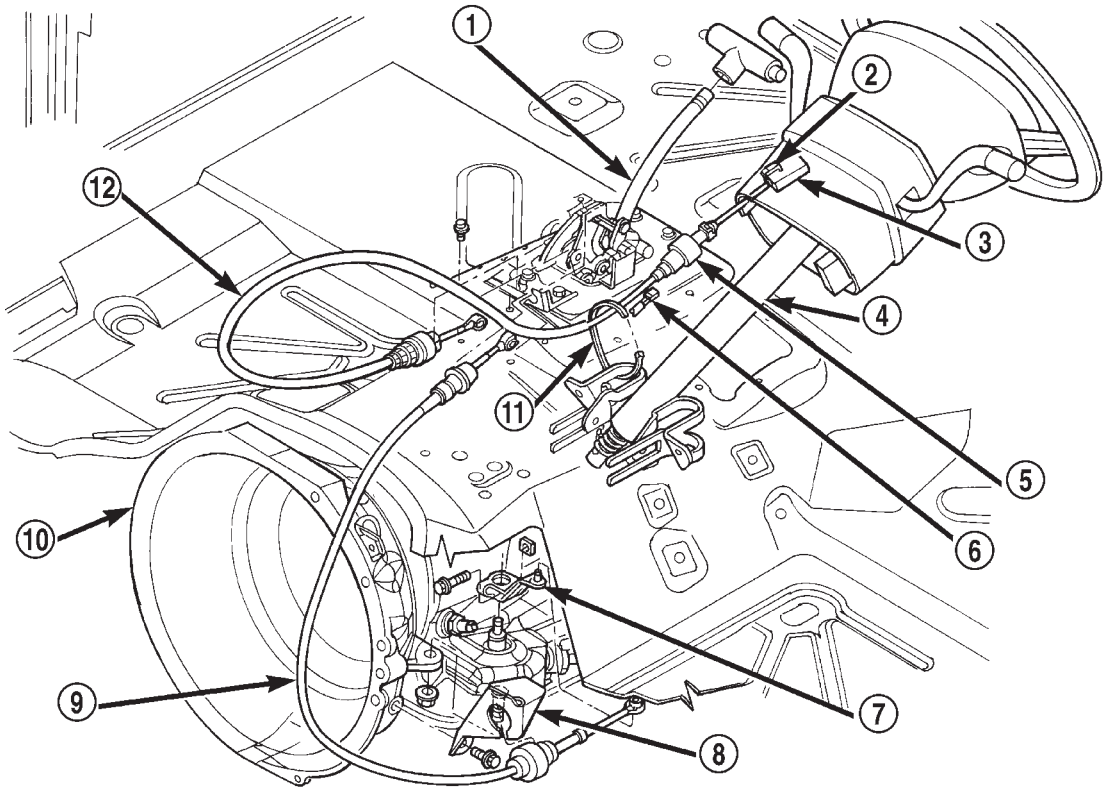


Fig. 77 Cable and Shifter

1 – SHIFT MECHANISM
2 – LOCK-TAB
3 – IGNITION LOCK INTERLOCK
4 – STEERING COLUMN
5 – SOLENOID
6 – WIRE CONNECTOR
7 – LEVER
8 – MOUNT BRACKET
9 – SHIFT CABLE
10 – AUTOMATIC TRANSMISSION
11 – TIE STRAP
12 – PARK/BRAKE INTERLOCK CABLE

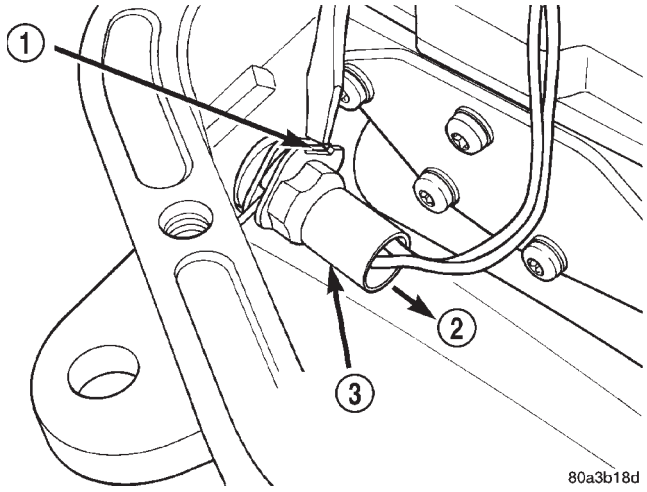


Fig. 78 Solenoid Wire Connector

1 – PUSH CLIP IN
2 – PULL
3 – CONVERTER CLUTCH SOLENOID CONNECTOR

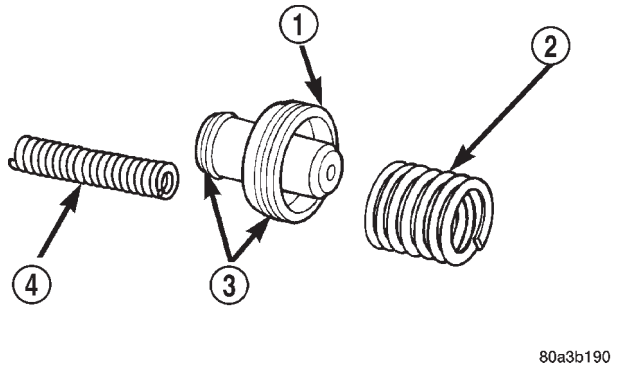


Fig. 79 Accumulator Piston And Springs

1 – ACCUMULATOR PISTON
2 – OUTER SPRING
3 – PISTON SEAL RINGS
4 – INNER SPRING (32RH)

(5) Position accumulator spring between accumulator piston and valve body.

REMOVAL AND INSTALLATION (Continued)

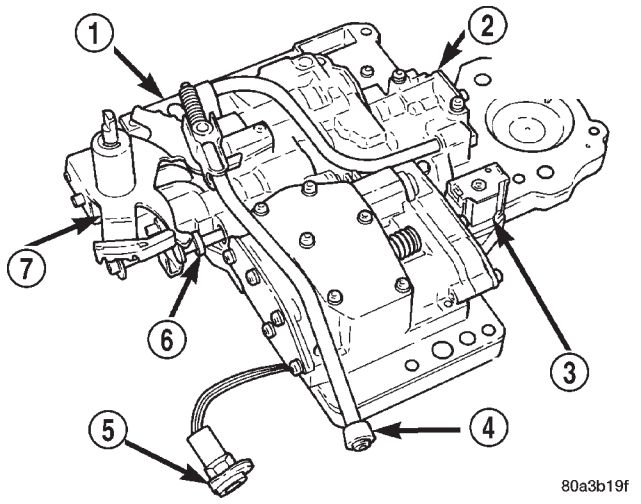


Fig. 80 Valve Body

1 – VALVE BODY
2 – CONVERTER CLUTCH MODULE
3 – SOLENOID
4 – PARK ROD
5 – CONVERTER CLUTCH SOLENOID CONNECTOR
6 – MANUAL VALVE
7 – MANUAL LEVER

(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. 81).

(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. 81).

(3) Install extension housing.

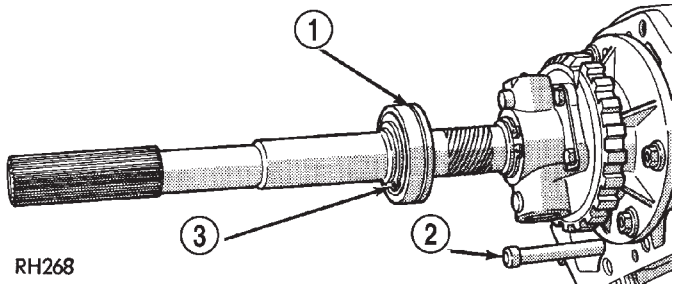


Fig. 81 Output Shaft Rear Bearing—Typical

1 – BEARING SNAP RING GROOVE
2 – PARK LOCK CONTROL ROD
3 – REAR SNAP RING

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. 82).

(10) Remove governor valve and shaft from governor body (Fig. 82).

(11) Remove snap rings and spacer that retain governor body and park gear assembly on output shaft (Fig. 83).

REMOVAL AND INSTALLATION (Continued)

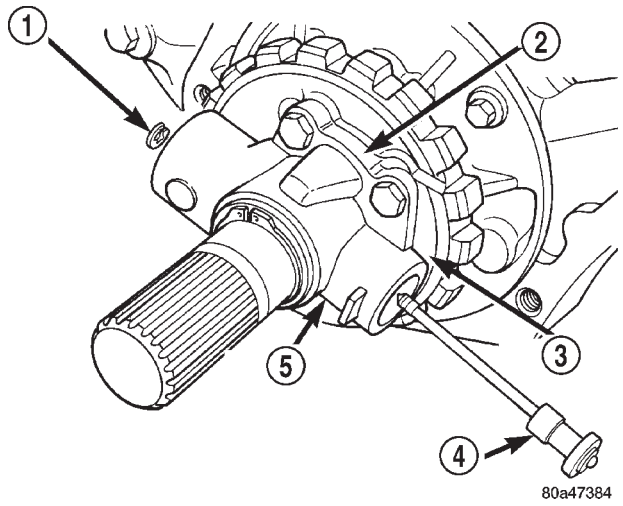


Fig. 82 Governor Valve

1 – E-CLIP
2 – PARK GEAR
3 – CURVER BOSS
4 – GOVERNOR VALVE
5 – GOVERNOR

(12) Remove bolts holding governor body to park gear (Fig. 84).

(13) Separate governor from park gear.

(14) Pull park gear from rear support.

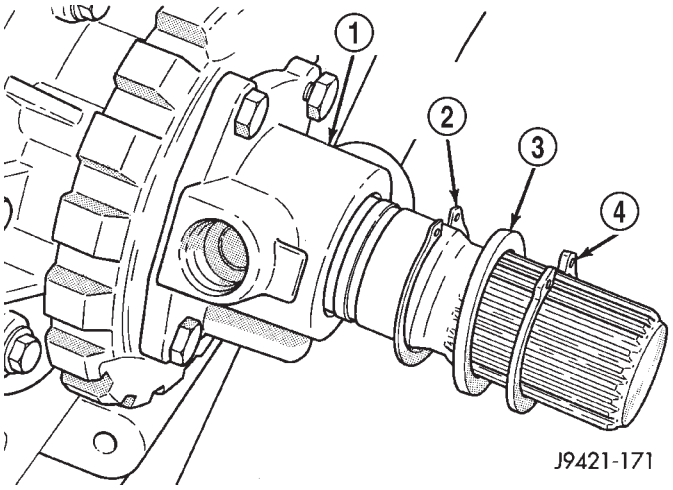


Fig. 83 Snap Rings And Spacer

1 – GOVERNOR BODY
2 – THIN SNAP RING
3 – THRUST WASHER
4 – THICK SNAP RING

INSTALLATION

(1) Install park gear into rear support so crown on curved boss is in line with hole through output shaft.

(2) Install governor filter in park gear.

(3) Slip governor body over output shaft and align port to filter.

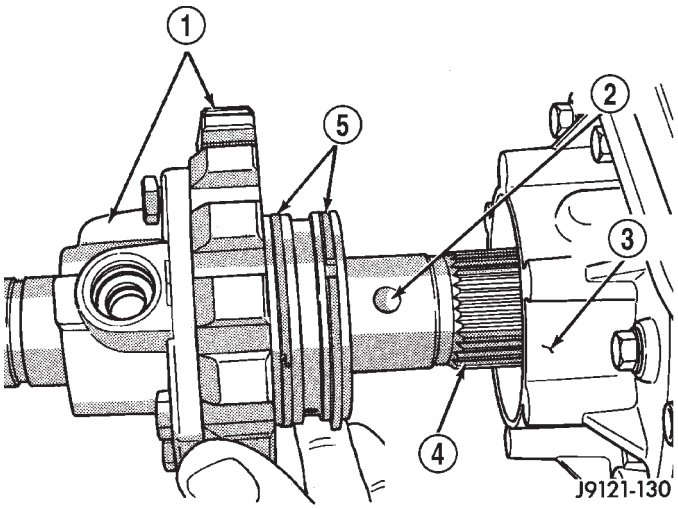


Fig. 84 Governor Body

1 – GOVERNOR/PARK GEAR ASSEMBLY
2 – GOVERNOR VALVE SHAFT BORE
3 – REAR SUPPORT
4 – OUTPUT SHAFT SPLINES
5 – SEAL RINGS

(4) Install bolts to hold governor body to park gear. Tighten bolts to 11 N·m (95 in. lbs.) torque (Fig. 84).

(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. 83).

(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. 82).

(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. 85).

(4) Remove snap ring and slide reaction plug and pin assembly out of housing.

REMOVAL AND INSTALLATION (Continued)

(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. 85).

(4) Position sprag and spring in housing and insert sprag shaft. Be sure square lug on sprag is toward park gear. Also be sure spring is positioned so it moves sprag away from gear.

(5) Install extension housing.

(6) Install propeller shaft and lower vehicle.

(7) Check transmission fluid level. Add fluid if necessary.

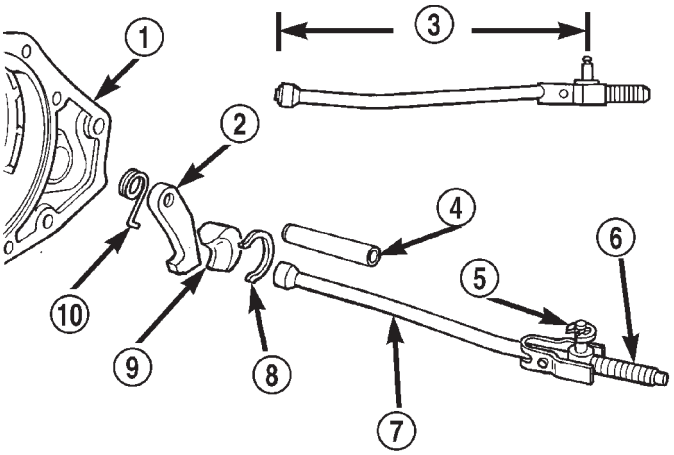


Fig. 85 Park Lock

1 – EXTENSION HOUSING
2 – SPRAG
3 – 8''
4 – SHAFT
5 – E-CLIP
6 – SPRING
7 – CONTROL ROD
8 – SNAP RING
9 – PLUG AND PIN
10 – SPRING

DISASSEMBLY AND ASSEMBLY

GOVERNOR AND PARK GEAR

DISASSEMBLY

(1) Remove governor body from transmission.

(2) Clean and inspect governor filter (Fig. 86).

(3) Remove snap ring and washer that secure governor weight assembly in body (Fig. 87).

(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. 88).

(7) Push inner weight downward with nut driver. Then remove inner weight snap ring with Miller Plier Tool 6823 (Fig. 88).

(8) Remove inner weight and spring from intermediate weight.

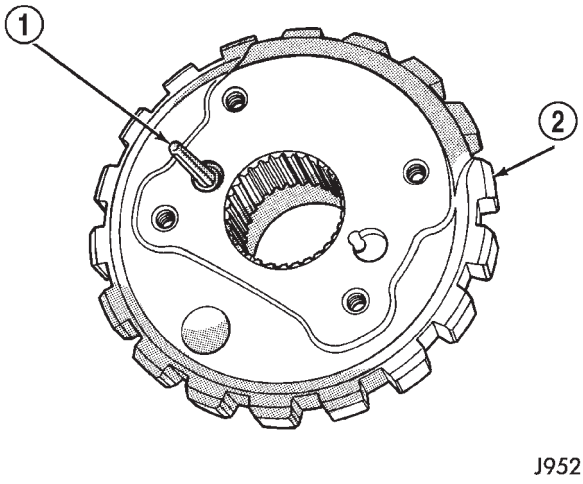


Fig. 86 Governor Filter

1 – GOVERNOR FILTER
2 – PARK GEAR

DISASSEMBLY AND ASSEMBLY (Continued)

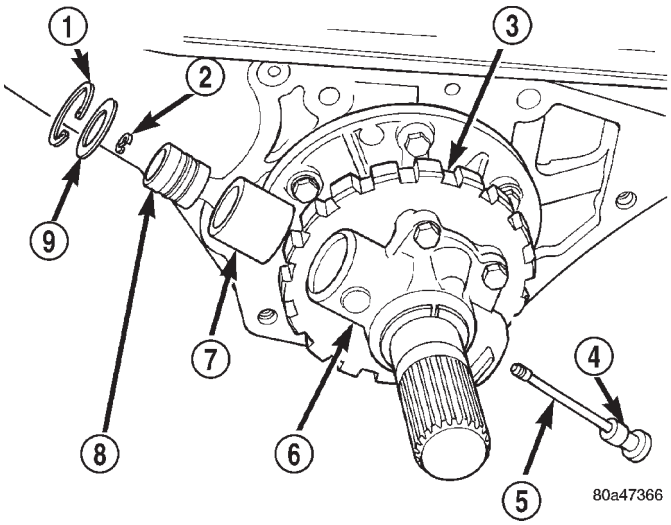


Fig. 87 Snap Ring, Washer, and Outer Weight

1 – SNAP-RING
2 – E-CLIP
3 – PARK GEAR
4 – GOVERNOR VALVE
5 – SHAFT
6 – GOVERNOR
7 – OUTER WEIGHT
8 – INTERMEDIATE WEIGHT
9 – WASHER

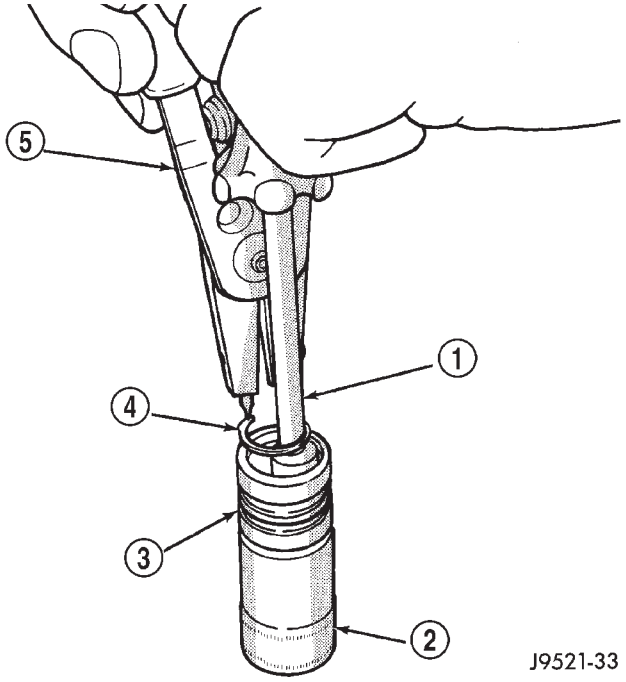


Fig. 88 Inner Weight Snap Ring

1 – NUT DRIVER
2 – SUITABLE SIZE SOCKET
3 – INTERMEDIATE WEIGHT
4 – INNER WEIGHT SNAP RING
5 – SPECIAL TOOL 6823

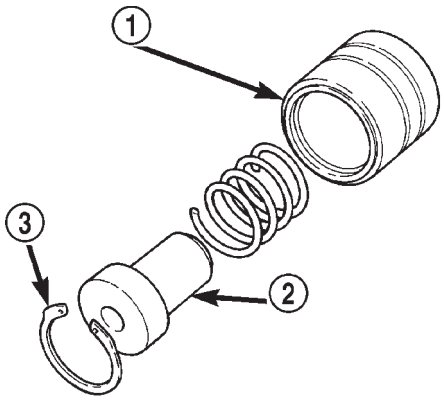


Fig. 89 Intermediate and Inner Governor Weights

1 – INTERMEDIATE WEIGHT
2 – INNER WEIGHT
3 – SNAP-RING

ASSEMBLY

CAUTION: Exercise care when installing the rings. They are easily broken if overspread or twisted during installation.

If it was necessary to remove the park gear, inspect the seal rings and bore in rear support. Install new seal rings on park gear hub only if original rings are damaged, or worn. Install ring with interlock ends first and ring with plain ends last. Slip each ring on hub and seat them in grooves. Verify that rear ring ends are securely interlocked before proceeding. If the bore in rear support is damaged, replace the rear support.

(1) Lubricate governor components with Mopar® ATF Plus 3, Type 7176 transmission fluid before assembly.

(2) Clean and inspect governor weights and bores for scoring or wear. Replace the governor body and weights if damaged. Refer to Cleaning and Inspection section of this group for proper procedure.

(3) Insert spring into intermediate weight.

(4) Insert inner weight into intermediate weight and install snap-ring (Fig. 89). Verify snap-ring is fully seated in groove in intermediate weight (Fig. 88).

(5) Assemble governor weights into governor body (Fig. 87).

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

CAUTION: Do not clamp any part of the valve body assembly (Fig. 90) 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. 91).

(3) Remove switch valve and spring, pressure regulator valve and spring, kickdown valve and spring, and throttle valve from valve body (Fig. 91).

(4) Secure detent ball and spring in housing with Retainer Tool 6583 (Fig. 92).

(5) Remove manual shaft E-clip, washer, and seal (Fig. 93).

(6) Pull manual shaft and park rod assembly upward out of valve body and off throttle lever (Fig. 93).

(7) Remove manual valve from valve body (Fig. 94)

(8) Remove Retainer Tool 6583. Then remove and retain detent ball and spring (Fig. 93).

(9) Remove throttle lever (Fig. 93).

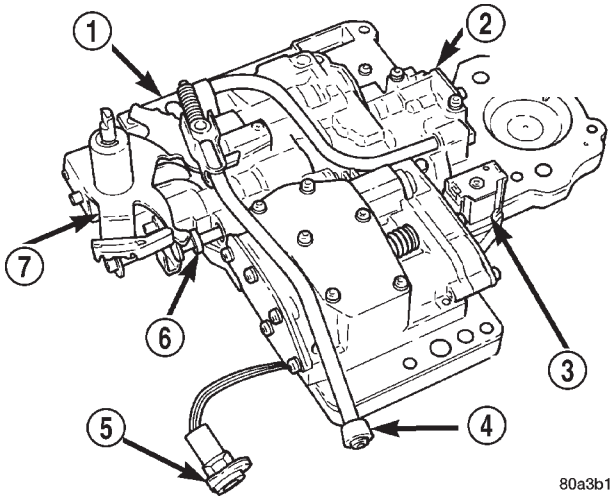


Fig. 90 Valve Body Assembly

1 – VALVE BODY
2 – CONVERTER CLUTCH MODULE
3 – SOLENOID
4 – PARK ROD
5 – CONVERTER CLUTCH SOLENOID CONNECTOR
6 – MANUAL VALVE
7 – MANUAL LEVER

(10) Remove park rod E-clip and separate rod from manual lever (Fig. 95).

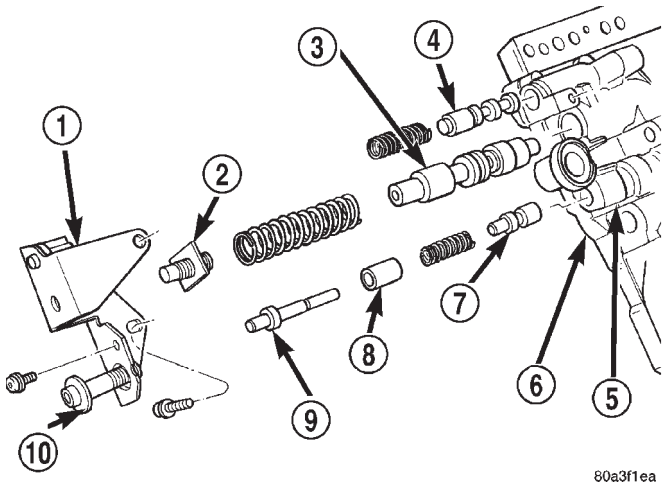


Fig. 91 Adjusting Screw Bracket, Springs, Valve Removal

1 – ADJUSTER BRACKET
2 – LINE PRESSURE ADJUSTER
3 – PRESSURE REGULATOR VALVE
4 – SWITCH VALVE
5 – VALVE BODY
6 – TRANSFER PLATE
7 – THROTTLE VALVE
8 – SLEEVE
9 – KICKDOWN VALVE
10 – THROTTLE PRESSURE ADJUSTER

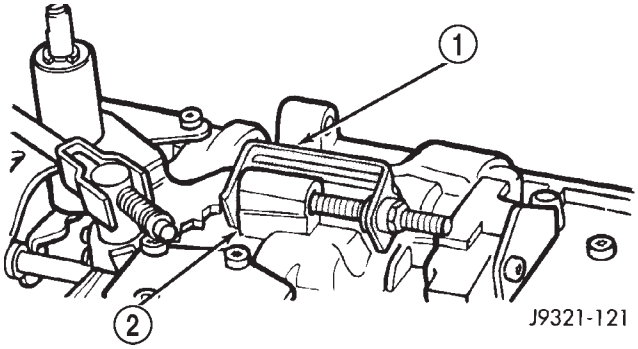


Fig. 92 Securing Detent Ball And Spring With Retainer Tool

1 – SPECIAL TOOL 6583
2 – DETENT BALL AND SPRING HOUSING

(11) Remove converter clutch solenoid from separator plate (Fig. 96). 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. 97).

(13) Remove screws attaching end cover plate to torque converter module (Fig. 98).

(14) Remove converter clutch valve, fail safe valve, and springs (Fig. 98)

DISASSEMBLY AND ASSEMBLY (Continued)

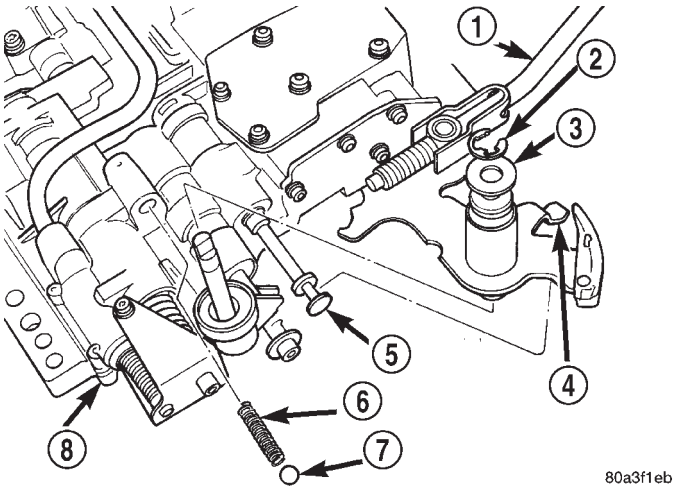


Fig. 93 Manual And Throttle Levers

1 – PARK ROD
2 – E-RING
3 – WASHER
4 – MANUAL LEVER
5 – MANUAL VALVE
6 – SPRING
7 – DETENT BALL
8 – VALVE BODY

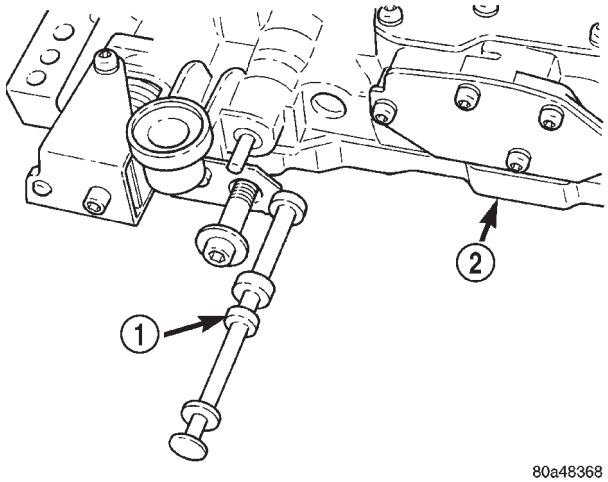


Fig. 94 Manual Valve

1 – MANUAL VALVE
2 – VALVE BODY

(15) Turn valve body over so transfer plate is facing upward (Fig. 99). 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. 99).

(17) Remove transfer plate and separator plate from valve body (Fig. 99). 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.

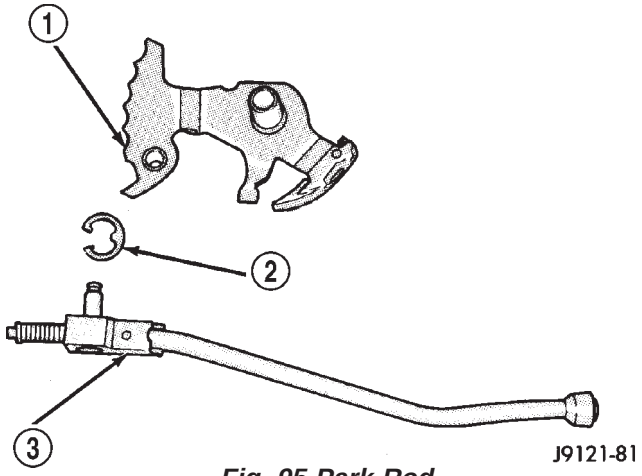


Fig. 95 Park Rod

1 – MANUAL LEVER
2 – E-CLIP
3 – PARK ROD

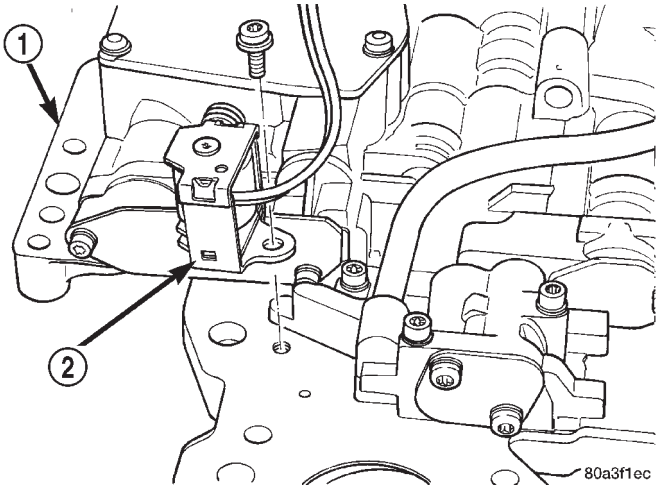


Fig. 96 Converter Clutch Solenoid

1 – VALVE BODY
2 – TORQUE CONVERTER CLUTCH SOLENOID

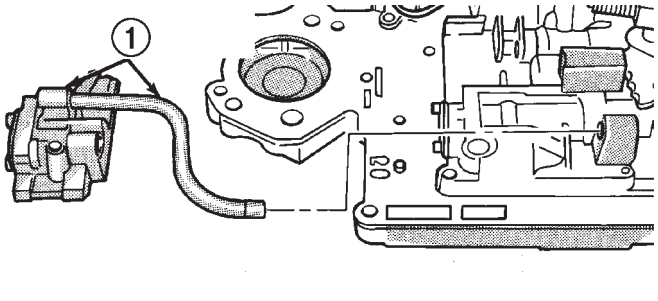


Fig. 97 Clutch Module And Connecting Tube

1 – MODULE AND CONNECTING TUBE

DISASSEMBLY AND ASSEMBLY (Continued)

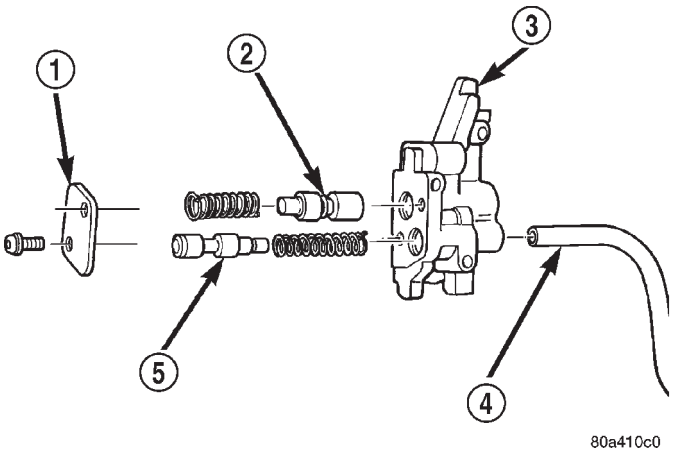


Fig. 98 Converter Clutch and Fail Safe Valves

1 – COVER PLATE
2 – CONVERTER CLUTCH VALVE
3 – TORQUE CONVERTER CLUTCH MODULE
4 – MODULE CONNECTING TUBE
5 – FAIL-SAFE VALVE

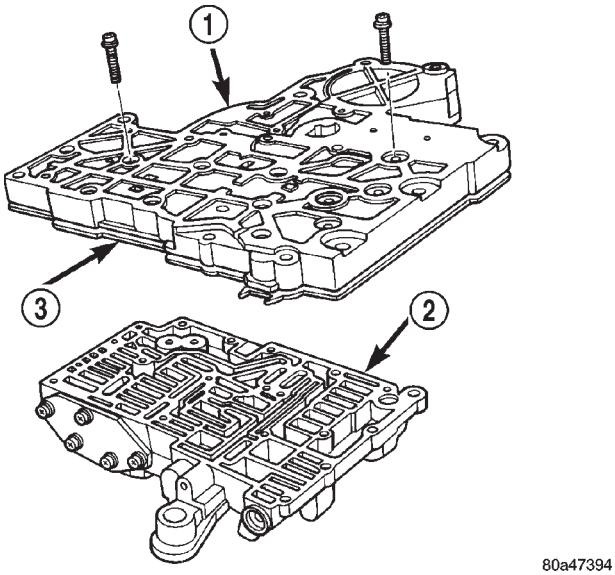


Fig. 99 Valve Body Transfer Plate Screws

1 – TRANSFER PLATE
2 – VALVE BODY
3 – SEPARATOR PLATE

(19) Remove screws attaching separator plate to transfer plate (Fig. 100).

(20) Note position of filter, rear clutch servo and rear servo check balls for assembly reference (Fig. 100) and (Fig. 101).

(21) Remove shuttle valve end plate (Fig. 102).

(22) Remove shuttle valve E-clip and remove secondary spring and spring guides from end of valve (Fig. 103).

(23) Remove governor plug end plate (Fig. 104).

(24) Remove 1-2 and 2-3 shift valve governor plugs from valve body (Fig. 104).

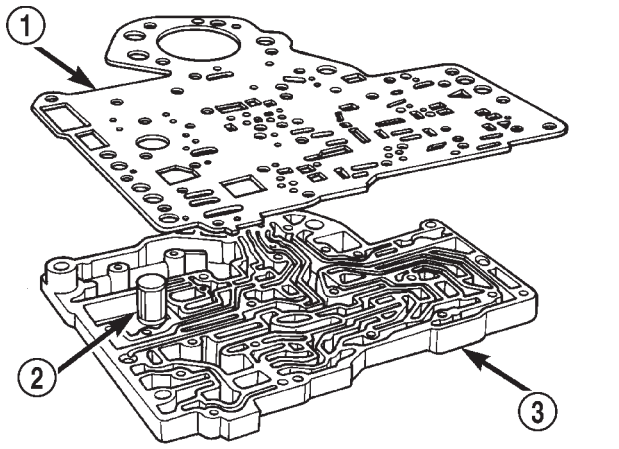


Fig. 100 Transfer And Separator Plates

1 – SEPARATOR PLATE
2 – FILTER
3 – TRANSFER PLATE

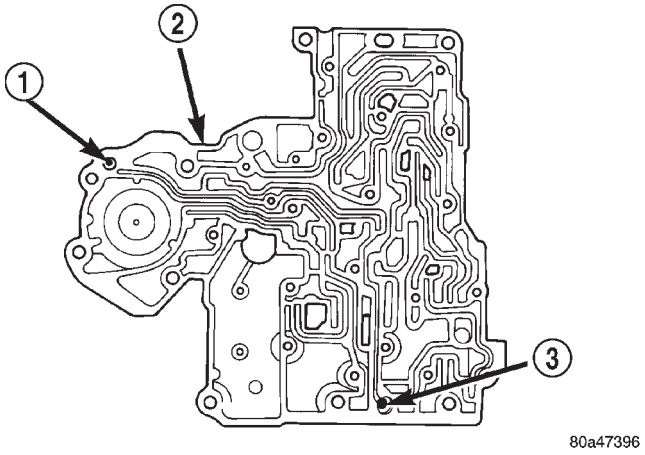


Fig. 101 Rear Servo and Rear Clutch Check Balls

1 – REAR SERVO CHECK BALL
2 – TRANSFER PLATE
3 – REAR CLUTCH CHECK BALL

(25) Remove shuttle valve throttle plug, primary spring and shuttle valve from valve body (Fig. 104).

(26) Remove screws attaching kickdown limit valve body to valve body (Fig. 104).

(27) Remove 1-2 shift control valve and spring from valve body (Fig. 104).

(28) Remove 2-3 shift valve and spring from valve body (Fig. 104).

(29) Remove 1-2 shift valve and spring from valve body (Fig. 104).

(30) Remove throttle pressure plug from kickdown limit valve body (Fig. 104).

(31) Remove retainer from end of kickdown limit valve body (Fig. 104).

(32) Remove kickdown limit valve and spring from kickdown limit valve body (Fig. 104).

DISASSEMBLY AND ASSEMBLY (Continued)

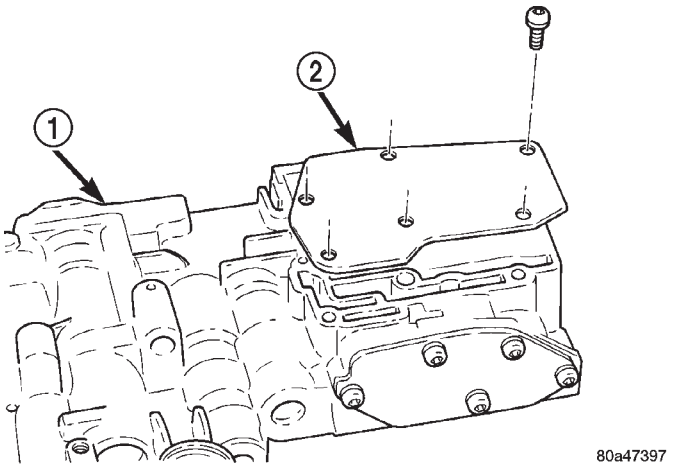


Fig. 102 Shuttle Valve End Plate

1 – VALVE BODY
2 – SHUTTLE VALVE END PLATE

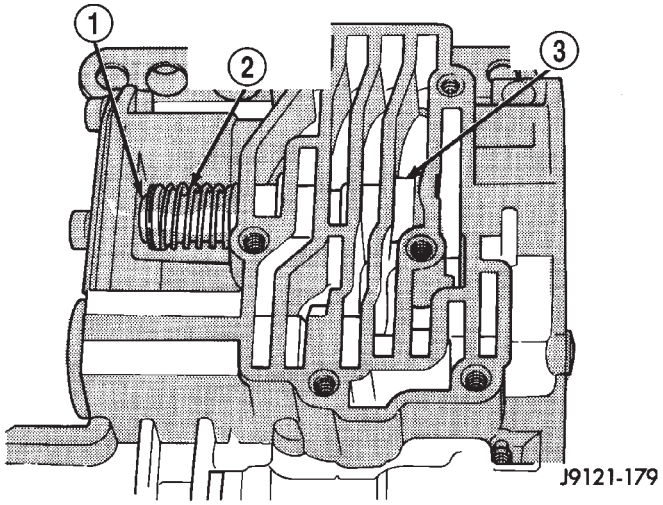


Fig. 103 Shuttle Valve E-Clip And Secondary Spring

1 – E-CLIP
2 – SECONDARY SPRING AND GUIDES
3 – SHUTTLE VALVE

(33) Remove regulator valve end plate from valve body (Fig. 104).

(34) Remove regulator valve line pressure plug, pressure plug sleeve, regulator valve throttle pressure plug and spring (Fig. 104).

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.

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. 104). Verify valve components slide freely.

(3) Install regulator valve end plate on valve body (Fig. 104).

(4) Install kickdown limit valve and spring in kickdown limit valve body (Fig. 104). 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. 104).

(7) Install throttle pressure plug in kickdown limit valve body (Fig. 104).

(8) Install 1-2 shift valve and spring into valve body (Fig. 104).

(9) Install 2-3 shift valve and spring into valve body (Fig. 104).

(10) Install 1-2 shift control valve and spring into valve body (Fig. 104).

(11) Verify valve components slide freely.

(12) Place kickdown limit valve body and end plate in position on valve body and compress springs (Fig. 104).

(13) Install screws to attach kickdown limit valve body to valve body (Fig. 104).

(14) Install shuttle valve throttle plug, primary spring and shuttle valve into valve body (Fig. 104). Verify valve components slide freely.

(15) Install 1-2 and 2-3 shift valve governor plugs into valve body (Fig. 104). 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. 104).

DISASSEMBLY AND ASSEMBLY (Continued)

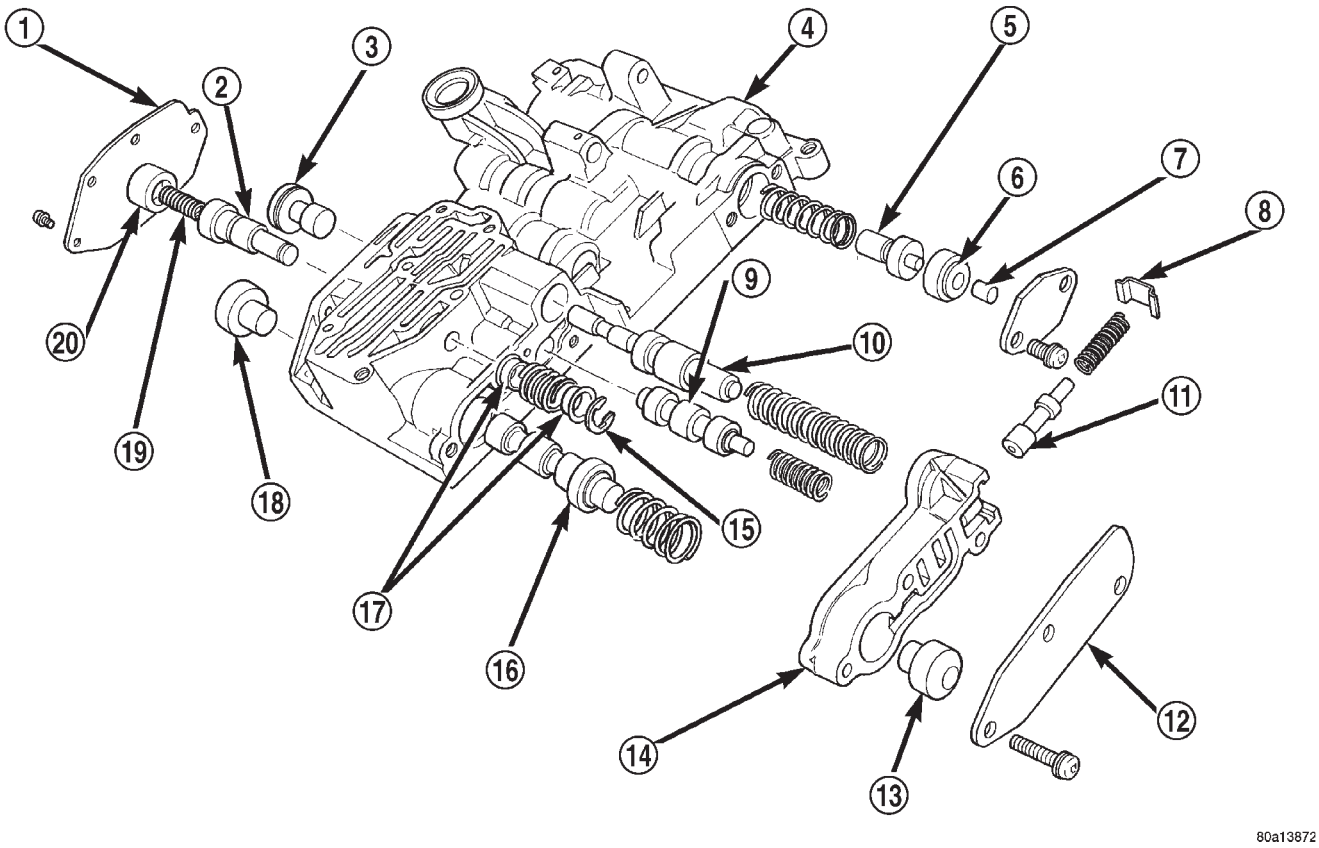


Fig. 104 Control Valves, Shift Valves, And Governor Plugs

1 – GOVERNOR PLUG END PLATE
2 – SHUTTLE VALVE
3 – 1–2 GOVERNOR PLUG
4 – VALVE BODY
5 – REGULATOR VALVE THROTTLE PRESSURE PLUG
6 – SLEEVE
7 – LINE PRESSURE PLUG
8 – RETAINER
9 – 1–2 SHIFT VALVE
10 – 1–2 SHIFT CONTROL VALVE
11 – KICKDOWN LIMIT VALVE
12 – END PLATE
13 – THROTTLE PRESSURE PLUG
14 – KICKDOWN LIMIT VALVE BODY
15 – E-RING
16 – 2–3 SHIFT VALVE
17 – GUIDES
18 – 2–3 GOVERNOR PLUG
19 – PRIMARY SPRING
20 – SHUTTLE VALVE THROTTLE PLUG

DISASSEMBLY AND ASSEMBLY (Continued)

(18) Assemble shuttle valve spring and guides (Fig. 104). Place spring and guides in position on shuttle valve stem.

(19) Compress spring and install E-clip in groove on shuttle valve stem (Fig. 105).

(20) Place shuttle valve end plate in position on valve body (Fig. 106).

(21) Install screws to attach shuttle valve end plate to valve body (Fig. 106).

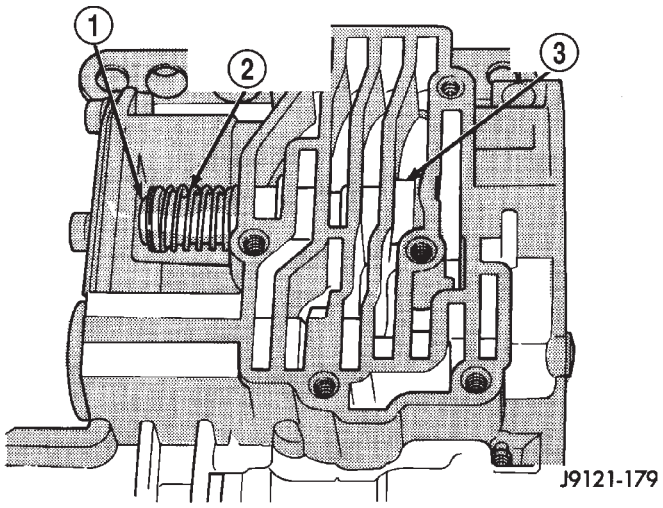


Fig. 105 Shuttle Valve E-Clip And Secondary Spring

1 – E-CLIP
2 – SECONDARY SPRING AND GUIDES
3 – SHUTTLE VALVE

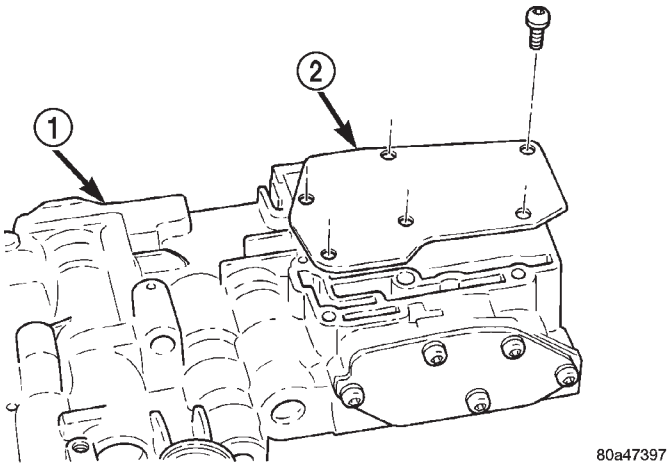


Fig. 106 Shuttle Valve End Plate

1 – VALVE BODY
2 – SHUTTLE VALVE END PLATE

(22) Install rear clutch servo and rear servo check balls in proper cavities in transfer plate (Fig. 107).

(23) Insert filter into opening in separator plate (Fig. 108).

(24) Place separator plate in position on transfer plate and install screws to attach separator plate to transfer plate (Fig. 108).

(25) Place one 11/32 in. check ball and six 1/4 in. check balls in the proper cavities in the valve body (Fig. 109).

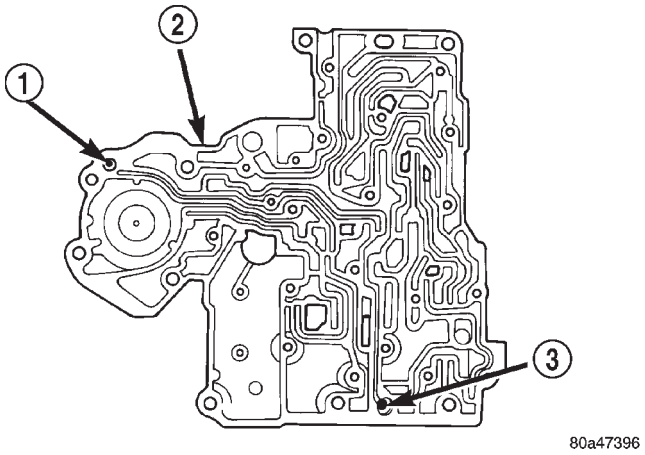


Fig. 107 Rear Servo and Rear Clutch Check Balls

1 – REAR SERVO CHECK BALL
2 – TRANSFER PLATE
3 – REAR CLUTCH CHECK BALL

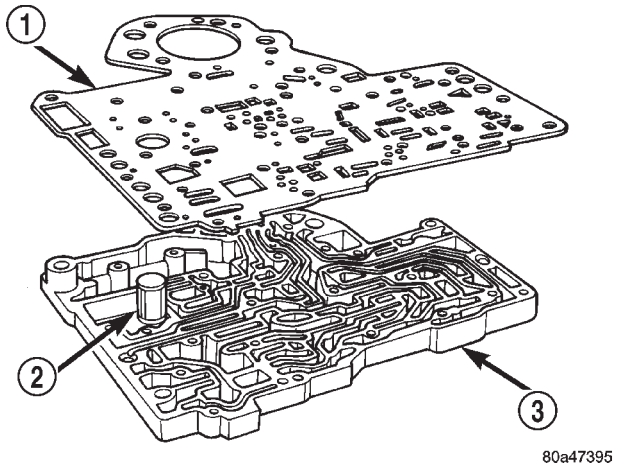


Fig. 108 Transfer And Separator Plates

1 – SEPARATOR PLATE
2 – FILTER
3 – TRANSFER PLATE

(26) Place transfer plate in position on valve body (Fig. 110).

(27) Install screws to attach transfer plate to valve body (Fig. 110).

(28) Turn valve body over to expose the separator plate.

(29) Insert converter clutch valve and spring into converter clutch valve module (Fig. 111). Verify valve components slide freely.

DISASSEMBLY AND ASSEMBLY (Continued)

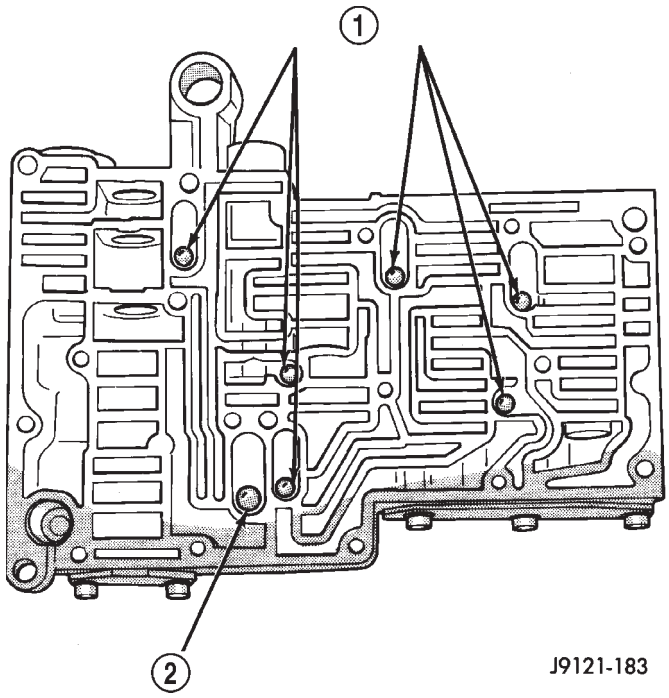


Fig. 109 Correct Position Of Valve Body Check Balls

1 – 1/4'' CHECK BALLS (6)
2 – 11/32'' CHECK BALL (1)

(30) Insert spring and fail-safe valve into converter clutch valve module (Fig. 111). Verify valve components slide freely.

(31) Place cover plate in position on converter clutch valve module (Fig. 111).

(32) Install screws to attach cover to converter clutch valve module (Fig. 111).

(33) Insert connecting tube into converter clutch valve module (Fig. 111).

(34) Insert connecting tube into valve body opening (Fig. 112).

(35) Place converter clutch valve module in position on separator plate. Install screws to attach converter clutch module to valve body (Fig. 112).

(36) If necessary, install a new O-ring on converter clutch solenoid (Fig. 113).

(37) Insert converter clutch solenoid into transfer plate (Fig. 113).

(38) Install screw to attach solenoid to transfer plate (Fig. 113).

(39) If necessary, insert park rod end into manual lever and install E-clip (Fig. 114).

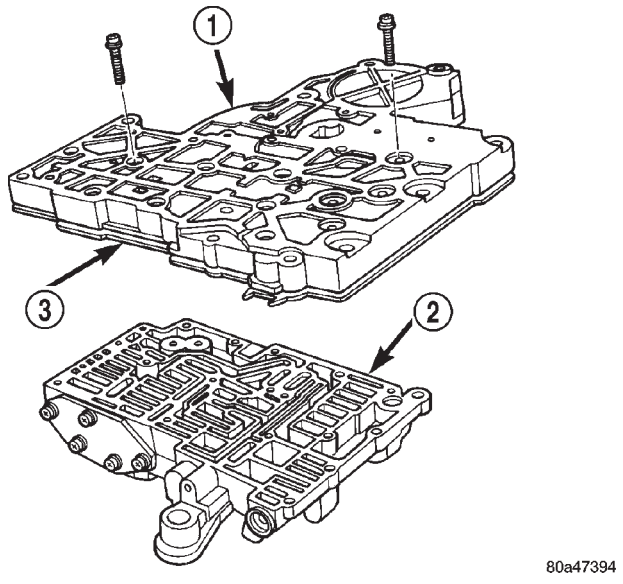


Fig. 110 Valve Body Transfer Plate Screws

1 – TRANSFER PLATE
2 – VALVE BODY
3 – SEPARATOR PLATE

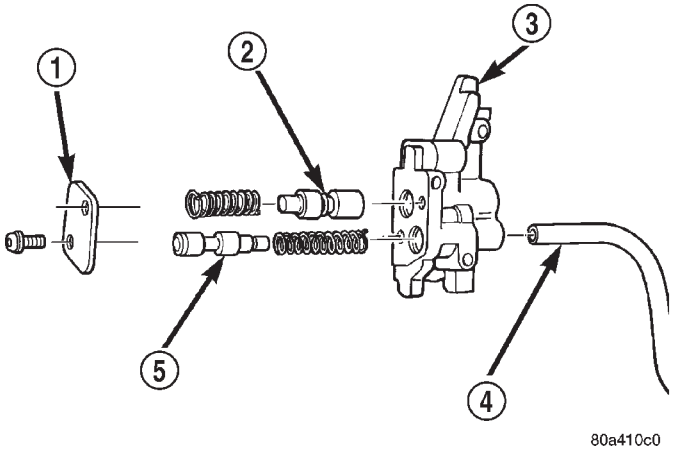


Fig. 111 Converter Clutch Valve Module

1 – COVER PLATE
2 – CONVERTER CLUTCH VALVE
3 – TORQUE CONVERTER CLUTCH MODULE
4 – MODULE CONNECTING TUBE
5 – FAIL-SAFE VALVE

DISASSEMBLY AND ASSEMBLY (Continued)

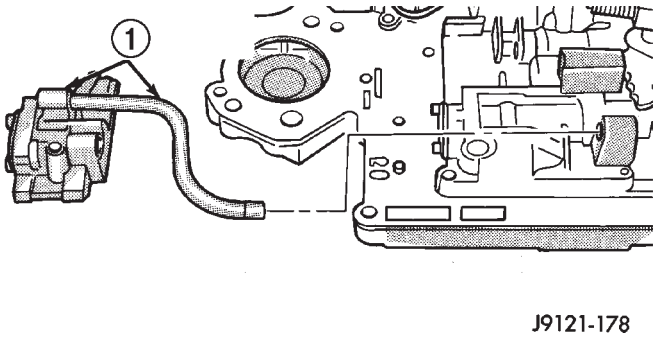


Fig. 112 Clutch Module And Connecting Tube

1 – MODULE AND CONNECTING TUBE

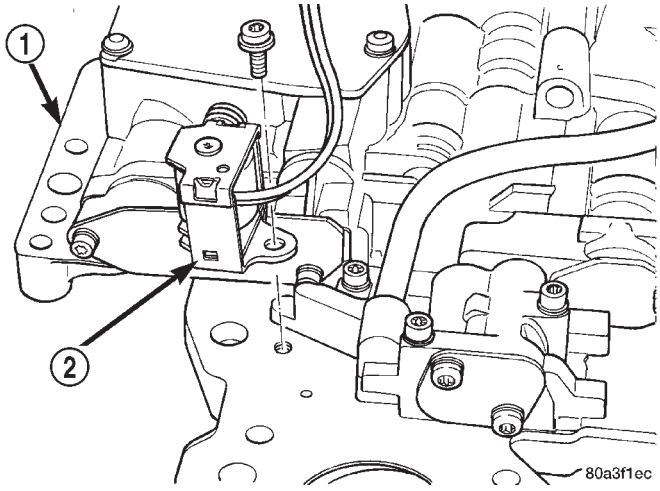


Fig. 113 Converter Clutch Solenoid

1 – VALVE BODY
2 – TORQUE CONVERTER CLUTCH SOLENOID

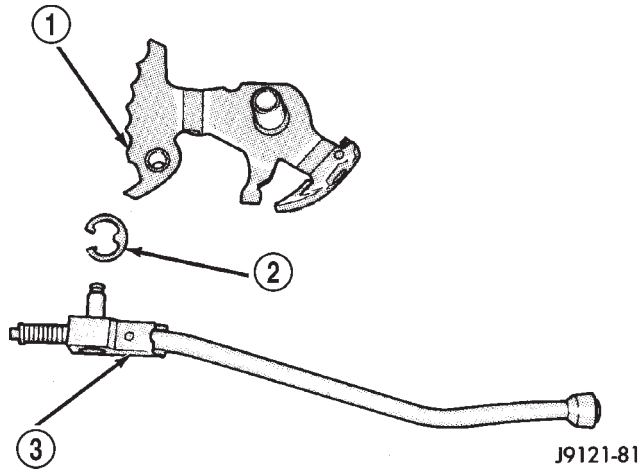


Fig. 114 Park Rod

1 – MANUAL LEVER
2 – E-CLIP
3 – PARK ROD

(40) Insert detent spring and ball into opening in valve body and install Retainer Tool 6583 (Fig. 115).

(41) Install manual valve into valve body (Fig. 116).

(42) Insert throttle lever through transfer plate side of valve body and upward (Fig. 117).

(43) Insert throttle lever into groove in manual valve (Fig. 118).

(44) Install seal, washer, and E-clip to retain manual shaft to valve body (Fig. 117).

(45) Install switch valve and spring, pressure regulator valve and spring, kickdown valve and spring, and throttle valve into valve body (Fig. 119).

(46) Place adjusting screw bracket and line pressure adjusting screw in position on valve body and compress springs (Fig. 91).

(47) Install screws to attach adjuster bracket to valve body.

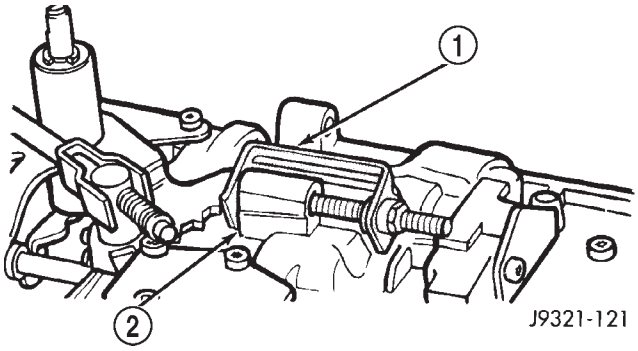


Fig. 115 Securing Detent Ball And Spring With Retainer Tool

1 – SPECIAL TOOL 6583
2 – DETENT BALL AND SPRING HOUSING

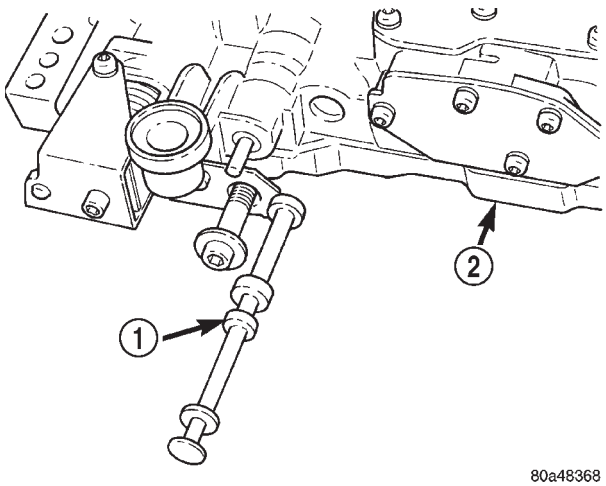


Fig. 116 Manual Valve

1 – MANUAL VALVE
2 – VALVE BODY

DISASSEMBLY AND ASSEMBLY (Continued)

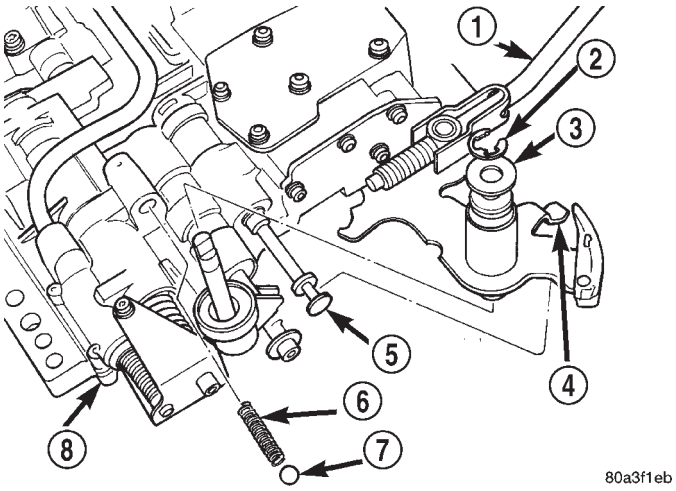


Fig. 117 Manual And Throttle Levers

1 – PARK ROD
2 – E-RING
3 – WASHER
4 – MANUAL LEVER
5 – MANUAL VALVE
6 – SPRING
7 – DETENT BALL
8 – VALVE BODY

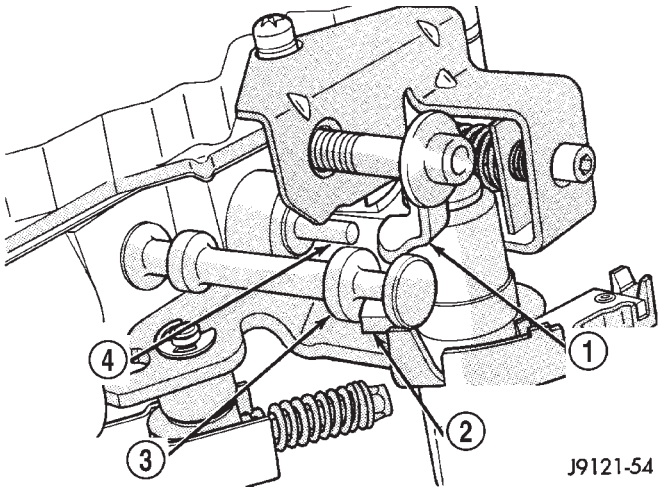


Fig. 118 Manual Valve And Throttle Lever Alignment

1 – THROTTLE LEVER
2 – MANUAL LEVER VALVE ARM
3 – MANUAL VALVE
4 – KICKDOWN VALVE

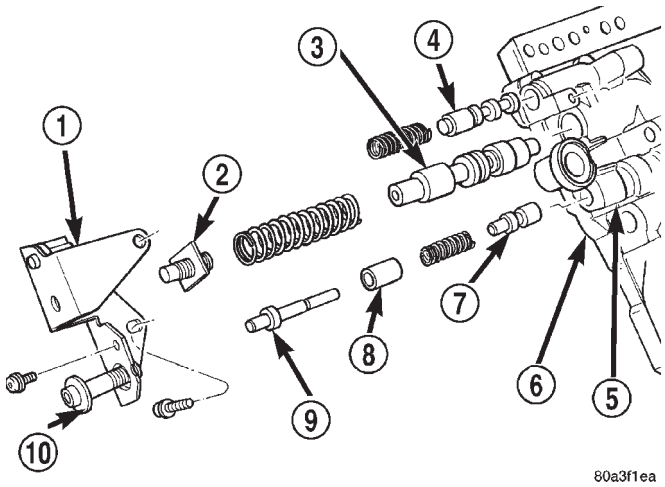


Fig. 119 Adjusting Screw Bracket, Springs, and Valves

1 – ADJUSTER BRACKET
2 – LINE PRESSURE ADJUSTER
3 – PRESSURE REGULATOR VALVE
4 – SWITCH VALVE
5 – VALVE BODY
6 – TRANSFER PLATE
7 – THROTTLE VALVE
8 – SLEEVE
9 – KICKDOWN VALVE
10 – THROTTLE PRESSURE ADJUSTER

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. 120).

(7) Remove extension housing.

(8) Remove fluid pan.

(9) Remove park/neutral position switch and seal (Fig. 121).

(10) Remove valve body.

(11) Remove accumulator spring and piston (Fig. 122).

NOTE: The 32RH is equipped with an additional spring under the accumulator piston.

(12) Loosen front band adjusting screw lock nut (Fig. 123) 4-5 turns. Then tighten band adjusting screw until band is tight around front clutch. This

DISASSEMBLY AND ASSEMBLY (Continued)

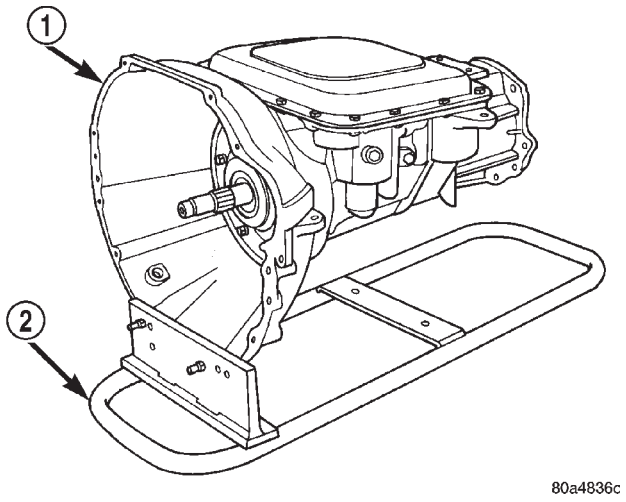


Fig. 120 Repair Stand

1 – TRANSMISSION
2 – STAND

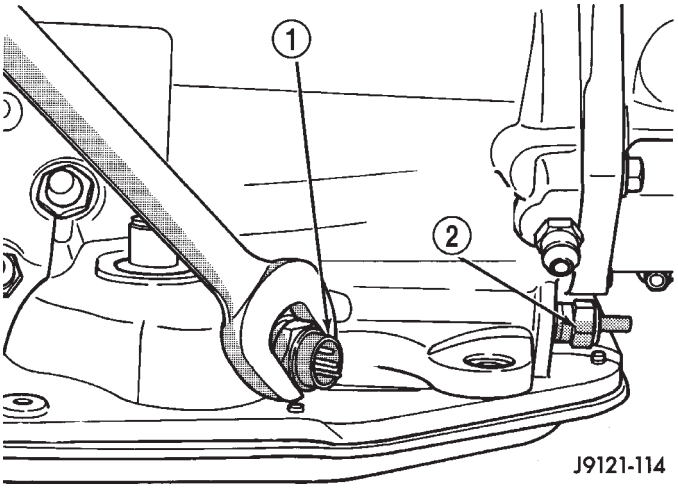


Fig. 121 Park/Neutral Position Switch

1 – NEUTRAL SWITCH
2 – SOLENOID CONNECTOR

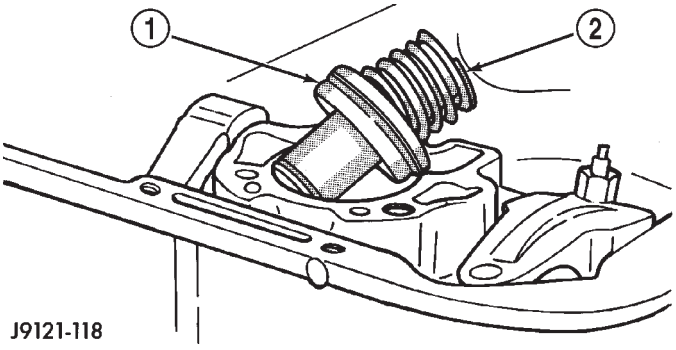


Fig. 122 Accumulator Piston And Spring

1 – ACCUMULATOR PISTON
2 – PISTON SPRING

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. 124).

(15) Bump slide hammer weights outward to remove pump and reaction shaft support assembly from case (Fig. 124).

(16) Loosen front band adjusting screw until band is completely loose (Fig. 123).

(17) Squeeze front band together and remove band strut (Fig. 125).

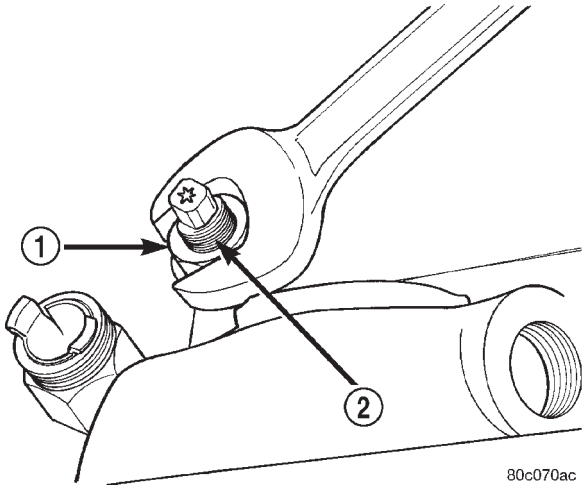


Fig. 123 Front Band Adjusting Screw Lock Nut

1 – LOCK-NUT
2 – FRONT BAND ADJUSTER

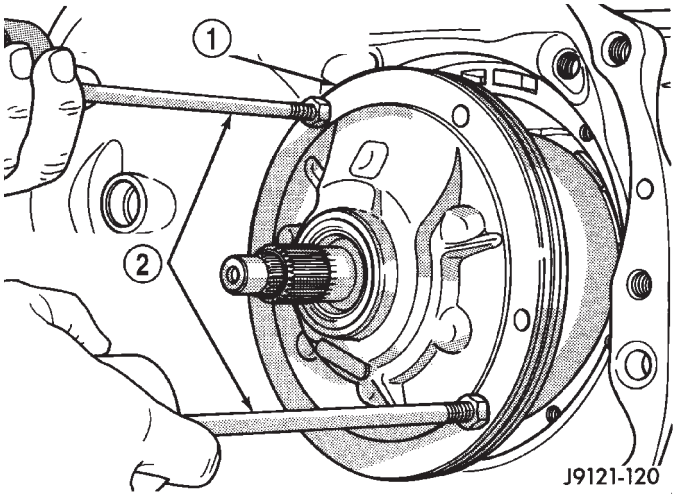


Fig. 124 Oil Pump/Reaction Shaft Support

1 – OIL PUMP AND REACTION SHAFT SUPPORT ASSEMBLY
2 – SLIDE HAMMER TOOLS C-3752

DISASSEMBLY AND ASSEMBLY (Continued)

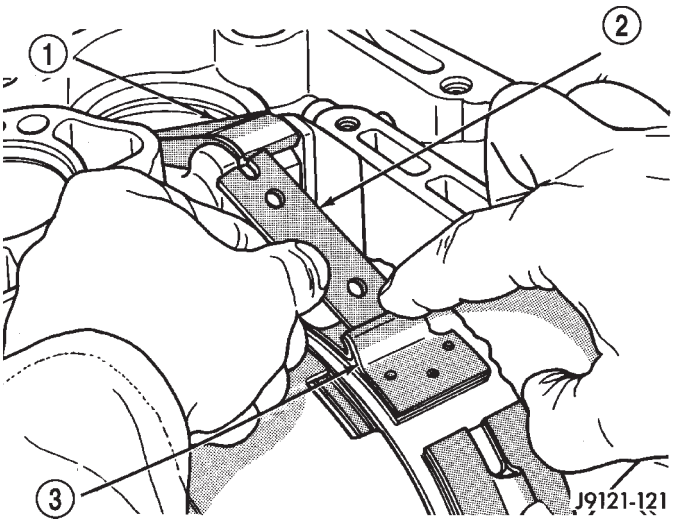


Fig. 125 Front Band Strut

1 – BAND LEVER
2 – BAND STRUT
3 – FRONT BAND

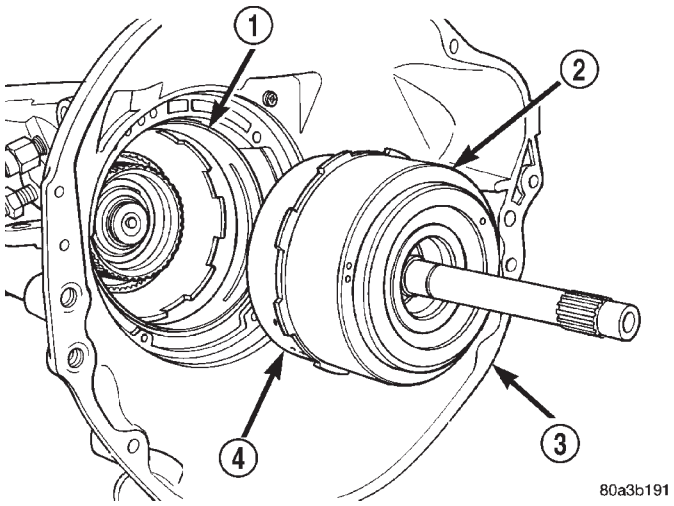


Fig. 126 Front/Rear Clutch Assemblies

1 – FRONT BAND
2 – FRONT CLUTCH AND DRUM
3 – TRANSMISSION HOUSING
4 – REAR CLUTCH

(18) Remove front and rear clutch units as an assembly. Grasp input shaft, hold clutch units together and remove them from case (Fig. 126).

(19) Lift front clutch off rear clutch (Fig. 127). Set clutch units aside for overhaul.

(20) Remove output shaft thrust washer from output shaft (or from rear clutch hub) (Fig. 128).

(21) Remove output shaft thrust plate and washer from output shaft hub (Fig. 128).

(22) Remove front band from case (Fig. 129).

(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. 130). Support geartrain with both hands during removal. Do not allow machined surfaces on output shaft to become nicked or scratched.

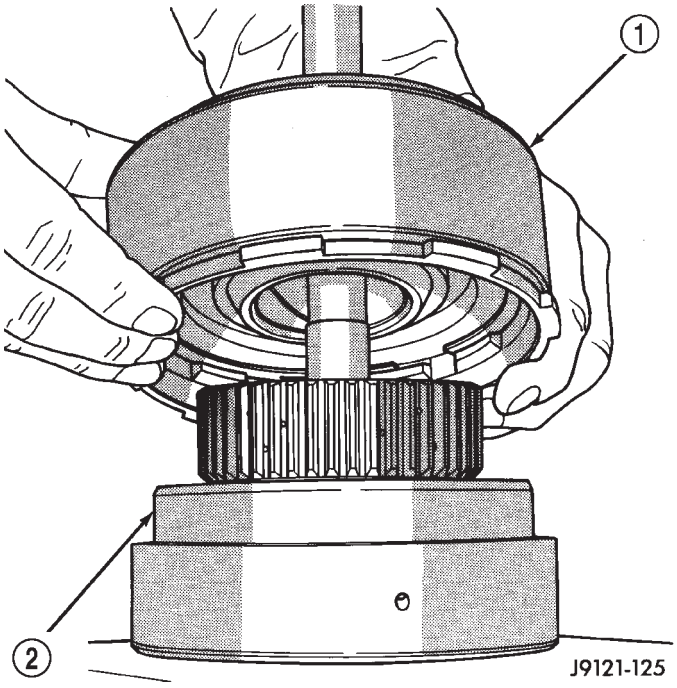


Fig. 127 Separating Front Clutch From Rear Clutch

1 – FRONT CLUTCH
2 – REAR CLUTCH

DISASSEMBLY AND ASSEMBLY (Continued)

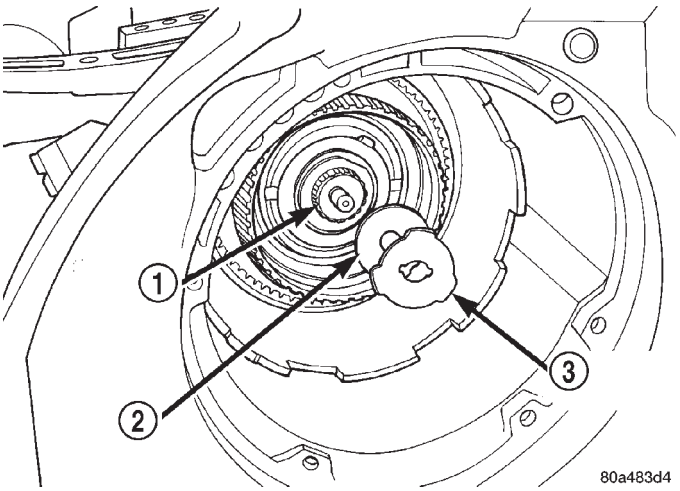


Fig. 128 Output Shaft Thrust Plate and Washer

1 – OUTPUT SHAFT
2 – THRUST PLATE
3 – THRUST WASHER

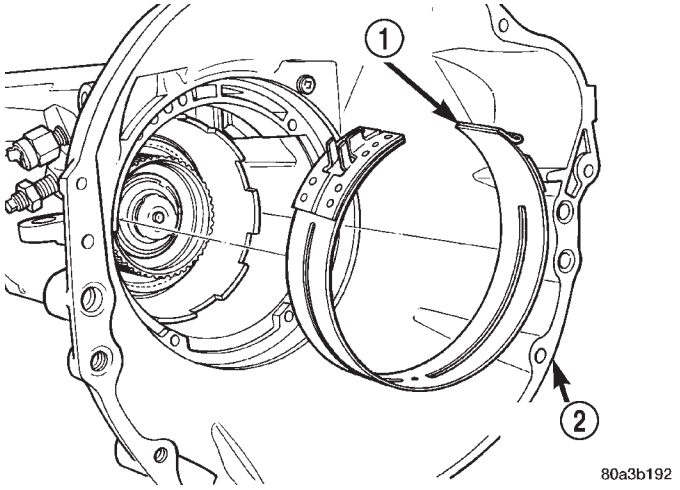


Fig. 129 Front Band

1 – FRONT BAND
2 – TRANSMISSION HOUSING

(26) Loosen rear band adjusting screw 4-5 turns (Fig. 131).

(27) Remove snap ring that secures low-reverse drum to rear support hub, however do not remove drum (Fig. 132).

(28) Remove bolts attaching rear support to transmission case and pull support from low-reverse drum (Fig. 133).

(29) Remove bolts attaching overrunning clutch cam and low-reverse drum to transmission case (Fig. 134).

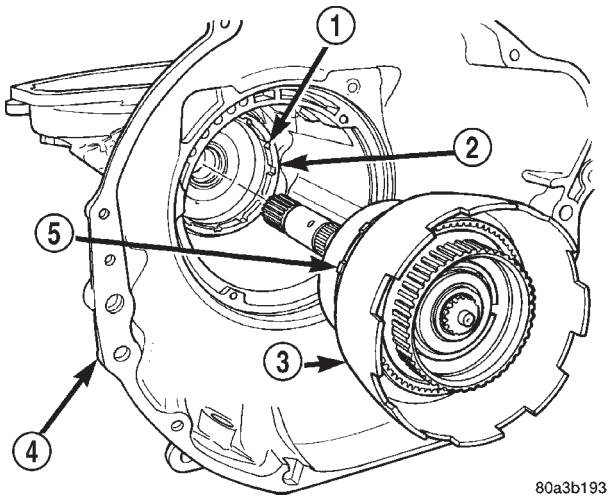


Fig. 130 Planetary Geartrain

1 – SLOTS
2 – LOW-REVERSE DRUM
3 – PLANETARY GEARTRAIN
4 – TRANSMISSION HOUSING
5 – LUGS

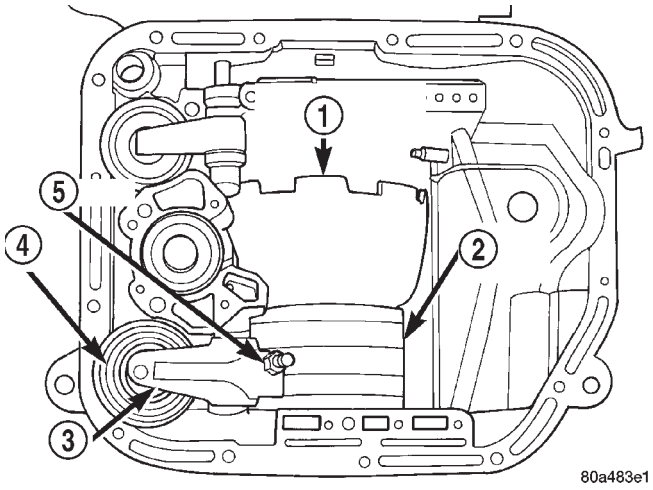


Fig. 131 Rear Band Adjuster Location

1 – PLANETARY GEARTRAIN
2 – REAR BAND
3 – LEVER
4 – SERVO
5 – ADJUSTER

DISASSEMBLY AND ASSEMBLY (Continued)

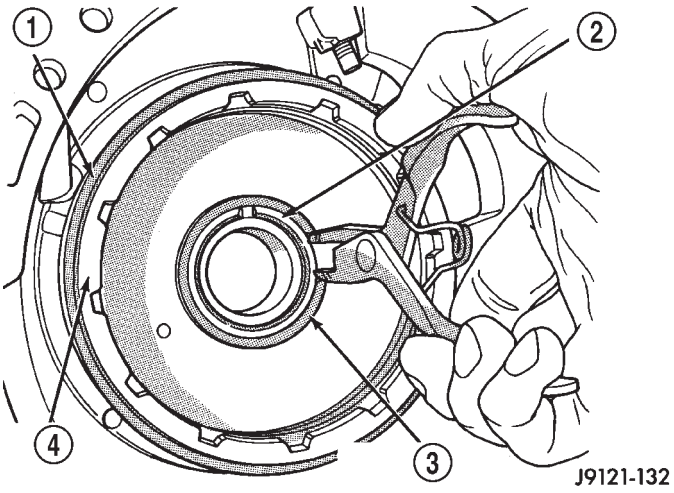


Fig. 132 Low-Reverse Drum Snap Ring

1 – REAR BAND
2 – REAR SUPPORT HUB
3 – LOW-REVERSE DRUM SNAP RING
4 – LOW-REVERSE DRUM

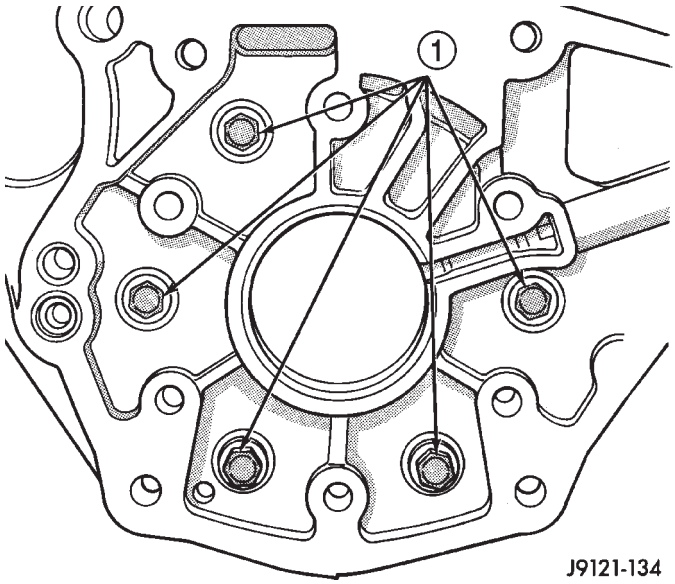


Fig. 134 Overrunning Clutch Cam Bolt Locations

1 – OVERRUNNING CLUTCH CAM BOLTS

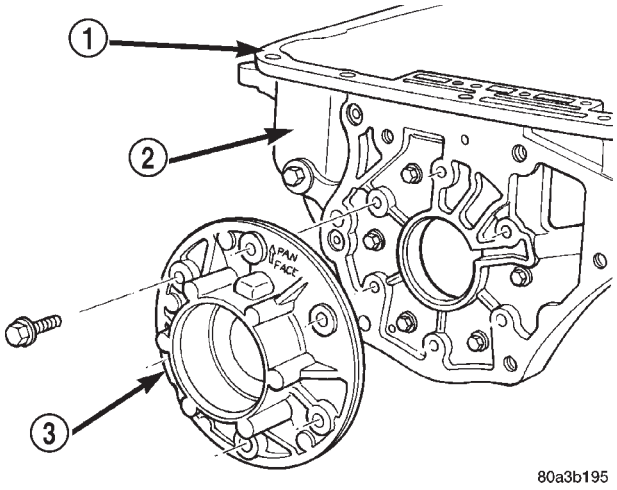


Fig. 133 Rear Support

1 – OIL PAN FACE
2 – TRANSMISSION HOUSING
3 – REAR SUPPORT

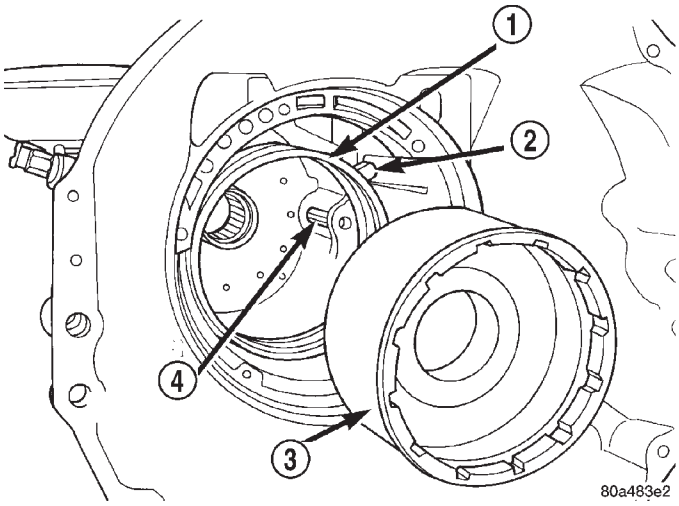


Fig. 135 Low- Reverse Band and Drum—32RH

1 – REAR BAND
2 – LUGS
3 – LOW-REVERSE DRUM
4 – REAR BAND ANCHOR PIN

REAR BAND—32RH.

(30) Remove rear band. The 32RH transmission is equipped with a double-wrap band that does not require a link bar.

(a) Remove low-reverse drum and overrunning clutch as assembly. Slide drum and clutch through rear band and out of case (Fig. 135). Set drum and clutch assembly aside for cleaning and inspection.

(b) Remove rear band from case (Fig. 135).

REAR BAND—30RH

(31) Remove rear band. The 30RH transmission is equipped with a single-wrap band with a link bar.

(a) Using snap-ring plier, pull rear band anchor pin (located on the servo side of the rear support) from transmission case.

(b) Remove rear band and link from transmission (Fig. 136).

(c) Separate rear band from link (Fig. 137).

(32) If necessary remove front and rear band servo levers. All transmission components can be serviced without removing the levers.

(a) Using a 1/4 inch drive extension remove front band reaction pin access plug (Fig. 138).

DISASSEMBLY AND ASSEMBLY (Continued)

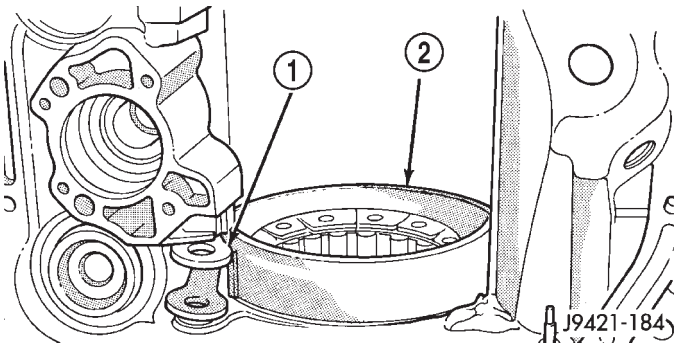


Fig. 136 Rear Band and Link—30RH

1 – LINK
2 – REAR BAND

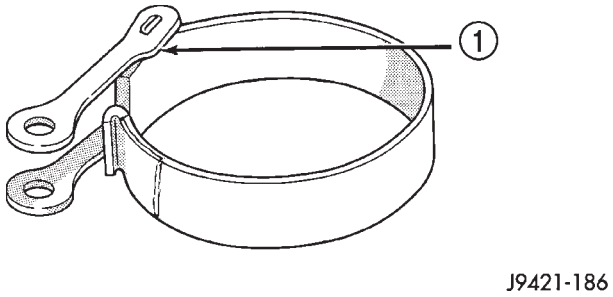


Fig. 137 Rear Band and Link—30RH

1 – NOTCHED SIDE OF LINK GOES TOWARD BAND

(b) Remove front band reaction pin with pencil magnet. Pin is accessible from converter housing side of case (Fig. 139).

(c) Remove front band lever (Fig. 140).

(d) Using snap-ring plier, pull rear band lever pivot from transmission case (Fig. 141).

(e) Separate rear band servo lever from transmission.

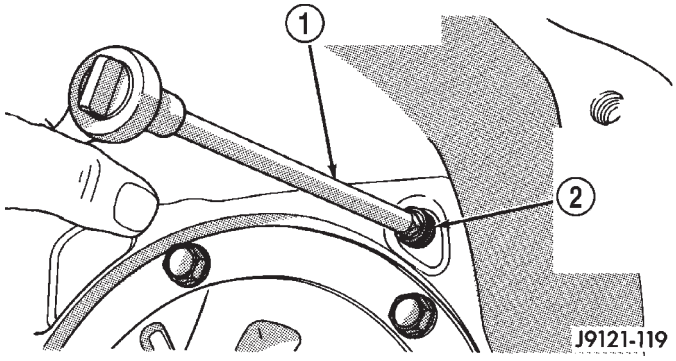


Fig. 138 Front Band Reaction Pin Access Plug

1 – 1/4'' DRIVE EXTENSION
2 – FRONT BAND REACTION PIN ACCESS PLUG

(33) Compress front servo rod guide about 1/8 in. with large C-clamp and Tool C-4470, or Spring Compressor Tool C-3422-B (Fig. 142).

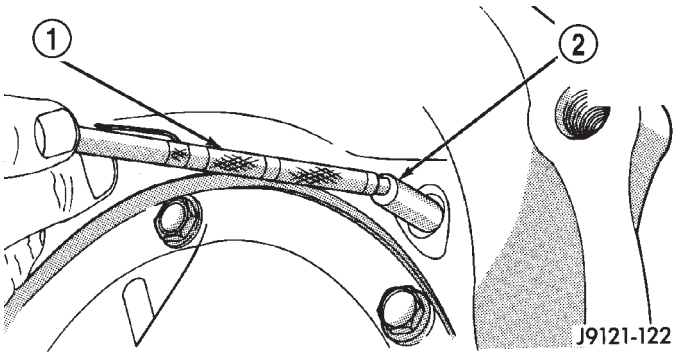


Fig. 139 Front Band Reaction Pin

1 – PENCIL MAGNET
2 – FRONT BAND REACTION PIN

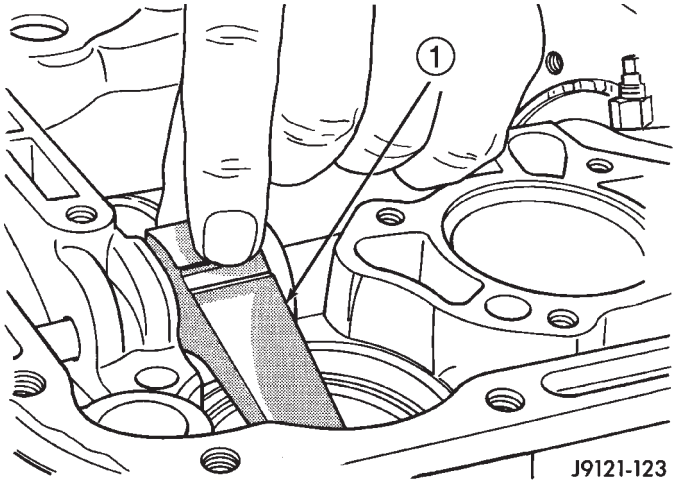


Fig. 140 Front Band Lever

1 – FRONT BAND LEVER

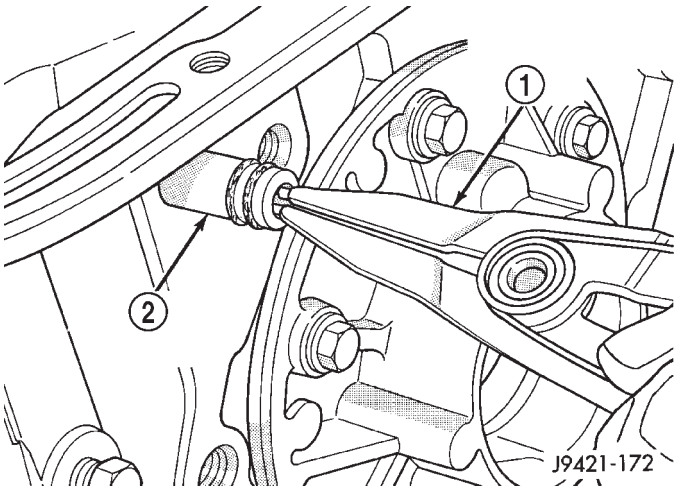


Fig. 141 Rear Band Servo Lever Pin

1 – PARALLEL JAW SNAP RING PLIERS
2 – REAR BAND LEVER PIVOT PIN

DISASSEMBLY AND ASSEMBLY (Continued)

(34) Remove front servo rod guide snap ring (Fig. 142). **Exercise caution when removing snap ring. Servo bore can be scratched or nicked if care is not exercised.**

(35) Remove compressor tools and remove front servo rod guide, spring and servo piston.

(36) Compress rear servo spring retainer about 1/16 in. with C-clamp and Tool C-4470 or SP-5560 (Fig. 143). Valve Spring Compressor C-3422-B can also be used to compress spring retainer.

(37) Remove rear servo spring retainer snap ring. Then remove compressor tools and remove rear servo spring and piston.

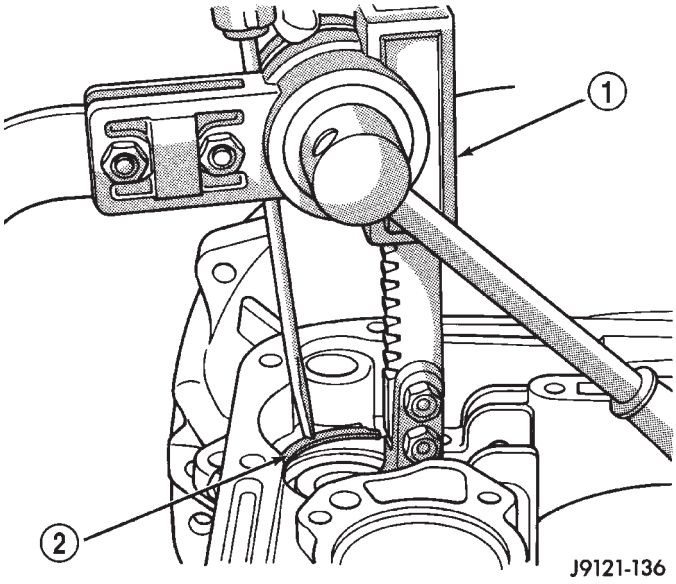


Fig. 142 Compressing Front Servo

1 – SPRING COMPRESSOR TOOL C-3422–B
2 – ROD GUIDE SNAP RING

ASSEMBLY

(1) Install rear servo piston, spring and spring retainer. Compress rear servo spring and retainer with Compressor Tool C-3422-B (Fig. 143) or a large C-clamp.

(2) Install front servo piston, spring, and rod guide. Compress front servo rod guide with Valve Spring Compressor C-3422-B and install servo snap ring (Fig. 142).

REAR BAND—32RH

(3) Install rear band

(a) Insert rear band through pan opening in transmission case. Single lug toward pan face.

(b) Place single lug under adjuster screw and two lugs over anchor pin in transmission case (Fig. 135).

REAR BAND—30RH

(4) Install rear band.

(a) Assemble link bar to band. Notched side of link toward band (Fig. 141).

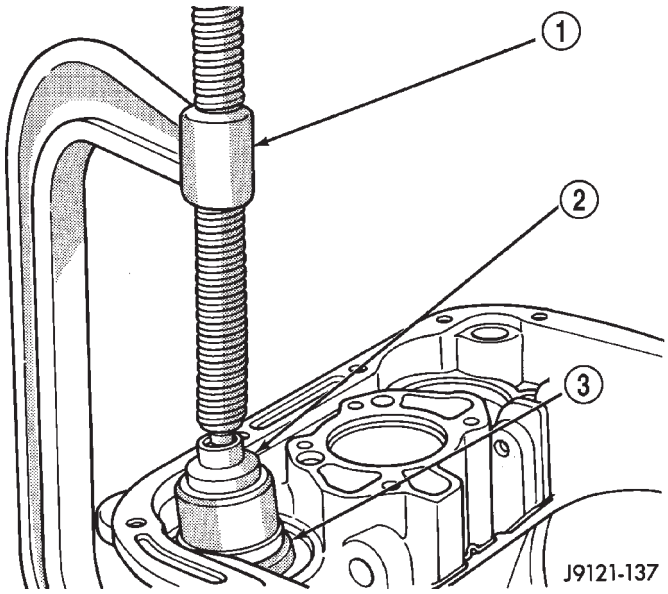


Fig. 143 Compressing Rear Servo Spring

1 – LARGE C-CLAMP
2 – TOOL C-4470 OR SP5560
3 – SERVO SPRING RETAINER

(b) Insert rear band through pan opening in transmission case.

(c) Insert hook on band onto adjuster lever.

(d) Align holes in link bar with hole in transmission case outboard of rear support opening (Fig. 140).

(e) Insert anchor pin into case through link bar.

(5) Examine bolt holes in overrunning clutch cam. Note that one hole is **not threaded** (Fig. 144). 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).

(6) Lubricate overrunning clutch rollers, springs and cam with Mopar® ATF Plus 3, type 7176, transmission fluid.

(7) Position overrunning clutch on a clean, flat work surface with countersunk holes downward.

(8) Place rear of low-reverse drum over overrunning clutch and align clutch rollers to hub of drum.

(9) While slightly pivoting low-reverse drum, push hub of drum into overrunning clutch. Verify that countersunk holes are facing outward. **Cam should be able to rotate in the drum clockwise only.**

(10) Insert a suitable awl through the rear support mounting hole closest to the pan sealing face. The awl should be next to the wide space area at the back of transmission case.

DISASSEMBLY AND ASSEMBLY (Continued)

(11) Insert low-reverse drum and overrunning clutch into front of transmission case and into rear band.

(12) Insert awl tip into the threaded hole next to the non-threaded hole in the overrunning clutch cam. Verify that non-threaded hole is aligned with wide space area on transmission case.

(13) Push low-reverse drum rearward to close gap between cam and case.

(14) Install overrunning clutch cam bolts. **Clutch cam bolts are shorter than rear support bolts.** Tighten cam bolts to 17 N·m (150 in. lbs. or 13 ft. lbs.) torque.

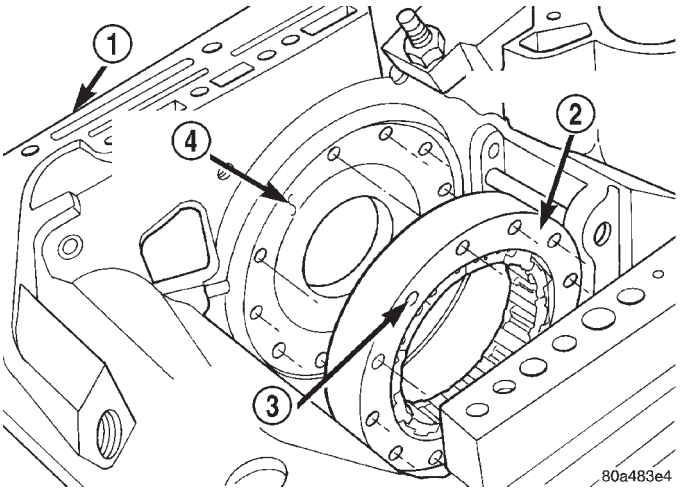


Fig. 144 Clutch Cam Alignment

1 – TRANSMISSION CASE
2 – OVERRUNNING CLUTCH
3 – NON-THREADER HOLE
4 – WIDE SPACE AREA

(15) Hold low-reverse drum in position so rear support will not push it out of overrunning clutch.

(16) Insert rear support into opening at rear of transmission case (Fig. 145).

(17) Align support with the embossed arrow in the direction of the pan face.

(18) Install and tighten rear support bolts to 17 N·m (150 in. lbs.) torque.

(19) Install snap ring to retain low-reverse drum to hub of rear support (Fig. 146).

(20) Lubricate output shaft, rear support bore and low-reverse drum hub with transmission fluid.

(21) Install assembled output shaft and planetary geartrain in case (Fig. 147).

(22) Align drive lugs on rear planetary gear with slots in low-reverse drum (Fig. 147). Then seat planetary assembly in drum.

(23) Install governor on output shaft.

(24) Turn and secure transmission so that front opening is upward.

(25) Assemble front and rear clutches together.

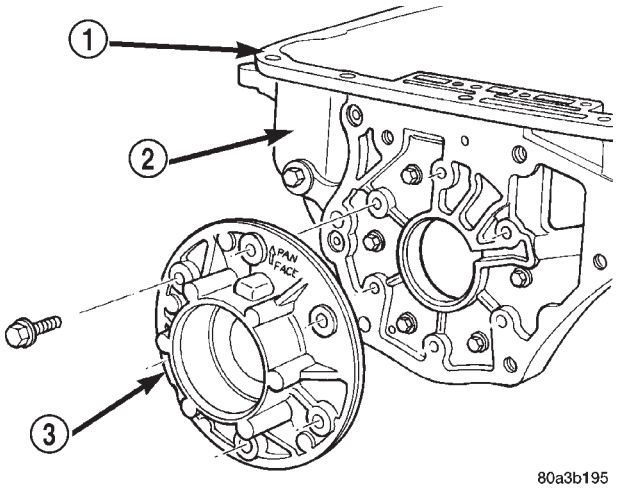


Fig. 145 Rear Support

1 – OIL PAN FACE
2 – TRANSMISSION HOUSING
3 – REAR SUPPORT

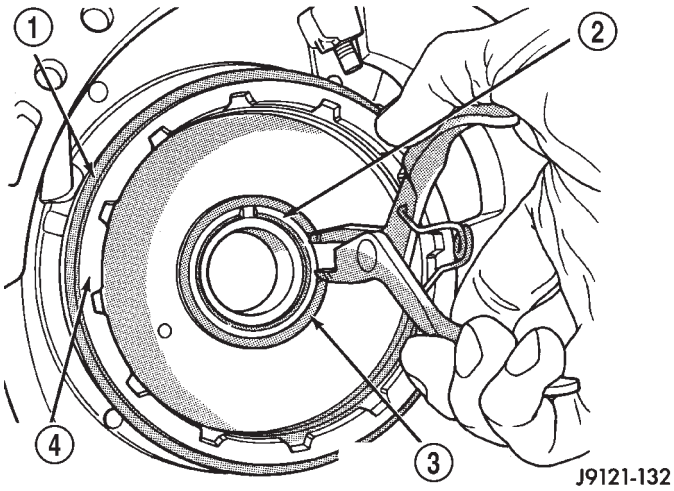


Fig. 146 Low-Reverse Drum Snap Ring

1 – REAR BAND
2 – REAR SUPPORT HUB
3 – LOW-REVERSE DRUM SNAP RING
4 – LOW-REVERSE DRUM

(a) Check input shaft seal rings (Fig. 148). 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. 149).

(d) Engage teeth on rear clutch hub into teeth on clutch (Fig. 151). Rotate front clutch retainer back and forth until completely seated on rear clutch.

DISASSEMBLY AND ASSEMBLY (Continued)

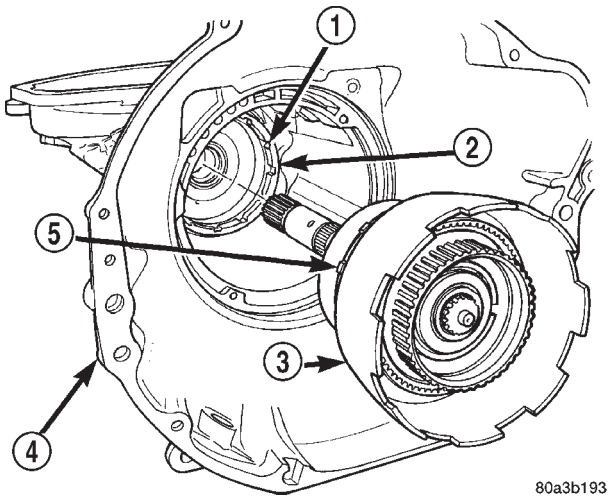


Fig. 147 Output Shaft And Planetary Geartrain

1 – SLOTS
2 – LOW-REVERSE DRUM
3 – PLANETARY GEARTRAIN
4 – TRANSMISSION HOUSING
5 – LUGS

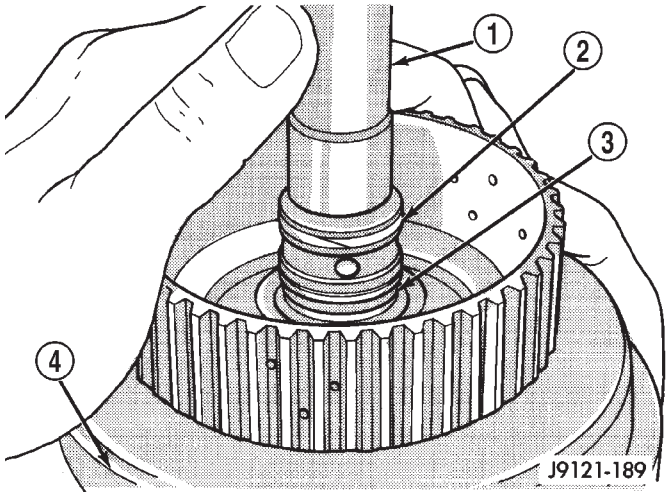


Fig. 148 Input Shaft Seal Ring Location

1 – INPUT SHAFT
2 – TEFLON SEAL RING
3 – METAL SEAL RING
4 – REAR CLUTCH RETAINER

(26) Install output shaft thrust plate on shaft hub in planetary geartrain driving shell (Fig. 150). Use petroleum jelly to hold thrust plate in place.

(27) Check rear clutch thrust washer. Use additional petroleum jelly to hold washer in place if necessary.

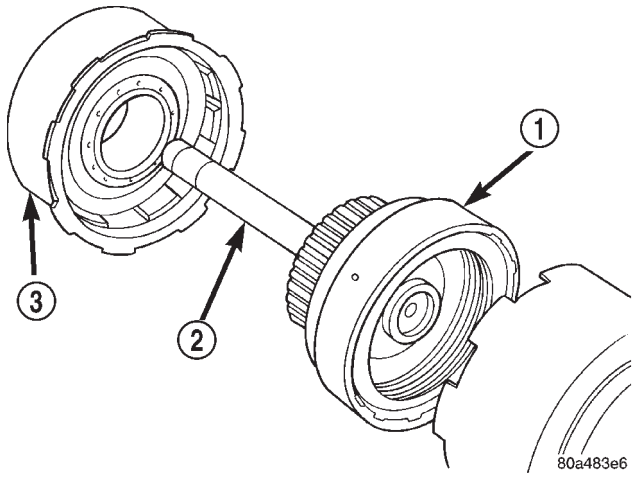


Fig. 149 Front and Rear Clutches

1 – REAR CLUTCH
2 – INPUT SHAFT
3 – FRONT CLUTCH

(28) Coat output shaft thrust washer with petroleum jelly. Install washer in rear clutch hub (Fig. 152). Use enough petroleum jelly to hold washer in place. **Be sure grooved side of washer faces rearward (toward output shaft) as shown. Also note that washer only fits one way in clutch hub.**

(29) Align drive teeth on rear clutch discs with small screwdriver (Fig. 153). This will make installation into front of planetary geartrain easier.

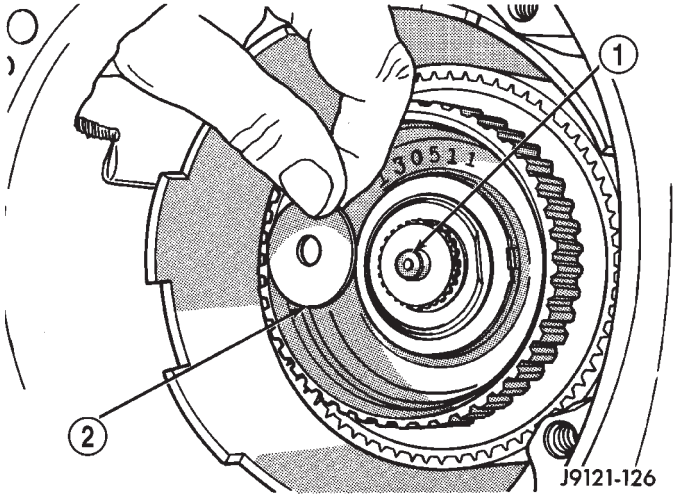


Fig. 150 Output Shaft Thrust Plate

1 – OUTPUT SHAFT HUB
2 – OUTPUT SHAFT THRUST PLATE

DISASSEMBLY AND ASSEMBLY (Continued)

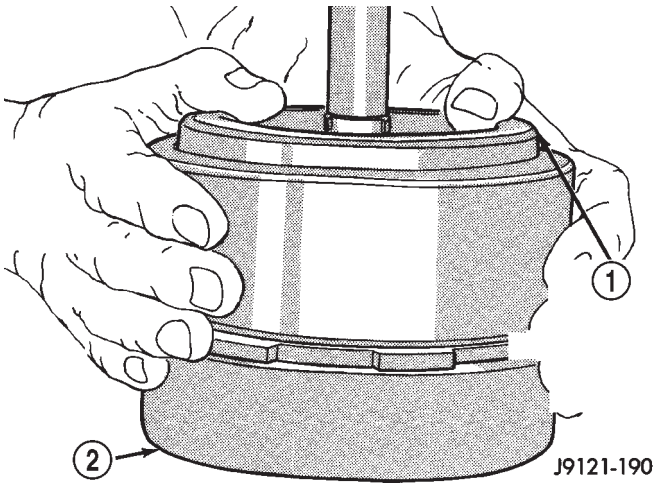


Fig. 151 Assembling Front And Rear Clutch Units

1 – TURN FRONT CLUTCH BACK & FORTH UNTIL SEATED
2 – REAR CLUTCH ASSEMBLY

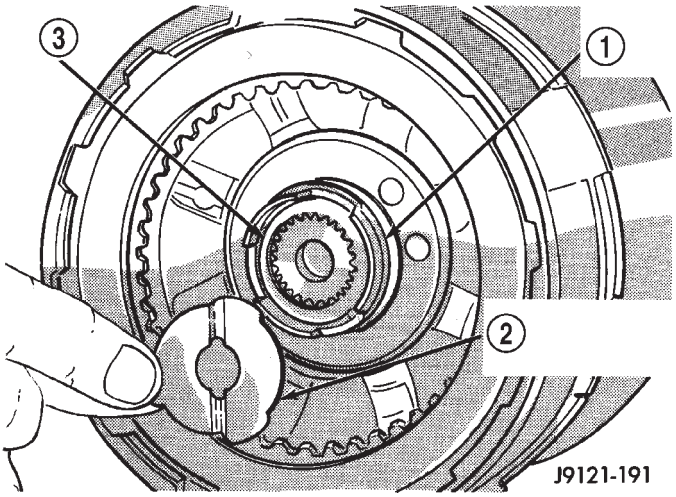


Fig. 152 Output Shaft Thrust Washer

1 – REAR CLUTCH HUB
2 – OUTPUT SHAFT THRUST WASHER
3 – OUTPUT SHAFT

(30) Insert front band into opening at front of transmission case (Fig. 154).

(31) Install front and rear clutch units as assembly (Fig. 155). Align rear clutch with front annulus gear and install assembly in driving shell. **Be sure output shaft thrust washer and thrust plate are not displaced during installation.**

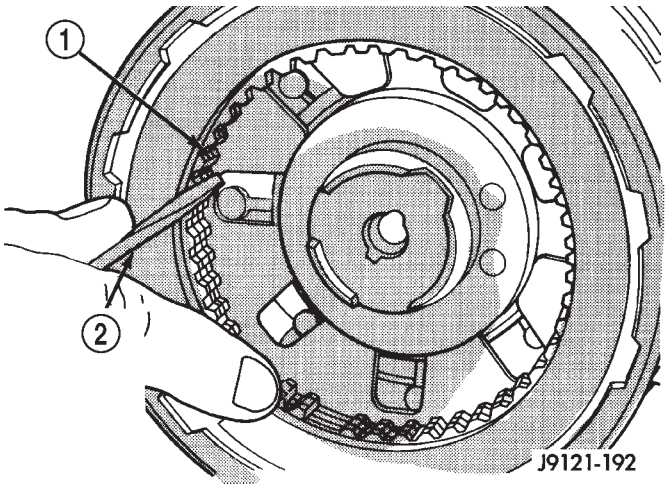


Fig. 153 Aligning Rear Clutch Disc Lugs

1 – REAR CLUTCH DISCS
2 – USE SMALL SCREWDRIVER TO ALIGN CLUTCH DISC TEETH

(32) Carefully work assembled clutches back and forth to engage and seat rear clutch discs on front annulus gear. Verify that front clutch drive lugs are fully engaged in slots of driving shell after installation.

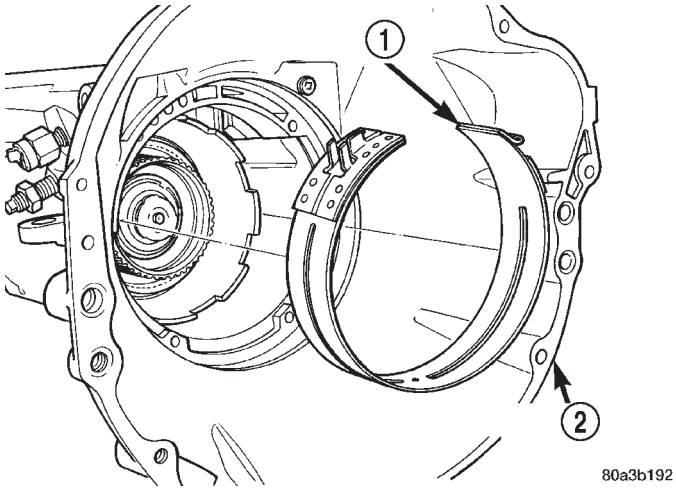


Fig. 154 Front Band

1 – FRONT BAND
2 – TRANSMISSION HOUSING

(33) Engage front band on adjusting screw and hold band in place.

(34) Install strut between band lever and front band (Fig. 156).

DISASSEMBLY AND ASSEMBLY (Continued)

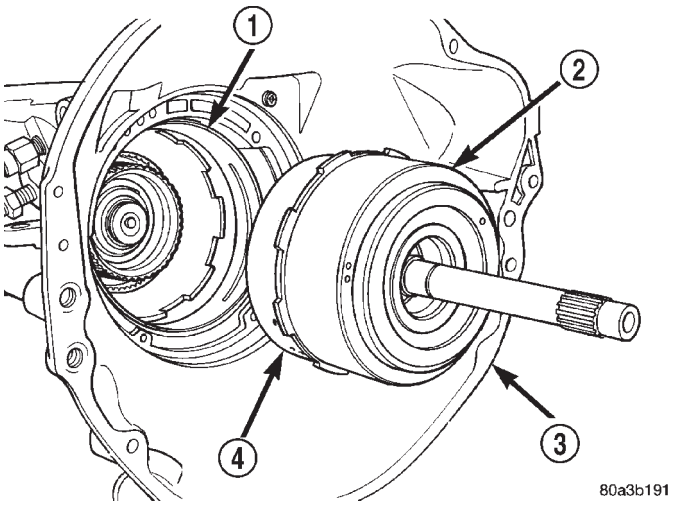


Fig. 155 Installing Front/Rear Clutch

1 – FRONT BAND
2 – FRONT CLUTCH AND DRUM
3 – TRANSMISSION HOUSING
4 – REAR CLUTCH

(35) Tighten front band adjusting screw until band just grips clutch retainer. Verify that front/rear clutches are still seated before continuing.

(36) Verify that reaction shaft support hub seal rings are hooked together (Fig. 157).

(37) Coat front clutch thrust washer with petroleum jelly to hold it in place. Then install washer over reaction shaft hub and seat it on pump (Fig. 158).

CAUTION: The thrust washer bore (I. D.), is chamfered on one side. Make sure the chamfered side is installed so it faces the pump.

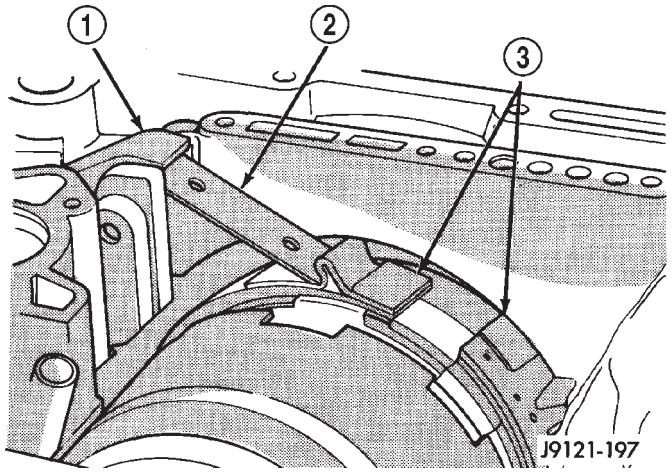


Fig. 156 Front Band Linkage Installation

1 – BAND LEVER
2 – BAND STRUT
3 – FRONT BAND

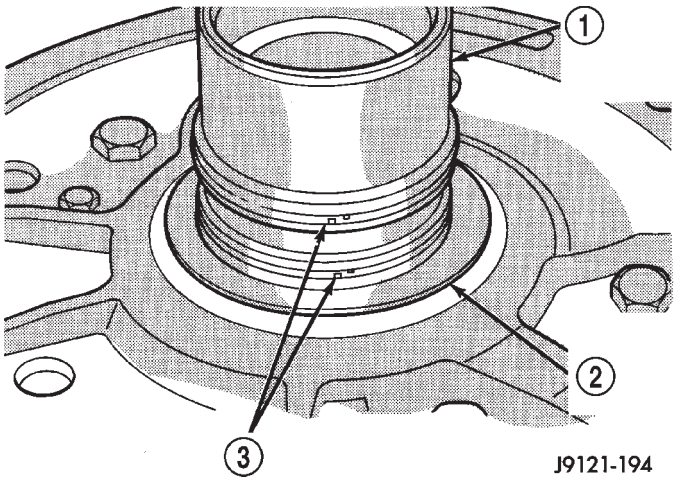


Fig. 157 Reaction Shaft Support Seal Rings

1 – REACTION SHAFT SUPPORT HUB
2 – FRONT CLUTCH THRUST WASHER
3 – SEAL RINGS

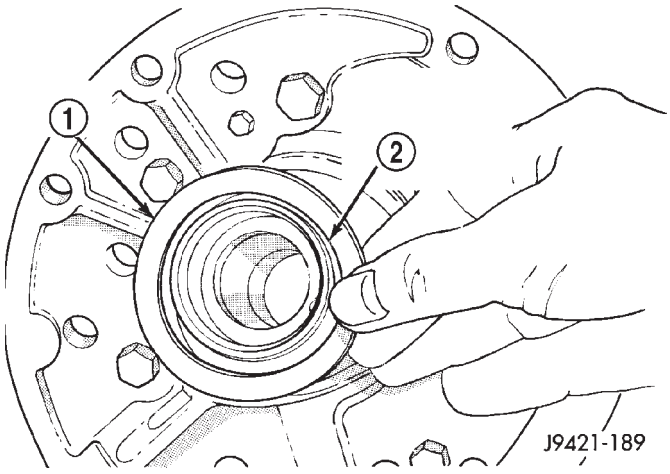


Fig. 158 Front Clutch Thrust Washer Installation

1 – THRUST WASHER
2 – CHAMFERED SIDE OF WASHER BORE GOES TOWARD PUMP

(38) Thread two Pilot Stud Tools C-3288-B into bolt holes in oil pump flange (Fig. 159).

(39) Align and install oil pump gasket (Fig. 159).

(40) Lubricate oil pump seals with Mopar® Door-Ease, or Ru-Glyde, Door Eze, or ATF Plus 3.

(41) Install oil pump (Fig. 160). Align and position pump on pilot studs. Slide pump down studs and work it into front clutch hub and case by hand. Then install two or three pump bolts to hold pump in place.

(42) Remove pilot stud tools and install remaining oil pump bolts. Tighten bolts alternately in diagonal pattern to 20 N·m (15 ft. lbs.).

DISASSEMBLY AND ASSEMBLY (Continued)

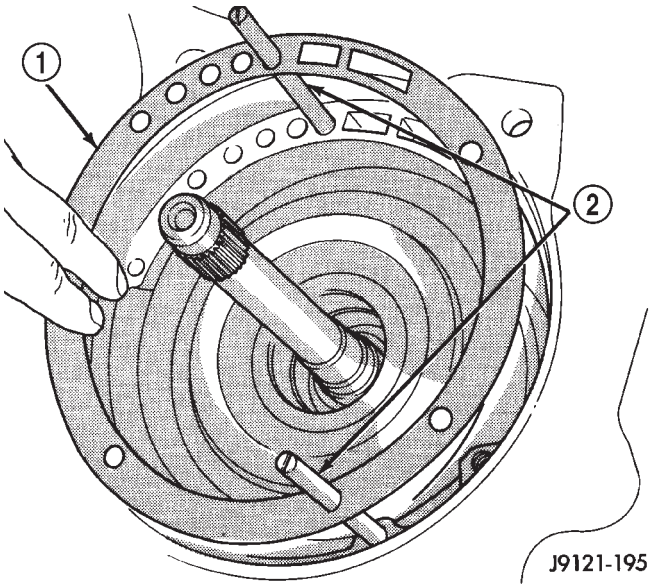


Fig. 159 Installing Pilot Studs And Oil Pump Gasket

1 – OIL PUMP GASKET
2 – PILOT STUD TOOLS C-3288–B

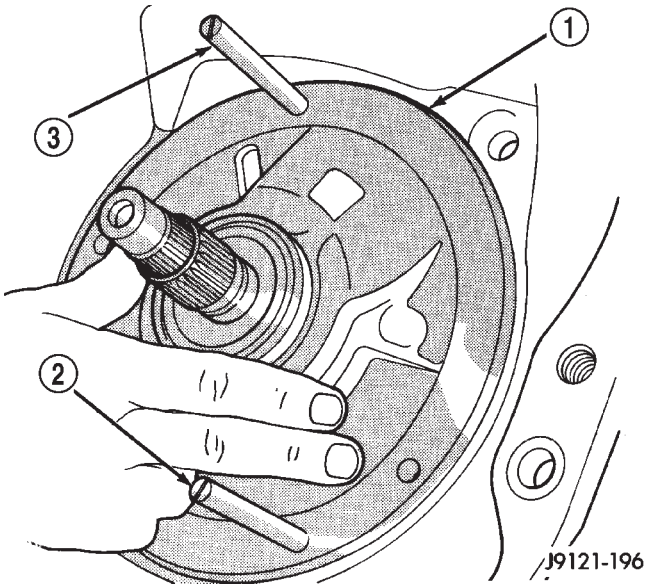


Fig. 160 Installing Oil Pump And Reaction Shaft Support

1 – OIL PUMP
2 – PILOT STUD TOOL
3 – PILOT STUD TOOL

(43) Measure input shaft end play (Fig. 161).

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 Adapter 8266–7 to Handle 8266–8.

(b) Attach dial indicator (C-3339) to Handle 8266–8.

(c) Install the assembled tool onto the input shaft of the transmission and tighten the retaining screw on Adapter 8266–7 to secure it to the input shaft.

(d) Position the dial indicator plunger against a flat spot on the oil pump and zero the dial indicator.

(e) Move input shaft in and out and record reading. End play should be 0.56 - 2.31 mm (0.022 - 0.091 in.).

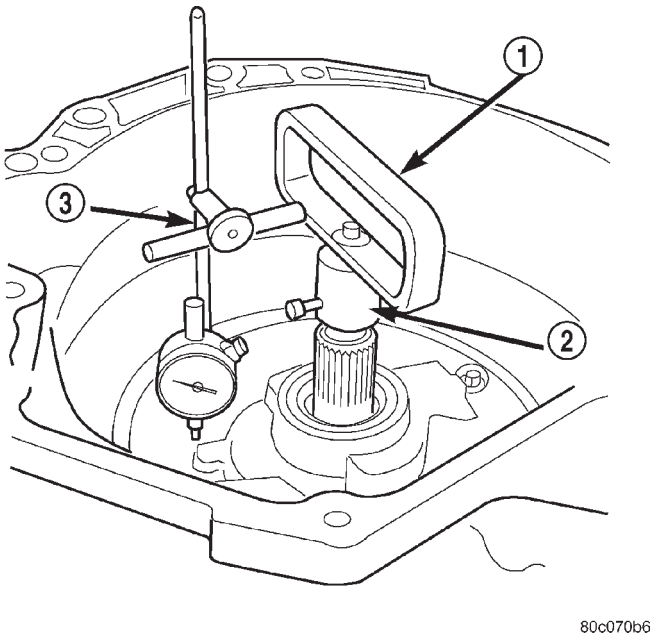


Fig. 161 Checking Input Shaft End Play

1 – TOOL 8266–8
2 – TOOL 8266–7
3 – TOOL C-3339

(44) Position transmission on work surface with pan face upward.

(45) Install valve body.

(46) Adjust front and rear bands.

(47) Install fluid filter and pan.

(48) Install rear extension housing.

(49) Install torque converter.

OVERRUNNING CLUTCH/LOW-REVERSE DRUM

DISASSEMBLY

(1) If the clutch assembly came out with the low-reverse drum, thread two clutch cam bolts into the cam. Then lift the cam out of the drum with the bolts (Fig. 162). Rotate the cam back and forth to ease removal if necessary.

(2) Remove the clutch roller and spring assembly from the overrunning clutch race.

