GROUP TAB LOCATOR

INTRODUCTION

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VEHICLE SAFETY CERTIFICATION LABEL

DESCRIPTION

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

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

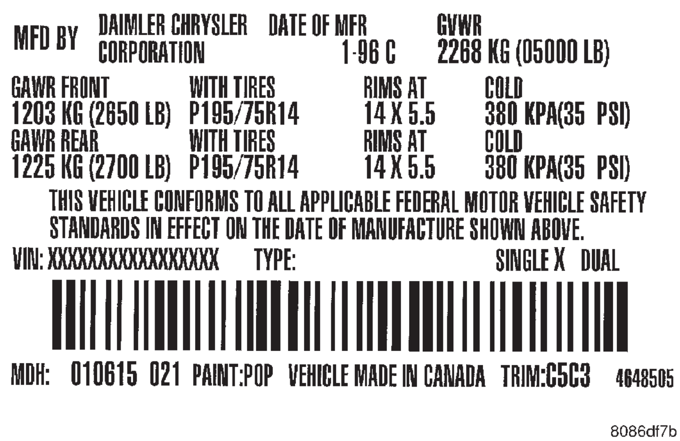


Fig. 1 VEHICLE SAFETY CERTIFICATION LABEL - TYPICAL

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:

- 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 (LHD) 4 = Wrangler 4X4 (RHD)
6	Series	2 = SE 3 = X 4 = Sport 5 = Sahara
7	Body Style	9 = Open Body
8	Engine	P = 2.5L Gasoline S = 4.0L Gasoline
9	Check Digit	0 through 9 or X
10	Model Year	2=2002
11	Assembly Plant	P = Toledo #2
12 thru 17	Vehicle Build Sequence	

VEHICLE EMISSION CONTROL INFORMATION (VECI) LABEL

DESCRIPTION

All models have a Vehicle Emission Control Information (VECI) Label. DaimlerChrysler permanently attaches the label in the engine compartment (Fig. 2). It cannot be removed without defacing information and destroying the label.

The label contains the vehicle's emission specifications and vacuum hose routings. All hoses must be connected and routed according to the label.

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.

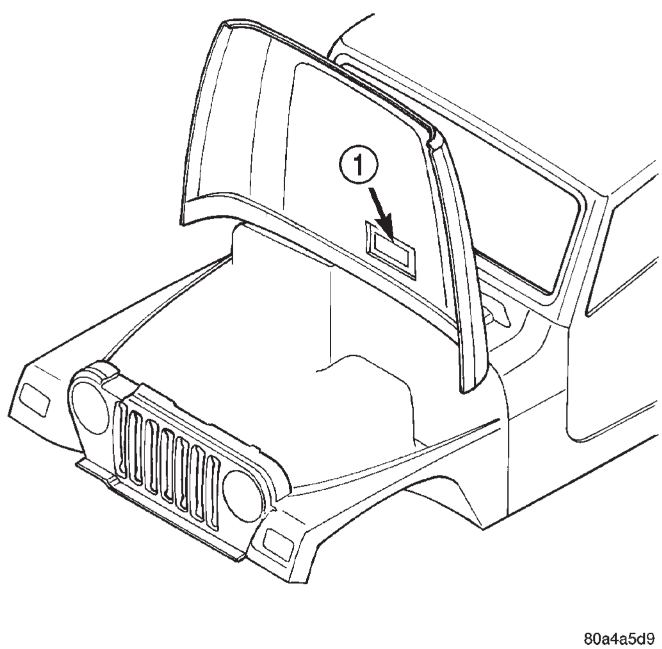


Fig. 2 VECI Label Location

1 - VECI LABEL

BODY CODE PLATE

DESCRIPTION

BODY CODE PLATE

A metal body code plate is attached to the floor pan under the drivers seat (Fig. 3). 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. 4).

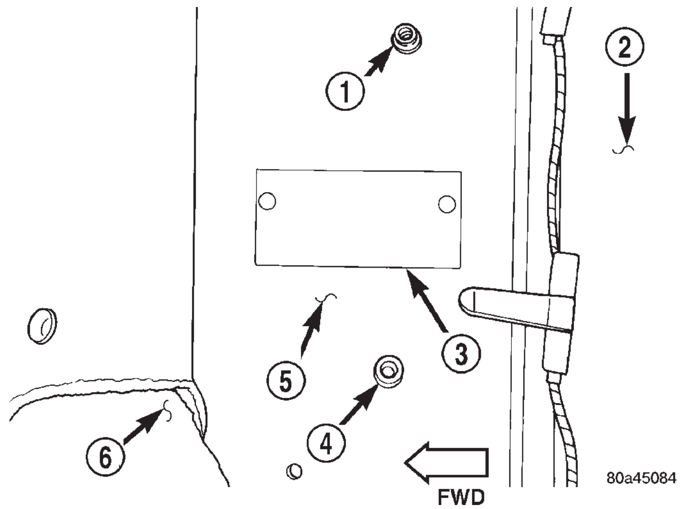


Fig. 3 Body Code Plate Location

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

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.

BODY CODE PLATE (Continued)

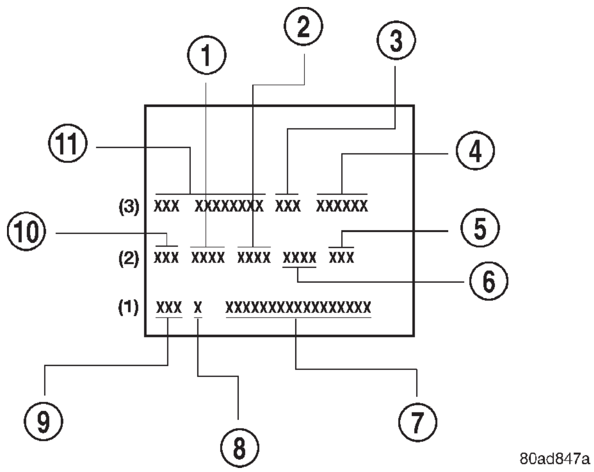


Fig. 4 Body Code Plate Decoding

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

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)

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 23 - BODY/PAINT - SPECIFICATIONS) 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 DATA/VEHICLE INFORMATION/VEHICLE IDENTIFICATION NUMBER - DESCRIPTION) for breakdown of VIN code.

INTERNATIONAL SYMBOLS

DESCRIPTION

The graphic symbols illustrated in the following International Control and Display Symbols Chart (Fig. 5) are used to identify various instrument controls. The symbols correspond to the controls and displays that are located on the instrument panel.

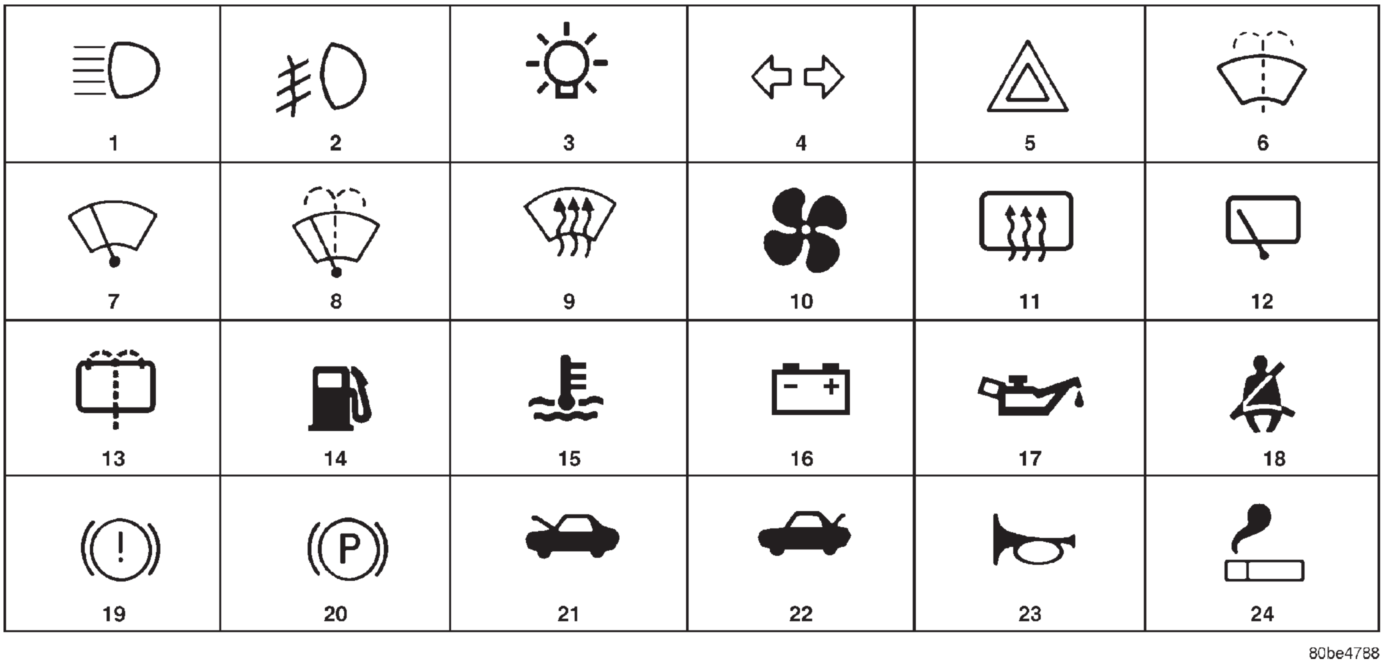


Fig. 5 INTERNATIONAL CONTROL AND DISPLAY SYMBOLS

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

FASTENER IDENTIFICATION

DESCRIPTION

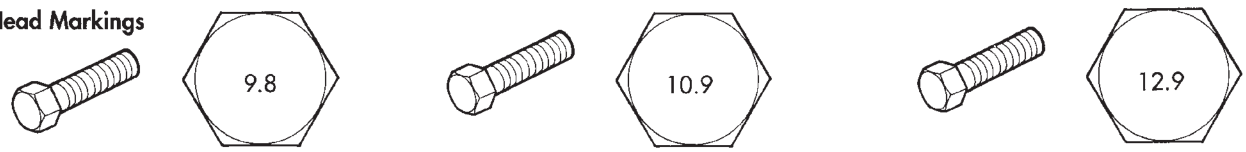
The SAE bolt strength grades range from grade 2 to grade 8. The higher the grade number, the greater the bolt strength. Identification is determined by the line marks on the top of each bolt head. The actual bolt strength grade corresponds to the number of line marks plus 2. The most commonly used metric 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 (Fig. 6) and (Fig. 7).

FASTENER IDENTIFICATION (Continued)

Bolt Markings and Torque - Metric

Commercial Steel Class	9.8	10.9	12.9

Bolt Head Markings

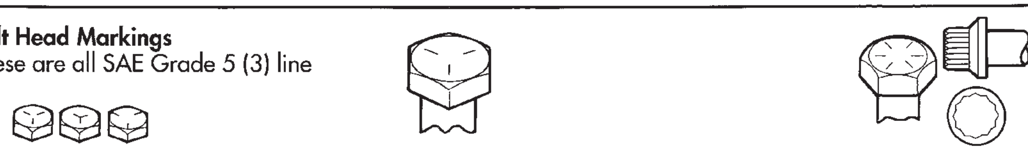


Body Size Diam. mm	9.8 Torque Cast Iron N•m	ft-lb	Aluminum N•m	ft-lb	10.9 Torque Cast Iron N•m	ft-lb	Aluminum N•m	ft-lb	12.9 Torque Cast Iron N•m	ft-lb	Aluminum N•m	ft-lb
6	9	5	7	4	14	9	11	7	14	9	11	7
7	14	9	11	7	18	14	14	11	23	18	18	14
8	25	18	18	14	32	23	25	18	36	27	28	21
10	40	30	30	25	60	45	45	35	70	50	55	40
12	70	55	55	40	105	75	80	60	125	95	100	75
14	115	85	90	65	160	120	125	95	195	145	150	110
16	180	130	140	100	240	175	190	135	290	210	220	165
18	230	170	180	135	320	240	250	185	400	290	310	230

Bolt Markings and Torque Values - U.S. Customary

SAE Grade Number	5	8

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



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

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Fig. 6 FASTENER IDENTIFICATION

FASTENER IDENTIFICATION (Continued)

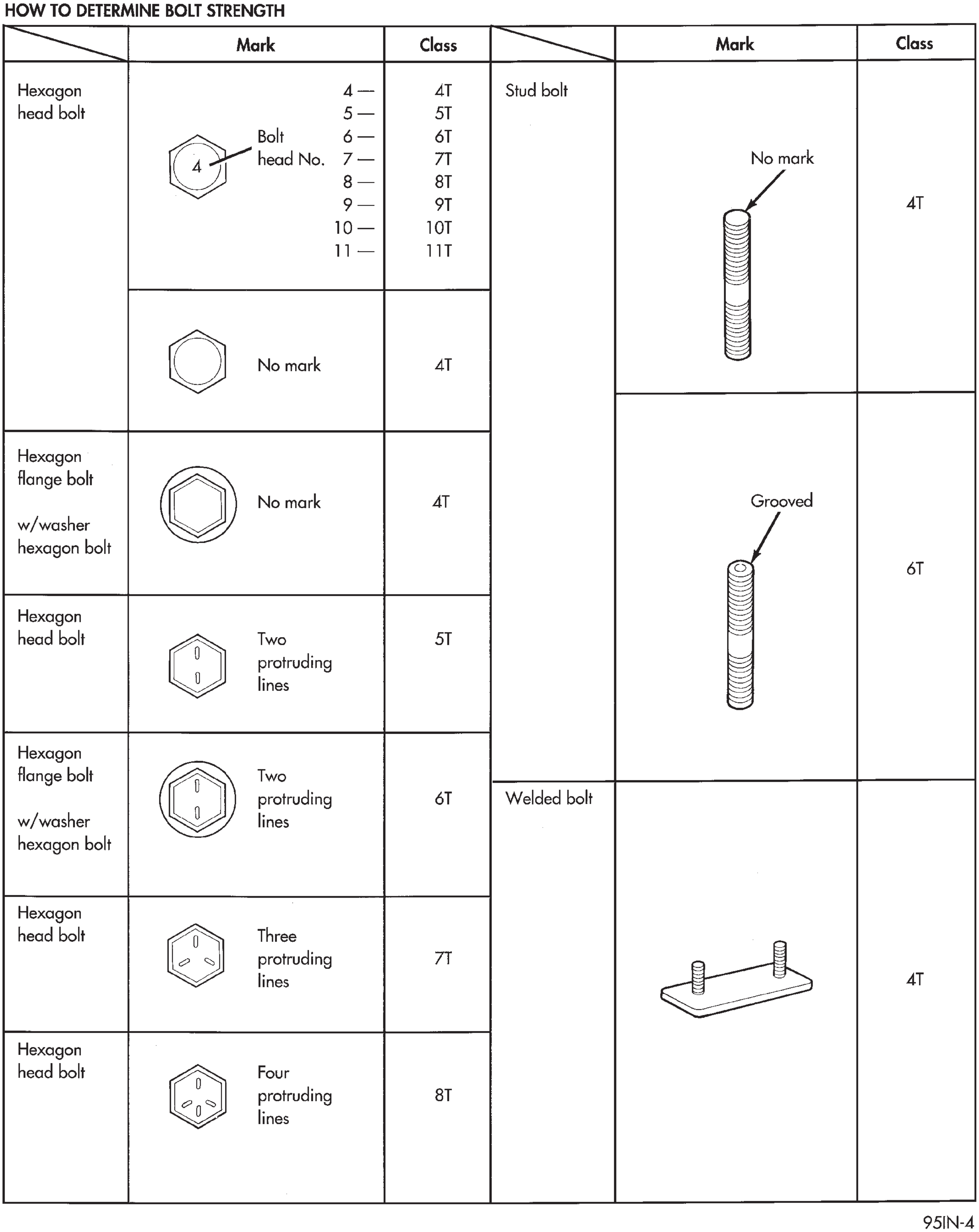

Fig. 7 FASTENER STRENGTH

FASTENER USAGE

DESCRIPTION

DESCRIPTION - FASTENER USAGE

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

Fasteners and torque specifications 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.

DESCRIPTION - THREADED HOLE REPAIR

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

METRIC SYSTEM

DESCRIPTION

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

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

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	x 1.0936	= Yards
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
mph	x 0.4470	= Meters/Sec (M/S)	M/S	x 2.237	= mph
Kilometers/Hr. (Km/h)	x 0.27778	= Meters/Sec (M/S)	M/S	x 3.600	Kilometers/Hr. (Km/h)

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	

Refer to the Metric Conversion Chart to convert torque values listed in metric Newton- meters (N·m). Also, use the chart to convert between millimeters (mm) and inches (in.) (Fig. 8).

METRIC SYSTEM (Continued)

in-lbs to N•m

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

N•m to in-lbs

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

ft-lbs to N•m

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

N•m to ft-lbs

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

in. to mm

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

mm to in.

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

J901N-10

Fig. 8 METRIC CONVERSION CHART

TORQUE REFERENCES

DESCRIPTION

Individual Torque Charts appear within many or the Groups. Refer to the Standard Torque Specifications Chart for torque references not listed in the individual torque charts (Fig. 9).

SPECIFIED TORQUE FOR STANDARD BOLTS

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

Fig. 9 TORQUE SPECIFICATIONS

LUBRICATION & MAINTENANCE

TABLE OF CONTENTS

LUBRICATION & MAINTENANCE

SPECIFICATIONS - FLUID CAPACITIES

DESCRIPTION	SPECIFICATION
FUEL TANK	19 U.S. Gallons (71.9 Liters)****
ENGINE OIL	
Engine Oil - with Filter - 2.5L	3.8L (4.0 qts.)
Engine Oil - with Filter - 4.0L	5.7L (6.0 qts.)
ENGINE COOLANT	
Cooling System - 2.5 L	8.5 L (9.0 qts.)
Cooling System - 4.0 L	9.9 L (10.5 qts.)
AUTOMATIC TRANSMISSION	
Service Fill - 30RH	3.8 L (4.0 qts)
O-haul Fill - 30RH	4.67 L (9.86 pts.)
Service Fill - 32RH	3.8 L (4.0 qts)
O-haul Fill - 32RH	6.31L (13.33 pts.)
Dry fill capacity 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 21 - TRANSMISSION/TRANSAXLE/ AUTOMATIC/FLUID - STANDARD PROCEDURE)	
TRANSFER CASE	
NV231	1.0 L (2.2 pts.)
MANUAL TRANSMISSION	
AX5 Approximate dry fill or fill to bottom edge of the fill plug hole.	3.3 L (3.49 qts.)
NV3550 Approximate dry fill or fill to bottom edge of fill plug hole.	2.28 L (2.41 qts.)
FRONT AXLE ± .03 L (1 oz.)	
181 FBI (Model 30)	1.2 L (2.5 pts.)
REAR AXLE ± .03 L (1 oz.)	
194 RBI (Model 35)	1.66 L (3.5 pts.)*
216 RBI (Model 44)	1.89 L (4.0 pts.)*
* With Trac-lok add 0.11 L (4.0 oz.) of Friction Modifier.	
****Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.	

INTERNATIONAL SYMBOLS

DESCRIPTION — INTERNATIONAL SYMBOLS

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

INTERNATIONAL SYMBOLS (Continued)

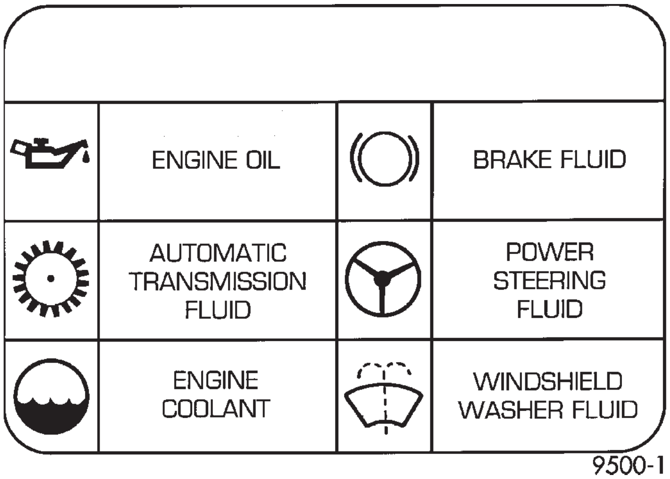

Fig. 1 International Symbols

PARTS & LUBRICANT RECOMMENDATION

DESCRIPTION - FLUID TYPES

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.

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

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

SAE VISCOSITY RATING

An SAE viscosity grade is used to specify the viscosity of engine oil. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Example SAE 5W-30 = multigrade engine oil.

DaimlerChrysler Corporation only recommends multigrade 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 DaimlerChrysler Corporation.

Fig. 2 API Symbol

GEAR LUBRICANTS

SAE ratings also apply to multigrade gear lubricants. In addition, API classification defines the lubricants usage. Such as API GL-5 and SAE 75W-90.

LUBRICANTS AND GREASES

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

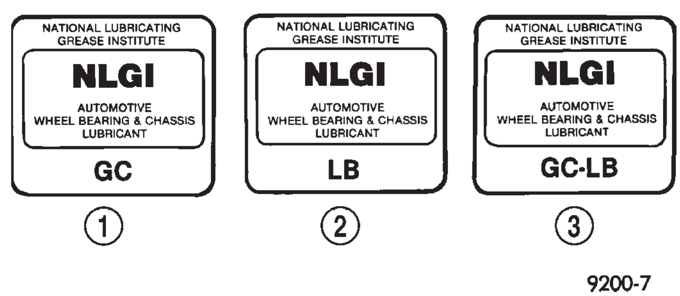

Fig. 3 NLGI Symbol

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

SPECIALIZED LUBRICANTS AND OILS

Some maintenance or repair procedures may require the use of specialized lubricants or oils. Consult the appropriate sections in this manual for the correct application of these lubricants.

FLUID TYPES

DESCRIPTION

DESCRIPTION - FUEL REQUIREMENTS

Your engine is designed to meet all emissions regulations and provide excellent fuel economy and performance when using high quality unleaded "regular" gasoline having an octane rating of 87. The routine use of premium gasoline is not recommended. Under normal conditions the use of premium fuel will not provide a benefit over high quality regular gasolines 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.

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 support 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.

FLUID TYPES (Continued)

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 DaimlerChrysler 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.

DESCRIPTION - ENGINE COOLANT

WARNING: ANTIFREEZE IS AN ETHYLENE GLYCOL BASE COOLANT AND IS HARMFUL IF SWALLOWED OR INHALED. IF SWALLOWED, DRINK TWO GLASSES OF WATER AND INDUCE VOMITING. IF INHALED, MOVE TO FRESH AIR AREA. SEEK MEDICAL ATTENTION IMMEDIATELY. DO NOT STORE IN OPEN OR UNMARKED CONTAINERS. WASH SKIN AND CLOTHING THOROUGHLY AFTER COMING IN CONTACT WITH ETHYLENE GLYCOL. KEEP OUT OF REACH OF CHILDREN. DISPOSE OF GLYCOL BASE COOLANT PROPERLY, CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA. DO NOT OPEN A COOLING SYSTEM WHEN THE ENGINE IS AT OPERATING TEMPERATURE OR HOT UNDER PRESSURE, PERSONAL INJURY CAN RESULT. AVOID RADIATOR COOLING FAN WHEN ENGINE COMPARTMENT RELATED SERVICE IS PERFORMED, PERSONAL INJURY CAN RESULT.

CAUTION: Use of Propylene Glycol based coolants is not recommended, as they provide less freeze protection and less corrosion protection.

The cooling system is designed around the coolant. The coolant must accept heat from engine metal, in the cylinder head area near the exhaust valves and engine block. Then coolant carries the heat to the radiator where the tube/fin radiator can transfer the heat to the air.

The use of aluminum cylinder blocks, cylinder heads, and water pumps requires special corrosion protection. Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (MS-9769), or the equivalent ethylene glycol base coolant with organic corrosion inhibitors (called HOAT, for Hybrid Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% Ethylene Glycol and 50% distilled water to obtain a freeze point of -37°C (-35°F). If it loses color or becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

CAUTION: Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (MS-9769) may not be mixed with any other type of antifreeze. Mixing of coolants other than specified (non-HOAT or other HOAT), may result in engine damage that may not be covered under the new vehicle warranty, and decreased corrosion protection.

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 protec-

FLUID TYPES (Continued)

tion 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

The use of aluminum cylinder blocks, cylinder heads and water pumps requires special corrosion protection. Only Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (glycol base coolant with corrosion inhibitors called HOAT, for Hybrid Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% distilled water to obtain to obtain a freeze point of -37°C (-35°F). If it loses color or becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

CAUTION: Do not use coolant additives that are claimed to improve engine cooling.

DESCRIPTION - ENGINE OIL

WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE, DISPOSE OF USED ENGINE OIL PROPERLY. CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA.

API SERVICE GRADE CERTIFIED

Use an engine oil that is API Service Grade Certified. MOPAR® provides engine oils that conform to this service grade.

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with multiple viscosities such as 5W-30 or 10W-30. These oils are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation. (Fig. 4)

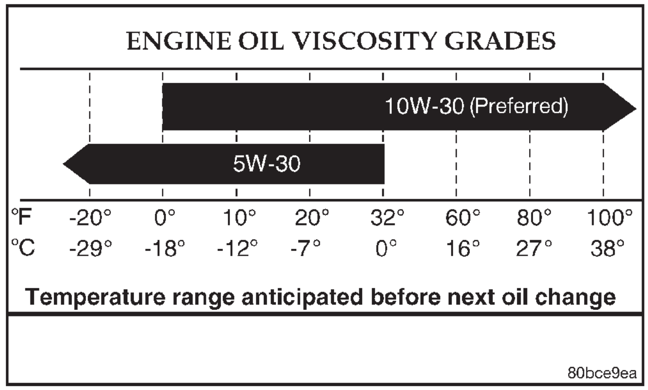

Fig. 4 Temperature/Engine Oil Viscosity

ENERGY CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. The designation of ENERGY CONSERVING is located on the label of an engine oil container.

CONTAINER IDENTIFICATION

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans (Fig. 5).

9400-9

Fig. 5 API Symbol

DESCRIPTION - GEAR LUBRICATION RATINGS

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

DESCRIPTION - TRANSFER CASE - NV231

Recommended lubricant for the NV231 transfer case is Mopar® ATF +4, type 9602, Automatic Transmission Fluid.

FLUID TYPES (Continued)

DESCRIPTION - AXLE LUBRICATION

A multi-purpose hypoid gear lubricant which conforms to MIL-L-2105C and API GL 5 quality specifications should be used. Mopar Hypoid Gear Lubricant conforms to these specifications.

FRONT AXLE

- 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.

REAR AXLE

- 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.

NOTE: Trac-lok® equipped axles require a friction modifier be added to the lubricant.

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

DESCRIPTION - MANUAL TRANSMISSION

Mopar® manual transmission fluid is the lubricant recommended for the NV3550 transmission. The recommended lubricant for the AX5 transmission is Mopar® 75W-90 API Grade GL-3.

DESCRIPTION - AUTOMATIC TRANSMISSION FLUID

NOTE: Refer to the maintenance schedules in this group for the recommended maintenance (fluid/filter change) intervals for this transmission.

NOTE: Refer to Service Procedures in this group for fluid level checking procedures.

Mopar® ATF +4, type 9602, 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 +4, type 9602, 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.** ATF+4 also has a unique odor that may change with age. Consequently, odor and color cannot be used to indicate the fluid condition or the need for a fluid change.

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 - AUTOMATIC TRANSMISSION FLUID

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 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.

HOISTING

STANDARD PROCEDURE - HOISTING RECOMMENDATIONS

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

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.

HOISTING (Continued)

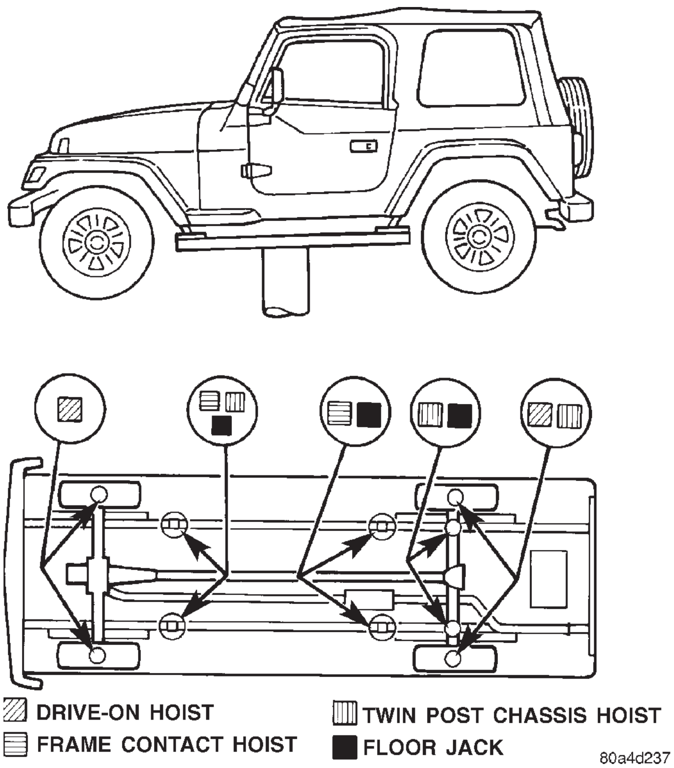

Fig. 6 Vehicle Lifting Locations

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

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

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

HOIST

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

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.

TOWING

STANDARD PROCEDURE - 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. 7) and (Fig. 8).

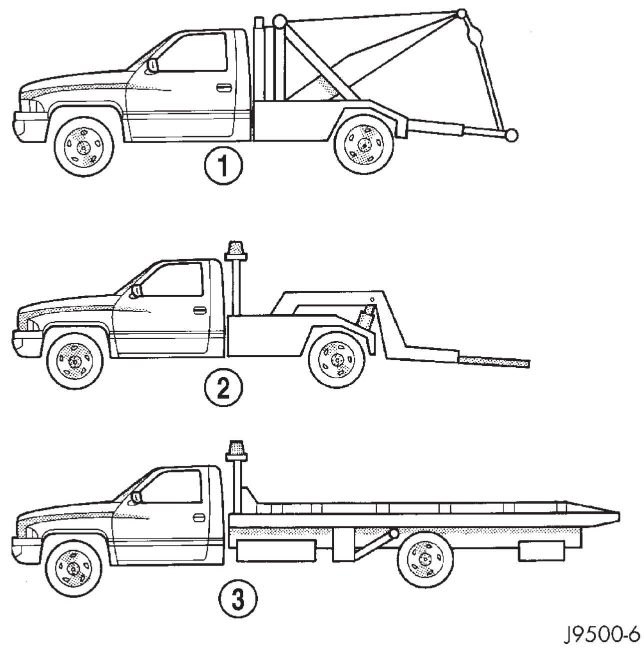

Fig. 7 Tow Vehicles With Approved Equipment

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

TOWING (Continued)

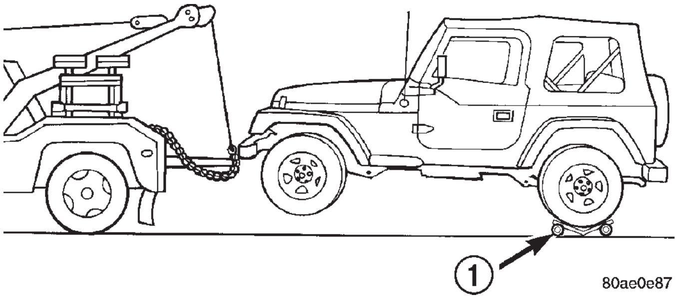

Fig. 8 Towing With Tow Dollies

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.

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. 9).

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

(4) Attach the safety chains to the vehicle (Fig. 10).

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

TOWING (Continued)

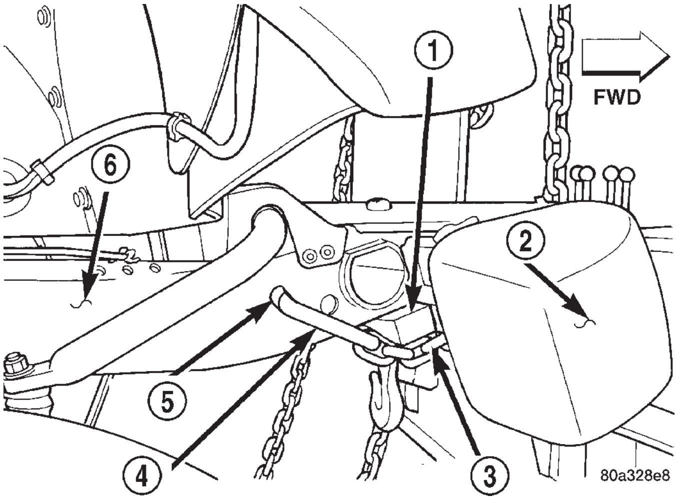

Fig. 9 T-Hook Attachment

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

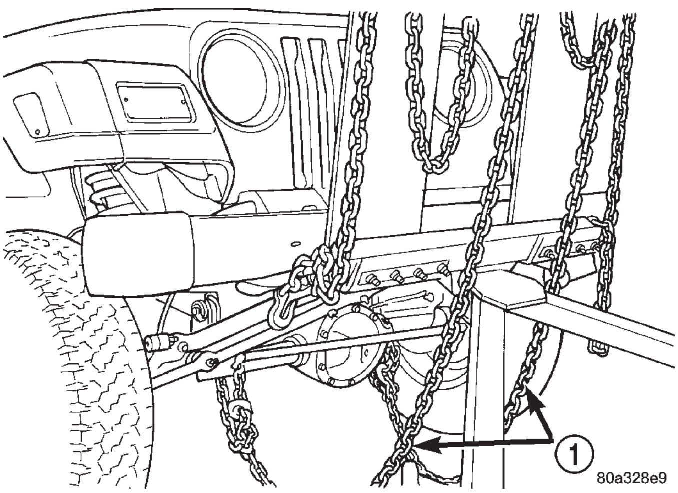

Fig. 10 Safety Chain Attachment

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.

JUMP STARTING

STANDARD PROCEDURE - 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.

JUMP STARTING (Continued)

(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. 11). 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. 11).

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.

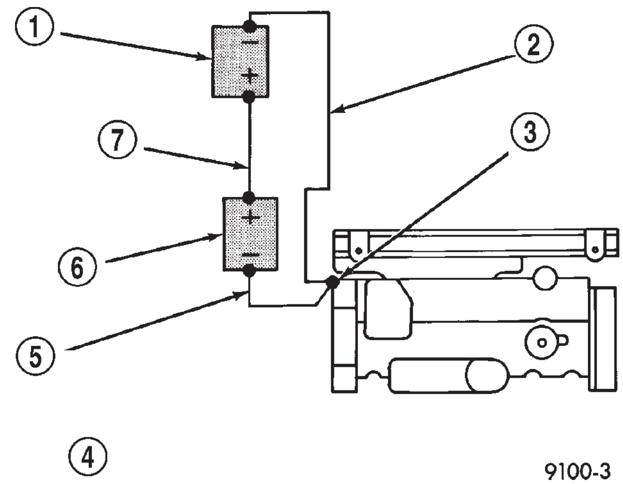

Fig. 11 Jumper Cable Clamp Connections

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

EMERGENCY TOW HOOKS

DESCRIPTION — 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.

SUSPENSION

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WHEEL ALIGNMENT

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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 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 (Fig. 1)
- **CAMBER** is the inward or outward tilt of the wheel relative to the center of the vehicle. Tilting the top of the wheel inward provides negative camber. Tilting the top of the wheel outward provides positive camber. Incorrect camber will cause wear on the inside or outside edge of the tire. The angle is not adjustable, damaged component(s) must be replaced to correct the camber angle (Fig. 1)

WHEEL ALIGNMENT (Continued)

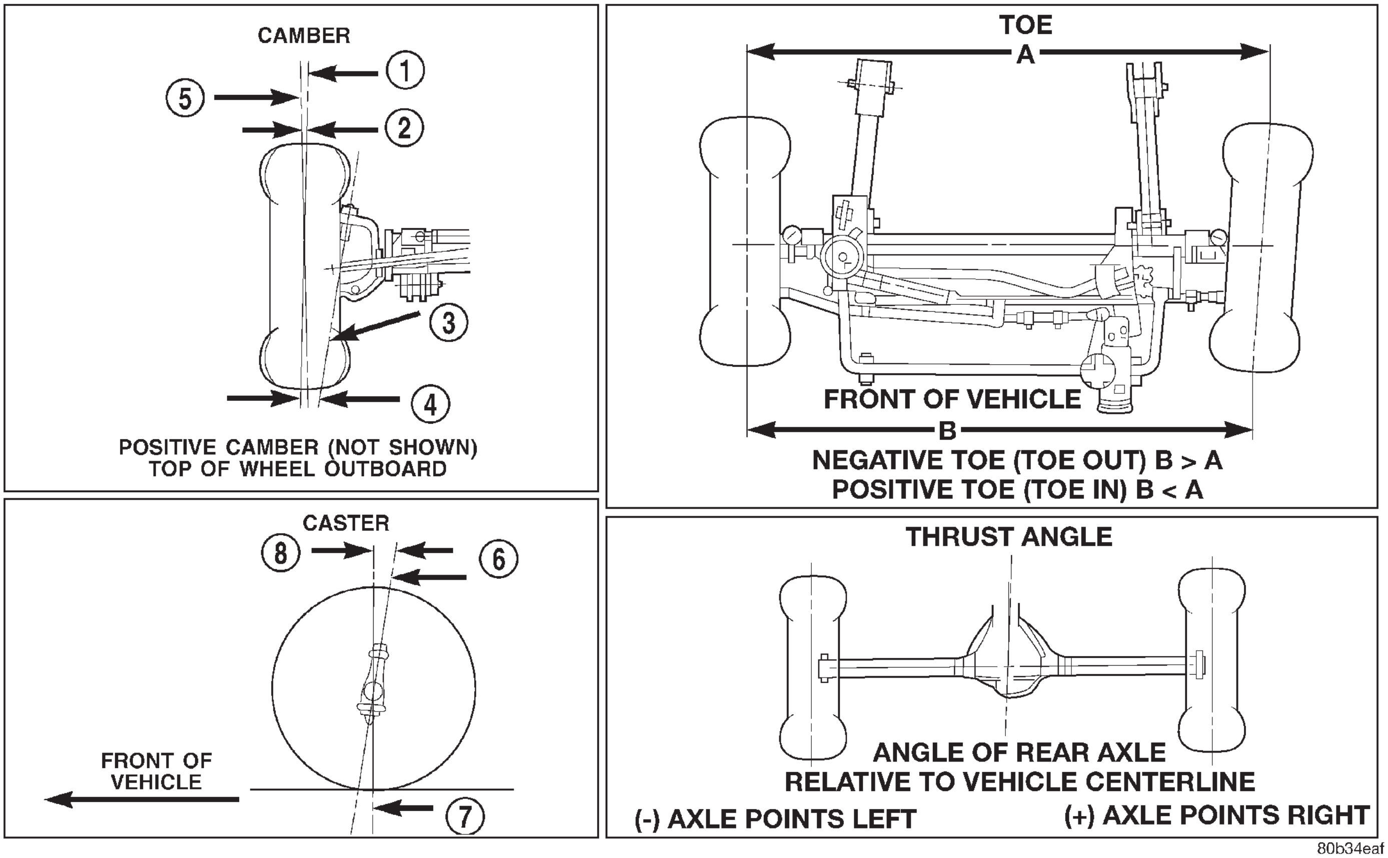

Fig. 1 Wheel Alignment Measurements

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

• **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 (Fig. 1)

• **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 (Fig. 1)

• **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 (Continued)

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.

WHEEL ALIGNMENT (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.

STANDARD PROCEDURE

STANDARD PROCEDURE - CAMBER

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.

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

STANDARD PROCEDURE - CASTER

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.

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 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.

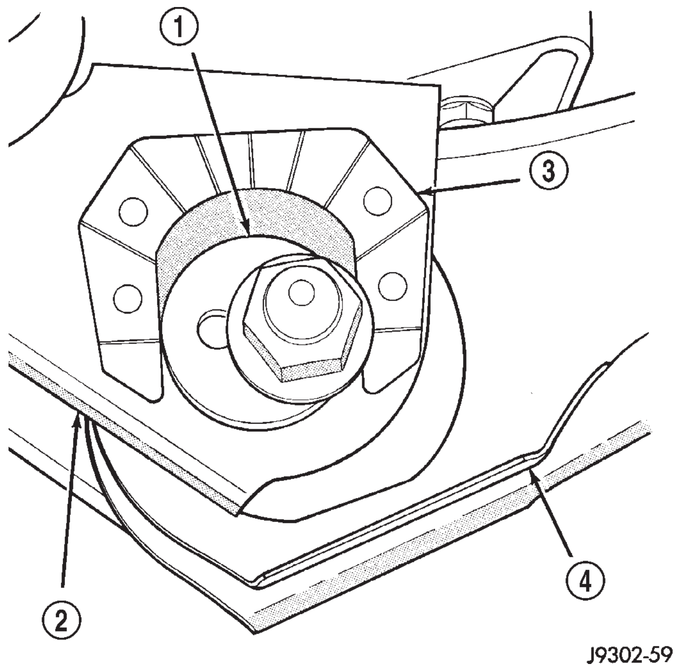

Fig. 2 Cam Adjuster

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

STANDARD PROCEDURE - TOE POSITION

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.

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.

WHEEL ALIGNMENT (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.**

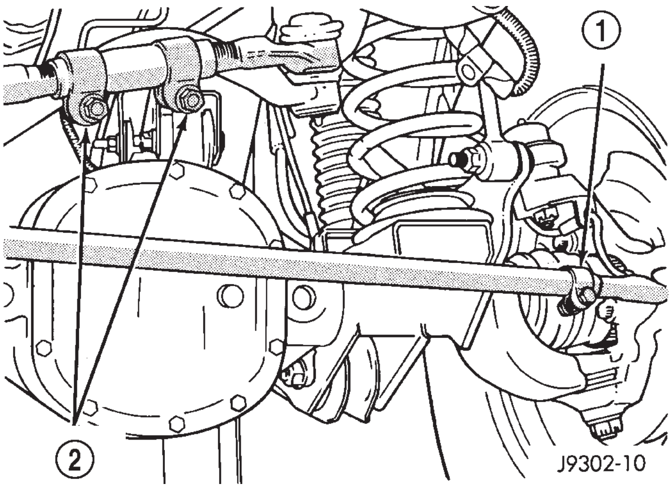

Fig. 3 Drag Link and Tie Rod Clamp

1 - TIE ROD CLAMP
2 - DRAG LINK CLAMPS

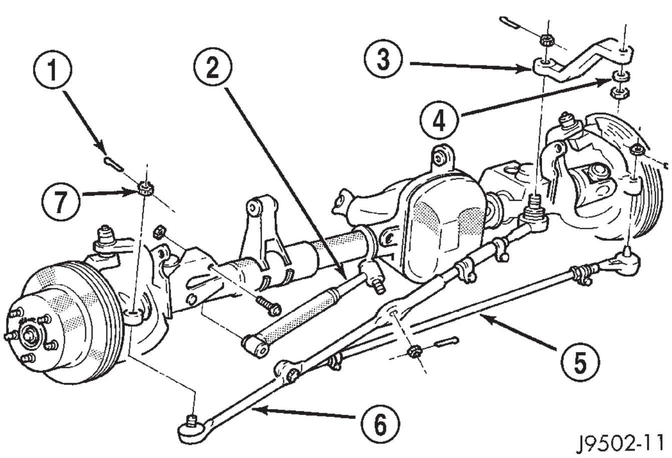

Fig. 4 Steering Linkage

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.

SPECIFICATIONS

DESCRIPTION	SPECIFICATION		
PREFERRED	CASTER + 7.0°	CAMBER (fixed angle) − 0.25°	TOTAL TOE-IN + 0.15° (each front wheel)
RANGE	±1.0°	± 0.63°	±0.06°
MAX RT/LT DIFFERENCE	0.65°	±1.0°	.06°
REAR SPECIFICATION			
PREFERRED	N/A	REAR CAMBER –0.25°	TOTAL TOE-IN +0.25°
RANGE	N/A	0° to –.50°	0° to .5°
THRUST ANGLE 0° ± 0.25°			

FRONT

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FRONT

DESCRIPTION

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.

STANDARD PROCEDURE - LUBRICATION

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

The following component must be lubricated:

- Track bar

FRONT (Continued)

SPECIFICATIONS

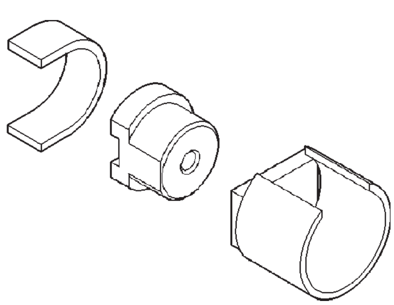
TORQUE CHART

TORQUE SPECIFICATIONS

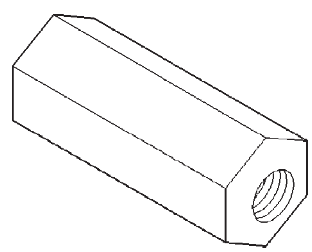
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Shock Absorber Upper Nut	23	17	—
Shock Absorber Lower Nut	28	—	250
Suspension Arm Lower Axle Bracket Nut	115	85	—
Suspension Arm Lower Frame Bracket Nut	176	130	—
Suspension Arm Upper Axle Bracket Nut	75	55	—
Suspension Arm Upper Frame Bracket Bolt	75	55	—
Stabilizer Bar Retainer Bolts	54	40	—
Stabilizer Bar Link Upper Nut	61	45	—
Stabilizer Bar Link Lower Bolt	95	70	—
Track Bar Ball Stud Nut	81	60	—
Track Bar Axle Bracket Bolt	47	40	—
Hub/Bearing Bolts	102	75	—
Hub/Bearing Axle Nut	237	175	—

SPECIAL TOOLS

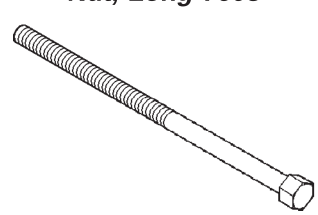
FRONT SUSPENSION



Remover/Installer Suspension Bushing 7932

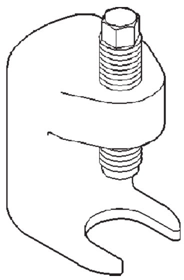


Nut, Long 7603



Bolt, Special 7604

FRONT (Continued)



Remover C-4150A

BUSHINGS

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. 1).

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

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

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

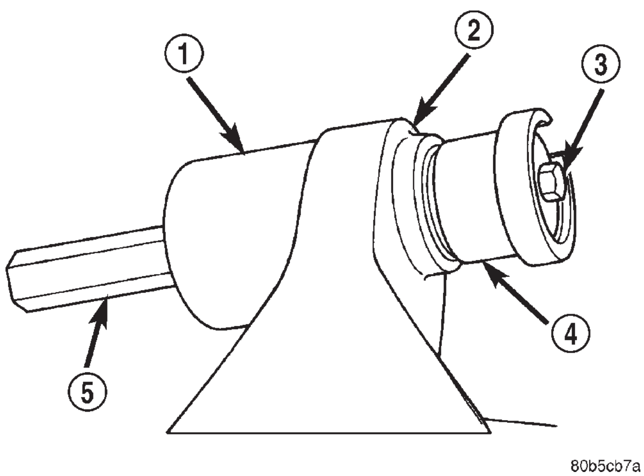


Fig. 1 Bushing Removal

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. 2).

(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.

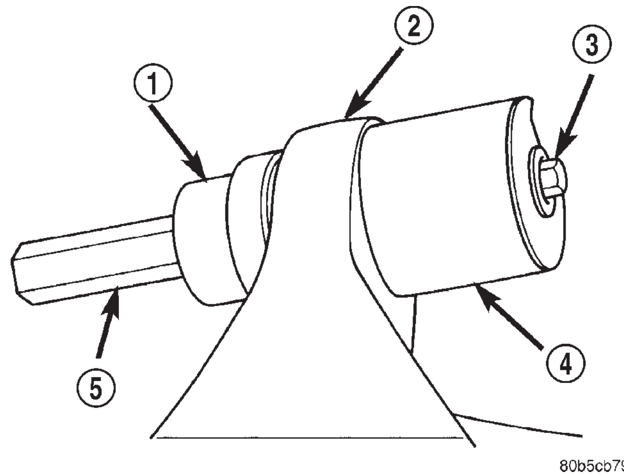


Fig. 2 Bushing Installation

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

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

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.

HUB / BEARING (Continued)

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 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(4) Remove the cotter pin, nut retainer and axle hub nut (Fig. 3).

(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 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(5) Install the wheel and tire assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(6) Remove support and lower the vehicle.

JOUNCE BUMPER

DESCRIPTION

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

KNUCKLE

REMOVAL

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.

(1) Remove hub bearing and axle shaft. (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - REMOVAL) (Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - 181FBI/AXLE SHAFTS - REMOVAL).

(2) Disconnect the tie-rod or drag link from the steering knuckle arm,(Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL) OR (Refer to 19 - STEERING/LINKAGE/DRAG LINK - REMOVAL).

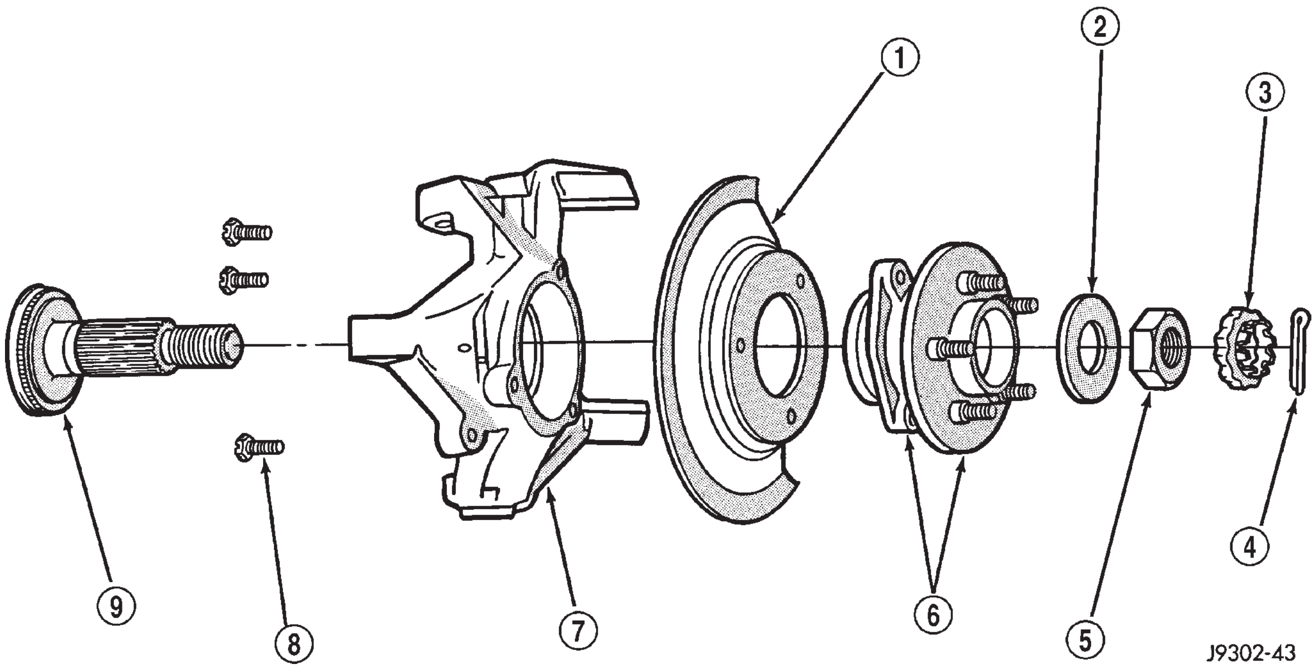


Fig. 3 Hub Bearing & Knuckle

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)

KNUCKLE (Continued)

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

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

(5) Using special tool C-4150A seperate the ball joints from the steering knuckle. Remove knuckle from ball studs (Fig. 4).

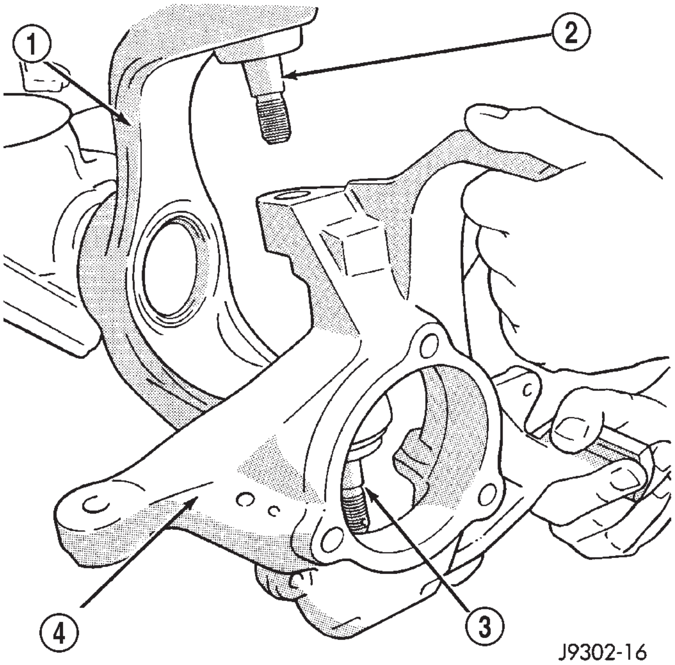


Fig. 4 Steering Knuckle Removal/Installation

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

INSTALLATION

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.

(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. (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - INSTALLATION) (Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - 181FBI/AXLE SHAFTS - INSTALLATION).

(5) Connect the tie-rod or drag link end to the steering knuckle arm,(Refer to 19 - STEERING/ LINKAGE/TIE ROD END - INSTALLATION) OR (Refer to 19 - STEERING/LINKAGE/DRAG LINK - INSTALLATION).

LOWER BALL JOINT

REMOVAL

Ball stud service procedures below require removal of the hub bearing and axle shaft. (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - REMOVAL) (Refer to 3 - DIFFERENTIAL & DRIVELINE/ FRONT AXLE - 181FBI/AXLE SHAFTS - REMOVAL). Removal and installation of upper and lower ball studs require the use of Tool Kit 6289.

(1) Position tools as shown to remove and install ball stud (Fig. 5).

LOWER CONTROL ARM

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.

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. 6) .

(4) Remove the lower suspension arm nut and bolt from the axle (Fig. 7) .

(5) Remove the nut and bolt/cam bolt from the frame rail bracket and remove the lower suspension arm (Fig. 7) .

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.

(5) Lower the vehicle.

LOWER CONTROL ARM (Continued)

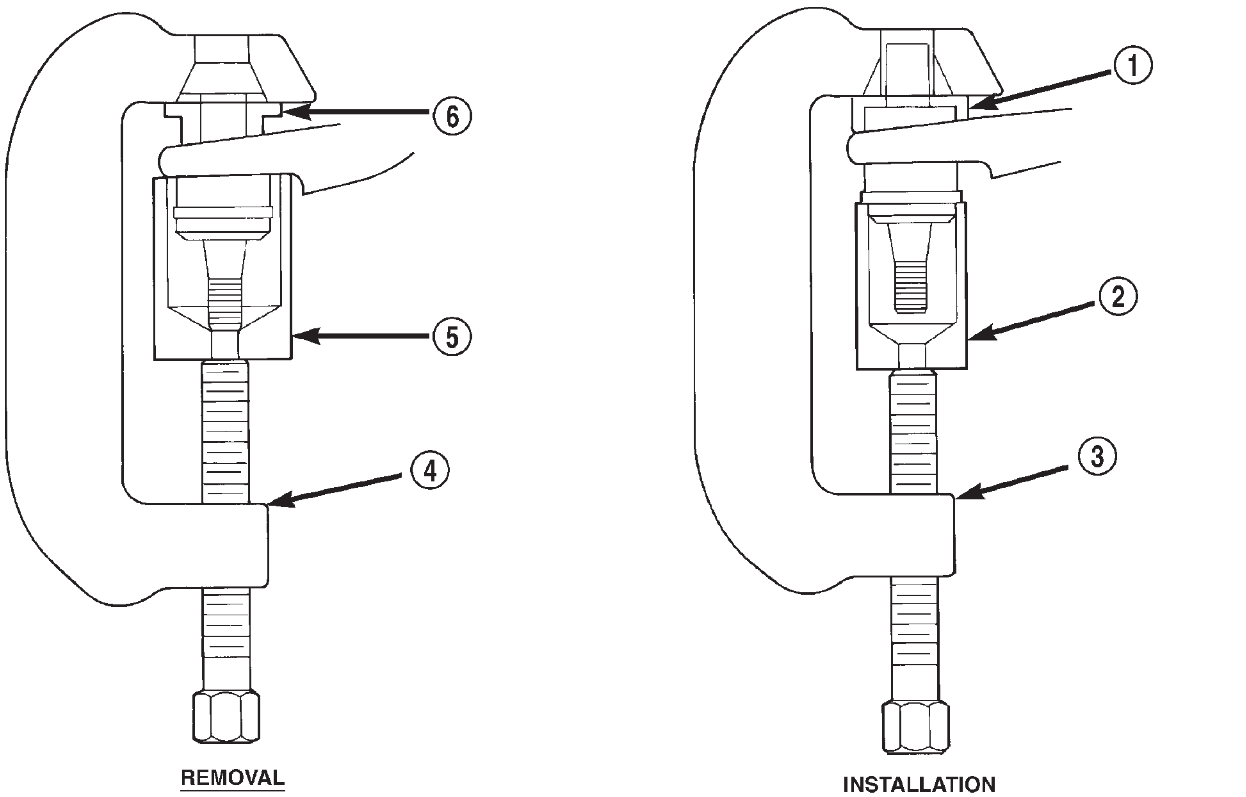


Fig. 5 Lower Ball Stud Remove/Install

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

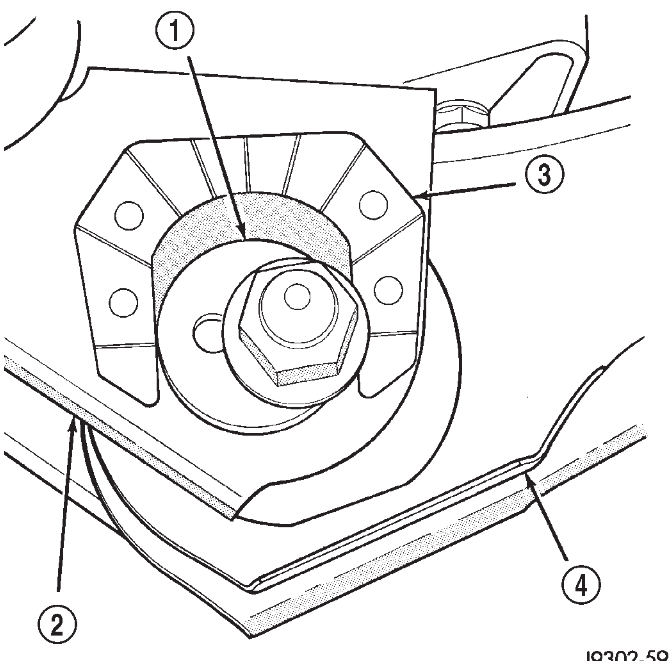


Fig. 6 Cam Bolt Service Package

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

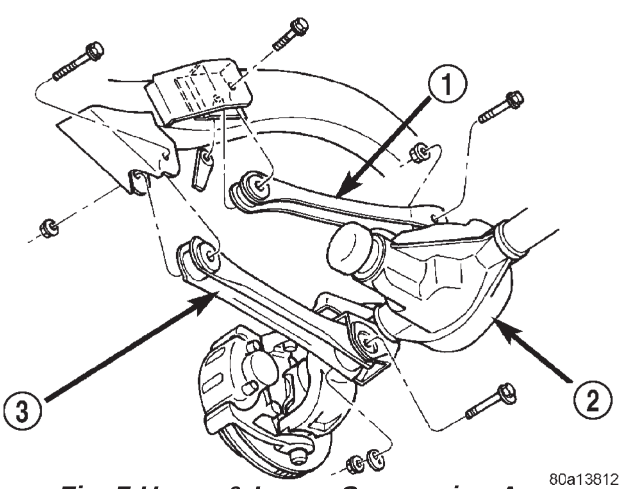


Fig. 7 Upper & Lower Suspension Arms

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

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

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

LOWER CONTROL ARM (Continued)

(8) Align vehicle to specifications. (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

SHOCK

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.

DIAGNOSIS AND TESTING - SHOCK ABSORBER

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

(1) Remove the nut, retainer and grommet from the upper stud through engine compartment access hole (Fig. 8).

(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.).

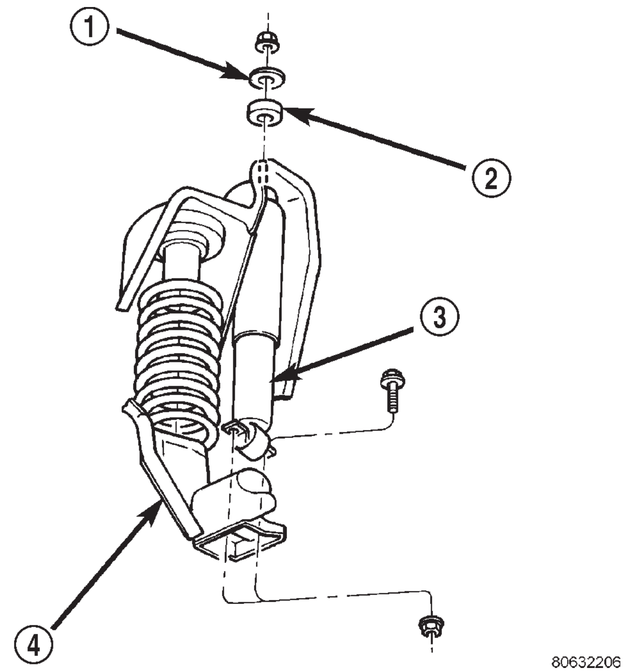


Fig. 8 Coil Spring & Shock Absorber

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

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

SPRING

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.

OPERATION

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

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assemblies.

(3) Position a hydraulic jack under the axle to support it.

(4) Remove the front shocks at the lower mountings,(Refer to 2 - SUSPENSION/FRONT/SHOCK - REMOVAL).

SPRING (Continued)

(5) Remove the ABS wire mounting brackets at the axle. (if equipped)

(6) Remove lower suspension arms mounting nuts and bolts from the frame, (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - REMOVAL).

(7) Remove the track bar from the axle bracket, (Refer to 2 - SUSPENSION/FRONT/TRACK BAR - REMOVAL).

(8) Remove the right side of the drag link from the right side knuckle, (Refer to 19 - STEERING/LINKAGE/DRAG LINK - REMOVAL).

(9) Lower the axle until the spring is free from the upper mount.

NOTE: Rotation of the spring and prying down slightly on the axle will aid in removal.

(10) Remove the coil spring retainer clip and remove the spring.

(11) Remove the upper spring isolator. (if needed)

(12) Pull jounce bumper out of mount. (if needed)

INSTALLATION

(1) Install jounce bumper into mount.

(2) Install the spring isolator.

NOTE: Rotation of the spring and prying down slightly on the axle will aid in installation.

(3) Position the coil spring on the axle pad. It may be necessary to rotate the spring while installing.

(4) Install the spring retainer clip and bolt. Tighten bolt to 21 N·m (16 ft. lbs.).

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

(6) Install the shock at the axle, (Refer to 2 - SUSPENSION/FRONT/SHOCK - INSTALLATION).

(7) Install the ABS wire mounting brackets at the axle (if equipped).

(8) Install the track bar to the axle bracket, (Refer to 2 - SUSPENSION/FRONT/TRACK BAR - INSTALLATION).

(9) Install the lower suspension arms to the frame. Install mounting bolts and nuts finger tight, (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - INSTALLATION).

(10) Install the drag link to the right side knuckle, (Refer to 19 - STEERING/LINKAGE/DRAG LINK - INSTALLATION).

(11) Remove the hydraulic jack from under the axle.

(12) Install the wheel and tire assemblies, (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(13) Remove the supports and lower the vehicle.

(14) Tighten the lower suspension arms nuts to 115 N·m (85 ft. lbs.) at normal ride height with the vehicle weight.

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.

REMOVAL

(1) Remove upper link nuts (Fig. 9) and separate the links from the stabilizer bar with Remover MB-991113.

(2) Remove front bumper valence.

(3) Remove stabilizer retainer bolts (Fig. 9) and remove retainers.

(4) Remove stabilizer bar.

(5) Remove lower link nuts and bolts and remove links (Fig. 9).

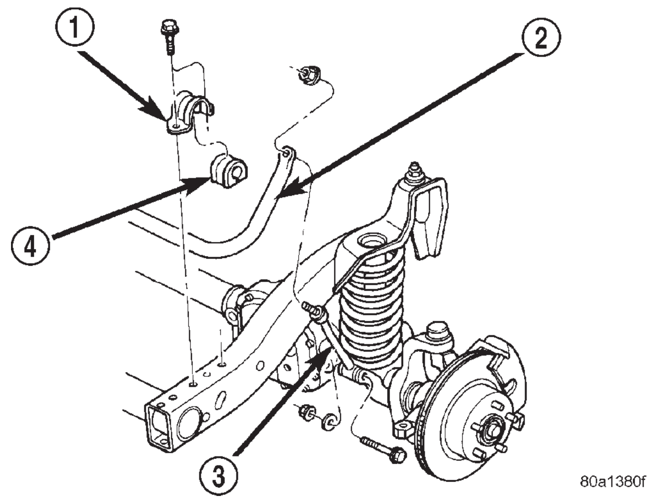


Fig. 9 Stabilizer Bar

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.).

STABILIZER BAR (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

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.

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. 10).

(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. 10) . Remove the track bar.

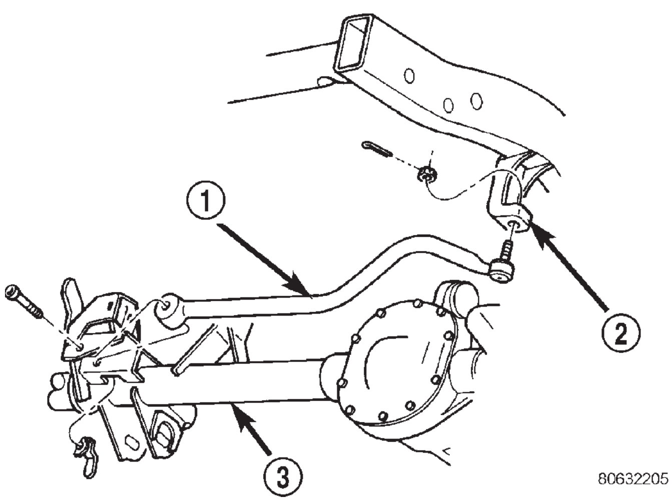


Fig. 10 Track Bar

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 81N·m (60 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 47 N·m (40 ft. lbs.).

(6) Check alignment if a new track bar was installed. (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

UPPER BALL JOINT

REMOVAL

Ball stud service procedures below require removal of the hub bearing and axle shaft. (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - REMOVAL) (Refer to 3 - DIFFERENTIAL & DRIVELINE/ FRONT AXLE - 181FBI/AXLE SHAFTS - REMOVAL). Removal and installation of upper and lower ball studs require the use of Tool Kit 6289.

(1) Position tools as shown to remove and install ball stud (Fig. 11).

UPPER BALL JOINT (Continued)

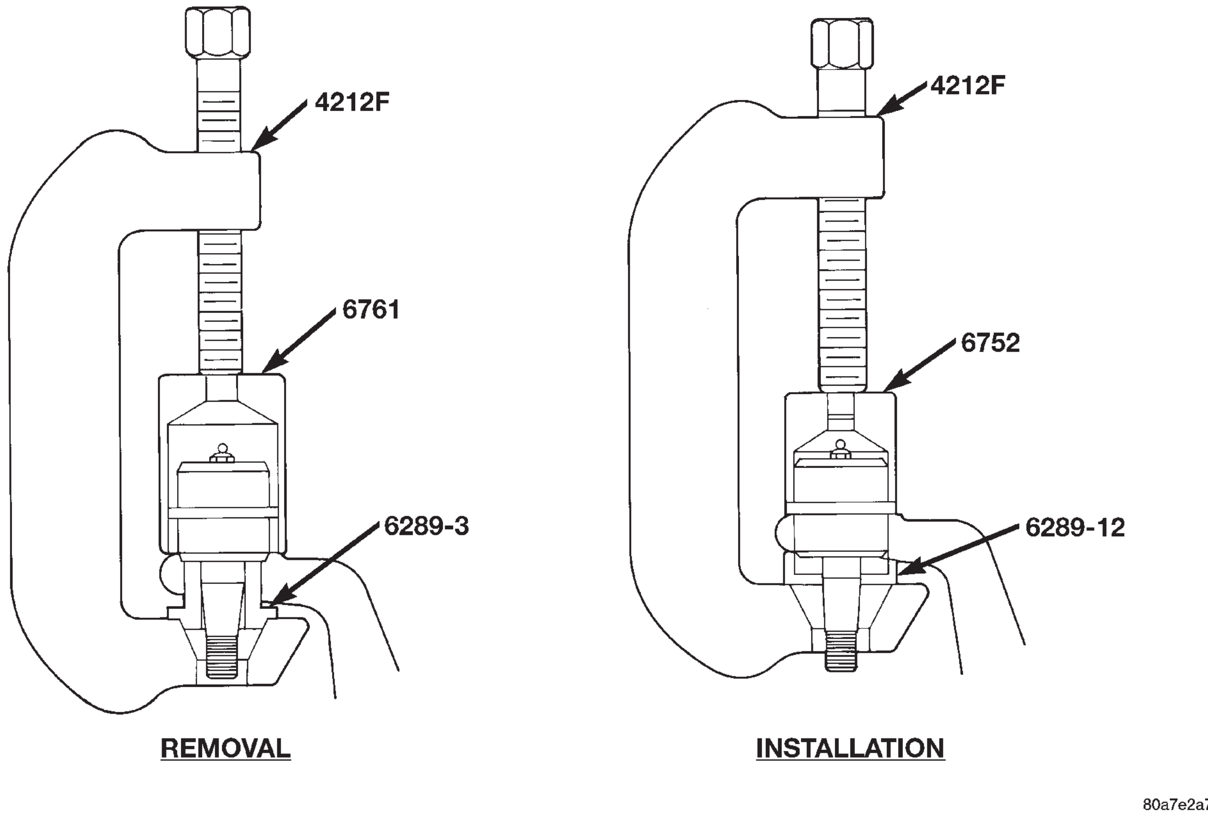


Fig. 11 Upper

UPPER CONTROL ARM

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.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the upper suspension arm nut and bolt at the axle bracket (Fig. 7) .

(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.).

REAR

TABLE OF CONTENTS

REAR

DESCRIPTION

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.

REAR (Continued)

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Shock Absorber Upper Bolts	35	26	—
Shock Absorber Lower Nut	100	74	—
Suspension Arm Lower Axle Bracket Nut	177	130	—
Suspension Arm Lower Frame Bracket Nut	177	130	—
Suspension Arm Upper Axle Bracket Nut	75	55	—
Suspension Arm Upper Frame Bracket Bolt	75	55	—
Stabilizer Bar Retainer Bolts	54	40	—
Stabilizer Bar Link Nut/Bolt	54	40	—
Track Bar Frame Bracket Nut	100	74	—
Track Bar Axle Bracket Bolt	100	74	—

JOUNCE BUMPER

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 CONTROL ARM

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.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the lower suspension arm nut and bolt at the axle bracket (Fig. 1).

(3) Remove the nut and bolt at the frame rail mount (Fig. 2) and remove the lower suspension arm.

INSTALLATION

(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.).

LOWER CONTROL ARM (Continued)

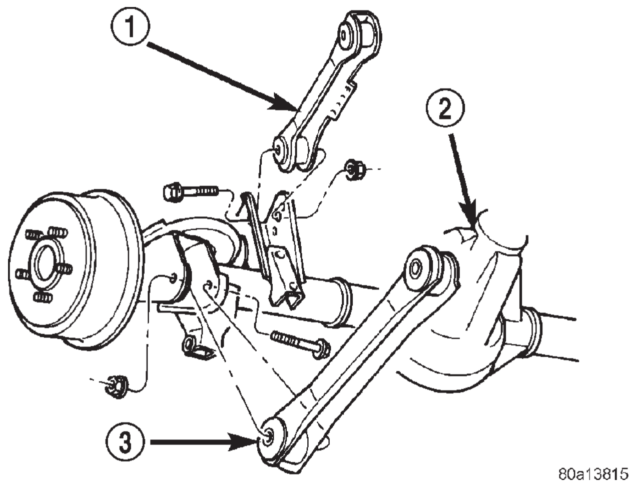


Fig. 1 Upper & Lower Suspension Arms

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

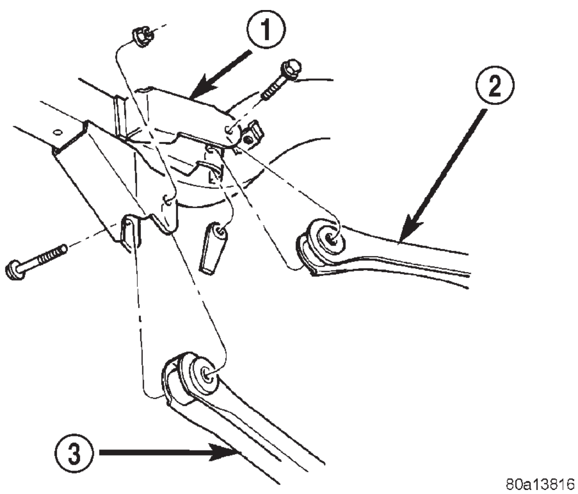


Fig. 2 Upper & Lower Suspension Arms

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

SHOCK

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.

DIAGNOSIS AND TESTING - SHOCK ABSORBER

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

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

(2) Remove the upper mounting bolts (Fig. 3).

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

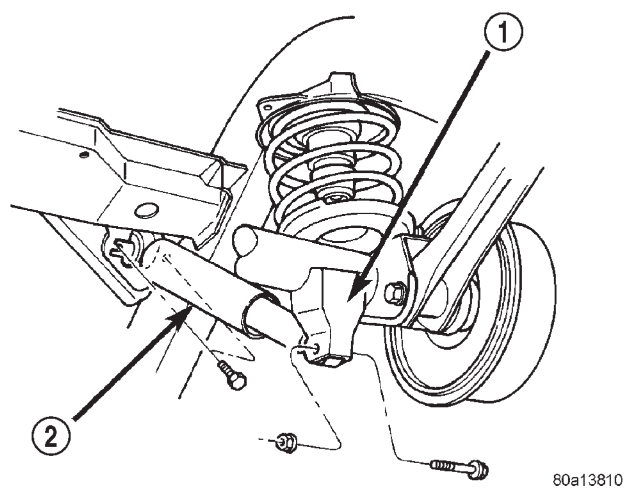


Fig. 3 Shock Absorber

1 - AXLE BRACKET
2 - SHOCK

SHOCK (Continued)

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.).

SPRING

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.

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. (Refer to 2 - SUSPENSION/REAR/STABILIZER BAR - REMOVAL) (Refer to 2 - SUSPENSION/REAR/SHOCK - REMOVAL).

(3) Disconnect the track bar from the frame rail bracket. (Refer to 2 - SUSPENSION/REAR/TRACK BAR - REMOVAL).

(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.

STABILIZER BAR

DESCRIPTION

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

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the stabilizer bar link bolts from the frame mounts (Fig. 4) .

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

(4) Remove the stabilizer bar retainer bolts and retainers from the axle mounts (Fig. 5) and remove the bar.

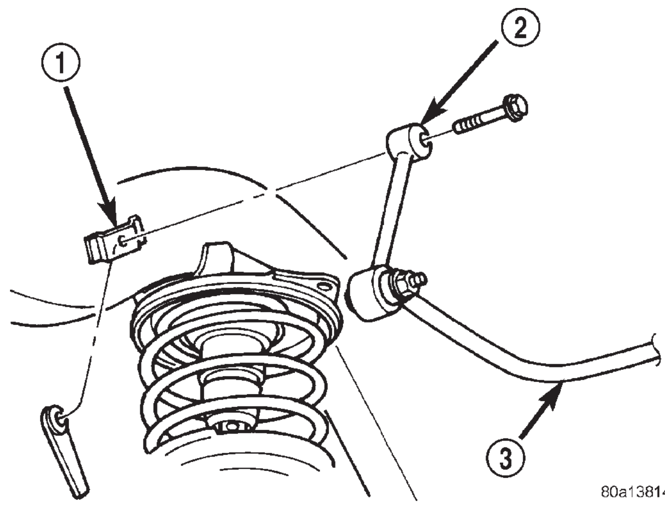


Fig. 4 Stabilizer Bar Link

1 - FRAME MOUNT
2 - LINK
3 - STABILIZER BAR

INSTALLATION

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

NOTE: Ensure the bar is centered with equal spacing on both sides and is positioned above the differential housing (Fig. 5) .

STABILIZER BAR (Continued)

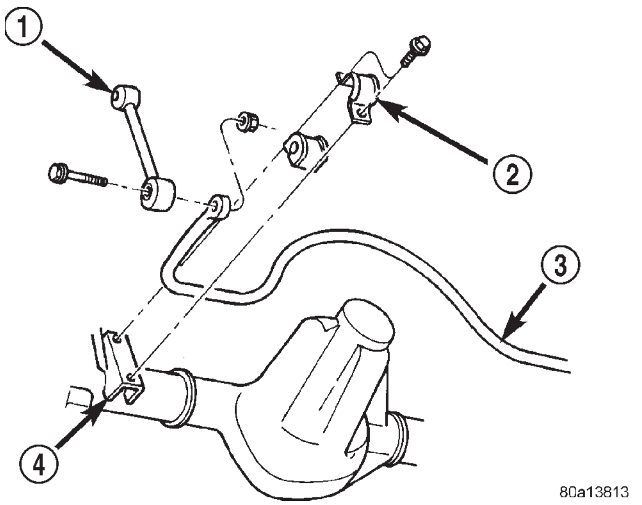


Fig. 5 Stabilizer Bar

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

(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

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.

REMOVAL

(1) Raise and support the vehicle.
(2) Remove the bolt and nut from the frame rail bracket (Fig. 6) .
(3) Remove the bolt from the axle bracket (Fig. 6) and remove the track bar.

INSTALLATION

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

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

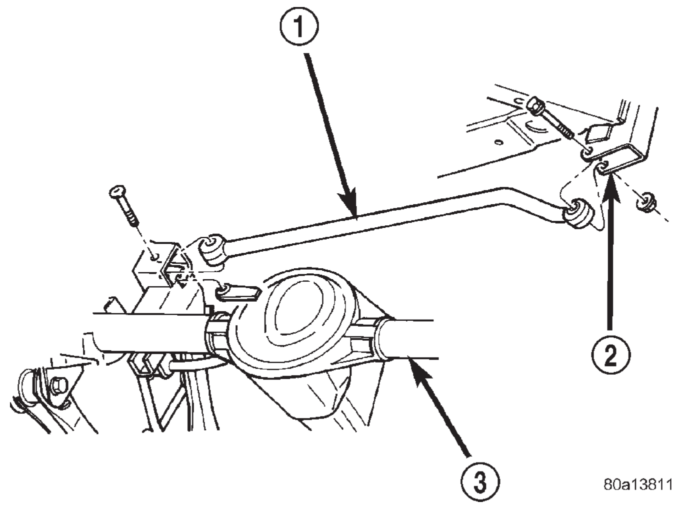


Fig. 6 Rear Track Bar

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

(3) Remove supports and lower the vehicle.
(4) Tighten the track bar nut/bolt at both ends to 100 N·m (74 ft. lbs.).

UPPER CONTROL 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. 7).

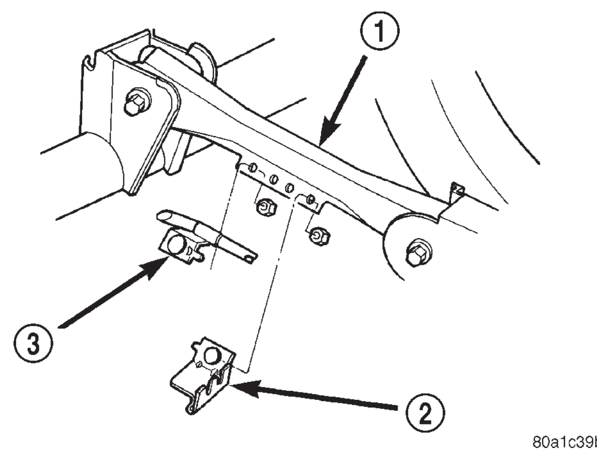


Fig. 7 Parking Brake Cable/Bracket And Wiring Bracket

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

UPPER CONTROL ARM (Continued)

(3) Remove the upper suspension arm nut and bolt from the axle bracket (Fig. 1).

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

DIFFERENTIAL & DRIVELINE

TABLE OF CONTENTS

PROPELLER SHAFT

TABLE OF CONTENTS

PROPELLER SHAFT

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.

PROPELLER SHAFT (Continued)

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 U-joints as necessary.

BALANCE

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. 1).

(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. 2)and repeat the test.

(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. 3).

(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.

PROPELLER SHAFT (Continued)

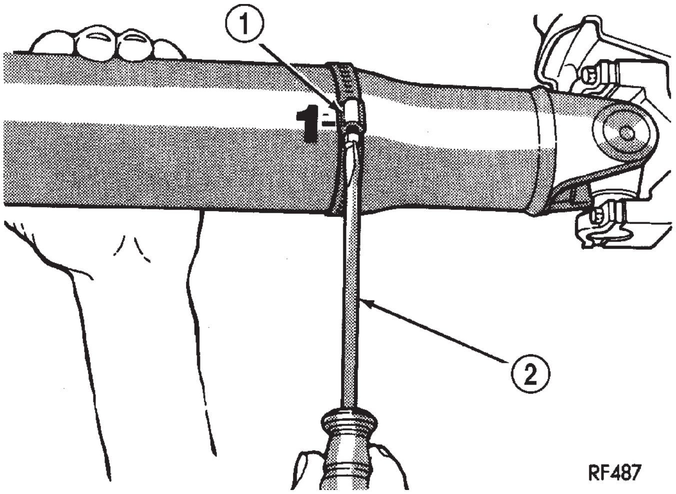


Fig. 1 CLAMP SCREW AT POSITION 1

1 - CLAMP
2 - SCREWDRIVER

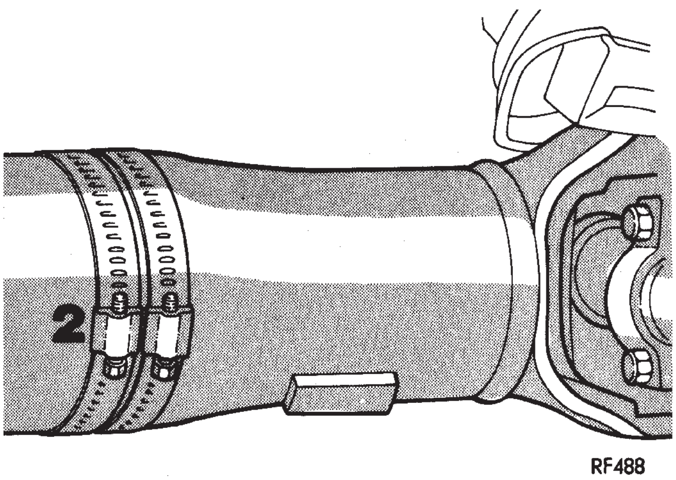


Fig. 2 TWO CLAMP SCREWS

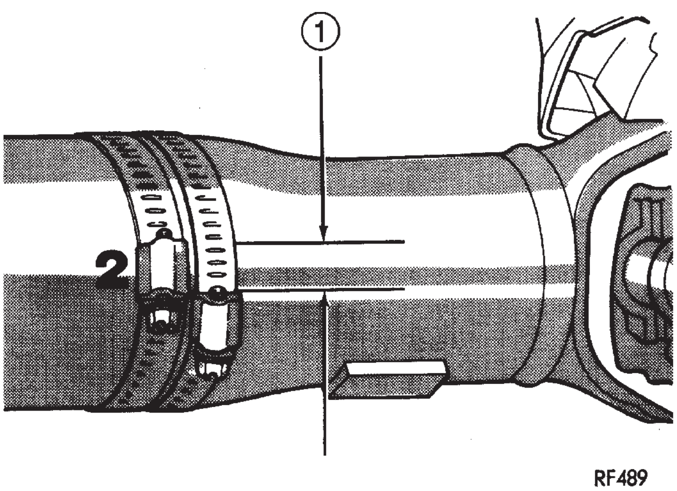


Fig. 3 CLAMP SCREWS SEPARATED

1 - 1/2 INCH

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

STANDARD PROCEDURE - PROPELLER SHAFT ANGLE

(1) Place transmission in netural.

(2) Raise and support the vehicle at the axles as level as possible.

(3) Remove any external bearing snap rings from universal joint so protractor base sits flat.

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

NOTE: Always make measurements from front to rear and from the same side of the vehicle.

(5) Place Inclinometer 7663 (J-23498A) on yoke bearing (A) parallel to the shaft (Fig. 4). Center bubble in sight glass and record measurement.

PROPELLER SHAFT (Continued)

NOTE: This measurement will give you the Output Yoke Angle (A).

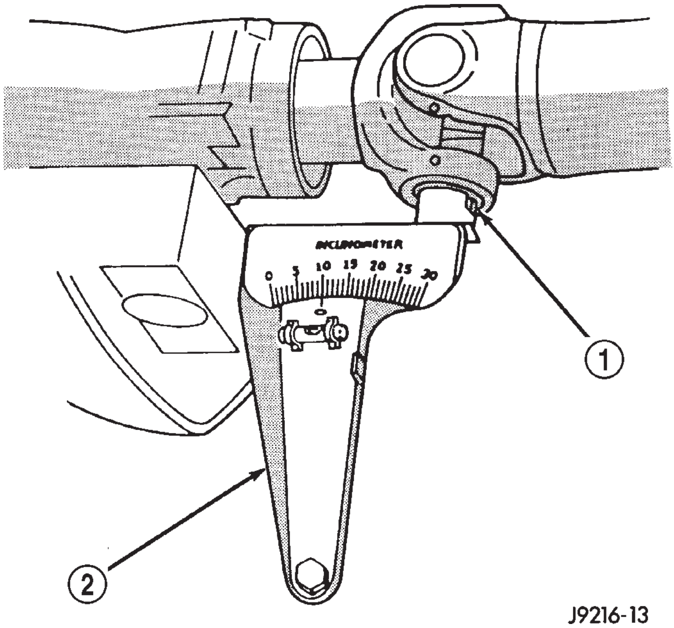


Fig. 4 OUTPUT YOKE ANGLE (A)

1 - SLIP YOKE BEARING CAP
2 - INCLINOMETER

(6) Rotate propeller shaft 90 degrees and place Inclinometer on yoke bearing parallel to the shaft (Fig. 5). Center bubble in sight glass and record measurement. This measurement can also be taken at the rear end of the shaft.

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

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

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

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

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

Refer to rules given below and the example in (Fig. 7) for additional information.

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

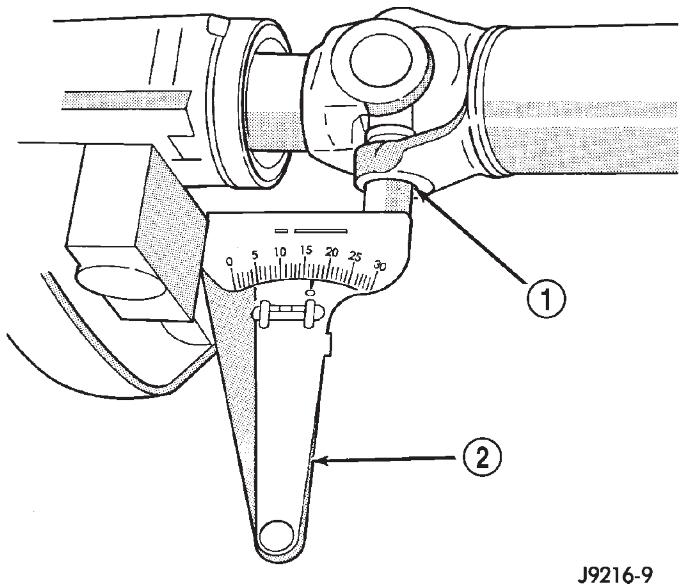


Fig. 5 PROPELLER SHAFT ANGLE (C)

1 - SHAFT YOKE BEARING CAP
2 - INCLINOMETER

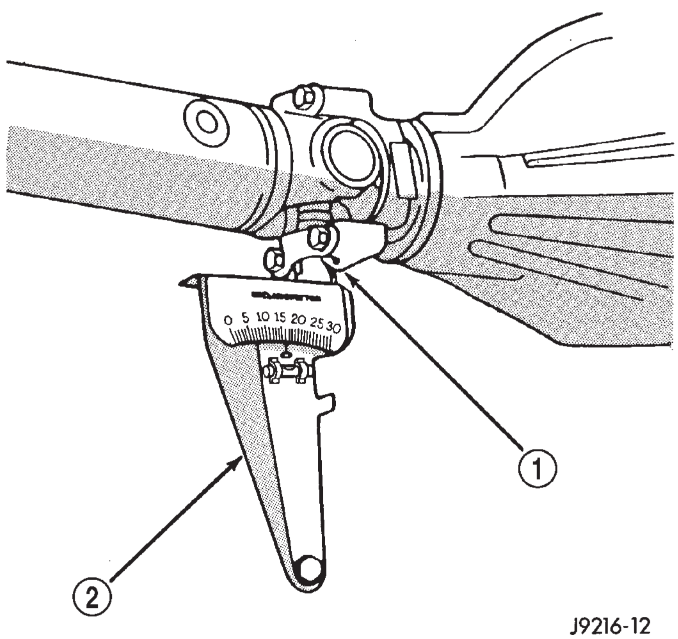


Fig. 6 INPUT YOKE ANGLE (B)

1 - PINION YOKE BEARING CAP
2 - INCLINOMETER

PROPELLER SHAFT (Continued)

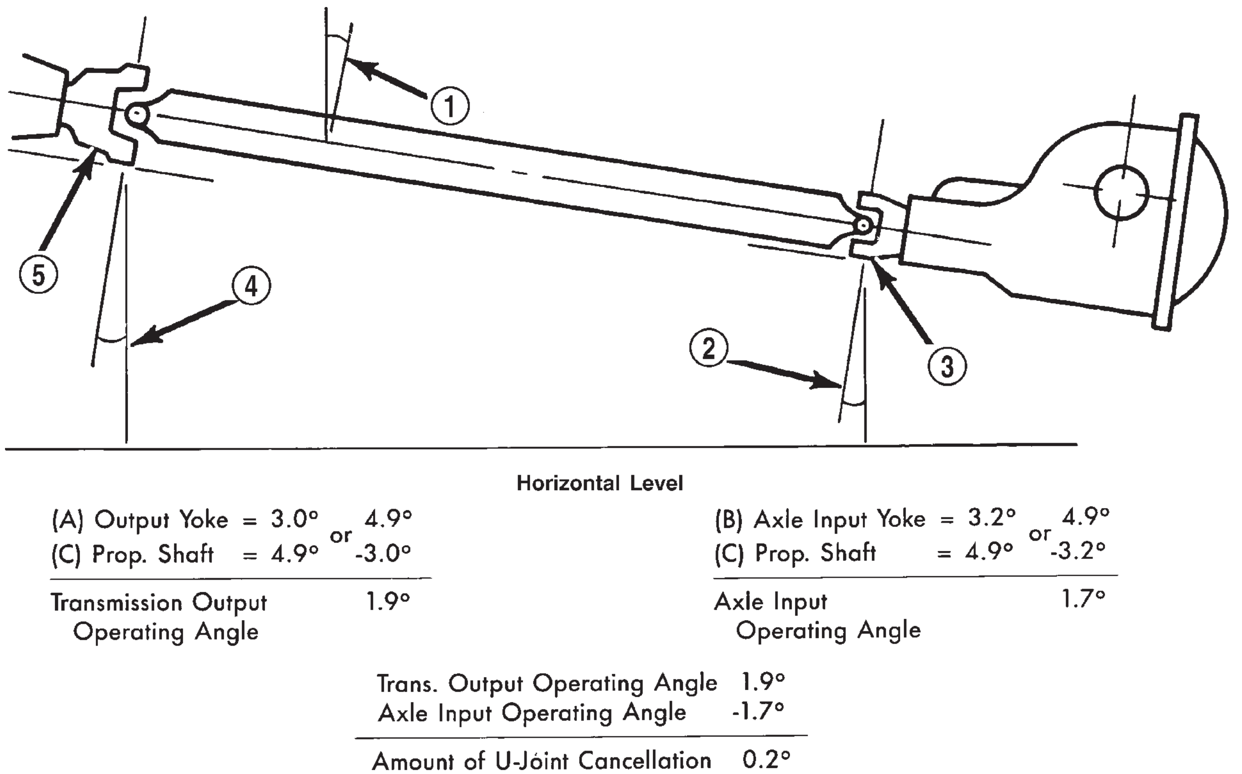


Fig. 7 U-JOINT ANGLE EXAMPLE

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

ADJUSTMENTS

ADJUSTMENT - PINION ANGLE

The pinion angle of the front axle can be adjusted by the use of adjustment cams in the lower suspension arms (Fig. 8). The primary function of the cams is to adjust caster angle for alignment of the front suspension. When using the cams to adjust pinion angle, make sure that both cams are moved equally. After pinion angle is adjusted, the front suspension alignment should be checked to ensure that side-to-side caster is with in acceptable range. Having the correct pinion angle does have priority over having the preferred caster angle.

A cam kit is available for 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.

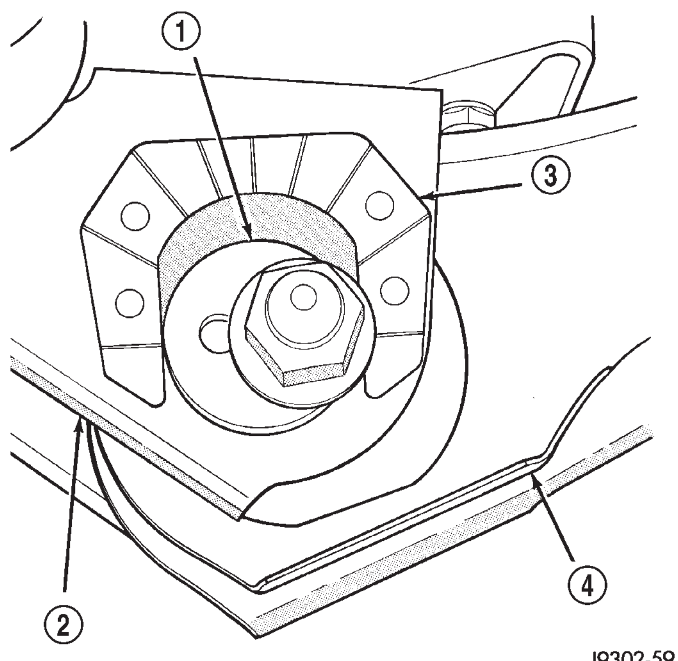


Fig. 8 Adjustment Cam

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

PROPELLER SHAFT (Continued)

SPECIFICATIONS

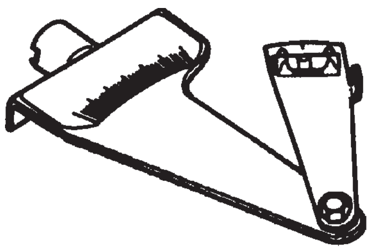
PROPELLER SHAFT

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Front Shaft Front Yoke Bolts	19	14	-
Front Shaft Rear Flange Bolts	27	20	-
Rear Saft Rear Yoke Bolts	19	14	-

SPECIAL TOOLS

PROPELLER SHAFT



INCLINOMETER 7663

PROPELLER SHAFT - FRONT

REMOVAL

(1) Shift transmission and transfer case into Neutral.

(2) Raise and support vehicle.

(3) Remove skid plate if equipped to gain access to the propeller shaft.

(4) Mark a line across the yokes at the transfer case, link yoke and propeller shaft yoke for installation reference (Fig. 9).

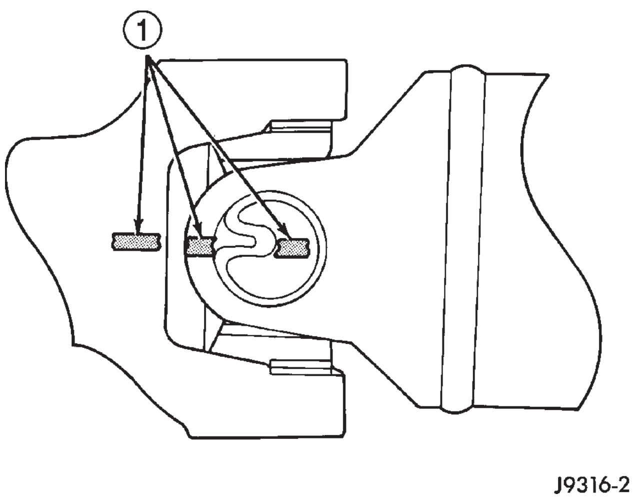


Fig. 9 YOKE REFERENCE MARKS

1 - REFERENCE MARKS

(5) Remove the U-joint strap bolts at the pinion shaft yoke (Fig. 10).

(6) Remove transfer case yoke bolts.

(7) Push rear of propeller shaft forward to clear transfer case yoke.

(8) Remove propeller shaft from vehicle.

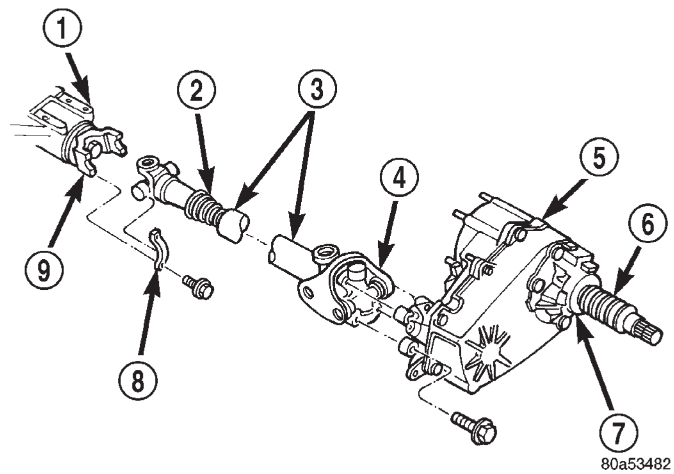


Fig. 10 FRONT PROPELLER SHAFT

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

INSTALLATION

(1) Install propeller shaft with reference marks aligned.

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

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

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

(5) Lower the vehicle.

PROPELLER SHAFT - REAR

REMOVAL

(1) Shift the transmission and transfer case into Neutral.

(2) Raise and support vehicle.

(3) Mark a line across the pinion shaft and at each end of the propeller shaft 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. 11).

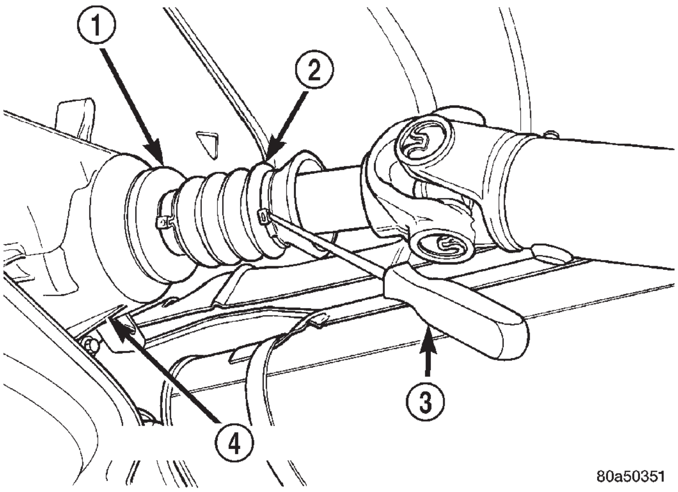


Fig. 11 DUST BOOT CLAMP

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

(6) Slide the slip yoke off of the transmission/transfer case output shaft and remove the propeller shaft (Fig. 12).

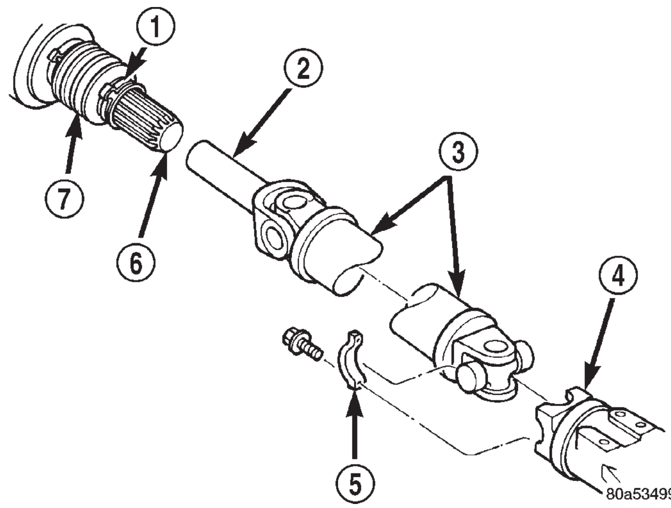


Fig. 12 REAR PROPELLER SHAFT

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 installation reference marks at the axle yoke and install the propeller shaft.

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

(3) Tighten clamp with Clamp Tool C-4975A to hold dust boot to propeller shaft yoke (Fig. 13).

(4) Remove support and lower the vehicle.

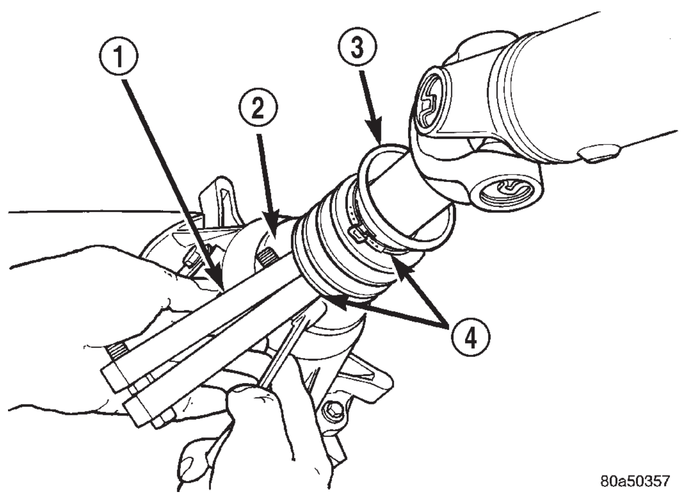


Fig. 13 CRIMPING DUST BOOT CLAMP

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

SINGLE CARDAN UNIVERSAL JOINTS

DISASSEMBLY

NOTE: Individual components of cardan universal joints are not serviceable, they must be replaced as an assembly.

(1) Remove the propeller shaft.
(2) Tap the outside of the bearing cap assembly with a drift to loosen the snap rings.
(3) Remove snap rings from both sides of yoke (Fig. 14).

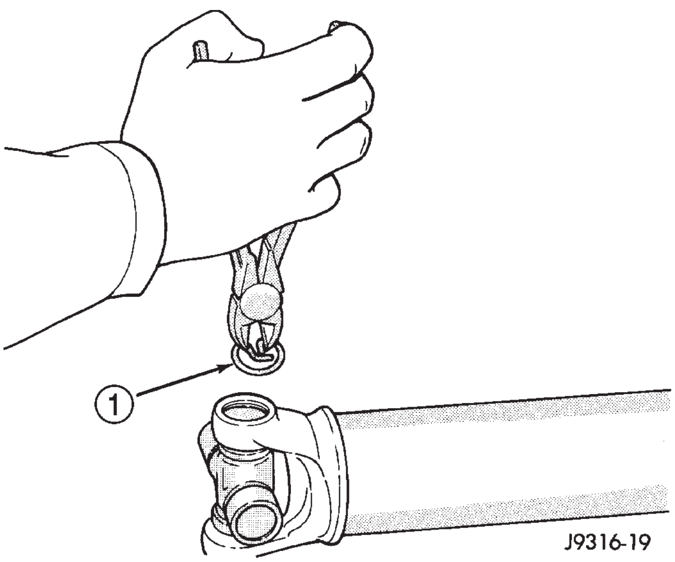


Fig. 14 YOKE SNAP RING

1 - SNAP RING

(4) Position a socket with a inside diameter large enough to receive the bearing cap beneath the yoke on the press.
(5) Position yoke with the grease fitting if equipped, pointing up.
(6) Place another socket with an outside diameter smaller than bearing cap on the upper bearing cap and press the lower cap through the yoke (Fig. 15).
(7) Pull bearing cap of the yoke.

NOTE: If bearing cap will not come out, tap the yoke ear near the bearing cap to dislodge the cap.

(8) Turn the yoke over and straighten the cross in the open hole. Then carefully press the end of the cross until the other bearing cap can be removed (Fig. 16).

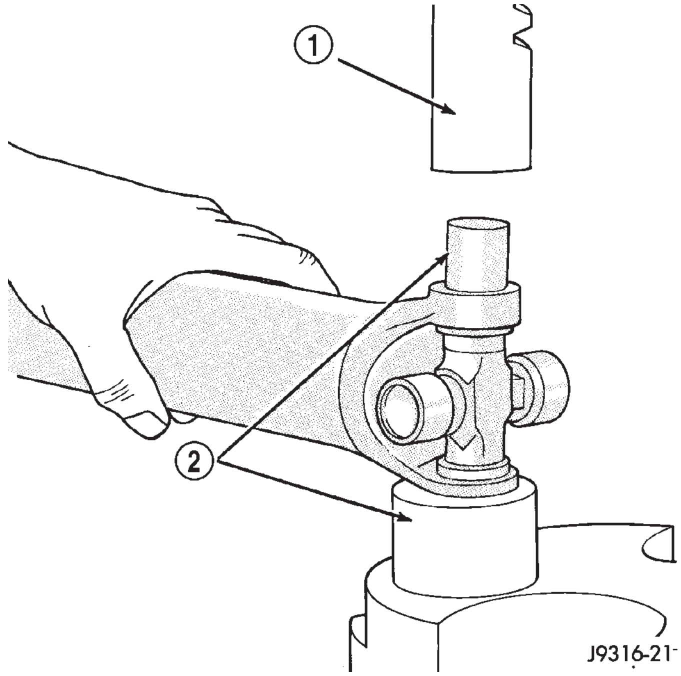


Fig. 15 PRESS OUT BEARING CAP

1 - PRESS
2 - SOCKET

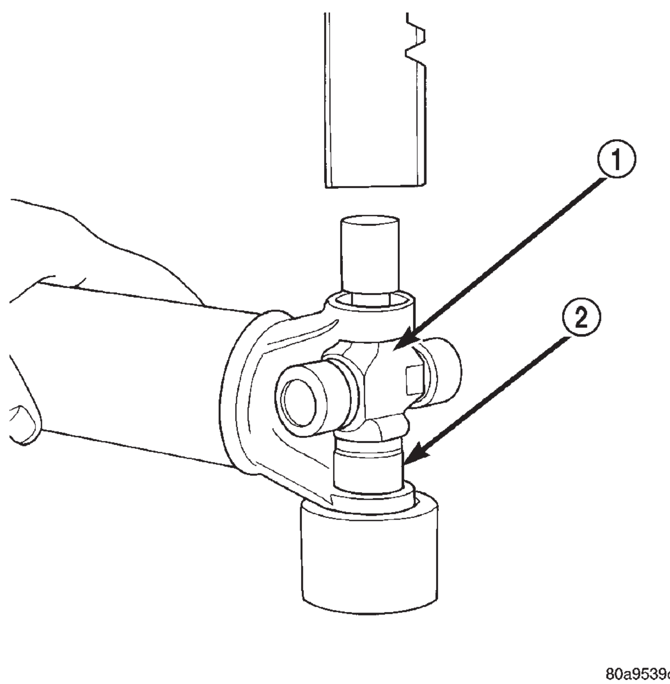


Fig. 16 PRESS OUT BEARING CAP

1 - CROSS
2 - BEARING CAP

SINGLE CARDAN UNIVERSAL JOINTS (Continued)

ASSEMBLY

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.

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

(2) Position the cross in the yoke with its lube fitting if equipped, pointing up (Fig. 17).

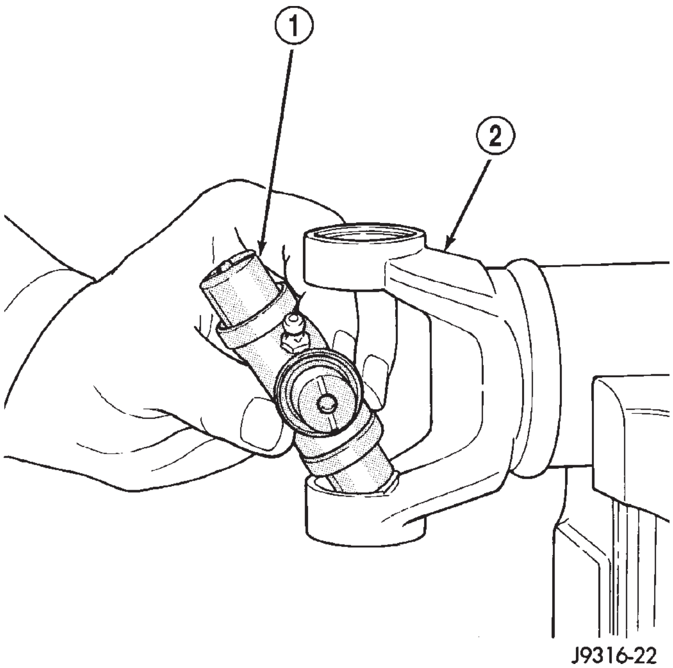


Fig. 17 U-JOINT CROSS

1 - CROSS
2 - YOKE

(3) Place a bearing cap over the trunnion and align cap with yoke bore (Fig. 18). Keep needle bearings upright in the cap.

(4) Press bearing cap into the yoke bore enough to clear snap ring groove.

(5) Install a snap ring.

(6) Repeat Step 3 and Step 4 to install the other bearing cap.

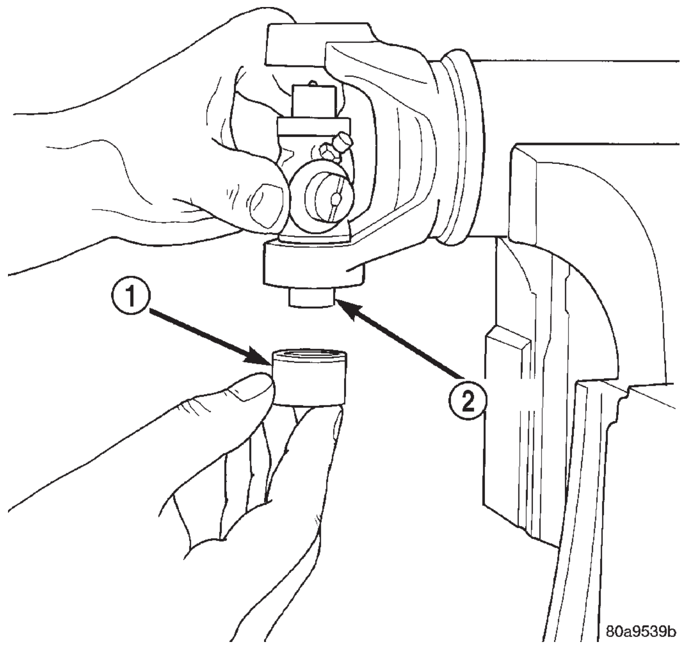


Fig. 18 BEARING AND TRUNNION

1 - BEARING CAP
2 - TRUNNION

NOTE: If 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 UNIVERSAL JOINTS

DISASSEMBLY

NOTE: Individual components of cardan universal joints are not serviceable they must be replaced as an assembly.

(1) Remove the propeller shaft.

(2) Mark the propeller shaft yoke and link yoke for assembly reference.

(3) Tap the outside of the bearing cap assembly with drift to loosen snap rings.

(4) Remove all the bearing cap snap rings (Fig. 19).

DOUBLE CARDAN UNIVERSAL JOINTS (Continued)

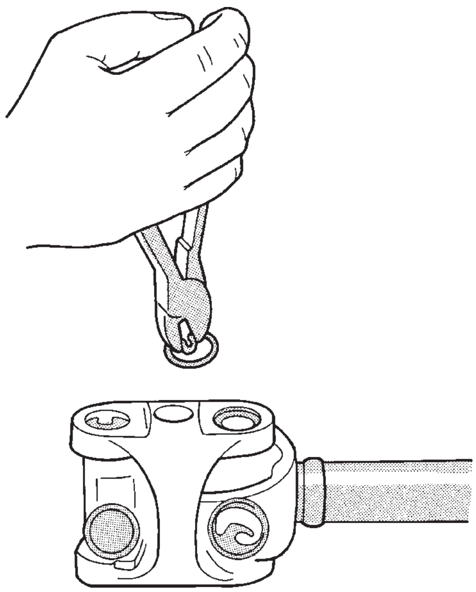


Fig. 19 SNAP RINGS

(5) Remove any grease fittings if equipped.

(6) Position a socket on the press with an inside diameter large enough to receive the bearing cap under the link yoke.

(7) Place another socket with an outside diameter smaller than the bearing cap on the upper bearing cap.

(8) Press one bearing cap from the outboard side of the link yoke enough to grasp the cap with vise jaws (Fig. 20).

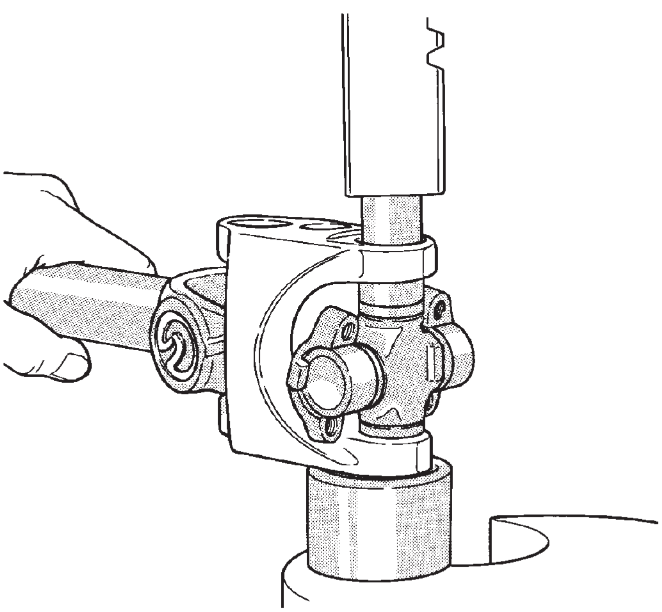


Fig. 20 PRESS OUT BEARING

(9) Grasp protruding bearing cap with vise jaws and tap link yoke with a mallet and drift to remove bearing cap (Fig. 21).

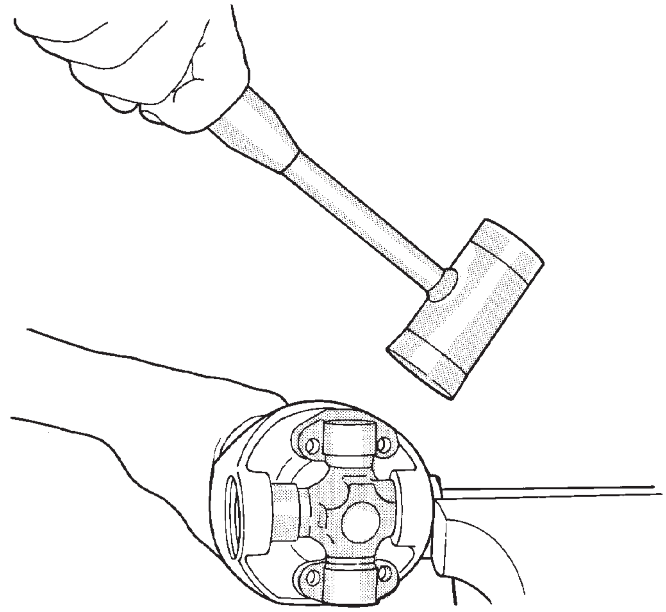


Fig. 21 REMOVE BEARING FROM YOKE

(10) Flip assembly and repeat Step 6, Step 7, Step 8 and Step 9 to remove the opposite bearing cap.

(11) Remove the cross centering kit assembly and spring (Fig. 22).

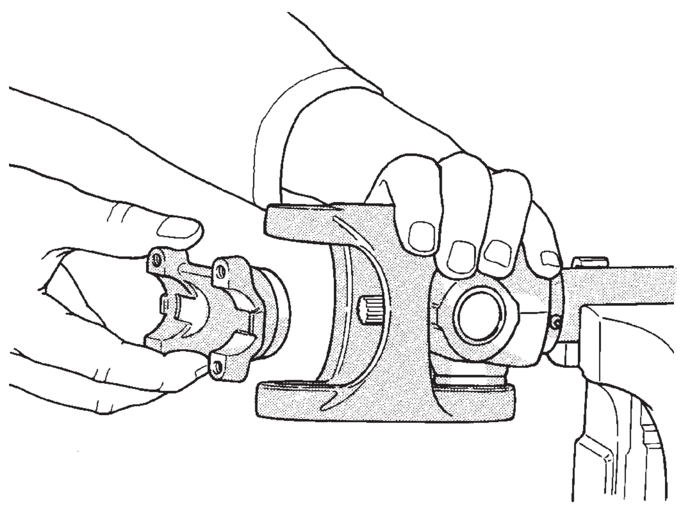


Fig. 22 REMOVE CENTERING KIT

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

DOUBLE CARDAN UNIVERSAL JOINTS (Continued)

ASSEMBLY

CAUTION: All alignment marks on the link yoke and propeller shaft yoke must be aligned during assembled.

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

(2) Fit a cross into the propeller shaft yoke (Fig. 23).

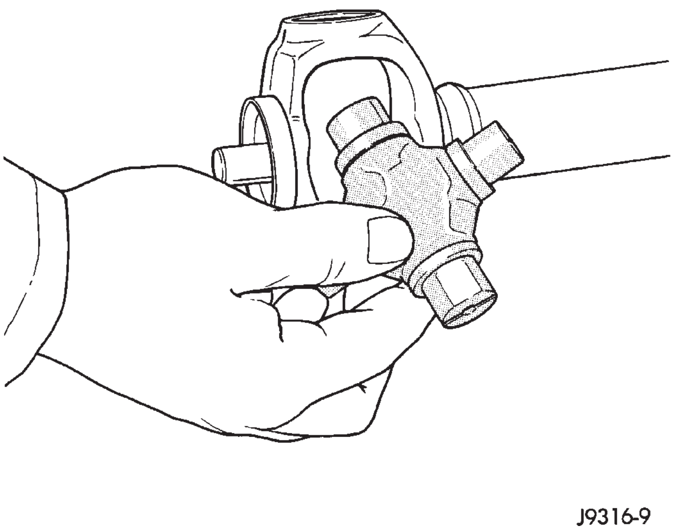


Fig. 23 INSTALL CROSS IN YOKE

(3) Place a bearing cap over the trunnion and align the cap with the yoke bore (Fig. 24). Keep needle bearings upright in the bearing cap.

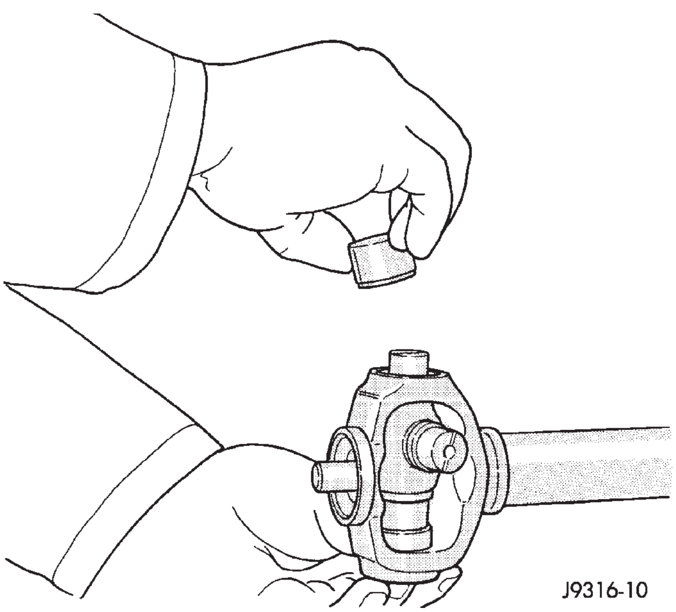


Fig. 24 INSTALL BEARING CAP

(4) Press bearing cap into the yoke bore enough to clear snap ring groove (Fig. 25).

(5) Install a snap ring.

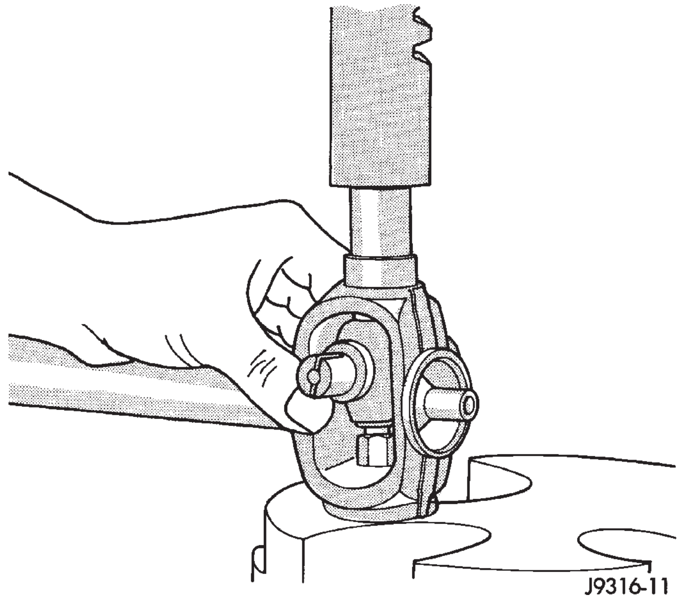


Fig. 25 PRESS BEARING CAP

(6) Flip propeller shaft yoke and install other bearing cap onto the opposite trunnion and install a snap ring (Fig. 26).

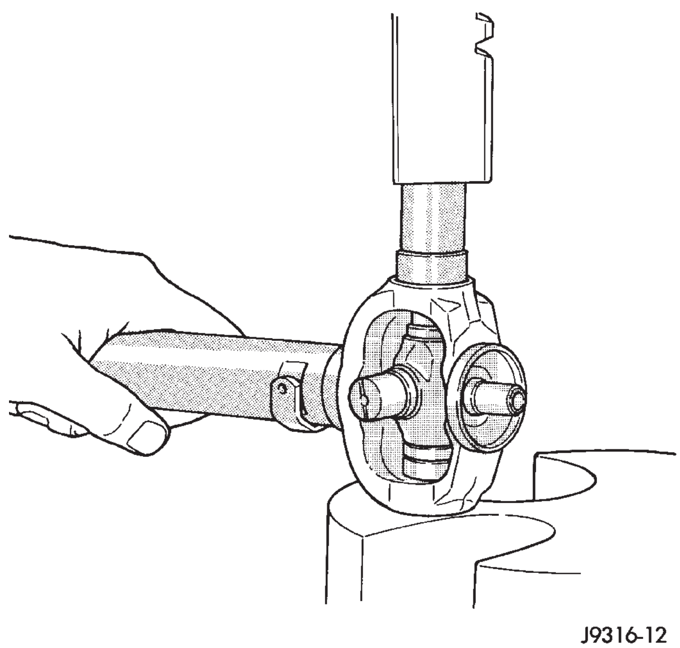


Fig. 26 PRESS BEARING CAP

DOUBLE CARDAN UNIVERSAL JOINTS (Continued)

(7) Fit the link yoke onto the remaining trunnions and press both bearing caps into place and install snap rings (Fig. 27).

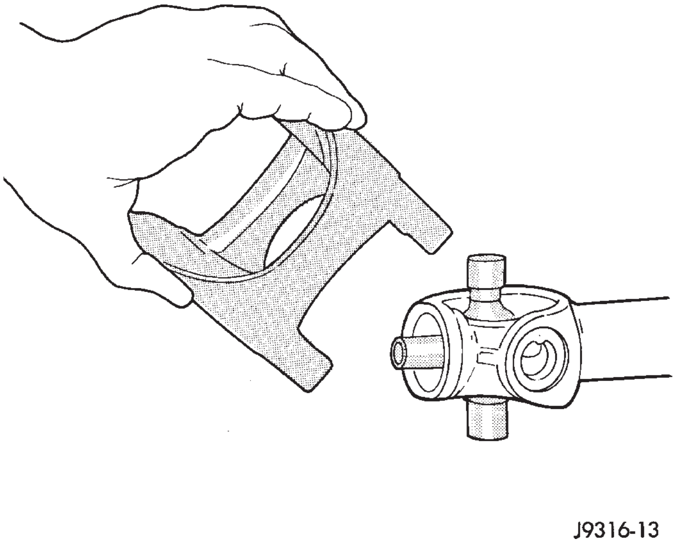


Fig. 27 INSTALL LINK YOKE

(8) Install centering kit assembly inside the link yoke (Fig. 28).

NOTE: Making sure the spring is properly positioned.

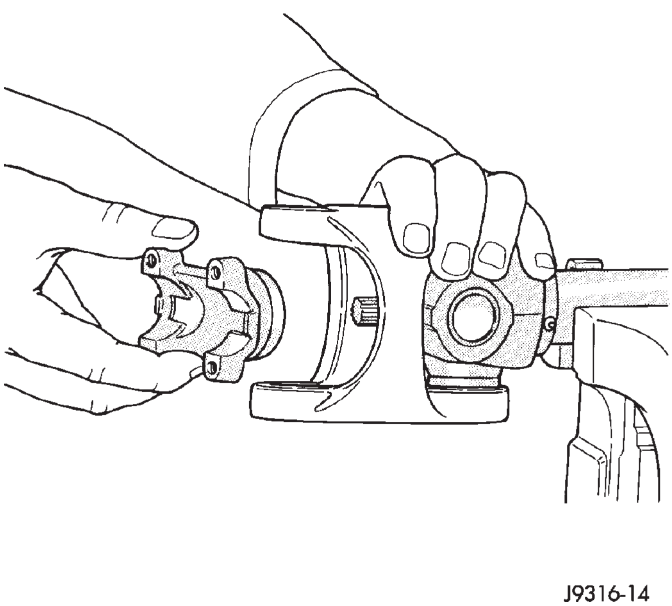


Fig. 28 CENTERING KIT

(9) 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. 29).

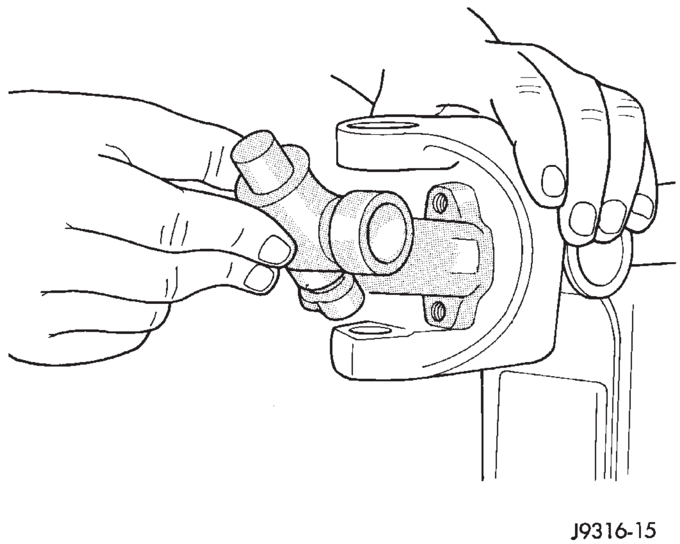


Fig. 29 REMAINING CROSS

(10) Press the remaining two bearing caps into place and install snap rings (Fig. 30).

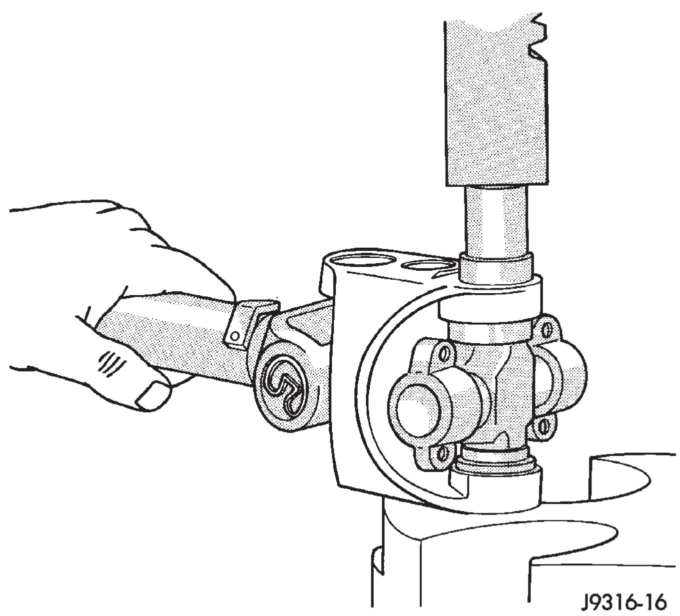


Fig. 30 PRESS BEARING CAP

DOUBLE CARDAN UNIVERSAL JOINTS (Continued)

(11) Tap the snap rings to seat them into the grooves (Fig. 31).

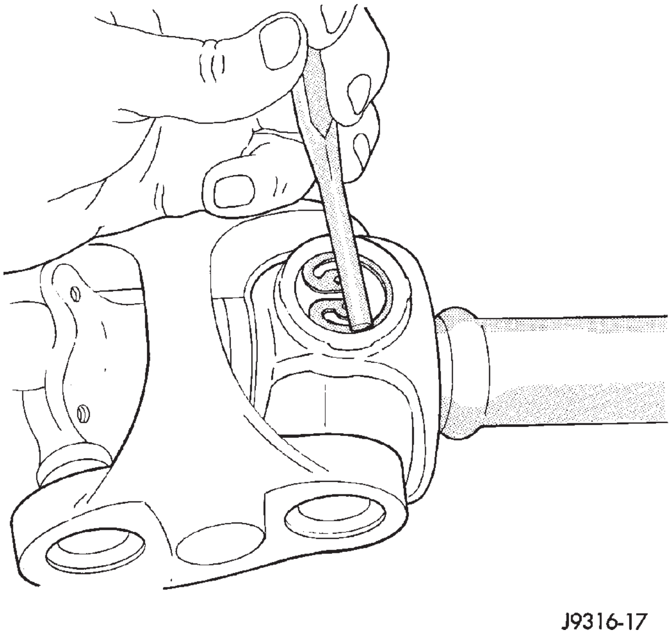


Fig. 31 SEAT SNAP RINGS

(12) Verify for proper assembly. Flexing the joint beyond center, the joint should snap over-center in both directions if correctly assembled (Fig. 32).

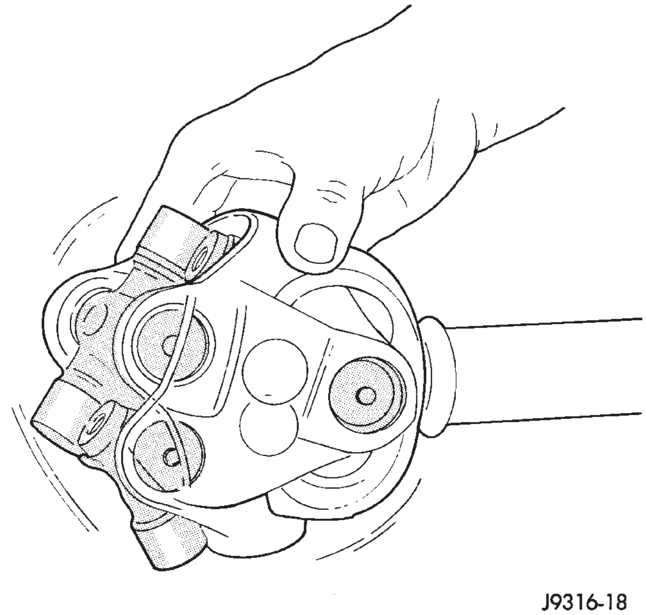


Fig. 32 VERIFY ASSEMBLY

(13) Install the propeller shaft.

FRONT AXLE - 181FBI

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FRONT AXLE - 181FBI

DESCRIPTION

The Front Beam-design Iron (FBI) axle consists of a cast iron differential housing with axle shaft tubes extending from either side. The tubes are pressed into the differential housing and welded. The integral type housing, hypoid gear design has the centerline of the pinion set above the centerline of the ring gear.

The 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. Vehicles with ABS brakes, have wheel speed sensors are attached to the knuckle assemblies. The tone rings for the ABS system are pressed onto the axle shaft.

The differential case is a one–piece design. The differential pinion mate shaft is retained with a roll pin. Differential bearing preload and ring gear backlash is adjusted by the use of shims (select thickness). The shims are located between the differential bearing cones and case. Pinion bearing preload is set and maintained by the use of shims (select thickness). The differential cover provides a means for inspection and servicing the differential. A vent hose is used to relieve internal pressure caused by lubricant vaporization and internal expansion.

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.

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).

FRONT AXLE - 181FBI (Continued)

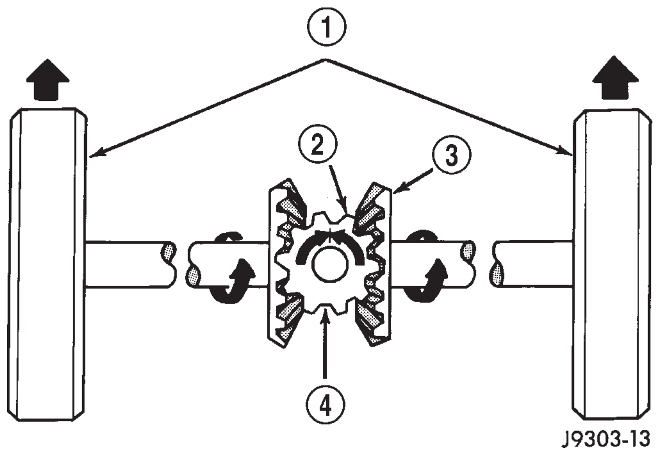


Fig. 1 DIFFERENTIAL-STRAIGHT AHEAD DRIVING

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. 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.

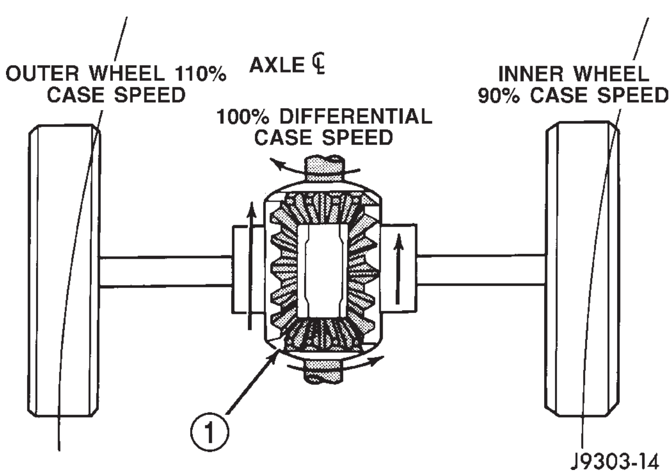


Fig. 2 DIFFERENTIAL-ON TURNS

1 - PINION GEARS ROTATE ON PINION SHAFT

DIAGNOSIS AND TESTING

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.

FRONT AXLE - 181FBI (Continued)

VIBRATION

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

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

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

All driveline components should be examined before starting any repair.

(Refer to 22 - TIRES/WHEELS - DIAGNOSIS AND TESTING)

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.

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.

FRONT AXLE - 181FBI (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.

FRONT AXLE - 181FBI (Continued)

Condition	Possible Causes	Correction
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.
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.

REMOVAL

(1) Raise and support the vehicle.

(2) Position a lift under the axle and secure to the axle.

(3) Remove wheels and tires.

(4) Remove brake calipers, rotors and wheel speed sensors if equipped. Refer to 5 Brakes for procedures.

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

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

(7) Remove propeller shaft.

(8) Remove stabilizer bar links at the axle.

(9) Remove shock absorbers from axle brackets.

(10) Remove track bar.

(11) Remove tie rod and drag link from the steering knuckle.

(12) Remove steering damper from the axle bracket.

(13) Remove upper and lower suspension arms from the axle brackets.

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

(15) 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 springs and retainers and tighten retainer bolts to 21 N·m (16 ft. lbs.).

(2) Position axle under the vehicle and align it with the spring pads.

(3) Install upper and lower suspension arms in the axle brackets and loosely install bolts and nuts.

FRONT AXLE - 181FBI (Continued)

(4) Connect the vent hose to the axle shaft tube.
(5) Install track bar to the axle bracket and loosely install the bolt.
(6) Install shock absorbers and tighten the bolts to torque specification.
(7) Install stabilizer bar links to the axle brackets and tighten the nut to torque specification.
(8) Install drag link and tie rod and tighten nut to torque specification
(9) Install steering damper to the axle bracket and tighten nut to torque specification.
(10) Install brake rotors, calipers and wheel speed sensors if equipped. Refer to 5 Brakes for procedures.
(11) Install propeller shaft with marks aligned.
(12) Check and fill axle lubricant if necessary.
(13) Install the wheel and tire assemblies.
(14) Remove lift from the axle and lower the vehicle.
(15) Tighten upper and lower control arm nuts to torque specification.
(16) Tighten track bar bolt at the axle bracket to torque specification.
(17) Check the front wheel alignment.

ADJUSTMENTS

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion gear are etched/marked onto each gear (Fig. 3). A plus (+) number, minus (–) number or zero (0) is etched/marked on 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/marked 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.

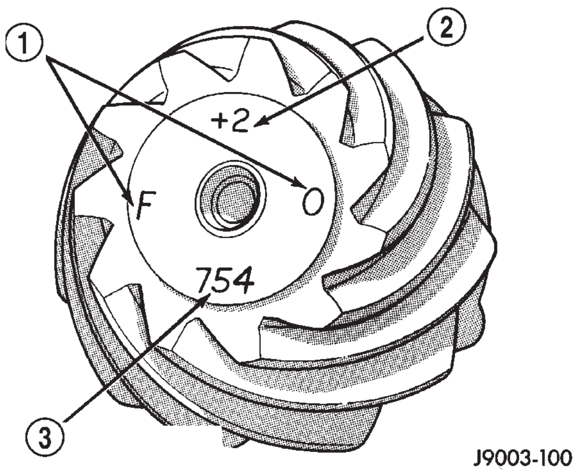


Fig. 3 PINION GEAR ID NUMBERS

1 - PRODUCTION NUMBERS
2 - PINION GEAR DEPTH VARIANCE
3 - GEAR MATCHING NUMBER

Compensation for pinion depth variance is achieved with a select shim/oil slinger. The shims are placed between the rear pinion bearing and the pinion gear head (Fig. 4).

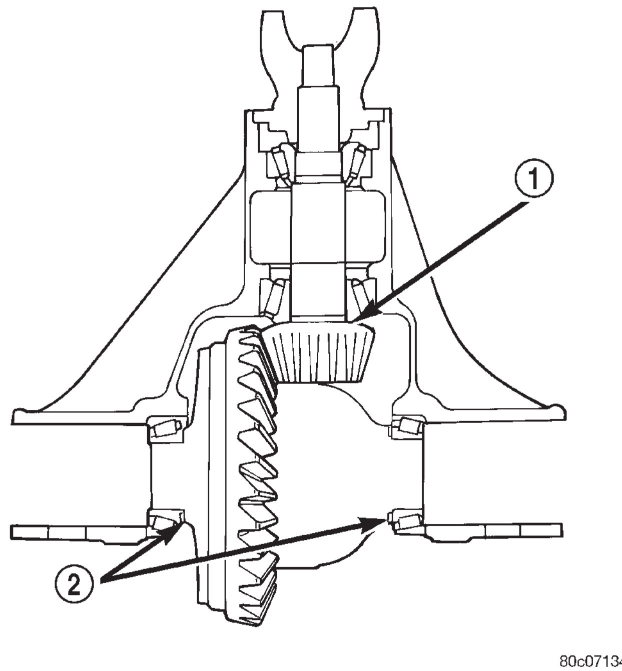


Fig. 4 SHIM LOCATIONS

1 - PINION GEAR DEPTH SHIM/OIL SLINGER
2 - DIFFERENTIAL BEARING SHIM

If a new gear set is being installed, note the depth variance etched into both the original and replacement pinion. Add or subtract this number from the thickness of the original depth shim/oil slinger to compensate for the difference in the depth variances. Refer to the Pinion Gear Depth Variance chart.

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

Note the etched number on the face of the pinion gear head (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shims. If the number is positive, subtract that value from the thickness of the depth shim. If the number is 0 no change is necessary.

FRONT AXLE - 181FBI (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

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Measurements are taken with pinion bearing cups and pinion bearings installed in the housing. Take measurements with Pinion Gauge Set and Dial Indicator C-3339 (Fig. 5).

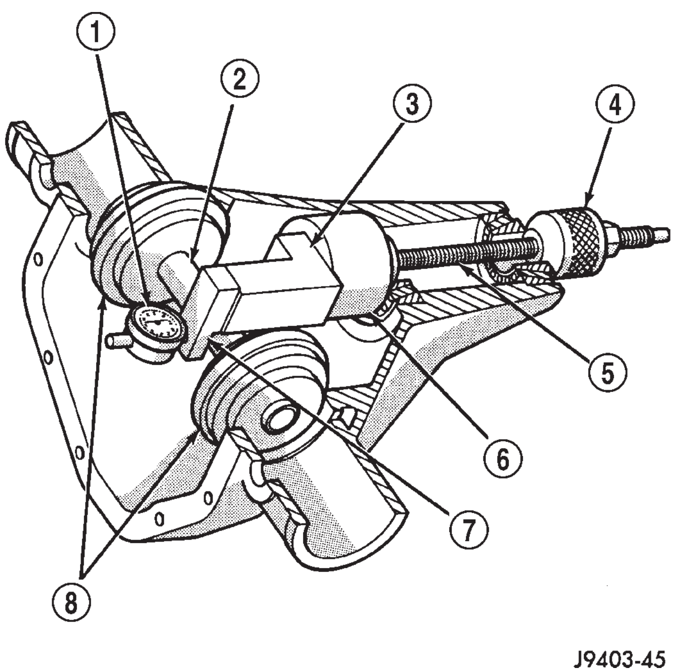


Fig. 5 PINION GEAR DEPTH GAUGE TOOLS

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

(1) Assemble Pinion Height Block 6739, Pinion Block 6733 and rear pinion bearing onto Screw 6741 (Fig. 5).

(2) Insert assembled height gauge components, rear bearing and screw into the housing through pinion bearing cups (Fig. 6).

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

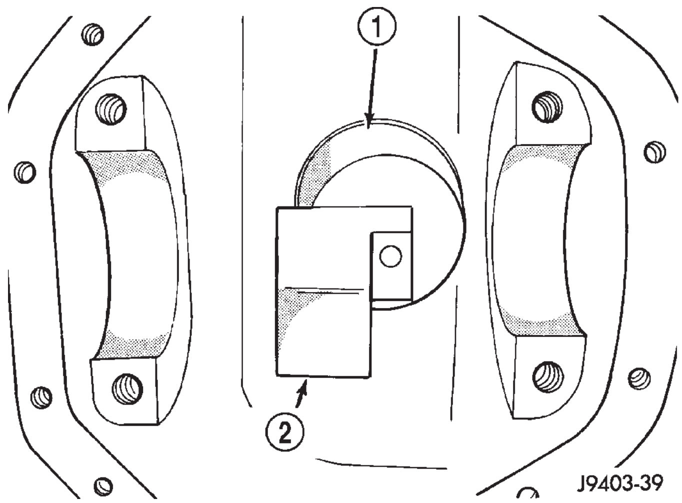


Fig. 6 PINION HEIGHT BLOCK

1 - PINION BLOCK
2 - PINION HEIGHT BLOCK

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in axle housing side bearing cradles (Fig. 7). Install differential bearing caps on arbor discs and tighten cap bolts to 41 N·m (30 ft. lbs.).

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

FRONT AXLE - 181FBI (Continued)

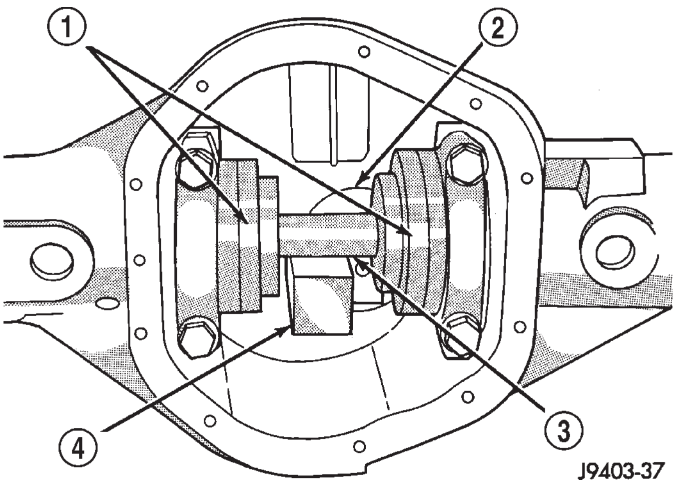


Fig. 7 GAUGE TOOLS IN HOUSING

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

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

(6) Position Scooter Block/Dial Indicator flush on the pinion height block. Hold scooter block and zero the dial indicator.

(7) Slowly slide the scooter block across the pinion height block over to the arbor (Fig. 8). Move the scooter block till the dial indicator probe crests the arbor and record the highest reading.

(8) Select a shim/oil baffle equal to the dial indicator reading plus the pinion depth variance number etched in the face of the pinion (Fig. 3). For example, if the depth variance is –2, add +0.002 in. to the dial indicator reading.

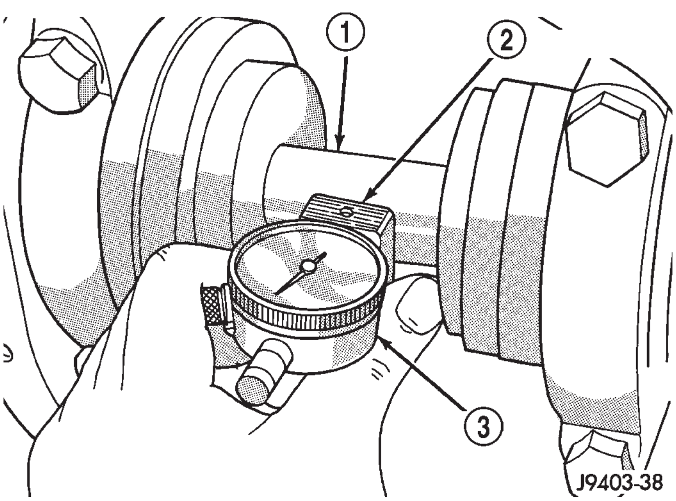


Fig. 8 PINION DEPTH MEASUREMENT

1 - ARBOR
2 - SCOOTER BLOCK
3 - DIAL INDICATOR

DIFFERENTIAL SIDE BEARING PRELOAD AND GEAR BACKLASH

Differential side bearing preload and gear backlash is achieved by selective shims positioned behind the differential side bearing cones. The proper shim thickness can be determined using slip-fit Dummy Bearings D-348 in place of the differential side bearings and a Dial Indicator C-3339. Before proceeding with the differential bearing preload and gear backlash measurements, measure the pinion gear depth and prepare the pinion 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. 9). Differential shim measurements are performed with spreader W-129-B removed.

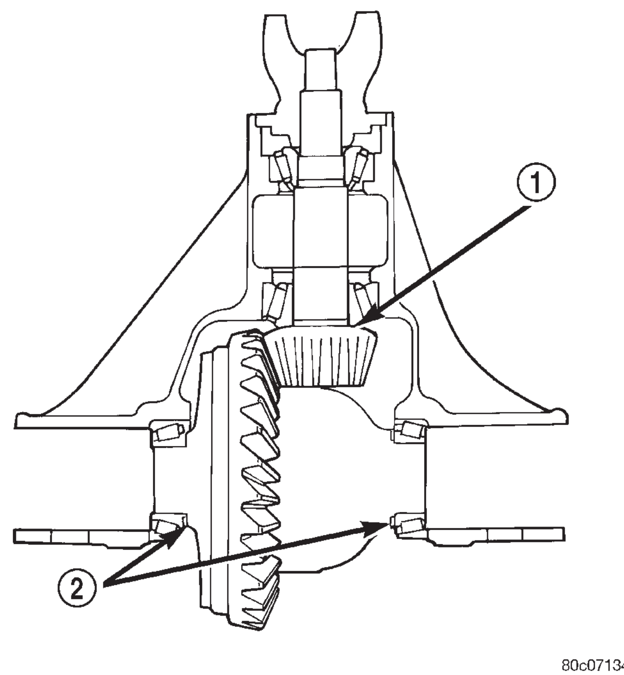


Fig. 9 SHIM LOCATIONS

1 - PINION GEAR DEPTH SHIM/OIL SLINGER
2 - DIFFERENTIAL BEARING SHIM

PRELOAD SHIM SELECTION

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

FRONT AXLE - 181FBI (Continued)

(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 the housing.

(6) Install marked bearing caps in their correct positions. Install and snug the bolts (Fig. 10).

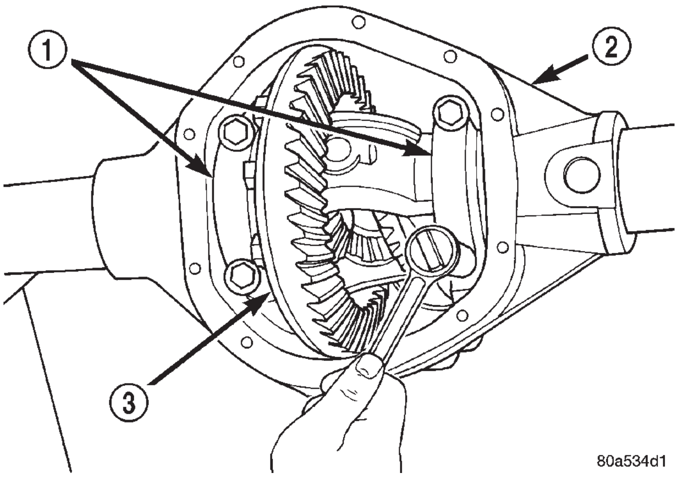


Fig. 10 BEARING CAP BOLTS

1 - BEARING CAP
2 - DIFFERENTIAL HOUSING
3 - DIFFERENTIAL CASE

(7) With a dead-blow hammer, seat the differential dummy bearings to each side of the housing (Fig. 11) and (Fig. 12).

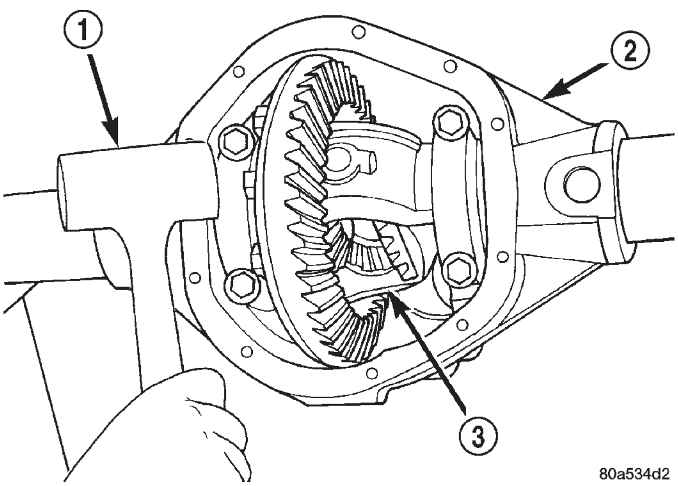


Fig. 11 SEAT DUMMY BEARINGS PINION SIDE

1 - MALLET
2 - DIFFERENTIAL HOUSING
3 - DIFFERENTIAL CASE

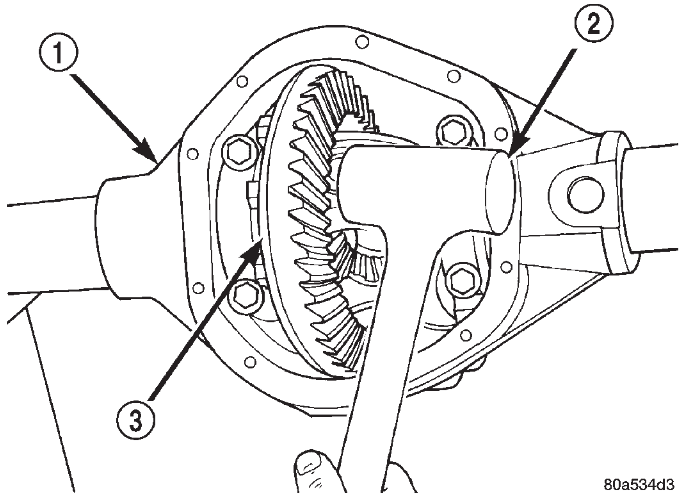


Fig. 12 SEAT DUMMY BEARING RING GEAR SIDE

1 - DIFFERENTIAL HOUSING
2 - MALLET
3 - DIFFERENTIAL CASE

(8) Thread Pilot Stud C-3288-B into rear cover bolt hole below ring gear (Fig. 13).

(9) Attach the Dial Indicator C-3339 to pilot stud. Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 13).

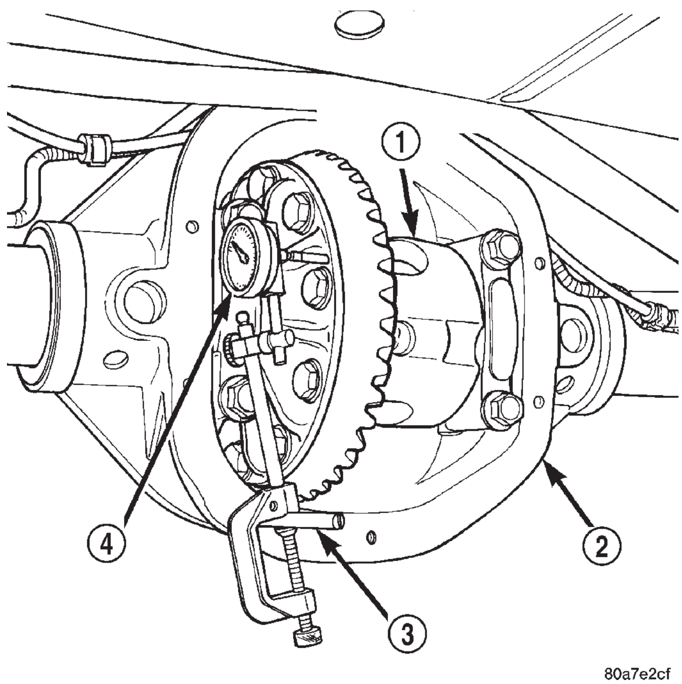


Fig. 13 DIFFERENTIAL SIDE PLAY MEASUREMENT

1 - DIFFERENTIAL CASE
2 - DIFFERENTIAL HOUSING
3 - PILOT STUD
4 - DIAL INDICATOR

(10) Push and hold differential case to pinion gear side of the housing and zero dial indicator (Fig. 14).

FRONT AXLE - 181FBI (Continued)

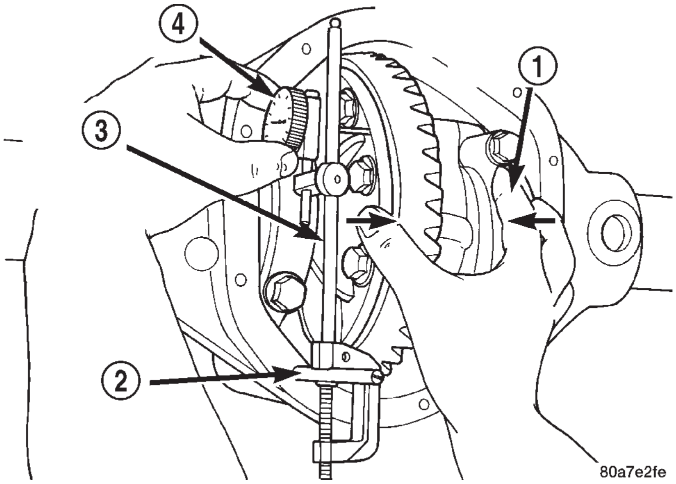


Fig. 14 DIAL INDICATOR LOCATION

1 - FORCE DIFFERENTIAL CASE TO PINION GEAR SIDE
2 - PILOT STUD
3 - DIAL INDICATOR
4 - ZERO DIAL INDICATOR FACE

(11) Push and hold differential case to ring gear side of the housing and record the dial indicator reading (Fig. 15).

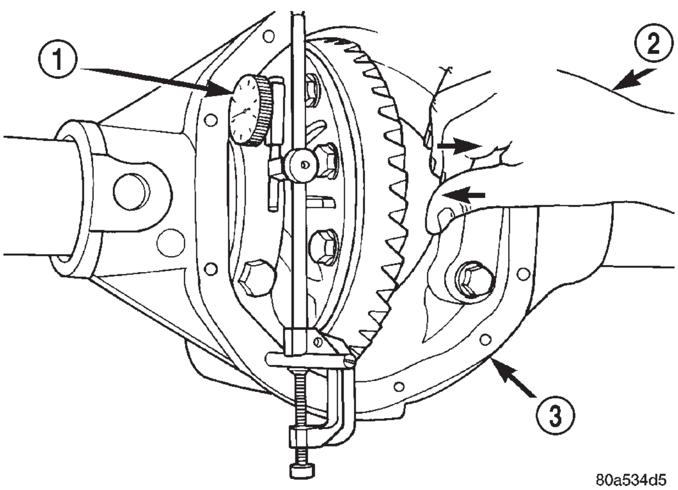


Fig. 15 READ DIAL INDICATOR

1 - READ DIAL INDICATOR
2 - DIFFERENTIAL CASE TO RING GEAR SIDE
3 - DIFFERENTIAL HOUSING

(12) 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.

(13) Rotate dial indicator out of the way on the pilot stud.

(14) Remove differential case and dummy bearings from the housing.

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

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

(17) Seat ring gear side dummy bearing (Fig. 12).

(18) Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 13).

(19) Push and hold differential case toward pinion gear and zero the dial indicator (Fig. 16).

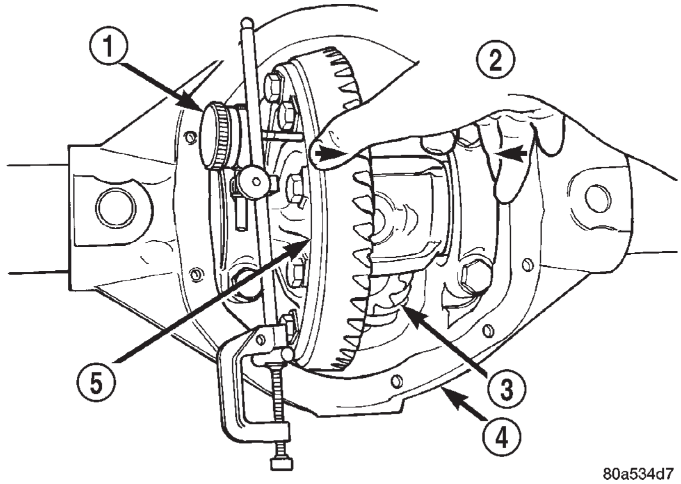


Fig. 16 ZERO DIAL INDICATOR

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

(20) Push and hold differential case to ring gear side of the housing and record dial indicator reading (Fig. 17).

(21) Subtract 0.05 mm (0.002 in.) 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.

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

(23) Rotate dial indicator out of the way on pilot stud.

(24) Remove differential case and dummy bearings from the housing.

(25) Install the selected side bearing shims onto the differential case hubs.

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

(27) Install spreader W-129-B and adaters from Adapter Set 6987, onto housing. Spread the housing to receive differential case.

(28) Install differential case into the housing.

(29) Remove spreader from the housing.

FRONT AXLE - 181FBI (Continued)

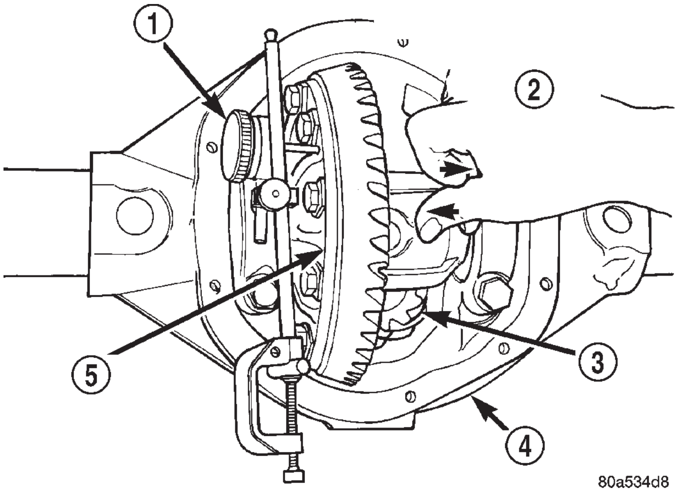


Fig. 17 DIFFERENTIAL CASE RING GEAR SIDE

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

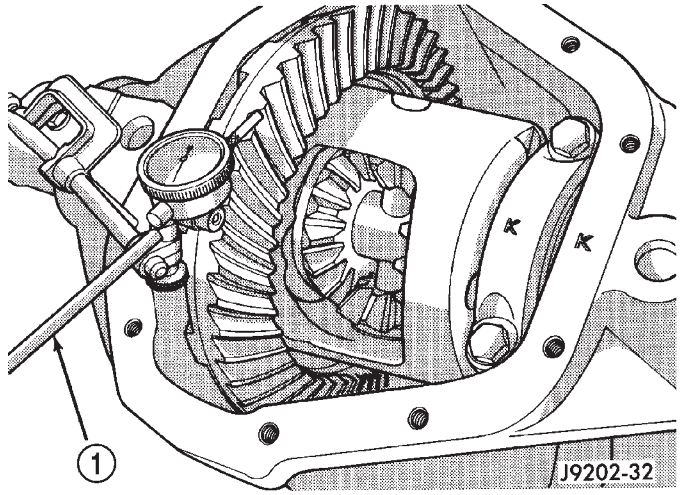


Fig. 18 RING GEAR BACKLASH MEASUREMENT

1 - DIAL INDICATOR

(30) Install bearing caps and tighten bolts to 61 N·m (45 ft. lbs.).

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

(32) Position the indicator plunger against a ring gear tooth (Fig. 18).

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

(34) Zero dial indicator face to pointer.

(35) 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 housing to the other (Fig. 19).

(36) 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 procedure.

GEAR CONTACT PATTERN

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

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

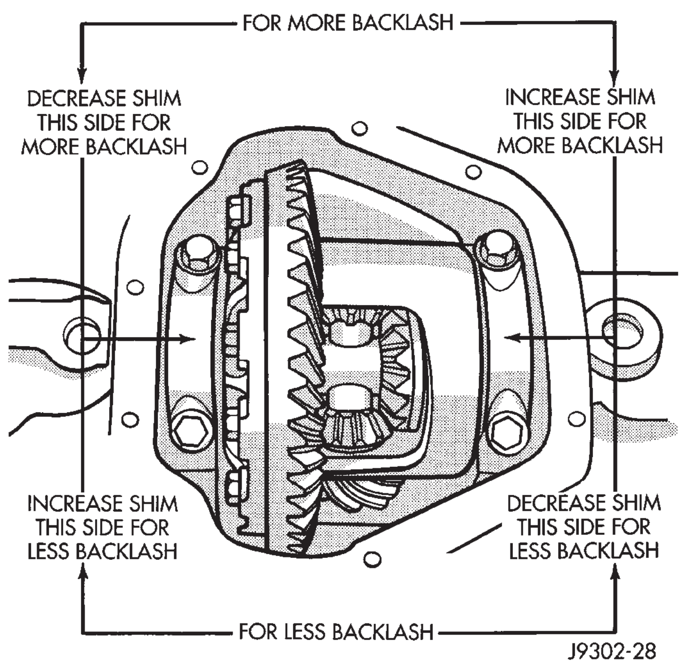


Fig. 19 BACKLASH SHIM

(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) With a boxed end wrench on the 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 squeeze 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. 20) and adjust pinion depth and gear backlash as necessary.

FRONT AXLE - 181FBI (Continued)

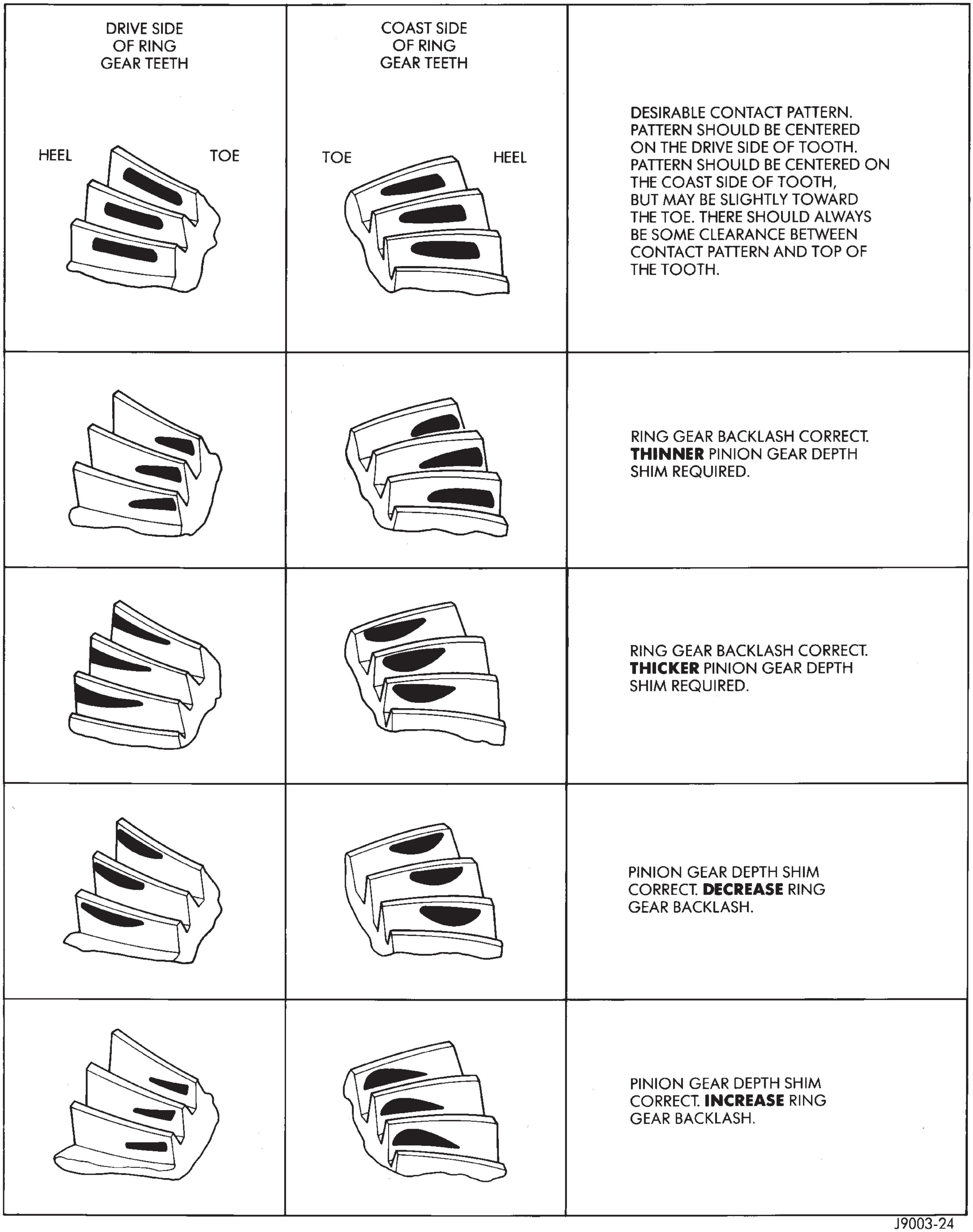


Fig. 20 GEAR CONTACT PATTERNS

FRONT AXLE - 181FBI (Continued)

DIFFERENTIAL BEARING PRELOAD CHECK

The final check on the differential assembly before installing the axles is torque to rotate pinion and differential combined. This will verify the correct differential bearing preload.

Torque to rotate the differential and pinion should be the torque to rotate the pinion plus 0.79-1.24 N·m (7-11 in. lbs.).

SPECIFICATIONS

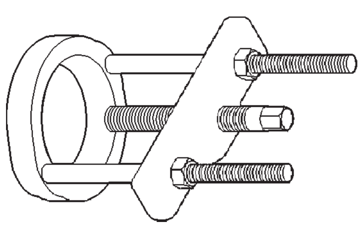
AXLE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Axle Ratio	3.07, 3.55, 3.73, 4.10
Differential Side Gear Clearance	0.12-0.20 mm (0.005-0.008 in.)
Differential Bearing Preload	0.2 mm (0.008 in.)
Ring Gear Diameter	181 mm (7.125 in.)
Ring Gear Backlash	0.12-0.20 mm (0.005-0.008 in.)
Pinion Gear Standard 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	2-3.4 N·m (15-30 in. lbs.)

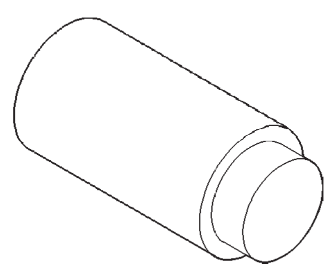
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Fill Hole Plug	34	25	-
Differential Cover Bolts	41	30	-
Bearing Cap Bolts	61	45	-
Ring Gear Bolts	108	80	-
Pinion Bearing Nut	352 Max.	260 Max.	-
Axle Nut	237	175	-
Hub Bearing Bolts	102	75	-

SPECIAL TOOLS

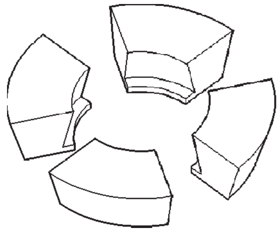


Puller C-293-PA

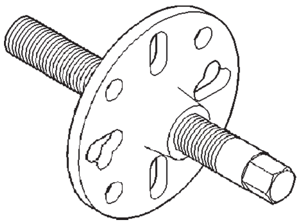


Plug SP-3289

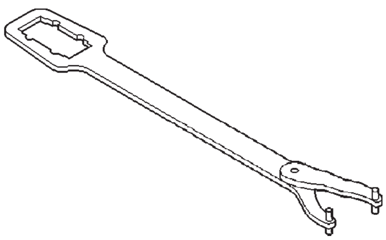
FRONT AXLE - 181FBI (Continued)



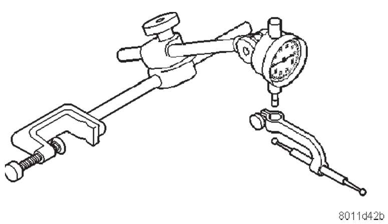
Adapter C-293-39



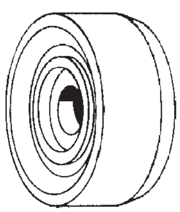
Puller C-452



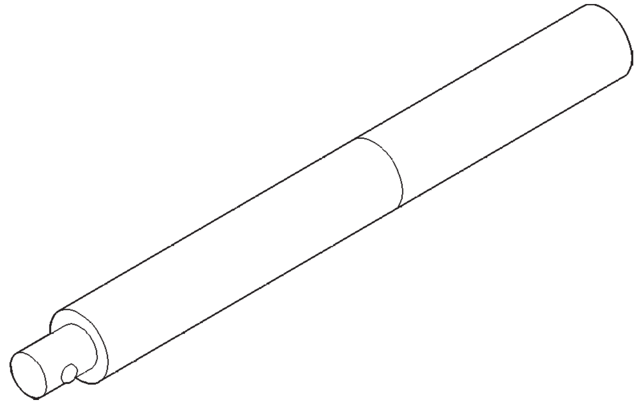
Wrench C-3281



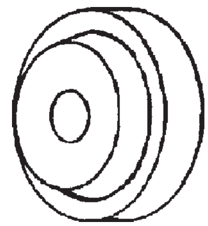
Dial Indicator C-3339



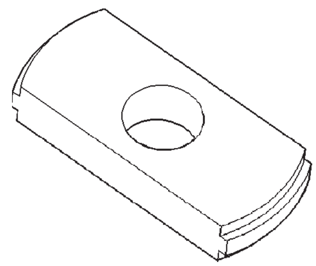
Installer C-3716-A



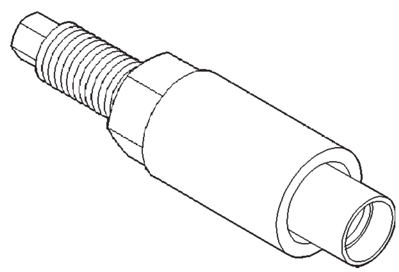
Handle C-4171



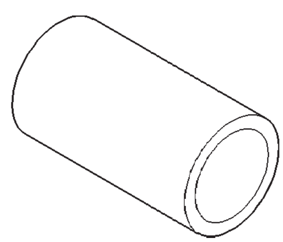
Installer D-146



Remover D-149

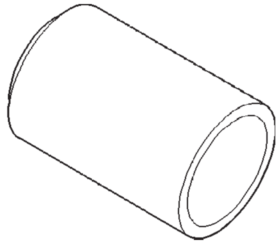


Installer W-162-D

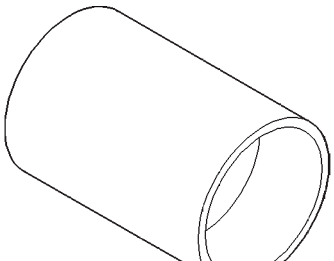


Cup 8109

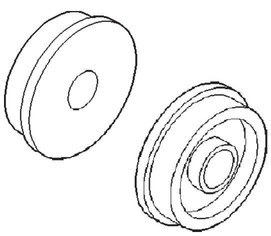
FRONT AXLE - 181FBI (Continued)



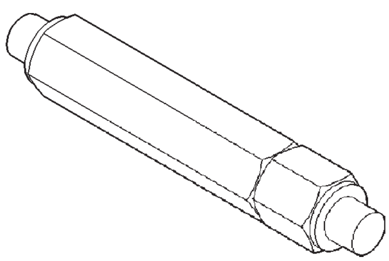
Installer 6761



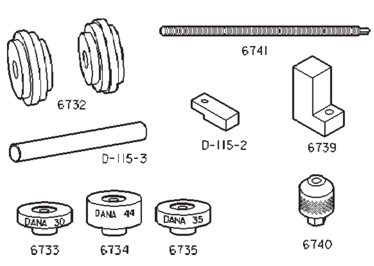
Installer 6752



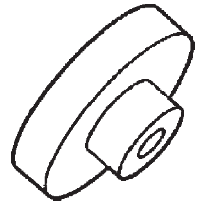
Installer Discs 8110



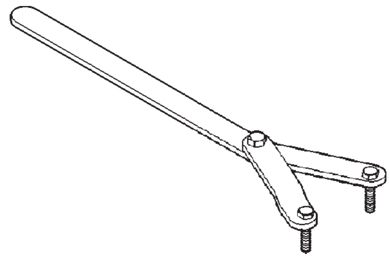
Turnbuckle 6797



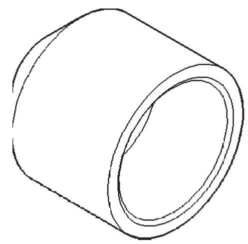
Pinion Depth Set 6774



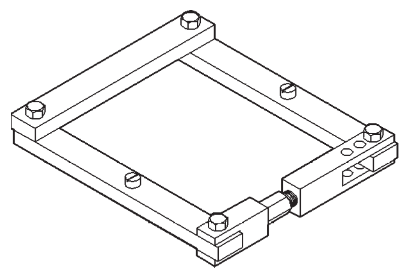
Pinion Block 6733



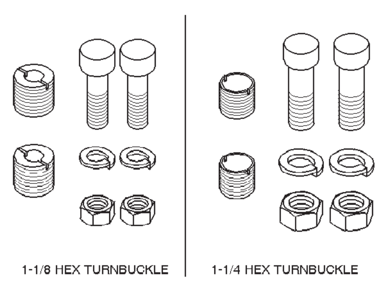
Spanner Wrench 6958



Installer C-3972-A

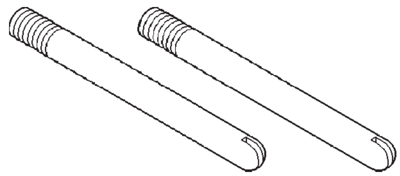


Spreader W-129-B

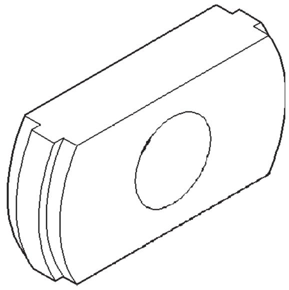


Adapter Kit 6987B

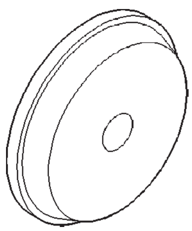
FRONT AXLE - 181FBI (Continued)



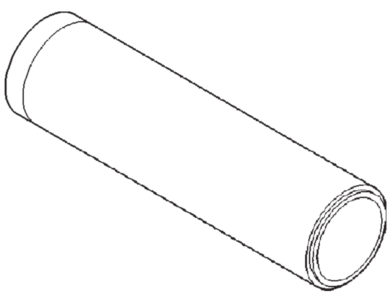
Pilot Stud C-3288-B



Remover C-4345



Installer D-130



Installer W-262

AXLE SHAFTS

REMOVAL

NOTE: 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.

(1) Raise and support the vehicle.
(2) Remove the wheel and tire assembly.
(3) Remove brake caliper, rotor and wheel speed sensor if equipped.
(4) Remove cotter pin, nut retainer and axle hub nut.
(5) Remove hub bearing bolts (Fig. 21).
(6) Remove hub bearing from the steering knuckle.

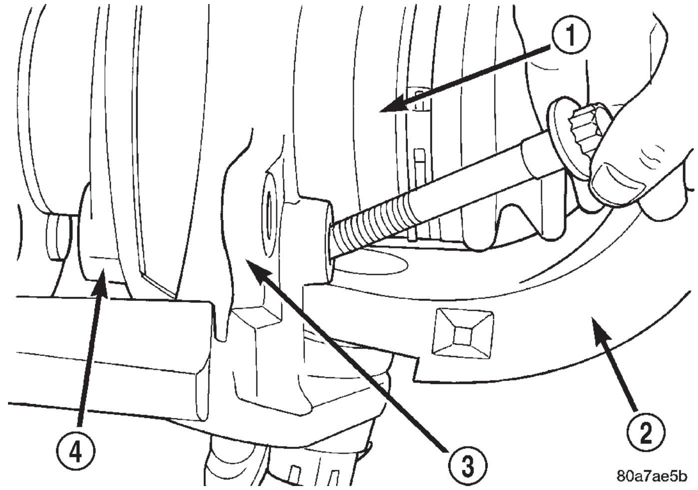


Fig. 21 HUB BEARING BOLTS

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

(7) Remove axle shaft assembly (Fig. 22) from axle. **Avoid damaging the axle shaft oil seals in the axle housing.**

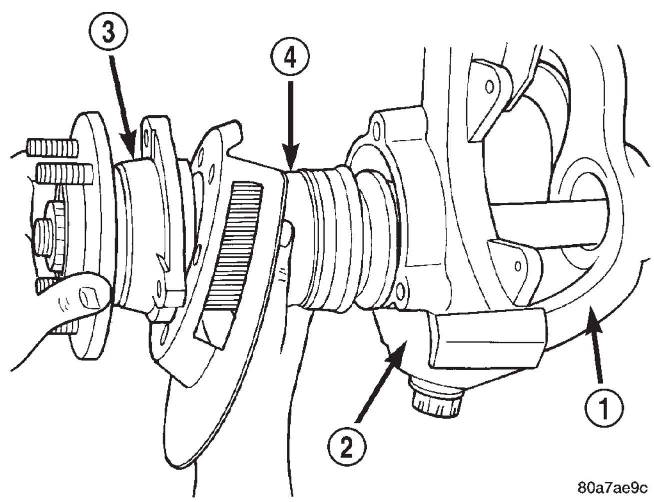


Fig. 22 HUB BEARING AND AXLE

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

(8) Remove the brake rotor shield from the hub bearing or knuckle.

INSTALLATION

(1) Clean axle shaft and apply a thin film of Mopar Wheel Bearing Grease or equivalent to the shaft splines seal contact surface and hub bore.
(2) Install brake rotor shield on the knuckle.

AXLE SHAFTS (Continued)

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

(4) Install hub bearing and tighten bolts to 102 N·m (75 ft. lbs.).

(5) Install axle washer and nut. Tighten nut to 237 N·m (175 ft. lbs.) and install the nut retainer and a new cotter pin.

(6) Install the brake rotor, caliper and wheel speed sensor, if equipped.

(7) Install the wheel and tire assembly.

(8) Remove support and lower the vehicle.

AXLE SHAFT SEALS

REMOVAL

(1) Raise and support vehicle.

(2) Remove axle shafts.

(3) Remove differential assembly.

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

INSTALLATION

(1) Remove any sealer remaining from original seals.

(2) Install oil seals with Discs 8110 and Turnbuckle 6797 (Fig. 23). Tighten tool until disc bottoms in housing.

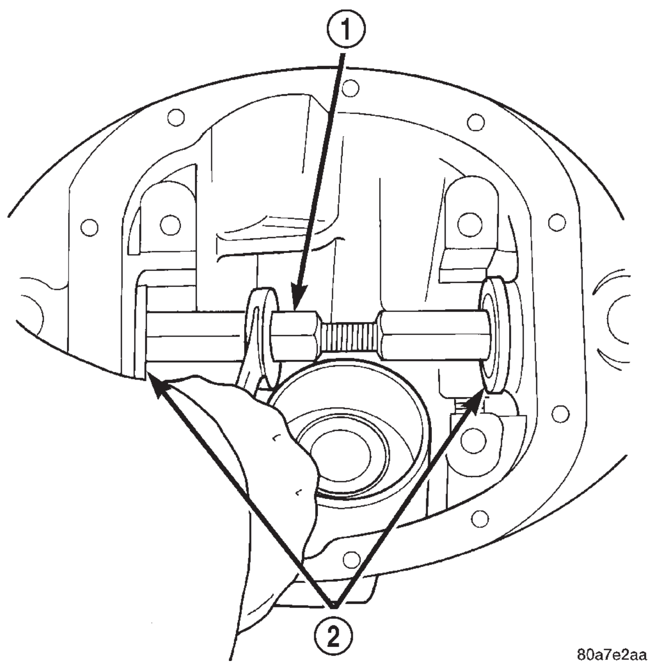


Fig. 23 AXLE SEAL TOOLS

1 - TURNBUCKLE
2 - DISCS

(3) Install differential and axle shafts.

(4) Fill differential with lubricant.

(5) Remove support and lower vehicle.

SINGLE CARDAN UNIVERSAL JOINT

REMOVAL

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

(1) Remove axle shaft.

(2) Remove the bearing cap retaining snap rings (Fig. 24).

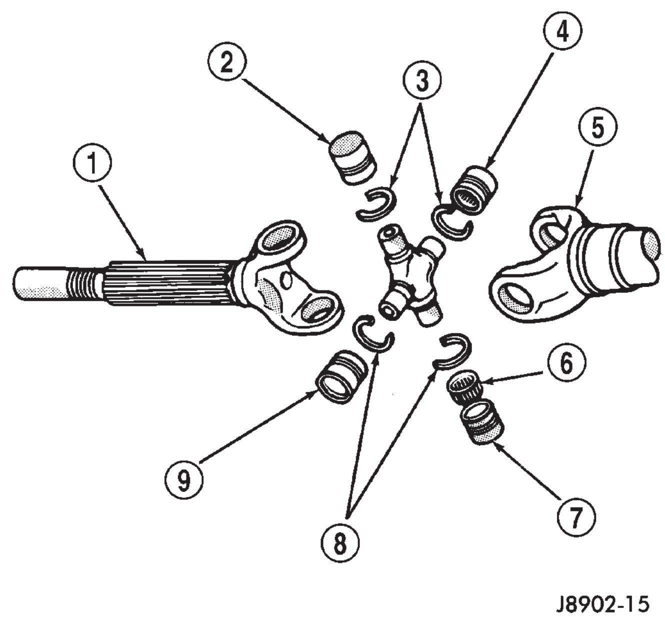


Fig. 24 AXLE SHAFT OUTER U-JOINT

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

NOTE: Saturate the bearing caps with penetrating oil prior to removal.

(3) Locate a socket with an inside diameter is larger 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 with an outside diameter is smaller than the bearing cap. Place the socket (driver) against the opposite bearing cap.

SINGLE CARDAN UNIVERSAL JOINT (Continued)

(5) Position the yoke with the sockets in a vise (Fig. 25).

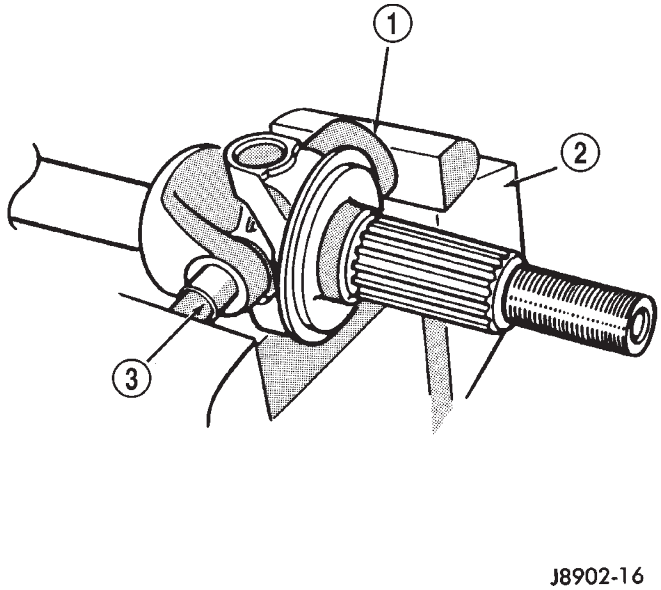


Fig. 25 YOKE BEARING CAP

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

(6) Tighten 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 and remove 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, then tap 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 in a vise.

(4) Tighten 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 SEAL

REMOVAL

(1) Raise and support the vehicle.

(2) Remove wheel and tire assemblies.

(3) Remove brake rotors and calipers.

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

(5) Remove propeller shaft from the yoke.

(6) Rotate pinion gear three or four times.

(7) Record rotating torque of the pinion gear with an inch pound torque wrench, for installation reference.

(8) Hold pinion yoke with Wrench 6958 and remove pinion nut and washer.

(9) Remove pinion yoke with Remover C-452 and Wrench C-3281 (Fig. 26).

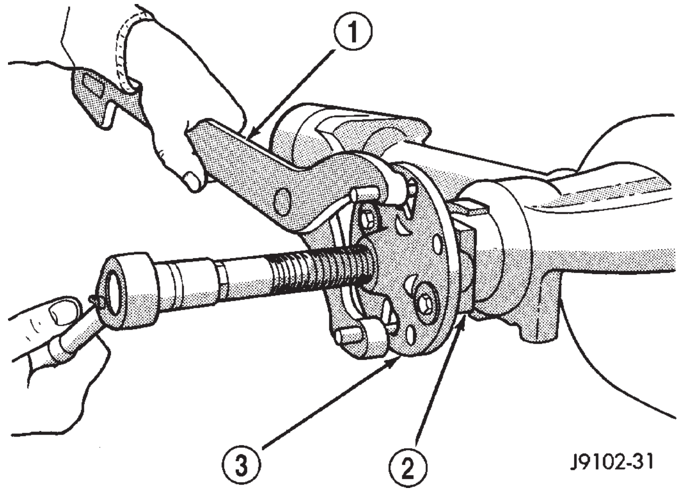


Fig. 26 PINION YOKE REMOVER

1 - WRENCH
2 - PINION YOKE
3 - REMOVER

(10) Remove seal with a pry tool or a slide hammer mounted screw.

INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with an appropriate installer (Fig. 27).

(2) Install yoke on the pinion gear with Installer W-162-D, Cup 8109 and Holder 6958 (Fig. 28).

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 shaft. **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 an inch pound torque wrench. Rotating torque should be equal to the reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.) (Fig. 29).

PINION SEAL (Continued)

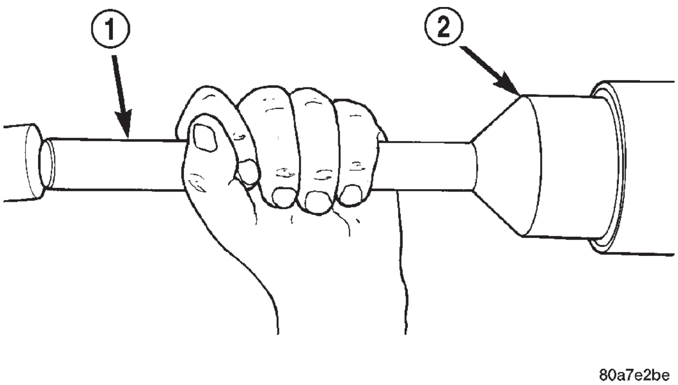


Fig. 27 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

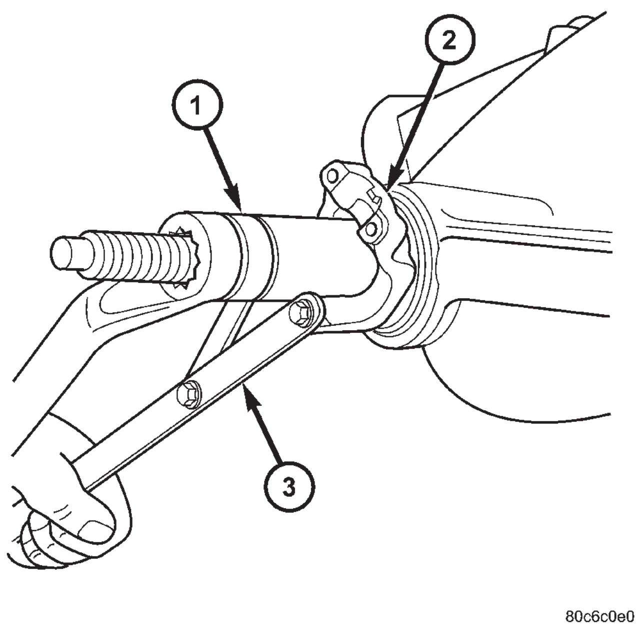


Fig. 28 PINION YOKE INSTALLER

1 - INSTALLER
2 - PINION YOKE
3 - SPANNER WRENCH

(6) If the rotating torque is low, use Holder 6958 (Fig. 30) to hold the pinion yoke, and tighten pinion shaft nut in 6.8 N·m (5 ft. lbs.) increments until proper rotating torque is achieved.

(7) Install propeller shaft with reference marks aligned.

(8) Check and fill the gear lubricant.

(9) Install brake rotors and calipers.

(10) Install wheel and tire assemblies.

(11) Lower the vehicle.

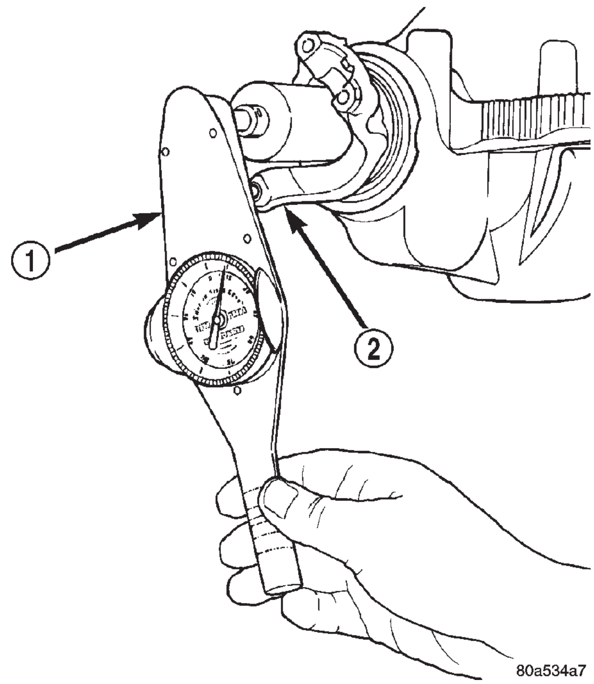


Fig. 29 PINION ROTATING TORQUE

1 - TORQUE WRENCH
2 - PINION YOKE

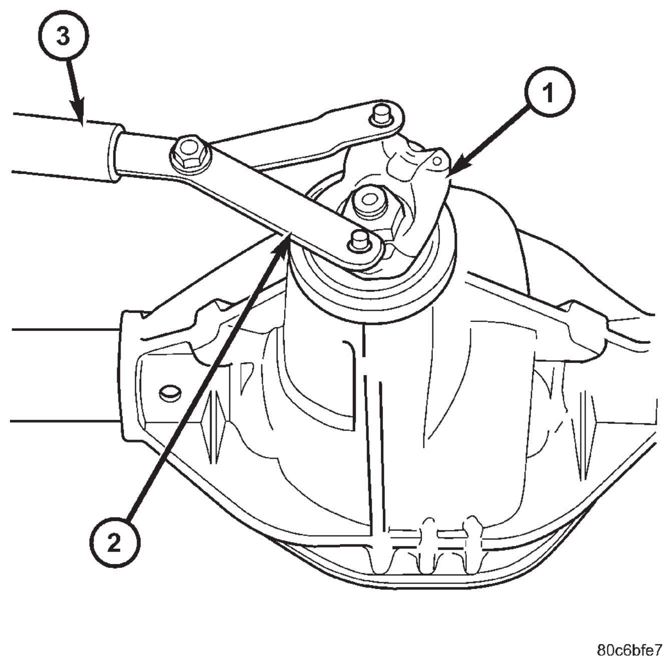


Fig. 30 YOKE HOLDER

1 - PINION YOKE
2 - SPANNER WRENCH
3 - PIPE

COLLAPSIBLE SPACER

REMOVAL

(1) Raise and support the vehicle.
(2) Remove wheel and tire assemblies.
(3) Remove brake rotors and calipers.
(4) Mark propeller shaft and pinion yoke for installation reference.
(5) Remove propeller shaft from the yoke.
(6) Rotate pinion gear three or four times.
(7) Record the rotating torque of the pinion gear with an inch pound torque wrench.
(8) Hold the pinion yoke with Spanner Wrench 6958 and remove the pinion nut and washer.
(9) Remove pinion yoke with Remover C-452 and Flange Wrench C-3281 (Fig. 31).

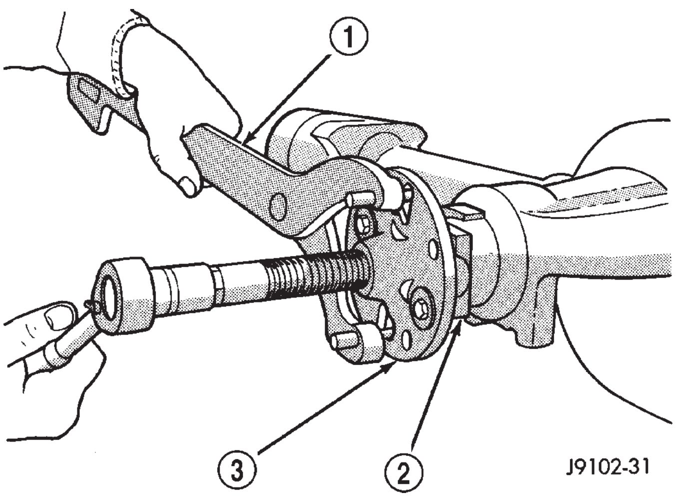


Fig. 31 PINION YOKE REMOVER
1 - WRENCH
2 - PINION YOKE
3 - REMOVER

(10) Remove pinion seal with a suitable pry tool or a slide hammer mounted screw.
(11) Remove front pinion bearing with a pair of pick tools to pull the bearing off the pinion gear shaft. If the bearing becomes bound on the shaft, lightly tap the end of the pinion gear with a rawhide/ rubber hammer.
(12) Remove the collapsible spacer.

INSTALLATION

(1) Install **new** collapsible spacer on the pinion shaft.
(2) Install front pinion bearing.
(3) Apply a light coating of gear lubricant on the lip of pinion seal and install seal with an appropriate installer (Fig. 32).
(4) Install yoke with Installer W-162-D, Cup 8109 and Spanner Wrench 6958 (Fig. 33).

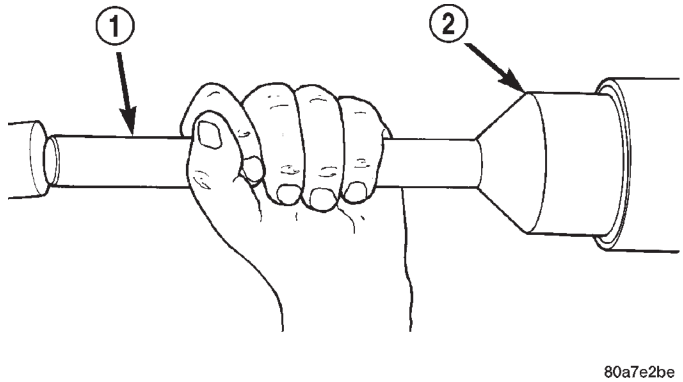


Fig. 32 PINION SEAL INSTALLER
1 - HANDLE
2 - INSTALLER

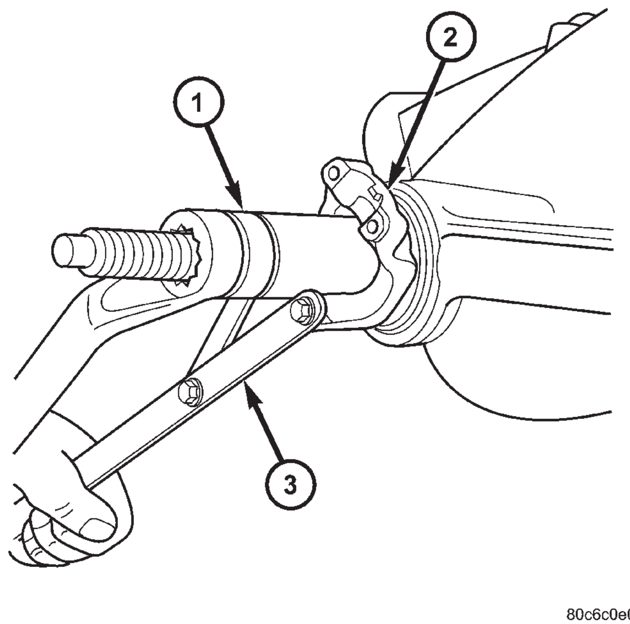


Fig. 33 PINION YOKE INSTALLER
1 - INSTALLER
2 - PINION YOKE
3 - SPANNER WRENCH

(5) Install the pinion washer and a **new** nut and tighten the nut to 217 N·m (160 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.

(6) Using yoke Spanner Wrench 6958 and a torque wrench set at 353 N·m (260 ft. lbs.), slowly tighten the nut (Fig. 34) in 6.8 N·m (5 ft. lbs.) increments until

COLLAPSIBLE SPACER (Continued)

rotating torque is achieved. Measure the rotating torque with inch pound torque wrench frequently to avoid over crushing the collapsible spacer (Fig. 35).

NOTE: If more than 353 N·m (260 ft. lbs.) torque is required to crush the collapsible spacer, the spacer is defective and must be replaced.

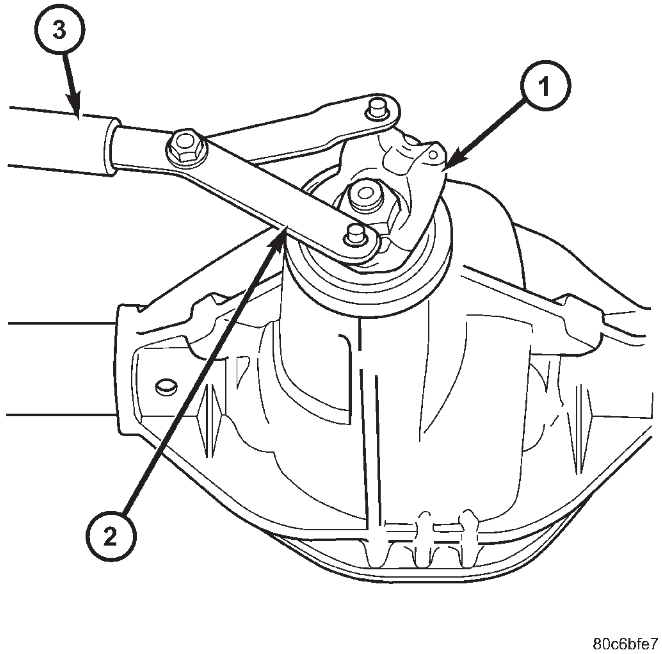


Fig. 34 YOKE SPANNER WRENCH

1 - PINION YOKE
2 - SPANNER WRENCH
3 - PIPE

(7) Rotating torque should be the recorded reading during removal, plus an additional 0.56 N·m (5 in. lbs.).

(8) Install propeller shaft with reference marks aligned.

(9) Install brake rotors and calipers.

(10) Install wheel and tire assemblies.

(11) Lower vehicle.

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) 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 hub bearings and axle shafts.

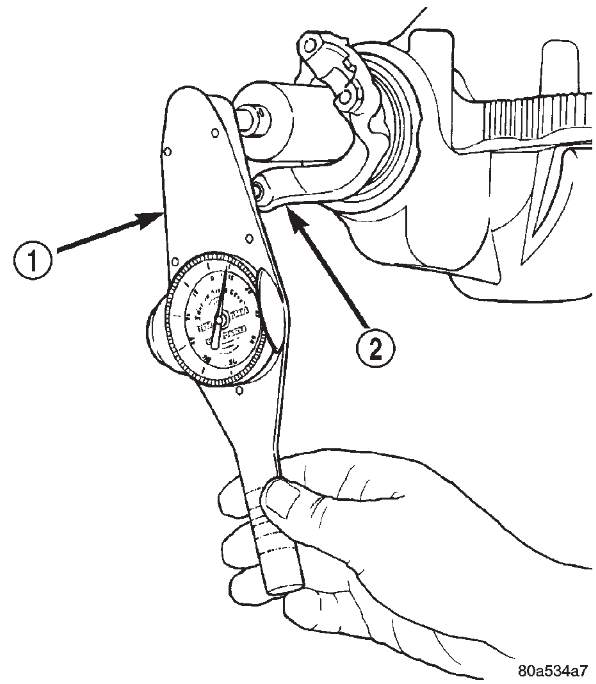


Fig. 35 PINION ROTATING TORQUE

1 - TORQUE WRENCH
2 - PINION YOKE

(6) Note the installation reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 36).

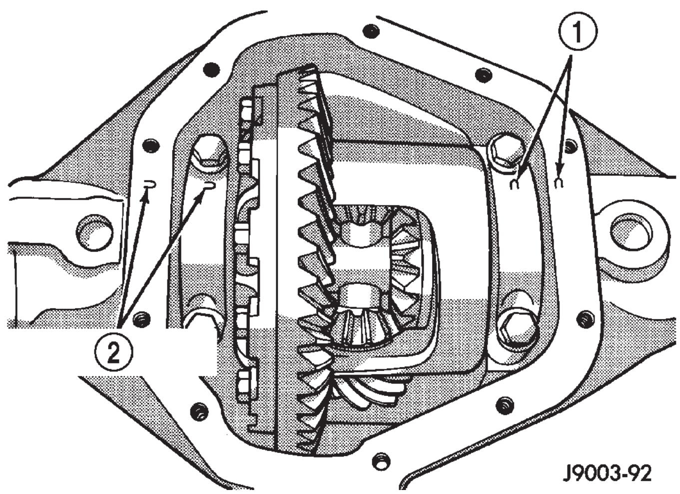


Fig. 36 BEARING CAP IDENTIFICATION

1 - INSTALLATION REFERENCE LETTERS
2 - INSTALLATION REFERENCE LETTERS

(7) Loosen the differential bearing cap bolts.

(8) Position Spreader W-129-B, utilizing some items from Adapter Kit 6987, with the tool dowel pins seated in the locating holes (Fig. 37). Install the holddown clamps and tighten the tool turnbuckle finger-tight.

DIFFERENTIAL (Continued)

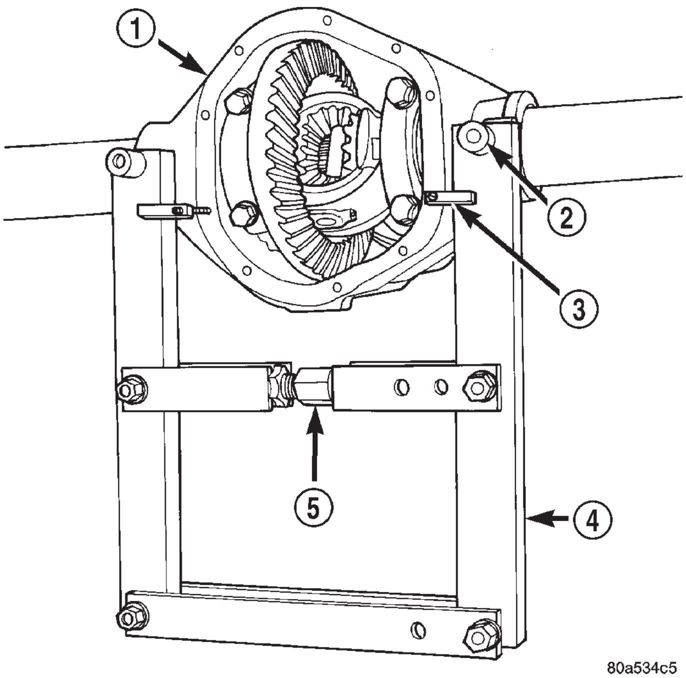


Fig. 37 SPREADER LOCATION

1 - AXLE HOUSING
2 - DOWEL
3 - SAFETY HOLD DOWN
4 - SPREADER
5 - TURNBUCKLE

(9) Install a Pilot Stud 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. 38) 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.

(10) Spread the housing enough to remove the differential case from the housing. Measure the distance with the dial indicator (Fig. 39).

(11) Remove the dial indicator.

(12) Hold the differential case in position while removing the differential bearing cap bolts and caps.

(13) Remove differential from the housing. Ensure that the differential bearing cups remain in position on the differential bearings (Fig. 40).

(14) Remove spreader from housing.

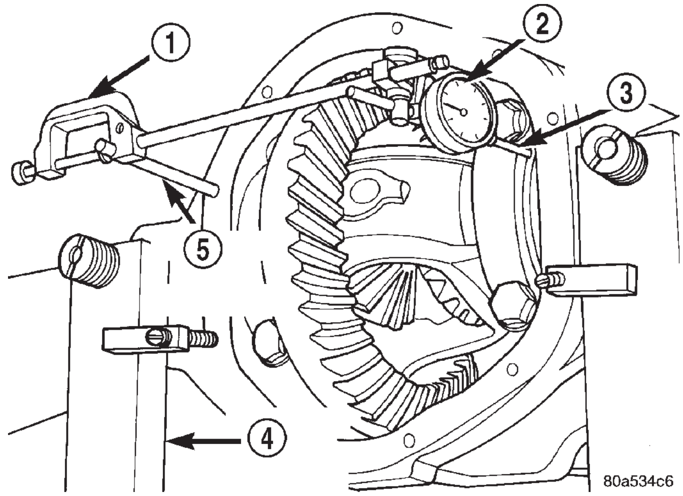


Fig. 38 DIAL INDICATOR LOCATION

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

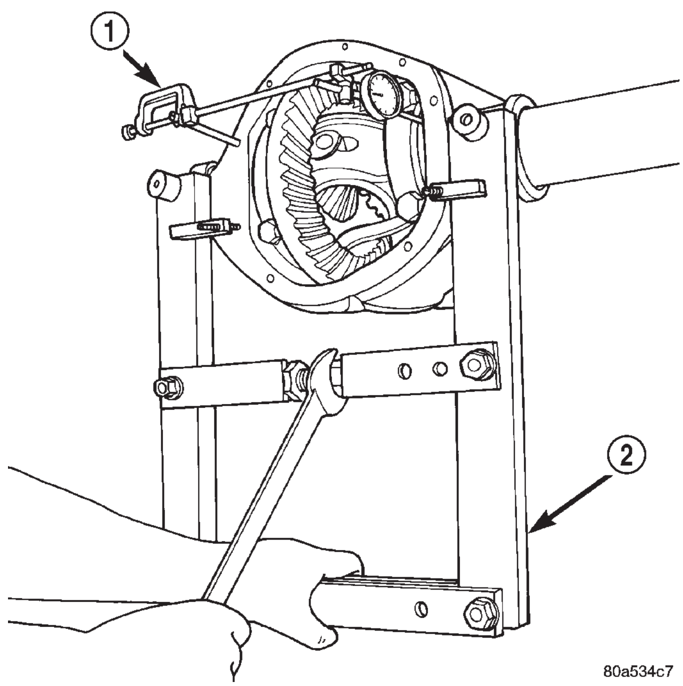


Fig. 39 SPREAD DIFFERENTIAL HOUSING

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

DIFFERENTIAL (Continued)

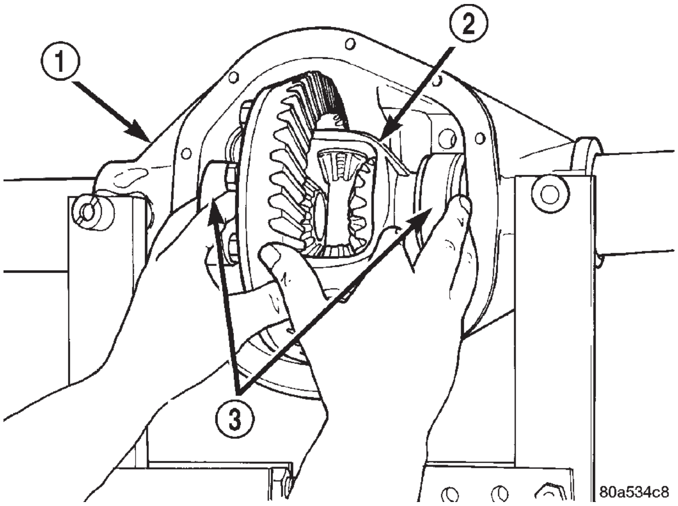


Fig. 40 DIFFERENTIAL CASE

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

DISASSEMBLY

(1) Remove the ring gear.

(2) Drive out the roll pin holding pinion gear mate shaft with a punch (Fig. 41).

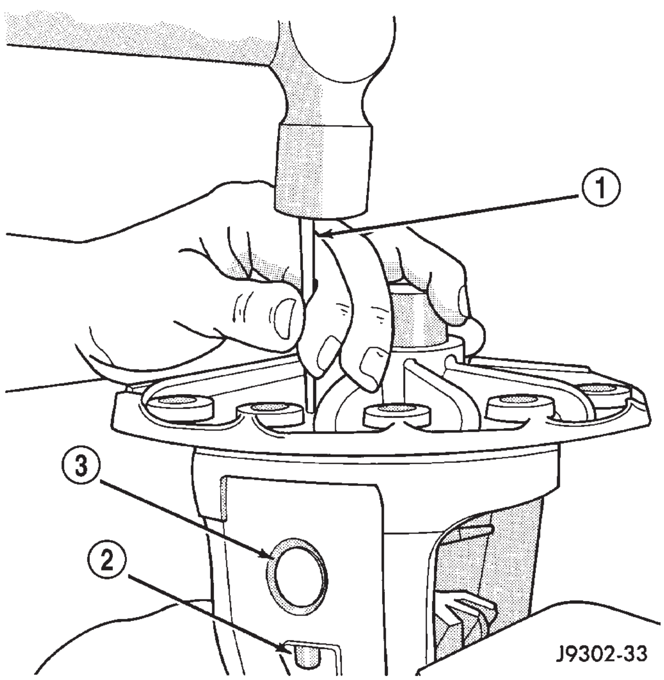


Fig. 41 MATE SHAFT ROLL PIN

1 - DRIFT
2 - LOCKPIN
3 - MATE SHAFT

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

(4) Rotate differential side gears and remove pinion mate gears and thrust washers (Fig. 42).

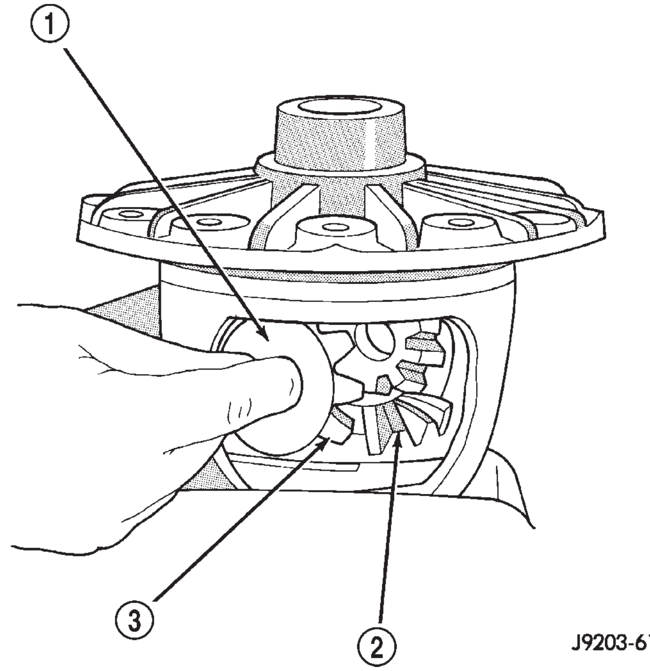


Fig. 42 PINION MATE GEAR

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

(5) Remove differential side gears and thrust washers.

ASSEMBLY

(1) Install differential side gears and thrust washers.

(2) Install pinion mate gears and thrust washers.

(3) Install 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. 43).

(5) Install the ring gear.

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

INSTALLATION

NOTE: If replacement differential bearings or differential case are being installed, differential side bearing shim requirements may change. Refer to Adjustments (Differential Bearing Preload and Gear Backlash) to determine the proper shim selection.

DIFFERENTIAL (Continued)

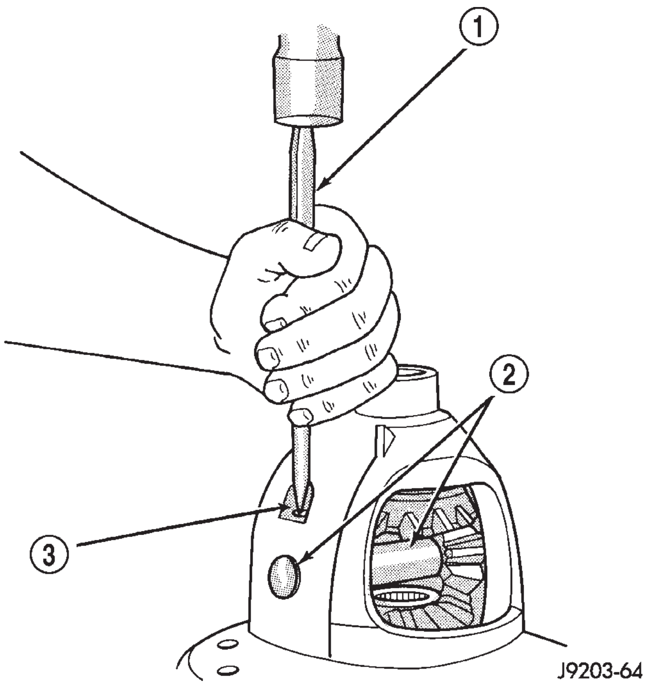


Fig. 43 MATE SHAFT ROLL PIN

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

(1) Position Spreader W-129-B, utilizing some items from Adapter Kit 6987, with the tool dowel pins seated in the locating holes (Fig. 44). Install the holddown 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 lever adapter against the opposite side of the housing (Fig. 45) 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.

(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. 46).

(7) Loosely install differential bearing cap bolts.

(8) Remove axle housing spreader.

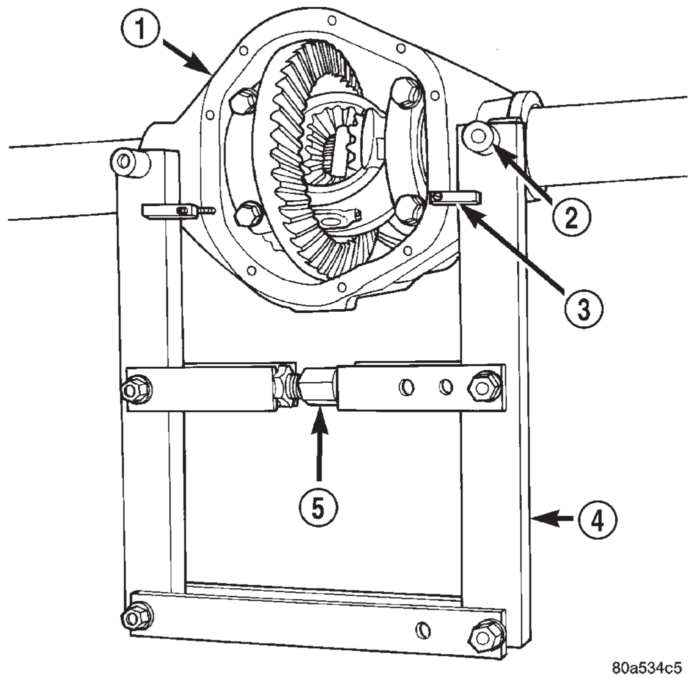


Fig. 44 SPREADER LOCATION

1 - AXLE HOUSING
2 - DOWEL
3 - SAFETY HOLD DOWN
4 - SPREADER
5 - TURNBUCKLE

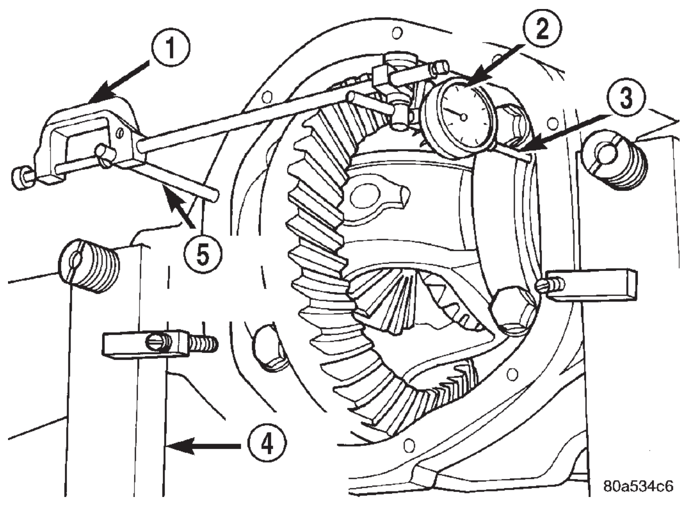


Fig. 45 DIAL INDICATOR LOCATION

1 - CLAMP
2 - DIAL INDICATOR
3 - LEVER ADAPTER
4 - SPREADER
5 - PILOT STUD

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

(10) Install the hub bearings and axle shafts.

DIFFERENTIAL (Continued)

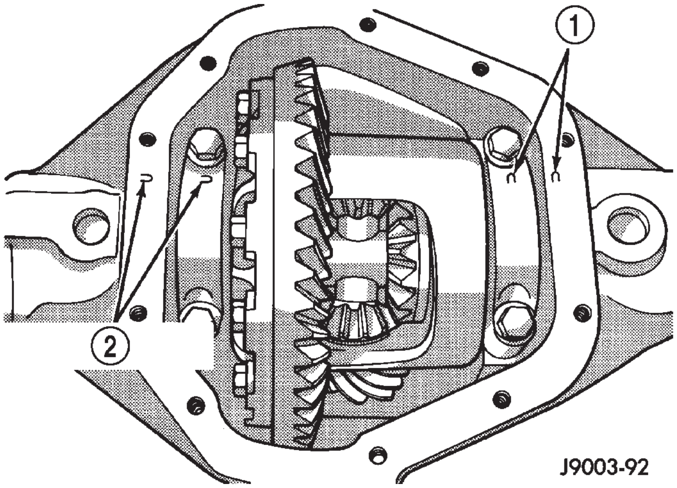


Fig. 46 BEARING CAP IDENTIFICATION

1 - INSTALLATION REFERENCE LETTERS
2 - INSTALLATION REFERENCE LETTERS

(11) Apply a 6.35mm (1/4 in.) bead of red Mopar Silicone Rubber Sealant or equivalent to the housing cover (Fig. 47).

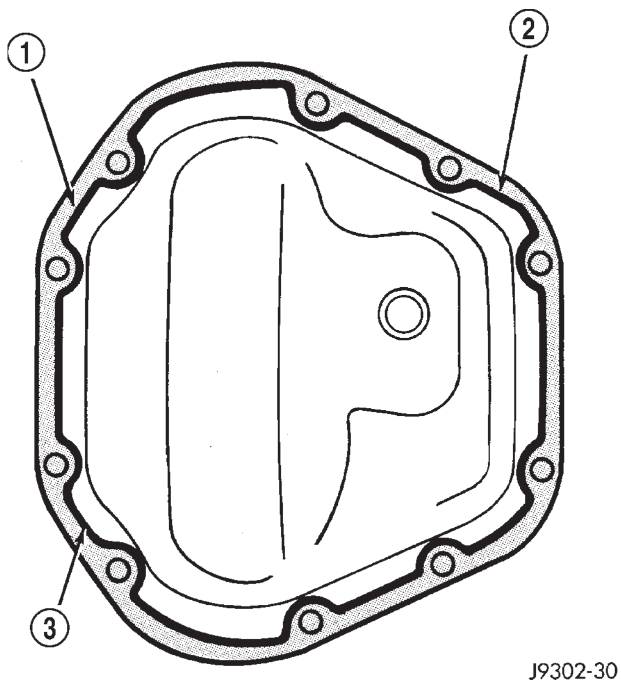


Fig. 47 HOUSING COVER - TYPICAL

1 - SEALANT SURFACE
2 - SEALANT
3 - SEALANT THICKESS

CAUTION: If housing cover is not installed within 3 to 5 minutes, the cover must be cleaned and new RTV applied or adhesion quality will be compromised.

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

(13) Fill the differential with Mopar Hypoid Gear Lubricant or equivalent to bottom of the fill plug hole. Refer to Lubricant Specifications for correct quantity and type.

(14) Install fill hole plug and tighten to 34 N·m (25 ft. lbs.).

(15) Remove support and lower vehicle.

DIFFERENTIAL CASE BEARINGS

REMOVAL

(1) Remove differential case from the housing.

(2) Remove bearings from the differential case with Puller/Press C-293-PA, C-293-39 Adapter and Plug SP-3289 (Fig. 48).

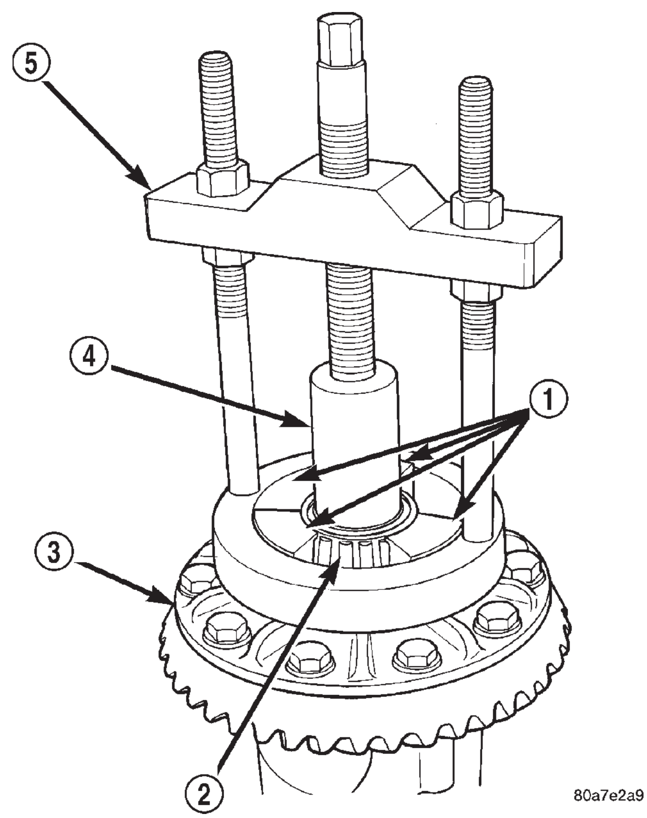


Fig. 48 DIFFERENTIAL BEARING

1 - ADAPTERS
2 - BEARING
3 - DIFFERENTIAL
4 - PLUG
5 - PULLER

DIFFERENTIAL CASE BEARINGS (Continued)

INSTALLATION

NOTE: If replacement differential side bearings or differential case are being installed, differential side bearing shim requirements may change. Refer to Adjustments (Differential Bearing Preload and Gear Backlash) to determine the proper shim selection.

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

(2) Install differential side bearings with Installer C-3716-A and Handle C-4171 (Fig. 49).

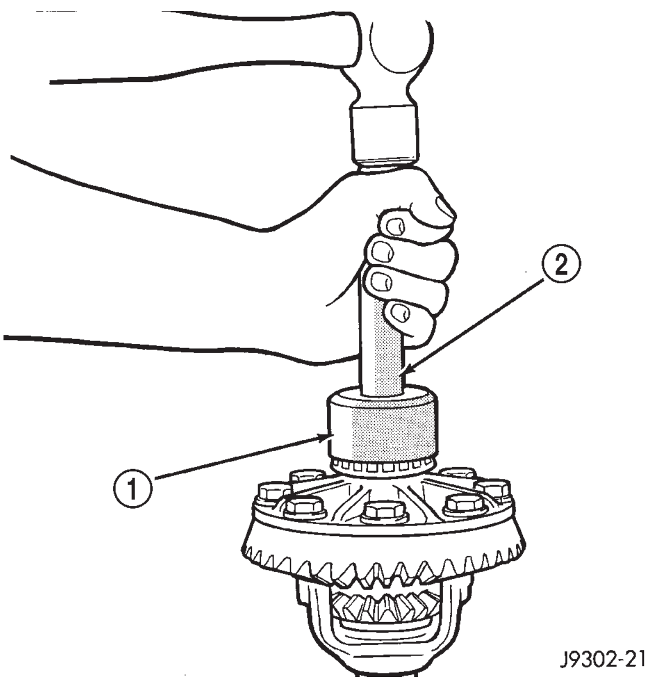


Fig. 49 DIFFERENTIAL CASE BEARING

1 - INSTALLER
2 - HANDLE

(3) Install differential in the housing.

PINION GEAR/RING GEAR

REMOVAL

NOTE: The ring and pinion gears are serviced as a matched set. Never replace one gear without replacing the other matched gear.

(1) Raise and support the vehicle.

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

(3) Disconnect propeller shaft from pinion yoke and tie propeller shaft to underbody.

(4) Remove differential from axle housing.

(5) Secure differential case in a vise with soft metal jaw (Fig. 50).

(6) Remove ring gear bolts from the differential case.

(7) Drive ring gear off the differential case with a rawhide hammer (Fig. 50).

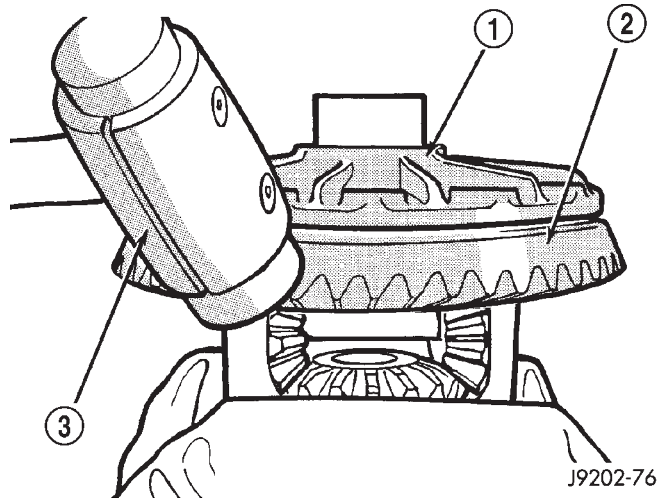


Fig. 50 RING GEAR

1 - DIFFERENTAIL CASE
2 - RING GEAR
3 - HAMMER

(8) Hold yoke with Spanner Wrench 6958 and remove the pinion nut and washer (Fig. 51).

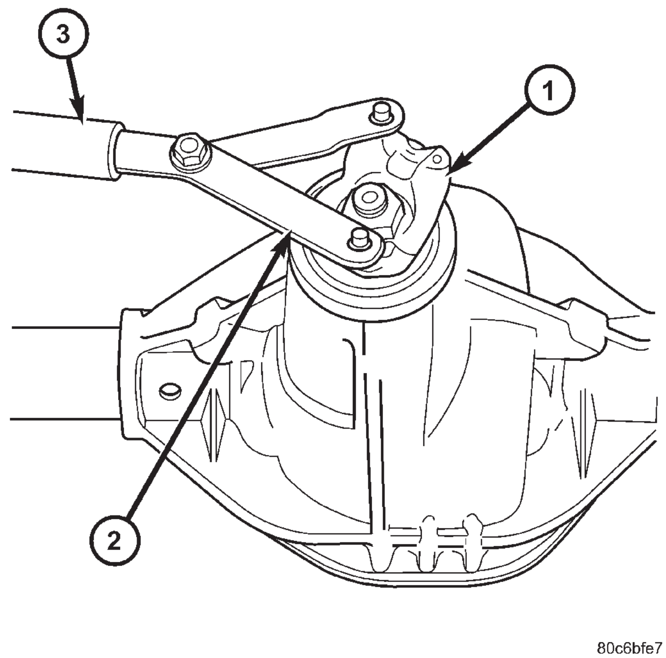


Fig. 51 YOKE SPANNER WRENCH

1 - PINION YOKE
2 - SPANNER WRENCH
3 - PIPE

PINION GEAR/RING GEAR (Continued)

(9) Remove pinion yoke with Remover C-452 and Flange Wrench C-3281 (Fig. 52).

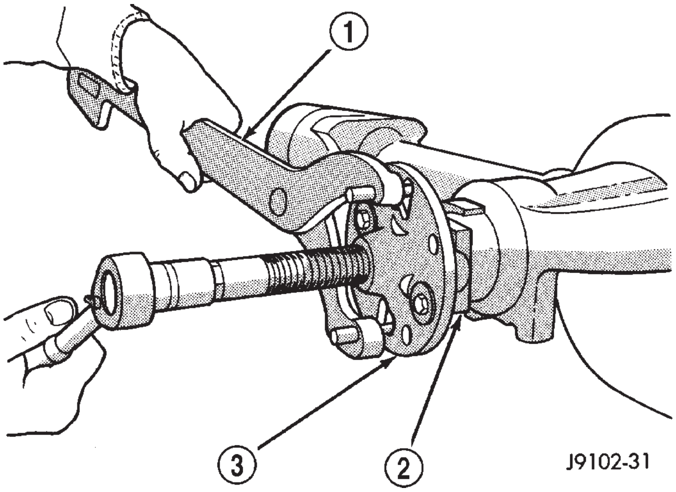


Fig. 52 PINION YOKE

1 - FLANGE WRENCH
2 - PINION YOKE
3 - REMOVER

(10) Remove pinion and collapsible spacer from the housing (Fig. 53).

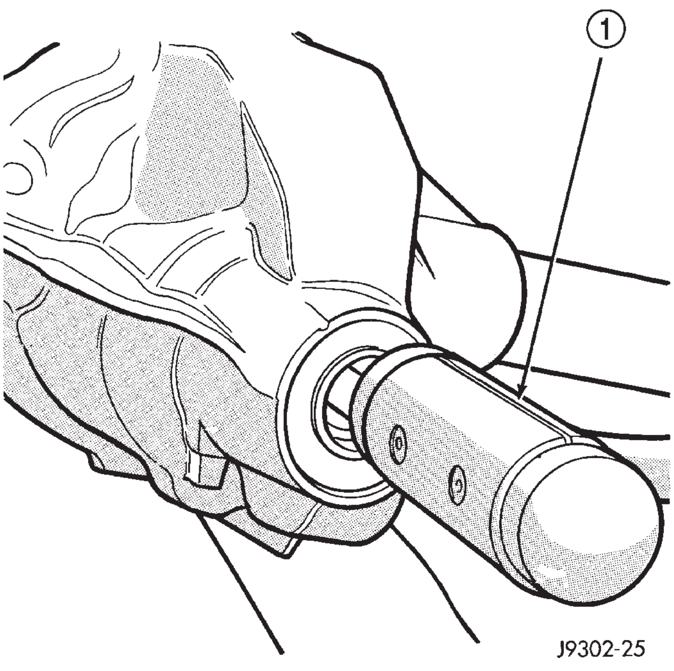


Fig. 53 PINION GEAR

1 - RAWHIDE HAMMER

(11) Remove front pinion bearing cup, bearing, oil slinger and pinion seal with Remover D-103 and Handle C-4171 (Fig. 54).

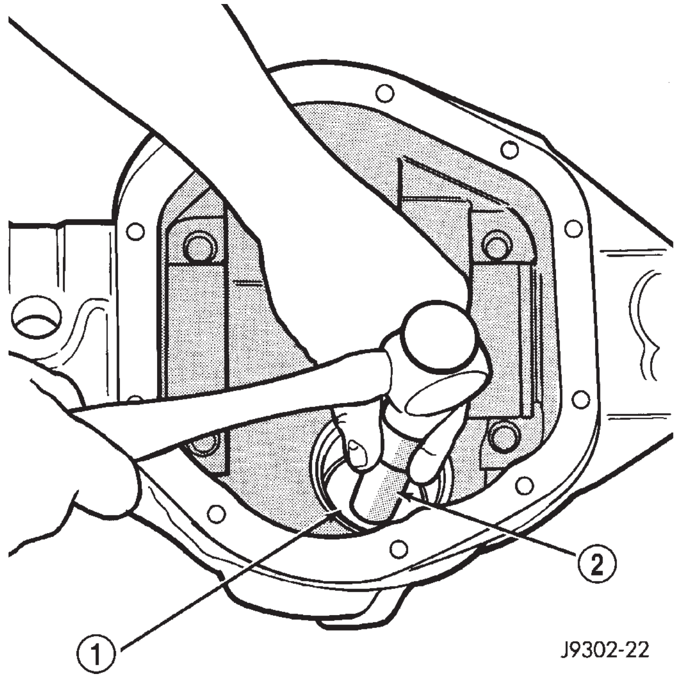


Fig. 54 FRONT BEARING CUP

1 - REMOVER
2 - HANDLE

(12) Remove rear pinion bearing cup from the housing (Fig. 55) with Remover D-149 and Handle C-4171.

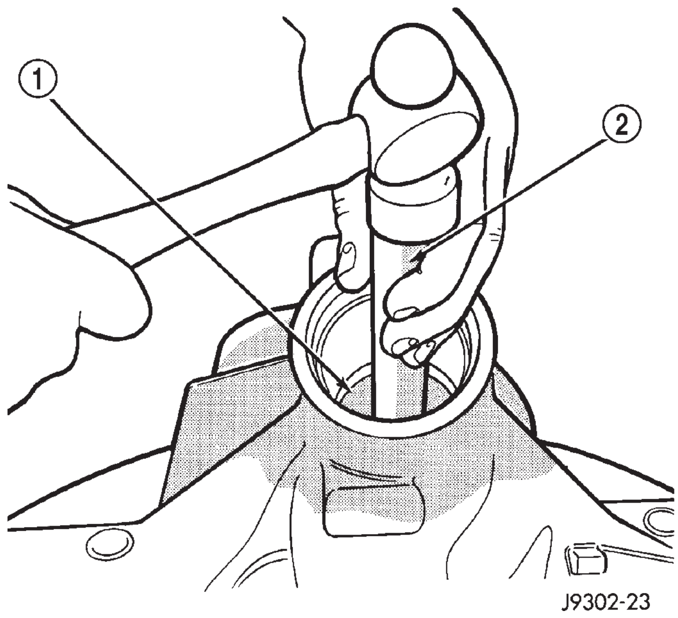


Fig. 55 REAR BEARING CUP

1 - REMOVER
2 - HANDLE

(13) Remove collapsible spacer from pinion shaft (Fig. 56).

PINION GEAR/RING GEAR (Continued)

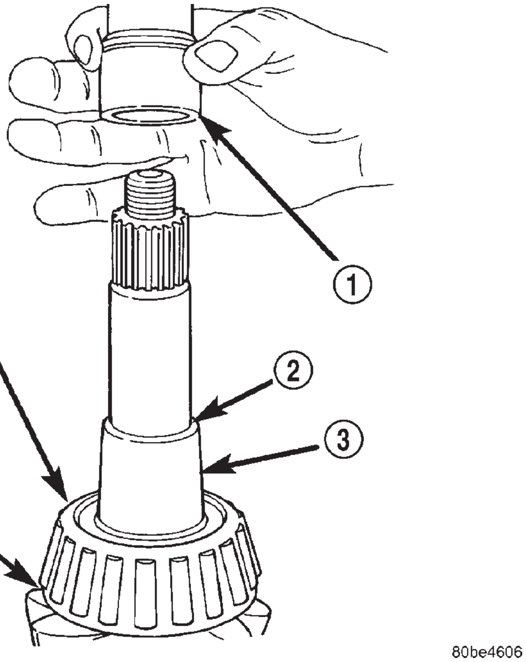


Fig. 56 COLLAPSIBLE SPACER

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

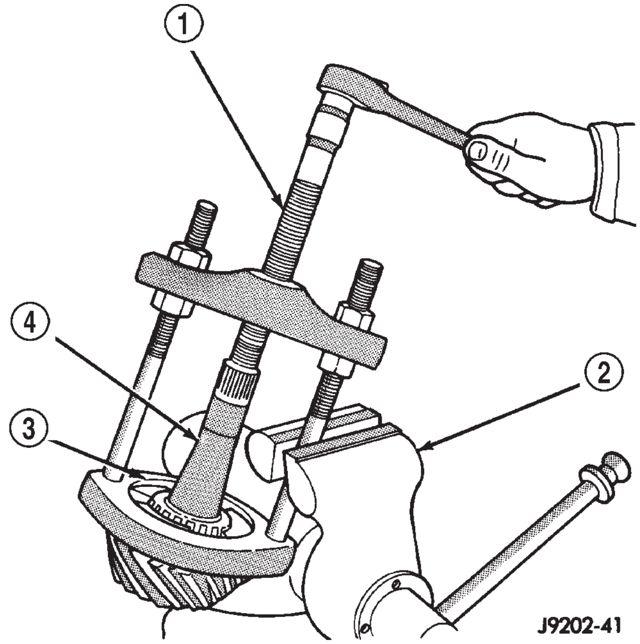


Fig. 57 REAR PINION BEARING

1 - PULLER
2 - VISE
3 - ADAPTERS
4 - PINION GEAR SHAFT

(14) Remove rear pinion bearing with Puller/Press C-293-PA and Adapters C-293-39 (Fig. 57).

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

(15) Remove pinion depth shim/oil slinger from the pinion shaft and record thickness.

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 ring gear and pinion are reused, the pinion depth shim/oil slinger should not require replacement. Refer toAdjustment (Pinion Gear Depth) to select the proper thickness shim/oil slinger if ring and pinion gears are replaced.

(1) Apply Mopar® Door Ease or equivalent lubricant to outside surface of the pinion bearing cups. Install rear bearing cup with Installer D-146 and Driver Handle C-4171 (Fig. 58) and verify cup is seated.

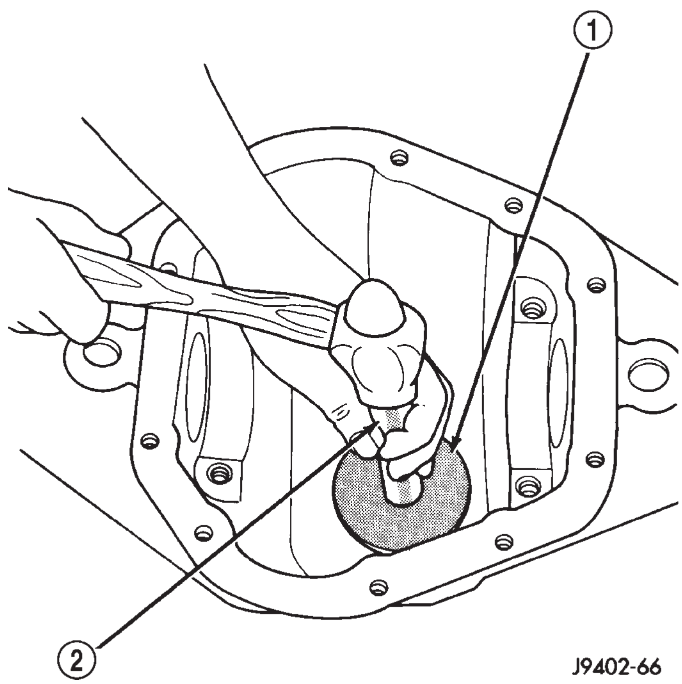


Fig. 58 REAR PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

PINION GEAR/RING GEAR (Continued)

(2) Install front bearing cup with Installer D-130 and Handle C-4171 (Fig. 59) and verify cup is seated.

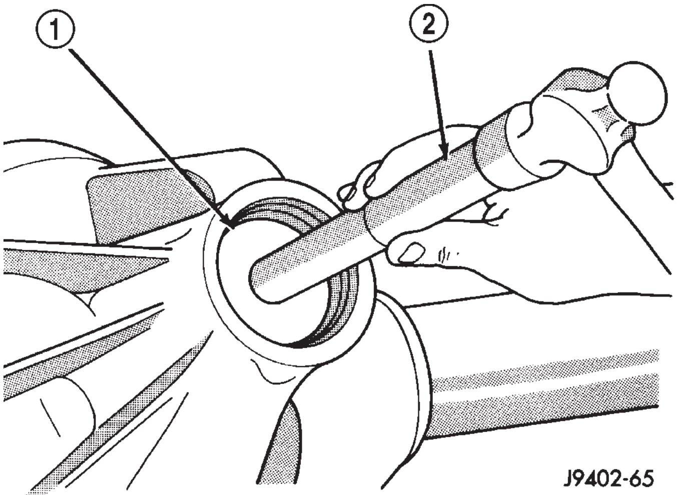


Fig. 59 FRONT PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

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

(4) Apply a light coating of gear lubricant on the lip of pinion seal and install seal with an appropriate installer (Fig. 60).

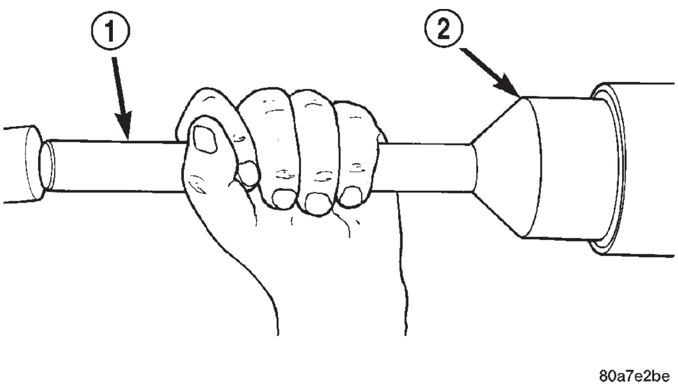


Fig. 60 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

(5) Install rear pinion depth shim/oil slinger and bearing on the pinion shaft with Installer W-262 and a press (Fig. 61).

(6) Install **new** collapsible spacer on pinion shaft and install pinion into the housing (Fig. 62).

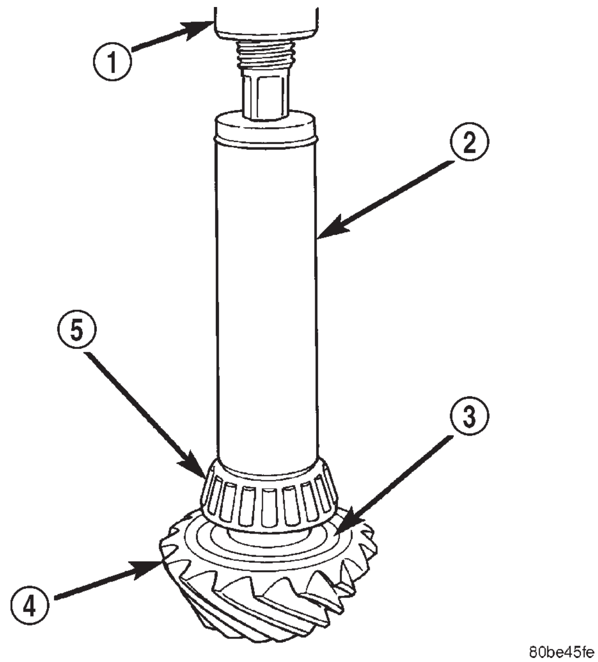


Fig. 61 REAR PINION BEARING

1 - PRESS
2 - INSTALLATER
3 - PINION DEPTH SHIM/OIL SLINGER
4 - DRIVE PINION
5 - REAR PINION BEARING

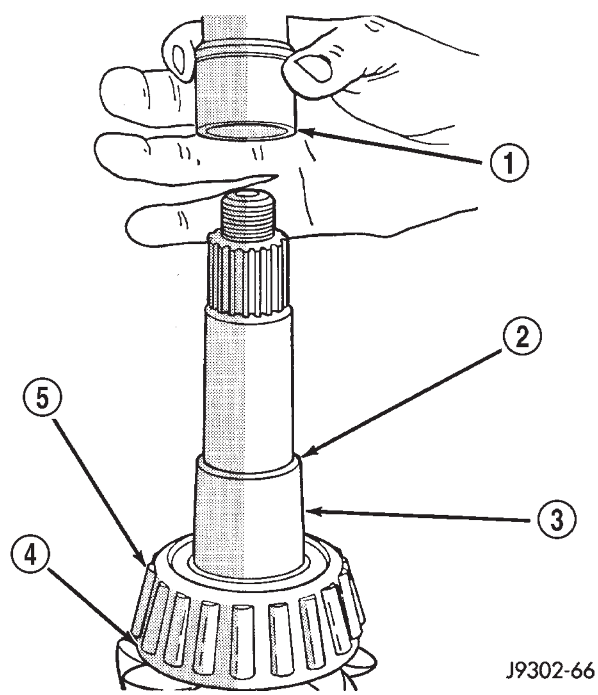


Fig. 62 COLLAPSIBLE PRELOAD SPACER

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

PINION GEAR/RING GEAR (Continued)

(7) Install yoke with Installer W-162-B, Cup 8109 and Spanner Wrench 6958 (Fig. 63).

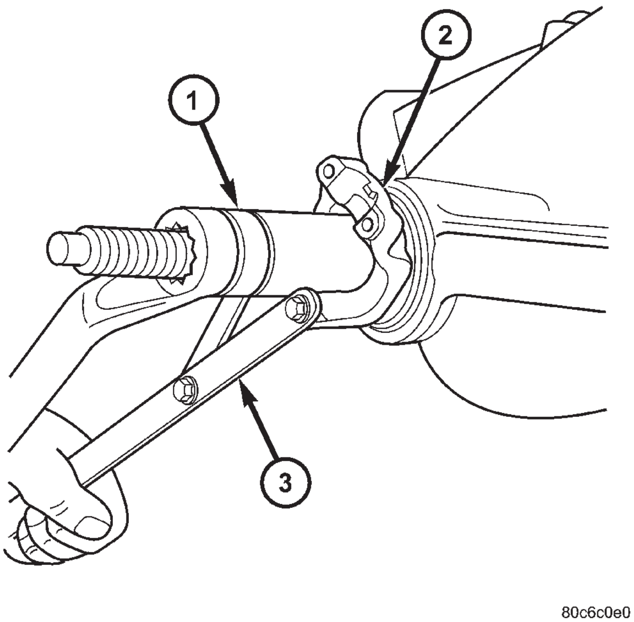


Fig. 63 PINION YOKE INSTALLER

1 - INSTALLER
2 - PINION YOKE
3 - SPANNER WRENCH

(8) Install pinion washer and a **new** nut onto the pinion. Tighten the nut to 216 N·m (160 ft. lbs.).

CAUTION: Never loosen the 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.

(9) Using Spanner Wrench 6958 and torque wrench set at 352 N·m (260 ft. lbs.) (Fig. 64). Slowly tighten the nut in 6.8 N·m (5 ft. lb.) increments until the rotating torque is achieved. Measure rotating torque frequently to avoid over crushing the collapsible spacer (Fig. 65).

CAUTION: If more than 352 N·m (260 ft. lbs.) torque is required to crush the collapsible spacer, the spacer is defective and must be replaced.

(10) Check bearing rotating torque with an inch pound torque wrench (Fig. 65). The torque necessary to rotate the pinion should be:

- Original Bearings: 1 to 2 N·m (10 to 20 in. lbs.).
- New Bearings: 1.7 to 3.4 N·m (15 to 30 in. lbs.).

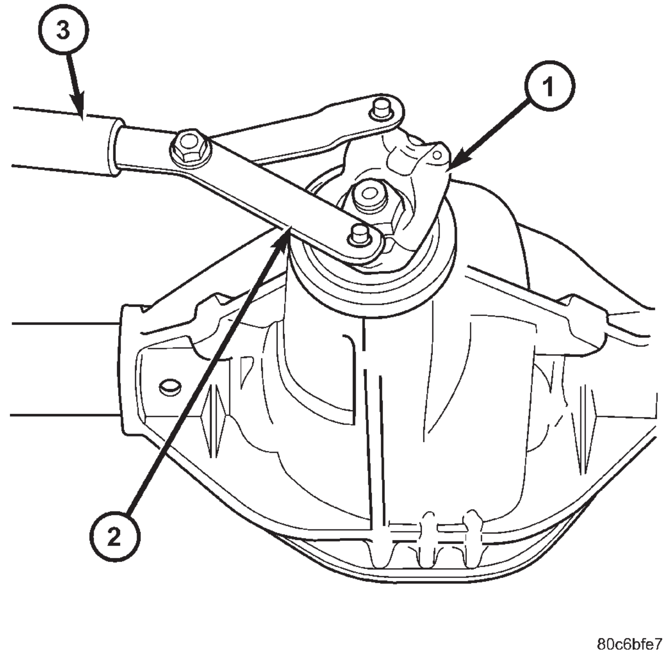


Fig. 64 YOKE SPANNER WRENCH

1 - PINION YOKE
2 - SPANNER WRENCH
3 - PIPE

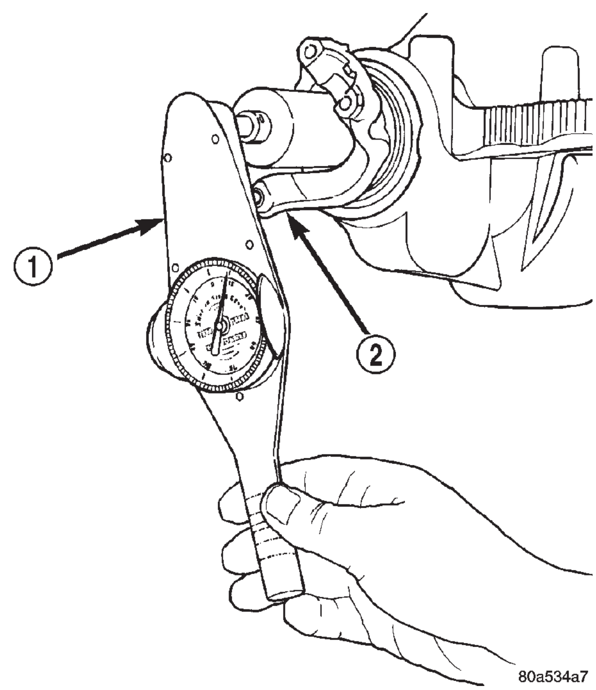


Fig. 65 PINION ROTATION TORQUE

1 - TORQUE WRENCH
2 - PINION YOKE

PINION GEAR/RING GEAR (Continued)

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

(12) Invert the differential case in the vise and install **new** ring gear bolts and alternately tighten to 108 N·m (80 ft. lbs.) (Fig. 66).

CAUTION: Never reuse ring gear bolts, the bolts can fracture causing extensive damage.

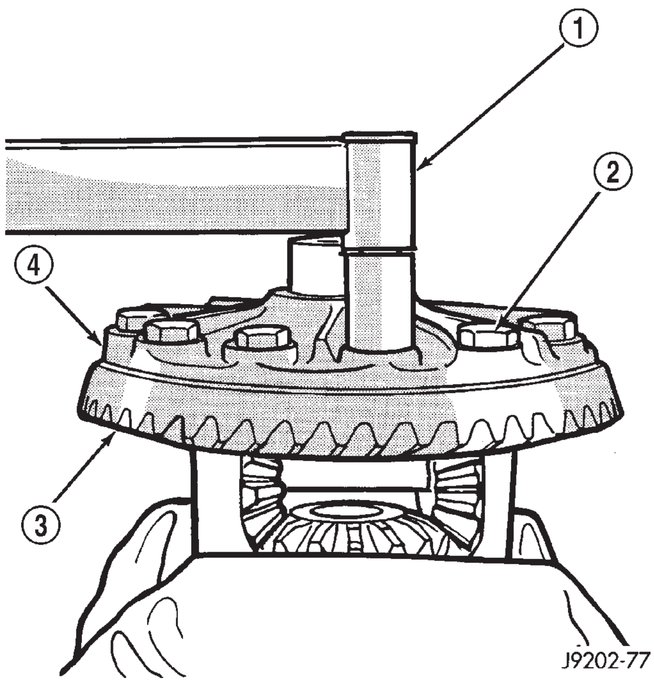


Fig. 66 RING GEAR BOLT

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

(13) Install differential in the housing and verify differential bearing preload, gear mesh and contact pattern.

(14) Install differential cover and fill with gear lubricate.

(15) Install propeller shaft with reference marks aligned.

(16) Remove supports and lower vehicle.

REAR AXLE - 194RBI

TABLE OF CONTENTS

REAR AXLE - 194RBI

DESCRIPTION

The 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 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. Vehicles equipped with ABS brakes, 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 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).

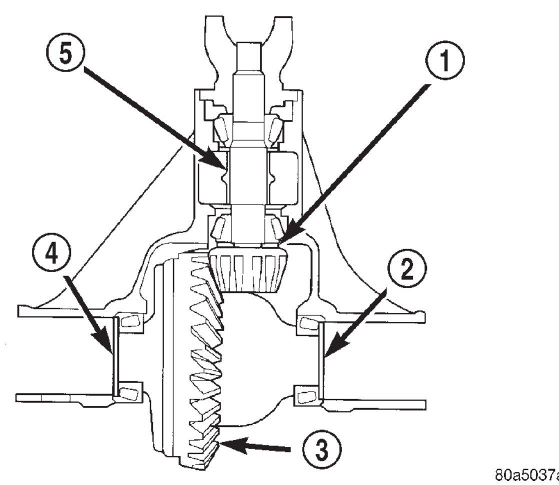


Fig. 1 Shim Locations

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

REAR AXLE - 194RBI (Continued)

Axles equipped with a Trac-Lok® differential are optional. This differential has a one-piece differential case, and the same internal components as a standard differential, plus two clutch disc packs.

The cover provides a means for servicing the differential without removing the axle. A vent hose is use to relieve internal pressure caused by lubricant vaporization and internal expansion.

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.

STANDARD DIFFERENTIAL

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).

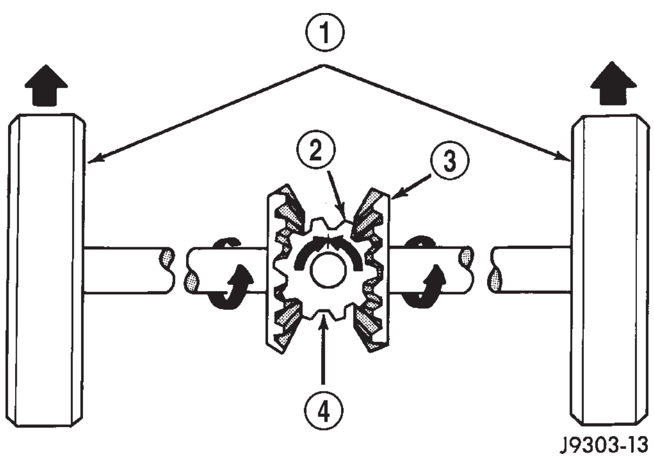


Fig. 2 STRAIGHT AHEAD DRIVING

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.

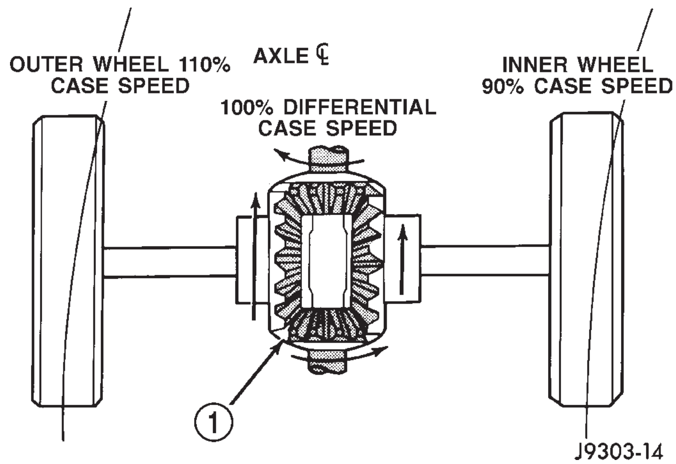


Fig. 3 DIFFERENTIAL ON TURNS

1 - PINION GEARS ROTATE ON PINION SHAFT

TRAC-LOK® DIFFERENTIAL

This differentials 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).

This 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. This differential resist wheel spin on bumpy roads and provide more pulling power when one wheel looses traction. Pulling power is provided continuously until both wheels loose traction. If both wheels slip due to unequal traction, Trac-lok™ operation is normal. In extreme cases of differences of traction, the wheel with the least traction may spin.

DIAGNOSIS AND TESTING

GEAR NOISE

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, incorrect pinion depth, 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 acceler-

REAR AXLE - 194RBI (Continued)

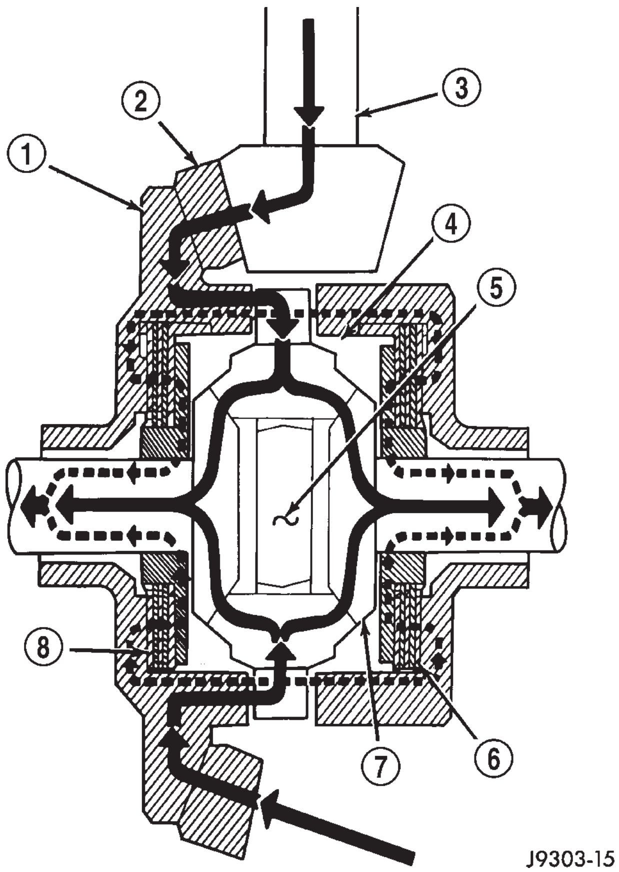


Fig. 4 TRAC-LOK LIMITED SLIP DIFFERENTIAL

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

ate 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 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).

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

NOTE: All driveline components should be examined before starting any repair.

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.

REAR AXLE - 194RBI (Continued)

- 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.

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.
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.
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.

REAR AXLE - 194RBI (Continued)

Condition	Possible Causes	Correction
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.
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. Adjust backlash or pinion depth.
	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.

REAR AXLE - 194RBI (Continued)

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) Dis connect upper and lower control arms from the axle brackets.

(15) Separate the axle from the vehicle.

INSTALLATION

NOTE: The weight of the vehicle must be supported by the springs before suspension arms and track bar fasteners can be tightened. If the springs are not at their normal ride position, vehicle ride height and handling could be affected.

(1) Raise the axle with lifting device and align the spring centering bolts with the mating holes in the axle spring perch.

(2) Install the upper and lower control arms in the axle brackets. Install the mounting bolts but do not tighten at this time.

(3) Install shock absorbers and tighten nuts to torque specification.

(4) Install stabilizer bar links and tighten nuts to torque specification.

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

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

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

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

(9) Install axle vent hose.

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

(11) Install the wheels and tires.

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

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

(14) Tighten upper and lower control arms nuts to torque specification.

ADJUSTMENTS

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. 5). 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.

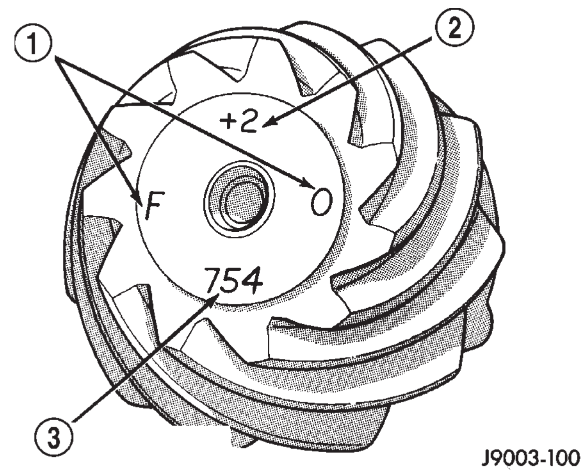


Fig. 5 PINION GEAR ID NUMBERS

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. 6).

REAR AXLE - 194RBI (Continued)

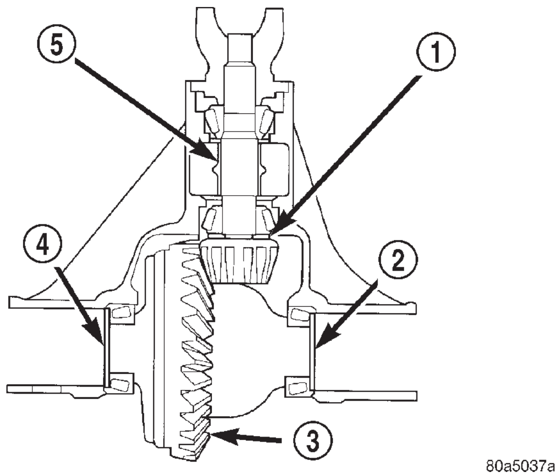


Fig. 6 ADJUSTMENT SHIM LOCATIONS

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

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.

Note the etched number on the face of the drive pinion gear (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shim(s). If the number is positive, subtract that value from the thickness of the depth shim(s). If the number is 0 no change is necessary. Refer to the Pinion Gear Depth Variance Chart.

PINION GEAR DEPTH VARIANCE

Original Pinion Gear Depth Variance	Replacement Pinion Gear Depth Variance									
	−4	−3	−2	−1	0	+1	+2	+3	+4	
+4		+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3		+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2		+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1		+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0		+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1		+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2		+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3		+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4		0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

PINION DEPTH MEASUREMENT

Measurements are taken with pinion cups and pinion bearings installed in the housing. Take measurements with a Pinion Gauge Set, Pinion Block 6735, Arbor Discs 6732 and Dial Indicator C-3339 (Fig. 7).

(1) Assemble Pinion Height Block 6739, Pinion Block 6735 and rear pinion bearing onto Screw 6741 (Fig. 7).

(2) Insert assembled height gauge components, rear bearing and screw into the housing through pinion bearing cups (Fig. 8).

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

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in the housing side bearing cradles (Fig. 9). 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.

REAR AXLE - 194RBI (Continued)

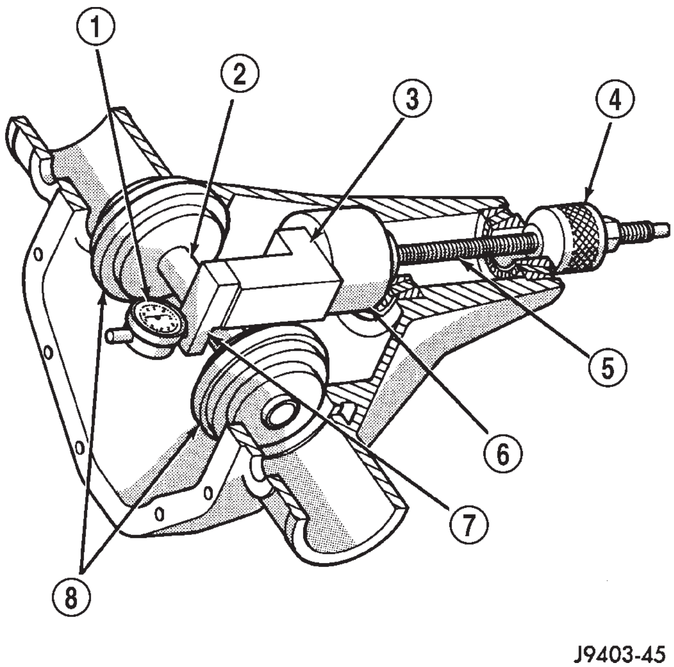


Fig. 7 Pinion Gear Depth Tools

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

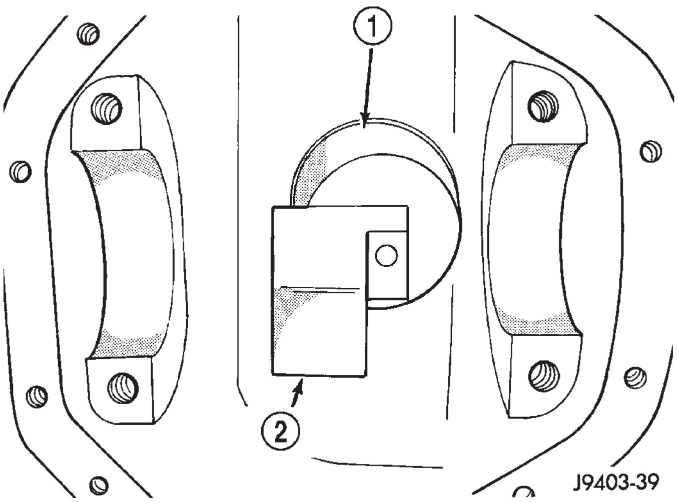


Fig. 8 Pinion Height Block

1 - PINION BLOCK
2 - PINION HEIGHT BLOCK

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

(6) Position Scooter Block/Dial Indicator flush on the pinion height block. Hold scooter block and zero the dial indicator.

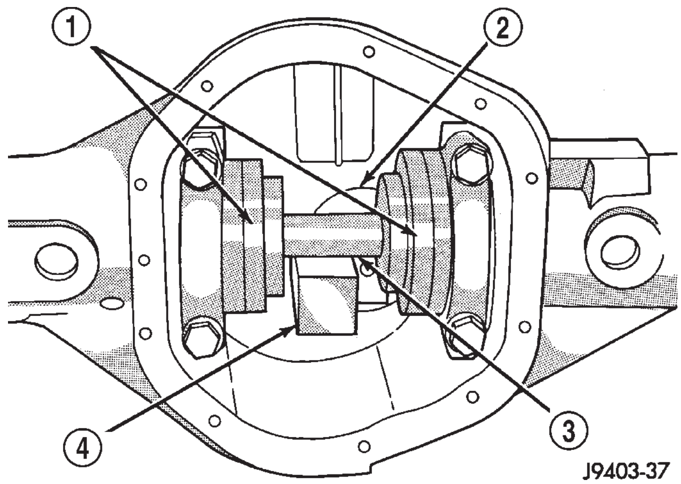


Fig. 9 Gauge Tools In Housing

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

(7) Slowly slide the scooter block across the pinion height block over to the arbor (Fig. 10). Move the scooter block till the dial indicator probe crests the arbor, then record the highest reading.

(8) Select a shim equal to the dial indicator reading plus the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 5) 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.

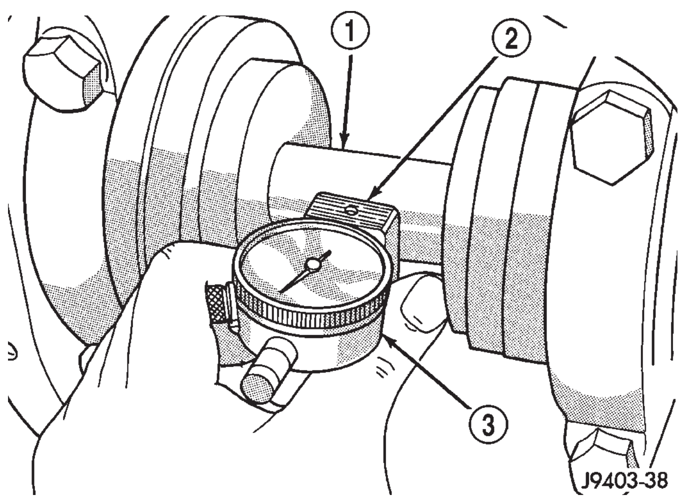


Fig. 10 Pinion Gear Depth Measurement

1 - ARBOR
2 - SCOOTER BLOCK
3 - DIAL INDICATOR

(9) Remove the pinion depth gauge components from the housing

REAR AXLE - 194RBI (Continued)

DIFFERENTIAL BEARING PRELOAD

Differential side bearing preload and gear backlash is achieved by selective shims inserted between the bearing cup and the 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. 11).

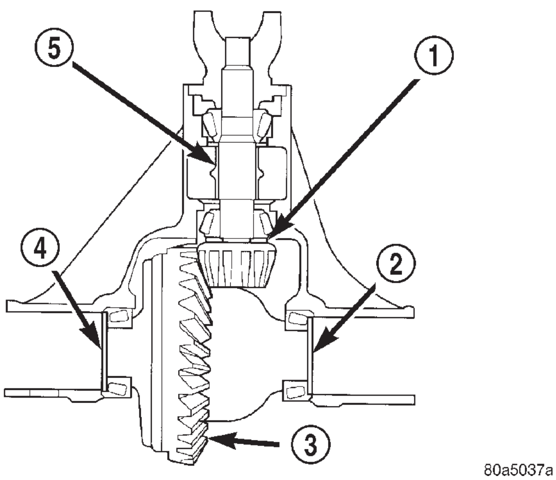


Fig. 11 Adjustment Shim

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

PRELOAD 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 Bearings D-348 on differential case.

(4) Install differential case in the housing.

(5) Insert Dummy Shims 8107 (3.0 mm / 0.118 in.) starting point shims between the dummy bearing and the housing (Fig. 12).

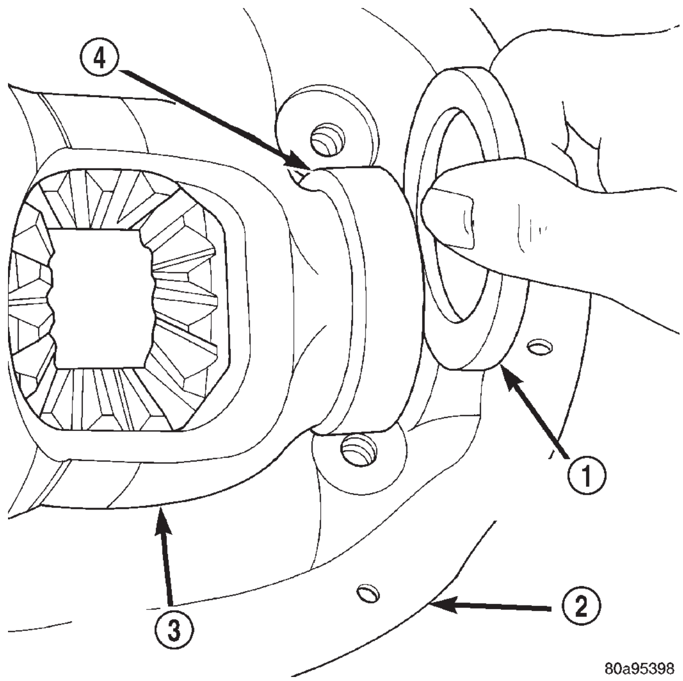


Fig. 12 DUMMY SHIMS

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

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

(7) Using a dead-blow hammer to seat the differential dummy bearings to each side of the housing (Fig. 13) and (Fig. 14).

REAR AXLE - 194RBI (Continued)

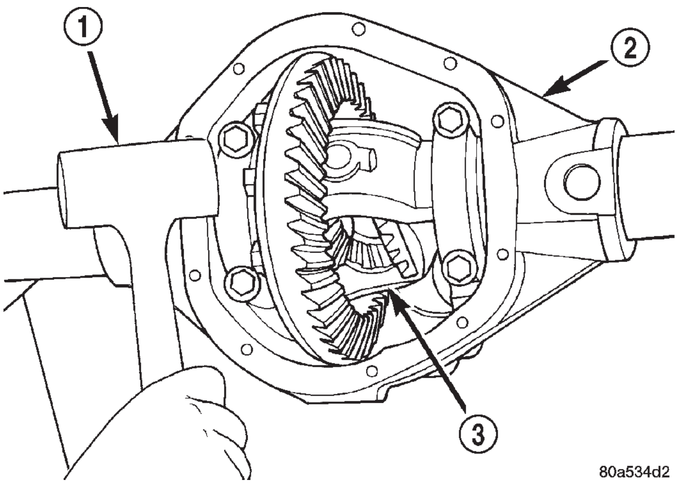


Fig. 13 SEAT PINION GEAR SIDE DUMMY BEARING

1 - MALLET
2 - AXLE HOUSING
3 - DIFFERENTIAL CASE

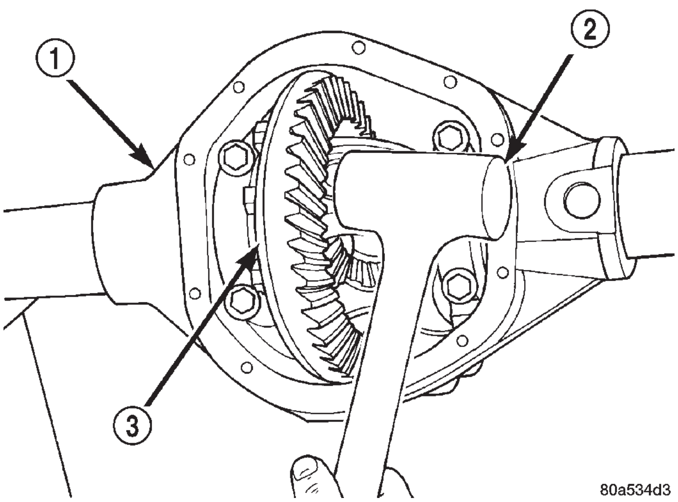


Fig. 14 SEAT RING GEAR SIDE DUMMY BEARING

1 - AXLE HOUSING
2 - MALLET
3 - DIFFERENTIAL CASE

(8) Thread Pilot Stud C-3288-B into rear cover bolt hole below ring gear (Fig. 15).

(9) Attach Dial Indicator C-3339 to the pilot stud and position indicator plunger on a flat surface of the ring gear bolt head (Fig. 15).

(10) Push differential case to the pinion gear side of the housing (Fig. 16) and zero dial indicator.

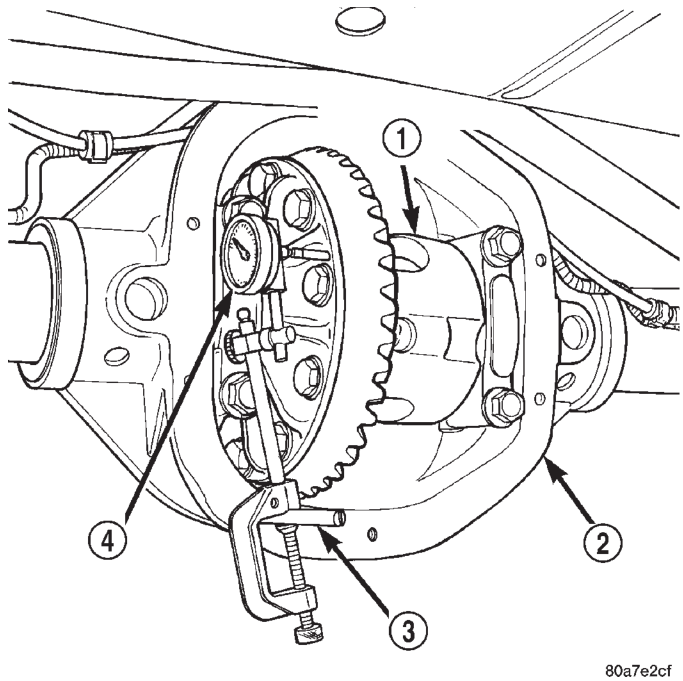


Fig. 15 DIFFERENTIAL SIDE PLAY MEASUREMENT

1 - DIFFERENTIAL CASE
2 - DIFFERENTIAL HOUSING
3 - PILOT STUD
4 - DIAL INDICATOR

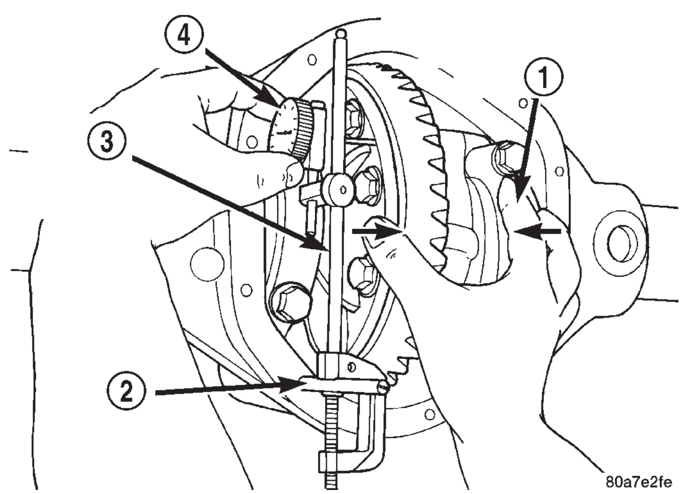


Fig. 16 ZERO DIAL INDICATOR

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

REAR AXLE - 194RBI (Continued)

(11) Push differential case to the ring gear side and record dial indicator reading (Fig. 17).

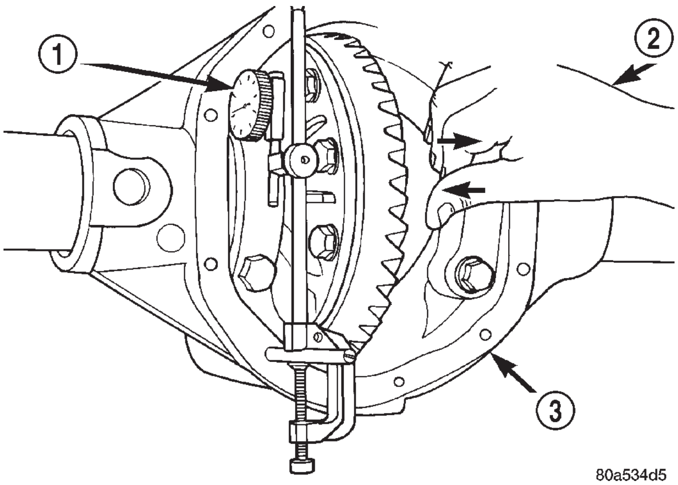


Fig. 17 READ DIAL INDICATOR

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

(12) Add the dial indicator reading to the starting point shim thickness to determine total shim thickness to achieve zero differential end play.

(13) 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.

(14) Rotate dial indicator out of the way.

(15) Remove differential case, dummy bearings and starting point shims from the housing.

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

(17) Install differential case and dummy bearings in the housing (without shims) and tighten retaining cap bolts.

(18) Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 15).

(19) Push and hold differential case toward pinion gear.

(20) Zero dial indicator face to pointer.

(21) Push and hold differential case to ring gear side of the housing and record dial indicator reading.

(22) 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.

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

(24) Rotate dial indicator out of the way on pilot stud.

(25) Remove differential case and dummy bearings from the housing.

(26) Install new side bearing cones and cups on differential case.

(27) Install spreader W-129-B and some components of Adapter Set 6987 on differential housing and spread axle opening enough to receive differential case.

(28) Place side bearing shims into the housing against the axle tubes.

(29) Install differential case in the housing.

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

(31) Position the indicator plunger against a ring gear tooth (Fig. 18).

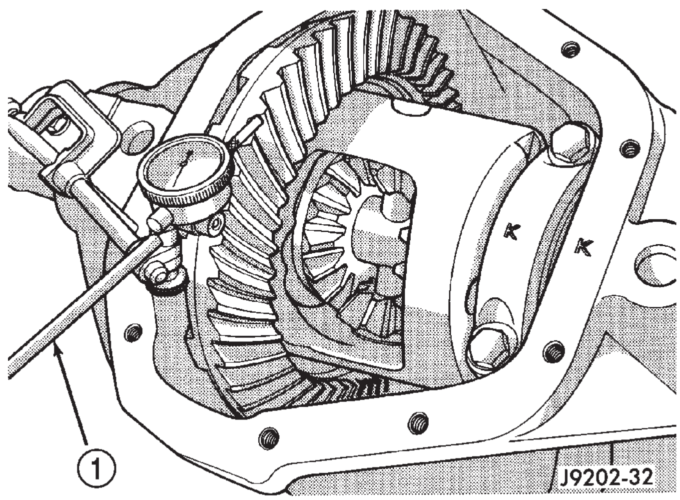


Fig. 18 RING GEAR BACKLASH

1 - DIAL INDICATOR

REAR AXLE - 194RBI (Continued)

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

(33) Zero dial indicator face to pointer.

(34) 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. 19).

(35) 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 the Gear Contact Pattern Analysis procedure.

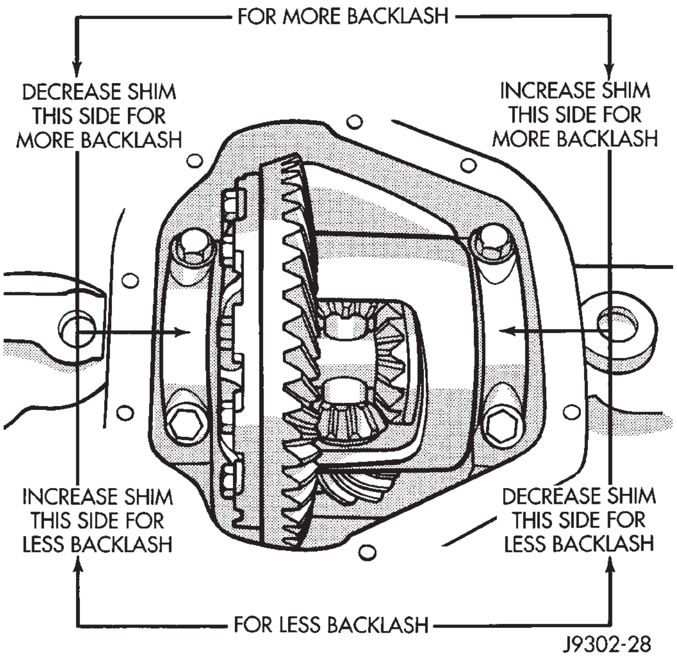


Fig. 19 BACKLASH SHIM ADJUSTMENT

GEAR CONTACT PATTERN

The ring gear and pinion teeth contact patterns will show if the pinion depth is correct in the 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) With 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.

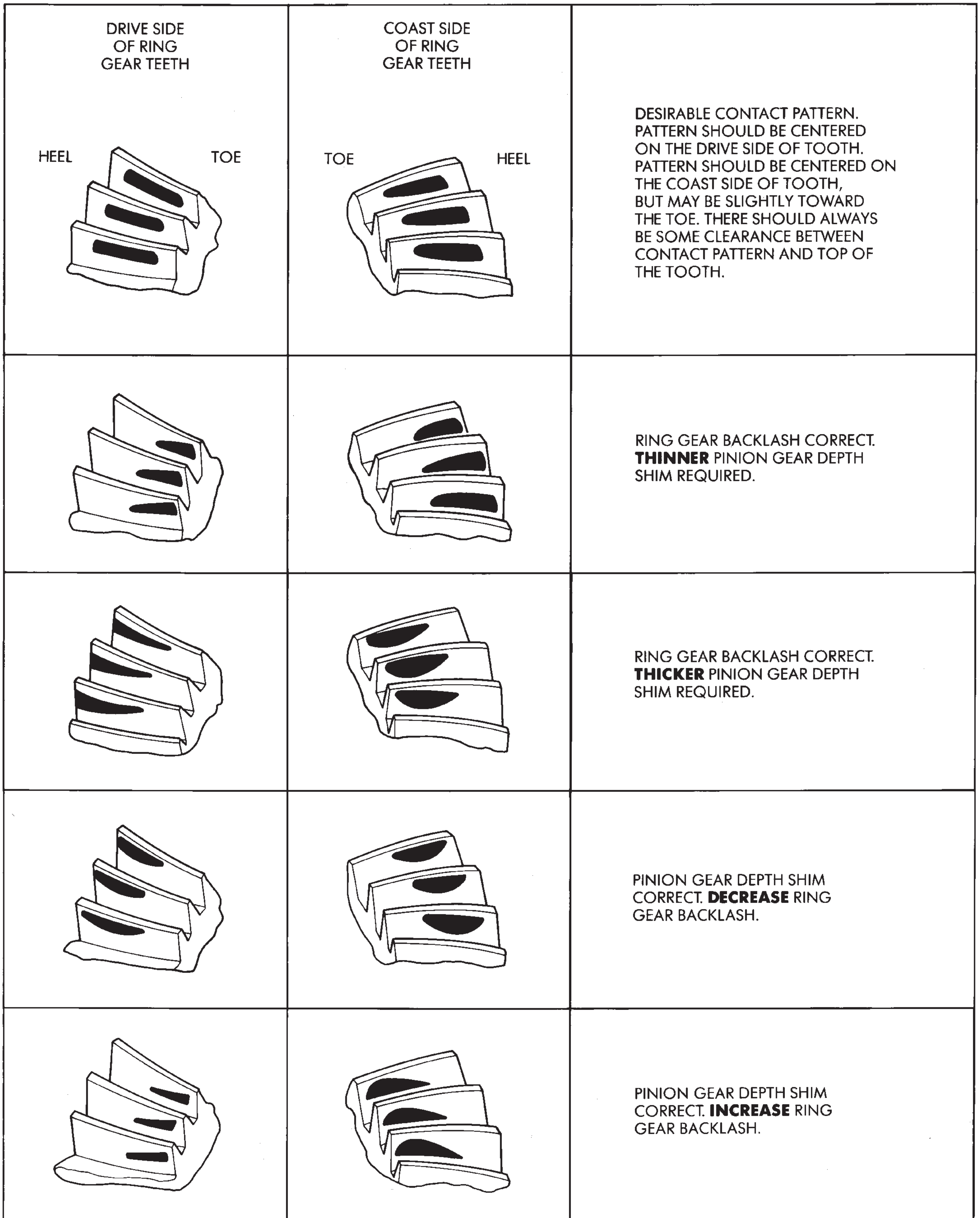
The areas on the ring gear teeth with the greatest degree of contact against the pinion teeth will squeeze the compound to the areas with the least amount of contact. Note and compare patterns on the ring gear teeth to Gear Tooth Contact Patterns chart (Fig. 20) and adjust pinion depth and gear backlash as necessary.

DIFFERENTIAL BEARING PRELOAD CHECK

The final check on the differential assembly before installing the axles is torque to rotate pinion and differential combined. This will verify the correct differential bearing preload.

Torque to rotate the differential and pinion should be the torque to rotate the pinion plus 0.79-1.24 N·m (7-11 in. lbs.).

REAR AXLE - 194RBI (Continued)



J9003-24

Fig. 20 GEAR TOOTH CONTACT PATTERNS

REAR AXLE - 194RBI (Continued)

SPECIFICATIONS

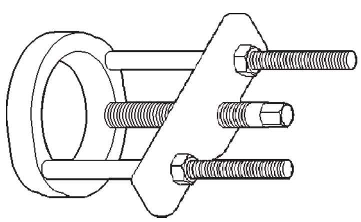
AXLE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Axle Ratio	3.07, 3.55, 3.73, 4.11
Differential Bearing Preload	0.2 mm (0.008 in.)
Differential Side Gear Clearance	0.0-0.15 mm (0.0-0.006 in.)
Ring Gear Diameter	194 mm (7.638 in.)
Ring Gear Backlash	0.12-0.20 mm (0.005-0.008 in.)
Pinion Gear Standard Depth	96.85 mm (3.813 in.)
Pinion Bearing Preload - Original Bearings	1-2 N·m (10-20 in. lbs.)
Pinion Bearing Preload - New Bearings	2-4 N·m (20-35 in. lbs.)