DISASSEMBLY AND ASSEMBLY (Continued)

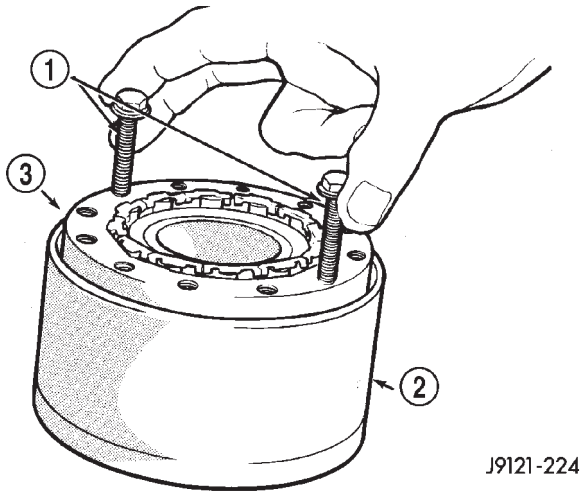


Fig. 162 Removing Overrunning Clutch From Low-Reverse Drum

1 – CAM BOLTS
2 – LOW-REVERSE DRUM
3 – OVERRUNNING CLUTCH AND CAM

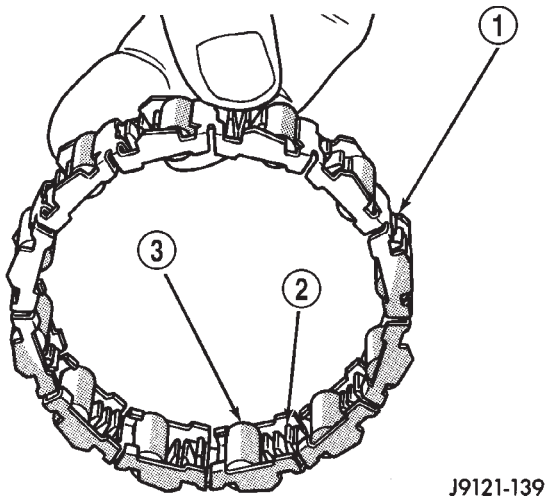


Fig. 163 Overrunning Clutch Rollers, Springs, Retainer

1 – RETAINER
2 – SPRING
3 – ROLLER

ASSEMBLY

(1) Assemble clutch rollers and springs in retainer if necessary (Fig. 163).

(2) Install overrunning clutch roller, spring and retainer assembly in clutch cam (Fig. 164).

(3) Temporarily assemble and check overrunning clutch operation as follows:

(a) Assemble cam and clutch.

(b) Install clutch assembly on low-reverse drum with twisting motion (Fig. 165).

(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).**

FRONT SERVO PISTON

DISASSEMBLY

(1) Remove seal ring from rod guide (Fig. 167).

(2) Remove small snap ring from servo piston rod. Then remove piston rod, spring and washer from piston.

(3) Remove and discard servo component O-ring and seal rings.

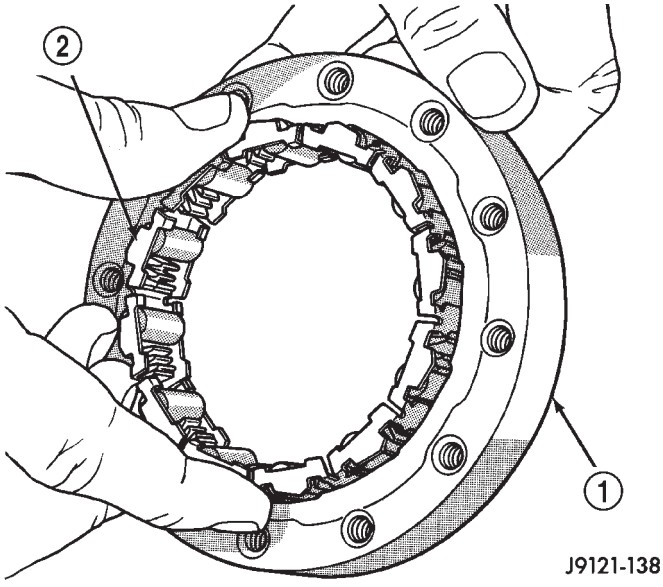


Fig. 164 Assembling Overrunning Clutch And Cam

1 – CLUTCH CAM
2 – CLUTCH ROLL ASSEMBLY

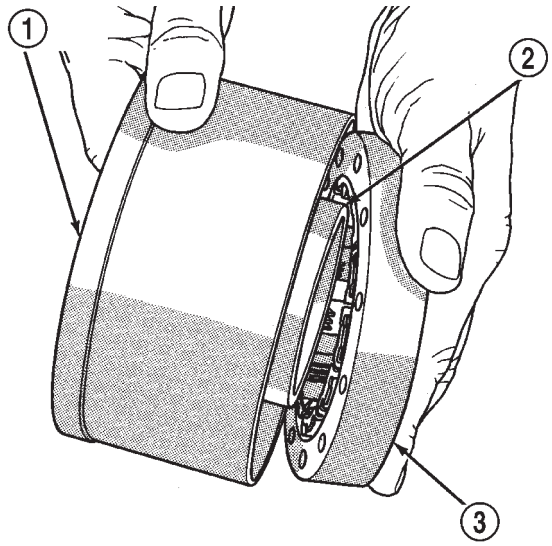
ASSEMBLY

(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. 167).

(3) Set servo components aside for installation during transmission reassembly.

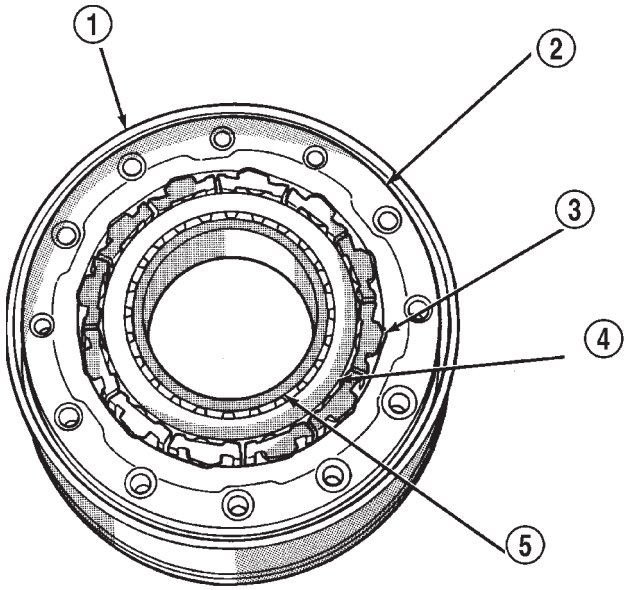
DISASSEMBLY AND ASSEMBLY (Continued)



J9121-135

Fig. 165 Temporary Assembly Of Clutch And Drum To Check Operation

1 – LOW-REVERSE DRUM
2 – CLUTCH RACE (ON HUB OF DRUM)
3 – OVERRUNNING CLUTCH



J9121-140

Fig. 166 Assembled Overrunning Clutch

1 – LOW-REVERSE DRUM
2 – OVERRUNNING CLUTCH CAM
3 – ROLLER AND SPRING ASSEMBLY
4 – CLUTCH RACE
5 – HUB OF LOW-REVERSE DRUM

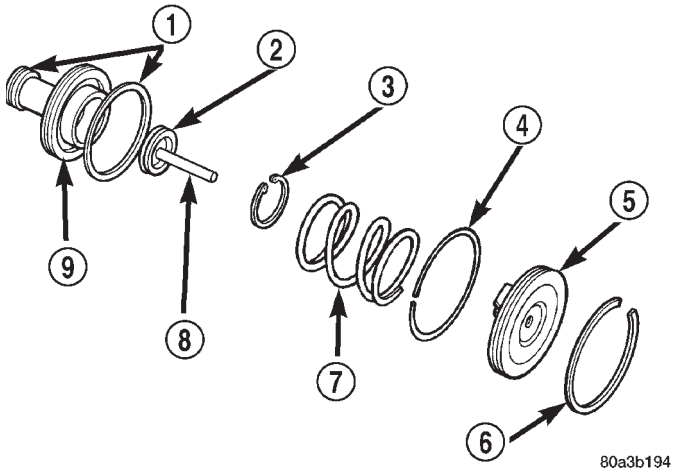


Fig. 167 Front Servo

1 – PISTON RINGS
2 – O-RING
3 – SNAP-RING
4 – SEAL RING
5 – PISTON ROD GUIDE
6 – SNAP-RING
7 – SERVO SPRING
8 – PISTON ROD
9 – SERVO PISTON

REAR SERVO PISTON

DISASSEMBLY

(1) Remove small snap ring and remove plug and spring from servo piston (Fig. 168).
(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.

OIL PUMP AND REACTION SHAFT SUPPORT

DISASSEMBLY

(1) Remove seal ring from housing and reaction shaft support (Fig. 169).
(2) Mark pump housing and support assembly for alignment reference.
(3) Remove bolts attaching pump body to support (Fig. 170).
(4) Separate support from pump housing (Fig. 171).
(5) Remove inner and outer gears from reaction shaft support (Fig. 172).

DISASSEMBLY AND ASSEMBLY (Continued)

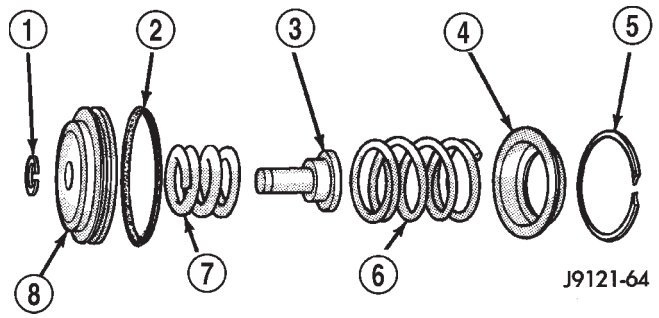


Fig. 168 Rear Servo Components

1 – SNAP RING
2 – PISTON SEAL
3 – PISTON PLUG
4 – SPRING RETAINER
5 – SNAP RING
6 – PISTON SPRING
7 – CUSHION SPRING
8 – PISTON

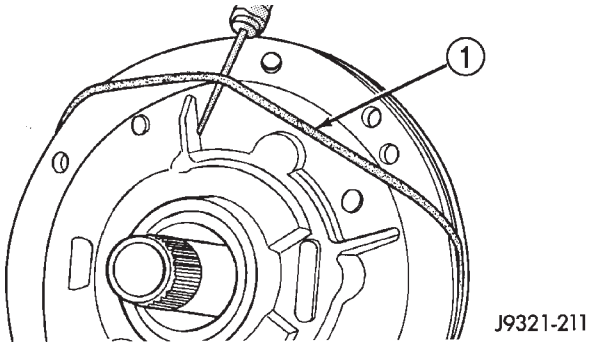


Fig. 169 Removing Pump Seal Ring

1 – PUMP HOUSING SEAL RING

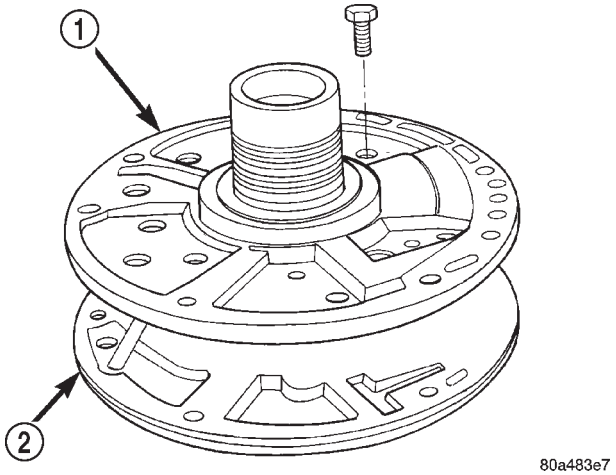


Fig. 170 Pump Support Bolts

1 – REACTION SHAFT SUPPORT
2 – PUMP

(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. 173).

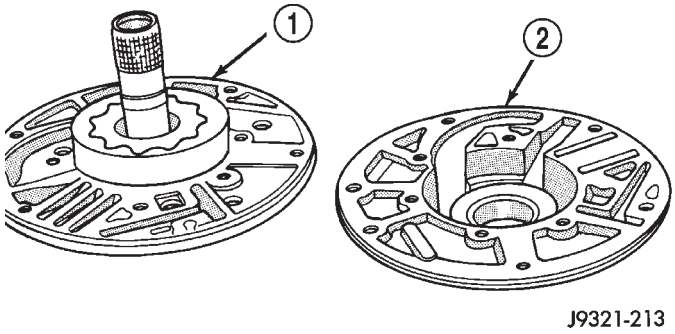


Fig. 171 Separating Pump Housing From Reaction Shaft Support

1 – REACTION SHAFT SUPPORT
2 – PUMP HOUSING

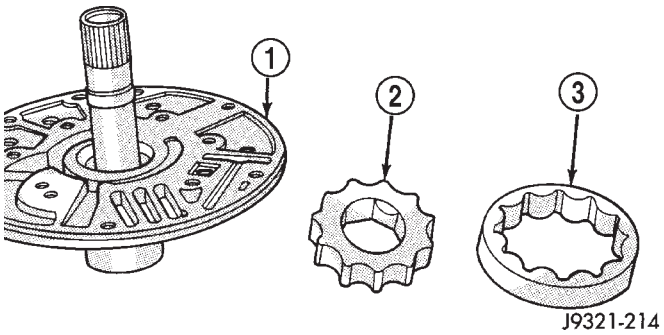


Fig. 172 Pump Gear Removal

1 – REACTION SHAFT SUPPORT
2 – INNER GEAR
3 – OUTER GEAR

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. 174).

(2) Install new pump bushing with Tool Handle C-4171 and Bushing Installer SP-5117 (Fig. 174). Bushing should be flush with pump housing bore.

(3) Stake new pump bushing in two places with blunt punch (Fig. 175). Remove burrs from stake points with knife blade afterward.

DISASSEMBLY AND ASSEMBLY (Continued)

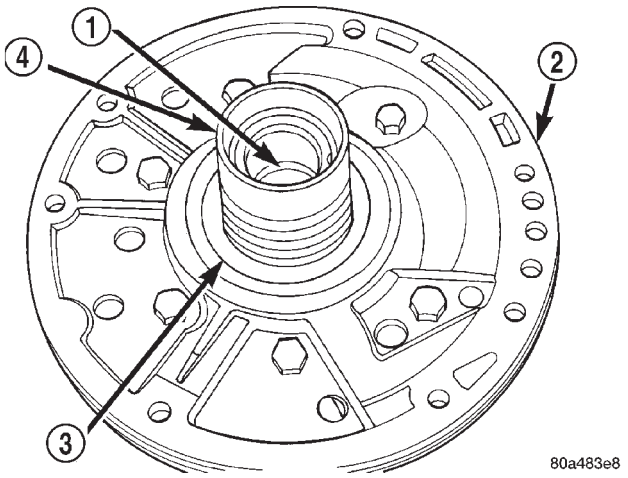


Fig. 173 Support Hub Thrust Washer

1 – BUSHING
2 – REACTION SHAFT SUPPORT
3 – THRUST WASHER
4 – HUB

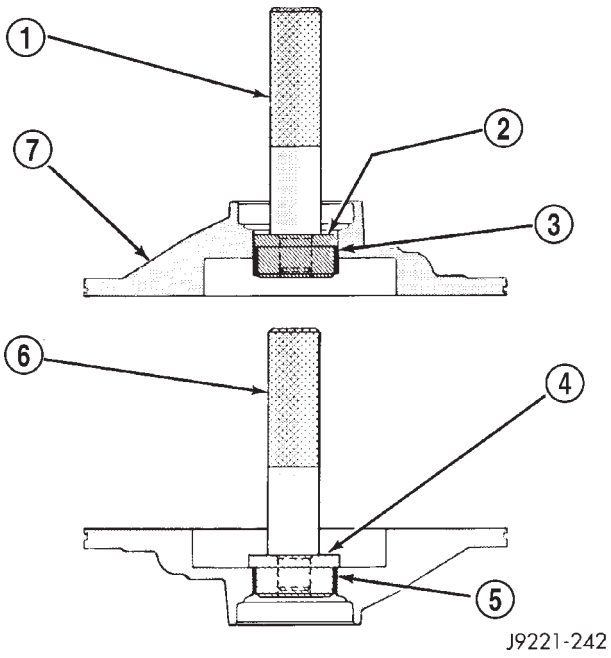


Fig. 174 Removing Oil Pump Bushing

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL SP-3551
3 – BUSHING
4 – SPECIAL TOOL SP-5117
5 – BUSHING
6 – SPECIAL TOOL C-4171
7 – PUMP HOUSING

REACTION SHAFT SUPPORT BUSHING REMOVAL

(1) Assemble Bushing Remover Tools SP-1191, 3633 and 5324 (Fig. 176). **Do not clamp any part of reaction shaft or support in vise.**

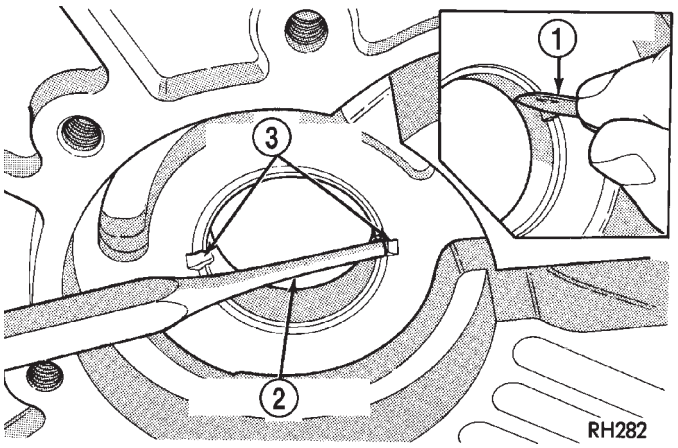


Fig. 175 Staking Oil Pump Bushing

1 – NARROW BLADE
2 – BLUNT PUNCH
3 – TWO STAKES

(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. 176).

(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.

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. 177).

(4) Install outer gear in pump housing (Fig. 177). Gear can be installed either way (it is not a one-way fit).

(5) Install pump inner gear (Fig. 178).

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).

DISASSEMBLY AND ASSEMBLY (Continued)

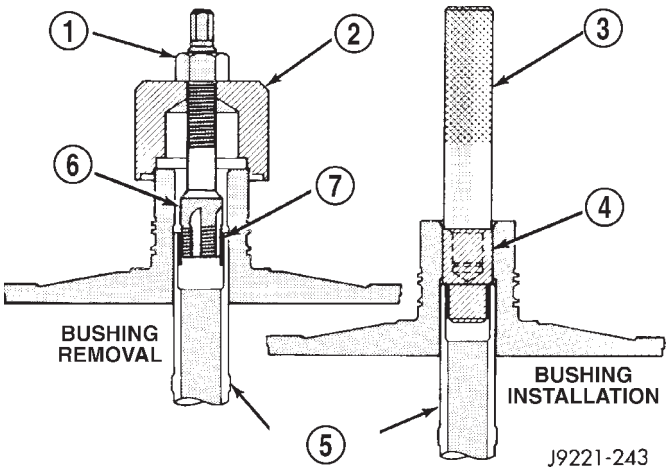


Fig. 176 Replacing Reaction Shaft Support Bushing

1 – SPECIAL TOOL SP-1191
2 – SPECIAL TOOL SP-3633
3 – SPECIAL TOOL C-4171
4 – SPECIAL TOOL SP-5325
5 – REACTION SHAFT
6 – SPECIAL TOOL SP-5324
7 – BUSHING

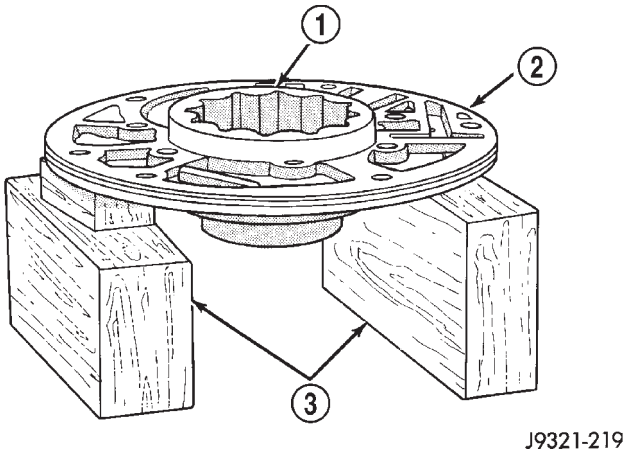


Fig. 177 Supporting Pump And Installing Outer Gear

1 – OUTER GEAR
2 – PUMP HOUSING
3 – WOOD BLOCKS

(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. 179). Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

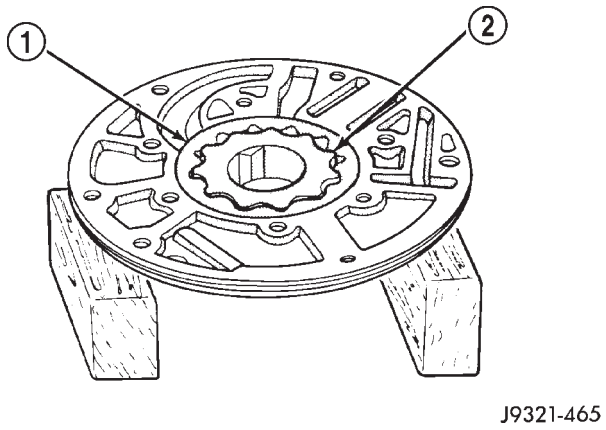


Fig. 178 Pump Inner Gear Installation

1 – OUTER GEAR
2 – INNER GEAR

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.

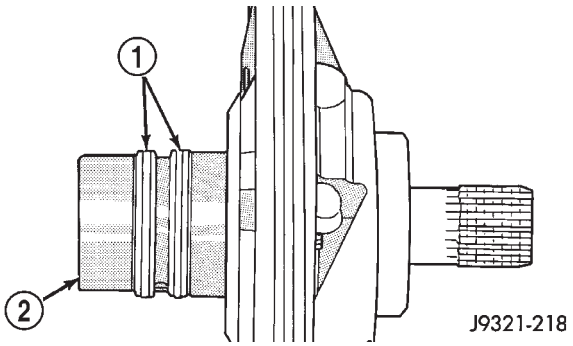


Fig. 179 Hub Seal Ring Position

1 – SEAL RINGS
2 – SUPPORT HUB

(8) Install reaction shaft support on pump housing (Fig. 180).

(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).

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

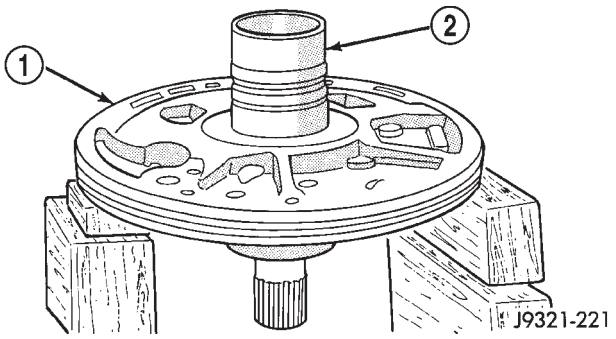


Fig. 180 Assembling Reaction Shaft Support And Pump Housing

1 – PUMP HOUSING
2 – REACTION SHAFT SUPPORT

(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. 181). 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.

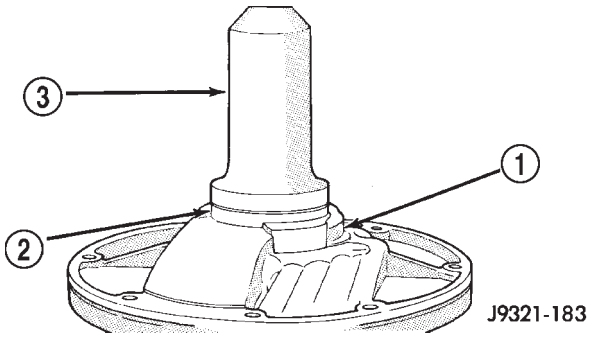


Fig. 181 Pump Oil Seal Installation

1 – PUMP BODY
2 – PUMP SEAL
3 – SPECIAL TOOL C-4193

FRONT CLUTCH

DISASSEMBLY

(1) Remove waved snap ring and remove pressure plate, clutch plates and clutch discs (Fig. 182).

(2) Compress clutch piston spring with Compressor Tool C-3575-A (Fig. 183). 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. 184). 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. 185).

(6) Position spring retainer on top of piston spring (Fig. 186). **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.**

DISASSEMBLY AND ASSEMBLY (Continued)

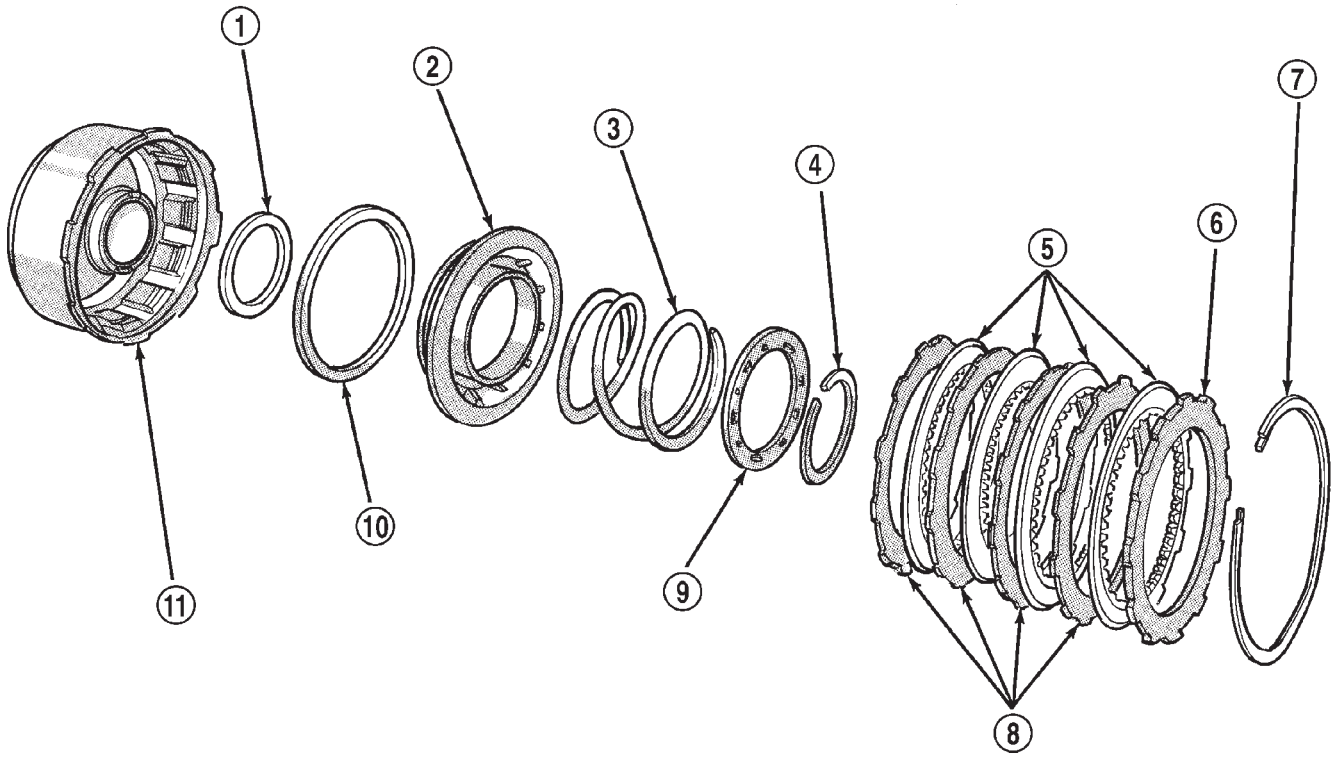


Fig. 182 Front Clutch Components

1 – RETAINER HUB SEAL
2 – CLUTCH PISTON
3 – PISTON SPRING
4 – SPRING RETAINER SNAP RING
5 – CLUTCH DISCS
6 – PRESSURE PLATE
7 – SNAP RING (WAVED)
8 – CLUTCH PLATES
9 – SPRING RETAINER
10 – PISTON SEAL
11 – FRONT CLUTCH RETAINER

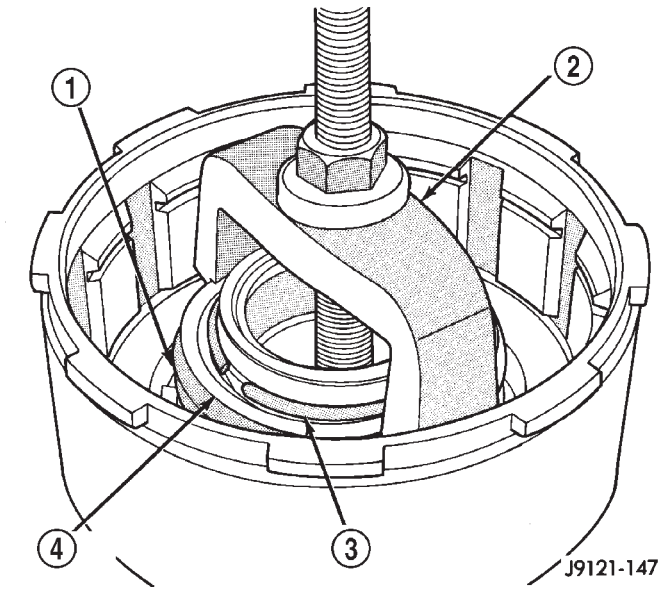


Fig. 183 Compressing Front Clutch Piston Spring

1 – FRONT CLUTCH SPRING
2 – COMPRESSOR TOOL C-3575–A
3 – RETAINER SNAP RING
4 – SPRING RETAINER

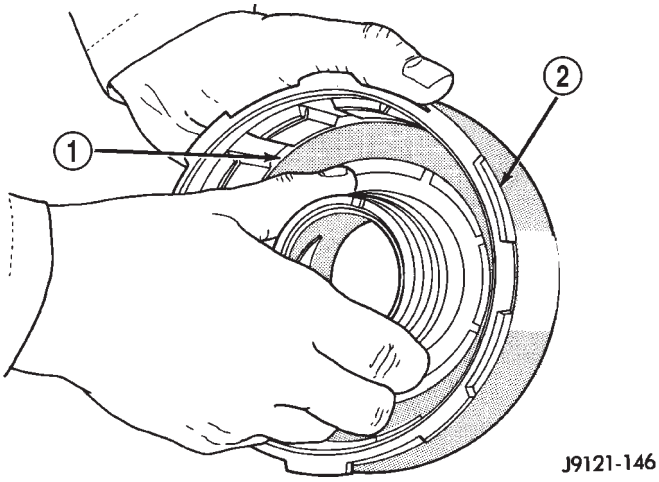


Fig. 184 Front Clutch Piston Installation

1 – CLUTCH PISTON
2 – FRONT CLUTCH RETAINER

DISASSEMBLY AND ASSEMBLY (Continued)

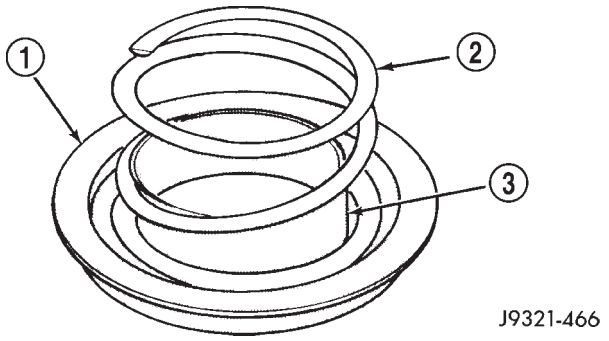


Fig. 185 Clutch Piston Spring Installation

1 – RETAINER
2 – CLUTCH SPRING
3 – PISTON

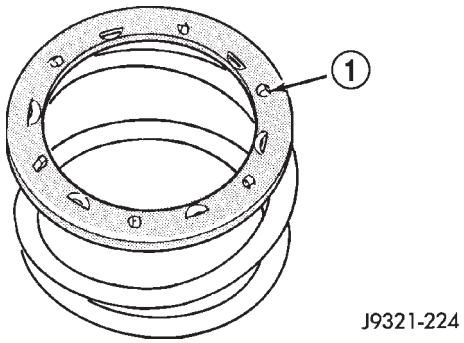


Fig. 186 Correct Spring Retainer Installed Position

1 – SMALL TABS ON RETAINER FACE UPWARD

(7) Compress piston spring and retainer with Compressor Tool C-3575-A (Fig. 183). Then install new snap ring to secure spring retainer and spring.

(8) Install clutch plates and discs (Fig. 182). Install steel plate then disc until all plates and discs are installed. The front clutch uses 4 clutch discs.

(9) Install pressure plate and waved snap ring (Fig. 182).

(10) Using a suitable gauge bar and dial indicator, measure clutch plate clearance (Fig. 187).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 187).

(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.

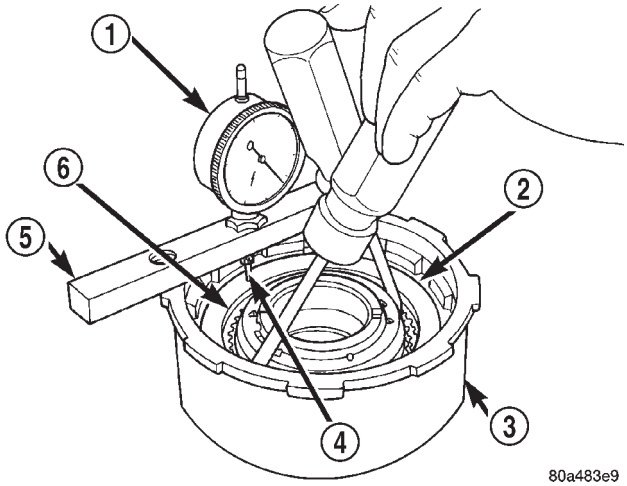


Fig. 187 Measuring Front Clutch Pack Clearance

1 – DIAL INDICATOR
2 – WAVED SNAP-RING
3 – FRONT CLUTCH
4 – POINTER
5 – GAUGE BAR
6 – PRESSURE PLATE

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. 188).

(4) Remove top pressure plate, clutch discs, steel plates, bottom pressure plate and wave snap ring and wave spring (Fig. 188).

(5) Remove clutch piston with rotating motion.

(6) Remove and discard piston seals.

(7) Remove input shaft snap-ring (Fig. 189). It may be necessary to press the input shaft in slightly to relieve tension on the snap-ring

(8) Press input shaft out of retainer with shop press and suitable size press tool. Use a suitably sized press tool to support the retainer as close to the input shaft as possible.

DISASSEMBLY AND ASSEMBLY (Continued)

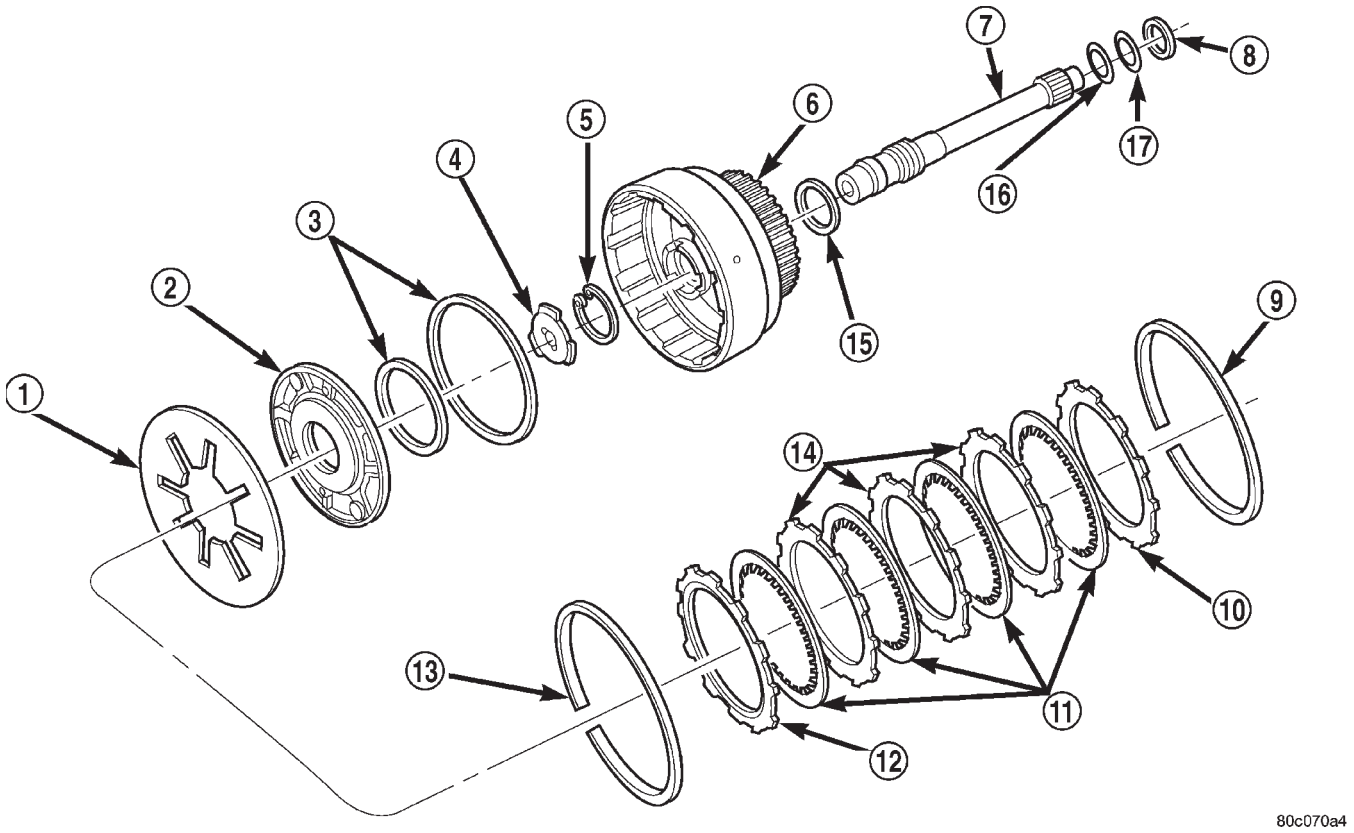


Fig. 188 Rear Clutch Components

1 – PISTON SPRING
2 – REAR CLUTCH PISTON
3 – CLUTCH PISTON SEALS
4 – OUTPUT SHAFT THRUST WASHER (METAL)
5 – INPUT SHAFT SNAP RING
6 – REAR CLUTCH RETAINER
7 – INPUT SHAFT
8 – REAR CLUTCH THRUST WASHER (FIBER)
9 – CLUTCH PACK SNAP RING (SELECTIVE)
10 – TOP PRESSURE PLATE
11 – CLUTCH DISCS (4)
12 – BOTTOM PRESSURE PLATE
13 – WAVE SPRING
14 – CLUTCH PLATES (3)
15 – RETAINER SEAL RING
16 – SHAFT REAR SEAL RING (PLASTIC)
17 – SHAFT FRONT SEAL RING (TEFLON)

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. 190).

(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. 189).

(5) Invert retainer and press input shaft in opposite direction until snap-ring is seated.

(6) Install new seals on clutch piston. Be sure lip of each seal faces interior of clutch retainer.

(7) Lubricate lip of piston seals with generous quantity of Mopar® Door Ease. Then lubricate retainer hub and bore with light coat of transmission fluid.

(8) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.020” thick), can be used to guide seals into place if necessary.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip. In addition, never use any type of metal tool to help ease the piston seals into place. Metal tools will cut, shave, or score the seals.

(9) Install piston spring in retainer and on top of piston (Fig. 193). Concave side of spring faces downward (toward piston).

(10) Install wave spring in retainer (Fig. 193). Be sure spring is completely seated in retainer groove.

DISASSEMBLY AND ASSEMBLY (Continued)

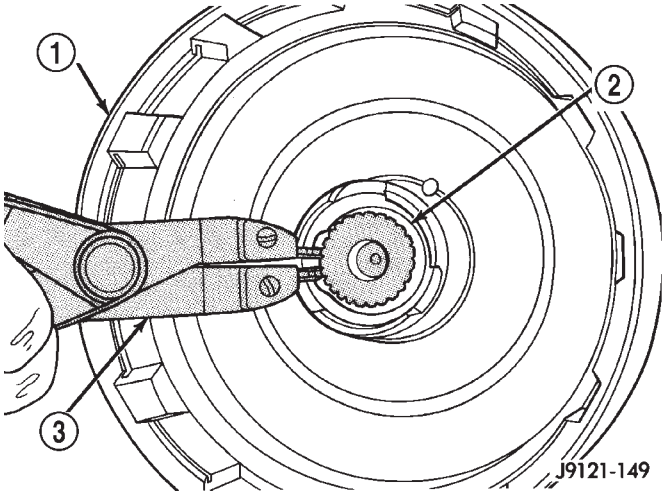


Fig. 189 Removing/Installing Input Shaft Snap-Ring

1 – REAR CLUTCH RETAINER
2 – INPUT SHAFT SNAP RING
3 – SNAP RING PLIERS

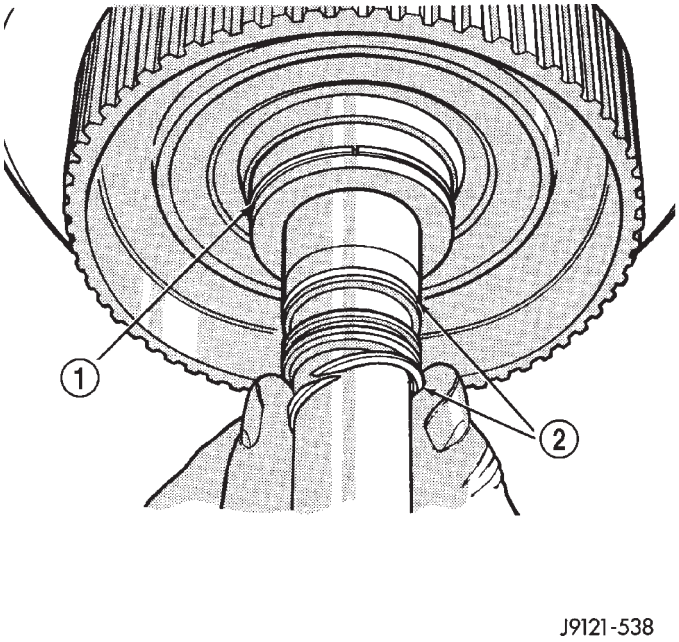


Fig. 190 Rear Clutch Retainer And Input Shaft Seal Ring Installation

1 – REAR CLUTCH RETAINER HUB SEAL RING
2 – INPUT SHAFT SEAL RINGS

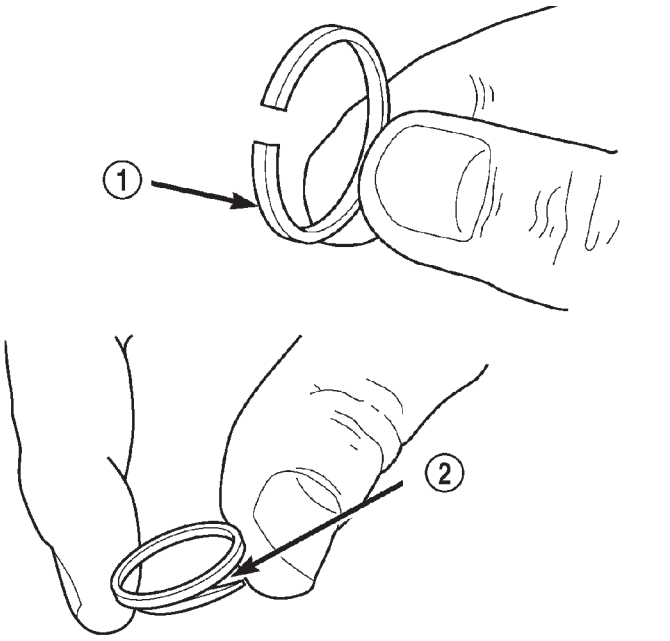


Fig. 191 Input Shaft Seal Ring Identification

1 – PLASTIC REAR SEAL RING
2 – TEFLON FRONT SEAL RING (SQUEEZE RING TOGETHER SLIGHTLY BEFORE INSTALLATION FOR BETTER FIT)

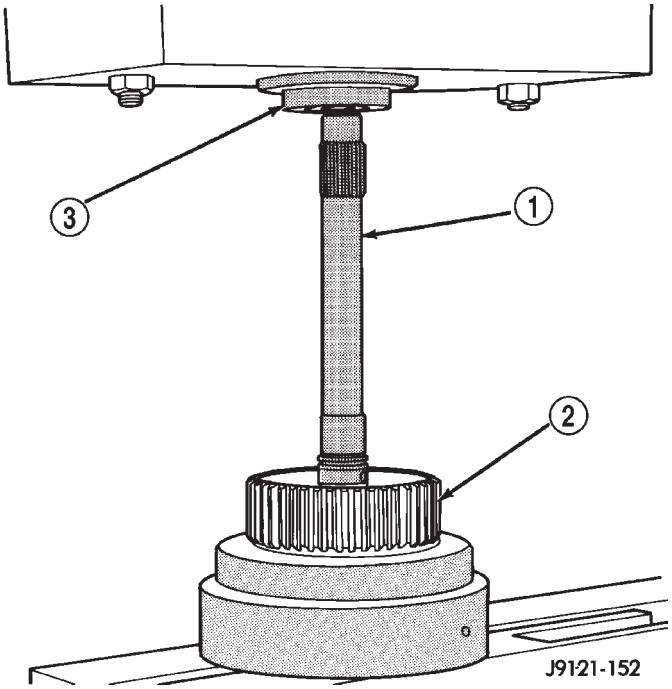


Fig. 192 Pressing Input Shaft Into Rear Clutch Retainer

1 – INPUT SHAFT
2 – REAR CLUTCH RETAINER
3 – PRESS RAM

DISASSEMBLY AND ASSEMBLY (Continued)

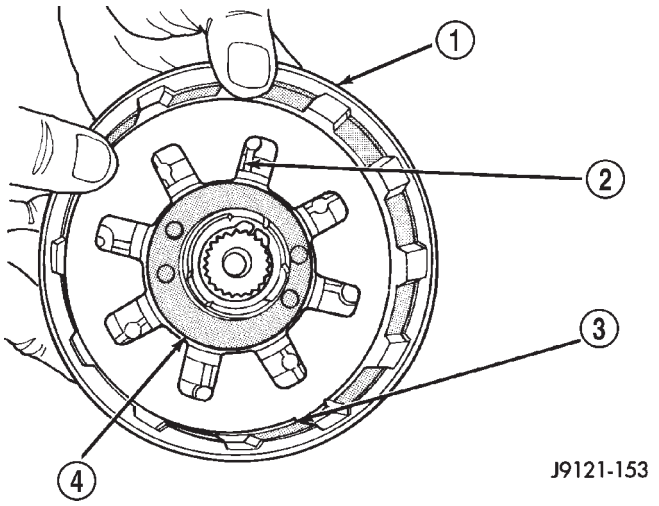


Fig. 193 Piston Spring/Wave Spring Position

1 – REAR CLUTCH RETAINER
2 – PISTON SPRING
3 – WAVE SPRING
4 – CLUTCH PISTON

(11) Install bottom pressure plate (Fig. 188). 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. 188).

(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. 194).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 194).

(b) Using two small screw drivers, lift the pressure plate and release it.

(c) Zero the dial indicator.

(d) Lift the pressure plate until it contacts the snap-ring and record the dial indicator reading.

Clearance should be 0.64 - 1.14 mm (0.025 - 0.045 in.). If clearance is incorrect, steel plates, discs, selective snap ring and pressure plates may have to be changed.

The selective snap ring thicknesses are:

- .107–.109 in.
- .098–.100 in.
- .095–.097 in.
- .083–.085 in.
- .076–.078 in.
- .071–.073 in.
- .060–.062 in.

(16) Coat rear clutch thrust washer with petroleum jelly and install washer over input shaft and into clutch retainer (Fig. 195). Use enough petroleum jelly to hold washer in place.

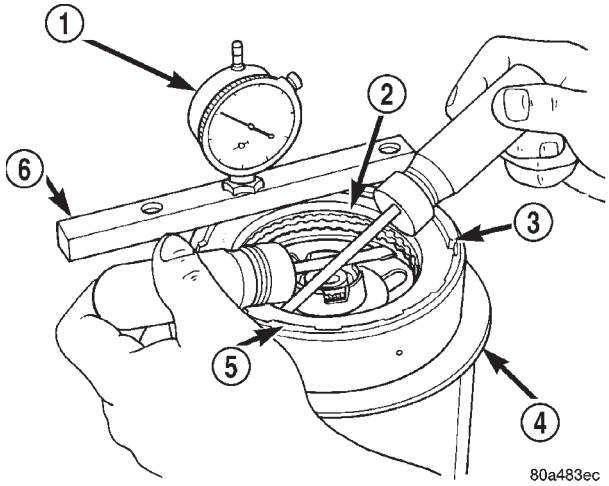


Fig. 194 Checking Rear Clutch Pack Clearance

1 – DIAL INDICATOR
2 – PRESSURE PLATE
3 – SNAP RING
4 – STAND
5 – REAR CLUTCH
6 – GAUGE BAR

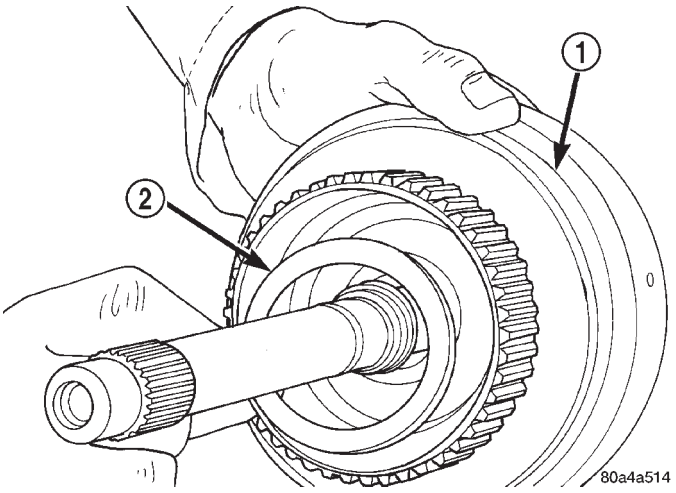


Fig. 195 Installing Rear Clutch Thrust Washer

1 – REAR CLUTCH RETAINER
2 – REAR CLUTCH THRUST WASHER

PLANETARY GEARTRAIN/OUTPUT SHAFT

DISASSEMBLY

(1) Remove planetary snap ring (Fig. 196).

(2) Remove front annulus and planetary assembly from driving shell (Fig. 196).

(3) Remove snap ring that retains front planetary gear in annulus gear (Fig. 197).

DISASSEMBLY AND ASSEMBLY (Continued)

(4) Remove tabbed thrust washer and tabbed thrust plate from hub of front annulus (Fig. 198).

(5) Separate front annulus and planetary gears (Fig. 198).

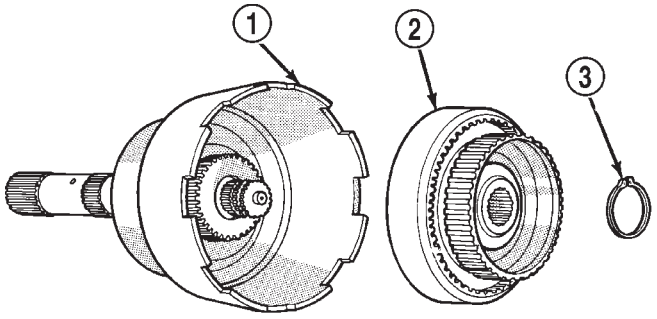
(6) Remove front planetary gear front thrust washer from annulus gear hub.

(7) Separate and remove driving shell, rear planetary and rear annulus from output shaft (Fig. 199).

(8) Remove front planetary rear thrust washer from driving shell.

(9) Remove tabbed thrust washers from rear planetary gear.

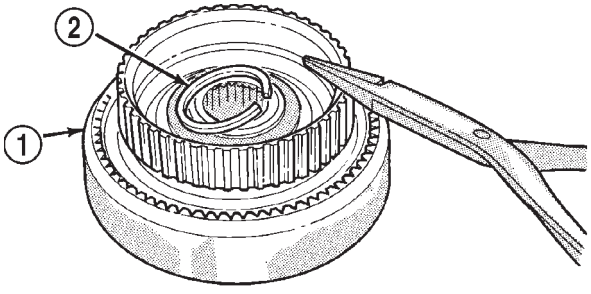
(10) Remove lock ring that retains sun gear in driving shell. Then remove sun gear, spacer and thrust plates.



J9421-175

Fig. 196 Front Annulus And Planetary Assembly Removal

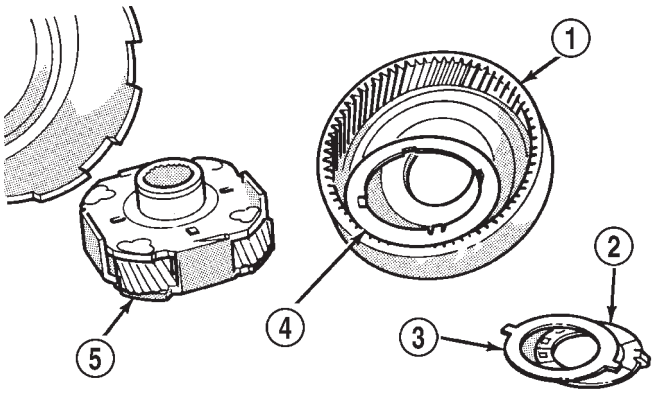
1 – DRIVING SHELL
2 – FRONT ANNULUS AND PLANETARY ASSEMBLY
3 – PLANETARY SNAP RING



J9421-176

Fig. 197 Front Planetary Snap Ring Removal

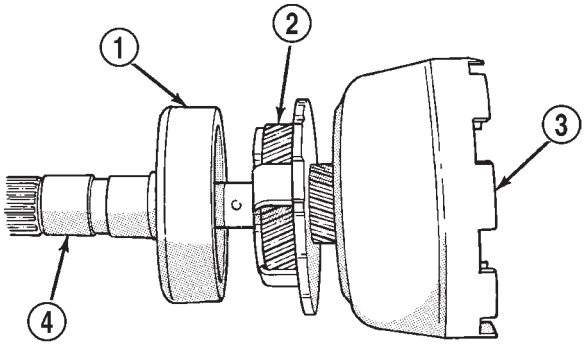
1 – FRONT ANNULUS GEAR
2 – PLANETARY SNAP RING



J9421-177

Fig. 198 Front Planetary And Annulus Gear Disassembly

1 – FRONT ANNULUS
2 – THRUST WASHER
3 – THRUST PLATE
4 – FRONT THRUST WASHER
5 – FRONT PLANETARY



J9421-178

Fig. 199 Removing Driving Shell, Rear Planetary And Rear Annulus

1 – REAR ANNULUS
2 – REAR PLANETARY
3 – DRIVING SHELL
4 – OUTPUT SHAFT

DISASSEMBLY AND ASSEMBLY (Continued)

ASSEMBLY

(1) Lubricate output shaft and planetary components with transmission fluid. Use petroleum jelly to lubricate and hold thrust washers and plates in position.

(2) Assemble rear annulus gear and support if disassembled. Be sure support snap ring is seated and that shoulder-side of support faces rearward (Fig. 200).

(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. 200).

(5) Install assembled rear planetary and annulus gear on output shaft (Fig. 201). Verify that assembly is fully seated on shaft.

(6) Install front thrust washer on rear planetary gear (Fig. 202). 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. 203).

(8) Install thrust plate on sun gear (Fig. 204). Note that driving shell thrust plates are interchangeable. Use either plate on sun gear and at front/rear of shell.

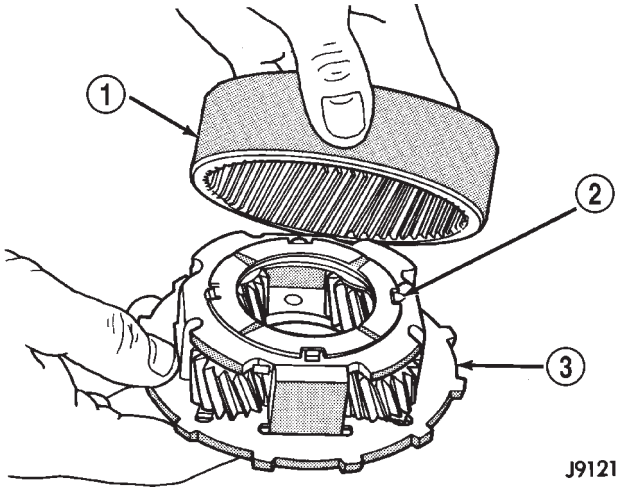


Fig. 200 Assembling Rear Annulus And Planetary Gear

1 – REAR ANNULUS GEAR
2 – TABBED THRUST WASHER
3 – REAR PLANETARY

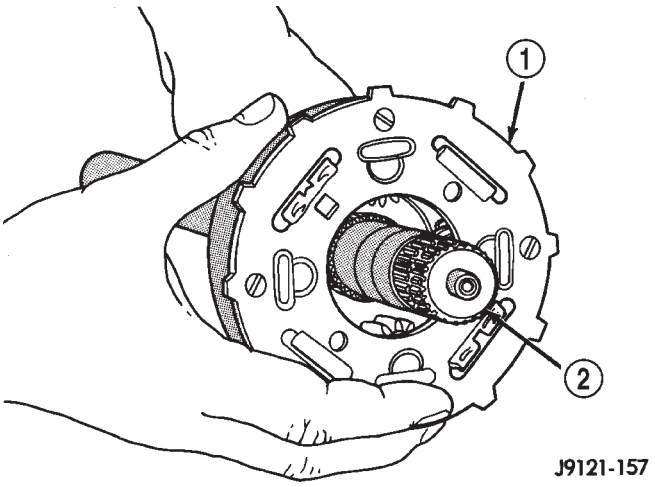


Fig. 201 Installing Rear Annulus And Planetary On Output Shaft

1 – REAR ANNULUS AND PLANETARY GEAR ASSEMBLY
2 – OUTPUT SHAFT

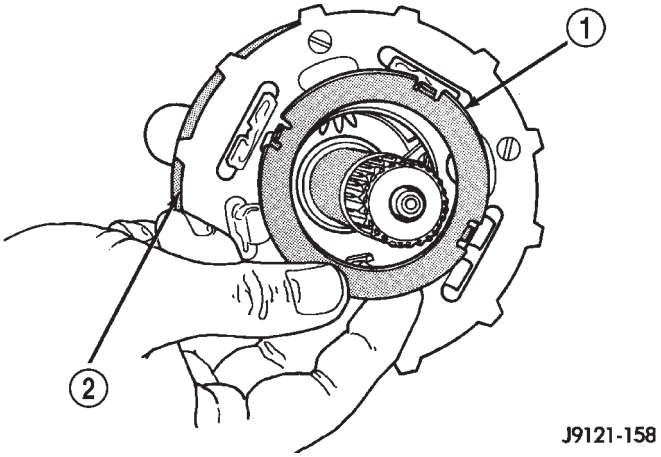


Fig. 202 Installing Rear Planetary Front Thrust Washer

1 – FRONT TABBED THRUST WASHER
2 – REAR PLANETARY GEAR

DISASSEMBLY AND ASSEMBLY (Continued)

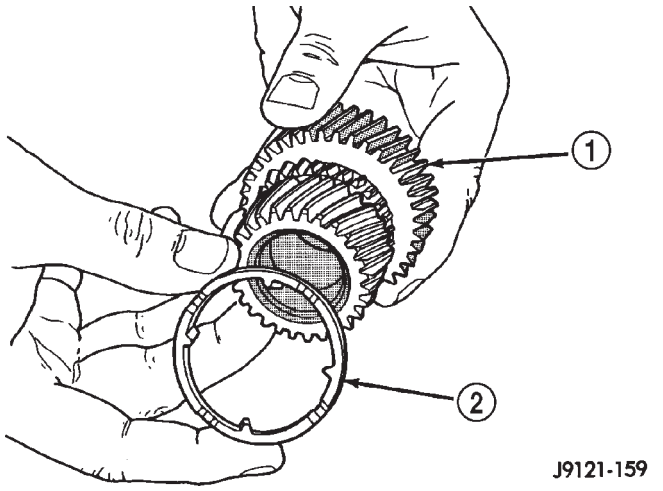


Fig. 203 Installing Spacer On Sun Gear

1 – SUN GEAR
2 – SUN GEAR SPACER

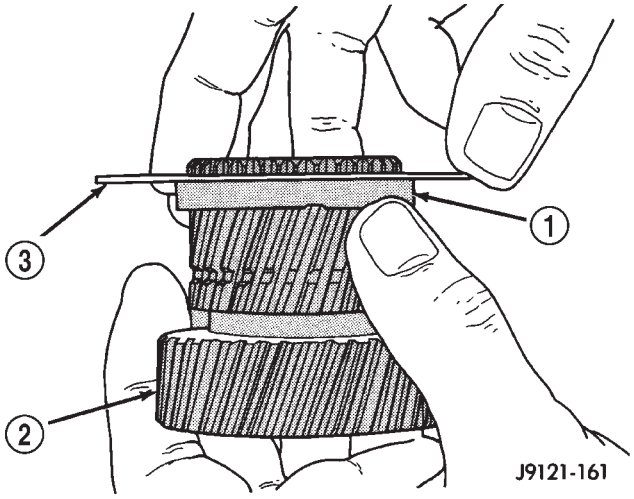


Fig. 204 Installing Driving Shell Front Thrust Plate On Sun Gear

1 – SPACER
2 – SUN GEAR
3 – THRUST PLATE

(9) Hold sun gear in place and install thrust plate over sun gear at rear of driving shell (Fig. 205).

(10) Position wood block on bench and support sun gear on block (Fig. 206). This makes it easier to align and install sun gear lock ring. Keep wood block handy as it will also be used for geartrain end play check.

(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. 207).

(12) Install assembled driving shell and sun gear on output shaft (Fig. 208).

(13) Install rear thrust washer on front planetary gear (Fig. 209). Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

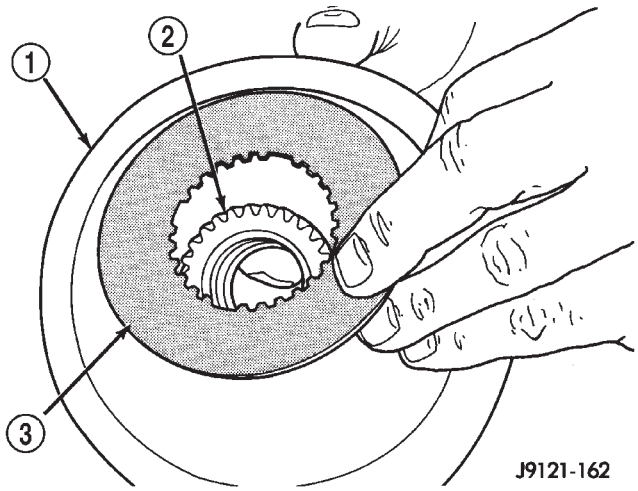


Fig. 205 Installing Driving Shell Rear Thrust Plate

1 – DRIVING SHELL
2 – SUN GEAR
3 – REAR THRUST PLATE

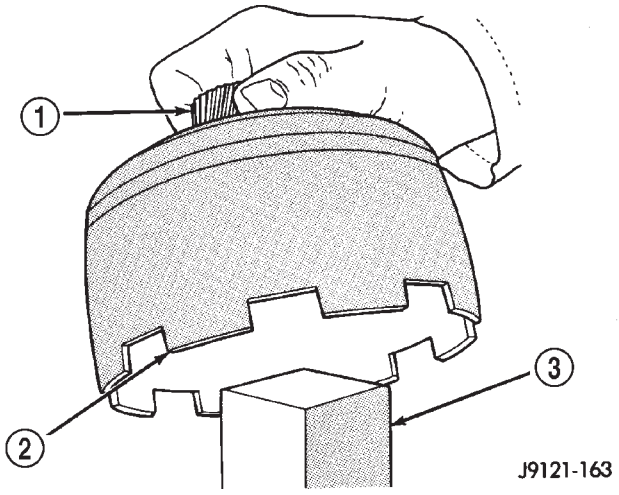


Fig. 206 Supporting Sun Gear On Wood Block

1 – SUN GEAR
2 – DRIVING SHELL
3 – WOOD BLOCK

DISASSEMBLY AND ASSEMBLY (Continued)

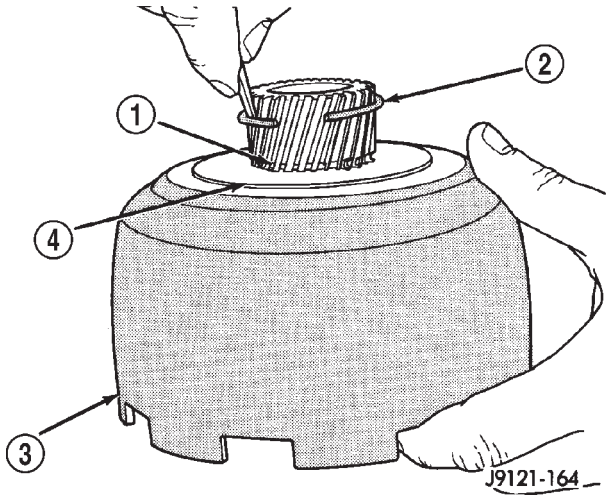


Fig. 207 Installing Sun Gear Lock Ring

1 – LOCK RING GROOVE
2 – SUN GEAR LOCK RING
3 – DRIVING SHELL
4 – REAR THRUST PLATE

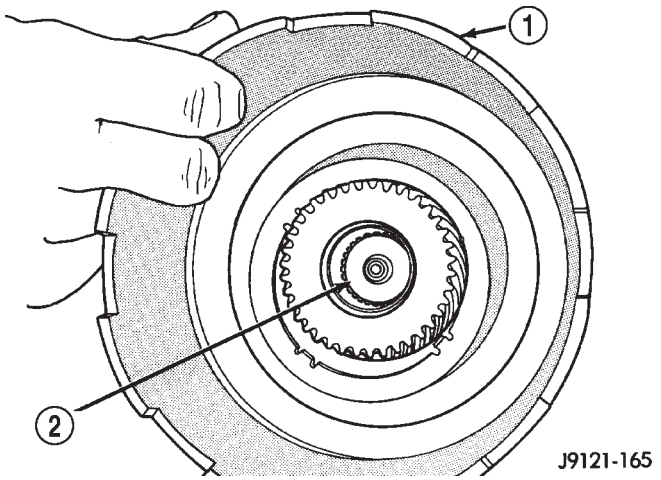


Fig. 208 Installing Assembled Sun Gear And Driving Shell On Output Shaft

1 – SUN GEAR/DRIVING SHELL ASSEMBLY
2 – OUTPUT SHAFT

(14) Install front planetary gear on output shaft and in driving shell (Fig. 210).

(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.

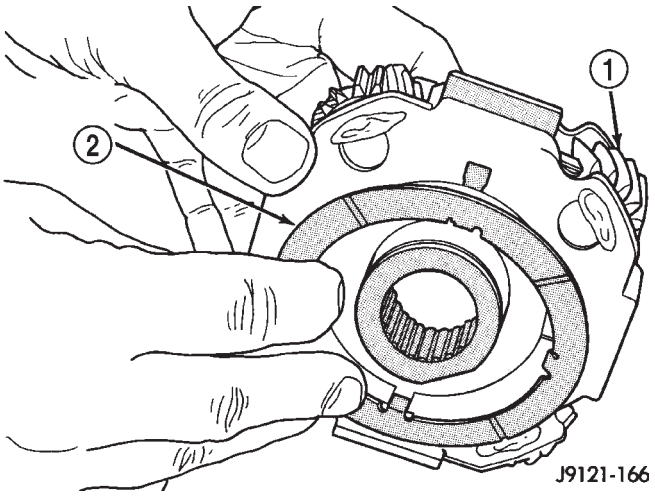


Fig. 209 Installing Rear Thrust Washer On Front Planetary Gear

1 – FRONT PLANETARY GEAR
2 – REAR TABBED THRUST WASHER

(17) Install front annulus on front planetary (Fig. 210).

(18) Position thrust plate on front annulus gear support (Fig. 211). **Note that plate has two tabs on it. These tabs fit in notches of annulus hub.**

(19) Install thrust washer in front annulus (Fig. 212). **Align flat on washer with flat on planetary hub. Also be sure washer tab is facing up.**

(20) Install front annulus snap ring (Fig. 213). 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. 214). 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. 215). 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.

DISASSEMBLY AND ASSEMBLY (Continued)

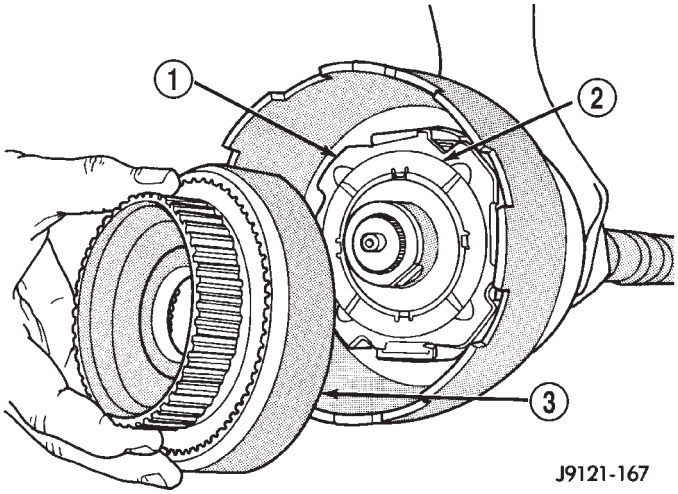


Fig. 210 Installing Front Planetary And Annulus Gears

1 – FRONT PLANETARY GEAR
2 – FRONT THRUST WASHER
3 – FRONT ANNULUS GEAR

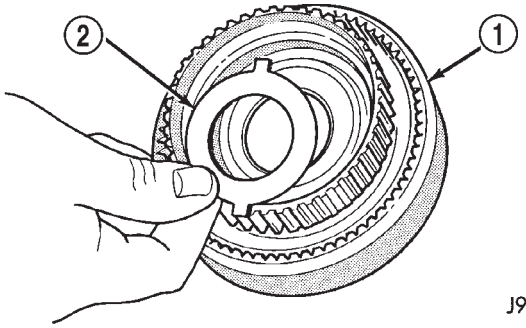


Fig. 211 Positioning Thrust Plate On Front Annulus Support

1 – FRONT ANNULUS
2 – THRUST PLATE

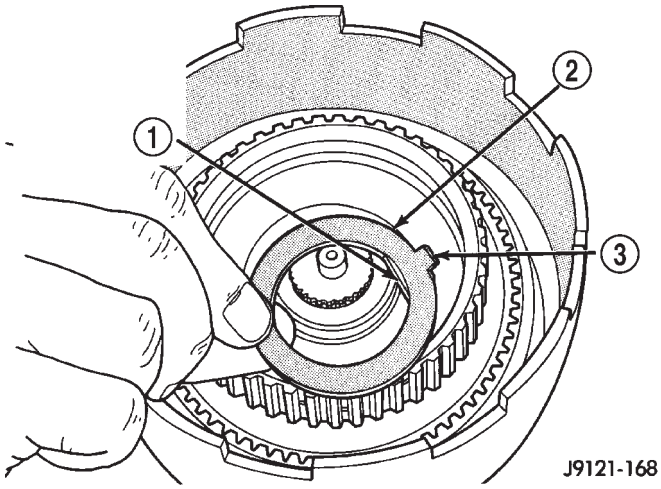


Fig. 212 Installing Front Annulus Thrust Washer

1 – WASHER FLAT ALIGNS WITH FLAT ON PLANETARY HUB
2 – FRONT ANNULUS THRUST WASHER
3 – TAB FACES FRONT

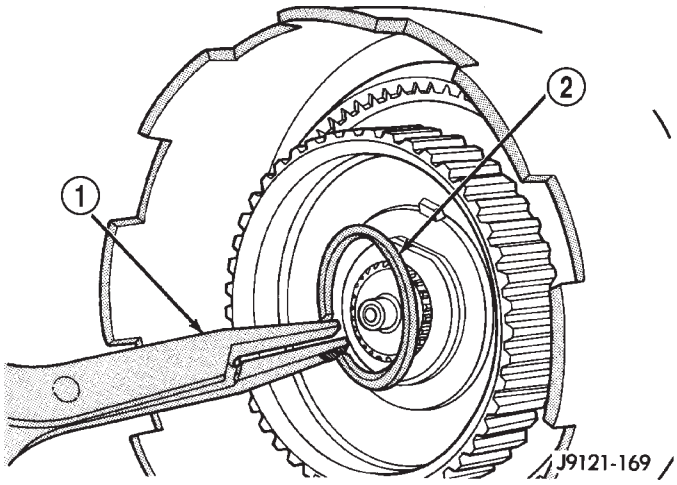


Fig. 213 Installing Front Annulus Snap Ring

1 – SNAP RING PLIERS
2 – FRONT ANNULUS SNAP RING

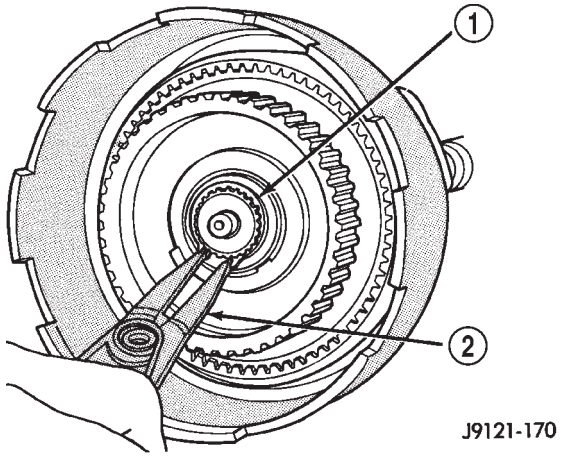


Fig. 214 Installing Planetary Selective Snap Ring

1 – SELECTIVE SNAP RING
2 – SNAP RING PLIERS

DISASSEMBLY AND ASSEMBLY (Continued)

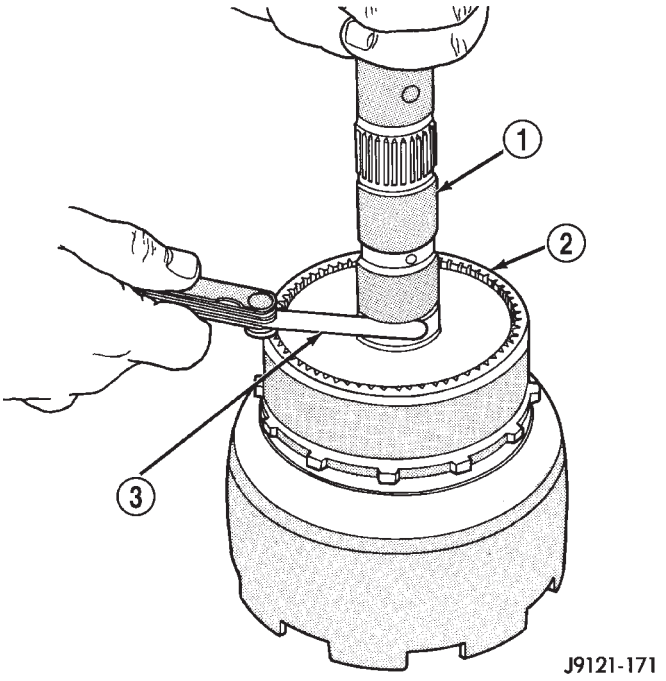


Fig. 215 Checking Planetary Geartrain End Play

1 – OUTPUT SHAFT
2 – REAR ANNULUS GEAR
3 – FEELER GAUGE

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. 216) and the governor valve (Fig. 217), 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.

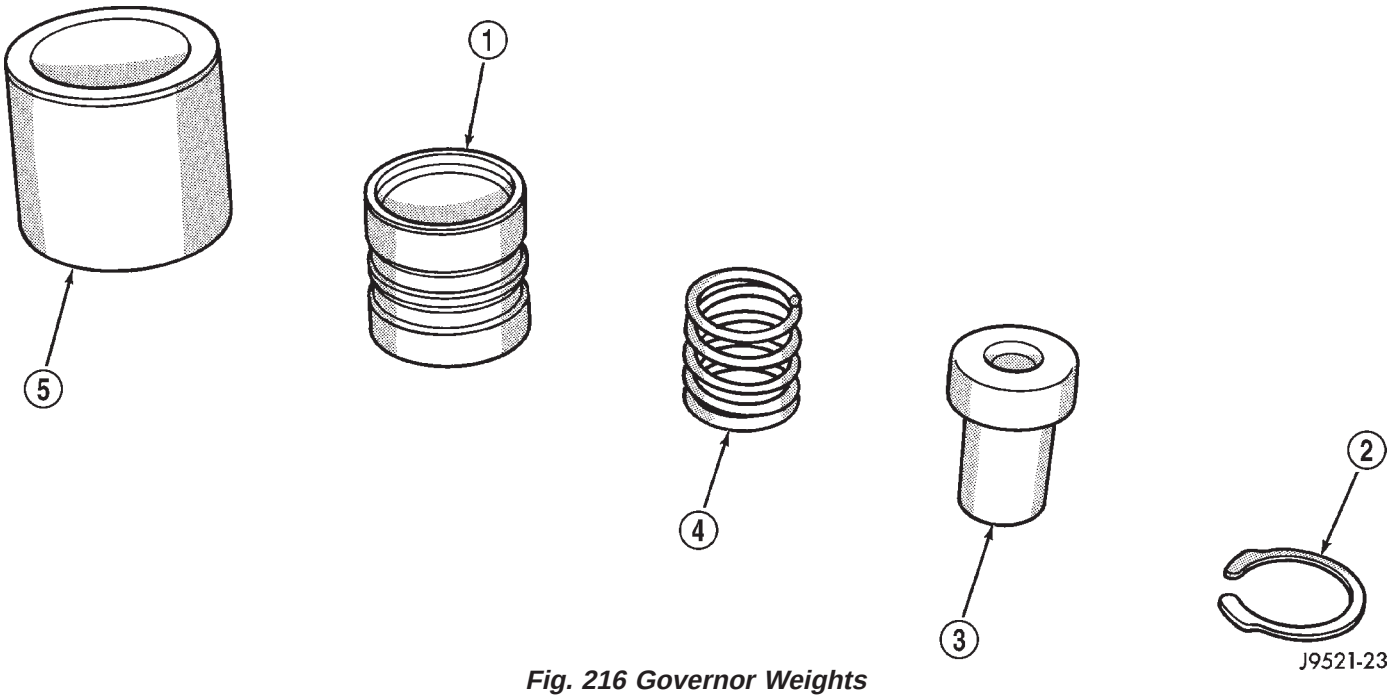


Fig. 216 Governor Weights

1 – INTERMEDIATE WEIGHT
2 – SNAP RING
3 – INNER WEIGHT
4 – INNER WEIGHT SPRING
5 – OUTER WEIGHT

CLEANING AND INSPECTION (Continued)

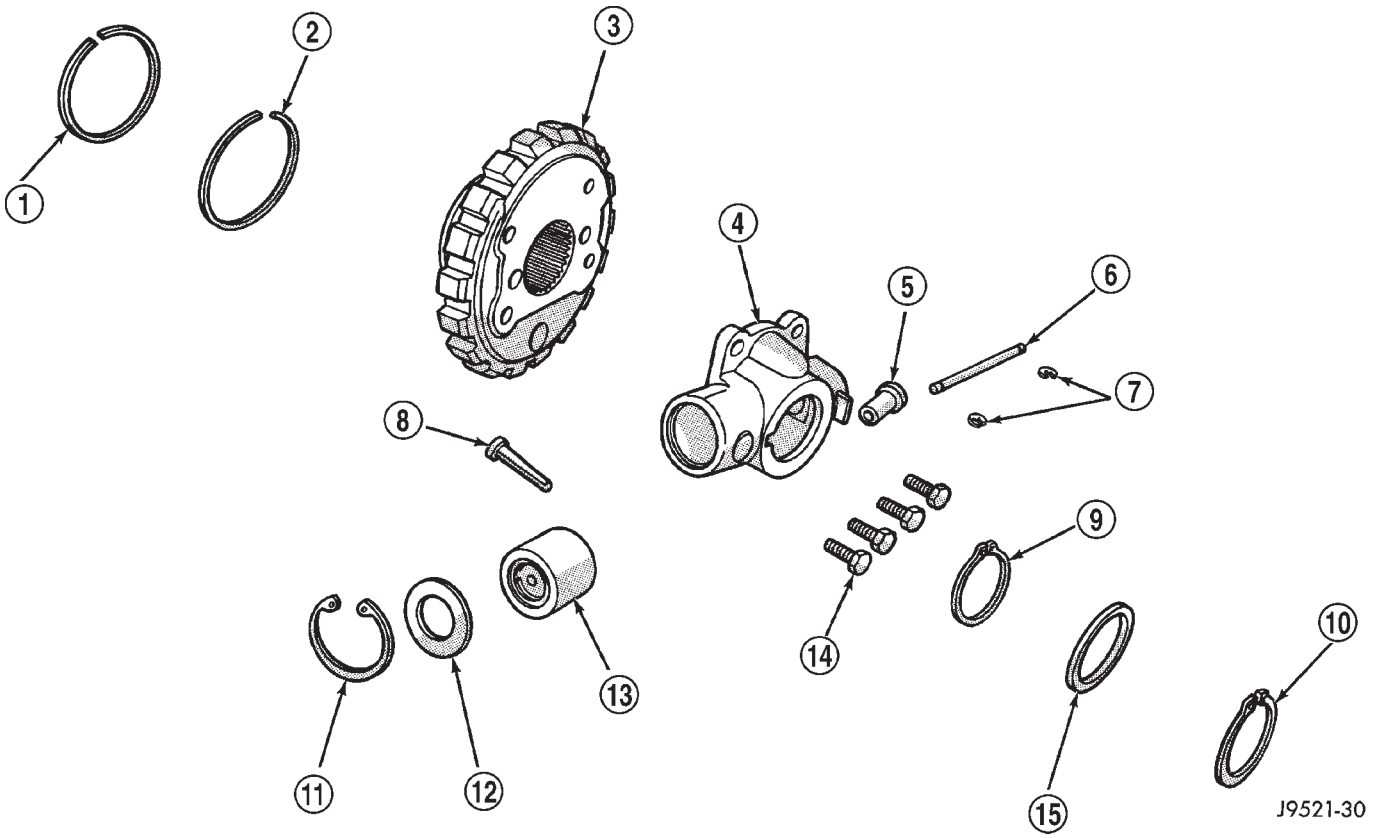


Fig. 217 Governor Components

1 – SEAL RING (PLAIN END)
2 – SEAL RING (HOOK END)
3 – PARK GEAR
4 – GOVERNOR BODY
5 – GOVERNOR VALVE
6 – VALVE SHAFT
7 – E-CLIPS (2)
8 – FILTER
9 – SNAP RING (THIN)
10 – SNAP RING (THICK)
11 – SNAP RING
12 – RETAINER WASHER
13 – GOVERNOR WEIGHT ASSEMBLY
14 – GOVERNOR BODY BOLTS (4)
15 – WASHER

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. 218) and remove the sprag and spring. Then remove the spring clip and reaction plug (Fig. 219). **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. 220). Also be sure the spring is correctly positioned as shown (Fig. 220). The sprag may not retract if the spring is improperly installed.

VALVE BODY

Serviceable valve body components are:

- park lock rod and E-clip
- switch valve and spring
- pressure adjusting screw bracket
- throttle valve lever
- manual lever
- manual lever shaft seal, washer, E-clip and detent ball
- fluid filter
- converter clutch solenoid

The remaining valve body components are serviced only as part of a complete valve body assembly.

Clean the valve body components in a parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution. Dry the parts with compressed air. Make sure all passages are clean and free from obstructions.

CLEANING AND INSPECTION (Continued)

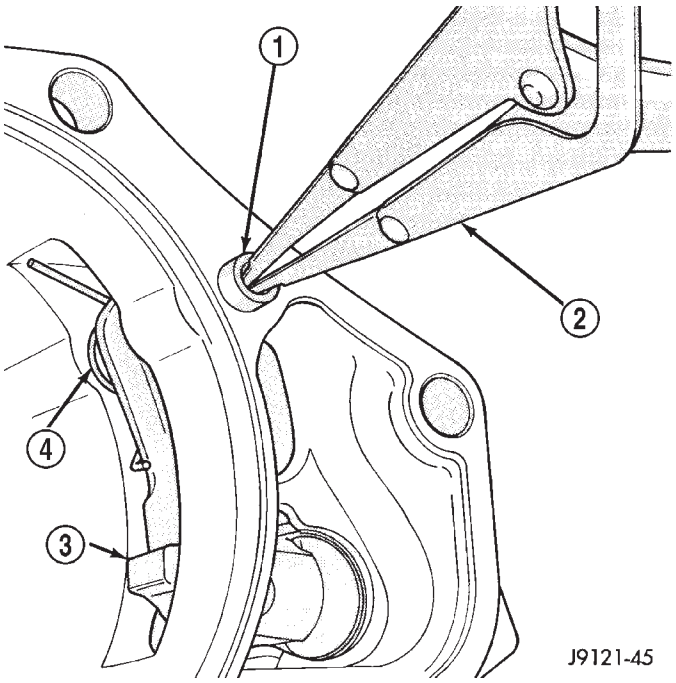


Fig. 218 Park Sprag, Shaft And Spring

1 – SPRAG SHAFT
2 – PARALLEL JAW SNAP RING PLIERS
3 – SPRAG
4 – SPRING

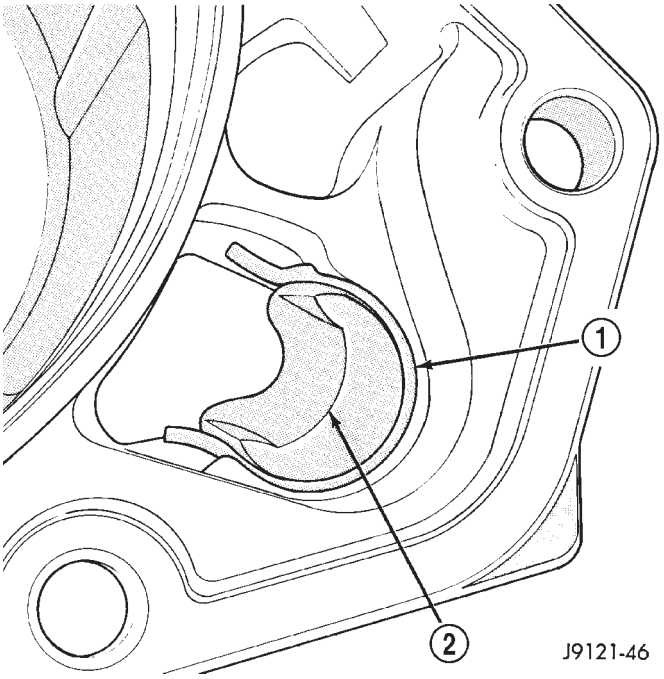


Fig. 219 Park Sprag Reaction Plug And Spring Location

1 – SPRING CLIP
2 – REACTION PLUG

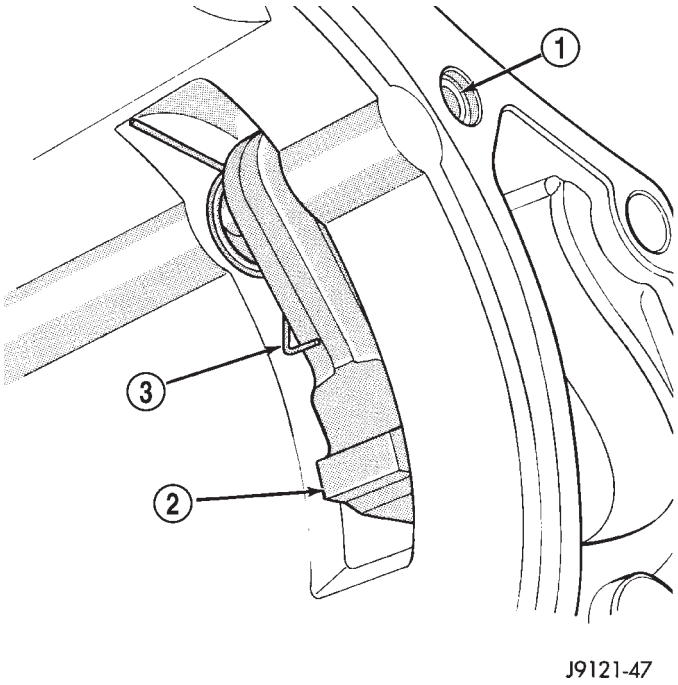


Fig. 220 Correct Position Of Sprag And Spring

1 – SPRAG SHAFT
2 – SPRAG LOCKING LUG
3 – 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.

Inspect the throttle and manual valve levers and shafts. Do not attempt to straighten a bent shaft or correct a loose lever. Replace these components if worn, bent, loose or damaged in any way.

Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straightedge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with crocus cloth. The cloth should be in sheet form and be positioned on a surface plate, sheet of plate glass, or equally flat surface. However, if distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CLEANING AND INSPECTION (Continued)

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. 221). If the coating is damaged or worn through, the valve (or valve body) should be replaced.

Aluminum valves and plugs should not be sanded or polished under any circumstances. However, minor burrs or scratches on steel valves and plugs can be removed with crocus cloth but do not round off the valve or plug edges. Squareness of these edges is vitally important. These edges prevent foreign matter from lodging between the valves, plugs and bore.

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores. Valve body bores do not change dimensionally with use. If the valve body functioned correctly when new, it will continue to operate properly after cleaning and inspection. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

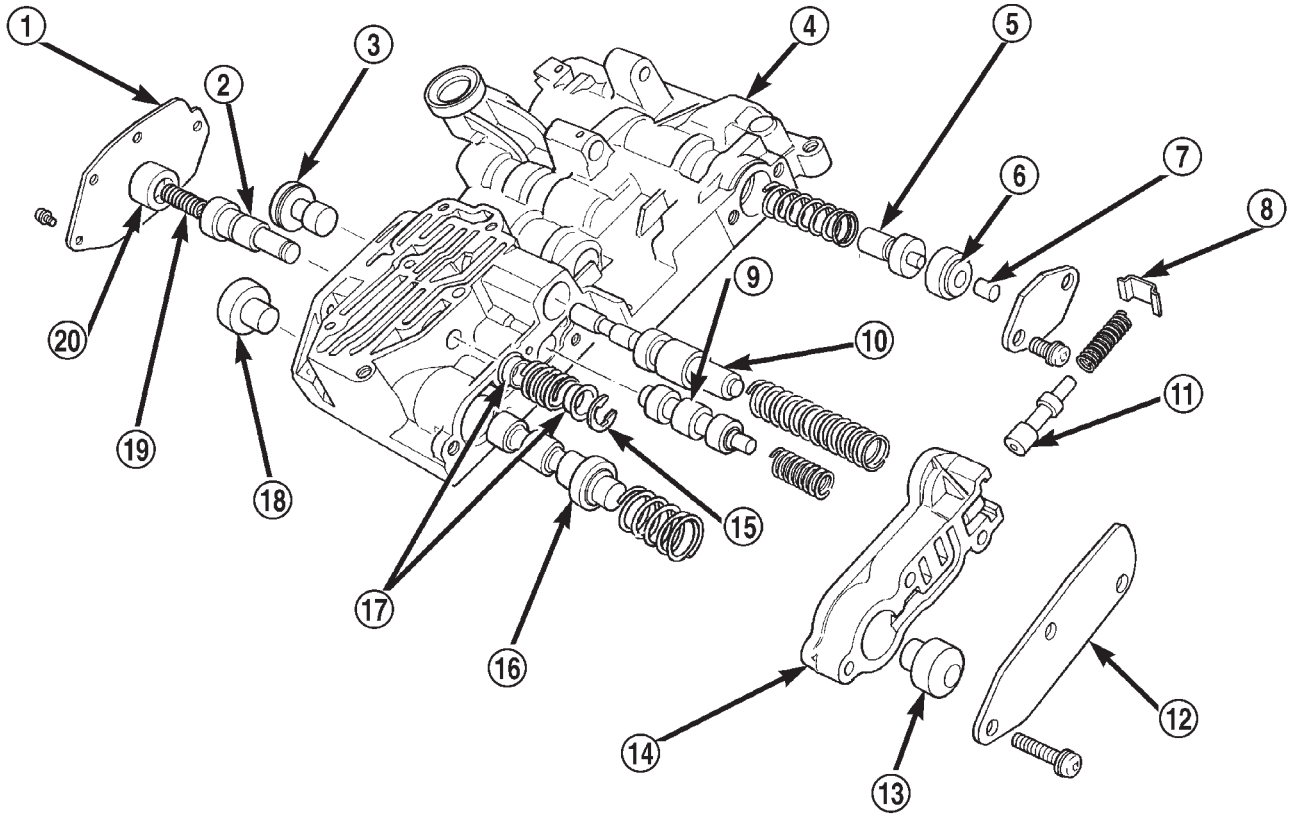


Fig. 221 Valve Body Components

1 – GOVERNOR PLUG END PLATE
2 – SHUTTLE VALVE
3 – 1–2 GOVERNOR PLUG
4 – VALVE BODY
5 – REGULATOR VALVE THROTTLE PRESSURE PLUG
6 – SLEEVE
7 – LINE PRESSURE PLUG
8 – RETAINER
9 – 1–2 SHIFT VALVE
10 – 1–2 SHIFT CONTROL VALVE
11 – KICKDOWN LIMIT VALVE
12 – END PLATE
13 – THROTTLE PRESSURE PLUG
14 – KICKDOWN LIMIT VALVE BODY
15 – E-RING
16 – 2–3 SHIFT VALVE
17 – GUIDES
18 – 2–3 GOVERNOR PLUG
19 – PRIMARY SPRING
20 – SHUTTLE VALVE THROTTLE PLUG

CLEANING AND INSPECTION (Continued)

TRANSMISSION

Clean the case in a solvent tank. Flush the case bores and fluid passages thoroughly with solvent. Dry the case and all fluid passages with compressed air. Be sure all solvent is removed from the case and that all fluid passages are clear.

NOTE: Do not use shop towels or rags to dry the case (or any other transmission component) unless they are made from lint-free materials. Lint will readily adhere to case surfaces and transmission components and will circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

Inspect the case for cracks, porous spots, worn servo bores, or damaged threads. However, the case will have to be replaced if it exhibits damage or wear.

Lubricate the front band adjusting screw and locknut with petroleum jelly and thread it part way into the case. Be sure the screw turns freely and does not bind. Install the locknut on the screw after checking screw thread operation.

Inspect all the transmission bushings during overhaul. Bushing condition is important as worn, scored bushings contribute to low pressures, clutch slip and accelerated wear of other components. Replace worn, or scored bushings, or if doubt exists about bushing condition.

Use recommended tools to replace bushings. The tools are sized and designed to remove, install and seat bushings correctly. The bushing replacement tools are included in Bushing Tool Sets C-3887-B, or C-3887-J.

Pre-sized service bushings are available for replacement purposes. Only the sun gear bushings are not serviced. Replace the gear as an assembly if the bushings are severely scored, or worn.

Heli-Coil inserts are recommended for repairing damaged, stripped or worn threads in aluminum parts. Stainless steel inserts are preferred.

The use of crocus cloth is permissible where necessary, providing it is used carefully. When used on valves, use extreme care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

Lubricate transmission parts with Mopar® ATF Plus 3, Type 7176 transmission fluid during assembly. Use Mopar® Door Ease, or Ru-Glyde to lubricate piston seals and O-rings. Use petroleum jelly on thrust washers and to hold parts in place during reassembly.

OVERRUNNING CLUTCH/LOW-REVERSE DRUM/OVERDRIVE PISTON RETAINER

Clean the overrunning clutch assembly, clutch cam, low-reverse drum, and overdrive piston retainer in solvent. Dry them with compressed air after cleaning.

Inspect condition of each clutch part after cleaning. Replace the overrunning clutch roller and spring assembly if any rollers or springs are worn or damaged, or if the roller cage is distorted, or damaged. Replace the cam if worn, cracked or damaged.

Replace the low-reverse drum if the clutch race, roller surface or inside diameter is scored, worn or damaged. **Do not remove the clutch race from the low-reverse drum under any circumstances. Replace the drum and race as an assembly if either component is damaged.**

Examine the overdrive piston retainer carefully for wear, cracks, scoring or other damage. Be sure the retainer hub is a snug fit in the case and drum. Replace the retainer if worn or damaged.

FRONT SERVO

Clean the servo piston components with solvent and dry them with compressed air. Wipe the band clean with lint free shop towels.

Replace the front band if distorted, lining is burned, flaking off, or worn to the point where the grooves in the lining material are no longer visible.

Inspect the servo components (Fig. 222). 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. 223). 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.

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

CLEANING AND INSPECTION (Continued)

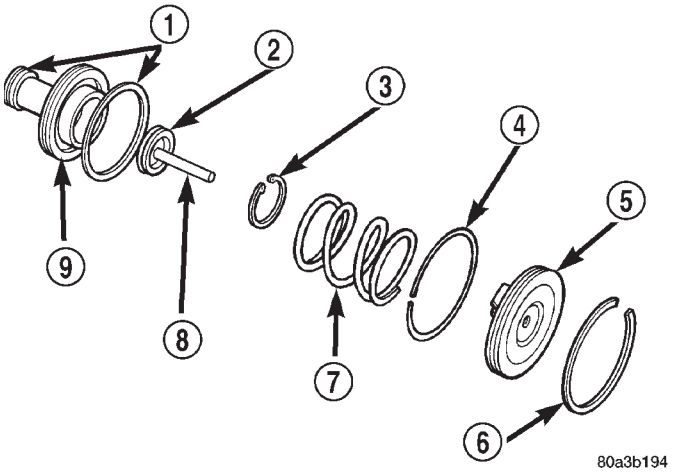


Fig. 222

1 – PISTON RINGS
2 – O-RING
3 – SNAP-RING
4 – SEAL RING
5 – PISTON ROD GUIDE
6 – SNAP-RING
7 – SERVO SPRING
8 – PISTON ROD
9 – SERVO PISTON

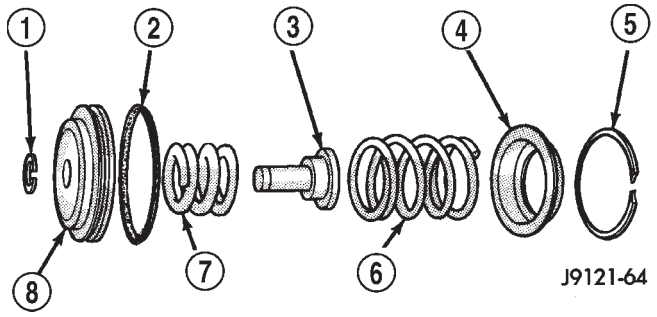


Fig. 223 Rear Servo Components

1 – SNAP RING
2 – PISTON SEAL
3 – PISTON PLUG
4 – SPRING RETAINER
5 – SNAP RING
6 – PISTON SPRING
7 – CUSHION SPRING
8 – PISTON

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. 224). The ball must move freely and not stick.

NOTE: Inspect the clutch retainer bushings carefully (Fig. 225). 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.

CLEANING AND INSPECTION (Continued)

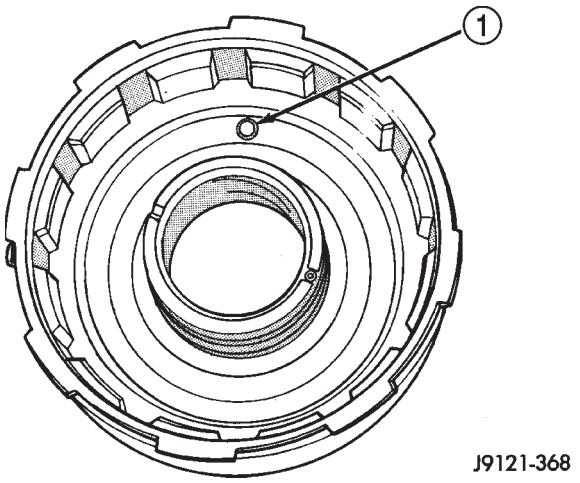


Fig. 224 Front Clutch Piston Retainer Check Ball Location

1 – RETAINER CHECK BALL

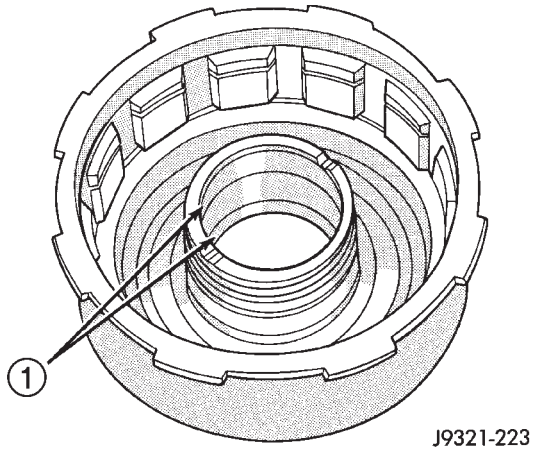


Fig. 225 Retainer Bushing Location/Inspection

1 – FRONT CLUTCH RETAINER BUSHINGS (NON-SERVICEABLE)

REAR CLUTCH

Clean the clutch components with solvent and dry them with compressed air.

Check condition of the input shaft seal rings. It is not necessary to remove or replace rings unless they are broken, cracked, or no longer securely hooked together.

Inspect the input shaft splines and machined surfaces. Very minor nicks or scratches can be smoothed off with crocus cloth. replace the shaft if the splines are damaged, or any of the machined surfaces are severely scored.

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off.

Replace the steel plates and the pressure plate if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston spring and wave spring if either part is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The steel plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged. Also check action of the retainer check ball. The ball must move freely and not stick.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously damaged.

Check thrust washer condition. Washer thickness should be 1.55 to 1.60 mm (0.061 to 0.063 in.). Replace the washer if worn or damaged.

Check condition of the two seal rings on the input shaft and the single seal ring on the piston retainer hub. Replace the seal rings only if severely worn, cracked, or cannot be hooked together.

PLANETARY GEARTRAIN/OUTPUT SHAFT

Clean the intermediate shaft and planetary components in solvent and dry them with compressed air. Do not spin the planetary pinion gears with compressed air.

Inspect the planetary gear sets and annulus gears. The planetary pinions, shafts, washers, and retaining pins are serviceable. However, if a pinion carrier is damaged, the entire planetary gear set must be replaced as an assembly.

Replace the annulus gears if the teeth are chipped, broken, or worn, or the gear is cracked. Replace the planetary thrust plates and the tabbed thrust washers if cracked, scored or worn.

Inspect the machined surfaces of the output shaft. Be sure the oil passages are open and clear. Replace the shaft if scored, pitted, or damaged.

Inspect the sun gear and driving shell. If either component is worn or damaged, remove the sun gear rear retaining ring and separate the sun gear and thrust plate from the driving shell. Then replace the necessary component.

Replace the sun gear as an assembly if the gear teeth are chipped or worn. Also replace the gear as an assembly if the bushings are scored or worn. The sun gear bushings are not serviceable. Replace the thrust plate if worn, or severely scored. Replace the driving shell if distorted, cracked, or damaged in any way.

Replace all snap rings during geartrain assembly. Reusing snap rings is not recommended.

ADJUSTMENTS

GEARSHIFT CABLE

Check adjustment by starting the engine in Park and Neutral. Adjustment is OK if the engine starts only in these positions. Adjustment is incorrect if the engine starts in one but not both positions. If the engine starts in any position other than Park or Neutral, or if the engine will not start at all, the park/neutral position switch may be faulty.

Gearshift Adjustment Procedure

(1) Shift transmission into Park.
(2) Raise vehicle.
(3) Release cable adjuster clamp (at transmission end of cable) to unlock cable.
(4) Unsnap cable from cable mounting bracket on transmission (Fig. 226).
(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.

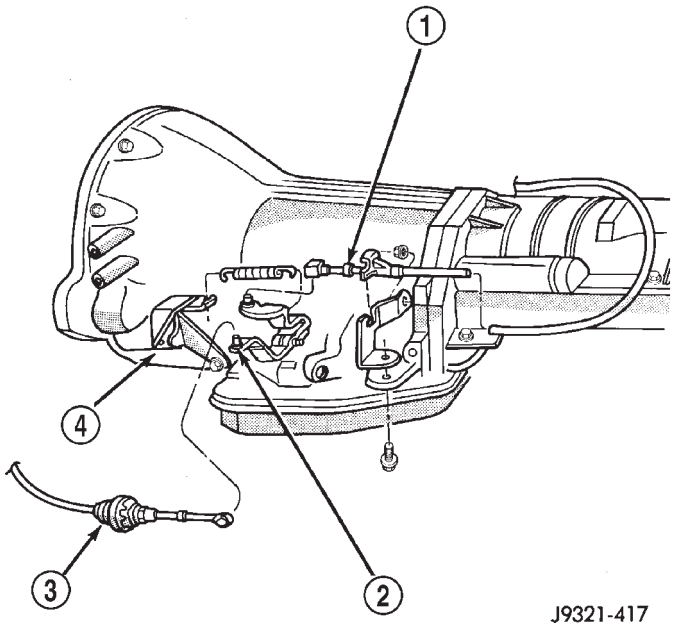


Fig. 226 Shift Cable Attachment At Transmission–Typical

1 – THROTTLE VALVE CABLE
2 – TRANSMISSION SHIFT LEVER
3 – SHIFT CABLE
4 – SHIFT CABLE BRACKET

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. 227).
(4) Turn ignition switch to LOCK position.
(5) Use a spacer to create a one millimeter gap between the shifter pawl and top of the shift gate.
(6) Pull cable forward. Then release cable and press cable lock button down until it snaps in place.
(7) Check adjustment as follows:
(a) Check movement of release shift handle button (floor shift) or release lever (column shift). You 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

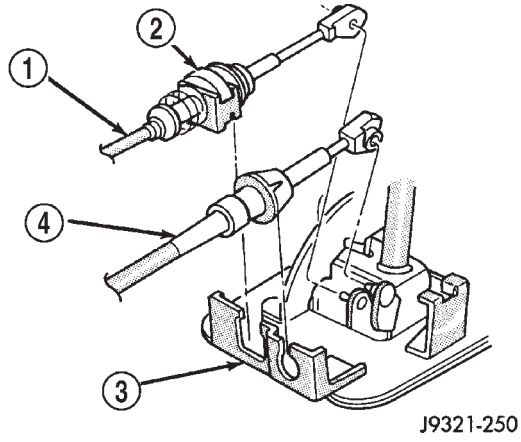


Fig. 227 Park Lock Cable Attachment

1 – PARK LOCK CABLE
2 – CABLE LOCK BUTTON
3 – SHIFT LEVER ASSEMBLY
4 – SHIFT CABLE

ADJUSTMENTS (Continued)

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. 228). 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.

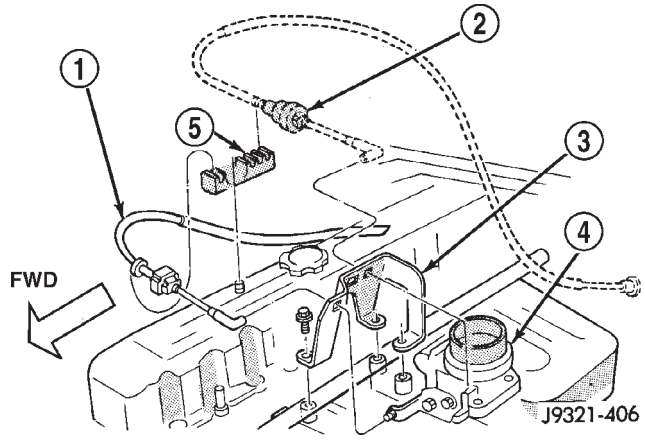


Fig. 228 Throttle Cable Attachment At Engine

1 – TRANSMISSION THROTTLE VALVE CABLE
2 – ACCELERATOR CABLE
3 – CABLE ENGINE BRACKET
4 – THROTTLE BODY
5 – CABLE GUIDE

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. 229) 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.

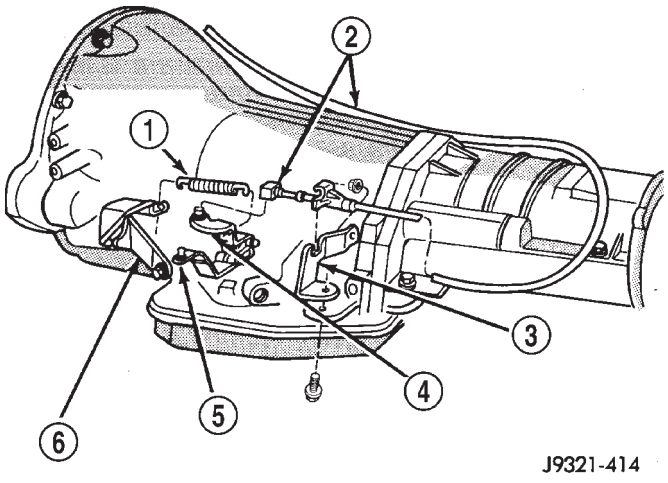


Fig. 229 Throttle Cable Attachment At Transmission

1 – RETURN SPRING
2 – THROTTLE VALVE CABLE
3 – THROTTLE VALVE CABLE BRACKET
4 – THROTTLE VALVE LEVER
5 – GEAR SELECTOR LEVER
6 – SHIFT CABLE BRACKET

- 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.).

ADJUSTMENTS (Continued)

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. 230). 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 appropriate torx socket.

CAUTION: If Adapter C-3705 is needed to reach the adjusting screw, tighten the screw to only 5 N·m (47-50 in. lbs.) torque.

(4) Back off front band adjusting screw 2-1/2 turns for the 30RH and 2-1/4 turns for the 32RH.

(5) Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

(6) Lower vehicle.

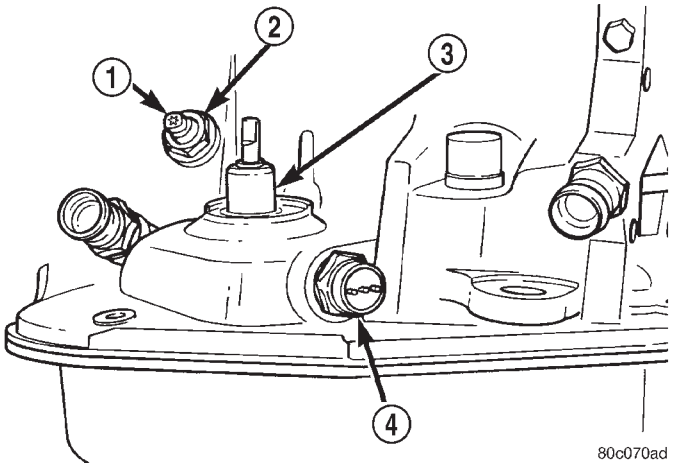


Fig. 230 Front Band Adjustment Screw Location

1 – FRONT BAND ADJUSTING SCREW
2 – LOCK NUT
3 – MANUAL LEVER SHAFT
4 – PARK/NEUTRAL POSITION SWITCH

REAR BAND ADJUSTMENT

The transmission oil pan must be removed for access to the rear band adjusting screw.

(1) Raise vehicle.

(2) Remove transmission oil pan and drain fluid.

(3) Loosen band adjusting screw locknut 5-6 turns. Be sure adjusting screw turns freely in lever.

(4) Tighten adjusting screw to 5 N·m (41 in. lbs.) for the 30RH and 8 N·m (72 in. lbs.) torque for the 32RH (Fig. 231).

(5) Back off adjusting screw 7 turns for the 30RH and 4 turns for the 32RH.

(6) Hold adjusting screw in place and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(7) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(8) Lower vehicle and refill transmission with Mopar® ATF Plus 3, Type 7176, fluid.

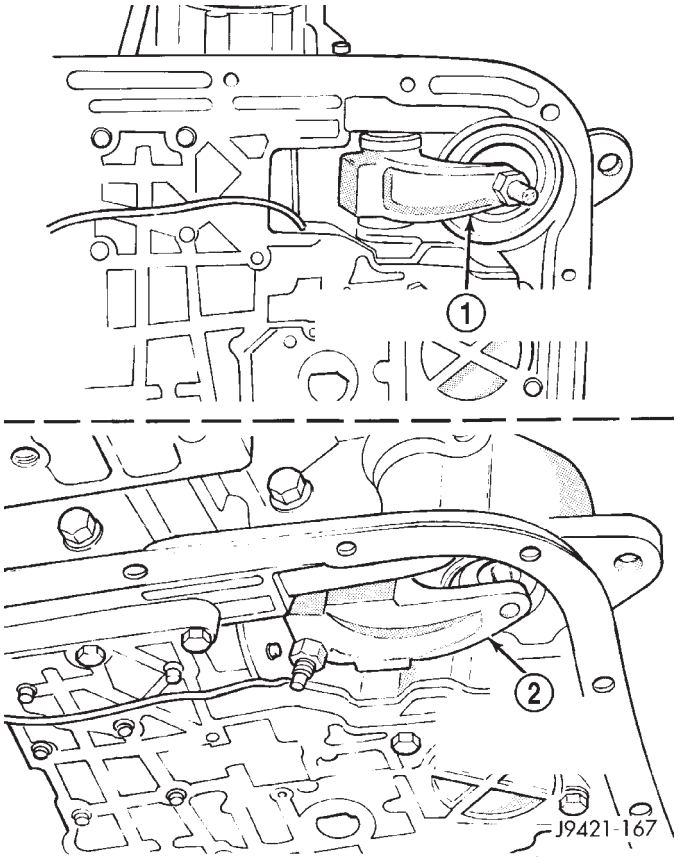


Fig. 231 Rear Band Adjustment Screw Location

1 – 30RH REAR BAND LEVER AND ADJUSTING SCREW
2 – 32RH REAR BAND LEVER AND ADJUSTING SCREW

ADJUSTMENTS (Continued)

VALVE BODY

CONTROL PRESSURE ADJUSTMENTS

There are two control pressure adjustments on the valve body;

- Line Pressure
- Throttle Pressure

Line and throttle pressures are interdependent because each affects shift quality and timing. As a result, both adjustments must be performed properly and in the correct sequence. Adjust line pressure first and throttle pressure last.

LINE PRESSURE ADJUSTMENT

Measure distance from the valve body to the inner edge of the adjusting screw with an accurate steel scale (Fig. 232).

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.

THROTTLE PRESSURE ADJUSTMENT

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 233).

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.

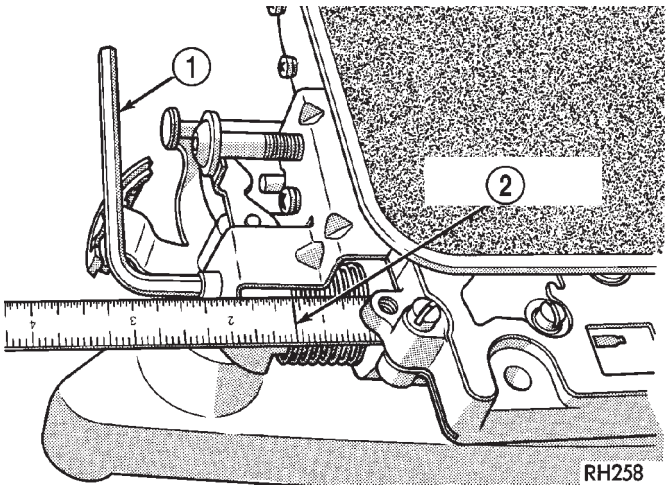


Fig. 232 Line Pressure Adjustment

1 – WRENCH
2 – 1–5/16 INCH

NOTE: The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.