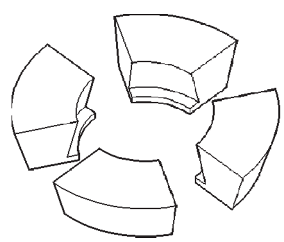
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Differential Cover Bolts	41	30	-
Bearing Cap Bolts	77	57	-
Ring Gear Bolts	108	80	-
Pinion Nut	271-475	200-350	-
Pinion Mate Shaft Screw	16.25	12	-

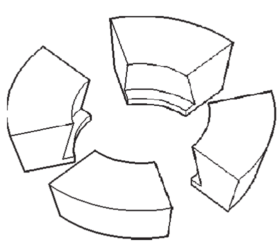
SPECIAL TOOLS



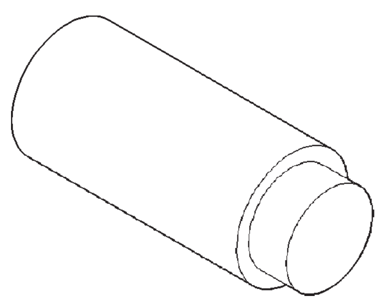
Puller C-293-PA



Adapter C-293-40

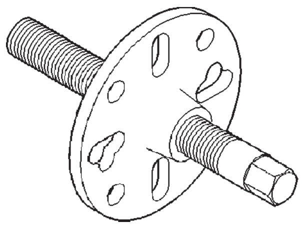


Adapter C-293-39

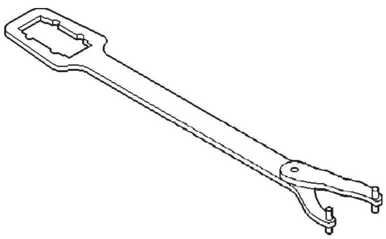


Adapter Plug SP-3289

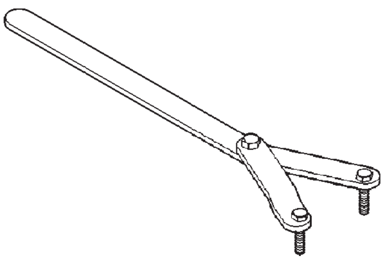
REAR AXLE - 194RBI (Continued)



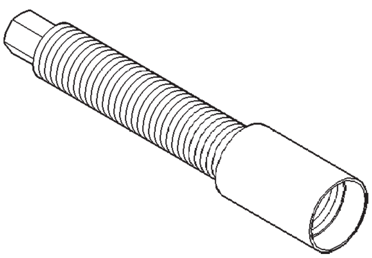
Puller C-452



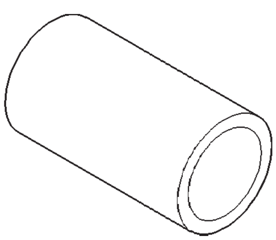
Wrench C-3281



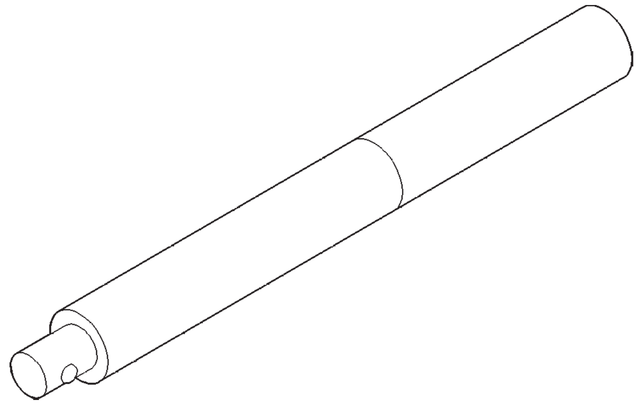
Wrench Spanner 6958



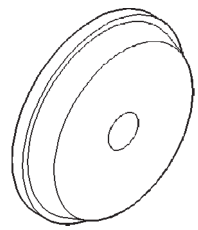
Installer Screw 8112



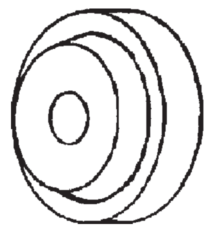
Cup 8109



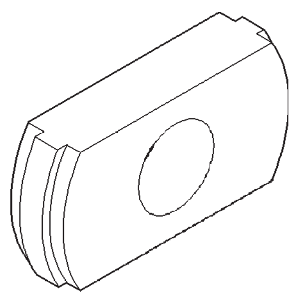
Handle C-4171



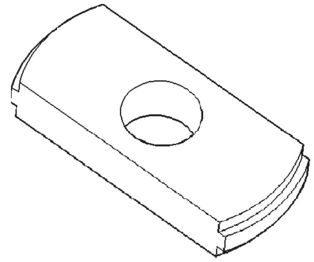
Installer D-130



Installer D-146

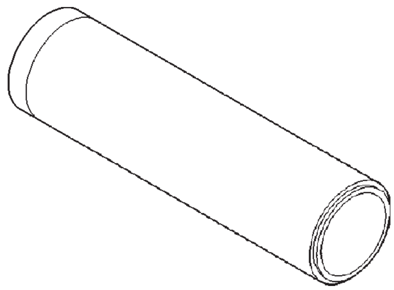


Remover C-4345

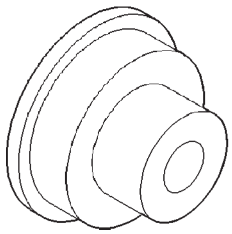


Remover D-149

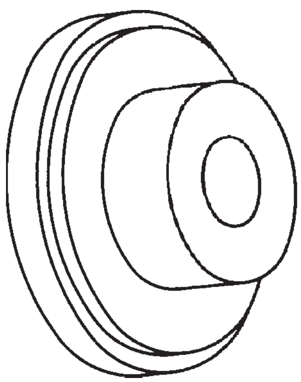
REAR AXLE - 194RBI (Continued)



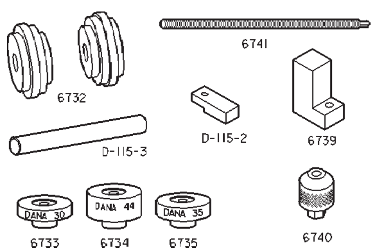
Installer W-262



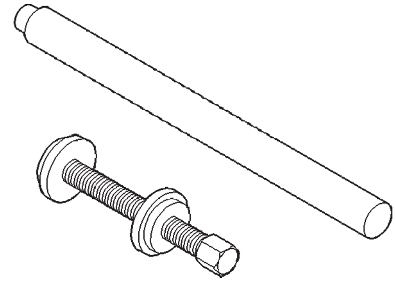
Installer 6436



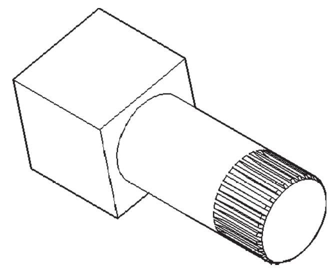
Installer 6437



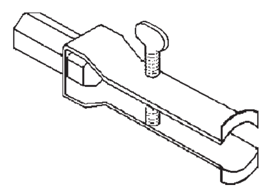
Pinion Depth 6774



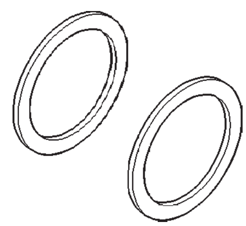
Trac-lok Tools 6960



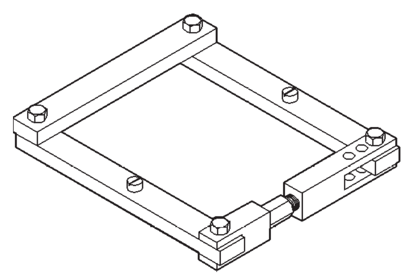
Holder Fixture 6965



Puller 7794-A

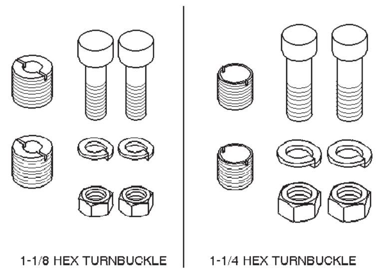


Shim Dummy 8107

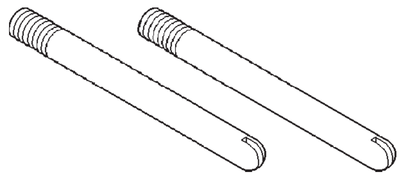


Spreader W-129-B

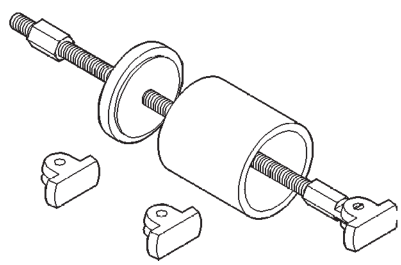
REAR AXLE - 194RBI (Continued)



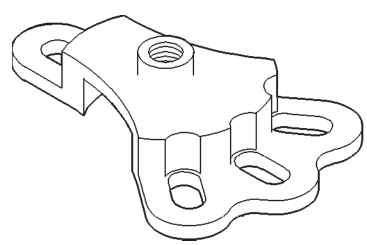
Adapter Kit 6987



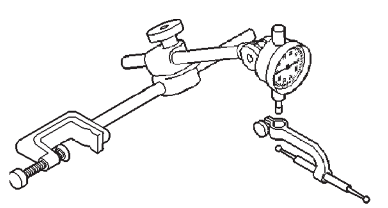
Pilot Studs C-3288-B



Bearing Remover 6310



Hub Puller 6790



Dial Indicator C-3339

AXLE SHAFTS

REMOVAL

(1) Place transmission is in neutral.

(2) Raise and support vehicle.

(3) Remove wheel and tire assembly.

(4) Remove brake drum (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DRUM - REMOVAL).

(5) Remove differential housing cover and drain fluid.

(6) Rotate differential case to access pinion mate gear shaft lock screw. Remove lock screw and shaft from differential case (Fig. 21).

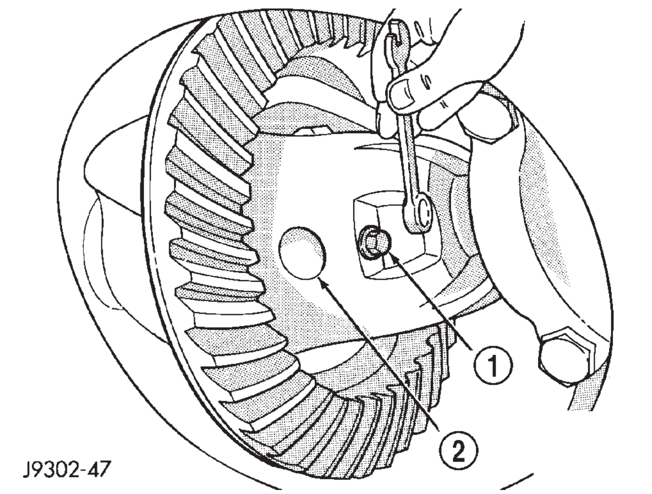


Fig. 21 MATE SHAFT LOCK SCREW

1 - LOCK SCREW

2 - PINION GEAR MATE SHAFT

(7) Push axle shaft inward and remove axle C-clip lock (Fig. 22).

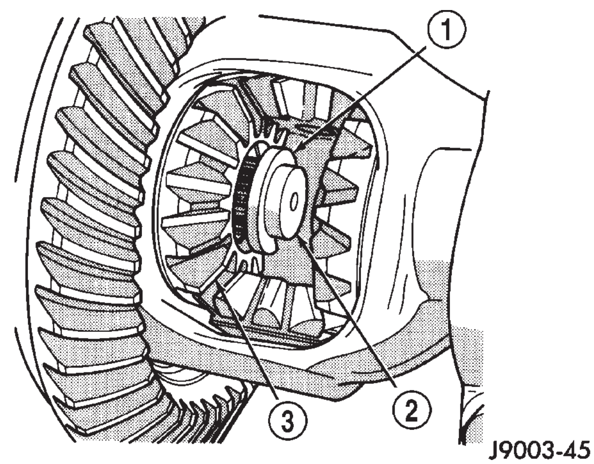


Fig. 22 AXLE SHAFT C-CLIP

1 - C-CLIP LOCK

2 - AXLE SHAFT

3 - SIDE GEAR

(8) Remove axle shaft carefully to prevent damage to axle bearing and wheel speed sensor if equipped.

(9) Inspect roller bearing contact surface on axle shaft for signs of brinelling, galling and pitting. If any of these conditions exist, the axle shaft/bearing must be replaced.

AXLE SHAFTS (Continued)

INSTALLATION

(1) Lubricate bearing bore and seal lip with gear lubricant. Insert axle shaft through seal, bearing, and engage it into side gear splines.

CAUTION: Use care to prevent shaft splines from damaging axle shaft seal lip. Also, exercise care not to damage the wheel speed sensor on vehicles if equipped.

(2) Install C-clip lock on the axle shaft, then push axle outward to seat C-clip lock in side gear.

(3) Insert pinion mate shaft into differential case and through thrust washers and pinion gears.

(4) Align hole in shaft with hole in the differential case and install lock screw with Loctite® on the threads. Tighten lock screw to 19 N·m (14 ft. lbs.).

(5) Install cover and add fluid to the bottom of the fill plug hole.

(6) Install brake drum (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DRUM - INSTALLATION).

(7) Install wheel and tire.

(8) Lower vehicle.

AXLE SHAFT SEALS

REMOVAL

(1) Remove the axle shaft.

(2) Remove axle shaft seal from the end of the axle shaft tube with a small pry bar.

(3) Inspect the axle shaft tube bore for roughness and burrs and remove as necessary.

INSTALLATION

(1) Wipe the axle shaft tube bore clean.

(2) Install **new** axle shaft seal with Installer 6437 and Handle C-4171 (Fig. 23).

(3) Install the axle shaft.

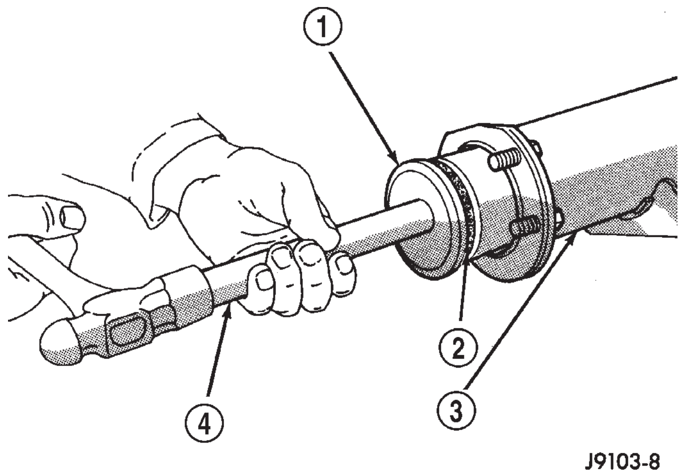


Fig. 23 AXLE SHAFT SEAL

1 - INSTALLER
2 - SEAL
3 - AXLE SHAFT TUBE
4 - HANDLE

AXLE BEARINGS

REMOVAL

(1) Remove the axle shaft.

(2) Remove axle shaft seal from the end of the axle shaft tube with a small pry bar.

(3) Remove axle shaft bearing from the axle tube with Bearing Removal Tool Set 6310 and Adapter Foot 6310-5 (Fig. 24).

(4) Inspect the axle shaft tube bore for roughness and burrs and remove as necessary.

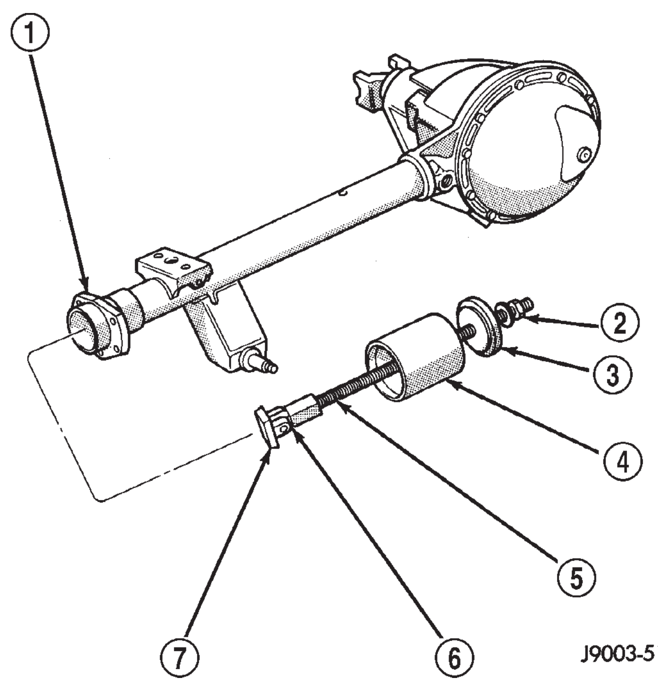


Fig. 24 AXLE SHAFT BEARING TOOLS

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

INSTALLATION

(1) Wipe the axle shaft tube bore clean.

(2) Install axle shaft bearing with Installer 6436 and Handle C-4171.

AXLE BEARINGS (Continued)

NOTE: Part number on the bearing must be against the installer.

(3) Install **new** axle shaft seal with Installer 6437 and Handle C-4171 (Fig. 25).

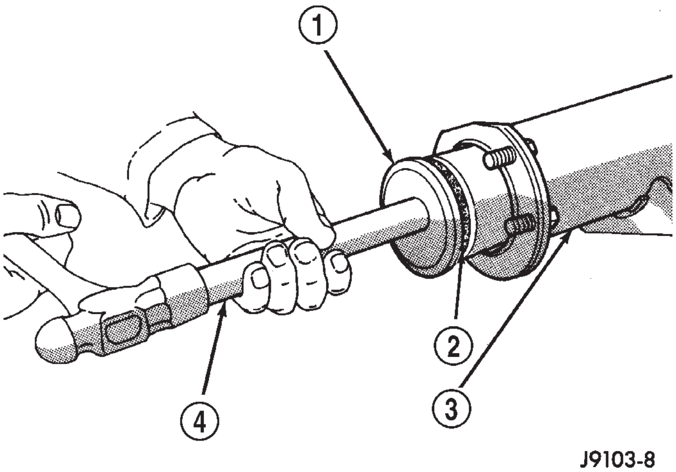


Fig. 25 AXLE SHAFT SEAL INSTALLER

1 - INSTALLER
2 - SEAL
3 - AXLE SHAFT TUBE
4 - HANDLE

(4) Install the axle shaft.

PINION SEAL

REMOVAL

(1) Raise and support the vehicle.
(2) Remove wheel and tire assemblies.
(3) Remove the brake drums (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DRUM - REMOVAL).
(4) Mark 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) Recored torque necessary to rotate the pinion gear with an inch pound dial-type torque wrench.
(8) Hold the yoke with Wrench 6958 and remove the pinion nut and washer.
(9) Remove pinion yoke with Remover C-452 and Wrench C-3281 (Fig. 26).
(10) Remove pinion seal with a pry tool or slide hammer mounted screw.

INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal and install seal with an appropriate installer (Fig. 27).

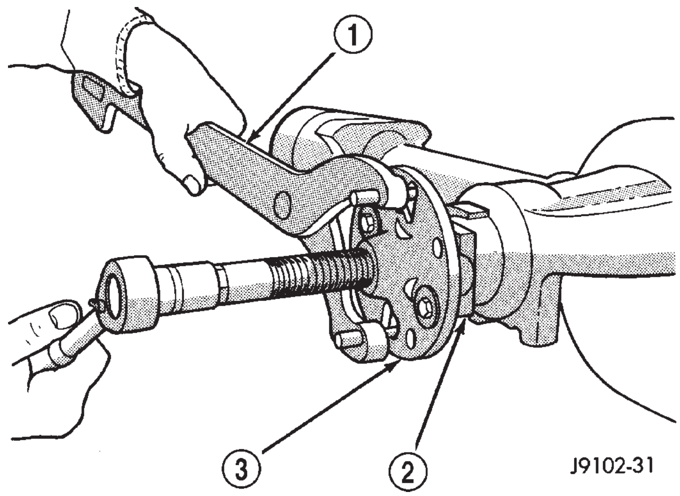


Fig. 26 PINION YOKE REMOVER

1 - WRENCH
2 - YOKE
3 - REMOVER

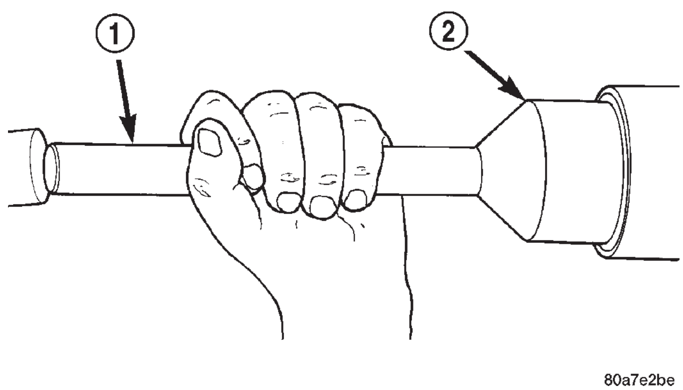


Fig. 27 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

(2) Install yoke on the pinion gear with Screw 8112, Cup 8109 and Spanner Wrench 6958 (Fig. 28).

CAUTION: Do not exceed the minimum tightening torque 271 N·m (200 ft. lbs.) when installing the pinion yoke at this point. Damage to the collapsible spacer or bearings may result.

(3) Install yoke washer and **new** nut on the pinion gear and tighten nut until there is zero bearing end-play.
(4) 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.

PINION SEAL (Continued)

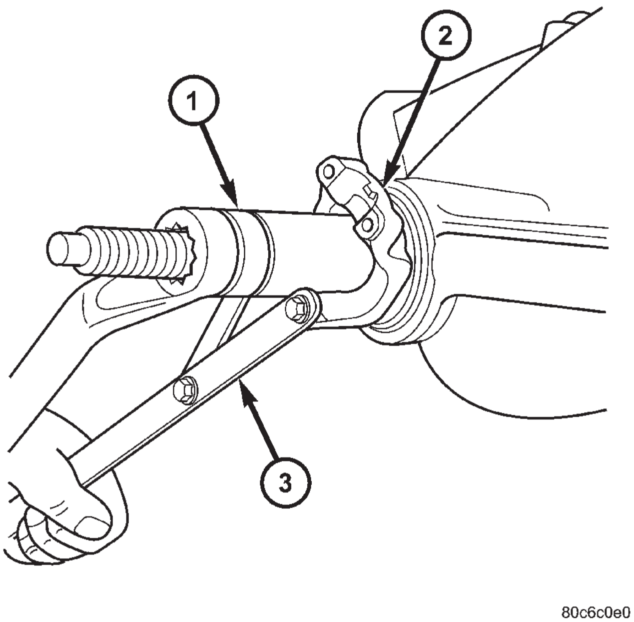


Fig. 28 PINION YOKE INSTALLER

1 - INSTALLER
2 - PINION YOKE
3 - SPANNER WRENCH

(5) Rotate the pinion shaft using an inch pound torque wrench. Rotating torque should be equal to the reading recorded during removal plus an additional 0.56 N·m (5 in. lbs.) (Fig. 29).

(6) If the rotating torque is low, use Wrench 6958 to hold the pinion yoke (Fig. 30), 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 475 N·m (350 ft. lbs.) is reached prior to reaching the required rotating torque, the collapsible spacer may have been damaged. Replace the collapsible spacer.

(7) Install the propeller shaft with the reference marks alinged.

(8) Add gear lubricant to the differential housing, if necessary.

(9) Install the brake drums, refer to Group 5 Brakes for procedures.

(10) Install wheel and tire assemblies.

(11) Lower the vehicle.

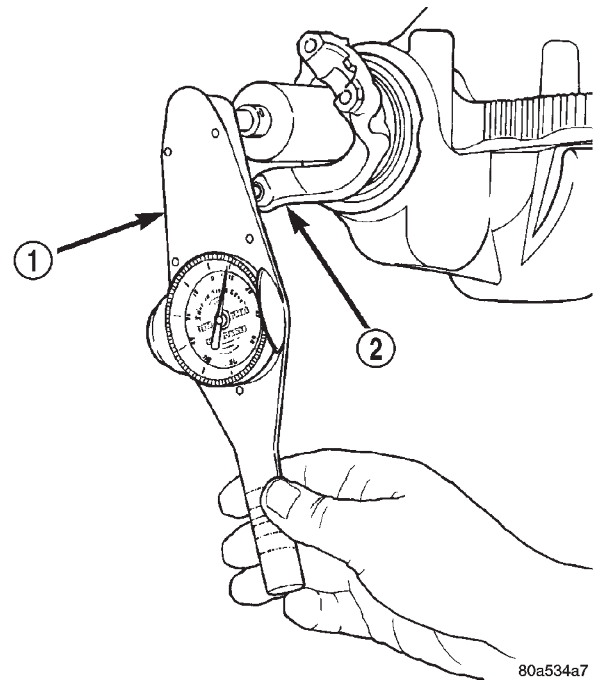


Fig. 29 PINION ROTATING TORQUE

1 - TORQUE WRENCH
2 - PINION YOKE

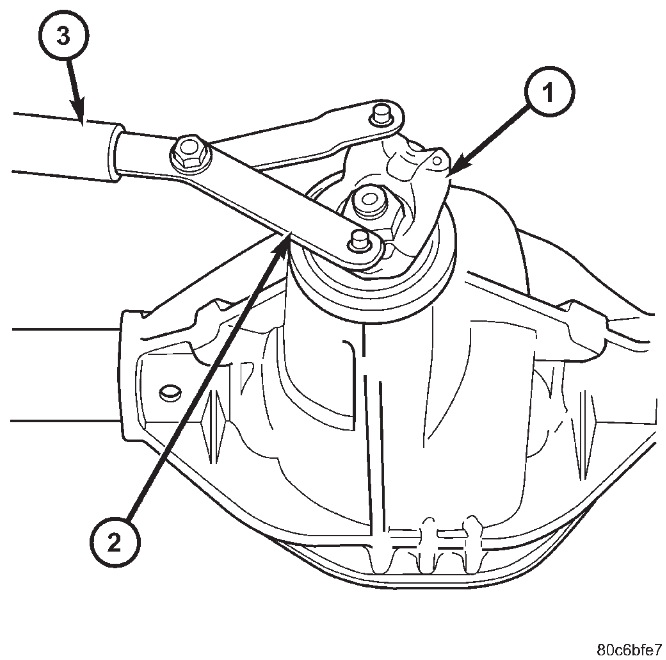


Fig. 30 YOKE HOLDER

1 - PINION YOKE
2 - SPANNER WRENCH
3 - PIPE

COLLAPSIBLE SPACER

REMOVAL

(1) Raise and support the vehicle.
(2) Remove wheel and tire assemblies.
(3) Remove rear brake drums (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DRUM - REMOVAL).
(4) Mark propeller shaft and pinion yoke for installation reference.
(5) Remove propeller shaft from the yoke.
(6) Rotate pinion gear three or four times.
(7) Record torque necessary to rotate the pinion gear with an inch pound dial-type torque wrench.
(8) Hold pinion yoke with Spanner Wrench 6958 and remove pinion nut and washer.
(9) Remove pinion yoke with Remover C-452 and Flange Wrench C-3281 (Fig. 31).

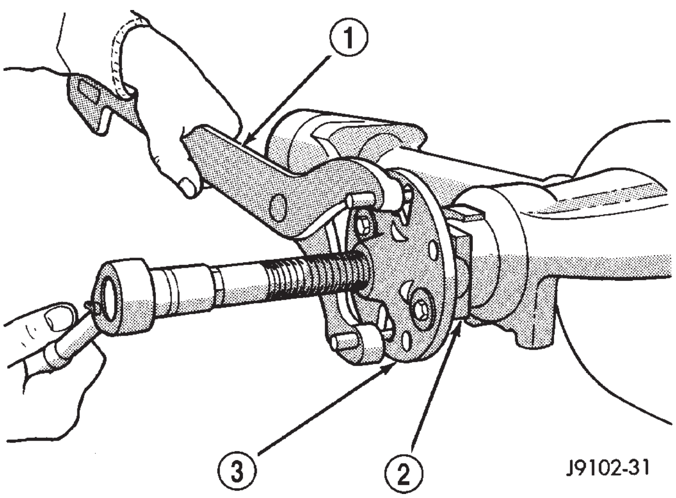


Fig. 31 PINION YOKE REMOVER

1 - WRENCH
2 - YOKE
3 - REMOVER

(10) Remove pinion shaft seal with a pry tool or a slide hammer mounted screw.
(11) Remove front pinion bearing using a pair of pick tools to pull the bearing straight off the pinion gear shaft.

NOTE: If bearing becomes bound on pinion shaft, lightly tap the pinion shaft with a rawhide/rubber hammer.

(12) Remove the collapsible spacer.

INSTALLATION

(1) Install a **new** collapsible preload spacer on pinion shaft.
(2) Install pinion front bearing.
(3) Apply a light coating of gear lubricant on the lip of pinion seal and install seal with an appropriate installer (Fig. 32).

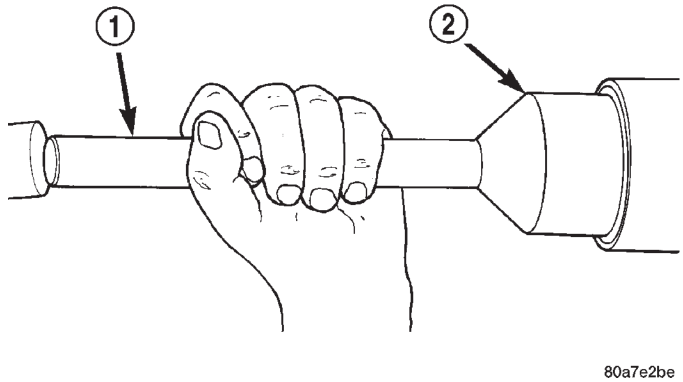


Fig. 32 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

(4) Install yoke with Screw 8112, Cup 8109 and Spanner Wrench 6958 (Fig. 33).

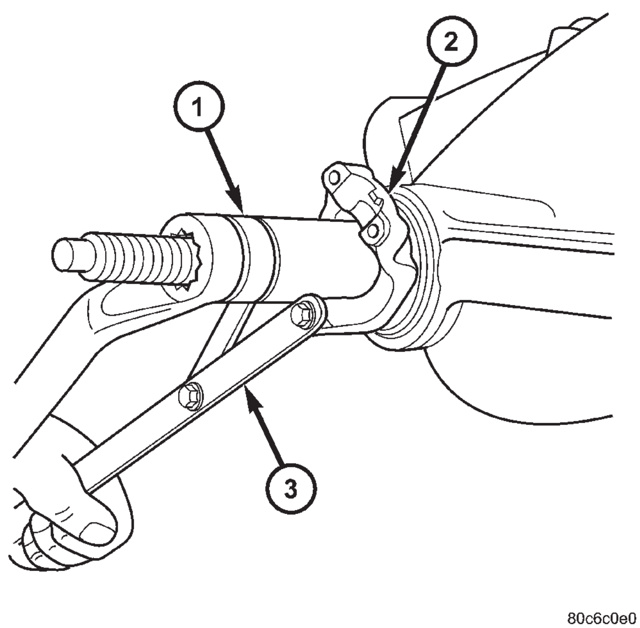


Fig. 33 PINION YOKE INSTALLER

1 - INSTALLER
2 - PINION YOKE
3 - SPANNER WRENCH

(5) Install yoke washer and **new** nut on the pinion gear. Tighten the nut to 271 N·m (200 ft. lbs.).

COLLAPSIBLE SPACER (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.

(6) Using yoke with Spanner Wrench 6958 and a torque wrench set at 475 N·m (350 ft. lbs.), (Fig. 34) 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. 35).

NOTE: If more than 475 N·m (350 ft. lbs.) torque is required to crush the collapsible spacer, the spacer is defective and must be replaced.

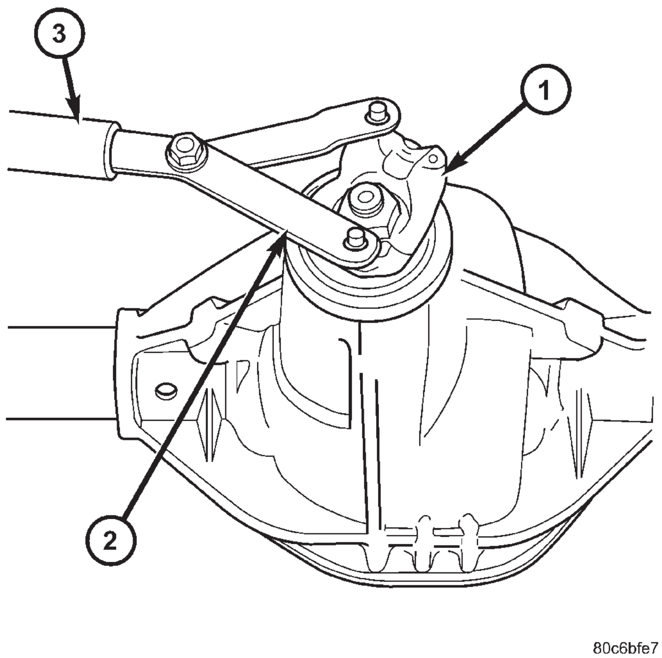


Fig. 34 YOKE HOLDER

1 - PINION YOKE
2 - SPANNER WRENCH
3 - PIPE

(7) Check rotating torque with an inch pound torque wrench (Fig. 35). The rotating torque of the pinion gear should be, the reading recorded during removal plus an additional 0.56 N·m (5 in. lbs.).

(8) Install propeller shaft with reference marks aligned.

(9) Install rear brake drums.

(10) Add gear lubricant, if necessary.

(11) Install wheel and tire assemblies.

(12) Remove supports and lower vehicle.

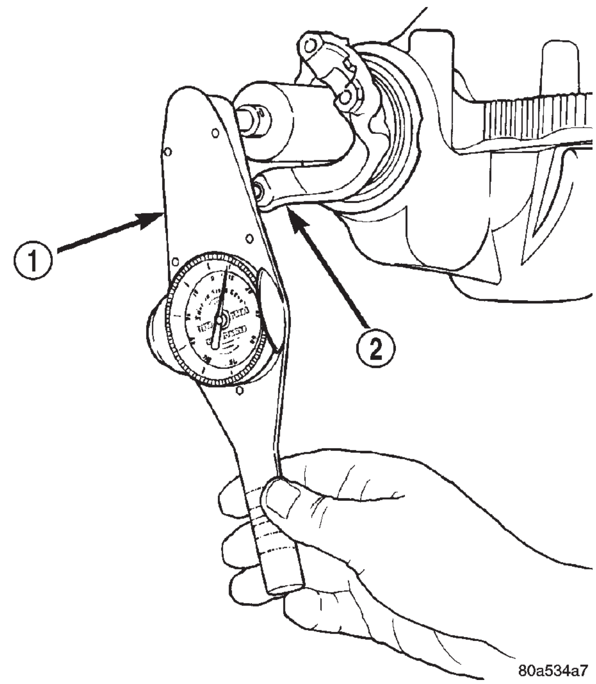


Fig. 35 PINION ROTATING TORQUE

1 - TORQUE WRENCH
2 - PINION YOKE

DIFFERENTIAL

REMOVAL

(1) Raise and support vehicle.

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

(3) Remove differential housing cover and drain fluid.

(4) Clean the housing cavity with flushing oil, light engine oil or lint free cloth.

NOTE: Do not use water, steam, kerosene or gasoline for cleaning.

(5) Remove axle shafts.

(6) Note the reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 36).

(7) Loosen the differential bearing cap bolts.

(8) Position Spreader W-129-B with Adapter Kit 6987B on differential locating holes (Fig. 37). Install holddown clamps and tighten the turnbuckle finger-tight.

(9) 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. 38) and zero the indicator.

DIFFERENTIAL (Continued)

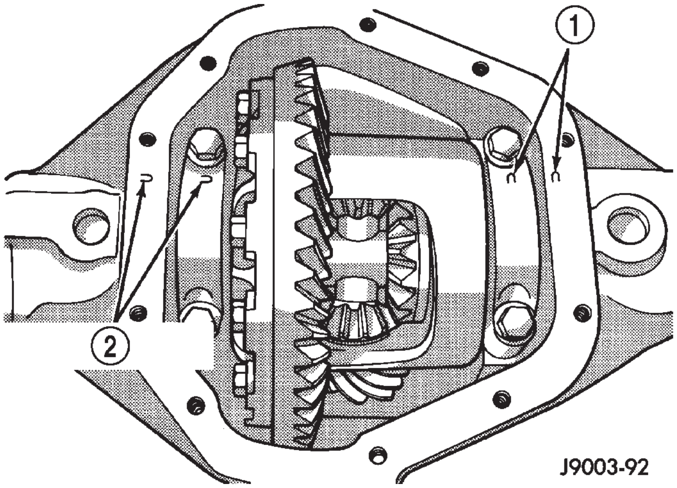


Fig. 36 BEARING CAP REFERENCE

1 - REFERENCE LETTERS
2 - REFERENCE LETTERS

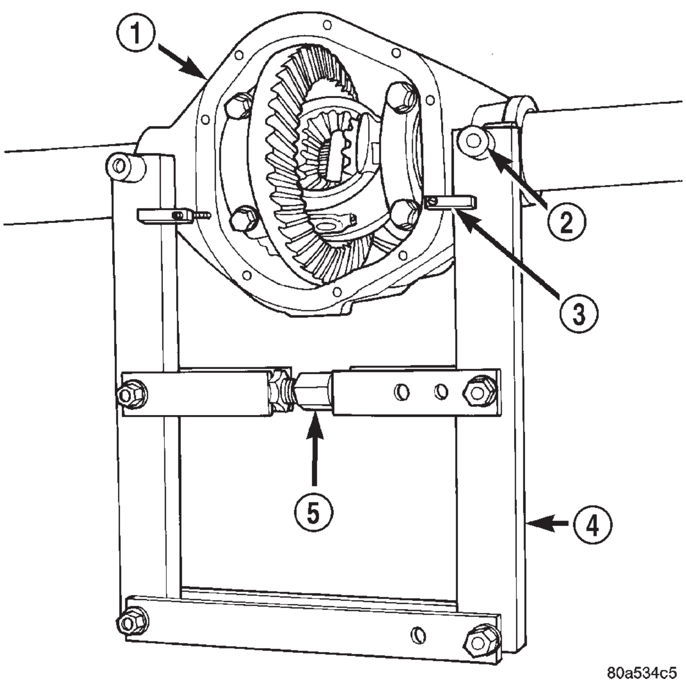


Fig. 37 SPREADER LOCATION

1 - DIFFERENTIAL HOUSING
2 - DOWEL
3 - SAFETY HOLD DOWN
4 - SPREADER
5 - TURNBUCKLE

CAUTION: Never spread the housing over 0.38 mm (0.015 in). If housing is over-spread, it could distorted and damaged the housing.

(10) Spread housing enough to remove the differential case from the housing. Measure the distance with the dial indicator (Fig. 39).

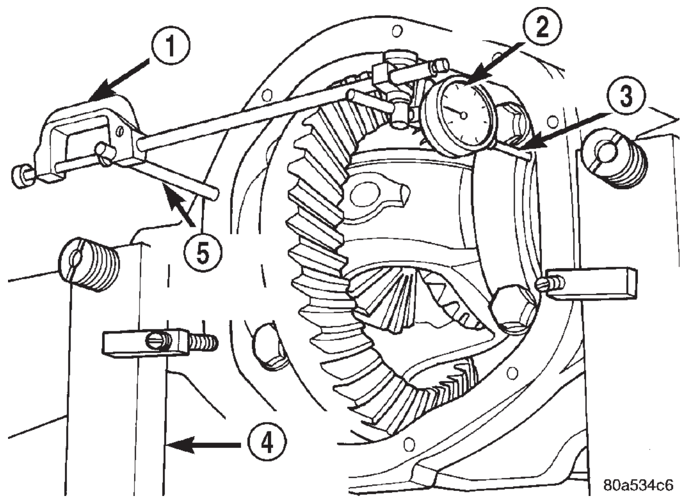


Fig. 38 DIAL INDICATOR LOCATION

1 - CLAMP
2 - DIAL INDICATOR
3 - LEVER ADAPTER
4 - SPREADER
5 - PILOT STUD

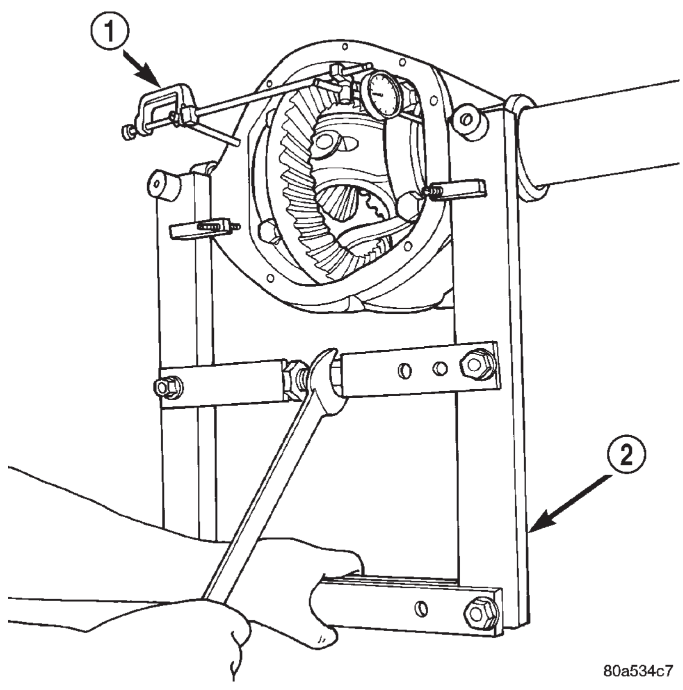


Fig. 39 SPREAD DIFFERENTIAL HOUSING

1 - DIAL INDICATOR
2 - SPREADER

(11) Remove the dial indicator.

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

(13) Remove differential from the housing and tag differential bearing cups to indicate location (Fig. 40).

(14) Remove spreader from housing.

DIFFERENTIAL (Continued)

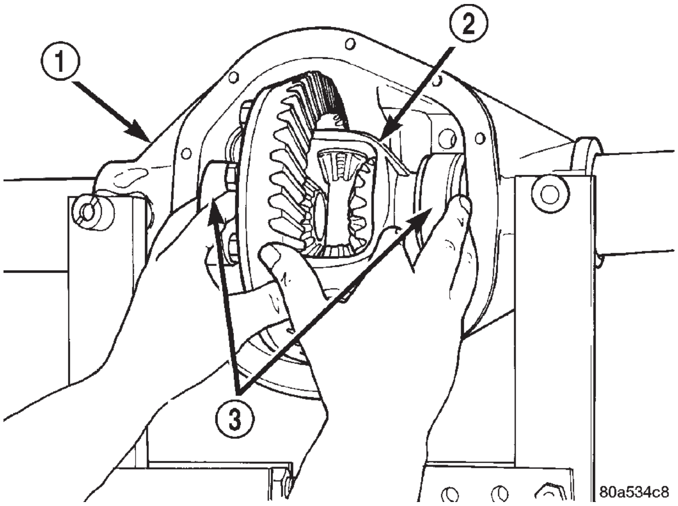


Fig. 40 DIFFERENTIAL CASE REMOVAL

1 - DIFFERENTIAL HOUSING
2 - DIFFERENTIAL CASE
3 - BEARING CUPS

DISASSEMBLY

(1) Remove pinion shaft lock roll pin with a hammer and punch.

(2) Remove pinion shaft.

(3) Rotate differential side gears and remove the differential pinions and thrust washers (Fig. 41).

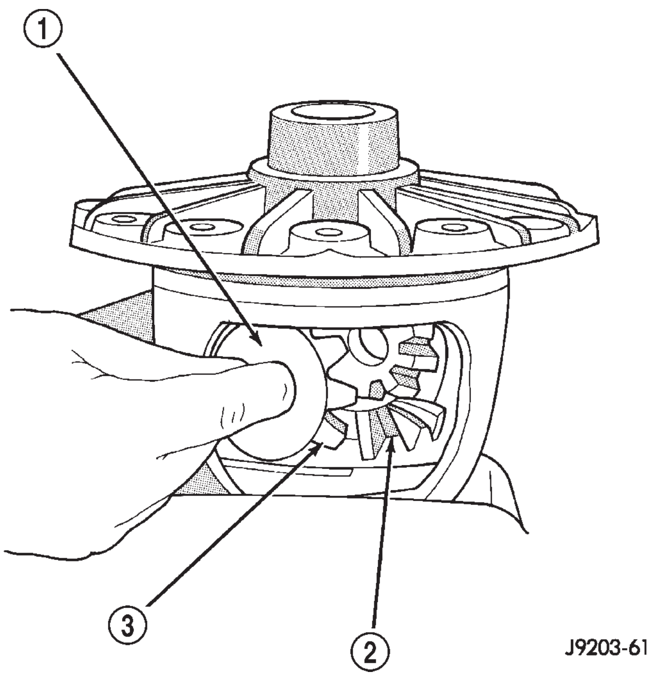


Fig. 41 DIFFERENTIAL GEARS

1 - THRUST WASHER
2 - SIDE GEAR
3 - DIFFERENTIAL PINION

(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 roll pin.

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

INSTALLATION

NOTE: If replacement differential bearings or differential case are being installed, differential side bearing shim requirements may change. Refer Adjustments (Differential Bearing Preload and Gear Backlash) to determine the proper shim selection.

(1) Position Spreader W-129-B and adapters from Adapter set 6987, with the tool dowel pins seated in the locating holes (Fig. 42). Install holddown clamps and tighten the tool turnbuckle finger-tight.

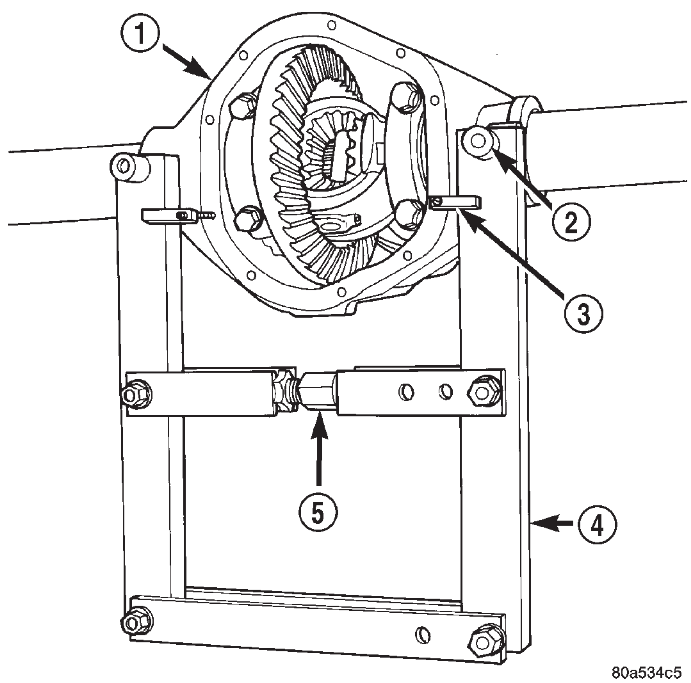


Fig. 42 SPREADER LOCATION

1 - DIFFERENTIAL HOUSING
2 - DOWEL
3 - SAFETY HOLD DOWN
4 - SPREADER
5 - TURNBUCKLE

DIFFERENTIAL (Continued)

(2) Install 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 and zero the indicator.

CAUTION: Never 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.

(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 seated in the housing.

(6) Install bearing caps in their original locations (Fig. 43).

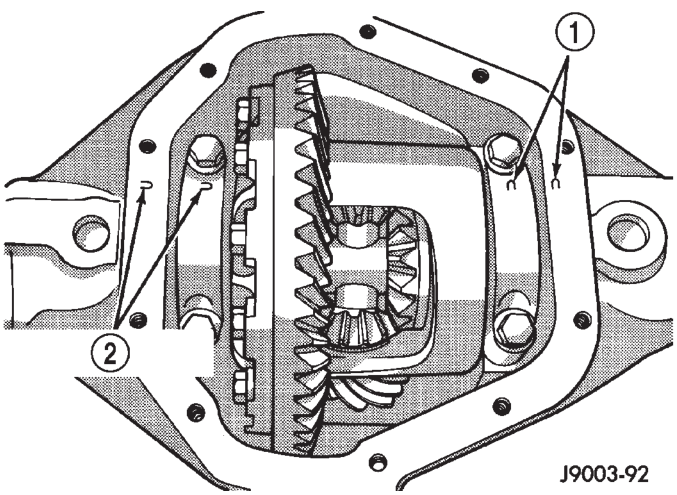


Fig. 43 BEARING CAP REFERENCE

1 - REFERENCE LETTERS
2 - REFERENCE LETTERS

(7) Loosely install differential bearing cap bolts.

(8) Remove axle housing spreader.

(9) Tighten the bearing cap bolts to 77 N·m (57 ft. lbs.).

(10) Install the axle shafts.

(11) Apply a 6.35mm (1/4 in.) bead of red Mopar Silicone Rubber Sealant or equivalent to the housing cover (Fig. 44).

CAUTION: If housing cover is not installed within 3 to 5 minutes, the cover must be cleaned and new RTV applied or adhesion quality will be compromised.

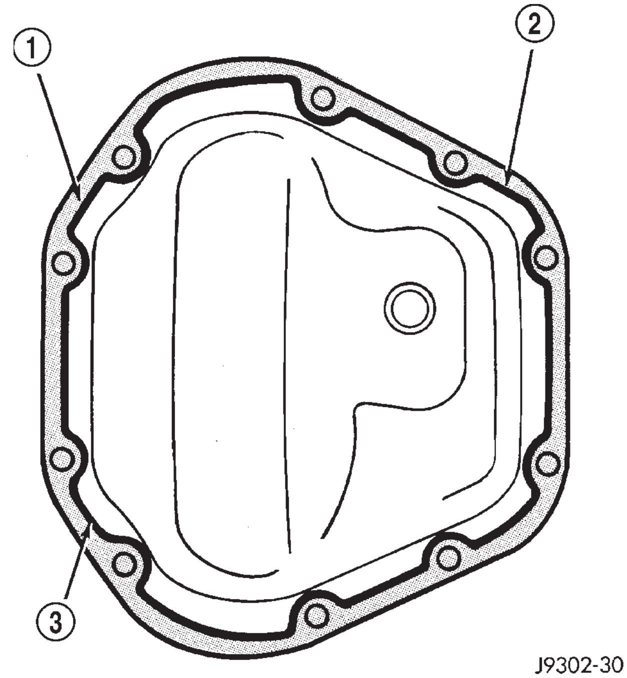


Fig. 44 DIFFERENTIAL COVER

1 - SEALANT SURFACE
2 - SEALANT
3 - SEALANT THICKNESS

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

(13) Refill the differential with Mopar Hypoid Gear Lubricant or equivalent to bottom of the fill plug hole.

(14) Install the fill hole plug.

(15) Install wheel and tire assemblies.

(16) Remove support and lower the vehicle.

DIFFERENTIAL - TRAC-LOK

DIAGNOSIS AND TESTING - TRAC-LOK®

The most common problem is a chatter noise when turning corners. Before removing the unit for repair, drain, flush and refill the axle with the specified lubricant. 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.

DIFFERENTIAL - TRAC-LOK (Continued)

DIFFERENTIAL TEST

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 or equivalent tool to studs.

(5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 45).

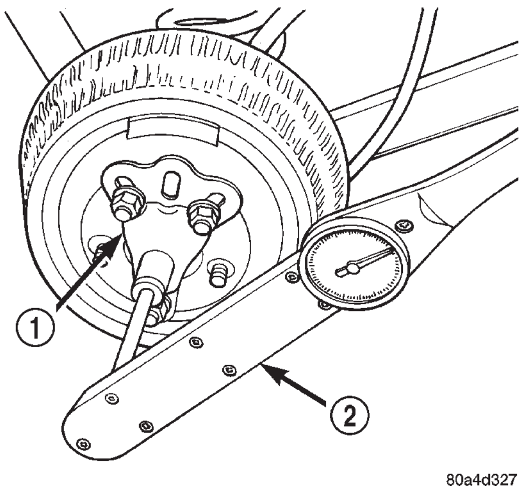


Fig. 45 ROTATING TORQUE TEST

1 - SPECIAL TOOL WITH BOLT IN CENTER HOLE
2 - TORQUE WRENCH

(6) If rotating torque is less than 41 N·m (56 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be serviced.

DISASSEMBLY

(1) Clamp side gear Fixture 6965 in a vise and set differential case on the fixture (Fig. 46).

(2) Remove ring gear if the ring gear is to be replaced. The Trac-lok® differential can be serviced with the ring gear installed.

(3) Remove pinion gear mate shaft lock screw (Fig. 47).

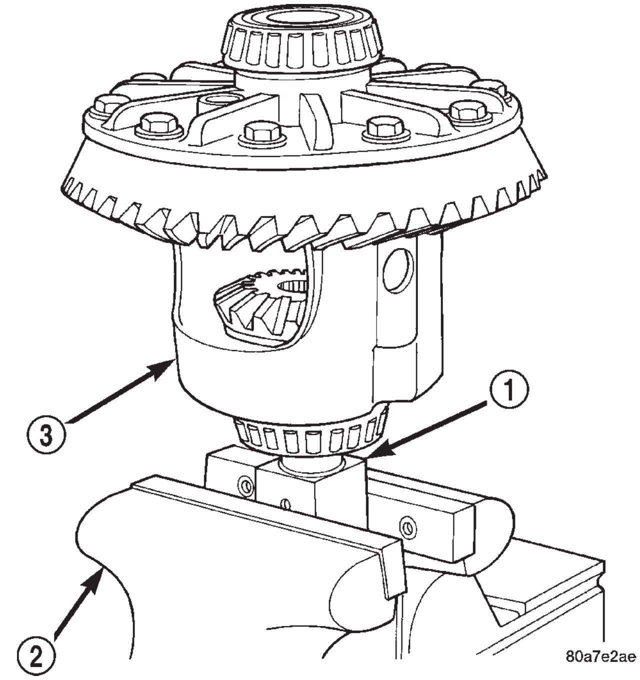


Fig. 46 DIFFERENTIAL CASE FIXTURE

1 - HOLDING FIXTURE
2 - VISE
3 - DIFFERENTIAL

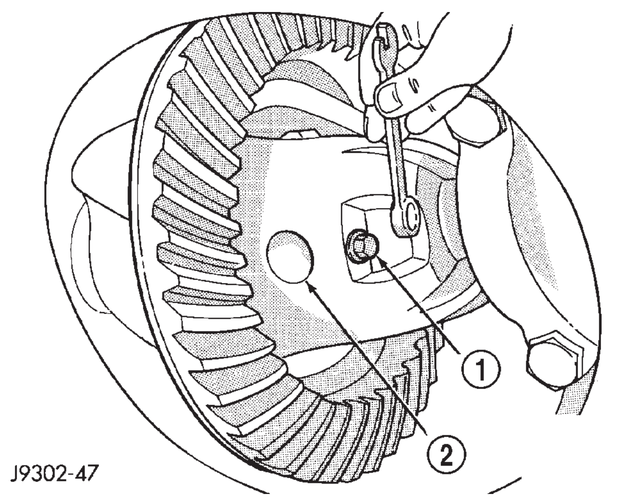


Fig. 47 MATE SHAFT LOCK SCREW

1 - LOCK SCREW
2 - PINION GEAR MATE SHAFT

DIFFERENTIAL - TRAC-LOK (Continued)

(4) Remove pinion gear mate shaft with a drift and hammer.

(5) Install and lubricate Step Plate C-6960-3 (Fig. 48).

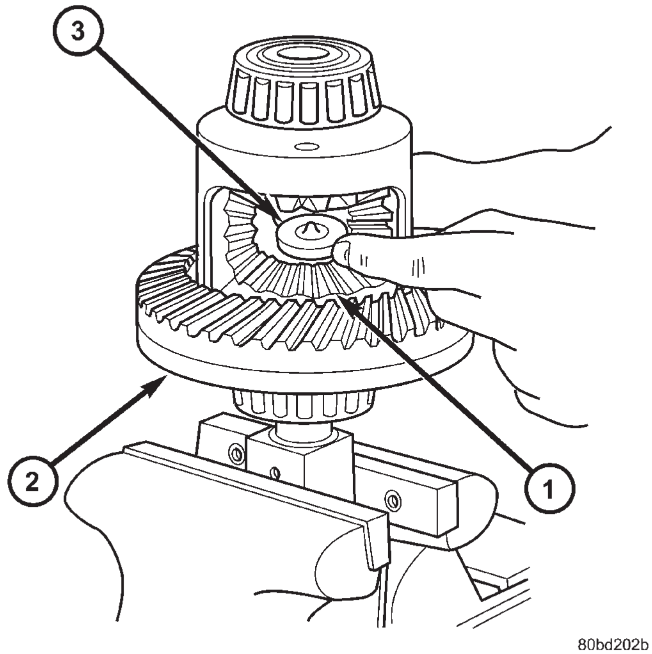


Fig. 48 Step Plate

1 - LOWER SIDE GEAR
2 - DIFFERENTIAL CASE
3 - STEP PLATE

(6) 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.

(7) Position a small screw driver in slot of Threaded Adapter Disc C-6960-3 (Fig. 49) to prevent adapter from turning.

(8) Install Forcing Screw C-6960-4 and tighten screw to 122 N·m (90 ft. lbs.) maximum to compress Belleville springs in clutch packs (Fig. 50).

(9) With a feeler gauge remove thrust washers from behind the pinion gears (Fig. 51).

(10) Insert Turning Bar C-6960-2 into the pinion mate shaft hole in the case (Fig. 52).

(11) Loosen the Forcing Screw in small increments until the clutch pack tension is relieved and the differential case can be turned using Turning Bar.

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

(13) Remove pinion gears from differential case.

(14) Remove Forcing Screw, Step Plate and Threaded Adapter.

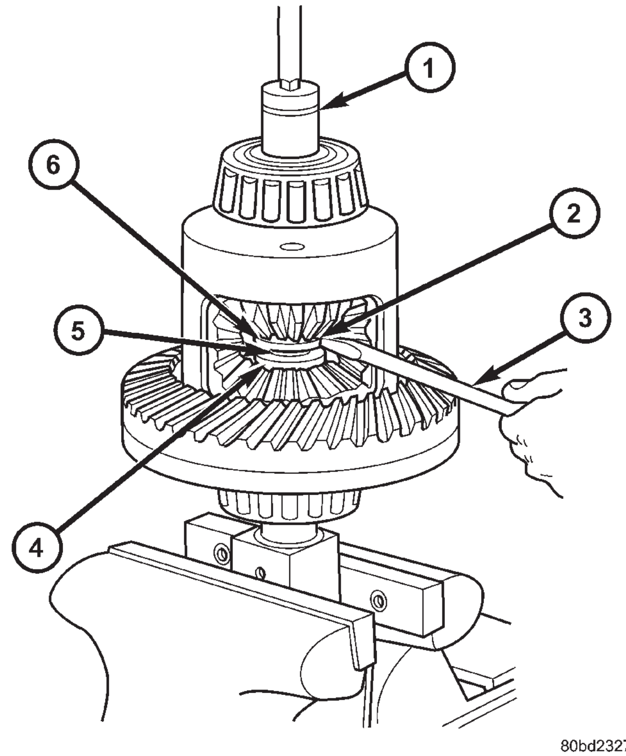


Fig. 49 THREAD ADAPTER DISC

1 - SOCKET
2 - SLOT IN ADAPTER
3 - SCREWDRIVER
4 - STEP PLATE
5 - THREADED ROD
6 - ADAPTER DISC

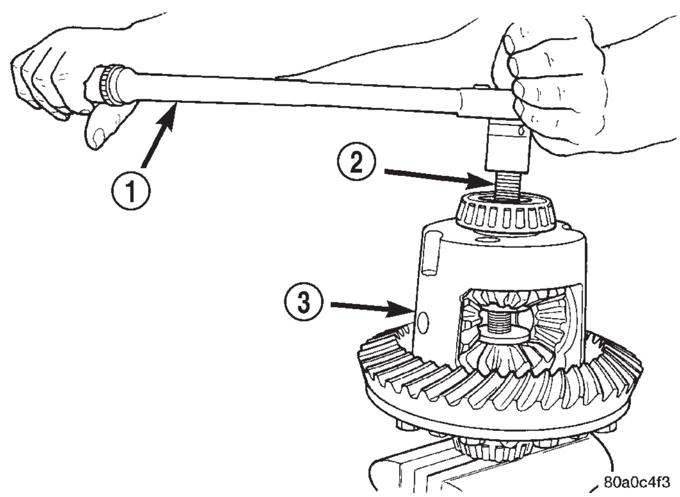


Fig. 50 COMPRESS BELLEVILLE SPRING

1 - TORQUE WRENCH
2 - FORCING SCREW
3 - DIFFERENTIAL CASE

DIFFERENTIAL - TRAC-LOK (Continued)

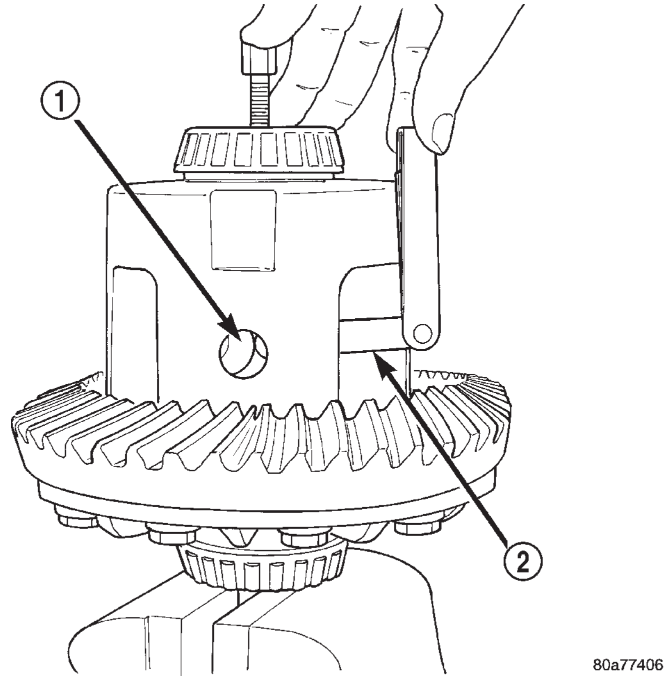


Fig. 51 PINION GEAR THRUST WASHER

1 - THRUST WASHER
2 - FEELER GAUGE

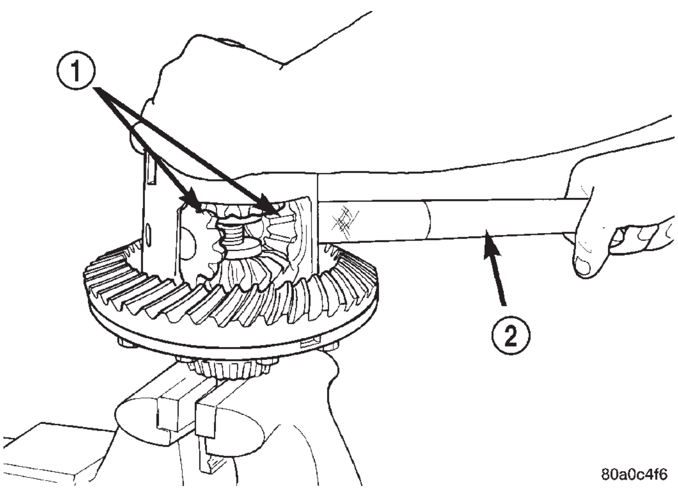


Fig. 52 PINION GEARS

1 - PINION GEARS
2 - TURNING BAR

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

(16) Remove differential case from the Holding Fixture. Remove side gear, clutch pack retainer and clutch pack. Keep plates in order during removal.

CLEANING

Clean all components in cleaning solvent and dry components with compressed air.

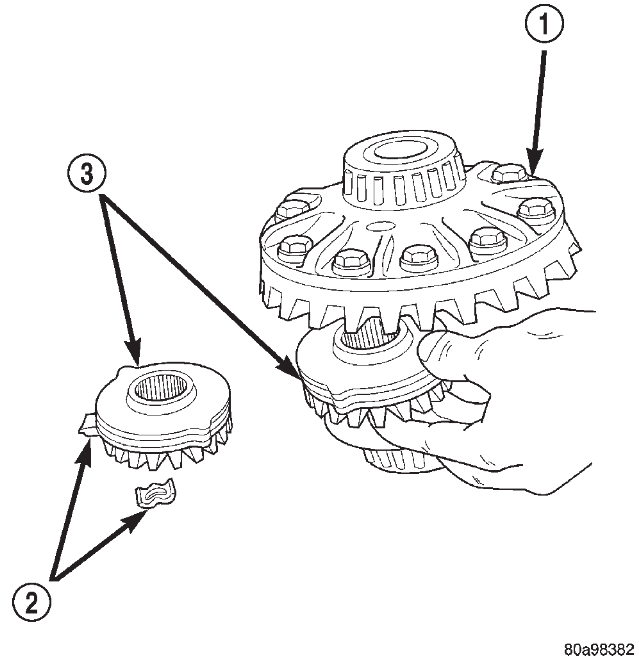


Fig. 53 SIDE GEARS AND CLUTCH DISCS

1 - DIFFERENTIAL CASE
2 - RETAINER
3 - SIDE GEAR AND CLUTCH DISC PACK

INSPECTION

Inspect clutch pack plates for wear, scoring or damage. Replace both clutch packs if any one component in either pack is damaged. Inspect side and pinion gears for cracks chips or damage and replace as necessary. Inspect differential case and pinion shaft and replace if worn or damaged.

ASSEMBLY

NOTE: New 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.

(1) Lubricate components with gear lubricant.

(2) Assemble clutch discs into packs and secure disc packs with retaining clips (Fig. 54).

NOTE: Dished plate is position with the convex side against the side gear.

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

(4) Install clutch pack and side gear in the ring gear side of the differential case (Fig. 55).**Verify clutch pack retaining clips are in position and seated in the case pockets.**

(5) Position the differential case on the Holding Fixture 6965.

DIFFERENTIAL - TRAC-LOK (Continued)

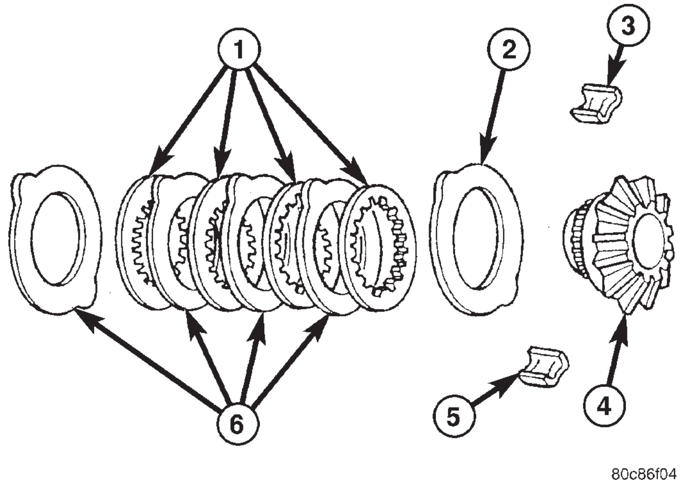


Fig. 54 CLUTCH PACK

1 - DISCS
2 - DISHED PLATE
3 - RETAINER
4 - SIDE GEAR
5 - RETAINER
6 - PLATES

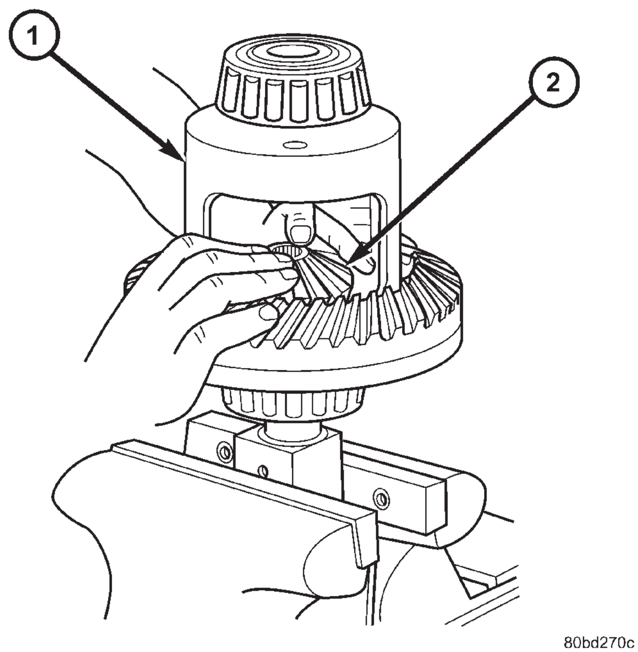


Fig. 55 CLUTCH PACK AND LOWER SIDE GEAR

1 - DIFFERENTIAL CASE
2 - SIDE GEAR AND CLUTCH PACK

(6) Install lubricated Step Plate C-6960-3 in lower side gear (Fig. 56).

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

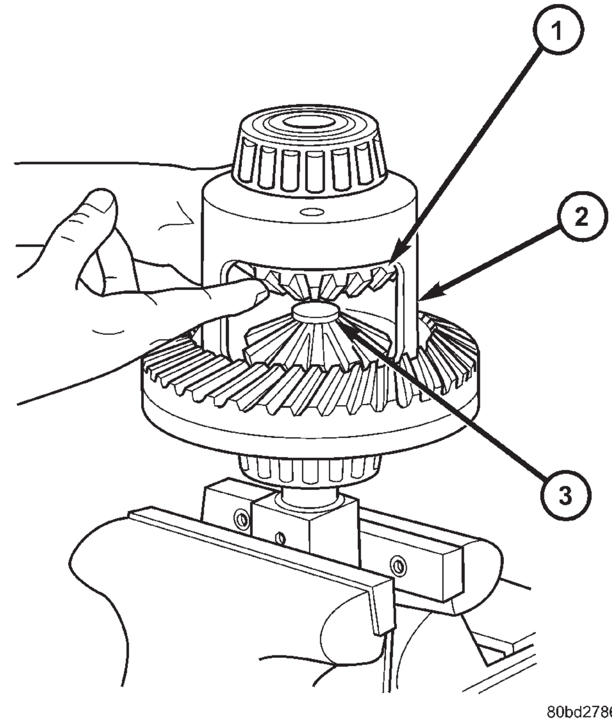


Fig. 56 CLUTCH PACK AND UPPER SIDE GEAR

1 - SIDE GEAR AND CLUTCH PACK
2 - DIFFERENTIAL CASE
3 - STEP PLATE

(8) Hold assembly in position. Insert Threaded Adapter C-6960-1 into top side gear.

(9) Install Forcing Screw C-6960-4 and tighten screw to slightly compress clutch disc.

(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, Step Plate and Threaded Adapter.

(15) Install pinion gear mate shaft and align holes in shaft and case.

(16) Install pinion mate shaft lock screw finger tight to hold shaft during differential installation.

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

DIFFERENTIAL CASE BEARINGS

REMOVAL

(1) Remove differential from the housing.

(2) Remove bearings from the differential case with Puller/Press C-293-PA , C-293-39 Blocks and Plug SP-3289 (Fig. 57).

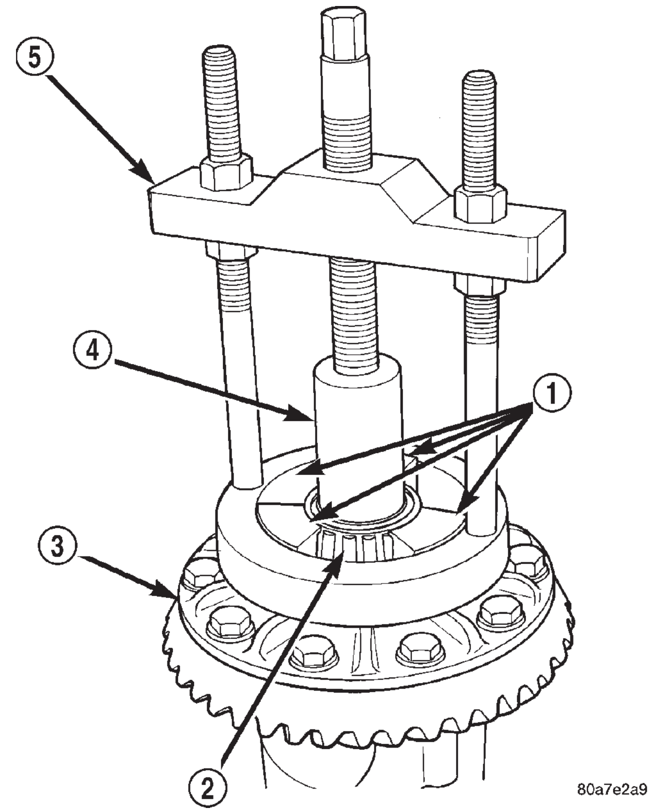


Fig. 57 BEARING REMOVAL

1 - ADAPTERS
2 - BEARING
3 - DIFFERENTIAL
4 - PLUG
5 - PULLER

INSTALLATION

(1) Install differential side bearings with Installer C-3716-A with Handle C-4171 (Fig. 58).

(2) Install differential in the housing.

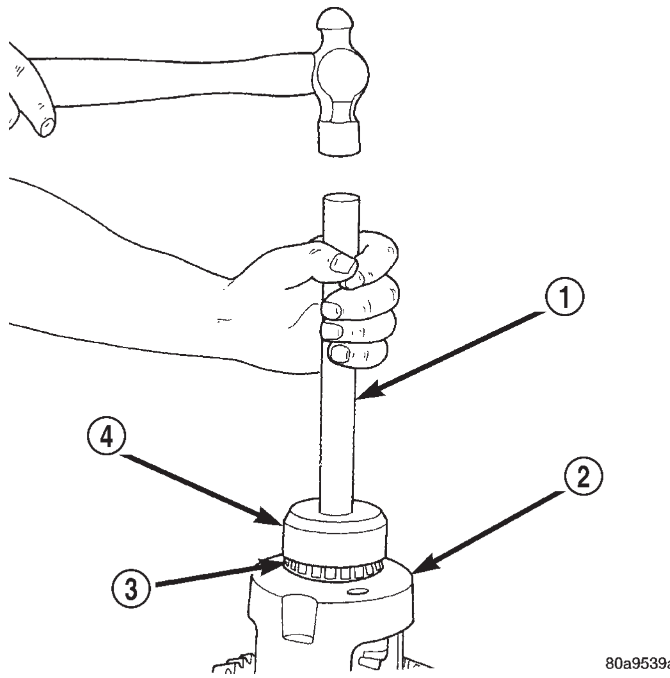


Fig. 58 DIFFERENTIAL CASE BEARINGS

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

PINION GEAR/RING GEAR

REMOVAL

NOTE: The ring and pinion gears are serviced in a matched set. Never replace one gear without replacing the other gear.

(1) Raise and support the vehicle.

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

(3) Disconnect propeller shaft from pinion yoke. Tie propeller shaft to underbody.

(4) Remove differential from axle housing.

(5) Place differential case in a vise with soft metal jaw.

(6) Remove ring gear bolts from the differential case.

(7) Drive ring gear from the differential case with a rawhide hammer (Fig. 59).

(8) Hold pinion yoke with Wrench 6958 and remove pinion yoke nut and washer.

(9) Remove pinion yoke from pinion shaft with Remover C-452 and Wrench C-3281 (Fig. 60).

(10) Remove the pinion gear from housing (Fig. 61).

(11) Remove pinion shaft seal with a pry tool or a slide hammer mounted screw.

PINION GEAR/RING GEAR (Continued)

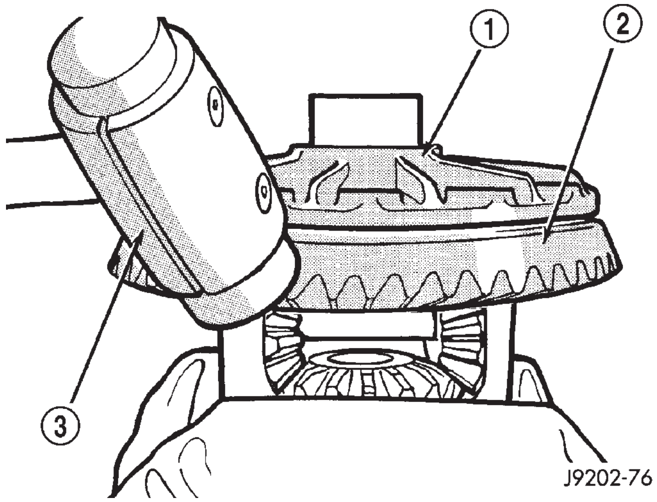


Fig. 59 RING GEAR

1 - CASE
2 - RING GEAR
3 - RAWHIDE HAMMER

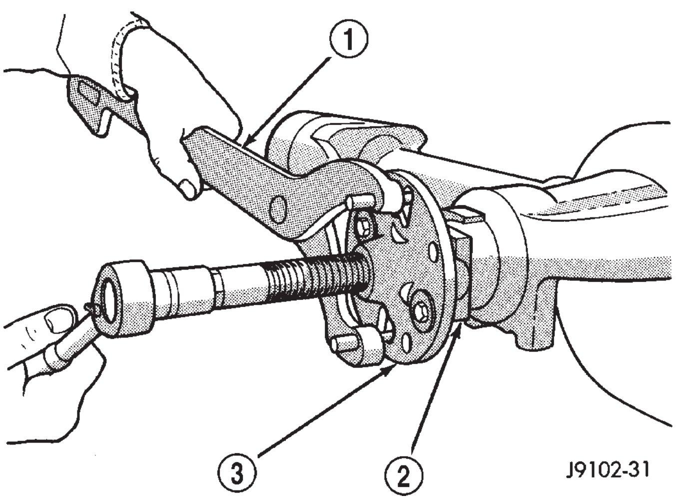


Fig. 60 PINION YOKE REMOVER

1 - WRENCH
2 - YOKE
3 - PULLER

(12) Remove oil slinger, if equipped, and front pinion bearing.

(13) Remove front pinion bearing cup with Remover C-4345 and Handle C-4171 (Fig. 62).

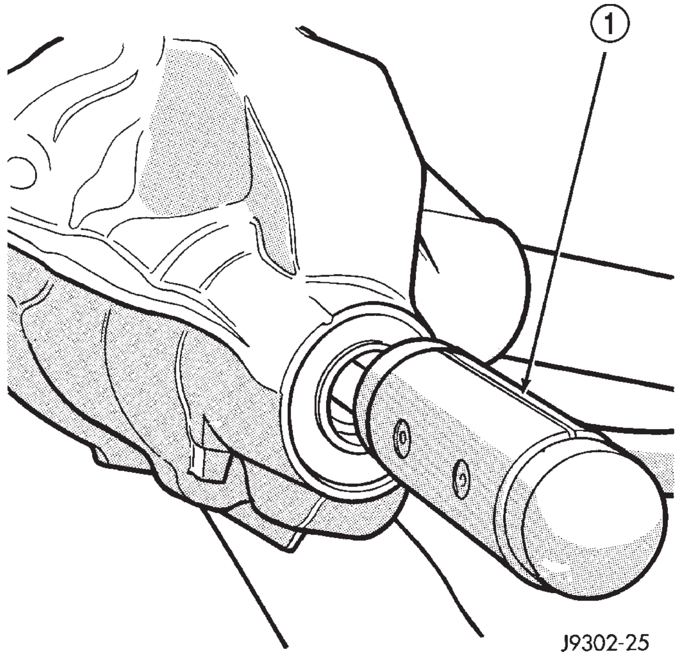


Fig. 61 REMOVE PINION GEAR

1 - RAWHIDE HAMMER

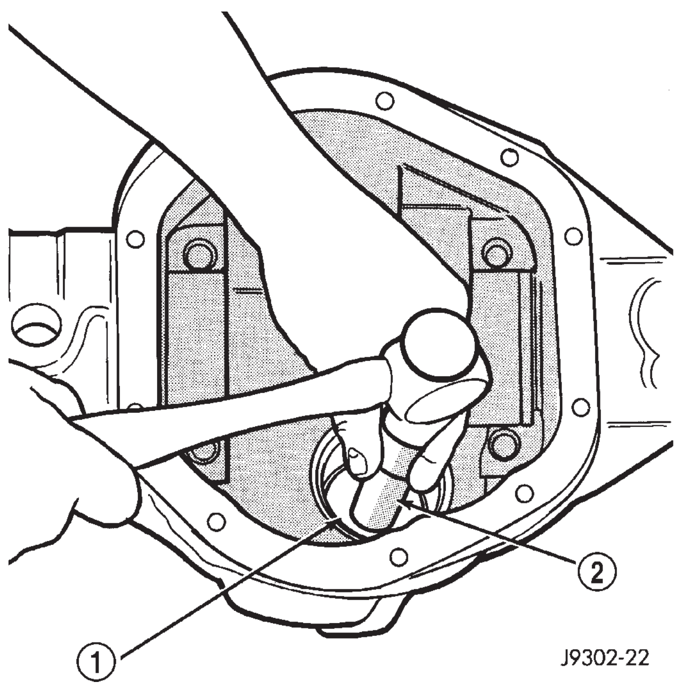


Fig. 62 FRONT PINION BEARING CUP

1 - REMOVER
2 - HANDLE

PINION GEAR/RING GEAR (Continued)

(14) Remove rear bearing cup from housing (Fig. 63) with Remover D-149 and Handle C-4171.

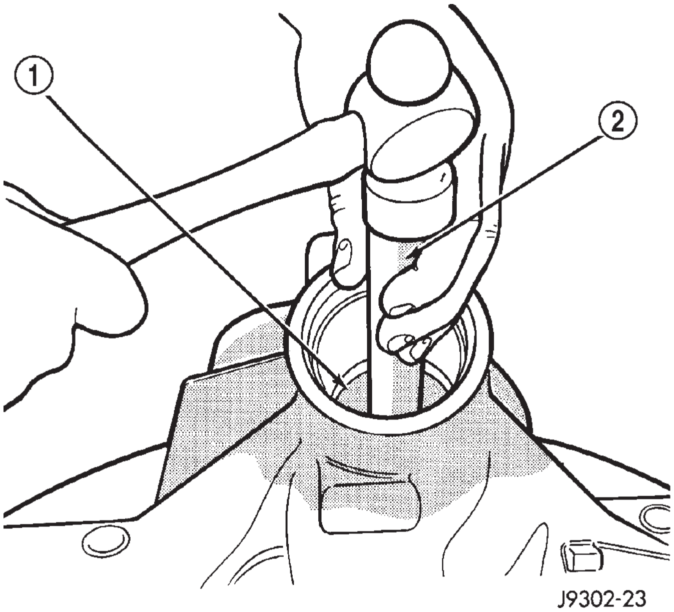


Fig. 63 REAR PINION BEARING CUP

1 - DRIVER
2 - HANDLE

(15) Remove collapsible preload spacer (Fig. 64).

(16) Remove rear bearing from the pinion shaft with Puller/Press C-293-PA and Adapters C-293-40 (Fig. 65).

(17) Remove depth shims from the pinion shaft and record the shims thickness.

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 ring gear and pinion are reused, the pinion depth shim/oil slinger should not require replacement. Refer to Adjustment (Pinion Gear Depth) to select the proper thickness shim/oil slinger if ring and pinion gears are replaced.

(1) Apply Mopar Door Ease or equivalent lubricant to outside surface of bearing cups.

(2) Install pinion rear bearing cup with Installer D-146 and Driver Handle C-4171 (Fig. 66) and verify cup is seated.

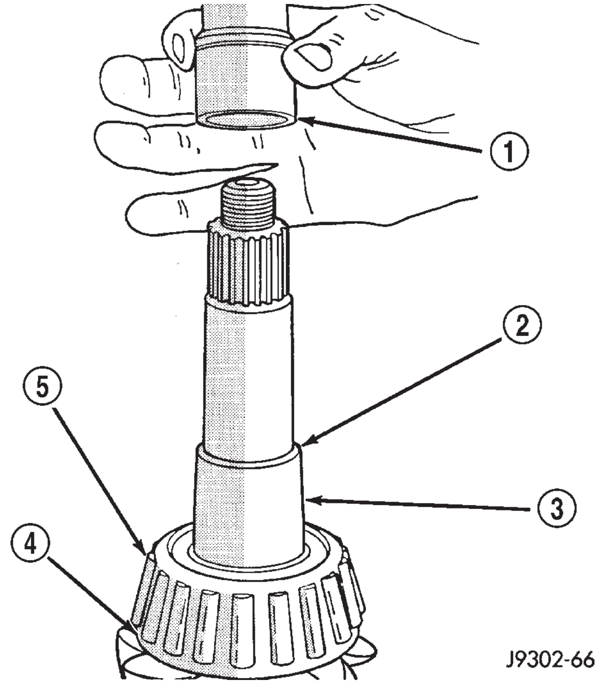


Fig. 64 COLLAPSIBLE SPACER

1 - COLLAPSIBLE SPACER
2 - SHOULDER
3 - PINION GEAR
4 - SHIM
5 - REAR BEARING

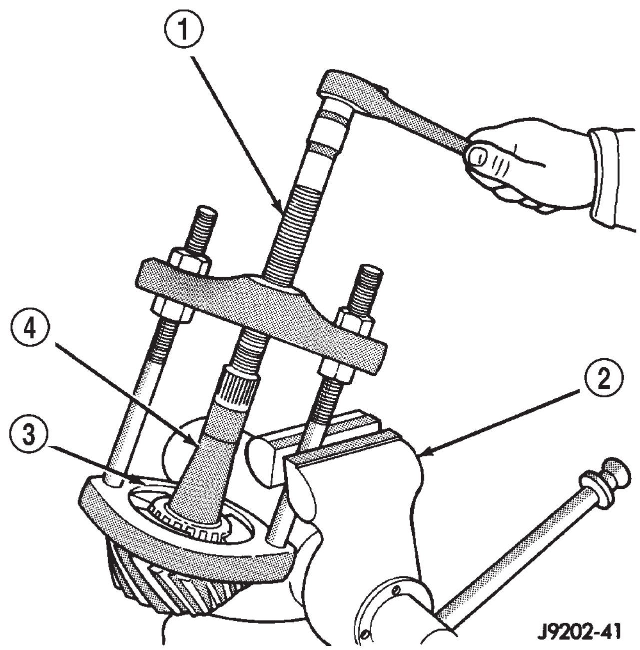


Fig. 65 REAR PINION BEARING

1 - PULLER
2 - VISE
3 - ADAPTERS
4 - DRIVE PINION GEAR SHAFT

PINION GEAR/RING GEAR (Continued)

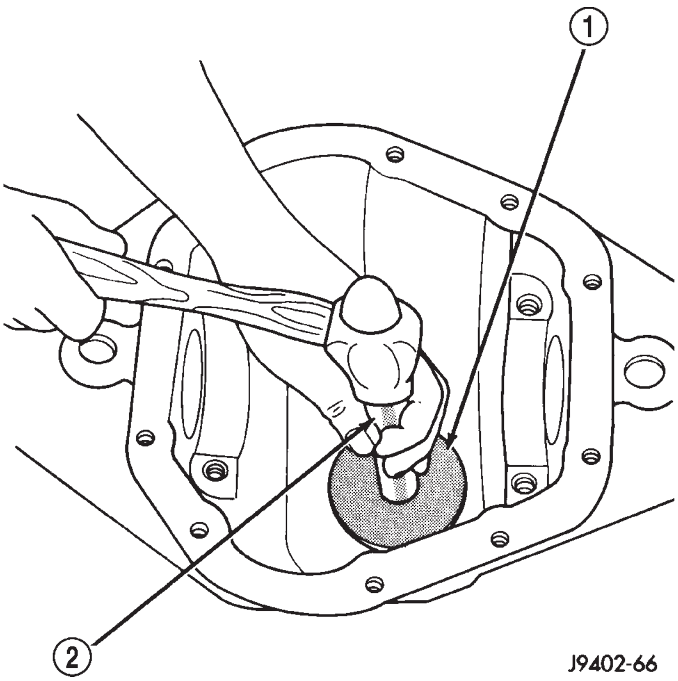


Fig. 66 REAR PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

(3) Install pinion front bearing cup with Installer D-130 and Handle C-4171 (Fig. 67) and verify cup is seated.

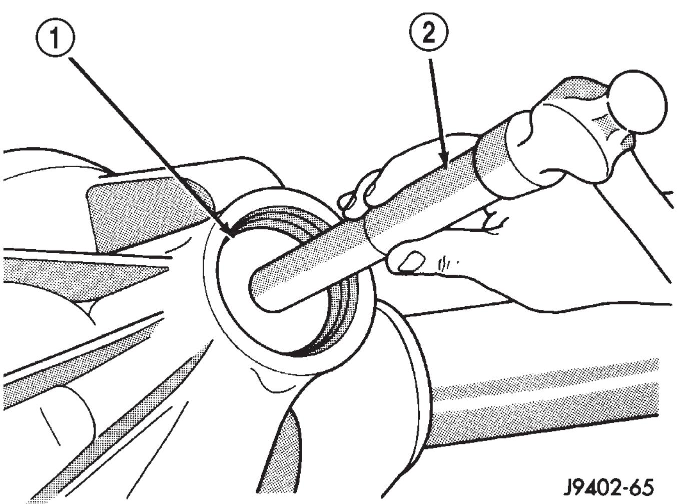


Fig. 67 FRONT PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

(4) Install pinion front bearing and shim.

(5) Apply a light coating of gear lubricant on the lip of pinion seal and install seal with an appropriate installer (Fig. 68).

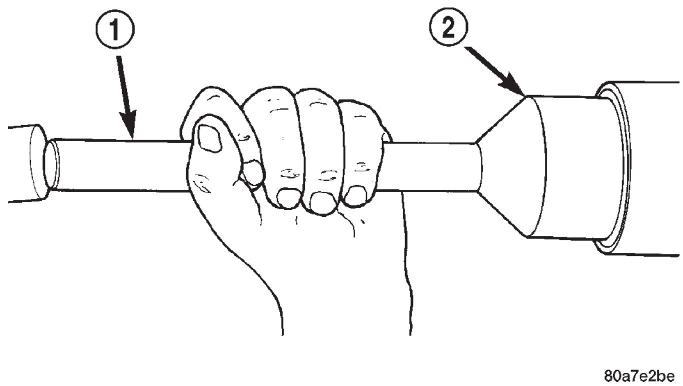


Fig. 68 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

(6) Install depth shim on the pinion gear.

(7) Install rear bearing and shim on the pinion gear with Installer W-262 and a press (Fig. 69).

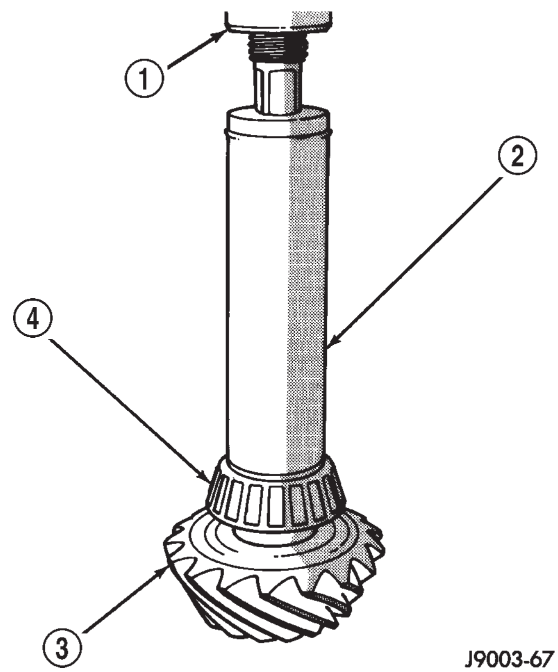


Fig. 69 REAR PINION BEARING

1 - PRESS
2 - INSTALLER
3 - DRIVE PINION GEAR
4 - REAR PINION BEARING

PINION GEAR/RING GEAR (Continued)

(8) Install a **new** collapsible preload spacer on pinion shaft and install pinion gear in the housing (Fig. 70).

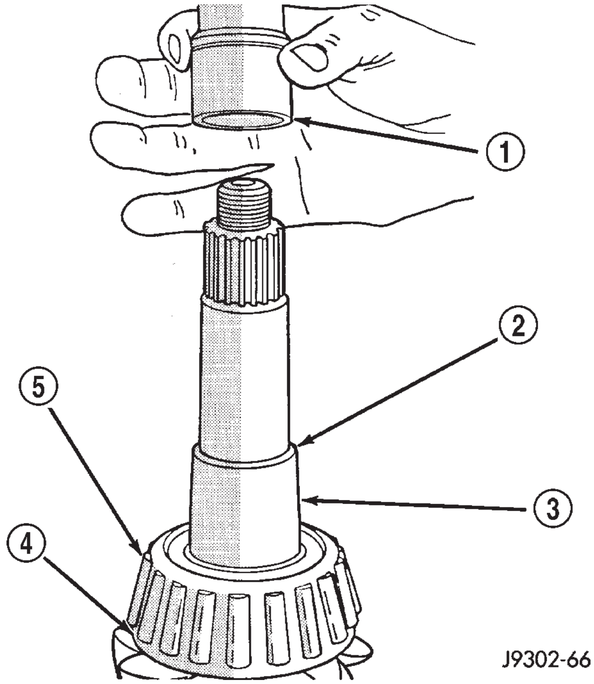


Fig. 70 COLLAPSIBLE SPACER

1 - COLLAPSIBLE SPACER
2 - SHOULDER
3 - PINION GEAR
4 - SHIM
5 - REAR BEARING

(9) Install yoke with Installer Screw 8112, Cup 8109 and Wrench 6958 (Fig. 71).

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

(11) 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.

(12) Using Spanner Wrench 6958 and a torque wrench set at 475 N·m (350 ft. lbs.), (Fig. 72) 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. 73).

NOTE: If more than 475 N·m (350 ft. lbs.) torque is required to crush the collapsible spacer, the spacer is defective and must be replaced.

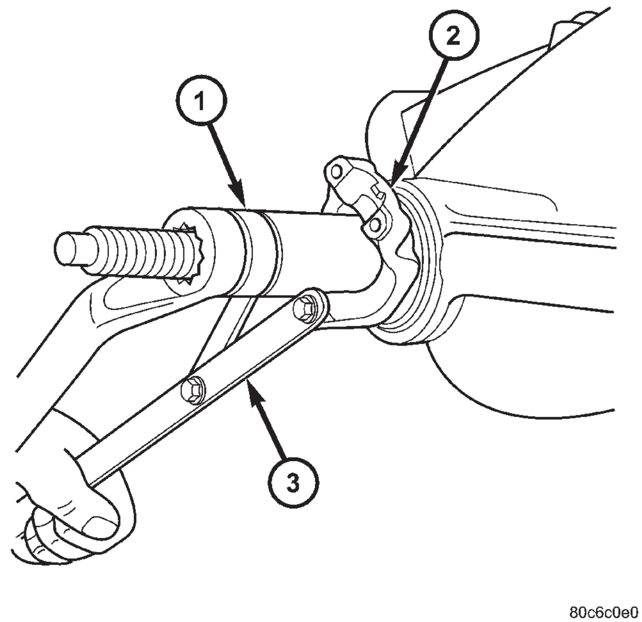


Fig. 71 PINION YOKE INSTALLER

1 - INSTALLER
2 - PINION YOKE
3 - SPANNER WRENCH

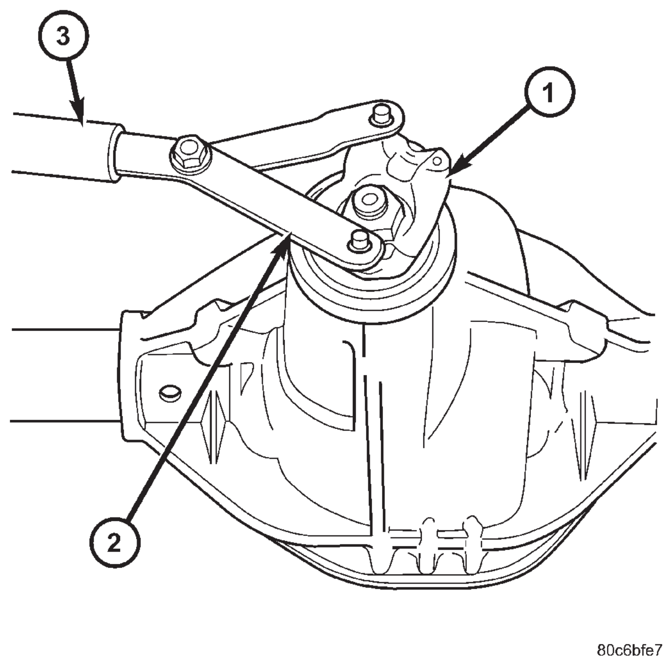


Fig. 72 PION YOKE WRENCH

1 - PINION YOKE
2 - SPANNER WRENCH
3 - PIPE

PINION GEAR/RING GEAR (Continued)

(13) Check bearing rotating torque with a inch pound torque wrench (Fig. 73). The pinion gear rotating torque should be:

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

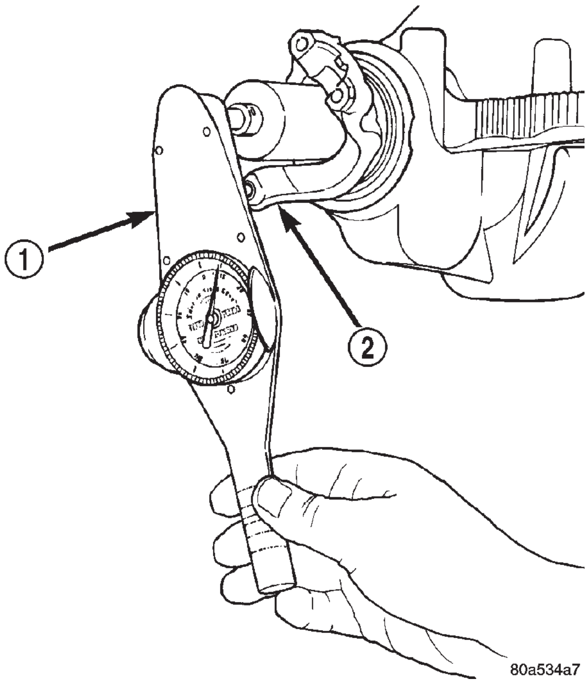


Fig. 73 PINION ROTATING TORQUE

1 - TORQUE WRENCH
2 - PINION YOKE

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

(15) Invert the differential case in the vise.

(16) Install new ring gear bolts and alternately tighten to 108 N·m (80 ft. lbs.) (Fig. 74).

CAUTION: Do not reuse ring gear bolts, the bolts can fracture causing extensive damage.

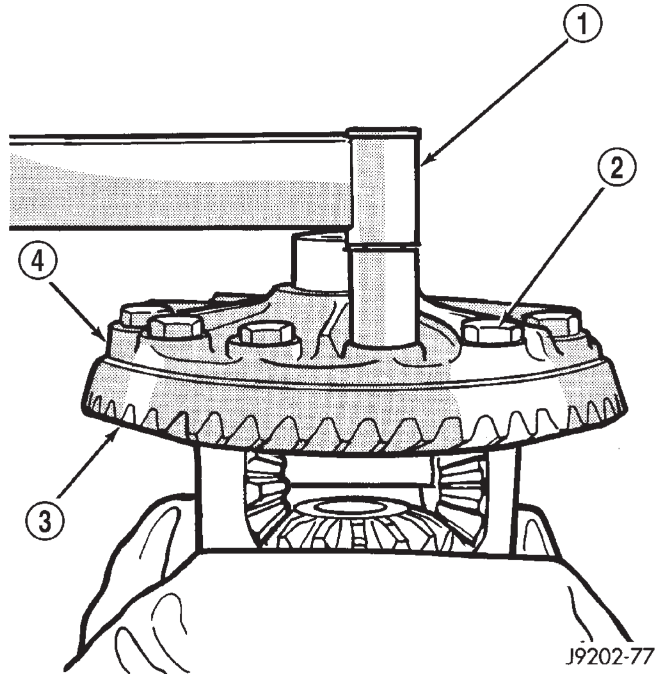


Fig. 74 RING GEAR BOLTS

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

(17) Install differential in axle housing and verify gear mesh and contact pattern. Refer to Ajustment (Gear Contact Pattern) for procedure.

(18) Install differential cover and fill with gear lubricant.

(19) Install the propeller shaft with the reference marks aligned.

(20) Remove supports and lower vehicle.

REAR AXLE - 216RBI

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REAR AXLE - 216RBI

DESCRIPTION

The 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 axles are equipped with semi–floating axle shafts, meaning that loads are supported by the axle shaft and bearings. The axle shafts are retained a bearing and retainer plate.

The 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 bearing preload, ring gear backlash and Pinion bearing preload is adjusted by the use of selective shims. The cover provides a means for servicing the differential without removing the axle. The axle has a vent hose to relieve internal pressure caused by lubricant vaporization and internal expansion.

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

STANDARD DIFFERENTIAL

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

REAR AXLE - 216RBI (Continued)

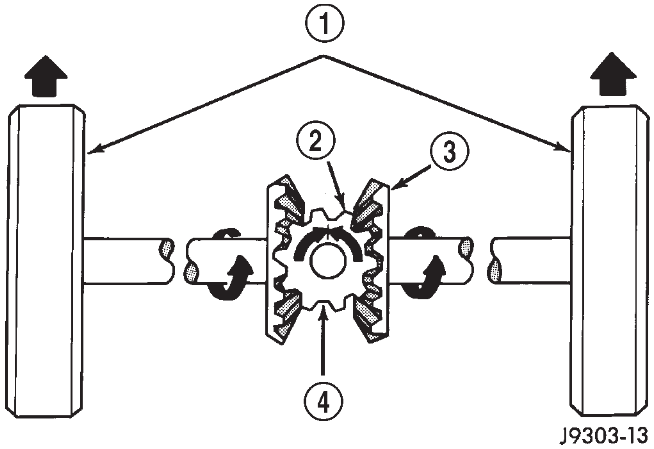


Fig. 1 STRAIGHT AHEAD DRIVING

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

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.

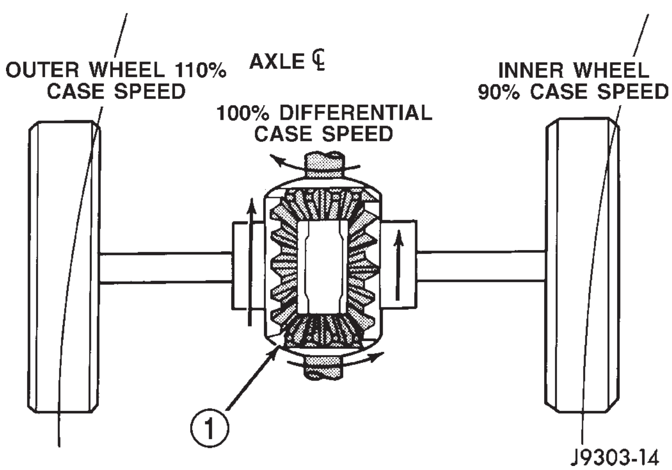


Fig. 2 DIFFERENTIAL ON TURNS

1 - PINION GEARS ROTATE ON PINION SHAFT

TRAC-LOK® DIFFERENTIAL

This differentials 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. 3).

This design provides the differential action needed for turning corners and for driving straight ahead

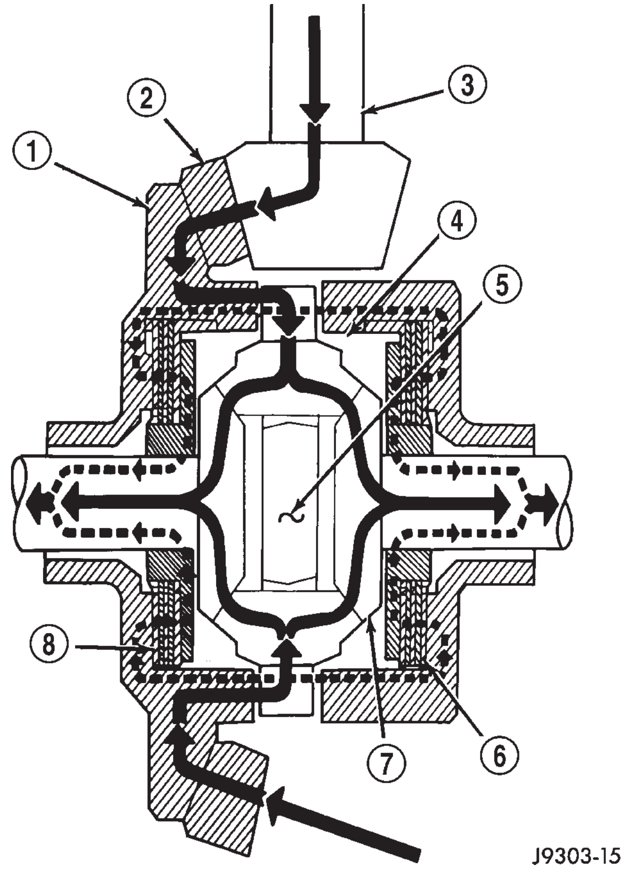


Fig. 3 TRAC-LOK LIMITED SLIP DIFFERENTIAL

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

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

DIAGNOSIS AND TESTING

GEAR NOISE

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

REAR AXLE - 216RBI (Continued)

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 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).

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

NOTE: All driveline components should be examined before starting any repair.

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.

REAR AXLE - 216RBI (Continued)

DIAGNOSTIC CHART

Condition	Possible Causes	Correction
Wheel Noise	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Replace bearing.
Axle Shaft Noise	1. Misaligned axle tube. 2. Bent or sprung axle shaft.	1. Inspect axle tube alignment. Correct as necessary. 2. Inspect and correct as necessary.
Axle Shaft Broke	1. Misaligned axle tube. 2 Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace the broken shaft after correcting tube mis-alignment. 2. Replace broken shaft and avoid excessive weight on vehicle. 3. Replace broken shaft and avoid or correct erratic clutch operation. 4. Replace broken shaft and inspect and repair clutch as necessary.
Differential Cracked	1. Improper adjustment of the differential bearings. 2. Excessive ring gear backlash. 3. Vehicle overloaded. 4. Erratic clutch operation.	1. Replace case and inspect gears and bearings for further damage. Set differential bearing pre-load properly. 2. Replace case and inspect gears and bearings for further damage. Set ring gear backlash properly. 3. Replace case and inspect gears and bearings for further damage. Avoid excessive vehicle weight. 4. Replace case and inspect gears and bearings for further damage. Avoid erratic use of clutch.
Differential Gears Scored	1. Insufficient lubrication. 2. Improper grade of lubricant. 3. Excessive spinning of one wheel/tire.	1. Replace scored gears. Fill differential with the correct fluid type and quantity. 2. Replace scored gears. Fill differential with the correct fluid type and quantity. 3. Replace scored gears. Inspect all gears, pinion bores, and shaft for damage. Service as necessary.

REAR AXLE - 216RBI (Continued)

Condition	Possible Causes	Correction
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.
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. Adjust backlash or pinion depth.
	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.

REAR AXLE - 216RBI (Continued)

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 Brakes for procedure.
(6) Disconnect parking brake cables from brackets and lever.
(7) Remove wheel speed sensors, if necessary. Refer to Brakes for procedure.
(8) Disconnect the brake hose at the axle junction block. Do not disconnect the brake hydraulic lines at the wheel cylinders. Refer to Brakes for procedure.
(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.).
(5) Install stabilizer bar links and tighten nuts to 54 N·m (40 ft. lbs.).
(6) Install the wheel speed sensors, if necessary. Refer to Brakes for procedures.
(7) Connect parking brake cable to brackets and lever.
(8) Install the brake drums. Refer to Brakes for procedures.
(9) Connect the brake hose to the axle junction block. Refer to Brakes for 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.).
(12) Install the wheels and tires.
(13) Add gear lubricant, if necessary. Refer to Lubricant Specifications 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.).
(16) Tighten upper suspension arm bolts to 75 N·m (55 ft. lbs.).
(17) Tighten track bar bolts to 100 N·m (74 ft. lbs.).

ADJUSTMENTS

RING AND PINION GEAR

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. 4). 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 Backlash and Contact Pattern Analysis Paragraph in this section for additional information.

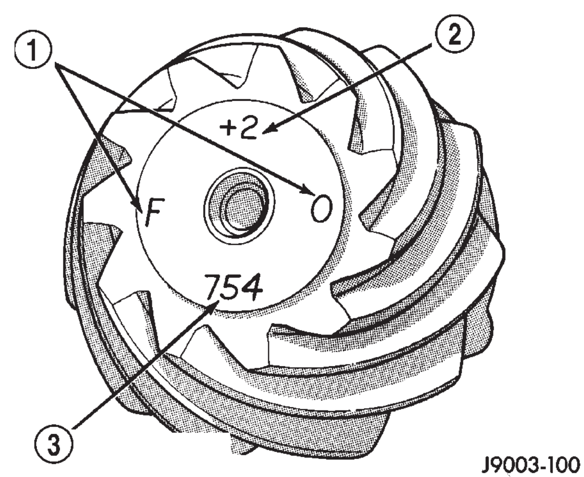


Fig. 4 Pinion Gear ID Numbers

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

REAR AXLE - 216RBI (Continued)

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. 5).

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.

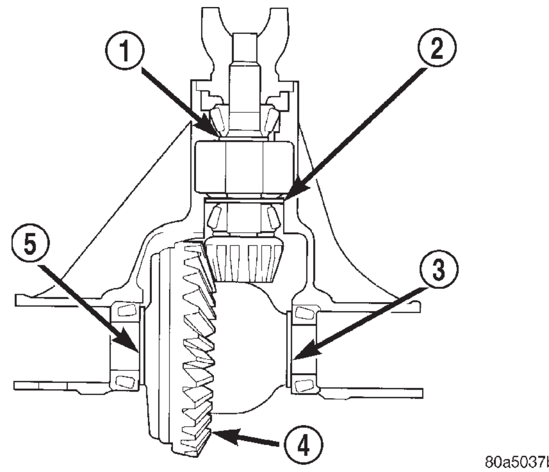


Fig. 5 Adjustment Shim Locations

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

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

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. 6).

(1) Assemble Pinion Height Block 6739, Pinion Block 6734 and rear pinion bearing onto Screw 6741 (Fig. 6).

(2) Insert assembled height gauge components, rear bearing and screw into axle housing through pinion bearing cups (Fig. 7).

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

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in the housing side bearing cradles (Fig. 8). Install differential bearing caps on Arbor Discs and tighten cap bolts to 41 N·m (30 ft. lbs.).

REAR AXLE - 216RBI (Continued)

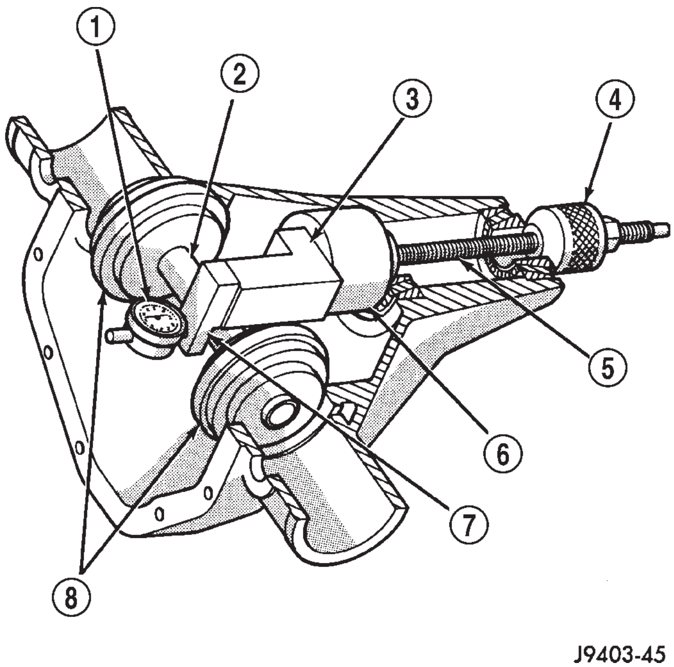


Fig. 6 Pinion Gear Depth Gauge Tools

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

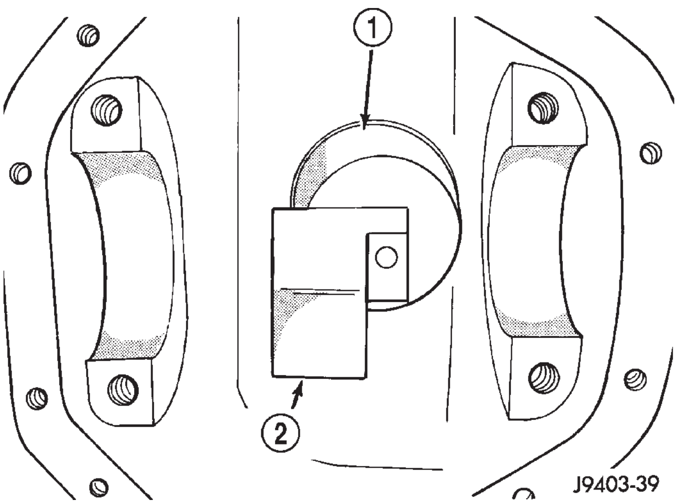


Fig. 7 Pinion Height Block

1 - PINION BLOCK
2 - PINION HEIGHT BLOCK

NOTE: Arbor Discs 6732 have different step diameters to fit other axle sizes. Pick correct size step for axle being serviced.

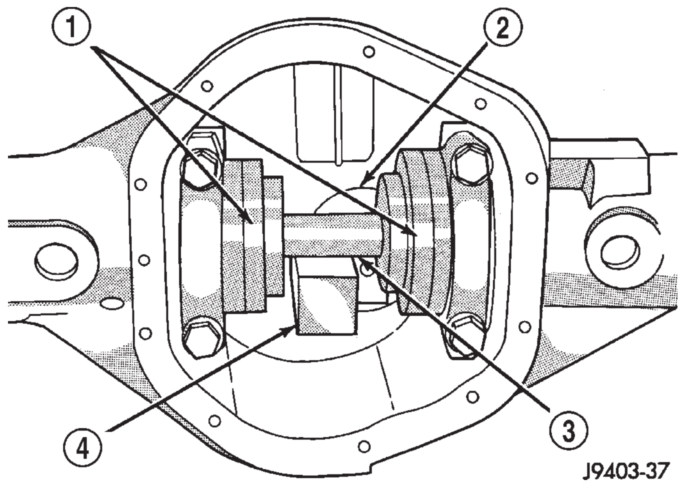


Fig. 8 Gauge Tools In Housing

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

(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. 9). 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 thickest dial indicator reading plus or minus the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 4).

(10) Remove the pinion depth gauge components from the axle housing.

REAR AXLE - 216RBI (Continued)

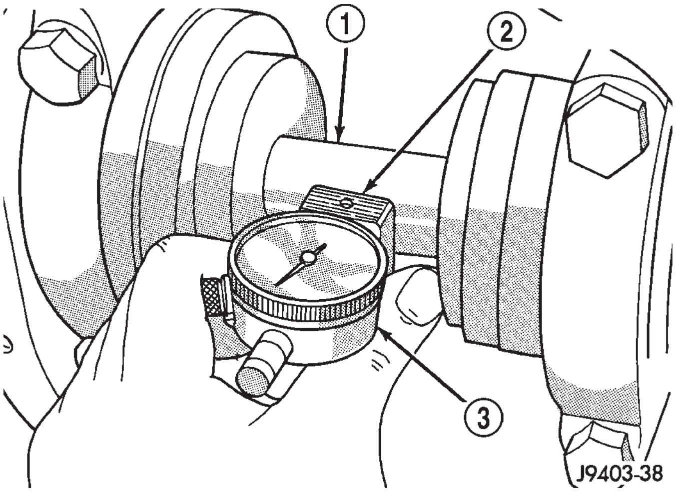


Fig. 9 Pinion Gear Depth Measurement

1 - ARBOR
2 - SCOOTER BLOCK
3 - DIAL INDICATOR

SHIM SELECTION

Differential side bearing preload and gear backlash is achieved by selective shims inserted between the bearing cup and the axle housing. The proper shim thickness can be determined using slip-fit dummy bearings D-345 in place of the differential side bearings and a dial indicator C-3339. Before proceeding with the differential bearing preload and gear backlash measurements, measure the pinion gear depth and prepare the pinion gear for installation. Establishing proper pinion gear depth is essential to establishing gear backlash and tooth contact patterns. After the overall shim thickness to take up differential side play is measured, the pinion gear is installed, and the gear backlash shim thickness is measured. The overall shim thickness is the total of the dial indicator reading and the preload specification added together. The gear backlash measurement determines the thickness of the shim used on the ring gear side of the differential case. Subtract the gear backlash shim thickness from the total overall shim thickness and select that amount for the pinion gear side of the differential (Fig. 10).

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.

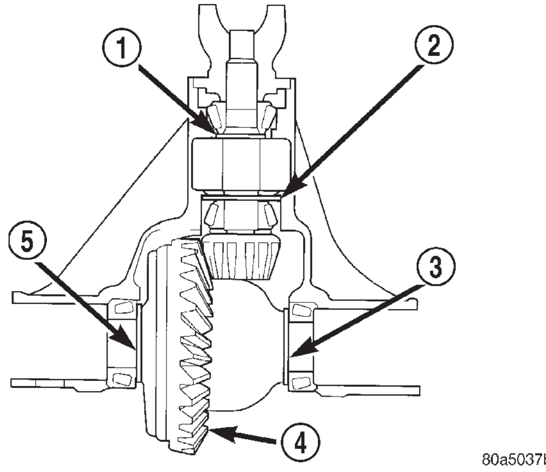


Fig. 10 Adjustment Shim Locations

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

(4) Install dummy side bearings D-345 on differential case.

(5) Install differential case in axle housing (Fig. 11).

(6) Install the marked bearing caps in their correct positions. Install and snug the bolts (Fig. 12).

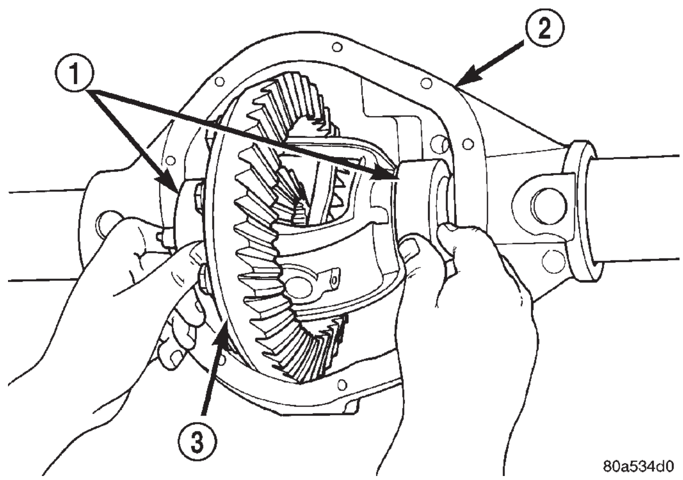


Fig. 11 Differential Dummy Bearings

1 - SPECIAL TOOL D-345
2 - AXLE HOUSING
3 - DIFFERENTIAL CASE

(7) Using a dead-blow hammer seat the differential dummy bearings to each side of the housing (Fig. 13) and (Fig. 14).

(8) Thread Pilot Stud C-3288-B into rear cover bolt hole below ring gear (Fig. 15).

REAR AXLE - 216RBI (Continued)

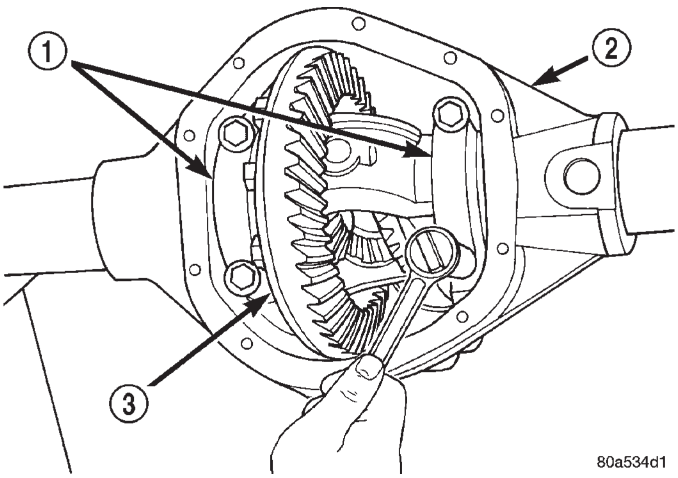


Fig. 12 Tighten Bolts Holding Bearing Caps

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

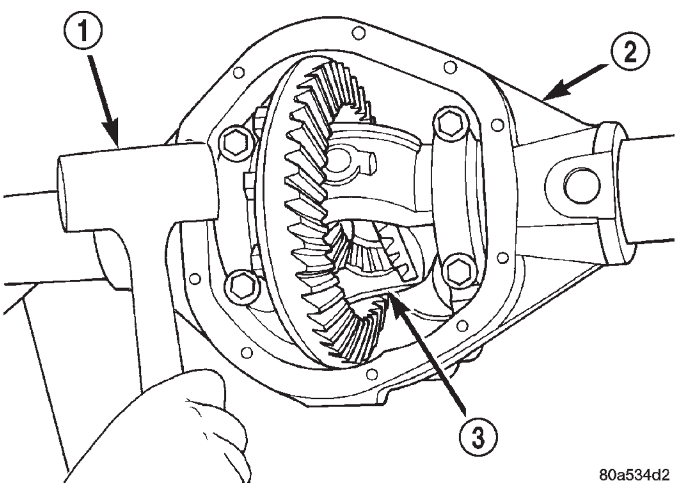


Fig. 13 Seat Pinion Gear Side Differential Dummy Bearing

1 - MALLET
2 - AXLE HOUSING
3 - DIFFERENTIAL CASE

(9) Attach a dial indicator C-3339 to Pilot Stud C-3288-B. Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 15).

(10) Push and hold differential case to pinion gear side of the housing and zero dial indicator (Fig. 16).

(11) Push and hold differential case to ring gear side of the housing and record dial indicator reading (Fig. 17).

(12) Add dial indicator reading to the starting point shim thickness. This is the total shim thickness to achieve zero differential end play.

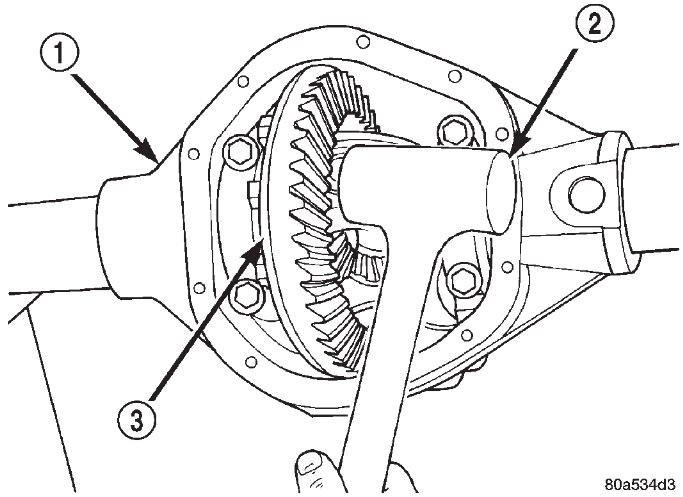


Fig. 14 Seat Ring Gear Side Differential Dummy Bearing

1 - AXLE HOUSING
2 - MALLET
3 - DIFFERENTIAL CASE

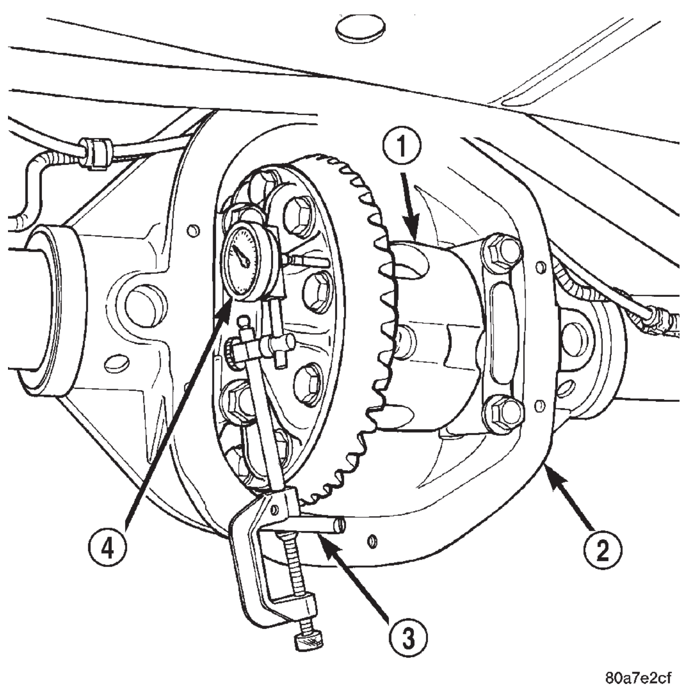


Fig. 15 Differential Side Play Measurement

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

(13) 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.

(14) Rotate dial indicator out of the way on pilot stud.

REAR AXLE - 216RBI (Continued)

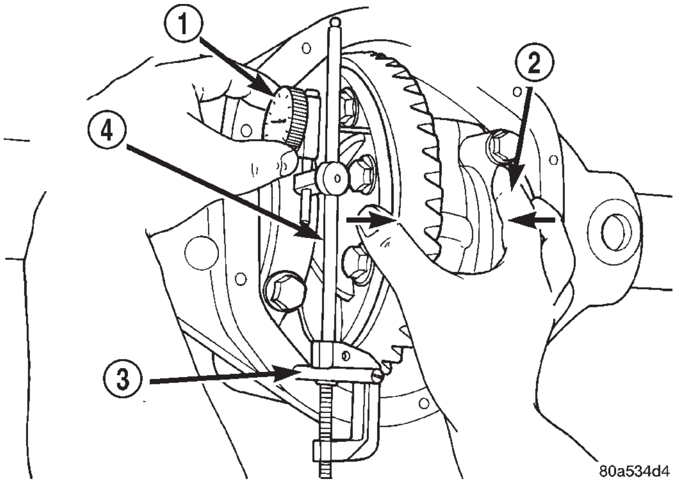


Fig. 16 Differential Case and Dial Indicator

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

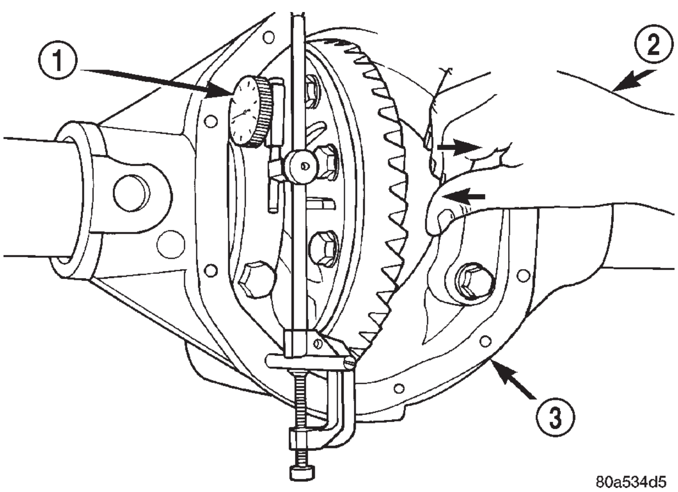


Fig. 17 Hold Differential Case and Read Dial Indicator

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

(15) Remove differential case and dummy bearings from the housing.

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

(17) Install differential case and dummy bearings D-345 in the housing (without shims), install bearing caps and tighten bolts snug.

(18) Seat ring gear side dummy bearing (Fig. 14).

(19) Position the dial indicator plunger on a flat surface between the ring gear bolt heads. (Fig. 15).

(20) Push and hold differential case toward the pinion gear and zero the dial indicator (Fig. 18).

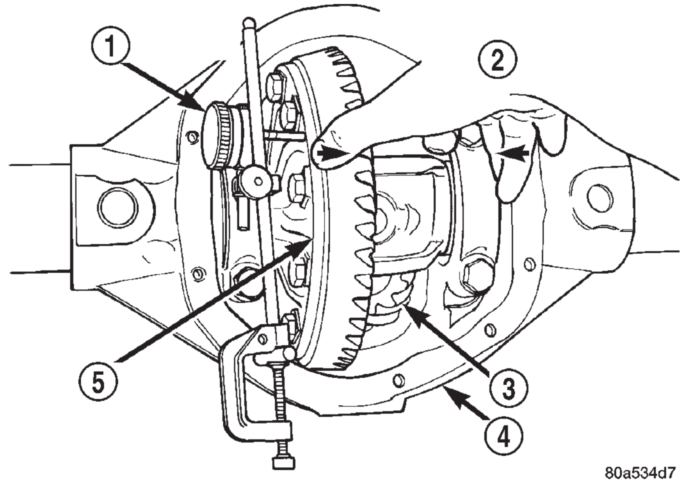


Fig. 18 Differential Case and Dial Indicator

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

(21) Push and hold differential case to ring gear side of the housing and record dial indicator reading (Fig. 19).

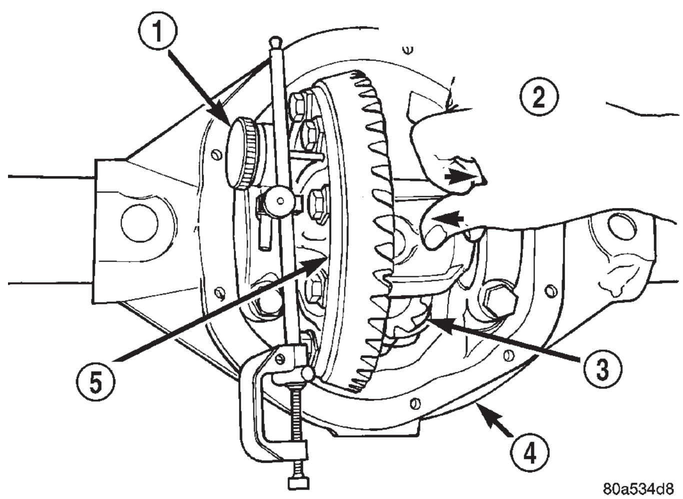


Fig. 19 Hold Differential Case and Read Dial Indicator

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

(22) 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.

REAR AXLE - 216RBI (Continued)

(23) Subtract the backlash shim thickness from the total preload shim thickness. The remainder is the shim thickness required on the pinion side of the housing.
(24) Rotate dial indicator out of the way on pilot stud.
(25) Remove differential case and dummy bearings from the housing.
(26) Install side bearing shims on differential case hubs.
(27) Install new side bearing cones and cups on differential case.
(28) Install spreader W-129-B on the housing and spread axle opening enough to receive differential case.
(29) Install differential case in the housing.
(30) Install differential bearing caps loosely.
(31) Remove spreader from the housing.
(32) Tighten bearing caps bolts to 108 N·m (80 ft. lbs.).
(33) Rotate the differential case several times to seat the side bearings.
(34) Position the indicator plunger against a ring gear tooth (Fig. 20).
(35) Push and hold ring gear upward while not allowing the pinion gear to rotate and zero dial indicator.
(36) 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 housing to the other (Fig. 21).
(37) 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.

GEAR CONTACT PATTERN

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.

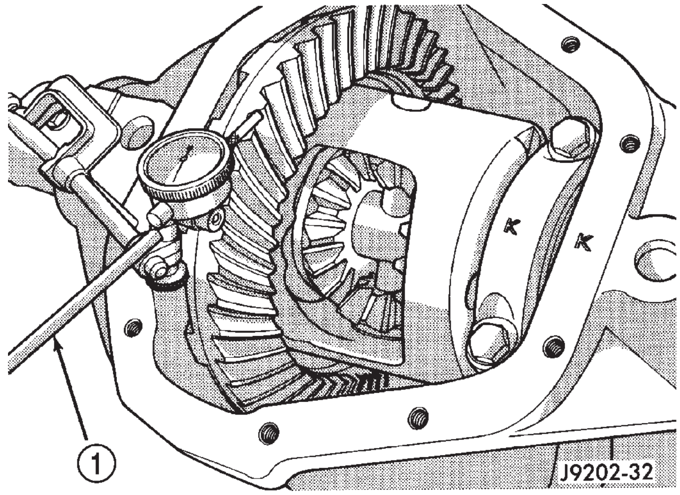


Fig. 20 Ring Gear Backlash Measurement

1 - DIAL INDICATOR

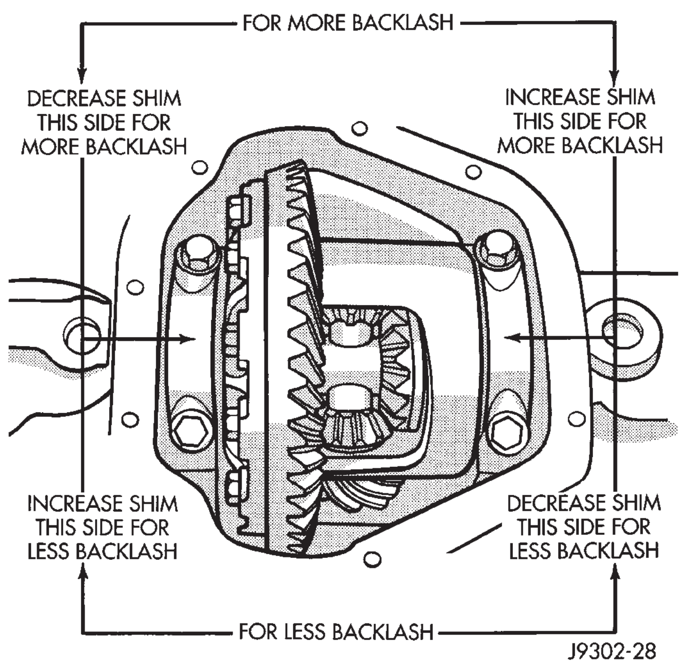


Fig. 21 Backlash Shim Adjustment

(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. 22)and adjust pinion depth and gear backlash as necessary.

REAR AXLE - 216RBI (Continued)

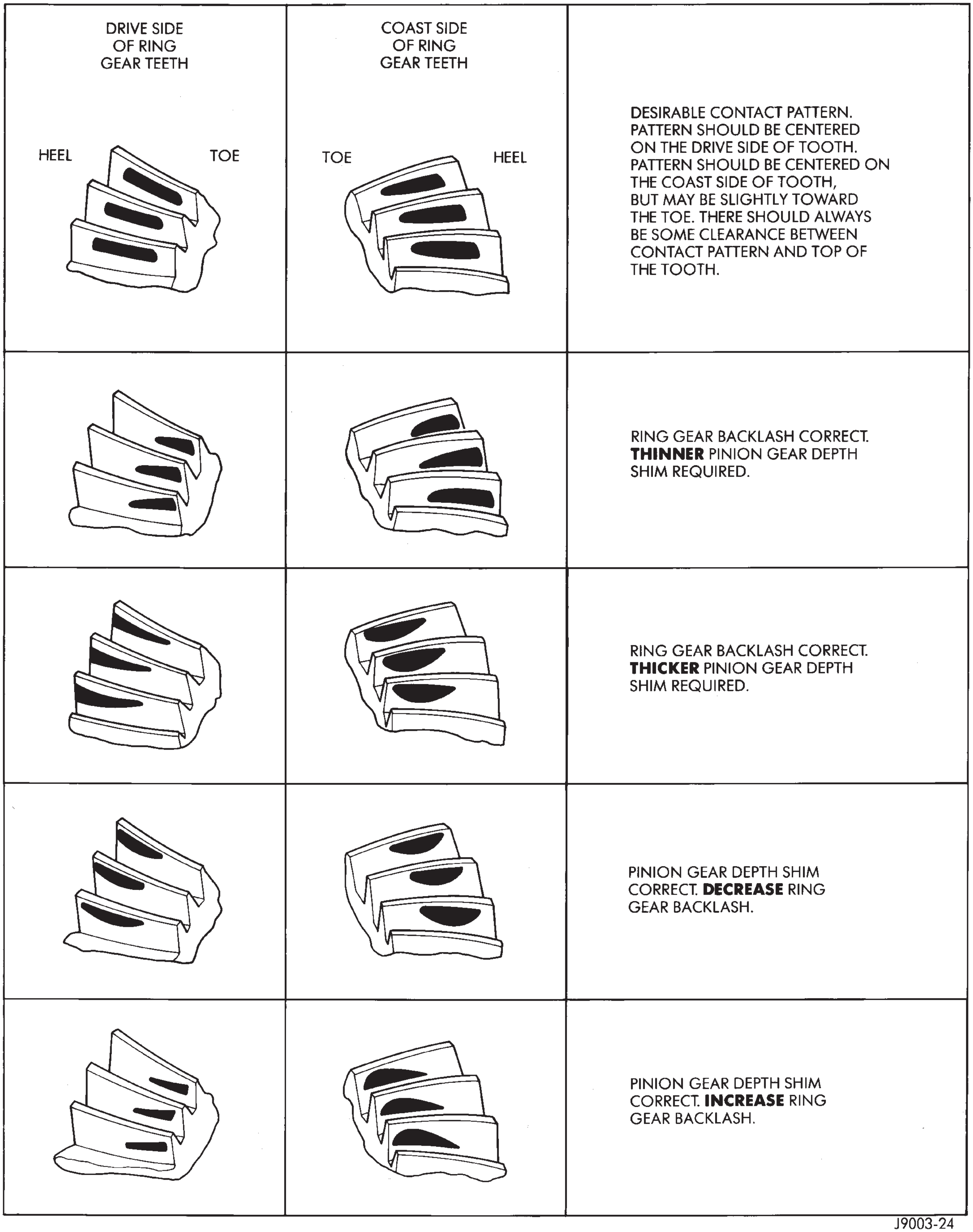


Fig. 22 Gear Tooth Contact Patterns

REAR AXLE - 216RBI (Continued)

DIFFERENTIAL BEARING PRELOAD CHECK

The final check on the differential assembly before installing the axles is torque to rotate pinion and differential combined. This will verify the correct differential bearing preload.

Torque to rotate the differential and pinion should be the torque to rotate the pinion plus 0.79-1.24 N·m (7-11 in. lbs.).

SPECIFICATIONS

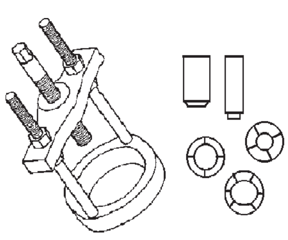
AXLE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Axle Ratio	3.07, 3.55, 3.73, 4.10
Differential Bearing Preload	0.1 mm (0.004 in.)
Differential Side Gear Clearance	0.0-0.15 mm (0.0-0.006 in.)
Ring Gear Diameter	216 mm (8.5 in.)
Ring Gear Backlash	0.12-0.20 mm (0.005-0.008 in.)
Pinion Gear Standard Depth	109.52 mm (4.312 in.)
Pinion Bearing Preload - Original Bearings	1-2 N·m (10-20 in. lbs.)
Pinion Bearing Preload - New Bearings	2-4.5 N·m (20-40 in. lbs.)

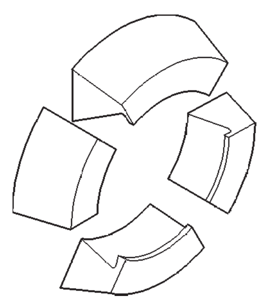
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Fill Hole Plug	34	25	-
Differential Cover Bolts	41	30	-
Bearing Cap Bolts	108	80	-
Ring Gear Bolts	108	80	-
Pinion Nut	217-271	160-200	-

SPECIAL TOOLS

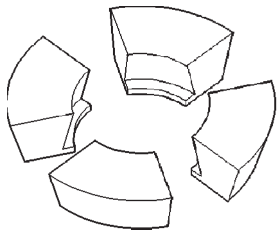


Puller Set C-293-M

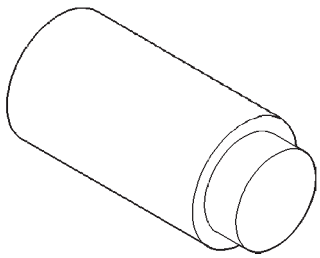


Adapters C-293-18

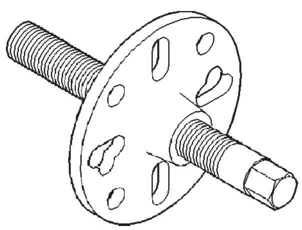
REAR AXLE - 216RBI (Continued)



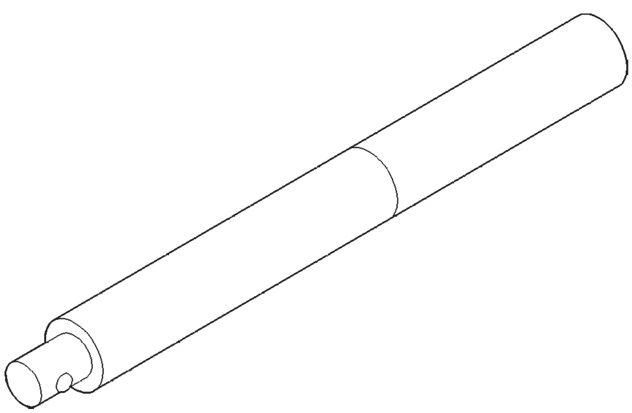
Adapters C-293-48



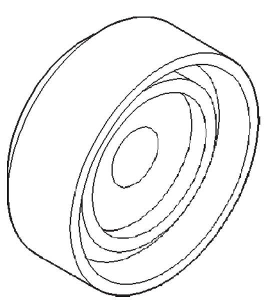
Adapter Plug C-293-3



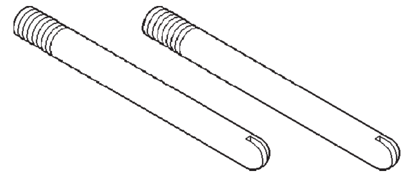
Remover C-452



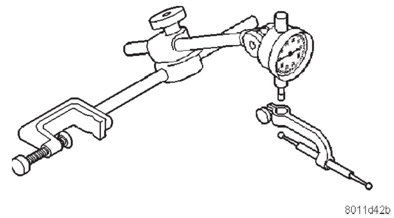
Handle C-4171



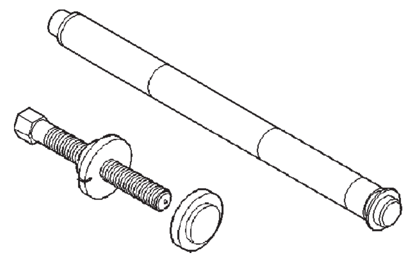
Installer



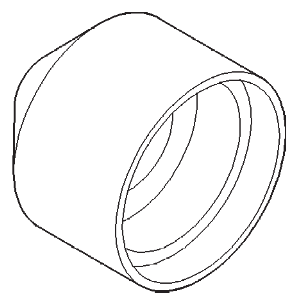
Pilot Studs C-3288-B



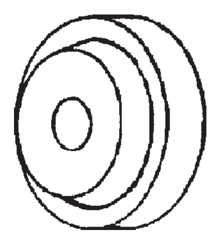
Dial Indicator C-3339



Trac-lok Tools

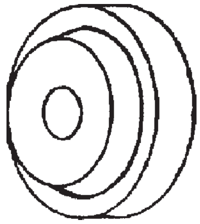


Installer C-3972-A

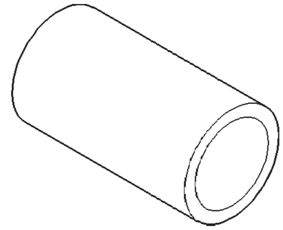


Installer D-144

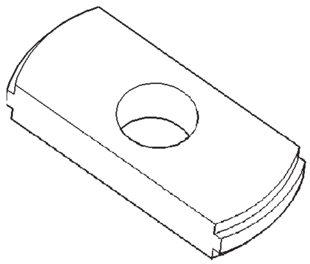
REAR AXLE - 216RBI (Continued)



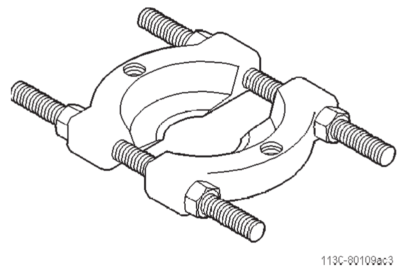
Installer D-145



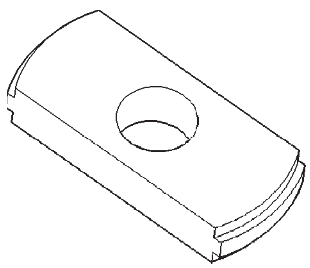
Cup 8109



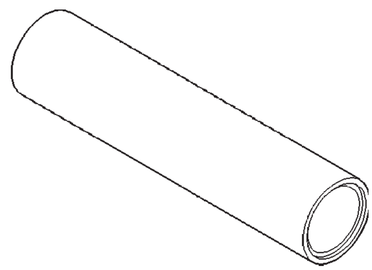
Remover D-147



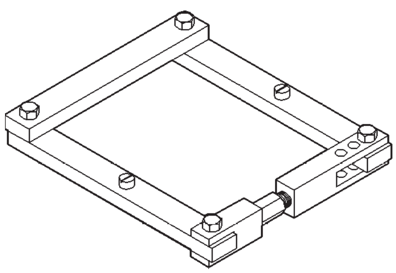
Splitter 1130



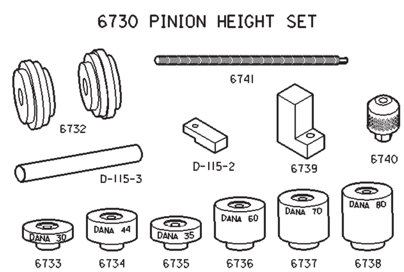
Remover D-148



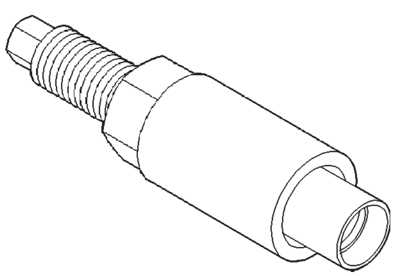
Installer W-262



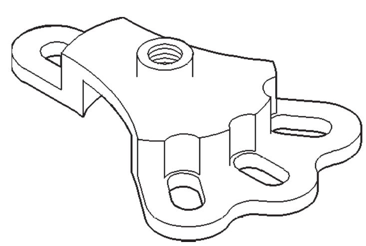
Spreader W-129-B



Pinion Depth Set 6730

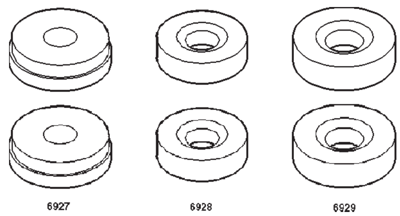


Installer W-162-D

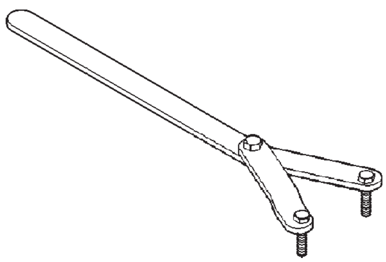


Adapter 6790

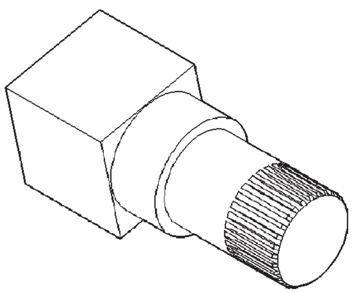
REAR AXLE - 216RBI (Continued)



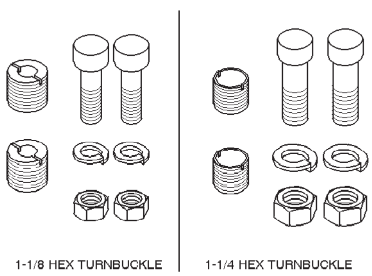
Adapter Set 6956



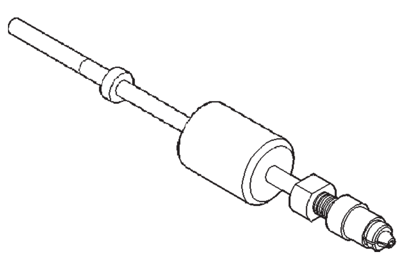
Wrench Spanner 6958



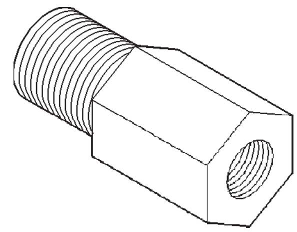
Holder Fixture 6963-A



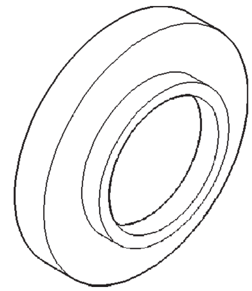
Adapter Set 6987



Slide Hammer 7420



Adapter 7420-8



Installer 7913-A

AXLE SHAFTS

REMOVAL

(1) Place transmission in neutral.
(2) Raise and support vehicle.
(3) Remove wheel and tire assembly.
(4) Remove brake drum.
(5) Remove axle retainer plate nuts through access hole in axle flange.
(6) Pull axle shaft from the axle with Slide Hammer 7420 and Adapter 6790 (Fig. 23).

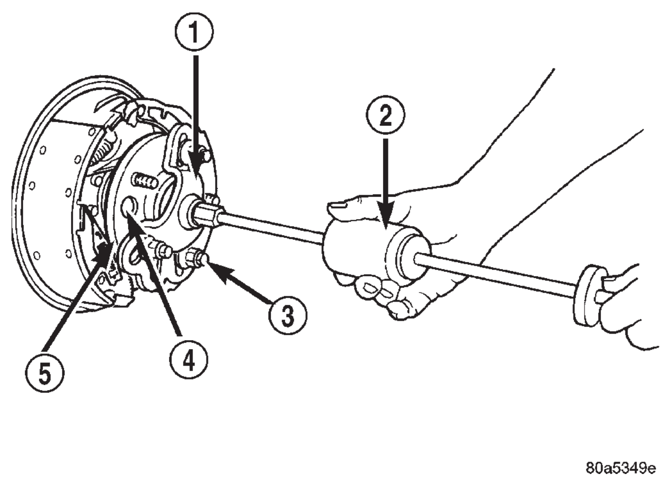


Fig. 23 AXLE SHAFT REMOVAL

1 - ADAPTER
2 - SLIDE HAMMER
3 - LUGNUT
4 - ACCESS HOLE
5 - AXLE SHAFT

AXLE SHAFTS (Continued)

INSTALLATION

WARNING: NEVER REUSE AXLE RETAINING BOLTS AND NUTS. USED TORQUE NUT CAN LOOSEN, CAUSING A DANGEROUS CONDITION.

(1) Insall axle into the axle tube with the flat area of the retainer plate upward.
(2) Install **new** axle retaining bolts.
(3) Install **new** retaining nuts and tighten to 61 N·m (45 ft. lbs.).
(4) Install brake drum.
(5) Install wheel and tire assembly.
(6) Check and fill the differential with gear lubricant.
(7) Lower vehicle.

AXLE BEARINGS

REMOVAL

(1) Raise and support vehicle.
(2) Remove axle shaft from vehicle.

NOTE: It is normal that the axle bearing race is loose in the axle tube.

(3) Drill a shallow hole into soft steel axle bearing retaining ring with a 3/8 in. drill bit (Fig. 24). Use a drill depth stop to avoid marking the axle.
(4) With a cold chisel cut the retaining ring across drilled hole. (Fig. 25)
(5) Slide retaining ring from axle shaft.
(6) Remove the axle bearing from the shaft with, a press and Splitter 1130 placed between the seal and bearing (Fig. 26).
(7) Remove seal from axle.
(8) Remove retaining plate from axle shaft.

INSTALLATION

(1) Verify axle shaft retaining plate is flat with a straight edge.

NOTE: Replace the retaining plate if warped.

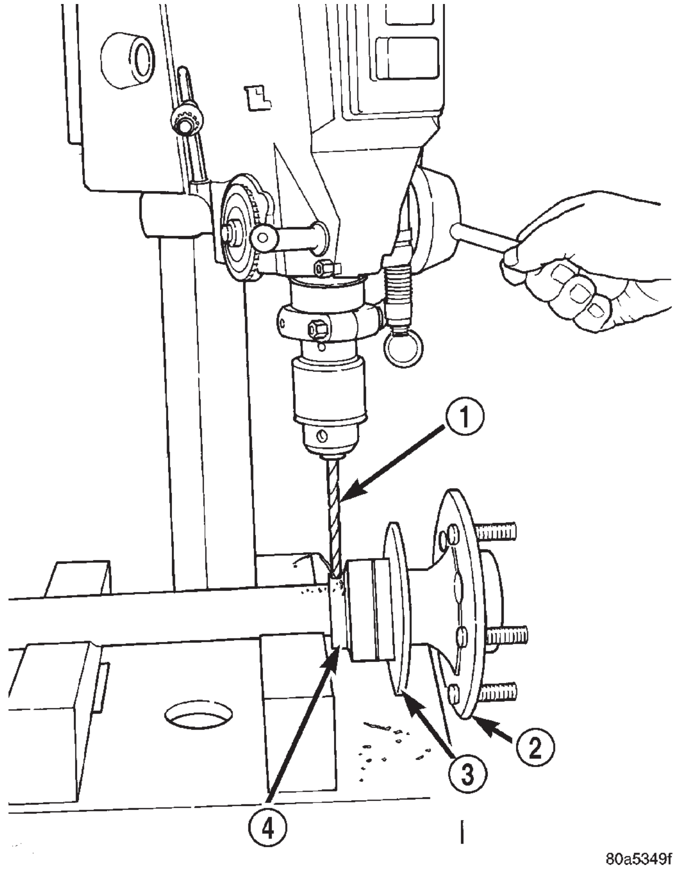


Fig. 24 DRILL RETAINING RING

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

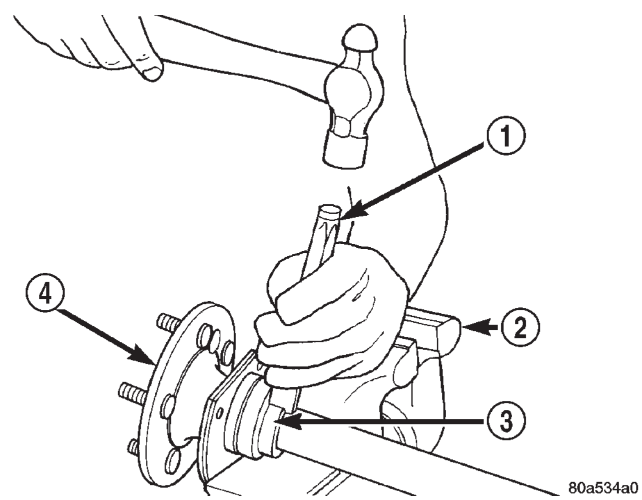


Fig. 25 CUT RETAINING RING

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

AXLE BEARINGS (Continued)

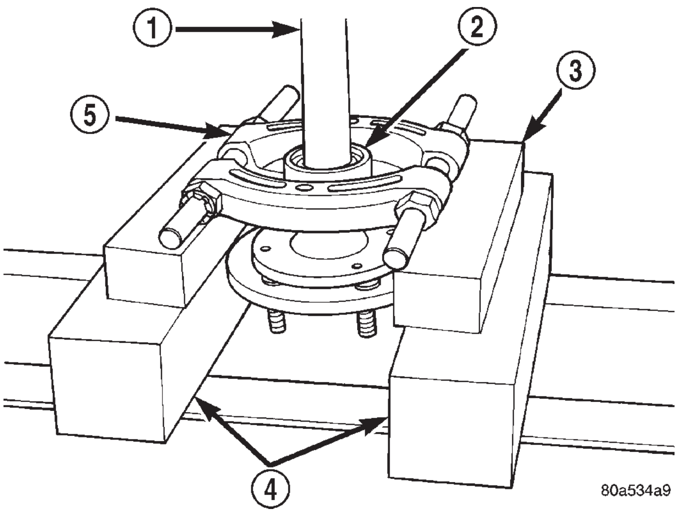


Fig. 26 AXLE BEARING AND SEAL

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

(2) Install retaining plate on axle (Fig. 27).

(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. 27).

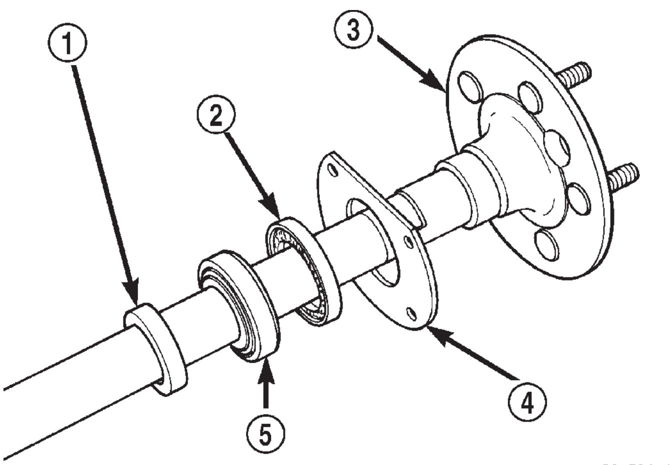


Fig. 27 AXLE BEARING AND SEAL COMPONENTS

1 - RETAINING RING
2 - SEAL
3 - AXLE
4 - RETAINING PLATE
5 - BEARING

(5) Lubricate bearing with Mopar Wheel Bearing Grease, or equivalent. Wipe excess grease from outside of bearing.

(6) Install bearing on the axle shaft with Installer 7913 and a press (Fig. 28).

NOTE: Install bearing with groove on the outer surface toward the seal.

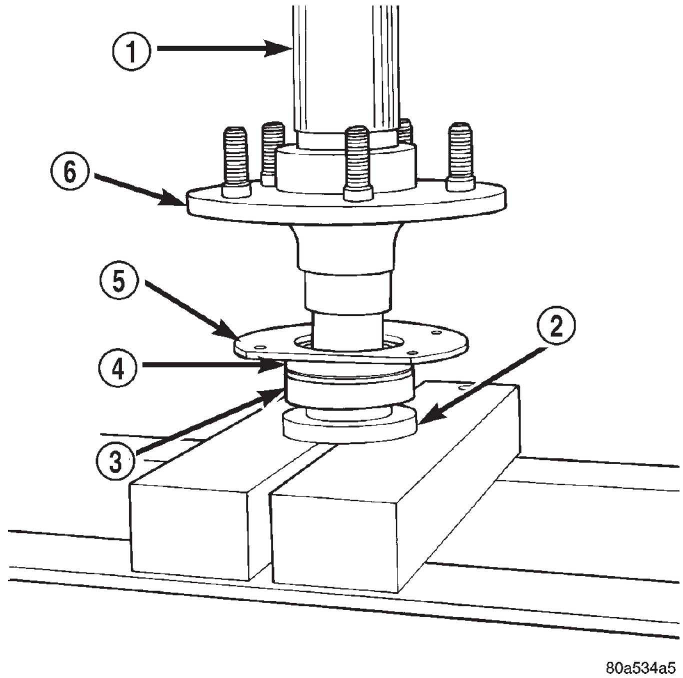


Fig. 28 PRESS BEARING ON AXLE

1 - PRESS RAM
2 - INSTALLER
3 - UNIT BEARING
4 - SEAL
5 - RETAINING PLATE
6 - AXLE

(7) Press soft metal retaining ring onto axle shaft with Installer 7913 and a press (Fig. 29).

(8) Install axle in vehicle.

PINION SEAL

REMOVAL

(1) Raise and support the vehicle.

(2) Remove wheel and tire assemblies.

(3) Remove brake drums.

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

(5) Remove propeller shaft from the yoke.

(6) Rotate pinion gear three or four times and verify that pinion rotates smoothly.

(7) Using Spanner Wrench 6958 to hold the pinion yoke, remove the pinion nut and washer.

(8) Remove pinion yoke with Remover C-452 and Flange Wrench C-3281 (Fig. 30).

PINION SEAL (Continued)

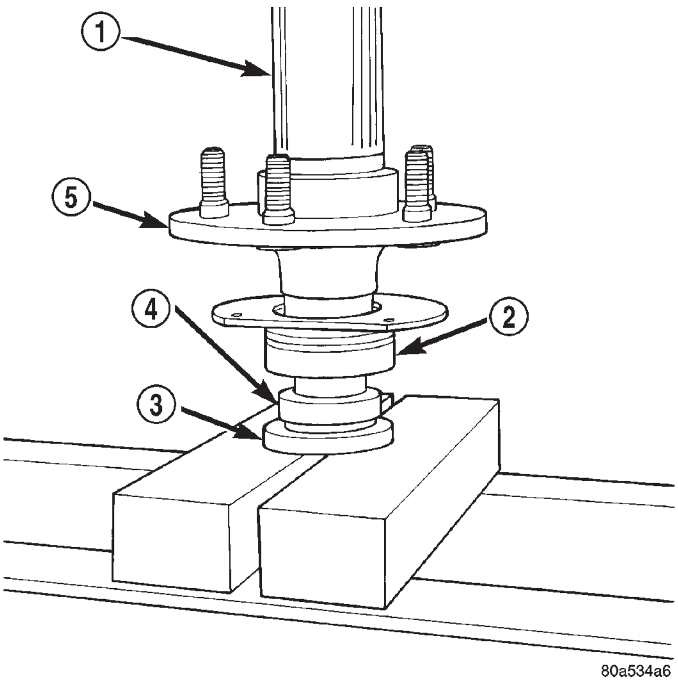


Fig. 29 PRESS RETAINING RING ON AXLE

1 - PRESS RAM
2 - UNIT BEARING
3 - INSTALLER
4 - METAL RETAINING RING
5 - AXLE

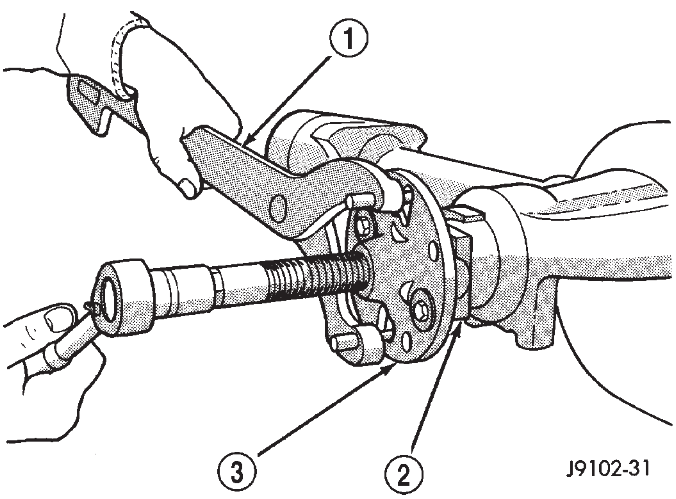


Fig. 30 PINION YOKE REMOVER

1 - FLANGE WRENCH
2 - PINION YOKE
3 - REMOVER

(9) Remove pinion shaft seal with a pry tool or slide hammer mounted screw.

INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with an appropriate installer (Fig. 31).

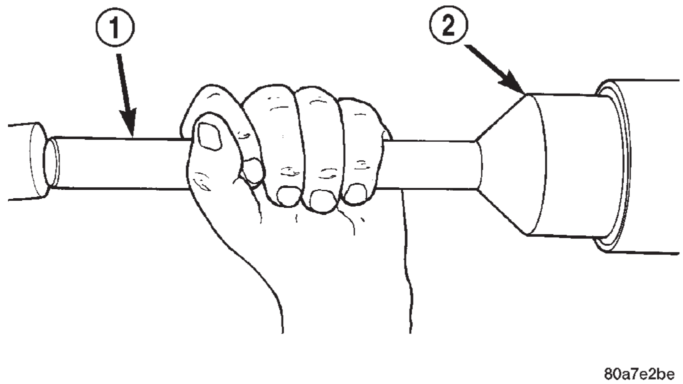


Fig. 31 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

(2) Install yoke on pinion gear with Installer W-162–D, Cup 8109 and Spanner Wrench 6958 (Fig. 32).

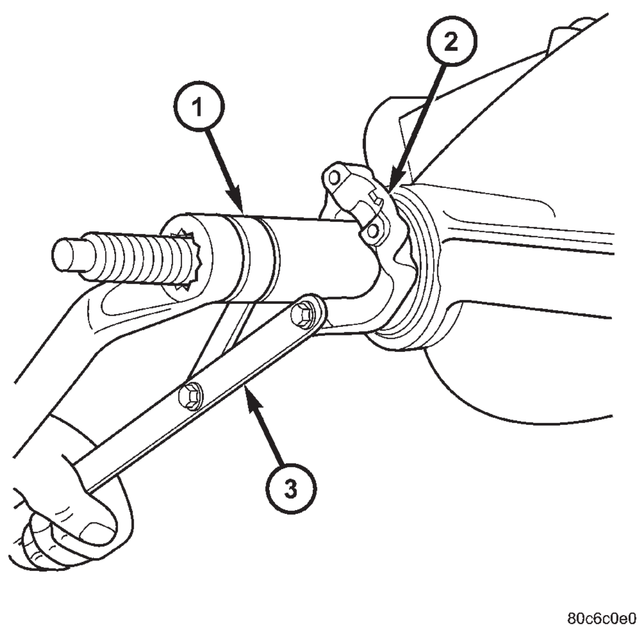


Fig. 32 YOKE SPANNER WRENCH

1 - INSTALLER
2 - PINION YOKE
3 - SPANNER WRENCH

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

PINION SEAL (Continued)

(4) Hold pinion yoke with Spanner Wrench 6958 (Fig. 33) and tighten pinion nut to 217 to 271N·m (160 to 200 ft. lbs.).

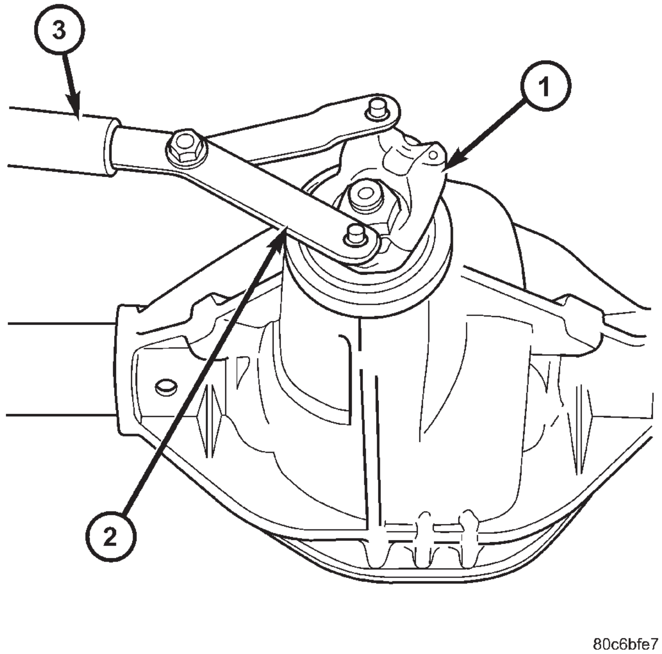


Fig. 33 YOKE SPANNER WRENCH

1 - PINION YOKE
2 - SPANNER WRENCH
3 - PIPE

(5) Install propeller shaft with reference marks aligned.
(6) Add gear lubricant to the differential if necessary.
(7) Install the brake drums.
(8) Install wheel and tire assemblies.
(9) Lower the vehicle.

DIFFERENTIAL

REMOVAL

(1) Raise and support vehicle.
(2) Remove fill hole plug from the differential housing cover.
(3) Remove differential housing cover and drain fluid.
(4) Clean the housing cavity with flushing oil, light engine oil or lint free cloth.

NOTE: Do not use water, steam, kerosene or gasoline for cleaning.

(5) Remove axle shafts.
(6) Note the reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 34).

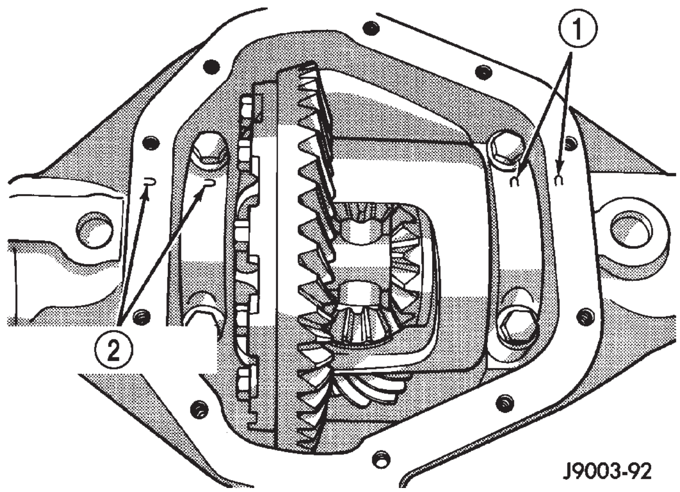


Fig. 34 BEARING CAP REFERENCE

1 - REFERENCE LETTERS
2 - REFERENCE LETTERS

(7) Loosen the differential bearing cap bolts.
(8) Position Spreader W-129-B with Adapter Kit 6987B on differential locating holes (Fig. 35). Install holddown clamps and tighten the turnbuckle finger-tight.
(9) 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. 36) and zero the indicator.

CAUTION: Never spread the housing over 0.38 mm (0.015 in). If housing is over-spread, it could distorted and damaged the housing.

(10) Spread housing enough to remove the differential case from the housing. Measure the distance with the dial indicator (Fig. 37).
(11) Remove the dial indicator.
(12) While holding the differential case in position, remove the differential bearing cap bolts and caps.
(13) Remove differential from the housing and tag differential bearing cups to indicate location (Fig. 38).
(14) Remove spreader from housing.

DIFFERENTIAL (Continued)

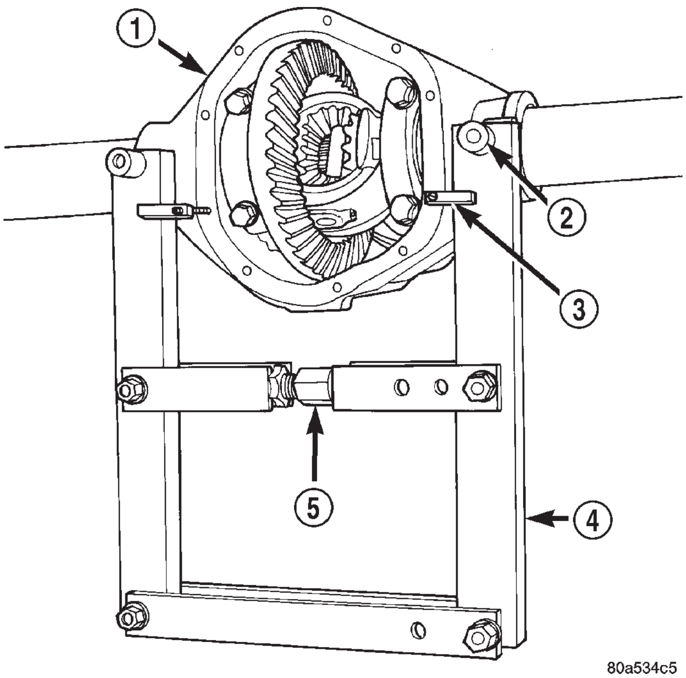


Fig. 35 SPREADER LOCATION

1 - DIFFERENTIAL HOUSING
2 - DOWEL
3 - SAFETY HOLD DOWN
4 - SPREADER
5 - TURNBUCKLE

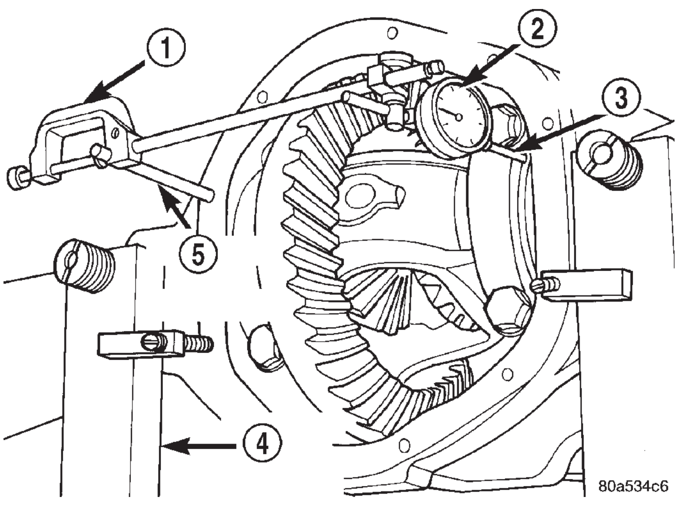


Fig. 36 DIAL INDICATOR LOCATION

1 - CLAMP
2 - DIAL INDICATOR
3 - LEVER ADAPTER
4 - SPREADER
5 - PILOT STUD

DISASSEMBLY

(1) Remove pinion shaft lock roll pin with a hammer and punch.

(2) Remove pinion shaft.

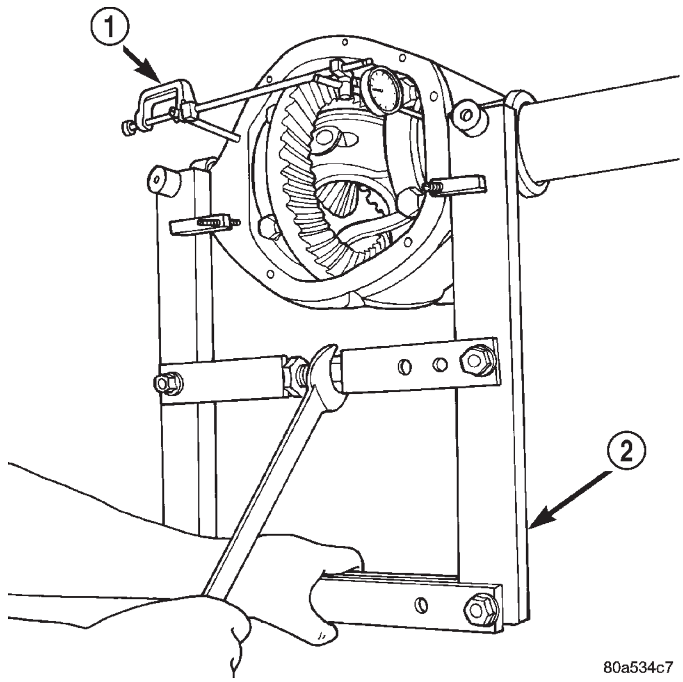


Fig. 37 SPREAD DIFFERENTIAL HOUSING

1 - DIAL INDICATOR
2 - SPREADER

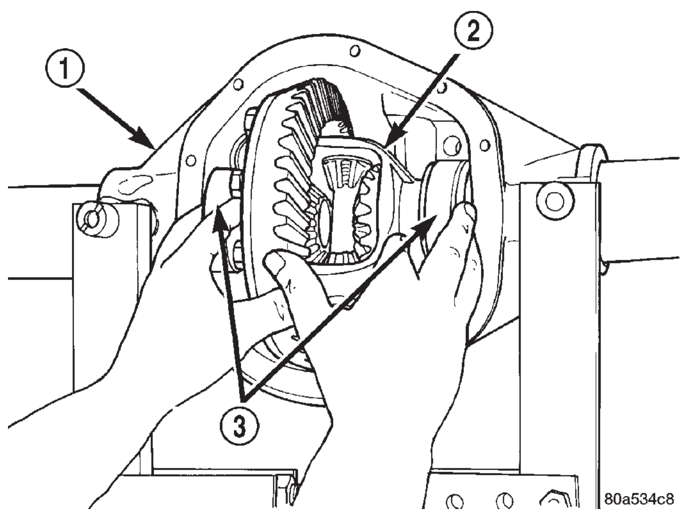


Fig. 38 DIFFERENTIAL CASE REMOVAL

1 - DIFFERENTIAL HOUSING
2 - DIFFERENTIAL CASE
3 - BEARING CUPS

(3) Rotate differential side gears and remove the differential pinions and thrust washers (Fig. 39).

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

DIFFERENTIAL (Continued)

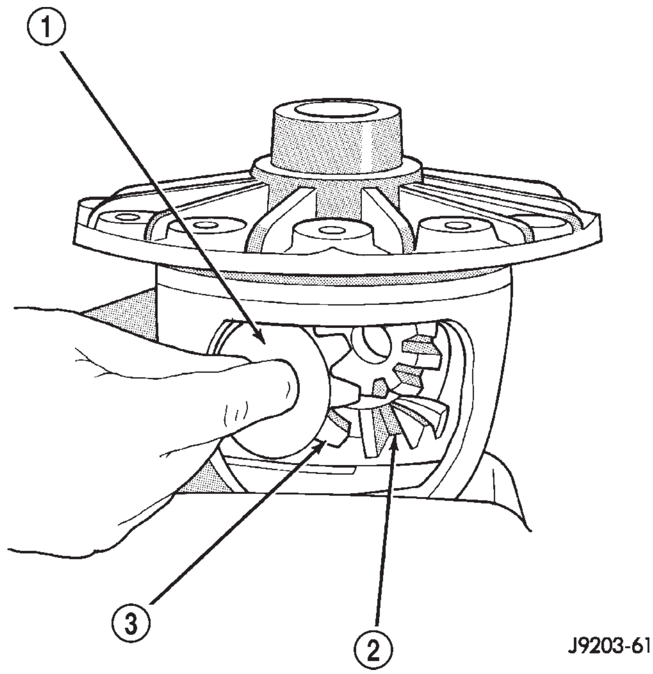


Fig. 39 DIFFERENTIAL GEARS

1 - THRUST WASHER
2 - SIDE GEAR
3 - DIFFERENTIAL PINION

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 roll pin.

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

INSTALLATION

NOTE: If replacement differential bearings or differential case are being installed, differential side bearing shim requirements may change. Refer Adjustments (Differential Bearing Preload and Gear Backlash) to determine the proper shim selection.

(1) Position Spreader W-129-B and adapters from Adapter set 6987, with the tool dowel pins seated in the locating holes (Fig. 40). Install holddown clamps and tighten the tool turnbuckle finger-tight.

(2) Install 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 and zero the indicator.

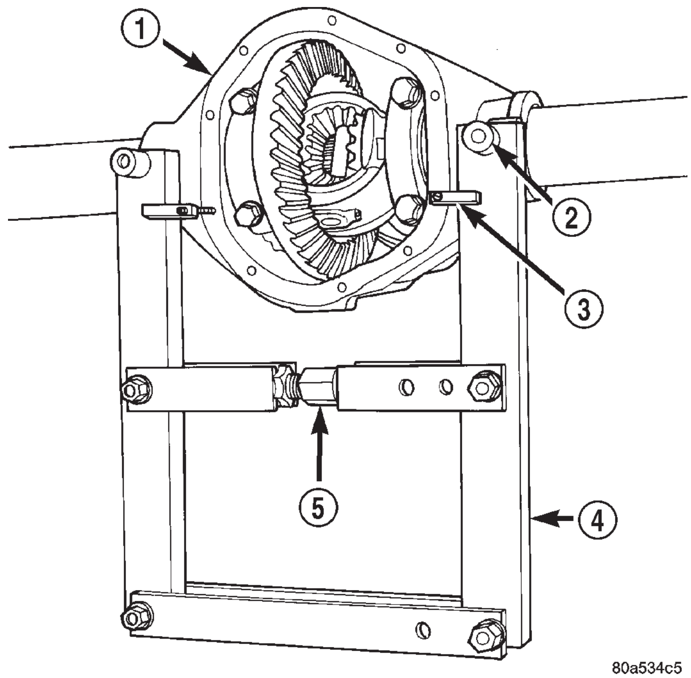


Fig. 40 SPREADER LOCATION

1 - DIFFERENTIAL HOUSING
2 - DOWEL
3 - SAFETY HOLD DOWN
4 - SPREADER
5 - TURNBUCKLE

CAUTION: Never 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.

(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 seated in the housing.

(6) Install bearing caps in their original locations (Fig. 41).

(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.).

(10) Install the axle shafts.

(11) Apply a 6.35mm (1/4 in.) bead of red Mopar Silicone Rubber Sealant or equivalent to the housing cover (Fig. 42).

CAUTION: If housing cover is not installed within 3 to 5 minutes, the cover must be cleaned and new RTV applied or adhesion quality will be compromised.

DIFFERENTIAL (Continued)

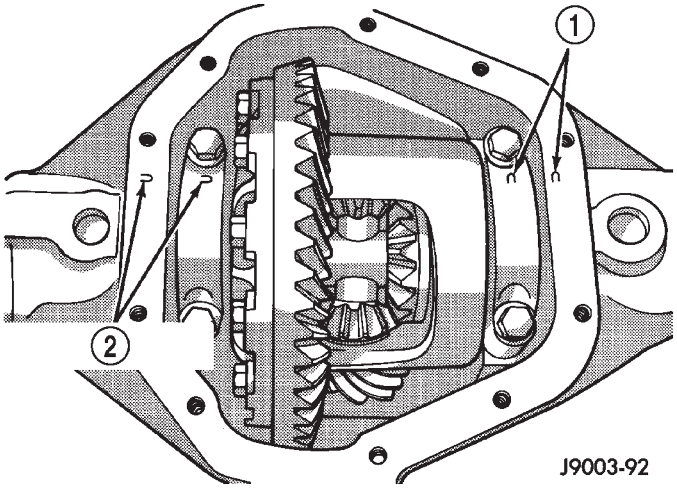


Fig. 41 BEARING CAP REFERENCE

1 - REFERENCE LETTERS
2 - REFERENCE LETTERS

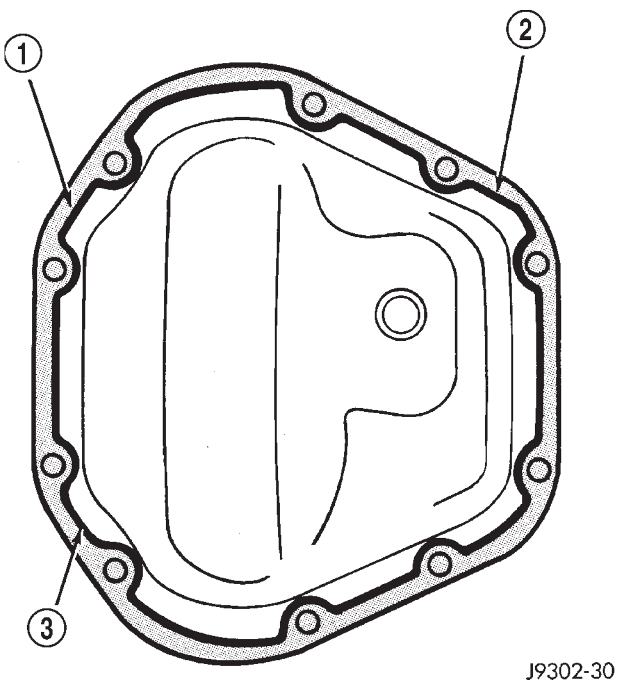


Fig. 42 DIFFERENTIAL COVER

1 - SEALANT SURFACE
2 - SEALANT
3 - SEALANT THICKNESS

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

(13) Refill the differential with Mopar Hypoid Gear Lubricant or equivalent to bottom of the fill plug hole.

(14) Install the fill hole plug.

(15) Install wheel and tire assemblies.

(16) Remove support and lower the vehicle.

DIFFERENTIAL - TRAC-LOK

DIAGNOSIS AND TESTING - TRAC-LOK®

The most common problem is a chatter noise when turning corners. Before removing the unit for repair, drain, flush and refill the axle with the specified lubricant. 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.

DIFFERENTIAL TEST

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 or equivalent tool to studs.

(5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 43).

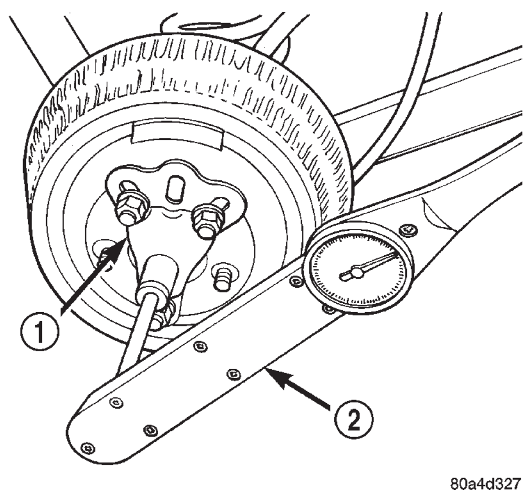


Fig. 43 ROTATING TORQUE TEST

1 - SPECIAL TOOL WITH BOLT IN CENTER HOLE
2 - TORQUE WRENCH

(6) If rotating torque is less than 41 N·m (56 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be serviced.

DIFFERENTIAL - TRAC-LOK (Continued)

DISASSEMBLY

(1) Clamp side gear Fixture 6965 in a vise and set differential case on the fixture (Fig. 44).

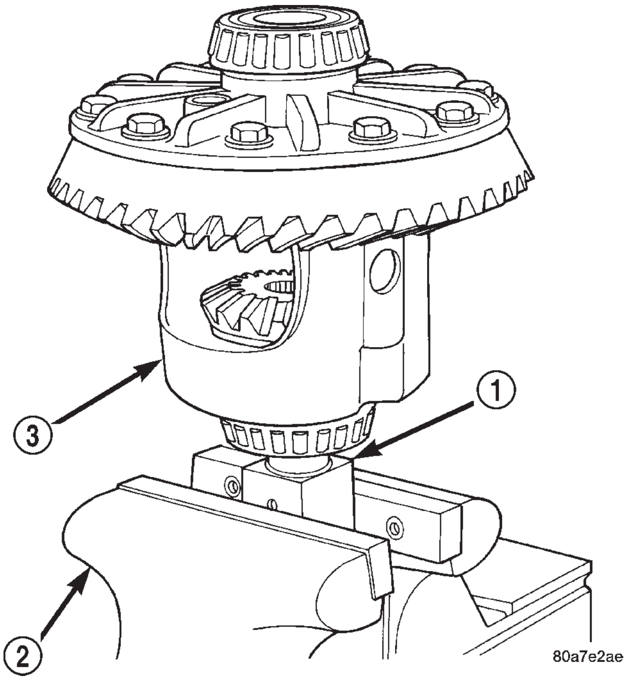


Fig. 44 DIFFERENTIAL CASE FIXTURE

1 - HOLDING FIXTURE
2 - VISE
3 - DIFFERENTIAL

(2) Remove ring gear if the ring gear is to be replaced.

NOTE: The Trac-lok® differential can be serviced with the ring gear installed unless the gear hangs over the pinion shaft, then it must be removed.

(3) Remove pinion gear mate shaft lock screw (Fig. 45).

(4) Remove pinion gear mate shaft with a drift and hammer.

(5) Install and lubricate Step Plate C-6960-3 (Fig. 46).

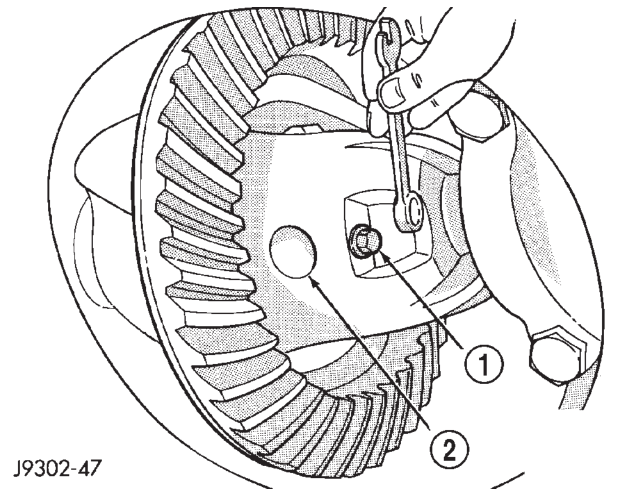


Fig. 45 MATE SHAFT LOCK SCREW

1 - LOCK SCREW
2 - PINION GEAR MATE SHAFT

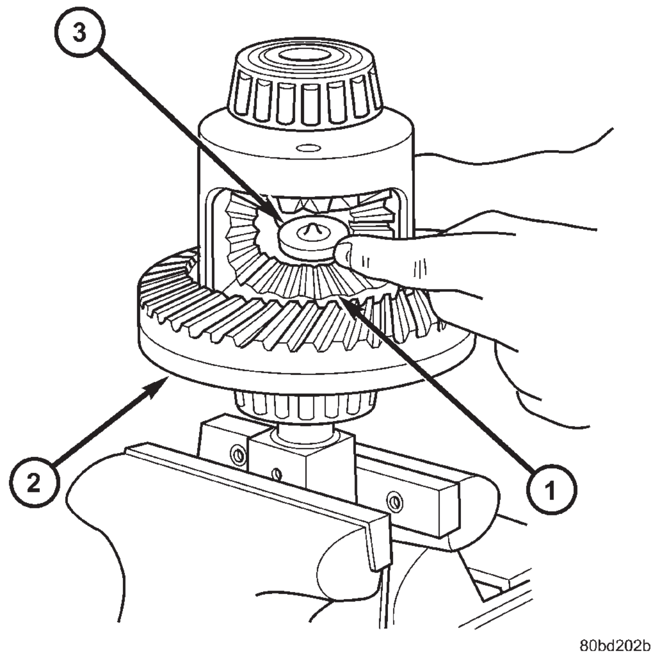


Fig. 46 STEP PLATE

1 - LOWER SIDE GEAR
2 - DIFFERENTIAL CASE
3 - STEP PLATE

DIFFERENTIAL - TRAC-LOK (Continued)

(6) 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.

(7) Position a small screw driver in slot of Threaded Adapter Disc C-6960-3 (Fig. 47) to prevent adapter from turning.

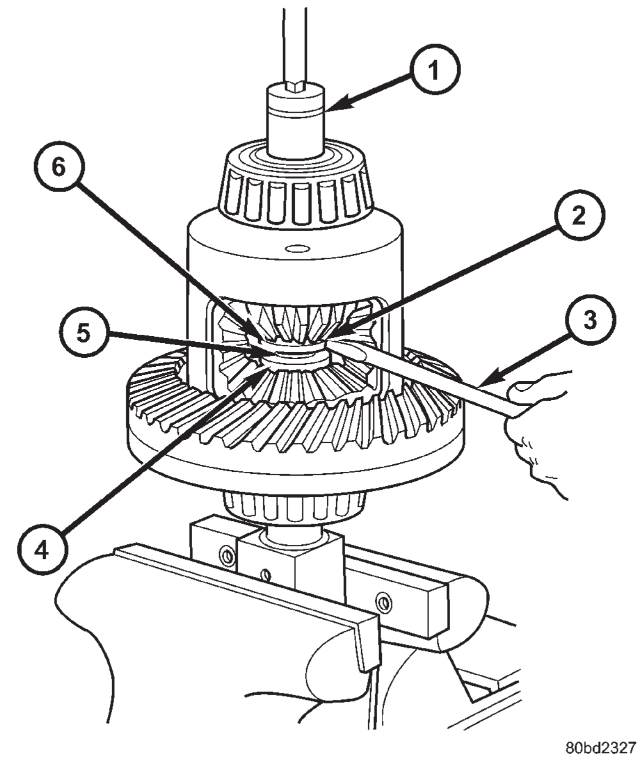


Fig. 47 THREAD ADAPTER DISC

1 - SOCKET
2 - SLOT IN ADAPTER
3 - SCREWDRIVER
4 - STEP PLATE
5 - THREADED ROD
6 - ADAPTER DISC

(8) Install Forcing Screw C-6960-4 and tighten screw to 122 N·m (90 ft. lbs.) maximum to compress Belleville springs in clutch packs (Fig. 48).

(9) With a feeler gauge remove thrust washers from behind the pinion gears (Fig. 49).

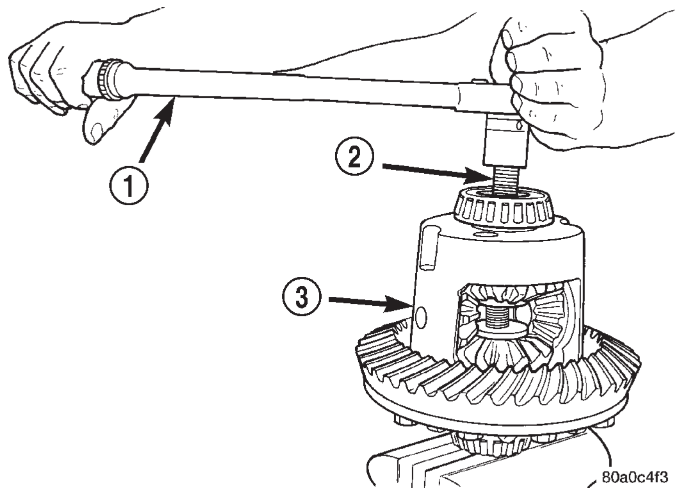


Fig. 48 COMPRESS BELLEVILLE SPRING

1 - TORQUE WRENCH
2 - FORCING SCREW
3 - DIFFERENTIAL CASE

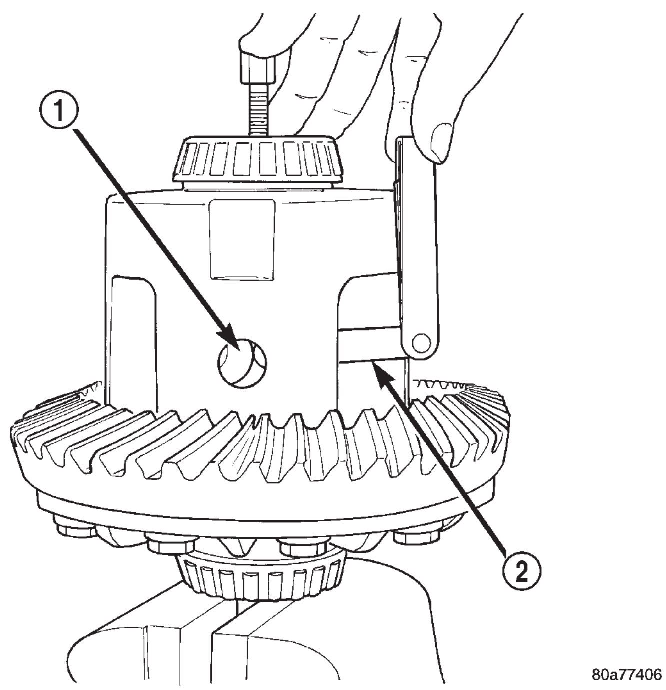


Fig. 49 PINION GEAR THRUST WASHER

1 - THRUST WASHER
2 - FEELER GAUGE

DIFFERENTIAL - TRAC-LOK (Continued)

(10) Insert Turning Bar C-6960-2 into the pinion mate shaft hole in the case (Fig. 50).

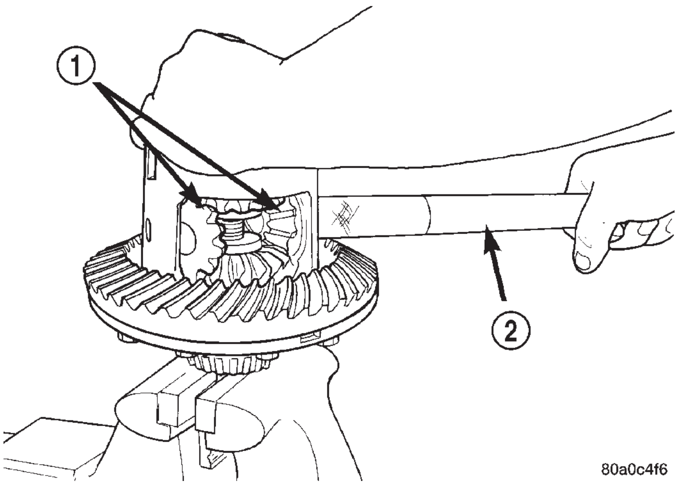


Fig. 50 PINION GEARS

1 - PINION GEARS
2 - TURNING BAR

(11) Loosen the Forcing Screw in small increments until the clutch pack tension is relieved and the differential case can be turned using Turning Bar.

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

(13) Remove pinion gears from differential case.

(14) Remove Forcing Screw, Step Plate and Threaded Adapter.

(15) Remove top side gear, clutch pack retainer and clutch pack. Keep plates in order during removal (Fig. 51).

(16) Remove differential case from the Holding Fixture. Remove side gear, clutch pack retainer and clutch pack. Keep plates in order during removal.

CLEANING

Clean all components in cleaning solvent and dry components with compressed air.

INSPECTION

Inspect clutch pack plates for wear, scoring or damage. Replace both clutch packs if any one component in either pack is damaged. Inspect side and pinion gears for cracks chips or damage and replace as necessary. Inspect differential case and pinion shaft and replace if worn or damaged.

ASSEMBLY

NOTE: New 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.

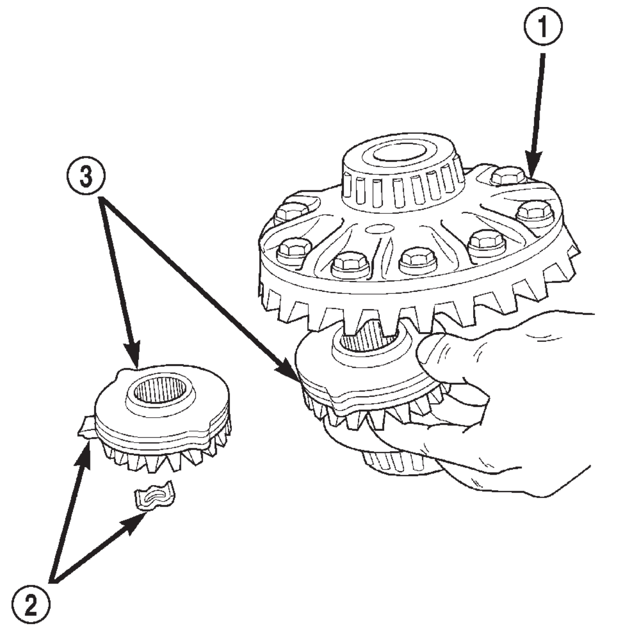


Fig. 51 SIDE GEARS AND CLUTCH DISCS

1 - DIFFERENTIAL CASE
2 - RETAINER
3 - SIDE GEAR AND CLUTCH DISC PACK

(1) Lubricate components with gear lubricant.

(2) Assemble clutch discs into packs and secure disc packs with retaining clips (Fig. 52).

NOTE: Dished plate is position with the convex side against the side gear.

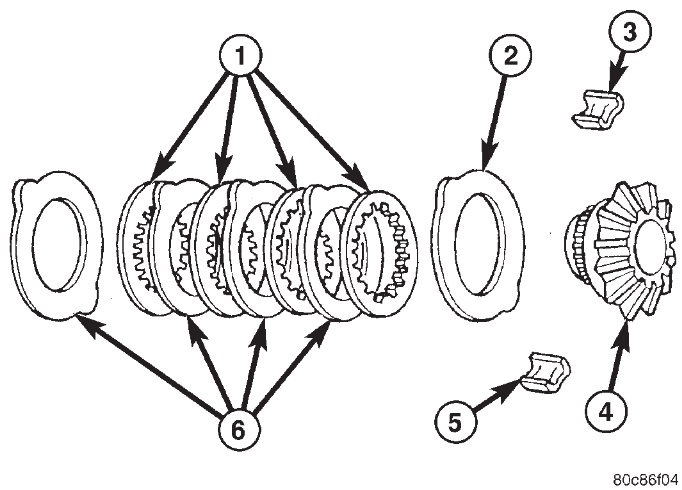


Fig. 52 CLUTCH PACK

1 - DISCS
2 - DISHED PLATE
3 - RETAINER
4 - SIDE GEAR
5 - RETAINER
6 - PLATES

DIFFERENTIAL - TRAC-LOK (Continued)

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

(4) Install clutch pack and side gear in the ring gear side of the differential case (Fig. 53). **Verify clutch pack retaining clips are in position and seated in the case pockets.**

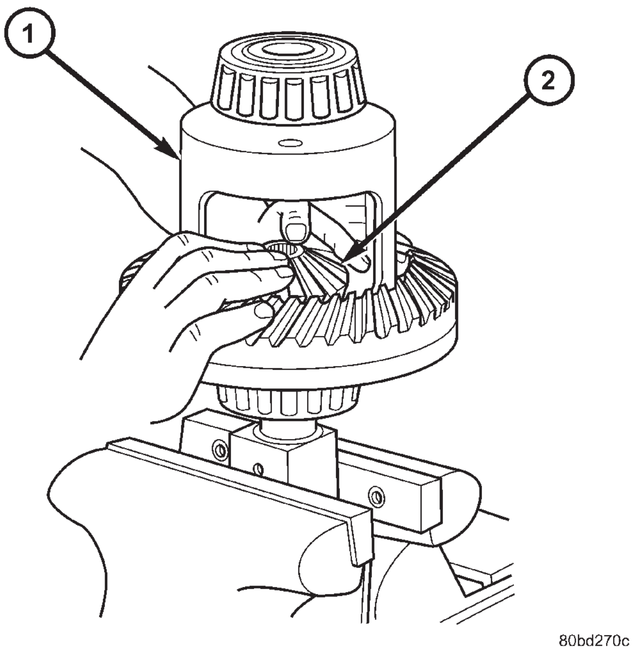


Fig. 53 CLUTCH PACK AND LOWER SIDE GEAR

1 - DIFFERENTIAL CASE
2 - SIDE GEAR AND CLUTCH PACK

(5) Position the differential case on the Holding Fixture 6965.

(6) Install lubricated Step Plate C-6960-3 in lower side gear (Fig. 54).

(7) Install the upper side gear and clutch disc pack (Fig. 54).

(8) Hold assembly in position. Insert Threaded Adapter C-6960-1 into top side gear.

(9) Install Forcing Screw C-6960-4 and tighten screw to slightly compress clutch disc.

(10) Place pinion gears in position in side gears and verify that the pinion mate shaft hole is aligned.

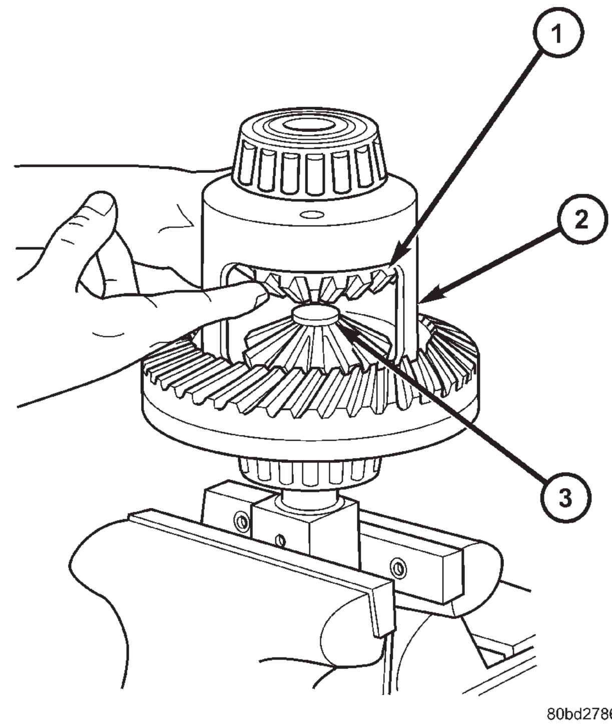


Fig. 54 CLUTCH PACK AND UPPER SIDE GEAR

1 - SIDE GEAR AND CLUTCH PACK
2 - DIFFERENTIAL CASE
3 - STEP PLATE

(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, Step Plate and Threaded Adapter.

(15) Install pinion gear mate shaft and align holes in shaft and case.

(16) Install pinion mate shaft lock screw finger tight to hold shaft during differential installation.

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

DIFFERENTIAL CASE BEARINGS

REMOVAL

(1) Remove differential case from axle housing.

(2) Remove bearings from the differential case with Puller/Press C-293-PA, Adapters C-293-18 and Plug SP-3289 (Fig. 55).

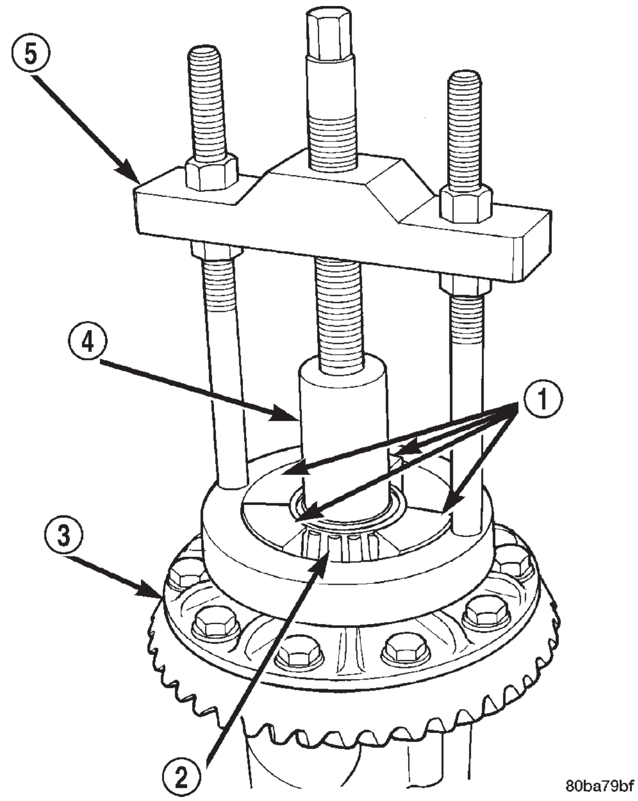


Fig. 55 DIFFERENTIAL CASE BEARING

1 - ADAPTERS
2 - BEARING
3 - DIFFERENTIAL
4 - PLUG
5 - PULLER

INSTALLATION

NOTE: If replacement differential side bearings or differential case are being installed, differential side bearing shim requirements may change. Refer to Adjustments for (Differential Bearing Preload and Gear Backlash) procedures.

(1) Install differential side bearings with Installer D-156 and Handle C-4171 (Fig. 56).

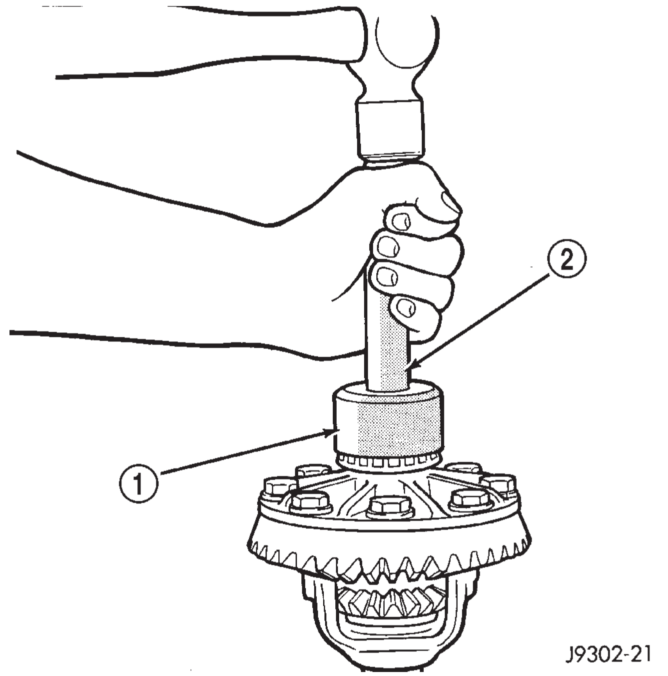


Fig. 56 DIFFERENTIAL SIDE BEARING

1 - INSTALLER
2 - HANDLE

(2) Install differential into the housing.

PINION GEAR/RING GEAR

REMOVAL

NOTE: The ring gear and pinion are serviced as a matched set. Nevar replace one gear without replacing the other matched gear.

(1) Raise and support vehicle

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

(3) Remove propeller shaft from pinion yoke and tie propeller shaft to underbody.

(4) Remove differential assembly from axle housing.

(5) Place differential case in a vise with soft metal jaw.

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

PINION GEAR/RING GEAR (Continued)

(7) Driver ring gear off the differential case with a rawhide hammer (Fig. 57).

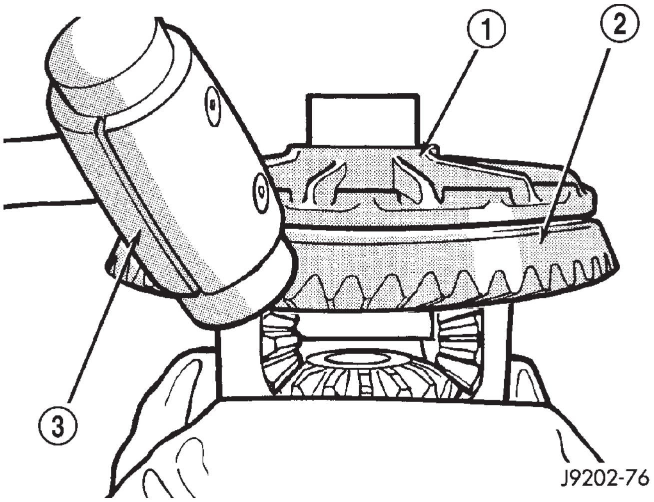


Fig. 57 RING GEAR

1 - CASE
2 - RING GEAR
3 - RAWHIDE HAMMER

(8) Using Spanner Wrench 6958 to hold yoke, remove the pinion nut and washer (Fig. 58).

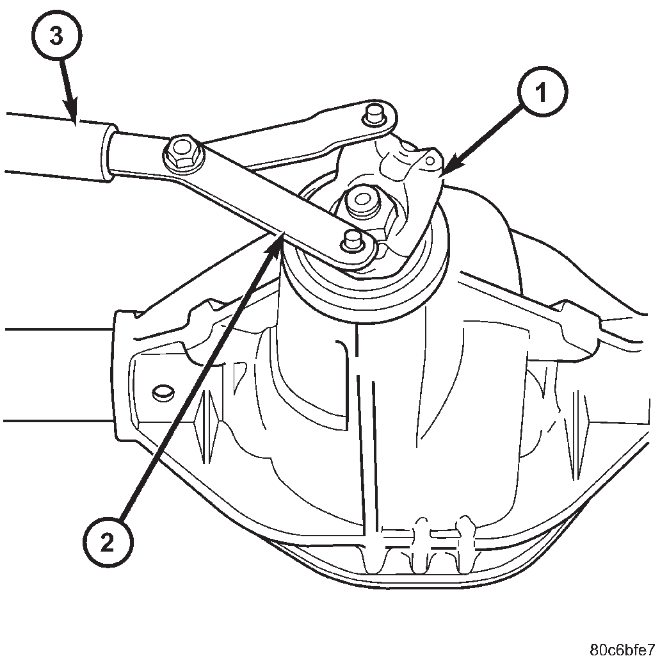


Fig. 58 YOKE SPANNER WRENCH

1 - PINION YOKE
2 - SPANNER WRENCH
3 - PIPE

(9) Remove pinion yoke from pinion shaft with Remover C-452 and Flange Wrench C-3281 (Fig. 59).

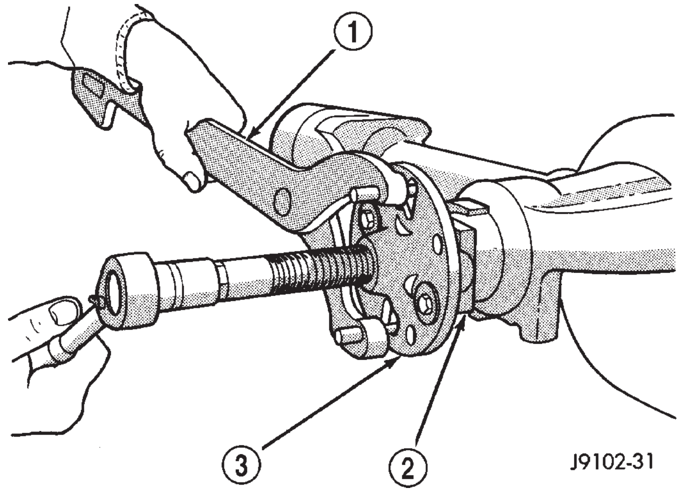


Fig. 59 PINION YOKE REMOVER

1 - REMOVER
2 - PINION YOKE
3 - FLANGE WRENCH

(10) Remove pinion gear and preload shims from housing (Fig. 60).

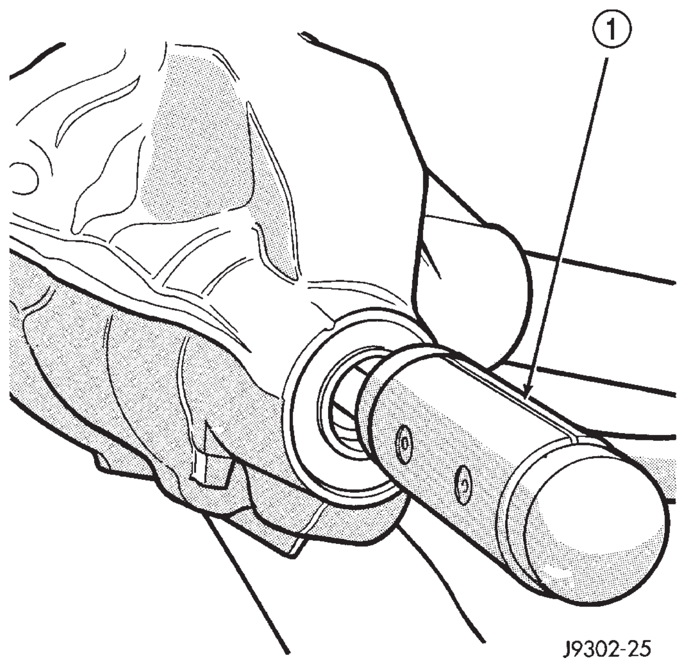


Fig. 60 PINION GEAR

1 - RAWHIDE HAMMER

(11) Remove front pinion bearing cup, bearing and pinion seal with Remover D-147 and Handle C-4171 (Fig. 61).

PINION GEAR/RING GEAR (Continued)

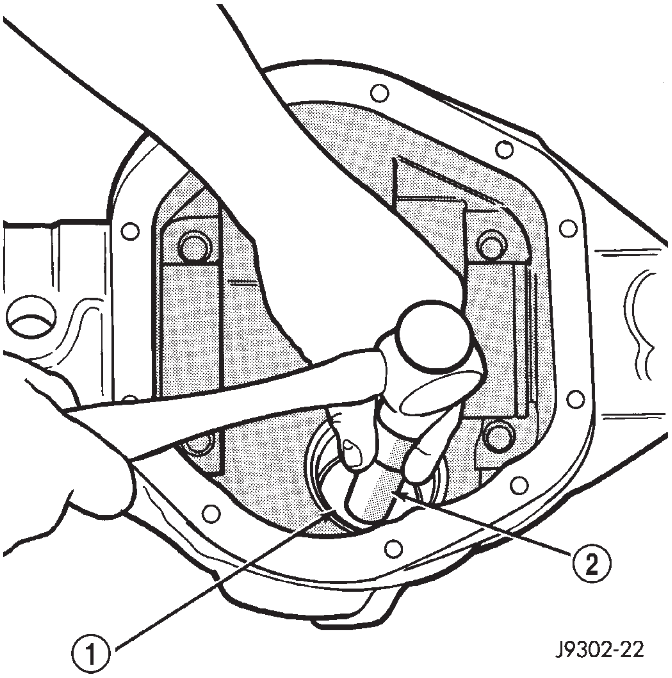


Fig. 61 FRONT BEARING CUP

1 - REMOVER
2 - HANDLE

(12) Remove rear pinion bearing cup from axle housing with remover D-148 and Handle C-4171 (Fig. 62).

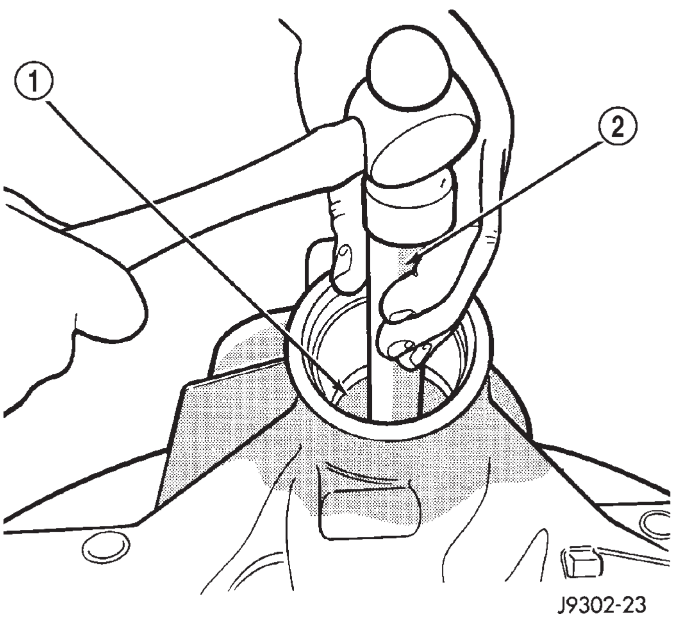


Fig. 62 REAR BEARING CUP

1 - DRIVER
2 - HANDLE

(13) Remove depth shims from rear pinion bearing cup bore in differential housing and record the thickness.

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

(14) Remove rear pinion bearing from the pinion with Puller/Press C-293-PA and Adapters C-293-48 (Fig. 63).

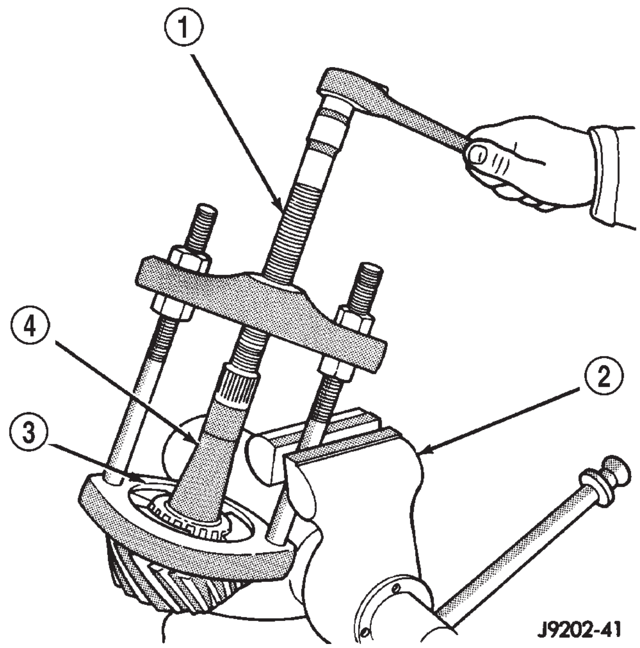


Fig. 63 REAR PINION BEARING

1 - PULLER
2 - VISE
3 - ADAPTERS
4 - 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 ring and pinion gears are reused, the original pinion depth shim can be used. Refer to Adjustments (Pinion Gear Depth) to select the proper shim thickness.

(1) Install pinion depth shim in rear pinion bearing cup bore.

(2) Apply Mopar Door Ease or equivalent lubricant to the outside surface of pinion bearing cups. Install rear bearing cup with Installer D-145 and Handle C-4171 (Fig. 64) and verify cup is seated.

(3) Install front bearing cup with Installer D-144 and Handle C-4171 (Fig. 65) and verify cup is seated.

PINION GEAR/RING GEAR (Continued)

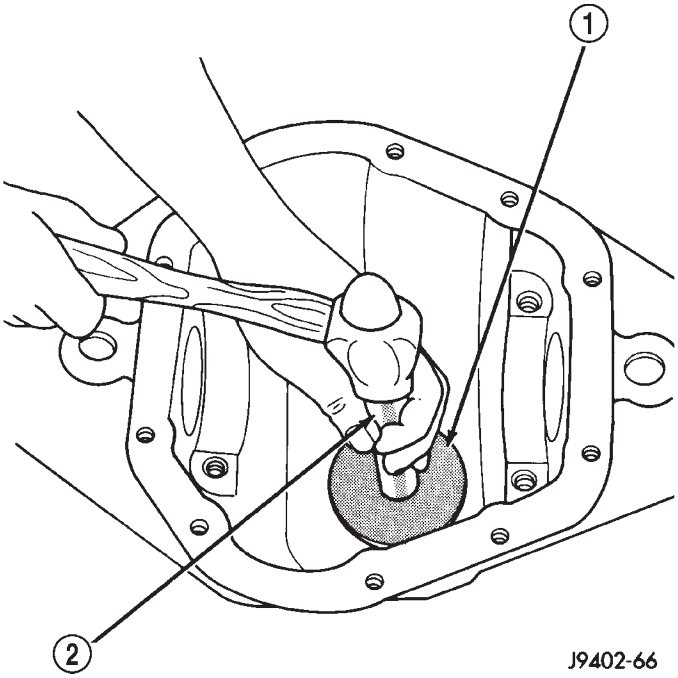


Fig. 64 REAR BEARING CUP

1 - INSTALLER
2 - HANDLE

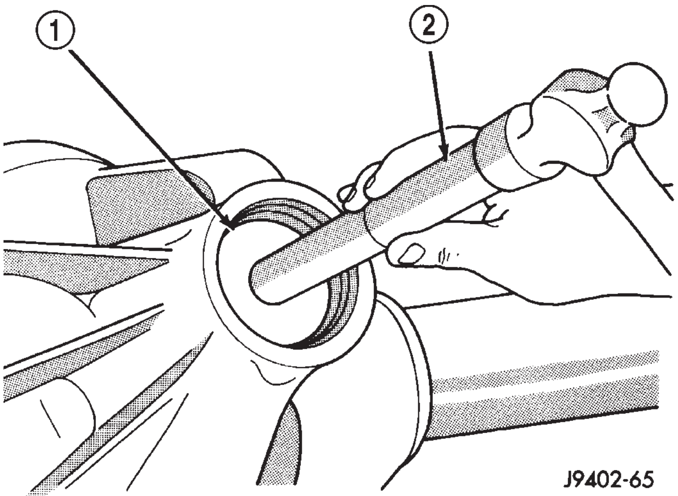


Fig. 65 FRONT BEARING CUP

1 - INSTALLER
2 - HANDLE

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

(5) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with an appropriate installer (Fig. 66).

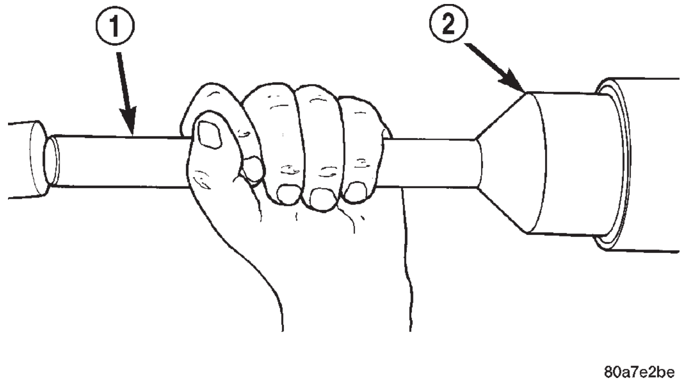


Fig. 66 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

(6) Install rear pinion bearing and slinger if equipped on the pinion gear with Installer W-262 and a press (Fig. 67).

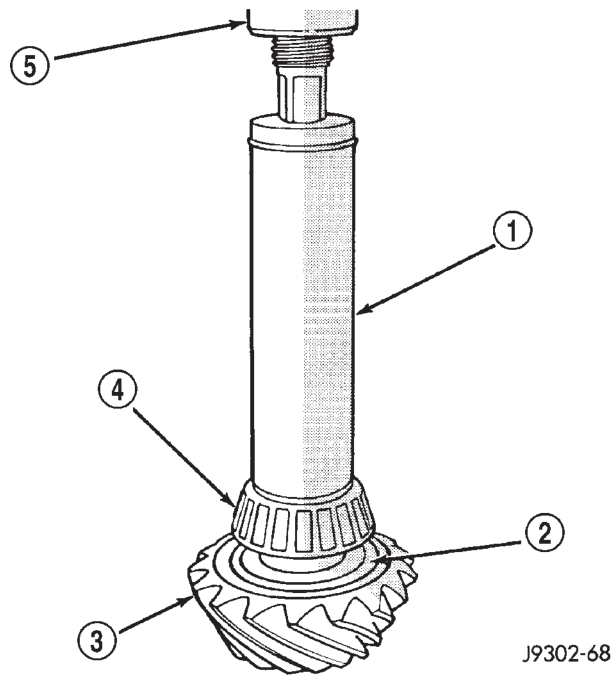


Fig. 67 REAR PINION BEARING

1 - INSTALLER
2 - OIL SLINGER
3 - DRIVE PINION GEAR
4 - REAR PINION BEARING
5 - PRESS

(7) Install pinion bearing preload shims onto the pinion gear (Fig. 68).

(8) Install pinion gear into the housing.

PINION GEAR/RING GEAR (Continued)

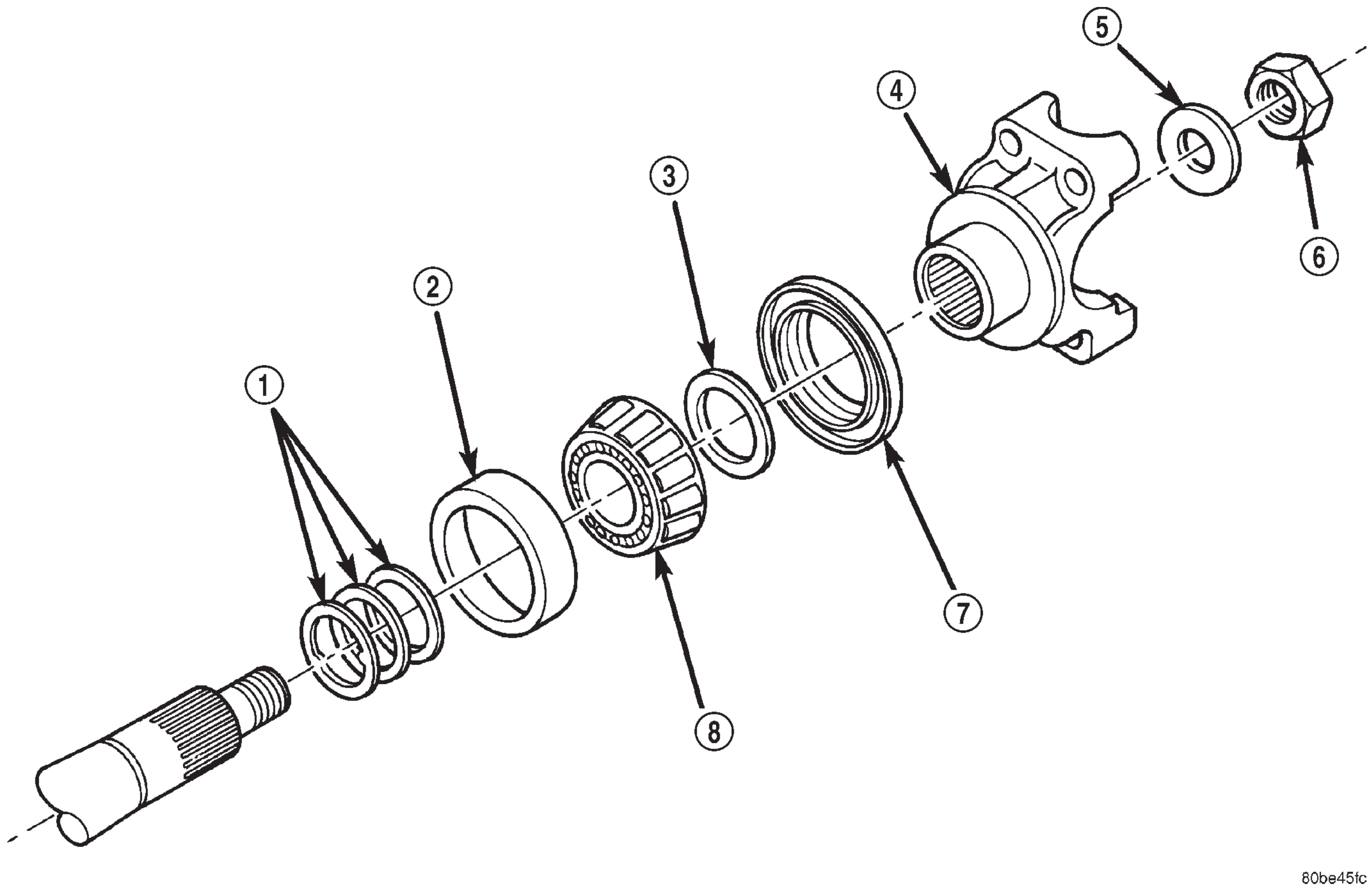


Fig. 68 PINION PRELOAD SHIMS

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

(9) Install yoke with Installer W-162-B, Cup 8109 and Spanner Wrench 6958 (Fig. 69).

(10) Install pinion washer and a **new** nut hold pinion yoke Spanner Wrench 6958 (Fig. 70) and tighten nut to 217-271 N·m (160-200 ft. lbs.).

(11) Check bearing preload torque with an inch pound torque wrench (Fig. 71). 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.).

PINION GEAR/RING GEAR (Continued)

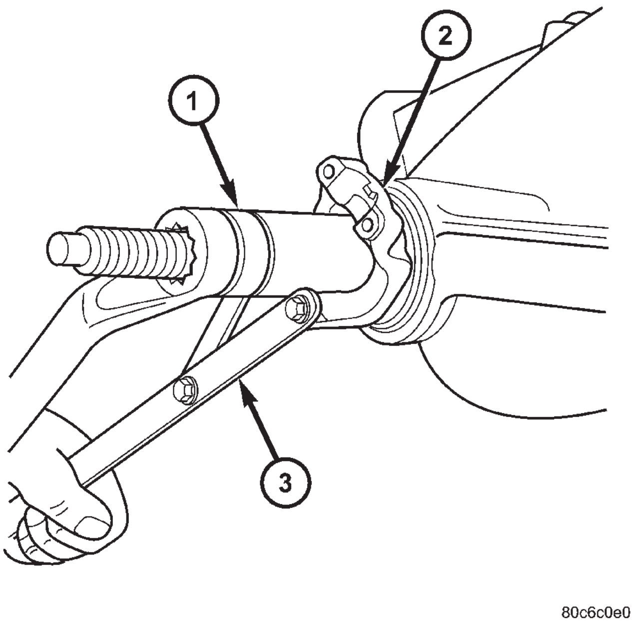


Fig. 69 PINION YOKE INSTALLER

1 - INSTALLER
2 - PINION YOKE
3 - SPANNER WRENCH

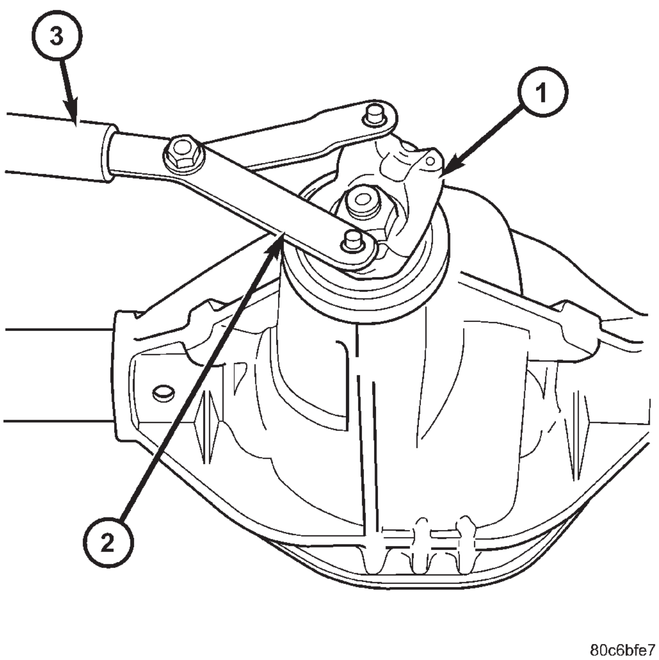


Fig. 70 YOKE SPANNER WRENCH

1 - PINION YOKE
2 - SPANNER WRENCH
3 - PIPE

(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) 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.).

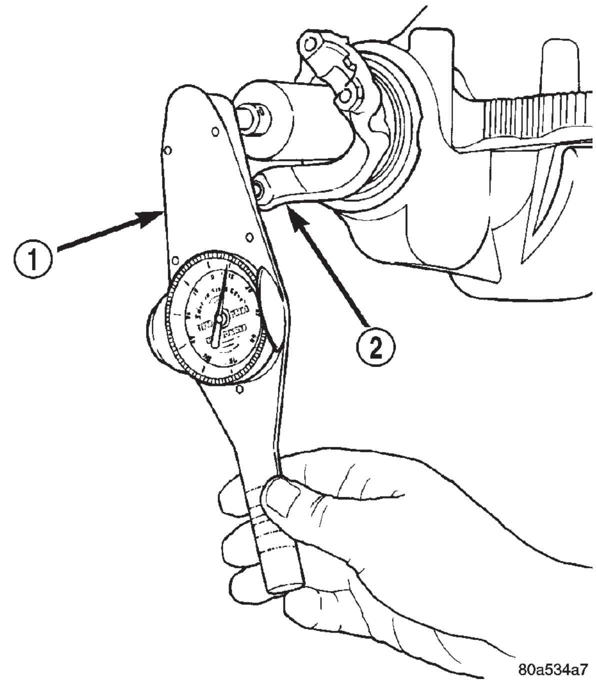


Fig. 71 PINION ROTATING TORQUE

1 - TORQUE WRENCH
2 - PINION YOKE

PINION GEAR/RING GEAR (Continued)

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

CAUTION: Never reuse ring gear bolts, the bolts can fracture causing extensive damage.

(15) Invert differential case in the vise.

(16) Install **new** ring gear bolts and alternately tighten to 95-122 N·m (70-90 ft. lbs.) (Fig. 72).

(17) Install differential in axle housing and verify gear mesh and contact pattern. Refer to Adjustment (Gear Contact Pattern).

(18) Install differential cover and fill with fluid.

(19) Install propeller shaft with reference marks aligned.

(20) Remove support and lower vehicle.

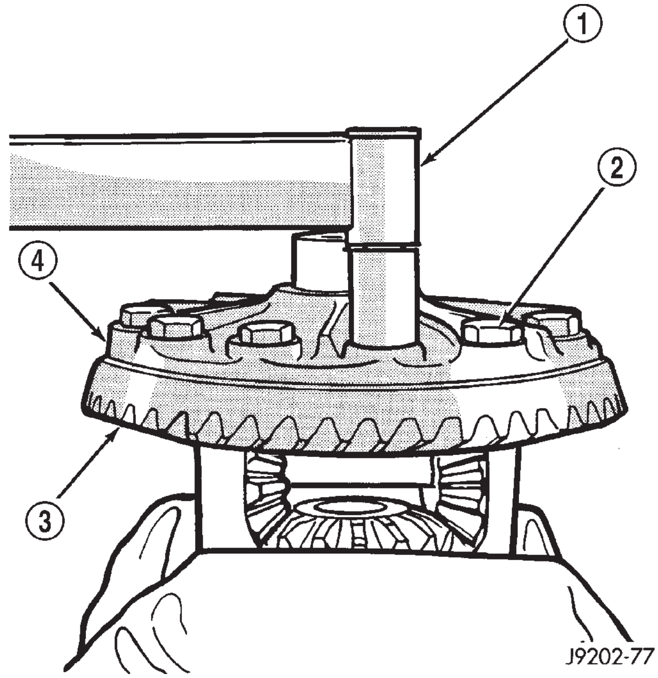


Fig. 72 RING GEAR

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

BRAKES

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BRAKES - BASE

DESCRIPTION

DESCRIPTION - BRAKE SYSTEM

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

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

A dual diaphragm vacuum power brake booster is used for all applications. All models have an aluminum master cylinder with plastic reservoir.

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

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

DESCRIPTION - SERVICE WARNINGS & CAUTIONS

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.

BRAKES - BASE (Continued)

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.

DIAGNOSIS AND TESTING - BASE BRAKE SYSTEM

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

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

The first diagnosis step is the preliminary check.

PRELIMINARY BRAKE CHECK

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

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

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

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

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

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

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

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

ROAD TESTING

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

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

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

PEDAL FALLS AWAY

A brake pedal that falls away under steady foot pressure is generally the result of a system leak. The leak point could be at a brake line, fitting, hose, or caliper/wheel cylinder. Internal leakage in the master cylinder caused by worn or damaged piston cups, may also be the problem cause.

If leakage is severe, fluid will be evident at or around the leaking component. However, internal leakage in the master cylinder may not be physically evident.

LOW PEDAL

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

SPONGY PEDAL

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

HARD PEDAL OR HIGH PEDAL EFFORT

A hard pedal or high pedal effort may be due to lining that is water soaked, contaminated, glazed, or badly worn. The power booster or check valve could also be faulty.

BRAKES - BASE (Continued)

PEDAL PULSATION

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

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

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

BRAKE DRAG

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

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

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

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

Possible causes for brake drag condition are:

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

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.

BRAKES - BASE (Continued)

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.

STANDARD PROCEDURE

STANDARD PROCEDURE - MANUAL 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.

(1) Remove reservoir filler caps and fill reservoir.

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

(3) Attach one end of bleed hose to bleed screw and insert opposite end in glass container partially filled with brake fluid (Fig. 1). Be sure end of bleed hose is immersed in fluid.

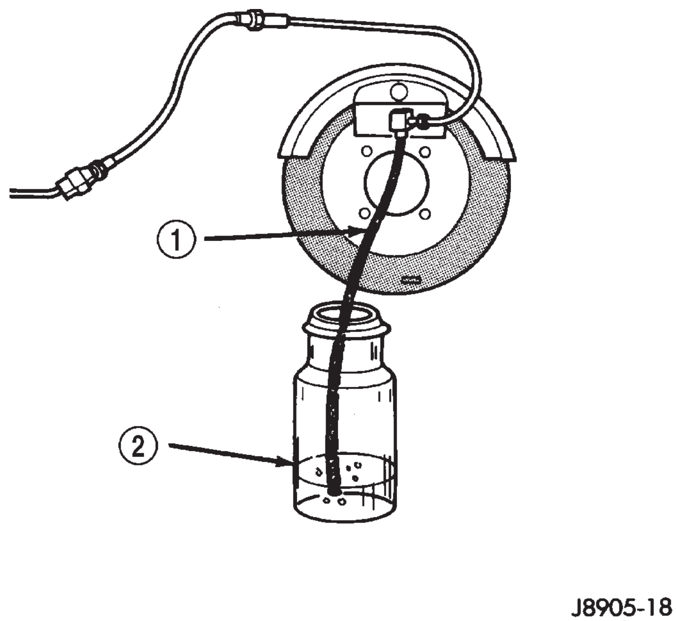


Fig. 1 Bleed Hose Setup

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.

STANDARD PROCEDURE - PRESSURE 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.

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.

BRAKES - BASE (Continued)

SPECIFICATIONS

BRAKE COMPONENTS

SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Disc Brake Caliper Type	Sliding
Disc Brake Rotor Type	Ventilated
Disc Brake Rotor Size	279.4 x 23.876 mm (11 x 0.94 in.)
Disc Brake Rotor Max. Runout	0.12 mm (0.005 in.)
Disc Brake Rotor Max. Thickness Variation	0.013 mm (0.0005 in.)
Disc Brake Rotor 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

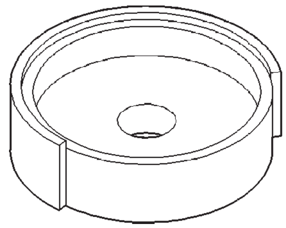
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Brake Pedal Support Bolt	28	21	—
Brake Booster Mounting Nuts	39	29	—
Master Cylinder Mounting Nuts	17	13	—
Master Cylinder Brake Lines	19	14	—
Combination Valve Mounting Nuts	20	15	—
Combination Valve Brake Lines	19	14	—
Caliper Mounting Bolts	15	11	—
Caliper Brake Hose Bolt	31	23	—
Wheel Cylinder Mounting Bolts	10	7	—
Wheel Cylinder Brake Line	16	12	—
Parking Brake Lever Bolts	12	9	—
Parking Brake Lever Bracket Bolts	12	9	—
Parking Brake Cable Retainer Nut	1.5	—	14

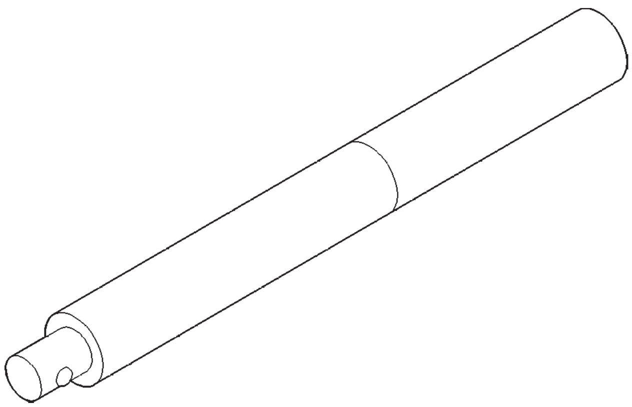
BRAKES - BASE (Continued)

SPECIAL TOOLS

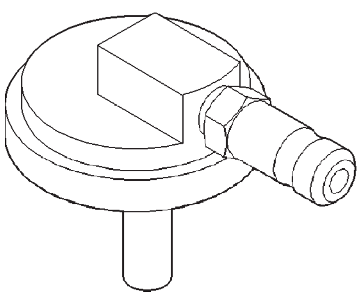
BASE BRAKES



Installer Caliper Dust Boot C-4842



Handle C-4171



Adaptor Cap Pressure Bleeder 6921

BRAKE 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 - 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 LINES (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - 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. 2).

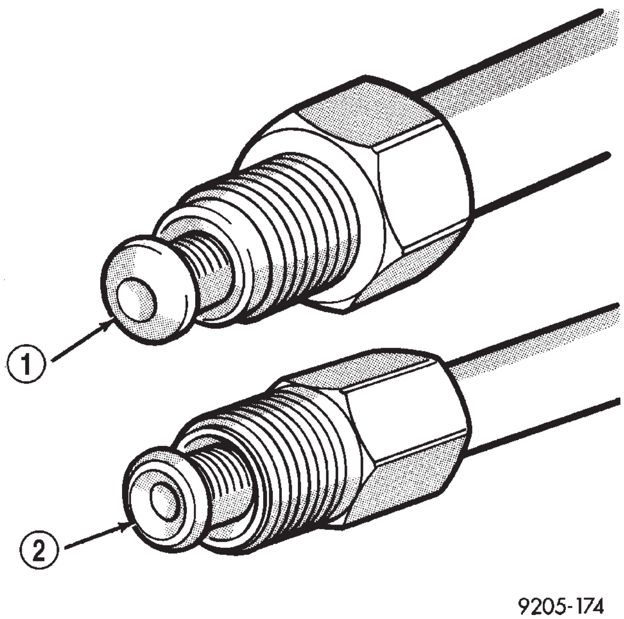


Fig. 2 Inverted Flare And ISO Flare

1 - ISO-STYLE FLARE
2 - DOUBLE INVERTED-STYLE FLARE

STANDARD PROCEDURE - DOUBLE INVERTED 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.

(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. 3).

(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.

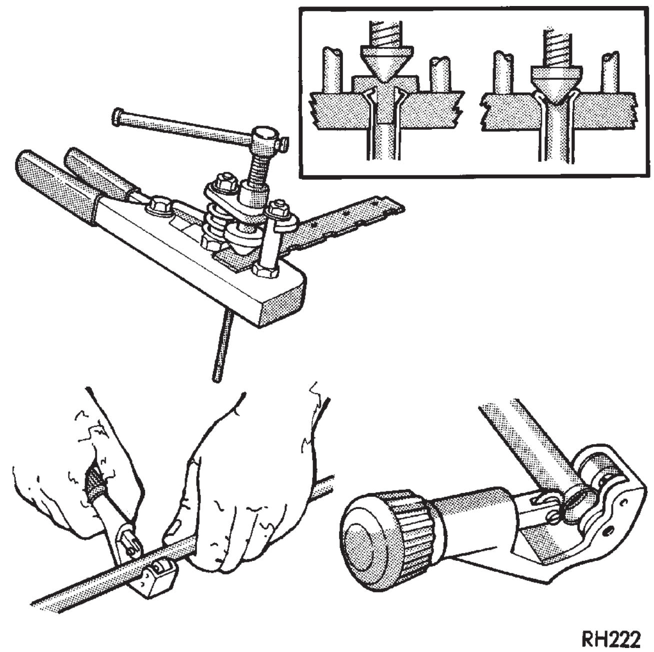


Fig. 3 Inverted Flare Tools

STANDARD PROCEDURE - ISO 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.

To make a ISO flare use a Flaring Tool kit.

(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. 4). 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. 4).

(8) Turn the yoke screw in until the adaptor is squarely seated on the tool bar.

BRAKE LINES (Continued)

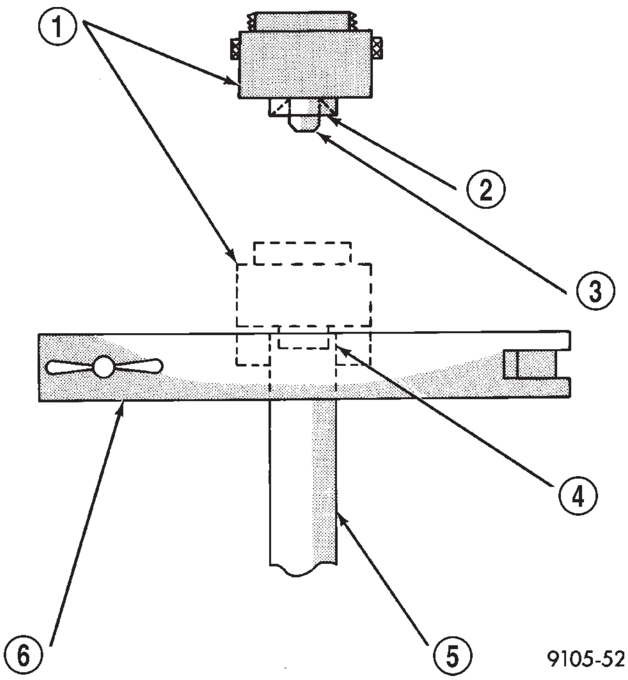


Fig. 4 ISO Flaring

1 - ADAPTER
2 - LUBRICATE HERE
3 - PILOT
4 - FLUSH WITH BAR
5 - TUBING
6 - BAR ASSEMBLY

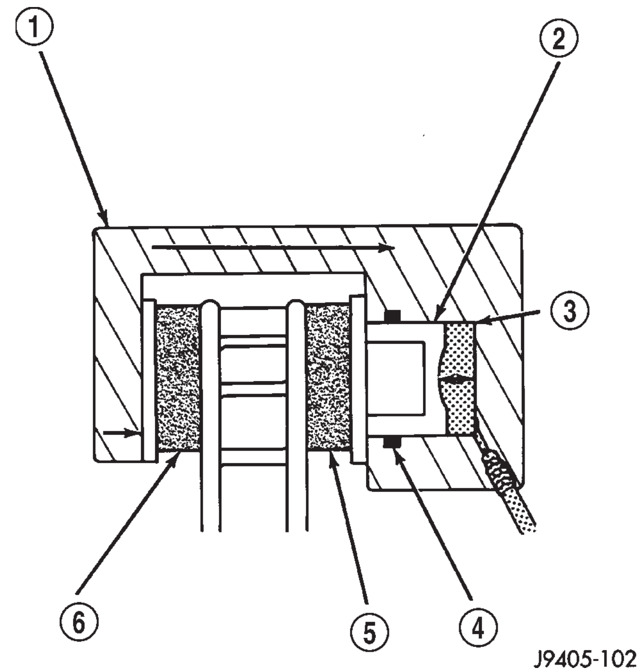


Fig. 5 Brake Caliper Operation

1 - CALIPER
2 - PISTON
3 - PISTON BORE
4 - SEAL
5 - INBOARD SHOE
6 - OUTBOARD SHOE

DISC BRAKE CALIPERS

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. 5) .

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. 6) . 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.

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.

DISC BRAKE CALIPERS (Continued)

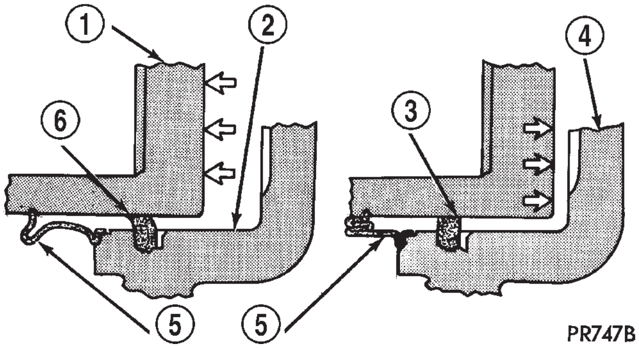


Fig. 6 Lining Wear Compensation By Piston Seal

1 - PISTON
2 - CYLINDER BORE
3 - PISTON SEAL BRAKE PRESSURE OFF
4 - CALIPER HOUSING
5 - DUST BOOT
6 - PISTON SEAL BRAKE PRESSURE ON

(4) Bottom caliper piston in bore with C-clamp. Position clamp screw on outboard brake shoe and clamp frame on rear of caliper (Fig. 7). **Do not allow clamp screw to bear directly on outboard shoe retainer spring. Use wood or metal spacer between shoe and clamp screw.**

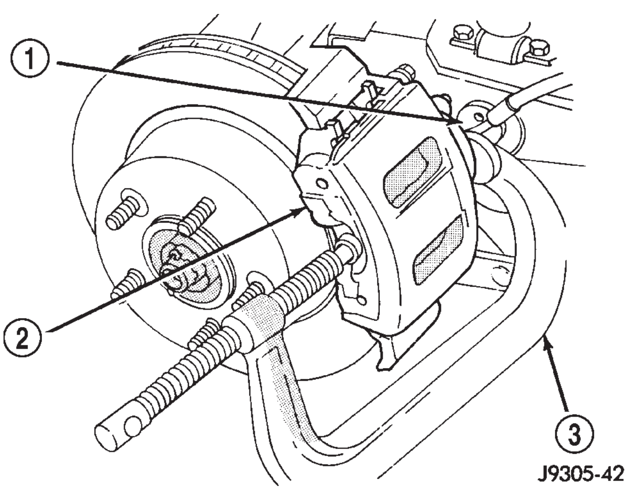


Fig. 7 Bottoming Caliper Piston With C-Clamp

1 - CALIPER BOSS
2 - OUTBOARD BRAKESHOE
3 - C-CLAMP

(5) Remove brake hose mounting bolt and discard washers (Fig. 8).

(6) Remove caliper mounting bolts (Fig. 9).

(7) Tilt top of caliper outward with pry tool if necessary (Fig. 10) and remove caliper.

(8) Remove caliper from vehicle.

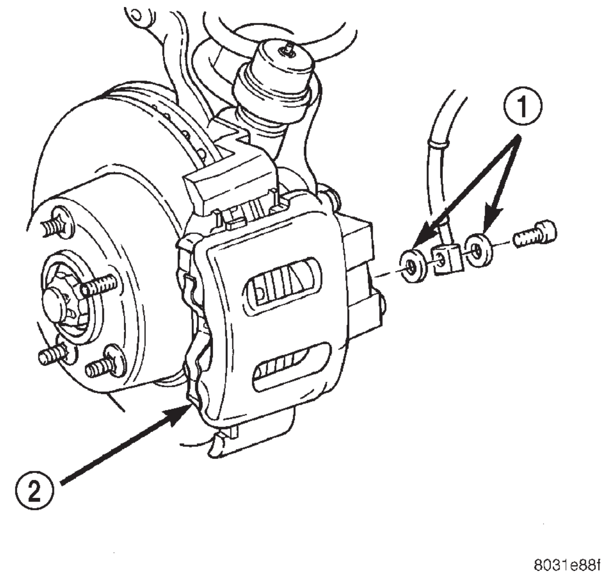


Fig. 8 Brake Hose And Bolt

1 - FITTING WASHERS
2 - CALIPERS

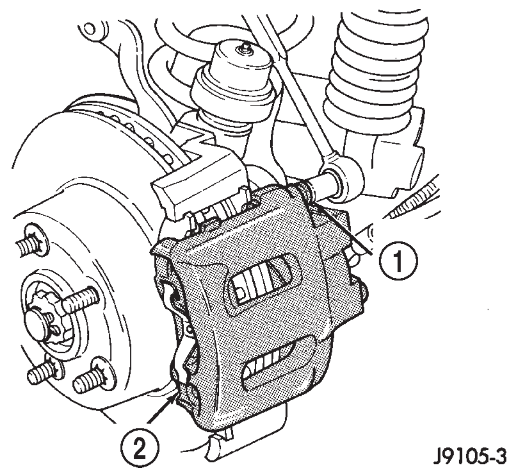


Fig. 9 Caliper Mounting Bolts

1 - CALIPER MOUNTING BOLT (2)
2 - 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. 11).

(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. 12).

DISC BRAKE CALIPERS (Continued)

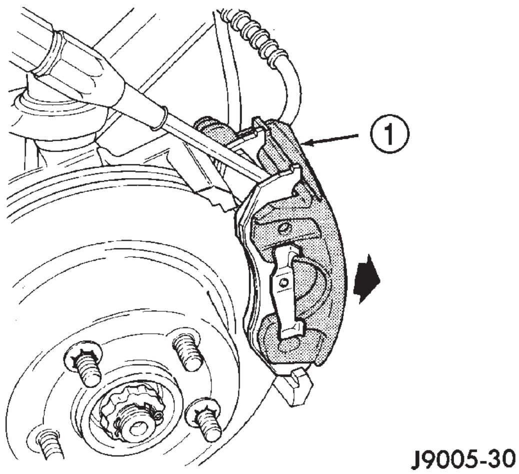


Fig. 10 Caliper Removal

1 - TILT CALIPER OUTBOARD TO REMOVE

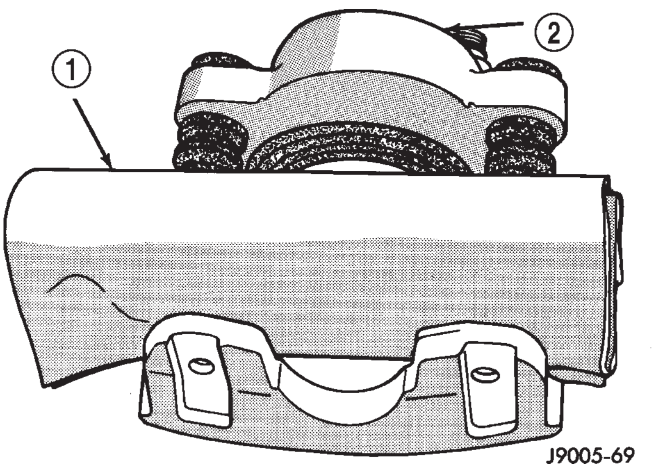


Fig. 11 Padding Caliper Interior

1 - SHOP TOWELS OR CLOTHS
2 - CALIPER

CAUTION: Do not blow the piston out of the bore with sustained air pressure. This could result in a cracked piston. Use only enough air pressure to ease the piston out.

WARNING: NEVER ATTEMPT TO CATCH THE PISTON AS IT LEAVES THE BORE. THIS MAY RESULT IN PERSONAL INJURY.

(5) Remove caliper piston dust boot with suitable pry tool (Fig. 13).

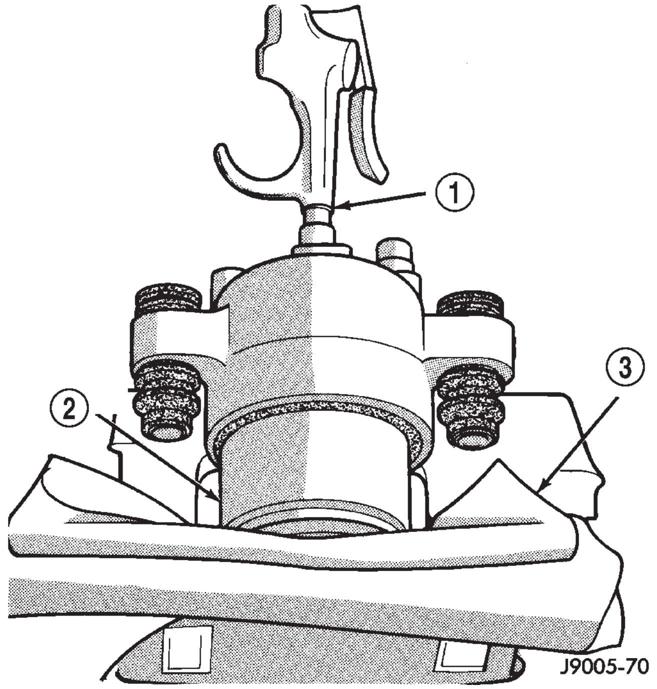


Fig. 12 Caliper Piston Removal

1 - AIR GUN
2 - CALIPER PISTON
3 - PADDING MATERIAL

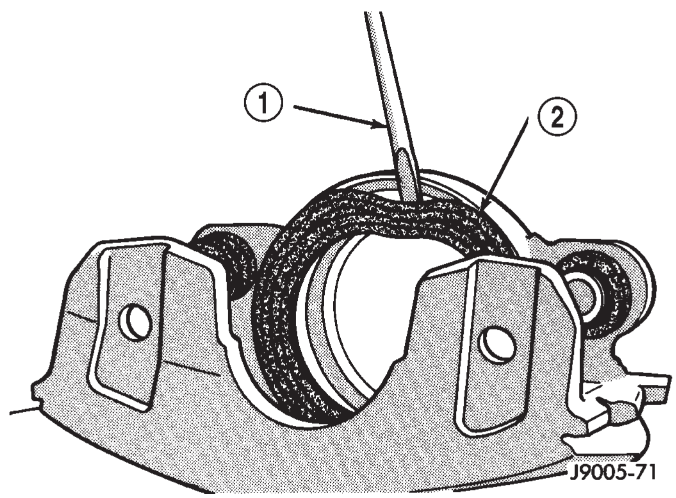


Fig. 13 Caliper

1 - COLLAPSE BOOT WITH PUNCH OR SCREWDRIVER
2 - PISTON DUST BOOT

DISC BRAKE CALIPERS (Continued)

(6) Remove caliper piston seal with wood or plastic tool (Fig. 14). Do not use metal tools as they will scratch piston bore.

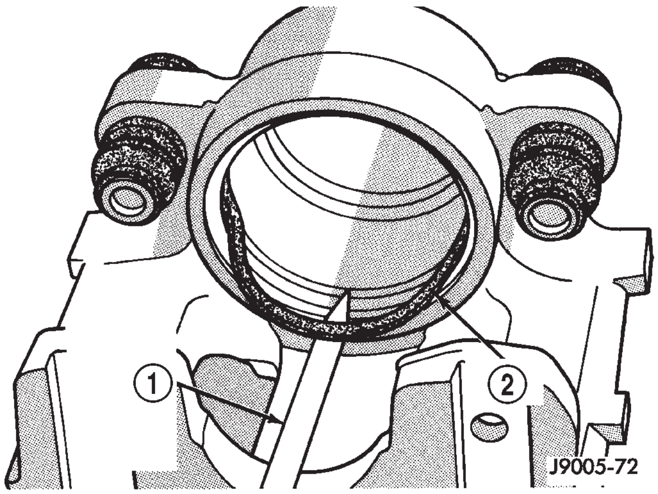


Fig. 14 Piston Seal Removal

1 - REMOVE SEAL WITH WOOD PENCIL OR SIMILAR TOOL
2 - PISTON SEAL

(7) Remove caliper mounting bolt bushings and boots (Fig. 15).

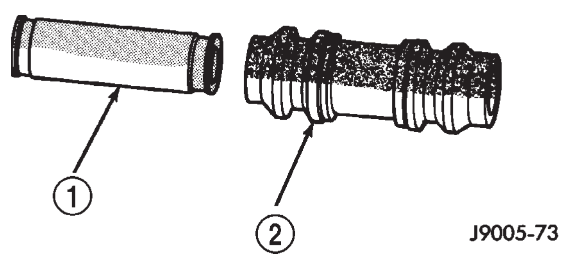


Fig. 15 Mounting Bolt Bushing And Boot

1 - CALIPER SLIDE BUSHING
2 - BOOT

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. 16) . 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).

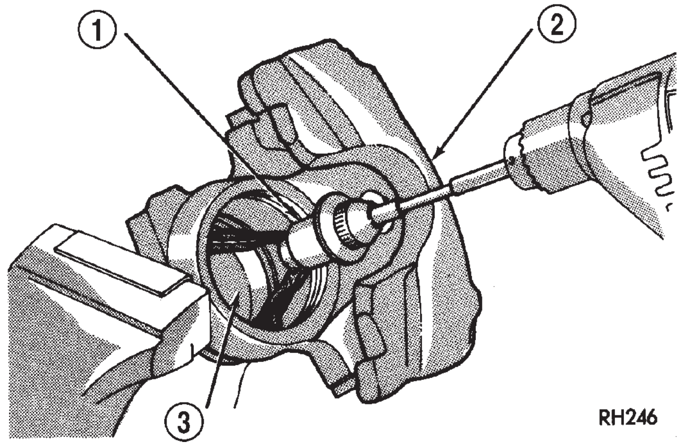


Fig. 16 Polishing Piston Bore

1 - SPECIAL HONE
2 - CALIPER
3 - PISTON BORE

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. 17).
(4) Install new piston seal into seal groove with finger (Fig. 18).
(5) Install new dust boot on caliper piston and seat boot in piston groove (Fig. 19).
(6) Press piston into caliper bore by hand, use a turn and push motion to work piston into seal (Fig. 20).
(7) Press caliper piston to bottom of bore.

DISC BRAKE CALIPERS (Continued)

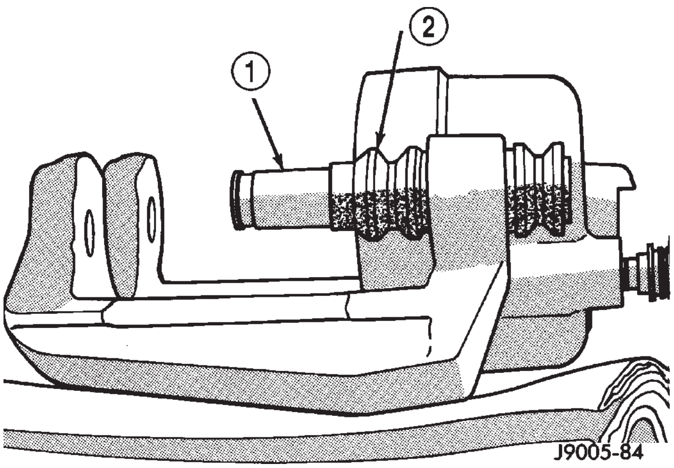


Fig. 17 Bushings And Boots Installation

1 - BUSHING
2 - BOOT

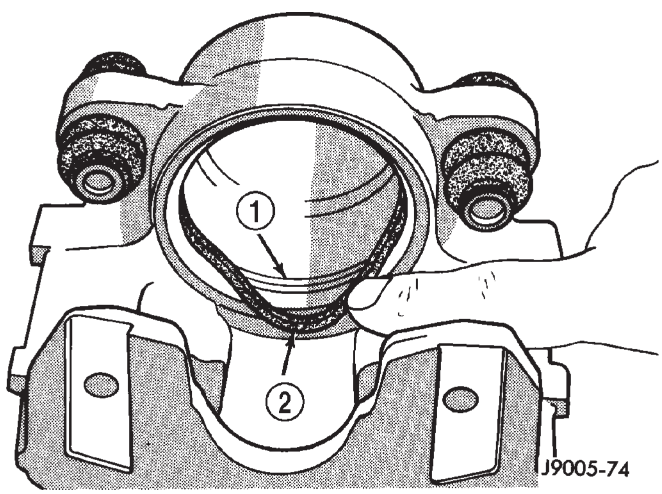


Fig. 18 Piston Seal Installation

1 - SEAL GROOVE
2 - PISTON SEAL

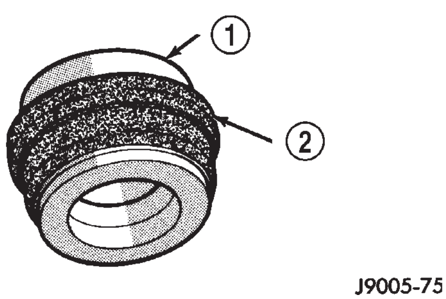


Fig. 19 Dust Boot On Piston

1 - PISTON
2 - DUST BOOT

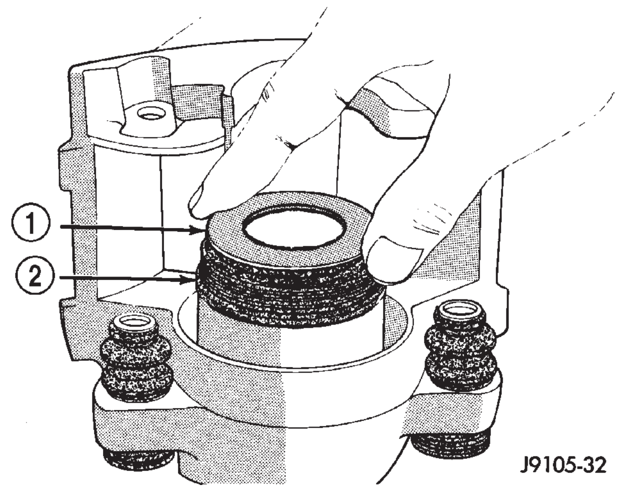


Fig. 20 Caliper Piston Installation

1 - PISTON
2 - BOOT

(8) Seat dust boot in caliper with Installer Tool C-4842 and Tool Handle C-4171 (Fig. 21).

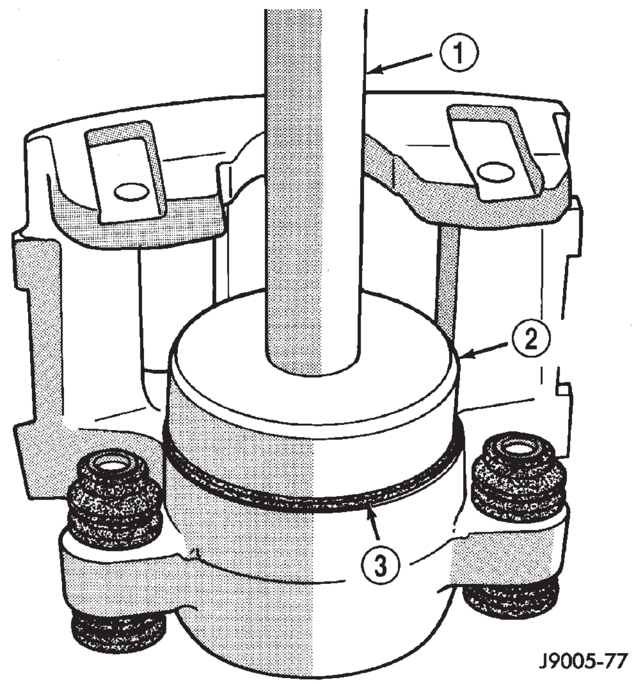


Fig. 21 Piston Dust Boot Installation

1 - HANDLE C-4171
2 - INSTALLER C-4842
3 - DUST BOOT

(9) Replace caliper bleed screw if removed.

DISC BRAKE CALIPERS (Continued)

INSTALLATION

(1) Clean brake shoe mounting ledges with wire brush and apply light coat of Mopar multi-mileage grease to surfaces (Fig. 22).

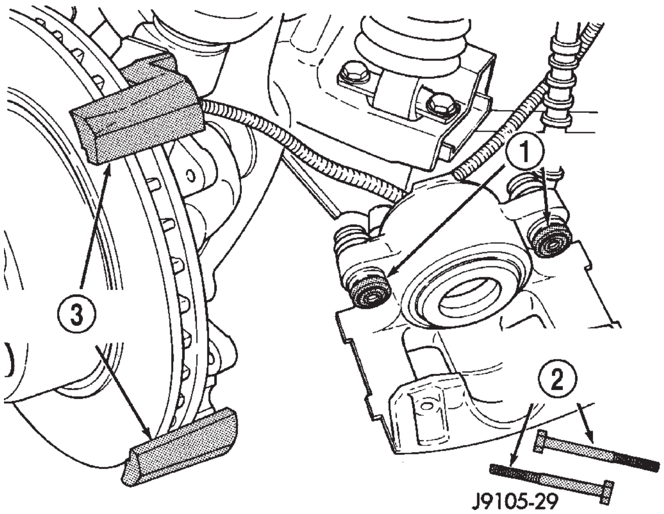


Fig. 22 Caliper Lubrication Points

1 - BUSHINGS
2 - CALIPER MOUNTING BOLTS
3 - MOUNTING LEDGES

(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. 23).

(3) Coat caliper mounting bolts with silicone grease. Then install and tighten bolts to 15 N·m (11 ft. lbs.).

CAUTION: If new caliper bolts are being installed, or if the original reason for repair was a drag/pull condition, check caliper bolt length before proceeding. Bolts must not have a shank length greater than 67.6 mm (2.66 in.) (Fig. 24).

(4) Install brake hose to caliper with **new seal washers** and tighten fitting bolt to 31 N·m (23 ft. lbs.).

CAUTION: Verify brake hose is not twisted or kinked before tightening fitting bolt.

(5) Bleed base brake system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

(6) Install wheel and tire assemblies. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

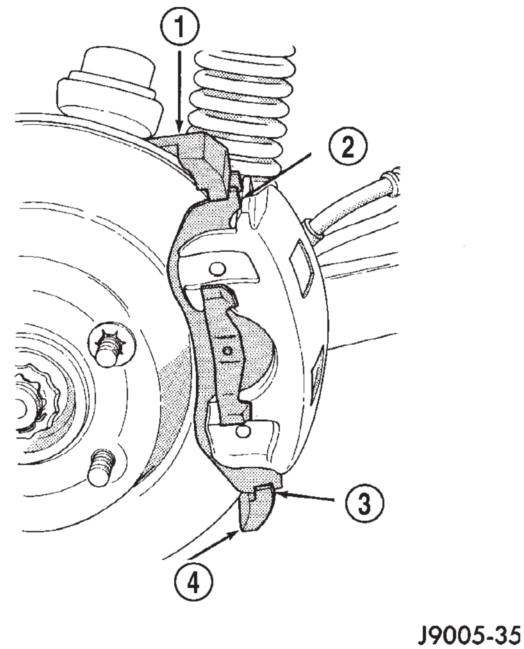


Fig. 23 Caliper Installation

1 - TOP LEDGE
2 - BRAKESHOE TAB ON LEDGE OUTER SURFACE
3 - LEDGE SEATED IN BRAKESHOE NOTCH
4 - BOTTOM LEDGE

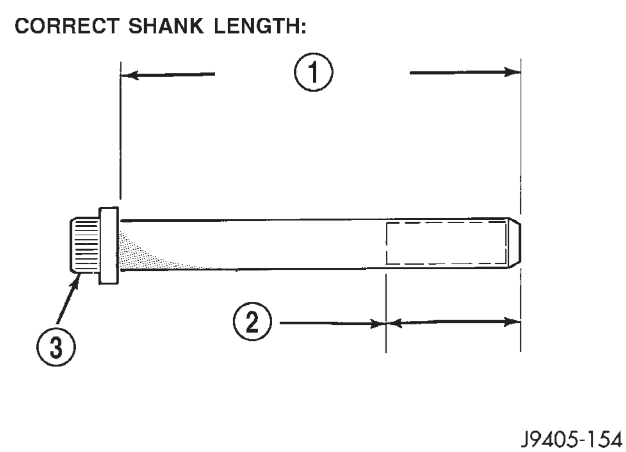


Fig. 24 Mounting Bolt Dimensions

1 - 67 mm (± 0.6 mm) 2.637 in. (± 0.0236 in.)
2 - 22 mm (0.866 in.) THREAD LENGTH
3 - CALIPER BOLT

(7) Remove supports and lower vehicle.

(8) Verify firm pedal before moving vehicle.

BRAKE PADS/SHOES

REMOVAL

REMOVAL - DISC BRAKE SHOES

(1) Raise and support vehicle.
(2) Remove wheel and tire assembly.
(3) Remove caliper. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).
(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. 25).

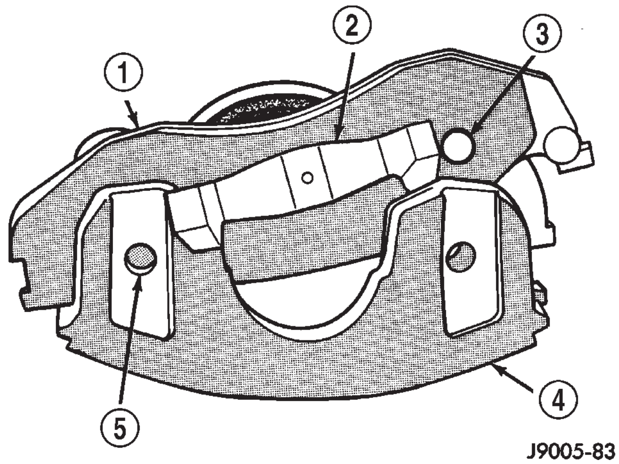


Fig. 25 Outboard Brake Shoe Removal

1 - OUTBOARD BRAKESHOE
2 - SHOE SPRING
3 - LOCATING LUG
4 - CALIPER
5 - LOCATING LUG

(5) Grasp ends of inboard shoe and tilt shoe outward to release springs from caliper piston (Fig. 26) and remove shoe from caliper.

NOTE: If original brake shoes will be used, keep them in sets left and right. They are not interchangeable.

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

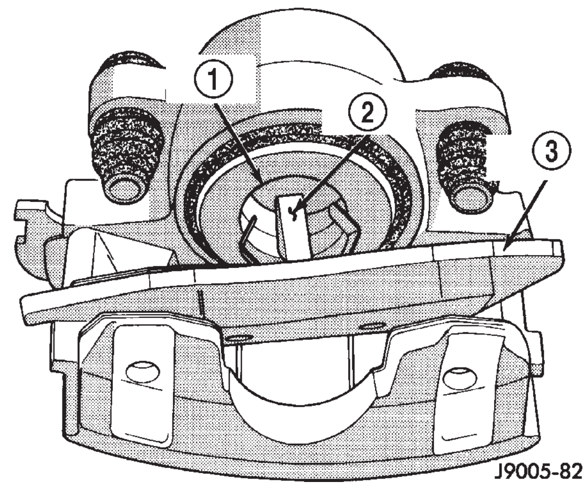


Fig. 26 Inboard Brake

1 - CALIPER PISTON
2 - SHOE SPRINGS
3 - INBOARD BRAKESHOE

(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.

REMOVAL - DRUM BRAKE SHOES

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

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

(4) Remove U-clip and washer securing adjuster cable to parking brake lever (Fig. 27).
(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.

BRAKE PADS/SHOES (Continued)

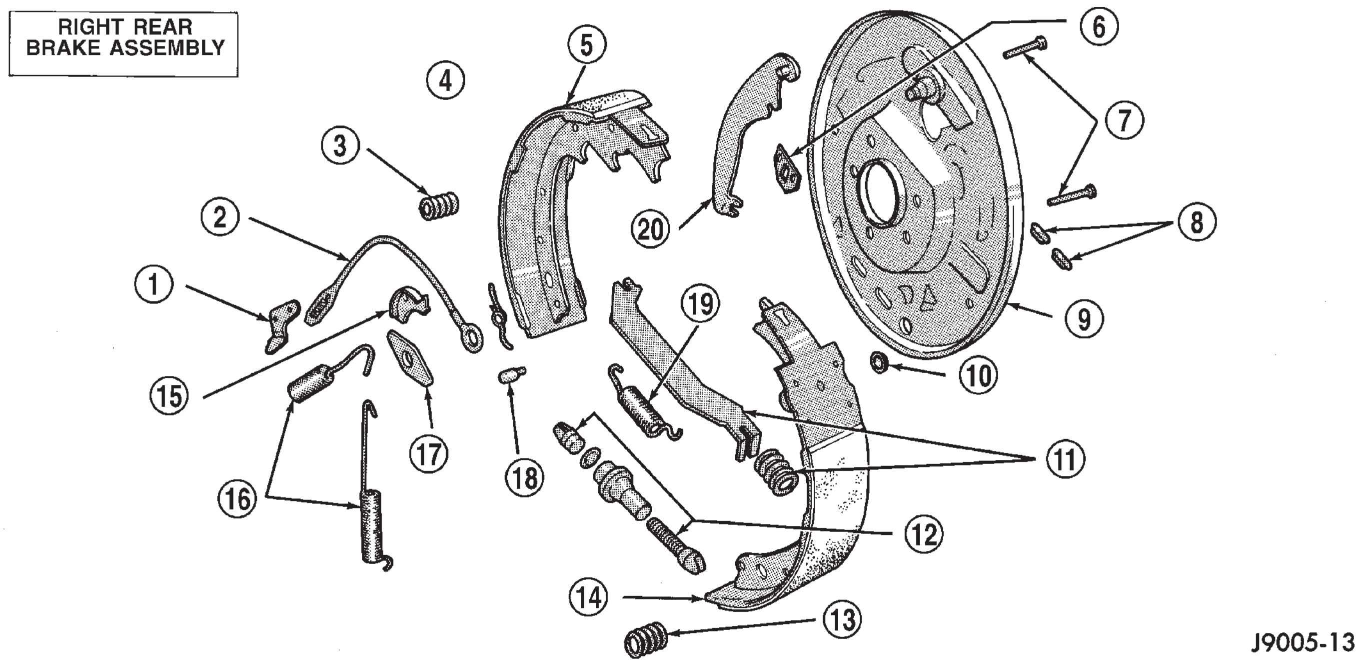


Fig. 27 Drum Brake Components—Typical

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

INSTALLATION

INSTALLATION - DISC BRAKE SHOES

(1) Install inboard shoe in caliper and verify shoe retaining is fully seated into the piston.

(2) Starting one end of outboard shoe in caliper and rotating shoe downward into place. Verify shoe locating lugs and shoe spring are seated.

(3) Install caliper. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).

(4) Install wheel and tire assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(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.

INSTALLATION - DRUM BRAKE SHOES

(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. 28).

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

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

(6) Remove wheel cylinder clamps.

(7) Attach parking brake cable to lever.

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

(9) Install parking brake strut and spring.

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

(11) Install primary and secondary return springs.

(12) Install adjuster cable guide on secondary shoe.

(13) Lubricate and assemble adjuster screw.

BRAKE PADS/SHOES (Continued)

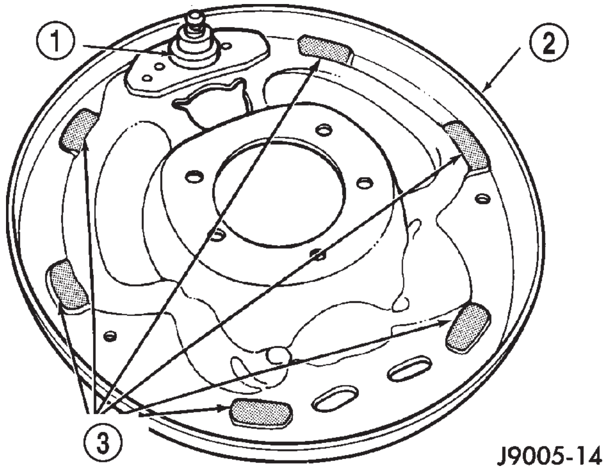


Fig. 28 Shoe Contact Surfaces

1 - ANCHOR PIN
2 - SUPPORT PLATE
3 - SHOE CONTACT SURFACES

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

(15) Adjust shoes to drum. (Refer to 5 - BRAKES/ HYDRAULIC/MECHANICAL/DRUM - ADJUSTMENTS).

(16) Install wheel/tire assemblies and lower vehicle. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(17) Verify firm brake pedal before moving vehicle.

DRUM

DESCRIPTION

The brake systems use a leading shoe (primary) and trailing shoe (secondary). The mounting hardware is similar but not interchangeable (Fig. 27).

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. (Fig. 27)

DIAGNOSIS AND TESTING - BRAKE DRUM RUNOUT

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 drum if runout or variation exceed these values. Replace the drum if machining causes the drum to exceed the maximum allowable diameter.

STANDARD PROCEDURE - 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.

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.

DRUM (Continued)

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. 29).

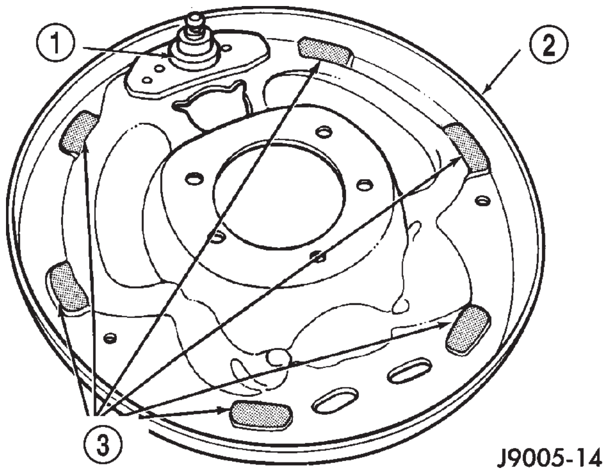


Fig. 29 Shoe Contact Surfaces

1 - ANCHOR PIN
2 - SUPPORT PLATE
3 - SHOE CONTACT SURFACES

ADJUSTMENTS - 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. 30).

(5) Reverse gauge and install it on brake shoes. Position gauge legs at shoe centers as shown (Fig. 31). If gauge does not fit (too loose/too tight), adjust shoes.

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

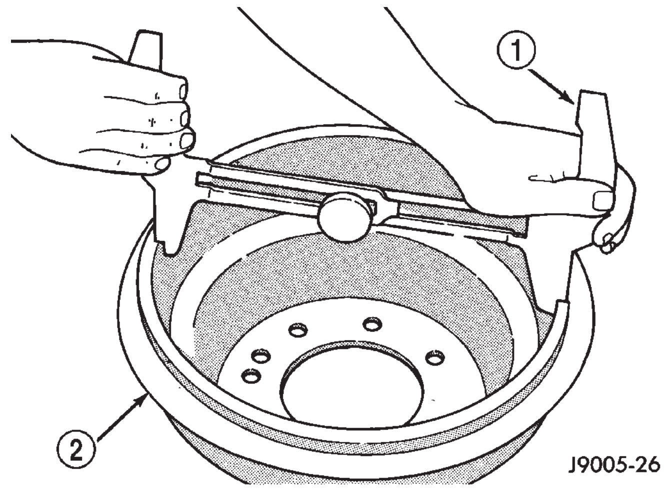


Fig. 30 Adjusting Gauge On Drum

1 - BRAKE GAUGE
2 - BRAKE DRUM

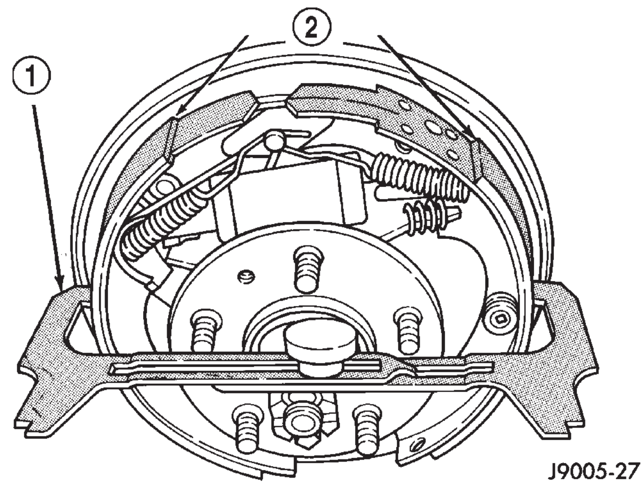


Fig. 31 Adjusting Gauge On Brake Shoes

1 - BRAKE GAUGE
2 - BRAKE SHOES

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

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

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

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

DRUM (Continued)

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. 32).

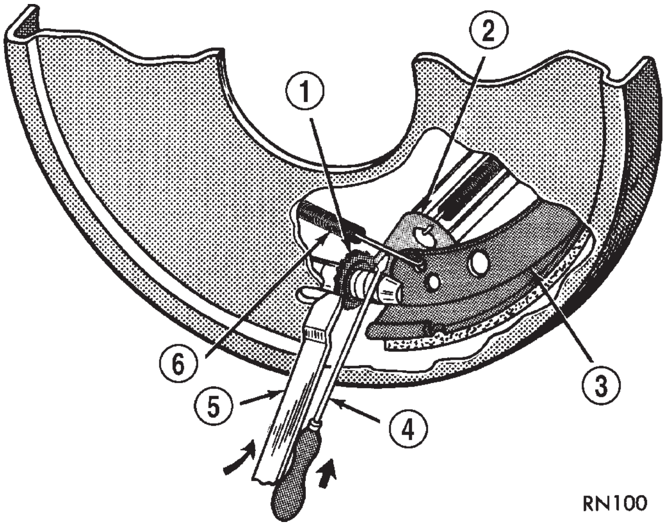


Fig. 32 Brake Adjustment

1 - STAR WHEEL
2 - LEVER
3 - BRAKE SHOE WEB
4 - SCREWDRIVER
5 - ADJUSTING TOOL
6 - ADJUSTER SPRING

(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.

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

FLUID

DIAGNOSIS AND TESTING - BRAKE FLUID CONTAMINATION

Indications of fluid contamination are swollen or deteriorated rubber parts.

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

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

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

STANDARD PROCEDURE - 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. 33).

The correct fluid level is to the FULL indicator on the side of the reservoir. If necessary, add fluid to the proper level.

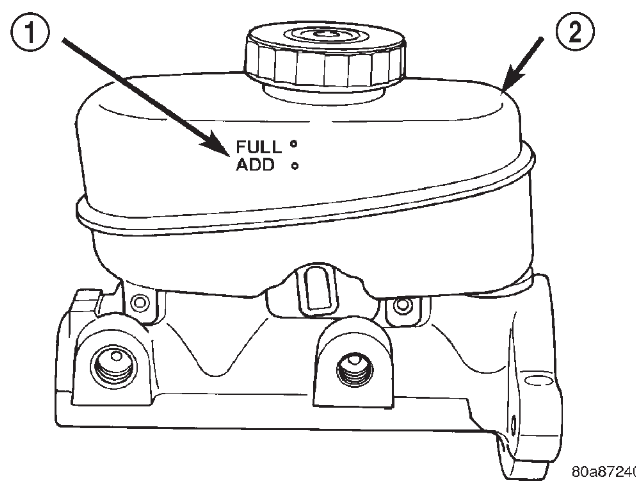


Fig. 33 Master Cylinder Fluid

1 - INDICATOR
2 - RESERVOIR

FLUID (Continued)

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.

FLUID 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. 34).

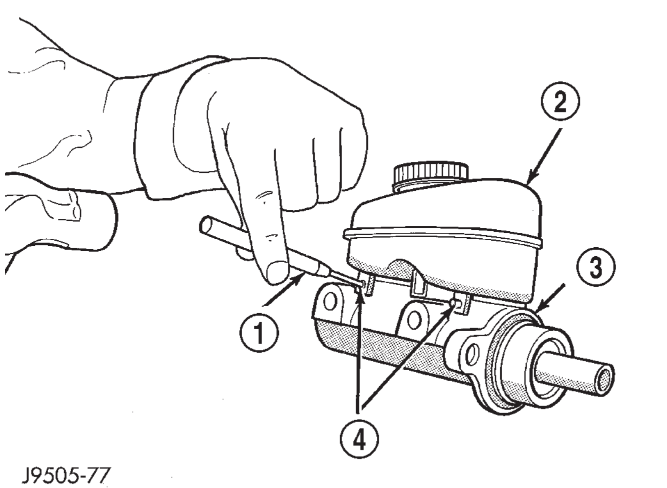


Fig. 34 Reservoir Retaining Pins

1 - PIN PUNCH
2 - RESERVOIR
3 - BODY
4 - ROLL PINS

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

(4) Loosen reservoir from grommets with pry tool (Fig. 35).

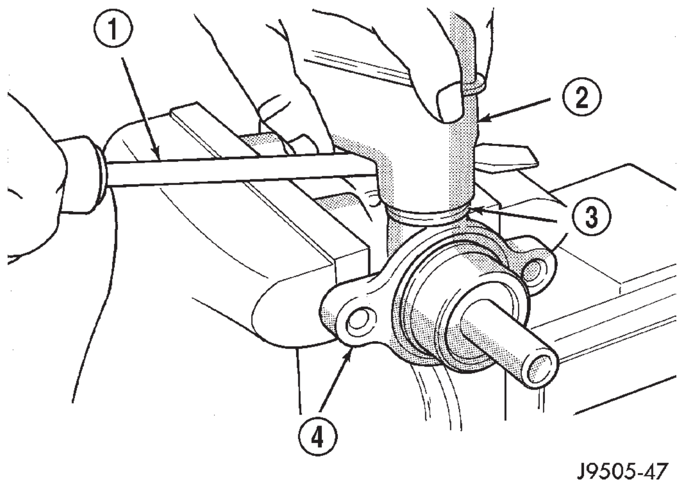


Fig. 35 Loosening Reservoir

1 - PRY TOOL
2 - RESERVOIR
3 - GROMMET
4 - MASTER CYLINDER BODY

(5) Remove reservoir by rocking it to one side and pulling free of grommets (Fig. 36).

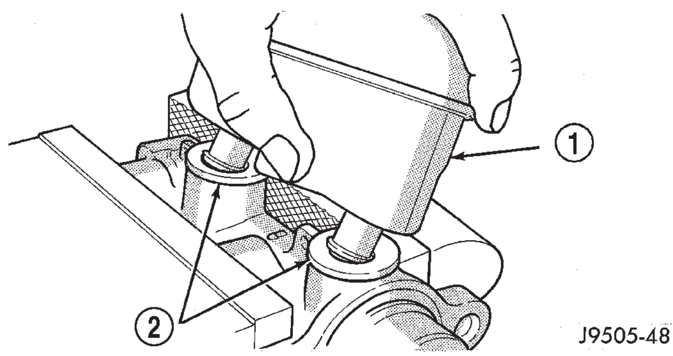


Fig. 36 Reservoir Removal

1 - RESERVOIR
2 - GROMMETS

(6) Remove old grommets from cylinder body (Fig. 37).

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.

FLUID RESERVOIR (Continued)

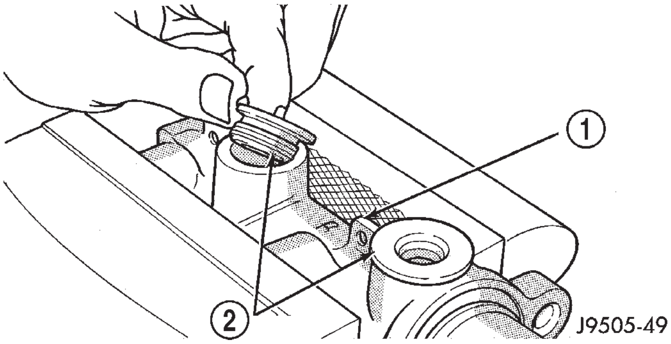


Fig. 37 Grommet Removal

1 - MASTER CYLINDER BODY
2 - GROMMETS

(1) Lubricate new grommets with clean brake fluid and Install new grommets in cylinder body (Fig. 38). Use finger pressure to install and seat grommets.

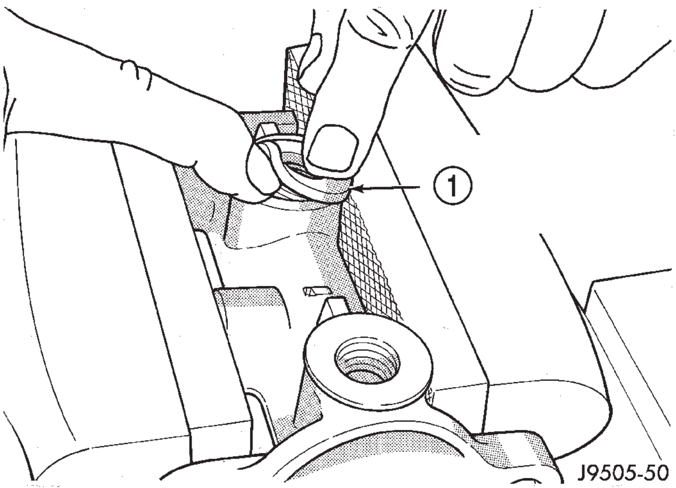


Fig. 38 Grommet Installation

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.

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.

DIAGNOSIS AND TESTING - 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.

MASTER CYLINDER (Continued)

POWER BOOSTER VACUUM TEST

(1) Connect vacuum gauge to booster check valve with short length of hose and T-fitting (Fig. 39).

(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.

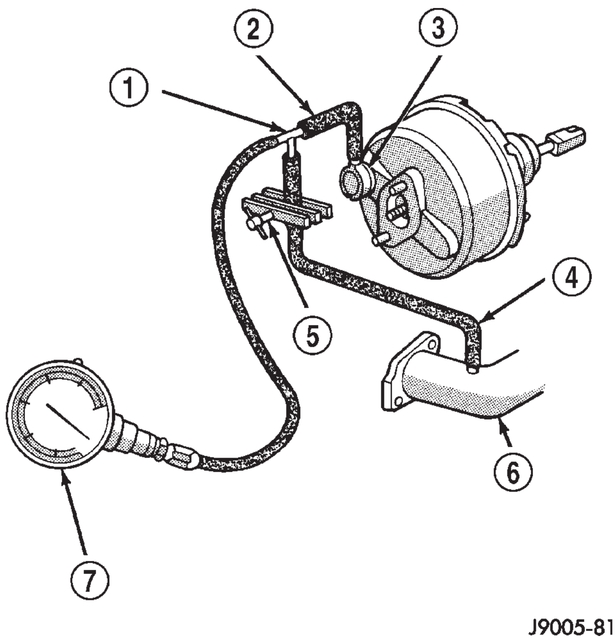


Fig. 39 Typical Booster Vacuum Test Connections

1 - TEE FITTING
2 - SHORT CONNECTING HOSE
3 - CHECK VALVE
4 - CHECK VALVE HOSE
5 - CLAMP TOOL
6 - INTAKE MANIFOLD
7 - VACUUM GAUGE

POWER BOOSTER CHECK VALVE TEST

(1) Disconnect vacuum hose from check valve.

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

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

(4) Apply 15-20 inches vacuum at large end of check valve (Fig. 40).

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

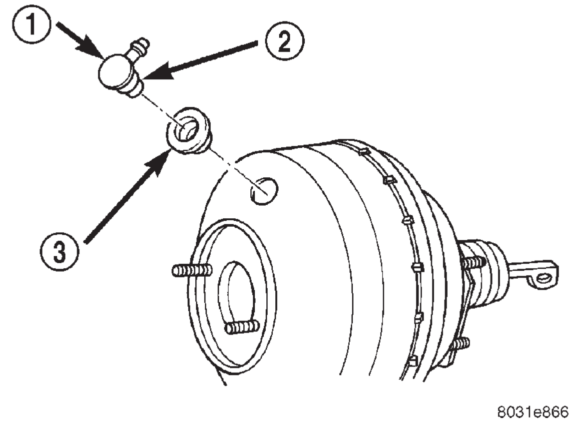


Fig. 40 Vacuum Check Valve And Seal

1 - BOOSTER CHECK VALVE
2 - APPLY TEST VACUUM HERE
3 - VALVE SEAL

STANDARD PROCEDURE - 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.

(1) Mount master cylinder in vise.

(2) Attach bleed tubes to cylinder outlet ports. Then position each tube end into the reservoir (Fig. 41).

(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.

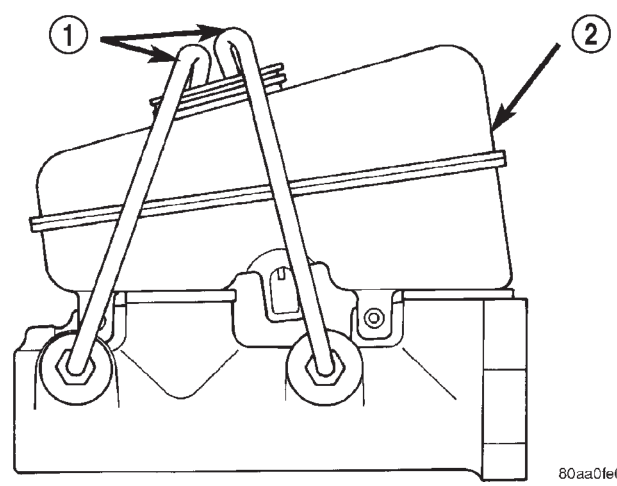


Fig. 41 Master Cylinder Bleeding

1 - BLEEDING TUBES
2 - RESERVOIR

MASTER CYLINDER (Continued)

REMOVAL

(1) Remove evaporative canister.

(2) Disconnect brake lines to master cylinder and combination valve (Fig. 42).

(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.

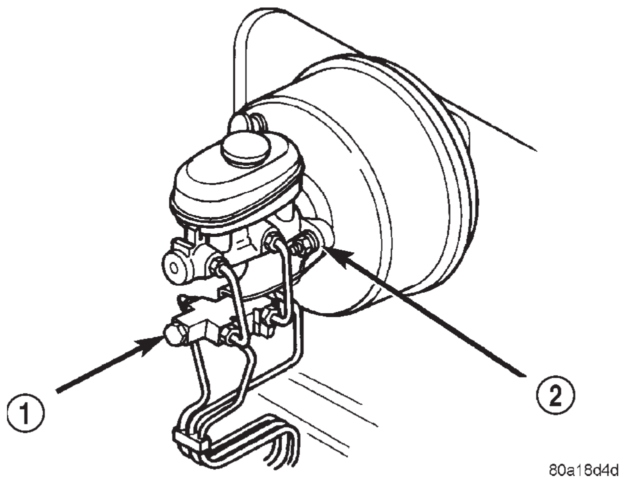


Fig. 42 Master

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.).

(7) Tighten combination valve brake lines to 19 N·m (14 ft. lbs.).

(8) Install evaporative canister.

(9) Bleed base brake system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

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.

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. 43) and clutch rod retainer clip if equipped.

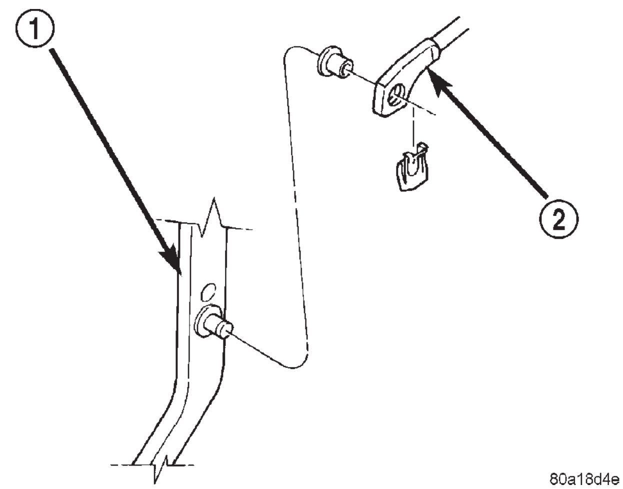


Fig. 43 Push Rod Attachment

1 - BRAKE PEDAL
2 - BOOSTER ROD

(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.

PEDAL (Continued)

(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.

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. 43) 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.

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. 44) .

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.

POWER BRAKE BOOSTER (Continued)

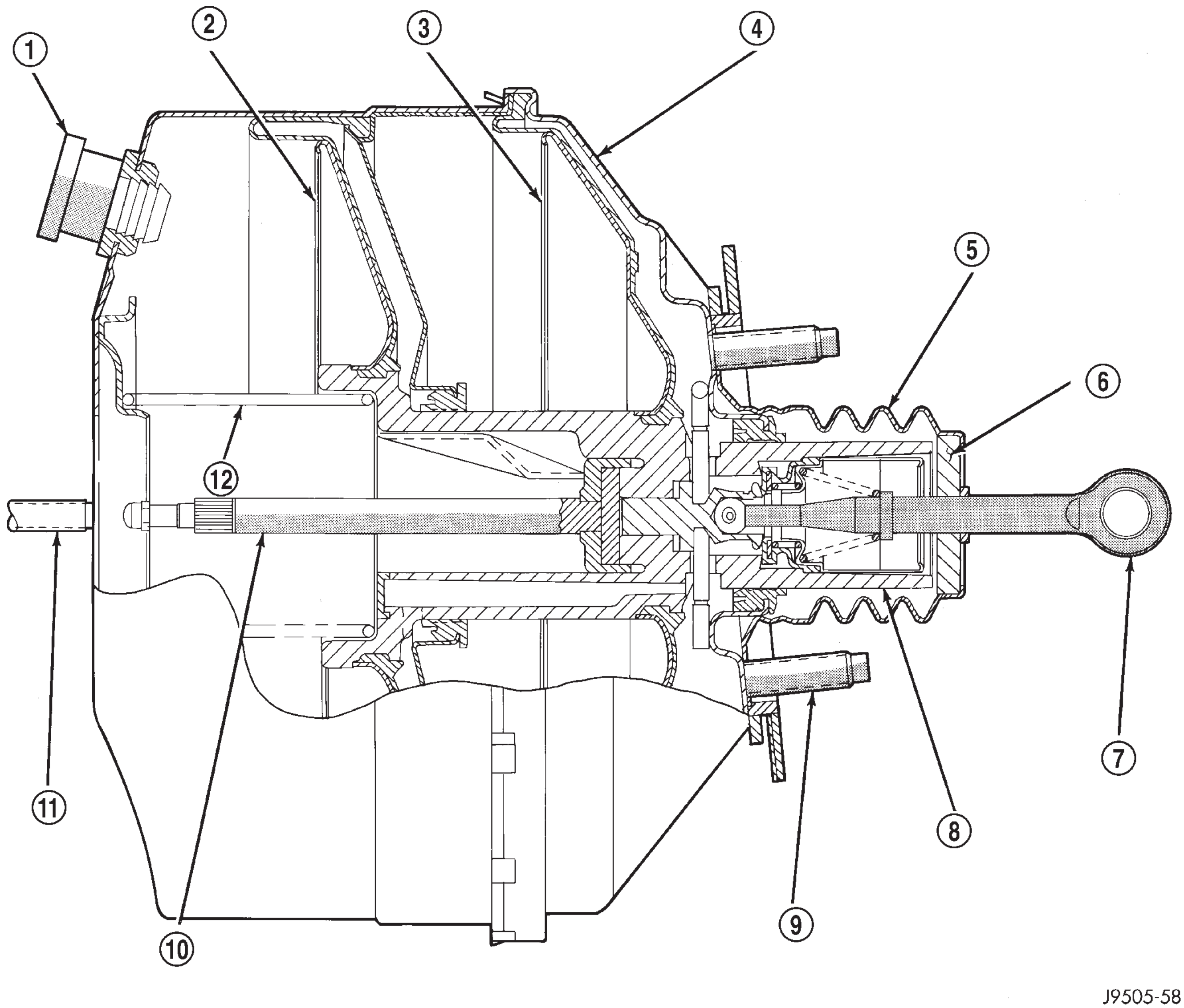


Fig. 44 Power Brake Booster–Typical

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

POWER BRAKE BOOSTER (Continued)

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. 45) and slide the rod off the pin.

(4) Remove four nuts attaching booster to front cowl panel (Fig. 46).

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

(6) Remove dash seal from booster.

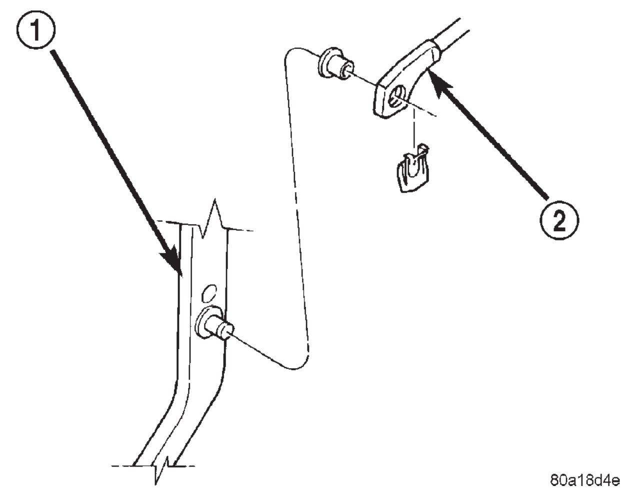


Fig. 45 Push Rod & Clip

1 - BRAKE PEDAL
2 - BOOSTER ROD

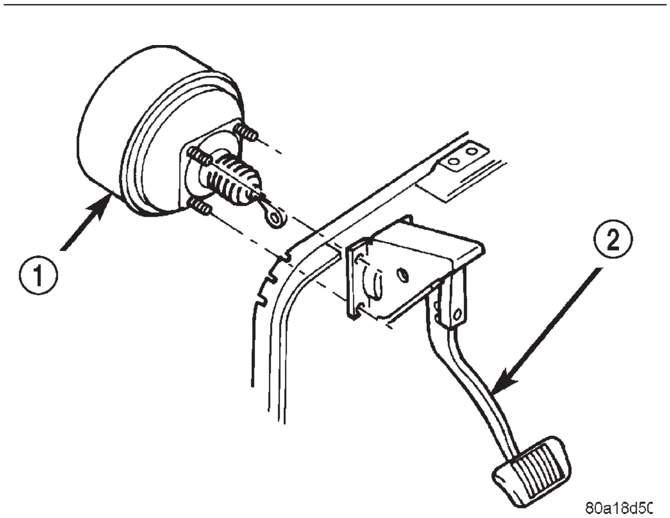


Fig. 46 Booster Mounting Nuts

1 - BOOSTER
2 - BRAKE PEDAL

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.

(8) Install master cylinder and combination valve.

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

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.

COMBINATION VALVE (Continued)

DIAGNOSIS AND TESTING - 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.

REMOVAL

(1) Remove brake lines that connect master cylinder to combination valve (Fig. 47).

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

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

(4) Remove nuts attaching combination valve bracket to booster studs and remove valve bracket off booster studs (Fig. 48).

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. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

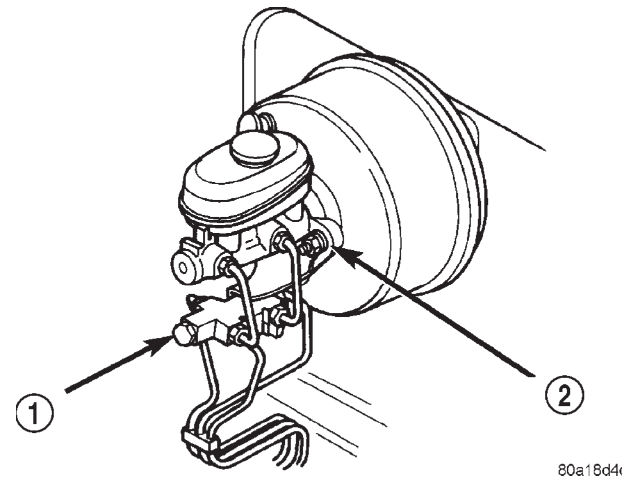


Fig. 47 Combination Valve/Master Cylinder

1 - COMBINATION VALVE
2 - MASTER CYLINDER

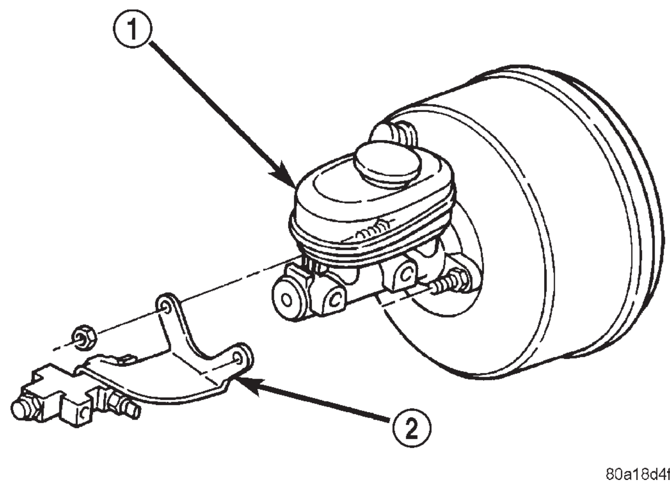


Fig. 48 Combination Valve Bracket

1 - MASTER CYLINDER
2 - COMBINATION VALVE BRACKET

ROTORS

DIAGNOSIS AND TESTING - 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

ROTORS (Continued)

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. 49). 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.).

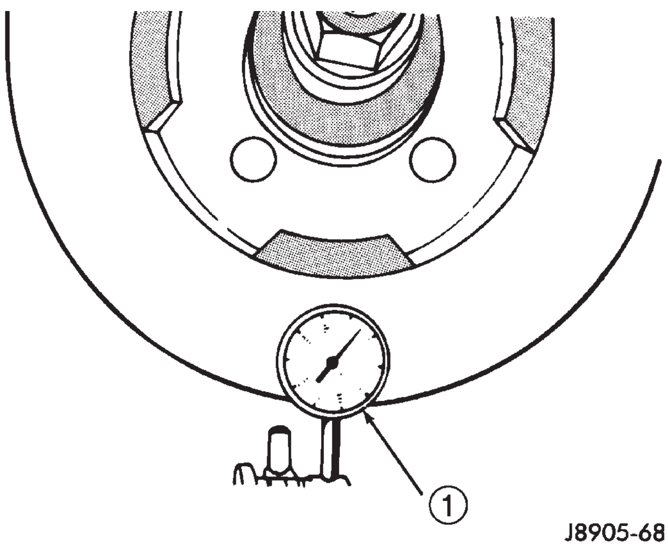


Fig. 49 Checking Rotor Runout And Thickness Variation

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. 50).

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

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

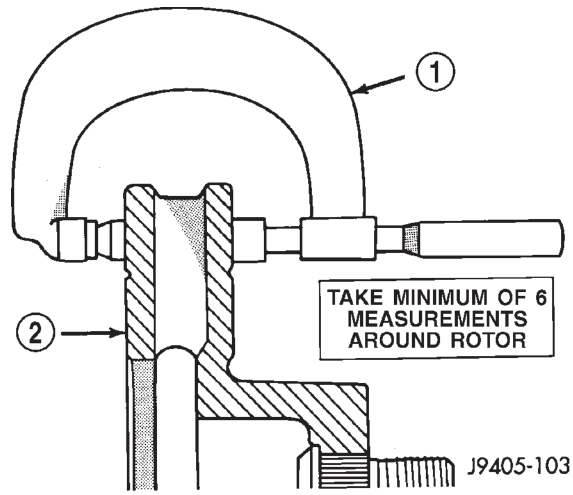


Fig. 50 Measuring Rotor Thickness

1 - MICROMETER
2 - ROTOR

STANDARD PROCEDURE - 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.

REMOVAL

(1) Remove wheel and tire assemble.

(2) Remove caliper. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).

(3) Remove retainers securing rotor to hub studs (Fig. 51).

(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.

ROTORS (Continued)

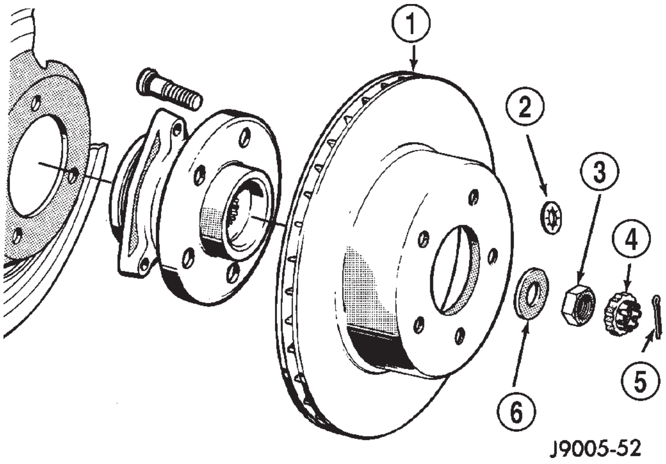


Fig. 51 Rotor & Hub

1 - ROTOR
2 - RETAINER
3 - BEARING NUT
4 - NUT LOCK
5 - COTTER PIN
6 - WASHER

(2) Install rotor on hub.

(3) Install caliper. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).

(4) Install wheel and tire assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

WHEEL CYLINDERS

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.

DISASSEMBLY

(1) Remove push rods and boots (Fig. 52).

(2) Press pistons, cups and spring and expander out of cylinder bore.

(3) Remove bleed screw.

CLEANING

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

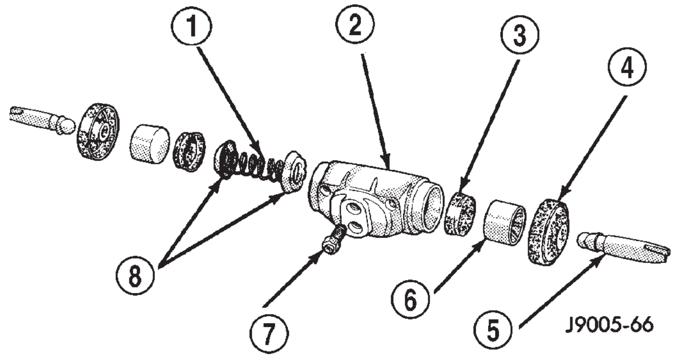


Fig. 52 Wheel Cylinder Components–Typical

1 - SPRING
2 - CYLINDER
3 - PISTON CLIP
4 - BOOT
5 - PUSH ROD
6 - PISTON
7 - BLEED SCREW
8 - CUP EXPANDERS

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.

ASSEMBLY

(1) Lubricate wheel cylinder bore, pistons, piston cups and spring and expander with clean brake fluid.

(2) Install first piston in cylinder bore. Then install first cup in bore and against piston. **Be sure lip of piston cup is facing inward (toward spring and expander) and flat side is against piston.**

(3) Install spring and expander followed by remaining piston cup and piston.

WHEEL CYLINDERS (Continued)

(4) Install boots on each end of cylinder and insert push rods in boots.

(5) Install cylinder bleed screw.

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. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(7) Bleed base brake system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

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. 53) .

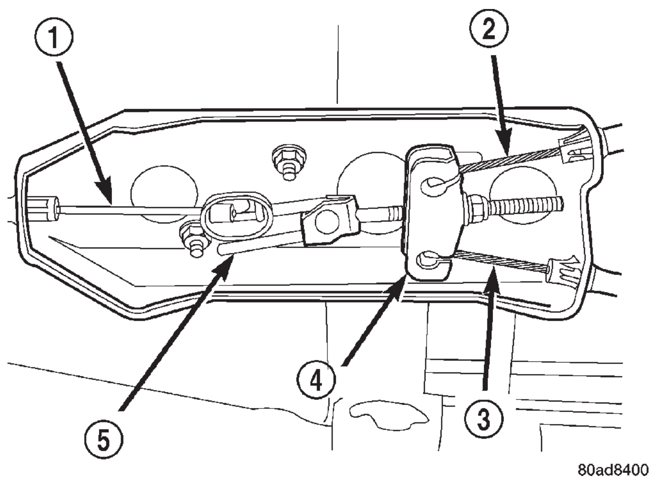


Fig. 53 Parking Brake Components

1 - FRONT CABLE
2 - L.R. CABLE
3 - R.R. CABLE
4 - EQUALIZER
5 - TENSIONER ROD

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

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

DIAGNOSIS AND TESTING - 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, PARKING BRAKE (Continued)

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.

CABLES

REMOVAL

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

(2) Disengage cable from equalizer and remove cable.

(3) Remove cable bracket from upper suspension arm (Fig. 54).

(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. 55) and remove cable from backing plate.

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.

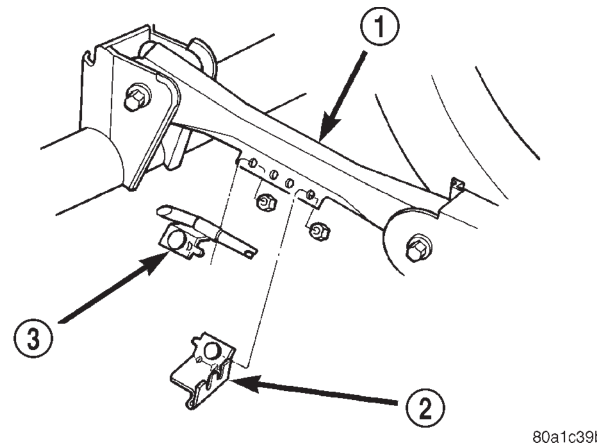


Fig. 54 Parking Brake Cable Bracket

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

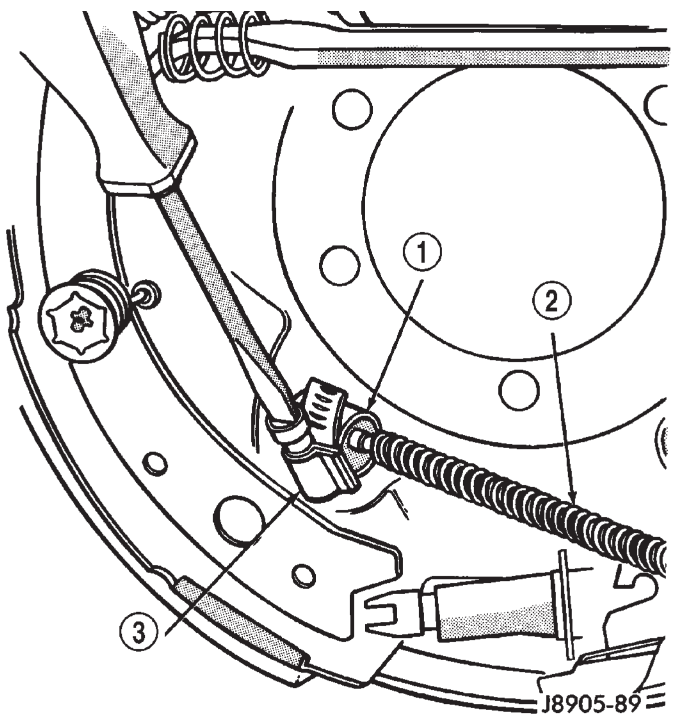


Fig. 55 Cable Retainer

1 - CABLE RETAINER
2 - REAR CABLE
3 - WORM DRIVE HOSE CLAMP

BRAKES - ABS

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BRAKES - ABS

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.

BRAKES - ABS (Continued)

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.

STANDARD PROCEDURE - 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.

SPECIFICATIONS

T0RQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
G-Sensor Sensor Bolt	4-5	—	35-45
G-Sensor Bracket Bolt	8-13	—	75-115
Hydraulic Control Unit Bracket to HCU Bolts	6.5	—	57
Hydraulic Control Unit Body Bracket Bolts	16-24	—	142-212
Hydraulic Control Unit HCU to Body Bracket Bolts	9-13	—	80-115
Hydraulic Control Unit Brake Lines	15-18	—	130-160
Controller Anitlock Brakes Mounting Bolt	7-9	—	60-80
Wheel Speed Sensors Front Mounting Bolt	4-6	—	34-50
Wheel Speed Sensors Rear Mounting Bolt	12-14	—	106-124

FRONT WHEEL SPEED SENSOR

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

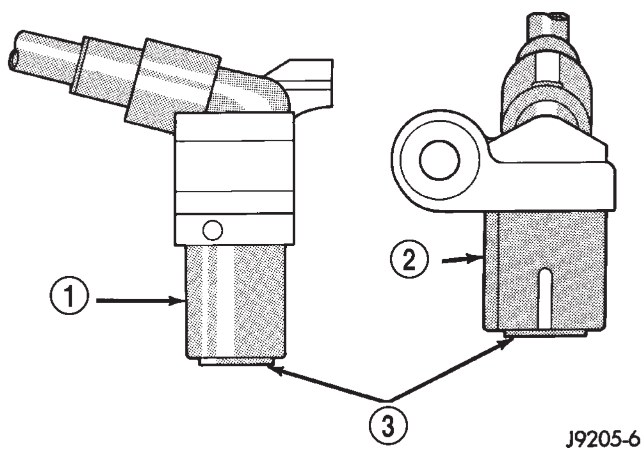

Fig. 1 Typical Wheel Speed Sensors

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.

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. 2).

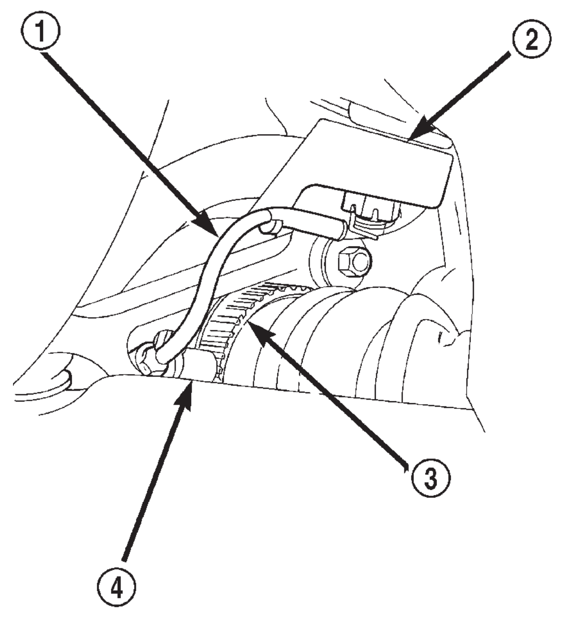

Fig. 2 Front Wheel Speed Sensor

1 - WHEEL SPEED SENSOR PIGTAIL
2 - STEERING KNUCKLE
3 - TONE WHEEL
4 - FRONT WHEEL SPEED SENSOR

FRONT WHEEL SPEED SENSOR (Continued)

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.

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

(7) Connect sensor wire to harness.

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

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. 4).

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. 3).

(1) Position switch on mounting bracket.

(2) Install mounting bolts and tighten to 4-5 N·m (35-45 in. lbs.)

(3) Connect harness to switch.

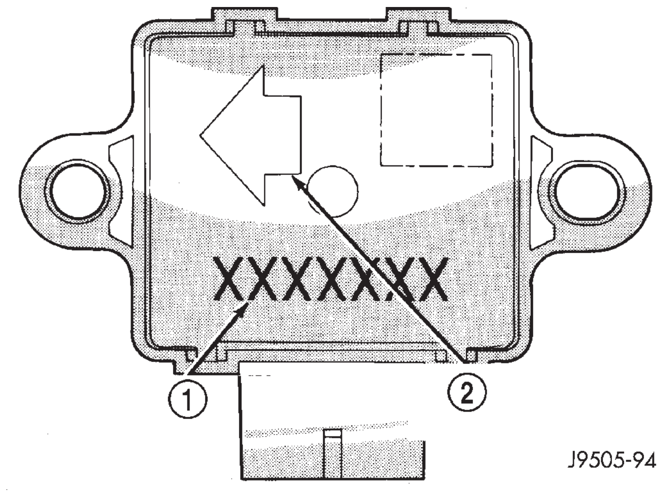

Fig. 3 G-Switch

1 - SWITCH PART NUMBER

2 - ARROW INDICATES FRONT OF SWITCH FOR PROPER MOUNTING

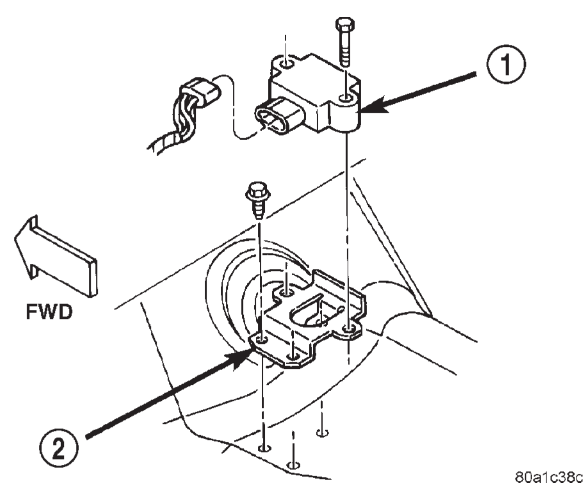

Fig. 4 G-Switch

1 - ACCELERATION SWITCH

2 - MOUNTING BRACKET

(4) Place carpet back into position.

REAR WHEEL SPEED SENSOR

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

REAR WHEEL SPEED SENSOR (Continued)

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

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. 5) and remove sensor.

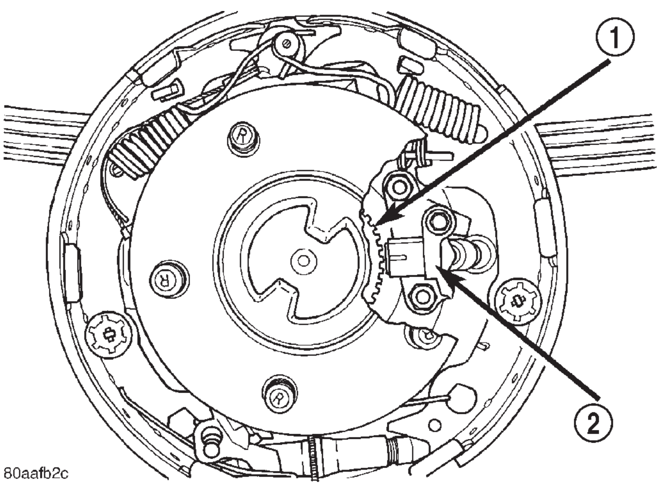

Fig. 5 Wheel Speed Sensor

1 - TONE WHEEL
2 - WHEEL SPEED SENSOR

INSTALLATION

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

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

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

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

(5) If **original** rear sensor was installed, adjust sensor air gap to 0.28-1.5 mm (0.011-0.059 in.). Use feeler gauge to measure air gap (Fig. 6). Tighten sensor bolt to 12-14 N·m (106-124 in. lbs.).

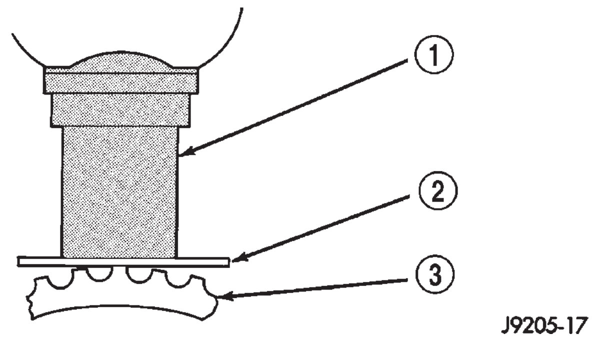

Fig. 6 Setting Air Gap On Original Rear Sensor

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. 7). 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.

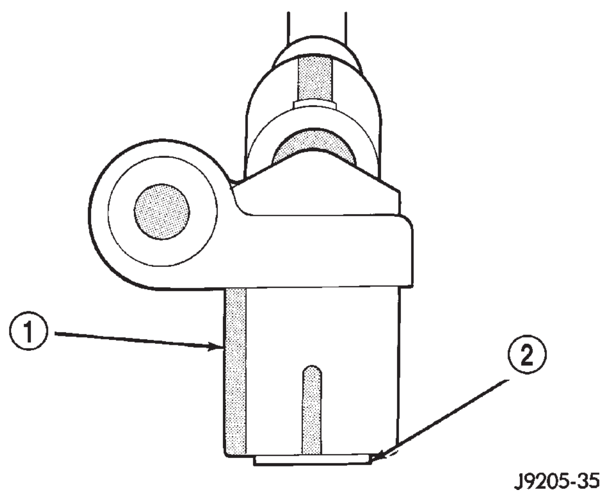

Fig. 7 New Rear Sensor

1 - REAR SENSOR
2 - AIR GAP SPACER ATTACHED TO 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. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(10) Lower vehicle.

(11) Connect sensor wire to harness connector.

HCU (HYDRAULIC CONTROL UNIT)

DESCRIPTION

The HCU consists of a valve body, pump motor, and wire harness.

OPERATION

Accumulators in the valve body store 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 valves modulate brake pressure during antilock braking and are controlled by the CAB.

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

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

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

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

PRESSURE DECREASE

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

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

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

PRESSURE HOLD

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

PRESSURE INCREASE

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

REMOVAL

(1) Install prop rod on the brake pedal to keep pressure on the brake system.

(2) Remove negative battery cable from the battery.

(3) Pull up on the CAB harness connector release (Fig. 8)and remove connector.

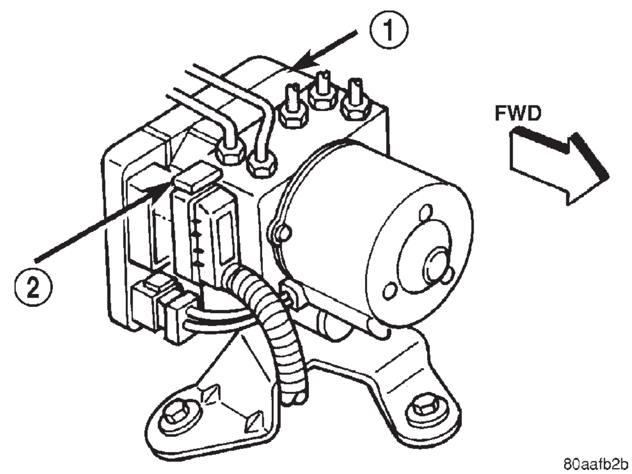

Fig. 8 CAB Harness Connector Release

1 - CAB
2 - CAB HARNESS RELEASE

(4) Remove brake lines from the HCU.

(5) Remove HCU/CAB mounting nuts and bolt (Fig. 9) and remove HCU/CAB.

HCU (HYDRAULIC CONTROL UNIT) (Continued)

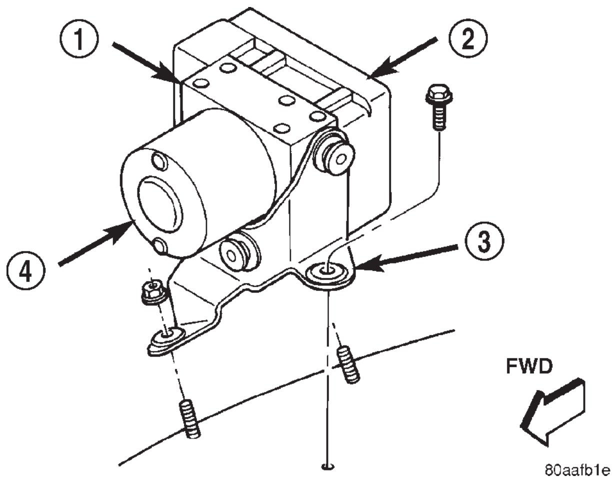

Fig. 9 HCU/CAB Mounting

1 - HCU
2 - CAB
3 - HCU/CAB BRACKET
4 - MOTOR

INSTALLATION

(1) Install HCU/CAB on the mounting studs.

(2) Install mounting nuts and bolt. Tighten to 11.5 N·m (102 in. lbs.).

(3) Install brake lines to the HCU and tighten to 19 N·m (170 in. lbs.).

(4) Install wiring harness connector to the CAB and push down on the release to secure the connector.

(5) Install negative battery cable to the battery.

(6) Bleed ABS brake system (Refer to 5 - BRAKES - STANDARD PROCEDURE).

CLUTCH

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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.

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 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).

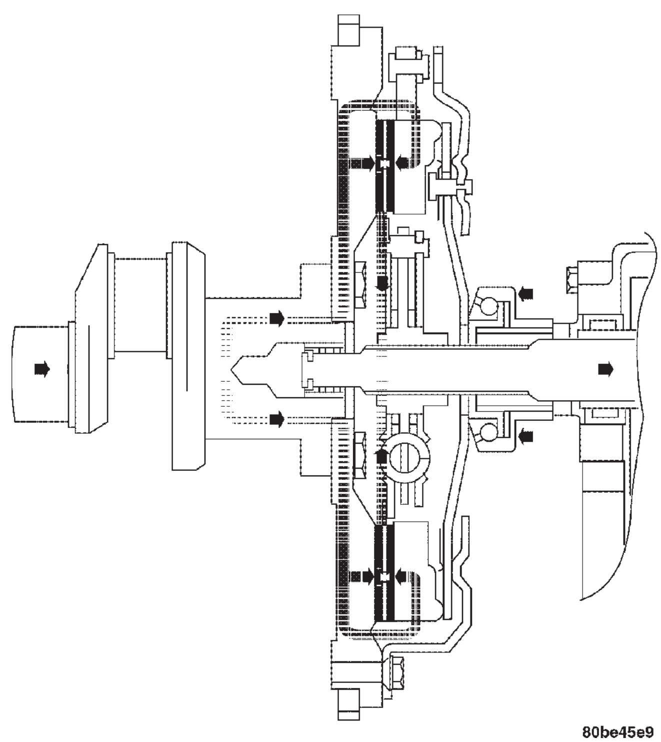


Fig. 1 Engine Powerflow

CLUTCH (Continued)

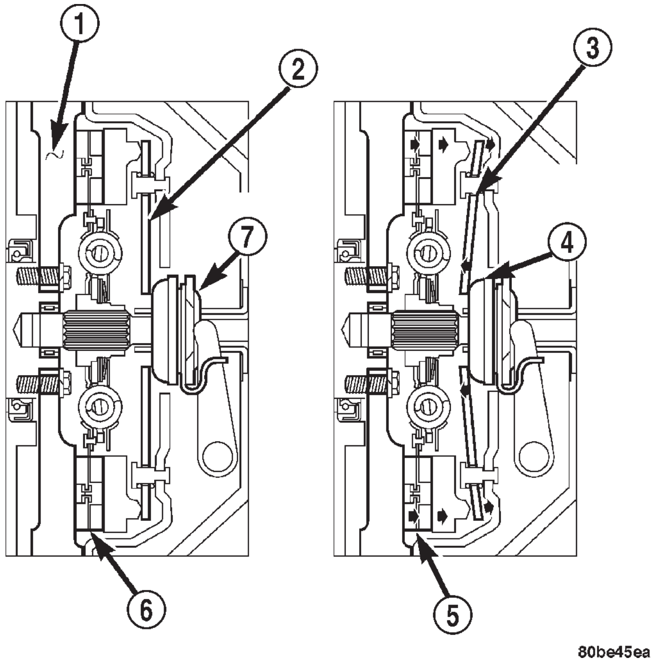


Fig. 2 Clutch Operation

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

WARNING

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.

DIAGNOSIS AND TESTING

A road test and component inspection (Fig. 3) is recommended to determine a clutch problem.

During a road test, drive the vehicle at normal speeds. Shift the transmission through all gear ranges and observe clutch action. If the clutch chatters, grabs, slips or does not release properly, remove and inspect the clutch components. If the problem is noise or hard shifting, further diagnosis may be needed as the transmission or another driveline component may be at fault.

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.

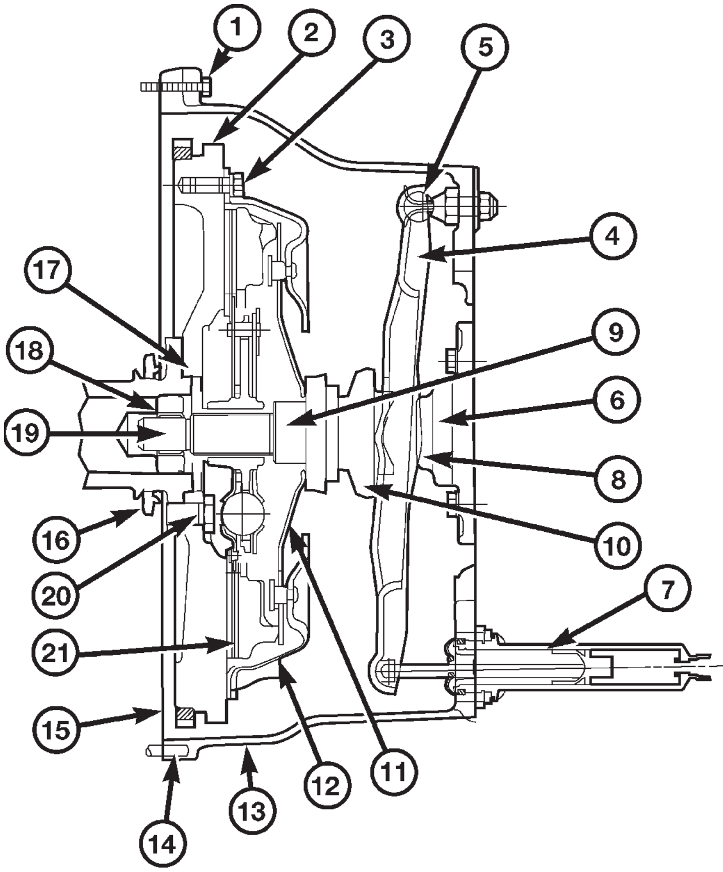
IMPROPER RELEASE OR CLUTCH ENGAGEMENT

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.

CLUTCH (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. 3 CLUTCH COMPONENTS AND INSPECTION

CLUTCH (Continued)

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 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.

DIAGNOSIS CHART

The clutch inspection chart (Fig. 3) 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 Diagnosis Chart 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 (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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.
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 (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
Clutch will not disengage properly.	1. Low clutch fluid level.	1. Add Fluid / Replace hydraulic linkage assembly.
	2. Clutch cover loose.	2. Follow proper bolt tightening procedure.
	3. Clutch disc bent or distorted.	3. Replace clutch disc.
	4. Clutch cover diaphragm spring bent or warped.	4. Replace clutch cover.
	5. Clutch disc installed backwards.	5. Remove and install clutch disc correctly.
	6. Release fork bent or fork pivot loose or damaged.	6. Replace fork or pivot as necessary.
	7. Clutch master or slave cylinder failure.	7. Replace hydraulic linkage assembly.
Clutch pedal squeak.	1. Pivot pin loose.	1. Tighten pivot pin if possible. Replace clutch pedal if necessary.
	2. Master cylinder bushing not lubricated.	2. Lubricate master cylinder bushing.
	3. Pedal bushings worn out or cracked.	3. Replace and lubricate bushings.
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.	1. Replace clutch cover and release bearing.
	2. Release bearing defective or damaged.	2. Replace the release bearing.
	3. Release bearing misaligned.	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.	1. Replace clutch disc and cover.
	2. Clutch cover, spring, or release fingers bent or distorted.	2. Replace clutch disc and cover.
	3. Clutch disc damaged or distorted.	2. Replace clutch disc.
	4. Clutch misalignment.	4. Check alignment and runout of flywheel, disc, pressure plate, andør clutch housing. Correct as necessary.

CLUTCH (Continued)

SPECIFICATION

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Clutch Cover Bolts - 2.5L	31	23	-
Clutch Cover Bolts - 4.0L	50	37	-
Clutch Cylinder Bolts	23	-	200
Clutch Housing Bolts - M12	75	55	-
Clutch Housing Bolts - 3/8	37	27	-
Clutch Housing Bolts - 7/16	58	43	-
Clutch Housing/Trans Bolts	46	34	-
Dust Shield Bolts - M8	8	-	72
Dust Shield Bolts - Lower	50	37	-
Flywheel Bolts - 2.5L	95	70	-
Flywheel Bolts - 4.0L	142	105	-
Rear Support Bolts	45	33	-
Crossmember Frame Bolts	41	30	-

CLUTCH DISC

REMOVAL

(1) Remove transmission. Refer to 21 Transmission and Transfer Case for procedures.

(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.

CAUTION: If original cover will be reused, loosen cover bolts evenly and in rotation to relieve spring tension equally. This is necessary to avoid warping cover.

(4) Remove cover bolts and remove cover and disc (Fig. 4).

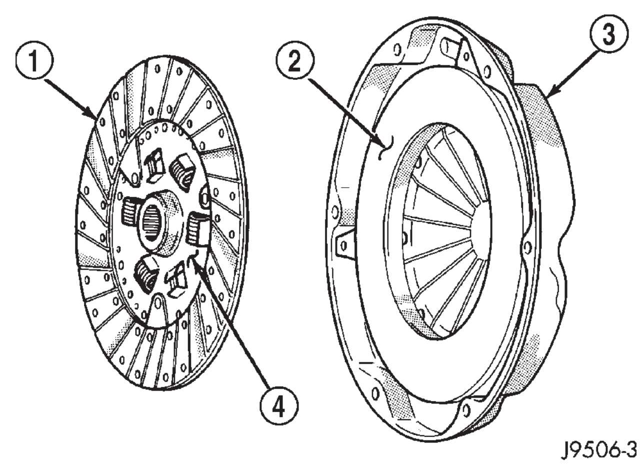

Fig. 4 Clutch Disc And Pressure Plate

1 - DISC
2 - PRESSURE PLATE
3 - PRESSURE PLATE COVER
4 - “FLYWHEEL SIDE” STAMPED ON THIS SURFACE

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) Position clutch disc on flywheel with side marked flywheel positioned against flywheel.

NOTE: If disc is not marked, flat side of disc hub goes towards the flywheel.

(4) Insert alignment tool through disc and into the pilot bearing on the flywheel (Fig. 5).

(5) Position pressure plate over disc and on flywheel (Fig. 5).

CLUTCH DISC (Continued)

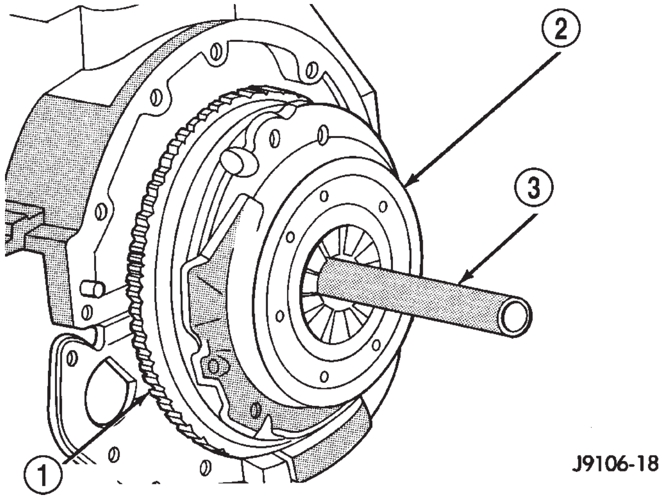

Fig. 5 Aligning Clutch Disc

1 - FLYWHEEL
2 - PRESSURE PLATE AND DISC
3 - ALIGNMENT TOOL

(6) Install clutch cover bolts finger tight.

(7) Tighten cover bolts evenly and in rotation a few threads at a time. Tightening bolts to 31 N·m (23 ft. lbs.) on 2.5L engines and 50 N·m (37 ft. lbs.) on 4.0 L engines.

NOTE: Cover bolts must be tightened evenly and to specified torque to avoid distorting cover.

(8) Apply light coat of Mopar high temperature bearing grease or equivalent to clutch disc hub and splines of transmission input shaft. **Do not over lubricate shaft splines. This will result in grease contamination of disc.**

(9) Install the transmission.

CLUTCH RELEASE BEARING

REMOVAL

(1) Remove the transmission.

(2) Disconnect release bearing from release lever and remove bearing (Fig. 6).

(3) Inspect bearing slide surface of transmission front bearing retainer. Replace retainer if slide surface is scored, worn, or cracked.

(4) Inspect release fork and fork pivot. Be sure pivot is secure and in good condition. Be sure fork is not distorted or worn. Replace release fork retainer spring if bent or damaged.

INSTALLATION

(1) Lubricate crankshaft pilot bearing, input shaft splines, bearing retainer slide surface, fork pivot and release fork pivot surface. Lubricate with Mopar high temperature bearing grease or equivalent.

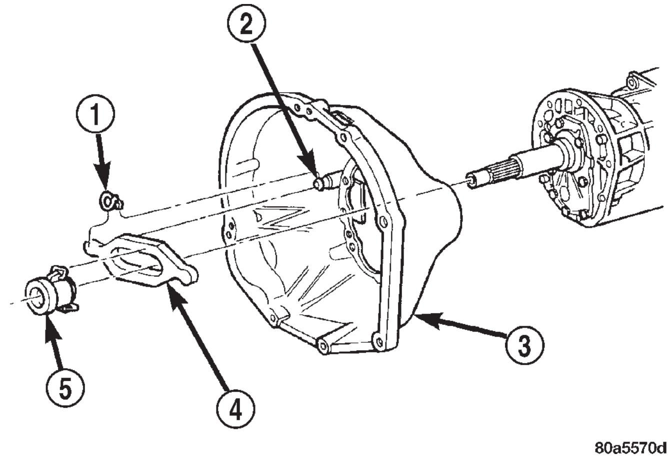

Fig. 6 Release Bearing

1 - RETAINER SPRING
2 - PIVOT BALL STUD
3 - CLUTCH HOUSING
4 - RELEASE FORK
5 - RELEASE BEARING

(2) Install new release bearing. Verify bearing is properly secured to release fork.

(3) Install the transmission.

FLYWHEEL

DIAGNOSIS AND TESTING

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. 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.

FLYWHEEL (Continued)

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 or equivalent. Tighten flywheel bolts to specified torque only. Over-tightening can distort the flywheel hub causing runout.

PILOT BEARING

REMOVAL

(1) Remove the transmission.
(2) Remove pressure plate and clutch disc.
(3) Remove pilot bearing with an internal (blind hole) puller.

INSTALLATION

(1) Lubricate new bearing with Mopar high temperature bearing grease or equivalent.
(2) Start new bearing into crankshaft by hand. Then seat bearing with clutch alignment tool (Fig. 7).

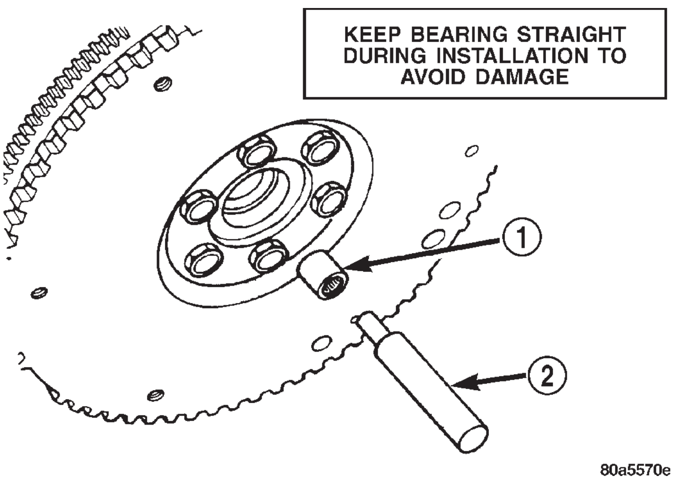

Fig. 7 Pilot Bearing Installer

1 - PILOT BEARING
2 - ALIGNMENT TOOL

(3) Lightly scuff sand flywheel surface with 180 grit emery cloth. Then clean surface with wax and grease remover.
(4) Install clutch disc and pressure plate.
(5) Install the transmission.

LINKAGE

REMOVAL

Clutch master cylinder, slave cylinder and connecting line are serviced as an assembly only. Components cannot be overhauled or serviced separately. Cylinders and connecting line are sealed units. Removal/installation procedures for right and left hand drive models are basically the same.

(1) Raise vehicle.
(2) Remove fasteners attaching slave cylinder to clutch housing.
(3) Remove slave cylinder from clutch housing (Fig. 8).
(4) Disengage clutch fluid line from body clips.
(5) Lower vehicle.
(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. 8) or (Fig. 9).
(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.

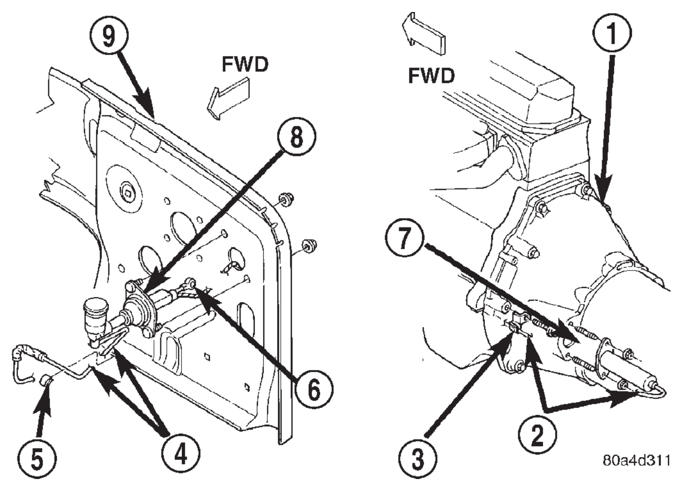

Fig. 8 Left Hand Drive Clutch Linkage

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

INSTALLATION

Clutch master cylinder, slave cylinder and connecting line are serviced as an assembly only. Components cannot be overhauled or serviced separately. Cylinders and connecting line are sealed units. Removal/installation procedures for right and left hand drive models are basically the same.

LINKAGE (Continued)

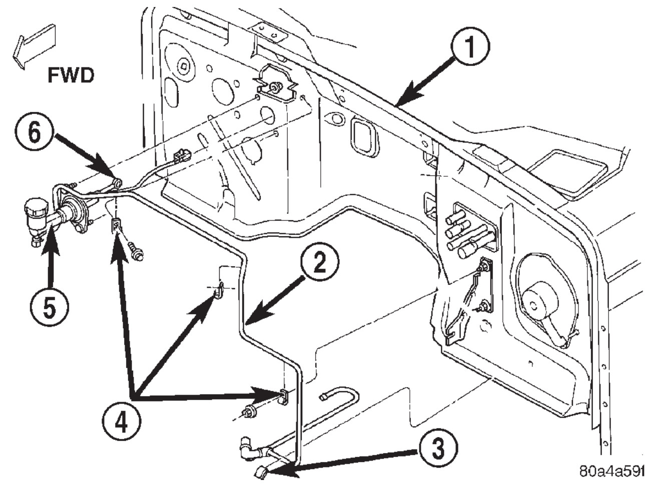

Fig. 9 Right Hand Drive Clutch Linkage

1 - DASH PANEL
2 - FLUID LINE
3 - CLIP
4 - HOLD DOWN STRAP
5 - CLUTCH MASTER CYLINDER
6 - CAPTURED BUSHING

(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.

(3) Position clutch master cylinder on dash panel.

(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.).

(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.).

(9) Secure clutch fluid line in body and transmission clips.

(10) Lower vehicle.

(11) Connect clutch interlock safety switch wires.

MASTER CYLINDER

INSPECTION

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. 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.

CLUTCH PEDAL

REMOVAL

(1) Remove steering column lower cover and knee blocker for access.

(2) Disconnect clutch pedal position switch wires.

(3) Disengage captured bushing lock tabs attaching clutch master cylinder actuator to pedal pivot (Fig. 10) or (Fig. 11).

(4) Remove nuts attaching pedal and bracket to dash panel and upper cowl support (Fig. 10) or (Fig. 11).

(5) Separate pedal assemble from vehicle.

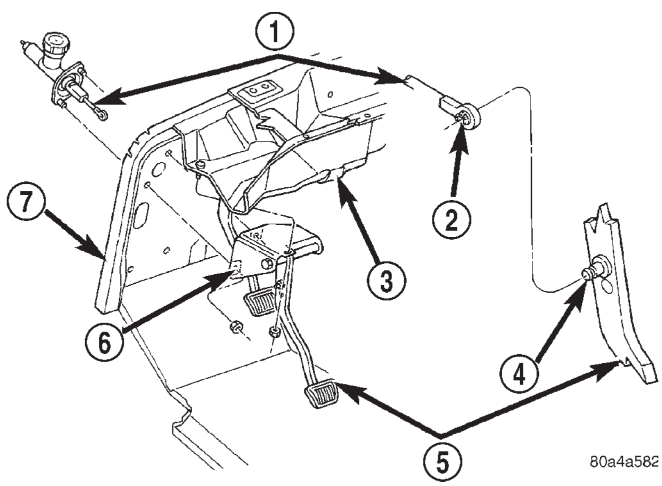

Fig. 10 CLUTCH PEDAL MOUNTING-LHD

1 - CLUTCH CYLINDER ACTUATOR
2 - CAPTURED BUSHING
3 - UPPER COWL SUPPORT
4 - PIVOT
5 - CLUTCH PEDAL
6 - BRACKET
7 - DASH PANEL

CLUTCH PEDAL (Continued)

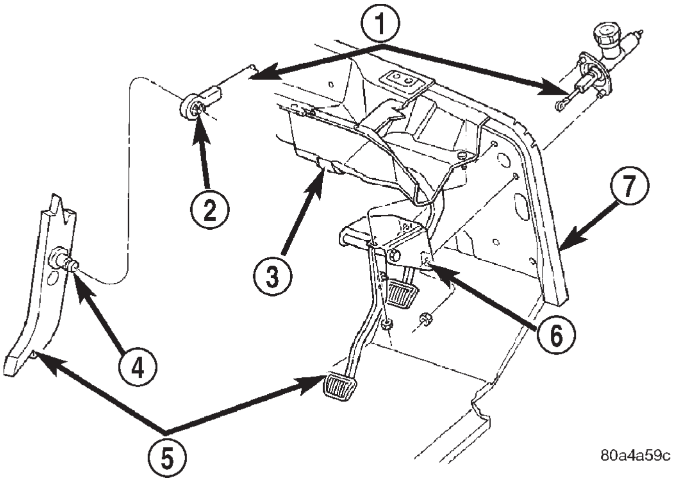

Fig. 11 Clutch Pedal Mounting-RHD

1 - CLUTCH CYLINDER ACTUATOR
2 - CAPTURED BUSHING
3 - UPPER COWL SUPPORT
4 - PIVOT
5 - CLUTCH PEDAL
6 - BRACKET
7 - DASH PANEL

INSTALLATION

(1) Place clutch pedal and bracket over studs on dash panel and cowl support.

(2) Install nuts to attach pedal and bracket to dash panel and upper cowl support. Tighten nuts to 39 N·m (29 ft. lbs.).

(3) Engage captured bushing and actuator on brake pedal pivot.

(4) Connect clutch pedal position switch wires.

COOLING

TABLE OF CONTENTS

COOLING

DESCRIPTION

DESCRIPTION - 2.5L ENGINE

The cooling system (Fig. 1) 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

DESCRIPTION - 4.0L ENGINE

The cooling system (Fig. 2) 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

COOLING (Continued)

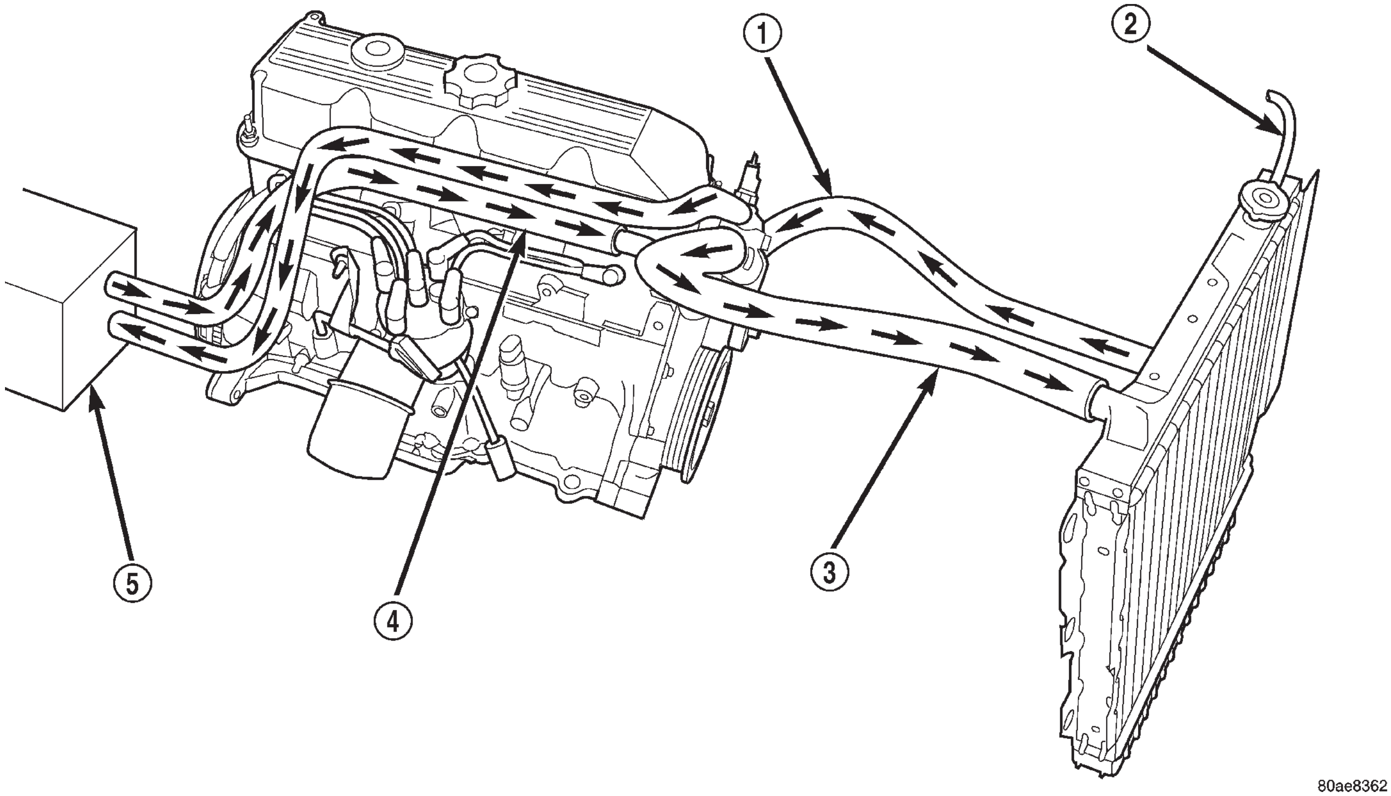

Fig. 1 Coolant Circulation - 2.5L Engine

1 - RADIATOR LOWER HOSE
2 - TO COOLANT RECOVERY BOTTLE
3 - RADIATOR UPPER HOSE
4 - TO WATER PUMP
5 - HEATER CORE

DESCRIPTION - HOSE CLAMPS

The cooling system utilizes both worm drive and spring type hose clamps. If a spring type clamp replacement is necessary, replace with the original Mopar® equipment spring type clamp.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only a original equipment clamp with matching number or letter (Fig. 3).

OPERATION - HOSE CLAMPS

The worm type hose clamp uses a specified torque value to maintain proper tension on a hose connection.

The spring type hose clamp applies constant tension on a hose connection. To remove a spring type hose clamp, use Special Tool 6094 or equivalent, constant tension clamp pliers (Fig. 4) to compress the hose clamp.

DIAGNOSIS AND TESTING

ON-BOARD DIAGNOSTICS (OBD)

COOLING SYSTEM RELATED DIAGNOSTICS

The Powertrain Control Module (PCM) has been programmed to monitor the certain following cooling system components:

- If the engine has remained cool for too long a period, such as with a stuck open thermostat, a Diagnostic Trouble Code (DTC) can be set.
- If an open or shorted condition has developed in the relay circuit controlling the electric radiator fan, a Diagnostic Trouble Code (DTC) can be set.

If the problem is sensed in a monitored circuit often enough to indicate an actual problem, a DTC is stored. The DTC will be stored in the PCM memory for eventual display to the service technician.

ACCESSING DIAGNOSTIC TROUBLE CODES

To read DTC's and to obtain cooling system data, (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION)

COOLING (Continued)

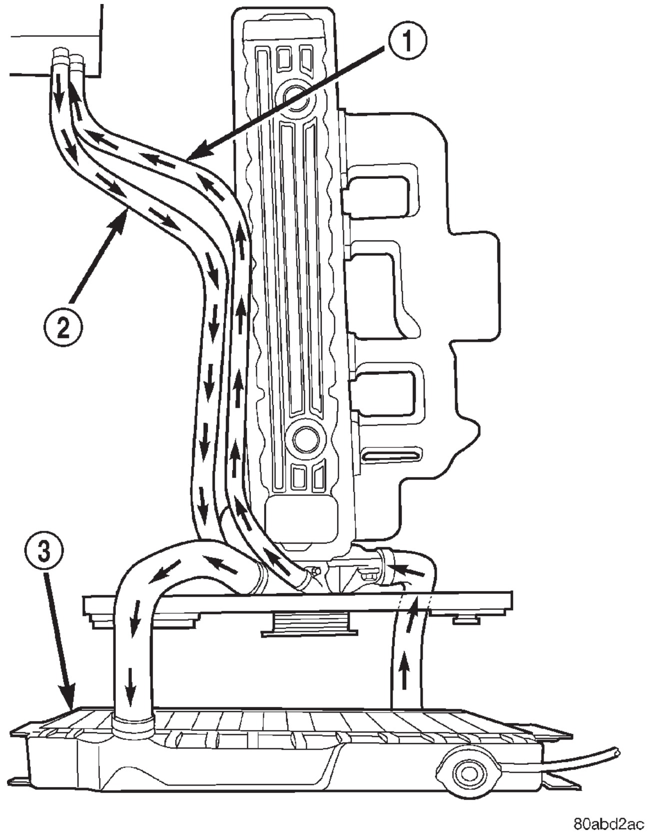

Fig. 2 Coolant Circulation - 4.0L Engine

1 - FROM THERMOSTAT
2 - TO WATER PUMP
3 - RADIATOR

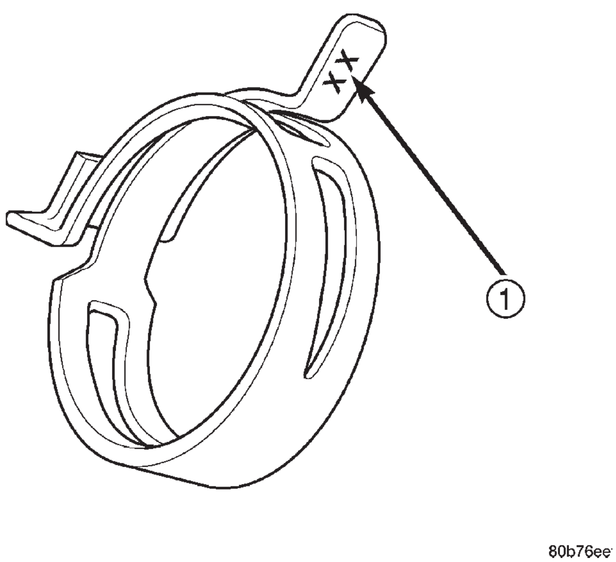

Fig. 3 Spring Clamp Size Location

1 - SPRING CLAMP SIZE LOCATION

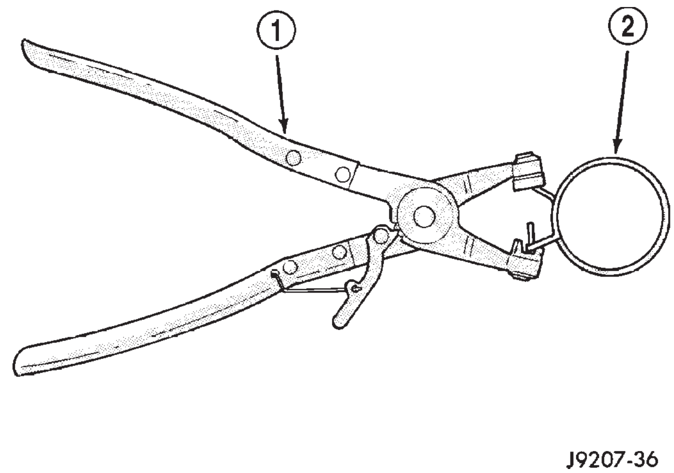

Fig. 4 Hose Clamp Tool

1 - HOSE CLAMP TOOL 6094
2 - HOSE CLAMP

DIAGNOSIS AND TESTING - PRELIMINARY CHECKS

ENGINE COOLING SYSTEM OVERHEATING

Establish what driving conditions caused the complaint. Abnormal loads on the cooling system such as the following may be the cause:

- PROLONGED IDLE
- VERY HIGH AMBIENT TEMPERATURE
- SLIGHT TAIL WIND AT IDLE
- SLOW TRAFFIC
- TRAFFIC JAMS
- HIGH SPEED OR STEEP GRADES

Driving techniques that avoid overheating are:

- Idle with A/C off when temperature gauge is at end of normal range.
- Increasing engine speed for more air flow is recommended.

TRAILER TOWING:

Consult Trailer Towing section of owners manual. Do not exceed limits.

AIR CONDITIONING; ADD-ON OR AFTER MARKET:

A maximum cooling package should have been ordered with vehicle if add-on or after market A/C is installed. If not, maximum cooling system components should be installed for model involved per manufacturer's specifications.

COOLING (Continued)

RECENT SERVICE OR ACCIDENT REPAIR:

Determine if any recent service has been performed on vehicle that may effect cooling system. This may be:

- Engine adjustments (incorrect timing)
- Slipping engine accessory drive belt(s)
- Brakes (possibly dragging)
- Changed parts. Incorrect water pump or pump rotating in wrong direction due to belt not correctly routed
- Reconditioned radiator or cooling system refilling (possibly under filled or air trapped in system).

NOTE: If investigation reveals none of the previous items as a cause for an engine overheating complaint, refer to COOLING SYSTEM DIAGNOSIS CHART BELOW.

These charts are to be used as a quick-reference only. Refer to COOLING SYSTEM DIAGNOSIS CHART

COOLING SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW	1. Has a Diagnostic Trouble Code (DTC) been set indicating a stuck open thermostat?	1. (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION) for On-Board Diagnostics and DTC information. Replace thermostat if necessary.
	2. Is the temperature sending unit connected?	2. Check the temperature sensor connector. (Refer to 8 - ELECTRICAL/ INSTRUMENT CLUSTER - SCHEMATIC - ELECTRICAL) Repair connector if necessary.
	3. Is the temperature gauge operating OK?	3. Check gauge operation. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER/ENGINE TEMPERATURE GAUGE - DESCRIPTION). Repair as necessary.
	4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.	4. Check coolant level in the coolant reserve/overflow tank and the radiator. Inspect system for leaks. Repair leaks as necessary. Refer to the Coolant section of the manual text for WARNINGS and CAUTIONS associated with removing the radiator cap.
	5. Improper operation of internal heater doors or heater controls.	5. Inspect heater and repair as necessary. (Refer to 24 - HEATING & AIR CONDITIONING - DIAGNOSIS AND TESTING) for procedures.

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH OR THE COOLANT WARNING LAMP ILLUMINATES. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM THE COOLING SYSTEM	1. Trailer is being towed, a steep hill is being climbed, vehicle is operated in slow moving traffic, or engine is being idled with very high ambient (outside) temperatures and the air conditioning is on. Higher altitudes could aggravate these conditions.	1. This may be a temporary condition and repair is not necessary. Turn off the air conditioning and attempt to drive the vehicle without any of the previous conditions. Observe the temperature gauge. The gauge should return to the normal range. If the gauge does not return to the normal range, determine the cause for overheating and repair. Refer to Possible Causes (2-20).
	2. Is the temperature gauge reading correctly?	2. Check gauge. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - SCHEMATIC - ELECTRICAL). Repair as necessary.
	3. Is the temperature warning illuminating unnecessarily?	3. (Refer to 8 - ELECTRICAL/ INSTRUMENT CLUSTER - SCHEMATIC - ELECTRICAL).
	4. Coolant low in coolant reserve/ overflow tank and radiator?	4. Check for coolant leaks and repair as necessary. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
	5. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following Step 6.	5. Tighten cap
	6. Poor seals at the radiator cap.	6. (a) Check condition of cap and cap seals. Refer to Radiator Cap. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator.
	7. Coolant level low in radiator but not in coolant reserve/overflow tank. This means the radiator is not drawing coolant from the coolant reserve/ overflow tank as the engine cools	7. (a) Check condition of radiator cap and cap seals. Refer to Radiator Cap in this Group. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator. (c) Check condition of the hose from the radiator to the coolant tank. It should fit tight at both ends without any kinks or tears. Replace hose if necessary. (d) Check coolant reserve/overflow tank and tanks hoses for blockage. Repair as necessary.
	8. Incorrect coolant concentration	8. Check coolant. (Refer to LUBRICATION & MAINTENANCE/ FLUID TYPES - DESCRIPTION).

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	9. Coolant not flowing through system	9. Check for coolant flow at radiator filler neck with some coolant removed, engine warm and thermostat open. Coolant should be observed flowing through radiator. If flow is not observed, determine area of obstruction and repair as necessary.
	10. Radiator or A/C condenser fins are dirty or clogged.	10. Remove insects and debris. (Refer to 7 - COOLING - STANDARD PROCEDURE).
	11. Radiator core is corroded or plugged.	11. Have radiator re-cored or replaced.
	12. Aftermarket A/C installed without proper radiator.	12. Install proper radiator.
	13. Fuel or ignition system problems.	13. Refer to 14 - Fuel System or 8 - Electrical for diagnosis and testing procedures.
	14. Dragging brakes.	14. Check and correct as necessary. (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING) for correct procedures.
	15. Bug screen or cardboard is being used, reducing airflow.	15. Remove bug screen or cardboard.
	16. Thermostat partially or completely shut.	16. Check thermostat operation and replace as necessary. (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - REMOVAL).
	17. Viscous fan drive not operating properly.	17. Check fan drive operation and replace as necessary. (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
	18. Cylinder head gasket leaking.	18. Check for cylinder head gasket leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
	19. Heater core leaking.	19. Check heater core for leaks. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - DIAGNOSIS AND TESTING). Repair as necessary.

COOLING (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 this circuit.	2. Check operation of gauge and repair if necessary. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING).
	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 should return to normal range after vehicle is driven.
	4. Gauge reading high after re-starting a warmed up (hot) engine.	4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.
	5. Coolant level low in radiator (air will build up in the cooling system causing the thermostat to open late).	5. Check and correct coolant leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
	6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing a thermostat to open late.	6. (a) Check for cylinder head gasket leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
		(b) Check for coolant in the engine oil. Inspect for white steam emitting from the exhaust system. Repair as necessary.
	7. Water pump impeller loose on shaft.	7. Check water pump and replace as necessary. (Refer to 7 - COOLING/ ENGINE/WATER PUMP - REMOVAL).
	8. Loose accessory drive belt. (water pump slipping)	8. (Refer to 7 - COOLING/ ACCESSORY DRIVE/DRIVE BELTS - DIAGNOSIS AND TESTING). Check and correct as necessary.
	9. Air leak on the suction side of the 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 7 - COOLING/ ENGINE/RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). Replace cap as necessary.

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
COOLANT LOSS TO THE GROUND WITHOUT PRESSURE CAP BLOWOFF. GAUGE READING HIGH OR HOT	1. Coolant leaks in radiator, cooling system hoses, water pump or engine.	1. Pressure test and repair as necessary. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
DETONATION OR PRE-IGNITION (NOT CAUSED BY IGNITION SYSTEM). GAUGE MAY OR MAY NOT BE READING HIGH	1. Engine overheating.	1. Check reason for overheating and repair as necessary.
	2. Freeze point of coolant not correct. Mixture is too rich or too lean.	2. Check coolant concentration. (Refer to LUBRICATION & MAINTENANCE/ FLUID TYPES - DESCRIPTION).
HOSE OR HOSES COLLAPSE WHILE ENGINE IS RUNNING	1. Vacuum created in cooling system on engine cool-down is not being relieved through coolant reserve/ overflow system.	1. (a) Radiator cap relief valve stuck. (Refer to 7 - COOLING/ENGINE/ RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). Replace if necessary
		(b) Hose between coolant reserve/ overflow tank and radiator is kinked. Repair as necessary.
		(c) Vent at coolant reserve/overflow tank is plugged. Clean vent and repair as necessary.
		(d) Reserve/overflow tank is internally blocked or plugged. Check for blockage and repair as necessary.
NOISY VISCOUS FAN/ DRIVE	1. Fan blades loose.	1. Replace fan blade assembly. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL)
	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 7 - COOLING/ ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
	5. A certain amount of fan noise may be evident on models equipped with a thermal viscous fan drive. Some of this noise is normal.	5. (Refer to 7 - COOLING/ENGINE/ FAN DRIVE VISCOUS CLUTCH - DESCRIPTION) for an explanation of normal fan noise.

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
INADEQUATE HEATER PERFORMANCE. THERMOSTAT FAILED IN OPEN POSITION	1. Has a Diagnostic trouble Code (DTC) been set?	1. (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION) for correct procedures and replace thermostat if necessary
	2. Coolant level low	2. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
	3. Obstructions in heater hose/fittings	3. Remove heater hoses at both ends and check for obstructions
	4. Heater hose kinked	4. Locate kinked area and repair as necessary
	5. Water pump is not pumping water to/through the heater core. When the engine is fully warmed up, both heater hoses should be hot to the touch. If only one of the hoses is hot, the water pump may not be operating correctly or the heater core may be plugged. Accessory drive belt may be slipping causing poor water pump operation.	5. (Refer to 7 - COOLING/ENGINE/ WATER PUMP - REMOVAL). If a slipping belt is detected, (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - DIAGNOSIS AND TESTING). If heater core obstruction is detected, (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/HEATER CORE - REMOVAL).
STEAM IS COMING FROM THE FRONT OF VEHICLE NEAR THE GRILL AREA WHEN WEATHER IS WET, ENGINE IS WARMED UP AND RUNNING, AND VEHICLE IS STATIONARY. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. During wet weather, moisture (snow, ice or rain condensation) on the radiator will evaporate when the thermostat opens. This opening allows heated water into the radiator. When the moisture contacts the hot radiator, steam may be emitted. This usually occurs in cold weather with no fan or airflow to blow it away.	1. Occasional steam emitting from this area is normal. No repair is necessary.
COOLANT COLOR	1. Coolant color is not necessarily an indication of adequate corrosion or temperature protection. Do not rely on coolant color for determining condition of coolant.	1. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION). Adjust coolant mixture as necessary.
COOLANT LEVEL CHANGES IN COOLANT RESERVE/OVERFLOW TANK. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. Level changes are to be expected as coolant volume fluctuates with engine temperature. If the level in the tank was between the FULL and ADD marks at normal operating temperature, the level should return to within that range after operation at elevated temperatures.	1. A normal condition. No repair is necessary.

COOLING (Continued)

DIAGNOSIS AND TESTING - 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 parts department. Place the heater control unit in HEAT position. Start and operate the engine until the radiator upper hose is warm to the touch. Aim the commercially available black light tool at the components to be checked. If leaks are present, the black light will cause the additive to glow a bright green color.

The black light can be used along with a pressure tester to determine if any external leaks exist (Fig. 5).

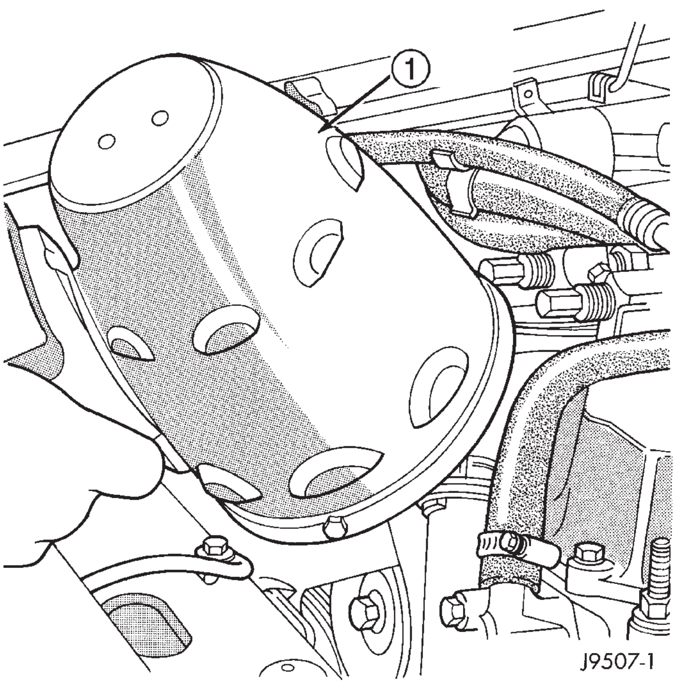

Fig. 5 Leak Detection Using Black Light—Typical

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. 6).

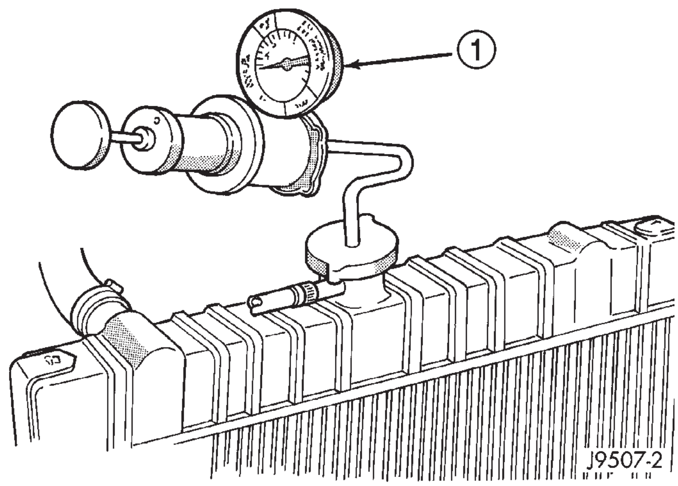

Fig. 6 Pressurizing System—Typical

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 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

COOLING (Continued)

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.

Remove thermostat (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - REMOVAL).

Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

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.

DIAGNOSIS AND TESTING - 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.

STANDARD PROCEDURE

STANDARD PROCEDURE—COOLANT LEVEL CHECK

NOTE: Do not remove radiator cap for routine coolant level inspections. The coolant level can be checked at coolant reserve/overflow tank.

The coolant reserve/overflow system provides a quick visual method for determining coolant level without removing radiator pressure cap. With engine idling and at normal operating temperature, observe coolant level in reserve/overflow tank. The coolant level should be between ADD and FULL marks.

STANDARD PROCEDURE—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.

COOLING (Continued)

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. 7).

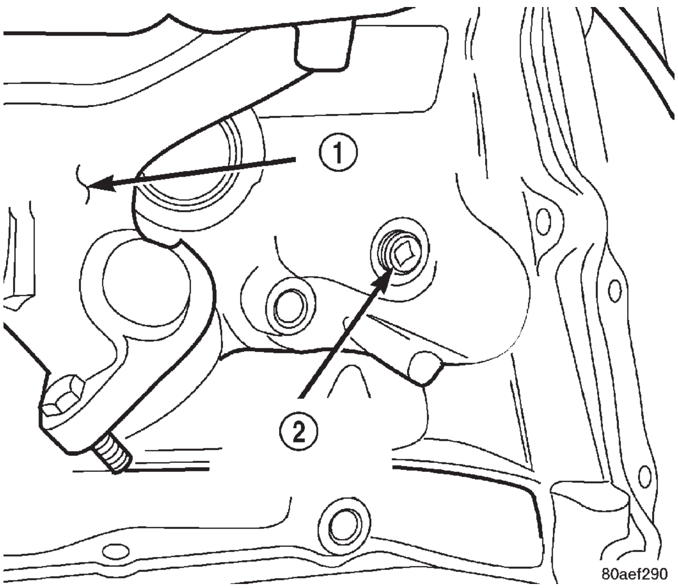

Fig. 7 Draining Coolant From Block—2.5L/4.0L Engines

1 - EXHAUST MANIFOLD
2 - CYLINDER BLOCK COOLANT DRAIN PLUG

STANDARD PROCEDURE—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. 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.**

STANDARD PROCEDURE - COOLING SYSTEM - REVERSE FLUSHING

CAUTION: The cooling system normally operates at 97-to-124 kPa (14-to -18 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

Reverse flushing of the cooling system is the forcing of water through the cooling system. This is done using air pressure in the opposite direction of normal coolant flow. It is usually only necessary with very dirty systems with evidence of partial plugging.

CHEMICAL CLEANING

If visual inspection indicates the formation of sludge or scaly deposits, use a radiator cleaner (Mopar Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid the flushing operation.

CAUTION: Be sure instructions on the container are followed.

REVERSE FLUSHING RADIATOR

Disconnect the radiator hoses from the radiator fittings. Attach a section of radiator hose to the radiator bottom outlet fitting and insert the flushing gun. Connect a water supply hose and air supply hose to the flushing gun.

CAUTION: The cooling system normally operates at 97-to-124 kPa (14- to-18 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

Allow the radiator to fill with water. When radiator is filled, apply air in short blasts allowing radiator to refill between blasts. Continue this reverse flushing until clean water flows out through rear of radiator cooling tube passages. For more information, refer to operating instructions supplied with flushing equipment. Have radiator cleaned more extensively by a radiator repair shop.

REVERSE FLUSHING ENGINE

Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE). 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.

COOLING (Continued)

CAUTION: Be sure that the heater control valve is closed (heat off). This is done to prevent coolant flow with scale and other deposits from entering the heater core.

Connect the water supply hose and air supply hose to the flushing gun. Allow the engine to fill with water. When the engine is filled, apply air in short blasts, allowing the system to fill between air blasts. Continue until clean water flows through the lead away hose. For more information, refer to operating instructions supplied with flushing equipment.

Remove the lead away hose, flushing gun, water supply hose and air supply hose. Remove the thermostat housing (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - REMOVAL). Install the thermostat and housing with a replacement gasket (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - INSTALLATION). Connect the radiator hoses. Refill the cooling system with the correct antifreeze/water mixture (Refer to 7 - COOLING - STANDARD PROCEDURE).

ACCESSORY DRIVE

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ACCESSORY DRIVE

SPECIFICATIONS

BELT TENSION

Belt tension can not be adjusted. Refer to the following Belt Tension chart for specifications.

DESCRIPTION	N·m	Lbs. ft.
New Serpentine Belt*	800-900	180-200
Used Serpentine Belt	623-712	140-160
* Belt is considered new if it has been used 15 minutes or less.		

BELT TENSIONERS - 2.5L

REMOVAL

(1) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Remove the pulley bolt, bushing, pulley and spacer (Fig. 1).

(3) Remove the tensioner adjustment bolt and tensioner collar (Fig. 1).

INSTALLATION

(1) Position tensioner collar and install the tensioner adjustment bolt.

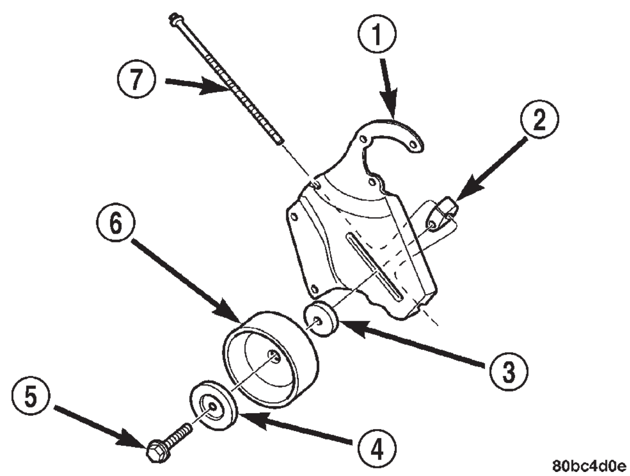

Fig. 1 Accessory Drive Belt Tensioner - 2.5L Engine

1 - TENSIONER BRACKET
2 - TENSIONER COLLAR
3 - SPACER
4 - BUSHING
5 - BOLT
6 - IDLER PULLEY
7 - TENSIONER ADJUSTMENT BOLT

(2) Position the spacer, idler pulley, bushing and bolt.

(3) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

BELT TENSIONERS - 4.0L

DESCRIPTION

The automatic belt tensioner (Fig. 2) is a spring loaded arm and pulley assembly. The tensioner assembly is designed to apply constant pressure on the accessory drive belt to maintain proper belt tension. There are three marks on the tensioner body, these marks are there to indicate belt wear and belt tension.

NOTE: On 4.0L engines, the tensioner arm has three marks. Upon installation of a new belt, the double line marks close to each other should be very close to the mark on the base. The belt should be replaced if the single line mark lines up with the mark on the base.

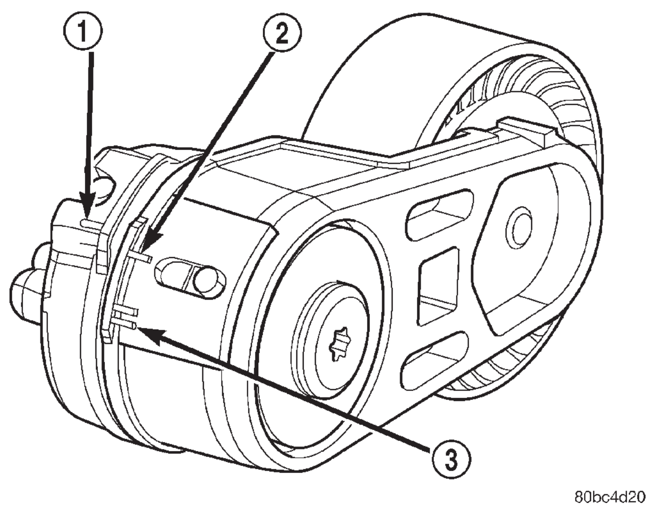

Fig. 2 Accessory Drive Belt Wear Indicator - 4.0L Engine

1 - INDICATOR MARK
2 - MINIMUM TENSION MARK
3 - MAXIMUM TENSION MARK

REMOVAL

On 4.0L engines, the tensioner arm has three marks. Upon installation of a new belt, the double line marks close to each other should be very close to the mark on the base. The belt should be replaced if the single line mark lines up with the mark on the base.

If the above specification cannot be met, check for:

- The wrong belt being installed (incorrect length/width)
- Worn bearings on an engine accessory (A/C compressor, power steering pump, water pump, idler pulley or generator)
- A pulley on an engine accessory being loose
- Misalignment of an engine accessory
- Belt incorrectly routed.

NOTE: A used belt should be replaced if tensioner indexing arrow has moved to the minmum travel indicator. Tensioner travel stops at this point.

(1) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Remove tensioner assembly from mounting bracket (Fig. 3).

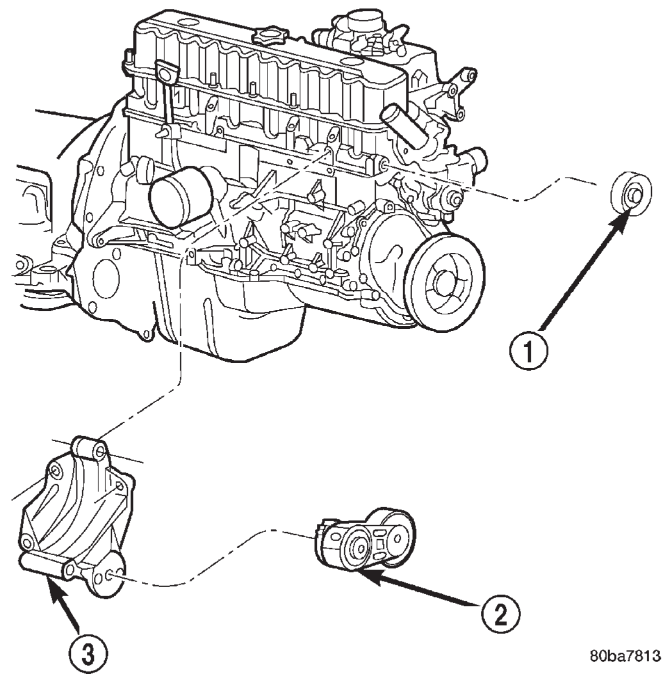

Fig. 3 Automatic Belt Tensioner - 4.0L Engine

1 - IDLER PULLEY TIGHTEN TO 47 N·m (35 FT. LBS.)
2 - AUTOMATIC BELT TENSIONER
3 - GENERATOR MOUNTING BRACKET

WARNING: BECAUSE OF HIGH SPRING TENSION, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY.

INSTALLATION

(1) Install tensioner assembly to mounting bracket, align the two dowels on the tensioner with the mounting bracket and hand start the bolt. Tighten bolt to 28 N·m (250 in. lbs.).

(2) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(3) Check belt indexing marks.

DRIVE BELTS - 2.5L

DIAGNOSIS AND TESTING - ACCESSORY DRIVE BELT

VISUAL DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 4), 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. 4). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to the ACCESSORY DRIVE BELT DIAGNOSIS CHART for further belt diagnosis.

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.

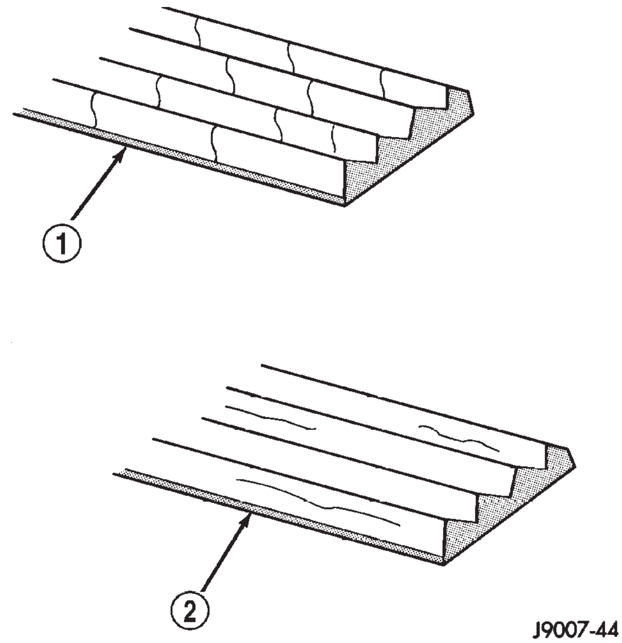

Fig. 4 Belt Wear Patterns

1 - NORMAL CRACKS BELT OK
2 - NOT NORMAL CRACKS REPLACE BELT

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.

DRIVE BELTS - 2.5L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
LONGITUDAL BELT CRACKING	1. Belt has mistracked from pulley groove 2. Pulley groove tip has worn away rubber to tensile member	1. Replace belt 2. Replace belt
″GROOVE JUMPING″ (Belt does not maintain correct position on pulley)	1. Belt tension either too low or too high 2. Pulley(s) not within design tolerance 3. Foreign object(s) in grooves 4. Pulley misalignment 5. Belt cordline is broken	1. Adjust belt tension (2.5L) 2. Replace pulley(s) 3. Remove foreign objects from grooves 4. Align component 5. Replace belt
BELT BROKEN (Note: Identify and correct problem before new belt is installed)	1. Excessive tension 2. Tensile member damaged during belt installation 3. Severe misalignment 4. Bracket, pulley, or bearing failure	1. Replace belt and adjust tension to specification 2. Replace belt 3. Align pulley(s) 4. Replace defective component and belt
NOISE (Objectionable squeal, squeak, or rumble is heard or felt while drive belt is in operation)	1. Belt slippage 2. Bearing noise 3. Belt misalignment 4. Belt to pulley mismatch 5. Driven component induced vibration 6. System resonant frequency induced vibration	1. Adjust belt tension (2.5L) 2. Locate and repair 3. Align belt/pulley(s) 4. Install correct belt 5. Locate defective driven component and repair 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 2. Excessive heat causing woven fabric to age 3. Tension sheeting splice has fractured	1. Correct rubbing condition 2. Replace belt 3. Replace belt
CORD EDGE FAILURE (Tensile member exposed at edges of belt or separated from belt body)	1. Excessive tension 2. Belt contacting stationary object 3. Pulley(s) out of tolerance 4. Insufficient adhesion between tensile member and rubber matrix	1. Adjust belt tension (2.5L) 2. Replace belt 3. Replace pulley 4. Replace belt and adjust tension to specifications

DRIVE BELTS - 2.5L (Continued)

REMOVAL

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 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. 5).

(3) Loosen tension adjusting bolt (Fig. 5) and remove accessory drive belt.

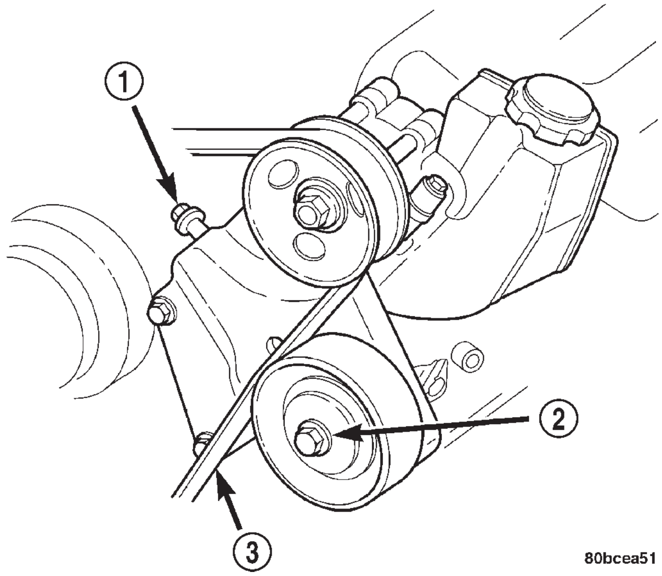

Fig. 5 Power Steering Pump Bracket and Idler Pulley - 2.5L

1 - ADJUSTMENT BOLT
2 - IDLER BOLT/ANCHOR BOLT
3 - ACCESSORY DRIVE 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. 6) or (Fig. 7) for correct belt routing, or refer to Belt Routing Label located in the vehicle engine compartment.

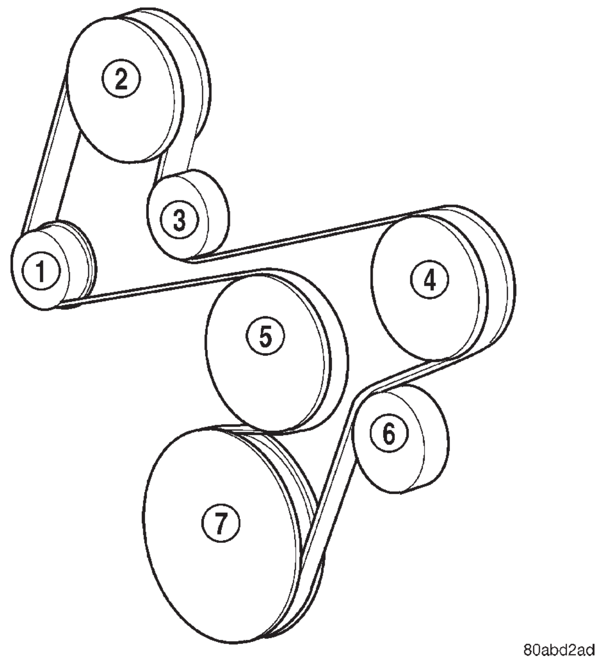

Fig. 6 2.5L - With A/C

1 - ALT
2 - A/C
3 - IDL
4 - P/S
5 - WATER PUMP AND FAN
6 - IDL
7 - CRANK

DRIVE BELTS - 2.5L (Continued)

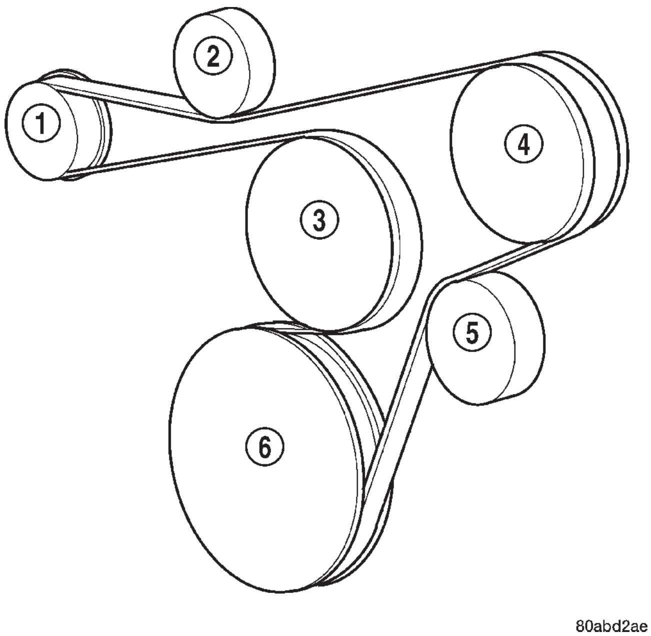

Fig. 7 2.5L Engines - Without A/C

1 - ALT
2 - IDL
3 - WATER PUMP AND FAN
4 - P/S
5 - IDL
6 - CRANK

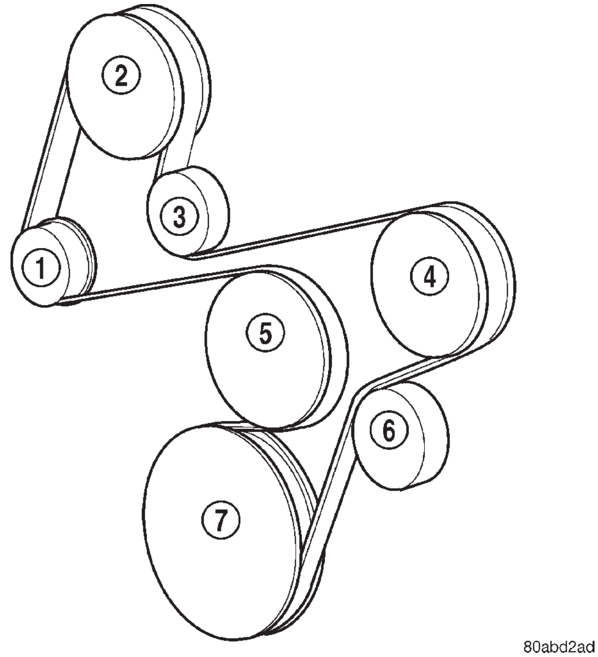

Fig. 8 2.5L - With A/C

1 - ALT
2 - A/C
3 - IDL
4 - P/S
5 - WATER PUMP AND FAN
6 - IDL
7 - CRANK

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. 8) or (Fig. 9) for correct belt routing.

(2) Install new belt. Install belt tension gauge C-4162 and tighten adjustment bolt (Fig. 5) until belt tension is within specification range (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - ADJUSTMENTS).

(3) Tighten idler pulley bolt and re-check belt tension. Adjust if necessary.

ADJUSTMENTS

ADJUSTMENT—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.

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 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - DIAGNOSIS AND TESTING) 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 Chart .

DRIVE BELTS - 2.5L (Continued)

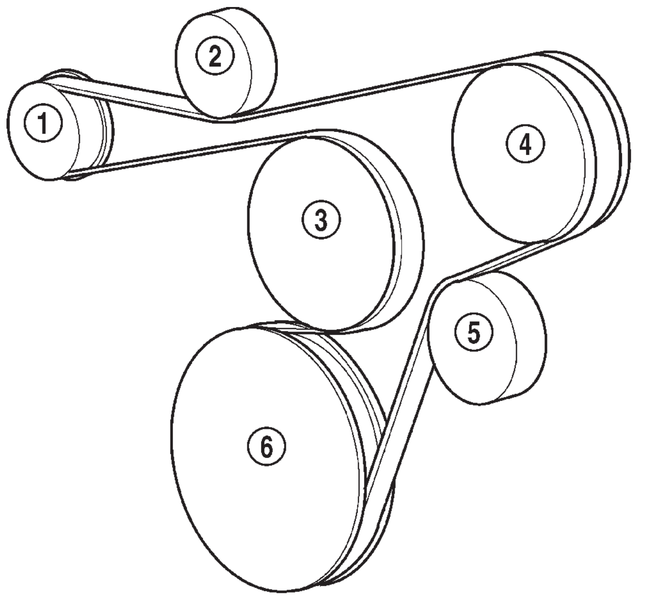

Fig. 9 2.5L Engines - Without A/C

1 - ALT
2 - IDL
3 - WATER PUMP AND FAN
4 - P/S
5 - IDL
6 - CRANK

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. 10).

(4) Adjust tension adjusting bolt (Fig. 10) until reading is within specification.

(5) Tighten idler pulley bolt and re-check belt tension. Adjust if necessary.

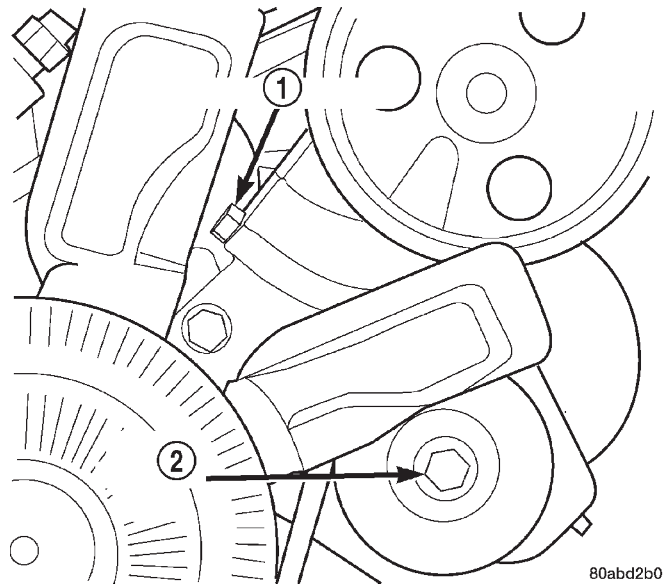

Fig. 10 Power Steering Pump Bracket and Idler Pulley

1 - ADJUSTING BOLT
2 - IDLER PULLEY BOLT

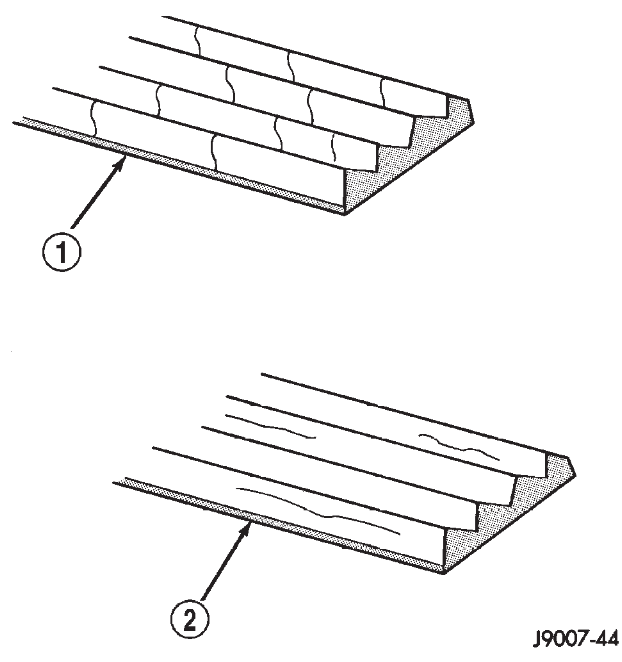

Fig. 11 Belt Wear Patterns

1 - NORMAL CRACKS BELT OK
2 - NOT NORMAL CRACKS REPLACE BELT

DRIVE BELTS - 4.0L

DIAGNOSIS AND TESTING - ACCESSORY DRIVE BELT

VISUAL DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 11), 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. 11). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to the ACCESSORY DRIVE BELT DIAGNOSIS CHART for further belt diagnosis.

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.

DRIVE BELTS - 4.0L (Continued)

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. Inspect auto tensioner. Replace as necessary.
	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. Inspect auto belt tensioner. Replace as necessary.
	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

DRIVE BELTS - 4.0L (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. Inspect auto tensioner. Replace belt or tensioner as necessary.
	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. Inspect auto tensioner. Replace as necessary.
	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

DRIVE BELTS - 4.0L (Continued)

REMOVAL

NOTE: The belt routing schematics are published from the latest information available at the time of publication. If anything differs between these schematics and the Belt Routing Label, use the schematics on Belt Routing Label. This label is located in the engine compartment.

CAUTION: DO NOT LET TENSIONER ARM SNAP BACK TO THE FREEARM POSITION, SEVERE DAMAGE MAY OCCUR TO THE TENSIONER.

Belt tension is not adjustable. Belt adjustment is maintained by an automatic (spring load) belt tensioner.

(1) Disconnect negative battery cable from battery.

(2) Rotate belt tensioner until it contacts its stop. Remove belt, then slowly rotate the tensioner into the freearm position. (Fig. 12) or (Fig. 13).

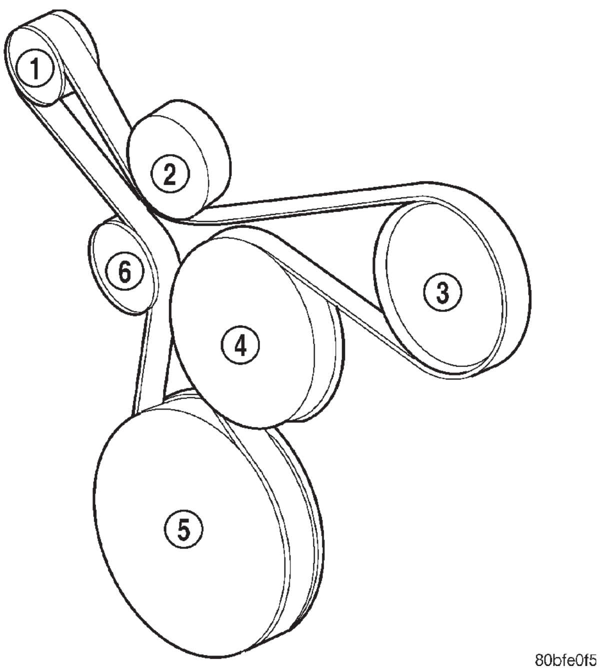

Fig. 12 4.0L Engines—Without A/C

1 - GENERATOR PULLEY
2 - IDLER PULLEY
3 - POWER STEERING PUMP PULLEY
4 - WATER PUMP PULLEY
5 - CRANKSHAFT PULLEY
6 - TENSIONER PULLEY

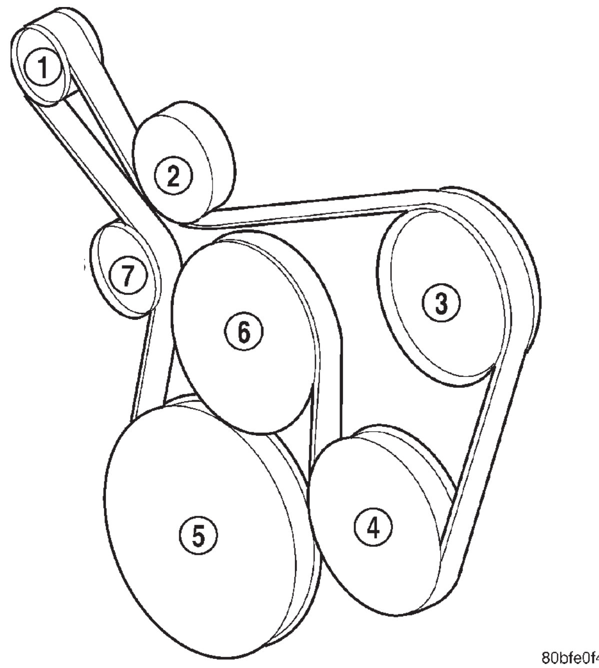

Fig. 13 4.0L Engines–With A/C

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

DRIVE BELTS - 4.0L (Continued)

INSTALLATION

Belt tension is not adjustable. Belt adjustment is maintained by an automatic (spring load) belt tensioner.

(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 (Fig. 15) (Fig. 16).

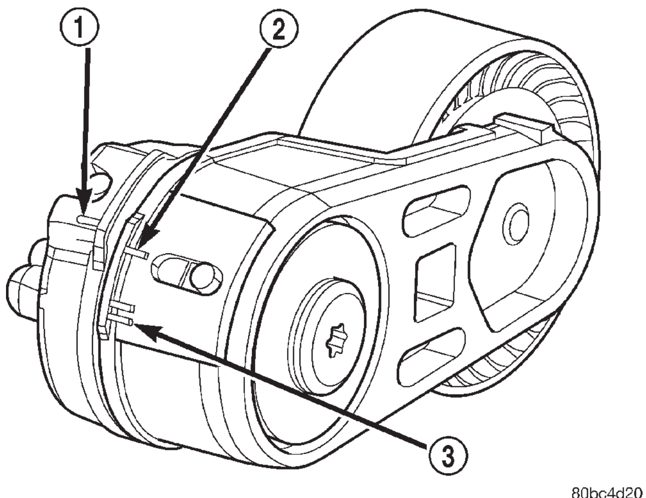

Fig. 14 Accessory Drive Belt Wear Indicator - 4.0L Engine

1 - INDICATOR MARK
2 - MINIMUM TENSION MARK
3 - MAXIMUM TENSION MARK

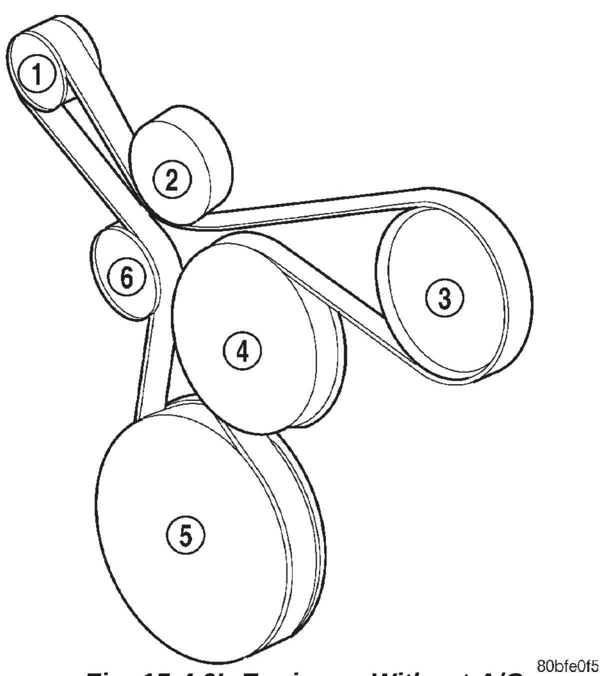

Fig. 15 4.0L Engines - Without A/C

1 - GENERATOR PULLEY
2 - IDLER PULLEY
3 - POWER STEERING PUMP PULLEY
4 - WATER PUMP PULLEY
5 - CRANKSHAFT PULLEY
6 - TENSIONER PULLEY

(2) Install new belt (Fig. 15) (Fig. 16). Route the belt around all pulleys except the idler pulley. Rotate the tensioner arm until it contacts its stop position. Route the belt around the idler and slowly let the tensioner rotate into the belt. Make sure the belt is seated onto all pulleys.

(3) With the drive belt installed, inspect the belt wear indicator (Fig. 14). On 4.0L Engines, the indicator mark must be between the minimum and maximum marks. If the measurement exceedes this specification replace the serpentine accessory drive belt.

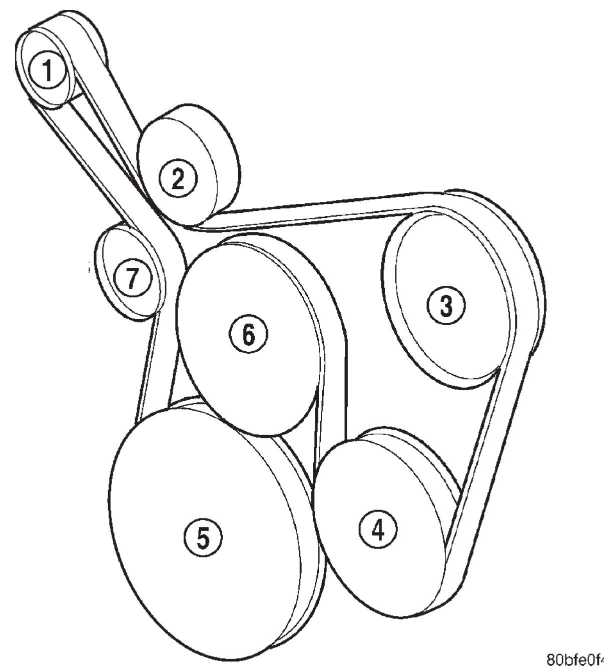

Fig. 16 4.0L Engines - With A/C

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

ENGINE

TABLE OF CONTENTS

COOLANT RECOVERY CONTAINER

DESCRIPTION

The coolant reserve/overflow system consists of a radiator mounted pressurized cap, a plastic coolant recovery bottle (Fig. 1) , a tube (hose) connecting the 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.

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.

REMOVAL

(1) Disconnect the hose from radiator filler neck.
(2) Remove coolant recovery bottle (Fig. 2).

COOLANT RECOVERY CONTAINER (Continued)

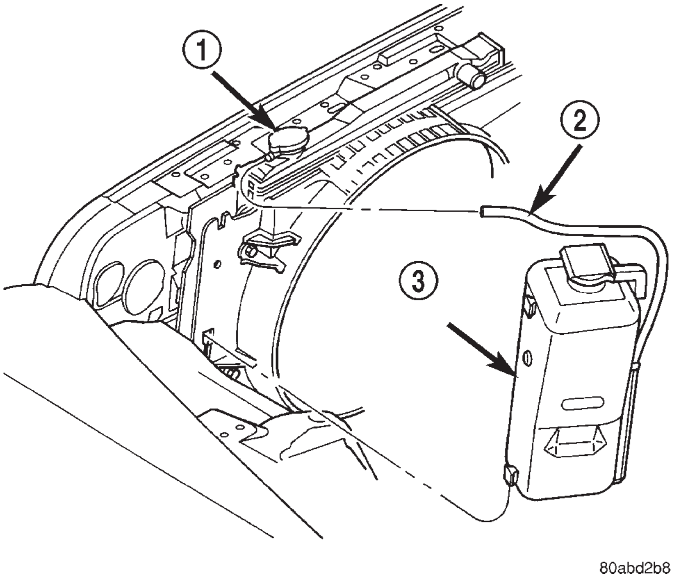

Fig. 1 Coolant Recovery Bottle

1 - RADIATOR PRESSURE CAP
2 - HOSE
3 - COOLANT RECOVERY BOTTLE

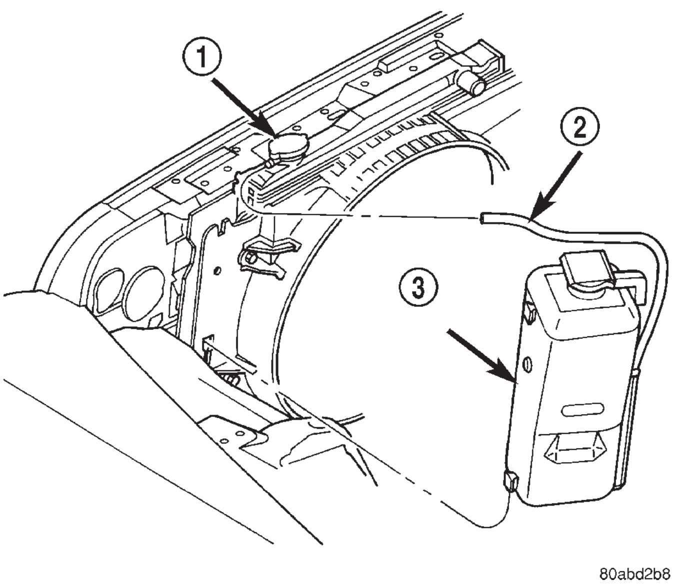

Fig. 2 Coolant Reserve/Overflow Bottle

1 - RADIATOR PRESSURE CAP
2 - HOSE
3 - COOLANT RECOVERY BOTTLE

INSTALLATION

(1) Position the tabs on the overflow bottle into the slots on the fan shroud.

(2) Reconnect the overflow hose onto the radiator filler neck.

(3) Fill resrevoir/overflow bottle.

ENGINE 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 (Fig. 3) 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.

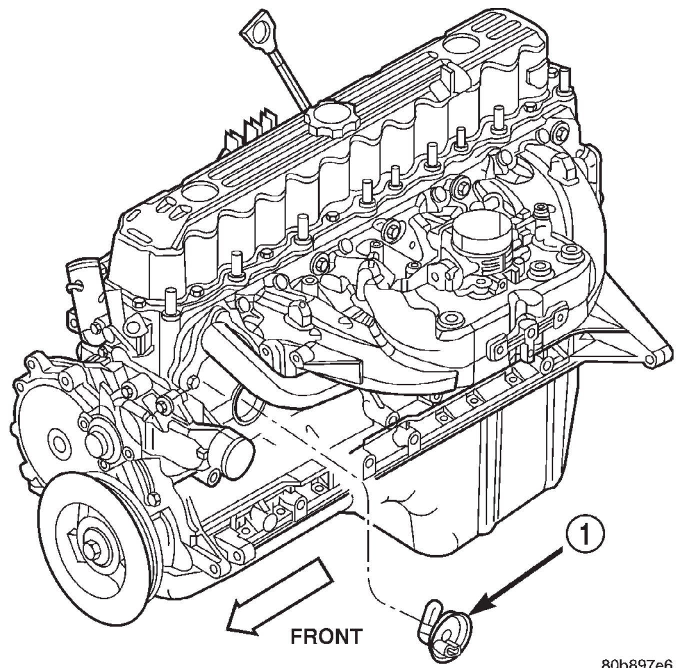

Fig. 3 Block Heater - Typical

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.

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.

ENGINE BLOCK HEATER (Continued)

(1) Drain coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(2) Unplug power cord from block heater.

(3) Loosen screw in center of block heater (Fig. 4) or (Fig. 5).

(4) Remove block heater from cylinder block.

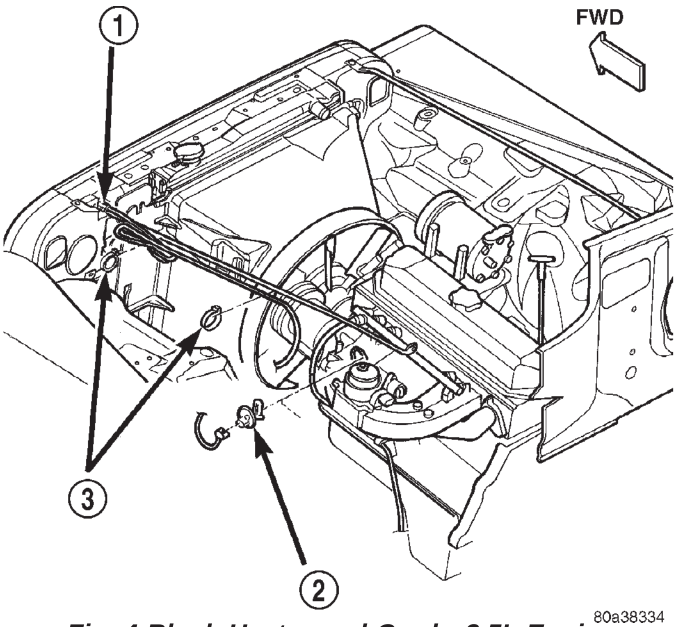

Fig. 4 Block Heater and Cord - 2.5L Engine

1 - POWER CORD
2 - BLOCK HEATER
3 - TIE-STRAPS

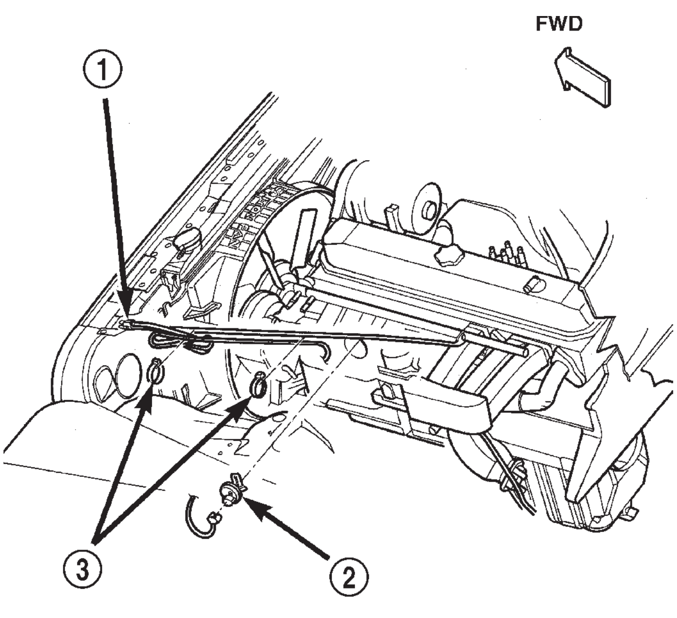

Fig. 5 Block Heater and Cord - 4.0L Engine

1 - POWER CORD
2 - BLOCK HEATER
3 - TIE-STRAPS

INSTALLATION

(1) Thoroughly clean the engine core hole and the block heater seat.

(2) Insert block heater assembly into core hole with element loop pointing **Up** (Fig. 6) or (Fig. 7).

(3) Seat block heater flush against block face. Tighten mounting screw to 4 N·m (31 in. lbs.) torque.

(4) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE), and inspect for leaks (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).

(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.

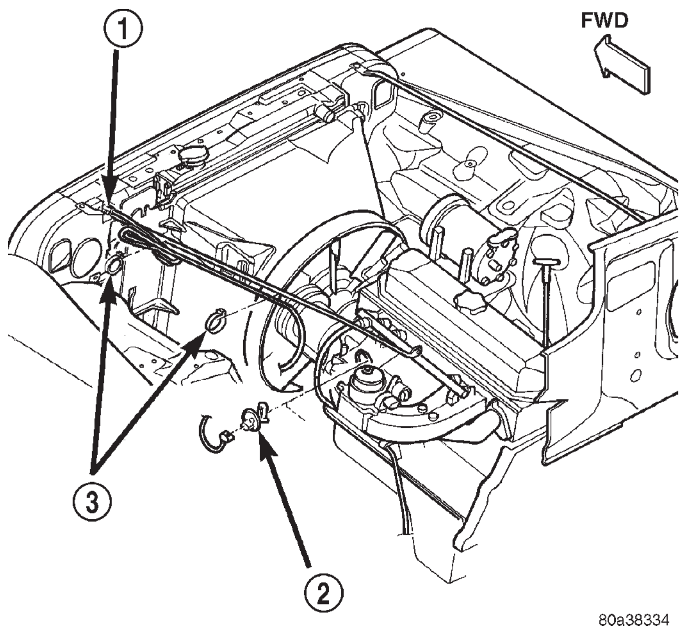

Fig. 6 Block Heater and Cord - 2.5L Engine

1 - POWER CORD
2 - BLOCK HEATER
3 - TIE-STRAPS

ENGINE BLOCK HEATER (Continued)

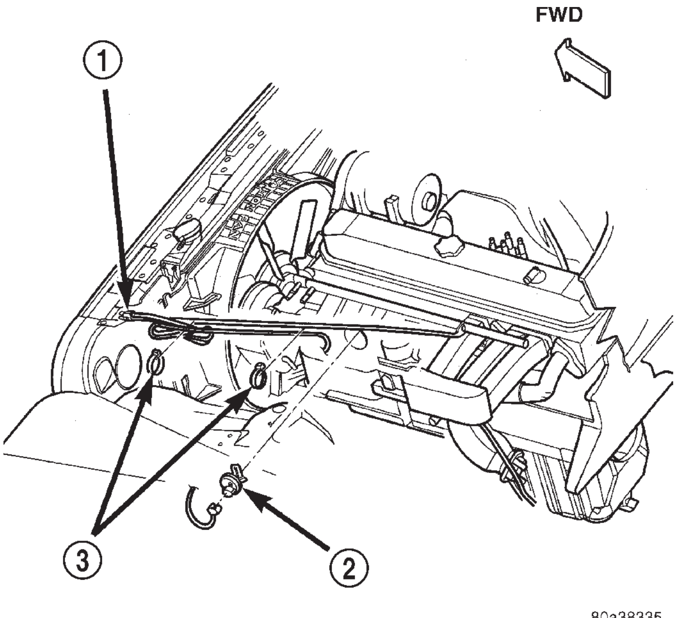

Fig. 7 Block Heater and Cord - 4.0L Engine

1 - POWER CORD
2 - BLOCK HEATER
3 - TIE-STRAPS

ENGINE COOLANT TEMPERATURE SENSOR

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

REMOVAL

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR.

The coolant temperature sensor is installed in the thermostat housing (Fig. 8).

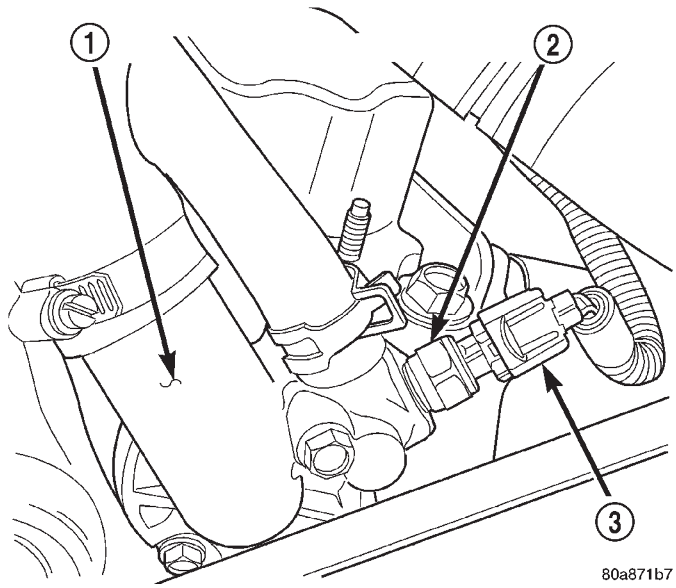

Fig. 8 Engine Coolant Temperature Sensor - Typical

1 - THERMOSTAT HOUSING
2 - ENGINE COOLANT TEMPERATURE SENSOR
3 - ELECTRICAL CONNECTOR

(1) Partially drain cooling system until coolant level is below cylinder head. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(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 7 - COOLING - STANDARD PROCEDURE).

ENGINE COOLANT THERMOSTAT

DESCRIPTION

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

The thermostat (Fig. 9) 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.

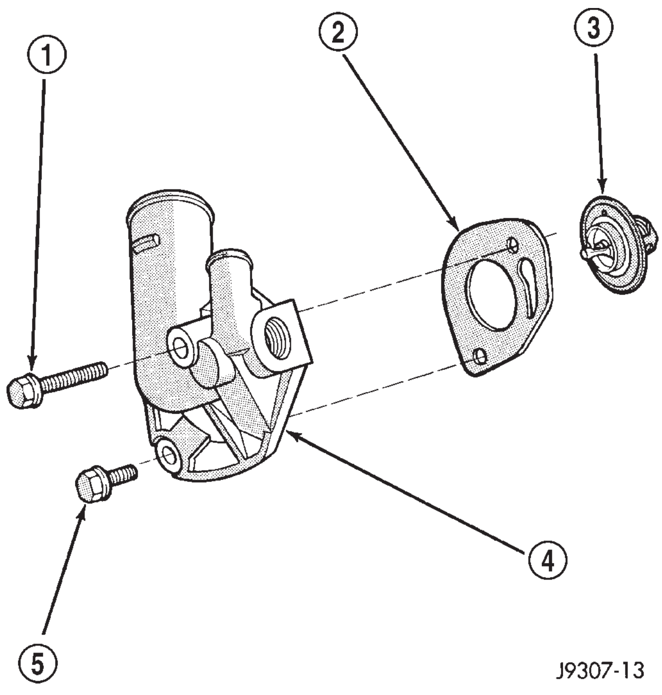

Fig. 9 Thermostat—Typical

1 - LONG BOLT
2 - GASKET
3 - THERMOSTAT
4 - THERMOSTAT HOUSING
5 - SHORT BOLT

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.

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Drain the coolant from the radiator until the level is below the thermostat housing (Refer to 7 - COOLING - STANDARD PROCEDURE).

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. 30). 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. 31). If replacement is necessary, use only an original equipment clamp with matching number or letter.

(2) Remove radiator upper hose and heater hose at thermostat housing.

(3) Disconnect wiring connector at engine coolant temperature sensor.

(4) Remove thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 10). 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. 11).

(3) Position thermostat into this groove with arrow and air bleed hole on outer flange pointing up.

ENGINE COOLANT THERMOSTAT (Continued)

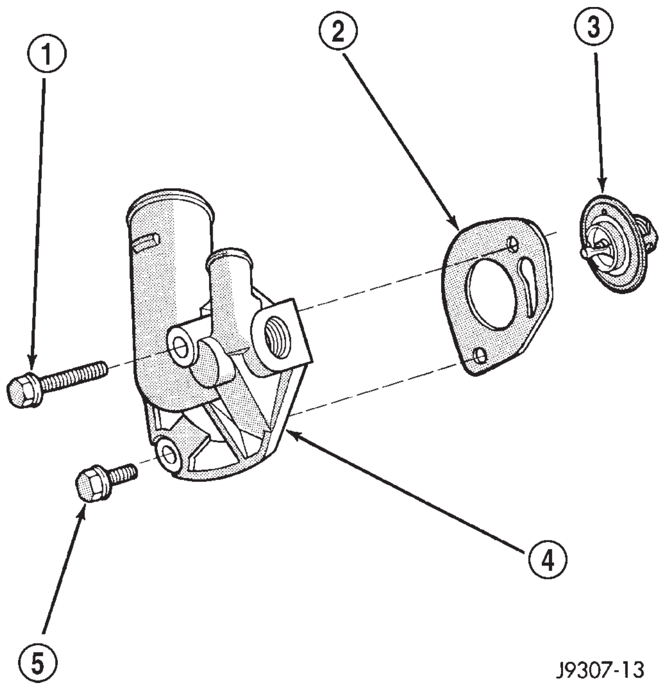

Fig. 10 Thermostat Removal/Installation

1 - LONG BOLT
2 - GASKET
3 - THERMOSTAT
4 - THERMOSTAT HOUSING
5 - SHORT BOLT

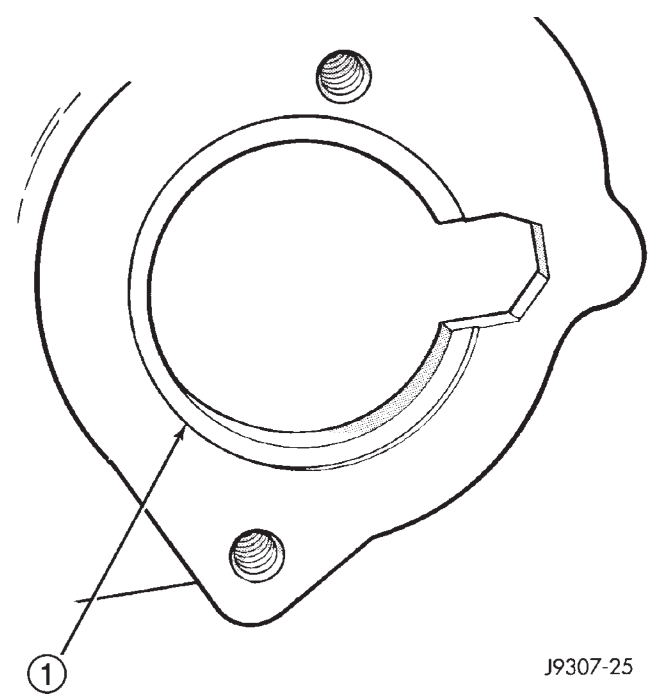

Fig. 11 Thermostat Recess

1 - GROOVE

(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.
(7) Install electrical connector to coolant temperature sensor.
(8) Be sure that the radiator draincock is tightly closed. Fill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(9) Start and warm the engine. Check for leaks.

FAN DRIVE VISCOUS CLUTCH

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. 12) and (Fig. 13) 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. 14) (Fig. 15). This spring coil reacts to the temperature of the radiator discharge air. It engages the viscous fan drive for higher fan speed if the air temperature from the radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced rpm regardless of engine speed.

Only when sufficient heat is present, will the viscous fan drive engage. This is when the air flowing through the radiator core causes a reaction to the bimetallic coil. It then increases fan speed to provide the necessary additional engine cooling.

Once the engine has cooled, the radiator discharge temperature will drop. The bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

FAN DRIVE VISCOUS CLUTCH (Continued)

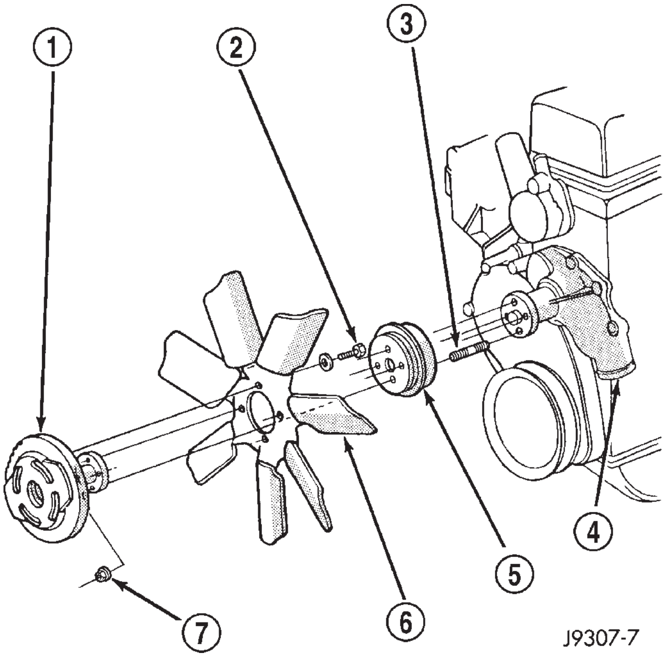

Fig. 12 Water Pump Mounted Fan Drive - 2.5L Engine

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

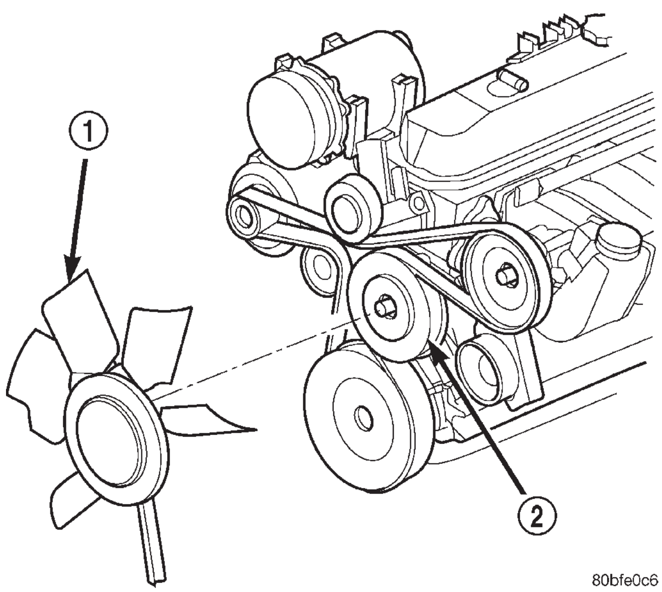

Fig. 13 Water Pump Mounted Fan Drive - 4.0L Engine

1 - FAN AND FAN DRIVE
2 - WATER PUMP PULLEY

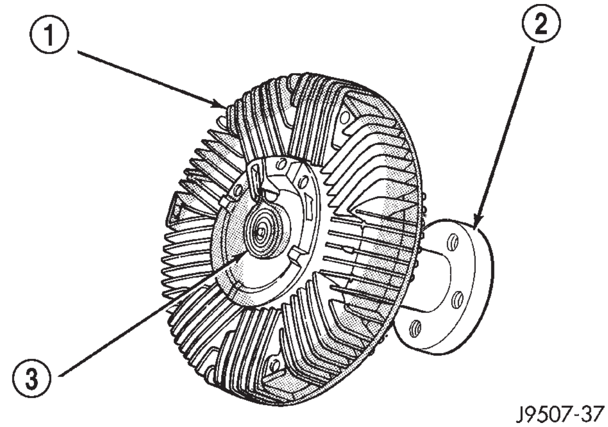

Fig. 14 Viscous Fan Drive - 2.5L Engine

1 - VISCOUS FAN DRIVE
2 - MOUNTING HUB
3 - THERMOSTATIC SPRING

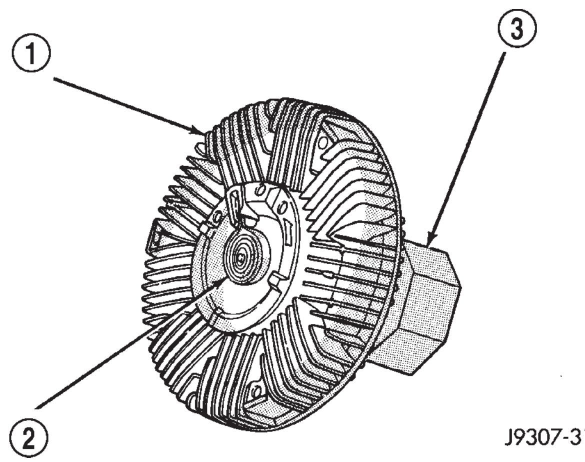

Fig. 15 Viscous Fan Drive - 4.0L Engine

1 - VISCOUS FAN DRIVE
2 - THERMOSTATIC SPRING
3 - MOUNTING NUT TO WATER PUMP HUB

DIAGNOSIS AND TESTING

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.

FAN DRIVE VISCOUS CLUTCH (Continued)

• Cool silicone fluid within the fan drive unit is being redistributed back to its normal disengaged (warm) position. This can occur during the first 15 seconds to one minute after engine start-up on a cold engine.

LEAKS

Viscous fan drive operation is not affected by small oil stains near the drive bearing. If leakage appears excessive, replace the fan drive unit.

TESTING

If the fan assembly free-wheels without drag (the fan blades will revolve more than five turns when spun by hand), replace the fan drive. This spin test must be performed when the engine is cool.

For the following test, the cooling system must be in good condition. It also will ensure against excessively high coolant temperature.

WARNING: BE SURE THAT THERE IS ADEQUATE FAN BLADE CLEARANCE BEFORE DRILLING.

(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.

REMOVAL

(1) **2.5L Engine**Loosen but do not remove at this time, the four fan hub mounting nuts (Fig. 16).

(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. 17).

(3) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(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. 16) 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.

FAN DRIVE VISCOUS CLUTCH (Continued)

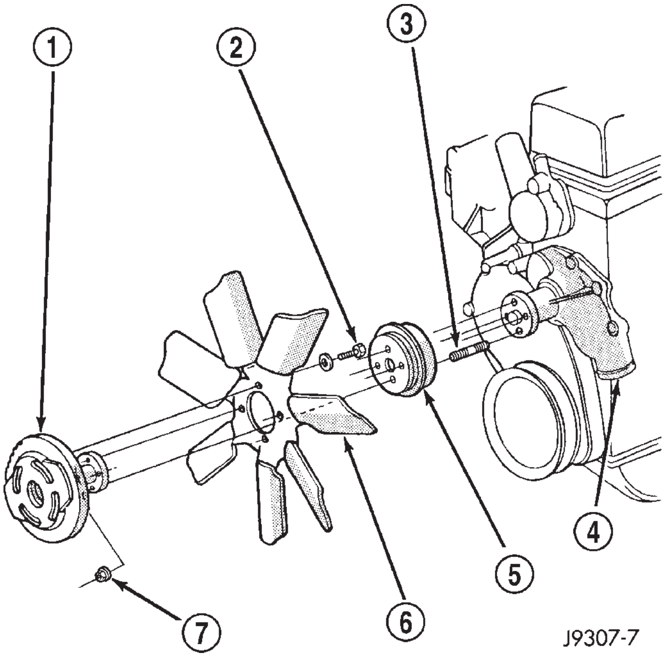

Fig. 16 Fan Mount - 2.5L Engine

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

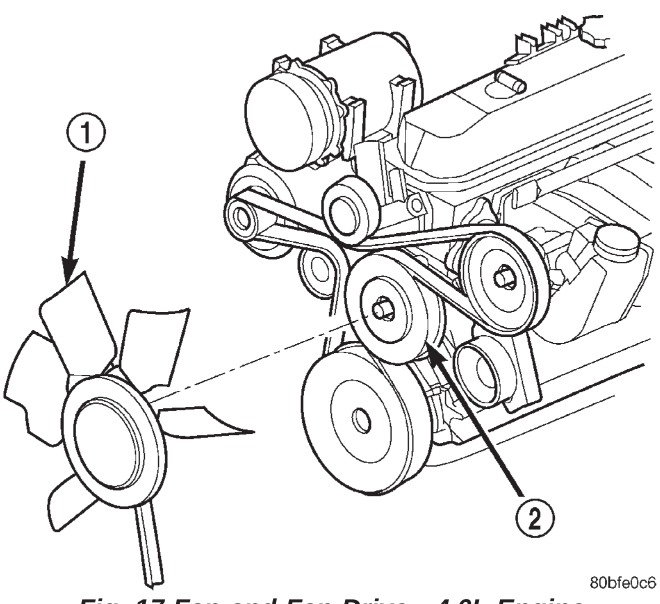

Fig. 17 Fan and Fan Drive - 4.0L Engine

1 - FAN AND FAN DRIVE
2 - WATER PUMP PULLEY

(3) **4.0L Engine**Thread the fan and fan drive onto the water pump pulley.

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.

(4) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

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 (Fig. 18). 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.

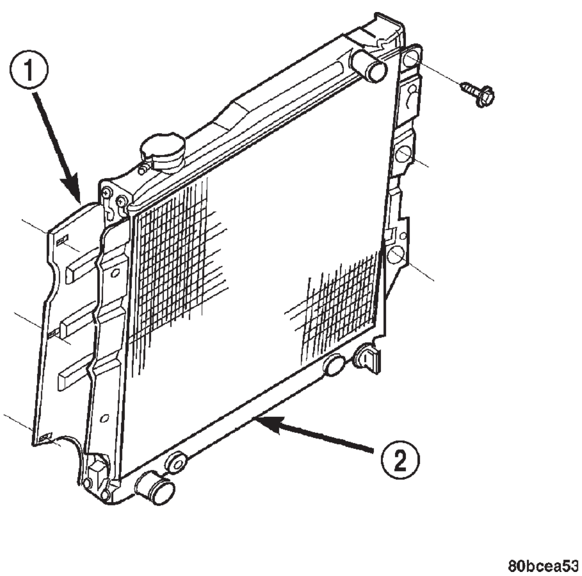

Fig. 18 Downflow Radiator - Typical

1 - DOWNFLOW RADIATOR
2 - INTEGRAL TRANSMISSION OIL COOLER (INTERNAL TO RADIATOR)

OPERATION

As air passes through the radiator core, the heat within the coolant is dissipated into the ambient air.

RADIATOR (Continued)

DIAGNOSIS AND TESTING - RADIATOR COOLANT FLOW

The following procedure will determine if coolant is flowing through the cooling system.

If engine is cold, idle engine until normal operating temperature is reached. Then feel the upper radiator hose. If hose is hot, the thermostat is open and water is circulating through cooling system.

REMOVAL

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND 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. 19).

(4) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE) drain coolant into a clean container for reuse.

(5) Remove radiator upper and lower hose clamps. Remove radiator hoses.

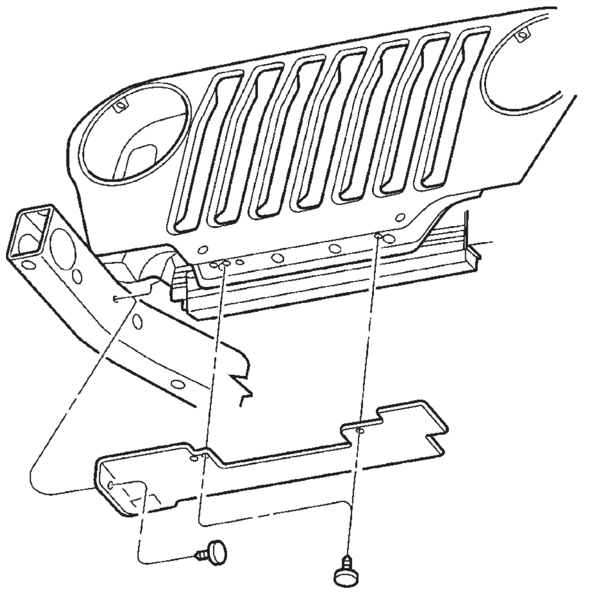

Fig. 19 Condenser Lower Seal

(6) Disconnect coolant reserve/overflow tank hose from radiator.

(7) Remove the four fan shroud mounting bolts (Fig. 20). 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.

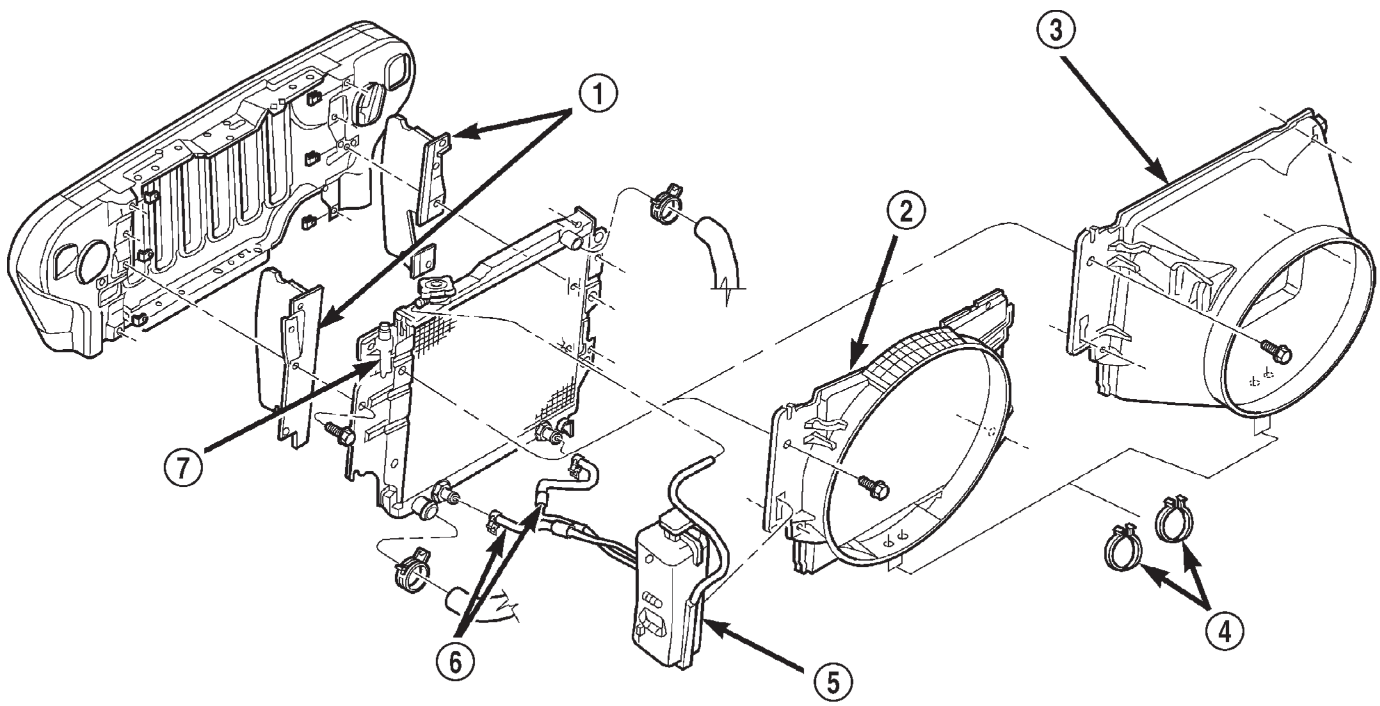

Fig. 20 Radiator - Remove/Install

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

RADIATOR (Continued)

(8) If equipped, disconnect and plug automatic transmission fluid cooler lines.

(9) Remove six radiator mounting bolts. Position the front axle vent hose (Fig. 20) 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. 20). To prevent possible overheating, these seals must be installed to their original positions.

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.

INSTALLATION

(1) Position the radiator. Install and tighten the six mounting bolts (Fig. 20) 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. 19).

(7) Connect battery negative cable.

(8) Fill cooling system with correct coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(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.

WATER PUMP - 2.5L

DESCRIPTION

CAUTION: The 2.5L 4-cylinder and the 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 (Fig. 21) 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.

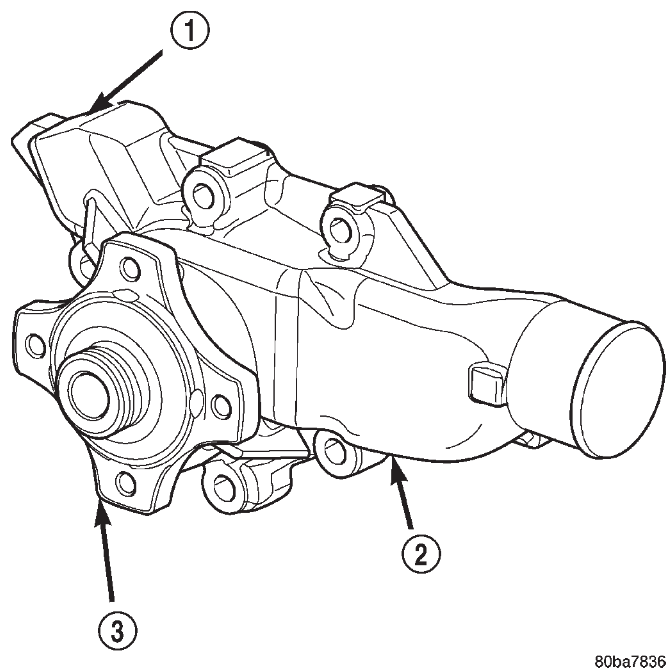

Fig. 21 Water Pump

1 - HEATER HOSE FITTING BORE
2 - WATER PUMP
3 - WATER PUMP HUB

WATER PUMP - 2.5L (Continued)

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.

REMOVAL

The water pump can be removed without discharging the air conditioning system (if equipped).

CAUTION: All engines have a reverse (counterclockwise) rotating water pump. The letter R is stamped into the back of the water pump impeller (Fig. 22) to identify. Engines from previous model years, depending upon application, may be equipped with a forward (clockwise) rotating water pump. Installation of the wrong water pump will cause engine over heating.

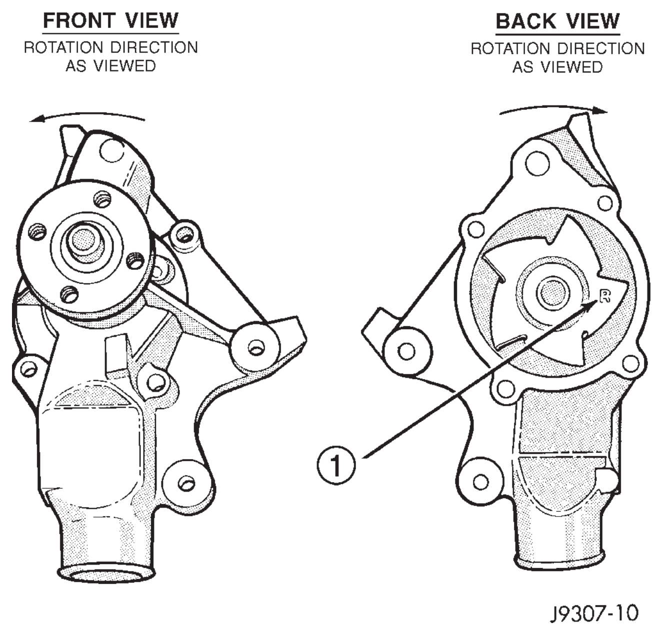

Fig. 22 Reverse Rotating Water Pump

1 - R STAMPED INTO IMPELLER

The water pump impeller is pressed on the rear of the pump shaft and bearing assembly. The water pump is serviced only as a complete assembly.

WARNING: DO NOT REMOVE THE BLOCK DRAIN PLUG(S) OR LOOSEN RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain coolant into a clean container for reuse.

(1) Disconnect negative battery cable at battery.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Loosen (but do not remove at this time) the four fan hub-to-water pump pulley mounting nuts (Fig. 23).

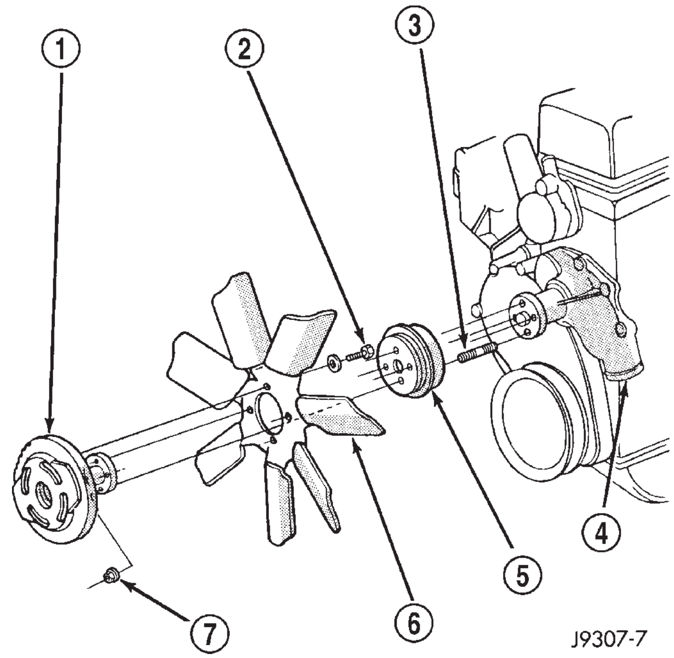

Fig. 23 Fan Mounting Nuts

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 (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(5) Remove power steering pump.

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. 24) SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

WATER PUMP - 2.5L (Continued)

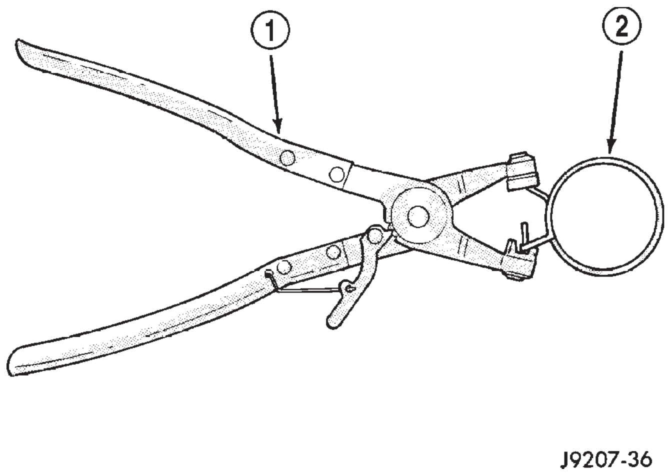

Fig. 24 Hose Clamp Tool – Typical

1 - HOSE CLAMP TOOL 6094
2 - HOSE CLAMP

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 25). If replacement is necessary, use only an original equipment clamp with matching number or letter.

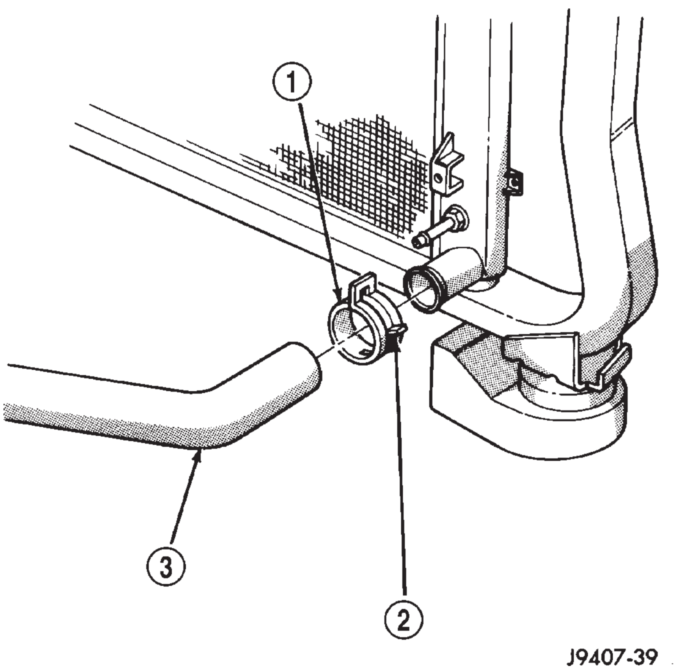

Fig. 25 Clamp Number/Letter Location

1 - TYPICAL CONSTANT TENSION HOSE CLAMP
2 - CLAMP NUMBER/LETTER LOCATION
3 - TYPICAL HOSE

(6) Remove lower radiator hose from water pump. Remove heater hose from water pump fitting.

(7) Remove four nuts previously loosened and remove the fan blade assembly and pulley.

(8) After removing fan blade/viscous fan drive assembly, **do not** place thermal viscous fan drive in horizontal position. If stored horizontally, silicone fluid in viscous fan drive could drain into its bearing assembly and contaminate lubricant.

(9) Remove the four pump mounting bolts (Fig. 26) and remove pump from vehicle. Discard old gasket. Note that one of the four bolts is longer than the other bolts.

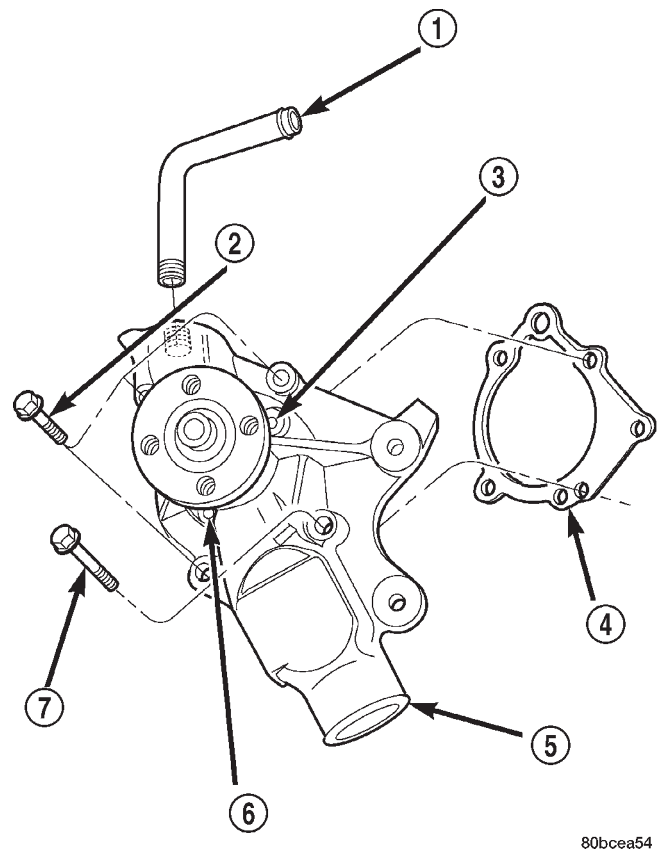

Fig. 26 Water Pump Remove/Install

1 - HEATER HOSE FITTING
2 - UPPER VENT HOLE
3 - PUMP GASKET
4 - WATER PUMP
5 - LOWER VENT HOLE
6 - LONG BOLT
7 - BOLTS (3) SHORT

(10) If pump is to be replaced, the heater hose fitting must be removed. Note position of fitting before removal.

INSTALLATION

(1) If pump is being replaced, install the heater hose fitting to the pump. Use a sealant on the fitting such as Mopar® Thread Sealant With Teflon. Refer to the directions on the package.

(2) Clean the gasket mating surfaces. If the original pump is used, remove any deposits or other for-

WATER PUMP - 2.5L (Continued)

eign 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) Position water pump pulley to water pump hub.

(6) Install fan and four nuts to water pump hub. Tighten or nuts to 27 N·m (20 ft. lbs.) torque.

(7) Install power steering pump.

CAUTION: When installing the serpentine engine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION). You may also refer to the Belt Routing Label in the vehicle engine compartment.

(8) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(9) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(10) Connect battery cable to battery.

(11) Start and warm the engine. Check for leaks.

WATER PUMP - 4.0L

DESCRIPTION

CAUTION: The 2.5L 4-cylinder and the 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 (Fig. 27) 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.

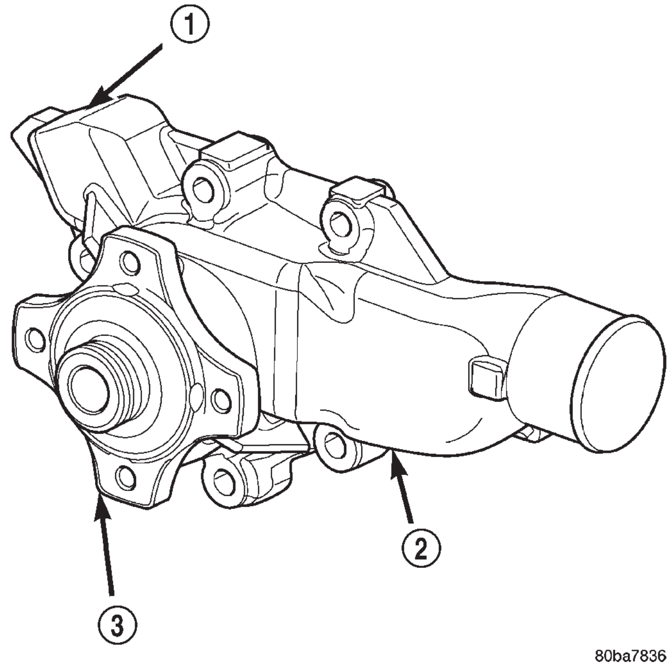

Fig. 27 Water Pump

1 - HEATER HOSE FITTING BORE
2 - WATER PUMP
3 - WATER PUMP HUB

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.

REMOVAL

The water pump can be removed without discharging the air conditioning system (if equipped).

CAUTION: All engines have a reverse (counterclockwise) rotating water pump. The letter R is stamped into the back of the water pump impeller (Fig. 28) to identify. Engines from previous model years, depending upon application, may be equipped with a forward (clockwise) rotating water pump. Installation of the wrong water pump will cause engine over heating.

The water pump impeller is pressed on the rear of the pump shaft and bearing assembly. The water pump is serviced only as a complete assembly.

WATER PUMP - 4.0L (Continued)

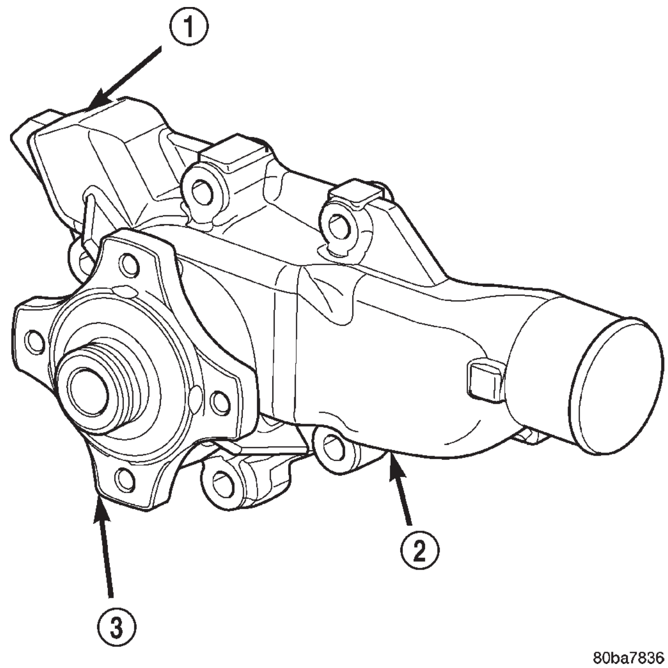

Fig. 28 Water Pump - 4.0L Engine

1 - HEATER HOSE FITTING BORE
2 - WATER PUMP
3 - WATER PUMP HUB

WARNING: DO NOT REMOVE THE BLOCK DRAIN PLUG(S) OR LOOSEN RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain coolant into a clean container for reuse.

(1) Disconnect negative battery cable at battery.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

NOTE: The engine accessory drive belt must be removed prior to removing the fan.

(3) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) 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. 29).

(5) Remove power steering pump (Refer to 19 - STEERING/PUMP - REMOVAL).

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES.

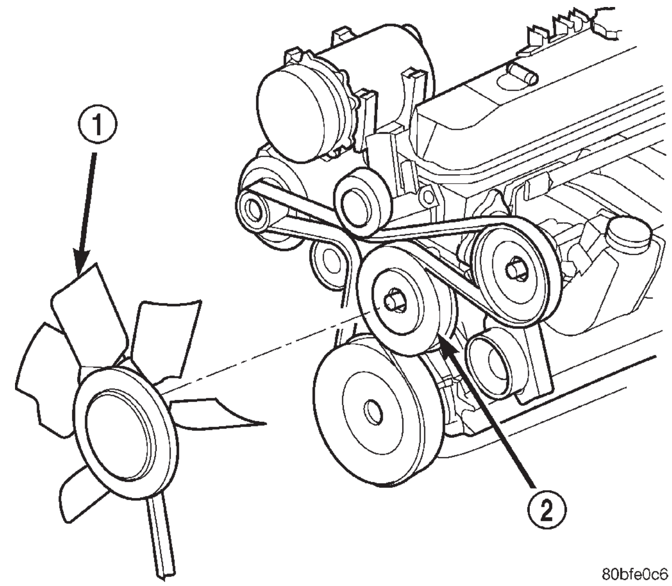

Fig. 29 Fan and Fan Drive Mounting - 4.0L Engine

1 - FAN AND FAN DRIVE
2 - WATER PUMP PULLEY

WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 30) SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

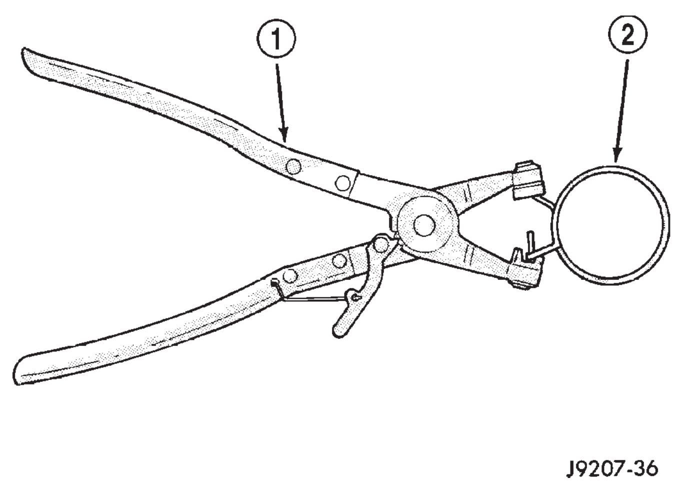

Fig. 30 Hose Clamp Tool - Typical

1 - HOSE CLAMP TOOL 6094
2 - HOSE CLAMP

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 31). If replacement is necessary, use only an original equipment clamp with matching number or letter.

WATER PUMP - 4.0L (Continued)

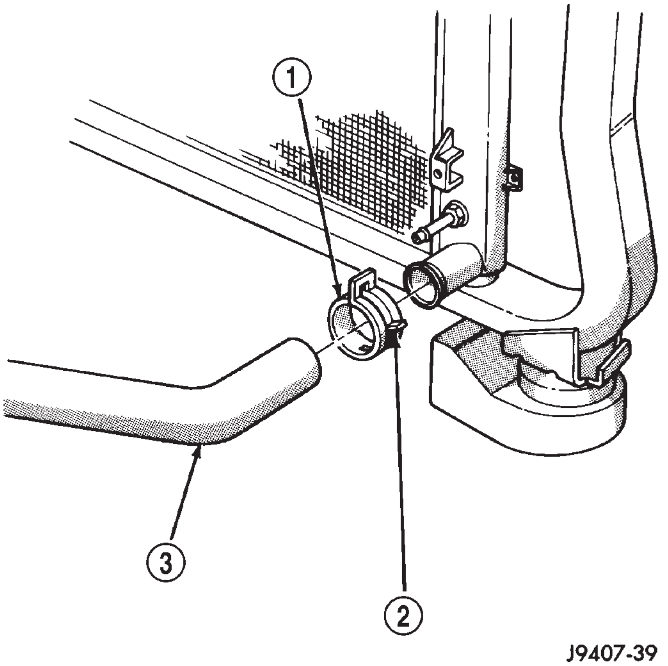

Fig. 31 Clamp Number/Letter Location

1 - TYPICAL CONSTANT TENSION HOSE CLAMP
2 - CLAMP NUMBER/LETTER LOCATION
3 - TYPICAL HOSE

(6) Remove lower radiator hose from water pump. Remove heater hose from water pump fitting.

(7) 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.

(8) Remove the four pump mounting bolts (Fig. 32) and remove pump from vehicle. Discard old gasket. Note that one of the four bolts is longer than the other bolts.

(9) If pump is to be replaced, the heater hose fitting must be removed. Note position of fitting before removal.

INSTALLATION

(1) If pump is being replaced, install the heater hose fitting to the pump. Use a sealant on the fitting such as Mopar® Thread Sealant With Teflon. Refer to the directions on the package.

(2) Clean the gasket mating surfaces. If the original pump is used, remove any deposits or other foreign material. Inspect the cylinder block and water pump mating surfaces for erosion or damage from cavitation.

(3) Install the gasket and water pump. The silicone bead on the gasket should be facing the water pump. Also, the gasket is installed dry. Tighten mounting bolts to 23 N·m (200 in. lbs.) torque. Rotate the shaft by hand to be sure it turns freely.

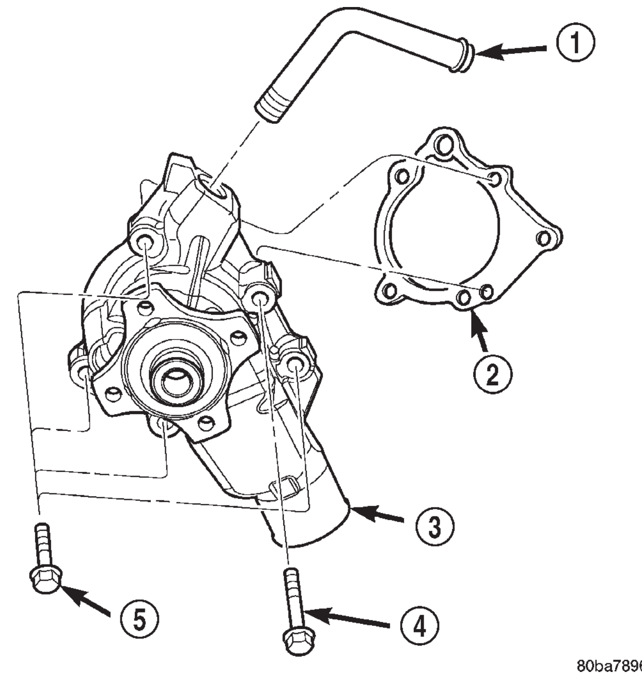

Fig. 32 Water Pump Remove/Install - 4.0L Engine

1 - HEATER HOSE FITTING
2 - PUMP GASKET
3 - WATER PUMP
4 - LONG BOLT
5 - BOLTS (4) SHORT

(4) Connect the radiator and heater hoses to the water pump.

(5) Install power steering pump (Refer to 19 - STEERING/PUMP - INSTALLATION).

(6) Thread the fan and fan hub into the water pump hub shaft.

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. for appropriate belt routing. You may also refer to the Belt Routing Label in the vehicle engine compartment.

(7) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(8) Fill cooling system with coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(9) Connect battery cable to battery.

(10) Start and warm the engine. Check for leaks.

RADIATOR PRESSURE CAP

DESCRIPTION

All radiators are equipped with a pressure cap (Fig. 33). This cap releases pressure at some point within a range of 124-to-145 kPa (18-to-21 psi). The pressure relief point (in pounds) is engraved on top of the cap

The cooling system will operate at pressures slightly above atmospheric pressure. This results in a higher coolant boiling point allowing increased radiator cooling capacity. The cap contains a spring-loaded pressure relief valve. This valve opens when system pressure reaches the release range of 124-to-145 kPa (18-to-21 psi).

A rubber gasket seals the radiator filler neck. This is done to maintain vacuum during coolant cool-down and to prevent leakage when system is under pressure.

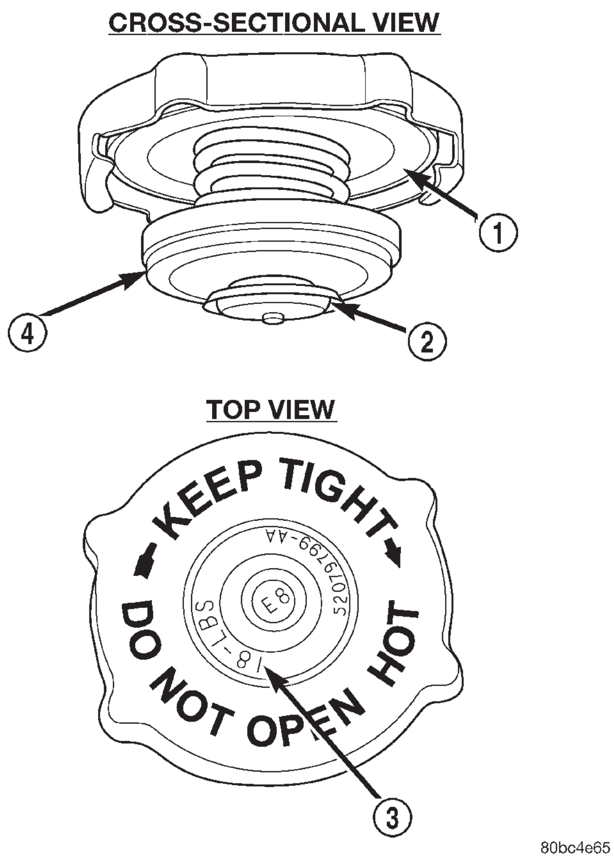

Fig. 33 Radiator Pressure Cap - Typical

1 - FILLER NECK SEAL
2 - VACUUM VENT VALVE
3 - PRESSURE RATING
4 - PRESSURE VALVE

OPERATION

A vent valve in the center of the cap will remain shut as long as the cooling system is pressurized. As the coolant cools, it contracts and creates a vacuum in 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, or overflow hose is kinked, radiator hoses will collapse on cool-down.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - RADIATOR CAP-TO-FILLER NECK SEAL

The pressure cap upper gasket (seal) pressure relief can be tested by removing overflow hose from radiator filler neck nipple. Attach hose of pressure tester tool 7700 (or equivalent) to nipple. It will be necessary to disconnect hose from its adapter for filler neck. Pump air into radiator. The pressure cap upper gasket should relieve at 69-124 kPa (10-18 psi) and hold pressure at a minimum of 55 kPa (8 psi).

WARNING: THE WARNING WORDS —DO NOT OPEN HOT— ON RADIATOR PRESSURE CAP, ARE A SAFETY PRECAUTION. WHEN HOT, PRESSURE BUILDS UP IN COOLING SYSTEM. TO PREVENT SCALDING OR INJURY, RADIATOR CAP SHOULD NOT BE REMOVED WHILE SYSTEM IS HOT AND/OR UNDER PRESSURE.

Do not remove radiator cap at any time **except** for the following purposes:

(1) Check and adjust antifreeze freeze point.
(2) Refill system with new antifreeze.
(3) Conducting service procedures.
(4) 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 CAP AND WITHOUT PUSHING CAP DOWN, ROTATE IT COUNTERCLOCKWISE TO FIRST STOP. ALLOW FLUID TO ESCAPE THROUGH THE COOLANT RESERVE/OVERFLOW HOSE INTO 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 - RADIATOR CAP

Remove cap from radiator. Be sure that sealing surfaces are clean. Moisten rubber gasket with water and install cap on pressure tester 7700 or an equivalent (Fig. 34).

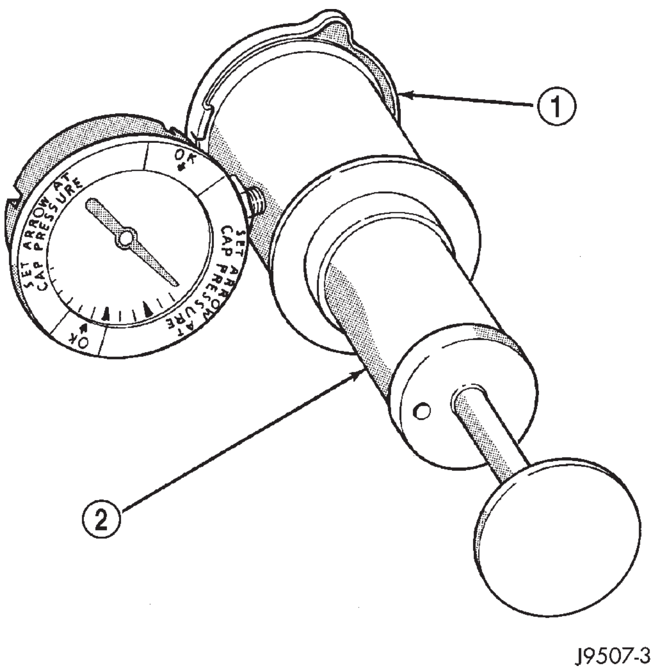

Fig. 34 Pressure Testing Radiator Cap - Typical

1 - PRESSURE CAP
2 - TYPICAL COOLING SYSTEM PRESSURE TESTER

Operate tester pump to bring pressure to 117 kPa (17 psi) on gauge. If pressure cap fails to hold pressure of at least 110 kPa (16 psi) replace cap. Refer to the following **CAUTION**.

The pressure cap may test properly while positioned on tool 7700 (or equivalent). It may not hold pressure or vacuum when installed on radiator. If so, inspect radiator filler neck and cap's top gasket for damage. Also inspect for dirt or distortion that may prevent cap from sealing properly.

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.

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 (Fig. 29) 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 FAN

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.

TRANSMISSION

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TRANSMISSION COOLER

DESCRIPTION

NOTE: The internal transmission oil cooler located within the radiator is not serviceable. If it requires service, the radiator must be replaced.

All models equipped with an automatic transmission are equipped with a transmission oil cooler (water-to-oil) mounted internally within the radiator tank (Fig. 1). This internal cooler is supplied as standard equipment on all models equipped with an automatic transmission.

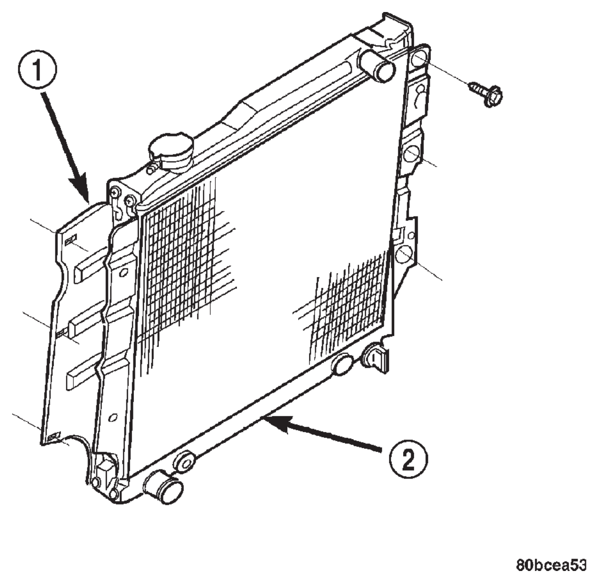

Fig. 1 Radiator with Integral Transmission Oil Cooler

1 - DOWNFLOW RADIATOR
2 - INTEGRAL TRANSMISSION OIL COOLER (INTERNAL TO RADIATOR)

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.

STANDARD PROCEDURE - FLUSHING COOLERS AND TUBES

When a transmission failure has contaminated the fluid, the oil cooler(s) must be flushed. The torque converter must also be replaced. This will insure that metal particles or sludged oil are not later transferred back into the reconditioned (or replaced) transmission.

The only recommended procedure for flushing coolers and lines is to use Tool 6906-B Cooler Flusher.

WARNING: WEAR PROTECTIVE EYEWEAR THAT MEETS THE REQUIREMENTS OF OSHA AND ANSI Z87.1–1968. WEAR STANDARD INDUSTRIAL RUBBER GLOVES.
KEEP LIGHTED CIGARETTES, SPARKS, FLAMES, AND OTHER IGNITION SOURCES AWAY FROM THE AREA TO PREVENT THE IGNITION OF COMBUSTIBLE LIQUIDS AND GASES. KEEP A CLASS (B) FIRE EXTINGUISHER IN THE AREA WHERE THE FLUSHER WILL BE USED.
KEEP THE AREA WELL VENTILATED.
DO NOT LET FLUSHING SOLVENT COME IN CONTACT WITH YOUR EYES OR SKIN: IF EYE CONTAMINATION OCCURS, FLUSH EYES WITH WATER FOR 15 TO 20 SECONDS. REMOVE CONTAMINATED CLOTHING AND WASH AFFECTED SKIN WITH SOAP AND WATER. SEEK MEDICAL ATTENTION.

(1) Remove cover plate filler plug on Tool 6906-B. Fill reservoir 1/2 to 3/4 full of fresh flushing solution. Flushing solvents are petroleum based solutions generally used to clean automatic transmission components. **DO NOT** use solvents containing acids, water, gasoline, or any other corrosive liquids.

(2) Reinstall filler plug on Tool 6906-B.

(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.

TRANSMISSION COOLER (Continued)

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) Turn pump ON for two to three minutes to flush cooler(s) and lines.

(8) Turn pump OFF.

(9) Disconnect CLEAR suction line from reservoir at cover plate. Disconnect CLEAR return line at cover plate, and place it in a drain pan.

(10) Turn pump ON for 30 seconds to purge flushing solution from cooler and lines. Turn pump OFF.

(11) Place CLEAR suction line into a one quart container of Mopar® ATF +4, type 9602, Automatic Transmission Fluid.

(12) Turn pump ON until all transmission fluid is removed from the one quart container and lines. This purges any residual cleaning solvent from the transmission cooler and lines. Turn pump OFF.

(13) Disconnect alligator clips from battery. Reconnect flusher lines to cover plate, and remove flushing adapters from cooler lines.

AUDIO

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AUDIO

DESCRIPTION

Available factory-installed radio receivers for this model include an AM/FM/cassette (RAS sales code) and an AM/FM/CD/3-band graphic equalizer (RBR sales code). All factory-installed radio receivers are stereo Electronically Tuned Radios (ETR), and include an electronic digital clock function.

Models equipped with the RBR 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.

DIAGNOSIS AND TESTING - AUDIO

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, (REFER TO ELECTRICAL/RESTRAINTS) 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.

AUDIO (Continued)

Audio System Diagnosis		
CONDITION	POSSIBLE CAUSE	CORRECTION
NO AUDIO.	1. Fuse faulty.	1. Check radio fuse and Ignition-Off Draw fuse in Power Distribution Center. Replace fuses, if required.
	2. Radio connector faulty.	2. Check for loose or corroded radio connector. Repair, if required.
	3. Wiring faulty.	3. Check for battery voltage at radio connector. Repair wiring, if required.
	4. Ground faulty.	4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.
	5. Radio faulty.	5. Exchange or replace radio, if required.
	6. Speakers faulty.	6. Refer to speaker diagnosis.
NO DISPLAY.	1. Fuse faulty.	1. Check radio fuse and Ignition-Off Draw fuse in Power Distribution Center. Replace fuses, if required.
	2. Radio connector faulty.	2. Check for loose or corroded radio connector. Repair, if required.
	3. Wiring faulty.	3. Check for battery voltage at radio connector. Repair wiring, if required.
	4. Ground faulty.	4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.
	5. Radio faulty.	5. Exchange or replace radio, if required.
CLOCK WILL NOT KEEP SET TIME.	1. Fuse faulty.	1. Check ignition-off draw fuse. Replace fuse, if required.
	2. Radio connector faulty.	2. Check for loose or corroded radio connector. Repair, if required.
	3. Wiring faulty.	3. Check for battery voltage at radio connector. Repair wiring, if required.
	4. Ground faulty.	4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.
	5. Radio faulty.	5. Exchange or replace radio, if required.
POOR RADIO RECEPTION.	1. Antenna faulty.	1. See antenna diagnosis, in this group. Repair or replace antenna, if required.
	2. Ground faulty.	2. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required..
	3. Radio faulty.	3. Exchange or replace radio, if required.
NO/POOR TAPE OPERATION.	1. Faulty tape.	1. Insert known good tape and test operation.
	2. Foreign objects behind tape door.	2. Remove foreign objects and test operation.
	3. Dirty cassette tape head.	3. Clean head with Mopar Cassette Head Cleaner.
	4. Faulty tape deck.	4. Exchange or replace radio, if required.
NO COMPACT DISC OPERATION	1. Faulty CD.	1. Insert known good CD and test operation.
	2. Foreign material on CD.	2. Clean CD and test operation.
	3. Condensation on CD or optics.	3. Allow temperature of vehicle interior to stabilize and test operation.
	4. Faulty CD player.	4. Exchange or replace radio, if required.

AMPLIFIER CHOKE AND RELAY

DESCRIPTION

Models equipped with the premium speaker package have a amplifier choke and relay. The amplifier choke and relay is mounted behind the left instrument panel speaker.

The amplifier choke and relay should be checked if there is no sound output from the speakers. The amplifier choke and relay can not be repaired or adjusted and, if faulty or damaged, the unit must be replaced.

OPERATION

The amplifier choke and relay is used to control the supply of fused battery current to the front door speaker-mounted dual amplifiers. The speaker relay is energized by a fused 12 volt output from the radio receiver whenever the radio is turned on. For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

DIAGNOSIS AND TESTING - AMPLIFIER CHOKE AND RELAY

The amplifier choke and relay is used to switch power to the individual speaker amplifiers used with the premium speaker package. The amplifier choke and relay is serviced only as a unit. If all of the speakers are inoperative the amplifier choke and relay should be inspected. Before replacement, make the following inspections of the amplifier choke and relay circuits. For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

(1) Check the fused B(+) fuse in the junction block. If OK, go to Step 2. If not OK, replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit to the battery as required.

(3) Disconnect the instrument panel wire harness connector from the amplifier choke and relay. Check for battery voltage at the fused B(+) circuit cavity of the instrument panel wire harness connector for the amplifier choke and relay. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit to the junction block fuse as required.

(4) Probe the ground circuit cavity of the instrument panel wire harness connector for the amplifier choke and relay. Check for continuity to a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the open ground circuit to ground as required.

(5) Turn the ignition switch to the RUN position and turn the radio ON. Check for battery voltage at the radio 12-volt output circuit cavity of the instrument panel wire harness connector for the amplifier choke and relay. If OK, go to Step 6. If not OK, repair the open radio 12-volt output circuit to the radio as required.

(6) Turn the radio and ignition switches to the OFF position. Reconnect the instrument panel wire harness connector to the amplifier choke and relay. Check for battery voltage at the amplified speaker (+) circuit cavity of the instrument panel wire harness connector for the amplifier choke and relay. There should be zero volts. Turn the ignition and radio switches to the ON position. There should now be battery voltage. If OK, repair the open amplified speaker (+) circuits to the speaker-mounted amplifiers as required. If not OK, replace the faulty amplifier choke and relay.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the left speaker bezel from the instrument panel.

(3) Remove left speaker from instrument panel (Refer to 8 - ELECTRICAL/AUDIO/SPEAKER - REMOVAL).

(4) Remove mounting screws (Fig. 1).

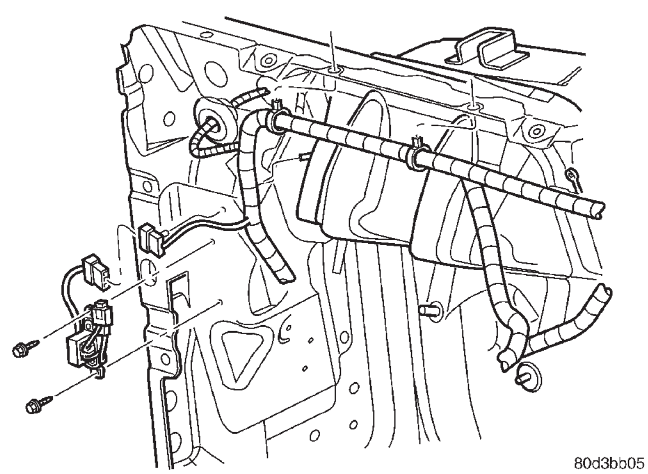

Fig. 1 AMPLIFIER CHOKE AND RELAY

AMPLIFIER CHOKE AND RELAY (Continued)

(5) Disconnect electrical harness connector and remove from instrument panel.

INSTALLATION

(1) Connect electrical harness connector and install to instrument panel.

(2) Install mounting screws. Tighten to 2 N·m (20 in. lbs.)

(3) Install speaker (Refer to 8 - ELECTRICAL/AUDIO/SPEAKER - INSTALLATION).

(4) Install speaker bezel.

(5) Connect battery negative cable.

AMPLIFIED SUBWOOFER

DESCRIPTION

The available amplified subwoofer is mounted within the center console. The amplified subwoofer is rated at 40 watts per channel. The amplified subwoofer should be checked if there is no bass output noted from the rear speakers. The amplified subwoofer can not be repaired or adjusted, and if faulty or damaged, the unit must be replaced.

OPERATION

The amplified subwoofer receives fused current from the Radio Choke Relay. The amplified subwoofer provides low frequency bass and receives inputs from the rear speaker circuits.

DIAGNOSIS AND TESTING - AMPLIFIED SUBWOOFER

For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO ELECTRICAL, RESTRAINTS 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 receiver on. Adjust the balance and fader controls to check the performance of each individual speaker. Note the speaker locations that are not performing correctly.

(2) Disconnect the wire harness connector from the amplified subwoofer. Turn the ignition switch to the ON position. Turn the radio ON. Check the battery feed and ground cavities in the wire harness connector. Check the radio choke relay wire harness connector. If not OK, repair shorted or open wires as necessary. If OK, go to (STEP #3).

(3) Turn the radio receiver off. Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the radio receiver and the amplified subwoofer. Check both the speaker feed (+) circuit and return (–) circuit cavities for the inoperative speaker location(s) from the radio receiver wire harness connectors and to the amplified subwoofer for continuity. In each case, there should be continuity. If not OK, repair the shorted speaker feed (+) and/or return (–) circuit(s) to the speaker as required. If OK, replace the amplified subwoofer.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the center console (Refer to 23 - BODY/INTERIOR/CENTER CONSOLE - REMOVAL).

(3) Disconnect wire harness retainer.

(4) Disconnect wire harness connector.

(5) Remove the mounting screws from the side of the console.

(6) Open console lid and remove the retaining fasteners from the console.

(7) Remove amplified subwoofer from console.

INSTALLATION

(1) Install amplified subwoofer to console.

(2) Install retaining fasteners to the top of the console.

(3) Install the mounting screws to the side of the console.

(4) Connect wire harness connector and retainer.

(5) Install the center console (Refer to 23 - BODY/INTERIOR/CENTER CONSOLE - INSTALLATION).

(6) Connect the battery negative cable.

ANTENNA BODY & CABLE

DESCRIPTION

All models use a fixed-length stainless steel rod-type antenna mast, installed on the right front cowl side panel of the vehicle. The antenna mast is connected to the center wire of the coaxial antenna cable, and is not grounded to any part of the vehicle.

To eliminate static, the antenna base must have a good ground. The antenna coaxial cable shield (the outer wire mesh of the cable) is grounded to the antenna base and the radio chassis.

The antenna 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.

DIAGNOSIS AND TESTING - ANTENNA BODY AND CABLE

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, (REFER TO ELECTRICAL/RESTRAINTS) 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. 2).

NOTE: This model has a two-piece antenna coaxial cable. Tests 2 and 4 must be conducted in two steps to isolate a coaxial cable problem; from the coaxial cable connection under the right end of the instrument panel near the right cowl side inner panel to the antenna base, and then from the coaxial cable connection to the radio chassis connection.

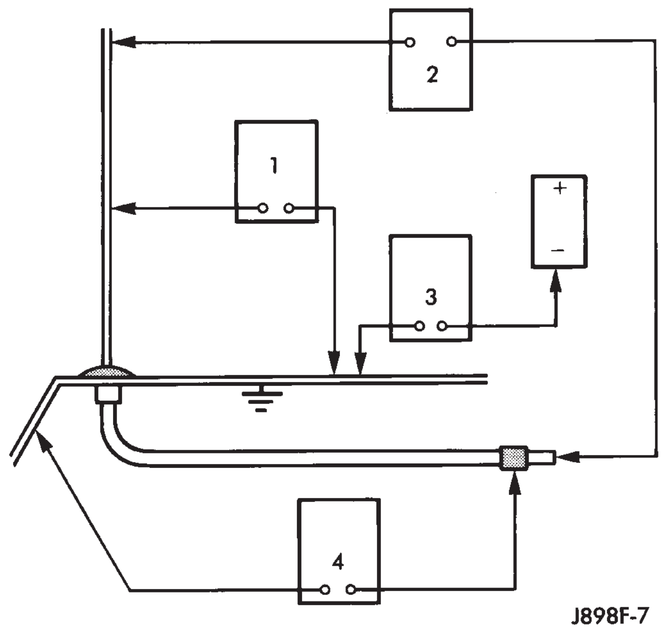

Fig. 2 Antenna Tests

TEST 1

Test 1 determines if the antenna mast is insulated from the base. Proceed as follows:

(1) Unplug the antenna coaxial cable connector from the radio chassis and isolate.

(2) Connect one ohmmeter test lead to the tip of the antenna mast. Connect the other test lead to the antenna base. Check for continuity.

(3) There should be no continuity. If continuity is found, replace the faulty or damaged antenna base and cable assembly.

TEST 2

Test 2 checks the antenna for an open circuit as follows:

(1) Unplug the antenna coaxial cable connector from the radio chassis.

(2) Connect one ohmmeter test lead to the tip of the antenna mast. Connect the other test lead to the center pin of the antenna coaxial cable connector.

(3) Continuity should exist (the ohmmeter should only register a fraction of an ohm). High or infinite resistance indicates damage to the base and cable assembly. Replace the faulty base and cable, if required.

TEST 3

Test 3 checks the condition of the vehicle body ground connection. This test should be performed with the battery positive cable removed from the battery. Disconnect both battery cables, the negative cable first. Reconnect the battery negative cable and perform the test as follows:

ANTENNA BODY & CABLE (Continued)

(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.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, (REFER TO ELECTRICAL/RESTRAINTS) 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 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(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. 3).

(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.

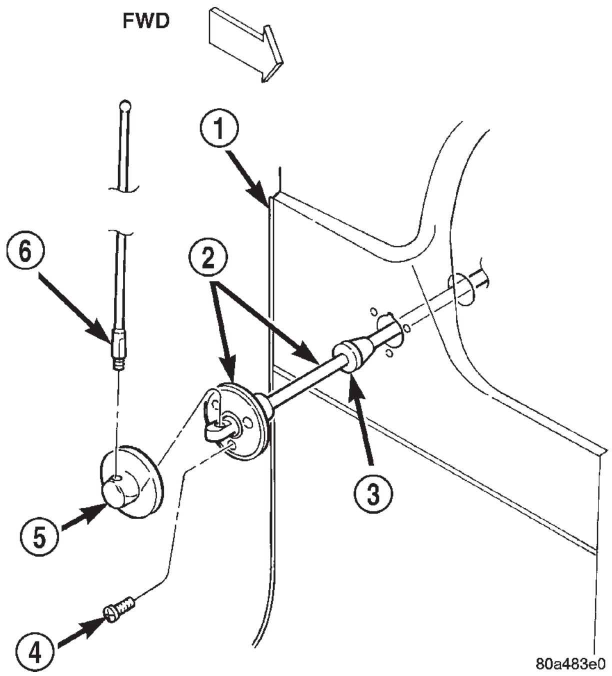

Fig. 3 Antenna Remove/Install

1 - RIGHT COWL SIDE PANEL
2 - BASE & CABLE
3 - GROMMET
4 - SCREW
5 - COVER
6 - MAST

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, (REFER TO ELECTRICAL/RESTRAINTS) 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) From outside the vehicle, feed the antenna cable and base assembly through the outer cowl side panel.

(2) From inside the passenger compartment, pull the cable and grommet into the hole in the inside cowl side panel until the grommet is seated.

(3) Install the three screws retaining the antenna body base to right outer cowl side panel. Tighten the screws to 3.3 N·m (30 in. lbs.).

(4) Screw the antenna mast to the antenna body base.

(5) Reach through the glove box opening and secure the antenna coaxial cable the radio antenna port.

ANTENNA BODY & CABLE (Continued)

(6) Install the glove box to the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION).

(7) Connect the battery negative cable.

RADIO

DIAGNOSIS AND TESTING - RADIO

For circuit descriptions and diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, (REFER TO ELECTRICAL/RESTRAINTS) 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.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, (REFER TO ELECTRICAL/RESTRAINTS) 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 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - REMOVAL).

(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. 4).

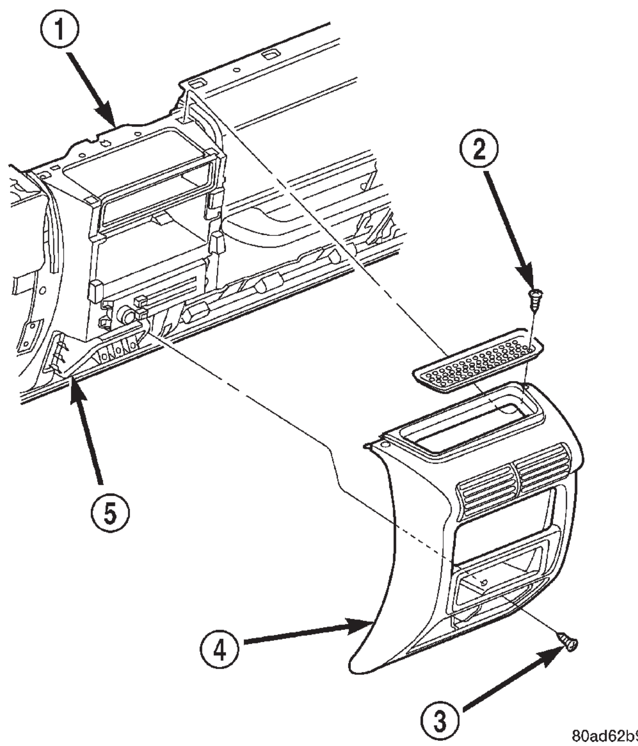

Fig. 4 Center Bezel Remove/Install

1 - INSTRUMENT PANEL
2 - SCREW
3 - SCREW
4 - CENTER BEZEL
5 - ACCESSORY SWITCH BEZEL

RADIO (Continued)

(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. 5).

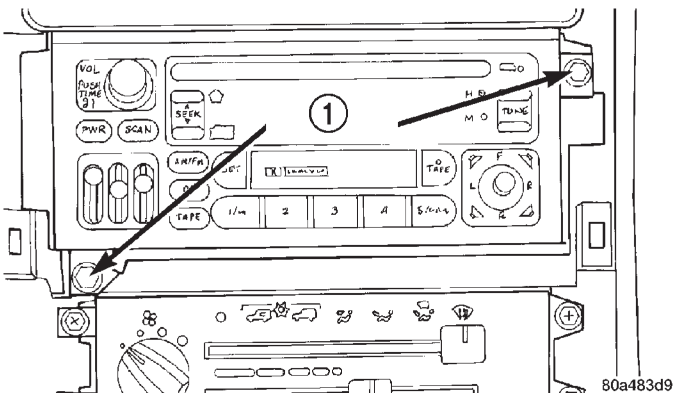

Fig. 5 Radio Remove/Install

1 - MOUNTING SCREWS

(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 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(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. 6).

(13) Pull the radio out from the instrument panel far enough to access the wire harness connectors and the antenna coaxial cable connector (Fig. 6).

(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.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, (REFER TO ELECTRICAL/RESTRAINTS) 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.

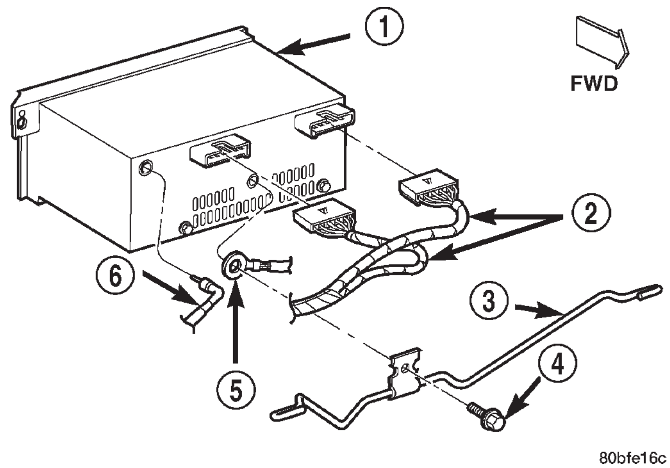

Fig. 6 Radio Connections - Typical

1 - RADIO RECEIVER
2 - INSTRUMENT PANEL WIRE HARNESS
3 - CD RADIO BRACKET
4 - SCREW
5 - GROUND STRAP
6 - ANTENNA CABLE

(1) Position the radio into the instrument panel.

(2) Install the screw that secures the ground strap to the back of the radio receiver chassis.

(3) Connect the coaxial antenna cable at the rear of the radio chassis.

(4) Connect the radio wire harness connectors to the rear of the radio.

(5) Install the two radio retaining screws. Tighten the screws to 5 N·m (20 in. lbs).

(6) Install the center bezel to the instrument panel. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

(7) Install the one screw located at the back of the ash receiver housing that secures the center bezel to the lower instrument panel.

(8) Install the ash receiver.

(9) Connect the battery negative cable.

RADIO NOISE SUPPRESSION GROUND STRAP

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.

RADIO NOISE SUPPRESSION GROUND STRAP (Continued)

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 8 - ELECTRICAL/IGNITION CONTROL - DESCRIPTION).

DIAGNOSIS AND TESTING - RADIO NOISE SUPPRESSION GROUND STRAP

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, (REFER TO ELECTRICAL/RESTRAINTS) 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 complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds. 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 8 - ELECTRICAL/IGNITION CONTROL - SPECIFICATIONS) and (refer to 8 - ELECTRICAL/IGNITION CONTROL - SPECIFICATIONS):

- 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

ENGINE-TO-BODY GROUND STRAP

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.

RADIO NOISE SUPPRESSION GROUND STRAP (Continued)

(1) Remove the screw that secures the engine-to-body ground strap eyelet to the hood panel center reinforcement (Fig. 7).

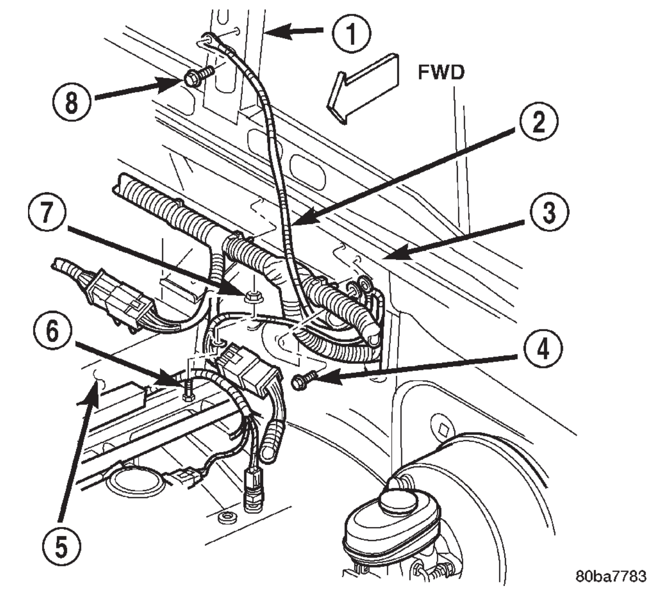

Fig. 7 Engine-To-Body Ground Strap

1 - HOOD PANEL
2 - GROUND STRAP
3 - DASH PANEL
4 - SCREW
5 - ENGINE
6 - STUD
7 - NUT
8 - SCREW

(2) Remove the screw that secures the engine-to-body ground strap eyelet to the dash panel.

(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.

ENGINE-TO-FRAME GROUND STRAP

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.

(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. 8) or (Fig. 9).

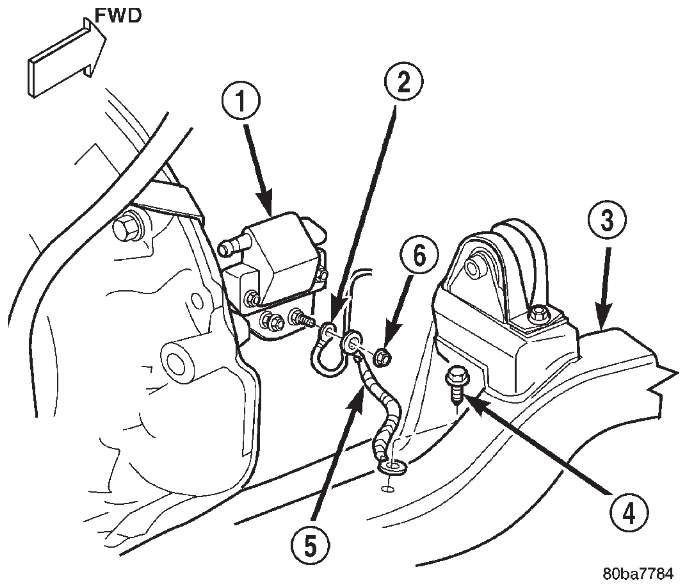

Fig. 8 Engine-To-Frame Ground Strap

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.).

RADIO NOISE SUPPRESSION GROUND STRAP (Continued)

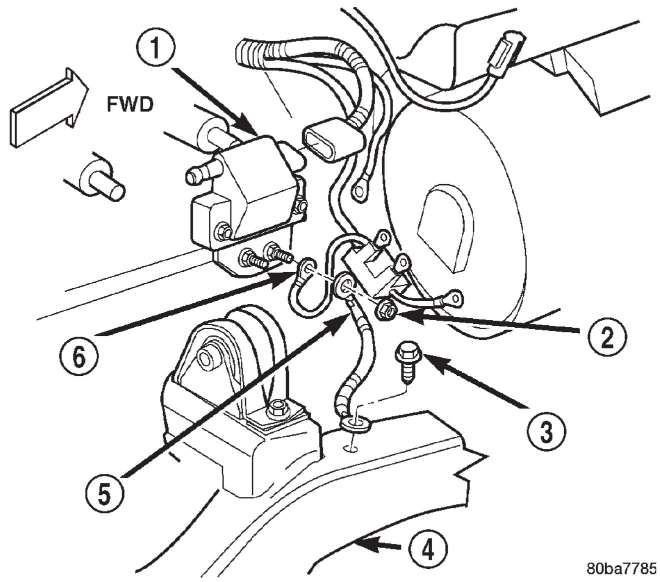

Fig. 9 Engine-To-Frame Ground Strap - 4.0L

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.).

SOUND BAR

REMOVAL

(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 23 - BODY/REMOVEABLE TOP/TOP - REMOVAL).

(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.

(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. 10).

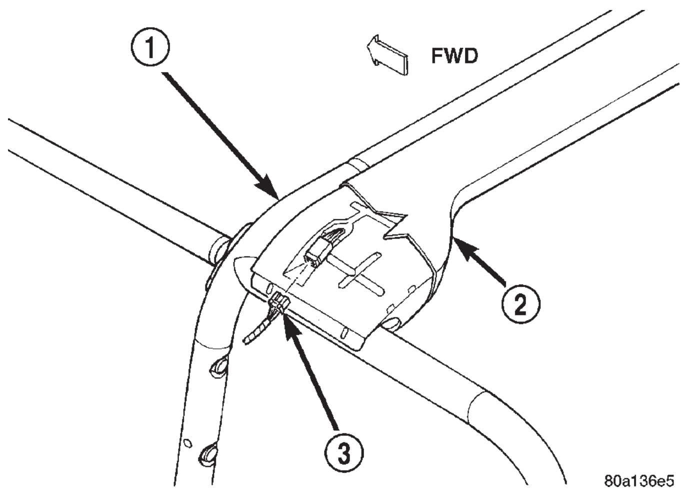

Fig. 10 Sound Bar Wire Harness Connector Remove/Install

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. 11).

(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.

INSTALLATION

(1) Position the sound bar onto the sport bar.

(2) Install the two screws retaining the sound bar to the sport bar.

(3) Connect the sound bar wire harness connector.

SOUND BAR (Continued)

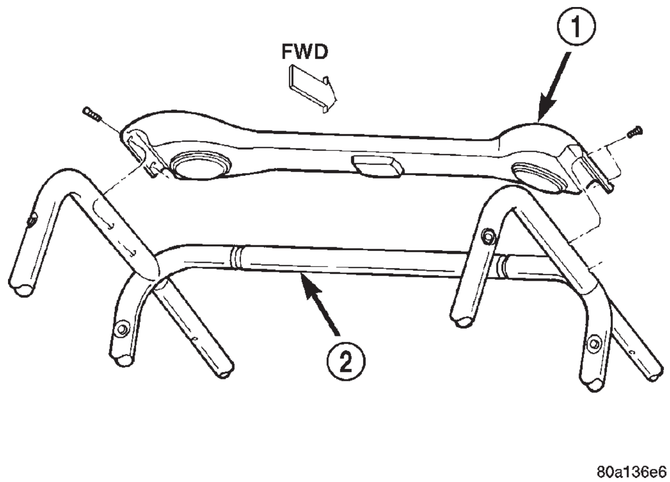

Fig. 11 Sound Bar Remove/Install

1 - SOUND BAR
2 - SPORT BAR

(4) Position the sound bar trim cover and attach the hook and loop.

(5) If the vehicle is equipped with the standard soft top, raise the soft top.

(6) If the vehicle is equipped with the optional hard top, install the hard top (Refer to 23 - BODY/ REMOVEABLE TOP/TOP - INSTALLATION).

(7) Connect the battery negative cable.

SPEAKER

DESCRIPTION

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. With the premium speaker system, the standard front speakers are replace with an enclosure assembly that includes a 4 inch speaker and a 1 inch tweeter. 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.

DIAGNOSIS AND TESTING

DIAGNOSIS & TESTING - SPEAKER

For circuit descriptions and diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

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CAUTION: The speaker output of the radio is a “floating ground” system. Do not allow any speaker lead to short to ground, as damage to the radio may result.

(1) Turn the 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 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

SPEAKER (Continued)

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.

REMOVAL

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.

(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. 12).

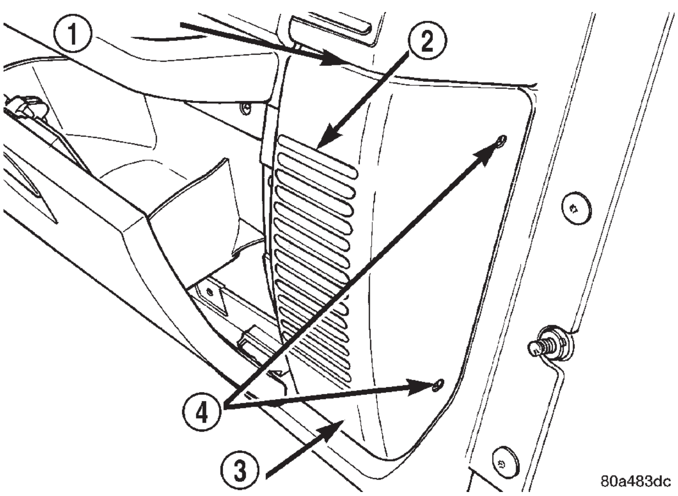

Fig. 12 Instrument Panel Speaker Bezel Remove/Install

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. 13).

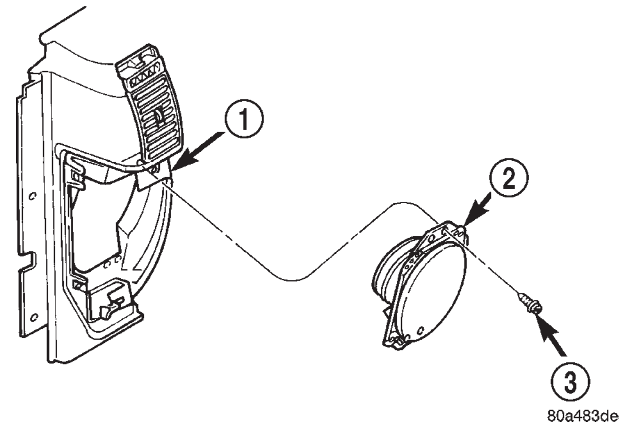

Fig. 13 Instrument Panel Speaker Remove/Install

1 - INSTRUMENT PANEL
2 - SPEAKER
3 - SCREW

(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.

(8) Remove the speaker from the instrument panel.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, (REFER TO ELECTRICAL/RESTRAINTS) 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) Connect the speaker wire connector to the speaker.

(2) Position the speaker to the instrument panel.

(3) Install the four speaker retaining screws. Tighten the screws to 1.1 N·m (10.in.lbs).

(4) Install the speaker bezel to the instrument panel. Tighten the screws to 2.2 N·m (20 in. lbs.).

(5) Connect the battery negative cable.

CHIME/BUZZER

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CHIME WARNING SYSTEM

DESCRIPTION

A chime warning system is standard factory-installed equipment on this model. The chime warning system uses a single chime tone generator that is integral to the instrument cluster to provide an audible indication of various vehicle conditions that may require the attention of the vehicle operator. The chime warning system includes the following major components, which are described in further detail elsewhere in this service information:

- **Door Ajar Switch** - A door ajar switch is mounted to each front door hinge pillar. This switch provides an input to the chime warning system indicating whether the front doors are open or closed.
- **Ignition Switch** - A key-in ignition switch is integral to the ignition switch. The key-in ignition switch provides an input to the chime warning system indicating whether a key is present in the ignition lock cylinder.
- **Instrument Cluster** - The instrument cluster contains an integral chime tone generator, integrated circuitry, a central processing unit and the programming to provide all of the proper chime warning system features based upon the monitored inputs. The instrument cluster circuitry monitors hard-wired switch inputs, as well as message inputs received from other vehicle electronic modules on the Programmable Communications Interface (PCI) data bus network.
- **Left Multi-Function Switch** - The exterior lighting switch is integral to the left multi-function switch. The exterior lighting switch provides an input to the chime warning system indicating when the exterior lamps are turned On or Off.
- **Seat Belt Switch** - A seat belt switch is integral to the driver side front seat belt buckle-half unit. The seat belt switch provides an input to the chime warning system indicating whether the driver side front seat belt is fastened.

Hard wired circuitry connects many of the chime warning system components to each other through the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the chime warning system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

The instrument cluster chime warning system circuitry and the integral chime tone generator cannot be adjusted or repaired. If the instrument cluster or the chime tone generator are damaged or faulty, the instrument cluster unit must be replaced.

OPERATION

The chime warning system is designed to provide an audible output as an indication of various conditions that may require the attention or awareness of the vehicle operator. The chime warning system components operate on battery current received through the Ignition-Off Draw (IOD) fuse in the Power Distribution Center (PDC) on a non-switched fused B(+) circuit so that the system may operate regardless of the ignition switch position.

The chime warning system provides an audible warning to the vehicle operator under the following conditions:

- **Air Bag Warning** - The instrument cluster chime tone generator will generate a single chime tone when the airbag indicator is illuminated for an airbag system fault condition. The instrument cluster uses airbag indicator lamp-on and lamp-off message inputs received from the Airbag Control Module (ACM) over the Programmable Communications Interface (PCI) data bus indicating that the airbag indicator should be illuminated for an airbag system fault condition.
- **Charging System Warning** - The instrument cluster chime tone generator will generate a single chime tone when the check gauges indicator is illuminated for a charging system fault or a system voltage

CHIME WARNING SYSTEM (Continued)

high warning condition. The instrument cluster uses system voltage message inputs received from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus indicating the electrical system voltage is too high or too low to illuminate the check gauges indicator for a charging system fault or system voltage high condition. This chime feature will only occur once in an ignition cycle.

- **Driver Door Ajar Warning -** The instrument cluster chime tone generator will generate repetitive chime tones at a slow rate to announce that the hard wired inputs from the driver door ajar switch and the ignition switch as well as an engine speed message input received from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus indicate that the driver door is opened with the ignition switch in the On position and the engine is not running. The chimes will continue to sound for a duration of about twenty minutes, until the driver door is closed, until the ignition switch is turned to the Off position, or until the engine speed message indicates the engine is running, whichever occurs first.
- **Engine Coolant Temperature High Warning** - The instrument cluster chime tone generator will generate a single chime tone when the check gauges indicator is illuminated for a high or critical engine coolant temperature condition. The instrument cluster uses engine coolant temperature message inputs received from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus indicating that the engine coolant temperature is high or critical to illuminate the check gauges indicator for a coolant temperature high condition. This chime feature will only occur once in an ignition cycle.
- **Fasten Seat Belt Warning -** The instrument cluster chime tone generator will generate repetitive chime tones at a slow rate each time the ignition switch is turned to the On or Start positions to announce that the hard wired inputs from the seat belt switch and the ignition switch indicate that the driver side front seat belt is not fastened. The chimes will continue to sound for a duration of about six seconds, until the driver side front seat belt is fastened, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Head/Park Lights-On Warning -** The instrument cluster chime tone generator will generate repetitive chime tones at a slow rate to announce that the hard wired inputs from the driver door ajar switch, the ignition switch, and the exterior lighting circuitry of the left multi-function switch indicate that the exterior lamps are turned On with the driver door opened and the ignition switch in the Off position. The chimes will continue to sound for about three minutes or until the exterior lamps are turned Off, the driver door is closed, or the ignition switch is turned to the On position, whichever occurs first.
- **Key-In-Ignition Warning -** The instrument cluster chime tone generator will generate repetitive chime tones at a slow rate to announce that the hard wired inputs from the driver door ajar switch, the ignition switch, and the key-in ignition circuitry of the ignition switch indicate that the key is in the ignition lock cylinder with the driver door opened and the ignition switch in the Off position. The chimes will continue to sound until the key is removed from the ignition lock cylinder, the driver door is closed, or the ignition switch is turned to the On position, whichever occurs first.
- **Low Fuel Warning -** The instrument cluster chime tone generator will generate one chime tone when the low fuel indicator is illuminated by the instrument cluster. The instrument cluster uses a percent tank full message input received from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus indicating that there is less than about one-eighth tank of fuel remaining to illuminate the low fuel indicator. This chime feature will only occur once in an ignition cycle.
- **Low Oil Pressure Warning -** The instrument cluster chime tone generator will generate repetitive chime tones at a fast rate when the check gauges indicator is illuminated for a low oil pressure condition. The instrument cluster uses engine speed and oil pressure message inputs received from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus indicating that the engine is running at greater than 300 rpm and that the oil pressure is low to illuminate the check gauges indicator for a low oil pressure condition. The chimes will continue to sound for five seconds, until the engine oil pressure message indicates that the oil pressure is not low, or until the engine speed message indicates that the engine is running at less than 300 rpm, whichever occurs first. This chime tone will only occur once in an ignition cycle.
- **Overspeed Warning -** The instrument cluster chime tone generator will generate repetitive chime tones at a slow rate to announce that a vehicle speed message input received from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus indicates that the vehicle speed is above 120 kilometers-per-hour (75 miles-per-hour). The chimes will continue to sound until the vehicle speed message indicates that the vehicle speed is below 120 kilometers-per-hour (75 miles-per-hour). This feature is only enabled on an instrument cluster that has been programmed with a Middle East Gulf Coast Country (GCC) country code.

CHIME WARNING SYSTEM (Continued)

- **Park Brake Reminder** - The instrument cluster chime tone generator will generate ten repetitive chime tones at a slow rate to announce that the hard wired input from the park brake switch and a vehicle speed message input received from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus indicates that the park brake is applied and the vehicle is moving. This chime feature will repeat each time the input conditions are met.
- **Passenger Door Ajar Warning** - The instrument cluster chime tone generator will generate three sets of two chime tones at a slow rate to announce that the hard wired inputs from the passenger door ajar switch and the ignition switch as well as an engine speed message input received from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus indicate that the passenger door is opened with the ignition switch in the On position and the engine is not running. This chime feature will repeat each time the input conditions are met.
- **Sentry Key Immobilizer System "Customer Learn" Mode Announcement** - This chime feature is only active on vehicles equipped with the optional Sentry Key Immobilizer System (SKIS) and sold in markets where the optional "Customer Learn" programming feature is available. The instrument cluster chime tone generator will generate one chime tone to announce that a status message input received from the Sentry Key Immobilizer Module (SKIM) over the Programmable Communications Interface (PCI) data bus indicates that the SKIS is in the "Customer Learn" mode, which is used for programming additional sentry key transponders.
- **Turn Signal On Warning** - The instrument cluster chime tone generator will generate repetitive chime tones at a slow rate to announce that the hard wired input for the right or left turn signal indicator as well as vehicle distance and speed message inputs received from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus indicate that a turn signal has been active continuously for 1.6 kilometers (1 mile) with the vehicle speed greater than 22 kilometers-per-hour (15 miles-per hour). Vehicles built for markets other than the United States and Canada have a revised distance threshold of 4 kilometers for this feature. The chime will continue until the turn signal input becomes inactive or changes (right to left, or left to right), or until the vehicle speed message indicates that the speed is less than 22 kilometers-per-hour (15 miles-per-hour), whichever occurs first. The hazard warning flashers will not activate this chime feature.

The instrument cluster provides chime service for all available features in the chime warning system. The instrument cluster relies upon its internal programming, hard wired inputs from numerous switches, and electronic message inputs received from other electronic modules over the PCI data bus network to provide chime service for all of the chime warning system features. Upon receiving the proper inputs, the instrument cluster activates the integral chime tone generator to provide the audible chime tone to the vehicle operator. The chime tone generator in the instrument cluster is capable of producing single chime tones, or repeated chime tones at two different rates: about fifty chime tones per minute, or about 180 chime tones per minute. The internal programming of the instrument cluster determines the priority of each chime tone request input that is received, as well as the rate and duration of each chime tone that is to be generated.

The hard wired chime warning system inputs to the instrument cluster, as well as other hard wired circuits for this system may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the instrument cluster or the PCI data bus network. The most reliable, efficient and accurate means to diagnose the instrument cluster and the PCI data bus network inputs for the chime warning system requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. See the owner's manual in the vehicle glove box for more information on the features provided by the chime warning system.

DIAGNOSIS AND TESTING - CHIME WARNING SYSTEM

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds. The chime warning system features driven by hard wired inputs to the instrument cluster may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the chime warning system features driven by message inputs to the instrument cluster over the Programmable Communications Interface (PCI) data bus network. The most reliable, efficient and accurate means to diagnose the instrument cluster and the PCI data bus network inputs for the chime warning system requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

CHIME WARNING SYSTEM (Continued)

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.

CONDITION	POSSIBLE CAUSES	CORRECTION
NO SEAT BELT WARNING CHIME WITH SEAT BELT UNBUCKLED, BUT OTHER CHIME FEATURES OK	1. Seat belt switch ground circuit open.	1. Check for continuity between the ground circuit cavity of the floor wire harness connector for the seat belt switch and a good ground. Repair open ground circuit, if required.
	2. Seat belt switch sense circuit open.	2. Check for continuity between the seat belt switch sense circuit cavities of the floor wire harness connector for the seat belt switch and the instrument panel wire harness instrument cluster C2 connector. Repair the open seat belt switch sense circuit, if required.
	3. Faulty seat belt switch.	3. Check for continuity between the ground circuit cavity and the seat belt switch sense circuit cavity of the seat belt switch pigtail connector. There should be continuity with the seat belt unbuckled. Replace the faulty seat belt, if required.
SEAT BELT WARNING CHIME WITH SEAT BELT BUCKLED	1. Seat belt switch sense circuit shorted.	1. With the floor wire harness connector for the seat belt switch and the instrument panel wire harness instrument cluster C2 connector disconnected, there should be no continuity between the seat belt switch sense circuit and a good ground. Repair the shorted seat belt switch sense circuit, if required.
	2. Faulty seat belt switch.	2. Check for continuity between the ground circuit cavity and the seat belt switch sense circuit cavity of the seat belt switch pigtail connector. There should be no continuity with the seat belt buckled. Replace the faulty seat belt, if required.

CHIME WARNING SYSTEM (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO KEY-IN IGNITION WARNING CHIME, BUT OTHER CHIME FEATURES OK	1. Driver door ajar switch sense circuit open.	1. Check for continuity between the driver door ajar switch sense circuit cavities of the connector for the driver door ajar switch and the cross body wire harness ignition switch C2 connector. Repair the open driver door ajar switch sense circuit, if required.
	2. Key-in ignition switch sense circuit open.	2. Check for continuity between the key-in ignition switch sense circuit cavities of the cross body wire harness ignition switch connector and the instrument panel wire harness instrument cluster C2 connector. Repair the open key-in ignition switch sense circuit, if required.
	3. Ignition switch ground circuit open.	3. Check for continuity between the ground circuit cavity of the cross body wire harness ignition switch connector and a good ground. Repair the open ground circuit, if required
	4. Faulty ignition switch.	4. Check for continuity between the ground circuit terminal and the key-in ignition switch sense circuit terminal in the ignition switch connector receptacle. There should be continuity with a key in the ignition lock cylinder. Replace the faulty ignition switch, if required.
NO HEADLAMPS-ON WARNING CHIME, BUT OTHER CHIME FEATURES OK	1. Driver door ajar switch sense circuit open.	1. Check for continuity between the driver door ajar switch sense circuit cavities of the connector for the driver door ajar switch and the instrument panel wire harness instrument cluster C2 connector. Repair the open driver door ajar switch sense circuit, if required.
	2. Headlamp switch output circuit open.	2. Check for continuity between the headlamp switch output circuit cavity of the instrument panel wire harness instrument cluster C1 connector and the park lamp feed circuit cavity of the cross body wire harness left multi-function switch connector. Repair the open headlamp switch output circuit, if required.
	3. Faulty multi-function switch.	3. Check for continuity between the fused B(+) circuit (F33) terminal and the park lamp feed circuit terminal in the left multi-function switch connector receptacle. There should be continuity with the headlamp switch in the On position. Replace the faulty left multi-function switch, if required.

CHIME WARNING SYSTEM (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO CHIMES AND OTHER INSTRUMENT CLUSTER FEATURES ERRATIC OR DISABLED	1. Instrument cluster ground circuit open.	1. Check for continuity between the ground circuit cavity of the instrument panel wire harness instrument cluster C1 connector and a good ground. Repair the open ground circuit, if required.
	2. Instrument cluster fused B(+) circuit open.	2. Check for battery voltage at the fused B(+) circuit cavity of the instrument panel wire harness instrument cluster C1 connector. Repair the open fused B(+) circuit, if required.
	3. Instrument cluster fused ignition switch output (run-start) circuit open.	3. With the ignition switch in the On position, check for battery voltage at the fused ignition switch output (run-start) circuit cavity of the instrument panel wire harness instrument cluster C1 connector. Repair the open fused ignition switch output (run-start) circuit, if required.
	4. Faulty instrument cluster.	4. Replace the faulty instrument cluster, if required.
NO CHIMES, BUT ALL OTHER INSTRUMENT CLUSTER FEATURES OK	1. Faulty instrument cluster.	1. Replace the faulty instrument cluster, if required.

ELECTRONIC CONTROL MODULES

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ELECTRONIC CONTROL MODULES

STANDARD PROCEDURE - PCM/SKIM PROGRAMMING

NOTE: Before replacing the PCM for a failed driver, control circuit, or ground circuit, be sure to check the related component/circuit integrity for failures not detected due to a double fault in the circuit. Most PCM driver/control circuit failures are caused by internal component failures (i.e. relays and solenoids) and shorted circuits (i.e. pull-ups, drivers, and switched circuits). These failures are difficult to detect when a double fault has occurred and only one DTC has been set.

When a PCM (JTEC) and the SKIM are replaced at the same time, perform the following steps in order:

(1) Program the new PCM (JTEC).
(2) Program the new SKIM.
(3) Replace all ignition keys and program them to the new SKIM.

PROGRAMMING THE PCM (JTEC)

The SKIS Secret Key is an ID code that is unique to each SKIM. This code is programmed and stored in the SKIM, the PCM, and the ignition key transponder chip(s). When replacing the PCM, it is necessary to program the secret key into the new PCM using the DRBIII® scan tool. Perform the following steps to program the secret key into the PCM.

(1) Turn the ignition switch to the On position (transmission in Park/Neutral).
(2) Use the DRBIII® and select THEFT ALARM, SKIM, then MISCELLANEOUS.
(3) Select PCM REPLACED (GAS ENGINE).
(4) Enter secured access mode by entering the vehicle four-digit PIN.
(5) Select ENTER to update PCM VIN.

NOTE: If three attempts are made to enter secured access mode using an incorrect PIN, secured access mode will be locked out for one hour. To exit this lockout mode, turn the ignition switch to the ON position for one hour, then enter the correct PIN. (Ensure all accessories are turned off. Also monitor the battery state and connect a battery charger if necessary).

(6) Press ENTER to transfer the secret key (the SKIM will send the secret key to the PCM).

ELECTRONIC CONTROL MODULES (Continued)

(7) Press PAGE BACK to get to the Select System menu and select ENGINE, MISCELLANEOUS, and SRI MEMORY CHECK.

(8) The DRBIII® will ask, "Is odometer reading between XX and XX?" Select the YES or NO button on the DRBIII®. If NO is selected, the DRBIII® will read, "Enter Odometer Reading (From I.P. odometer)". Enter the odometer reading from the instrument cluster and press ENTER.

PROGRAMMING THE SKIM

(1) Turn the ignition switch to the On position (transmission in Park/Neutral).

(2) Use the DRBIII® and select THEFT ALARM, SKIM, then MISCELLANEOUS.

(3) Select PCM REPLACED (GAS ENGINE).

(4) Program the vehicle four-digit PIN into SKIM.

(5) Select COUNTRY CODE and enter the correct country.

NOTE: Be sure to enter the correct country code. If the incorrect country code is programmed into SKIM, it cannot be changed and the SKIM must be replaced.

(6) Select YES to update VIN (the SKIM will learn the VIN from the PCM).

(7) Press ENTER to transfer the secret key (the PCM will send the secret key to the SKIM).

(8) Program ignition keys to the SKIM.

NOTE: If the PCM and the SKIM are replaced at the same time, all vehicle ignition keys will need to be replaced and programmed to the new SKIM.

PROGRAMMING IGNITION KEYS TO THE SKIM

(1) Turn the ignition switch to the On position (transmission in Park/Neutral).

(2) Use the DRBIII® and select THEFT ALARM, SKIM, then MISCELLANEOUS.

(3) Select PROGRAM IGNITION KEY'S.

(4) Enter secured access mode by entering the vehicle four-digit PIN.

NOTE: A maximum of eight keys can be learned to each SKIM. Once a key is learned to a SKIM it (the key) cannot be transferred to another vehicle.

(5) Obtain ignition keys to be programmed from the customer (8 keys maximum).

(6) Using the DRBIII®, erase all ignition keys by selecting MISCELLANEOUS, and ERASE ALL CURRENT IGN. KEYS.

(7) Program all of the ignition keys.

If ignition key programming is unsuccessful, the DRBIII® will display one of the following messages:

- **Programming Not Attempted** - The DRBIII® attempts to read the programmed key status and there are no keys programmed into SKIM memory.
- **Programming Key Failed (Possible Used Key From Wrong Vehicle)** - SKIM is unable to program an ignition key transponder due to one of the following:
- The ignition key transponder is faulty.
- The ignition key transponder is or has been already programmed to another vehicle.
- **8 Keys Already Learned, Programming Not Done** - The SKIM transponder ID memory is full.
- **Learned Key In Ignition** - The ID for the ignition key transponder currently in the ignition lock cylinder is already programmed in SKIM memory.

COMMUNICATION

DESCRIPTION

The DaimlerChrysler Programmable Communication Interface (PCI) data bus system is a single wire multiplex system used for vehicle communications on many DaimlerChrysler Corporation vehicles. Multiplexing is a system that enables the transmission of several messages over a single channel or circuit. All DaimlerChrysler vehicles use this principle for communication between various microprocessor-based electronic control modules. The PCI data bus exceeds the Society of Automotive Engineers (SAE) J1850 Standard for Class B Multiplexing.

Many of the electronic control modules in a vehicle require information from the same sensing device. In the past, if information from one sensing device was required by several controllers, a wire from each controller needed to be connected in parallel to that sensor. In addition, each controller utilizing analog sensors required an Analog/Digital (A/D) converter in order to ″read″ these sensor inputs. Multiplexing reduces wire harness complexity, sensor current loads and controller hardware because each sensing device is connected to only one controller, which reads and distributes the sensor information to the other controllers over the data bus. Also, because each controller on the data bus can access the controller sensor inputs to every other controller on the data bus, more function and feature capabilities are possible.

In addition to reducing wire harness complexity, component sensor current loads and controller hardware, multiplexing offers a diagnostic advantage. A multiplex system allows the information flowing between controllers to be monitored using a diagnostic scan tool. The DaimlerChrysler system allows an electronic control module to broadcast message data out onto the bus where all other electronic control

COMMUNICATION (Continued)

modules can "hear" the messages that are being sent. When a module hears a message on the data bus that it requires, it relays that message to its microprocessor. Each module ignores the messages on the data bus that are being sent to other electronic control modules.

OPERATION

Data exchange between modules is achieved by serial transmission of encoded data over a single wire broadcast network. The wire colors used for the PCI data bus circuits are yellow with a violet tracer, or violet with a yellow tracer, depending upon the application. The PCI data bus messages are carried over the bus in the form of Variable Pulse Width Modulated (VPWM) signals. The PCI data bus speed is an average 10.4 Kilo-bits per second (Kbps). By comparison, the prior two-wire Chrysler Collision Detection (CCD) data bus system is designed to run at 7.8125 Kbps.

The voltage network used to transmit messages requires biasing and termination. Each module on the PCI data bus system provides its own biasing and termination. Each module (also referred to as a node) terminates the bus through a terminating resistor and a terminating capacitor. There are two types of nodes on the bus. The dominant node terminates the bus through a 1 KW resistor and a 3300 pF capacitor. The Powertrain Control Module (PCM) is the only dominant node for the PCI data bus system. A standard node terminates the bus through an 11 KW resistor and a 330 pF capacitor.

The modules bias the bus when transmitting a message. The PCI bus uses low and high voltage levels to generate signals. Low voltage is around zero volts and the high voltage is about seven and one-half volts. The low and high voltage levels are generated by means of variable-pulse width modulation to form signals of varying length. The Variable Pulse Width Modulation (VPWM) used in PCI bus messaging is a method in which both the state of the bus and the width of the pulse are used to encode bit information. A "zero" bit is defined as a short low pulse or a long high pulse. A "one" bit is defined as a long low pulse or a short high pulse. A low (passive) state on the bus does not necessarily mean a zero bit. It also depends upon pulse width. If the width is short, it stands for a zero bit. If the width is long, it stands for a one bit. Similarly, a high (active) state does not necessarily mean a one bit. This too depends upon pulse width. If the width is short, it stands for a one bit. If the width is long, it stands for a zero bit.

In the case where there are successive zero or one data bits, both the state of the bus and the width of the pulse are changed alternately. This encoding scheme is used for two reasons. First, this ensures that only one symbol per transition and one transition per symbol exists. On each transition, every transmitting module must decode the symbol on the bus and begin timing of the next symbol. Since timing of the next symbol begins with the last transition detected on the bus, all of the modules are re-synchronized with each symbol. This ensures that there are no accumulated timing errors during PCI data bus communication.

The second reason for this encoding scheme is to guarantee that the zero bit is the dominant bit on the bus. When two modules are transmitting simultaneously on the bus, there must be some form of arbitration to determine which module will gain control. A data collision occurs when two modules are transmitting different messages at the same time. When a module is transmitting on the bus, it is reading the bus at the same time to ensure message integrity. When a collision is detected, the module that transmitted the one bit stops sending messages over the bus until the bus becomes idle.

Each module is capable of transmitting and receiving data simultaneously. The typical PCI bus message has the following four components:

- **Message Header -** One to three bytes in length. The header contains information identifying the message type and length, message priority, target module(s) and sending module.
- **Data Byte(s) -** This is the actual message that is being sent.
- **Cyclic Redundancy Check (CRC) Byte -** This byte is used to detect errors during a message transmission.
- **In-Frame Response (IFR) byte(s) -** If a response is required from the target module(s), it can be sent during this frame. This function is described in greater detail in the following paragraph.

The IFR consists of one or more bytes, which are transmitted during a message. If the sending module requires information to be received immediately, the target module(s) can send data over the bus during the original message. This allows the sending module to receive time-critical information without having to wait for the target module to access the bus. After the IFR is received, the sending module broadcasts an End of Frame (EOF) message and releases control of the bus.

The PCI data bus can be monitored using the DRBIII® scan tool. It is possible, however, for the bus to pass all DRBIII® tests and still be faulty if the voltage parameters are all within the specified range and false messages are being sent.

CONTROLLER ANTILOCK BRAKE

DESCRIPTION

The CAB operates the ABS system, 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 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.

REMOVAL

(1) Remove the negative battery cable from the battery.
(2) Pull up on the CAB harness connector release (Fig. 1)and remove connector.

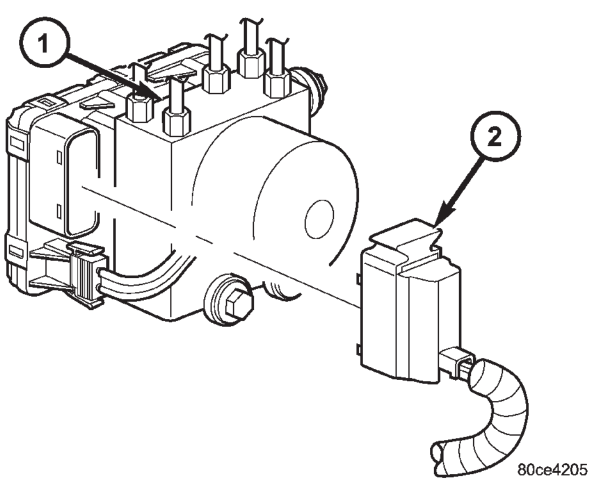

Fig. 1 CAB HARNESS CONNECTOR RELEASE

1 - ABS MODULE
2 - ELECTRICAL CONNECTOR

(3) Remove the pump connector from the CAB.
(4) Remove the CAB mounting bolts.
(5) Remove the CAB from the HCU (Fig. 2).

INSTALLATION

(1) Install CAB to the HCU (Fig. 2).
(2) Install mounting bolts. Tighten to 2 N·m (16 in. lbs.).
(3) Install the pump electircal connector to the CAB (Fig. 2).

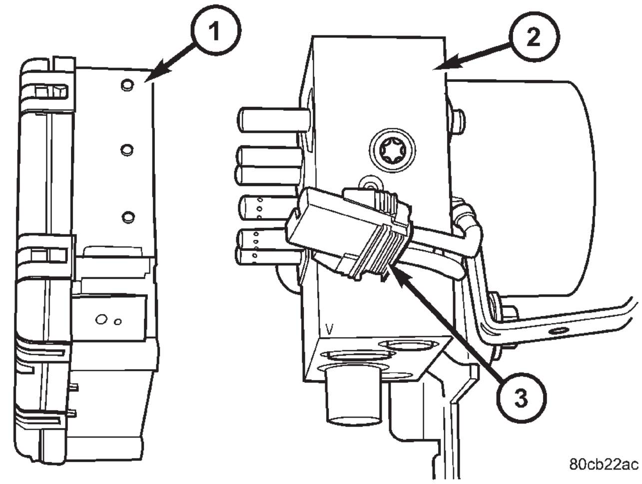

Fig. 2 CONTROLLER AND HCU

1 - CONTROLLER ANTILOCK BRAKE MODULE
2 - HYDRAULIC CONTROL UNIT (H.C.U)
3 - ELECTRICAL CONNECTOR

(4) Install the wiring harness connector to the CAB and push down on the release to secure the connector.
(5) Install negative battery cable to the battery.

DATA LINK CONNECTOR

DESCRIPTION - DATA LINK CONNECTOR

The data link connector (DLC) is located at the lower edge of the instrument panel near the steering column.

OPERATION - DATA LINK CONNECTOR

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).

POWERTRAIN CONTROL MODULE

DESCRIPTION

The PCM is located in the engine compartment (Fig. 3) . The PCM is referred to as JTEC.

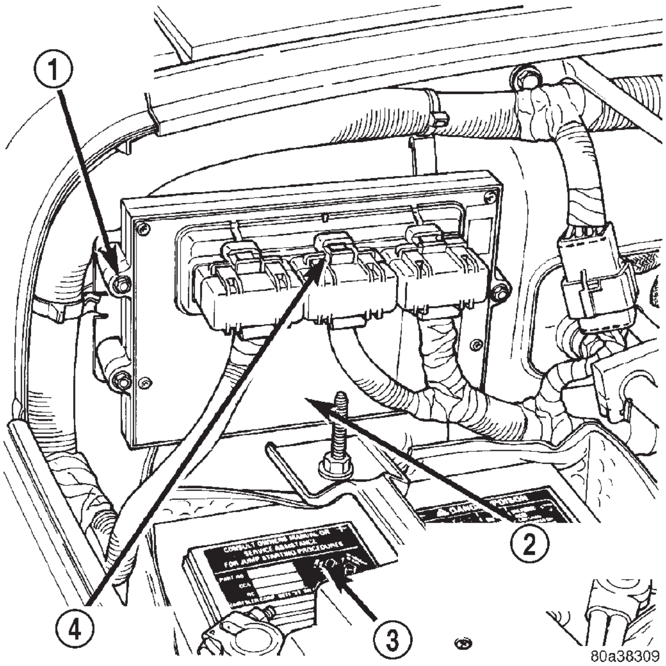

Fig. 3 PCM Location

1 - PCM MOUNTING BOLTS (3)
2 - POWERTRAIN CONTROL MODULE (PCM)
3 - BATTERY
4 - (3) 32–WAY CONNECTOR

DESCRIPTION - MODES OF OPERATION

As input signals to the Powertrain Control Module (PCM) change, the PCM adjusts its response to the output devices. For example, the PCM must calculate different injector pulse width and ignition timing for idle than it does for wide open throttle (WOT).

The PCM will operate in two different modes: **Open Loop and Closed Loop**.

During Open Loop modes, the PCM receives input signals and responds only according to preset PCM programming. Input from the oxygen (O2S) sensors is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O2S) sensors input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio. This ratio is 14.7 parts air-to-1 part fuel. By monitoring the exhaust oxygen content through the O2S sensor, the PCM can fine tune the injector pulse width. This is done to achieve optimum fuel economy combined with low emission engine performance.

The fuel injection system has the following modes of operation:

- Ignition switch ON
- Engine start-up (crank)
- Engine warm-up
- Idle
- Cruise
- Acceleration
- Deceleration
- Wide open throttle (WOT)
- Ignition switch OFF

The ignition switch On, engine start-up (crank), engine warm-up, acceleration, deceleration and wide open throttle modes are Open Loop modes. The idle and cruise modes, (with the engine at operating temperature) are Closed Loop modes.

IGNITION SWITCH (KEY-ON) MODE

This is an Open Loop mode. When the fuel system is activated by the ignition switch, the following actions occur:

- The 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

POWERTRAIN CONTROL MODULE (Continued)

- 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.

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

POWERTRAIN CONTROL MODULE (Continued)

- 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.

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.

DESCRIPTION - 5 VOLT SUPPLIES

Two different Powertrain Control Module (PCM) five volt supply circuits are used; primary and secondary.

DESCRIPTION - IGNITION CIRCUIT SENSE

This circuit ties the ignition switch to the Powertrain Control Module (PCM).

DESCRIPTION - POWER GROUNDS

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.

POWERTRAIN CONTROL MODULE (Continued)

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

DESCRIPTION - SENSOR RETURN

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.

DESCRIPTION - DATA LINK CONNECTOR

The data link connector (DLC) is located at the lower edge of the instrument panel near the steering column.

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.

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

POWERTRAIN CONTROL MODULE (Continued)

OPERATION - 5 VOLT SUPPLIES

Primary 5–volt supply:

• supplies the required 5 volt power source to the Crankshaft Position (CKP) sensor.

• supplies the required 5 volt power source to the Camshaft Position (CMP) sensor.

• supplies a reference voltage for the Manifold Absolute Pressure (MAP) sensor.

• supplies a reference voltage for the Throttle Position Sensor (TPS) sensor.

Secondary 5–volt supply:

• supplies the required 5 volt power source to the oil pressure sensor.

• supplies the required 5 volt power source for the Vehicle Speed Sensor (VSS) (if equipped).

• supplies the 5 volt power source to the transmission pressure sensor (if equipped with an RE automatic transmission).

OPERATION - IGNITION CIRCUIT SENSE

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.

OPERATION - DATA LINK CONNECTOR

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).

REMOVAL

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.

The PCM is located in the engine compartment (Fig. 4).

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.

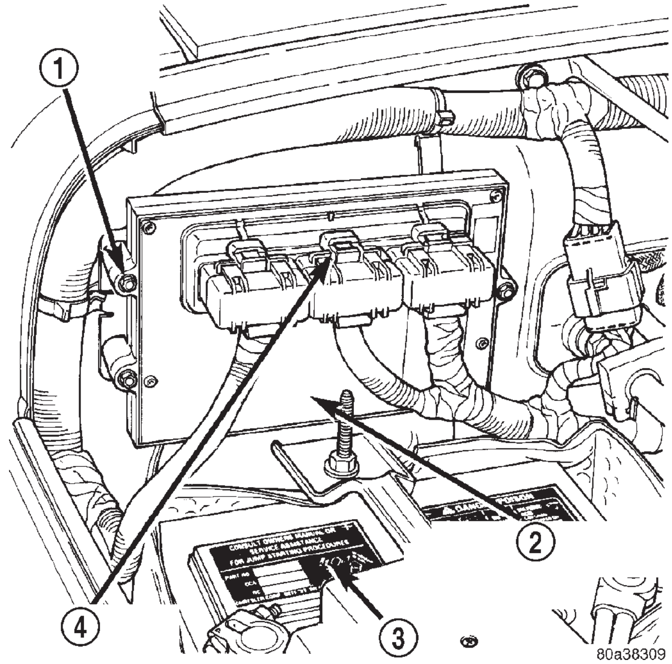

Fig. 4 PCM Location

1 - PCM MOUNTING BOLTS (3)
2 - POWERTRAIN CONTROL MODULE (PCM)
3 - BATTERY
4 - (3) 32–WAY CONNECTOR

(3) Carefully unplug three 32–way connectors (Fig. 4) from PCM.

(4) Remove three PCM mounting bolts and remove PCM from vehicle.

INSTALLATION

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.

(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.

SENTRY KEY IMMOBILIZER MODULE

DESCRIPTION

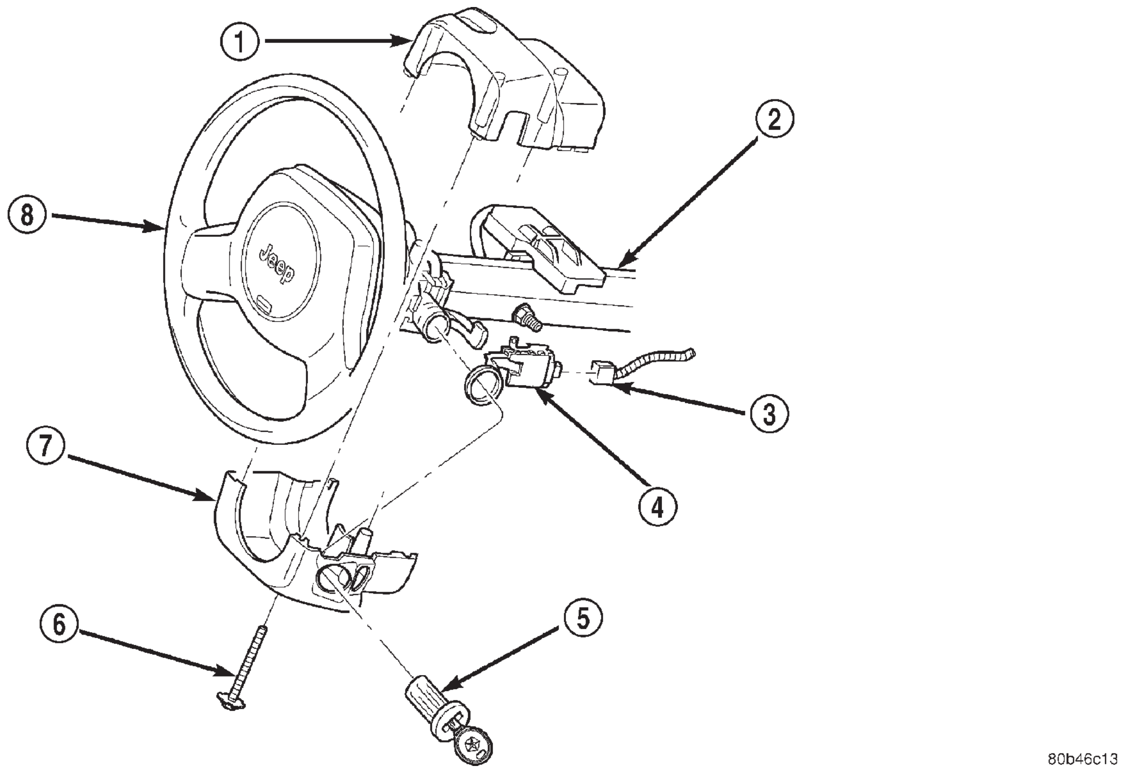

Fig. 5 Sentry Key Immobilizer Module - Typical

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

The Sentry Key Immobilizer Module (SKIM) is the primary component of the Sentry Key Immobilizer System (SKIS) (Fig. 5). The SKIM is located in the steering column, below the ignition lock cylinder housing. The SKIM has an integral halo-like antenna ring that extends from one end. When the SKIM is properly installed on the steering column, the antenna ring is oriented around the circumference of the ignition lock cylinder housing.

The SKIM cannot be adjusted or repaired. If faulty or damaged, the entire SKIM unit must be replaced.

OPERATION

The Sentry Key Immobilizer Module (SKIM) contains a Radio Frequency (RF) transceiver and a microprocessor. The SKIM transmits RF signals to, and receives RF signals from the Sentry Key transponder through a tuned antenna enclosed within the molded plastic antenna ring integral to the SKIM housing. If this antenna ring is not mounted properly around the ignition lock cylinder housing, communication problems between the SKIM and the transponder may arise. These communication problems will result in Sentry Key transponder-related faults. The SKIM also communicates over the Programmable Communications Interface (PCI) data bus with the Powertrain Control Module (PCM), the ElectroMechanical Instrument Cluster (EMIC) and/or the DRBIII® scan tool.

SENTRY KEY IMMOBILIZER MODULE (Continued)

The SKIM retains in memory the ID numbers of any Sentry Key transponder that is programmed into it. A maximum of eight Sentry Key transponders can be programmed into the SKIM. For added system security, each SKIM is programmed with a unique Secret Key code. This code is stored in memory, sent over the PCI data bus to the PCM, and is encoded to the transponder of every Sentry Key that is programmed into the SKIM. Therefore, the Secret Key code is a common element that is found in every component of the Sentry Key Immobilizer System (SKIS). Another security code, called a PIN, is used to gain access to the SKIM Secured Access Mode. The Secured Access Mode is required during service to perform the SKIS initialization and Sentry Key transponder programming procedures. The SKIM also stores the Vehicle Identification Number (VIN) in its memory, which it learns through a PCI data bus message from the PCM during SKIS initialization.

In the event that a SKIM replacement is required, the Secret Key code can be transferred to the new SKIM from the PCM using the DRBIII® scan tool and the SKIS initialization procedure. Proper completion of the SKIS initialization will allow the existing Sentry Keys to be programmed into the new SKIM so that new keys will not be required. In the event that the original Secret Key code cannot be recovered, SKIM replacement will also require new Sentry Keys. The DRBIII® scan tool will alert the technician during the SKIS initialization procedure if new Sentry Keys are required.

When the ignition switch is On, the SKIM transmits an RF signal to the transponder in the ignition key. The SKIM then waits for an RF signal response from the transponder. If the response received identifies the key as valid, the SKIM sends a valid key message to the PCM over the PCI data bus. If the response received identifies the key as invalid, or if no response is received from the key transponder, the SKIM sends an invalid key message to the PCM. The PCM will enable or disable engine operation based upon the status of the SKIM messages. It is important to note that the default condition in the PCM is an invalid key; therefore, if no message is received from the SKIM by the PCM, the engine will be disabled and the vehicle immobilized after two seconds of running.

The SKIM also sends SKIS indicator status messages to the EMIC. This indicator status message tells the EMIC to turn the indicator on for about three seconds each time the ignition switch is turned On, as a bulb test. The SKIM sends indicator status messages to the EMIC to turn the indicator off, turn the indicator on, or to flash the indicator on and off. If the SKIS indicator flashes upon ignition On or stays on solid after the bulb test, it signifies a SKIS fault. If the SKIM detects a system malfunction and/or the SKIS has become inoperative, the SKIS indicator will stay on solid. If the SKIM detects an invalid key or if a key transponder-related fault exists, the SKIS indicator will flash. If the vehicle is equipped with the Customer Learn transponder programming feature, the SKIM will also send messages to the EMIC to flash the SKIS indicator and to generate a single audible chime whenever the Customer Learn programming mode is being utilized. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - STANDARD PROCEDURE - SENTRY KEY TRANSPONDER PROGRAMMING).

The SKIS performs a self-test each time the ignition switch is turned to the On position, and will store fault information in the form of Diagnostic Trouble Codes (DTC's) in SKIM memory if a system malfunction is detected. The SKIM can be diagnosed, and any stored DTC's can be retrieved using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

REMOVAL

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.

SENTRY KEY IMMOBILIZER MODULE (Continued)

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the screws that secure the lower steering column shroud to the upper shroud (Fig. 6).

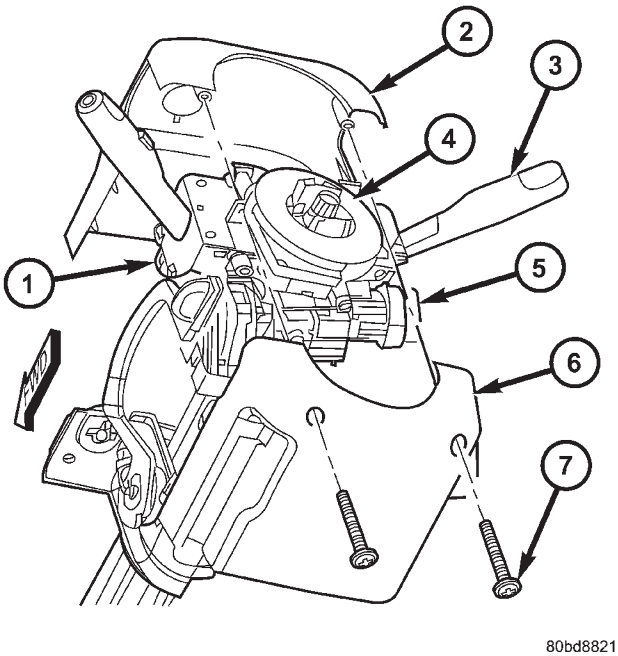

Fig. 6 Steering Column Shrouds Remove/Install

1 - LEFT MULTI-FUNCTION SWITCH
2 - UPPER SHROUD
3 - RIGHT MULTI-FUNCTION SWITCH
4 - CLOCKSPRING
5 - IGNITION LOCK CYLINDER HOUSING
6 - LOWER SHROUD
7 - SCREW (2)

(4) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully lowered position and leave the tilt release lever in the released (down) position.

(5) Remove the upper and lower shrouds from the steering column.

(6) On models equipped with a manual transmission, remove the screws that secure the multi-function switch assembly to the upper steering column housing.

(7) Disconnect the cross body wire harness connector for the SKIM from the SKIM connector (Fig. 7).

(8) The SKIM mounting bracket features a clip 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. On models with a manual transmission, lift the multi-function switch upward off of the upper steering column housing far enough to extract the SKIM antenna from between the ignition key release button and the right multi-function switch housing.

(10) Remove the SKIM from the steering column.

INSTALLATION

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.

(1) Position the Sentry Key Immobilizer Module (SKIM) (Fig. 7). On models with a manual transmission, lift the multi-function switch upward off of the upper steering column housing far enough to insert the SKIM antenna formation between the ignition key release button and the multi-function switch housing.

(2) Slide the SKIM antenna ring around the ignition switch lock cylinder housing, then rotate the SKIM and its mounting bracket upwards and toward the steering column.

(3) Align the SKIM mounting bracket clip with the inboard lower flange of the steering column and, push upward firmly on the connector end of the SKIM mounting bracket to engage the clip with the steering column.

(4) Reconnect the cross body wire harness connector for the SKIM to the SKIM connector.

SENTRY KEY IMMOBILIZER MODULE (Continued)

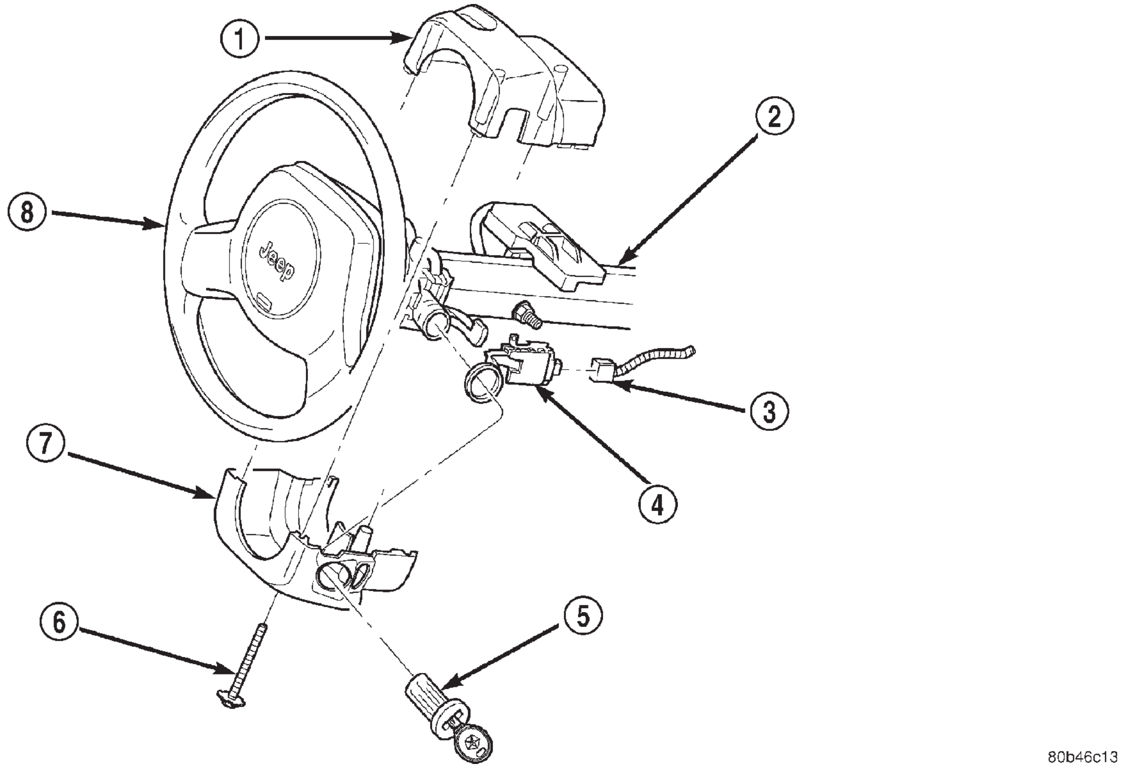

Fig. 7 Sentry Key Immobilizer Module - Typical

1 - UPPER SHROUD	5 - IGNITION LOCK CYLINDER
2 - STEERING COLUMN	6 - SCREW
3 - WIRE HARNESS CONNECTOR	7 - LOWER SHROUD
4 - SENTRY KEY IMMOBILIZER MODULE	8 - STEERING WHEEL

(5) On models equipped with a manual transmission, install and tighten the screws that secure the multi-function switch assembly to the upper steering column housing. Tighten the screws to 2 N·m (20 in. lbs.).

(6) Position both the upper and lower shrouds onto the steering column (Fig. 6).

(7) Install and tighten the screws that secure the lower steering column shroud to the upper shroud. Tighten the screws to 2 N·m (18 in. lbs.).

(8) Move the tilt steering column to the fully raised position and secure it in place by moving the tilt release lever back to the locked (up) position.

(9) Reinstall the steering column opening cover. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(10) Reconnect the battery negative cable.

NOTE: If the SKIM has been replaced with a new unit, the Sentry Key Immobilizer System (SKIS) MUST be initialized before the vehicle can be operated. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - STANDARD PROCEDURE - SKIS INITIALIZATION).

ENGINE SYSTEMS

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BATTERY SYSTEM

TABLE OF CONTENTS

BATTERY SYSTEM

DESCRIPTION

A single 12-volt battery system is standard factory-installed equipment on this model. All of the components of the battery system are located within the engine compartment of the vehicle. The service information for the battery system in this vehicle covers the following related components, which are covered in further detail elsewhere in this service manual:

- **Battery** - The storage battery provides a reliable means of storing a renewable source of electrical energy within the vehicle.
- **Battery Cable** - The battery cables connect the battery terminal posts to the vehicle electrical system.
- **Battery Holddown** - The battery holddown hardware secures the battery in the battery tray in the engine compartment.

BATTERY SYSTEM (Continued)

- **Battery Thermal Guard** - The battery thermal guard insulates the battery to protect it from engine compartment temperature extremes.
- **Battery Tray** - The battery tray provides a secure mounting location in the vehicle for the battery and an anchor point for the battery holddown hardware.

For battery system maintenance schedules and jump starting procedures, see the owner's manual in the vehicle glove box. Optionally, refer to Lubrication and Maintenance for the proper battery jump starting procedures. While battery charging can be considered a maintenance procedure, the battery charging procedures and related 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 system diagnosis or testing procedures can be performed. Refer to Standard Procedures for the proper battery charging procedures.

OPERATION

The battery system is designed to provide a safe, efficient, reliable and mobile means of delivering and storing electrical energy. This electrical energy is 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 system is also designed to provide a reserve of electrical energy to supplement the charging system for short durations while the engine is running and the electrical current demands of the vehicle exceed the output of the charging system. In addition to delivering, and storing electrical energy for the vehicle, the battery system serves as a capacitor and voltage stabilizer for the vehicle electrical system. It absorbs most abnormal or transient voltages caused by the switching of any of the electrical components or circuits in the vehicle.

DIAGNOSIS AND TESTING - BATTERY SYSTEM

The battery, starting, and charging systems in the vehicle operate with one another and must be tested as a complete system. In order for the engine to start and the battery to maintain its charge properly, all of the components that are used in these systems must perform within specifications. It is important that the battery, starting, and charging systems be thoroughly tested and inspected any time a battery needs to be charged or replaced. The cause of abnormal battery 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, and charging systems 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 for the proper charging system on-board diagnostic test procedures.

MICRO 420 ELECTRICAL SYSTEM TESTER

The Micro 420 automotive battery tester is designed to help the dealership technicians diagnose a defective battery. Follow the instruction manual supplied with the tester to properly diagnose a vehicle. If the instruction manual is not available refer to the standard procedure in this section, which includes the directions for using the Micro 420 electrical system tester.

BATTERY SYSTEM (Continued)

BATTERY SYSTEM DIAGNOSIS		
CONDITION	POSSIBLE CAUSES	CORRECTION
THE BATTERY SEEMS WEAK OR DEAD WHEN ATTEMPTING TO START THE ENGINE.	1. The electrical system ignition-off draw is excessive.	1. Refer to the IGNITION-OFF DRAW TEST Standard Procedure for the proper test procedures. Repair the excessive ignition-off draw, as required.
	2. The charging system is faulty.	2. Determine if the charging system is performing to specifications. Refer to Charging System for charging system diagnosis and testing procedures. Repair the faulty charging system, as required.
	3. The battery is discharged.	3. Determine the battery state-of-charge using the Micro 420 battery tester. Refer to the Standard Procedures in this section for additional test procedures. Charge the faulty battery, as required.
	4. The battery terminal connections are loose or corroded.	4. Refer to Battery Cables for the proper battery cable diagnosis and testing procedures. Clean and tighten the battery terminal connections, as required.
	5. The battery has an incorrect size or rating for this vehicle.	5. Refer to Battery System Specifications for the proper size and rating. Replace an incorrect battery, as required.
	6. The battery is faulty.	6. Determine the battery cranking capacity using the Micro 420 battery tester. Refer to the Standard Procedures in this section for additional test procedures. Replace the faulty battery, as required.
	7. The starting system is faulty.	7. Determine if the starting system is performing to specifications. Refer to Starting System for the proper starting system diagnosis and testing procedures. Repair the faulty starting system, as required.
	8. The battery is physically damaged.	8. Inspect the battery for loose terminal posts or a cracked and leaking case. Replace the damaged battery, as required.

BATTERY SYSTEM (Continued)

BATTERY SYSTEM 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.	1. Refer to Battery System Specifications for the proper specifications. Replace an incorrect battery, as required.
	2. The battery terminal connections are loose or corroded.	2. Refer to Battery Cable for the proper cable diagnosis and testing procedures. Clean and tighten the battery terminal connections, as required.
	3. The electrical system ignition-off draw is excessive.	3. Refer to the IGNITION-OFF DRAW TEST Standard Procedure for the proper test procedures. Repair the faulty electrical system, as required.
	4. The battery is faulty.	4. Test the battery using the Micro 420 battery tester. Refer to Standard Procedures for additional test procedures. Replace the faulty battery, as required.
	5. The starting system is faulty.	5. Determine if the starting system is performing to specifications. Refer to Starting System for the proper starting system diagnosis and testing procedures. Repair the faulty starting system, as required.
	6. The charging system is faulty.	6. Determine if the charging system is performing to specifications. Refer to Charging System for additional charging system diagnosis and testing procedures. Repair the faulty charging system, as required.
	7. Electrical loads exceed the output of the charging system.	7. Inspect the vehicle for aftermarket electrical equipment which might cause excessive electrical loads.
	8. Slow driving or prolonged idling with high-amperage draw systems in use.	8. Advise the vehicle operator, as required.
THE BATTERY WILL NOT ACCEPT A CHARGE.	1. The battery is faulty.	1. Test the battery using the Micro 420 battery tester. Charge or replace the faulty battery, as required.

ABNORMAL BATTERY DISCHARGING

Any of the following conditions can result in abnormal battery discharging:

- A faulty or incorrect charging system component. Refer to Charging System for charging system diagnosis and testing procedures.
- A faulty or incorrect battery. Use Micro 420 battery tester and refer to Battery System for additional battery diagnosis and testing procedures.
- A faulty circuit or component causing excessive ignition-off draw.
- Electrical loads that exceed the output of the charging system. This can be due to equipment installed after manufacture, or repeated short trip use.
- A faulty or incorrect starting system component. Refer to Starting System for the proper starting system diagnosis and testing procedures.
- Corroded or loose battery posts and/or terminal clamps.
- Slow driving speeds (heavy traffic conditions) or prolonged idling, with high-amperage draw systems in use.

BATTERY SYSTEM (Continued)

CLEANING

The following information details the recommended cleaning 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.

(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. 1).

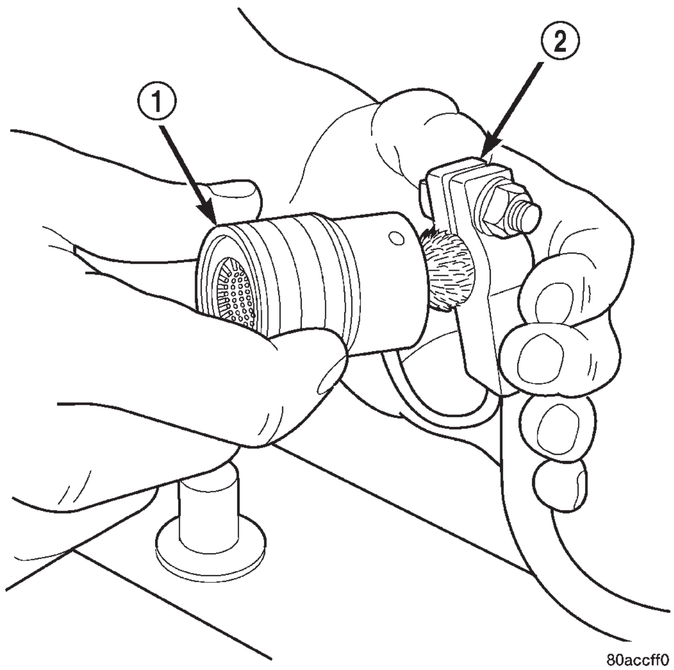


Fig. 1 Clean Battery Cable Terminal Clamp - Typical

1 - TERMINAL BRUSH
2 - BATTERY CABLE

(2) Clean the battery tray and battery holddown 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. 2). 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 System Specifications for the factory-installed battery specifications. Confirm that the replacement battery is the correct size and has the correct ratings for the vehicle.

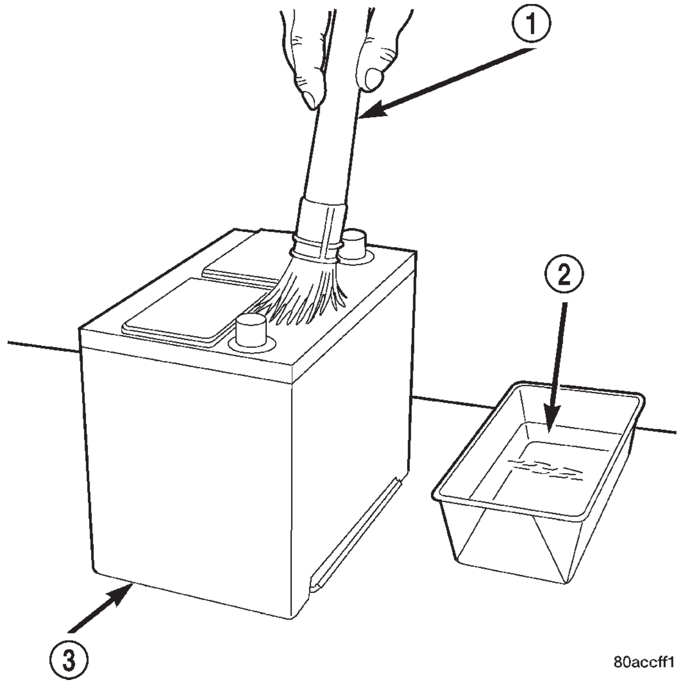


Fig. 2 Clean Battery - Typical

1 - CLEANING BRUSH
2 - WARM WATER AND BAKING SODA SOLUTION
3 - BATTERY

(4) Clean the battery thermal guard with a sodium bicarbonate (baking soda) and warm water cleaning solution using a stiff bristle parts cleaning brush to remove any acid film.

(5) Clean any corrosion from the battery terminal posts with a wire brush or a post and terminal cleaner, and a sodium bicarbonate (baking soda) and warm water cleaning solution (Fig. 3).

INSPECTION

The following information details the recommended 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.

(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 holddown hardware for damage. Replace any damaged parts.

(3) Slide the thermal guard 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.

BATTERY SYSTEM (Continued)

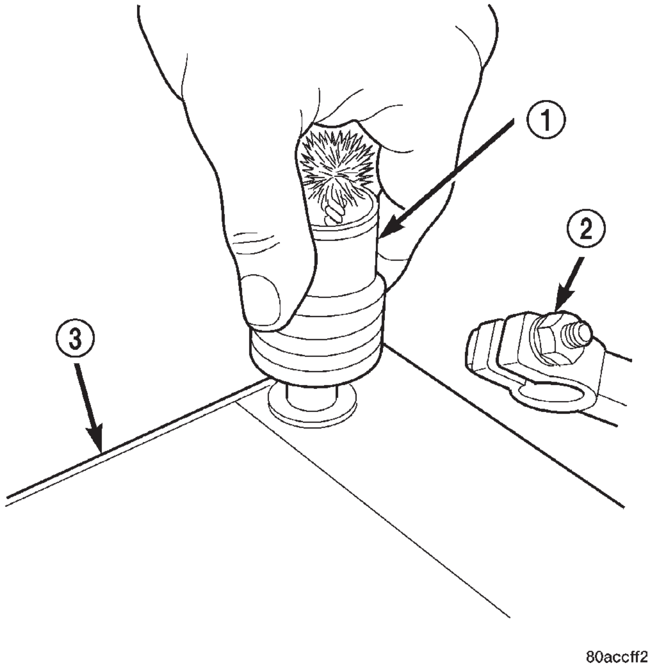


Fig. 3 Clean Battery Terminal Post - Typical

1 - TERMINAL BRUSH
2 - BATTERY CABLE
3 - BATTERY

(4) Inspect the battery thermal guard for tears, cracks, deformation or other damage. Replace any battery thermal guard that has been damaged.

(5) 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 Standard Procedures for the proper battery built-in indicator test procedures. Also refer to Standard Procedures for the proper battery charging procedures.

SPECIFICATIONS

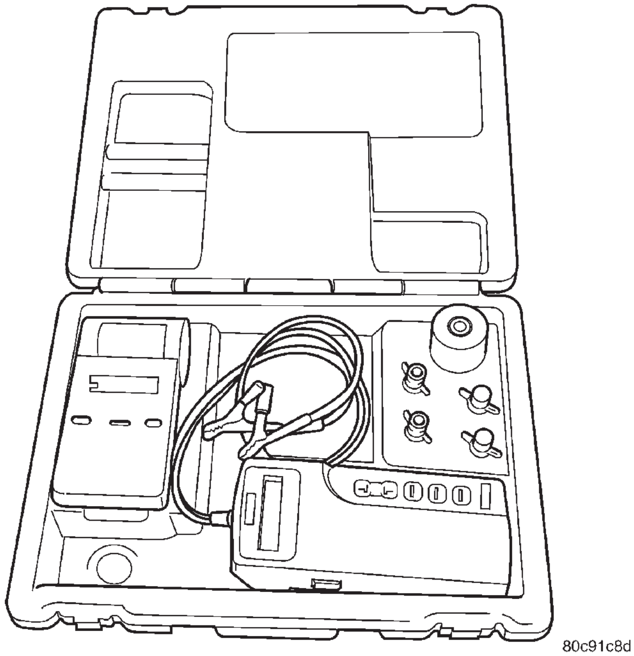
The battery Group Size number, the Cold Cranking Amperage (CCA) rating, and the Reserve Capacity (RC) rating or Ampere-Hours (AH) rating can be found on the original equipment battery label. Be certain that a replacement battery has the correct Group Size number, as well as CCA, and RC or AH ratings that equal or exceed the original equipment specification for the vehicle being serviced. 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.

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

BATTERY SYSTEM (Continued)

SPECIAL TOOLS



MICRO 420 BATTERY TESTER

BATTERY

DESCRIPTION

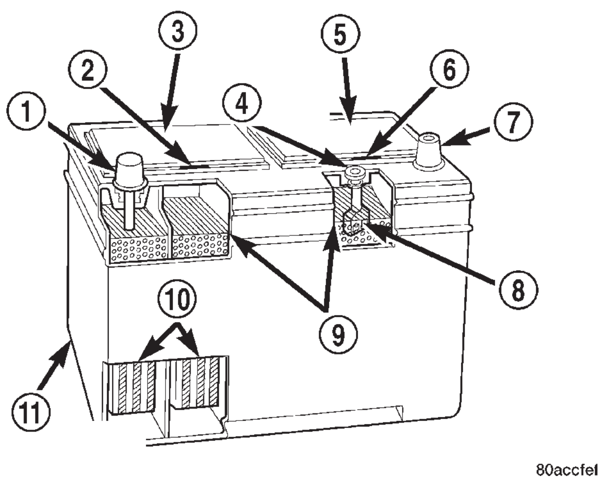


Fig. 4 Low-Maintenance Battery - Typical

1 - POSITIVE POST
2 - VENT
3 - CELL CAP
4 - VENT
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. 4) is standard factory-installed equipment on this model. Refer to Battery Specifications for the proper specifications of the factory-installed batteries available 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 physically larger in diameter than the negative terminal post to ensure proper battery connection. 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 identification confirmation (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/ CABLES - DESCRIPTION).

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 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. Refer to Standard Procedures for the proper built-in indicator test 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 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING).

BATTERY (Continued)

OPERATION

The battery is designed to store electrical energy in a chemical form. 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 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.

DIAGNOSIS AND TESTING - BATTERY

The battery must be completely charged and the terminals should be properly cleaned and inspected before diagnostic procedures are performed. Refer to Battery System Cleaning for the proper cleaning procedures, and Battery System Inspection for the proper battery inspection procedures. Refer to Standard Procedures for the proper battery charging procedures.

MICRO 420 ELECTRICAL SYSTEM TESTER

The Micro 420 automotive battery tester is designed to help the dealership technicians diagnose the cause of a defective battery. Follow the instruction manual supplied with the tester to properly diagnose a vehicle. If the instruction manual is not available refer to the standard procedure in this section, which includes the directions for using the Micro 420 electrical system tester.

WARNING: IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING OR LOOSE POSTS, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

WARNING: 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.

WARNING: 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.

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 Standard Procedures for the proper battery charging procedures.

STANDARD PROCEDURE

STANDARD PROCEDURE - 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.

BATTERY (Continued)

• 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: NEVER EXCEED TWENTY AMPERES WHEN CHARGING A COLD (-1° C [30° F] OR LOWER) BATTERY. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

WARNING: IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, 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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WARNING: IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.

CAUTION: Always disconnect and isolate the battery negative cable before charging a battery. Do not exceed sixteen volts while charging a battery. Damage to the vehicle electrical system components may result.

CAUTION: 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.

CAUTION: 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.

After the battery has been charged to 12.4 volts or greater, perform a load test to determine the battery cranking capacity (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - STANDARD PROCEDURE). 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 8 - ELECTRICAL/BATTERY SYSTEM - CLEANING), and (Refer to 8 - ELECTRICAL/BATTERY SYSTEM - INSPECTION).

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. 5). 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.

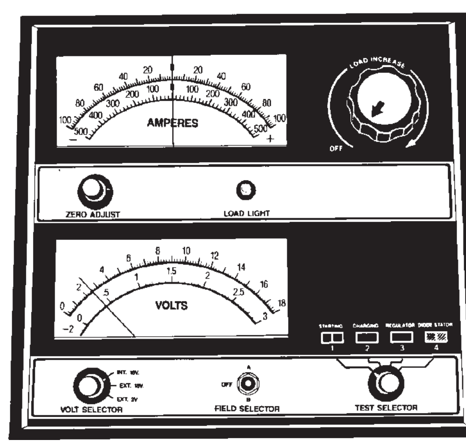

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Fig. 5 Voltmeter - Typical

(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

BATTERY (Continued)

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 Table. 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 TABLE	
Voltage	Hours
16.0 volts maximum	up to 4 hours
14.0 to 15.9 volts	up to 8 hours
13.9 volts or less	up to 16 hours

CHARGING TIME REQUIRED

The time required to charge a battery will vary, depending upon the following factors:

- **Battery Capacity** - A completely discharged heavy-duty battery requires twice the charging time of a small capacity battery.
- **Temperature** - A longer time will be needed to charge a battery at -18° C (0° F) than at 27° C (80° F). When a fast 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.

The Battery Charging Time Table gives an indication of the time required to charge a typical battery at room temperature based upon the battery state-of-charge and the charger capacity.

BATTERY CHARGING TIME TABLE			
Charging Amperage	5 Amps	10 Amps	20 Amps
Open Circuit Voltage	Hours Charging @ 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

STANDARD PROCEDURE - BUILT-IN INDICATOR TEST

An indicator (hydrometer) built into the top of the battery case provides visual information for battery testing (Fig. 6). Like a hydrometer, the built-in indicator measures the specific gravity of the battery electrolyte. The specific gravity of the electrolyte 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 Standard Procedures for the proper battery load test procedures.

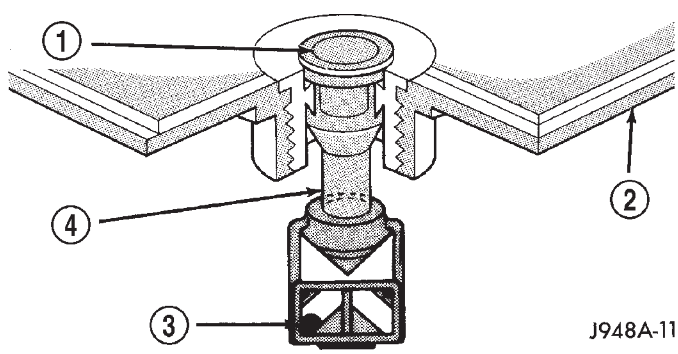

Fig. 6 Built-In Indicator

1 - SIGHT GLASS
2 - BATTERY TOP
3 - GREEN BALL
4 - PLASTIC ROD

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 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.**

BATTERY (Continued)

To read the built-in indicator, look into the sight glass and note the color of the indication (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 Standard Procedures for the proper battery load test 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 Standard Procedures for the proper battery charging procedures. Also refer to Diagnosis and Testing for more information on 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 built-in 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 Standard Procedures for the proper battery filling procedures. A low electrolyte level may be caused by an overcharging condition. Refer to Charging System for the proper charging system diagnosis and testing procedures.

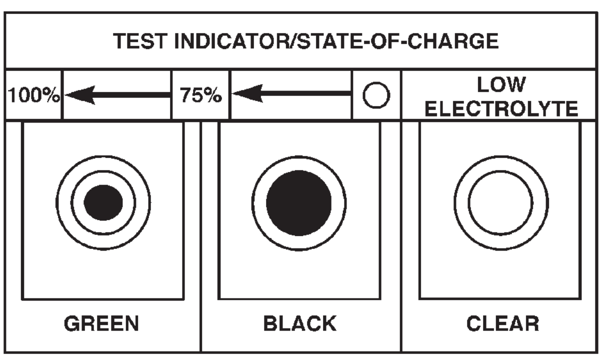

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Fig. 7 Built-In Indicator Sight Glass Chart

STANDARD PROCEDURE - OPEN-CIRCUIT VOLTAGE TEST

A battery open-circuit voltage (no load) test will show the approximate 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.

Before proceeding with this test, completely charge the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - STANDARD PROCEDURE).

(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. 8).

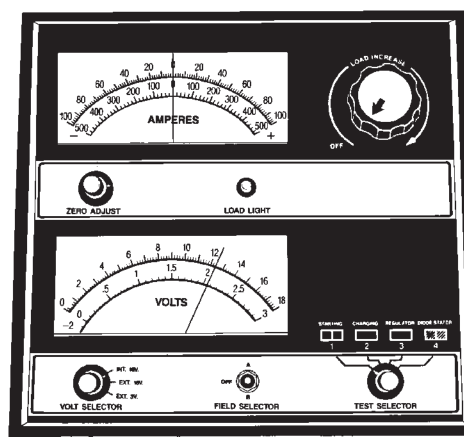

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Fig. 8 Testing Open-Circuit Voltage - Typical

See the Open-Circuit Voltage Table. 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 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - STANDARD PROCEDURE).

OPEN CIRCUIT VOLTAGE TABLE	
Open Circuit Voltage	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%

BATTERY (Continued)

STANDARD PROCEDURE - 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 thirty-five milliamperes (0.005 to 0.035 ampere) with the ignition switch in the Off position, and all non-ignition controlled circuits in proper working order. Up to thirty-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 thirty-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.

(2) Determine that the underhood 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 Junction Block (JB), one at a time until the amperage reading becomes very low, or nonexistent. Refer to the appropriate wiring information in this service manual for complete PDC and JB fuse, circuit breaker, and circuit identification. 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 for 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 thirty-five milliamperes (0.035 ampere). If the current draw exceeds thirty-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.

STANDARD PROCEDURE - USING MICRO 420 ELECTRICAL TESTER

Always use the Micro 420 Instruction Manual that was supplied with the tester as a reference. If the Instruction Manual is not available the following procedure can be used:

WARNING: ALWAYS WEAR APPROPRIATE EYE PROTECTION AND USE EXTREME CAUTION WHEN WORKING WITH BATTERIES.

BATTERY (Continued)

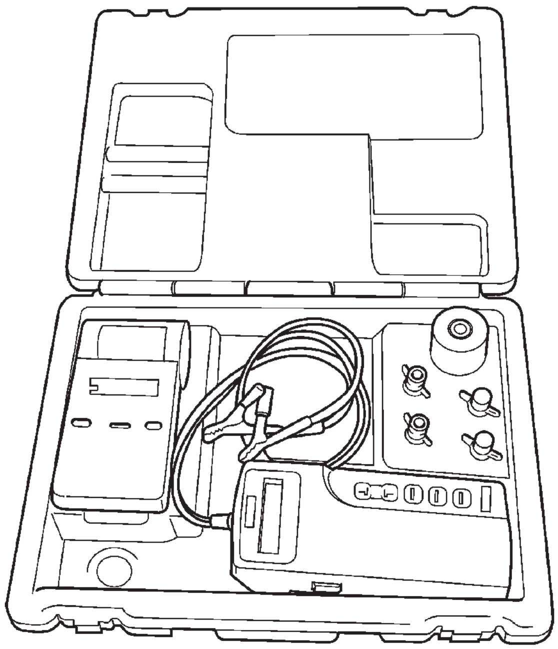


Fig. 9 MICRO 420 BATTERY TESTER

BATTERY TESTING

(1) If testing the battery OUT-OF-VEHICLE, clean the battery terminals with a wire brush before testing. If the battery is equipped with side post terminals, install and tighten the supplied lead terminal stud adapters. Do not use steel bolts. Failure to properly install the stud adapters, or using stud adapters that are dirty or worn-out may result in false test readings.

(2) If testing the battery IN-THE-VEHICLE, make certain all of the vehicle accessory loads are OFF, including the ignition. **The preferred test position is at the battery terminal**. If the battery is not accessible, you may test using both the positive and negative jumper posts. Select TESTING AT JUMPER POST when connecting to that location.

(3) Connect the tester (Fig. 9) to the battery or jumper posts, the red clamp to positive (+) and the black clamp to negative (–).

NOTE: Multiple batteries connected in parallel must have the ground cable disconnected to perform a battery test. Failure to disconnect may result in false battery test readings.

(4) Using the ARROW key select **in** or **out** of vehicle testing and press ENTER to make a selection.

(5) If not selected, choose the Cold Cranking Amp (CCA) battery rating. Or select the appropriate battery rating for your area (see menu). The tester will then run its self programmed test of the battery and display the results. Refer to the test result table noted below.

CAUTION: If REPLACE BATTERY is the result of the test, this may mean a poor connection between the vehicle's cables and battery exists. After disconnecting the vehicle's battery cables from the battery, retest the battery using the OUT-OF-VEHICLE test before replacing.

(6) While viewing the battery test result, press the CODE button and the tester will prompt you for the last 4 digits of the VIN. Use the UP/DOWN arrow buttons to scroll to the correct character; then press ENTER to select and move to the next digit. Then press the ENTER button to view the SERVICE CODE. Pressing the CODE button a second time will return you to the test results.

BATTERY TEST RESULTS	
GOOD BATTERY	Return to service
GOOD - RECHARGE	Fully charge battery and return to service
CHARGE & RETEST	Fully charge battery and retest battery
REPLACE BATTERY	Replace the battery and retest complete system
BAD-CELL REPLACE	Replace the battery and retest complete system

NOTE: The SERVICE CODE is required on every warranty claim submitted for battery replacement.

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. 10).

(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 holddowns from the battery. Refer to Battery Holddown for the proper battery holddown removal procedures.

BATTERY (Continued)

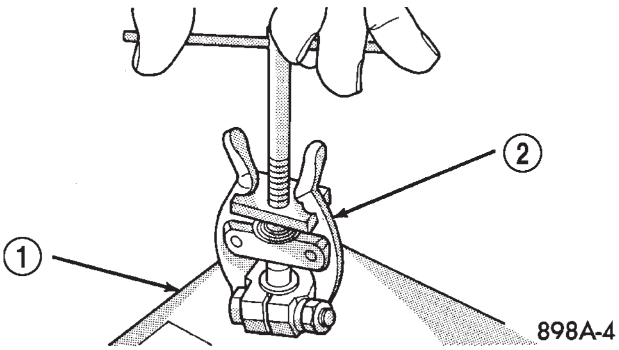


Fig. 10 Remove Battery Cable Terminal Clamp - Typical

1 - BATTERY
2 - BATTERY TERMINAL PULLER

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 thermal guard from the battery tray as a unit.

(8) Remove the battery thermal guard from the battery case. Refer to Thermal Guard for the proper battery thermal guard removal procedures.

INSTALLATION

(1) Clean and inspect all of the battery system components. Refer to Battery System Cleaning for the proper cleaning procedures, and refer to Battery System Inspection for the proper inspection procedures.

(2) Reinstall the battery thermal guard onto the battery case. Refer to Thermal Guard for the proper battery thermal guard installation procedures.

(3) Position the battery and the battery thermal guard 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. 11).

(4) Reinstall the battery holddowns onto the battery. Refer to Battery Holddown for the proper installation procedure.

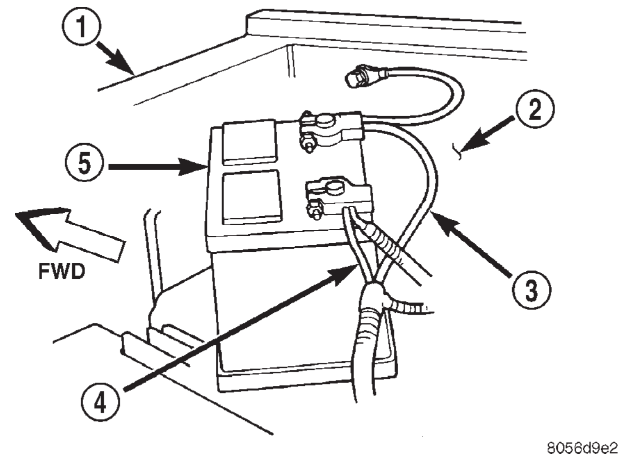


Fig. 11 Battery Cables - Typical

1 - RADIATOR CROSSMEMBER
2 - WHEELHOUSE INNER PANEL
3 - NEGATIVE CABLE
4 - POSITIVE CABLE
5 - BATTERY

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 System Cleaning for cleaning procedure.

(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 HOLDDOWN

DESCRIPTION

The battery hold down hardware (Fig. 12) 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.

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

BATTERY HOLDDOWN (Continued)

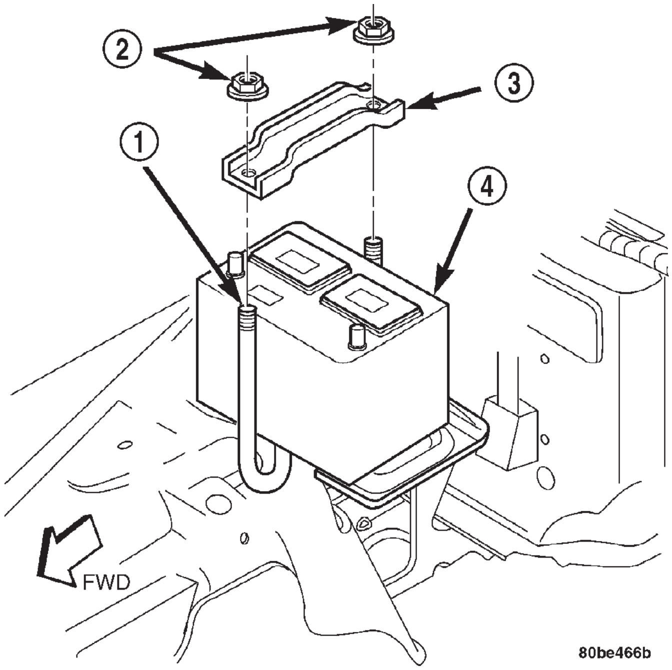


Fig. 12 Battery Hold Downs

1 - J-BOLT (2)
2 - NUT (2)
3 - BRACKET
4 - BATTERY

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.