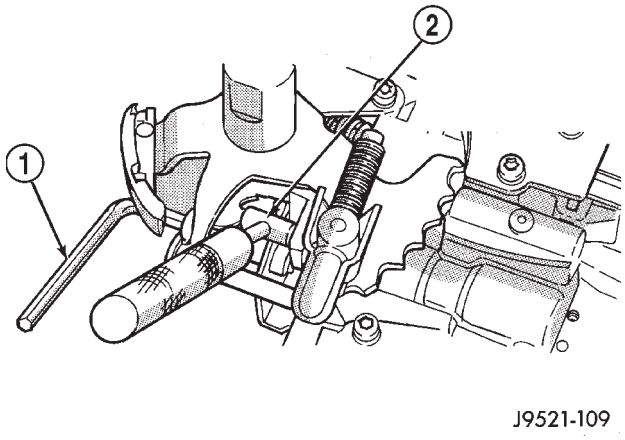


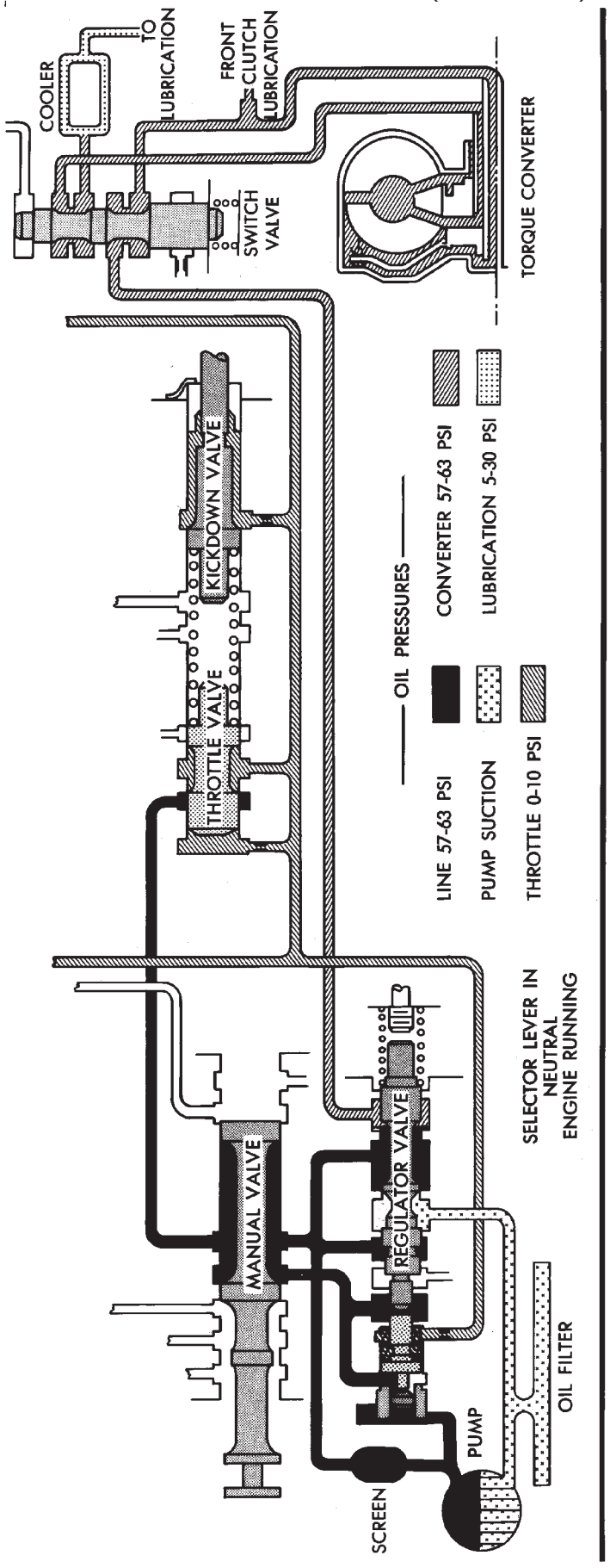
Fig. 233 Throttle Pressure Adjustment

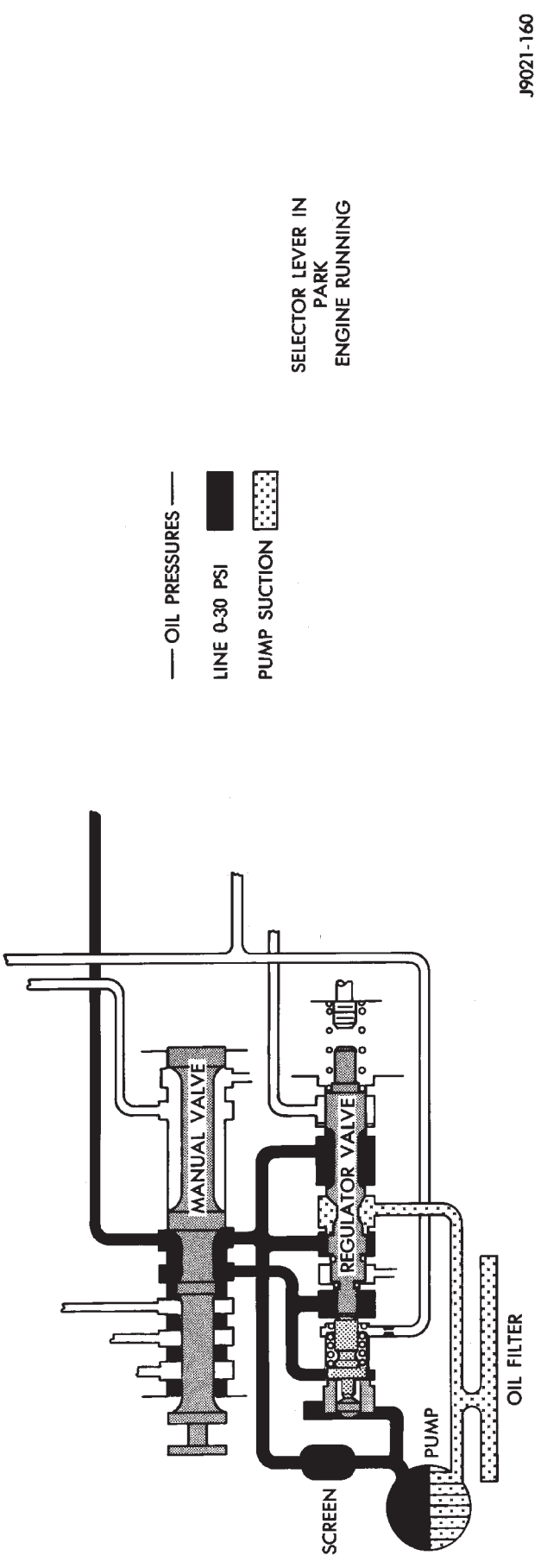
1 – HEX WRENCH (IN THROTTLE LEVER ADJUSTING SCREW)
2 – SPECIAL TOOL C-3763 (POSITIONED BETWEEN THROTTLE LEVER AND KICKDOWN VALVE)

SCHEMATICS AND DIAGRAMS

HYDRAULIC SCHEMATICS

SCHEMATICS AND DIAGRAMS (Continued)

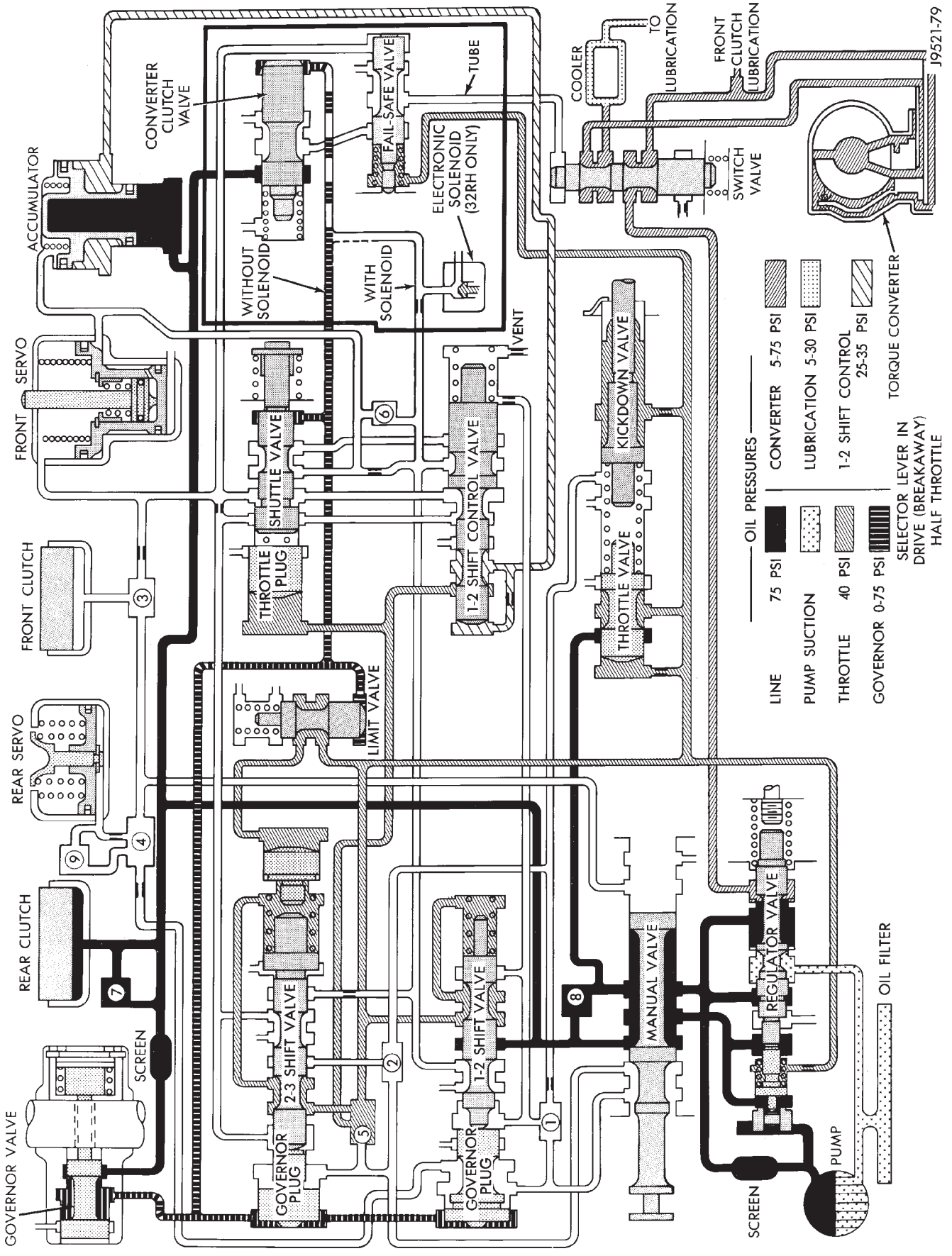




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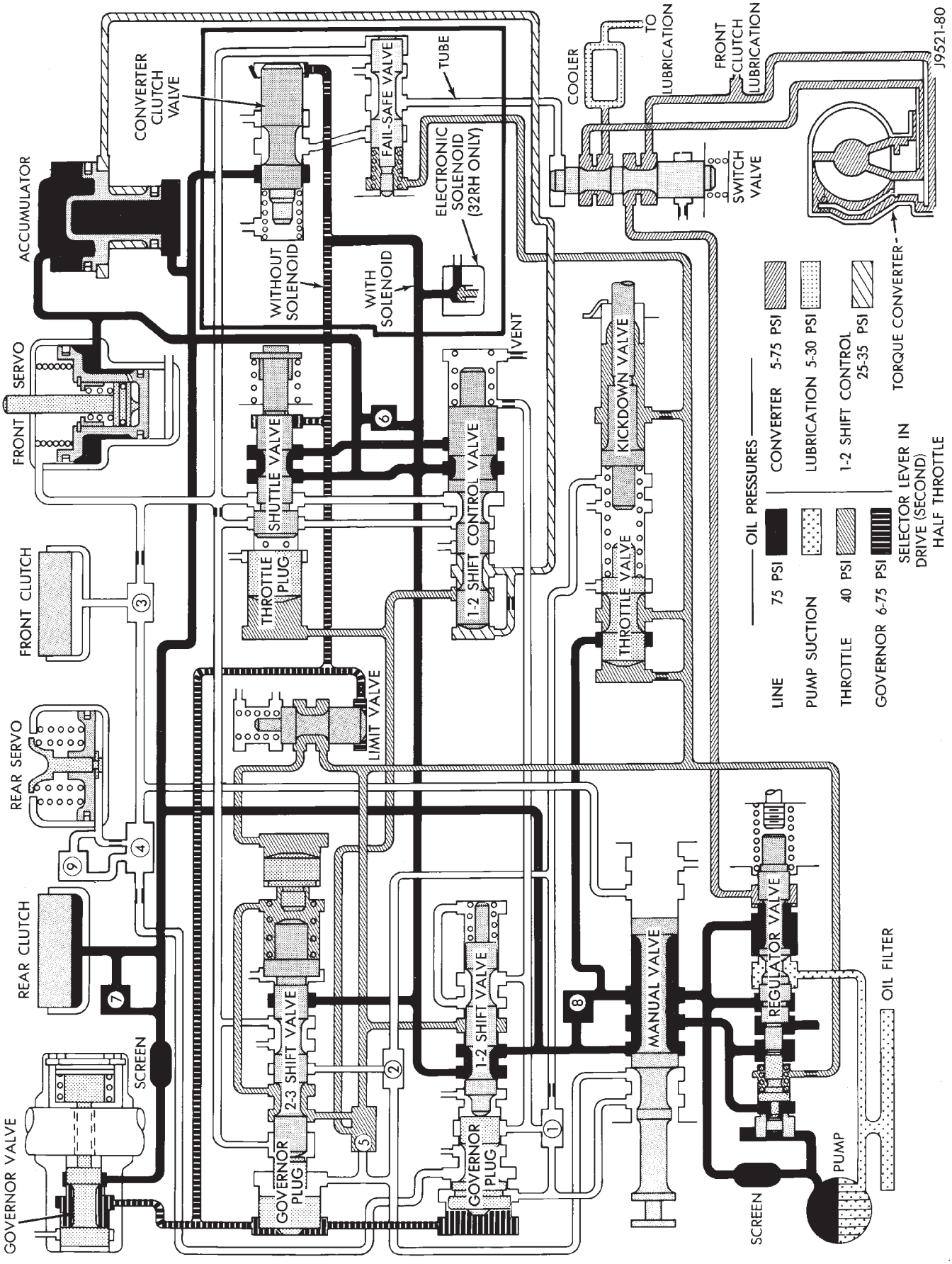
HYDRAULIC FLOW IN PARK/NEUTRAL

SCHEMATICS AND DIAGRAMS (Continued)



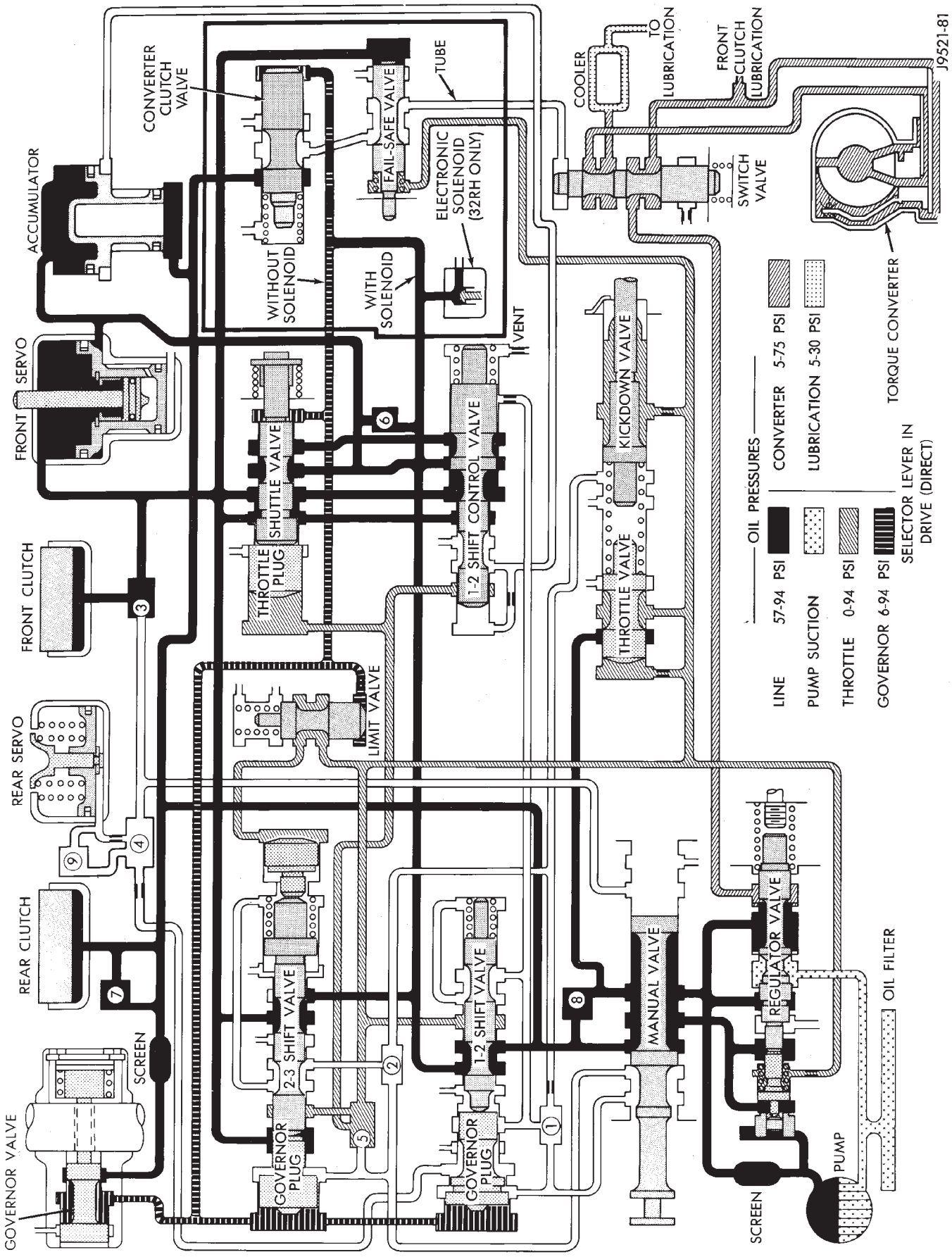
HYDRAULIC FLOW IN D-FIRST GEAR

SCHEMATICS AND DIAGRAMS (Continued)



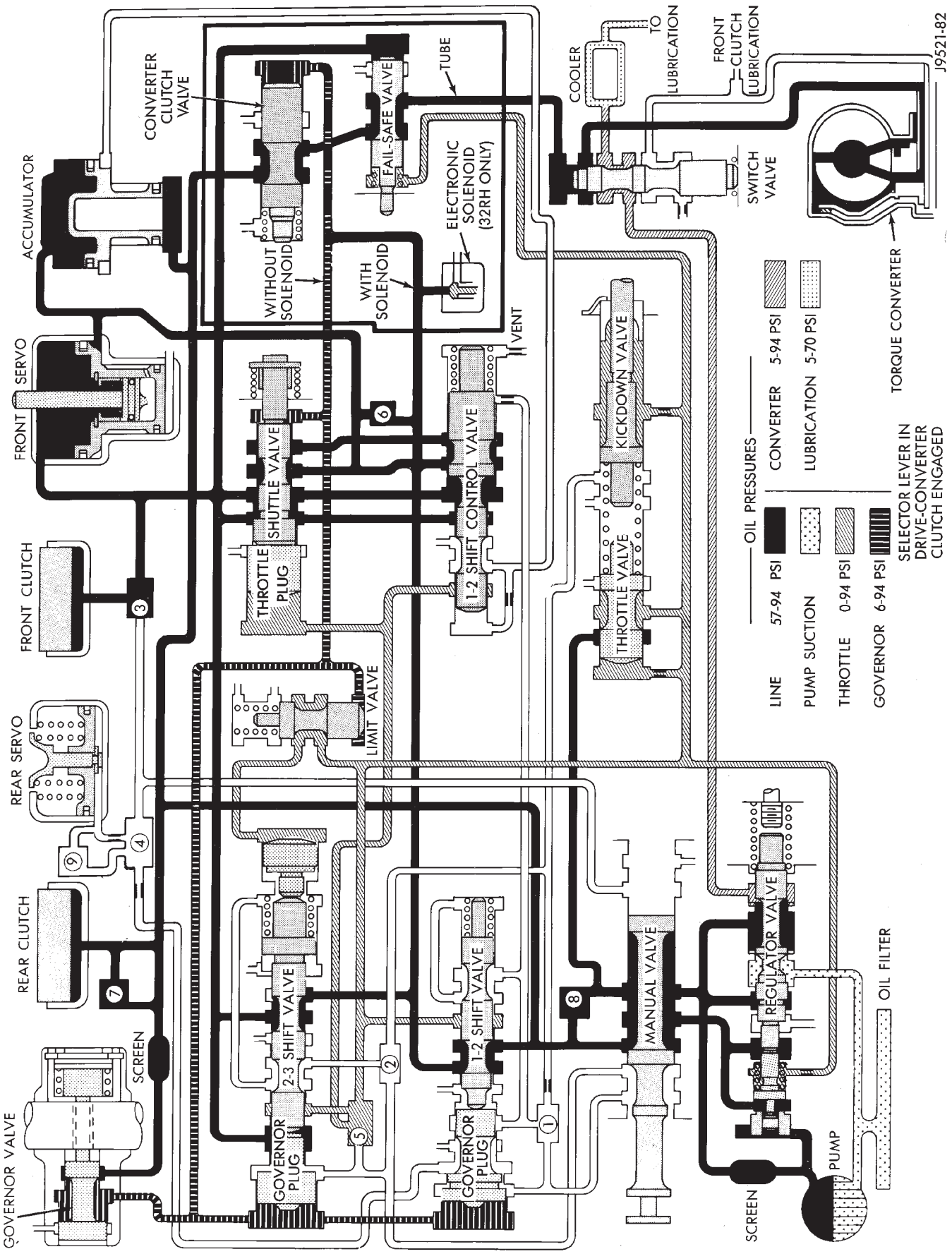
HYDRAULIC FLOW IN D-SECOND GEAR

SCHEMATICS AND DIAGRAMS (Continued)



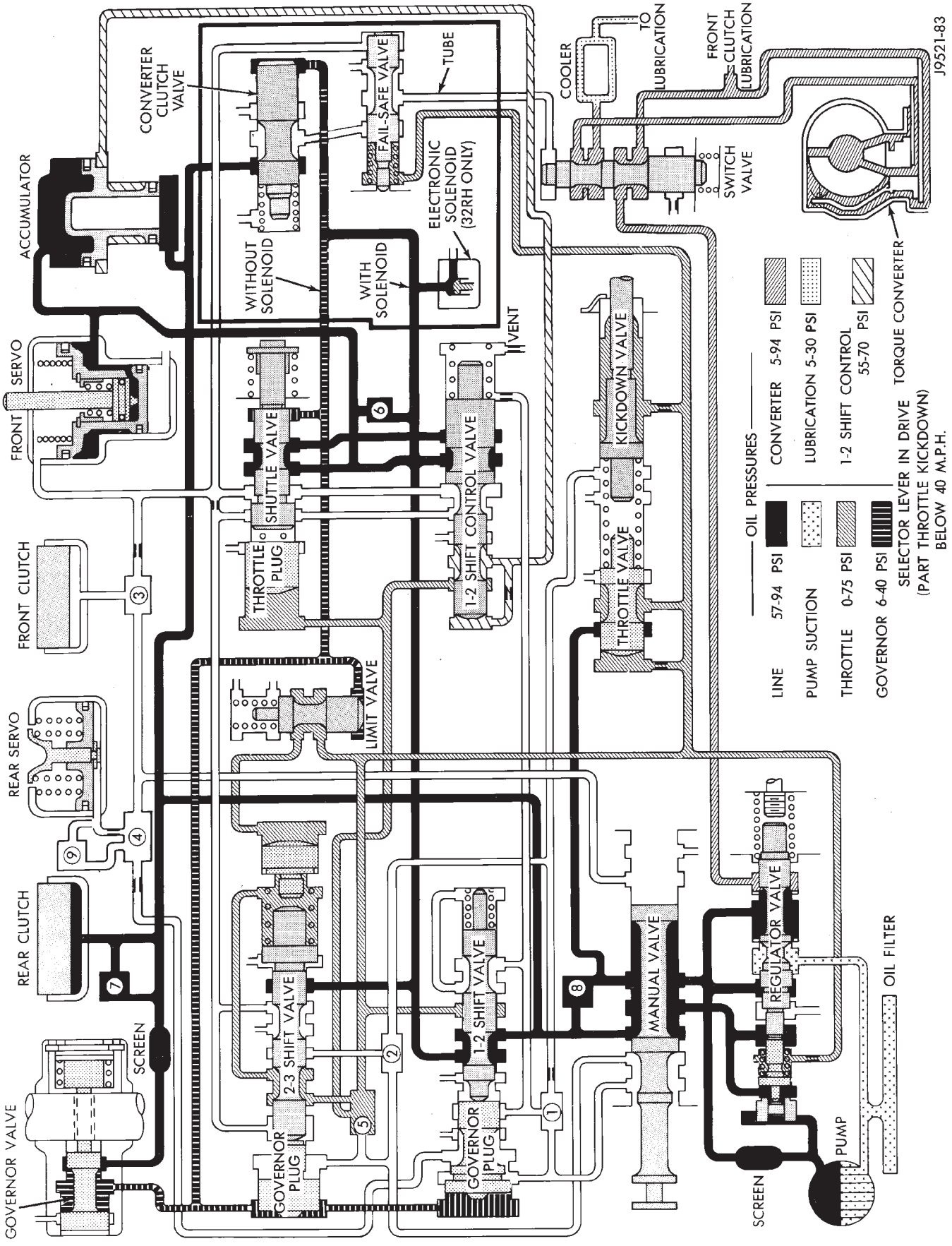
HYDRAULIC FLOW IN D-THIRD GEAR

SCHEMATICS AND DIAGRAMS (Continued)



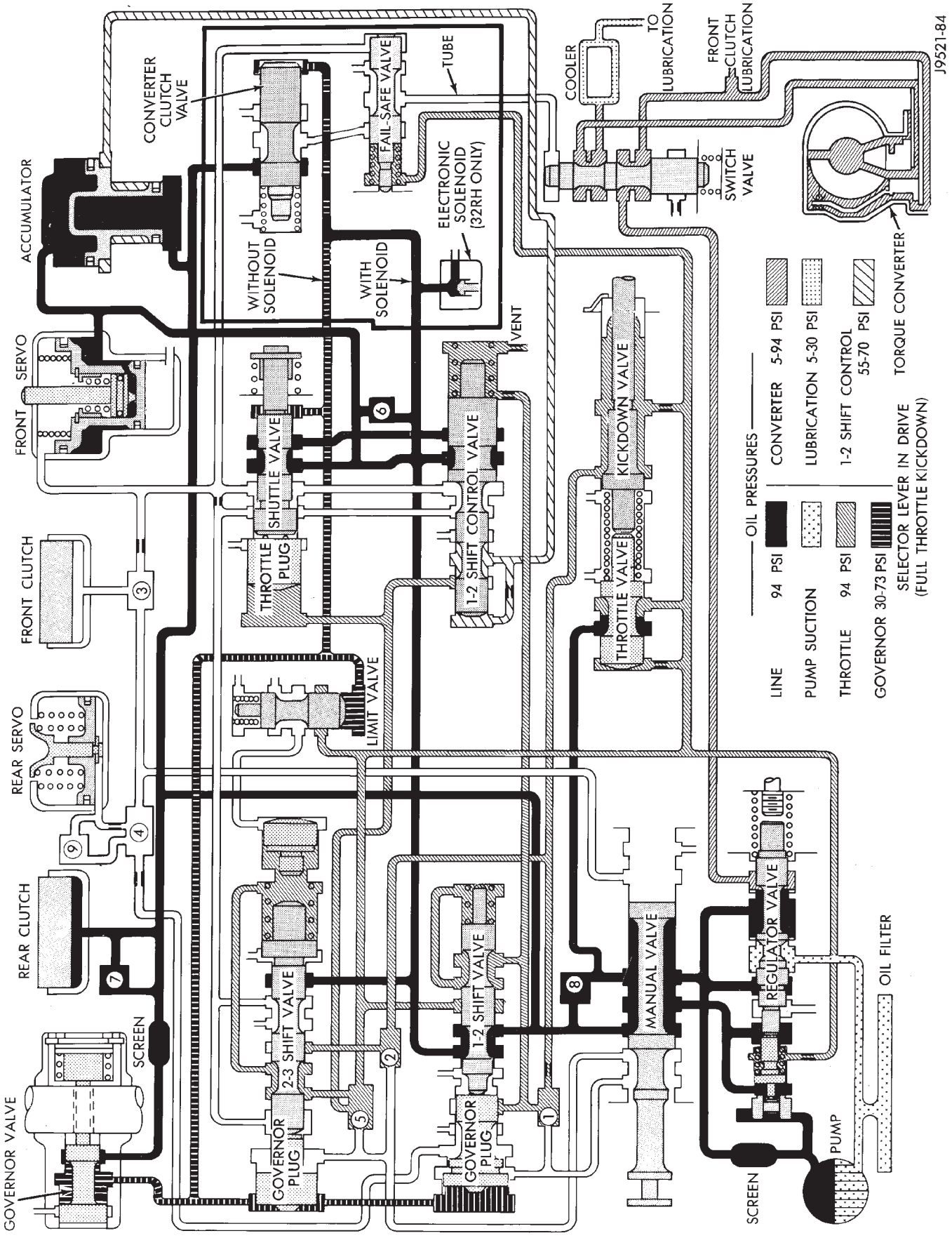
HYDRAULIC FLOW IN D-THIRD GEAR (CONVERTER CLUTCH APPLIED)

SCHEMATICS AND DIAGRAMS (Continued)



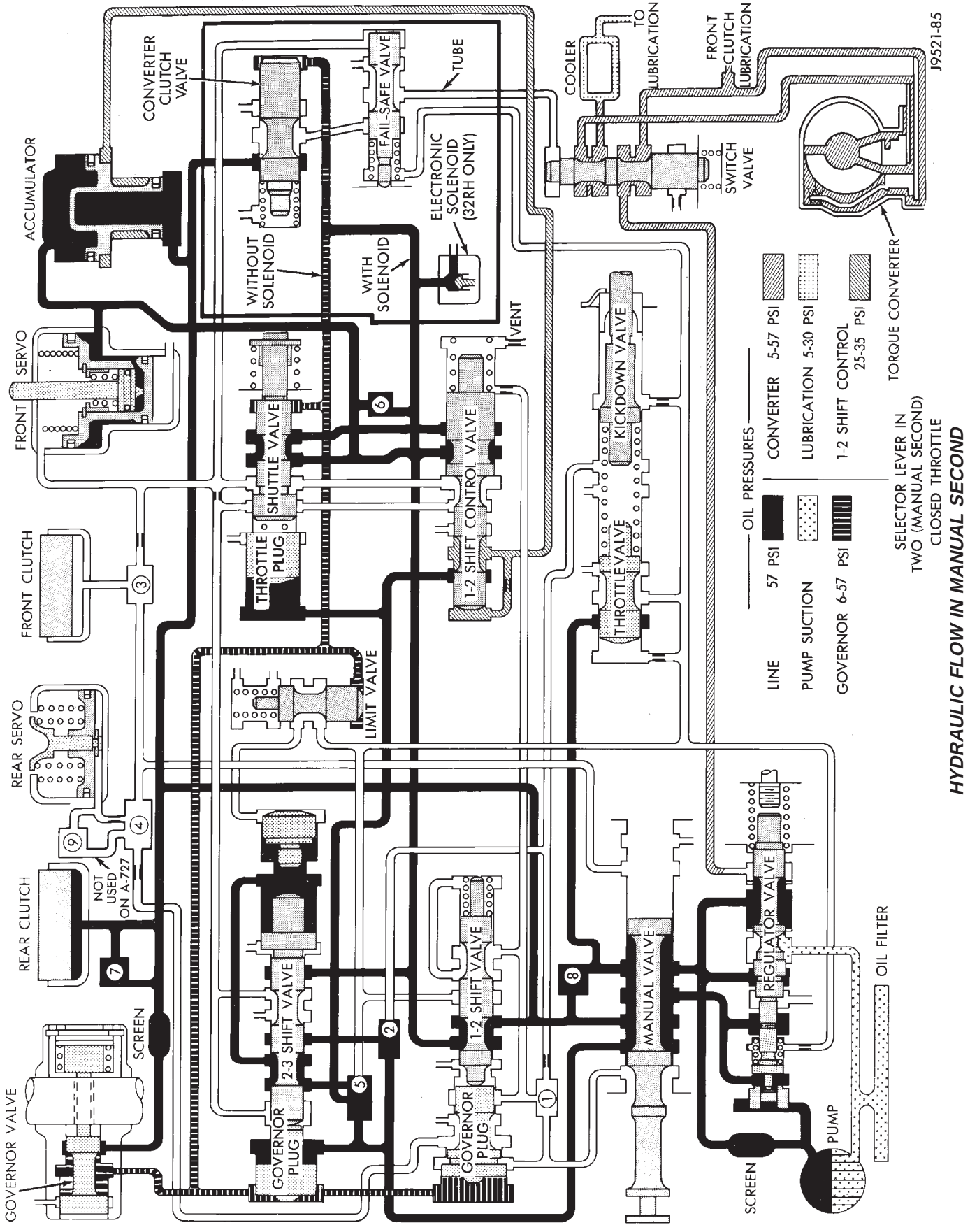
HYDRAULIC FLOW AT PART THROTTLE 3-2 KICKDOWN

SCHEMATICS AND DIAGRAMS (Continued)



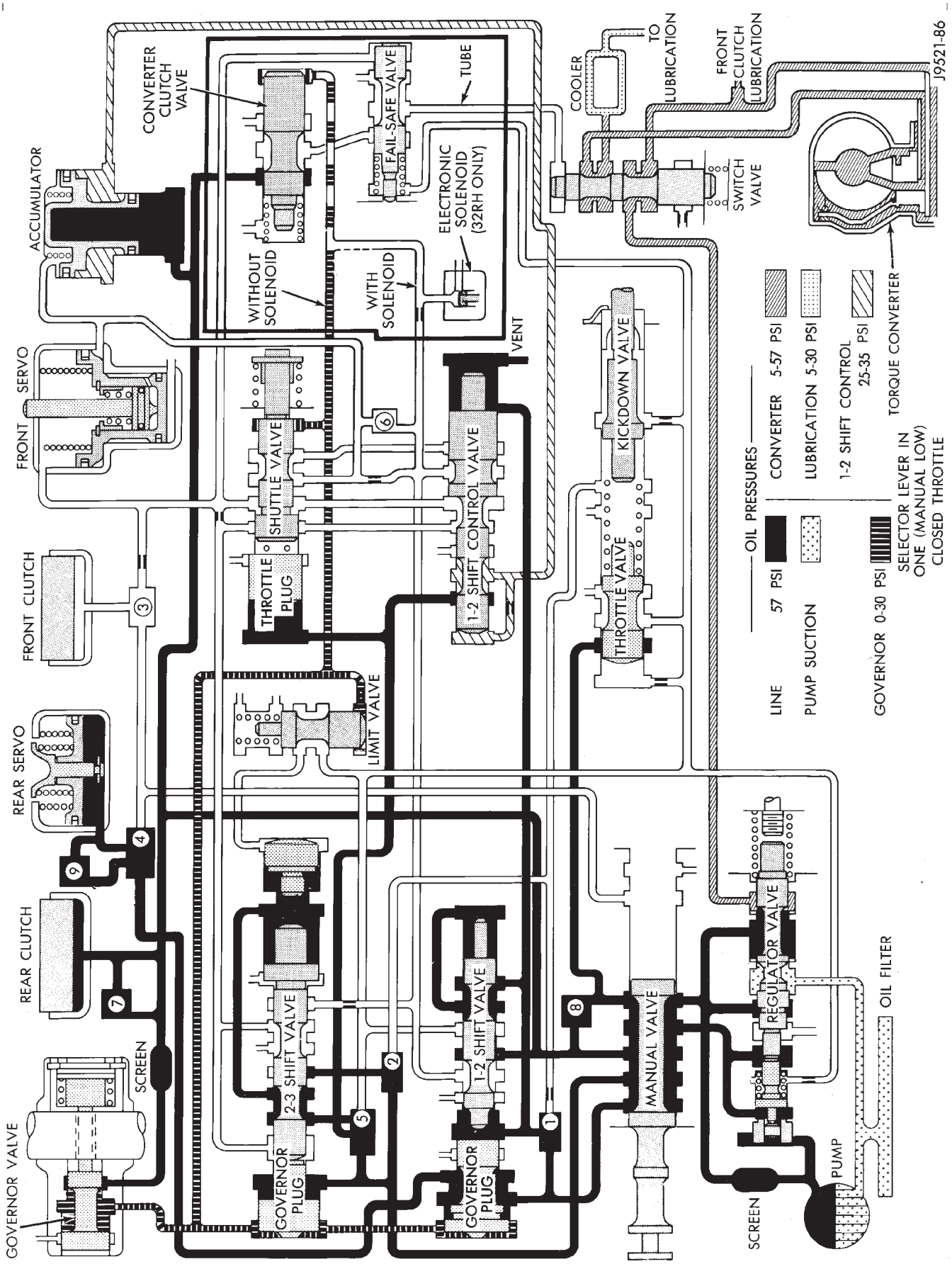
HYDRAULIC FLOW AT FULL THROTTLE 3-2 KICKDOWN

SCHEMATICS AND DIAGRAMS (Continued)



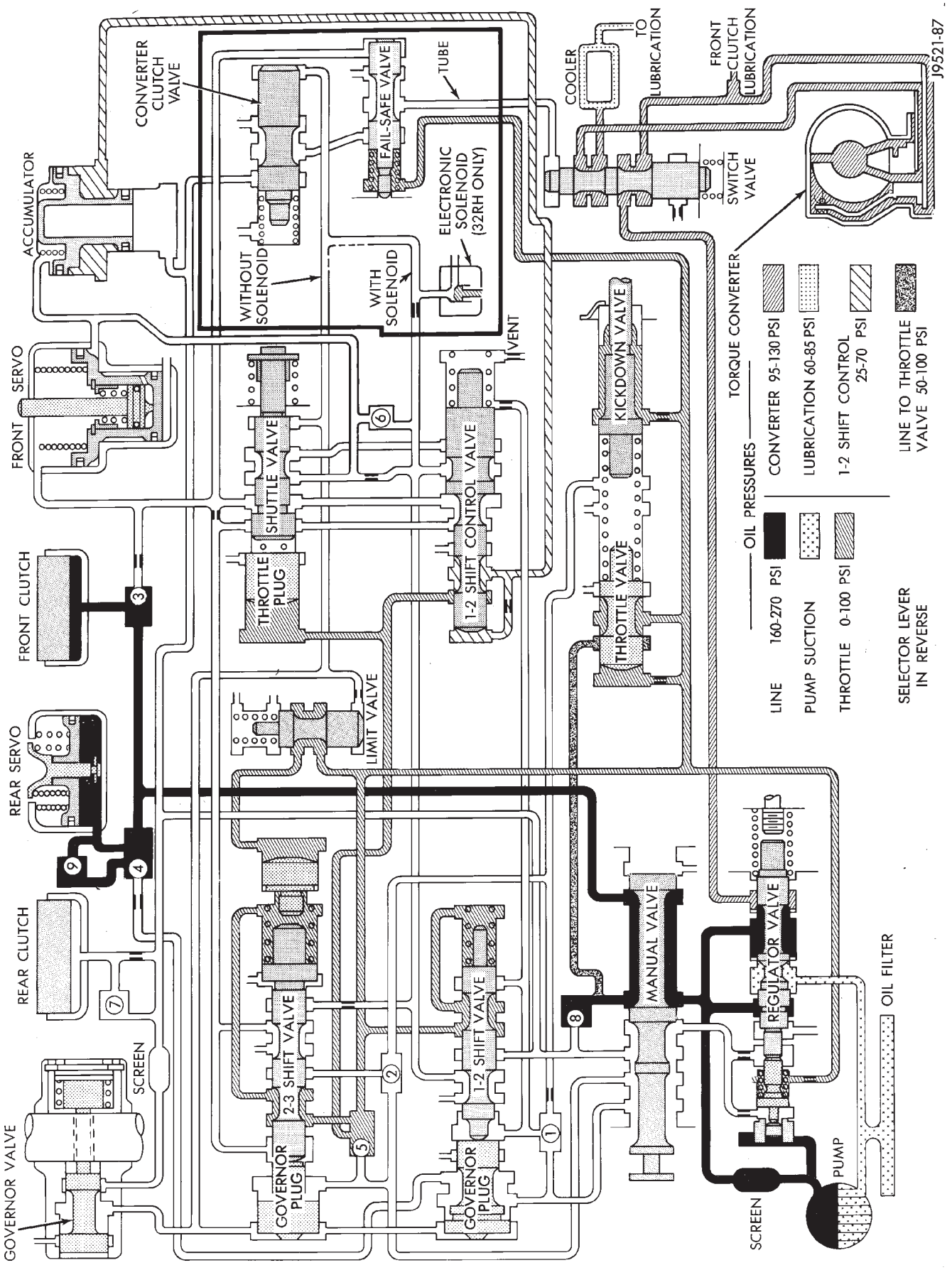
HYDRAULIC FLOW IN MANUAL SECOND

SCHEMATICS AND DIAGRAMS (Continued)



HYDRAULIC FLOW IN MANUAL LOW

SCHEMATICS AND DIAGRAMS (Continued)



HYDRAULIC FLOW IN REVERSE

SPECIFICATIONS

30/32RH AUTOMATIC TRANSMISSION

GENERAL

COMPONENT	METRIC	INCH
Oil pump gear tip clearance	0.089-0.190 mm	0.0035-0.0075 in.
Planetary end play	0.125-1.19 mm	0.001-0.047 in.
Input shaft end play	0.56-2.31 mm	0.022-0.091 in.
Clutch pack clearance/Front 4-disc.	1.70-3.40 mm	0.067-0.134 in.
Clutch pack clearance/Rear 4-disc.	0.559-0.940 mm	0.022-0.037 in.
Front clutch spring usage	1 spring	
32RH-Front Band adjustment from 72 in. lbs.	Back off 2.25 turns	
32RH-Rear Band adjustment from 72 in. lbs.	Back off 4 turns	
30RH-Front Band adjustment from 72 in. lbs.	Back off 2.5 turns	
30RH-Rear Band adjustment from 41 in. lbs.	Back off 7 turns	
Recommended fluid	Mopar®, ATF Plus 3, Type 7176	

THRUST WASHER/SPACER/SNAP RING DIMENSIONS

COMPONENT	METRIC	INCH
Front clutch thrust washer (reaction shaft support hub)	1.55 mm	0.061 in.
Rear clutch thrust washer (clutch retainer)	1.55 mm	0.061 in.
Output shaft thrust plate (output shaft pilot hub)	1.5-1.6mm	0.060-0.063 in.
Output shaft thrust washer (rear clutch hub)	1.3-1.4 mm	0.052-0.054 in.
	1.7-1.8 mm	0.068-0.070 in.
	2.1-2.2 mm	0.083-0.086 in.
Rear clutch pack snap ring	1.5-1.6 mm	0.06-0.062 in.
	1.7-1.8 mm	0.068-0.070 in.
	1.9-2.0 mm	0.076-0.078 in.
Planetary geartrain snap ring (at front of output shaft)	1.0-1.1 mm	0.040-0.044 in.
	1.6-1.7 mm	0.062-0.066 in.
	2.1-2.2 mm	0.082-0.086 in.

SPECIFICATIONS (Continued)

PRESSURE TEST—ALL

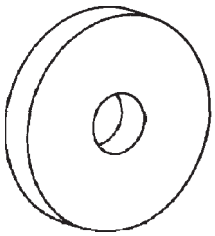
ITEM	RANGE	PRESSURE
Line pressure (at accumulator)	Closed throttle	372-414 kPa (54-60 psi).
Front servo	Third gear only	No more than 21 kPa (3 psi) lower than line pressure.
Rear servo	1 range R range	No more than 21 kPa (3 psi) lower than line pressure. 1103 kPa (160 psi) at idle, builds to 1862 kPa (270 psi) at 1600 rpm.
Governor	D range closed throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1.5 psi) when stopped with transmission in D, 1, 2. Pressure above 7 kPa (1.5 psi) at stand still will prevent transmission from downshifting.

TORQUE

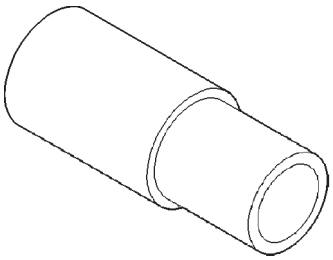
DESCRIPTION	TORQUE
Bolt/nut, crossmember	68 N·m (50 ft. lbs.)
Bolt, driveplate to crankshaft	75 N·m (55 ft. lbs.)
Plug, front band reaction	17 N·m (13 ft. lbs.)
Locknut, front band adj.	34 N·m (25 ft. lbs.)
Switch, park/neutral	34 N·m (25 ft. lbs.)
Bolt, fluid pan	17 N·m (13 ft. lbs.)
Bolt, oil pump	20 N·m (15 ft. lbs.)
Bolt, overrunning clutch cam	17 N·m (13 ft. lbs.)
Plug, pressure test port	14 N·m (10 ft. lbs.)
Bolt, reaction shaft support	20 N·m (15 ft. lbs.)
Locknut, rear band	41 N·m (30 ft. lbs.)
Bolt. speedometer adapter	11 N·m (8 ft. lbs.)
Screw, fluid filter	4 N·m (35 in. lbs.)
Bolt, valve body to case	12 N·m (100 in. lbs.)

SPECIAL TOOLS

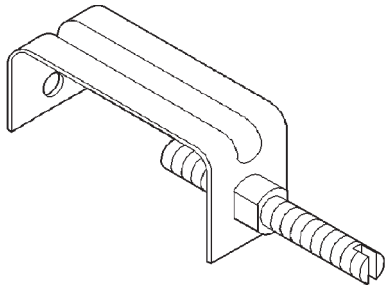
30/32RH TRANSMISSIONS



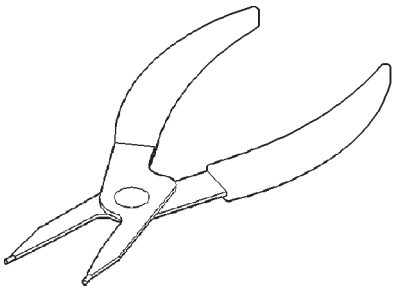
Remover—6957



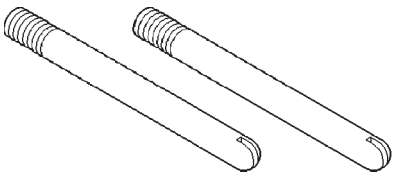
Installer—6951



Retainer, Detent Ball and Spring—6583

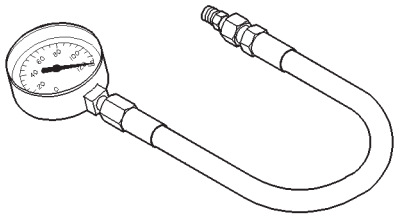


Snap-ring Plier—6823

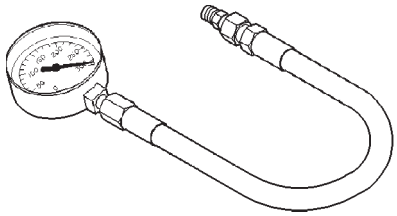


Pilot Stud—C-3288-B

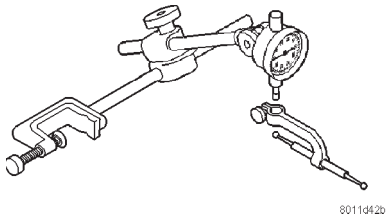
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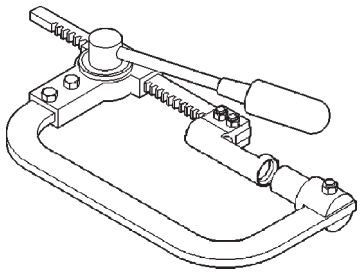
Pressure Gauge—C-3292



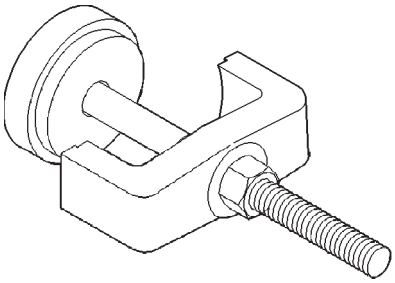
Pressure Gauge—C-3293SP



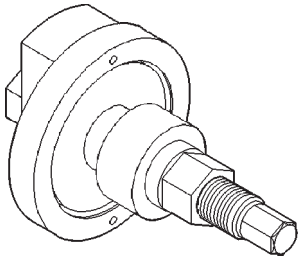
Dial Indicator—C-3339



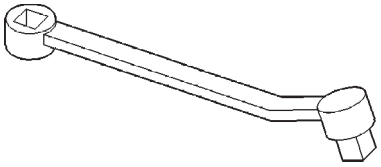
Spring Compressor—C-3422-B



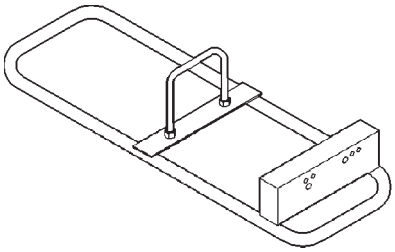
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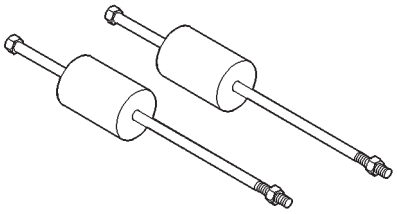
Spring Compressor—C-3863-A



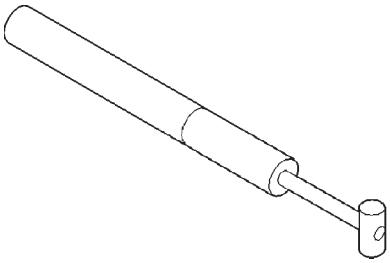
Adapter, Band Adjuster—C-3705



Transmission Repair Stand—C-3750-B

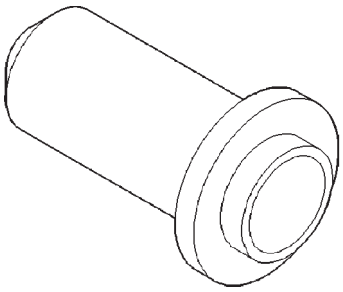


Puller, Slide Hammer—C-3752

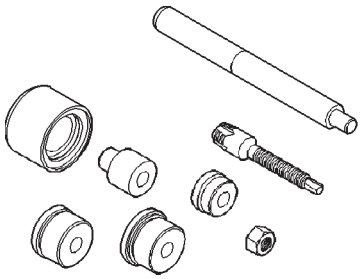


Gauge, Throttle Setting—C-3763

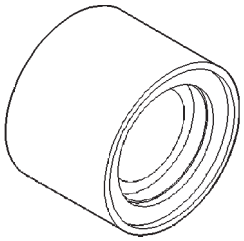
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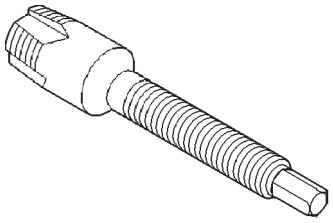
Seal Installer—C-3860-A



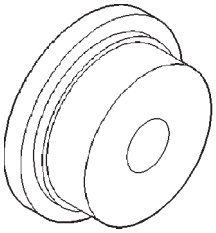
Bushing Remover/Installer—C-3887-J



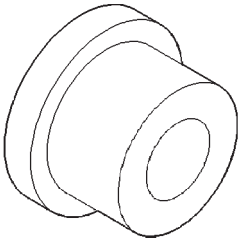
Cup, Remover—SP-3633



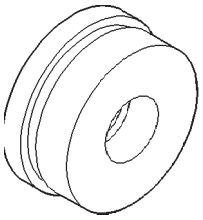
Remover, Bushing—SP-5301



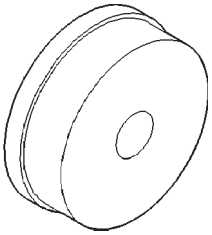
Installer, Bushing—SP-5118



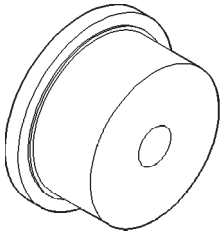
Installer, Bushing—SP-5302



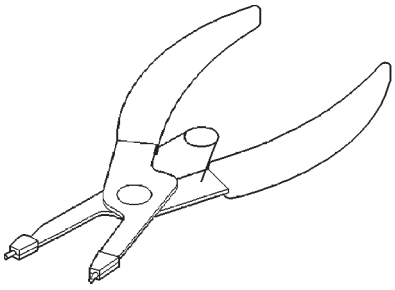
Remover, Bushing—SP-3550



Remover, Bushing—SP-3629

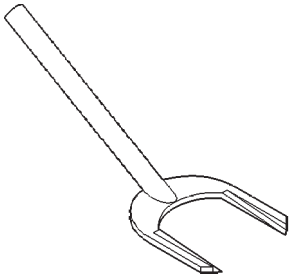


Installer, Bushing—SP-5511

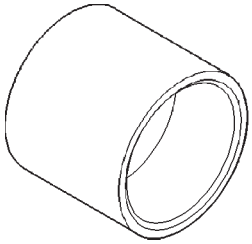


Snap-ring Plier—C-3915

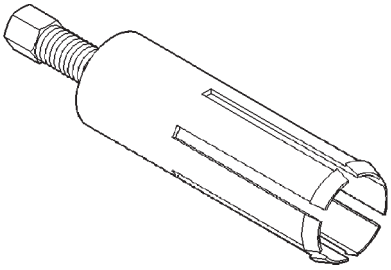
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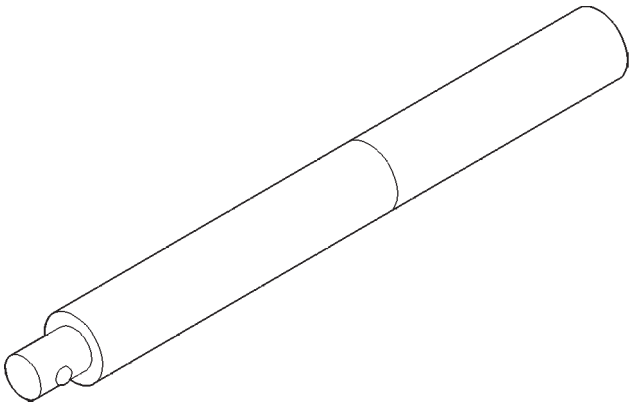
Seal Remover—C-3985-B



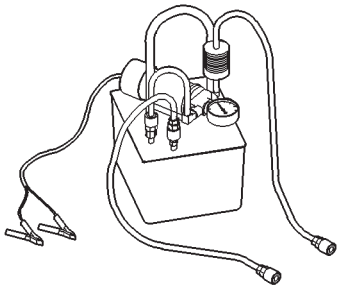
Installer—C-3995-A



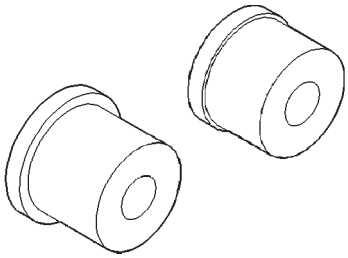
Bushing, Remover—6957



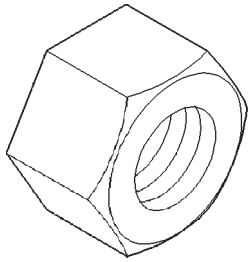
Universal Handle—C-4171



Flusher, Oil Cooler—6906



Remover/Installer—C-4470



Nut, Bushing Remover—SP-1191

NV231 TRANSFER CASE

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DESCRIPTION AND OPERATION

NV231 TRANSFER CASE

DESCRIPTION

The NV231 is a part-time transfer case with a low range reduction gear system. The NV231 has three operating ranges plus a Neutral position. A low range system provides a reduction ratio for increased low speed torque capability.

The geartrain is mounted in two aluminum case halves attached with bolts. The mainshaft front and rear bearings are mounted in aluminum retainer housings bolted to the case halves.

OPERATING RANGES

Transfer case operating ranges are:

- 2WD (2-wheel drive)
- 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.

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.

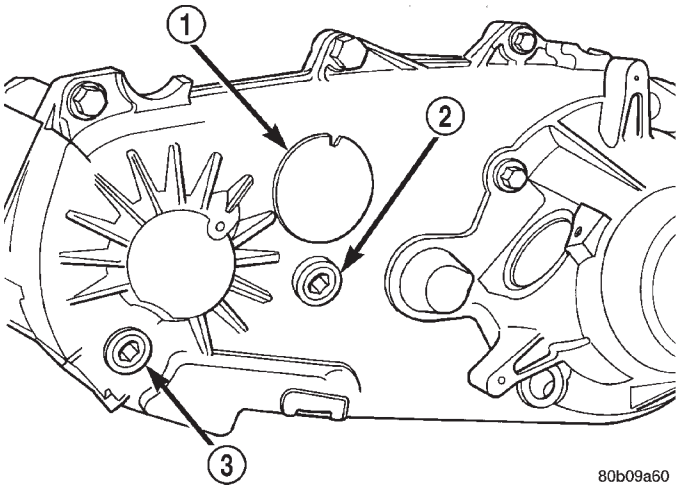


Fig. 1 Fill/Drain Plug And I. D. Tag Locations

1 – I. D. TAG
2 – FILL PLUG
3 – DRAIN PLUG

OPERATION

The input gear is splined to the transmission output shaft. The input gear drives the mainshaft through the planetary assembly and range hub. The front output shaft is operated by a drive chain that connects the shaft to a drive sprocket on the mainshaft. The drive sprocket is engaged/disengaged by the mode fork, which operates the mode sleeve and

DESCRIPTION AND OPERATION (Continued)

hub. The sleeve and hub are not equipped with a synchronizer mechanism for shifting.

LUBRICANT AND FILL LEVEL

DESCRIPTION

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. 2). 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.

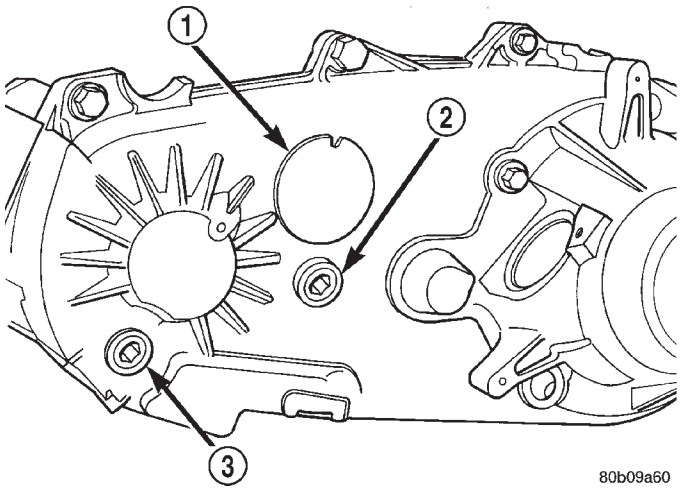


Fig. 2 Fill/Drain Plug Locations

1 – I. D. TAG
2 – FILL PLUG
3 – DRAIN PLUG

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.

DIAGNOSIS AND TESTING (Continued)

Condition	Possible Cause	Correction
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) Support transmission with jack stand.
(4) Remove skid plate.
(5) Drain transfer case lubricant.
(6) Mark front and rear propeller shaft yokes for alignment reference.
(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.
(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.

INSTALLATION

(1) Mount transfer case on a transmission jack.
(2) Secure transfer case to jack with chains.

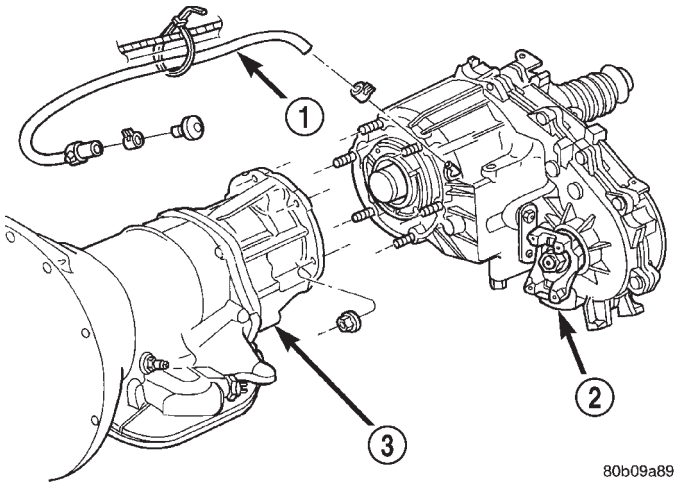


Fig. 3 Transfer Case Mounting

1 – VENT TUBE
2 – TRANSFER CASE
3 – TRANSMISSION

(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. Secure wire harness to clips on transfer case.

REMOVAL AND INSTALLATION (Continued)

(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) Connect shift rod to transfer case range lever.

(11) Adjust transfer case shift linkage.

(12) Install skid plate.

(13) Remove transmission jack and support stand.

(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.

TORQUE	
A	3-4 N•m (27-35 in. lbs.)
B	11-14 N•m (97-123 in.Ë lbs.)
C	8-14 N•m (72-120 in. lbs.)

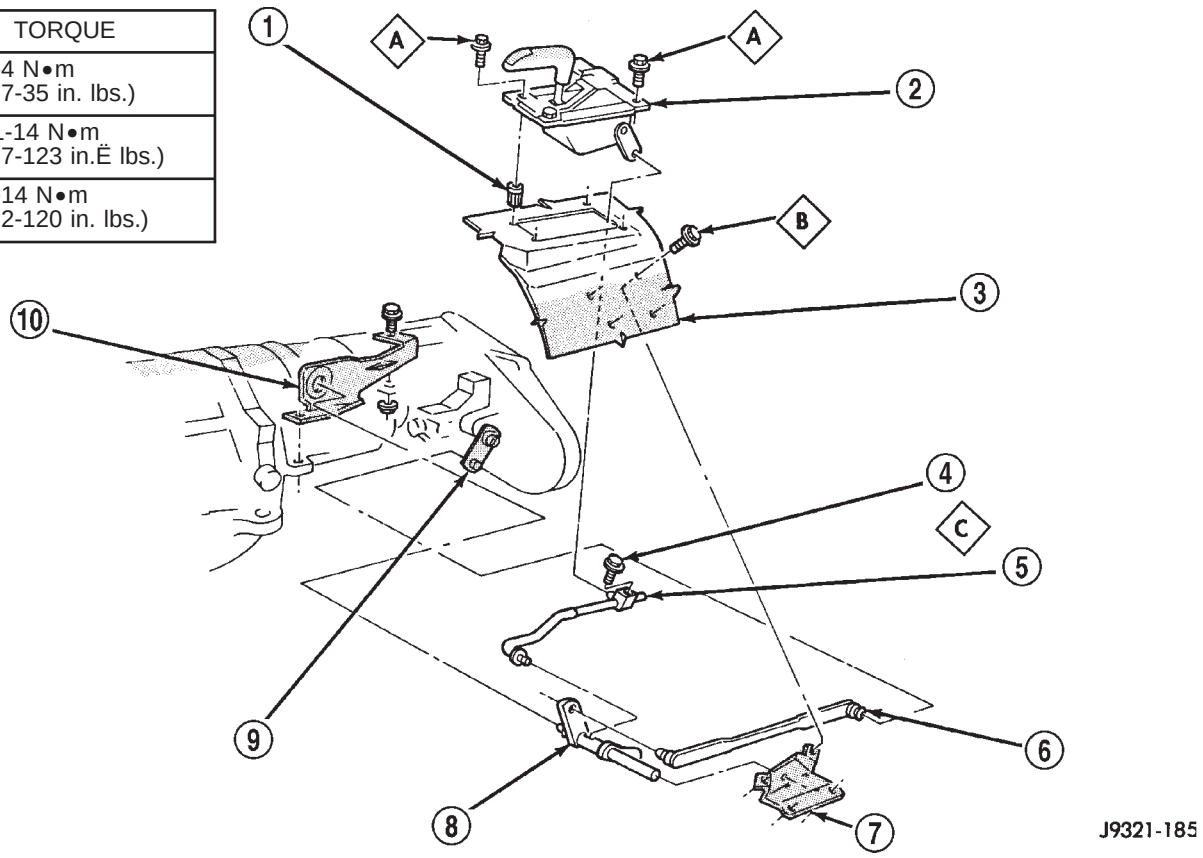


Fig. 4 Shift Linkage

1 – RIVNUT (4)
2 – SHIFT LEVER ASSEMBLY
3 – FLOORPAN
4 – TRUNNION LOCK BOLT
5 – SELECTOR ROD AND TRUNNION
6 – SHIFT LEVER ROD
7 – TORQUE SHAFT FRAME BRACKET
8 – TORQUE SHAFT
9 – TRANSFER CASE SHIFT LEVER
10 – TORQUE SHAFT TRANSFER CASE BRACKET

REMOVAL AND INSTALLATION (Continued)

(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).
(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.

ITEM	TORQUE
A	2-3 N·m (15-27 in. lbs.)
B	10-12 N·m (90-110 in. lbs.)

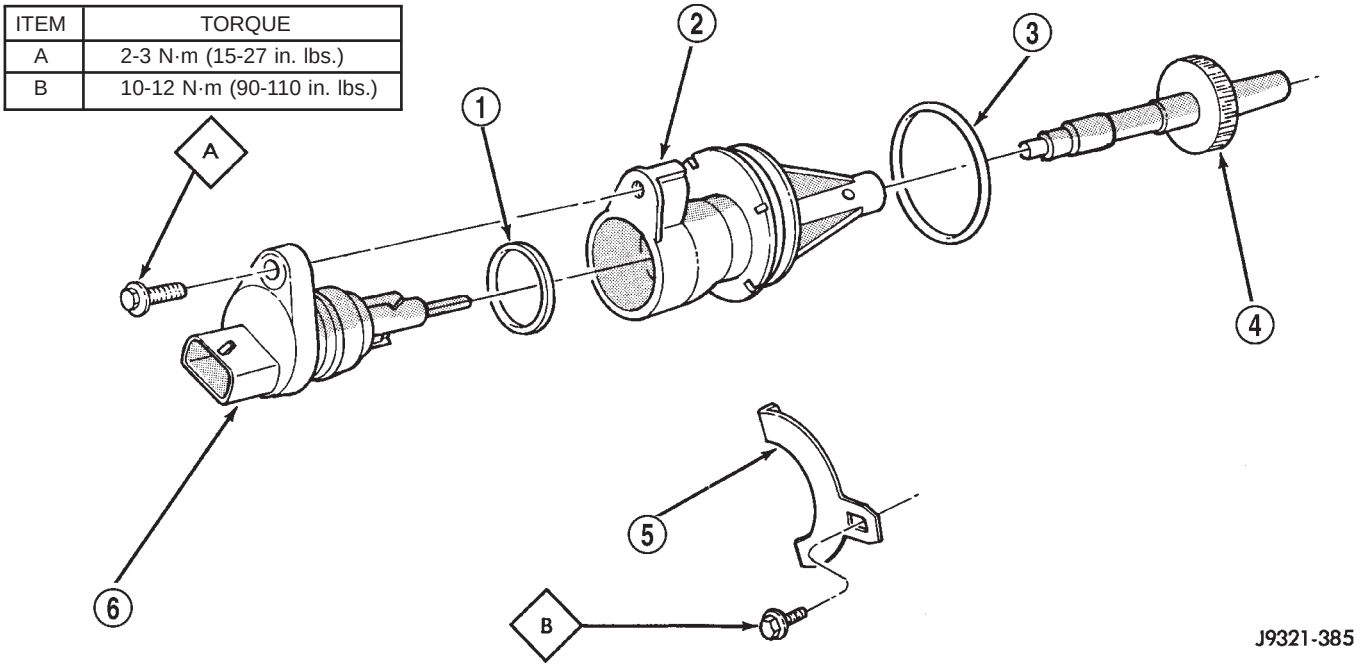


Fig. 5 Speedometer Components

1 – SENSOR O-RING
2 – SPEEDOMETER ADAPTER
3 – ADAPTER O-RING
4 – SPEEDOMETER PINION
5 – ADAPTER CLAMP
6 – VEHICLE SPEED SENSOR

REMOVAL AND INSTALLATION (Continued)

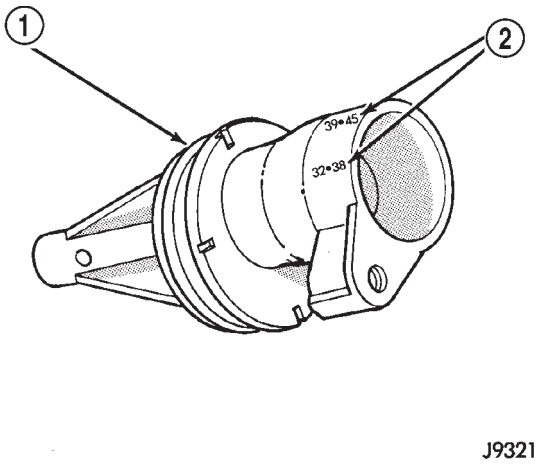


Fig. 6 Location Of Index Numbers On Speedometer Adapter

1 – SPEEDOMETER ADAPTER
2 – INDEX NUMBER LOCATION

(3) Remove front output shaft yoke.

(4) Remove seal from front case with pry tool (Fig. 7).

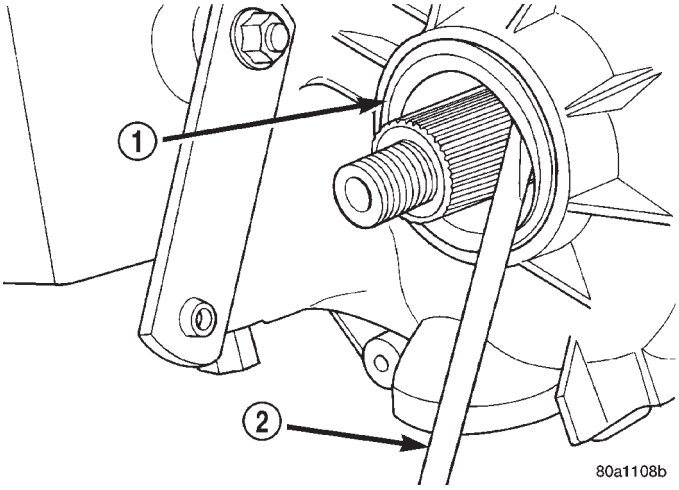


Fig. 7 Remove Front Output Shaft Seal

1 – OUTPUT SHAFT SEAL
2 – PRYBAR

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. 8). Once seal is started, continue tapping seal into bore until installer tool seats against case.

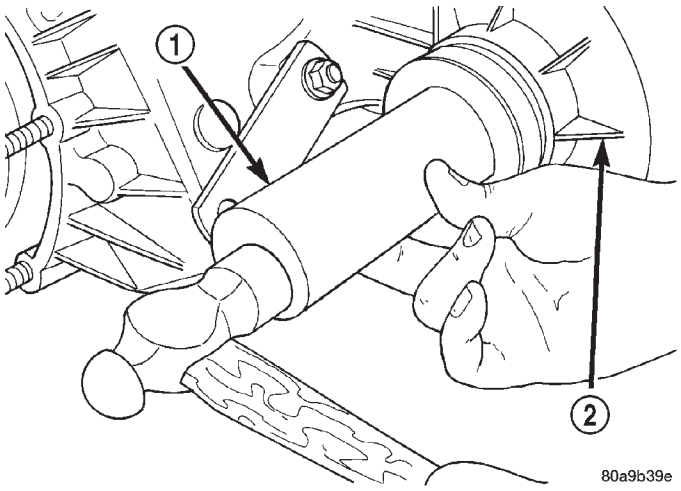


Fig. 8 Front Output Seal Installation

1 – INSTALLER 8143
2 – TRANSFER CASE

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. 9).

(5) Use a suitable pry tool, or a slide hammer mounted screw, to remove the seal from the rear retainer (Fig. 10).

(6) Remove the rear output bearing I. D. retaining ring (Fig. 11).

(7) Remove the bolts holding the rear retainer to the rear case half.

(8) Tap rear retainer with rawhide or rubber mallet to loosen sealer bead.

(9) Remove rear retainer from rear case half (Fig. 12).

DISASSEMBLY AND ASSEMBLY (Continued)

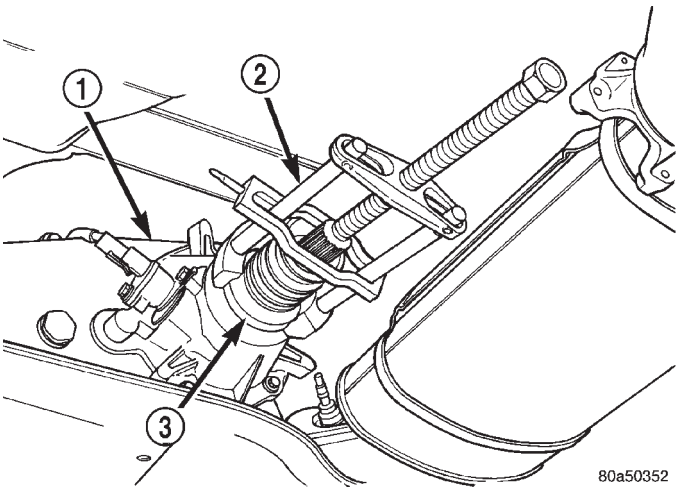


Fig. 9 Rear Slinger Removal

1 – TRANSFER CASE
2 – SPECIAL TOOL MD998056–A
3 – SLINGER

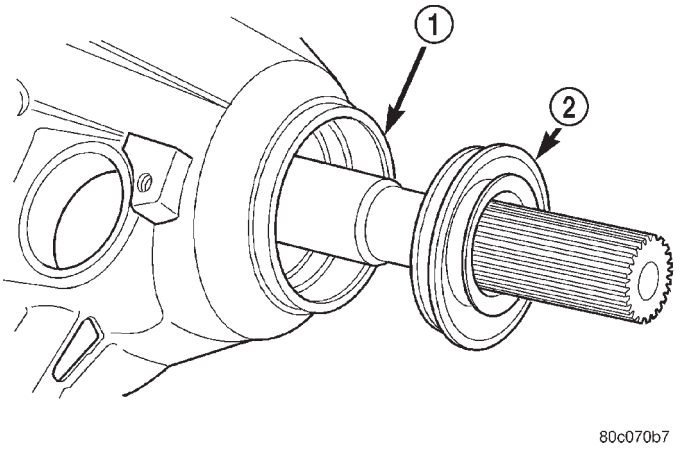


Fig. 10 Rear Retainer Seal

1 – REAR RETAINER
2 – OUTPUT SHAFT SEAL

(10) Remove snap-ring holding oil pump in position on output shaft.

(11) Disengage oil pickup tube from oil pump and remove oil pump assembly. Remove oil pump by tilting the edge of the oil pump from under the edge of the rear case half and sliding the pump (Fig. 13).

(12) Remove pick-up tube o-ring from oil pump (Fig. 14), if necessary. Do not disassemble the oil pump, it is not serviceable.

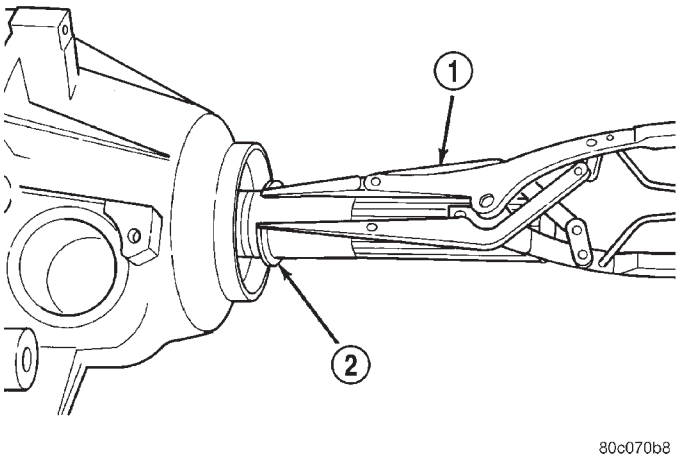


Fig. 11 Output Shaft Rear Bearing Retaining Ring

1 – SNAP RING PLIERS
2 – REAR BEARING I. D. RETAINING RING

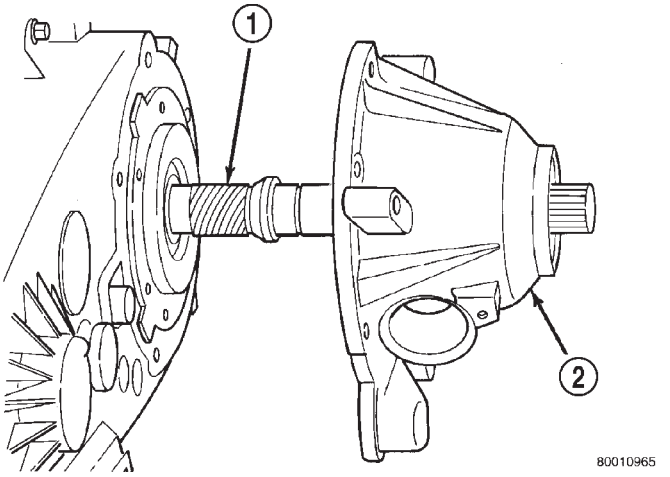


Fig. 12 Rear Retainer Removal

1 – MAINSHAFT
2 – REAR RETAINER

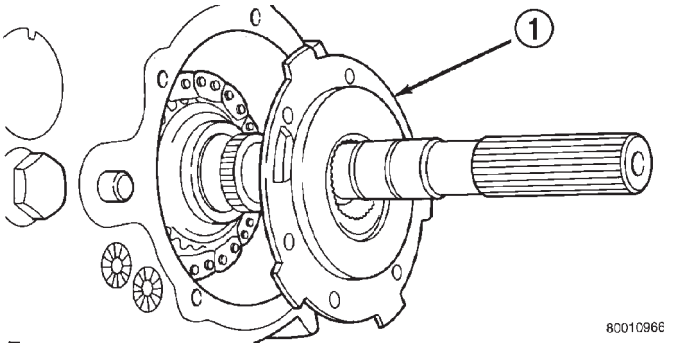


Fig. 13 Oil Pump Removal

1 – OIL PUMP

DISASSEMBLY AND ASSEMBLY (Continued)

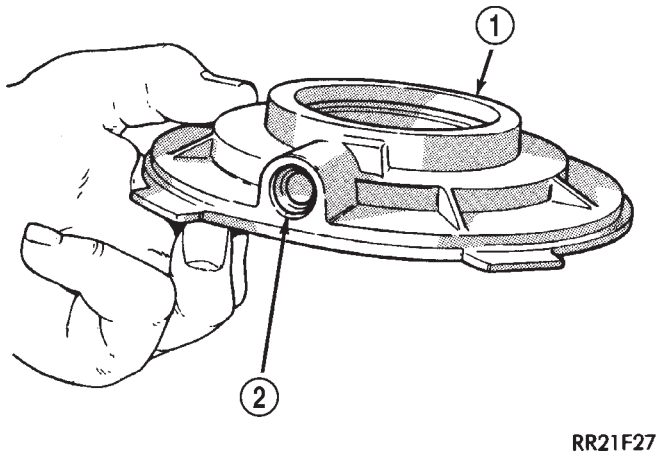


Fig. 14 Pick-up Tube O-ring Location

1 – OIL PUMP
2 – O-RING

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.

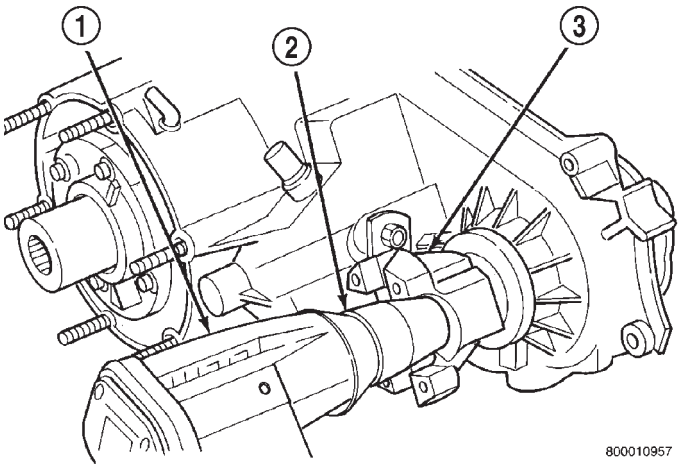


Fig. 15 Yoke Nut Removal

1 – IMPACT WRENCH
2 – SOCKET
3 – YOKE

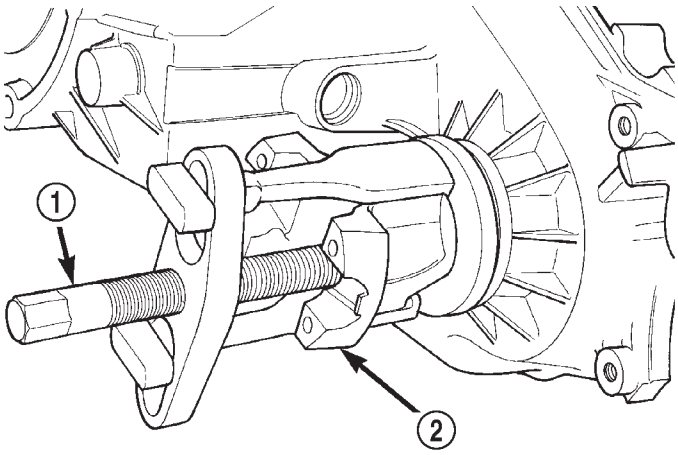


Fig. 16 Yoke Removal

1 – PULLER TOOL
2 – YOKE

(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).

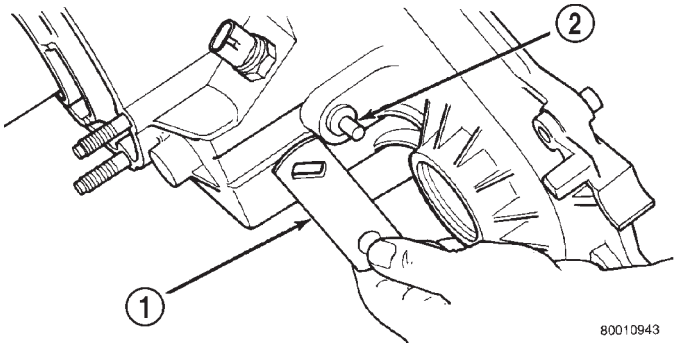


Fig. 17 Range Lever Removal

1 – RANGE LEVER
2 – SECTOR SHAFT

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.

DISASSEMBLY AND ASSEMBLY (Continued)

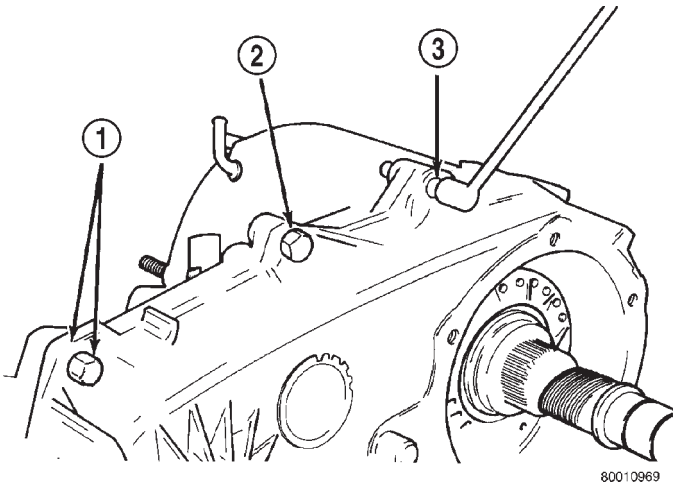


Fig. 18 Rear Case Alignment Bolt Locations

1 – DOWEL BOLT AND WASHER (2)
2 – CASE BOLT (5)
3 – SPLINE HEAD BOLT (1)

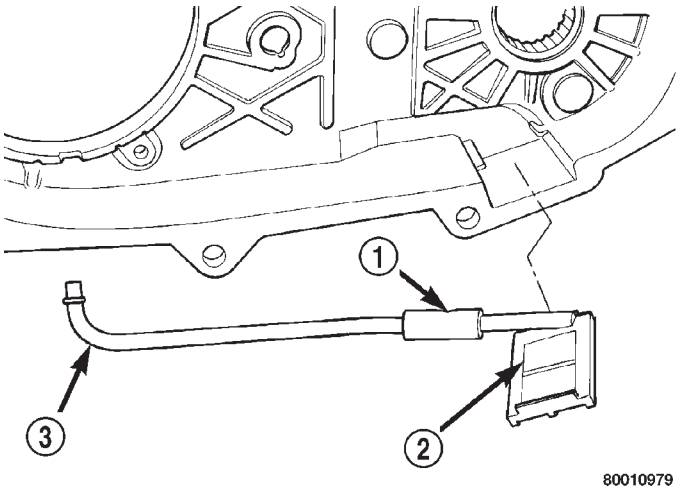


Fig. 20 Oil Pickup Tube Removal

1 – CONNECTING HOSE
2 – PICKUP SCREEN
3 – PICKUP TUBE

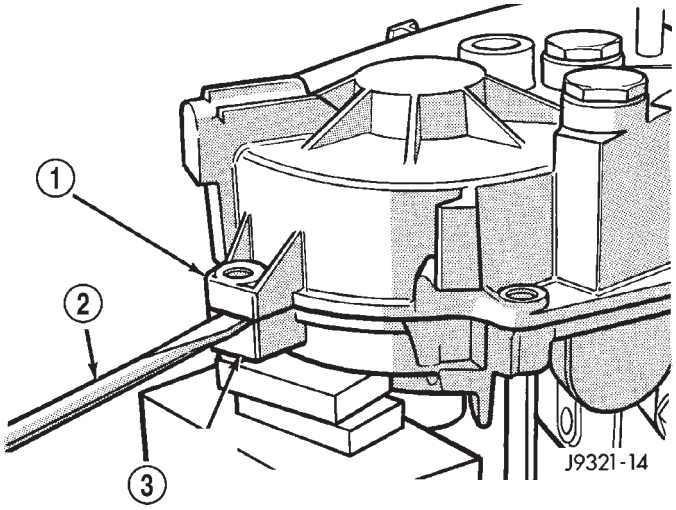


Fig. 19 Loosening Rear Case

1 – REAR CASE
2 – PRY TOOL (IN CASE SLOT)
3 – FRONT CASE

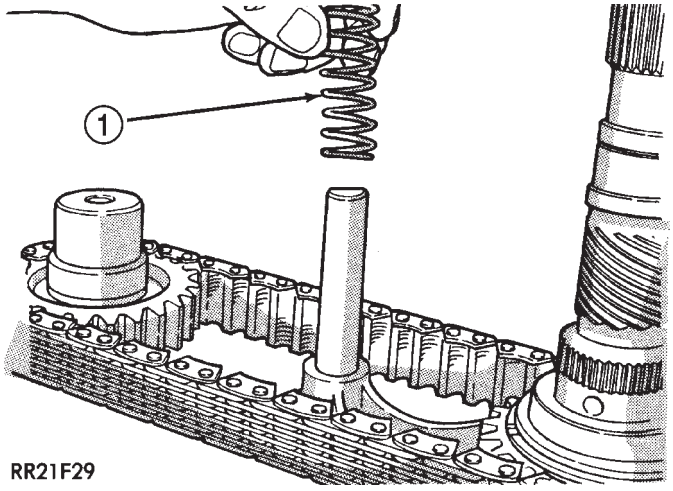


Fig. 21 Mode Fork Spring Removal

1 – MODE SPRING

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

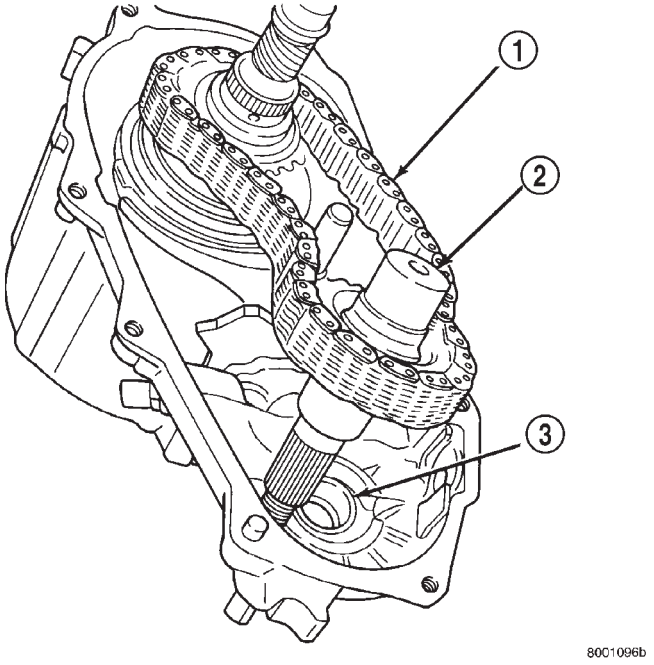


Fig. 22 Remove Front Output Shaft And Chain

1 – DRIVE CHAIN
2 – FRONT OUTPUT SHAFT
3 – SHAFT FRONT BEARING

SHIFT FORKS AND MAINSHAFT REMOVAL

(1) Remove detent plug, O-ring, detent spring and detent plunger (Fig. 23).

(2) Remove mainshaft from mode sleeve and input gear pilot bearing.

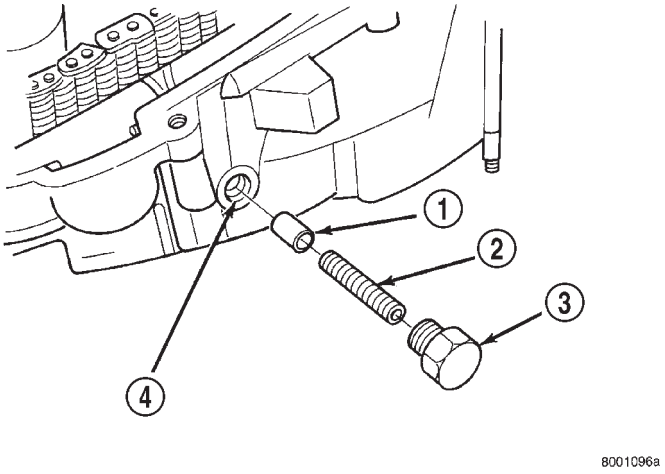


Fig. 23 Detent Plug, Spring And Plunger Removal

1 – POPPET
2 – SPRING
3 – SCREW
4 – POPPET BORE (IN CASE)

(3) Remove mode fork and sleeve as an assembly (Fig. 24). Note position of sleeve for assembly reference. The short side of the sleeve faces upward.

(4) Remove range fork and hub as an assembly (Fig. 25). Note fork position for installation reference.

(5) Remove shift sector from front case (Fig. 26).

(6) Remove shift sector bushing and O-ring (Fig. 27).

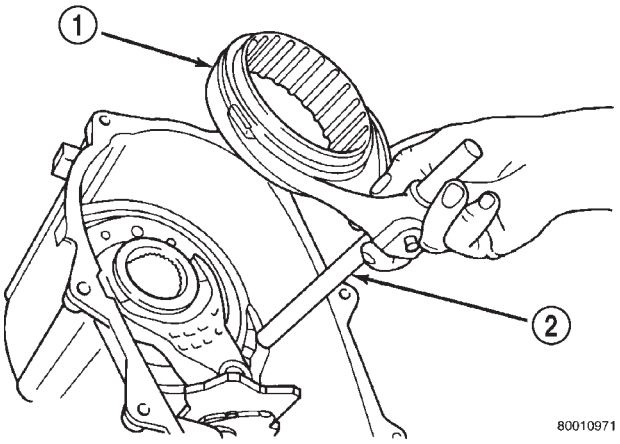


Fig. 24 Mode Fork And Sleeve Removal

1 – MODE SLEEVE
2 – MODE FORK AND RAIL

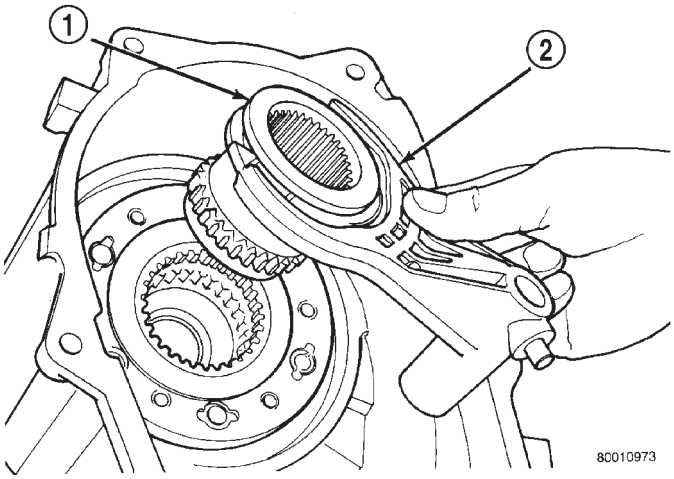


Fig. 25 Range Fork And Hub Removal

1 – RANGE HUB
2 – RANGE FORK

DISASSEMBLY AND ASSEMBLY (Continued)

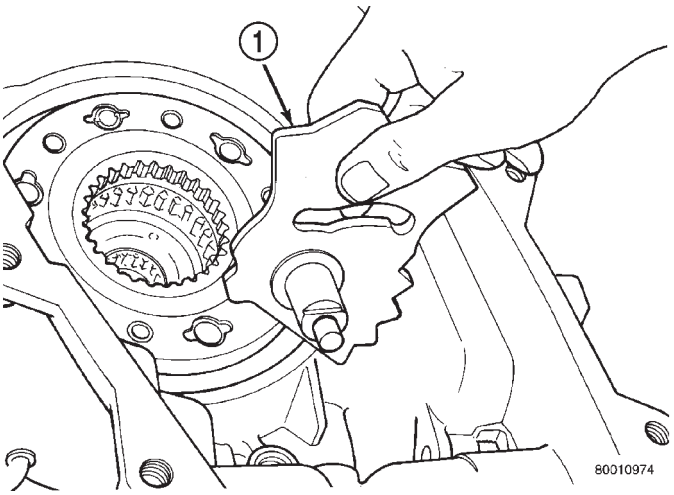


Fig. 26 Shift Sector Removal

1 – SHIFT SECTOR

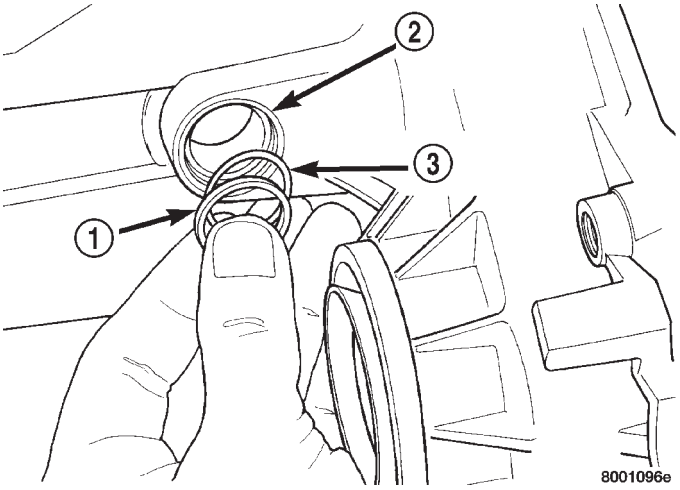


Fig. 27 Sector Bushing And O-Ring Removal

1 – SEAL RETAINER
2 – SECTOR SHAFT BORE
3 – O-RING SEAL

MAINSHAFT DISASSEMBLY

(1) Remove mode hub retaining ring with heavy duty snap-ring pliers (Fig. 28).

(2) Slide mode hub off mainshaft (Fig. 29).

(3) Slide drive sprocket off mainshaft (Fig. 30).

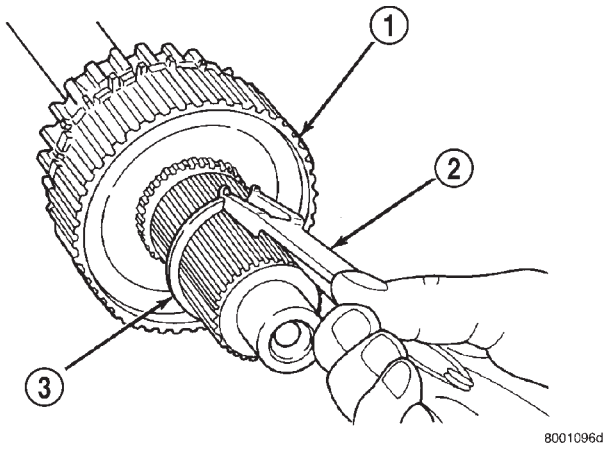


Fig. 28 Mode Hub Retaining Ring Removal

1 – MODE HUB
2 – SNAP RING PLIERS (HEAVY DUTY)
3 – MODE HUB RETAINING RING

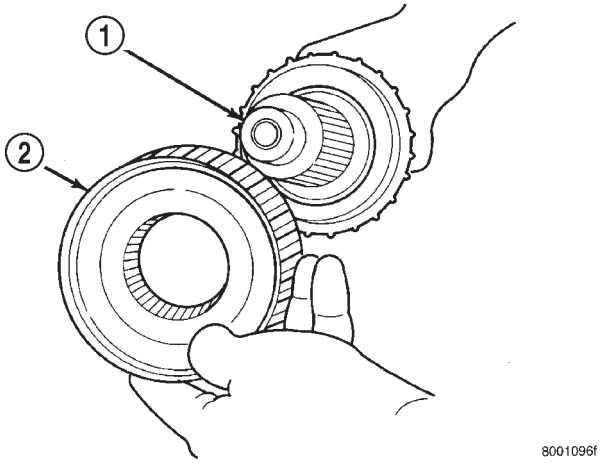


Fig. 29 Mode Hub Removal

1 – MAINSHAFT
2 – MODE HUB

DISASSEMBLY AND ASSEMBLY (Continued)

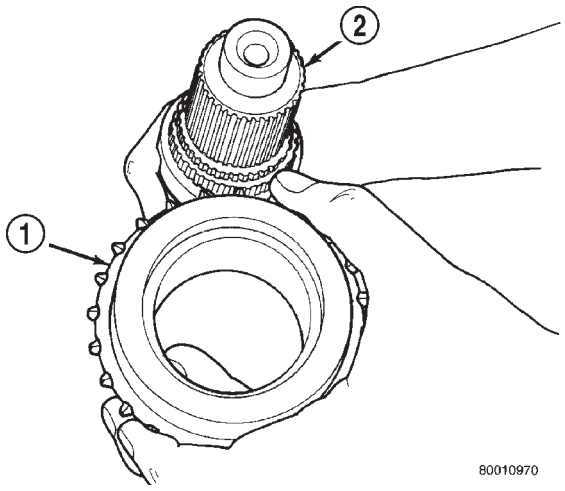


Fig. 30 Drive Sprocket Removal

1 – DRIVE SPROCKET
2 – MAINSHAFT

INPUT GEAR AND LOW RANGE GEAR REMOVAL

(1) Remove front bearing retainer attaching bolts (Fig. 31).

(2) Remove front bearing retainer. Pry retainer loose with pry tool positioned in slots at each end of retainer (Fig. 32).

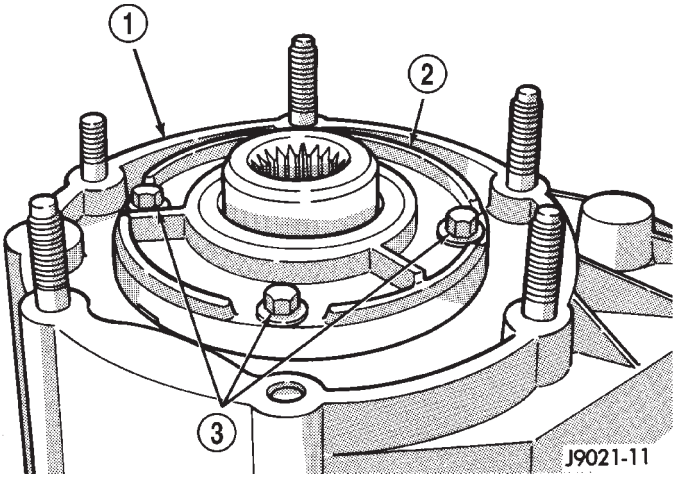


Fig. 31 Front Bearing Retainer Bolts

1 – FRONT CASE
2 – FRONT BEARING RETAINER
3 – RETAINER BOLTS

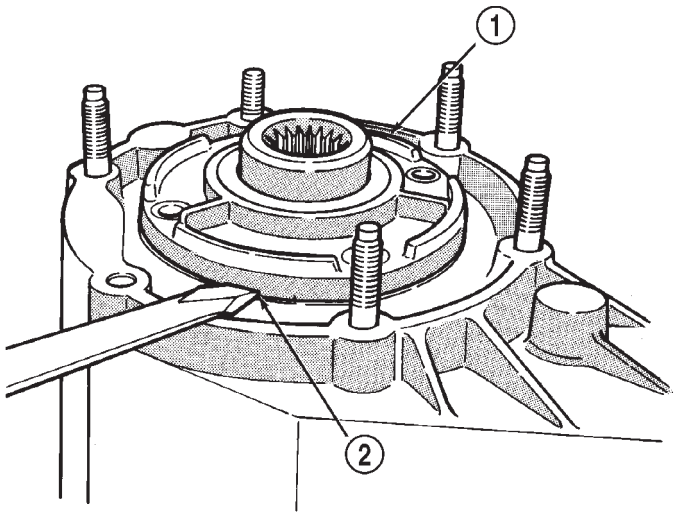


Fig. 32 Front Bearing Retainer Removal

1 – FRONT BEARING RETAINER
2 – RETAINER SLOT

(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)

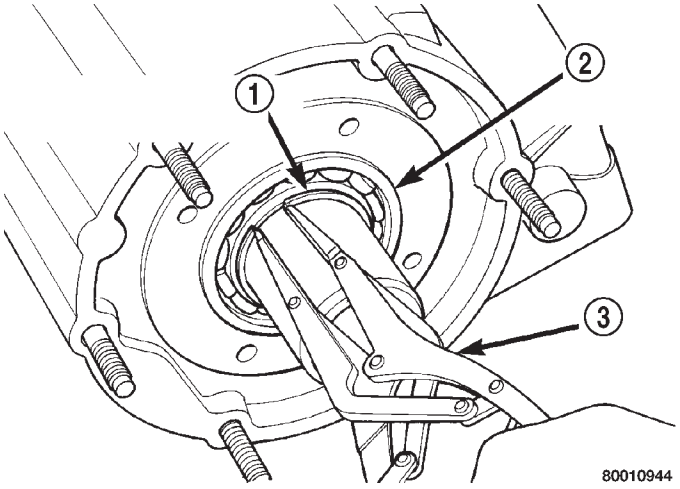


Fig. 33 Removing Input Gear Retaining Ring

1 – INPUT GEAR BEARING RETAINING RING
2 – INPUT GEAR BEARING
3 – SNAP RING PLIERS

DISASSEMBLY AND ASSEMBLY (Continued)

(5) Place front case in horizontal position. Then remove input gear and low range gear as an assembly (Fig. 34). Tap gear out of bearing with plastic mallet if necessary.

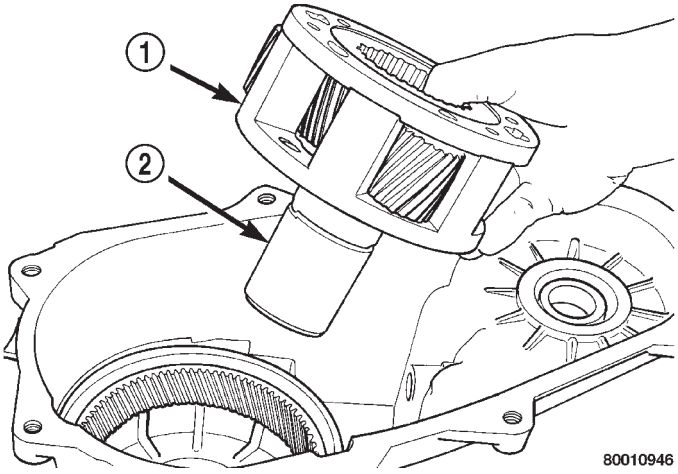


Fig. 34 Input Gear And Planetary Carrier Removal

1 – PLANETARY ASSEMBLY
2 – INPUT GEAR

INPUT AND LOW RANGE GEAR 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).

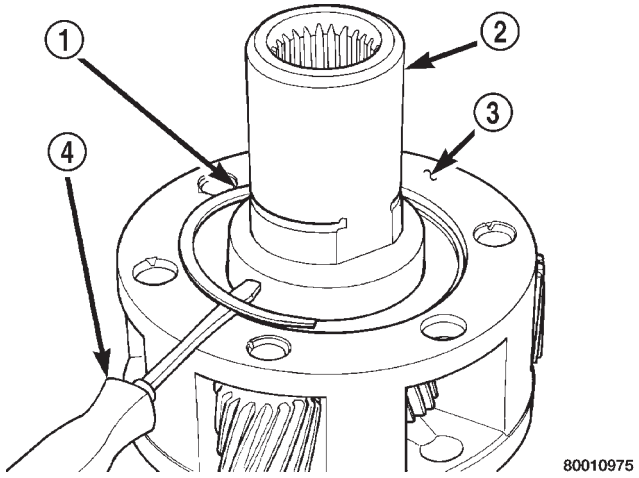


Fig. 35 Input Gear Snap-Ring Removal

1 – CARRIER LOCK RETAINING RING
2 – INPUT GEAR
3 – PLANETARY CARRIER
4 – SCREWDRIVER

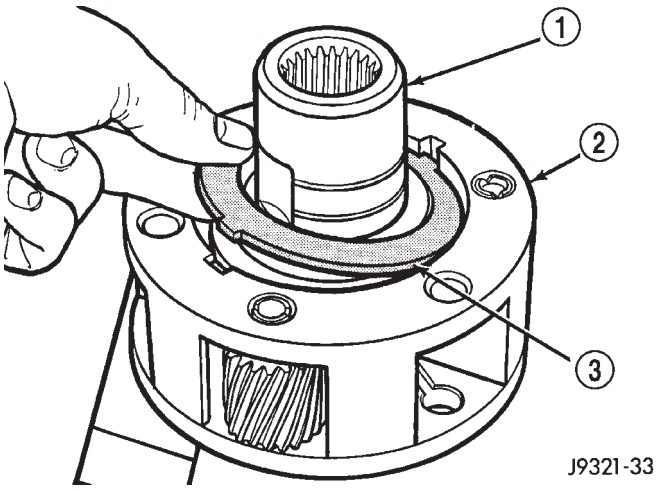


Fig. 36 Input Gear Retainer Removal

1 – INPUT GEAR
2 – LOW RANGE GEAR
3 – RETAINER

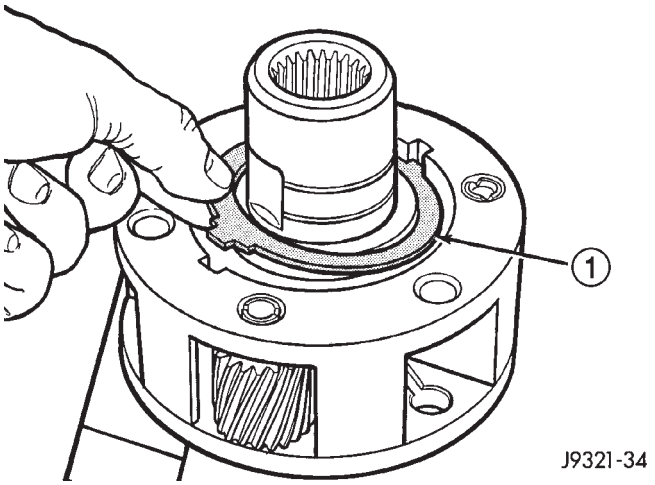


Fig. 37 Front Tabbed Thrust Washer Removal

1 – FRONT TABBED THRUST WASHER

DISASSEMBLY AND ASSEMBLY (Continued)

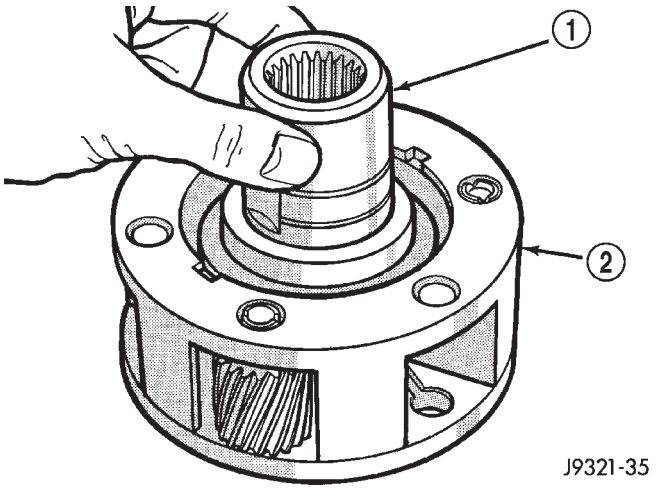


Fig. 38 Input Gear Removal

1 – INPUT GEAR
2 – LOW RANGE GEAR

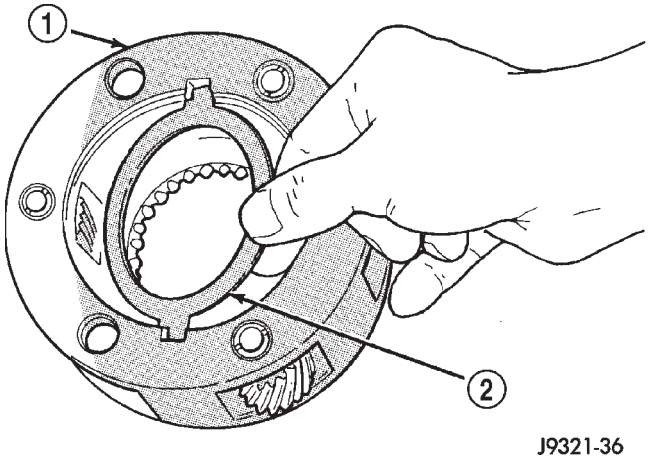


Fig. 39 Rear Tabbed Thrust Washer Removal

1 – LOW RANGE GEAR
2 – REAR TABBED THRUST WASHER

ASSEMBLY

Lubricate transfer case components with Mopar® Dexron II automatic transmission fluid or petroleum jelly (where indicated) during assembly.

BEARING AND SEAL INSTALLATION

CAUTION: The bearing bores in various transfer case components contain oil feed holes. Make sure replacement bearings do not block the holes.

(1) Remove the front output shaft seal from case with pry tool (Fig. 40).

(2) Remove the front output shaft bearing retaining ring with screwdriver (Fig. 41).

(3) Remove bearing with Tool Handle C-4171 and Tool 5065 (Fig. 42).

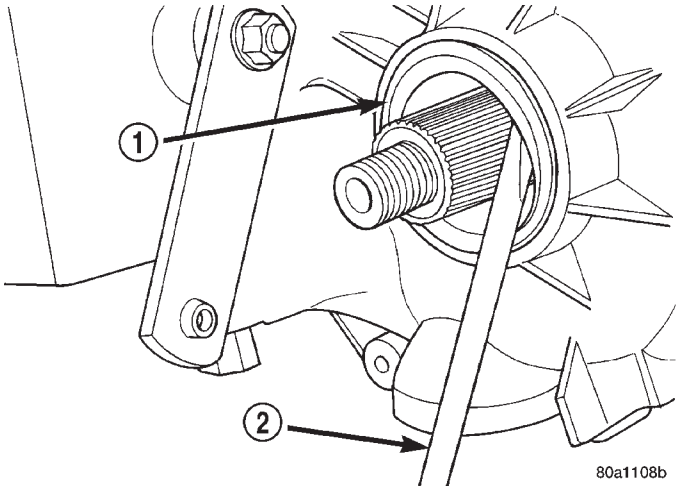


Fig. 40 Front Output Seal Removal

1 – OUTPUT SHAFT SEAL
2 – PRYBAR

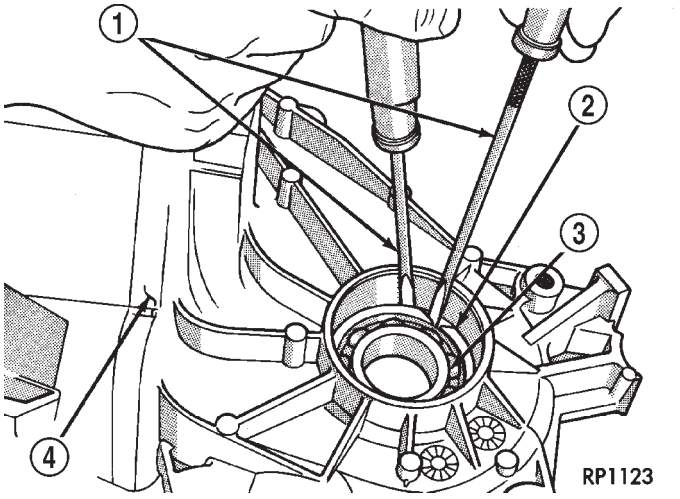


Fig. 41 Front Output Shaft Bearing Retaining Ring Removal

1 – SCREWDRIVERS
2 – SNAP RING
3 – FRONT OUTPUT SHAFT BEARING
4 – FRONT CASE

DISASSEMBLY AND ASSEMBLY (Continued)

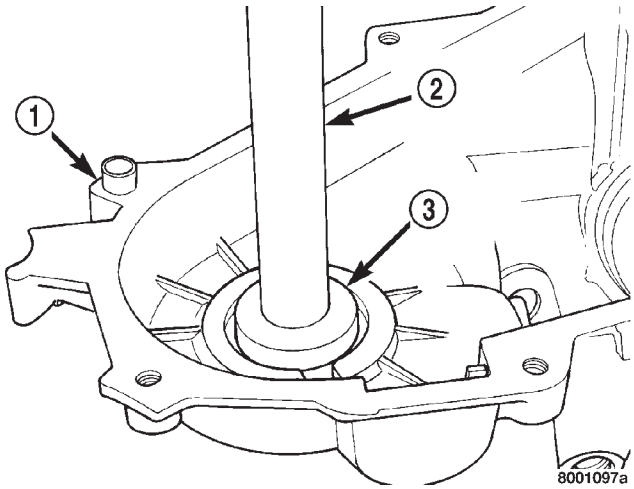


Fig. 42 Front Output Shaft Bearing Removal

1 – FRONT CASE
2 – SPECIAL TOOL C-4171
3 – SPECIAL TOOL 5065

(4) Install front output shaft front bearing in case with Tool Handle C-4171 and Installer 5064 (Fig. 43).

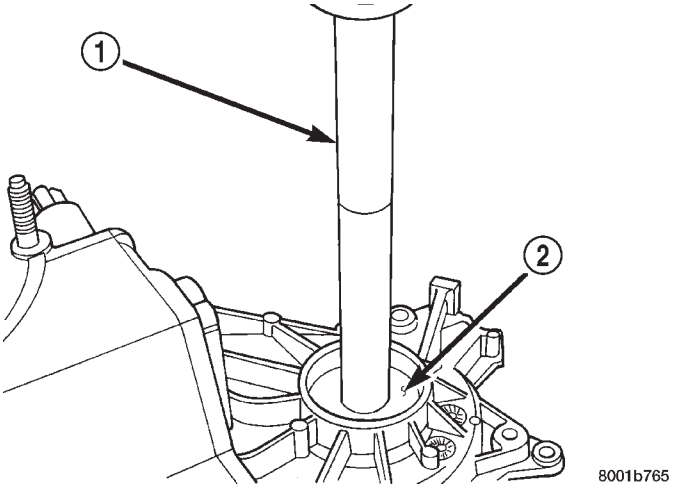


Fig. 43 Front Output Shaft Bearing Installation

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL 5064

(5) Install output shaft front bearing retaining ring (Fig. 44). Start ring into place by hand. Then use small screwdriver to work ring into case groove. Be sure ring is fully seated before proceeding.

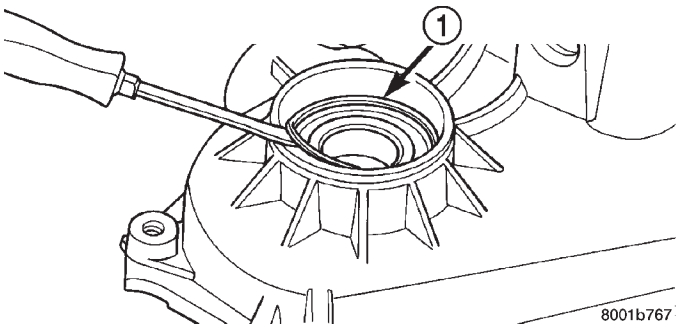


Fig. 44 Installing Output Shaft Front Bearing Retaining Ring

1 – WORK RETAINING RING INTO BORE GROOVE WITH SMALL SCREWDRIVER

(6) Install new front output seal in front case with Installer Tool 8143 as follows:

(a) Place new seal on tool. **Garter spring on seal goes toward interior of case.**

(b) Start seal in bore with light taps from hammer (Fig. 45). Once seal is started, continue tapping seal into bore until installer tool bottoms against case.

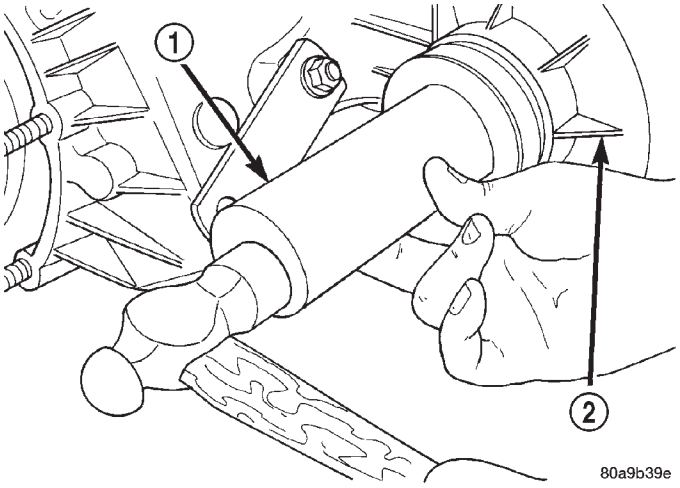


Fig. 45 Front Output Seal Installation

1 – INSTALLER 8143
2 – TRANSFER CASE

(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).

DISASSEMBLY AND ASSEMBLY (Continued)

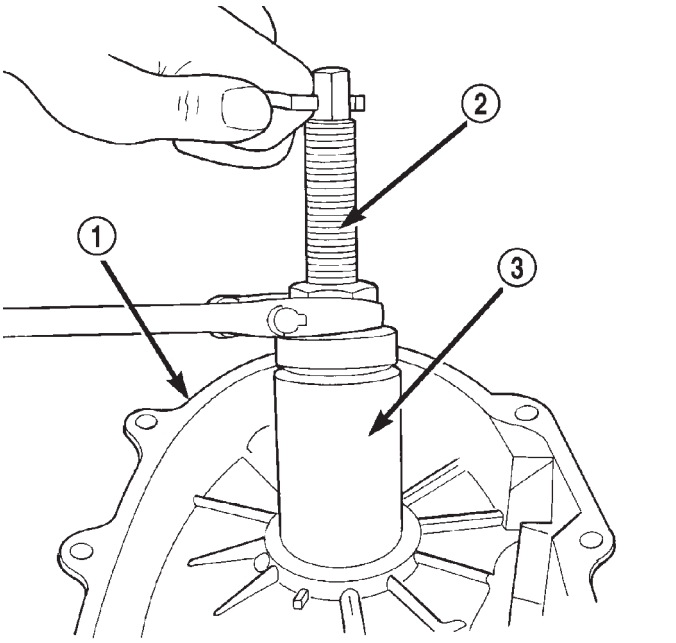


Fig. 46 Output Shaft Rear Bearing Removal

1 – REAR CASE
2 – SPECIAL TOOL L-4454–1 AND L-4454–3
3 – SPECIAL TOOL 8148

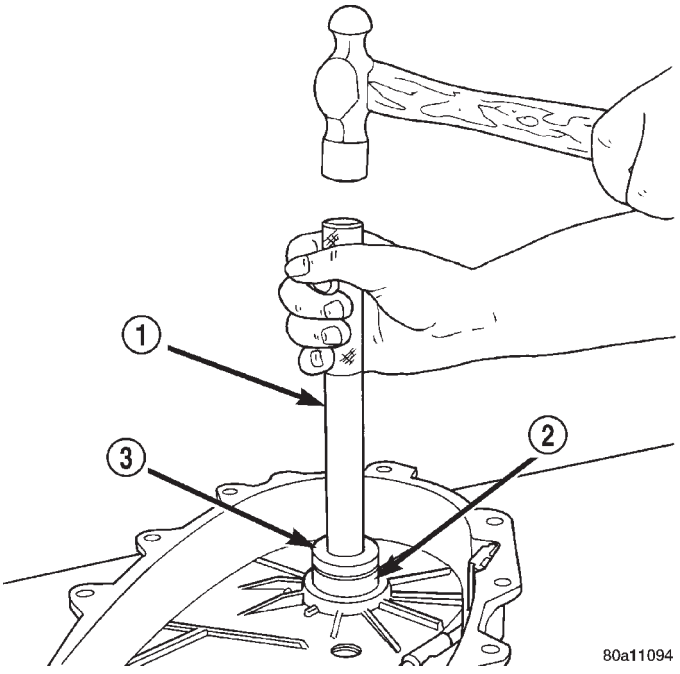


Fig. 47 Output Shaft Rear Bearing Installation

1 – HANDLE C-4171
2 – OUTPUT SHAFT INNER BEARING
3 – INSTALLER 5066

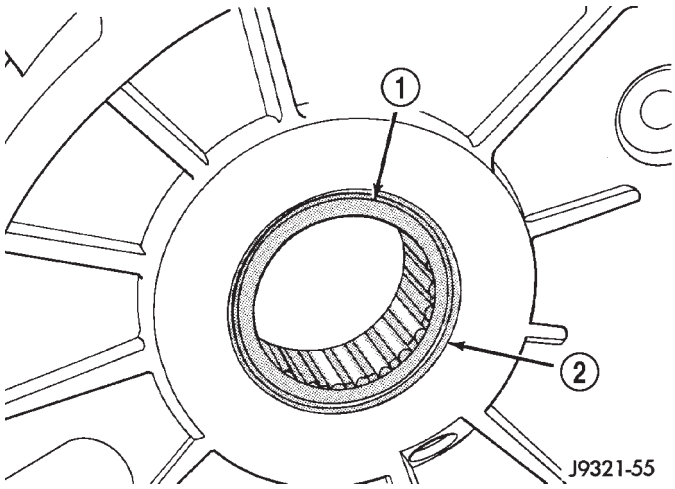


Fig. 48 Output Shaft Rear Bearing Installation Depth

1 – BEARING (SEATED) AT LOWER EDGE OF CHAMFER
2 – CHAMFER

(9) Using Remover C-4210 and Handle C-4171, drive input shaft bearing from inside the annulus gear opening in the case. (Fig. 49).

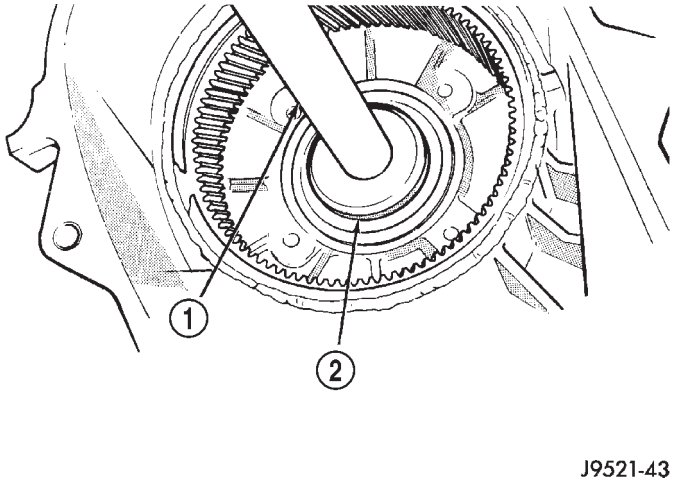


Fig. 49 Input Shaft Bearing Removal

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL C-4210

(10) Install locating ring on new bearing.

(11) Position case so forward end is facing upward.

(12) Using Remover C-4210 and Handle C-4171, drive input shaft bearing into case. The bearing locating ring must be fully seated against case surface (Fig. 50).

(13) Remove input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 51).

(14) Install new pilot bearing with Installer 5065 and Handle C-4171 (Fig. 52).

DISASSEMBLY AND ASSEMBLY (Continued)

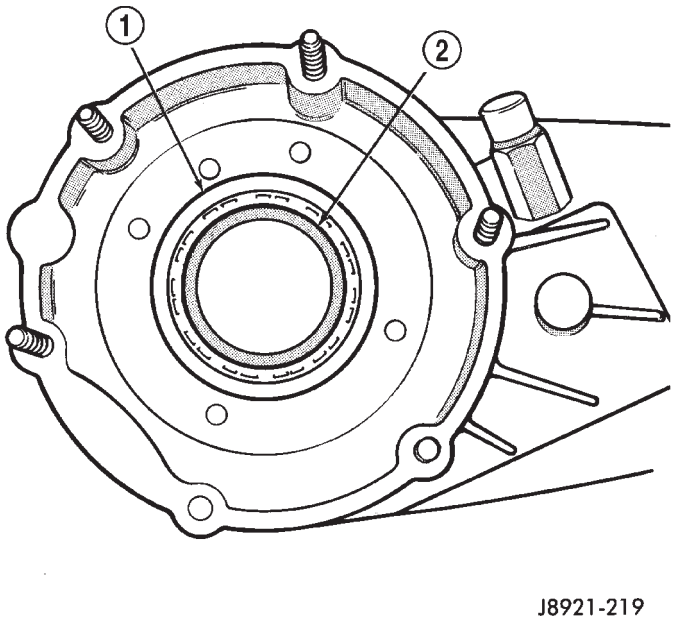


Fig. 50 Seating Input Shaft Bearing

1 – SNAP RING
2 – INPUT SHAFT BEARING

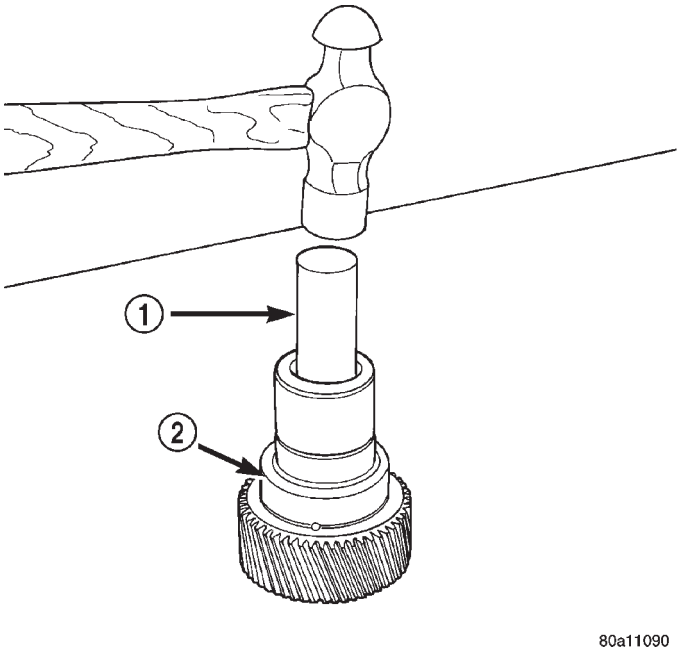


Fig. 51 Remove Input Gear Pilot Bearing

1 – DRIFT
2 – INPUT GEAR

(15) Remove front bearing retainer seal with suitable pry tool.

(16) Install new front bearing retainer seal with Installer 7884 (Fig. 53).

(17) Remove seal from oil pump housing with a suitable pry tool

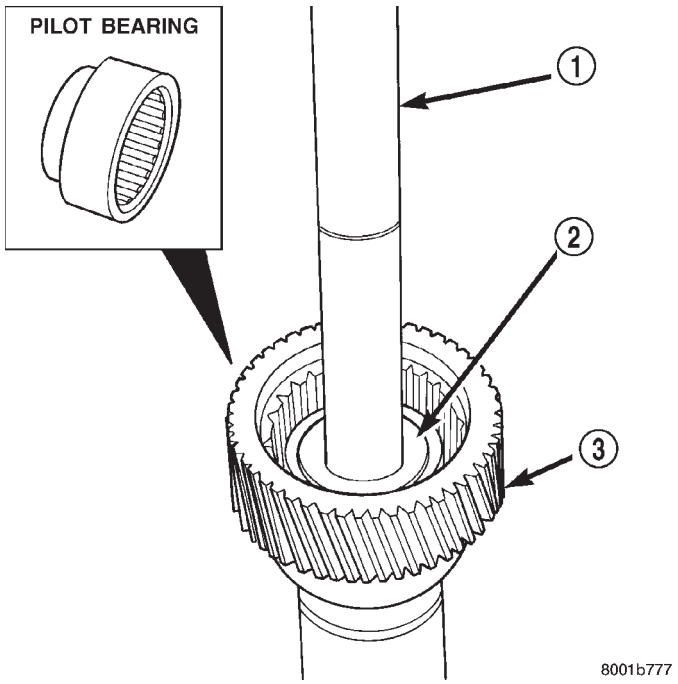


Fig. 52 Install Input Gear Pilot Bearing

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL 5065
3 – INPUT GEAR

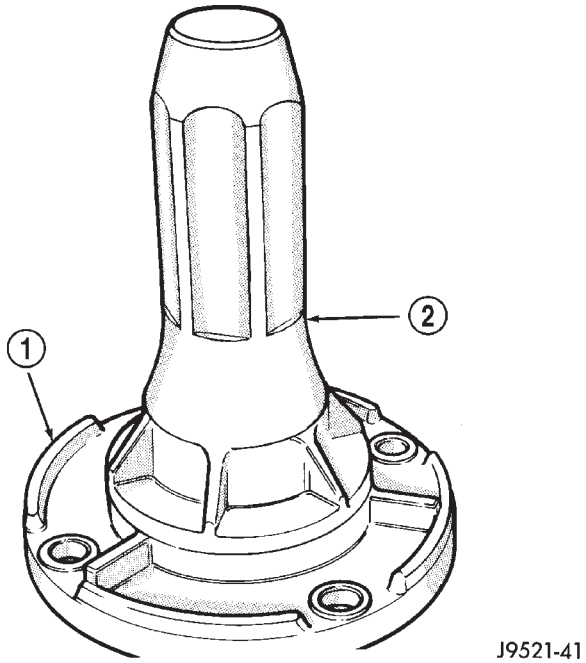


Fig. 53 Install Front Bearing Retainer Seal

1 – FRONT BEARING RETAINER
2 – SPECIAL TOOL 7884

(18) Install new seal in oil pump housing with Installer 7888 (Fig. 54).

DISASSEMBLY AND ASSEMBLY (Continued)

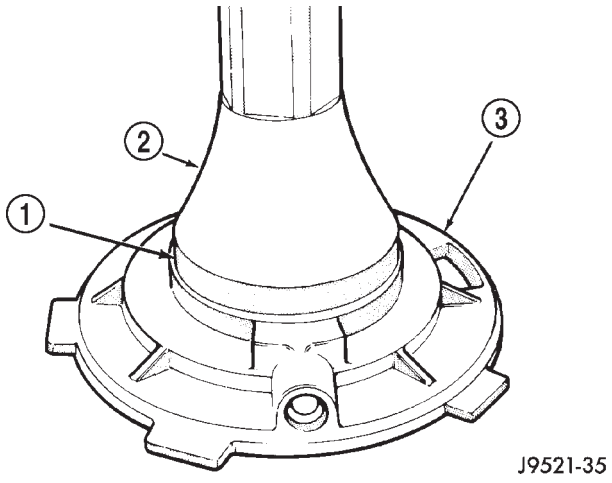


Fig. 54 Oil Pump Seal Installation

1 – HOUSING SEAL
2 – SPECIAL TOOL 7888
3 – OIL PUMP FEED HOUSING

(19) Remove rear retainer bearing with Installer 8128 and Handle C-4171.

(20) Install rear bearing in retainer with Handle C-4171 and Installer 5064 (Fig. 55).

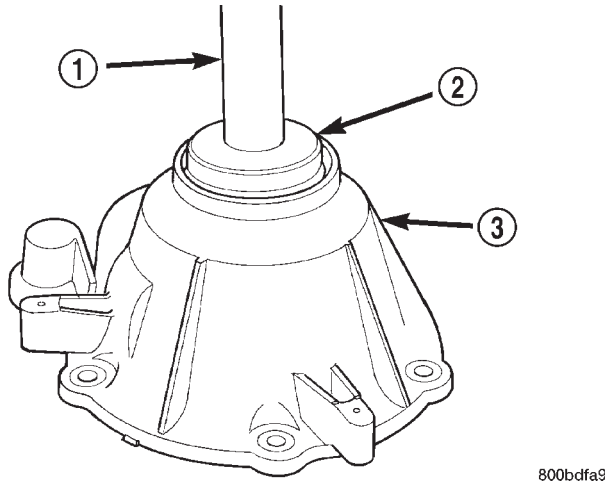


Fig. 55 Installing Rear Bearing In Retainer

1 – SPECIAL TOOL C-4171
2 – SPECIAL TOOL 5064
3 – REAR RETAINER

INPUT AND LOW RANGE GEAR ASSEMBLY

(1) Lubricate gears and thrust washers (Fig. 56) with recommended transmission fluid.

(2) Install first thrust washer in low range gear (Fig. 56). Be sure washer tabs are properly aligned in gear notches.

(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.

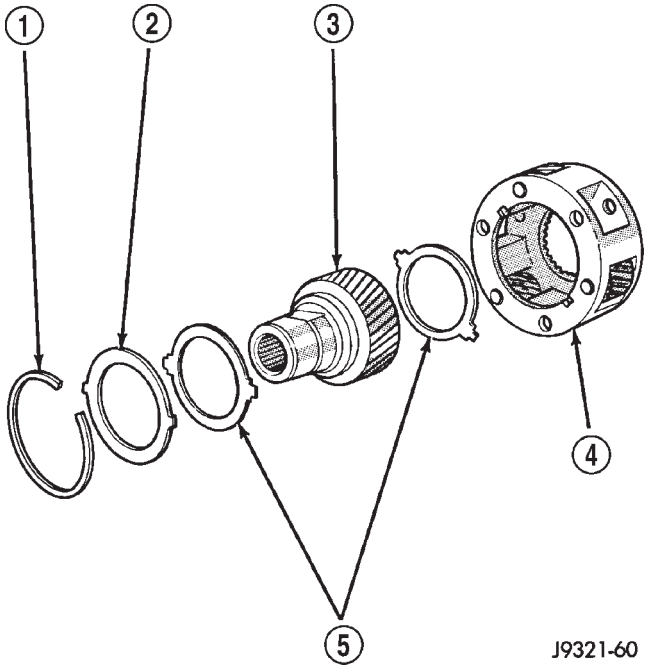


Fig. 56 Input/Low Range Gear Components

1 – SNAP RING
2 – RETAINER PLATE
3 – INPUT GEAR
4 – LOW RANGE GEAR
5 – THRUST WASHERS

INPUT GEAR AND LOW RANGE GEAR INSTALLATION

(1) Align and install low range/input gear assembly in front case (Fig. 57). Be sure low range gear pinions are engaged in annulus gear and that input gear shaft is fully seated in front bearing.

(2) Install snap-ring to hold input/low range gear into front bearing (Fig. 58).

(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.

DISASSEMBLY AND ASSEMBLY (Continued)

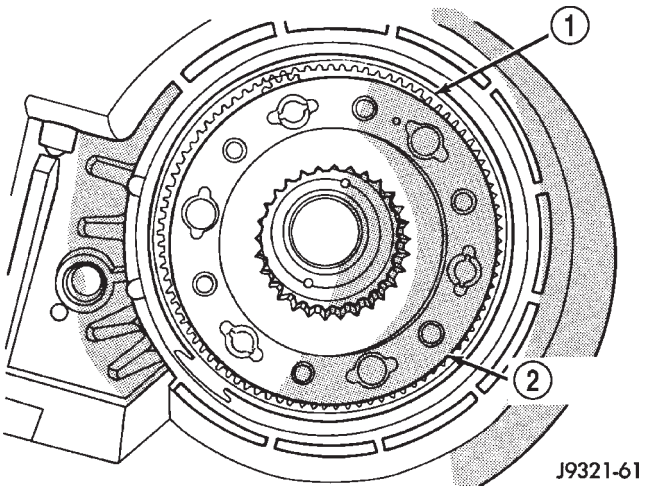


Fig. 57 Input/Low Range Gear Installation

1 – ANNULUS GEAR
2 – INPUT/LOW RANGE GEAR

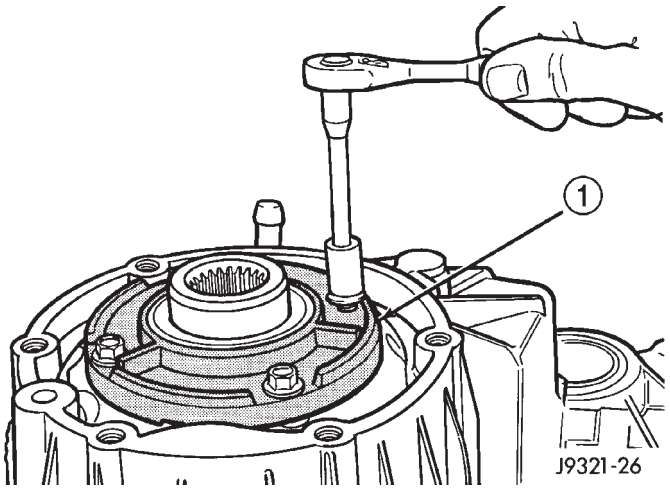


Fig. 59 Install Front Bearing Retainer

1 – FRONT BEARING RETAINER

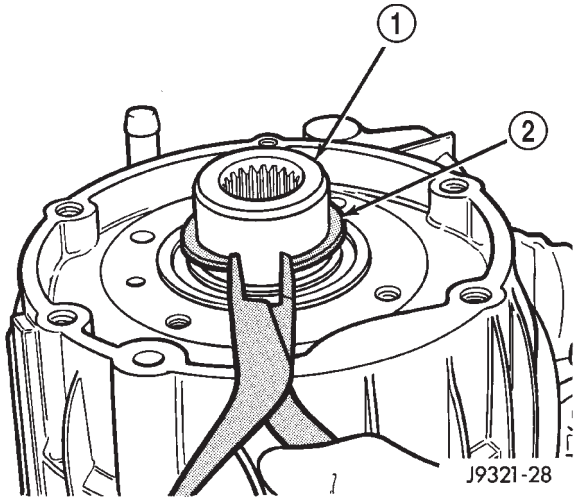


Fig. 58 Install Snap-Ring

1 – INPUT GEAR
2 – SNAP RING

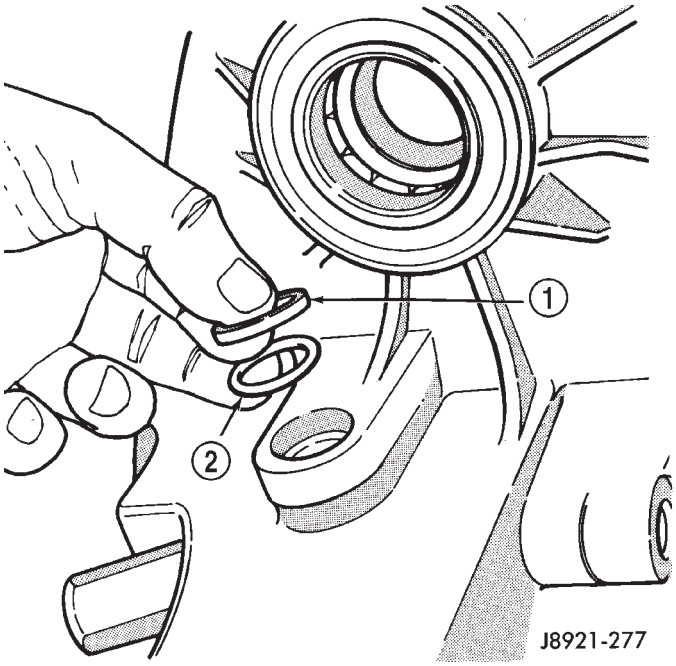


Fig. 60 Sector O-Ring And Bushing Installation

1 – SECTOR BUSHING
2 – O-RING

MAINSHAFT ASSEMBLY

(1) Lubricate mainshaft splines with recommended transmission fluid.