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 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY HOLDDOWN - INSTALLATION) the proper hold down fastener tightness specifications.

OPERATION

The battery holddown secures the battery in the battery tray. This holddown is designed to prevent battery movement during the most extreme vehicle operation conditions. Periodic removal and lubrication of the battery holddown hardware is recommended to prevent hardware seizure at a later date.

CAUTION: Never operate a vehicle without a battery holddown device properly installed. Damage to the vehicle, components and battery could result.

REMOVAL

All of the battery hold down hardware can be serviced without removal of the battery or the battery tray.

(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. 13) .

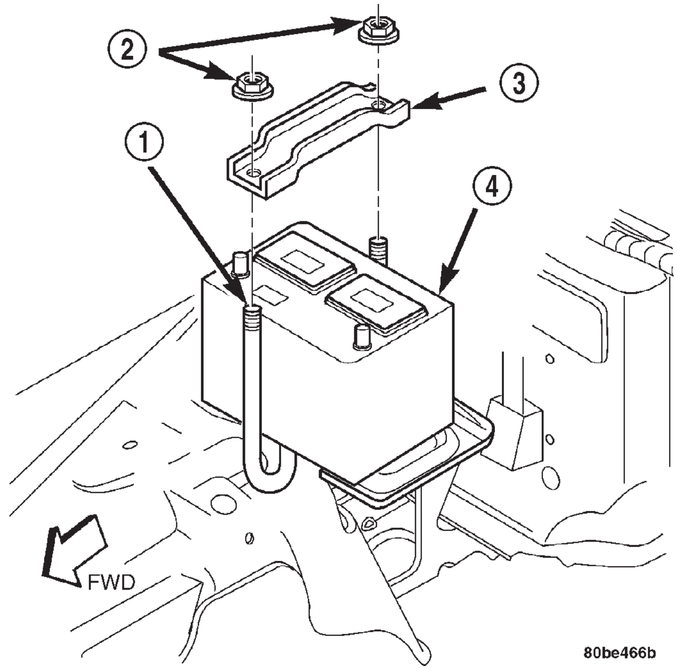


Fig. 13 Battery Hold Downs Remove/Install

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.

BATTERY HOLDDOWN (Continued)

INSTALLATION

All of the battery hold down hardware can be serviced without removal of the battery or the battery tray.

(1) Clean and inspect the battery hold down hardware. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM - CLEANING).

(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.

(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 CABLES

DESCRIPTION

The battery cables 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. The battery cables feature a clamping type female battery terminal made of soft lead that 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 feature 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 the appropriate wiring information in this service manual for the location of the proper battery cable wire harness diagrams. The wiring information also includes proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

OPERATION

The battery cables connect the battery terminal posts to the vehicle electrical system. These cables also provide a path back to the battery 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 opposite ends of the battery cable wires from the female battery terminal clamps provide secure and reliable connection of the battery cables to the vehicle electrical system.

The battery positive cable terminal clamp is die cast onto the ends of two wires. One wire has an eyelet terminal that connects the battery positive cable to the B(+) terminal stud of the Power 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 cylinder 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 front fender inner shield, near the battery.

DIAGNOSIS AND TESTING - BATTERY CABLES

A voltage drop test will determine if there is excessive resistance in the battery cable terminal connections or the battery cable. 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

BATTERY CABLES (Continued)

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.

VOLTAGE DROP TEST

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 Standard Procedures for the proper battery charging and 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 Shut Down (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.

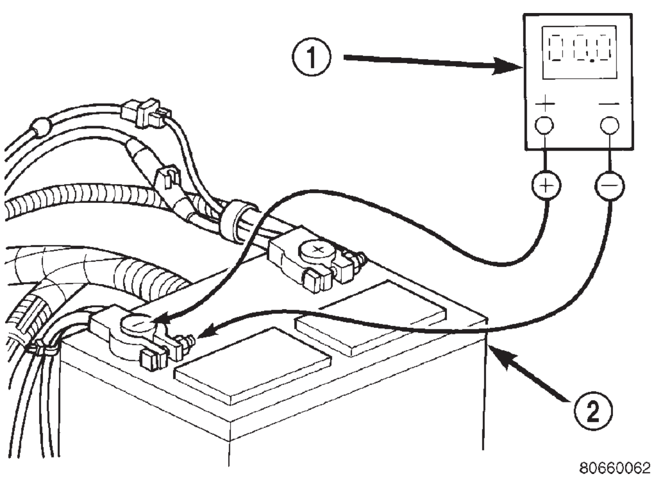


Fig. 14 TEST BATTERY NEGATIVE CONNECTION RESISTANCE - TYPICAL

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.

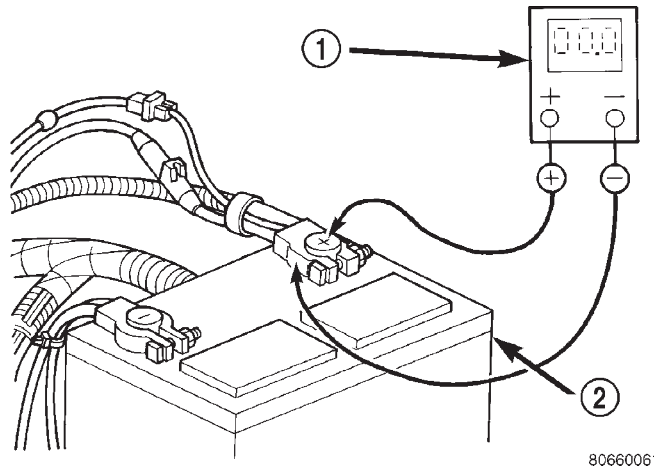


Fig. 15 TEST BATTERY POSITIVE CONNECTION RESISTANCE - TYPICAL

1 - VOLTMETER
2 - BATTERY

(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.

(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.

REMOVAL

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.

(1) Turn the ignition switch to the Off position. Be certain that all electrical accessories are turned off.

BATTERY CABLES (Continued)

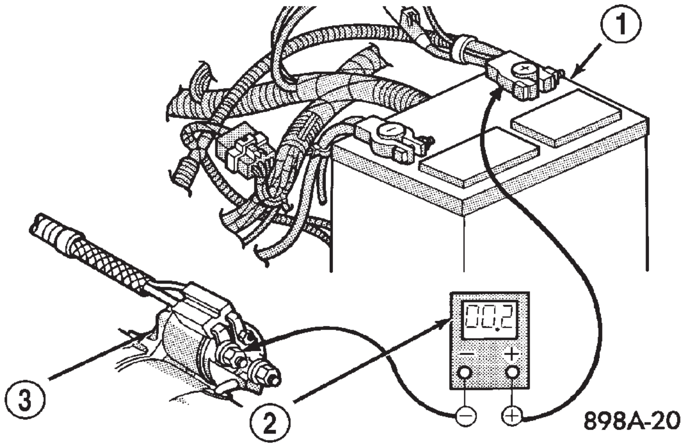


Fig. 16 TEST BATTERY POSITIVE CABLE RESISTANCE - TYPICAL

1 - BATTERY
2 - VOLTMETER
3 - STARTER MOTOR

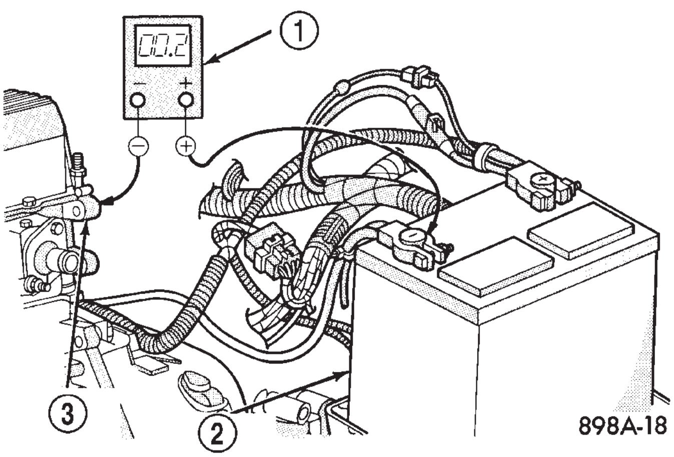


Fig. 17 TEST GROUND CIRCUIT RESISTANCE - TYPICAL

1 - VOLTMETER
2 - BATTERY
3 - ENGINE GROUND

(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

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.

(1) Clean and inspect the battery cable terminal clamps and the battery terminal posts (Refer to 8 - ELECTRICAL/BATTERY SYSTEM - CLEANING), and (Refer to 8 - ELECTRICAL/BATTERY SYSTEM - INSPECTION).

(2) Position the battery wire harness into the engine compartment.

(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.

BATTERY CABLES (Continued)

(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 TRAY

DESCRIPTION

The battery is mounted in a stamped steel tray (Fig. 18) 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.

A hole in the bottom of the battery tray is fitted with a battery temperature sensor (Refer to 8 - ELECTRICAL/CHARGING/BATTERY TEMPERATURE SENSOR - DESCRIPTION).

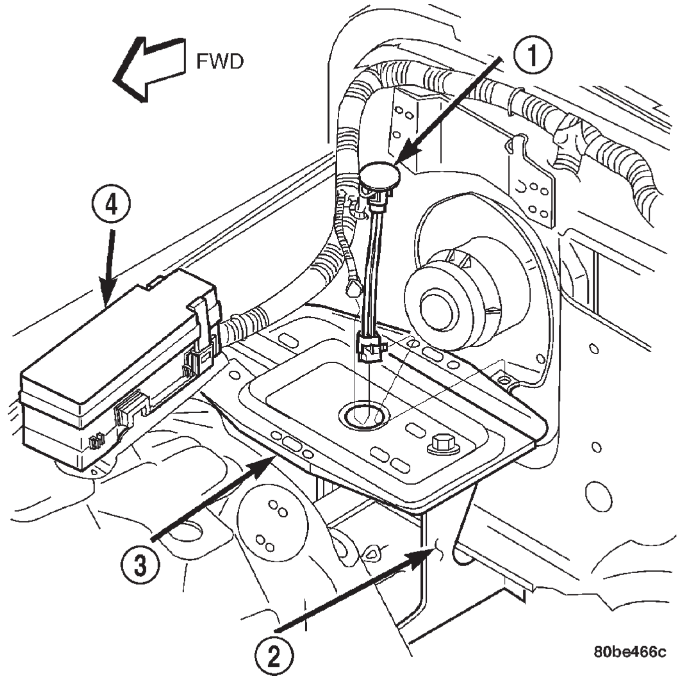


Fig. 18 Battery Tray

1 - BATTERY TEMPERATURE SENSOR
2 - REINFORCEMENT
3 - BATTERY TRAY
4 - POWER DISTRIBUTION CENTER

OPERATION

The battery tray provides a secure mounting location and supports the battery. On some vehicles, the battery tray also provides the anchor point/s for the battery holddown hardware. The battery tray and the battery holddown 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 could result in damage to the vehicle, the battery, or both.

REMOVAL

(1) Remove the battery from the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - REMOVAL).

(2) Remove the battery temperature sensor from the battery tray (Refer to 8 - ELECTRICAL/CHARGING/BATTERY TEMPERATURE SENSOR - REMOVAL).

(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. 19).

(4) Remove the battery tray from the reinforcement in the engine compartment.

BATTERY TRAY (Continued)

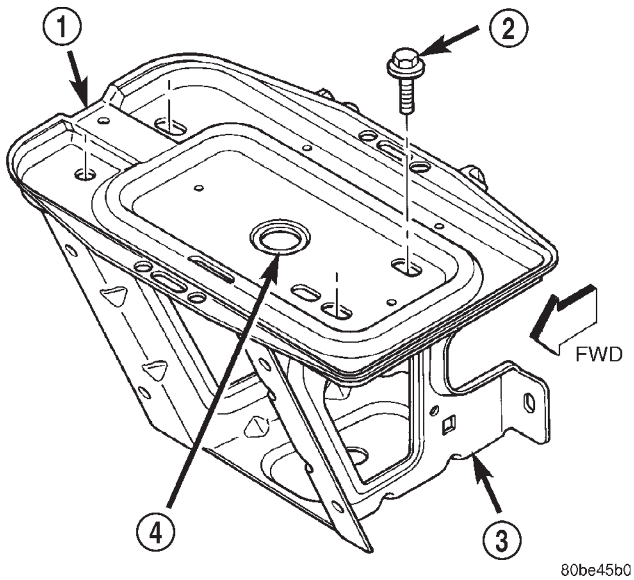


Fig. 19 Battery Tray Remove/Install

1 - BATTERY TRAY
2 - SCREW (4)
3 - REINFORCEMENT
4 - BATTERY TEMPERATURE SENSOR MOUNTING HOLE

INSTALLATION

(1) Clean and inspect the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM - CLEANING), and (Refer to 8 - ELECTRICAL/BATTERY SYSTEM - INSPECTION).

(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 8 - ELECTRICAL/CHARGING/ BATTERY TEMPERATURE SENSOR - INSTALLATION).

(5) Install the battery onto the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - INSTALLATION).

THERMAL GUARD

DESCRIPTION

A flexible plastic bubble-wrap style thermal guard (Fig. 20) slides over the battery case to enclose the sides of the battery. The thermal guard 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.

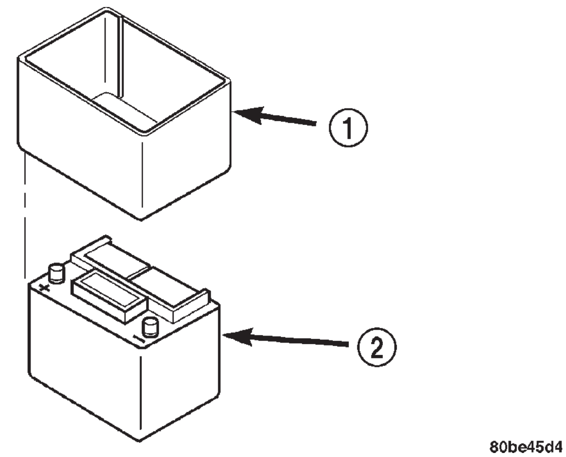


Fig. 20 Battery Thermal guard

1 - THERMAL GUARD
2 - BATTERY

OPERATION

The thermal guard protects the battery from engine compartment temperature extremes. The temperature of the battery can affect battery performance. The air trapped between the plastic plies of the thermal guard create a dead air space, which helps to insulate the sides of the battery case from the air temperature found in the surrounding engine compartment.

REMOVAL

(1) Remove the battery and the battery thermal guard from the battery tray as a unit (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - REMOVAL).

(2) Carefully and evenly slide the battery thermal guard up off of the battery case.

INSTALLATION

(1) Clean and inspect the battery thermal guard. Refer to Battery System Cleaning for the proper cleaning procedures, and refer to Battery System Inspection for the proper inspection procedures.

(2) Carefully and evenly slide the battery thermal guard down over the battery case.

(3) Install the battery and the battery thermal guard into the battery tray as a unit. Refer to Battery Installation for the proper battery installation procedures.

CHARGING

TABLE OF CONTENTS

CHARGING

DESCRIPTION

The charging system consists of:

- Generator
- Electronic Voltage Regulator (EVR) circuitry within the Powertrain Control Module (PCM)
- Ignition switch
- Battery (refer to 8, Battery for information)
- Battery temperature sensor
- Generator Lamp (if equipped)
- Check Gauges Lamp (if equipped)
- Voltmeter (refer to 8, Instrument Cluster for information)
- Wiring harness and connections (refer to 8, 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 Diagnostic Trouble Codes in; Powertrain Control Module; Electronic Control Modules 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 8, Instrument Cluster for additional information.

DIAGNOSIS AND TESTING - CHARGING SYSTEM

The following procedures may be used to diagnose the charging system if:

- the check gauges 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

CHARGING (Continued)

• a faulty or improperly adjusted switch that allows a lamp to stay on. Refer to Ignition-Off Draw Test in 8, Battery for more information.

INSPECTION

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 charging system circuits are checked continuously, and some are checked only under certain conditions.

Refer to Diagnostic Trouble Codes in; Powertrain Control Module; Electronic Control Modules for more DTC information. This will include a complete list of DTC's including DTC's for the charging system.

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 8, Battery for procedures.

(2) Inspect condition of battery cable terminals, battery posts, connections at engine block, starter solenoid and relay. They should be clean and tight. Repair as required.

(3) Inspect all fuses in both the fuseblock and Power Distribution Center (PDC) for tightness in receptacles. They should be properly installed and tight. Repair or replace as required.

(4) Inspect generator mounting bolts for tightness. Replace or tighten bolts if required. Refer to the Generator Removal/Installation section of this group for torque specifications.

(5) Inspect generator drive belt condition and tension. Tighten or replace belt as required. Refer to Belt Tension Specifications in 7, Cooling System.

(6) Inspect automatic belt tensioner (if equipped). Refer to 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.

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

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Generator Mounting Bolt (2.5L/4.0L)	55	41	-
Generator Pivot Bolt/Nut (2.5L/4.0L)	55	41	-
B+ Nut at Rear of Generator	10	-	90

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 degrees F.

REMOVAL

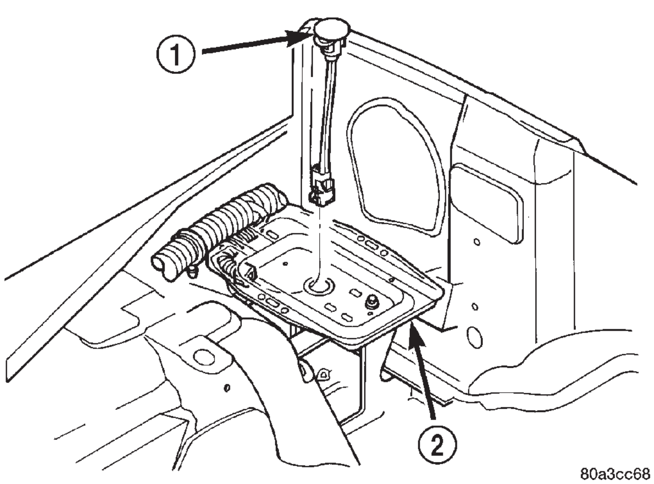


Fig. 1 Battery Temperature Sensor Remove/Install

1 - BATTERY TEMPERATURE SENSOR
2 - BATTERY TRAY

The battery temperature sensor is located under the vehicle battery (Fig. 1) and is attached to a mounting hole on battery tray.

(1) Remove battery. Refer to 8, Battery for procedures.

(2) Disconnect sensor pigtail harness from engine wire harness.

(3) Pry sensor straight up from battery tray mounting hole.

INSTALLATION

The battery temperature sensor is located under the vehicle battery and is attached to a mounting hole on battery tray.

(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 8, Battery for procedures.

GENERATOR

DESCRIPTION

The generator is belt-driven by the engine using a serpentine type drive belt. It is serviced only as a complete assembly. If the generator fails for any reason, the entire assembly must be replaced.

OPERATION

As the energized rotor begins to rotate within the generator, the spinning magnetic field induces a current into the windings of the stator coil. Once the generator begins producing sufficient current, it also provides the current needed to energize the rotor.

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.

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.

GENERATOR (Continued)

(2) Remove generator drive belt. Refer to 7, Cooling System for procedure.

(3) Remove generator pivot and mounting bolts/nut (Fig. 2) or (Fig. 3). 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. 4) or (Fig. 5). Disconnect terminal from generator.

(6) Disconnect field wire connector at rear of generator by pushing on connector tab.

(7) Remove generator from vehicle.

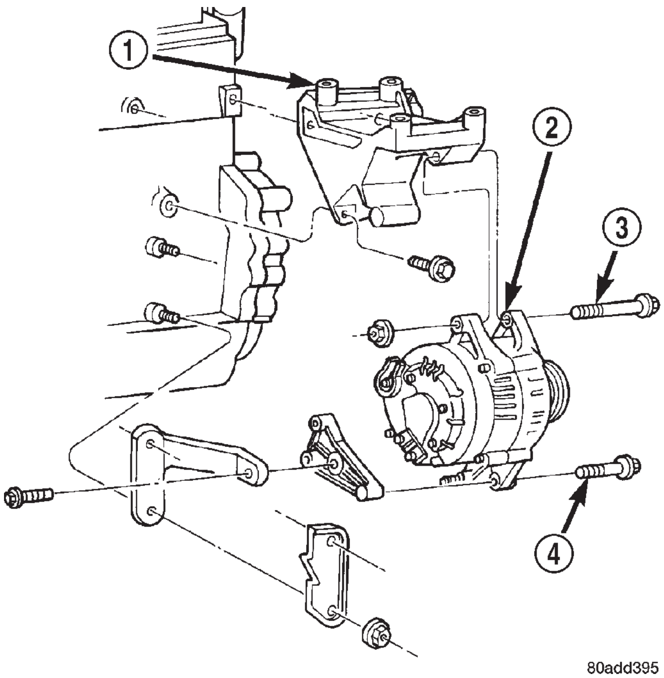


Fig. 2 Generator Remove/Install 2.5L Engine

1 - UPPER MOUNTING BRACKET
2 - GENERATOR
3 - UPPER BOLT
4 - LOWER BOLT

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.

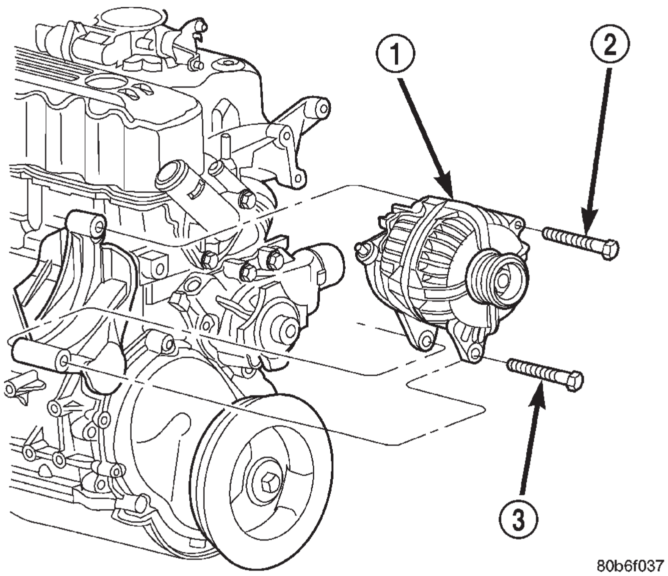


Fig. 3 Generator Remove/Install 4.0L Engine

1 - GENERATOR
2 - UPPER BOLT
3 - LOWER BOLT

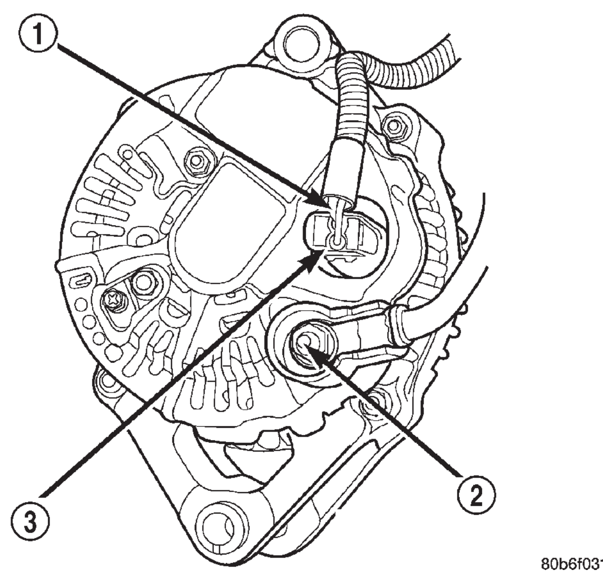


Fig. 4 Generator Connectors 2.5L Engine (Typical Denso)

1 - FIELD WIRES
2 - B+ (OUTPUT TERMINAL)
3 - FIELD WIRE CONNECTOR

CAUTION: Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

GENERATOR (Continued)

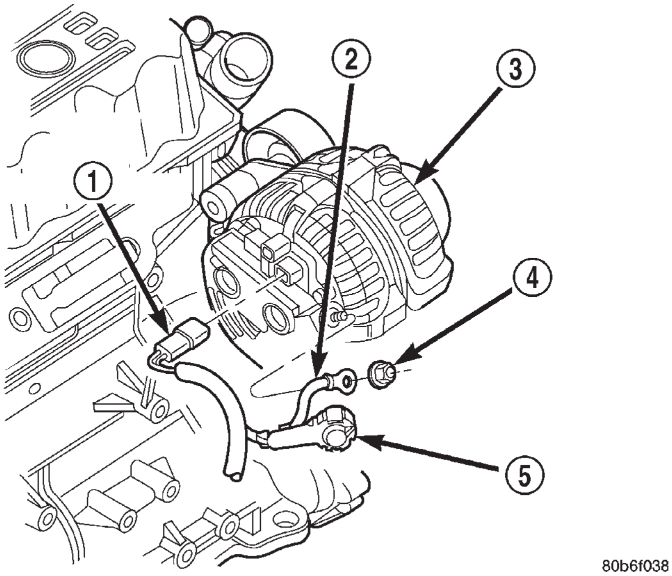


Fig. 5 Generator Connectors 4.0L Engine

1 - FIELD WIRE CONNECTOR
2 - B+ CABLE
3 - GENERATOR
4 - B+ CABLE MOUNTING NUT
5 - CABLE PROTECTOR

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 7, Cooling System.

(5) Install generator drive belt. Refer to 7, Cooling System for procedure.

(6) Install negative battery cable to battery.

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.

STARTING

TABLE OF CONTENTS

STARTING

DESCRIPTION

The starting system consists of:

- Starter relay
- Starter motor (including an integral starter solenoid)

Other components to be considered as part of starting system are:

- Battery
- Battery cables
- Ignition switch and key lock cylinder
- Clutch pedal position switch (manual transmission)
- Park/neutral position switch (automatic transmission)
- Wire harnesses and connections.

The Battery, Starting, and Charging systems operate in conjunction with one another, and must be tested as a complete system. For correct operation of starting/ charging systems, all components used in these 3 systems must perform within specifications. When attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used in each of these groups include the most basic conventional diagnostic methods, to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of an induction-type milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

Certain starting system components are monitored by the PCM and may produce a Diagnostic Trouble Code (DTC). Refer to Emission Control. See Diagnostic Trouble Codes for additional information and a list of codes.

OPERATION

The starting system components form two separate circuits. A high-amperage feed circuit that feeds the starter motor between 150 and 350 amperes (700 amperes - diesel engine), and a low-amperage control circuit that operates on less than 20 amperes. The high-amperage feed circuit components include the battery, the battery cables, the contact disc portion of the starter solenoid, and the starter motor. The low-amperage control circuit components include the ignition switch, the clutch pedal position switch (manual transmission), the park/neutral position switch (automatic transmission), the starter relay, the electromagnetic windings of the starter solenoid, and the connecting wire harness components.

If the vehicle is equipped with a manual transmission, it has a clutch pedal position switch installed in series between the ignition switch and the coil battery terminal of the starter relay. This normally open switch prevents the starter relay from being energized when the ignition switch is turned to the momentary Start position, unless the clutch pedal is depressed. This feature prevents starter motor operation while the clutch disc and the flywheel are engaged. The starter relay coil ground terminal is always grounded on vehicles with a manual transmission.

STARTING (Continued)

If the vehicle is equipped with an automatic transmission, battery voltage is supplied through the low-amperage control circuit to the coil battery terminal of the starter relay when the ignition switch is turned to the momentary Start position. The park/neutral position switch is installed in series between the starter relay coil ground terminal and ground. This normally open switch prevents the starter relay from being energized and the starter motor from operating unless the automatic transmission gear selector is in the Neutral or Park positions.

When the starter relay coil is energized, the normally open relay contacts close. The relay contacts connect the relay common feed terminal to the relay normally open terminal. The closed relay contacts energize the starter solenoid coil windings.

The energized solenoid pull-in coil pulls in the solenoid plunger. The solenoid plunger pulls the shift lever in the starter motor. This engages the starter overrunning clutch and pinion gear with the starter ring gear on the manual transmission flywheel or on the automatic transmission torque converter or torque converter drive plate.

As the solenoid plunger reaches the end of its travel, the solenoid contact disc completes the high-amperage starter feed circuit and energizes the solenoid plunger hold-in coil. Current now flows between the solenoid battery terminal and the starter motor, energizing the starter.

Once the engine starts, the overrunning clutch protects the starter motor from damage by allowing the starter pinion gear to spin faster than the pinion shaft. When the driver releases the ignition switch to the On position, the starter relay coil is de-energized. This causes the relay contacts to open. When the relay contacts open, the starter solenoid plunger hold-in coil is de-energized.

When the solenoid plunger hold-in coil is de-energized, the solenoid plunger return spring returns the plunger to its relaxed position. This causes the contact disc to open the starter feed circuit, and the shift lever to disengage the overrunning clutch and pinion gear from the starter ring gear.

DIAGNOSIS AND TESTING - STARTING SYSTEM

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** for on-board diagnostic test procedures.

Starting System Diagnosis		
Condition	Possible Cause	Correction
Starter fails to operate.	1. Battery discharged or faulty.	1. Refer to 8, Battery. Replace faulty battery as required.
	2. Starting circuit wiring faulty.	2. Refer to Wiring. Test and repair faulty starter feed and/or control circuits, as required.
	3. Starter relay faulty.	3. Refer to Starter Relay. Replace faulty starter relay as required.
	4. Ignition switch faulty.	4. Refer to Ignition Switch and Key Lock Cylinder. Replace faulty ignition switch as required.
	5. Clutch pedal position switch faulty.	5. Refer to Clutch Pedal Position Switch. Replace faulty clutch hydraulic linkage unit as required.
	6. Park/Neutral position switch faulty or misadjusted.	6. Refer to Park/Neutral Position Switch. Replace faulty park/neutral position switch as required.

STARTING (Continued)

Starting System Diagnosis		
Condition	Possible Cause	Correction
	7. Starter solenoid faulty.	7. Refer to Starter Motors. Replace faulty starter motor as required.
	8. Starter motor faulty.	8. Refer to Starter Motor. Replace faulty starter motor as required.
Starter engages, fails to turn engine.	1. Battery discharged or faulty.	1. Refer to Battery. Replace faulty battery as required.
	2. Starting circuit wiring faulty.	2. Refer to Wiring. Test and repair faulty starter feed and/or control circuits as required.
	3. Starter motor faulty.	3. Refer to Starter Motor. Replace faulty starter motor as required.
	4. Engine seized.	4. Refer to 9, Engine Diagnosis. Repair or replace faulty engine as required.
Starter engages, spins out before engine starts.	1. Starter ring gear faulty.	1. Refer to Starter Motor. Remove starter motor to inspect starter ring gear. Replace faulty starter ring gear as required.
	2. Starter motor faulty.	2. Refer to Starter Motor. Replace faulty starter motor as required.
Starter does not disengage.	1. Starter motor improperly installed.	1. Refer to Starter Motor. Tighten starter motor mounting hardware to correct tightness specifications as required.
	2. Starter relay faulty.	2. Refer to Starter Relay. Replace faulty starter relay as required.
	3. Ignition switch faulty.	3. Refer to Ignition Switch and Key Lock Cylinder. Replace faulty ignition switch as required.
	4. Starter motor faulty.	4. Refer to Starter Motor. Replace faulty starter motor as required.

TESTING

Before testing the starting system perform a visual inspection of the starting system components and connections.

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** for battery charging procedures. Refer to **Battery** for battery diagnosis and testing procedures, including 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. 1). 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** for starter motor diagnosis and testing procedures. If the starter motor tests OK, refer to **Engine Diagnosis** engine diagnosis and testing procedures. If the starter motor is not OK, replace faulty starter motor.

STARTING (Continued)

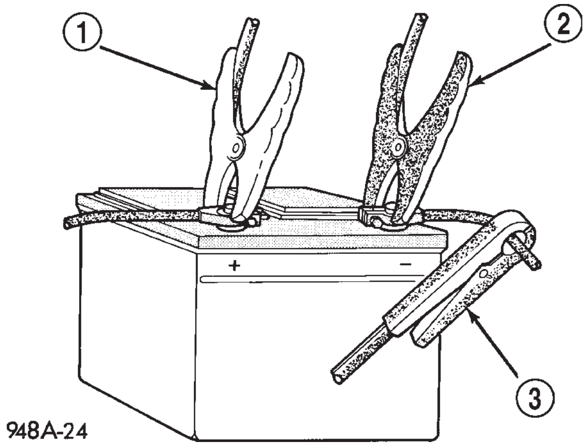


Fig. 1 Volts-Amps Tester Connections - Typical

1 - POSITIVE CLAMP
2 - NEGATIVE CLAMP
3 - INDUCTION AMMETER CLAMP

(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.

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** for battery charging procedures. Refer to **Battery** for battery diagnosis and testing procedures, including 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. 2). 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.

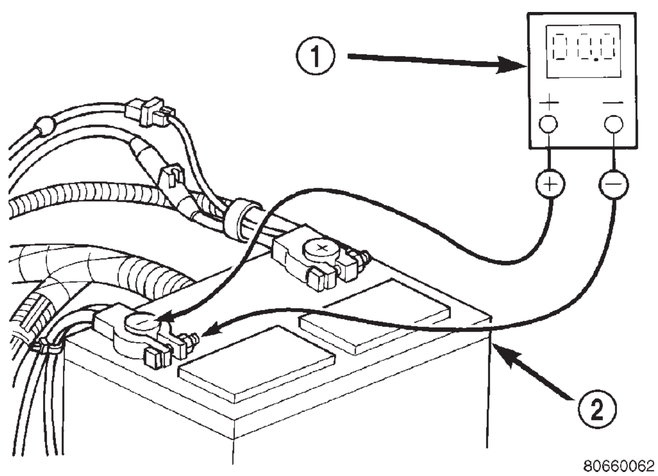


Fig. 2 Test Battery Negative Connection Resistance - Typical

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

STARTING (Continued)

terminal clamp (Fig. 3). 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.

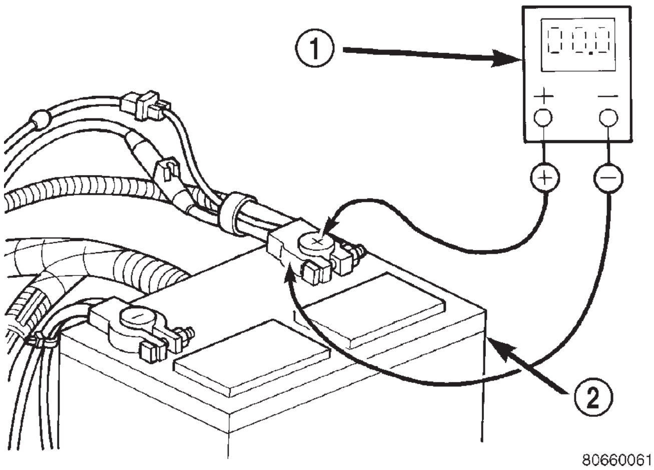


Fig. 3 Test Battery Positive Connection Resistance - Typical

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. 4). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery 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.

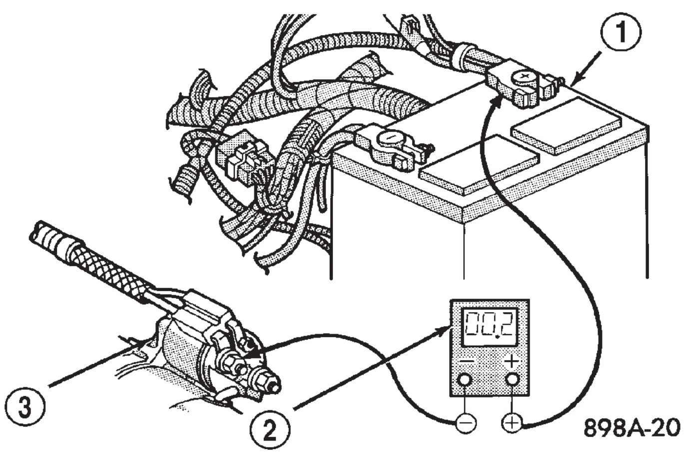


Fig. 4 Test Battery Positive Cable Resistance - Typical

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. 5). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery negative cable 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.

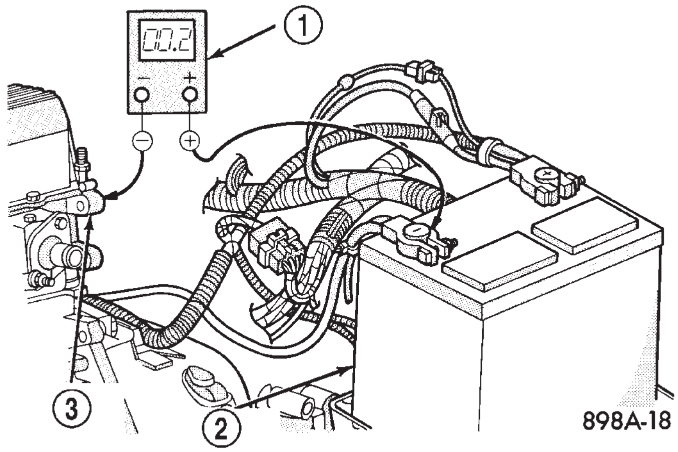


Fig. 5 Test Ground Circuit Resistance - Typical

1 - VOLTMETER
2 - BATTERY
3 - ENGINE GROUND

(5) Connect the positive lead of the voltmeter to the starter housing. Connect the negative lead of the voltmeter to the battery negative terminal post (Fig. 6). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, correct the poor starter to engine block ground contact.

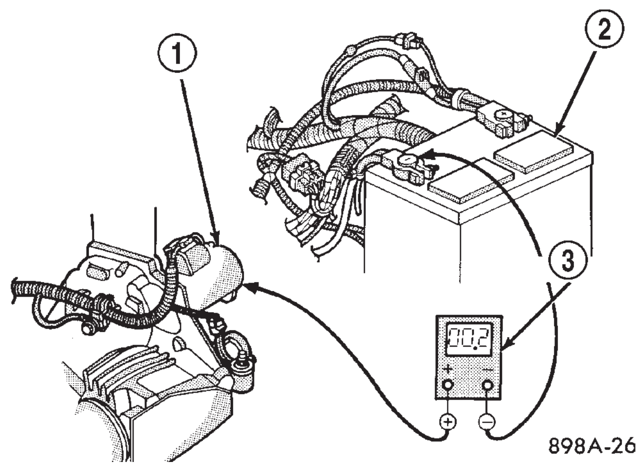


Fig. 6 Test Starter Ground - Typical

1 - STARTER MOTOR
2 - BATTERY
3 - VOLTMETER

STARTING (Continued)

If the resistance tests detect no feed circuit problems, refer to **Starter Motor**.

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**.

Starter Solenoid

- Refer to **Starter Motor**.

Ignition Switch

- Refer to **Ignition Switch and Key Lock Cylinder** for 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** for 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** for park/neutral position switch diagnosis and testing procedures.

INSPECTION - STARTING SYSTEM

The following starting system components should be carefully inspected whenever any starting system problem is encountered.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE AIRBAG SYSTEM. FAILURE TO TAKE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

Battery

- Visually inspect battery for indications of physical damage and loose or corroded cable connections. Determine state-of-charge and cranking capacity of battery. Charge or replace battery, if required. Refer to **Battery** for battery cleaning and inspection procedures.

Ignition Switch

- Visually inspect ignition switch for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Wiring Diagrams**. Refer to **Ignition Switch and Key Lock Cylinder** for ignition switch service procedures.

Clutch Pedal Position Switch

- If vehicle is equipped with a manual transmission, visually inspect clutch pedal position switch for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Clutch Hydraulic Linkage** for clutch pedal position switch service procedures.

Park/Neutral Position Switch

- If vehicle is equipped with an automatic transmission, visually inspect park/neutral position switch for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Park/Neutral Position Switch** for park/neutral position switch service procedures.

Starter Relay

- Visually inspect starter relay for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Starter Relay** for starter relay service procedures.

Starter Motor

- Visually inspect starter motor for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. If problem being diagnosed involves improper starter engagement, disengagement or noise complaints, starter motor should be removed. With starter motor removed, inspect starter pinion and ring gears for damaged or missing teeth. Replace faulty components as required. Refer to **Starter Motor** for removal/installation procedures.

Starter Solenoid

- Visually inspect starter solenoid for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Starter Motor** for starter solenoid service procedures.

Wiring

- Visually inspect starting system wire harnesses for indications of physical damage. Repair or replace any faulty wiring, as required. Refer to **Wiring Diagrams** for repair or connector and terminal service procedures.

STARTING (Continued)

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 Permanent Magnets	6
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.	
** The starter is equipped with permanent magnets. Never strike the starter case to attempt to loosen a sticking/ stuck armature as permanent magnets may crack or break.	

TORQUE

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Starter Solenoid B+ Terminal Nut	11.3	-	100
Starter Mounting Bolts (2.5L)	45	33	-
Starter Mounting Bolt (forward facing 4.0L)	41	30	-
Starter Mounting Bolt (rearward facing 4.0L)	48	35	-

STARTER MOTOR

DESCRIPTION

The starter motors used for both the 2.5L and the 4.0L engines available in this model are not interchangeable (Fig. 7). 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 elec-

STARTER MOTOR (Continued)

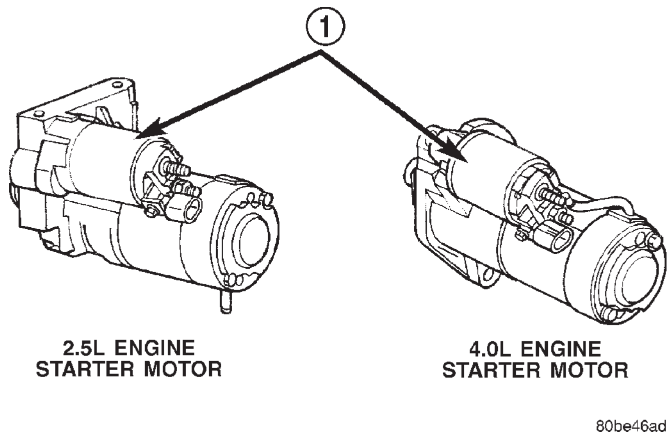


Fig. 7 Starter Motors

1 - STARTER SOLENOID

tric 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.

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.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - STARTER MOTOR/SOLENOID

Correct starter motor operation can be confirmed by performing the following free running bench test. This test can only be performed with starter motor removed from vehicle. Refer to 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 starter field frame. The starter should only be clamped by mounting flange. Do not reverse battery cable connections to starter motor when testing. The permanent magnets may be damaged and starter rendered unserviceable if it is subjected to any of these conditions.

STARTER MOTOR TESTING

(1) Remove starter motor from vehicle. Refer to **Starter Motor** for removal/installation.

(2) Mount starter motor securely in a soft-jawed bench vise. The vise jaws should be clamped on mounting flange of starter motor. Never clamp on starter motor by field frame.

STARTER MOTOR (Continued)

(3) Connect a suitable volt-ampere tester and12-volt battery to starter motor in series, and set ammeter to 100 ampere scale. See instructions provided by manufacturer of volt-ampere tester being used.

(4) Install a jumper wire from solenoid terminal to solenoid B(+) terminal stud. The starter motor should operate. If starter motor fails to operate, replace faulty starter motor.

(5) Adjust carbon pile load of tester to obtain free running test voltage. Refer to starter motor free running test voltage specifications.

(6) Note reading on ammeter and compare reading to free running test maximum amperage draw. Refer to starter motor free running test maximum amperage draw specifications.

(7) If ammeter reading exceeds maximum amperage draw specification, replace faulty starter motor.

STARTER SOLENOID TESTING

This test can only be performed with starter motor removed from vehicle.

(1) Remove starter motor from vehicle. Refer to **Starter Motor** for removal/installation.

(2) Disconnect wire from solenoid field coil terminal.

(3) Check for continuity between solenoid terminal and solenoid field coil terminal with a continuity tester (Fig. 8). There should be continuity. If OK, go to Step 4. If not OK, replace faulty starter motor.

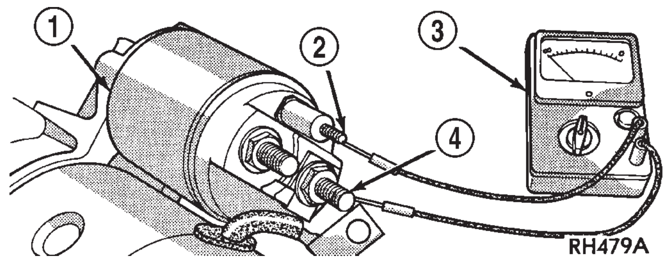


Fig. 8 Continuity Test Between Solenoid Terminal and Field Coil Terminal

1 - SOLENOID
2 - SOLENOID TERMINAL
3 - OHMMETER
4 - FIELD COIL TERMINAL

(4) Check for continuity between solenoid terminal and solenoid case (Fig. 9). There should be continuity. If not OK, replace faulty starter motor.

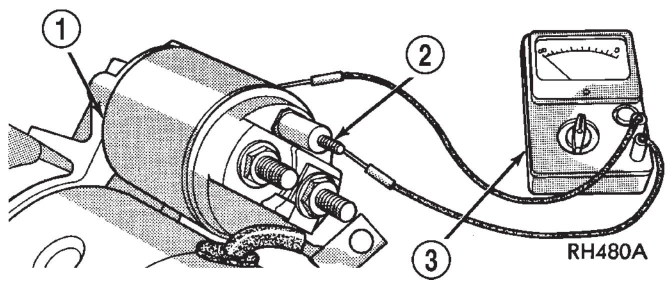


Fig. 9 Continuity Test Between Solenoid Terminal and Solenoid Case - Typical

1 - SOLENOID
2 - SOLENOID TERMINAL
3 - OHMMETER

STARTER MOTOR (Continued)

DIAGNOSIS AND TESTING - STARTER MOTOR NOISE - 2.5L ENGINE

Refer to following Starter Motor Noise Diagnosis chart. If complaint is similar to Conditions 1 and 2 in chart, correction can be made by placing shims between starter motor and engine block using following procedures:

STARTER MOTOR NOISE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
1. VERY HIGH FREQUENCY WHINE BEFORE ENGINE STARTS BUT 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 BUT 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, unsual wear and excessive runout. Replace flywheel/drive plate as necessary.
3. A LOUD ″WHOOP″ AFTER ENGINE STARTS WHILE STARTER MOTOR IS ENGAGED.	3. Most probable cause is defective overrunning clutch.	3. Replace starter motor.
4. A ″RUMBLE, GROWL OR KNOCK″ AS STARTER MOTOR COASTS TO A STOP AFTER ENGINE STARTS.	4. Most probable cause is bent or unbalanced starter motor armature.	4. Replace starter motor.

(1) If the complaint is similar to Condition 1, the starter motor must be moved toward starter ring gear by removing shims from both starter mounting pads on engine block (Fig. 10). Refer to **Starter Motor** for removal/installation.

NOTE: The shim thickness is 0.381 mm (0.015 in.). These shims may be stacked if additional thickness is required.

(2) If complaint is similar to Condition 2, starter motor must be moved away from starter ring gear. This is done by installing shim(s) across both starter mounting pads on engine block. More than one shim may be required. Refer to **Starter Motor** for removal/installation.

NOTE: This is a condition that will generally cause broken starter (flywheel/torque converter drive plate) ring gear teeth or broken starter motor housings.

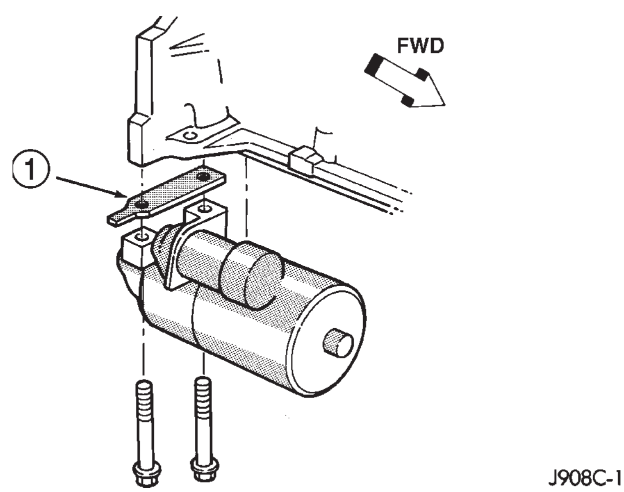


Fig. 10 Starter Motor Shim

1 - STARTER MOTOR SHIM

STARTER MOTOR (Continued)

REMOVAL

2.5L ENGINE

(1) Disconnect and isolate negative battery cable.

(2) Raise and support vehicle.

(3) While supporting starter motor, remove two bolts securing starter motor to engine block (Fig. 11).

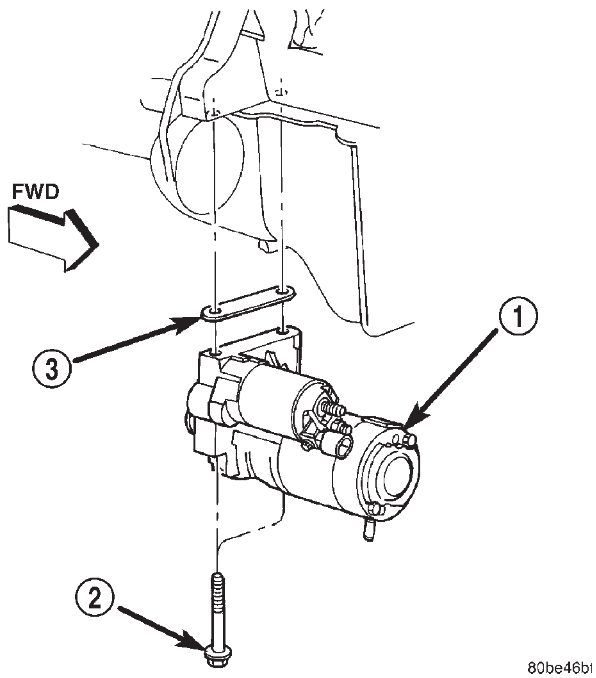


Fig. 11 Starter Motor Remove/Install - 2.5L Engine

1 - STARTER MOTOR
2 - SCREW (2)
3 - SHIM

(4) Lower starter motor from engine block far enough to access and remove nut securing battery positive cable eyelet terminal to starter solenoid B(+) terminal stud (Fig. 12). Always support starter motor during this process. Do not let starter motor hang from wire harness.

(5) Remove battery positive cable eyelet terminal from starter solenoid B(+) terminal stud.

(6) Disconnect solenoid terminal wire harness connector from connector receptacle on starter solenoid.

(7) Remove starter motor and any starter motor shims (if used) from engine block.

4.0L ENGINE

(1) Disconnect and isolate negative battery cable.

(2) Raise and support vehicle.

(3) Remove lower bolt (forward facing) securing starter motor to transmission housing (Fig. 13).

(4) While supporting starter motor, remove upper bolt (rearward facing) securing starter motor to transmission housing.

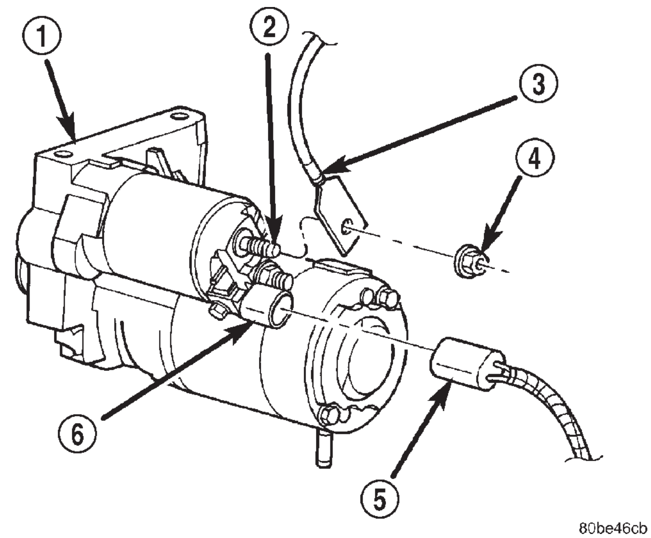


Fig. 12 Starter Connections Remove/Install - Typical

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

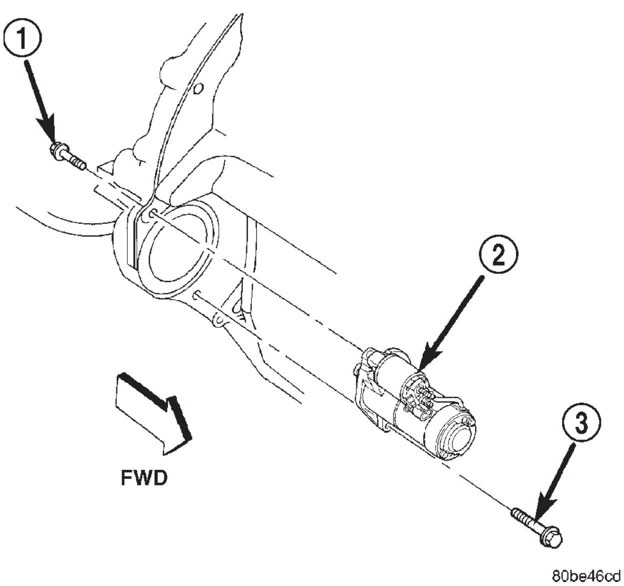


Fig. 13 Starter Motor Remove/Install - 4.0L Engine

1 - SCREW
2 - STARTER MOTOR
3 - SCREW

(5) Lower starter motor from front of transmission housing far enough to access and remove nut securing battery positive cable eyelet terminal to starter solenoid B(+) terminal stud (Fig. 12). Always support starter motor during this process. Do not let starter motor hang from wire harness.

STARTER MOTOR (Continued)

(6) Remove battery positive cable eyelet terminal from solenoid B(+) terminal stud.

(7) Disconnect solenoid terminal wire harness connector from connector receptacle on the starter solenoid.

(8) Remove starter motor from transmission housing.

INSTALLATION

2.5L ENGINE

(1) Position starter motor to engine block.

(2) Connect solenoid terminal wire harness connector to connector receptacle on starter solenoid. Always support starter motor during this process. Do not let starter motor hang from wire harness.

(3) Install battery positive cable eyelet terminal onto starter solenoid B(+) terminal stud.

(4) Install and tighten nut securing battery positive cable eyelet terminal to starter solenoid B(+) terminal stud. Tighten nut to 11.3 N·m (100 in. lbs.).

(5) Position starter motor and any starter motor shims to engine block. Loosely install two mounting bolts.

NOTE: Shim thickness available is 0.381 mm (0.015 in.). Refer to Starter Motor Noise – 2.5L Engine.

(6) Tighten two bolts mounting bolts to 44.7 N·m (33 ft. lbs.).

(7) Lower vehicle.

(8) Connect battery negative cable.

4.0L ENGINE

(1) Position starter motor to transmission housing.

(2) Connect solenoid terminal wire harness connector to connector receptacle on the starter solenoid. Always support starter motor during this process. Do not let starter motor hang from the wire harness.

(3) Install battery positive cable eyelet terminal onto starter solenoid B(+) terminal stud.

(4) Install and tighten nut securing battery positive cable eyelet terminal to starter solenoid B(+) terminal stud. Tighten nut to 11.3 N·m (100 in. lbs.).

(5) Position starter motor to transmission housing. Loosely install two mounting bolts.

(6) Tighten lower (forward facing) mounting bolt to 40.7 N·m (30 ft. lbs.).

(7) Tighten upper (rearward facing) to 47.5 N·m (35 ft. lbs.).

(8) Lower vehicle.

(9) Connect battery cable.

STARTER MOTOR RELAY

DESCRIPTION

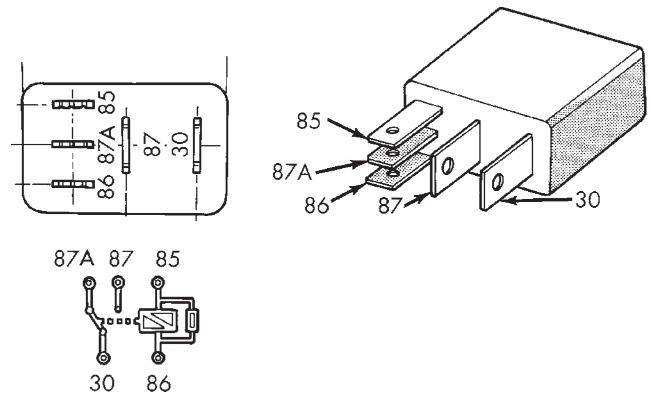


Fig. 14 Starter Relay

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

The starter relay (Fig. 14) 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, STARTER MOTOR RELAY (Continued)

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 - STARTER RELAY

The starter relay (Fig. 15) is located in the Power Distribution Center (PDC), in engine compartment. Refer to fuse and relay layout label affixed to underside of PDC cover starter relay identification and location.

RELAY TEST

(1) Remove starter relay from PDC. Refer to **Starter Relay**.

(2) A relay in 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 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 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 Relay Circuit Test that follows. If not OK, replace faulty relay.

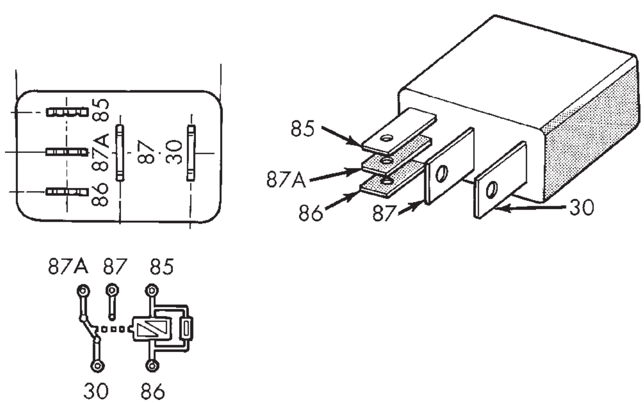


Fig. 15 Starter Relay

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

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 open circuit to fused B(+) fuse in PDC as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in 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 energized position. This terminal supplies battery voltage to starter solenoid field coil. There should be continuity between cavity for relay terminal 87 and starter solenoid terminal at all times. If OK, go to Step 4. If not OK, repair open engine starter motor relay output circuit to starter solenoid as required.

(4) The coil battery terminal (86) is connected to electromagnet in relay. It is energized when ignition switch is held in Start position. On vehicles with a manual transmission, the clutch pedal must be blocked in fully depressed position for this test. Check for battery voltage at cavity for relay terminal 86 with ignition switch in Start position, and no voltage when ignition switch is released to On position. If OK, go to Step 5. If not OK with a manual transmission, disconnect clutch pedal position switch wire harness connector and install a jumper wire between two cavities in body half of connector and check for battery voltage again at cavity for relay terminal 86. If now OK, replace faulty clutch pedal position switch. If still not OK with a manual transmission or if not OK with an automatic transmission, check for open or shorted fused ignition switch output (start) circuit to ignition switch and repair, as required. If fused ignition switch output (start) circuit is OK, refer to **Ignition Switch and Key Lock Cylinder**.

(5) The coil ground terminal (85) is connected to electromagnet in relay. On vehicles with a manual transmission, it is grounded at all times. On vehicles with an automatic transmission, it is grounded through park/neutral position switch only when gearshift selector lever is in Park or Neutral positions. Check for continuity to ground at cavity for relay terminal 85. If not OK with a manual transmission, repair 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 park/neutral position switch and repair, as required. If park/neutral position switch sense circuit checks OK, refer to **Park/Neutral Position Switch**.

STARTER MOTOR RELAY (Continued)

REMOVAL

(1) Disconnect and isolate battery negative cable.
(2) Unlatch and open cover on Power Distribution Center (PDC) (Fig. 16).
(3) See fuse and relay layout label affixed to underside of PDC cover for starter relay identification and location.
(4) Remove starter relay from PDC.

INSTALLATION

(1) See fuse and relay layout label affixed to underside of PDC cover for proper starter relay location.
(2) Position starter relay in proper receptacle in PDC.
(3) Align starter relay terminals with terminal cavities in PDC receptacle.
(4) Push down firmly on starter relay until terminals are fully seated in terminal cavities in PDC receptacle.
(5) Close and latch PDC cover.
(6) Connect negative battery cable.

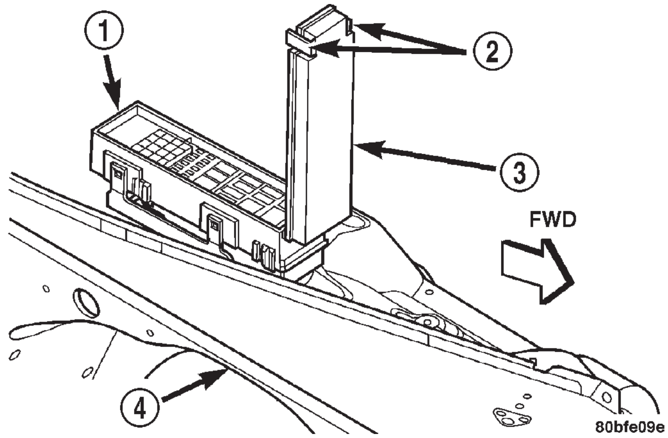


Fig. 16 Power Distribution Center

1 - POWER DISTRIBUTION CENTER
2 - LATCHES
3 - PDC COVER
4 - RIGHT FRONT FENDER

HEATED SYSTEMS

TABLE OF CONTENTS

WINDOW DEFOGGER

DESCRIPTION - REAR WINDOW DEFOGGER

The rear window defogger system will only operate when the ignition switch is in the run position. When the defogger switch is in the run position, an electric heater grid on the rear window glass is energized. Vehicles with the heated mirror options also have heater grids located behind the outside rear view mirror glass. Each of these grids produce heat to help clear the rear window glass and outside rear view mirrors of ice, snow, or fog.

OPERATION - REAR WINDOW DEFOGGER

The rear window defogger system is controlled by a switch installed with the HVAC control assembly. An amber indicator lamp in the switch button will light to indicate when the rear window 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 rear window defogger system through a hard-wired control output to the rear window defogger relay. 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.

The rear window 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 rear window defogger switch is turned on again during the same ignition cycle, the defogger system will automatically turn off after about five minutes.

The rear window defogger system will automatically shut off if the ignition switch is turned to the Off position, or it can be turned off manually by depressing the instrument panel switch. Following are general descriptions of the major components in the rear window defogger system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the defogger system.

DIAGNOSIS AND TESTING - DEFOGGER SYSTEM

For circuit descriptions and diagrams, refer to 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:

- 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.
- 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.
- 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.

WINDOW DEFOGGER (Continued)

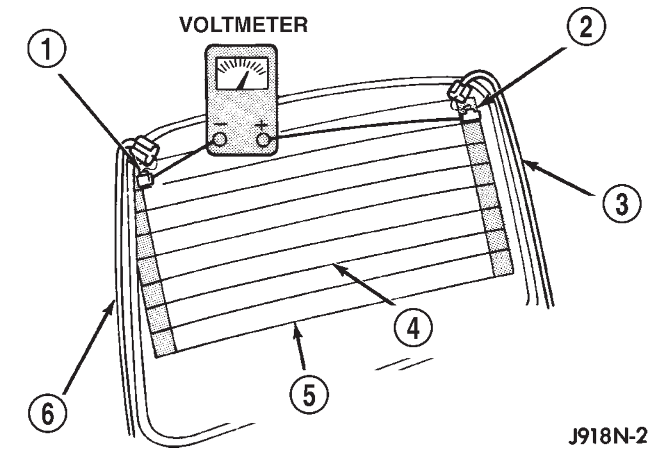


Fig. 1 Rear Window Glass Grid Test - Typical

1 - TERMINAL “A”
2 - TERMINAL “B”
3 - FEED WIRE
4 - MID-POINT “C” (TYPICAL)
5 - HEATED REAR WINDOW DEFOGGER GRID
6 - GROUND WIRE

The above checks will confirm system operation. Illumination of the defogger switch indicator lamp means that there is electrical current available at the output of the defogger relay, but does not confirm that the electrical current is reaching the rear glass heating grid lines.

If the defogger system does not operate, the problem should be isolated in the following manner:

(1) Confirm that the ignition switch is in the On position.

(2) Ensure that the rear glass heating grid feed and ground wires are connected to the glass. Confirm that the ground wire has continuity to ground.

(3) Check the fuses in the Power Distribution Center (PDC) and in the flash back 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 WINDOW DEFOGGER GRID

DESCRIPTION

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.

OPERATION

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.

DIAGNOSIS AND TESTING - REAR GLASS HEATING GRID

For circuit descriptions and diagrams, refer to 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.

REAR WINDOW DEFOGGER GRID (Continued)

(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.

REAR WINDOW DEFOGGER RELAY

DESCRIPTION

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 RELAY

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. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

RELAY TEST

The defogger relay (Fig. 2) 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.

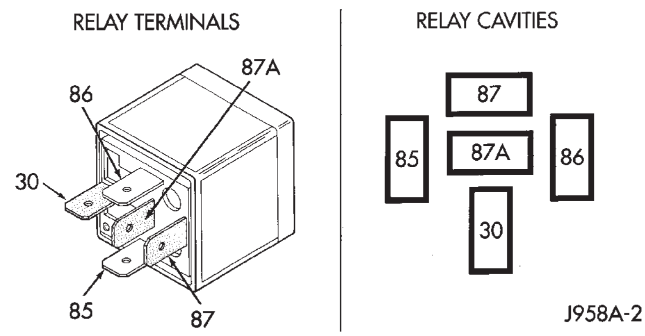


Fig. 2 Defogger Relay

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the open circuit to the PDC fuse as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the rear glass heating grid and the defogger switch indicator lamp. There should be continuity between the cavity for relay terminal 87 and the rear window defogger relay output circuit cavities of the rear glass heating grid and defogger switch connec-

REAR WINDOW DEFOGGER RELAY (Continued)

tors 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.

(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 fuse block module as required.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unlatch and open the cover on the Power Distribution Center (PDC) (Fig. 3).

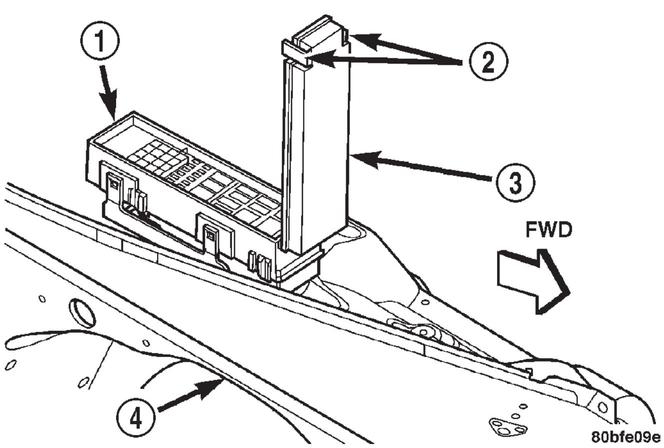


Fig. 3 Power Distribution Center

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 rear window defogger relay identification and location.

(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.

REAR WINDOW DEFOGGER SWITCH

DESCRIPTION

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.

DIAGNOSIS AND TESTING - DEFOGGER SWITCH

For circuit descriptions and diagrams, refer to Rear Window Defogger in Group 8W - Wiring Diagrams.

REAR WINDOW DEFOGGER SWITCH (Continued)

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. 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. 4). 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.

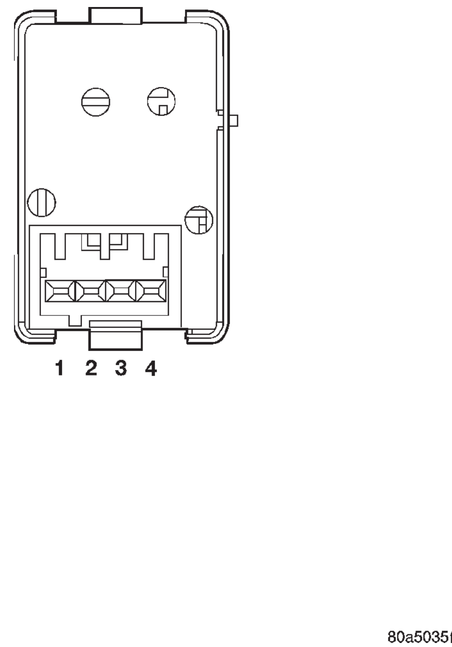


Fig. 4 Defogger Switch Continuity

SWITCH POSITION	CONTINUITY BETWEEN
OFF	LAMPS
ON	MOMENTARY 1 AND 2
ILLUMINATION LAMP	1 AND 4
INDICATOR LAMP	1 AND 3

REMOVAL- DEFOGGER SWITCH

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. 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 (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - REMOVAL).

(3) Remove the four screws that secure the accessory switch bezel to the instrument panel (Fig. 5).

(4) Pull the accessory switch bezel out from the instrument panel far enough to access the wire harness connectors.

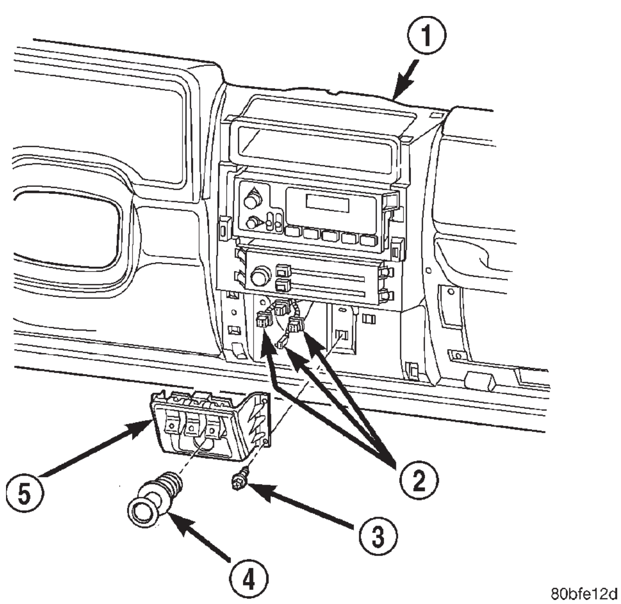


Fig. 5 Accessory Switch Bezel Remove/Install

1 - INSTRUMENT PANEL
2 - WIRE HARNESS CONNECTORS
3 - SCREW (4)
4 - CIGAR LIGHTER
5 - ACCESSORY SWITCH BEZEL

REAR WINDOW DEFOGGER SWITCH (Continued)

(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.

INSTALLATION

(1) Install the rear window defogger switch receptacle to the back of the accessory switch bezel and push switch into the bezel.

(2) Plug the wire harness connectors to the rear of the accessory switches and the cigar lighter/power outlet.

(3) Install the accessory switch bezel to the instrument panel.

(4) Install the four screws that secure the accessory switch bezel to the instrument panel. (Fig. 6)

(5) Install the center bezel to the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - INSTALLATION).

(6) Connect the negative battery cable.

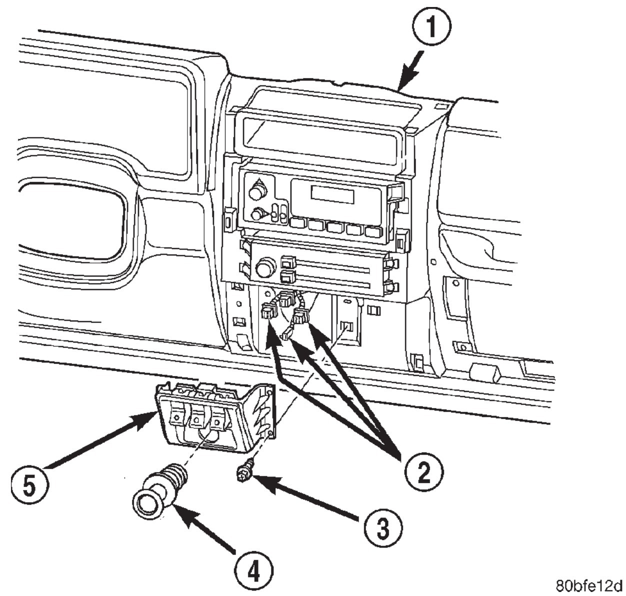


Fig. 6 Accessory Switch Bezel Remove/Install

1 - INSTRUMENT PANEL
2 - WIRE HARNESS CONNECTORS
3 - SCREW (4)
4 - CIGAR LIGHTER
5 - ACCESSORY SWITCH BEZEL

HORN

TABLE OF CONTENTS

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 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - DESCRIPTION). Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds. 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 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 (if equipped), 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.

HORN (Continued)

When the horn is energized, electrical current flows through the closed contact points to the electromagnet. The resulting electromagnetic field draws the plunger and diaphragm toward it until that movement mechanically opens the contact points. When the contact points open, the electromagnetic field collapses allowing the plunger and diaphragm to return to their relaxed positions and closing the contact points again. This cycle continues repeating at a very rapid rate producing the vibration and movement of air that creates the sound that is directed through the horn outlet.

DIAGNOSIS AND TESTING - HORN

For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

(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 continuity. 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

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the wire harness connectors from the horn connector receptacles (Fig. 1).

(3) Remove the screw that secures the horn and mounting bracket units to the left front inner fender shield.

(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. Ensure that the anti-rotation tab on the horn bracket is inserted into the hole in the 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 101 N·m (75 ft. lbs.).

(3) Reconnect the wire harness connectors to the horn connector receptacles.

(4) Reconnect the battery negative cable.

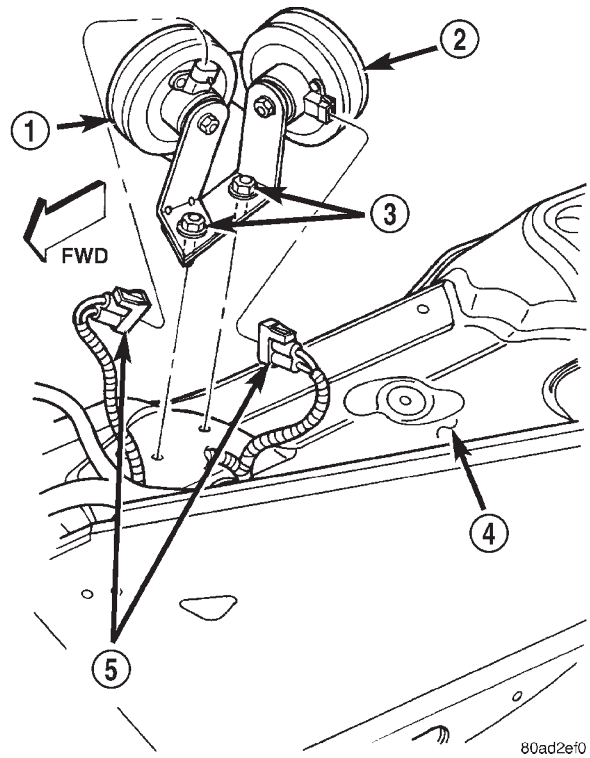


Fig. 1 Horns Remove/Install

1 - HIGH NOTE HORN AND BRACKET
2 - LOW NOTE HORN AND BRACKET
3 - SCREWS
4 - INNER FENDER
5 - HORN CONNECTORS

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.

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.

HORN RELAY (Continued)

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.

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 the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

(1) Remove the horn relay from the PDC. (Refer to 8 - ELECTRICAL/HORN/HORN RELAY - REMOVAL).

(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.

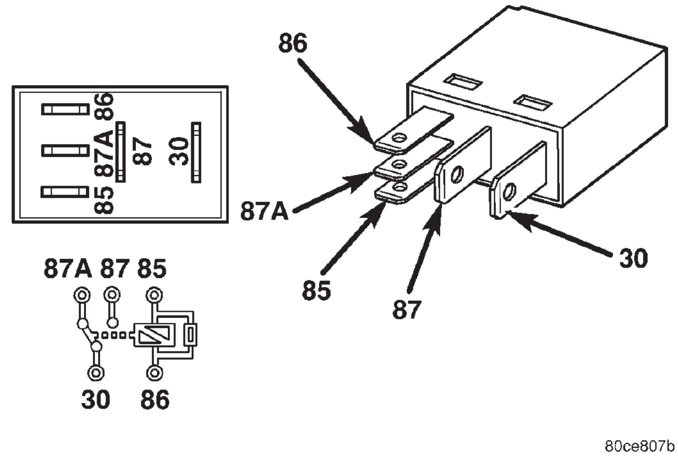


Fig. 2 Horn Relay

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the open circuit to the fuse in the PDC as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the horn(s). There should be continuity between the cavity for relay terminal 87 and each horn feed from relay pin of the horn connectors at all times. If OK, go to Step 4. If not OK, repair the open circuit to the horn(s) as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. It is connected to battery voltage and should be hot at all times. Check for battery voltage at the cavity for relay terminal 86. If OK, go to Step 5. If not OK, repair the open circuit to the 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 8 - ELECTRICAL/HORN/HORN SWITCH - DIAGNOSIS AND TESTING).

HORN RELAY (Continued)

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unlatch and open the cover on the Power Distribution Center (PDC) (Fig. 3).

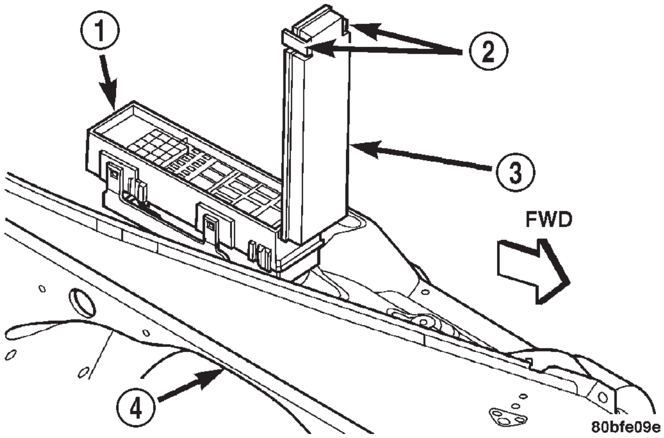


Fig. 3 Power Distribution Center

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) Push down firmly on the horn relay until the terminals are fully seated in the terminal cavities in the PDC receptacle.

(3) Close and latch the cover onto the PDC.

(4) Reconnect the battery negative cable.

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. 4) . 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.

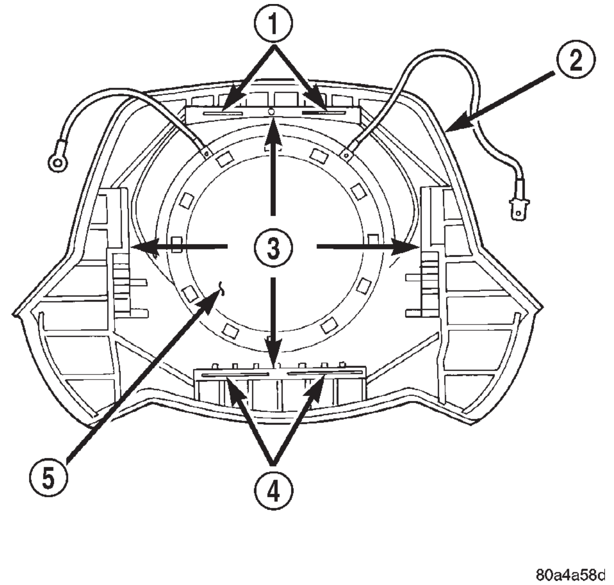


Fig. 4 Driver Side Airbag Module Trim Cover and Horn Switch - Typical

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 resistive tension of the convex membrane separates the two electrically conductive grids and opens the switch circuit.

DIAGNOSIS AND TESTING - HORN SWITCH

For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

HORN SWITCH (Continued)

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the knee blocker from the instrument panel.

(3) Check for continuity between the metal steering column jacket and a good ground. There should be continuity. If OK, go to Step 4. If not OK, (Refer to 19 - STEERING/COLUMN - INSTALLATION).

(4) Remove the driver side airbag module from the steering wheel. Disconnect the horn switch wire harness connectors from the driver side airbag module.

(5) 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 6. If not OK, repair the shorted horn relay control circuit to the horn relay in the PDC as required.

(6) 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 7. If not OK, repair the open horn relay control circuit to the horn relay in the PDC as required.

(7) 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 8. If not OK, replace the faulty horn switch.

(8) 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.

IGNITION CONTROL

TABLE OF CONTENTS

IGNITION CONTROL

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)

IGNITION CONTROL (Continued)

- 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:

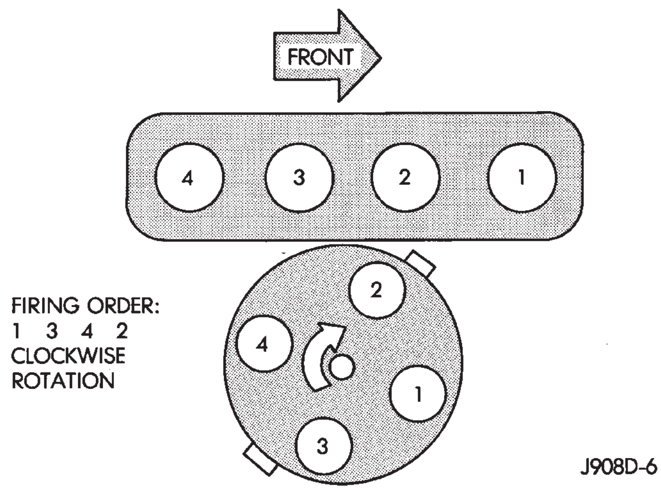
- Spark Plugs
- Ignition Coil(s)
- Powertrain Control Module (PCM)
- Crankshaft Position Sensor
- Camshaft Position Sensor
- The MAP, TPS, IAC and ECT also have an effect on the control of the ignition system.

SPECIFICATIONS

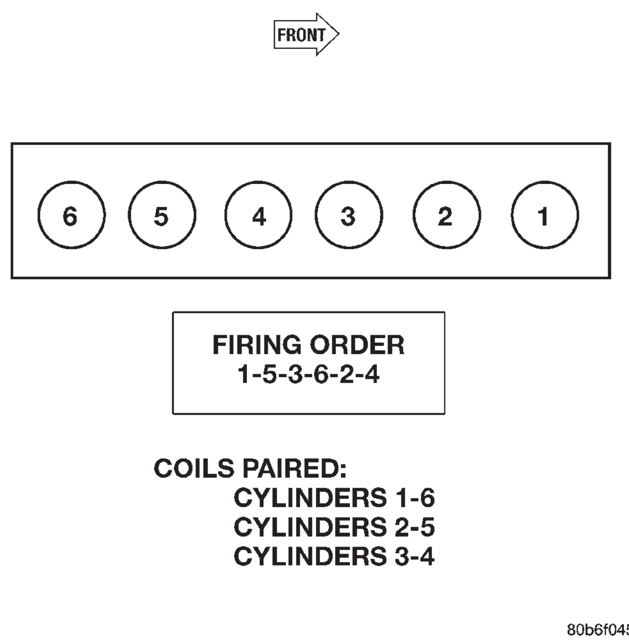
SPECIFICATIONS - IGNITION TIMING

Ignition timing is not adjustable on any engine.

ENGINE FIRING ORDER - 2.5L 4-CYLINDER ENGINE



ENGINE FIRING ORDER - 4.0L 6-CYLINDER ENGINE



IGNITION CONTROL (Continued)

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

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.)

SPECIFICATIONS - SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

SPECIFICATIONS - TORQUE - IGNITION SYSTEM

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft Position Sensor Mounting Bolts – 4.0L Engine	2		15
Crankshaft Position Sensor Bolts—with manual transmission	12	9	
Crankshaft Position Sensor Nuts—2.5L with auto.trans.	12	9	
Crankshaft Position Sensor Bolt—4.0L with auto. trans.	7		60
Distributor Hold Down Bolt—2.5L	23	17	
Distributor Cap Screws—2.5L	3		26
Ignition Coil Mounting (if tapped bolts are used)—2.5L	5		50

IGNITION CONTROL (Continued)

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Ignition Coil Mounting (if nuts/bolts are used)—2.5L	11		100
Ignition Coil Rail Mounting Bolts—4.0L	29		250
Oil Pump Drive Hold-down Bolt—4.0L	23	17	
Spark Plugs (all engines)	41	30	

AUTO SHUT DOWN RELAY

DESCRIPTION - PCM OUTPUT

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

OPERATION - ASD SENSE - PCM INPUT

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).

OPERATION - PCM OUTPUT

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.

DIAGNOSIS AND TESTING - 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. 1) or (Fig. 2).

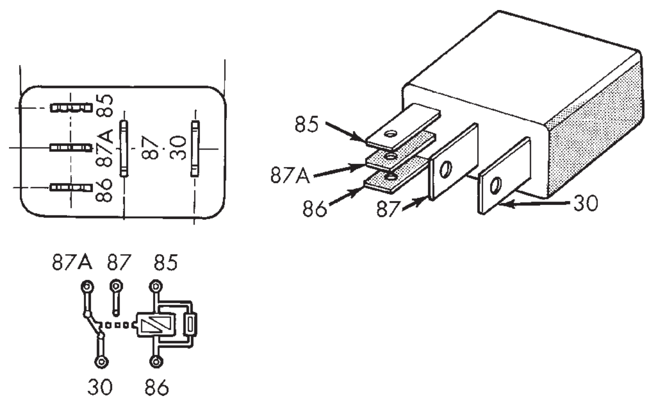


Fig. 1 ASD and Fuel Pump Relay Terminals—Type 1

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

- 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.

AUTO SHUT DOWN RELAY (Continued)

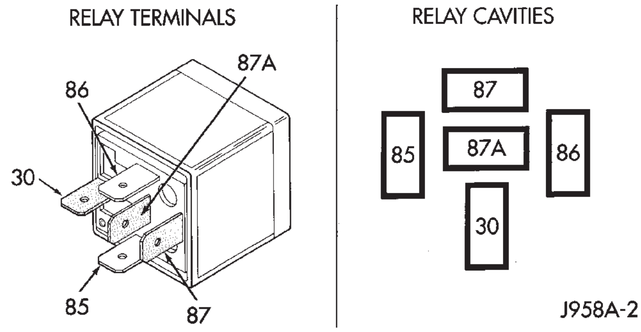


Fig. 2 ASD and Fuel Pump Relay Terminals—Type 2

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

This is the On position. Terminal 87 supplies voltage to the rest of the circuit.

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 75 ohms +/- 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. DAMAGE TO OHMMETER MAY RESULT.

(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 8, Wiring Diagrams.

REMOVAL

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 3). Refer to label on PDC cover for relay location.

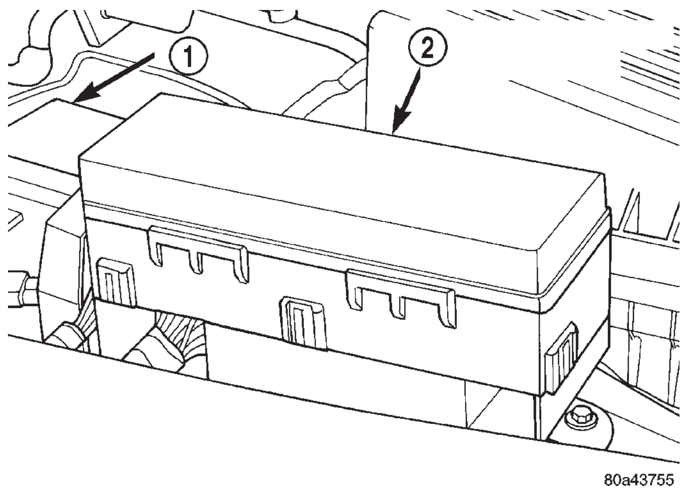


Fig. 3 Power Distribution Center (PDC)

1 - BATTERY
2 - POWER DISTRIBUTION CENTER (PDC)

(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

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 3). Refer to label on PDC cover for relay location.

(1) Install relay to PDC.

(2) Install cover to PDC.

CAMSHAFT POSITION SENSOR

DESCRIPTION - 2.5L

On the 2.5L 4–cylinder engine the Camshaft Position (CMP) sensor is located in the distributor.

OPERATION - 2.5L

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.

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.

REMOVAL - 2.5L

On 2.5L engines, the camshaft position sensor is located in the distributor (Fig. 4).

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.

(4) Remove distributor rotor from distributor shaft.

(5) Lift camshaft position sensor assembly from distributor housing (Fig. 4).

INSTALLATION - 2.5L

On 2.5L engines, the camshaft position sensor is located in the distributor (Fig. 4).

(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.

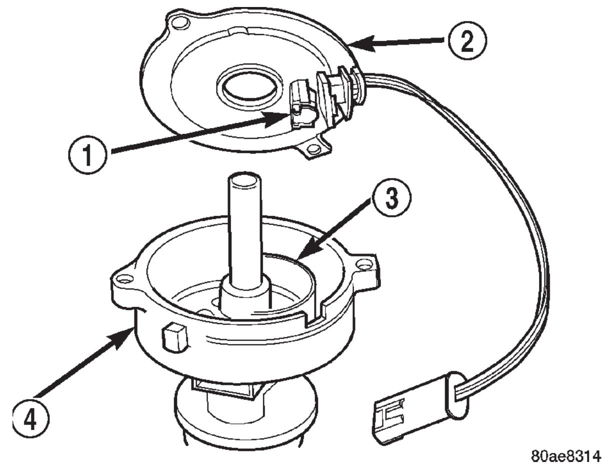


Fig. 4 Camshaft Position Sensor—2.5L Engine

1 - SYNC SIGNAL GENERATOR
2 - CAMSHAFT POSITION SENSOR
3 - PULSE RING
4 - DISTRIBUTOR ASSEMBLY

CAMSHAFT POSITION SENSOR

DESCRIPTION - 4.0L

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. 5). The sensor and drive shaft assembly is located on the right side of the engine near the oil filter (Fig. 6).

OPERATION - 4.0L

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. 5). 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.

CAMSHAFT POSITION SENSOR (Continued)

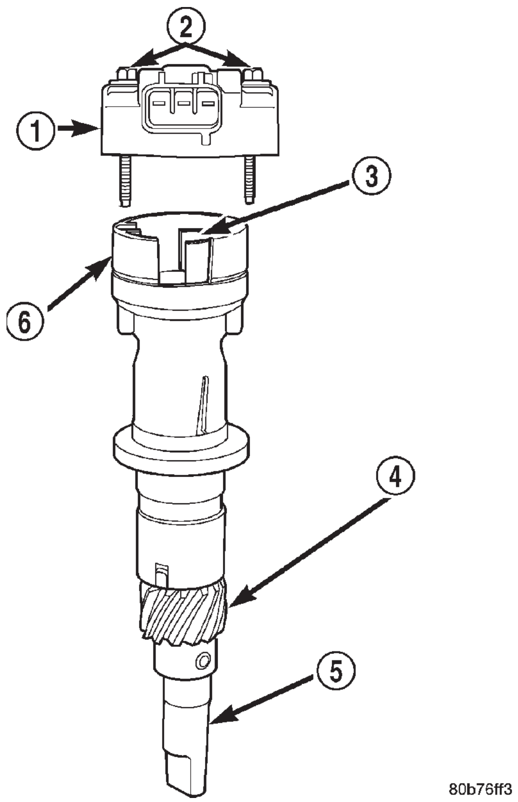


Fig. 5 CMP and Oil Pump Drive Shaft—4.0L Engine

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 - 4.0L

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. 7). The sensor and drive shaft assembly is located on the right side of the engine near the oil filter (Fig. 8).

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.

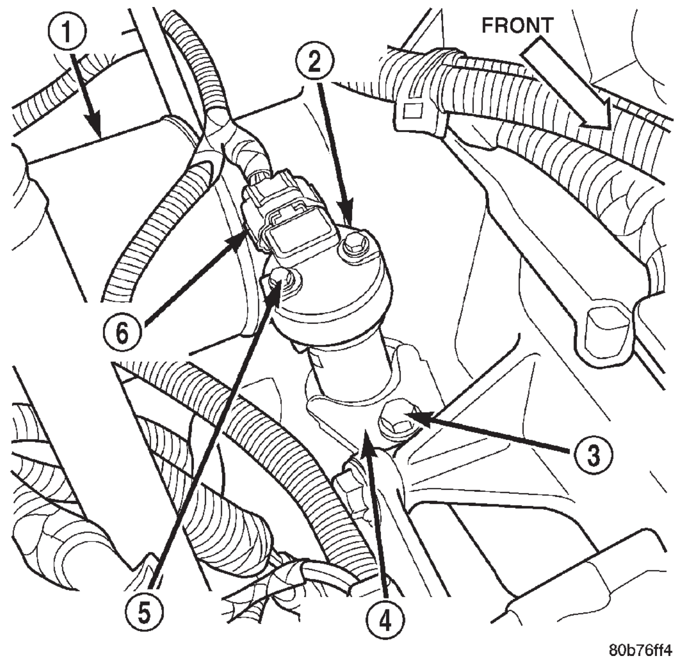


Fig. 6 CMP Location—4.0L Engine

1 - OIL FILTER
2 - CAMSHAFT POSITION SENSOR
3 - CLAMP BOLT
4 - HOLD-DOWN CLAMP
5 - MOUNTING BOLTS (2)
6 - ELEC. CONNECTOR

Two different procedures are used 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.

CAMSHAFT POSITION SENSOR (Continued)

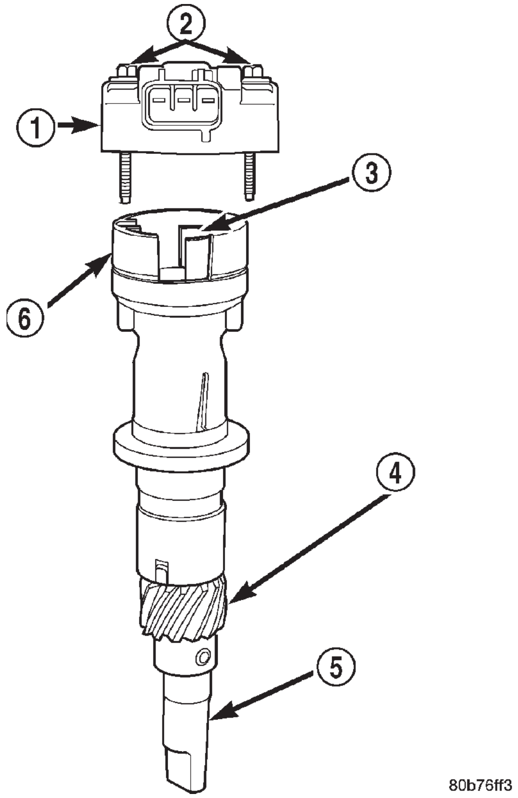


Fig. 7 CMP and Oil Pump Drive Shaft - 4.0L Engine

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)

SENSOR ONLY - 4.0L

(1) Disconnect electrical connector at CMP sensor (Fig. 8).

(2) Remove 2 sensor mounting bolts (Fig. 7) or (Fig. 8).

(3) Remove sensor from oil pump drive.

OIL PUMP DRIVE AND SENSOR - 4.0L

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. 8).

(2) Remove 2 sensor mounting bolts (Fig. 7) or (Fig. 8).

(3) Remove sensor from oil pump drive.

(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. 8).

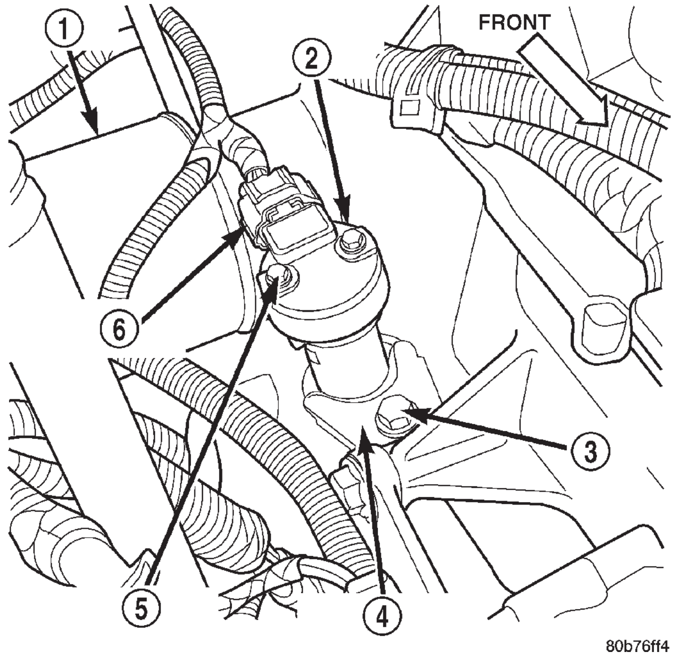


Fig. 8 CMP Location - 4.0L Engine

1 - OIL FILTER
2 - CAMSHAFT POSITION SENSOR
3 - CLAMP BOLT
4 - HOLD-DOWN CLAMP
5 - MOUNTING BOLTS (2)
6 - ELEC. CONNECTOR

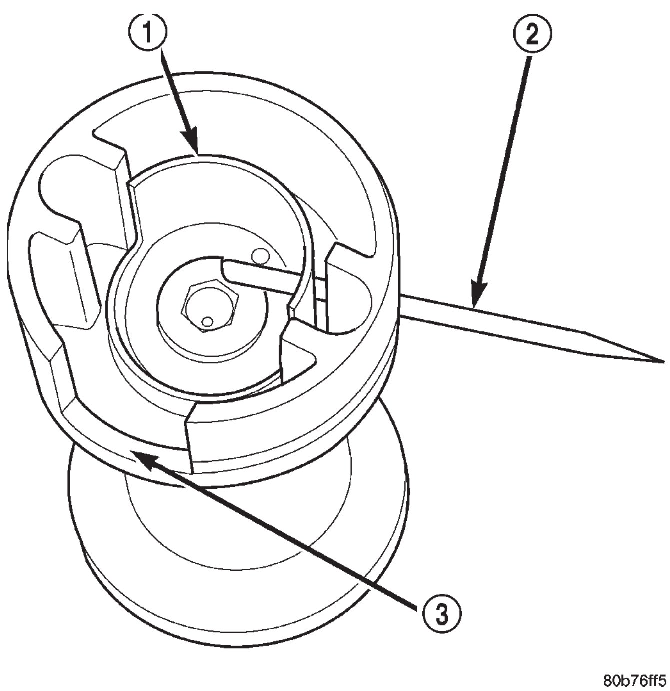


Fig. 9 CMP Pulse Ring Alignment - 4.0L Engine

1 - PULSE RING (SHUTTER)
2 - TOOTHPICK
3 - SENSOR BASE (OIL PUMP DRIVESHAFT ASSEMBLY)

CAMSHAFT POSITION SENSOR (Continued)

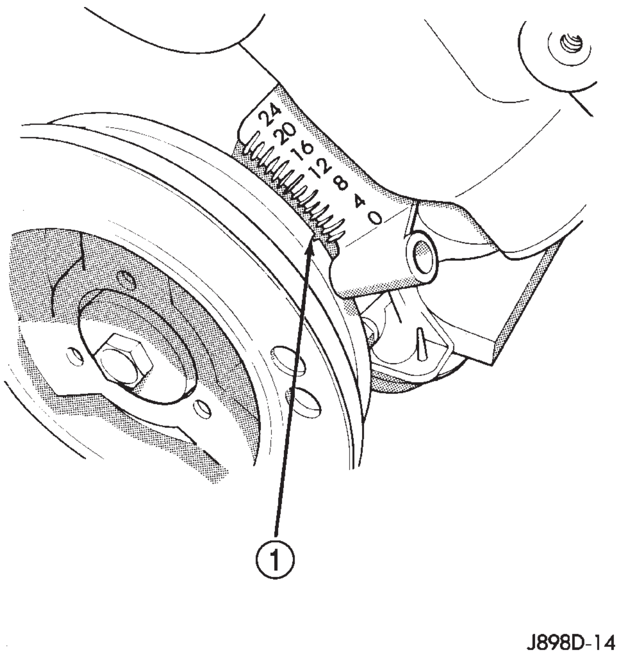


Fig. 10 Align Timing Marks - 4.0L Engine

1 - CRANKSHAFT VIBRATION DAMPER TIMING MARK

(6) While pulling assembly from engine, note direction and position of pulse ring (Fig. 7). 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 - 4.0L

SENSOR ONLY - 4.0L

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. 7). The sensor and drive shaft assembly is located on the right side of the engine near the oil filter (Fig. 8).

(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.

OIL PUMP DRIVE AND SENSOR - 4.0L

(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. 9).

(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.

(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. 10). 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.

CAMSHAFT POSITION SENSOR (Continued)

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.

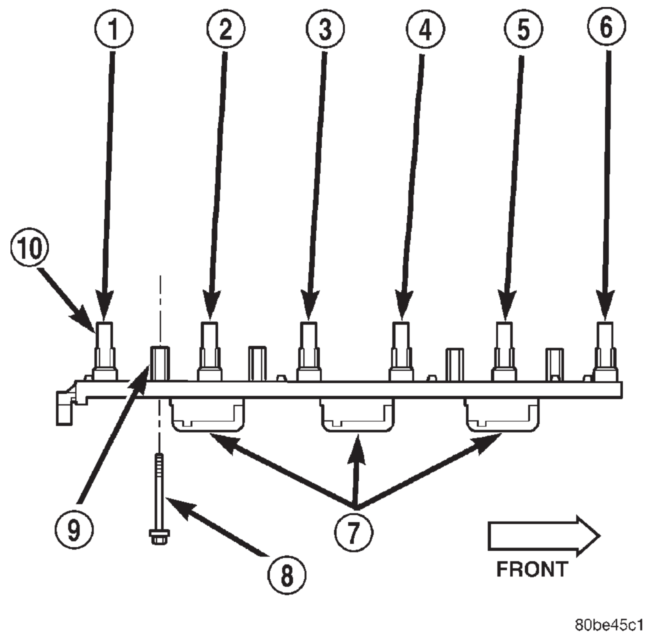


Fig. 11 Ignition Coil Assembly—4.0L 6–Cylinder Engine

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)

COIL RAIL

DESCRIPTION

A one-piece coil rail assembly containing three individual coils is used on the 4.0L 6–cylinder engine (Fig. 11) . The coil rail must be replaced as one assembly. The bottom of the coil is equipped with 6 individual rubber boots (Fig. 11) 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. 12) . 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.

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.

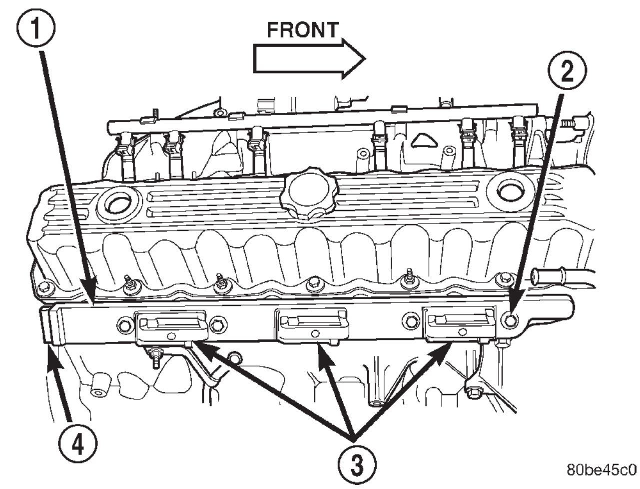


Fig. 12 Coil Location—4.0L Engine

1 - COIL RAIL
2 - COIL MOUNTING BOLTS (4)
3 - COIL
4 - COIL ELECTRICAL CONNECTION

COIL RAIL (Continued)

REMOVAL

A one-piece coil rail assembly containing three individual coils is used on the 4.0L engine (Fig. 13) . The coil rail must be replaced as one assembly. The bottom of the coil is equipped with 6 individual rubber boots (Fig. 13) 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. 14) .

(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. 15) . After slide tab has been positioned outwards, push in on secondary release lock (Fig. 15) on side of connector and pull connector from coil.

(5) Remove coil from vehicle.

INSTALLATION

(1) Connect engine harness connector to coil by snapping into position. Move slide tab towards engine (Fig. 15) for a positive lock.

(2) Position ignition coil rubber boots to all spark plugs. Push down on coil assembly until bolt bases have contacted cylinder head

(3) 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.

(4) Connect negative battery cable to battery.

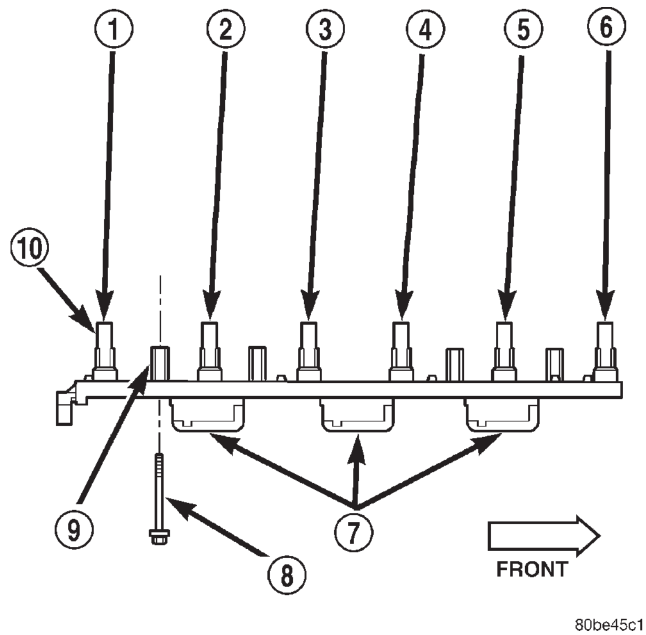


Fig. 13 Ignition Coil Assembly—4.0L 6–Cylinder Engine

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)

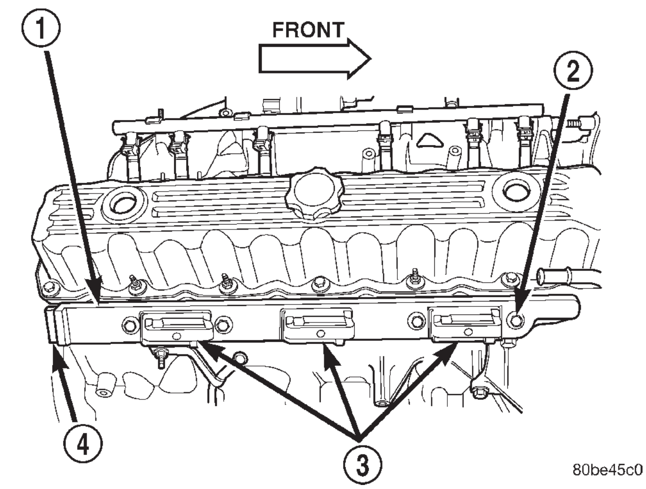


Fig. 14 Ignition Coil Rail Location—4.0L 6–Cylinder Engine

1 - COIL RAIL
2 - COIL MOUNTING BOLTS (4)
3 - COIL
4 - COIL ELECTRICAL CONNECTION

COIL RAIL (Continued)

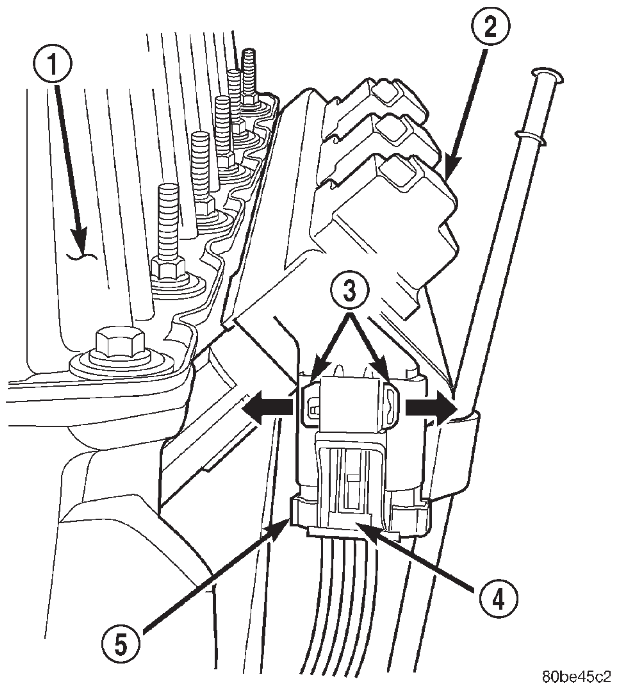


Fig. 15 Ignition Coil Electrical Connector—4.0L 6–Cylinder Engine

1 - REAR OF VALVE COVER
2 - COIL RAIL
3 - SLIDE TAB
4 - RELEASE LOCK
5 - COIL CONNECTOR

DISTRIBUTOR

DESCRIPTION - 2.5L

The 2.5L engine is equipped with a camshaft driven mechanical distributor (Fig. 16) containing a shaft driven distributor rotor. The distributor is also equipped with an internal camshaft position (fuel sync) sensor (Fig. 16).

OPERATION - 2.5L

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.**

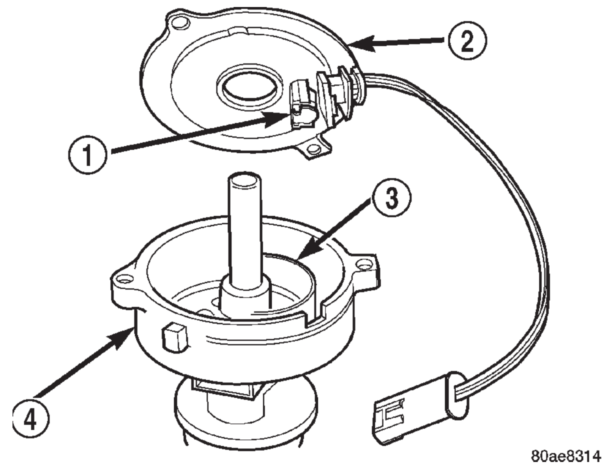


Fig. 16 Distributor and Camshaft Position Sensor-2.5L Engine

1 - SYNC SIGNAL GENERATOR
2 - CAMSHAFT POSITION SENSOR
3 - PULSE RING
4 - DISTRIBUTOR ASSEMBLY

All distributors contain an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

REMOVAL - 2.5L

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. 17). 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.

The camshaft position sensor is located in the distributor (Fig. 18). For removal/installation procedures, refer to Camshaft Position Sensor. Distributor removal is not necessary for sensor removal.

Refer to (Fig. 18) 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. 18). 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.

DISTRIBUTOR (Continued)

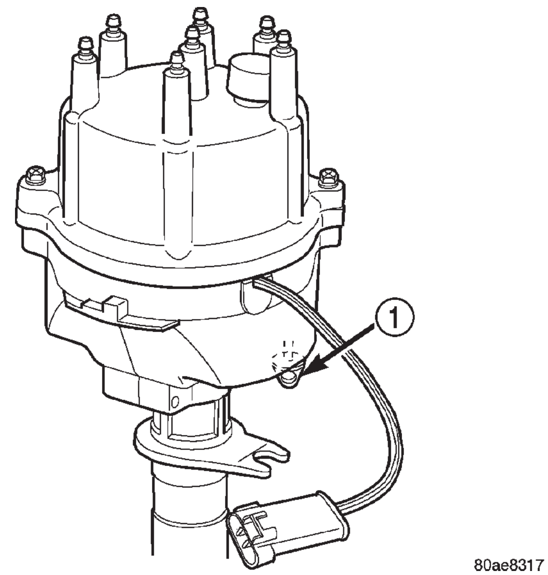


Fig. 17 Plastic Alignment Pin—2.5L Engine

1 - PLASTIC ALIGNMENT PIN

NOTE: Do not attempt to modify this fork to attain ignition timing.

(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. 19). Always rotate engine in direction of normal rotation. Do not rotate engine backward to align timing marks.

(8) On models equipped with A/C, remove electrical cooling fan and shroud assembly from radiator. Refer to Group 7, Cooling System for procedures.

(9) This will provide room to turn engine crankshaft with a socket and ratchet using vibration damper bolt.

(10) Remove distributor holddown bolt and clamp.

(11) Remove distributor from engine by slowly lifting straight up.

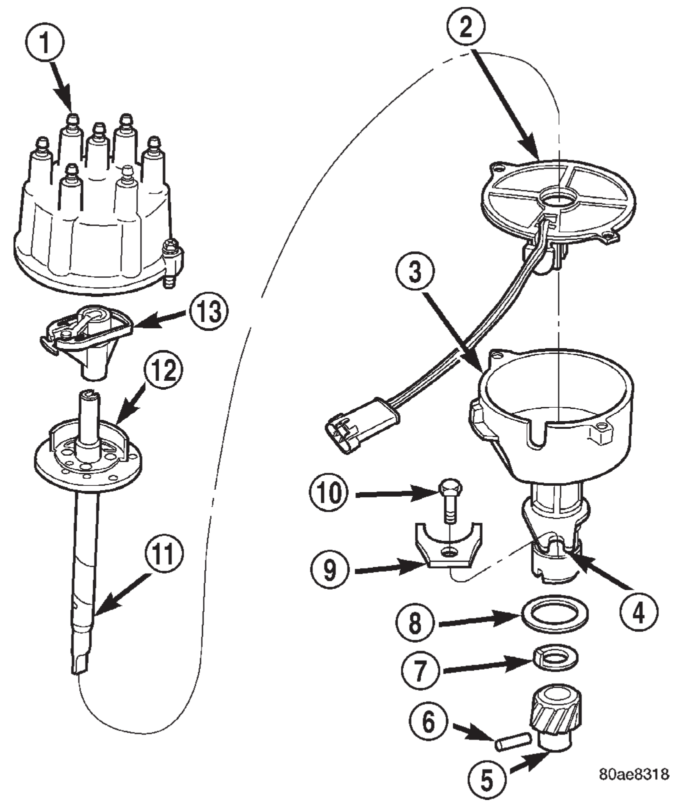


Fig. 18 Distributor—2.5L Engine—Typical

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

(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. 20).

(15) Remove and discard the old distributor-to-engine block gasket.

DISTRIBUTOR (Continued)

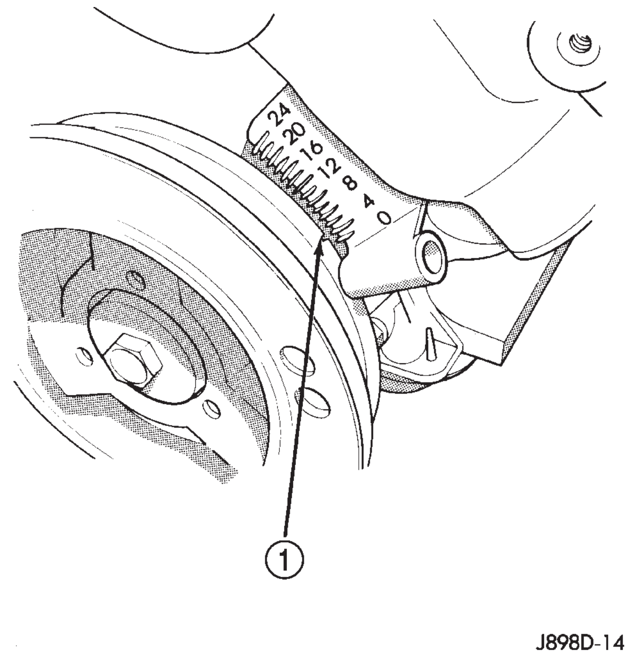


Fig. 19 Align Timing Marks - 4.0L Engine

1 - CRANKSHAFT VIBRATION DAMPER TIMING MARK

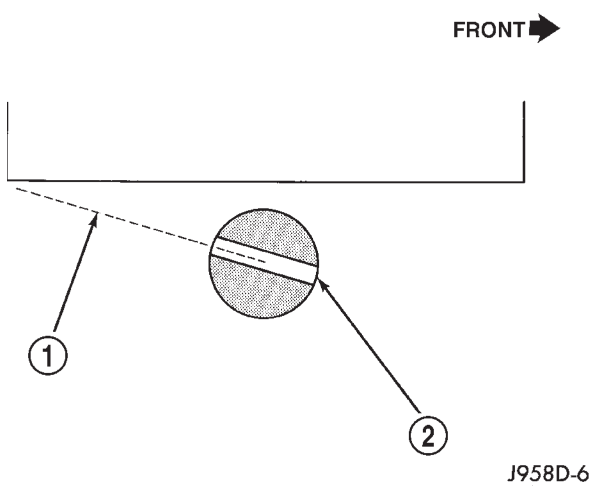


Fig. 20 Slot At 10 O'clock

1 - 10 0'CLOCK POSITION
2 - OIL PUMP SLOT

INSTALLATION - 2.5L

The distributor contains an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

(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 (counter-clockwise of) 10 o'clock position (Fig. 20). 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. 17). 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. 21). **Note that 2.5L and 4.0L engines have different alignment holes (Fig. 21).**

(7) Rotate distributor shaft and install pin punch tool through proper alignment hole in plastic ring (Fig. 21) and into mating access hole in distributor housing. This will prevent distributor shaft and rotor from rotating.

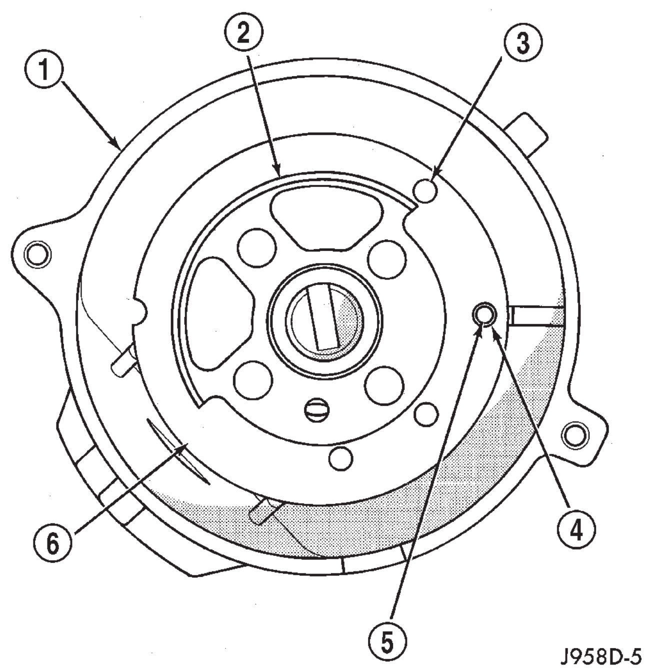


Fig. 21 Pin Alignment Holes—2.5L Engine

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

DISTRIBUTOR (Continued)

(8) Clean distributor mounting hole area of engine block.

(9) Install new distributor-to-engine block gasket (Fig. 18).

(10) Install rotor to distributor shaft.

(11) Pre-position distributor into engine while holding centerline of base slot in 1 o'clock position (Fig. 22). 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. 23). 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.

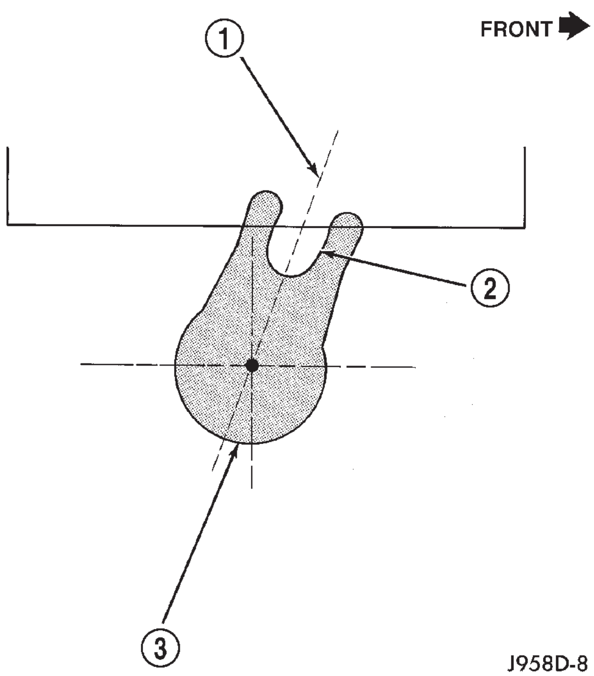


Fig. 22 Distributor Pre-position—2.5L Engine

1 - 1 O'CLOCK POSITION
2 - BASE SLOT
3 - DISTRIBUTOR BASE

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.

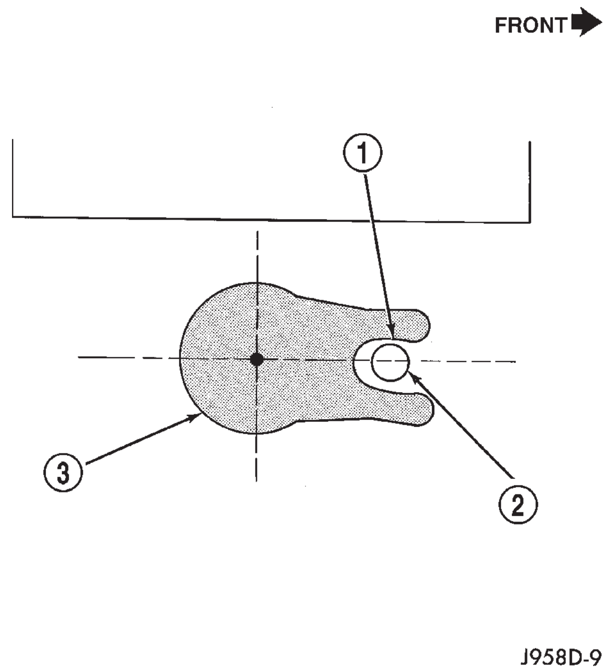


Fig. 23 Distributor Engaged Position—2.5L Engine

1 - DISTRIBUTOR BASE SLOT
2 - CLAMP BOLT MOUNTING HOLE (ON ENGINE)
3 - DISTRIBUTOR BASE

No adjustments are necessary. Proceed to next step.

(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.

DISTRIBUTOR CAP

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. 24) or (Fig. 25). 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.

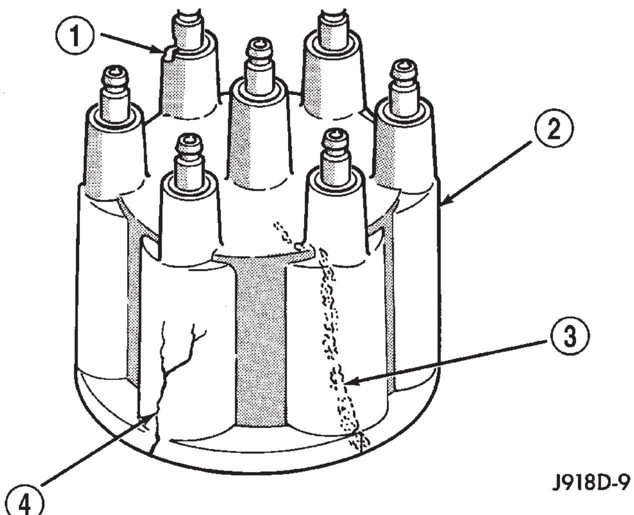


Fig. 24 Cap Inspection—External—Typical

1 - BROKEN TOWER
2 - DISTRIBUTOR CAP
3 - CARBON PATH
4 - CRACK

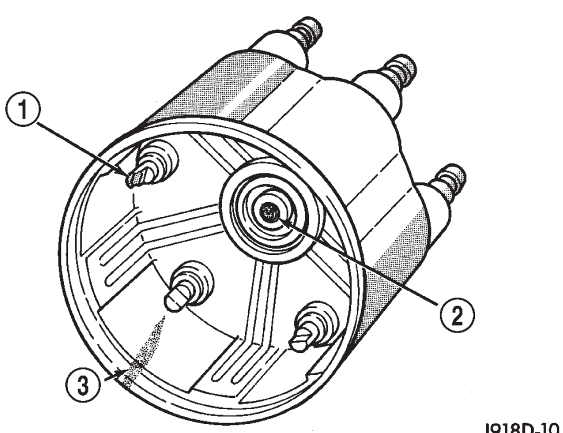


Fig. 25 Cap Inspection—Internal—Typical

1 - CHARRED OR ERODED TERMINALS
2 - WORN OR DAMAGED ROTOR BUTTON
3 - CARBON PATH

DISTRIBUTOR ROTOR

DIAGNOSIS AND TESTING

DISTRIBUTOR ROTOR-2.5L ENGINE

Visually inspect the rotor (Fig. 26) for cracks, evidence of corrosion or the effects of arcing on the metal tip. Also check for evidence of mechanical interference with the cap. Some charring is normal on the end of the metal tip. The silicone-dielectric-varnish-compound applied to the rotor tip for radio interference noise suppression, will appear charred. This is normal. **Do not remove the charred compound.** Test the spring for insufficient tension. Replace a rotor that displays any of these adverse conditions.

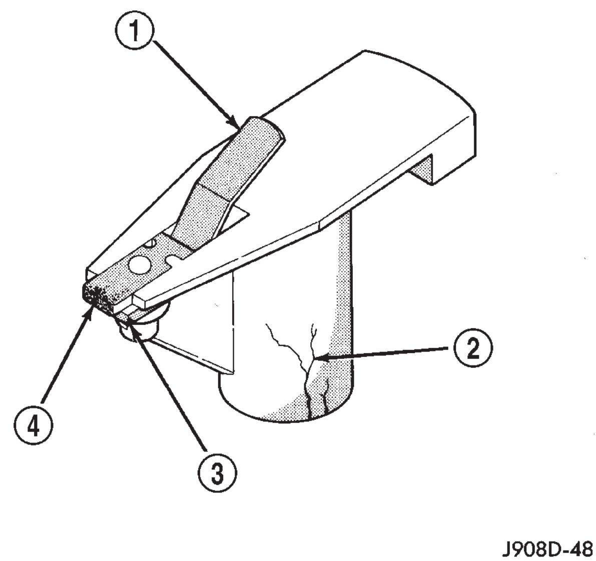


Fig. 26 Rotor Inspection—Typical

1 - INSUFFICIENT SPRING TENSION
2 - CRACKS
3 - EVIDENCE OF PHYSICAL CONTACT WITH CAP
4 - ROTOR TIP CORRODED

IGNITION COIL

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.

IGNITION COIL (Continued)

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.

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. 27) .

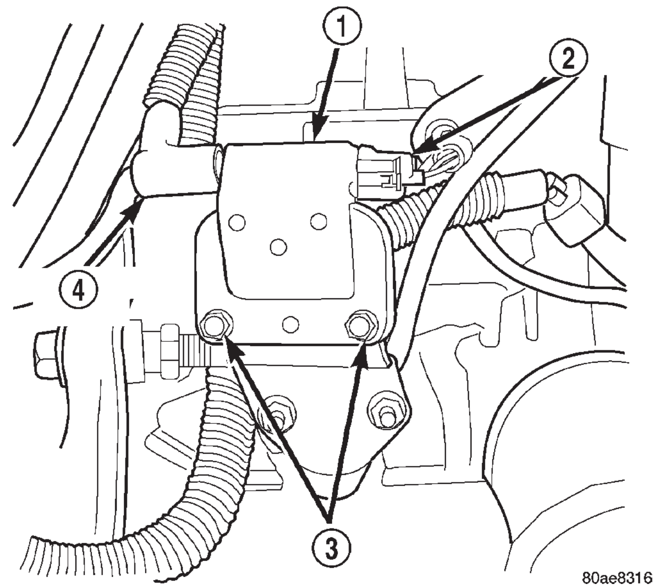


Fig. 27 Ignition Coil—2.5L Engine

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.

SPARK PLUG

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.

DIAGNOSIS AND TESTING - 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. 28). 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.

SPARK PLUG (Continued)

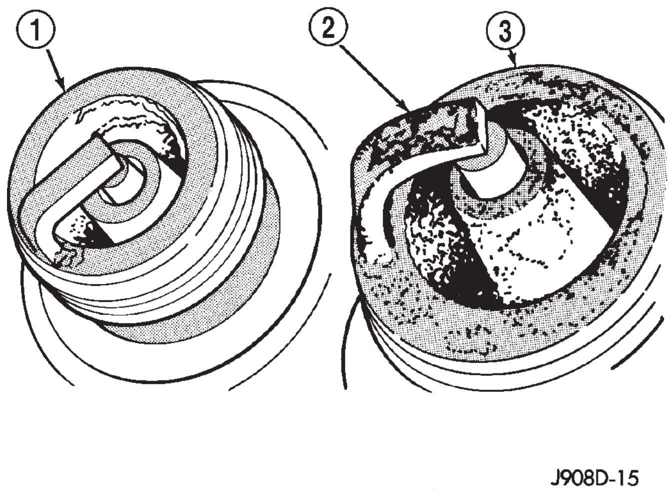


Fig. 28 Normal Operation and Cold (Carbon) Fouling

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. 28). 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. 29), evaluate engine condition for the cause of oil entry into that particular combustion chamber.

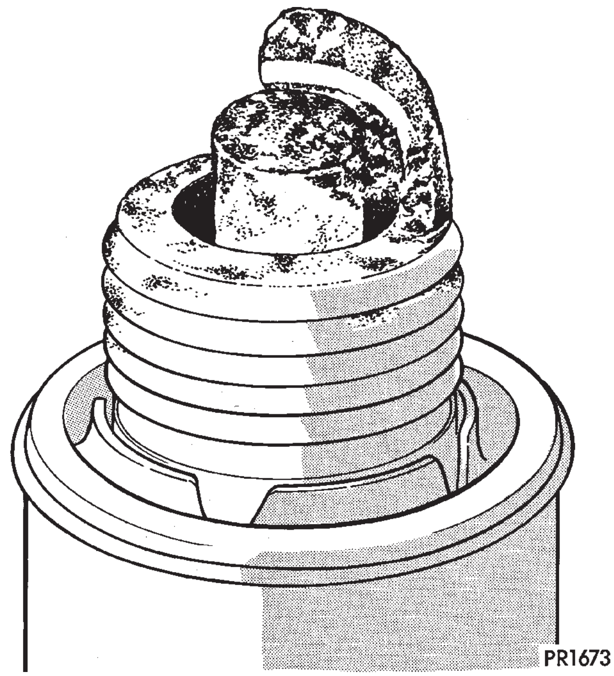


Fig. 29 Oil or Ash Encrusted

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. 30). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

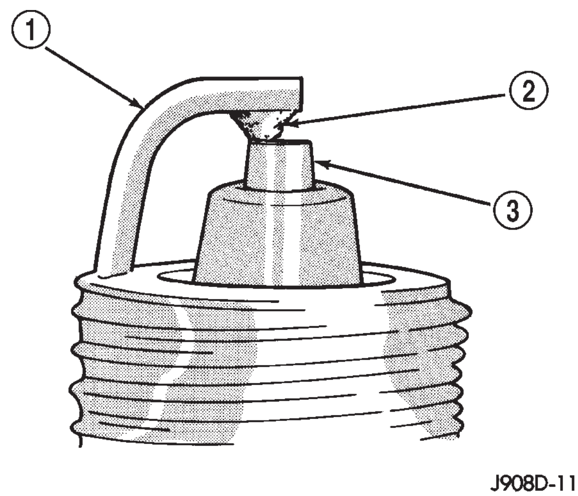


Fig. 30 Electrode Gap Bridging

1 - GROUND ELECTRODE
2 - DEPOSITS
3 - CENTER ELECTRODE

SPARK PLUG (Continued)

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 31). They may appear to be harmful, but this is a normal condition caused by chemical additives in certain fuels. These additives are designed to change the chemical nature of deposits and decrease spark plug misfire tendencies. Notice that accumulation on the ground electrode and shell area may be heavy, but the deposits are easily removed. Spark plugs with scavenger deposits can be considered normal in condition and can be cleaned using standard procedures.

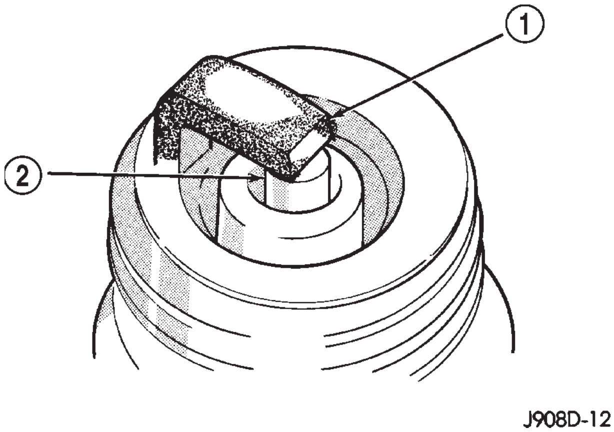


Fig. 31 Scavenger Deposits

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. 32). Spark plugs with this condition must be replaced.

PREIGNITION DAMAGE

Preignition damage is usually caused by excessive combustion chamber temperature. The center electrode dissolves first and the ground electrode dissolves somewhat latter (Fig. 33). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine. Determine if ignition timing is over advanced or if other operating conditions are causing engine overheating. (The heat range rating refers to the operating temperature of a particular type spark plug. Spark plugs are designed to operate within specific temperature ranges. This depends upon the thickness and length of the center electrodes porcelain insulator.)

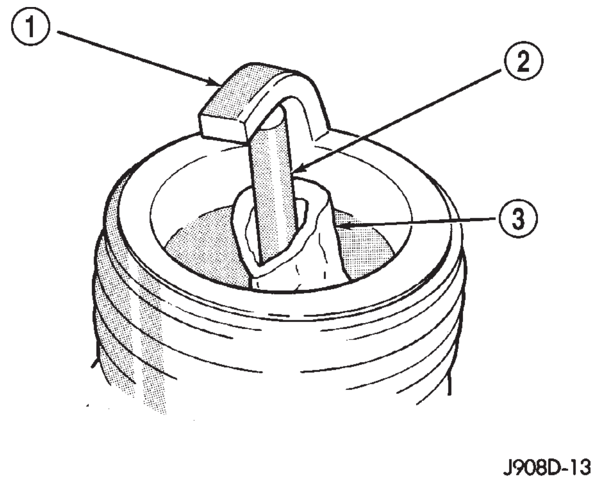


Fig. 32 Chipped Electrode Insulator

1 - GROUND ELECTRODE
2 - CENTER ELECTRODE
3 - CHIPPED INSULATOR

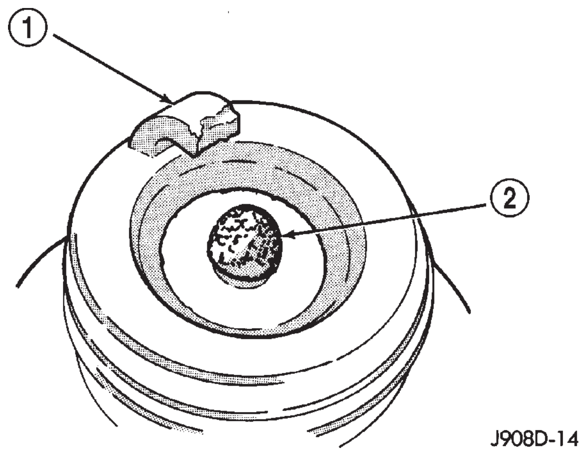


Fig. 33 Preignition Damage

1 - GROUND ELECTRODE STARTING TO DISSOLVE
2 - CENTER ELECTRODE DISSOLVED

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 34). The increase in electrode gap will be considerably in excess of 0.001 inch per 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.

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.

SPARK PLUG (Continued)

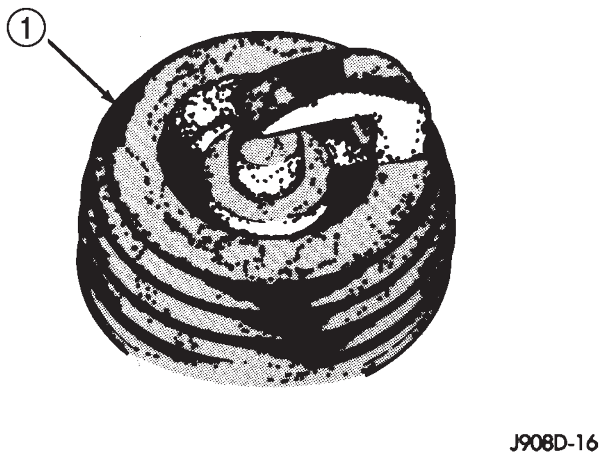


Fig. 34 Spark Plug Overheating

1 - BLISTERED WHITE OR GRAY COLORED INSULATOR

(1) 2.5L 4–Cylinder Engine: Always remove spark plug or ignition coil cables by grasping at the cable boot. Turn the cable boot 1/2 turn and pull straight back in a steady motion. Never pull directly on the cable. Internal damage to cable will result.

(2) Prior to removing the spark plug, spray compressed air around the spark plug hole and the area around the spark plug. This will help prevent foreign material from entering the combustion chamber.

(3) Remove the spark plug using a quality socket with a rubber or foam insert.

(4) Inspect the spark plug condition. Refer to Spark Plugs Conditions.

CLEANING SPARK PLUGS

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.

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.

SPARK PLUG CABLE

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.

DIAGNOSIS AND TESTING - 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

SPARK PLUG CABLE (Continued)

drop, the cable and/or spark plug may not be operating properly and should be replaced. Also check engine cylinder compression.

With the engine not running, connect one end of a test probe to a good ground. Start the engine and run the other end of the test probe along the entire length of all spark plug cables. If cables are cracked or punctured, there will be a noticeable spark jump from the damaged area to the test probe. The cable running from the ignition coil to the distributor cap can be checked in the same manner. Cracked, damaged or faulty cables should be replaced with resistance type cable. This can be identified by the words ELECTRONIC SUPPRESSION printed on the cable jacket.

Use an ohmmeter to test for open circuits, excessive resistance or loose terminals. Remove the distributor cap from the distributor. **Do not remove cables from cap.** Remove cable from spark plug. Connect ohmmeter to spark plug terminal end of cable and to corresponding electrode in distributor cap. Resistance should be 250 to 1000 Ohms per inch of cable. If not, remove cable from distributor cap tower and connect ohmmeter to the terminal ends of cable. If resistance is not within specifications as found in the SPARK PLUG CABLE RESISTANCE chart, replace the cable. Test all spark plug cables in this manner.

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

To test ignition coil-to-distributor cap cable, do not remove the cable from the cap. Connect ohmmeter to rotor button (center contact) of distributor cap and terminal at ignition coil end of cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, remove the cable from the distributor cap. Connect the ohmmeter to the terminal ends of the cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, replace the cable. Inspect the ignition coil tower for cracks, burns or corrosion.

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. 35).

(1) Grasp the boot (not the cable) and pull it off with a steady, even force.

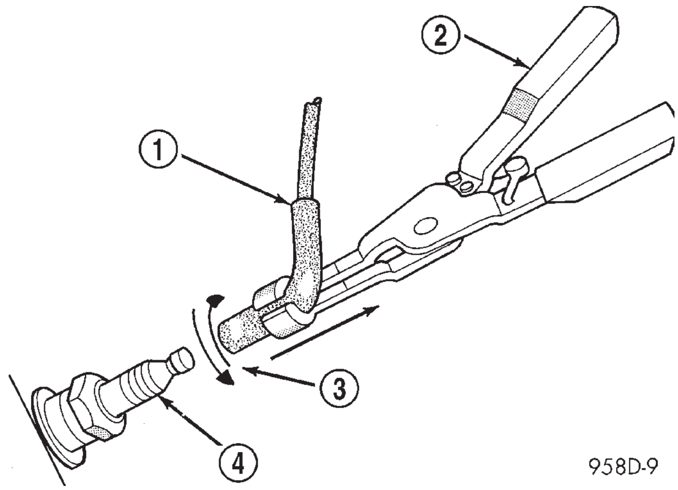


Fig. 35 Cable Removal

1 - SPARK PLUG CABLE AND BOOT
2 - SPARK PLUG BOOT PULLER
3 - TWIST AND PULL
4 - SPARK PLUG

INSTALLATION

(1) Push the cable firmly onto the sparkplug.

INSTRUMENT CLUSTER

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INSTRUMENT CLUSTER

DESCRIPTION

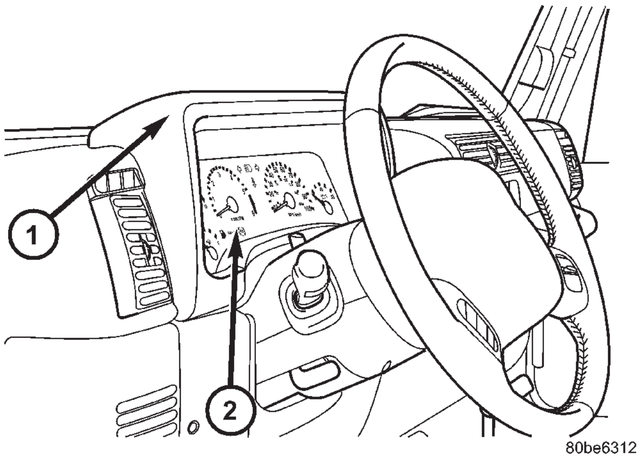

Fig. 1 Instrument Cluster

1 - CLUSTER BEZEL
2 - INSTRUMENT CLUSTER

The instrument cluster for this model is an ElectroMechanical Instrument Cluster (EMIC) module that is located in the instrument panel above the steering column opening, directly in front of the driver (Fig. 1). The EMIC gauges and indicators are protected by an integral clear plastic cluster lens, and are visible through a dedicated opening in the cluster bezel on the instrument panel. Just behind the cluster lens is the cluster hood and integral cluster mask, which are constructed of molded black plastic. The cluster hood serves as a visor and shields the face of the cluster from ambient light and reflections to reduce glare, while the cluster mask trims the outside perimeter of the cluster overlay. Behind the cluster hood and mask is the cluster overlay and gauges. The overlay is a laminated plastic unit. The dark, visible, outer surface of the overlay is marked with all of the gauge identification and graduations, but this layer is also translucent. The darkness of this outer layer prevents the cluster from appearing cluttered or busy by concealing the cluster indicators that are not illuminated, while the translucence of this layer allows those indicators and icons that are illuminated to be readily visible. The underlying layer of the overlay is opaque and allows light from the various indicators and illumination lamps behind it to be visible through the outer layer of the mask only through predetermined stencil-like cutouts. On the lower edge of the cluster lens just right of center, a small molded rubber odometer/trip odometer switch knob boot covers the switch knob and seals the hole in the lens through which the knob protrudes. The remainder of the EMIC, including the mounts and the electrical connections, are concealed behind the cluster bezel. The molded plastic EMIC housing has four integral mounting tabs, two on the lower edge of the housing and one on each side. The EMIC is secured to the instrument panel structural support with four screws. All electrical connections to the EMIC are made at the back of the cluster housing through two color-coded connector receptacles that connect the cluster to the vehicle electrical system through two take outs and connectors of the instrument panel wire harness.

A single EMIC module is offered on this model; however, some variations of this module exist due to optional equipment and regulatory requirements. This module utilizes integrated circuitry and information carried on the Programmable Communications Interface (PCI) data bus network for control of all gauges and many of the indicators. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - DESCRIPTION). The EMIC also uses several hard wired inputs in order to perform its many functions. In addition to instrumentation and indicators, the EMIC has hardware and/or software to support the following functions:

- **Chime Warning Service** - The EMIC performs the functions necessary to provide audible alerts to the vehicle operator and eliminates the need for a separate chime module. (Refer to 8 - ELECTRICAL/CHIME/BUZZER - DESCRIPTION).
- **Interior Lighting Control Service** - The EMIC performs the functions necessary to provide control of the interior lighting. This control includes providing illuminated entry, fade-to-off (theater) dimming, and battery saver (load shedding) features for all interior courtesy lighting.
- **Rear Window Defogger Control and Timer Service** - The EMIC performs the functions necessary to control and time the output to the rear window defogger on vehicles so equipped and eliminates the need for a separate control and timer module for the rear window defogger system. (Refer to 8 - ELECTRICAL/WINDOW DEFOGGER - DESCRIPTION).
- **Vacuum Fluorescent Display (VFD) and Panel Lamps Dimming Service** - The EMIC performs the functions necessary to eliminate the need for a separate dimming module. The cluster converts an analog input signal from the headlamp and panel lamps dimmer switches to the appropriate digital, pulse-width modulated outputs to control the dimming levels of both the instrument cluster and radio VFDs as well as the incandescent cluster and panel illumination lighting. This includes providing features such as VFD illumination when a door is ajar, radio illumination control, a parade mode, and dim-

INSTRUMENT CLUSTER (Continued)

mable cruise, four-wheel drive, and upshift indicators.

The EMIC module incorporates a blue-green electronic digital VFD for displaying odometer, trip odometer, and diagnostic information. The EMIC includes the following analog gauges:

- **Coolant Temperature Gauge**
- **Fuel Gauge**
- **Oil Pressure Gauge**
- **Speedometer**
- **Tachometer**
- **Voltage Gauge**

The EMIC also includes provisions for the following indicators:

- **Airbag Indicator**
- **Antilock Brake System (ABS) Indicator**
- **Brake Indicator**
- **Check Gauges Indicator**
- **Cruise Indicator**
- **Fog Lamp (Front or Rear) Indicator**
- **Four-Wheel Drive (Part Time and/or Full Time) Indicator**
- **High Beam Indicator**
- **Low Fuel Indicator**
- **Malfunction Indicator Lamp (MIL)**
- **Seatbelt Indicator**
- **Sentry Key Immobilizer System (SKIS) Indicator**
- **Turn Signal (Right and Left) Indicators**
- **Upshift Indicator (Manual Transmission)**

Some of these indicators are automatically configured when the EMIC is connected to the vehicle electrical system. This feature allows those indicators to be activated or deactivated for compatibility with certain optional equipment. The EMIC uses electronic messages received over the PCI data bus from the Airbag Control Module (ACM), the Sentry Key Immobilizer Module (SKIM), and the Powertrain Control Module (PCM) to learn whether the vehicle is equipped with airbags, the Sentry Key Immobilizer System (SKIS), or cruise control; then, configures the appropriate indicators accordingly. Once the EMIC learns that a vehicle has these equipment options installed, these indicators will function accordingly for the remainder of the cluster life.

Cluster illumination is accomplished by adjustable incandescent back lighting, which illuminates the gauges for visibility when the exterior lighting is turned on. The EMIC high beam indicator is illuminated by a dedicated incandescent bulb. The remaining indicators in the EMIC are each illuminated by a dedicated Light Emitting Diode (LED) that is soldered onto the electronic circuit board. Each of the incandescent bulbs is secured by an integral bulb holder to the electronic circuit board from the back of the cluster housing.

Hard wired circuitry connects the EMIC to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the EMIC through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

The EMIC modules for this model are serviced only as complete units. The EMIC module cannot be adjusted or repaired. If a gauge, an LED indicator, the VFD, the electronic circuit board, the circuit board hardware, the cluster overlay, or the EMIC housing are damaged or faulty, the entire EMIC module must be replaced. The cluster lens, the cluster hood and mask unit, the rear cluster housing cover, the odometer/trip odometer switch knob boot, and the incandescent lamp bulbs with holders are available for individual service replacement.

OPERATION

The ElectroMechanical Instrument Cluster (EMIC) is designed to allow the vehicle operator to monitor the conditions of many of the vehicle components and operating systems. The gauges and indicators in the EMIC provide valuable information about the various standard and optional powertrains, fuel and emissions systems, cooling systems, lighting systems, safety systems, and many other convenience items. The EMIC is installed in the instrument panel so that all of these monitors can be easily viewed by the vehicle operator when driving, while still allowing relative ease of access for service. The microprocessor-based EMIC hardware and software uses various inputs to control the gauges and indicators visible on the face of the cluster. Some of these inputs are hard wired, but most are in the form of electronic messages that are transmitted by other electronic modules over the Programmable Commutations Interface (PCI) data bus network. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - OPERATION).

The EMIC microprocessor smooths the input data using algorithms to provide gauge readings that are accurate, stable, and responsive to operating conditions. These algorithms are designed to provide gauge readings during normal operation that are consistent with customer expectations. However, when abnormal conditions exist, such as low/high battery

INSTRUMENT CLUSTER (Continued)

voltage, low oil pressure, or high coolant temperature, the algorithm drives the gauge pointer to an extreme position and the microprocessor turns on the Check Gauges indicator to provide a distinct visual indication of a problem to the vehicle operator. The instrument cluster circuitry may also generate a chime tone when it monitors certain conditions or inputs to provide the vehicle operator with an audible alert.

The EMIC circuitry operates on battery current received through the Ignition-Off Draw (IOD) fuse in the Power Distribution Center (PDC) on a non-switched fused B(+) circuit, and on battery current received through a fuse in the fuse block on a fused ignition switch output (run-start) circuit. This arrangement allows the EMIC to provide chime service and interior lighting control regardless of the ignition switch position, while other features will operate only with the ignition switch in the On or Start positions. The EMIC circuitry is grounded by a single ground circuit through one of the instrument cluster connectors and take outs of the instrument panel wire harness. This ground circuit receives ground through a single wire take out with an eyelet terminal connector that is secured under a ground screw to the back of the instrument panel structural support near the lower left corner of the instrument panel, just inboard of the left instrument panel end bracket.

The EMIC also has a self-diagnostic actuator test capability, which will test each of the PCI 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. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). See the owner's manual in the vehicle glove box for more information on the features, use and operation of the EMIC.

GAUGES

All gauges receive battery current through the EMIC circuitry when the ignition switch is in the On or Start positions. With the ignition switch in the Off position battery current is not supplied to any gauges, and the EMIC circuitry is programmed to move all of the gauge needles back to the low end of their respective scales. Therefore, the gauges do not accurately indicate any vehicle condition unless the ignition switch is in the On or Start positions. All of the EMIC gauges, except the odometer, are air core magnetic units. Two fixed electromagnetic coils are located within each 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 pivot shaft, while 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 EMIC circuitry in response to messages received over the PCI data bus. The gauge needle moves as the movable permanent magnet aligns itself to the changing magnetic fields created around it by the electromagnets.

The gauges are diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the data bus message inputs to the EMIC that control each gauge require the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific operation details for each gauge may be found elsewhere in this service information.

VACUUM-FLUORESCENT DISPLAY

The Vacuum-Fluorescent Display (VFD) module is soldered to the EMIC electronic circuit board. The display is active when either door is opened or with the ignition switch in the On or Start positions, and inactive about twenty seconds after both doors are closed when the ignition switch is in any other position. If a door is left open with ignition switch in any position except On or Start, the VFD will remain illuminated until the interior lights control battery saver (load shedding) timer expires after about twenty minutes. The VFD has several display capabilities including: odometer, trip odometer, software version display, and can display various diagnostic information. An odometer/trip odometer switch on the EMIC circuit board is used to control several of the display modes. This switch is actuated manually by depressing the odometer/trip odometer switch knob that extends through the lower edge of the cluster lens, just right of center. Actuating this switch momentarily with the VFD illuminated will toggle the display between the odometer and trip odometer modes. Depressing the switch button for about two seconds while the VFD is in the trip odometer mode will reset the trip odometer value to zero. Holding this switch depressed while turning the ignition switch from the Off position to the On position will activate the EMIC self-diagnostic actuator test. When illuminated, the VFD will automatically display the message “no BuS” in place of the odometer or trip odometer information if there is a loss of PCI data bus communication, and will display the message “noFuSE” if the instrument cluster is not receiving battery current through the fused B(+) circuit from the Ignition-Off Draw (IOD) fuse. The VFD will

INSTRUMENT CLUSTER (Continued)

also display various information used in several diagnostic procedures. Refer to the appropriate diagnostic information for additional details on these VFD functions.

The VFD is diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the data bus message inputs to the EMIC that control some of the VFD functions requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific operation details for the odometer and trip odometer functions of the VFD may be found elsewhere in this service information.

INDICATORS

Indicators are located in various positions within the EMIC and are all connected to the EMIC electronic circuit board. The antilock brake system indicator, four-wheel drive indicators, headlamp high beam indicator, front/rear fog lamp indicator, and turn signal indicators are hard wired. The brake indicator is controlled by the hard wired park brake/brake warning indicator switch input to the EMIC and the EMIC programming. The seatbelt indicator is controlled by the hard wired seat belt switch input to the EMIC and the EMIC programming. The Malfunction Indicator Lamp (MIL) is normally controlled by PCI data bus messages from the Powertrain Control Module (PCM); however, if the EMIC loses PCI data bus communications, the EMIC circuitry will automatically turn the MIL on and display the message “no BuS” in the odometer VFD until PCI data bus communication is restored. The EMIC uses PCI data bus messages from the PCM, Airbag Control Module (ACM), and the Sentry Key Immobilizer Module (SKIM) to control all of the remaining indicators. Different indicators are controlled by different strategies; some receive fused ignition switch output from the EMIC circuitry and have a switched ground, while others are grounded through the EMIC circuitry and have a switched battery feed.

In addition, certain indicators in this instrument cluster are configurable. This feature allows these indicators to be automatically enabled or disabled by the EMIC circuitry for compatibility with certain optional equipment. The airbag indicator, cruise indicator, and the Sentry Key Immobilizer System (SKIS) indicator are automatically configured. Once a configurable indicator is enabled by the EMIC, it is learned and stored in cluster memory for the remainder of the cluster life.

The hard wired indicators are diagnosed using conventional diagnostic methods. The EMIC and PCI bus message controlled indicators are diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the data bus message inputs to the EMIC that control each indicator requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific operation details for each indicator may be found elsewhere in this service information.

CLUSTER ILLUMINATION

The EMIC has several illumination lamps that are illuminated when the exterior lighting is turned on with the headlamp switch circuitry of the left multi-function switch. The illumination brightness of these lamps is adjusted by the panel lamps dimmer rheostat when the control ring on the left multi-function switch control stalk is rotated (downward to dim, upward to brighten). An analog/digital (A/D) converter in the EMIC converts the analog panel lamps dimmer rheostat input from the left multi-function switch to a digital dimming level pulse-width modulated signal for controlling the lighting levels of the EMIC VFD and cluster illumination lamps. The EMIC also controls and synchronizes the radio and other instrument panel lighting levels through a hard wired panel lamp feed output circuit.

The hard wired cluster illumination inputs and outputs are diagnosed using conventional diagnostic methods. Proper testing of the VFD dimming level and the EMIC A/D converter function require the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

CHIME SERVICE

The EMIC is equipped with hardware and software to provide chime service for all available features in the chime warning system. Upon receiving the proper chime inputs, the EMIC activates an integral chime tone generator to provide the audible chime tone to the vehicle operator. The chime tone generator in the EMIC is capable of producing single chime tones or repeated chime tones at two different rates: a slow rate of about fifty chime tones per minute, and a fast rate of about 180 chime tones per minute. The internal programming of the EMIC determines the priority of each chime tone request input that is received, as well as the rate and duration of each chime tone that is to be generated.

The EMIC relies upon hard wired inputs from the door ajar switches, the left multi-function switch, the ignition switch, and the park brake/brake warning indicator switches to provide chime service for the driver/passenger door ajar warning, the head/park lights-on reminder, and the key-in ignition reminder. For the remaining chime warning functions the EMIC uses a combination of hard wired inputs, elec-

INSTRUMENT CLUSTER (Continued)

tronic message inputs received from other modules over the PCI data bus, and internal programming. (Refer to 8 - ELECTRICAL/CHIME/BUZZER - OPERATION). The hard wired chime inputs to the EMIC are diagnosed using conventional diagnostic methods. Proper testing of the EMIC, its programming, and the PCI data bus chime request message functions requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

INTERIOR LIGHTING CONTROL

The EMIC contains an integral timer and logic circuit to perform both timer and control functions for the interior courtesy lamps. The EMIC uses hard wired inputs from the ignition switch, both door ajar switches on separate driver and passenger door ajar switch sense circuits, from the resistor multiplexed panel lamps dimmer circuitry of the left multi-function switch on the panel lamps dimmer signal circuit and its control logic to provide a battery current output to the courtesy lamps on a courtesy lamp feed circuit. The EMIC control provides a theater-type fade-to-off feature that will slowly dim the courtesy lamps about five seconds after both doors are closed. The EMIC also provides an illuminated entry/exit feature by monitoring the door ajar and ignition switch inputs. When a door is opened with the ignition switch in the Off position, the EMIC turns on the courtesy lamps. When the ignition switch is turned to the On or Start positions, the EMIC turns the courtesy lamps off immediately with no theater dimming. When the ignition switch is turned from the On position to the Off position, the EMIC turns on the interior lights for about ten seconds or until the ignition switch is again turned to the On or Start positions, whichever occurs first. The EMIC also provides a battery saver feature (load shedding) for the interior lighting. Unless the engine is running, the instrument cluster will automatically turn off the interior lights if they are left on for more than about twenty minutes, regardless of the status of the ignition switch, door ajar switch, or left multi-function switch inputs to the cluster.

The hard wired inputs and output of the EMIC interior lighting control can be diagnosed using conventional diagnostic methods; however, there are no other diagnostic tools available for the EMIC timer and logic circuitry. If the input and output components and circuits of the interior lighting system test OK, but the system fails to operate, the EMIC must be replaced.

REAR WINDOW DEFOGGER CONTROL

The EMIC contains an integral timer and logic circuit to perform the rear window defogger timer and control functions for the optional rear window defogger system. The EMIC uses a hard wired input from the rear window defogger switch on the rear window defogger switch sense circuit and its control logic to determine the correct output to the rear window defogger relay. The EMIC controls the ground path of the rear window defogger relay control coil through an output on the rear window defogger relay control circuit. The EMIC is programmed to interpret each momentary ground signal it receives on the rear window defogger switch sense circuit as a request to change the current state of the output on the rear window defogger relay control circuit. Therefore, with the ignition switch in the On position, the first ground input on the rear window defogger switch sense circuit turns the system On, the second ground input turns the system Off, and so forth. Once the rear window defogger system has been turned On, it can be turned off manually by depressing the rear window defogger switch a second time or by turning the ignition switch to the Off position. The timer function of the EMIC will also automatically turn the rear window defogger system Off. The timer turns the system Off after about ten minutes of operation; however, after the first timed interval has expired, each time the system is turned On again during that same ignition cycle, the timer will automatically turn it Off after about five minutes of operation.

The hard wired input and output of the EMIC rear window defogger control can be diagnosed using conventional diagnostic methods; however, there are no other diagnostic tools available for the EMIC rear window defogger timer and logic circuitry. If the input and output components and circuits of the rear window defogger system test OK, but the system fails to operate, the EMIC must be replaced.

DIAGNOSIS AND TESTING - INSTRUMENT CLUSTER

If all of the instrument cluster gauges and/or indicators are inoperative, refer to PRELIMINARY DIAGNOSIS . If an individual gauge or Programmable Communications Interface (PCI) data bus message-controlled indicator is inoperative, refer to ACTUATOR TEST . If an individual hard wired indicator is inoperative, refer to the diagnosis and testing information for that specific indicator. If the instrument cluster chime service is inoperative, refer to CHIME SERVICE DIAGNOSIS . If the instrument cluster illumination lighting is inoperative, refer to CLUSTER ILLUMINATION DIAGNOSIS . If the instrument cluster interior lighting control function is inoperative, refer to INTERIOR LIGHTING CONTROL DIAGNOSIS . If the instrument cluster rear window defogger control function is inoperative, refer to REAR WINDOW DEFOGGER CONTROL DIAGNOSIS . Refer to the appropriate wiring information.

INSTRUMENT CLUSTER (Continued)

The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

NOTE: Certain indicators in this instrument cluster are automatically configured. This feature allows those indicators to be activated for compatibility with certain optional equipment. If the problem being diagnosed involves illumination of the airbag indicator, the cruise indicator, or the SKIM indicator when the vehicle does not have this equipment, the instrument cluster must be replaced with a new unit.

PRELIMINARY DIAGNOSIS

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.

(1) If the indicators operate, but none of the gauges operate, go to Step 2. If all of the gauges and the PCI data bus message-controlled indicators are inoperative, go to Step 5.

(2) Check the fused B(+) fuse (Fuse 24 - 10 ampere) 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 (Fuse 24 - 10 ampere) in the PDC. If OK, go to Step 4. If not OK, repair the open B(+) circuit between the PDC and the battery as required.

(4) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Reconnect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the instrument panel wire harness connector (Connector C1) for the instrument cluster. If OK, refer to ACTUATOR TEST . If not OK, repair the open fused B(+) circuit between the instrument cluster and the PDC as required.

(5) Check the fused ignition switch output (run-start) fuse (Fuse 10 - 10 ampere) in the fuse block. If OK, go to Step 6. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(6) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run-start) fuse (Fuse 10 - 10 ampere) in the fuse block. If OK, go to Step 7. If not OK, repair the open fused ignition switch output (run-start) circuit between the fuse block and the ignition switch as required.

(7) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Reinstall the instrument cluster. Reconnect the battery negative cable. Turn the ignition switch to the On position. Set the park brake. The brake indicator in the instrument cluster 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 control ring on the left multi-function switch to the full bright position. The cluster illumination lamps should light. If OK, refer to ACTUATOR TEST . If not OK, go to Step 10.

(9) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the instrument cluster. Reconnect 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 panel wire harness connector (Connector C1) for the instrument cluster. If OK, refer to ACTUATOR TEST . If not OK, repair the open fused ignition switch output (run-start) circuit between the instrument cluster and the fuse block as required.

(10) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Check for continuity between the ground circuit cavity of the instrument panel wire harness connector (Connector C1) for the instrument cluster and a good ground. There should be continuity. If OK, refer to ACTUATOR TEST . If not OK, repair the open ground circuit to ground (G201) as required.

INSTRUMENT CLUSTER (Continued)

ACTUATOR TEST

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.

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, the PCI data bus message controlled indicator lamps, and the chime tone generator are capable of operating as designed. During the actuator test the instrument cluster circuitry will sound the chime tone generator, position each of the gauge needles at various specified calibration points, illuminate each of the segments in the Vacuum-Fluorescent Display (VFD), and turn all of the PCI data bus message-controlled indicators on and off again.

Successful completion of the actuator test will confirm that the instrument cluster is operational. However, there may still be a problem with the PCI 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 DRBIII® scan tool to diagnose these components. Refer to the appropriate diagnostic information.

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 screws securing the inoperative gauge to the instrument cluster electronic circuit board are properly tightened before considering instrument cluster replacement. If the gauge mounting screws check OK, replace the faulty instrument cluster.

(1) Begin the test with the ignition switch in the Off position.

(2) Depress the odometer/trip odometer switch button.

(3) While still holding the odometer/trip odometer switch button depressed, turn the ignition switch to the On position, but do not start the engine.

(4) Release the odometer/trip odometer switch button.

(5) The instrument cluster will automatically begin the actuator test sequence, as follows:

(a) The cluster will generate a single chime tone to confirm the functionality of the chime tone generator and the chime control circuitry.

(b) The cluster will scroll the number “8” across the odometer/trip odometer VFD to confirm the functionality of all VFD segments and their control circuitry.

(c) The cluster will illuminate the decimal point in the odometer/trip odometer VFD to confirm the functionality of this VFD segment and its control circuitry.

(d) The cluster will display the EMIC software level in the odometer/trip odometer VFD (example: “SOF 8.9”).

(e) The cluster will display the last six digits (sequence number) of the Vehicle Identification Number (VIN) in the odometer/trip odometer VFD.

(f) If any faults have been set by the cluster, the cluster will display the fault information in the odometer/trip odometer VFD. If no faults have been set, the cluster will scroll “no FAULtS” across the odometer/trip odometer VFD.

(g) The cluster will turn on, then off again each of the following indicators, one at a time, in sequence to confirm the functionality of the indicator and the cluster control circuitry:

- High Beam
- Brake
- Seatbelt
- MIL
- Check Gauges
- Low Fuel
- Full Time
- Part Time
- SKIS
- Cruise
- Upshift

(h) The cluster will sweep the needles for each of the following gauges, one at a time, to several calibration points in sequence to confirm the functionality of the gauge and the cluster control circuitry:

- Speedometer
- Fuel
- Temperature
- Tachometer
- Voltage
- Oil Pressure

INSTRUMENT CLUSTER (Continued)

INSTRUMENT CLUSTER FAILURE MESSAGE		
VFD Message	Description	Correction
″buS b0″	PCM - MIL Message	The cluster is not receiving a MIL lamp message from the PCM. A DRBIII® scan tool is required for further diagnosis. Refer to the appropriate diagnostic information.
″buS b1″	SKIM - SKIM Message	The cluster is not receiving a SKIS lamp message from the SKIM. A DRBIII® scan tool is required for further diagnosis. Refer to the appropriate diagnostic information.
″buS b8″	ACM - Airbag Message	The cluster is not receiving an Airbag lamp message from the ACM. A DRBIII® scan tool is required for further diagnosis. Refer to the appropriate diagnostic information.
″PanEL OPEn″	Panel Sense - Open Circuit	The cluster is not receiving an input from the the panel lamps dimmer circuitry of the left multi-function switch on the panel lamps dimmer signal circuit. Repair the open circuit or replace the faulty switch as required.
″Airbag″	Telltale Open/Shorted	The EMIC airbag indicator is open or shorted. Replace the faulty cluster.

(6) The actuator test is now completed. 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 over the PCI data bus during the test.

(7) Go back to Step 1 to repeat the test, if required.

CHIME SERVICE DIAGNOSIS

Before performing this test, complete the testing of each of the hard wired chime warning system switches. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

NOTE: The following tests may not prove conclusive in the diagnosis of this system. The most reliable, efficient, and accurate means to diagnose the Chime Service function of the instrument cluster requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster from the instrument panel.

(2) Disconnect the cross body wire harness connector for the ignition switch from the switch connector receptacle. Check for continuity between the key-in switch sense circuit cavity of the instrument panel wire harness connector (Connector C2) for the instrument cluster and a good ground. There should be no continuity. If OK, go to Step 3. If not OK, repair the shorted key-in switch sense circuit as required.

(3) Check for continuity between the key-in switch sense circuit cavities of the instrument panel wire harness connector for the instrument cluster (Connector C2) and the cross body wire harness connector for the ignition switch. There should be continuity. If OK, go to Step 4. If not OK, repair the open key-in ignition switch sense circuit between the instrument cluster and the ignition switch as required.

(4) Disconnect the floor wire harness connector from the seat belt switch pigtail wire connector.

INSTRUMENT CLUSTER (Continued)

Check for continuity between the seat belt switch sense circuit cavity of the instrument panel wire harness connector (Connector C2) for the instrument cluster and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the shorted seat belt switch sense circuit between the instrument cluster and the seat belt switch as required.

(5) Check for continuity between the seat belt switch sense circuit cavities of the instrument panel wire harness connector (Connector C2) for the instrument cluster and the floor wire harness connector for the seat belt switch. There should be continuity. If OK, refer to PRELIMINARY DIAGNOSIS . If not OK, repair the open seat belt switch sense circuit between the instrument cluster and the seat belt switch as required.

INTERIOR LIGHTING CONTROL DIAGNOSIS

Before performing this test, complete the testing of each of the hard wired interior lighting switches. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

NOTE: The following tests may not prove conclusive in the diagnosis of this system. The most reliable, efficient, and accurate means to diagnose the Interior Lighting Control function of the instrument cluster requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

(1) Check the door ajar switch output fuse (Fuse 4 - 10 ampere) in the fuse block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for continuity between the door ajar switch output fuse (Fuse 4 - 10 ampere) in the fuse block and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open ground circuit between the fuse block and ground (G300) as required.

(3) Disconnect and isolate the battery negative cable. Disconnect the cross body wire harness connector for the driver and/or passenger door ajar switch from the switch connector receptacle. Check for continuity between the door ajar switch output circuit cavity of the driver or passenger door ajar switch and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open door ajar switch output circuit between the driver or passenger door ajar switch and the fuse block as required.

(4) Remove the instrument cluster from the instrument panel. Disconnect the instrument panel wire harness connector (Connector C2) for the instrument cluster from the cluster connector receptacle. Check for continuity between the driver and/or passenger door ajar switch sense circuit cavities of the instrument panel wire harness connector (Connector C2) for the instrument cluster and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the shorted driver and/or passenger door ajar switch sense circuits between the instrument cluster and the driver and/or passenger door ajar switches as required.

(5) Check for continuity between the driver and/or passenger door ajar switch sense circuit cavities of the instrument panel wire harness connector (Connector C2) for the instrument cluster and the cross body wire harness connector for the driver and/or passenger door ajar switches. There should be continuity. If OK, use a DRBIII® scan tool to complete the diagnosis of the instrument cluster interior lighting control. Refer to the appropriate diagnostic information. If not OK, repair the open driver and/or passenger door ajar switch sense circuits between the instrument cluster and the driver and/or passenger door ajar switches as required.

REAR WINDOW DEFOGGER CONTROL DIAGNOSIS

Before performing this test, complete the testing of the rear window defogger switch and the rear window defogger relay. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

INSTRUMENT CLUSTER (Continued)

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.

(1) Disconnect and isolate the battery negative cable. Remove the rear window defogger relay from the receptacle in the Power Distribution Center (PDC). Disconnect the instrument panel wire harness connector for the rear window defogger switch from the switch connector receptacle. Remove the instrument cluster from the instrument panel.

(2) Check for continuity between the rear window defogger switch sense circuit cavity of the instrument panel wire harness connector (Connector C2) for the instrument cluster and a good ground. There should be no continuity. If OK, go to Step 3. If not OK, repair the shorted rear window defogger switch sense circuit between the instrument cluster and the rear window defogger switch as required.

(3) Check for continuity between the rear window defogger switch sense circuit cavities of the instrument panel wire harness connectors for the instrument cluster (Connector C2) and the rear window defogger switch. There should be continuity. If OK, go to Step 4. If not OK, repair the open rear window defogger switch sense circuit between the instrument cluster and the rear window defogger switch as required.

(4) Check for continuity between the rear window defogger relay control circuit cavity of the instrument panel wire harness connector (Connector C2) for the instrument cluster and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the shorted rear window defogger relay control circuit between the instrument cluster and the PDC as required.

(5) Check for continuity between the rear window defogger relay control circuit cavities of the instrument panel wire harness connector (Connector C2) for the instrument cluster and the rear window defogger relay receptacle in the PDC. There should be continuity. If OK, replace the faulty instrument cluster. If not OK, repair the open rear window defogger relay control circuit between the instrument cluster and the PDC as required.

CLUSTER ILLUMINATION DIAGNOSIS

The diagnosis found here addresses an inoperative instrument cluster illumination lamp condition. If the problem being diagnosed is a single inoperative illumination lamp, be certain that the bulb and bulb holder unit are properly installed in the instrument cluster electronic circuit board. If no installation problems are found replace the faulty bulb and bulb holder unit. If all of the cluster illumination lamps are inoperative and the problem being diagnosed includes inoperative exterior lighting controlled by the left multi-function switch, that system needs to be repaired first. If the exterior lamps controlled by the left multi-function switch are inoperative, (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP - DIAGNOSIS AND TESTING). If no exterior lighting system problems are found, the following procedure will help locate a short or open in the cluster illumination lamp circuit. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

(1) Disconnect and isolate the battery negative cable. Disconnect the cross body wire harness connector for the left multi-function switch from the switch connector receptacle. Check for continuity between the ground circuit cavity of the cross body wire harness connector for the left multi-function switch and a good ground. There should be continuity. If OK, go to Step 2. If not OK, repair the open ground circuit to ground (G300) as required.

(2) Remove the instrument cluster from the instrument panel. Disconnect the instrument panel wire harness connector (Connector C2) for the instrument cluster from the cluster connector receptacle. Check for continuity between the panel lamp dimmer signal circuit cavity of the instrument panel wire harness connector (Connector C2) for the instrument cluster

INSTRUMENT CLUSTER (Continued)

and a good ground. There should be no continuity. If OK, go to Step 3. If not OK, repair the shorted panel lamp dimmer signal circuit between the instrument cluster and the left multi-function switch as required.

(3) Check for continuity between the panel lamp dimmer signal circuit cavities of the instrument panel wire harness connector (Connector C2) for the instrument cluster and the cross body wire harness connector for the left multi-function switch. There should be continuity. If OK, use a DRBIII® scan tool to complete the diagnosis of the instrument cluster illumination lighting. Refer to the appropriate diagnostic information. If not OK, repair the open panel lamp dimmer signal circuit between the instrument cluster and the left multi-function switch as required.

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - REMOVAL).

(3) Remove the four screws that secure the instrument cluster to the instrument panel structural support (Fig. 2).

(4) Pull the instrument cluster forward far enough to access and disconnect the two instrument panel wire harness connectors for the instrument cluster from the connector receptacles on the back of the cluster housing.

(5) Remove the instrument cluster from the instrument panel.

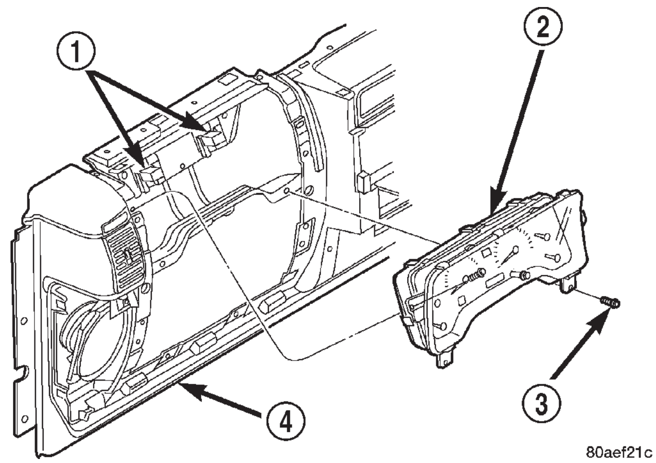

Fig. 2 Instrument Cluster Remove/Install

1 - WIRE HARNESS CONNECTORS
2 - INSTRUMENT CLUSTER
3 - SCREW (4)
4 - INSTRUMENT PANEL

DISASSEMBLY

Some of the components for the instrument cluster used in this vehicle are serviced individually. The serviced components include: the incandescent instrument cluster indicator and illumination lamp bulbs (including the integral bulb holders), the cluster lens, the trip odometer reset knob boot, the cluster hood and mask unit, and the cluster housing rear cover. Following are the procedures for disassembling these components from the instrument cluster unit.

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CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp or indicator bulb and bulb holder units. However, the illumination lamps and the indicators use different bulb and bulb holder unit sizes. They must never be interchanged.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

INSTRUMENT CLUSTER (Continued)

(3) Turn the bulb holder counterclockwise about sixty degrees on the cluster electronic circuit board (Fig. 3).

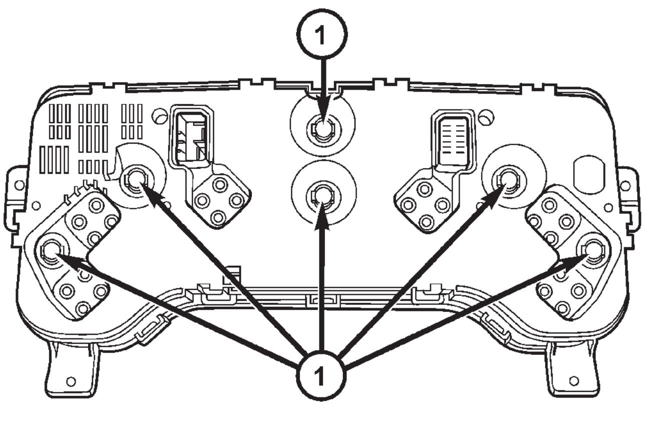

Fig. 3 Cluster Bulb Locations

1 - CLUSTER INCANDESCENT BULBS

(4) Pull the bulb and bulb holder unit straight back to remove it from the bulb mounting hole in the cluster electronic circuit board.

CLUSTER LENS

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) Work around the perimeter of the cluster lens and disengage each of the latches that secure the lens to the cluster housing (Fig. 4).

(4) Gently pull the cluster lens away from the cluster housing.

TRIP ODOMETER RESET KNOB BOOT

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) Remove the cluster lens from the cluster housing. Refer to CLUSTER LENS for the proper cluster lens removal procedures.

(4) Remove the odometer reset knob boot by pulling it out from the face of the cluster lens (Fig. 4).

CLUSTER HOOD AND MASK

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

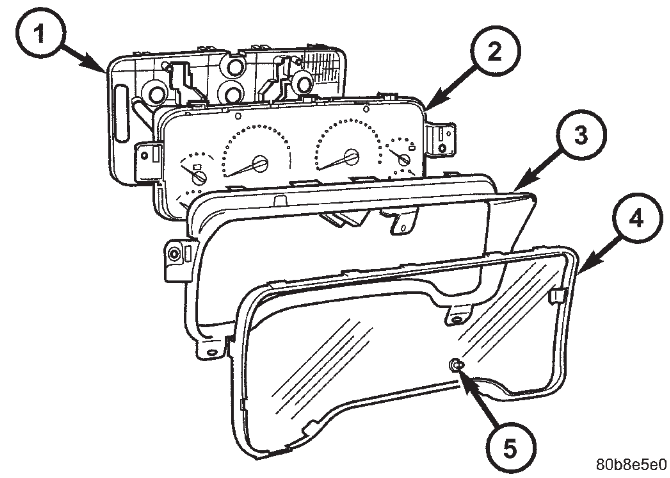

Fig. 4 Instrument Cluster Components

1 - CLUSTER HOUSING REAR COVER
2 - CLUSTER HOUSING
3 - CLUSTER HOOD & MASK
4 - CLUSTER LENS
5 - RESET KNOB BOOT

(3) Remove the cluster lens from the cluster housing. Refer to CLUSTER LENS for the proper cluster lens removal procedures.

(4) Work around the perimeter of the cluster hood and mask unit and disengage each of the latches that secure the cluster hood and mask unit to the cluster housing (Fig. 4).

(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 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) Remove the two screws that secure the rear cover to the cluster housing.

(4) Work around the perimeter of the cluster housing rear cover and disengage each of the latches that secure the cover to the outside of the cluster housing (Fig. 4).

(5) Disengage the one inboard latch located near the lower edge of the rear cover just right of center that secures the rear cover to the cluster housing.

(6) Gently pull the cluster housing rear cover away from the back of the cluster housing.

INSTRUMENT CLUSTER (Continued)

ASSEMBLY

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CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp or indicator bulb and bulb holder units. However, the illumination lamps and the indicators use different bulb and bulb holder unit sizes. They must never be interchanged.

CAUTION: 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) Insert the bulb and bulb holder unit straight into the correct bulb mounting hole in the cluster electronic circuit board (Fig. 3).

(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) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(4) Reconnect the battery negative cable.

CLUSTER LENS

(1) Align the cluster lens with the cluster hood and mask unit (Fig. 4). Be certain that the trip odometer reset knob boot is aligned with the reset switch knob.

(2) Press firmly and evenly on the cluster lens to install it onto the cluster housing.

(3) Work around the perimeter of the cluster lens to be certain that each of the latches that secure the lens to the cluster housing is fully engaged.

(4) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(5) Reconnect the battery negative cable.

TRIP ODOMETER RESET KNOB BOOT

(1) Position the trip odometer reset knob boot to the mounting hole from the back of the cluster lens (Fig. 4).

(2) Gently pull the trip odometer reset knob boot into the mounting hole from the face of the cluster lens.

(3) Reinstall the cluster lens onto the cluster housing. Refer to CLUSTER LENS for the proper cluster lens installation procedures.

(4) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(5) Reconnect the battery negative cable.

CLUSTER HOOD AND MASK

(1) Align the cluster hood and mask unit with the cluster housing (Fig. 4).

(2) Press firmly and evenly on the cluster hood and mask unit to install it onto the cluster housing.

(3) Work around the perimeter of the cluster hood and mask unit to be certain that each of the latches that secure the hood and mask unit to the cluster housing is fully engaged.

(4) Reinstall the cluster lens onto the cluster housing. Refer to CLUSTER LENS for the proper cluster lens installation procedures.

(5) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(6) Reconnect the battery negative cable.

CLUSTER HOUSING REAR COVER

(1) Position the cluster housing rear cover to the back of the cluster housing.

(2) Press firmly and evenly on the cluster housing rear cover to install it onto the cluster housing.

(3) Work around the perimeter of the cluster housing rear cover to be certain that each of the latches that secure the rear cover to the cluster housing is fully engaged.

(4) Install and tighten the two screws that secure the rear cover to the cluster housing. Tighten the screws to 2 N·m (20 in. lbs.).

(5) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(6) Reconnect the battery negative cable.

INSTRUMENT CLUSTER (Continued)

INSTALLATION

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.

(1) Position the instrument cluster to the instrument panel.

(2) Reconnect the two instrument panel wire harness connectors for the instrument cluster to the connector to the connector receptacles on the back of the cluster housing (Fig. 2).

(3) Position the instrument cluster to the instrument panel structural support.

(4) Install and tighten the four screws that secure the instrument cluster to the instrument panel structural support. Tighten the screws to 2.2 N·m (20 in. lbs.).

(5) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/ CLUSTER BEZEL - INSTALLATION).

(6) Reconnect the battery negative cable.

NOTE: Some of the indicators in a new instrument cluster are automatically configured (airbag, cruise, and Sentry Key Immobilizer System indicators) when the cluster is connected to the vehicle electrical system. This feature allows those indicators to be automatically enabled for compatibility with certain optional equipment.

ABS INDICATOR

DESCRIPTION

An Antilock Brake System (ABS) indicator is standard equipment on all instrument clusters, but is only functional on vehicles equipped with the ABS option. The ABS indicator is located near the lower edge of the instrument cluster overlay, to the left of the odometer/trip odometer Vacuum-Fluorescent Display (VFD). The ABS indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Failure of Anti-lock Braking System” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber lens behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. The ABS indicator is serviced as a unit with the instrument cluster.

OPERATION

The ABS indicator gives an indication to the vehicle operator when the ABS system is faulty or inoperative. This indicator is hard wired on the instrument cluster electronic circuit board, and is completely controlled by the Controller Antilock Brake (CAB). The ABS indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the CAB through the CAB relay in the Power Distribution Center (PDC). The CAB continually monitors the ABS circuits and sensors to decide whether the system is in good operating condition. The indicator is turned on by the CAB for about two seconds after the ignition switch is turned to the On position as a bulb test. After the bulb test, the CAB turns the indicator on or off based upon the results of the ABS self-tests. If the CAB turns the indicator on after the bulb test, it indicates that the CAB has detected a system malfunction and/or that the ABS system has become inoperative. (Refer to 5 - BRAKES - DESCRIPTION). The ABS indicator can be diagnosed using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - ABS INDICATOR

The diagnosis found here addresses an inoperative Antilock Brake System (ABS) indicator condition. If there are problems with several indicators in the instrument cluster, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the ABS indicator stays on with the ignition switch in the On position or comes on and stays on while driving, (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING). If no ABS problem is found, the following procedure will help to locate a short or open in the ABS indicator lamp circuit. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing

ABS INDICATOR (Continued)

and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster from the instrument panel. Disconnect the instrument panel wire harness connector (Connector C2) for the instrument cluster from the connector receptacle on the back of the cluster housing. Reconnect the battery negative cable. Turn the ignition switch to the On position and within about two seconds check for continuity between the ABS warning indicator driver circuit cavity of the instrument panel wire harness connector (Connector C2) for the instrument cluster and a good ground. There should be continuity for about two seconds after ignition On, and then an open circuit. If OK, proceed to the diagnosis for the ABS brake system. (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING). If not OK, go to Step 2.

(2) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the Controller Antilock Brake (CAB) relay from the receptacle in the Power Distribution Center (PDC). Check for continuity between the ABS warning indicator driver circuit cavity of the instrument panel wire harness connector (Connector C2) for the instrument cluster and a good ground. There should be no continuity. If OK, go to Step 3. If not OK, repair the shorted ABS warning indicator driver circuit between the instrument cluster and the PDC as required.

(3) Check for continuity between the ABS warning indicator driver circuit cavities of the instrument panel wire harness connector (Connector C2) for the instrument cluster and the CAB relay receptacle in the PDC. There should be continuity. If OK, proceed to the diagnosis for the ABS brake system. (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING). If not OK, repair the open ABS warning indicator driver circuit between the instrument cluster and the PDC as required.

AIRBAG INDICATOR

DESCRIPTION

An airbag indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with airbags, this indicator is electronically disabled. The airbag indicator is located near the lower edge of the instrument cluster overlay, to the right of the odometer/trip odometer Vacuum-Fluorescent Display (VFD). The airbag indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Airbag” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when the it is not illuminated. A red lens behind the cutout in the opaque layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. The airbag indicator is serviced as a unit with the instrument cluster.

OPERATION

The airbag indicator gives an indication to the vehicle operator when the airbag system is faulty or inoperative. The airbag indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Airbag Control Module (ACM) over the Programmable Communications Interface (PCI) data bus. The airbag indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the airbag indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the airbag indicator is illuminated for about seven seconds. The first two seconds is the cluster bulb test function, and the remainder is the ACM bulb test function.
- **ACM Lamp-On Message** - Each time the cluster receives a lamp-on message from the ACM, the airbag indicator will be illuminated. The indicator remains illuminated for about twelve seconds or until the cluster receives a lamp-off message from the ACM, whichever is longer.
- **Communication Error** - If the cluster receives no airbag messages for five consecutive seconds, the airbag indicator is illuminated. The indicator

AIRBAG INDICATOR (Continued)

remains illuminated for about twelve seconds or until the cluster receives a single lamp-off message from the ACM, whichever is longer.

- **Actuator Test** - Each time the cluster is put through the actuator test, the airbag indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The ACM continually monitors the airbag system circuits and sensors to decide whether the system is in good operating condition. The ACM then sends the proper lamp-on or lamp-off messages to the instrument cluster. If the ACM sends a lamp-on message after the bulb test, it indicates that the ACM has detected a system malfunction and/or that the airbags may not deploy when required, or may deploy when not required. The ACM will store a Diagnostic Trouble Code (DTC) for any malfunction it detects. Each time the airbag indicator fails to illuminate due to an open or short in the cluster airbag indicator circuit, the cluster sends a message notifying the ACM of the condition and stores a DTC. For further diagnosis of the airbag indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the airbag system, the ACM, the PCI data bus, or the message inputs to the instrument cluster that control the airbag indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

BRAKE/PARK BRAKE INDICATOR

DESCRIPTION

A brake indicator is standard equipment on all instrument clusters. The brake indicator is located near the lower edge of the instrument cluster overlay, to the left of the odometer/trip odometer Vacuum-Fluorescent Display (VFD). The brake indicator consists of a stencil-like cutout of the word “BRAKE” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red lens behind the cutout in the opaque layer of the overlay causes the “BRAKE” text to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. The brake indicator is serviced as a unit with the instrument cluster.

OPERATION

The brake indicator gives an indication to the vehicle operator when the parking brake is applied, or when there are certain brake hydraulic system malfunctions. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming, electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus, and hard wired inputs to the instrument cluster from the park brake switch and the brake warning indicator switch. The brake indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the brake indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On or Start positions the brake indicator is illuminated for about four seconds as a bulb test.
- **Park Brake Switch Input** - Each time the cluster detects ground on the red brake warning indicator driver circuit (park brake switch closed = park brake applied or not fully released) the brake indicator is illuminated solid. If a vehicle speed message is received by the cluster from the PCM over the PCI data bus indicating the vehicle is moving while the red brake warning indicator driver input is ground, the brake indicator is flashed on and off repeatedly. Whether illuminated solid or flashing, the indicator remains illuminated until the red brake warning indicator driver input to the cluster is an open circuit (park brake switch open = park brake fully released), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Brake Hydraulic System Malfunction** - Each time the cluster detects ground on the red brake warning indicator driver circuit (brake warning indicator switch closed = pressures in the two halves of the split brake hydraulic system are unequal) the brake indicator is illuminated solid. The indicator remains illuminated until the red brake warning indicator driver input to the cluster is an open circuit (brake warning indicator switch open = brake hydraulic system pressures are equal), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the instrument cluster is put through the actuator test, the brake indicator will be turned on, then off again during the

BRAKE/PARK BRAKE INDICATOR (Continued)

bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The park brake switch and the brake warning pressure switch are each connected in parallel between ground and the red brake warning indicator driver input to the instrument cluster so that each of their inputs will illuminate the indicator independently of the other. The park brake switch and brake warning indicator switch inputs to the instrument cluster can be diagnosed using conventional diagnostic tools and methods. (Refer to 5 - BRAKES/PARKING BRAKE - OPERATION). (Refer to 5 - BRAKES/ELECTRICAL/BRAKE PRESSURE SWITCH - OPERATION). For further diagnosis of the brake indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the brake indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

DIAGNOSIS AND TESTING - BRAKE INDICATOR

The diagnosis found here addresses an inoperative brake indicator condition. If there are problems with several indicators in the instrument cluster, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the brake indicator lamp stays on with the ignition switch in the On position and the park brake released, or comes on while driving, (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING). If no brake system problem is found, the following procedures will help to locate a shorted or open circuit, or a faulty switch input. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

INDICATOR ILLUMINATES DURING BULB TEST, BUT DOES NOT WHEN PARK BRAKE APPLIED

(1) Disconnect and isolate the battery negative cable. Disconnect the floor wire harness connector for the park brake switch from the switch terminal. Apply the parking brake. Check for continuity between the park brake switch terminal and a good ground. There should be continuity. If OK, go to Step 2. If not OK, replace the faulty park brake switch.

(2) Disconnect the headlamp and dash wire harness connector for the brake warning indicator switch from the switch terminals. Check for continuity between the red brake warning indicator driver (G9) circuit cavities of the floor wire harness connector for the park brake switch and the headlamp and dash wire harness connector for the brake warning indicator switch. There should be continuity. If not OK, repair the open red brake warning indicator driver (G9) circuit between the park brake switch and the brake warning indicator switch as required.

INDICATOR REMAINS ILLUMINATED - BRAKE SYSTEM CHECKS OK

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster from the instrument panel. Disconnect the instrument panel wire harness connector (Connector C2) for the instrument cluster from the connector receptacle on the back of the cluster housing. Disconnect the headlamp and dash wire harness connector for the brake warning indicator switch from the switch terminals. Check for continuity between the red brake warning indicator driver circuit (G99) cavity of the headlamp and dash wire harness connector for the brake warning indicator switch and a good ground. There should be no continuity. If OK, go to Step 2. If not OK, repair the shorted red brake warning indicator driver circuit (G99) between the brake warning indicator switch and the instrument cluster as required.

(2) Disconnect the floor wire harness connector for the park brake switch from the switch terminals. Check for continuity between the red brake warning indicator driver circuit (G9) cavity of the headlamp and dash wire harness connector for the brake warning indicator switch and a good ground. There should be no continuity. If OK, go to Step 3. If not OK, repair the shorted red brake warning indicator driver circuit (G9) between the brake warning indicator switch and the park brake switch as required.

(3) Check for continuity between each of the two terminals of the brake warning indicator switch and a good ground. In each case, there should be no continuity. If OK, go to Step 4. If not OK, replace the faulty brake warning indicator switch.

BRAKE/PARK BRAKE INDICATOR (Continued)

(4) Check for continuity between the terminal of the park brake switch and a good ground. There should be no continuity with the park brake released, and continuity with the park brake applied. If not OK, replace the faulty park brake switch.

CHECK GAUGES INDICATOR

DESCRIPTION

A check gauges indicator is standard equipment on all instrument clusters. The check gauges indicator is located on the lower edge of the instrument cluster overlay, to the right of the odometer/trip odometer Vacuum-Fluorescent Display (VFD). The check gauges indicator consists of a stencil-like cutout of the words “CHECK GAUGES” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red lens behind the cutout in the opaque layer of the overlay causes the “CHECK GAUGES” text to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. The check gauges indicator is serviced as a unit with the instrument cluster.

OPERATION

The check gauges indicator gives an indication to the vehicle operator when certain instrument cluster gauge readings reflect a condition requiring immediate attention. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The check gauges indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a ground path by the instrument cluster transistor. The instrument cluster will turn on the check gauges indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the check gauges indicator is illuminated for about two seconds as a bulb test.
- **Engine Temperature High Message** - Each time the cluster receives a message from the PCM indicating the engine coolant temperature is about 127° C or higher (about 261° F or higher), the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM indicating that the engine temperature is about 124° C or lower (about 255° F or lower), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Engine Oil Pressure Low Message** - Each time the cluster receives a message from the PCM indicating the engine oil pressure is about 0.3 kg/cm or lower (about 4 psi or lower), the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM indicating that the engine oil pressure is about 0.6 kg/cm or higher (about 8 psi or higher), or until the ignition switch is turned to the Off position, whichever occurs first. The cluster will only turn the indicator on in response to an engine oil pressure low message if the engine speed is 300 rpm or greater.
- **Charge Fail Message** - Each time the cluster receives a message from the PCM indicating a charge fail condition (system voltage is nine volts or lower), the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM indicating there is no charge fail condition (system voltage twelve volts or higher, but lower than sixteen volts) or until the ignition switch is turned to the Off position, whichever occurs first.
- **Voltage High Message** - Each time the cluster receives a message from the PCM indicating a voltage high condition (system voltage is sixteen volts or higher), the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM indicating there is no voltage high condition (system voltage is sixteen volts or lower, but higher than nine volts) or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the check gauges indicator will be turned on, then off again during the bulb check portion of the test in order to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the engine temperature, oil pressure, and electrical system voltage, then sends the proper messages to the instrument cluster. For further diagnosis of the check gauges indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the check gauges indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

CRUISE INDICATOR

DESCRIPTION

A cruise indicator is standard equipment on all instrument clusters, but is only functional on vehicles equipped with the optional speed control system. The cruise indicator is located near the upper edge of the instrument cluster overlay, in the upper left quadrant of the cluster. The cruise indicator consists of a stencil-like cutout of the word “CRUISE” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when the it is not illuminated. A green lens behind the cutout in the opaque layer of the overlay causes the “CRUISE” text to appear in green through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. When the exterior lighting is turned On, the illumination intensity of the cruise indicator is one-step dimmable, which is adjusted using the panel lamps dimmer control ring on the left multi-function switch control stalk. The cruise indicator is serviced as a unit with the instrument cluster.

OPERATION

The cruise indicator gives an indication to the vehicle operator when the speed control system is turned On, regardless of whether the speed control is engaged. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The cruise indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided with a path to ground by the instrument cluster transistor. The instrument cluster will turn on the cruise indicator for the following reasons:

- **Cruise Lamp-On Message** - Each time the cluster receives a cruise lamp-on message from the PCM indicating the speed control system has been turned On, the cruise indicator is illuminated. The indicator remains illuminated until the cluster receives a cruise lamp-off message from the PCM or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the cruise indicator will be turned on, then off again during the bulb check portion of the test in order to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the speed control switches to determine the proper outputs to the speed control servo. The PCM then sends the proper cruise indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the cruise indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the speed control system, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the cruise indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

ENGINE TEMPERATURE GAUGE

DESCRIPTION

An engine coolant temperature gauge is standard equipment on all instrument clusters. The engine coolant temperature gauge is located in the lower right quadrant of the instrument cluster, below the oil pressure gauge. The engine coolant temperature gauge consists of a movable gauge needle or pointer controlled by the instrument cluster electronic circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from 40° C (or 100° F) to 125° C (or 260° F). An International Control and Display Symbol icon for “Engine Coolant Temperature” is located on the cluster overlay, in the center of the gauge directly above the hub of the gauge needle. The engine coolant temperature gauge graphics are white and blue against a black field except for a single red graduation at the high end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the white graphics appear white, the blue graphics appear blue, and the red graphics appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The engine coolant temperature gauge is serviced as a unit with the instrument cluster.

OPERATION

The engine coolant temperature gauge gives an indication to the vehicle operator of the engine cool-

ENGINE TEMPERATURE GAUGE (Continued)

ant temperature. This gauge is controlled by the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The engine coolant temperature gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Engine Temperature Message** - Each time the cluster receives a message from the PCM indicating the engine coolant temperature is between about 40° C (100° F) and 124° C (255° F), the gauge needle is moved to the appropriate linear position on the gauge scale to represent the actual engine temperature. The gauge needle will continue to be positioned at the actual temperature position on the gauge scale until the cluster receives a message from the PCM that indicates the engine temperature is low, high, or critical, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Engine Temperature Low Message** - Each time the cluster receives a message from the PCM indicating the engine coolant temperature is at or below about 40° C (100° F), the gauge needle is held at the 40° C (100° F) graduation at the far left end of the gauge scale. The gauge needle remains at the far left end of the scale until the cluster receives a message from the PCM indicating that the engine temperature is above about 40° C (100° F), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Engine Temperature High Message** - Each time the cluster receives a message from the PCM indicating the engine coolant temperature is about 127° C or higher (about 261° F or higher), the gauge needle is moved to the center of the red zone on the gauge scale, the check gauges indicator is illuminated, and a single chime tone is sounded. The chime tone feature will occur only once per ignition cycle. The gauge needle remains in the center of the red zone and the check gauges indicator remains illuminated until the cluster receives a message from the PCM indicating that the engine temperature is about 124° C or lower (about 255° F or lower), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Engine Temperature Critical Message** - Each time the cluster receives a message from the PCM indicating the engine coolant temperature is about 129° C or higher (about 264° F or higher), the gauge needle is moved to the far right end of the red zone on the gauge scale. The gauge needle remains at the far right end of the red zone until the cluster receives a message from the PCM indicating that the engine temperature is about 127° C or lower (about 261° F or lower), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Message Failure** - If the cluster fails to receive an engine temperature message for more than about twelve seconds, it will move the gauge needle to the minimum graduation of the gauge scale until a new message is received, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the engine coolant temperature sensor to determine the engine operating temperature. The PCM then sends the proper engine coolant temperature messages to the instrument cluster. For further diagnosis of the engine coolant temperature gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the check gauges indicator due to a high or critical engine temperature gauge reading, it may indicate that the engine or the engine cooling system requires service. For proper diagnosis of the engine coolant temperature sensor, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the engine coolant temperature gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

FOG LAMP INDICATOR

DESCRIPTION

A fog lamp indicator is standard equipment on all instrument clusters, but is only functional on vehicles equipped with the optional front and/or rear fog lamps. The fog lamp indicator is located near the upper edge of the instrument cluster overlay, in the upper left quadrant of the cluster. The fog lamp indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Fog Lamps” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A green lens behind the cutout in the opaque layer of the overlay causes the indicator to

FOG LAMP INDICATOR (Continued)

appear in green through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. The fog lamp indicator is serviced as a unit with the instrument cluster.

OPERATION

The fog lamp indicator gives an indication to the vehicle operator when the optional front and/or rear fog lamps are turned On. The availability of the front fog lamps, or rear fog lamps options varies by the market for which the vehicle is manufactured. This indicator is controlled by a hard wired input from the fog lamp switch circuitry of the left multi-function switch to the cluster. The fog lamp indicator Light Emitting Diode (LED) is grounded on the instrument cluster electronic circuit board at all times; therefore, the LED will be on anytime the front or rear fog lamps are turned on, regardless of the ignition switch position. The LED only illuminates when it is provided battery current by the fog lamp switch circuitry of the left multi-function switch.

The fog lamp switch circuitry of the left multi-function switch is connected in series between a fused B(+) fuse in the Power Distribution Center (PDC) and the front or rear fog lamp feed input to the instrument cluster through the fog lamp relay, which is also in the PDC. The fog lamp switch input to the instrument cluster can be diagnosed using conventional diagnostic tools and methods. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/LEFT MULTI-FUNCTION SWITCH - OPERATION) for more information on the fog lamp switch.

DIAGNOSIS AND TESTING - FRONT/REAR FOG LAMP INDICATOR

The diagnosis found here addresses an inoperative front/rear fog lamp indicator condition. Before beginning this test, confirm the functionality of the front or rear fog lamp system. If no fog lamp system problem is found, the following procedure will help to locate an open in the front or rear fog lamp feed circuit between the fog lamp relay and the instrument cluster. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pinout information and location views for the various wire harness connectors, splices and grounds.

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.

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster from the instrument panel. Disconnect the instrument panel wire harness connector (Connector C1) for the instrument cluster from the connector receptacle on the back of the cluster housing.

(2) Reconnect the battery negative cable. Turn the fog lamps on by pulling out the control knob on the end of the left-multi-function switch control stalk. Check for battery voltage at the front or rear fog lamp feed circuit cavity of the instrument panel wire harness connector (Connector C1) for the instrument cluster. If OK, replace the faulty instrument cluster. If not OK, repair the open front or rear fog lamp feed circuit between the fog lamp relay and the instrument cluster as required.

FUEL GAUGE

DESCRIPTION

A fuel gauge is standard equipment on all instrument clusters. The fuel gauge is located in the lower left quadrant of the instrument cluster, below the voltage gauge. The fuel gauge consists of a movable gauge needle or pointer controlled by the instrument cluster electronic circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from E (or Empty) to F (or Full). An International Control and Display Symbol icon for “Fuel” is located on the cluster overlay, in the center of the gauge directly above the hub of the gauge needle. An arrowhead icon pointed toward the left side of the vehicle is imprinted on the cluster overlay next to the “Fuel” icon in the fuel gauge to provide the driver with a reminder as to the location of the fuel filler access. The fuel gauge graphics are white and blue against a black field except for a single red graduation at the low end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the white graphics appear white, the blue graphics appear blue, and the red graphics appear red. The orange gauge needle is internally illuminated. Cluster illumination is provided by replaceable incandescent bulb and bulb

FUEL GAUGE (Continued)

holder units located on the instrument cluster electronic circuit board. The fuel gauge is serviced as a unit with the instrument cluster.

OPERATION

The fuel gauge gives an indication to the vehicle operator of the level of fuel in the fuel tank. This gauge is controlled by the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The fuel gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Percent Tank Full Message -** Each time the cluster receives a message from the PCM indicating the percent tank full, the cluster programming applies an algorithm to calculate the proper gauge needle position, then moves the gauge needle to the proper position on the gauge scale. The algorithm is used to dampen gauge needle movement against the negative effect that fuel sloshing within the fuel tank can have on accurate inputs from the fuel tank sending unit to the PCM. The gauge needle will continue to be positioned at the proper position on the gauge scale until the cluster receives a message from the PCM that indicates the percent tank full is less than empty, more than full, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Less Than 12.5 Percent Tank Full Message -** Each time the cluster receives a message from the PCM indicating that the percent tank full is less than 12.5 (one-eighth), the gauge needle is moved to the proper position on the gauge scale, the low fuel indicator is illuminated, and a single chime tone is sounded. The low fuel indicator remains illuminated until the cluster receives messages from the PCM for a continuous twenty seconds indicating that the percent tank full has increased by more than 0.625 gallons or until the ignition switch is turned to the Off position, whichever occurs first. This strategy is intended to reduce the effect that fuel sloshing within the fuel tank can have on reliable indications. The chime tone feature will occur only once per ignition cycle.
- **Less Than Empty Percent Tank Full Message -** Each time the cluster receives a message from the PCM indicating that the percent tank full is less than empty, the gauge needle is moved to the far left (low) end of the gauge scale and the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM is a short circuit.
- **More Than Full Percent Tank Full Message -** Each time the cluster receives a message from the PCM indicating the percent tank full is more than full, the gauge needle is moved to the far left (low) end of the gauge scale and the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM is an open circuit.
- **Message Failure -** If the cluster fails to receive a percent tank full message, it will hold the gauge needle at the last indication for about twelve seconds, until a new message is received, or until the ignition switch is turned to the Off position, whichever occurs first. After about twelve seconds, the gauge needle is moved to the far left (low) end of the gauge scale and the low fuel indicator is illuminated immediately.
- **Actuator Test -** Each time the cluster is put through the actuator test, the gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the fuel tank sending unit, then sends the proper messages to the instrument cluster. For further diagnosis of the fuel gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the fuel tank sending unit, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the fuel gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

HIGH BEAM INDICATOR

DESCRIPTION

A high beam indicator is standard equipment on all instrument clusters. The high beam indicator is located near the upper edge of the instrument cluster overlay, between the tachometer and the speedometer. The high beam indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “High Beam” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A blue lens behind the cutout in the opaque layer of the overlay causes the icon to appear in blue through the translucent outer layer of the overlay when it is illuminated from behind by a replaceable incandescent bulb and bulb

HIGH BEAM INDICATOR (Continued)

holder unit located on the instrument cluster electronic circuit board. The high beam indicator is serviced as a unit with the instrument cluster.

OPERATION

The high beam indicator gives an indication to the vehicle operator when the headlamp high beams are illuminated, or when the exterior lamps are inadvertently left On. This indicator is controlled by a hard wired input from the headlamp beam select switch circuitry of the left multi-function switch to the cluster, and by the instrument cluster electronic circuit board based upon cluster programming and hard wired inputs from the head/park/fog lamp switch circuitry of the left multi-function switch, the driver door ajar switch, and the ignition switch. The high beam indicator bulb is grounded on the instrument cluster electronic circuit board at all times; therefore, the bulb will be illuminated anytime the headlamp high beams are turned on, regardless of the ignition switch position. The bulb only illuminates when it is provided battery current by the beam select switch circuitry of the left multi-function switch, or by the instrument cluster electronic circuit board. The instrument cluster will turn on the high beam indicator for the following reasons:

- **Beam Select Switch Input** - Each time the cluster detects battery current on the beam select switch sense circuit (beam select switch closed = high beams selected or optical horn feature activated) the high beam indicator will be illuminated solid. This input can occur when the headlamp high beams are selected or when the optical horn feature is activated. The indicator remains illuminated until the beam select switch sense input to the cluster is an open circuit (beam select switch open = high beams not selected and optical horn feature not activated), or until the exterior lighting is turned off, whichever occurs first.
- **Exterior Lamps-On Optical Warning** - Each time the cluster detects battery current on the headlamp switch output circuit (park or head lamp switch closed = exterior lighting is On), ground on the driver door ajar switch sense circuit (driver door ajar switch closed = driver door is open), and the fused ignition switch output (run-start) input is an open circuit (ignition switch is in a position other than On or Start), the high beam indicator will be flashed On and Off repeatedly. The indicator will continue to flash until the exterior lighting is turned Off, the driver door is closed, or the ignition switch is turned to the On or Start positions, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the high beam indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the bulb and the cluster control circuitry.

The headlamp beam select switch and circuitry is integral to the left multi-function switch on the steering column, and is connected in series between fused B(+) and the high beam indicator driver circuit input to the instrument cluster. The left multi-function switch inputs to the instrument cluster circuitry can be diagnosed using conventional diagnostic tools and methods.(Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/LEFT MULTI-FUNCTION SWITCH - OPERATION). For further diagnosis of the high beam indicator or the instrument cluster circuitry that controls the indicator bulb, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING).

DIAGNOSIS AND TESTING - HIGH BEAM INDICATOR

The diagnosis found here addresses an inoperative high beam indicator condition. Before beginning this test, confirm the functionality of the high beam indicator bulb and the cluster control circuitry by performing the instrument cluster actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the high beam indicator fails to illuminate during the actuator test, replace the indicator bulb and bulb holder with a known good unit and repeat the test. If the indicator still fails to illuminate, replace the faulty instrument cluster. If the problem being diagnosed is related to inoperative headlamp high beams, be certain to repair the headlamp system circuits and switches before attempting to diagnose or repair the high beam indicator. If no headlamp system problems are found and the high beam indicator illuminates during the instrument cluster actuator test, the following procedure will help locate an open in the high beam indicator driver circuit. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

HIGH BEAM INDICATOR (Continued)

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.

(1) Disconnect and isolate the battery negative cable. Remove the instrument cluster from the instrument panel. Disconnect the instrument panel wire harness connector (Connector C1) for the instrument cluster from the connector receptacle on the back of the cluster housing.

(2) Reconnect the battery negative cable. Turn the headlamps On and select the headlamp high beams with the left multi-function switch control stalk. Check for battery voltage at the high beam indicator driver circuit cavity of the instrument panel wire harness connector (Connector C1) for the instrument cluster. If OK, replace the faulty instrument cluster. If not OK, repair the open high beam indicator driver circuit between the instrument cluster and the left multi-function switch as required.

LOW FUEL INDICATOR

DESCRIPTION

A low fuel indicator is standard equipment on all instrument clusters. The low fuel indicator is located near the lower edge of the instrument cluster overlay, to the left of the odometer/trip odometer Vacuum Fluorescent Display (VFD). The low fuel indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Fuel” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber lens behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. The low fuel indicator is serviced as a unit with the instrument cluster.

OPERATION

The low fuel indicator gives an indication to the vehicle operator when the level of fuel in the fuel tank becomes low. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The low fuel indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the low fuel indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the low fuel indicator is illuminated for about two seconds as a bulb test.
- **Less Than 12.5 Percent Tank Full Message** - Each time the cluster receives a message from the PCM indicating that the percent tank full is less than 12.5 (one-eighth), the low fuel indicator is illuminated and a single chime tone is sounded. The low fuel indicator remains illuminated until the cluster receives messages from the PCM for a continuous twenty seconds indicating that the percent tank full has increased by more than 0.625 gallons or until the ignition switch is turned to the Off position, whichever occurs first. This strategy is intended to reduce the effect that fuel sloshing within the fuel tank can have on reliable indications. The chime tone feature will occur only once per ignition cycle.
- **Less Than Empty Percent Tank Full Message** - Each time the cluster receives a message from the PCM indicating the percent tank full is less than empty, the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM is a short circuit.
- **More Than Full Percent Tank Full Message** - Each time the cluster receives a message from the PCM indicating the percent tank full is more than full, the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM is an open circuit.
- **Actuator Test** - Each time the cluster is put through the actuator test, the low fuel indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the fuel tank sending unit, then sends the proper messages to the

LOW FUEL INDICATOR (Continued)

instrument cluster. For further diagnosis of the low fuel indicator lamp or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the fuel tank sending unit, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the low fuel indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

MALFUNCTION INDICATOR LAMP (MIL)

DESCRIPTION

A Malfunction Indicator Lamp (MIL) is standard equipment on all instrument clusters. The MIL is located near the lower edge of the instrument cluster overlay, to the right of the odometer/trip odometer Vacuum-Fluorescent Display (VFD). The MIL consists of a stencil-like cutout of the International Control and Display Symbol icon for “Engine” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber lens behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. The MIL is serviced as a unit with the instrument cluster.

OPERATION

The Malfunction Indicator Lamp (MIL) gives an indication to the vehicle operator when the Powertrain Control Module (PCM) has recorded a Diagnostic Trouble Code (DTC) for an On-Board Diagnostics II (OBDII) emissions-related circuit or component malfunction. The MIL is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the PCM over the Programmable Communications Interface (PCI) data bus. The MIL Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the MIL for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the indicator is illuminated for about seven seconds as a bulb test.
- **PCM Lamp-On Message** - Each time the cluster receives a lamp-on message from the PCM, the indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the PCM message. For some DTC’s, if a problem does not recur, the PCM will send a lamp-off message automatically. Other DTC’s may require that a fault be repaired and the PCM be reset before a lamp-off message will be sent. For more information on the PCM and the DTC set and reset parameters, (Refer to 25 - EMISSIONS CONTROL - OPERATION).
- **Communication Error** - If the cluster receives no lamp-on or lamp-off message from the PCM for twenty seconds, the MIL is illuminated by the instrument cluster and a “no BuS” message will appear in the odometer/trip odometer Vacuum Fluorescent Display (VFD) to indicate a loss of bus communication. The indicator remains controlled and illuminated by the cluster until a valid lamp-on or lamp-off message is received from the PCM.
- **Actuator Test** - Each time the cluster is put through the actuator test, the MIL will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the fuel and emissions system circuits and sensors to decide whether the system is in good operating condition. The PCM then sends the proper lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the MIL or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the MIL after the bulb test, it may indicate that a malfunction has occurred and that the fuel and emissions system may require service. For proper diagnosis of the fuel and emissions systems, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the MIL, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

ODOMETER

DESCRIPTION

An odometer and trip odometer are standard equipment in all instrument clusters. The odometer and trip odometer information are displayed in a common electronic Vacuum Fluorescent Display (VFD), which is centered on the lower edge of the instrument cluster and visible through a small window cutout on the instrument cluster overlay. How-

ODOMETER (Continued)

ever, the odometer and trip odometer information are not displayed simultaneously. The trip odometer reset switch on the instrument cluster electronic circuit board toggles the display between odometer and trip odometer modes by depressing the odometer/trip odometer switch knob that extends through the lower edge of the cluster lens, just right of the odometer VFD. Both the odometer and trip odometer information is stored in the instrument cluster memory.

The odometer can display values up to 999,999 kilometers (999,999 miles). The odometer will not roll over, but will latch at the maximum value. The trip odometer can display values up to 9999.9 kilometers (9999.9 miles) before it rolls over to zero. The odometer display does not have a decimal point and will not show values less than a full unit (kilometer or mile), the trip odometer display does have a decimal point and will show tenths of a unit (kilometer or mile). The unit of measure for the odometer and trip odometer display is not shown in the VFD. If the instrument cluster has a speedometer with a primary scale in kilometers-per-hour, the letters “KM” are printed on the cluster mask next to the VFD window to indicate the odometer unit of measure. During daylight hours (exterior lamps Off) the VFD is illuminated at full brightness for clear visibility. At night (exterior lamps are On) an analog/digital (A/D) converter on the instrument cluster electronic circuit board converts the analog panel lamps dimmer input from the left multi-function switch to a digital dimming level signal for controlling the lighting level of the VFD. However, a “Parade” mode position of the panel lamps dimmer control ring of the left multi-function switch control stalk allows the VFD to be illuminated at full brightness while the exterior lamps are turned On during daylight hours.

The VFD, the trip odometer switch, and the trip odometer switch button are serviced as a unit with the instrument cluster. The rubber trip odometer reset knob boot on the outside of the cluster lens is available for separate service replacement.

OPERATION

The odometer and trip odometer give an indication to the vehicle operator of the distance the vehicle has traveled. This gauge is controlled by the instrument cluster electronic circuitry based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The odometer and trip odometer information is displayed by the instrument cluster Vacuum Fluorescent Display (VFD), and the VFD will display odometer or trip odometer cluster information whenever the driver door is opened or the ignition switch is turned to the On or Start positions. The instrument cluster circuitry controls the VFD and provides the following features:

- **Odometer/Trip Odometer Display Toggling** - Actuating the trip odometer reset switch momentarily with the VFD illuminated will toggle the display between the odometer and trip odometer information. Each time the VFD is illuminated the display will automatically return to the last mode previously selected (odometer or trip odometer).
- **Trip Odometer Reset** - When the trip odometer reset switch is pressed and held for longer than about two seconds, trip odometer will be reset to 0.0 kilometers (miles). The VFD must be displaying the trip odometer information in order for the trip odometer information to be reset.
- **Message Failure** - If the cluster fails to receive a distance message during normal operation, it will hold and display the last data received until the ignition switch is turned to the Off position. If the cluster does not receive a distance message within one second after the ignition switch is turned to the On position, it will display the last distance message stored in the cluster memory. If the cluster is unable to display distance information due to an error internal to the cluster, either “888888”will be displayed in the VFD or the VFD will be blank.
- **Actuator Test** - Each time the cluster is put through the actuator test, the VFD will scroll the number “8” from right-to-left across the display, then illuminate the trip odometer decimal point “.” in order to confirm the functionality of the VFD and the cluster control circuitry.

The PCM continually monitors the vehicle speed sensor, then sends the proper distance messages to the instrument cluster. For further diagnosis of the odometer/trip odometer or the instrument cluster circuitry that controls these functions, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the vehicle speed sensor, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the odometer/trip odometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

OIL PRESSURE GAUGE

DESCRIPTION

An oil pressure gauge is standard equipment on all instrument clusters. The oil pressure gauge is located in the upper right quadrant of the instrument cluster, above the engine coolant temperature gauge. The oil pressure gauge consists of a movable gauge needle or pointer controlled by the instrument cluster electronic circuitry and a fixed 90 degree scale on the

OIL PRESSURE GAUGE (Continued)

cluster overlay that reads left-to-right from 0 kg/cm (or 0 psi) to 5.4 kg/cm (or 80 psi). An International Control and Display Symbol icon for “Engine Oil” is located on the cluster overlay, in the center of the gauge directly above the hub of the gauge needle. The oil pressure gauge graphics are white and blue against a black field, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the white graphics appear white, and the blue graphics appear blue. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The oil pressure gauge is serviced as a unit with the instrument cluster.

OPERATION

The oil pressure gauge gives an indication to the vehicle operator of the engine oil pressure. This gauge is controlled by the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The oil pressure gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster electronic circuitry controls the gauge needle position and provides the following features:

- **Engine Oil Pressure Message** - Each time the cluster receives a message from the PCM indicating the engine oil pressure is between about 0.3 kg/cm (4 psi) and about 6.7 kg/cm (95 psi), the cluster moves the gauge needle to the appropriate linear position on the gauge scale to represent the actual engine oil pressure. The gauge needle will continue to be positioned at the actual engine oil pressure position on the gauge scale until the cluster receives a message from the PCM that indicates the engine oil pressure is low, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Engine Oil Pressure Low Message** - Each time the cluster receives a message from the PCM indicating the engine oil pressure is below about 0.3 kg/cm (4 psi), the gauge needle is moved to the minimum increment on the far left (low) end of the gauge scale, the check gauges indicator is illuminated, and a single chime tone is generated. The gauge needle remains at the low end of the scale and the check gauges indicator remains illuminated until the cluster receives a message from the PCM indicating that the engine oil pressure is about 0.6 kg/cm (8 psi) or higher, or until the ignition switch is turned to the Off position, whichever occurs first. The cluster will only turn the check gauges indicator on in response to an engine oil pressure low message if the engine speed is 300 rpm or greater for more than about five seconds.
- **Message Failure** - If the cluster fails to receive an engine oil pressure message for more than about twelve seconds, it will move the gauge needle to the minimum graduation of the gauge scale until a new message is received, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the engine oil pressure sensor to determine the engine oil pressure. The PCM then sends the proper engine oil pressure messages to the instrument cluster. For further diagnosis of the oil pressure gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the check gauges indicator due to a low oil pressure gauge reading, it may indicate that the engine or the engine oiling system requires service. For proper diagnosis of the engine oil pressure sensor, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the oil pressure gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SEATBELT INDICATOR

DESCRIPTION

A seatbelt indicator is standard equipment on all instrument clusters. The seatbelt indicator is located near the center of the instrument cluster overlay, directly below the high beam indicator and above the odometer/trip odometer Vacuum Fluorescent Display (VFD). The seatbelt indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Seat Belt” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red lens behind the cutout in the opaque layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by a Light Emitting Diode

SEATBELT INDICATOR (Continued)

(LED) soldered onto the instrument cluster electronic circuit board. The seatbelt indicator is serviced as a unit with the instrument cluster.

OPERATION

The seatbelt indicator gives an indication to the vehicle operator of the status of the driver side front seatbelt. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming and a hard wired input from the seatbelt switch in the driver side front seatbelt buckle unit through the seat belt indicator driver circuit. The seatbelt indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the seatbelt indicator for the following reasons:

- **Seatbelt Reminder Function** - Each time the cluster receives a battery current input on the fused ignition switch output (run-start) circuit, the indicator will be illuminated as a seatbelt reminder for about seven seconds, or until the ignition switch is turned to the Off position, whichever occurs first. This reminder function will occur regardless of the status of the seatbelt switch input to the cluster.
- **Driver Side Front Seatbelt Not Buckled** - Following the seatbelt reminder function, each time the cluster detects a ground on the seat belt switch sense circuit (seatbelt switch closed = seatbelt unbuckled) with the ignition switch in the Start or On positions, the seatbelt indicator will be illuminated. The seatbelt indicator remains illuminated until the seat belt switch sense input to the cluster is an open circuit (seatbelt switch open = seatbelt buckled), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the seatbelt indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The seatbelt switch is connected in series between ground and the seat belt switch sense input to the instrument cluster. The seatbelt switch input to the instrument cluster circuitry can be diagnosed using conventional diagnostic tools and methods. For further diagnosis of the seatbelt indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING).

SHIFT INDICATOR (TRANSFER CASE)

DESCRIPTION

DESCRIPTION - PART TIME INDICATOR

A part time indicator is standard equipment on all instrument clusters. The part time indicator is located near the upper edge of the instrument cluster overlay, in the upper right quadrant of the cluster. The part time indicator consists of a stencil-like cutout of the words “PART TIME” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber lens behind the cutout in the opaque layer of the overlay causes the “PART TIME” text to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. When the exterior lighting is turned On, the illumination intensity of the part time indicator is one-step dimmable, which is adjusted using the panel lamps dimmer control ring on the left multi-function switch control stalk. The part time indicator is serviced as a unit with the instrument cluster.

DESCRIPTION - FULL TIME INDICATOR

A full time indicator is standard equipment on all instrument clusters, but is only functional on vehicles in some markets where the Selec-Trac four-wheel drive system is an available option. The full time indicator is located near the upper edge of the instrument cluster overlay, in the upper right quadrant of the cluster. The full time indicator consists of a stencil-like cutout of the words “FULL TIME” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A green lens behind the cutout in the opaque layer of the cluster overlay causes the “FULL TIME” text to appear in green through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. When the exterior lighting is turned On, the illumination intensity of the full time indicator is one-step dimmable, which is adjusted using the panel lamps dimmer control ring on the left multi-function switch control stalk. The full time indicator is serviced as a unit with the instrument cluster.

OPERATION

OPERATION - PART TIME INDICATOR

The part time indicator gives an indication to the vehicle operator that a part time operating mode of the four-wheel drive transfer case is selected. On vehicles equipped with the standard Command-Trac four-wheel drive system, the part time indicator lights when the transfer case is engaged in the 4H or 4L positions. On vehicles in some markets where the Selec-Trac four-wheel drive system is an available option, the part time indicator lights when the transfer case is engaged in the 4 X 4 Part Time or 4 Lo positions. This indicator is controlled by a transistor on the instrument cluster electronic circuit board, and is controlled by a hard wired transfer case switch input to the cluster. The part time indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the part time indicator for the following reasons:

- **Transfer Case Switch Input** - Each time the cluster detects a ground on the 4WD switch sense (part time) circuit (transfer case switch closed = part time 4WD selected) the part time indicator will be illuminated. The indicator remains illuminated until the 4WD switch sense (part time) input to the cluster is an open circuit (transfer case switch open = part time 4WD not selected), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the part time indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The transfer case switch is connected in series between ground and the 4WD switch sense (part-time) input to the instrument cluster. The transfer case switch input to the instrument cluster circuitry can be diagnosed using conventional diagnostic tools and methods. (Refer to 21 - TRANSMISSION/TRANSAXLE/TRANSFER CASE - DESCRIPTION) for more information on the transfer case switch. For further diagnosis of the part time indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING).

OPERATION - FULL TIME INDICATOR

The full time indicator gives an indication to the vehicle operator that a full time operating mode of the four-wheel drive transfer case is selected. On vehicles in some markets where the Selec-Trac four-wheel drive system is an available option, the full time indicator lights when the transfer case is engaged in the 4 X 4 Full Time position. This indicator is controlled by a transistor on the instrument cluster electronic circuit board, and is controlled by a hard wired transfer case switch input to the cluster. The full time indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the full time indicator for the following reasons:

- **Transfer Case Switch Input** - Each time the cluster detects a ground on the 4WD switch sense (full time) circuit (transfer case switch closed = full time 4WD selected) the full time indicator will be illuminated. The indicator remains illuminated until the 4WD switch sense (full time) input to the cluster is an open circuit (transfer case switch open = full time 4WD not selected), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the full time indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The transfer case switch is connected in series between ground and the 4WD switch sense (full-time) input to the instrument cluster. The transfer case switch input to the instrument cluster circuitry can be diagnosed using conventional diagnostic tools and methods. (Refer to 21 - TRANSMISSION/TRANSAXLE/TRANSFER CASE - DESCRIPTION) for more information on the transfer case switch. For further diagnosis of the part time indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING).

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - PART TIME INDICATOR

The diagnosis found here addresses an inoperative part time indicator condition. Before beginning this

SHIFT INDICATOR (TRANSFER CASE) (Continued)

test, confirm the functionality of the part time indicator Light Emitting Diode (LED) and the cluster control circuitry by performing the instrument cluster actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the part time indicator fails to illuminate during the actuator test, replace the faulty instrument cluster. If the problem being diagnosed is related to indicator accuracy, be certain to confirm that the problem is with the indicator or transfer case switch and not a mechanical malfunction of the transfer case or transfer case shift linkage. (Refer to 21 - TRANSMISSION/TRANSAXLE/TRANSFER CASE - DIAGNOSIS AND TESTING). If no transfer case problem is found, the following procedure will help to locate a short or open in the 4WD switch sense (part time) circuit. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

INDICATOR DOES NOT ILLUMINATE WITH PART TIME MODE SELECTED

(1) Disconnect and isolate the battery negative cable. Disconnect the engine wire harness connector for the transfer case switch from the transfer case switch connector receptacle. Check for continuity between the ground circuit cavity of the engine wire harness connector for the transfer case switch and a good ground. There should be continuity. If OK, go to Step 2. If not OK, repair the open ground circuit to ground (G105) as required.

(2) Reconnect the battery negative cable. Turn the ignition switch to the On position. Install a jumper wire between the 4WD switch sense (part-time) circuit cavity of the engine wire harness connector for the transfer case switch and a good ground. The part time indicator should light. If OK, replace the faulty transfer case switch. 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 cluster from the instrument panel. Disconnect the instrument panel wire harness connector (Connector C2) for the instrument cluster from the connector receptacle on the back of the cluster housing. Check for continuity between the 4WD switch sense (part-time) circuit cavities of the instrument panel wire harness connector (Connector C2) for the instrument cluster and the engine wire harness connector for the transfer case switch. There should be continuity. If OK, replace the faulty instrument cluster. If not OK, repair the open 4WD switch sense (part-time) circuit between the instrument cluster and the transfer case switch as required.

INDICATOR STAYS ILLUMINATED WITH PART TIME MODE NOT SELECTED

(1) Disconnect and isolate the battery negative cable. Disconnect the engine wire harness connector for the transfer case switch from the transfer case switch connector receptacle. Check for continuity between the ground circuit and the 4WD switch sense (part-time) circuit terminals in the transfer case switch connector receptacle. There should be no continuity. If OK, go to Step 2. If not OK, replace the faulty transfer case switch.

(2) Remove the instrument cluster from the instrument panel. Disconnect the instrument panel wire harness connector (Connector C2) for the instrument cluster from the connector receptacle on the back of the cluster housing. Check for continuity between the 4WD switch sense (part-time) circuit cavity of the instrument panel wire harness connector (Connector C2) for the instrument cluster and a good ground. There should be no continuity. If OK, replace the faulty instrument cluster. If not OK, repair the shorted 4WD switch sense (part-time) circuit between the transfer case switch and the instrument cluster as required.

DIAGNOSIS AND TESTING - FULL TIME INDICATOR

The diagnosis found here addresses an inoperative full time indicator condition. Before beginning this test, confirm the functionality of the full time indicator Light Emitting Diode (LED) and the cluster control circuitry by performing the instrument cluster actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the full time indicator fails to illuminate during the actuator test, replace the faulty instrument cluster. If the problem being diagnosed is related to indicator accuracy, be certain to confirm that the problem is

SHIFT INDICATOR (TRANSFER CASE) (Continued)

with the indicator or transfer case switch and not a mechanical malfunction of the transfer case or transfer case shift linkage. (Refer to 21 - TRANSMISSION/TRANSAXLE/TRANSFER CASE - DIAGNOSIS AND TESTING). If no transfer case problem is found, the following procedure will help to locate a short or open in the 4WD switch sense (full time) circuit. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

INDICATOR DOES NOT ILLUMINATE WITH FULL TIME MODE SELECTED

(1) Disconnect and isolate the battery negative cable. Disconnect the engine wire harness connector for the transfer case switch from the transfer case switch connector receptacle. Check for continuity between the ground circuit cavity of the engine wire harness connector for the transfer case switch and a good ground. There should be continuity. If OK, go to Step 2. If not OK, repair the open ground circuit to ground (G105) as required.

(2) Reconnect the battery negative cable. Turn the ignition switch to the On position. Install a jumper wire between the 4WD switch sense (full-time) circuit cavity of the engine wire harness connector for the transfer case switch and a good ground. The full time indicator should light. If OK, replace the faulty transfer case switch. 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 cluster from the instrument panel. Disconnect the instrument panel wire harness connector (Connector C2) for the instrument cluster from the connector receptacle on the back of the cluster housing. Check for continuity between the 4WD switch sense (full-time) circuit cavities of the instrument panel wire harness connector (Connector C2) for the instrument cluster and the engine wire harness connector for the transfer case switch. There should be continuity. If OK, replace the faulty instrument cluster. If not OK, repair the open 4WD switch sense (full-time) circuit between the instrument cluster and the transfer case switch as required.

INDICATOR STAYS ILLUMINATED WITH FULL TIME MODE NOT SELECTED

(1) Disconnect and isolate the battery negative cable. Disconnect the engine wire harness connector for the transfer case switch from the transfer case switch connector receptacle. Check for continuity between the ground circuit and the 4WD switch sense (full-time) circuit terminals in the transfer case switch connector receptacle. There should be no continuity. If OK, Step 2. If not OK, replace the faulty transfer case switch.

(2) Remove the instrument cluster from the instrument panel. Disconnect the instrument panel wire harness connector (Connector C2) for the instrument cluster from the connector receptacle on the back of the cluster housing. Check for continuity between the 4WD switch sense (full-time) circuit cavity of the instrument panel wire harness connector (Connector C2) for the instrument cluster and a good ground. There should be no continuity. If OK, replace the faulty instrument cluster. If not OK, repair the shorted 4WD switch sense (full-time) circuit between the transfer case switch and the instrument cluster as required.

SKIS INDICATOR

DESCRIPTION

A Sentry Key Immobilizer System (SKIS) indicator is standard equipment on all instrument clusters, but is only operational on vehicles equipped with the optional SKIS. The SKIS indicator is located near the upper edge of the instrument cluster overlay, in the upper left quadrant of the cluster. The SKIS indicator consists of a stencil-like cutout of a graphical representation or icon of a key that is circled and crossed-out in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber lens behind the cutout in the opaque layer of the overlay causes the indicator to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. The SKIS indicator is serviced as a unit with the instrument cluster.

SKIS INDICATOR (Continued)

OPERATION

The Sentry Key Immobilizer System (SKIS) indicator gives an indication to the vehicle operator of the status of the SKIS. This indicator is controlled by the instrument cluster electronic circuit board based upon electronic messages received by the cluster from the Sentry Key Immobilizer Module (SKIM) over the Programmable Communications Interface (PCI) data bus. The SKIS indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is switched to ground by the instrument cluster transistor. The instrument cluster will turn on the SKIS indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position, the SKIM tells the cluster to illuminate the SKIS indicator for about three seconds as a bulb test.
- **SKIM Lamp-On Message** - Each time the cluster receives a lamp-on message from the SKIM, the SKIS indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the SKIM message. For more information on the SKIS and the SKIS indicator control parameters, (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - OPERATION). The indicator remains illuminated until the cluster receives a lamp-off message from the SKIM or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the SKIS indicator will be turned on, then off again in a prescribed sequence to confirm the functionality of the LED and the cluster control circuitry.

The SKIM performs a self-test each time the ignition switch is turned to the On position to decide whether the system is in good operating condition. The SKIM then sends the proper SKIS lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the SKIS indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the SKIS indicator after the bulb test, either solid or flashing, it indicates that a SKIS malfunction has occurred or that the SKIS is inoperative. For proper diagnosis of the SKIS, the PCI data bus, or the message inputs to the instrument cluster that control the SKIS indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SPEEDOMETER

DESCRIPTION

A speedometer is standard equipment in all instrument clusters. The speedometer is located next to the tachometer, just to the right of center in the instrument cluster. The speedometer consists of a movable gauge needle or pointer controlled by the instrument cluster electronic circuitry and a fixed 210 degree primary outer scale on the cluster overlay that reads left-to-right either from 0 to 100 mph, from 0 to 110 mph, or from 0 to 180 km/h, depending upon the requirements of the market for which the vehicle was manufactured. Each version also has a secondary inner scale on the cluster overlay that provides the equivalent opposite units from the primary scale. A label on the cluster overlay beneath the hub of the speedometer pointer abbreviates the unit of measure for the primary scale in all upper case letters (i.e.: MPH or KM/H), followed by the unit of measure for the secondary scale in all lower case letters (i.e.: mph or km/h). The speedometer graphics are white (primary scale) and blue (secondary scale) against a black field, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the white graphics appear white and the blue graphics appear blue. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The speedometer is serviced as a unit with the instrument cluster.

OPERATION

The speedometer gives an indication to the vehicle operator of the vehicle road speed. This gauge is controlled by the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The speedometer is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Vehicle Speed Message** - Each time the cluster receives a vehicle speed message from the PCM it will calculate the correct vehicle speed reading and

SPEEDOMETER (Continued)

position the gauge needle at that speed position on the gauge scale. The cluster will receive a new vehicle speed message and reposition the gauge pointer accordingly about every 86 milliseconds. The gauge needle will continue to be positioned at the actual vehicle speed position on the gauge scale until the ignition switch is turned to the Off position.

- **Message Failure** - If the cluster fails to receive a speedometer message, it will hold the gauge needle at the last indication for about six seconds, or until the ignition switch is turned to the Off position, whichever occurs first. If a new speedometer message is not received after about six seconds, the gauge needle will return to the far left (low) end of the scale.
- **Actuator Test** - Each time the cluster is put through the actuator test, the gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the vehicle speed sensor to determine the vehicle road speed, then sends the proper vehicle speed messages to the instrument cluster. For further diagnosis of the speedometer or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the vehicle speed sensor, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the speedometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

TACHOMETER

DESCRIPTION

A tachometer is standard equipment on all instrument clusters. The tachometer is located next to the speedometer, just to the left of center in the instrument cluster. The tachometer consists of a movable gauge needle or pointer controlled by the instrument cluster electronic circuitry and a fixed 210 degree scale on the cluster overlay that reads left-to-right from 0 to 6. The text “X 1000 RPM” imprinted on the cluster overlay directly below the hub of the tachometer needle identifies that each number on the tachometer scale is to be multiplied by 1000 rpm. A red line on the high end of the gauge scale designates the engine overspeed area of the gauge. The tachometer graphics are white against a black field, except for the single red line, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the white graphics appear white and the red graphics appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The tachometer is serviced as a unit with the instrument cluster.

OPERATION

The tachometer gives an indication to the vehicle operator of the engine speed. This gauge is controlled by the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The tachometer is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster electronic circuitry controls the gauge needle position and provides the following features:

- **Engine Speed Message** - Each time the cluster receives an engine speed message from the PCM it will calculate the correct engine speed reading and position the gauge needle at that speed position on the gauge scale. The cluster will receive a new engine speed message and reposition the gauge pointer accordingly about every 86 milliseconds. The gauge needle will continue to be positioned at the actual engine speed position on the gauge scale until the ignition switch is turned to the Off position.
- **Message Failure** - If the cluster fails to receive an engine speed message, it will hold the gauge needle at the last indication for about six seconds, or until the ignition switch is turned to the Off position, whichever occurs first. If a new engine speed message is not received after about six seconds, the gauge needle will return to the far left (low) end of the scale.
- **Actuator Test** - Each time the cluster is put through the actuator test, the gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the crankshaft position sensor to determine the engine speed, then sends the proper engine speed messages to the instrument cluster. For further diagnosis of the tachometer or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TEST-

TACHOMETER (Continued)

ING). For proper diagnosis of the crankshaft position sensor, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the tachometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

TURN SIGNAL INDICATOR

DESCRIPTION

Two turn signal indicators, one right and one left, are standard equipment on all instrument clusters. The turn signal indicators are located near the upper edge of the instrument cluster overlay, between the speedometer and the tachometer. Each turn signal indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Turn Warning” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents these icons from being clearly visible when they are not illuminated. A green lens behind each cutout in the opaque layer of the cluster overlay causes the indicator to appear in green through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. The turn signal indicators are serviced as a unit with the instrument cluster.

OPERATION

The turn signal indicators give an indication to the vehicle operator that the turn signal (left or right indicator flashing) or hazard warning (both left and right indicators flashing) have been selected. These indicators are controlled by two individual hard wired inputs from the turn signal switch and hazard warning switch circuitry of the left multi-function switch to the cluster. Each turn signal indicator Light Emitting Diode (LED) is grounded on the instrument cluster electronic circuit board at all times; therefore, the LED can be on anytime the turn signal or hazard warning systems are turned on, regardless of the ignition switch position. Each LED will only illuminate when it is provided battery current by the turn signal switch or hazard warning switch circuitry of the left multi-function switch.

The turn signal switch and hazard warning switch circuitry of the left multi-function switch are connected in series between the output of the combination flasher on the left multi-function switch and the left or right turn signal inputs to the instrument cluster, but in parallel with the other turn signal circuits. This arrangement allows the turn signal indicators to remain functional, regardless of the condition of the other circuits in the turn signal and hazard warning systems. The turn signal switch and hazard warning switch inputs to the instrument cluster can be diagnosed using conventional diagnostic tools and methods. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/LEFT MULTI-FUNCTION SWITCH - OPERATION) for more information on the turn signal switch and hazard warning switch.

UPSHIFT INDICATOR

DESCRIPTION

An upshift indicator is standard equipment on all instrument clusters, however, on vehicles not built for the United States or Canadian markets and those not equipped with a manual transmission, this indicator is electronically disabled. The upshift indicator is located near the right upper edge of the instrument cluster overlay, just above the oil pressure gauge. The upshift indicator consists of an upward pointed arrow icon that is a stencil-like cutout in the opaque layer of the instrument cluster overlay. The dark outer layer of the cluster overlay prevents the icon from being clearly visible when the lamp is not illuminated. An amber lens behind the cutout in the opaque layer of the cluster overlay causes the icon to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. When the exterior lighting is turned On, the illumination intensity of the part time indicator is one-step dimmable, which is adjusted using the panel lamps dimmer control ring on the left multi-function switch control stalk. The upshift indicator is serviced as a unit with the instrument cluster.

OPERATION

The upshift indicator gives an indication to the vehicle operator when the manual transmission should be shifted to the next highest gear in order to achieve the best fuel economy. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The upshift indicator function of the instrument cluster is electronically enabled or disabled by a PCI data bus message received by the cluster from the PCM. The upshift indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the indicator will always be off when the

UPSHIFT INDICATOR (Continued)

ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the upshift indicator for the following reasons:

- **Upshift Lamp-On Message** - Each time the cluster receives an upshift lamp-on message from the PCM indicating the engine speed and load conditions are right for a transmission upshift to occur, the upshift indicator is illuminated. The indicator remains illuminated until the cluster receives an upshift lamp-off message from the PCM or until the ignition switch is turned to the Off position, whichever occurs first. The PCM will normally send an upshift lamp-off message three to five seconds after a lamp-on message, if an upshift is not performed. The indicator will then remain off until the vehicle stops accelerating and is brought back into the range of indicator operation, or until the transmission is shifted into another gear.
- **Actuator Test** - Each time the cluster is put through the actuator test, the upshift indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the engine speed and load conditions to determine the proper fuel and ignition requirements. The PCM then sends the proper upshift indicator messages to the instrument cluster. For further diagnosis of the upshift indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the upshift indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

VOLTAGE GAUGE

DESCRIPTION

A voltage gauge is standard equipment on all instrument clusters. The voltage gauge is located in the upper left quadrant of the instrument cluster, above the fuel gauge. The voltage gauge consists of a movable gauge needle or pointer controlled by the instrument cluster electronic circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from 9 volts to 19 volts. An International Control and Display Symbol icon for “Battery Charging Condition” is located on the cluster overlay, in the center of the gauge directly above the hub of the gauge needle. The voltage gauge graphics are white and blue against a black field except for a single red graduation at each end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the white graphics appear white, the blue graphics appear blue, and the red graphics appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The voltage gauge is serviced as a unit with the instrument cluster.

OPERATION

The voltage gauge gives an indication to the vehicle operator of the electrical system voltage. This gauge is controlled by the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The voltage gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **System Voltage Message** - Each time the cluster receives a message from the PCM indicating the system voltage, the gauge needle is moved to the actual system voltage position on the gauge scale. The gauge needle will continue to be positioned at the actual system voltage position on the gauge scale until the cluster receives a message from the PCM that indicates the system voltage is low (charge fail), high, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Charge Fail Message** - Each time the cluster receives a message from the PCM indicating a charge fail condition (system voltage is nine volts or lower), the gauge needle is moved to the 9 volt graduation on the gauge scale and the check gauges indicator is illuminated. The gauge needle remains on the 9 volt graduation and the check gauges indicator remains illuminated until the cluster receives a message from the PCM indicating there is no charge fail condition (system voltage is twelve volts or higher, but lower than sixteen volts), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Voltage High Message** - Each time the cluster receives a message from the PCM indicating a voltage high condition (system voltage is nineteen volts

VOLTAGE GAUGE (Continued)

or higher), the gauge needle is moved to the 19 volt graduation on the gauge scale and the check gauges indicator is illuminated. The gauge needle remains on the 19 volt graduation and the check gauges indicator remains illuminated until the cluster receives a message from the PCM indicating there is no voltage high condition (system voltage is sixteen volts or lower, but higher than nine volts), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Message Failure** - If the cluster fails to receive a system voltage message for more than about twelve seconds, it will move the gauge needle to the minimum graduation of the gauge scale until a new message is received, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the system voltage to control the generator output. The PCM then sends the proper system voltage messages to the instrument cluster. For further diagnosis of the voltage gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the check gauges indicator due to a charge fail or voltage high condition, it may indicate that the charging system requires service. For proper diagnosis of the charging system, the PCI data bus, or the message inputs to the instrument cluster that control the voltage gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

LAMPS

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LAMPS/LIGHTING - EXTERIOR

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LAMPS/LIGHTING - EXTERIOR

DESCRIPTION

DESCRIPTION - TURN SIGNAL & HAZARD WARNING SYSTEM

A turn signal and hazard warning system is standard factory-installed safety equipment on this model. The turn signal and hazard warning system includes the following major components, which are described in further detail elsewhere in this service information:

- **Combination Flasher** - The electronic combination flasher is located on the back of the left multi-function switch, beneath the upper steering column shroud on the top of the steering column.
- **Front Side Marker Lamps** - The front side marker lamps are located on the outboard ends of the two front fenders.
- **Hazard Warning Switch** - The hazard warning switch is integral to the left multi-function switch on the left side of the steering column. The hazard warning switch button protrudes from a dedicated opening in the shroud on the top of the steering column, just below the steering wheel.
- **Turn Signal Cancel Cam** - The turn signal cancel cam is integral to the clockspring, which is located beneath the shrouds on the top of the steering column, just below the steering wheel.
- **Turn Signal Indicators** - The two turn signal indicators, one right and one left, are integral to the ElectroMechanical Instrument Cluster (EMIC) located in the instrument panel.
- **Turn Signal Lamps** - The front turn signal lamps are integral to the front park/turn signal lamps located beside each headlamp on the front fender. The rear turn signal lamps are integral to the back-up/brake/rear turn signal/tail lamps located on either side of the rear of the quarter panels.
- **Turn Signal Switch** - The turn signal switch is integral to the left multi-function switch on the left side of the steering column. The left multi-function switch control stalk that actuates the turn signal switch protrudes from a dedicated opening in the shroud on the left side of the steering column, just below the steering wheel.

The turn signal system in this vehicle includes a turn signal-on warning chime feature. The EMIC electronic circuitry monitors the turn signal indicators as well as electronic vehicle speed and distance messages received from the Powertrain Control Module over the Programmable Communications Interface (PCI) data bus network to provide this feature. If an indicator remains illuminated continuously with the vehicle speed above about 25 kilometers per hour (15 miles per hour) for a distance of greater than about 1.6 kilometers (1 mile), the EMIC generates a chime tone through an integral chime tone generator. For vehicles manufactured for markets other than the United States and Canada, the distance threshold for the turn signal-on chime warning is extended to about 4.0 kilometers.

Hard wired circuitry connects the turn signal and hazard warning system components to each other through the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the turn signal and hazard warning system components through the use of a combination of soldered splices, splice block connectors and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

DESCRIPTION - 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.

OPERATION - TURN SIGNAL & HAZARD WARNING SYSTEM

The turn signal system operates on battery current received on a fused ignition switch output (run) circuit so that the turn signals will only operate with the ignition switch in the On position. The hazard warning system operates on non-switched battery current received on a fused B(+) circuit so that the hazard warning remains operational regardless of the ignition switch position. When the turn signal (left multi-function) switch control stalk is 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, front park/turn signal lamp, front side marker lamp and rear tail/stop/turn signal lamp to flash on and off. 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 indicators, front park/turn signal lamps, front side marker lamps and rear tail/stop/turn signal lamps to flash on and off.

In order to provide the turn signal-on warning, the ElectroMechanical Instrument Cluster (EMIC) monitors vehicle speed and distance messages received from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus and the hard wired turn signal switch input to the cluster electronic circuit board. If a turn signal remains indicated for a distance of greater than about 1.6 kilometers (1 mile) and the vehicle speed remains greater than about 24 kilometers-per-hour (15 miles-per-hour), the EMIC generates a repetitive chime tone at a slow rate through its integral chime tone generator to provide an audible reminder that a turn signal has been left on. On vehicles manufactured for markets outside the United States and Canada, the distance threshold for the turn signal-on warning is extended to 4.0 kilometers. Once the warning chime begins to sound, it will continue until the turn signal is cancelled (either manually or mechanically), until the vehicle speed falls below about 24 kilometers-per-hour (15 miles-per-hour), or until the ignition switch is turned to the Off position, whichever occurs first. This feature is not activated by a hazard warning input to the instrument cluster.

During both the turn signal and the hazard warning operation, 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. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the turn signal and hazard warning system.

WARNING

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.

CAUTION: 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.

CAUTION: Do not use fuses, circuit breakers, or relays having greater amperage values than indicated on the fuse panel or in the Owner's Manual.

NOTE: When it is necessary to remove components to service another, it should not be necessary to apply excessive force or bend a component to remove it. Before damaging a trim component, verify hidden fasteners or captured edges are not holding the component in place.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - TURN SIGNAL & HAZARD WARNING SYSTEM

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 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING). If the problem being diagnosed is related to a failure of the turn signals to automatically cancel following completion of a turn, inspect the multifunction switch for a faulty or damaged cancel actuator and inspect the turn signal cancel cam lobes on the clockspring mechanism for damage or improper installation. For complete circuit diagrams, refer to the appropriate wiring information.

LAMPS/LIGHTING - EXTERIOR (Continued)

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.

(1) Turn the ignition switch On. 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. If the turn signal indicator(s) fail to light, go to Step 2.

(2) Turn the ignition switch to the Off position. Check the fused ignition switch (run-acc) fuse in the fuse block and/or 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(s).

(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 between the PDC and the battery.

(4) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch (run-acc) fuse in the fuse block. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (run-acc) circuit between the fuse block and 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 the left multi-function switch and replace it with a known good unit. Reconnect the battery negative cable. Turn the ignition switch to the On position. Test the operation of the turn signal and hazard warning system. 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 Off position. Disconnect and isolate the battery negative cable. Disconnect the cross body wire harness connector for the left multi-function from the switch connector. Reconnect 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 of the cross body wire harness connector for the left multi-function switch. If OK, go to Step 7. If not OK, repair the open fused ignition switch output (run-acc) circuit between the left multi-function switch and the fuse block.

(7) Turn the ignition switch Off. Place the hazard warning switch in the On position. Check for battery voltage at the hazard flasher feed circuit in the cross body wire harness connector for the left multi-function switch. If OK, go to Step 8. If not OK, repair the open fused B(+) circuit between the left multi-function switch and the PDC.

(8) Disconnect and isolate the battery negative cable. Check for continuity between the ground circuit of the cross body wire harness connector for the left multi-function switch and a good ground. There should be continuity. If OK, proceed to the diagnosis for the left multi-function switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/LEFT MULTI-FUNCTION SWITCH - DIAGNOSIS AND TESTING). If not OK, repair the open ground circuit.

DIAGNOSIS AND TESTING - HEADLAMP SYSTEM

Always begin any diagnosis by testing all of the fuses and circuit breakers in the system. Refer to the appropriate wiring information.

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Conventional and halogen headlamps are interchangeable. It is recommended that they not be intermixed.

LAMPS/LIGHTING - EXTERIOR (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMPS ARE DIM WITH ENGINE IDLING OR IGNITION TURNED OFF	1. Loose or corroded battery cables. 2. Loose or worn generator drive belt. 3. Charging system output too low. 4. Battery has insufficient charge. 5. Battery is sulfated or shorted. 6. Poor lighting circuit ground. 7. Both headlamp bulbs faulty.	1. Clean and secure battery cable clamps and posts. 2. Adjust or replace generator drive belt. 3. Test and repair charging system. (Refer to 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING) 4. Test battery state-of -charge. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - DIAGNOSIS AND TESTING) 5. Load test battery. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - DIAGNOSIS AND TESTING) 6. Test for voltage drop across ground locations. 7. Replace both headlamp bulbs.
HEADLAMP BULBS BURN OUT FREQUENTLY	1. Charging system output too high. 2. Loose or corroded terminals or splices in circuit.	1. Test and repair charging system. (Refer to 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING) 2. Inspect and repair all connectors and splices.
HEADLAMPS ARE DIM WITH ENGINE RUNNING ABOVE IDLE*	1. Charging system output too low. 2. Poor lighting circuit ground. 3. High resistance in headlamp circuit. 4. Both headlamp bulbs faulty.	1. Test and repair charging system. (Refer to 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING) 2. Test for voltage drop across ground locations. 3. Test amperage draw of headlamp circuit. 4. Replace both headlamp bulbs.
HEADLAMPS FLASH RANDOMLY	1. Poor lighting circuit ground. 2. High resistance in headlamp circuit. 3. Faulty headlamps switch circuit breaker. 4. Loose or corroded terminals or splices in circuit.	1. Test for voltage drop across ground locations. 2. Test amperage draw of headlamp circuit. Should not exceed 30 amps. 3. Replace headlamp switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/ HEADLAMP SWITCH - REMOVAL) 4. Inspect and repair all connectors and splices.
HEADLAMPS DO NOT ILLUMINATE	1. No voltage to headlamps. 2. No ground at headlamps. 3. Faulty headlamp switch. 4. Faulty headlamp dimmer (multi-function) switch. 5. Broken connector terminal or wire splice in headlamp circuit. 6. Both headlamp bulbs faulty.	1. Repair open headlamp circuit. 2. Repair circuit ground. 3. Replace headlamp switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/ HEADLAMP SWITCH - REMOVAL) 4. Replace multi-function switch. 5. Repair connector terminal or wire splice. 6. Replace both headlamp bulbs.
*Canada vehicles must have lamps ON.		

LAMPS/LIGHTING - EXTERIOR (Continued)

DIAGNOSIS AND TESTING - FOG LAMP SYSTEM

Always begin any diagnosis by testing all of the fuses and circuit breakers in the system. Refer to the appropriate wiring information.

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.

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 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING)
	4. Battery has insufficient charge.	4. Test battery state-of -charge. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/ BATTERY - DIAGNOSIS AND TESTING)
	5. Battery is sulfated or shorted.	5. Load test battery. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/ BATTERY - DIAGNOSIS AND TESTING)
	6. Poor lighting circuit ground.	6. Test for voltage drop across ground locations.
FOG LAMP BULBS BURN OUT FREQUENTLY	1. Charging system output too high.	1. Test and repair charging system. (Refer to 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING)
	2. Loose or corroded terminals or splices in circuit.	2. Inspect and repair all connectors and splices.
FOG LAMPS ARE DIM WITH ENGINE RUNNING ABOVE IDLE	1. Charging system output too low.	1. Test and repair charging system. (Refer to 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING)
	2. Poor lighting circuit Z1-ground.	2. Test for voltage drop across Z1-ground locations.
	3. High resistance in fog lamp circuit.	3. Test amperage draw of fog lamp circuit.
FOG LAMPS FLASH RANDOMLY	1. Poor lighting circuit ground.	1. Test for voltage drop across ground locations.
	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.
FOG LAMPS DO NOT ILLUMINATE	1. Blown fuse for fog lamp.	1. Replace fuse.
	2. No ground at fog lamps.	2. Repair circuit ground.
	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. Faulty or burned out bulb.	5. Replace bulb.

LAMPS/LIGHTING - EXTERIOR (Continued)

DIAGNOSIS AND TESTING - DAYTIME RUNNING LAMP SYSTEM

Always begin any diagnosis by testing all of the fuses and circuit breakers in the system. Refer to the appropriate wiring information.

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.

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. 4. Check L3 circuit. 5. Replace DRL module.

SPECIFICATIONS

EXTERIOR LAMPS

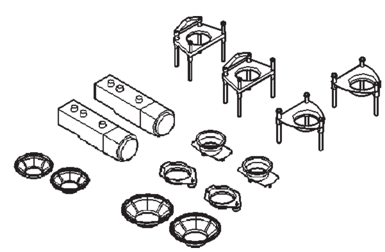
CAUTION: Do not use bulbs that have a higher candle power than the bulb listed in the Bulb Application Table. Damage to lamp can result. Do not touch halogen bulbs with fingers or other oily surfaces. Bulb life will be reduced.

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

SPECIAL TOOLS

HEADLAMP ALIGNMENT



Headlamp Aiming Kit C-4466–A

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.

BRAKE LAMP SWITCH (Continued)

The primary function of the brake switch is to turn on the brake lamps during braking. The switch is also used to send signals to components that must know when the brakes are applied, such as the Powertrain Control Module (PCM), which uses the signal to cancel speed control. The Controller Antilock Brake (CAB) uses the brake switch signal to monitor brake pedal application. When the normally closed switch contacts open, the CAB receives the brake applied signal. The CAB then monitors the ABS system to anticipate the need for a ABS stop.

DIAGNOSIS AND TESTING - 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. 1).

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

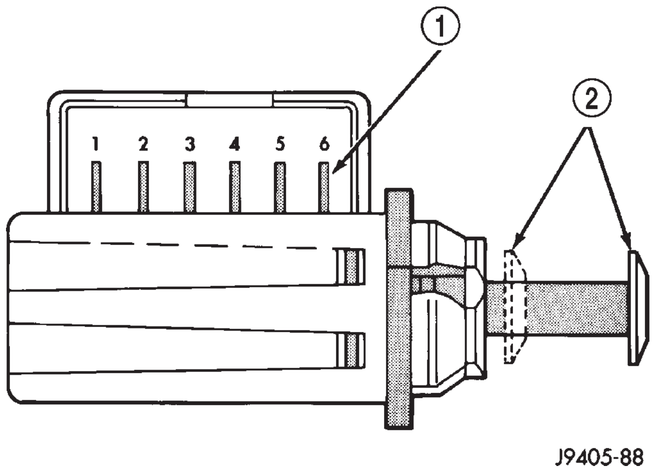


Fig. 1 Brake Lamp Switch Terminal Identification

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.

REMOVAL

(1) Remove the steering column cover and the lower trim panel.

(2) Press the brake pedal downward to fully applied position.

(3) Rotate the switch approximately 30° in counterclockwise direction. Then pull the switch rearward and out of bracket.

(4) Disconnect the switch harness and remove the switch (Fig. 2).

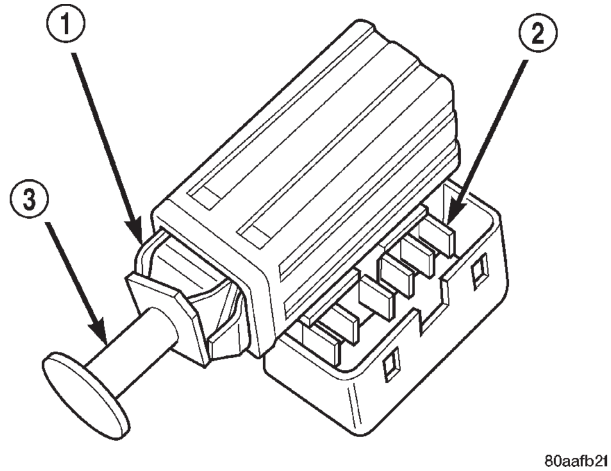


Fig. 2 Brake Lamp Switch

1 - RETAINER
2 - TERMINALS
3 - SWITCH PLUNGER

INSTALLATION

(1) Pull the switch plunger all of the way out, to fully extended position.

(2) Connect the harness connector to the switch.

(3) Press and hold the brake pedal in the applied position.

(4) Align the tab on the switch with the notch in the switch bracket. Then insert the switch in the bracket and turn it clockwise about 30° to lock it in place.

(5) Release the brake pedal, then pull the pedal fully rearward. Pedal will set the plunger to the correct position as the pedal pushes the plunger into the switch body. The switch will make ratcheting sound as it self adjusts.

BRAKE LAMP SWITCH (Continued)

ADJUSTMENTS

ADJUSTMENT

(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.

CENTER HIGH MOUNTED STOP LAMP UNIT

REMOVAL

NOTE: It may be necessary to remove spare tire.

(1) Disconnect and isolate the battery negative cable.
(2) Remove screws attaching CHMSL lamp/bracket to spare tire carrier bracket.
(3) Disengage CHMSL wire harness from retaining clips.
(4) Remove cover from CHMSL contact buttons.
(5) Carefully pull wire harness terminal ends from contact buttons (Fig. 3).
(6) Route wire harness through tailgate and separate CHMSL from vehicle.

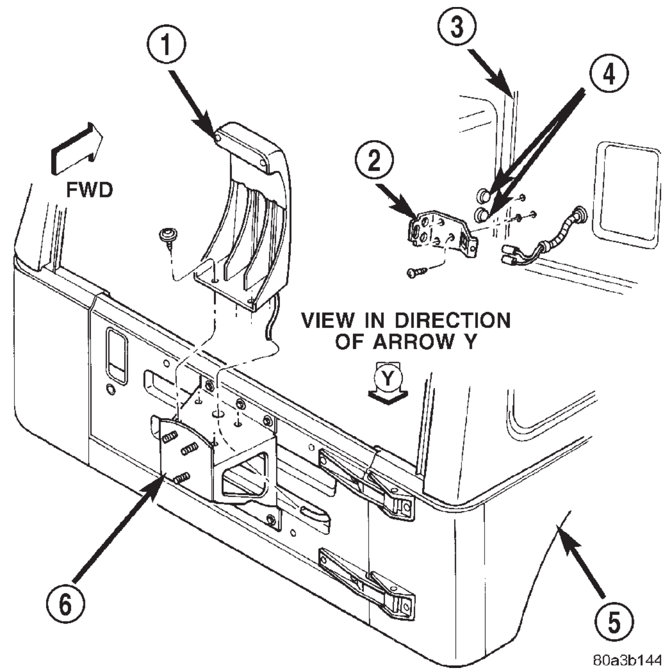


Fig. 3 CHMSL Contact Buttons

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.
(6) Connect the battery negative cable.

CENTER HIGH MOUNTED STOP LAMP BULB

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Remove the screws attaching the CHMSL lens to the CHMSL (Fig. 4).
(3) Rotate the bulb socket one third turn counterclockwise and separate from lamp housing.
(4) Pull the bulb straight out of the socket.

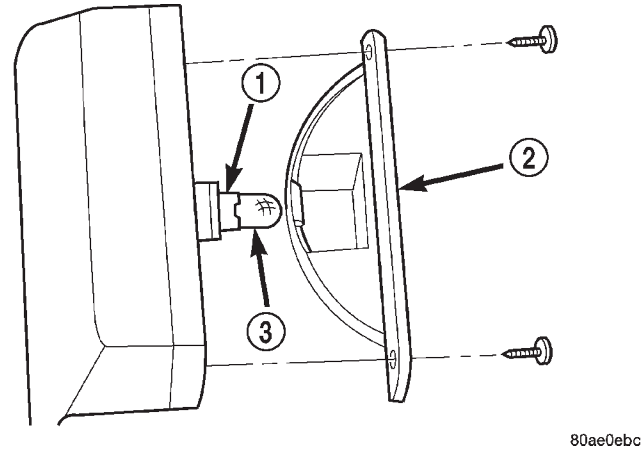


Fig. 4 CHMSL Bulb

1 - SOCKET
2 - CHMSL
3 - BULB

INSTALLATION

(1) Install the bulb.
(2) Position the lens on the CHMSL and install the screws.
(3) Connect the battery negative cable.

COMBINATION FLASHER

DESCRIPTION

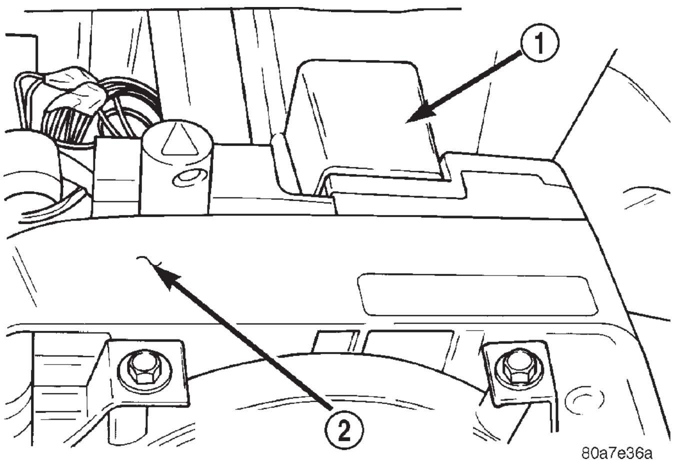


Fig. 5 Combination Flasher

1 - COMBINATION FLASHER
2 - LEFT MULTI-FUNCTION SWITCH

The combination flasher is located to the back of the left multi-function switch housing on the top of the steering column, where it is concealed beneath the upper steering column shroud (Fig. 5). 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.

The combination flasher cannot be repaired or adjusted and, if faulty or damaged, it must be replaced.

OPERATION

The combination flasher has five blade-type terminals that are intended for the following inputs and outputs: ground, fused B(+), fused ignition switch output (run-acc), turn signal/hazard switch sense, and combination flasher output. Constant battery voltage is 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. The Integrated Circuit (IC) within the combination flasher contains the logic that controls the flasher operation and the flash rate. The IC receives sense ground inputs from the multi-function switch for the hazard flasher, right turn signal, and left turn signal. 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.

Because of the active 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 and hazard warning system. Then replace the combination flasher with a known good unit to confirm system operation. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR - DIAGNOSIS AND TESTING).

REMOVAL

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COMBINATION FLASHER (Continued)

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the screws that secure the lower steering column shroud to the upper shroud (Fig. 6).

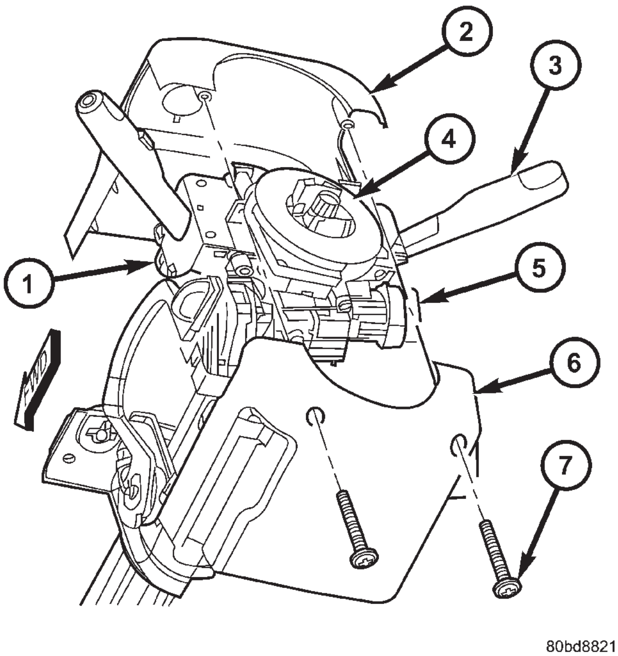

Fig. 6 Steering Column Shrouds Remove/Install

1 - LEFT MULTI-FUNCTION SWITCH
2 - UPPER SHROUD
3 - RIGHT MULTI-FUNCTION SWITCH
4 - CLOCKSPRING
5 - IGNITION LOCK CYLINDER HOUSING
6 - LOWER SHROUD
7 - SCREW (2)

(4) Move the tilt steering column to the fully lowered position and leave the tilt release lever in the released position.

(5) Remove the upper shroud from the steering column.

(6) Grasp the combination flasher firmly and pull it toward the dash panel to disengage the flasher terminals. (Fig. 7).

(7) Remove the combination flasher.

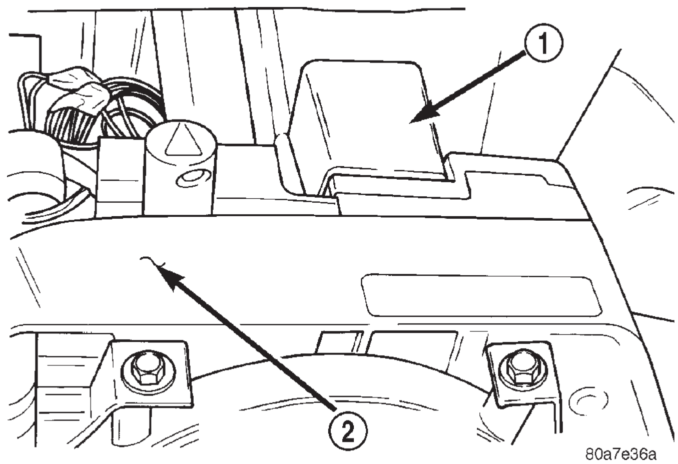

Fig. 7 Combination Flasher

1 - COMBINATION FLASHER
2 - LEFT MULTI-FUNCTION SWITCH

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, 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.

(1) Align the combination flasher terminals with the terminals in the connector on the back of the left multi-function switch housing. (Fig. 7).

(2) Push on the combination flasher until the terminals are fully seated in the left multi-function switch connector.

(3) Position the upper shroud onto the steering column (Fig. 21).

(4) Install and tighten the screws that secure the lower steering column shroud to the upper shroud. Tighten the screws to 2 N·m (18 in. lbs.).

(5) Move the tilt steering column to the fully raised position and secure it in place by moving the tilt release lever back to the locked position.

(6) Reinstall the steering column opening cover. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(7) Reconnect the battery negative cable.

DAYTIME RUNNING LAMP MODULE

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.

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Disconnect the wire harness connector from the module.
(3) Remove the screws that attach the module to the cowl (Fig. 8).
(4) Separate the module from the vehicle.

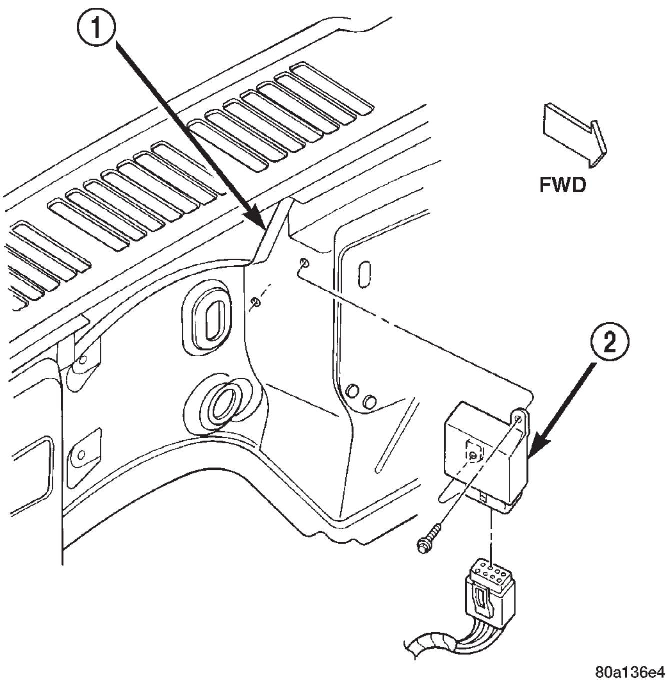

Fig. 8 DRL Module

1 - COWL
2 - DAYTIME RUNNING LAMP MODULE

INSTALLATION

(1) Position the DRL module on the cowl.
(2) Install the screws.
(3) Connect the wire harness connector to the module.
(4) Connect the battery negative cable.

FOG LAMP UNIT

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Disconnect the fog lamp wire harness connector.
(3) Remove the nut attaching the fog lamp to the front bumper.
(4) Remove the fog lamp.

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.
(4) Connect the battery negative cable.

ADJUSTMENTS

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. 9).
(1) Loosen the nut attaching the fog lamp to the mounting bracket (Fig. 10).
(2) Move the fog lamp to adjust beam height.
(3) Tighten the nut attaching the fog lamp to the mounting bracket.

FOG LAMP UNIT (Continued)

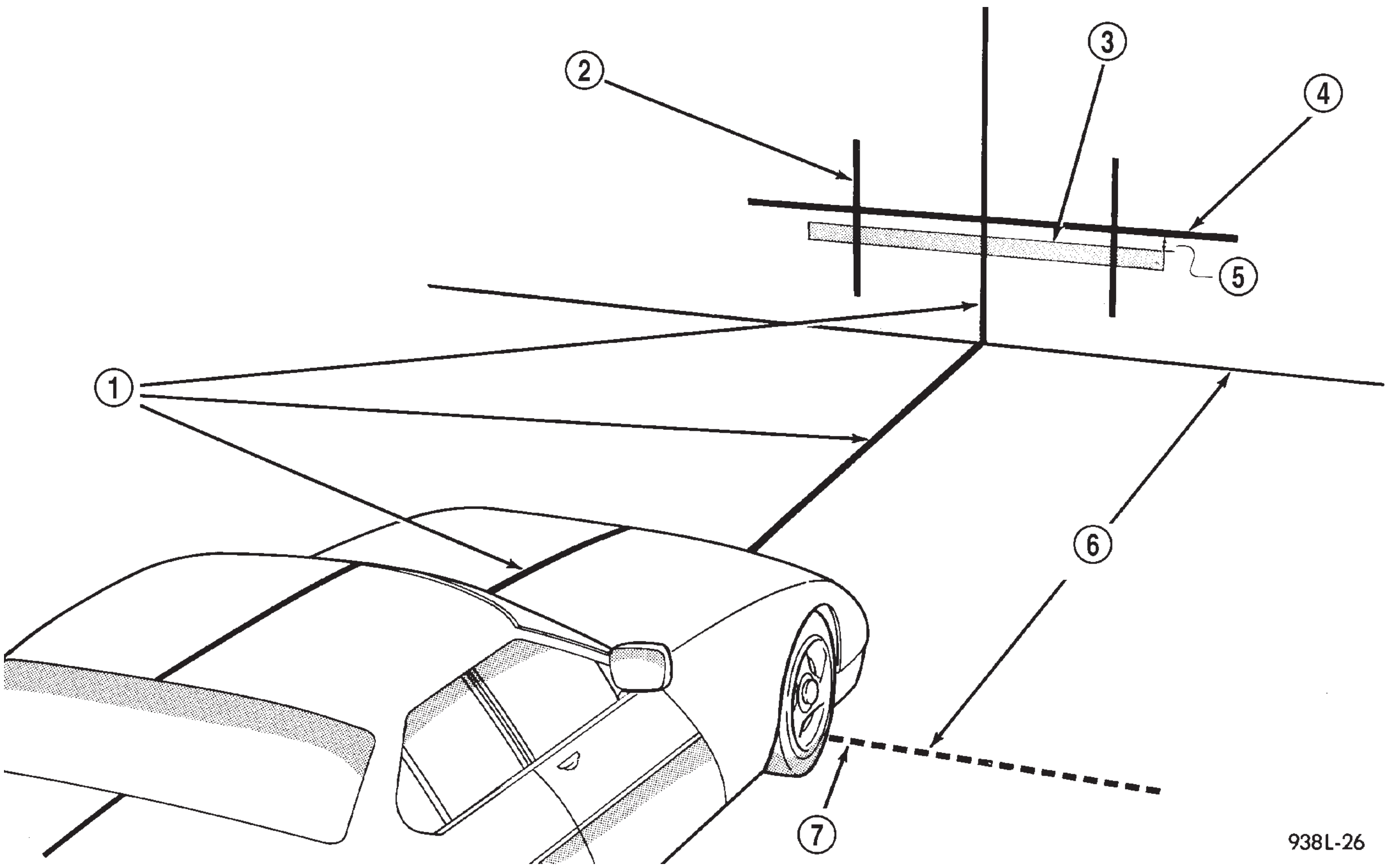

Fig. 9 Fog Lamp Alignment —Typical

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

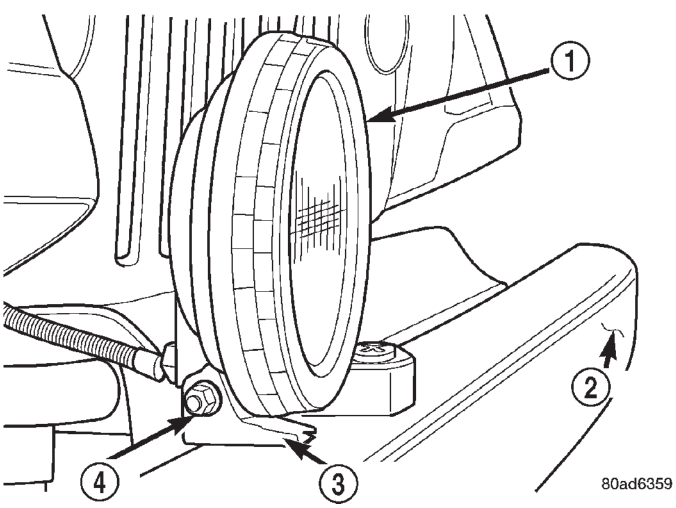

Fig. 10 Fog Lamp Adjustment

1 - FOG LAMP
2 - BUMPER
3 - MOUNTING BRACKET
4 - NUT

FOG LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the screws that attach the reflector to the lamp housing.

(3) Separate the reflector from the lamp housing.

(4) Squeeze the bulb retainer together to disengage it from the reflector.

(5) Remove the bulb/element from the reflector (Fig. 11).

(6) 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.

FOG LAMP (Continued)

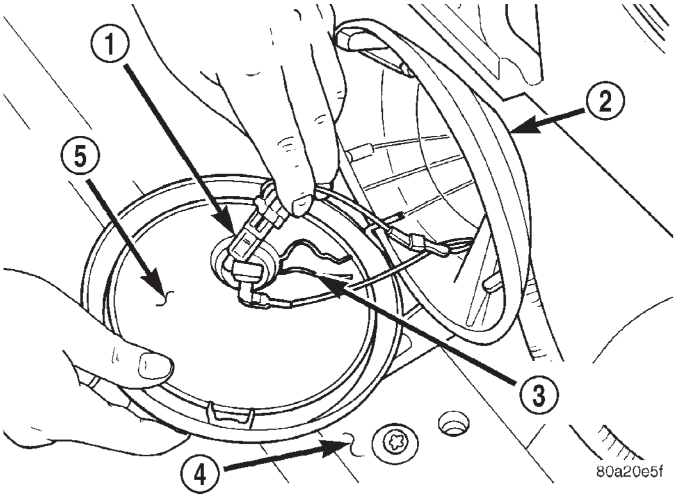

Fig. 11 Fog Lamp Bulb

1 - BULB
2 - FOG LAMP HOUSING
3 - BULB RETAINER
4 - FRONT BUMPER
5 - REFLECTOR HOUSING

(4) Position the reflector in the lamp housing.
(5) Install the screws that attach the reflector to the lamp housing.
(6) Connect the battery negative cable.

FRONT PARK/TURN SIGNAL LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Remove the park/turn signal lamp bulb socket via the underside of the fender.
(3) Rotate the bulb socket one-third turn counter-clockwise and separate it from the lamp housing.
(4) Pull the bulb straight out of the socket.

INSTALLATION

(1) Install the bulb in the socket.
(2) Install the bulb and socket in the lamp housing.
(3) Connect the battery negative cable.

FRONT PARK/TURN SIGNAL LAMP UNIT

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.

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Remove the park/turn signal lamp housing screws (Fig. 12).
(3) Separate the park/turn signal lamp housing from the fender.
(4) Rotate bulb socket one third turn counter-clockwise and separate bulb socket from lamp.

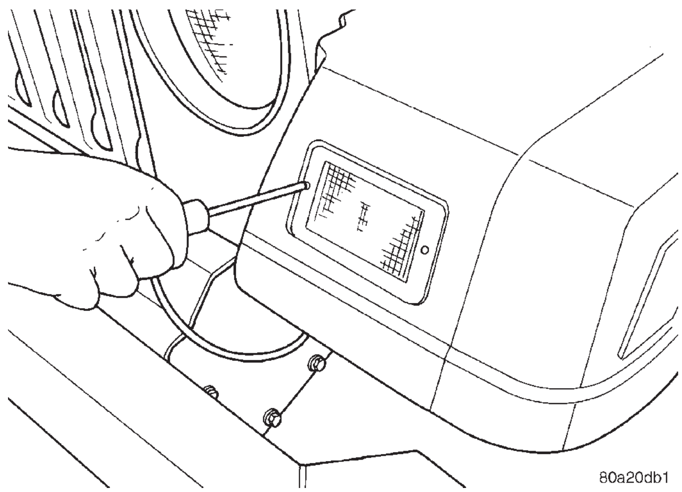

Fig. 12 Park/Turn Signal Lamp

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.
(4) Connect the battery negative cable.

HEADLAMP UNIT

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 UNIT (Continued)

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the screws that attach the headlamp bezel (Fig. 13).

(3) Remove the screws that attach the headlamp retaining ring (Fig. 14).

(4) Disconnect the headlamp wire harness connector and remove the bulb from the bucket (Fig. 15).

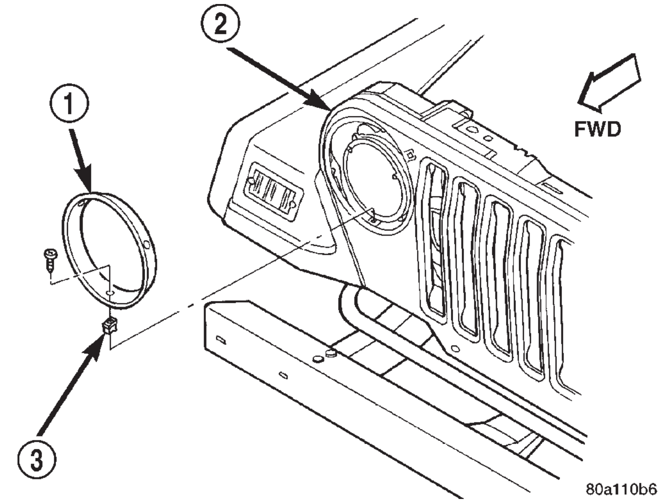

Fig. 13 Headlamp Bezel

1 - HEADLAMP BEZEL
2 - GRILLE
3 - NUT

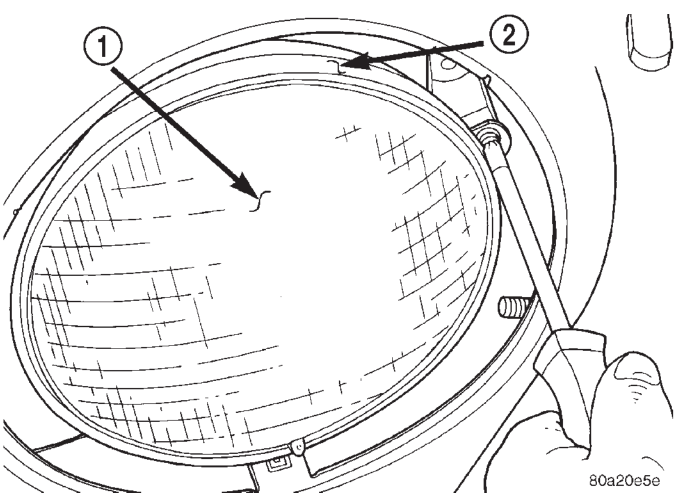

Fig. 14 Headlamp Retaining

1 - HEADLAMP
2 - HEADLAMP RETAINER

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.

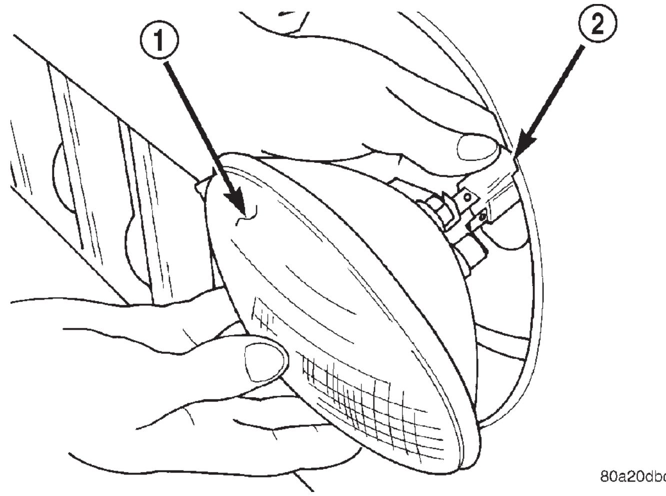

Fig. 15 Headlamp Connector

1 - HEADLAMP
2 - CONNECTOR

(3) Install the headlamp bezel. Tighten the screws securely.

(4) Connect the battery negative cable.

ADJUSTMENTS

HEADLAMP ALIGNMENT PREPARATION

(1) Verify headlamp dimmer switch and high beam indicator operation.

(2) Correct defective components that could hinder proper headlamp alignment.

(3) Verify proper tire inflation.

(4) Clean headlamp lenses.

(5) Verify that luggage area is not heavily loaded.

(6) Fuel tank should be FULL. Add 2.94 kg (6.5 lbs.) of weight over the fuel tank for each estimated gallon of missing fuel.

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. 16).

(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.

HEADLAMP UNIT (Continued)

(7) Measure distance from the centerline of the vehicle to the center of each headlamp being aligned. Transfer measurements to screen (with tape) to each side of vehicle centerline. Use these lines for left/right adjustment reference.

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. 17)until the headlamp beam pattern on screen/wall is similar to the pattern depicted in (Fig. 16).

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. 17) until the headlamp beam pattern on the aiming screen/wall similar to the pattern in (Fig. 16).

(5) Cover front of the headlamp that has been adjusted and adjust the other headlamp beam as instructed above.

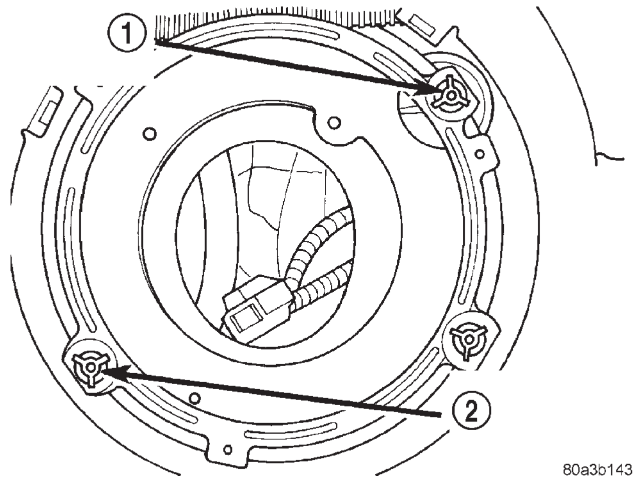

Fig. 17 Headlamp Adjustment Screws

1 - UP/DOWN ADJUSTMENT SCREW
2 - LEFT/RIGHT ADJUSTMENT SCREW

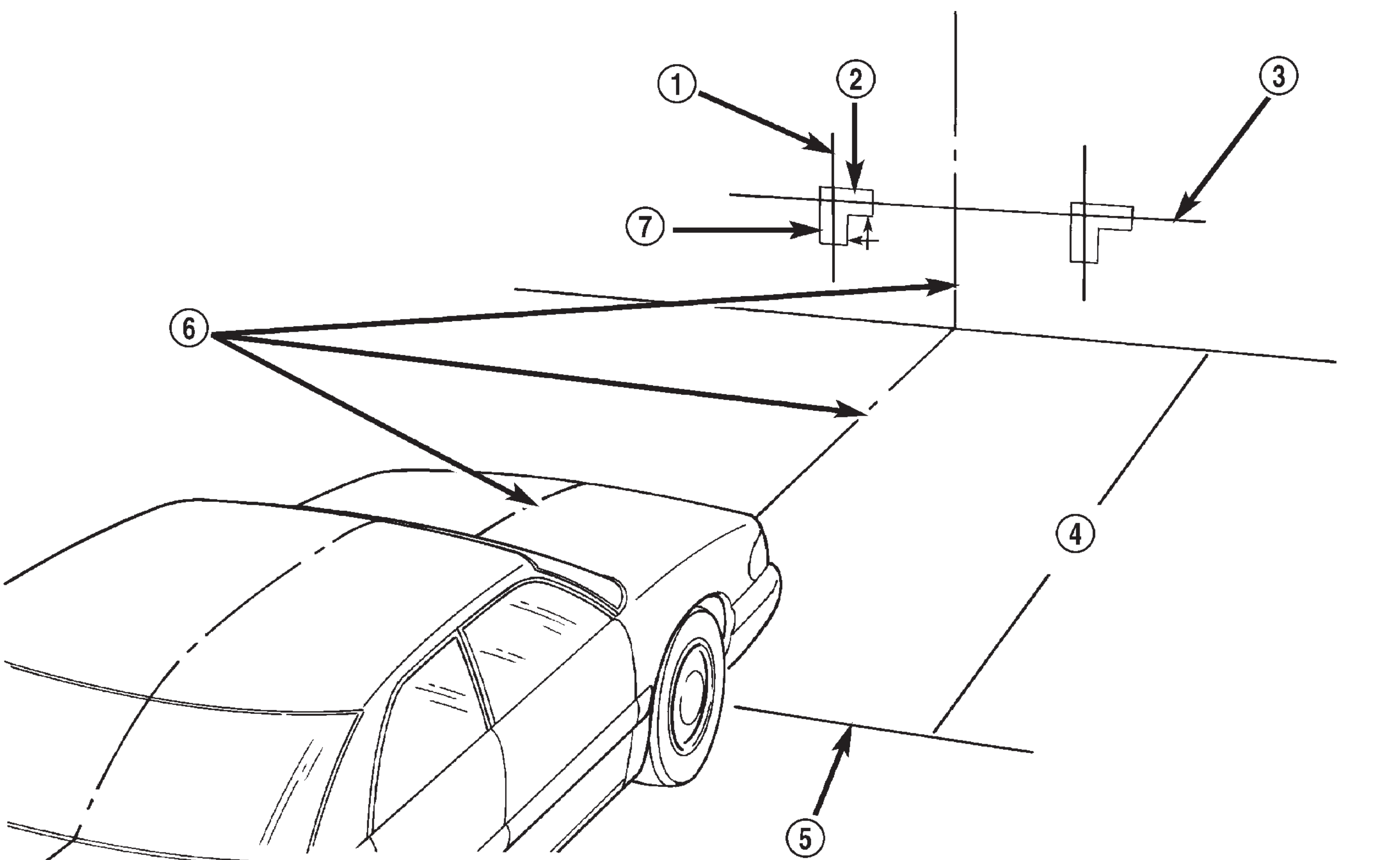

Fig. 16 Headlamp Alignment Screen—Typical

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

LEFT MULTI-FUNCTION SWITCH

DESCRIPTION

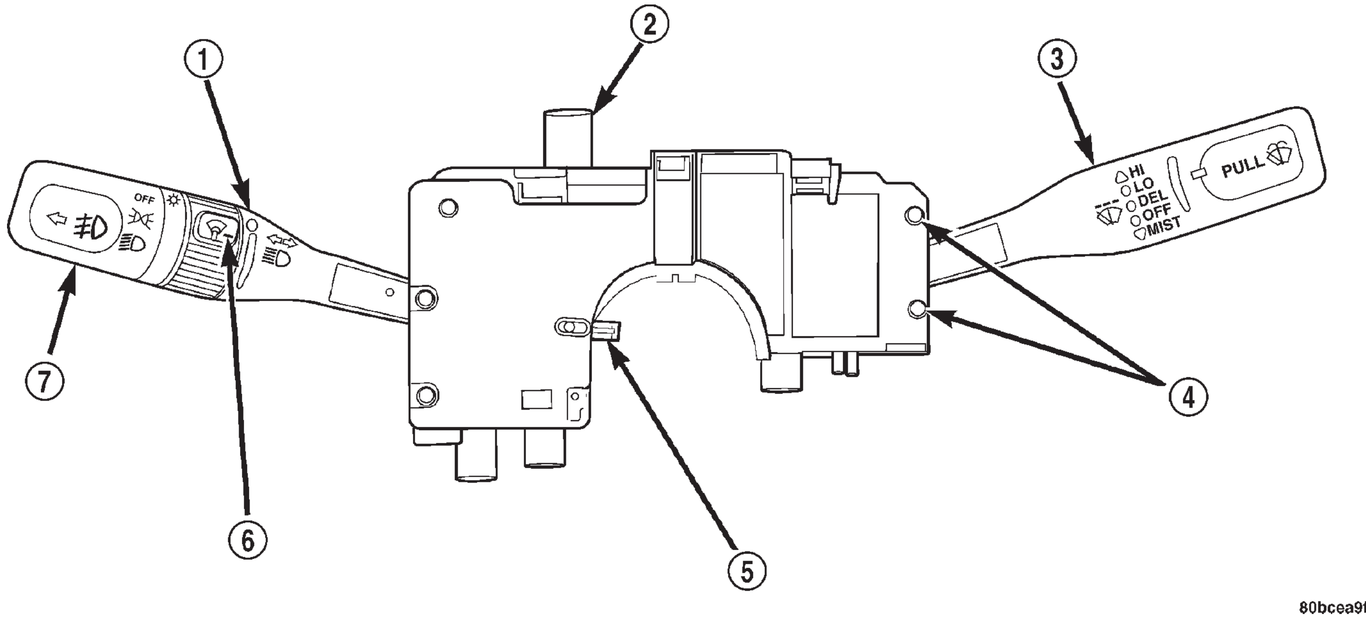

Fig. 18 Multi-Function Switches

1 - LEFT MULTI-FUNCTION SWITCH CONTROL STALK
2 - HAZARD WARNING SWITCH BUTTON
3 - RIGHT MULTI-FUNCTION SWITCH CONTROL STALK
4 - SCREW (2)
5 - TURN SIGNAL CANCEL ACTUATOR
6 - LEFT MULTI-FUNCTION SWITCH CONTROL RING
7 - LEFT MULTI-FUNCTION SWITCH CONTROL KNOB

The left multi-function switch is secured to the upper steering column housing, below the steering wheel. (Fig. 18). The hazard warning switch push button is located on the top of the multi-function switch housing.

A connector containing eighteen terminal pins is located on the back of the switch housing and connects the switch to the vehicle electrical system. A second connector on the back of the switch housing accepts the combination flasher. The right and left multi-function switchs are mounted together by two screws, and the combined multi-function switch is secured to the upper steering column housing.

The left multi-function switch is the primary control for the interior and exterior lighting systems of the vehicle. The left multi-function switch supports the following functions:

- Hazard Warning Control
- Exterior Lighting Control
- Headlamp Beam Selection
- Headlamp Optical Horn
- Interior Lighting Contro
- Turn Signal Control

The left multi-function switch cannot be adjusted or repaired. If any function of the switch is faulty, or if the switch is damaged, the entire switch unit must be replaced. The combination flasher and the right multi-function switch are available for separate service replacement.