(2) Slide drive sprocket onto mainshaft.

(3) Slide mode hub onto mainshaft.

(4) Install mode hub retaining ring. Verify that the retaining ring is fully seated in mainshaft groove.

SHIFT FORKS AND MAINSHAFT INSTALLATION

(1) Install new sector shaft O-ring and bushing (Fig. 60).

(2) Install shift sector in case (Fig. 61). Lubricate sector shaft with transmission fluid before installation.

(3) Install range lever, washer, and nut on sector shaft (Fig. 62). Tighten range lever nut to 27–34 N.m (20–25 ft. lbs.) torque.

(4) Assemble and install range fork and hub (Fig. 63). Be sure hub is properly seated in low range gear and engaged to the input gear.

(5) Align and insert range fork pin in shift sector slot.

(6) Install assembled mainshaft (Fig. 64). Be sure shaft is seated in pilot bearing and input gear.

(7) Install new pads on mode fork if necessary.

DISASSEMBLY AND ASSEMBLY (Continued)

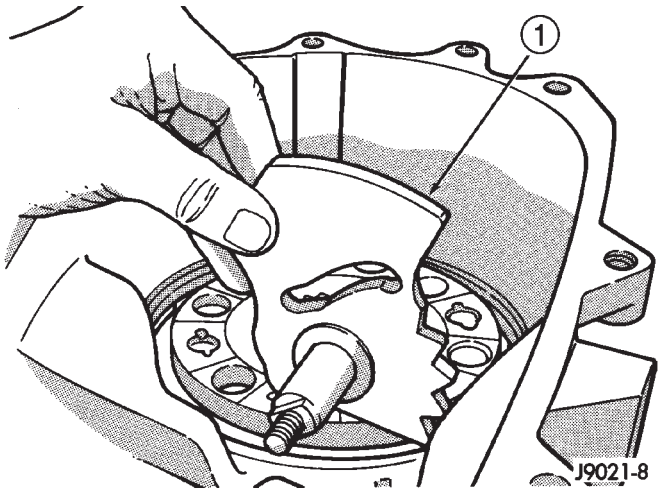


Fig. 61 Shift Sector Installation

1 – SHIFT SECTOR

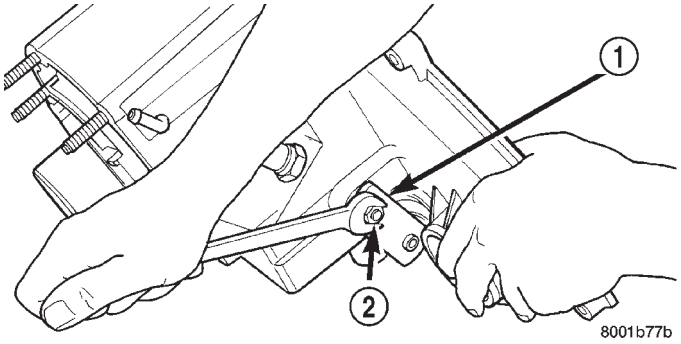


Fig. 62 Range Lever Installation

1 – RANGE LEVER
2 – LEVER NUT

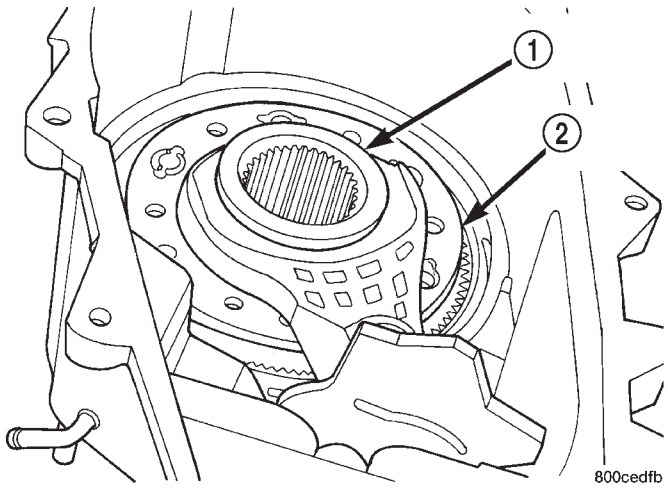


Fig. 63 Install Range Fork And Hub Assembly

1 – RANGE HUB
2 – RANGE FORK

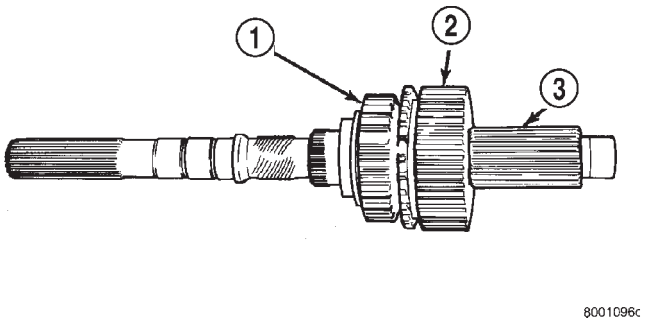


Fig. 64 Mainshaft Assembly Installation

1 – DRIVE SPROCKET
2 – MODE HUB
3 – MAINSHAFT

(8) Insert mode sleeve in mode fork mode fork. Be sure long side of sleeve is toward long end of shift rail (Fig. 65).

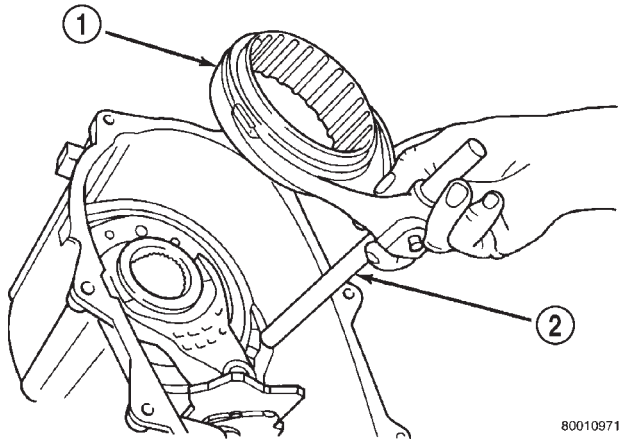


Fig. 65 Assembling Mode Fork And Sleeve

1 – MODE SLEEVE
2 – MODE FORK AND RAIL

(9) Install assembled mode fork and sleeve (Fig. 66). Be sure fork rail goes through range fork and into case bore. Also be sure sleeve is aligned and seated on mainshaft hub.

(10) Rotate sector to Neutral position.

(11) Install new O-ring on detent plug (Fig. 67).

(12) Lubricate detent plunger with transmission fluid or light coat of petroleum jelly.

(13) Install detent plunger, spring and plug (Fig. 67).

(14) Verify that plunger is properly engaged in sector.

FRONT OUTPUT SHAFT AND DRIVE CHAIN INSTALLATION

(1) Lubricate front output shaft-sprocket assembly, drive chain, and drive sprocket with transmission fluid.

DISASSEMBLY AND ASSEMBLY (Continued)

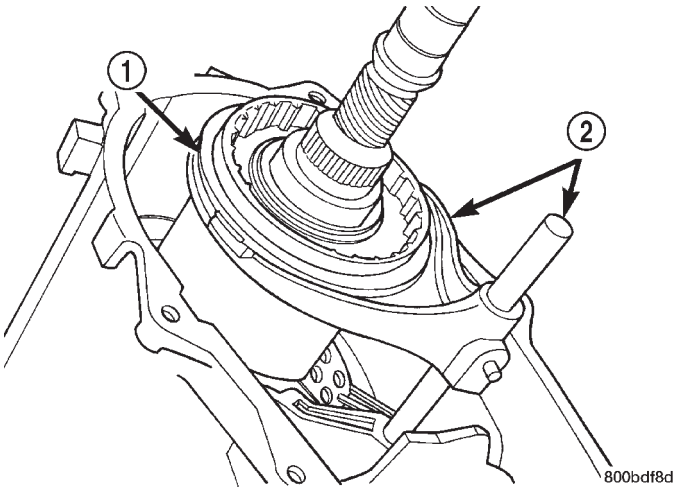


Fig. 66 Mode Fork And Sleeve Installation

1 – MODE SLEEVE
2 – MODE FORK AND RAIL

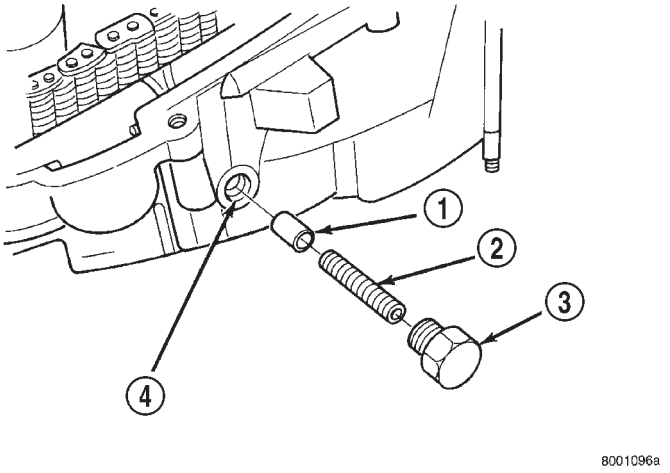


Fig. 67 Shift Detent Components

1 – POPPET
2 – SPRING
3 – SCREW
4 – POPPET BORE (IN CASE)

(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).

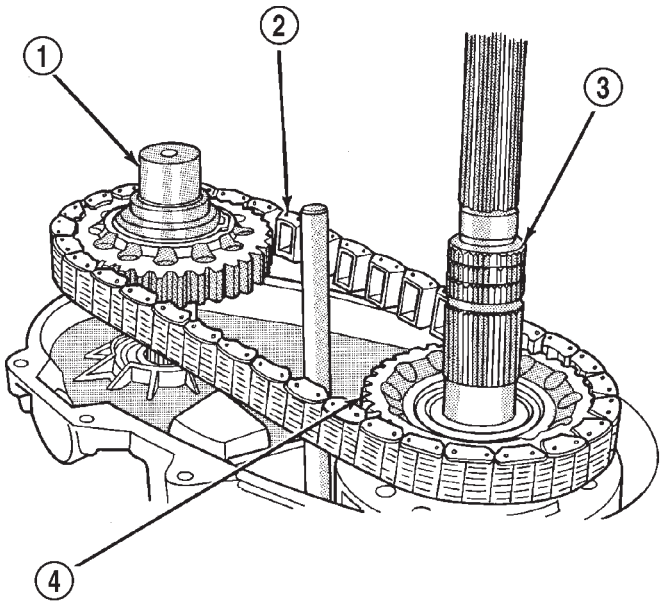


Fig. 68 Installing Drive Chain And Front Output Shaft

1 – FRONT OUTPUT SHAFT
2 – DRIVE CHAIN
3 – MAINSHAFT
4 – DRIVE SPROCKET

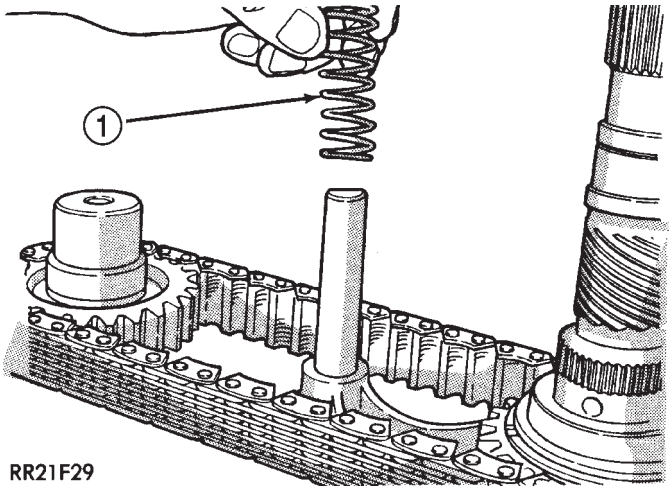


Fig. 69 Install Mode Fork Spring

1 – MODE SPRING

DISASSEMBLY AND ASSEMBLY (Continued)

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).

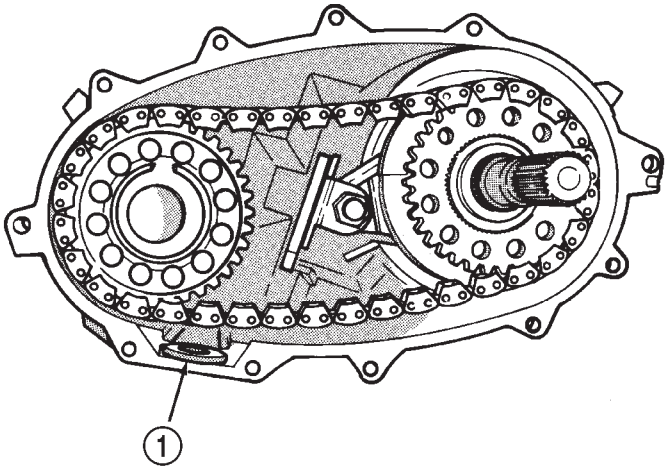


Fig. 70 Installing Case Magnet

1 – MAGNET

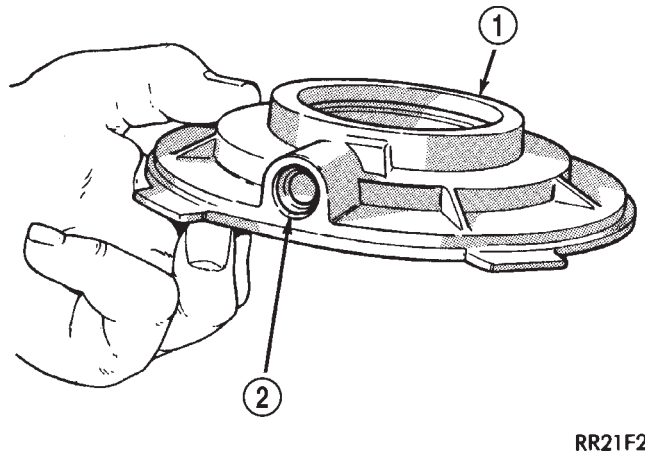


Fig. 71 Pickup Tube O-Ring Position

1 – OIL PUMP
2 – O-RING

(4) Insert oil pickup tube in oil pump inlet.

(5) Position assembled oil pump and pickup tube in rear case. Be sure pickup screen is securely seated in case slot. Also be sure oil pump locating tabs are outside rear case (Fig. 72).

(6) Apply 3 mm (1/8 in.) wide bead of Mopar® gasket maker or silicone adhesive sealer to mounting flange of front case. Work sealer bead around bolt holes.

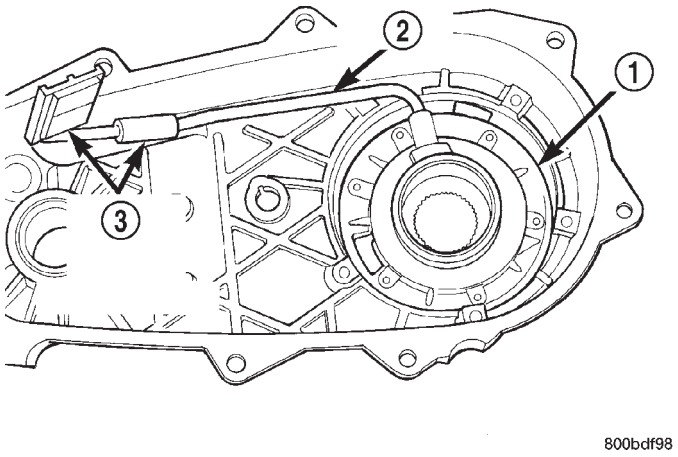


Fig. 72 Oil Pump And Pickup Tube Installation

1 – OIL PUMP
2 – PICKUP TUBE
3 – PICKUP SCREEN AND CONNECTOR

(7) Lift rear case and oil pump and carefully position assembly on front case. Be sure case dowels are aligned and that mode fork rail extends through rear case before seating rear case on front case.

(8) Install case attaching bolts. Alignment bolts at each end of case are only ones requiring washers (Fig. 73).

(9) Tighten case bolts to 27-34 N·m (20-25 ft. lbs.) torque.

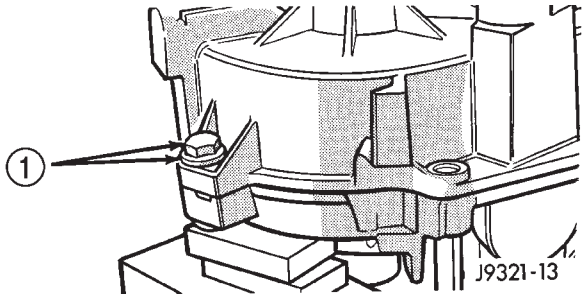


Fig. 73 Alignment Bolt Location

1 – ALIGNMENT BOLT AND WASHER (AT EACH END OF CASE)

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.

(6) Install yoke and new yoke nut on front output shaft (Fig. 75).

DISASSEMBLY AND ASSEMBLY (Continued)

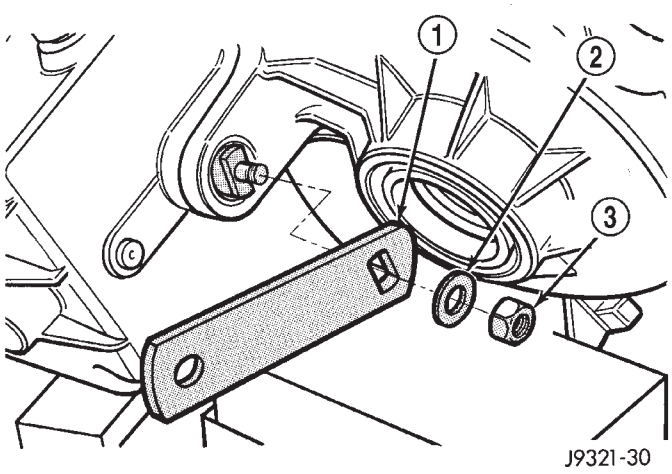


Fig. 74 Range Lever Installation

1 – RANGE LEVER
2 – WASHER
3 – LOCKNUT

(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.

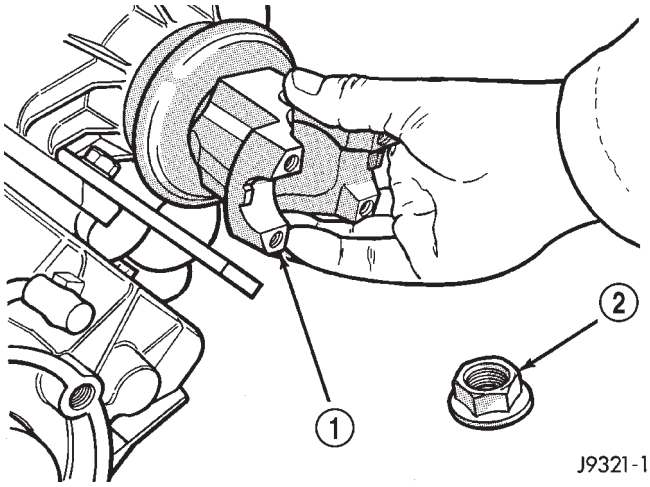


Fig. 75 Output Shaft Yoke Installation

1 – OUTPUT SHAFT YOKE
2 – YOKE NUT

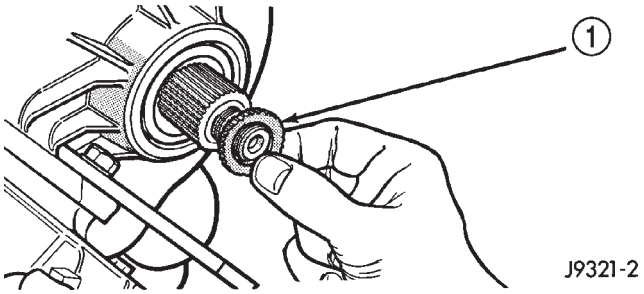


Fig. 76 Yoke Seal Washer Installation

1 – YOKE SEAL WASHER

REAR RETAINER INSTALLATION

(1) Apply bead of Mopar® Sealer P/N 82300234, or Loctite™ Ultra Gray, to mating surface of rear retainer. Sealer bead should be a maximum of 3/16 inch.

(2) Install rear retainer on rear case. Tighten retainer bolts to 20–27 N·m (15–20 ft. lbs.) torque.

(3) Install rear bearing I. D. retaining ring and spacer on output shaft.

(4) Apply liberal quantity of petroleum jelly to new rear seal and to output shaft. Petroleum jelly is needed to protect seal lips during installation.

(5) Slide seal onto Seal Protector 6992 (Fig. 77). Slide seal protector and seal onto output shaft.

(6) Slide Installer C-4076-B onto seal protector with the recessed side of the tool toward the seal. Drive seal into rear bearing retainer with Installer C-4076-B and Handle MD-998323 (Fig. 78).

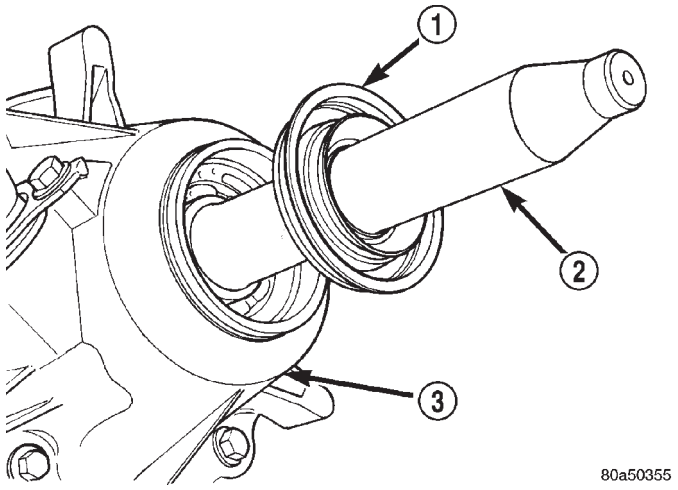


Fig. 77 Output Shaft Seal and Protector

1 – OUTPUT SHAFT SEAL
2 – SPECIAL TOOL 6992
3 – TRANSFER CASE

(7) Install rear slinger with Installer 8408.

(8) Install boot on output shaft slinger and crimp retaining clamp with tool C-4975-A (Fig. 79).

DISASSEMBLY AND ASSEMBLY (Continued)

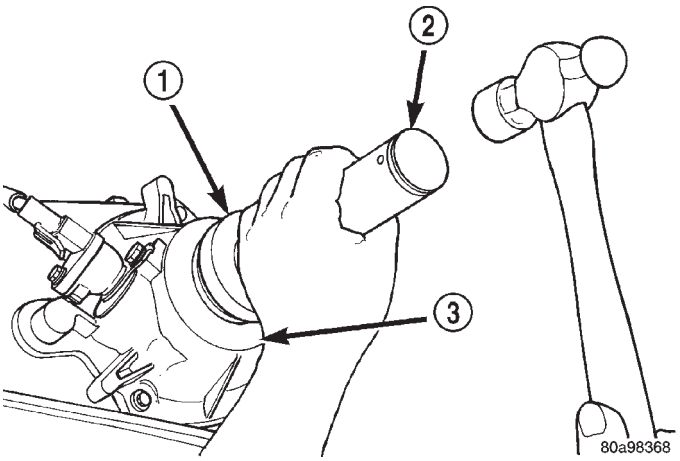


Fig. 78 Rear Seal Installation

1 – SPECIAL TOOL C-4076–B
2 – SPECIAL TOOL MD998323
3 – TRANSFER CASE

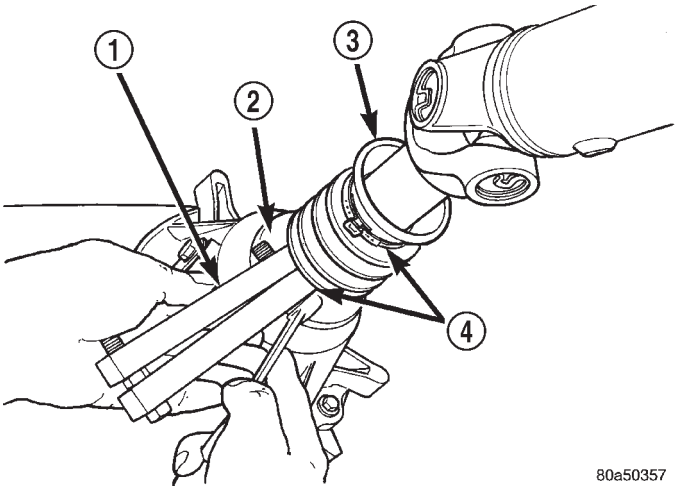


Fig. 79 Slinger Boot Installation

1 – SPECIAL TOOL C-4975–A
2 – SLINGER
3 – BOOT
4 – CLAMP

CLEANING AND INSPECTION

NV231 TRANSFER CASE

Clean the transfer case parts with a standard parts cleaning solvent. Remove all traces of sealer from the cases and retainers with a scraper and 3M all purpose cleaner. Use compressed air to remove solvent residue from oil feed passages in the case halves, retainers, gears, and shafts.

The oil pickup screen can be cleaned with solvent. Shake excess solvent from the screen after cleaning and allow it to air dry. Do not use compressed air.

MAINSHAFT/SPROCKET/HUB INSPECTION

Inspect the splines on the hub and shaft and the teeth on the sprocket (Fig. 80). Minor nicks and scratches can be smoothed with an oilstone. However, replace any part that is damaged.

Check the contact surfaces in the sprocket bore and on the mainshaft. Minor nicks and scratches can be smoothed with 320–400 grit emery cloth but do not try to salvage the shaft if nicks or wear is severe.

INPUT GEAR AND PLANETARY CARRIER

Check the teeth on the gear (Fig. 81). Minor nicks can be dressed off with an oilstone but replace the gear if any teeth are broken, cracked, or chipped. The bearing surface on the gear can be smoothed with 300–400 grit emery cloth if necessary.

Examine the carrier body and pinion gears for wear or damage. The carrier will have to be replaced as an assembly if the body, pinion pins, or pinion gears are damaged.

Check the lock ring and both thrust washers for wear or cracks. Replace them if necessary. Also replace the lock retaining ring if bent, distorted, or broken.

CLEANING AND INSPECTION (Continued)

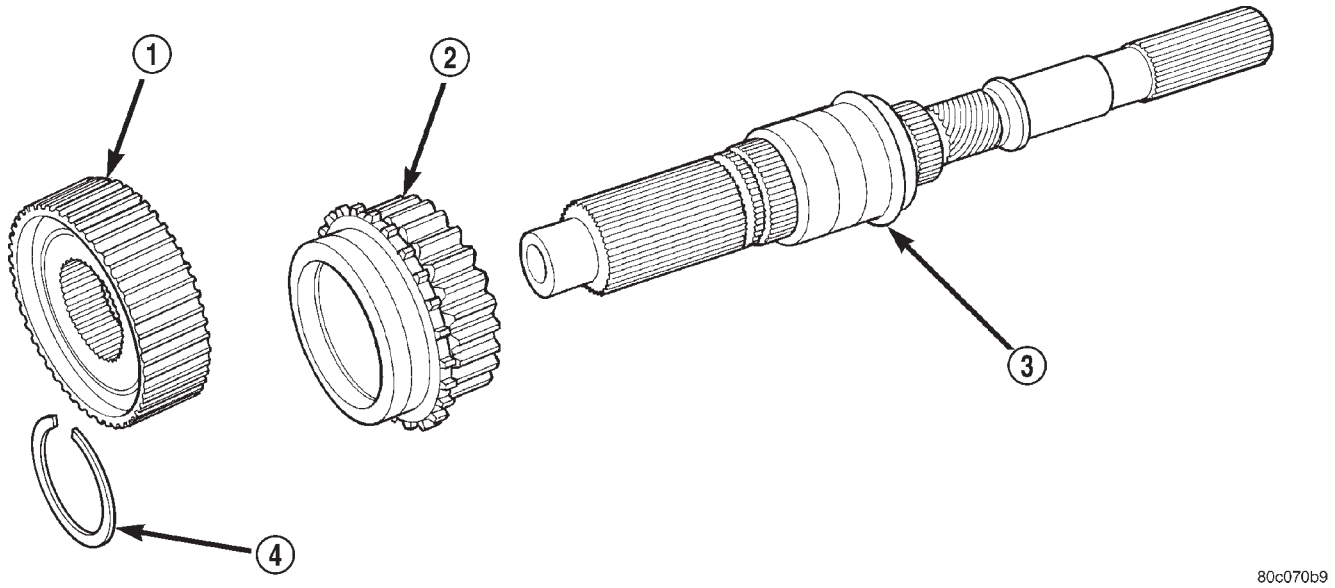


Fig. 80 Mainshaft, Mode Hub, And Drive Sprocket

1 – MODE HUB
2 – DRIVE SPROCKET
3 – MAINSHAFT
4 – MODE HUB RETAINING RING

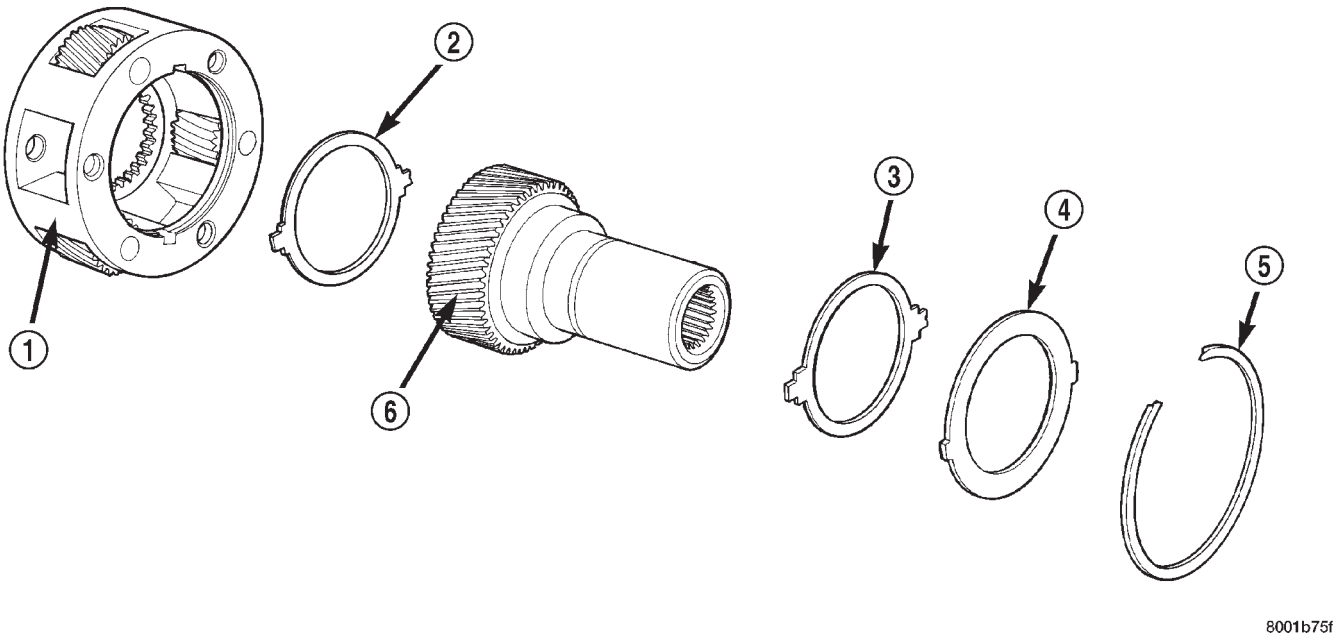


Fig. 81 Input Gear And Carrier Components

1 – PLANETARY CARRIER
2 – REAR THRUST WASHER
3 – FRONT THRUST WASHER
4 – CARRIER LOCK RING
5 – CARRIER LOCK RETAINING RING
6 – INPUT GEAR

SHIFT FORKS/HUBS/SLEEVES

Check condition of the shift forks and mode fork shift rail (Fig. 82). Minor nicks on the shift rail can be smoothed with 320–400 grit emery cloth.

Inspect the shift fork wear pads (Fig. 83). The mode fork pads are serviceable and can be replaced if necessary. The range fork pads are not serviceable. The fork must be replaced as an assembly if the pads are worn or damaged.

CLEANING AND INSPECTION (Continued)

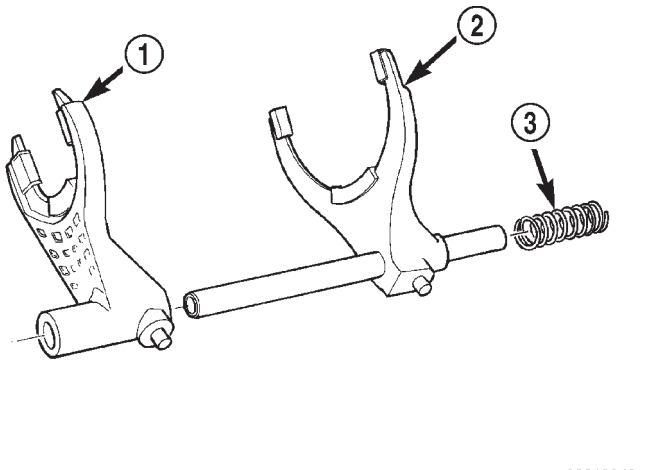


Fig. 82 Shift forks

1 – RANGE FORK
2 – MODE FORK AND RAIL
3 – MODE SPRING

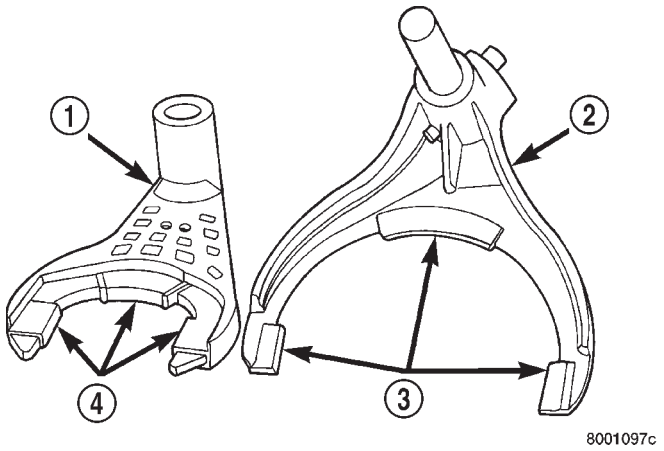


Fig. 83 Shift Fork And Wear Pad Locations

1 – RANGE FORK
2 – MODE FORK
3 – WEAR PADS (SERVICEABLE)
4 – WEAR PADS (NON-SERVICEABLE)

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

REAR RETAINER/BEARING/ SEAL/SLINGER/BOOT

Inspect the retainer components (Fig. 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.

Replace any part if distorted, bent, or broken. Also replace the boot if cut or torn. Replace the boot band clamps, do not reuse them.

REAR OUTPUT SHAFT/YOKE/DRIVE CHAIN

Check condition of the seal contact surfaces of the yoke slinger (Fig. 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)

CLEANING AND INSPECTION (Continued)

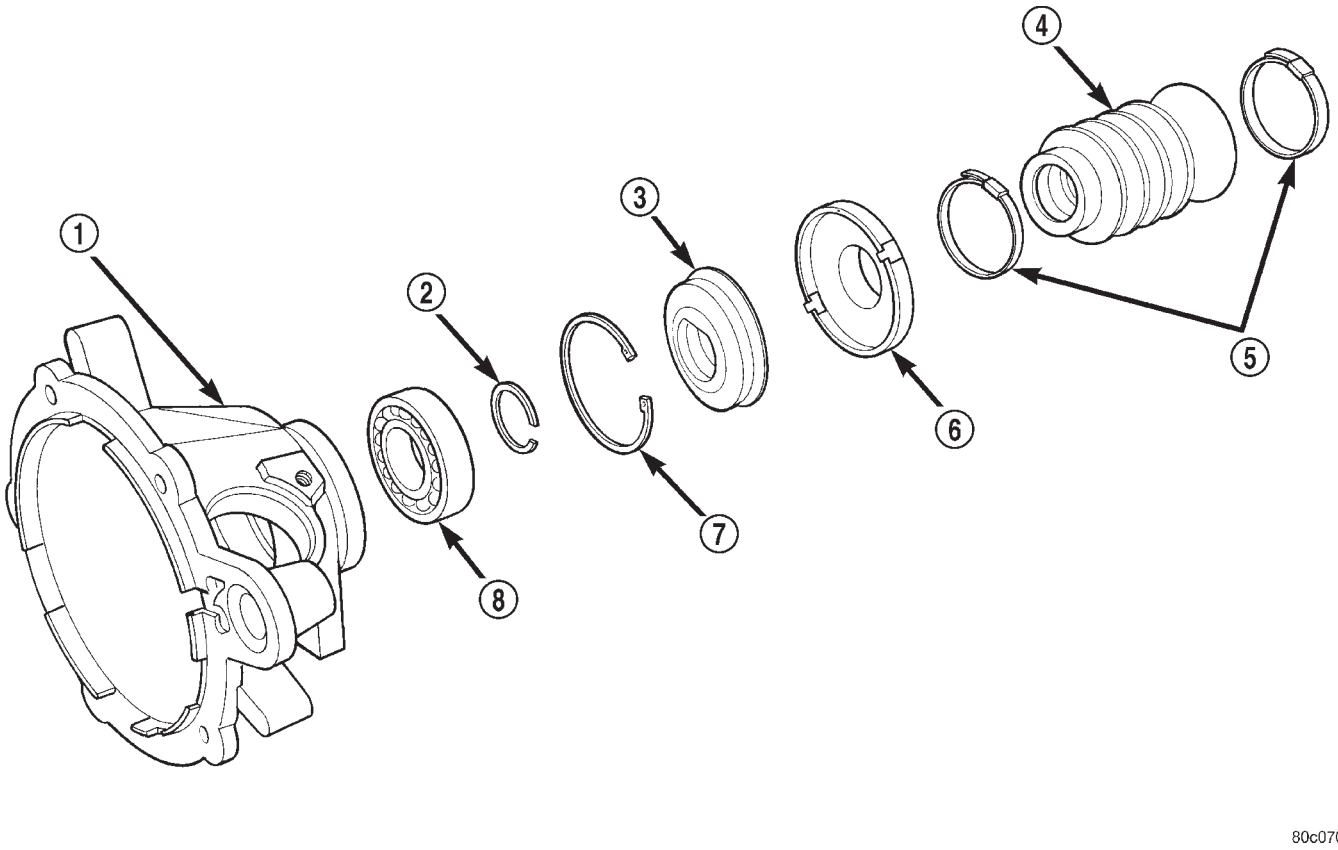


Fig. 84 Rear Retainer Components

1 – REAR RETAINER
2 – REAR BEARING I. D. RETAINING RING
3 – REAR SEAL
4 – BOOT
5 – BAND CLAMPS
6 – REAR SLINGER
7 – REAR BEARING O. D. RETAINING RING
8 – REAR BEARING

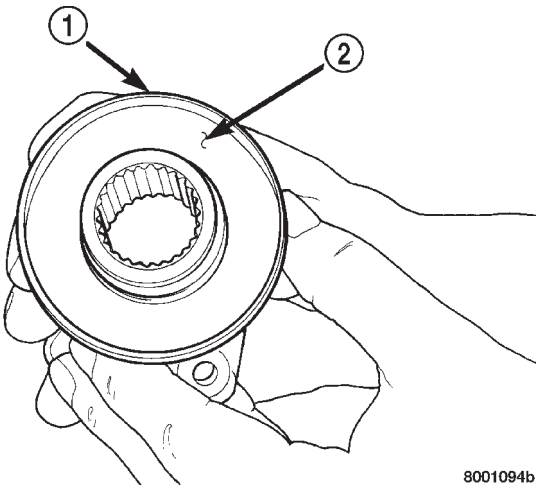


Fig. 85 Seal Contact Surface Of Yoke Slinger

1 – FRONT SLINGER (PART OF YOKE)
2 – SEAL CONTACT SURFACE MUST BE CLEAN AND SMOOTH

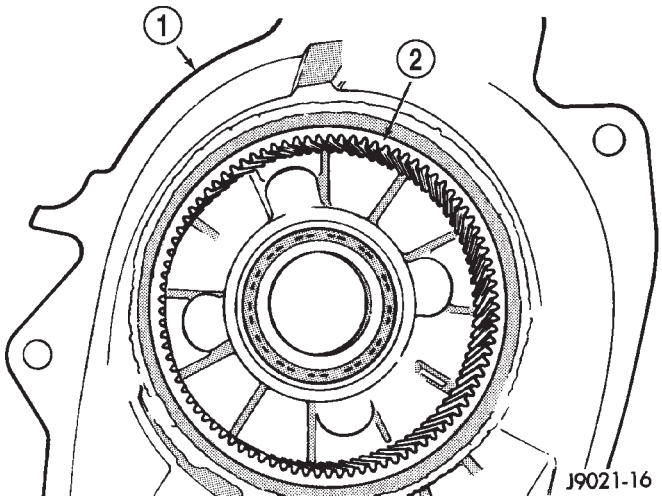


Fig. 86 Low Range Annulus Gear

1 – FRONT CASE
2 – LOW RANGE ANNULUS GEAR

CLEANING AND INSPECTION (Continued)

FRONT-REAR CASES AND FRONT RETAINER

Inspect the cases and retainer for wear and damage. Clean the sealing surfaces with a scraper and 3M all purpose cleaner. This will ensure proper sealer adhesion at assembly. Replace the input retainer seal; do not reuse it.

Check case condition. If leaks were a problem, look for gouges and severe scoring of case sealing surfaces. Also make sure the front case mounting studs are in good condition.

Check the front case mounting studs and vent tube. The tube can be secured with Loctite 271 or 680 if loose. The stud threads can be cleaned up with a die if necessary. Also check condition of the fill/drain plug threads in the rear case. The threads can be repaired with a thread chaser or tap if necessary. Or the threads can be repaired with Helicoil stainless steel inserts if required.

OIL PUMP/OIL PICKUP

Examine the oil pump pickup parts. Replace the pump if any part appears to be worn or damaged. Do not disassemble the pump as individual parts are not available. The pump is only available as a complete assembly. The pickup screen, hose, and tube are the only serviceable parts and are available separately.

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.

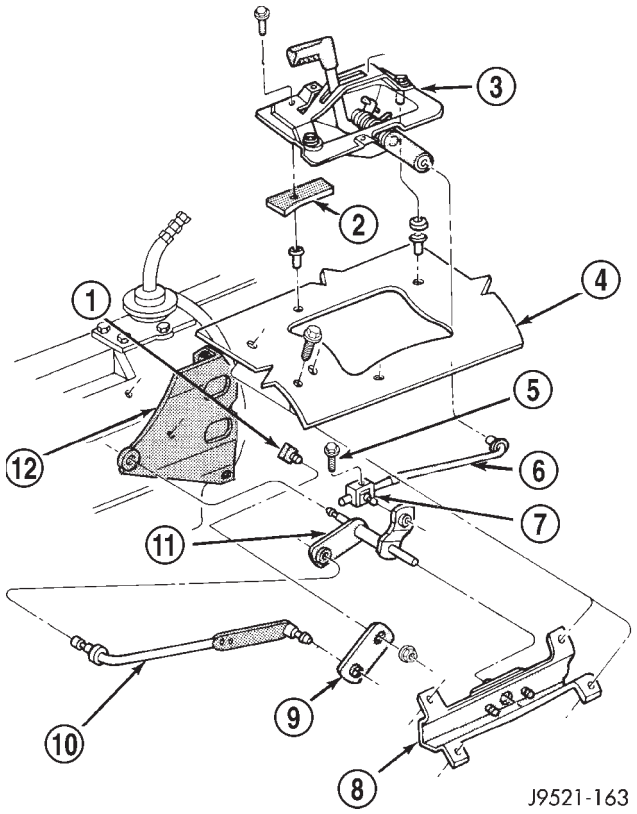


Fig. 87 Shift Linkage

1 – TRANSFER CASE RANGE LEVER SHAFT
2 – SEAL
3 – TRANSFER CASE SHIFT LEVER ASSEMBLY
4 – FLOORPAN
5 – TRUNNION LOCK BOLT
6 – SHIFT ROD
7 – ADJUSTING TRUNNION
8 – TORQUE SHAFT BRACKET
9 – RANGE LEVER
10 – TORQUE SHAFT ROD
11 – TORQUE SHAFT
12 – LINKAGE BRACKET

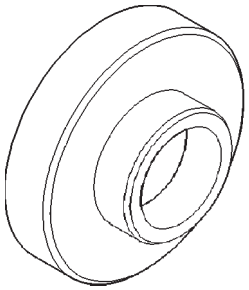
SPECIFICATIONS

TORQUE

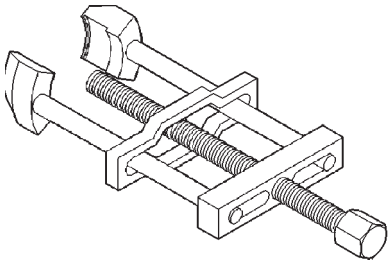
DESCRIPTION	TORQUE
Plug, Detent	16–24 N·m (12–18 ft. lbs.)
Plug, Drain/Fill	20–34 N·m (15–20 ft. lbs.)
Plug, Drain/Fill	40–45 N·m (30–40 ft. lbs.)
Bolt, Extension Housing	35–46 N·m (26–34 ft. lbs.)
Bolt, Front Brg. Retainer	21 N·m (16 ft. lbs.)
Bolt, Case Half	27–34 N·m (20–25 ft. lbs.)
Nut, Front Yoke	122–176 N·m (90–130 ft. lbs.)
Nut, Range Lever	27–34 N·m (20–25 ft. lbs.)
Bolt, Rear Retainer	35–46 N·m (26–34 ft. lbs.)
Nuts, Mounting	29–40 N·m (22–30 ft. lbs.)
Switch, Indicator	20–34 N·m (15–25 ft. lbs.)

SPECIAL TOOLS

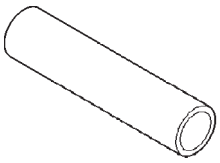
NV231



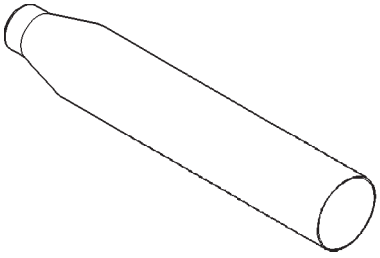
Installer—C-4076-B



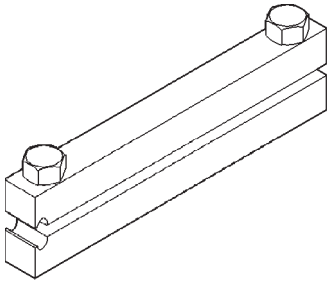
Puller, Slinger—MD-998056–A



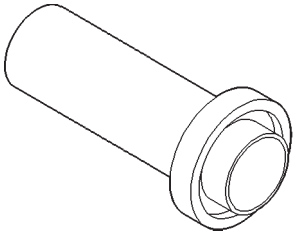
Installer—MD-998323



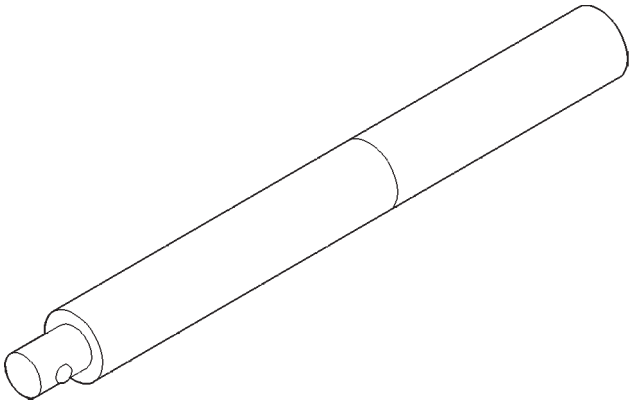
Seal Protector—6992



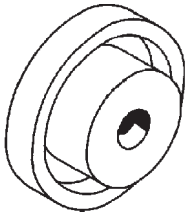
Installer, Boot Clamp—C-4975-A



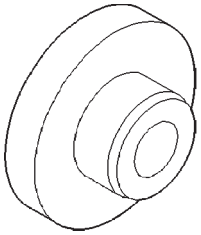
Installer, Seal—8143



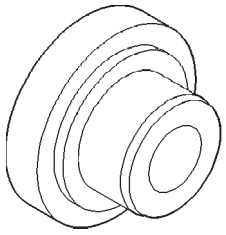
Handle, Universal—C-4171



Installer, Seal—C-4210

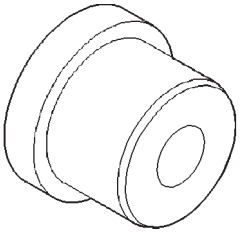


Installer, Bearing—5064

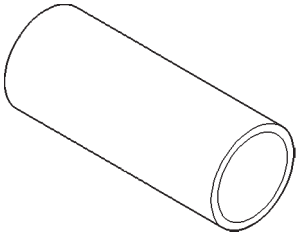


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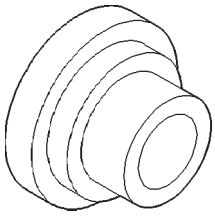
SPECIAL TOOLS (Continued)



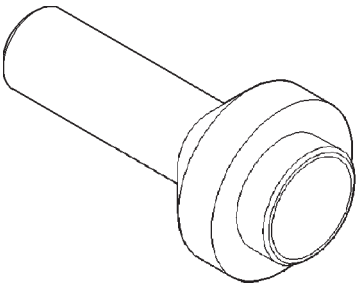
Installer, Bushing—5066



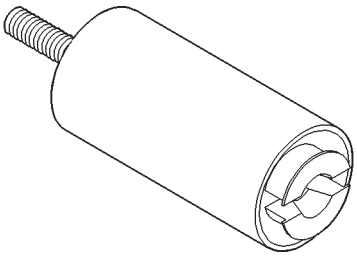
Cup—8148



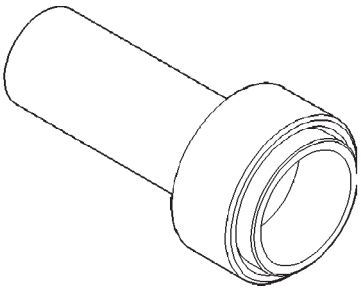
Installer, Bearing—8128



Installer, Seal—7884



Remover—L-4454



Installer, Pump Housing Seal—7888

TIRES AND WHEELS

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DESCRIPTION AND OPERATION

TIRES

DESCRIPTION

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.

DESCRIPTION AND OPERATION (Continued)

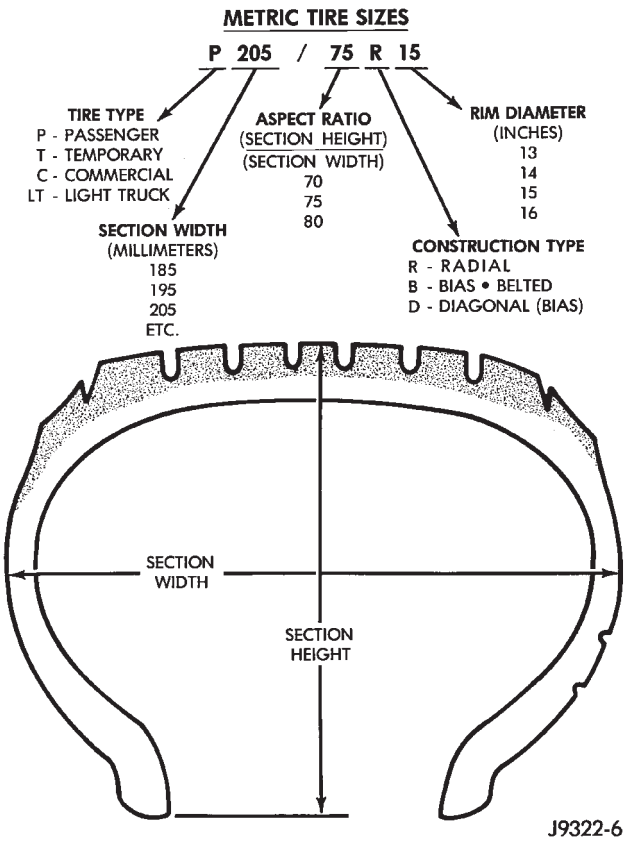


Fig. 1 Tire Identification

TIRE CHAINS

Tire snow chains may be used on **certain** models. Refer to the Owner's Manual for more information.

RADIAL-PLY TIRES

DESCRIPTION

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

DESCRIPTION

The temporary spare tire is designed for emergency use only. The original tire should be repaired or replaced at the first opportunity, then reinstalled. Do not exceed speeds of 50 M. P. H. when using the temporary spare tire. Refer to Owner's Manual for complete details.

TIRE INFLATION PRESSURES

DESCRIPTION

Under inflation will cause rapid shoulder wear, tire flexing, and possible tire failure (Fig. 2).

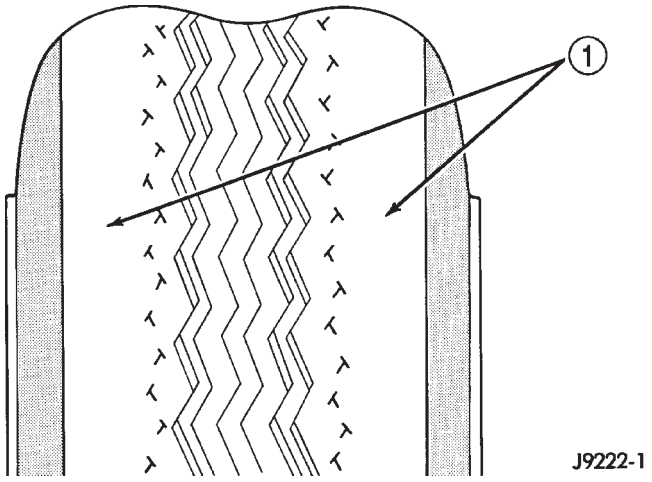


Fig. 2 Under Inflation Wear

1 – THIN TIRE TREAD AREAS

Over inflation will cause rapid center wear and loss of the tire's ability to cushion shocks (Fig. 3).

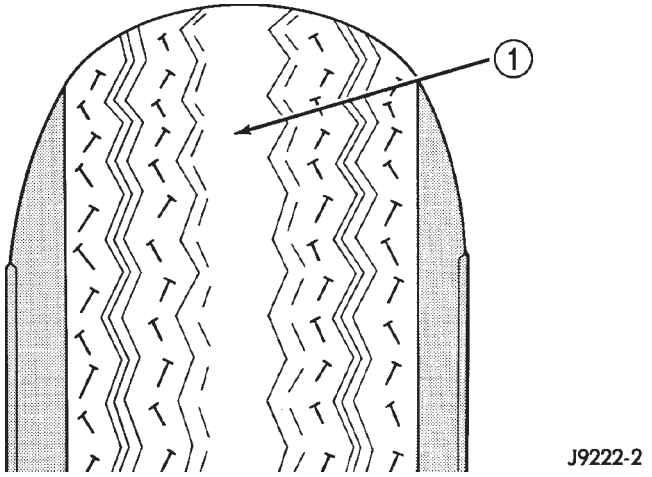


Fig. 3 Over Inflation Wear

1 – THIN TIRE TREAD AREA

DESCRIPTION AND OPERATION (Continued)

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 vehicles Owners Manual. A Certification Label on the drivers side door pillar provides the minimum tire and rim size for the vehicle. The label also list the cold inflation pressure for these tires at full load operation

Tire pressures have been chosen to provide safe operation, vehicle stability, and a smooth ride. Tire pressure should be checked cold once a month. Tire pressure decreases as the ambient temperature drops. Check tire pressure frequently when ambient temperature varies widely.

Tire inflation pressures are cold inflation pressure. The vehicle must sit for at least 3 hours to obtain the correct cold inflation pressure reading. Or be driven less than one mile after sitting for 3 hours. Tire inflation pressures may increase from 2 to 6 pounds per square inch (psi) during operation. Do not reduce this normal pressure build-up.

WARNING: OVER OR UNDER INFLATED TIRES CAN AFFECT VEHICLE HANDLING AND TREAD WEAR. THIS MAY CAUSE THE TIRE TO FAIL SUDDENLY, RESULTING IN LOSS OF VEHICLE CONTROL.

TIRE PRESSURE FOR HIGH SPEED

DESCRIPTION

Where speed limits allow the vehicle to be driven at high speeds, correct tire inflation pressure is very important. For speeds up to and including 120 km/h (75 mph), tires must be inflated to the pressures shown on the tire placard. For continuous speeds in excess of 120 km/h (75 mph), tires must be inflated to the maximum pressure specified on the tire sidewall.

Vehicles loaded to the maximum capacity should not be driven at continuous speeds above 75 mph (120 km/h).

For emergency vehicles that are driven at speeds over 90 mph (144 km/h), special high speed tires must be used. Consult tire manufacturer for correct inflation pressure recommendations.

REPLACEMENT TIRES

DESCRIPTION

The original equipment tires provide a proper balance of many characteristics such as:
- Ride
- Noise
- Handling
- Durability
- Tread life
- Traction
- Rolling resistance
- Speed capability

It is recommended that tires equivalent to the original equipment tires be used when replacement is needed.

Failure to use equivalent replacement tires may adversely affect the safety and handling of the vehicle.

The use of oversize tires may cause interference with vehicle components. Under extremes of suspension and steering travel, interference with vehicle components may cause tire damage.

WARNING: FAILURE TO EQUIP THE VEHICLE WITH TIRES HAVING ADEQUATE SPEED CAPABILITY CAN RESULT IN SUDDEN TIRE FAILURE.

DIAGNOSIS AND TESTING

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.

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)

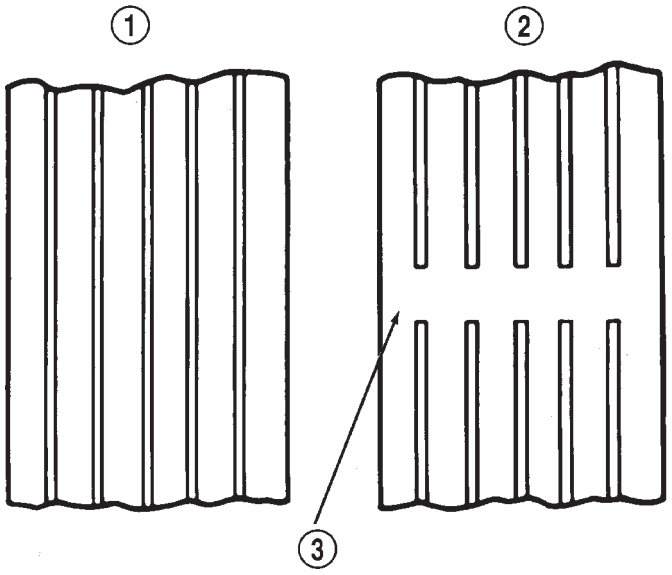


Fig. 4 Tread Wear Indicators

1 – TREAD ACCEPTABLE
2 – TREAD UNACCEPTABLE
3 – WEAR INDICATOR

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.

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.

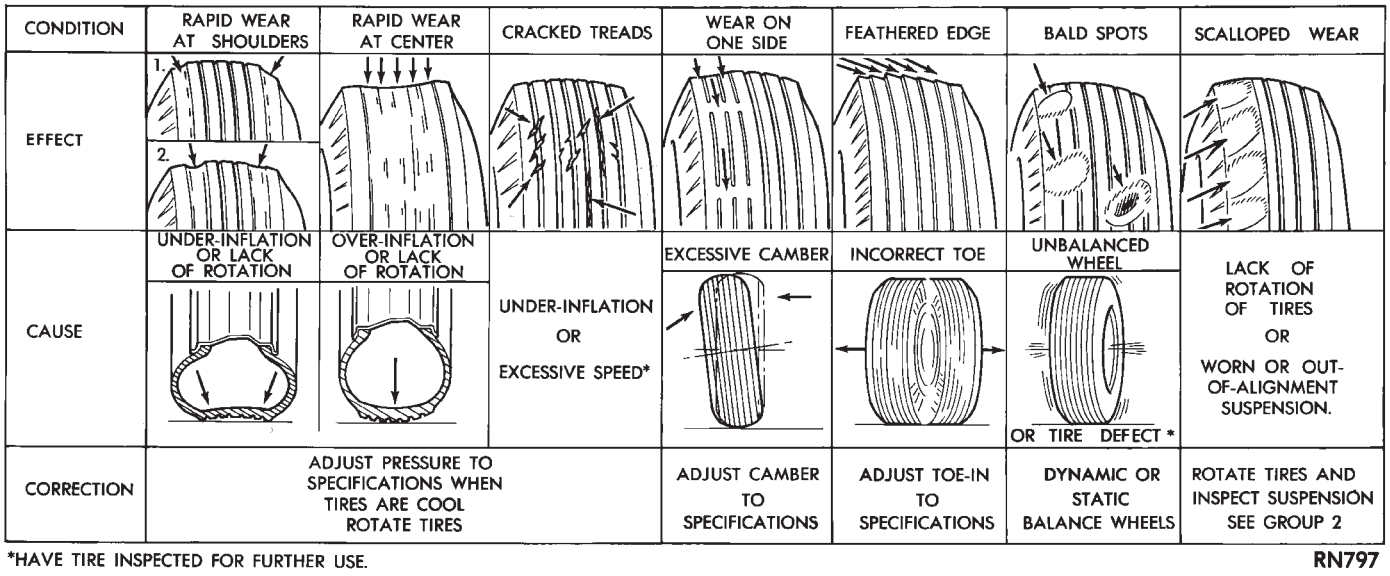


Fig. 5 Tire Wear Patterns

TIRE NOISE OR VIBRATION

Radial-ply tires are sensitive to force impulses caused by improper mounting, vibration, wheel defects, or possibly tire imbalance.

To find out if tires are causing the noise or vibration, drive the vehicle over a smooth road at varying speeds. Note the noise level during acceleration and deceleration. The engine, differential and exhaust noises will change as speed varies, while the tire noise will usually remain constant.

SERVICE PROCEDURES (Continued)

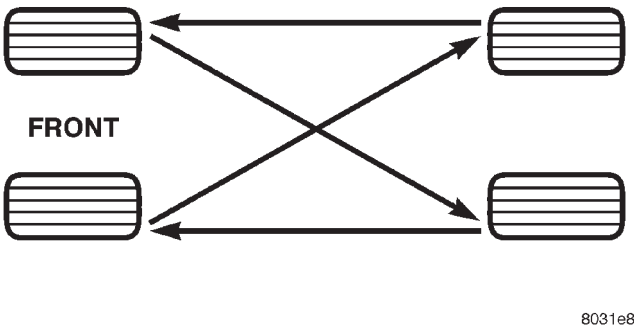


Fig. 6 Tire Rotation Pattern

(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).

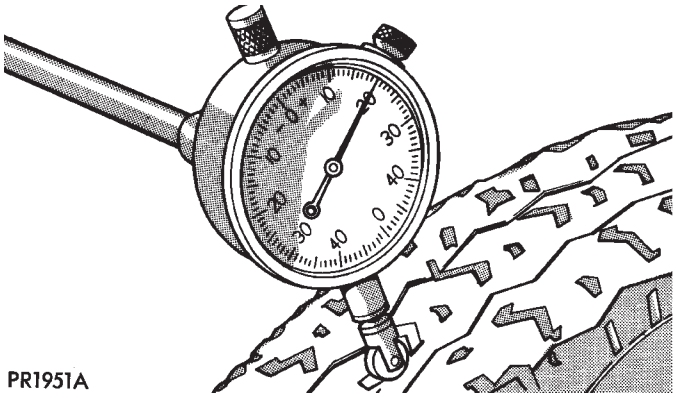


Fig. 7 Dial Indicator

(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.

(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.

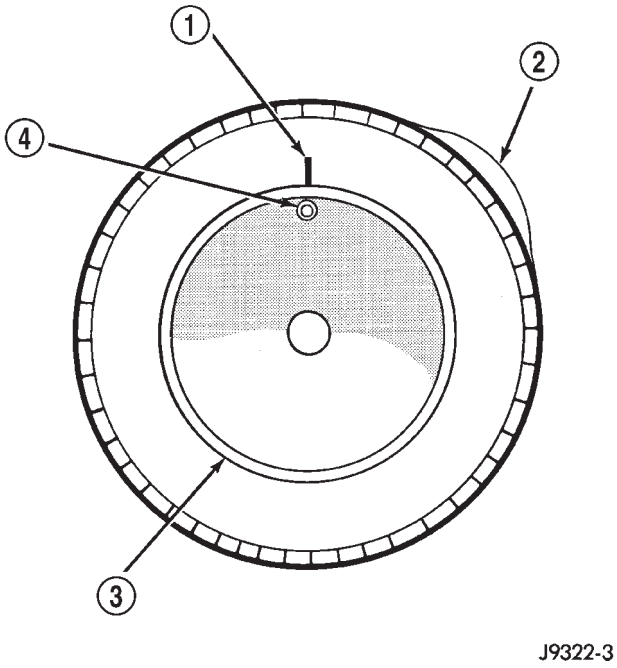


Fig. 8 First Measurement On Tire

1 – REFERENCE MARK
2 – 1ST MEASUREMENT HIGH SPOT MARK TIRE AND RIM
3 – WHEEL
4 – VALVE STEM

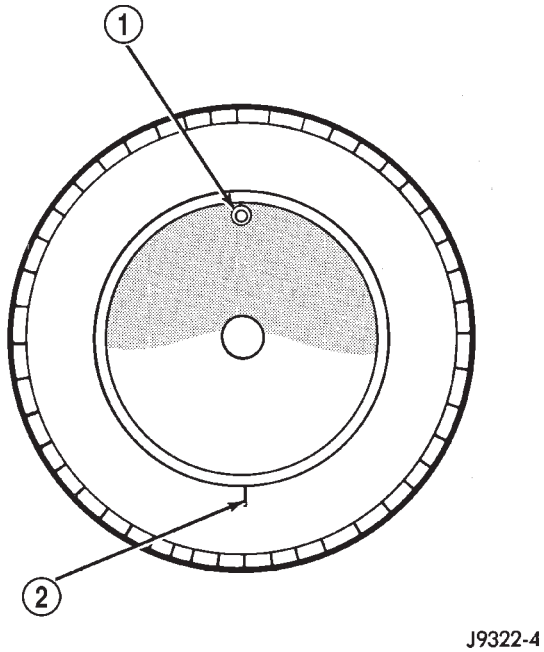


Fig. 9 Remount Tire 180 Degrees

1 – VALVE STEM
2 – REFERENCE MARK

SERVICE PROCEDURES (Continued)

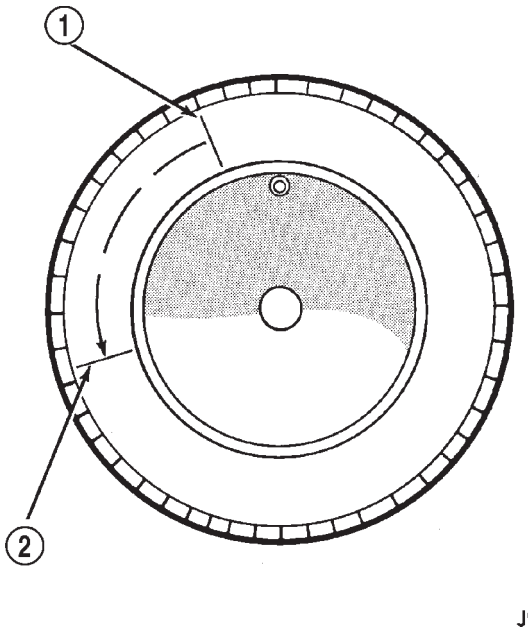


Fig. 10 Remount Tire 90 Degrees In Direction of Arrow

1 – 2ND HIGH SPOT ON TIRE
2 – 1ST HIGH SPOT ON TIRE

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.

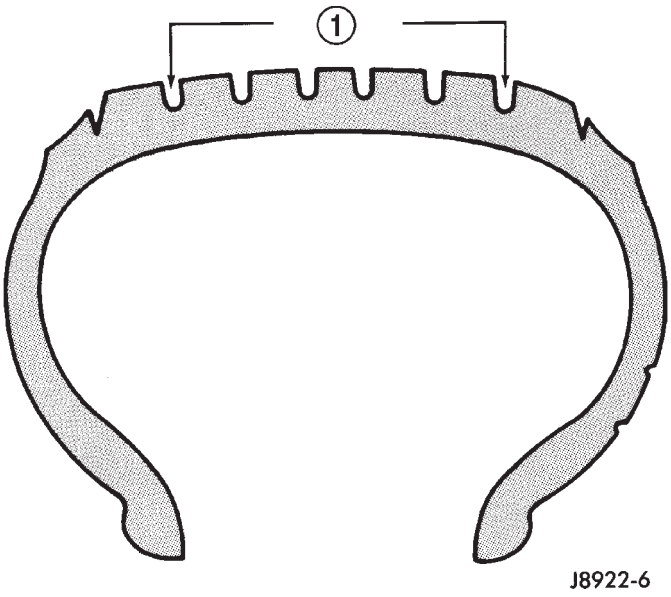


Fig. 11 Tire Repair Area

1 – REPAIRABLE AREA

CLEANING AND INSPECTION

CLEANING TIRES

Remove the protective coating on the tires before delivery of a vehicle. This coating may cause deterioration of the tires.

To remove the protective coating, apply warm water and let it soak for a few minutes. Afterwards, scrub the coating away with a soft bristle brush. Steam cleaning may also be used to remove the coating.

NOTE: DO NOT use gasoline, mineral oil, oil-based solvent or a wire brush for cleaning.

SPECIFICATIONS

TIRE SIZE

TIRE SIZE	SUPPLIER
P205/75R15	Goodyear
P215/75R15	Goodyear
P225/75R15	Goodyear
P225/70R16	Michelin
30x9.50R15	Goodyear

WHEELS

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DESCRIPTION AND OPERATION

WHEEL

DESCRIPTION

The rim size is on the vehicle safety certification label located on the drivers door shut face. The size of the rim is determined by the drivetrain package. Original equipment wheels/rims are designed for operation up to the specified maximum vehicle capacity.

All models use stamped steel, cast aluminum or forged aluminum wheels. Every wheel has raised sections between the rim flanges and rim drop well called safety humps (Fig. 1).

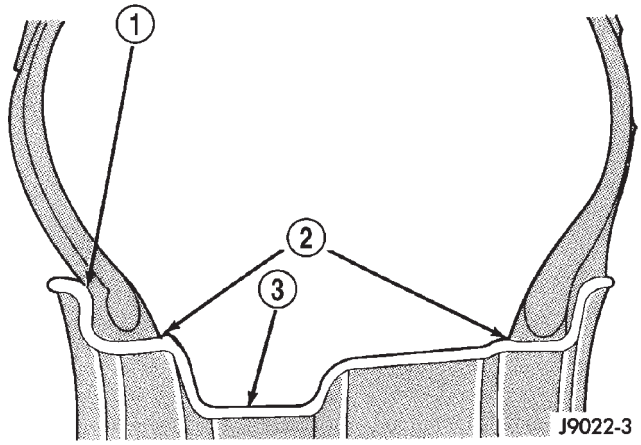


Fig. 1 Safety Rim

1 – FLANGE
2 – RIDGE
3 – WELL

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.

DIAGNOSIS AND TESTING (Continued)

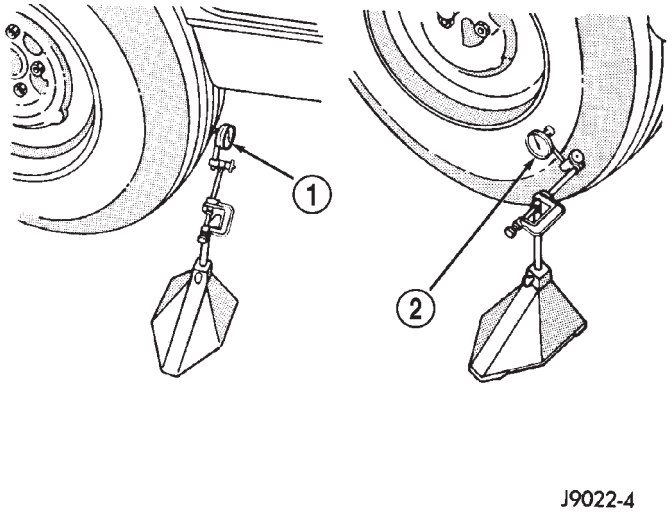


Fig. 2 Checking Tire/Wheel/Hub Runout

1 – RADIAL RUNOUT
2 – LATERAL RUNOUT

Radial runout of more than 1.5 mm (.060 inch) measured at the center line of the tread may cause the vehicle to shake.

Lateral runout of more than 2.0 mm (.080 inch) measured near the shoulder of the tire may cause the vehicle to shake.

Sometimes radial runout can be reduced. Relocate the wheel and tire assembly on the mounting studs (See Method 1). If this does not reduce runout to an acceptable level, the tire can be rotated on the wheel. (See Method 2).

METHOD 1 (RELOCATE WHEEL ON HUB)

(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.

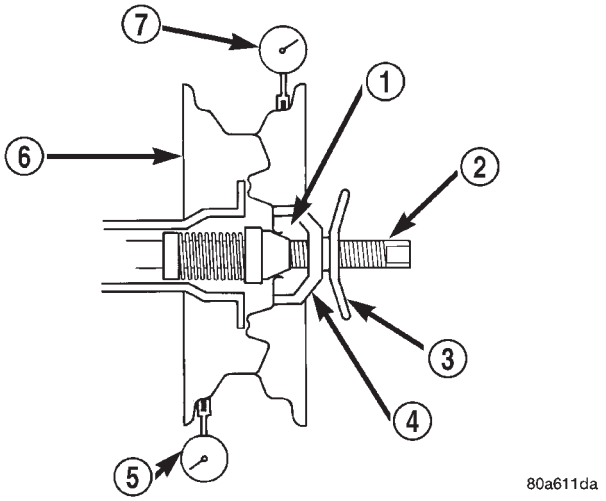


Fig. 3 Radial Runout

1 – MOUNTING CONE
2 – SPINDLE SHAFT
3 – WING NUT
4 – PLASTIC CUP
5 – DIAL INDICATOR
6 – WHEEL
7 – DIAL INDICATOR

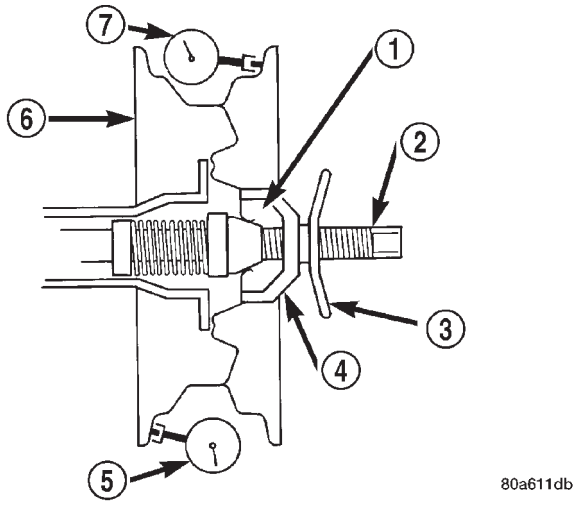


Fig. 4 Lateral Runout

1 – MOUNTING CONE
2 – SPINDLE SHAFT
3 – WING NUT
4 – PLASTIC CUP
5 – DIAL INDICATOR
6 – WHEEL
7 – DIAL INDICATOR

SERVICE PROCEDURES

WHEEL INSTALLATION

The wheel studs and nuts are designed for specific applications. They must be replaced with equivalent parts. Do not use replacement parts of lesser quality or a substitute design. All aluminum and some steel wheels have wheel stud nuts which feature an enlarged nose. This enlarged nose is necessary to ensure proper retention of the aluminum wheels.

Before installing the wheel, be sure to remove any build up of corrosion on the wheel mounting surfaces. Ensure wheels are installed with good metal-to-metal contact.

To install the wheel, first position it properly on the mounting surface. All wheel nuts should then be tightened just snug. Gradually tighten them in sequence to the proper torque specification (Fig. 5).

WARNING: NEVER USE OIL OR GREASE ON STUDS OR NUTS. INSTALLING WHEELS WITHOUT GOOD METAL-TO-METAL CONTACT OR USING CHROME PLATED LUG NUTS WITH CHROME PLATED WHEELS COULD CAUSE LOOSENING OF WHEEL NUTS. THIS COULD AFFECT THE SAFETY AND HANDLING OF THE VEHICLE.

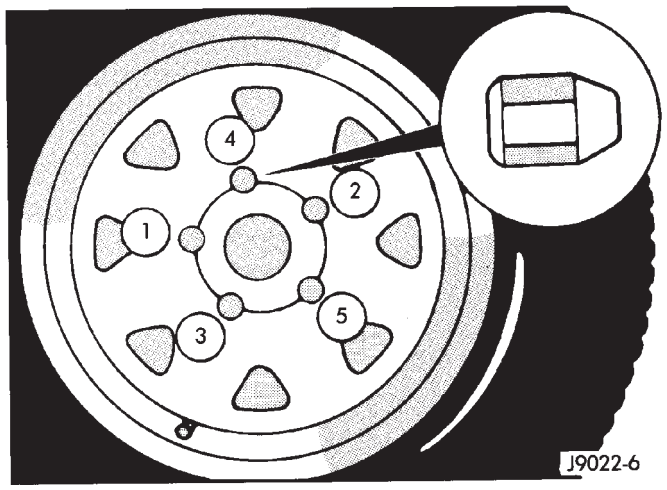


Fig. 5 Lug Nut Tightening Pattern

WHEEL REPLACEMENT

Wheels must be replaced if they have:

- Excessive runout
- Bent or dented
- Leak air through welds
- Have damaged bolt holes

Wheel repairs employing hammering, heating, or welding are not allowed.

Original equipment wheels are available through your dealer. Replacement wheels from any other source should be equivalent in:

- Load carrying capacity
- Diameter
- Width
- Offset
- Mounting configuration

Failure to use equivalent replacement wheels may affect the safety and handling of your vehicle. Replacement with **used** wheels is not recommended. Their service history may have included severe treatment.

TIRE AND WHEEL BALANCE

It is recommended that a two plane service dynamic balancer be used when a tire and wheel assembly require balancing. Refer to balancer operation instructions for proper cone mounting procedures. Typically use front cone mounting method for steel wheels. For aluminum wheel use back cone mounting method without cone spring.

NOTE: Static should be used only when a two plane balancer is not available.

NOTE: Cast aluminum 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)

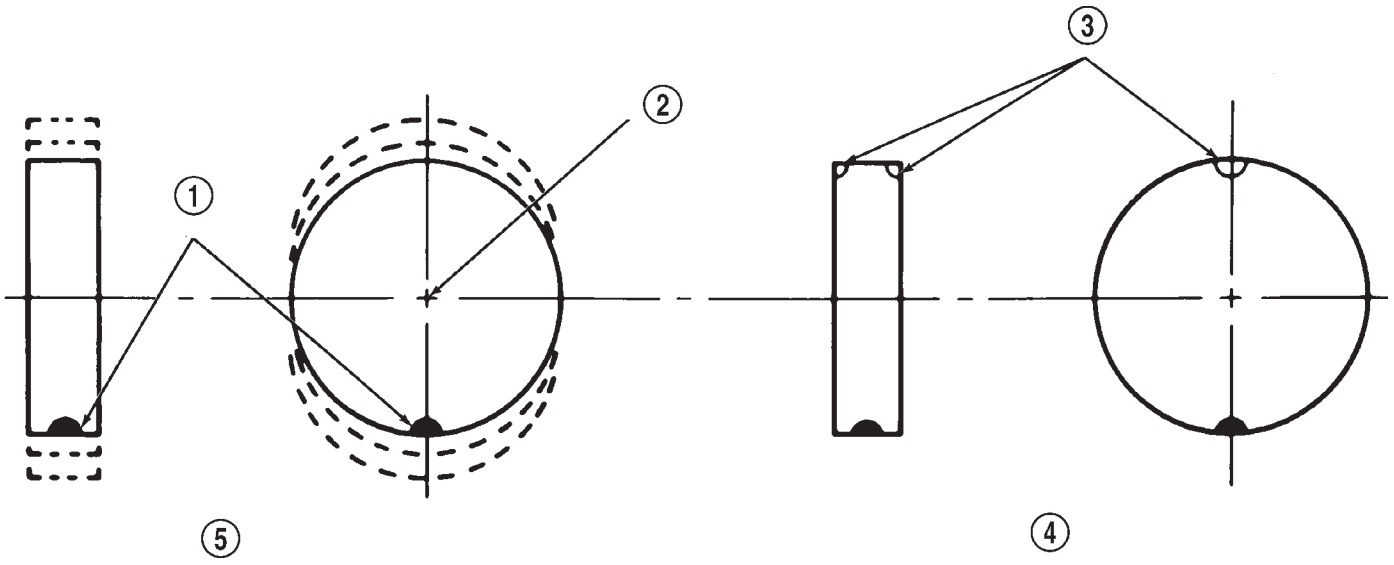


Fig. 6 Static Unbalance & Balance

1 – HEAVY SPOT
2 – CENTER LINE OF SPINDLE
3 – ADD BALANCE WEIGHTS HERE
4 – CORRECTIVE WEIGHT LOCATION
5 – TIRE OR WHEEL TRAMP, OR WHEEL HOP

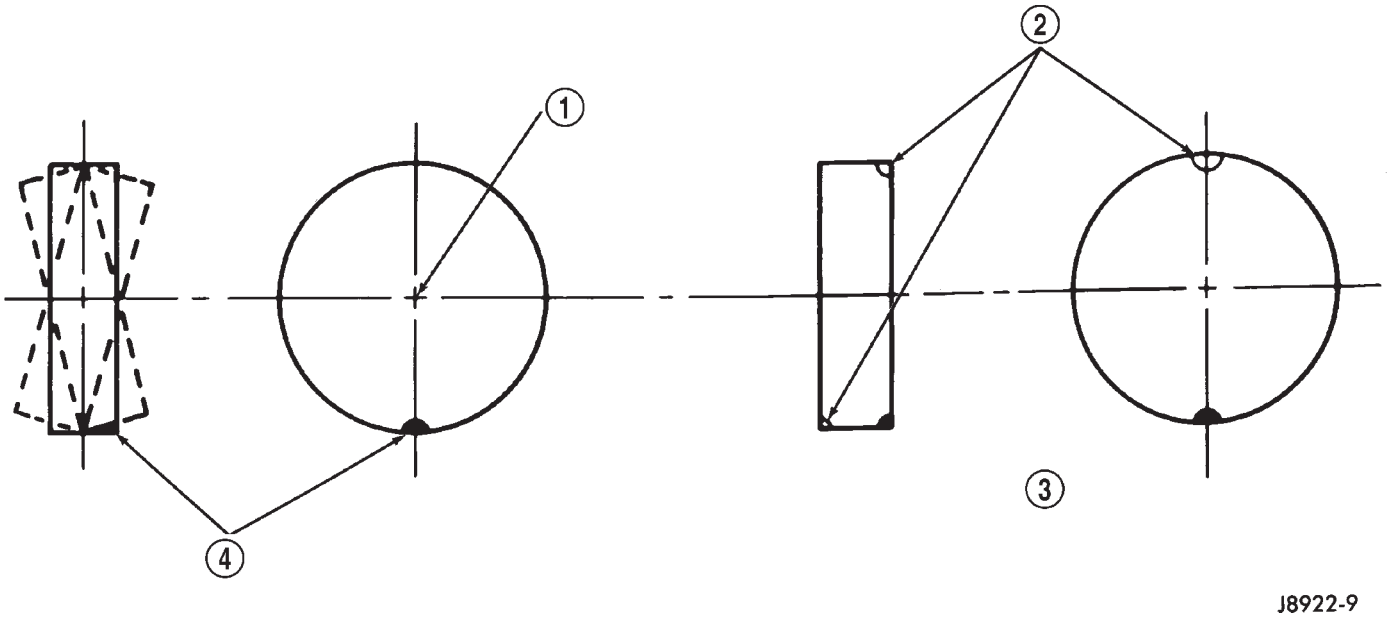


Fig. 7 Dynamic Unbalance & Balance

1 – CENTER LINE OF SPINDLE
2 – ADD BALANCE WEIGHTS HERE
3 – CORRECTIVE WEIGHT LOCATION
4 – HEAVY SPOT WHEEL SHIMMY AND VIBRATION

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Lug Nut	
1/2 X 20 with 60° Cone	115 to 156 N·m (85 to 115 ft. lbs.)

BODY

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DESCRIPTION AND OPERATION

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DESCRIPTION AND OPERATION

BODY COMPONENTS

PAINT

DESCRIPTION

The original equipment finish is a multi-step process that involves cleaning, electrodepostion (e-coat), base coat, and clear coat steps. Additionally, selected areas of the vehicle may be coated with an anti-chip finish.

OPERATION

On most vehicles a two-stage paint application (base coat/clear coat) is used. Color that is applied to primer is called base coat. The clear coat protects the base coat from ultraviolet light and provides a durable high-gloss finish.

STATIONARY GLASS

DESCRIPTION

Windshield glass is a structural member of the vehicle. The windshield glass is bonded to the windshield frame with urethane adhesive.

OPERATION

Windshields are made of two pieces of glass with a plastic inner layer. Windshields and other stationary glass protect the occupants from the effects of the elements. Windshields are also used to retain some airbags in position during deployment. Urethane bonded glass is difficult to salvage during removal. The urethane bonding is difficult to cut or clean from any surface. Before removing the glass, check the availability of replacement components.

SEATS

DESCRIPTION

Seat modules are made up of a seat frame, seat cushion, seat back cushion, a covering material, and the electrical components used for power operation. Some seat systems also contain seat belt components and supplemental restraint systems.

OPERATION

Seat assemblies transport the occupants in comfort and safety. Seat assemblies also help position occupants correctly in the event of airbag deployment. Seat cushions, coverings, and electrical components are serviceable. Refer to the appropriate group in this manual.

EXTERIOR COMPONENTS

DESCRIPTION

Exterior sheet metal components make up the exterior of the vehicle. The Wrangler uses either a soft (fabric) top, or a hard (composite) top. Some exterior trim items are made of composite.

DESCRIPTION AND OPERATION (Continued)

OPERATION

The exterior sheet metal is repairable and adjustable for fit and finish. The composite hard top is repairable or replaceable. Trim components made of composite are stamped with the type of material used. DaimlerChrysler uses various fasteners to retain trim items. At times, it is not possible to remove trim items without damaging the fastener. If it is not possible to remove an item without damaging a component, cut or break the fasteners and use new ones when installing the component.

SERVICE PROCEDURES

SAFETY PRECAUTIONS AND WARNINGS

DESCRIPTION

WARNING: USE A OSHA APPROVED BREATHING FILTER WHEN SPRAYING PAINT OR SOLVENTS IN A CONFINED AREA. PERSONAL INJURY CAN RESULT.

AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL – BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT.

DO NOT STAND UNDER A HOISTED VEHICLE THAT IS NOT PROPERLY SUPPORTED ON SAFETY STANDS. PERSONAL INJURY CAN RESULT.

CAUTION: When holes must be drilled or punched in an inner body panel, verify depth of space to the outer body panel, electrical wiring, or other components. Damage to vehicle can result.

Do not weld exterior panels unless combustible material on the interior of vehicle is removed from the repair area. Fire or hazardous conditions, can result.

Always have a fire extinguisher ready for use when welding.

Disconnect the negative (-) cable clamp from the battery when servicing electrical components that are live when the ignition is OFF. Damage to electrical system can result.

Do not use abrasive chemicals or compounds on painted surfaces. Damage to finish can result.

Do not use harsh alkaline based cleaning solvents on painted or upholstered surfaces. Damage to finish or color can result.

Do not hammer or pound on plastic trim panel when servicing interior trim. Plastic panels can break.

DaimlerChrysler Corporation uses many different types of push-in fasteners to secure the interior and exterior trim to the body. Most of these fasteners can be reused to assemble the trim during various repair procedures. At times, a push-in fastener cannot be removed without damaging the fastener or the component it is holding. If it is not possible to remove a fastener without damaging a component or body, cut or break the fastener and use a new one when installing the component. Never pry or pound on a plastic or pressed-board trim component. Using a suitable fork-type prying device, pry the fastener from the retaining hole behind the component being removed. When installing, verify fastener alignment with the retaining hole by hand. Push directly on or over the fastener until it seats. Apply a low-force pull to the panel to verify that it is secure.

When it is necessary to remove components to service another, it should not be necessary to apply excessive force or bend a component to remove it. Before damaging a trim component, verify hidden fasteners or captured edges holding the component in place.

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SERVICE PROCEDURES

PAINT CODE

The paint code is identified on the Vehicle Safety Certification Label, which is located on the driver's door shut face The color names, provided in the Paint and Trim Code Description chart, are the color names used on most repair product containers.

BASE COAT/CLEAR COAT FINISH

On most vehicles a two-stage paint application (base coat/clear coat) is used. Color that is applied to primer is called base coat. The clear coat protects the base coat from ultraviolet light and provides a durable high-gloss finish.

FINESSE SANDING, BUFFING, AND POLISHING

Minor acid etching, orange peel, or surface scratches in clear coat or single-stage finishes can be reduced with light finesse sanding, buffing, and polishing. **If the finish has been finesse sanded in the past, it cannot be repeated. Finesse sanding operation should be performed by a trained automotive paint technician.**

CAUTION: Do not remove clear coat finish more than.5 mils, if equipped (Use a paint thickness gauge to verify paint thickness). Base coat paint must retain clear coat for durability.

PAINTED SURFACE TOUCH-UP

DESCRIPTION

When a painted metal surface has been scratched or chipped, it should be touched-up as soon as possible to avoid corrosion. For best results, use Mopar® Scratch Filler/Primer, Touch-Up Paints and Clear Top Coat. Refer to Introduction group of this manual for Body Code Plate information.

WARNING: USE A OSHA APPROVED BREATHING FILTER WHEN SPRAYING PAINT OR SOLVENTS IN A CONFINED AREA. PERSONAL INJURY CAN RESULT.

OPERATION

(1) Scrape loose paint and corrosion from inside scratch or chip.

(2) Clean affected area with Mopar® Tar/Road Oil Remover, and allow to dry.

(3) Fill the inside of the scratch or chip with a coat of filler/primer. Do not overlap primer onto good surface finish. The applicator brush should be wet enough to puddle-fill the defect without running. Do not stroke brush applicator on body surface. Allow the filler/primer to dry hard.

(4) Cover the filler/primer with color touch-up paint. Do not overlap touch-up color onto the original color coat around the scratch or chip. Butt the new color to the original color, if possible. Do not stroke applicator brush on body surface. Allow touch-up paint to dry hard.

(5) On vehicles without clear coat, the touch-up color can be lightly finesse sanded (1500 grit) and polished with rubbing compound.

(6) On vehicles with clear coat, apply clear top coat to touch-up paint with the same technique as described in Step 4. Allow clear top coat to dry hard. If desired, Step 5 can be performed on clear top coat.

WARNING: AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL – BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT.

SERVICE PROCEDURES (Continued)

AFTERMARKET PAINT REPAIR PRODUCTS

EXTERIOR COLOR

EXTERIOR COLOR	DAIMLER CHRYSLER CODE	PPG	DuPONT	S-W** M-S**	AKZO NOBEL SIKKENS	SPIES HECKER	ICI**
Flame Red Clear Coat	PR4	4679	B9326	46916	CHA93:PR4	30116	RNN6B
Chili Pepper Red	VEA	5361	B9823	54470	CHA98:VEA	33688	HMT3B
Medium Fern Pearl Coat	RJP	4969	B9524	50270	CHA99:RJP	61088	7CD6B
Deep Amethyst Pearl Coat	TCN	5246	B9736	52566	CHA97:TCN	54755	FNE4B
Forest Green Pearl Coat	SG8	5065	B9609	51062	CHA95:SG8	61633	7MR8B
Desert Sand	WTD	5474	B9884	56153	CHA99:WTD	81764	KGC7B
Intense Blue Pearl Coat	VB3	5357	B9822	54468	CHA98:VB3	55321	HMR9B
Gun Metal Pearl Coat	TQ7	5248	B9735	52952	CHA97:TQ7	73320	ERA9B
Black Clear Coat	DX8	9700	99	34858 90-5950	CHA85:DX8	73328	TC60B
Stone White Clear Coat	SW1	83542	B9622	51539	CHA96:SW1	15069	8KY5B

HARD TOP

HARD TOP	DAIMLER CHRYSLER CODE*	PPG	DuPONT	S-W** M-S**	AKZO NOBEL SIKKENS	SPIES HECKER	ICI**
Spice	LTB	27315	C9523	46487	CHA90:LTB		FPP6
Carmel	VK9	28589	C9846	58115	CHAVK9M		NVM9
Black	BX7	9418	44219	58115	CHABX7M		NVN1
Stone White	SW1	5072	C9622	52779	CHASWM1		NNV6

INTERIOR COLOR

INTERIOR COLOR	DAIMLER CHRYSLER CODE*	PPG	DuPONT	S-W** M-S**	AKZO NOBEL SIKKENS	SPIES HECKER	ICI**
Agate	AZ	9856 / 2-1461	C9208	45994	CHALAZI	75016	7WC8
Camel	K5	27731 / 2-1584	C9603	51541	CHARJ5I	81796	7VX6
Camel / Dark Green	KG	N/A	N/A	N/A	N/A	N/A	K5/G8

SERVICE PROCEDURES (Continued)

NOTE: *Herberts Standox 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.

HARD TOP REPAIR

The hard top fiberglass material can be repaired. The required repair materials include:

- Fiberglass mat or cloth.
- Fiberglass resin and hardener.
- structural adhesive (3M brand or an equivalent product).
- Glazing putty.
- Plastic spreader.

HARD TOP HOLE REPAIR

(1) Use a grinder to remove the paint and outline the damaged area. Use a grade 36 grit disc for paint removal.

(2) Grind the outlined surface area again with a 50 grit disc to prevent coarse scratches from appearing in the final finish.

(3) If cracks extend from the hole, it will be necessary to stop-drill the crack(s) with a 3-mm (1/8-in) diameter drill bit.

(4) Position a fiberglass mat or cloth on the repair surface area. Cut the mat to allow a 2.5-cm (1-in) overlap of the repair surface area.

(5) Clean the repair surface area.

(6) Place the fiberglass cloth on aluminum foil.

(7) Pour the fiberglass resin into a clean container.

(8) Mix the appropriate amount of hardener and resin. Follow the manufacturers instructions.

(9) Apply the hardener/resin mixture to both sides of the fiberglass cloth.

(10) Place the fiberglass cloth over the repair surface area. Next, place the aluminum foil over the cloth. Use a plastic spreader to smooth-out the cloth and resin. Use firm pressure to remove air bubbles and to smooth-out the cloth.

(11) Allow the resin to cure.

(12) Smooth-out the surface area to the contour of the hard top with a 50-grit disc.

(13) Apply plastic filler to complete the repair. Finish smoothing the surface area with 80-grit paper.

(14) Repeat the previous step on the inside surface area of the hard top.

(15) Featheredge the repaired surface area.

(16) Prime the repaired surface area with PPG Epoxy Primer, or an equivalent product.

(17) Apply surface primer to the surface area.

(18) Prime the surface area for the color coat.

(19) Apply color coat to the repaired surface area.

FRACTURE REPAIR

(1) Use a grinder to remove the paint (from both, the inner and outer surface areas of the hard top) and to outline the damaged area.

(2) Stop-drill the crack(s) with a 3-mm (1/8-in) diameter drill bit.

(3) Bevel the edges of the crack(s) on both sides with a rotary file.

NOTE: The edges should be beveled on the inside and outside of the top to ensure sufficient surface area for good bonding.

(4) Complete the repairs with fiberglass cloth and resin as described above in the hard top hole repair procedure.

STATIONARY GLASS

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SERVICE PROCEDURES

WINDSHIELD SAFETY PRECAUTIONS

DESCRIPTION

WARNING: DO NOT OPERATE THE VEHICLE WITHIN 24 HOURS OF WINDSHIELD INSTALLATION. IT TAKES AT LEAST 24 HOURS FOR URETHANE ADHESIVE TO CURE. IF IT IS NOT CURED, THE WINDSHIELD MAY NOT PERFORM PROPERLY IN AN ACCIDENT.

URETHANE ADHESIVES ARE APPLIED AS A SYSTEM. USE GLASS CLEANER, GLASS PREP SOLVENT, GLASS PRIMER, PVC (VINYL) PRIMER AND PINCH WELD (FENCE) PRIMER PROVIDED BY THE ADHESIVE MANUFACTURER. IF NOT, STRUCTURAL INTEGRITY COULD BE COMPROMISED.

DAIMLERCHRYSLER DOES NOT RECOMMEND GLASS ADHESIVE BY BRAND. TECHNICIANS SHOULD REVIEW PRODUCT LABELS AND TECHNICAL DATA SHEETS, AND USE ONLY ADHESIVES THAT THEIR 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.

OPERATION

The windshield is attached to the window frame with urethane adhesive. The urethane adhesive is applied cold and seals the surface area between the window opening and the glass. The primer adheres the urethane adhesive to the windshield.

It is difficult to salvage a windshield during the removal operation. The windshield is part of the structural support for the roof. The urethane bonding used to secure the windshield to the fence is difficult to cut or clean from any surface. If the moldings are set in urethane, it would also be unlikely they could be salvaged. Before removing the windshield, check the availability of the windshield and moldings from the parts supplier.

REMOVAL AND INSTALLATION

WINDSHIELD

The windshield is positioned in the reveal molding and is bonded to the windshield frame with urethane adhesive. The windshield interior trim molding is positioned onto the inner windshield frame pinch-weld.

REMOVAL

(1) Cover body surface areas with protective covering to avoid paint damage and extra clean-up time.

(2) Remove the windshield wiper arms and the rearview mirror.

(3) Using a razor knife, slide the blade between the windshield glass and the inboard edge of the reveal molding.

(4) Cut around the interior perimeter of the reveal molding and sever the cap of the reveal molding.

REMOVAL AND INSTALLATION (Continued)

(5) Using a cold knife, cut the urethane around the perimeter of the windshield (Fig. 1).

(6) Remove the windshield glass from the frame (Fig. 2).

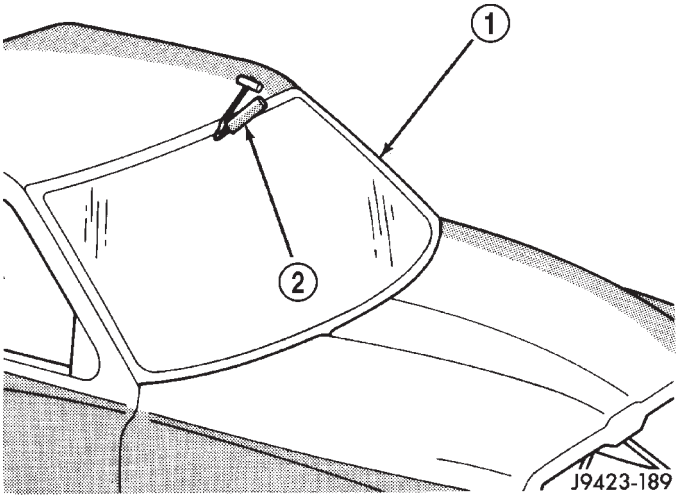


Fig. 1 Cutting Urethane Around Windshield—Typical

1 – WINDSHIELD
2 – COLD KNIFE

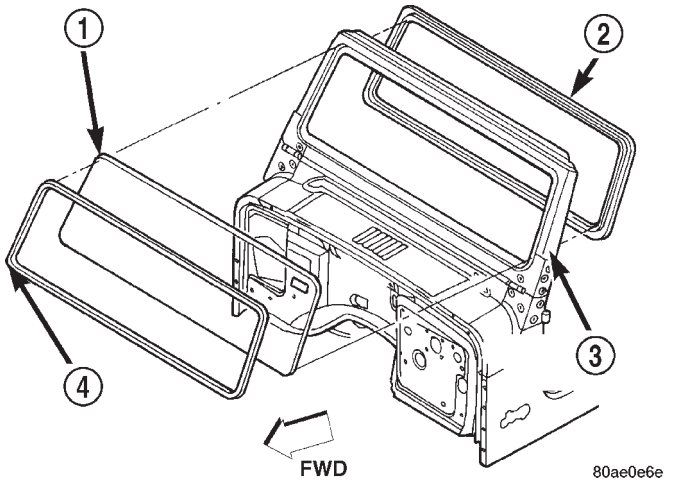


Fig. 2 Windshield

1 – WINDSHIELD
2 – INNER TRIM MOLDING
3 – WINDSHIELD FRAME
4 – WINDSHIELD MOLDING

INSTALLATION

(1) Trim the urethane from the pinchweld flanges. Leave a 3 mm (0.1 in.) level base of urethane on the pinchweld flanges.

(2) Place replacement windshield into windshield opening and position glass in the center of the opening against pinchweld flange.

(3) Verify the glass lays evenly against the pinch weld fence at the sides, top and bottom of the replacement windshield. If not, the pinchweld flange must be formed to the shape of the new glass. Next, make alignment marks on glass and body with a grease pencil.

(4) Remove replacement windshield from windshield opening.

(5) Position the windshield inside up on a suitable work surface with two padded, wood 10 cm by 10 cm by 50 cm (4 in. by 4 in. by 20 in.) blocks, placed parallel 75 cm (2.5 ft.) apart (Fig. 3).

WARNING: DO NOT USE SOLVENT BASED GLASS CLEANER TO CLEAN WINDSHIELD BEFORE APPLYING GLASS PREP AND PRIMER. POOR ADHESION CAN RESULT.

(6) Clean inside of windshield with ammonia based glass cleaner and lint-free cloth.

(7) Apply molding to perimeter of windshield. The butt weld of the molding should be centered at the bottom edge of the windshield.

(8) Apply Glass Prep adhesion promoter 25 mm (1 in.) wide around perimeter of windshield and wipe with clean/dry lint-free cloth until no streaks are visible.

(9) Apply Glass Primer 25 mm (1 in.) wide around perimeter of windshield. Allow at least three minutes drying time.

(10) Apply Pinchweld primer 15 mm (.75 in.) wide around the windshield fence. Allow at least three minutes drying time.

(11) Apply a urethane bead (Fig. 4) on the pinchweld flange surface area 6 mm (.25 in.) from the outboard edge.

CAUTION: Be prepared to install the windshield glass immediately after applying the adhesive. The adhesive begins to cure within 10-15 minutes.

(12) Align the windshield with the grease pencil marks and position windshield on pinchweld flanges.

(13) Push the windshield glass inward until the reveal molding is seated on the windshield frame. Use care to avoid excessive squeeze-out of adhesive.

(14) Open windows and liftgate to prevent pressure build-up while the urethane is curing.

(15) Starting in each corner, apply 150 mm (6 in.) lengths of 50 mm (2 in.) masking tape spaced 250 mm (10 in.) apart to hold windshield in place until urethane cures.

(16) Install the rearview mirror on the mirror button.

(17) Install the wiper arms.

(18) After urethane has cured, remove tape strips and water test windshield to verify repair.

REMOVAL AND INSTALLATION (Continued)

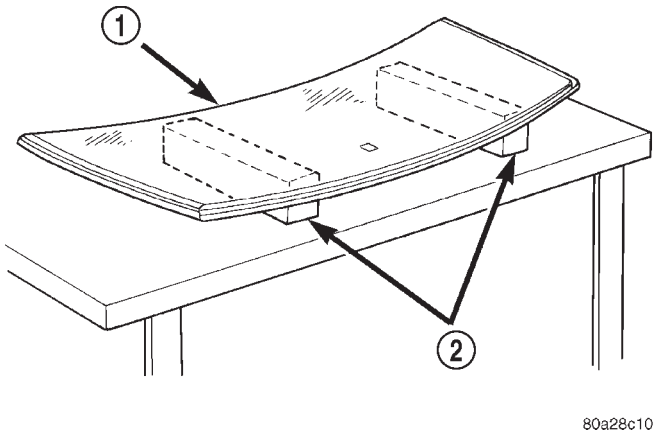


Fig. 3 Work Surface Set up and Molding Installation

1 – WINDSHIELD AND MOLDINGS
2 – BLOCKS

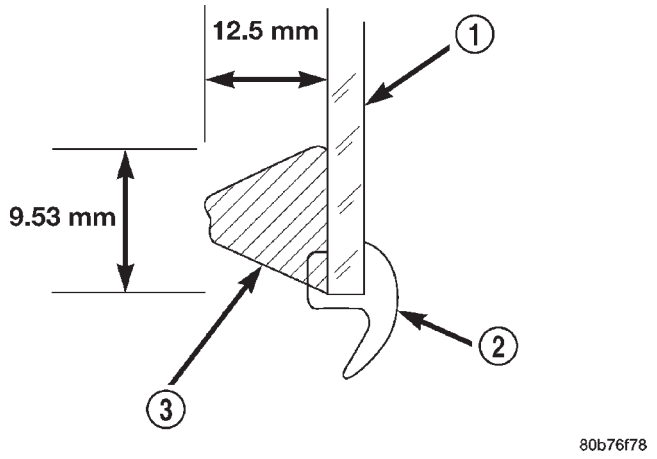


Fig. 4 Urethane Bead

1 – WINDSHIELD
2 – MOLDING
3 – URETHANE BEAD

QUARTER GLASS

REMOVAL

(1) Cover surface areas with protective covering to avoid paint damage and extra clean-up time.

(2) Using a razor knife, slide the blade between the quarter glass and the inboard edge of the reveal molding.

(3) Cut around the interior perimeter of the reveal molding and sever the cap of the reveal molding.

(4) Using a cold knife, cut the urethane around the perimeter of the quarter glass.

(5) Remove the quarter glass from the opening (Fig. 5).

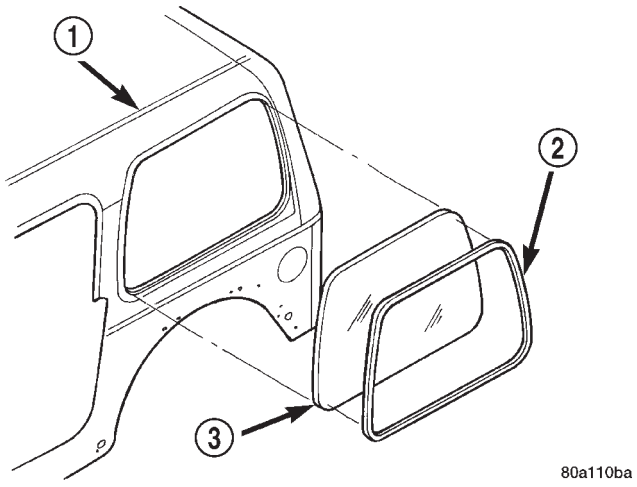


Fig. 5 Hard Top Quarter Glass

1 – HARD TOP
2 – QUARTER GLASS REVEAL MOLDING
3 – QUARTER GLASS

INSTALLATION

(1) Trim the urethane from the quarter glass opening fence. Leave a 3 mm (0.1 in.) level base of urethane on the quarter glass opening fence.

(2) Place replacement quarter glass into quarter glass opening and position glass in the center of the opening against fence.

(3) Verify the glass lays evenly against the fence at the sides, top and bottom of the replacement quarter glass. Next, make alignment marks on glass and top with a grease pencil.

(4) Remove replacement quarter glass from opening.

(5) Position the quarter glass inside up on a suitable work surface.

WARNING: DO NOT USE SOLVENT BASED GLASS CLEANER TO CLEAN QUARTER GLASS BEFORE APPLYING GLASS PREP AND PRIMER. POOR ADHESION CAN RESULT.

(6) Clean inside of quarter glass with ammonia based glass cleaner and lint-free cloth.

(7) Clean the outer edge of the window glass with naphtha or a similar product.

(8) Apply molding to perimeter of quarter glass. The butt weld of the molding should be centered at the bottom edge of the quarter glass.

(9) Apply Glass Prep adhesion promoter 25 mm (1 in.) wide around perimeter of the quarter glass and wipe with clean/dry lint-free cloth until no streaks are visible.

(10) Apply Glass Primer 25 mm (1 in.) wide around perimeter of quarter glass. Allow at least three minutes drying time.

REMOVAL AND INSTALLATION (Continued)

(11) Apply Pinchweld primer 15 mm (.75 in.) wide around the quarter glass fence. Allow at least three minutes drying time.

(12) Apply a 10 mm (0.4 in.) diameter bead of urethane to the center of the quarter glass fence surface area.

CAUTION: Be prepared to install the quarter glass immediately after applying the adhesive. The adhesive begins to cure within 10-15 minutes.

(13) Align the quarter glass with the grease pencil marks and position quarter glass on fence.

(14) Push the quarter glass inward until the reveal molding is seated on the hardtop. Use care to avoid excessive squeeze-out of adhesive.

(15) Open windows and liftgate to prevent pressure build-up while the urethane is curing.

(16) Apply 150 mm (6 in.) lengths of 50 mm (2 in.) masking tape spaced 250 mm (10 in.) apart to hold quarter glass in place until urethane cures.

(17) After urethane has cured, remove tape strips and water test quarter glass to verify repair.

SEATS

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REMOVAL AND INSTALLATION

BUCKET SEATBACK

REMOVAL

(1) Remove seat.
(2) Remove the inboard seatback pivot bolt.
(3) Disengage the retainers attaching the cushion cover to the outboard seat cushion frame (Fig. 1).
(4) Disengage the seat cushion corner cover zipper.
(5) Remove the bolts attaching the recliner to the seat cushion frame (Fig. 2).
(6) Passenger seat and driver dumping seat:
(a) Disengage seat track release cable from back inboard U-nut (Fig. 2).
(7) Route the recliner handle through the seat cushion cover and separate the seatback from the seat cushion.

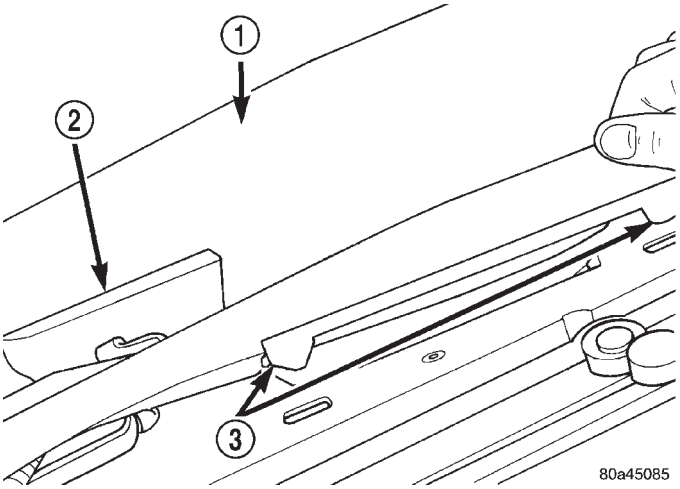


Fig. 1 Cushion Cover Retainers

1 – CUSHION COVER
2 – RECLINER HANDLE
3 – RETAINER

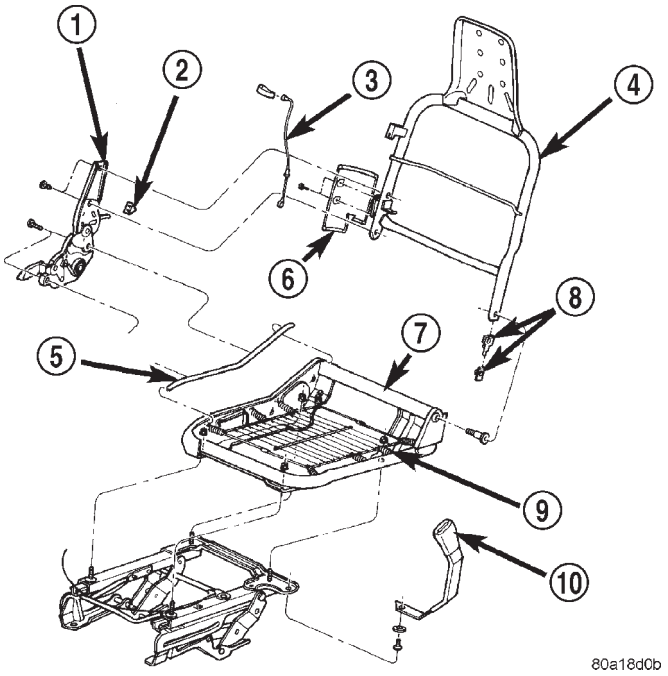


Fig. 2 Passenger Seat

1 – RECLINER
2 – KNOB
3 – RECLINER RELEASE CABLE
4 – SEAT BACK FRAME
5 – EDGE PROTECTOR
6 – RECLINER SHIELD
7 – SEAT CUSHION FRAME
8 – U-NUT
9 – SPRING
10 – BUCKLE

INSTALLATION

(1) Position the seatback on the seat cushion while routing the recliner handle through the cushion cover opening.
(2) Passenger seat and driver dumping seat:
(a) Engage seat track release cable to back inboard U-nut
(3) Install the bolts attaching the recliner to the seat cushion frame.
(4) Engage the seat cushion corner cover zipper.

REMOVAL AND INSTALLATION (Continued)

(5) Engage the retainers attaching the cushion cover to the outboard seat cushion frame.
(6) Install the inboard seatback pivot bolt.
(7) Install seat.

BUCKET SEATBACK COVER

REMOVAL

(1) Remove seat.
(2) Remove seatback.
(3) Disengage zipper at seatback base.
(4) Roll cover upward and over tilt release lever.
(5) Continue to roll cover upward and disengage hook and loop fastener (Fig. 3).
(6) Passenger seat and driver dumping seat:
(a) Route recliner release cable/strap through cover.
(7) Separate cover from seatback.

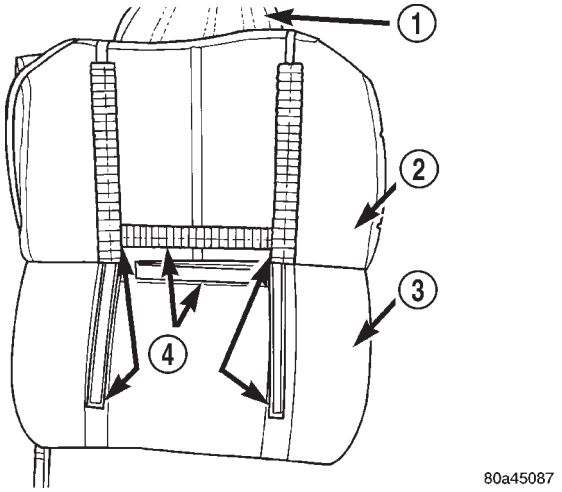


Fig. 3 Seat Back Cover

1 – SEAT BACK
2 – SEAT BACK COVER
3 – SEAT BACK CUSHION
4 – HOOK AND LOOP FASTENER

INSTALLATION

(1) Position cover on seatback.
(2) Passenger seat and driver dumping seat:
(a) Route recliner release cable/strap through cover.
(3) Roll cover downward and engage hook and loop fastener.
(4) Engage zipper at seatback base.
(5) Install seatback.
(6) Install seat.

RECLINER RELEASE CABLE

REMOVAL

(1) Remove seat.
(2) Disengage seat track release cable from bottom of cushion and pivot bracket.
(3) Remove seat back.
(4) Remove seat back cover.
(5) Disengage cable from recliner release.
(6) Route cable through seat back pad.
(7) Disengage cable from mounting bracket.

INSTALLATION

(1) Engage cable to mounting bracket.
(2) Route cable through seat back pad.
(3) Engage cable to recliner release.
(4) Install seat back cover.
(5) Install seat back.
(6) Engage seat track release cable to bottom of cushion and pivot bracket.
(7) Install seat.

BUCKET SEAT CUSHION COVER

REMOVAL

(1) Remove seat.
(2) Remove seatback.
(3) Disengage inboard J-strap.
(4) Disengage front J-strap.
(5) Roll cover up to access hog rings.
(6) Disengage inboard, outboard and front hog rings.
(7) From the underside of the cushion, disengage the rear hog rings (Fig. 4).
(8) Separate cover from cushion.

INSTALLATION

(1) Position cover on cushion and align seams.
(2) From the underside of the cushion, engage the rear hog rings.
(3) Engage inboard, outboard and front hog rings.
(4) Roll cover over cushion edges.
(5) Engage inboard J-strap.
(6) Engage front J-strap.
(7) Install seatback.
(8) Install seat.

REMOVAL AND INSTALLATION (Continued)

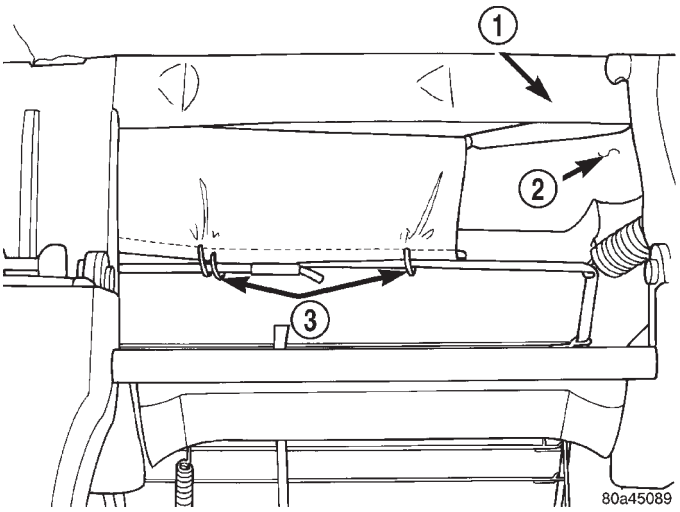


Fig. 4 Rear Hog Rings

1 – SEAT CUSHION FRAME
2 – SEAT CUSHION
3 – HOG RINGS

REAR SEATBACK

REMOVAL

(1) Remove rear seat from vehicle.
(2) Remove torx bolts attaching seatback to seat cushion (Fig. 5).
(3) Separate the seat back from the seat cushion.

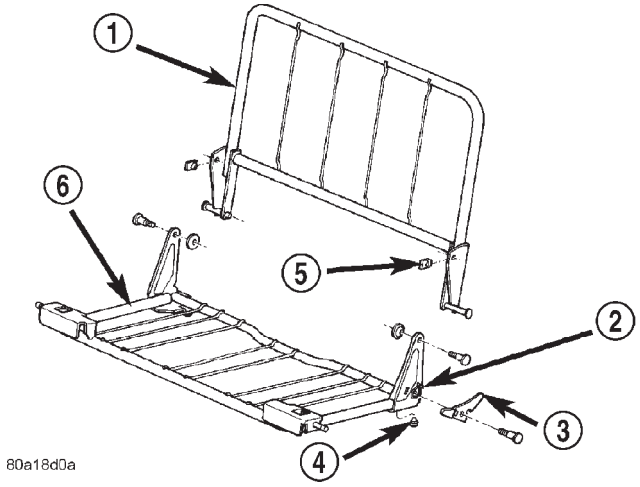


Fig. 5 Rear Seat Components

1 – SEAT BACK FRAME
2 – SPRING
3 – SEAT BACK RELEASE LEVER
4 – BUMPER
5 – U-NUT
6 – SEAT CUSHION FRAME

INSTALLATION

(1) Position the seat back on the seat cushion.
(2) Install the torx bolts attaching seatback to seat cushion.
(3) Install rear seat.

REAR SEATBACK COVER

REMOVAL

(1) Remove rear seat.
(2) Remove the seatback.
(3) Disengage the hook and loop fasteners at the seatback lower corners (Fig. 6).
(4) Disengage the seatback cover zipper.
(5) Carefully, remove the seatback frame from the cushion/cover.
(6) Roll the seatback cover upward and disengage the hook and loop fasteners.

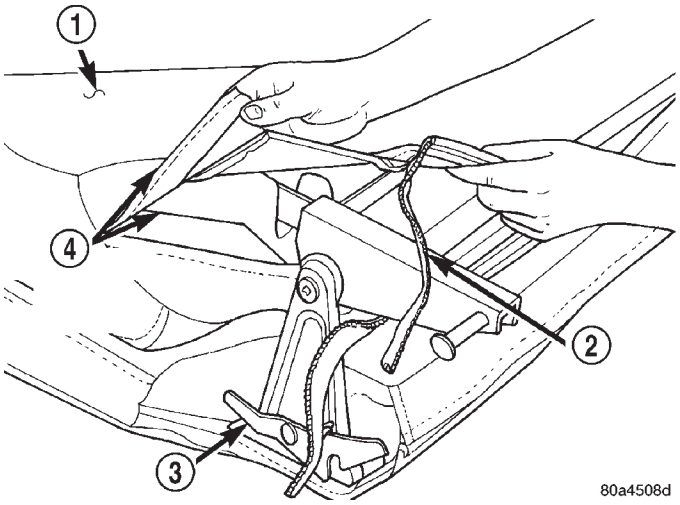


Fig. 6 Seat Back Cover

1 – SEAT BACK
2 – ZIPPER
3 – REAR SEAT RELEASE LEVER
4 – HOOK AND LOOP FASTENER

INSTALLATION

(1) Position the cover on the seatback cushion.
(2) Roll the seatback cover downward over the cushion.
(3) Install the seatback frame into the cushion/cover.
(4) Engage the seatback cover zipper.
(5) Engage the hook and loop fasteners at the seatback lower corners.
(6) Install the seatback.
(7) Install rear seat.

REMOVAL AND INSTALLATION (Continued)

REAR SEAT CUSHION COVER

REMOVAL

(1) Remove rear seat.
(2) Remove the seatback.
(3) Disengage the J-straps at the rear cushion corners.
(4) Disengage the seat cushion cover zipper.
(5) Carefully, remove the seat cushion frame from the cushion/cover.
(6) Roll the cover from seat cushion and disengage the hook and loop fasteners (Fig. 7).

INSTALLATION

(1) Position the cover on the cushion and roll cover downward over the corners.
(2) Install the seat cushion frame into the cushion/cover.
(3) Engage the seat cushion cover zipper.
(4) Engage the J-straps at the rear cushion corners.
(5) Install the seatback.

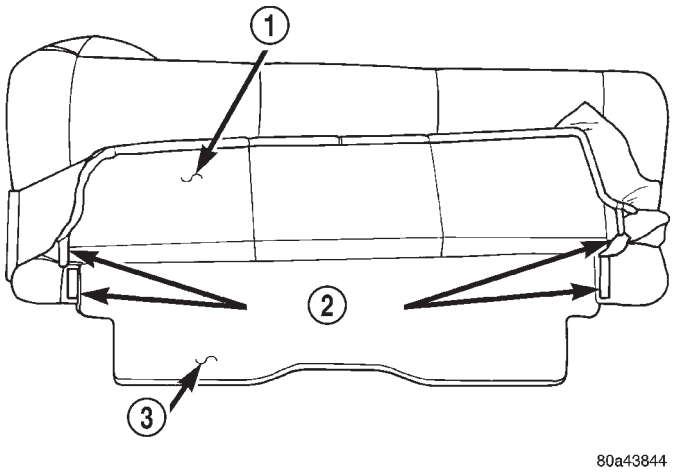


Fig. 7 Hook And Loop Fasteners

1 – REAR SEAT CUSHION COVER
2 – HOOK AND LOOP FASTENER
3 – REAR SEAT CUSHION

(6) Install rear seat.

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SERVICE PROCEDURES

BODY LUBRICATION

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

All applicable exterior and interior vehicle operating mechanisms should be inspected and cleaned. Pivot/sliding contact areas on the mechanisms should then be lubricated.

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

(2) Apply silicone lubricant to a cloth and wipe it on door seals to avoid over-spray that can soil passenger's clothing.

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

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

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

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

REMOVAL AND INSTALLATION

RADIATOR GRILLE PANEL

REMOVAL

(1) Remove the front crossmember cover.

(2) Remove the crossmember valence cover.

(3) Remove the radiator overflow bottle.

(4) Remove the bolts that attach the radiator and shroud from the grille panel.

(5) If A/C equipped:

(a) Evacuate the system.

(b) Disconnect the high and low pressure lines at the quick disconnect couplings.

(c) Cover (cap) the lines to prevent contamination.

(6) Remove the bolts attaching the radiator support rods to the grille panel.

(7) Disconnect the head lamp, turn signal, marker lamp and horn wire harness connectors.

(8) Remove the bolts attaching the fenders to the grille panel.

(9) Remove the bolt attaching the grille to the frame mount.

(10) Separate the grille from the vehicle.

INSTALLATION

Transfer all related components.

(1) Position the grille panel on the vehicle. Ensure the rubber support bumpers are aligned (Fig. 1).

(2) Install the bolt attaching the grille to the frame mount.

(3) Install the bolts attaching the fenders to the grille panel.

(4) Connect the head lamp, turn signal, marker lamp and horn wire harness connectors.

(5) Install the bolts attaching the radiator support rods to the grille panel.

(6) If A/C equipped:

(a) Connect the high and low pressure lines at the quick disconnect couplings.

(b) Evacuate and charge the system.

(7) Install the radiator and shroud to the grille panel.

(8) Install the radiator overflow bottle.

(9) Install the crossmember valence cover.

(10) Install the front crossmember cover.

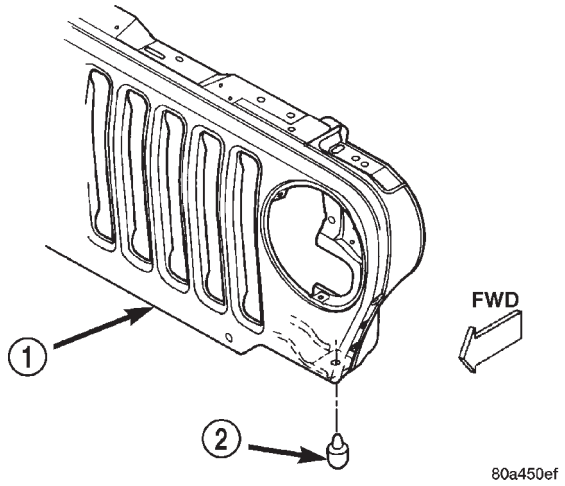


Fig. 1 Grille Bumpers

1 – GRILLE PANEL
2 – BUMPER

HOOD

REMOVAL

(1) Raise and support the hood.

(2) Disconnect the underhood lamp wire harness connector.

(3) Disconnect the windshield washer nozzles.

(4) Disconnect the ground strap.

REMOVAL AND INSTALLATION (Continued)

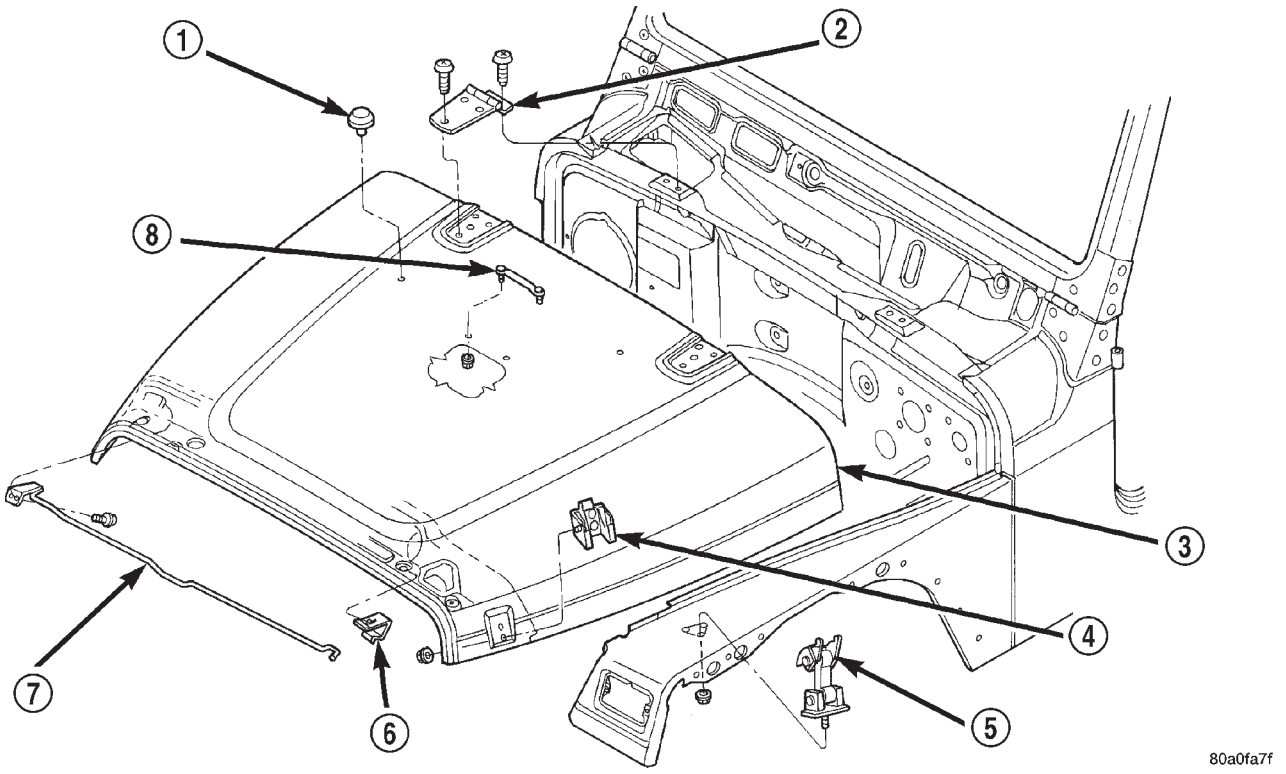


Fig. 2 Hood Components

1 – WINDSHIELD REST BUMPER
2 – HOOD HINGE
3 – HOOD
4 – HOOD CATCH BRACKET
5 – HOOD CATCH
6 – PROP ROD CLIP
7 – PROP ROD
8 – WINDSHIELD HOOD DOWN LOOP

(5) Mark the position of the hinges on the hood for installation alignment reference.

(6) Remove the screws attaching the hood to the hinge and remove the hood (Fig. 2).

(7) If the hood must be replaced, remove and transfer the insulator panel, hinges, latches, bumpers, brackets, footman loop, hood lamp, support rod, and safety latch to the replacement hood (Fig. 2).

INSTALLATION

(1) Position the hood on the vehicle and install the screws attaching the hinge to the hood.

(2) Align the hinges with the installation reference marks on the hood and tighten the hinge screws securely.

(3) Connect the underhood lamp wire harness connector.

(4) Connect the windshield washer nozzles.

(5) Connect the ground strap.

(6) Close the hood.

HOOD HINGE

REMOVAL

(1) Remove the wiper arms.

(2) Remove the cowl panel and screen.

(3) Remove the bolts attaching the hinge to the cowl.

(4) Using a wax pencil, mark the position of the hinge on the hood for installation alignment reference.

(5) Remove the screws attaching the hinge to the hood (Fig. 2).

(6) Separate the hinge from the hood.

INSTALLATION

(1) Prepare and paint the replacement hinge to match the body paint color.

(2) Align the hinge with the installation reference marks on the hood

(3) Install the screws attaching the hinge to the hood and cowl. Tighten the screws to 17 N·m (155 in. lbs.) torque.

(4) Install the bolts attaching the hinge to the cowl.

REMOVAL AND INSTALLATION (Continued)

(5) Install the cowl panel and screen.
(6) Install the wiper arms.

HOOD SAFETY LATCH

REMOVAL

(1) Raise and support the hood.
(2) Remove the bolt attaching the safety latch to the hood (Fig. 3).
(3) Remove the latch from the hood.

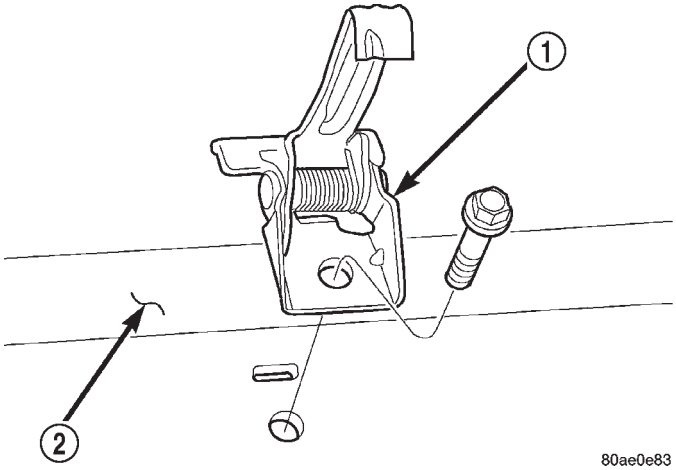


Fig. 3 Hood Safety Latch

1 – SAFETY LATCH
2 – HOOD

INSTALLATION

(1) Position the latch on the hood.
(2) Install the bolt attaching the safety latch to the hood.
(3) Remove the support rod and close the hood.

COWL WEATHERSTRIP

REMOVAL

(1) Carefully separate the weatherstrip from the cowl flange (Fig. 4).

INSTALLATION

(1) Position the weatherstrip on the cowl flange and press it into place.

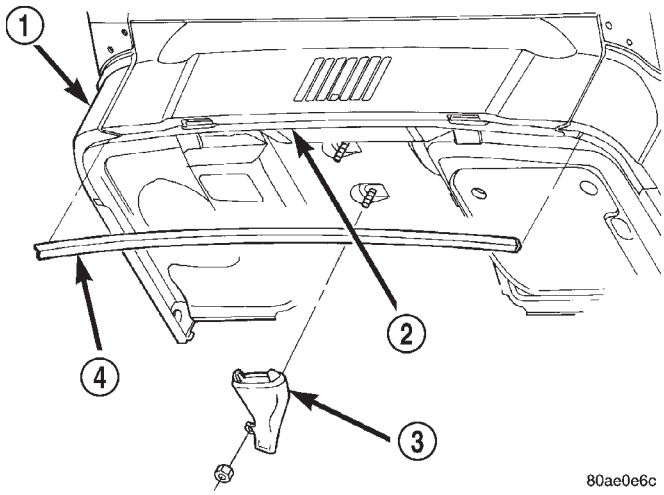


Fig. 4 Cowl Weatherstrip

1 – COWL
2 – COWL FLANGE
3 – COWL PLENUM DRAIN
4 – COWL WEATHERSTRIP

COWL GRILLE AND SCREEN

REMOVAL

(1) Open the hood and remove the screws that attach the cowl grille and screen to the cowl (Fig. 5).
(2) Remove the grille and screen from the cowl.

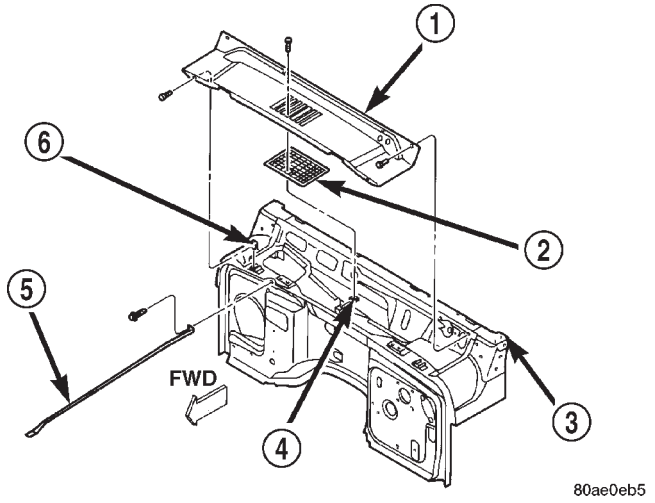


Fig. 5 Cowl Grille And Screen

1 – COWL GRILLE
2 – COWL GRILLE SCREEN
3 – COWL
4 – U NUT
5 – DASH PANEL TIE ROD
6 – U NUT

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

NOTE: When installing the cowl grille, ensure the foam seals on the cowl (Fig. 6) are positioned correctly and in good condition. Misaligned or damaged seals may allow water to enter the HEVAC.

(1) Position the cowl screen and grille on the cowl.
(2) Install the screws that attach the grille and screen to the cowl.

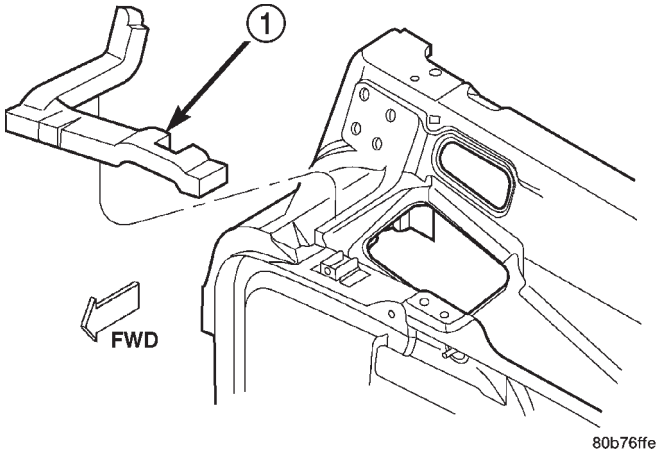


Fig. 6 Cowl Foam Seal

1 – FOAM SEAL

WINDSHIELD FRAME

REMOVAL

(1) Unlatch top.
(2) Remove the bolts attaching the sport bar to the windshield frame.
(3) Remove the windshield wiper arms.
(4) Remove the torx screw closest to the hinge pivot point and tilt the windshield forward.
(5) Remove the torx screws attaching the windshield hinge to the windshield frame (Fig. 7).
(6) Separate the windshield frame from the vehicle.

INSTALLATION

(1) Position the windshield frame on the vehicle.
(2) Install the torx screws attaching the windshield hinge to the windshield frame.
(3) Tilt the windshield rearward.
(4) Install the torx screw closest to the hinge pivot point and lock the windshield in the upright position.
(5) Install the windshield wiper arms.
(6) Install the bolts attaching the sport bar to the windshield frame.
(7) Latch top.

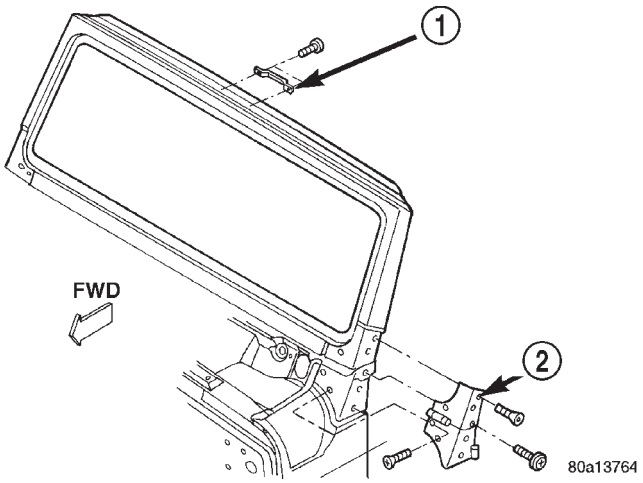


Fig. 7 Windshield Frame

1 – WINDSHIELD HOLD DOWN LOOP
2 – WINDSHIELD HINGE

WINDSHIELD FRAME WEATHERSTRIP

UPPER FRAME WEATHERSTRIP REMOVAL

(1) Disconnect the top from the windshield frame.
(2) Disengage the push-in fasteners attaching the weatherstrip to the windshield frame.
(3) Peel the weatherstrip from the frame.

UPPER FRAME WEATHERSTRIP INSTALLATION

(1) Clean the seal contact surface on the windshield frame with isopropyl alcohol or equivalent.

NOTE: Ensure that the contact surface is dry and free from any residue, poor adhesion will result.

(2) Position the weatherstrip on the windshield frame, align the push-in fasteners and press it into place (Fig. 8).
(3) Remove adhesive backing from the bottom of the weatherstrip.
(4) Using forceful hand pressure, seat the adhesive on the contact surface.

NOTE: If tape surface becomes contaminated, it will not adhere to the windshield frame.

(5) Connect the top to the windshield frame.

REMOVAL AND INSTALLATION (Continued)

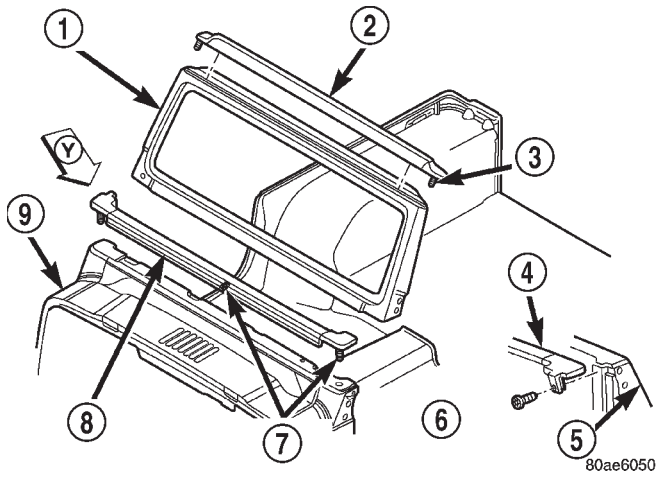


Fig. 8 Windshield Frame Weatherstrip

1 – WINDSHIELD FRAME
2 – UPPER WEATHERSTRIP
3 – PUSH-IN FASTENER
4 – LOWER WEATHERSTRIP
5 – COWL
6 – VIEW OF ARROW Y
7 – PUSH-IN FASTENER
8 – LOWER WEATHERSTRIP
9 – COWL

LOWER FRAME WEATHERSTRIP REMOVAL

The lower windshield frame weatherstrip can be removed with the frame tilted forward to the full horizontal position.

(1) Mark the position of the wiper arms and remove the arms.

(2) Disconnect the top from the windshield frame.

(3) Remove the cowl grille.

(4) Remove the torx screws on each side of the windshield frame allowing the windshield frame to tilt to the full horizontal position.

(5) Disengage the outboard push-in fasteners at the top of cowl and unscrew the fasteners that hold the weatherstrip on each hinge pillar (Fig. 8).

(6) Disengage the push-in fastener at the center of cowl.

(7) Remove the weatherstrip from the cowl.

LOWER FRAME WEATHERSTRIP INSTALLATION

(1) Position the weatherstrip on the cowl, align the center push-in fastener and press it into place.

(2) Align the outer push-in fasteners and press it into place.

(3) Install the screws attaching the lower weatherstrip to the hinge pillars.

(4) Tilt the windshield frame rearward to the full vertical position.

(5) Install the torx screws on each side of the windshield securing the windshield frame.

(6) Connect the top to the windshield frame.

(7) Install cowl grille and wiper arms.

WINDSHIELD HINGE

REMOVAL

If both hinges are to be replaced, the windshield must be tilted to the full forward position. Refer to the Windshield Frame Removal/Installation procedure in this group for windshield frame lowering information.

(1) Remove door.

(2) Remove the bolts attaching the hinge to the cowl (Fig. 9).

(3) Remove the bolts attaching the hinge to the windshield frame.

(4) Separate the hinge from the vehicle.

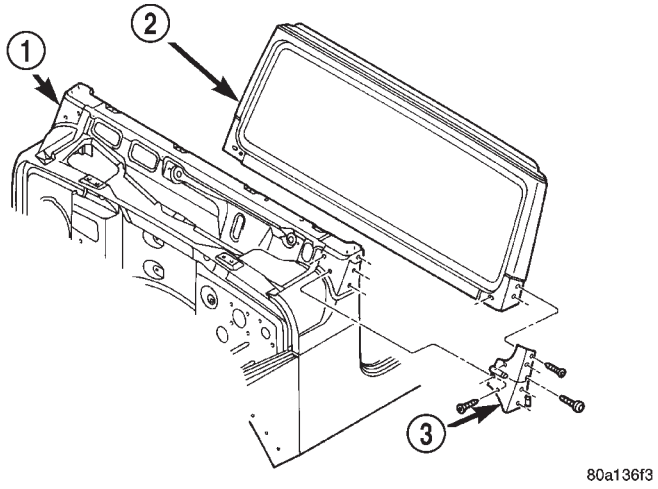


Fig. 9 Windshield Hinge

1 – COWL
2 – WINDSHIELD
3 – WINDSHIELD HINGE

INSTALLATION

(1) Paint as required.

(2) Clean the contact surface of the hinge and cowl with isopropyl alcohol or equivalent.

(3) Apply a 4 mm bead of Mopar Vinyl Acrylic Sealant or equivalent around the perimeter of the hinge contact surface. The bead should be 10 mm inboard of the edge.

(4) Position the hinge on the vehicle.

(5) Install the bolts attaching the hinge to the windshield frame.

(6) Install the bolts attaching the hinge to the cowl.

(7) Ensure that the sealant provides complete coverage. Wipe away excess sealant.

(8) Install door.

REMOVAL AND INSTALLATION (Continued)

BODY DECALS

TJ decals (Fig. 10) are durable tape decals with a adhesive backing.

To eliminate blisters and air bubbles in a decal, pierce them with a needle or pin. Force the trapped air out of the hole.

A heat gun can also be used to remove small wrinkles and irregularities in a decal.

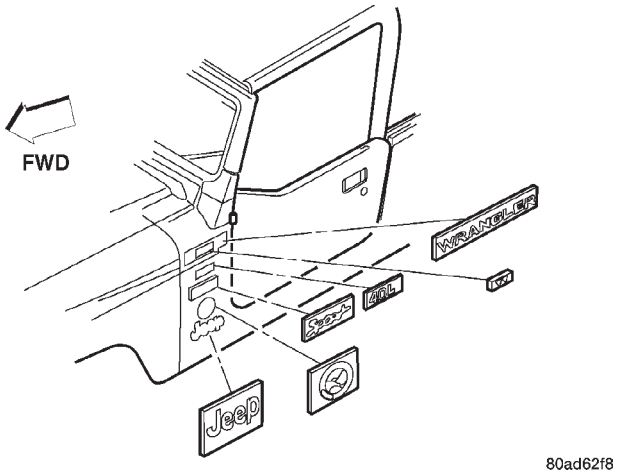


Fig. 10 TJ—Decals

REMOVAL

NOTE: The key to successful decal removal is to apply heat to area and slowly peel the decal from panel.

(1) Clean the surface as necessary.

(2) Place a piece of masking tape above or below the decal as a reference mark.

(3) Start at one end of the decal and apply heat with a heat gun. Slowly peel the decal from the panel by pulling it back. **Do not pull the decal outward from the panel.**

INSTALLATION

(1) The area that will be covered by the decal must be cleaned with an cleaning solution to remove any residue paint. Freshly painted surfaces must be thoroughly dry.

(2) Clean painted surface with a commercial wax and silicone removal solution. Wipe surface with a clean cloth and allow to dry.

(3) Position decal and carrier on panel and hold it in-place with pieces masking tape.

(4) Lift the bottom edge of the decal and carrier, use the tape sections as hinges, and reverse the position of the decal and carrier.

CAUTION: Always remove the carrier from the tape stripe/decal, never remove the tape stripe/decal from the carrier.

(5) Bend a corner of the carrier outward, separate the corner of the carrier from the decal.

(6) Using the masking tape on the body panel, align the decal.

(7) Separate the carrier from one end of the decal.

(8) Hold tape decal firmly against the panel surface while separating the carrier from the decal.

(9) Inspect tape decal with reflected light to check for defects that could have developed during the installation process. Remove all air and/or moisture bubbles.

SIDE VIEW MIRROR

REMOVAL

(1) Remove the screws attaching the mirror to the door hinge (Fig. 11).

(2) Remove the mirror from the door hinge.

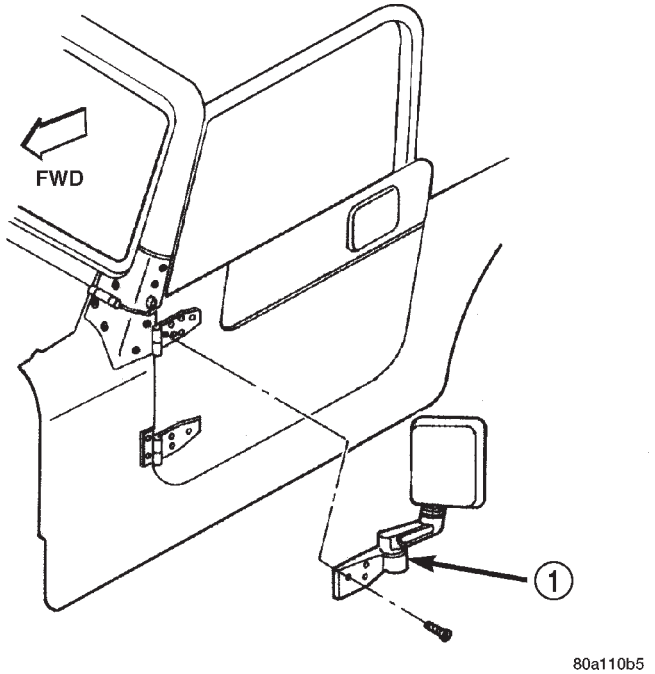


Fig. 11 Side View Mirror

1 – MIRROR

INSTALLATION

(1) Clean the door hinge-mirror base contact surface.

(2) Position the mirror base at the door hinge.

(3) Install the screws attaching the mirror base to the door hinge.

REMOVAL AND INSTALLATION (Continued)

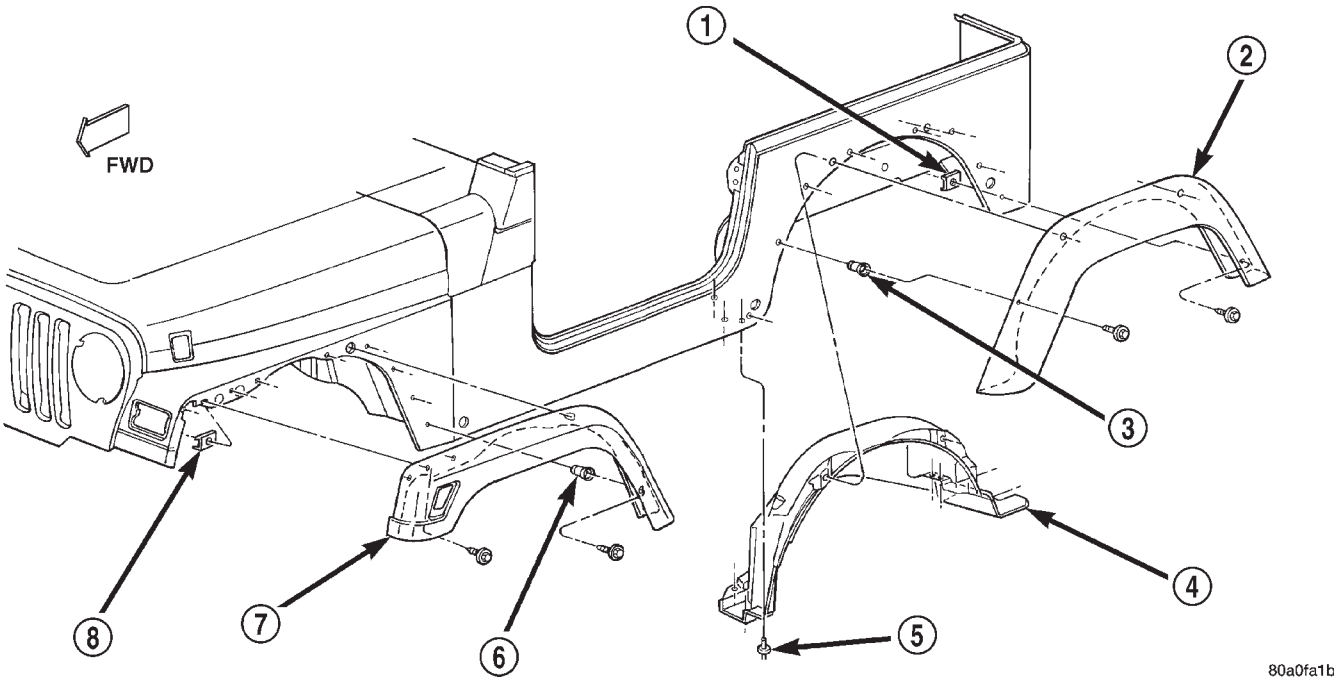


Fig. 12 Fender Flares

1 – U-NUT
2 – FENDER FLARE
3 – NUTSERT
4 – SPLASH SHIELD
5 – RIVET
6 – NUTSERT
7 – FENDER FLARE
8 – U-NUT

FENDER FLARE

REMOVAL

(1) Remove the side marker lamp.
(2) Remove the screws that attach the flare to the front fender or rear wheelhouse (Fig. 12).
(3) Separate the flare from the body.

INSTALLATION

(1) Clean the contact surface on the body.
(2) Clean the contact surface on the flare and position it on the front fender or wheelhouse.
(3) Install the screws attaching the flares to the front fender or wheelhouse.
(4) If removed, install the side marker lamp.

FRONT FENDER

RIGHT FENDER REMOVAL

(1) Disconnect and remove the battery.
(2) Remove the air cleaner housing.
(3) Remove the bolts attaching the Power Distribution Center (PDC) to the fender.
(4) Disengage the PDC wire harness retainers on the battery tray and fender.
(5) Move and secure the PDC.
(6) Disengage the high pressure air conditioning line retainer on the fender.
(7) Disengage the front end lighting wire harness retainers on the fender.
(8) Remove the battery tray.
(9) Disengage the battery temperature sensor connector.
(10) Disengage the vacuum line at the reservoir under the battery tray reinforcement bracket.
(11) Disengage the headlamp wire connector.
(12) Route the fog lamp (if equipped), park lamp and side marker wire harness through the access hole in the fender well.
(13) If equipped, remove the fender flare extension and body side molding (Fig. 13).
(14) Remove the bolts attaching the fender to the cowl (Fig. 14).
(15) Remove the bolts attaching the fender to the battery tray reinforcement bracket.
(16) Remove the bolts attaching the fender to the grille.
(17) Separate the fender from the vehicle.

RIGHT FENDER INSTALLATION

Transfer all related components. Replace harness retainers if damaged.
(1) Position the fender on the vehicle.

REMOVAL AND INSTALLATION (Continued)

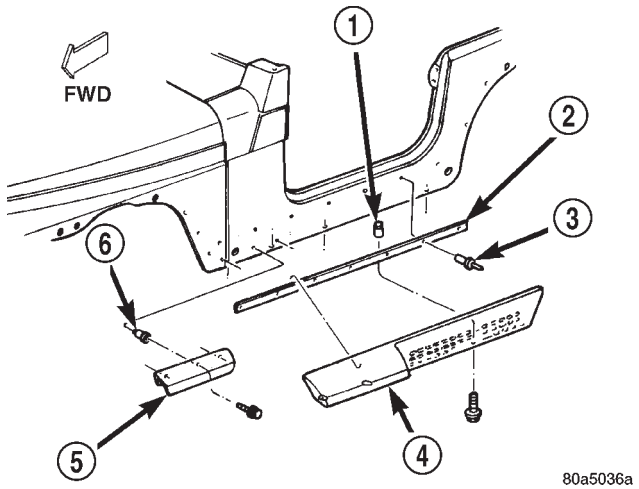


Fig. 13 Body Side Molding

1 – NUTSERT
2 – MOLDING SUPPORT
3 – RIVET
4 – BODY SIDE MOLDING
5 – FENDER FLARE EXTENSION
6 – NUTSERT

(2) Install the bolts attaching the fender to the grille.

(3) Install the bolts attaching the fender to the battery tray reinforcement bracket.

(4) Install the bolts attaching the fender to the cowl.

(5) If equipped, install the fender flare extension and body side molding.

(6) Route the fog lamp (if equipped), park lamp and side marker wire harness through the access hole in the fender well. Seat the grommet

(7) Engage the headlamp wire connector.

(8) Engage the battery temperature sensor connector.

(9) Engage the vacuum line at the reservoir under the battery tray reinforcement bracket.

(10) Install the battery tray.

(11) Position the front end lighting wire harness into the retainers on the fender. Engage the retainers to secure.

(12) Position the high pressure air conditioning line into the retainer on the fender. Engage the retainer to secure.

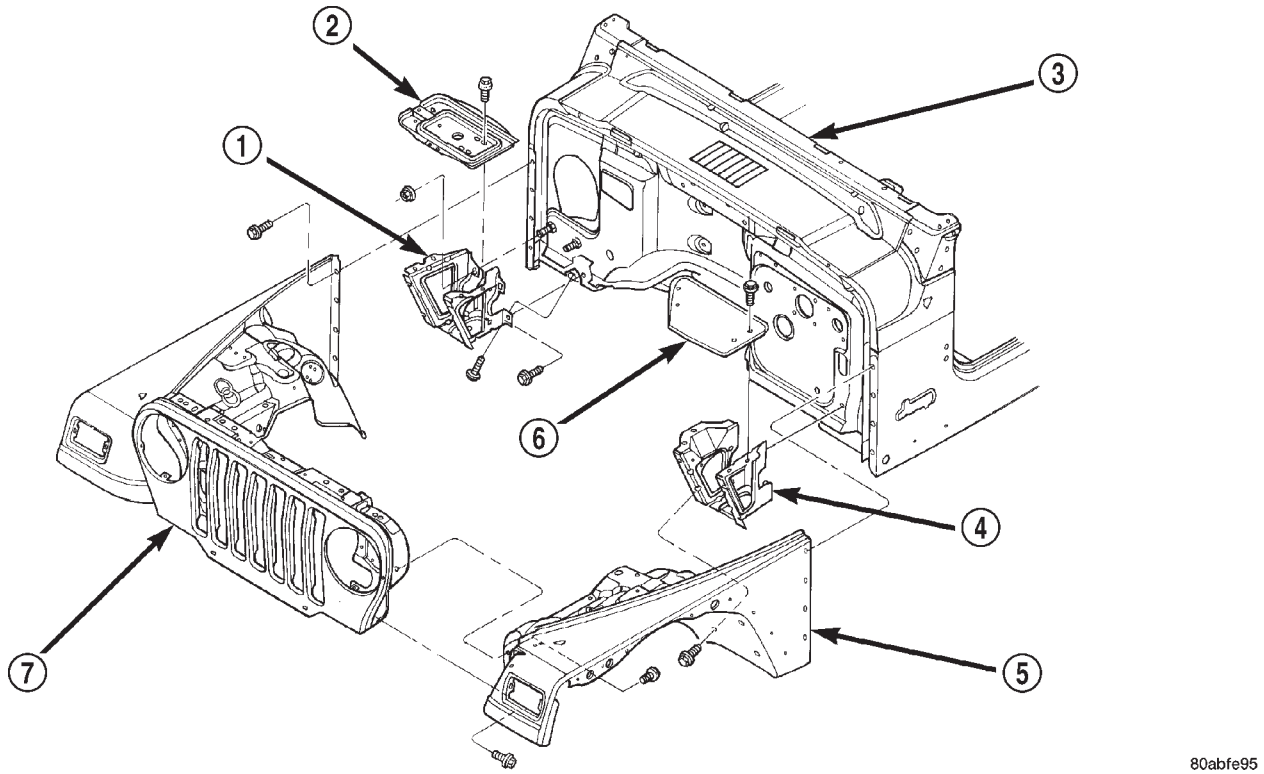


Fig. 14 Front Fender

1 – REINFORCEMENT
2 – BATTERY TRAY
3 – BODY
4 – REINFORCEMENT
5 – FENDER
6 – TRAY
7 – RADIATOR GRILLE PANEL

REMOVAL AND INSTALLATION (Continued)

(13) Position the PDC on the fender and install the bolts.
(14) Position the PDC wire harness into the retainers on the fender and battery tray. Engage the retainers to secure.
(15) Install the air cleaner housing.
(16) Install and connect the battery.

LEFT FENDER REMOVAL

(1) Disconnect the negative terminal on the battery.
(2) Remove the windshield washer reservoir.
(3) Disengage horn wire connectors.
(4) Remove horns.
(5) Remove EVAP canister.
(6) Remove the bolts attaching the ABS Hydraulic Control Unit (HCU) to the support tray.
(7) Secure the HCU.
(8) Remove the HCU tray.
(9) Disengage the front end lighting wire harness retainers on the fender.
(10) Disengage the headlamp wire connector.
(11) Route the fog lamp (if equipped), park lamp and side marker wire harness through the access hole in the fender well.
(12) If equipped, remove the body side molding (Fig. 13).
(13) Remove the bolts attaching the fender to the cowl (Fig. 14).
(14) Remove the bolts attaching the fender to the HCU tray reinforcement bracket.
(15) Remove the bolts attaching the fender to the grille.
(16) Separate the fender from the vehicle.

LEFT FENDER INSTALLATION

Transfer all related components. Replace harness retainers if damaged.
(1) Position the fender on the vehicle.
(2) Install the bolts attaching the fender to the grille.
(3) Position the front end lighting wire harness into the retainers on the fender. Engage the retainers to secure.
(4) Install the bolts attaching the fender to the HCU tray reinforcement bracket.
(5) Install the bolts attaching the fender to the cowl.
(6) If equipped, install the body side molding.
(7) Route the fog lamp (if equipped), park lamp and side marker wire harness through the access hole in the fender well. Seat the grommet
(8) Engage the headlamp wire connector.
(9) Install the HCU tray.
(10) Position the HCU on the support tray and install the bolts.
(11) Install EVAP canister.
(12) Install horns.
(13) Engage horn wire connectors.
(14) Install the windshield washer reservoir.
(15) Connect the negative terminal on the battery.

BODY SIDE MOLDING

REMOVAL

(1) Remove the bolts from underside of the body side molding (Fig. 15).
(2) Lift the molding upward to release it from the molding support.
(3) Remove the molding support by drilling out the rivets.

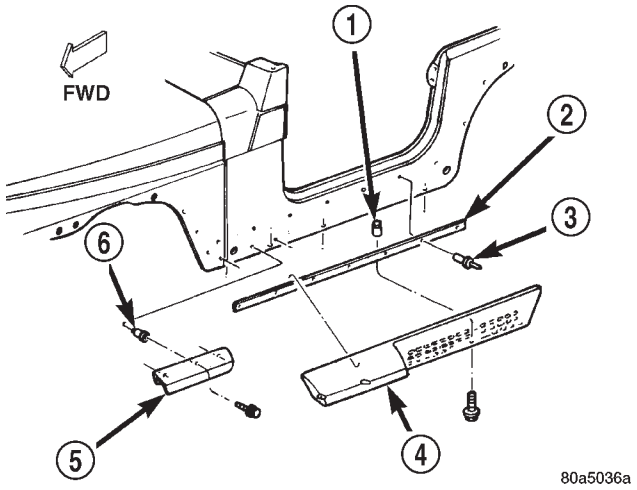


Fig. 15 Body Side Molding

1 – NUTSERT
2 – MOLDING SUPPORT
3 – RIVET
4 – BODY SIDE MOLDING
5 – FENDER FLARE EXTENSION
6 – NUTSERT

INSTALLATION

(1) If removed, position the molding support on the body and install the rivets.
(2) Place the upper edge of the molding over the top of the molding support and slide it downward.
(3) Install the bolts into the underside of the body side molding.

SIDE STEP

REMOVAL

(1) Remove the bolts that attach the side step to the frame (Fig. 16).
(2) Separate the side step from the frame.

INSTALLATION

(1) Position the side step on the frame.

REMOVAL AND INSTALLATION (Continued)

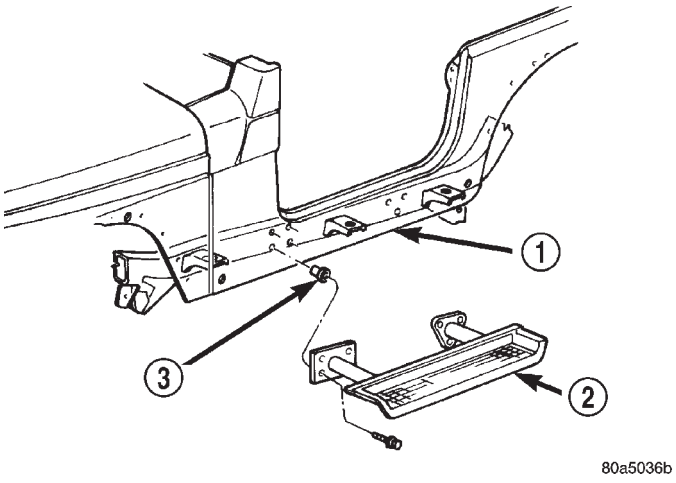


Fig. 16 Side Step

1 – FRAME
2 – SIDE STEP
3 – NUTSERT

(2) Install the bolts that attach the side step to the frame.

FULL DOOR TRIM PANEL

REMOVAL

(1) Lower the window.

(2) Remove the clip attaching the window glass regulator handle to the regulator. Remove the handle.

(3) Remove the screws attaching trim panel to door (Fig. 17).

(4) Remove push-in fasteners attaching trim panel to door with special tool C-4829.

(5) Lift the trim panel upward and separate the trim panel from the door.

INSTALLATION

(1) Position the trim panel on the door.

(2) Press the push-in fasteners attaching trim panel to door into place.

(3) Install the screws attaching trim panel to door.

(4) Position the clip on regulator handle and install the handle on the regulator.

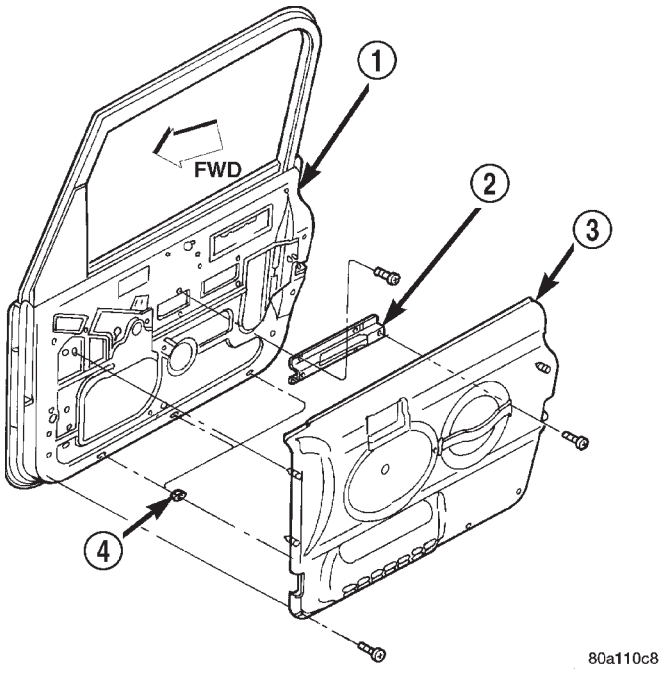


Fig. 17 Full Door Trim Panel

1 – FULL DOOR
2 – GRAB HANDLE BRACKET
3 – TRIM PANEL
4 – NUT

FULL DOOR

REMOVAL

(1) Open the door.

(2) Disconnect the door restraint strap from the pin (Fig. 18).

(3) Remove the nuts at the door hinge pivots and lift the door from the body.

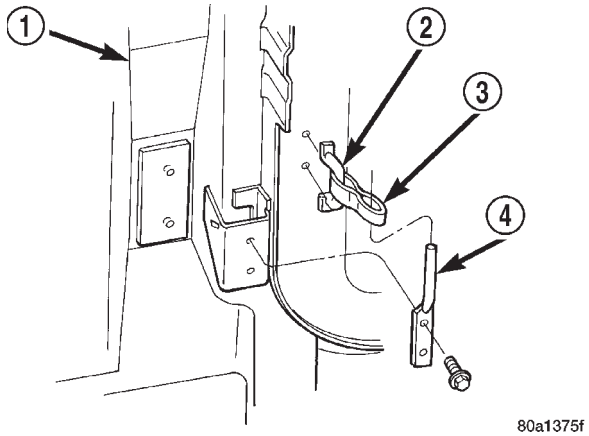


Fig. 18 Restraint Strap

1 – BODY
2 – FOOTMAN LOOP
3 – STRAP
4 – RESTRAINT PIN

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position the door in the hinge and install the nuts.
(2) Connect the door restraint strap at the pin.

FULL DOOR HINGE

REMOVAL

(1) Remove the door.
(2) Mark the outline of the existing hinge on the body and the door with a wax pencil for installation alignment reference.
(3) Remove the nut from the upper hinge pin (Fig. 19).

NOTE: When removing the door or hinge DO NOT discard the plastic shims or the hinge pin.

(4) Remove the hinge-to-body screws and the hinge-to-door screws. Remove the hinge from the door and body. Support the door as necessary.

The upper hinge is integrated with the windshield hinge. When removing it, support the windshield frame with an appropriate device prior to removal.

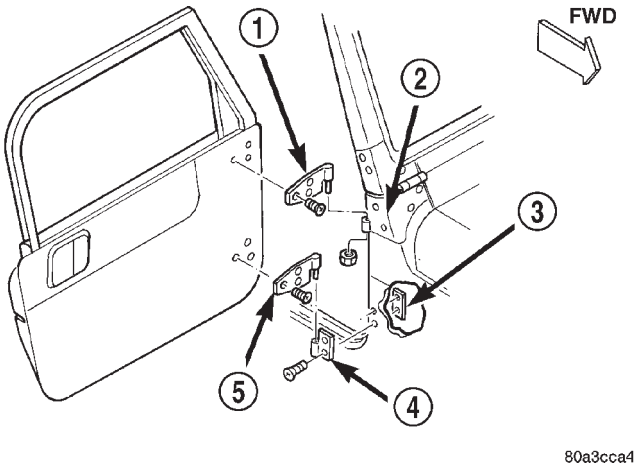


Fig. 19 Full Door Hinge

1 – HINGE HALF
2 – HINGE HALF
3 – TAPPING PLATE
4 – HINGE HALF
5 – HINGE HALF

INSTALLATION

(1) Clean the replacement hinge with an appropriate solvent and dry it with compressed air.
(2) Paint the hinge to match the vehicle body.
(3) Lubricate the hinge with spray lubricant.
(4) Position the hinge on the door, align carefully with the wax pencil installation alignment reference marks, and install the screws.
(5) Position the hinge on the vehicle body. Align the wax pencil marks installation alignment reference marks. Install the screws.
(6) Install the door,
(7) Inspect the windshield alignment after hinge installation.
(8) Inspect the door alignment. Adjust, if necessary.

FULL DOOR OUTSIDE RELEASE HANDLE

REMOVAL

(1) Remove the door trim panel.
(2) Position the window in the full upward position.
(3) Remove the grab handle support bracket (Fig. 20).
(4) Peel back the waterdam from the door inner panel to access the door latch.
(5) Disconnect from the latch, the inside lock knob to latch rod and, the outside release handle to latch rod (Fig. 21).
(6) Disengage tail of retainer from handle keeper.
(7) Using a long flat blade, tap the handle keepers upward and remove from the door handle (Fig. 22).
(8) Remove the latch release rod from the door handle.
(9) Separate the handle and gasket from the door.

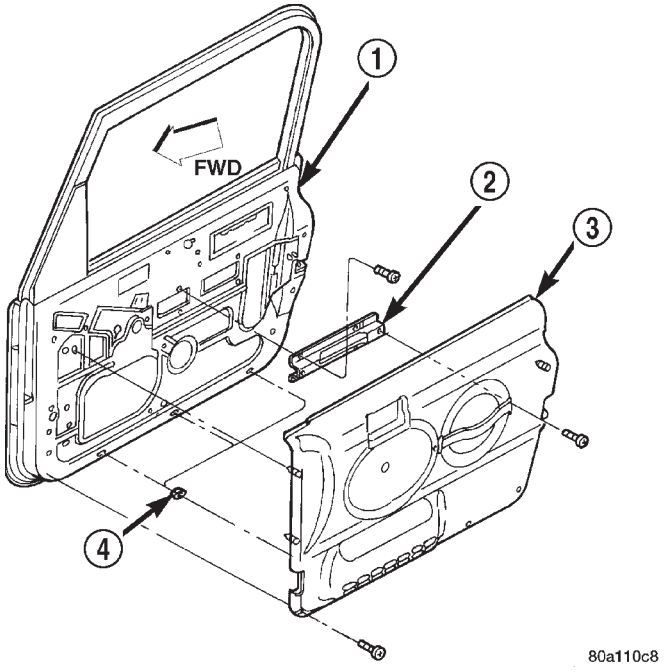


Fig. 20 Grab Handle Support Bracket

1 – FULL DOOR
2 – GRAB HANDLE BRACKET
3 – TRIM PANEL
4 – NUT

REMOVAL AND INSTALLATION (Continued)

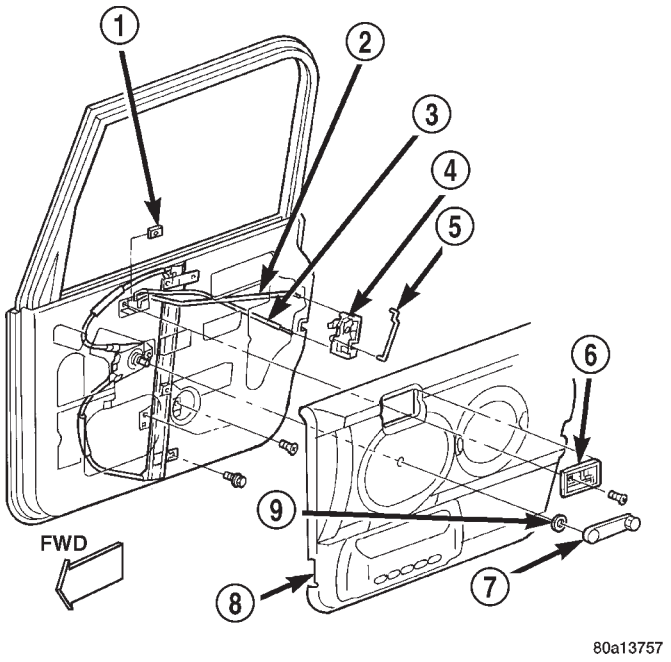


Fig. 21 Latch Rods

1 – U-NUT
2 – INSIDE HANDLE TO LATCH ROD
3 – INSIDE LOCK TO LATCH ROD
4 – LATCH
5 – LOCK CYLINDER TO LATCH ROD
6 – INSIDE HANDLE ACTUATOR
7 – WINDOW REGULATOR HANDLE
8 – TRIM PANEL
9 – SPACER

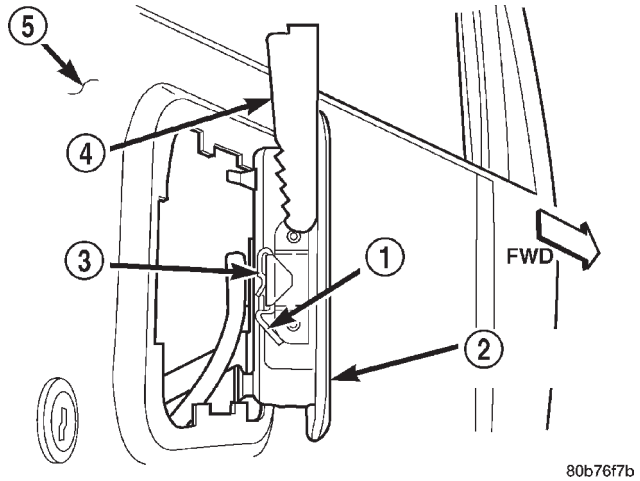


Fig. 22 Outside Door Handle Removal

1 – TAIL
2 – OUTSIDE HANDLE
3 – RETAINER
4 – HANDLE KEEPER
5 – DOOR

INSTALLATION

(1) Engage the latch release rod to the door handle.
(2) Position the gasket and handle in the door.
(3) Slide the keepers into the door handle from the top.
(4) Lower the window.
(5) Using a long flat blade, lightly tap the handle keepers downward to secure the handle. The tail of the retainer must be positioned on the 2nd or 3rd step from the bottom on the handle keeper.
(6) Raise the window.
(7) Connect to the latch, the inside lock knob to latch rod and, the outside release handle to latch rod.
(8) Install the waterdam
(9) Install the grab handle support bracket.
(10) Install the door trim panel.

FULL DOOR LOCK CYLINDER

REMOVAL

(1) Remove trim panel.
(2) Peel back waterdam.
(3) Disconnect lock cylinder to latch rod.
(4) Remove lock cylinder retaining clip.
(5) Remove the lock cylinder from the door.

INSTALLATION

(1) Install the lock cylinder in the door.
Install lock cylinder retaining clip.
(2) Connect lock cylinder to latch rod.
(3) Install the lock cylinder in the door.
Install lock cylinder retaining clip.
(4) Connect lock cylinder to latch rod.
(5) Secure the waterdam to the door.
(6) Install trim panel.

LOCK CYLINDERS

Ignition, door, deck lid, and rear hatch lock cylinders are all codable to the key. Lock barrels, tumblers, and tumbler springs are available to allow the technician to change replacement locks cylinders to match the customer's original key set. See the appropriate section in this manual for lock cylinder removal. See the Mopar® catalogue for part numbers and lock coding procedures.

FULL DOOR LATCH

REMOVAL

(1) Remove trim panel.
(2) Roll window to full upward position.
(3) Disconnect the lock cylinder to latch rod (Fig. 23).
(4) Disconnect the lock knob to latch rod.
(5) Disconnect the outside handle to latch rod.

REMOVAL AND INSTALLATION (Continued)

(6) Remove the screws attaching the latch to the door (Fig. 24).

(7) Lower the latch in the door and disconnect the inside handle to latch rod.

(8) Remove the latch from the door.

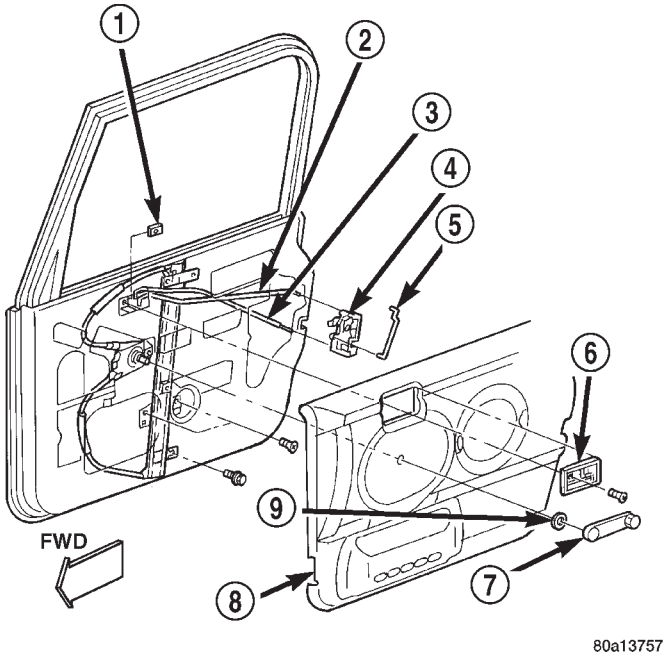


Fig. 23 Latch Rods

1 – U-NUT
2 – INSIDE HANDLE TO LATCH ROD
3 – INSIDE LOCK TO LATCH ROD
4 – LATCH
5 – LOCK CYLINDER TO LATCH ROD
6 – INSIDE HANDLE ACTUATOR
7 – WINDOW REGULATOR HANDLE
8 – TRIM PANEL
9 – SPACER

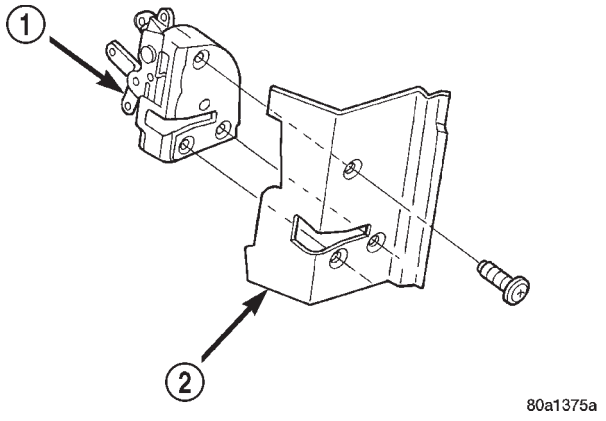


Fig. 24 Full Door Latch

1 – LATCH
2 – FULL DOOR

INSTALLATION

(1) Position the latch in the door.

(2) Connect the inside handle to latch rod.

(3) Install the screws attaching the latch to the door.

(4) Position the door weatherstrip in place, apply adhesive as necessary.

(5) Connect the outside handle to latch rod.

(6) Connect the lock knob to latch rod.

(7) Connect the lock cylinder to latch rod.

(8) Install trim panel.

FULL DOOR LATCH STRIKER

REMOVAL

(1) Remove the screws attaching the striker to the body.

(2) Separate the striker and the spacer from the body (Fig. 25).

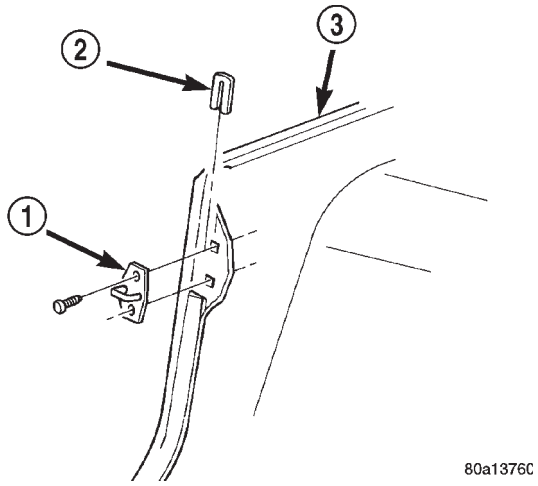


Fig. 25 Latch Striker

1 – STRIKER
2 – SPACER
3 – BODY

INSTALLATION

(1) Position the striker and the spacer on the body.

(2) Install the screws attaching the striker and spacer to the body.

FULL DOOR INSIDE HANDLE ACTUATOR

REMOVAL

(1) Remove the torx screw attaching the inside handle to the door.

(2) Carefully pull the handle from the door.

(3) Disconnect the latch rods from the handle (Fig. 26).

REMOVAL AND INSTALLATION (Continued)

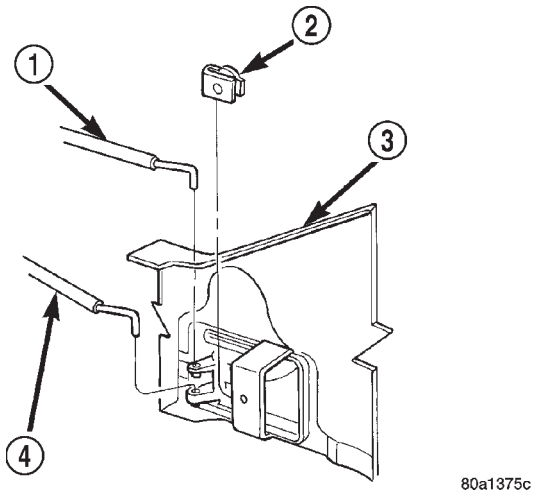


Fig. 26 Inside Handle Actuator

1 – LOCK KNOB TO LATCH ROD
2 – U-NUT
3 – HALF DOOR TRIM PANEL
4 – INSIDE RELEASE HANDLE TO LATCH ROD

INSTALLATION

INSTALLATION

(1) Connect the latch rods to the handle.
(2) Position handle and seal in door.
(3) Install the torx screw attaching the inside handle the to door.

FULL DOOR GLASS

REMOVAL

(1) Remove the door trim panel and the waterdam.
(2) Pull the door glass run channel from the door sail.
(3) Roll glass fully downward.
(4) Remove the door sail panel (Fig. 27) and (Fig. 28).
(5) Roll glass 1/4 upward to access regulator arm guide.
(6) Remove the screws that attach the regulator arm guide to the glass.
(7) Lift the glass upward while tilting inward and remove from the door.

INSTALLATION

(1) Position the glass in the door ensuring the glass is aligned in the glass run channel.
(2) Install the screws that attach the regulator arm guide to the glass.
(3) Install the door sail panel.
(4) Install the run channel in the door sail.
(5) Install the waterdam and the door trim panel.

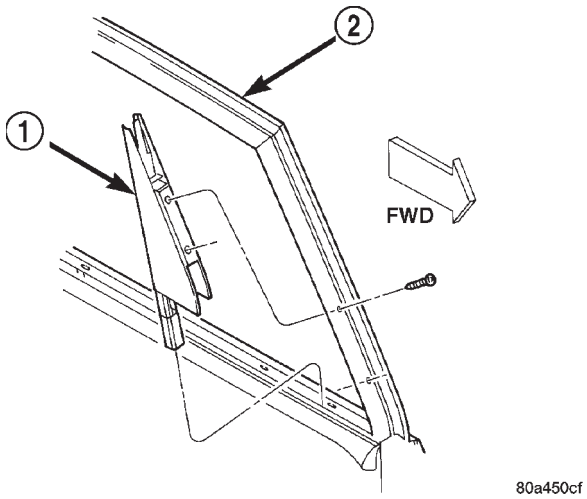


Fig. 27 Door Sail Screws

1 – DOOR SAIL
2 – DOOR

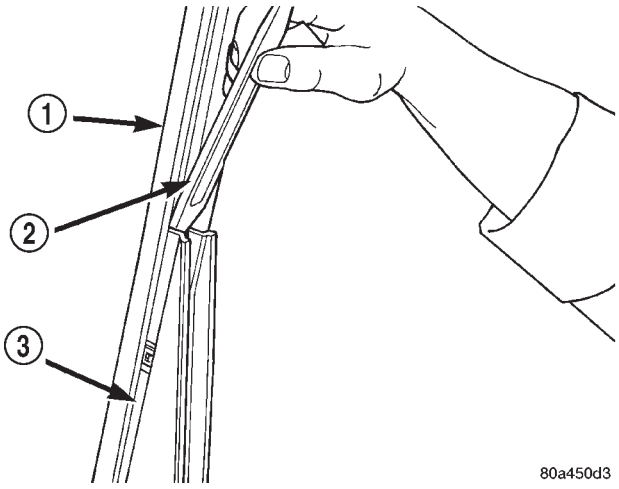


Fig. 28 Door Sail Removal

1 – DOOR FRAME
2 – TRIM STICK
3 – DOOR SAIL

FULL DOOR INNER BELT WEATHERSTRIP

The inner belt weatherstrip is attached to the door trim panel and is not serviceable. If the inner belt weatherstrip needs to be replaced, replace the door trim panel.

REMOVAL AND INSTALLATION (Continued)

FULL DOOR OUTER BELT SEAL

REMOVAL

(1) Remove the door sail panel.
(2) Disengage the clips attaching the outer belt seal to the door (Fig. 29).
(3) Separate the seal from the door.

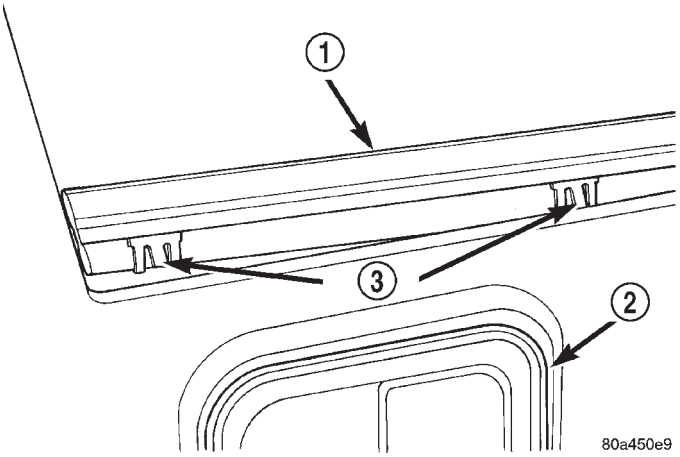


Fig. 29 Full Door Outer Belt Seal

1 – OUTER BELTLINE WEATHERSTRIP
2 – OUTSIDE DOOR HANDLE
3 – CLIPS

INSTALLATION

(1) Position the seal on the door.
(2) Engage the clips attaching the outer belt seal to the door.
(3) Install the door sail panel.

FULL DOOR GLASS RUN CHANNEL WEATHERSTRIP

REMOVAL

(1) Lower the window.
(2) Using a trim stick, carefully pry the glass run channel weatherstrip from the window opening frame.
(3) Remove the door glass.
(4) Grasp the glass run channel weatherstrip in the door (Fig. 30) and pull from the channel.

INSTALLATION

Applying a small amount of lubricant to the weatherstrip may ease the installation.
(1) Position the weatherstrip in the door channels and press into place.
(2) Install the door glass.
(3) Position the weatherstrip in the window opening frame and press into place.

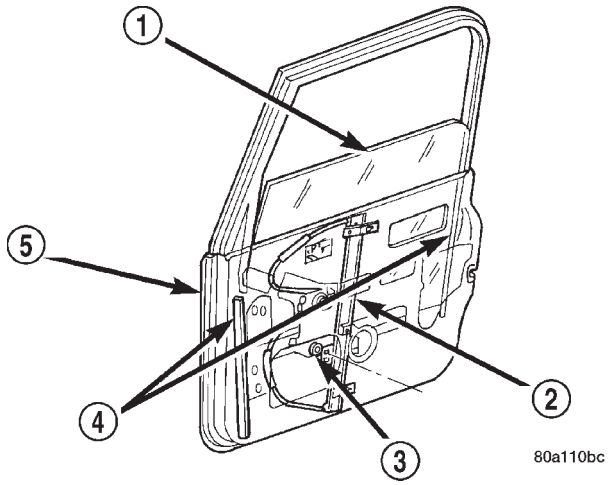


Fig. 30 Full Door Glass Run Channel Weatherstrip

1 – WINDOW GLASS
2 – REGULATOR
3 – GROMMET
4 – GLASS RUN CHANNEL WEATHERSTRIP
5 – DOOR

NOTE: Ensure that the glass is seated properly. Improperly seated door glass will result in high glass roll-up/roll-down effort.

FULL DOOR WEATHERSTRIP

The upper portion of the weatherstrip is seated into a channel around the window opening frame. The channel that seats the lower portion of the weatherstrip is attached to the door with push-in fasteners and double sided tape.

REMOVAL

(1) Peel the weatherstrip from the channel.
(2) Separate the weatherstrip from the door.
(3) If necessary, remove the push-in fasteners attaching the weatherstrip channel to the door and peel the channel from the door (Fig. 31).

INSTALLATION

(1) If the weatherstrip channel has been removed, clean the contact surfaces with isopropyl alcohol or equivalent.
(2) Remove backing from the weatherstrip channel, position the channel on the door and install the push-in fasteners. Use a roller or forceful hand pressure to ensure good adhesive contact.
(3) Install the weatherstrip in the upper and lower weatherstrip channels ensuring that the weatherstrip is completely engaged to the weatherstrip channels.

REMOVAL AND INSTALLATION (Continued)

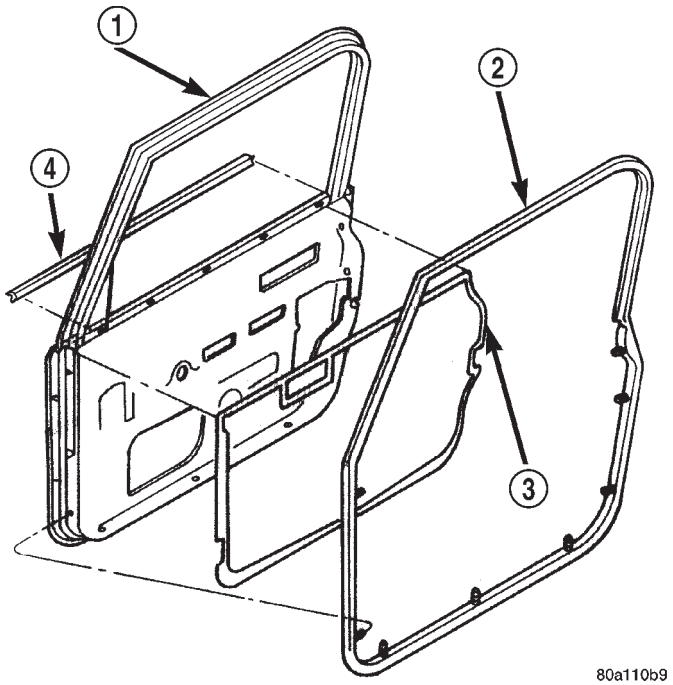


Fig. 31 Full Door Weatherstrip

1 – FULL DOOR
2 – WEATHERSTRIP
3 – WATERDAM
4 – OUTER DOOR BELT SEAL

FULL DOOR WINDOW REGULATOR

REMOVAL

(1) Remove door trim panel.
(2) Remove door glass.
(3) Loosen the bolts in the slotted holes (Fig. 32).
(4) Remove the bolts attaching the regulator to the door inner panel.
(5) Lift the regulator upward to free it from the slotted holes in the door inner panel.
(6) Lower the regulator and remove it through the access hole in the door inner panel (Fig. 33).

INSTALLATION

(1) Position the regulator in the door.
(2) Align regulator bolts into slotted holes.
(3) Install bolts attaching regulator to the inner door panel.
(4) Tighten the bolts in the slotted holes.
(5) Install door glass.
(6) Install door trim panel.

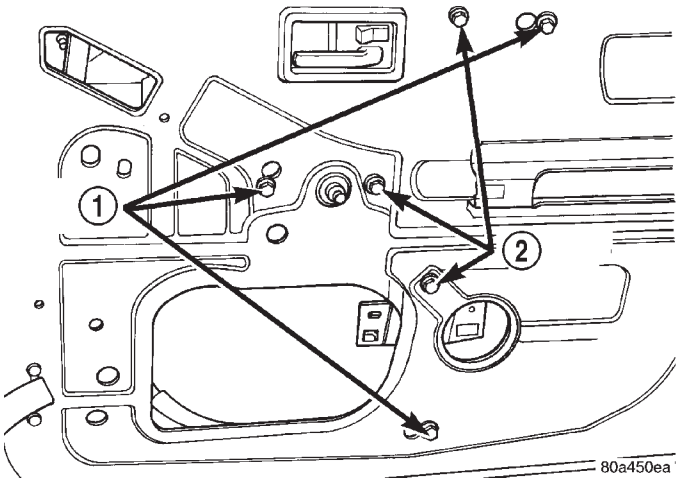


Fig. 32 Window Regulator Bolts

1 – LOOSEN BOLTS
2 – REMOVE BOLTS

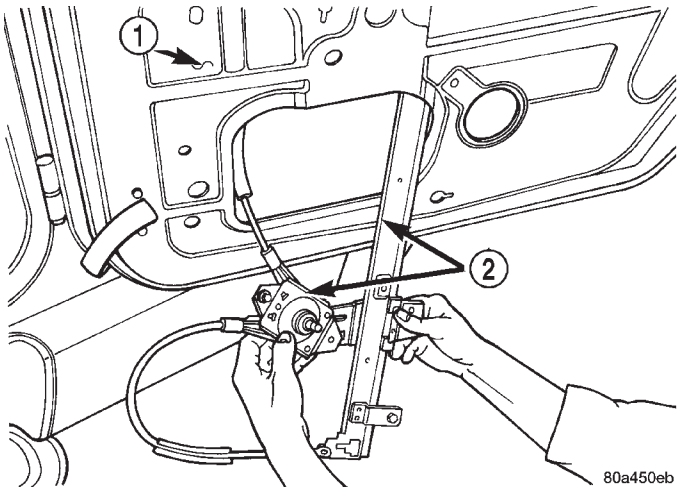


Fig. 33 Regulator Removal

1 – DOOR
2 – REGULATOR ASSEMBLY

HALF DOOR TRIM PANEL

REMOVAL

(1) Remove half door window.
(2) Rotate window retainer sleeves 90°. Using a trim stick, pry sleeve retainers from door.
(3) Remove the screws attaching trim panel to door.
(4) Remove push-in fasteners attaching trim panel to door with special tool C-4829.
(5) Separate the trim panel from the door.

INSTALLATION

(1) Position the trim panel on the door.
(2) Press the push-in fasteners attaching trim panel to door into place.

REMOVAL AND INSTALLATION (Continued)

(3) Install the screws attaching trim panel to door.
(4) Position retainer sleeves into door. Rotate retainer sleeves 90° to secure into place.
(5) Install half door window.

HALF DOOR

REMOVAL

(1) Open the door.
(2) Disconnect the door restraint strap from the pin (Fig. 34).
(3) Remove the nuts at the door hinge pivots and lift the door from the body.

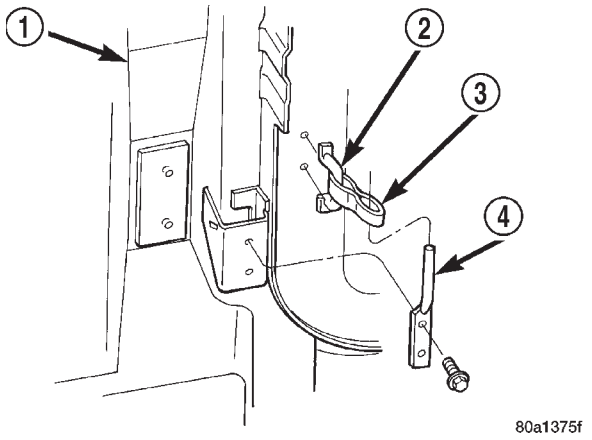


Fig. 34 Restraint Strap

1 – BODY
2 – FOOTMAN LOOP
3 – STRAP
4 – RESTRAINT PIN

INSTALLATION

(1) Position the door in the hinge and install the nuts.
(2) Connect the door restraint strap at the pin.

HALF DOOR HINGE

The service procedures for the half door hinge are the same as the full door hinge. Refer to, Full Door Hinge Removal/Installation procedures in this group.

HALF DOOR OUTSIDE HANDLE

REMOVAL

(1) Remove trim panel.
(2) Disconnect the outside handle to latch rod (Fig. 35).
(3) Remove screws attaching the outside handle to the door.
(4) Separate the outside handle and seal from the door.

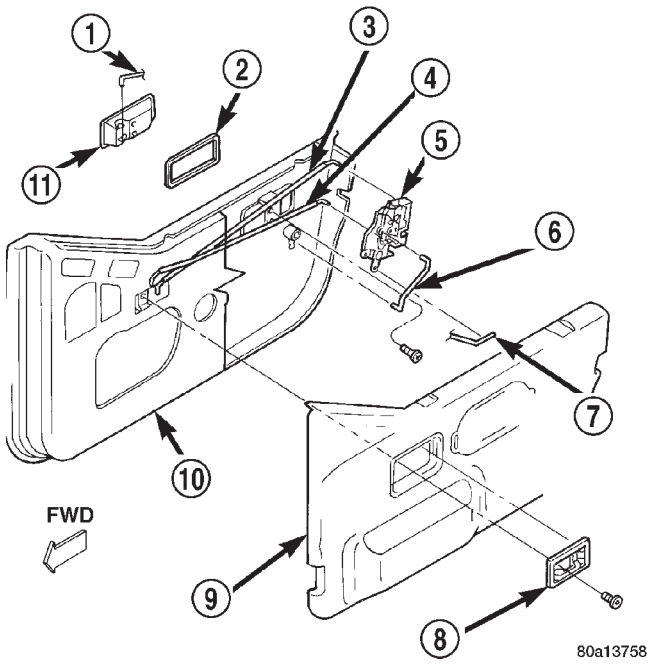


Fig. 35 Outside Handle

1 – OUTSIDE HANDLE TO LATCH ROD
2 – SEAL
3 – INSIDE HANDLE TO LATCH ROD
4 – INSIDE LOCK TO LATCH ROD
5 – LATCH
6 – LOCK CYLINDER TO LATCH ROD
7 – OUTSIDE HANDLE TO LATCH ROD
8 – INSIDE HANDLE ACTUATOR
9 – TRIM PANEL
10 – HALF DOOR
11 – OUTSIDE HANDLE

INSTALLATION

(1) Position the outside handle and seal in the door.
(2) Install screws attaching the outside handle to the door.
(3) Connect the outside handle to latch rod.
(4) Install trim panel.

HALF DOOR LOCK CYLINDER

REMOVAL

(1) Remove trim panel.
(2) Peel back the waterdam.
(3) Disconnect lock cylinder to latch rod (Fig. 36).
(4) Remove lock cylinder retaining clip.
(5) Remove the lock cylinder from the door.

INSTALLATION

(1) Install the lock cylinder in the door.
Install lock cylinder retaining clip.
(2) Connect lock cylinder to latch rod.
(3) Secure the waterdam.

REMOVAL AND INSTALLATION (Continued)

(4) Install trim panel.

HALF DOOR LATCH

REMOVAL

(1) Remove trim panel.
(2) Disconnect the lock cylinder to latch rod (Fig. 36).
(3) Disconnect the lock knob to latch rod.
(4) Disconnect the outside handle to latch rod.
(5) Using a trim stick or equivalent, pry back the door weatherstrip at the latch to access the screw attaching the latch to the door.
(6) Remove the screws attaching the latch to the door (Fig. 37).
(7) Lower the latch in the door and disconnect the inside handle to latch rod.
(8) Remove the latch from the door.

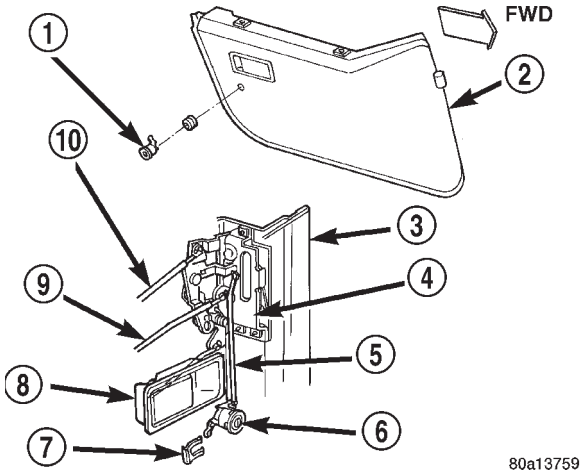


Fig. 36 Half Door Latch Rods

1 – LOCK CYLINDER
2 – HALF DOOR
3 – HALF DOOR
4 – LATCH
5 – LOCK CYLINDER TO LATCH ROD
6 – LOCK CYLINDER
7 – RETAINER
8 – OUTSIDE HANDLE
9 – INSIDE HANDLE TO LATCH ROD
10 – INSIDE LOCK TO LATCH ROD

INSTALLATION

(1) Position the latch in the door.
(2) Connect the inside handle to latch rod.
(3) Install the screws attaching the latch to the door.
(4) Position the door weatherstrip in place, apply adhesive as necessary.
(5) Connect the outside handle to latch rod.
(6) Connect the lock knob to latch rod.
(7) Connect the lock cylinder to latch rod (Fig. 36).
(8) Install trim panel.

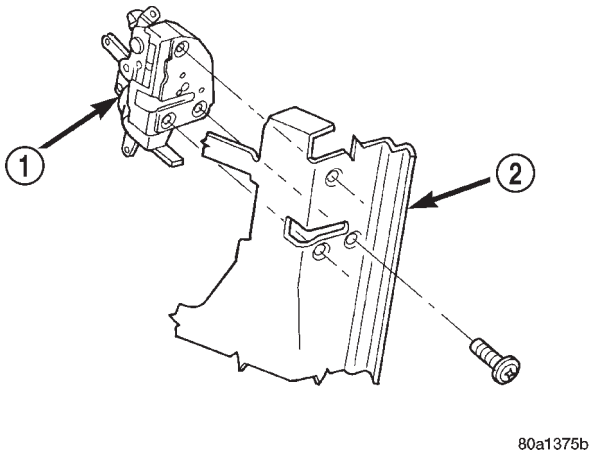


Fig. 37 Door Latch

1 – LATCH
2 – HALF DOOR

HALF DOOR LATCH STRIKER

REMOVAL

(1) Remove the screws attaching the striker to the body.
(2) Separate the striker and the spacer from the body (Fig. 38).

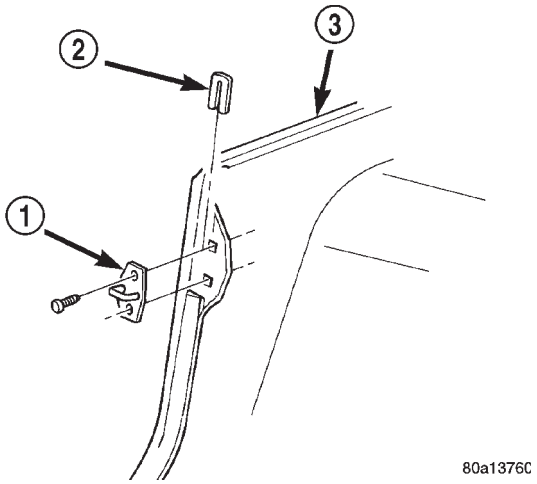


Fig. 38 Latch Striker

1 – STRIKER
2 – SPACER
3 – BODY

INSTALLATION

(1) Position the striker and the spacer on the body.
(2) Install the screws attaching the striker and spacer to the body.

REMOVAL AND INSTALLATION (Continued)

HALF DOOR INSIDE HANDLE ACTUATOR

REMOVAL

(1) Remove the torx screw attaching the inside handle to the door.
(2) Carefully pull handle from door.
(3) Disconnect the latch rods from the handle (Fig. 39).

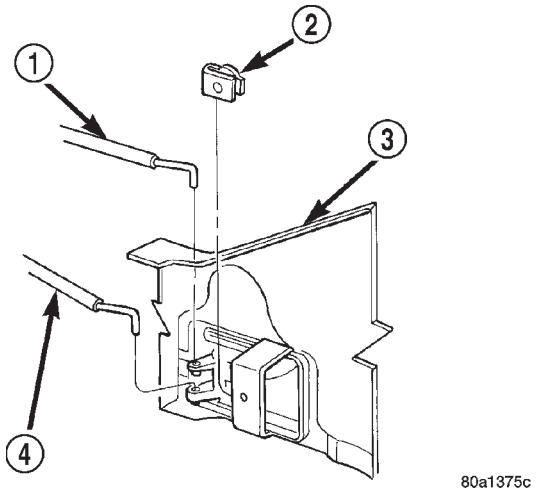


Fig. 39 Inside Handle Actuator

1 – LOCK KNOB TO LATCH ROD
2 – U-NUT
3 – HALF DOOR TRIM PANEL
4 – INSIDE RELEASE HANDLE TO LATCH ROD

INSTALLATION

(1) Connect the latch rods to the handle.
(2) Position handle and seal in door.
(3) Install the torx screw attaching the inside handle the to door.

HALF DOOR WEATHERSTRIP

The weatherstrip is seated into a channel around the door. The channel that seats the weatherstrip is attached to the door with push-in fasteners and double sided tape.

REMOVAL

(1) Remove trim panel.
(2) Remove window retaining sleeve.
(3) Remove the push-in fasteners attaching the weatherstrip to the top of the door.
(4) Peel the weatherstrip from the channel.
(5) If necessary, remove the push-in fasteners attaching the weatherstrip channel to the door and peel the channel from the door (Fig. 40).

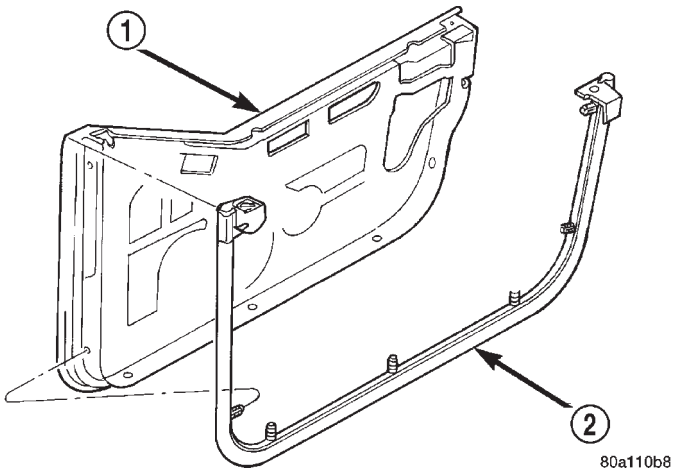


Fig. 40 Half Door Weatherstrip

1 – HALF DOOR
2 – WEATHERSTRIP

INSTALLATION

(1) If the weatherstrip channel has been removed, clean the contact surfaces with isopropyl alcohol or equivalent.
(2) Remove the backing from the weatherstrip channel, position the channel on the door and install the push-in fasteners. Use a roller or forceful hand pressure to ensure good adhesive contact.
(3) Position the seal on the door and press it into place.
(4) Install the weatherstrip in the weatherstrip channel ensuring that the weatherstrip is fully engaged in the weatherstrip channel.
(5) Install window retaining sleeve.
(6) Install trim panel.

HALF DOOR WINDOW

REMOVAL

(1) Open the door.
(2) Grasp the window at both front and rear edges and firmly lift upward (Fig. 41).

INSTALLATION

(1) Starting at the most forward alignment pin, position the window alignment pins into the restraint sleeves and push downward until seated.

REMOVAL AND INSTALLATION (Continued)

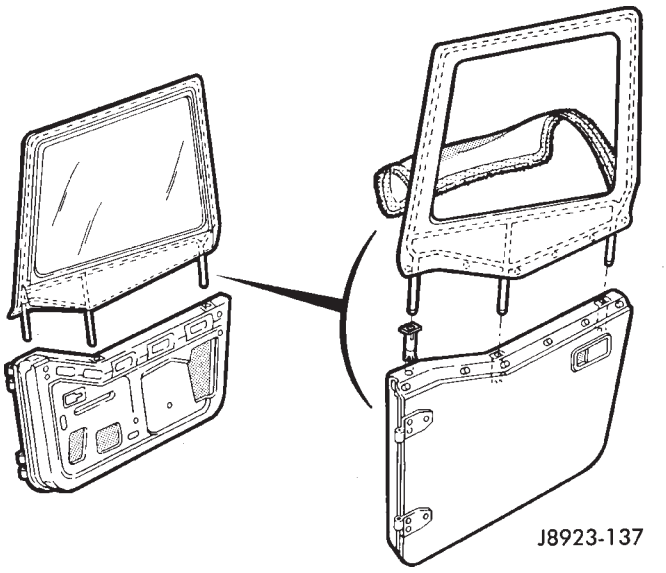


Fig. 41 Half Window

HARD TOP

REMOVAL

(1) Disengage latches at windshield frame (Fig. 42).

(2) Remove the bolts that attach the hard top to the body (Fig. 43).

(3) Depress tab on wiper motor connector and pull downward to disengage (Fig. 44).

(4) Disconnect the rear washer fluid hose. Cap the hose to prevent washer fluid leakage (Fig. 45).

(5) Remove the hard top from the vehicle.

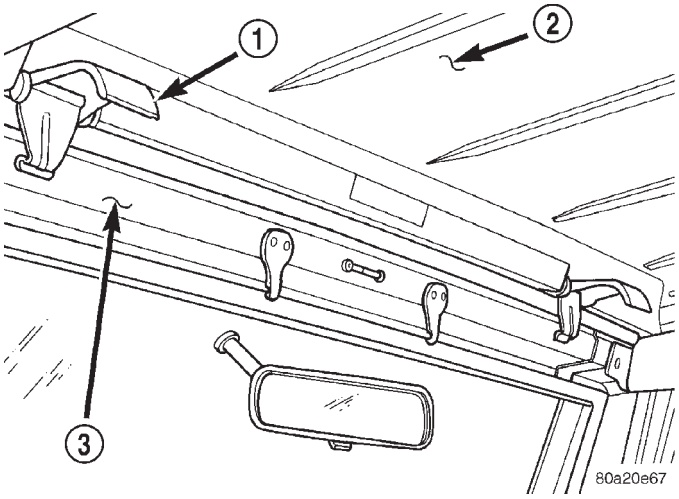


Fig. 42 Hard Top Latch

1 – LATCH
2 – HARD TOP
3 – WINDSHIELD FRAME

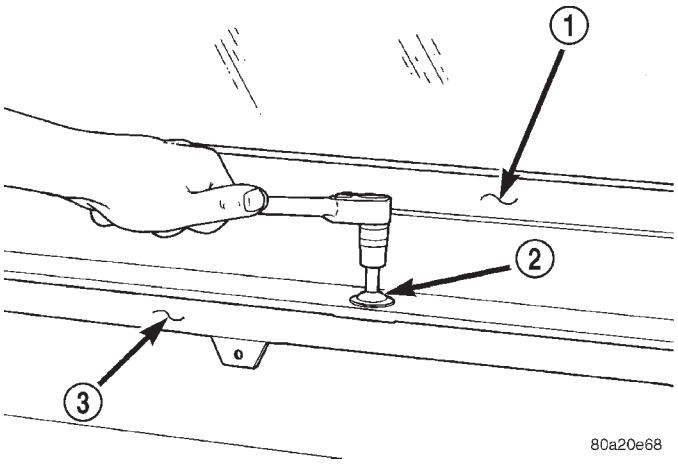


Fig. 43 Hard Top Removal

1 – HARD TOP
2 – HOLD DOWN BOLT
3 – BODY RAIL

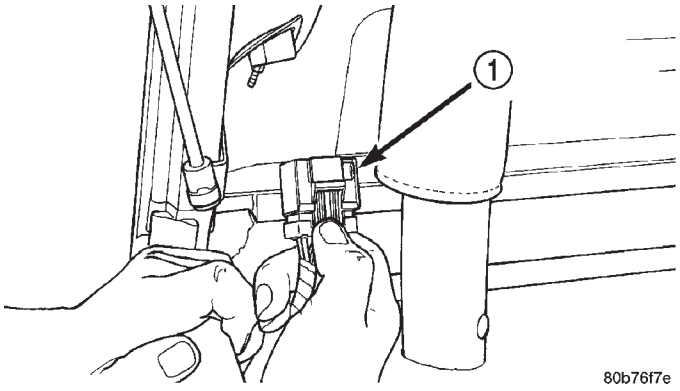


Fig. 44 Rear Wiper Wire Harness Connector

1 – WIPER MOTOR CONNECTOR

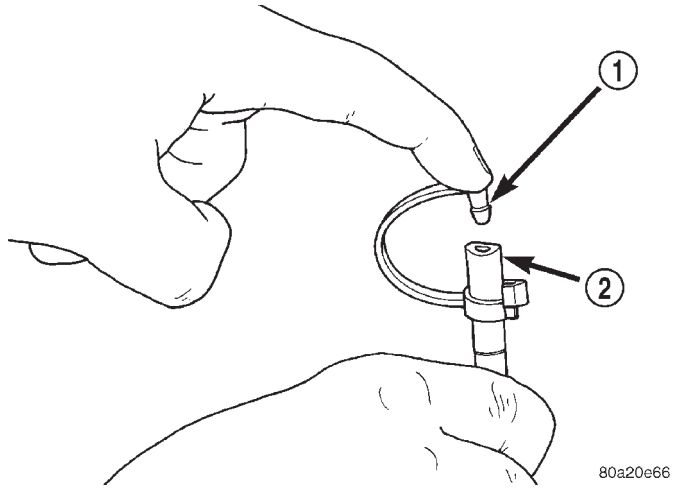


Fig. 45 Rear Washer Fluid Tube

1 – CAP
2 – WASHER FLUID TUBE

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Inspect the hard top seals for damage and replace, if necessary.

(2) Carefully position the hard top on the vehicle. Ensure that the latches are not pinched between the top and windshield frame.

(3) Loosely install the bolts. Ensure that the top is centered on the vehicle. Tighten the bolts securely.

(4) Connect the wire wiper motor harness connector.

(5) Connect the rear washer fluid hose.

(6) Engage the latches at windshield frame.

HARD TOP AIR EXHAUSTER

The hard top air exhauster fits very tightly into the hard top and generally cannot be removed without being damaged. It is recommended that availability of a replacement air exhauster is determined prior to attempting to remove it.

REMOVAL

(1) Using a trim stick, C-4755, between air exhauster and hard top, disengage one edge of exhauster from hard top.

(2) Separate the air exhauster from the hard top.

INSTALLATION

(1) Position the air exhauster on the hard top.

(2) Press air exhauster into opening in hard top until fully seated.

SOFT TOP

REMOVAL

(1) Disengage the retainers attaching the rear window to the body.

(2) Remove rear window, unzipping from right to left.

(3) Disengage J-straps at soft top rear corners (Fig. 46).

(4) Unzip quarter windows, disengage J-strap and remove quarter windows.

(5) Starting at the rear of the upper door opening frame and working forward, disengage driprail retainers attaching the soft top to the door opening frame.

(6) Unlatch top at windshield frame.

(7) Lower the top to the rearward position.

(8) Remove the screws attaching the roof bows to the pivot bracket (Fig. 47).

(9) Lift up bows at pivot bracket to disengage from pivot bracket.

(10) Remove the top (Fig. 48).

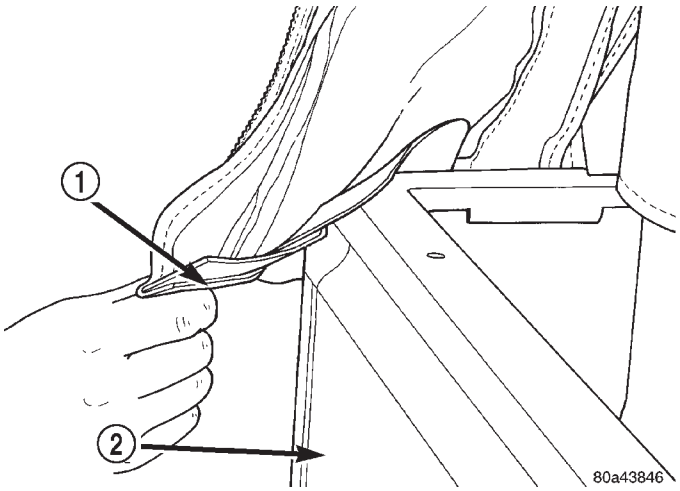


Fig. 46 Soft Top J-Straps

1 – SOFT TOP CORNER J-STRAP
2 – QUARTER PANEL

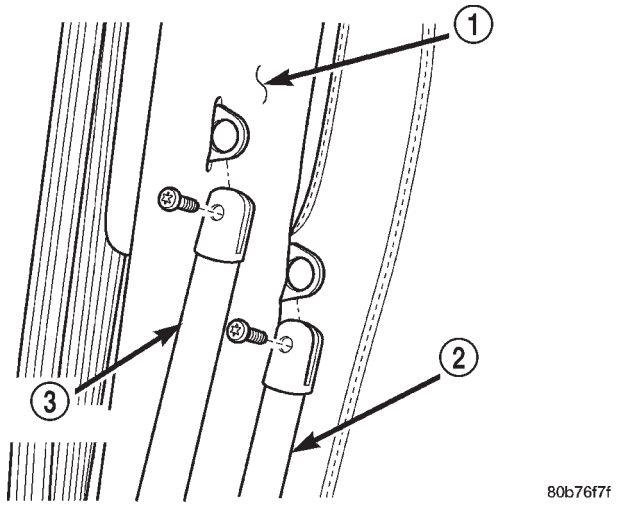


Fig. 47 Roof Bow Removal

1 – SPORT BAR
2 – REAR ROOF BOW
3 – SIDE ROOF BOW

INSTALLATION

(1) Position the top on the vehicle.

(2) Install the screws attaching the roof bows to the pivot bracket. (The front bow is attached to the pivot bracket on the upper outward location).

(3) Raise the top.

(4) Position latch in windshield frame.

(5) Install the quarter windows.

(6) Working from front to rear, engage the J-straps attaching the quarter window to the body.

(7) Install rear window.

(8) Engage driprail retainers above door opening frame.

REMOVAL AND INSTALLATION (Continued)

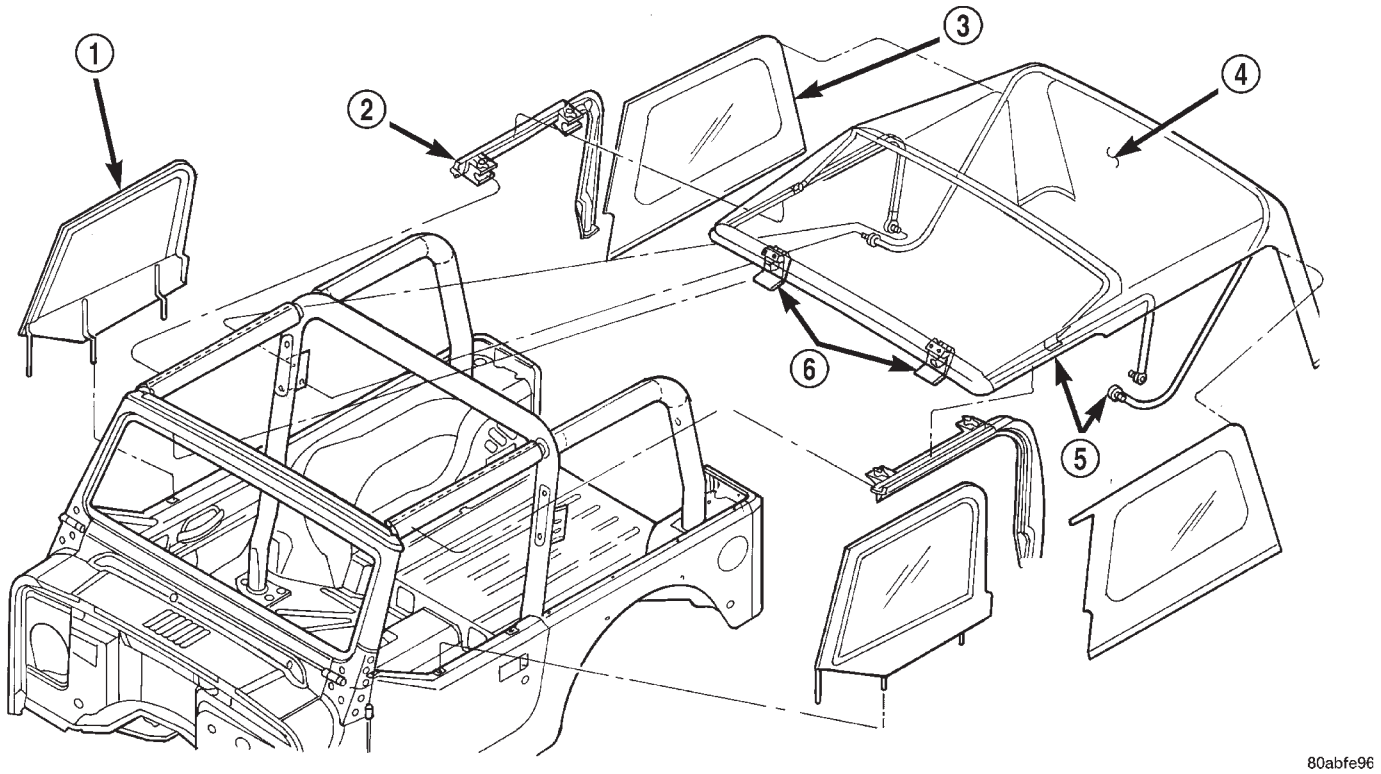


Fig. 48 Soft Top

1 – HALF DOOR WINDOW
2 – DOOR OPENING FRAME
3 – QUARTER WINDOW
4 – SOFT TOP
5 – ROOF BOW
6 – LATCH REINFORCEMENT

(9) Working from front to rear, engage J-straps at soft top rear corners.

(10) Engage the retainers attaching the rear window to the body.

(11) Close latch at windshield frame.

SOFT TOP FABRIC

REMOVAL

(1) Disengage the snaps attaching the soft top fabric to the rear roof bow.

(2) Disengage the hook and loop fastener attaching soft top fabric to the center roof bow.

(3) Lower the soft top.

(4) Remove the screws attaching the soft top fabric to the front roof bow and fold back fabric.

(5) Separate the soft top fabric from the frame.

INSTALLATION

(1) Position the soft top fabric on the frame.

(2) Install the screws attaching the soft top fabric to the front roof bow.

(3) Engage the hook and loop fastener attaching soft top fabric to the center roof bow.

(4) Engage the snaps attaching the soft top fabric to the rear roof bow.

(5) Raise and secure the soft top.

HARD/SOFT TOP LATCH

REMOVAL

(1) Unlatch the top (Fig. 49).

(2) Using a wax pencil, mark the position of the latch on the top.

(3) Remove the screws attaching the latch to the top.

INSTALLATION

(1) Position the latch on the top and install the screws.

REMOVAL AND INSTALLATION (Continued)

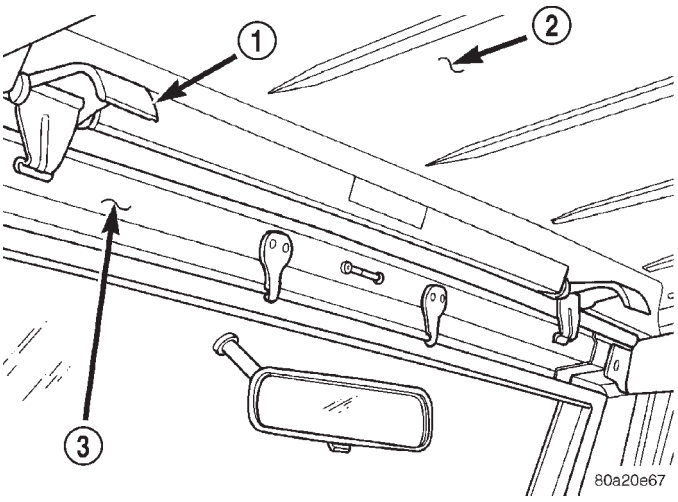


Fig. 49 Hard/Soft Top Latch

1 – LATCH
2 – HARD TOP
3 – WINDSHIELD FRAME

DOOR OPENING FRAME

Vehicles equipped with a soft top require a door opening frame to complete the seal for the soft top door assembly.

REMOVAL

(1) Lower the top to the rearward position.

(2) Turn the knobs located on top of the door opening frame counter clockwise and remove completely (Fig. 50).

(3) Pull door opening frame outward and up. Separate from vehicle.

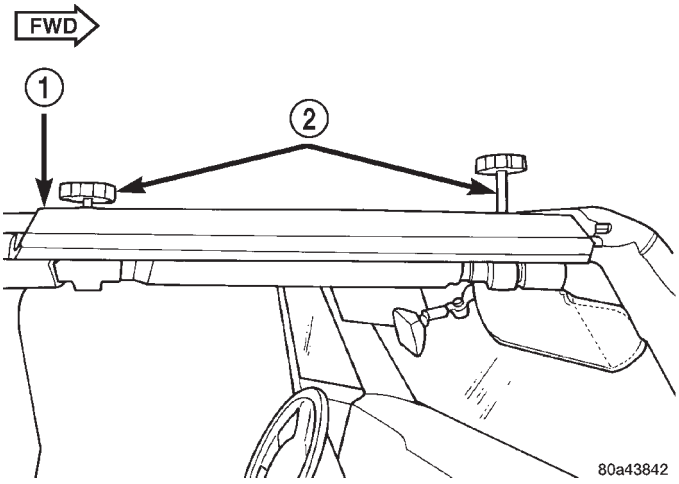


Fig. 50 Door Opening Frame

1 – DOOR OPENING FRAME
2 – KNOBS

INSTALLATION

(1) Install the alignment pin at the base of the door opening frame into the hole at the top of the quarter panel.

(2) Position the door opening frame on the side support bar and install the knobs.

(3) Raise and secure the top.

FRONT SHOULDER/LAP BELT AND BUCKLE

WARNING: INSPECT THE SHOULDER BELT, RETRACTOR AND BUCKLE. REPLACE THE BELT OR BUCKLE THAT IS EITHER CUT, FRAYED, TORN OR DAMAGED. REPLACE THE BELT IF THE RETRACTOR IS INOPERATIVE.

FRONT SHOULDER/LAP BELT AND RETRACTOR REMOVAL

(1) Move front seat to the full forward position.

(2) Remove the bolt attaching the retractor to the sport bar (Fig. 51).

(3) Using a small flat blade, pry the cover from the turning loop.

(4) Remove the bolt attaching the turning loop to the height adjuster (Fig. 52).

(5) Separate the belt assembly from the vehicle.

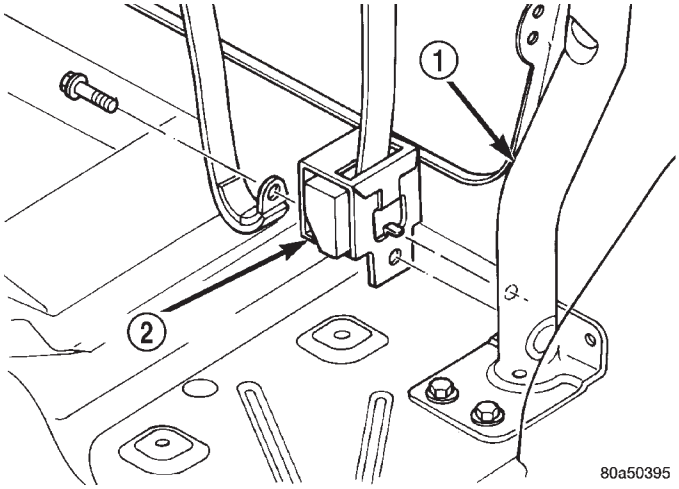


Fig. 51 Front Retractor

1 – SPORT BAR
2 – RETRACTOR

REMOVAL AND INSTALLATION (Continued)

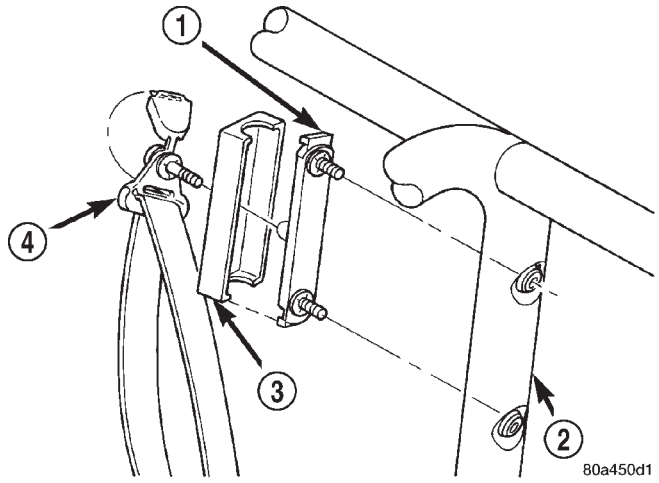


Fig. 52 Front Turning Loop

1 – HEIGHT ADJUSTER
2 – SPORT BAR
3 – HEIGHT ADJUSTER COVER
4 – TURNING LOOP

FRONT SHOULDER/LAP BELT AND RETRACTOR INSTALLATION

(1) Position the turning loop on the height adjuster and install the bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

(2) Close the cover on the turning loop.

(3) Install the bolt attaching the retractor to the sport bar. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

FRONT SEAT BELT BUCKLE REMOVAL

(1) Remove the bolt attaching the seat belt buckle to the seat track/seat riser (Fig. 53).

(2) Disengage seat belt harness connector (driver's seat only).

(3) Remove buckle from vehicle.

FRONT SEAT BELT BUCKLE INSTALLATION

(1) Position the buckle on the seat track/seat riser and install the bolt.

(2) Engage seat belt harness connector (driver's seat only).

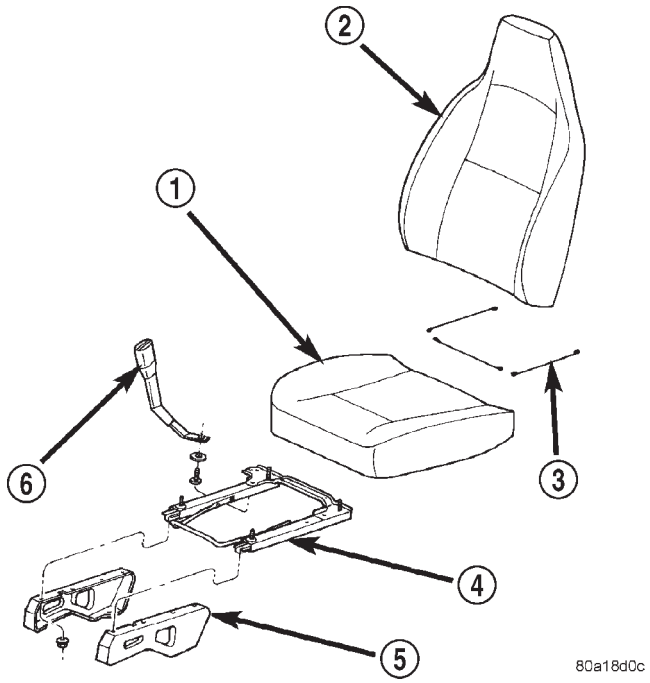


Fig. 53 Seat Belt Buckle

1 – SEAT CUSHION
2 – SEATBACK
3 – TRIM ATTACHMENT WIRE
4 – SEAT TRACK
5 – SEAT RISER
6 – BUCKLE

REAR SHOULDER/LAP BELT AND BUCKLE

WARNING: INSPECT THE SHOULDER BELT, RETRACTOR AND BUCKLE. REPLACE THE BELT OR BUCKLE THAT IS EITHER CUT, FRAYED, TORN OR DAMAGED. REPLACE THE BELT IF THE RETRACTOR IS INOPERATIVE.

SEAT/LAP BELT AND RETRACTOR REMOVAL

(1) Move the rear seat to the forward tumble position.

(2) Remove the anchor bolt attaching the belt to the wheelhouse (Fig. 56).

(3) Using a flat blade, pry the cover off the turning loop (Fig. 54).

(4) Remove the bolt attaching the turning loop to the sport bar (Fig. 55).

(5) Remove the bolt attaching the retractor to the sport bar.

(6) Separate the belt assembly from the vehicle.

REMOVAL AND INSTALLATION (Continued)

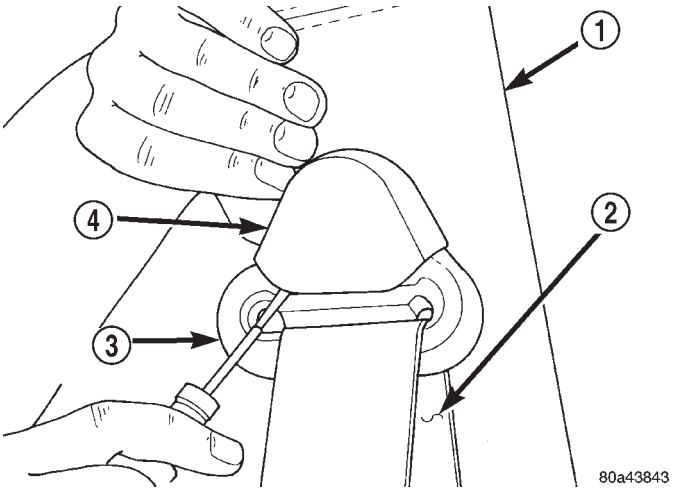


Fig. 54 Turning Loop Cover

1 – SPORT BAR
2 – REAR SHOULDER BELT
3 – TURNING LOOP
4 – TURNING LOOP COVER

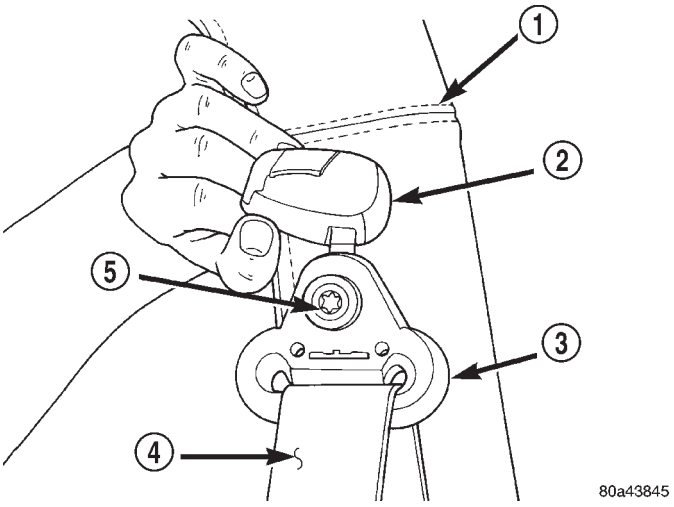


Fig. 55 Turning Loop

1 – SPORT BAR
2 – TURNING LOOP COVER
3 – TURNING LOOP
4 – REAR SHOULDER BELT
5 – ANCHOR BOLT

SEAT/LAP BELT AND RETRACTOR INSTALLATION

(1) Position the retractor on the sport bar and install the bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

(2) Position the turning loop on the sport bar and install the bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

(3) Close cover on turning loop.

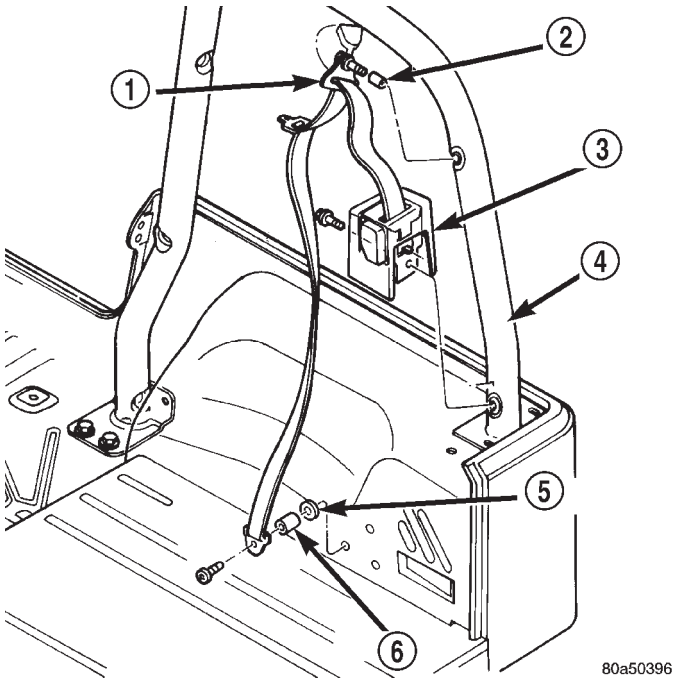


Fig. 56 Rear Belt Assembly

1 – TURNING LOOP
2 – SPACER
3 – RETRACTOR
4 – SPORT BAR
5 – WASHER
6 – SPACER

(4) Position the belt anchor on the wheelhouse and install the bolt. Tighten the bolt to 47 N·m (35 ft. lbs.) torque.

(5) Move the rear seat back to the latch position.

REAR BUCKLE REMOVAL

(1) Move the rear seat to the forward tumble position.

(2) Grasp the carpet between the buckles and lift to access the anchor bolt.

(3) Remove the anchor bolt and separate the buckle from the vehicle (Fig. 57).

REMOVAL AND INSTALLATION (Continued)

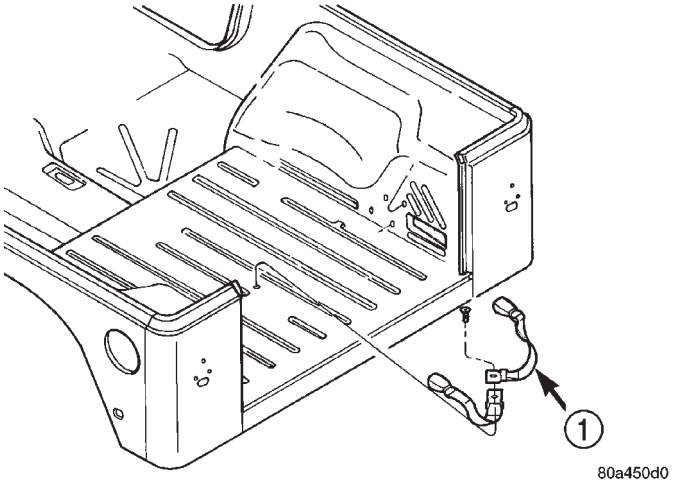


Fig. 57 Rear Buckle

1 – REAR BUCKLE

REAR BUCKLE INSTALLATION

(1) Route the buckle through the carpet and align the holes.

(2) Install the anchor bolt. Tighten the bolt to 43 N·m (32 ft. lbs.) torque.

(3) Move the rear seat back to the latch position.

BUCKET SEAT

REMOVAL

(1) Disengage seat belt electrical connector (Fig. 58).

(2) Remove the bolts attaching the seat frame to the floor panel (Fig. 59).

(3) Remove the seat from the vehicle.

INSTALLATION

(1) Position the seat in the vehicle.

(2) Install the bolts attaching the rear of seat frame to the floor panel. Tighten outboard bolt to 33 N·m (25 ft. lbs.) torque. Tighten inboard bolt to 74 N·m (55 ft. lbs.) torque.

(3) Install the bolts attaching the front of seat frame to the floor panel. Tighten bolts to 33 N·m (25 ft. lbs.) torque.

(4) Engage seat belt electrical connector.

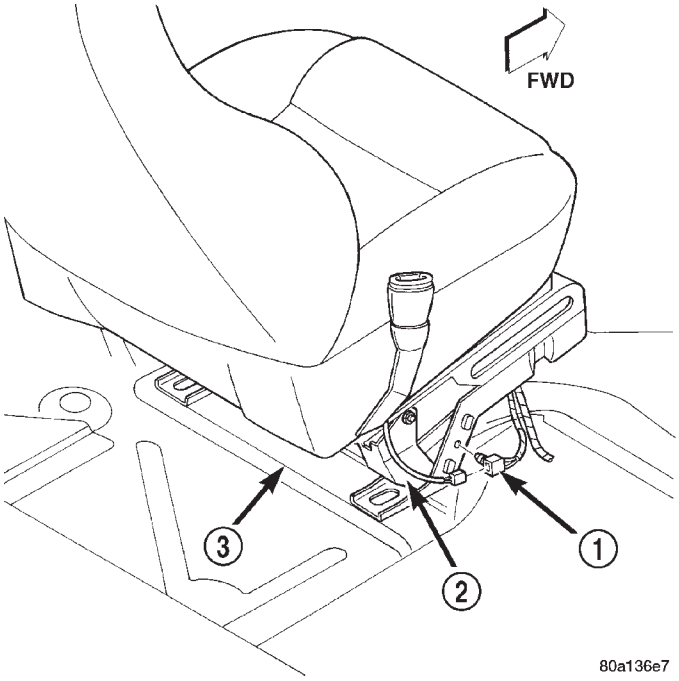


Fig. 58 Bucket Seat

1 – CONNECTOR
2 – SEAT
3 – BODY

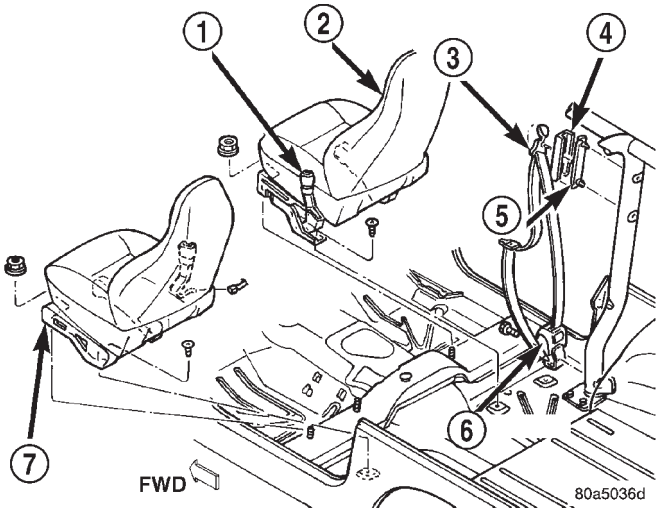


Fig. 59 Bucket Seat Removal

1 – BUCKLE
2 – SEAT
3 – TURNING LOOP
4 – COVER
5 – ADJUSTER
6 – RETRACTOR
7 – MOUNTING BRACKET

REMOVAL AND INSTALLATION (Continued)

MINI FLOOR CONSOLE

REMOVAL

(1) Move the seats to the full rearward position.
(2) Grasp shift handle (auto trans only) and firmly pull upward to remove.
(3) Using a small flat blade, pry up shift indicator bezel, disengage bezel lamp connector and remove bezel (auto trans only).
(4) Using a trim stick, pry up shift boot and remove (manual trans only).
(5) Remove the trim disc from the bottom of the cup holder.
(6) Remove the bolts attaching the console to the floor pan (Fig. 60).
(7) Shift transfer case to four low position.
(8) Lift the console upward and shift transmission to L (2nd gear for man. trans.).
(9) Remove console through the passenger door.

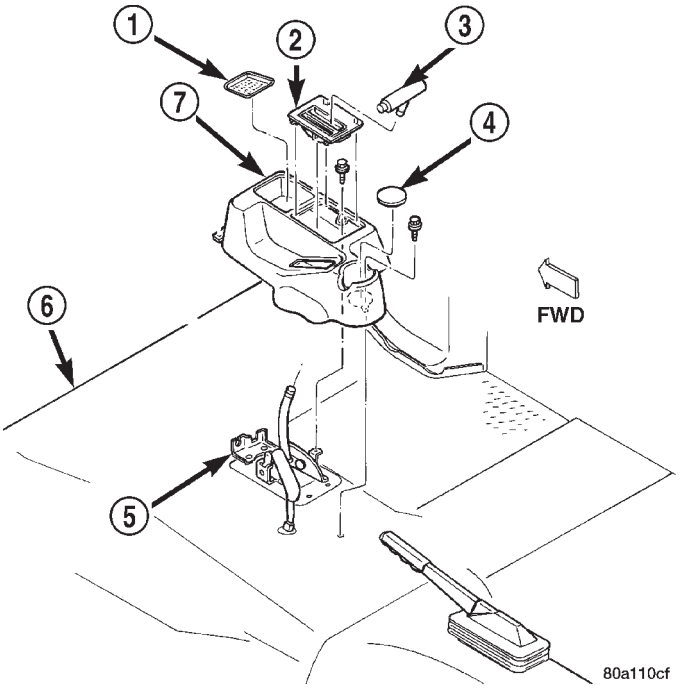


Fig. 60 Mini Floor Console

1 – MAT
2 – SHIFT BEZEL
3 – HANDLE
4 – CUP HOLDER MAT
5 – CONSOLE MOUNTING BRACKET
6 – FLOOR PAN
7 – CONSOLE

INSTALLATION

(1) Position and align the console in the vehicle.
(2) Install the bolts attaching the console to the floor pan.
(3) Install the trim disc
(4) Install shift boot/indicator bezel.
(5) Return seats to normal position.
(6) Install the shift handle.

FULL FLOOR CONSOLE

REMOVAL

(1) Move the seats to the full rearward position.
(2) Move the passenger seat in the full recline position.
(3) Grasp shift handle (auto trans only) and firmly pull upward to remove.
(4) Using a small flat blade, pry up shift indicator bezel, disengage bezel lamp connector and remove bezel (auto trans only).
(5) Using a trim stick, pry up shift boot and remove (manual trans only).
(6) Remove the bolts attaching the console to the floor pan (Fig. 61).
(7) Shift transfer case to four low position.
(8) Engage parking brake.
(9) Lift the console upward and rotate to remove through the passenger door.

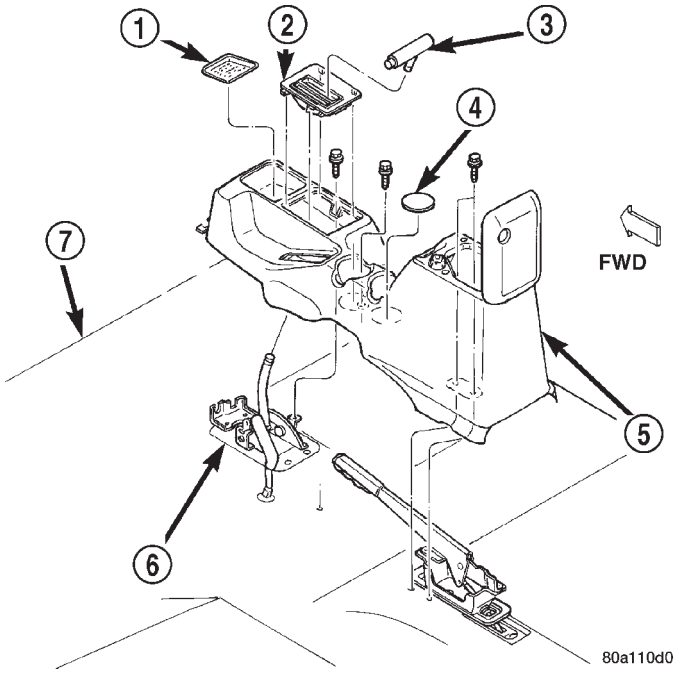


Fig. 61 Full Floor Console

1 – MAT
2 – SHIFT BEZEL
3 – HANDLE
4 – CUP HOLDER MAT
5 – CONSOLE
6 – CONSOLE MOUNTING BRACKET
7 – FLOOR PAN

INSTALLATION

(1) Position and align the console in the vehicle.

REMOVAL AND INSTALLATION (Continued)

(2) Install the bolts attaching the console to the floor pan.
(3) Install shift boot/indicator bezel.
(4) Return seats to normal position.
(5) Install the shift handle.

CONSOLE LOCK CYLINDER

REMOVAL

(1) Open the console cover.
(2) Remove the screw that attaches the retainer to the lock and then remove the retainer from the lock (Fig. 62).
(3) Remove the lock cylinder from the console cover.

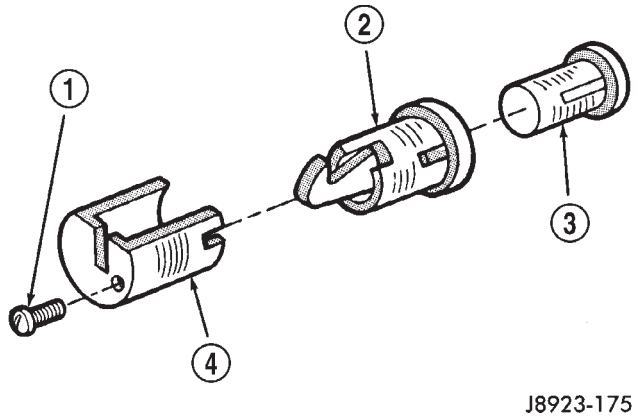


Fig. 62 Console Lock Cylinder

1 – ATTACHING SCREW
2 – LOCK
3 – LOCK CYLINDER
4 – RETAINER

INSTALLATION

(1) Insert the assembled lock in the console cover hole and position the retainer on the lock and install the screw.

SHIFT BOOT

REMOVAL

(1) Using a trim stick, pry the shift boot from the bezel.
(2) Using a small flat blade, pry the shift pattern insert from the shift knob.
(3) Remove the nut attaching the shift knob to the shift lever (Fig. 63).
(4) Remove the knob and slide the shift boot from the shift lever.

INSTALLATION

(1) Slide the shift boot over the shift lever.
(2) Position the shift knob on the lever and install the nut.

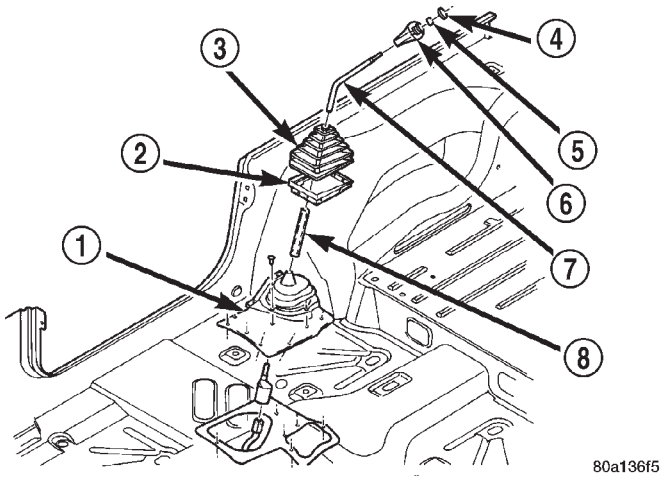


Fig. 63 Shift Boot

1 – COVER
2 – BEZEL
3 – SHIFT BOOT
4 – SHIFT PATTERN INSERT
5 – NUT
6 – KNOB
7 – SHIFT LEVER
8 – SHIFT TUBE

(3) Position the shift pattern insert on the knob and press into place.

REAR SEAT

REMOVAL

(1) Move the front seats to the full forward position.
(2) Pull on the rear seat latch to disengage the rear seat from the striker.
(3) Lift the rear seat to the forward tumble position.
(4) Remove the hitch pins from the seat frame pivot pins.
(5) Slide the seat to the left to disengage the pivot pin from the pivot bracket.
(6) Slide the seat to the right to disengage the opposite pivot pin from the pivot bracket (Fig. 64).
(7) Remove the seat through the passenger door opening.

INSTALLATION

(1) Position the seat on the rear floor panel and engage the seat frame pivot pins with the pivot brackets.
(2) Install the hitch pins on the seat frame pivot pins.
(3) Move the seat back to the latch position and engage the strikers with the latch brackets.