LEFT MULTI-FUNCTION SWITCH (Continued)

OPERATION

The left multi-function switch uses a combination of resistor multiplexed and conventionally switched outputs to control the many functions and features it provides. The switch is grounded to the left cowl side inner panel, beneath the instrument panel. The switch receives battery current from a fuse in the Power Distribution Center (PDC), a fused B(+) circuit and, when the ignition switch is in the Accessory or On positions, from a fuse in the fuse block through a fused ignition switch output (run-acc) circuit. Following are descriptions of the how the left multi-function switch operates to control the many functions and features it provides:

- **Front/Rear Fog Lamps** - The control knob on the end of the left multi-function switch control stalk is pulled outward to activate the optional fog lamps. The control knob is keyed so that it cannot be pulled outward unless the knob is first rotated to turn on the exterior lighting. The internal circuitry of the left multi-function switch then provides battery current through a fused fog lamp relay output circuit and the fog lamp relay to the fog lamps and to the instrument cluster for control of the fog lamp indicator.
- **Hazard Warning System** - The hazard warning push button is pushed down to unlatch the switch and activate the hazard warning system, and pushed down again to latch the switch and turn the system off. When the hazard warning switch is latched, the push button will be in a lowered position on the top of the steering column shroud; and, when the hazard warning switch is unlatched, the push button will be in a raised position. The left multi-function switch hazard warning simultaneously provides a signal to the hazard warning sense of the combination flasher to activate or deactivate the flasher output, and directs the output of the flasher to the hazard warning lamps.
- **Headlamps** - The control knob on the end of the left multi-function switch control stalk is rotated forward to its second detent from the Off position to activate the headlamps. The internal circuitry of the left multi-function switch then provides battery current through the integral beam select switch and the headlamp low beam or high beam circuits to the appropriate headlamp filaments and to the instrument cluster for control of the high beam indicator.
- **Headlamp Beam Selection** - The left multi-function switch control stalk is pulled towards the steering wheel past a detent, then released to actuate the integral beam select switch circuitry. Each time the control stalk is actuated in this manner, the opposite headlamp mode from what is currently selected will be activated.
- **Headlamp Optical Horn** - The left multi-function switch control stalk is pulled towards the steering wheel to just before a detent, to momentarily activate the headlamp high beams. The high beams will remain illuminated until the control stalk is released. The internal beam select switch circuitry directs battery current through the headlamp high beam circuit of the left multi-function switch to the headlamp high beams and to the instrument cluster for control of the high beam indicator.
- **Interior Lamps Control** - A control ring on the left multi-function switch control stalk is rotated to a full forward detent to illuminate all interior courtesy lamps. The instrument cluster circuitry monitors the hard wired variable resistor output of the left multi-function switch through the panel lamps dimmer signal circuit then, based upon that input, provides a ground path to activate all interior courtesy lamps through a courtesy lamp feed circuit output.
- **Panel Lamps Dimming** - A control ring on the left multi-function switch control stalk is rotated to one of six intermediate detent positions to select the desired illumination intensity of all adjustable instrument panel and instrument cluster lighting. The control ring is rotated forward to brighten, or rearward to dim the lighting. The instrument cluster monitors the hard wired variable resistor output of the left multi-function switch through the panel lamps dimmer signal circuit then, based upon that input, provides a pulse width modulated output, to control the instrument cluster lighting levels. The instrument cluster also controls the lighting levels of the other adjustable instrument panel lighting based upon this panel lamps dimmer signal through a panel lamps driver circuit output.
- **Parade Mode** - A control ring on the left multi-function switch control stalk is rotated to an intermediate detent that is one detent rearward from the full forward detent to illuminate the Vacuum Fluorescent Display (VFD) in the instrument cluster and the radio at full intensity. The instrument cluster monitors the hard wired variable resistor output of the left multi-function switch through the panel lamps dimmer signal circuit then, based upon that input, adjusts the instrument cluster VFD to its full intensity and provides a battery current signal to the radio on a park lamp relay output circuit that signals the radio to light its VFD to full intensity.
- **Park Lamps** - The control knob on the end of the left multi-function switch control stalk is rotated forward to its first detent to activate the parking lamps. The left multi-function switch then provides battery voltage to the parking lamps and to the instrument cluster as a request for cluster illumination and panel lamps output.
- **Turn Signal Control** - The left multi-function switch control stalk actuates the turn signal switch-.The multi-function switch turn signal circuitry

LEFT MULTI-FUNCTION SWITCH (Continued)

simultaneously provides a signal to the turn signal sense circuit of the combination flasher to activate the flasher output. 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 left multi-function switch control stalk is released. When the control stalk is moved to a turn signal switch detent position, the cancel actuator extends toward the center of the steering column. A turn signal cancel cam that is integral to the clockspring, rotates with the steering wheel and the cam lobes contact the cancel actuator when it is extended from the multi-function switch. When the steering wheel is rotated during a turning maneuver, one of the two turn signal cancel cam lobes will contact the turn signal cancel actuator. The cancel actuator latches against the cancel cam rotation in the direction opposite that which is signaled. If only momentary signaling such as indication of a lane change is desired, the switch is actuated to a left or right intermediate detent position. In this position the signal lamps flash as described above, but the switch returns to the Off position as soon as the lever is released. When the system is activated, one of two turn indicators in the instrument cluster flashes in unison with the turn signal lamps, indicating to the driver that the system is operating.

DIAGNOSIS AND TESTING - LEFT MULTI-FUNCTION SWITCH

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the left multi-function switch from the steering column (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/LEFT MULTI-FUNCTION SWITCH - REMOVAL).

(3) Remove the combination flasher from the left multi-function switch.

(4) Using an ohmmeter, perform the continuity and resistance tests at the terminals in the left multi-function switch connector receptacles as shown in the Left Multi-Function Switch Test table. Refer to (Fig. 19) and (Fig. 20) for connector terminal and cavity identification.

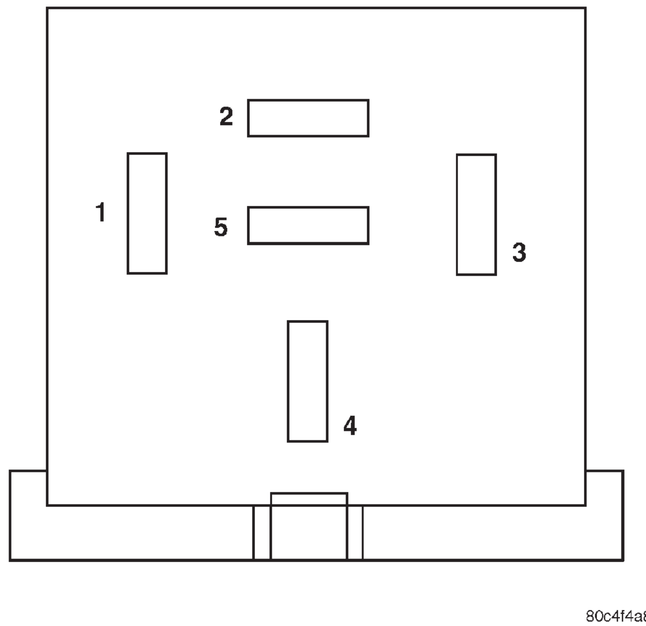

Fig. 19 Combination Flasher Receptacle (Connector A)

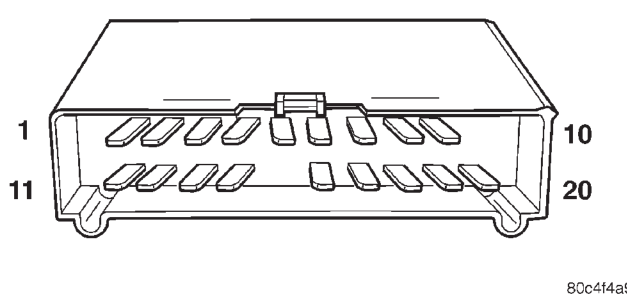

Fig. 20 Left Multi-Function Switch Connector Receptacle (Connector B)

LEFT MULTI-FUNCTION SWITCH (Continued)

LEFT (LIGHTING) MULTI-FUNCTION SWITCH TEST		
TURN SIGNAL AND HAZARD WARNING SWITCH TESTS		
SWITCH POSITION		CONTINUITY BETWEEN
TURN	HAZARD	
Neutral	Off	B1 & B4, B1 & B5
Left	Off	A2 & B2, A2 & B4, B1 & B5
Right	Off	A2 & B5, B1 & B4
Neutral	On	A2 & B2, A2 & B4, A2 & B5, A2 & B6, A3 & B7, A3 & A5

EXTERIOR LIGHTING SWITCH TESTS	
SWITCH POSITION	CONTINUITY BETWEEN
Park Lamps On	B9 & B20
Headlamp Low Beams On	B16 & B18, B16 & B19
Headlamp High Beams On	B17 & B18, B17 & B19
Fog Lamps On	B13 & B14
Optical Horn On	B17 & B18, B17 & B19

INTERIOR LIGHTING SWITCH TESTS		
SWITCH POSITION	RESISTANCE BETWEEN	RESISTANCE (OHMS)
Panel Lamps Dimming Position 1 (Dimmest)	B7 & B8	5653 ± 10%
Dimming Position 2	B7 & B8	3743 ± 10%
Dimming Position 3	B7 & B8	2593 ± 10%
Dimming Position 4	B7 & B8	1825 ± 10%
Dimming Position 5	B7 & B8	1221 ± 10%
Dimming Position 6 (Brightest)	B7 & B8	768 ± 10%
Parade Mode On	B7 & B8	412 ± 10%
Courtesy Lamps On	B7 & B8	150 ± 10%

(5) If the left multi-function switch fails any of the continuity or resistance tests, replace the faulty switch unit as required.

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the two screws that secure the lower steering column shroud to the upper shroud (Fig. 21).

(4) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully lowered position and leave the tilt release lever in the released (down) position.

(5) Remove both the upper and lower shrouds from the steering column.

(6) Disconnect the cross body wire harness connector for the left multi-function switch from the connector receptacle on the back of the switch.

(7) Disconnect the cross body wire harness connector for the right multi-function switch from the connector receptacle on the back of the switch.

(8) Remove the two screws that secure the multi-function switch assembly to the upper steering column housing (Fig. 22).

LEFT MULTI-FUNCTION SWITCH (Continued)

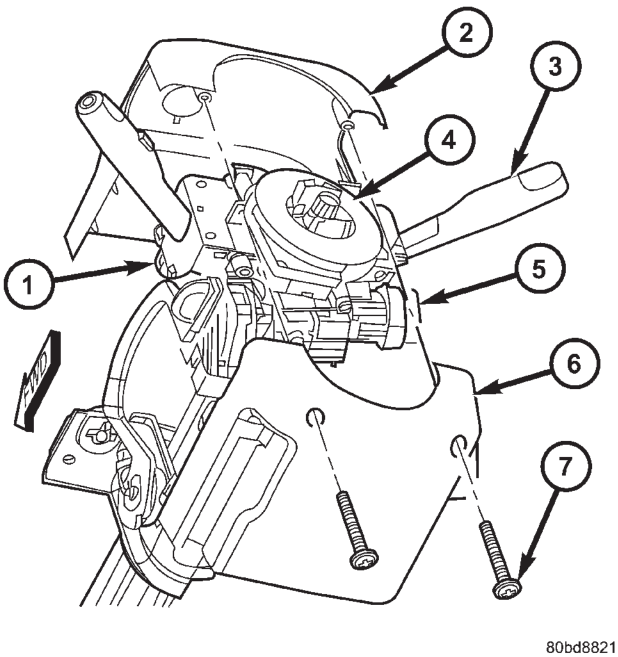

Fig. 21 Steering Column Shrouds Remove/Install

1 - LEFT MULTI-FUNCTION SWITCH
2 - UPPER SHROUD
3 - RIGHT MULTI-FUNCTION SWITCH
4 - CLOCKSPRING
5 - IGNITION LOCK CYLINDER HOUSING
6 - LOWER SHROUD
7 - SCREW (2)

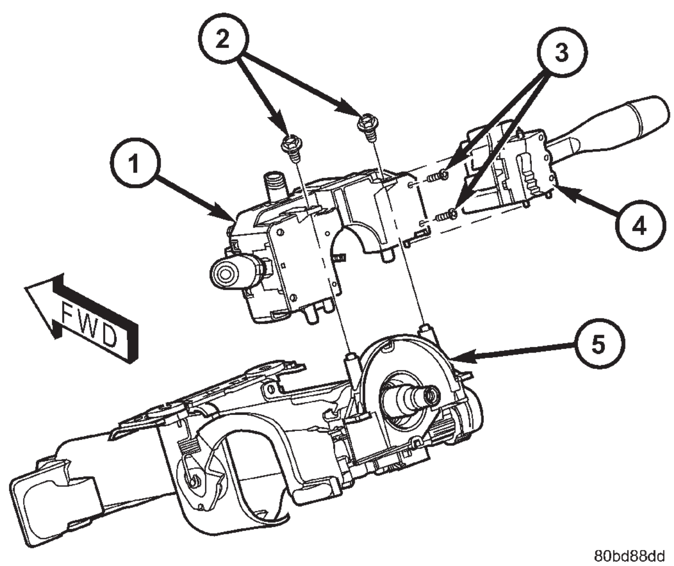

Fig. 22 Multi-Function Switch Remove/Install

1 - LEFT MULTI-FUNCTION SWITCH
2 - SCREW (2)
3 - SCREW (2)
4 - RIGHT MULTI-FUNCTION SWITCH
5 - UPPER STEERING COLUMN HOUSING

(9) Remove the multi-function switch assembly from the upper steering column housing.

(10) Remove the two small screws that secure the right multi-function switch to the left multi-function switch mounting housing.

(11) Grasp the right multi-function switch control stalk firmly and pull the switch toward the right far enough to disengage the alignment pins on the top (1) and bottom (2) of the right switch housing from the alignment ramps on the left multi-function switch mounting housing.

(12) Remove the right multi-function switch from the left multi-function switch.

(13) Remove the combination flasher from the connector receptacle on the back of the left multi-function switch.

INSTALLATION

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(1) Install the combination flasher into the connector receptacle on the back of the left multi-function switch.

(2) Position the right multi-function switch to the left multi-function switch.

(3) Grasp the right multi-function switch control stalk firmly and slide the switch toward the left far enough to engage the alignment pins on the top (1) and bottom (2) of the right switch housing into the alignment ramps on the left multi-function switch mounting housing.

(4) Install and tighten the two small screws that secure the right multi-function switch to the left multi-function switch mounting housing (Fig. 22). Tighten the screws to 2 N·m (20 in. lbs.).

(5) Position the multi-function switch assembly onto the upper steering column housing.

(6) Install and tighten the two screws that secure the multi-function switch assembly to the upper steering column housing. Tighten the screws to 2 N·m (20 in. lbs.).

LEFT MULTI-FUNCTION SWITCH (Continued)

(7) Reconnect the cross body wire harness connector for the right multi-function switch to the connector receptacle on the back of the switch.

(8) Reconnect the cross body wire harness connector for the left multi-function switch to the connector receptacle on the back of the switch.

(9) Position both the upper and lower shrouds onto the steering column (Fig. 23). Be certain that the locating tabs for the left and right multi-function switch control stalk watershields are properly engaged in the openings of both the upper and lower shrouds.

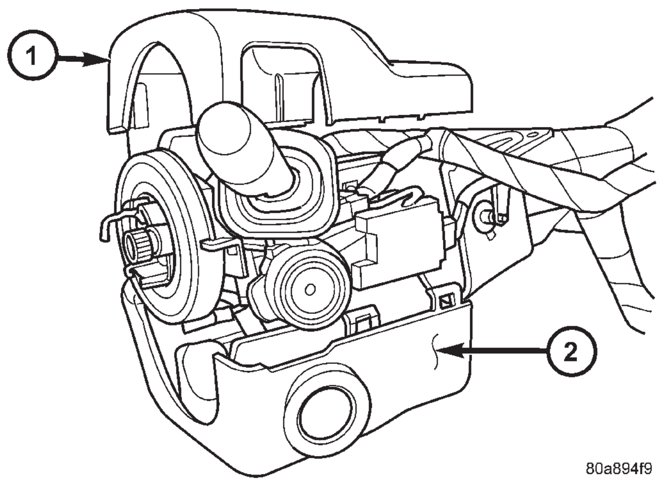

Fig. 23 Shroud Remove/Install

1 - UPPER SHROUD
2 - LOWER SHROUD

(10) Install and tighten the two screws that secure the lower steering column shroud to the upper shroud. Tighten the screws to 2 N·m (18 in. lbs.).

(11) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully raised position and secure it in place by moving the tilt release lever back to the locked (up) position.

(12) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(13) Reconnect the battery negative cable.

SIDE MARKER LAMP UNIT

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) From underside of the fender, remove nut attaching marker lamp to fender.

(3) Separate lamp from fender.

(4) 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.

(4) Connect battery negative cable.

SIDE MARKER LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) 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.

(3) Remove the bulb from the socket by pulling it straight outward.

INSTALLATION

(1) Install a replacement bulb in the socket.

(2) Install the bulb and socket in the side marker lamp housing.

(3) Connect the battery negative cable.

TAIL LAMP UNIT

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.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) 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.

(3) Pull the rear of the wheelhouse splash shield away from the body and reach upward to disengage the tail lamp electrical connector.

TAIL LAMP UNIT (Continued)

(4) Remove the screws attaching the lens to the tail lamp housing.

(5) Remove the bolts attaching the tail lamp housing to the body (Fig. 24).

(6) Separate the lamp housing from the body.

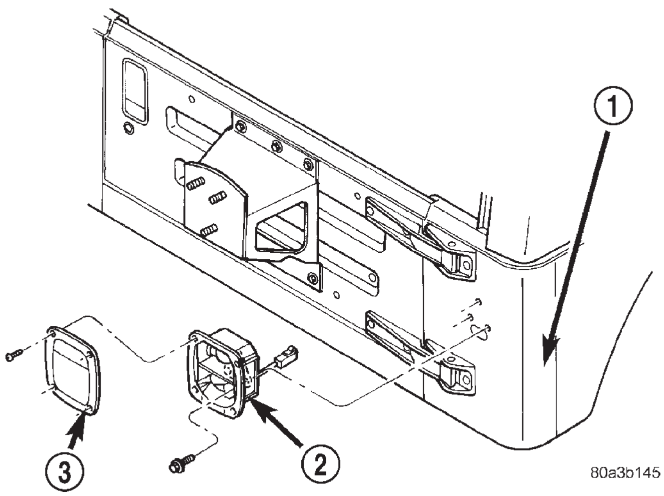

Fig. 24 Tail Lamp Housing

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.

(6) Connect the battery negative cable.

TAIL LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the screws attaching the lens to the tail lamp housing (Fig. 25).

(3) Separate the lens from the tail lamp housing.

(4) Push the bulb inward and rotate counter-clockwise.

(5) Remove the bulb from the lamp socket.

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.

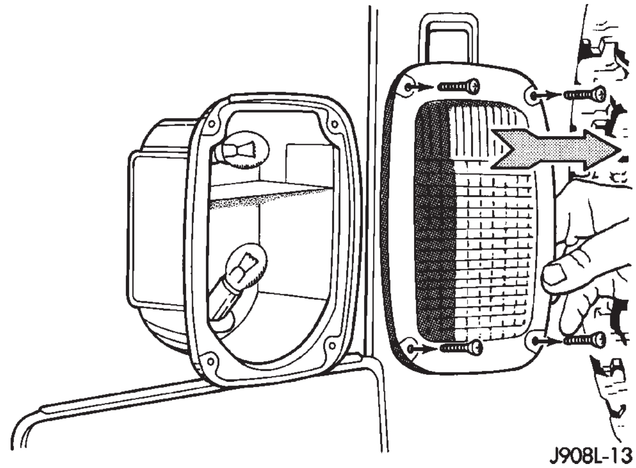

Fig. 25 Lens Removal

(4) Connect the battery negative cable.

TURN SIGNAL CANCEL CAM

DESCRIPTION

The turn signal cancel cam is concealed within the steering column below the steering wheel. The turn signal cancel 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, the driver airbag, and the speed control switches on the steering wheel and the cross body 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 cancel cam lobes rotate with the steering wheel.

The turn signal cancel cam is integral to the clockspring and cannot be repaired. If faulty or damaged, the entire clockspring assembly must be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

OPERATION

The turn signal cancel cam has two lobes molded into the lower surface of the clockspring rotor. When the turn signals are activated by moving the left multi-function switch control stalk to a detent position, a turn signal cancel actuator is extended from the inside surface of the left multi-function switch housing toward the clockspring rotor. When the steering wheel is rotated during the turn, one of the two turn signal cancel cam lobes will contact the turn signal cancel actuator, but the cancel actuator stays latched. When the steering wheel is rotated back to center as the turn is completed, the cancel actuator is unlatched and releases the left multi-function switch control stalk from its detent, cancelling the turn signal event.

UNDERHOOD LAMP UNIT

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Disconnect the wire harness connector from the lamp.
(3) Remove lamp lens.
(4) Remove bulb.
(5) Remove screw attaching underhood lamp to the inner hood panel.
(6) 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. 26). 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.
(7) Connect the battery negative cable.

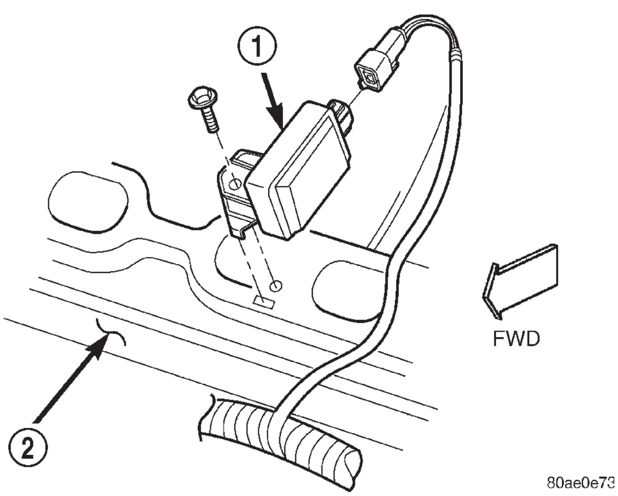

Fig. 26 Underhood Lamp

1 - UNDER HOOD LAMP
2 - HOOD

UNDERHOOD LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Insert a small flat blade in the access slot between the lamp base and lamp lens.
(3) Pry the lamp lens upward and remove the lamp lens (Fig. 27).
(4) Depress the bulb terminal inward (Fig. 28) to release the bulb.

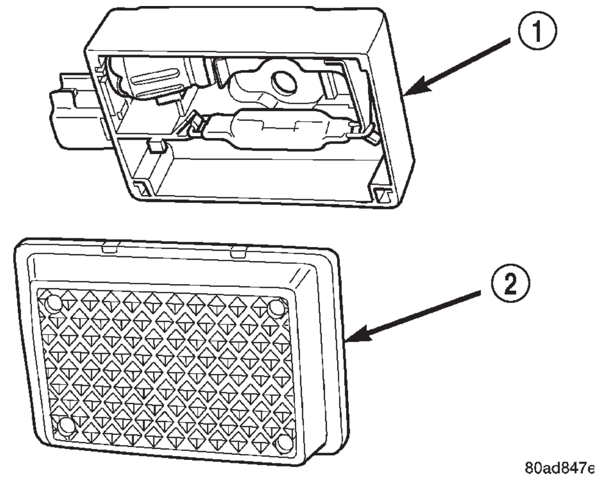

Fig. 27 Underhood Lamp Lens

1 - LAMP
2 - LAMP LENS

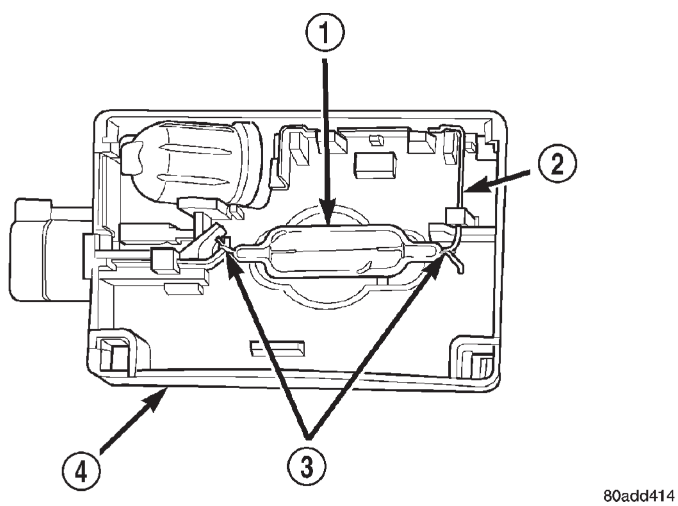

Fig. 28 Underhood Lamp Bulb

1 - BULB
2 - DEPRESS TERMINAL INWARD
3 - BULB WIRE LOOP
4 - LAMP BASE

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.
(4) Connect the battery negative cable.

LAMPS/LIGHTING - INTERIOR

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LAMPS/LIGHTING - INTERIOR

SPECIFICATIONS

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.

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 (Sound Bar)	912
Under Hood	561
Underpanel Courtesy	906
Instrument Cluster Illumination	103
Instrument Cluster Warning	74
Automatic Transmission Indicator	658

SOUND BAR DOME LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Insert a small flat blade between the lamp housing and lamp lens. Carefully pry lamp lens from the lamp housing.

(3) Separate lens from lamp.

(4) Remove the screws attaching the lamp to the sound bar (Fig. 1).

(5) Disengage lamp electrical connector.

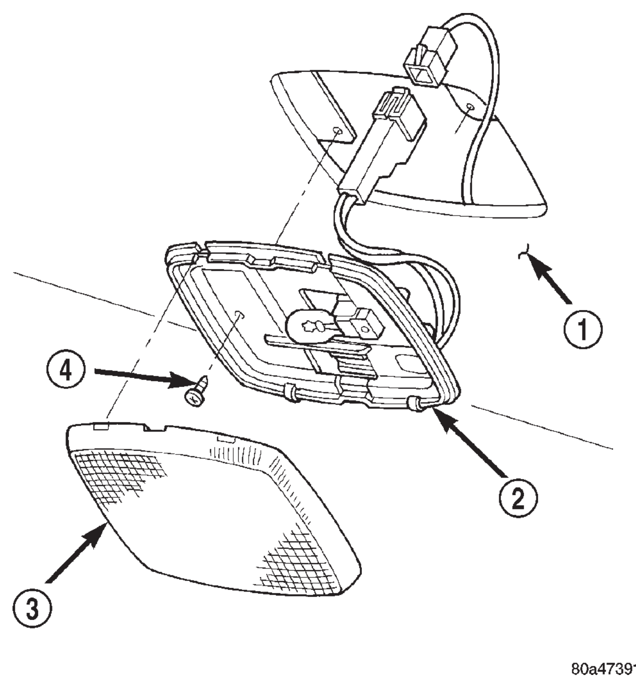

Fig. 1 Sound Bar Dome Lamp

1 - SOUND BAR
2 - DOME LAMP HOUSING
3 - DOME LAMP LENS
4 - SCREW

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.

(5) Connect the battery negative cable.

SOUND BAR DOME LAMP BULB

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Insert a small flat blade between the lamp housing and lamp lens. Carefully pry lamp lens to disengage lens retaining tabs.
(3) Separate lens from lamp housing.
(4) Grasp bulb and pull from lamp.

INSTALLATION

(1) Position bulb in lamp socket and press into place.
(2) Position lamp lens on lamp housing and press into place.
(3) Connect the battery negative cable.

DOOR AJAR SWITCH

DESCRIPTION

Two door ajar switches are standard equipment in this vehicle, one is installed in the the driver side door hinge pillar and one is installed in the passenger side door hinge pillar. The door ajar switches are constructed of molded black plastic and feature integral snap features on the outside of the switch housing. A molded connector receptacle on one end of the switch connects it to the vehicle electrical system through a dedicated take out and connector of the cross body wire harness. A self-adjusting, spring loaded plunger on the other end of the switch is actuated by the hinge face of the door. The self adjusting feature of the switch plunger is a one-time feature, it can be adjusted inward (compressed), but cannot be readjusted outward (extended) once it has been compressed. This normally open switch only closes when the door is open.

The door ajar switch cannot be repaired and, if faulty or damaged, it must be replaced.

OPERATION

The door ajar switches close a path to ground through separate driver and passenger door ajar switch sense circuit inputs to the instrument cluster chime warning circuitry when a door is opened, and open that ground path when the door is closed. The door ajar switch inputs to the instrument cluster can be diagnosed using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - DOOR AJAR SWITCH

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices, and grounds.

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.

(1) Disconnect and isolate the battery negative cable. Remove the door ajar switch from its mounting hole in the door hinge pillar. Disconnect the cross body wire harness connector for the door ajar switch from the switch connector receptacle. Check for continuity between the door ajar switch output and the driver or passenger door ajar switch sense circuit terminals in the door ajar switch connector receptacle. There should be continuity with the switch plunger released, and no continuity with the switch plunger depressed. If OK, go to Step 2. If not OK, replace the faulty door ajar switch.
(2) Check for continuity between the door ajar switch output circuit cavity of the cross body wire harness connector for the driver or passenger door ajar switch and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open door ajar switch output circuit to ground (G300) as required.
(3) Remove the instrument cluster from the instrument panel. Disconnect the instrument panel wire harness connector (Connector C2) for the instrument cluster from the cluster connector receptacle on the back of the cluster housing. Check for continuity between the driver or passenger door ajar switch sense circuit cavity of the cross body wire harness connector for the driver or passenger door ajar switch and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the shorted driver or passenger door ajar switch sense circuit between the door ajar switch and the instrument cluster as required.

DOOR AJAR SWITCH (Continued)

(4) Check for continuity between the driver or passenger door ajar switch sense circuit cavities of the cross body wire harness connector for the driver or passenger door ajar switch and the instrument panel wire harness connector (Connector C2) for the instrument cluster. There should be continuity. If not OK, repair the open driver or passenger door ajar switch sense circuit between the door ajar switch and the instrument cluster as required.

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable

(2) Unlatch and open the door fully.

(3) Using a small screwdriver, pry carefully between the hinge pillar and the outer circumference of the door ajar switch housing to release the switch snap features from the mounting hole in the pillar.

(4) Pull the door ajar switch out through the mounting hole in the hinge pillar far enough to access and disconnect the cross body wire harness connector for the door ajar switch from the switch connector receptacle.

(5) Remove the door ajar switch from the door hinge pillar.

INSTALLATION

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.

(1) Position the door ajar switch to the door hinge pillar.

(2) Reconnect the cross body wire harness connector for the door ajar switch to the switch connector receptacle.

(3) Guide the cross body wire harness take out for the door ajar switch and the receptacle end of the switch into the mounting hole in the door hinge pillar.

(4) Using hand pressure, press the door ajar switch housing into the mounting hole in the door hinge pillar until the snap features of the switch are fully engage in the mounting hole.

(5) Slowly close the door and allow the door ajar switch plunger self-adjuster mechanism to ratchet to the proper position.

(6) Reconnect the battery negative cable.

(7) Open and close the door to verify proper door ajar switch operation.

RESTRAINTS

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RESTRAINTS

DESCRIPTION

A dual front airbag system is standard factory-installed safety equipment on this model. The airbag system is a passive, inflatable, Supplemental Restraint System (SRS) and vehicles with this equipment can be readily identified by the “SRS - AIRBAG” logo molded into the driver airbag trim cover in the center of the steering wheel and also into the passenger airbag door on the instrument panel above the glove box (Fig. 1). Vehicles with the airbag system can also be identified by the airbag indicator, which will illuminate in the instrument cluster for about seven seconds as a bulb test each time the ignition switch is turned to the On position.

The dual front airbag system consists of the following major components, which are described in further detail elsewhere in this service information:

- **Airbag Control Module** - The Airbag Control Module (ACM) is located on a mount on the floor panel transmission tunnel, below the center of the instrument panel.
- **Airbag Indicator** - The airbag indicator is integral to the ElectroMechanical Instrument Cluster (EMIC), which is located on the instrument panel in front of the driver.

RESTRAINTS (Continued)

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Fig. 1 SRS Logo

- **Clockspring** - The clockspring is located near the top of the steering column, directly beneath the steering wheel.
- **Driver Airbag** - The driver airbag is located in the center of the steering wheel, beneath the driver airbag trim cover.
- **Driver Knee Blocker** - The driver knee blocker is a molded plastic structural unit secured to the back side of and integral to the instrument panel steering column opening cover.
- **Passenger Airbag** - The passenger airbag is located on the instrument panel, beneath the passenger airbag door on the instrument panel above the glove box on the passenger side of the vehicle.
- **Passenger Airbag On/Off Switch** - The passenger airbag on/off switch is located in a dedicated opening in the forward end of the center console on the floor panel transmission tunnel.
- **Passenger Knee Blocker** - The passenger knee blocker is a structural reinforcement that is integral to and concealed within the glove box door.

The ACM and the EMIC each contain a central processing unit and programming that allow them to communicate with each other using the Programmable Communications Interface (PCI) data bus network. This method of communication is used for control of the airbag indicator on all models. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - DESCRIPTION).

Hard wired circuitry connects the airbag system components to each other through the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system, and to the airbag system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

OPERATION

The airbag system is referred to as a supplemental restraint system because it 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. It is referred to as a passive system because the vehicle occupants are not required to do anything to make it work. The primary passenger restraints in this or any other vehicle are the standard equipment factory-installed seat belts. Seat belts are referred to as an active restraint because the vehicle occupants are required to physically fasten and properly adjust these restraints in order to benefit from them. The vehicle occupants must be wearing their seat belts in order to obtain the maximum safety benefit from the factory-installed airbag system.

The airbag system electrical circuits are continuously monitored and controlled by a microprocessor and software contained within the Airbag Control Module (ACM). An airbag indicator in the ElectroMechanical Instrument Cluster (EMIC) 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 is turned on or off by the ACM to indicate the status of the airbag system. If the airbag indicator comes on at any time other than during the bulb test, it indicates that there is a problem in the airbag system electrical circuits. Such a problem may cause the airbags not to deploy when required, or to deploy when not required.

The clockspring on the top of the steering column allows a continuous electrical circuit to be maintained between the stationary steering column and the driver airbag inflator, which rotates with the steering wheel. The passenger airbag on/off switch allows the passenger side airbag to be disabled when circumstances necessitate that a child, or an adult with certain medical conditions be placed in the front passenger seating position. Refer to the owner's manual in the vehicle glove box for recommendations concerning the specific circumstances where the passenger airbag on/off switch should be used to disable the passenger airbag.

Deployment of the airbags depends upon the angle and severity of the impact. The airbag system is designed to deploy upon a frontal impact within a

RESTRAINTS (Continued)

thirty degree angle from either side of the vehicle center line. Deployment is not based upon vehicle speed; rather, deployment is based upon the rate of deceleration as measured by the forces of gravity (G force) upon the airbag system impact sensor, which is integral to the ACM. When a frontal impact is severe enough, the microprocessor in the ACM signals the inflator units of both airbag modules to deploy the airbags. During a frontal vehicle impact, the knee blockers work in concert with properly fastened and adjusted seat belts to restrain both the driver and the front seat passenger in the proper position for an airbag deployment. The knee blockers also absorb and distribute the crash energy from the driver and the front seat passenger to the structure of the instrument panel.

Typically, the driver and front seat passenger recall more about the events preceding and following a collision than they have of the airbag deployment itself. This is because the airbag deployment and deflation occur so rapidly. In a typical 48 kilometer-per-hour (30 mile-per-hour) barrier impact, from the moment of impact until both airbags are fully inflated takes about 40 milliseconds. Within one to two seconds from the moment of impact, both airbags are almost entirely deflated. The times cited for these events are approximations, which apply only to a barrier impact at the given speed. Actual times will vary somewhat, depending upon the vehicle speed, impact angle, severity of the impact, and the type of collision.

When the ACM monitors a problem in any of the airbag system circuits or components, it stores a fault code or Diagnostic Trouble Code (DTC) in its memory circuit and sends an electronic message to the EMIC to turn on the airbag indicator. Proper testing of the airbag system components, the Programmable Communications Interface (PCI) data bus, the data bus message inputs to and outputs from the EMIC or the ACM, as well as the retrieval or erasure of a DTC from the ACM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

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.

WARNING

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.

WARNING: THE DRIVER AIRBAG INFLATOR UNIT 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 UNIT CONTAINS ARGON GAS PRESSURIZED TO OVER 2500 PSI. DO NOT ATTEMPT TO DISMANTLE AN AIRBAG UNIT 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).

WARNING: REPLACE AIRBAG SYSTEM COMPONENTS ONLY WITH PARTS SPECIFIED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG. SUBSTITUTE PARTS MAY APPEAR INTERCHANGEABLE, BUT INTERNAL DIFFERENCES MAY RESULT IN INFERIOR OCCUPANT PROTECTION.

WARNING: 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 DAIMLERCHRYSLER MOPAR PARTS CATALOG.

WARNING: WHEN A STEERING COLUMN HAS AN AIRBAG UNIT ATTACHED, NEVER PLACE THE COLUMN ON THE FLOOR OR ANY OTHER SURFACE WITH THE STEERING WHEEL OR AIRBAG UNIT FACE DOWN.

DIAGNOSIS AND TESTING - AIRBAG SYSTEM

Proper diagnosis and testing of the airbag system components, the PCI data bus, the data bus message inputs to and outputs from the ElectroMechanical Instrument Cluster (EMIC) or the Airbag Control Module (ACM), as well as the retrieval or erasure of

RESTRAINTS (Continued)

a Diagnostic Trouble Code (DTC) from the ACM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

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.

STANDARD PROCEDURE

STANDARD PROCEDURE - HANDLING OF NON-DEPLOYED AIRBAGS

At no time should any source of electricity be permitted near the inflator on the back of a non-deployed airbag. When carrying a non-deployed airbag, the trim cover or airbag cushion side of the unit should be pointed away from the body to minimize injury in the event of an accidental deployment. If the airbag unit is placed on a bench or any other surface, the trim cover or airbag cushion side of the unit 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.

All damaged, faulty, or non-deployed driver or passenger airbags which are replaced on vehicles are to be handled and disposed of properly. If an airbag unit is faulty or damaged and non-deployed, refer to the Hazardous Substance Control System for proper disposal. Dispose of all non-deployed and deployed airbags in a manner consistent with state, provincial, local and federal regulations.

AIRBAG STORAGE

Airbags must be stored in their original, special container until they are used for service. Also, they must be stored in a clean, dry environment; away from sources of extreme heat, sparks, and high electrical energy. Always place or store any airbag on a surface with its trim cover or airbag cushion side facing up, to minimize movement in case of an accidental deployment.

STANDARD PROCEDURE - SERVICE AFTER AN AIRBAG DEPLOYMENT

Any vehicle which is to be returned to use following an airbag deployment, must have both airbags, the driver airbag trim cover, the horn switch, the clockspring, and the passenger airbag door replaced. These components are not intended for reuse and will be damaged or weakened as a result of an airbag deployment, which may or may not be obvious during a visual inspection. Other vehicle components should be closely inspected, but are to be replaced only as required by the extent of the visible damage incurred.

CLEANUP PROCEDURE

Following an airbag 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 propellant used to deploy the airbags. However, this residue may also contain traces of sodium hydroxide powder, a chemical by-product of the propellant material that is used to generate the inert 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).

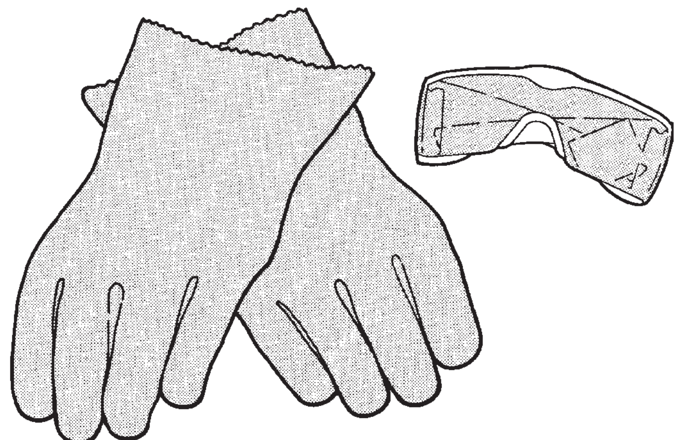


Fig. 2 Wear Safety Glasses and Rubber Gloves - Typical

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.

RESTRAINTS (Continued)

(1) Begin the cleanup by using 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.

(2) Be certain 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.

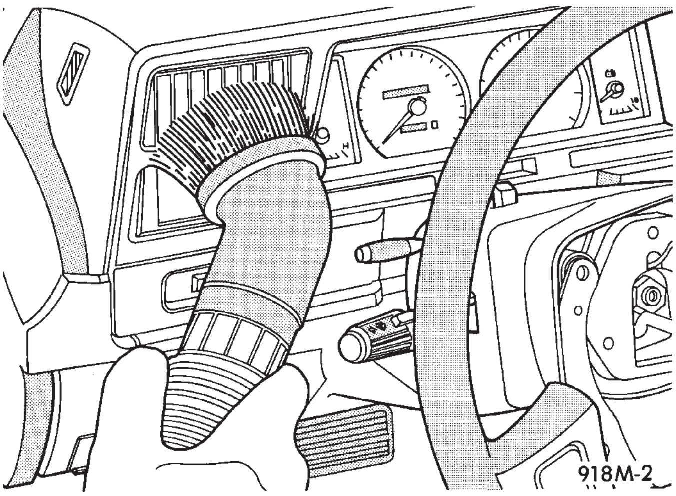


Fig. 3 Vacuum Heater and A/C Outlets - Typical

CAUTION: Refer to the Hazardous Substance Control System for proper disposal procedures. Dispose of all non-deployed and deployed airbags in a manner consistent with state, provincial, local, and federal regulations.

(3) Next, remove the deployed airbags from the vehicle. Refer to the appropriate service removal procedures.

(4) You may need to vacuum the interior of the vehicle a second time to recover all of the powder.

STANDARD PROCEDURE - VERIFICATION TEST

The following procedure should be performed using a DRBIII® scan tool to verify proper airbag system operation following the service or replacement of any airbag system component.

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.

(1) During the following test, the battery negative cable remains disconnected and isolated, as it was during the airbag component removal and installation procedures.

(2) Be certain that the DRBIII® scan tool contains the latest version of the proper DRBIII® software. Connect the DRBIII® to the 16-way Data Link Connector (DLC). The DLC is located on the driver side lower edge of the instrument panel, outboard of the steering column (Fig. 4).

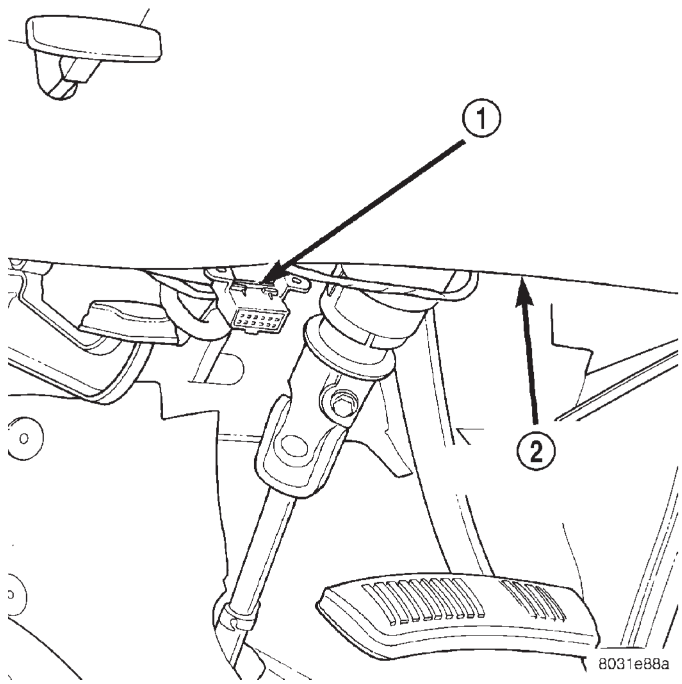


Fig. 4 16-Way Data Link Connector - Typical

1 - 16–WAY DATA LINK CONNECTOR
2 - BOTTOM OF INSTRUMENT PANEL

(3) Turn the ignition switch to the On position and exit the vehicle with the DRBIII®.

(4) Check to be certain that nobody is in the vehicle, then reconnect the battery negative cable.

(5) Using the DRBIII®, read and record the active (current) Diagnostic Trouble Code (DTC) data.

(6) Next, use the DRBIII® to read and record any stored (historical) DTC data.

(7) If any DTC is found in Step 5 or Step 6, refer to the appropriate diagnostic information.

(8) Use the DRBIII® to erase the stored DTC data. If any problems remain, the stored DTC data will not erase. Refer to the appropriate diagnostic information to diagnose any stored DTC that will not erase. If the stored DTC information is successfully erased, go to Step 9.

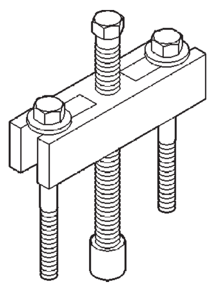
(9) Turn the ignition switch to the Off position for about fifteen seconds, and then back to the On posi-

RESTRAINTS (Continued)

tion. Observe the airbag indicator 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 and that the repairs are complete. If the airbag indicator fails to light, or lights and stays on, there is still an active airbag system fault or malfunction. Refer to the appropriate diagnostic information to diagnose the problem.

SPECIAL TOOLS

AIRBAG SYSTEM



Puller C-3428-B

AIRBAG CONTROL MODULE

DESCRIPTION

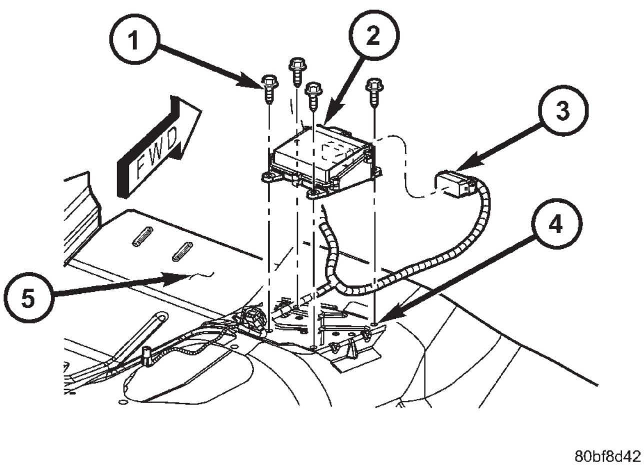


Fig. 5 Airbag Control Module

1 - SCREW (4)
2 - AIRBAG CONTROL MODULE
3 - WIRE HARNESS CONNECTOR
4 - MOUNTING BRACKET
5 - FRONT FLOOR PANEL

The Airbag Control Module (ACM) is secured with four screws to a mounting bracket that is welded onto the top of the floor panel transmission tunnel below the instrument panel and forward of the center floor console in the passenger compartment of the vehicle (Fig. 5). The ACM contains an electronic microprocessor, an electronic impact sensor, an electromechanical safing sensor, and an energy storage capacitor. The ACM is connected to the vehicle electrical system through a dedicated take out and connector of the cross body wire harness.

The ACM cannot be repaired or adjusted and, if damaged or faulty, it must be replaced.

OPERATION

The microprocessor in the ACM contains the airbag system logic circuits, and it monitors and controls all of the airbag system components. The ACM also uses On-Board Diagnostics (OBD) and can communicate with other electronic modules in the vehicle as well as with the DRBIII® scan tool using the Programmable Communications Interface (PCI) data bus network. This method of communication is used for control of the airbag indicator in the ElectroMechanical Instrument Cluster (EMIC) and for airbag system diagnosis and testing through the 16-way data link connector located on the lower left edge of the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER/AIRBAG INDICATOR - OPERATION). The ACM microprocessor continuously monitors all of the airbag system electrical circuits to determine the system readiness. If the ACM detects a monitored system fault, it sets an active Diagnostic Trouble Code (DTC) and sends messages to the EMIC over the PCI data bus to turn on the airbag indicator. An active fault only remains for the duration of the fault or in some cases the duration of the current ignition switch cycle, while a stored fault causes a DTC to be stored in memory by the ACM. For some DTCs, if a fault does not recur for a number of ignition cycles, the ACM will automatically erase the stored DTC. For other internal faults, the stored DTC is latched forever.

The ACM also receives a resistor multiplexed input from the passenger airbag on/off switch and provides a control output for the Off indicator in the switch through a passenger airbag indicator driver circuit. If the passenger airbag on/off switch is set to the Off position, the ACM turns on the passenger airbag on/off switch Off indicator and will internally disable the passenger airbag from being deployed if an impact is detected that is sufficient for an airbag deployment. The ACM also turns on the on/off switch Off indicator for about seven seconds each time the ignition switch is turned to the On position as a bulb test. Following the bulb test, the ACM controls the status of the Off indicator based upon the resistance of the input from the on/off switch. The ACM will also set and/or store a DTC for faults it detects in the passenger airbag on/off switch circuits, and will turn on the airbag indicator in the EMIC if a fault has been detected.

AIRBAG CONTROL MODULE (Continued)

The ACM receives battery current through two circuits, on a fused ignition switch output (run) circuit through a fuse in the fuse block, and on a fused ignition switch output (run-start) circuit through a second fuse in the fuse block. The ACM is grounded through a ground circuit and take out of the cross body wire harness. This take out has a single eyelet terminal connector secured by a ground screw to the right cowl side inner panel below the instrument panel in the passenger compartment. Therefore, the ACM is operational whenever the ignition switch is in the Start or On positions. The ACM also contains an energy-storage capacitor. When the ignition switch is in the Start or On positions, this capacitor is continually being charged with enough electrical energy to deploy the airbags for up to one second following a battery disconnect or failure. The purpose of the capacitor is to provide backup airbag system protection in case there is a loss of battery current supply to the ACM during an impact. The capacitor is only serviced as a unit with the ACM.

Two sensors are contained within the ACM, an electronic impact sensor and a safing sensor. The electronic impact sensor is an accelerometer that senses the rate of vehicle deceleration, which provides verification of the direction and severity of an impact. 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. The safing sensor is an electromechanical sensor within the ACM that is connected in series between the ACM microprocessor deployment circuit and the airbags. The safing sensor is a normally open switch that is used to verify or confirm the need for an airbag deployment by detecting impact energy of a lesser magnitude than that of the electronic impact sensor, and must be closed in order for the airbags to deploy. The impact sensor and safing sensor are calibrated for the specific vehicle, and are only serviced as a unit with the ACM.

REMOVAL

WARNING: 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.

WARNING: THE AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE AIRBAGS. 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.

(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 the carpet on the right and left sides of the floor panel transmission tunnel rearward far enough to access the Airbag Control Module (ACM), which is forward of the floor console.

(3) If the vehicle is equipped with the optional Anti-lock Brake System (ABS), remove the acceleration switch from the left side of the mounting bracket on the floor panel transmission tunnel. (Refer to 5 - BRAKES/ELECTRICAL/G-SWITCH - REMOVAL).

(4) Remove the four screws that secure the Airbag Control Module (ACM) to the mounting bracket that is welded onto the floor panel transmission tunnel (Fig. 6).

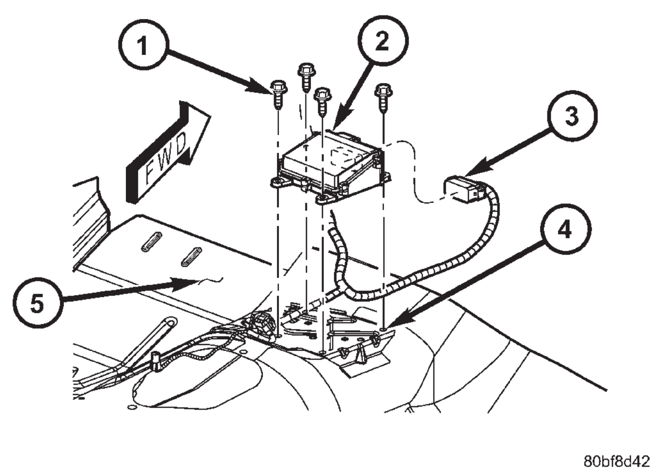


Fig. 6 Airbag Control Module Remove/Install

1 - SCREW (4)
2 - AIRBAG CONTROL MODULE
3 - WIRE HARNESS CONNECTOR
4 - MOUNTING BRACKET
5 - FRONT FLOOR PANEL

AIRBAG CONTROL MODULE (Continued)

(5) Lift the ACM upward from the mounting bracket far enough to disengage the locator pins on the ACM housing from the locator holes in the mounting bracket, then pull the ACM out from under the instrument panel far enough to access the wire harness connector.

(6) Disconnect the cross body wire harness connector for the ACM from the ACM connector receptacle. To disconnect the cross body wire harness connector from the ACM (Fig. 7):

(a) Pull the white Connector Positive Assurance (CPA) locks on each side of the connector out about 3 millimeters (0.125 in.).

(b) Squeeze the latch tabs on each side of the connector between the thumb and forefinger and pull the connector straight away from the ACM connector receptacle.

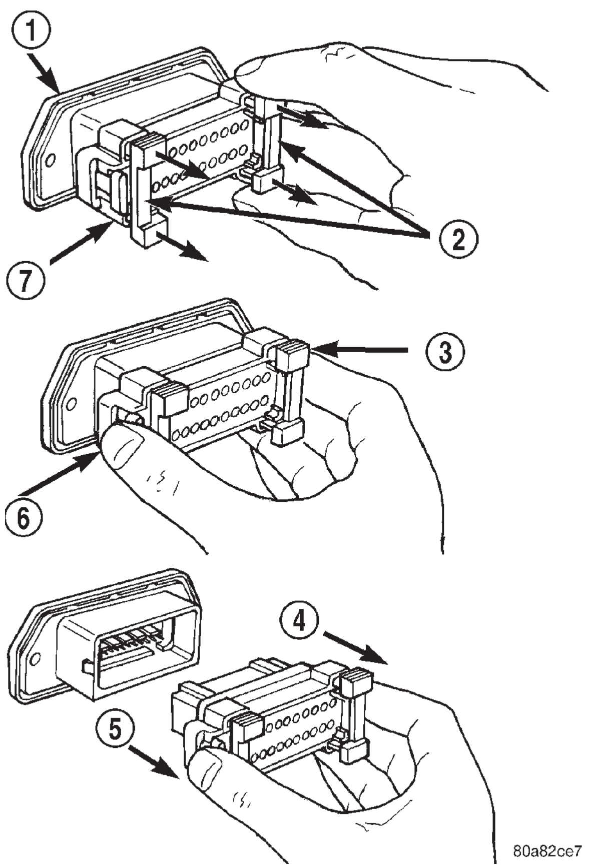


Fig. 7 Airbag Control Module Connector Removal

1 - AIRBAG CONTROL MODULE
2 - PULL TWO LOCKS OUT
3 - SQUEEZE LATCHES
4 - PULL
5 - PULL
6 - SQUEEZE LATCHES
7 - WIRE HARNESS CONNECTOR

(7) Remove the ACM from beneath the instrument panel.

INSTALLATION

WARNING: 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.

WARNING: THE AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE AIRBAGS. 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.

(1) Position the Airbag Control Module (ACM) beneath the instrument panel.

(2) Reconnect the cross body wire harness connector for the ACM to the ACM connector receptacle (Fig. 7). Be certain that the connector latches and the white Connector Positive Assurance (CPA) locks are fully engaged.

(3) Carefully position the ACM to the mounting bracket that is welded onto the floor panel transmission tunnel (Fig. 6). When the ACM is correctly positioned, the locator pins on the ACM housing will be engaged in the locator holes in the mounting bracket, and the arrow on the ACM label will be pointed forward in the vehicle.

(4) Install and tighten the four screws that secure the ACM to the mounting bracket welded onto the floor panel transmission tunnel. Tighten the screws to 14 N·m (125 in. lbs.).

(5) If the vehicle is equipped with the optional ABS brakes, reinstall the acceleration switch onto the left side of the mounting bracket on the floor panel transmission tunnel. (Refer to 5 - BRAKES/ ELECTRICAL/G-SWITCH - INSTALLATION).

(6) Restore the carpet on the right and left sides of the floor panel transmission tunnel to its proper position beneath the instrument panel.

AIRBAG CONTROL MODULE (Continued)

(7) Do not reconnect the battery negative cable at this time. The airbag system verification test procedure should be performed following service of any airbag system component (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

CLOCKSPRING

DESCRIPTION

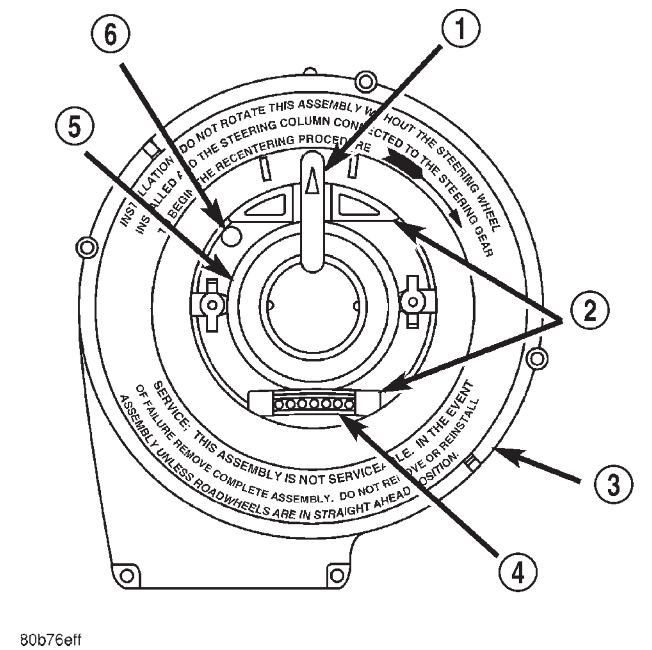


Fig. 8 Clockspring

1 - LOCKING PIN
2 - ROTOR FLATS
3 - CASE
4 - UPPER CLOCKSPRING PIGTAIL WIRES (WIRES NOT SHOWN)
5 - ROTOR
6 - INDEX HOLE

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 (Fig. 8). The clockspring consists of a flat, round molded plastic case with a stubby tail that hangs below the steering column and contains two connector receptacles that face toward the instrument panel. Within the plastic housing is a spool-like molded plastic rotor with a large exposed hub. The upper surface of the rotor hub has a large center hole, two large flats, and two or three short pigtail wires with connectors. The third pigtail wire is used on vehicles equipped with the optional speed control system. The lower surface of the rotor hub has a molded plastic turn signal cancel cam consisting of two lobes that are molded into the rotor. Within the plastic case and wound around the rotor spool is a long ribbon-like tape that consists of several thin copper wire leads sandwiched between two thin plastic membranes. The outer end of the tape terminates at the connector receptacles that face the instrument panel, while the inner end of the tape terminates at the pigtail wires on the hub of the clockspring rotor that face the steering wheel.

Service replacement clocksprings are shipped precentered and with a locking pin that snaps into a receptacle on the rotor and is engaged between two tabs on the upper surface of the rotor case. The locking pin secures the centered clockspring rotor to the clockspring case during shipment, but the locking pin must be removed from the clockspring after it is installed on the steering column. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CENTERING).

The clockspring cannot be repaired. If the clockspring is faulty, damaged, or if the driver airbag has been deployed, the clockspring must be replaced.

OPERATION

The clockspring is a mechanical electrical circuit component that is used to provide continuous electrical continuity between the fixed cross body wire harness on the steering column and the electrical components mounted on or in the rotating steering wheel. On this model the rotating electrical components include the driver airbag, the horn switch, and the speed control switches if the vehicle is so equipped. The clockspring case is positioned and secured to the upper steering column housing near the top of the steering column. The connector receptacles on the tail of the fixed clockspring case connect the clockspring to the vehicle electrical system through two take outs with connectors from the cross body wire harness. The clockspring rotor is movable and is keyed by two flats molded into the rotor hub to two flats that are cast into the lower surface of the steering wheel armature. The two lobes on the turn signal cancel cam on the lower surface of the clockspring rotor hub contact a turn signal cancel actuator of the multi-function switch to provide automatic turn signal cancellation. The pigtail wires on the upper surface of the clockspring rotor connect the clockspring to the driver airbag, the horn switch, and the steering wheel wire harness for the two speed control switches if the vehicle is so equipped.

Like the clockspring in a timepiece, the clockspring tape has travel limits and can be damaged by being wound too tightly during full stop-to-stop steering wheel rotation. To prevent this from occurring, the clockspring is centered when it is installed on the

CLOCKSPRING (Continued)

steering column. Centering the clockspring indexes the clockspring tape to the movable steering components so that the tape can operate within its designed travel limits. However, if the clockspring is removed from the steering column or if the steering shaft is disconnected from the steering gear, the clockspring spool can change position relative to the movable steering components and must be re-centered following completion of the service or the tape may be damaged. Service replacement clocksprings are shipped pre-centered and with a plastic locking pin installed. This locking pin should not be disengaged until the clockspring has been installed on the steering column. If the locking pin is removed or damaged before the clockspring is installed on a steering column, the clockspring centering procedure must be performed. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CENTERING).

STANDARD PROCEDURE - 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 such service or the clockspring tape may be damaged. Service replacement clocksprings are shipped pre-centered and with a plastic locking pin installed (Fig. 9). 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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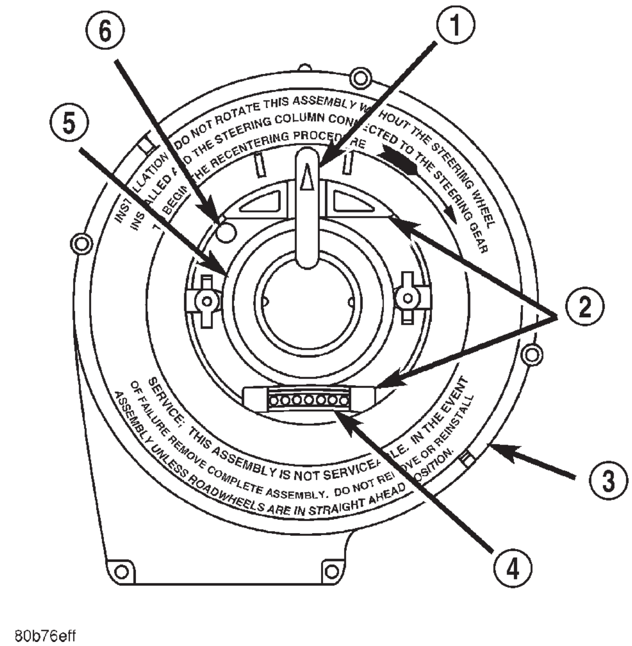

Fig. 9 Clockspring

1 - LOCKING PIN
2 - ROTOR FLATS
3 - CASE
4 - UPPER CLOCKSPRING PIGTAIL WIRES (WIRES NOT SHOWN)
5 - ROTOR
6 - INDEX HOLE

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 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

(3) Rotate the clockspring rotor clockwise to the end of its travel. **Do not apply excessive torque.**

(4) From the end of the clockwise travel, rotate the rotor about two and one-half turns counterclockwise, until the rotor flats are horizontal. If the clockspring pigtail wires are not oriented towards the bottom of the clockspring, rotate the rotor another one-half turn in the counterclockwise direction.

(5) 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

CLOCKSPRING (Continued)

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.

(6) The front wheels should still be in the straight-ahead position. Reinstall the clockspring onto the steering column. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - INSTALLATION).

REMOVAL

The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver airbag has been deployed.

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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 driver airbag from the steering wheel. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

(3) If the vehicle is so equipped, disconnect the upper clockspring pigtail wire connector from the steering wheel wire harness for the speed control switches located within the hub cavity of the steering wheel.

(4) Remove the screw that secures the steering wheel armature to the steering column upper shaft, which is located within the hub cavity of the steering wheel.

CAUTION: Be certain that the screws that secure the steering wheel puller to the steering wheel are fully engaged in the steering wheel armature without passing through the steering wheel and damaging the clockspring.

(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 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(7) Remove the two screws that secure the lower steering column shroud to the upper shroud (Fig. 10).

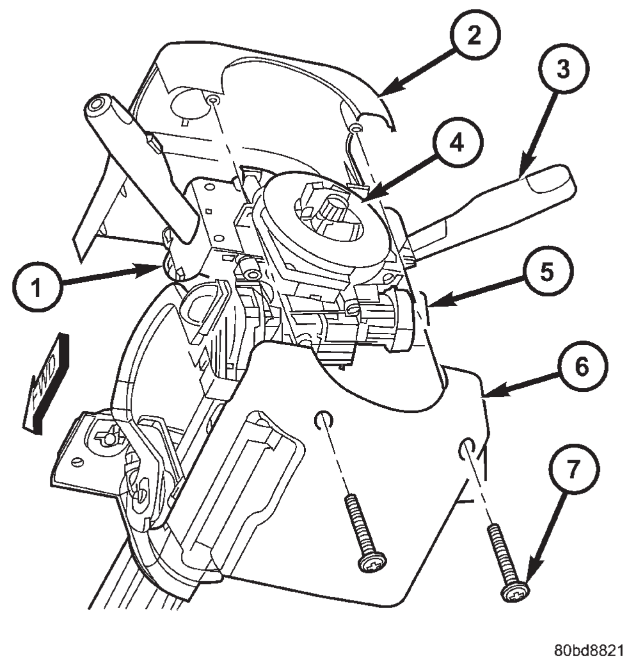

Fig. 10 Steering Column Shrouds Remove/Install

1 - LEFT MULTI-FUNCTION SWITCH
2 - UPPER SHROUD
3 - RIGHT MULTI-FUNCTION SWITCH
4 - CLOCKSPRING
5 - IGNITION LOCK CYLINDER HOUSING
6 - LOWER SHROUD
7 - SCREW (2)

(8) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully lowered position and leave the tilt release lever in the released (down) position.

(9) Remove both the upper and lower shrouds from the steering column.

(10) Disconnect the two cross body wire harness connectors from the lower clockspring connector receptacles (Fig. 11).

(11) Using a small screwdriver, 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.

(12) Remove the clockspring from the steering column. The clockspring cannot be repaired. It must be

CLOCKSPRING (Continued)

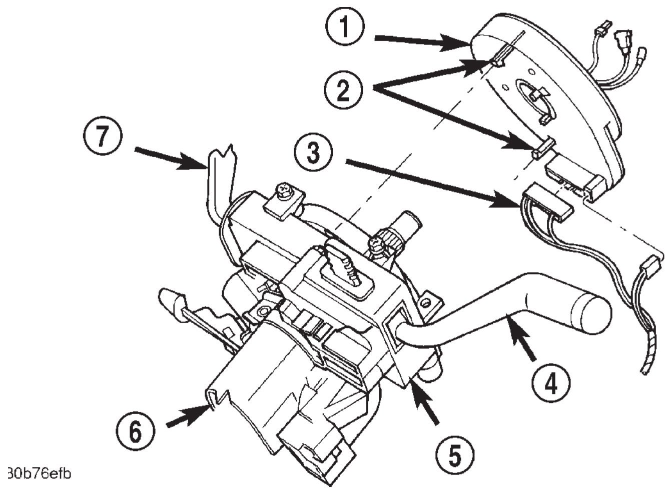

Fig. 11 Clockspring Remove/Install - Typical

1 - CLOCKSPRING
2 - LATCHES
3 - CROSS BODY WIRE HARNESS
4 - LEFT MULTI-FUNCTION SWITCH
5 - SWITCH HOUSING
6 - STEERING COLUMN
7 - RIGHT MULTI-FUNCTION SWITCH

replaced if faulty or damaged, or if the driver airbag has been deployed.

(13) 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. Bend the wire over after it has been inserted through the index hole to prevent it from falling out. If clockspring centering is not maintained, the clockspring must be centered again before it is reinstalled. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CENTERING).

INSTALLATION

The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver airbag has been deployed.

If the clockspring is not properly centered in relation to the steering wheel, steering shaft and steering gear, it may be damaged. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CENTERING). Service replacement clocksprings are shipped pre-centered and with a plastic 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 that the front wheels are still in the straight-ahead position.

(1) If the removed clockspring is being reinstalled, 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 left multi-function switch control stalk is in the neutral position, then carefully slide the centered clockspring down over the steering column upper shaft until both the upper and lower clockspring latches engage the steering column upper housing (Fig. 11).

(3) Reconnect the two cross body wire harness connectors to the lower clockspring connector receptacles.

(4) Position both the upper and lower shrouds onto the steering column (Fig. 12). Be certain that the locating tabs for the left and right multi-function switch control stalk watershields are properly engaged in the openings of both the upper and lower shrouds.

(5) Install and tighten the two screws that secure the lower steering column shroud to the upper shroud. Tighten the screws to 2 N·m (18 in. lbs.).

(6) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully raised position and secure it in place by moving the tilt release lever back to the locked (up) position.

(7) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(8) If a new clockspring has been installed, remove the locking pin that is securing the clockspring rotor to the clockspring case to maintain clockspring centering.

CLOCKSPRING (Continued)

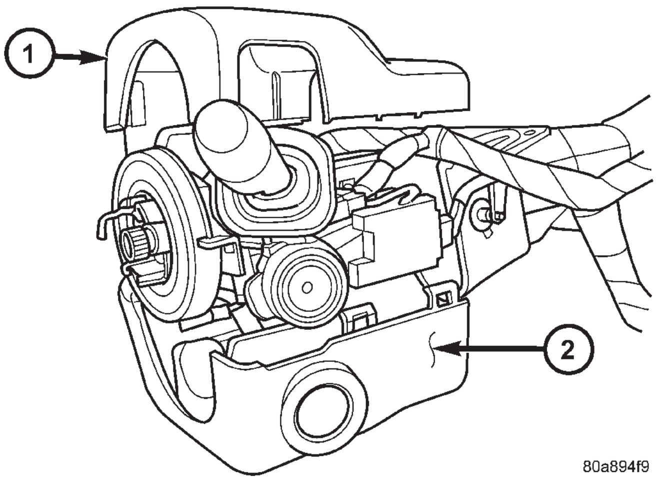

Fig. 12 Shroud Remove/Install

1 - UPPER SHROUD
2 - LOWER SHROUD

(9) Reinstall 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 pigtail wires through the lower hole in the steering wheel armature.

(10) Install and tighten the screw that secures the steering wheel to the steering column upper shaft. Tighten the screw to 54 N·m (40 ft. lbs.). Be certain not to pinch the clockspring pigtail wires or the steering wheel wire harness between the steering wheel and the screw.

(11) If the vehicle is so equipped, reconnect the upper clockspring pigtail wire connector to the steering wheel wire harness for the speed control switches.

(12) Reinstall the driver airbag onto the steering wheel. (Refer to 8 - ELECTRICAL/RESTRAINTS/ DRIVER AIRBAG - INSTALLATION).

DRIVER AIRBAG

DESCRIPTION

The driver airbag protective trim cover is the most visible part of the driver airbag (Fig. 13). The airbag used in this model is a Next Generation-type that complies with revised federal airbag standards to deploy with less force than those used in some prior models. The driver airbag is located in the center of the steering wheel, where it is secured with two screws to the steering wheel armature. Concealed beneath the driver airbag trim cover are the horn switch, the folded airbag cushion, the airbag retainer or housing, the airbag inflator, and the retainers that secure the trim cover to the airbag housing. The

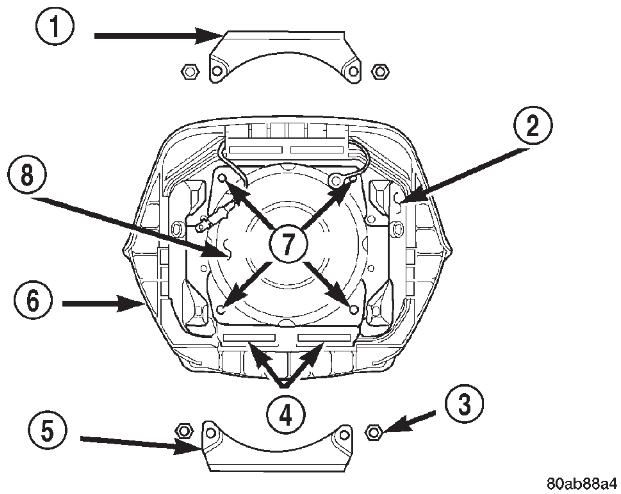

Fig. 13 Driver Airbag - Typical

1 - UPPER RETAINER
2 - AIRBAG HOUSING
3 - NUT (4)
4 - RETAINER SLOTS
5 - LOWER RETAINER
6 - TRIM COVER
7 - STUDS
8 - INFLATOR

resistive membrane-type horn switch is secured with heat stakes to the inside surface of the driver airbag trim cover, between the trim cover and the folded airbag cushion. The airbag inflator is a conventional pyrotechnic-type unit that is secured with nuts to four studs on the back of the stamped metal airbag housing.

The driver airbag trim cover has locking blocks molded into the back side of it that engage a lip formed around the perimeter of the airbag housing. Two stamped metal retainers then fit over the inflator mounting studs on the back of the airbag housing and are engaged in slots on the inside of the trim cover, securely locking the cover into place. One horn switch pigtail wire has an eyelet terminal connector that is captured on the upper left inflator mounting stud between the inflator and the upper trim cover retainer. The other horn switch pigtail wire is routed between the upper right inflator stud and the inflator, then secured with a small nylon retainer that is pressed onto the inflator stud. The driver airbag cannot be repaired, and must be replaced if deployed or in any way damaged. The driver airbag trim cover and the horn switch are available as a unit and may be disassembled from the driver airbag for service replacement.

OPERATION

The driver airbag is deployed by an electrical signal generated by the Airbag Control Module (ACM)

DRIVER AIRBAG (Continued)

through the driver airbag line 1 and line 2 (or squib) circuits. When the ACM sends the proper electrical signal to the airbag inflator, the electrical energy generates enough heat to initiate a small pyrotechnic charge which, in turn, ignites chemical pellets within the inflator. Once ignited, these chemical pellets burn rapidly and produce a large quantity of nitrogen gas. The inflator is sealed to the back of the airbag housing and a diffuser in the inflator directs all of the nitrogen gas into the airbag cushion, causing the cushion to inflate. As the cushion inflates, the driver airbag trim cover will split at predetermined breakout lines, then fold back out of the way along with the horn switch. Following an airbag deployment, the airbag cushion quickly deflates by venting the nitrogen gas towards the instrument panel through the porous fabric material used on the steering wheel side of the airbag cushion.

Some of the chemicals used to create the nitrogen gas are considered hazardous in their solid state, before they are burned, but they are securely sealed within the airbag inflator. However, the nitrogen gas that is produced when the chemicals are burned is harmless. A small amount of residue from the burned chemicals may cause some temporary discomfort if it contacts the skin, eyes, or breathing passages. If skin or eye irritation is noticed, rinse the affected area with plenty of cool, clean water. If breathing passages are irritated, move to another area where there is plenty of clean, fresh air to breath. If the irritation is not alleviated by these actions, contact a physician.

REMOVAL

The following procedure is for replacement of a faulty or damaged driver airbag. If the driver airbag has been deployed, the clockspring must also be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

WARNING: 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.

WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG CUSHION AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.

(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 airbag to the steering wheel armature (Fig. 14).

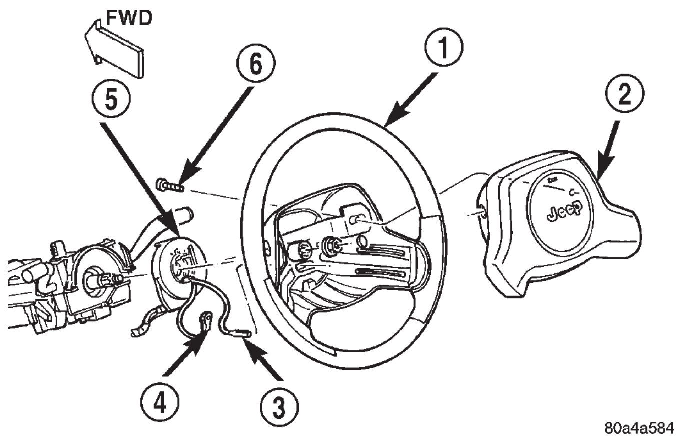

Fig. 14 Driver Airbag Remove/Install - Typical

1 - STEERING WHEEL
2 - DRIVER AIRBAG
3 - CLOCKSPRING PIGTAIL WIRE (HORN SWITCH)
4 - CLOCKSPRING PIGTAIL WIRE (AIRBAG)
5 - CLOCKSPRING
6 - SCREW (2)

(3) Pull the driver airbag away from the steering wheel far enough to access the two wire harness connectors on the back of the airbag.

(4) Disconnect the clockspring horn switch pigtail wire connector for the horn switch from the switch feed pigtail wire connector, which is located on the back of the driver airbag.

CAUTION: Do not pull on the clockspring wire harness to disengage the connector from the driver airbag inflator connector receptacle.

(5) The clockspring driver airbag pigtail wire connector is a tight snap fit into the airbag inflator connector receptacle, which is located on the back of the driver airbag. Firmly grasp and pull or gently pry on the clockspring driver airbag pigtail wire connector to disconnect it from the airbag inflator connector receptacle.

(6) Remove the driver airbag from the steering wheel.

DRIVER AIRBAG (Continued)

(7) If the driver airbag has been deployed, the clockspring must be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

DISASSEMBLY

The horn switch is integral to the driver airbag trim cover. If either component is faulty or damaged, the entire driver airbag trim cover and horn switch unit must be replaced.

WARNING: 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.

WARNING: THE HORN SWITCH IS INTEGRAL TO THE DRIVER AIRBAG UNIT. SERVICE OF THIS UNIT SHOULD BE PERFORMED ONLY BY DAIMLERCHRYSLER-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.

(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 airbag from the steering wheel. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

(3) Remove the plastic horn switch pigtail wire retainer from the stud on the back of the driver airbag housing (Fig. 15).

(4) Remove the four nuts that secure the upper and lower trim cover retainers to the studs on the back of the driver airbag housing (Fig. 16).

(5) Remove the upper and lower trim cover retainers from the airbag housing studs.

(6) Remove the horn switch ground pigtail wire eyelet terminal connector from the upper left airbag housing stud.

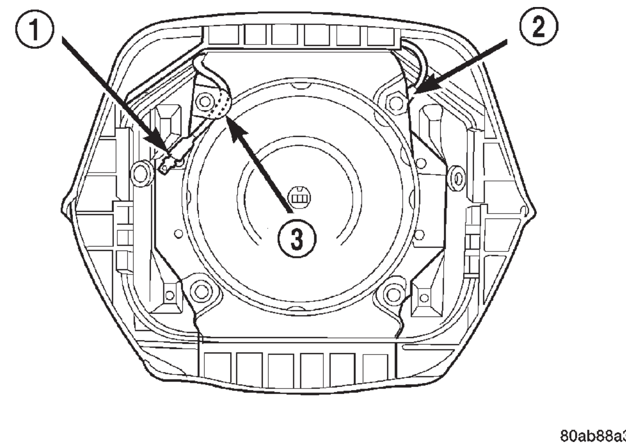

Fig. 15 Horn Switch Feed Wire Remove/Install

1 - HORN SWITCH FEED PIGTAIL WIRE
2 - HORN SWITCH GROUND PIGTAIL WIRE
3 - RETAINER

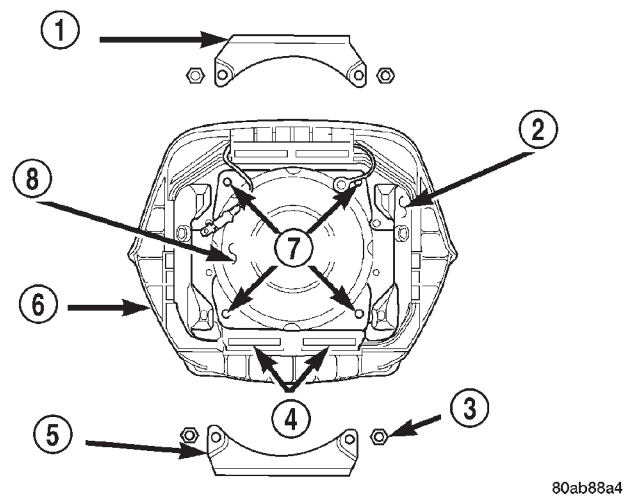

Fig. 16 Driver Airbag Trim Cover

1 - UPPER RETAINER
2 - AIRBAG HOUSING
3 - NUT (4)
4 - RETAINER SLOTS
5 - LOWER RETAINER
6 - TRIM COVER
7 - STUDS
8 - INFLATOR

DRIVER AIRBAG (Continued)

(7) Disengage the four trim cover locking blocks from the lip around the outside edge of the driver airbag housing and remove the housing from the cover (Fig. 17).

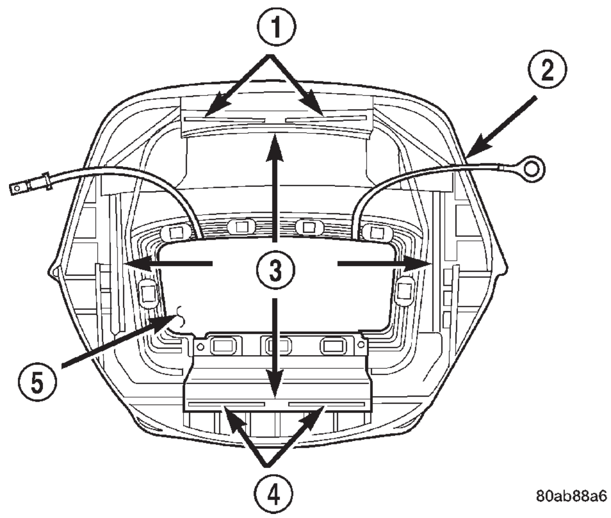

Fig. 17 Driver Airbag Trim Cover Remove/Install

1 - RETAINER SLOTS
2 - TRIM COVER
3 - LOCKING BLOCKS
4 - RETAINER SLOTS
5 - HORN SWITCH

ASSEMBLY

The horn switch is integral to the driver airbag trim cover. If either component is faulty or damaged, the entire driver airbag trim cover and horn switch unit must be replaced.

WARNING: 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.

WARNING: THE HORN SWITCH IS INTEGRAL TO THE DRIVER AIRBAG UNIT. SERVICE OF THIS UNIT SHOULD BE PERFORMED ONLY BY DAIMLERCHRYSLER-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.

WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE DRIVER AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE DRIVER AIRBAG CUSHION AND THE DRIVER AIRBAG TRIM COVER. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

WARNING: THE DRIVER AIRBAG 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 airbag in the trim cover. Be certain that the horn switch feed and ground pigtail wires are not pinched between the airbag housing and the trim cover locking blocks.
(2) Engage the upper and lower trim cover locking blocks with the lip of the driver 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. 18).
(3) Reinstall the horn switch ground pigtail wire eyelet terminal connector over the left upper airbag housing stud.
(4) Reinstall 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. 17).
(5) Install and tighten the nuts that secure the trim cover retainers to the airbag housing studs. Tighten the nuts to 10 N·m (90 in. lbs.).
(6) Reinstall the driver airbag onto the steering wheel. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

INSTALLATION

The following procedure is for replacement of a faulty or damaged driver airbag. If the driver airbag has been deployed, the clockspring must also be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - INSTALLATION).

DRIVER AIRBAG (Continued)

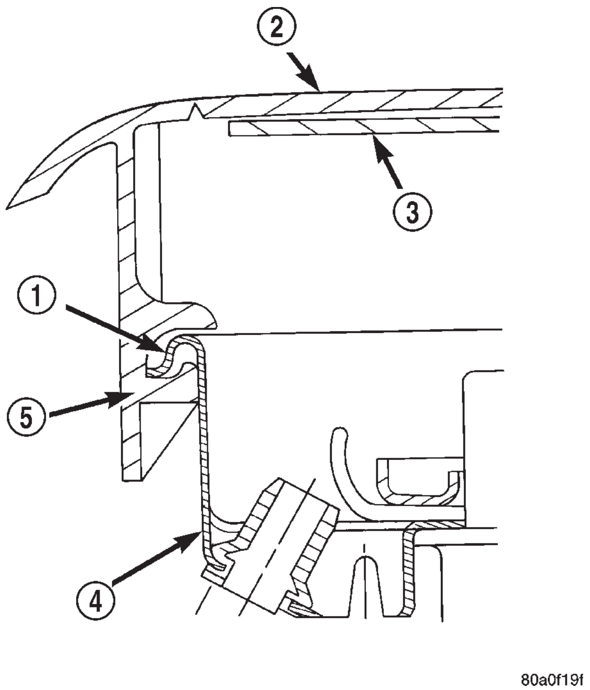

Fig. 18 Driver Airbag Trim Cover Locking Blocks Engaged

1 - LIP
2 - TRIM COVER
3 - HORN SWITCH
4 - AIRBAG HOUSING
5 - LOCKING BLOCK

WARNING: 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.

WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE DRIVER AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE DRIVER AIRBAG CUSHION AND THE DRIVER AIRBAG TRIM COVER. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

WARNING: THE DRIVER AIRBAG 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) Assemble the driver airbag trim cover onto the airbag housing. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - ASSEMBLY).

(2) When installing the driver airbag, reconnect the clockspring driver airbag pigtail wire connector to the airbag module connector receptacle by pressing straight in on the connector (Fig. 14). You can be certain that the connector is fully engaged by listening carefully for a distinct, audible click as the connector snaps into place.

(3) Reconnect the clockspring pigtail wire connector for the horn switch to the switch feed pigtail wire connector, which is located on the back of the driver airbag.

(4) Carefully position the driver airbag in the steering wheel. Be certain that the clockspring and steering wheel wire harnesses in the steering wheel hub area are not pinched between the driver airbag and the steering wheel.

(5) From the underside of the steering wheel, install and tighten the two screws that secure the driver airbag to the steering wheel armature. Tighten the screws to 10 N·m (90 in. lbs.).

(6) Do not reconnect the battery negative cable at this time. The airbag system verification test procedure should be performed following service of any airbag system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

FRONT SEAT BELT & RETRACTOR

REMOVAL

WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

(1) Move the front seats to their most forward position for easiest access to the front shoulder belt lower anchor screw, the belt retractor and the sport bar.

(2) Unsnap and lift the front shoulder belt turning loop cover to access the screw that secures the turning loop to the height adjuster near the top of the sport bar (Fig. 19).

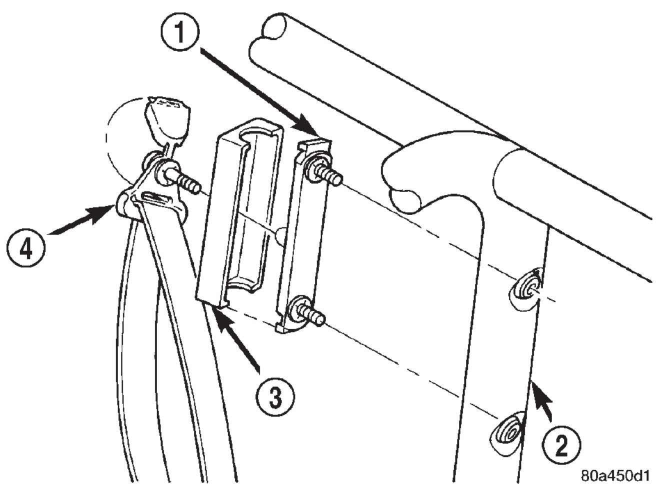

Fig. 19 Front Shoulder Belt Turning Loop

1 - HEIGHT ADJUSTER
2 - SPORT BAR
3 - TRIM COVER
4 - TURNING LOOP

(3) Remove the screw that secures the shoulder belt turning loop to the adjuster.

(4) Remove the shoulder belt turning loop and the support/guide washer from the adjuster.

(5) Remove the screw that secures the retractor and lower seat belt anchor plate to the sport bar near its base (Fig. 20).

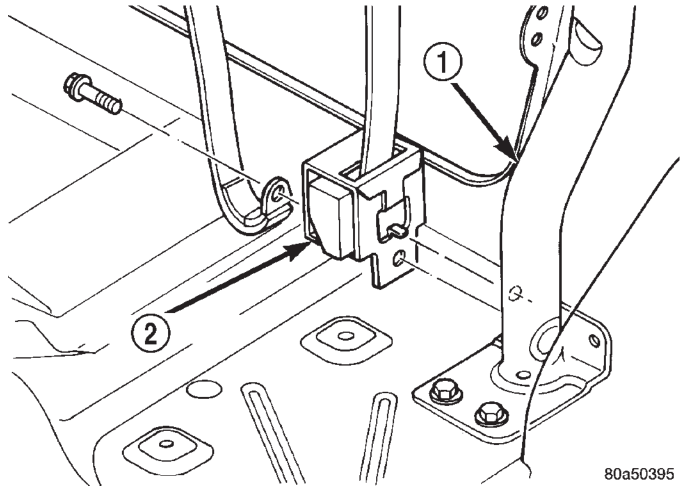

Fig. 20 Front Shoulder Belt and Retractor - Typical

1 - SPORT BAR
2 - RETRACTOR

(6) Remove the front seat shoulder belt and retractor from the sport bar.

INSTALLATION

WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

(1) Position the front seat shoulder belt and retractor near the base of the sport bar (Fig. 20). Be certain to engage the locator tab on the retractor in the locator hole on the sport bar.

(2) Install and tighten the screw that secures the retractor and lower seat belt anchor plate to the sport bar. Tighten the screw to 43 N·m (32 ft. lbs.).

FRONT SEAT BELT & RETRACTOR (Continued)

(3) Position the support/guide washer and the shoulder belt turning loop onto the height adjuster near the top of the sport bar (Fig. 19).

(4) Install and tighten the screw that secures the shoulder belt turning loop to the adjuster. Tighten the screw to 43 N·m (32 ft. lbs.).

(5) Fold and snap the shoulder belt turning loop cover back into place over the screw that secures the turning loop to the adjuster.

FRONT SEAT BELT BUCKLE

REMOVAL

WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

(1) On the driver side only, disconnect the seat belt switch pigtail wire connector from the body wire harness connector for the seat belt switch (Fig. 21).

(2) Remove the screw that secures the seat belt buckle to the bracket on the rear of the upper inner front seat track (Fig. 22).

(3) Remove the seat belt buckle from the seat track bracket.

INSTALLATION

WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

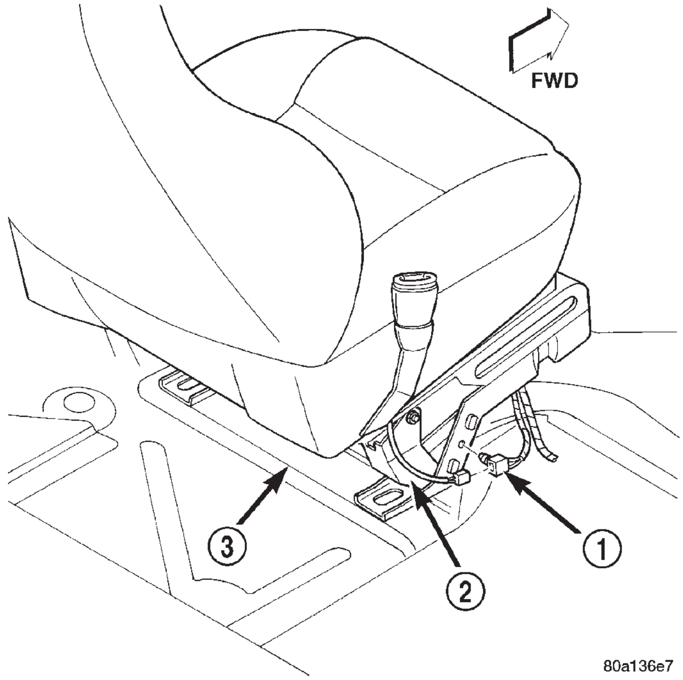

Fig. 21 Seat Belt Switch

1 - WIRE HARNESS CONNECTOR
2 - DRIVER SEAT RISER
4 - FLOOR PANEL

(1) Position the seat belt buckle to the bracket on the rear of the upper inner front seat track.

(2) Install and tighten the screw that secures the seat belt buckle to the seat track bracket (Fig. 22). Tighten the screw to 43 N·m (32 ft. lbs.).

(3) On the driver side only, reconnect the seat belt switch pigtail wire connector to the body wire harness connector for the seat belt switch (Fig. 21).

PASSENGER AIRBAG

DESCRIPTION

The passenger airbag door on the instrument panel above the glove box is the most visible part of the passenger airbag. The airbag used in this model is a Next Generation-type that complies with revised federal airbag standards to deploy with less force than those used in some prior models. The passenger airbag is located in the instrument panel in front of the front seat passenger seating position, where it is secured with nuts to three weld studs on the instrument panel structural support and two weld studs on the dash panel. Concealed beneath the passenger airbag door are the folded airbag cushion, the airbag retainer or housing, and the airbag inflator. The airbag inflator is a hybrid-type unit that is secured to

PASSENGER AIRBAG (Continued)

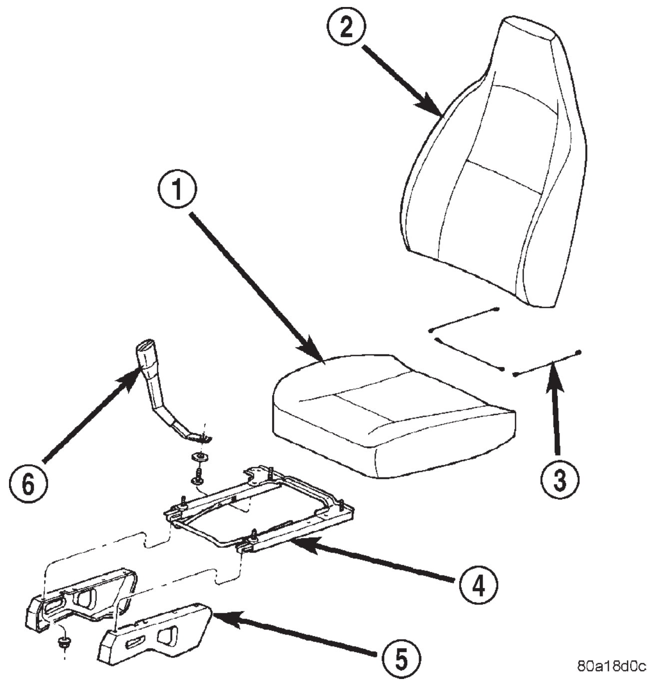

Fig. 22 Seat Belt Buckle

1 - SEAT CUSHION
2 - SEAT BACK
3 - TRIM ATTACHMENT WIRES
4 - SEAT TRACK
5 - SEAT RISER
6 - SEATBELT BUCKLE

and sealed within the stamped metal airbag housing along with the folded airbag cushion. A yellow connector on the end of a short, two-wire pigtail harness connects the passenger airbag inflator to the vehicle electrical system.

The molded plastic passenger airbag door also serves as a trim cover and has two flanges and a stamped metal bracket that secure it in place. The two flanges are secured with screws to the top of the instrument panel structural support and the upper glove box opening reinforcement. The stamped metal bracket is secured to the back of the instrument panel structural support with two screws, and also serves as the passenger airbag door hinge. Following a passenger airbag deployment, the passenger airbag and the passenger airbag door must be replaced. The passenger airbag cannot be repaired, and must be replaced if faulty or in any way damaged. The passenger airbag door can be disassembled from the instrument panel and replaced as a separate service item.

OPERATION

The passenger airbag is deployed by an electrical signal generated by the Airbag Control Module (ACM) through the passenger airbag line 1 and line 2 (or squib) circuits. The hybrid-type inflator assembly includes a small canister of highly compressed argon gas. When the ACM sends the proper electrical signal to the airbag inflator, the electrical energy generates enough heat to ignite chemical pellets within the inflator. Once ignited, these chemical pellets burn rapidly and produce the pressure necessary to rupture a containment disk in the argon gas canister. The inflator and argon gas canister are sealed to the airbag cushion so that all of the released argon gas is directed into the airbag cushion, causing the cushion to inflate. As the cushion inflates, the passenger airbag door will split at predetermined breakout lines, then fold back over the top of the instrument panel and out of the way. Following an airbag deployment, the airbag cushion quickly deflates by venting the argon gas through the porous fabric material used on each end panel of the airbag cushion.

Some of the chemicals used to create the pressure to burst the argon gas containment disk are considered hazardous in their solid state, before they are burned, but they are securely sealed within the airbag inflator. However, the gas that is produced when the chemicals are burned is harmless. A small amount of residue from the burned chemicals may cause some temporary discomfort if it contacts the skin, eyes, or breathing passages. If skin or eye irritation is noticed, rinse the affected area with plenty of cool, clean water. If breathing passages are irritated, move to another area where there is plenty of clean, fresh air to breath. If the irritation is not alleviated by these actions, contact a physician immediately.

REMOVAL

The following procedure is for replacement of a faulty or damaged passenger airbag. If the passenger airbag has been deployed, the instrument panel assembly must be replaced. Replacement instrument panels include the passenger airbag and the passenger airbag door. (Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL).

WARNING: 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.

PASSENGER AIRBAG (Continued)

WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG UNIT AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.

(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 from the passenger compartment of the vehicle. (Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL).

(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 airbag to the weld studs on the instrument panel structural support (Fig. 23).

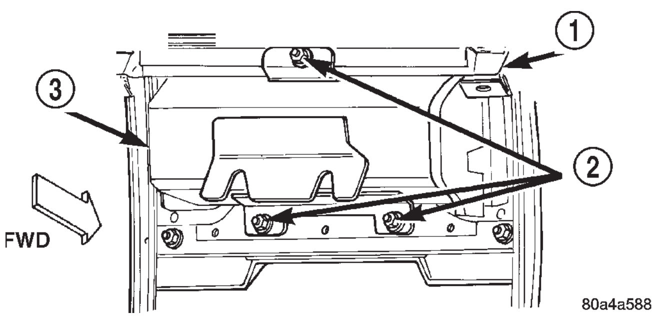

Fig. 23 Passenger Airbag Remove/Install

1 - STRUCTURAL SUPPORT
2 - NUT (3)
3 - PASSENGER AIRBAG

(5) Remove the passenger airbag from the instrument panel structural support.

INSTALLATION

The following procedure is for replacement of a faulty or damaged passenger airbag. If the passenger airbag has been deployed, the instrument panel assembly must be replaced. Replacement instrument panels include the passenger airbag and the passenger airbag door. (Refer to 23 - BODY/INSTRUMENT PANEL - INSTALLATION).

WARNING: 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.

WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG UNIT AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.

WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE PASSENGER AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE PASSENGER AIRBAG CUSHION AND THE PASSENGER AIRBAG DOOR. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

WARNING: THE PASSENGER 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) Carefully position the passenger airbag onto the weld studs on the instrument panel structural support (Fig. 23).

(2) Install and tighten the three nuts that secure the passenger airbag upper and lower mounting brackets to the weld studs on the instrument panel structural support. Tighten the nuts to 12 N·m (105 in. lbs.).

(3) Reinstall the instrument panel into the passenger compartment of the vehicle. (Refer to 23 - BODY/INSTRUMENT PANEL - INSTALLATION). When installing the instrument panel, be certain to reconnect the passenger airbag pigtail wire connector 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. The airbag system verification test procedure should be performed following service of any airbag system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

PASSENGER AIRBAG DOOR

REMOVAL

WARNING: 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.

(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 airbag from the instrument panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG - REMOVAL).

(3) Remove the five screws that secure the upper flange of the passenger airbag door to the top of the instrument panel structural support (Fig. 24).

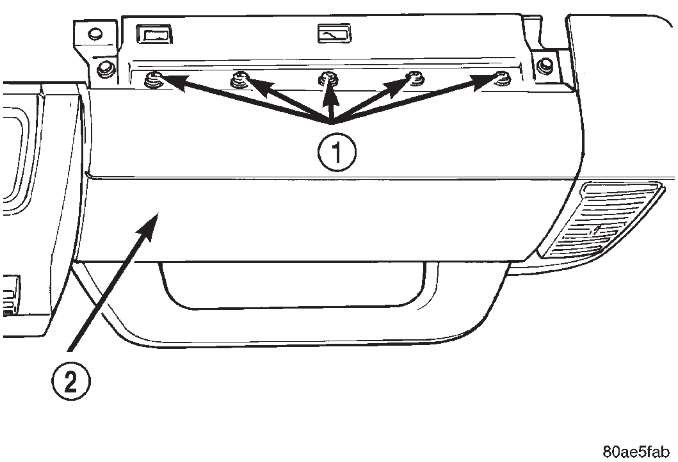

Fig. 24 Passenger Airbag Door Upper Flange Remove/Install

1 - SCREW (5)
2 - PASSENGER AIRBAG DOOR

(4) Remove the grab handle bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GRAB HANDLE BEZEL - REMOVAL).

(5) Remove the five screws that secure the lower flange of the passenger airbag door to the upper glove box opening reinforcement.

(6) Remove the two screws that secure the ends of the passenger airbag door bracket to the instrument panel structural support (Fig. 25).

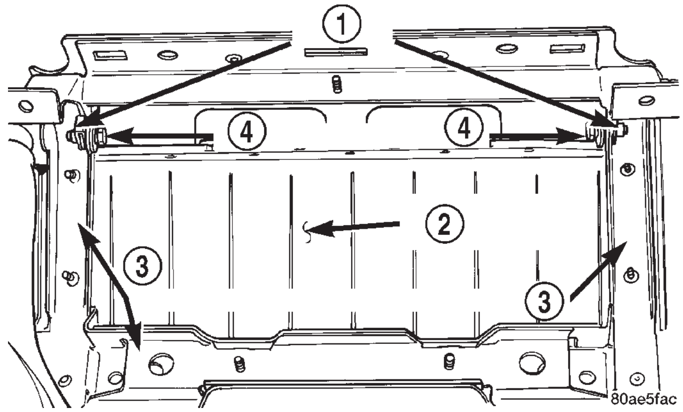

Fig. 25 Passenger Airbag Door Remove/Install

1 - J-NUT (2)
2 - PASSENGER AIRBAG DOOR
3 - STRUCTURAL SUPPORT
4 - SCREW (2)

(7) Remove and discard the two passenger airbag door bracket J-nuts from the instrument panel structural support. These J-nuts must be replaced with new parts whenever the passenger airbag door bracket screws are removed.

(8) Remove the passenger airbag door from the instrument panel.

INSTALLATION

WARNING: 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.

WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE PASSENGER AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE PASSENGER AIRBAG CUSHION AND THE PASSENGER AIRBAG DOOR. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

PASSENGER AIRBAG DOOR (Continued)

WARNING: THE PASSENGER 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 structural support (Fig. 25). These J-nuts must be replaced with new parts whenever the passenger airbag door bracket screws are removed.

(2) Position the passenger airbag door onto the instrument panel and align the mounting holes in each end of the airbag door bracket with the J-nuts on the instrument panel structural support.

(3) Install and tighten the two screws that secure the passenger airbag door bracket to the instrument panel structural support. Tighten the screws to 12 N·m (105 in. lbs.).

(4) Install and tighten the five screws that secure the lower flange of the passenger airbag door to the upper glove box opening reinforcement. Tighten the screws to 2 N·m (20 in. lbs.).

(5) Reinstall the grab handle bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GRAB HANDLE BEZEL - INSTALLATION).

(6) Install and tighten the five screws that secure the upper flange of the passenger airbag door to the top of the instrument panel structural support (Fig. 24). Tighten the screws to 2 N·m (20 in. lbs.).

(7) Reinstall the passenger airbag onto the instrument panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG - INSTALLATION).

PASSENGER AIRBAG ON/OFF SWITCH

DESCRIPTION

The passenger airbag on-off switch is standard equipment on all versions of this model (Fig. 26). This switch is a two-position, resistor multiplexed switch with a single integral red Light-Emitting Diode (LED), and a non-coded key cylinder-type actuator. The switch is located on the forward end of the floor console (both full and mini versions) to make the Off indicator visible to all front seat occupants. When the switch is in its installed position, the only components visible through the dedicated opening of the console switch bezel is the key cylinder actuator. A small, tethered, molded plastic cap fits into the key cylinder actuator hole when the

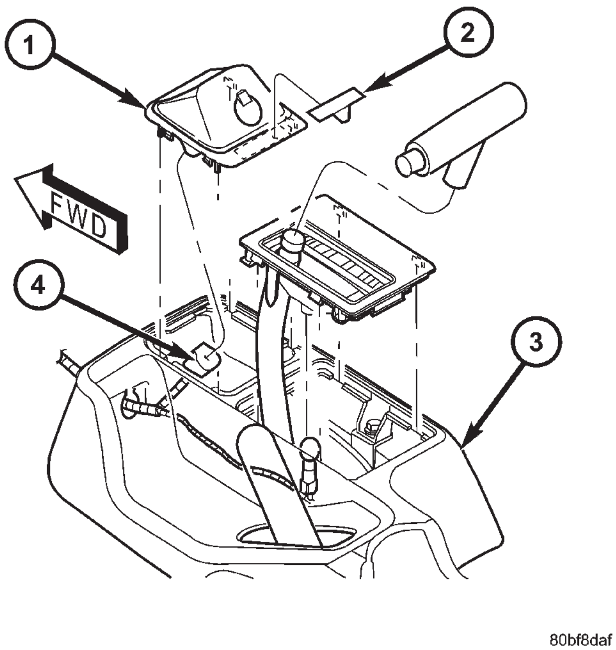

Fig. 26 Passenger Airbag On/Off Switch

1 - PASSENGER AIRBAG ON/OFF SWITCH
2 - LABEL
3 - FLOOR CONSOLE
4 - WIRE HARNESS CONNECTOR

switch is not being used. The switch nomenclature and a lens are integral to the console switch bezel. When the switch ″Off″ position is selected with the ignition switch in the On position, the LED illuminates the text “Off” in amber in the console switch bezel. The “On” position of the switch is designated by text imprinted upon the console switch bezel, but is not illuminated. The remainder of the switch is concealed behind the console switch bezel.

The passenger airbag on-off switch housing is constructed of molded plastic and has three integral mounting tabs. These mounting tabs are used to secure the switch to the back of the molded plastic console switch bezel with three small screws. The console switch bezel has four molded plastic snap features that are used to secure the switch and bezel unit to the floor console. A molded plastic connector receptacle on the back of the switch housing connects the switch to the vehicle electrical system through a dedicated take out of the cross body wire harness. The harness take out is equipped with a molded plastic connector insulator that is keyed and latched to ensure proper and secure switch electrical connections. The passenger airbag on/off switch cannot be adjusted or repaired and, if faulty or damaged, the switch must be replaced.

PASSENGER AIRBAG ON/OFF SWITCH (Continued)

OPERATION

The passenger airbag on-off switch allows the customer to turn the passenger airbag function On or Off to accommodate certain uses of the right front seating position where airbag protection may not be desired. See the owner's manual in the vehicle glove box for specific recommendations on when to enable or disable the passenger airbag. The Off indicator of the switch will be illuminated whenever the switch is turned to the Off position and the ignition switch is in the On position. The ignition key is the only key or object that should ever be inserted into the key cylinder actuator of the switch. The on-off switch requires only a partial key insertion to fully depress a spring-loaded locking plunger. The spring-loaded locking plunger prevents the user from leaving the key in the switch. The key will be automatically ejected when force is not applied. To actuate the passenger side airbag on/off switch, insert the ignition key into the switch key actuator far enough to fully depress the plunger, and rotate the actuator to the desired switch position. When the switch key actuator is rotated to its clockwise stop (the key actuator slot will be aligned with the Off indicator), the Off indicator is illuminated and the passenger airbag is disabled. When the switch is rotated to its counterclockwise stop (the key actuator slot will be in a vertical position), the Off indicator will be extinguished and the passenger airbag is enabled.

The passenger airbag on/off switch is connects one of two internal resistors in series between the passenger airbag mux switch sense and passenger airbag mux switch return circuits of the Airbag Control Module (ACM). The ACM continually monitors the resistance in these circuits to determine the switch position that has been selected. When the switch is in the Off position, the ACM provides a ground input to the switch through the passenger airbag indicator driver circuit, which energizes the Light-Emitting Diode (LED) that illuminates the Off indicator of the switch. The ACM will also illuminate the Off indicator of the switch for about seven seconds each time the ignition switch is turned to the On position as a bulb test. The ACM will store a Diagnostic Trouble Code (DTC) for any fault it detects in the passenger airbag on/off switch or Off indicator circuits, and will illuminate the airbag indicator in the instrument cluster if a fault is detected. For proper diagnosis of the passenger airbag on/off switch or the ACM, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

REMOVAL

WARNING: 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.

(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) Using a trim stick or another suitable wide flat-bladed tool, gently pry the console switch bezel away from the floor console far enough to release the four snap features that secure the bezel to the console (Fig. 27).

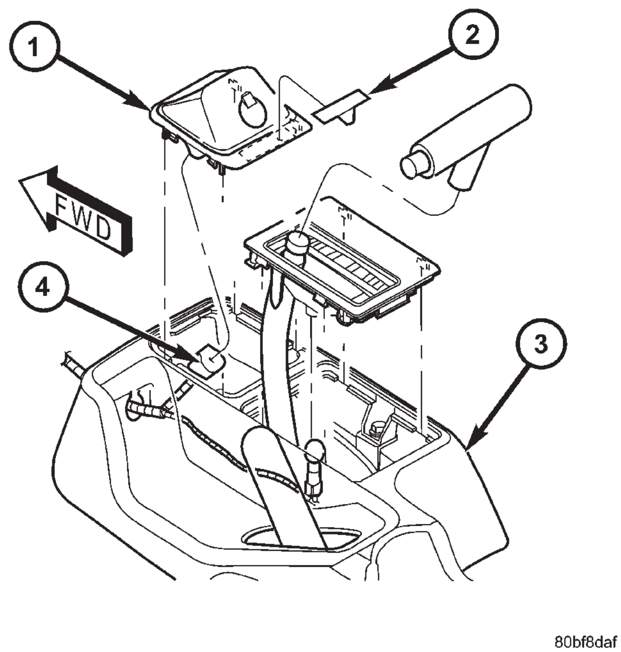

Fig. 27 Passenger Airbag On/Off Switch Remove/Install

1 - PASSENGER AIRBAG ON/OFF SWITCH
2 - LABEL
3 - FLOOR CONSOLE
4 - WIRE HARNESS CONNECTOR

PASSENGER AIRBAG ON/OFF SWITCH (Continued)

(3) Lift the console switch bezel away from the console far enough to access and disconnect the cross body wire harness connector for the passenger airbag on/off switch from the switch connector receptacle.

(4) Remove the passenger airbag on/off switch and console switch bezel unit from the floor console.

(5) From the underside of the console switch bezel, remove the three screws that secure the passenger airbag on/off switch to the back of the bezel.

(6) Remove the passenger airbag on/off switch from the console switch bezel.

INSTALLATION

(1) Position the passenger airbag on/off switch to the underside of the console switch bezel.

(2) Install and tighten the three screws that secure the passenger airbag on/off switch to the back of the console switch bezel. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Position the passenger airbag on/off switch and console switch bezel unit to the mounting hole at the front of the floor console (Fig. 27).

(4) Reconnect the cross body wire harness connector for the passenger airbag on/off switch to the switch connector receptacle.

(5) Align the four snap features on the console switch bezel with the slots on either side of the mounting hole in the floor console.

(6) Using hand pressure, press down firmly and evenly on the console switch bezel until each of the four snap features is fully engaged in the slots on either side of the mounting hole in the floor console.

(7) Do not reconnect the battery negative cable at this time. The airbag system verification test procedure should be performed following service of any airbag system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

REAR SEAT BELT & RETRACTOR

REMOVAL

WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

(1) Slide both rear seat belt buckle units between the seat cushion and seat back into the cargo area.

(2) Lift the rear seat back release lever and fold the rear seat back forward, then tumble the folded rear seat cushion and back unit forward against the backs of the two front bucket seats.

(3) Remove the screw that secures the lower anchor plate of the rear seat shoulder belt to the inner rear wheel house panel (Fig. 28).

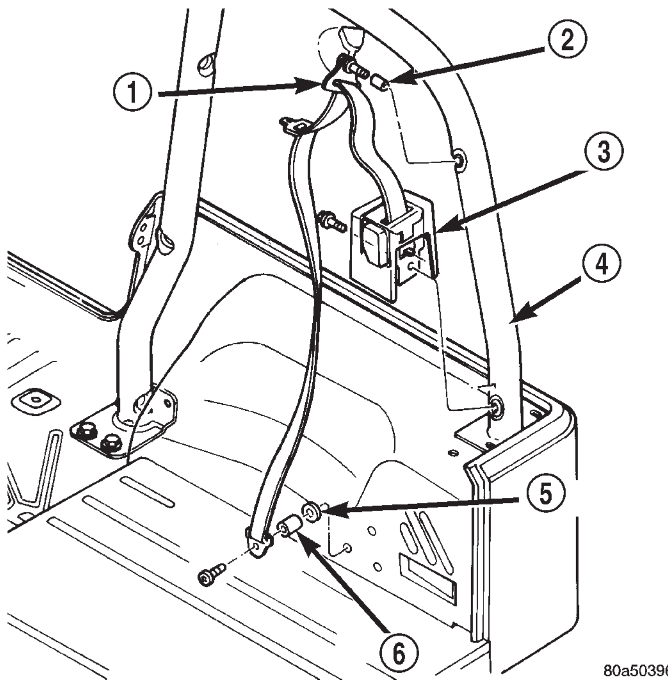

Fig. 28 Rear Seat Shoulder Belt & Retractor Remove/Install

1 - TURNING LOOP
2 - SPACER
3 - BELT & RETRACTOR
4 - SPORT BAR
5 - WASHER
6 - SPACER

(4) Remove the rear seat shoulder belt lower anchor plate from the inner rear wheel house panel.

(5) Unsnap and lift the rear shoulder belt turning loop cover to access the screw that secures the turning loop anchor plate to the sport bar near the top of the bar (Fig. 29).

(6) Remove the screw that secures the shoulder belt turning loop anchor plate to the sport bar.

(7) Remove the shoulder belt turning loop anchor plate from the sport bar.

REAR SEAT BELT & RETRACTOR (Continued)

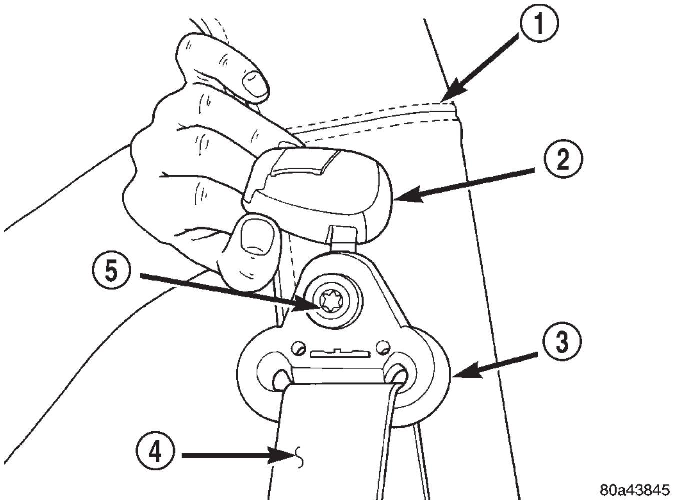

Fig. 29 Turning Loop

1 - SPORT BAR
2 - TURNING LOOP COVER
3 - TURNING LOOP
4 - REAR SHOULDER BELT
5 - SCREW

(8) Remove the screw that secures the retractor to the sport bar near the top of the inner rear wheel house panel.

(9) Remove the rear seat shoulder belt and retractor from the sport bar.

INSTALLATION

WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

(1) Position the rear seat shoulder belt and retractor to the sport bar near the top of the inner rear wheel house panel (Fig. 28). Be certain to engage the locator tab on the retractor in the locator hole on the sport bar.

(2) Install and tighten the screw that secures the retractor to the sport bar. Tighten the screw to 43 N·m (32 ft. lbs.).

(3) Position the rear shoulder belt turning loop anchor plate to the sport bar near the top of the bar (Fig. 29).

(4) Install and tighten the screw that secures the turning loop anchor plate to the sport bar. Tighten the screw to 43 N·m (32 ft. lbs.).

(5) Fold and snap the shoulder belt turning loop cover back into place over the screw that secures the turning loop to the sport bar.

(6) Position the rear seat shoulder belt lower anchor plate to the inner rear wheel house panel.

(7) Install and tighten the screw that secures the rear seat shoulder belt lower anchor plate to the inner rear wheel house panel. Tighten the screw to 43 N·m (32 ft. lbs.).

(8) Tumble the folded rear seat cushion and back unit rearward onto the rear floor panel.

(9) Slide both rear seat belt buckle units between the seat cushion and the seat back.

(10) Unfold the rear seat back from the seat cushion until the seat back latch is fully engaged.

REAR SEAT BELT BUCKLE

REMOVAL

WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

(1) Slide both rear seat belt buckle units between the seat cushion and seat back into the cargo area.

(2) Lift the rear seat back release lever and fold the rear seat back forward, then tumble the folded rear seat cushion and back unit forward against the backs of the two front bucket seats.

(3) Lift the cargo area carpet between the two rear seat belt buckle units far enough to access and remove the screw that secures the anchor plate of the buckle units to the rear floor panel through one of the clearance slots in the carpet (Fig. 30).

REAR SEAT BELT BUCKLE (Continued)

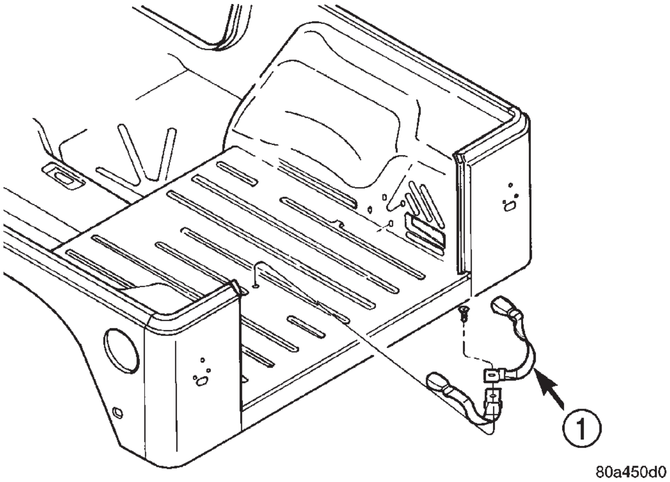

Fig. 30 Rear Seat Belt Buckles Remove/Install

1 - REAR SEAT BELT BUCKLE UNIT

(4) Remove the rear seat belt buckle unit from the rear floor panel through one of the clearance slots in the cargo area carpet.

INSTALLATION

WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

(1) Lift the cargo area carpet far enough to position the rear seat belt buckle unit onto the rear floor panel through one of the clearance slots in the carpet.

(2) Working through one of the clearance slots in the cargo area carpet, install and tighten the screw that secures the anchor plate of the rear seat belt buckle unit to the rear floor panel (Fig. 30). Tighten the screw to 43 N·m (32 ft. lbs.).

(3) Tumble the folded rear seat cushion and back unit rearward onto the rear floor panel.

(4) Slide both rear seat belt buckle units between the seat cushion and the seat back.

(5) Unfold the rear seat back from the seat cushion until the seat back latch is fully engaged.

SEAT BELT SWITCH

DESCRIPTION

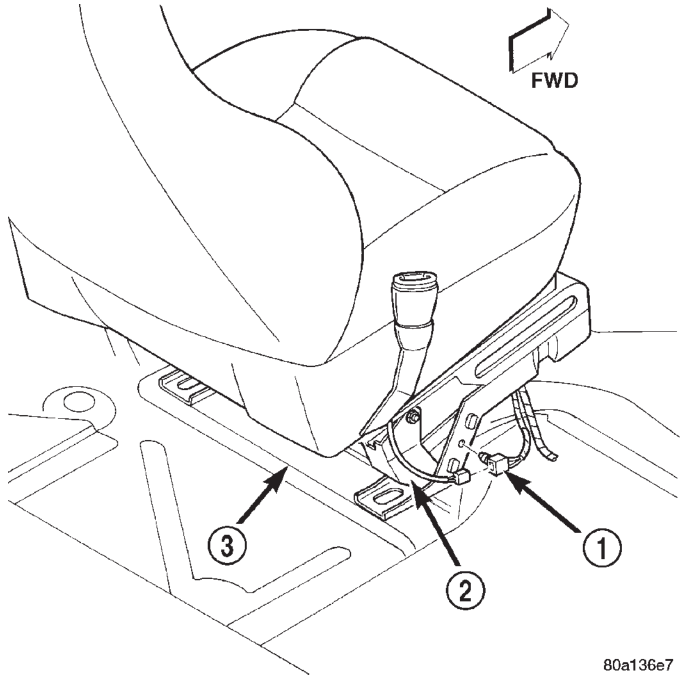

Fig. 31 Seat Belt Switch

1 - WIRE HARNESS CONNECTOR
2 - DRIVER SEAT RISER
4 - FLOOR PANEL

The seat belt switch is a small, normally closed, single pole, single throw, leaf contact, momentary switch. Only one seat belt switch is installed in the vehicle, and it is integral to the buckle of the driver seat belt buckle-half, located between the inboard side of the driver side front seat and the floor panel transmission tunnel (Fig. 31). The seat belt switch is connected to the vehicle electrical system through a two-wire pigtail wire and connector on the seat belt buckle-half, which is connected to a wire harness connector and take out of the body wire harness routed along the left side of the body sill in the passenger compartment.

The seat belt switch cannot be adjusted or repaired and, if faulty or damaged, the entire driver seat belt buckle-half unit must be replaced.

OPERATION

The seat belt switch is designed to control a path to ground for the seat belt switch sense input of the instrument cluster. When the driver side seat belt tip-half is inserted in the seat belt buckle, the switch opens the path to ground; and, when the driver side seat belt tip-half is removed from the seat belt buckle, the switch closes the ground path. The switch

SEAT BELT SWITCH (Continued)

is actuated by the latch mechanism within the seat belt buckle.

The seat belt switch receives ground through its pigtail wire connection to the body wire harness from another take out of the body wire harness. An eyelet terminal connector on that ground take out is secured under a ground screw on the left cowl side inner panel, beneath the instrument panel. The seat belt switch is connected in series between ground and the seat belt switch sense input of the instrument cluster.

DIAGNOSIS AND TESTING - SEAT BELT SWITCH

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

(1) Disconnect and isolate the battery negative cable. Disconnect the seat belt switch pigtail wire connector from the body wire harness connector for the seat belt switch on the floor near the driver side seat belt buckle-half anchor. Check for continuity between the seat belt switch sense circuit and the ground circuit cavities of the seat belt switch pigtail wire 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 wire harness connector for the seat belt switch and a good ground. There should be continuity. If OK, refer to for further diagnosis of the instrument cluster chime service input from the seat belt switch. If not OK, repair the open ground circuit to ground (G302) as required.

SEAT BELT TURNING LOOP ADJUSTER

REMOVAL

WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

(1) Unsnap and lift the shoulder belt turning loop cover to access the screw that secures the turning loop to the adjuster (Fig. 32).

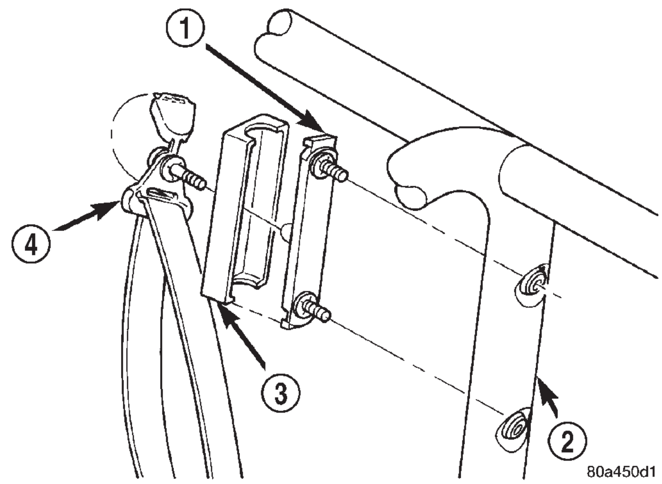

Fig. 32 Front Turning Loop Height Adjuster

1 - HEIGHT ADJUSTER
2 - SPORT BAR
3 - TRIM COVER
4 - TURNING LOOP

(2) Remove the screw that secures the shoulder belt turning loop to the adjuster.

(3) Remove the shoulder belt turning loop and the support/guide washer from the adjuster.

(4) Unsnap and remove the trim cover from the height adjuster.

(5) Remove the two screws that secure the turning loop adjuster to the sport bar.

SEAT BELT TURNING LOOP ADJUSTER (Continued)

(6) Remove the turning loop adjuster from the sport bar.

INSTALLATION

WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

(1) Position the turning loop adjuster onto the sport bar (Fig. 32). Be certain that the word “Up” stamped on the adjuster is properly oriented.

(2) Install and tighten the two screws that secure the turning loop adjuster to the sport bar. Tighten the screws to 43 N·m (32 ft. lbs.).

(3) Align the trim cover over the height adjuster and, using hand pressure, press firmly and evenly on the cover until it snaps into place.

(4) Position the support/guide washer and the shoulder belt turning loop onto the adjuster.

(5) Install and tighten the screw that secures the shoulder belt turning loop to the adjuster. Tighten the screw to 43 N·m (32 ft. lbs.).

(6) Fold and snap the shoulder belt turning loop cover back into place over the screw that secures the turning loop to the adjuster.

SPEED CONTROL

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SPEED CONTROL

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.

SPEED CONTROL (Continued)

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.

OVERSHOOT/UNDERSHOOT

If the vehicle operator repeatedly presses and releases the SET button with their foot off of the accelerator (referred to as a “lift foot set”), the vehicle may accelerate and exceed the desired set speed by up to 5 mph (8 km/h). It may also decelerate to less than the desired set speed, before finally achieving the desired set speed.

The Speed Control System has an adaptive strategy that compensates for vehicle-to-vehicle variations in speed control cable lengths. When the speed control is set with the vehicle operators foot off of the accelerator pedal, the speed control thinks there is excessive speed control cable slack and adapts accordingly. If the “lift foot sets” are continually used, a speed control overshoot/undershoot condition will develop.

To “unlearn” the overshoot/undershoot condition, the vehicle operator has to press and release the set button while maintaining the desired set speed using the accelerator pedal (not decelerating or accelerating), and then turning the cruise control switch to the OFF position (or press the CANCEL button if equipped) after waiting 10 seconds. This procedure must be performed approximately 10–15 times to completely unlearn the overshoot/undershoot condition.

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 8J, Instrument Cluster 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.

SPECIFICATIONS

TORQUE - SPEED CONTROL

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Servo Mounting Bracket-to-Servo Nuts	8.5	-	75
Speed Control Switch Mounting Screws	1.5	-	14
Vacuum Reservoir Mounting Bolt (screw)	1.2	-	10

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.

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. 1). **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. 1). 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 Servo Removal/Installation.

INSTALLATION

(1) Attach end of cable to speed control servo. Refer to 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.

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.

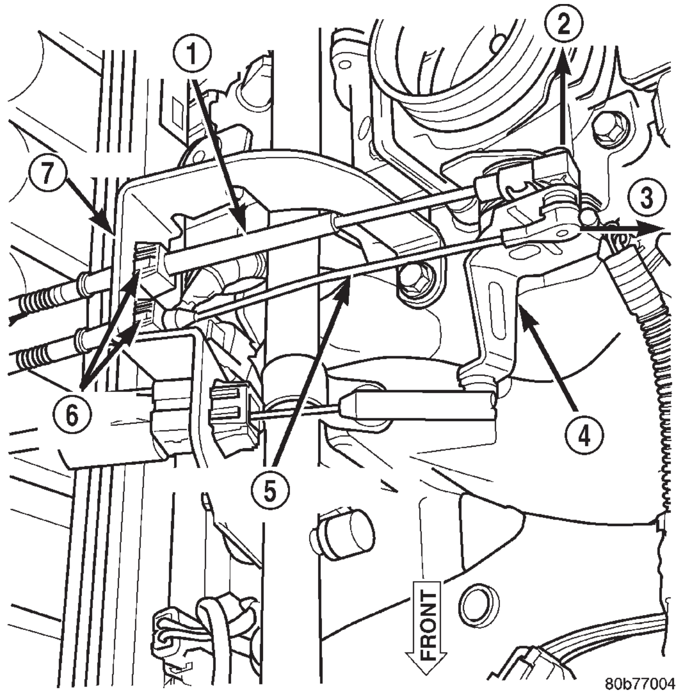

Fig. 1 Speed Control Servo Cable at Throttle Body

1 - ACCELERATOR CABLE
2 - OFF
3 - OFF
4 - THROTTLE BODY BELLCRANK
5 - SPEED CONTROL CABLE
6 - RELEASE TABS
7 - BRACKET

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.

SERVO (Continued)

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.

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Disconnect vacuum line at servo (Fig. 2).

(3) Disconnect electrical connector at servo.

(4) Disconnect servo cable at throttle body. Refer to Cable Removal/Installation.

(5) Remove 2 mounting nuts holding servo cable sleeve to bracket (Fig. 2) or (Fig. 3).

(6) Pull speed control cable sleeve and servo away from servo mounting bracket to expose cable retaining clip (Fig. 3) and remove clip. Note: The servo mounting bracket displayed in (Fig. 3) is a typical bracket and may/may not be applicable to this model vehicle.

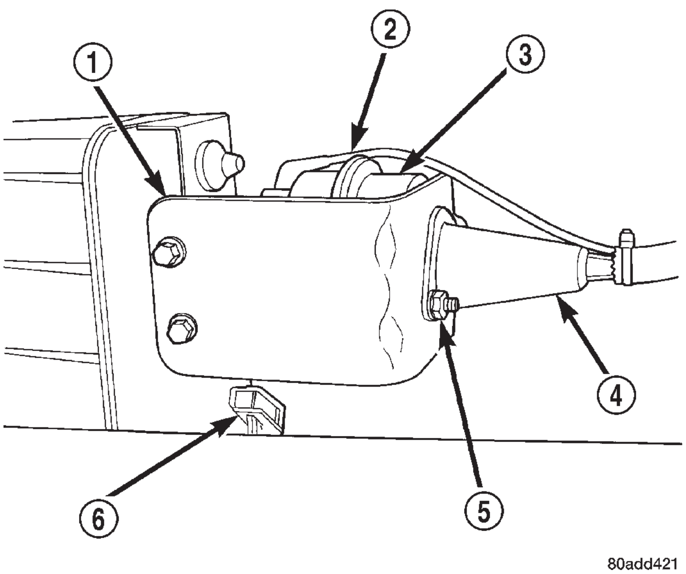

Fig. 2 Speed Control Servo Location

1 - SERVO MOUNTING BRACKET
2 - VACUUM LINE
3 - SPEED CONTROL SERVO
4 - CABLE SLEEVE
5 - SERVO MOUNTING NUTS (2)
6 - ELECTRICAL CONNECTOR

(7) Remove servo from mounting bracket. While removing, note orientation of servo to bracket.

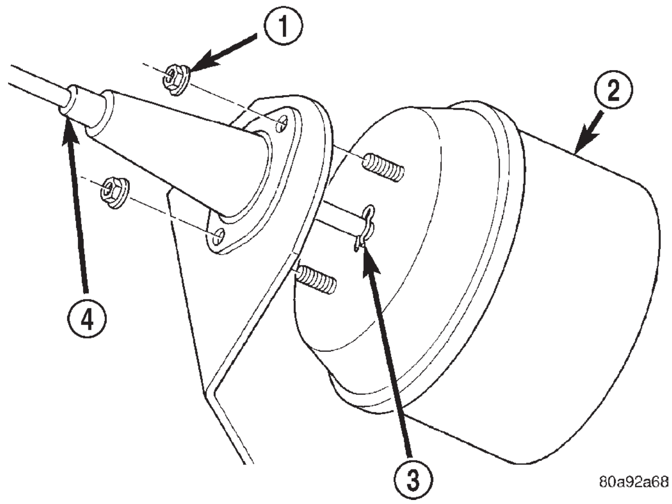

Fig. 3 Servo Cable Clip Remove/Install—Typical

1 - SERVO MOUNTING NUTS (2)
2 - SERVO
3 - CABLE RETAINING CLIP
4 - SERVO CABLE AND SLEEVE

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 Cable Removal/Installation.

(8) Connect negative battery cable to battery.

(9) Before starting engine, operate accelerator pedal to check for any binding.

SWITCH

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.

SWITCH (Continued)

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.

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.

REMOVAL

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.

(1) Disconnect and isolate negative battery cable from battery.

(2) Remove airbag module. Refer to 8, Passive Restraint Systems.

(3) From underside of steering wheel, remove speed control switch mounting screw (Fig. 4).

(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 8, Passive Restraint Systems.

(5) Connect negative battery cable to battery.

SWITCH (Continued)

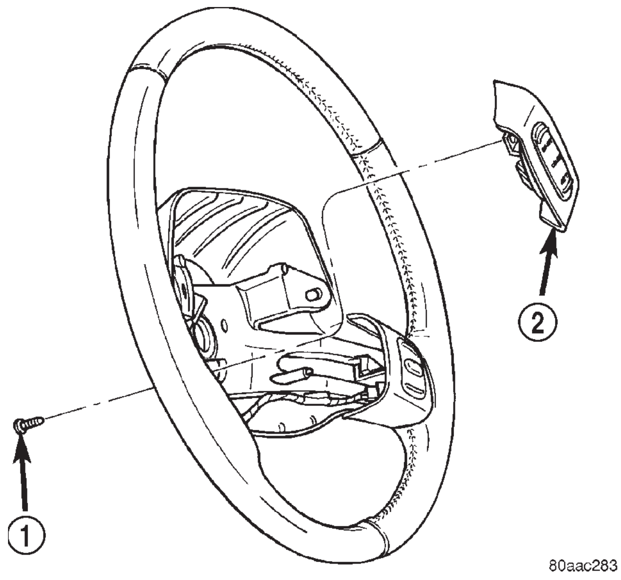

Fig. 4 Speed Control Switch Remove/Install

1 - MOUNTING SCREW
2 - SPEED CONTROL SWITCH

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.

DIAGNOSIS AND TESTING - VACUUM RESERVOIR

(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

The vacuum reservoir is located under the vehicle battery tray (Fig. 5).

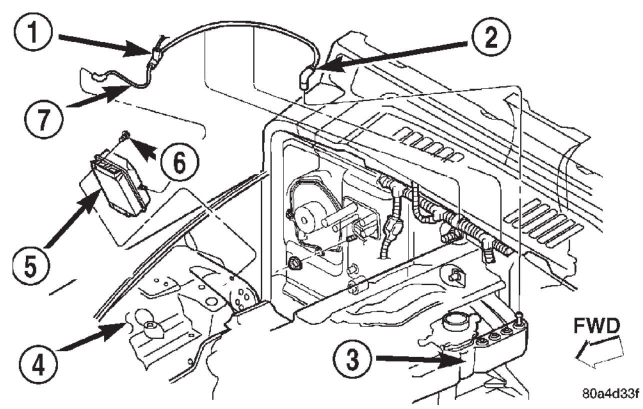

Fig. 5 Vacuum Reservoir Removal/Installation

1 - TEE
2 - VACUUM CHECK VALVE
3 - INTAKE MANIFOLD
4 - INNER FENDER
5 - RESERVOIR
6 - SCREW
7 - VACUUM SUPPLY LINE

(1) Remove battery and battery tray. Refer to Battery Removal/Installation.

(2) Disconnect vacuum supply line at reservoir (Fig. 5).

VACUUM RESERVOIR (Continued)

(3) Remove screw securing reservoir to inner fender.

(4) Remove reservoir from vehicle.

INSTALLATION

The vacuum reservoir is located under the vehicle battery tray (Fig. 5) .

(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.

VEHICLE THEFT SECURITY

TABLE OF CONTENTS

VEHICLE THEFT SECURITY

DESCRIPTION

The Sentry Key Immobilizer System (SKIS) is available as a factory-installed option on this model. Vehicles equipped with this option can be readily identified by the presence of an amber SKIS indicator in the instrument cluster that will illuminate for about three seconds each time the ignition switch is turned to the On position, or by a gray molded rubber cap on the head of the ignition key. Models not equipped with SKIS still have a SKIS indicator in the cluster, but it will not illuminate when the ignition switch is turned to the On position. Also, models not equipped with the SKIS have a black molded rubber cap on the head of the ignition key.

The SKIS includes the following major components, which are described in further detail elsewhere in this service manual:

- **Powertrain Control Module (PCM)** - The PCM is located on the right side of the dash panel in the engine compartment.
- **Sentry Key Immobilizer Module (SKIM)** - The SKIM is located on the steering column near the ignition lock cylinder housing and an integral molded plastic antenna ring circles the ignition lock cylinder like a halo. The SKIM and its antenna are concealed beneath the steering column shrouds.
- **Sentry Key Transponder** - The Sentry Key transponder is molded into the head of the ignition key, and concealed by a gray molded rubber cap.
- **SKIS Indicator** - The SKIS indicator is located in the upper left corner of the instrument cluster overlay.

Except for the Sentry Key transponders, which rely upon Radio Frequency (RF) communication, hard wired circuitry connects the SKIS components to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the SKIS components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

OPERATION

The Sentry Key Immobilizer System (SKIS) is designed to provide passive protection against unauthorized vehicle use by disabling the engine, after about two seconds of running, whenever any method other than a valid Sentry Key is used to start the vehicle. The SKIS is considered a passive protection system because it is always active when the ignition system is energized and does not require any customer intervention. The SKIS uses Radio Frequency (RF) communication to obtain confirmation that the key in the ignition switch is a valid key for operating the vehicle. The microprocessor-based SKIS hardware and software also uses electronic messages to communicate with other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ COMMUNICATION - OPERATION).

VEHICLE THEFT SECURITY (Continued)

Pre-programmed Sentry Key transponders are provided with the vehicle from the factory. Each Sentry Key Immobilizer Module (SKIM) will recognize a maximum of eight Sentry Keys. If the customer would like additional keys other than those provided with the vehicle, they may be purchased from any authorized dealer. These additional keys must be programmed to the SKIM in the vehicle in order for the system to recognize them as valid keys. This can be done by the dealer using a DRBIII® scan tool or, if Customer Learn programming is an available SKIS feature in the market where the vehicle was purchased, the customer can program the additional keys, as long as at least two valid Sentry Keys are already available. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - STANDARD PROCEDURE - SENTRY KEY TRANSPONDER PROGRAMMING).

The SKIS performs a self-test each time the ignition switch is turned to the On position, and will store fault information in the form of Diagnostic Trouble Codes (DTC's) if a system malfunction is detected. The SKIS can be diagnosed, and any stored DTC's can be retrieved using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

DIAGNOSIS AND TESTING - SENTRY KEY IMMOBILIZER SYSTEM

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.

SENTRY KEY IMMOBILIZER SYSTEM DIAGNOSIS		
CONDITION	POSSIBLE CAUSES	CORRECTION
SKIS INDICATOR FAILS TO LIGHT DURING BULB TEST	1. Indicator faulty.	1. Test and replace the faulty instrument cluster or bulb as required.
	2. Fuse faulty.	2. Test and replace the SKIM fused B(+) and fused ignition switch output (run-start) fuses in the fuse block as required.
	3. Ground circuit faulty.	3. Test and repair the SKIM ground circuit as required.
	4. Fused B(+) circuit faulty.	4. Test and repair the SKIM fused B(+) circuit as required.
	5. Fised ignition switch output circuit faulty.	5. Terst and repair the SKIM fused ignition switch output (run-start) circuit as required.
SKIS INDICATOR FLASHES WHEN IGNITION SWITCH IS TURNED TO THE ″ON″ POSITION	1. Invalid key in ignition switch lock cylinder.	1. Replace the key with a known valid key.
	2. Key-related fault.	2. Use a DRBIII® scan tool to diagnose the key-related fault. Refer to the appropriate diagnostic information.
SKIS INDICATOR LIGHTS SOLID FOLLOWING BULB TEST	1. SKIS system malfunction/ fault detected.	1. Use a DRBIII® scan tool to diagnose the SKIS. Refer to the appropriate diagnostic information.

VEHICLE THEFT SECURITY (Continued)

SKIS INDICATOR FAILS TO LIGHT DURING BULB TEST

If the Sentry Key Immobilizer System (SKIS) indicator in the instrument cluster fails to illuminate for about three seconds after the ignition switch is turned to the On position (bulb test), perform the instrument cluster actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING - ACTUATOR TEST). If the SKIS indicator still fails to light during the bulb test, a wiring problem resulting in the loss of battery current or ground to the Sentry Key Immobilizer Module (SKIM) should be suspected, and the following procedure should be used for diagnosis. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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 requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

(1) Check the B(+) fuse (Fuse 1 - 20 ampere) in the fuse block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the B(+) fuse (Fuse 1 - 20 ampere) in the fuse block. If OK, go to Step 3. If not OK, repair the open B(+) circuit between the fuse block and the battery as required.

(3) Check the ignition switch output (run-start) fuse (Fuse 12 - 10 ampere) in the fuse block. If OK, go to Step 4. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(4) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run-start) fuse (Fuse 12 - 10 ampere) in the fuse block. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (run-start) circuit between the fuse block and the ignition switch as required.

(5) Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector for the Sentry Key Immobilizer Module (SKIM) from the SKIM connector receptacle. Check for continuity between each of the two ground circuit cavities of the instrument panel wire harness connector for the SKIM and a good ground. There should be continuity. If OK, go to Step 6. If not OK, repair the open ground circuit(s) to ground (G105 and G302) as required.

(6) Reconnect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the instrument panel wire harness connector for the SKIM. If OK, go to Step 7. If not OK, repair the open fused B(+) circuit between the SKIM and the fuse block as required.

(7) 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 panel wire harness connector for the SKIM. If OK, use a DRBIII® scan tool to complete the diagnosis of the SKIS. Refer to the appropriate diagnostic information. If not OK, repair the open fused ignition switch output (run-start) circuit between the SKIM and the fuse block as required.

SKIS INDICATOR FLASHES OR LIGHTS SOLID FOLLOWING BULB TEST

A SKIS indicator that flashes following a successful bulb test indicates that an invalid key has been detected, or that a key-related fault has been set. A SKIS indicator that lights solid following a successful bulb test indicates that the SKIM has detected a system malfunction or that the SKIS is inoperative. In either case, fault information will be stored in the SKIM memory. For retrieval of this fault information and further diagnosis of the SKIS, the PCI data bus, the SKIM message outputs to the instrument cluster that control the SKIS indicator and/or chime service, or the message inputs and outputs between the SKIM and the Powertrain Control Module (PCM) that control engine operation, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information. Following are preliminary troubleshooting guidelines to be followed during diagnosis using a DRBIII® scan tool:

(1) Using the DRBIII® scan tool, read and record the faults as they exist in the SKIM when you first begin your diagnosis of the vehicle. It is important to document these faults because the SKIM does not differentiate between historical faults (those that have occurred in the past) and active faults (those that are currently present). If this problem turns out to be an intermittent condition, this information may become invaluable to your diagnosis.

(2) Using the DRBIII® scan tool, erase all of the faults from the SKIM.

(3) Cycle the ignition switch to the Off position, then back to the On position.

(4) Using the DRBIII® scan tool, read any faults that are now present in the SKIM. These are the active faults.

(5) Using this active fault information, refer to the proper procedure in the appropriate diagnostic information for the additional specific diagnostic steps.

VEHICLE THEFT SECURITY (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - SKIS INITIALIZATION

The Sentry Key Immobilizer System (SKIS) must be initialized following a Sentry Key Immobilizer Module (SKIM) replacement. SKIS initialization requires the use of a DRBIII® scan tool. Initialization will also require that you have access to the unique four-digit PIN code that was assigned to the original SKIM. The PIN code **must** be used to enter the Secured Access Mode in the SKIM. This PIN number may be obtained from the vehicle owner, from the original vehicle invoice, or from the DaimlerChrysler Customer Center. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES - STANDARD PROCEDURE - PCM/SKIM PROGRAMMING).

NOTE: If a Powertrain Control Module (PCM) is replaced on a vehicle equipped with the Sentry Key Immobilizer System (SKIS), the unique Secret Key data must be transferred from the Sentry Key Immobilizer Module (SKIM) to the new PCM using the PCM replacement procedure. This procedure also requires the use of a DRBIII® scan tool and the unique four-digit PIN code to enter the Secured Access Mode in the SKIM. Refer to the appropriate diagnostic information for the proper PCM replacement procedures.

STANDARD PROCEDURE - SENTRY KEY TRANSPONDER PROGRAMMING

All Sentry Keys included with the vehicle are preprogrammed to work 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 a total of eight Sentry Keys. When programming a blank Sentry Key transponder, the key must first be cut to match the ignition switch lock cylinder in the vehicle for which it will be used. Once the additional or new key has been cut, the SKIM must be programmed to recognize it as a valid key. There are two possible methods to program the SKIM to recognize a new or additional valid key, the Secured Access Method and the Customer Learn Method. Following are the details of these two programming methods.

SECURED ACCESS METHOD

The Secured Access method applies to all vehicles. This method requires the use of a DRBIII® scan tool. This method will also require that you have access to the unique four-digit PIN code that was assigned to the original SKIM. The PIN code **must** be used to enter the Secured Access Mode in the SKIM. This PIN number may be obtained from the vehicle owner, from the original vehicle invoice, or from the DaimlerChrysler Customer Center. Refer to the appropriate diagnostic information for the proper Secured Access method programming procedures.

CUSTOMER LEARN METHOD

The Customer Learn feature is only available on domestic vehicles, or those vehicles which have a U.S. country code designator. This programming method also requires access to at least two valid Sentry Keys. If two valid Sentry Keys are not available, or if the vehicle does not have a U.S. country code designator, the Secured Access Method **must** be used to program new or additional valid keys to the SKIM. The Customer Learn programming method procedures are as follows:

(1) Obtain the blank Sentry Key(s) that are to be programmed as valid keys for the vehicle. Cut the blank key(s) to match the ignition switch lock cylinder mechanical key codes.

(2) Insert one of the two valid Sentry Keys 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 longer than three seconds, but no more than fifteen seconds, cycle the ignition switch back to the Off position. Replace the first valid Sentry Key in the ignition switch lock cylinder with the second valid Sentry Key and turn the ignition switch back to the On position. The second valid Sentry Key must be inserted in the lock cylinder within fifteen seconds of removing the first valid key.

(4) About ten seconds after the completion of Step 3, the SKIS indicator in the instrument cluster 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 sixty 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 will stop flashing, stay on solid for three seconds, then turn off to indicate that the blank Sentry Key has been successfully programmed. The SKIS will immediately exit the Customer Learn programming mode and the vehicle may now be started using the newly programmed valid Sentry Key.

Each of these steps must be repeated and completed in their entirety for each additional Sentry Key that is to be programmed. If the above steps are not completed in the given sequence, or within the

VEHICLE THEFT SECURITY (Continued)

allotted time, the SKIS will exit the Customer Learn programming mode and the programming will be unsuccessful. 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 (8) valid Sentry Keys, or if the ignition switch is turned to the Off position for more than about fifty seconds.

NOTE: If an attempt is made to start the vehicle while in the Customer Learn mode (SKIS indicator flashing), the SKIS will respond as though the vehicle were being started with an invalid key. In other words, the engine will stall after about two seconds of operation. No faults will be set.

NOTE: Once a Sentry Key has been programmed as a valid key to a vehicle, it cannot be programmed as a valid key for use on any other vehicle.

SENTRY KEY IMMOBILIZER MODULE

DESCRIPTION

The Sentry Key Immobilizer Module (SKIM) is the primary component of the Sentry Key Immobilizer System (SKIS) (Fig. 1). The SKIM is located on the right side of the steering column, below the ignition lock cylinder housing and is concealed beneath the steering column shrouds. The molded black plastic housing for the SKIM has an integral molded plastic halo-like antenna ring that extends from one end. When the SKIM is properly installed on the steering column, the antenna ring is oriented around the circumference of the ignition lock cylinder housing. A single integral connector receptacle containing six terminal pins is located on the opposite end of the SKIM housing from the antenna ring. A stamped metal mounting bracket secured to the SKIM housing has a U-shaped clip formation that is used to secure the unit to the right lower flange of the steering column jacket.

The SKIM cannot be adjusted or repaired. If faulty or damaged, the entire SKIM unit must be replaced.

OPERATION

The Sentry Key Immobilizer Module (SKIM) contains a Radio Frequency (RF) transceiver and a microprocessor. The SKIM transmits RF signals to, and receives RF signals from the Sentry Key transponder through a tuned antenna enclosed within the molded plastic antenna ring integral to the SKIM housing. If this antenna ring is not mounted properly around the ignition lock cylinder housing, communication problems between the SKIM and the transponder may arise. These communication problems will result in Sentry Key transponder-related faults. The SKIM also communicates over the Programmable Communications Interface (PCI) data bus with the Powertrain Control Module (PCM), the ElectroMechanical Instrument Cluster (EMIC) and/or the DRBIII® scan tool.

The SKIM retains in memory the ID numbers of any Sentry Key transponder that is programmed into it. A maximum of eight Sentry Key transponders can be programmed into the SKIM. For added system security, each SKIM is programmed with a unique Secret Key code. This code is stored in memory, sent over the PCI data bus to the PCM, and is encoded to the transponder of every Sentry Key that is programmed into the SKIM. Therefore, the Secret Key code is a common element that is found in every component of the Sentry Key Immobilizer System (SKIS). Another security code, called a PIN, is used to gain access to the SKIM Secured Access Mode. The Secured Access Mode is required during service to perform the SKIS initialization and Sentry Key transponder programming procedures. The SKIM also stores the Vehicle Identification Number (VIN) in its memory, which it learns through a PCI data bus message from the PCM during SKIS initialization.

In the event that a SKIM replacement is required, the Secret Key code can be transferred to the new SKIM from the PCM using the DRBIII® scan tool and the SKIS initialization procedure. Proper completion of the SKIS initialization will allow the existing Sentry Keys to be programmed into the new SKIM so that new keys will not be required. In the event that the original Secret Key code cannot be recovered, SKIM replacement will also require new Sentry Keys. The DRBIII® scan tool will alert the technician during the SKIS initialization procedure if new Sentry Keys are required.

When the ignition switch is turned to the On position, the SKIM transmits an RF signal to the transponder in the ignition key. The SKIM then waits for an RF signal response from the transponder. If the response received identifies the key as valid, the SKIM sends a valid key message to the PCM over the PCI data bus. If the response received identifies the key as invalid, or if no response is received from the key transponder, the SKIM sends an invalid key message to the PCM. The PCM will enable or disable engine operation based upon the status of the SKIM messages. It is important to note that the default condition in the PCM is an invalid key; therefore, if no message is received from the SKIM by the PCM, the engine will be disabled and the vehicle immobilized after two seconds of running.

SENTRY KEY IMMOBILIZER MODULE (Continued)

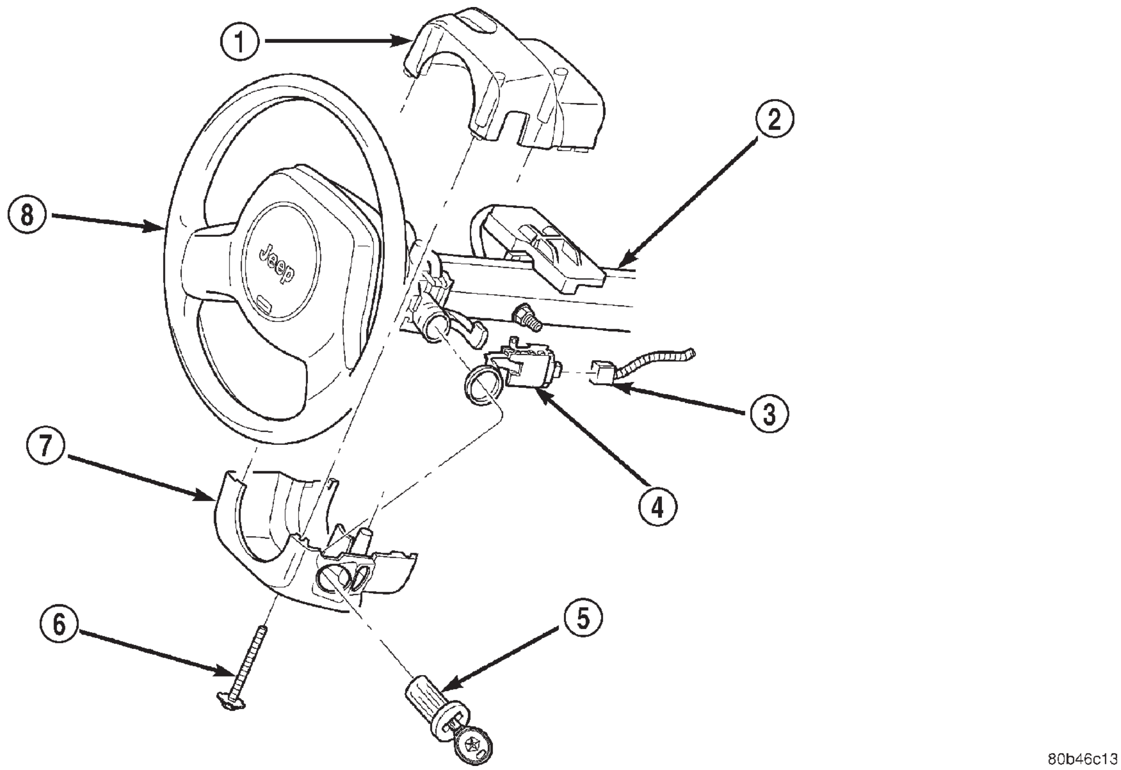

Fig. 1 Sentry Key Immobilizer Module

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

The SKIM also sends SKIS indicator status messages to the EMIC over the PCI data bus to tell the EMIC how to operate the SKIS indicator. This indicator status message tells the EMIC to turn the indicator on for about three seconds each time the ignition switch is turned to the On position as a bulb test. After completion of the bulb test, the SKIM sends indicator status messages to the EMIC to turn the indicator off, turn the indicator on, or to flash the indicator on and off. If the SKIS indicator flashes or stays on solid after the bulb test, it signifies a SKIS fault. If the SKIM detects a system malfunction and/or the SKIS has become inoperative, the SKIS indicator will stay on solid. If the SKIM detects an invalid key or if a key transponder-related fault exists, the SKIS indicator will flash. If the vehicle is equipped with the Customer Learn transponder programming feature, the SKIM will also send messages to the EMIC to flash the SKIS indicator and to generate a single audible chime tone whenever the Customer Learn programming mode is being utilized. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - STANDARD PROCEDURE - SENTRY KEY TRANSPONDER PROGRAMMING).

The SKIS performs a self-test each time the ignition switch is turned to the On position, and will store fault information in the form of Diagnostic Trouble Codes (DTC's) in SKIM memory if a system malfunction is detected. The SKIM can be diagnosed, and any stored DTC's can be retrieved using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

SENTRY KEY IMMOBILIZER MODULE (Continued)

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the two screws that secure the lower steering column shroud to the upper shroud (Fig. 2).

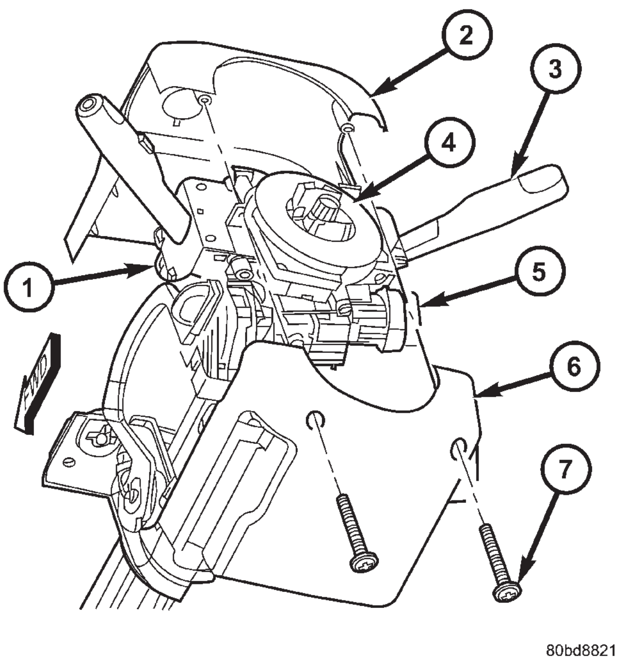

Fig. 2 STEERING COLUMN SHROUDS REMOVE/I

1 - LEFT MULTI-FUNCTION SWITCH
2 - UPPER SHROUD
3 - RIGHT MULTI-FUNCTION SWITCH
4 - CLOCKSPRING
5 - IGNITION LOCK CYLINDER HOUSING
6 - LOWER SHROUD
7 - SCREW (2)

(4) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully lowered position and leave the tilt release lever in the released (down) position.

(5) Remove both the upper and lower shrouds from the steering column.

(6) On models equipped with a manual transmission, remove the two screws that secure the multi-function switch assembly to the upper steering column housing.

(7) Disconnect the cross body wire harness connector for the SKIM from the SKIM connector receptacle (Fig. 3).

(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. On models with a manual transmission, lift the multi-function switch upward off of the upper steering column housing far enough to extract the SKIM antenna formation from between the ignition key release button and the right multi-function switch housing.

(10) Remove the SKIM from the steering column.

INSTALLATION

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.

(1) Position the Sentry Key Immobilizer Module (SKIM) to the right side of the steering column (Fig. 3). On models with a manual transmission, lift the multi-function switch upward off of the upper steering column housing far enough to insert the SKIM antenna formation between the ignition key release button and the right multi-function switch housing.

(2) Slide the SKIM antenna ring around the ignition switch lock cylinder housing, then rotate the

SENTRY KEY IMMOBILIZER MODULE (Continued)

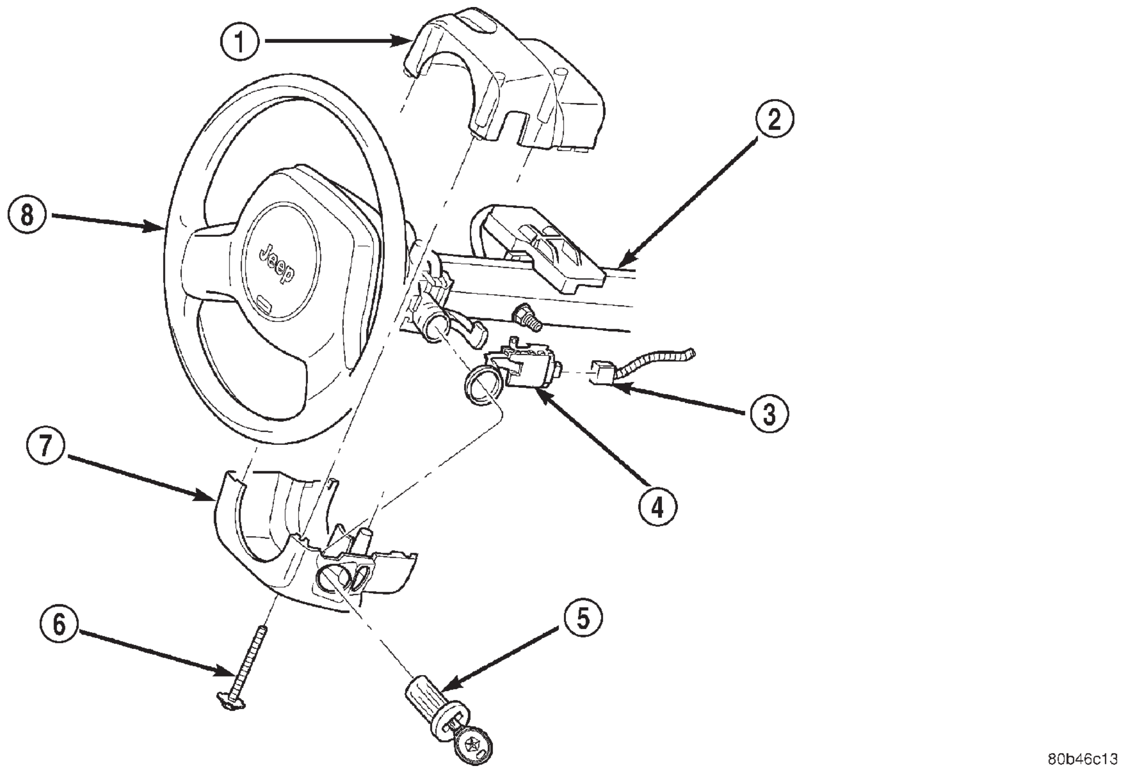

Fig. 3 Sentry Key Immobilizer Module

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

SKIM and its mounting bracket upwards and toward the steering column.

(3) Align the SKIM mounting bracket clip formation with the inboard lower flange of the steering column jacket and, using hand pressure, push upward firmly and evenly on the connector end of the SKIM mounting bracket to engage this clip with the steering column jacket.

(4) Reconnect the cross body wire harness connector for the SKIM to the SKIM connector receptacle.

(5) On models equipped with a manual transmission, install and tighten the two screws that secure the multi-function switch assembly to the upper steering column housing. Tighten the screws to 2 N·m (20 in. lbs.).

(6) Position both the upper and lower shrouds onto the steering column (Fig. 2). Be certain that the locating tabs for the left and right multi-function switch control stalk watershields are properly engaged in the openings of both the upper and lower shrouds.

(7) Install and tighten the two screws that secure the lower steering column shroud to the upper shroud. Tighten the screws to 2 N·m (18 in. lbs.).

(8) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully raised position and secure it in place by moving the tilt release lever back to the locked (up) position.

(9) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(10) Reconnect the battery negative cable.

NOTE: If the SKIM has been replaced with a new unit, the Sentry Key Immobilizer System (SKIS) MUST be initialized before the vehicle can be operated. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - STANDARD PROCEDURE - SKIS INITIALIZATION).

SKIS INDICATOR

DESCRIPTION

A Sentry Key Immobilizer System (SKIS) indicator is standard equipment on all instrument clusters, but is only operational on vehicles equipped with the optional SKIS. The SKIS indicator is located near the upper edge of the instrument cluster overlay, in the upper left quadrant of the cluster. The SKIS indicator consists of a stencil-like cutout of a graphical representation or icon of a key that is circled and crossed-out in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber lens behind the cutout in the opaque layer of the overlay causes the indicator to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. The SKIS indicator is serviced as a unit with the instrument cluster.

OPERATION

The Sentry Key Immobilizer System (SKIS) indicator gives an indication to the vehicle operator of the status of the SKIS. This indicator is controlled by the instrument cluster electronic circuit board based upon electronic messages received by the cluster from the Sentry Key Immobilizer Module (SKIM) over the Programmable Communications Interface (PCI) data bus. The SKIS indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions; therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is switched to ground by the instrument cluster transistor. The instrument cluster will turn on the SKIS indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position, the SKIM tells the cluster to illuminate the SKIS indicator for about three seconds as a bulb test.
- **SKIM Lamp-On Message** - Each time the cluster receives a lamp-on message from the SKIM, the SKIS indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the SKIM message. For more information on the SKIS and the SKIS indicator control parameters, (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - OPERATION). The indicator remains illuminated until the cluster receives a lamp-off message from the SKIM or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the SKIS indicator will be turned on, then off again in a prescribed sequence to confirm the functionality of the LED and the cluster control circuitry.

The SKIM performs a self-test each time the ignition switch is turned to the On position to decide whether the system is in good operating condition. The SKIM then sends the proper SKIS lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the SKIS indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the SKIS indicator after the bulb test, either solid or flashing, it indicates that a SKIS malfunction has occurred or that the SKIS is inoperative. For proper diagnosis of the SKIS, the PCI data bus, or the message inputs to the instrument cluster that control the SKIS indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

TRANSPONDER KEY

DESCRIPTION

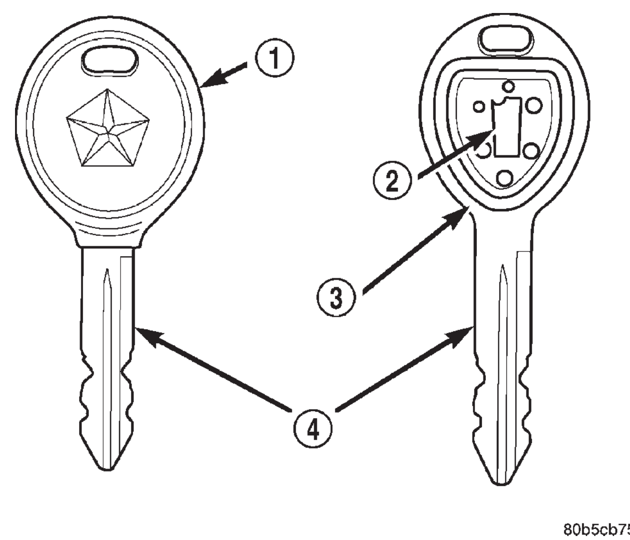

Fig. 4 Sentry Key Immobilizer Transponder

1 - MOLDED CAP
2 - TRANSPONDER CHIP
3 - MOLDED CAP REMOVED
4 - TRANSPONDER KEY

TRANSPONDER KEY (Continued)

Each ignition key used in the Sentry Key Immobilizer System (SKIS) has an integral transponder chip (Fig. 4). Ignition keys with this feature can be readily identified by a gray rubber cap molded onto the head of the key, while conventional ignition keys have a black molded rubber cap. The transponder chip is concealed beneath the molded rubber cap, where it is molded within a plastic mount into the head of the metal key. In addition to being cut to match the mechanical coding of the ignition lock cylinder, each new Sentry Key has a unique transponder identification code permanently programmed into it by the manufacturer. The Sentry Key transponder cannot be adjusted or repaired. If faulty or damaged, the entire key must be replaced.

OPERATION

When the ignition switch is turned to the On position, the Sentry Key Immobilizer Module (SKIM) communicates through its antenna with the Sentry Key transponder using a Radio Frequency (RF) signal. The SKIM then listens for a RF response from the transponder through the same antenna. The Sentry Key transponder chip is within the range of the SKIM transceiver antenna ring when it is inserted into the ignition lock cylinder. The SKIM determines whether a valid key is present in the ignition lock cylinder based upon the response from the transponder. If a valid key is detected, that fact is communicated by the SKIM to the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus, and the PCM allows the engine to continue running. If the PCM receives an invalid key message, or receives no message from the SKIM over the PCI data bus, the engine will be disabled after about two seconds of operation. The ElectroMechanical Instrument Cluster (EMIC) will also respond to the invalid key message on the PCI data bus by flashing the SKIS indicator on and off.

Each Sentry Key has a unique transponder identification code permanently programmed into it by the manufacturer. Likewise, the SKIM has a unique Secret Key code programmed into it by the manufacturer. When a Sentry Key is programmed into the memory of the SKIM, the SKIM stores the transponder identification code from the Sentry Key, and the Sentry Key learns the Secret Key code from the SKIM. Once the Sentry Key learns the Secret Key code of the SKIM, it is permanently stored in the memory of the transponder. Therefore, once a Sentry Key has been programmed to a particular vehicle, it cannot be used on any other vehicle. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - STANDARD PROCEDURE - SENTRY KEY TRANSPONDER PROGRAMMING).

The SKIS performs a self-test each time the ignition switch is turned to the On position, and will store key-related fault information in the form of Diagnostic Trouble Codes (DTC's) in SKIM memory if a Sentry Key transponder problem is detected. The Sentry Key transponder chip can be diagnosed, and any stored DTC's can be retrieved using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

WIPERS/WASHERS

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FRONT WIPERS/WASHERS

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FRONT WIPERS/WASHERS

DESCRIPTION

An electrically operated intermittent front wiper and washer system is standard factory-installed safety equipment on this model. The front wiper and washer system includes the following major components, which are described in further detail elsewhere in this service information:

- **Front Washer Nozzles** - The two front washer nozzles are secured by integral snap features to dedicated openings near the rear of the hood panel. The washer plumbing fittings for the washer nozzles are concealed beneath the hood panel.

FRONT WIPERS/WASHERS (Continued)

- **Front Washer Pump/Motor** - The front washer pump/motor unit is located in a dedicated hole on the lower inboard side of the washer reservoir, on the top of the left front wheel house in the engine compartment. The front washer pump/motor unit is located forward of the optional rear washer pump/motor unit mounting hole.
- **Front Wiper Arms** - The two front wiper arms are secured to the two wiper pivots, which extend through the cowl plenum cover/grille panel located near the base of the windshield.
- **Front Wiper Blades** - The two front wiper blades are secured to the two front wiper arms, and are parked on the glass near the bottom of the windshield when the front wiper system is not in operation.
- **Front Wiper Module** - The front wiper pivots are the only visible components of the front wiper module. The remainder of the module is concealed within the cowl plenum beneath the cowl plenum cover/grille panel. The front wiper module includes the module bracket, the single front wiper motor, the front wiper linkage, and the two front wiper pivots.
- **Right Multi-Function Switch** - The right multi-function switch is secured to the left multi-function switch housing on the right side of the steering column lock housing. Only the control stalk and control knob of the right multi-function switch are visible. The remainder of the right multi-function switch is concealed beneath the steering column shrouds. The right multi-function switch contains all of the switches and control circuitry for the front wiper and washer system.
- **Washer Reservoir** - The washer reservoir is secured to the top of the left front fender wheel house, in the left front corner of the engine compartment.

Features of the front wiper and washer system include the following:

- **Continuous Wipe Modes** - The two-speed wiper motor and the internal circuitry of the right multi-function switch provide two continuous wipe cycles, low speed or high speed.
- **Intermittent Wipe Mode** - The internal circuitry of the right multi-function switch provides an intermittent wipe mode with adjustable delay intervals between wipe cycles of about one second to about fifteen seconds.
- **Mist Wipe Mode** - The internal circuitry of the right multi-function switch has a momentary Mist position that will operate the front wipers for a single complete cycle, then park the wiper blades near the base of the windshield.
- **Washer Mode** - When the front washer system is activated with the right multi-function switch while the front wiper system is operating, washer fluid will be dispensed onto the windshield glass through the washer nozzles for as long as the front washer pump is energized.
- **Wipe-After-Wash Mode** - The internal circuitry of the right multi-function switch provides a wipe-after-wash feature which, if the front wipers are turned Off, will operate the front washer pump/motor and the front wipers for as long as the washer system is activated, then provide one or two additional wipe cycles after the washer system is deactivated before parking the front wiper blades near the base of the windshield.

Hard wired circuitry connects the front wiper and washer system components to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the front wiper and washer system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

OPERATION

The front wiper and washer system is intended to provide the vehicle operator with a convenient, safe, and reliable means of maintaining visibility through the windshield glass. The various components of this system are designed to convert electrical energy produced by the vehicle electrical system into the mechanical action of the wiper blades to wipe the outside surface of the glass, as well as into the hydraulic action of the washer system to apply washer fluid stored in an on-board reservoir to the area of the glass to be wiped. When combined, these components provide the means to effectively maintain clear visibility for the vehicle operator by removing excess accumulations of rain, snow, bugs, mud, or other minor debris that might be encountered while driving the vehicle under numerous types of inclement operating conditions from the outside windshield glass surface. The vehicle operator initiates all front wiper and washer system functions with the right multi-function switch control stalk that extends from the right side of the steering column, just below the steering wheel. Moving the control stalk upward selects the front wiper system operating mode. The front wiper system allows the vehicle operator to select from two continuous wiper speeds, Hi or Lo, or

FRONT WIPERS/WASHERS (Continued)

the intermittent wipe Delay mode. Pulling the control stalk downwards and releasing it selects the front wiper system Mist mode, which operates the front wipers for one complete wipe cycle. Rotating the control knob on the end of the control stalk allows the vehicle operator to select the intermittent wipe Delay interval. Pulling the control stalk towards the steering wheel activates the front washer pump/motor, which dispenses washer fluid onto the windshield glass through the front washer nozzles.

When the ignition switch is in the Accessory or On positions, battery current from a fuse in the Power Distribution Center (PDC) is provided to the front wiper and washer system fuse in the fuse block. This fuse provides battery current through separate fused ignition switch output (run-acc) circuits to the right multi-function switch, and to the front wiper motor. Within the right multi-function switch, this battery current is fed to one side of the control coil in the wiper motor relay, and to the electronic intermittent wipe logic circuit, which are both integral to the switch. When the Lo position of the right multi-function switch control stalk is selected, the Lo position circuitry within the switch directs battery current to the low speed brush of the front wiper motor, which causes the front wipers to cycle at a low speed. When the Hi position of the control stalk is selected, the Hi position circuitry within the switch directs battery current to the high speed brush of the front wiper motor, which causes the front wipers to cycle at a high speed. In order to provide the mist feature, the Mist position circuitry within the switch momentarily directs battery current to the low speed brush of the front wiper motor, which causes the front wipers to cycle at low speed for as long as the switch is held in the Mist position, then complete the current wipe cycle and park after the switch is released.

The intermittent wipe and wipe-after-wash features of the front wiper and washer system are both provided by the electronic intermittent wipe logic circuit within the right multi-function switch. In order to provide the intermittent wipe feature, the logic circuit monitors the wiper switch state, the intermittent delay resistance setting, and the wiper motor park switch state. In order to provide the wipe-after-wash feature, the logic circuit monitors both the front washer switch state and the wiper motor park switch state. When the Delay position of the right multi-function switch control stalk is selected, the Delay position circuitry within the switch directs battery current to a request input of the logic circuit. The Delay position circuitry also directs battery current through an internal variable resistor to the intermittent wipe delay sense input of the logic circuit, which indicates the delay interval that has been selected by the vehicle operator. The logic circuit responds to the Delay mode request inputs by calculating the correct delay interval. The logic circuit then energizes the wiper motor relay by pulling the relay control coil to ground. The energized wiper motor relay directs battery current from the normally open relay terminal through the common feed relay terminal and the Delay position wiper switch circuitry to the low speed brush of the wiper motor. The logic circuit monitors the front wiper motor operation through the wiper park switch sense circuit, which allows the logic circuit to determine the proper timing to begin the next wiper blade sweep.

When the Off position of the right multi-function switch control stalk is selected, one of two events is possible. The event that will occur depends upon the position of the wiper blades on the windshield at the moment that the Off position is selected. If the wiper blades are in the down position on the windshield when the Off position is selected, the park switch that is integral to the front wiper motor is closed to ground and the wiper motor ceases to operate. If the wiper blades are not in the down position on the windshield at the moment the Off position is selected, the park switch is closed to battery current through the fused ignition switch output (run-acc) circuit of the front wiper motor. The park switch sense circuit directs this battery current to the low speed brush of the wiper motor through the normally closed circuit of the wiper motor relay and the Off position circuitry of the wiper switch. This causes the wiper motor to continue running until the wiper blades are in the down position on the windshield and the park switch is again closed to ground.

When the Wash position of the right multi-function switch control stalk is selected, the Wash position circuitry within the switch directs battery current to the front washer pump/motor. The intermittent wipe logic circuit monitors the washer switch state through a washer switch sense input. When the washer switch is closed with the front wiper system turned Off, the intermittent wipe logic circuit operates the front wiper motor through the wiper motor relay in the same manner as it does to provide the Delay mode operation, but uses the Off position circuitry of the wiper switch to feed battery current to the low speed brush of the front wiper motor. When the Wash position circuitry state changes to open, the intermittent wipe logic circuit monitors the front wiper motor through the wiper park switch sense circuit, which allows the logic circuit to count the number of wiper blade sweeps.

Refer to the owner's manual in the vehicle glove box for more information on the features and operation of the front wiper and washer system.

FRONT WIPERS/WASHERS (Continued)

DIAGNOSIS AND TESTING - FRONT WIPER & WASHER SYSTEM

WIPER SYSTEM

The diagnosis found here addresses an electrically inoperative front wiper system. If the front wiper motor operates, but the wipers do not move on the windshield, replace the faulty front wiper module. If the wipers operate, but chatter, lift, or do not clear the glass, clean and inspect the wiper system components as required. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - INSPECTION) and (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - CLEANING). Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

(1) Check the front wiper and washer system fuse (Fuse 14 - 25 ampere) in the fuse block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the front wiper and washer system fuse (Fuse 14 - 25 ampere) in the fuse block. If OK, go to Step 3. If not OK, repair the open fused ignition switch output (run-acc) circuit between the fuse block and the ignition switch as required.

(3) Disconnect and isolate the battery negative cable. Disconnect the cross body wire harness connector for the right multi-function switch from the switch connector receptacle. Check for continuity between the ground circuit cavity of the cross body wire harness connector for the right multi-function switch and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open ground circuit to ground (G300) as required.

(4) Reconnect 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 cross body wire harness connector for the right multi-function switch. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (run-acc) circuit between the right multi-function switch and the fuse block as required.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the right multi-function switch from the steering column and check the switch continuity. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS/RIGHT MULTI-FUNCTION SWITCH - DIAGNOSIS AND TESTING). If OK, go to Step 6. If not OK, replace the faulty switch.

(6) Disconnect the cross body wire harness connector for the front wiper motor from the wiper motor pigtail wire connector. Check for continuity between the ground circuit cavity in the cross body wire harness connector for the front wiper motor and a good ground. There should be continuity. If OK, go to Step 7. If not OK, repair the open ground circuit to ground (G300) as required.

(7) Reconnect 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 cross body wire harness connector for the front wiper motor. If OK, go to Step 8. If not OK, repair the open fused ignition switch output (run-acc) circuit between the front wiper motor and the fuse block as required.

(8) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. The cross body wire harness connector for the right multi-function switch is still disconnected. Check each of the following circuits at the proper cavity of the cross body wire harness connector for the front wiper motor for continuity to ground. In each case, there should be no continuity. If OK, go to Step 9. If not OK, repair the shorted circuit between the front wiper motor and the right multi-function switch as required.

- Wiper park switch sense
- Wiper switch low speed output
- Wiper switch high speed output

(9) Check the continuity of each of the following circuits between the proper cavities of the cross body wire harness connectors for the front wiper motor and the right multi-function switch. In each case, there should be continuity. If OK, replace the faulty front wiper module. If not OK, repair the open circuit between the front wiper motor and the right multi-function switch as required.

- Wiper park switch sense
- Wiper switch low speed output
- Wiper switch high speed output

FRONT WIPERS/WASHERS (Continued)

WASHER SYSTEM

The diagnosis found here addresses an electrically inoperative washer system. If the washer pump/motor operates, but no washer fluid is emitted from the washer nozzles, be certain to check the fluid level in the reservoir. Also inspect the washer system components as required. (Refer to 8 - ELECTRICAL/ FRONT WIPERS/WASHERS - INSPECTION). Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

(1) Turn the ignition switch to the On position. Move the right multi-function switch control stalk to the Lo or Hi wiper position. Check whether the front wiper system operates. If OK, go to Step 2. If not OK, repair the wiper system as required before you proceed with washer system diagnosis. Refer to WIPER SYSTEM .

(2) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the headlamp and dash wire harness connector for the front washer pump/motor from the washer pump/motor connector receptacle. Check for continuity between the ground circuit cavity of the headlamp and dash wire harness connector for the front washer pump/motor and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open ground circuit to ground (G102) as required.

(3) Reconnect the battery negative cable. Turn the ignition switch to the On position. While pulling the right multi-function switch control stalk toward the steering wheel to close the washer switch, check for battery voltage at the washer pump control switch output circuit cavity of the headlamp and dash wire harness connector for the front washer pump/motor. If OK, replace the faulty front washer pump/motor. 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 cross body wire harness connector for the right multi-function switch from the switch connector receptacle. Check for continuity between the washer pump control switch output circuit cavity of the headlamp and dash wire harness connector for the front washer pump/motor and a good ground. There should be no continuity. If OK, go to Step 5 If not OK, repair the shorted washer pump control switch output circuit between the front washer pump/motor and the right multi-function switch as required.

(5) Check for continuity between the washer pump control switch output circuit cavities of the headlamp and dash wire harness connector for the front washer pump/motor and the cross body wire harness connector for the right multi-function switch. There should be continuity. If OK, replace the faulty right multi-function switch. If not OK, repair the open washer pump control switch output circuit between the front washer pump/motor and the right multi-function switch as required.

CLEANING - FRONT WIPER & WASHER SYSTEM

WIPER SYSTEM

The squeegees of wiper blades exposed to the elements for a long time tend to lose their wiping effectiveness. Periodic cleaning of the squeegees is suggested to remove any deposits of salt or road film. The wiper blades, arms, and windshield glass should only be cleaned using a sponge or soft cloth and windshield washer fluid, a mild detergent, or a non-abrasive cleaner. If the wiper blades continue to leave streaks, smears, hazing, or beading on the glass after thorough cleaning of the squeegees and the glass, the entire wiper blade assembly must be replaced.

CAUTION: Protect the rubber squeegees of the wiper blades from any petroleum-based cleaners, solvents, or contaminants. These products can rapidly deteriorate the rubber squeegees.

WASHER SYSTEM

If the washer system is contaminated with foreign material, drain the washer reservoir by removing the front washer pump/motor from the reservoir. Clean foreign material from the inside of the washer reservoir using clean washer fluid, a mild detergent, or a non-abrasive cleaner. Flush foreign material from the washer system plumbing by first disconnecting the washer hoses from the washer nozzles, then running

FRONT WIPERS/WASHERS (Continued)

the washer pump/motor to run clean washer fluid or water through the system. Plugged or restricted washer nozzles should be carefully back-flushed using compressed air. If the washer nozzle obstruction cannot be cleared, replace the washer nozzle.

CAUTION: Never introduce petroleum-based cleaners, solvents, or contaminants into the washer system. These products can rapidly deteriorate the rubber seals and hoses of the washer system, as well as the rubber squeegees of the wiper blades.

CAUTION: Never use compressed air to flush the washer system plumbing. Compressed air pressures are too great for the washer system plumbing components and will result in further system damage.

INSPECTION - FRONT WIPER & WASHER SYSTEM

WIPER SYSTEM

The front wiper blades and wiper arms should be inspected periodically, not just when wiper performance problems are experienced. This inspection should include the following points:

(1) Inspect the wiper arms for any indications of damage, or contamination. If the wiper arms are contaminated with any foreign material, clean them as required. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - CLEANING). If a wiper arm is damaged or corrosion is evident, replace the wiper arm with a new unit. Do not attempt to repair a wiper arm that is damaged or corroded.

(2) Carefully lift the wiper blade off of the glass. Note the action of the wiper arm hinge. The wiper arm should pivot freely at the hinge, but with no lateral looseness evident. If there is any binding evident in the wiper arm hinge, or there is evident lateral play in the wiper arm hinge, replace the wiper arm.

CAUTION: Do not allow the wiper arm to spring back against the glass without the wiper blade in place or the glass may be damaged.

(3) Once proper hinge action of the wiper arm is confirmed, check the hinge for proper spring tension. Remove the wiper blade from the wiper arm. Either place a small postal scale between the blade end of the wiper arm and the glass, or carefully lift the blade end of the arm away from the glass using a small fish scale. Compare the scale readings between the right and left wiper arms. Replace a wiper arm if it has comparatively lower spring tension, as evidenced by a lower scale reading.

(4) Inspect the wiper blades and squeegees for any indications of damage, contamination, or rubber deterioration (Fig. 1). If the wiper blades or squeegees are contaminated with any foreign material, clean them and the glass as required. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - CLEANING). After cleaning the wiper blade and the glass, if the wiper blade still fails to clear the glass without smearing, streaking, chattering, hazing, or beading, replace the wiper blade. Also, if a wiper blade is damaged or the squeegee rubber is damaged or deteriorated, replace the wiper blade with a new unit. Do not attempt to repair a wiper blade that is damaged.

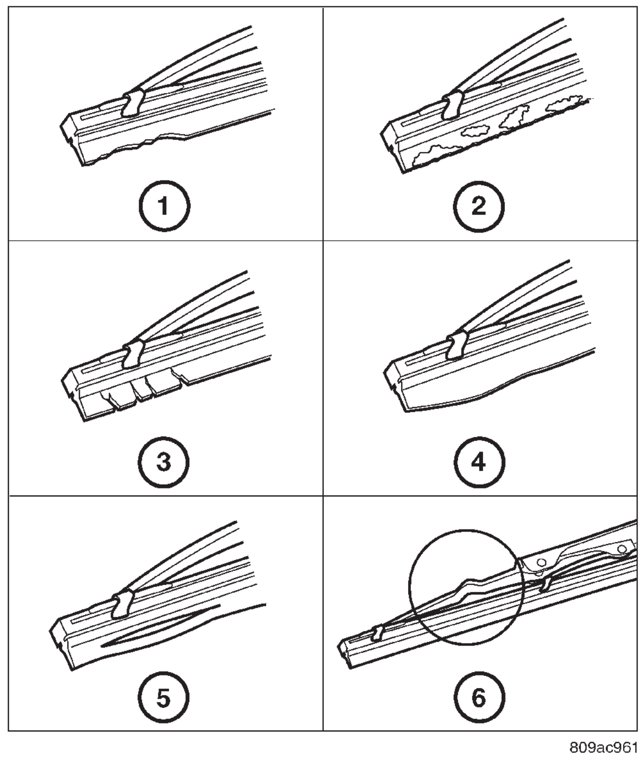

Fig. 1 Wiper Blade Inspection

1 - WORN OR UNEVEN EDGES
2 - ROAD FILM OR FOREIGN MATERIAL DEPOSITS
3 - HARD, BRITTLE, OR CRACKED
4 - DEFORMED OR FATIGUED
5 - SPLIT
6 - DAMAGED SUPPORT COMPONENTS

WASHER SYSTEM

The washer system components should be inspected periodically, not just when washer performance problems are experienced. This inspection should include the following points:

(1) Check for ice or other foreign material in the washer reservoir. If contaminated, clean and flush the washer system. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - CLEANING).

FRONT WIPERS/WASHERS (Continued)

(2) Inspect the washer plumbing for pinched, leaking, deteriorated, or incorrectly routed hoses and damaged or disconnected hose fittings. Replace damaged or deteriorated hoses and hose fittings. Leaking washer hoses can sometimes be repaired by cutting the hose at the leak and splicing it back together using an in-line connector fitting. Similarly, sections of deteriorated hose can be cut out and replaced by splicing in new sections of hose using in-line connector fittings. Whenever routing a washer hose or a wire harness containing a washer hose, it must be routed away from hot, sharp, or moving parts. Also, sharp bends that might pinch the washer hose must be avoided.

FRONT CHECK VALVE

DESCRIPTION

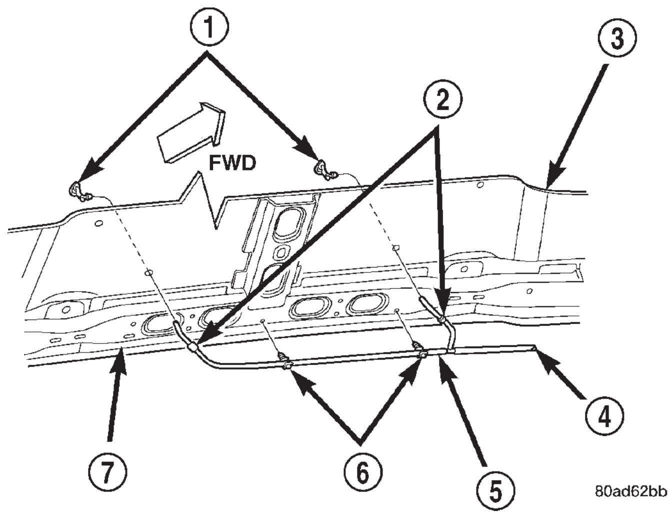

Fig. 2 Front Washer Plumbing

1 - FRONT WASHER NOZZLE (2)
2 - FRONT CHECK VALVE (2)
3 - HOOD
4 - TO WASHER RESERVOIR
5 - WASHER HOSE
6 - CLIPS
7 - REAR HOOD REINFORCEMENT

Two front washer system check valves are standard equipment on this model, and are installed in the front washer system plumbing (Fig. 2). The front check valves are located in the engine compartment in the washer supply hose for each front washer nozzle between the molded plastic hose tee fitting and the washer nozzle. The check valve consists of a molded plastic valve body with a raised center section that is tapered in the direction of the flow through the valve. A barbed hose nipple is formed on each side of the raised center section of the valve body. Within the check valve body, a small check ball is held against an integral valve seat at one end of the valve by a small coiled spring. The front check valve cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

OPERATION

The front check valve provides more than one function in this application. It prevents washer fluid from draining out of the front washer supply hoses back to the washer reservoir. This drain-back would result in a lengthy delay from when the front washer switch is actuated until washer fluid was dispensed through the front washer nozzles, because the front washer pump would have to refill the front washer plumbing from the reservoir to the nozzle. Also, the front check valve prevents washer fluid from siphoning through the front washer nozzles after the front washer system is turned Off. When the front washer pump pressurizes and pumps washer fluid from the reservoir through the front washer plumbing, the fluid pressure overrides the spring pressure applied to the check ball within the valve and unseats the check ball, allowing washer fluid to flow toward the front washer nozzle. When the front washer pump stops operating, spring pressure seats the check ball in the valve and fluid flow in either direction within the front washer plumbing is prevented. The front check valve cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

REMOVAL

(1) Open and support the hood.

(2) Locate the front check valve in the washer supply hose for each front washer nozzle. A check valve is installed between the molded plastic tee fitting and each nozzle near the rear hood panel reinforcement (Fig. 3).

(3) Disconnect the nozzle half of the washer supply hose from the barbed nipple on the front washer system check valve. A small quantity of washer fluid may drain from the disconnected hose.

(4) Disconnect the engine compartment half of the washer supply hose from the other barbed nipple of the front check valve. Either install a temporary plug in the engine compartment half of the supply hose or secure the loose end of this hose at a point higher than the washer reservoir to prevent the contents of the washer reservoir from draining through this hose.

(5) Remove the front check valve from the engine compartment.

INSTALLATION

(1) Position the front check valve in the engine compartment.

FRONT CHECK VALVE (Continued)

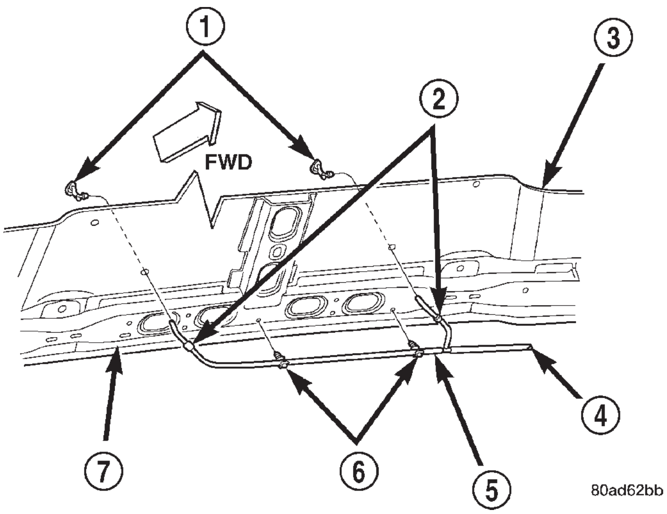

Fig. 3 Front Washer Plumbing

1 - FRONT WASHER NOZZLE (2)
2 - FRONT CHECK VALVE (2)
3 - HOOD
4 - TO WASHER RESERVOIR
5 - WASHER HOSE
6 - CLIPS
7 - REAR HOOD REINFORCEMENT

(2) With the tapered end of the check valve pointed in the direction of the system flow (Fig. 4), reconnect the engine compartment half of the washer supply hose to the barbed nipple of the front check valve.

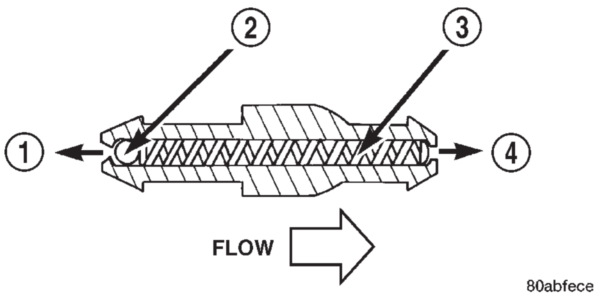

Fig. 4 Front Check Valve

1 - TO RESERVOIR
2 - CHECKBALL
3 - SPRING
4 - TO FRONT NOZZLE

(3) Reconnect the front washer nozzle half of the washer supply hose to the other barbed nipple of the front check valve.

(4) Check that the washer supply hoses are properly routed and are not pinched.

(5) Close and latch the hood.

FRONT WASHER HOSES/ TUBES

OPERATION

Washer fluid in the washer reservoir is pressurized and fed by the front washer pump/motor through the front washer system plumbing and fittings to the two front washer nozzles. Whenever routing the washer hose or a wire harness containing a washer hose, it must be routed away from hot, sharp, or moving parts; and, sharp bends that might pinch the hose must be avoided.

FRONT WASHER NOZZLE

DESCRIPTION

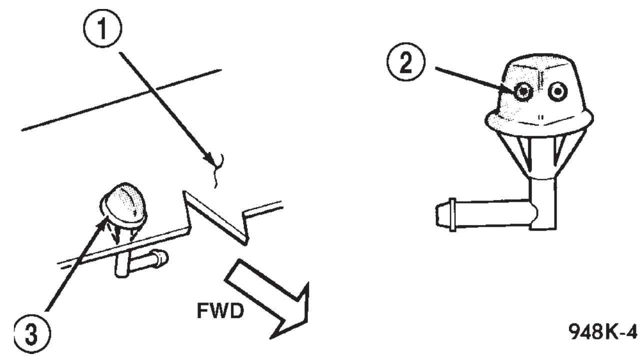

Fig. 5 Front Washer Nozzles

1 - HOOD PANEL
2 - ADJUST WITH A PIN
3 - FRONT WASHER NOZZLE

The two front washer nozzles are secured by integral snap features within two dedicated mounting holes near the rear of the hood panel (Fig. 5). The washer nozzles are constructed of molded plastic and each nozzle includes two small socket formations that each contains a small ball-shaped, adjustable stainless steel orifice. The forward facing nozzle hood and the two rearward facing orifices of the nozzle are visible on the outer surface of the hood panel. The washer plumbing fittings for the washer nozzles are concealed beneath the hood panel. The two washer nozzles each emit two streams of washer fluid into the wipe pattern. If the aim of the washer fluid streams is unacceptable, each stream can be adjusted using a pin inserted in the nozzle orifice to rotate the nozzle ball. The nozzles are accessed for service from the underside of the hood panel. The front washer nozzles cannot be repaired and, if faulty or damaged, they must be replaced.

FRONT WASHER NOZZLE (Continued)

OPERATION

The two front washer nozzles are designed to dispense washer fluid into the wiper pattern area on the outside of the windshield glass. Pressurized washer fluid is fed to each nozzle from the washer reservoir by the front washer pump/motor through a single hose, which is attached to a barbed nipple on each front washer nozzle below the hood panel. The each washer nozzle incorporates two adjustable orifices, which causes each nozzle to emit the pressurized washer fluid as two adjustable streams to more effectively cover a larger area of the glass area to be cleaned.

REMOVAL

(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 front washer nozzle (Fig. 6).

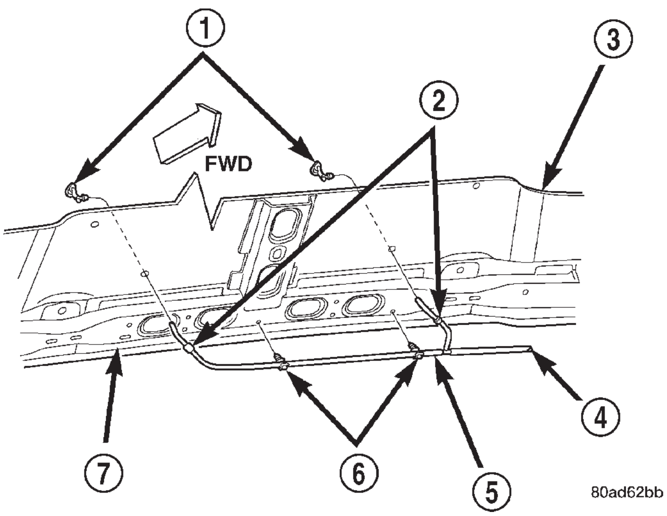

Fig. 6 Front Washer Nozzles Removal/Installation

1 - FRONT WASHER NOZZLE (2)
2 - FRONT CHECK VALVE (2)
3 - HOOD
4 - TO WASHER RESERVOIR
5 - WASHER HOSE
6 - CLIPS
7 - REAR HOOD REINFORCEMENT

(3) From under the rear of the hood, gently squeeze the snap features of the front washer nozzle and push the nozzle out through the mounting hole towards the outside of the hood panel.

(4) Remove the front washer nozzle from the top of the hood panel.

INSTALLATION

(1) Position the front washer nozzle into the mounting hole from the top of the hood panel. Be certain the two nozzle orifices are oriented towards the windshield.

(2) Using hand pressure, press the front washer nozzle firmly and evenly into the mounting hole from the top of the hood panel until the snap features of the nozzle are fully engaged.

(3) Open and support the hood.

(4) From under the rear of the hood, reconnect the washer supply hose to the barbed nipple of the front washer nozzle (Fig. 6).

(5) Close and latch the hood.

(6) Operate the front washer system and inspect the front washer nozzle spray pattern. Adjust the nozzle orifices as required. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS/FRONT WASHER NOZZLE - DESCRIPTION).

FRONT WASHER PUMP/ MOTOR

DESCRIPTION

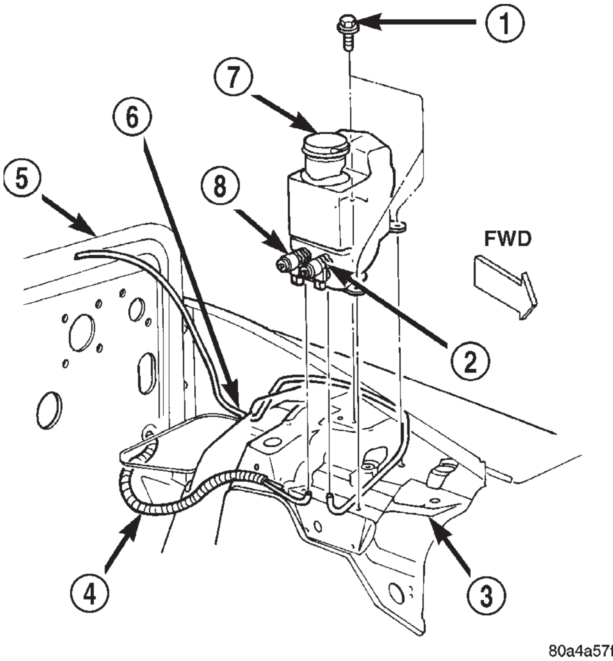

Fig. 7 Washer Reservoir

1 - SCREW (3)
2 - FRONT WASHER PUMP/MOTOR
3 - FRONT FENDER WHEEL HOUSE
4 - REAR WASHER HOSE
5 - DASH PANEL
6 - FRONT WASHER HOSE
7 - WASHER RESERVOIR
8 - REAR WASHER PUMP/MOTOR

The front washer pump/motor unit is located on the inboard side and near the front of the washer

FRONT WASHER PUMP/MOTOR (Continued)

reservoir, on the top of the left front fender wheel house in the engine compartment (Fig. 7). A small permanently lubricated and sealed electric motor is coupled to the rotor-type washer pump. A seal flange with a barbed nipple on the pump housing passes through a rubber grommet seal installed in one of two dedicated mounting holes near the bottom of the washer reservoir. The front washer pump/motor unit is always mounted in the forward pump mounting hole of the reservoir. The washer pump/motor unit is retained on the reservoir by the interference fit between the barbed pump nipple and the grommet seal, which is a light press fit. The front washer pump/motor unit cannot be repaired. If faulty or damaged, the entire washer pump/motor unit must be replaced.

OPERATION

The front washer pump/motor unit is connected to the vehicle electrical system through a single take out and two-cavity connector of the headlamp and dash wire harness. The washer pump/motor is grounded at all times through a take out of the headlamp and dash wire harness with a single eyelet terminal connector that is secured under a ground screw to the radiator closure panel behind the left headlamp in the engine compartment. The front washer pump/motor receives battery current through the closed contacts of the momentary front washer switch within the right multi-function switch only when the switch control stalk is pulled towards the steering wheel. Washer fluid is gravity-fed from the washer reservoir to the inlet side of the washer pump. When the pump motor is energized, the rotor-type pump pressurizes the washer fluid and forces it through the pump outlet nipple, the front washer plumbing, and the front washer nozzles onto the windshield glass.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the washer supply hose from the barbed outlet nipple of the front washer pump/motor unit and allow the washer fluid from the washer reservoir to drain into a clean container for reuse (Fig. 8).

(3) Disconnect the headlamp and dash wire harness connector for the front washer pump/motor from the washer pump/motor connector receptacle.

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the barbed inlet nipple of the front washer pump out of the rubber grommet seal in the washer reservoir. Care must be taken not to damage the washer reservoir.

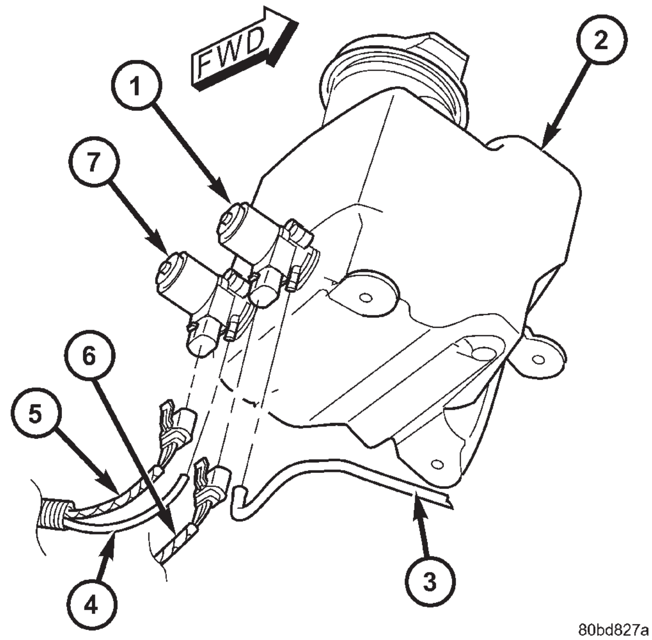

Fig. 8 Front Washer Pump/Motor Remove/Install

1 - FRONT WASHER PUMP/MOTOR
2 - WASHER RESERVOIR
3 - FRONT WASHER HOSE
4 - REAR WASHER HOSE
5 - REAR BODY WIRE HARNESS
6 - HEADLAMP & DASH WIRE HARNESS
7 - REAR WASHER PUMP/MOTOR

(5) Remove the front washer pump/motor unit from the washer reservoir.

(6) Remove the rubber grommet seal from the front washer pump/motor mounting hole in the washer reservoir and discard.

INSTALLATION

(1) Install a new rubber grommet seal into the front washer pump/motor mounting hole of the washer reservoir.

(2) Position the front washer pump/motor unit inlet nipple to the washer reservoir (Fig. 8).

(3) Using hand pressure, firmly and evenly press the barbed inlet nipple of the front washer pump/motor unit through the rubber grommet seal and into the washer reservoir. Care must be taken not to damage the washer reservoir.

(4) Reconnect the headlamp and dash wire harness connector for the front washer pump/motor to the washer pump/motor connector receptacle.

(5) Reconnect the washer supply hose to the barbed outlet nipple of the front washer pump/motor unit.

FRONT WASHER PUMP/MOTOR (Continued)

(6) Refill the washer reservoir with the washer fluid drained from the reservoir during the removal procedure.

(7) Reconnect the battery negative cable.

FRONT WIPER ARM

DESCRIPTION

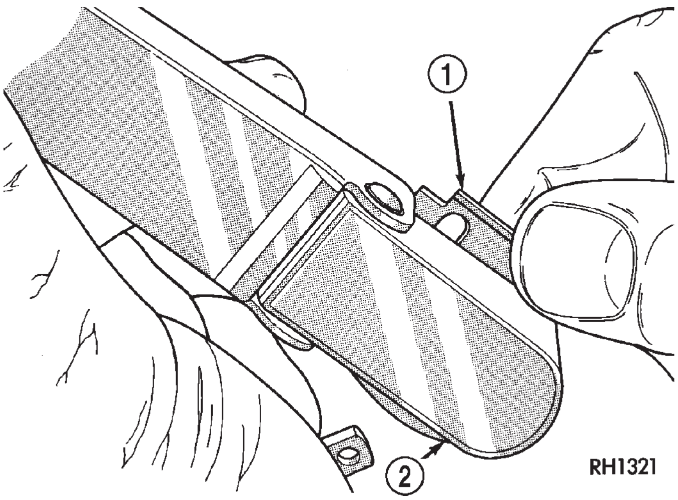

Fig. 9 Wiper Arm

1 - LOCKING LATCH
2 - ARM

The front wiper arms are the rigid members located between the wiper pivots that protrude from the cowl plenum cover/grille panel near the base of the windshield and the wiper blades on the windshield glass. The wiper arm has a die cast metal pivot end (Fig. 9). On the underside of this pivot end is a socket formation with internal serrations and a small, movable, stamped steel latch plate that is secured loosely under a small strap that is staked to the pivot end. The wide end of a tapered, stamped steel channel is secured with a hinge pin to the pivot end of the wiper arm. One end of a long, rigid, stamped steel strap, with a small hole near its pivot end, is riveted and crimped within the narrow end of the stamped steel channel. The tip of the wiper blade end of this strap is bent back under itself to form a small hook. Concealed within the stamped steel channel, one end of a long spring is hooked through a hole in a small stamped steel strap on the hinge pin within the die cast pivot end, while the other end of the spring is hooked through the small hole in the steel strap. The entire wiper arm has a satin black finish applied to all of its visible surfaces.

A wiper arm cannot be adjusted or repaired. If damaged or faulty, the entire wiper arm unit must be replaced.

OPERATION

The front wiper arms are designed to mechanically transmit the motion from the wiper pivots to the wiper blades. The wiper arm must be properly indexed to the wiper pivot in order to maintain the proper wiper blade travel on the glass. The socket formation with internal serrations in the wiper arm pivot end interlocks with the serrations on the outer circumference of the wiper pivot driver, allowing positive engagement and finite adjustment of this connection. The latch plate on the underside of the wiper arm pivot end locks the wiper arm to the wiper pivot when in its installed position and, when in its unlocked position, also serves as a blocker to hold the spring-loaded wiper arm off of the glass to facilitate removal and installation. The spring-loaded wiper arm hinge controls the down-force applied through the tip of the wiper arm to the wiper blade on the glass. The hook formation on the tip of the wiper arm provides a cradle for securing and latching the wiper blade pivot block to the wiper arm.

REMOVAL

(1) Lift the front wiper arm far enough to raise the wiper blade off of the glass and permit the wiper arm latch plate to be pulled out to its holding position, then release the arm (Fig. 10). The wiper arm and blade will remain off the glass with the latch in this position.

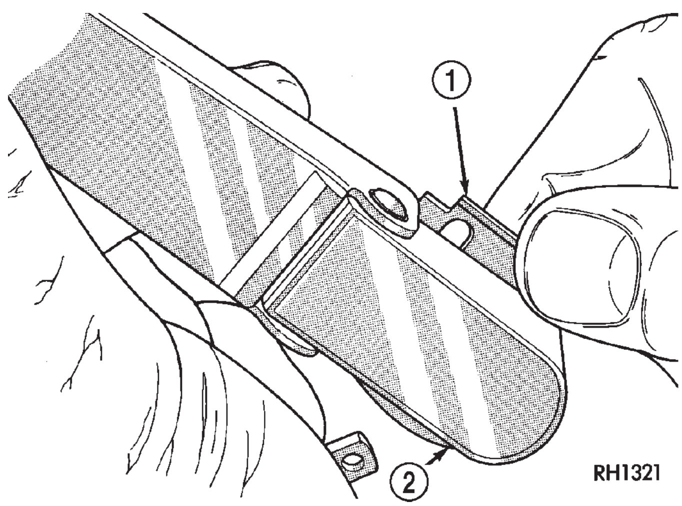

Fig. 10 Front Wiper Arm Remove/Install

1 - LOCKING LATCH
2 - 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 wiper pivot during wiper operation, regardless of how carefully it is reinstalled.

FRONT WIPER ARM (Continued)

(2) Using a slight rocking motion, remove the front wiper arm pivot end from the wiper pivot.

INSTALLATION

NOTE: Be certain that the wiper motor is in the park position before attempting to install the wiper arms. Turn the ignition switch to the On position and move the right multi-function switch control stalk to its Off position. If the wiper pivots move, wait until they stop moving, then turn the ignition switch back to the Off position. The wiper motor is now in its park position.

(1) The front wiper arms must be indexed to the wiper pivots with the wiper motor in the park position to be properly installed (Fig. 11). Position the front wiper arm pivot ends onto the wiper pivots so that the tip of the wiper blade is on the upper edge of the lower windshield blackout area, + 15 millimeters/– 0 millimeter (+ 0.59 inch/– 0 inch).

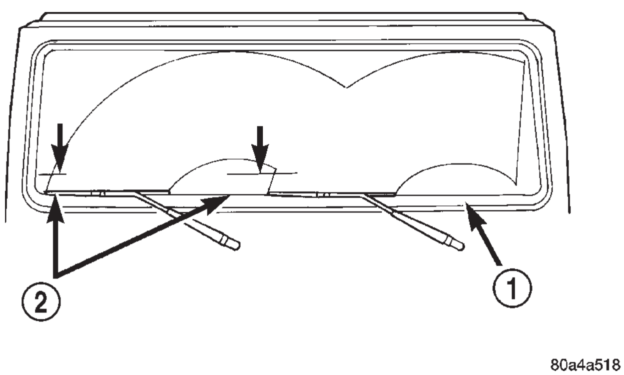

Fig. 11 Front Wiper Arm Installation

1 - WINDSHIELD BLACKOUT AREA
2 - PARK BLADE ON UPPER EDGE OF BLACKOUT AREA +15 mm – 0 mm (+0.59 in. – 0 in.)

(2) Once the wiper arm is indexed to the wiper pivot, lift the wiper arm away from the windshield slightly to relieve the spring tension on the latch plate, then push the latch plate into the locked position (Fig. 10). Gently lower the wiper arm until the wiper blade rests on the glass.

(3) Wet the windshield glass, then operate the front wipers. Turn the wiper switch to the Off position, then check for the correct wiper arm position and adjust as required.

FRONT WIPER BLADE

DESCRIPTION

Each front wiper blade is secured by an integral latching pivot block to the hook formation on the tip of the front wiper arms, and rests on the glass near the base of the windshield when the wipers are not in operation (Fig. 12). The wiper blade consists of the following components:

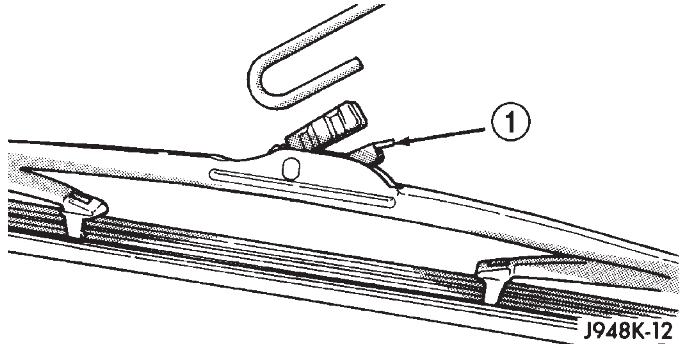

Fig. 12 Wiper Blade - Typical

1 - RELEASE TAB

- **Superstructure -** The superstructure includes several stamped steel bridges and links with claw formations that grip the wiper blade element. Also included in this unit is the latching, molded plastic pivot block that secures the superstructure to the wiper arm. All of the metal components of the wiper blade have a satin black finish applied.
- **Element -** The wiper element or squeegee is the resilient rubber member of the wiper blade that contacts the glass.
- **Flexor -** The flexor is a rigid metal component running along the length of each side of the wiper element where it is gripped by the claws of the superstructure.

All Wrangler models have two 33-centimeter (13-inch) front wiper blades with non-replaceable elements (squeegees). The wiper blades cannot be adjusted or repaired. If faulty, worn, or damaged the entire wiper blade unit must be replaced.

OPERATION

The wiper blade is moved back and forth across the glass by the wiper arms when the wipers are being operated. The wiper blade superstructure is the flexible frame that grips the wiper blade element and evenly distributes the force of the spring-loaded wiper arm along the length of the element. The combination of the wiper arm force and the flexibility of the superstructure makes the element conform to and maintain proper contact with the glass, even as the blade is moved over the varied curvature found across the glass surface. The wiper element flexor provides the claws of the blade superstructure with a rigid, yet flexible component on the element which can be gripped. The rubber element is designed to be stiff enough to maintain an even cleaning edge as it is drawn across the glass, but resilient enough to conform to the glass surface and flip from one cleaning edge to the other each time the wiper blade changes directions.

FRONT WIPER BLADE (Continued)

REMOVAL

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 front wiper arm to raise the wiper blade and element off of the glass.

(2) To remove the wiper blade from the wiper arm, push the pivot block latch release tab under the tip of the arm and slide the blade away from the tip towards the pivot end of the arm far enough to disengage the pivot block from the hook (Fig. 13).

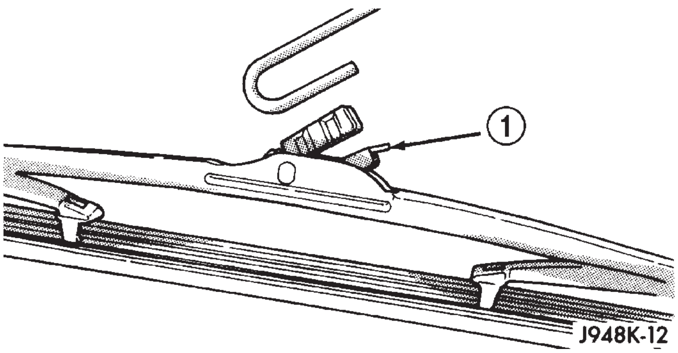

Fig. 13 Wiper Blade Remove/Install - Typical

1 - RELEASE TAB

(3) Extract the hook formation on the tip of the wiper arm from the opening in the wiper blade superstructure ahead of the wiper blade pivot block/latch unit.

CAUTION: Do not allow the wiper arm to spring back against the glass without the wiper blade in place or the glass may be damaged.

(4) Gently lower the wiper arm tip onto the glass.

INSTALLATION

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 front wiper arm off of the windshield glass.

(2) Position the front wiper blade near the hook formation on the tip of the arm with the notched retainer for the wiper element oriented towards the end of the wiper arm that is nearest to the wiper pivot.

(3) Insert the hook formation on the tip of the wiper arm through the opening in the wiper blade superstructure ahead of the wiper blade pivot block/latch unit far enough to engage the pivot block with the hook (Fig. 13).

(4) Slide the wiper blade pivot block/latch up into the hook formation on the tip of the wiper arm until the latch release tab snaps into its locked position.

(5) Gently lower the wiper blade onto the glass.

FRONT WIPER MODULE

DESCRIPTION

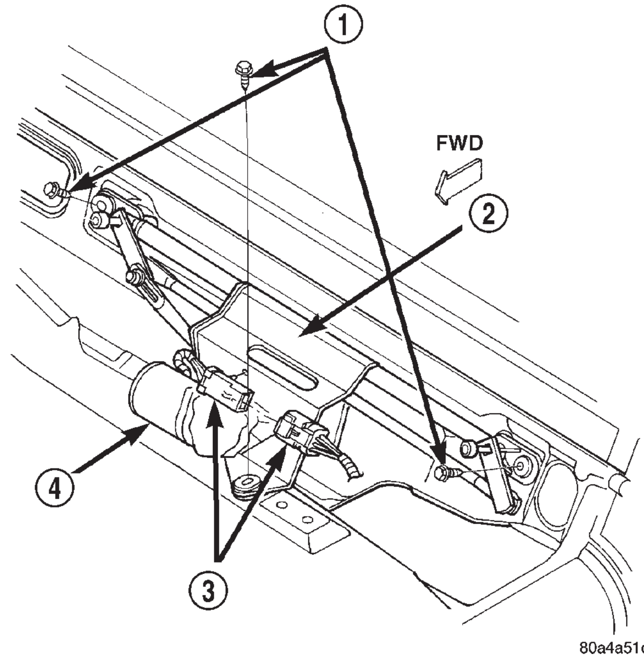

Fig. 14 Front Wiper Module

1 - SCREW (3)
2 - MODULE BRACKET
3 - WIRE HARNESS CONNECTOR
4 - WIPER MOTOR

The front wiper module is secured with screws to the cowl top panel and concealed within the cowl plenum area beneath the cowl plenum cover/grille panel (Fig. 14). The ends of the wiper pivot shafts that protrude through dedicated openings in the cowl plenum cover/grille panel to drive the wiper arms and blades are the only visible components of the front wiper module. The front wiper module consists of the following major components:

- **Bracket -** The front wiper module bracket consists of a long tubular steel main member that has a stamped pivot bracket formation near each end where the two wiper pivots are secured. A stamped steel mounting plate for the wiper motor is secured with welds near the center of the main member. The bracket includes metal-sleeved rubber isolators at each of the three bracket mounting points.
- **Crank Arm -** The front wiper motor crank arm is a stamped steel unit with a slotted hole on the

FRONT WIPER MODULE (Continued)

driven end that is secured to the wiper motor output shaft with a nut, and has a ball stud secured to the drive end.

- **Linkage** - The two front wiper linkage members are each constructed of stamped steel. A connecting link with a plastic socket-type bushing in each end is fit over the pivot ball studs to join the two pivots. The wiper drive link has a plastic socket-type bushing on each end. One end of the drive link is snap-fit over a second ball stud on the passenger side pivot crank arm, while the other end is snap-fit over the ball stud on the wiper motor crank arm.
- **Motor** - The front wiper motor is secured with three screws to the motor mounting plate near the center of the wiper module bracket 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. The two-speed permanent magnet wiper motor features an integral transmission, an internal park switch, and an internal automatic resetting circuit breaker.
- **Pivots** - The two front wiper pivots are secured to the ends of the wiper module bracket. A crank arm extends from the lower end of each pivot shaft. The driver side pivot crank arm has a single ball stud secured to it, while the passenger side crank arm has two ball studs. The upper end of each pivot shaft where the wiper arms will be fastened each has an externally serrated drum secured to it.

The front wiper module for this model is serviced only as a complete unit. If any linkage component or the mounting bracket of the module is faulty or damaged, the entire front wiper module unit must be replaced. The front wiper motor and boot unit is available for service replacement and may be disassembled from the front wiper module.

OPERATION

The front wiper module operation is controlled by the vehicle operator through battery current inputs received by the wiper motor from the right multi-function switch on the steering column. The wiper motor is connected to the vehicle electrical system through a dedicated take out and wire harness connector of the cross body wire harness. The wiper motor speed is controlled by current flow to either the low speed or the high speed set of brushes. The park switch is a single pole, single throw, momentary switch within the wiper motor that is mechanically actuated by the wiper motor transmission components. The park switch alternately closes the wiper park switch sense circuit to ground or to battery current, depending upon the position of the wipers on the glass. This feature allows the motor to complete its current wipe cycle after the wiper system has been turned Off, and to park the wiper blades in the lowest portion of the wipe pattern. The automatic resetting circuit breaker protects the motor from overloads. The wiper motor crank arm, the two wiper linkage members, and the two wiper pivots mechanically convert the rotary output of the wiper motor to the back and forth wiping motion of the wiper arms and blades on the glass.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the front wiper arms from the wiper pivots. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS/FRONT WIPER ARMS - REMOVAL).

(3) Remove the cowl plenum cover/grille panel from the cowl top panel. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE AND SCREEN - REMOVAL).

(4) Reach into the cowl plenum to access and disconnect the cross body wire harness connector for the front wiper motor from the front wiper motor pigtail wire connector (Fig. 15).

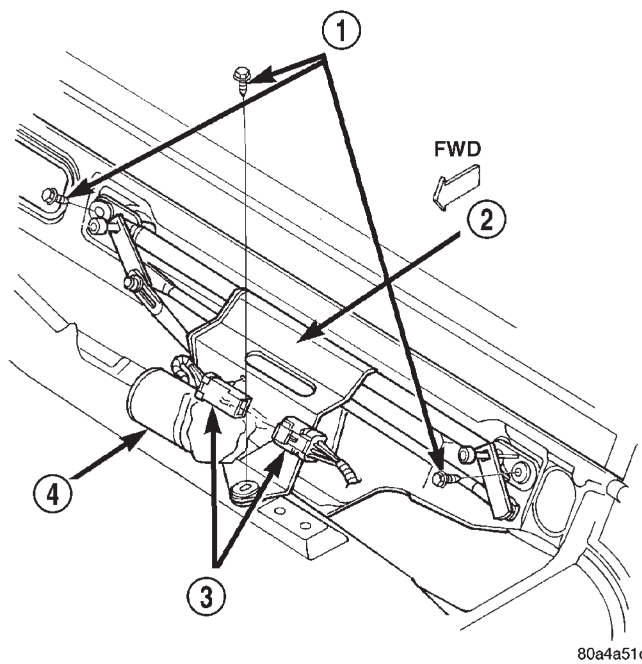

Fig. 15 Front Wiper Module Remove/Install

1 - SCREW (3)
2 - MODULE BRACKET
3 - WIRE HARNESS CONNECTOR
4 - WIPER MOTOR

(5) Remove the three screws that secure the front wiper module mounting bracket to the cowl plenum panel.

(6) Remove the front wiper module from the cowl plenum as a unit.

FRONT WIPER MODULE (Continued)

DISASSEMBLY

The front wiper motor and its rubber boot are available for service replacement. Following are the procedures for disassembling these components from the front wiper module unit.

(1) Remove the front wiper module from the cowl plenum. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS/FRONT WIPER MODULE - REMOVAL).

(2) Release the retainer that secures the wiper motor pigtail wire connector to the front wiper module bracket.

(3) Turn the front wiper module over and remove the nut that secures the wiper motor crank arm to the wiper motor output shaft.

(4) Remove the three screws that secure the wiper motor to the front wiper module mounting bracket.

(5) Remove the wiper motor from the front wiper module bracket.

ASSEMBLY

The front wiper motor and its rubber boot are available for service replacement. Following are the procedures for reassembling these components onto the front wiper module unit.

(1) Position the wiper motor onto the front wiper module bracket.

(2) Install and tighten the three screws that secure the wiper motor to the front wiper module bracket. Tighten the screws to 8 N·m (70 in. lbs.).

(3) Position the wiper motor crank arm onto the front wiper motor output shaft.

(4) Install and tighten the nut that secures the wiper motor crank arm to the front wiper motor output shaft. Tighten the nut to 12 N·m (101 in. lbs.).

(5) Engage the wiper motor pigtail wire connector retainer in the locating hole on the front wiper module bracket.

(6) Reinstall the front wiper module into the cowl plenum. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS/FRONT WIPER MODULE - INSTALLATION).

INSTALLATION

(1) Position the front wiper module into the cowl plenum as a unit (Fig. 15).

(2) Install and tighten the three screws that secure the front wiper module mounting bracket to the cowl plenum panel. Tighten the screws to 6 N·m (50 in. lbs.).

(3) Reach into the cowl plenum to access and reconnect the cross body wire harness connector for the front wiper motor to the front wiper motor pigtail wire connector.

(4) Reinstall the cowl plenum cover/grille panel onto the cowl top panel. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE AND SCREEN - INSTALLATION).

(5) Reinstall the front wiper arms onto the wiper pivots. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS/FRONT WIPER ARMS - INSTALLATION).

(6) Reconnect the battery negative cable.

RIGHT MULTI-FUNCTION SWITCH

DESCRIPTION

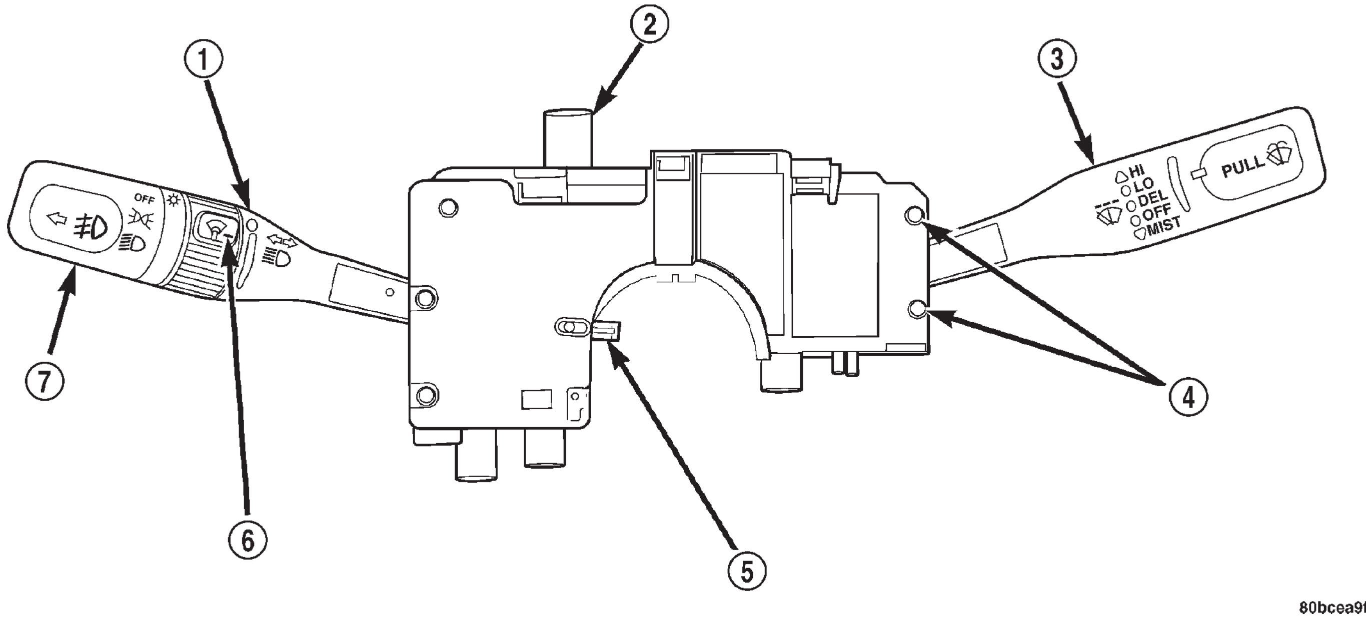

Fig. 16 Multi-Function Switch

1 - LEFT MULTI-FUNCTION SWITCH CONTROL STALK
2 - HAZARD WARNING SWITCH BUTTON
3 - RIGHT MULTI-FUNCTION SWITCH CONTROL STALK
4 - SCREW (2)
5 - TURN SIGNAL CANCEL ACTUATOR
6 - LEFT MULTI-FUNCTION SWITCH CONTROL RING
7 - LEFT MULTI-FUNCTION SWITCH CONTROL KNOB

The right multi-function switch is mounted on the right side of the steering column (Fig. 16). The only visible part of the right multi-function switch is the control stalk that extends from the right side of the steering column just below the steering wheel. The right multi-function switch control stalk has both nomenclature and international control and display symbols on it, which identify its many functions. On the end of the control stalk is a plastic knob with a rounded end and a flattened face to allow it to be easily rotated. The remainder of the right multi-function switch is concealed beneath the steering column shrouds. The switch housing and its control stalk are constructed of molded black plastic. A single connector receptacle containing six terminal pins is located on the back of the switch housing and connects the switch to the vehicle electrical system through a take out and connector of the cross body wire harness. The switch is secured to the left multi-function switch mounting housing by two screws. The right multi-function switch is the primary control for the front wiper and washer system, and contains switches, circuitry, an intermittent wipe logic circuit, and an internal wiper motor relay to provide the following features:

- **Continuous Wipe Modes** - The internal circuitry of the right multi-function switch provides two continuous wipe cycles, low speed or high speed.
- **Intermittent Wipe Mode** - The internal circuitry of the right multi-function switch provides an intermittent wipe mode with adjustable delay intervals between wipe cycles of about one second to about fifteen seconds.
- **Mist Mode** - The internal circuitry of the right multi-function switch provides a mist mode that operates the front wipers for as long as the momentary switch is closed, and parks the front wipers following completion of the current wipe cycle when the switch is opened.
- **Washer Mode** - When the front washer system is activated with the right multi-function switch while the front wiper system is operating, washer fluid will be dispensed onto the windshield glass through the washer nozzles for as long as the front washer pump is energized.
- **Wipe-After-Wash Mode** - The internal circuitry of the right multi-function switch provides a wipe-af-

RIGHT MULTI-FUNCTION SWITCH (Continued)

ter-wash feature which, if the front wipers are turned Off, will operate the front washer pump/motor and the front wipers for as long as the washer system is activated, then provide one or two additional wipe cycles after the washer system is deactivated before parking the front wiper blades near the base of the windshield.

The right multi-function switch cannot be adjusted or repaired. If any function of the switch is faulty, or if the switch is damaged, the entire switch unit must be replaced.

OPERATION

Moving the control stalk of the right multi-function switch up or down to one of four detent positions actuates the triple pole, quadruple throw front wiper switch and selects the Off, Low, High, or Delay front wiper operating mode. Moving the control stalk downward from the Off position actuates a momentary single pole, single throw switch that selects the Mist operating mode. Pulling the control stalk towards the steering wheel actuates the momentary single pole, single throw front washer switch and operates the front washer pump/motor. Rotating the control knob on the end of the control stalk actuates the front wiper delay variable resistor and selects the wiper delay interval when the Delay mode is selected with the front wiper switch control stalk. The intermittent wipe logic circuit within the right multi-function switch monitors inputs from the front wiper switch, the front washer switch, the front wiper delay variable resistor, and the front wiper motor park switch. The programming of the logic circuit then determines the proper outputs to the front wiper motor. The low current logic circuit controls the high current front wiper motor by pulling the control coil of the integral wiper motor relay to ground. The wiper motor relay switches a circuit that feeds battery current to the low speed brush of the front wiper motor.

When the ignition switch is in the Accessory or On positions, battery current from a fuse in the Power Distribution Center (PDC) is provided to the wiper and washer system fuse in the fuse block. This fuse provides battery current through a fused ignition switch output (run-acc) circuit to the right multi-function switch. The electronic intermittent wipe logic circuit receives a logic ground through the cross body harness from a take out with an eyelet terminal connector located under a ground screw on the left inner cowl side panel, below the left end of the instrument panel. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the right multi-function switch.

DIAGNOSIS AND TESTING - RIGHT MULTI-FUNCTION SWITCH

Be certain to perform the diagnosis for the front wiper system and/or front washer system before testing the right multi-function switch. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - DIAGNOSIS AND TESTING). Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the right multi-function switch from the steering column and disconnect the cross body wire harness connector for the switch from the switch connector receptacle.

RIGHT MULTI-FUNCTION SWITCH (Continued)

(3) Using an ohmmeter, check the right multi-function switch continuity at the switch terminals (Fig. 17).

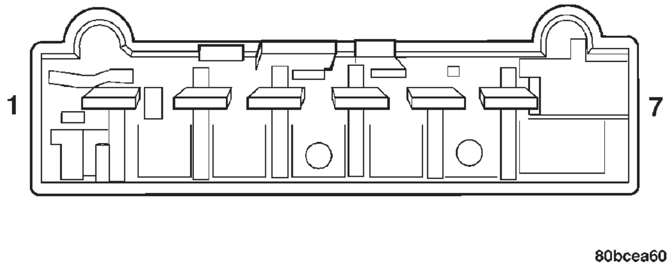

Fig. 17 Right Multi-Function Switch Connector Receptacle

SWITCH POSITION	CONTINUITY BETWEEN PINS
OFF	1 & 6
*LOW	4 & 6
*MIST	4 & 6
HIGH	4 & 5
WASH	3 & 4
*DELAY	1 & 6
*The intermittent wipe logic circuit within the right multi-function switch contains active electronic elements, which cannot be tested using conventional diagnostic tools. In addition, the function of the normally open contacts of the wiper relay internal to the switch cannot be tested properly unless the switch is connected to battery current (Pin 4) and ground (Pin 2). If all circuits and functions of the front wiper system and the right multi-function switch are operative except for the intermittent wipe, wipe-after-wash feature, and/or the front wipers will not park, replace the right multi-function switch with a known good unit and test system operation again.	

(4) If the switch fails any of the continuity checks, replace the faulty right multi-function switch. If the switch is OK, repair the open or shorted front wiper and washer system circuits between the right multi-function switch and the front wiper motor or the front washer pump/motor as required.

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the two screws that secure the lower steering column shroud to the upper shroud (Fig. 18).

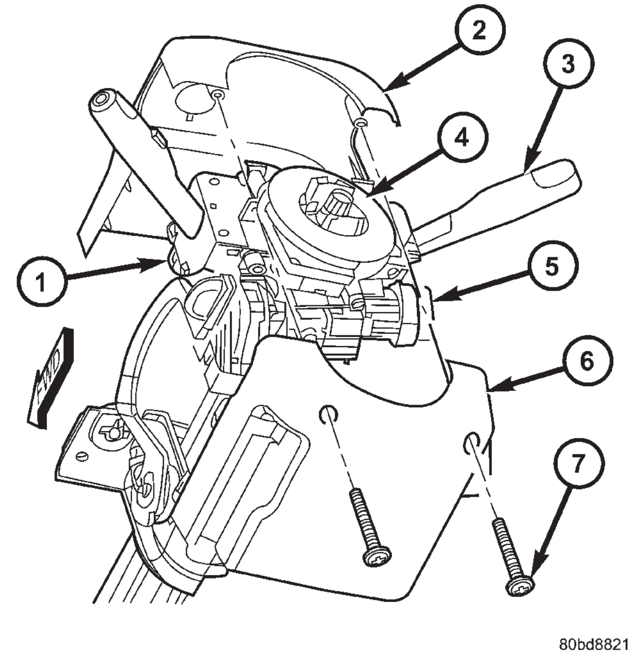


Fig. 18 Steering Column Shrouds Remove/Install

1 - LEFT MULTI-FUNCTION SWITCH
2 - UPPER SHROUD
3 - RIGHT MULTI-FUNCTION SWITCH
4 - CLOCKSPRING
5 - IGNITION LOCK CYLINDER HOUSING
6 - LOWER SHROUD
7 - SCREW (2)

(4) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully lowered position and leave the tilt release lever in the released (down) position.

(5) Remove both the upper and lower shrouds from the steering column.

(6) Disconnect the cross body wire harness connector for the left multi-function switch from the connector receptacle on the back of the switch.

(7) Disconnect the cross body wire harness connector for the right multi-function switch from the connector receptacle on the back of the switch.

RIGHT MULTI-FUNCTION SWITCH (Continued)

(8) Remove the two screws that secure the multi-function switch assembly to the upper steering column housing (Fig. 19).

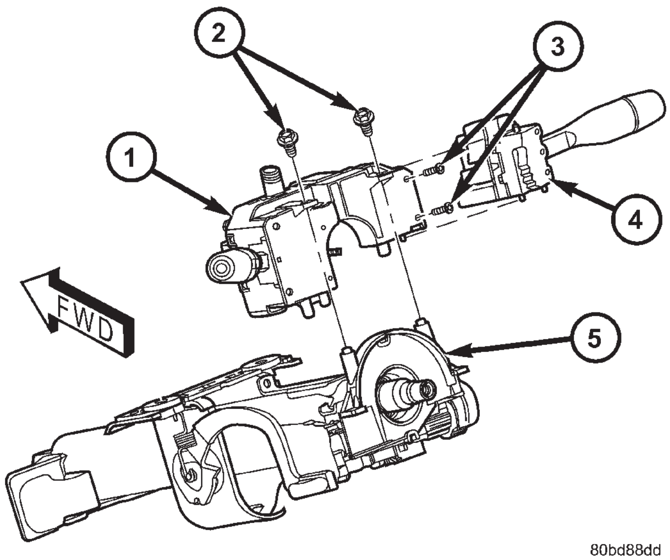


Fig. 19 Multi-Function Switch Remove/Install

1 - LEFT MULTI-FUNCTION SWITCH
2 - SCREW (2)
3 - SCREW (2)
4 - RIGHT MULTI-FUNCTION SWITCH
5 - UPPER STEERING COLUMN HOUSING

(9) Remove the multi-function switch assembly from the upper steering column housing.

(10) Remove the two small screws that secure the right multi-function switch to the left multi-function switch mounting housing.

(11) Grasp the right multi-function switch control stalk firmly and pull the switch toward the right far enough to disengage the alignment pins on the top (1) and bottom (2) of the right switch housing from the alignment ramps on the left multi-function switch mounting housing.

(12) Remove the right multi-function switch from the left multi-function switch.

INSTALLATION

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.

(1) Position the right multi-function switch to the left multi-function switch.

(2) Grasp the right multi-function switch control stalk firmly and slide the switch toward the left far enough to engage the alignment pins on the top (1) and bottom (2) of the right switch housing into the alignment ramps on the left multi-function switch mounting housing.

(3) Install and tighten the two small screws that secure the right multi-function switch to the left multi-function switch mounting housing (Fig. 19). Tighten the screws to 2 N·m (20 in. lbs.).

(4) Position the multi-function switch assembly onto the upper steering column housing.

(5) Install and tighten the two screws that secure the multi-function switch assembly to the upper steering column housing. Tighten the screws to 2 N·m (20 in. lbs.).

(6) Reconnect the cross body wire harness connector for the right multi-function switch to the connector receptacle on the back of the switch.

(7) Reconnect the cross body wire harness connector for the left multi-function switch to the connector receptacle on the back of the switch.

(8) Position both the upper and lower shrouds onto the steering column (Fig. 20). Be certain that the locating tabs for the left and right multi-function switch control stalk watershields are properly engaged in the openings of both the upper and lower shrouds.

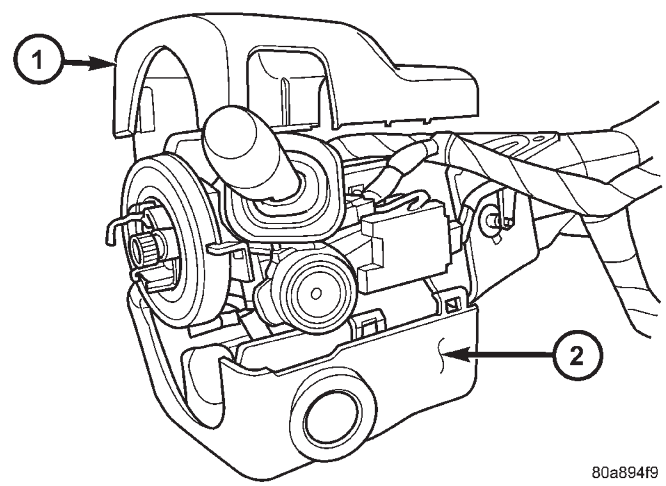


Fig. 20 Shroud Remove/Install

1 - UPPER SHROUD
2 - LOWER SHROUD

(9) Install and tighten the two screws that secure the lower steering column shroud to the upper shroud. Tighten the screws to 2 N·m (18 in. lbs.).

RIGHT MULTI-FUNCTION SWITCH (Continued)

(10) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully raised position and secure it in place by moving the tilt release lever back to the locked (up) position.

(11) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(12) Reconnect the battery negative cable.

WASHER RESERVOIR

DESCRIPTION

A single washer fluid reservoir is used for both the standard front and optional rear washer systems (Fig. 21). The molded plastic washer reservoir is secured to the left front fender wheel house in the engine compartment. A bright yellow plastic filler cap with an International Control and Display Symbol icon for "Windshield Washer" and the text "Washer Fluid Only" molded into it and a rubber gasket snaps over the open end of the filler neck. The cap hinges on a hinge molded into the cap and is secured to the reservoir by a hook molded into the top of the reservoir behind the filler neck.

There are separate, dedicated holes on the lower inboard side of the reservoir provided for the mounting of the front and rear washer/pump motor units. On models not equipped with the optional rear washer system, the rear washer pump/motor mounting hole in the washer reservoir is sealed with a plastic plug. The washer reservoir is secured to the left front fender wheel house by three screws installed through three mounting tabs that are integral to the reservoir.

The washer reservoir cannot be repaired and, if faulty or damaged, it must be replaced. The reservoir filler cap is available for service replacement.

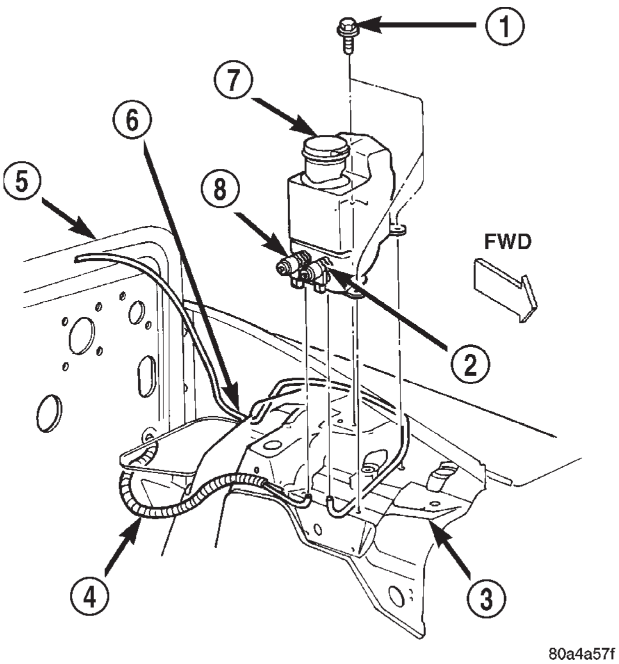


Fig. 21 Washer Reservoir

1 - SCREW (3)
2 - FRONT WASHER PUMP/MOTOR
3 - FRONT FENDER WHEEL HOUSE
4 - REAR WASHER HOSE
5 - DASH PANEL
6 - FRONT WASHER HOSE
7 - WASHER RESERVOIR
8 - REAR WASHER PUMP/MOTOR

OPERATION

The washer fluid reservoir provides a secure, on-vehicle storage location for a large reserve of washer fluid for operation of the standard front and optional rear washer systems. The washer reservoir filler cap provides a clearly marked and readily accessible point from which to add washer fluid to the reservoir. The front and rear washer/pump motor units are located in a sump area on the inboard side of the reservoir to be certain that washer fluid will be available to the pumps as the fluid level in the reservoir becomes depleted. The front washer pump/motor unit is mounted in the lowest position in the sump so that the front washers will operate even after the rear washer system will no longer operate.

WASHER RESERVOIR (Continued)

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the three screws that secure the washer reservoir to the left front fender wheel house (Fig. 22).

(3) Lift the reservoir far enough to access the washer pump/motor(s).

(4) Disconnect the washer supply hose(s) from the barbed outlet nipple(s) of the washer pump/motor unit(s) and allow the washer fluid from the washer reservoir to drain into a clean container for reuse.

(5) Disconnect the headlamp and dash wire harness connector for the front washer pump/motor from the connector receptacle on the motor.

(6) If the vehicle is so equipped, disconnect the rear body wire harness connector for the rear washer pump/motor from the connector receptacle on the motor.

(7) Remove the washer reservoir from the engine compartment.

INSTALLATION

(1) Position the washer reservoir into the engine compartment (Fig. 22).

(2) If the vehicle is so equipped, reconnect the rear body wire harness connector for the rear washer pump/motor to the connector receptacle on the motor.

(3) Reconnect the headlamp and dash wire harness connector for the front washer pump/motor to the connector receptacle on the motor.

(4) Reconnect the washer supply hose(s) to the barbed outlet nipple(s) of the washer pump/motor unit(s).

(5) Position the washer reservoir onto the left front fender wheel house.

(6) Install and tighten the three screws that secure the washer reservoir to the left front fender wheel house. Tighten the screws to 4 N·m (35 in. lbs.).

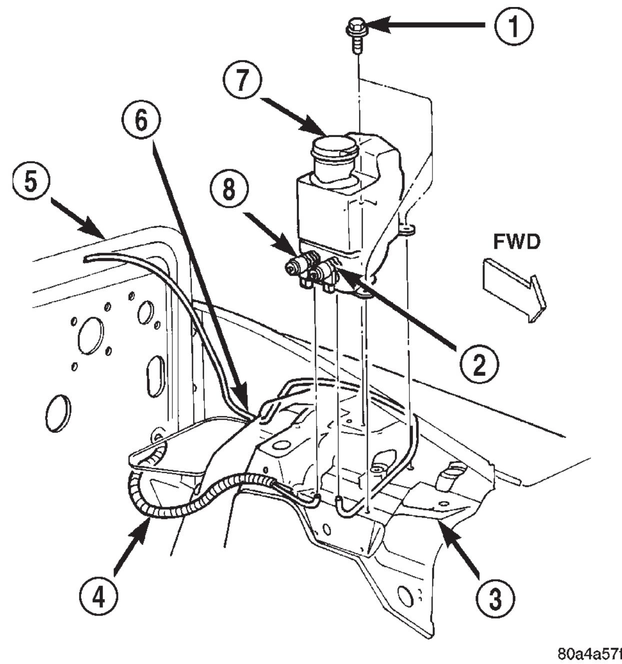


Fig. 22 Washer Reservoir Remove/Install

1 - SCREW (3)
2 - FRONT WASHER PUMP/MOTOR
3 - FRONT FENDER WHEEL HOUSE
4 - REAR WASHER HOSE
5 - DASH PANEL
6 - FRONT WASHER HOSE
7 - WASHER RESERVOIR
8 - REAR WASHER PUMP/MOTOR

(7) Refill the washer reservoir with clean washer fluid.

(8) Reconnect the battery negative cable.

REAR WIPERS/WASHERS

TABLE OF CONTENTS

REAR WIPERS/WASHERS

DESCRIPTION

An electrically operated fixed interval rear wiper and washer system is optional factory-installed equipment on this model when it is also equipped with the optional hardtop roof. The rear wiper and washer system includes the following major components, which are described in further detail elsewhere in this service information:

- **Rear Washer Nozzle** - The rear washer nozzle is secured by a plastic hex nut in a hole in the rear liftglass near the rear wiper motor output shaft. The remainder of the rear washer system plumbing, including a check valve and a cap, are concealed within and routed through the interior of the vehicle.
- **Rear Washer Pump/Motor** - The rear washer pump/motor unit is located in a dedicated hole on the lower inboard side of the washer reservoir, on the top of the left front fender wheel house in the engine compartment. The optional rear washer pump is located behind the standard front washer pump mounting hole.
- **Rear Wiper and Washer Switch** - The rear wiper and washer switch is secured to the accessory switch bezel near the bottom of the instrument panel center stack area on the instrument panel. Only the switch rocker button is visible through the lower opening of the instrument panel center bezel, the remainder of the switch is concealed behind the accessory switch bezel within the instrument panel. The rear wiper and washer switch contains switches to control both the rear wiper and washer system.
- **Rear Wiper Arm** - The single rear wiper arm is secured by an integral latch directly to the rear wiper motor output shaft, which extends through a hole in the liftglass near the upper right liftglass hinge.
- **Rear Wiper Blade** - The single rear wiper blade is secured to the rear wiper arm, and is parked near the top of the liftglass when the rear wiper system is not in operation.
- **Rear Wiper Motor** - The rear wiper motor output shaft is the only visible component of the rear

REAR WIPERS/WASHERS (Continued)

wiper motor. The remainder of the motor is concealed behind a plastic trim cover near the upper right liftglass hinge within the passenger compartment of the vehicle. The rear wiper motor includes the motor bracket, the rear wiper motor, an internal automatic resetting circuit breaker, a diode, and the rear wiper motor park switch.

- **Washer Reservoir** - The rear washer system shares a single reservoir with the front washer system, but has its own dedicated washer pump/motor and plumbing. The reservoir is secured to the top of the left front fender wheel house within the engine compartment of the vehicle.

Features of the rear wiper and washer system include the following:

- **Washer Mode** - The rear wiper and washer switch rocker must first be moved to the Wipe detent in order to access the momentary Wash position and operate the rear washer system. When the Wash position is selected, washer fluid will be dispensed from the washer reservoir onto the liftgate glass through the rear washer nozzle and the rear wiper will operate in a fixed cycle for as long as the rear washer pump/motor remains energized. The rear wiper and washer switch rocker must be manually moved to the Off position following rear washer operation to turn the rear wiper system off.
- **Wiper Mode** - When the rear wiper and washer switch rocker is moved to the Wipe position, the rear wiper will be operated in a fixed interval wipe mode until the switch is moved to the Off position. When the Off position is selected, the rear wiper motor will continue to operate until the current wipe cycle is complete, then park the wiper blade near the top of the liftglass.

Hard wired circuitry connects the rear wiper and washer system components to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the rear wiper and washer system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

OPERATION

The rear wiper and washer system is intended to provide the vehicle operator with a convenient, safe, and reliable means of maintaining visibility through the liftglass. The various components of this system are designed to convert electrical energy produced by the vehicle electrical system into the mechanical action of the wiper blade to wipe the outside surface of the glass, as well as into the hydraulic action of the washer system to apply washer fluid stored in an on-board reservoir to the area of the glass to be wiped. When combined, these components provide the means to effectively maintain clear visibility for the vehicle operator by removing excess accumulations of rain, snow, bugs, mud, or other minor debris that might be encountered while driving the vehicle under numerous types of inclement operating conditions from the outside liftglass surface. The vehicle operator initiates all rear wiper and washer system functions with the rear wiper and washer switch located in the instrument panel accessory switch bezel, just below the heater and air conditioner controls. Moving the switch rocker downward to a detent position selects the rear wiper system fixed cycle operating mode. Moving the switch rocker downward to the momentary position past the wipe mode detent activates the rear washer pump/motor, which dispenses washer fluid onto the liftglass through the rear washer nozzle and operates the rear wiper system in the fixed cycle mode for as long as the washer switch is closed.

When the ignition switch is in the On position, battery current from a fuse in the Power Distribution Center (PDC) is provided to the rear wiper and washer system fuse in the fuse block. This fuse provides battery current through a fused ignition switch output (run) circuit to the rear wiper and washer switch, and to one fixed contact of the rear wiper motor park switch. When the rear wiper and washer switch Wipe mode is selected, the Wipe position circuitry within the switch directs battery current through the rear wiper motor control circuit to the rear wiper motor, which causes the rear wiper motor to run at a fixed cycle. When the rear wiper and washer switch Wash mode is selected, the Wash position circuitry within the switch directs battery current to the rear washer pump and to the rear washer motor control circuit of the rear wiper motor, which causes the wiper motor to run at a fixed cycle for as long as the Wash mode is selected.

When the Off position of the rear wiper and washer switch is selected, one of two events is possible. The event that will occur depends upon the position of the wiper blade on the liftglass at the moment that the Off position is selected. If the wiper blade is in the up position on the glass when the Off position is selected, the park switch is closed to ground through the rear wiper motor control circuit input of the wiper motor and the wiper motor ceases to oper-

REAR WIPERS/WASHERS (Continued)

ate. If the wiper blade is not in the up position on the glass when the Off position is selected, the park switch is closed to battery current through the fused ignition switch output (run) circuit. The park switch directs this battery current to the rear wiper motor brush causing the motor to continue running until the wiper blade is in the up position on the glass and the park switch opens the battery current feed to the rear wiper motor brush and is again closed to ground through the rear wiper motor control circuit and the wiper motor ceases to operate.

Refer to the owner's manual in the vehicle glove box for more information on the features and operation of the rear wiper and washer system.

DIAGNOSIS AND TESTING - REAR WIPER & WASHER SYSTEM

WIPER SYSTEM

The diagnosis found here addresses an electrically inoperative rear wiper system. If the rear wiper motor operates, but the wiper does not move on the liftglass, replace the faulty rear wiper motor. If the wiper operates, but chatters, lifts, or does not clear the glass, clean and inspect the wiper system components as required. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - INSPECTION) and (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - CLEANING). Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

(1) Check the rear wiper and washer fuse (Fuse 6 - 20 ampere) in the fuse block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at rear wiper and washer fuse (Fuse 6 - 20 ampere) in the fuse block. If OK, go to Step 3. If not OK, repair the open fused ignition switch output (run) circuit between the fuse block and the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector for the rear wiper and washer switch from the switch connector receptacle. Reconnect 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 instrument panel wire harness connector for the rear wiper and washer switch. If OK, go to Step 4. If not OK, repair the open fused ignition switch output (run) circuit between the rear wiper and washer switch and the fuse block as required.

(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 instrument panel wire harness connector for the rear wiper and washer switch and a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the open ground circuit to ground (G200) as required.

(5) Test the rear wiper and washer switch continuity. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS/REAR WIPER/WASHER SWITCH - DIAGNOSIS AND TESTING). If OK, go to Step 6. If not OK, replace the faulty rear wiper and washer switch.

(6) Disconnect the hardtop wire harness connector for the rear wiper motor from the motor pigtail wire connector. Reconnect 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 hardtop wire harness connector for the rear wiper motor. If OK, go to Step 7. If not OK, repair the open fused ignition switch output (run) circuit between the rear wiper motor and the fuse block as required.

(7) 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 hardtop wire harness connector for the rear wiper motor and a good ground. There should be continuity. If OK, go to Step 8. If not OK, repair the open ground circuit to ground (G302) as required.

(8) Check for continuity between the rear wiper motor control circuit cavity of the hardtop wire harness connector for the rear wiper motor and a good ground. There should be no continuity. If OK, go to Step 9. If not OK, repair the shorted rear wiper motor control circuit between the rear wiper motor and the rear wiper and washer switch as required.

REAR WIPERS/WASHERS (Continued)

(9) Check for continuity between the rear wiper motor control circuit cavities of the hardtop wire harness connector for the rear wiper motor and the instrument panel wire harness connector for the rear wiper and washer switch. There should be continuity. If OK, replace the faulty rear wiper motor. If not OK, repair the open rear wiper motor control circuit between the rear wiper motor and the rear wiper and washer switch as required.

WASHER SYSTEM

The diagnosis found here addresses an electrically inoperative rear washer system. If the rear washer pump/motor operates, but no washer fluid is emitted from the rear washer nozzle, be certain to check the fluid level in the reservoir. Also inspect the washer system components as required. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - INSPECTION). Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

(1) Turn the ignition switch to the On position. Place the rear wiper and washer switch rocker in the Wipe position. Check whether the rear wiper is operating. If OK, go to Step 2. If not OK, repair the wiper system as required before you proceed with washer system diagnosis. Refer to WIPER SYSTEM .

(2) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the rear body wire harness connector for the rear washer pump/motor from the pump/motor connector receptacle. Check for continuity between the ground circuit cavity of the rear body wire harness connector for the rear washer pump/motor and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open ground circuit to ground (G302) as required.

(3) Reconnect 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 body wire harness connector for the rear washer pump/motor while the rear wiper and washer switch rocker is actuated to the Wash position. If OK, replace the faulty rear washer pump/motor unit. 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 instrument panel wire harness connector for the rear wiper and washer switch from the switch connector receptacle. Check for continuity between the rear washer motor control circuit cavities of the rear body wire harness connector for the rear washer pump/motor and the instrument panel wire harness connector for the rear wiper and washer switch. There should be continuity. If OK, go to Step 5. If not OK, repair the open rear washer motor control circuit between the rear wiper and washer switch and the rear washer pump/motor as required.

(5) Test the rear wiper and washer switch continuity. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS/REAR WIPER/WASHER SWITCH - DIAGNOSIS AND TESTING). If not OK, replace the faulty rear wiper and washer switch.

CLEANING - REAR WIPER & WASHER SYSTEM

WIPER SYSTEM

The squeegee of a wiper blade exposed to the elements for a long time tends to lose its wiping effectiveness. Periodic cleaning of the squeegee is suggested to remove any deposits of salt or road film. The wiper blade, arm, and liftgate glass should only be cleaned using a sponge or soft cloth and windshield washer fluid, a mild detergent, or a non-abrasive cleaner. If the wiper blade continues to leave streaks, smears, hazing, or beading on the glass after thorough cleaning of the squeegees and the glass, the entire wiper blade assembly must be replaced.

CAUTION: Protect the rubber squeegee of the wiper blade from any petroleum-based cleaners, solvents, or contaminants. These products can rapidly deteriorate the rubber squeegee.

WASHER SYSTEM

If the washer system is contaminated with foreign material, drain the washer reservoir by removing the front washer pump/motor from the reservoir. Clean foreign material from the inside of the washer reservoir using clean washer fluid, a mild detergent, or a non-abrasive cleaner. Flush foreign material from the washer system plumbing by first disconnecting the

REAR WIPERS/WASHERS (Continued)

washer hose from the washer nozzle, then running the washer pump/motor to run clean washer fluid or water through the system. A plugged or restricted washer nozzle should be carefully back-flushed using compressed air. If the washer nozzle obstruction cannot be cleared, replace the washer nozzle.

CAUTION: Never introduce petroleum-based cleaners, solvents, or contaminants into the washer system. These products can rapidly deteriorate the rubber seals and hoses of the washer system, as well as the rubber squeegee of the wiper blade.

CAUTION: Never use compressed air to flush the washer system plumbing. Compressed air pressures are too great for the washer system plumbing components and will result in further system damage. Never use sharp instruments to clear a plugged washer nozzle or damage to the nozzle orifice and improper nozzle spray patterns will result.

INSPECTION - REAR WIPER & WASHER SYSTEM

WIPER SYSTEM

The rear wiper blade and wiper arm should be inspected periodically, not just when wiper performance problems are experienced. This inspection should include the following points:

(1) Inspect the wiper arm for any indications of damage, or contamination. If the wiper arm is contaminated with any foreign material, clean as required. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - CLEANING). If a wiper arm is damaged or corrosion is evident, replace the wiper arm with a new unit. Do not attempt to repair a wiper arm that is damaged or corroded.

(2) Carefully lift the wiper blade off of the glass. Note the action of the wiper arm hinge. The wiper arm should pivot freely at the hinge, but with no lateral looseness evident. If there is any binding evident in the wiper arm hinge, or there is evident lateral play in the wiper arm hinge, replace the wiper arm.

CAUTION: Do not allow the wiper arm to spring back against the glass without the wiper blade in place or the glass may be damaged.

(3) Once proper hinge action of the wiper arm is confirmed, check the hinge for proper spring tension. The spring tension of the wiper arm should be sufficient to cause the rubber squeegee to conform to the curvature of the glass. Replace a wiper arm if it has low or no spring tension.

(4) Inspect the wiper blade and squeegee for any indications of damage, contamination, or rubber deterioration (Fig. 1). If the wiper blade or squeegee is contaminated with any foreign material, clean them and the glass as required. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - CLEANING). If after cleaning the wiper blade and the glass, the wiper blade fails to clear the glass without smearing, streaking, chattering, hazing, or beading, replace the wiper blade. Also, if a wiper blade is damaged or if the squeegee rubber is damaged or deteriorated, replace the wiper blade with a new unit. Do not attempt to repair a wiper blade that is damaged.

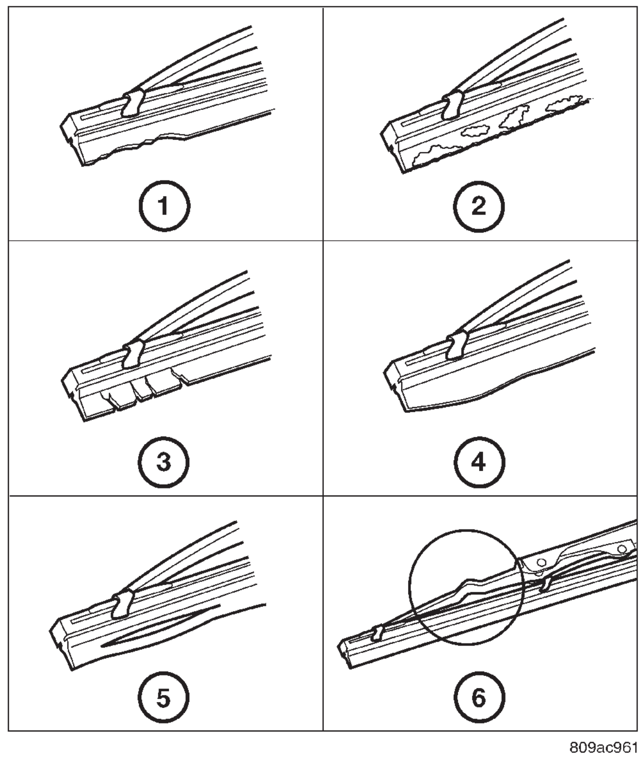


Fig. 1 Wiper Blade Inspection

1 - WORN OR UNEVEN EDGES
2 - ROAD FILM OR FOREIGN MATERIAL DEPOSITS
3 - HARD, BRITTLE, OR CRACKED
4 - DEFORMED OR FATIGUED
5 - SPLIT
6 - DAMAGED SUPPORT COMPONENTS

WASHER SYSTEM

The washer system components should be inspected periodically, not just when washer performance problems are experienced. This inspection should include the following points:

(1) Check for ice or other foreign material in the washer reservoir. If contaminated, clean and flush the washer system. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - CLEANING).

REAR WIPERS/WASHERS (Continued)

(2) Inspect the washer plumbing for pinched, leaking, deteriorated, or incorrectly routed hoses and damaged or disconnected hose fittings. Replace damaged or deteriorated hoses and hose fittings. Leaking washer hoses can sometimes be repaired by cutting the hose at the leak and splicing it back together using an in-line connector fitting. Similarly, sections of deteriorated hose can be cut out and replaced by splicing in new sections of hose using in-line connector fittings. Whenever routing a washer hose or a wire harness containing a washer hose, it must be routed away from hot, sharp, or moving parts. Also, sharp bends that might pinch the washer hose must be avoided.

REAR CHECK VALVE

DESCRIPTION

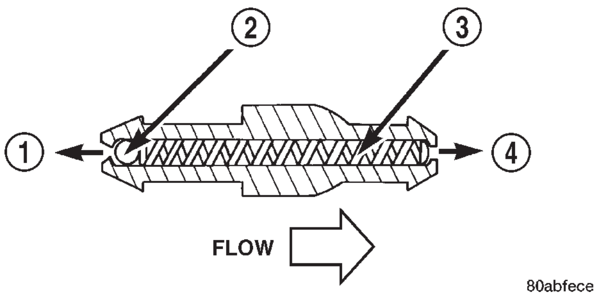


Fig. 2 Rear Check Valve

1 - TO RESERVOIR
2 - CHECK BALL
3 - SPRING
4 - TO REAR NOZZLE

Models equipped with the optional rear wiper and washer system have a check valve installed in the rear washer system plumbing (Fig. 2). The check valve is located at the joint between the rear washer supply hose in the rear body wire harness and the rear washer supply hose in the hardtop wire harness, near the belt line in the left rear corner of the vehicle. The check valve consists of a molded plastic valve body with a raised center section that is tapered in the direction of the flow through the valve. A barbed hose nipple is formed on each side of the raised center section of the valve body. Within the check valve body, a small check ball is held against an integral valve seat at one end of the valve by a small coiled spring. The rear check valve cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

OPERATION

The rear check valve provides more than one function in this application. It serves as an in-line connector fitting between the body and hardtop sections of the rear washer supply hose. It also prevents washer fluid from draining out of the rear washer supply hoses back to the washer reservoir. This drain-back would result in a lengthy delay from when the rear washer switch is actuated until washer fluid was dispensed through the rear washer nozzle, because the rear washer pump would have to refill the rear washer plumbing from the reservoir to the nozzle. Finally, the rear check valve prevents washer fluid from siphoning through the rear washer nozzle after the rear washer system is turned Off. When the rear washer pump pressurizes and pumps washer fluid from the reservoir through the rear washer plumbing, the fluid pressure overrides the spring pressure applied to the check ball within the valve and unseats the check ball, allowing washer fluid to flow toward the rear washer nozzle. When the rear washer pump stops operating, spring pressure seats the check ball in the valve and fluid flow in either direction within the rear washer plumbing is prevented.

REMOVAL

(1) Disconnect the hardtop half of the washer supply hose from the barbed nipple of the rear check valve.

(2) Disconnect the body half of the washer supply hose from the other barbed nipple of the rear check valve.

(3) Remove the rear check valve from the left rear corner of the vehicle near the belt line.

INSTALLATION

(1) Position the rear check valve into the left rear corner of the vehicle near the belt line.

(2) With the tapered end of the check valve pointed in the direction of the system flow (Fig. 3), reconnect the body half of the washer supply hose to the barbed nipple of the rear check valve.

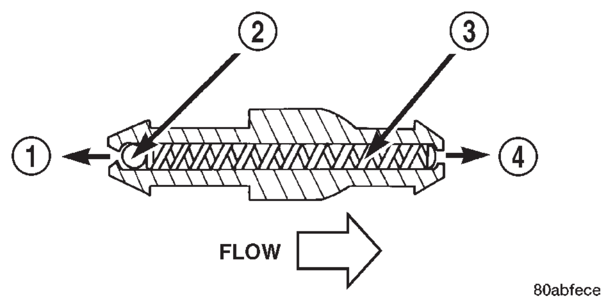


Fig. 3 Rear Washer System Check Valve

1 - TO RESERVOIR
2 - CHECK BALL
3 - SPRING
4 - TO REAR NOZZLE

(3) Reconnect the hardtop half of the washer supply hose to the other barbed nipple of the rear check valve.

REAR WASHER HOSES/TUBES

DESCRIPTION

The rear washer plumbing consists of a small diameter rubber hose that is integral to and routed with the rear body wire harness from the barbed outlet nipple of the rear washer pump/motor on the washer reservoir through the dash panel to the left cowl side inner panel under the instrument panel. The washer hose and wire harness pass from the engine compartment into the passenger compartment through a rubber grommet in a dedicated hole near the left side of the lower dash panel. The rear body wire harness and washer hose are routed from the left cowl side inner panel, along the left door opening sill, then up the B-pillar and along the upper inner edge of the left rear fender panel to the left rear corner of the passenger compartment. At the left rear corner of the passenger compartment the hose connects to a check valve, which also serves as an in-line connector between the body and hardtop halves of the rear washer supply hose. At this same location there is also a washer hose cap attached to the body half of the washer supply hose below the rear check valve (Fig. 4). When the hardtop is removed from the vehicle the body half of the washer hose must be disconnected from the rear 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.

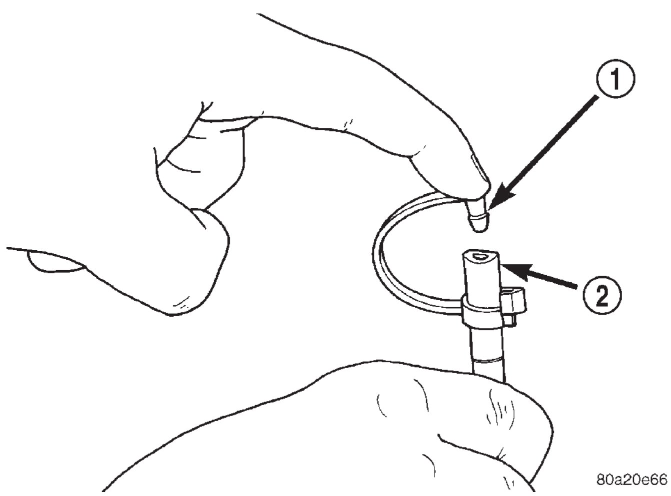


Fig. 4 Rear Washer Hose Cap

1 - WASHER HOSE CAP
2 - REAR WASHER SUPPLY HOSE - BODY HALF

The hardtop half of the rear washer supply hose is routed with the hardtop wire harness through the left rear pillar and across the upper liftglass opening reinforcement to the rear washer nozzle located near the right liftglass hinge. The hardtop washer hose is connected directly to the barbed nipple of the rear washer nozzle on the inside of the liftglass.

Washer hose is available for service only as roll stock, which must then be cut to length. For service replacement of the hose that is integral to the hardtop or body wire harnesses, it is suggested that a suitable length of washer hose be carefully routed along and secured to the outside of the harness. The molded plastic washer hose fittings cannot be repaired. If these fittings are faulty or damaged, they must be replaced.

OPERATION

Washer fluid in the washer reservoir is pressurized and fed by the rear washer pump/motor through the rear washer system plumbing and fittings to the rear washer nozzle on the hardtop liftglass. Whenever routing the washer hose or a wire harness containing a washer hose, it must be routed away from hot, sharp, or moving parts; and, sharp bends that might pinch the hose must be avoided.

REAR WASHER NOZZLE

DESCRIPTION

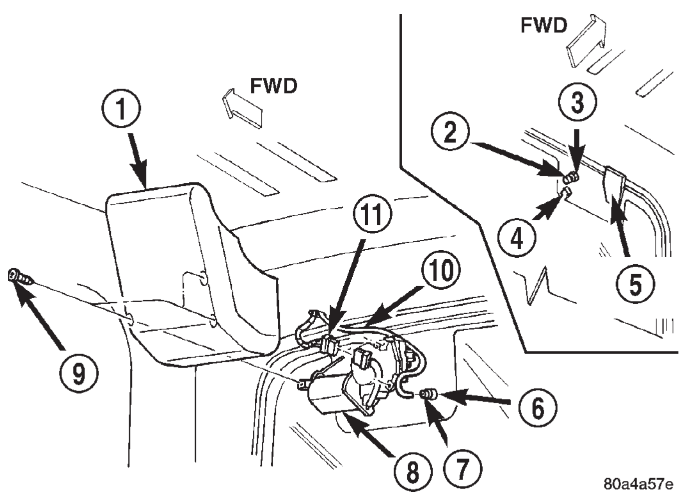


Fig. 5 Rear Washer Nozzle

1 - TRIM COVER
2 - REAR WIPER MOTOR OUTPUT SHAFT
3 - NUT
4 - REAR WASHER NOZZLE
5 - RIGHT LIFTGLASS HINGE
6 - NUT
7 - REAR WASHER NOZZLE NIPPLE
8 - REAR WIPER MOTOR
9 - SCREW (3)
10 - REAR WASHER SUPPLY HOSE
11 - HARDTOP WIRE HARNESS CONNECTOR

The rear washer nozzle is constructed of molded plastic and has a small threaded and barbed nipple molded into its back side that is inserted through a

REAR WASHER NOZZLE (Continued)

seal and a hole in the liftglass to the inside of the passenger compartment, where it is secured to the glass with a plastic nut (Fig. 5). The molded hood of the washer nozzle is visible on the outside of the liftglass near the rear wiper motor output shaft and the right liftglass hinge. The remainder of the rear washer nozzle and its plumbing are concealed behind a trim cover secured to the rear wiper motor bracket on the inside of the liftglass. The rear washer nozzle cannot be adjusted or repaired. If the nozzle is faulty or damaged, it must be replaced.

OPERATION

The rear washer nozzle is designed to dispense washer fluid into the wiper pattern area on the outside of the liftglass. Pressurized washer fluid is fed to the nozzle from the washer reservoir by the rear washer pump/motor through a single hose, which is attached to a barbed nipple on the rear washer nozzle behind the rear wiper motor trim cover. Because the washer nozzle is located near the pivot point of the rear wiper arm, it is able to dispense pressurized washer fluid onto the liftglass directly and effectively in the area of the glass to be cleaned.

REMOVAL

(1) From the inside of the liftglass, remove the three screws that secure the trim cover to the rear wiper motor bracket (Fig. 6).

(2) Remove the trim cover from the rear wiper motor.

(3) Disconnect the washer supply hose from the barbed nipple of the rear washer nozzle.

(4) While holding the nozzle securely from the outside of the liftglass, from the inside of the liftglass remove the plastic nut that secures the threaded nipple of the rear washer nozzle to the liftglass.

(5) From the inside of the liftglass, push the nipple of the rear washer nozzle through the hole in the liftglass.

(6) Remove the rear washer nozzle and seal from the outside of the liftglass.

INSTALLATION

(1) Position the rear washer nozzle and seal onto the outside of the liftglass (Fig. 6).

(2) From the inside of the liftglass, install and tighten the nut that secures the threaded nipple of the rear washer nozzle to the liftglass. Tighten the nut to 1 N·m (8 in. lbs.).

(3) Reconnect the washer supply hose to the barbed nipple of the rear washer nozzle.

(4) From the inside of the liftglass, position the trim cover over the rear wiper motor.

(5) From the inside of the liftglass, install and tighten the three screws that secure the trim cover to the rear wiper motor bracket. Tighten the screws to 1 N·m (10 in. lbs.).

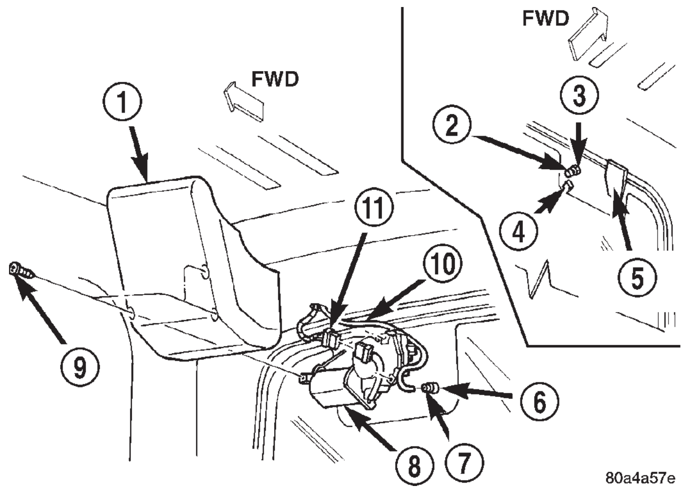


Fig. 6 Rear Washer Nozzle Remove/Install

1 - TRIM COVER
2 - REAR WIPER MOTOR OUTPUT SHAFT
3 - NUT
4 - REAR WASHER NOZZLE
5 - RIGHT LIFTGLASS HINGE
6 - NUT
7 - REAR WASHER NOZZLE NIPPLE
8 - REAR WIPER MOTOR
9 - SCREW (3)
10 - REAR WASHER SUPPLY HOSE
11 - HARDTOP WIRE HARNESS CONNECTOR

REAR WASHER PUMP/MOTOR

DESCRIPTION

The rear washer pump/motor unit is located on the inboard side and near the rear of the washer reservoir, on the top of the left front fender wheel house in the engine compartment (Fig. 7). A small permanently lubricated and sealed electric motor is coupled to the rotor-type washer pump. A seal flange with a barbed nipple on the pump housing passes through a rubber grommet seal installed in one of two dedicated mounting holes near the bottom of the washer reservoir. The rear washer pump/motor unit is always mounted in the rear pump mounting hole of the reservoir. The washer pump/motor unit is retained on the reservoir by the interference fit between the barbed pump nipple and the grommet seal, which is a light press fit. The rear washer pump/motor unit cannot be repaired. If faulty or damaged, the entire washer pump/motor unit must be replaced.

REAR WASHER PUMP/MOTOR (Continued)

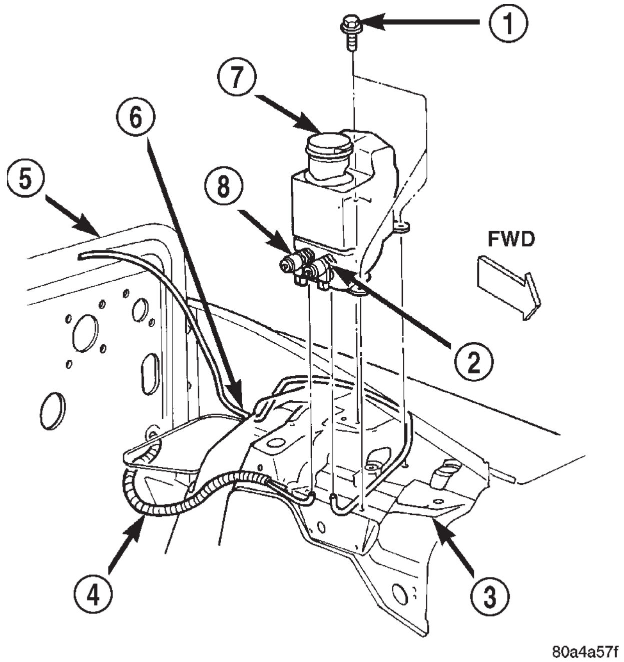


Fig. 7 Washer Reservoir

1 - SCREW (3)
2 - FRONT WASHER PUMP/MOTOR
3 - FRONT FENDER WHEEL HOUSE
4 - REAR WASHER HOSE
5 - DASH PANEL
6 - FRONT WASHER HOSE
7 - WASHER RESERVOIR
8 - REAR WASHER PUMP/MOTOR

OPERATION

The rear washer pump/motor unit is connected to the vehicle electrical system through a single take out and two-cavity connector of the rear body wire harness. The washer pump/motor is grounded at all times through a take out of the rear body wire harness with a single eyelet terminal connector that is secured under a ground screw to the left cowl side inner panel below the instrument panel in the passenger compartment. The rear washer pump/motor receives battery current through the closed contacts of the momentary rear washer switch within the rear wiper and washer switch unit only when the bottom of the switch rocker is pushed towards the instrument panel. Washer fluid is gravity-fed from the washer reservoir to the inlet side of the washer pump. When the pump motor is energized, the rotor-type pump pressurizes the washer fluid and forces it through the pump outlet nipple, the rear washer plumbing, and the rear washer nozzle onto the liftglass.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the washer supply hose from the barbed outlet nipple of the rear washer pump/motor unit and allow the washer fluid from the washer reservoir to drain into a clean container for reuse (Fig. 8).

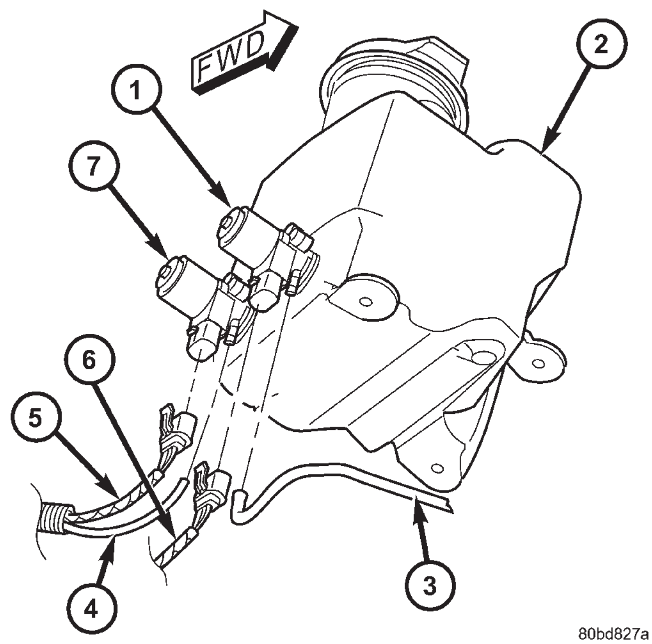


Fig. 8 Rear Washer Pump/Motor Remove/Install

1 - FRONT WASHER PUMP/MOTOR
2 - WASHER RESERVOIR
3 - FRONT WASHER HOSE
4 - REAR WASHER HOSE
5 - REAR BODY WIRE HARNESS
6 - HEADLAMP & DASH WIRE HARNESS
7 - REAR WASHER PUMP/MOTOR

(3) Disconnect the rear body wire harness connector for the rear washer pump/motor from the washer pump/motor connector receptacle.

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the barbed inlet nipple of the rear washer pump/motor unit out of the rubber grommet seal in the washer reservoir. Care must be taken not to damage the washer reservoir.

(5) Remove the rear washer pump/motor unit from the washer reservoir.

(6) Remove the rubber grommet seal from the rear washer pump/motor mounting hole in the washer reservoir and discard.

INSTALLATION

(1) Install a new rubber grommet seal into the rear washer pump/motor mounting hole of the washer reservoir.

(2) Position the rear washer pump/motor unit inlet nipple to the washer reservoir (Fig. 8).

REAR WASHER PUMP/MOTOR (Continued)

(3) Firmly and evenly press the barbed inlet nipple of the rear washer pump/motor unit through the rubber grommet seal in the washer reservoir. Care must be taken not to damage the washer reservoir.

(4) Reconnect the rear body wire harness connector for the rear washer pump/motor to the washer pump/motor connector receptacle.

(5) Reconnect the washer supply hose to the barbed outlet nipple of the rear washer pump/motor unit.

(6) Refill the washer reservoir with the washer fluid drained from the reservoir during the removal procedure.

(7) Reconnect the battery negative cable.

REAR WIPER ARM

DESCRIPTION

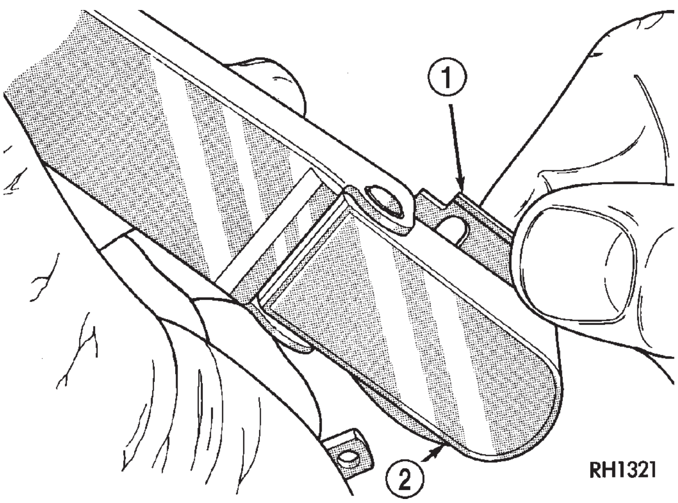


Fig. 9 Wiper Arm

1 - LOCKING LATCH
2 - ARM

The rear wiper arm is the rigid member located between the rear wiper motor output shaft that protrudes from the outer liftglass near the base of the right liftglass hinge and the wiper blade on the liftglass. The wiper arm has a die cast metal pivot end. On the underside of this pivot end is a socket formation with internal serrations and a small, movable, stamped steel latch plate that is secured loosely under a small strap that is staked to the pivot end (Fig. 9). The wide end of a tapered, stamped steel channel is secured with a hinge pin to the pivot end of the wiper arm. One end of a long, rigid, stamped steel strap, with a small hole near its pivot end, is riveted and crimped within the narrow end of the stamped steel channel. The tip of the wiper blade end of this strap is bent back under itself to form a small hook. Concealed within the stamped steel channel, one end of a long spring is hooked through a hole in a small stamped steel strap on the hinge pin within the die cast pivot end, while the other end of the spring is hooked through the small hole in the steel strap. The entire wiper arm has a satin black finish applied to all of its visible surfaces.

A wiper arm cannot be adjusted or repaired. If damaged or faulty, the entire wiper arm unit must be replaced.

OPERATION

The rear wiper arm is designed to mechanically transmit the motion from the rear wiper motor output shaft to the rear wiper blade. The wiper arm must be properly indexed to the motor output shaft in order to maintain the proper wiper blade travel on the glass. The socket formation with internal serrations in the wiper arm pivot end interlocks with the serrations on the outer circumference of the wiper pivot driver, allowing positive engagement and finite adjustment of this connection. The latch plate on the underside of the wiper arm pivot end locks the wiper arm to the wiper pivot when in its installed position and, when in its unlocked position, also serves as a blocker to hold the spring-loaded wiper arm off of the glass to facilitate removal and installation. The spring-loaded wiper arm hinge controls the downforce applied through the tip of the wiper arm to the wiper blade on the glass. The hook formation on the tip of the wiper arm provides a cradle for securing and latching the wiper blade pivot block to the wiper arm.

REMOVAL

(1) Lift the rear wiper arm far enough to raise the wiper blade off of the glass and permit the wiper arm latch plate to be pulled out to its holding position, then release the arm (Fig. 10). The wiper arm and blade will remain off the glass with the latch in this position.

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 wiper pivot during wiper operation, regardless of how carefully it is reinstalled.

(2) Using a slight rocking motion, remove the rear wiper arm pivot end from the motor output shaft.

REAR WIPER ARM (Continued)

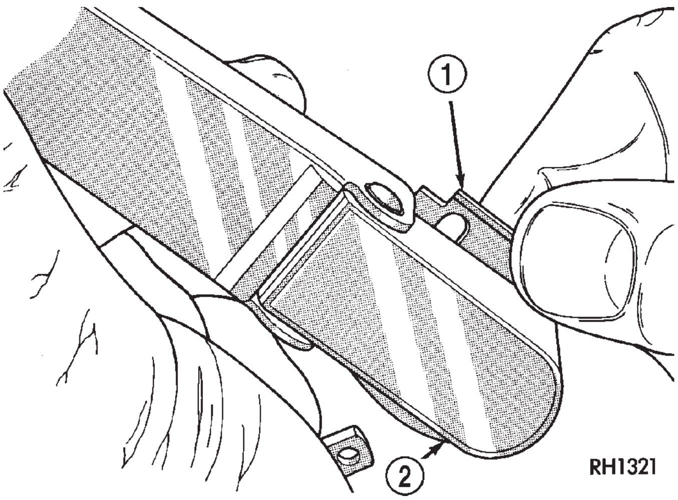


Fig. 10 Rear Wiper Arm Remove/Install

1 - LOCKING LATCH
2 - ARM

INSTALLATION

NOTE: Be certain that the rear wiper motor is in the park position before attempting to install the wiper arm. Turn the ignition switch to the On position and move the rear wiper and washer switch rocker to its Off position. If the wiper motor output shaft moves, wait until it stops moving, then turn the ignition switch back to the Off position. The wiper motor is now in its park position.

(1) The rear wiper arm must be indexed to the motor output shaft with the rear wiper motor in the park position to be properly installed. Position the rear wiper arm pivot end onto the motor output shaft so that the wiper blade is parallel to or tipped down from the upper edge of the liftglass a maximum of 80 millimeters (3.14 inches) (Fig. 11).

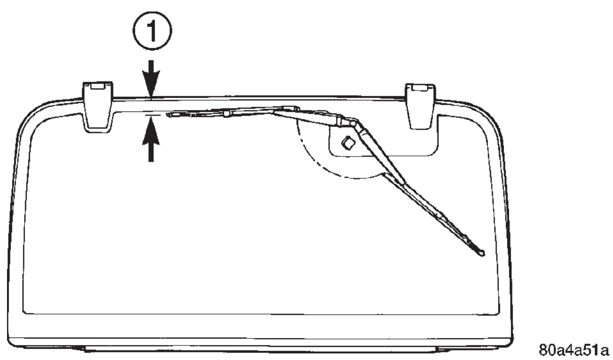


Fig. 11 Rear Wiper Arm Installation

1 - TIP OF BLADE PARALLEL TO OR TIPPED DOWN FROM EDGE OF GLASS MAXIMUM 80 mm (3.14 in.)

(2) Once the wiper arm is indexed to the motor output shaft, lift the wiper blade away from the liftglass slightly to relieve the spring tension on the latch plate, then push the latch plate into the locked position (Fig. 10). Gently lower the wiper arm until the wiper blade rests on the glass.

(3) Wet the liftglass, then operate the rear wiper. Turn the wiper switch to the Off position, then check for the correct wiper arm position and adjust as required.

REAR WIPER BLADE

DESCRIPTION

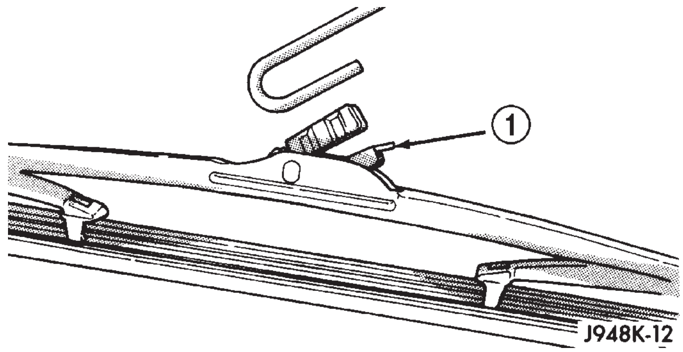


Fig. 12 Rear Wiper Blade - Typical

1 - RELEASE TAB

The rear wiper blade is secured by an integral latching pivot block to the hook formation on the tip of the rear wiper arm, and rests on the glass near the top of the liftglass when the wiper is not in operation (Fig. 12). The wiper blade consists of the following components:

- **Superstructure** - The superstructure includes a stamped steel bridge and plastic links with claw formations that grip the wiper blade element. Also included in this unit is the latching, molded plastic pivot block that secures the superstructure to the wiper arm. All of the metal components of the wiper blade have a satin black finish applied.
- **Element** - The wiper element or squeegee is the resilient rubber member of the wiper blade that contacts the glass.
- **Flexor** - The flexor is a rigid metal component running along the length of each side of the wiper element where it is gripped by the claws of the superstructure.

All Wrangler models with the optional rear wiper and washer system have one 46.0-centimeter (18-inch) rear wiper blade with a non-replaceable element (squeegee). The wiper blade cannot be adjusted or repaired. If faulty, worn, or damaged the entire wiper blade unit must be replaced.

REAR WIPER BLADE (Continued)

OPERATION

The rear wiper blade is moved back and forth across the glass by the wiper arm when the rear wiper system is in operation. The wiper blade superstructure is the flexible frame that grips the wiper blade element and evenly distributes the force of the spring-loaded wiper arm along the length of the element. The combination of the wiper arm force and the flexibility of the superstructure makes the element conform to and maintain proper contact with the liftglass, even as the blade is moved over the varied curvature found across the glass surface. The wiper element flexor provides the claws of the blade superstructure with a rigid, yet flexible component on the element which can be gripped. The rubber element is designed to be stiff enough to maintain an even cleaning edge as it is drawn across the glass, but resilient enough to conform to the glass surface and flip from one cleaning edge to the other each time the wiper blade changes directions.

REMOVAL

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 rear wiper motor output shaft.

(1) Lift the rear wiper arm to raise the wiper blade and element off of the liftglass.

(2) To remove the wiper blade from the wiper arm, push the pivot block latch release tab under the tip of the arm and slide the blade away from the tip towards the rear wiper motor output shaft end of the arm far enough to disengage the pivot block from the hook (Fig. 13).

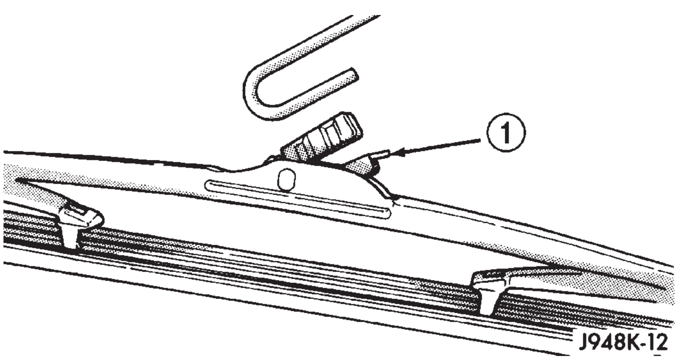


Fig. 13 Wiper Blade Remove/Install - Typical

1 - RELEASE TAB

(3) Extract the hook formation on the tip of the wiper arm from the opening in the wiper blade superstructure ahead of the wiper blade pivot block/latch unit.

CAUTION: Do not allow the wiper arm to spring back against the glass without the wiper blade in place or the glass may be damaged.

(4) Gently lower the wiper arm tip onto the glass.

INSTALLATION

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 rear wiper motor output shaft.

(1) Lift the rear wiper arm off of the liftglass.

(2) Position the rear wiper blade near the hook formation on the tip of the arm with the notched retainer for the wiper element oriented towards the end of the wiper arm that is nearest to the rear wiper motor output shaft.

(3) Insert the hook formation on the tip of the wiper arm through the opening in the wiper blade superstructure ahead of the wiper blade pivot block/latch unit far enough to engage the pivot block with the hook (Fig. 13).

(4) Slide the wiper blade pivot block/latch up into the hook formation on the tip of the wiper arm until the latch release tab snaps into its locked position.

(5) Gently lower the wiper blade onto the glass.

REAR WIPER MOTOR

DESCRIPTION

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 (Fig. 14). A molded plastic trim cover conceals the wiper motor from the passenger compartment, while a large black out area of the liftglass conceals the unit from the exterior of the vehicle. 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 motor consists of the following major components:

- **Bracket** - The rear wiper motor bracket consists of a stamped steel mounting plate for the wiper motor that is secured with screws to the wiper motor.
- **Motor** - The single-speed permanent magnet rear wiper motor is secured with screws to the rear wiper motor bracket. The wiper motor includes an integral transmission, a motor output shaft, a diode, and the rear wiper motor park switch.

The rear wiper motor cannot be adjusted or repaired. If any component of the motor is faulty or damaged, the entire rear wiper motor unit must be

REAR WIPER MOTOR (Continued)

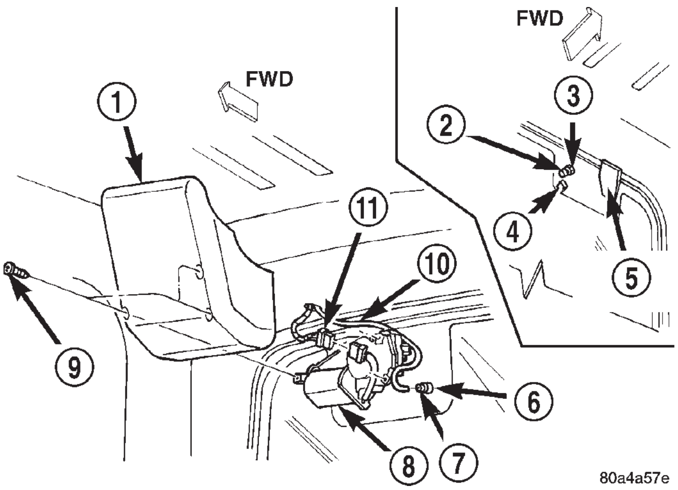


Fig. 14 Rear Wiper Motor

1 - TRIM COVER
2 - REAR WIPER MOTOR OUTPUT SHAFT
3 - NUT
4 - REAR WASHER NOZZLE
5 - RIGHT LIFTGLASS HINGE
6 - NUT
7 - REAR WASHER NOZZLE NIPPLE
8 - REAR WIPER MOTOR
9 - SCREW (3)
10 - REAR WASHER SUPPLY HOSE
11 - HARDTOP WIRE HARNESS CONNECTOR

replaced. The motor output shaft gasket, bezel, and nut are available for service replacement.

OPERATION

The rear wiper motor operation is controlled by the vehicle operator through battery current inputs received by the rear wiper motor from the rear wiper and washer switch on the instrument panel, and the rear wiper motor park switch, which control current flow to the wiper motor brushes. The park switch is a single pole, single throw, momentary switch within the wiper motor that is mechanically actuated by the wiper motor transmission components. The park switch alternately closes the wiper motor brush to the rear wiper and washer switch output or to a fused ignition switch output (run) circuit, depending upon the position of the wiper on the glass. This feature allows the motor to complete its current wipe cycle after the wiper system has been turned Off, and to park the wiper blade in the uppermost portion of the wipe pattern. An internal diode protects the motor from feedback through the park switch when the switch is closed to the fused ignition switch output (run) circuit. An internal circuit breaker protects the motor from overloads. The wiper motor transmission converts the rotary output of the wiper motor to the back and forth wiping motion of the rear wiper arm and blade on the liftglass.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the rear wiper arm from the rear wiper motor output shaft. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS/REAR WIPER ARM - REMOVAL).

(3) From the outside of the liftglass, remove the rear wiper motor output shaft nut and bezel unit (Fig. 15).