REMOVAL AND INSTALLATION (Continued)

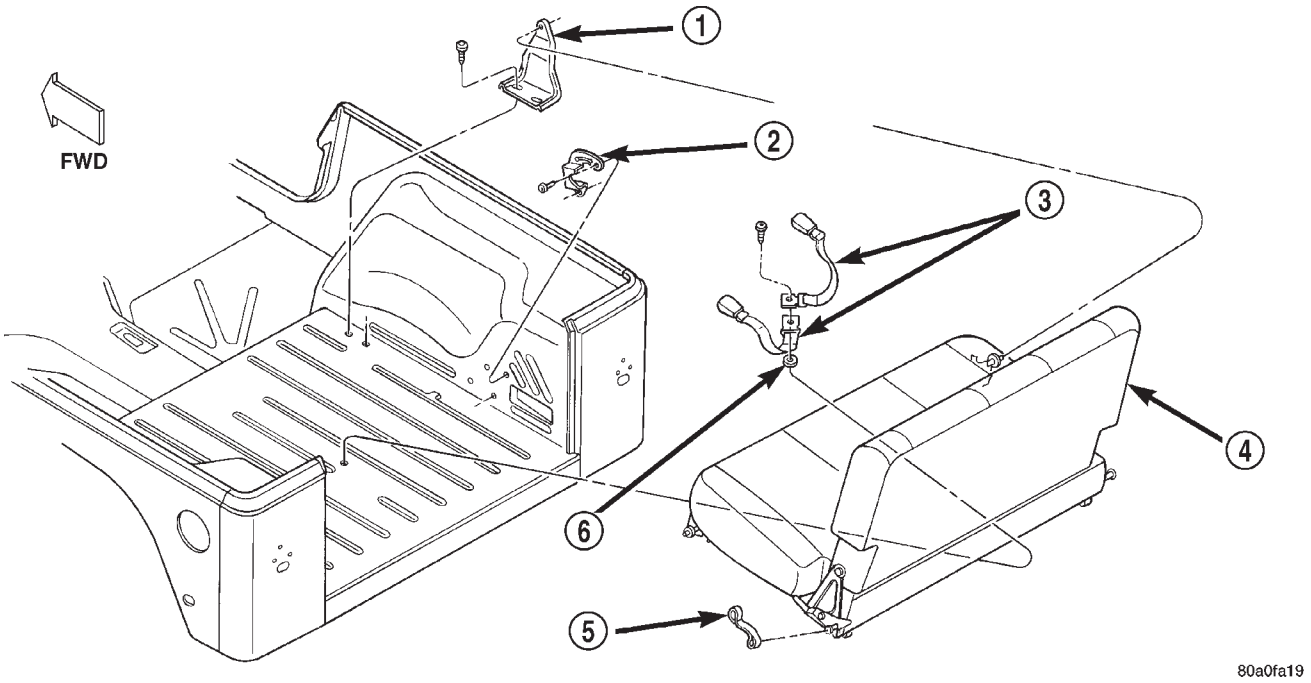


Fig. 64 Rear Seat

1 – PIVOT BRACKET
2 – SEAT LATCH STRIKER
3 – REAR BUCKLE
4 – REAR SEAT
5 – STRAP
6 – WASHER

ADD-A-TRUNK

REMOVAL

(1) Release latches under trunk panel and lift panel up.

(2) Remove bolts attaching trunk to inner body panel (Fig. 65).

(3) Separate trunk from vehicle.

INSTALLATION

(1) Position the trunk in the cargo space.

(2) Install the bolts.

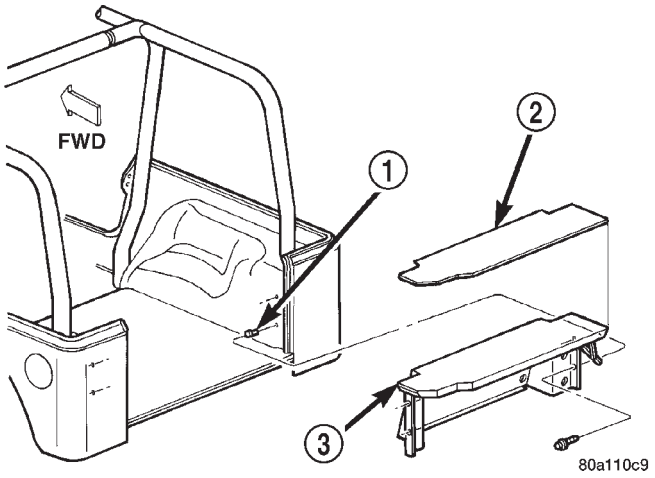


Fig. 65 Add-A-Trunk

1 – RIVET
2 – ADD-A-TRUNK CARPET
3 – ADD-A-TRUNK PANEL

REMOVAL AND INSTALLATION (Continued)

FRONT CARPET

REMOVAL

(1) Remove the screws attaching the console to the floor pan.
(2) Remove the retainers attaching the carpet to the dash panel (Fig. 66).
(3) Disengage the snaps under front seats.
(4) Remove carpet from the vehicle

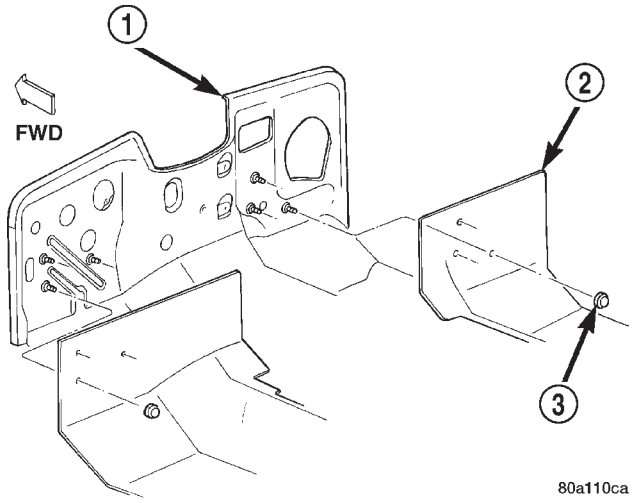


Fig. 66 Front Carpet

1 – DASH PANEL
2 – CARPET
3 – PUSH ON RETAINER

INSTALLATION

(1) Position the carpet in the vehicle
(2) Engage the snaps around under front seats.
(3) If equipped, Install the retainers attaching the carpet to the dash panel.
(4) Install the screws attaching the console to the floor pan.

CENTER CARPET

REMOVAL

(1) Disengage the snaps under front seats.
(2) Remove the carpet.

INSTALLATION

(1) Position the carpet in the vehicle.
(2) Engage the snaps under front seats.

CARGO AREA CARPET

REMOVAL

(1) Position the rear seat in the full forward position.
(2) Pull the carpet from under the rear seat.
(3) If equipped, remove the Add-A-Trunk.
(4) Route the rear seat belt buckles through the cargo area carpet.
(5) Separate the carpet from the vehicle (Fig. 67).

INSTALLATION

(1) Position the carpet in the vehicle.
(2) Route the rear seat belt buckles through the cargo area carpet.
(3) If equipped, install the Add-A-Trunk.
(4) Return the rear seat to the full rearward position.

WHEELHOUSE CARPET

REMOVAL

(1) Position the rear seat in the full forward position.
(2) If equipped, remove the Add-A-trunk.
(3) Grasp wheelhouse carpet and remove from vehicle (Fig. 67).

INSTALLATION

(1) Position wheelhouse carpet in vehicle and adjust as necessary.
(2) If equipped, install the Add-A-trunk.
(3) Return the rear seat to the full rearward position.

REMOVAL AND INSTALLATION (Continued)

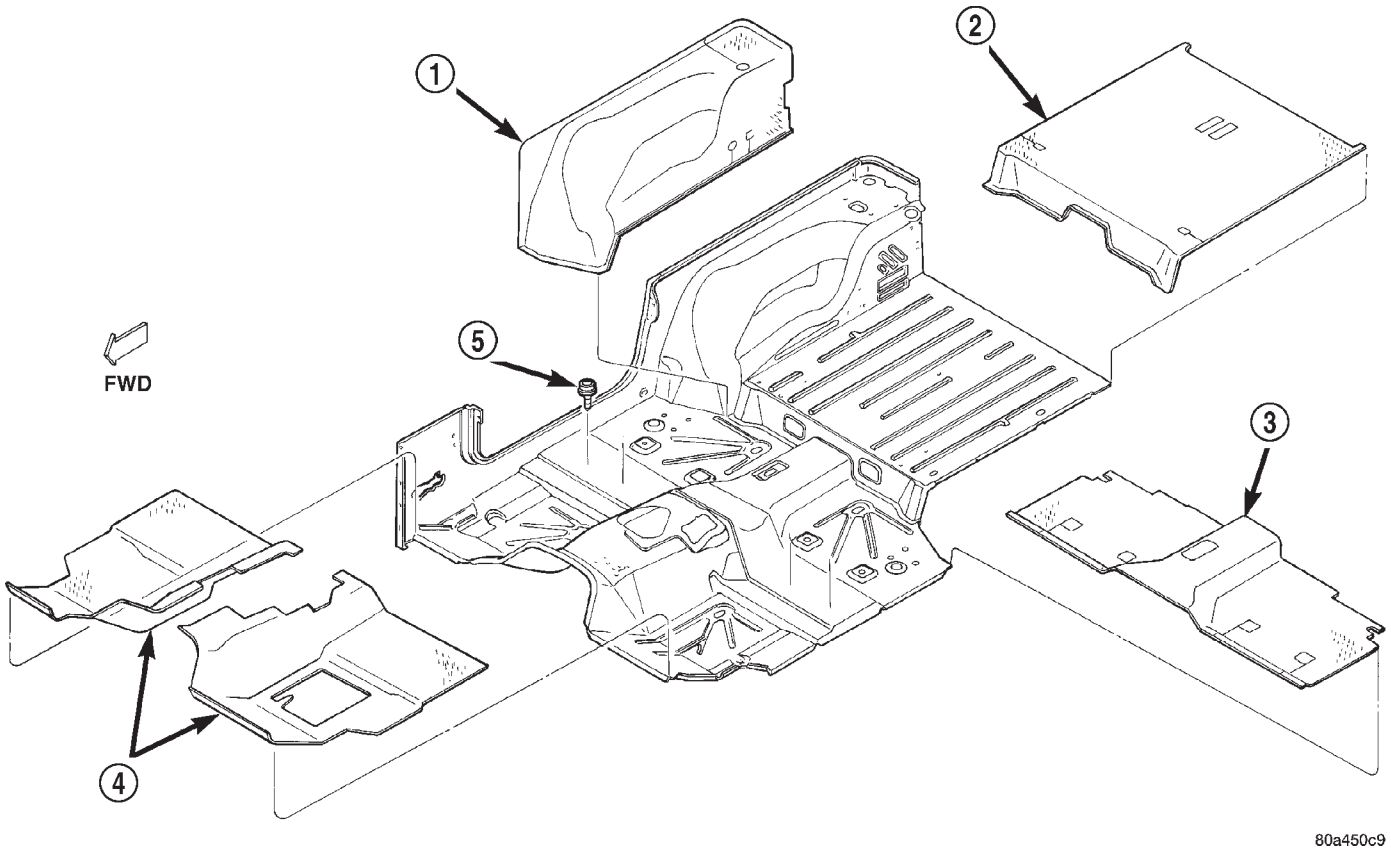


Fig. 67 Vehicle Carpet

1 – WHEEL HOUSE CARPET
2 – CARGO AREA CARPET
3 – CENTER FLOOR CARPET
4 – FRONT FLOOR CARPET
5 – SNAP

SPORT BAR

REMOVAL

(1) Remove hard top and/or soft top.
(2) Remove the door opening frames.
(3) Remove the sunvisors.
(4) Remove the A-pillar weatherstrips strips (Fig. 68).
(5) Disengage center support bar cover zipper.
(6) Remove the bolts attaching the side support bars to the center support bar (Fig. 69).
(7) Remove the bolts attaching the side support bars to the windshield frame.
(8) Separate the side support bars from the vehicle.
(9) Pull back the center section of the carpet and remove the bolts attaching the sport bar to the cargo floor panel.
(10) Lower the rear seat and lift rear seat to the full forward position.
(11) Pull back wheelhouse carpet and remove bolts attaching the directional cross bars to the wheelhouse.
(12) Remove the bolts attaching the seatbelt anchors to the wheelhouse.
(13) Disconnect sound bar. Refer to Group 8F, Audio Systems for removal and installation procedures.
(14) Carefully lift the sport bar upward and remove it from the vehicle.
(15) If necessary, remove the pads and covers from the sport bar.

INSTALLATION

(1) If necessary, transfer all attached components.
(2) Clean the base plate contact surface areas on the floor and wheelhouse panels.
(3) Apply epoxy chromate primer to the attaching hole edges for protection against corrosion.
(4) Position the sport bar base plates on the floor and wheelhouse panels with the holes aligned.

NOTE: To prevent water seepage, apply 3M Drip-Chek Sealant (or an equivalent product) to the underside of the sport bar base flanges and all the bolt heads before installation.

REMOVAL AND INSTALLATION (Continued)

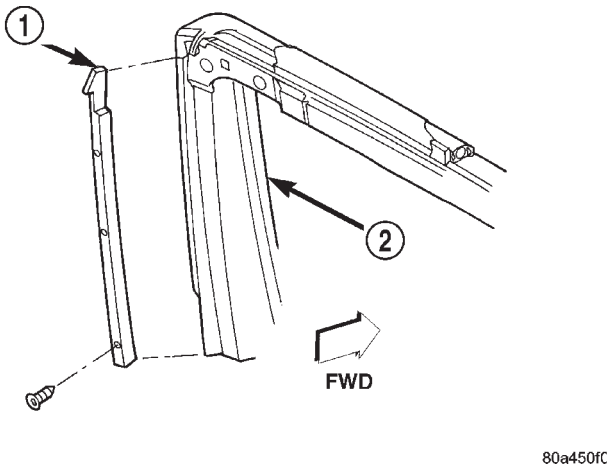


Fig. 68 A-Pillar Weatherstrip

1 – A-PILLAR WEATHERSTRIP
2 – WINDSHIELD FRAME

(5) Connect sound bar. Refer to Group 8F, Audio Systems for removal and installation procedures.

(6) Install the bolts attaching the seatbelt anchors to the wheelhouse.

(7) Install the bolts attaching the directional cross bars to the wheelhouse and install the wheelhouse carpet. Tighten the bolts to 40 N·m (30 ft. lbs.) torque.

(8) Return seat back to upright position.

(9) Install the bolts attaching the sport bar to the cargo floor panel and install the center carpet. Tighten the bolts to 40 N·m (30 ft. lbs.) torque.

(10) Position side supports at the windshield and install the bolts attaching the side support bars to the windshield frame. Tighten the bolts to 32 N·m (24 ft. lbs.) torque.

(11) Install the bolts attaching the side support bars to the center support bar. Tighten the bolts to 71 N·m (53 ft. lbs.) torque.

(12) Engage center support bar cover zipper.

(13) Install the A-pillar windshield strips.

(14) Install the door opening frames.

(15) Install hard top and/or soft top.

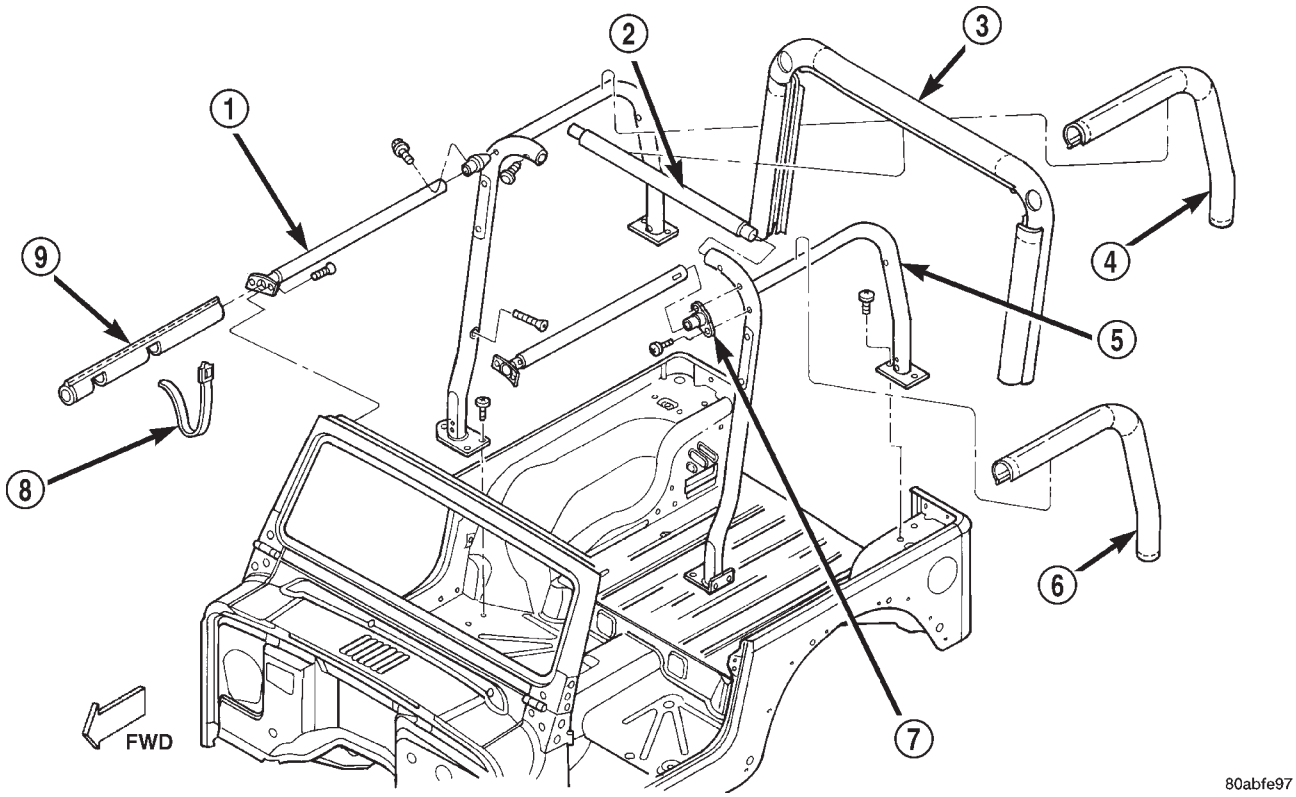


Fig. 69 Sport Bar

1 – SIDE SUPPORT BAR
2 – CENTER SUPPORT BAR
3 – COVER
4 – COVER
5 – DIRECTIONAL CROSS BAR
6 – COVER
7 – BRACKET
8 – STRAP
9 – COVER

REMOVAL AND INSTALLATION (Continued)

REAR VIEW MIRROR

REMOVAL

(1) Loosen the mirror set screw.

(2) Slide the mirror up and off the support button (bracket) (Fig. 70).

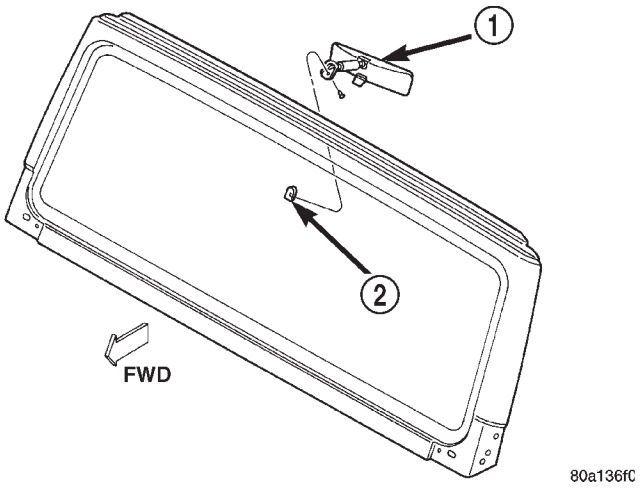


Fig. 70 Rear View Mirror

1 – REAR VIEW MIRROR
2 – SUPPORT BUTTON

INSTALLATION

(1) Slide the mirror onto the support button (bracket).

CAUTION: Do not over-tighten the setscrew because glass chipping and/or breakage could result.

(2) Tighten the mirror setscrew to 1 N·m (9 in. lbs.) torque.

REARVIEW MIRROR SUPPORT BRACKET

INSTALLATION

(1) Mark the position for the mirror bracket on the outside of the windshield glass with a wax pencil.

(2) Clean the bracket contact area on the glass. Use a mild powdered cleanser on a cloth saturated with isopropyl (rubbing) alcohol. Finally, clean the glass with a paper towel dampened with alcohol.

(3) Sand the surface on the support bracket with fine grit-sandpaper. Wipe the bracket surface clean with a paper towel.

(4) Apply accelerator to the surface on the bracket according to the following instructions:

- Crush the vial to saturate the felt applicator.
- Remove the paper sleeve.
- Apply accelerator to the contact surface on the bracket.
- Allow the accelerator to dry for five minutes.
- Do not touch the bracket contact surface after the accelerator has been applied.

(5) Apply adhesive accelerator to the bracket contact surface on the windshield glass. Allow the accelerator to dry for one minute. Do not touch the glass contact surface after the accelerator has been applied.

(6) Install the bracket according to the following instructions:

- Apply one drop of adhesive at the center of the bracket contact-surface on the windshield glass.
- Apply an even coat of adhesive to the contact surface on the bracket.
- Align the bracket with the marked position on the windshield glass.
- Press and hold the bracket in place for at least one minute.

NOTE: Verify that the mirror support bracket is correctly aligned, because the adhesive will cure rapidly.

(7) Allow the adhesive to cure for 8-10 minutes. Remove any excess adhesive with an alcohol-dampened cloth.

(8) Allow the adhesive to cure for an additional 8-10 minutes before installing the mirror.

SUNVISOR

REMOVAL

(1) Remove the screws that attach the sunvisor arm support brackets to the windshield frame (Fig. 71).

(2) Remove the sunvisor from the windshield frame

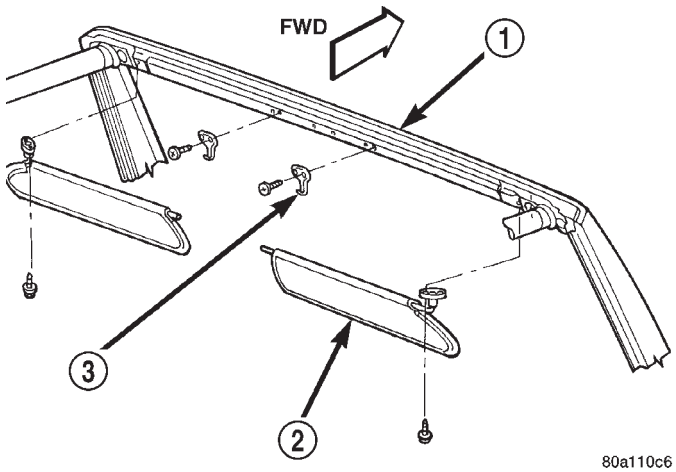


Fig. 71 Sunvisor

1 – WINDSHIELD FRAME
2 – SUNVISOR
3 – SUNVISOR SUPPORT

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position the sunvisor on the windshield frame and align the arm support bracket holes with the frame.

(2) Install the screws that attach the sunvisor arm support brackets to the frame. Tighten the screws securely.

WHEELHOUSE SPLASH SHIELD

REMOVAL

(1) Remove the plastic push pins that attach the splash shield to the wheelhouse (Fig. 72).

(2) Remove the push-in fasteners attaching the splash shield to the wheelhouse. (The push-in fasteners are molded into the splash shield.)

(3) Remove the splash shield from the wheelhouse.

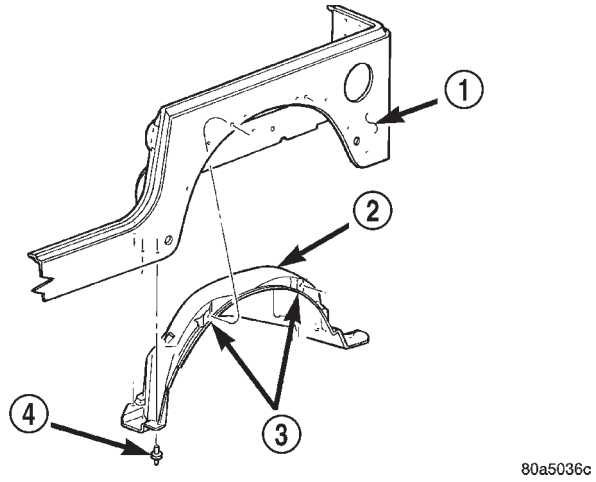


Fig. 72 Wheelhouse Splash Shield

1 – BODY
2 – WHEELHOUSE SPLASH SHIELD
3 – PUSH-IN FASTENERS
4 – RIVET

INSTALLATION

(1) Position the splash shield in the wheelhouse.

(2) Press the splash shield push-in fasteners into place.

(3) Attach the splash shield to the wheelhouse with push pins.

LIFTGATE GLASS SUPPORT CYLINDER

REMOVAL

WARNING: DO NOT REMOVE THE LIFTGATE SUPPORT RODS WITH THE LIFTGATE CLOSED. THE SUPPORT ROD PISTONS ARE OPERATED BY HIGH PRESSURE GAS AND COULD CAUSE PERSONAL INJURY AND/OR VEHICLE DAMAGE IF THEY ARE REMOVED WITH THE PISTONS COMPRESSED (LIFTGATE CLOSED). ONCE REMOVED, DO NOT ATTEMPT TO DISASSEMBLE OR REPAIR THE SUPPORT RODS.

(1) Open and support the liftgate glass.

(2) Remove the support rod cylinder retaining clips at both ends of each support rod cylinder (Fig. 73).

(3) Pull the support rods off the ball studs (Fig. 74).

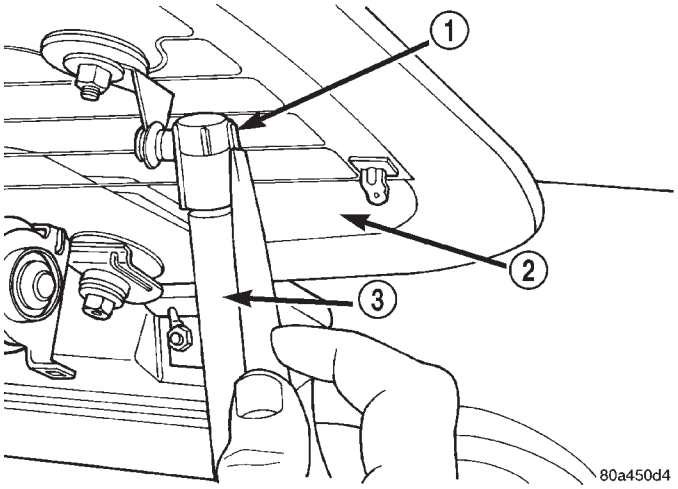


Fig. 73 Support Rod Cylinder

1 – CLIP
2 – LIFTGATE GLASS
3 – SUPPORT CYLINDER

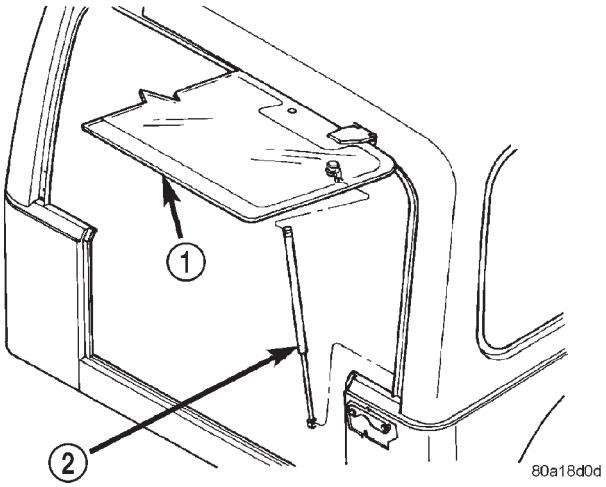


Fig. 74 Support Rod Cylinder Removal

1 – REAR WINDOW LIFT GLASS
2 – SUPPORT CYLINDER

INSTALLATION

(1) Position the support rod cylinders on the ball studs.

(2) Install the support rod cylinder retainer clips.

REMOVAL AND INSTALLATION (Continued)

LIFTGATE GLASS

REMOVAL

(1) If equipped, disconnect the rear defroster harness connectors (Fig. 75).

(2) If equipped, disconnect the wiper motor harness connectors.

WARNING: DO NOT REMOVE THE LIFTGATE SUPPORT RODS WITH THE LIFTGATE CLOSED. THE SUPPORT ROD PISTONS ARE OPERATED BY HIGH PRESSURE GAS AND COULD CAUSE PERSONAL INJURY AND/OR VEHICLE DAMAGE IF THEY ARE REMOVED WITH THE PISTONS COMPRESSED (LIFTGATE CLOSED). ONCE REMOVED, DO NOT ATTEMPT TO DISASSEMBLE OR REPAIR THE SUPPORT RODS.

(3) Open the tailgate and liftgate.

(4) Remove support rod cylinders.

(5) Remove the bolts attaching the liftgate hinge to the hardtop (Fig. 76).

(6) Separate the liftgate glass from the hard top.

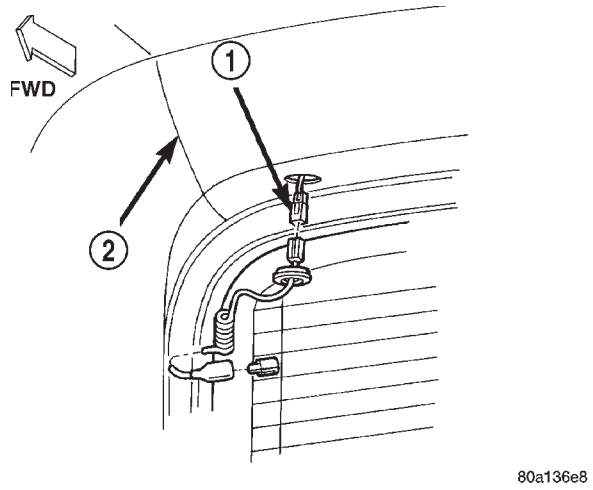


Fig. 75 Rear Defroster Connectors

1 – CONNECTOR
2 – HARD TOP

INSTALLATION

Transfer all related components

(1) If removed, install support rod ball studs. Tighten the nut to 12 N·m (112 in. lbs.) torque.

(2) Position the liftgate glass at the hard top.

(3) Install the bolts attaching the liftgate hinge to the hardtop. Tighten the bolts to 10 N·m (95 in. lbs.) torque.

(4) Position the support rod cylinders on the ball studs and install the clips.

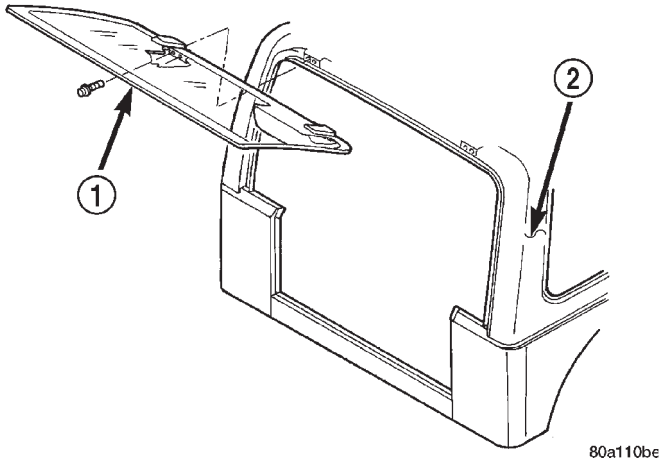


Fig. 76 Liftgate Glass

1 – LIFTGATE REAR WINDOW
2 – HARD TOP

LIFTGATE GLASS HINGE

REMOVAL

(1) Open tailgate.

(2) Open and support liftgate glass.

(3) Remove wiper motor cover (right hinge only).

(4) Remove the nut attaching the liftgate hinge to the liftgate glass.

(5) Mark the position of the hinge in the top and remove the bolts attaching the hinge to the top (Fig. 77).

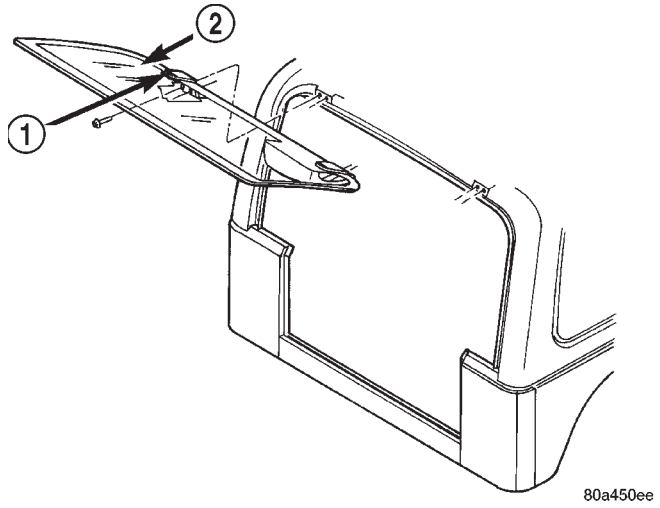


Fig. 77 Liftgate Hinge

1 – LIFTGATE HINGE
2 – LIFTGATE GLASS

INSTALLATION

(1) Align and position the hinge on the top and install the bolts.

REMOVAL AND INSTALLATION (Continued)

(2) Install the nut attaching the liftgate hinge to the liftgate glass. Tighten the nut to 6 N·m (53 in. lbs.) torque.

(3) If removed, install wiper motor cover.

LIFTGATE GLASS WEATHERSTRIP

The liftgate glass weatherstrip is attached to the liftgate glass and is not serviceable. If the liftgate glass weatherstrip needs to be replaced, replace the liftgate glass.

SPARE TIRE CARRIER

REMOVAL

(1) Remove the spare tire from the wheel bracket (Fig. 78).

(2) Remove the bolts that attach the tire bracket to the tailgate (Fig. 79).

(3) Disconnect CHMSL.

(4) Remove the bracket and the gaskets from the tailgate.

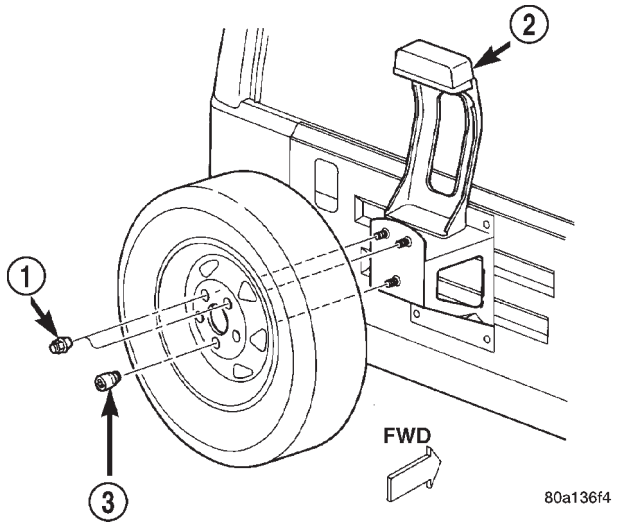


Fig. 78 Spare Tire

1 – WHEEL NUT
2 – CHMSL
3 – LOCK NUT

INSTALLATION

(1) Position the gaskets and the tire bracket on the tailgate and install the bolts. Tighten the bolts to 24 N·m (17 ft. lbs.) torque.

(2) Connect CHMSL connector.

(3) Install the spare tire on the tire bracket.

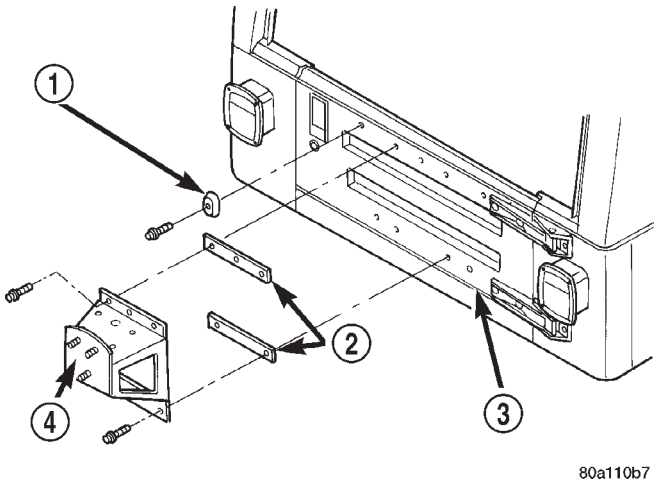


Fig. 79 Spare Tire Bracket

1 – BUMPER
2 – GASKET
3 – TAILGATE
4 – SPARE TIRE BRACKET

LICENSE PLATE BRACKET

REMOVAL

(1) If installed, remove the license plate.

(2) Remove the screws attaching the license plate bracket to the body (Fig. 80).

(3) Separate the bracket from the body.

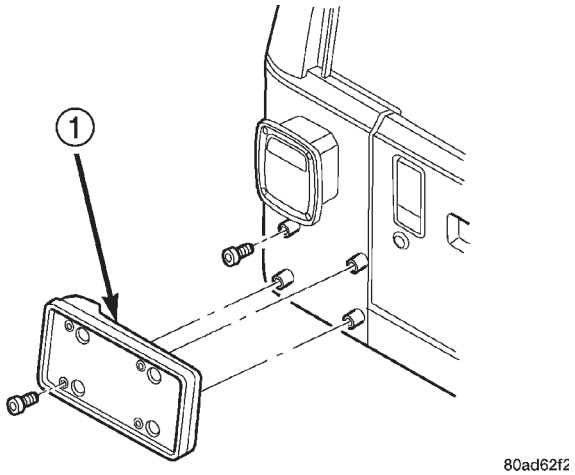


Fig. 80 License Plate Bracket

1 – LICENSE PLATE BRACKET

INSTALLATION

(1) Position the bracket on the body.

(2) Install the screws attaching the license plate bracket to the body.

(3) If removed, install the license plate.

REMOVAL AND INSTALLATION (Continued)

TAILGATE

REMOVAL

(1) Remove the spare tire.
(2) Open the tailgate and remove the CHMSL contact cover (Fig. 81).
(3) Disengage the CHMSL electrical connectors.
(4) Remove the screws that attach the tailgate hinge to the tailgate.
(5) Separate the tailgate from the vehicle.

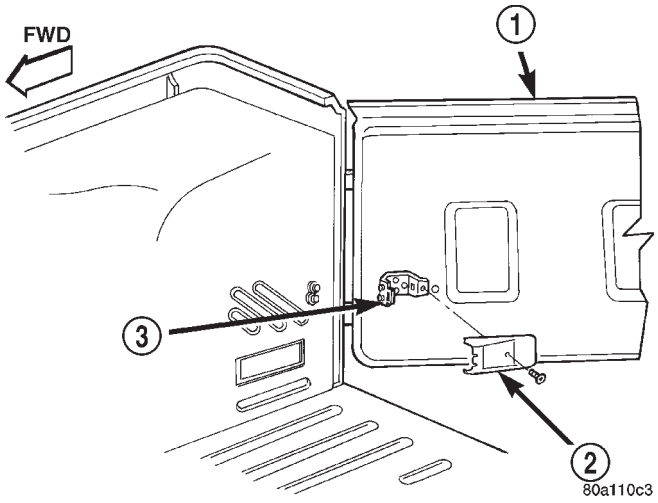


Fig. 81 CHMSL Contact Cover

1 – TAILGATE
2 – COVER
3 – CHMSL CONTACT COVER BRACKET

INSTALLATION

If necessary, transfer tailgate related components.
(1) Install the screws that attach the tailgate hinge to the tailgate.
(2) Engage the CHMSL electrical connectors.
(3) Install the CHMSL contact cover.
(4) Close the tailgate and install the spare tire.

TAILGATE HINGE

Hinges may be serviced individually. If both are to be serviced, remove/install hinges one at a time.

REMOVAL

(1) Using a wax pencil, mark the position of the hinge on the body.
(2) Remove the screws attaching the hinge to the body and tailgate (Fig. 82).
(3) Separate the hinge from the tailgate.

INSTALLATION

(1) Prepare and paint the replacement hinge to match the body paint color.
(2) Lubricate the hinge with spray lubricant.

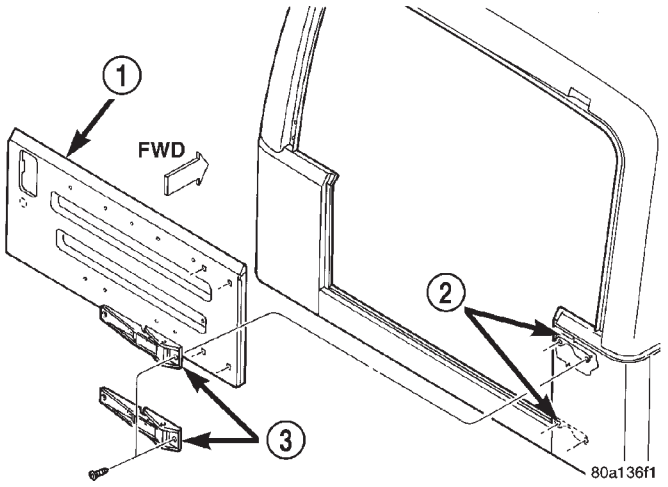


Fig. 82 Tailgate Hinge

1 – TAILGATE
2 – NUT PLATE
3 – HINGE

(3) Align and position the hinge on the body and tailgate.
(4) Install the screws. Tighten the screws to 23 N·m (200 in. lbs.) torque

TAILGATE OUTSIDE HANDLE

REMOVAL

(1) Remove the latch from the tailgate.
(2) Remove the screws attaching the outside handle to the tailgate (Fig. 83).
(3) Separate the outside handle and seal from the tailgate.

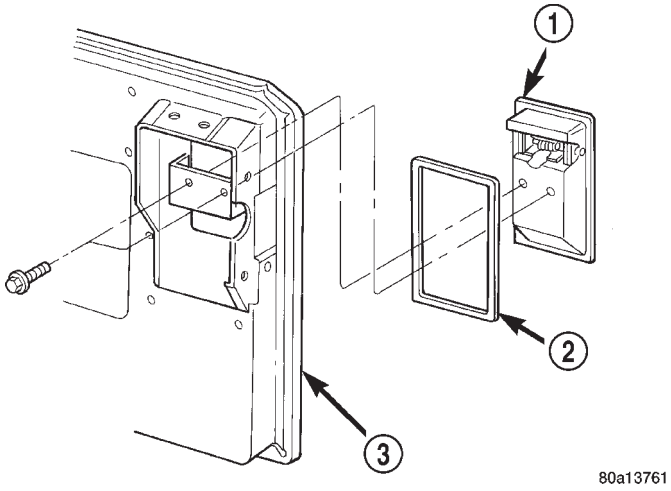


Fig. 83 Tailgate Outside Handle

1 – OUTSIDE HANDLE
2 – SEAL
3 – TAILGATE

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position the seal and outside release handle on the tailgate. and install screws.
(2) Install the screws attaching the outside handle to the tailgate.
(3) Install the latch.

TAILGATE LOCK CYLINDER

REMOVAL

(1) Open the tailgate.
(2) Remove the latch cover.
(3) Remove the lock cylinder retainer clip.
Remove the lock cylinder from the tailgate opening.

INSTALLATION

(1) Position the lock cylinder in the tailgate opening.
(2) Connect the lock cylinder to latch rod.
(3) Install the lock cylinder retainer clip.
(4) Install the latch cover.

TAILGATE LATCH

REMOVAL

(1) Open the tailgate and remove the latch trim cover (Fig. 84).
(2) Disconnect the outside handle to latch rod.
(3) Disconnect the lock cylinder to latch rod.
(4) Remove the screw attaching latch to tailgate.
(5) Separate the latch from the tailgate.

INSTALLATION

(1) Position the latch in the tailgate.
(2) Install the screw attaching latch to tailgate. Do not tighten screw.
(3) Connect the lock cylinder to latch rod.
(4) Connect the outside handle to latch rod.
(5) Install the latch trim cover. Tighten all screws.

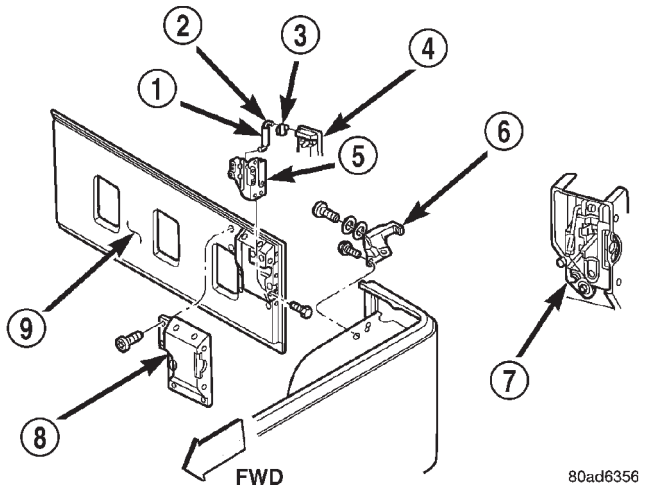


Fig. 84 Tailgate Latch Cover

1 – SLEEVE
2 – OUTSIDE HANDLE TO LATCH ROD
3 – CLIP
4 – OUTSIDE HANDLE
5 – LATCH
6 – STRIKER MOUNTING BRACKET
7 – LATCH TO LOCK CYLINDER ROD
8 – LATCH COVER
9 – TAILGATE

TAILGATE LATCH STRIKER

REMOVAL

(1) Remove the striker from the bracket with a Torx bit.
(2) Remove the shim washers from the bracket.
(3) Remove the screws attaching the striker bracket to the body.

INSTALLATION

(1) Position the striker bracket on the body and install the screws.
(2) Position the striker and shim washers on the striker bracket.
(3) Install the striker in the bracket with a Torx bit. Tighten the striker to 71 N·m (52 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

TAILGATE WEATHERSTRIP AND CHANNEL

REMOVAL

(1) Open the tailgate.
(2) Remove the push-in fasteners attaching the weatherstrip to the top corners of the tailgate (Fig. 85).
(3) Peel the weatherstrip from the upper tailgate corners.
(4) Slide the weatherstrip out of the tailgate.
(5) If the weatherstrip channel requires replacement, peel the weatherstrip channel from the tailgate.

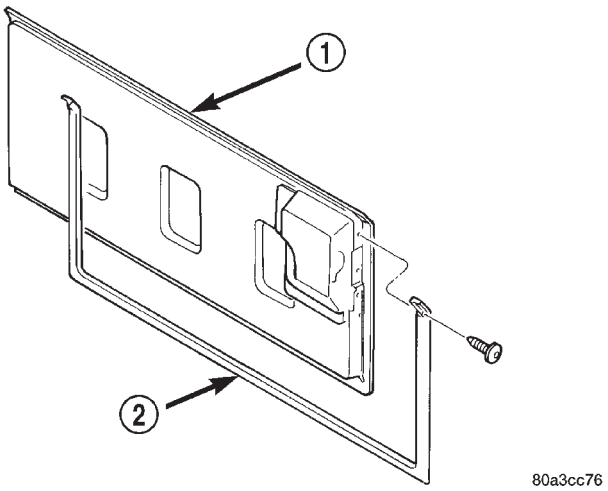


Fig. 85 Tailgate Weatherstrip

1 – TAILGATE
2 – WEATHERSTRIP

INSTALLATION

(1) If the weatherstrip channel is being replaced;
(a) Clean the channel contact surface on the tailgate with isopropyl alcohol, or equivalent.
(b) Peel the paper backing from the weatherstrip channel.
(c) Position weatherstrip channel to the tailgate and press into place.
(d) Use hand pressure or a roller to wet out the tape adhesive holding the weatherstrip channel to the tailgate.
(2) Slide the weatherstrip into the weatherstrip channel.
(3) Clean the weatherstrip contact surface on the tailgate with isopropyl alcohol, or equivalent.
(4) Remove paper backing from upper ends of weatherstrip.
(5) Position the weatherstrip to the tailgate and press it into place.
(6) Install the push-in fasteners attaching the weatherstrip to the tailgate.
(7) Use hand pressure or a roller to wet out the tape adhesive holding the weatherstrip to the tailgate.

ADJUSTMENTS

HOOD ADJUSTMENT

The hood hinge screw holes are oversized to facilitate hood adjustment movement.
(1) Loosen the screws.
(2) Move the hood in the direction(s) required for correct alignment.
(3) Tighten the screws.

DOOR ADJUSTMENT

The doors are adjusted at the hinge attaching locations on either the body or the door. Enlarged holes are located in the body (lower hinge only) for fore, aft and tilt adjustments. Enlarged holes are also located in the door (upper and lower hinges) for up, down, fore, aft and tilt adjustments.

Prior to door adjustment or alignment, the door latch must be removed to allow the door to close freely and be properly aligned.

The door latch striker should be adjusted in or out to allow the door latch to be fully engaged. The door should be flush with the adjacent body panels.

TAILGATE ADJUSTMENT

(1) Loosen the tailgate hinge-to-body screws.
(2) Align the tailgate in the body opening and tighten the hinge screws.

SPECIFICATIONS

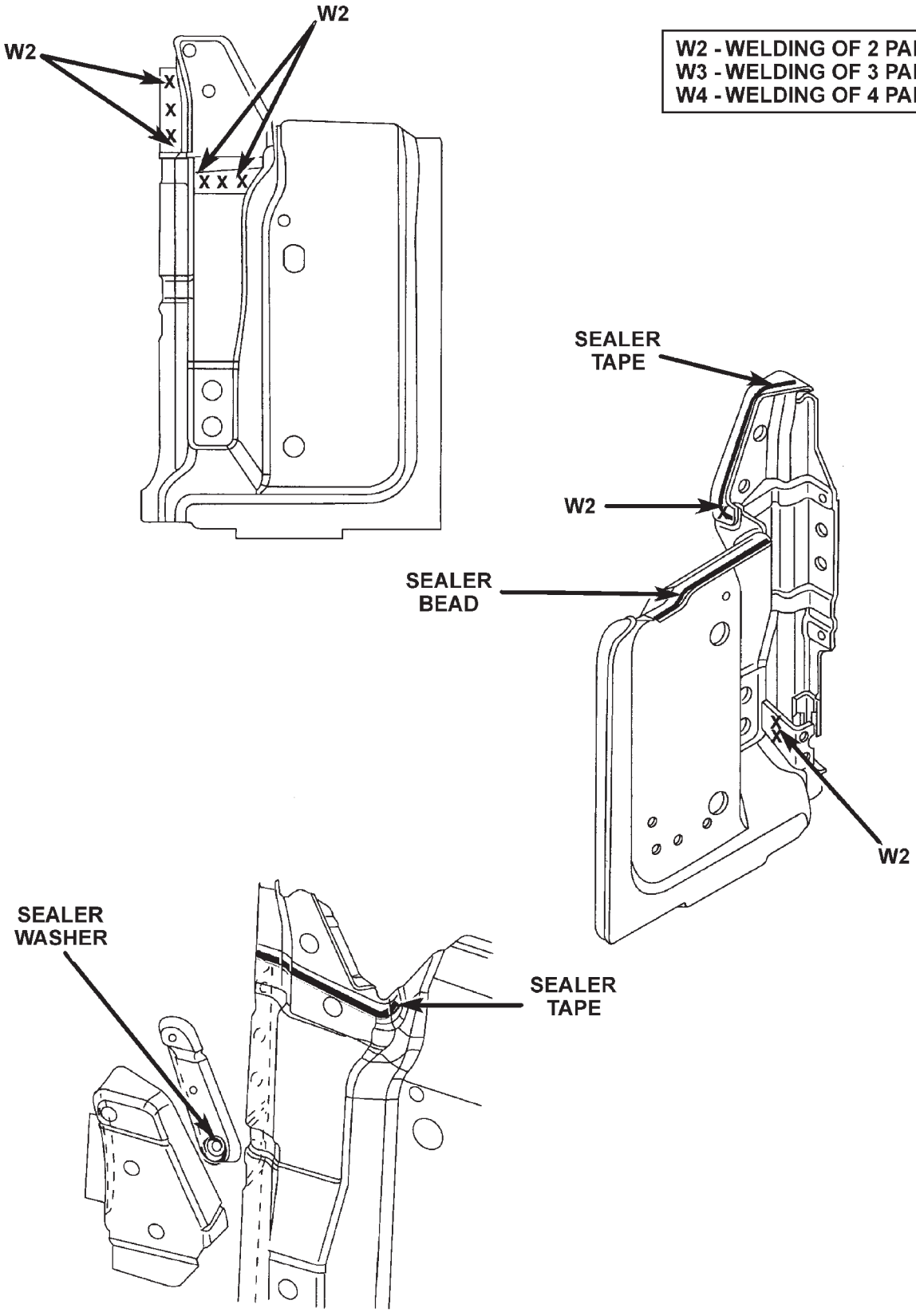
BODY LUBRICANTS

COMPONENT	SERVICE INTERVAL	LUBRICANT
Door Latches	As Required	Multi-Purpose Grease NLGI GC-LB (Water Resistant) (1)
Hood Latch, Release Mechanism & Safety Latch	As Required (When Performing Other Underhood Service)	Multi-Purpose Grease NLGI GC-LB 2 EP (2)
Hood Hinges	As Required	Engine Oil
Seat Track & Release Mechanism	As Required	Multi-Purpose Grease NLGI GC-LB 2 EP (2)
Tailgate Hinge	As Required	Multi-Purpose Grease NLGI GC-LB 2 EP (2)
Liftgate Support Arms	As Required	Engine Oil
Tailgate Latches	As Required	White Spray Lubricant (3)
Tailgate Release Handle	As Required	Multi-Purpose Grease NLGI GC-LB 2 EP (2)
Window System Components	As Required	White Spray Lubricant (3)
Lock Cylinders	Twice A Year	Lock Cylinder Lubricant (4)
Parking Brake Mechanism	As Required	Multi-Purpose Grease NLGI GC-LB 2 EP (1)
1 = Mopar Wheel Bering Grease (High Temp) 2 = Mopar Multi-Mileage Lubricant 3 = Mopar Spray White Lube 4 = Mopar Lock Cylinder Lubricant		

SPECIFICATIONS (Continued)

WELD LOCATIONS

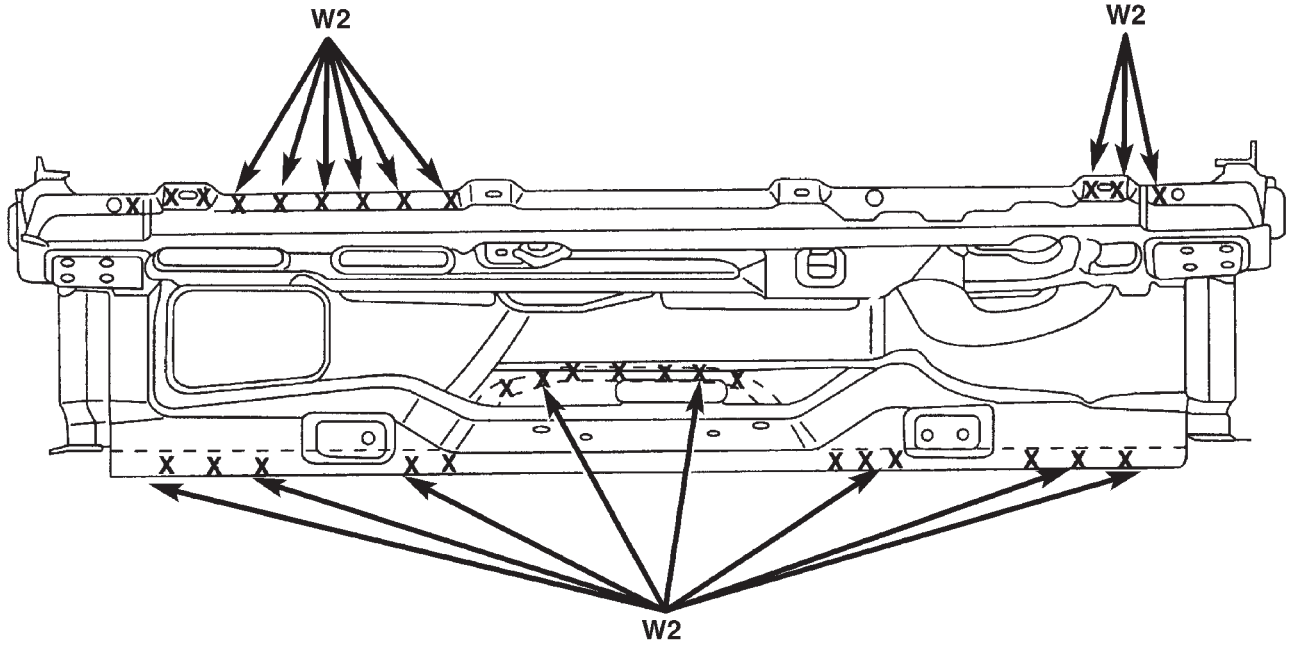
DASH, COWL AND PLENUM



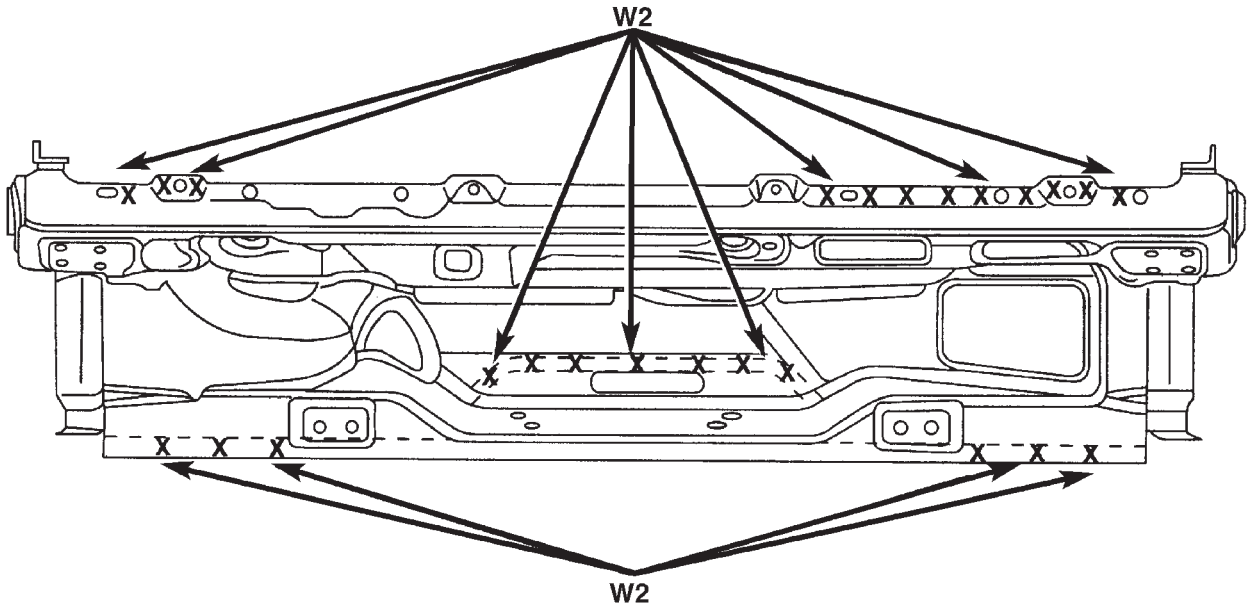
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SPECIFICATIONS (Continued)

DASH, COWL AND PLENUM



LEFT HAND DRIVE



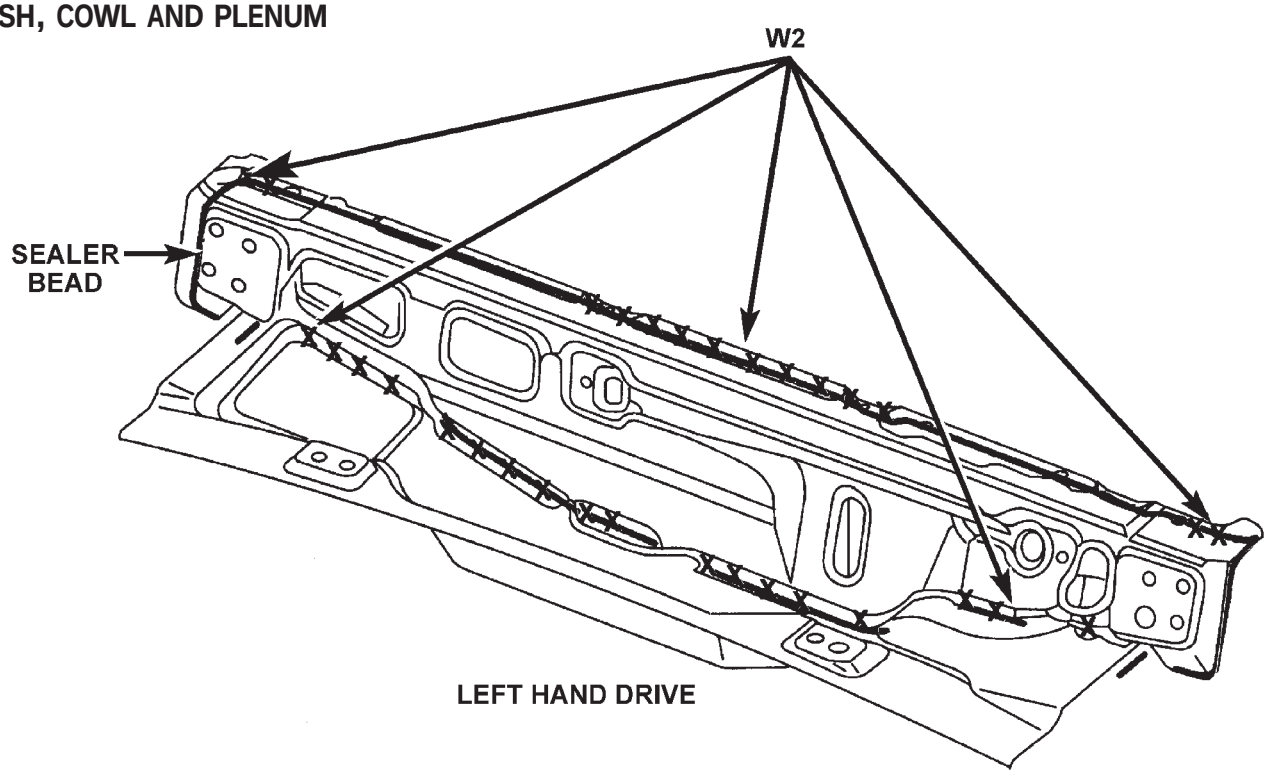
RIGHT HAND DRIVE

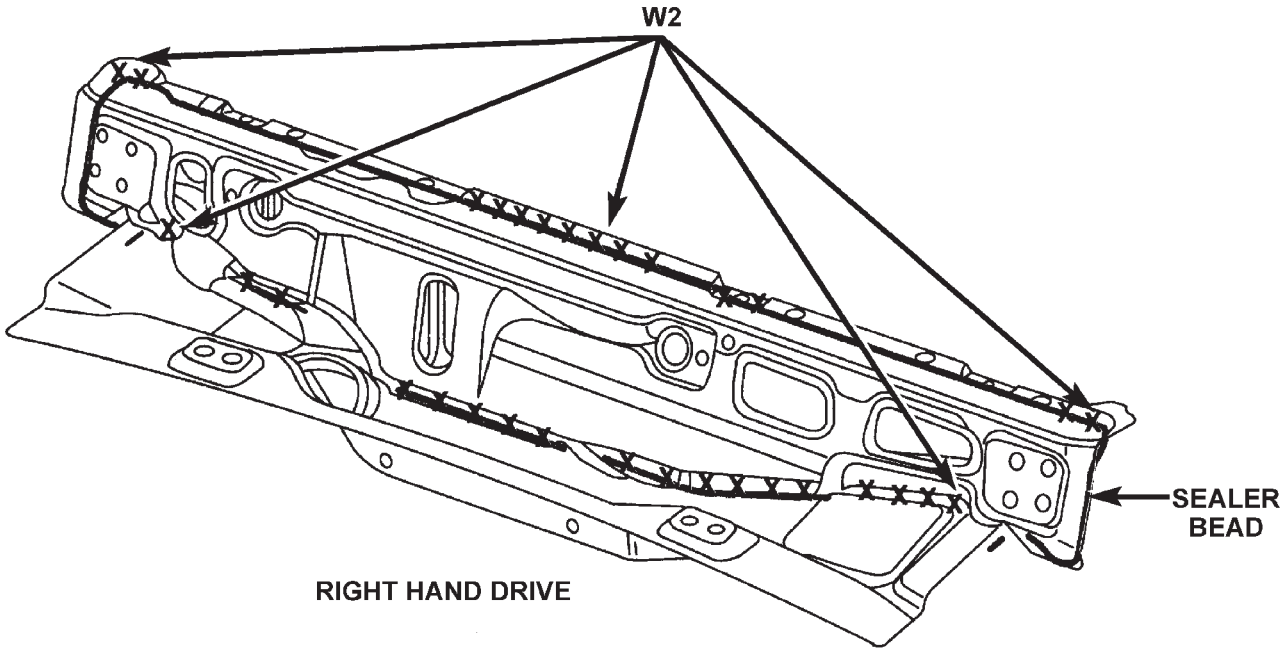
W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

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SPECIFICATIONS (Continued)

DASH, COWL AND PLENUM



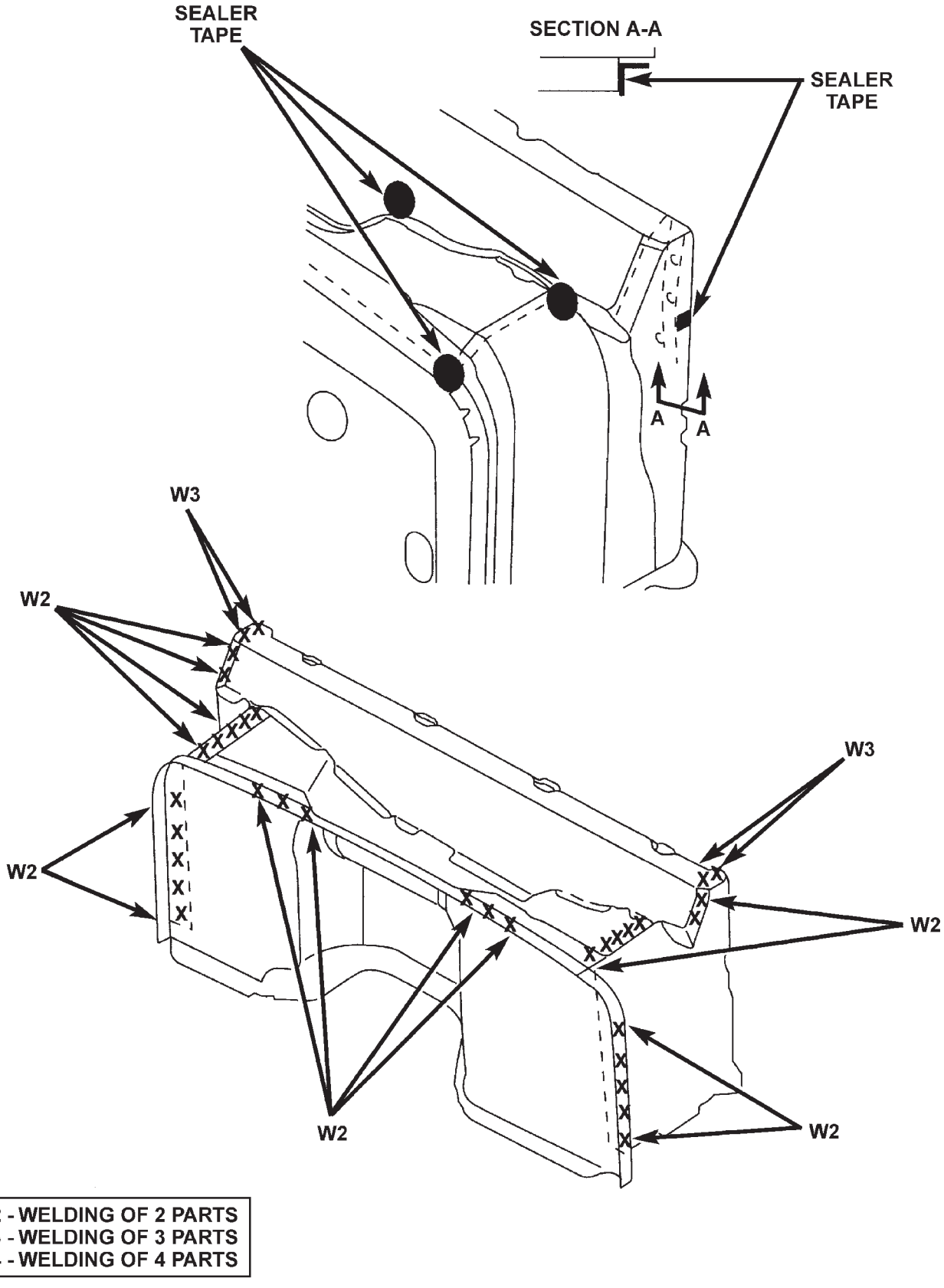


W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

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SPECIFICATIONS (Continued)

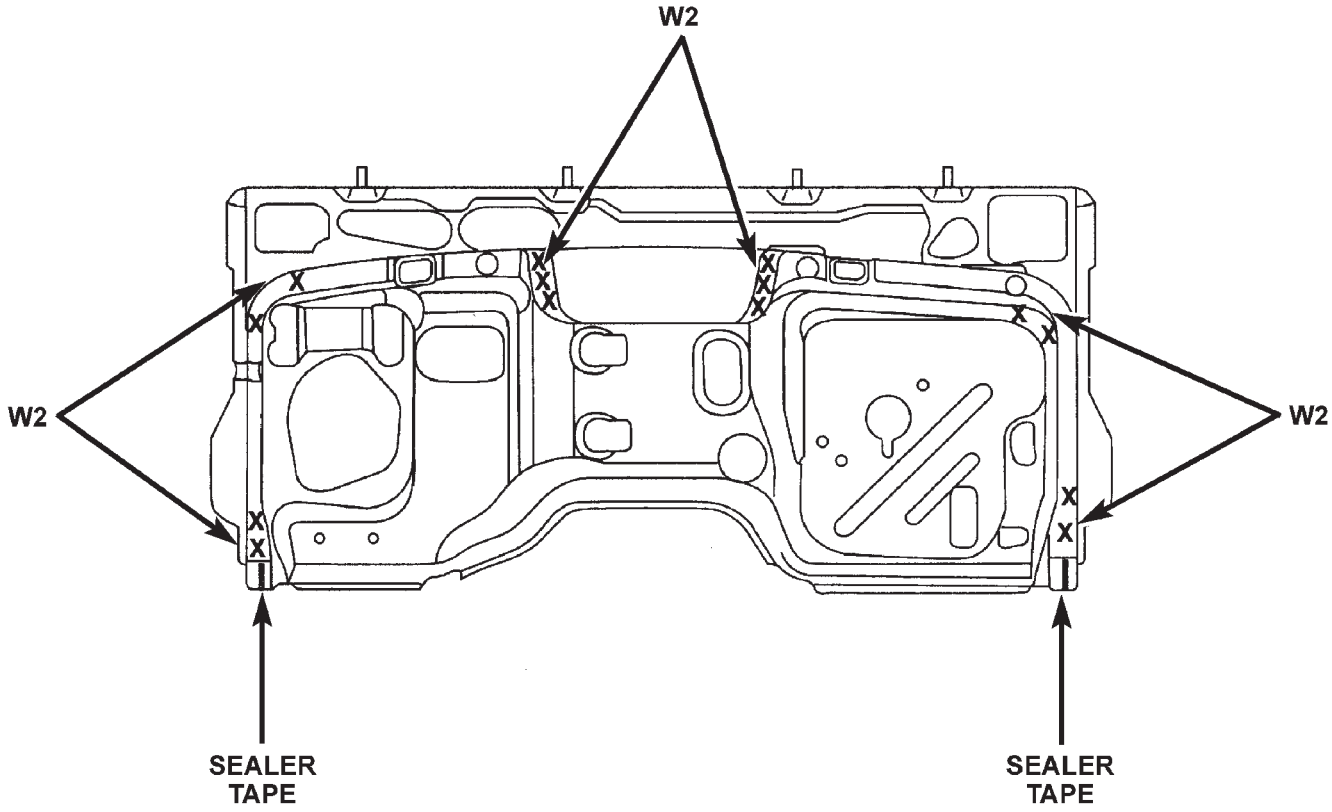
DASH, COWL AND PLENUM

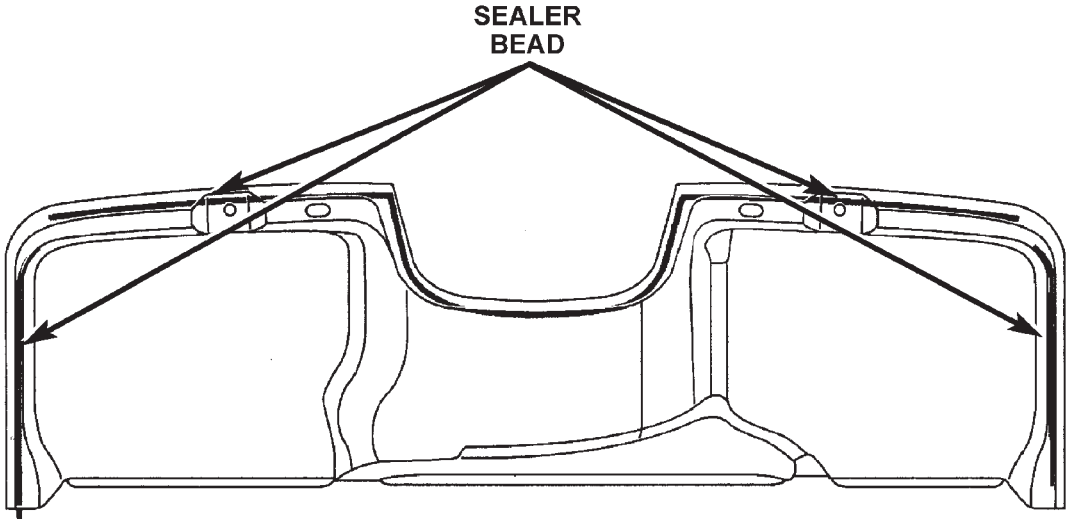


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SPECIFICATIONS (Continued)

DASH, COWL AND PLENUM



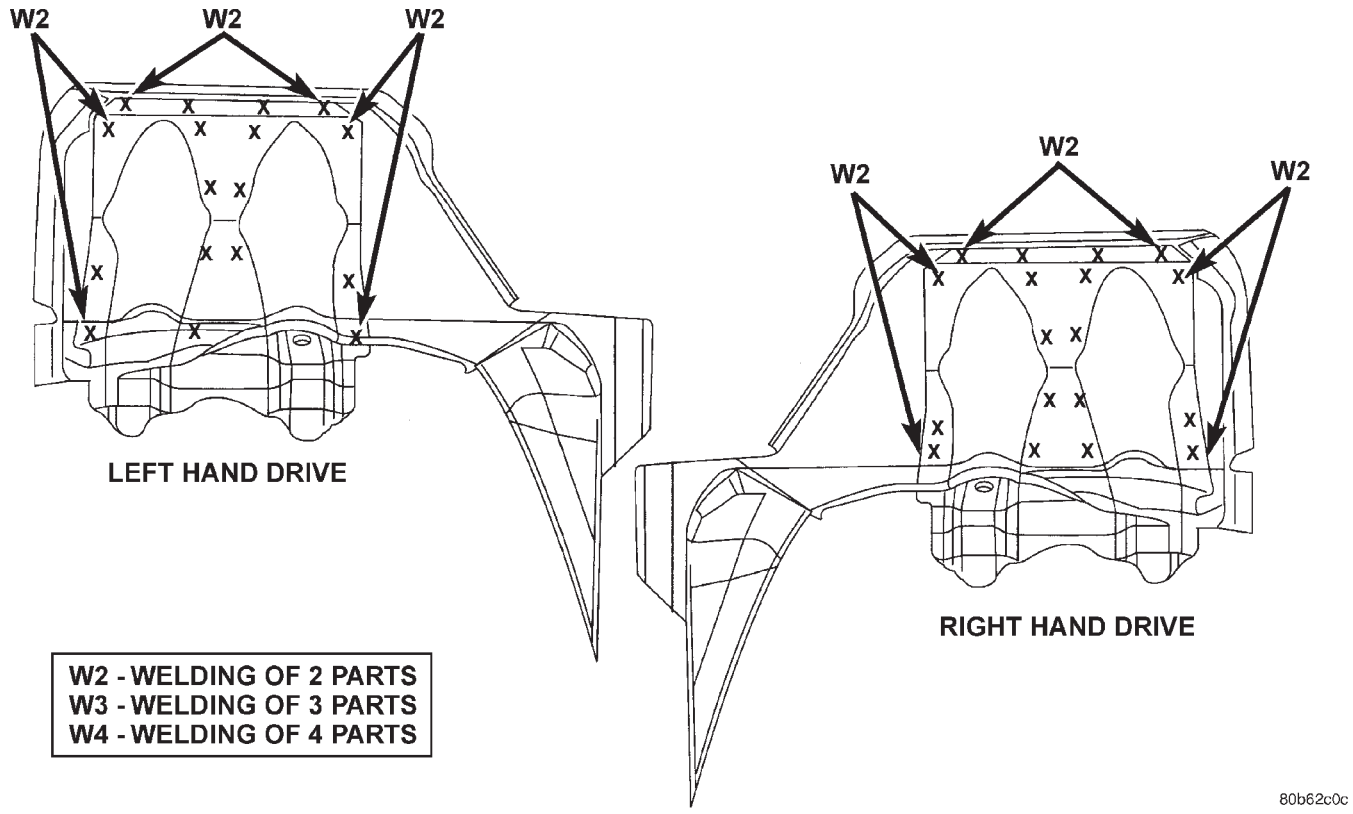


W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

80b62c0b

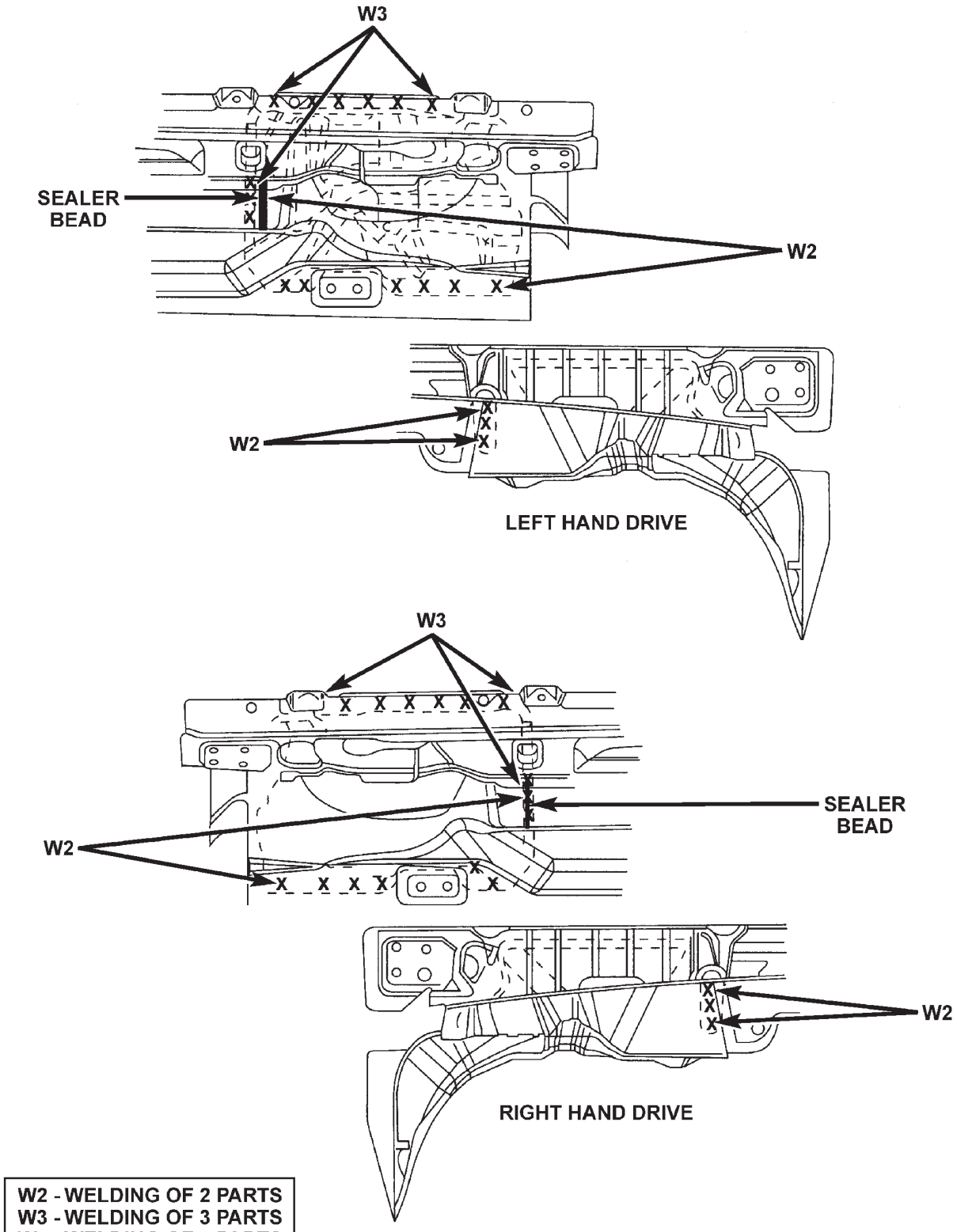
SPECIFICATIONS (Continued)

DASH, COWL AND PLENUM SUPPORTS AND REINFORCEMENTS



SPECIFICATIONS (Continued)

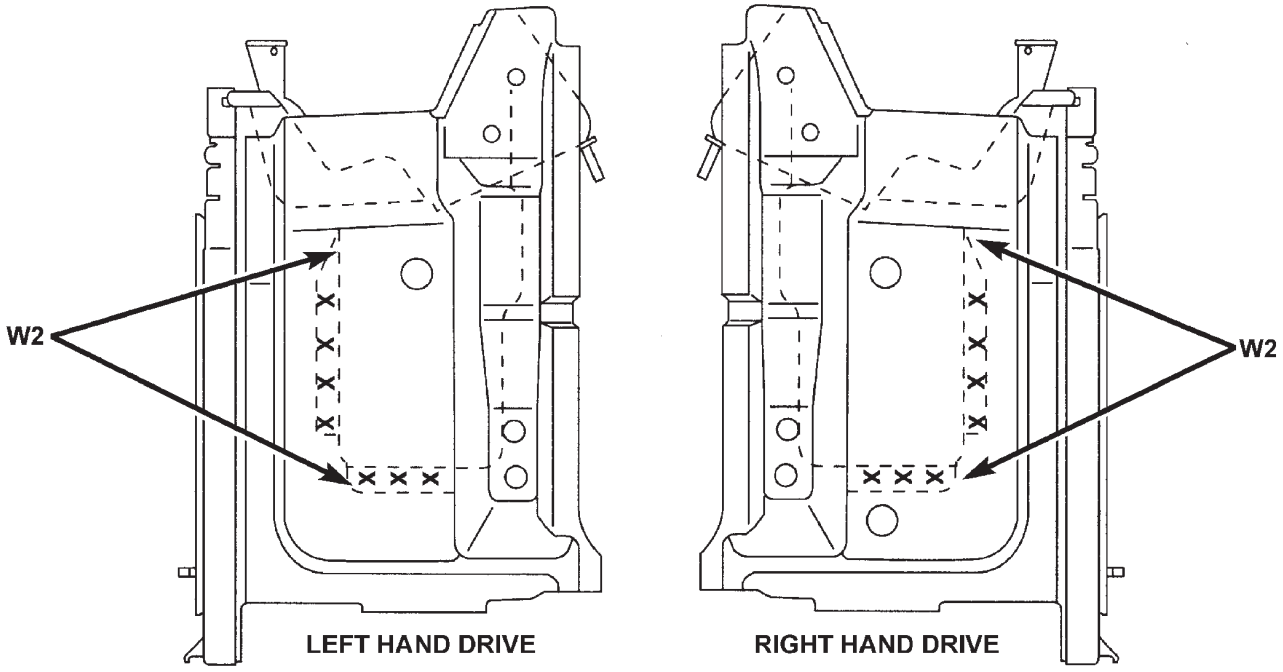
DASH, COWL AND PLENUM SUPPORTS AND REINFORCEMENTS

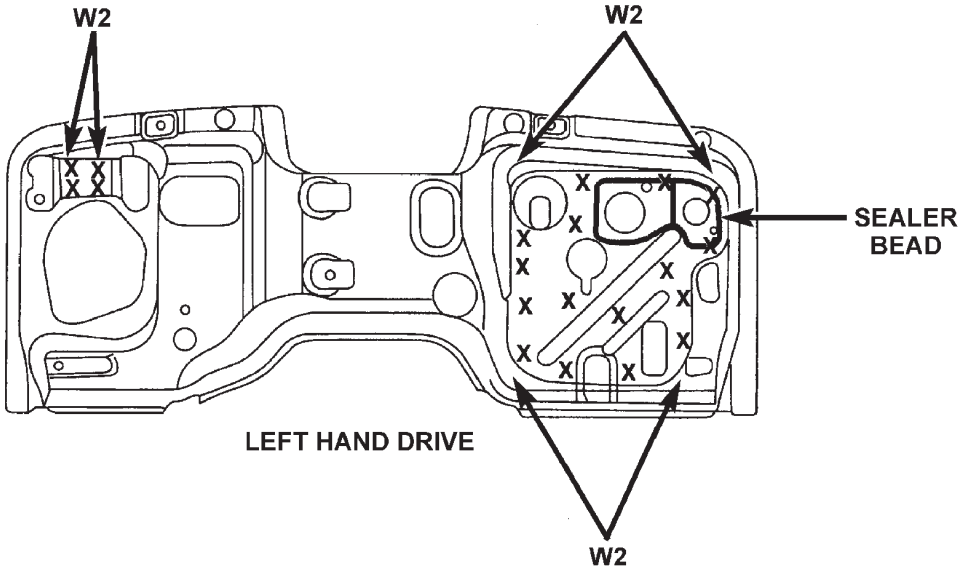


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SPECIFICATIONS (Continued)

DASH, COWL AND PLENUM SUPPORTS AND REINFORCEMENTS



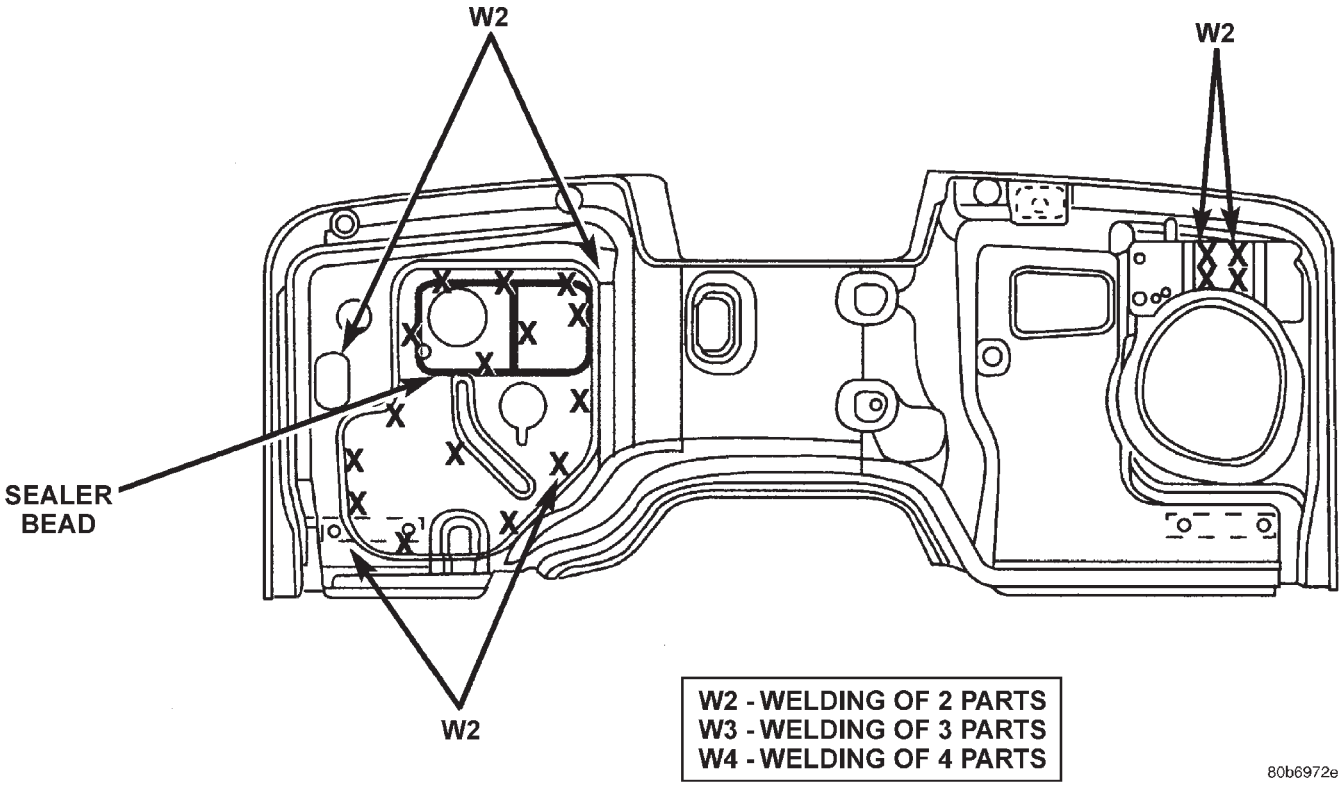


W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

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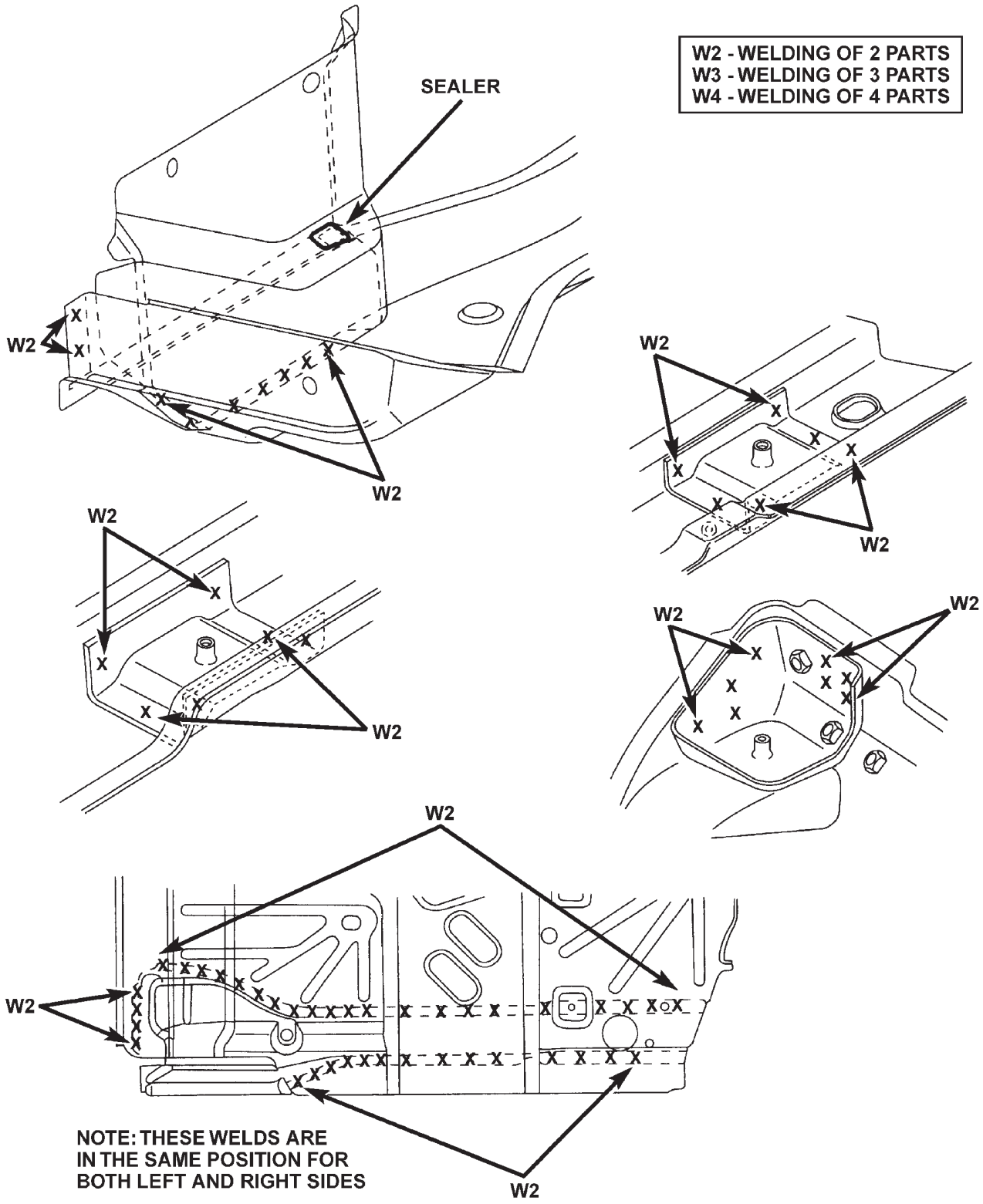
SPECIFICATIONS (Continued)

DASH, COWL AND PLENUM SUPPORTS AND REINFORCEMENTS



SPECIFICATIONS (Continued)

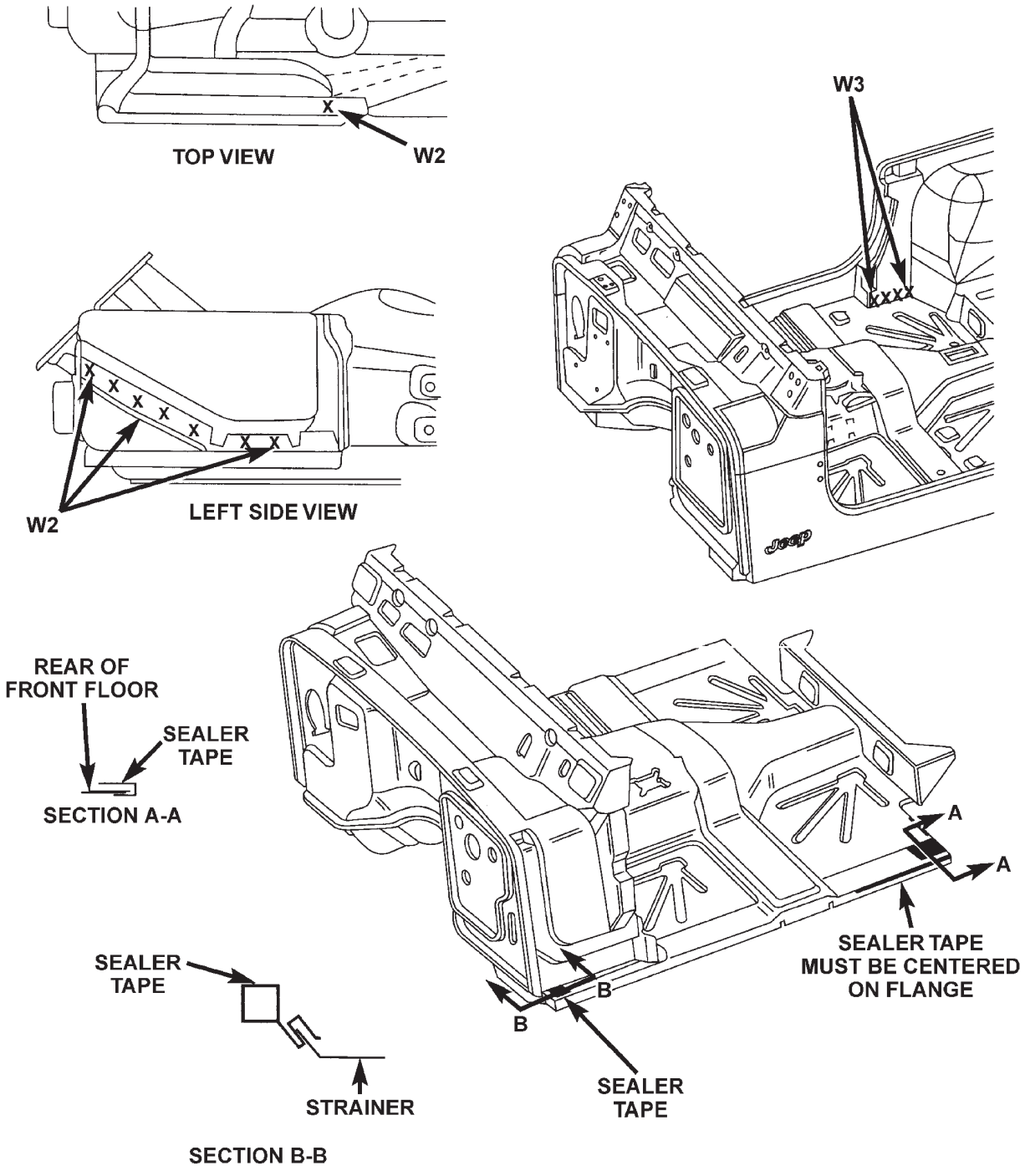
FRONT FLOOR, STRAINER, REINFORCEMENT AND COWL SIDE LOWER



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SPECIFICATIONS (Continued)

FRONT FLOOR, STRAINER, REINFORCEMENT AND COWL SIDE LOWER

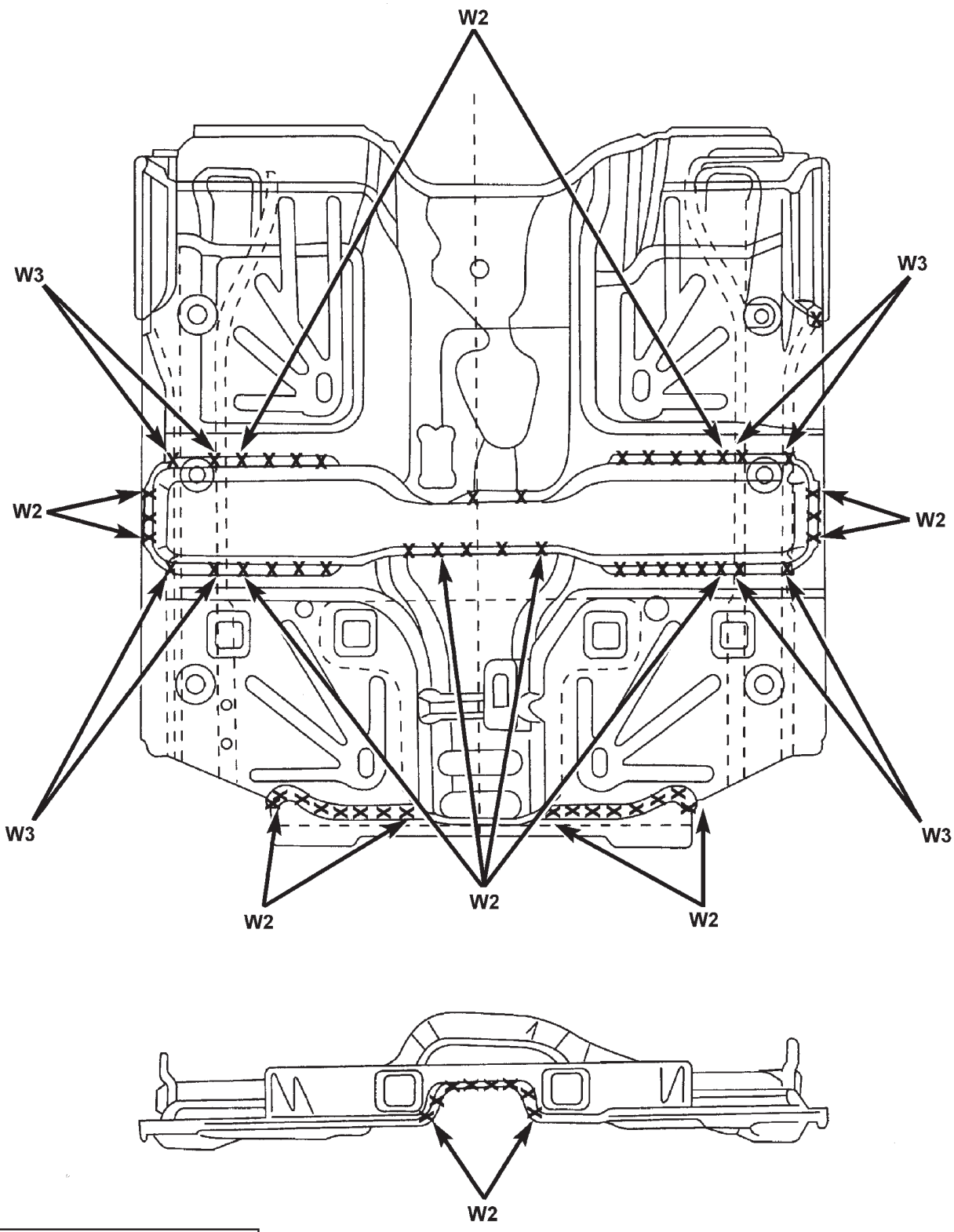


W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

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SPECIFICATIONS (Continued)

FRONT FLOOR, STRAINER, REINFORCEMENT AND COWL SIDE LOWER



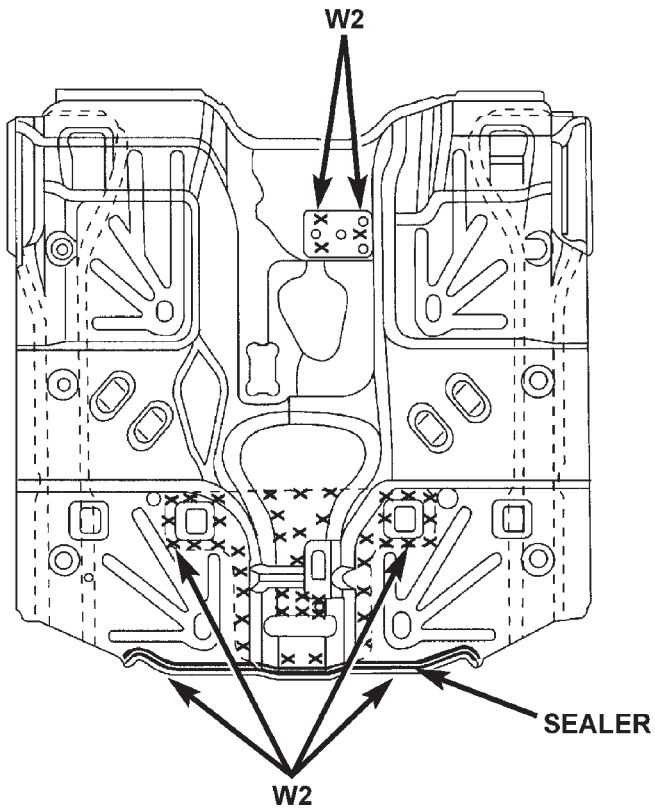
REAR VIEW

W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

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SPECIFICATIONS (Continued)

FRONT FLOOR, STRAINER, REINFORCEMENT AND COWL SIDE LOWER



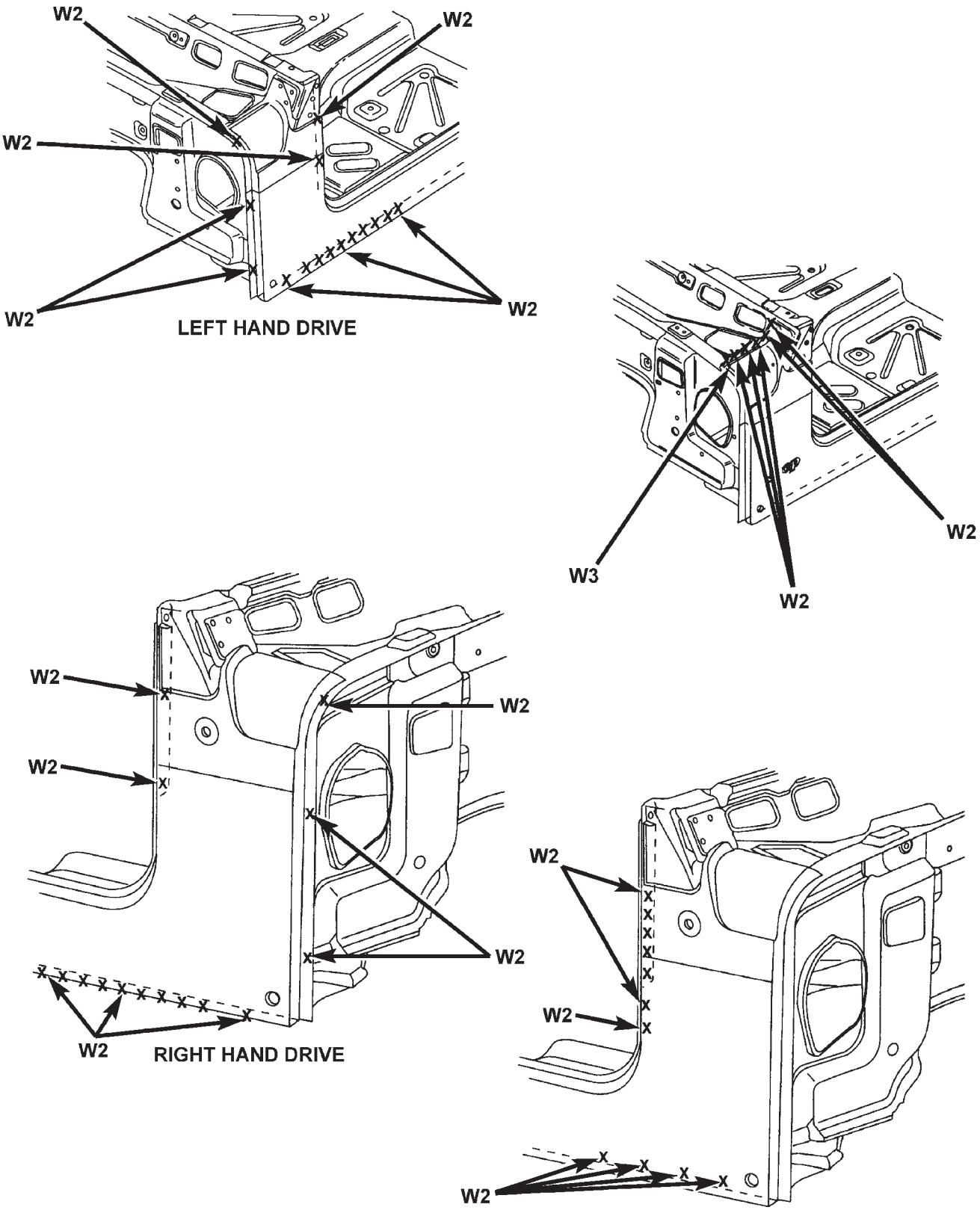
TOP VIEW

W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

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SPECIFICATIONS (Continued)

SIDE APERTURE

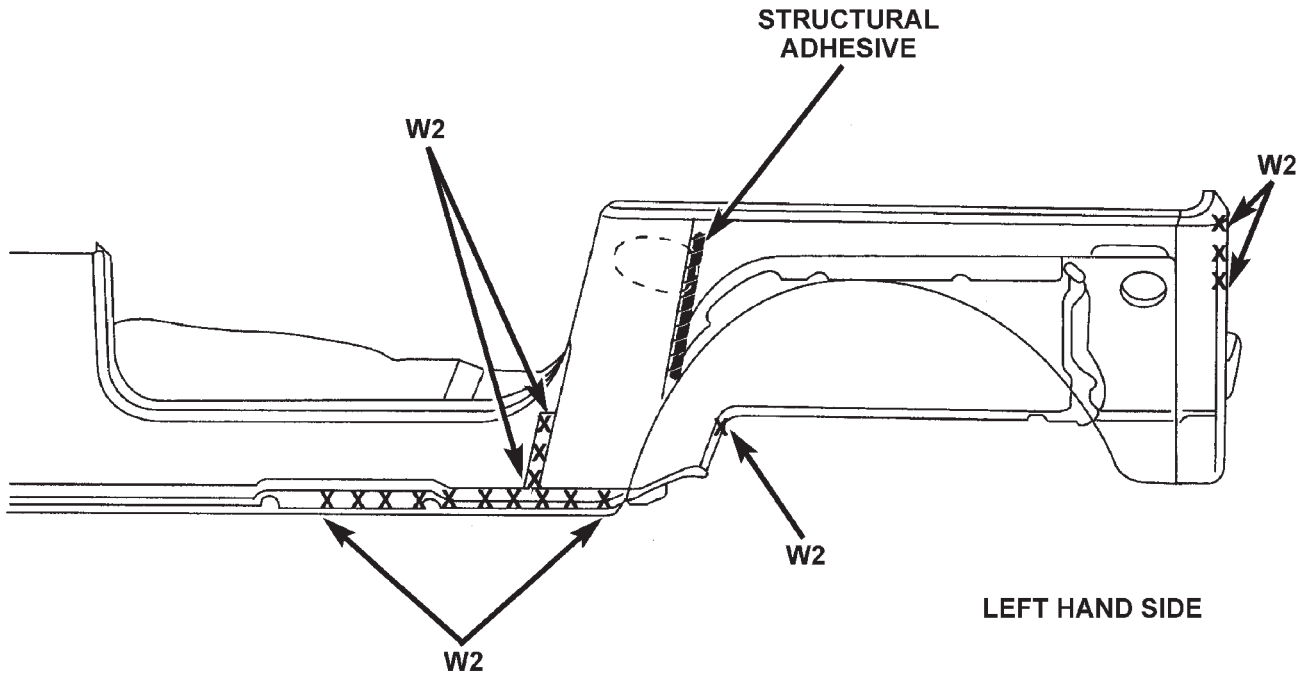


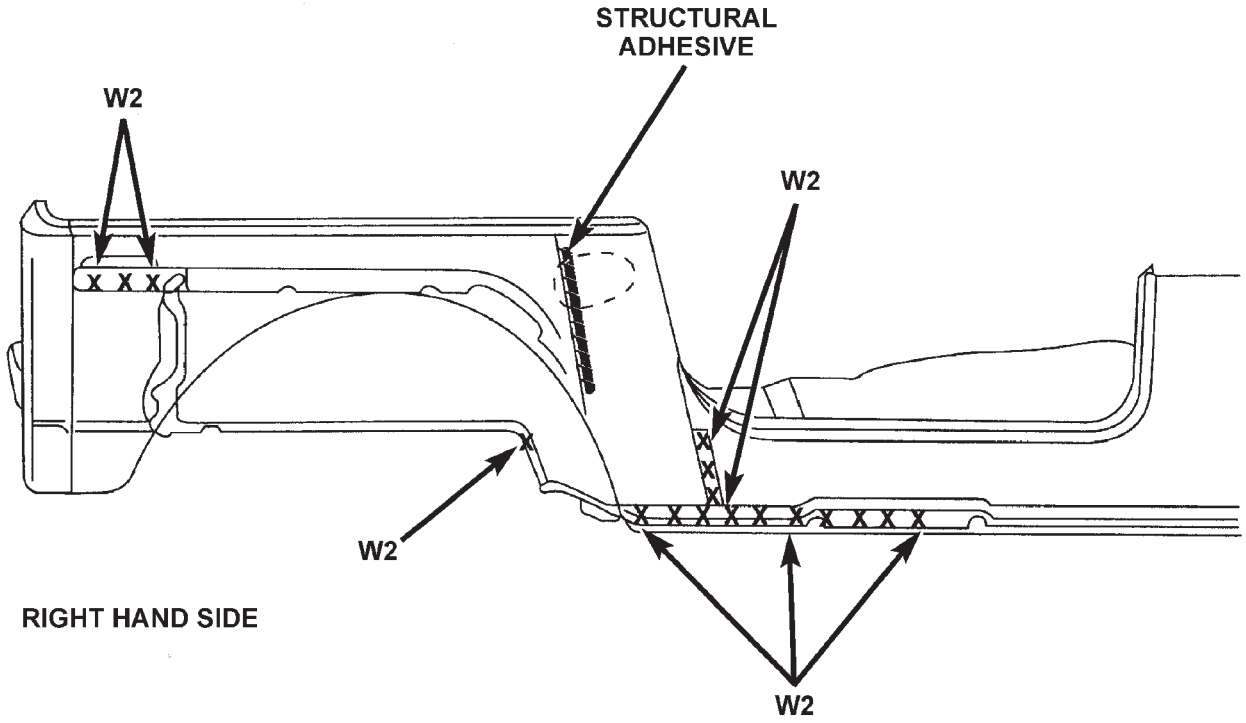
W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

80b69733

SPECIFICATIONS (Continued)

SIDE APERTURE



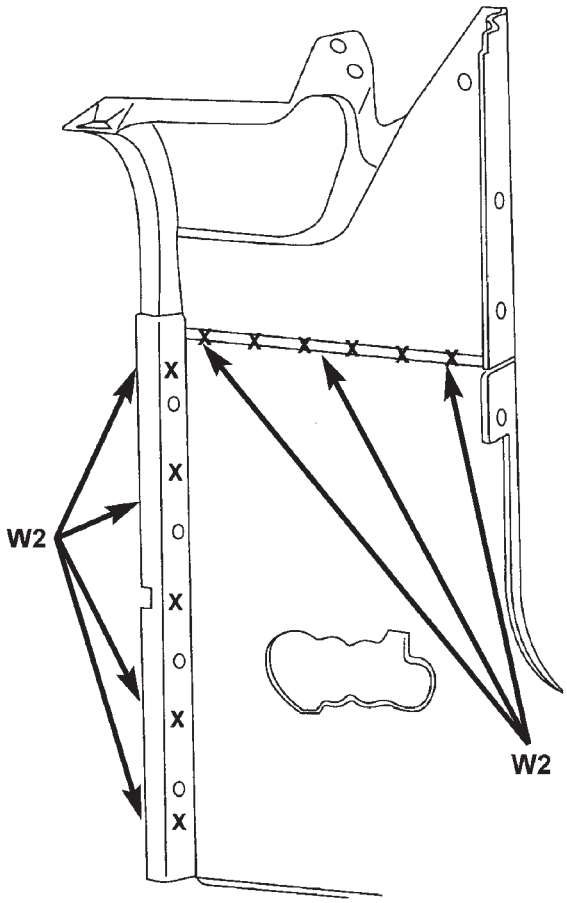


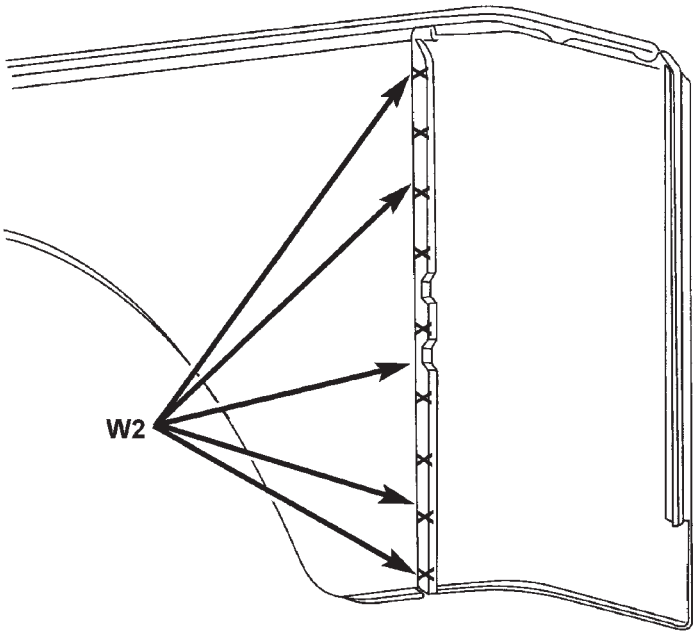
W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

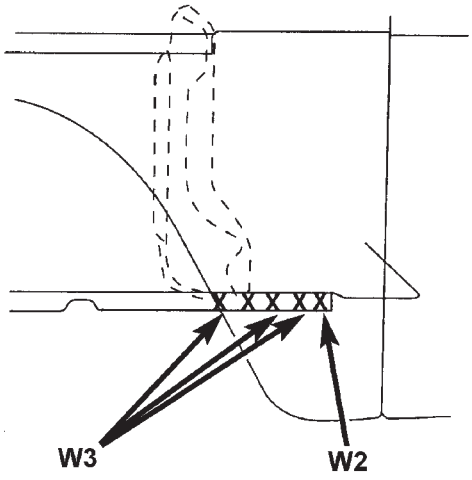
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SPECIFICATIONS (Continued)

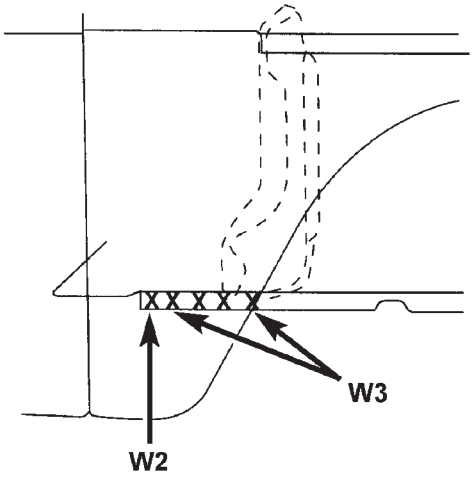
SIDE APERTURE







LEFT SIDE



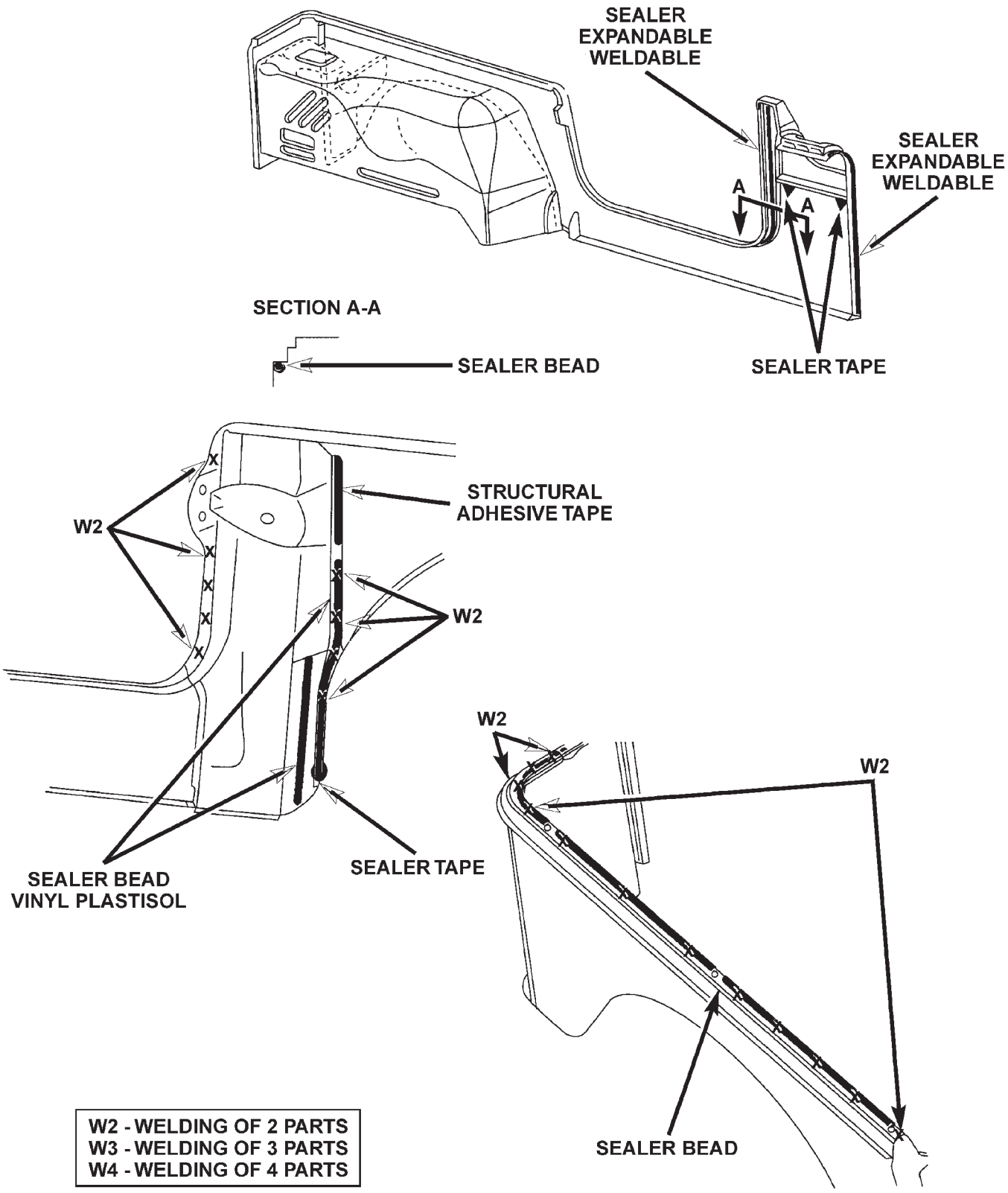
RIGHT SIDE

W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

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SPECIFICATIONS (Continued)

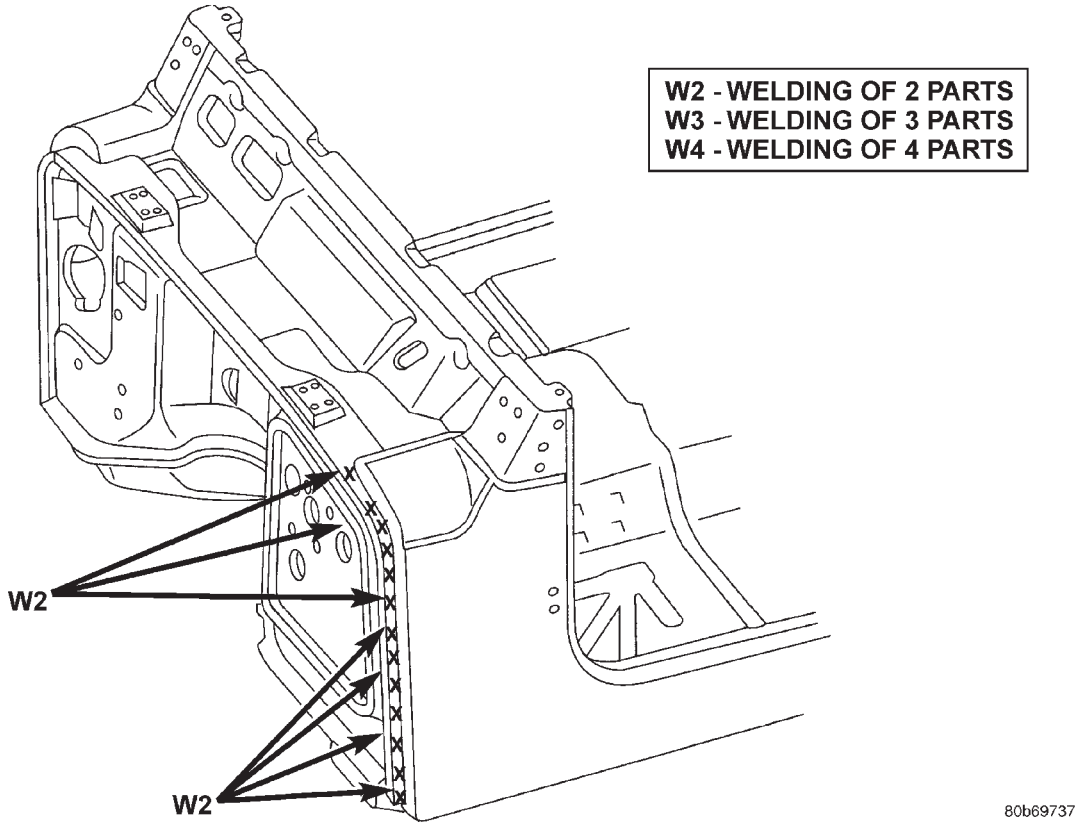
SIDE APERTURE



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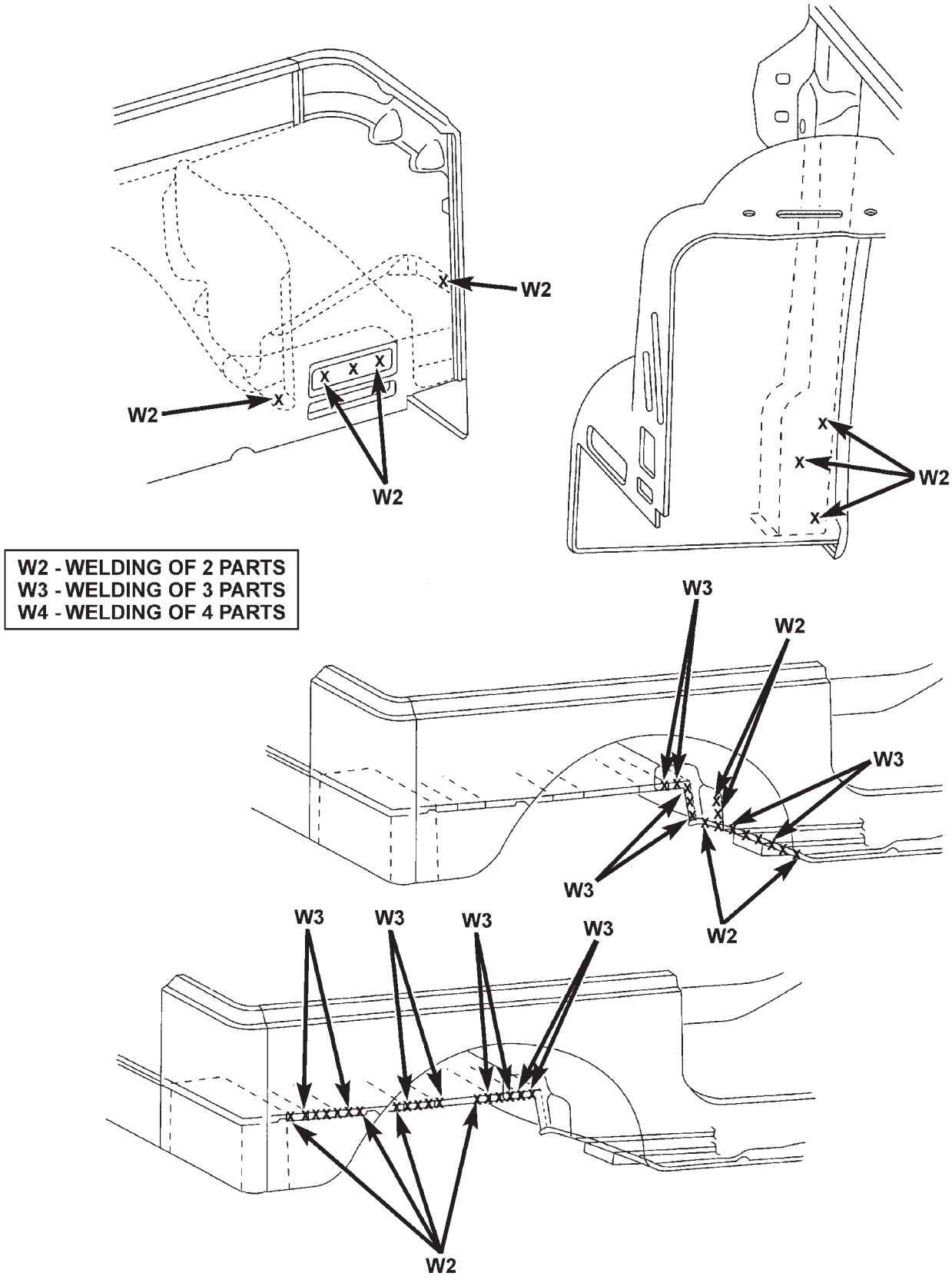
SPECIFICATIONS (Continued)