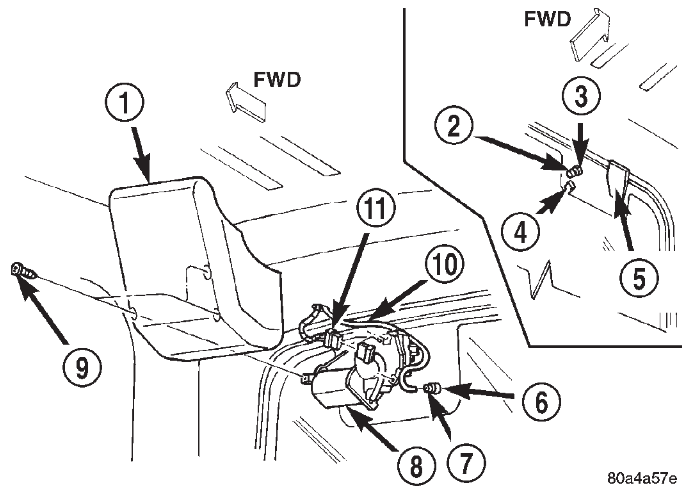


Fig. 15 Rear Wiper Motor Remove/Install

1 - TRIM COVER
2 - REAR WIPER MOTOR OUTPUT SHAFT
3 - NUT
4 - REAR WASHER NOZZLE
5 - RIGHT LIFTGLASS HINGE
6 - NUT
7 - REAR WASHER NOZZLE NIPPLE
8 - REAR WIPER MOTOR
9 - SCREW (3)
10 - REAR WASHER SUPPLY HOSE
11 - HARDTOP WIRE HARNESS CONNECTOR

(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 trim cover to the rear wiper motor mounting bracket.

(6) Remove the trim cover from the rear wiper motor.

(7) Disconnect the hardtop wire harness connector for the rear wiper motor from the motor pigtail wire connector.

(8) Loosen, but do not remove, the right liftglass hinge nut.

(9) 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.

(10) Move the rear wiper motor towards the right side of the vehicle until the slotted hole in the motor

REAR WIPER MOTOR (Continued)

mounting bracket clears the grommet under the right liftglass hinge nut.

(11) Remove the rear wiper motor from the liftglass.

INSTALLATION

(1) Position the rear wiper motor to the inside of the liftglass (Fig. 15).

(2) Slide the rear wiper motor towards the left side of the vehicle until the slotted hole in the motor mounting bracket engages the grommet under the right liftglass hinge nut.

(3) Tighten the right liftglass hinge nut to 6 N·m (53 in. lbs.).

(4) Reconnect the hardtop wire harness connector for the rear wiper motor to the motor pigtail wire connector.

(5) Position the trim cover over the rear wiper motor.

(6) Install and tighten the three screws that secure the trim to the rear wiper motor mounting bracket. Tighten the screws to 1 N·m (10 in. lbs.).

(7) From the outside of the liftglass, install the rubber gasket over the rear wiper motor output shaft.

(8) Install and tighten the nut and bezel unit that secure the rear wiper motor output shaft to the liftglass. Tighten the nut to 3 N·m (30 in. lbs.).

(9) Reinstall the rear wiper arm onto the rear wiper motor output shaft. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS/REAR WIPER ARM - INSTALLATION).

(10) Reconnect the battery negative cable.

REAR WIPER/WASHER SWITCH

DESCRIPTION

The rear wiper and washer switch is located in the accessory switch bezel near the bottom of the instrument panel center stack area on the instrument panel (Fig. 16). The single two-function switch is molded from black plastic and is secured by a snap fit in a dedicated receptacle molded into the back of the accessory switch bezel. A single six pin connector receptacle is molded into the back of the switch housing. Only the switch toggle button is visible through the lower opening of the instrument panel center bezel. The remainder of the switch is concealed behind the accessory switch bezel within the instrument panel. The rear wiper and washer switch contains switches to control both the rear wiper and the rear washer, and also has an integral incandescent illumination lamp with a serviceable bulb. The switch rocker is identified with an International Control and Display Symbol icon for windshield wiper and washer, and the icon is illuminated from behind when the exterior lamps are turned On. The rear wiper and washer switch cannot be repaired and, if faulty or damaged, the entire switch unit must be replaced. The switch illumination lamp bulb is available for service replacement.

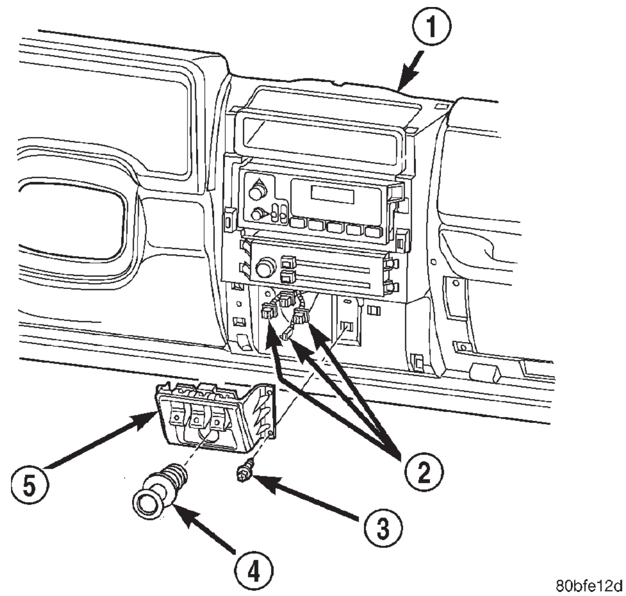


Fig. 16 Rear Wiper and Washer Switch

1 - INSTRUMENT PANEL
2 - WIRE HARNESS CONNECTORS
3 - SCREW (4)
4 - CIGAR LIGHTER
5 - ACCESSORY SWITCH BEZEL

OPERATION

The rear wiper and washer switch features a detent in the Wipe position, and a momentary Wash position. The switch toggle button is pushed downward to its detent to activate the rear wiper system, and down again to a momentary position to activate the rear washer system. Pushing the switch toggle button upwards moves the switch to the Off position, which also has a detent. When the ignition switch is in the On position, battery current from a fuse in the Power Distribution Center (PDC) is provided to the rear wiper and washer system fuse in the fuse block, which provides battery current to the switch through a fused ignition switch output (run) circuit. The switch is connected to the vehicle electrical system through a single dedicated take out and connector in the instrument panel wire harness. The intensity of the switch illumination lamp is controlled by a lamp driver output from the instrument cluster based upon the panel lamps dimmer input to the cluster from the left multi-function switch. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the rear wiper and washer switch.

DIAGNOSIS AND TESTING - REAR WIPER & WASHER SWITCH

Be certain to perform the diagnosis for the rear wiper system and/or rear washer system before testing the rear wiper and washer switch. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - DIAGNOSIS AND TESTING). Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

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.

(1) Disconnect and isolate the battery negative cable. Remove the accessory switch bezel from the instrument panel and disconnect the instrument panel wire harness connector for the rear wiper and washer switch from the switch connector receptacle.

(2) Using an ohmmeter, check the rear wiper and washer switch continuity at the switch terminals as shown in the Rear Wiper & Washer Switch Continuity chart (Fig. 17).

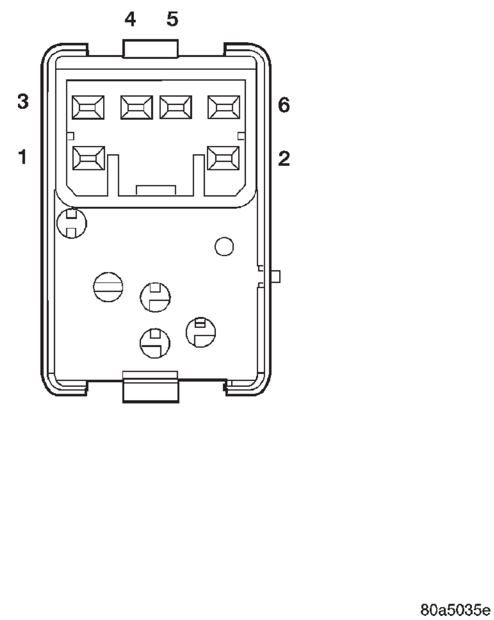


Fig. 17 Rear Wiper & Washer Switch Continuity

SWITCH POSITION	CONTINUITY BETWEEN
OFF	1 & 4
WIPE	4 & 5
WASH	2 & 5, 4 & 5
LAMP	1 & 3

(3) If the switch fails any of the continuity checks, replace the faulty switch. If the switch is OK, repair the open or shorted rear wiper and/or rear washer system circuits as required.

REAR WIPER/WASHER SWITCH (Continued)

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the accessory switch bezel from the instrument panel center bezel from the instrument panel (Fig. 18). (Refer to 23 - BODY/INSTRUMENT PANEL/ACCESSORY SWITCH BEZEL - REMOVAL).

(3) 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.

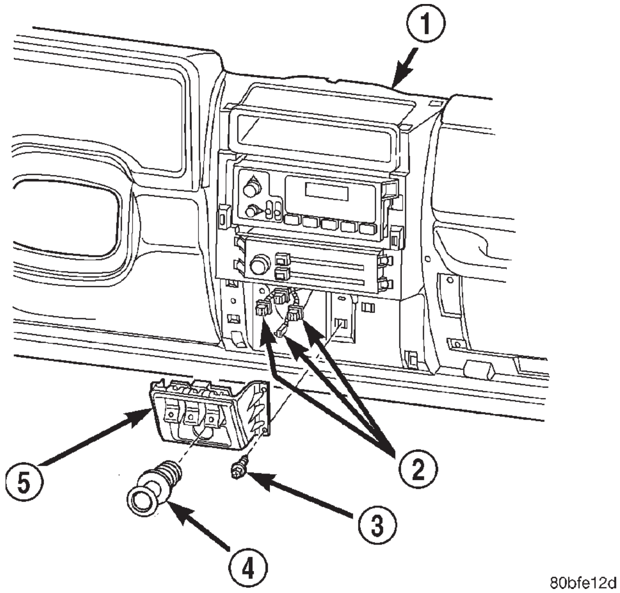


Fig. 18 Accessory Switch Bezel Remove/Install

1 - INSTRUMENT PANEL
2 - WIRE HARNESS CONNECTORS
3 - SCREW (4)
4 - CIGAR LIGHTER
5 - ACCESSORY SWITCH BEZEL

INSTALLATION

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.

(1) Position the rear wiper and washer switch over the proper receptacle on the back of the accessory switch bezel.

(2) Gently and evenly push the rear wiper and washer switch into the receptacle until each of the snap retainers is fully engaged.

(3) Reinstall the accessory switch bezel onto the instrument panel (Fig. 18). (Refer to 23 - BODY/INSTRUMENT PANEL/ACCESSORY SWITCH BEZEL - INSTALLATION).

(4) Reconnect the battery negative cable.

WIRING

TABLE OF CONTENTS

8W-01 WIRING DIAGRAM INFORMATION

TABLE OF CONTENTS

WIRING DIAGRAM INFORMATION

DESCRIPTION

DESCRIPTION - HOW TO USE WIRING DIAGRAMS

DaimlerChrysler Corporation wiring diagrams are designed to provide information regarding the vehicles wiring content. In order to effectively use the wiring diagrams to diagnose and repair DaimlerChrysler Corporation vehicles, 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 (Fig. 1).

All switches, components, and modules are shown in the at rest position with the doors closed and the key removed from the ignition (Fig. 2).

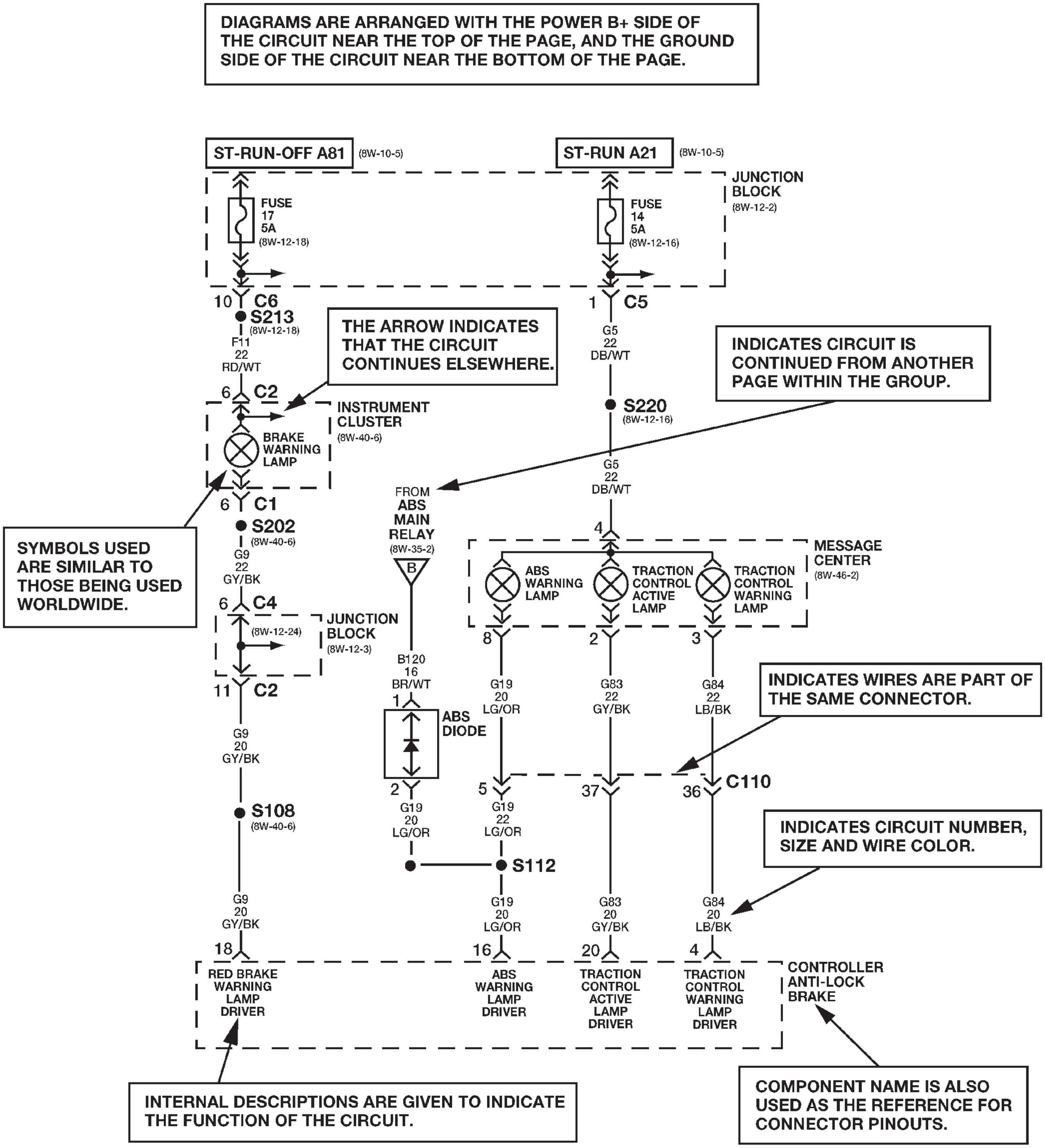
Components are shown two ways. A solid line around a component indicates that the component is complete. A dashed line around the component indicates that the component is being shown is not complete. Incomplete components have a reference number to indicate the page where the component is shown complete.

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.

SYMBOLS

International symbols are used throughout the wiring diagrams. These symbols are consistent with those being used around the world (Fig. 3).

WIRING DIAGRAM INFORMATION (Continued)

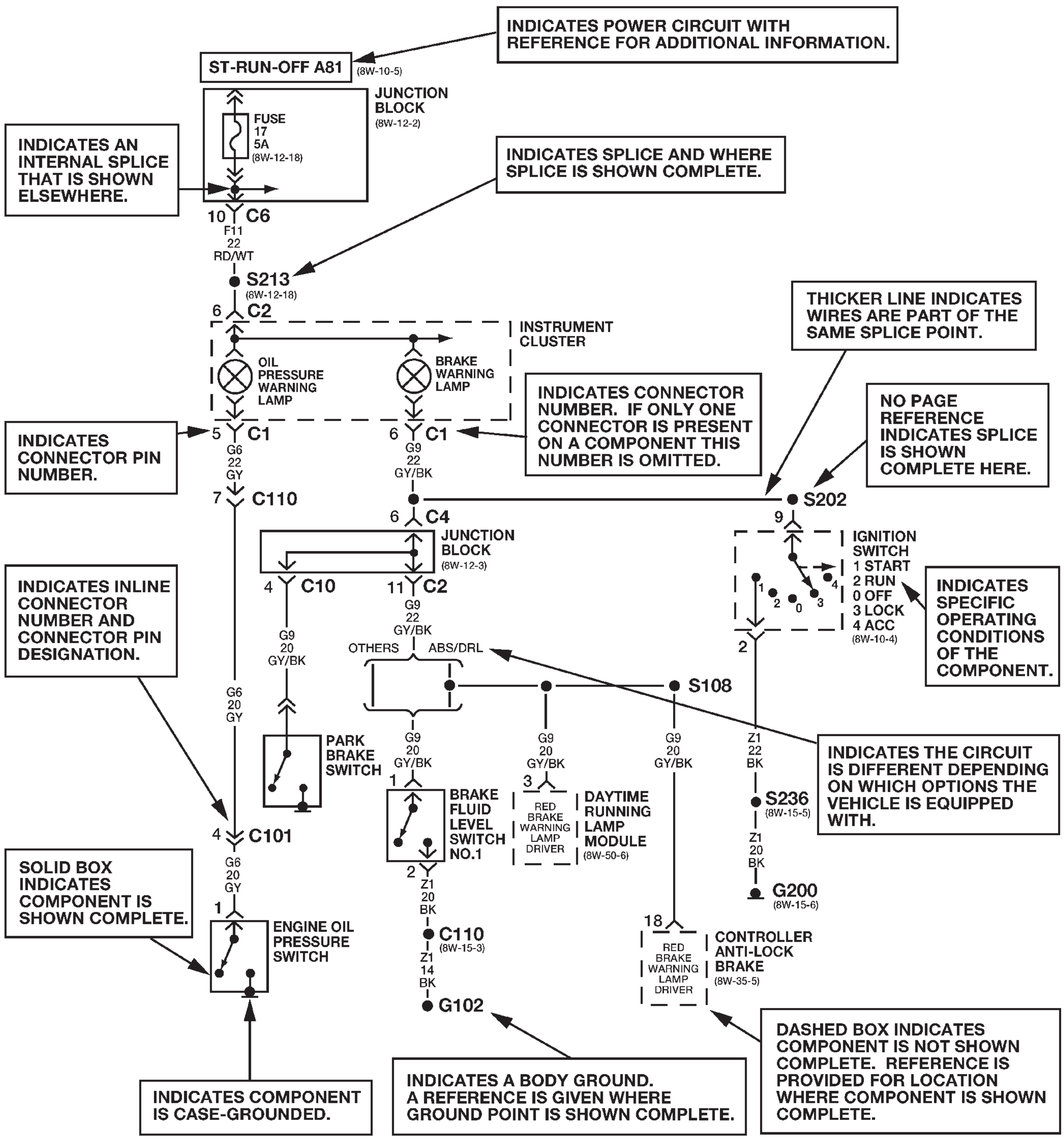


The System shown here is an EXAMPLE ONLY. It does not represent the actual circuit shown in the WIRING DIAGRAM SECTION.

80c06d01

Fig. 1 WIRING DIAGRAM EXAMPLE 1

WIRING DIAGRAM INFORMATION (Continued)



The System shown here is an EXAMPLE ONLY. It does not represent the actual circuit shown in the WIRING DIAGRAM SECTION.

80c06d02

Fig. 2 WIRING DIAGRAM EXAMPLE 2

WIRING DIAGRAM INFORMATION (Continued)

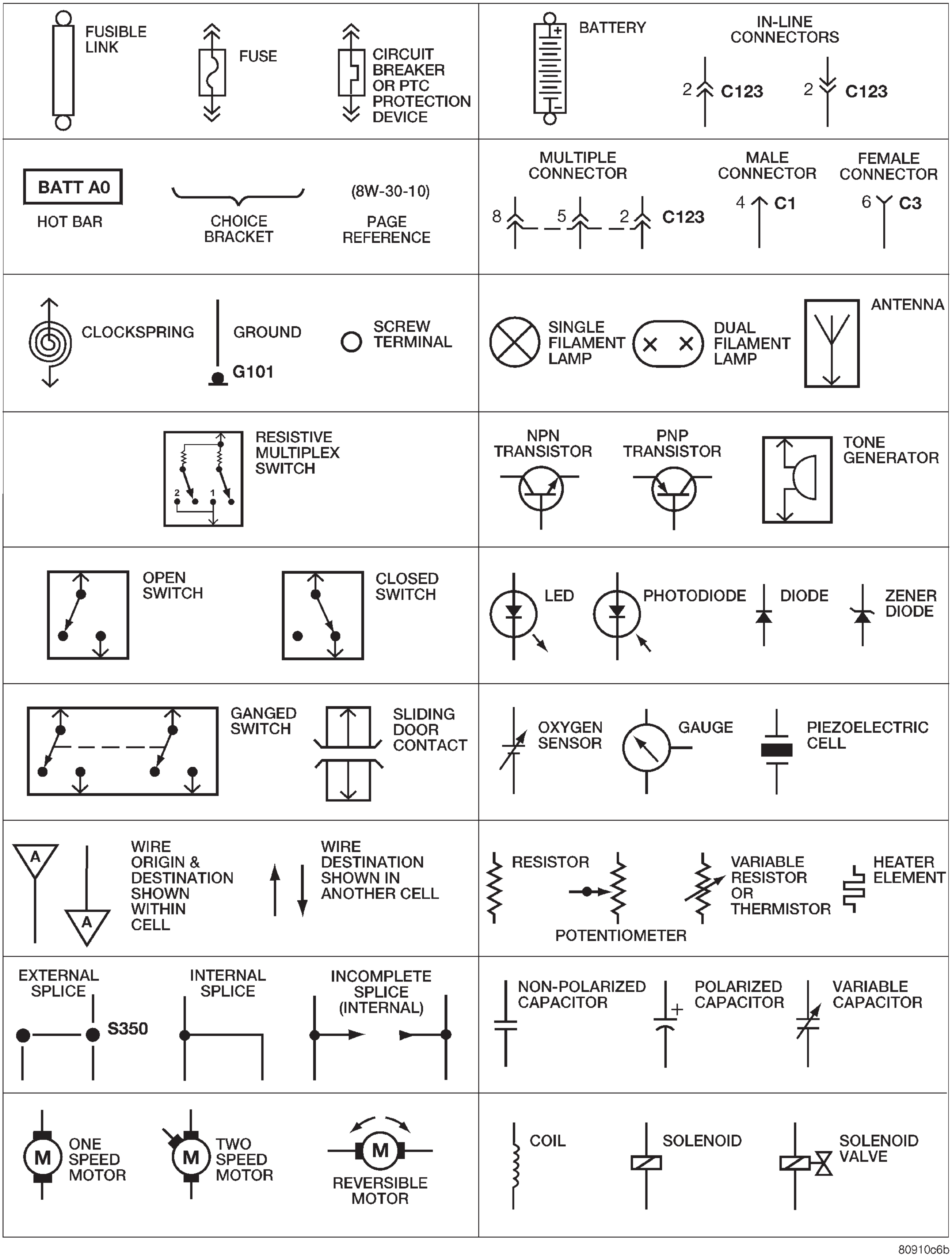


Fig. 3 WIRING DIAGRAM SYMBOLS

WIRING DIAGRAM INFORMATION (Continued)

TERMINOLOGY

This is a list of terms and definitions used in the wiring diagrams.

LHD . . . . Left Hand Drive Vehicles
RHD . . . . Right Hand Drive Vehicles
ATX . . Automatic Transmissions-Front Wheel Drive
MTX . . . . Manual Transmissions-Front Wheel Drive
AT . . . . Automatic Transmissions-Rear Wheel Drive
MT . . . . . Manual Transmissions-Rear Wheel Drive
SOHC . . . . Single Over Head Cam Engine
DOHC . . . . Double Over Head Cam Engine
Built-Up-Export . . . . Vehicles Built For Sale In Markets Other Than North America
Except Built-Up-Export . . Vehicles Built For Sale In North America

DESCRIPTION - 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. 4).

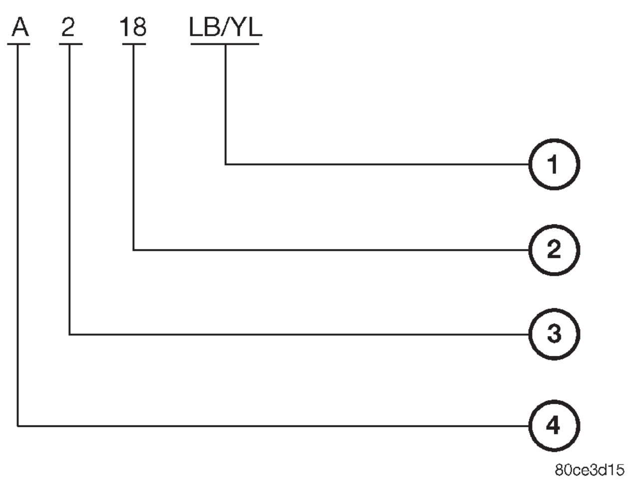


Fig. 4 WIRE CODE IDENTIFICATION

1 - COLOR OF WIRE (LIGHT BLUE WITH YELLOW TRACER
2 - GAGE OF WIRE (18 GAGE)
3 - PART OF MAIN CIRCUIT (VARIES DEPENDING ON EQUIPMENT)
4 - MAIN CIRCUIT IDENTIFICATION

WIRE COLOR CODE CHART

COLOR CODE	COLOR
BL	BLUE
BK	BLACK
BR	BROWN
DB	DARK BLUE
DG	DARK GREEN
GY	GRAY
LB	LIGHT BLUE
LG	LIGHT GREEN
OR	ORANGE
PK	PINK
RD	RED
TN	TAN
VT	VIOLET
WT	WHITE
YL	YELLOW
*	WITH TRACER

WIRING DIAGRAM INFORMATION (Continued)

DESCRIPTION - CIRCUIT FUNCTIONS

All circuits in the diagrams use an alpha/numeric code to identify the wire and it's 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 - SECTION IDENTIFICATION AND INFORMATION

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.

Splice diagrams in Section 8W-70 show the entire splice and provide references to other sections the splices serves. Section 8W-70 only contains splice diagrams that are not shown in their entirety somewhere else in the wiring diagrams.

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.

WIRING SECTION CHART

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-91	Connector, Ground and Splice Locations

WIRING DIAGRAM INFORMATION (Continued)

DESCRIPTION - CONNECTOR, GROUND AND SPLICE 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 in the engine compartment are C100 series numbers
- In-line connectors located in the Instrument Panel area are C200 series numbers.
- In-line connectors located in the body 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 connectors.
- Splices are identified with an "S" and follow the same series numbering as the in-line connectors.
- 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-91 contains connector/ground/splice location illustrations. The illustrations contain the connector name (or number)/ground number/splice number and component identification. Connector/ground/splice location charts in section 8W-91 reference the figure numbers of the illustrations.

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. The abbreviation N/S means Not Shown in the illustrations

WARNING

WARNINGS - GENERAL

WARNINGS provide information to prevent personal injury and vehicle damage. Below is a list of general warnings that should be followed any time a vehicle is being serviced.

WARNING: ALWAYS WEAR SAFETY GLASSES FOR EYE PROTECTION.

WARNING: USE SAFETY STANDS ANYTIME A PROCEDURE REQUIRES BEING UNDER A VEHICLE.

WARNING: BE SURE THAT THE IGNITION SWITCH ALWAYS IS IN THE OFF POSITION, UNLESS THE PROCEDURE REQUIRES IT TO BE ON.

WARNING: SET THE PARKING BRAKE WHEN WORKING ON ANY VEHICLE. AN AUTOMATIC TRANSMISSION SHOULD BE IN PARK. A MANUAL TRANSMISSION SHOULD BE IN NEUTRAL.

WARNING: OPERATE THE ENGINE ONLY IN A WELL-VENTILATED AREA.

WARNING: KEEP AWAY FROM MOVING PARTS WHEN THE ENGINE IS RUNNING, ESPECIALLY THE FAN AND BELTS.

WARNING: TO PREVENT SERIOUS BURNS, AVOID CONTACT WITH HOT PARTS SUCH AS THE RADIATOR, EXHAUST MANIFOLD(S), TAIL PIPE, CATALYTIC CONVERTER AND MUFFLER.

WARNING: DO NOT ALLOW FLAME OR SPARKS NEAR THE BATTERY. GASES ARE ALWAYS PRESENT IN AND AROUND THE BATTERY.

WARNING: ALWAYS REMOVE RINGS, WATCHES, LOOSE HANGING JEWELRY AND AVOID LOOSE CLOTHING.

DIAGNOSIS AND TESTING - WIRING HARNESS

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 vehicles are Solid State. When checking voltages in these circuits, use a meter with a 10 - megohm or greater impedance rating.

WIRING DIAGRAM INFORMATION (Continued)

• 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 vehicles 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's electrical system can cause damage to the equipment and provide false readings.

• Probing Tools - These tools are used for probing terminals in connectors (Fig. 5). Select the proper size tool from Special Tool Package 6807, and insert it into the terminal being tested. Use the other end of the tool to insert the meter probe.

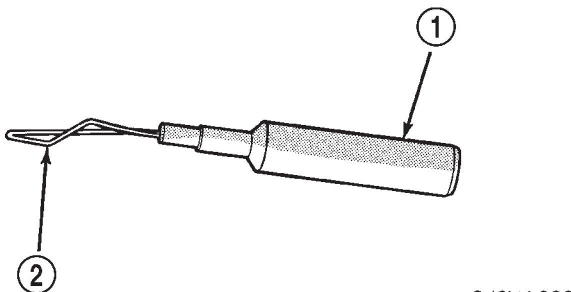


Fig. 5 PROBING TOOL

1 - SPECIAL TOOL 6801
2 - PROBING END

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 into 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 or moisture
• Wire insulation that has rubbed through causing a short to ground
• Some or all of the wiring strands broken inside of the insulation
• Wiring broken inside of the insulation

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 area.
(6) Verify the proper operation. For this step, check for proper operation of all items on the repaired circuit. Refer to the wiring diagrams.

STANDARD PROCEDURE

STANDARD PROCEDURE - ELECTROSTATIC DISCHARGE (ESD) SENSITIVE DEVICES

All ESD sensitive components are solid state and a symbol (Fig. 6) is used to indicate this. When handling any component with this symbol, comply with the following procedures to reduce the possibility of electrostatic charge build up on the body and inadvertent discharge into the component. If it is not known whether the part is ESD sensitive, assume that it is.

(1) Always touch a known good ground before handling the part. This should be repeated while handling the part and more frequently after sliding across a seat, sitting down from a standing position, or walking a distance.
(2) Avoid touching electrical terminals of the part, unless instructed to do so by a written procedure.
(3) When using a voltmeter, be sure to connect the ground lead first.
(4) Do not remove the part form it's protective packing until it is time to install the part.
(5) Before removing the part from it's pakage, ground the pakage to a known good ground on the vehicle.

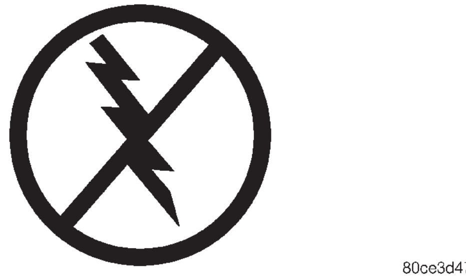


Fig. 6 ELECTROSTATIC DISCHARGE SYMBOL

WIRING DIAGRAM INFORMATION (Continued)

STANDARD PROCEDURE - TESTING OF VOLTAGE POTENTIAL

(1) Connect the ground lead of a voltmeter to a known good ground (Fig. 7).

(2) Connect the other lead of the voltmeter to the selected test point. The vehicle ignition may need to be turned ON to check voltage. Refer to the appropriate test procedure.

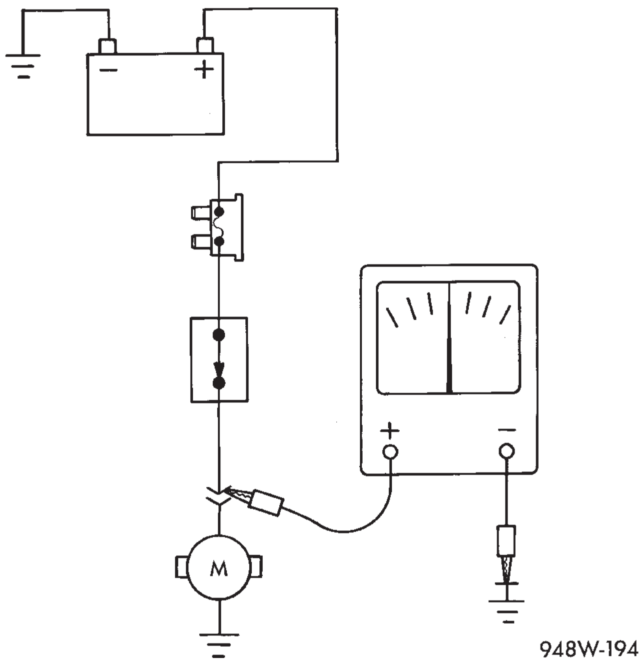


Fig. 7 TESTING FOR VOLTAGE POTENTIAL

STANDARD 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. 8).

(3) Connect the other lead to the other end of the circuit being tested. Low or no resistance means good continuity.

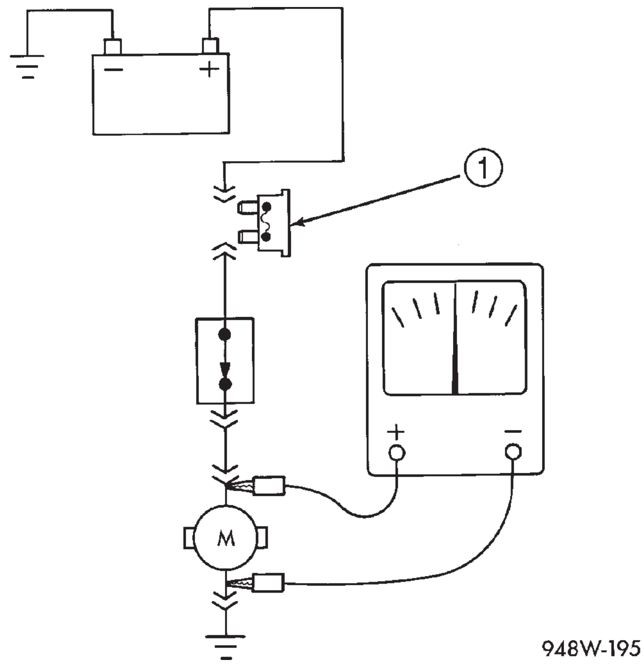


Fig. 8 TESTING FOR CONTINUITY

1 - FUSE REMOVED FROM CIRCUIT

STANDARD PROCEDURE - 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.

STANDARD PROCEDURE - TESTING FOR A SHORT TO GROUND ON FUSES POWERING SEVERAL LOADS

(1) Refer to the wiring diagrams and disconnect or isolate all items on the suspected fused circuits.

(2) Replace the blown fuse.

(3) Supply power to the fuse by turning ON the ignition switch or re-connecting the battery.

(4) Start connecting or energizing the items in the fuse circuit one at a time. When the fuse blows the circuit with the short to ground has been isolated.

WIRING DIAGRAM INFORMATION (Continued)

STANDARD PROCEDURE - TESTING FOR A VOLTAGE DROP

(1) Connect the positive lead of the voltmeter to the side of the circuit closest to the battery (Fig. 9).

(2) Connect the other lead of the voltmeter to the other side of the switch, component or circuit.

(3) Operate the item.

(4) The voltmeter will show the difference in voltage between the two points.

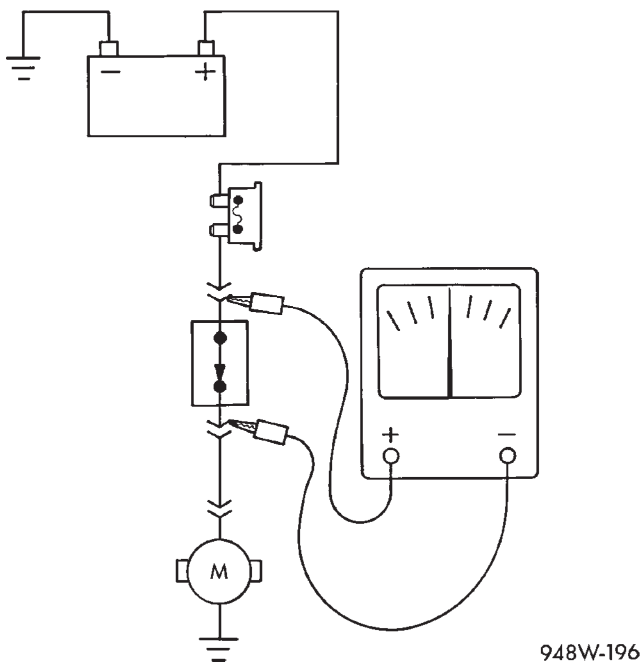
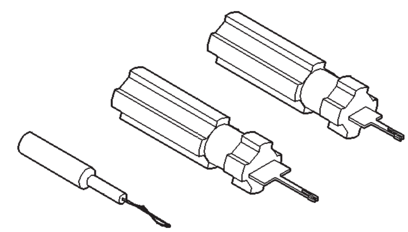


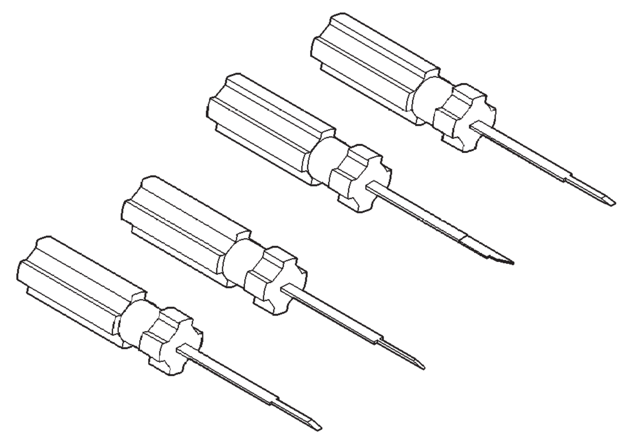
Fig. 9 TESTING FOR VOLTAGE DROP

SPECIAL TOOLS

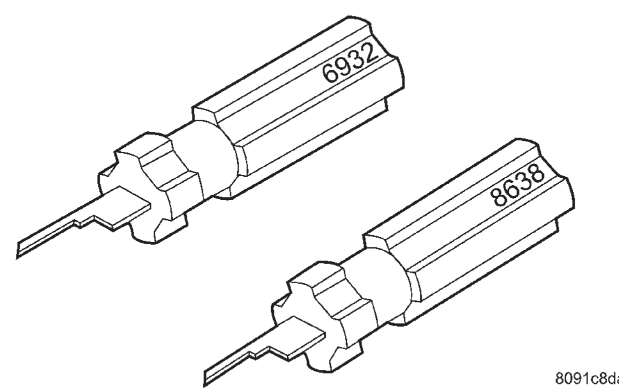
WIRING/TERMINAL



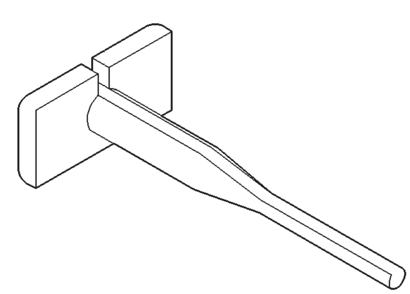
PROBING TOOL PACKAGE 6807



TERMINAL PICK TOOL SET 6680



TERMINAL REMOVING TOOLS 6932 AND 8638



TERMINAL REMOVING TOOL 6934

CONNECTOR

REMOVAL

(1) Disconnect battery.
(2) Release Connector Lock (Fig. 10).
(3) Disconnect the connector being repaired from its mating half/component.
(4) Remove the dress cover (if applicable) (Fig. 10).

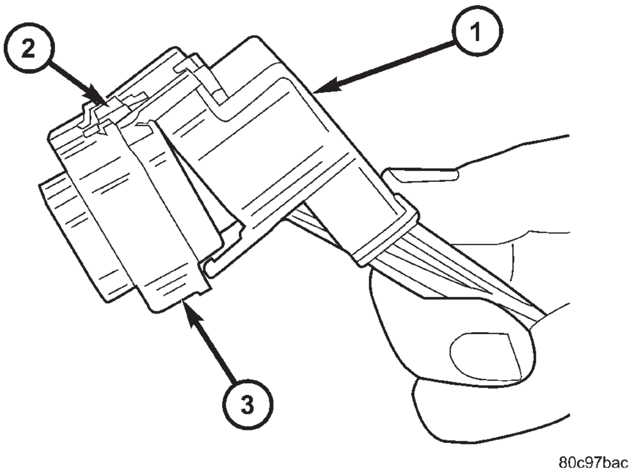


Fig. 10 REMOVAL OF DRESS COVER

1 - DRESS COVER
2 - CONNECTOR LOCK
3 - CONNECTOR

(5) Release the Secondary Terminal Lock, if required (Fig. 11).
(6) Position the connector locking finger away from the terminal using the proper special tool. Pull on the wire to remove the terminal from the connector (Fig. 12).

INSTALLATION

(1) Insert the removed terminal in the same cavity on the repair connector.
(2) Repeat steps for each terminal 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.
(3) When the connector is re-assembled, the secondary terminal lock must be placed in the locked position to prevent terminal push out.
(4) Replace dress cover (if applicable).
(5) Connect connector to its mating half/component.
(6) Connect battery and test all affected systems.

CONNECTOR (Continued)

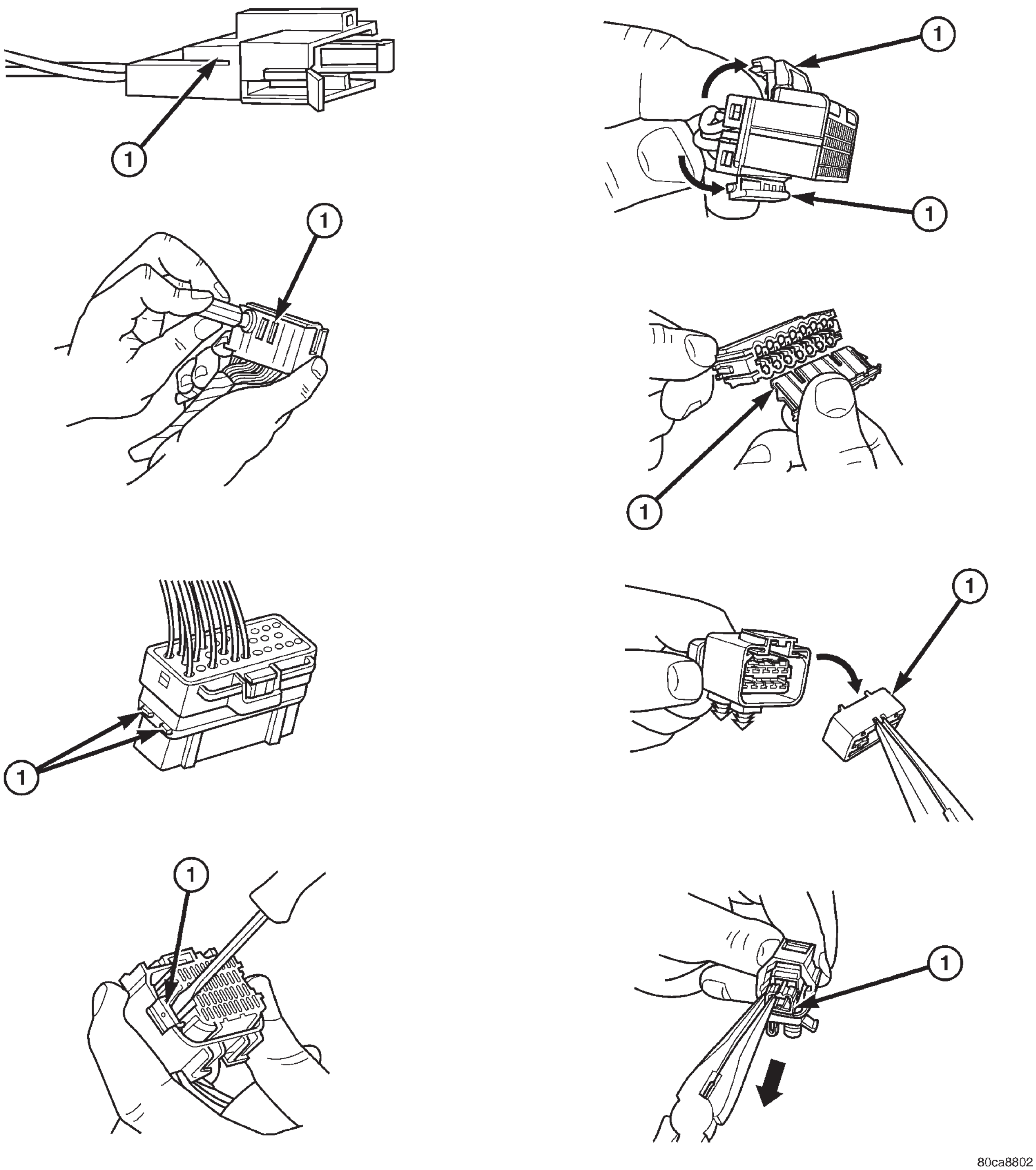


Fig. 11 EXAMPLES OF CONNECTOR SECONDARY TERMINAL LOCKS

1 - Secondary Terminal Lock

CONNECTOR (Continued)

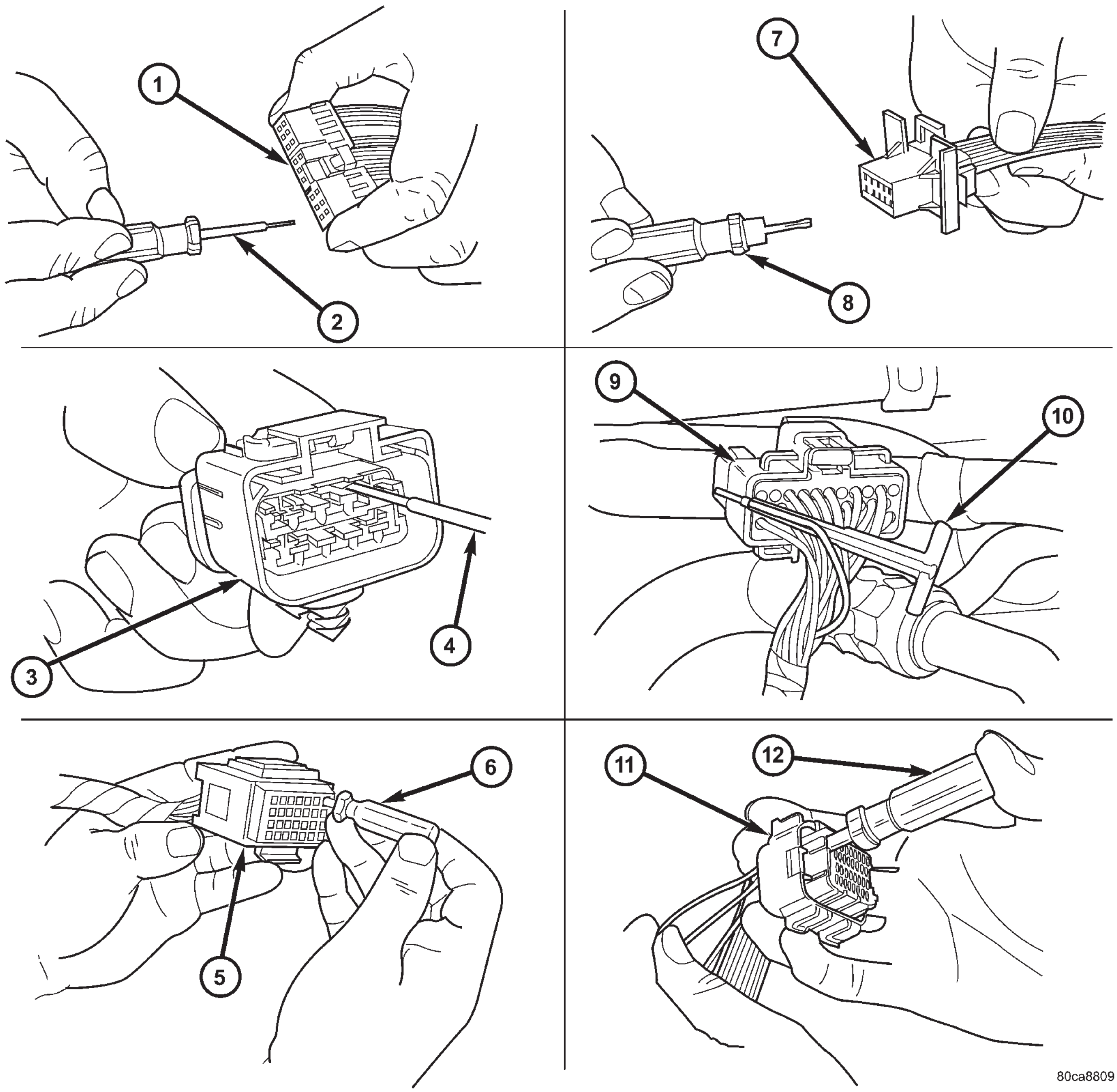


Fig. 12 TERMINAL REMOVAL

1 - TYPICAL CONNECTOR
2 - PICK FROM SPECIAL TOOL KIT 6680
3 - APEX CONNECTOR
4 - PICK FROM SPECIAL TOOL KIT 6680
5 - AUGAT CONNECTOR
6 - SPECIAL TOOL 6932
7 - MOLEX CONNECTOR
8 - SPECIAL TOOL 6742
9 - THOMAS AND BETTS CONNECTOR
10 - SPECIAL TOOL 6934
11 - TYCO CONNECTOR
12 - SPECIAL TOOL 8638

DIODE

REMOVAL

(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. 13).

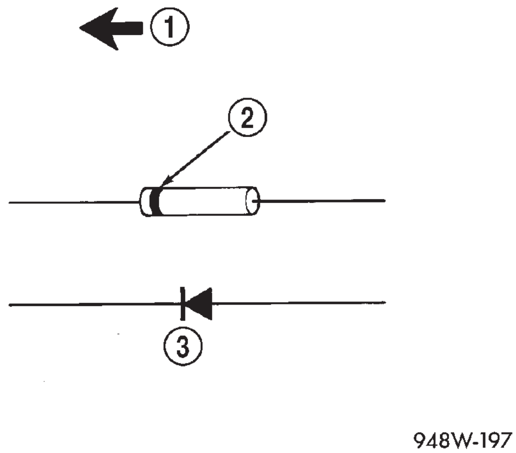


Fig. 13 DIODE IDENTIFICATION

1 - CURRENT FLOW
2 - BAND AROUND DIODE INDICATES CURRENT FLOW
3 - DIODE AS SHOWN IN THE DIAGRAMS

INSTALLATION

(1) Remove the insulation from the wires in the harness. Only remove enough insulation to solder in the new diode.

(2) Install the new diode in the harness, making sure current flow is correct. If necessary, refer to the appropriate wiring diagram for current flow (Fig. 13).

(3) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(4) Tape the diode to the harness using electrical tape. Make sure the diode is completely sealed from the elements.

(5) Re-connect the battery and test affected systems.

TERMINAL

REMOVAL

(1) Follow steps for removing terminals described in the connector removal section.

(2) Cut the wire 6 inches from the back of the connector.

INSTALLATION

(1) Select a wire from the terminal repair kit that best matches the color and gage of the wire being repaired.

(2) Cut the repair wire to the proper length and remove one–half (1/2) inch of insulation.

(3) Splice the repair wire to the wire harness (see wire splicing procedure).

(4) Insert the repaired wire into the connector.

(5) Install the connector locking wedge, if required, and reconnect the connector to its mating half/component.

(6) Re-tape the wire harness starting at 1–1/2 inches behind the connector and 2 inches past the repair.

(7) Connect battery and test all affected systems.

WIRE

STANDARD PROCEDURE - WIRE SPLICING

When splicing a wire, it is important that the correct gage be used as shown in the wiring diagrams.

(1) Remove one-half (1/2) inch of insulation from each wire that needs to be spliced.

(2) Place a piece of adhesive lined heat shrink tubing on one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.

(3) Place the strands of wire overlapping each other inside of the splice clip (Fig. 14).

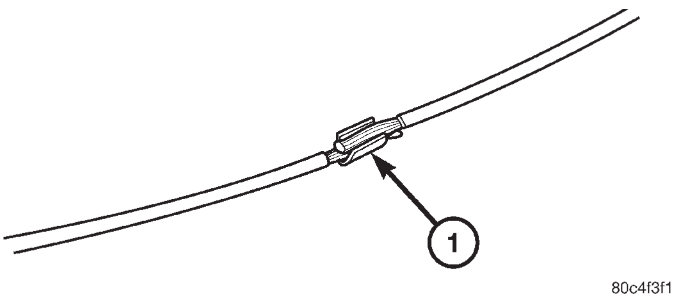


Fig. 14 SPLICE BAND

1 - SPLICE BAND

(4) Using crimping tool, Mopar p/n 05019912AA, crimp the splice clip and wires together (Fig. 15).

(5) Solder the connection together using rosin core type solder only (Fig. 16).

CAUTION: DO NOT USE ACID CORE SOLDER.

(6) 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 (Fig. 17).

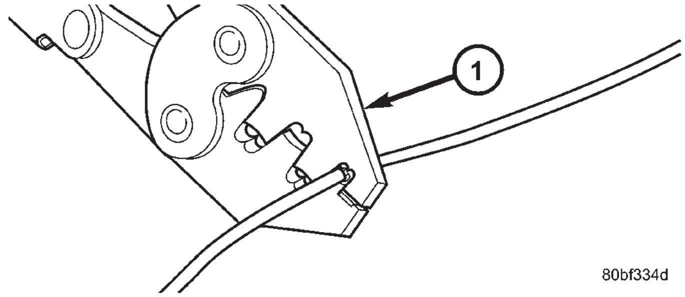


Fig. 15 CRIMPING TOOL

1 - CRIMPING TOOL

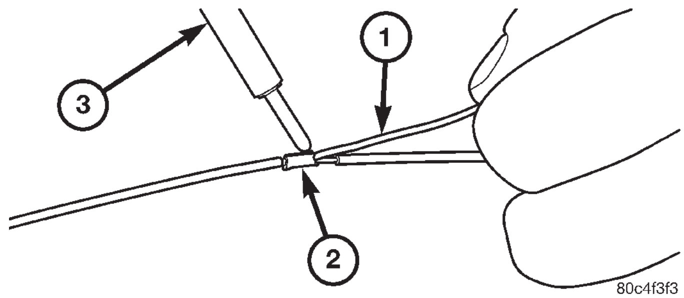


Fig. 16 SOLDER SPLICE

1 - SOLDER
2 - SPLICE BAND
3 - SOLDERING IRON

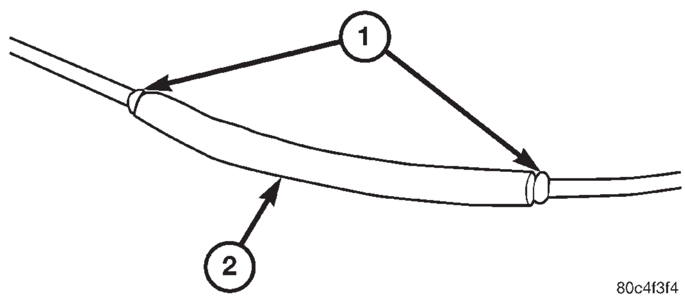


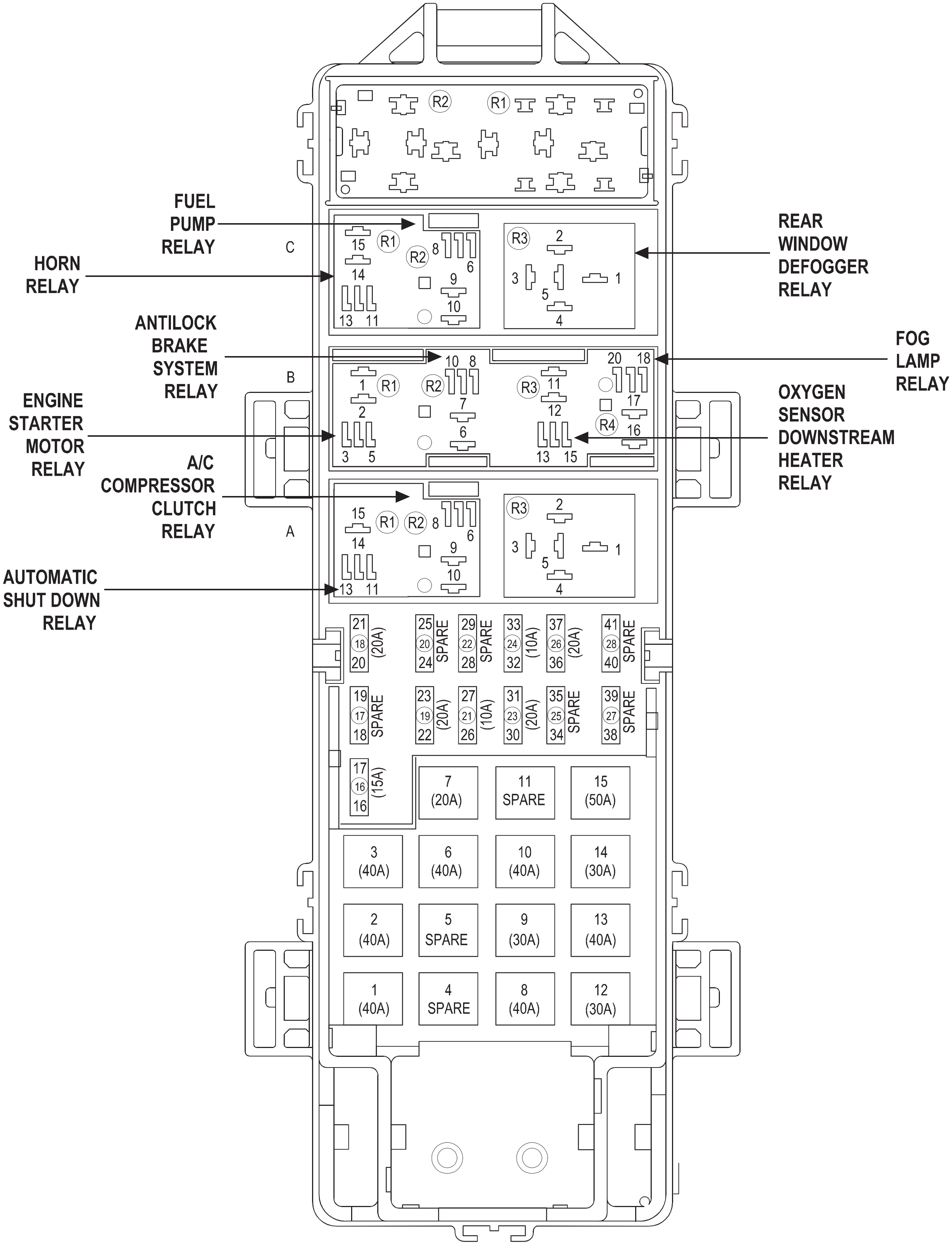
Fig. 17 HEAT SHRINK TUBE

1 - SEALANT
2 - HEAT SHRINK TUBE

8W-02 COMPONENT INDEX

8W-10 POWER DISTRIBUTION

POWER DISTRIBUTION CENTER



FUSES

FUSE NO.	AMPS	FUSED CIRCUIT	FUNCTION
1	40A	A111 12RD/LB	FUSED B(+)
2	40A	INTERNAL	INTERNAL
3	40A	A6 12RD/BK	FUSED B(+)
4	-	-	-
5	-	-	-
6	40A	A2 12PK/BK ▿▿	FUSED B(+)
		INTERNAL	INTERNAL
7	20A	L9 16BK/WT ▿▿	FUSED B(+)
8	40A	A10 12RD/DG	FUSED B(+)
9	30A	A14 14RD/WT	FUSED B(+)
		INTERNAL	INTERNAL
10	40A	A3 12RD/WT	FUSED B(+)
11	-	-	-
12	30A	A20 12RD/DB	FUSED B(+)
13	40A	F30 12RD/PK	FUSED B(+)
14	30A	A1 14RD	FUSED B(+)
15	50A	M1 16PK/WT	FUSED B(+)
16	15A	F142 18OR/DG	AUTOMATIC SHUT DOWN RELAY OUTPUT
17	-	-	-
18	20A	INTERNAL	INTERNAL
		INTERNAL	INTERNAL
19	20A	F39 16PK/LG	FUSED B(+)
20	-	-	-
21	10A	INTERNAL	INTERNAL
22	-	-	-
23	20A	INTERNAL	INTERNAL
24	10A	M1 20PK/WT	FUSED B(+)
25	-	-	-
26	20A	F42 18DG/LG	AUTOMATIC SHUT DOWN RELAY OUTPUT
27	-	-	-
28	-	-	-

▿▿ ABS

A/C COMPRESSOR CLUTCH RELAY

CAVITY	CIRCUIT	FUNCTION
A6	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN-START)
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(+)

ANTILOCK BRAKE SYSTEM RELAY

CAVITY	CIRCUIT	FUNCTION
B6	G19 20LG/OR	ABS WARNING INDICATOR DRIVER
B7	-	-
B8	F20 20VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
B9	Z1 18BK	GROUND
B10	G83 18GY/BK	ABS SYSTEM RELAY CONTROL

AUTOMATIC SHUT DOWN RELAY

CAVITY	CIRCUIT	FUNCTION
A11	K51 18DB/YL	AUTOMATIC SHUT DOWN RELAY CONTROL
A12	-	-
A13	F15 20DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
	F15 20DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
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 (START)

FOG LAMP RELAY

CAVITY	CIRCUIT	FUNCTION
B16	F61 16WT/OR	FUSED B(+)
B17	-	-
B18	G34 14RD/GY ●	HIGH BEAM INDICATOR
B18	L3 14RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
B19	L39 16LB	FOG LAMP LAMP NO. 1 OUTPUT
B20	Z1 18BK	GROUND

FUEL PUMP RELAY

CAVITY	CIRCUIT	FUNCTION
C6	F15 20DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
	F15 20DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
C7	-	-
C8	K31 18BR	FUEL PUMP RELAY CONTROL
C9	A141 18DG/WT	FUEL PUMP RELAY OUTPUT
C10	A61 18DG/BK	FUSED B(+)

● DRL

HORN RELAY

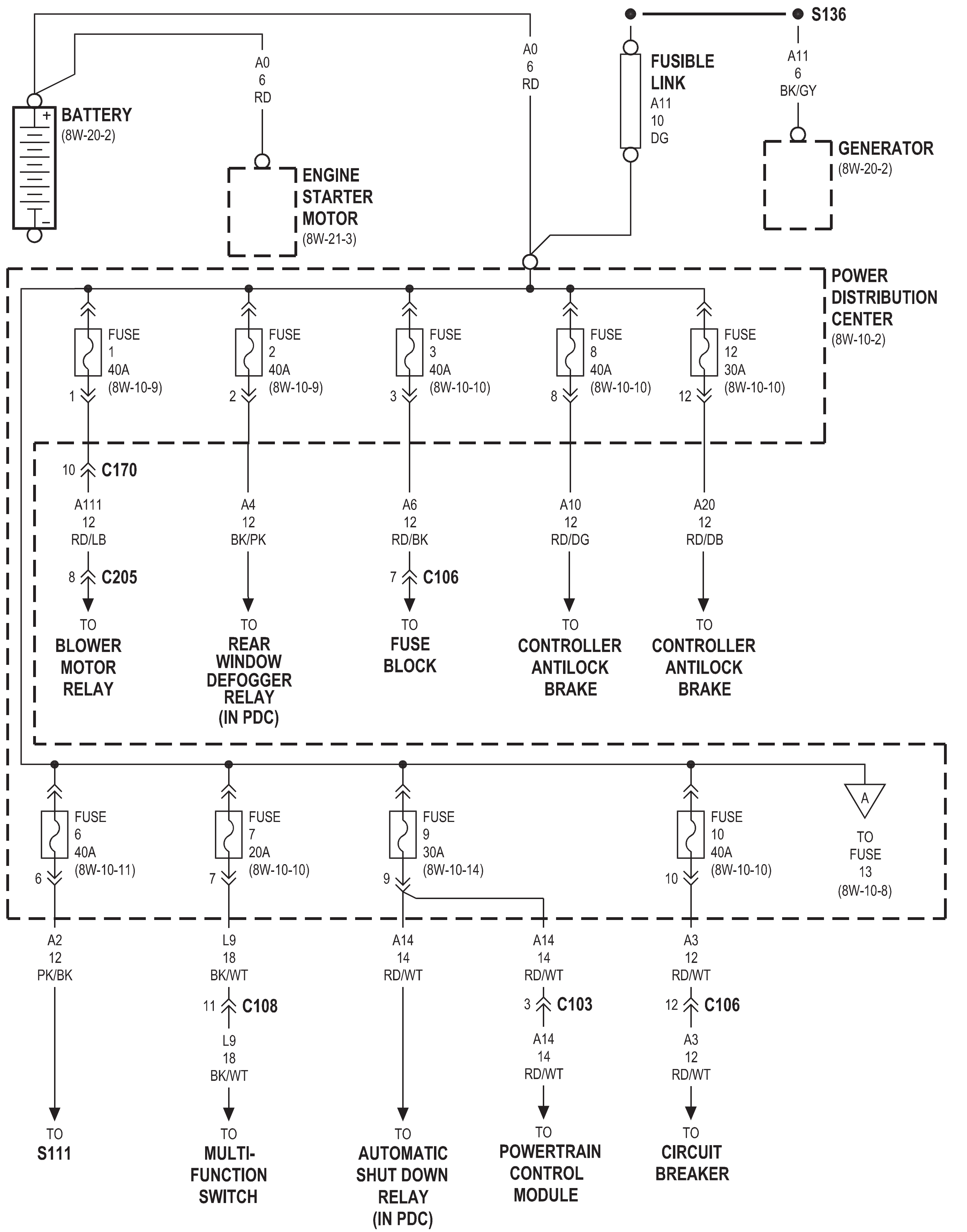
CAVITY	CIRCUIT	FUNCTION
C11	F31 18VT	FUSED B(+)
C12	-	-
C13	X3 20RD/YL	HORN RELAY CONTROL
C14	X2 18WT/RD	HORN RELAY OUTPUT
C15	F31 18VT	FUSED B(+)

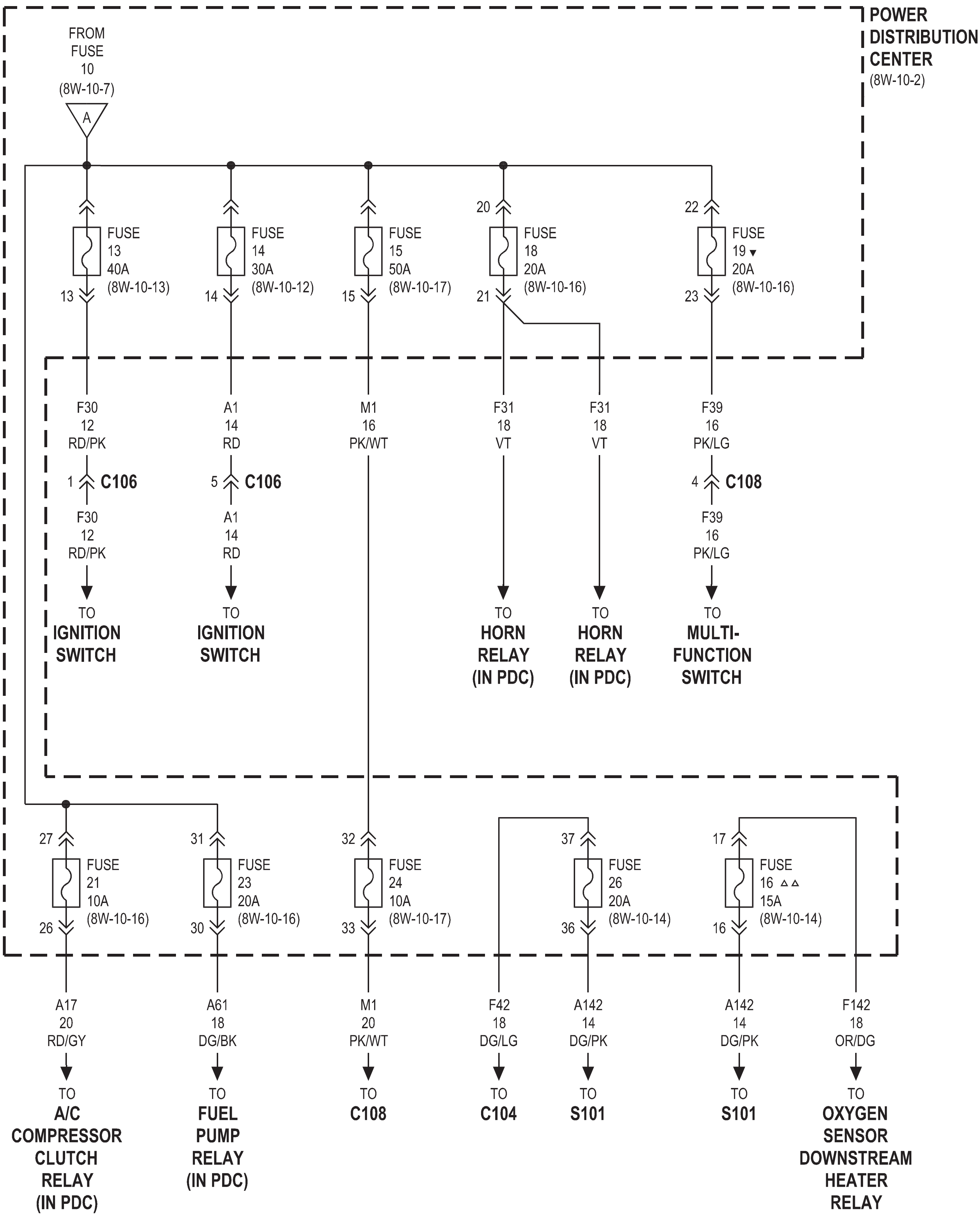
OXYGEN SENSOR DOWNSTREAM HEATER RELAY

CAVITY	CIRCUIT	FUNCTION
B11	A142 18OR/DG	FUSED B(+)
	A142 18OR/DG	FUSED B(+)
B12	A242 18VT/OR	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
B13	F142 18 OR/DG	FUSED B(+)
	F142 18 OR/DG	FUSED B(+)
B14	-	-
B15	K512 18RD/YL	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT

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	-	-


S136
FUSIBLE LINK
A11
10
DG
A11
6
BK/GY
GENERATOR
(8W-20-2)
BATTERY
(8W-20-2)
A0
6
RD
A0
6
RD
ENGINE STARTER MOTOR
(8W-21-3)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 1 40A (8W-10-9)
FUSE 2 40A (8W-10-9)
FUSE 3 40A (8W-10-10)
FUSE 8 40A (8W-10-10)
FUSE 12 30A (8W-10-10)
10 C170
A111 12 RD/LB
8 C205
TO BLOWER MOTOR RELAY
A4 12 BK/PK
TO REAR WINDOW DEFOGGER RELAY (IN PDC)
A6 12 RD/BK
7 C106
TO FUSE BLOCK
A10 12 RD/DG
TO CONTROLLER ANTILOCK BRAKE
A20 12 RD/DB
TO CONTROLLER ANTILOCK BRAKE
FUSE 6 40A (8W-10-11)
FUSE 7 20A (8W-10-10)
FUSE 9 30A (8W-10-14)
FUSE 10 40A (8W-10-10)
A
TO FUSE 13 (8W-10-8)
A2 12 PK/BK
TO S111
L9 18 BK/WT
11 C108
L9 18 BK/WT
TO MULTI-FUNCTION SWITCH
A14 14 RD/WT
TO AUTOMATIC SHUT DOWN RELAY (IN PDC)
A14 14 RD/WT
3 C103
A14 14 RD/WT
TO POWERTRAIN CONTROL MODULE
A3 12 RD/WT
12 C106
A3 12 RD/WT
TO CIRCUIT BREAKER



▼ FRONT FOG LAMPS

△△ EXCEPT CALIFORNIA/EUROPEAN III

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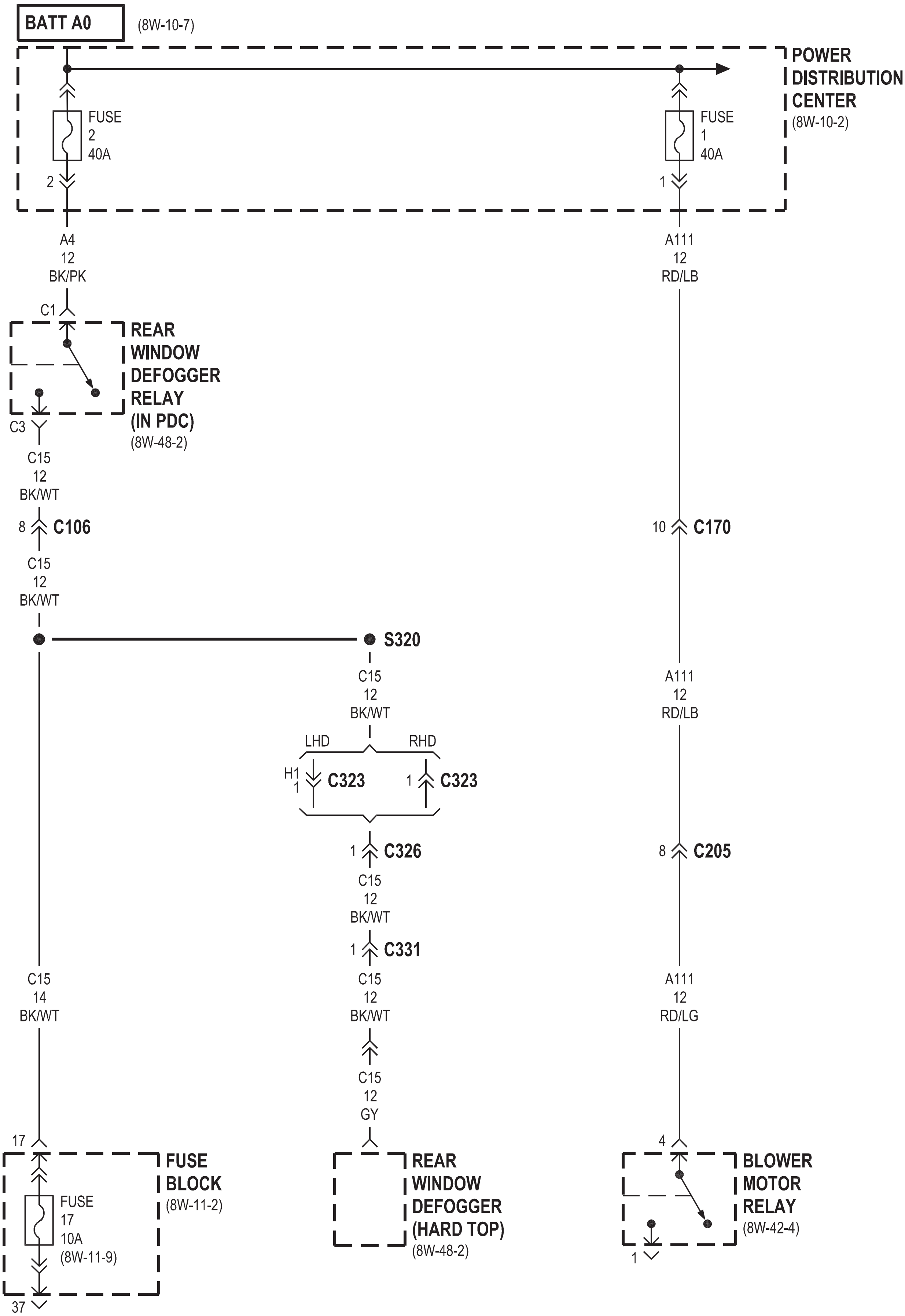
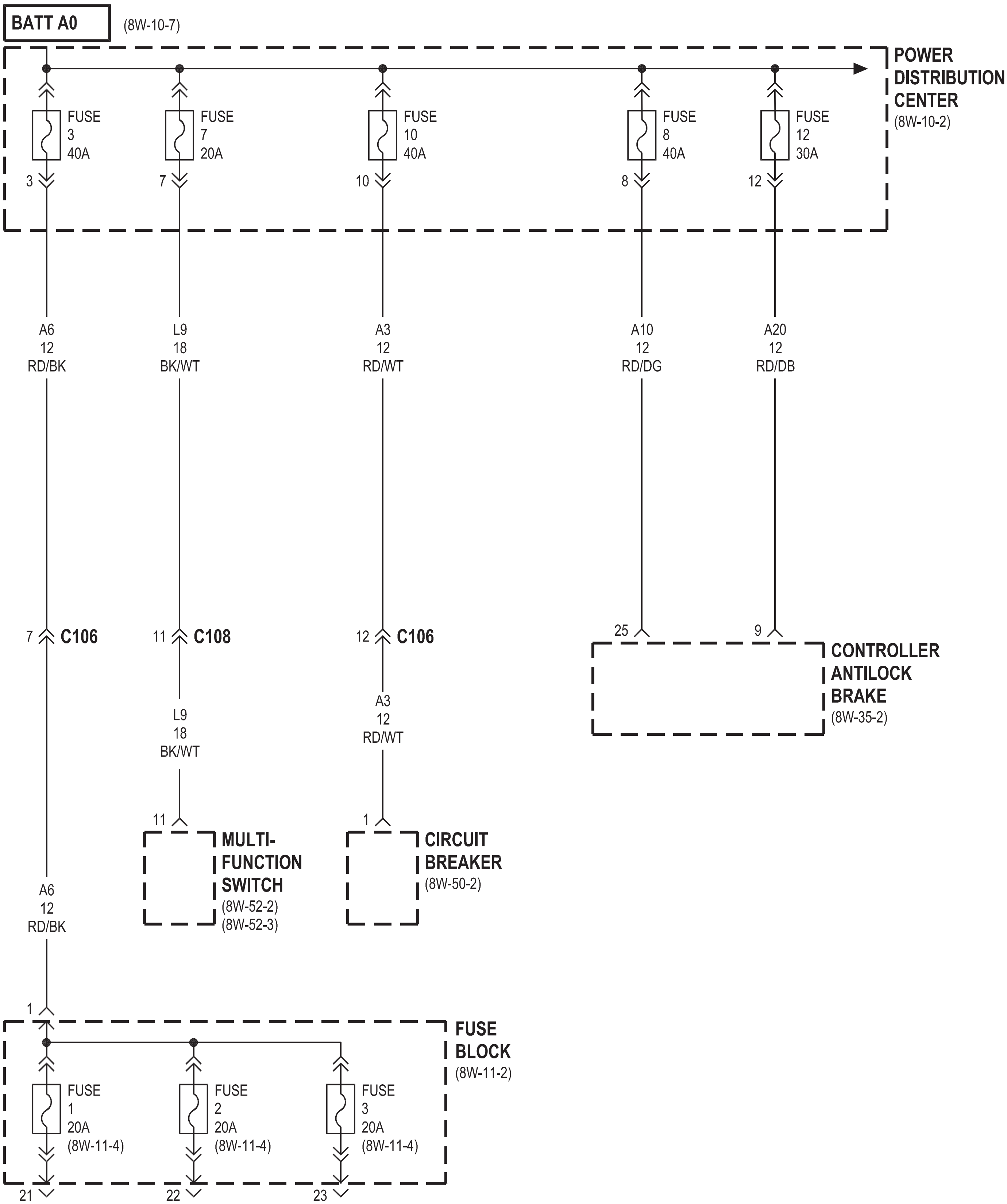
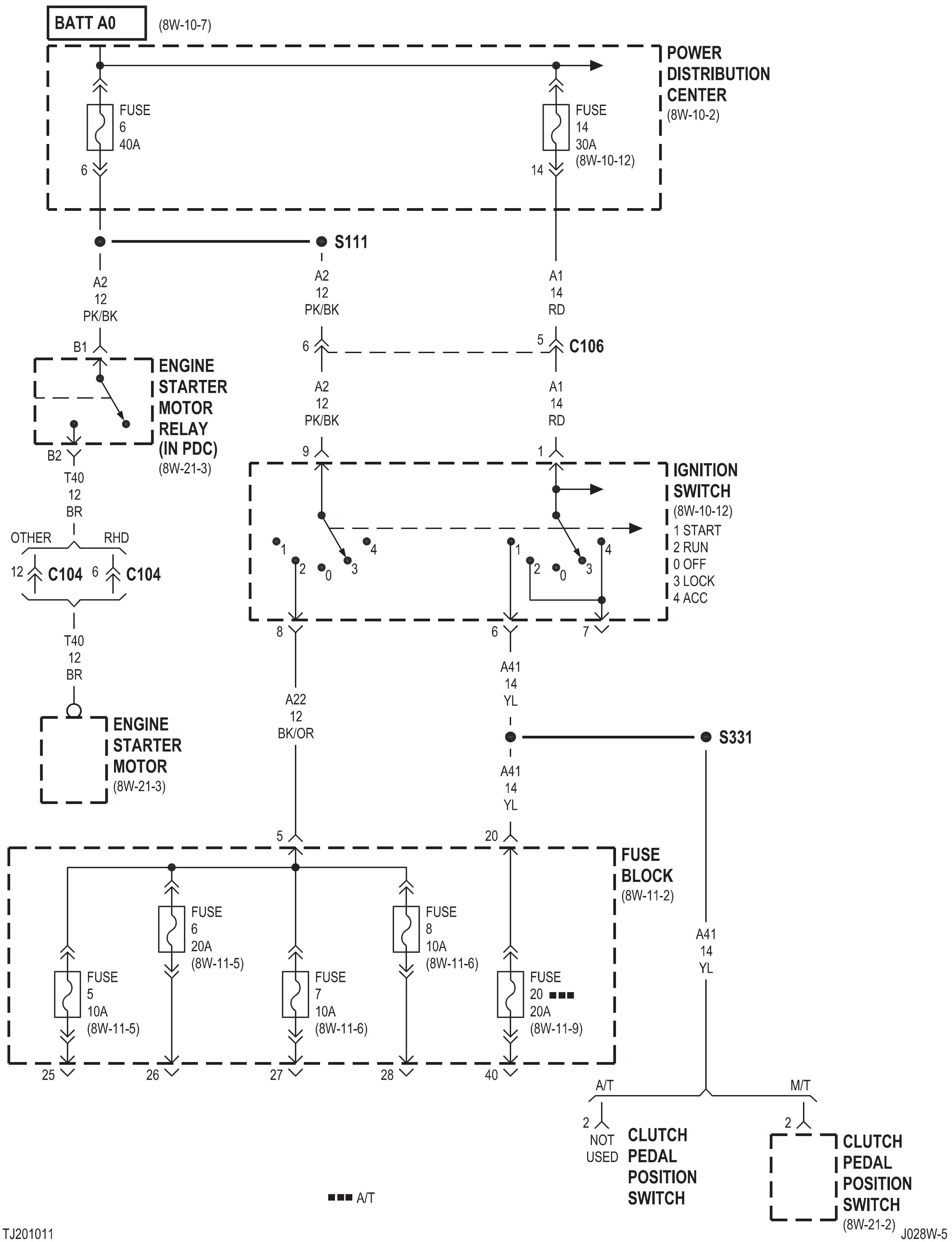
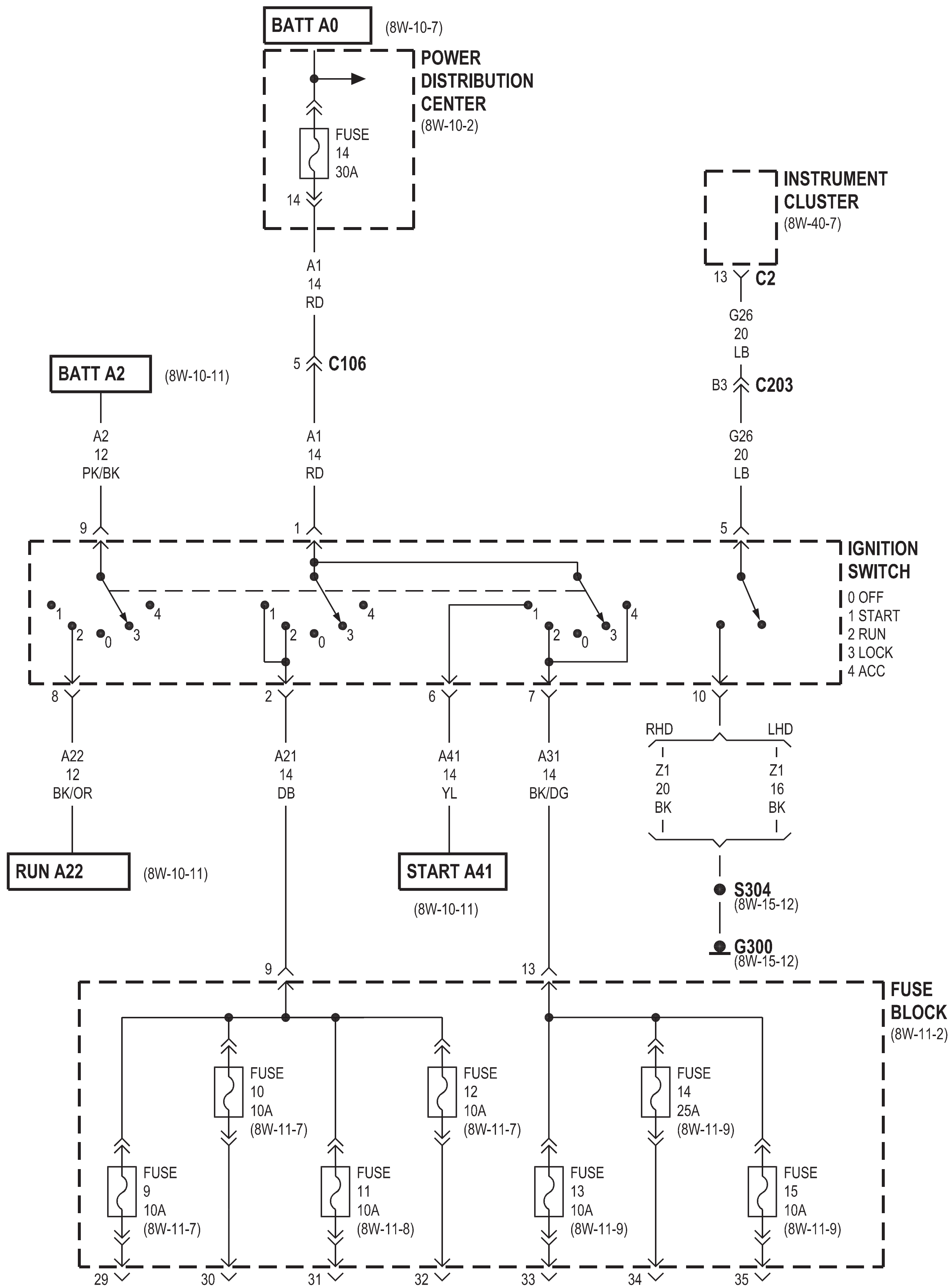
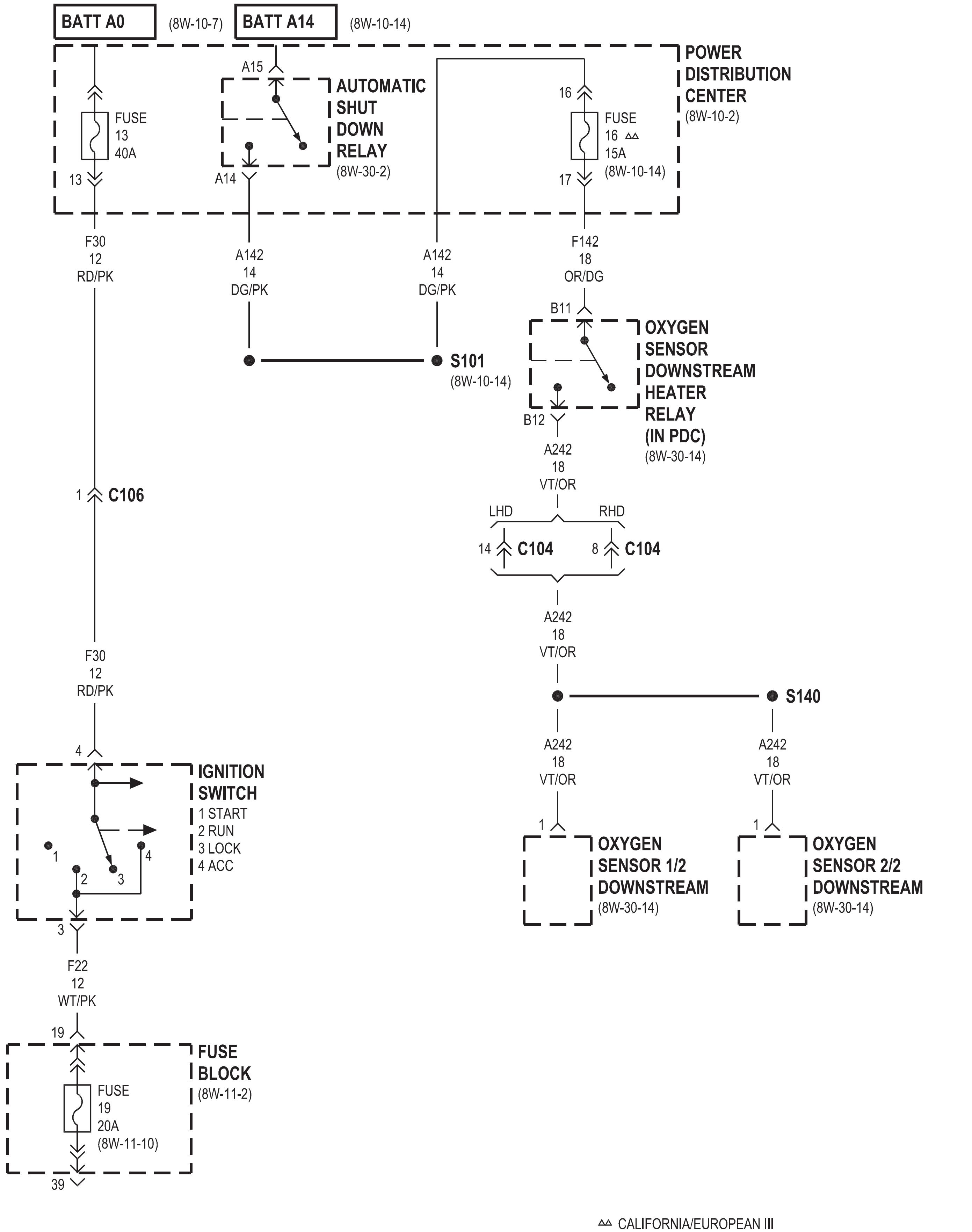
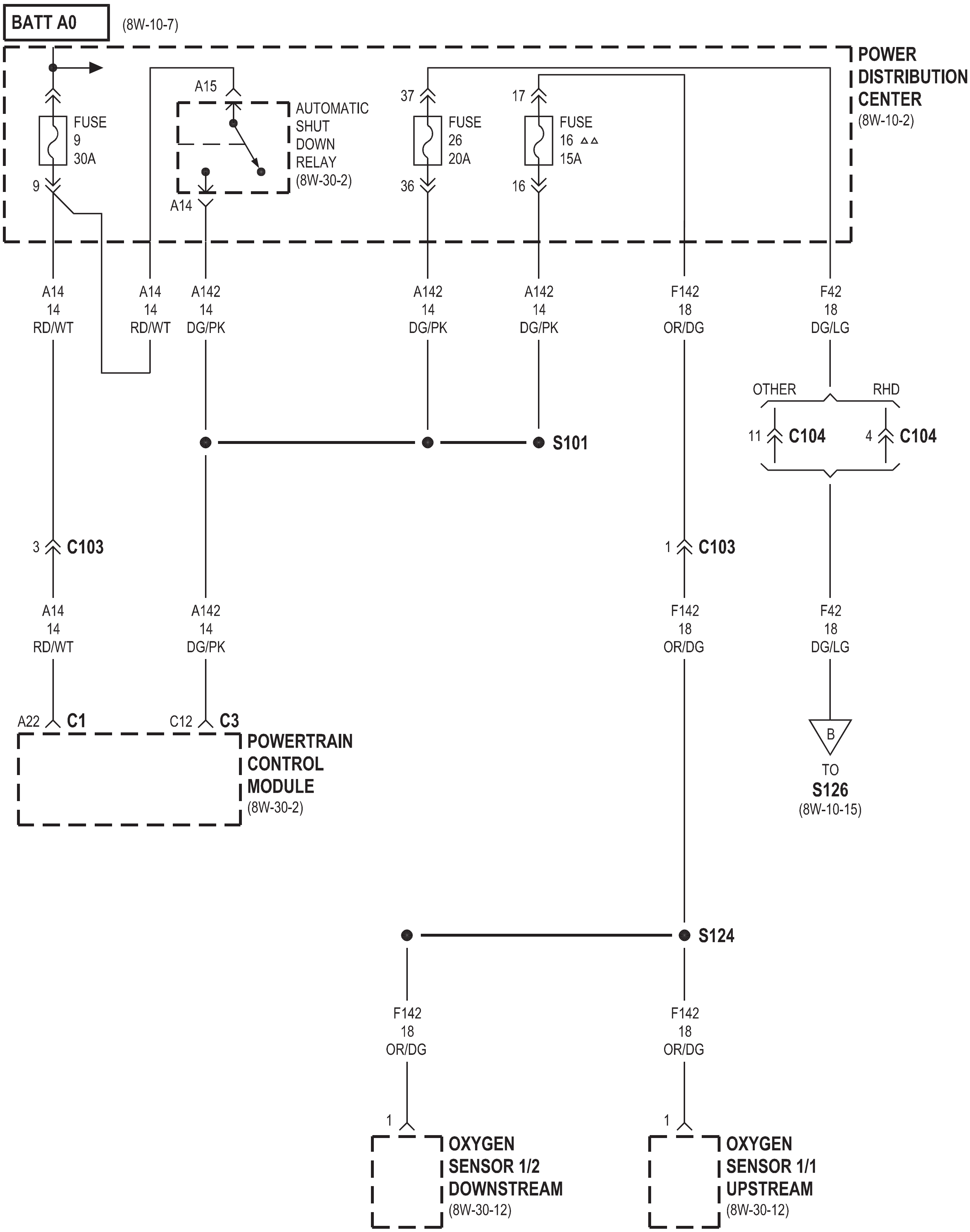

BATT A0
(8W-10-7)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
2
40A
2
FUSE
1
40A
1
A4
12
BK/PK
A111
12
RD/LB
C1
REAR
WINDOW
DEFOGGER
RELAY
(IN PDC)
(8W-48-2)
C3
C15
12
BK/WT
8
C106
10
C170
C15
12
BK/WT
S320
C15
12
BK/WT
A111
12
RD/LB
LHD
RHD
H1
1
C323
1
C323
1
C326
8
C205
C15
12
BK/WT
1
C331
C15
14
BK/WT
C15
12
BK/WT
A111
12
RD/LG
C15
12
GY
17
FUSE
BLOCK
(8W-11-2)
FUSE
17
10A
(8W-11-9)
37
REAR
WINDOW
DEFOGGER
(HARD TOP)
(8W-48-2)
4
BLOWER
MOTOR
RELAY
(8W-42-4)
1


BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 3 40A
FUSE 7 20A
FUSE 10 40A
FUSE 8 40A
FUSE 12 30A
3
7
10
8
12
A6 12 RD/BK
L9 18 BK/WT
A3 12 RD/WT
A10 12 RD/DG
A20 12 RD/DB
7 C106
11 C108
12 C106
L9 18 BK/WT
A3 12 RD/WT
25
9
CONTROLLER ANTILOCK BRAKE
(8W-35-2)
11
MULTI-FUNCTION SWITCH
(8W-52-2)
(8W-52-3)
1
CIRCUIT BREAKER
(8W-50-2)
A6 12 RD/BK
1
FUSE BLOCK
(8W-11-2)
FUSE 1 20A (8W-11-4)
FUSE 2 20A (8W-11-4)
FUSE 3 20A (8W-11-4)
21
22
23

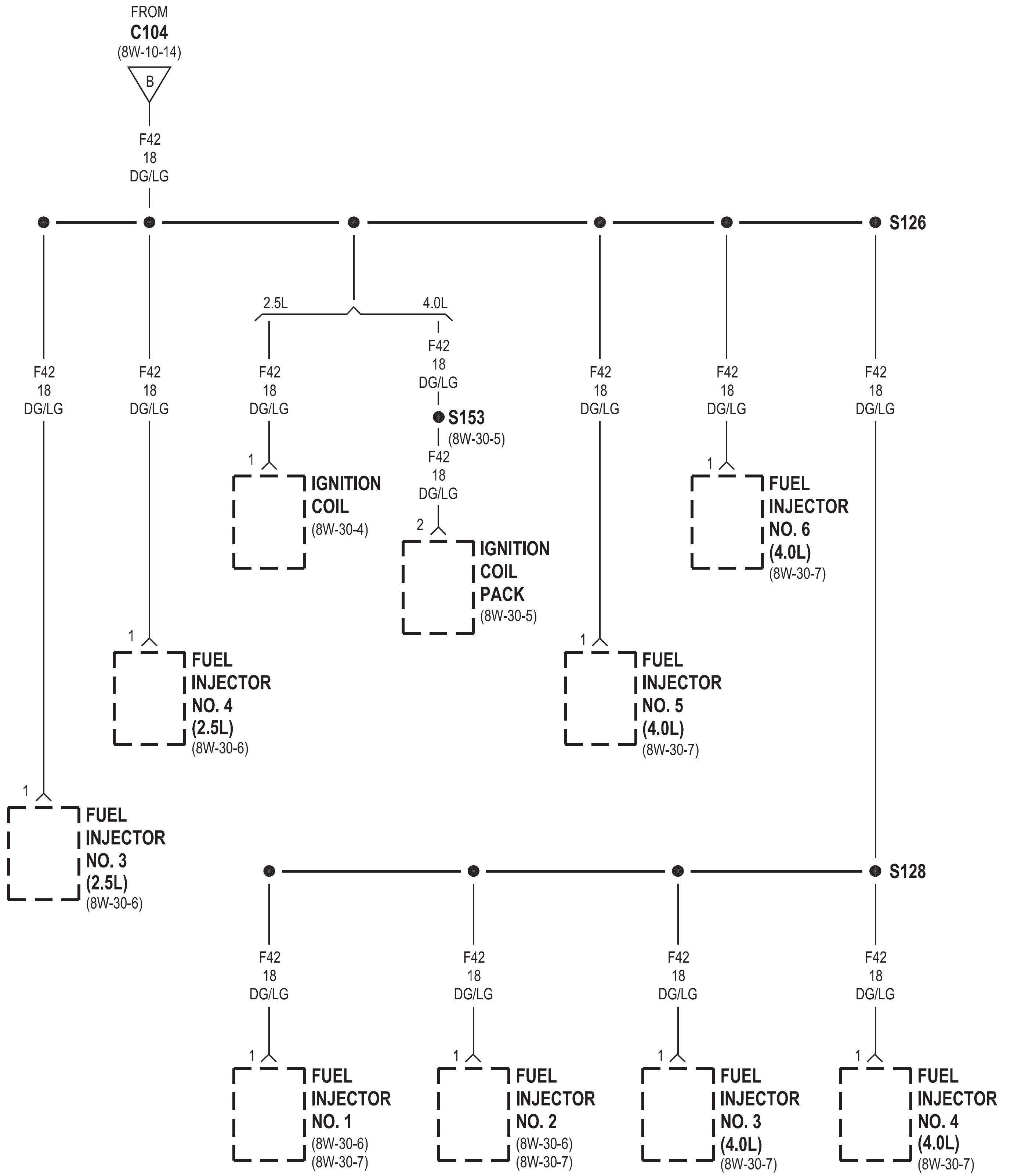

BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 6 40A
FUSE 14 30A (8W-10-12)
S111
A2 12 PK/BK
A1 14 RD
C106
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-3)
B1
B2
T40 12 BR
OTHER
RHD
C104
IGNITION SWITCH
(8W-10-12)
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
A22 12 BK/OR
A41 14 YL
S331
ENGINE STARTER MOTOR
(8W-21-3)
FUSE BLOCK
(8W-11-2)
FUSE 5 10A (8W-11-5)
FUSE 6 20A (8W-11-5)
FUSE 7 10A (8W-11-6)
FUSE 8 10A (8W-11-6)
FUSE 20 ■■■ 20A (8W-11-9)
A/T
M/T
NOT USED
CLUTCH PEDAL POSITION SWITCH
CLUTCH PEDAL POSITION SWITCH
(8W-21-2)
■■■ A/T

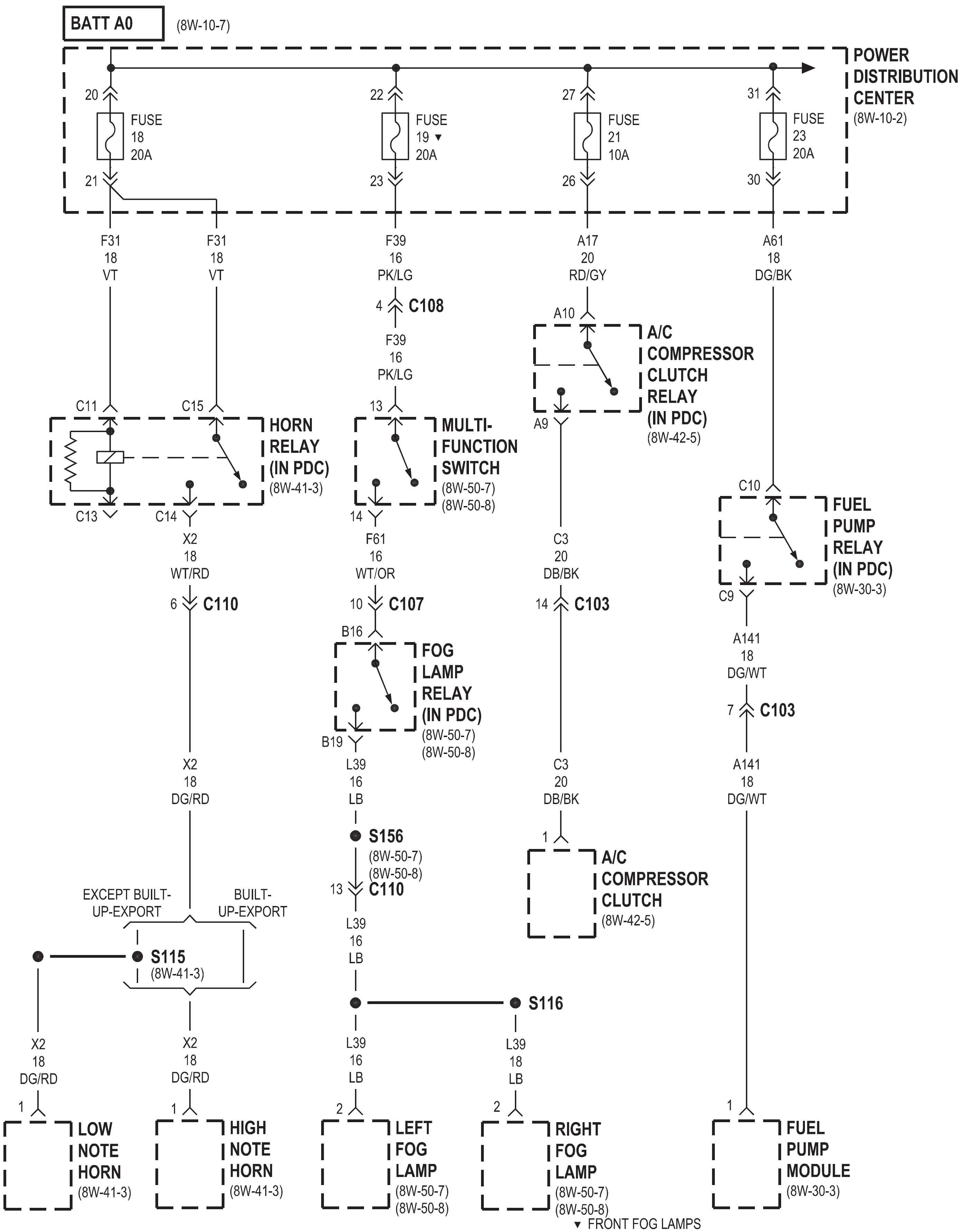

BATT A0
(8W-10-7)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
14
30A
14
A1
14
RD
5
C106
A1
14
RD
1
INSTRUMENT
CLUSTER
(8W-40-7)
13
C2
G26
20
LB
B3
C203
G26
20
LB
5
BATT A2
(8W-10-11)
A2
12
PK/BK
9
IGNITION
SWITCH
0 OFF
1 START
2 RUN
3 LOCK
4 ACC
1
2
0
3
4
8
2
6
7
10
A22
12
BK/OR
RUN A22
(8W-10-11)
A21
14
DB
A41
14
YL
START A41
(8W-10-11)
A31
14
BK/DG
RHD
LHD
Z1
20
BK
Z1
16
BK
S304
(8W-15-12)
G300
(8W-15-12)
9
13
FUSE
BLOCK
(8W-11-2)
FUSE
9
10A
(8W-11-7)
FUSE
10
10A
(8W-11-7)
FUSE
11
10A
(8W-11-8)
FUSE
12
10A
(8W-11-7)
FUSE
13
10A
(8W-11-9)
FUSE
14
25A
(8W-11-9)
FUSE
15
10A
(8W-11-9)
29
30
31
32
33
34
35

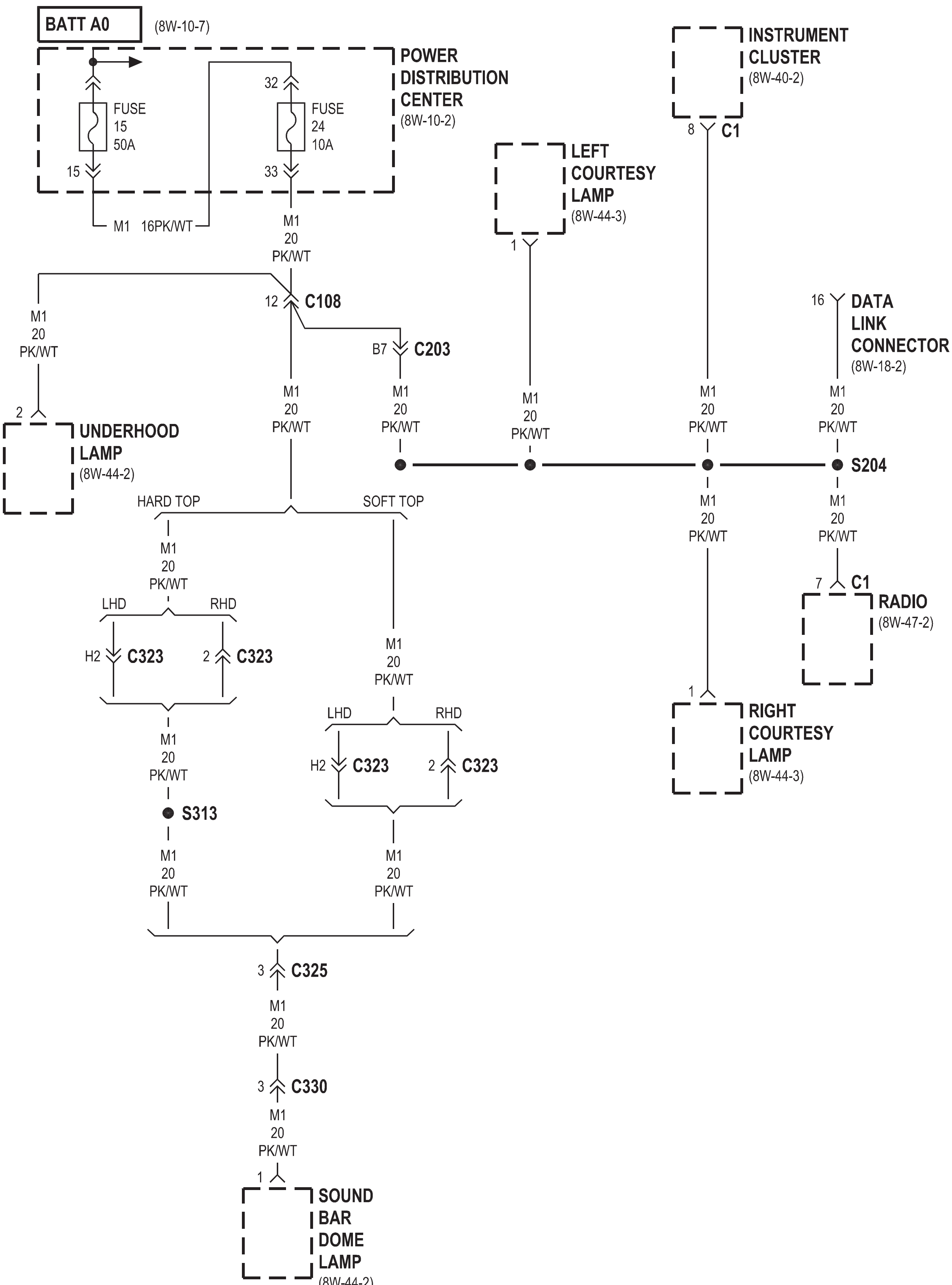

BATT A0
(8W-10-7)
BATT A14
(8W-10-14)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
13
40A
13
A15
AUTOMATIC
SHUT
DOWN
RELAY
(8W-30-2)
A14
16
FUSE
16
15A
(8W-10-14)
17
F30
12
RD/PK
A142
14
DG/PK
A142
14
DG/PK
F142
18
OR/DG
B11
OXYGEN
SENSOR
DOWNSTREAM
HEATER
RELAY
(IN PDC)
(8W-30-14)
S101
(8W-10-14)
B12
A242
18
VT/OR
1
C106
LHD
RHD
14
C104
8
C104
A242
18
VT/OR
F30
12
RD/PK
S140
A242
18
VT/OR
A242
18
VT/OR
4
IGNITION
SWITCH
1 START
2 RUN
3 LOCK
4 ACC
1
2
3
4
1
OXYGEN
SENSOR 1/2
DOWNSTREAM
(8W-30-14)
1
OXYGEN
SENSOR 2/2
DOWNSTREAM
(8W-30-14)
3
F22
12
WT/PK
19
FUSE
BLOCK
(8W-11-2)
FUSE
19
20A
(8W-11-10)
39
CALIFORNIA/EUROPEAN III



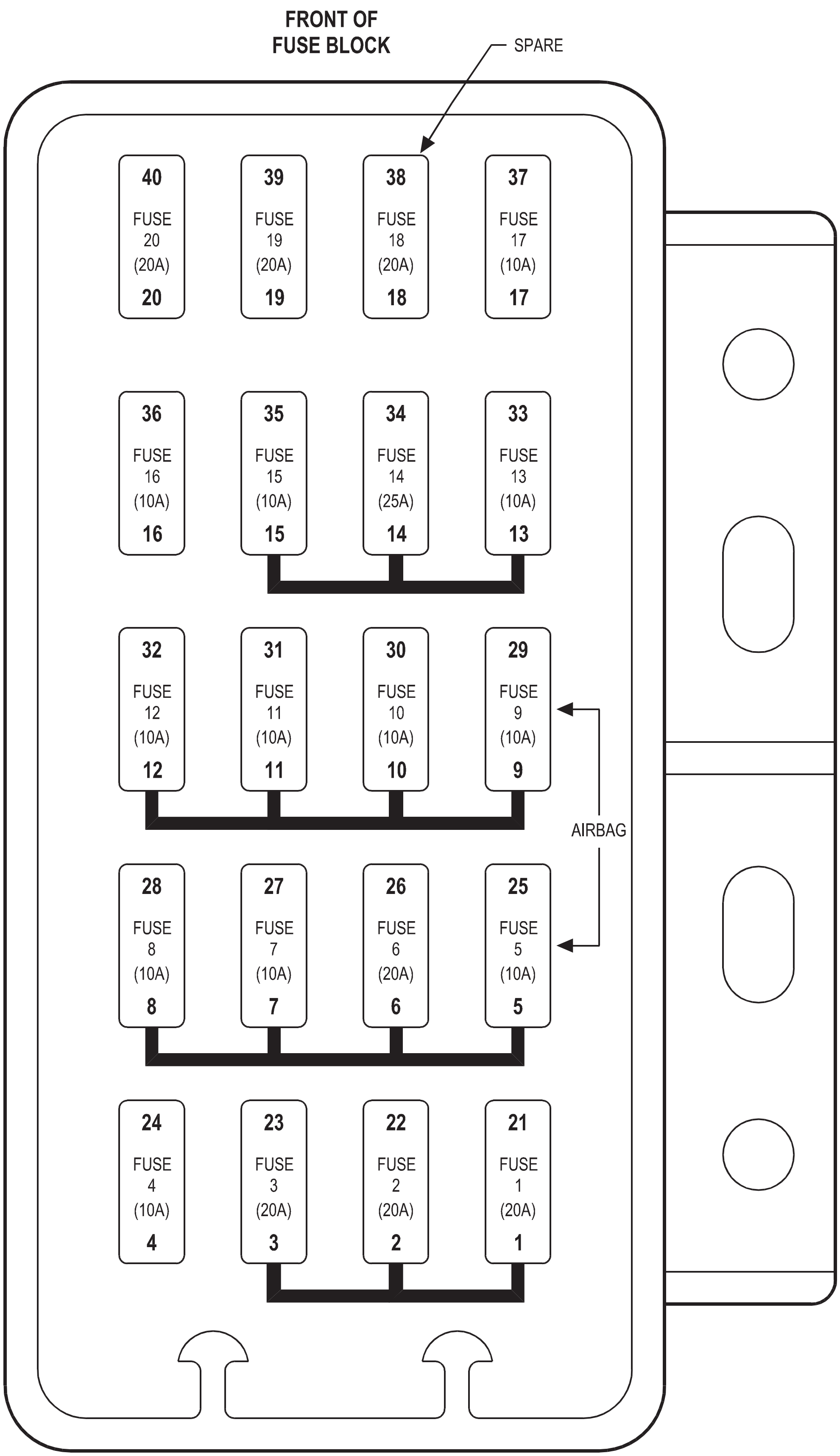
▵▵ EXCEPT CALIFORNIA/EUROPEAN III


FROM
C104
(8W-10-14)
B
F42
18
DG/LG
S126
2.5L
4.0L
F42
18
DG/LG
S153
(8W-30-5)
1
IGNITION
COIL
(8W-30-4)
2
IGNITION
COIL
PACK
(8W-30-5)
FUEL
INJECTOR
NO. 6
(4.0L)
(8W-30-7)
FUEL
INJECTOR
NO. 4
(2.5L)
(8W-30-6)
FUEL
INJECTOR
NO. 5
(4.0L)
(8W-30-7)
FUEL
INJECTOR
NO. 3
(2.5L)
(8W-30-6)
S128
FUEL
INJECTOR
NO. 1
(8W-30-6)
(8W-30-7)
FUEL
INJECTOR
NO. 2
(8W-30-6)
(8W-30-7)
FUEL
INJECTOR
NO. 3
(4.0L)
(8W-30-7)
FUEL
INJECTOR
NO. 4
(4.0L)
(8W-30-7)


BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 18 20A
FUSE 19 ▼ 20A
FUSE 21 10A
FUSE 23 20A
F31 18 VT
F31 18 VT
F39 16 PK/LG
C108
A17 20 RD/GY
A61 18 DG/BK
HORN RELAY (IN PDC)
(8W-41-3)
MULTI-FUNCTION SWITCH
(8W-50-7)
(8W-50-8)
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
(8W-42-5)
FUEL PUMP RELAY (IN PDC)
(8W-30-3)
X2 18 WT/RD
F61 16 WT/OR
C3 20 DB/BK
A141 18 DG/WT
C110
C107
C103
FOG LAMP RELAY (IN PDC)
(8W-50-7)
(8W-50-8)
X2 18 DG/RD
L39 16 LB
S156
(8W-50-7)
(8W-50-8)
A/C COMPRESSOR CLUTCH
(8W-42-5)
EXCEPT BUILT-UP-EXPORT
BUILT-UP-EXPORT
S115
(8W-41-3)
S116
L39 18 LB
LOW NOTE HORN
(8W-41-3)
HIGH NOTE HORN
(8W-41-3)
LEFT FOG LAMP
(8W-50-7)
(8W-50-8)
RIGHT FOG LAMP
(8W-50-7)
(8W-50-8)
FUEL PUMP MODULE
(8W-30-3)
▼ FRONT FOG LAMPS


BATT A0
(8W-10-7)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
15
50A
FUSE
24
10A
15
32
33
M1 16PK/WT
M1
20
PK/WT
12
C108
B7
C203
2
UNDERHOOD
LAMP
(8W-44-2)
HARD TOP
SOFT TOP
LHD
RHD
H2
C323
2
C323
S313
3
C325
3
C330
1
SOUND
BAR
DOME
LAMP
(8W-44-2)
LEFT
COURTESY
LAMP
(8W-44-3)
INSTRUMENT
CLUSTER
(8W-40-2)
8
C1
16
DATA
LINK
CONNECTOR
(8W-18-2)
S204
7
C1
RADIO
(8W-47-2)
RIGHT
COURTESY
LAMP
(8W-44-3)

8W-11 FUSE BLOCK



J028W-5 TJ201102

FUSES

FUSE NO.	AMPS	FUSED CIRCUIT	FUNCTION
1	20A	F33 18PK/RD	FUSED B(+)
		F33 20PK/RD	FUSED B(+)
2	20A	F32 18PK/DB	FUSED B(+)
3	20A	X60 16DG/RD	FUSED B(+)
4	10A	Z1 20BK	DOOR AJAR SWITCH OUTPUT
5	10A	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
6	20A	V23 18BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
7	10A	F20 20VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
8	10A	F24 20RD/DG	FUSED IGNITION SWITCH OUTPUT (RUN)
9	10A	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
		F14 18LG/YL ●●	FUSED IGNITION SWITCH OUTPUT (RUN-START)
10	10A	G5 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
11	10A	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN-START)
12	10A	F15 20DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
		F15 20DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
13	10A	L5 20BK/GY	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
14	25A	V6 16PK/BK	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
		V6 16PK/BK	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
15	10A	X12 16PK	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
16	10A	L22 20LG/DG	DIMMER SWITCH LOW BEAM OUTPUT
17	10A	F81 20DB/RD	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
18	20A	A18 16RD/BK	FUSED B(+)
19	20A	F38 16LB	FUSED IGNITION SWITCH OUTPUT (RUN)
		F38 16LB	FUSED IGNITION SWITCH OUTPUT (RUN)
20	20A	T141 14YL/RD ■■■	FUSED IGNITION SWITCH OUTPUT (START)

●● RHD
■■■ ATX

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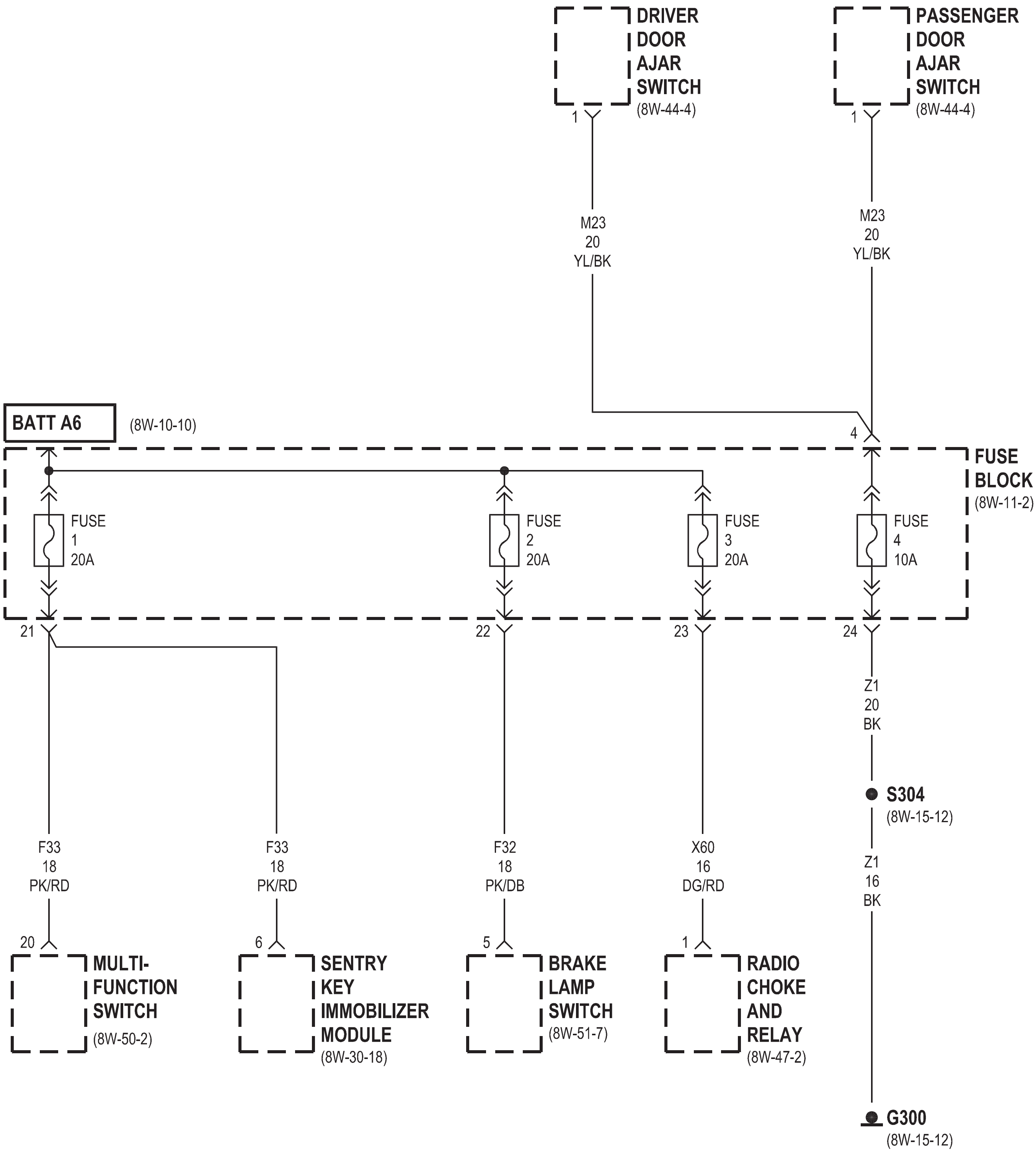
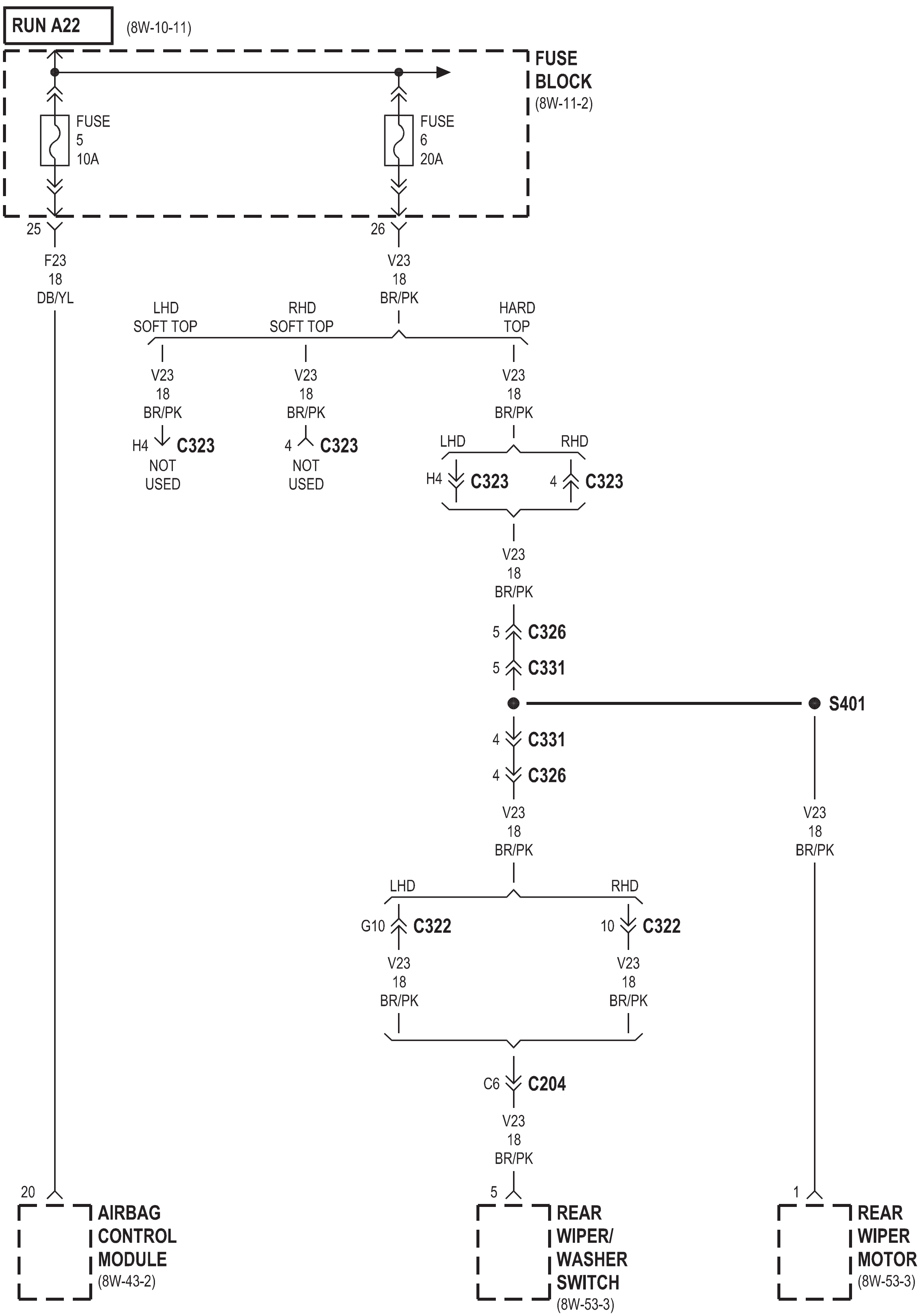
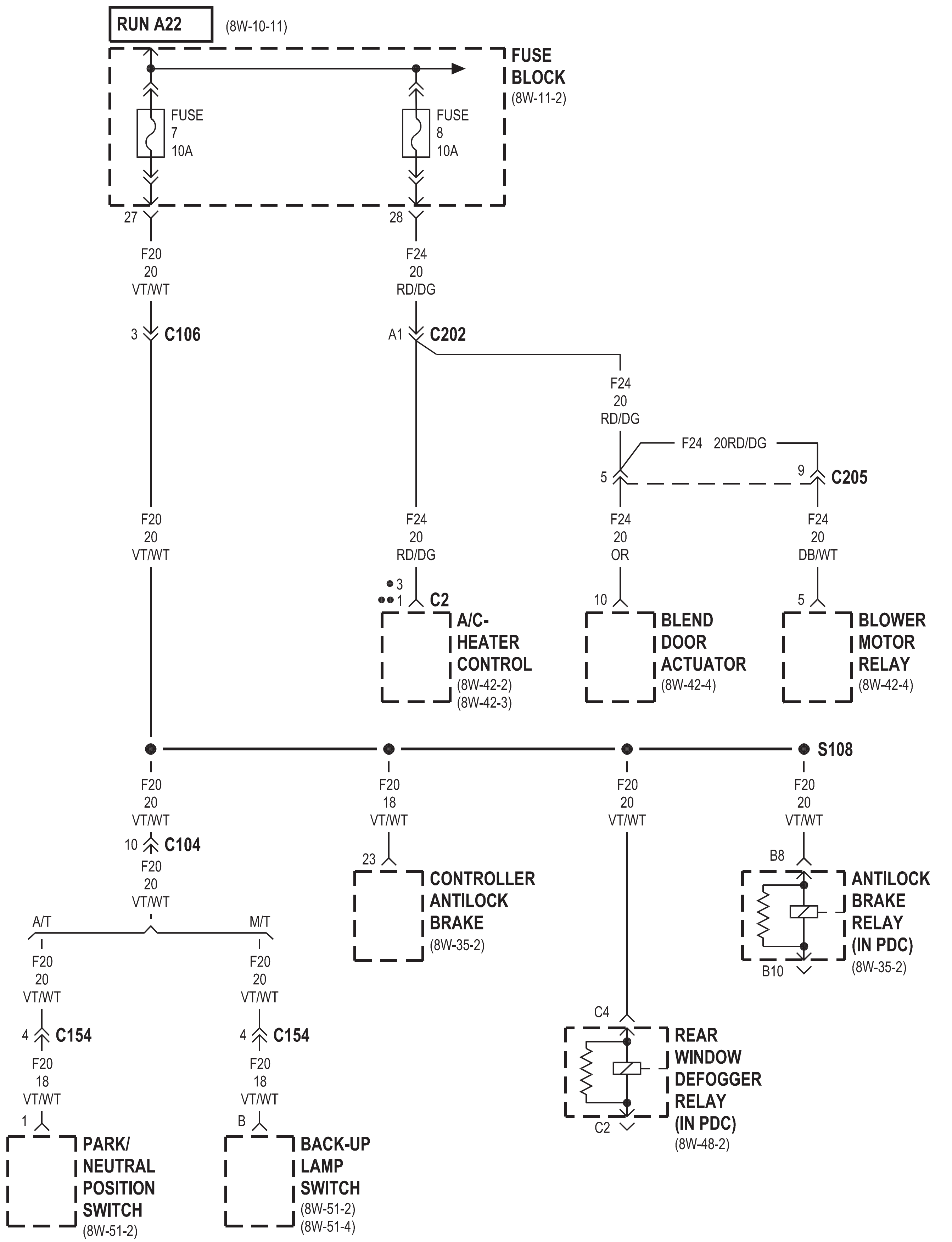
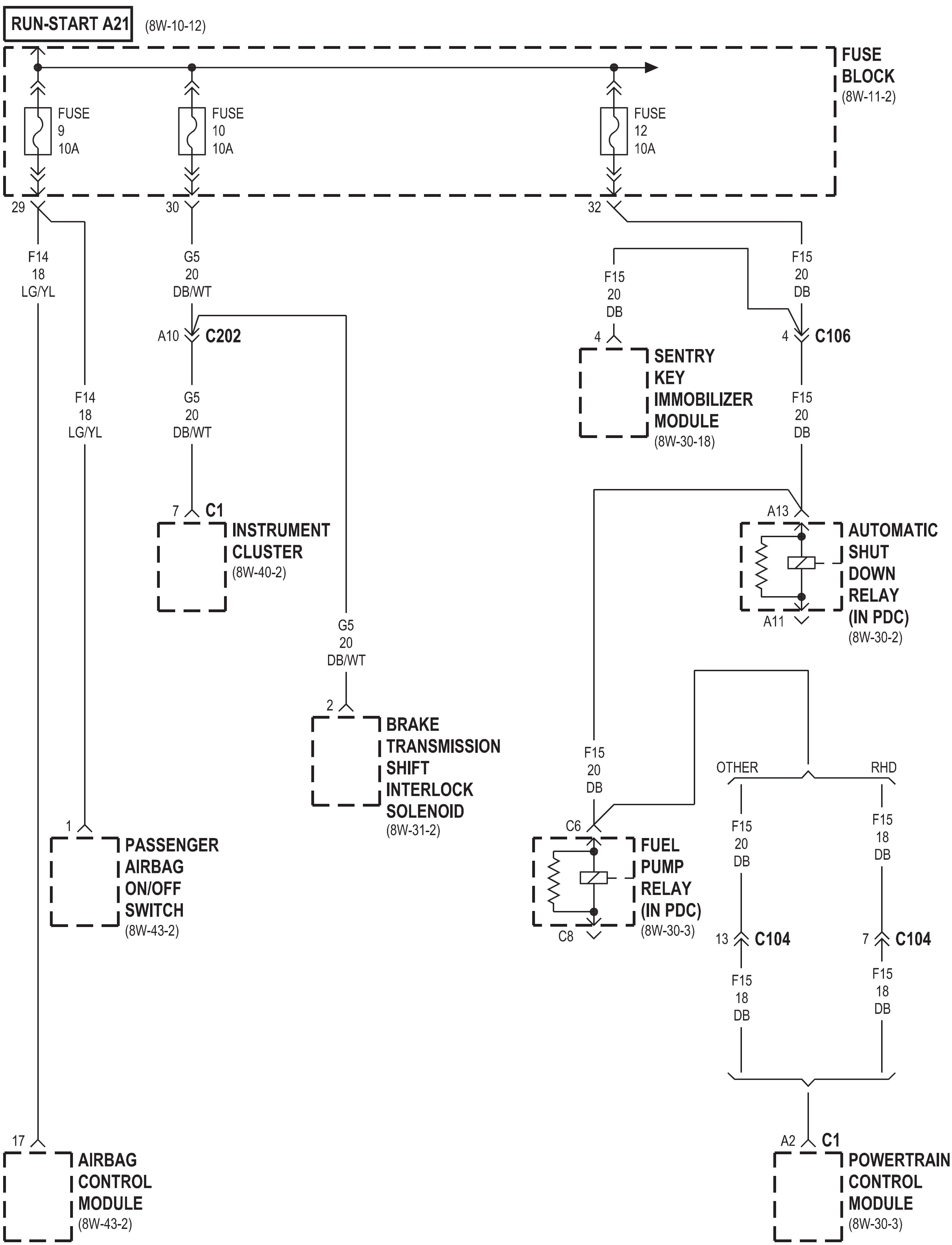
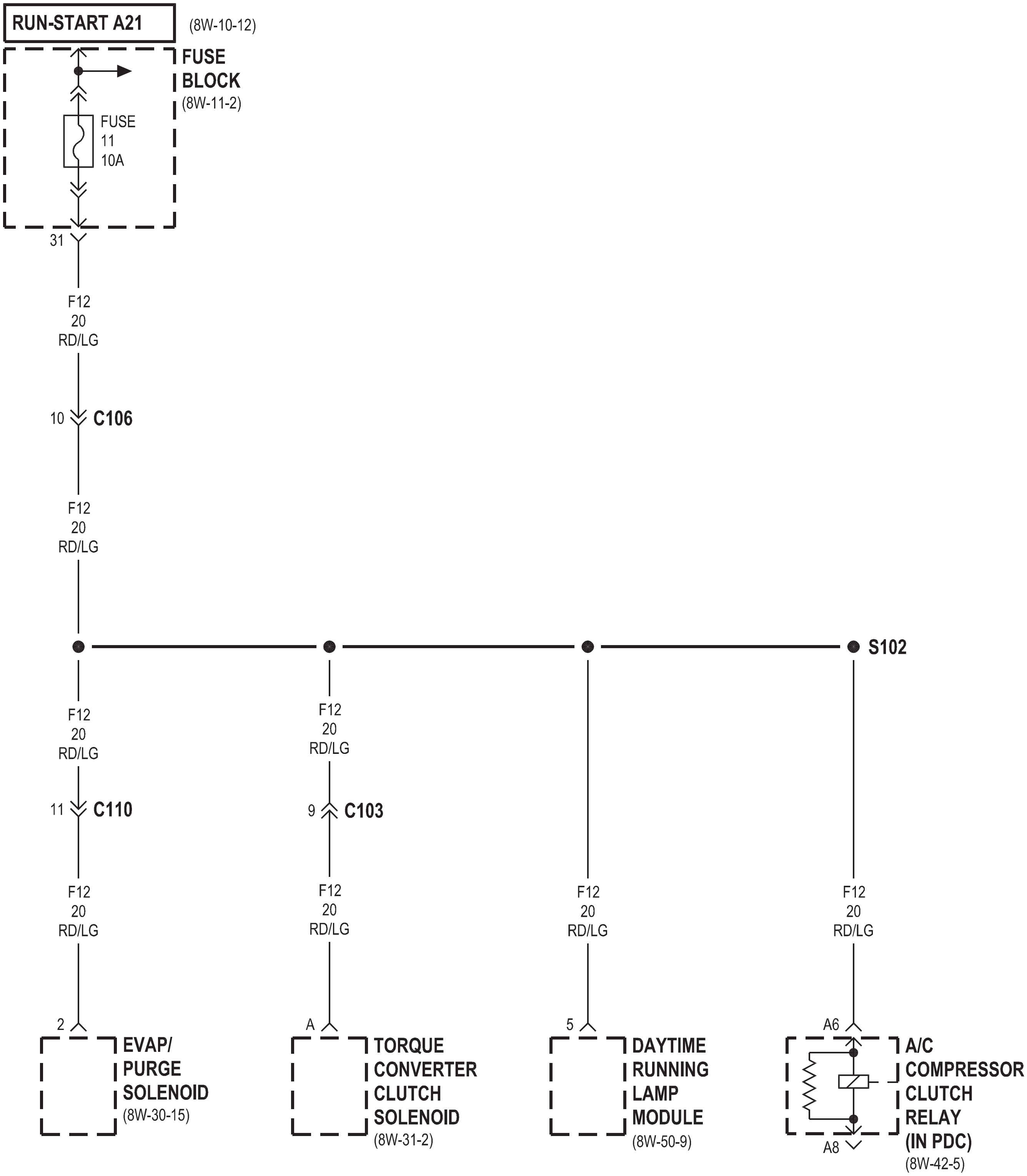
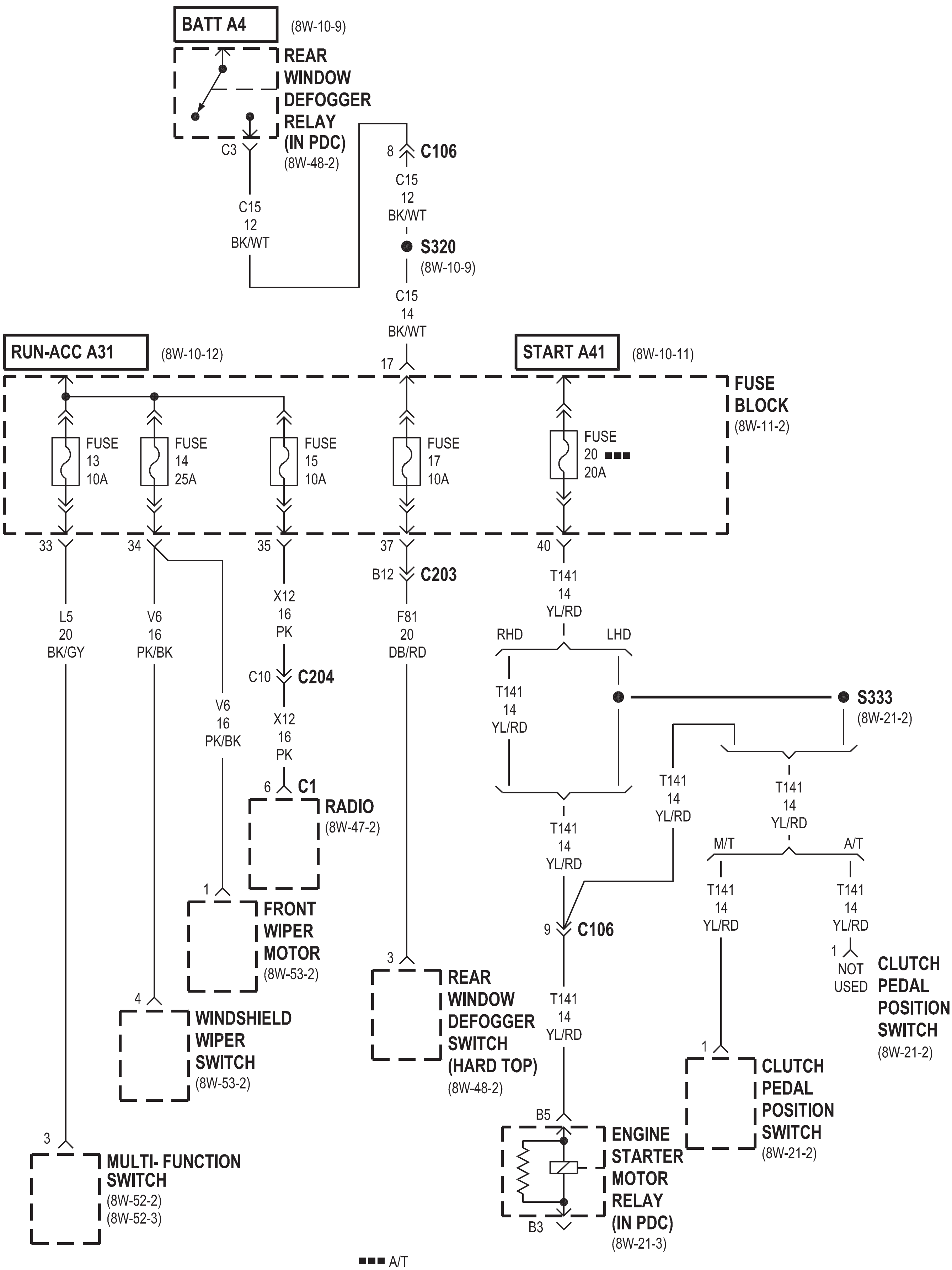

DRIVER DOOR AJAR SWITCH
(8W-44-4)
1
PASSENGER DOOR AJAR SWITCH
(8W-44-4)
1
M23
20
YL/BK
M23
20
YL/BK
BATT A6
(8W-10-10)
4
FUSE BLOCK
(8W-11-2)
FUSE
1
20A
FUSE
2
20A
FUSE
3
20A
FUSE
4
10A
21
22
23
24
Z1
20
BK
S304
(8W-15-12)
Z1
16
BK
F33
18
PK/RD
F33
18
PK/RD
F32
18
PK/DB
X60
16
DG/RD
20
6
5
1
MULTI-FUNCTION SWITCH
(8W-50-2)
SENTRY KEY IMMOBILIZER MODULE
(8W-30-18)
BRAKE LAMP SWITCH
(8W-51-7)
RADIO CHOKE AND RELAY
(8W-47-2)
G300
(8W-15-12)

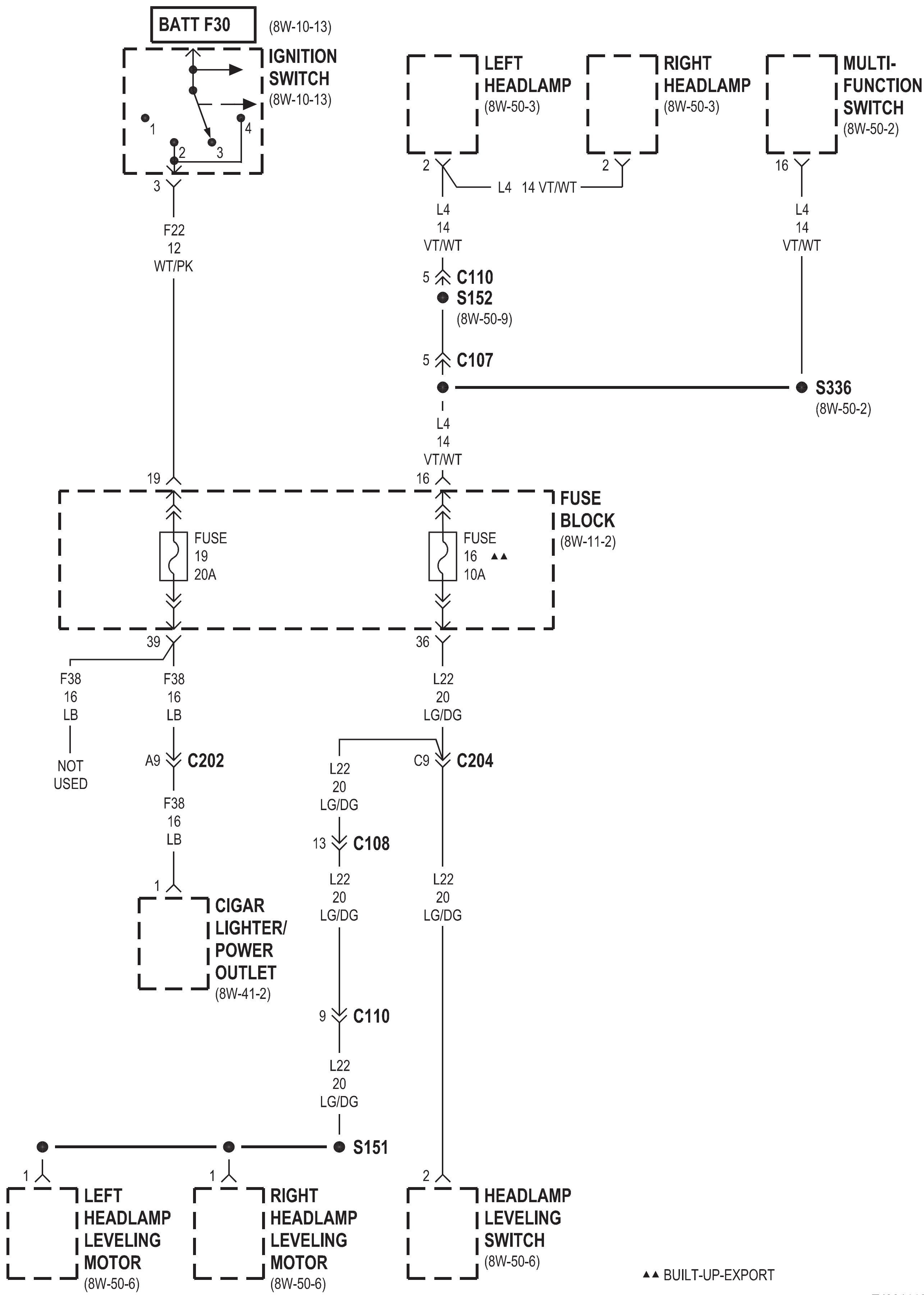

RUN A22
(8W-10-11)
FUSE BLOCK
(8W-11-2)
FUSE 5 10A
FUSE 6 20A
25
26
F23 18 DB/YL
V23 18 BR/PK
LHD SOFT TOP
RHD SOFT TOP
HARD TOP
V23 18 BR/PK
V23 18 BR/PK
V23 18 BR/PK
H4 C323 NOT USED
4 C323 NOT USED
LHD
RHD
H4 C323
4 C323
V23 18 BR/PK
5 C326
5 C331
S401
4 C331
4 C326
V23 18 BR/PK
V23 18 BR/PK
LHD
RHD
G10 C322
10 C322
V23 18 BR/PK
V23 18 BR/PK
C6 C204
V23 18 BR/PK
20
AIRBAG CONTROL MODULE
(8W-43-2)
5
REAR WIPER/ WASHER SWITCH
(8W-53-3)
1
REAR WIPER MOTOR
(8W-53-3)


RUN A22
(8W-10-11)
FUSE BLOCK
(8W-11-2)
FUSE 7 10A
FUSE 8 10A
27
28
F20 20 VT/WT
F24 20 RD/DG
3 C106
A1 C202
F24 20 RD/DG
F24 20RD/DG
5
9 C205
F20 20 VT/WT
F24 20 RD/DG
F24 20 OR
F24 20 DB/WT
3
1 C2
10
5
A/C-HEATER CONTROL
(8W-42-2)
(8W-42-3)
BLEND DOOR ACTUATOR
(8W-42-4)
BLOWER MOTOR RELAY
(8W-42-4)
S108
F20 20 VT/WT
F20 18 VT/WT
F20 20 VT/WT
F20 20 VT/WT
10 C104
F20 20 VT/WT
23
CONTROLLER ANTILOCK BRAKE
(8W-35-2)
B8
ANTILOCK BRAKE RELAY (IN PDC)
(8W-35-2)
B10
A/T
M/T
F20 20 VT/WT
F20 20 VT/WT
4 C154
4 C154
F20 18 VT/WT
F20 18 VT/WT
1
B
PARK/ NEUTRAL POSITION SWITCH
(8W-51-2)
BACK-UP LAMP SWITCH
(8W-51-2)
(8W-51-4)
C4
REAR WINDOW DEFOGGER RELAY (IN PDC)
(8W-48-2)
C2
LHD
RHD

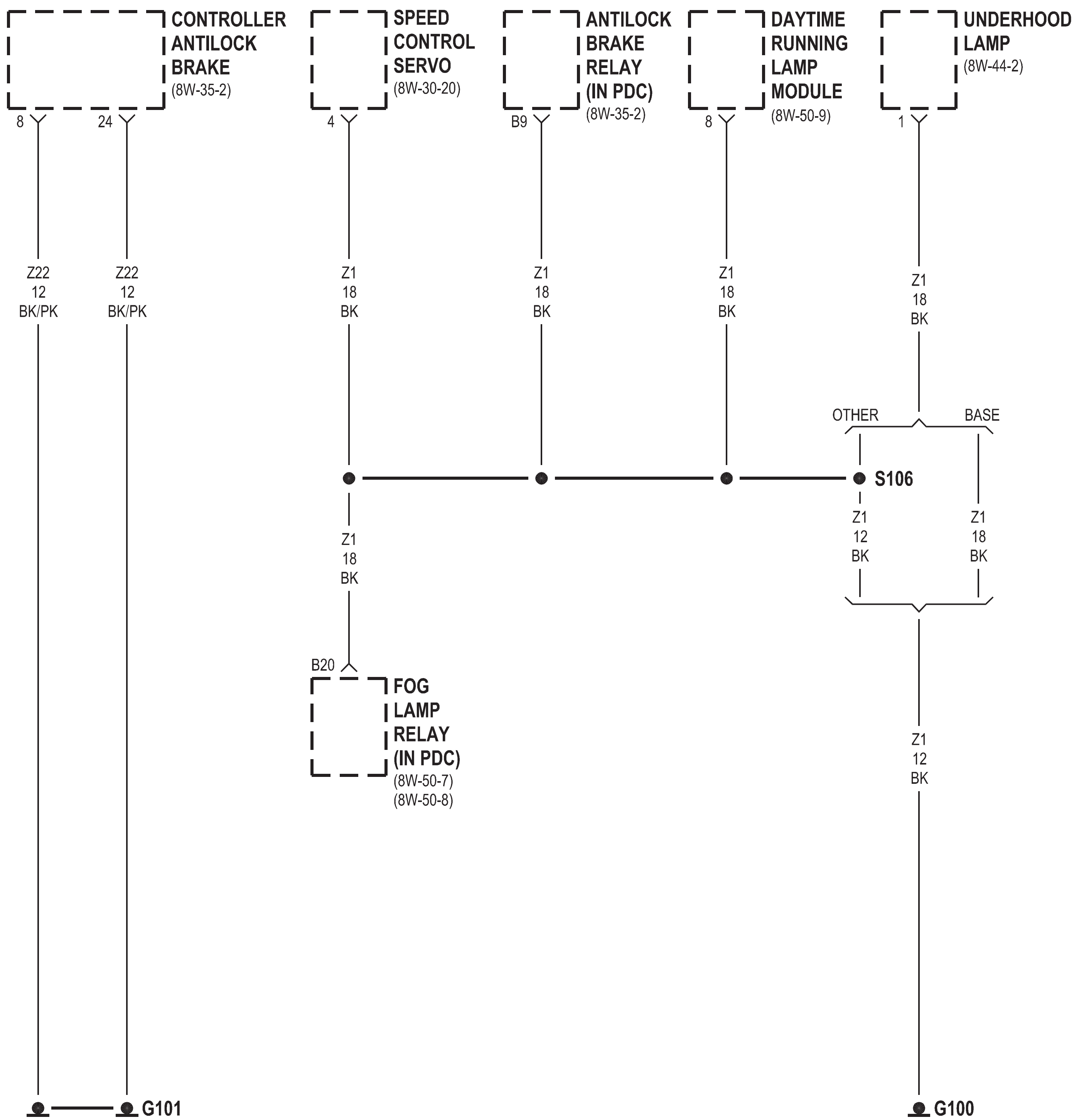

RUN-START A21
(8W-10-12)
FUSE
BLOCK
(8W-11-2)
FUSE
9
10A
FUSE
10
10A
FUSE
12
10A
29
30
32
F14
18
LG/YL
G5
20
DB/WT
F15
20
DB
F15
20
DB
A10
C202
4
4
C106
SENTRY
KEY
IMMOBILIZER
MODULE
(8W-30-18)
F14
18
LG/YL
G5
20
DB/WT
F15
20
DB
7
C1
INSTRUMENT
CLUSTER
(8W-40-2)
A13
AUTOMATIC
SHUT
DOWN
RELAY
(IN PDC)
(8W-30-2)
A11
G5
20
DB/WT
2
BRAKE
TRANSMISSION
SHIFT
INTERLOCK
SOLENOID
(8W-31-2)
F15
20
DB
OTHER
RHD
1
PASSENGER
AIRBAG
ON/OFF
SWITCH
(8W-43-2)
C6
FUEL
PUMP
RELAY
(IN PDC)
(8W-30-3)
C8
F15
20
DB
F15
18
DB
13
C104
7
C104
F15
18
DB
F15
18
DB
17
AIRBAG
CONTROL
MODULE
(8W-43-2)
A2
C1
POWERTRAIN
CONTROL
MODULE
(8W-30-3)


RUN-START A21
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 11 10A
31
F12 20 RD/LG
10 C106
F12 20 RD/LG
S102
F12 20 RD/LG
11 C110
F12 20 RD/LG
2
EVAP/ PURGE SOLENOID
(8W-30-15)
F12 20 RD/LG
9 C103
F12 20 RD/LG
A
TORQUE CONVERTER CLUTCH SOLENOID
(8W-31-2)
F12 20 RD/LG
5
DAYTIME RUNNING LAMP MODULE
(8W-50-9)
F12 20 RD/LG
A6
A8
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
(8W-42-5)

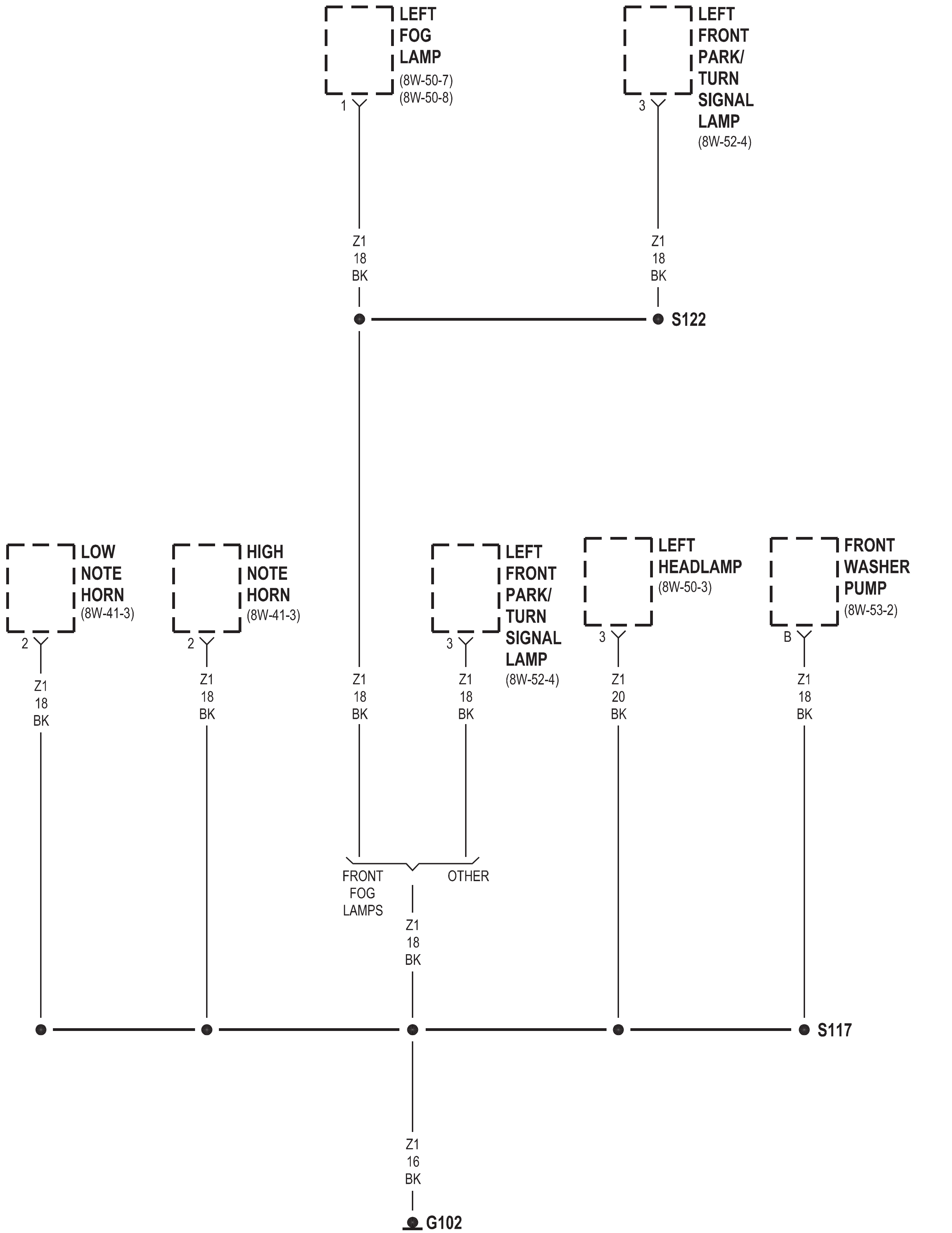

BATT A4
(8W-10-9)
REAR WINDOW DEFOGGER RELAY (IN PDC)
(8W-48-2)
C3
C15
12
BK/WT
8
C106
C15
12
BK/WT
S320
(8W-10-9)
C15
14
BK/WT
RUN-ACC A31
(8W-10-12)
17
START A41
(8W-10-11)
FUSE BLOCK
(8W-11-2)
FUSE
13
10A
FUSE
14
25A
FUSE
15
10A
FUSE
17
10A
FUSE
20 ■■■
20A
33
34
35
37
40
B12
C203
T141
14
YL/RD
X12
16
PK
L5
20
BK/GY
V6
16
PK/BK
F81
20
DB/RD
RHD
LHD
C10
C204
T141
14
YL/RD
S333
(8W-21-2)
V6
16
PK/BK
X12
16
PK
T141
14
YL/RD
T141
14
YL/RD
6
C1
RADIO
(8W-47-2)
T141
14
YL/RD
M/T
A/T
1
FRONT WIPER MOTOR
(8W-53-2)
T141
14
YL/RD
T141
14
YL/RD
9
C106
1
NOT USED
CLUTCH PEDAL POSITION SWITCH
(8W-21-2)
3
REAR WINDOW DEFOGGER SWITCH (HARD TOP)
(8W-48-2)
4
WINDSHIELD WIPER SWITCH
(8W-53-2)
T141
14
YL/RD
1
CLUTCH PEDAL POSITION SWITCH
(8W-21-2)
B5
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-3)
B3
3
MULTI- FUNCTION SWITCH
(8W-52-2)
(8W-52-3)
■■■ A/T


BATT F30
(8W-10-13)
IGNITION SWITCH
(8W-10-13)
1
2
3
4
3
F22
12
WT/PK
LEFT HEADLAMP
(8W-50-3)
RIGHT HEADLAMP
(8W-50-3)
MULTI-FUNCTION SWITCH
(8W-50-2)
2
2
16
L4 14 VT/WT
L4
14
VT/WT
L4
14
VT/WT
5
C110
S152
(8W-50-9)
5
C107
S336
(8W-50-2)
L4
14
VT/WT
19
16
FUSE BLOCK
(8W-11-2)
FUSE
19
20A
FUSE
16 ▲▲
10A
39
36
F38
16
LB
NOT USED
F38
16
LB
L22
20
LG/DG
A9
C202
C9
C204
F38
16
LB
L22
20
LG/DG
13
C108
L22
20
LG/DG
L22
20
LG/DG
1
CIGAR LIGHTER/ POWER OUTLET
(8W-41-2)
9
C110
L22
20
LG/DG
S151
1
1
2
LEFT HEADLAMP LEVELING MOTOR
(8W-50-6)
RIGHT HEADLAMP LEVELING MOTOR
(8W-50-6)
HEADLAMP LEVELING SWITCH
(8W-50-6)
▲▲ BUILT-UP-EXPORT

8W-15 GROUND DISTRIBUTION

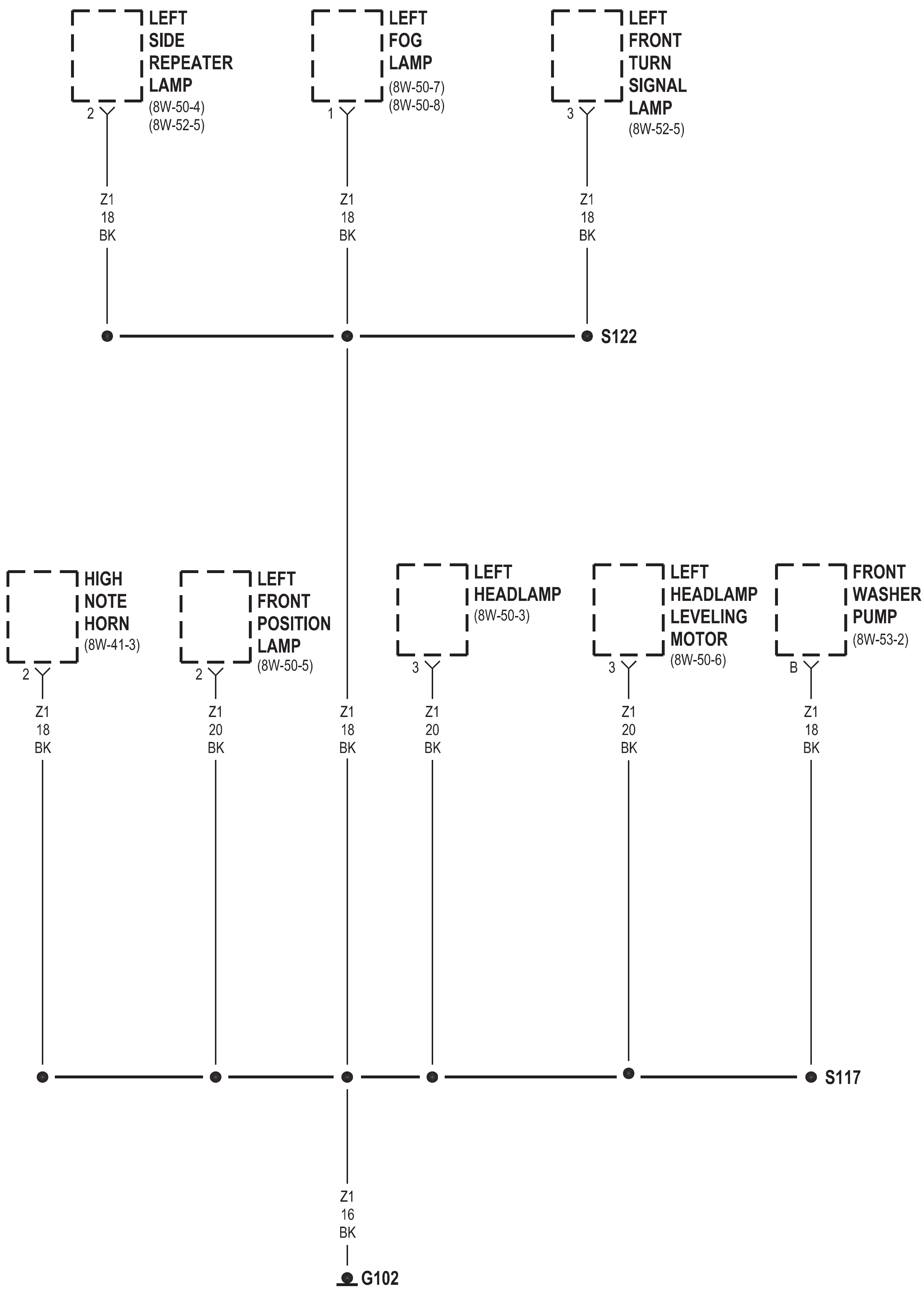

CONTROLLER ANTILOCK BRAKE
(8W-35-2)
8
24
SPEED CONTROL SERVO
(8W-30-20)
4
ANTILOCK BRAKE RELAY (IN PDC)
(8W-35-2)
B9
DAYTIME RUNNING LAMP MODULE
(8W-50-9)
8
UNDERHOOD LAMP
(8W-44-2)
1
Z22 12 BK/PK
Z22 12 BK/PK
Z1 18 BK
Z1 18 BK
Z1 18 BK
Z1 18 BK
OTHER
BASE
S106
Z1 12 BK
Z1 18 BK
Z1 18 BK
B20
FOG LAMP RELAY (IN PDC)
(8W-50-7)
(8W-50-8)
Z1 12 BK
G101
G100

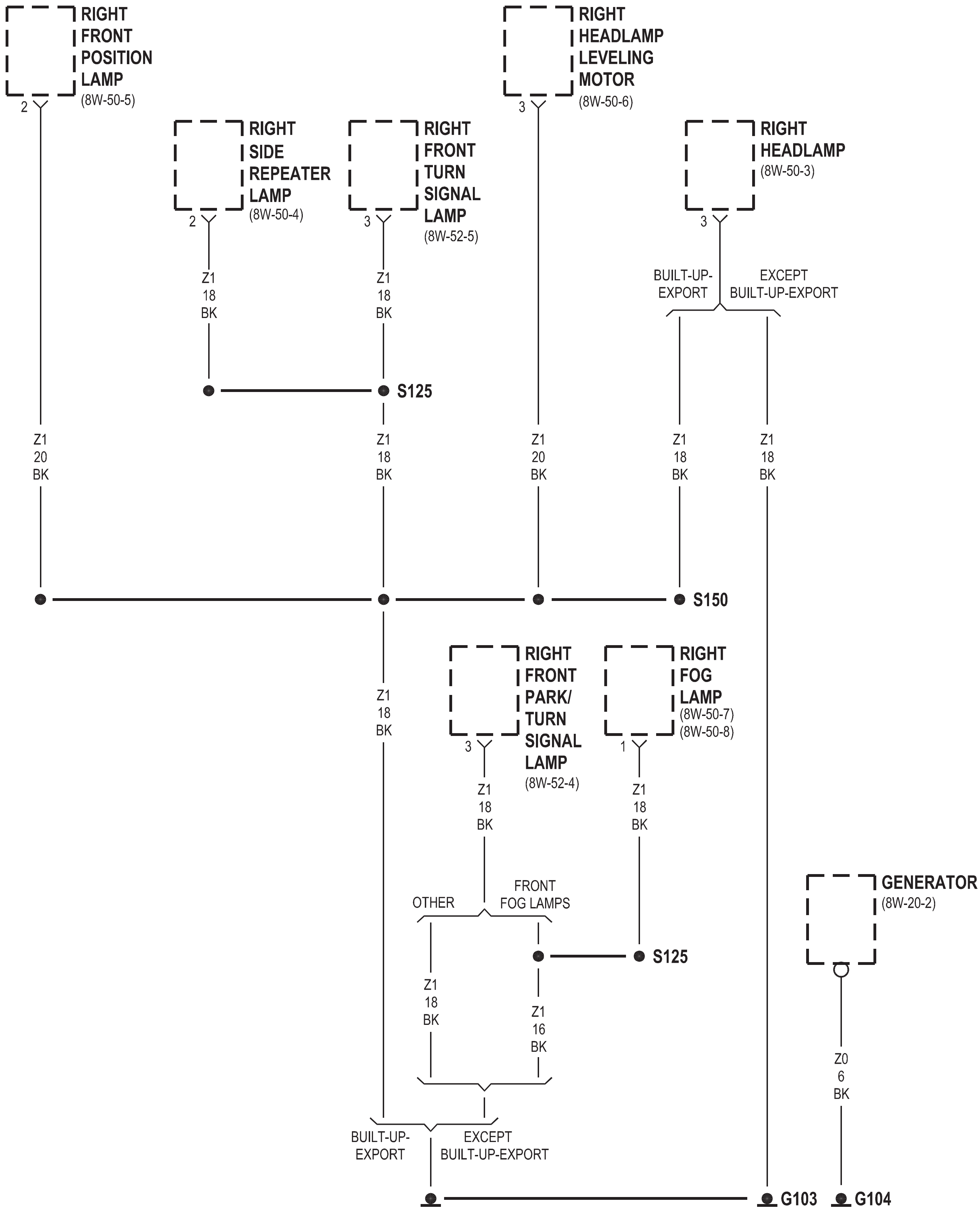
EXCEPT BUILT-UP-EXPORT



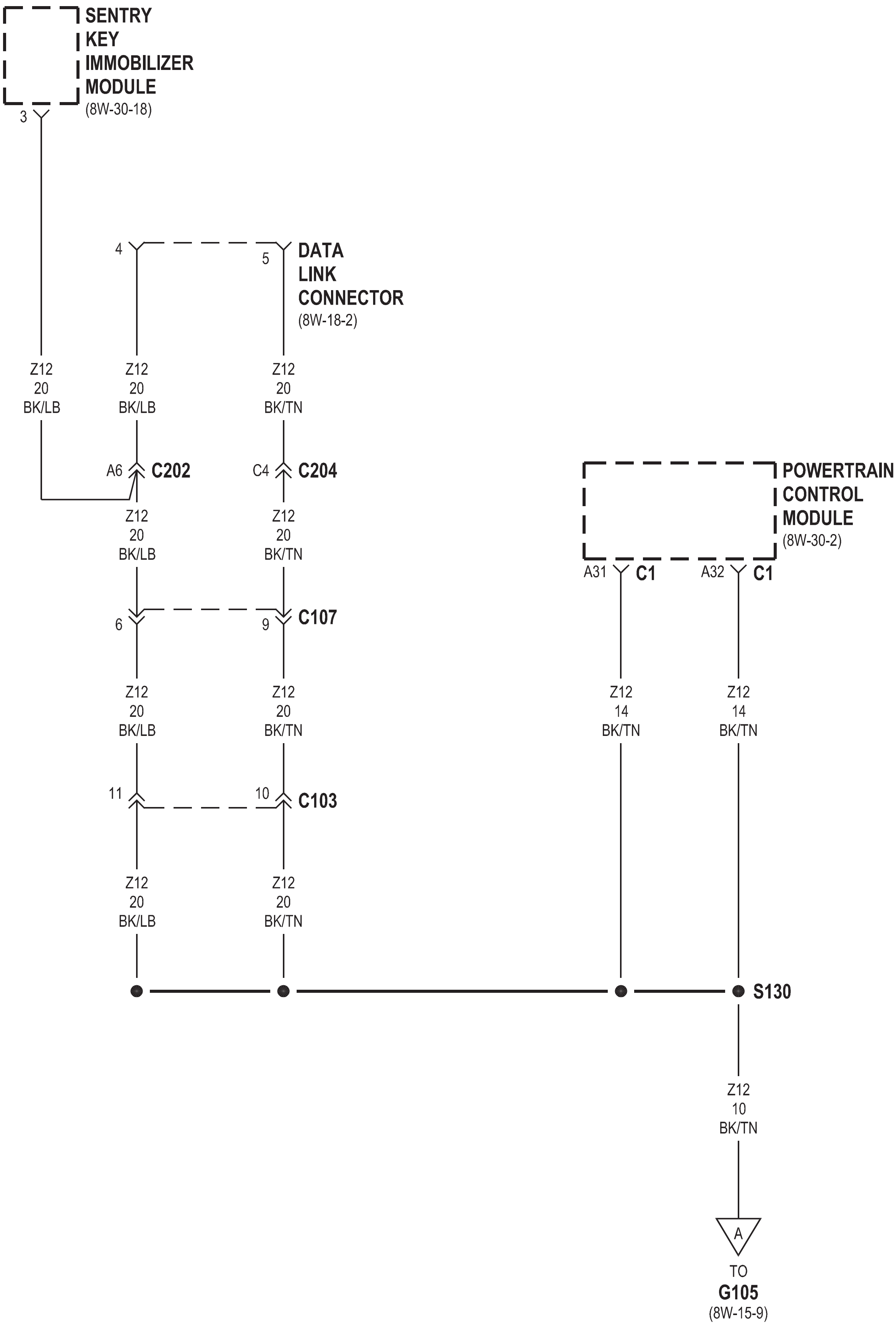
TJ201503 J028W-5

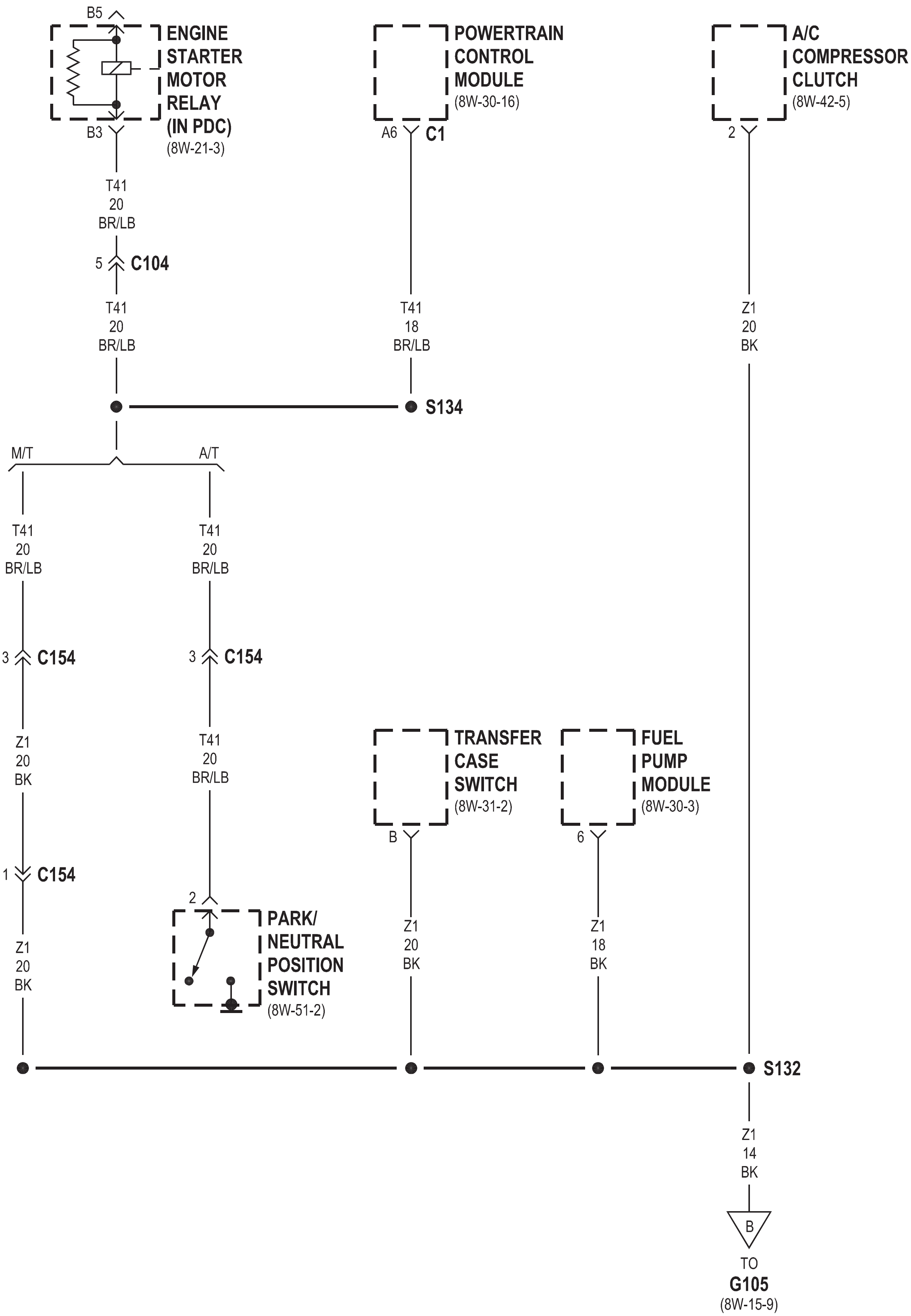
BUILT-UP-EXPORT

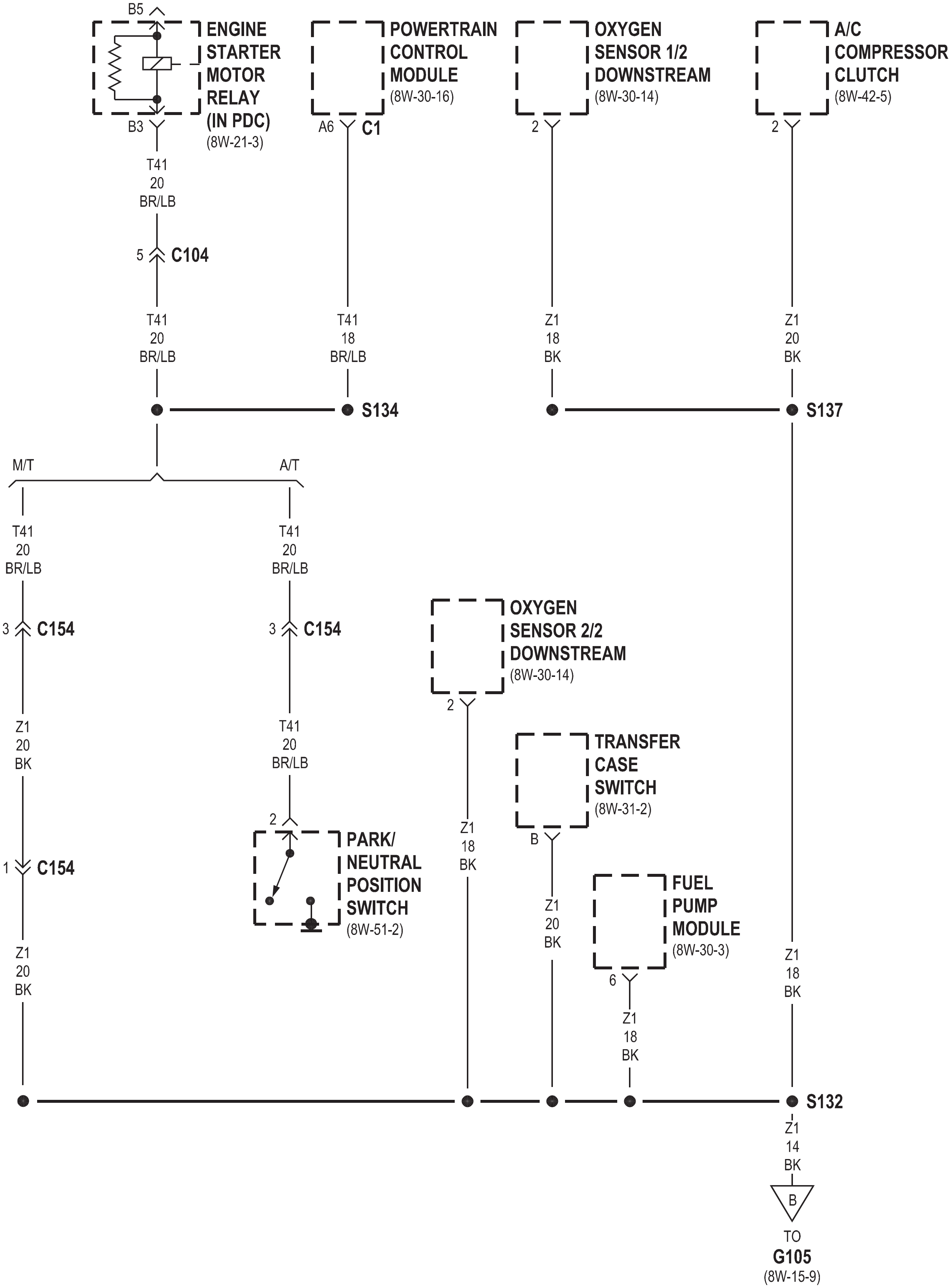


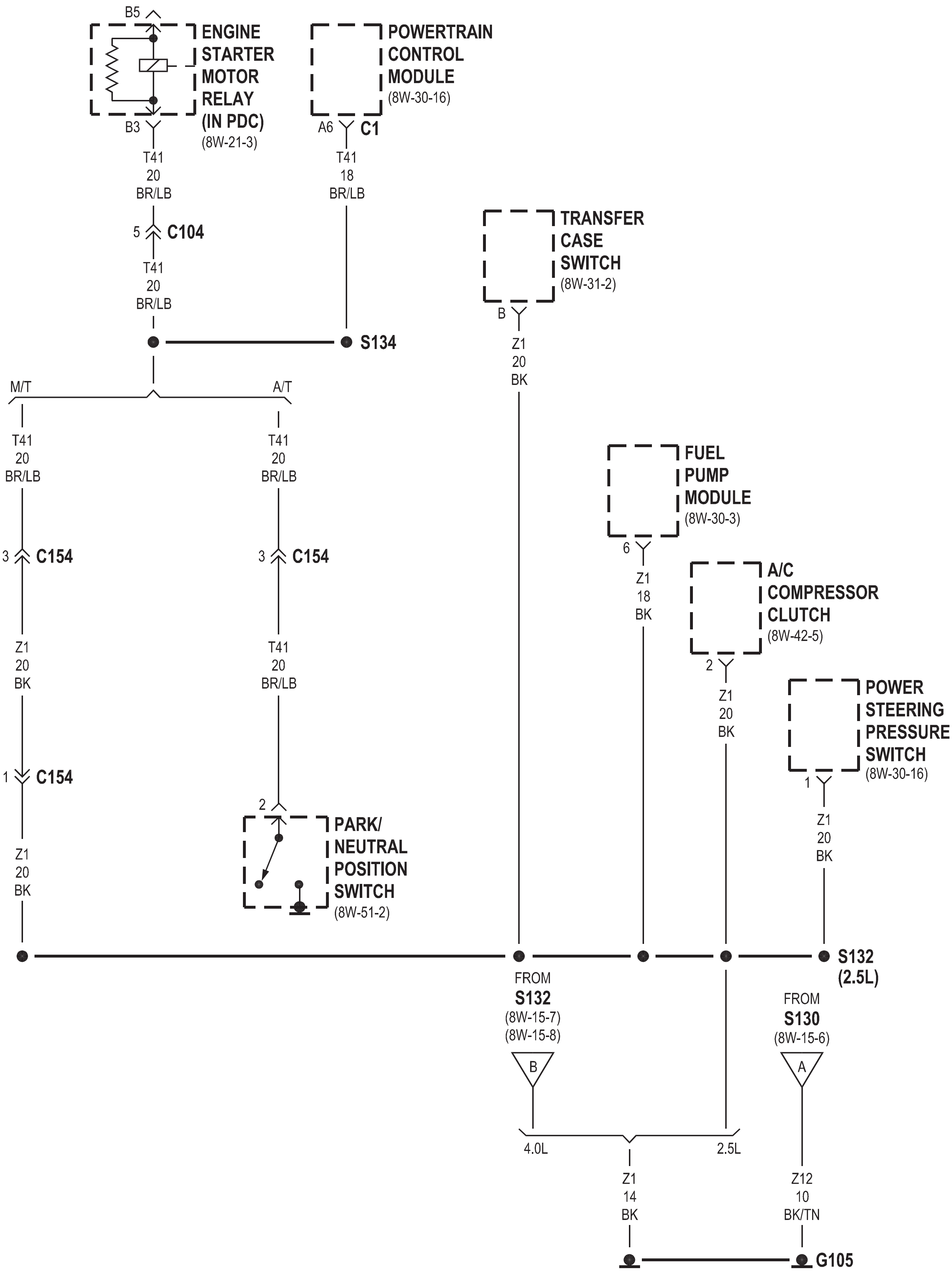

RIGHT
FRONT
POSITION
LAMP
(8W-50-5)
2
RIGHT
SIDE
REPEATER
LAMP
(8W-50-4)
2
RIGHT
FRONT
TURN
SIGNAL
LAMP
(8W-52-5)
3
RIGHT
HEADLAMP
LEVELING
MOTOR
(8W-50-6)
3
RIGHT
HEADLAMP
(8W-50-3)
3
BUILT-UP-
EXPORT
EXCEPT
BUILT-UP-EXPORT
Z1
18
BK
S125
Z1
20
BK
S150
RIGHT
FRONT
PARK/
TURN
SIGNAL
LAMP
(8W-52-4)
RIGHT
FOG
LAMP
(8W-50-7)
(8W-50-8)
1
GENERATOR
(8W-20-2)
OTHER
FRONT
FOG LAMPS
Z1
16
BK
Z0
6
BK
G103
G104

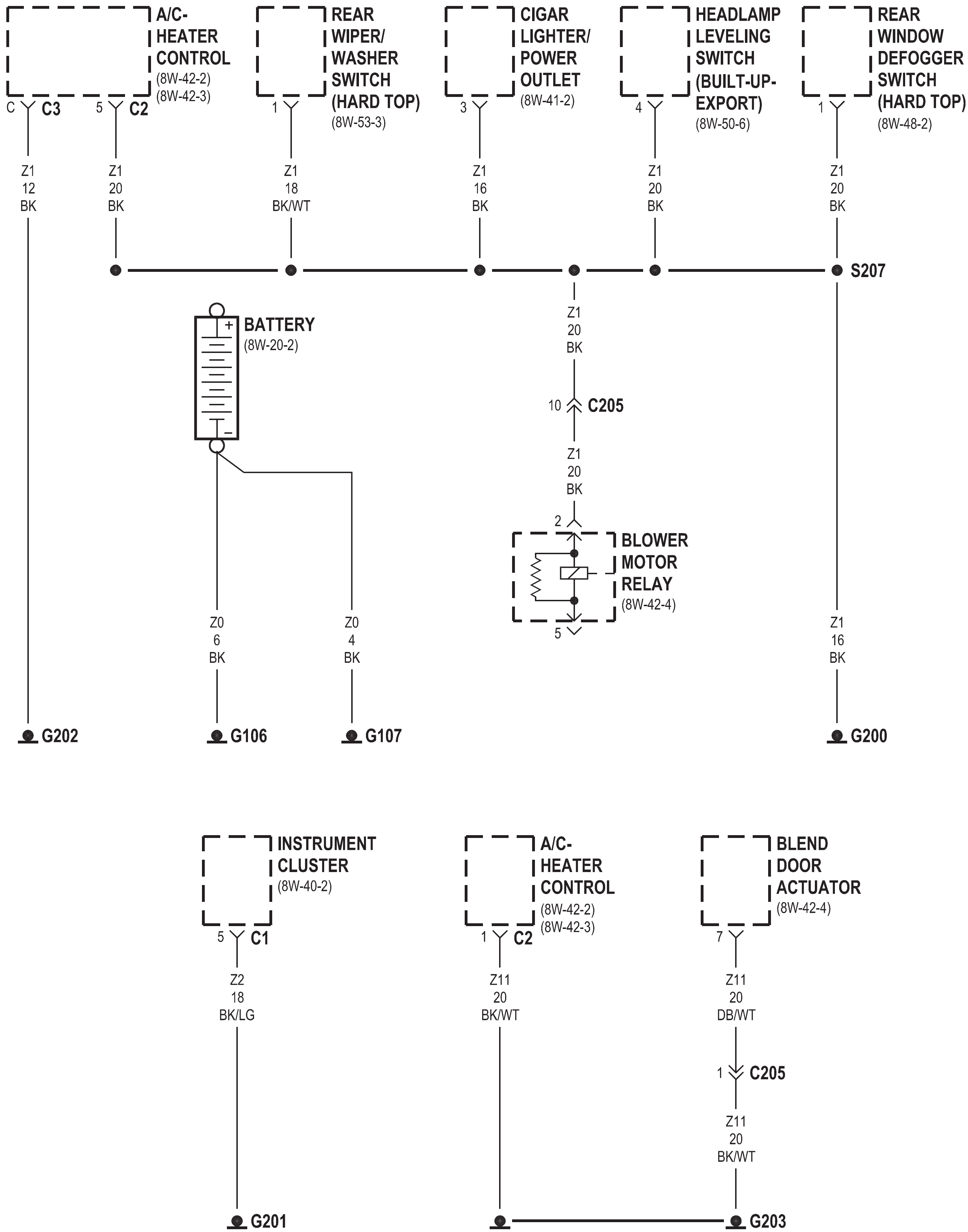
LHD


SENTRY
KEY
IMMOBILIZER
MODULE
(8W-30-18)
3
4
5
DATA
LINK
CONNECTOR
(8W-18-2)
Z12
20
BK/LB
Z12
20
BK/LB
Z12
20
BK/TN
A6
C202
C4
C204
POWERTRAIN
CONTROL
MODULE
(8W-30-2)
A31
C1
A32
C1
Z12
20
BK/LB
Z12
20
BK/TN
6
9
C107
Z12
20
BK/LB
Z12
20
BK/TN
Z12
14
BK/TN
Z12
14
BK/TN
11
10
C103
Z12
20
BK/LB
Z12
20
BK/TN
S130
Z12
10
BK/TN
A
TO
G105
(8W-15-9)

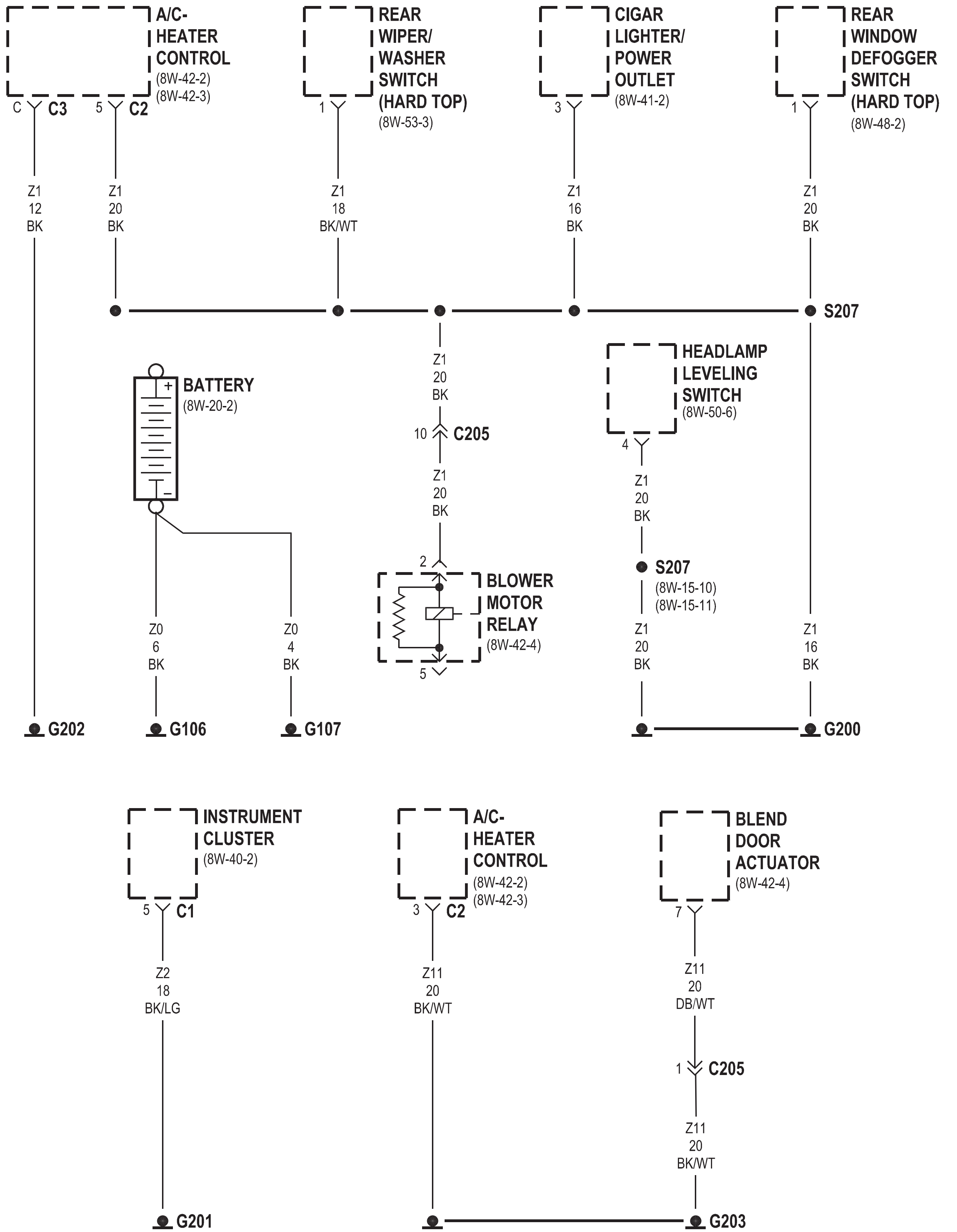

B5
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
(8W-21-3)
B3
T41
20
BR/LB
5
C104
T41
20
BR/LB
POWERTRAIN
CONTROL
MODULE
(8W-30-16)
A6
C1
T41
18
BR/LB
A/C
COMPRESSOR
CLUTCH
(8W-42-5)
2
Z1
20
BK
S134
M/T
A/T
T41
20
BR/LB
T41
20
BR/LB
3
C154
3
C154
Z1
20
BK
T41
20
BR/LB
1
C154
2
PARK/
NEUTRAL
POSITION
SWITCH
(8W-51-2)
Z1
20
BK
TRANSFER
CASE
SWITCH
(8W-31-2)
B
Z1
20
BK
FUEL
PUMP
MODULE
(8W-30-3)
6
Z1
18
BK
S132
Z1
14
BK
B
TO
G105
(8W-15-9)


B5
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-3)
B3
T41
20
BR/LB
5 C104
T41
20
BR/LB
POWERTRAIN CONTROL MODULE
(8W-30-16)
A6 C1
T41
18
BR/LB
S134
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-14)
2
Z1
18
BK
A/C COMPRESSOR CLUTCH
(8W-42-5)
2
Z1
20
BK
S137
M/T
A/T
T41
20
BR/LB
3 C154
Z1
20
BK
1 C154
Z1
20
BK
T41
20
BR/LB
3 C154
T41
20
BR/LB
2
PARK/ NEUTRAL POSITION SWITCH
(8W-51-2)
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-15-9)

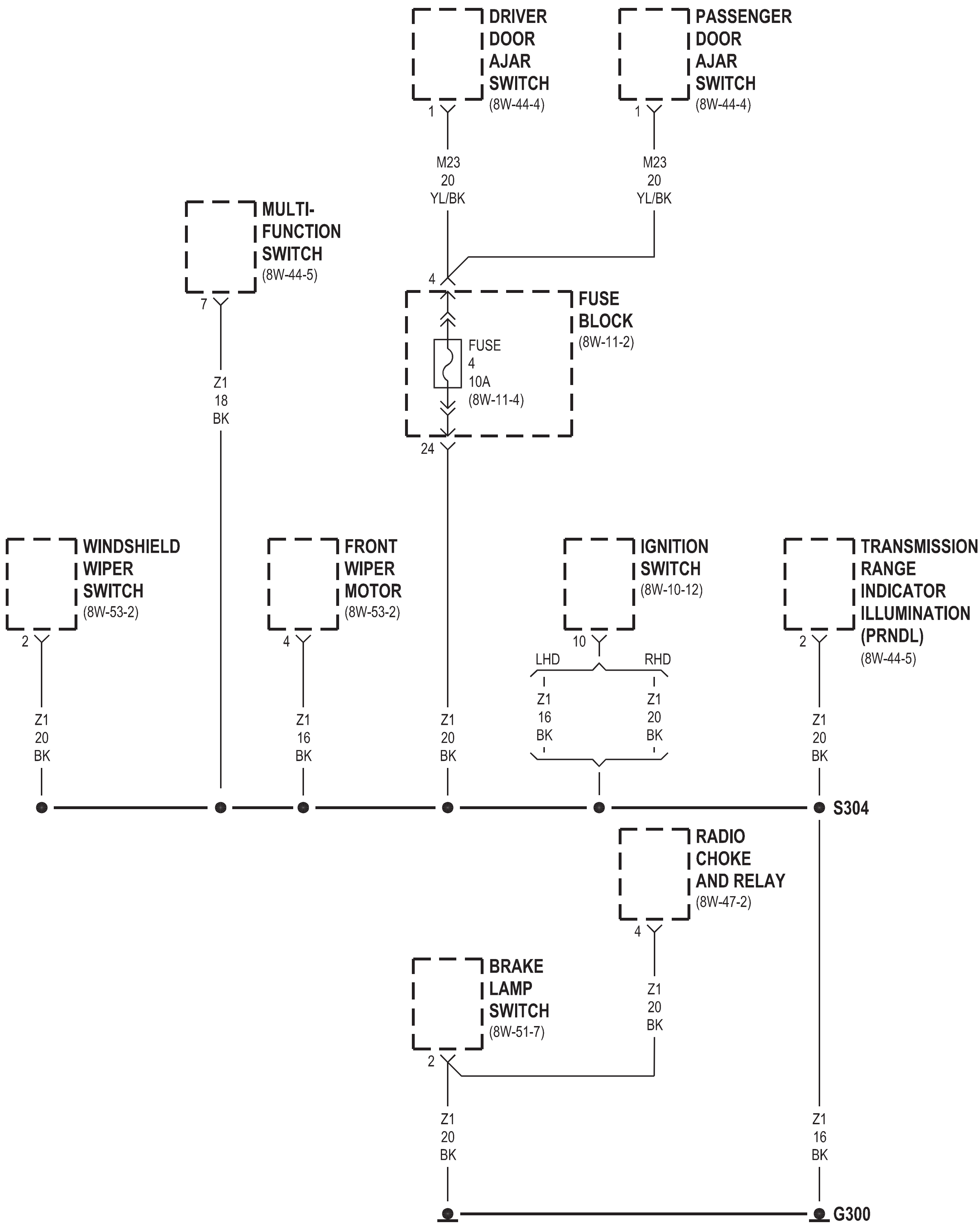

B5
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
(8W-21-3)
B3
T41
20
BR/LB
5
C104
T41
20
BR/LB
POWERTRAIN
CONTROL
MODULE
(8W-30-16)
A6
C1
T41
18
BR/LB
S134
M/T
A/T
T41
20
BR/LB
3
C154
Z1
20
BK
1
C154
Z1
20
BK
T41
20
BR/LB
3
C154
T41
20
BR/LB
2
PARK/
NEUTRAL
POSITION
SWITCH
(8W-51-2)
TRANSFER
CASE
SWITCH
(8W-31-2)
B
Z1
20
BK
FUEL
PUMP
MODULE
(8W-30-3)
6
Z1
18
BK
A/C
COMPRESSOR
CLUTCH
(8W-42-5)
2
Z1
20
BK
POWER
STEERING
PRESSURE
SWITCH
(8W-30-16)
1
Z1
20
BK
S132
(2.5L)
FROM
S132
(8W-15-7)
(8W-15-8)
B
FROM
S130
(8W-15-6)
A
4.0L
2.5L
Z1
14
BK
Z12
10
BK/TN
G105

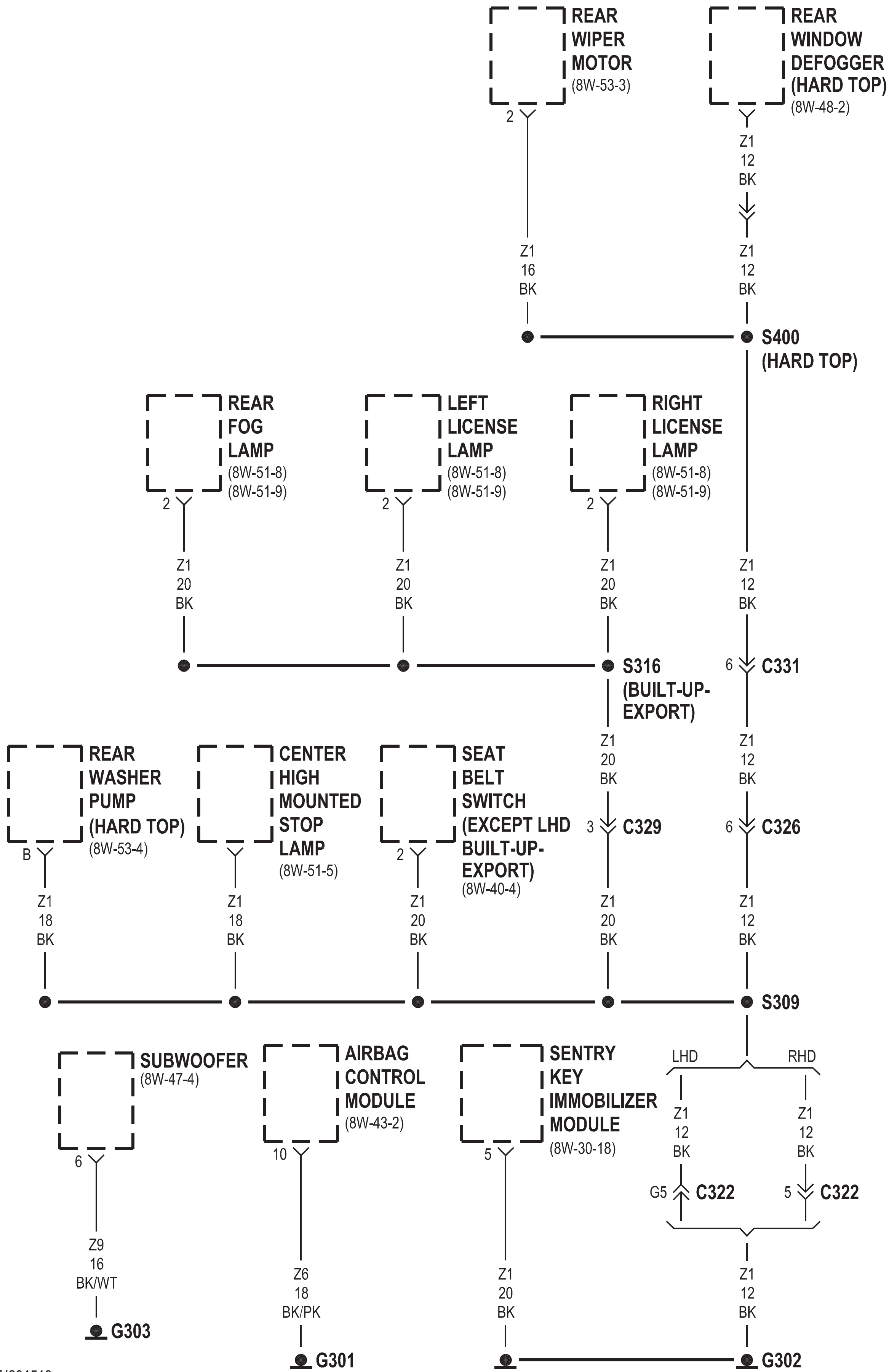

A/C-HEATER CONTROL
(8W-42-2)
(8W-42-3)
C C3
5 C2
REAR WIPER/ WASHER SWITCH (HARD TOP)
(8W-53-3)
1
CIGAR LIGHTER/ POWER OUTLET
(8W-41-2)
3
HEADLAMP LEVELING SWITCH (BUILT-UP-EXPORT)
(8W-50-6)
4
REAR WINDOW DEFOGGER SWITCH (HARD TOP)
(8W-48-2)
1
Z1 12 BK
Z1 20 BK
Z1 18 BK/WT
Z1 16 BK
Z1 20 BK
Z1 20 BK
S207
BATTERY
(8W-20-2)
+
−
Z1 20 BK
10 C205
Z1 20 BK
2
BLOWER MOTOR RELAY
(8W-42-4)
5
Z0 6 BK
Z0 4 BK
Z1 16 BK
G202
G106
G107
G200
INSTRUMENT CLUSTER
(8W-40-2)
5 C1
A/C-HEATER CONTROL
(8W-42-2)
(8W-42-3)
1 C2
BLEND DOOR ACTUATOR
(8W-42-4)
7
Z2 18 BK/LG
Z11 20 BK/WT
Z11 20 DB/WT
1 C205
Z11 20 BK/WT
G201
G203

4.0L EXCEPT CALIFORNIA/EUROPEAN III

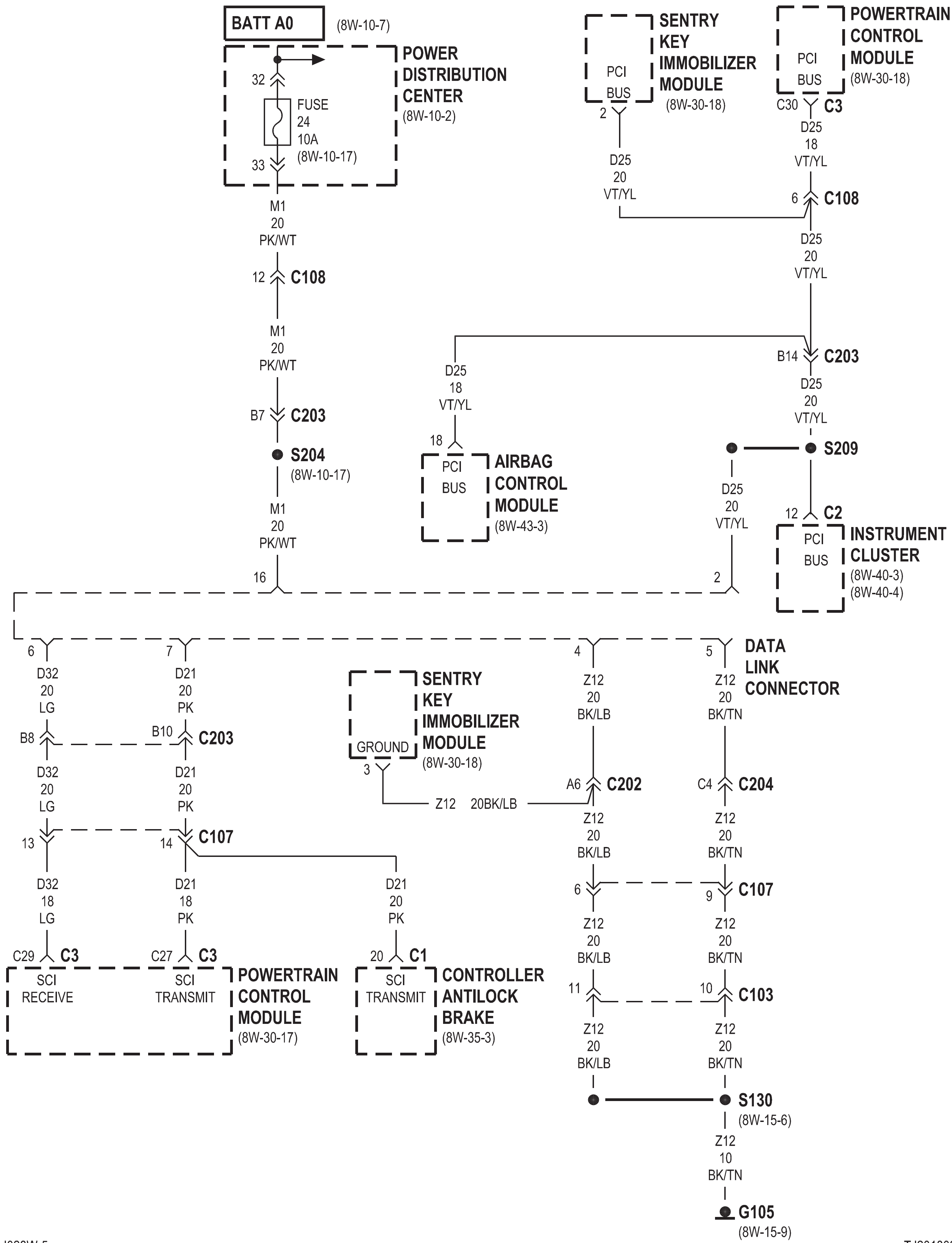


4.0L CALIFORNIA/EUROPEAN III

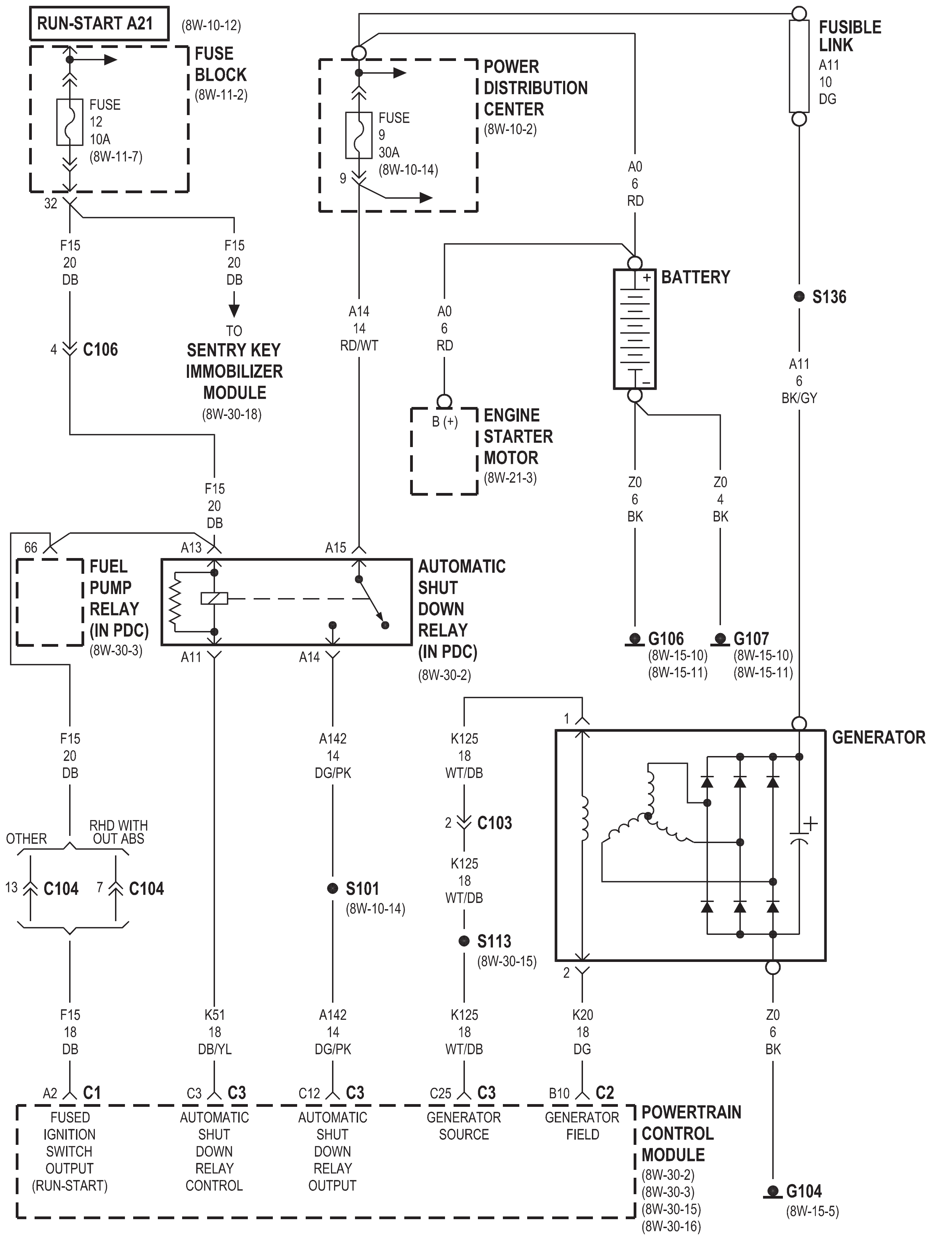


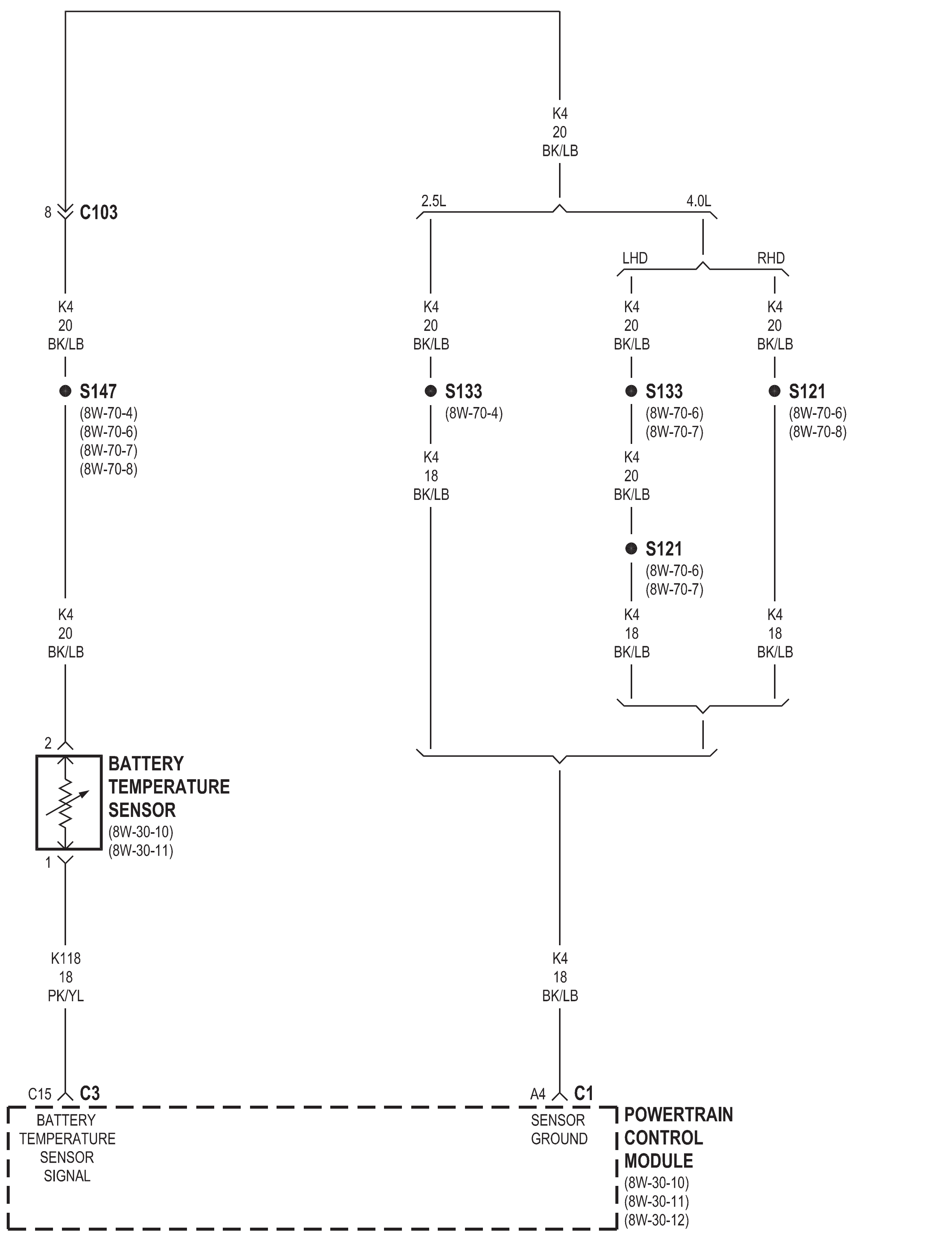

REAR WIPER MOTOR
(8W-53-3)
2
Z1 16 BK
REAR WINDOW DEFOGGER (HARD TOP)
(8W-48-2)
Z1 12 BK
Z1 12 BK
S400 (HARD TOP)
REAR FOG LAMP
(8W-51-8)
(8W-51-9)
2
Z1 20 BK
LEFT LICENSE LAMP
(8W-51-8)
(8W-51-9)
2
Z1 20 BK
RIGHT LICENSE LAMP
(8W-51-8)
(8W-51-9)
2
Z1 20 BK
Z1 12 BK
S316 (BUILT-UP-EXPORT)
6
C331
Z1 20 BK
Z1 12 BK
3
C329
6
C326
REAR WASHER PUMP (HARD TOP)
(8W-53-4)
B
Z1 18 BK
CENTER HIGH MOUNTED STOP LAMP
(8W-51-5)
Z1 18 BK
SEAT BELT SWITCH (EXCEPT LHD BUILT-UP-EXPORT)
(8W-40-4)
2
Z1 20 BK
Z1 20 BK
Z1 12 BK
S309
SUBWOOFER
(8W-47-4)
6
Z9 16 BK/WT
G303
AIRBAG CONTROL MODULE
(8W-43-2)
10
Z6 18 BK/PK
G301
SENTRY KEY IMMOBILIZER MODULE
(8W-30-18)
5
Z1 20 BK
LHD
RHD
Z1 12 BK
Z1 12 BK
G5
C322
5
C322
Z1 12 BK
G302

8W-18 BUS COMMUNICATION

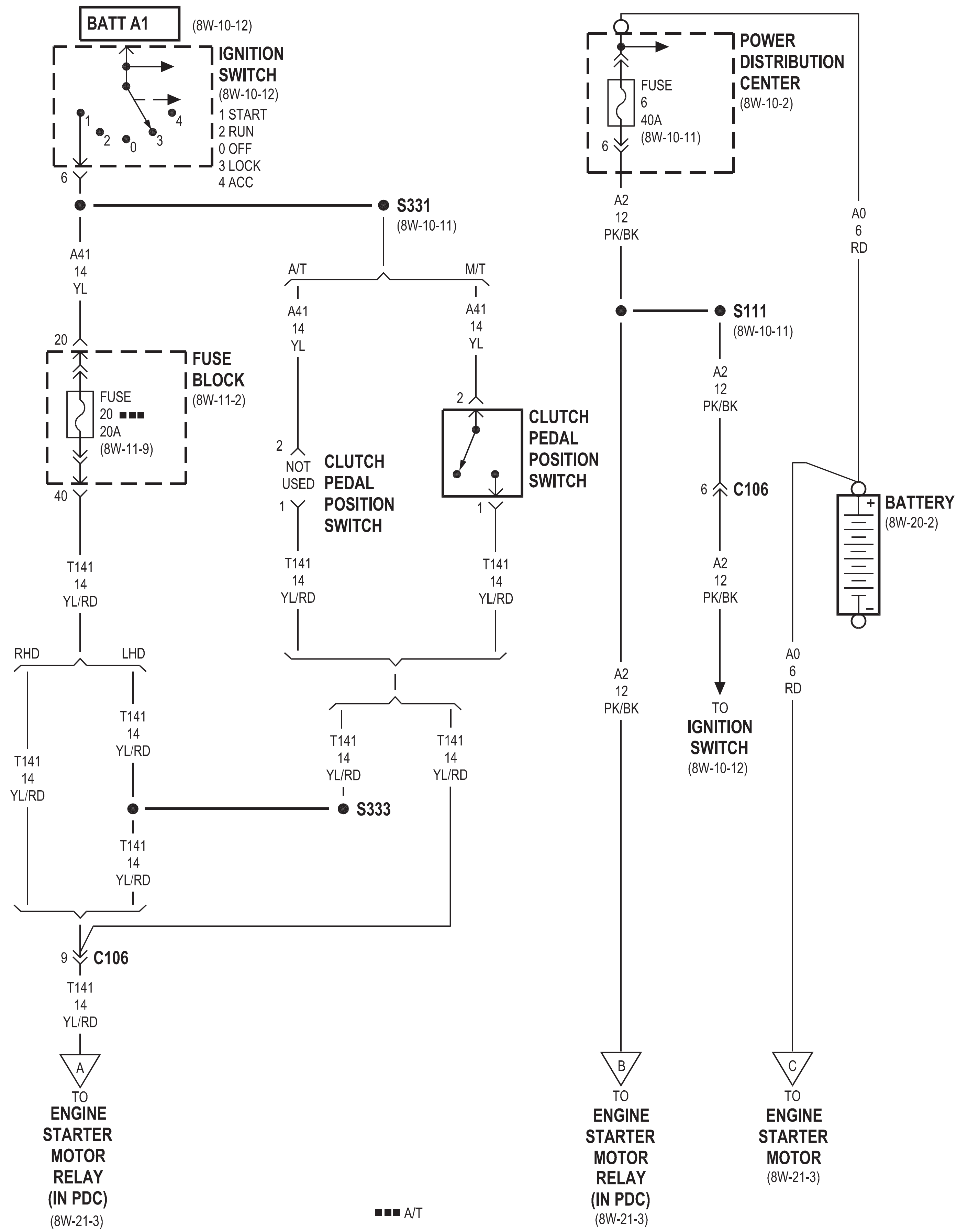

BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 24 10A
(8W-10-17)
M1 20 PK/WT
C108
C203
S204
(8W-10-17)
SENTRY KEY IMMOBILIZER MODULE
PCI BUS
(8W-30-18)
POWERTRAIN CONTROL MODULE
PCI BUS
(8W-30-18)
C3
D25 18 VT/YL
D25 20 VT/YL
AIRBAG CONTROL MODULE
(8W-43-3)
S209
C2
INSTRUMENT CLUSTER
(8W-40-3)
(8W-40-4)
DATA LINK CONNECTOR
D32 20 LG
D21 20 PK
C107
D32 18 LG
D21 18 PK
GROUND
Z12 20BK/LB
Z12 20 BK/LB
Z12 20 BK/TN
C202
C204
C103
C1
SCI RECEIVE
SCI TRANSMIT
POWERTRAIN CONTROL MODULE
(8W-30-17)
CONTROLLER ANTILOCK BRAKE
(8W-35-3)
S130
(8W-15-6)
Z12 10 BK/TN
G105
(8W-15-9)

8W-20 CHARGING SYSTEM

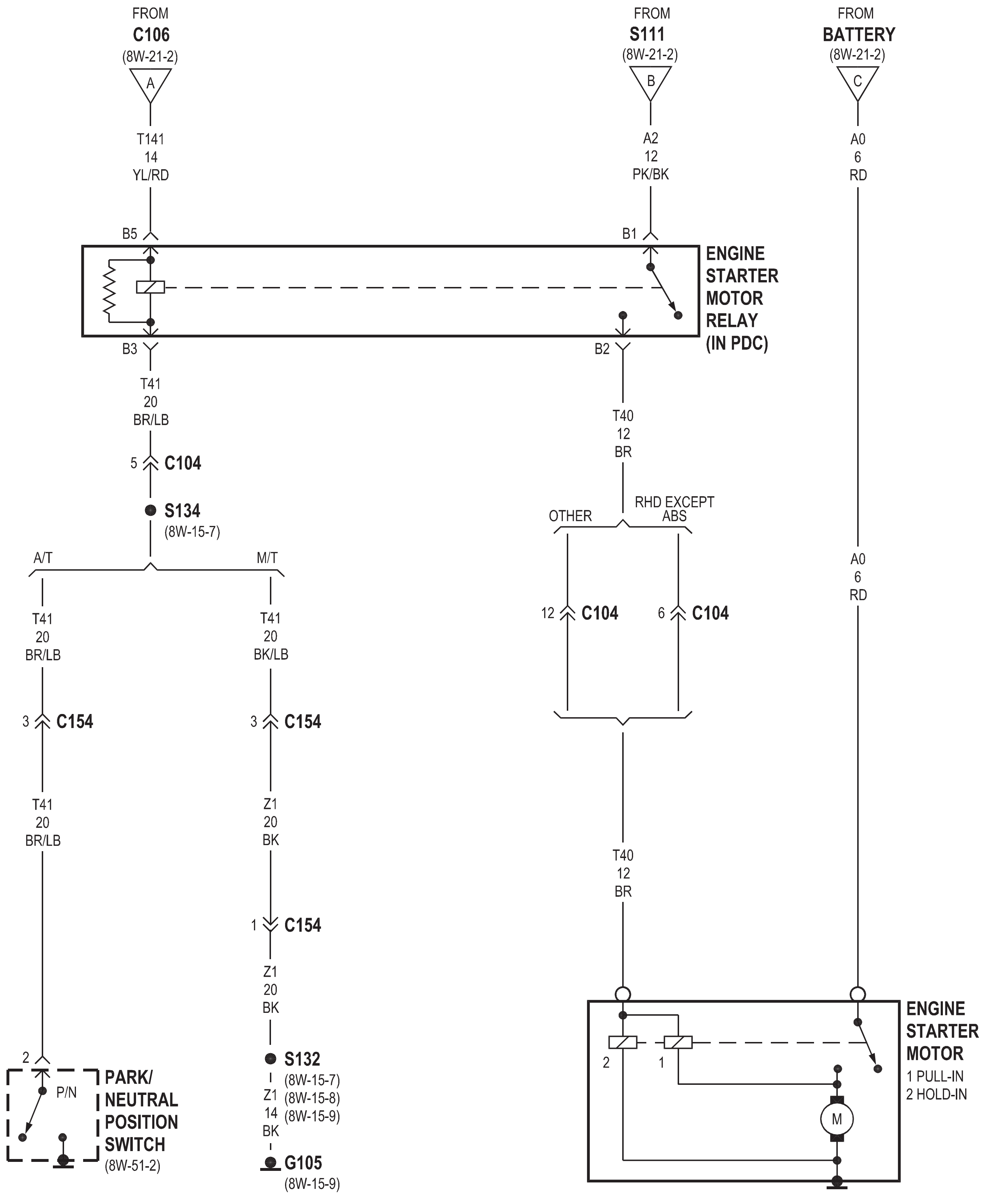

RUN-START A21
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE
12
10A
(8W-11-7)
32
F15
20
DB
F15
20
DB
TO
SENTRY KEY IMMOBILIZER MODULE
(8W-30-18)
4
C106
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
9
30A
(8W-10-14)
9
A14
14
RD/WT
A0
6
RD
A0
6
RD
FUSIBLE LINK
A11
10
DG
BATTERY
S136
A11
6
BK/GY
ENGINE STARTER MOTOR
B (+)
(8W-21-3)
Z0
6
BK
Z0
4
BK
G106
(8W-15-10)
(8W-15-11)
G107
(8W-15-10)
(8W-15-11)
F15
20
DB
66
A13
A15
FUEL PUMP RELAY (IN PDC)
(8W-30-3)
AUTOMATIC SHUT DOWN RELAY (IN PDC)
(8W-30-2)
A11
A14
GENERATOR
1
2
F15
20
DB
OTHER
RHD WITH OUT ABS
13
C104
7
C104
A142
14
DG/PK
S101
(8W-10-14)
K125
18
WT/DB
2
C103
K125
18
WT/DB
S113
(8W-30-15)
F15
18
DB
K51
18
DB/YL
A142
14
DG/PK
K125
18
WT/DB
K20
18
DG
Z0
6
BK
A2
C1
C3
C3
C12
C3
C25
C3
B10
C2
FUSED IGNITION SWITCH OUTPUT (RUN-START)
AUTOMATIC SHUT DOWN RELAY CONTROL
AUTOMATIC SHUT DOWN RELAY OUTPUT
GENERATOR SOURCE
GENERATOR FIELD
POWERTRAIN CONTROL MODULE
(8W-30-2)
(8W-30-3)
(8W-30-15)
(8W-30-16)
G104
(8W-15-5)


K4
20
BK/LB
8
C103
2.5L
4.0L
LHD
RHD
K4
20
BK/LB
S147
(8W-70-4)
(8W-70-6)
(8W-70-7)
(8W-70-8)
S133
(8W-70-4)
K4
18
BK/LB
S133
(8W-70-6)
(8W-70-7)
S121
(8W-70-6)
(8W-70-8)
S121
(8W-70-6)
(8W-70-7)
2
BATTERY TEMPERATURE SENSOR
(8W-30-10)
(8W-30-11)
1
K118
18
PK/YL
C15
C3
BATTERY TEMPERATURE SENSOR SIGNAL
A4
C1
SENSOR GROUND
POWERTRAIN CONTROL MODULE
(8W-30-10)
(8W-30-11)
(8W-30-12)

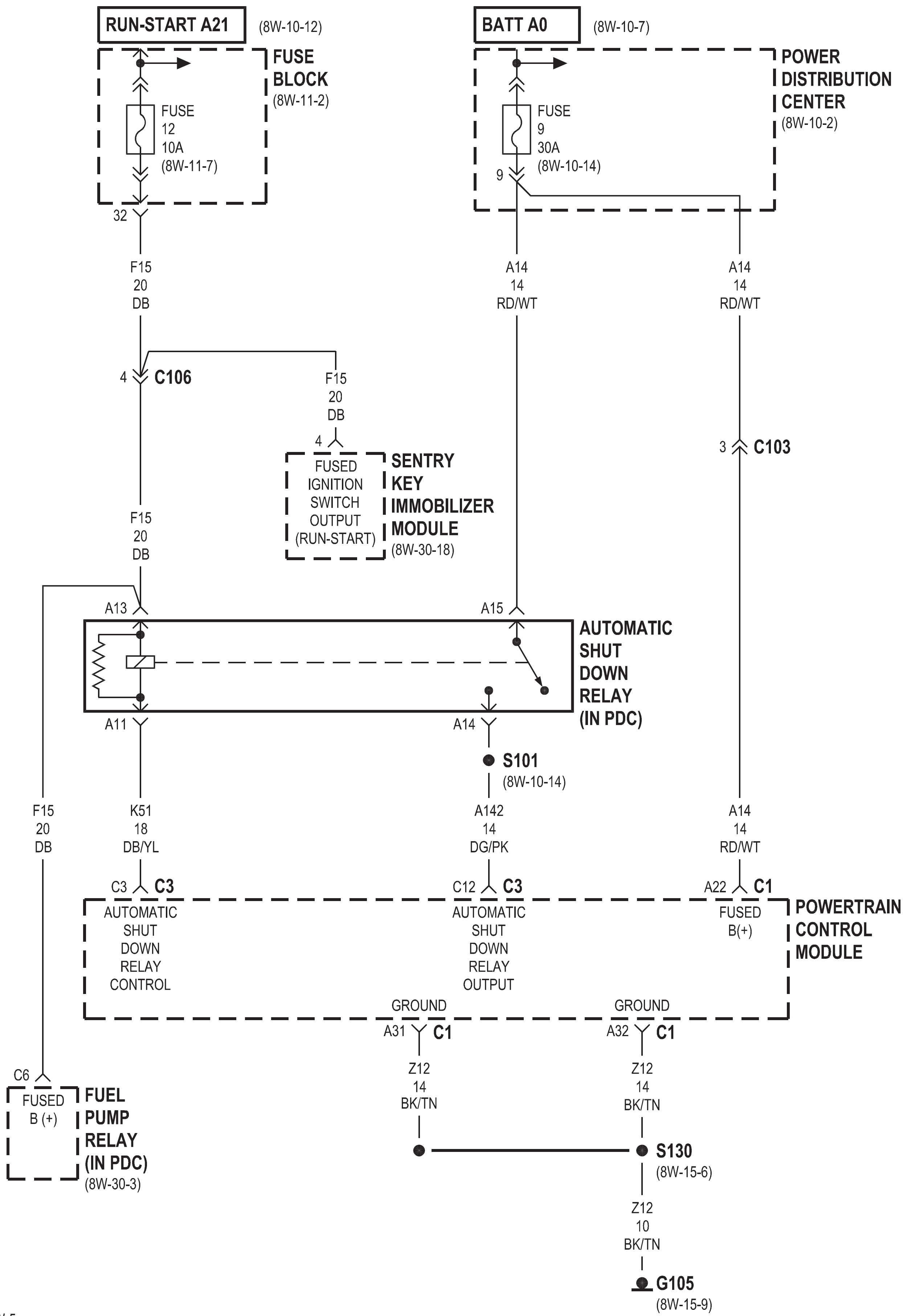
8W-21 STARTING SYSTEM

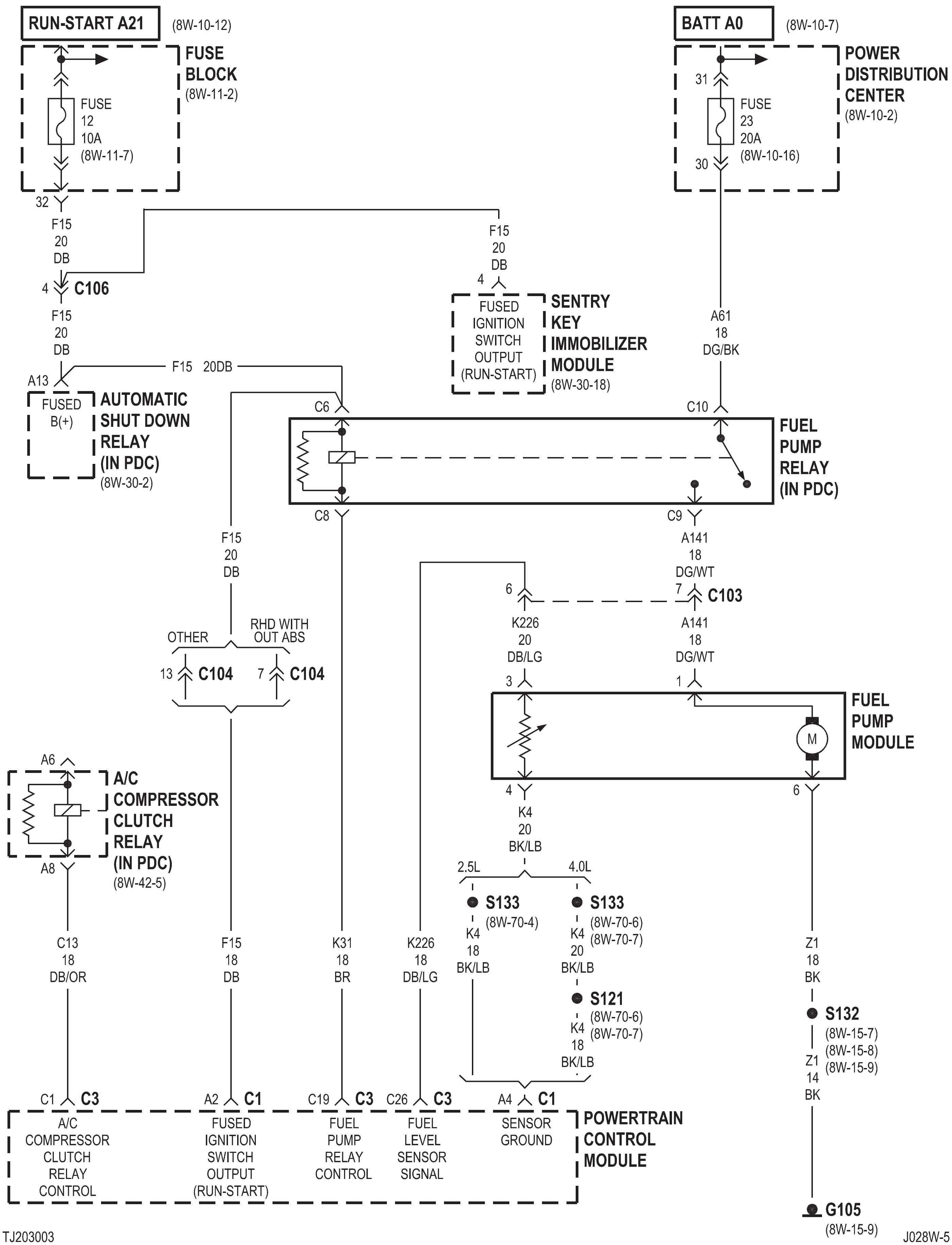


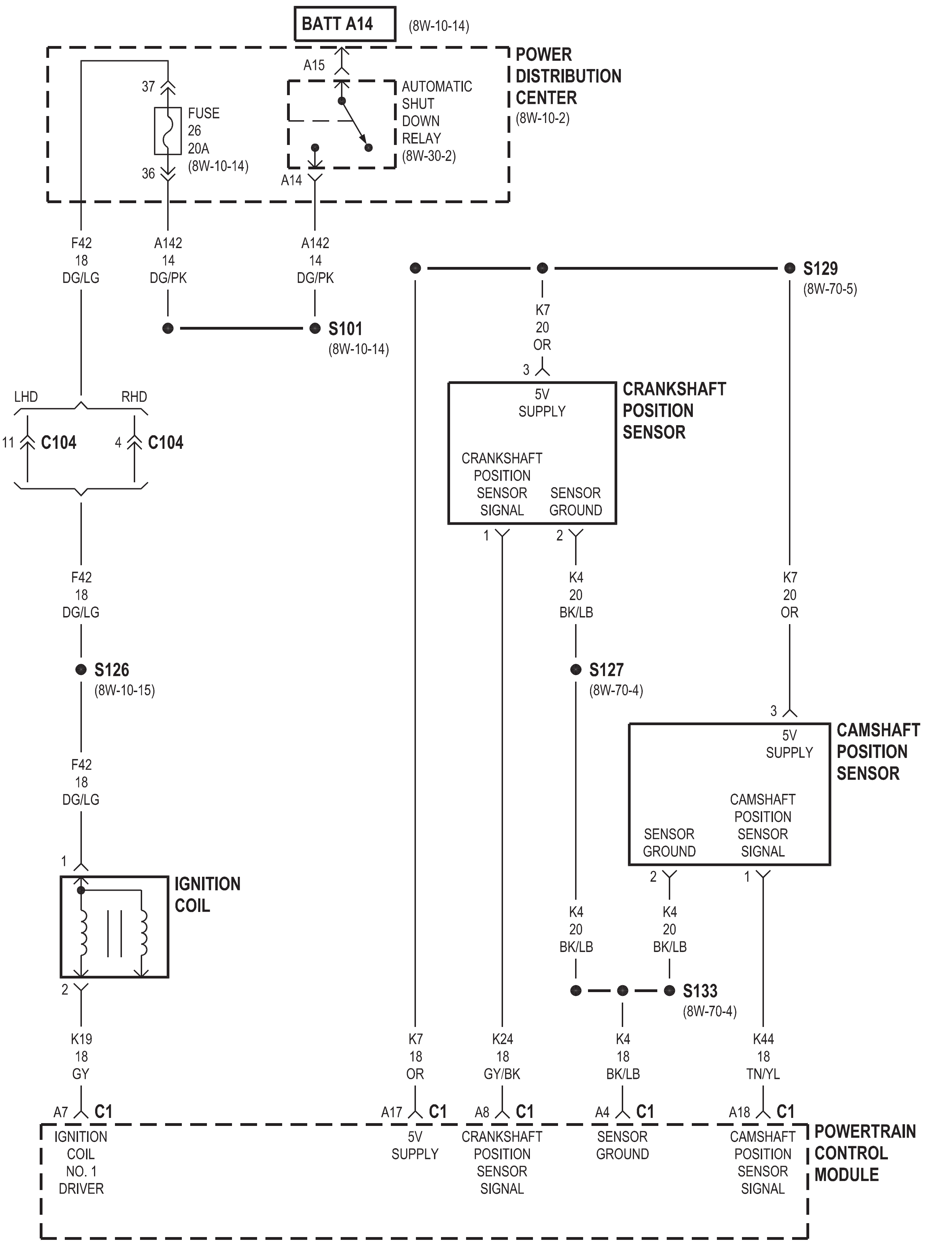
BATT A1
(8W-10-12)
IGNITION SWITCH
(8W-10-12)
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
S331
(8W-10-11)
A41
14
YL
A/T
M/T
FUSE BLOCK
(8W-11-2)
FUSE
20 ■■■
20A
(8W-11-9)
NOT USED
CLUTCH PEDAL POSITION SWITCH
T141
14
YL/RD
RHD
LHD
S333
C106
A
TO
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-3)
■■■ A/T
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
6
40A
(8W-10-11)
A2
12
PK/BK
A0
6
RD
S111
(8W-10-11)
BATTERY
(8W-20-2)
TO
IGNITION SWITCH
(8W-10-12)
B
TO
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-3)
C
TO
ENGINE STARTER MOTOR
(8W-21-3)

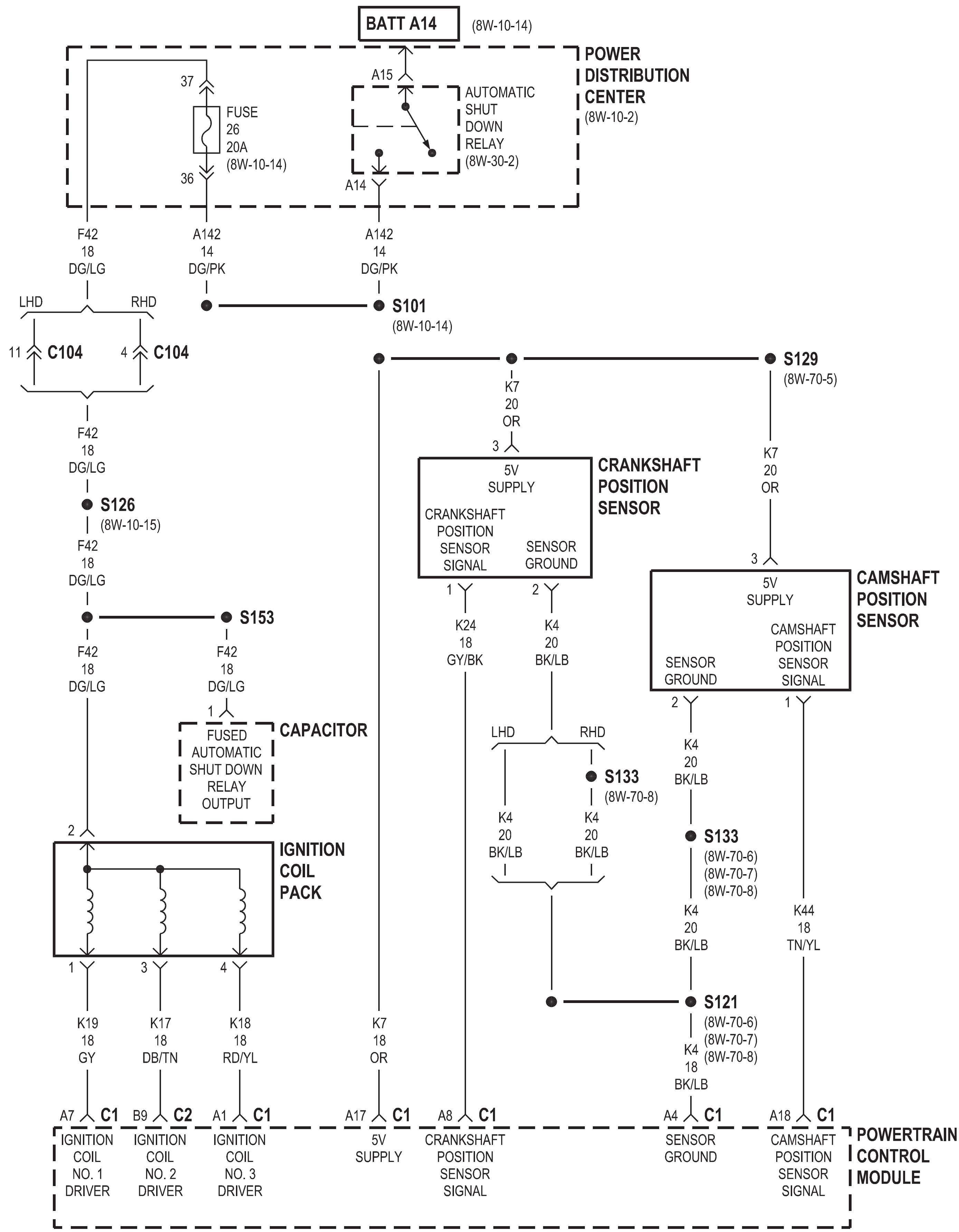

FROM
C106
(8W-21-2)
A
T141
14
YL/RD
FROM
S111
(8W-21-2)
B
A2
12
PK/BK
FROM
BATTERY
(8W-21-2)
C
A0
6
RD
B5
B1
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
B3
B2
T41
20
BR/LB
5 C104
S134
(8W-15-7)
A/T
M/T
T41
20
BR/LB
T41
20
BK/LB
3 C154
3 C154
T41
20
BR/LB
Z1
20
BK
1 C154
Z1
20
BK
S132
(8W-15-7)
(8W-15-8)
(8W-15-9)
Z1
14
BK
G105
(8W-15-9)
2
P/N
PARK/
NEUTRAL
POSITION
SWITCH
(8W-51-2)
T40
12
BR
OTHER
RHD EXCEPT
ABS
12 C104
6 C104
T40
12
BR
A0
6
RD
ENGINE
STARTER
MOTOR
1 PULL-IN
2 HOLD-IN
2
1
M

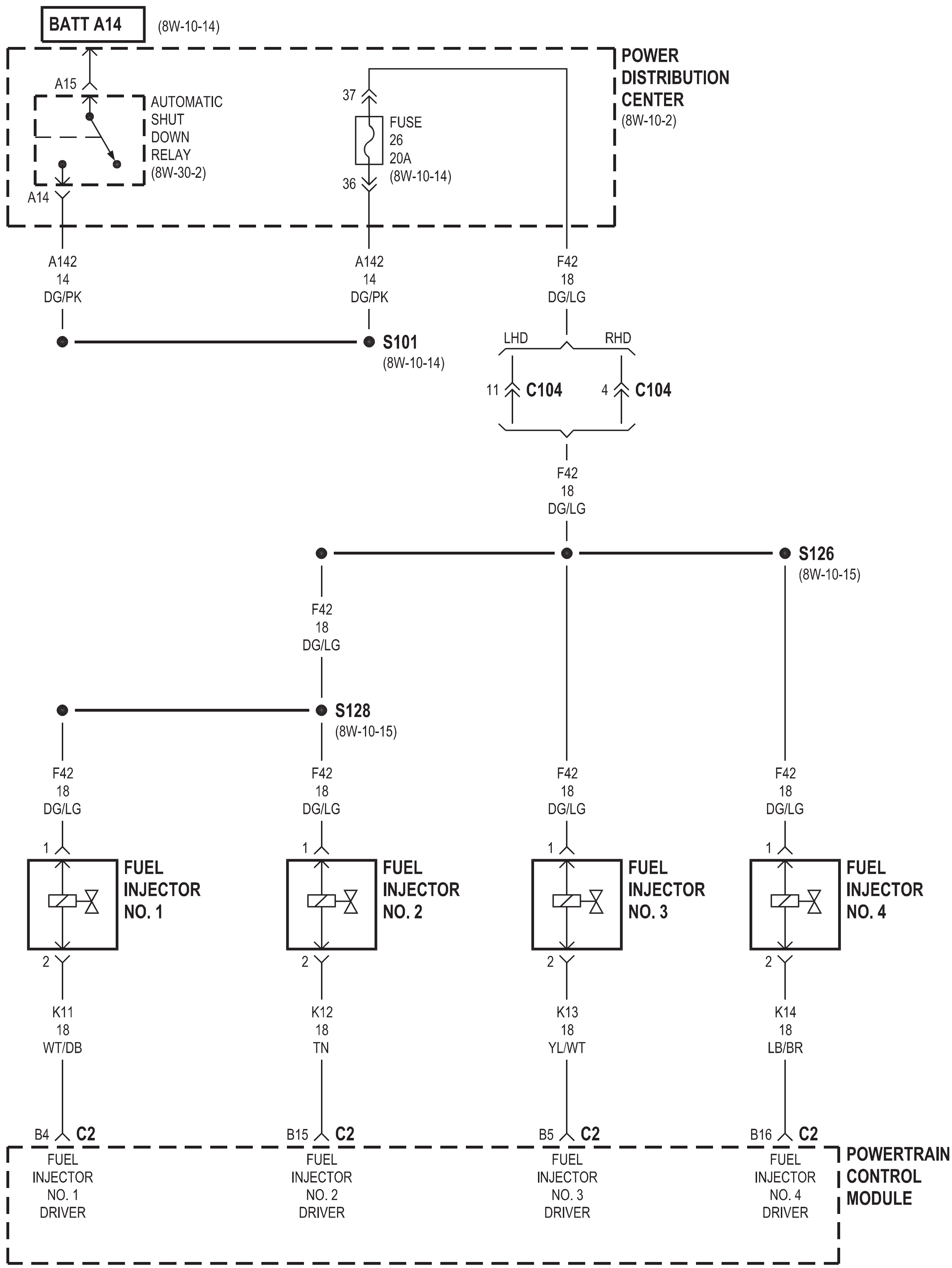
8W-30 FUEL/IGNITION SYSTEM

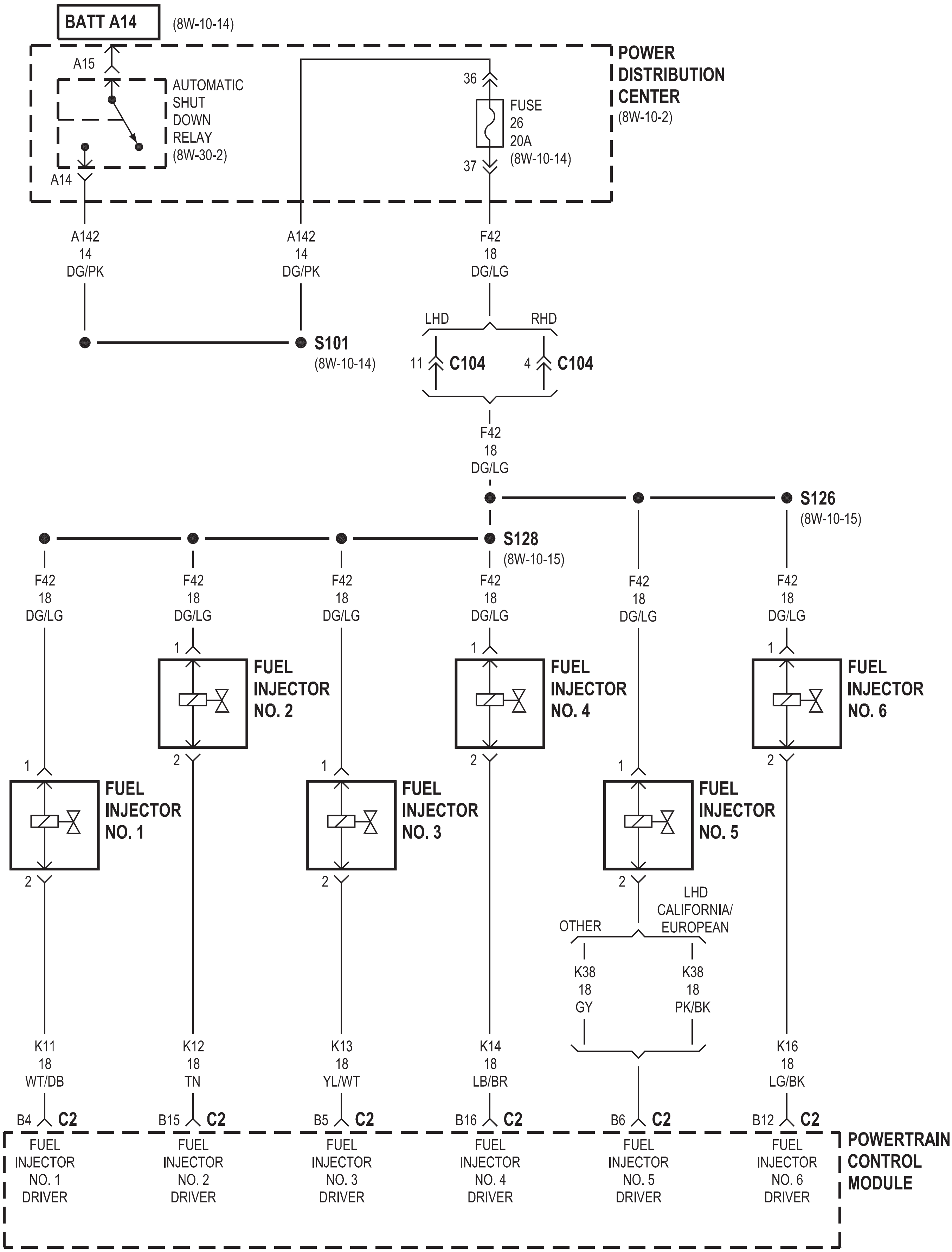

RUN-START A21
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 12 10A (8W-11-7)
32
F15 20 DB
4 C106
F15 20 DB
4
FUSED IGNITION SWITCH OUTPUT (RUN-START)
SENTRY KEY IMMOBILIZER MODULE
(8W-30-18)
F15 20 DB
BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 9 30A (8W-10-14)
9
A14 14 RD/WT
A14 14 RD/WT
3 C103
A13
A15
AUTOMATIC SHUT DOWN RELAY (IN PDC)
A11
A14
S101
(8W-10-14)
F15 20 DB
K51 18 DB/YL
A142 14 DG/PK
A14 14 RD/WT
C3 C3
C12 C3
A22 C1
AUTOMATIC SHUT DOWN RELAY CONTROL
AUTOMATIC SHUT DOWN RELAY OUTPUT
FUSED B(+)
POWERTRAIN CONTROL MODULE
GROUND
GROUND
A31 C1
A32 C1
Z12 14 BK/TN
Z12 14 BK/TN
C6
FUSED B (+)
FUEL PUMP RELAY (IN PDC)
(8W-30-3)
S130
(8W-15-6)
Z12 10 BK/TN
G105
(8W-15-9)

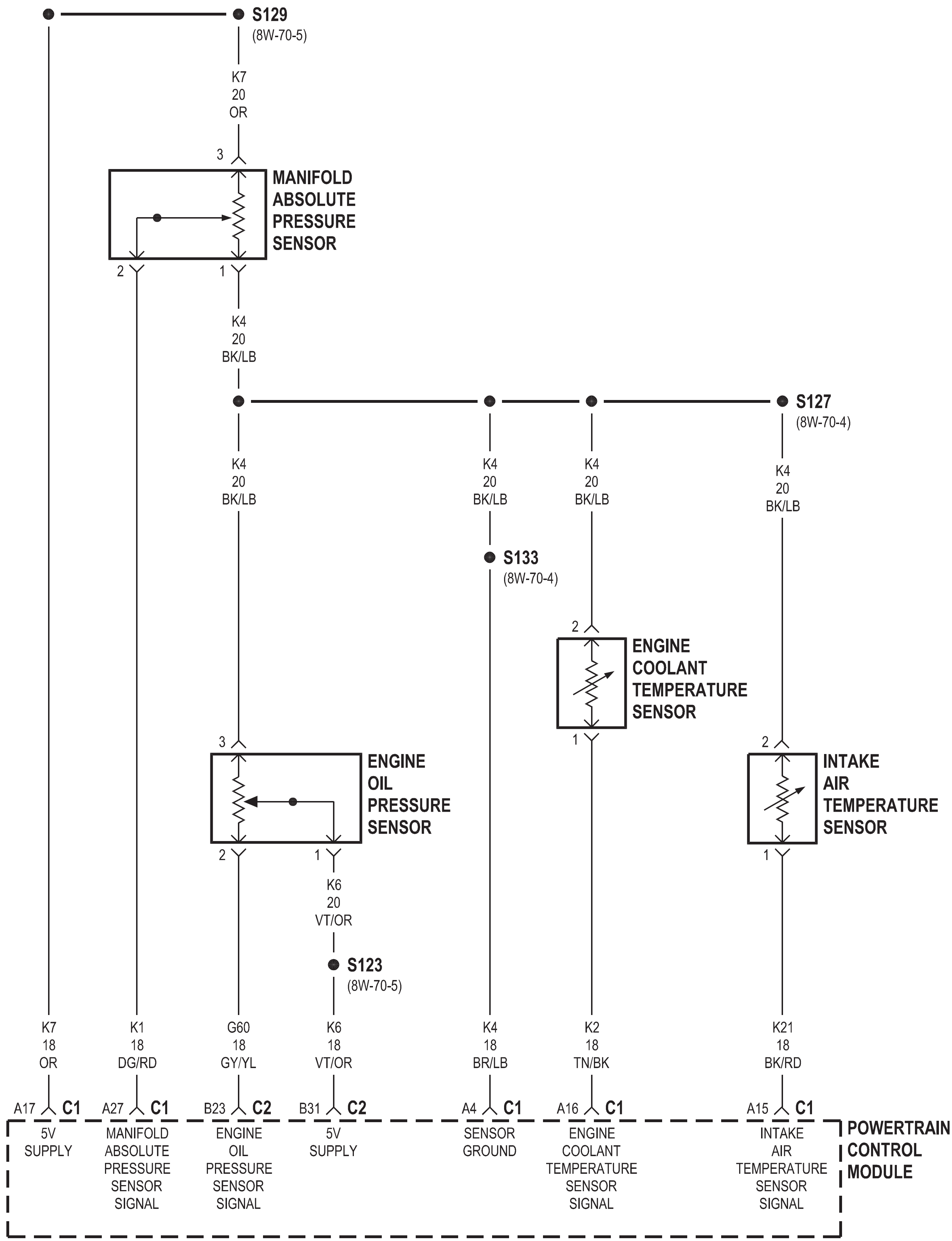

RUN-START A21
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE
12
10A
(8W-11-7)
32
F15
20
DB
4
C106
F15
20
DB
A13
FUSED B(+)
AUTOMATIC SHUT DOWN RELAY (IN PDC)
(8W-30-2)
F15 20DB
F15
20
DB
4
FUSED IGNITION SWITCH OUTPUT (RUN-START)
SENTRY KEY IMMOBILIZER MODULE
(8W-30-18)
BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
31
FUSE
23
20A
(8W-10-16)
30
A61
18
DG/BK
C6
C10
FUEL PUMP RELAY (IN PDC)
C8
C9
F15
20
DB
A141
18
DG/WT
6
7
C103
K226
20
DB/LG
A141
18
DG/WT
OTHER
RHD WITH OUT ABS
13
C104
7
C104
3
1
FUEL PUMP MODULE
M
4
6
K4
20
BK/LB
A6
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
(8W-42-5)
A8
2.5L
4.0L
S133
(8W-70-4)
S133
(8W-70-6)
(8W-70-7)
K4
18
BK/LB
K4
20
BK/LB
S121
(8W-70-6)
(8W-70-7)
K4
18
BK/LB
C13
18
DB/OR
F15
18
DB
K31
18
BR
K226
18
DB/LG
Z1
18
BK
S132
(8W-15-7)
(8W-15-8)
(8W-15-9)
Z1
14
BK
C1 C3
A2 C1
C19 C3
C26 C3
A4 C1
A/C COMPRESSOR CLUTCH RELAY CONTROL
FUSED IGNITION SWITCH OUTPUT (RUN-START)
FUEL PUMP RELAY CONTROL
FUEL LEVEL SENSOR SIGNAL
SENSOR GROUND
POWERTRAIN CONTROL MODULE
G105
(8W-15-9)
TJ203003
J028W-5

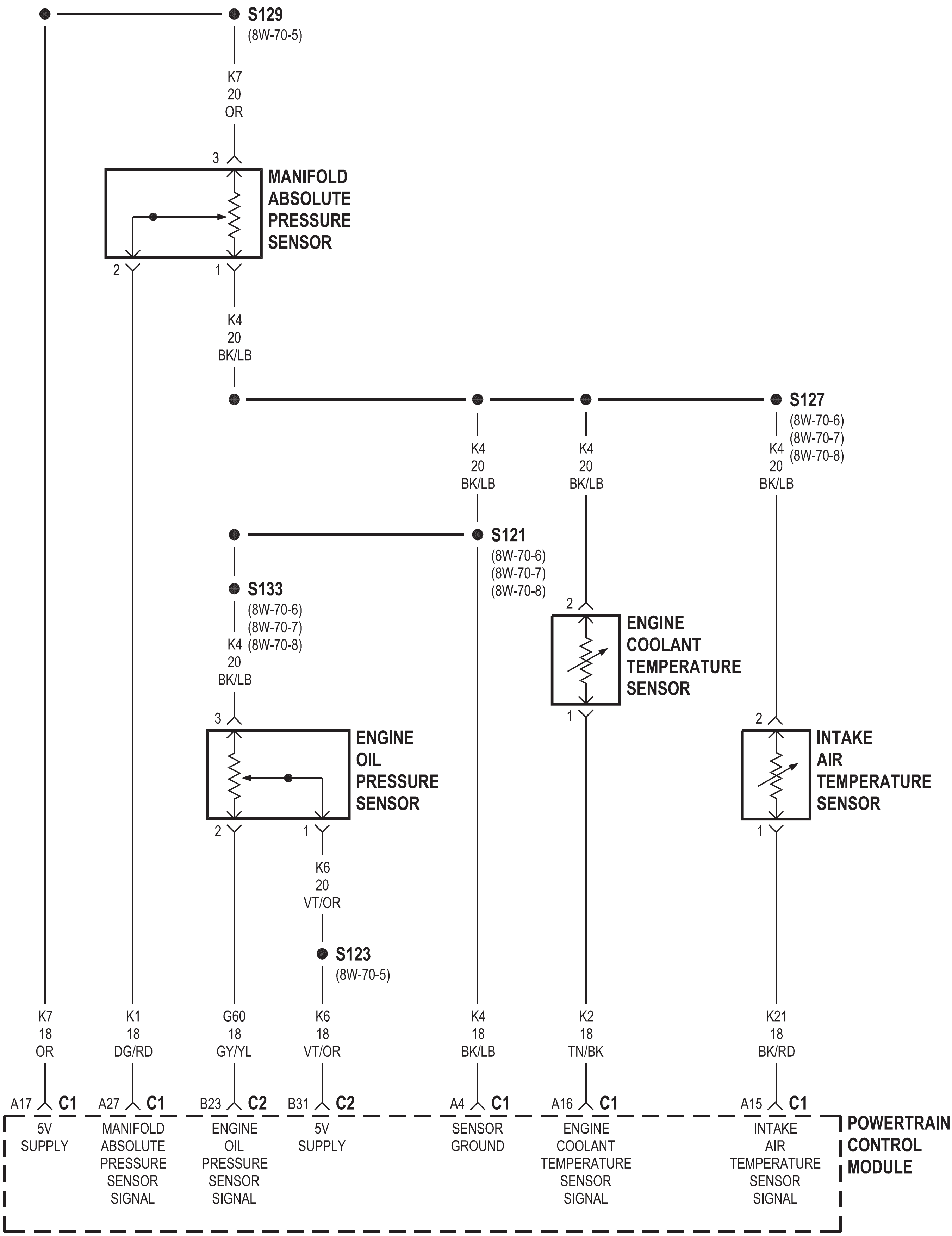

BATT A14
(8W-10-14)
A15
POWER
DISTRIBUTION
CENTER
(8W-10-2)
37
FUSE
26
20A
(8W-10-14)
36
AUTOMATIC
SHUT
DOWN
RELAY
(8W-30-2)
A14
F42
18
DG/LG
A142
14
DG/PK
A142
14
DG/PK
S101
(8W-10-14)
S129
(8W-70-5)
K7
20
OR
3
CRANKSHAFT
POSITION
SENSOR
5V
SUPPLY
CRANKSHAFT
POSITION
SENSOR
SIGNAL
SENSOR
GROUND
1
2
LHD
RHD
11
C104
4
C104
F42
18
DG/LG
K4
20
BK/LB
K7
20
OR
S126
(8W-10-15)
S127
(8W-70-4)
F42
18
DG/LG
3
CAMSHAFT
POSITION
SENSOR
5V
SUPPLY
CAMSHAFT
POSITION
SENSOR
SIGNAL
SENSOR
GROUND
2
1
IGNITION
COIL
1
2
K4
20
BK/LB
K4
20
BK/LB
S133
(8W-70-4)
K19
18
GY
K7
18
OR
K24
18
GY/BK
K4
18
BK/LB
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

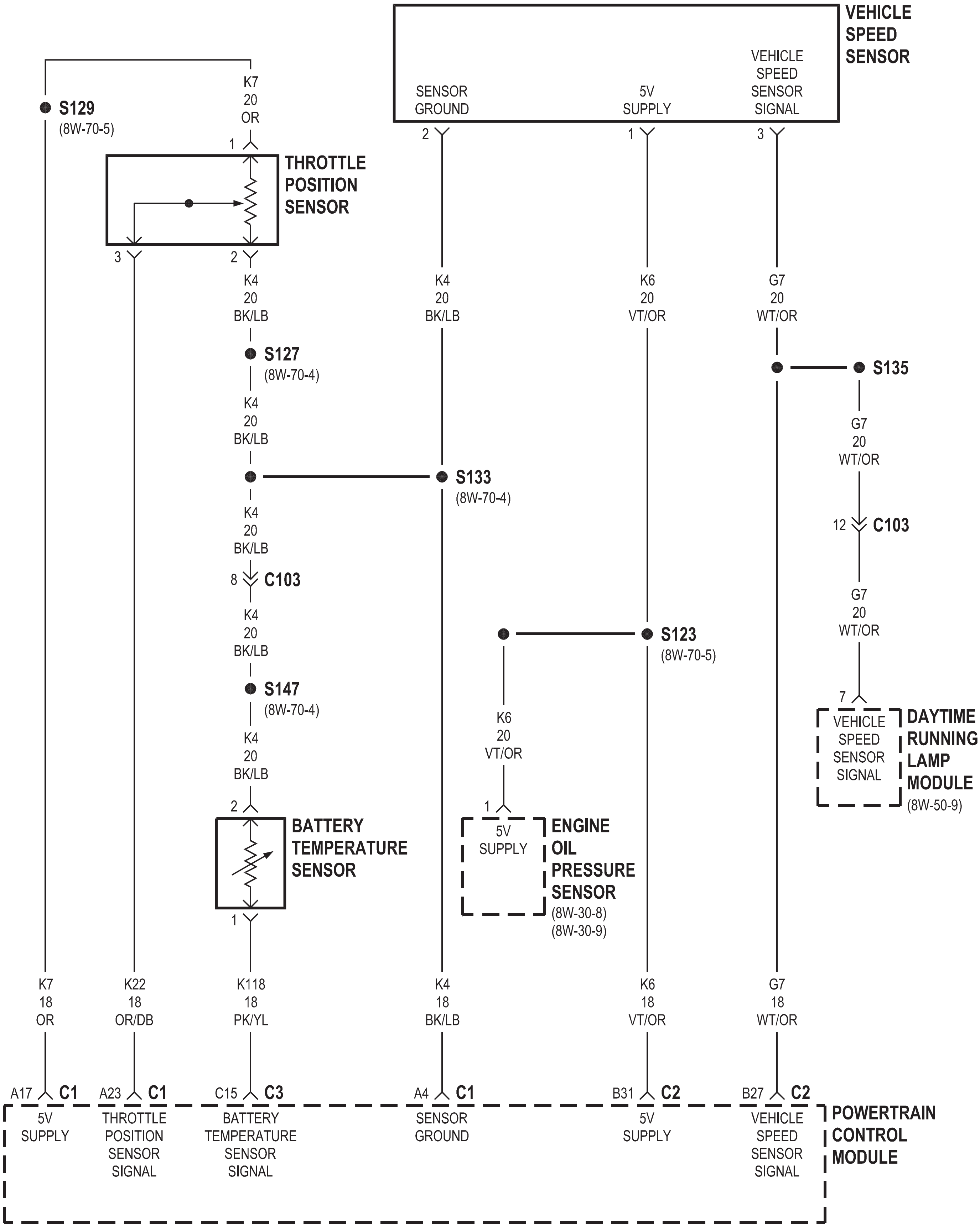

BATT A14
(8W-10-14)
POWER DISTRIBUTION CENTER
(8W-10-2)
37
FUSE
26
20A
(8W-10-14)
36
A15
AUTOMATIC SHUT DOWN RELAY
(8W-30-2)
A14
F42
18
DG/LG
A142
14
DG/PK
A142
14
DG/PK
LHD
RHD
S101
(8W-10-14)
11
C104
4
C104
S129
(8W-70-5)
K7
20
OR
3
CRANKSHAFT POSITION SENSOR
5V SUPPLY
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
1
2
K24
18
GY/BK
K4
20
BK/LB
F42
18
DG/LG
S126
(8W-10-15)
F42
18
DG/LG
S153
F42
18
DG/LG
F42
18
DG/LG
1
CAPACITOR
FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
K7
20
OR
3
CAMSHAFT POSITION SENSOR
5V SUPPLY
SENSOR GROUND
CAMSHAFT POSITION SENSOR SIGNAL
2
1
K4
20
BK/LB
LHD
RHD
S133
(8W-70-8)
K4
20
BK/LB
K4
20
BK/LB
S133
(8W-70-6)
(8W-70-7)
(8W-70-8)
K4
20
BK/LB
K44
18
TN/YL
2
IGNITION COIL PACK
1
3
4
S121
(8W-70-6)
(8W-70-7)
(8W-70-8)
K19
18
GY
K17
18
DB/TN
K18
18
RD/YL
K7
18
OR
K4
18
BK/LB
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

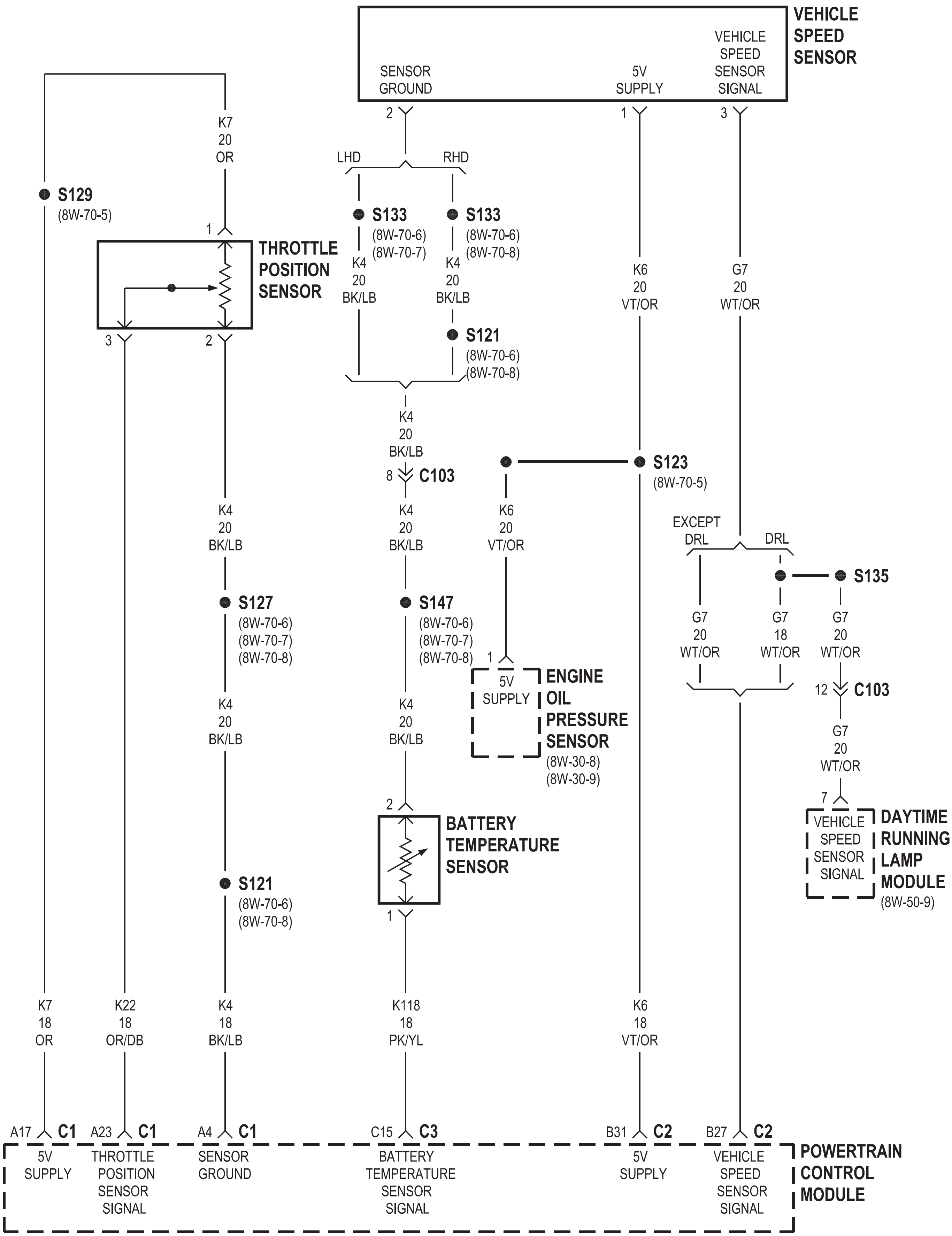

BATT A14
(8W-10-14)
A15
AUTOMATIC
SHUT
DOWN
RELAY
(8W-30-2)
A14
37
FUSE
26
20A
(8W-10-14)
36
POWER
DISTRIBUTION
CENTER
(8W-10-2)
A142
14
DG/PK
A142
14
DG/PK
F42
18
DG/LG
S101
(8W-10-14)
LHD
RHD
11
C104
4
C104
F42
18
DG/LG
S126
(8W-10-15)
F42
18
DG/LG
S128
(8W-10-15)
F42
18
DG/LG
1
FUEL
INJECTOR
NO. 1
2
K11
18
WT/DB
FUEL
INJECTOR
NO. 2
K12
18
TN
FUEL
INJECTOR
NO. 3
K13
18
YL/WT
FUEL
INJECTOR
NO. 4
K14
18
LB/BR
B4
C2
B15
B5
B16
FUEL
INJECTOR
NO. 1
DRIVER
FUEL
INJECTOR
NO. 2
DRIVER
FUEL
INJECTOR
NO. 3
DRIVER
FUEL
INJECTOR
NO. 4
DRIVER
POWERTRAIN
CONTROL
MODULE

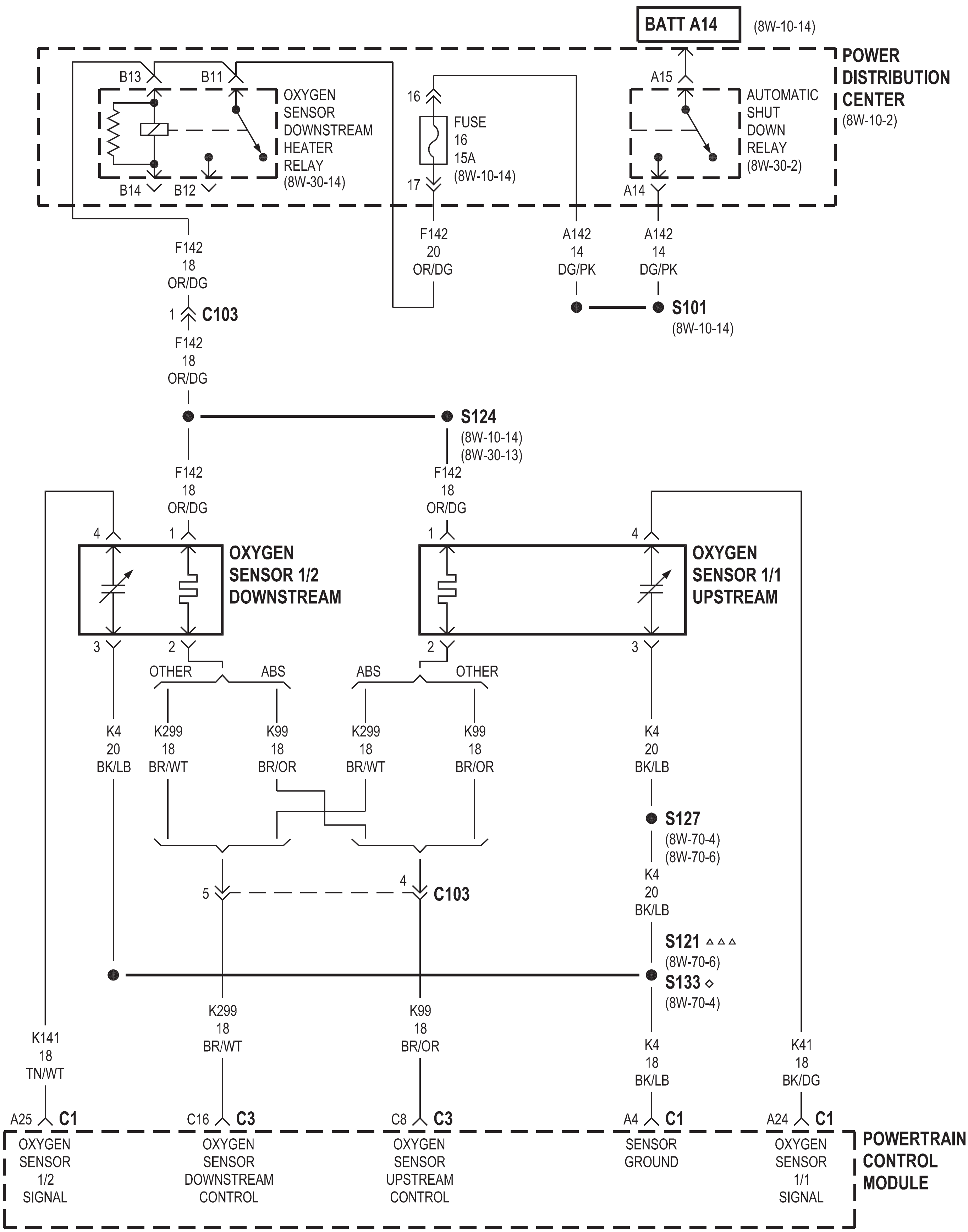

BATT A14
(8W-10-14)
A15
AUTOMATIC
SHUT
DOWN
RELAY
(8W-30-2)
A14
36
FUSE
26
20A
(8W-10-14)
37
POWER
DISTRIBUTION
CENTER
(8W-10-2)
A142
14
DG/PK
A142
14
DG/PK
F42
18
DG/LG
S101
(8W-10-14)
LHD
RHD
11
C104
4
C104
F42
18
DG/LG
S126
(8W-10-15)
S128
(8W-10-15)
F42
18
DG/LG
FUEL
INJECTOR
NO. 1
FUEL
INJECTOR
NO. 2
FUEL
INJECTOR
NO. 3
FUEL
INJECTOR
NO. 4
FUEL
INJECTOR
NO. 5
FUEL
INJECTOR
NO. 6
OTHER
LHD
CALIFORNIA/
EUROPEAN
K38
18
GY
K38
18
PK/BK
K11
18
WT/DB
K12
18
TN
K13
18
YL/WT
K14
18
LB/BR
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-70-5)
K7
20
OR
3
MANIFOLD
ABSOLUTE
PRESSURE
SENSOR
2
1
K4
20
BK/LB
S127
(8W-70-4)
K4
20
BK/LB
K4
20
BK/LB
K4
20
BK/LB
K4
20
BK/LB
S133
(8W-70-4)
2
ENGINE
COOLANT
TEMPERATURE
SENSOR
1
3
ENGINE
OIL
PRESSURE
SENSOR
2
1
2
INTAKE
AIR
TEMPERATURE
SENSOR
1
K6
20
VT/OR
S123
(8W-70-5)
K7
18
OR
K1
18
DG/RD
G60
18
GY/YL
K6
18
VT/OR
K4
18
BR/LB
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

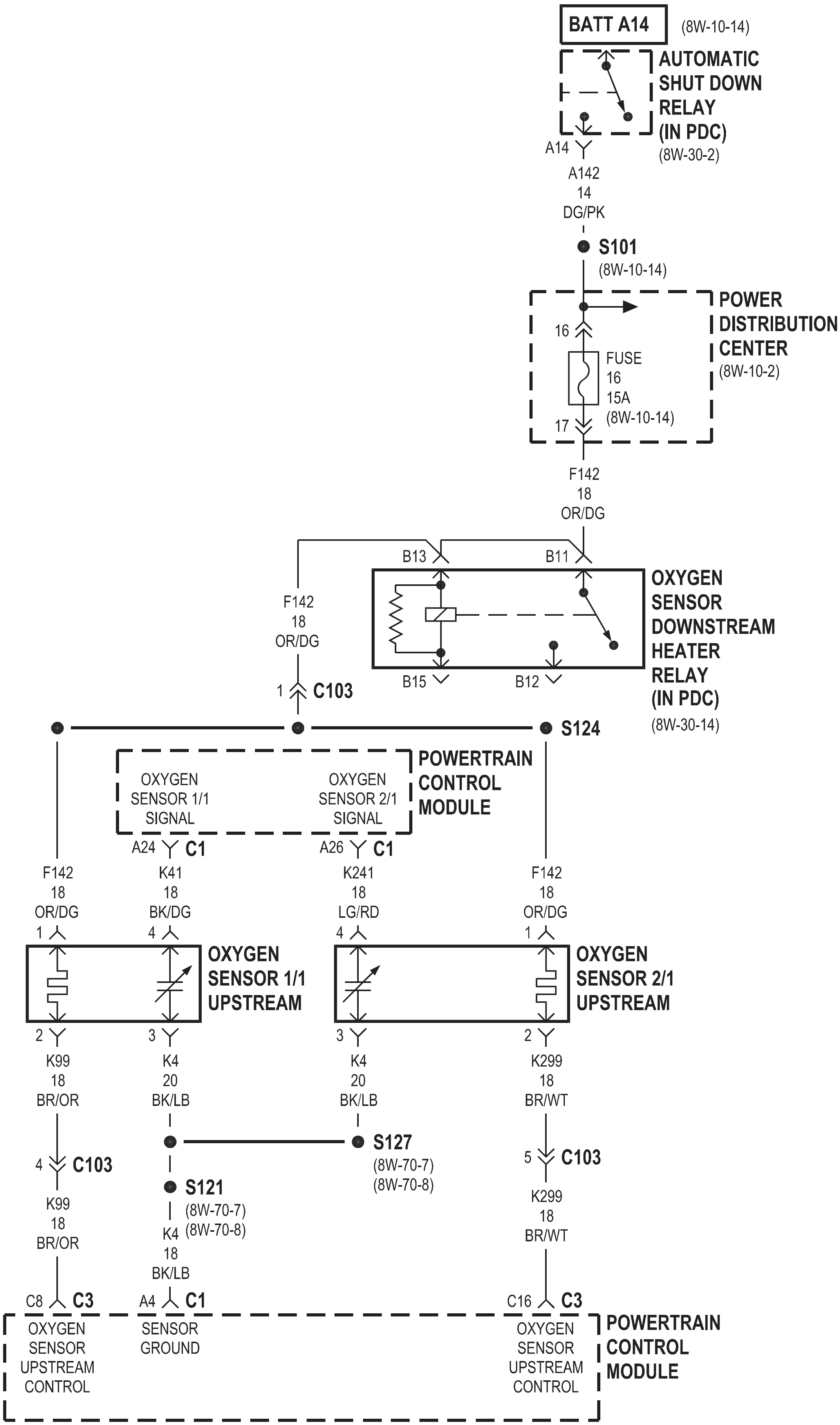

S129
(8W-70-5)
K7
20
OR
3
MANIFOLD
ABSOLUTE
PRESSURE
SENSOR
2
1
K4
20
BK/LB
S127
(8W-70-6)
(8W-70-7)
(8W-70-8)
K4
20
BK/LB
K4
20
BK/LB
K4
20
BK/LB
S121
(8W-70-6)
(8W-70-7)
(8W-70-8)
S133
(8W-70-6)
(8W-70-7)
(8W-70-8)
K4
20
BK/LB
2
ENGINE
COOLANT
TEMPERATURE
SENSOR
1
3
ENGINE
OIL
PRESSURE
SENSOR
2
1
K6
20
VT/OR
2
INTAKE
AIR
TEMPERATURE
SENSOR
1
S123
(8W-70-5)
K7
18
OR
K1
18
DG/RD
G60
18
GY/YL
K6
18
VT/OR
K4
18
BK/LB
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

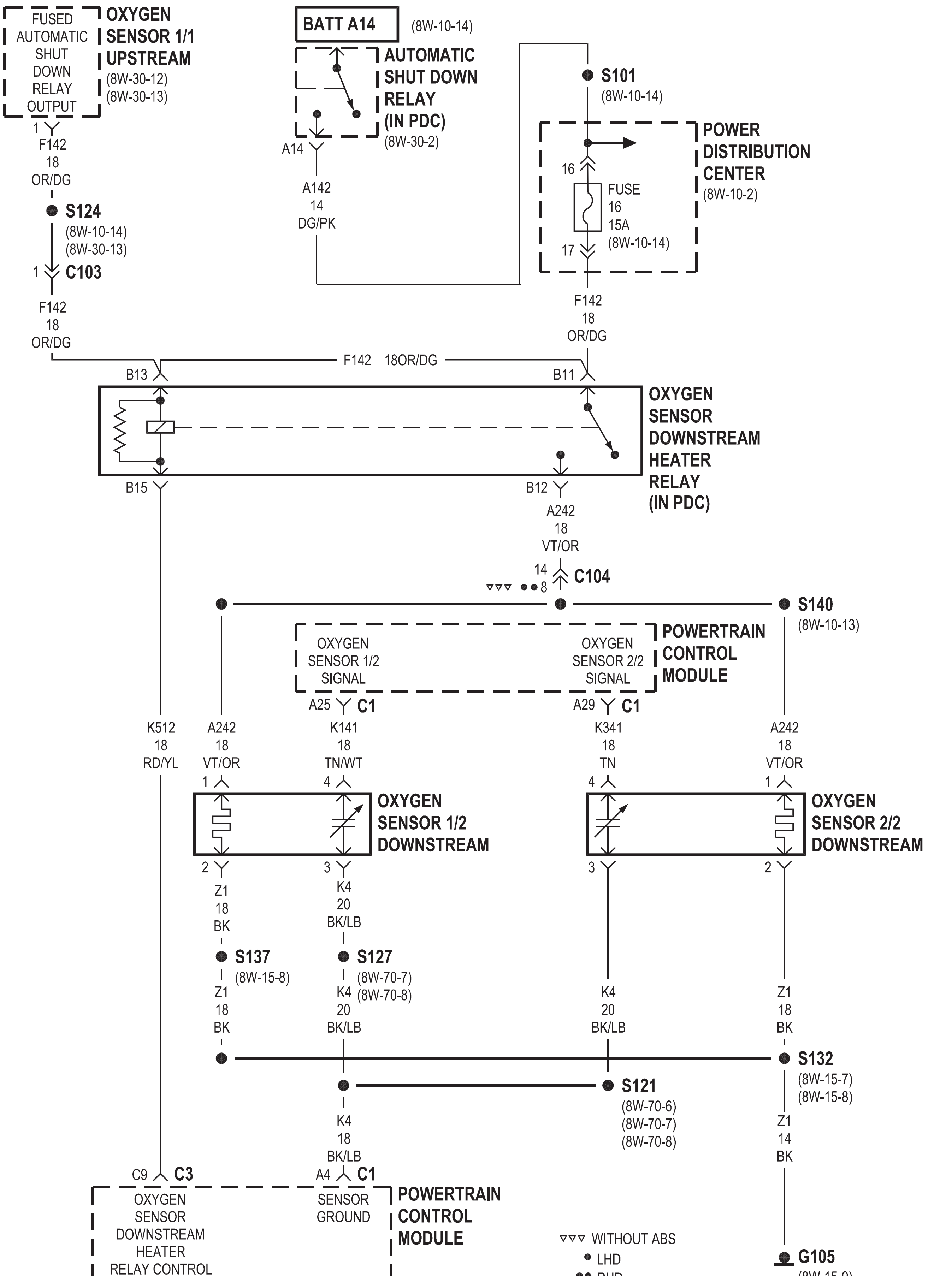

VEHICLE SPEED SENSOR
SENSOR GROUND
5V SUPPLY
VEHICLE SPEED SENSOR SIGNAL
2
1
3
S129
(8W-70-5)
K7 20 OR
1
THROTTLE POSITION SENSOR
3
2
K4 20 BK/LB
K6 20 VT/OR
G7 20 WT/OR
S127
(8W-70-4)
S135
S133
(8W-70-4)
12
C103
8
C103
S123
(8W-70-5)
S147
(8W-70-4)
K6 20 VT/OR
7
VEHICLE SPEED SENSOR SIGNAL
DAYTIME RUNNING LAMP MODULE
(8W-50-9)
BATTERY TEMPERATURE SENSOR
5V SUPPLY
ENGINE OIL PRESSURE SENSOR
(8W-30-8)
(8W-30-9)
K7 18 OR
K22 18 OR/DB
K118 18 PK/YL
K4 18 BK/LB
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

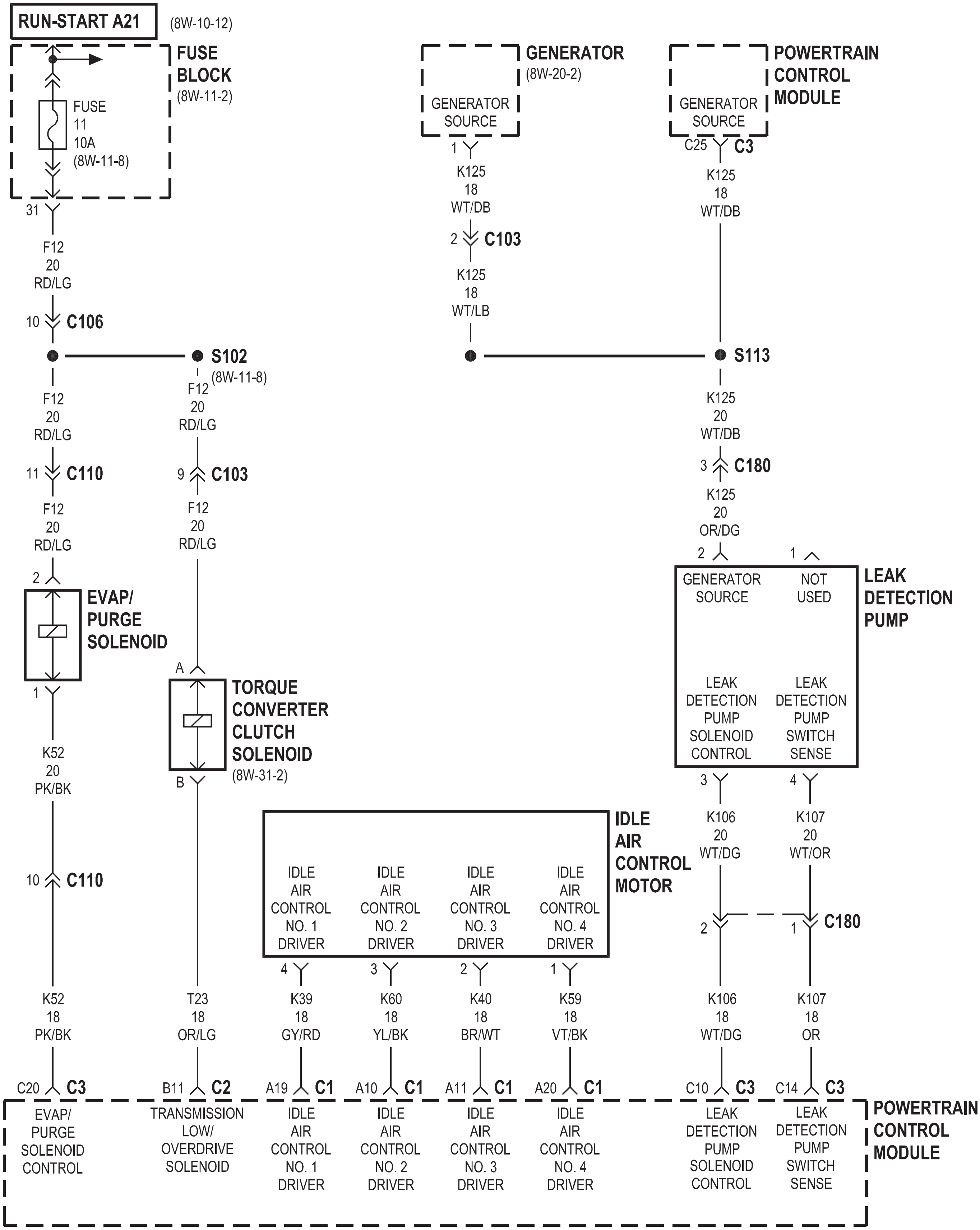

VEHICLE SPEED SENSOR
SENSOR GROUND
5V SUPPLY
VEHICLE SPEED SENSOR SIGNAL
K7 20 OR
S129 (8W-70-5)
THROTTLE POSITION SENSOR
LHD
RHD
S133 (8W-70-6) (8W-70-7)
S133 (8W-70-6) (8W-70-8)
K4 20 BK/LB
S121 (8W-70-6) (8W-70-8)
K6 20 VT/OR
G7 20 WT/OR
C103
S123 (8W-70-5)
EXCEPT DRL
DRL
S135
S127 (8W-70-6) (8W-70-7) (8W-70-8)
S147 (8W-70-6) (8W-70-7) (8W-70-8)
ENGINE OIL PRESSURE SENSOR (8W-30-8) (8W-30-9)
G7 18 WT/OR
DAYTIME RUNNING LAMP MODULE (8W-50-9)
BATTERY TEMPERATURE SENSOR
K7 18 OR
K22 18 OR/DB
K4 18 BK/LB
K118 18 PK/YL
K6 18 VT/OR
A17 C1
A23 C1
A4 C1
C15 C3
B31 C2
B27 C2
5V SUPPLY
THROTTLE POSITION SENSOR SIGNAL
SENSOR GROUND
BATTERY TEMPERATURE SENSOR SIGNAL
5V SUPPLY
VEHICLE SPEED SENSOR SIGNAL
POWERTRAIN CONTROL MODULE