SIDE APERTURE



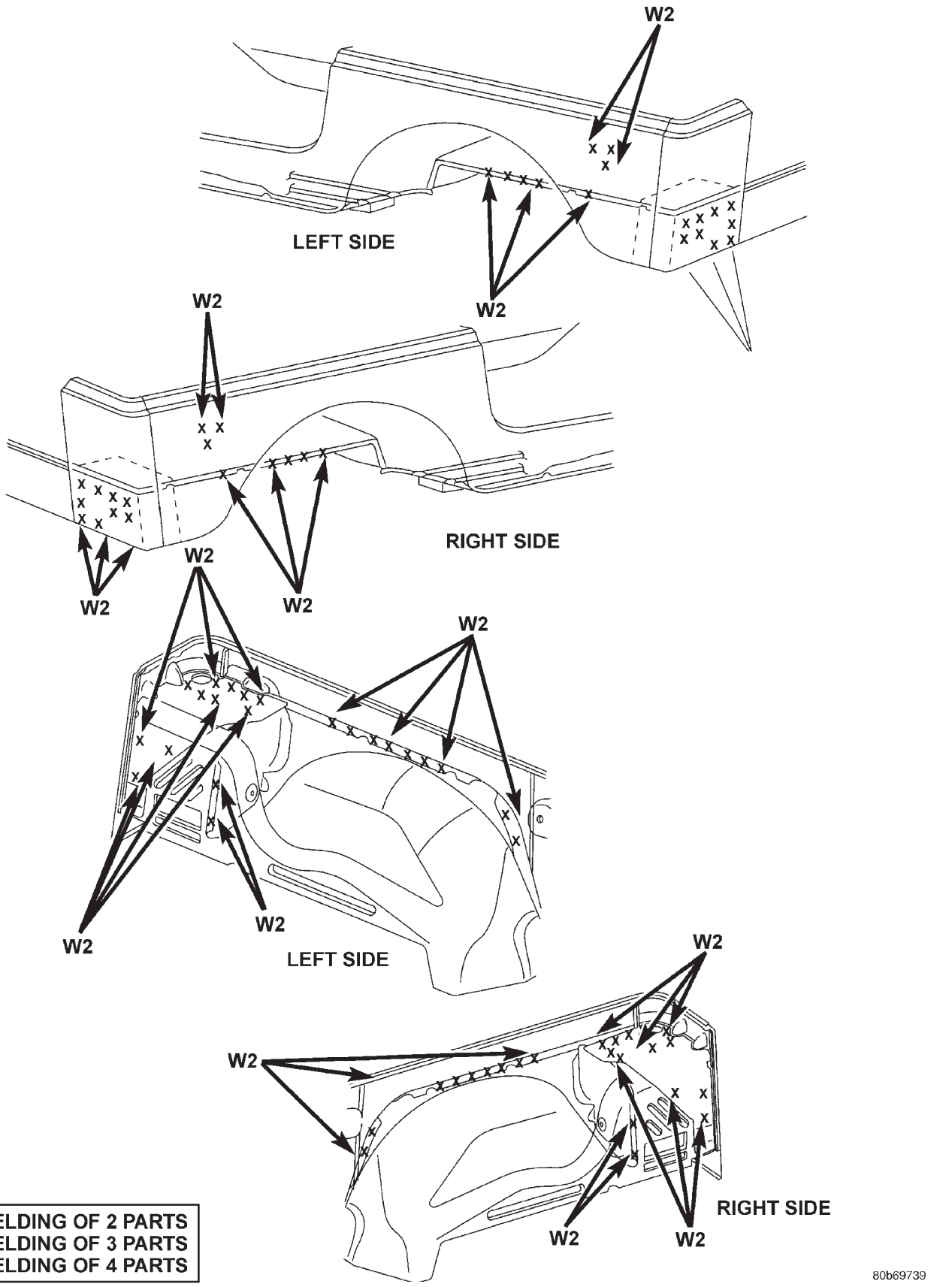
SPECIFICATIONS (Continued)

WHEELHOUSE



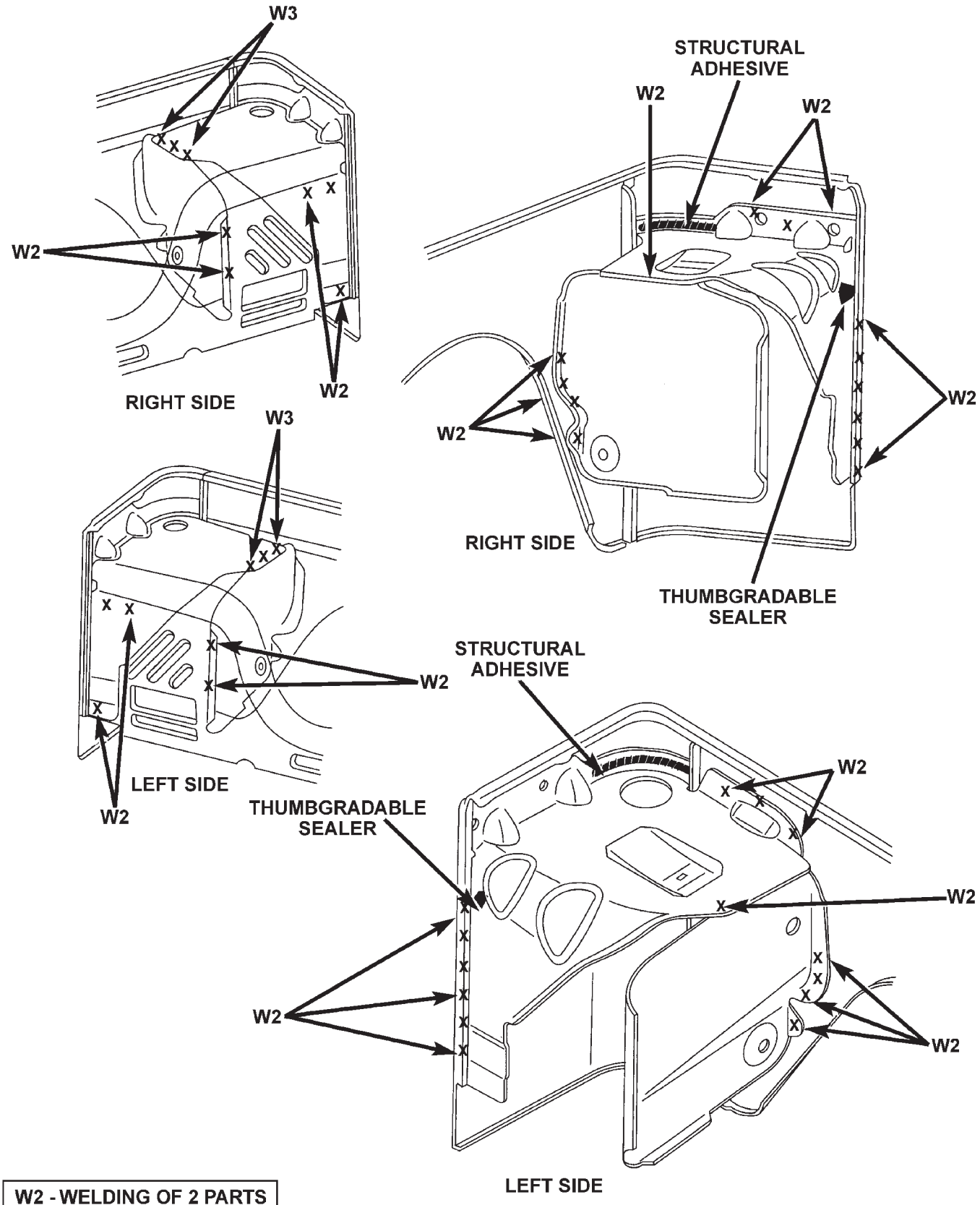
SPECIFICATIONS (Continued)

WHEELHOUSE



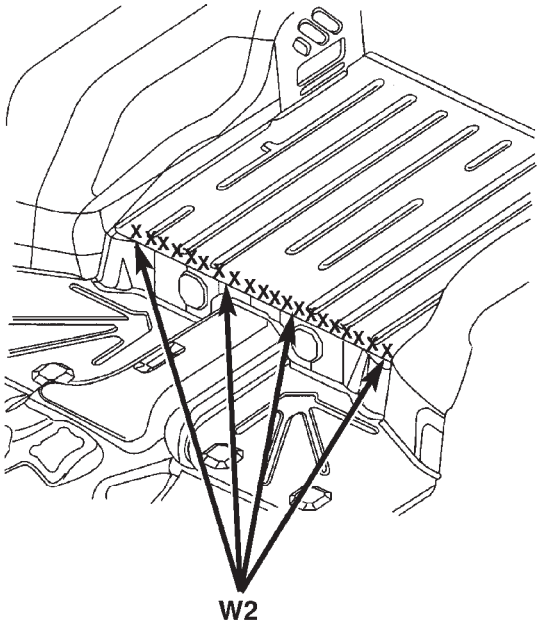
SPECIFICATIONS (Continued)

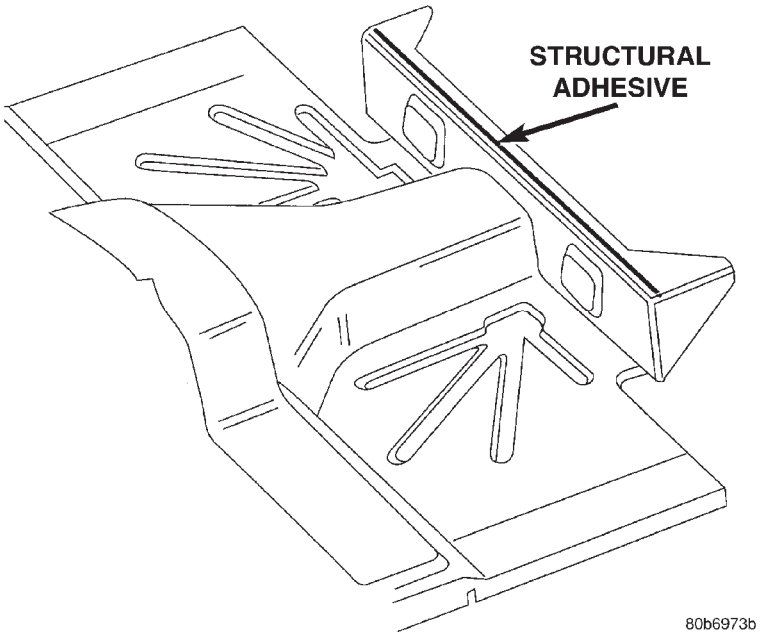
WHEELHOUSE



SPECIFICATIONS (Continued)

REAR FLOOR PAN AND REINFORCEMENTS



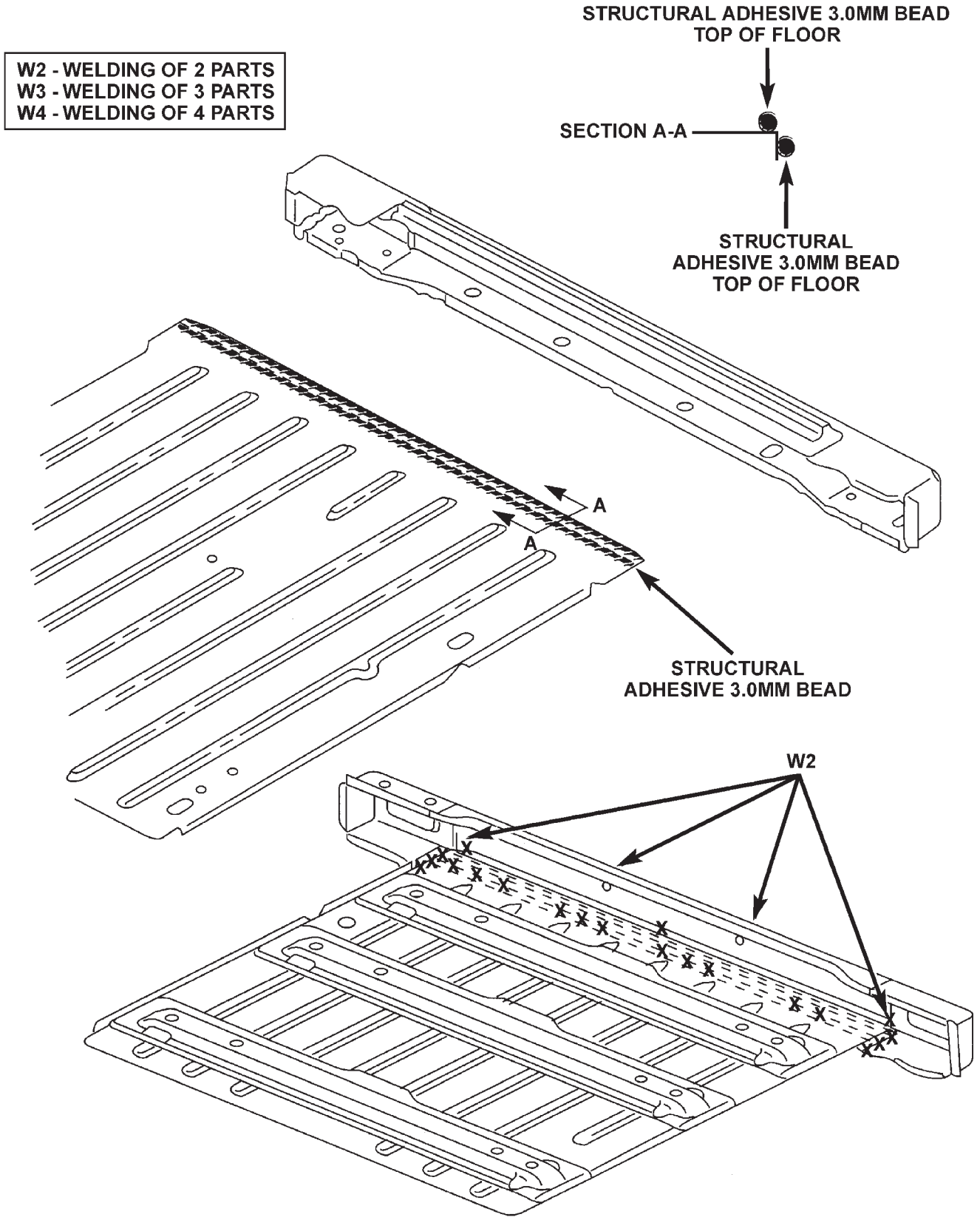


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W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

SPECIFICATIONS (Continued)

REAR FLOOR PAN AND REINFORCEMENTS

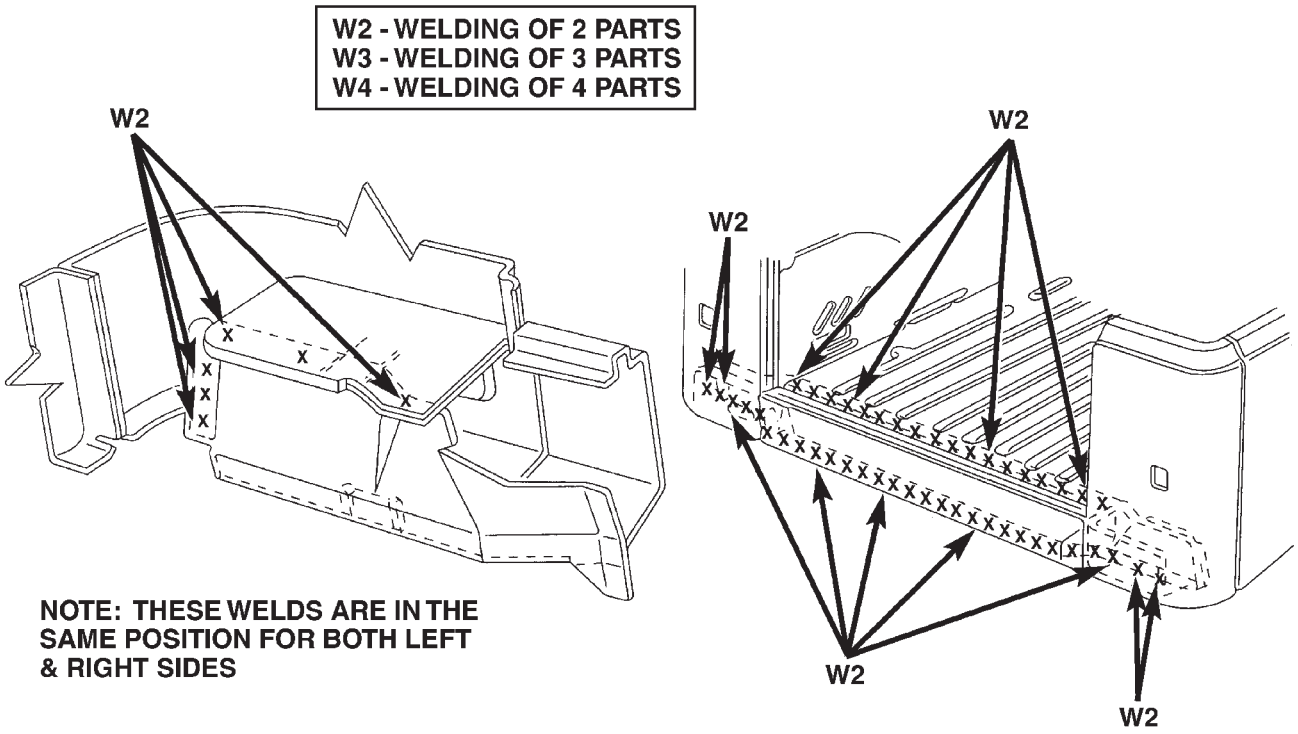


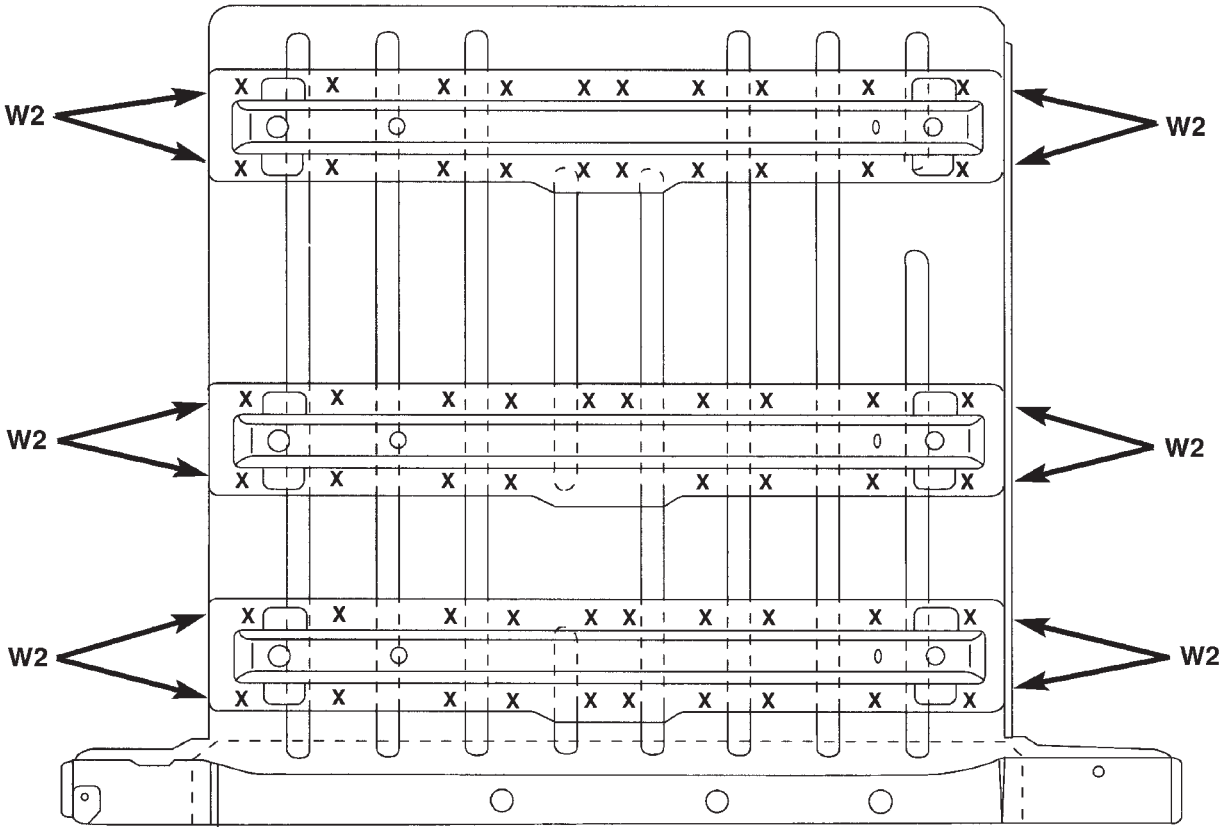
VIEW SHOWING UNDER SIDE OF REAR FLOOR

80b6973c

SPECIFICATIONS (Continued)

REAR FLOOR PAN AND REINFORCEMENTS



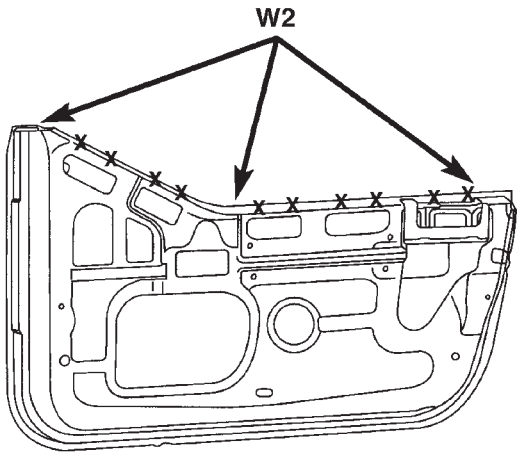


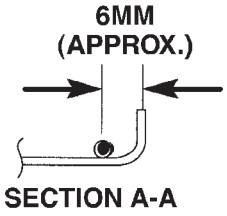
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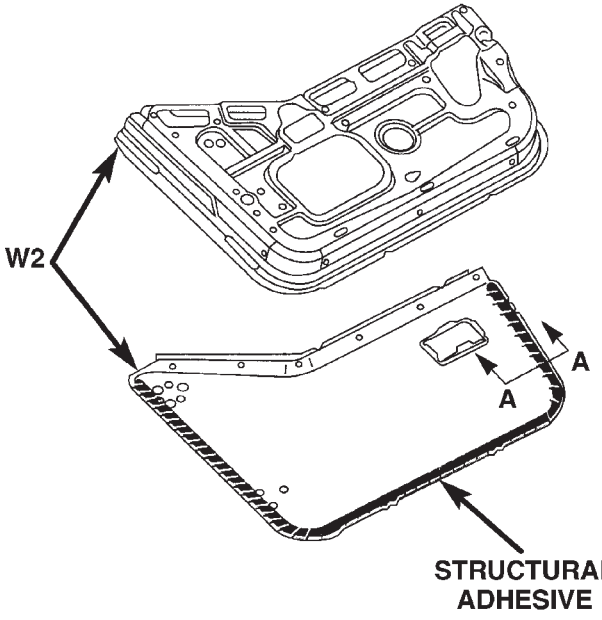
SPECIFICATIONS (Continued)

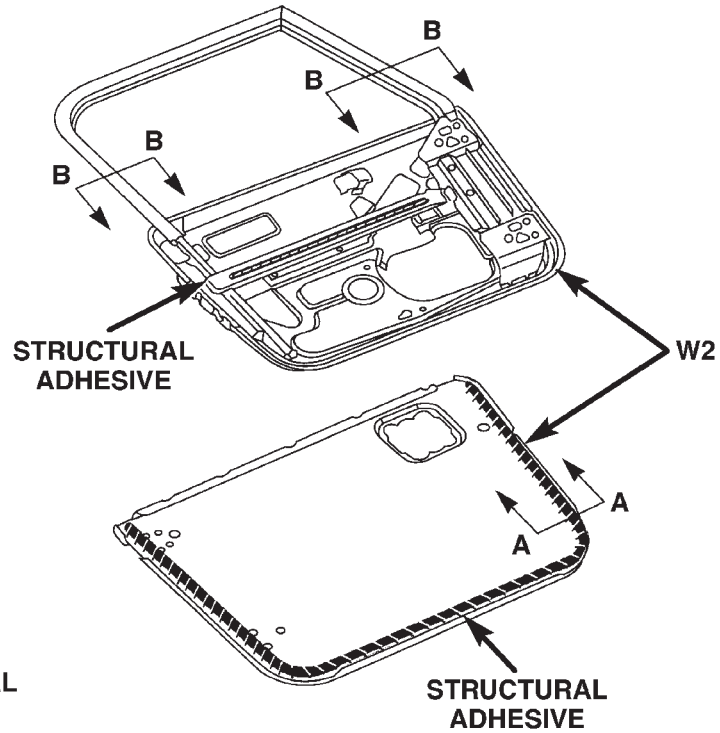
DOOR OUTER PANELS

W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS





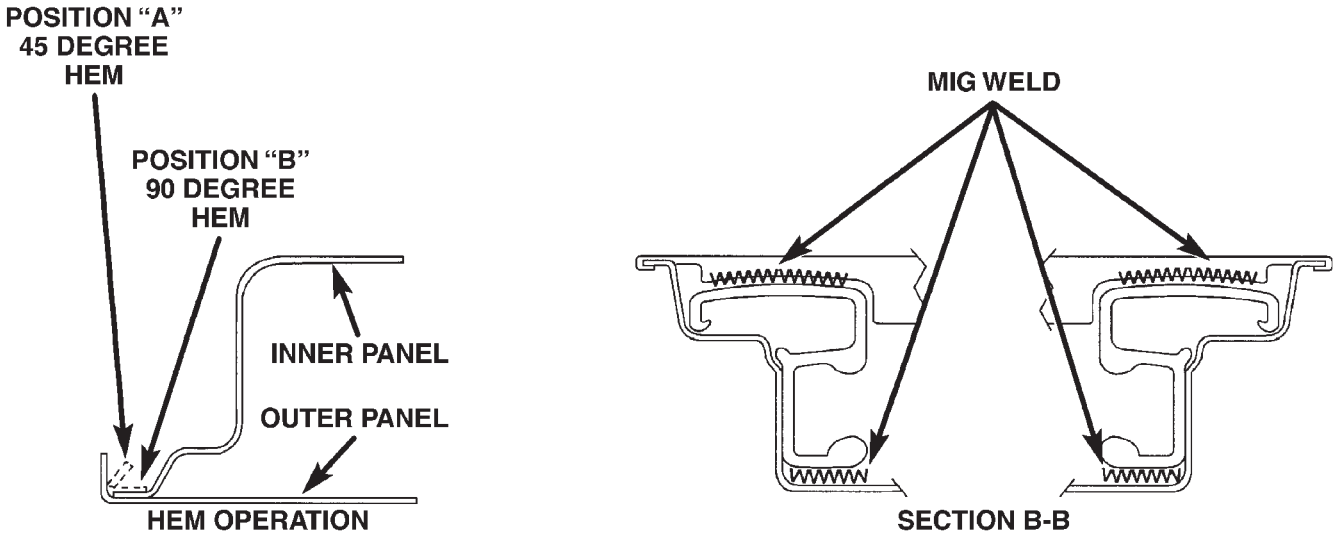




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SPECIFICATIONS (Continued)

DOOR OUTER PANELS

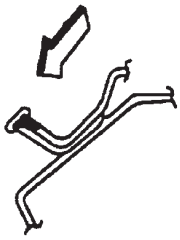


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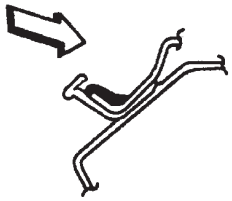
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SEALER LOCATIONS

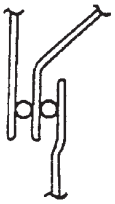
APPLICATION METHODS



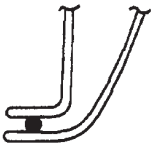
HOLD GUN NOZZLE IN DIRECTION OF ARROW IN ORDER TO EFFECTIVELY SEAL METAL JOINTS.



DO NOT HOLD GUN NOZZLE IN DIRECTION OF ARROW. SEALER APPLIED AS SHOWN IN INEFFECTIVE.



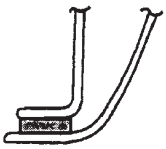
3 METAL THICKNESS



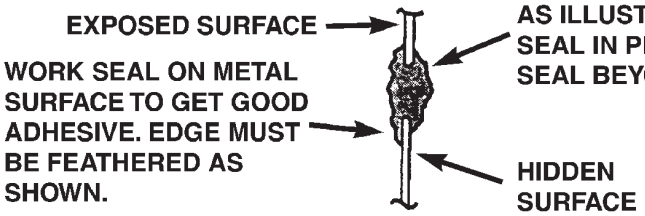
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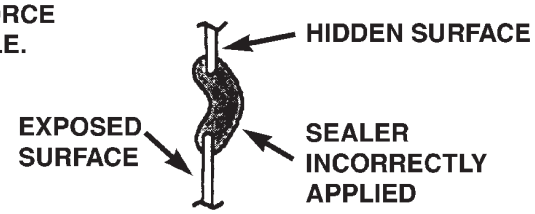


3 METAL THICKNESS



2 METAL THICKNESS





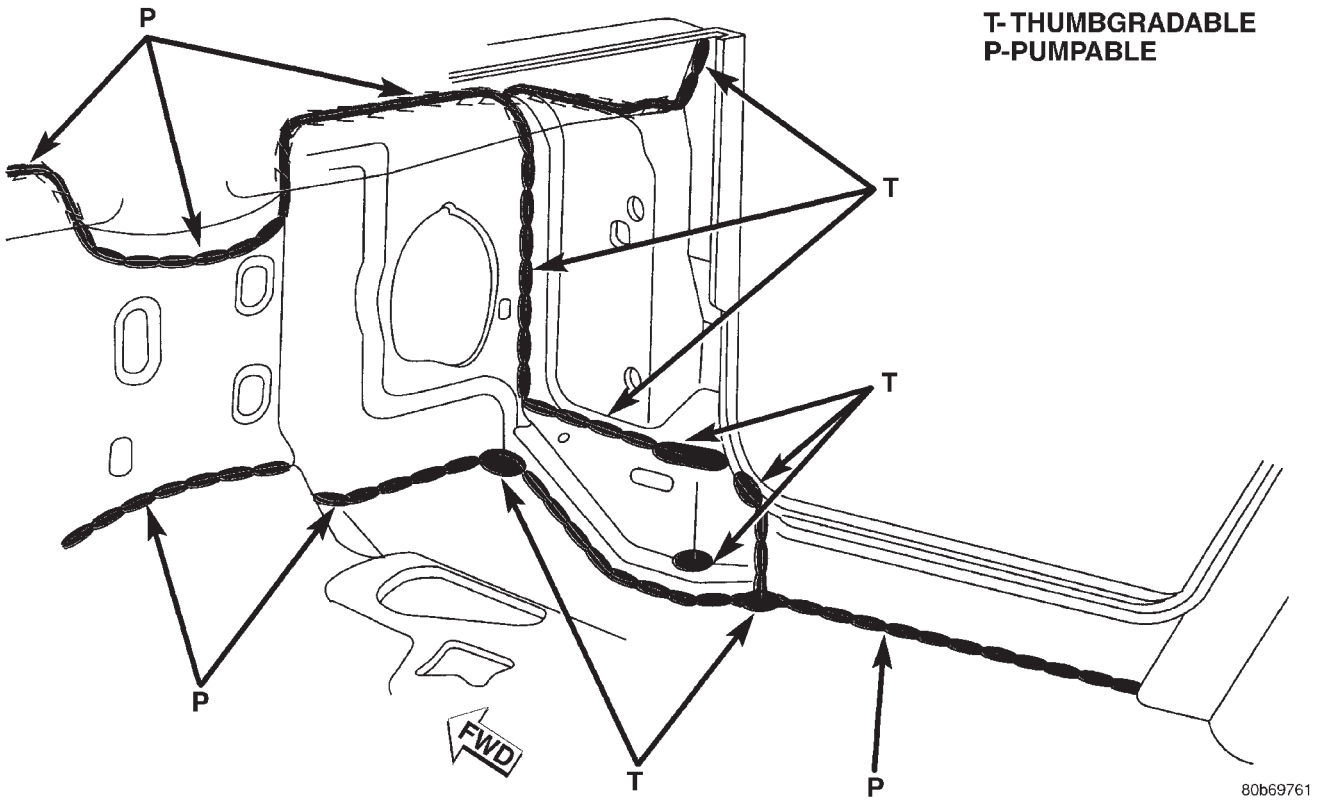
SYMBOLS

	THUMBGRADEABLE SEALER
	EXTRUDABLE THERMOPLASTIC
	EXPOSED THERMOPLASTIC SEALANT
zzzzzzzz	HIDDEN SEALANT

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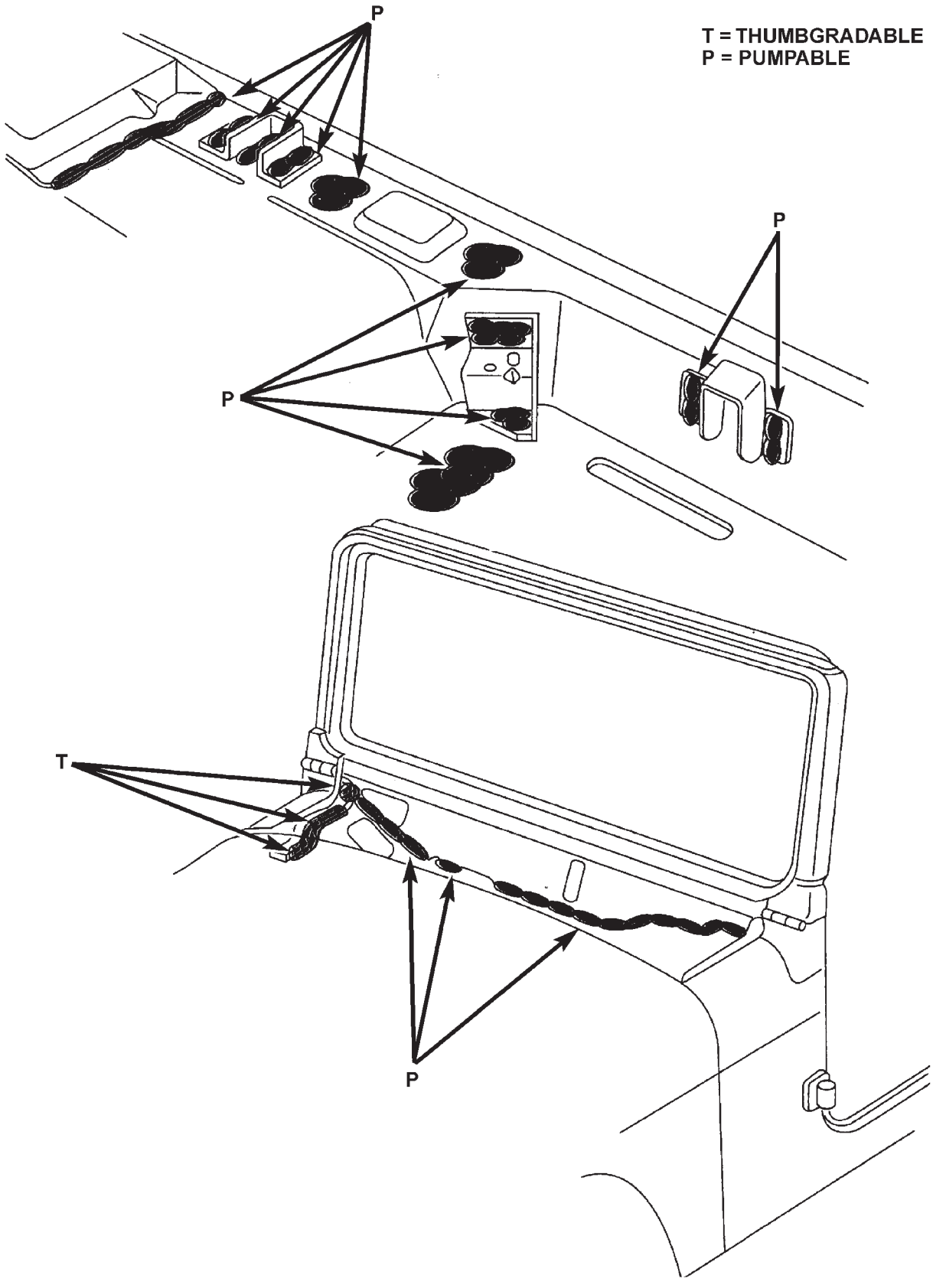
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COWL AND PLENUM



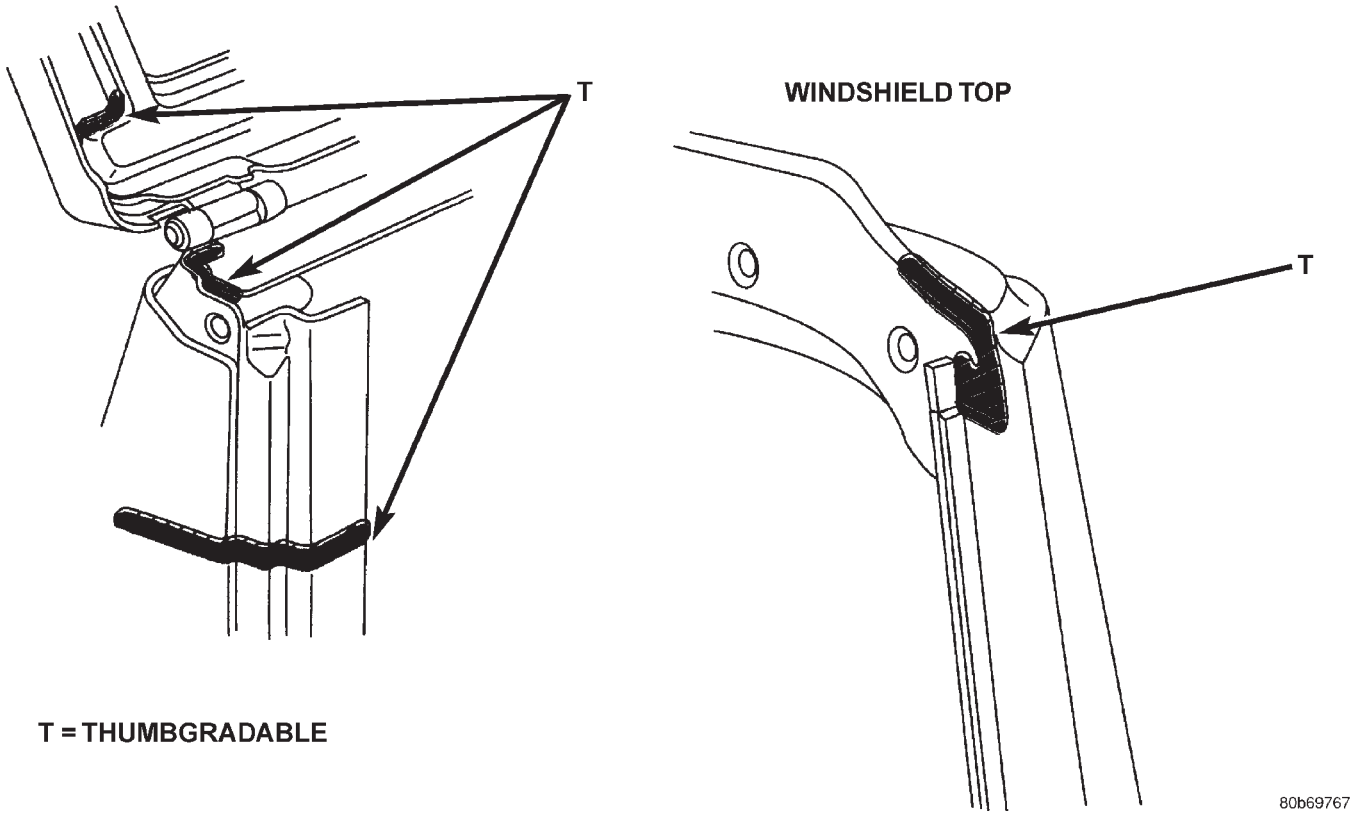
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COWL TOP END AND PLENUM

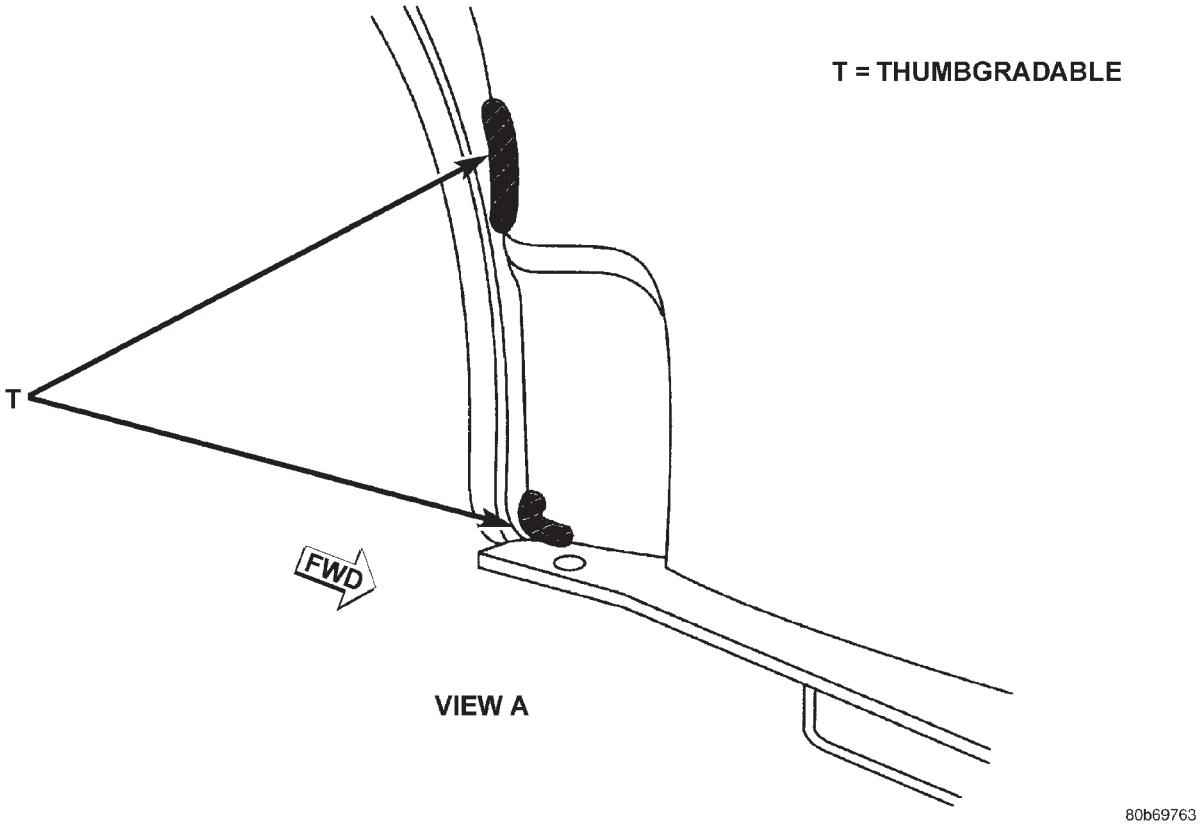


SPECIFICATIONS (Continued)

COWL AND WINDSHIELD OUTER PANEL

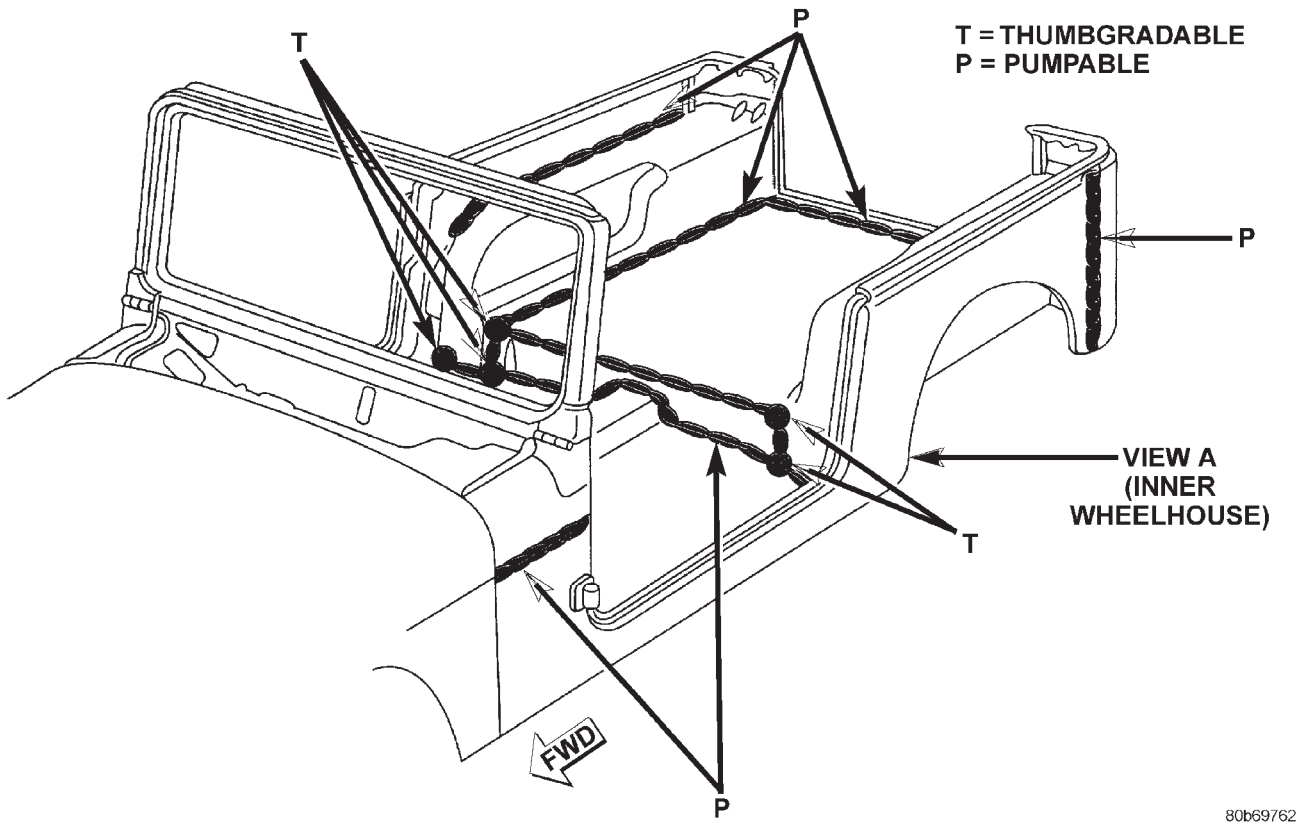


INNER WHEELHOUSE

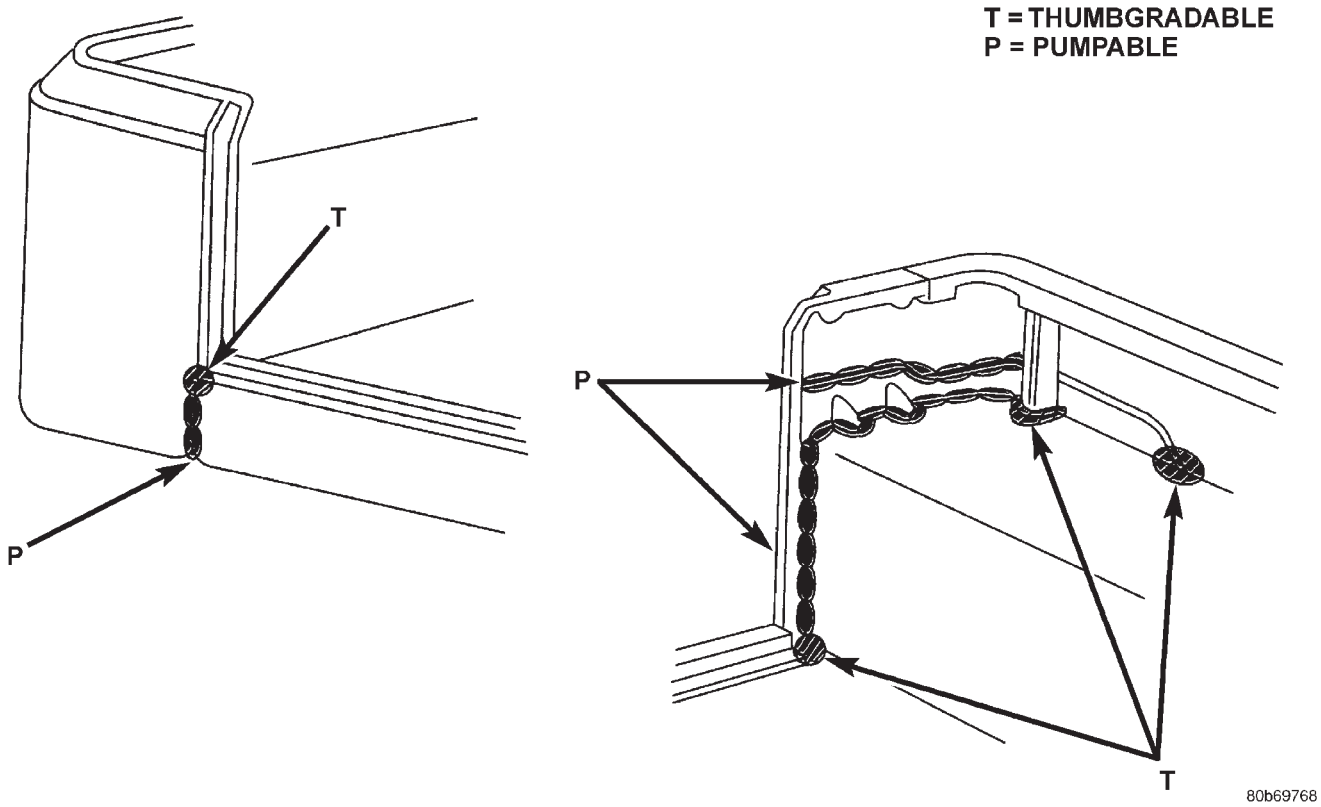


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REAR FLOOR RISER AND OUTER BODY SEAMS

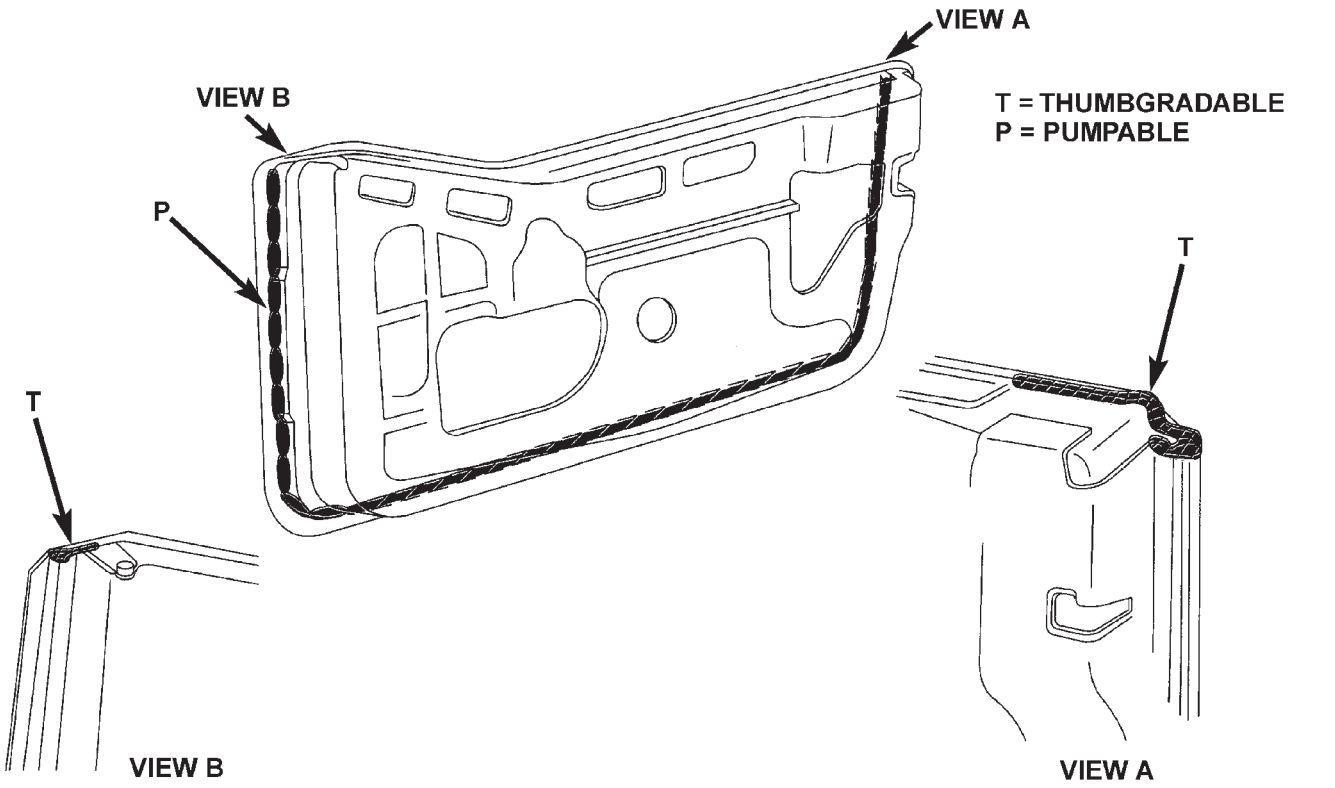


REAR CORNER PANEL

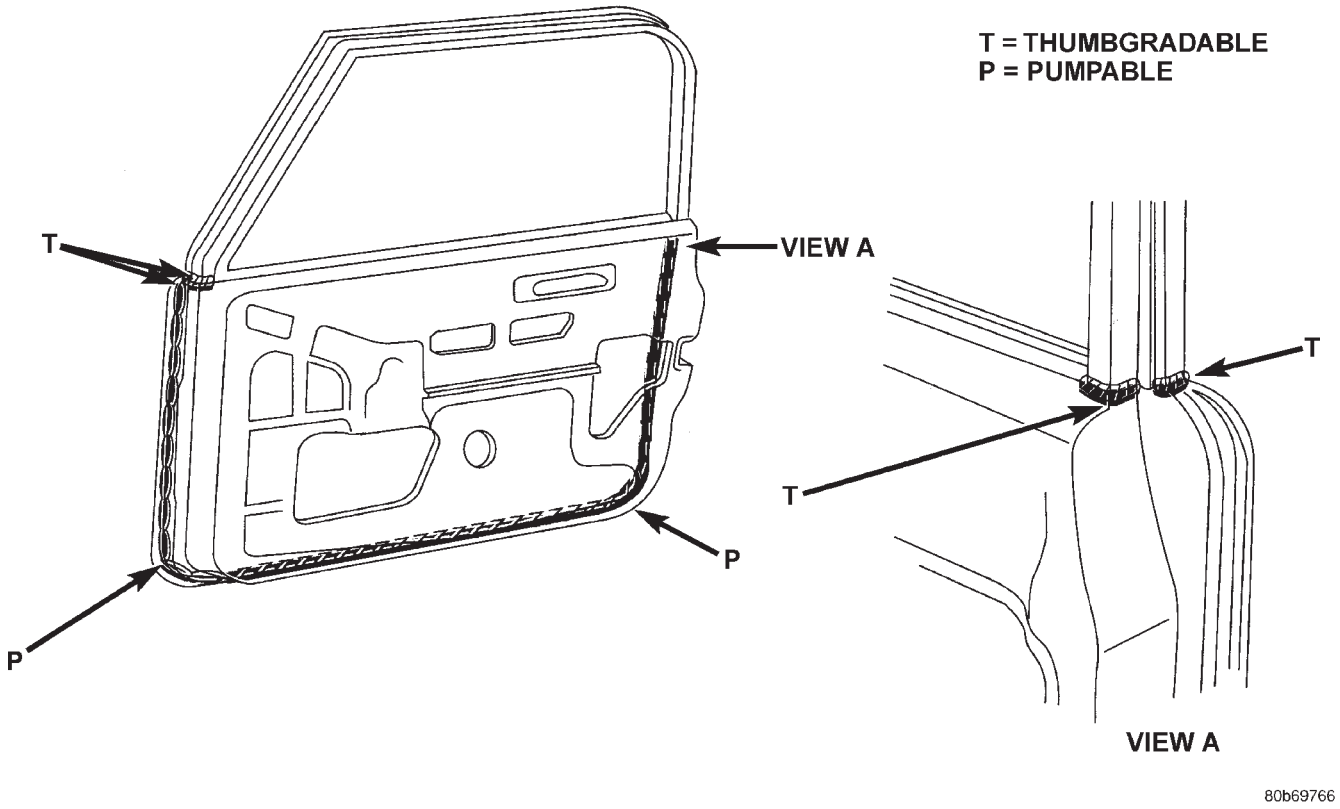


SPECIFICATIONS (Continued)

HALF DOOR



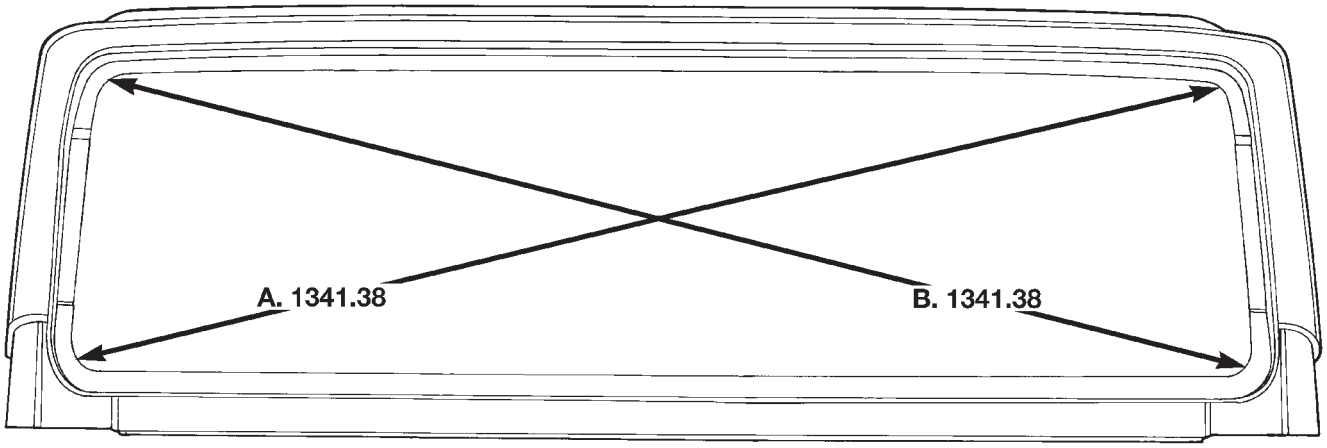
FULL DOOR



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BODY OPENING DIMENSIONS

WINDSHIELD OPENING

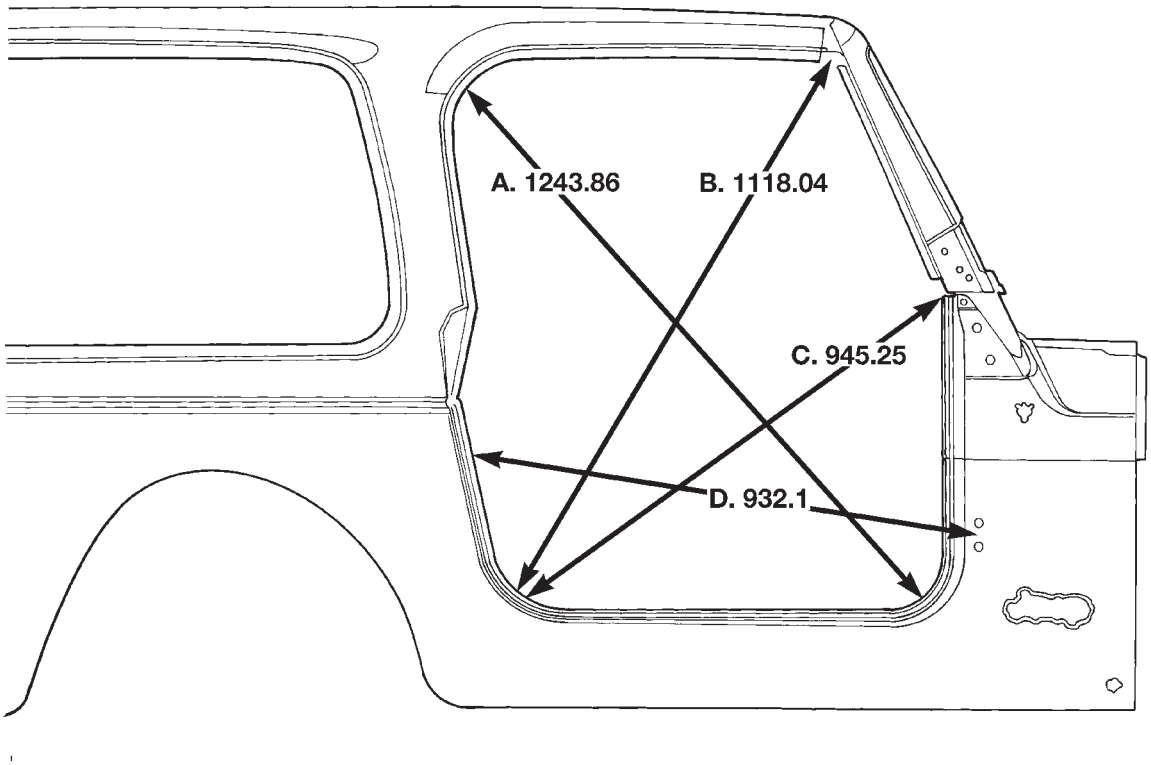


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- A & B. Center of radius at bottom to center of radius top.

SPECIFICATIONS (Continued)

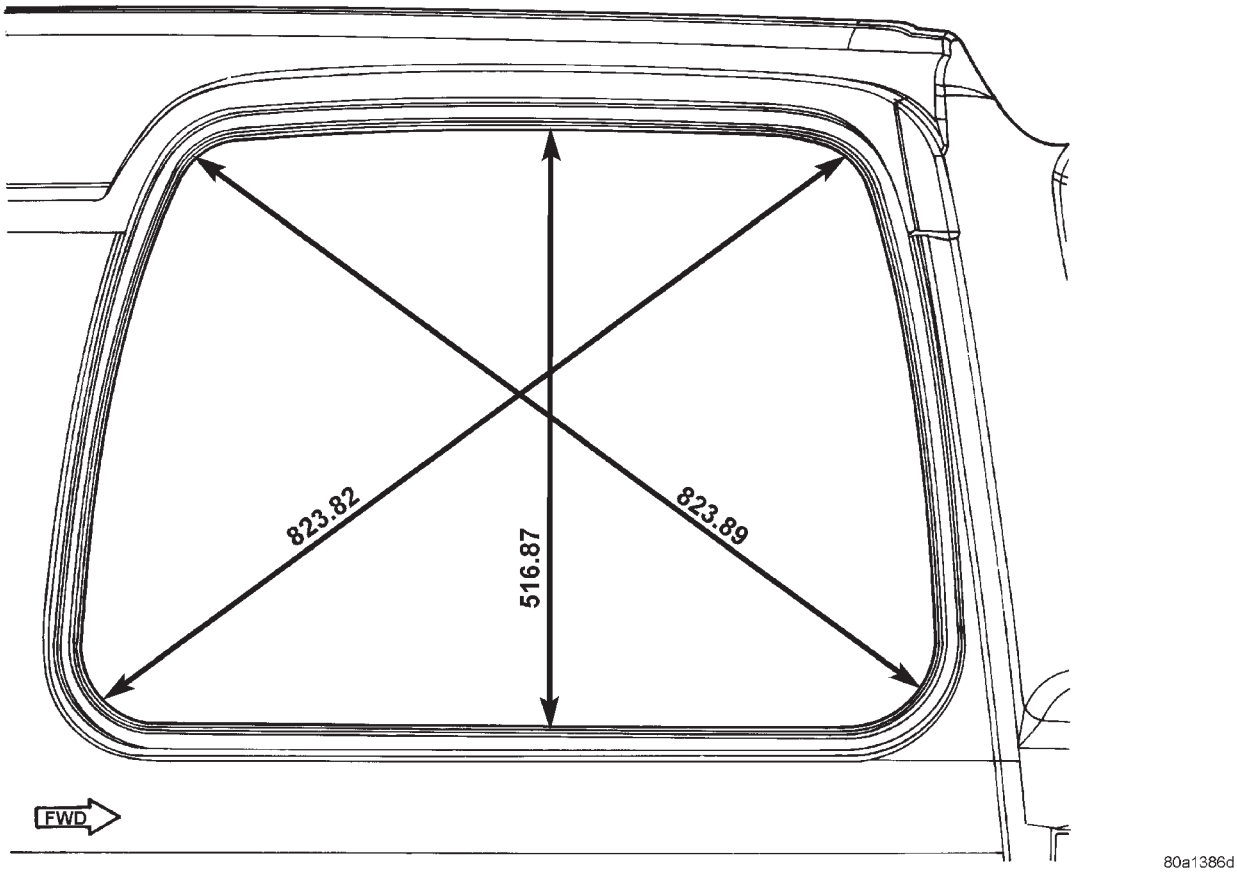
DOOR OPENING



- A. Center of radius at bottom front to center of radius at top rear.
- B. Center of door lower rear corner to center of top of windshield frame.
- C. Center of door lower rear corner to top of cowl.
- D. Center of door hinge mount to center of door striker mount.

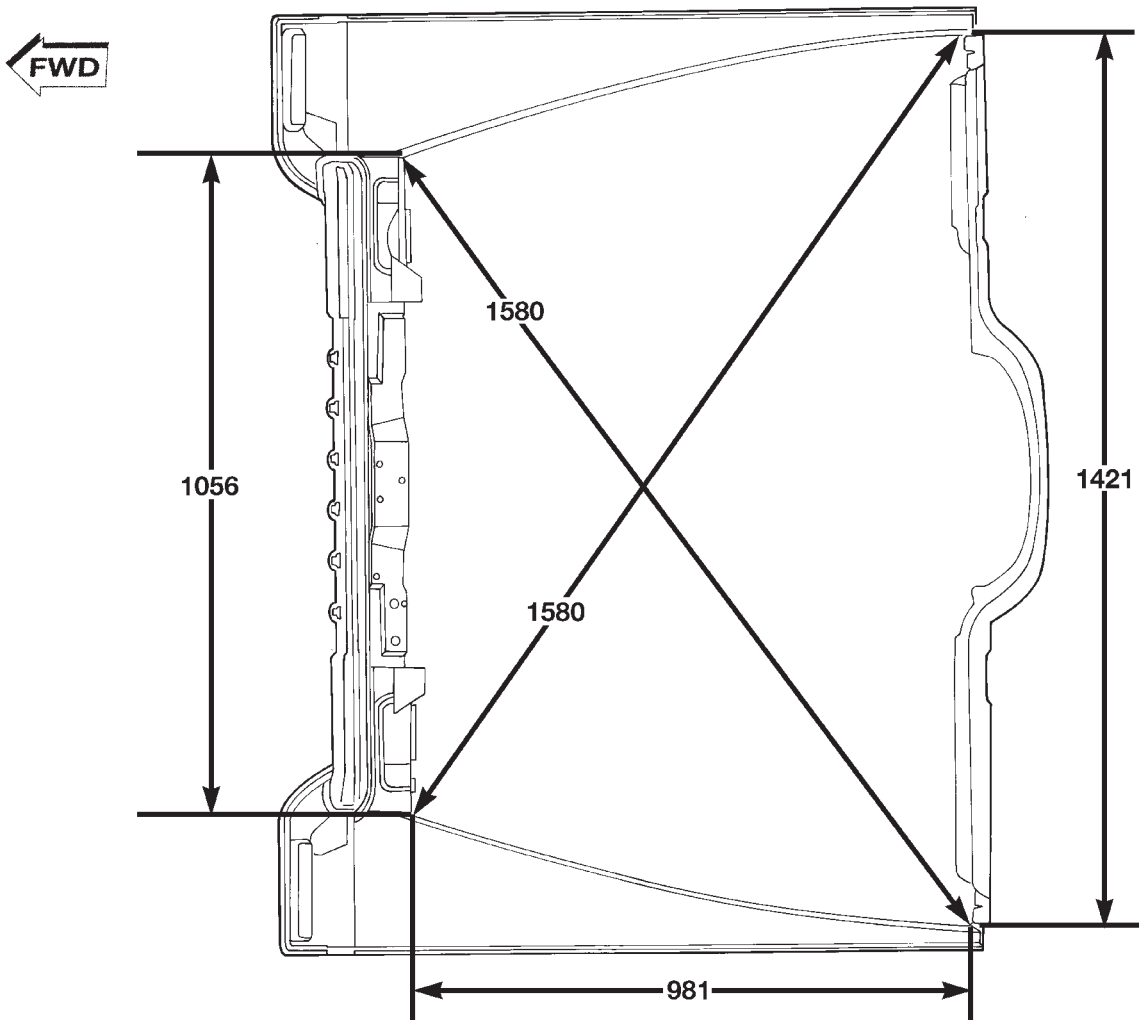
SPECIFICATIONS (Continued)

QUARTER WINDOW OPENING



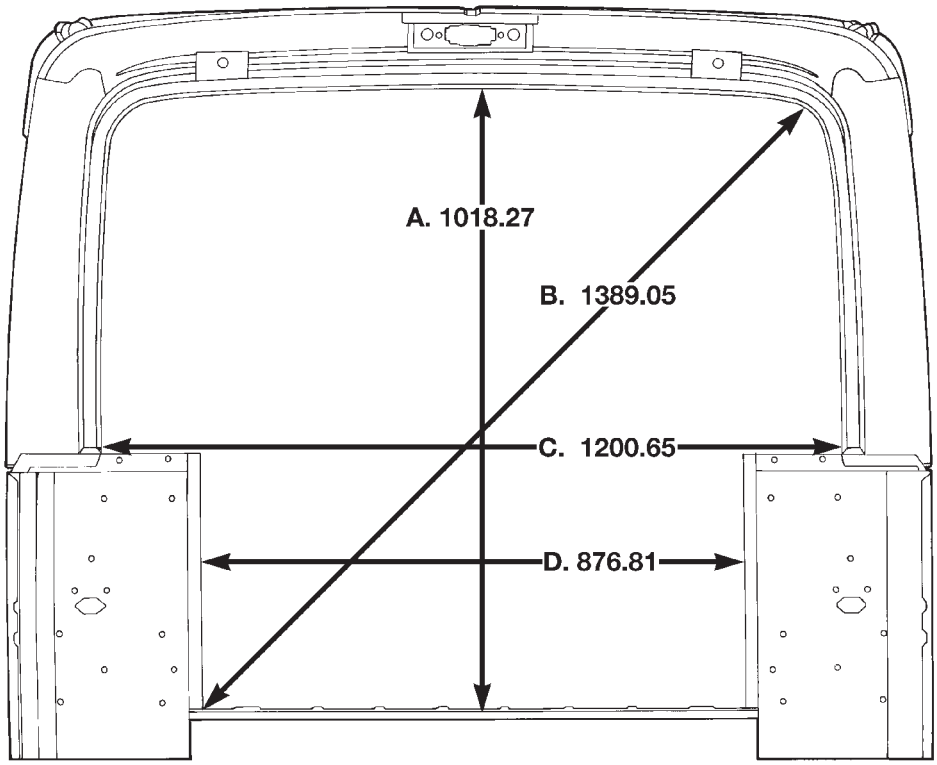
SPECIFICATIONS (Continued)

ENGINE COMPARTMENT



SPECIFICATIONS (Continued)

TAILGATE AND LIFTGATE OPENING



- A. Center of liftgate opening to floor.
- B. Center of radius upper corner to center of body and floor corner.
- C. Liftgate opening distance.
- D. Tailgate opening distance.

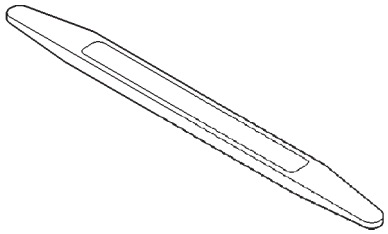
SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS

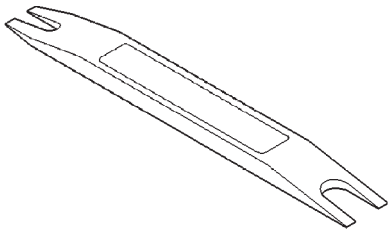
DESCRIPTION	TORQUE
Hood hinge screws	17 N·m (155 in. lbs.)
Bucket seat front anchor bolt	47 N·m (35 ft. lbs.)
Bucket seat rear inboard anchor bolt	74 N·m (55 ft. lbs.)
Bucket seat rear outboard anchor bolt	33 N·m (25 ft. lbs.)
Liftgate glass ball stud nut	12 N·m (112 in. lbs.)
Liftgate glass hinge nut	6 N·m (53 in. lbs.)
Liftgate hinge to hardtop bolt	10 N·m (95 in. lbs.)
Front turning loop bolt	47 N·m (35 ft. lbs.)
Front retractor bolt	47 N·m (35 ft. lbs.)
Rear retractor bolt	47 N·m (35 ft. lbs.)
Rear turning loop bolt	47 N·m (35 ft. lbs.)
Rear belt anchor bolt	47 N·m (35 ft. lbs.)
Rearview mirror setscrew	1 N·m (9 in. lbs.)
Rear buckle anchor bolt	43 N·m (32 ft. lbs.)
Side support bar to sport bar bolts	71 N·m (53 ft. lbs.)
Sport bar to wheelhouse bolts	40 N·m (30 ft. lbs.)
Sport bar to cargo floor bolts	40 N·m (30 ft. lbs.)
Sport bar to windshield frame bolts	32 N·m (24 ft. lbs.)
Tailgate hinge screws	23 N·m (200 in. lbs.)
Tailgate striker	71 N·m (52 ft. lbs.)

SPECIAL TOOLS

BODY



Trim Stick C-4755



Remover, Moldings C-4829

HEATING AND AIR CONDITIONING

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DESCRIPTION AND OPERATION

ACCUMULATOR

DESCRIPTION

The accumulator is mounted in the engine compartment between the evaporator coil outlet tube and the compressor inlet.

OPERATION

Refrigerant enters the accumulator canister as a low pressure vapor through the inlet tube. Any liquid, oil-laden refrigerant falls to the bottom of the canister, which acts as a separator. A desiccant bag is mounted inside the accumulator canister to absorb any moisture which may have entered and become trapped within the refrigerant system (Fig. 1).

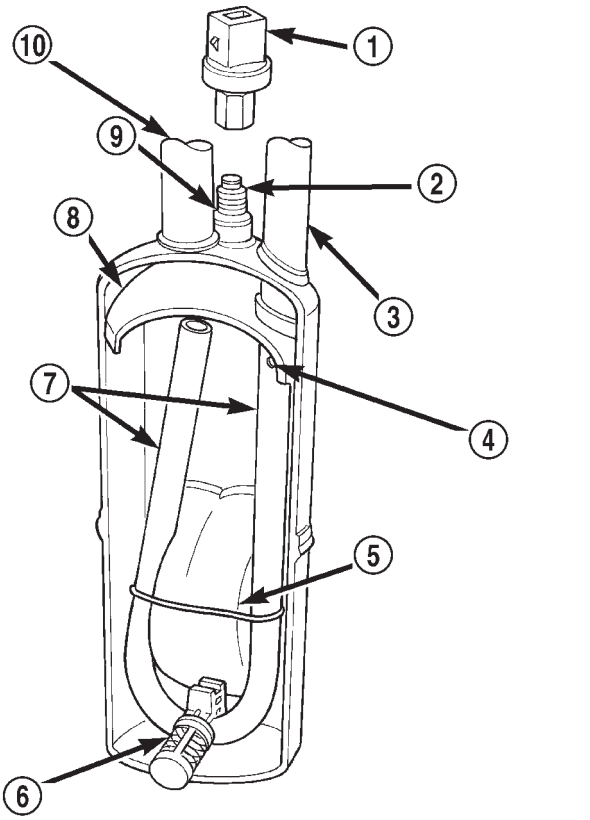


Fig. 1 Accumulator - Typical

1 – LOW PRESSURE CYCLING CLUTCH SWITCH
2 – PRESSURE SWITCH FITTING
3 – OUTLET TO COMPRESSOR
4 – ANTI-SIPHON HOLE
5 – DESICCANT BAG
6 – OIL RETURN ORIFICE FILTER
7 – VAPOR RETURN TUBE
8 – ACCUMULATOR DOME
9 – O-RING SEAL
10 – INLET FROM EVAPORATOR

BLOWER MOTOR

DESCRIPTION

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.

OPERATION

The blower motor will only operate when the ignition switch is in the On position, and the heater-A/C mode control switch knob is in any position, except Off. The blower motor receives a ground feed at all times. The blower motor battery feed circuit is protected by a fuse in the fuseblock module for all blower speeds except high. The high speed battery feed circuit is protected by a fuse in the Power Distribution Center (PDC). Blower motor speed is controlled by regulating the battery feed through the blower motor switch, blower motor resistor, and a blower motor relay.

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

DESCRIPTION

The blower motor relay is a International Standards Organization (ISO)-type relay. The relay is a electromechanical device that switches battery current to the blower motor.

OPERATION

When the blower motor switch is in any position except off, and the ignition is turned on, the blower motor relay is energized and provides battery feed to the blower motor from a fuse in the fuseblock module through the blower motor resistor.

The blower motor relay coil is controlled by a voltage signal from the blower motor 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 located near 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.

DESCRIPTION AND OPERATION (Continued)

BLOWER MOTOR RESISTOR

DESCRIPTION

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.

OPERATION

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 battery current to the correct resistor wire to obtain the selected speed. When the highest blower motor speed is selected, the blower motor relay connects the blower motor directly to battery current, bypassing the blower motor resistor.

The blower motor resistor cannot be repaired and, if faulty or damaged, it must be replaced.

BLOWER MOTOR SWITCH

DESCRIPTION

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.

OPERATION

The blower motor switch receives ignition-switched battery current through the mode control switch from a fuse in the fuseblock module. The blower motor switch directs the battery current to the blower motor resistor, or to the blower motor relay, as required to achieve the selected blower motor speed.

The blower motor switch cannot be repaired and, if faulty or damaged, it must be replaced. The blower motor switch knob is available for service replacement.

COMPRESSOR

DESCRIPTION

The air conditioning system uses a Denso 10PA17 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.

OPERATION

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

DESCRIPTION

The compressor clutch assembly consists of a stationary electromagnetic coil, a hub bearing and pulley assembly, and a clutch plate (Fig. 2). 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. These components provide the means to engage and disengage the compressor from the engine serpentine accessory drive belt.

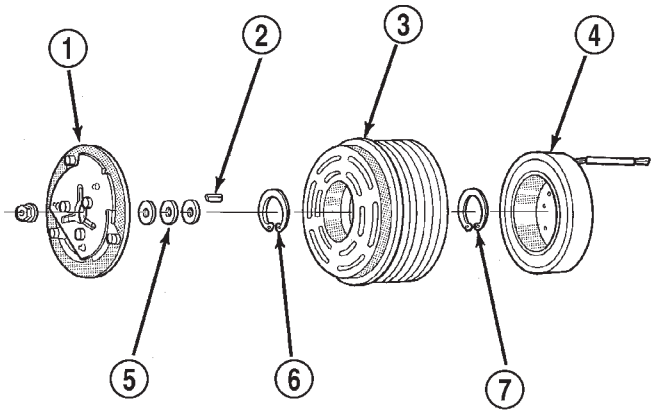


Fig. 2 Compressor Clutch

1 – CLUTCH PLATE
2 – SHAFT KEY
3 – PULLEY
4 – COIL
5 – CLUTCH SHIMS
6 – SNAP RING
7 – SNAP RING

DESCRIPTION AND OPERATION (Continued)

OPERATION

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

DESCRIPTION

The compressor clutch relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (footprint) is different, the current capacity is lower, and the relay case dimensions are smaller than those of the conventional ISO relay.

The compressor clutch relay is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for relay identification and location.

OPERATION

The compressor clutch relay is a electromechanical device that switches battery current to the compressor clutch coil when the Powertrain Control Module (PCM) grounds the coil side of the relay. The PCM responds to inputs from the 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 cannot be repaired and, if faulty or damaged, it must be replaced.

CONDENSER

DESCRIPTION

The condenser is located in the air flow in front of the engine cooling radiator. The condenser is a heat exchanger that allows the high-pressure refrigerant gas being discharged by the compressor to give up its heat to the air passing over the condenser fins.

OPERATION

When the refrigerant gas gives up its heat, it condenses. When the refrigerant leaves the condenser, it has become a high-pressure liquid refrigerant. The volume of air flowing over the condenser fins is critical to the proper cooling performance of the air conditioning system. Therefore, it is important that there are no objects placed in front of the radiator grille openings in the front of the vehicle or foreign material on the condenser fins that might obstruct proper air flow. Also, any factory-installed air seals or shrouds must be properly reinstalled following radiator or condenser service.

The condenser cannot be repaired and, if faulty or damaged, it must be replaced.

EVAPORATOR COIL

DESCRIPTION

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.

OPERATION

Refrigerant enters the evaporator from the fixed orifice tube as a low-temperature, low-pressure liquid. As air flows over the fins of the evaporator, the humidity in the air condenses on the fins, and the heat from the air is absorbed by the refrigerant. Heat absorption causes the refrigerant to boil and vaporize. The refrigerant becomes a low-pressure gas when it leaves the evaporator.

The evaporator coil cannot be repaired and, if faulty or damaged, it must be replaced.

FIXED ORIFICE TUBE

DESCRIPTION

The fixed orifice tube is factory installed as part of the liquid line, and connects the outlet of the condenser to the inlet of the evaporator. The orifice tube is located in the end of the liquid line 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. 3). 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

DESCRIPTION AND OPERATION (Continued)

the liquid line and prevent the refrigerant from bypassing the fixed metering orifice.

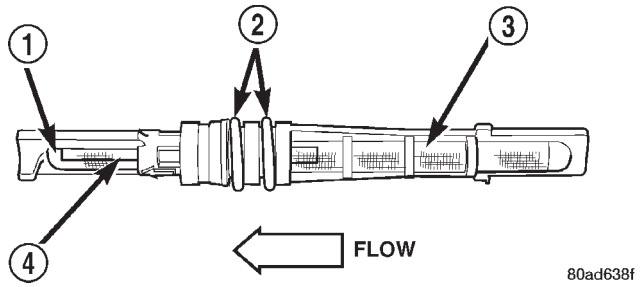


Fig. 3 Fixed Orifice Tube - Typical

1 – DIFFUSER SCREEN
2 – "O" RINGS
3 – INLET FILTER SCREEN
4 – ORIFICE

OPERATION

The fixed orifice tube is used to meter the flow of liquid refrigerant into the evaporator coil. The high-pressure liquid refrigerant from the condenser expands into a low-pressure liquid as it passes through the metering orifice and diffuser screen of the fixed orifice tube.

The fixed orifice tube is not serviceable. It cannot be repaired, and if faulty or plugged, it must be replaced as part of the refrigerant line.

HEATER AND AIR CONDITIONER CONTROL

DESCRIPTION

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 suggested operation and use of these controls.

OPERATION

The heater-only or heater-A/C control panel is located in the instrument panel center bezel below the radio and above the accessory switch bezel and ash receiver. The control panel contains a rotary-type temperature control, a rotary-type mode control switch, and a rotary-type blower motor speed switch.

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, the blower motor switch, and the control knobs are available for service replacement.

HEATER AND AIR CONDITIONER

DESCRIPTION

All vehicles are equipped with a common heater-A/C housing assembly (Fig. 4). 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.

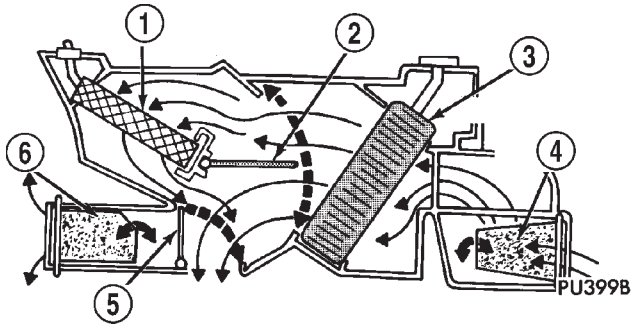


Fig. 4 Common Blend-Air Heater-Air Conditioner System - Typical

1 – HEATER CORE
2 – BLEND-AIR DOOR
3 – EVAPORATOR A/C ONLY
4 – RECIRCULATING AIR DOOR A/C ONLY
5 – FLOOR/PANEL DOOR
6 – FLOOR/DEFROST DOOR

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.

DESCRIPTION AND OPERATION (Continued)

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 actuating an electric motor, which operates 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.

HEATER CORE

DESCRIPTION

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.

OPERATION

Engine coolant is circulated through heater hoses to the heater core at all times. As the coolant flows through the heater core, heat removed from the engine is transferred to the heater core fins and tubes. Air directed through the heater core picks up the heat from the heater core fins. The 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

DESCRIPTION

The high pressure cut-off switch is located on the discharge line near the compressor. The switch is screwed onto a discharge line fitting that contains a Schrader-type valve, which allows the switch to be serviced without discharging the refrigerant system. The discharge line fitting is equipped with an O-ring to seal the switch connection.

OPERATION

The 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

DESCRIPTION

A high pressure relief valve is located on the compressor manifold, which is on the side of the compressor. This mechanical valve is designed to vent refrigerant from the system to protect against damage to the compressor and other system components, caused by condenser air flow restriction or an overcharge of refrigerant.

OPERATION

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 con-

DESCRIPTION AND OPERATION (Continued)

served 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

DESCRIPTION

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.

OPERATION

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

DESCRIPTION

The refrigerant used in this air conditioning system is a HydroFluoroCarbon (HFC), type R-134a. Unlike R-12, which is a ChloroFluoroCarbon (CFC), R-134a refrigerant does not contain ozone-depleting chlorine. R-134a refrigerant is a non-toxic, non-flammable, clear, and colorless liquefied gas.

Even though R-134a does not contain chlorine, it must be reclaimed and recycled just like CFC-type refrigerants. This is because R-134a is a greenhouse gas and can contribute to global warming.

OPERATION

R-134a refrigerant is not compatible with R-12 refrigerant in an air conditioning system. Even a small amount of R-12 added to an R-134a refrigerant system will cause compressor failure, refrigerant oil sludge or poor air conditioning system performance. In addition, the PolyAlkylene Glycol (PAG) synthetic refrigerant oils used in an R-134a refrigerant system are not compatible with the mineral-based refrigerant oils used in an R-12 refrigerant system.

R-134a refrigerant system service ports, service tool couplers and refrigerant dispensing bottles have all been designed with unique fittings to ensure that an R-134a system is not accidentally contaminated with the wrong refrigerant (R-12). There are also labels posted in the engine compartment of the vehicle and on the compressor identifying to service technicians that the air conditioning system is equipped with R-134a.

REFRIGERANT LINES

DESCRIPTION

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.

OPERATION

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 stat-O seal type flat steel gasket with a captured compressible O-ring, is used to

DESCRIPTION AND OPERATION (Continued)

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 COUPLERS

DESCRIPTION

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.

OPERATION

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.

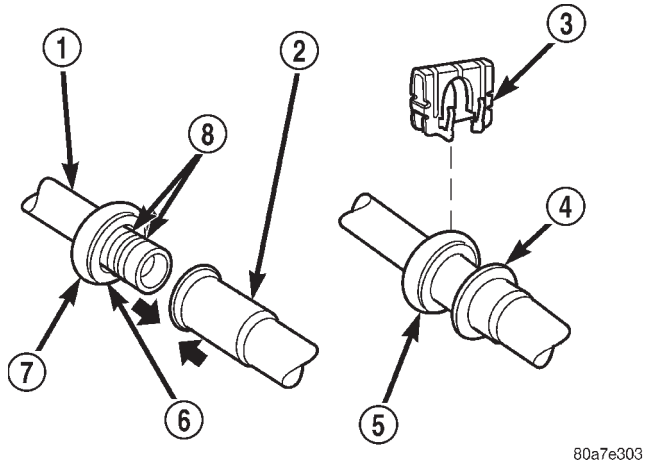


Fig. 5 Spring-Lock Coupler - Typical

1 – MALE HALF SPRING-LOCK COUPLER
2 – FEMALE HALF SPRING-LOCK COUPLER
3 – SECONDARY CLIP
4 – CONNECTION INDICATOR RING
5 – COUPLER CAGE
6 – GARTER SPRING
7 – COUPLER CAGE
8 – "O" RINGS

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

DESCRIPTION

The refrigerant oil used in R-134a refrigerant systems is a synthetic-based, PolyAlkylene Glycol (PAG), wax-free lubricant. Mineral-based R-12 refrigerant 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 10PA17 compressor used in this vehicle is designed to use an ND-8 PAG refrigerant oil. Use only refrigerant oil of this same type to service the refrigerant system.

OPERATION

After performing any refrigerant recovery or recycling operation, always replenish the refrigerant system with the same amount of the recommended refrigerant oil as was removed. Too little refrigerant oil can cause compressor damage, and too much can reduce air conditioning system performance.

PAG refrigerant oil is much more hygroscopic than mineral oil, and will absorb any moisture it comes into contact with, even moisture in the air. The PAG oil container should always be kept tightly capped until it is ready to be used. After use, recap the oil container immediately to prevent moisture contamination.

REFRIGERANT SYSTEM SERVICE PORT

DESCRIPTION

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.

DESCRIPTION AND OPERATION (Continued)

OPERATION

The high pressure service port is located on the refrigerant line, near the discharge port of the compressor. The low pressure service port is located on the liquid line at the rear of the engine compartment, near the evaporator inlet tube.

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

DESCRIPTION

A vacuum check valve is installed in the accessory vacuum supply line in the engine compartment, near the vacuum tap on the engine intake manifold, and at the HVAC unit takeout. The vacuum check valve is designed to allow vacuum to flow in only one direction through the accessory vacuum supply circuits.

OPERATION

The use of a vacuum check valve helps to maintain the system vacuum needed to retain the selected 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

DESCRIPTION

The vacuum reservoir is mounted to the rear of the right front inner fender wheelhouse in the engine compartment, under the battery tray. The battery and battery tray must be removed from the vehicle to access the vacuum reservoir for service.

OPERATION

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.

DIAGNOSIS AND TESTING (Continued)

(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. 6). 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.

(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.

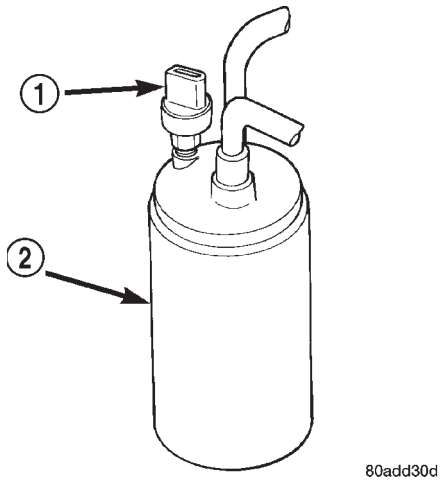


Fig. 6 Low Pressure Cycling Clutch Switch - Typical

1 – LOW PRESSURE CYCLING CLUTCH SWITCH
2 – ACCUMULATOR

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.

DIAGNOSIS AND TESTING (Continued)

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 fuseblock module. 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.

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 connections
- 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

DIAGNOSIS AND TESTING (Continued)

- Faulty blower motor relay
- 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.

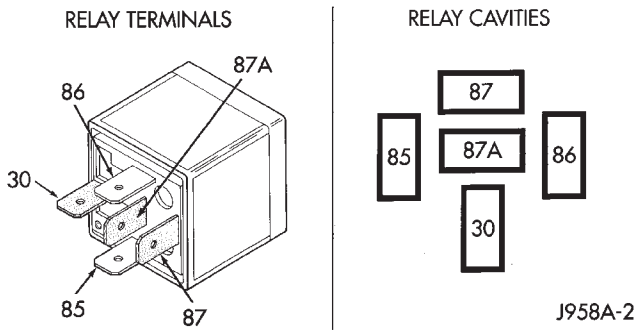
RELAY TEST

The blower motor relay (Fig. 7) 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.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 7 Blower Motor Relay

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to the blower motor. This terminal supplies fused battery feed directly from a fuse in the Power Distribution Center (PDC) when the relay is energized, and ignition switched battery feed from a fuse in the fuseblock module through the blower motor resistor when the relay is de-energized. There should be continuity between this cavity and the blower motor feed circuit cavity of the blower motor wire harness connector at all times. If OK, go to Step 2. If not OK, repair the open circuit as required.

(2) The relay normally closed terminal cavity (87A) is connected to the blower motor resistor output. When the relay is de-energized, terminal 87A is connected to terminal 30 and provides the blower motor resistor output to the blower motor feed circuit. There should be continuity between this cavity and the blower resistor outputs circuit cavity of the blower motor resistor wire harness connector at all times. If OK, go to Step 3. If not OK, repair the open circuit as required.

(3) The relay normally open terminal cavity (87) is connected to a fused battery feed from the PDC. When the relay is energized, terminal 87 is connected to terminal 30 and provides full battery current to the blower motor feed circuit. There should be battery voltage at this cavity at all times. If OK, go to Step 4. If not OK, repair the open circuit to the PDC as required.

(4) The coil battery terminal cavity (86) is connected to the high speed output contacts of the blower motor switch. When the blower motor switch is placed in the high speed position, fused ignition

DIAGNOSIS AND TESTING (Continued)

switch output is directed to the relay electromagnetic coil to energize the relay. There should be continuity between the cavity for relay terminal 86 and the high blower motor relay control circuit cavity of the blower motor switch wire harness connector at all times. If OK, go to Step 5. If not OK, repair the open circuit as required.

(5) The coil ground terminal cavity (85) is connected to ground. This terminal supplies the ground for the relay electromagnet coil. There should be continuity between the cavity for relay terminal 85 and a good ground at all times. If not OK, repair the open circuit as required.

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) Turn the ignition switch to the On position and check for battery voltage at the fuse in the fuseblock module. If OK, go to Step 2. If not OK, 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, but do not unplug the 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 (run) circuit cavity of the heater-A/C mode control switch wire harness connector. If OK, go to Step 3. If not OK, repair the open circuit to the fuseblock module as required.

(3) Select any one of the heater-A/C mode control positions except Off to turn the system on. Check for battery voltage at the low blower motor driver circuit cavity of the heater-A/C mode control switch wire harness connector. If OK, go to Step 4. If not OK, replace the faulty heater-A/C mode control switch.

(4) Check for battery voltage at the low blower motor driver circuit cavity of the blower motor switch wire harness connector. If OK, go to Step 5. If not OK, repair the open circuit to the heater-A/C mode control switch wire harness connector as required.

(5) Check for battery voltage at each of the remaining blower motor switch wire harness connector cavities as you move the switch to each blower motor speed position. Voltage should be present in each cavity at only one switch position. If OK, see the diagnosis for the blower motor resistor and/or the blower motor relay in this group. If not OK, replace the faulty blower motor switch.

COMPRESSOR

When investigating an air conditioning related noise, you must first know the conditions under which the noise occurs. These conditions include: weather, vehicle speed, transmission in gear or neutral, engine 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

DIAGNOSIS AND TESTING (Continued)

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 fuseblock module 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 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

For circuit descriptions and diagrams, refer to 8W-42 - Air Conditioning/Heater in Group 8W - Wiring Diagrams.

RELAY TEST

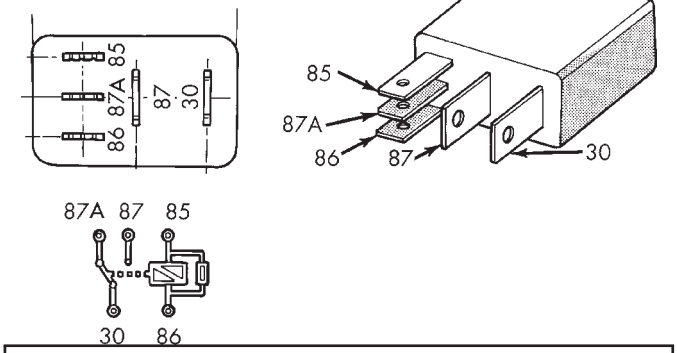
The compressor clutch relay (Fig. 8) is located in the Power Distribution Center (PDC). Refer to the PDC label for relay identification and location. Remove the relay from the PDC to perform the following tests:

(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.

DIAGNOSIS AND TESTING (Continued)

(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.



TERMINAL LEGEND	
NUMBER	**IDENTIFICATION**
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 8 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 fuseblock module as required.

(5) The coil ground terminal cavity (85) is switched to ground through the Powertrain Control Module (PCM). There should be continuity between this cavity and the A/C compressor clutch relay control circuit cavity of the PCM 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.

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.

DIAGNOSIS AND TESTING (Continued)

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 assembly in the control head.
- The electric blend-air door motor.
- Any associated wiring harness or connectors.
- 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 wire harness connector from the high pressure cut-off 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.

Also verify that the refrigerant system has the correct refrigerant charge. See Refrigerant System Charge in this group for the procedures.

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 in this group for the procedures.

(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.

DIAGNOSIS AND TESTING (Continued)

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-A/C housing. Testing of the heater-A/C mode control switch operation will determine if the vacuum, and mechanical controls are functioning. However, it is possible that a vacuum control system that operates perfectly at engine idle (high engine vacuum) may not function properly at high engine speeds or loads (low engine vacuum). This can be caused by leaks in the vacuum system, or a faulty vacuum check valve.

A vacuum system test will help to identify the source of poor vacuum system performance or vacuum system leaks. Before starting this test, stop the engine and make certain that the problem isn't a disconnected vacuum supply tube at the engine intake manifold vacuum tap or the vacuum reservoir.

Use an adjustable vacuum test set (Special Tool C-3707-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. 9), 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.

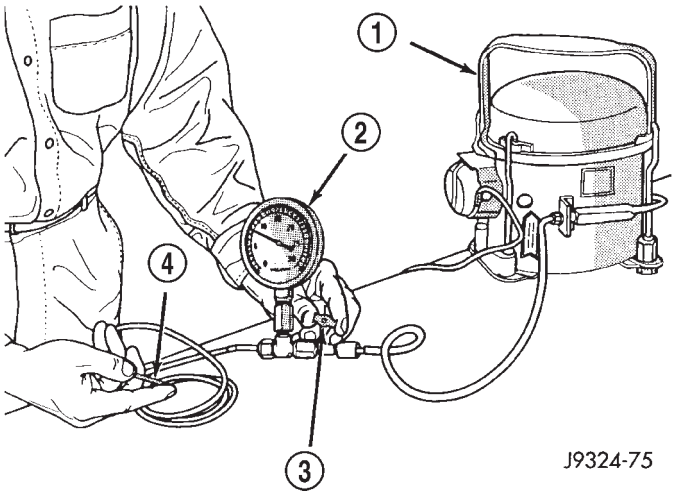


Fig. 9 Adjust Vacuum Test Bleed Valve

1 – VACUUM PUMP TOOL C-4289
2 – VACUUM TEST SET C-3707
3 – BLEED VALVE
4 – PROBE

VACUUM CHECK VALVE

(1) Remove the vacuum check valve. The valve is located in the (black) vacuum supply tube at the intake manifold vacuum tap.

(2) Connect the test set vacuum supply hose to the heater-A/C system (natural color) side of the valve. When connected to this side of the check valve, no vacuum should pass and the test set gauge should return to the 27 kPa (8 in. Hg.) setting. If OK, go to Step 3. If not OK, replace the faulty valve.

(3) Connect the test set vacuum supply hose to the engine vacuum (black color) side of the valve. When connected to this side of the check valve, vacuum should flow through the valve without restriction. If not OK, replace the faulty valve.

DIAGNOSIS AND TESTING (Continued)

HEATER-A/C CONTROLS

(1) Connect the test set vacuum probe to the heater-A/C vacuum supply (black) tube in the engine compartment. Position the test set gauge so that it can be viewed from the passenger compartment.

(2) Place the heater-A/C mode control switch knob in each mode position, one 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 near the back of the heater-A/C mode control switch on the control panel.

(2) Connect the test set vacuum hose probe to each port in the vacuum harness connector, one port at a time, and pause after each connection (Fig. 10). The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty mode control switch. If not OK, go to Step 3.

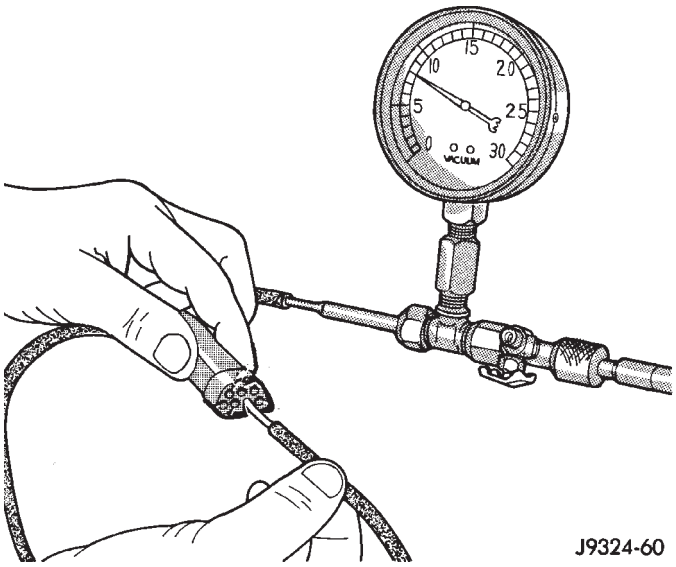


Fig. 10 Vacuum Circuit Test

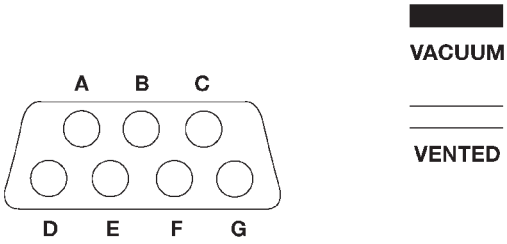
(3) Determine the vacuum line color of the vacuum circuit that is leaking. To determine the vacuum line colors, refer to the Vacuum Circuits chart (Fig. 11) or (Fig. 12).

(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.

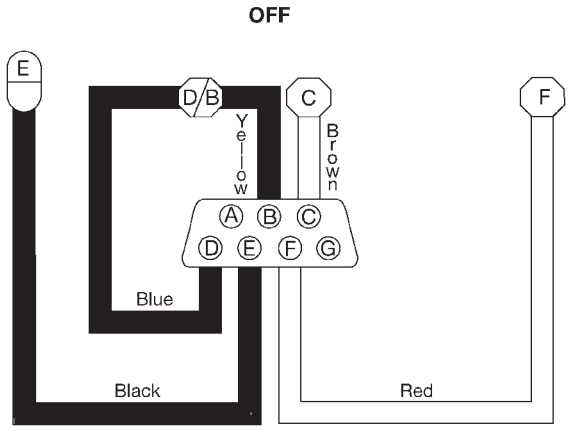
(5) Connect the test set hose or probe to the open end of the leaking circuit. The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty disconnected component. If not OK, go to Step 6.

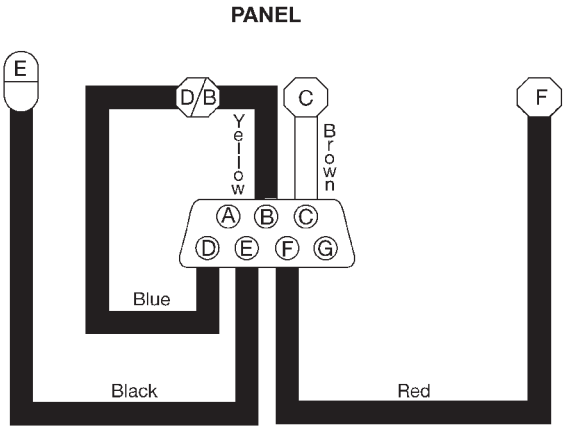
(6) To locate a leak in a vacuum line, leave one end of the line plugged and connect the test set hose or probe to the other end. Run your fingers slowly along the line while watching the test set gauge. The vacuum reading will fluctuate when your fingers contact the source of the leak. To repair the 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 (1/8-inch) inside diameter rubber hose.

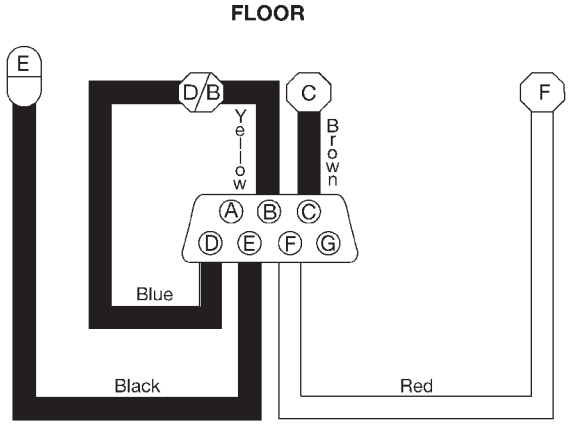
DIAGNOSIS AND TESTING (Continued)

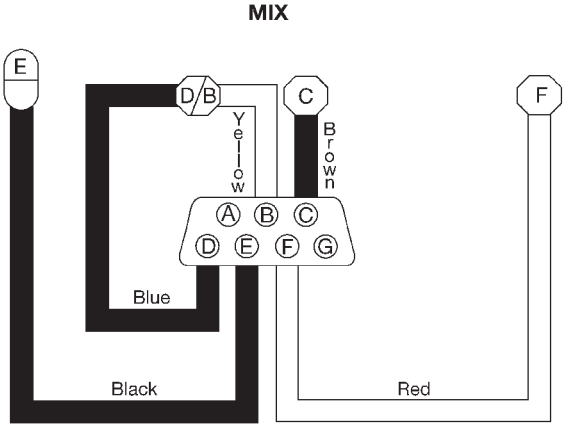


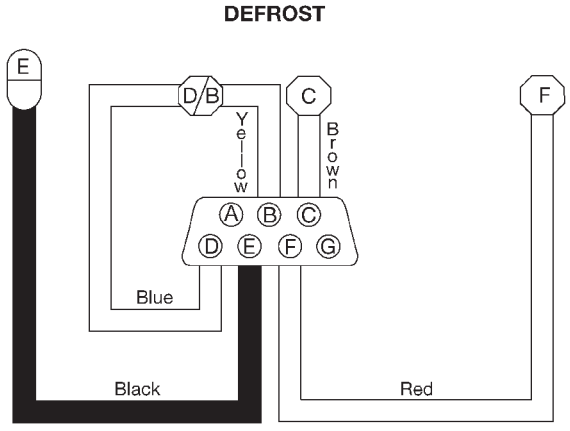
VACUUM CIRCUIT LEGEND		
I. D.	Function	Color
A	Not Used	N/A
B	Defrost Actuator (Full Position)	Yellow
C	Floor Actuator	Brown
D	Defrost Actuator (Mid-Position)	Blue
E	Vacuum Supply (Reservoir)	Black
F	Panel Actuator	Red
G	Recirculation Actuator	Green







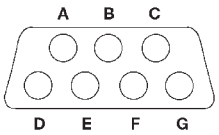




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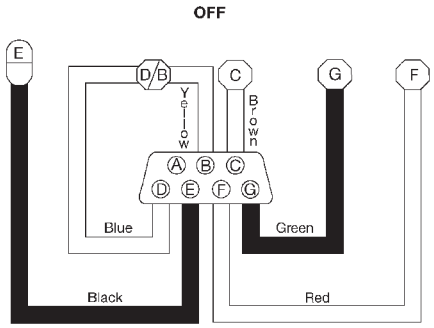
Fig. 11 Vacuum Circuits - Heater Only

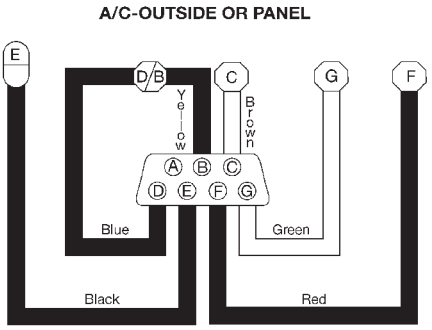
DIAGNOSIS AND TESTING (Continued)

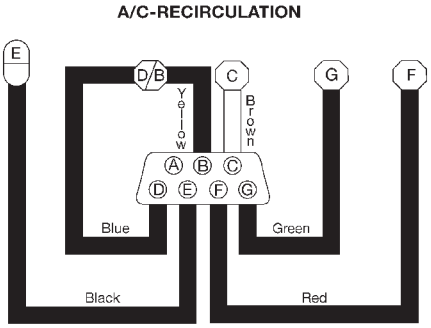


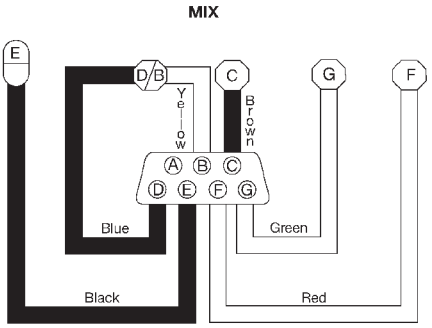


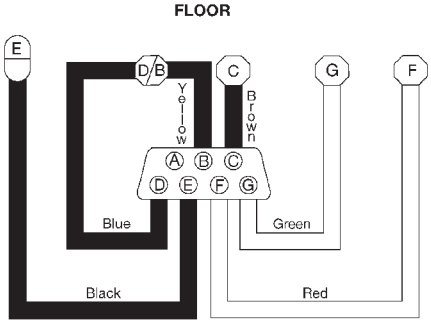
VACUUM CIRCUIT LEGEND		
I. D.	Function	Color
A	Not Used	N/A
B	Defrost Actuator (Full Position)	Yellow
C	Floor Actuator	Brown
D	Defrost Actuator (Mid-Position)	Blue
E	Vacuum Supply (Reservoir)	Black
F	Panel Actuator	Red
G	Recirculation Actuator	Green











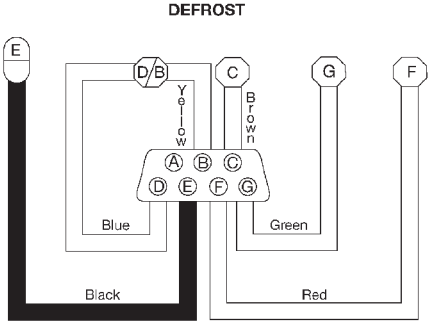


Fig. 12 Vacuum Circuits - Heater-A/C

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SERVICE PROCEDURES

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	180	6.1
Accumulator	90	3
Condenser	22	.75
Evaporator	45	1.5
Compressor	drain and measure the oil from the old compressor as noted	

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 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 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

SERVICE PROCEDURES (Continued)

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 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. 13). The service hoses on the gauge set being used should have manual (turn wheel), or automatic back-flow valves at the service port connector ends. This will prevent refrigerant from being released into the atmosphere.

MANIFOLD GAUGE SET CONNECTIONS

CAUTION: Do not use an R-12 manifold gauge set on an R-134a system. The refrigerants are not compatible and system damage will result.

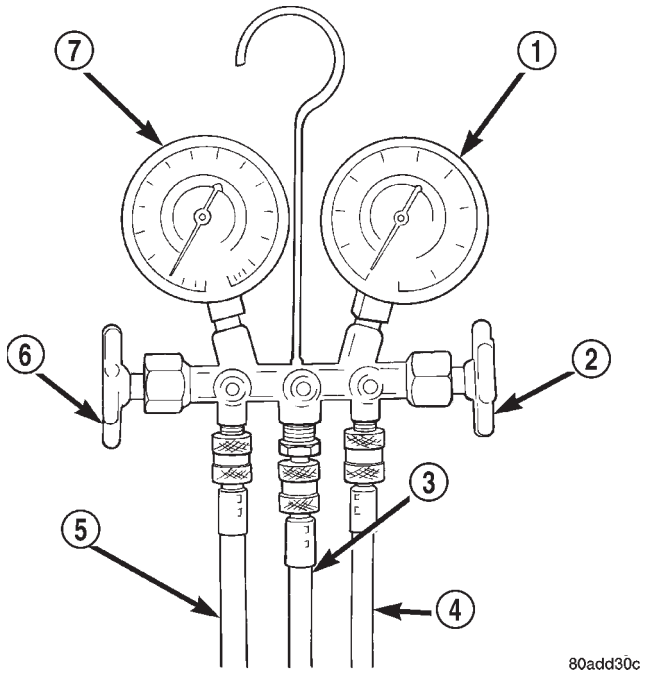


Fig. 13 Manifold Gauge Set - Typical

1 – HIGH PRESSURE GAUGE
2 – VALVE
3 – VACUUM/REFRIGERANT HOSE (YELLOW W/BLACK STRIPE)
4 – HIGH PRESSURE HOSE (RED W/BLACK STRIPE)
5 – LOW PRESSURE HOSE (BLUE W/BLACK STRIPE)
6 – VALVE
7 – LOW PRESSURE GAUGE

LOW PRESSURE GAUGE HOSE The low pressure hose (Blue with Black stripe) attaches to the suction service port. This port is located on the liquid line near the evaporator inlet tube at the rear of the engine compartment.

HIGH PRESSURE GAUGE HOSE The high pressure hose (Red with Black stripe) attaches to the discharge service port. This port is located on the manifold directly over the discharge port of the compressor.

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.

REMOVAL AND INSTALLATION

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.**

REMOVAL AND INSTALLATION (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.

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) Remove the plastic clip that secures the liquid line to the accumulator outlet tube near the dash panel.

(5) Loosen the screw that secures the accumulator retaining band to the support bracket on the dash panel (Fig. 14).

(6) 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.

(7) 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.

(8) 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.

(9) Remove the accumulator from the vehicle.

REMOVAL AND INSTALLATION (Continued)

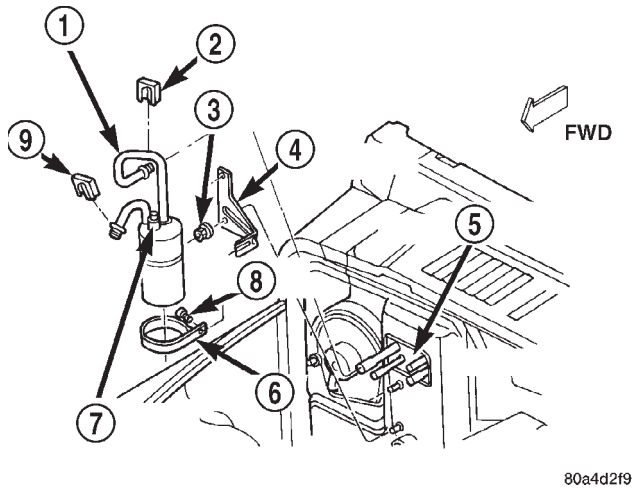


Fig. 14 Accumulator Remove/Install

1 – ACCUMULATOR
2 – CLIP
3 – NUT
4 – BRACKET
5 – EVAPORATOR
6 – BAND
7 – LOW PRESSURE CYCLING CLUTCH SWITCH
8 – SCREW
9 – CLIP

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 4.5 N·m (40 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) Install the plastic clip that secures the liquid line to the accumulator outlet tube near the dash panel.

(6) Plug the wire harness connector into the low pressure cycling clutch switch.

(7) Connect the battery negative cable.

(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.

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.

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 secure the blend-air door motor to the housing (Fig. 15).

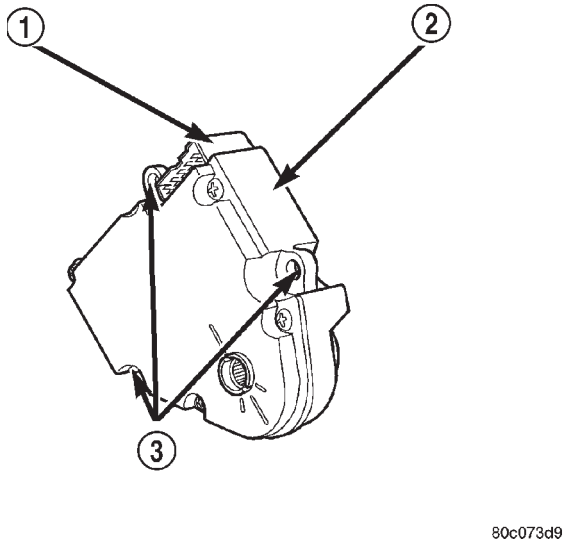


Fig. 15 Blend-Air Door Motor

1 – ELECTRICAL CONNECTOR
2 – BLEND-AIR DOOR MOTOR
3 – SCREW MOUNTING POINTS

(4) Remove the blend-air door motor.

INSTALLATION

(1) Reverse the removal procedures for installation.

REMOVAL AND INSTALLATION (Continued)

(2) Install and tighten the screws that secures the blend-air door motor to the housing. Tighten the mounting screws to 1 N·m (10 in. lbs.).

(3) Connect the battery negative cable.

BLOWER MOTOR

REMOVAL

(1) Remove the battery from the battery tray. Refer to Group 8A - Battery for the procedures.

(2) Remove the three screws that secure the Powertrain Control Module (PCM) to the mounting bracket on the engine compartment side of the dash panel. Move the PCM away from the blower motor opening in the dash panel (Fig. 16).

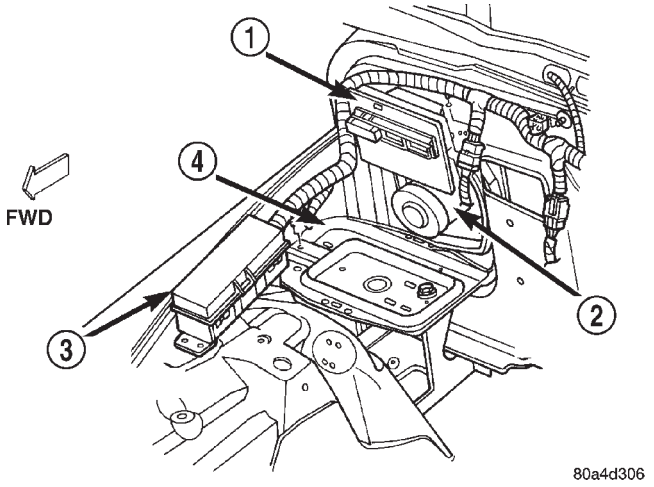


Fig. 16 Powertrain Control Module (PCM) Remove/Install

1 – POWERTRAIN CONTROL MODULE
2 – BLOWER MOTOR
3 – POWER DISTRIBUTION CENTER
4 – BATTERY TRAY

(3) Unplug the blower motor wire harness connector (Fig. 17).

(4) Remove the three screws that secure the blower motor and wheel assembly to the heater-A/C housing.

(5) 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.

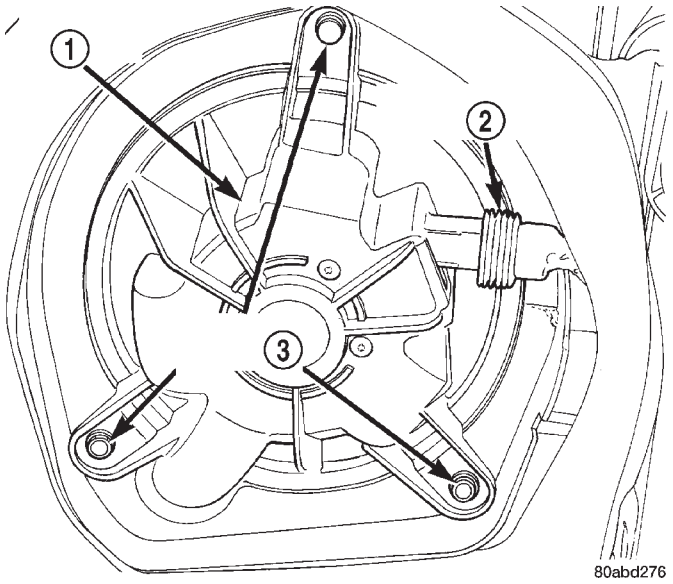


Fig. 17 Blower Motor Remove/Install

1 – BLOWER MOTOR
2 – WIRE HARNESS CONNECTOR
3 – MOUNTING SCREWS

(4) Position the PCM to the mounting bracket on the dash panel. Install and tighten the three screws that secure the PCM to the dash panel mounting bracket.

(5) Install the battery in the battery tray. Refer to Group 8A - Battery 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.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

(3) Locate the blower motor relay through the instrument panel glove box opening. The relay is mounted upright and to the right of the instrument panel harness. (Fig. 18).

(4) Unplug the blower motor relay from its wire harness connector.

REMOVAL AND INSTALLATION (Continued)

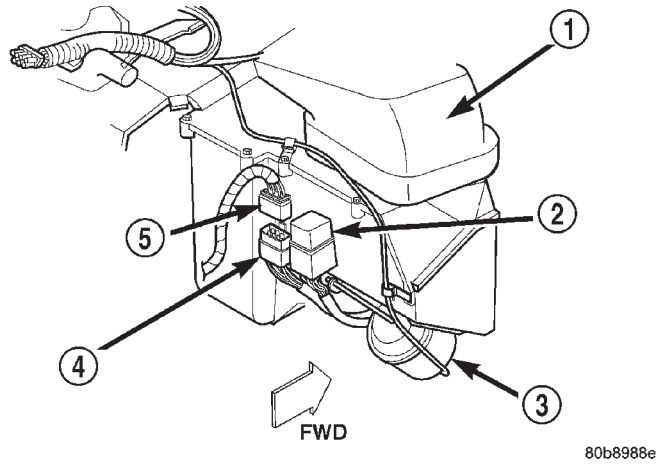


Fig. 18 Blower Motor Relay Remove/Install

1 – HEATER-A/C HOUSING
2 – BLOWER MOTOR RELAY
3 – VACUUM ACTUATOR
4 – HEATER-A/C WIRE HARNESS
5 – INSTRUMENT PANEL WIRE HARNESS

INSTALLATION

(1) 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.

(2) Reinstall the glove box in the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

(3) Connect the battery negative cable.

(4) 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. 19).

(4) Depress the latch on the blower motor resistor wire harness connector and unplug the connector from the resistor.

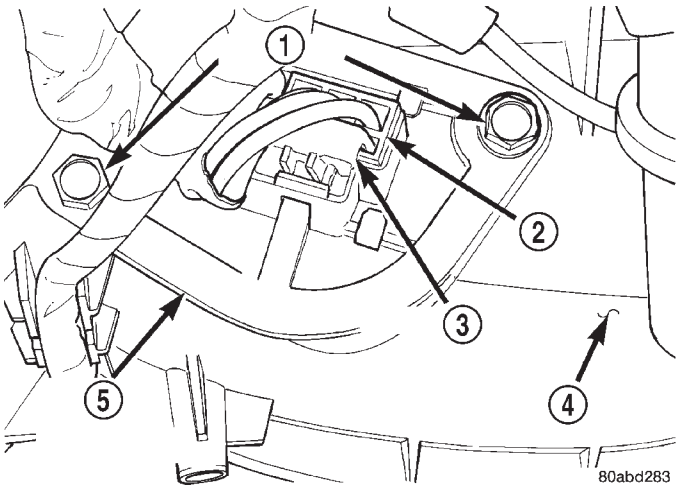


Fig. 19 Blower Motor Resistor Remove/Install

1 – SCREWS
2 – WIRE HARNESS CONNECTOR
3 – CONNECTOR LOCK
4 – HEATER-A/C HOUSING
5 – BLOWER MOTOR 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.).

BLOWER MOTOR 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) Using a trim stick or another suitable wide flat-bladed tool, gently pry the blower motor switch knob off of the switch stem from the front of the heater-A/C control.

(3) Remove the heater-A/C control from the instrument panel. See Heater-A/C Control in this group for the procedures.

(4) Remove the screw that secures the blower motor switch to the rear of the heater-A/C control (Fig. 20).

REMOVAL AND INSTALLATION (Continued)

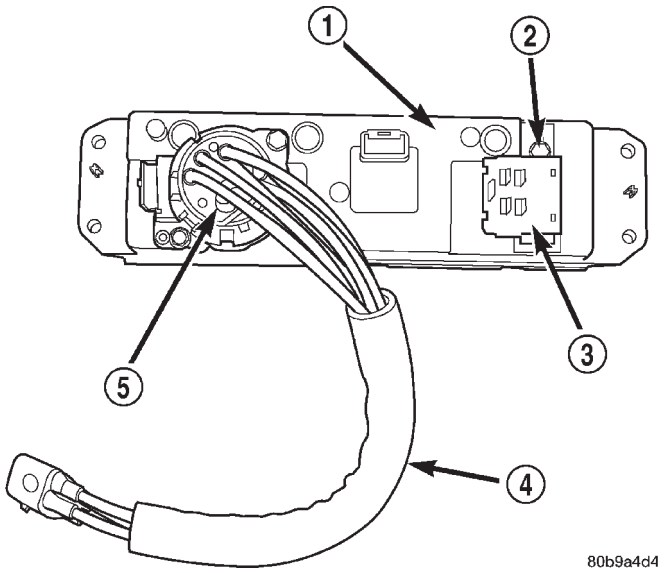


Fig. 20 Blower Motor Switch Remove/Install

1 – HEATER-A/C CONTROL
2 – SINGLE MOUNTING SCREW
3 – BLOWER MOTOR SWITCH
4 – VACUUM HARNESS
5 – VACUUM/ELECTRIC MODE SWITCH

(5) Remove the blower motor switch from the rear of the heater-A/C control.

INSTALLATION

(1) Reverse the removal procedures to install. Tighten the heater-A/C control and switch mounting screws to 2.2 N·m (20 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) Unplug the compressor clutch coil wire harness connector.

(5) Remove the screws that secure the suction line and discharge line block fittings to the manifold on the compressor (Fig. 21) and (Fig. 22). Install plugs in, or tape over all of the opened refrigerant fittings.

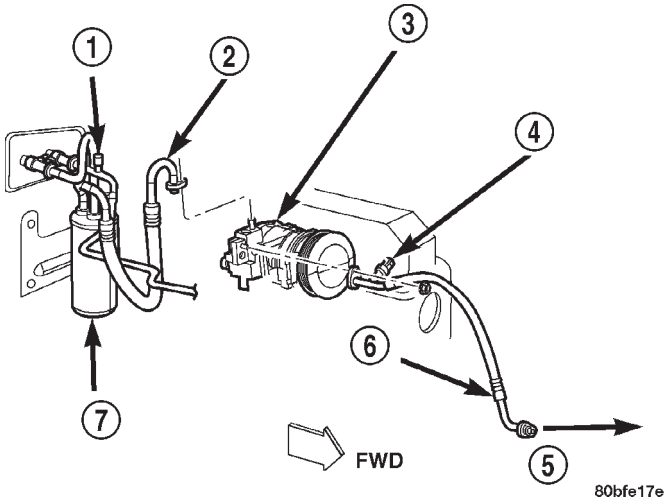


Fig. 21 Compressor Lines - 4 Cylinder Engine

1 – SERVICE PORT
2 – SUCTION LINE
3 – COMPRESSOR
4 – HIGH PRESSURE CUT-OFF SWITCH
5 – TO CONDENSER
6 – DISCHARGE LINE
7 – ACCUMULATOR

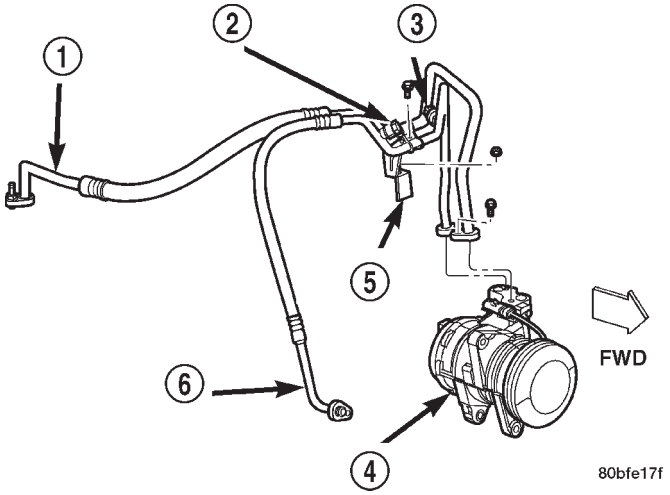


Fig. 22 Compressor Lines - 6 Cylinder Engine

1 – SUCTION LINE
2 – SERVICE PORT
3 – HIGH PRESSURE CUT-OFF SWITCH
4 – ENGINE MOUNTING BRACKET
5 – COMPRESSOR
6 – DISCHARGE LINE

REMOVAL AND INSTALLATION (Continued)

(6) Remove the screws that secure the compressor (Fig. 23) and (Fig. 24).