BATT A14
(8W-10-14)
POWER DISTRIBUTION CENTER
(8W-10-2)
B13
B11
OXYGEN SENSOR DOWNSTREAM HEATER RELAY
(8W-30-14)
B14
B12
16
FUSE 16 15A
(8W-10-14)
17
A15
AUTOMATIC SHUT DOWN RELAY
(8W-30-2)
A14
F142 18 OR/DG
F142 20 OR/DG
A142 14 DG/PK
A142 14 DG/PK
S101
(8W-10-14)
1
C103
F142 18 OR/DG
S124
(8W-10-14)
(8W-30-13)
F142 18 OR/DG
F142 18 OR/DG
4
1
OXYGEN SENSOR 1/2 DOWNSTREAM
3
2
1
4
OXYGEN SENSOR 1/1 UPSTREAM
2
3
OTHER
ABS
ABS
OTHER
K4 20 BK/LB
K299 18 BR/WT
K99 18 BR/OR
K299 18 BR/WT
K99 18 BR/OR
K4 20 BK/LB
S127
(8W-70-4)
(8W-70-6)
5
4
C103
K4 20 BK/LB
S121 △△△
(8W-70-6)
S133 ◇
(8W-70-4)
K141 18 TN/WT
K299 18 BR/WT
K99 18 BR/OR
K4 18 BK/LB
K41 18 BK/DG
A25 C1
C16 C3
C8 C3
A4 C1
A24 C1
OXYGEN SENSOR 1/2 SIGNAL
OXYGEN SENSOR DOWNSTREAM CONTROL
OXYGEN SENSOR UPSTREAM CONTROL
SENSOR GROUND
OXYGEN SENSOR 1/1 SIGNAL
POWERTRAIN CONTROL MODULE

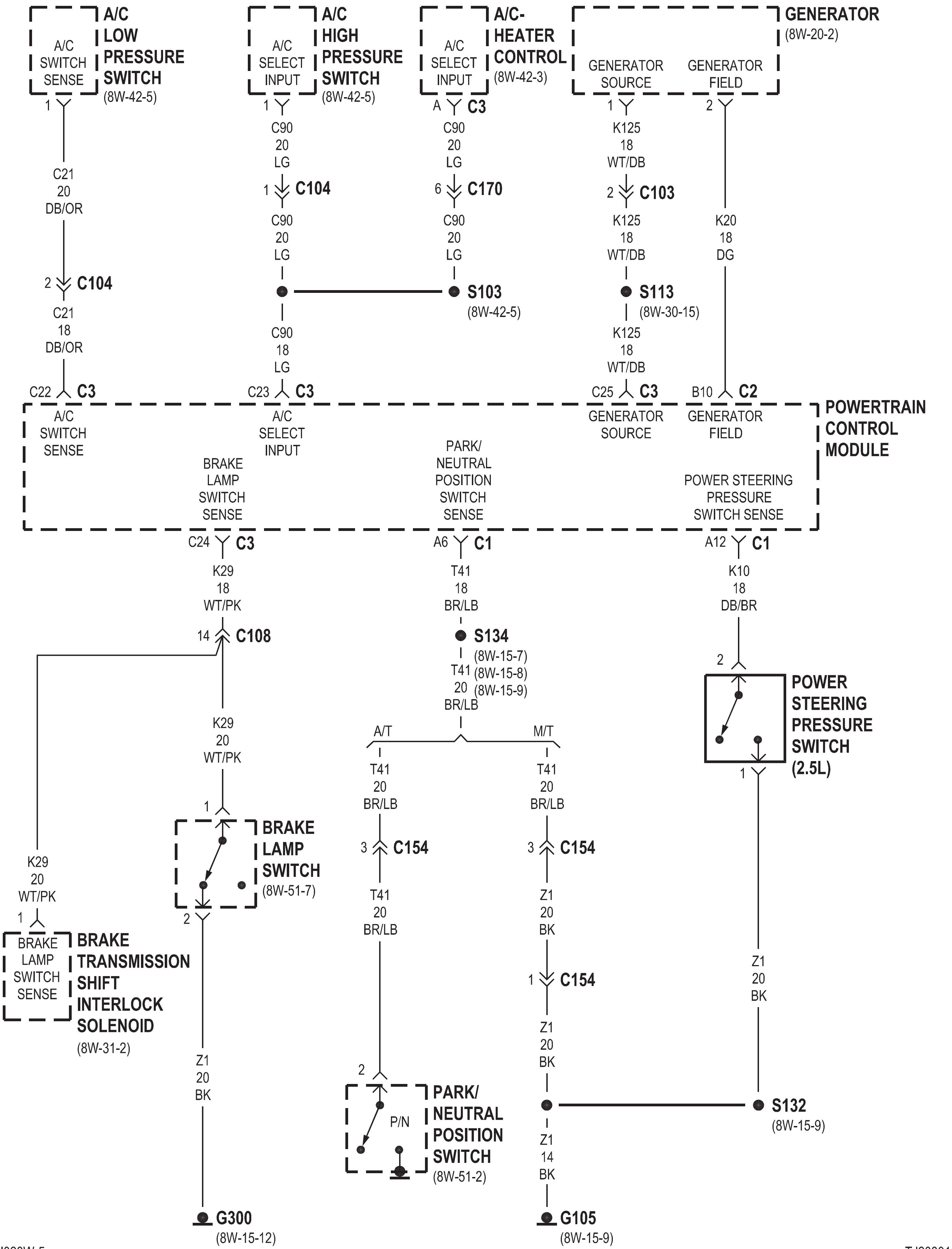
△△△ 4.0L
◇ 2.5L

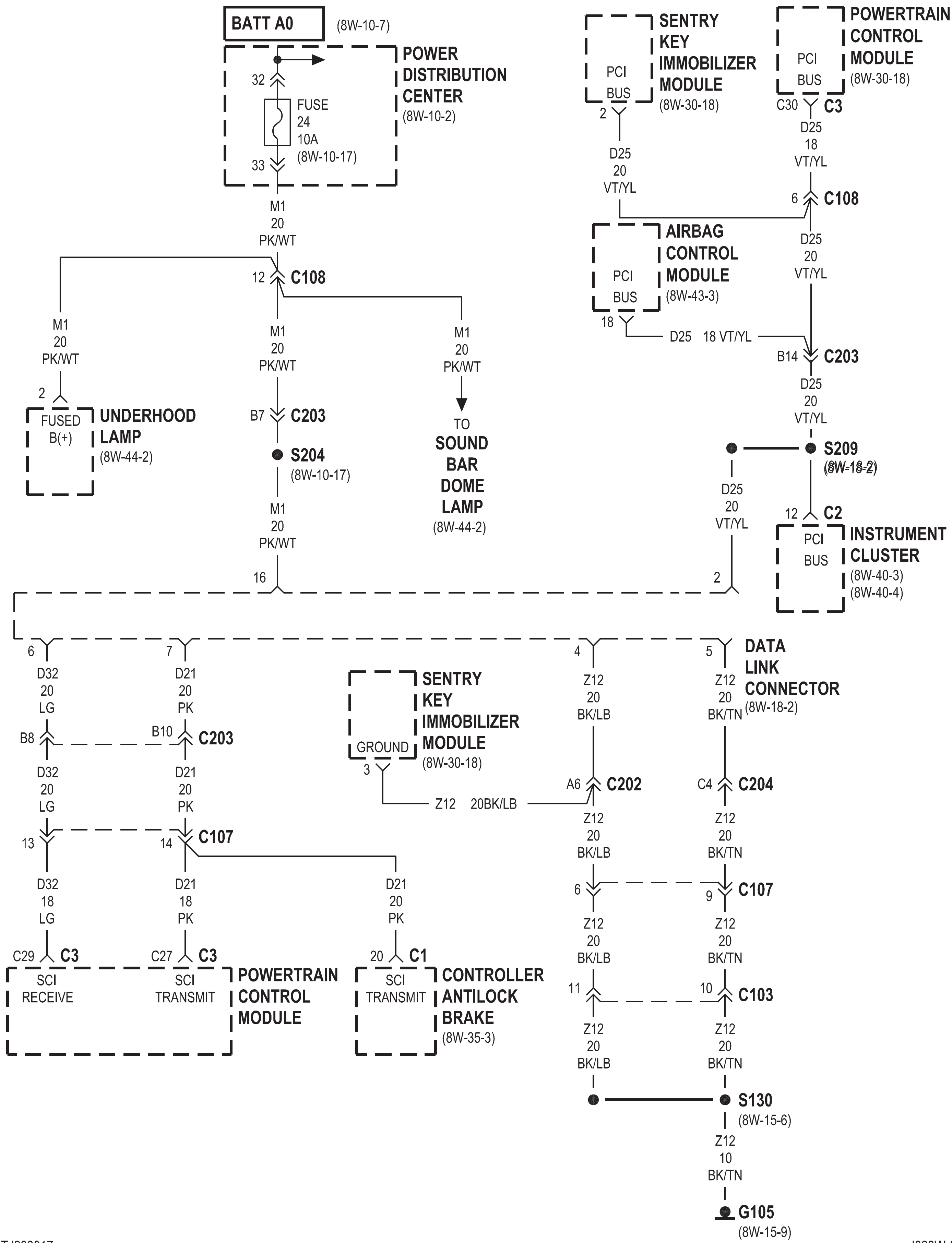

BATT A14
(8W-10-14)
AUTOMATIC SHUT DOWN RELAY (IN PDC)
(8W-30-2)
A14
A142
14
DG/PK
S101
(8W-10-14)
POWER DISTRIBUTION CENTER
(8W-10-2)
16
FUSE
16
15A
(8W-10-14)
17
F142
18
OR/DG
B13
B11
OXYGEN SENSOR DOWNSTREAM HEATER RELAY (IN PDC)
(8W-30-14)
B15
B12
F142
18
OR/DG
1
C103
S124
POWERTRAIN CONTROL MODULE
OXYGEN SENSOR 1/1 SIGNAL
OXYGEN SENSOR 2/1 SIGNAL
A24
C1
A26
C1
F142
18
OR/DG
K41
18
BK/DG
K241
18
LG/RD
F142
18
OR/DG
1
4
4
1
OXYGEN SENSOR 1/1 UPSTREAM
OXYGEN SENSOR 2/1 UPSTREAM
2
3
3
2
K99
18
BR/OR
K4
20
BK/LB
K4
20
BK/LB
K299
18
BR/WT
S127
(8W-70-7)
(8W-70-8)
4
C103
5
C103
S121
(8W-70-7)
(8W-70-8)
K99
18
BR/OR
K4
18
BK/LB
K299
18
BR/WT
C8
C3
A4
C1
C16
C3
OXYGEN SENSOR UPSTREAM CONTROL
SENSOR GROUND
OXYGEN SENSOR UPSTREAM CONTROL
POWERTRAIN CONTROL MODULE

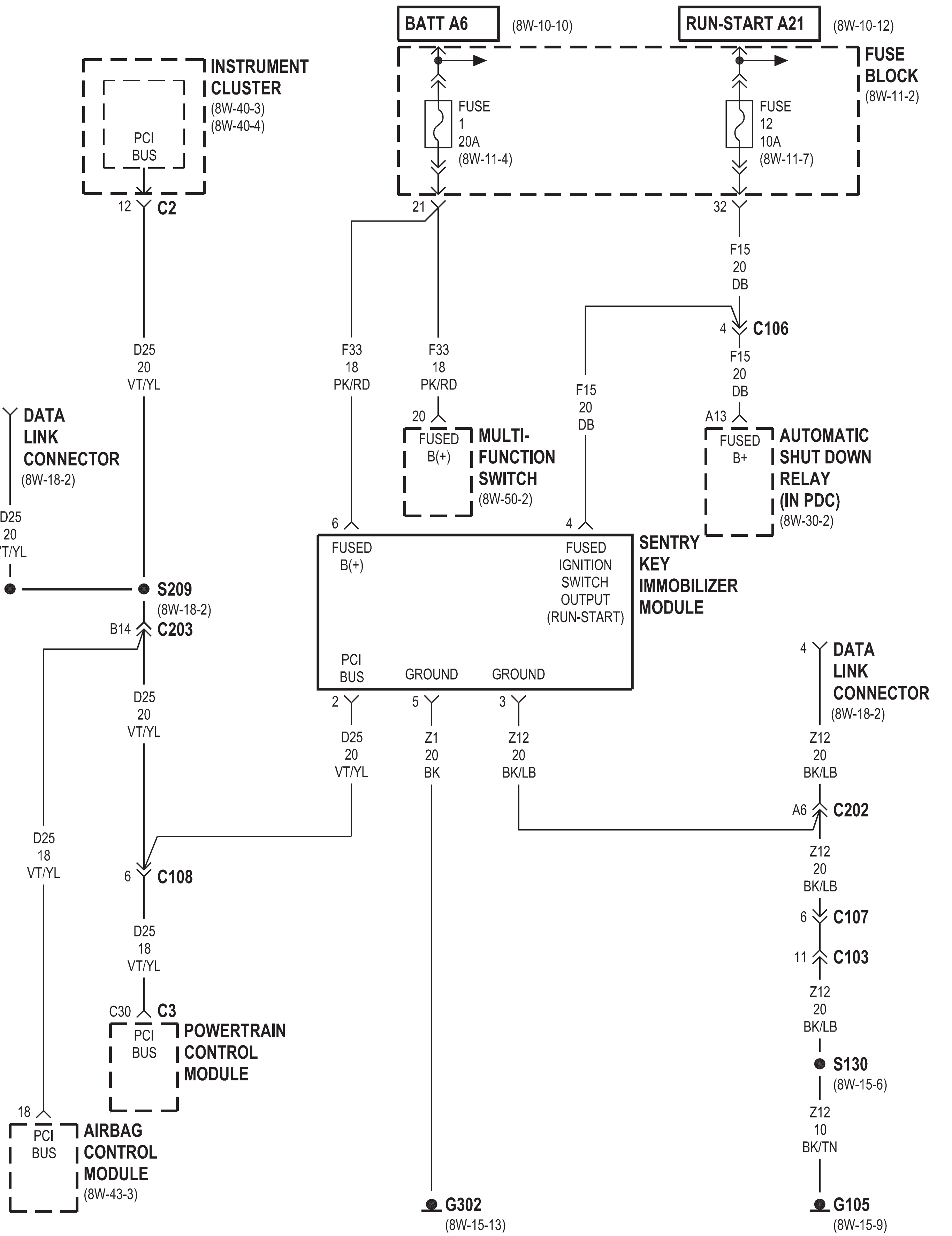

FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-12)
(8W-30-13)
1
F142
18
OR/DG
S124
(8W-10-14)
(8W-30-13)
1
C103
F142
18
OR/DG
BATT A14
(8W-10-14)
AUTOMATIC SHUT DOWN RELAY (IN PDC)
(8W-30-2)
A14
A142
14
DG/PK
S101
(8W-10-14)
POWER DISTRIBUTION CENTER
(8W-10-2)
16
FUSE
16
15A
(8W-10-14)
17
F142
18
OR/DG
F142 18OR/DG
B13
B11
OXYGEN SENSOR DOWNSTREAM HEATER RELAY (IN PDC)
B15
B12
A242
18
VT/OR
14
C104
8
S140
(8W-10-13)
OXYGEN SENSOR 1/2 SIGNAL
OXYGEN SENSOR 2/2 SIGNAL
POWERTRAIN CONTROL MODULE
A25
C1
A29
C1
K512
18
RD/YL
A242
18
VT/OR
K141
18
TN/WT
K341
18
TN
A242
18
VT/OR
1
4
4
1
OXYGEN SENSOR 1/2 DOWNSTREAM
OXYGEN SENSOR 2/2 DOWNSTREAM
2
3
3
2
Z1
18
BK
K4
20
BK/LB
S137
(8W-15-8)
S127
(8W-70-7)
(8W-70-8)
Z1
18
BK
K4
20
BK/LB
K4
20
BK/LB
Z1
18
BK
S132
(8W-15-7)
(8W-15-8)
S121
(8W-70-6)
(8W-70-7)
(8W-70-8)
K4
18
BK/LB
Z1
14
BK
C9
C3
A4
C1
OXYGEN SENSOR DOWNSTREAM HEATER RELAY CONTROL
SENSOR GROUND
POWERTRAIN CONTROL MODULE
WITHOUT ABS
LHD
RHD
G105
(8W-15-9)

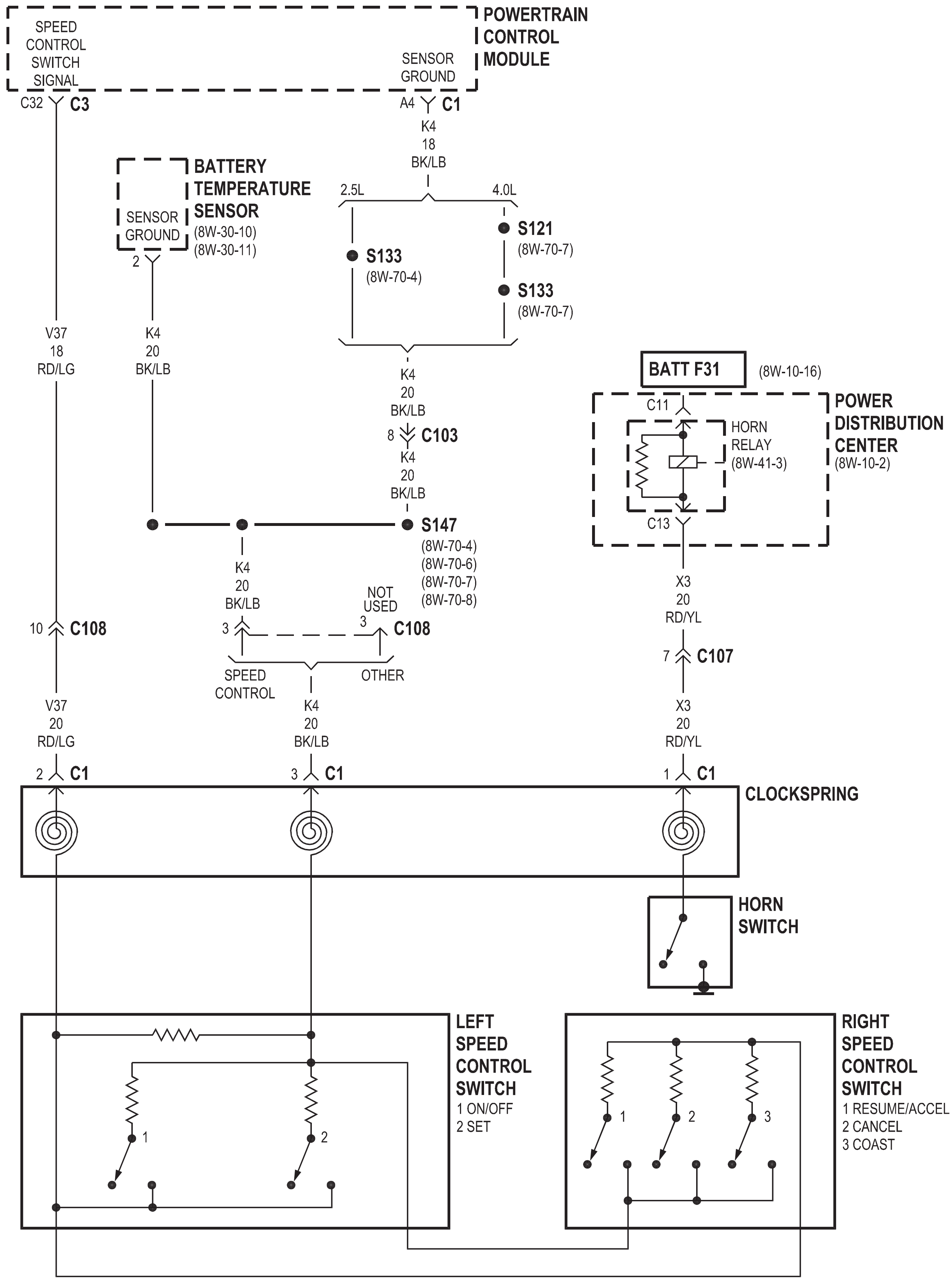

RUN-START A21
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE
11
10A
(8W-11-8)
31
F12
20
RD/LG
10
C106
S102
(8W-11-8)
F12
20
RD/LG
11
C110
9
C103
2
EVAP/ PURGE SOLENOID
1
K52
20
PK/BK
10
C110
A
TORQUE CONVERTER CLUTCH SOLENOID
B
(8W-31-2)
T23
18
OR/LG
K52
18
PK/BK
GENERATOR
(8W-20-2)
GENERATOR SOURCE
1
K125
18
WT/DB
2
C103
K125
18
WT/LB
POWERTRAIN CONTROL MODULE
GENERATOR SOURCE
C25
C3
K125
18
WT/DB
S113
K125
20
WT/DB
3
C180
K125
20
OR/DG
2
1
LEAK DETECTION PUMP
GENERATOR SOURCE
NOT USED
LEAK DETECTION PUMP SOLENOID CONTROL
LEAK DETECTION PUMP SWITCH SENSE
3
4
K106
20
WT/DG
K107
20
WT/OR
2
1
C180
K106
18
WT/DG
K107
18
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
C20
C3
B11
C2
A19
C1
A10
C1
A11
C1
A20
C1
C10
C3
C14
C3
POWERTRAIN CONTROL MODULE
EVAP/ PURGE SOLENOID CONTROL
TRANSMISSION LOW/ OVERDRIVE SOLENOID
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 SOLENOID CONTROL
LEAK DETECTION PUMP SWITCH SENSE

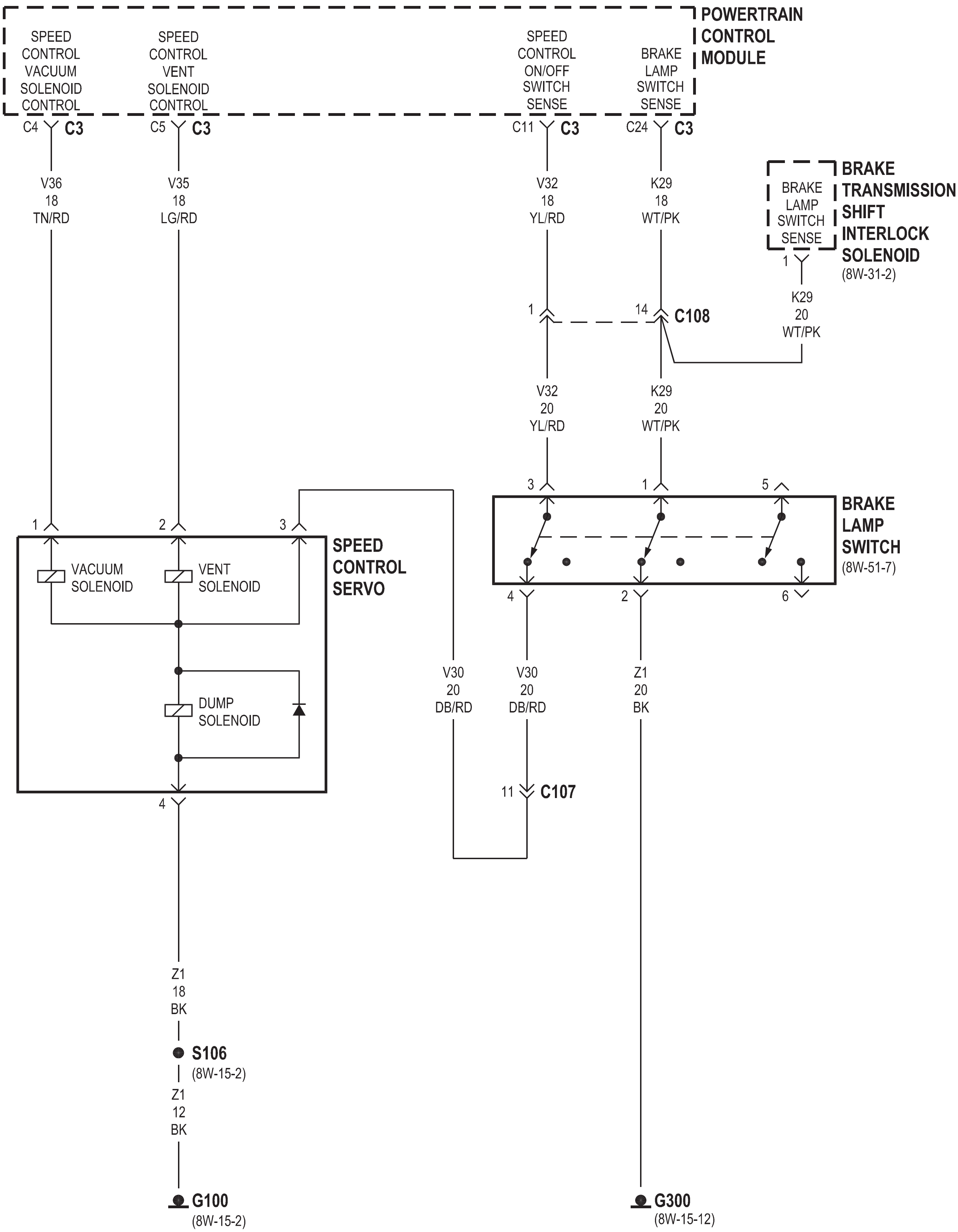
◆ ATX


A/C LOW PRESSURE SWITCH
(8W-42-5)
A/C SWITCH SENSE
A/C HIGH PRESSURE SWITCH
(8W-42-5)
A/C SELECT INPUT
A/C-HEATER CONTROL
(8W-42-3)
GENERATOR
(8W-20-2)
GENERATOR SOURCE
GENERATOR FIELD
C21 20 DB/OR
C104
C21 18 DB/OR
C90 20 LG
C170
S103
(8W-42-5)
C90 18 LG
K125 18 WT/DB
C103
S113
(8W-30-15)
K20 18 DG
C22 C3
C23 C3
C25 C3
B10 C2
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-15-7)
(8W-15-8)
(8W-15-9)
T41 20 BR/LB
K10 18 DB/BR
POWER STEERING PRESSURE SWITCH (2.5L)
A/T
M/T
K29 20 WT/PK
BRAKE LAMP SWITCH
(8W-51-7)
C154
Z1 20 BK
BRAKE TRANSMISSION SHIFT INTERLOCK SOLENOID
(8W-31-2)
PARK/ NEUTRAL POSITION SWITCH
(8W-51-2)
P/N
S132
(8W-15-9)
Z1 14 BK
G300
(8W-15-12)
G105
(8W-15-9)

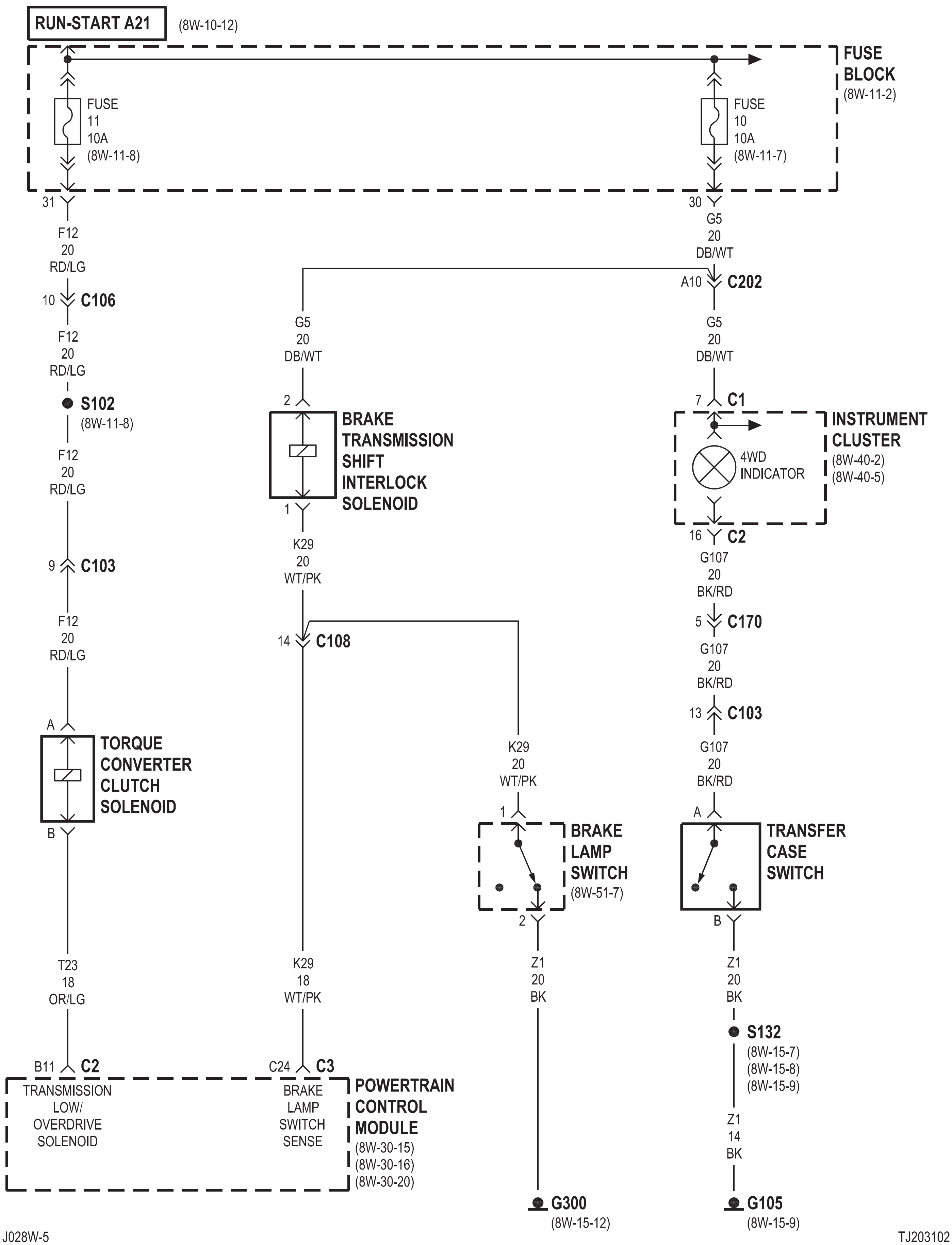

BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
32
FUSE 24 10A
(8W-10-17)
33
M1 20 PK/WT
12
C108
M1 20 PK/WT
M1 20 PK/WT
M1 20 PK/WT
2
FUSED B(+)
UNDERHOOD LAMP
(8W-44-2)
B7
C203
S204
(8W-10-17)
M1 20 PK/WT
TO SOUND BAR DOME LAMP
(8W-44-2)
16
SENTRY KEY IMMOBILIZER MODULE
(8W-30-18)
PCI BUS
2
D25 20 VT/YL
POWERTRAIN CONTROL MODULE
(8W-30-18)
PCI BUS
C30
C3
D25 18 VT/YL
6
C108
AIRBAG CONTROL MODULE
(8W-43-3)
PCI BUS
18
D25 18 VT/YL
D25 20 VT/YL
B14
C203
D25 20 VT/YL
S209
(8W-18-2)
D25 20 VT/YL
2
12
C2
PCI BUS
INSTRUMENT CLUSTER
(8W-40-3)
(8W-40-4)
DATA LINK CONNECTOR
(8W-18-2)
6
D32 20 LG
B8
D32 20 LG
13
D32 18 LG
C29
C3
7
D21 20 PK
B10
C203
D21 20 PK
14
C107
D21 18 PK
C27
C3
D21 20 PK
20
C1
SCI RECEIVE
SCI TRANSMIT
POWERTRAIN CONTROL MODULE
SCI TRANSMIT
CONTROLLER ANTILOCK BRAKE
(8W-35-3)
SENTRY KEY IMMOBILIZER MODULE
(8W-30-18)
GROUND
3
Z12 20BK/LB
4
Z12 20 BK/LB
A6
C202
Z12 20 BK/LB
6
Z12 20 BK/LB
11
Z12 20 BK/LB
5
Z12 20 BK/TN
C4
C204
Z12 20 BK/TN
9
C107
Z12 20 BK/TN
10
C103
Z12 20 BK/TN
S130
(8W-15-6)
Z12 10 BK/TN
G105
(8W-15-9)


BATT A6
(8W-10-10)
RUN-START A21
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 1 20A
(8W-11-4)
FUSE 12 10A
(8W-11-7)
INSTRUMENT CLUSTER
(8W-40-3)
(8W-40-4)
PCI BUS
12 C2
21
32
F15 20 DB
4 C106
D25 20 VT/YL
F33 18 PK/RD
F33 18 PK/RD
F15 20 DB
F15 20 DB
2 DATA LINK CONNECTOR
(8W-18-2)
20
FUSED B(+)
MULTI-FUNCTION SWITCH
(8W-50-2)
A13
FUSED B+
AUTOMATIC SHUT DOWN RELAY (IN PDC)
(8W-30-2)
D25 20 VT/YL
6
4
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (RUN-START)
SENTRY KEY IMMOBILIZER MODULE
S209
(8W-18-2)
B14 C203
PCI BUS
GROUND
GROUND
4 DATA LINK CONNECTOR
(8W-18-2)
2
5
3
D25 20 VT/YL
D25 20 VT/YL
Z1 20 BK
Z12 20 BK/LB
Z12 20 BK/LB
A6 C202
D25 18 VT/YL
Z12 20 BK/LB
6 C108
6 C107
D25 18 VT/YL
11 C103
Z12 20 BK/LB
C30 C3
PCI BUS
POWERTRAIN CONTROL MODULE
S130
(8W-15-6)
18
PCI BUS
AIRBAG CONTROL MODULE
(8W-43-3)
Z12 10 BK/TN
G302
(8W-15-13)
G105
(8W-15-9)

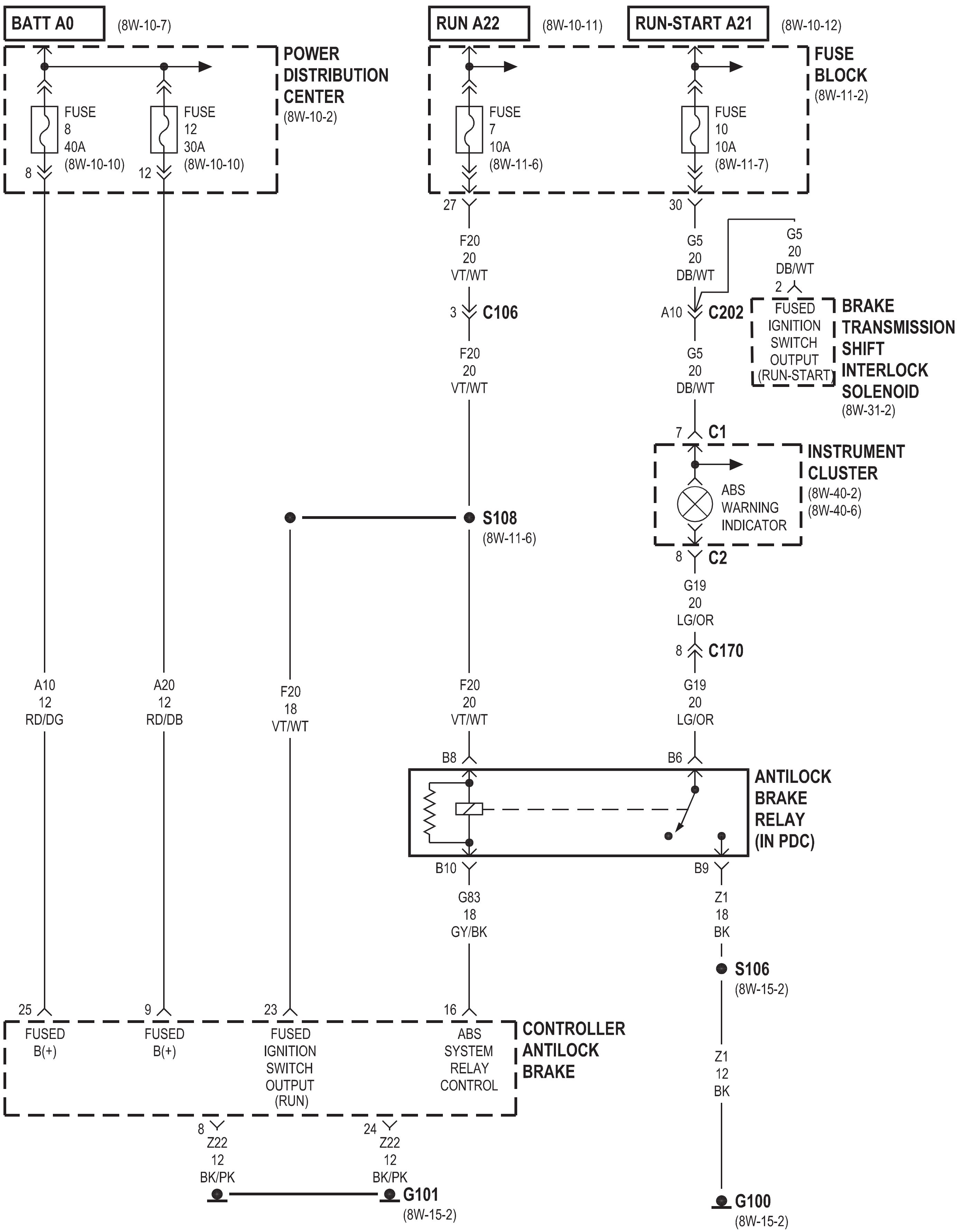

POWERTRAIN
CONTROL
MODULE
SPEED
CONTROL
SWITCH
SIGNAL
SENSOR
GROUND
C32
C3
A4
C1
K4
18
BK/LB
BATTERY
TEMPERATURE
SENSOR
SENSOR
GROUND
(8W-30-10)
(8W-30-11)
2
2.5L
4.0L
S121
(8W-70-7)
S133
(8W-70-4)
S133
(8W-70-7)
V37
18
RD/LG
K4
20
BK/LB
K4
20
BK/LB
8
C103
K4
20
BK/LB
S147
(8W-70-4)
(8W-70-6)
(8W-70-7)
(8W-70-8)
BATT F31
(8W-10-16)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
C11
HORN
RELAY
(8W-41-3)
C13
X3
20
RD/YL
K4
20
BK/LB
NOT
USED
10
C108
3
3
C108
7
C107
SPEED
CONTROL
OTHER
V37
20
RD/LG
K4
20
BK/LB
X3
20
RD/YL
2
C1
3
C1
1
C1
CLOCKSPRING
HORN
SWITCH
LEFT
SPEED
CONTROL
SWITCH
1 ON/OFF
2 SET
1
2
RIGHT
SPEED
CONTROL
SWITCH
1 RESUME/ACCEL
2 CANCEL
3 COAST
1
2
3

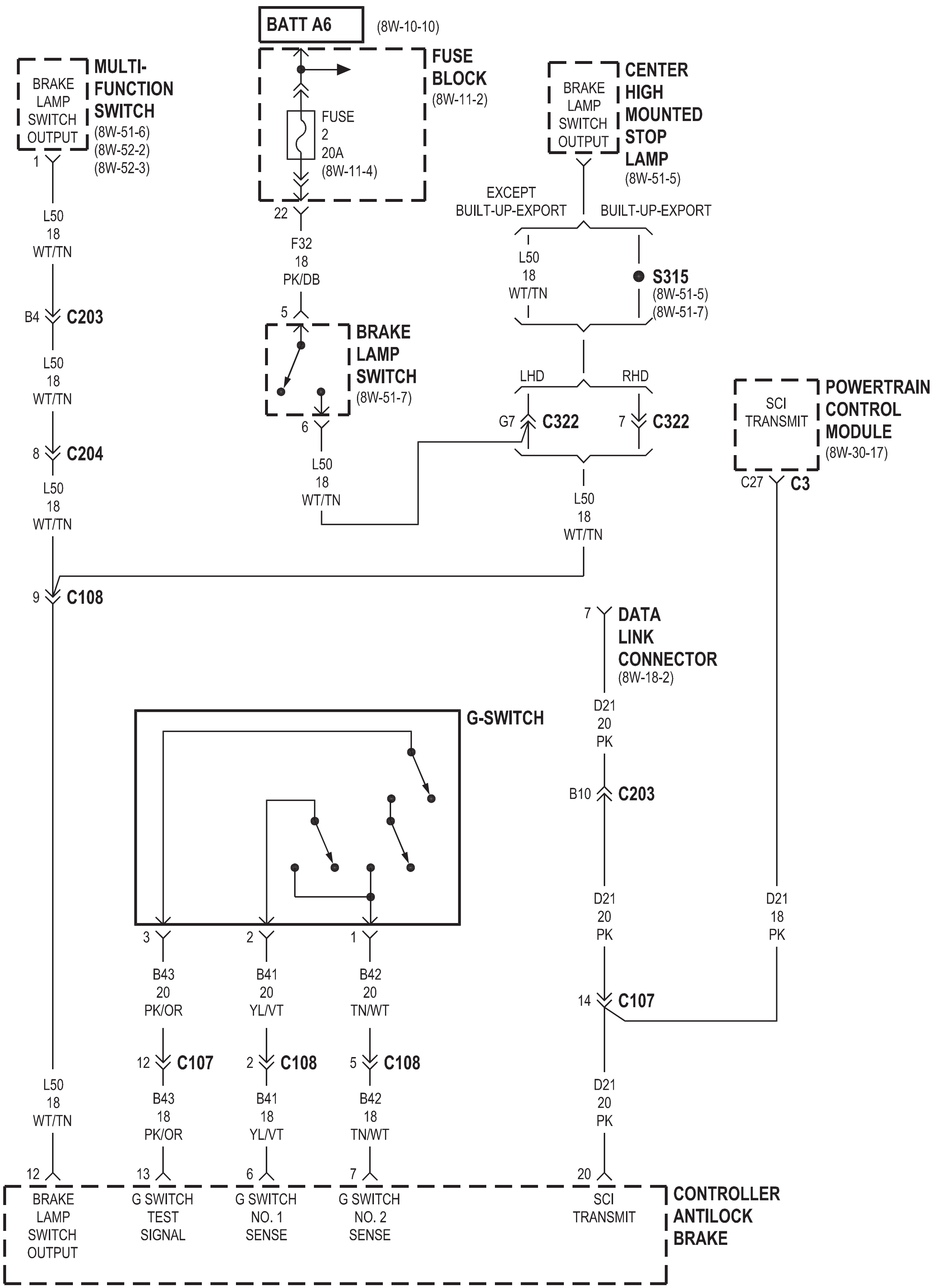

POWERTRAIN CONTROL MODULE
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL
SPEED CONTROL ON/OFF SWITCH SENSE
BRAKE LAMP SWITCH SENSE
C4 C3
C5 C3
C11 C3
C24 C3
V36 18 TN/RD
V35 18 LG/RD
V32 18 YL/RD
K29 18 WT/PK
BRAKE TRANSMISSION SHIFT INTERLOCK SOLENOID
(8W-31-2)
BRAKE LAMP SWITCH SENSE
1
K29 20 WT/PK
1
14
C108
V32 20 YL/RD
K29 20 WT/PK
3
1
5
BRAKE LAMP SWITCH
(8W-51-7)
4
2
6
1
2
3
SPEED CONTROL SERVO
VACUUM SOLENOID
VENT SOLENOID
DUMP SOLENOID
4
V30 20 DB/RD
V30 20 DB/RD
Z1 20 BK
11
C107
Z1 18 BK
S106
(8W-15-2)
Z1 12 BK
G100
(8W-15-2)
G300
(8W-15-12)

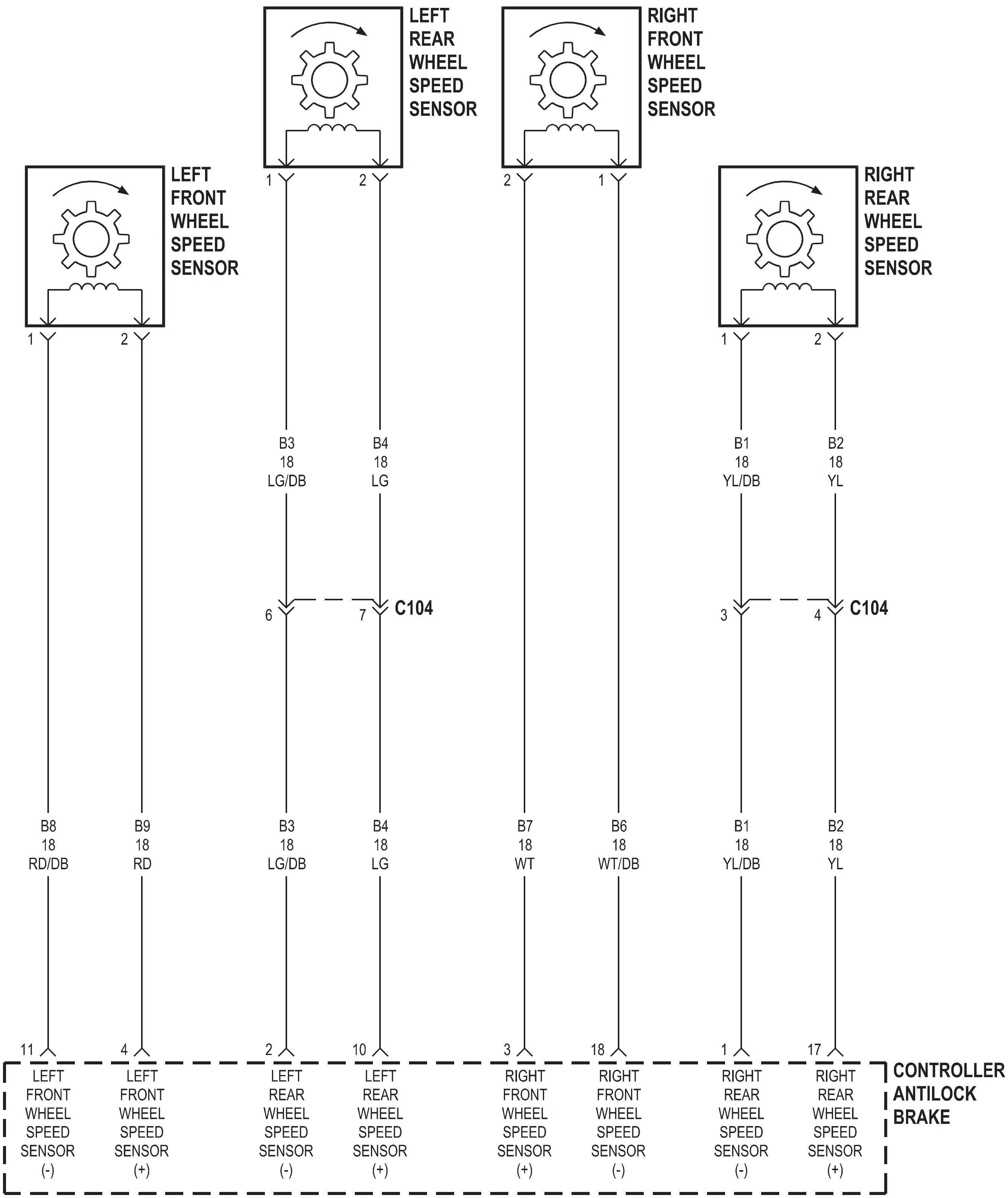
8W-31 TRANSMISSION CONTROL SYSTEM


RUN-START A21
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE
11
10A
(8W-11-8)
FUSE
10
10A
(8W-11-7)
31
30
F12
20
RD/LG
G5
20
DB/WT
A10
C202
10
C106
S102
(8W-11-8)
9
C103
2
BRAKE TRANSMISSION SHIFT INTERLOCK SOLENOID
1
K29
20
WT/PK
14
C108
7
C1
INSTRUMENT CLUSTER
(8W-40-2)
(8W-40-5)
4WD INDICATOR
16
C2
G107
20
BK/RD
5
C170
13
C103
A
TORQUE CONVERTER CLUTCH SOLENOID
B
BRAKE LAMP SWITCH
(8W-51-7)
TRANSFER CASE SWITCH
T23
18
OR/LG
K29
18
WT/PK
Z1
20
BK
S132
(8W-15-7)
(8W-15-8)
(8W-15-9)
Z1
14
BK
B11
C2
C24
C3
TRANSMISSION LOW/ OVERDRIVE SOLENOID
BRAKE LAMP SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-15)
(8W-30-16)
(8W-30-20)
G300
(8W-15-12)
G105
(8W-15-9)
J028W-5
TJ203102

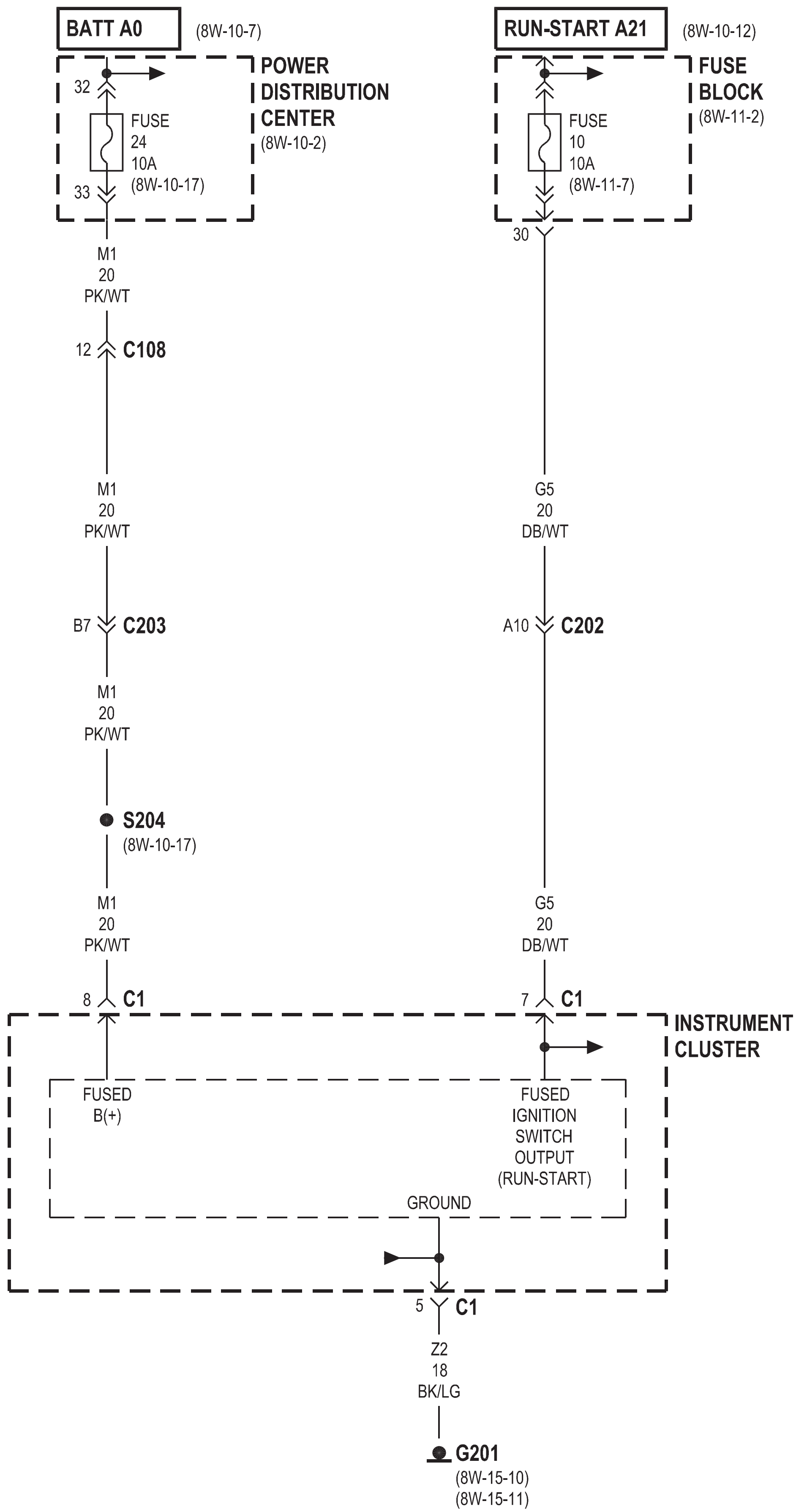
8W-35 ANTILOCK BRAKES

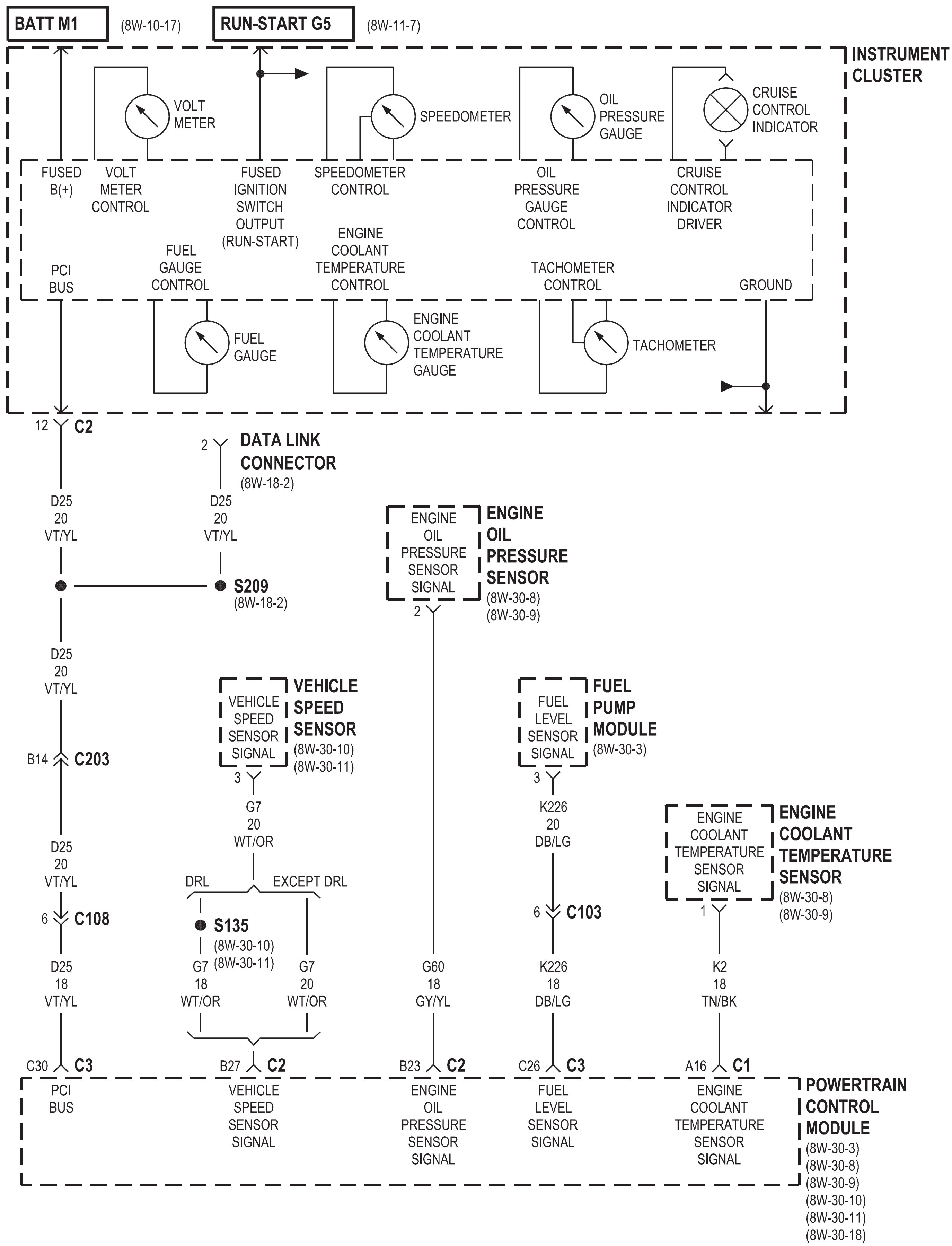

BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 8 40A (8W-10-10)
FUSE 12 30A (8W-10-10)
8
12
RUN A22
(8W-10-11)
RUN-START A21
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 7 10A (8W-11-6)
FUSE 10 10A (8W-11-7)
27
30
F20 20 VT/WT
G5 20 DB/WT
G5 20 DB/WT
2
3
C106
A10
C202
FUSED IGNITION SWITCH OUTPUT (RUN-START)
BRAKE TRANSMISSION SHIFT INTERLOCK SOLENOID
(8W-31-2)
F20 20 VT/WT
G5 20 DB/WT
7
C1
INSTRUMENT CLUSTER
(8W-40-2)
(8W-40-6)
ABS WARNING INDICATOR
S108
(8W-11-6)
8
C2
G19 20 LG/OR
8
C170
A10 12 RD/DG
A20 12 RD/DB
F20 18 VT/WT
F20 20 VT/WT
G19 20 LG/OR
B8
B6
ANTILOCK BRAKE RELAY (IN PDC)
B10
B9
G83 18 GY/BK
Z1 18 BK
S106
(8W-15-2)
25
9
23
16
FUSED B(+)
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (RUN)
ABS SYSTEM RELAY CONTROL
CONTROLLER ANTILOCK BRAKE
Z1 12 BK
8
24
Z22 12 BK/PK
Z22 12 BK/PK
G101
(8W-15-2)
G100
(8W-15-2)

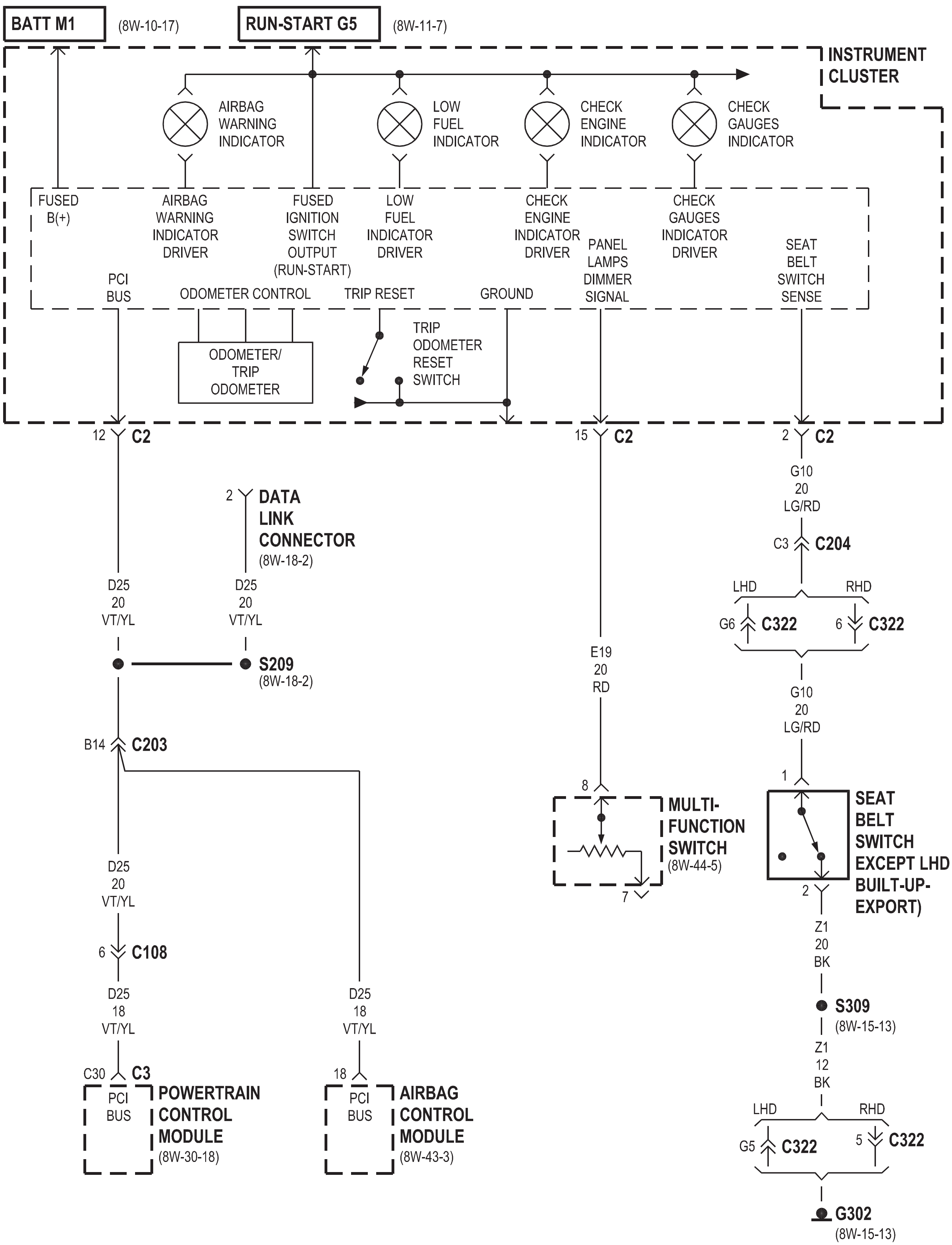

BATT A6
(8W-10-10)
FUSE BLOCK
(8W-11-2)
FUSE 2 20A (8W-11-4)
22
F32 18 PK/DB
5
BRAKE LAMP SWITCH
(8W-51-7)
6
L50 18 WT/TN
BRAKE LAMP SWITCH OUTPUT
MULTI-FUNCTION SWITCH
(8W-51-6)
(8W-52-2)
(8W-52-3)
1
L50 18 WT/TN
B4 C203
L50 18 WT/TN
8 C204
L50 18 WT/TN
9 C108
BRAKE LAMP SWITCH OUTPUT
CENTER HIGH MOUNTED STOP LAMP
(8W-51-5)
EXCEPT BUILT-UP-EXPORT
BUILT-UP-EXPORT
L50 18 WT/TN
S315
(8W-51-5)
(8W-51-7)
LHD
RHD
G7 C322
7 C322
L50 18 WT/TN
SCI TRANSMIT
POWERTRAIN CONTROL MODULE
(8W-30-17)
C27 C3
7 DATA LINK CONNECTOR
(8W-18-2)
D21 20 PK
B10 C203
D21 20 PK
D21 18 PK
14 C107
D21 20 PK
G-SWITCH
3
2
1
B43 20 PK/OR
B41 20 YL/VT
B42 20 TN/WT
12 C107
2 C108
5 C108
B43 18 PK/OR
B41 18 YL/VT
B42 18 TN/WT
L50 18 WT/TN
12
13
6
7
20
BRAKE LAMP SWITCH OUTPUT
G SWITCH TEST SIGNAL
G SWITCH NO. 1 SENSE
G SWITCH NO. 2 SENSE
SCI TRANSMIT
CONTROLLER ANTILOCK BRAKE

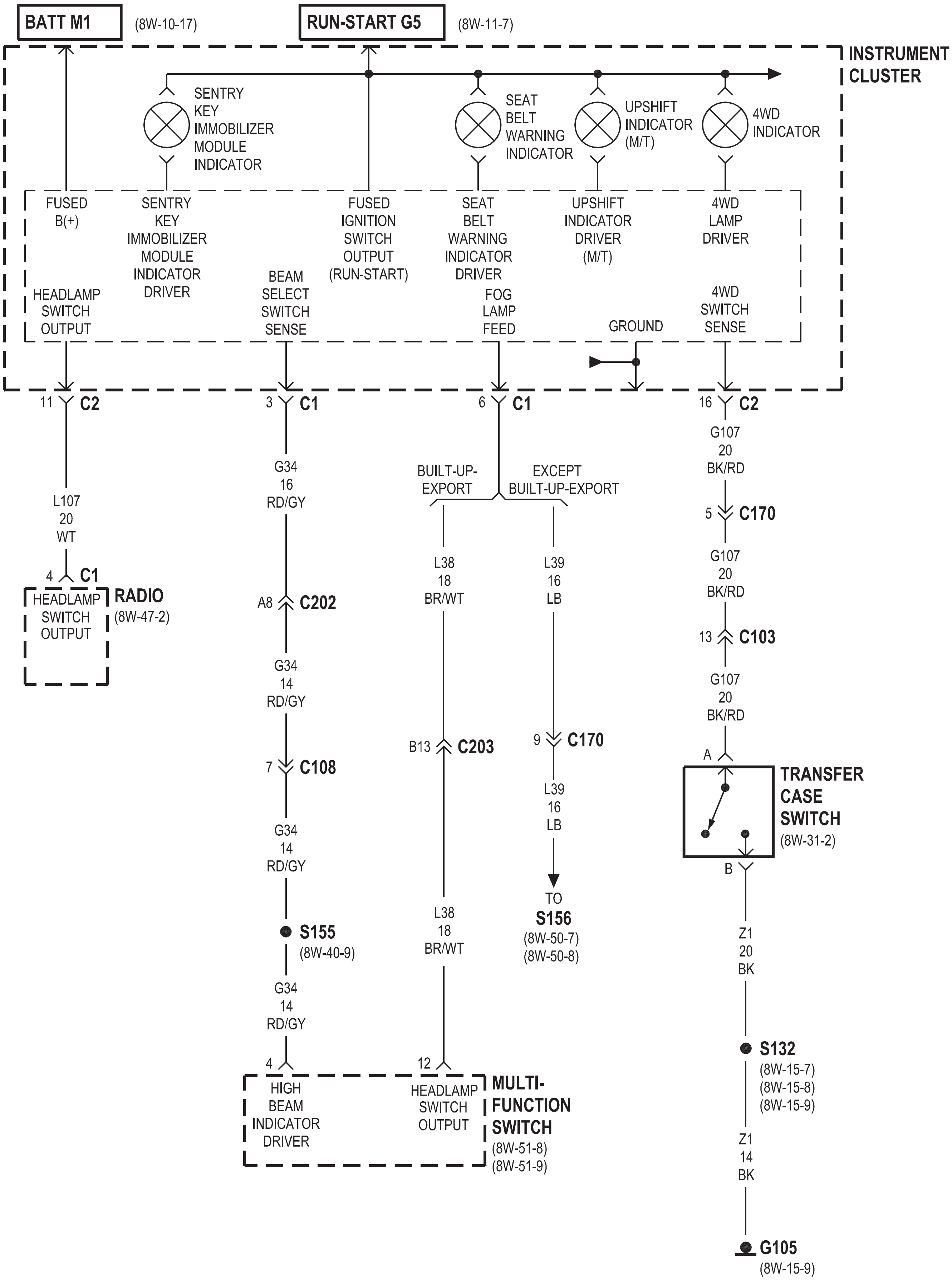

LEFT REAR WHEEL SPEED SENSOR
RIGHT FRONT WHEEL SPEED SENSOR
LEFT FRONT WHEEL SPEED SENSOR
RIGHT REAR WHEEL SPEED SENSOR
B3 18 LG/DB
B4 18 LG
B1 18 YL/DB
B2 18 YL
C104
B8 18 RD/DB
B9 18 RD
B3 18 LG/DB
B4 18 LG
B7 18 WT
B6 18 WT/DB
B1 18 YL/DB
B2 18 YL
LEFT FRONT WHEEL SPEED SENSOR (-)
LEFT FRONT WHEEL 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 ANTILOCK BRAKE

8W-40 INSTRUMENT CLUSTER

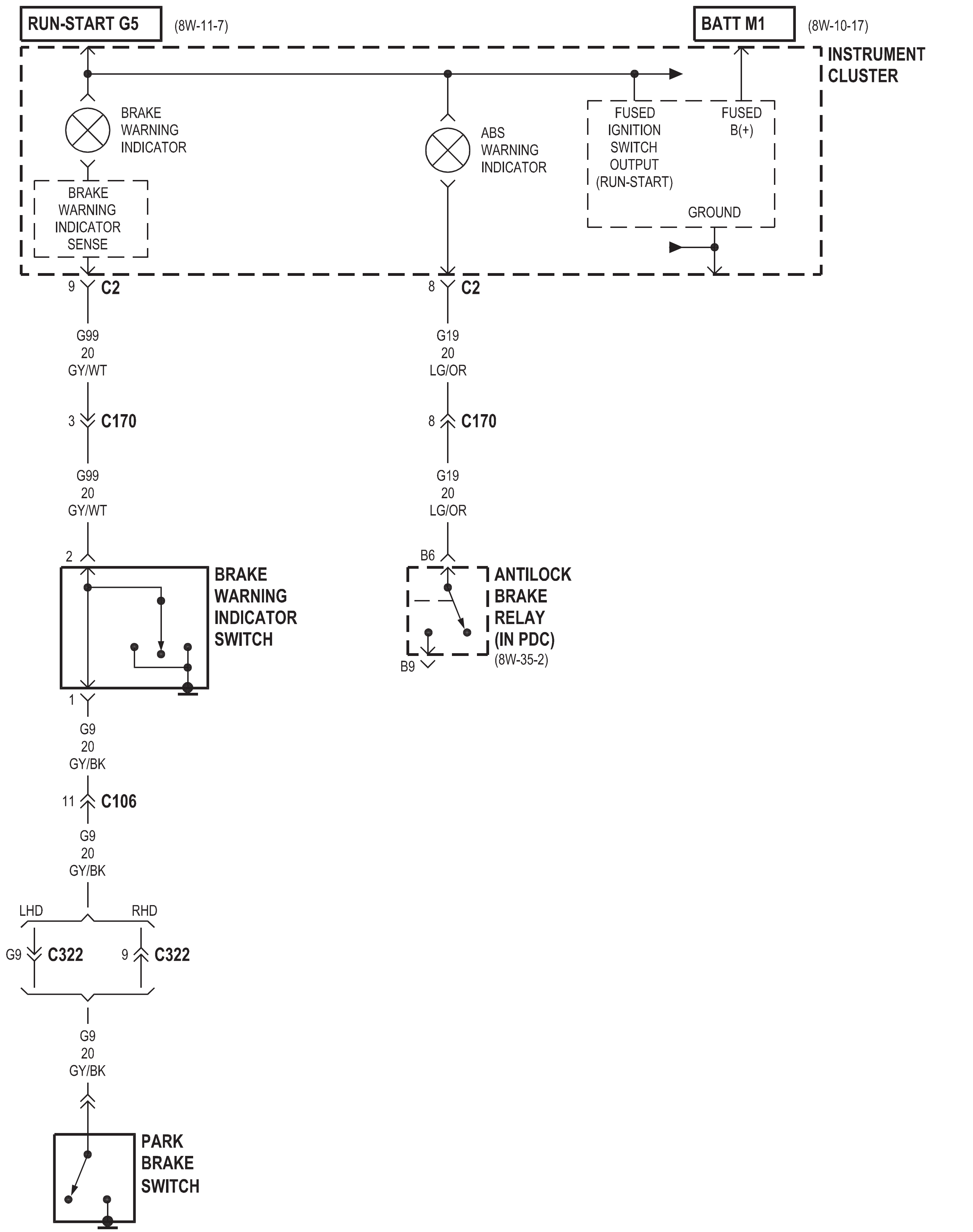

BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
32
FUSE
24
10A
(8W-10-17)
33
M1
20
PK/WT
12
C108
M1
20
PK/WT
B7
C203
M1
20
PK/WT
S204
(8W-10-17)
M1
20
PK/WT
8
C1
RUN-START A21
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE
10
10A
(8W-11-7)
30
G5
20
DB/WT
A10
C202
G5
20
DB/WT
7
C1
INSTRUMENT CLUSTER
FUSED
B(+)
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-START)
GROUND
5
C1
Z2
18
BK/LG
G201
(8W-15-10)
(8W-15-11)

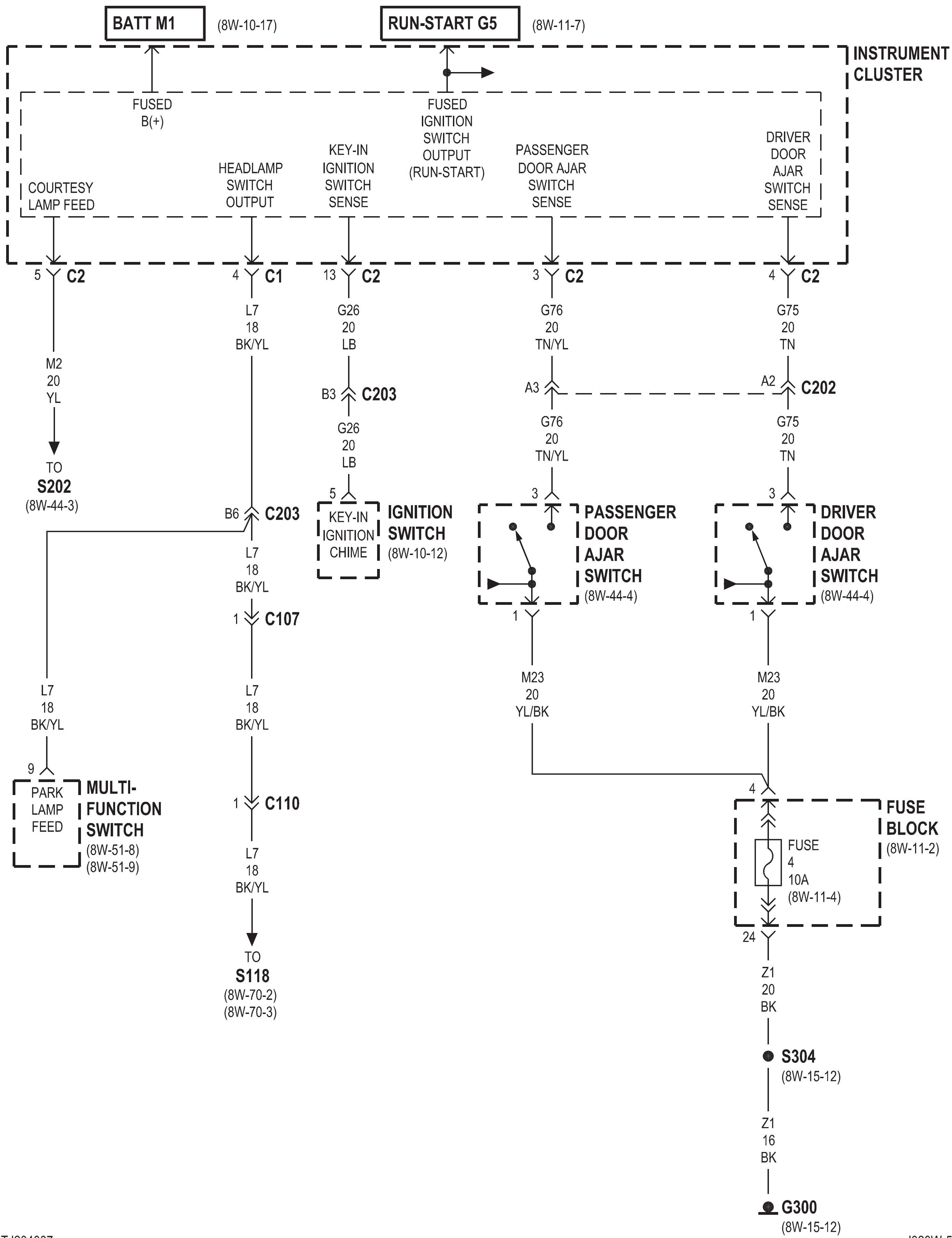

BATT M1
(8W-10-17)
RUN-START G5
(8W-11-7)
INSTRUMENT CLUSTER
VOLT METER
SPEEDOMETER
OIL PRESSURE GAUGE
CRUISE CONTROL INDICATOR
FUSED B(+)
VOLT METER CONTROL
FUSED IGNITION SWITCH OUTPUT (RUN-START)
SPEEDOMETER CONTROL
OIL PRESSURE GAUGE CONTROL
CRUISE CONTROL INDICATOR DRIVER
PCI BUS
FUEL GAUGE CONTROL
ENGINE COOLANT TEMPERATURE CONTROL
TACHOMETER CONTROL
GROUND
FUEL GAUGE
ENGINE COOLANT TEMPERATURE GAUGE
TACHOMETER
12 C2
2 DATA LINK CONNECTOR
(8W-18-2)
D25 20 VT/YL
D25 20 VT/YL
S209
(8W-18-2)
D25 20 VT/YL
B14 C203
D25 20 VT/YL
6 C108
D25 18 VT/YL
ENGINE OIL PRESSURE SENSOR SIGNAL
ENGINE OIL PRESSURE SENSOR
(8W-30-8)
(8W-30-9)
2
VEHICLE SPEED SENSOR SIGNAL
VEHICLE SPEED SENSOR
(8W-30-10)
(8W-30-11)
3
G7 20 WT/OR
DRL
EXCEPT DRL
S135
(8W-30-10)
(8W-30-11)
G7 18 WT/OR
G7 20 WT/OR
G60 18 GY/YL
FUEL LEVEL SENSOR SIGNAL
FUEL PUMP MODULE
(8W-30-3)
3
K226 20 DB/LG
6 C103
K226 18 DB/LG
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
ENGINE COOLANT TEMPERATURE SENSOR
(8W-30-8)
(8W-30-9)
1
K2 18 TN/BK
C30 C3
B27 C2
B23 C2
C26 C3
A16 C1
PCI 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)
(8W-30-10)
(8W-30-11)
(8W-30-18)

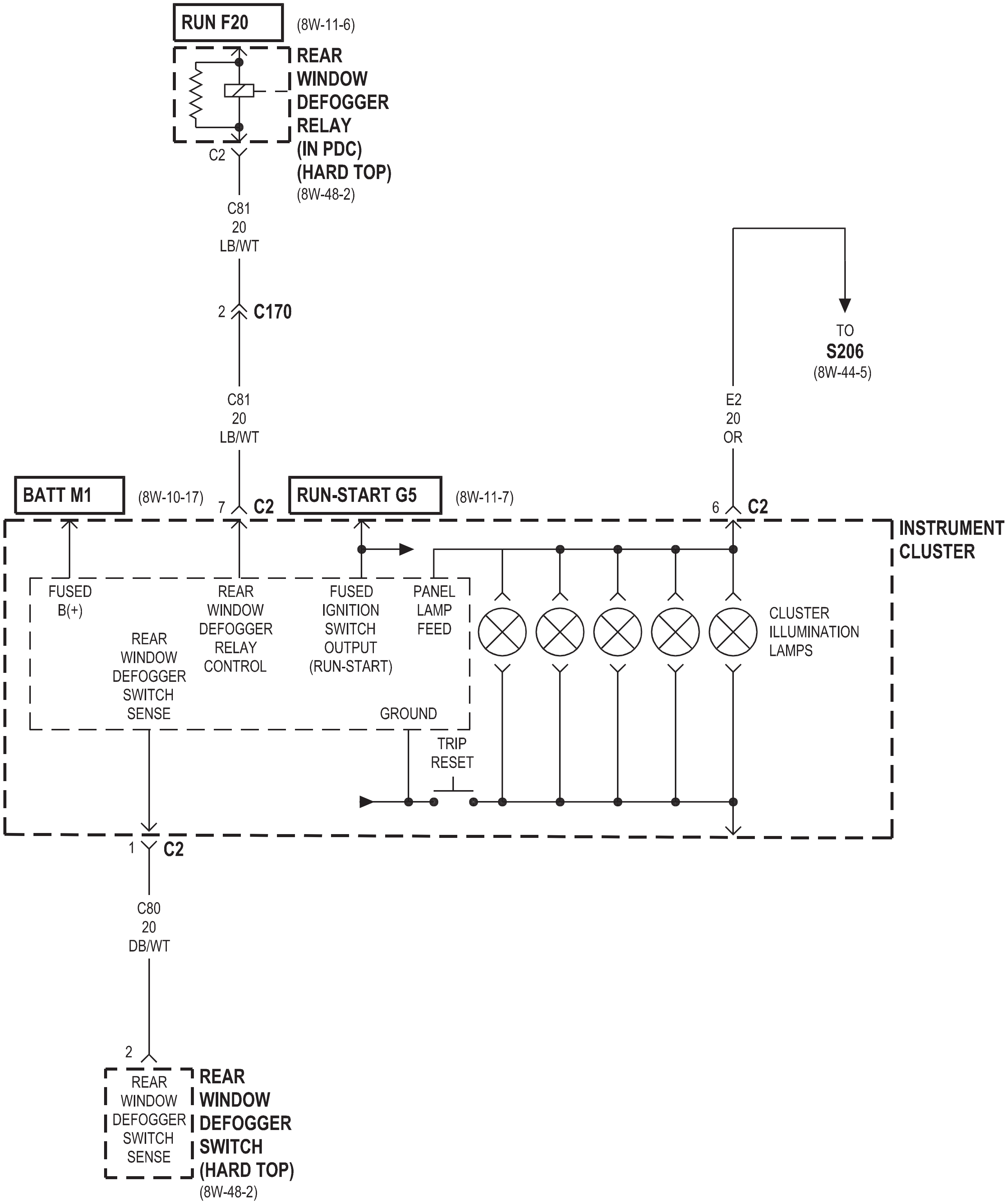

BATT M1
(8W-10-17)
RUN-START G5
(8W-11-7)
INSTRUMENT CLUSTER
AIRBAG WARNING INDICATOR
LOW FUEL INDICATOR
CHECK ENGINE INDICATOR
CHECK GAUGES INDICATOR
FUSED B(+)
AIRBAG WARNING INDICATOR DRIVER
FUSED IGNITION SWITCH OUTPUT (RUN-START)
LOW FUEL INDICATOR DRIVER
CHECK ENGINE INDICATOR DRIVER
PANEL LAMPS DIMMER SIGNAL
CHECK GAUGES INDICATOR DRIVER
SEAT BELT SWITCH SENSE
PCI BUS
ODOMETER CONTROL
TRIP RESET
GROUND
ODOMETER/ TRIP ODOMETER
TRIP ODOMETER RESET SWITCH
12 C2
15 C2
2 C2
2 DATA LINK CONNECTOR
(8W-18-2)
G10 20 LG/RD
C3 C204
LHD RHD
G6 C322
6 C322
D25 20 VT/YL
D25 20 VT/YL
S209
(8W-18-2)
E19 20 RD
G10 20 LG/RD
B14 C203
8
MULTI-FUNCTION SWITCH
(8W-44-5)
7
1
SEAT BELT SWITCH EXCEPT LHD BUILT-UP-EXPORT)
2
D25 20 VT/YL
6 C108
Z1 20 BK
S309
(8W-15-13)
D25 18 VT/YL
D25 18 VT/YL
Z1 12 BK
C30 C3
18
PCI BUS
POWERTRAIN CONTROL MODULE
(8W-30-18)
PCI BUS
AIRBAG CONTROL MODULE
(8W-43-3)
LHD RHD
G5 C322
5 C322
G302
(8W-15-13)

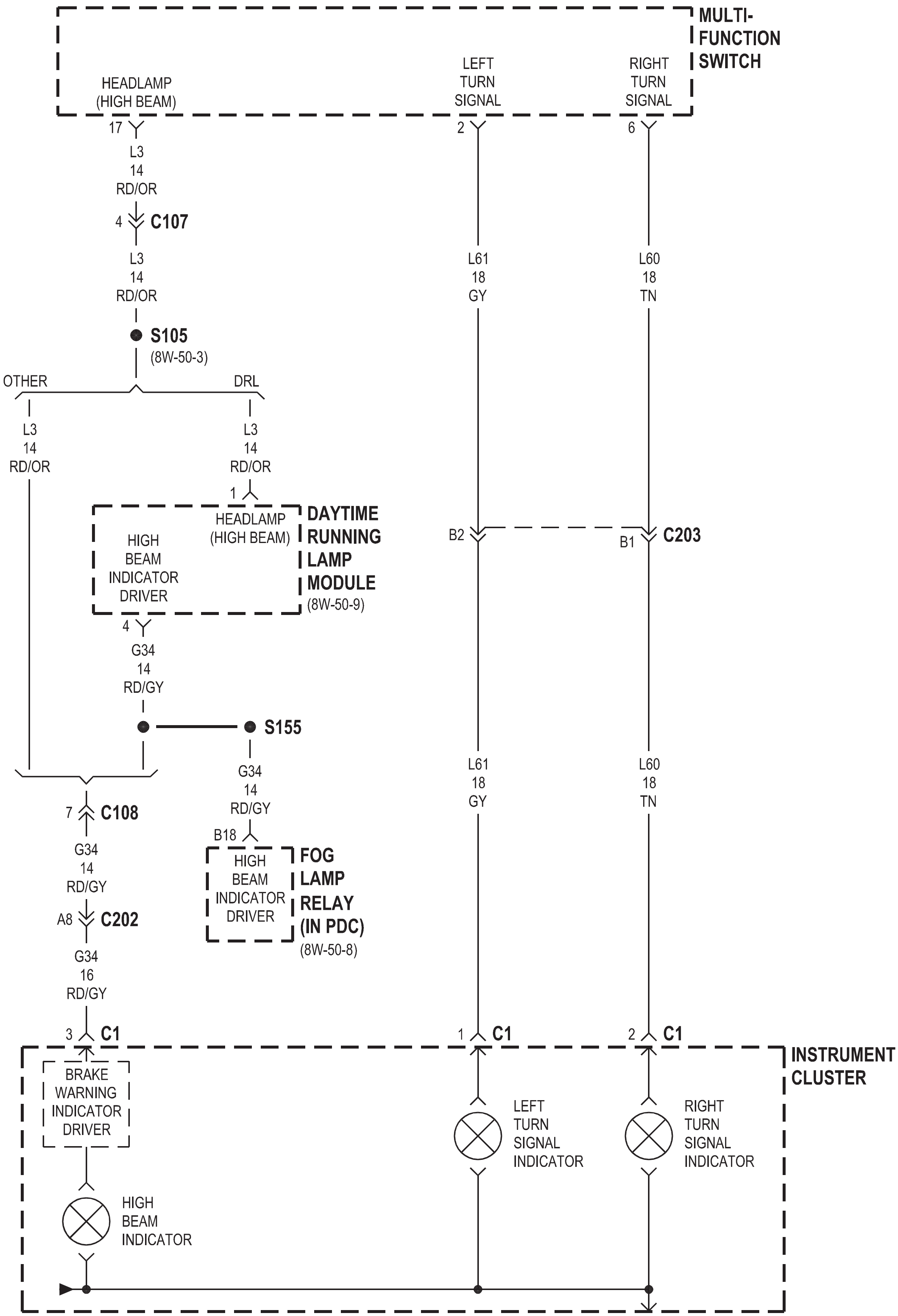


BATT M1
(8W-10-17)
RUN-START G5
(8W-11-7)
INSTRUMENT CLUSTER
SENTRY KEY IMMOBILIZER MODULE INDICATOR
SEAT BELT WARNING INDICATOR
UPSHIFT INDICATOR (M/T)
4WD INDICATOR
FUSED B(+)
SENTRY KEY IMMOBILIZER MODULE INDICATOR DRIVER
FUSED IGNITION SWITCH OUTPUT (RUN-START)
SEAT BELT WARNING INDICATOR DRIVER
UPSHIFT INDICATOR DRIVER (M/T)
4WD LAMP DRIVER
HEADLAMP SWITCH OUTPUT
BEAM SELECT SWITCH SENSE
FOG LAMP FEED
GROUND
4WD SWITCH SENSE
11 C2
3 C1
6 C1
16 C2
L107 20 WT
4 C1
HEADLAMP SWITCH OUTPUT
RADIO
(8W-47-2)
G34 16 RD/GY
A8 C202
G34 14 RD/GY
7 C108
G34 14 RD/GY
S155
(8W-40-9)
G34 14 RD/GY
BUILT-UP-EXPORT
EXCEPT BUILT-UP-EXPORT
L38 18 BR/WT
B13 C203
L38 18 BR/WT
L39 16 LB
9 C170
L39 16 LB
TO S156
(8W-50-7)
(8W-50-8)
4
12
HIGH BEAM INDICATOR DRIVER
HEADLAMP SWITCH OUTPUT
MULTI-FUNCTION SWITCH
(8W-51-8)
(8W-51-9)
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-15-7)
(8W-15-8)
(8W-15-9)
Z1 14 BK
G105
(8W-15-9)

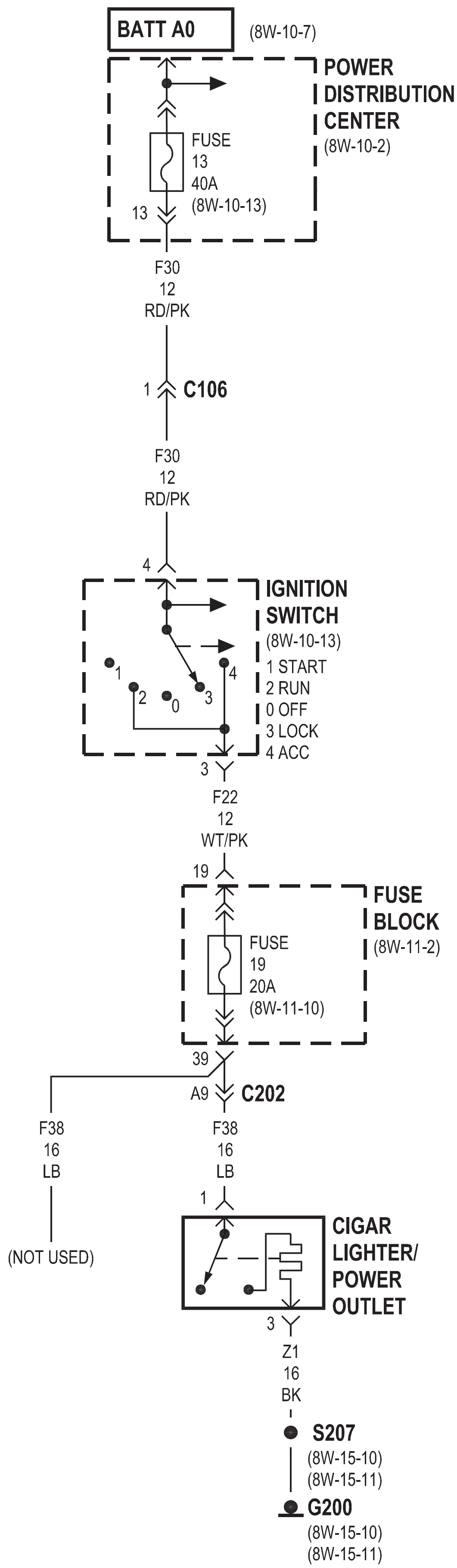

RUN-START G5
(8W-11-7)
BATT M1
(8W-10-17)
INSTRUMENT CLUSTER
BRAKE WARNING INDICATOR
ABS WARNING INDICATOR
FUSED IGNITION SWITCH OUTPUT (RUN-START)
FUSED B(+)
GROUND
BRAKE WARNING INDICATOR SENSE
9 C2
8 C2
G99
20
GY/WT
G19
20
LG/OR
3 C170
8 C170
G99
20
GY/WT
G19
20
LG/OR
2
B6
BRAKE WARNING INDICATOR SWITCH
ANTILOCK BRAKE RELAY (IN PDC)
(8W-35-2)
B9
1
G9
20
GY/BK
11 C106
G9
20
GY/BK
LHD
RHD
G9 C322
9 C322
G9
20
GY/BK
PARK BRAKE SWITCH

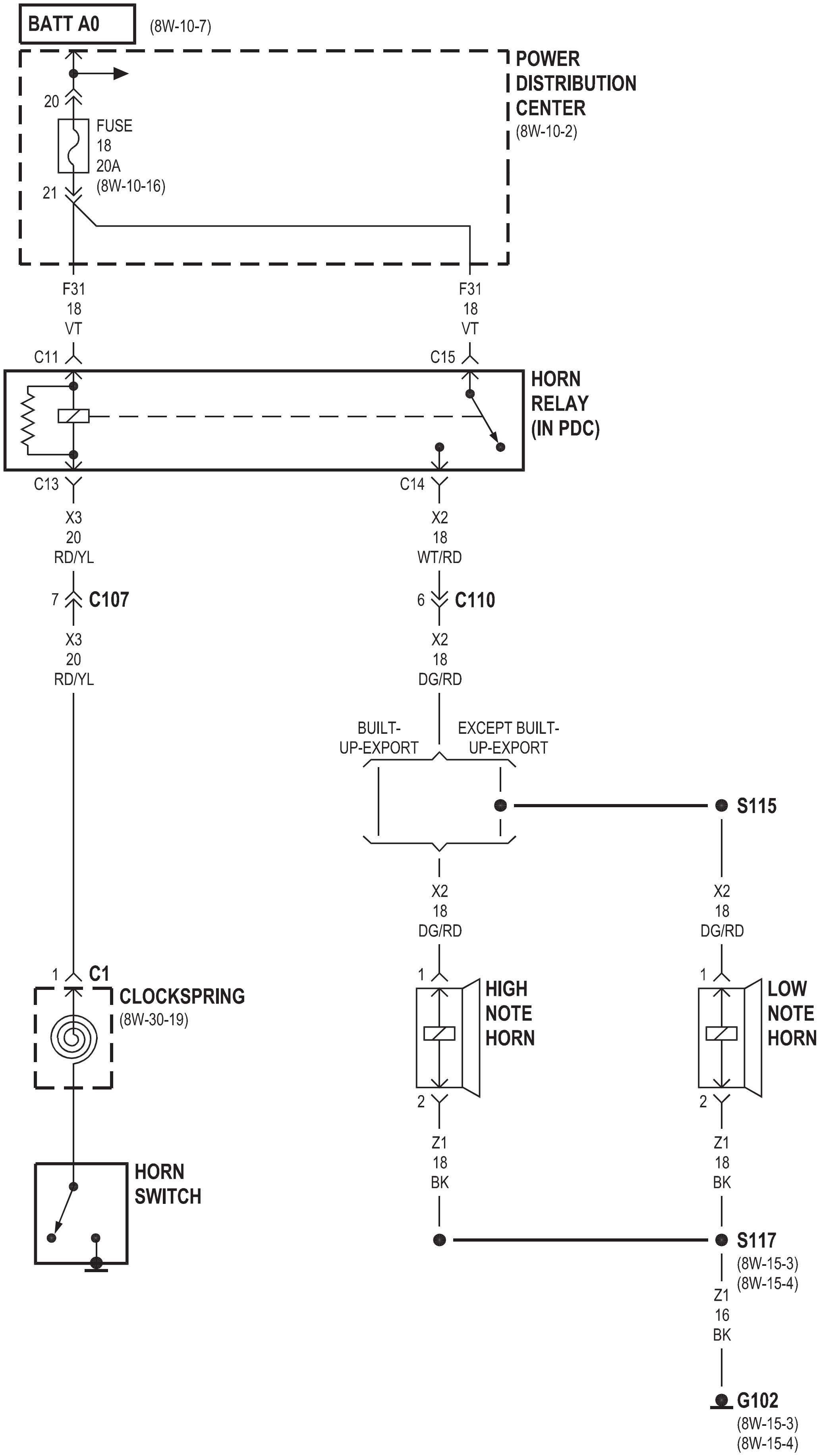

BATT M1
(8W-10-17)
RUN-START G5
(8W-11-7)
INSTRUMENT CLUSTER
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (RUN-START)
COURTESY LAMP FEED
HEADLAMP SWITCH OUTPUT
KEY-IN IGNITION SWITCH SENSE
PASSENGER DOOR AJAR SWITCH SENSE
DRIVER DOOR AJAR SWITCH SENSE
5 C2
4 C1
13 C2
3 C2
4 C2
M2 20 YL
TO S202 (8W-44-3)
L7 18 BK/YL
G26 20 LB
B3 C203
G26 20 LB
G76 20 TN/YL
A3
G75 20 TN
A2 C202
G76 20 TN/YL
G75 20 TN
B6 C203
5
KEY-IN IGNITION CHIME
IGNITION SWITCH (8W-10-12)
3
PASSENGER DOOR AJAR SWITCH (8W-44-4)
3
DRIVER DOOR AJAR SWITCH (8W-44-4)
L7 18 BK/YL
1 C107
1
1
L7 18 BK/YL
L7 18 BK/YL
M23 20 YL/BK
M23 20 YL/BK
9
PARK LAMP FEED
MULTI-FUNCTION SWITCH (8W-51-8) (8W-51-9)
1 C110
L7 18 BK/YL
TO S118 (8W-70-2) (8W-70-3)
4
FUSE BLOCK (8W-11-2)
FUSE 4 10A (8W-11-4)
24
Z1 20 BK
S304 (8W-15-12)
Z1 16 BK
G300 (8W-15-12)


RUN F20
(8W-11-6)
REAR WINDOW DEFOGGER RELAY (IN PDC) (HARD TOP)
(8W-48-2)
C2
C81
20
LB/WT
2
C170
C81
20
LB/WT
TO
S206
(8W-44-5)
E2
20
OR
BATT M1
(8W-10-17)
7
C2
RUN-START G5
(8W-11-7)
6
C2
INSTRUMENT CLUSTER
FUSED B(+)
REAR WINDOW DEFOGGER RELAY CONTROL
FUSED IGNITION SWITCH OUTPUT (RUN-START)
PANEL LAMP FEED
CLUSTER ILLUMINATION LAMPS
REAR WINDOW DEFOGGER SWITCH SENSE
GROUND
TRIP RESET
1
C2
C80
20
DB/WT
2
REAR WINDOW DEFOGGER SWITCH SENSE
REAR WINDOW DEFOGGER SWITCH (HARD TOP)
(8W-48-2)


MULTI-
FUNCTION
SWITCH
HEADLAMP
(HIGH BEAM)
LEFT
TURN
SIGNAL
RIGHT
TURN
SIGNAL
17
2
6
L3
14
RD/OR
4
C107
L3
14
RD/OR
L61
18
GY
L60
18
TN
S105
(8W-50-3)
OTHER
DRL
L3
14
RD/OR
L3
14
RD/OR
1
HEADLAMP
(HIGH BEAM)
HIGH
BEAM
INDICATOR
DRIVER
DAYTIME
RUNNING
LAMP
MODULE
(8W-50-9)
B2
B1
C203
4
G34
14
RD/GY
S155
G34
14
RD/GY
L61
18
GY
L60
18
TN
7
C108
B18
G34
14
RD/GY
HIGH
BEAM
INDICATOR
DRIVER
FOG
LAMP
RELAY
(IN PDC)
(8W-50-8)
A8
C202
G34
16
RD/GY
3
C1
1
C1
2
C1
INSTRUMENT
CLUSTER
BRAKE
WARNING
INDICATOR
DRIVER
LEFT
TURN
SIGNAL
INDICATOR
RIGHT
TURN
SIGNAL
INDICATOR
HIGH
BEAM
INDICATOR

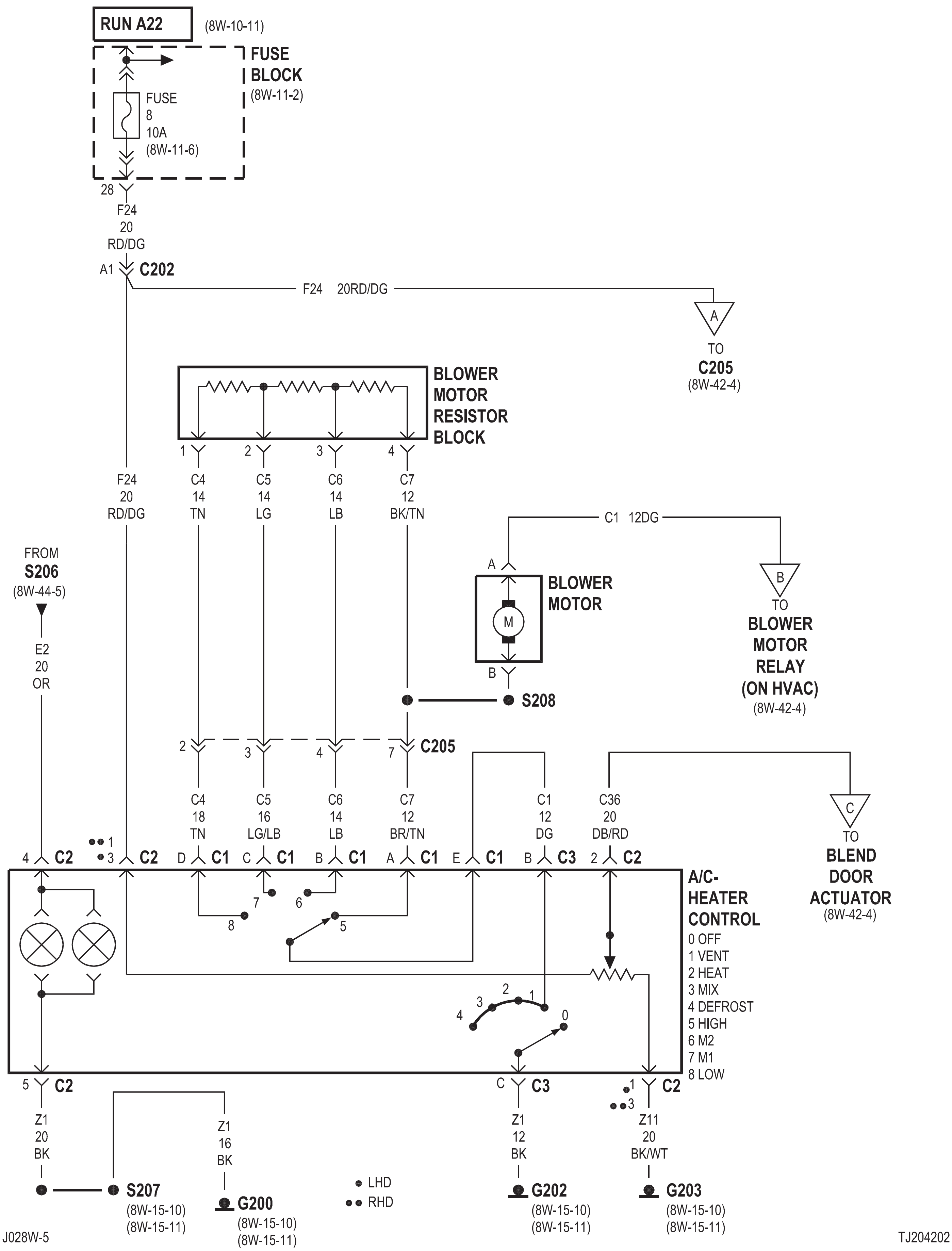
8W-41 HORN/CIGAR LIGHTER/POWER OUTLET


BATT A0
(8W-10-7)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
13
40A
(8W-10-13)
13
F30
12
RD/PK
1
C106
F30
12
RD/PK
4
IGNITION
SWITCH
(8W-10-13)
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
1
2
0
3
4
3
F22
12
WT/PK
19
FUSE
BLOCK
(8W-11-2)
FUSE
19
20A
(8W-11-10)
39
A9
C202
F38
16
LB
(NOT USED)
F38
16
LB
1
CIGAR
LIGHTER/
POWER
OUTLET
3
Z1
16
BK
S207
(8W-15-10)
(8W-15-11)
G200
(8W-15-10)
(8W-15-11)


BATT A0
(8W-10-7)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
20
FUSE
18
20A
(8W-10-16)
21
F31
18
VT
F31
18
VT
C11
C15
HORN
RELAY
(IN PDC)
C13
C14
X3
20
RD/YL
X2
18
WT/RD
7
C107
6
C110
X3
20
RD/YL
X2
18
DG/RD
BUILT-
UP-EXPORT
EXCEPT BUILT-
UP-EXPORT
S115
X2
18
DG/RD
X2
18
DG/RD
1
C1
CLOCKSPRING
(8W-30-19)
1
HIGH
NOTE
HORN
1
LOW
NOTE
HORN
2
2
Z1
18
BK
Z1
18
BK
HORN
SWITCH
S117
(8W-15-3)
(8W-15-4)
Z1
16
BK
G102
(8W-15-3)
(8W-15-4)

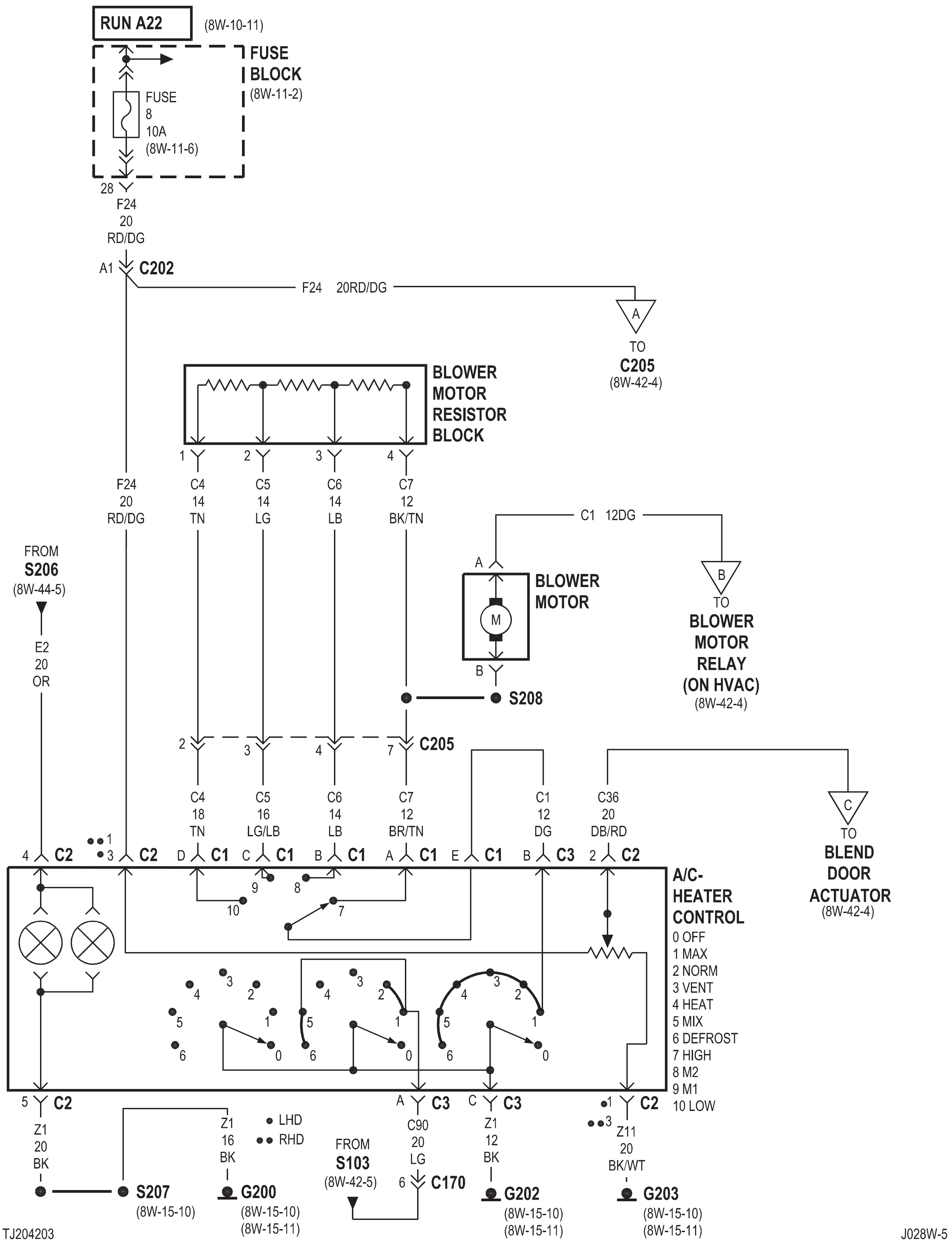
8W-42 AIR CONDITIONING-HEATER

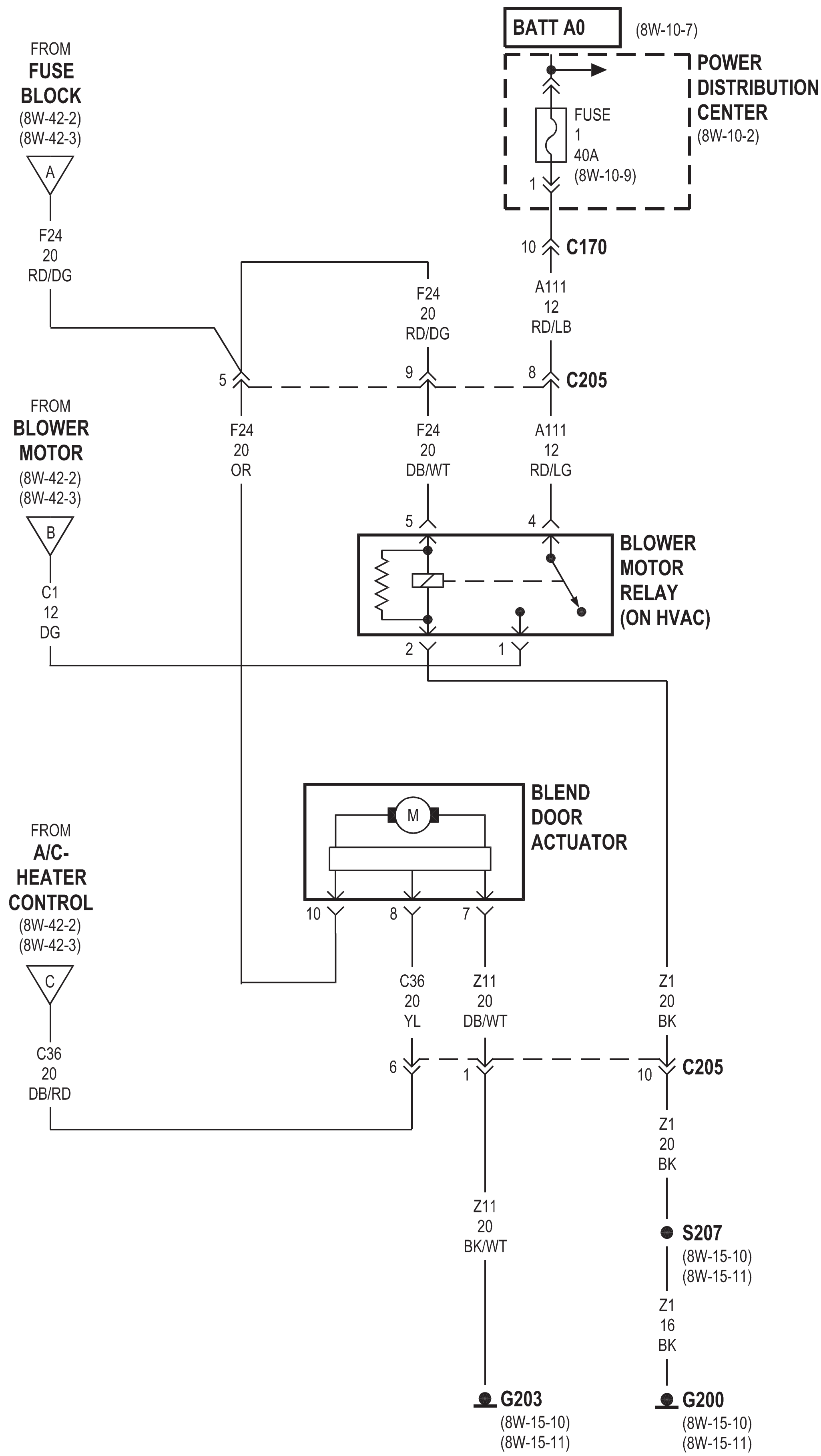
HEATER ONLY

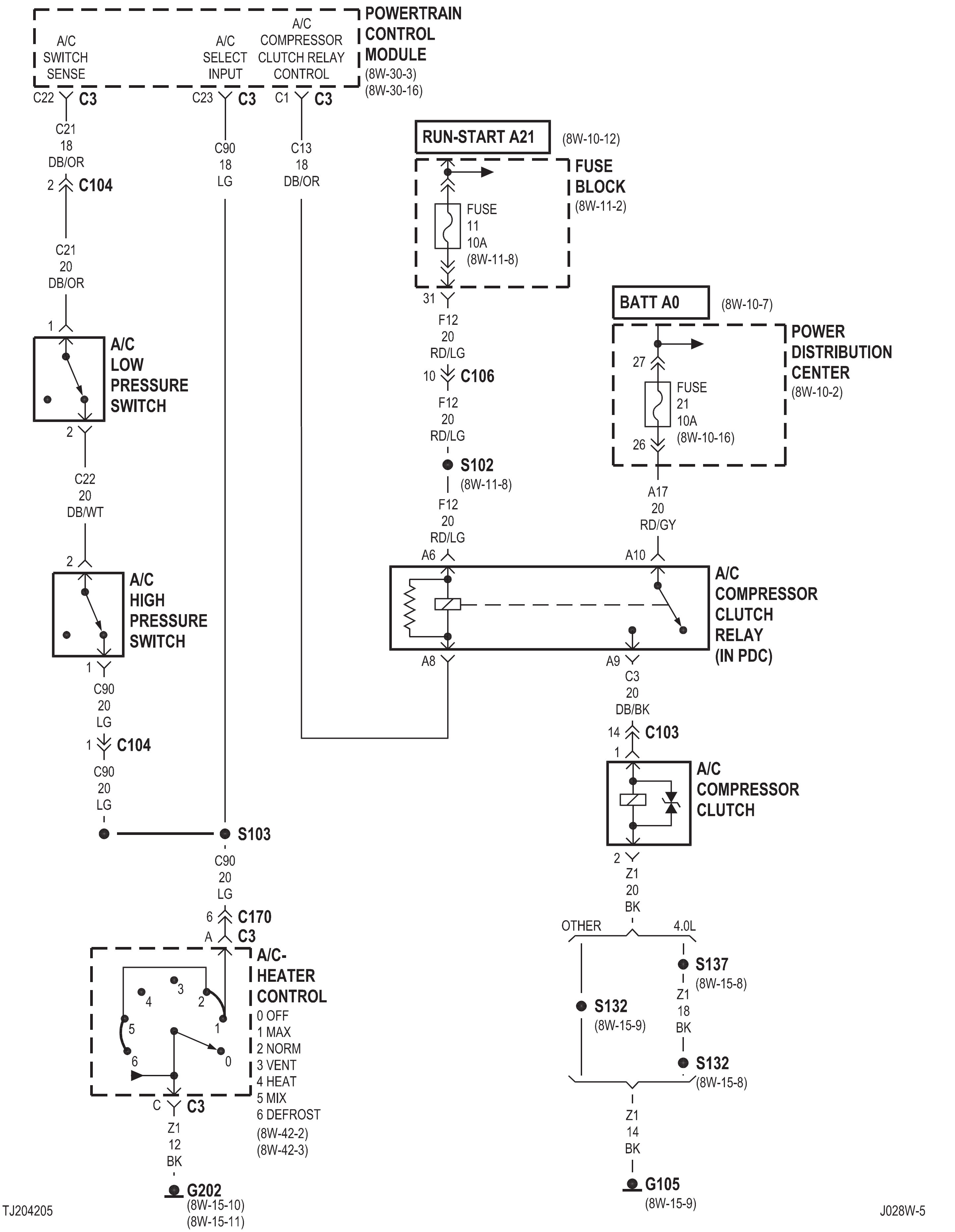


J028W-5

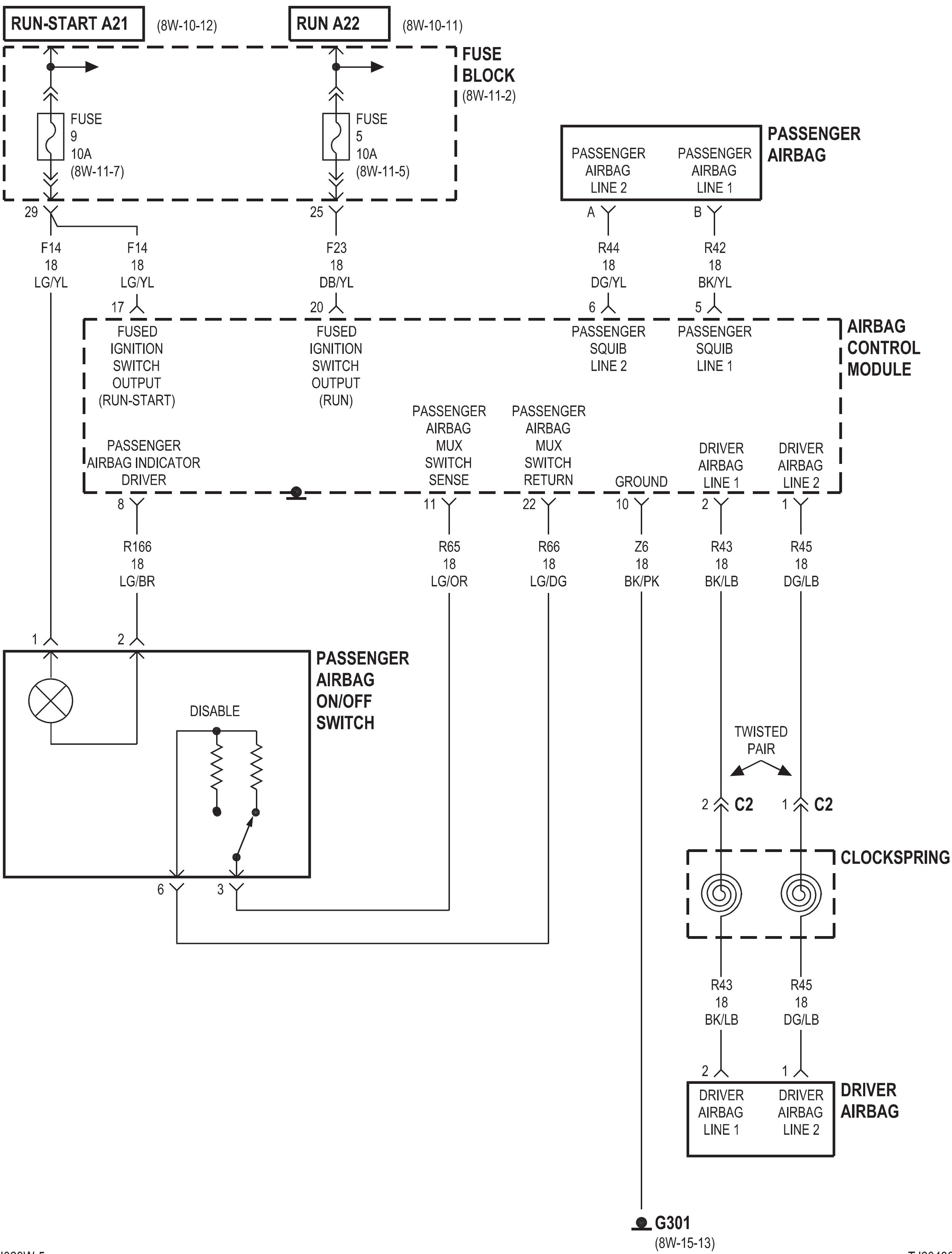
TJ204202

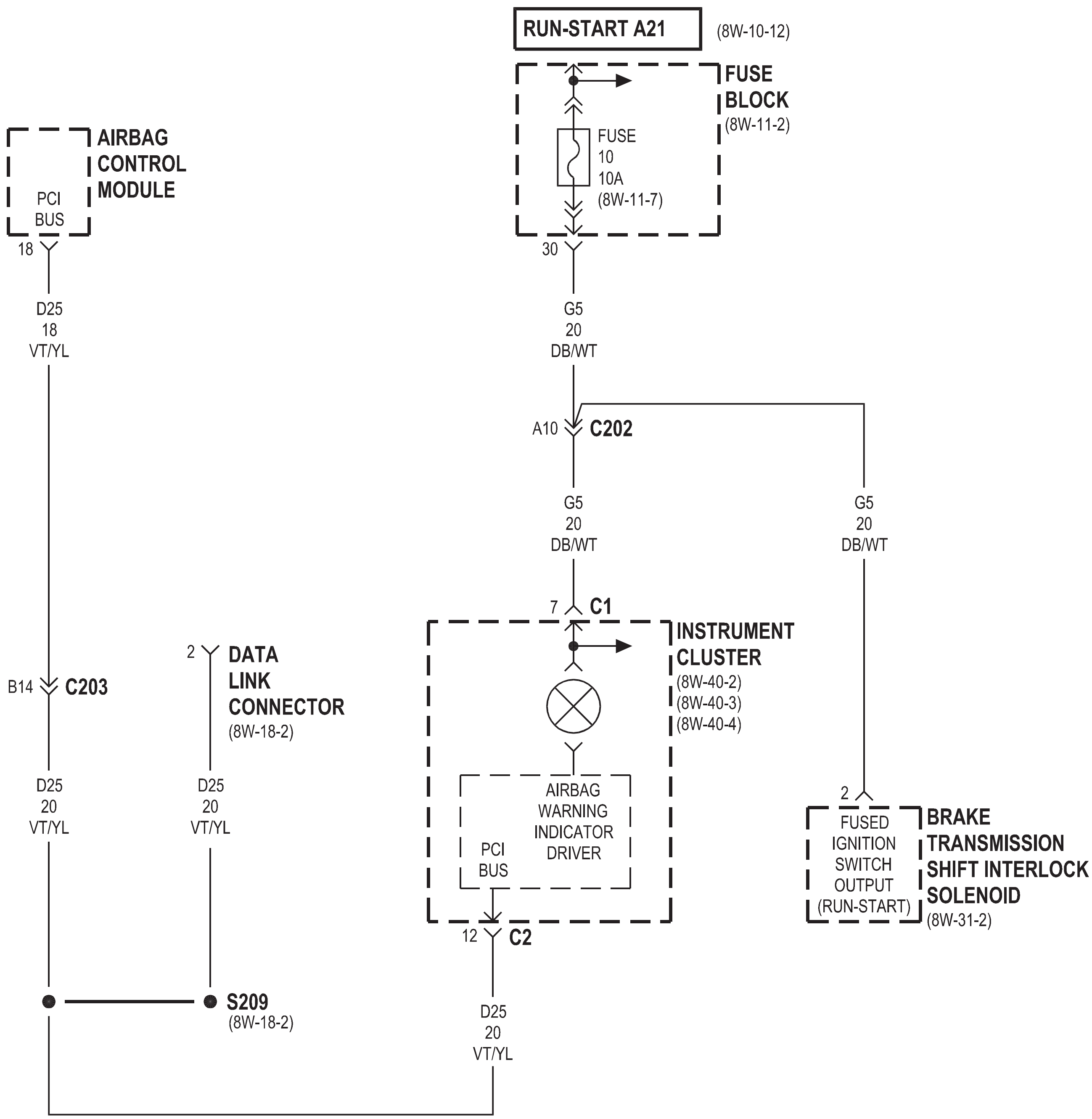

RUN A22
(8W-10-11)
FUSE BLOCK
(8W-11-2)
FUSE
8
10A
(8W-11-6)
28
F24
20
RD/DG
A1
C202
F24 20RD/DG
A
TO
C205
(8W-42-4)
BLOWER MOTOR RESISTOR BLOCK
1
2
3
4
F24
20
RD/DG
C4
14
TN
C5
14
LG
C6
14
LB
C7
12
BK/TN
C1 12DG
A
BLOWER MOTOR
M
B
B
TO
BLOWER MOTOR RELAY (ON HVAC)
(8W-42-4)
FROM
S206
(8W-44-5)
E2
20
OR
S208
C205
2
3
4
7
C4
18
TN
C5
16
LG/LB
C6
14
LB
C7
12
BR/TN
C1
12
DG
C36
20
DB/RD
C
TO
BLEND DOOR ACTUATOR
(8W-42-4)
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
9
8
10
7
4
3
2
5
1
6
0
5 C2
A C3
C C3
1 C2
3
Z1
20
BK
Z1
16
BK
LHD
RHD
FROM
S103
(8W-42-5)
C90
20
LG
6 C170
Z1
12
BK
Z11
20
BK/WT
S207
(8W-15-10)
G200
(8W-15-10)
(8W-15-11)
G202
(8W-15-10)
(8W-15-11)
G203
(8W-15-10)
(8W-15-11)
TJ204203
J028W-5


BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 1 40A (8W-10-9)
1
10
C170
A111 12 RD/LB
8
C205
A111 12 RD/LG
FROM FUSE BLOCK
(8W-42-2)
(8W-42-3)
A
F24 20 RD/DG
F24 20 RD/DG
5
9
F24 20 OR
F24 20 DB/WT
FROM BLOWER MOTOR
(8W-42-2)
(8W-42-3)
B
C1 12 DG
5
4
BLOWER MOTOR RELAY (ON HVAC)
2
1
BLEND DOOR ACTUATOR
M
10
8
7
FROM A/C-HEATER CONTROL
(8W-42-2)
(8W-42-3)
C
C36 20 DB/RD
C36 20 YL
Z11 20 DB/WT
Z1 20 BK
6
1
10
C205
Z1 20 BK
S207
(8W-15-10)
(8W-15-11)
Z1 16 BK
Z11 20 BK/WT
G203
(8W-15-10)
(8W-15-11)
G200
(8W-15-10)
(8W-15-11)

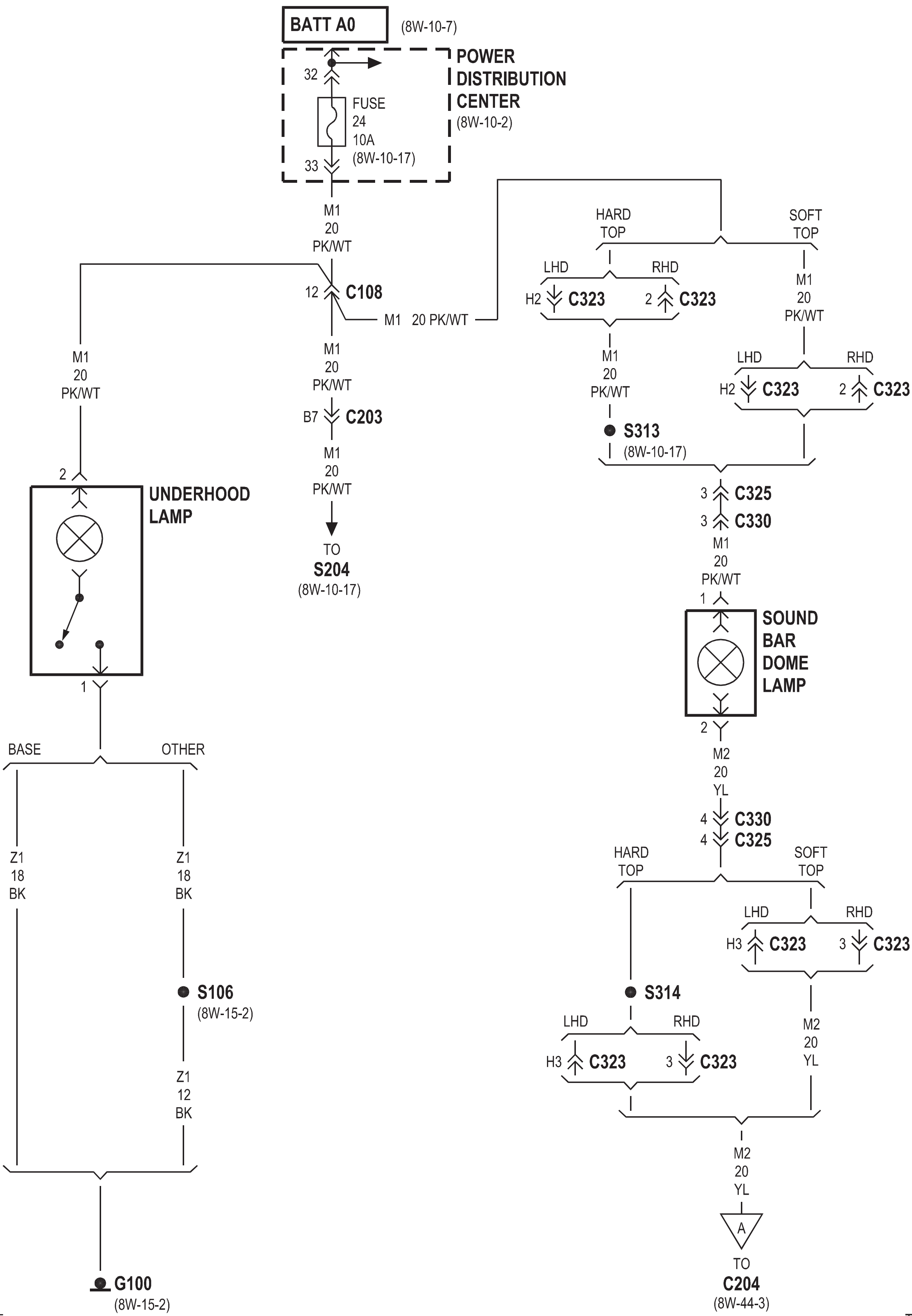

POWERTRAIN CONTROL MODULE
(8W-30-3)
(8W-30-16)
A/C SWITCH SENSE
A/C SELECT INPUT
A/C COMPRESSOR CLUTCH RELAY CONTROL
C22 C3
C23 C3
C1 C3
C21 18 DB/OR
C90 18 LG
C13 18 DB/OR
2 C104
C21 20 DB/OR
1
A/C LOW PRESSURE SWITCH
2
C22 20 DB/WT
2
A/C HIGH PRESSURE SWITCH
1
C90 20 LG
1 C104
C90 20 LG
S103
C90 20 LG
6 C170
A C3
A/C-HEATER CONTROL
0 OFF
1 MAX
2 NORM
3 VENT
4 HEAT
5 MIX
6 DEFROST
(8W-42-2)
(8W-42-3)
C C3
Z1 12 BK
G202
(8W-15-10)
(8W-15-11)
RUN-START A21
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 11 10A (8W-11-8)
31
F12 20 RD/LG
10 C106
F12 20 RD/LG
S102
(8W-11-8)
F12 20 RD/LG
BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
27
FUSE 21 10A (8W-10-16)
26
A17 20 RD/GY
A6
A10
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
A8
A9
C3 20 DB/BK
14 C103
1
A/C COMPRESSOR CLUTCH
2
Z1 20 BK
OTHER
4.0L
S137
(8W-15-8)
Z1 18 BK
S132
(8W-15-9)
S132
(8W-15-8)
Z1 14 BK
G105
(8W-15-9)
TJ204205
J028W-5

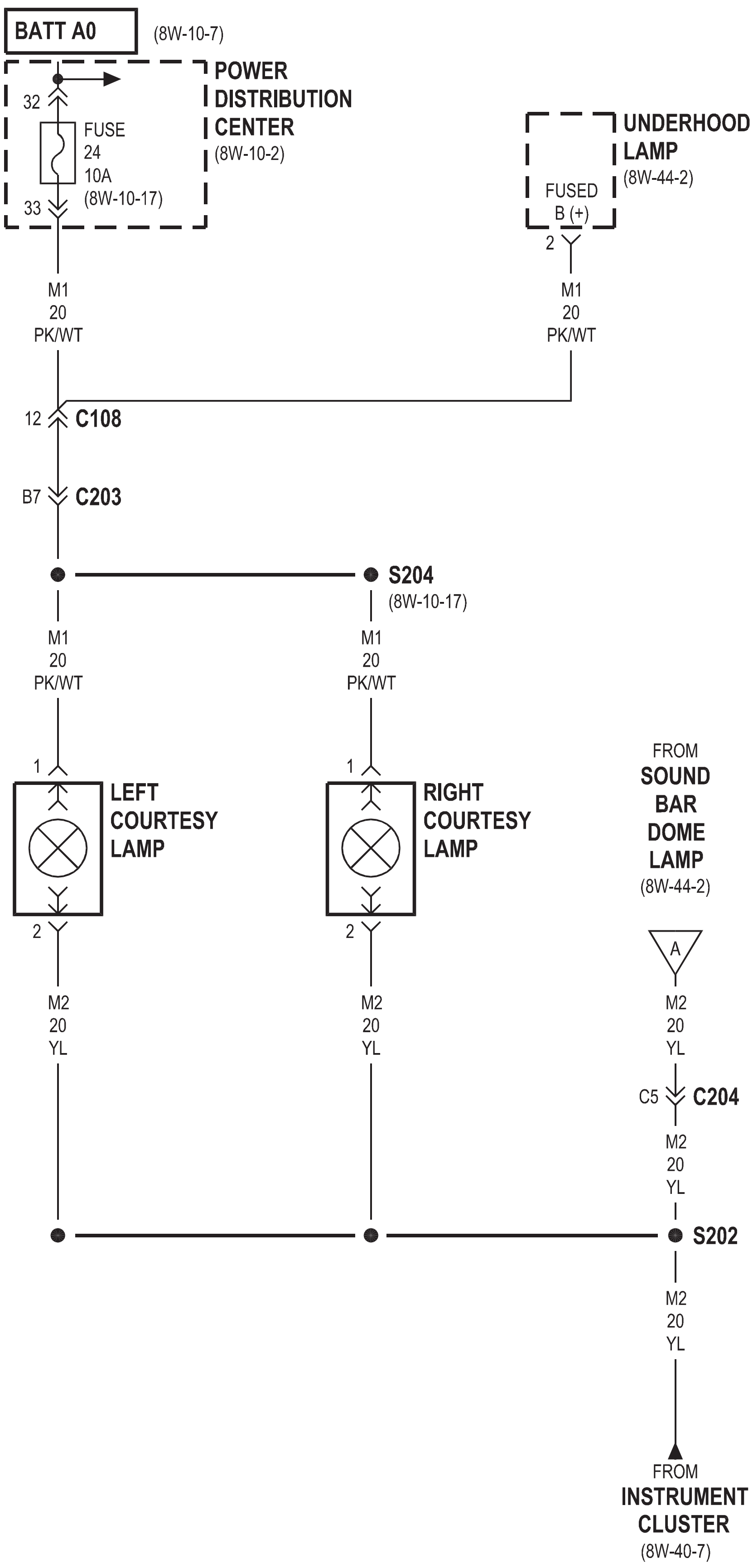
8W-43 AIRBAG SYSTEM

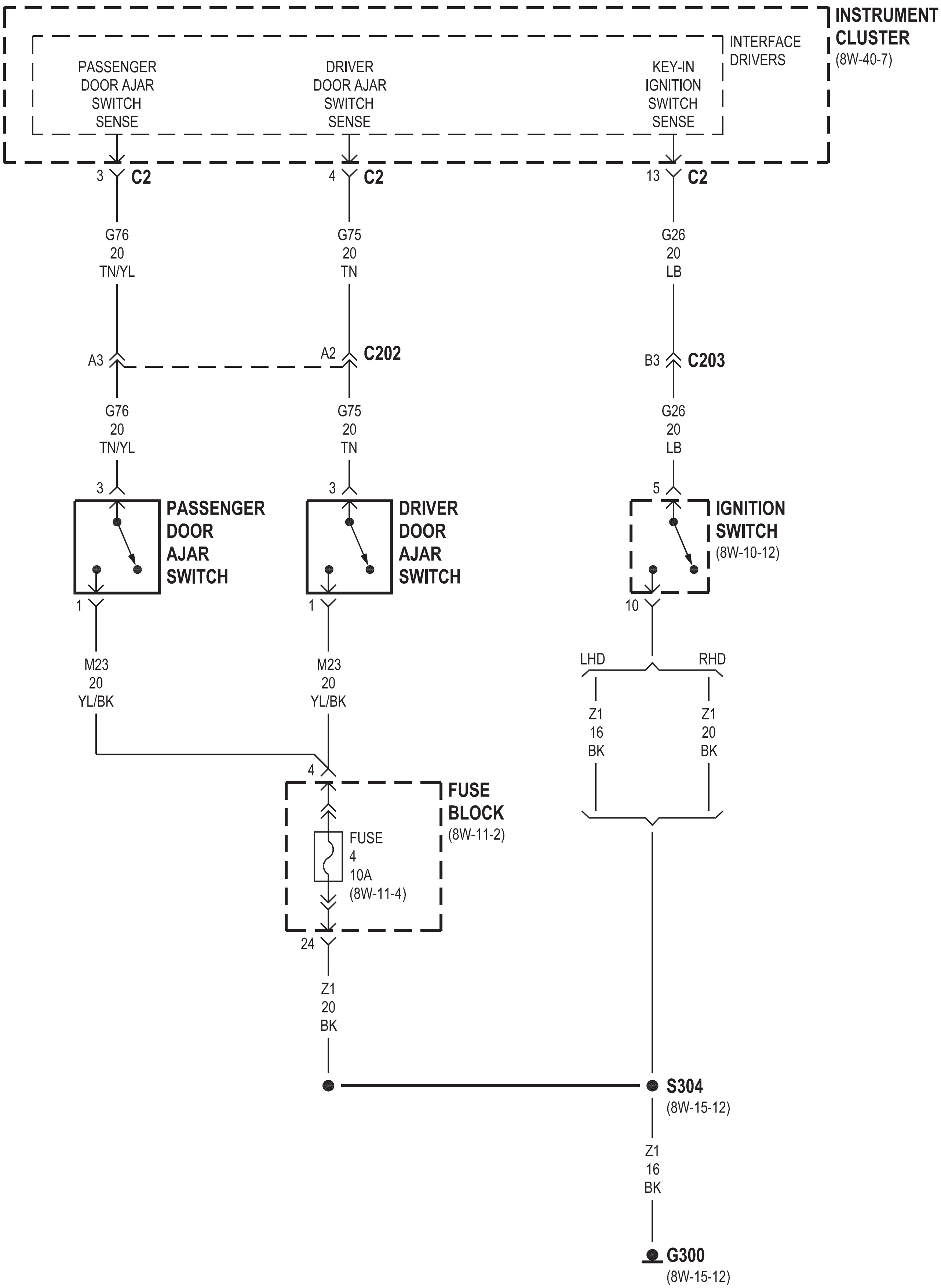

RUN-START A21
(8W-10-12)
RUN A22
(8W-10-11)
FUSE
BLOCK
(8W-11-2)
FUSE
9
10A
(8W-11-7)
FUSE
5
10A
(8W-11-5)
29
25
F14
18
LG/YL
F14
18
LG/YL
F23
18
DB/YL
PASSENGER
AIRBAG
PASSENGER
AIRBAG
LINE 2
PASSENGER
AIRBAG
LINE 1
A
B
R44
18
DG/YL
R42
18
BK/YL
17
20
6
5
AIRBAG
CONTROL
MODULE
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-START)
FUSED
IGNITION
SWITCH
OUTPUT
(RUN)
PASSENGER
SQUIB
LINE 2
PASSENGER
SQUIB
LINE 1
PASSENGER
AIRBAG INDICATOR
DRIVER
PASSENGER
AIRBAG
MUX
SWITCH
SENSE
PASSENGER
AIRBAG
MUX
SWITCH
RETURN
GROUND
DRIVER
AIRBAG
LINE 1
DRIVER
AIRBAG
LINE 2
8
11
22
10
2
1
R166
18
LG/BR
R65
18
LG/OR
R66
18
LG/DG
Z6
18
BK/PK
R43
18
BK/LB
R45
18
DG/LB
1
2
PASSENGER
AIRBAG
ON/OFF
SWITCH
DISABLE
6
3
TWISTED
PAIR
2 C2
1 C2
CLOCKSPRING
R43
18
BK/LB
R45
18
DG/LB
2
1
DRIVER
AIRBAG
LINE 1
DRIVER
AIRBAG
LINE 2
DRIVER
AIRBAG
G301
(8W-15-13)

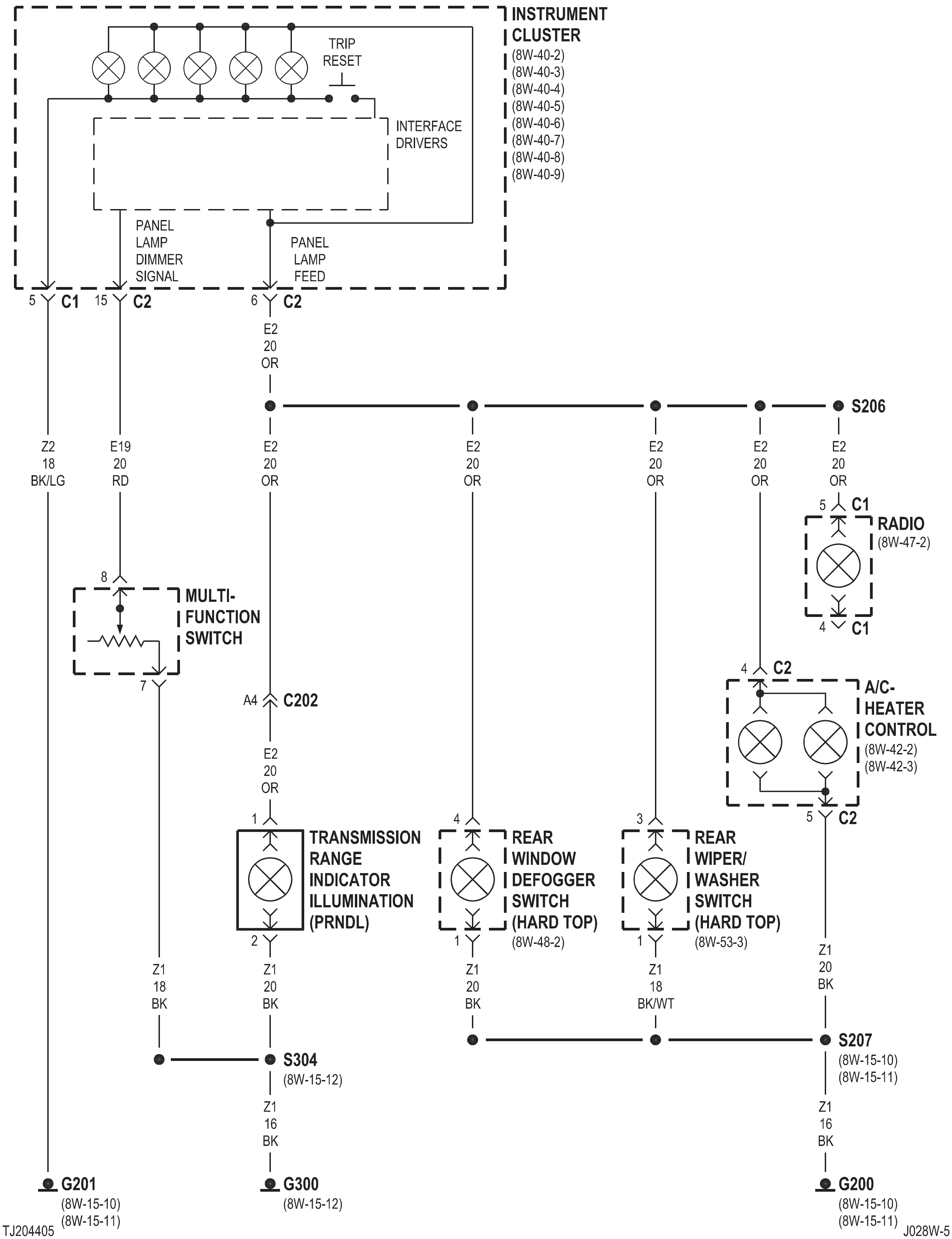

RUN-START A21
(8W-10-12)
FUSE
BLOCK
(8W-11-2)
FUSE
10
10A
(8W-11-7)
AIRBAG
CONTROL
MODULE
PCI
BUS
18
30
D25
18
VT/YL
G5
20
DB/WT
A10
C202
G5
20
DB/WT
G5
20
DB/WT
7
C1
INSTRUMENT
CLUSTER
(8W-40-2)
(8W-40-3)
(8W-40-4)
2
DATA
LINK
CONNECTOR
(8W-18-2)
B14
C203
AIRBAG
WARNING
INDICATOR
DRIVER
PCI
BUS
D25
20
VT/YL
D25
20
VT/YL
2
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-START)
BRAKE
TRANSMISSION
SHIFT INTERLOCK
SOLENOID
(8W-31-2)
12
C2
S209
(8W-18-2)
D25
20
VT/YL

8W-44 INTERIOR LIGHTING

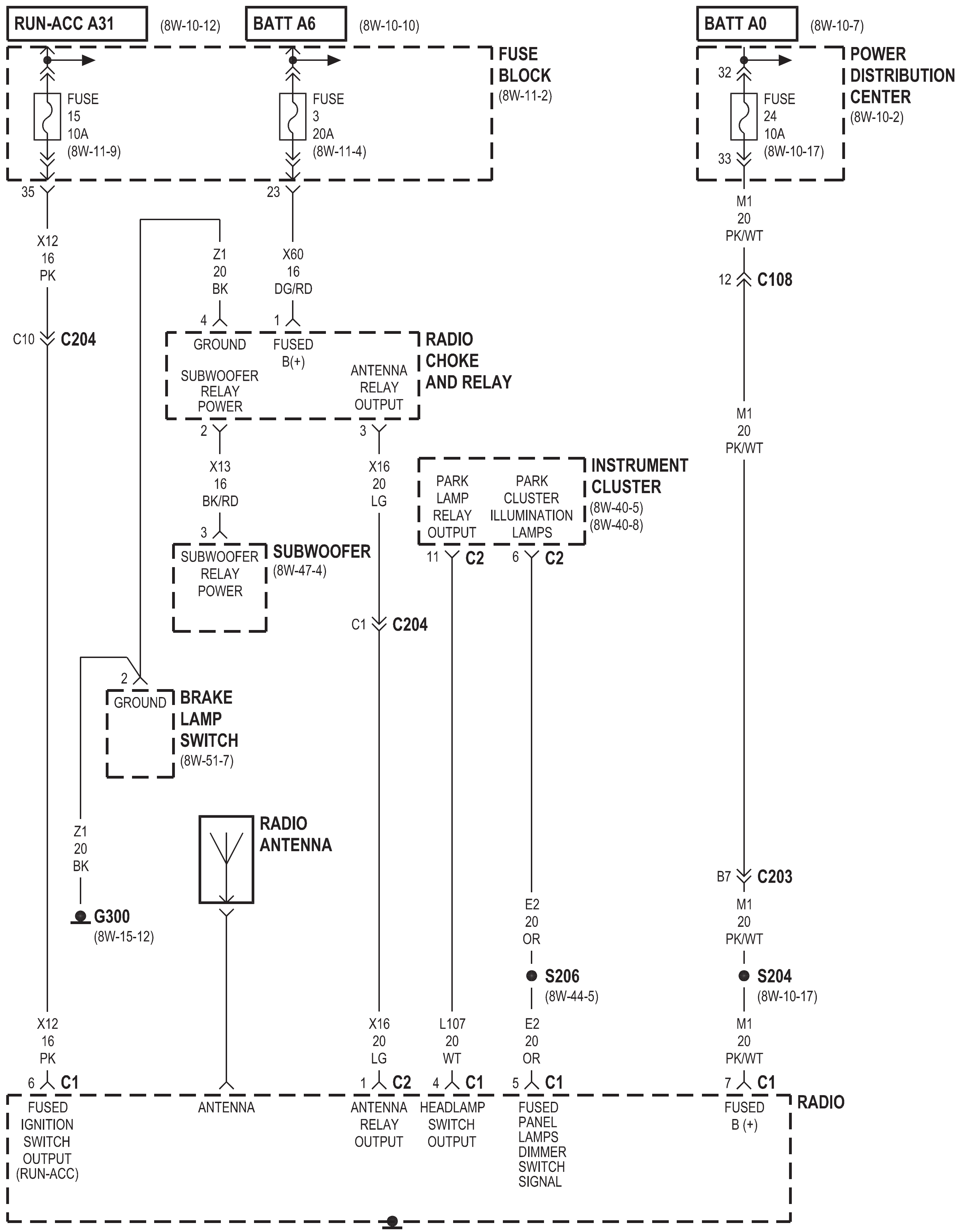

BATT A0
(8W-10-7)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
32
FUSE
24
10A
(8W-10-17)
33
M1
20
PK/WT
12
C108
M1 20 PK/WT
B7
C203
TO
S204
(8W-10-17)
2
UNDERHOOD
LAMP
1
BASE
OTHER
Z1
18
BK
S106
(8W-15-2)
Z1
12
BK
G100
(8W-15-2)
HARD
TOP
SOFT
TOP
LHD
RHD
H2
C323
2
S313
(8W-10-17)
3
C325
C330
1
SOUND
BAR
DOME
LAMP
M2
20
YL
4
H3
3
S314
A
TO
C204
(8W-44-3)

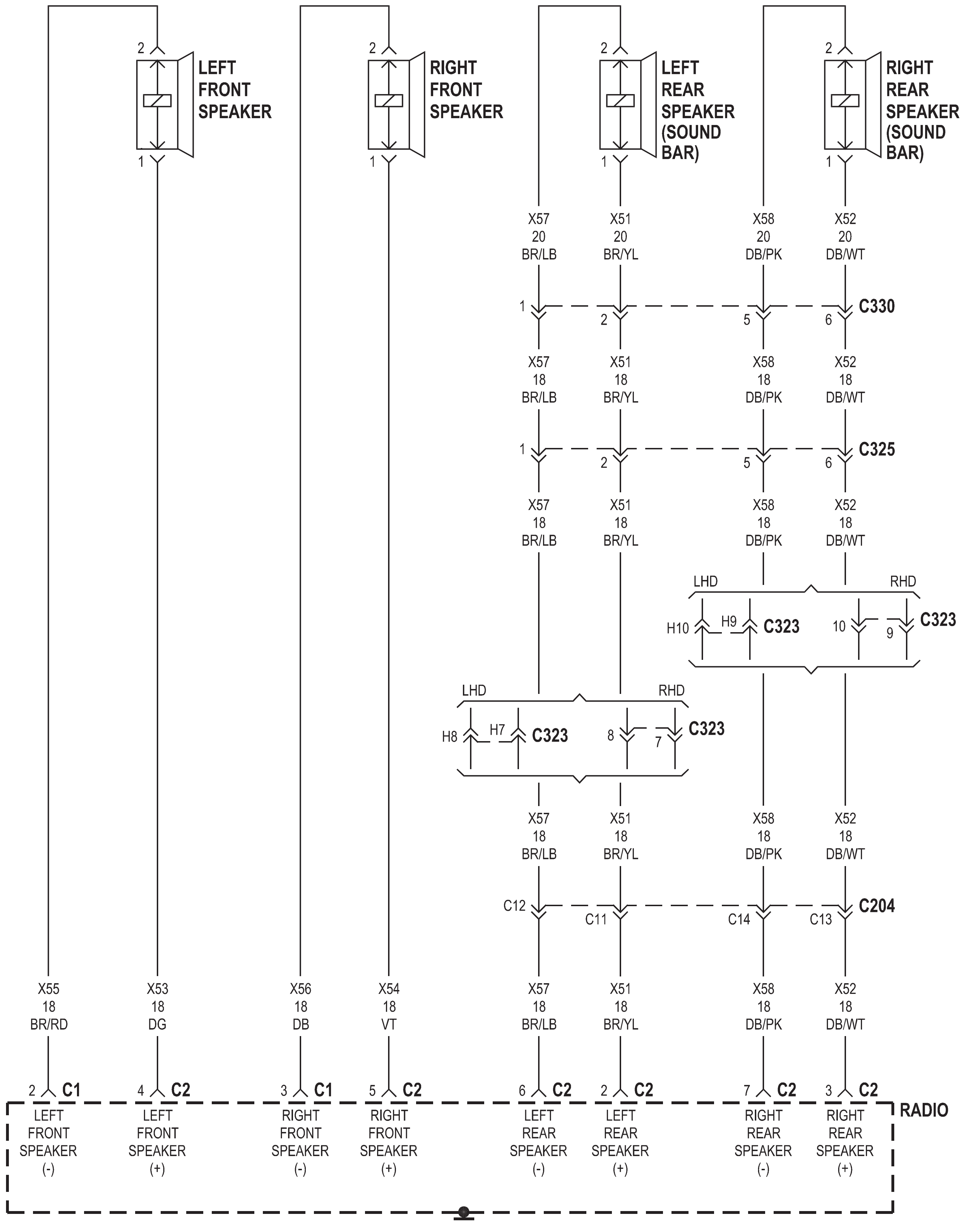

BATT A0
(8W-10-7)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
32
FUSE
24
10A
(8W-10-17)
33
UNDERHOOD
LAMP
(8W-44-2)
FUSED
B (+)
2
M1
20
PK/WT
M1
20
PK/WT
12
C108
B7
C203
S204
(8W-10-17)
M1
20
PK/WT
M1
20
PK/WT
1
LEFT
COURTESY
LAMP
2
1
RIGHT
COURTESY
LAMP
2
FROM
SOUND
BAR
DOME
LAMP
(8W-44-2)
A
M2
20
YL
M2
20
YL
M2
20
YL
C5
C204
M2
20
YL
S202
M2
20
YL
FROM
INSTRUMENT
CLUSTER
(8W-40-7)


INSTRUMENT CLUSTER
(8W-40-7)
INTERFACE DRIVERS
PASSENGER DOOR AJAR SWITCH SENSE
DRIVER DOOR AJAR SWITCH SENSE
KEY-IN IGNITION SWITCH SENSE
3 C2
4 C2
13 C2
G76 20 TN/YL
G75 20 TN
G26 20 LB
A3
A2 C202
B3 C203
G76 20 TN/YL
G75 20 TN
G26 20 LB
3
3
5
PASSENGER DOOR AJAR SWITCH
DRIVER DOOR AJAR SWITCH
IGNITION SWITCH
(8W-10-12)
1
1
10
M23 20 YL/BK
M23 20 YL/BK
LHD
RHD
Z1 16 BK
Z1 20 BK
4
FUSE BLOCK
(8W-11-2)
FUSE 4 10A (8W-11-4)
24
Z1 20 BK
S304
(8W-15-12)
Z1 16 BK
G300
(8W-15-12)

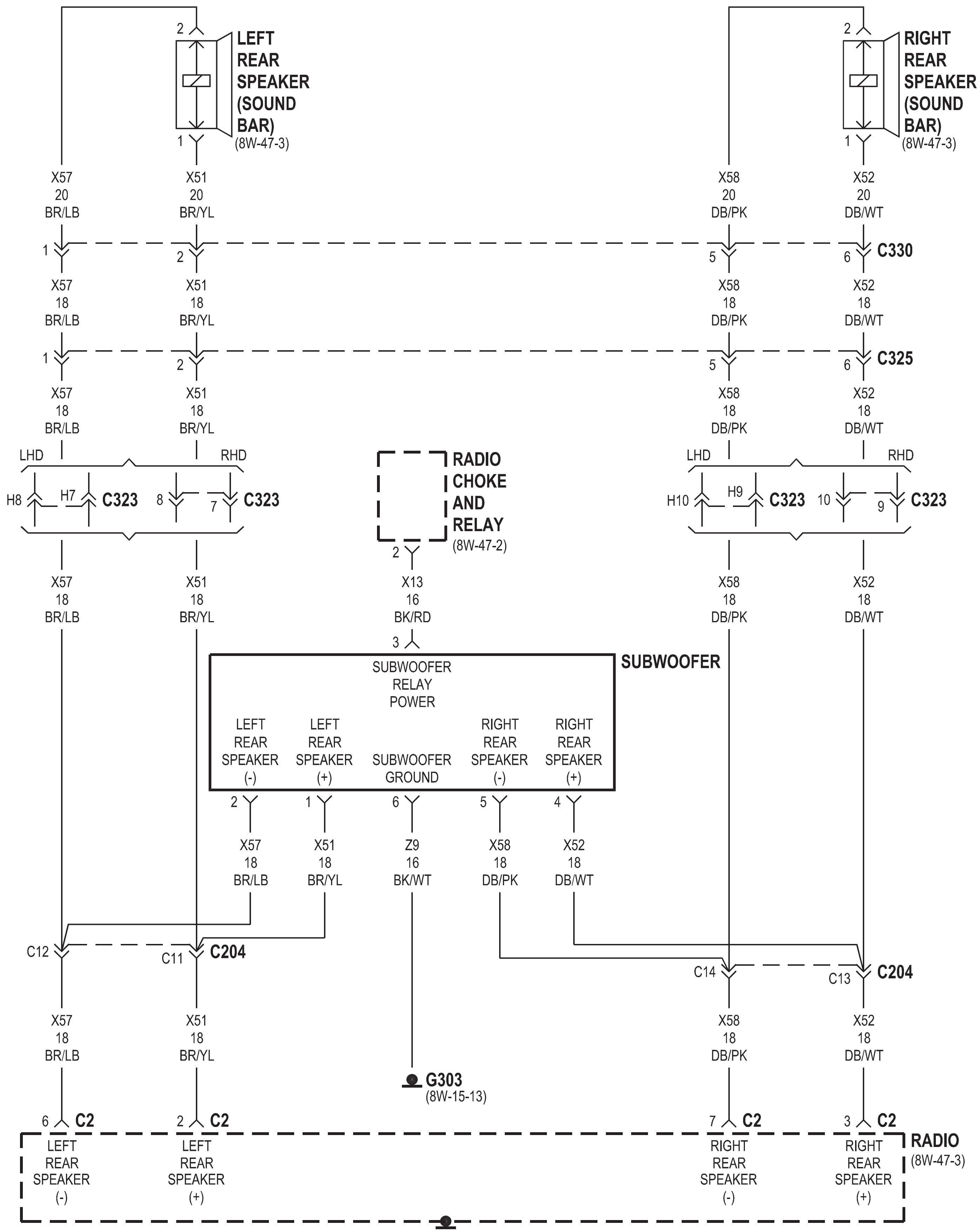

INSTRUMENT CLUSTER
(8W-40-2)
(8W-40-3)
(8W-40-4)
(8W-40-5)
(8W-40-6)
(8W-40-7)
(8W-40-8)
(8W-40-9)
TRIP RESET
INTERFACE DRIVERS
PANEL LAMP DIMMER SIGNAL
PANEL LAMP FEED
5 C1
15 C2
6 C2
E2 20 OR
S206
Z2 18 BK/LG
E19 20 RD
E2 20 OR
E2 20 OR
E2 20 OR
E2 20 OR
E2 20 OR
5 C1
RADIO
(8W-47-2)
4 C1
8
MULTI-FUNCTION SWITCH
7
4 C2
A/C-HEATER CONTROL
(8W-42-2)
(8W-42-3)
A4 C202
E2 20 OR
5 C2
1
TRANSMISSION RANGE INDICATOR ILLUMINATION (PRNDL)
2
4
REAR WINDOW DEFOGGER SWITCH (HARD TOP)
(8W-48-2)
1
3
REAR WIPER/ WASHER SWITCH (HARD TOP)
(8W-53-3)
1
Z1 20 BK
Z1 18 BK
Z1 20 BK
Z1 20 BK
Z1 18 BK/WT
S207
(8W-15-10)
(8W-15-11)
S304
(8W-15-12)
Z1 16 BK
Z1 16 BK
G201
(8W-15-10)
(8W-15-11)
G300
(8W-15-12)
G200
(8W-15-10)
(8W-15-11)
TJ204405
J028W-5

8W-47 AUDIO SYSTEM

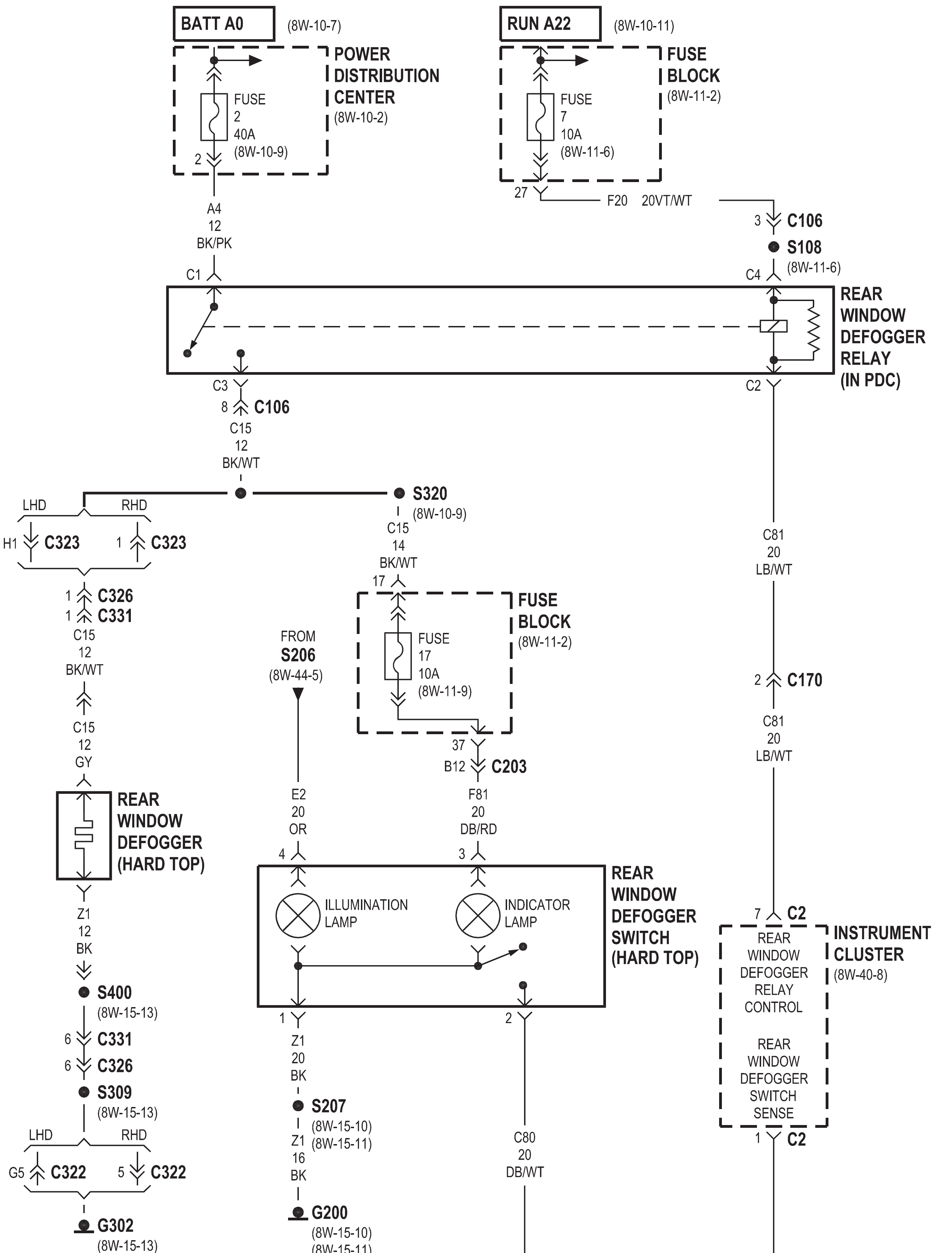

RUN-ACC A31
(8W-10-12)
BATT A6
(8W-10-10)
BATT A0
(8W-10-7)
FUSE BLOCK
(8W-11-2)
FUSE 15 10A (8W-11-9)
FUSE 3 20A (8W-11-4)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 24 10A (8W-10-17)
32
33
35
23
X12 16 PK
Z1 20 BK
X60 16 DG/RD
M1 20 PK/WT
12 C108
C10 C204
RADIO CHOKE AND RELAY
GROUND
FUSED B(+)
SUBWOOFER RELAY POWER
ANTENNA RELAY OUTPUT
X13 16 BK/RD
X16 20 LG
INSTRUMENT CLUSTER
(8W-40-5)
(8W-40-8)
PARK LAMP RELAY OUTPUT
PARK CLUSTER ILLUMINATION LAMPS
11 C2
6 C2
SUBWOOFER
(8W-47-4)
SUBWOOFER RELAY POWER
C1 C204
BRAKE LAMP SWITCH
(8W-51-7)
GROUND
RADIO ANTENNA
G300
(8W-15-12)
B7 C203
E2 20 OR
S206
(8W-44-5)
S204
(8W-10-17)
L107 20 WT
6 C1
1 C2
4 C1
5 C1
7 C1
RADIO
FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
ANTENNA
ANTENNA RELAY OUTPUT
HEADLAMP SWITCH OUTPUT
FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
FUSED B (+)


LEFT FRONT SPEAKER
RIGHT FRONT SPEAKER
LEFT REAR SPEAKER (SOUND BAR)
RIGHT REAR SPEAKER (SOUND BAR)
X57 20 BR/LB
X51 20 BR/YL
X58 20 DB/PK
X52 20 DB/WT
C330
X57 18 BR/LB
X51 18 BR/YL
X58 18 DB/PK
X52 18 DB/WT
C325
LHD
RHD
H10
H9
C323
10
9
C323
LHD
RHD
H8
H7
C323
8
7
C323
C12
C11
C14
C13
C204
X55 18 BR/RD
X53 18 DG
X56 18 DB
X54 18 VT
X57 18 BR/LB
X51 18 BR/YL
X58 18 DB/PK
X52 18 DB/WT
2 C1
4 C2
3 C1
5 C2
6 C2
2 C2
7 C2
3 C2
RADIO
LEFT FRONT SPEAKER (-)
LEFT FRONT SPEAKER (+)
RIGHT FRONT SPEAKER (-)
RIGHT FRONT SPEAKER (+)
LEFT REAR SPEAKER (-)
LEFT REAR SPEAKER (+)
RIGHT REAR SPEAKER (-)
RIGHT REAR SPEAKER (+)

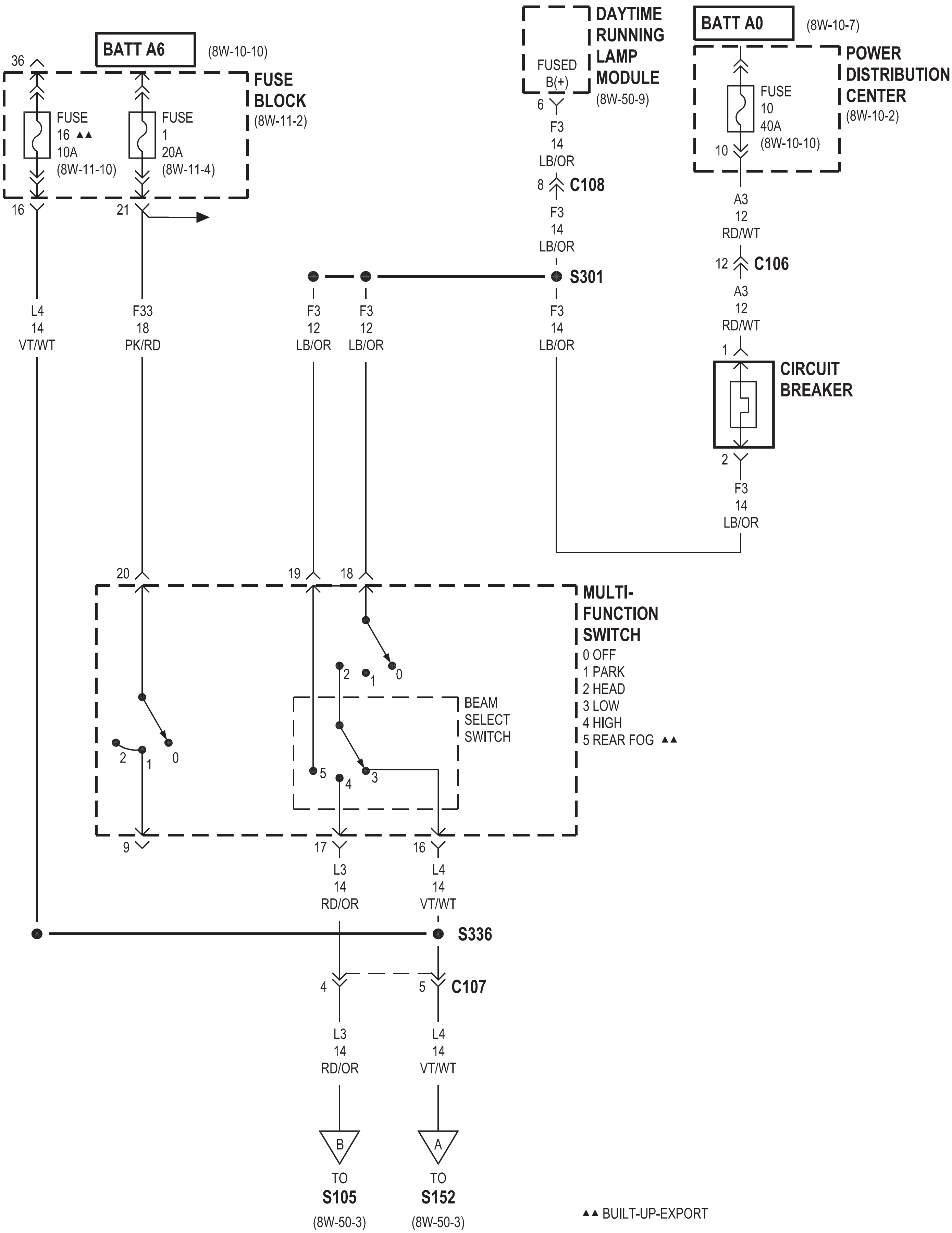
WITH SUBWOOFER



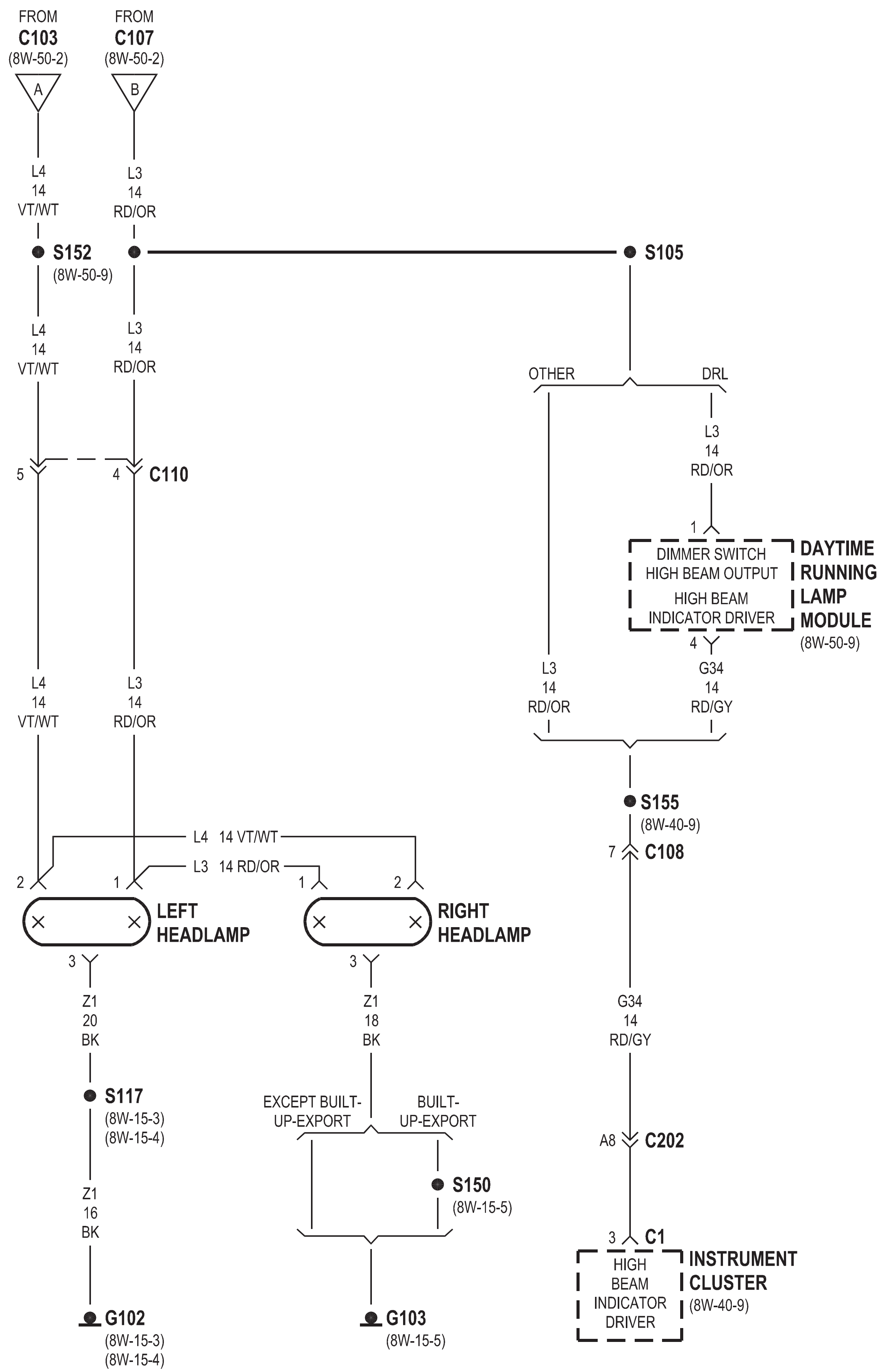
8W-48 REAR WINDOW DEFOGGER

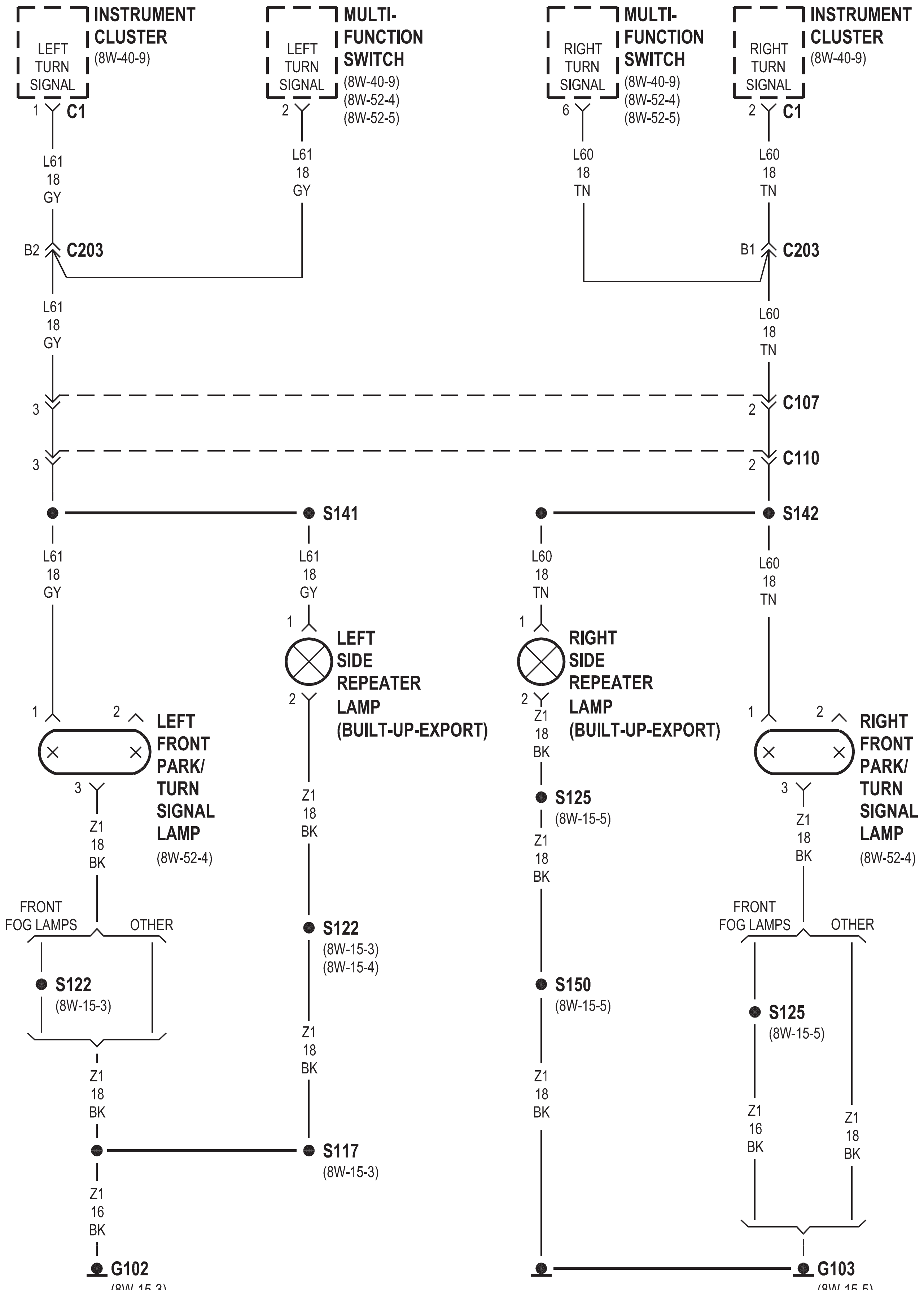

BATT A0
(8W-10-7)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
2
40A
(8W-10-9)
RUN A22
(8W-10-11)
FUSE
BLOCK
(8W-11-2)
FUSE
7
10A
(8W-11-6)
27
F20 20VT/WT
3 C106
S108
(8W-11-6)
A4
12
BK/PK
C1
C4
REAR
WINDOW
DEFOGGER
RELAY
(IN PDC)
C3
C2
8 C106
C15
12
BK/WT
S320
(8W-10-9)
LHD
RHD
H1 C323
1 C323
C15
14
BK/WT
17
FUSE
BLOCK
(8W-11-2)
FUSE
17
10A
(8W-11-9)
C81
20
LB/WT
1 C326
1 C331
C15
12
BK/WT
FROM
S206
(8W-44-5)
2 C170
C81
20
LB/WT
C15
12
GY
37
B12 C203
REAR
WINDOW
DEFOGGER
(HARD TOP)
E2
20
OR
F81
20
DB/RD
4
3
ILLUMINATION
LAMP
INDICATOR
LAMP
REAR
WINDOW
DEFOGGER
SWITCH
(HARD TOP)
7 C2
INSTRUMENT
CLUSTER
(8W-40-8)
REAR
WINDOW
DEFOGGER
RELAY
CONTROL
REAR
WINDOW
DEFOGGER
SWITCH
SENSE
Z1
12
BK
S400
(8W-15-13)
6 C331
6 C326
S309
(8W-15-13)
1
2
Z1
20
BK
S207
(8W-15-10)
(8W-15-11)
Z1
16
BK
C80
20
DB/WT
1 C2
LHD
RHD
G5 C322
5 C322
G302
(8W-15-13)
G200
(8W-15-10)
(8W-15-11)

8W-50 FRONT LIGHTING

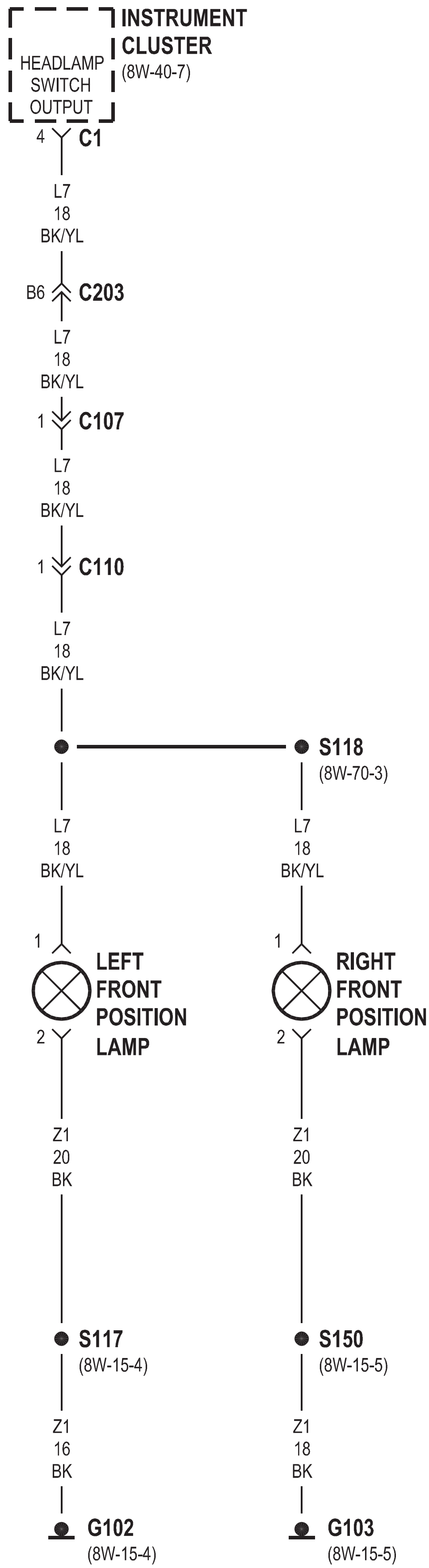


▲▲ BUILT-UP-EXPORT

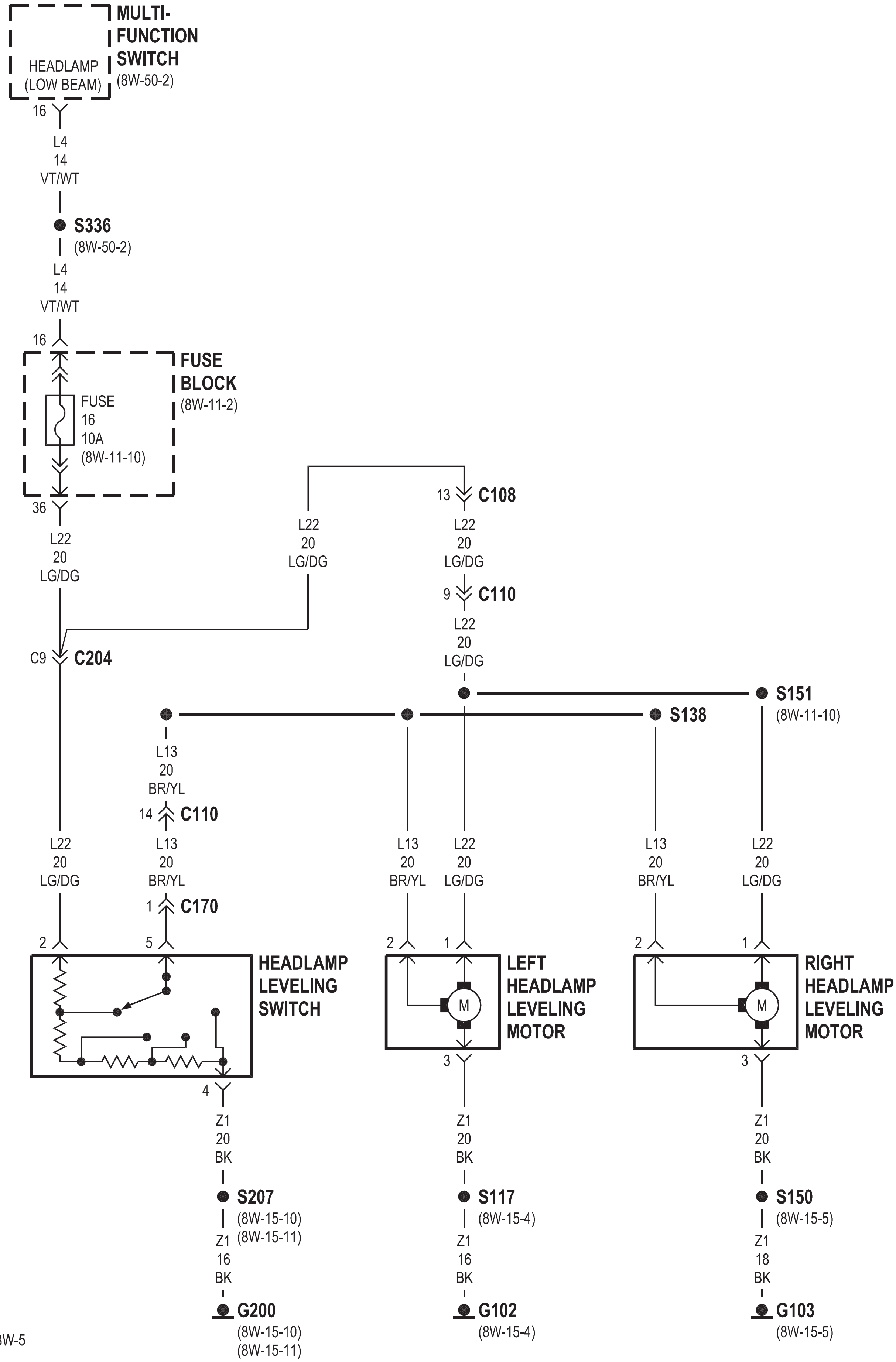

FROM
C103
(8W-50-2)
A
FROM
C107
(8W-50-2)
B
L4
14
VT/WT
L3
14
RD/OR
S152
(8W-50-9)
S105
OTHER
DRL
5
4
C110
1
DIMMER SWITCH
HIGH BEAM OUTPUT
HIGH BEAM
INDICATOR DRIVER
DAYTIME
RUNNING
LAMP
MODULE
(8W-50-9)
G34
14
RD/GY
S155
(8W-40-9)
7
C108
L4 14 VT/WT
L3 14 RD/OR
2
LEFT
HEADLAMP
RIGHT
HEADLAMP
3
Z1
20
BK
Z1
18
BK
S117
(8W-15-3)
(8W-15-4)
EXCEPT BUILT-
UP-EXPORT
BUILT-
UP-EXPORT
S150
(8W-15-5)
A8
C202
Z1
16
BK
C1
HIGH
BEAM
INDICATOR
DRIVER
INSTRUMENT
CLUSTER
(8W-40-9)
G102
(8W-15-3)
(8W-15-4)
G103
(8W-15-5)


INSTRUMENT CLUSTER (8W-40-9)
LEFT TURN SIGNAL
C1
MULTI-FUNCTION SWITCH (8W-40-9) (8W-52-4) (8W-52-5)
LEFT TURN SIGNAL
RIGHT TURN SIGNAL
INSTRUMENT CLUSTER (8W-40-9)
RIGHT TURN SIGNAL
L61 18 GY
L60 18 TN
C203
B2
B1
C107
C110
S141
S142
LEFT SIDE REPEATER LAMP (BUILT-UP-EXPORT)
RIGHT SIDE REPEATER LAMP (BUILT-UP-EXPORT)
LEFT FRONT PARK/ TURN SIGNAL LAMP (8W-52-4)
RIGHT FRONT PARK/ TURN SIGNAL LAMP (8W-52-4)
Z1 18 BK
Z1 16 BK
FRONT FOG LAMPS
OTHER
S122 (8W-15-3)
S122 (8W-15-3) (8W-15-4)
S125 (8W-15-5)
S150 (8W-15-5)
S117 (8W-15-3)
G102 (8W-15-3)
G103 (8W-15-5)

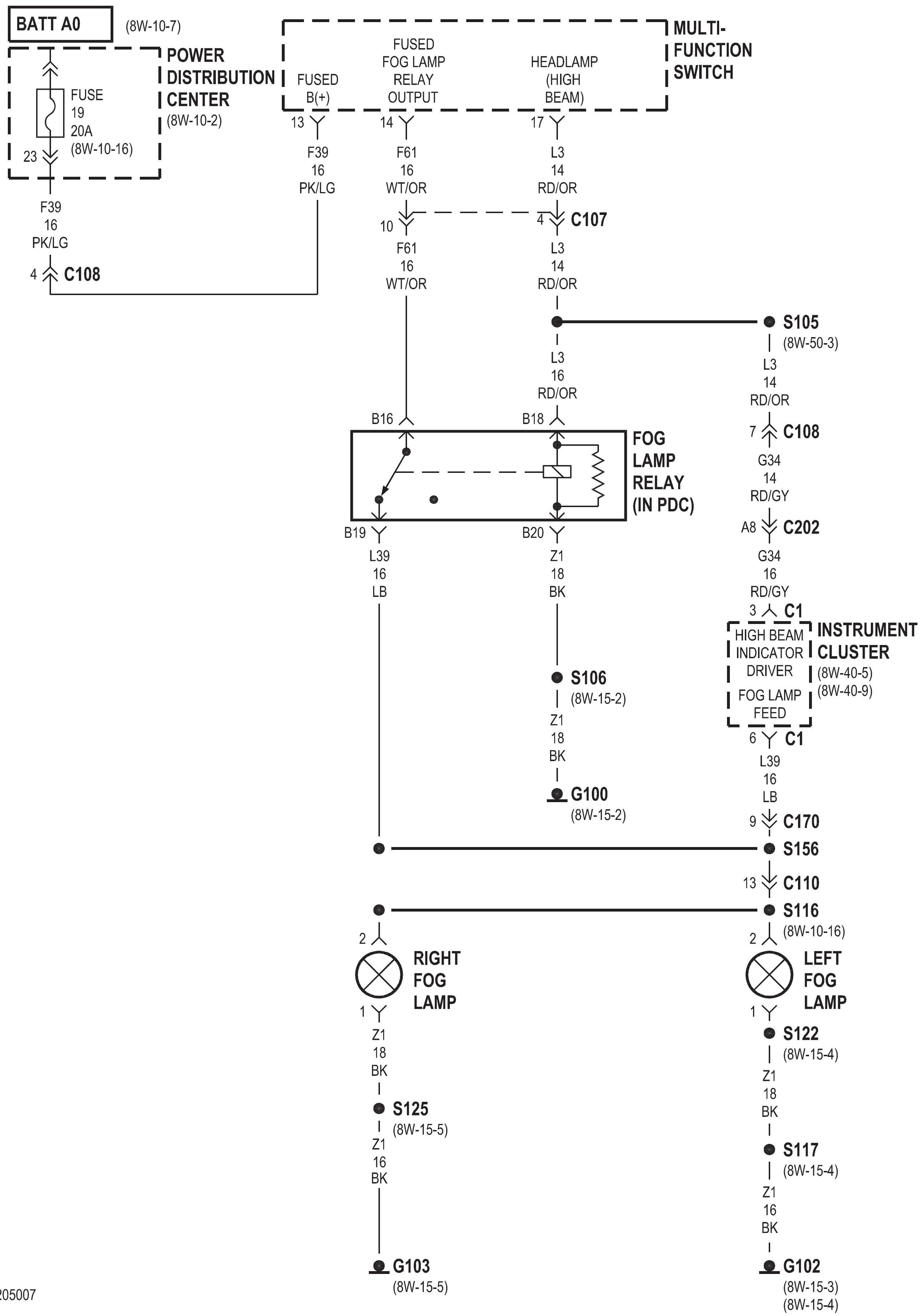
BUILT-UP-EXPORT



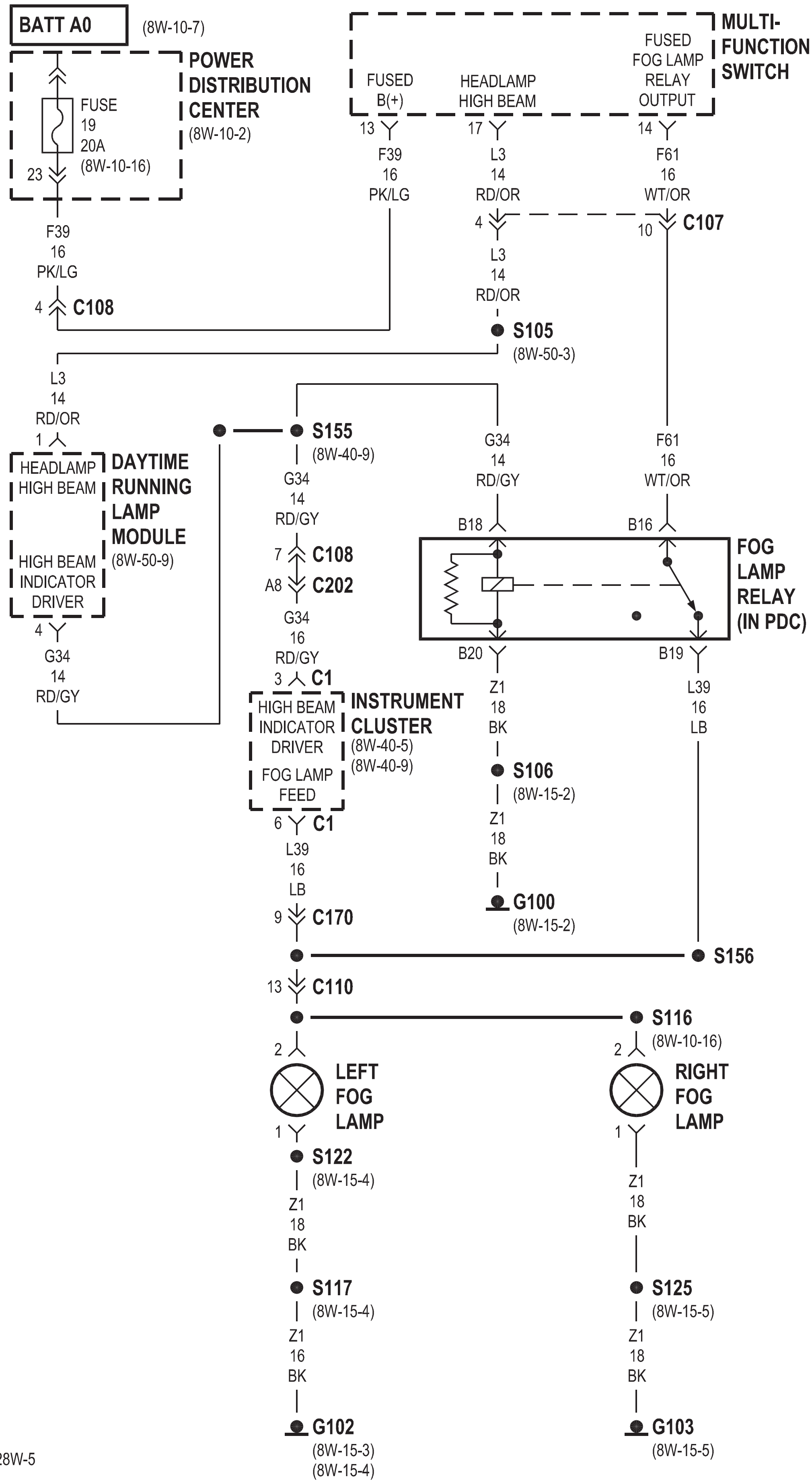
BUILT-UP-EXPORT



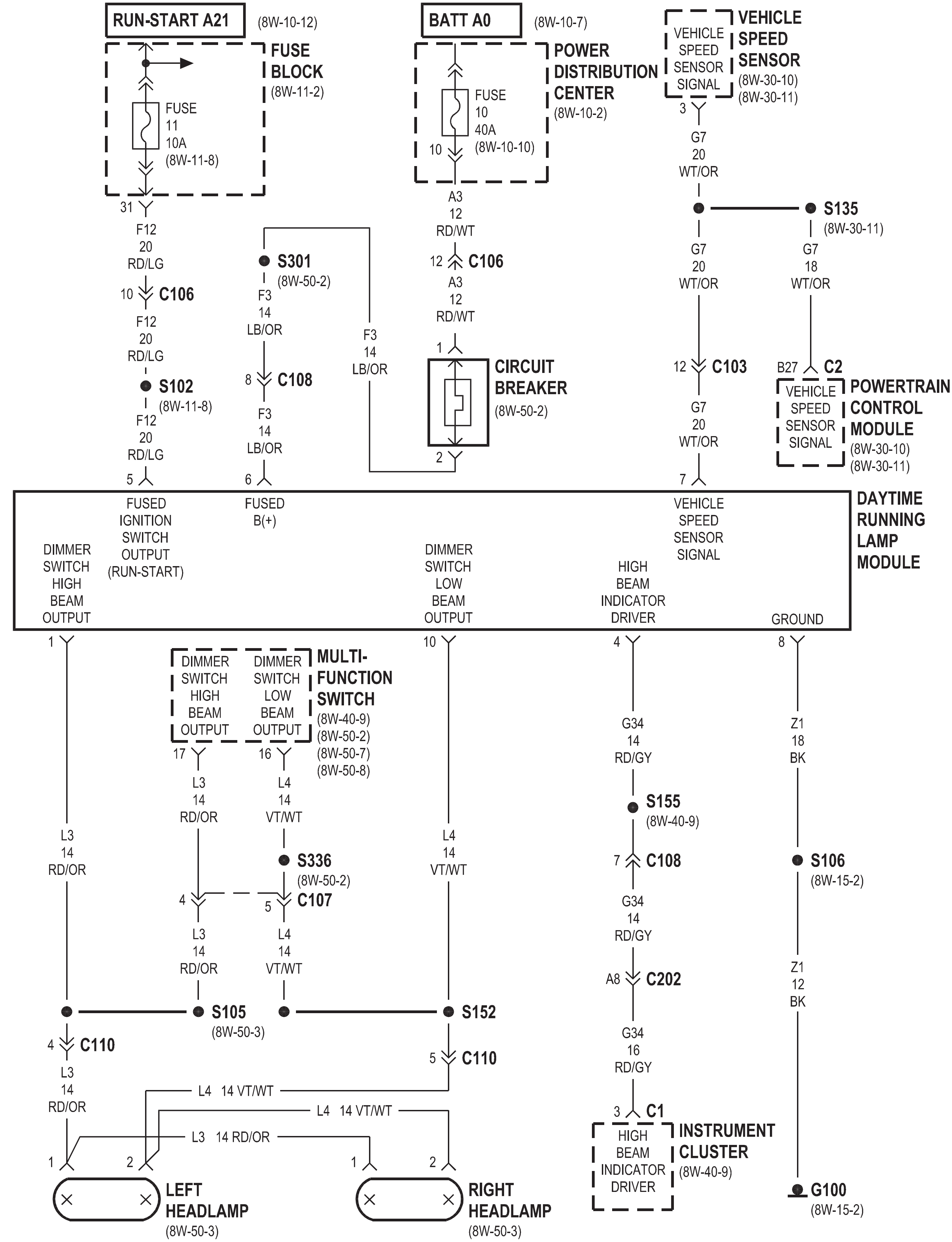
FOG LAMPS


BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 19 20A (8W-10-16)
23
F39 16 PK/LG
4 C108
MULTI-FUNCTION SWITCH
FUSED B(+)
FUSED FOG LAMP RELAY OUTPUT
HEADLAMP (HIGH BEAM)
13
14
17
F39 16 PK/LG
F61 16 WT/OR
L3 14 RD/OR
10
4 C107
F61 16 WT/OR
L3 14 RD/OR
S105
(8W-50-3)
L3 16 RD/OR
L3 14 RD/OR
B16
B18
FOG LAMP RELAY (IN PDC)
7 C108
G34 14 RD/GY
B19
B20
A8 C202
L39 16 LB
Z1 18 BK
G34 16 RD/GY
3 C1
HIGH BEAM INDICATOR DRIVER
FOG LAMP FEED
INSTRUMENT CLUSTER
(8W-40-5)
(8W-40-9)
S106
(8W-15-2)
Z1 18 BK
6 C1
L39 16 LB
G100
(8W-15-2)
9 C170
S156
13 C110
S116
(8W-10-16)
2
RIGHT FOG LAMP
2
LEFT FOG LAMP
1
1
Z1 18 BK
S122
(8W-15-4)
S125
(8W-15-5)
Z1 18 BK
Z1 16 BK
S117
(8W-15-4)
Z1 16 BK
G103
(8W-15-5)
G102
(8W-15-3)
(8W-15-4)

FOG LAMPS WITH DRL



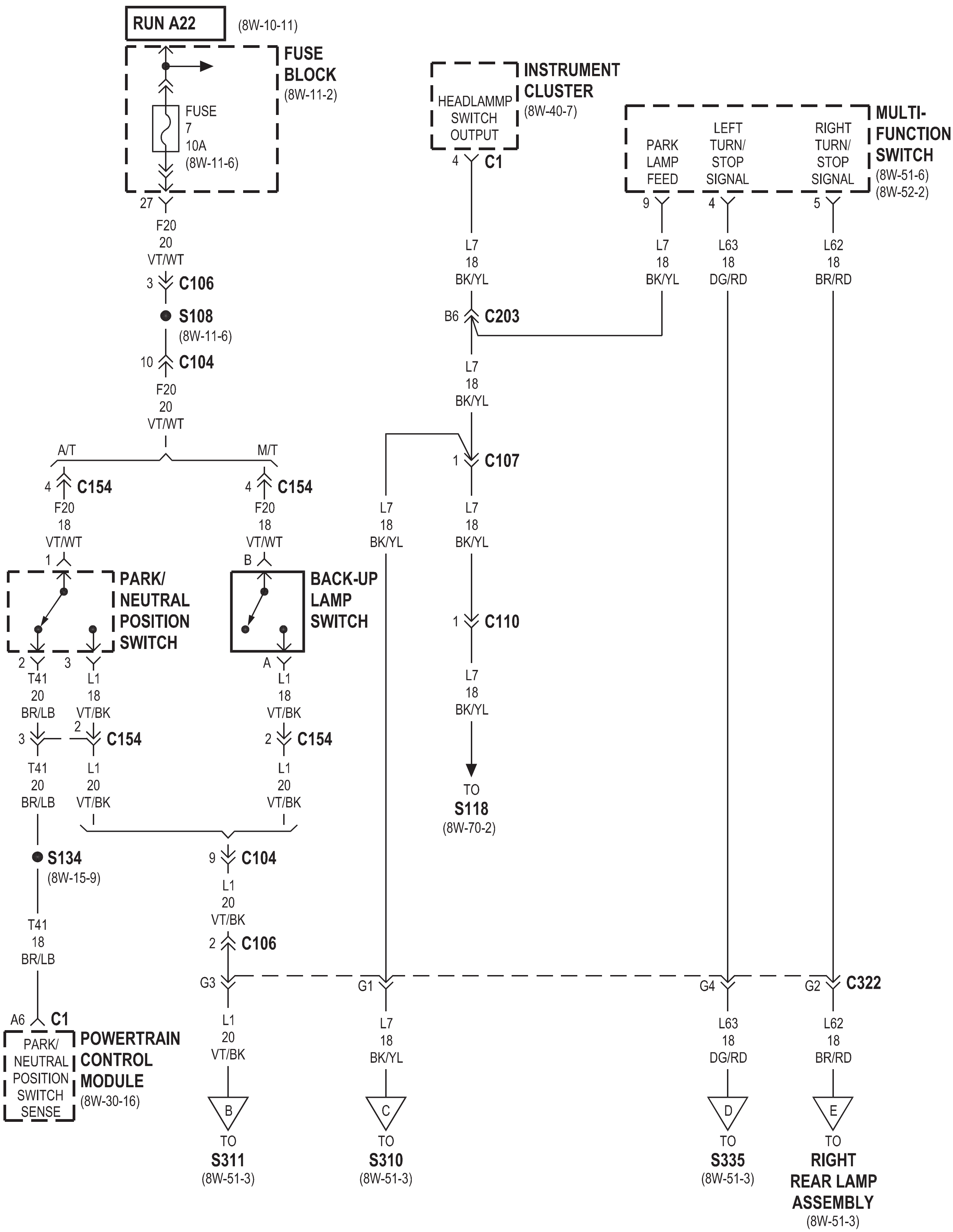
DRL

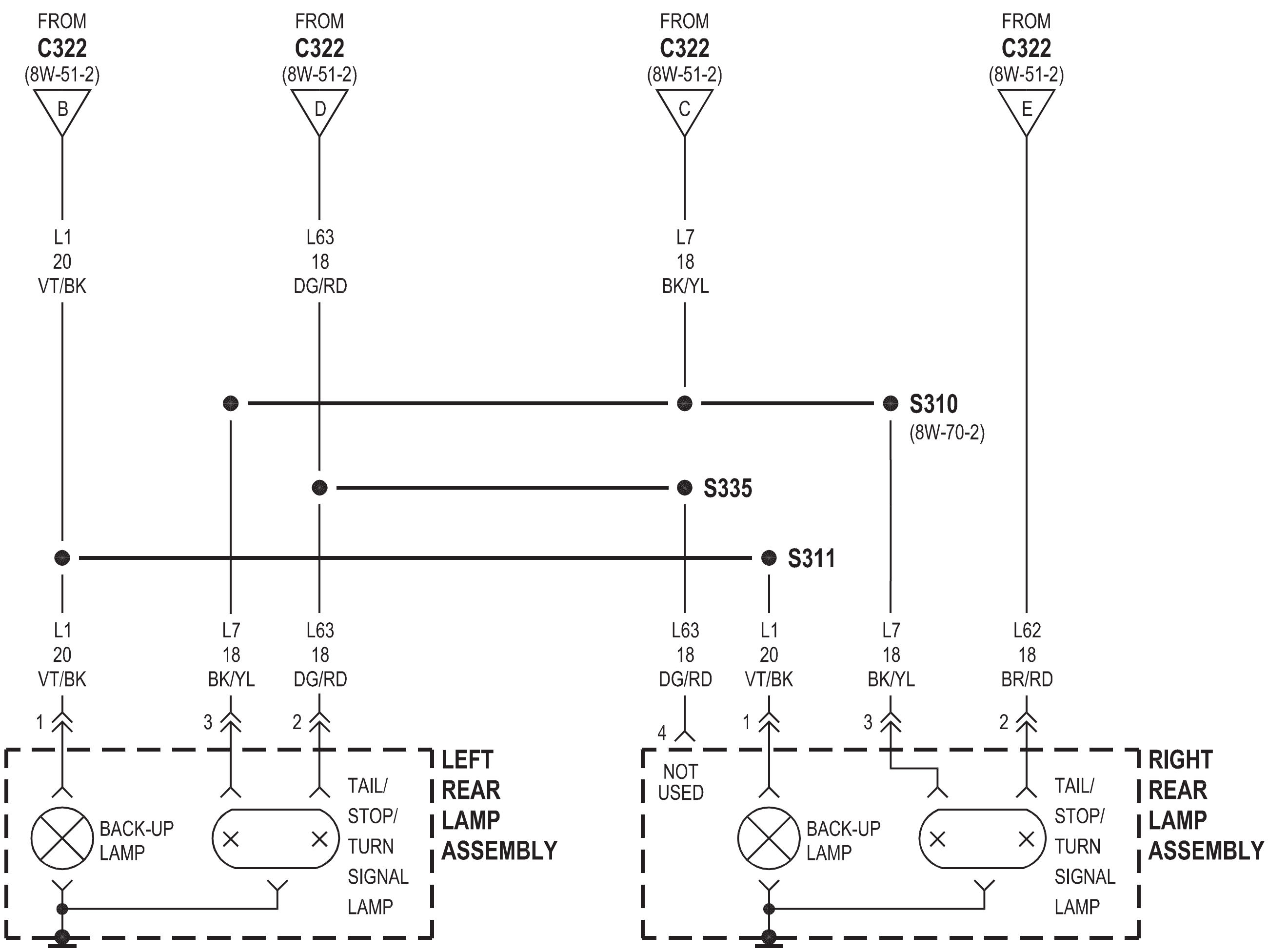


RUN-START A21
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 11 10A (8W-11-8)
31
F12 20 RD/LG
10 C106
S102
(8W-11-8)
5
BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 10 40A (8W-10-10)
10
A3 12 RD/WT
12 C106
1
CIRCUIT BREAKER
(8W-50-2)
2
S301
(8W-50-2)
F3 14 LB/OR
8 C108
6
VEHICLE SPEED SENSOR SIGNAL
VEHICLE SPEED SENSOR
(8W-30-10)
(8W-30-11)
3
G7 20 WT/OR
S135
(8W-30-11)
G7 18 WT/OR
12 C103
B27 C2
POWERTRAIN CONTROL MODULE
(8W-30-10)
(8W-30-11)
7
FUSED IGNITION SWITCH OUTPUT (RUN-START)
FUSED B(+)
DIMMER SWITCH HIGH BEAM OUTPUT
DIMMER SWITCH LOW BEAM OUTPUT
HIGH BEAM INDICATOR DRIVER
GROUND
DAYTIME RUNNING LAMP MODULE
1
10
4
8
MULTI-FUNCTION SWITCH
(8W-40-9)
(8W-50-2)
(8W-50-7)
(8W-50-8)
DIMMER SWITCH HIGH BEAM OUTPUT
DIMMER SWITCH LOW BEAM OUTPUT
17
16
L3 14 RD/OR
L4 14 VT/WT
S336
(8W-50-2)
4
5
C107
S105
(8W-50-3)
S152
4 C110
5 C110
L4 14 VT/WT
L3 14 RD/OR
G34 14 RD/GY
S155
(8W-40-9)
7 C108
A8 C202
G34 16 RD/GY
3 C1
HIGH BEAM INDICATOR DRIVER
INSTRUMENT CLUSTER
(8W-40-9)
Z1 18 BK
S106
(8W-15-2)
Z1 12 BK
G100
(8W-15-2)
1
2
LEFT HEADLAMP
(8W-50-3)
RIGHT HEADLAMP
(8W-50-3)

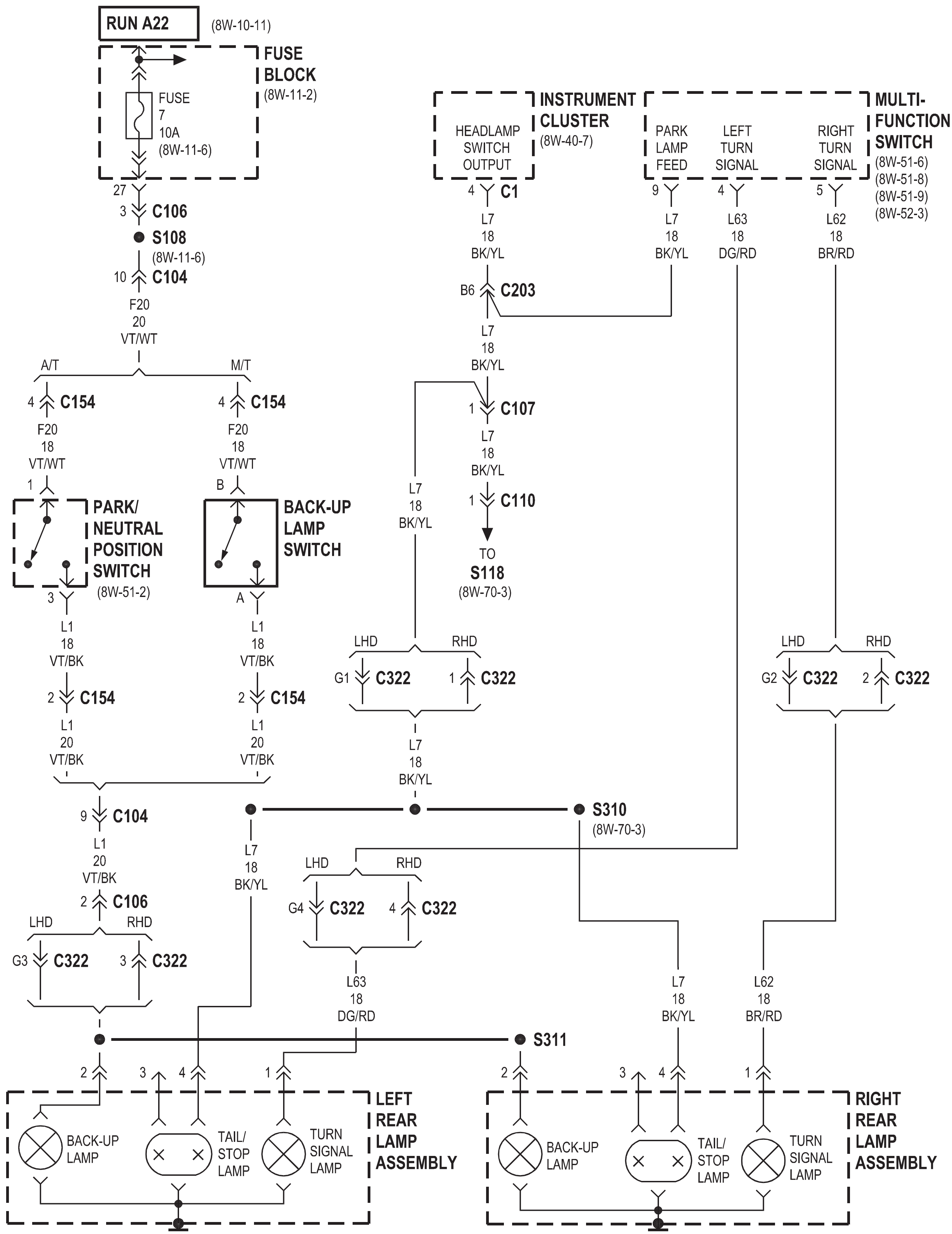
8W-51 REAR LIGHTING

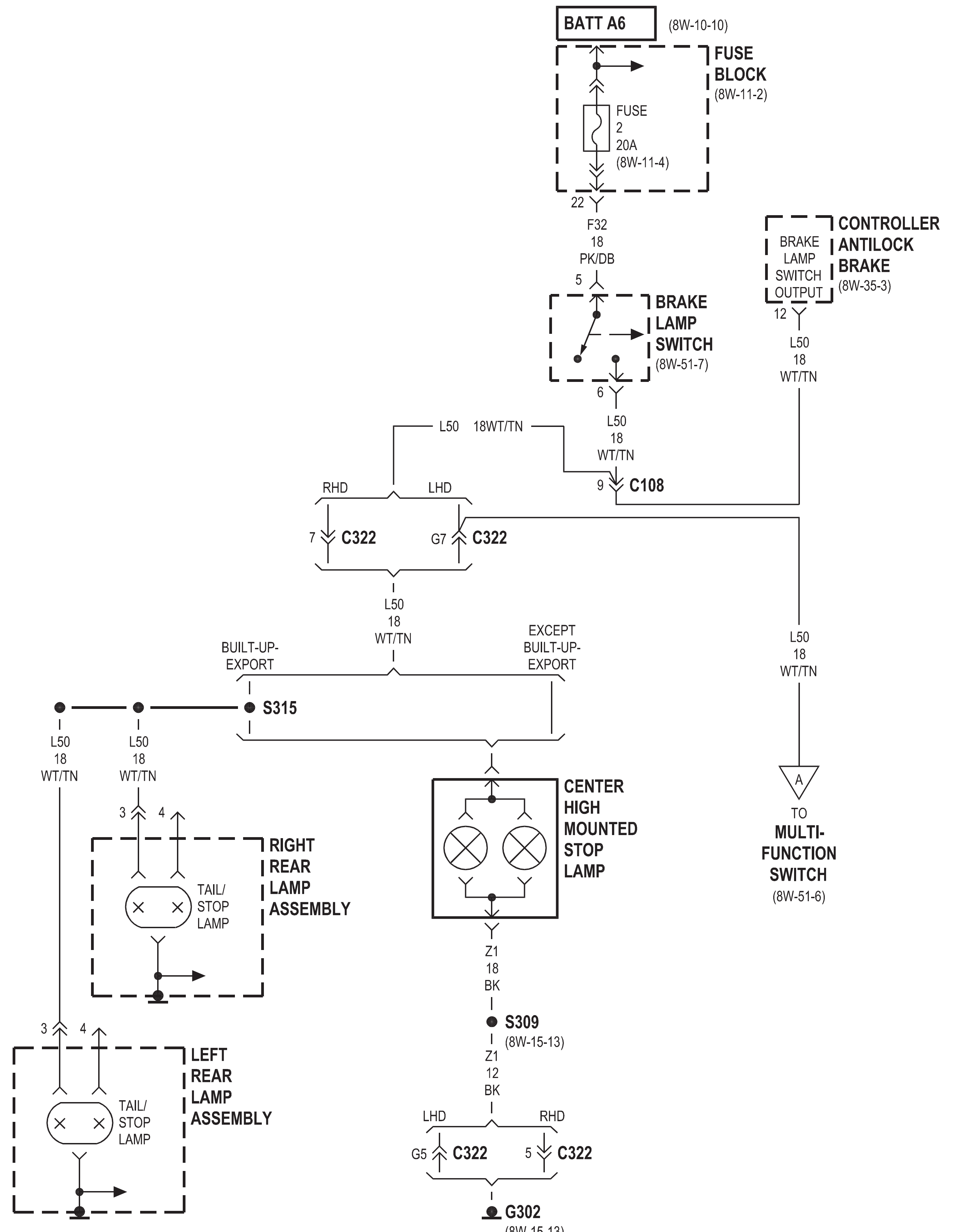
EXCEPT BUILT-UP-EXPORT

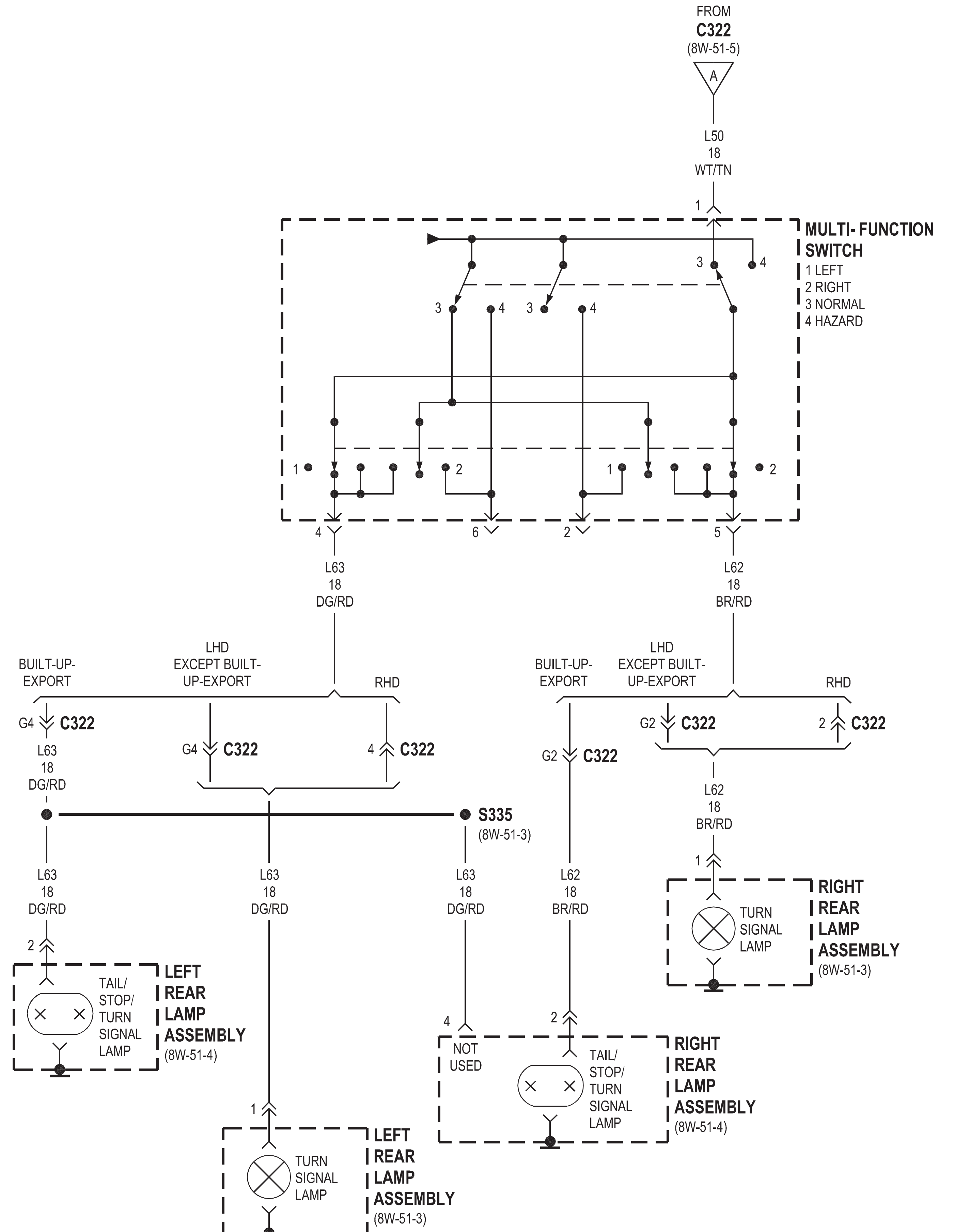



FROM
C322
(8W-51-2)
B
FROM
C322
(8W-51-2)
D
FROM
C322
(8W-51-2)
C
FROM
C322
(8W-51-2)
E
L1
20
VT/BK
L63
18
DG/RD
L7
18
BK/YL
S310
(8W-70-2)
S335
S311
L1
20
VT/BK
L7
18
BK/YL
L63
18
DG/RD
L63
18
DG/RD
L1
20
VT/BK
L7
18
BK/YL
L62
18
BR/RD
1
3
2
4
1
3
2
BACK-UP
LAMP
TAIL/
STOP/
TURN
SIGNAL
LAMP
LEFT
REAR
LAMP
ASSEMBLY
NOT
USED
BACK-UP
LAMP
TAIL/
STOP/
TURN
SIGNAL
LAMP
RIGHT
REAR
LAMP
ASSEMBLY

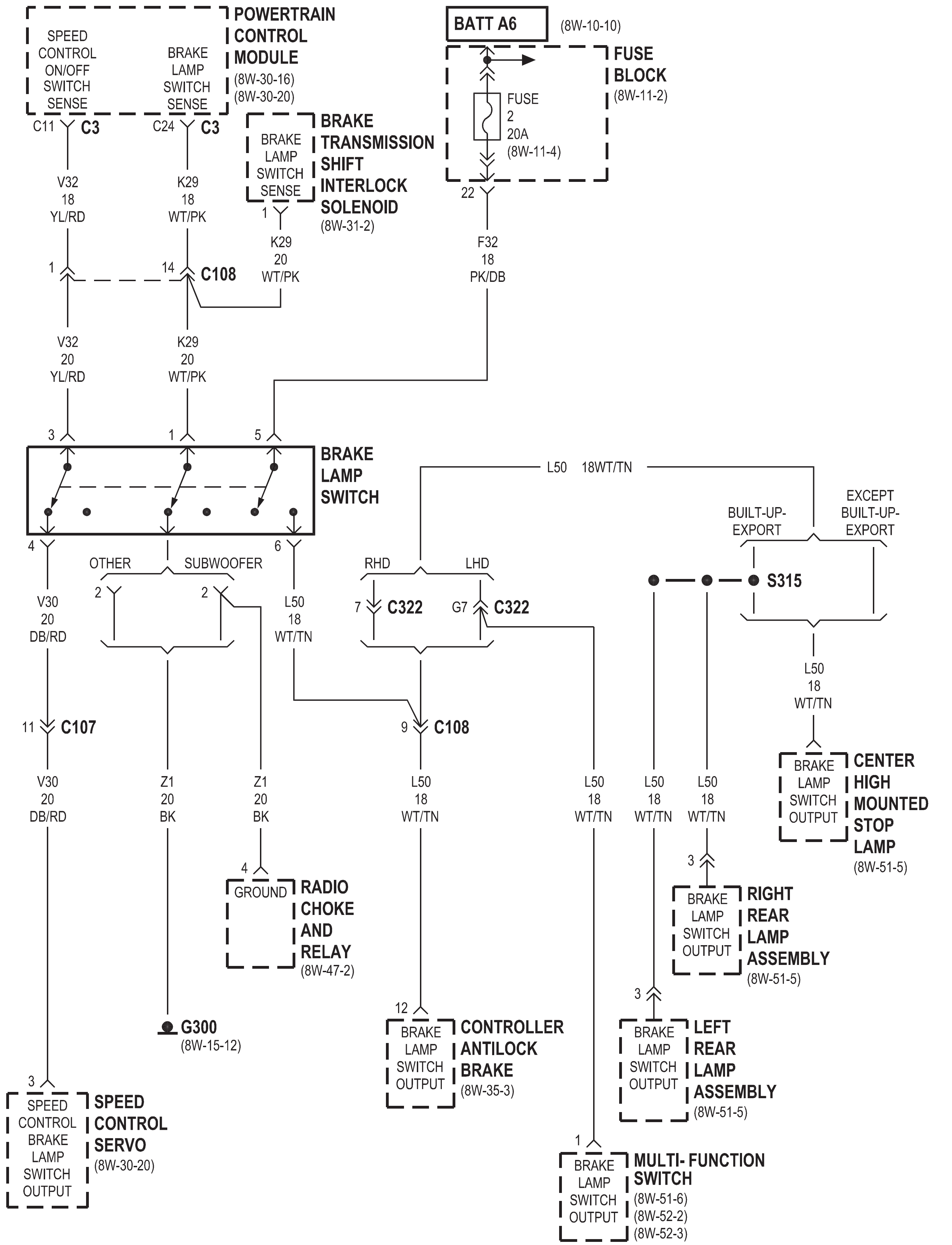
BUILT-UP-EXPORT



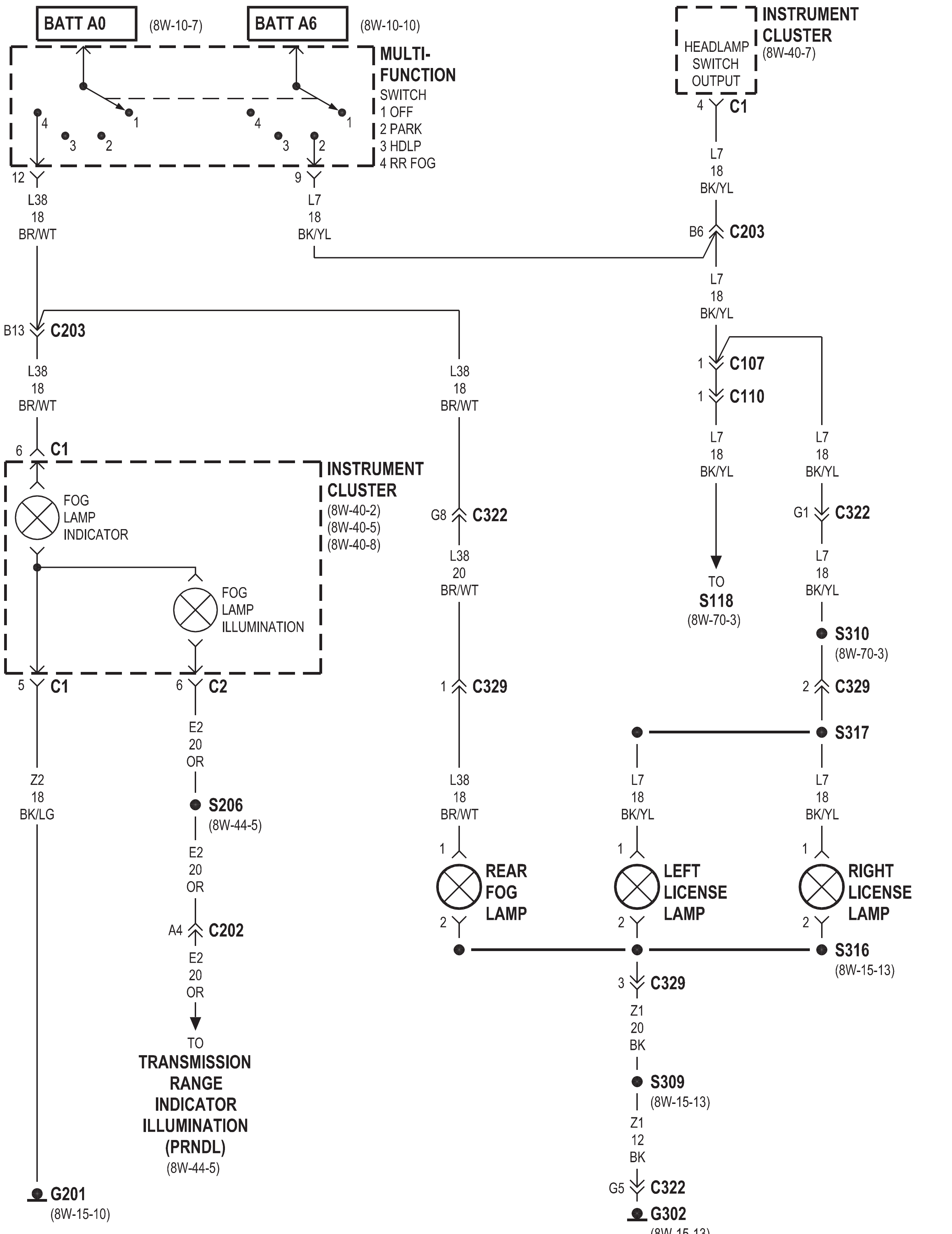

BATT A6
(8W-10-10)
FUSE BLOCK
(8W-11-2)
FUSE 2 20A
(8W-11-4)
22
F32 18 PK/DB
5
BRAKE LAMP SWITCH
(8W-51-7)
6
L50 18 WT/TN
CONTROLLER ANTILOCK BRAKE
(8W-35-3)
BRAKE LAMP SWITCH OUTPUT
12
L50 18 WT/TN
L50 18WT/TN
9 C108
RHD LHD
7 C322
G7 C322
L50 18 WT/TN
BUILT-UP-EXPORT
EXCEPT BUILT-UP-EXPORT
S315
L50 18 WT/TN
L50 18 WT/TN
3 4
RIGHT REAR LAMP ASSEMBLY
TAIL/ STOP LAMP
3 4
LEFT REAR LAMP ASSEMBLY
TAIL/ STOP LAMP
CENTER HIGH MOUNTED STOP LAMP
Z1 18 BK
S309
(8W-15-13)
Z1 12 BK
LHD RHD
G5 C322
5 C322
G302
(8W-15-13)
L50 18 WT/TN
A
TO MULTI-FUNCTION SWITCH
(8W-51-6)

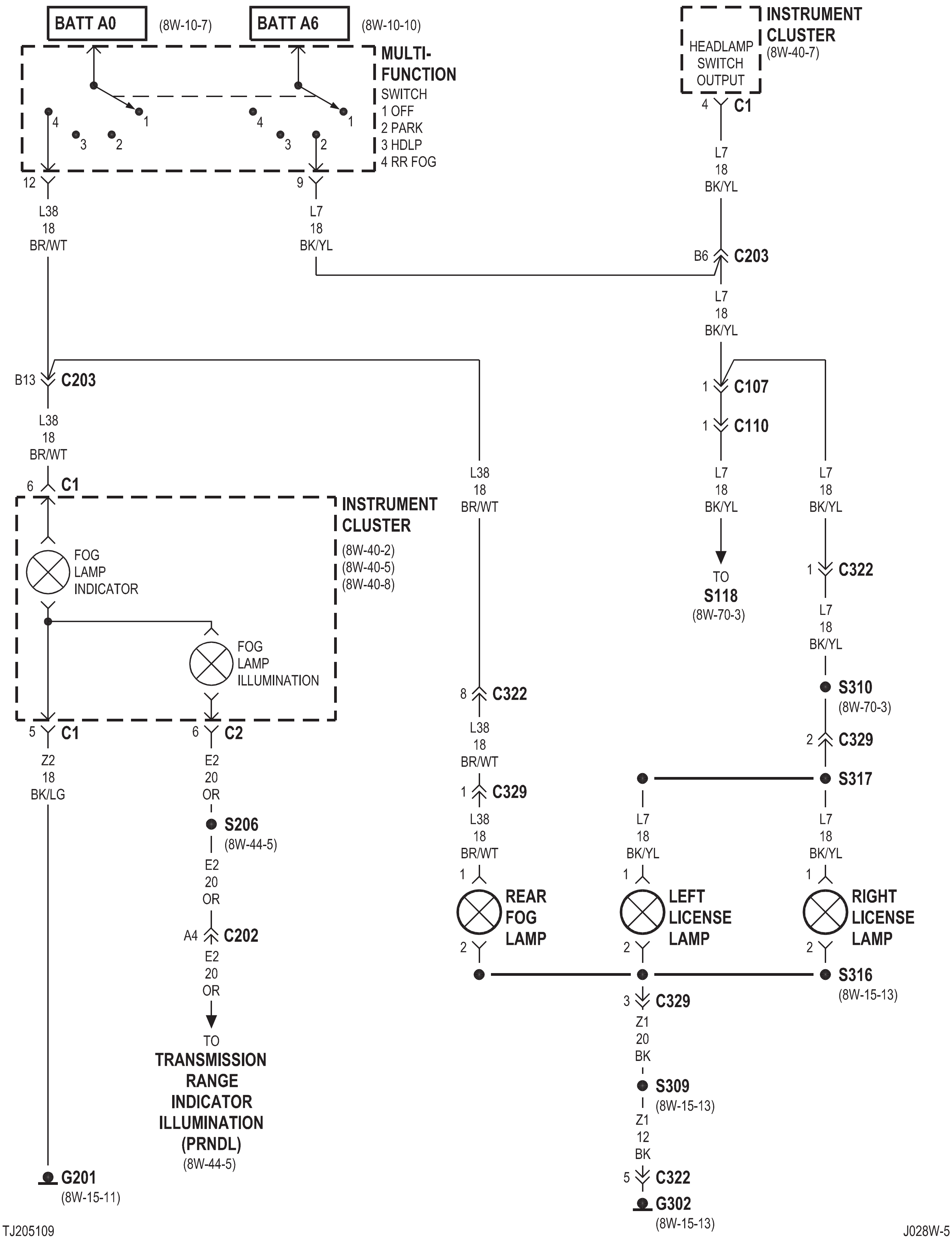


FROM
C322
(8W-51-5)
A
L50
18
WT/TN
1
MULTI- FUNCTION
SWITCH
1 LEFT
2 RIGHT
3 NORMAL
4 HAZARD
3
4
3
4
3
4
1
2
1
2
4
6
2
5
L63
18
DG/RD
L62
18
BR/RD
BUILT-UP-
EXPORT
LHD
EXCEPT BUILT-
UP-EXPORT
RHD
G4
C322
G4
C322
4
C322
BUILT-UP-
EXPORT
LHD
EXCEPT BUILT-
UP-EXPORT
RHD
G2
C322
2
C322
G2
C322
L63
18
DG/RD
L62
18
BR/RD
S335
(8W-51-3)
L63
18
DG/RD
L63
18
DG/RD
L63
18
DG/RD
L62
18
BR/RD
1
TURN
SIGNAL
LAMP
RIGHT
REAR
LAMP
ASSEMBLY
(8W-51-3)
2
TAIL/
STOP/
TURN
SIGNAL
LAMP
LEFT
REAR
LAMP
ASSEMBLY
(8W-51-4)
4
NOT
USED
2
TAIL/
STOP/
TURN
SIGNAL
LAMP
RIGHT
REAR
LAMP
ASSEMBLY
(8W-51-4)
1
TURN
SIGNAL
LAMP
LEFT
REAR
LAMP
ASSEMBLY
(8W-51-3)



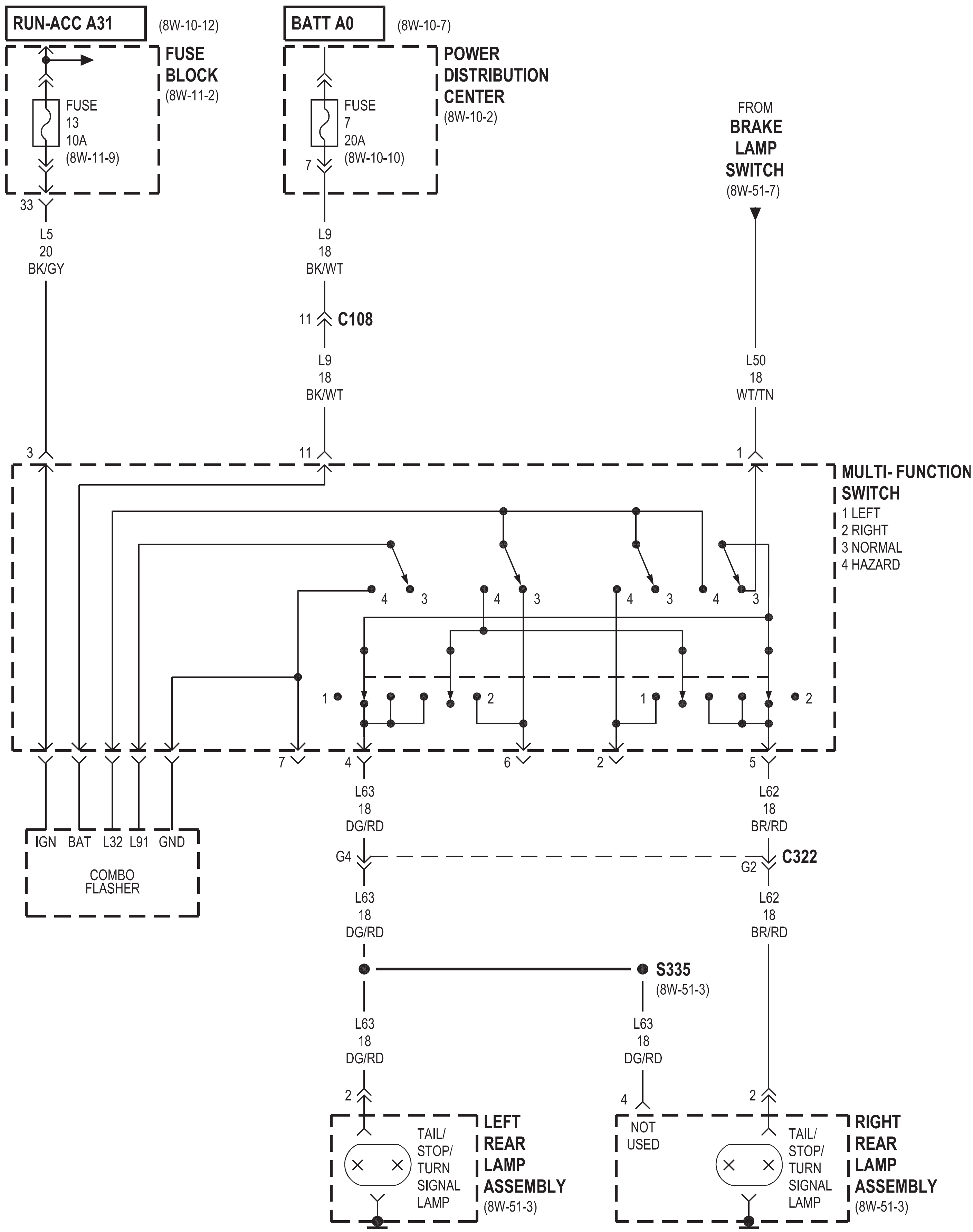
POWERTRAIN CONTROL MODULE
(8W-30-16)
(8W-30-20)
SPEED CONTROL ON/OFF SWITCH SENSE
BRAKE LAMP SWITCH SENSE
C11 C3
C24 C3
V32 18 YL/RD
K29 18 WT/PK
BATT A6
(8W-10-10)
FUSE BLOCK
(8W-11-2)
FUSE 2 20A
(8W-11-4)
22
F32 18 PK/DB
BRAKE TRANSMISSION SHIFT INTERLOCK SOLENOID
(8W-31-2)
BRAKE LAMP SWITCH SENSE
1
K29 20 WT/PK
1
14
C108
V32 20 YL/RD
K29 20 WT/PK
3
1
5
BRAKE LAMP SWITCH
4
6
L50 18WT/TN
OTHER
SUBWOOFER
2
2
V30 20 DB/RD
L50 18 WT/TN
RHD
LHD
7
C322
G7
C322
BUILT-UP-EXPORT
EXCEPT BUILT-UP-EXPORT
S315
11
C107
9
C108
L50 18 WT/TN
V30 20 DB/RD
Z1 20 BK
Z1 20 BK
L50 18 WT/TN
L50 18 WT/TN
L50 18 WT/TN
L50 18 WT/TN
4
GROUND
RADIO CHOKE AND RELAY
(8W-47-2)
CENTER HIGH MOUNTED STOP LAMP
(8W-51-5)
BRAKE LAMP SWITCH OUTPUT
3
RIGHT REAR LAMP ASSEMBLY
(8W-51-5)
BRAKE LAMP SWITCH OUTPUT
3
LEFT REAR LAMP ASSEMBLY
(8W-51-5)
BRAKE LAMP SWITCH OUTPUT
12
CONTROLLER ANTILOCK BRAKE
(8W-35-3)
BRAKE LAMP SWITCH OUTPUT
G300
(8W-15-12)
3
SPEED CONTROL SERVO
(8W-30-20)
SPEED CONTROL BRAKE LAMP SWITCH OUTPUT
1
MULTI- FUNCTION SWITCH
(8W-51-6)
(8W-52-2)
(8W-52-3)
BRAKE LAMP SWITCH OUTPUT

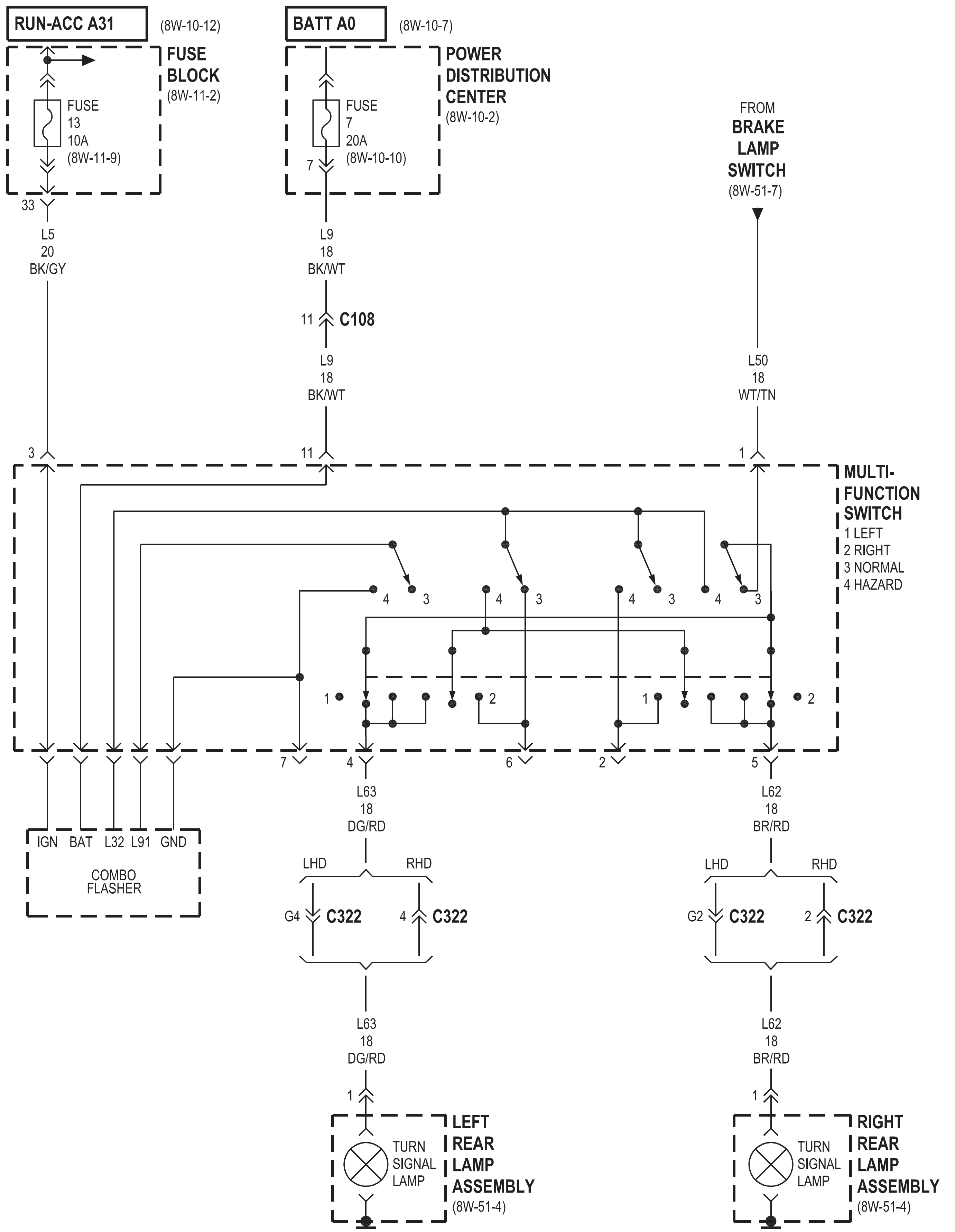

BATT A0
(8W-10-7)
BATT A6
(8W-10-10)
MULTI-
FUNCTION
SWITCH
1 OFF
2 PARK
3 HDLP
4 RR FOG
INSTRUMENT
CLUSTER
(8W-40-7)
HEADLAMP
SWITCH
OUTPUT
C1
L7
18
BK/YL
C203
L38
18
BR/WT
C1
INSTRUMENT
CLUSTER
(8W-40-2)
(8W-40-5)
(8W-40-8)
FOG
LAMP
INDICATOR
FOG
LAMP
ILLUMINATION
C2
Z2
18
BK/LG
E2
20
OR
S206
(8W-44-5)
C202
TO
TRANSMISSION
RANGE
INDICATOR
ILLUMINATION
(PRNDL)
(8W-44-5)
G201
(8W-15-10)
C107
C110
TO
S118
(8W-70-3)
C322
L38
20
BR/WT
S310
(8W-70-3)
C329
S317
REAR
FOG
LAMP
LEFT
LICENSE
LAMP
RIGHT
LICENSE
LAMP
S316
(8W-15-13)
Z1
20
BK
S309
(8W-15-13)
Z1
12
BK
G302
(8W-15-13)

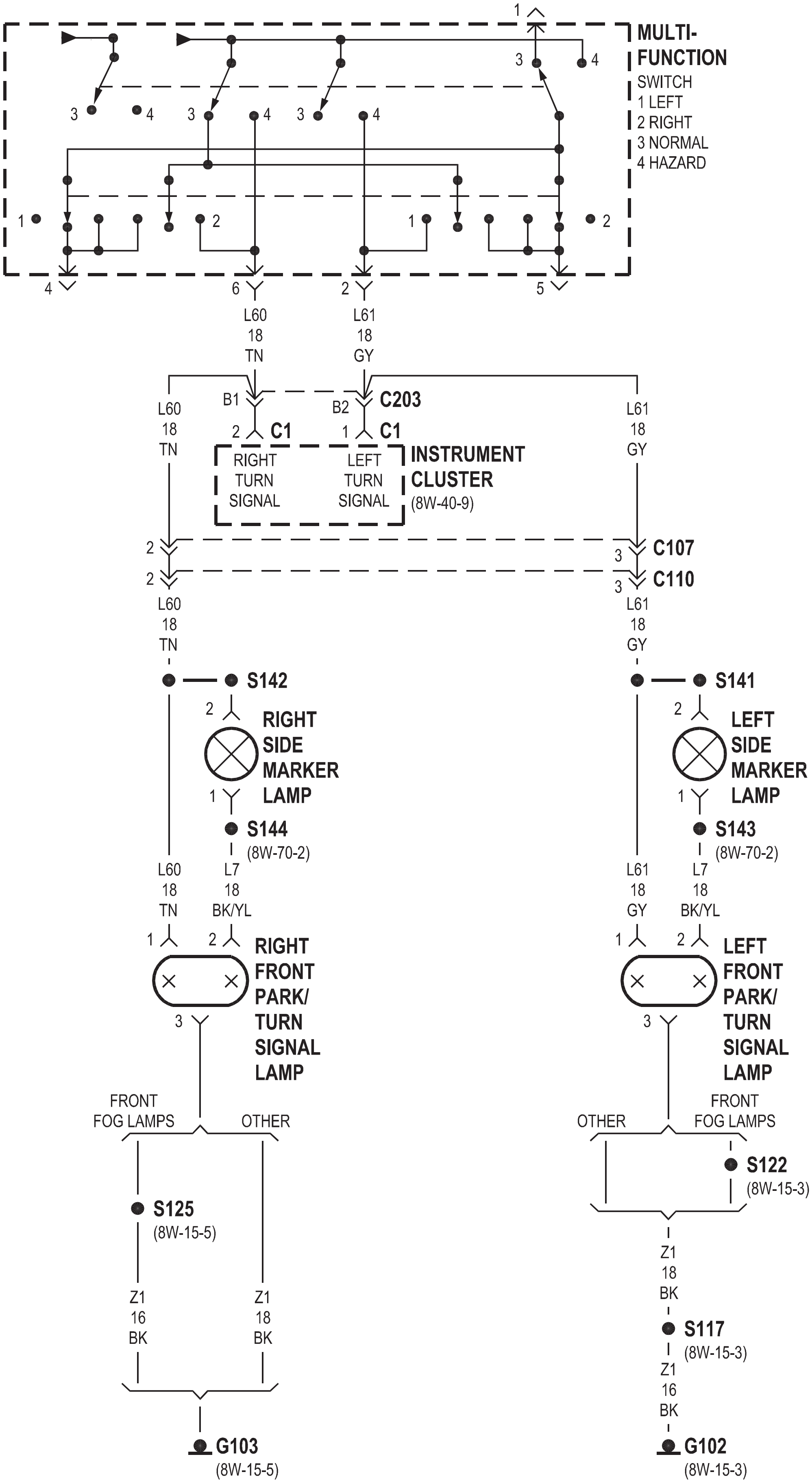

BATT A0
(8W-10-7)
BATT A6
(8W-10-10)
MULTI-FUNCTION SWITCH
1 OFF
2 PARK
3 HDLP
4 RR FOG
INSTRUMENT CLUSTER
(8W-40-7)
HEADLAMP SWITCH OUTPUT
C1
L38 18 BR/WT
L7 18 BK/YL
C203
C107
C110
C1
INSTRUMENT CLUSTER
(8W-40-2)
(8W-40-5)
(8W-40-8)
FOG LAMP INDICATOR
FOG LAMP ILLUMINATION
C2
Z2 18 BK/LG
E2 20 OR
S206
(8W-44-5)
C202
TO
TRANSMISSION RANGE INDICATOR ILLUMINATION (PRNDL)
(8W-44-5)
G201
(8W-15-11)
C322
C329
TO
S118
(8W-70-3)
S310
(8W-70-3)
S317
REAR FOG LAMP
LEFT LICENSE LAMP
RIGHT LICENSE LAMP
S316
(8W-15-13)
Z1 20 BK
S309
(8W-15-13)
Z1 12 BK
G302
(8W-15-13)

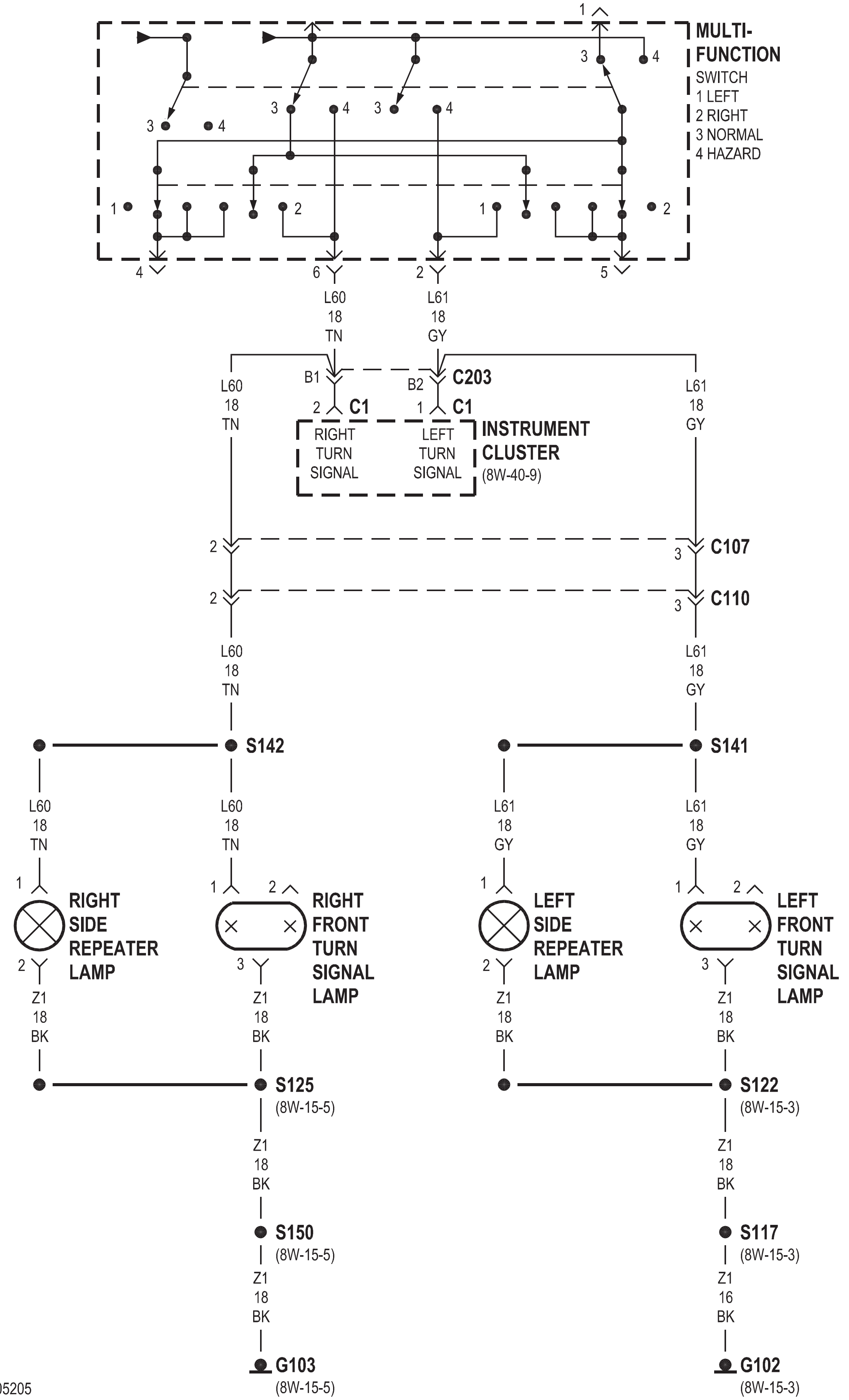
8W-52 TURN SIGNALS

8W-52 TURN SIGNALS EXCEPT BUILT-UP-EXPORT

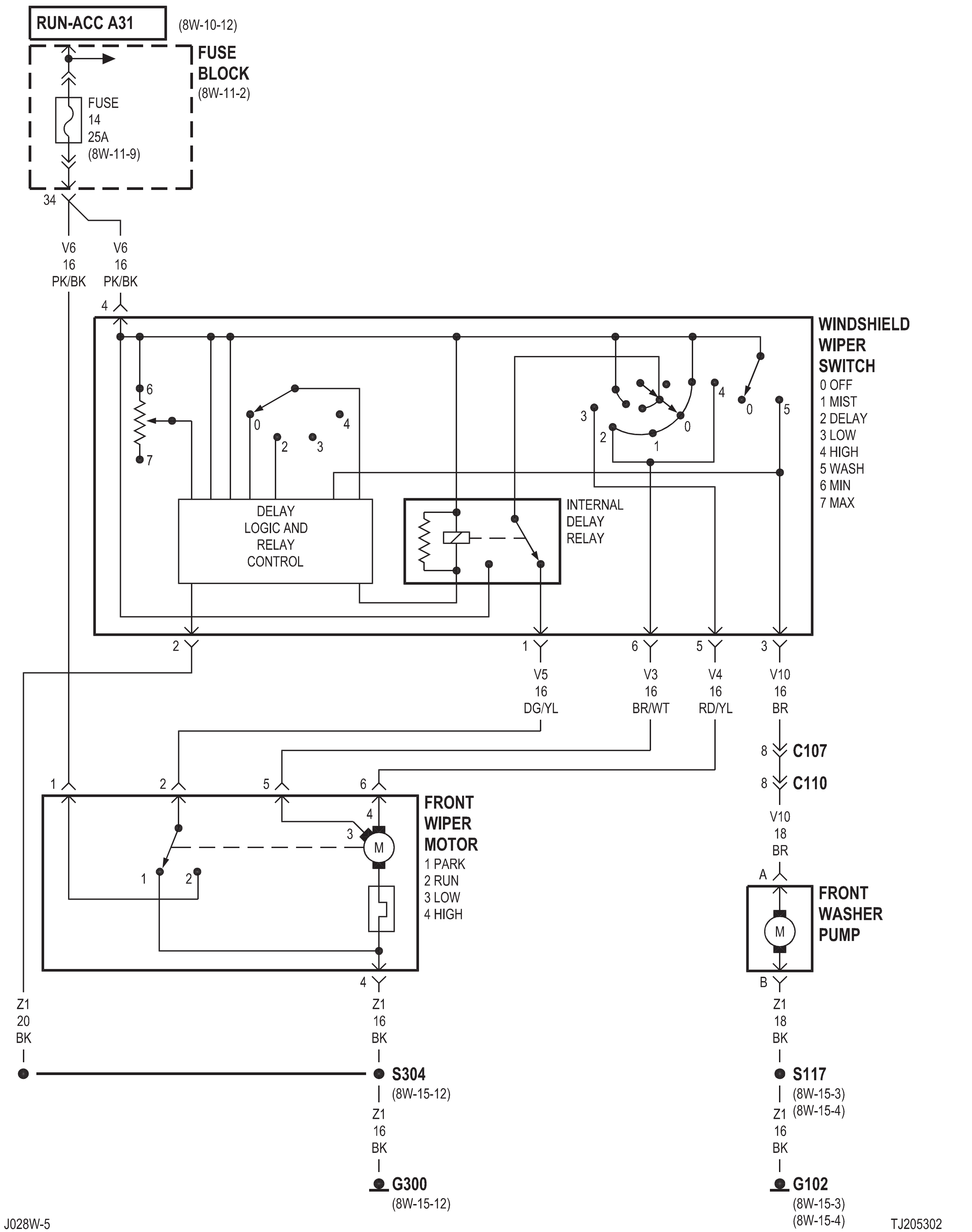


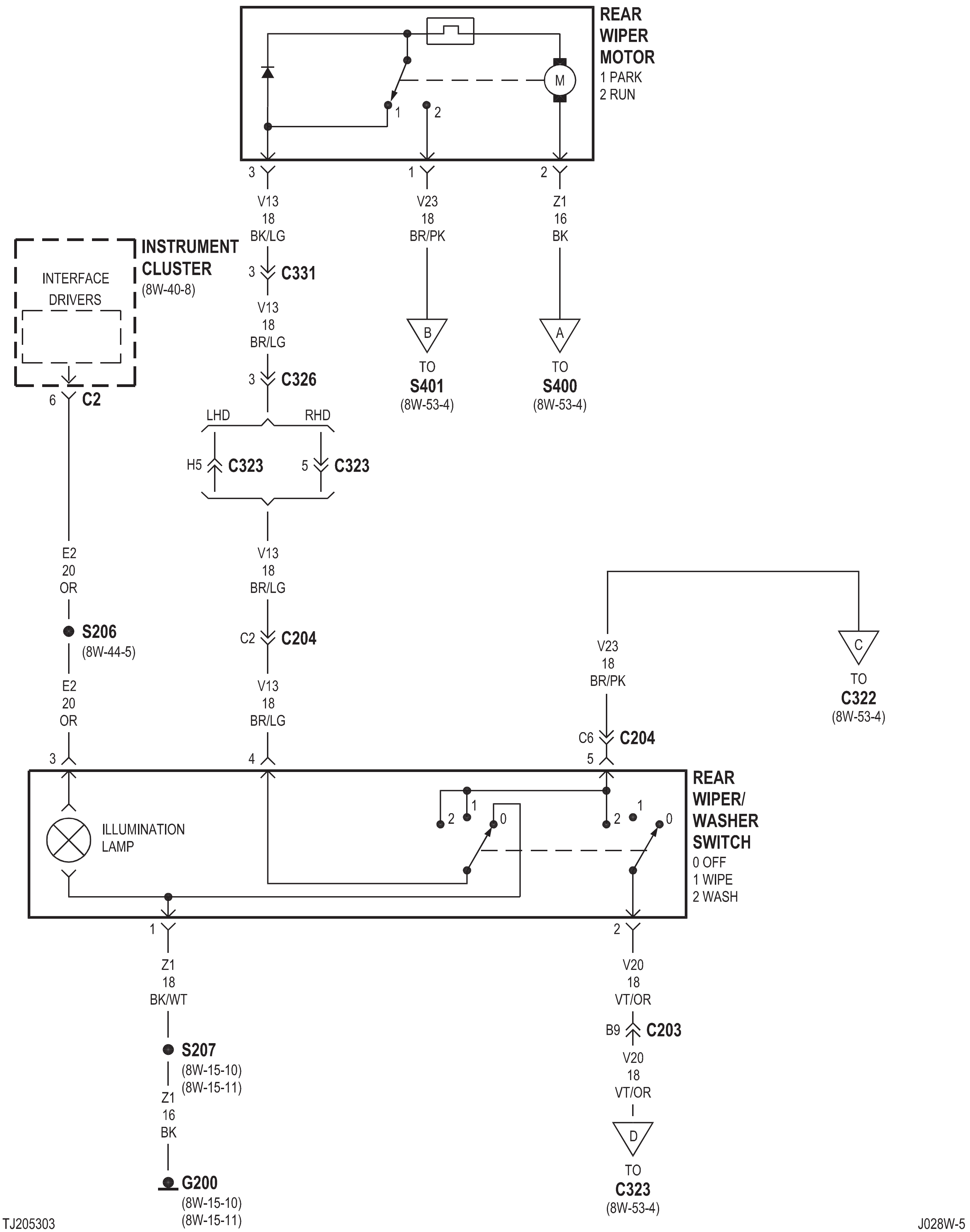

RUN-ACC A31
(8W-10-12)
FUSE BLOCK
(8W-11-2)
FUSE 13 10A (8W-11-9)
33
L5 20 BK/GY
BATT A0
(8W-10-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 7 20A (8W-10-10)
7
L9 18 BK/WT
11 C108
L9 18 BK/WT
FROM BRAKE LAMP SWITCH
(8W-51-7)
L50 18 WT/TN
3
11
1
MULTI-FUNCTION SWITCH
1 LEFT
2 RIGHT
3 NORMAL
4 HAZARD
7
4
6
2
5
IGN BAT L32 L91 GND
COMBO FLASHER
L63 18 DG/RD
LHD RHD
G4 C322
4 C322
L63 18 DG/RD
1
TURN SIGNAL LAMP
LEFT REAR LAMP ASSEMBLY
(8W-51-4)
L62 18 BR/RD
LHD RHD
G2 C322
2 C322
L62 18 BR/RD
1
TURN SIGNAL LAMP
RIGHT REAR LAMP ASSEMBLY
(8W-51-4)


MULTI-
FUNCTION
SWITCH
1 LEFT
2 RIGHT
3 NORMAL
4 HAZARD
L60
18
TN
L61
18
GY
B1
B2
C203
C1
C1
RIGHT
TURN
SIGNAL
LEFT
TURN
SIGNAL
INSTRUMENT
CLUSTER
(8W-40-9)
C107
C110
S142
RIGHT
SIDE
MARKER
LAMP
S144
(8W-70-2)
L7
18
BK/YL
S141
LEFT
SIDE
MARKER
LAMP
S143
(8W-70-2)
RIGHT
FRONT
PARK/
TURN
SIGNAL
LAMP
LEFT
FRONT
PARK/
TURN
SIGNAL
LAMP
FRONT
FOG LAMPS
OTHER
S125
(8W-15-5)
S122
(8W-15-3)
Z1
16
BK
Z1
18
BK
S117
(8W-15-3)
G103
(8W-15-5)
G102
(8W-15-3)

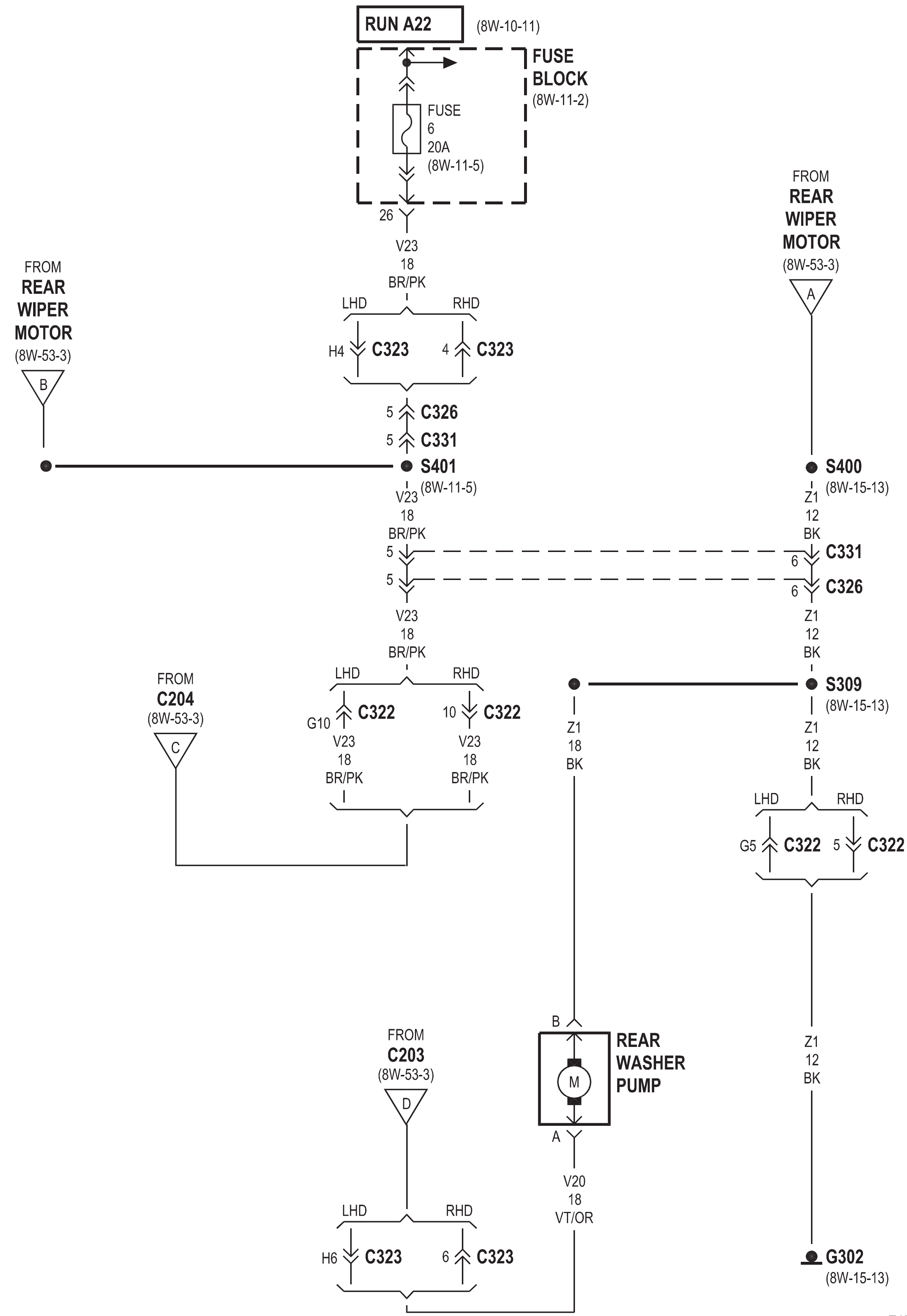

MULTI-
FUNCTION
SWITCH
1 LEFT
2 RIGHT
3 NORMAL
4 HAZARD
L60
18
TN
L61
18
GY
B1
B2
C203
C1
C1
RIGHT
TURN
SIGNAL
LEFT
TURN
SIGNAL
INSTRUMENT
CLUSTER
(8W-40-9)
C107
C110
S142
S141
RIGHT
SIDE
REPEATER
LAMP
RIGHT
FRONT
TURN
SIGNAL
LAMP
LEFT
SIDE
REPEATER
LAMP
LEFT
FRONT
TURN
SIGNAL
LAMP
Z1
18
BK
S125
(8W-15-5)
S122
(8W-15-3)
S150
(8W-15-5)
S117
(8W-15-3)
Z1
16
BK
G103
(8W-15-5)
G102
(8W-15-3)

8W-53 WIPERS


RUN-ACC A31
(8W-10-12)
FUSE
BLOCK
(8W-11-2)
FUSE
14
25A
(8W-11-9)
34
V6
16
PK/BK
V6
16
PK/BK
4
WINDSHIELD
WIPER
SWITCH
0 OFF
1 MIST
2 DELAY
3 LOW
4 HIGH
5 WASH
6 MIN
7 MAX
DELAY
LOGIC AND
RELAY
CONTROL
INTERNAL
DELAY
RELAY
2
1
6
5
3
V5
16
DG/YL
V3
16
BR/WT
V4
16
RD/YL
V10
16
BR
C107
C110
V10
18
BR
A
FRONT
WASHER
PUMP
B
FRONT
WIPER
MOTOR
1 PARK
2 RUN
3 LOW
4 HIGH
Z1
20
BK
Z1
16
BK
Z1
18
BK
S304
(8W-15-12)
Z1
16
BK
G300
(8W-15-12)
S117
(8W-15-3)
(8W-15-4)
Z1
16
BK
G102
(8W-15-3)
(8W-15-4)

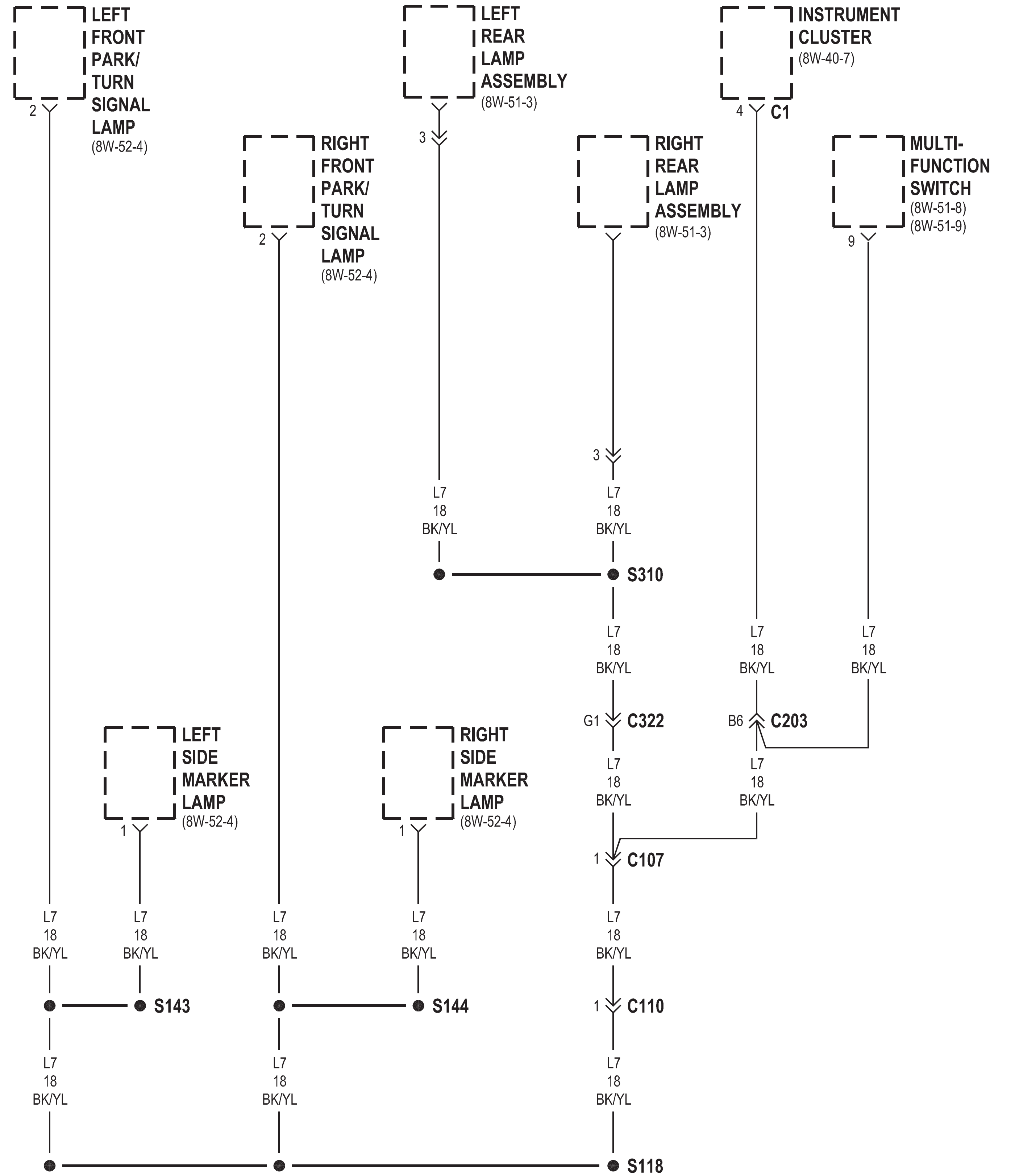

REAR WIPER MOTOR
1 PARK
2 RUN
M
1
2
3
1
2
V13
18
BK/LG
V23
18
BR/PK
Z1
16
BK
INSTRUMENT CLUSTER
(8W-40-8)
INTERFACE DRIVERS
3 C331
V13
18
BR/LG
3 C326
B
TO
S401
(8W-53-4)
A
TO
S400
(8W-53-4)
6 C2
LHD
RHD
H5 C323
5 C323
E2
20
OR
V13
18
BR/LG
S206
(8W-44-5)
C2 C204
E2
20
OR
V13
18
BR/LG
V23
18
BR/PK
C
TO
C322
(8W-53-4)
C6 C204
3
4
5
ILLUMINATION LAMP
REAR WIPER/ WASHER SWITCH
0 OFF
1 WIPE
2 WASH
2
1
0
2
1
0
1
2
Z1
18
BK/WT
V20
18
VT/OR
B9 C203
S207
(8W-15-10)
(8W-15-11)
V20
18
VT/OR
Z1
16
BK
D
TO
C323
(8W-53-4)
G200
(8W-15-10)
(8W-15-11)

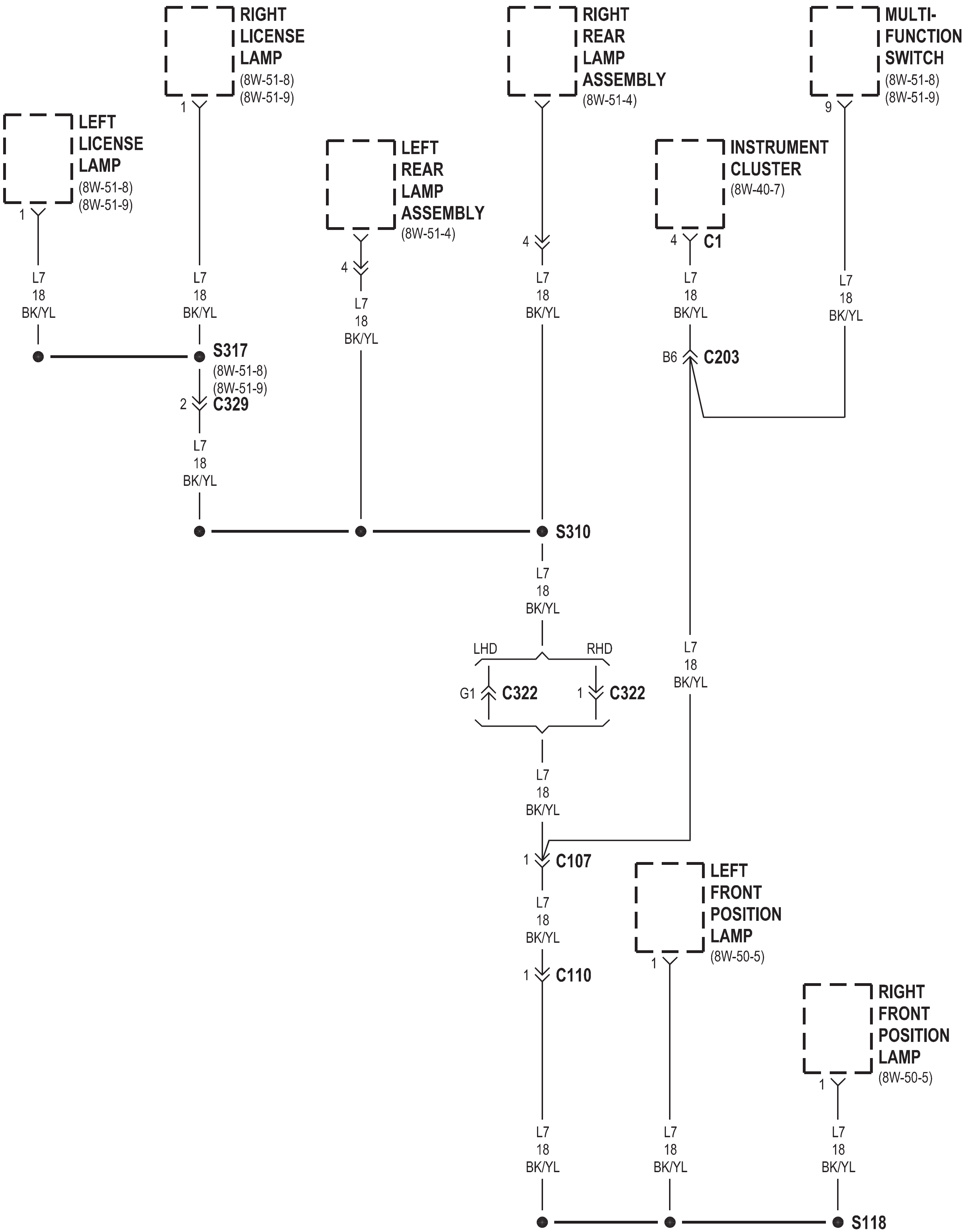
HARD TOP


RUN A22
(8W-10-11)
FUSE
BLOCK
(8W-11-2)
FUSE
6
20A
(8W-11-5)
26
V23
18
BR/PK
LHD
RHD
H4
C323
4
C323
5
C326
5
C331
S401
(8W-11-5)
FROM
REAR
WIPER
MOTOR
(8W-53-3)
B
FROM
REAR
WIPER
MOTOR
(8W-53-3)
A
S400
(8W-15-13)
Z1
12
BK
C331
6
C326
FROM
C204
(8W-53-3)
C
C322
G10
10
S309
Z1
18
BK
G5
5
REAR
WASHER
PUMP
M
FROM
C203
(8W-53-3)
D
H6
6
V20
18
VT/OR
G302
(8W-15-13)

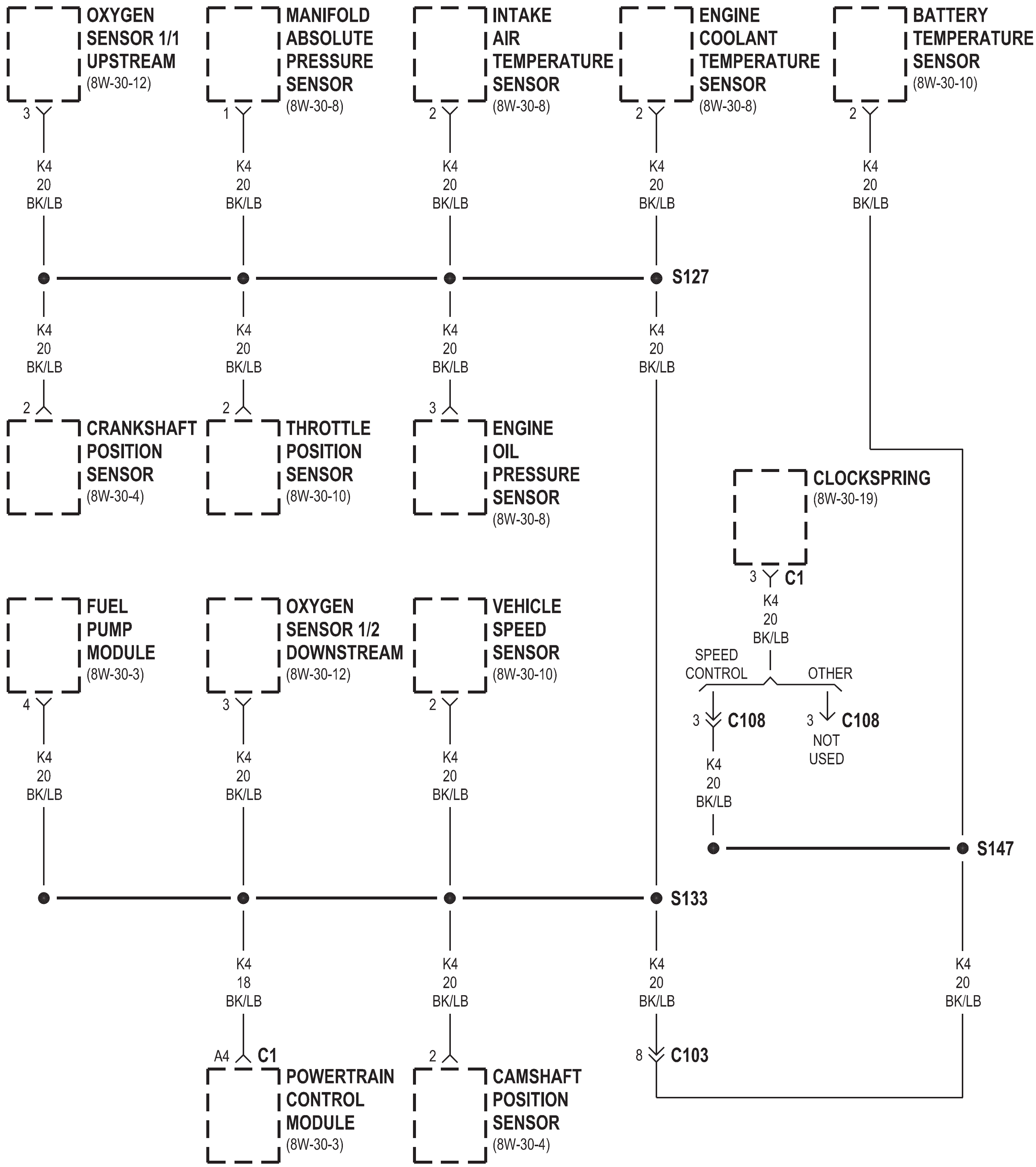
8W-70 SPLICE INFORMATION

EXCEPT BUILT-UP-EXPORT

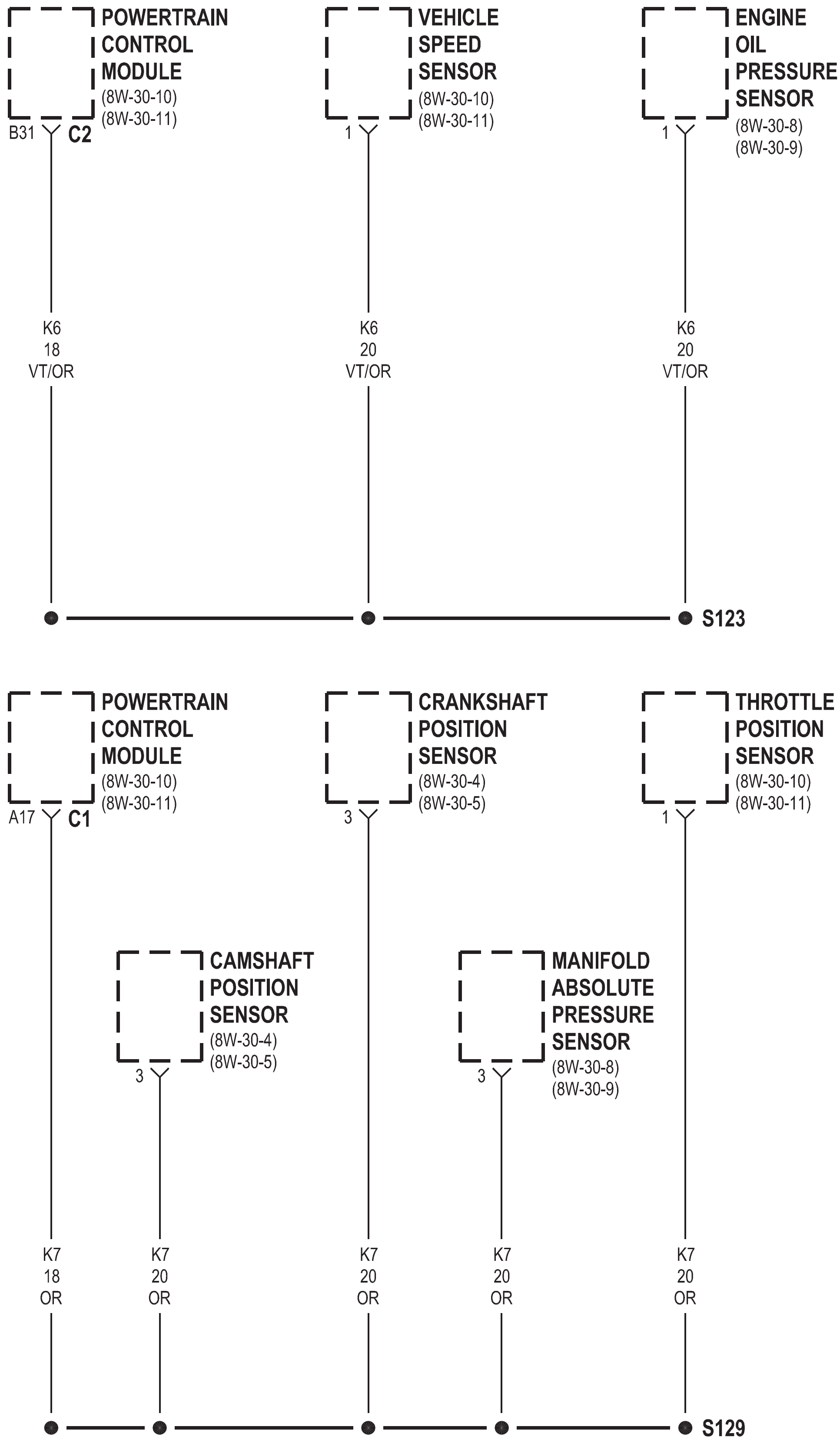



RIGHT LICENSE LAMP (8W-51-8) (8W-51-9)
RIGHT REAR LAMP ASSEMBLY (8W-51-4)
MULTI-FUNCTION SWITCH (8W-51-8) (8W-51-9)
LEFT LICENSE LAMP (8W-51-8) (8W-51-9)
LEFT REAR LAMP ASSEMBLY (8W-51-4)
INSTRUMENT CLUSTER (8W-40-7)
C1
L7 18 BK/YL
S317 (8W-51-8) (8W-51-9)
C329
C203
B6
S310
LHD
RHD
G1
C322
C107
C110
LEFT FRONT POSITION LAMP (8W-50-5)
RIGHT FRONT POSITION LAMP (8W-50-5)
S118

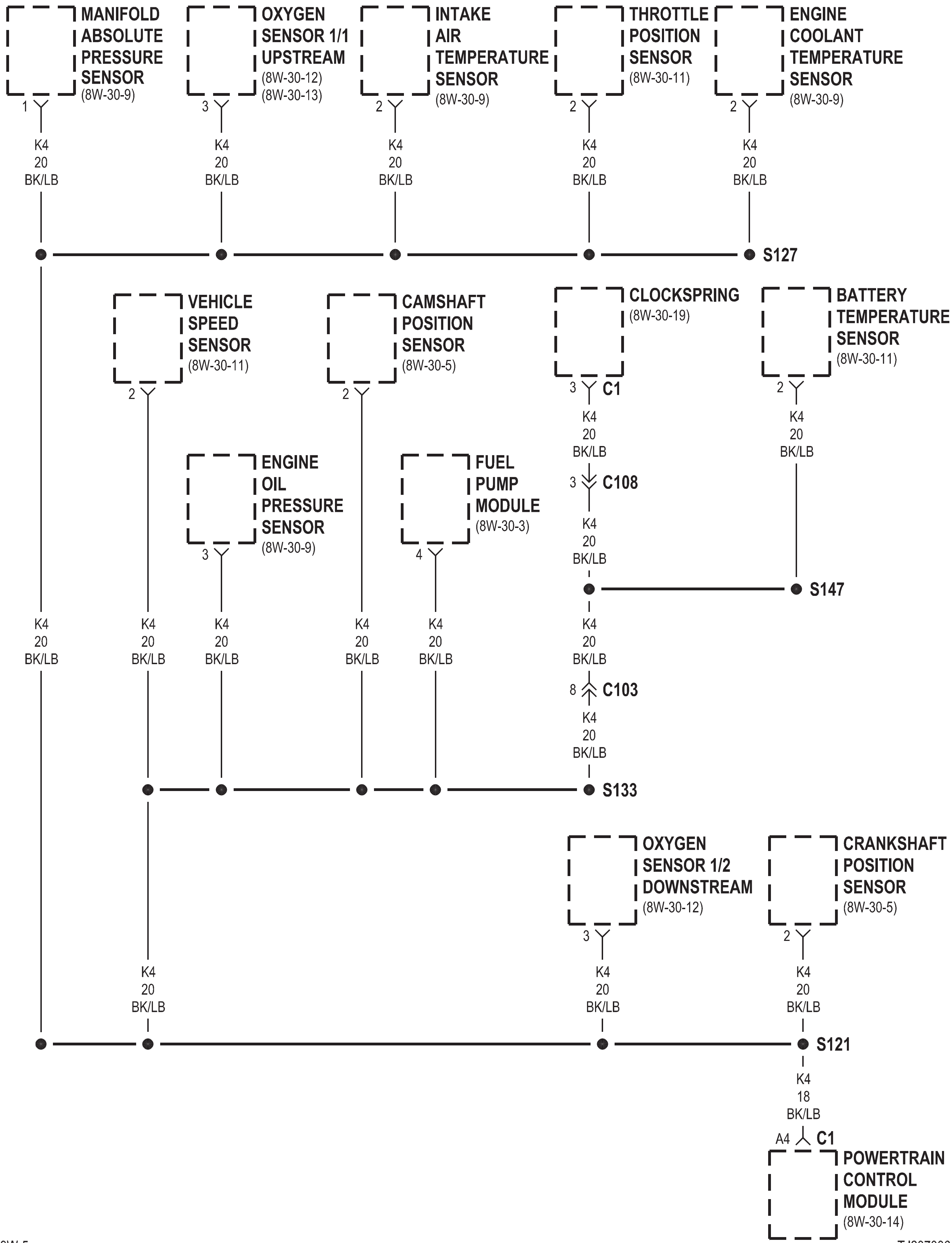
2.5L



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)
K4
20
BK/LB
S127
CRANKSHAFT POSITION SENSOR
(8W-30-4)
THROTTLE POSITION SENSOR
(8W-30-10)
ENGINE OIL PRESSURE SENSOR
(8W-30-8)
CLOCKSPRING
(8W-30-19)
C1
SPEED CONTROL
OTHER
C108
NOT USED
FUEL PUMP MODULE
(8W-30-3)
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-12)
VEHICLE SPEED SENSOR
(8W-30-10)
S147
S133
K4
18
BK/LB
A4
C103
POWERTRAIN CONTROL MODULE
(8W-30-3)
CAMSHAFT POSITION SENSOR
(8W-30-4)

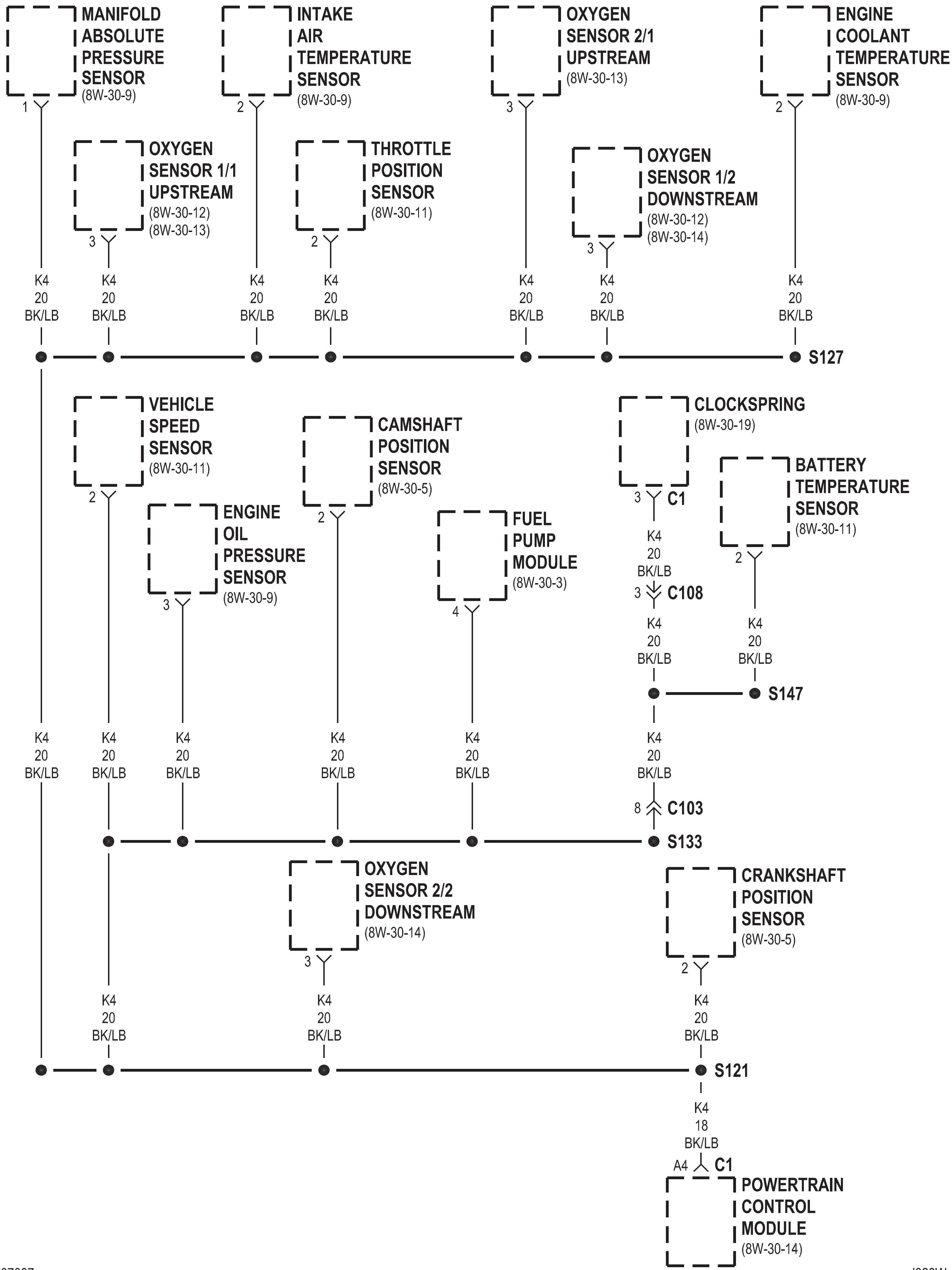

POWERTRAIN CONTROL MODULE
(8W-30-10)
(8W-30-11)
B31
C2
VEHICLE SPEED SENSOR
(8W-30-10)
(8W-30-11)
1
ENGINE OIL PRESSURE SENSOR
(8W-30-8)
(8W-30-9)
1
K6
18
VT/OR
K6
20
VT/OR
K6
20
VT/OR
S123
POWERTRAIN CONTROL MODULE
(8W-30-10)
(8W-30-11)
A17
C1
CRANKSHAFT POSITION SENSOR
(8W-30-4)
(8W-30-5)
3
THROTTLE POSITION SENSOR
(8W-30-10)
(8W-30-11)
1
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