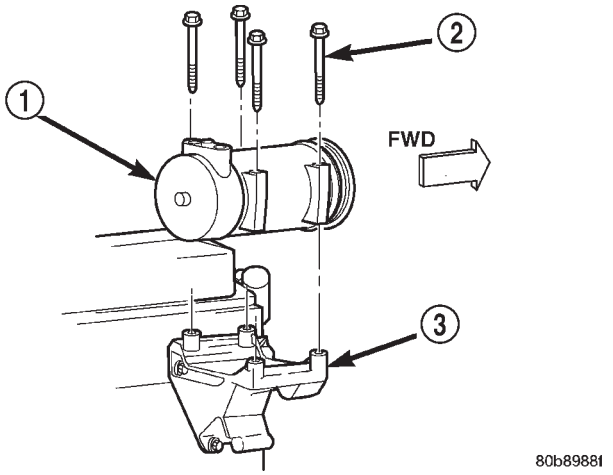


Fig. 23 Compressor - 4 Cylinder Engine

1 – A/C COMPRESSOR
2 – MOUNTING BOLTS
3 – A/C COMPRESSOR MOUNTING BRACKET

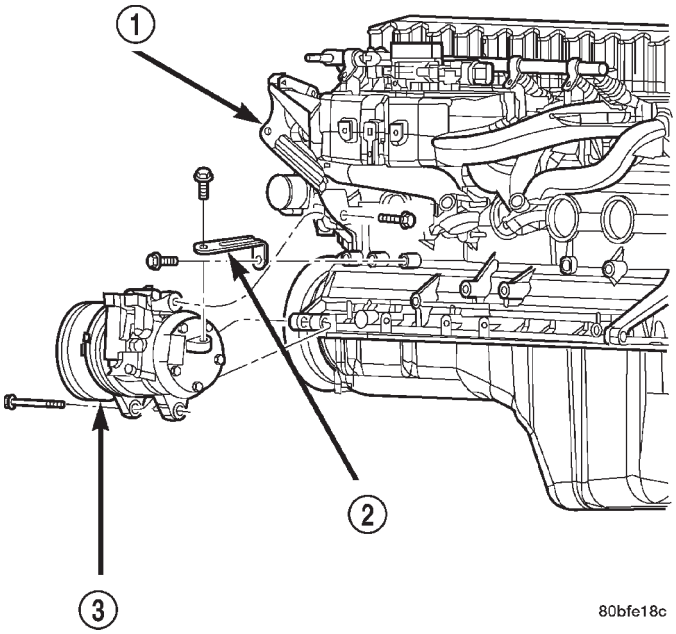


Fig. 24 Compressor - 6 Cylinder Engine

1 – POWER STEERING PUMP MOUNTING BRACKET
2 – BRACE
3 – A/C COMPRESSOR

(7) Remove the compressor.

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.
Tighten the 4.0L mounting bolts fastening the compressor to the block to 45-65 N·m (35-50 ft. lbs.). Tighten the mounting bolts holding the rear brace to the compressor and block to 40-55 N·m (30-40 ft. lbs.).
Tighten the 2.5L mounting bolts to 28 N·m (21 ft. lbs.).

(2) Remove the tape or plugs from all of the opened refrigerant line fittings. Install the suction line and discharge line block fittings to the manifold on the compressor. Tighten the mounting screws to 25.4 N·m (20 ft. lbs.).

(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) Remove the bolt that secures the compressor clutch to the compressor shaft (Fig. 25). A band-type oil filter wrench may be used to secure the clutch during bolt removal.

(4) Tap the clutch plate with a plastic mallet to release it from the splines on the compressor shaft. Remove the clutch plate and shim(s) from the compressor shaft (Fig. 26).

CAUTION: Do not pry between the clutch plate assembly and the pulley to remove it from the compressor shaft. Prying may damage the clutch plate assembly.

(5) Remove the external snap ring that secures the compressor clutch pulley to the nose of the compressor front housing with snap ring pliers (Special Tool C-4574) and slide the pulley assembly off of the compressor (Fig. 27).

REMOVAL AND INSTALLATION (Continued)

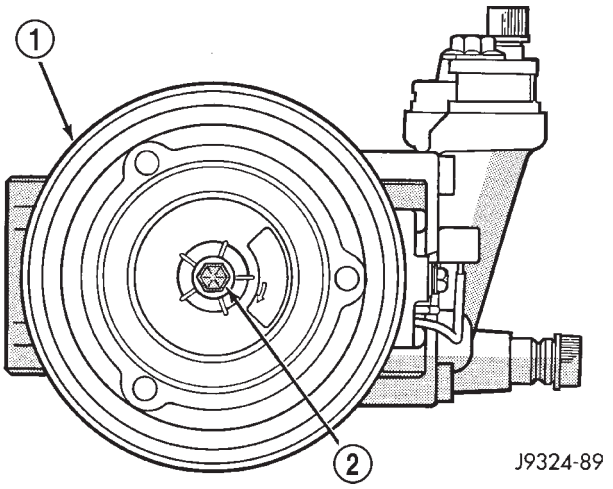


Fig. 25 Compressor Shaft Bolt

1 – COMPRESSOR CLUTCH PLATE
2 – COMPRESSOR SHAFT BOLT

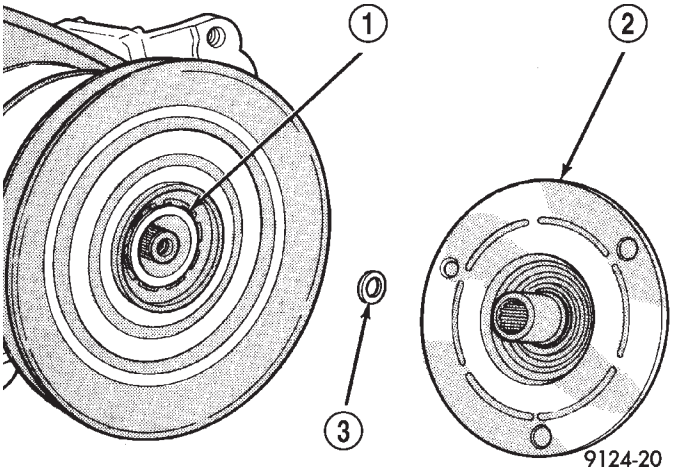


Fig. 26 Clutch Plate and Shim

1 – COMPRESSOR SHAFT
2 – CLUTCH PLATE
3 – CLUTCH PLATE SHIM

(6) Remove the screw and retainer from the clutch coil lead wire harness on the compressor front housing.

(7) Remove the external snap ring that secures the compressor clutch coil to the nose of the compressor front housing with snap ring pliers and slide the coil assembly off of the compressor (Fig. 28).

INSPECTION

Examine the friction surfaces of the clutch pulley and the clutch plate for wear. The pulley and 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 refrigerant oil.

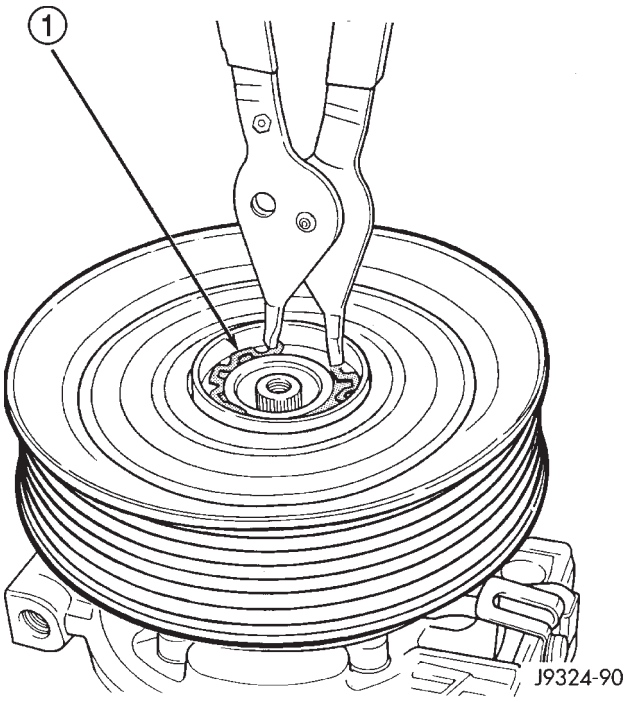


Fig. 27 Pulley Snap Ring

1 – SNAP RING

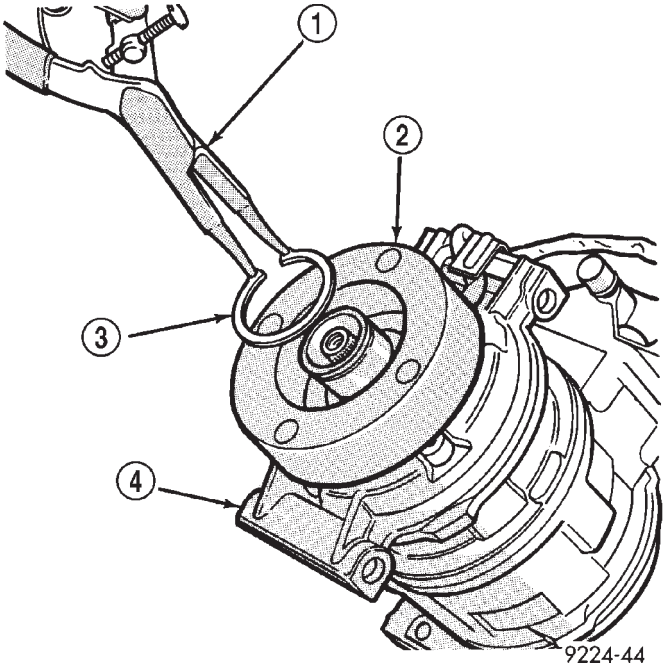


Fig. 28 Clutch Coil Snap Ring

1 – SNAP RING PLIERS
2 – CLUTCH COIL
3 – SNAP RING
4 – COMPRESSOR

Remove the felt wick from around the shaft inside the nose of the compressor front housing. If the felt is saturated with refrigerant oil, the compressor

REMOVAL AND INSTALLATION (Continued)

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) Align the dowel pin on the back of the clutch field coil with the hole in the compressor front housing and press the field coil into place over the nose of the compressor.

(2) Install the clutch coil lead wire harness retaining clip on the compressor front housing and tighten the retaining screw.

(3) Install the clutch field coil and snap ring with snap ring pliers (Special Tool C-4574). The bevel side of the snap ring must be facing outward. Also, both eyelets of the snap ring must be to the right or left of the pin on the compressor. Press in on the snap ring to be certain that 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.

(4) Install the pulley assembly onto the compressor. If necessary, place a block of wood on the friction surface and tap gently with a hammer (Fig. 29).

CAUTION: Do not mar the pulley friction surface.

(5) Install the pulley assembly retaining snap ring (bevel side outward) with snap ring pliers (Special Tool C-4574). Press in on the snap ring to be certain that it is properly seated in the groove.

(6) If the original clutch plate assembly and pulley assembly are to be reused, the old shim(s) can be used. If not, place a stack of shim(s) equal to the old shim(s) on the shaft against the shoulder.

(7) Install the clutch plate assembly onto the shaft.

(8) With the clutch plate assembly tight against the shim(s), measure the air gap between the clutch plate and the pulley face with feeler gauges. The air gap should be between 0.35 to 0.65 millimeter (0.014 to 0.026 inch). If the proper air gap is not obtained, add or subtract shims as needed until the desired air gap is obtained.

(9) Install the compressor shaft bolt. Tighten the bolt to 13 N·m (115 in. lbs.).

NOTE: The shims may compress after tightening the shaft bolt. Check the air gap in four or more places to verify the air gap is still correct. Spin the pulley before performing a final check of the air gap.

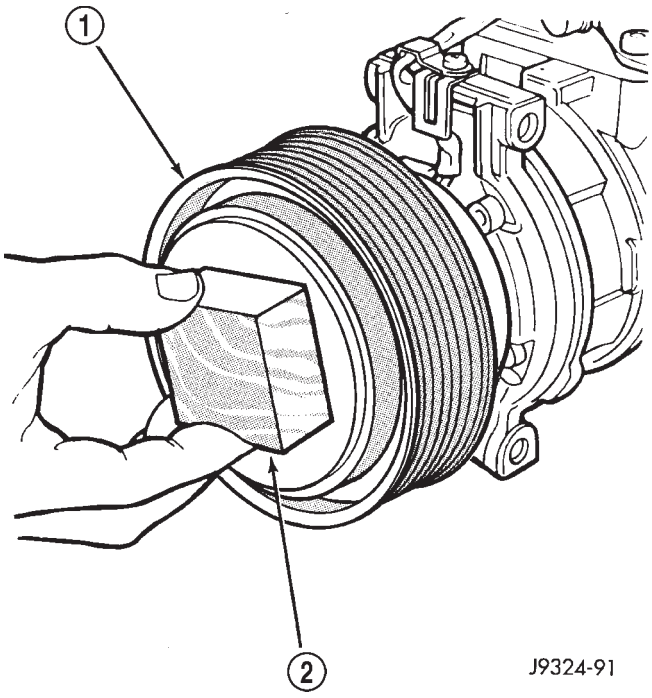


Fig. 29 Pulley Assembly Install

1 – PULLEY ASSEMBLY
2 – WOOD BLOCK

(10) 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 in the Recirculation Mode, the A/C button in the on position, 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).

(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)

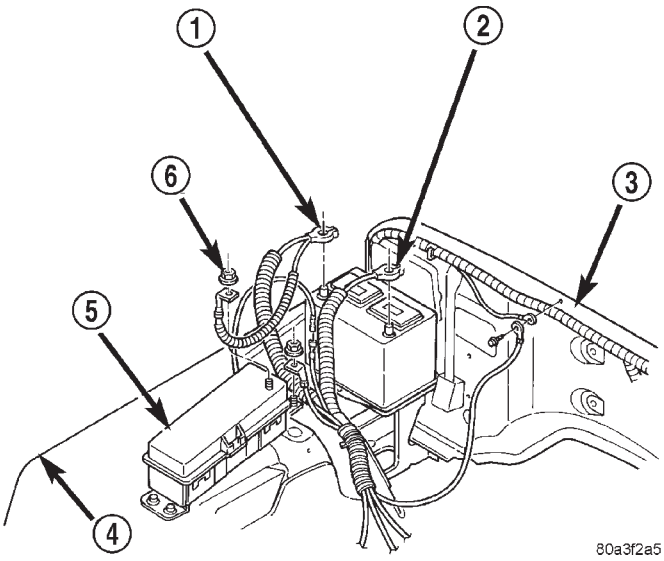


Fig. 30 Power Distribution Center

1 – POSITIVE CABLE
2 – NEGATIVE CABLE
3 – DASH PANEL
4 – FENDER
5 – POWER DISTRIBUTION CENTER
6 – NUT

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) Remove the three retainers that secure the upper condenser air seal to the grille panel and remove the upper air seal (Fig. 31).

(4) Remove the two screws that secure the upper condenser mounting brackets to the top of the grille panel.

(5) Reach through the right side of the grille panel opening from the front of the vehicle to remove the screws that secure the condenser inlet jumper tube and outlet jumper tube block fittings to the condenser. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the three retainers that secure the lower condenser air seal to the passenger side frame rail and the bottom of the grille panel and remove the lower air seal.

(7) Remove the two screws that secure the lower condenser mounting bracket to the bottom of the grille panel.

(8) Remove the three screws on each side of the radiator that secure the radiator mounting brackets to the sides of the grille panel.

(9) Tilt the radiator and shroud unit back towards the engine. Use care to prevent the cooling fan blades from damaging the radiator fins.

(10) Carefully lift the condenser out of the vehicle.

INSTALLATION

(1) Carefully position the condenser in the vehicle.

(2) Install and tighten the two screws that secure the upper condenser mounting brackets to the top of the grille panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Align the radiator mounting brackets to the sides of the grille panel. Install the six screws that secure the radiator and shroud unit to the grille panel. Tighten the screws to 8 N·m (72 in. lbs.).

(4) Install the upper condenser air seal to the top of the grille panel with three retainers.

(5) Remove the tape or plugs from the condenser and the inlet and outlet jumper tube refrigerant line block fittings. Reach through the grille opening from the front of the vehicle to install the inlet and outlet jumper tube block fittings to the condenser with two screws. Tighten the mounting screws to 12 N·m (105 in. lbs.).

(6) Install the two screws that secure the lower condenser bracket to the bottom of the grille panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(7) Install the lower condenser air seal to the bottom of the grille panel and the passenger side frame rail with three retainers.

(8) Connect the battery negative cable.

(9) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(10) 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.

REMOVAL AND INSTALLATION (Continued)

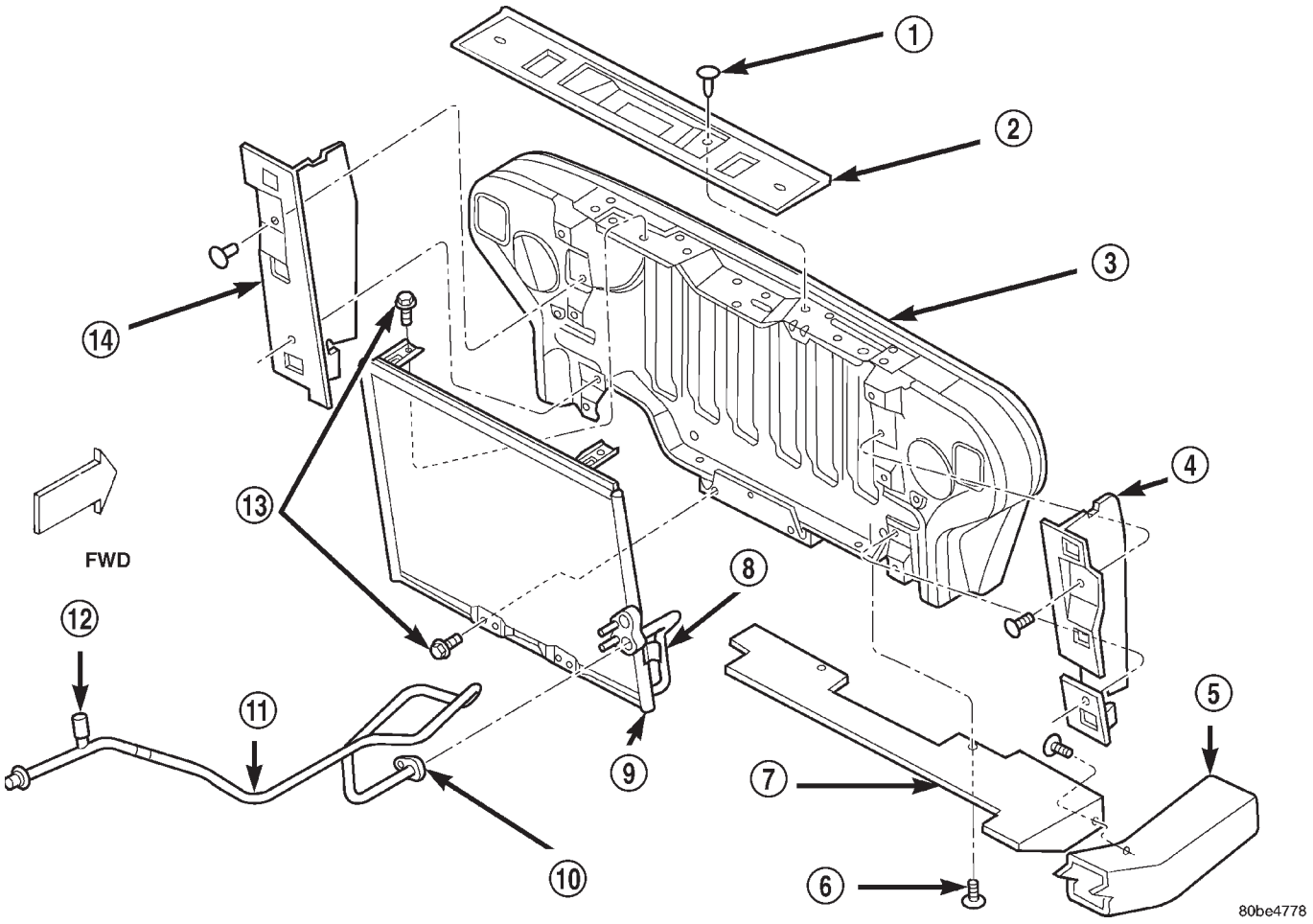


Fig. 31 Condenser Remove/Install

1 – RETAINER
2 – AIR SEAL
3 – GRILLE PANEL
4 – AIR SEAL
5 – FRAME RAIL
6 – RETAINER
7 – AIR SEAL
8 – TUBES AND FLANGES
9 – CONDENSER
10 – FIXED ORIFICE TUBE
11 – LIQUID LINE
12 – SERVICE PORT
13 – SCREWS
14 – AIR SEAL

DUCTS AND OUTLETS

Only the demister hoses and the panel outlet barrels can be removed without instrument panel assembly removal. Removal of the fresh air duct and collar requires that the heater-A/C housing also be partially removed. The panel outlet housings and demister outlets are serviced only as a part of the instrument panel or instrument panel center bezel.

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/DEMIST DUCT

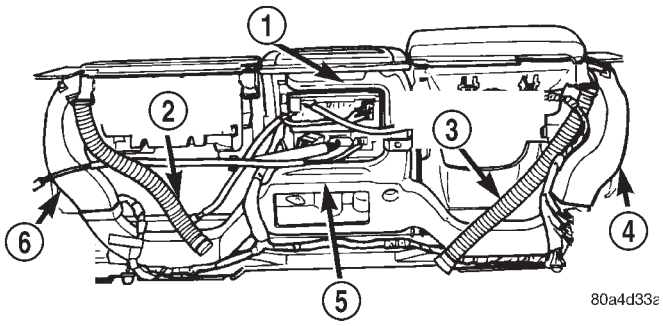
(1) Remove the instrument panel assembly from the vehicle. Refer to Group 8E - Instrument Panel Systems for the procedures.

(2) Remove the two push-nuts that secure the defrost/demist duct to the studs on the dash panel.

(3) Remove the defrost/demist duct from the studs on the dash panel.

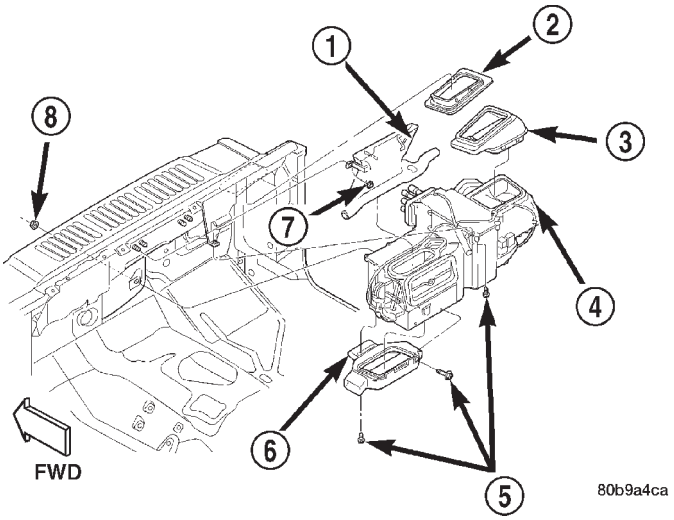
(4) Reverse the removal procedures to install.

REMOVAL AND INSTALLATION (Continued)



Instrument Panel Ducts and Outlets Remove/Install

1 – CENTER PANEL DUCT
2 – DEMISTER HOSE
3 – DEMISTER HOSE
4 – END PANEL DUCT
5 – MAIN PANEL DUCT
6 – END PANEL DUCT



Heater-A/C Housing Ducts Remove/Install

1 – DEFROST/DEMIST DUCT
2 – COLLAR
3 – FRESH AIR DUCT
4 – HEATER-A/C HOUSING
5 – SCREWS
6 – FLOOR DUCT
7 – NUT
8 – NUT

DEMISTER HOSES

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel to service the passenger side demister hose. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures. Remove the knee blocker from the instrument panel to service the driver side demister hose. Refer to Knee Blocker in Group 8E - Instrument Panel Systems for the procedures.

(3) Reach through the glove box opening or the steering column opening of the instrument panel to disconnect the ends of the demister hose from the demister outlet and the defrost/demist duct.

(4) Reverse the removal procedures to install.

FLOOR DUCT

(1) Remove the instrument panel from the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(2) Remove the two screws that secure the floor duct to the bottom of the heater-A/C housing.

(3) Release the snap clip that secures the floor duct to the dash panel side of the heater-A/C housing by pushing the snap clip towards the dash panel.

(4) Slide the floor duct out from under the heater-A/C housing.

(5) Reverse the removal procedures to install. Tighten the screws to 2.2 N·m (20 in. lbs.).

FRESH AIR DUCT AND COLLAR

(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 five nuts from the heater-A/C housing mounting studs on the engine compartment side of the dash panel. If necessary, loosen the battery hold-downs and reposition the battery for additional access. Refer to Group 8A - Battery for the procedures.

(3) Remove the floor duct from the bottom of the heater-A/C housing. See Floor Duct in this group for the procedures.

(4) Remove the one screw that secures the heater-A/C housing to the plenum bracket on the passenger compartment side of the dash panel.

(5) Push gently down on the top of the heater-A/C housing until sufficient clearance is obtained to unsnap the fresh air duct from the top of the heater-A/C housing.

(6) Remove the fresh air duct collar from the cowl plenum panel by reaching up above the heater-A/C housing fresh air duct opening and pulling the collar downward. The collar is retained in the cowl plenum panel by a light snap fit.

(7) Reverse the removal procedures to install. Tighten the plenum bracket screw to 3.4 N·m (30 in. lbs.). Tighten the dash panel mounting nuts to 6.2 N·m (55 in. lbs.).

PANEL DUCTS

(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 demister hoses from the demister outlets.

REMOVAL AND INSTALLATION (Continued)

(3) Remove the two screws from the center of the rearward facing side of the instrument panel that secure the main panel duct to the instrument panel base.

(4) Remove the one screw that secures each end panel duct and/or the center panel duct to the instrument panel base.

(5) Remove the panel ducts from the instrument panel.

(6) Reverse the removal procedures to install. Tighten the screws to 2.2 N·m (20 in. lbs.).

PANEL OUTLET BARRELS

(1) Using a trim stick or another suitable wide flat-bladed tool, gently pry the panel outlet barrel out of the panel outlet housing. The barrel is retained by a light snap fit.

(2) To install, position the barrel in the panel outlet housing and press in firmly and equally at both ends of the barrel until it snaps into place.

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. 32).

(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.

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.

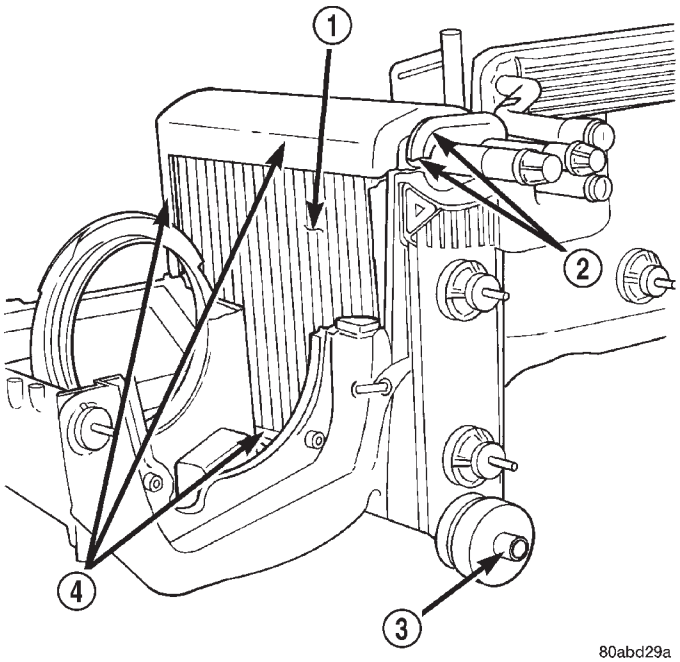


Fig. 32 Evaporator Coil Remove/Install

1 – EVAPORATOR COIL
2 – TUBE SEAL
3 – CONDENSATE DRAIN TUBE
4 – FOAM INSULATOR WRAP

(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. 33).

(3) Reverse the removal procedures to install. Be certain that the heater core foam insulator is reinstalled.

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.

REMOVAL AND INSTALLATION (Continued)

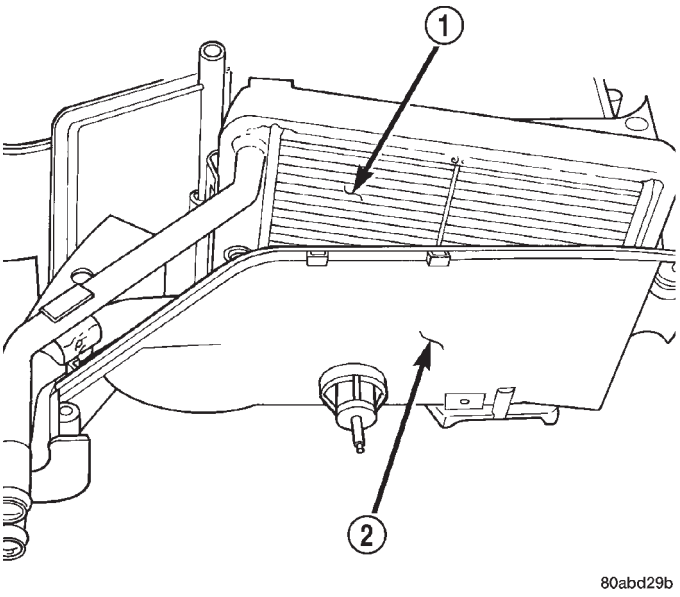


Fig. 33 Heater Core Remove/Install

1 – HEATER CORE
2 – LOWER HEATER-A/C HOUSING

(2) Remove the glove box from the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

(3) Remove the center bezel from the instrument panel. Refer to Instrument Panel Center Bezel in Group 8E - Instrument Panel Systems for the procedures.

(4) Reach through the instrument panel glove box opening to access and unplug the two halves of the heater-A/C vacuum harness connector.

(5) Remove the four screws that secure the heater-A/C control to the instrument panel (Fig. 34).

(6) Pull the heater-A/C control assembly away from the instrument panel far enough to access the connections on the back of the control.

(7) Unplug the three wire harness connectors from the back of the heater-A/C control (Fig. 35).

(8) Remove the heater-A/C control from the instrument panel.

INSTALLATION

(1) Plug the three wire harness connectors into the back of the heater-A/C control.

(2) 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.).

(3) Reach through the instrument panel glove box opening to reconnect the two halves of the heater-A/C vacuum harness connector.

(4) Reinstall the glove box in the instrument panel. Refer to Glove Box in Group 8E - Instrument Panel Systems for the procedures.

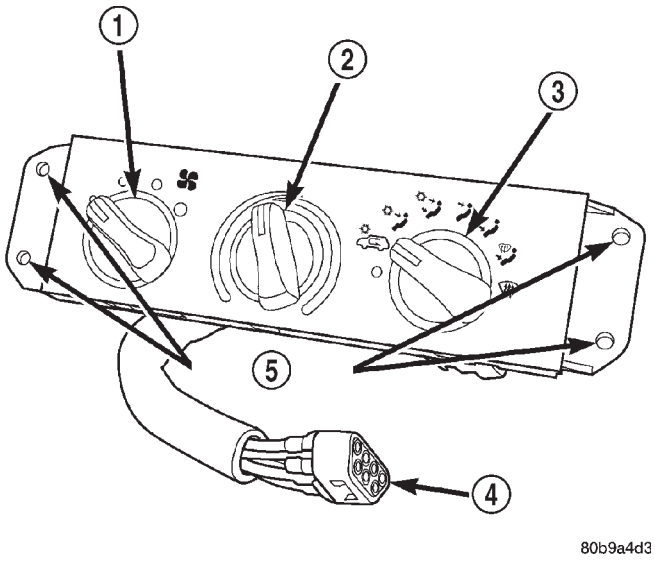


Fig. 34 Heater-A/C Control Remove/Install

1 – BLOWER MOTOR SWITCH
2 – TEMPERATURE CONTROL
3 – MODE SWITCH
4 – VACUUM HARNESS
5 – MOUNTING POINTS

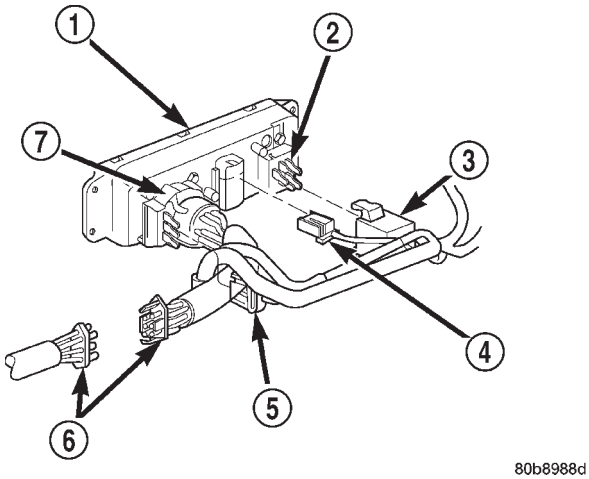


Fig. 35 Heater-A/C Control Connections

1 – HEATER-A/C CONTROL
2 – BLOWER MOTOR SWITCH
3 – BLOWER MOTOR SWITCH CONNECTOR
4 – TEMPERATURE CONTROL AND ILLUMINATION CONNECTOR
5 – MODE SWITCH CONNECTOR
6 – VACUUM HARNESS
7 – VACUUM/ELECTRIC MODE SWITCH

(5) Reinstall the center bezel onto the instrument panel. Refer to Instrument Panel Center Bezel in Group 8E - Instrument Panel Systems for the procedures.

(6) Connect the battery negative cable.

REMOVAL AND INSTALLATION (Continued)

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) Remove the five nuts from the heater-A/C housing mounting studs on the engine compartment side of the dash panel (Fig. 36). If necessary, loosen the battery holddowns and reposition the battery for additional access. Refer to Group 8A - Battery for the procedures.

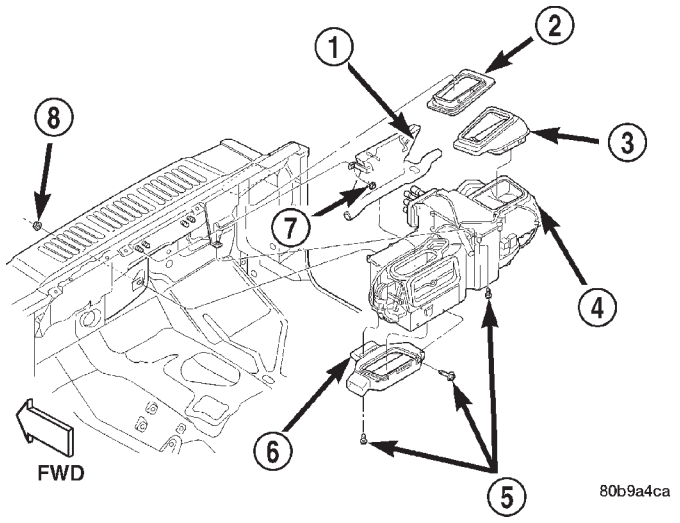


Fig. 36 Heater-A/C Housing Remove/Install

1 – DEFROST/DEMIST DUCT
2 – COLLAR
3 – FRESH AIR DUCT
4 – HEATER-A/C HOUSING
5 – SCREWS
6 – FLOOR DUCT
7 – NUT
8 – NUT

(10) Remove the cowl plenum drain tube from the heater-A/C housing mounting stud on the dash panel directly behind the engine cylinder head.

(11) Remove the floor duct from the bottom of the heater-A/C housing. See Floor Duct in this group for the procedures.

(12) Remove the one screw that secures the heater-A/C housing to the plenum bracket on the passenger compartment side of the dash panel.

(13) Pull the heater-A/C housing down far enough to clear the defrost/demist and fresh air ducts, and rearward far enough for the mounting studs and the evaporator condensate drain tube to clear the dash panel holes.

(14) 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.

REMOVAL AND INSTALLATION (Continued)

(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. 37).

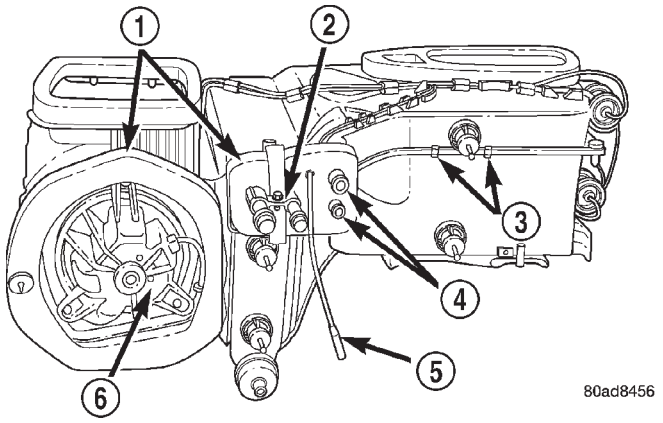


Fig. 37 Heater-A/C Housing Disassembly

1 – SEALS
2 – EVAPORATOR TUBE CLAMP
3 – CLIPS
4 – HEATER CORE TUBES
5 – VACUUM SUPPLY LINE
6 – BLOWER MOTOR

(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. 38).

(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.

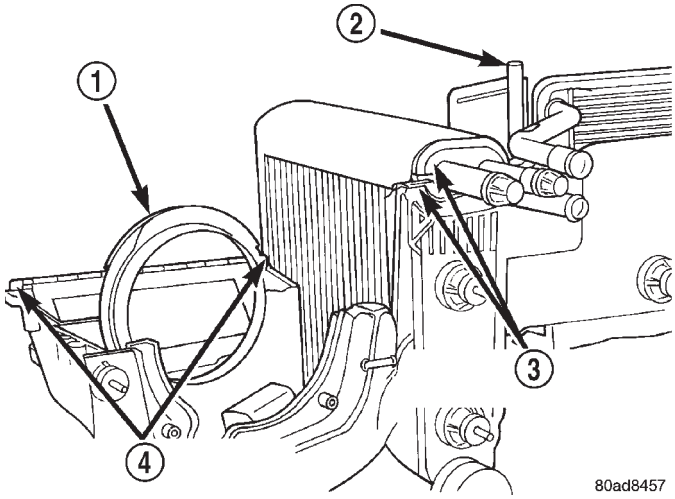


Fig. 38 Heater-A/C Housing Assembly

1 – BLOWER MOTOR VENTURI RING
2 – BLEND-AIR DOOR PIVOT
3 – EVAPORATOR COIL TUBE RUBBER SEAL
4 – RECIRCULATION AIR DOOR PIVOTS

(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.

(9) Install the heater-A/C housing in the vehicle.

REMOVAL AND INSTALLATION (Continued)

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, and that the openings on the top of the housing are properly aligned with the fresh air duct and defrost/demist duct.

(2) Install and tighten the one screw that secures the heater-A/C housing to the plenum bracket on the passenger compartment side of the dash panel. Tighten the screw to 3.4 N·m (30 in. lbs.).

(3) Install the floor duct to the bottom of the heater-A/C housing. See Floor Duct in this group for the procedures.

(4) Install the cowl drain tube onto the heater-A/C housing mounting stud on the dash panel directly behind the engine cylinder head.

(5) 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.).

(6) If the battery was repositioned during the removal procedure, position the battery and tighten the holddowns. Refer to Group 8A - Battery for the procedures.

(7) Connect the heater-A/C system vacuum supply line connector to the tee fitting near the heater core tubes.

(8) 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.

(9) If the vehicle is not equipped with air conditioning, go to Step 13. 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.

(10) 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.

(11) Evacuate the refrigerant system. See Refrigerant System Evacuate in this group for the procedures.

(12) Charge the refrigerant system. See Refrigerant System Charge in this group for the procedures.

(13) Install the instrument panel in the vehicle. Refer to Instrument Panel Assembly in Group 8E - Instrument Panel Systems for the procedures.

(14) Connect the battery negative cable.

(15) 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.

(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. 39).

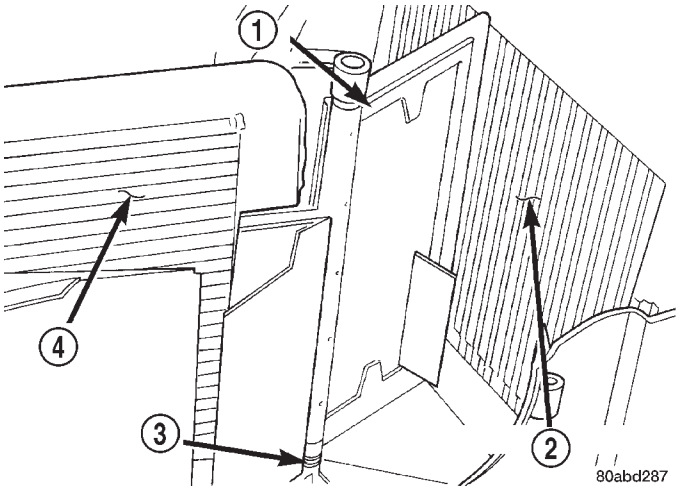


Fig. 39 Blend-Air Door

1 – BLEND-AIR DOOR
2 – EVAPORATOR COIL
3 – PIVOT HOLE
4 – HEATER CORE

(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. 40) of the panel/demist door pivot shaft to release the latch of the panel/demist door lever, and pull the

REMOVAL AND INSTALLATION (Continued)

lever out of the pivot shaft from the outside of the upper half of the heater-A/C housing.

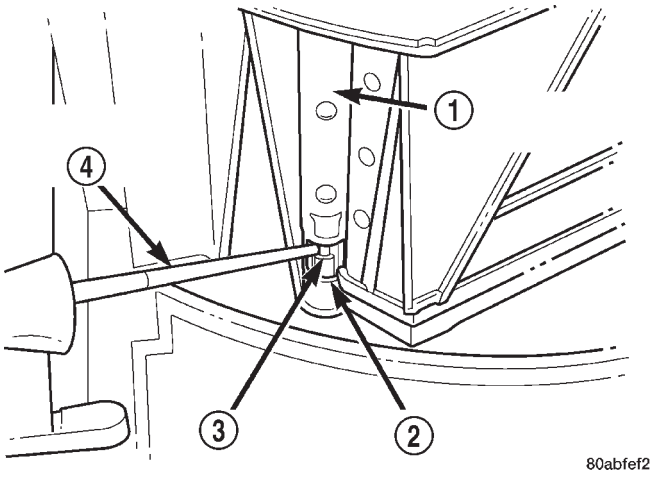


Fig. 40 Mode Door Lever Remove/Install - Typical

1 – DOOR PIVOT SHAFT
2 – LATCH HOLE
3 – CRANK ARM LATCH
4 – FLAT BLADE PRY TOOL

(4) Reach inside the upper half of the heater-A/C housing and carefully flex the panel/defrost door (Fig. 41) enough so that the door pivot clears the pivot hole in the housing.

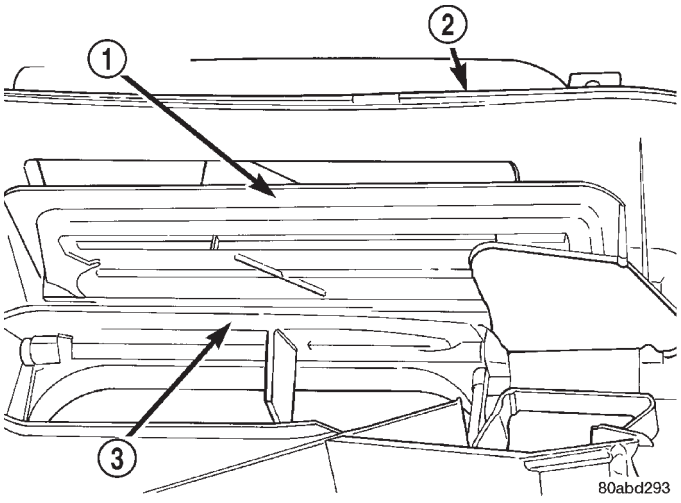


Fig. 41 Panel/Demist and Defrost Doors

1 – PANEL/DEMIST DOOR
2 – UPPER HEATER-A/C HOUSING
3 – DEFROST DOOR

(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. 40) 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. 41) 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. 40) 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. 42) enough so that the door pivot clears the pivot hole in the housing.

(5) Unscrew the 3 attaching screws and 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. 43).

REMOVAL AND INSTALLATION (Continued)

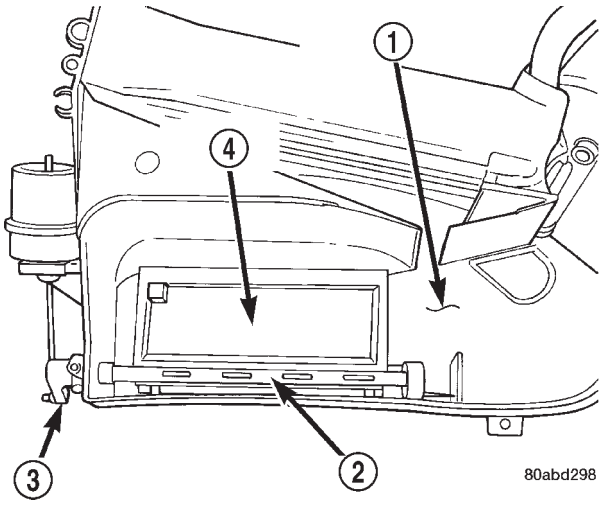


Fig. 42 Floor Door

1 – LOWER HEATER-A/C HOUSING
2 – PIVOT SHAFT
3 – CRANK ARM
4 – FLOOR DOOR

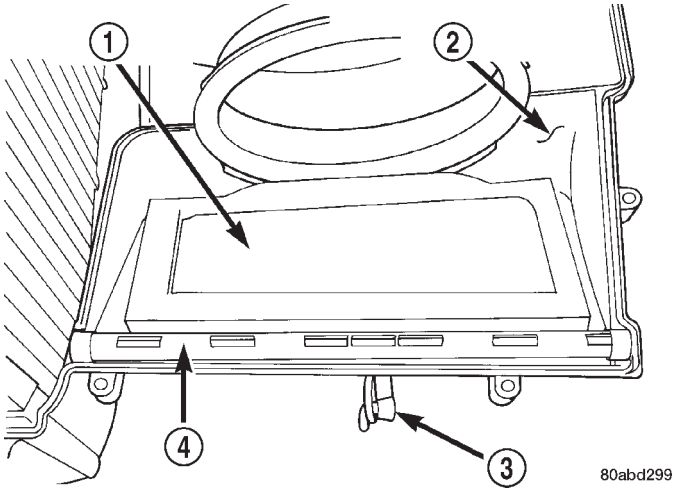


Fig. 43 Recirculation Air Door

1 – RECIRCULATION AIR DOOR
2 – LOWER HEATER-A/C HOUSING
3 – LEVER
4 – PIVOT SHAFT

(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.

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 non-flexible section of the discharge line nearest the compressor (Fig. 21) and (Fig. 22).

(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.

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. 44).

(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

REMOVAL AND INSTALLATION (Continued)

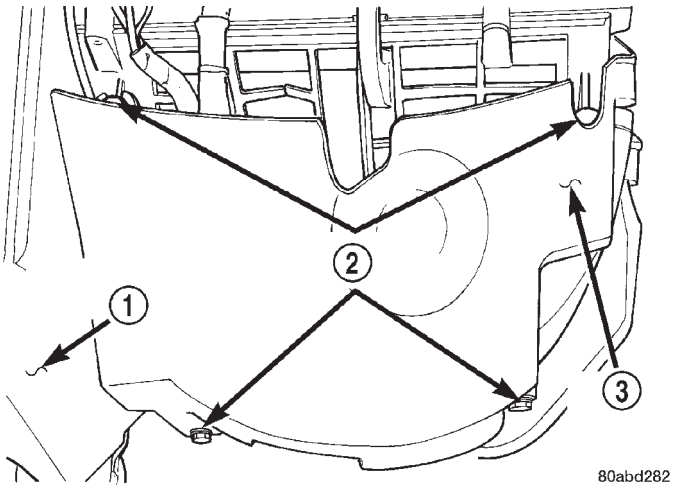


Fig. 44 Kick Cover Remove/Install

1 – HEATER-A/C HOUSING
2 – MOUNTING SCREWS
3 – KICK COVER

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.

LIQUID LINE/FIXED ORIFICE TUBE

NOTE: The fixed orifice tube is part of the liquid line assembly and cannot be serviced separately. Follow the liquid line removal and installation procedures for orifice tube replacement.

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) Remove the secondary clip from the spring-lock coupler which secures the liquid line to the accumulator outlet tube near the dash panel (Fig. 45).

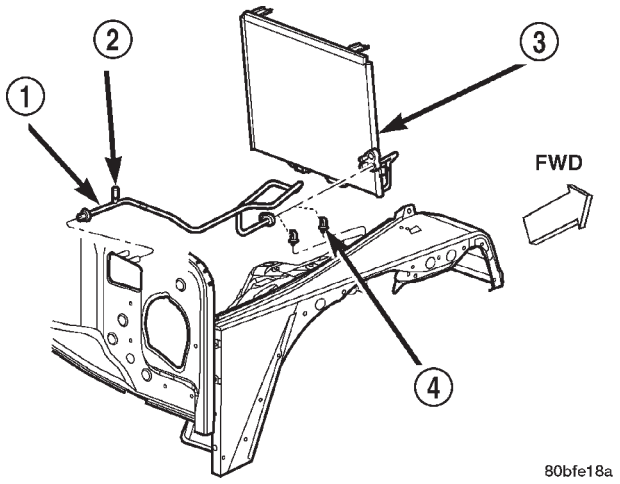


Fig. 45 Liquid Line Mounting

1 – LIQUID LINE
2 – SERVICE PORT
3 – CONDENSER
4 – LINE MOUNTING CLIPS

(4) Disconnect the liquid line refrigerant line fitting from the evaporator inlet tube. See Refrigerant Line Coupler Removal and Installation for the procedures. Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the fastener, and disconnect the liquid line from the condenser outlet tube refrigerant line fitting. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the liquid line from the plastic clips that secures it to the right inner fender shield.

(7) Remove the liquid line from the vehicle.

INSTALLATION

(1) Remove the tape or plugs from the refrigerant line fittings on the condenser outlet tube and the condenser end of the liquid line. Fasten the liquid line to the condenser outlet tube refrigerant line coupler. Tighten the fastener to 9 N·m (80 in. lbs.).

(2) Remove the tape or plugs from the refrigerant line fittings on the evaporator end of the liquid line and the evaporator inlet tube. Connect the liquid line refrigerant line coupler to the evaporator inlet tube. See Refrigerant Line Coupler in this group for the procedures.

REMOVAL AND INSTALLATION (Continued)

(3) Install the secondary clip that secures the liquid line to the accumulator outlet tube near the dash panel.

(4) Install the liquid line into the clips that secure it to the right inner fender shield.

(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.

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. 46).

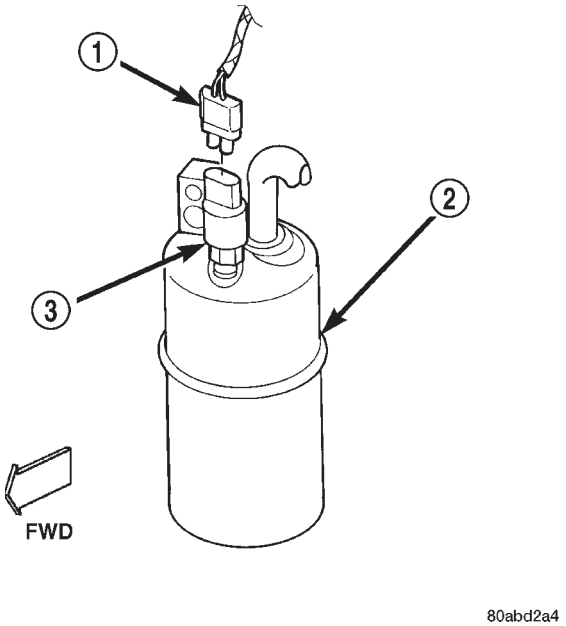


Fig. 46 Low Pressure Cycling Clutch Switch Remove/Install - Typical

1 – WIRE HARNESS CONNECTOR
2 – ACCUMULATOR
3 – LOW PRESSURE CYCLING CLUTCH SWITCH

(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.

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 knee blocker from the instrument panel. Refer to Knee Blocker in Group 8E - Instrument Panel Systems for the procedures.

(3) Unplug the two vacuum harness connectors from the defrost door actuator (Fig. 47).

(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. 48). Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(5) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the actuator link from the hooked pin on the end of the defrost door lever.

(6) Remove the defrost door vacuum actuator from the vehicle.

(7) Reverse the removal procedures to install.

FLOOR DOOR ACTUATOR

(1) Disconnect and isolate the battery negative cable.

(2) Remove the knee blocker from the instrument panel. Refer to Knee Blocker in Group 8E - Instrument Panel Systems for the procedures.

(3) Unplug the vacuum harness connector from the floor door actuator (Fig. 47).

(4) Remove the push nut fastening the floor door vacuum actuator linkage to the floor door lever.

REMOVAL AND INSTALLATION (Continued)

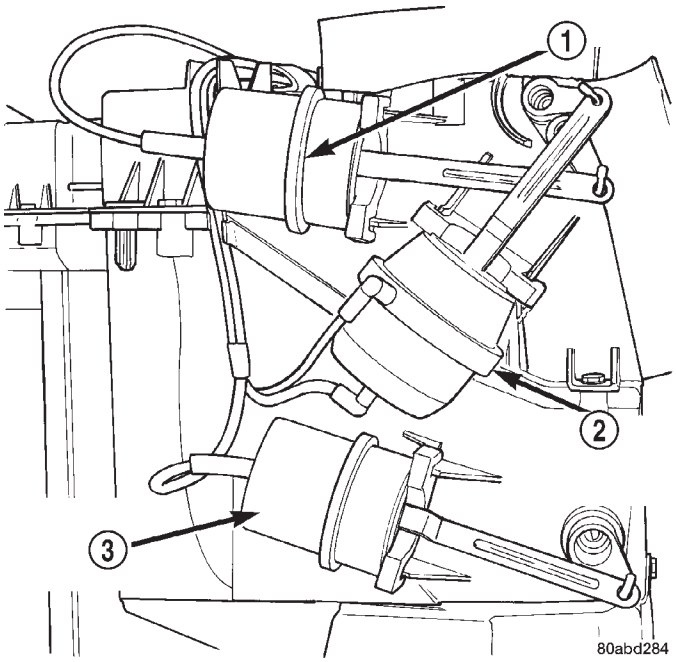


Fig. 47 Defrost, Floor, and Panel/Demist Door Vacuum Actuators

1 – PANEL/DEMIST DOOR ACTUATOR
2 – DEFROST DOOR ACTUATOR
3 – FLOOR DOOR ACTUATOR

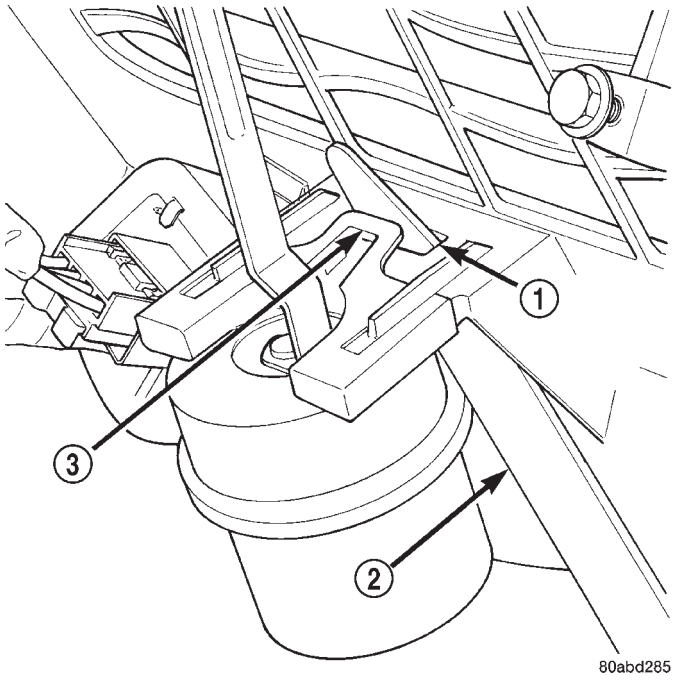


Fig. 48 Vacuum Actuator Remove/Install - Typical

1 – ACTUATOR MOUNT LATCH HOLE
2 – TRIM STICK
3 – ACTUATOR LATCH

(5) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount (Fig. 48). Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(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. 47).

(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. 48). 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. 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. 48). 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.

REMOVAL AND INSTALLATION (Continued)

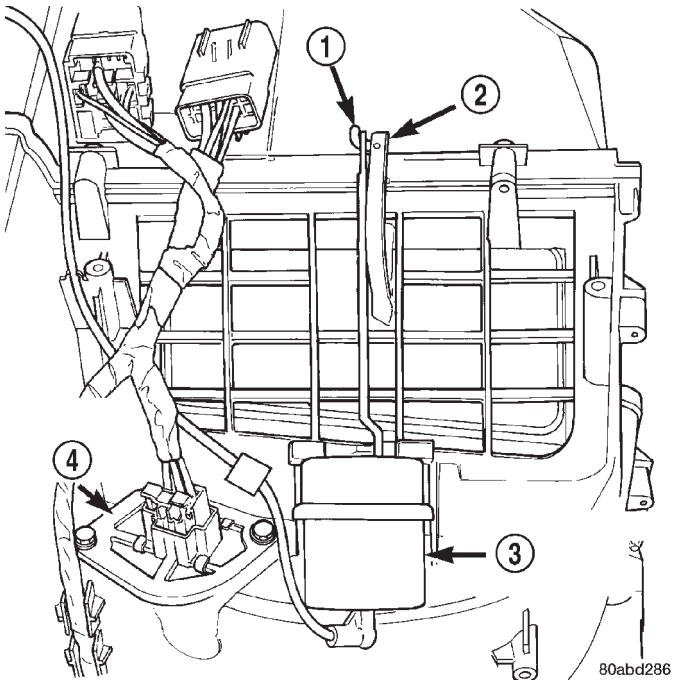


Fig. 49 Recirculation Air Door Vacuum Actuator Remove/Install

1 – HOOK
2 – LEVER
3 – RECIRCULATION AIR DOOR ACTUATOR
4 – BLOWER MOTOR RESISTOR

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. 50).

(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

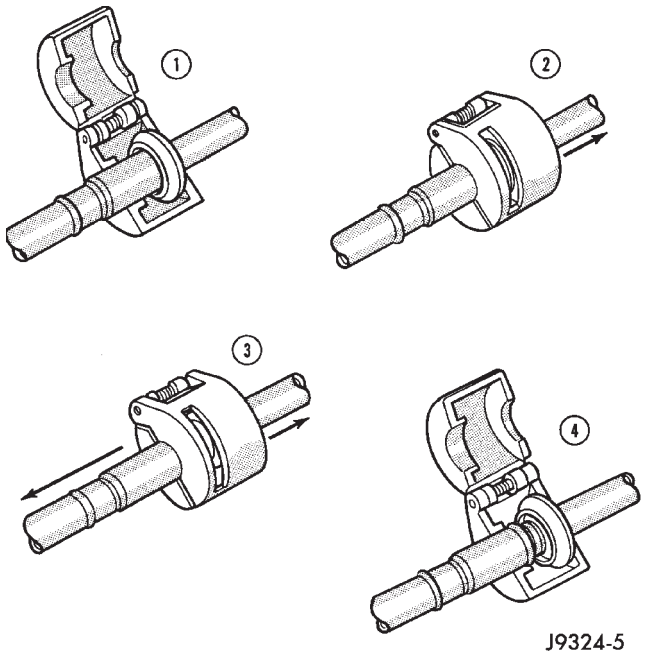


Fig. 50 Refrigerant Line Spring-Lock Coupler Disconnect

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.

REMOVAL AND INSTALLATION (Continued)

(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 (Fig. 51).

(4) Remove the bolt that secures the refrigerant line support bracket to the engine (4.0 L) (Fig. 52).

(5) Remove the fastener and disengage the discharge line fitting from the condenser inlet tube. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the fastener and disengage the suction line from the accumulator outlet tube refrigerant line fitting. Install plugs in, or tape over all of the opened refrigerant line fittings.

(7) Remove the fasteners that secure the suction and discharge lines to the compressor. Install plugs in, or tape over all of the opened refrigerant line fittings.

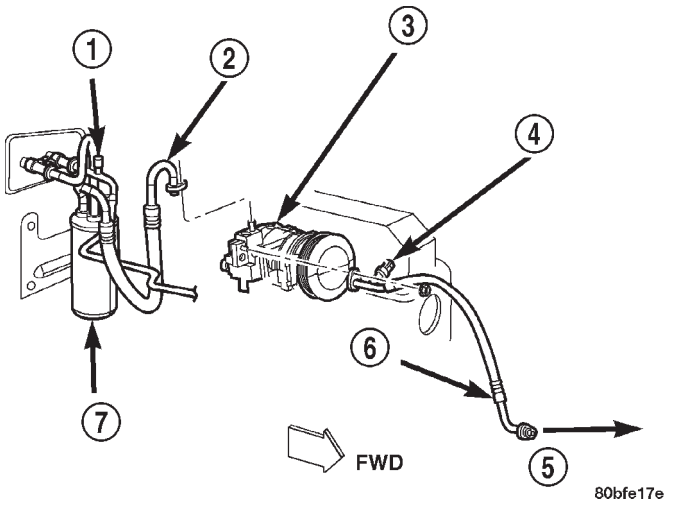


Fig. 51 Suction and Discharge Line 2.5 L

1 – SERVICE PORT
2 – SUCTION LINE
3 – COMPRESSOR
4 – HIGH PRESSURE CUT-OFF SWITCH
5 – TO CONDENSER
6 – DISCHARGE LINE
7 – ACCUMULATOR

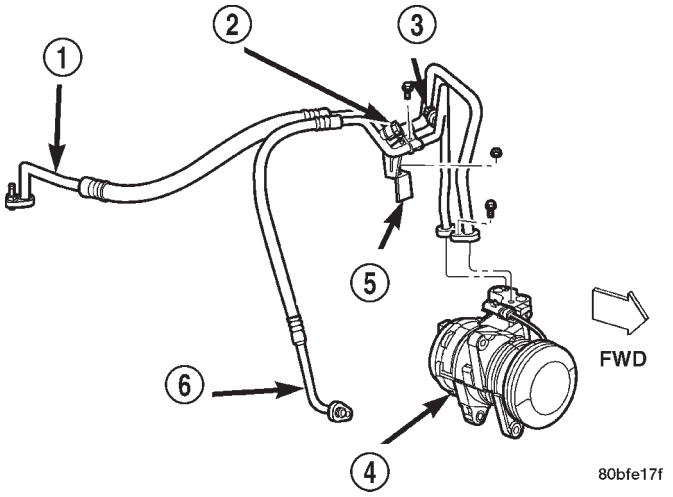


Fig. 52 Suction and Discharge Line 4.0 L

1 – SUCTION LINE
2 – SERVICE PORT
3 – HIGH PRESSURE CUT-OFF SWITCH
4 – COMPRESSOR
5 – ENGINE MOUNTING BRACKET
6 – DISCHARGE LINE

REMOVAL AND INSTALLATION (Continued)

(8) Remove the suction and discharge lines 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 22 N·m (200 in. lbs.).

(2) 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.

(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) Install the bolt that secures the discharge line support bracket to the compressor. Tighten the bolt to 28 N·m (21 ft. lbs.).

(5) Plug in the wire harness connector to the high pressure cut-off 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.

VACUUM CHECK VALVE

(1) Unplug the heater-A/C vacuum supply line connector at the vacuum check valve near the engine intake manifold vacuum adapter fitting.

(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 battery and battery tray from the engine compartment. Refer to Group 8A - Battery for the procedures.

(2) Unplug the vacuum supply line connector from the vacuum reservoir (Fig. 53).

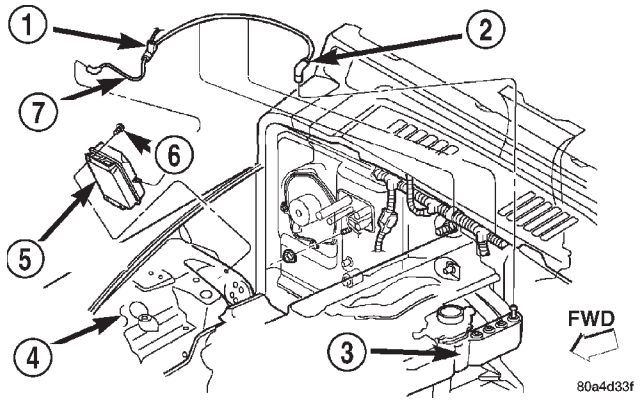


Fig. 53 Vacuum Reservoir Remove/Install

1 – TEE
2 – VACUUM CHECK VALVE
3 – INTAKE MANIFOLD
4 – INNER FENDER
5 – RESERVOIR
6 – SCREW
7 – VACUUM SUPPLY LINE

(3) Remove the one screw that secures the reservoir to the inner fender panel under the battery tray and behind the right front wheel house.

(4) Remove the vacuum reservoir from the engine compartment.

(5) Reverse the removal procedures to install. Tighten the reservoir mounting screw to 1 N·m (10 in. lbs.).

SPECIFICATIONS

A/C APPLICATION TABLE

Item	Description	Notes
Vehicle	TJ Wrangler	
System	R134a w/orifice tube	
Compressor	Denso 10PA17	ND-8 PAG oil
Freeze–up Control	Low Pressure cycling cutout switch	accumulator mounted
Low psi Control	opens < 20.5 psi - resets > 38 psi	
High psi Control	switch opens > 450 - 490 psi - resets < 270 - 330 psi	discharge line mounted switch
Control Head	manual type	
Mode Door	vacuum	
Blend Air Door	electric actuator	
Fresh/Recirc door	vacuum	
Blower Motor	control head switched	resistor block
Cooling Fan	viscous fan	
Clutch		
Control	relay	PCM
Draw	2 - 3.9 amps @ 12V	± 0.5V @ 70° F
Gap	0.016” - 0.031″	
DRB III®		
Reads	TPS, RPM, A/C switch test	
Actuators	clutch relay	

EMISSION CONTROL SYSTEMS

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ON-BOARD DIAGNOSTICS

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DESCRIPTION AND OPERATION

EMISSION SYSTEM

OPERATION

The Powertrain Control Module (PCM) monitors many different circuits in the fuel injection, ignition, emission and engine systems. If the PCM senses a problem with a monitored circuit often enough to indicate an actual problem, it stores a Diagnostic Trouble Code (DTC) in the PCM's memory. If the code applies to a non-emissions related component or system, and the problem is repaired or ceases to exist, the PCM cancels the code after 40 warm-up cycles. Diagnostic trouble codes that affect vehicle emissions illuminate the Malfunction Indicator Lamp (MIL). The MIL is displayed as an engine icon on the instrument panel. Refer to Malfunction Indicator Lamp (MIL) in this section.

Certain criteria must be met before the PCM stores a DTC in memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the PCM.

The PCM might not store a DTC for a monitored circuit even though a malfunction has occurred. This may happen because one of the DTC criteria for the circuit has not been met. **For example**, assume the diagnostic trouble code criteria requires the PCM to monitor the circuit only when the engine operates between 750 and 2000 RPM. Suppose the sensor's output circuit shorts to ground when engine operates above 2400 RPM (resulting in 0 volt input to the PCM). Because the condition happens at an engine speed above the maximum threshold (2000 rpm), the PCM will not store a DTC.

There are several operating conditions for which the PCM monitors and sets DTC's. Refer to Monitored Systems, Components, and Non-Monitored Circuits in this section.

Technicians must retrieve stored DTC's by connecting the DRB scan tool (or an equivalent scan tool) to the 16–way data link connector (Fig. 1).

NOTE: Various diagnostic procedures may actually cause a diagnostic monitor to set a DTC. For instance, pulling a spark plug wire to perform a spark test may set the misfire code. When a repair is completed and verified, connect the DRB scan tool to the 16–way data link connector to erase all DTC's and extinguish the MIL.

DESCRIPTION AND OPERATION (Continued)

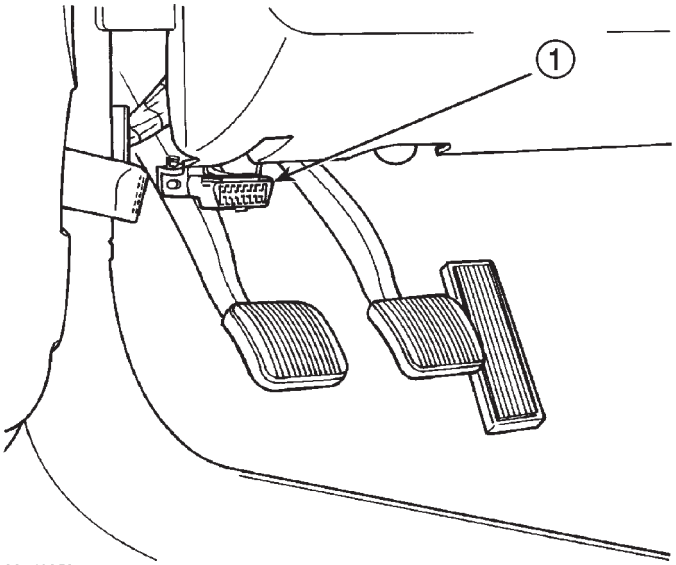


Fig. 1 Data Link (Diagnostic) Connector Location
1 – 16–WAY DATA LINK CONNECTOR

MALFUNCTION INDICATOR LAMP (MIL)

DESCRIPTION

The Malfunction Indicator Lamp (MIL) is located on the instrument panel. It is displayed as an engine icon (graphic).

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.

DESCRIPTION AND OPERATION (Continued)

(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.

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(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.
P0130 (M)	1/1 O2 Sensor Heater Circuit Malfunction	Oxygen sensor heater element malfunction.
P0131 (M)	1/1 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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.
P0136 (M)	1/2 O2 Sensor Heater Circuit Malfunction	Oxygen sensor heater element malfunction.
P0137 (M)	1/2 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0138 (M)	1/2 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0139 (M)	1/2 O2 Sensor Slow Response	Oxygen sensor response not as expected.
P0140 (M)	1/2 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0141 (M)	1/2 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0143 (M)	1/3 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0144 (M)	1/3 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0145 (M)	1/3 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0146 (M)	1/3 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0147 (M)	1/3 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0151 (M)	2/1 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0152 (M)	2/1 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage sustained above normal operating range.
P0153 (M)	2/1 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0154 (M)	2/1 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0155 (M)	2/1 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0157 (M)	2/2 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0158 (M)	2/2 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0159	2/2 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0160 (M)	2/2 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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.
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.

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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.
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.

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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).
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.

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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
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.

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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.
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).

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P0740 (M)	Torq Con Clu, No RPM Drop at Lockup	Relationship between engine and vehicle speeds indicated failure of torque convertor clutch lock-up system (TCC/PTU solenoid)
P0743 (M)	Torque Converter Clutch Solenoid/ Trans Relay Circuits	An open or shorted condition detected in the torque converter clutch (part throttle unlock) solenoid control circuit. Shift solenoid C electrical fault - Aisin transmission
P0743 (M)	Torque Converter Clutch Solenoid/ Trans Relay Circuits	An open or shorted condition detected in the torque converter part throttle unlock solenoid control circuit (3 or 4-speed auto. trans. only).
P0748 (M)	Governor Pressur Sol Control/Trans Relay Circuits	An open or shorted condition detected in the Governor Pressure Solenoid circuit or Trans Relay Circuit in JTEC RE transmissions.
P0748 (M)	Governor Pressure Sol Control/Trans Relay Circuits	An open or shorted condition detected in the governor pressure solenoid or relay circuits (4-speed auto. trans. only).
P0751 (M)	O/D Switch Pressed (Lo) More Than 5 Minutes	Overdrive override switch input is in a prolonged depressed state.
P0751 (M)	O/D Switch Pressed (LO) More Than 5 Min	Overdrive Off switch input too low for more than 5 minutes (4-speed auto. trans. only).
P0753 (M)	Trans 3-4 Shift Sol/Trans Relay Circuits	An open or shorted condition detected in the overdrive solenoid control circuit or Trans Relay Circuit in JTEC RE transmissions. Was MIL code 45.
P0753 (M)	Trans 3-4 Shift Sol/Trans Relay Circuits	An open or shorted condition detected in the transmission 2-4 shift solenoid circuit (4-speed auto. trans. only).
P0756	AW4 Shift Sol B (2-3) Functional Failure	Shift solenoid B (2-3) functional fault - Aisin transmission
P0783 (M)	3-4 Shift Sol, No RPM Drop at Lockup	The overdrive solenoid is unable to engage the gear change from 3rd gear to the overdrive gear.
P0801	Reverse Gear Lockout Circuit Open or Short	An open or shorted condition detected in the transmission reverse gear lock-out solenoid control circuit.
P0830	Clutch Depressed Switch Circuit	Problem detected in clutch switch circuit.
P0833	Clutch Released Switch Circuit	Problem detected in clutch switch circuit.
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)

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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.
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.

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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.
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.

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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.
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.

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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.

DESCRIPTION AND OPERATION (Continued)

(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P1763 (M)	Governor Pressure Sensor Volts Too HI	Voltage greater than 4.89 volts (4-speed auto. trans. only).
P1764 (M)	Governor Pressure Sensor Volts Too Low	The Governor Pressure Sensor input is below an acceptable voltage level.
P1764 (M)	Governor Pressure Sensor Volts Too Low	Voltage less than.10 volts (4-speed auto. trans. only).
P1765 (M)	Trans 12 Volt Supply Relay CTRL Circuit	An open or shorted condition is detected in the Transmission Relay control circuit. This relay supplies power to the TCC
P1765 (M)	Trans 12 Volt Supply Relay Ctrl Circuit	Current state of solenoid output port is different than expected (4-speed auto. trans. only).
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).

TASK MANAGER

DESCRIPTION

The PCM is responsible for efficiently coordinating the operation of all the emissions-related components. The PCM is also responsible for determining if the diagnostic systems are operating properly. The software designed to carry out these responsibilities is call the 'Task Manager'.

OPERATION

The Task Manager determines which tests happen when and which functions occur when. Many of the diagnostic steps required by OBD II must be performed under specific operating conditions. The Task Manager software organizes and prioritizes the diagnostic procedures. The job of the Task Manager is to determine if conditions are appropriate for tests to be run, monitor the parameters for a trip for each test, and record the results of the test. Following are the responsibilities of the Task Manager software:

- Test Sequence
- MIL Illumination
- Diagnostic Trouble Codes (DTCs)
- Trip Indicator
- Freeze Frame Data Storage
- Similar Conditions Window

Test Sequence

In many instances, emissions systems must fail diagnostic tests more than once before the PCM illuminates the MIL. These tests are know as 'two trip monitors.' Other tests that turn the MIL lamp on after a single failure are known as 'one trip monitors.' A trip is defined as 'start the vehicle and operate it to meet the criteria necessary to run the given monitor.'

Many of the diagnostic tests must be performed under certain operating conditions. However, there are times when tests cannot be run because another test is in progress (conflict), another test has failed (pending) or the Task Manager has set a fault that may cause a failure of the test (suspend).

- Pending

Under some situations the Task Manager will not run a monitor if the MIL is illuminated and a fault is stored from another monitor. In these situations, the Task Manager postpones monitors **pending** resolution of the original fault. The Task Manager does not run the test until the problem is remedied.

For example, when the MIL is illuminated for an Oxygen Sensor fault, the Task Manager does not run the Catalyst Monitor until the Oxygen Sensor fault is remedied. Since the Catalyst Monitor is based on signals from the Oxygen Sensor, running the test would produce inaccurate results.

- Conflict

There are situations when the Task Manager does not run a test if another monitor is in progress. In these situations, the effects of another monitor running could result in an erroneous failure. If this **conflict** is present, the monitor is not run until the conflicting condition passes. Most likely the monitor will run later after the conflicting monitor has passed.

For example, if the Fuel System Monitor is in

DESCRIPTION AND OPERATION (Continued)

progress, the Task Manager does not run the EGR Monitor. Since both tests monitor changes in air/fuel ratio and adaptive fuel compensation, the monitors will conflict with each other.

- Suspend

Occasionally the Task Manager may not allow a two trip fault to mature. The Task Manager will **suspend** the maturing of a fault if a condition exists that may induce an erroneous failure. This prevents illuminating the MIL for the wrong fault and allows more precis diagnosis.

For example, if the PCM is storing a one trip fault for the Oxygen Sensor and the EGR monitor, the Task Manager may still run the EGR Monitor but will suspend the results until the Oxygen Sensor Monitor either passes or fails. At that point the Task Manager can determine if the EGR system is actually failing or if an Oxygen Sensor is failing.

MIL Illumination

The PCM Task Manager carries out the illumination of the MIL. The Task Manager triggers MIL illumination upon test failure, depending on monitor failure criteria.

The Task Manager Screen shows both a Requested MIL state and an Actual MIL state. When the MIL is illuminated upon completion of a test for a third trip, the Requested MIL state changes to OFF. However, the MIL remains illuminated until the next key cycle. (On some vehicles, the MIL will actually turn OFF during the third key cycle) During the key cycle for the third good trip, the Requested MIL state is OFF, while the Actual MILL state is ON. After the next key cycle, the MIL is not illuminated and both MIL states read OFF.

Diagnostic Trouble Codes (DTCs)

With OBD II, different DTC faults have different priorities according to regulations. As a result, the priorities determine MIL illumination and DTC erasure. DTCs are entered according to individual priority. DTCs with a higher priority overwrite lower priority DTCs.

Priorities

- Priority 0 —Non-emissions related trouble codes
- Priority 1 — One trip failure of a two trip fault for non-fuel system and non-misfire.
- Priority 2 — One trip failure of a two trip fault for fuel system (rich/lean) or misfire.
- Priority 3 — Two trip failure for a non-fuel system and non-misfire or matured one trip comprehensive component fault.
- Priority 4 — Two trip failure or matured fault for fuel system (rich/lean) and misfire or one trip catalyst damaging misfire.

Non-emissions related failures have no priority. One trip failures of two trip faults have low priority. Two trip failures or matured faults have higher priority. One and two trip failures of fuel system and misfire monitor take precedence over non-fuel system and non-misfire failures.

DTC Self Erasure

With one trip components or systems, the MIL is illuminated upon test failure and DTCs are stored.

Two trip monitors are components requiring failure in two consecutive trips for MIL illumination. Upon failure of the first test, the Task Manager enters a maturing code. If the component fails the test for a second time the code matures and a DTC is set.

After three good trips the MIL is extinguished and the Task Manager automatically switches the trip counter to a warm-up cycle counter. DTCs are automatically erased following 40 warm-up cycles if the component does not fail again.

For misfire and fuel system monitors, the component must pass the test under a Similar Conditions Window in order to record a good trip. A Similar Conditions Window is when engine RPM is within ±375 RPM and load is within ±10% of when the fault occurred.

NOTE: It is important to understand that a component does not have to fail under a similar window of operation to mature. It must pass the test under a Similar Conditions Window when it failed to record a Good Trip for DTC erasure for misfire and fuel system monitors.

DTCs can be erased anytime with a DRB III. Erasing the DTC with the DRB III erases all OBD II information. The DRB III automatically displays a warning that erasing the DTC will also erase all OBD II monitor data. This includes all counter information for warm-up cycles, trips and Freeze Frame.

Trip Indicator

The **Trip** is essential for running monitors and extinguishing the MIL. In OBD II terms, a trip is a set of vehicle operating conditions that must be met for a specific monitor to run. All trips begin with a key cycle.

Good Trip

The Good Trip counters are as follows:

- Specific Good Trip
- Fuel System Good Trip
- Misfire Good Trip
- Alternate Good Trip (appears as a Global Good Trip on DRB III)
- Comprehensive Components
- Major Monitor
- Warm-Up Cycles

DESCRIPTION AND OPERATION (Continued)

Specific Good Trip

The term Good Trip has different meanings depending on the circumstances:

- If the MIL is OFF, a trip is defined as when the Oxygen Sensor Monitor and the Catalyst Monitor have been completed in the same drive cycle.
- If the MIL is ON and a DTC was set by the Fuel Monitor or Misfire Monitor (both continuous monitors), the vehicle must be operated in the Similar Condition Window for a specified amount of time.
- If the MIL is ON and a DTC was set by a Task Manager commanded once-per-trip monitor (such as the Oxygen Sensor Monitor, Catalyst Monitor, Purge Flow Monitor, Leak Detection Pump Monitor, EGR Monitor or Oxygen Sensor Heater Monitor), a good trip is when the monitor is passed on the next start-up.
- If the MIL is ON and any other emissions DTC was set (not an OBD II monitor), a good trip occurs when the Oxygen Sensor Monitor and Catalyst Monitor have been completed, or two minutes of engine run time if the Oxygen Sensor Monitor and Catalyst Monitor have been stopped from running.

Fuel System Good Trip

To count a good trip (three required) and turn off the MIL, the following conditions must occur:

- Engine in closed loop
- Operating in Similar Conditions Window
- Short Term multiplied by Long Term less than threshold
- Less than threshold for a predetermined time

If all of the previous criteria are met, the PCM will count a good trip (three required) and turn off the MIL.

Misfire Good Trip

If the following conditions are met the PCM will count one good trip (three required) in order to turn off the MIL:

- Operating in Similar Condition Window
- 1000 engine revolutions with no misfire

Warm-Up Cycles

Once the MIL has been extinguished by the Good Trip Counter, the PCM automatically switches to a Warm-Up Cycle Counter that can be viewed on the DRB III. Warm-Up Cycles are used to erase DTCs and Freeze Frames. Forty Warm-Up cycles must occur in order for the PCM to self-erase a DTC and Freeze Frame. A Warm-Up Cycle is defined as follows:

- Engine coolant temperature must start below and rise above 160° F
- Engine coolant temperature must rise by 40° F
- No further faults occur

Freeze Frame Data Storage

Once a failure occurs, the Task Manager records several engine operating conditions and stores it in a Freeze Frame. The Freeze Frame is considered one frame of information taken by an on-board data recorder. When a fault occurs, the PCM stores the input data from various sensors so that technicians can determine under what vehicle operating conditions the failure occurred.

The data stored in Freeze Frame is usually recorded when a system fails the first time for two trip faults. Freeze Frame data will only be overwritten by a different fault with a higher priority.

CAUTION: Erasing DTCs, either with the DRB III or by disconnecting the battery, also clears all Freeze Frame data.

Similar Conditions Window

The Similar Conditions Window displays information about engine operation during a monitor. Absolute MAP (engine load) and Engine RPM are stored in this window when a failure occurs. There are two different Similar conditions Windows: Fuel System and Misfire.

FUEL SYSTEM

- **Fuel System Similar Conditions Window** — An indicator that 'Absolute MAP When Fuel Sys Fail' and 'RPM When Fuel Sys Failed' are all in the same range when the failure occurred. Indicated by switching from 'NO' to 'YES'.
- **Absolute MAP When Fuel Sys Fail** — The stored MAP reading at the time of failure. Informs the user at what engine load the failure occurred.
- **Absolute MAP** — A live reading of engine load to aid the user in accessing the Similar Conditions Window.
- **RPM When Fuel Sys Fail** — The stored RPM reading at the time of failure. Informs the user at what engine RPM the failure occurred.
- **Engine RPM** — A live reading of engine RPM to aid the user in accessing the Similar Conditions Window.
- **Adaptive Memory Factor** — The PCM utilizes both Short Term Compensation and Long Term Adaptive to calculate the Adaptive Memory Factor for total fuel correction.
- **Upstream O2S Volts** — A live reading of the Oxygen Sensor to indicate its performance. For example, stuck lean, stuck rich, etc.
- **SCW Time in Window (Similar Conditions Window Time in Window)** — A timer used by the PCM that indicates that, after all Similar Conditions have been met, if there has been enough good engine running time in the SCW without failure detected. This timer is used to increment a Good Trip.

DESCRIPTION AND OPERATION (Continued)

- **Fuel System Good Trip Counter** — A Trip Counter used to turn OFF the MIL for Fuel System DTCs. To increment a Fuel System Good Trip, the engine must be in the Similar Conditions Window, Adaptive Memory Factor must be less than calibrated threshold and the Adaptive Memory Factor must stay below that threshold for a calibrated amount of time.
- **Test Done This Trip** — Indicates that the monitor has already been run and completed during the current trip.

MISFIRE

- **Same Misfire Warm-Up State** — Indicates if the misfire occurred when the engine was warmed up (above 160° F).
- **In Similar Misfire Window** — An indicator that 'Absolute MAP When Misfire Occurred' and 'RPM When Misfire Occurred' are all in the same range when the failure occurred. Indicated by switching from 'NO' to 'YES'.
- **Absolute MAP When Misfire Occurred** — The stored MAP reading at the time of failure. Informs the user at what engine load the failure occurred.
- **Absolute MAP** — A live reading of engine load to aid the user in accessing the Similar Conditions Window.
- **RPM When Misfire Occurred** — The stored RPM reading at the time of failure. Informs the user at what engine RPM the failure occurred.
- **Engine RPM** — A live reading of engine RPM to aid the user in accessing the Similar Conditions Window.
- **Adaptive Memory Factor** — The PCM utilizes both Short Term Compensation and Long Term Adaptive to calculate the Adaptive Memory Factor for total fuel correction.
- **200 Rev Counter** — Counts 0–100 720 degree cycles.
- **SCW Cat 200 Rev Counter** — Counts when in similar conditions.
- **SCW FTP 1000 Rev Counter** — Counts 0–4 when in similar conditions.
- **Misfire Good Trip Counter** — Counts up to three to turn OFF the MIL.
- **Misfire Data** — Data collected during test.
- **Test Done This Trip** — Indicates YES when the test is done.

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 Lamp (MIL) will be illuminated. These monitors generate Diagnostic Trouble Codes that can be displayed with the MIL or a scan tool.

The following is a list of the system monitors:

- Misfire Monitor
- Fuel System Monitor
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- Catalyst Monitor
- Leak Detection Pump Monitor (if equipped)

All these system monitors require two consecutive trips with the malfunction present to set a fault.

Refer to the appropriate Powertrain Diagnostics Procedures manual for diagnostic procedures.

The following is an operation and description of each system monitor :

OXYGEN SENSOR (O2S) MONITOR

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The O2S is also the main sensing element for the Catalyst and Fuel Monitors.

The O2S can fail in any or all of the following manners:

- slow response rate
- reduced output voltage
- dynamic shift
- shorted or open circuits

Response rate is the time required for the sensor to switch from lean to rich once it is exposed to a richer than optimum A/F mixture or vice versa. As the sensor starts malfunctioning, it could take longer to detect the changes in the oxygen content of the exhaust gas.

DESCRIPTION AND OPERATION (Continued)

The output voltage of the O2S ranges from 0 to 1 volt. A good sensor can easily generate any output voltage in this range as it is exposed to different concentrations of oxygen. To detect a shift in the A/F mixture (lean or rich), the output voltage has to change beyond a threshold value. A malfunctioning sensor could have difficulty changing beyond the threshold value.

OXYGEN SENSOR HEATER MONITOR

If there is an oxygen sensor (O2S) shorted to voltage DTC, as well as a O2S heater DTC, the O2S fault MUST be repaired first. Before checking the O2S fault, verify that the heater circuit is operating correctly.

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572 ° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The voltage readings taken from the O2S sensor are very temperature sensitive. The readings are not accurate below 300°C. Heating of the O2S sensor is done to allow the engine controller to shift to closed loop control as soon as possible. The heating element used to heat the O2S sensor must be tested to ensure that it is heating the sensor properly.

The O2S sensor circuit is monitored for a drop in voltage. The sensor output is used to test the heater by isolating the effect of the heater element on the O2S sensor output voltage from the other effects.

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.

DESCRIPTION AND OPERATION (Continued)

MISFIRE MONITOR

Excessive engine misfire results in increased catalyst temperature and causes an increase in HC emissions. Severe misfires could cause catalyst damage. To prevent catalytic convertor damage, the PCM monitors engine misfire.

The Powertrain Control Module (PCM) monitors for misfire during most engine operating conditions (positive torque) by looking at changes in the crankshaft speed. If a misfire occurs the speed of the crankshaft will vary more than normal.

FUEL SYSTEM MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide. The catalyst works best when the Air Fuel (A/F) ratio is at or near the optimum of 14.7 to 1.

The PCM is programmed to maintain the optimum air/fuel ratio of 14.7 to 1. This is done by making short term corrections in the fuel injector pulse width based on the O2S sensor output. The programmed memory acts as a self calibration tool that the engine controller uses to compensate for variations in engine specifications, sensor tolerances and engine fatigue over the life span of the engine. By monitoring the actual fuel-air ratio with the O2S sensor (short term) and multiplying that with the program long-term (adaptive) memory and comparing that to the limit, it can be determined whether it will pass an emissions test. If a malfunction occurs such that the PCM cannot maintain the optimum A/F ratio, then the MIL will be illuminated.

CATALYST MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide.

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 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)

DESCRIPTION AND OPERATION (Continued)

- 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 (MIL) will illuminate.

Some of the component monitors are checking for proper operation of the part. Electrically operated components now have input (rationality) and output (functionality) checks. Previously, a component like the Throttle Position sensor (TPS) was checked by the PCM for an open or shorted circuit. If one of these conditions occurred, a DTC was set. Now there is a check to ensure that the component is working. This is done by watching for a TPS indication of a greater or lesser throttle opening than MAP and engine rpm indicate. In the case of the TPS, if engine vacuum is high and engine rpm is 1600 or greater and the TPS indicates a large throttle opening, a DTC will be set. The same applies to low vacuum if the TPS indicates a small throttle opening.

All open/short circuit checks or any component that has an associated limp in will set a fault after 1 trip with the malfunction present. Components without 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.

DESCRIPTION AND OPERATION (Continued)

PCM SYSTEM GROUND

The PCM cannot determine a poor system ground. However, one or more diagnostic trouble codes may be generated as a result of this condition. The module should be mounted to the body at all times, also during diagnostic.

PCM CONNECTOR ENGAGEMENT

The PCM may not be able to determine spread or damaged connector pins. However, it might store diagnostic trouble codes as a result of spread connector pins.

HIGH AND LOW LIMITS

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

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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

DESCRIPTION

The fuel tank is equipped with 2 rollover valves. The valves are located on the top of the fuel tank (Fig. 1).

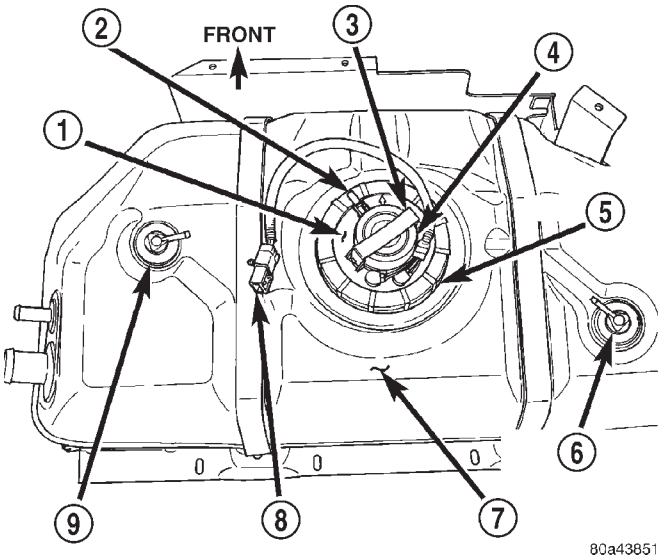


Fig. 1 Rollover Valve Location

1 – FUEL PUMP MODULE
2 – FUEL SUPPLY TUBE
3 – RETAINER CLAMP
4 – FUEL FILTER/FUEL PRESSURE REGULATOR
5 – LOCKNUT
6 – ROLLOVER VALVE
7 – TOP OF FUEL TANK
8 – ELECTRICAL CONNECTOR
9 – ROLLOVER VALVE

OPERATION

The rollover valves will prevent fuel flow through the fuel tank vent (EVAP) hoses in the event of an accidental vehicle rollover. The EVAP canister draws fuel vapors from the fuel tank through these valves.

The valves are not serviceable. If replacement is necessary, the fuel tank must be replaced.

DESCRIPTION AND OPERATION (Continued)

EVAP CANISTER

DESCRIPTION

The evaporative (EVAP) canister is located in the engine compartment on the left inner fender (Fig. 2).

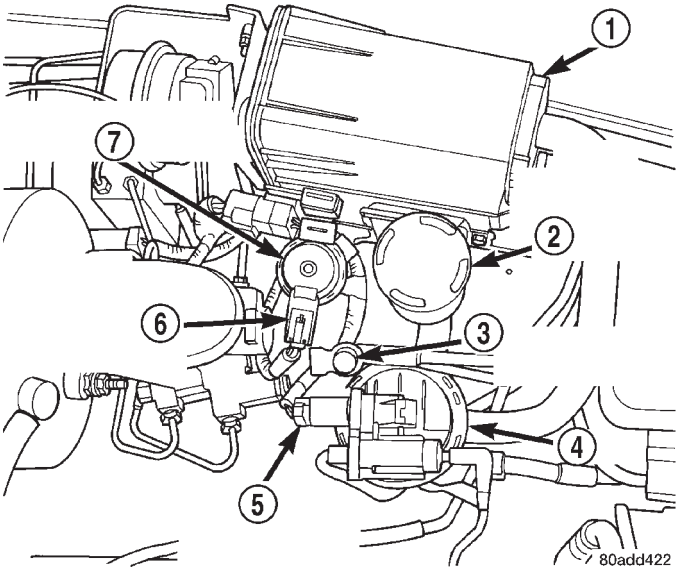


Fig. 2 EVAP Canister, EVAP Canister Purge Solenoid and LDP Location

1 – EVAP CANISTER
2 – LEAK DETECTION PUMP (LDP) FILTER
3 – EVAP SYSTEM TEST PORT
4 – LDP
5 – LDP ELECTRICAL CONNECTOR
6 – EVAP SOLENOID ELEC. CONNECTOR
7 – EVAP CANISTER PURGE SOLENOID

OPERATION

A maintenance free, EVAP canister is used on all vehicles. 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 cycle EVAP canister purge solenoid allows the EVAP canister to be purged at predetermined times and at certain engine operating conditions.

DUTY CYCLE EVAP CANISTER PURGE SOLENOID

OPERATION

The duty cycle EVAP canister purge solenoid (DCP) regulates the rate of vapor flow from the EVAP canister to the intake manifold. The Powertrain Control Module (PCM) operates the solenoid.

During the cold start warm-up period and the hot start time delay, the PCM does not energize the solenoid. When de-energized, no vapors are purged. The PCM de-energizes the solenoid during open loop operation.

The engine enters closed loop operation after it reaches a specified temperature and the time delay ends. During closed loop operation, the PCM cycles (energizes and de-energizes) the solenoid 5 or 10 times per second, depending upon operating conditions. The PCM varies the vapor flow rate by changing solenoid pulse width. Pulse width is the amount of time that the solenoid is energized. The PCM adjusts solenoid pulse width based on engine operating condition.

LEAK DETECTION PUMP (LDP)

OPERATION

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.

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.

DESCRIPTION AND OPERATION (Continued)

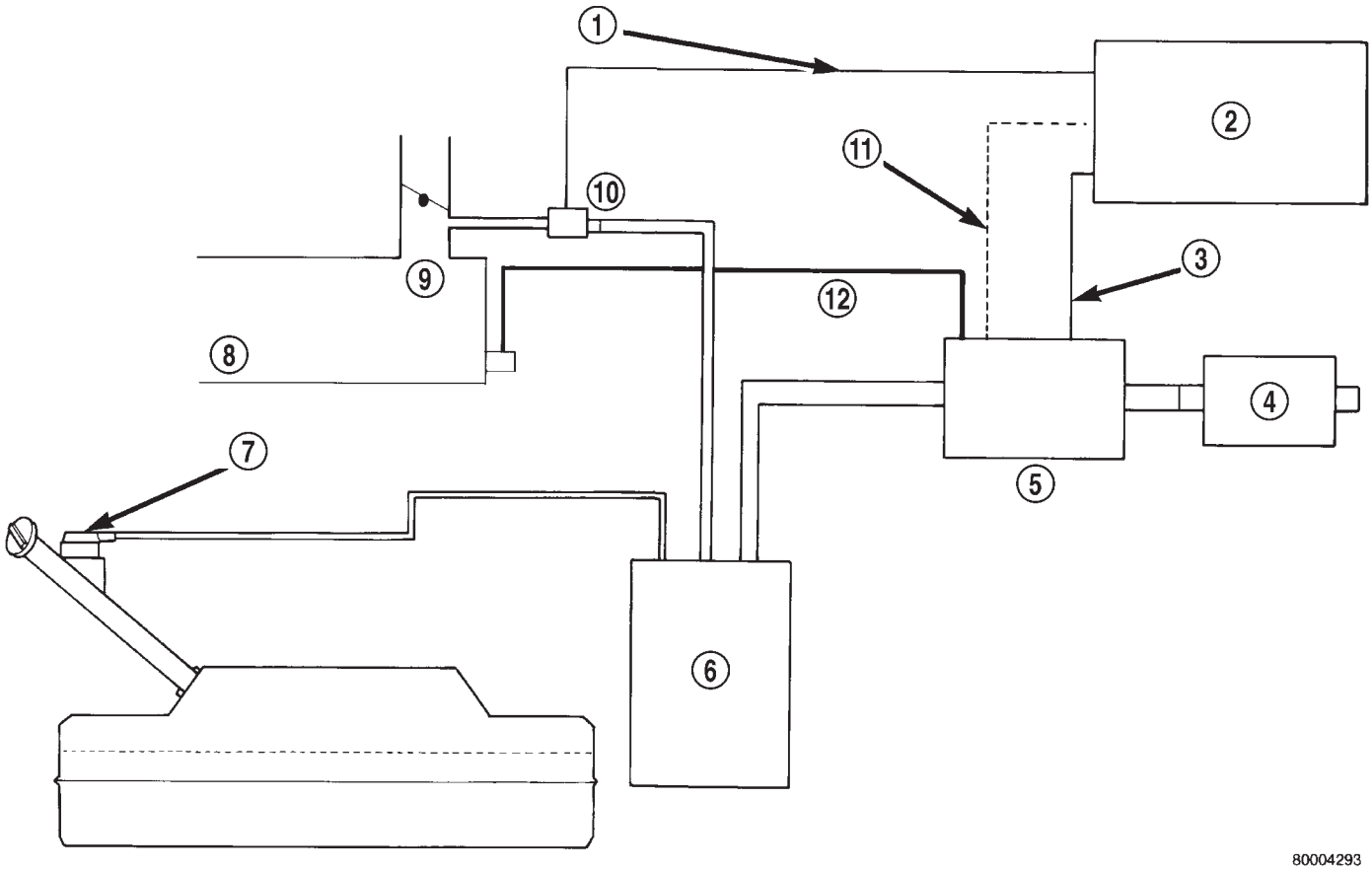


Fig. 3 Evaporative System Monitor Schematic—Typical

1 – DUTY CYCLE PURGE SOLENOID (DCPS) DRIVER
2 – POWERTRAIN CONTROL MODULE (PCM)
3 – 3-PORT SOLENOID DRIVER
4 – REMOTE FILTER
5 – COMBINED CANISTER VENT VALVE & LEAK DETECTION PUMP
6 – CANISTER
7 – TANK ROLLOVER VALVE & VAPOR FLOW CONTROL ORIFICE
8 – INTAKE MANIFOLD
9 – THROTTLE BODY
10 – DCPS
11 – SWITCH SIGNAL INPUT TO THE PCM
12 – ENGINE VACUUM LINE

If there is no leak the pump will quit. If there is a leak, the test is terminated at the end of the test mode.

If there is no leak, the purge monitor is run. If the cycle rate increases due to the flow through the purge system, the test is passed and the diagnostic is complete.

The canister vent valve will unseal the system after completion of the test sequence as the pump diaphragm assembly moves to the full travel position.

A typical system schematic is shown in (Fig. 3).

CRANKCASE VENTILATION SYSTEM

DESCRIPTION

All 2.5L 4–cylinder and 4.0L 6–cylinder engines are equipped with a Closed Crankcase Ventilation (CCV) system (Fig. 4) or (Fig. 5).

OPERATION

The Closed Crankcase Ventilation (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 CCV tube (hose) from the air cleaner is connected to front of cylinder head cover on 4.0L engines. It is connected to rear of cover on 2.5L engines.

DESCRIPTION AND OPERATION (Continued)

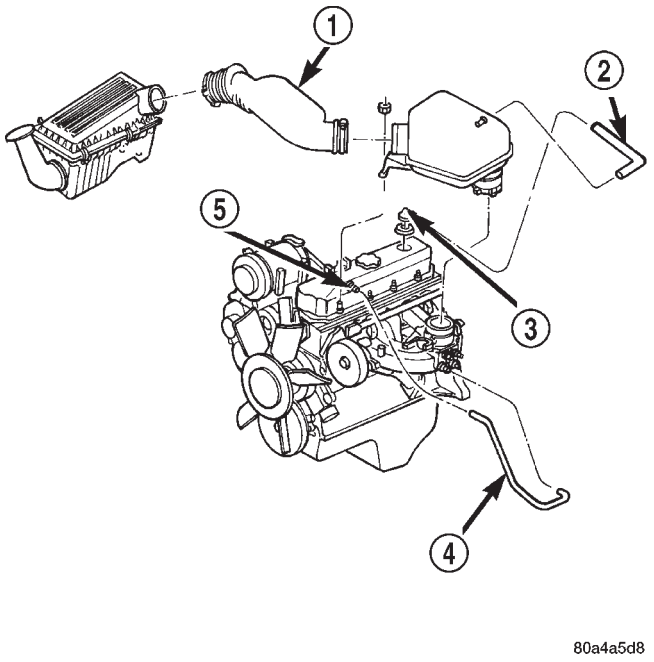


Fig. 4 CCV System—2.5L Engine

1 – AIR TUBE
2 – CCV TUBE
3 – AIR INLET FITTING
4 – CCV TUBE
5 – FIXED ORIFICE FITTING

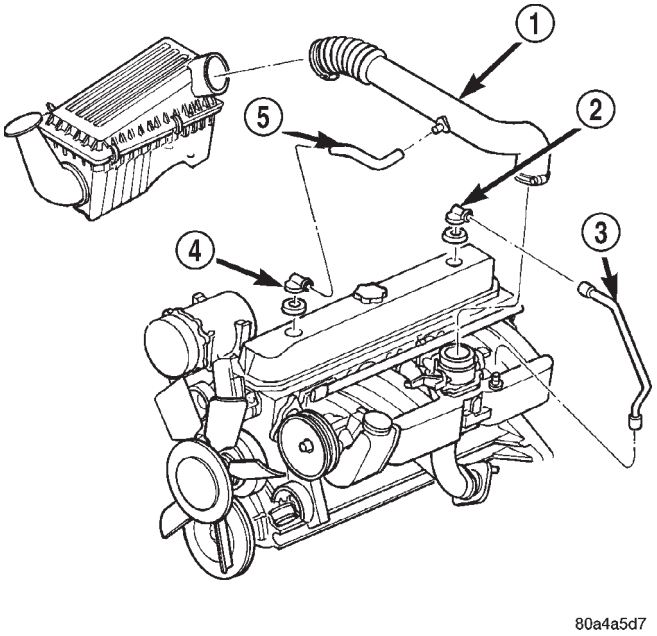


Fig. 5 CCV System—4.0L Engine

1 – AIR TUBE
2 – FIXED ORIFICE FITTING
3 – CCV TUBE
4 – AIR INLET FITTING
5 – CCV TUBE

When the engine is operating, fresh air enters the engine and mixes with crankcase vapors. Manifold vacuum draws the vapor/air mixture through the fixed orifice and into the intake manifold. The vapors are then consumed during combustion.

VEHICLE EMISSION CONTROL INFORMATION (VECI) LABEL

DESCRIPTION

All vehicles are equipped with a combined VECI label. This label is located in the engine compartment (Fig. 6).

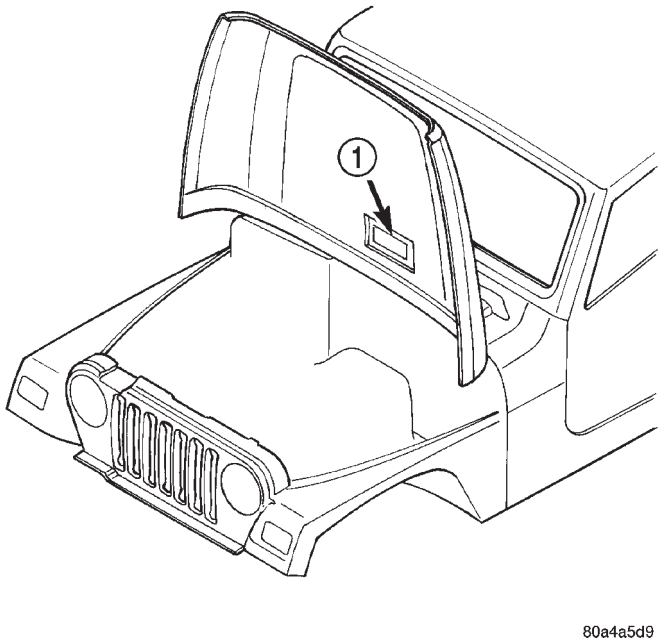


Fig. 6 VECI Label Location

1 – VECI LABEL

OPERATION

The VECI label contains the following:

- Engine family and displacement
- Evaporative family
- Emission control system schematic
- Certification application
- Engine timing specifications (if adjustable)
- Idle speeds (if adjustable)
- Spark plug and gap

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.

CRANKCASE VENTILATION SYSTEM

TESTING/CLEANING

The Crankcase Ventilation (CCV) system performs the same function as a conventional PCV system, but does not use a vacuum controlled valve. A vacuum fitting containing a fixed orifice of a calibrated size is used. It meters the amount of crankcase vapors drawn out of the engine.

(1) Check each CCV system tube (line) for leaks, cracks, kinks or bends. Replace as necessary

(2) Disconnect each CCV tube..

(3) Blow compressed air through each tube and check for blockage or restrictions. If cleaning is necessary, spray a soapy-type all-purpose cleaner into each component and blow out. After restriction is cleared, rinse out component with clear water. Blow water from component and install to vehicle. **To prevent damage to plastic components, never spray carburetor-type cleaner into any of the plastic tubes or the fixed orifice fitting. Never attempt to clean the fixed orifice fitting with a metal object as calibration could be affected. If fixed fitting cannot be cleared, replace it.**

REMOVAL AND INSTALLATION

EVAP CANISTER

The EVAP canister is mounted to a bracket, located in the engine compartment, on the left front inner fender (Fig. 7).

REMOVAL

(1) Disconnect vacuum lines/hoses at EVAP canister. Note location of lines/hoses before removal.

(2) Remove canister mounting bolt (Fig. 8).

(3) Disengage canister from vehicle by slipping 2 canister dowel pins from rubber mounting bracket bushings.

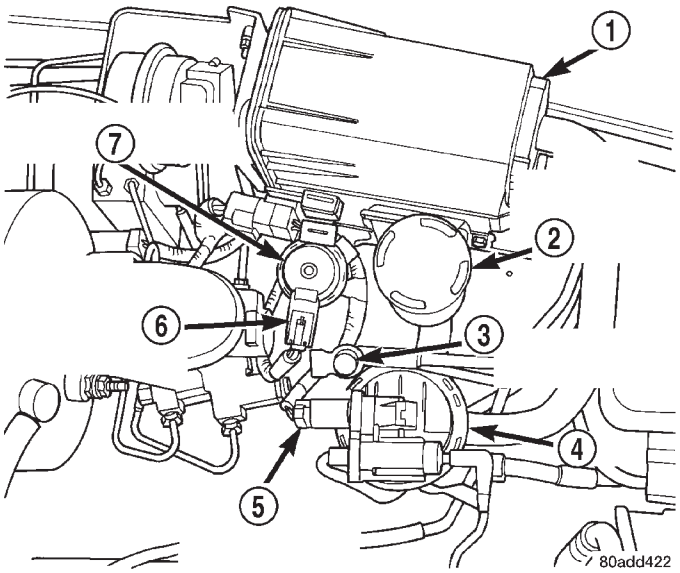


Fig. 7 EVAP Canister, Purge Solenoid and LDP Location

1 – EVAP CANISTER
2 – LEAK DETECTION PUMP (LDP) FILTER
3 – EVAP SYSTEM TEST PORT
4 – LDP
5 – LDP ELECTRICAL CONNECTOR
6 – EVAP SOLENOID ELEC. CONNECTOR
7 – EVAP CANISTER PURGE SOLENOID

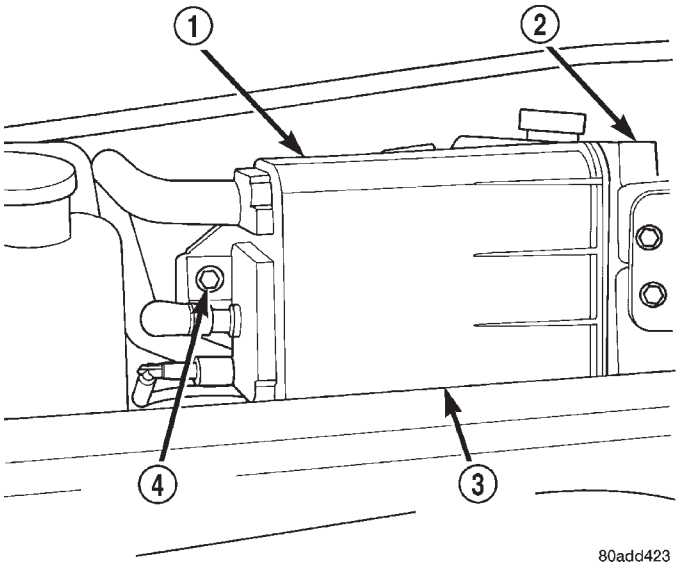


Fig. 8 EVAP Canister Removal/Installation

1 – EVAP CANISTER
2 – MOUNTING BRACKET
3 – L. F. FENDER
4 – MOUNTING BOLT

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position canister dowel pins into rubber bushings.
(2) Install canister mounting bolt.
(3) Tighten bolt to 9 N·m (80 in. lbs.) torque.
(4) Connect vacuum lines/hoses at EVAP canister.

EVAP CANISTER PURGE SOLENOID

REMOVAL

The duty cycle EVAP canister purge solenoid is located in the engine compartment on the EVAP canister mounting bracket (Fig. 7).
(1) Disconnect electrical wiring connector at solenoid.
(2) Disconnect vacuum lines/hoses at solenoid.
(3) Lift solenoid and rubber solenoid support from mounting bracket.

INSTALLATION

(1) Install purge solenoid and rubber support to its mounting bracket.
(2) Connect vacuum harness and wiring connector.

ROLLOVER VALVE

The fuel tank is equipped with 2 rollover valves. The valves are located on the top of the fuel tank (Fig. 9).

The valves are not serviceable. If replacement is necessary, the fuel tank must be replaced. Refer to the Fuel Tank section of Group 14, Fuel Systems for removal and installation procedures.

LEAK DETECTION PUMP (LDP)

The LDP is located in the engine compartment near the EVAP canister (Fig. 7). The LDP filter is also located near the EVAP canister (Fig. 7). The LDP and LDP filter are replaced (serviced) as one unit.

REMOVAL

(1) Carefully remove vapor/vacuum lines at LDP.
(2) Disconnect electrical connector at LDP.
(3) Remove LDP filter mounting bolt.
(4) Remove 3 LDP mounting screws (Fig. 10) and remove from vehicle.
(5) Carefully separate hose at bottom of LDP filter.

INSTALLATION

(1) Install LDP connecting hose to LDP and filter.
(2) Position LDP and LDP filter (as an assembly) to vehicle.
(3) Install LDP filter to mounting bracket. Tighten bolt to 7 N·m (65 in. lbs.) torque.

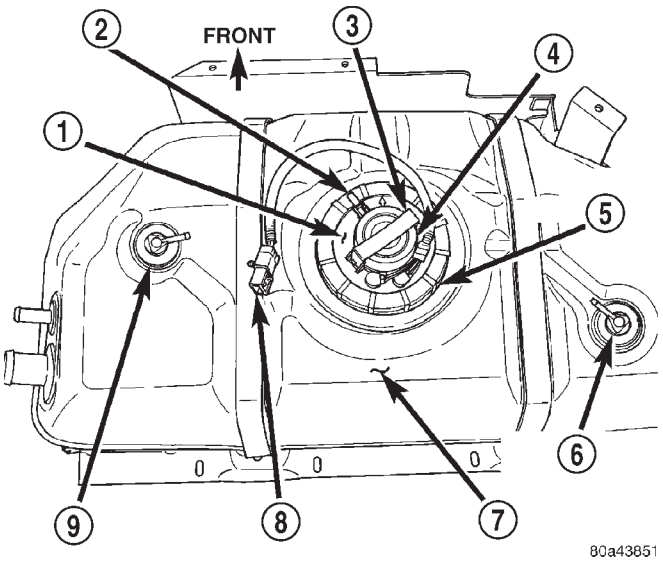


Fig. 9 Rollover Valve Location

1 – FUEL PUMP MODULE
2 – FUEL SUPPLY TUBE
3 – RETAINER CLAMP
4 – FUEL FILTER/FUEL PRESSURE REGULATOR
5 – LOCKNUT
6 – ROLLOVER VALVE
7 – TOP OF FUEL TANK
8 – ELECTRICAL CONNECTOR
9 – ROLLOVER VALVE

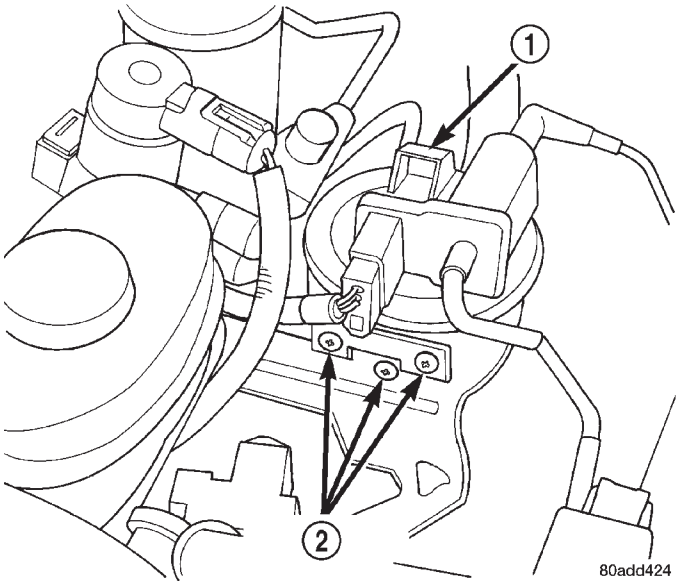


Fig. 10 Leak Detection Pump (LDP) Mounting Screws

1 – LEAK DETECTION PUMP (LDP)
2 – MOUNTING SCREWS

REMOVAL AND INSTALLATION (Continued)

(4) Install LDP to mounting bracket. Tighten screws to 1 N·m (11 in. lbs.) torque.

(5) Carefully install vapor/vacuum lines to LDP. **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.**

(6) Connect electrical connector to LDP.

SPECIFICATIONS

TORQUE CHART

Description	Torque
EVAP Canister Mounting Bolt	9 N·m (80 in. lbs.)
Leak Detection Pump (LDP) Filter Mounting Bolts	7 N·m (65 in. lbs.)
Leak Detection Pump (LDP) Mounting Screws	1 N·m (11 in. lbs.)

EMISSION CONTROL SYSTEMS

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ON-BOARD DIAGNOSTICS

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DESCRIPTION AND OPERATION

EMISSION CONTROL 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

As a functional test, the MIL (check engine) illuminates at key-on before engine cranking. Whenever the Powertrain Control Module (PCM) sets a Diagnostic Trouble Code (DTC) that affects vehicle emissions, it illuminates the MIL. If a problem is detected, the PCM sends a message to the 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

DESCRIPTION AND OPERATION (Continued)

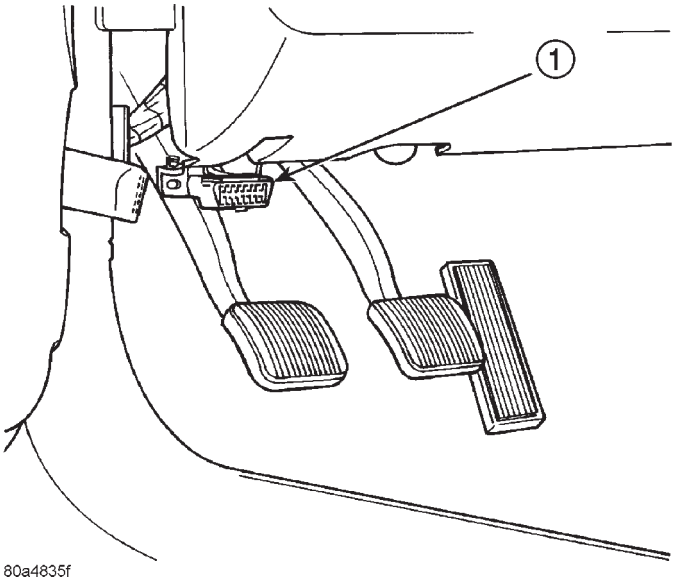


Fig. 1 Data Link (Diagnostic) Connector Location
1 – 16–WAY DATA LINK CONNECTOR

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.

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.

DIAGNOSTIC TROUBLE CODES

DESCRIPTION

A Diagnostic Trouble Code (DTC) indicates the PCM has recognized an abnormal condition in the system.

Diagnostic trouble codes 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 scan tool (or an equivalent scan tool) to the 16–way data link connector.

NOTE: For a list of DTC's, refer to the charts in this section.

OBTAINING DIAGNOSTIC TROUBLE CODES

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.

DESCRIPTION AND OPERATION (Continued)

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS

* Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

Hex Code	Generic Scan Tool Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
*01	P0340	No Cam Signal at PCM	No camshaft signal detected during engine cranking.
*02	P0601	Internal Controller Failure	PCM Internal fault condition detected.
05		Charging System Voltage Too Low	Battery voltage sense input below target charging during engine operation. Also, no significant change detected in battery voltage during active test of generator output circuit.
06		Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
0A		Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the auto shutdown relay circuit.
0B		Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
*0C	P0743	Torque Converter Clutch Soleniod/Trans Relay Circuit	An open or shorted condition detected in the torque converter part throttle unlock solenoid control circuit (3 speed auto RH trans. only).
0F		Speed Control Solenoid Circuits	An open or shorted condition detected in the Speed Control vacuum or vent solenoid circuits.
10		A/C Clutch Relay Circuit	An open or shorted condition detected in the A/C clutch relay circuit.
*12	P0443	EVAP Purge Solenoid Circuit	An open or shorted condition detected in the duty cycle purge solenoid circuit.
*13 or *14 or *15	P0203 or P0202 or P0201	Injector #3 Control Circuit Injector #2 Control Circuit Injector #1 Control Circuit	Injector #3 output driver does not respond properly to the control signal. Injector #2 output driver does not respond properly to the control signal. Injector #1 output driver does not respond properly to the control signal.
*19	P0505	Idle Air Control Motor Circuits	A shorted or open condition detected in one or more of the idle air control motor circuits.
*1A or *1B	P0122 or P0123	Throttle Position Sensor Voltage Low Throttle Position Sensor Voltage High	Throttle position sensor input below the minimum acceptable voltage Throttle position sensor input above the maximum acceptable voltage.
*1E	P0117 or	ECT Sensor Voltage Too Low	Engine coolant temperature sensor input below minimum acceptable voltage.

DESCRIPTION AND OPERATION (Continued)

Hex Code	Generic Scan Tool Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
*1F	P0118	ECT Sensor Voltage Too High	Engine coolant temperature sensor input above maximum acceptable voltage.
*23	P0500	No Vehicle Speed Sensor Signal	No vehicle speed sensor signal detected during road load conditions.
*24	P0107	MAP Sensor Voltage Too Low	MAP sensor input below minimum acceptable voltage.
	or		
*25	P0108	MAP Sensor Voltage Too High	MAP sensor input above maximum acceptable voltage.
*27	P1297	No Change in MAP From Start to Run	No difference recognized between the engine MAP reading and the barometric (atmospheric) pressure reading from start-up.
28	P0320	No Crank Reference Signal at PCM	No crank reference signal detected during engine cranking.
2B	P0351	Ignition Coil #1 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
2C	P1389	No ASD Relay Output Voltage at PCM	An Open condition Detected In The ASD Relay Output Circuit.
31	P1696	PCM Failure EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the PCM.
*39	P0112	Intake Air Temp Sensor Voltage Low	Intake air temperature sensor input below the maximum acceptable voltage.
*3A	P0113	Intake Air Temp Sensor Voltage High	Intake air temperature sensor input above the minimum acceptable voltage.
*3D	P0204	Injector #4 Control Circuit	Injector #4 output driver does not respond properly to the control signal.
*3E	P0132	1/1 O2 Sensor Shorted to Voltage	Left oxygen sensor input voltage maintained above the normal operating range.
44	P0600	PCM Failure SPI Communications	PCM Internal fault condition detected.
*45	P0205	Injector #5 Control Circuit	Injector #5 output driver does not respond properly to the control signal.
	or		
*46	P0206	Injector #6 Control Circuit	Injector #6 output driver does not respond properly to the control signal.
52		Speed Control Power Relay or Speed Control 12V Driver Circuit	Malfunction detected with power feed to speed control servo solenoids.
57		Speed Control Switch Always Low	Speed control switch input below the minimum acceptable voltage.
60	P1698		No CCD/PCI message from TCM
65		Fuel Pump Relay Control Circuit	An open or shorted condition detected in the fuel pump relay control circuit.
*72	P1899	Park/Neutral Switch Stuck In Park or In Gear	Incorrect input state detected for the Park/Neutral switch, auto. trans. only.

DESCRIPTION AND OPERATION (Continued)

Hex Code	Generic Scan Tool Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
*73	P0551	Power Steering Switch Failure	Power steering high pressure seen at high speed.
*76	P0172	Fuel System Rich 1/1 Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
*77	P0171	Fuel System Lean 1/1 Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.
*7E	P0138	1/2 O2 Sensor Shorted to Voltage	Downstream oxygen sensor input voltage maintained above the normal operating range.
*80	P0125	Closed Loop Temp Not Reached	Engine does not reach 20°F within 5 minutes with a vehicle speed signal.
*84	P0121	TPS Voltage Does Not Agree With MAP	TPS signal does not correlate to MAP sensor
89	P0700		Aisin AW4 transmission DTC present
94	P0740	Torq Conv Clu, No RPM Drop At Lockup	Relationship between engine speed and vehicle speed indicates no torque converter clutch engagement (auto. trans. only).
95 or 96		Fuel Level Sending Unit Volts Too Low Fuel Level Sending Unit Volts Too High	Open circuit between PCM and fuel gauge sending unit. Circuit shorted to voltage between PCM and fuel gauge sending unit.
*99 or *9A	P1493 P1492	Battery Temp Sensor Voltage Too Low Battery Temp Sensor Voltage Too High	Battery temperature sensor input voltage below an acceptable range. Battery temperature sensor input voltage above an acceptable range.
*9B or *9C	P0131 P0137	Upstream O2s Voltage Shorted to Ground Downstream O2s Voltage Shorted to Ground	O2 sensor voltage too low, tested after cold start. O2 sensor voltage too low, tested after cold start.
*9D	P1391	Intermittent Loss of CMP or CKP	Intermittent loss of either camshaft or crankshaft position sensor

DESCRIPTION AND OPERATION (Continued)

MONITORED SYSTEMS

DESCRIPTION

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:

- Fuel System Monitor
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- Catalyst Monitor

All these system monitors require two consecutive trips with the malfunction present to set a fault.

Refer to the appropriate Powertrain Diagnostics Procedures manual for diagnostic procedures.

The following is an operation and description of each system monitor :

OXYGEN SENSOR (O2S) MONITOR

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The O2S is also the main sensing element for the Catalyst and Fuel Monitors.

The O2S can fail in any or all of the following manners:

- slow response rate
- reduced output voltage
- dynamic shift
- shorted or open circuits

Response rate is the time required for the sensor to switch from lean to rich once it is exposed to a richer than optimum A/F mixture or vice versa. As the sensor starts malfunctioning, it could take longer to detect the changes in the oxygen content of the exhaust gas.

The output voltage of the O2S ranges from 0 to 1 volt. A good sensor can easily generate any output voltage in this range as it is exposed to different concentrations of oxygen. To detect a shift in the A/F mixture (lean or rich), the output voltage has to change beyond a threshold value. A malfunctioning sensor could have difficulty changing beyond the threshold value.

OXYGEN SENSOR HEATER MONITOR

If there is an oxygen sensor (O2S) shorted to voltage DTC, as well as a O2S heater DTC, the O2S fault MUST be repaired first. Before checking the O2S fault, verify that the heater circuit is operating correctly.

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572 ° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The voltage readings taken from the O2S sensor are very temperature sensitive. The readings are not accurate below 300°C. Heating of the O2S sensor is done to allow the engine controller to shift to closed loop control as soon as possible. The heating element used to heat the O2S sensor must be tested to ensure that it is heating the sensor properly.

The O2S sensor circuit is monitored for a drop in voltage. The sensor output is used to test the heater by isolating the effect of the heater element on the O2S sensor output voltage from the other effects.

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

DESCRIPTION AND OPERATION (Continued)

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.

EVAPORATIVE EMISSION CONTROLS

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DESCRIPTION AND OPERATION

EVAPORATION CONTROL SYSTEM

DESCRIPTION

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 in this section.

When equipped with certain emissions packages, a Leak Detection Pump (LDP) will be used as part of the evaporative system. This pump is used as part of OBD II requirements. Refer to Leak Detection Pump in this group for additional information.

NOTE: The evaporative system uses specially manufactured hoses. If replacement becomes necessary, only use fuel resistant hose.

VEHICLE EMISSION CONTROL INFORMATION (VECI) LABEL

DESCRIPTION

All vehicles are equipped with a combined VECI label. This label is located in the engine compartment (Fig. 1) 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

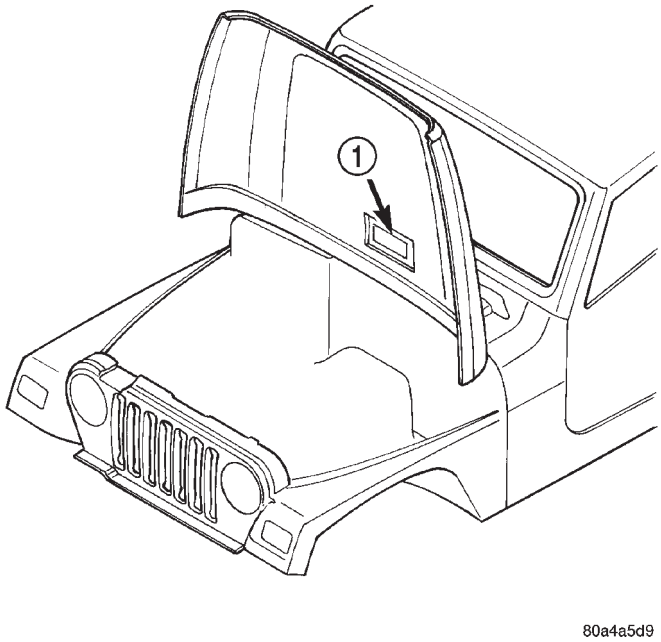


Fig. 1 VECI Label Location

1 – VECI LABEL

The label also contains an engine vacuum schematic. There are unique labels for vehicles built for sale in the state of California and the country of Canada. Canadian labels are written in both the English and French languages. These labels are permanently attached and cannot be removed without defacing information and destroying label.

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