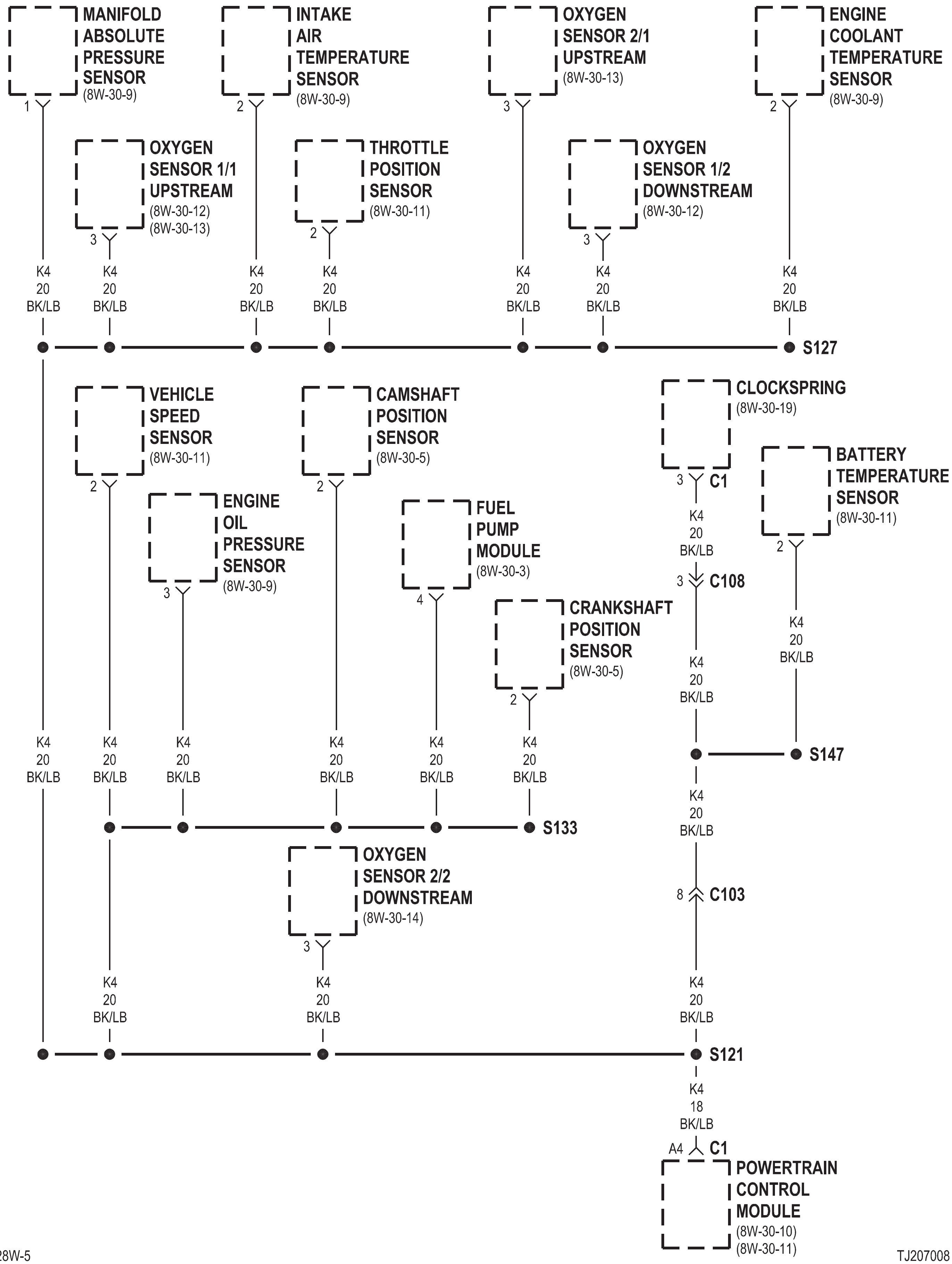
J028W-5 TJ207006

4.0L CALIFORNIA/EUROPEAN III



TJ207007 J028W-5

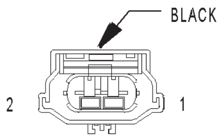
RHD 4.0L BUILT-UP-EXPORT



J028W-5 TJ207008

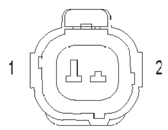
8W-80 CONNECTOR PIN-OUTS

Component	Page



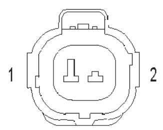
A/C COMPRESSOR CLUTCH - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	C3 20DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
2	Z1 20BK	GROUND



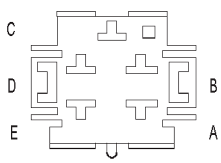
A/C HIGH PRESSURE SWITCH - 2 WAY

CAV	CIRCUIT	FUNCTION
1	C90 20LG	A/C HIGH PRESSURE SWITCH OUTPUT
2	C22 20DB/WT	A/C HIGH PRESSURE SWITCH SENSE



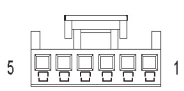
A/C LOW PRESSURE SWITCH - 2 WAY

CAV	CIRCUIT	FUNCTION
1	C21 20DB/OR	A/C SWITCH SENSE
2	C22 20DB/WT	A/C LOW PRESSURE SWITCH SENSE



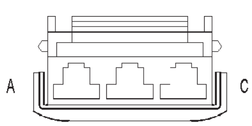
A/C-HEATER CONTROL C1 - 5 WAY

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 18TN	BLOWER MOTOR LOW SPEED
E	C1 12DG	BLOWER MOTOR FEED



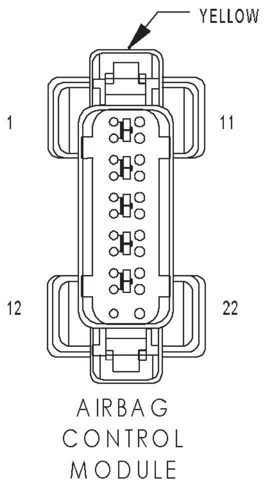
A/C-HEATER CONTROL C2 - 5 WAY

CAV	CIRCUIT	FUNCTION
1	F24 20RD/DG (RHD)	FUSED IGNITION SWITCH OUTPUT (RUN)
1	Z11 20BK/WT (LHD)	GROUND
2	C36 20DB/RD	BLEND DOOR FEEDBACK SIGNAL
3	Z11 20BK/WT (RHD)	GROUND
3	F24 20RD/DG (LHD)	FUSED IGNITION SWITCH OUTPUT (RUN)
4	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
5	Z1 20BK	GROUND



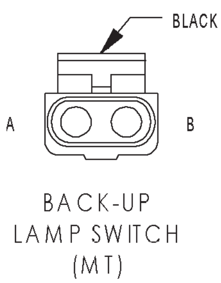
A/C-HEATER CONTROL C3 - 3 WAY

CAV	CIRCUIT	FUNCTION
A	C90 20LG	A/C SELECT INPUT
B	C1 12DG	BLOWER MOTOR FEED
C	Z1 12BK	GROUND



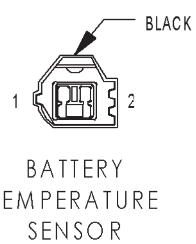
AIRBAG CONTROL MODULE - YELLOW 22 WAY

CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER SQUIB 1 LINE 2
2	R43 18BK/LB	DRIVER SQUIB 1 LINE 1
3	-	-
4	-	-
5	R42 18BK/YL	PASSENGER SQUIB 1 LINE 1
6	R44 18DG/YL	PASSENGER SQUIB 1 LINE 2
7	-	-
8	R166 18LG/BR	PASSENGER AIRBAG INDICATOR DRIVER
9	-	-
10	Z6 18BK/PK	GROUND
11	R65 18LG/OR	PASSENGER AIRBAG MUX SWITCH SENSE
12	-	-
13	-	-
14	-	-
15	-	-
16	-	-
17	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
18	D25 18VT/YL	PCI BUS
19	-	-
20	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
21	-	-
22	R66 18LG/DG	PASSENGER AIRBAG MUX SWITCH RETURN



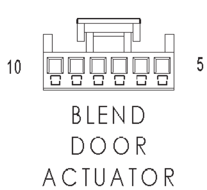
BACK-UP LAMP SWITCH (M/T) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
A	L1 18VT/BK	BACK-UP LAMP FEED
B	F20 18VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)



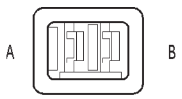
BATTERY TEMPERATURE SENSOR - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
2	K4 20BK/LB	SENSOR GROUND



BLEND DOOR ACTUATOR - 6 WAY

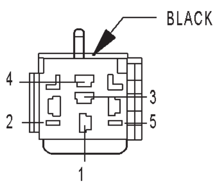
CAV	CIRCUIT	FUNCTION
5	-	-
6	-	-
7	Z11 20DB/WT	GROUND
8	C36 20YL	BLEND DOOR FEEDBACK SIGNAL
9	-	-
10	F24 20OR	FUSED IGNITION SWITCH OUTPUT (RUN)



BLOWER MOTOR

BLOWER MOTOR - 2 WAY

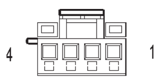
CAV	CIRCUIT	FUNCTION
A	C1 12DG	BLOWER MOTOR RELAY OUTPUT
B	C7 12BK/TN	BLOWER MOTOR HIGH DRIVER



BLOWER MOTOR RELAY

BLOWER MOTOR RELAY - BLACK 5 WAY

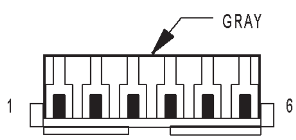
CAV	CIRCUIT	FUNCTION
1	C1 12DG	BLOWER MOTOR RELAY OUTPUT
2	Z1 20BK	GROUND
3	-	-
4	A111 12RD/LG	FUSED B(+)
5	F24 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)



BLOWER MOTOR RESISTOR BLOCK

BLOWER MOTOR RESISTOR BLOCK - 4 WAY

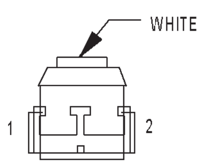
CAV	CIRCUIT	FUNCTION
1	C4 14TN	BLOWER MOTOR LOW DRIVER
2	C5 14LG	BLOWER MOTOR M1 DRIVER
3	C6 14LB	BLOWER MOTOR M2 DRIVER
4	C7 12BK/TN	BLOWER MOTOR HIGH DRIVER



BRAKE LAMP SWITCH

BRAKE LAMP SWITCH - GRAY 6 WAY

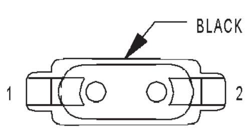
CAV	CIRCUIT	FUNCTION
1	K29 20WT/PK	BRAKE LAMP SWITCH SENSE
2	Z1 20 BK (SUBWOOFER)	GROUND
2	Z1 20BK	GROUND
3	V32 20YL/RD	SPEED CONTROL ON/OFF SWITCH SENSE
4	V30 20DB/RD	SPEED CONTROL BRAKE LAMP SWITCH OUTPUT
5	F32 18PK/DB	FUSED B(+)
6	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT



BRAKE TRANSMISSION SHIFT INTERLOCK SOLENOID

BRAKE TRANSMISSION SHIFT INTERLOCK SOLENOID - WHITE 2 WAY

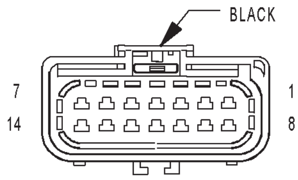
CAV	CIRCUIT	FUNCTION
1	K29 20WT/PK	BRAKE LAMP SWITCH SENSE
2	G5 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)



BRAKE WARNING INDICATOR SWITCH

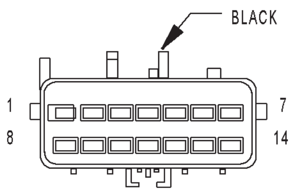
BRAKE WARNING INDICATOR SWITCH - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	G9 20GY/BK	BRAKE WARNING INDICATOR DRIVER
2	G99 20GY/WT	BRAKE WARNING INDICATOR DRIVER



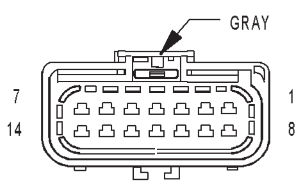
C103 - BLACK (DASH SIDE)

CAV	CIRCUIT
1	F142 18OR/DG
2	K125 18WT/DB
3	A14 14RD/WT
4	K99 18BR/OR
5	K299 18BR/WT
6	K226 18DB/LG
7	A141 18DG/WT
8	K4 20BK/LB
9	F12 20RD/LG
10	Z12 20BK/TN
11	Z12 20BK/LB
12	G7 20WT/OR (DRL) (CANADA)
13	G107 20BK/RD
14	C3 20DB/BK



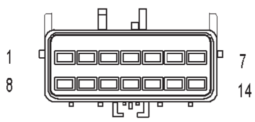
C103 - BLACK (ENGINE SIDE)

CAV	CIRCUIT
1	F142 18OR/DG
2	K125 18WT/DB
3	A14 14RD/WT
4	K99 18BR/OR
5	K299 18BR/WT
6	K226 20DB/LG
7	A141 18DG/WT
8	K4 20BK/LB
9	F12 20RD/LG
10	Z12 20BK/TN
11	Z12 20BK/LB
12	G7 20WT/OR (DRL)
13	G107 20BK/RD
14	C3 20DB/BK



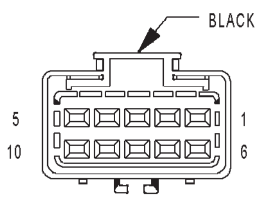
C104 (LHD) - GRAY (DASH SIDE)

CAV	CIRCUIT
1	C90 20LG
2	C21 18DB/OR
3	B1 18YL/DB (ABS)
4	B2 18YL (ABS)
5	T41 20BR/LB
6	B3 18LG/DB (ABS)
7	B4 18LG (ABS)
8	-
9	L1 20VT/BK
10	F20 20VT/WT
11	F42 18DG/LG
12	T40 12BR
13	F15 20DB
14	A242 18VT/OR (4.0L CALIFORNIA)



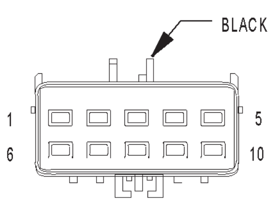
C104 (LHD) - (ENGINE SIDE)

CAV	CIRCUIT
1	C90 20LG
2	C21 20DB/OR
3	B1 18YL/DB (ABS)
4	B2 18YL (ABS)
5	T41 20BR/LB
6	B3 18LG/DB (ABS)
7	B4 18LG (ABS)
8	-
9	L1 20VT/BK
10	F20 20VT/WT
11	F42 18DG/LG
12	T40 12BR
13	F15 18DB
14	A242 18VT/OR (4.0L CALIFORNIA)



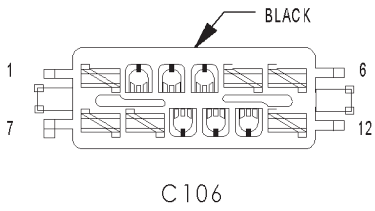
C104 (RHD) - BLACK (DASH SIDE)

CAV	CIRCUIT
1	C90 20LG
2	C21 18DB/OR
3	A42 18DG
4	F42 18DG/LG
5	T41 20BR/LB
6	T40 20BR
7	F15 20DB
8	A242 18VT/OR
9	L1 20VT/BK
10	F20 20VT/WT



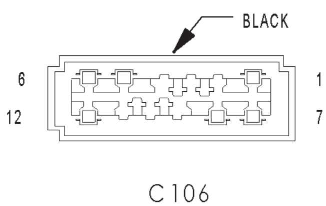
C104 (RHD) - BLACK (ENGINE SIDE)

CAV	CIRCUIT
1	C90 20LG
2	C21 20DB/OR
3	-
4	F42 18DG/LG
5	T41 20BR/LB
6	T40 12BR
7	F15 18DB
8	-
9	L1 20VT/BK
10	F20 20VT/WT



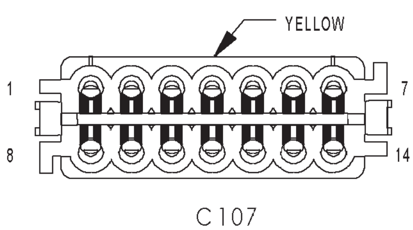
C106 - BLACK (DASH SIDE)

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	A3 12RD/WT



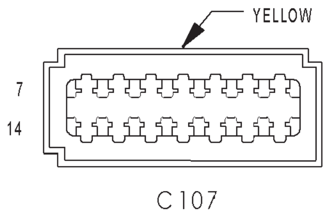
C106 - BLACK (CROSSBODY SIDE)

CAV	CIRCUIT
1	F30 12RD/PK
2	L1 20VT/BK
3	F20 20VT/WT
4	F15 20DB
4	F15 20DB
5	A1 14RD
6	A2 12PK/BK
7	A6 12RD/BK
8	C15 12BK/WT
9	T141 14YL/RD
9	T141 14YL/RD
10	F12 20RD/LG
11	G9 20GY/BK
12	A3 12RD/WT



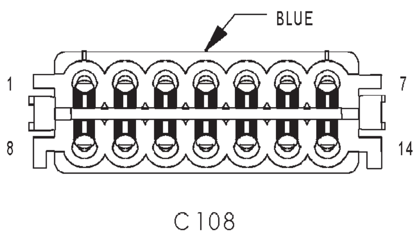
C107 - YELLOW (DASH SIDE)

CAV	CIRCUIT
1	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 16BR
9	Z12 20BK/TN
10	F61 16WT/OR
11	V30 20DB/RD
12	B43 18PK/OR (ABS)
13	D32 18LG
14	D21 20PK (ABS)
14	D21 18PK



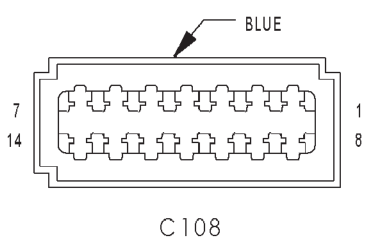
C107 - YELLOW (CROSSBODY SIDE)

CAV	CIRCUIT
1	L7 18BK/YL
1	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 16BR
9	Z12 20BK/TN
10	F61 16WT/OR (LHD)
11	V30 20DB/RD
12	B43 20PK/OR (LHD)
13	D32 20LG
14	D21 20PK



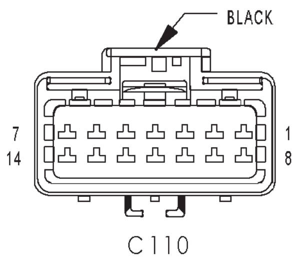
C108 - BLUE (DASH SIDE)

CAV	CIRCUIT
1	V32 18YL/RD
2	B41 18YL/VT
3	K4 20BK/LB
4	F39 16PK/LG
5	B42 18TN/WT
6	D25 18VT/YL
7	L3 14RD/OR (EXCEPT DRL)
7	G34 14RD/GY (DRL)
8	F3 14LB/OR (DRL)
9	L50 18WT/TN (ABS)
10	V37 18RD/LG (SPEED CONTROL)
11	L9 18BK/WT
12	M1 20PK/WT
12	M1 20PK/WT
13	L22 20LG/DG (EXCEPT CANADA)
14	K29 18WT/PK



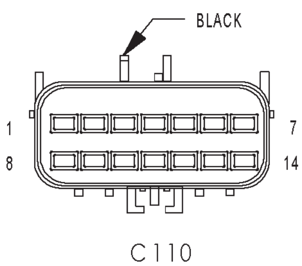
C108 - BLUE (CROSSBODY SIDE)

CAV	CIRCUIT
1	V32 20YL/RD
2	B41 20YL/VT (LHD)
3	K4 20BK/LB
4	F39 16PK/LG
5	B42 20TN/WT (LHD)
6	D25 20VT/YL
6	D25 20VT/YL
7	G34 14RD/GY
8	F3 14LB/OR (DRL)
9	L50 18WT/TN (LHD)
9	L50 18WT/TN (LHD)
10	V37 20RD/LG
11	L9 18BK/WT
12	M1 20PK/WT
12	M1 20PK/WT
13	L22 20LG/DG (EXCEPT CANADA)
14	K29 20WT/PK
14	K29 20WT/PK



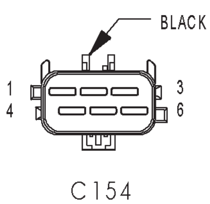
C110 - BLACK (HEADLAMP SIDE)

CAV	CIRCUIT
1	L7 18BK/YL
2	L60 18TN
3	L61 18GY
4	L3 14RD/OR
5	L4 14VT/WT
6	X2 18DG/RD
7	-
8	V10 16BR
9	L22 20LG/DG (BUILT-UP-EXPORT)
10	K52 20PK/BK
11	F12 20RD/LG
12	-
13	L39 16LB (FRONT FOG LAMPS)
14	L13 20BR/YL (BUILT-UP-EXPORT)



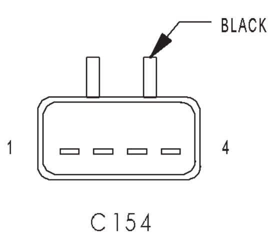
C110 - BLACK (DASH SIDE)

CAV	CIRCUIT
1	L7 18BK/YL
2	L60 18TN
3	L61 18GY
4	L3 14RD/OR
5	L4 14VT/WT
6	X2 18WT/RD
7	-
8	V10 16BR
9	L22 10LG/DG (EXCEPT CANADA)
10	K52 18PK/BK
11	F12 20RD/LG
12	-
13	L39 16LB (FRONT FOG LAMPS)
14	L13 20BR/YL (BUILT-UP-EXPORT)



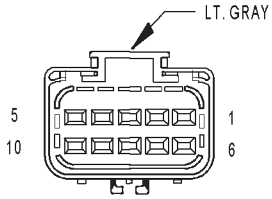
C154 - BLACK (ENGINE SIDE)

CAV	CIRCUIT
1	Z1 20BK
2	L1 20VT/BK
3	T41 20BR/LB
4	F20 20VT/WT



C154 - BLACK (TRANSMISSION SIDE)

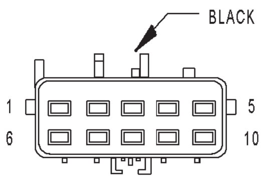
CAV	CIRCUIT
1	Z1 20BK
2	L1 18VT/BK
3	T41 20BR/LB (ATX)
3	Z1 20BK (MTX)
4	F20 18VT/WT



C170

C170 - LT. GRAY (DASH SIDE)

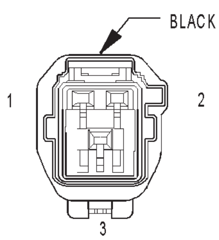
CAV	CIRCUIT
1	L13 20BR/YL (BUILT-UP-EXPORT)
2	C81 20LB/WT
3	G99 20GY/WT
4	-
5	G107 20BK/RD
6	C90 20LG
7	-
8	G19 20LG/OR (ABS)
9	L39 16LB (EXCEPT BUILT-UP-EXPORT)
10	A111 12RD/LB



C170

C170 - BLACK (I/P SIDE)

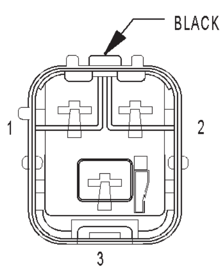
CAV	CIRCUIT
1	L13 20BR/YL (BUILT-UP-EXPORT)
2	C81 20LB/WT (HARD TOP)
3	G99 20GY/WT
4	-
5	G107 20BK/RD
6	C90 20LG
7	-
8	G19 20LG/OR
9	L39 16LB (EXCEPT BUILT-UP-EXPORT)
10	A111 12RD/LB



C180

C180 - (DASH SIDE)

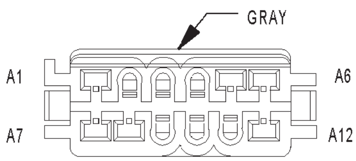
CAV	CIRCUIT
1	K107 18OR
2	K106 18WT/DG
3	K125 20DG/OR



C180

C180 - (LEAK DETECTION PUMP)

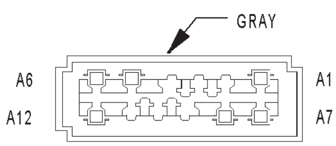
CAV	CIRCUIT
1	K107 20WT/OR
2	K106 20WT/DG
3	K125 20OR/DG



C202

C202 - GRAY (I/P SIDE)

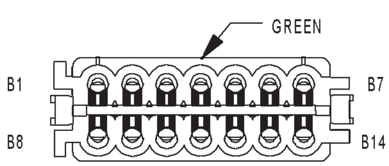
CAV	CIRCUIT
A1	F24 20RD/DG
A1	F24 20RD/DG
A2	G75 20TN
A3	G76 20TN/YL
A4	E2 20OR
A5	-
A6	Z12 20BK/LB
A7	-
A8	G34 16RD/GY
A9	F38 16LB
A10	G5 20DB/WT
A11	-
A12	-



C202

C202 - GRAY (CROSSBODY SIDE)

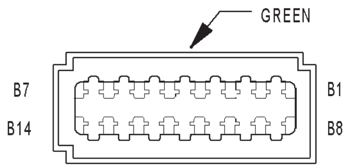
CAV	CIRCUIT
A7	-
A1	F24 20RD/DG
A2	G75 20TN
A3	G76 20TN/YL
A4	E2 20OR
A5	-
A6	Z12 20BK/LB
A6	Z12 20BK/LB
A8	G34 14RD/GY
A9	F38 16LB
A10	G5 20DB/WT
A10	G5 20DB/WT
A11	-
A12	-



C203

C203 - GREEN (I/P SIDE)

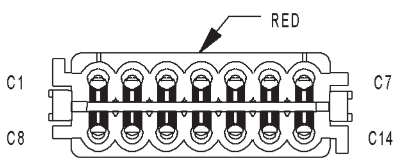
CAV	CIRCUIT
B1	L60 18TN
B2	L61 18GY
B3	G26 20LB
B3	G26 20LB
B4	L50 18WT/TN (LHD)
B5	-
B6	L7 18BK/YL
B7	M1 20PK/WT
B8	D32 20LG
B9	V20 18VT/OR
B10	D21 20PK
B11	-
B12	F81 20DB/RD
B13	L38 18BR/WT (BUILT-UP-EXPORT)
B14	D25 20VT/YL



C203

C203 - GREEN (CROSSBODY SIDE)

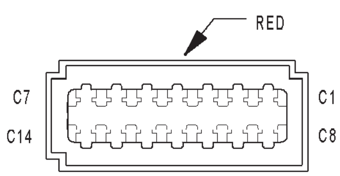
CAV	CIRCUIT
B1	L60 18TN
B1	L60 18TN
B2	L61 18GY
B2	L61 18GY
B3	G26 20LB
B4	L50 18WT/TN (LHD)
B5	-
B6	L7 18BK/YL
B6	L7 18BK/YL
B7	M1 20PK/WT
B8	D32 20LG
B9	V20 18VT/OR
B10	D21 20PK
B11	-
B12	F81 20DB/RD
B13	L38 18BR/WT
B13	L38 18BR/WT
B14	D25 2OVT/YL
B14	D25 18VT/YL



C204

C204 - RED (I/P SIDE)

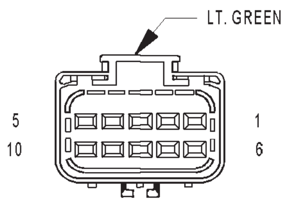
CAV	CIRCUIT
C1	X16 20LG
C2	V13 18BR/LG (HARD TOP)
C3	G10 20LG/RD
C4	Z12 20BK/TN
C5	M2 20YL
C6	V23 18BR/PK
C7	E19 20RD
C8	L50 18 WT/TN (LHD)
C9	L22 20LG/DG (BUILT-UP-EXPORT)
C10	X12 16PK
C11	X51 18BR/YL
C12	X57 18BR/LB
C13	X52 18DB/WT
C14	X58 18DB/PK



C204

C204 - RED (CROSSBODY SIDE)

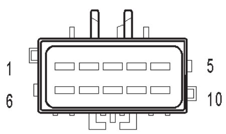
CAV	CIRCUIT
C1	X16 20LG
C2	V13 18BR/LG (HARD TOP)
C3	G10 20LG/RD
C4	Z12 20BK/TN
C5	M2 20YL
C6	V23 18BR/PK
C7	E19 20RD
C8	L50 18WT/TN (LHD)
C9	L22 20LG/DG
C9	L22 20LG/DG
C10	X12 16PK
C11	X51 18BR/YL
C12	X57 18BR/LB
C13	X52 18DB/WT
C14	X58 18DB/PK
C11	X51 18BR/YL
C12	X52 18BK/LB
C13	X52 18DB/WT
C14	X58 18DB/PK



C205

C205 - LT. GREEN (I/P SIDE)

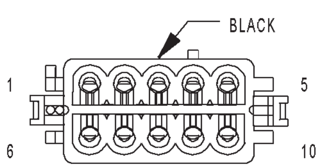
CAV	CIRCUIT
1	Z11 20BK/WT
2	C4 18TN
3	C5 16LG/LB
4	C6 14LB
5	F24 20RD/DG
5	F24 20RD/DG
6	C36 20DB/RD
7	C7 12BR/TN
8	A111 12RD/LB
9	F24 20RD/DG
10	Z1 20BK



C205

C205 - (HVAC SIDE)

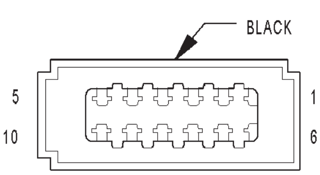
CAV	CIRCUIT
1	Z11 20DB/WT
2	C4 14TN
3	C5 14LG
4	C6 14LB
5	F24 20OR
6	C36 20YL
7	C7 12BK/TN
8	A111 12RD/LG
9	F24 20DB/WT
10	Z1 20BK



C322
(LHD)

C322 (LHD) - BLACK (REAR BODY SIDE)

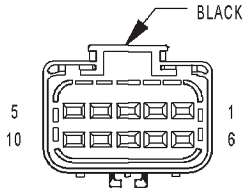
CAV	CIRCUIT
G1	L7 18BK/YL
G2	L62 18BR/RD
G3	L1 20VT/BK
G4	L63 18DG/RD
G5	Z1 12BK
G6	G10 20LG/RD
G7	L50 18WT/TN
G8	-
G9	G9 20GY/BK
G10	V23 18BR/PK (HARD TOP)



C322
(LHD)

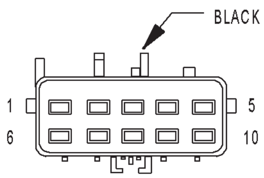
C322 (LHD) - BLACK (CROSSBODY SIDE)

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
G7	L50 18WT/TN
G8	-
G9	G9 20GY/BK
G10	V23 18BR/PK



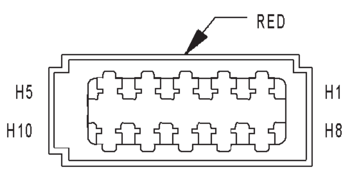
C322 (RHD) - BLACK (REAR BODY SIDE)

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 18BR/WT
9	G9 20GY/BK
10	V23 18BR/PK (HARD TOP)



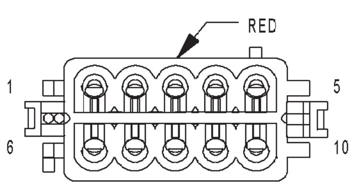
C322 (RHD) - BLACK (CROSSBODY SIDE)

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 18BR/WT
9	G9 20GY/BK
10	V23 18BR/PK (HARD TOP)



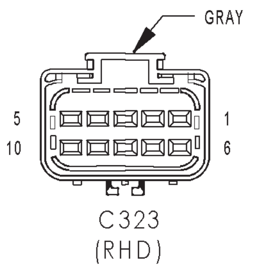
C323 (LHD) - RED (CROSSBODY SIDE)

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



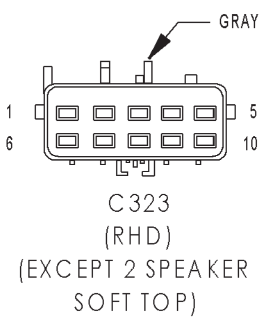
C323 (LHD) (EXCEPT 2 SPEAKER SOFT TOP) -
RED (REAR BODY SIDE)

CAV	CIRCUIT
H1	C15 12BK/WT (HARD TOP)
H2	M1 20PK/WT
H3	M2 20YL
H4	V23 18BR/PK (HARD TOP)
H5	V13 18BR/LG (HARD TOP)
H6	V20 18VT/OR (HARD TOP)
H7	X51 18BR/YL (4 SPEAKER SYSTEM)
H8	X57 18BR/LB (4 SPEAKER SYSTEM)
H9	X52 18DB/WT (4 SPEAKER SYSTEM)
H10	X58 18DB/PK (4 SPEAKER SYSTEM)



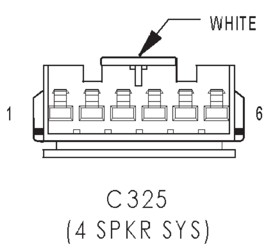
C323 (RHD) - GRAY (REAR BODY SIDE)

CAV	CIRCUIT
1	C15 12BK/WT (HARD TOP)
2	M1 20PK/WT
3	M2 20YL
4	V23 18BR/PK (HARD TOP)
5	V13 18BR/LG (HARD TOP)
6	V20 18VT/OR (HARD TOP)
7	X51 18BR/YL (4 SPEAKER SYSTEM)
8	X57 18BR/YL (4 SPEAKER SYSTEM)
9	X52 18DB/WT (4 SPEAKER SYSTEM)
10	X58 18DB/PK (4 SPEAKER SYSTEM)



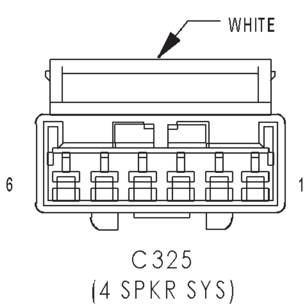
C323 (RHD) (EXCEPT 2 SPEAKER SOFT TOP) - GRAY (CROSSBODY SIDE)

CAV	CIRCUIT
1	C15 12BK/WT (HARD TOP)
2	M1 20PK/WT
3	M2 20YL
4	V23 18BR/PK (HARD TOP)
5	V13 18BR/LG (HARD TOP)
6	V20 18VT/OR (HARD TOP)
7	X51 18BR/YL (4 SPEAKER SYSTEM)
8	X57 18BR/LB (4 SPEAKER SYSTEM)
9	X52 18DB/WT (4SPEAKER SYSTEM)
10	X58 18DB/PK (4 SPEAKER SYSTEM)



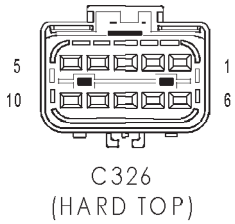
C325 (4 SPKR SYS) - WHITE (REAR BODY)

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



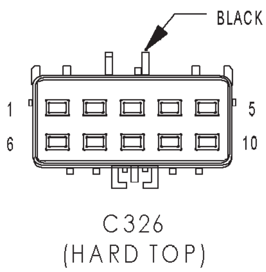
C325 (4 SPKR SYS) - WHITE (SOUND BAR SIDE)

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



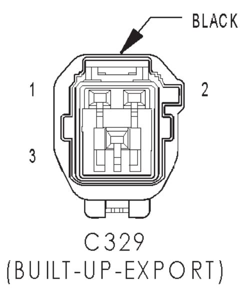
C326 (HARD TOP) - (REAR BODY SIDE)

CAV	CIRCUIT
1	C15 12BK/WT
2	-
3	V13 18BR/LG
4	V23 18BR/PK
5	V23 18BR/PK
6	Z1 12BK
7	-
8	-
9	-
10	-



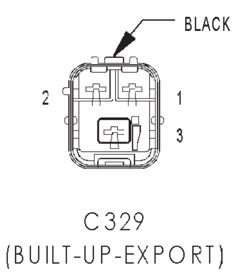
C326 (HARD TOP) - BLACK (HARD TOP SIDE)

CAV	CIRCUIT
1	C15 12BK/WT
2	-
3	V13 18BR/LG
4	V23 18BR/PK
5	V23 18BR/PK
6	Z1 12BK
7	-
8	-
9	-
10	-



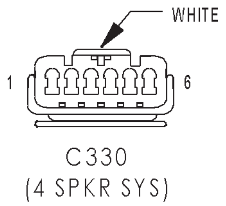
C329 (BUILT-UP-EXPORT) - BLACK (REAR BODY SIDE)

CAV	CIRCUIT
1	L38 18BR/WT
2	L7 18BK/YL
3	Z1 20BK



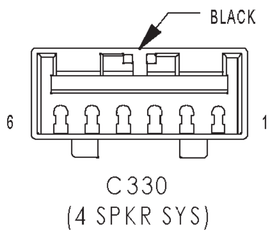
C329 (BUILT-UP-EXPORT) - BLACK (BUMPER SIDE)

CAV	CIRCUIT
1	L38 18BR/WT
2	L7 18BK/YL
3	Z1 20BK



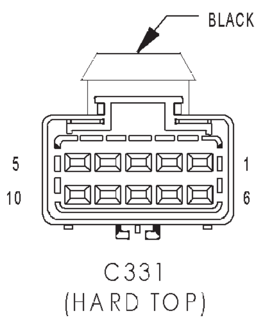
C330 (4 SPKR SYS) - WHITE (SOUND BAR JUMPER SIDE)

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



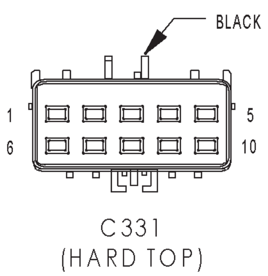
C330 (4 SPKR SYS) - BLACK (SOUND BAR SIDE)

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



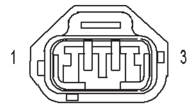
C331 (HARD TOP) - BLACK (HARD TOP JUMPER SIDE)

CAV	CIRCUIT
1	C15 12BK/WT
2	-
3	V13 18BK/LG
4	V23 18DB/RD
5	V23 18BR/PK
6	Z1 12BK
7	-
8	-
9	-
10	-



C331 (HARD TOP) - BLACK (HARD TOP SIDE)

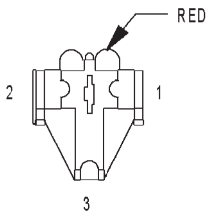
CAV	CIRCUIT
1	C15 12BK/WT
2	-
3	V13 18BK/LG
4	V23 18DB/RD
5	V23 18BR/PK
6	Z1 12BK
7	-
8	-
9	-
10	-



CAMSHAFT POSITION SENSOR

CAMSHAFT POSITION SENSOR - 3 WAY

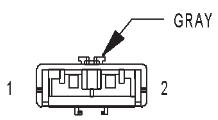
CAV	CIRCUIT	FUNCTION
1	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
2	K4 20BK/LB	SENSOR GROUND
3	K7 20OR	5V SUPPLY



CIGAR LIGHTER/ POWER OUTLET

CIGAR LIGHTER/POWER OUTLET - RED 3 WAY

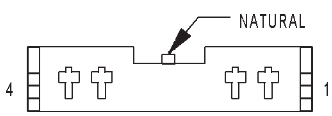
CAV	CIRCUIT	FUNCTION
1	F38 16LB	FUSED CIGAR LIGHTER/ACCESSORY RELAY OUTPUT
2	-	-
3	Z1 16BK	GROUND



CIRCUIT BREAKER

CIRCUIT BREAKER - GRAY 2 WAY

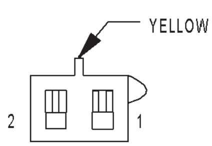
CAV	CIRCUIT	FUNCTION
1	A3 12RD/WT	HEADLAMP SWITCH RELAY FEED
2	F3 14LB/OR	DAYTIME RUNNING LAMP MODULE



CLOCKSPRING C1

CLOCKSPRING C1 - NATURAL 4 WAY

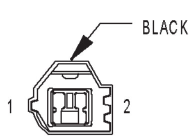
CAV	CIRCUIT	FUNCTION
1	X3 20RD/YL	HORN RELAY CONTROL
2	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL
3	K4 20BK/LB	SENSOR GROUND
4	-	-



CLOCKSPRING C2

CLOCKSPRING C2 - YELLOW 2 WAY

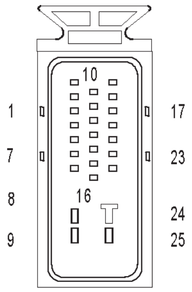
CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER SQUIB 1 LINE 2
2	R43 18BK/LB	DRIVER SQUIB 1 LINE 1



CLUTCH PEDAL POSITION SWITCH (M/T)

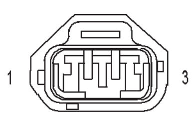
CLUTCH PEDAL POSITION SWITCH (M/T) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	T141 14YL/RD	FUSED IGNITION SWITCH OUTPUT (START)
2	A41 14YL	FUSED IGNITION SWITCH OUTPUT (START)



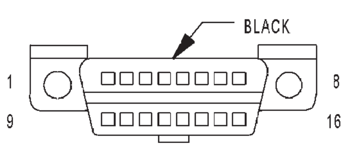
CONTROLLER ANTILOCK BRAKE - 25 WAY

CAV	CIRCUIT	FUNCTION
1	B1 18YL/DB	RIGHT REAR WHEEL SPEED SENSOR (-)
2	B3 18LG/DB	LEFT REAR WHEEL SPEED SENSOR (-)
3	B7 18WT	RIGHT FRONT WHEEL SPEED SENSOR (+)
4	B9 18RD	LEFT FRONT WHEEL SPEED SENSOR (+)
5	-	-
6	B41 18YL/VT	G-SWITCH NO. 1 SENSE
7	B42 18TN/WT	G-SWITCH NO. 2 SENSE
8	Z22 12BK/PK	GROUND
9	A20 12RD/DB	FUSED B(+)
10	B4 18LG	LEFT REAR WHEEL SPEED SENSOR (+)
11	B8 18RD/DB	LEFT FRONT WHEEL SPEED SENSOR (-)
12	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
13	B43 18PK/OR	G-SWITCH TEST SIGNAL
14	-	-
15	-	-
16	G83 18GY/BK	ABS RELAY CONTROL
17	B2 18YL	RIGHT REAR WHEEL SPEED SENSOR (+)
18	B6 18WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
19	-	-
20	D21 18PK	SCI TRANSMIT
21	-	-
22	-	-
23	F20 18VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
24	Z22 12BK/PK	GROUND
25	A10 12RD/DG	FUSED B(+)



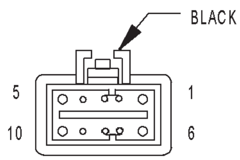
CRANKSHAFT POSITION SENSOR - 3 WAY

CAV	CIRCUIT	FUNCTION
1	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
2	K4 20BK/LB	SENSOR GROUND
3	K7 20OR	5V SUPPLY



DATA LINK CONNECTOR - BLACK 16 WAY

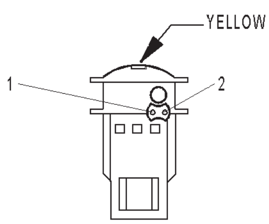
CAV	CIRCUIT	FUNCTION
1	-	-
2	D25 20VT/YL	PCI BUS
3	-	-
4	Z12 20BK/LB	GROUND
5	Z12 20BK/TN	GROUND
6	D32 20LG	SCI RECEIVE
7	D21 20PK	SCI TRANSMIT
8	-	-
9	-	-
10	-	-
11	-	-
12	-	-
13	-	-
14	-	-
15	-	-
16	M1 20PK/WT	FUSED B(+)



DAYTIME RUNNING LAMP MODULE (EXCEPT BUILT-UP-EXPORT)

DAYTIME RUNNING LAMP MODULE (EXCEPT BUILT-UP-EXPORT) - BLACK 10 WAY

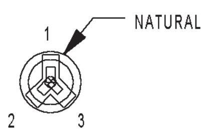
CAV	CIRCUIT	FUNCTION
1	L3 14RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
2	-	-
3	-	-
4	G34 14RD/GY	HIGH BEAM INDICATOR DRIVER
5	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN-START)
6	F3 14LB/OR	FUSED B(+)
7	G7 20WT/OR	VEHICLE SPEED SENSOR SIGNAL
8	Z1 18BK	GROUND
9	-	-
10	L4 14VT/WT	DIMMER SWITCH LOW BEAM OUTPUT



DRIVER AIRBAG

DRIVER AIRBAG - YELLOW 2 WAY

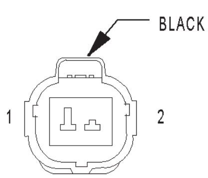
CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER SQUIB 1 LINE 2
2	R43 18BK/LB	DRIVER SQUIB 1 LINE 1



DRIVER DOOR AJAR SWITCH

DRIVER DOOR AJAR SWITCH - NATURAL 3 WAY

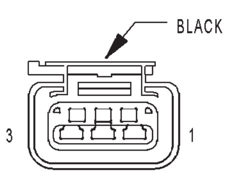
CAV	CIRCUIT	FUNCTION
1	M23 20YL/BK	DOOR AJAR SWITCH OUTPUT
2	-	-
3	G75 20TN	DRIVER DOOR AJAR SWITCH SENSE



ENGINE COOLANT TEMPERATURE SENSOR

ENGINE COOLANT TEMPERATURE SENSOR - BLACK 2 WAY

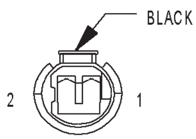
CAV	CIRCUIT	FUNCTION
1	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
2	K4 20BK/LB	SENSOR GROUND



ENGINE OIL PRESSURE SENSOR

ENGINE OIL PRESSURE SENSOR - BLACK 3 WAY

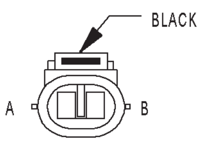
CAV	CIRCUIT	FUNCTION
1	K6 20VT/OR	5V SUPPLY
2	G60 18GY/YL	ENGINE OIL PRESSURE SENSOR SIGNAL
3	K4 20BK/LB	SENSOR GROUND



EVAP/PURGE SOLENOID

EVAP/PURGE SOLENOID - BLACK 2 WAY

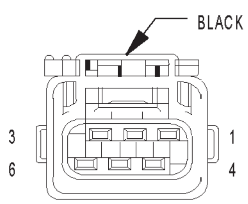
CAV	CIRCUIT	FUNCTION
1	K52 20PK/BK	EVAP/PURGE SOLENOID CONTROL
2	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN-START)



FRONT WASHER PUMP

FRONT WASHER PUMP - BLACK 2 WAY

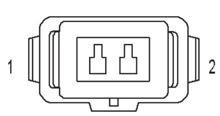
CAV	CIRCUIT	FUNCTION
A	V10 18BR	WASHER PUMP CONTROL SWITCH OUTPUT
B	Z1 18BK	GROUND



FRONT WIPER MOTOR

FRONT WIPER MOTOR - BLACK 6 WAY

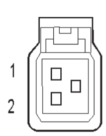
CAV	CIRCUIT	FUNCTION
1	V6 16PK/BK	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	V5 16DG/YL	WIPER PARK SWITCH SENSE
3	-	-
4	Z1 16BK	GROUND
5	V3 16BR/WT	LOW SPEED WIPER SWITCH OUTPUT
6	V4 16RD/YL	WIPER SWITCH HIGH SPEED OUTPUT



FUEL INJECTOR NO. 1 (2.5L)

FUEL INJECTOR NO. 1 (2.5L) - 2 WAY

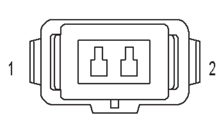
CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER



FUEL INJECTOR NO. 1 (4.0L)

FUEL INJECTOR NO. 1 (4.0L) - 2 WAY

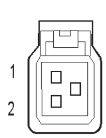
CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER



FUEL INJECTOR NO. 2 (2.5L)

FUEL INJECTOR NO. 2 (2.5L) - 2 WAY

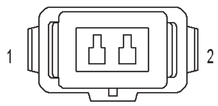
CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K12 18TN	FUEL INJECTOR NO. 2 DRIVER



FUEL INJECTOR NO. 2 (4.0L)

FUEL INJECTOR NO. 2 (4.0L) - 2 WAY

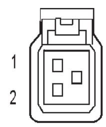
CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K12 18TN	FUEL INJECTOR NO. 2 DRIVER



FUEL INJECTOR NO. 3 (2.5L)

FUEL INJECTOR NO. 3 (2.5L) - 2 WAY

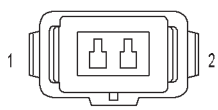
CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER



FUEL INJECTOR NO. 3 (4.0L)

FUEL INJECTOR NO. 3 (4.0L) - 2 WAY

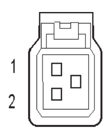
CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER



FUEL INJECTOR NO. 4 (2.5L)

FUEL INJECTOR NO. 4 (2.5L) - 2 WAY

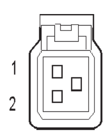
CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER



FUEL INJECTOR NO. 4 (4.0L)

FUEL INJECTOR NO. 4 (4.0L) - 2 WAY

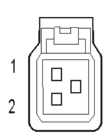
CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER



FUEL INJECTOR NO. 5 (4.0L)

FUEL INJECTOR NO. 5 (4.0L) - 2 WAY

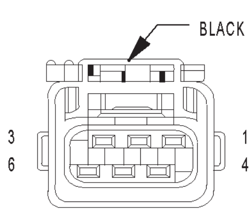
CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K38 18PK/BK (LHD CALIFORNIA/ EUROPEAN)	FUEL INJECTOR NO. 5 DRIVER
2	K38 18GY	FUEL INJECTOR NO. 5 DRIVER



FUEL INJECTOR NO. 6 (4.0L)

FUEL INJECTOR NO. 6 (4.0L) - 2 WAY

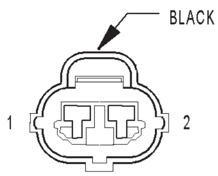
CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K16 18LG/BK	FUEL INJECTOR NO. 6 DRIVER



FUEL PUMP MODULE

FUEL PUMP MODULE - BLACK 6 WAY

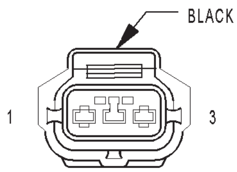
CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT	FUEL PUMP RELAY OUTPUT
2	-	-
3	K226 20DB/LG	FUEL LEVEL SENSOR SIGNAL
4	K4 20BK/LB	SENSOR GROUND
5	-	-
6	Z1 18BK	GROUND



GENERATOR

GENERATOR - BLACK 2 WAY

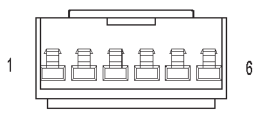
CAV	CIRCUIT	FUNCTION
1	K125 18WT/DB	GENERATOR SOURCE
2	K20 18DG	GENERATOR FIELD



G-SWITCH

G-SWITCH - BLACK 3 WAY

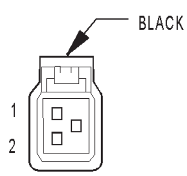
CAV	CIRCUIT	FUNCTION
1	B42 20TN/WT	G-SWITCH NO. 2 SENSE
2	B41 20YL/VT	G-SWITCH NO. 1 SENSE
3	B43 20PK/OR	G-SWITCH TEST SIGNAL



HEADLAMP
LEVELING
SWITCH
(BUILT-UP-EXPORT)

HEADLAMP LEVELING SWITCH (BUILT-UP-EXPORT) - 6 WAY

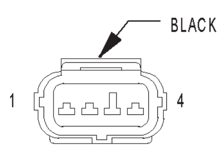
CAV	CIRCUIT	FUNCTION
1	-	-
2	L22 20LG/DG	FUSED HEADLAMP SWITCH OUTPUT
3	-	-
4	Z1 20BK	GROUND
5	L13 20BR/YL	HEADLAMP ADJUST SIGNAL
6	-	-



HIGH NOTE
HORN

HIGH NOTE HORN - BLACK 2 WAY

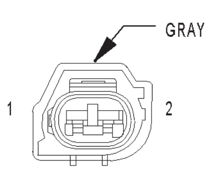
CAV	CIRCUIT	FUNCTION
1	X2 18DG/RD	HORN RELAY OUTPUT
2	Z1 18BK	GROUND



IDLE AIR
CONTROL MOTOR

IDLE AIR CONTROL MOTOR - BLACK 4 WAY

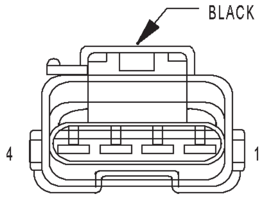
CAV	CIRCUIT	FUNCTION
1	K59 18VT/BK	IDLE AIR CONTROL NO. 4 DRIVER
2	K40 18BR/WT	IDLE AIR CONTROL NO. 3 DRIVER
3	K60 18YL/BK	IDLE AIR CONTROL NO. 2 DRIVER
4	K39 18GY/RD	IDLE AIR CONTROL NO. 1 DRIVER



IGNITION
COIL
(2.5L)

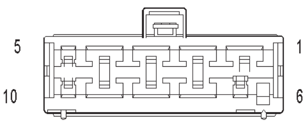
IGNITION COIL (2.5L) - GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	F42 18DG/LG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K19 18GY	IGNITION COIL NO. 1 DRIVER



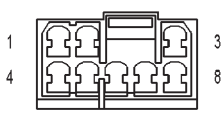
IGNITION COIL PACK (4.0L) - BLACK 4 WAY

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



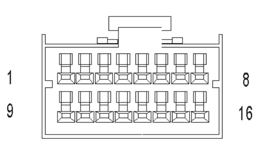
IGNITION SWITCH - 10 WAY

CAV	CIRCUIT	FUNCTION
1	A1 14RD	FUSED B(+)
2	A21 14DB	IGNITION SWITCH OUTPUT (RUN-START)
3	F22 12WT/PK	IGNITION SWITCH OUTPUT (RUN-ACC)
4	F30 12RD/PK	FUSED B(+)
5	G26 20LB	KEY-IN IGNITION SWITCH SENCE
6	A41 14YL	IGNITION SWITCH OUTPUT (START)
7	A31 14BK/DG	IGNITION SWITCH OUTPUT (RUN-ACC)
8	A22 12BK/OR	IGNITION SWITCH OUTPUT (RUN)
9	A2 12PK/BK	FUSED B(+)
10	Z1 20BK (RHD)	GROUND
10	Z1 16BK (LHD)	GROUND



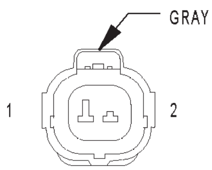
INSTRUMENT CLUSTER C1 - 8 WAY

CAV	CIRCUIT	FUNCTION
1	L61 18GY	LEFT TURN SIGNAL
2	L60 18TN	RIGHT TURN SIGNAL
3	G34 16RD/GY	HIGH BEAM INDICATOR DRIVER
4	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
5	Z2 18BK/LG	GROUND
6	L38 18BR/WT (BUILT-UP-EXPORT)	FOG LAMP FEED
6	L39 16LB (EXCEPT BUILT-UP-EXPORT)	REAR FOG LAMP FEED
7	G5 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
8	M1 20PK/WT	FUSED B(+)



INSTRUMENT CLUSTER C2 - 16 WAY

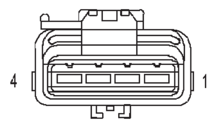
CAV	CIRCUIT	FUNCTION
1	C80 20DB/WT (EXCEPT LHD EXCEPT BUILT-UP-EXPORT)	REAR WINDOW DEFOGGER SENSE SWITCH
2	G10 20LG/RD	SEAT BELT SWITCH SENSE
3	G76 20TN/YL	PASSENGER DOOR AJAR SWITCH SENSE
4	G75 20TN	DRIVER DOOR AJAR SWITCH SENSE
5	M2 20YL	COURTESY LAMP FEED
6	E2 20OR	CLUSTER ILLUMINATION LAMPS
7	C81 20LB/WT (EXCEPT LHD EXCEPT BUILT-UP-EXPORT)	REAR WINDOW DEFOGGER RELAY CONTROL
8	G19 20LG/OR	ABS WARNING INDICATOR DRIVER
9	G99 20GY/WT	BRAKE WARNING INDICATOR DRIVER
10	-	-
11	L107 20WT	PARK LAMP RELAY OUTPUT
12	D25 20VT/YL	PCI BUS
13	G26 20LB	KEY-IN IGNITION SWITCH SENSE
14	-	-
15	E19 20RD	PANEL LAMPS DIMMER SIGNAL
16	G107 20BK/RD	4WD INDICATOR



INTAKE AIR TEMPERATURE SENSOR

INTAKE AIR TEMPERATURE SENSOR - GRAY 2 WAY

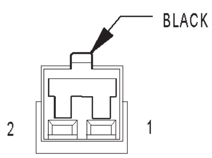
CAV	CIRCUIT	FUNCTION
1	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
2	K4 20BK/LB	SENSOR GROUND



LEAK DETECTION PUMP

LEAK DETECTION PUMP - 4 WAY

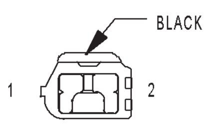
CAV	CIRCUIT	FUNCTION
1	-	-
2	K125 18OR/DG	GENERATOR SOURCE
3	K106 20WT/DG	LEAK DETECTION PUMP SOLENOID CONTROL
4	K107 20WT/OR	LEAK DETECTION PUMP SWITCH SENSE



LEFT COURTESY LAMP

LEFT COURTESY LAMP - BLACK 2 WAY

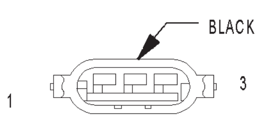
CAV	CIRCUIT	FUNCTION
1	M1 20PK/WT	FUSED B(+)
2	M2 20YL	COURTESY LAMPS DRIVER



LEFT FOG LAMP (EXCEPT BUILT-UP-EXPORT)

LEFT FOG LAMP (EXCEPT BUILT-UP-EXPORT) - BLACK 2 WAY

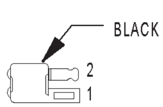
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L39 16LB	FOG LAMP RELAY NO. 1 OUTPUT



LEFT FRONT PARK/ TURN SIGNAL LAMP (EXCEPT BUILT-UP-EXPORT)

LEFT FRONT PARK/ TURN SIGNAL LAMP (EXCEPT BUILT-UP-EXPORT) - BLACK 3 WAY

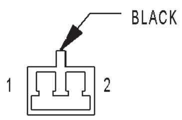
CAV	CIRCUIT	FUNCTION
1	L61 18GY	LEFT TURN SIGNAL
2	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
3	Z1 18BK	GROUND



LEFT FRONT POSITION LAMP (BUILT-UP-EXPORT)

LEFT FRONT POSITION LAMP (BUILT-UP-EXPORT) - BLACK 2 WAY

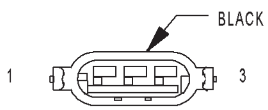
CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	Z1 20BK	GROUND



LEFT FRONT SPEAKER

LEFT FRONT SPEAKER - BLACK 2 WAY

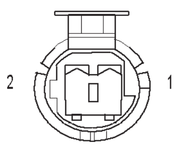
CAV	CIRCUIT	FUNCTION
1	X53 18DG	LEFT FRONT SPEAKER (+)
2	X55 18BR/RD	LEFT FRONT SPEAKER (-)



LEFT FRONT TURN SIGNAL LAMP (BUILT-UP-EXPORT)

LEFT FRONT TURN SIGNAL LAMP (BUILT-UP-EXPORT) - BLACK 3 WAY

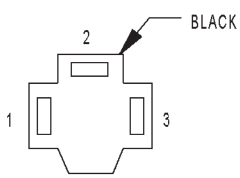
CAV	CIRCUIT	FUNCTION
1	L61 18GY	LEFT TURN SIGNAL
2	-	-
3	Z1 18BK	GROUND



LEFT FRONT WHEEL SPEED SENSOR

LEFT FRONT WHEEL SPEED SENSOR - 2 WAY

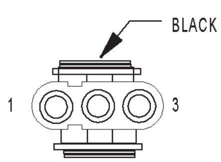
CAV	CIRCUIT	FUNCTION
1	B8 18RD/DB	LEFT FRONT WHEEL SPEED SENSOR (-)
2	B9 18RD	LEFT FRONT WHEEL SPEED SENSOR (+)



LEFT HEADLAMP

LEFT HEADLAMP - BLACK 3 WAY

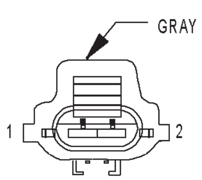
CAV	CIRCUIT	FUNCTION
1	L3 14RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
1	L3 14RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
2	L4 14VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
2	L4 14VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
3	Z1 20BK	GROUND



LEFT HEADLAMP LEVELING MOTOR (BUILT-UP-EXPORT)

LEFT HEADLAMP LEVELING MOTOR (BUILT-UP-EXPORT) - BLACK 3 WAY

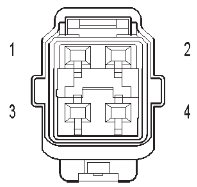
CAV	CIRCUIT	FUNCTION
1	L22 20LG/DG	FUSED HEADLAMP SWITCH OUTPUT
2	L13 20BR/YL	HEADLAMP ADJUST SIGNAL
3	Z1 20BK	GROUND



LEFT LICENSE LAMP (BUILT-UP-EXPORT)

LEFT LICENSE LAMP (BUILT-UP-EXPORT) - GRAY 2 WAY

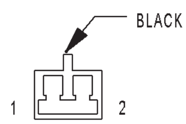
CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	Z1 20BK	GROUND



LEFT REAR LAMP ASSEMBLY

LEFT REAR LAMP ASSEMBLY - 4 WAY

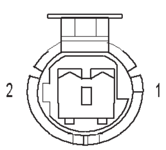
CAV	CIRCUIT	FUNCTION
1	L1 20VT/BK (EXCEPT BUILT-UP-EXPORT)	BACK-UP LAMP FEED
1	L63 18DG/RD (BUILT-UP-EXPORT)	LEFT TURN/STOP SIGNAL
2	L63 18DG/RD (EXCEPT BUILT-UP-EXPORT)	LEFT TURN/STOP SIGNAL
2	L1 20VT/BK (BUILT-UP-EXPORT)	BACK-UP LAMP FEED
3	L7 18BK/YL (EXCEPT BUILT-UP-EXPORT)	HEADLAMP SWITCH OUTPUT
3	L50 18WT/TN (BUILT-UP-EXPORT)	BRAKE LAMP SWITCH OUTPUT
4	-	-
4	L7 18BK/YL (BUILT-UP-EXPORT)	HEADLAMP SWITCH OUTPUT



LEFT REAR SPEAKER (SOUND BAR)

LEFT REAR SPEAKER (SOUND BAR) - BLACK 2 WAY

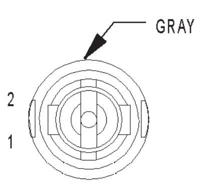
CAV	CIRCUIT	FUNCTION
1	X51 20BR/YL	LEFT REAR SPEAKER (+)
2	X57 20BR/LB	LEFT REAR SPEAKER (-)



LEFT REAR WHEEL SPEED SENSOR

LEFT REAR WHEEL SPEED SENSOR - 2 WAY

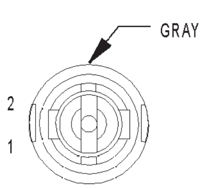
CAV	CIRCUIT	FUNCTION
1	B3 18LG/DB	LEFT REAR WHEEL SPEED SENSOR (-)
2	B4 18LG	LEFT REAR WHEEL SPEED SENSOR (+)



LEFT SIDE MARKER LAMP (EXCEPT BUILT-UP-EXPORT)

LEFT SIDE MARKER LAMP (EXCEPT BUILT-UP-EXPORT) - GRAY 2 WAY

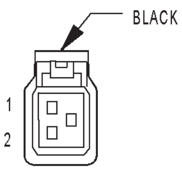
CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	L61 18GY	LEFT TURN SIGNAL



LEFT SIDE REPEATER LAMP (BUILT-UP-EXPORT)

LEFT SIDE REPEATER LAMP (BUILT-UP-EXPORT) - GRAY 2 WAY

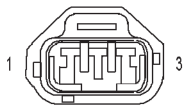
CAV	CIRCUIT	FUNCTION
1	L61 18GY	LEFT TURN SIGNAL
2	Z1 18BK	GROUND



LOW NOTE HORN (EXCEPT BUILT-UP-EXPORT)

LOW NOTE HORN (EXCEPT BUILT-UP-EXPORT) - BLACK 2 WAY

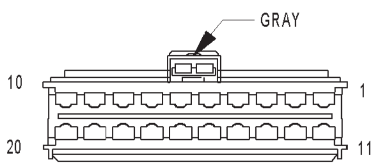
CAV	CIRCUIT	FUNCTION
1	X2 18DG/RD	HORN RELAY OUTPUT
2	Z1 18BK	GROUND



MANIFOLD ABSOLUTE PRESSURE SENSOR

MANIFOLD ABSOLUTE PRESSURE SENSOR - 3 WAY

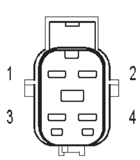
CAV	CIRCUIT	FUNCTION
1	K4 20BK/LB	SENSOR GROUND
2	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
3	K7 20OR	5V SUPPLY



MULTI-FUNCTION SWITCH

MULTI-FUNCTION SWITCH - GRAY 20 WAY

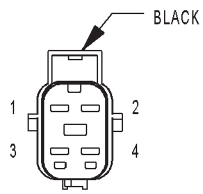
CAV	CIRCUIT	FUNCTION
1	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
2	L61 18GY	LEFT TURN SIGNAL
3	L5 20BK/GY	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
4	L63 18DG/RD	LEFT TURN/STOP SIGNAL
5	L62 18BR/RD	RIGHT TURN/STOP SIGNAL
6	L60 18TN	RIGHT TURN SIGNAL
7	Z1 18BK	GROUND
8	E19 20RD	PANEL LAMPS DIMMER SIGNAL
9	L7 18BK/YL	PARK LAMP FEED
10	-	-
11	L9 18BK/WT	HAZARD FLASHER FEED
12	L38 18BR/WT	HEADLAMP SWITCH OUTPUT
13	F39 16PK/LG	FUSED B(+)
14	F61 16WT/OR	FUSED FOG LAMP RELAY OUTPUT
15	-	-
16	L4 14VT/WT	HEADLAMP (LOW BEAM)
17	L3 14RD/OR	HEADLAMP (HI BEAM)
18	F3 12LB/OR	FUSED B(+)
19	F3 12LB/OR	FUSED B(+)
20	F33 18PK/RD	FUSED B(+)



OXYGEN SENSOR 1/1 UPSTREAM

OXYGEN SENSOR 1/1 UPSTREAM - 4 WAY

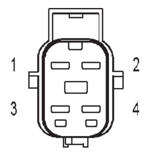
CAV	CIRCUIT	FUNCTION
1	F142 18OR/DG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K299 18BR/WT (ABS)	GROUND
2	K99 18BR/OR	GROUND
3	K4 20BK/LB	SENSOR GROUND
4	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL



OXYGEN SENSOR
1/2 DOWNSTREAM

OXYGEN SENSOR 1/2 DOWNSTREAM - BLACK 4 WAY

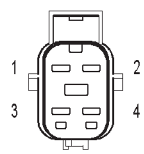
CAV	CIRCUIT	FUNCTION
1	A242 18VT/OR (4.0L CALIFORNIA)	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
1	F142 18OR/DG (EXCEPT 4.0L CALIFORNIA)	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	Z1 18BK(4.0L CALIFORNIA)	GROUND
2	K299 18BR/WT	GROUND
2	K99 18BR/OR (ABS)	GROUND
3	K4 10BK/LB	SENSOR GROUND
4	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL



OXYGEN SENSOR
2/1 UPSTREAM
(4.0L CALIFORNIA/EUROPEAN III)

OXYGEN SENSOR 2/1 UPSTREAM (4.0L CALIFORNIA/EUROPEAN III) - 4 WAY

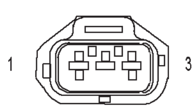
CAV	CIRCUIT	FUNCTION
1	F142 18OR/DG	OXYGEN SENSOR UPSTREAM HEATER RELAY OUTPUT
2	K299 18BR/WT	GROUND
3	K4 20BK/LB	SENSOR GROUND
4	K241 18LG/RD	OXYGEN SENSOR 2/1 SIGNAL



OXYGEN SENSOR
2/2 DOWNSTREAM
(4.0L CALIFORNIA/EUROPEAN III)

OXYGEN SENSOR 2/2 DOWNSTREAM (4.0L CALIFORNIA/EUROPEAN III) - 4 WAY

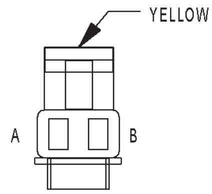
CAV	CIRCUIT	FUNCTION
1	A242 18VT/OR	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
2	Z1 18BK	GROUND
3	K4 20BK/LB	SENSOR GROUND
4	K341 18TN	OXYGEN SENSOR 2/2 SIGNAL



PARK/NEUTRAL
POSITION SWITCH
(A/T)

PARK/NEUTRAL POSITION SWITCH (A/T) - 3 WAY

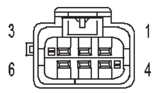
CAV	CIRCUIT	FUNCTION
1	F20 18VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
2	T41 20BR/LB	PARK/NEUTRAL POSITION SWITCH SENSE
3	L1 18VT/BK	BACK-UP LAMP FEED



PASSENGER AIRBAG

PASSENGER AIRBAG - YELLOW 2 WAY

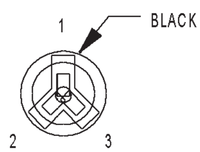
CAV	CIRCUIT	FUNCTION
A	R44 18DG/YL	PASSENGER SQUIB 1 LINE 2
B	R42 18BK/YL	PASSENGER SQUIB 1 LINE 1



PASSENGER AIRBAG ON/OFF SWITCH

PASSENGER AIRBAG ON/OFF SWITCH - 6 WAY

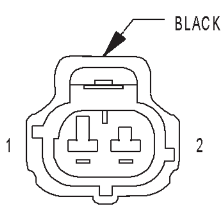
CAV	CIRCUIT	FUNCTION
1	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
2	R166 18LG/BR	PASSENGER AIRBAG INDICATOR DRIVER
3	R65 18LG/OR	PASSENGER AIRBAG MUX SWITCH SENSE
4	-	-
5	-	-
6	R66 18LG/DG	PASSENGER AIRBAG MUX SWITCH RETURN



PASSENGER DOOR AJAR SWITCH

PASSENGER DOOR AJAR SWITCH - BLACK 3 WAY

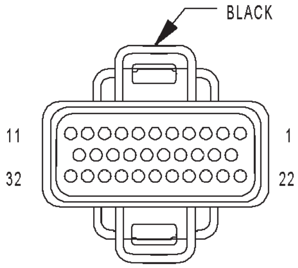
CAV	CIRCUIT	FUNCTION
1	M23 20YL/BK	DOOR AJAR SWITCH OUTPUT
2	-	-
3	G76 20TN/YL	PASSENGER DOOR AJAR SWITCH SENSE



POWER STEERING PRESSURE SWITCH (2.5L)

POWER STEERING PRESSURE SWITCH (2.5L) - BLACK 2 WAY

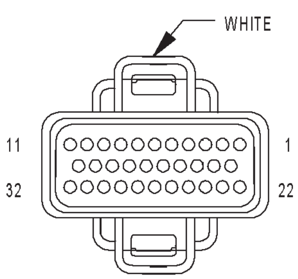
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	K10 18DB/BR	POWER STEERING PRESSURE SWITCH SENSE



POWERTRAIN CONTROL MODULE C1

POWERTRAIN CONTROL MODULE C1 - BLACK 32 WAY

CAV	CIRCUIT	FUNCTION
A1	K18 18RD/YL (4.0L)	IGNITION COIL NO. 3 DRIVER
A2	F15 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
A3	-	-
A4	K4 18BK/LB	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 (2.5L)	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	A4 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 (4.0L CALIFORNIA)	OXYGEN SENSOR 2/1 SIGNAL
A27	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
A28	-	-
A29	K341 18TN (4.0L CALIFORNIA)	OXYGEN SENSOR 2/2 SIGNAL
A30	-	-
A31	Z12 14BK/TN	GROUND
A32	Z12 14BK/TN	GROUND



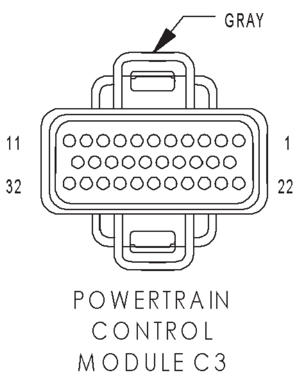
POWERTRAIN CONTROL MODULE C2

POWERTRAIN CONTROL MODULE C2 - WHITE 32 WAY

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	K38 18GY (4.0L)	FUEL INJECTOR NO. 5 DRIVER
B7	-	-
B8	-	-
B9	K17 18DB/TN (4.0L)	IGNITION COIL NO. 2 DRIVER
B10	K20 18DG	GENERATOR FIELD
B11	T23 18OR/LG	TRANSMISSION LOW/OVERDRIVE SOLENOID
B12	K16 18LG/BK (4.0L)	FUEL INJECTOR NO. 6 DRIVER
B15	K12 18TN	FUEL INJECTOR NO. 2 DRIVER
B14	-	-
B13	-	-
B16	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER
B17	-	-
B18	-	-

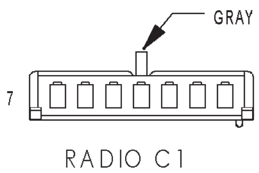
POWERTRAIN CONTROL MODULE C2 - WHITE 32 WAY

CAV	CIRCUIT	FUNCTION
B19	-	-
B20	-	-
B21	-	-
B22	-	-
B23	G60 18GY/YL	ENGINE OIL PRESSURE SENSOR SIGNAL
B24	-	-
B25	-	-
B26	-	-
B27	G7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL
B28	-	-
B29	-	-
B30	-	-
B31	K6 18VT/OR	5V SUPPLY
B32	-	-



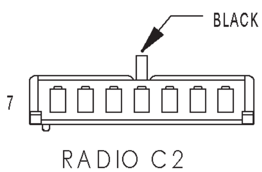
POWERTRAIN CONTROL MODULE C3 - GRAY 32 WAY

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)	SPEED CONTROL VACUUM SOLENOID CONTROL
C5	V35 18LG/RD (SPEED CONTROL)	SPEED CONTROL VENT SOLENOID CONTROL
C6	-	-
C7	-	-
C8	K99 18BR/OR (4.0L CALIFORNIA)	OXYGEN SENSOR UPSTREAM CONTROL
C9	K512 18RD/YL (4.0L CALIFORNIA)	OXYGEN SENSOR DOWNSTREAM HEATER RELAY CONTROL
C10	K106 18WT/DG (DRL)	LEAK DETECTION PUMP SOLENOID CONTROL
C11	V32 18YL/RD (SPEED CONTROL)	SPEED CONTROL ON/OFF SWITCH SENSE
C12	A142 14DG/PK	AUTOMATIC SHUT DOWN RELAY OUTPUT
C13	-	-
C14	K107 18OR	LEAK DETECTION PUMP SWITCH SENSE
C15	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
C16	K299 18BR/WT	OXYGEN SENSOR UPSTREAM CONTROL
C17	-	-
C18	-	-
C19	K31 18BR	FUEL PUMP RELAY CONTROL
C20	K52 18PK/BK	EVAP/PURGE SOLENOID CONTROL
C21	-	-
C22	C21 18DB/OR	A/C SWITCH SENSE
C23	C90 18LG	A/C SELECT INPUT
C24	K29 18WT/PK	BRAKE LAMP SWITCH SENSE
C25	K125 18WT/DB	GENERATOR SOURCE
C26	K226 18DB/LG	FUEL LEVEL SENSOR SIGNAL
C27	D21 18PK	SCI TRANSMIT
C28	-	-
C29	D32 18LG	SCI RECEIVE
C30	D25 18VT/YL	PCI BUS
C31	-	-
C32	V37 18RD/LG (SPEED CONTROL)	SPEED CONTROL SWITCH SIGNAL



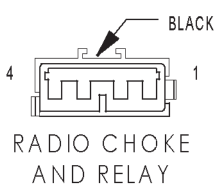
RADIO C1 - GRAY 7 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	X55 18BR/RD	LEFT FRONT SPEAKER (-)
3	X56 18DB	RIGHT FRONT SPEAKER (-)
4	L107 20WT	HEADLAMP SWITCH OUTPUT
5	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
6	X12 16PK	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
7	M1 20PK/WT	FUSED B(+)



RADIO C2 - BLACK 7 WAY

CAV	CIRCUIT	FUNCTION
1	X16 20LG	ANTENNA RELAY OUTPUT
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 (-)

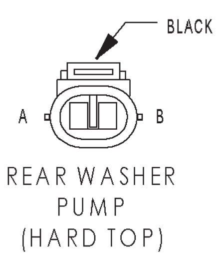


RADIO CHOKE AND RELAY - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	X60 16DG/RD	FUSED B(+)
2	X13 16BK/RD	SUBWOOFER RELAY POWER
3	X16 20LG	ANTENNA RELAY OUTPUT
4	Z1 20BK	GROUND

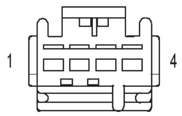
REAR FOG LAMP (BUILT-UP-EXPORT) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	L38 18BR/WT	REAR FOG LAMP FEED
2	Z1 20BK	GROUND



REAR WASHER PUMP (HARD TOP) - BLACK 2 WAY

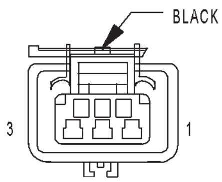
CAV	CIRCUIT	FUNCTION
A	V20 18VT/OR	REAR WASHER MOTOR CONTROL
B	Z1 18BK	GROUND



REAR WINDOW DEFOGGER SWITCH (HARD TOP)

REAR WINDOW DEFOGGER SWITCH (HARD TOP) - 4 WAY

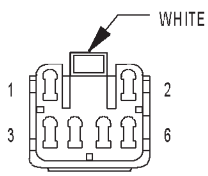
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	C80 20DB/WT	REAR WINDOW DEFOGGER SWITCH SENSE
3	F81 20DB/RD	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
4	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL



REAR WIPER MOTOR (HARD TOP)

REAR WIPER MOTOR (HARD TOP) - BLACK 3 WAY

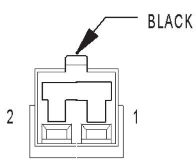
CAV	CIRCUIT	FUNCTION
1	V23 18BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
2	Z1 16BK	GROUND
3	V13 18BK/LG	REAR WIPER MOTOR CONTROL



REAR WIPER/ WASHER SWITCH (HARD TOP)

REAR WIPER/WASHER SWITCH (HARD TOP) - WHITE 6 WAY

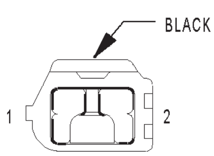
CAV	CIRCUIT	FUNCTION
1	Z1 18BK/WT	GROUND
2	V20 18VT/OR	REAR WASHER MOTOR CONTROL
3	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
4	V13 18BR/LG	REAR WIPER MOTOR CONTROL
5	V23 18BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
6	-	-



RIGHT COURTESY LAMP

RIGHT COURTESY LAMP - BLACK 2 WAY

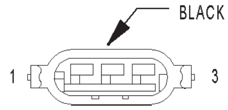
CAV	CIRCUIT	FUNCTION
1	M1 20PK/WT	FUSED B(+)
2	M2 20YL	COURTESY LAMPS DRIVER



RIGHT FOG LAMP (EXCEPT BUILT-UP-EXPORT)

RIGHT FOG LAMP (EXCEPT BUILT-UP-EXPORT) - BLACK 2 WAY

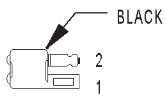
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L39 18LB	FOG LAMP RELAY NO. 1 OUTPUT



RIGHT FRONT PARK/ TURN SIGNAL LAMP (EXCEPT BUILT-UP-EXPORT)

RIGHT FRONT PARK/ TURN SIGNAL LAMP (EXCEPT BUILT-UP-EXPORT) - BLACK 3 WAY

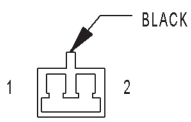
CAV	CIRCUIT	FUNCTION
1	L60 18TN	RIGHT TURN SIGNAL
2	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
3	Z1 18BK	GROUND



RIGHT FRONT POSITION LAMP (BUILT-UP-EXPORT)

RIGHT FRONT POSITION LAMP (BUILT-UP-EXPORT) - BLACK 2 WAY

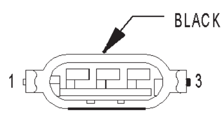
CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	Z1 20BK	GROUND



RIGHT FRONT SPEAKER

RIGHT FRONT SPEAKER - BLACK 2 WAY

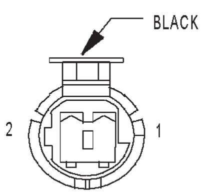
CAV	CIRCUIT	FUNCTION
1	X54 18VT	RIGHT FRONT SPEAKER (+)
2	X56 18DB	RIGHT FRONT SPEAKER (-)



RIGHT FRONT TURN SIGNAL LAMP (BUILT-UP-EXPORT)

RIGHT FRONT TURN SIGNAL LAMP (BUILT-UP-EXPORT) - BLACK 3 WAY

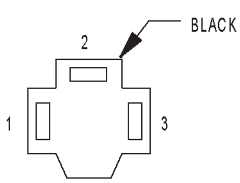
CAV	CIRCUIT	FUNCTION
1	L60 18TN	RIGHT TURN SIGNAL
2	-	-
3	Z1 18BK	GROUND



RIGHT FRONT WHEEL SPEED SENSOR

RIGHT FRONT WHEEL SPEED SENSOR - BLACK 2 WAY

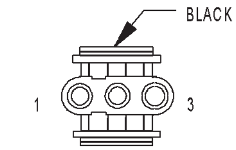
CAV	CIRCUIT	FUNCTION
1	B6 18WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
2	B7 18WT	RIGHT FRONT WHEEL SPEED SENSOR (+)



RIGHT HEADLAMP

RIGHT HEADLAMP - BLACK 3 WAY

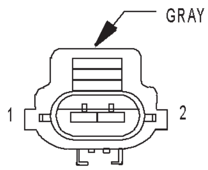
CAV	CIRCUIT	FUNCTION
1	L3 14RD/OR	DIMMER SWITCH HIGH BEAM OUTPUT
2	L4 14VT/WT	DIMMER SWITCH LOW BEAM OUTPUT
3	Z1 18BK	GROUND



RIGHT HEADLAMP LEVELING MOTOR (BUILT-UP-EXPORT)

RIGHT HEADLAMP LEVELING MOTOR (BUILT-UP-EXPORT) - BLACK 3 WAY

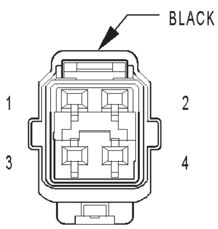
CAV	CIRCUIT	FUNCTION
1	L22 20LG/DG	FUSED HEADLAMP SWITCH OUTPUT
2	L13 20BR/YL	HEADLAMP ADJUST SIGNAL
3	Z1 20BK	GROUND



RIGHT LICENSE LAMP (BUILT-UP EXPORT)

RIGHT LICENSE LAMP (BUILT-UP EXPORT) - GRAY 2 WAY

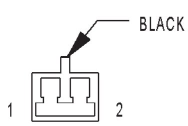
CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	Z1 20BK	GROUND



RIGHT REAR LAMP ASSEMBLY

RIGHT REAR LAMP ASSEMBLY - BLACK 4 WAY

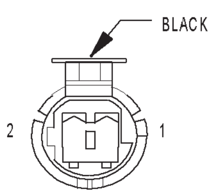
CAV	CIRCUIT	FUNCTION
1	L1 20VT/BK (EXCEPT BUILT-UP-EXPORT)	BACK-UP LAMP FEED
1	L62 18BR/RD (BUILT-UP-EXPORT)	RIGHT TURN/STOP SIGNAL
2	L62 18BR/RD (EXCEPT BUILT-UP-EXPORT)	RIGHT TURN/STOP SIGNAL
2	L1 20VT/BK (BUILT-UP-EXPORT)	BACK-UP LAMP FEED
3	L7 18BK/YL (EXCEPT BUILT-UP-EXPORT)	HEADLAMP SWITCH OUTPUT
3	L50 18WT/TN (BUILT-UP-EXPORT)	BRAKE LAMP SWITCH FEED
4	L63 18DG/RD (EXCEPT BUILT-UP-EXPORT)	LEFT TURN/STOP SIGNAL
4	L7 18BK/YL (BUILT-UP-EXPORT)	HEADLAMP SWITCH OUTPUT



RIGHT REAR SPEAKER (SOUND BAR)

RIGHT REAR SPEAKER (SOUND BAR) - BLACK 2 WAY

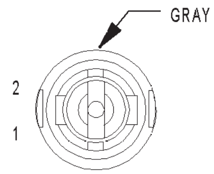
CAV	CIRCUIT	FUNCTION
1	X52 20DB/WT	RIGHT REAR SPEAKER (+)
2	X58 20DB/PK	RIGHT REAR SPEAKER (-)



RIGHT REAR WHEEL SPEED SENSOR

RIGHT REAR WHEEL SPEED SENSOR - BLACK 2 WAY

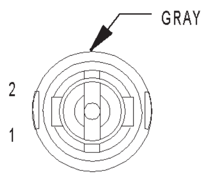
CAV	CIRCUIT	FUNCTION
1	B1 18YL/DB	RIGHT REAR WHEEL SPEED SENSOR (-)
2	B2 18YL	RIGHT REAR WHEEL SPEED SENSOR (+)



RIGHT SIDE MARKER LAMP (EXCEPT BUILT-UP-EXPORT)

RIGHT SIDE MARKER LAMP (EXCEPT BUILT-UP-EXPORT) - GRAY 2 WAY

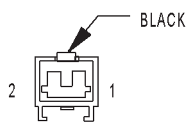
CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	L60 18TN	RIGHT TURN SIGNAL



RIGHT SIDE REPEATER LAMP (BUILT-UP-EXPORT)

RIGHT SIDE REPEATER LAMP (BUILT-UP-EXPORT) - GRAY 2 WAY

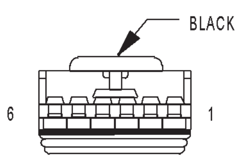
CAV	CIRCUIT	FUNCTION
1	L60 18TN	RIGHT TURN SIGNAL
2	Z1 18BK	GROUND



SEAT BELT SWITCH (RHD BUILT-UP-EXPORT)

SEAT BELT SWITCH (RHD BUILT-UP-EXPORT) - BLACK 2 WAY

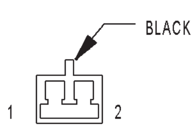
CAV	CIRCUIT	FUNCTION
1	G10 20LG/RD	SEAT BELT SWITCH SENSE
2	Z1 20BK	GROUND



SENTRY KEY IMMOBILIZER MODULE

SENTRY KEY IMMOBILIZER MODULE - BLACK 6 WAY

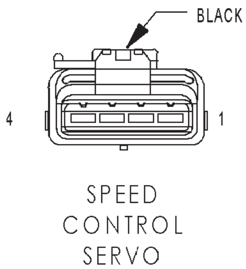
CAV	CIRCUIT	FUNCTION
1	-	-
2	D25 20VT/YL	PCI BUS
3	Z12 20BK/LB	GROUND
4	F15 20DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
5	Z1 20BK	GROUND
6	F33 18PK/RD	FUSED B(+)



SOUND BAR DOME LAMP

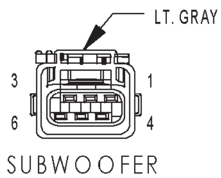
SOUND BAR DOME LAMP - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	M1 20PK/WT	FUSED B(+)
2	M2 20YL	COURTESY LAMPS DRIVER



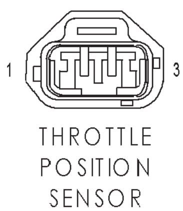
SPEED CONTROL SERVO - BLACK 4 WAY

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



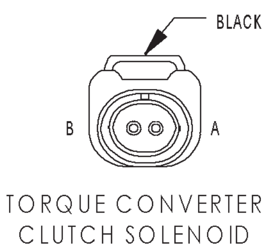
SUBWOOFER - LT. GRAY 6 WAY

CAV	CIRCUIT	FUNCTION
1	X51 18BR/YL	LEFT REAR SPEAKER (+)
2	X57 18BR/LB	LEFT REAR SPEAKER (-)
3	X13 16BK/RD	SUBWOOFER RELAY POWER
4	X52 18DB/WT	RIGHT REAR SPEAKER (+)
5	X58 18DB/PK	RIGHT REAR SPEAKER (-)
6	Z9 16BK/WT	GROUND



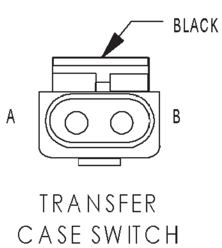
THROTTLE POSITION SENSOR - 3 WAY

CAV	CIRCUIT	FUNCTION
1	K7 20OR	5V SUPPLY
2	K4 20BK/LB	SENSOR GROUND
3	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL



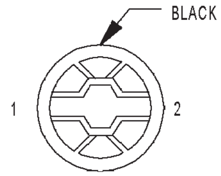
TORQUE CONVERTER CLUTCH SOLENOID - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
A	F12 20RD/LG	FUSED IGNITION SWITCH OUTPUT (RUN-START)
B	T23 18OR/LG	TRANSMISSION LOW/OVERDRIVE SOLENOID



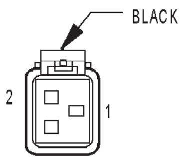
TRANSFER CASE SWITCH - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
A	G107 20BK/RD	4WD SENSE
B	Z1 20BK	GROUND



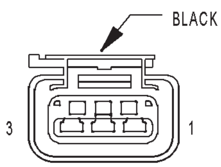
TRANSMISSION RANGE INDICATOR ILLUMINATION (PRNDL) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
2	Z1 20BK	GROUND



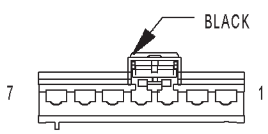
UNDERHOOD LAMP - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	M1 20PK/WT	FUSED B(+)



VEHICLE SPEED SENSOR - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K6 20VT/OR	5V SUPPLY
2	K4 20BK/LB	SENSOR GROUND
3	G7 20WT/OR	VEHICLE SPEED SENSOR SIGNAL



WINDSHIELD WIPER SWITCH - BLACK 7 WAY

CAV	CIRCUIT	FUNCTION
1	V5 16DG/YL	WIPER PARK SWITCH SENSE
2	Z1 20BK	GROUND
3	V10 16BR	WASHER PUMP CONTROL SWITCH OUTPUT
4	V6 16PK/BK	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
5	V4 16RD/YL	WIPER SWITCH HIGH SPEED OUTPUT
6	V3 16BR/WT	LOW SPEED WIPER SWITCH OUTPUT
7	-	-

8W-91 CONNECTOR/GROUND/SPLICE LOCATION

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CONNECTOR/GROUND/SPLICE LOCATION

DESCRIPTION

This section provides illustrations identifying connector, ground, and splice locations in the vehicle. Connector, ground, and splice indexes are provided. Use the wiring diagrams in each section for connector, ground, and splice identification. Refer to the index for the proper figure number. For items that are not shown in this section N/S is placed in the Fig. column.

CONNECTORS

Connector Name/Number	Color	Location	Fig.
A/C Compressor Clutch	BK	At A/C Compressor Clutch	4
A/C Heater Control - C1		Center of Instrument Panel	16,18
A/C Heater Control - C2		Center of Instrument Panel	16,18
A/C Heater Control - C3		Center of Instrument Panel	16,18
A/C High Pressure Switch		Left Side of Engine	4
A/C Low Pressure Switch		Near Powertrain Control Module	12, 13
Airbag Control Module	YL	Front of Floor Pan Tunnel	14,15
Back-up Lamp Switch (M/T)	BK	Right Side of Transmission	22,23
Battery Temperature Sensor	BK	Under Battery Tray	6, 7
Blend Door Actuator		On HVAC Harness	N/S
Blower Motor		On HVAC Harness	N/S
Blower Motor Relay	BK	On HVAC Harness	N/S
Blower Motor Resistor Block		On HVAC Harness	N/S
Brake Lamp Switch	GY	Top of Brake Pedal Bracket	14,15
Brake Transmission Shift Interlock Solenoid	WT	Near Steering Column	15
Brake Warning Indicator Switch	BK	On Brake Master Cylinder	N/S
C103	BK	Rear of Engine Compartment	6, 7, 12, 13
C104 (LHD)	GY	Rear of Engine Compartment	6, 12, 13
C104 (RHD)	BK	Rear of Engine Compartment	7, 12, 13
C104 (RHD ABS)	GY	Rear of Engine Compartment	N/S
C106 (LHD)	BK	Left Kick Panel	14, 19
C106 (RHD)	BK	Right Kick Panel	15
C107 (LHD)	YL	Left Kick Panel	14, 19
C107 (RHD)	YL	Right Kick Panel	15
C108 (LHD)	BL	Left Kick Panel	14, 19

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

Connector Name/Number	Color	Location	Fig.
C108 (RHD)	BL	Right Kick Panel	15
C110	BK	Left Fender Side Shield	1,6
C154	BK	Top Right Side of Transmission	10, 11, 22, 23, 24
C170 (LHD)	LT GY	Left Kick Panel	16, 19
C170 (RHD)	LT GY	Right Kick Panel	18
C180	BK	Below Evap/Purge Solenoid	N/S
C202 (LHD)	GY	Left Kick Panel	14, 16, 19
C202 (RHD)	GY	Right Kick Panel	15, 18
C203 (LHD)	GN	Left Kick Panel	14, 16, 19
C203 (RHD)	GN	Right Kick Panel	15, 18
C204 (LHD)	RD	Left Kick Panel	14, 16, 19
C204 (RHD)	RD	Right Kick Panel	15, 18
C205	LT GN	Left Kick Panel	17, 18
C322	BK	Left Kick Panel	14, 15, 25, 27
C323	BK	Left Kick Panel	25, 27
C323 (LHD)	RD	Left Kick Panel	14, 25, 27
C323 (RHD)	GY	Left Kick Panel	15
C325 (4 Spkr Sys)	WT	Left Side of Sound Bar	25
C326 (Hard Top)	BK	Left Rear Quarter Panel	25
C329 (Built-up-Export)	BK	Left Rear of Rear Bumper	28
C330 (4 Spkr Sys)	WT	Left Side of Sound Bar	25
C331 (Hard Top)	BK	Left Rear Quarter Panel	25
Camshaft Position Sensor	GY	Right Side of Engine	5, 10
Center High Mounted Stop Lamp		Near Right Rear Lamp Assembly	28
Cigar Lighter/Power Outlet	RD	Rear of Cigar Lighter	16, 18
Circuit Breaker	GY	Near Day Time Running Lamp Module	N/S
Clockspring - C1	NAT	Rear of Clockspring	20
Clockspring - C2	YL	Rear of Clockspring	20
Clutch Pedal Position Switch (M/T)	BK	Top of Clutch Pedal Bracket	14, 15, 27
Controller Anti-Lock Brake		Rear Left Side of Dash Panel	N/S
Crankshaft Position Sensor		At Rear of Intake Manifold	3, 5
Data Link Connector	BK	Bottom Driver Side of Instrument Panel	16, 18
Daytime Running Lamp Module (Except Built-Up-Export)	BK	Left Side of Engine Compartment	N/S
Driver Door Ajar Switch	NAT	At ″A″ Pillar	14, 15
Engine Coolant Temperature Sensor	BK	On Thermostat Housing	3, 4
Engine Oil Pressure Sensor	BK	Right Side of Engine Block	10, 11
Evap/Purge Solenoid	BK	Left Fender Side Shield	1
Front Washer Pump	BK	Under Washer Fluid Reservoir	1

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

Connector Name/Number	Color	Location	Fig.
Front Wiper Motor	BK	At Motor	8
Fuel Injector NO.1	BK	At Injector	3, 4
Fuel Injector NO.2	BK	At Injector	3, 4
Fuel Injector NO.3	BK	At Injector	3, 4
Fuel Injector NO.4	BK	At Injector	3, 4
Fuel Injector NO.5	BK	At Injector	4
Fuel Injector NO.6	BK	At Injector	4
Fuel Pump Module	BK	Above Fuel Tank	26
G Switch	BK	Near T/O for Controller Anti-Lock Brake	N/S
Generator	BK	Rear of Generator	5
Ground Strap		Attached to Center of Hood	6
Headlamp Leveling Switch (Built-Up-Export)	WT	At Switch	16, 18
High Note Horn	BK	Left Front Fender Side Shield	1
Idle Air Control Motor	BK	Side of Throttle Body	3, 4
Ignition Coil (2.5L)	GY	Right Side of Engine	10
Ignition Coil Capacitor (4.0L)	BK	Below Center of Ignition Coil Pack	5
Ignition Coil Pack (4.0L)	BK	Right Rear of Engine	5
Ignition Switch		On Steering Column	20
Instrument Cluster - C1		Rear of Cluster	16,18
Instrument Cluster - C2		Rear of Cluster	16,18
Intake Air Temperature Sensor	GY	Rear of Intake Manifold	3, 4
Leak Detection Pump (Except Built-Up-Export)	BK	Engine Compartment Left Side	9
Left Courtesy Lamp	BK	Left Side of Instrument Panel	16, 18
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
Left Front Position Lamp (Built-Up-Export)	BK	At Lamp	1
Left Front Speaker	BK	At Speaker	16, 18
Left Front Turn Signal Lamp (Built-Up-Export)	BK	At Lamp	N/S
Left Front Wheel Speed Sensor		Left Side of Engine Compartment Near Hydraulic Control Unit	N/S
Left Headlamp	BK	Rear of Lamp	1
Left Headlamp Leveling Motor (Built-Up-Export)	BK	Near Headlamp at Motor	1
Left License Lamp (Built-Up-Export)	GY	At Lamp	28
Left Rear Lamp Assembly	BK	At Lamp	28

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

Connector Name/Number	Color	Location	Fig.
Left Rear Speaker (Sound Bar)	BK	At Sound Bar	N/S
Left Rear Wheel Speed Sensor		Near Vehicle Speed Sensor T/O	26
Left Side Marker Lamp	GY	At Lamp	N/S
Left Side Repeater Lamp (Built-Up-Export)	GY	At Lamp	N/S
Low Note Horn (Except Built-Up-Export)	BK	Left Front Fender Side Shield	1
Manifold Absolute Pressure Sensor	BK	Side of Throttle Body	3, 4
Multi-Function Switch	GY	Steering Column	20
Oxygen Sensor 1/1 Upstream		On Front Exhaust Pipe	3, 4
Oxygen Sensor 1/2 Downstream	BK	Rear of Catalytic Converter	4, 21
Oxygen Sensor 2/1 Upstream (4.0L California/European III)		Near Idle Air Control Motor T/O	4
Oxygen Sensor 2/2 Downstream (4.0L California/ European III)	GY	T/O near Ignition Coil Pack T/O	5
Park Brake Switch		Left of Seat Belt Switch	25
Park/Neutral Position Switch (A/T)		Left Side of Transmission	24
Passenger Airbag	YL	Rear of Airbag	14, 15
Passenger Airbag On/Off Switch		Lower Center of Instrument Panel	14
Passenger Door Ajar Switch	BK	Near Top Hinge of Passenger Door	14, 15
Power Distribution Center	BK	Engine Compartment Right or Left Fenter	6, 7
Power Steering Pressure Switch (2.5L)	BK	Near Power Steering Pump	3
Powertrain Control Module - C1 (LHD)	BK	Right Rear of Engine Compartment	12, 13
Powertrain Control Module - C1 (RHD)	BK	Left Rear of Engine Compartment	N/S
Powertrain Control Module - C2 (LHD)	WT	Right Rear of Engine Compartment	12, 13
Powertrain Control Module - C2 (RHD)	WT	Left Rear of Engine Compartment	N/S
Powertrain Control Module - C3 (LHD)	GY	Right Rear of Engine Compartment	6, 7
Powertrain Control Module - C3 (RHD)	GY	Left Rear of Engine Compartment	N/S
Radio - C1	GY	Rear of Radio	16, 18
Radio - C2	BK	Rear of Radio	16, 18
Radio Choke and Relay	BK	Center Lower Instrument Panel	N/S

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

Connector Name/Number	Color	Location	Fig.
Rear Fog Lamp (Built-Up-Export)	BK	At Lamp	28
Rear Washer Pump (Hard Top)	BK	Under Washer Fluid Reservoir	1
Rear Window Defogger Switch (Hard Top)	GY	Behind Rear Window Defogger Switch	16, 18
Rear Wiper Motor (Hard Top)	BK	At Rear Wiper Motor	N/S
Rear Wiper/Washer Switch (Hard Top)	WT	Behind Rear Wiper/Washer Switch	16, 18
Right Courtesy Lamp	BK	Right Side of Instrument Panel	17, 18
Right Fog Lamp (Except Built-Up-Export)	BK	At Lamp	2
Right Front Park/Turn Signal Lamp (Except Built-Up-Export)	BK	At Lamp	2
Right Front Position Lamp (Built-Up- Export	BK	At Lamp	2
Right Front Speaker	BK	At Speaker	17, 18
Right Front Turn Signal Lamp (Built-Up-Export)	BK	At Lamp	2
Right Front Wheel Speed Sensor	BK	Rear of Engine	N/S
Right Headlamp	BK	Rear of Lamp	2
Right Headlamp Leveling Motor (Built-Up-Export)	BK	Near Headlamp at Motor	2
Right License Lamp	GY	At Lamp	28
Right Rear Lamp Assembly	BK	At Lamp	28
Right Rear Speaker (Sound Bar)	BK	At Sound Bar	N/S
Right Rear Wheel Speed Sensor	BK	Near Vehicle Speed Sensor T/O	26
Right Side Marker Lamp (Except Built-Up-Export)	GY	At Lamp	2
Right Side Repeater Lamp	GY	At Lamp	2
Seat Belt Switch	BK	Near Park Brake Switch	25
Sentry Key Immobilizer Module	BK	At Immobilizer	15, 20
Sound Bar Dome Lamp	BK	At Sound Bar	N/S
Speed Control Servo	BK	Left Side Engine Compartment	9
Starter Solenoid	BK	On Starter	10
Subwoofer	LTGY	Floor Pan	14, 15
Throttle Position Sensor	WT	Side of Throttle Body	3, 4
Torque Converter Clutch Solenoid	BK	Left Side of Transmission	N/S
Transfer Case Switch	BK	Left Side of Transfer Case	21

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

Connector Name/Number	Color	Location	Fig.
Transmission Range Indicator Illumination (PRNDL)	BK	Between Seats	14, 15
Underhood Lamp	BK	Under Hood	6, 7
Vehicle Speed Sensor	BK	Left Rear of Transfer Case	21
Windshield Wiper Switch	NAT	At Steering Column	N/S

GROUNDS

Connector Name/ Number	Location	Fig.
G100	Rear Center of Engine Compartment	6, 7
G101	Rear Center of Engine Compartment	6
G102	Left Radiator Closure Panel	1
G103	Right Radiator Closure Panel	2
G104	Near Generator	N/S
G105	Right Rear of Engine Block	5, 10, 11
G106	Right Rear of Engine Block	N/S
G107	Right Rear of Engine Block	N/S
G200 (LHD)	Left Rear of Instrument Panel	16
G200 (RHD)	Right Rear of Instrument Panel	18
G201 (LHD)	Left Rear of Instrument Panel	16
G201 (RHD)	Right Rear of Instrument Panel	18
G202 (LHD)	Right Rear of Instrument Panel	17
G202 (RHD)	Left Rear of Instrument Panel	18
G203 (LHD)	Right Rear of Instrument Panel	17
G203 (RHD)	Left Rear of Instrument Panel	18
G300 (LHD)	Left Kick Panel	14
G300 (RHD)	Right Kick Panel	15
G301 (LHD)	Between Front Seats	14
G301 (RHD)	Left Kick Panel	15
G302 (LHD)	Left Kick Panel	14
G302 (RHD)	Right Kick Panel	15
G303 (LHD)	Near Steering Column Mounting Bracket	N/S
G303 (RHD)	Near T/O for Crossbody 100 way	N/S

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

SPLICES

Splice Number	Location	Fig.
S101	Near T/O for Power Distribution Center	6, 7
S102	Near T/O for G100 or Daytime Running Lamp Module	6, 7
S103	Near T/O for G101	6, 7
S105	Near T/O for Daytime Running Lamp Module	N/S
S106	Near T/O for G100	6, 7
S108	Near T/O for Power Distribution Center	6, 7
S111	Near T/O for Battery Temperature Sensor or Power Distribution Center	6, 7
S113	Near T/O for G100	6, 7
S115 (Except Built-Up-Export)	Near T/O for 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
S121	Near T/O for Powertrain Control Module - C2	13
S122	Near Grommet for Left Front Turn Signal Lamp	N/S
S123	Near T/O for G105	10, 11, 12
S124	Near T/O for G105	10, 12
S125 (Built-Up-Export)	Near Grommet for Right Front Turn Signal Lamp	2
S126	Near T/O for C104	10, 12, 13
S127	Near T/O for Idle Air Control Motor	3, 4
S128	Between Fuel Injector NO. 2 and Fuel Injector NO. 3	3, 4
S129	Near T/O for C104	10, 12, 13
S130	Near T/O for C104	10, 12, 13
S132	Near T/O for C154	5, 10, 11
S133	Near T/O for C154	5, 10, 11
S134	Near T/O for C154	10, 12, 13
S135	Near T/O for Oxygen Sensor 1/2 Downstream	10, 13
S136	In Battery Harness Near PDC	N/S
S137	Near T/O for Throttle Position Sensor	4
S138	Middle of Radiator Closure Panel	2
S140	Near T/O for C104	N/S
S141	Near T/O for Left Front Turn Signal Lamp	N/S
S142	Near T/O for Right Front Turn Signal Lamp	2
S143	Near T/O for Left Front Park/Turn Signal Lamp	N/S
S144	Near T/O for Right Front Park/Turn Signal Lamp	2
S147	Between T/O's for Underhood Lamp and C103, C104	6, 7
S150	Right Headlamp T/O	2
S151	Left Headlamp T/O	2
S152	Near Left Headlamp T/O	N/S

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

Splice Number	Location	Fig.
S153	Near T/O for Camshaft Position Sensor	5
S155 (Day Time Running Lamps)	Near T/O for Day Time Running Lamp Module	6
S156	Near T/O for ABS Pump Motor	6
S202 (LHD)	Center of Instrument Panel	16
S202 (RHD)	Center Rear of Instrument Panel	18
S204	Center Rear of Instrument Panel	16, 18
S206	Center Rear of Instrument Panel	16, 18
S207	Near Cigar Lighter T/O	16, 18
S208	Near Blower Motor	N/S
S209	Near T/O for C202, C203, and C204	16, 18
S301 (LHD)	Center Rear of Dash Panel	14
S301 (RHD)	Near T/O for Sentry Key Immobilizer	15
S304 (LHD)	Center Rear of Dash Panel	14
S304 (RHD)	Near T/O for C202, C203, C204, C106, C107, and C108	15
S309	Front of Left Door Opening	25
S310	Left Rear Quarter Panel, Near Body Grommet	25
S311	Near Left Rear Lamp Assembly Connector	28
S313	Front of Left Rear Wheel Well	25
S314	Top of Left Rear Wheel Well	25
S315	Back of Right Rear Wheel Well	28
S316	In T/O for Rear Fog Lamp	28
S317	Near T/O for Left License Lamp	28
S320 (LHD)	Near T/O for 100 way Connector	14
S320 (RHD)	Near T/O for Fuse Block	15
S331 (LHD)	Near T/O for 100 way Connector	14
S331 (RHD)	Near T/O for Fuse Block	15
S332	Near T/O for Airbag Control Module	14
S333 (LHD)	Near T/O for 100 way Connector	14
S333 (RHD)	Near T/O for Airbag Control Module	15
S335 (Except Built-Up-Export)	Near Left Rear Lamp Assembly Connector	28
S336 (LHD)	Near T/O for Airbag Control Module	14
S336 (RHD)	Near T/O for 100 way Connector	15
S400	Near T/O for Rear Window Defogger Feed	N/S
S401	Near T/O for Rear Window Defogger Feed	N/S

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

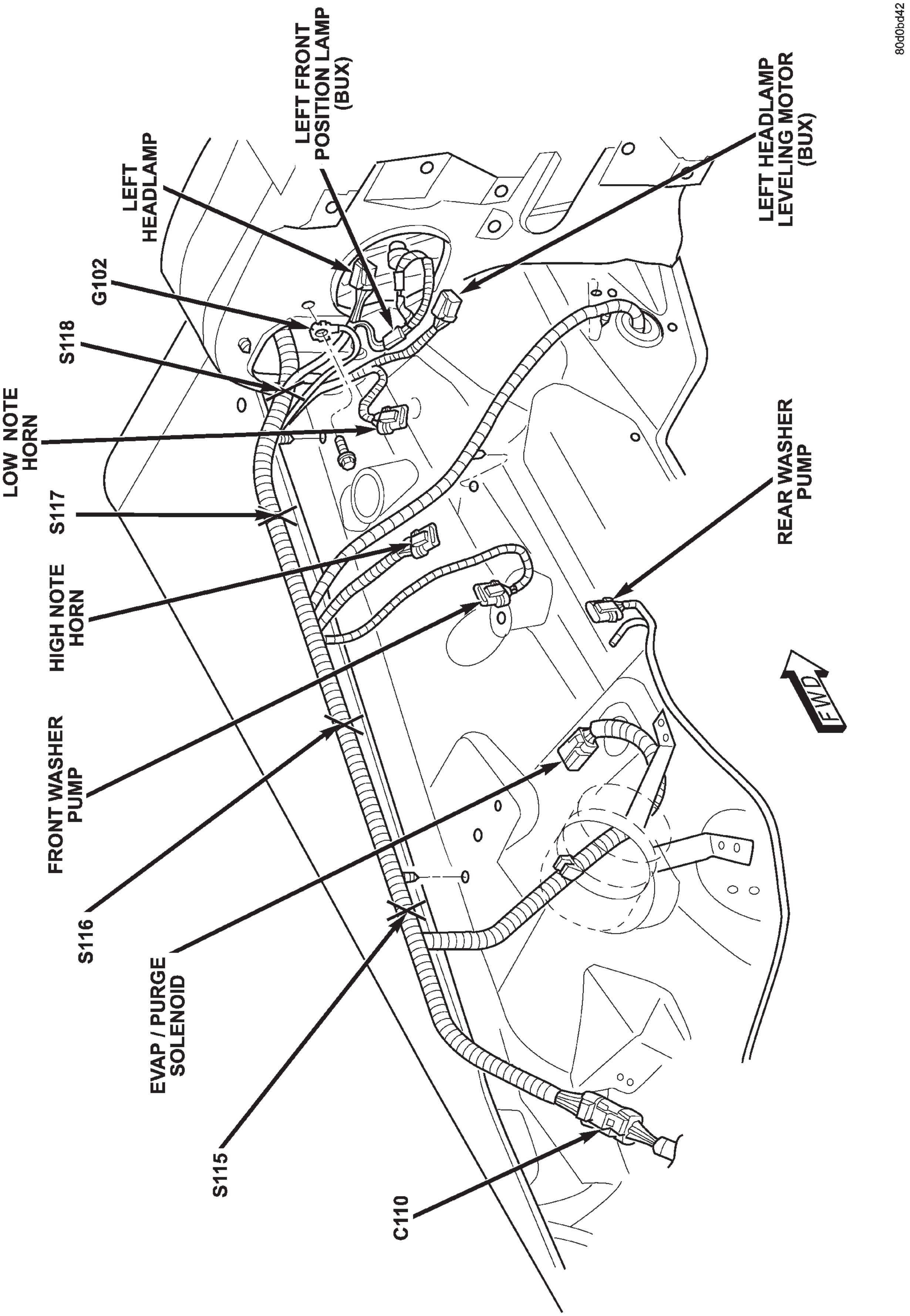


Fig. 1 LEFT HEADLAMP

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

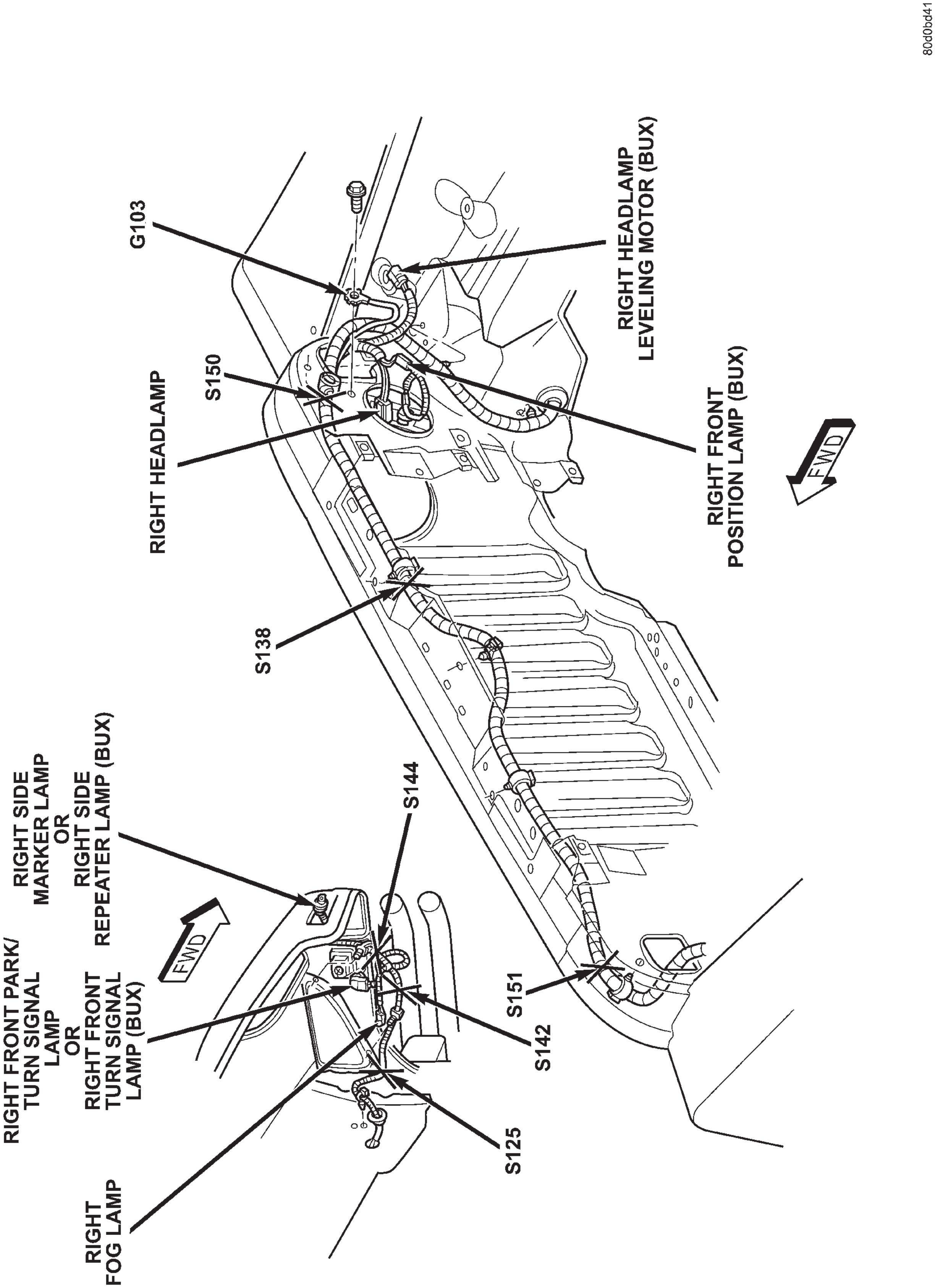


Fig. 2 RIGHT HEADLAMP

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

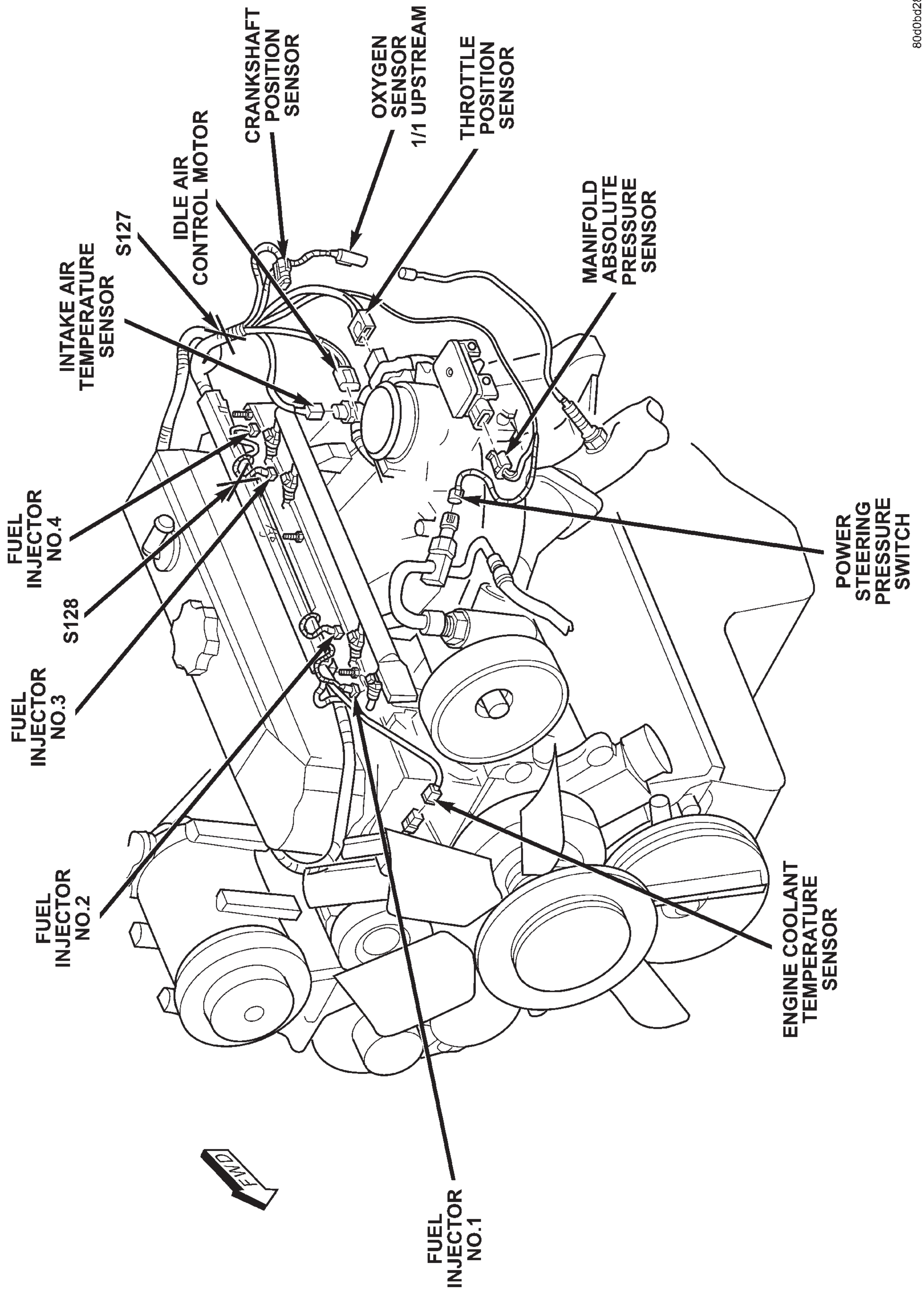


Fig. 3 2.5 LITER ENGINE LEFT SIDE

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

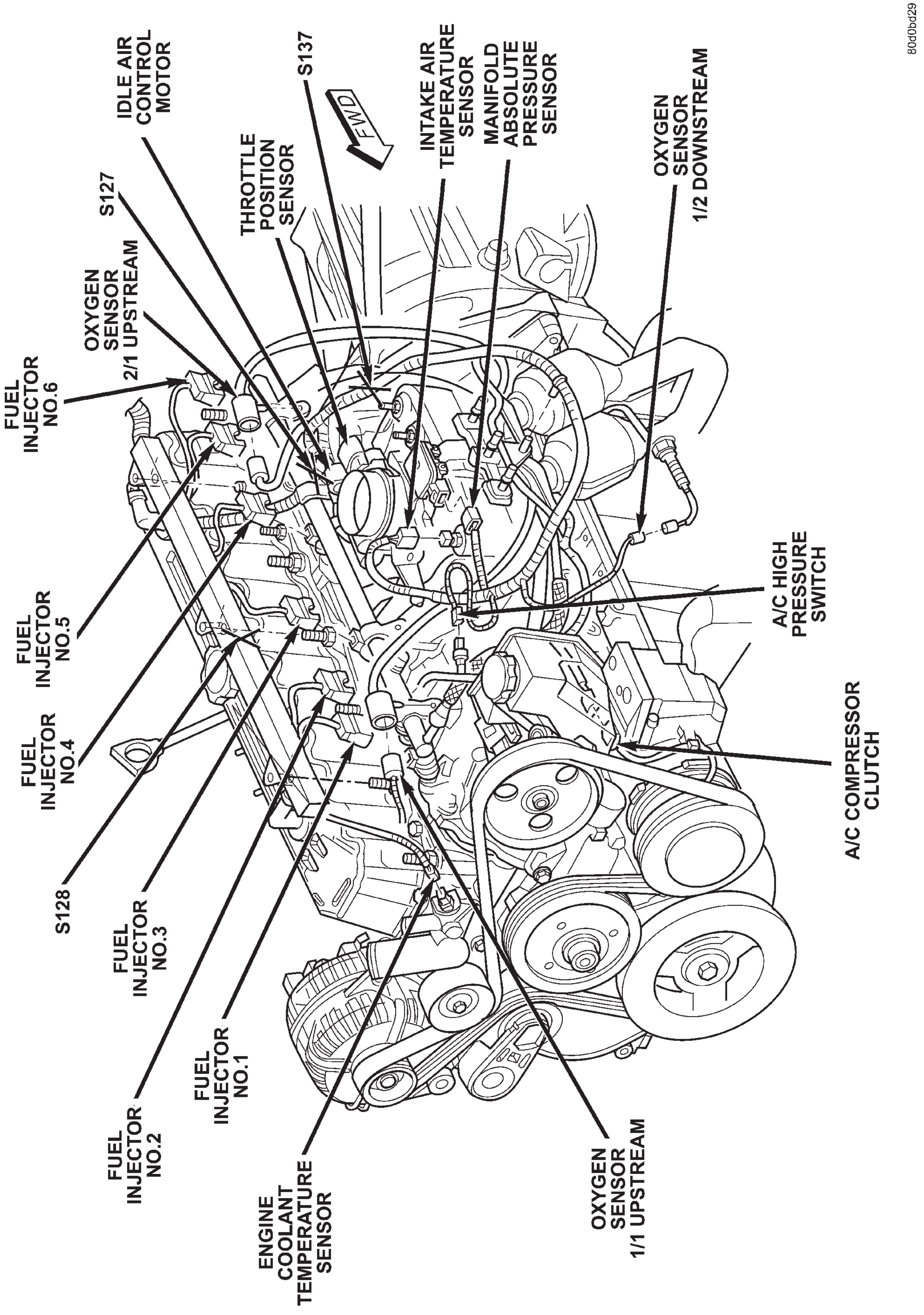


Fig. 4 4.0 LITER ENGINE LEFT SIDE

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

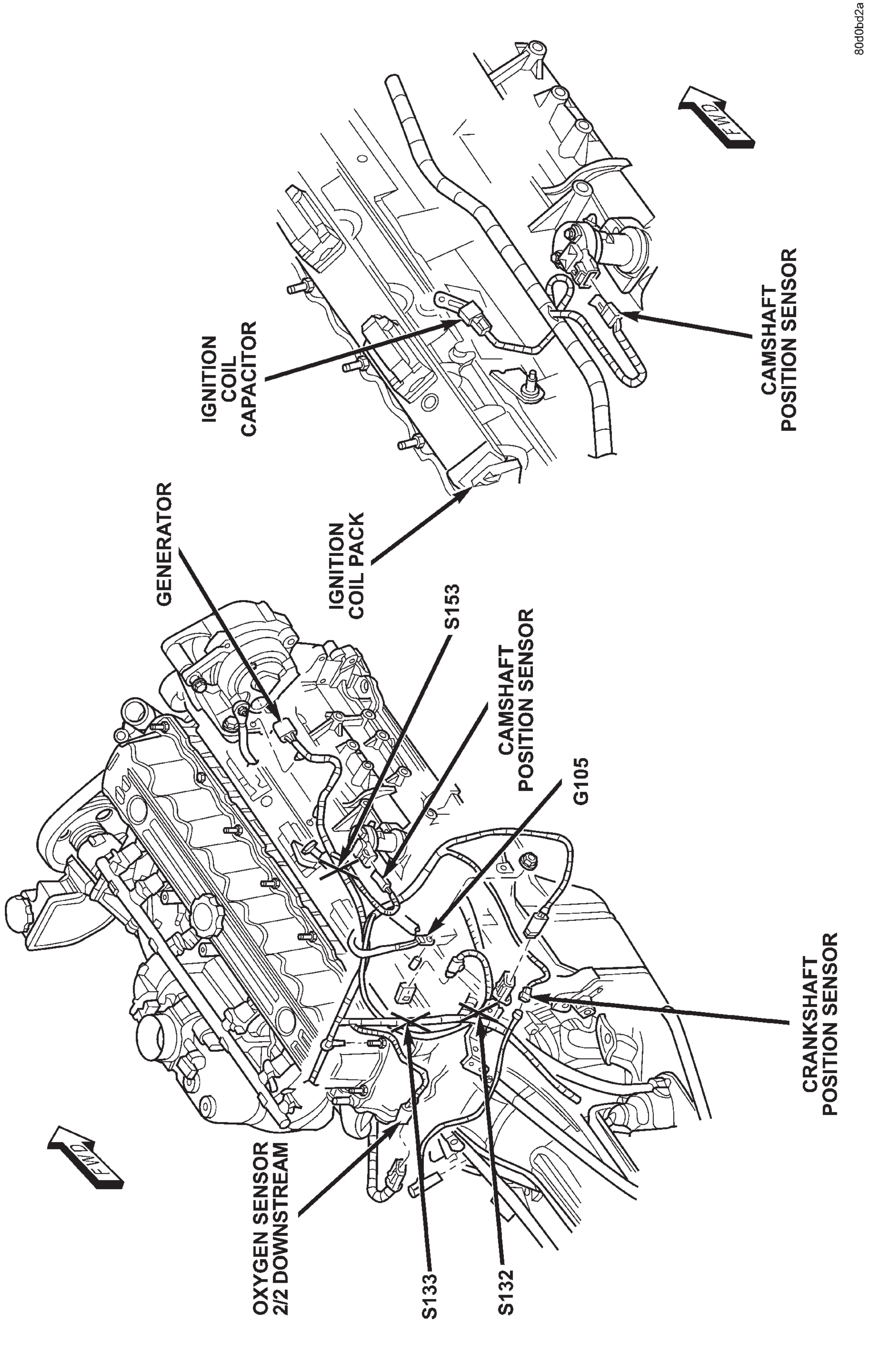


Fig. 5 4.0 LITER ENGINE RIGHT SIDE

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

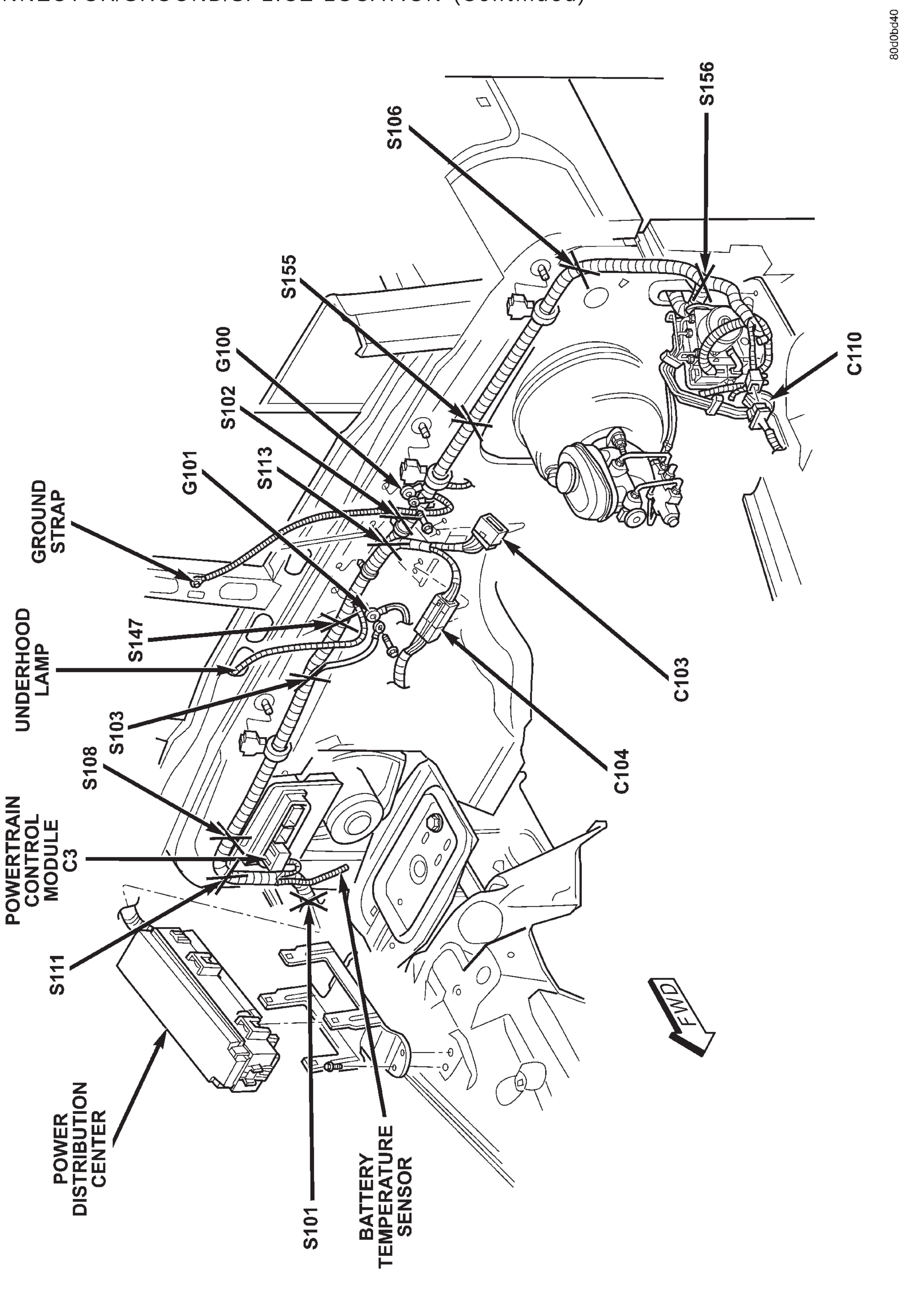


Fig. 6 ENGINE COMPARTMENT REAR LHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

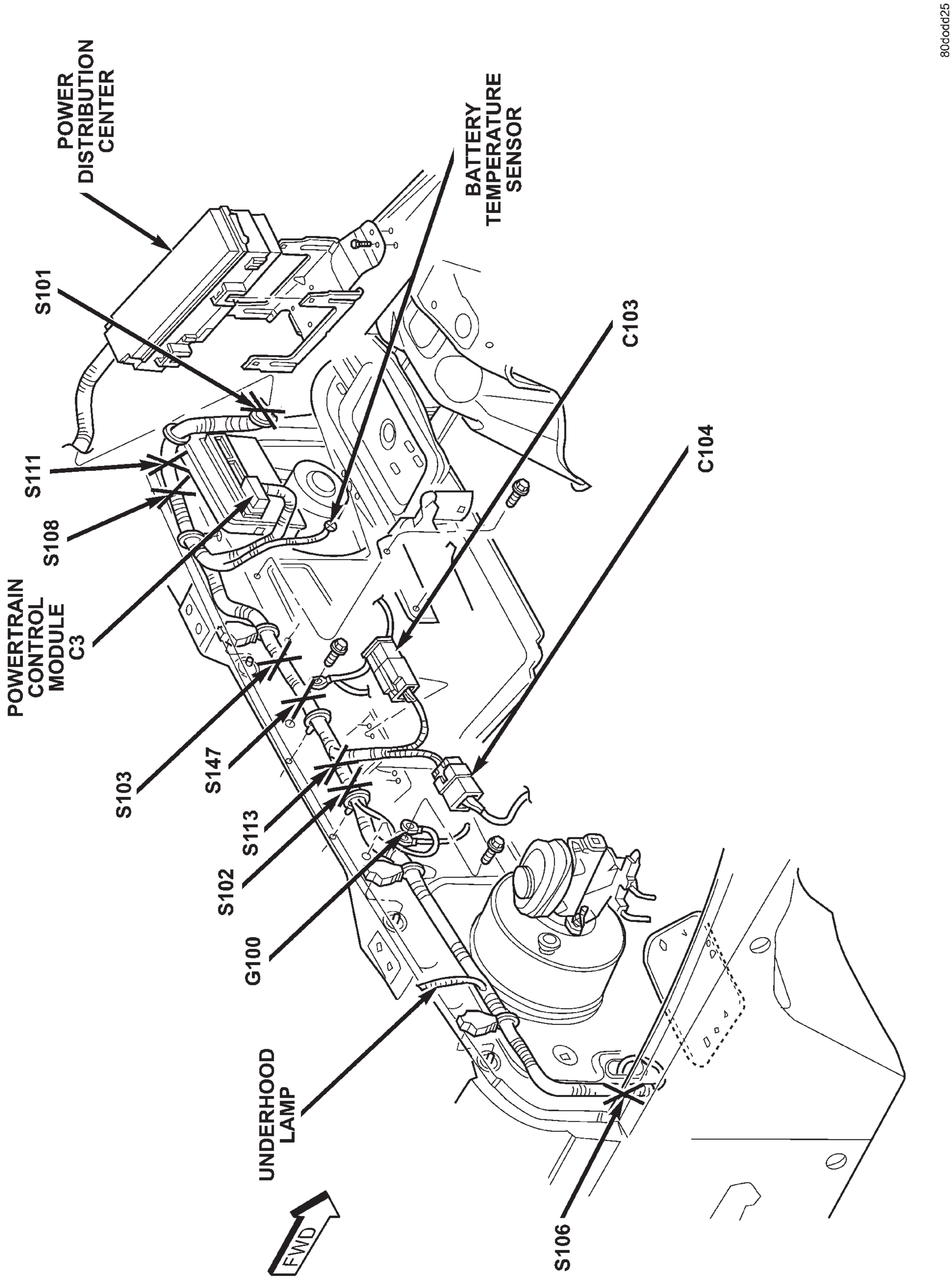


Fig. 7 REAR ENGINE COMPARTMENT RHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

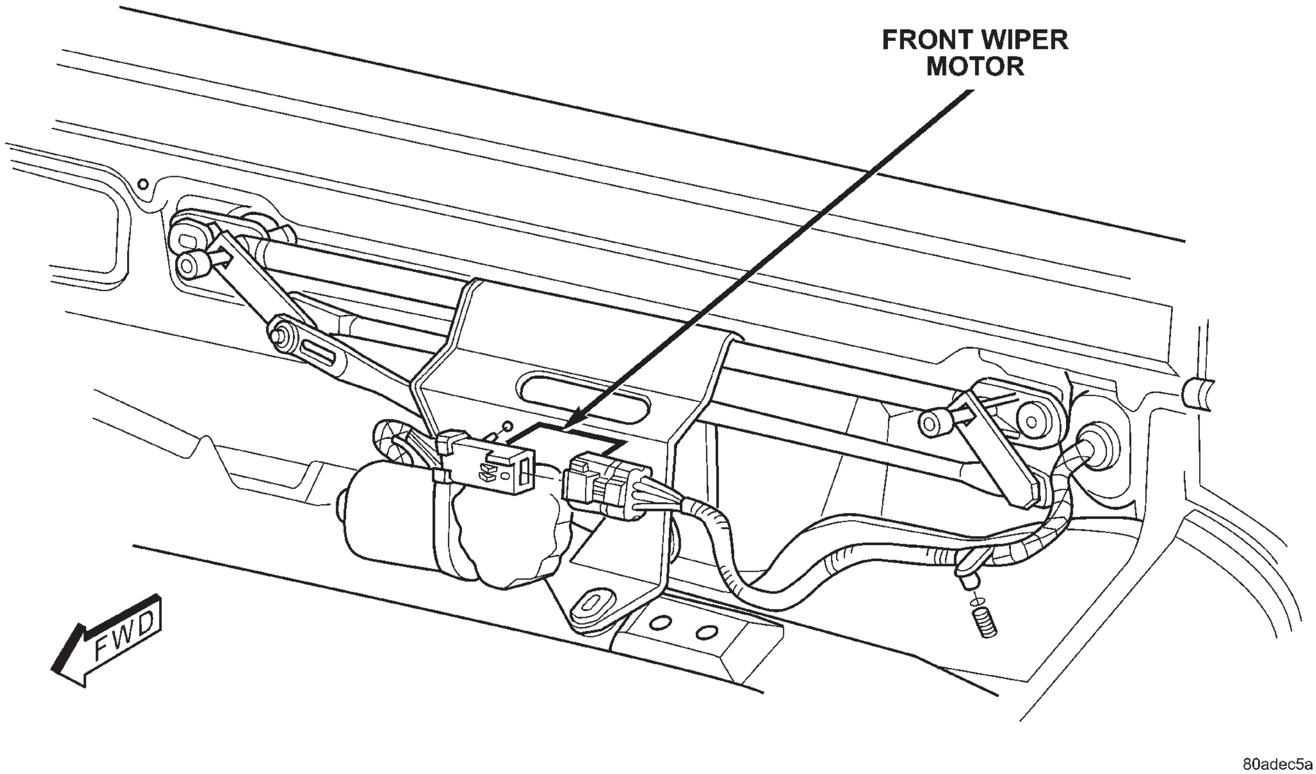


Fig. 8 FRONT WIPER MOTOR

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

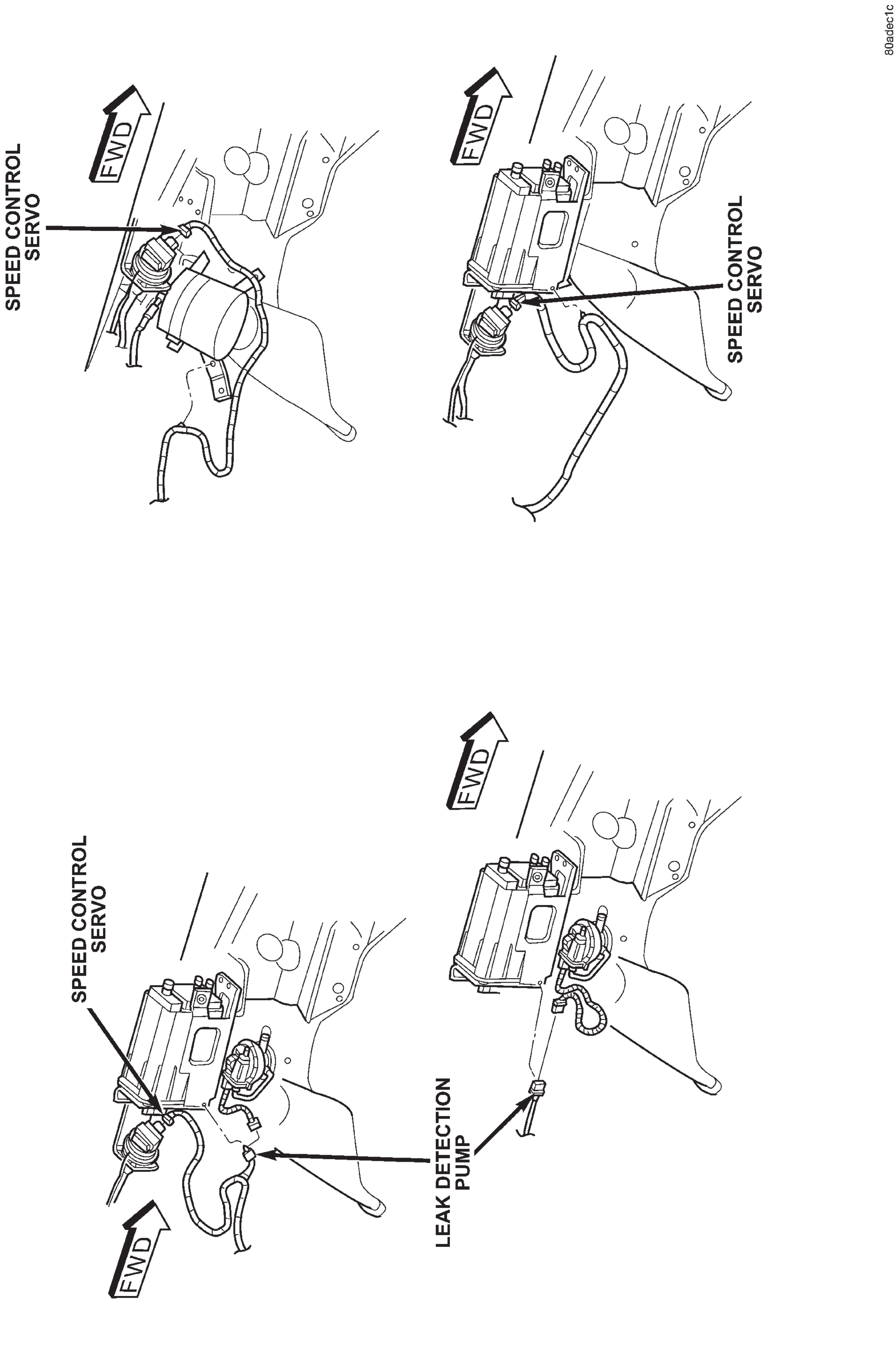


Fig. 9 SPEED CONTROL SERVO

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

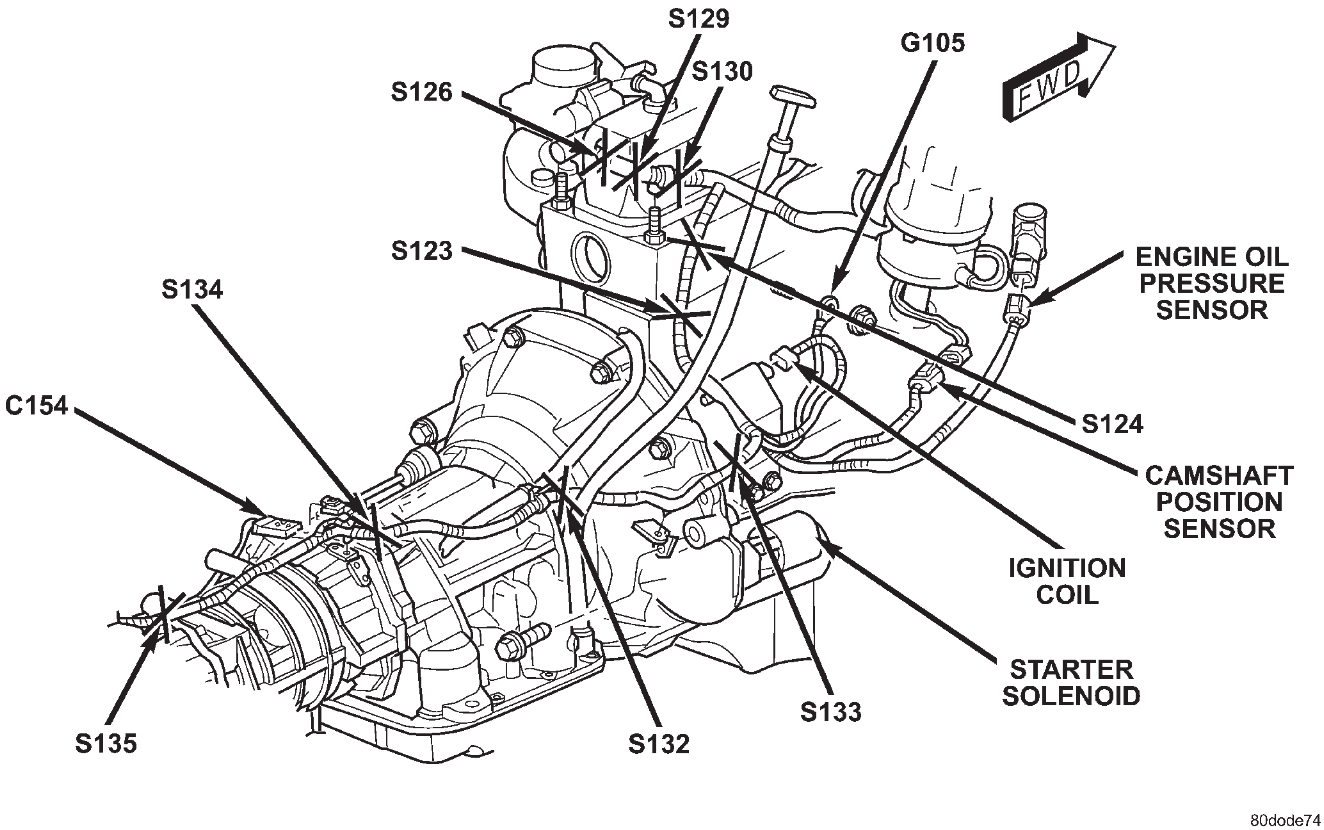


Fig. 10 2.5 LITER ENGINE AND TRANSMISSION

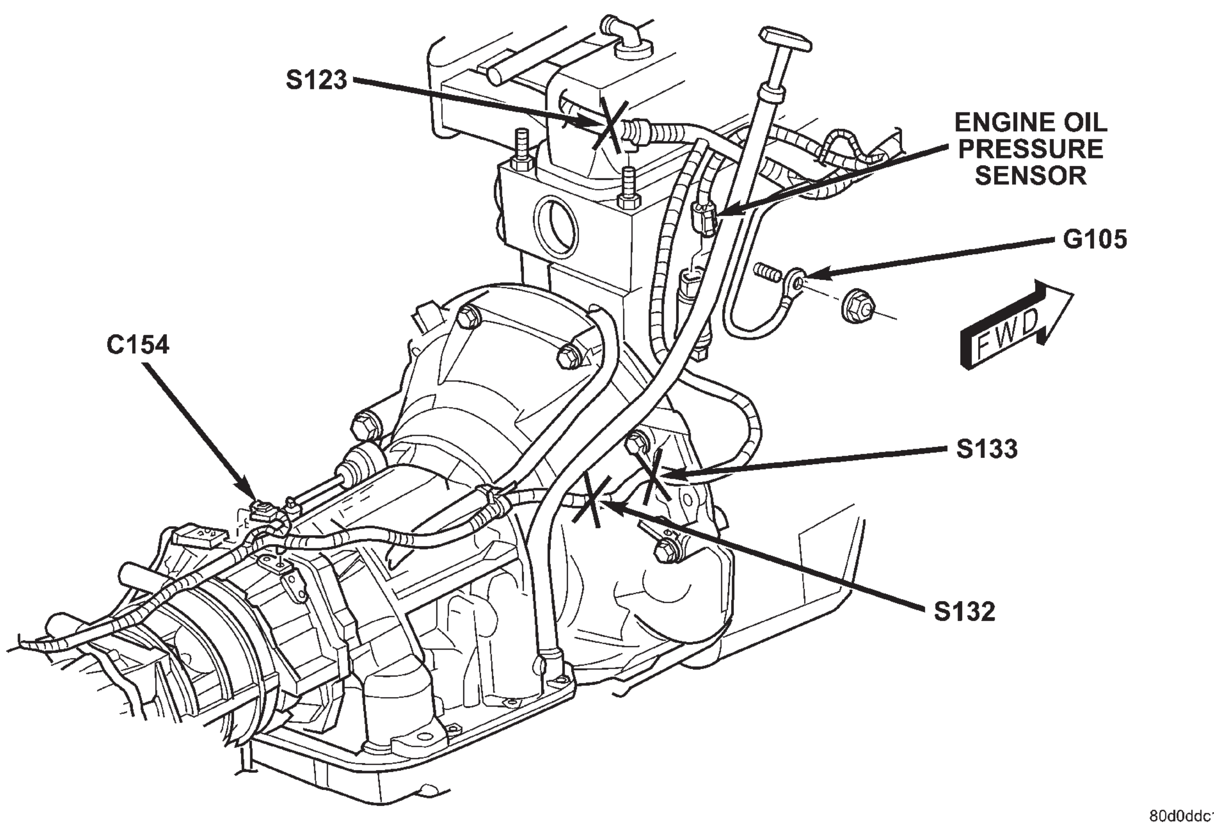


Fig. 11 4.0 LITER ENGINE AND TRANSMISSION

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

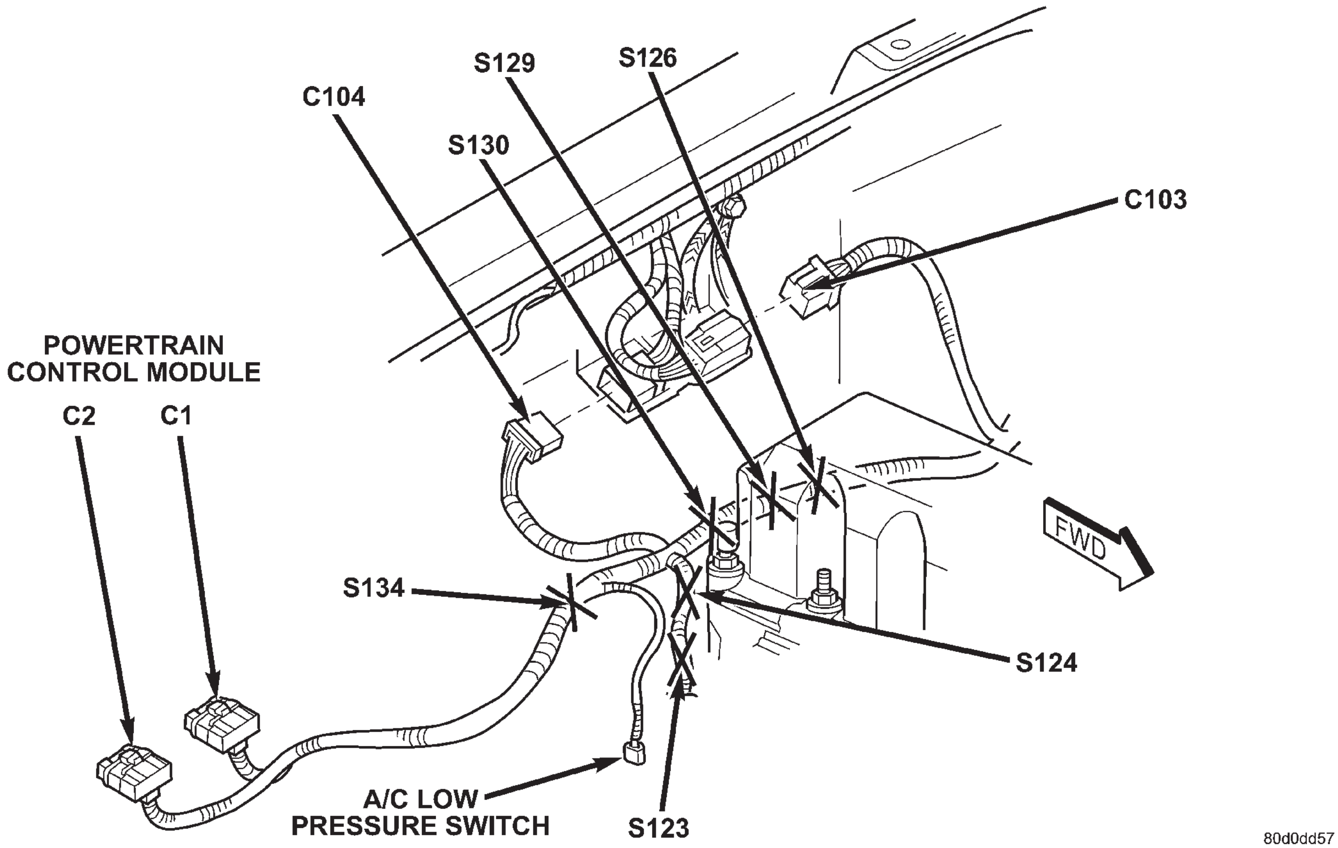


Fig. 12 2.5 LITER ENGINE REAR

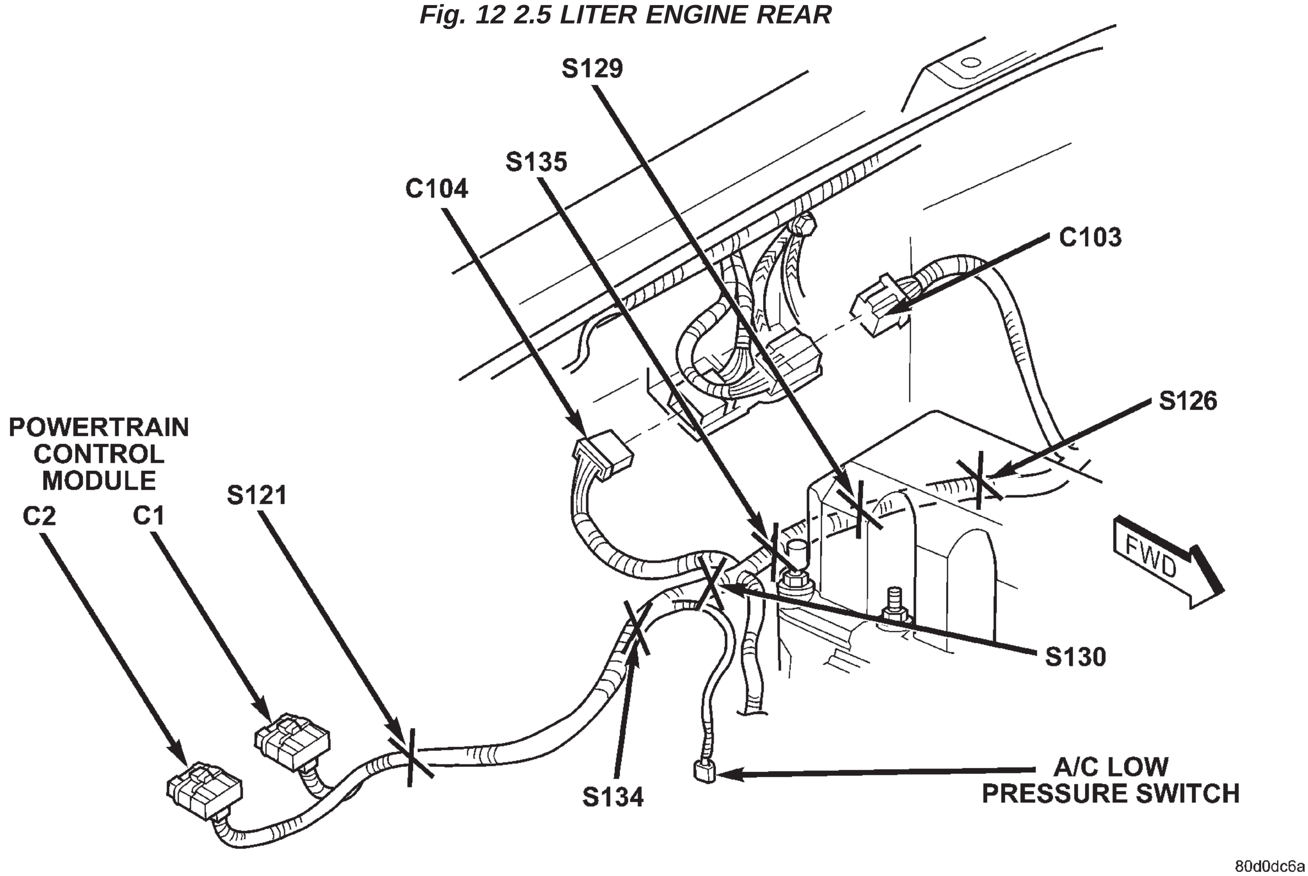


Fig. 13 4.0 LITER ENGINE REAR

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

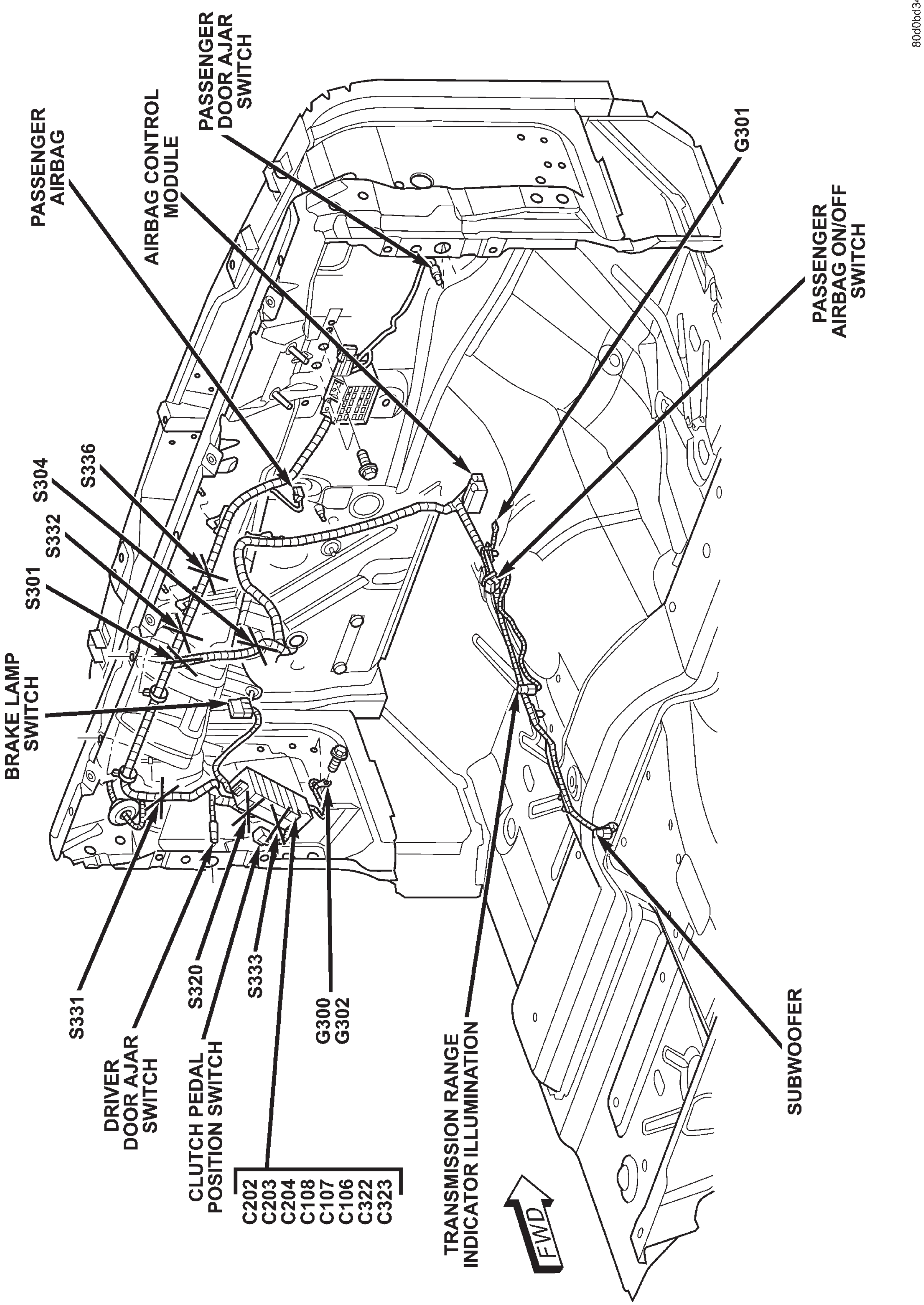


Fig. 14 DASH PANEL LHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

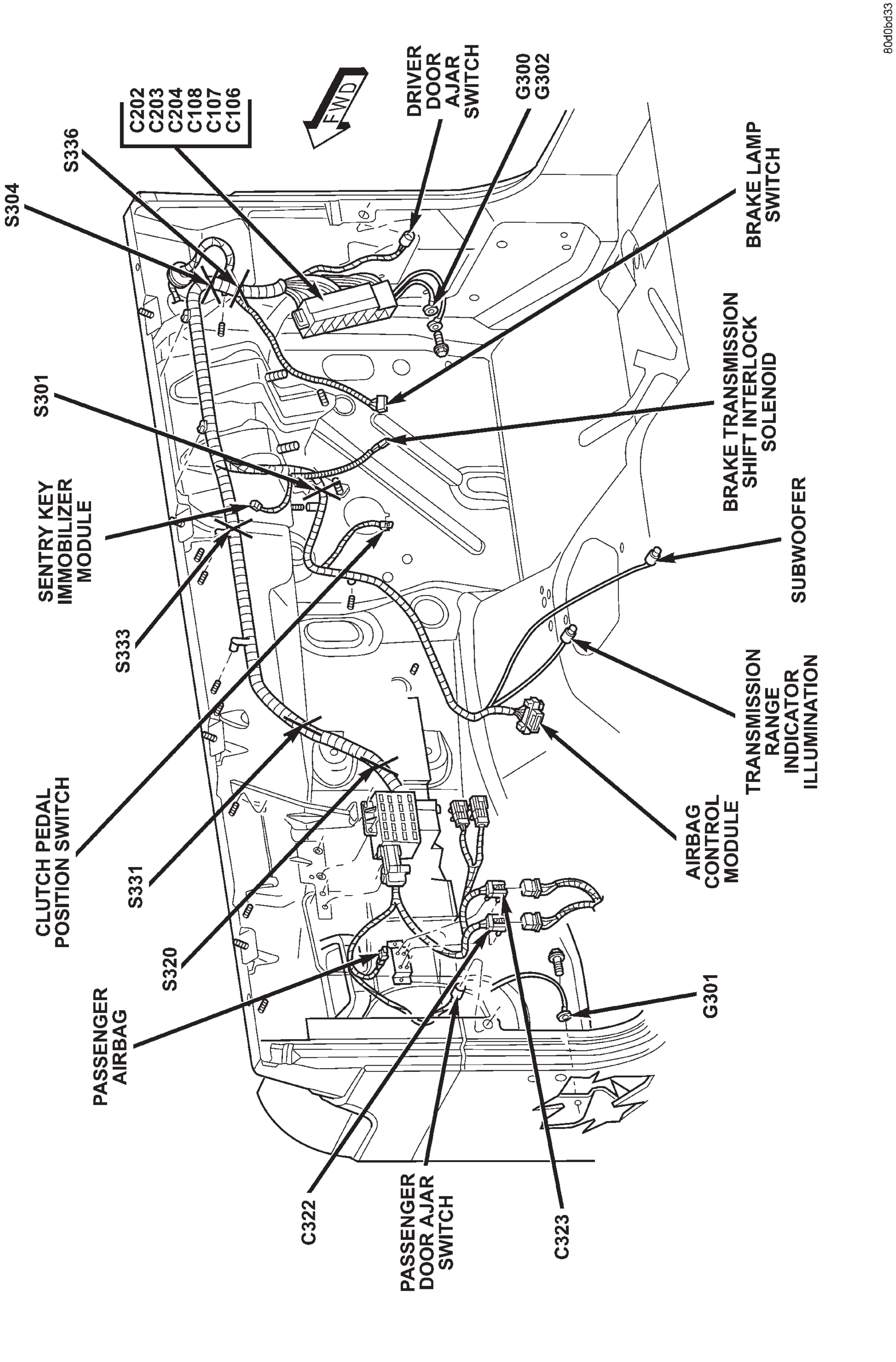


Fig. 15 DASH PANEL RHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

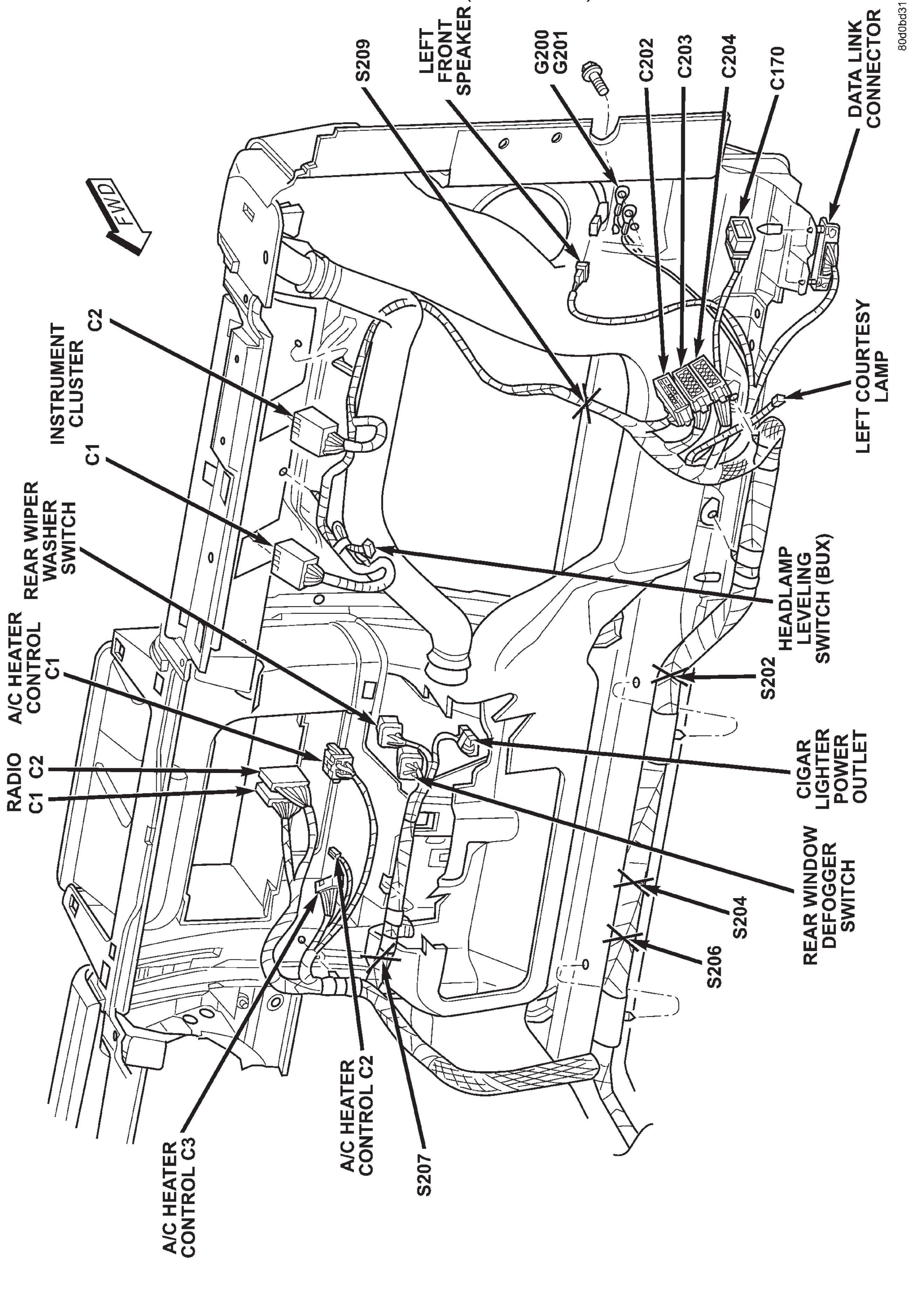


Fig. 16 LEFT SIDE INSTRUMENT PANEL LHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

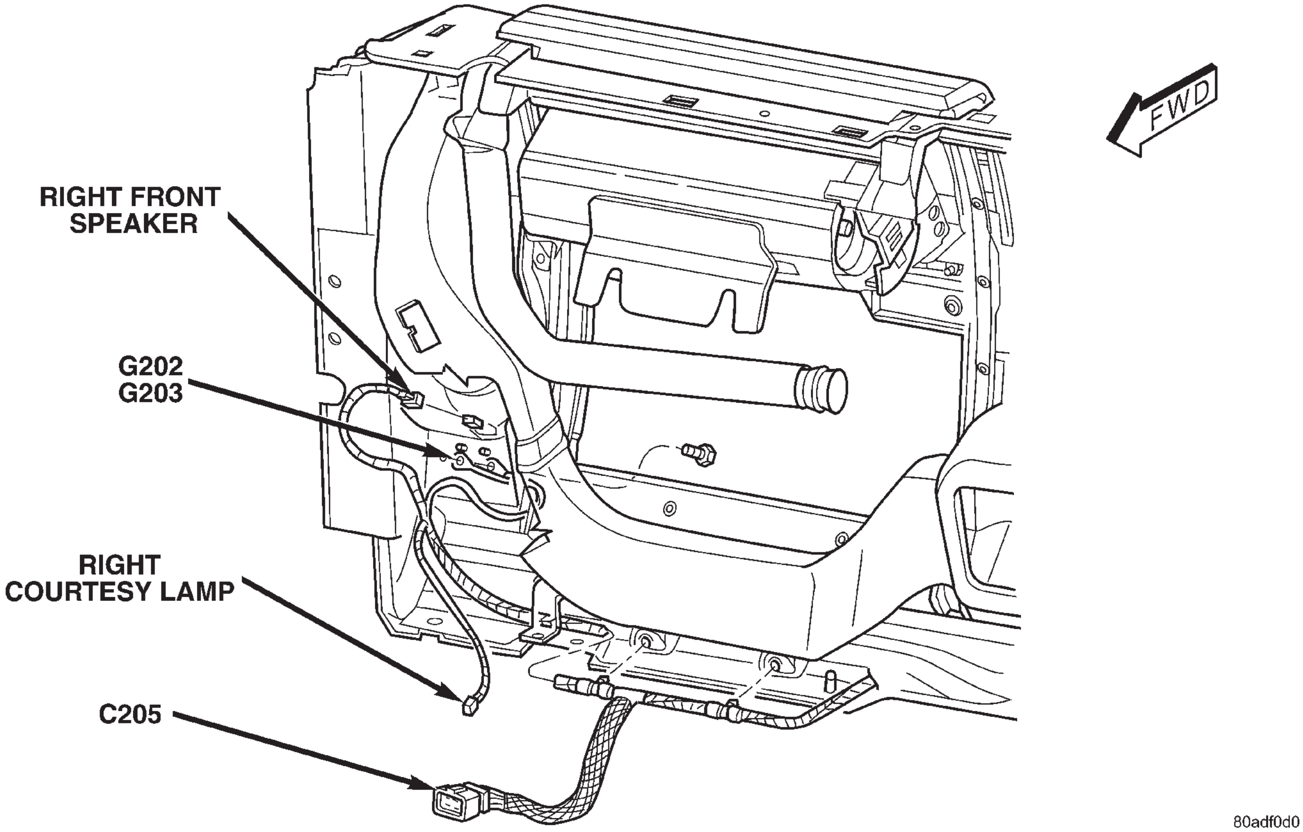


Fig. 17 RIGHT SIDE INSTRUMENT PANEL LHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

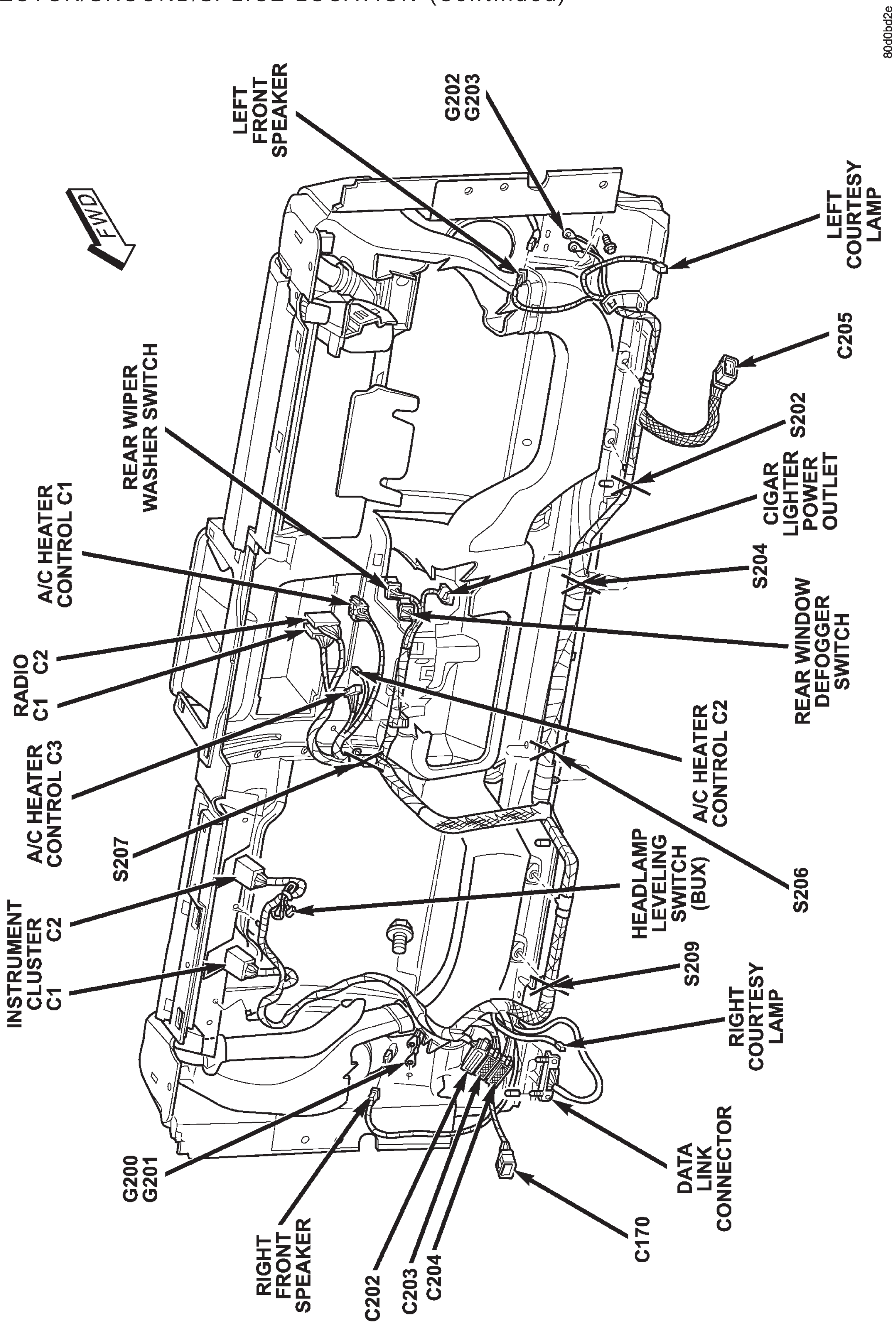


Fig. 18 INSTRUMENT PANEL RHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

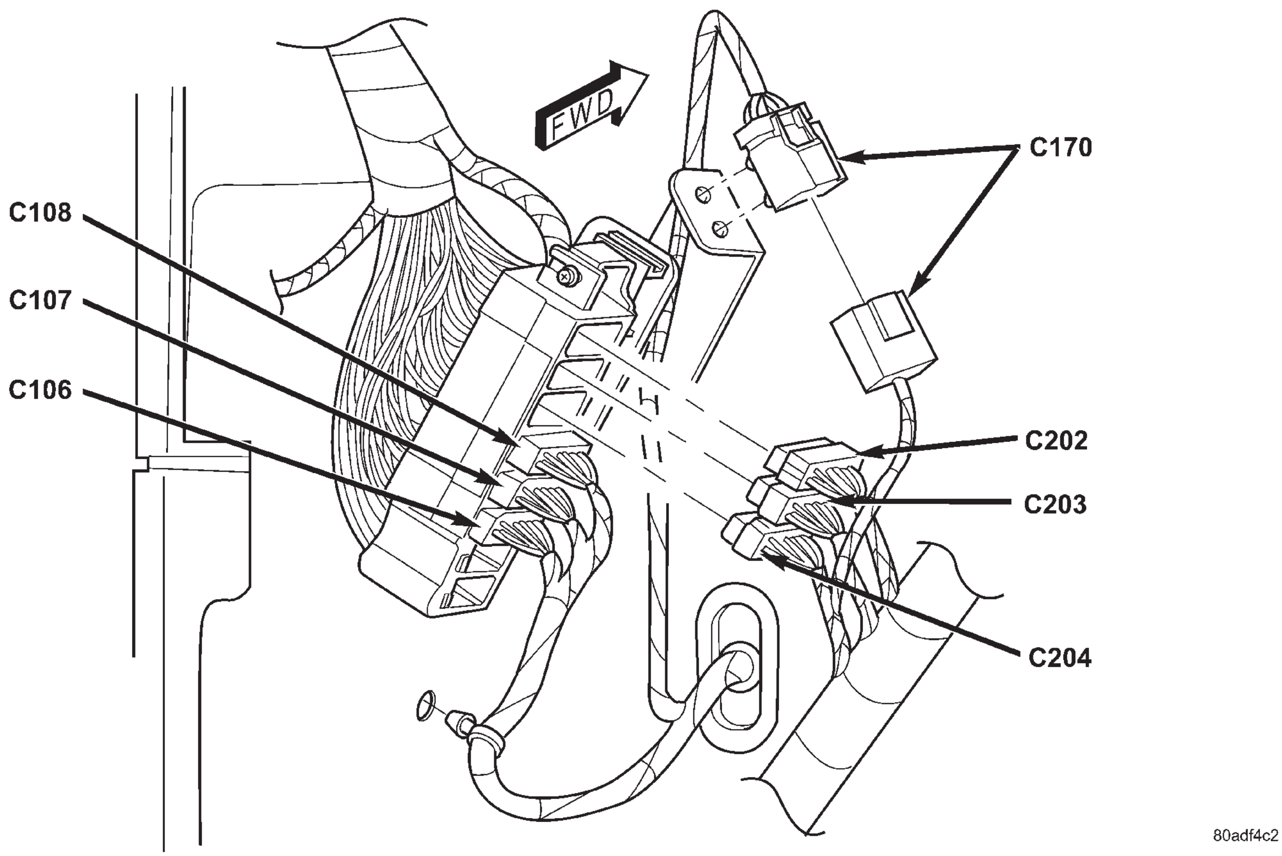


Fig. 19 LEFT COWL PANEL LHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

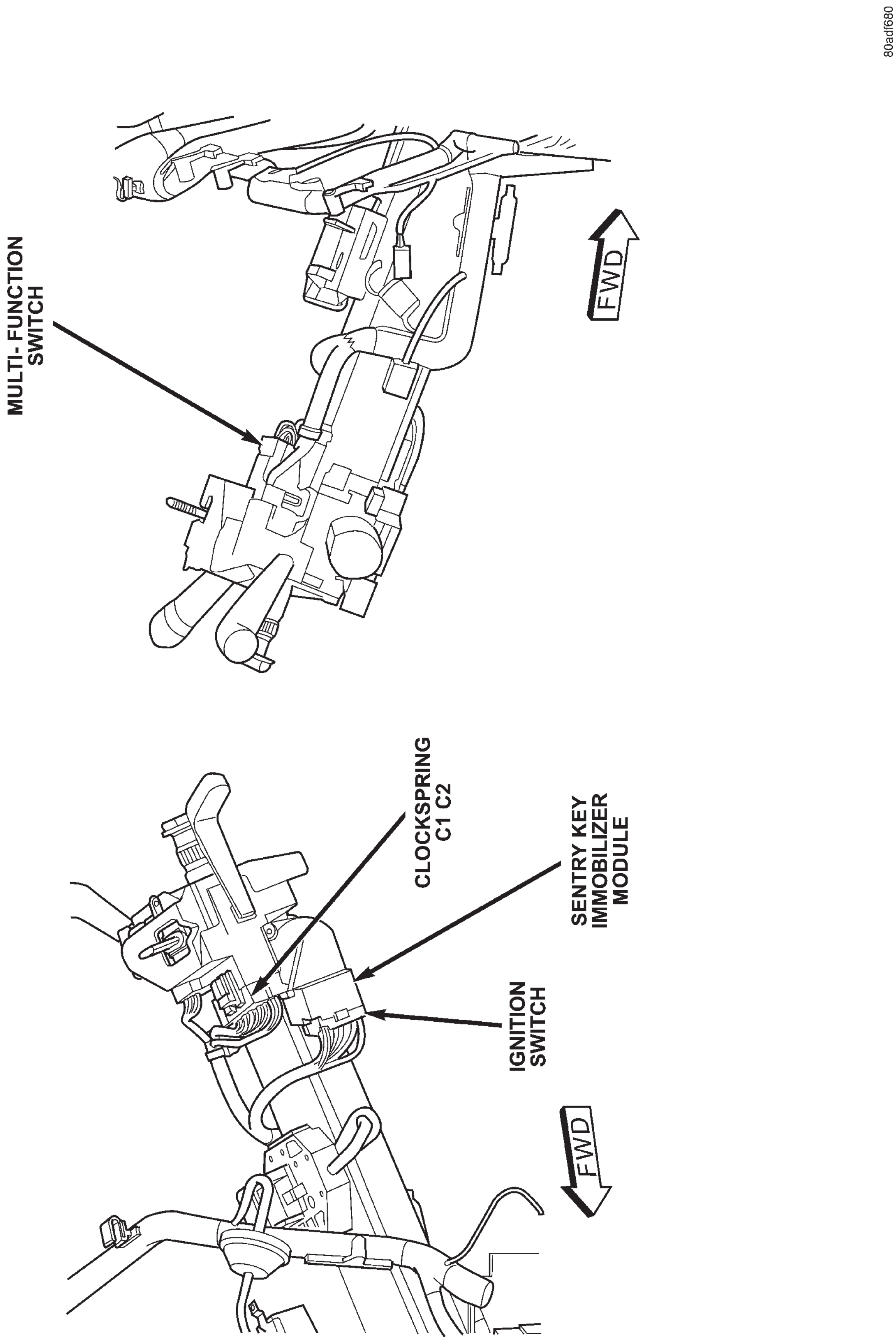


Fig. 20 STEERING COLUMN

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

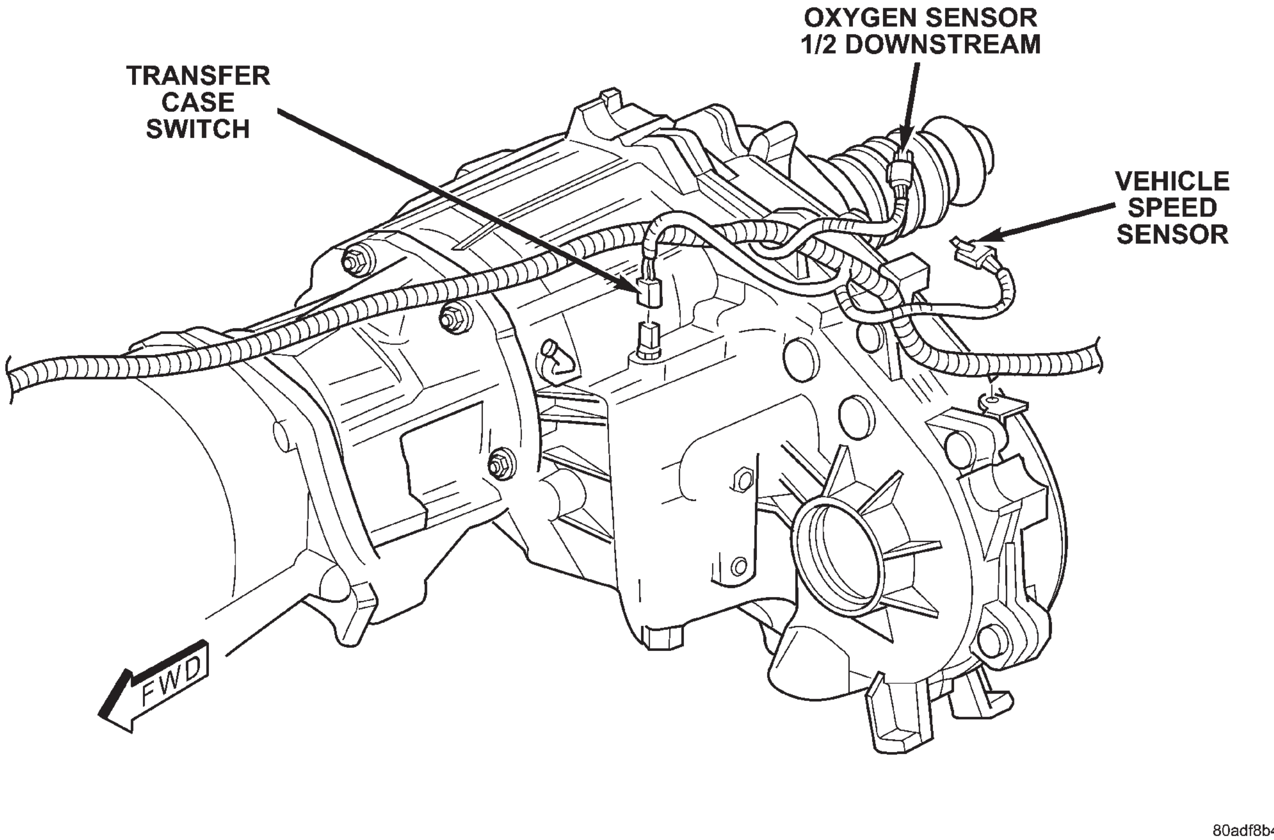


Fig. 21 TRANSFER CASE

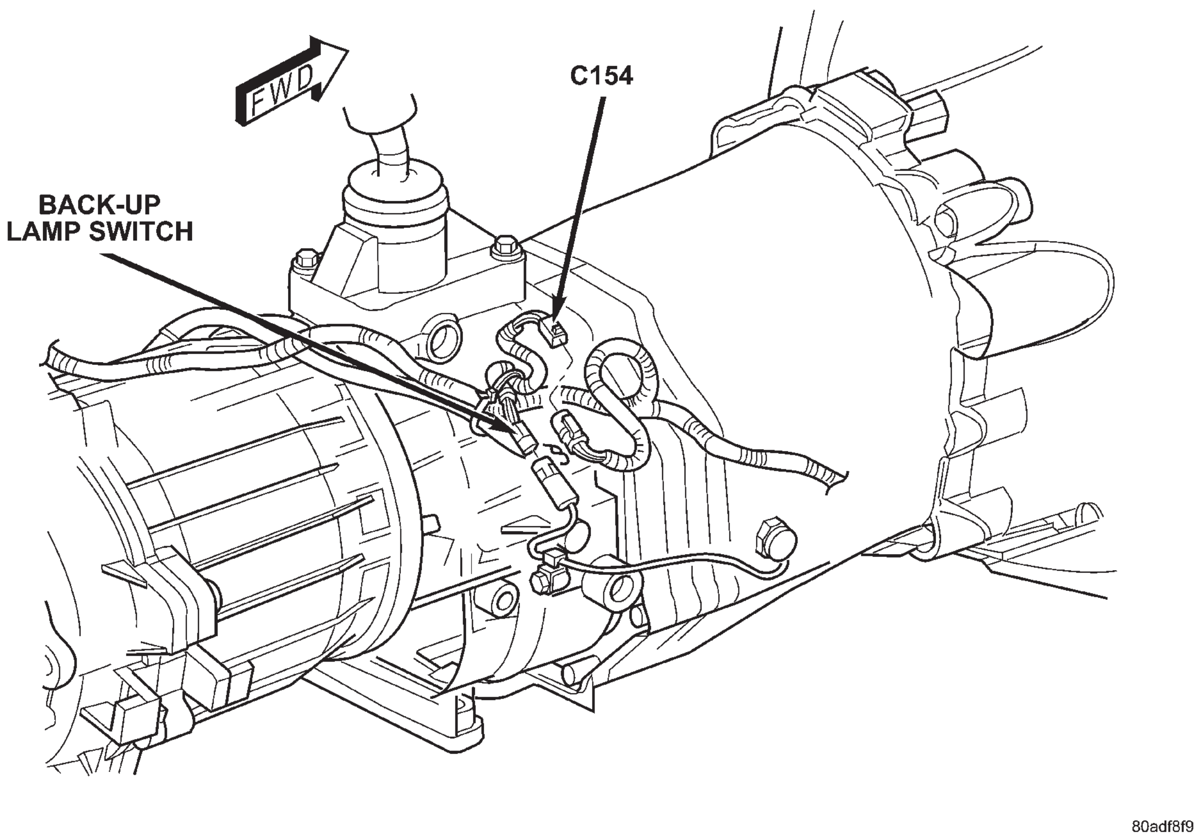


Fig. 22 MANUAL TRANSMISSION BUX

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

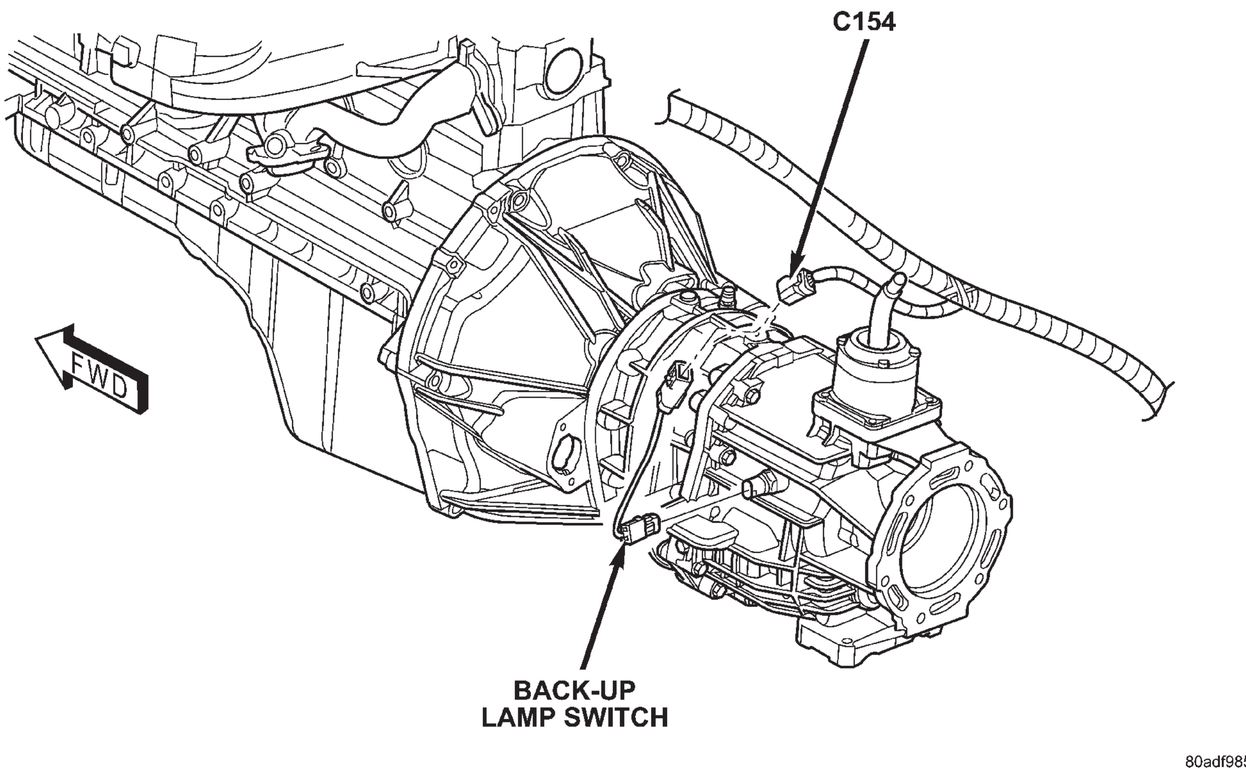


Fig. 23 MANUAL TRANSMISSION

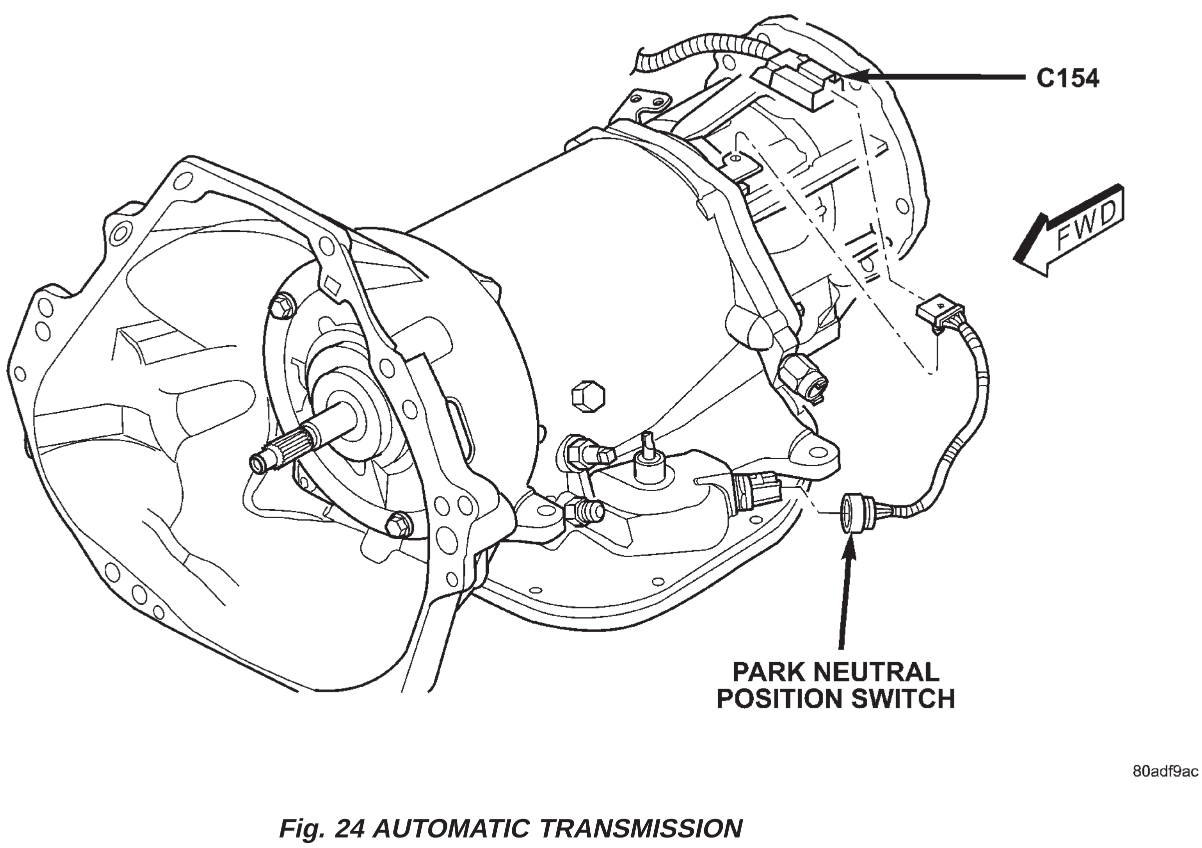


Fig. 24 AUTOMATIC TRANSMISSION

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

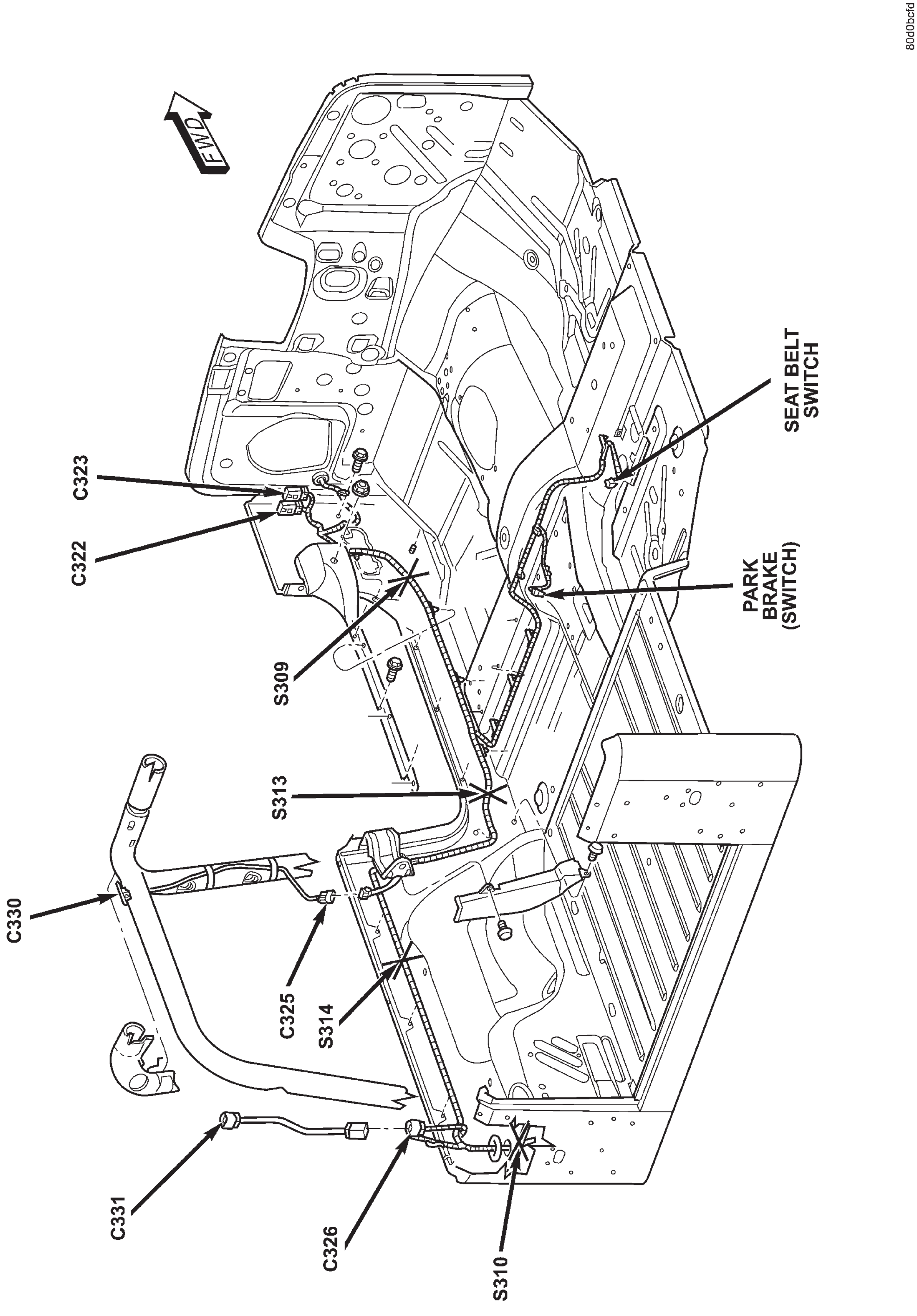


Fig. 25 BODY CONNECTORS

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

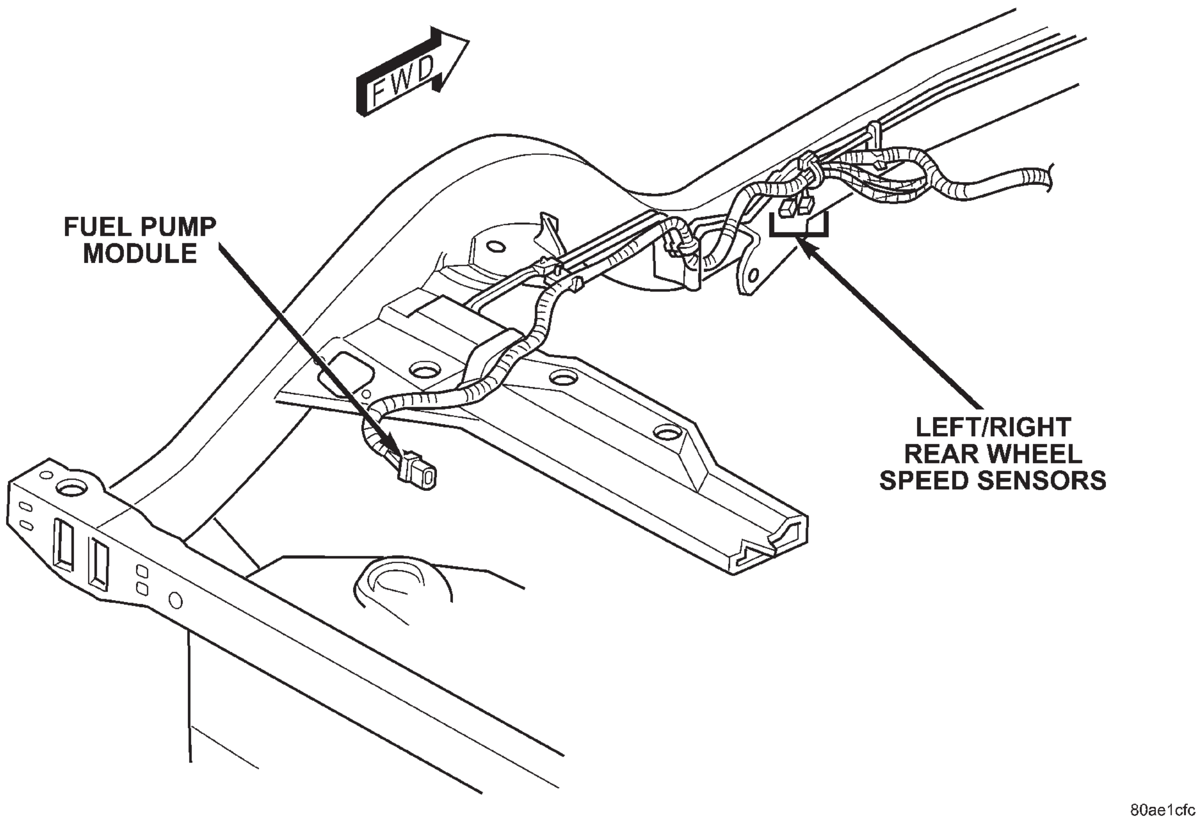


Fig. 26 FUEL PUMP

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

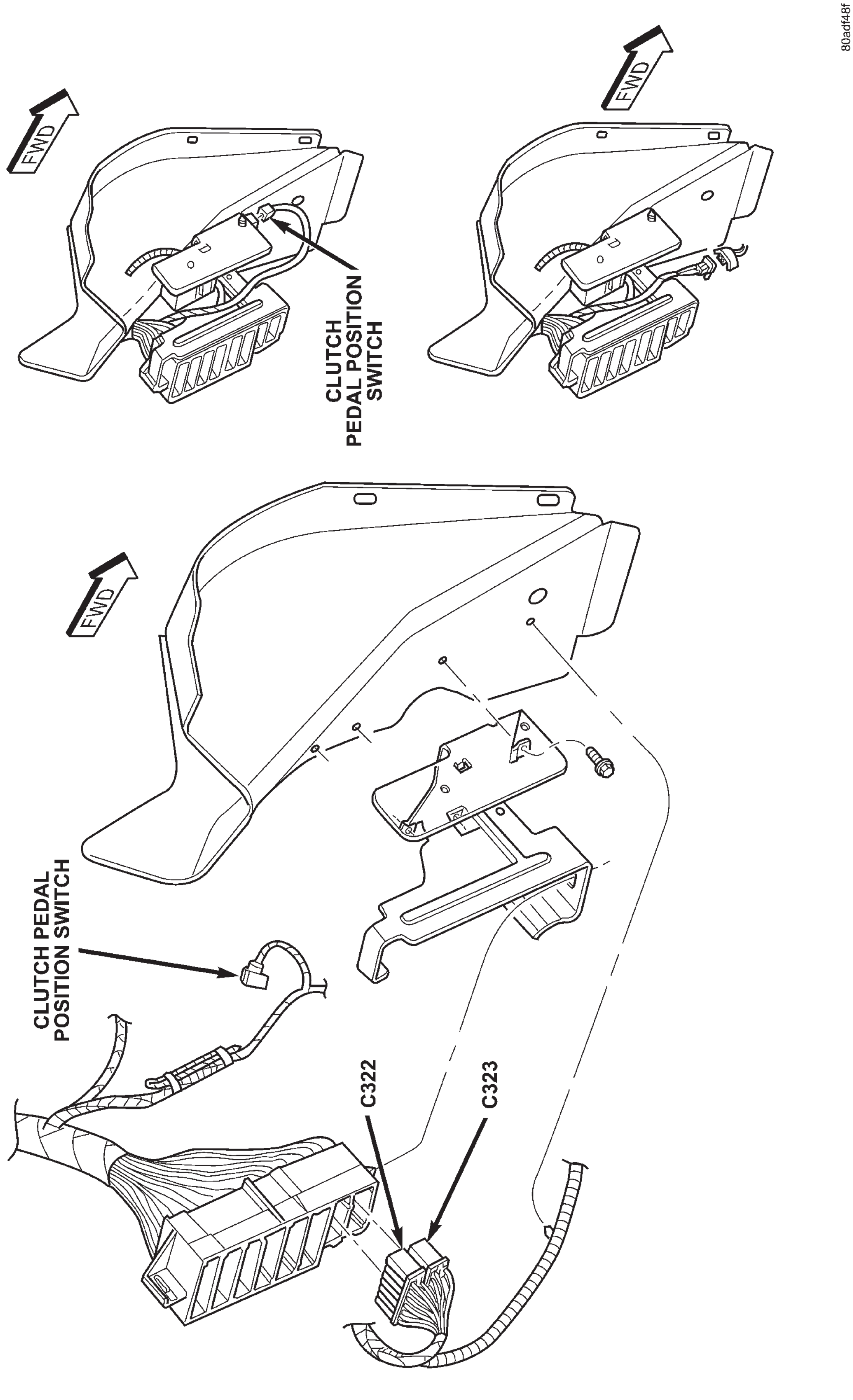


Fig. 27 LEFT COWL MANUAL TRANSMISSION LHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

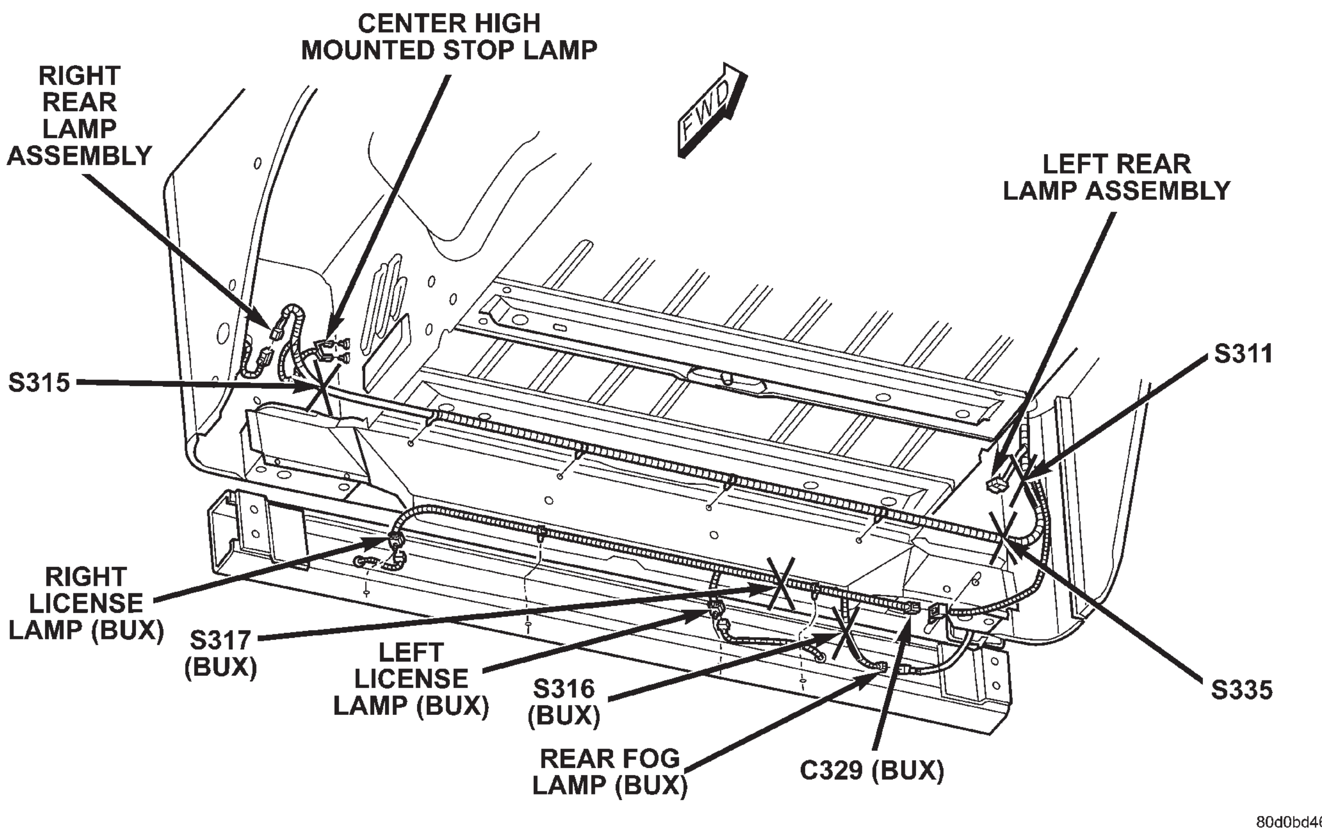


Fig. 28 REAR LAMPS

8W-97 POWER DISTRIBUTION

TABLE OF CONTENTS

POWER DISTRIBUTION

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
- Cigar Lighter Outlet

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.

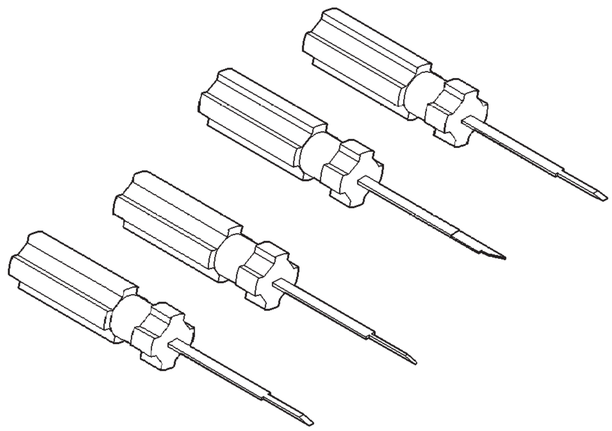
OPERATION

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 (Continued)

SPECIAL TOOLS

POWER DISTRIBUTION SYSTEMS



Terminal Pick Kit 6680

CIGAR LIGHTER OUTLET

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 (f13) in the Power Distribution Center (PDC) through the ignition switch, only when in the Accessory or On position and through a fuse (f19) in the fuseblock.′

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 the heating element is recessed and shielded around its circumference for safety.

DIAGNOSIS AND TESTING - CIGAR LIGHTER OUTLET

For complete circuit diagrams, refer to **Wiring Diagrams**.

WARNING: REFER TO THE RESTRAINTS SECTION OF THE SERVICE MANUAL 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 #3 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.

CIGAR LIGHTER OUTLET (Continued)

Check for battery voltage at cavity #1 of the cigar lighter wire harness connector. If OK, replace the faulty accessory switch bezel unit. If not OK, check for blown fuse in the fuseblock (f19) or in the PDC (f13). If fuse is blown check for short circuit. Repair the circuit as required and replace blown fuse.

FUSE BLOCK

DESCRIPTION

An electrical fuseblock module is mounted on the dash panel in the passenger compartment of the vehicle (Fig. 1). 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.

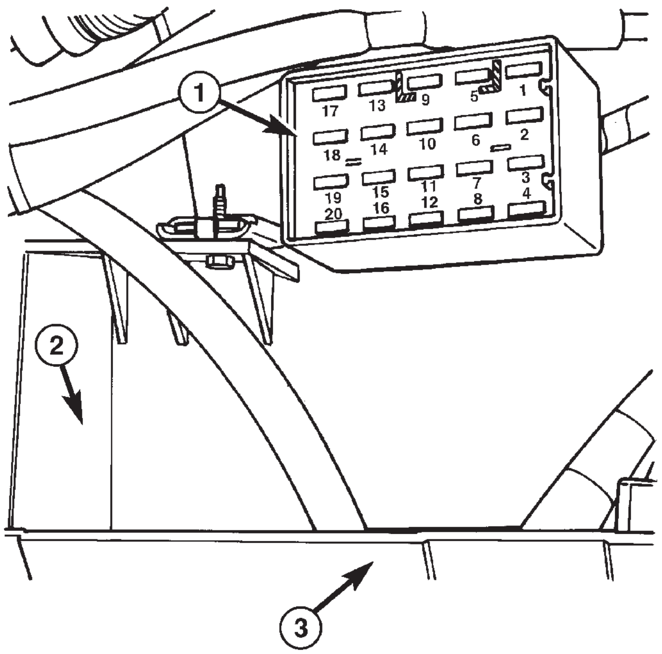
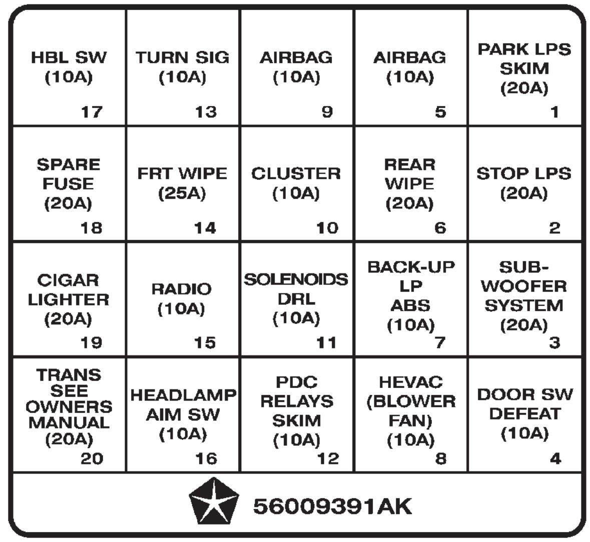


Fig. 1 Fuseblock Module Location

1 - FUSE BLOCK
2 - HEATER CASE
3 - GLOVE BOX OPENING

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 (Fig. 2)is located on the outside of the glove box bin (Fig. 3) 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.



HBL SW (10A) 17	TURN SIG (10A) 13	AIRBAG (10A) 9	AIRBAG (10A) 5	PARK LPS SKIM (20A) 1
SPARE FUSE (20A) 18	FRT WIPE (25A) 14	CLUSTER (10A) 10	REAR WIPE (20A) 6	STOP LPS (20A) 2
CIGAR LIGHTER (20A) 19	RADIO (10A) 15	SOLENOIDS DRL (10A) 11	BACK-UP LP ABS (10A) 7	SUB-WOOFER SYSTEM (20A) 3
TRANS SEE OWNERS MANUAL (20A) 20	HEADLAMP AIM SW (10A) 16	PDC RELAYS SKIM (10A) 12	HEVAC (BLOWER FAN) (10A) 8	DOOR SW DEFEAT (10A) 4

56009391AK

80d9ff50

Fig. 2 Fuseblock Label

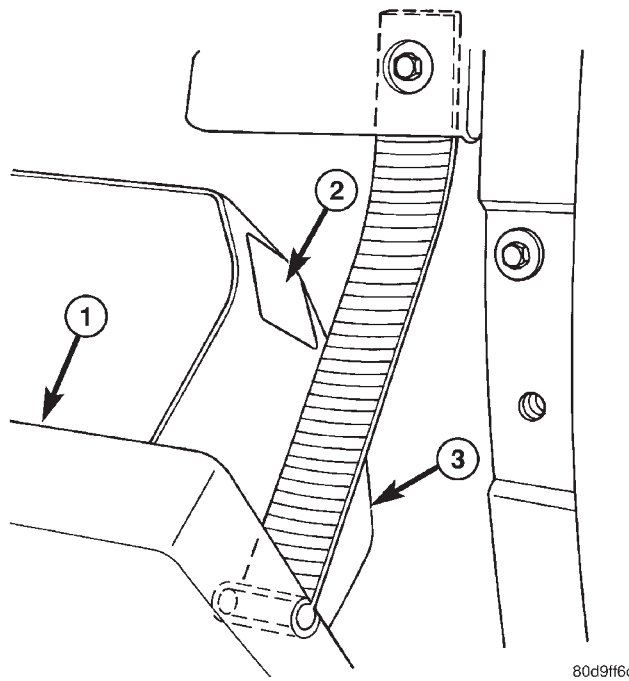


Fig. 3 Fuseblock Label Location

1 - GLOVE BOX DOOR
2 - FUSEBLOCK LABEL
3 - GLOVE BOX BIN

FUSE BLOCK (Continued)

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 **Wiring Diagrams** for the location of complete fuseblock module circuit diagrams.

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly from the dash panel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - REMOVAL).

(3) Disconnect each of the cross body wire harness connectors. Refer to **Connector Locations** in Wiring for the location of 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 Wiring for the location of the cross body wire harness ground 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 Wiring for the location of 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. 4).

(7) Remove the fuseblock module and the cross body wire harness from the dash panel as a unit.

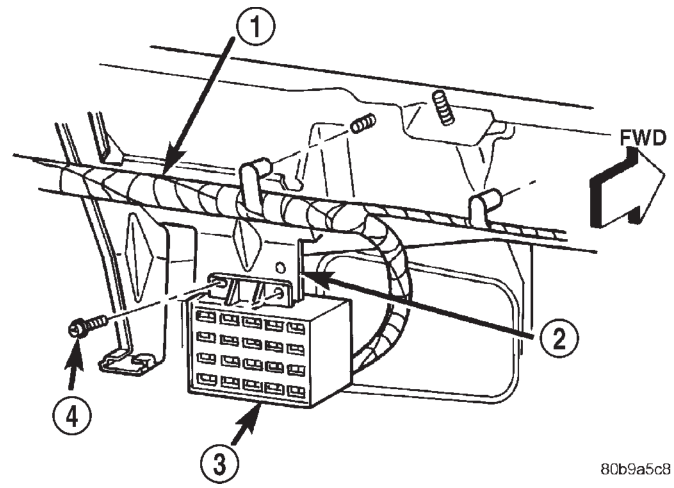


Fig. 4 Fuseblock Module Remove/Install

1 - CROSS BODY WIRE HARNESS
2 - BRACKET
3 - FUSEBLOCK MODULE
4 - SCREWS (2)

INSTALLATION

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.

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 Wiring for the location of 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 Wiring for the location of the cross body wire harness ground eyelet locations.

(5) Reconnect each of the cross body wire harness connectors. Refer to **Connector Locations** in Wiring for the location of the cross body wire harness connector locations.

(6) Install the instrument panel assembly onto the dash panel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(7) Reconnect the battery negative cable.

IOD FUSE

DESCRIPTION

All vehicles are equipped with an Ignition-Off Draw (IOD) fuse (Fig. 5) that is removed from its cavity in the Power Distribution Center (PDC) when

IOD FUSE (Continued)

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 15 as part of the preparation procedures performed just prior to new vehicle delivery.

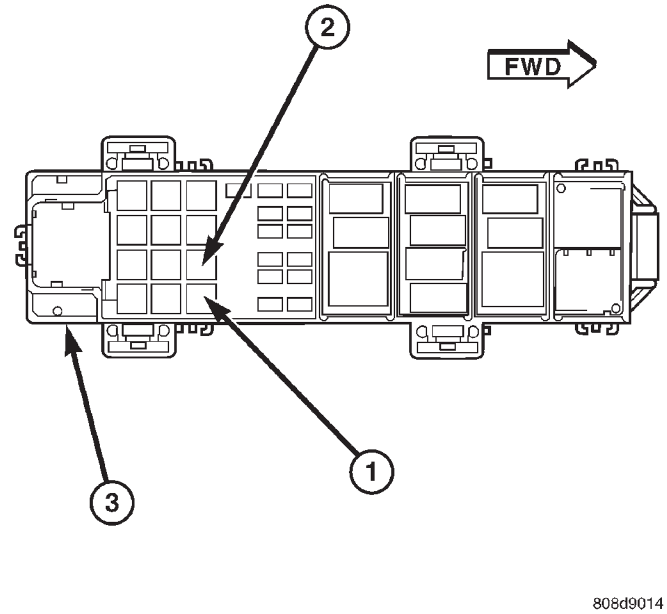


Fig. 5 Ignition-Off Draw Fuse

1 - IGNITION-OFF DRAW FUSE
2 - IGNITION-OFF DRAW FUSE STORAGE LOCATION
3 - POWER DISTRIBUTION CENTER

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 50 ampere cartridge-type fuse and, when removed, it is stored in the empty fuse cavity 11 of the PDC.

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 #15 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, 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.

REMOVAL

The Ignition-Off Draw (IOD) fuse is removed from Power Distribution Center (PDC) fuse cavity #15 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.

(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 #15 of the PDC.
(4) Store the removed IOD fuse by inserting the terminal blades of the fuse into the empty fuse cavity #11 of the PDC.
(5) Close and latch the cover onto the PDC.

INSTALLATION

The Ignition-Off Draw (IOD) fuse is removed from Power Distribution Center (PDC) fuse cavity #15 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.

(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 #11 of the PDC.

IOD FUSE (Continued)

(4) Align the terminal blades of the IOD fuse with the terminal receptacles in fuse cavity #15 of the PDC.

(5) Use a thumb to press the IOD fuse firmly down into PDC fuse cavity #15.

(6) Close and latch the cover onto the PDC.

POWER DISTRIBUTION CENTER

DESCRIPTION

All of the electrical current distributed throughout this vehicle is directed through the standard equipment Power Distribution Center (PDC) (Fig. 6). 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 (ISO) relays (four standard-type and eight micro-type).

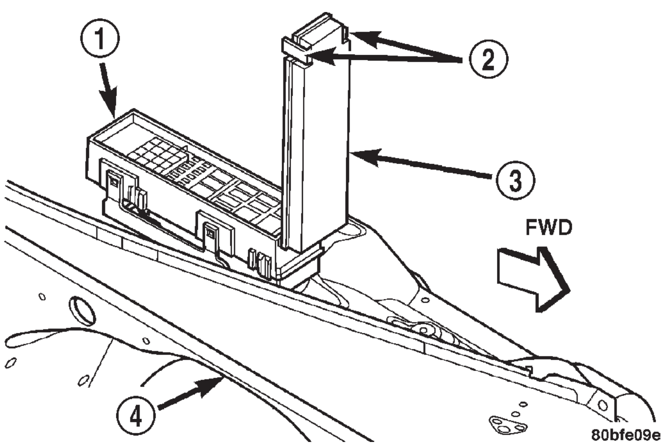


Fig. 6 Power Distribution Center Location

1 - POWER DISTRIBUTION CENTER
2 - LATCHES
3 - PDC COVER
4 - RIGHT FRONT FENDER

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.

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 the**Wiring** section of this service manual for wiring diagrams.

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect each of the dash wire harness connectors. Refer to **Connector Locations** in the Wiring section of this service manual for the location of 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 Wiring section of this service manual for the location of 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 Wiring section of this service manual for the location of the dash wire harness retainer locations.

POWER DISTRIBUTION CENTER (Continued)

(5) Unlatch and open the PDC cover (Fig. 7).

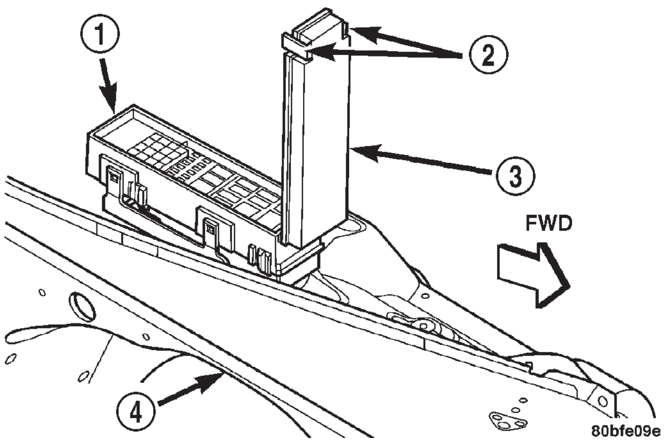


Fig. 7 Power Distribution Center

1 - POWER DISTRIBUTION CENTER
2 - LATCHES
3 - PDC COVER
4 - RIGHT FRONT FENDER

(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.

(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.

DISASSEMBLY

POWER DISTRIBUTION CENTER DISASSEMBLY

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. 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.

PDC HOUSING LOWER COVER REMOVAL

(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 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. 8).

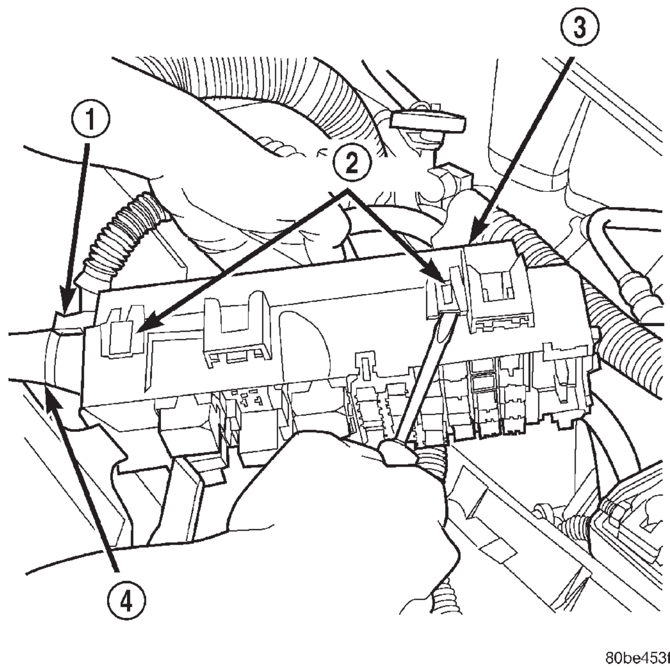


Fig. 8 PDC Housing Lower Cover Remove/Install - Typical

1 - THROUGH FORMATION
2 - LATCHES (5)
3 - PDC HOUSING LOWER COVER
4 - WIRE HARNESS

POWER DISTRIBUTION CENTER (Continued)

PDC B(+) TERMINAL MODULE REMOVAL

(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. 9).

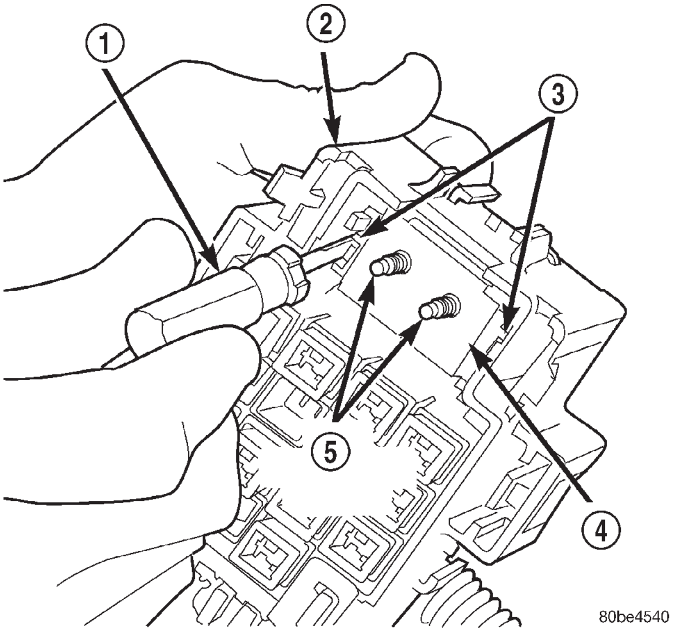


Fig. 9 PDC B(+) Terminal Module Latches

1 - FROM SPECIAL TOOL KIT 6680
2 - PDC HOUSING
3 - LATCHES
4 - BUS BAR
5 - B+ TERMINAL STUDS

(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. 10).

PDC RELAY WEDGE REMOVAL

(1) Remove the PDC housing lower cover.

(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. 11).

PDC RELAY CASSETTE REMOVAL

(1) Remove the relay wedge from the PDC relay cassette to be removed.

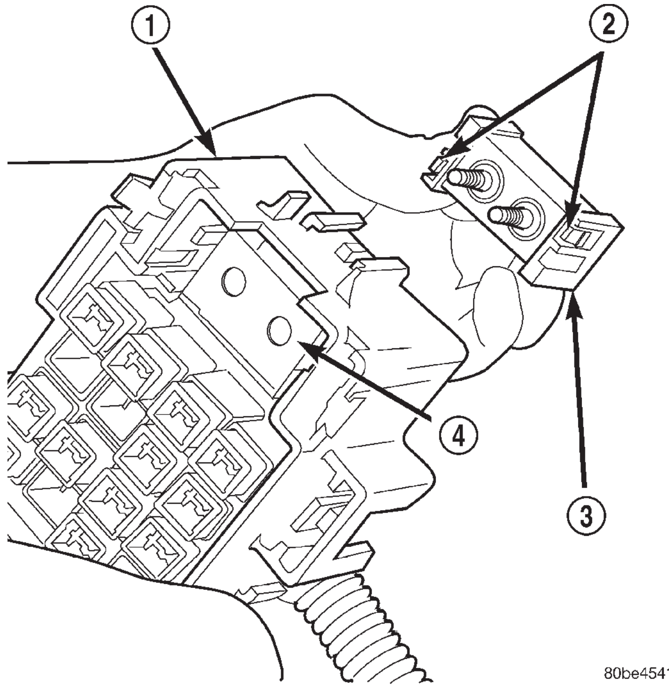


Fig. 10 PDC B(+) Terminal Module Remove/Install

1 - PDC HOUSING
2 - LATCHES
3 - B+ TERMINAL MODULE
4 - BUS BAR

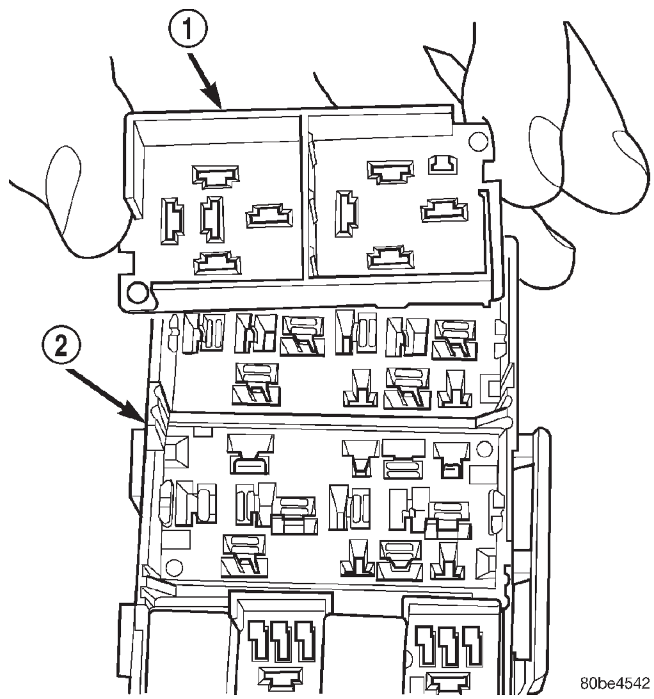


Fig. 11 PDC Relay Wedge Remove/Install - Typical

1 - RELAY WEDGE
2 - PDC HOUSING

POWER DISTRIBUTION CENTER (Continued)

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. 12).

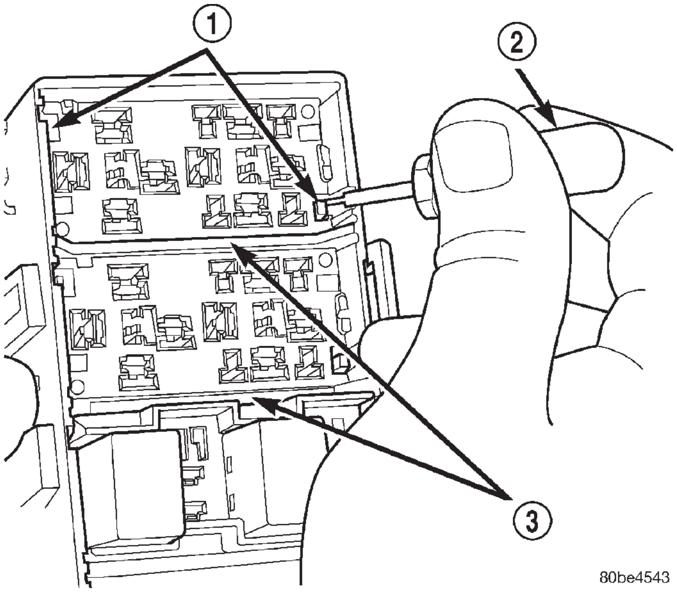


Fig. 12 PDC Relay Cassette Latches - Typical

1 - LATCHES
2 - FROM SPECIAL TOOL KIT 6680
3 - PDC RELAY CASSETTES

(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. 13).

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.

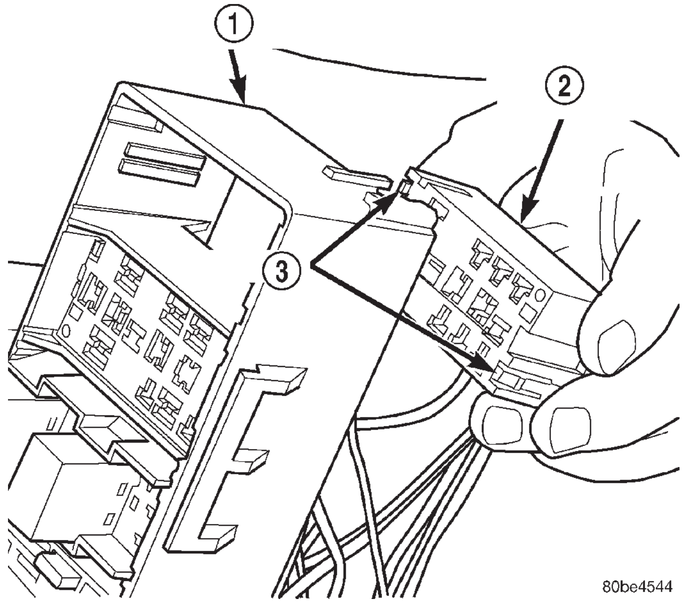


Fig. 13 PDC Relay Cassette Remove/Install - Typical

1 - PDC HOUSING
2 - PDC RELAY CASSETTE
3 - LATCHES

ASSEMBLY

POWER DISTRIBUTION CENTER ASSEMBLY

PDC HOUSING LOWER COVER INSTALLATION

(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.

PDC B+ TERMINAL MODULE INSTALLATION

(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.

POWER DISTRIBUTION CENTER (Continued)

(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 RELAY WEDGE INSTALLATION

(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.

(3) Install each of the removed relays into the proper cavities of the PDC relay wedge.

(4) Install the PDC housing lower cover.

PDC RELAY CASSETTE INSTALLATION

(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. 14).

(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.

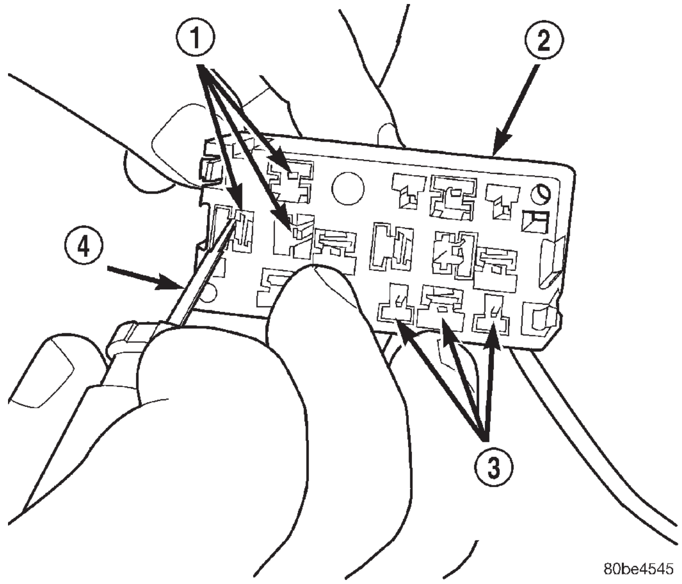


Fig. 14 PDC Relay Cassette Terminal Remove/Install

1 - TERMINAL CAVITIES
2 - PDC RELAY CASSETTE
3 - TERMINAL LATCHES
4 - FROM SPECIAL TOOL KIT 6680

(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.

INSTALLATION

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.

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.

POWER DISTRIBUTION CENTER (Continued)

(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 SUPPORT BRACKET

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the Power Distribution Center (PDC) from the PDC bracket (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/POWER DISTRIBUTION CENTER - REMOVAL).

(3) Remove the three screws that secure the PDC bracket to the right front inner fender (Fig. 15).

(4) Remove the PDC bracket from the right front inner fender.

INSTALLATION

(1) Position the PDC bracket onto the right front inner fender.

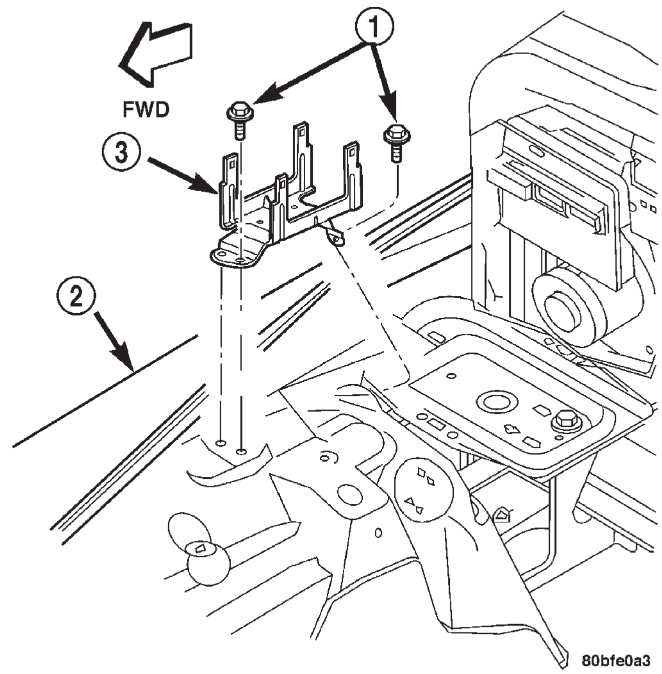


Fig. 15 PDC Bracket

1 - SCREWS (3)
2 - RIGHT FRONT FENDER
3 - PDC BRACKET

(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 8 - ELECTRICAL/POWER DISTRIBUTION/POWER DISTRIBUTION CENTER - INSTALLATION).

(4) Reconnect the battery negative cable.

MICRO-RELAY

DESCRIPTION

A micro-relay is a conventional International Standards Organization (ISO) micro relay (Fig. 16). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

Relays cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

OPERATION

A micro-relay is an electromechanical switch that uses a low current input from one source to control a high current output to another device. The movable common feed contact point is held against the fixed

MICRO-RELAY (Continued)

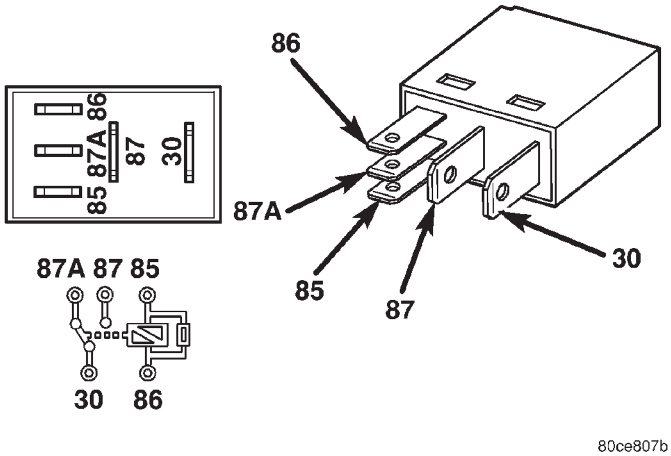


Fig. 16 ISO Micro Relay

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

DIAGNOSIS AND TESTING - MICRO-RELAY

(1) Remove the relay from its mounting location.

(2) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30 (Fig. 16). If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be 67.5 - 82.5 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, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

REMOVAL

(1) Remove the relay by grasping it firmly and pulling it straight out from its receptacle.

INSTALLATION

(1) Align the micro-relay terminals with the terminal cavities in the receptacle.

(2) Push firmly and evenly on the top of the relay until the terminals are fully seated in the terminal cavities in the receptacle.

RELAY

DESCRIPTION

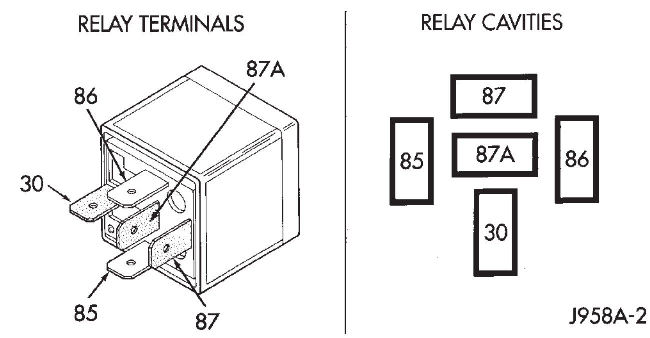


Fig. 17 ISO Relay

30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

A relay is an electromechanical device that switches fused battery current to a electrical component when the ignition switch is turned to the Accessory or Run positions, or when controlled by a electronic module. The relays are located in the junction block or power distribution center (Fig. 17).

The 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.

A 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 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 elec-

RELAY (Continued)

tromagnetic 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 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 - RELAY

The relays are located in the junction block or power distribution center. For complete circuit diagrams, refer to **Wiring Diagrams**.

(1) Remove the relay from its mounting location.

(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 60.7 - 80.3 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.

DIAGNOSIS & TESTING - RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) of the junction block or power distribution center is connected to battery voltage and should be hot at all times. Check for battery voltage at the fused B(+) circuit cavity in the junction block receptacle for the relay. If OK, go to Step 2. If not OK, repair the fused B(+) circuit to the Power Distribution Center (PDC) fuse as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the fused B(+) fuse in the junction block that feeds the accessory when the relay is energized by the ignition switch. There should be continuity between the junction block cavity for relay terminal 87 and the fused B(+) fuse in the junction block at all times. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit to the junction block fuse as required.

(4) The coil ground terminal (85) is connected to the electromagnet in the relay. It receives battery feed to energize the relay when the ignition switch is in the Accessory or Run positions. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (acc/run) circuit cavity for relay terminal 85 in the junction block receptacle for the relay. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (acc/run) circuit to the ignition switch as required.

(5) The coil battery terminal (86) is connected to the electromagnet in the relay. The junction block cavity for this terminal should have continuity to ground at all times. If not OK, repair the open ground circuit to ground as required.

REMOVAL

(1) Remove the relay by grasping it firmly and pulling it straight out from its receptacle.

INSTALLATION

(1) Position the relay to the proper receptacle.

(2) Align the relay terminals with the terminal cavities in the receptacle.

(3) Push firmly and evenly on the top of the relay until the terminals are fully seated in the terminal cavities in the receptacle.

ENGINE

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ENGINE 2.5L

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ENGINE 2.5L

DESCRIPTION

The 2.5 liter (150 CID) four-cylinder engine is an In-line, lightweight, overhead valve engine.

This engine is designed for unleaded fuel. The engine cylinder head has dual quench-type combustion chambers that create turbulence and fast burning of the air/fuel mixture. This results in good fuel economy.

The cylinders are numbered 1 through 4 from front to rear. The firing order is 1-3-4-2 (Fig. 1).

The crankshaft rotation is clockwise, when viewed from the front of the engine. The crankshaft rotates within five main bearings and the camshaft rotates within four bearings.

The engine Build Date Code is located on a machined surface on the right side of the cylinder block between the No.3 and No.4 cylinders (Fig. 2).

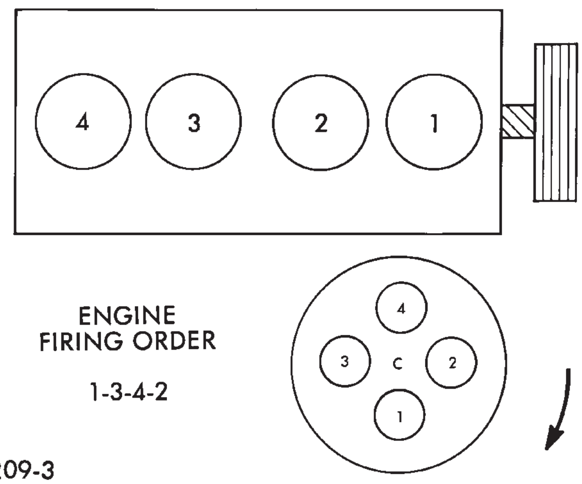


Fig. 1 Engine Firing Order

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.

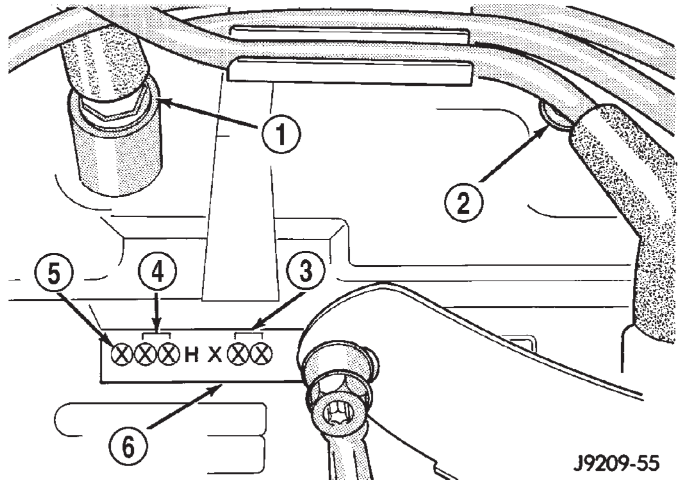


Fig. 2 Build Date Code Location

1 - NO. 4 CYLINDER
2 - NO. 3 CYLINDER
3 - DAY
4 - MONTH
5 - YEAR
6 - MACHINED SURFACE

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 9 - ENGINE - DIAGNOSIS AND TESTING) - PREFORMANCE and (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING) - MECHANICAL for possible causes and corrections of malfunctions. Refer to 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 (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Engine Cylinder Head Gasket Failure Diagnosis (Refer to 9 - ENGINE/CYLINDER HEAD - DIAGNOSIS AND TESTING).
- Intake Manifold Leakage Diagnosis (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).

ENGINE 2.5L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - PERFORMANCE

PERFORMANCE DIAGNOSIS CHART—GASOLINE ENGINES

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK	1. Weak or dead battery	1. Charge/Replace Battery. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/ BATTERY - STANDARD PROCEDURE). Check charging system. (Refer to 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING).
	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 8 - ELECTRICAL/STARTING - DIAGNOSIS AND TESTING)
	4. Seized accessory drive component	4. Remove accessory drive belt and attempt to start engine. If engine starts, repair/replace seized component.
	5. Engine internal mechanical failure or hydro-static lock	5. Refer to (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
ENGINE CRANKS BUT WILL NOT START	1. No spark	1. Check for spark. (Refer to 8 - ELECTRICAL/IGNITION CONTROL - DESCRIPTION)
	2. No fuel	2. Perform fuel pressure test, and if necessary, inspect fuel injector(s) and driver circuits. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING).
	3. Low or no engine compression	3. Perform cylinder compression pressure test. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
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 8 - ELECTRICAL/IGNITION CONTROL/DISTRIBUTOR - REMOVAL).
	3. Worn or incorrect gapped spark plugs	3. Clean plugs and set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ SPARK PLUG - CLEANING).
	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 (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
	9. Burned, warped, or pitted valves	9. Install/Reface valves as necessary

ENGINE 2.5L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	10. Plugged or restricted exhaust system	10. Install new parts as necessary
	11. Faulty ignition cables	11. Replace any cracked or shorted cables
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL).
ENGINE STALLS OR ROUGH IDLE	1. Carbon build-up on throttle plate	1. Remove throttle body and de-carbon. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).
	2. Engine idle speed too low	2. Check Idle Air Control circuit. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/IDLE AIR CONTROL MOTOR - DESCRIPTION)
	3. Worn or incorrectly gapped spark plugs	3. Replace or clean and re-gap spark plugs (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING)
	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 8 - ELECTRICAL/IGNITION CONTROL/ SPARK PLUG CABLE - DIAGNOSIS AND TESTING)
	6. Faulty coil	6. Test and replace, if necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL)
	7. Intake manifold vacuum leak	7. Inspect intake manifold gasket and vacuum hoses (Refer to 9 - ENGINE/ MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).
ENGINE MISSES ON ACCELERATION	1. Worn or incorrectly gapped spark plugs	1. Replace spark plugs or clean and set gap. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING)
	2. Spark plug cables defective or crossed	2. Replace or rewire secondary ignition cables. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG CABLE - REMOVAL)
	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 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL)

ENGINE 2.5L (Continued)

DIAGNOSIS AND TESTING— ENGINE 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 9 - ENGINE/ LUBRICATION/OIL - STANDARD PROCEDURE)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) for engine oil pressure test/specifications
	4. Dirt in tappets/lash adjusters	4. Clean/replace hydraulic tappets/ lash adjusters
	5. Bent push rod(s)	5. Install new push rods
	6. Worn rocker arms	6. Inspect oil supply to rocker arms and replace worn arms as needed
	7. Worn tappets/lash adjusters	7. Install new hydraulic tappets/lash adjusters
	8. Worn valve guides	8. Inspect all valve guides and replace as necessary
	9. Excessive runout of valve seats or valve faces	9. Grind valves and seats
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. (Refer to 9 - ENGINE/LUBRICATION/ OIL - STANDARD PROCEDURE) 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.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)
	3. Thin or diluted oil	3. Change oil to correct viscosity.

ENGINE 2.5L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	4. Excessive main bearing clearance	4. Measure bearings for correct clearance. Repair as necessary
	5. Excessive end play	5. Check crankshaft thrust bearing for excessive wear on flanges
	6. Crankshaft main journal out of round or worn	6. Grind journals or replace crankshaft
	7. Loose flywheel or torque converter	7. Inspect crankshaft, flexplate/ flywheel and bolts for damage. Tighten to correct torque
LOW OIL PRESSURE	1. Low oil level	1. Check oil level and fill if necessary
	2. Faulty oil pressure sending unit	2. Install new sending unit
	3. Clogged oil filter	3. Install new oil filter
	4. Worn oil pump	4. Replace oil pump assembly.
	5. Thin or diluted oil	5. Change oil to correct viscosity.
	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. CCV System malfunction	1. (Refer to 25 - EMISSIONS CONTROL/EVAPORATIVE EMISSIONS - DESCRIPTION) 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

ENGINE 2.5L (Continued)

DIAGNOSIS AND TESTING—CYLINDER COMPRESSION PRESSURE

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 (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL).

(3) Secure the throttle in the wide-open position.

(4) Disconnect the ignition coil.

(5) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(6) Record the compression pressure on the third revolution. Continue the test for the remaining cylinders.

(Refer to 9 - ENGINE - SPECIFICATIONS) for the correct engine compression pressures.

DIAGNOSIS AND TESTING - CYLINDER COMBUSTION PRESSURE LEAKAGE

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating)
- Leaks between adjacent cylinders or into water jacket
- Any causes for combustion/compression pressure loss

WARNING: DO NOT REMOVE THE RADIATOR CAP WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM HOT COOLANT CAN OCCUR.

Check the coolant level and fill as required. DO NOT install the radiator cap.

Start and operate the engine until it attains normal operating temperature, then turn OFF the engine.

Remove the spark plugs.

Remove the oil filler cap.

Remove the air cleaner.

Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

Perform the test procedure on each cylinder according to the tester manufacturer's instructions. While testing, listen for pressurized air escaping through the throttle body, tailpipe or 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 CYLINDER COMBUSTION PRESSURE LEAKAGE 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 2.5L (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** 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 which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II

Mopar® Engine RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

Mopar® Gasket Maker is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier then using precut gaskets.

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. 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 material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) 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 usage of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

STANDARD PROCEDURE - 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.

STANDARD PROCEDURE—HYDROSTATIC LOCK

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

ENGINE 2.5L (Continued)

(1) Perform the Fuel Pressure Release Procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(2) Disconnect the negative cable(s) 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 spark plugs.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

(6) Identify the fluid in the cylinders (coolant, fuel, oil, etc.).

(7) Be 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 a small amount of 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 41 N·m (30 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 LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(15) Connect the negative cable(s) to the battery.

(16) Start the engine and check for any leaks.

STANDARD PROCEDURE - CYLINDER BORE HONING

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 and 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). about 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 40° to 60° for proper seating of rings (Fig. 3).

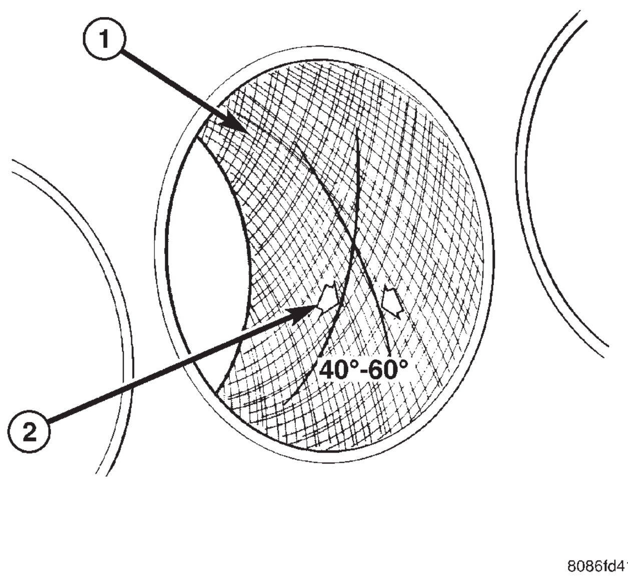


Fig. 3 Cylinder Bore Crosshatch Pattern

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 40° 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.

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.

ENGINE 2.5L (Continued)

(3) Remove the air cleaner resonator and related duct work. (Fig. 4)

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) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(5) Discharge A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE) and disconnect compressor suction/discharge hose assembly (if A/C equipped).

(6) Remove upper radiator hose.

(7) Remove the viscous fan/drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(8) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(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 (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(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. 4).

(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
- 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 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(28) Disconnect the fuel supply line at the fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD 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 (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).

(32) Remove the starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(33) Remove the engine support cushion-to-bracket through bolts.

(34) Disconnect the exhaust pipe from the manifold.

Manual Transmission models: (Fig. 6)

(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. 5)

(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.

ENGINE 2.5L (Continued)

(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.

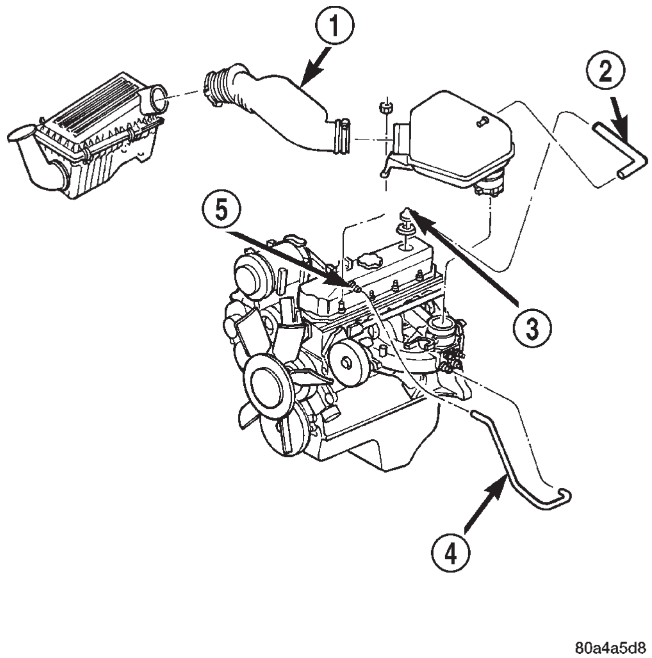


Fig. 4 Air Cleaner Resonator and Duct Work

1 - AIR TUBE
2 - CCV TUBE
3 - AIR INLET FITTING
4 - CCV TUBE
5 - FIXED ORIFICE FITTING

INSTALLATION

(1) Remove the oil filter.

(2) Lift the engine off the stand and lower it into the engine compartment. For easier installation, it may be useful to remove the engine support cushions from the engine support brackets as an aide for alignment of the engine-to-transmission.

Manual Transmission models: (Fig. 6)

(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. 5)

(7) Align converter housing with engine.

(8) Install and tighten the converter housing bolts to 38 N·m (28 ft. lbs.).

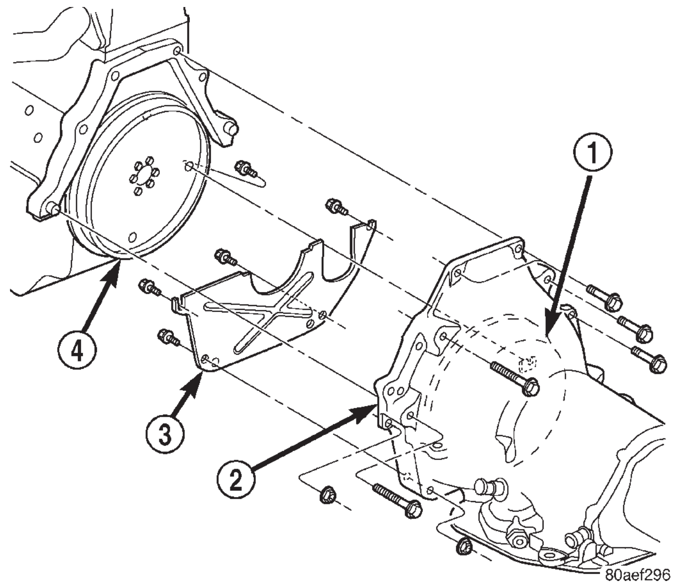


Fig. 5 Automatic Transmission

1 - TORQUE CONVERTER
2 - TORQUE CONVERTER HOUSING
3 - COVER
4 - FLEXPLATE

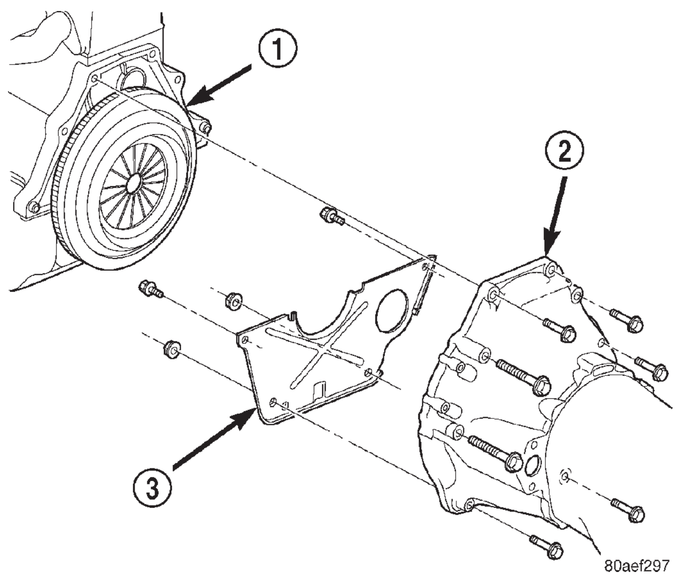


Fig. 6 Manual Transmission to Engine—2.5L

1 - FLYWHEEL/CLUTCH
2 - CLUTCH HOUSING
3 - COVER

(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

ENGINE 2.5L (Continued)

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 (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(17) Install the oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).

(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 (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(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 radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).

(28) Connect transmission cooler lines (if equipped). Tighten fittings to 15 N·m (135 in. lbs.).

(29) Install the viscous fan/drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(30) Install and tension the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(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

(33) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(34) Connect A/C suction/discharge hose and recharge A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(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.

ENGINE 2.5L (Continued)

SPECIFICATIONS

2.5L ENGINE

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°
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	

ENGINE 2.5L (Continued)

DESCRIPTION	SPECIFICATION
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.)
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.)

DESCRIPTION	SPECIFICATION
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.)
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.)

ENGINE 2.5L (Continued)

DESCRIPTION	SPECIFICATION
Valve Seat Angle Intake Exhaust	 44.5° 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)
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 Oil Control Ring	 1.530 to 1.555 mm (0.0602 to 0.0612 in.) 4.035 to 4.060 mm (0.1589 to 0.1598 in.)
Piston Ring Groove Diameter Compression Ring #1 Compression Ring #2 Oil Control Ring	 88.39 to 88.65 mm (3.48 to 3.49 in.) 87.63 to 87.88 mm (89.66 to 89.92 in.) 89.66 to 89.92 mm (3.53 to 3.54 in.)

DESCRIPTION	SPECIFICATION
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 RINGS	
Ring Gap Clearance Top Compression Ring 2nd Compression Ring Oil Control Steel Rails	 0.229 to 0.610 mm (0.0090 to 0.0240 in.) 0.483 to 0.965 mm (0.0190 to 0.0380 in.) 0.254 to 1.500 mm (0.010 to 0.060 in.)
Ring Side Clearance Compression Rings Oil Control Rings	 0.042 to 0.084 mm (0.0017 to 0.0033 in.) 0.06 to 0.21 mm (0.0024 to 0.0083 in.)
OIL PUMP AND OIL PRESSURE	
Gear to Body Clearance (Radial) (Radial Preferred)	 0.051 to 0.102 mm (0.002 to 0.004 in.) 0.051 mm (0.002 in.)
Gear End Clearance— Plastigage Plastigage Preferred Feeler Gauge Feeler Gauge Preferred	 0.051 to 0.152 mm (0.002 to 0.006 in.) 0.051 mm (0.002 in.) 0.1016 to 0.2032 mm (0.004 to 0.008 in.) 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)

ENGINE 2.5L (Continued)

TORQUE

2.5L ENGINE

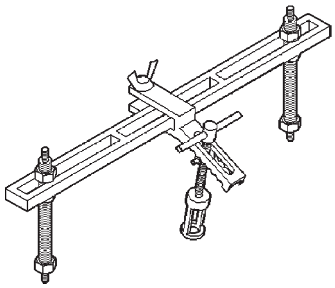
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs
A/C Compressor Bracket to Engine—Bolts	47	35	—
A/C Compressor Mounting Bolts	28	—	250
Block Heater Nut	1.8	—	16
Camshaft Sprocket Bolt	108	80	—
Clutch Cover to Flywheel Bolts	31	23	—
Connecting Rod Cap Nuts	45	33	—
Cylinder Block Drain Plugs	41	30	—
Cylinder Head Bolts #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	—

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	—

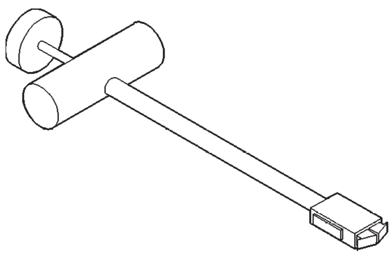
ENGINE 2.5L (Continued)

SPECIAL TOOLS

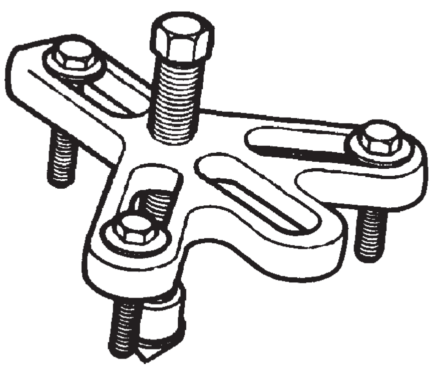
2.5L ENGINE



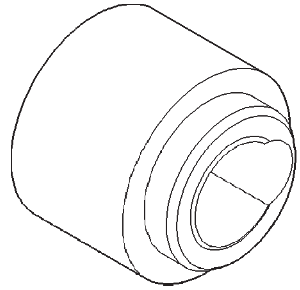
Valve Spring Compressor Tool MD-998772A



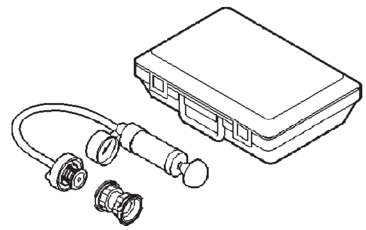
Hydraulic Valve Tappet Removal Tool C–4129–A



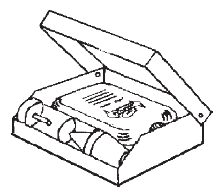
Vibration Damper Removal Tool 7697



Timing Case Cover Alignment and Seal Tool 6139



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A

AIR CLEANER ELEMENT

REMOVAL

(1) Loosen air tube clamp at housing cover (Fig. 7)
.

(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.

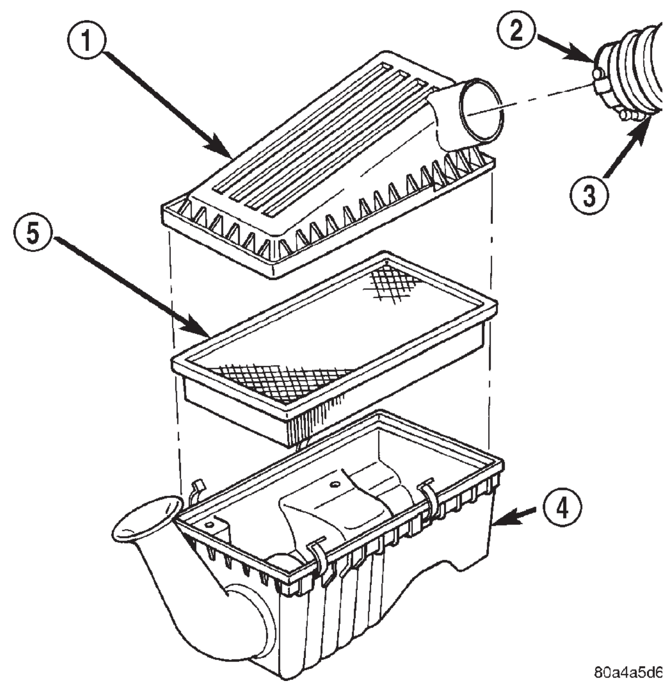


Fig. 7 AIR CLEANER ELEMENT

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.

CYLINDER HEAD

DESCRIPTION

The cast iron cylinder head (Fig. 8) is mounted to the cylinder block using ten bolts. The spark plugs are located in the peak of the wedge between the valves.

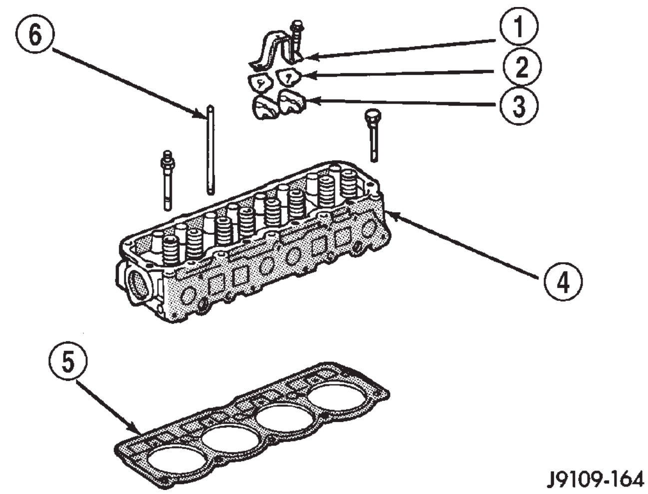


Fig. 8 Cylinder Head—2.5L Engine

1 - BRIDGE
2 - PIVOT ASM.
3 - ROCKER ARM
4 - CYLINDER HEAD
5 - HEAD GASKET
6 - PUSH ROD

OPERATION

The cylinder head closes the combustion chamber allowing the pistons to compress the air fuel mixture to the correct ratio for ignition. The valves located in the cylinder head open and close to either allow clean air into the combustion chamber or to allow the exhaust gases out, depending on the stroke of the engine.

DIAGNOSIS AND TESTING—CYLINDER HEAD GASKET FAILURE

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

• Possible indications of the cylinder head gasket leaking between adjacent cylinders are:
   – Loss of engine power
   – Engine misfiring
   – Poor fuel economy

• Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:
   – Engine overheating
   – Loss of coolant
   – Excessive steam (white smoke) emitting from exhaust
   – Coolant foaming

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test in this

CYLINDER HEAD (Continued)

section. 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 WITH COOLANT PRESSURE CAP REMOVED.

VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

COOLING SYSTEM TESTER METHOD

WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).

Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

REMOVAL

This procedure can be done with the engine in or out of the vehicle.

(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 (Refer to 7 - COOLING - STANDARD PROCEDURE) 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 in-let hose and resonator assembly.

(4) Remove the engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(5) Remove the capscrews, bridge and pivot assemblies and rocker arms (Fig. 9).

(6) Remove the push rods (Fig. 9). **Retain the push rods, bridges, pivots and rocker arms in the same order as removed.**

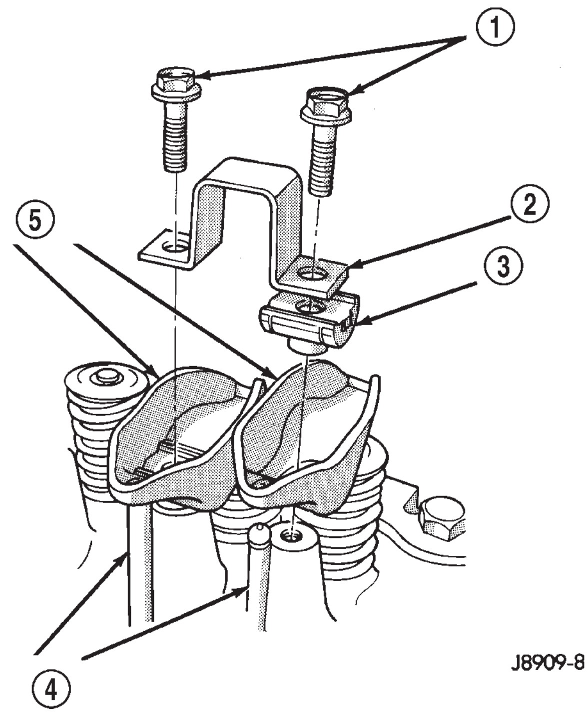


Fig. 9 Rocker Arm Assembly

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 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(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.

CYLINDER HEAD (Continued)

(10) Perform fuel pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(11) Remove the latch clip and disconnect the fuel supply hose (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(12) Remove the intake and engine exhaust manifolds from the engine cylinder head (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(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. 10).

(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.

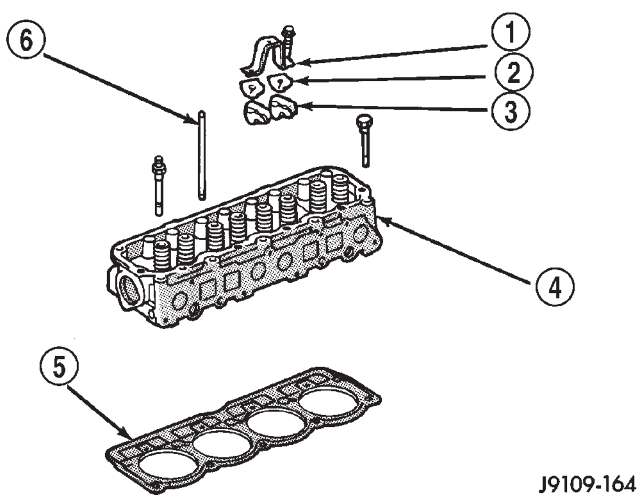


Fig. 10 Engine Cylinder Head Assembly

1 - BRIDGE
2 - PIVOT ASM.
3 - ROCKER ARM
4 - CYLINDER HEAD
5 - HEAD GASKET
6 - PUSH ROD

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.

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.

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.

INSTALLATION

This procedure can be done with the engine in or out of the vehicle.

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

CYLINDER HEAD (Continued)

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. 11). 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.

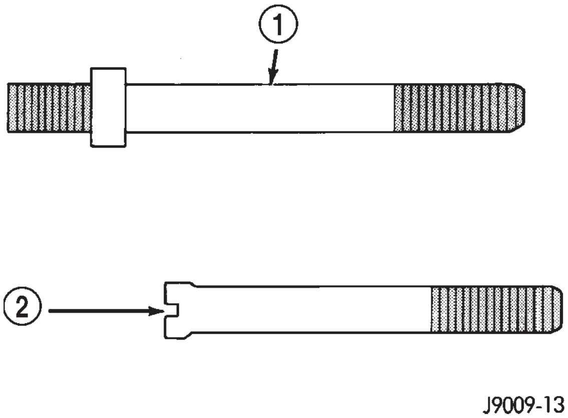


Fig. 11 Fabricate Alignment Dowels

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. 12).

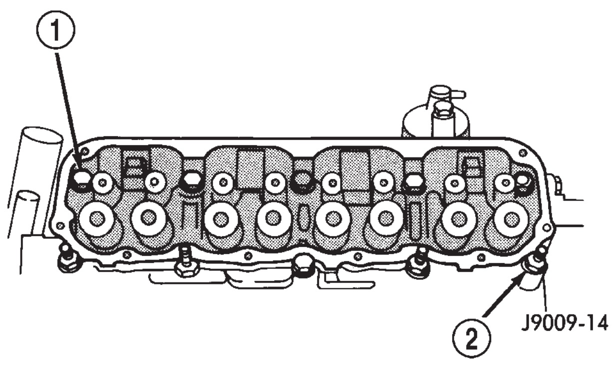


Fig. 12 Alignment Dowel Locations

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.

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. 13):

(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.

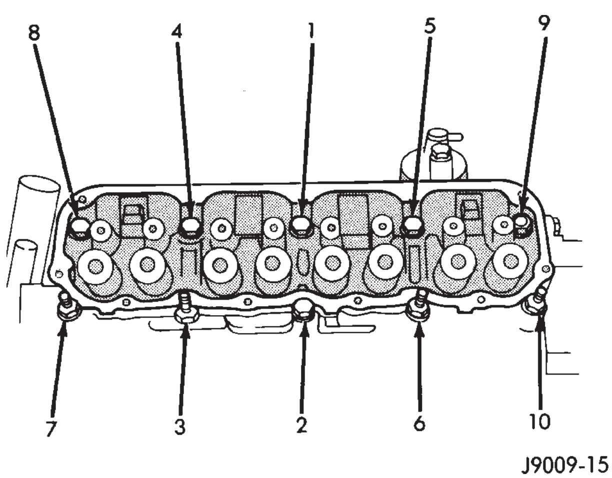


Fig. 13 Engine cylinder head Bolt Tightening Sequence

(11) Connect the coolant temperature sending unit connector.

(12) Install the spark plugs (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - INSTALLATION).

(13) Install the intake and exhaust manifolds.

CYLINDER HEAD (Continued)

(14) Install the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(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 (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(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 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(21) Install the resonator assembly and air in-let hose. Tighten clamps to 4 N·m (35 in. lbs.).

(22) Connect the hoses to the thermostat housing.

(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. (Refer to 7 - COOLING - STANDARD PROCEDURE) Check for leaks.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN DIRECT LINE WITH THE FAN. DO NOT PUT HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(27) Operate the engine with the radiator cap off. Inspect for leaks and continue operating the engine until the thermostat opens. Add coolant, if required.

CYLINDER HEAD COVER(S)

REMOVAL

A cured gasket is part of the engine cylinder head cover.

(1) Disconnect negative cable from battery.

(2) Disconnect the Crankcase Ventilation (CCV) vacuum hose from engine cylinder head cover (Fig. 14).

(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. 14).

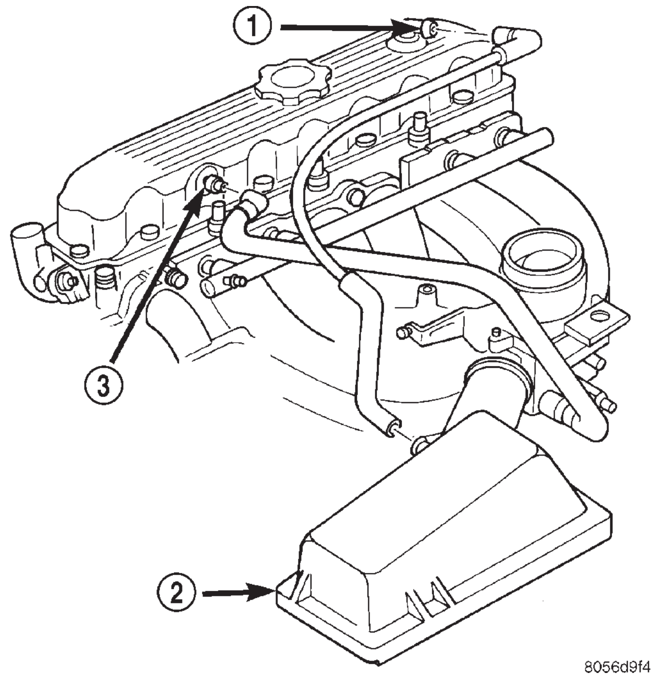


Fig. 14 Engine Cylinder Head Cover

1 - AIR INLET FITTING
2 - AIR FILTER COVER
3 - FIXED ORIFICE FITTING

(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.

CLEANING

Clean cylinder head cover gasket surface.

Clean head rail, if necessary.

INSPECTION

Inspect cover for distortion and straighten, if necessary.

Check the gasket for use in head cover installation. If damaged, use a new gasket.

INSTALLATION

A cured gasket is part of the engine cylinder head cover.

(1) Inspect the engine cylinder head cover for cracks. Replace the cover, if cracked.

CYLINDER HEAD COVER(S) (Continued)

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.
(3) Install engine cylinder head cover. Tighten the mounting bolts to 13 N·m (115 in. lbs.) torque.
(4) Connect the CCV hoses (Fig. 14).
(5) Connect negative cable to battery.
(6) Install the air inlet hose and resonator.

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

Both the intake and exhaust valves are made of steel. The intake valve is 48.768 mm (1.92 inches) in diameter and the exhaust valve is 41.148 mm (1.62 inches) in diameter and has a 2.032 mm (0.080 inch) wafer interia welded to the tip for durability. These valves are not splayed.

STANDARD PROCEDURE

STANDARD PROCEDURE—VALVE TIMING VERIFICATION

• Disconnect the spark plug wires and remove the spark plugs.
• Remove the engine cylinder head cover.
• Remove the capscrews, bridge and pivot assembly, and rocker arms from above the No.1 cylinder.
• Alternately loosen each capscrew, one turn at a time, to avoid damaging the bridge.
• Rotate the crankshaft until the No.4 piston is at top dead center (TDC) on the compression stroke.
• Rotate the crankshaft counterclockwise (viewed from the front of the engine) 90°.
• Install a dial indicator on the end of the No.1 cylinder intake valve push rod. Use rubber tubing to secure the indicator stem on the push rod.
• Set the dial indicator pointer at zero.
• 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.

STANDARD PROCEDURE—REFACING VALVES AND SEATS

VALVE REFACING

The intake and exhaust valves have a 43-1/4° to 43-3/4° face angle and a 44-1/4° to 44-3/4° seat angle (Fig. 15).

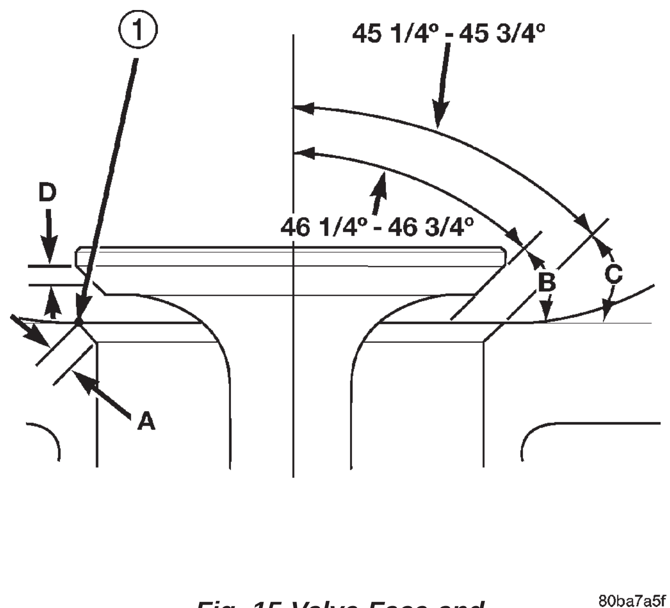


Fig. 15 Valve Face and

1 - CONTACT POINT

VALVE FACE AND VALVE SEAT ANGLE CHART

ITEM	DESCRIPTION	SPECIFICATION
A	SEAT WIDTH INTAKE EXHAUST	1.016 - 1.524 mm (0.040 - 0.060 in.) 1.524 - 2.032 mm (0.060 - 0.080 in.)
B	FACE ANGLE (INT. AND EXT.)	43¼° - 43¾°
C	SEAT ANGLE (INT. AND EXT.)	44¼° - 44¾°
D	CONTACT SURFACE	—

INTAKE/EXHAUST VALVES & SEATS (Continued)

Inspect the remaining margin after the valves are refaced (Fig. 16). Valves with less than 1.190 mm (0.047 in.) margin should be discarded.

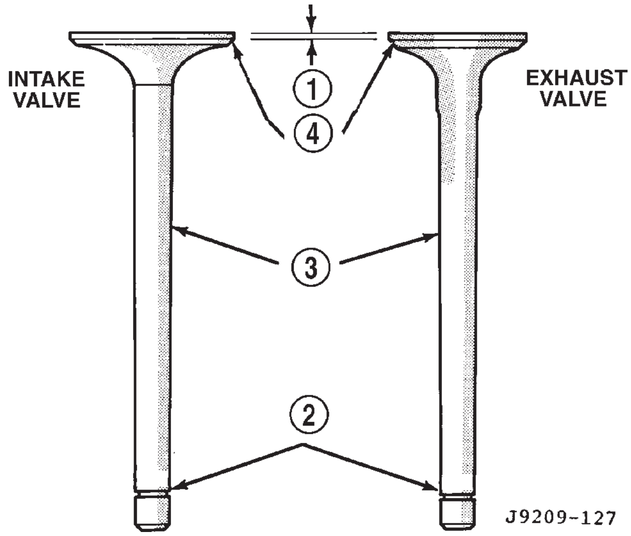


Fig. 16 Intake and Exhaust Valves

1 - MARGIN
2 - VALVE SPRING RETAINER LOCK GROOVE
3 - STEM
4 - FACE

VALVE SEAT REFACING

CAUTION: DO NOT un-shroud valves during valve seat refacing (Fig. 17).

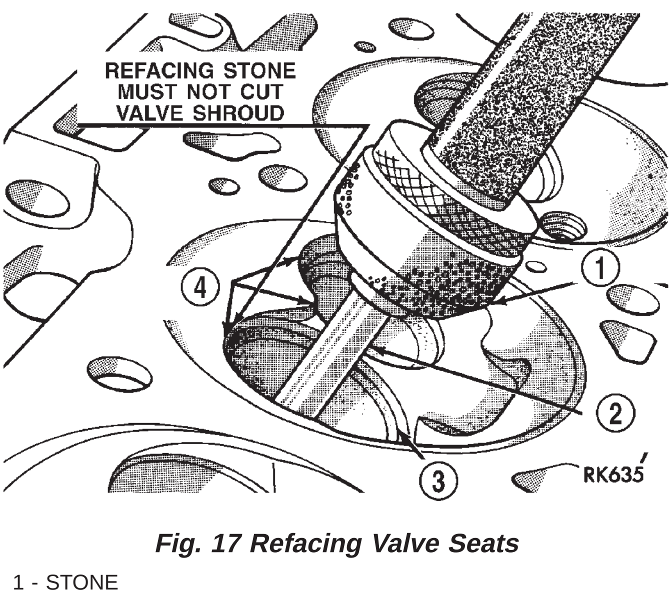


Fig. 17 Refacing Valve Seats

1 - STONE
2 - PILOT
3 - VALVE SEAT
4 - SHROUD

(1) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.051 mm (0.002 in.) total indicator reading.

(3) Inspect the valve seat with Prussian blue, to determine where the valve contacts the seat. To do this, coat valve seat LIGHTLY with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to the top edge of valve face, lower valve seat with a 15° stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60° stone.

(4) When seat is properly positioned the width of intake seats should be 1.016-1.524 mm (0.040-0.060 in.). The width of the exhaust seats should be 1.524-2.032 mm (0.060-0.080 in.).

STANDARD PROCEDURE—VALVE GUIDE WEAR - MEASURING

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 in.), replace the valve.

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 18). The special sleeve places the valve at the correct height for checking with a dial indicator.

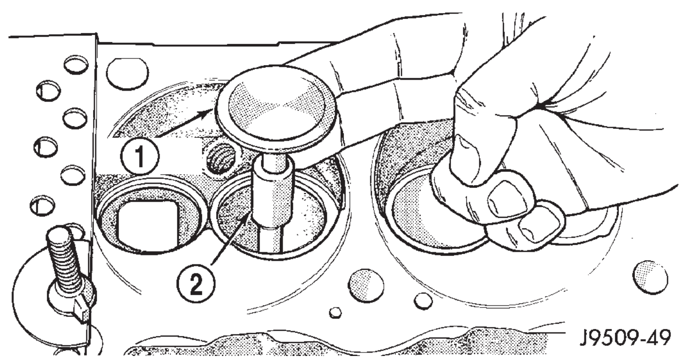


Fig. 18 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

INTAKE/EXHAUST VALVES & SEATS (Continued)

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 19).

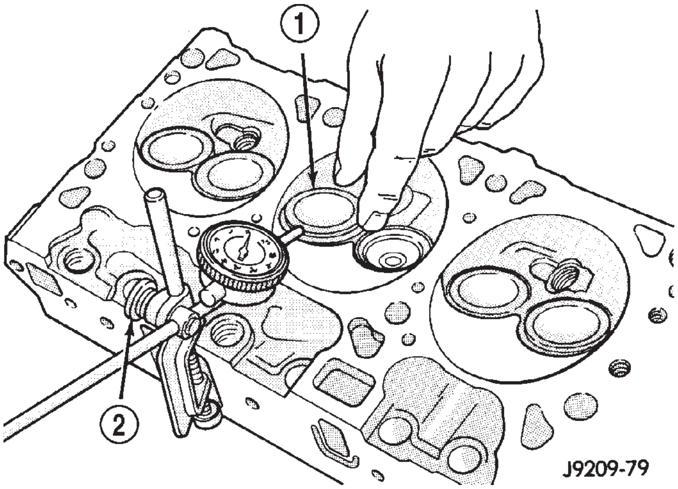


Fig. 19 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

(3) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 in.). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

STANDARD PROCEDURE—VALVE GUIDE SERVICE

Service valves with oversize stems are available. Refer to REAMER SIZES CHART .

REAMER SIZES CHART

REAMER O/S	VALVE GUIDE SIZE
0.076 mm (0.003 in.)	8.026 - 8.052 mm (0.316 - 0.317 in.)
0.381 mm (0.015 in.)	8.331 - 8.357 mm (0.328 - 0.329 in.)

(1) Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Ream the valve guides from standard to 0.381 mm (0.015 in.). Use a two step procedure so the valve guides are reamed true in relation to the valve seat:**

- Step 1—Ream to 0.0763 mm (0.003 inch).
- Step 2—Ream to 0.381 mm (0.015 inch).

REMOVAL

REMOVAL—VALVE SPRINGS

This procedure can be done with the engine cylinder head installed on the block.

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 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(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. 20).

(9) Remove valve spring and retainer (Fig. 20).

(10) Remove valve stem oil seals (Fig. 20). Note the valve seals are different for intake and exhaust valves. The top of each seal is marked either INT (intake/black in color) or EXH (exhaust/brown in color). DO NOT mix the seals.

REMOVAL—VALVES

NOTE: This procedure is done with the head removed.

(1) Compress valve springs using Valve Spring Compressor Tool MD-998772-A and adapter 6716A.

(2) Remove valve retaining locks, valve spring retainers, valve stem seals, and valve springs.

(3) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original locations.

INTAKE/EXHAUST VALVES & SEATS (Continued)

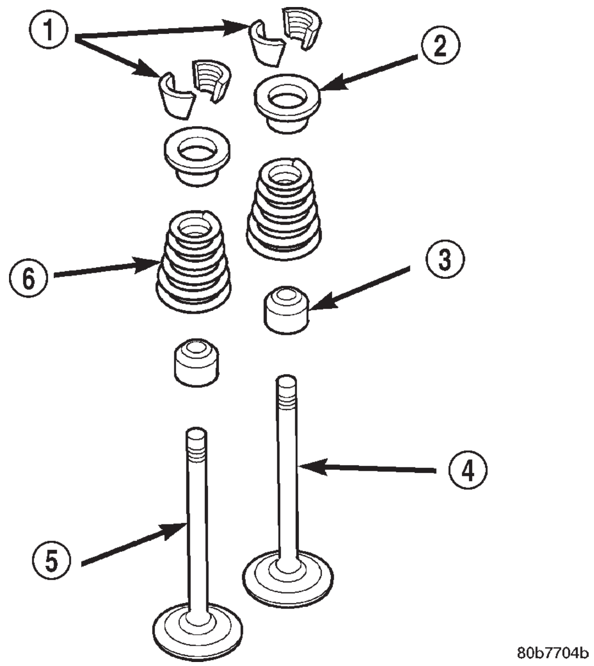


Fig. 20 Valve and Valve Components

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

CLEANING

Clean valves thoroughly. Discard burned, warped, or cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

INSTALLATION

INSTALLATION—VALVE SPRINGS

This procedure can be done with the engine cylinder head installed on the block.

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.

(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 (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

INSTALLATION—VALVES

(1) Coat valve stems with lubrication oil and insert them in cylinder head.

(2) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.

(3) Install new seals on all valve guides. Install valve springs and valve retainers.

(4) Compress valve springs with Valve Spring Compressor Tool MD-998772A and adapter 6716A, install locks and release tool. If valves and/or seats are ground, measure the installed height of springs. Be sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 in.) spacer in head counterbore. This should bring spring height back to normal 41.27 to 42.86 mm (1-5/8 to 1-11/16 in.).

VALVE SPRINGS

STANDARD PROCEDURE—VALVE SPRING - TESTING

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example the compression length of the spring to be tested is 1-5/16 in.. Turn table of Universal Valve Spring Tester Tool until surface is in line with the 1-5/16 in. mark on the threaded stud. Be sure the zero mark is to the front (Fig. 21). Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this

VALVE SPRINGS (Continued)

instant. Multiply this reading by 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. (Refer to 9 - ENGINE - SPECIFICATIONS) to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

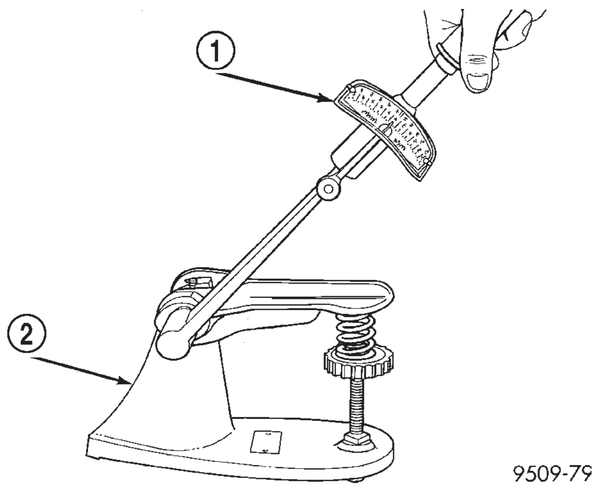


Fig. 21 Testing Valve Spring for Compressed Length

1 - TORQUE WRENCH
2 - VALVE SPRING TESTER

ROCKER ARMS

REMOVAL

(1) Remove the engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(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. 22). 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. 22). 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.

CLEANING

Clean all the components with cleaning solvent.

Use compressed air to blow out the oil passages in the rocker arms and push rods.

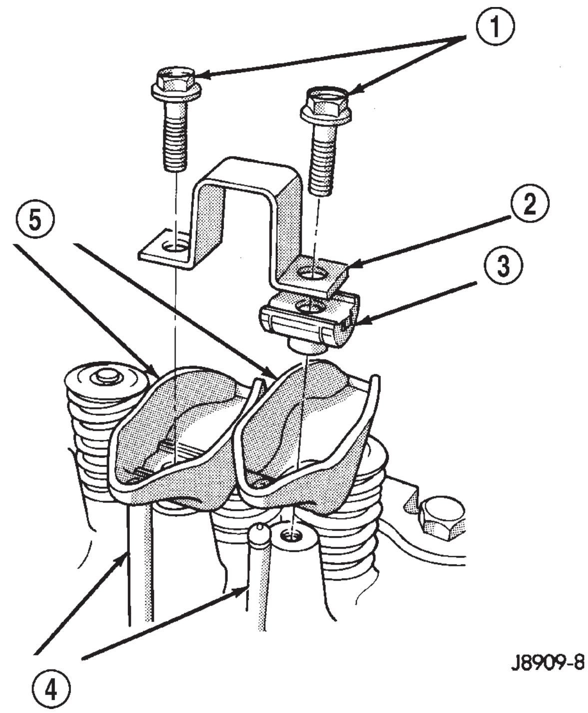


Fig. 22 Rocker Arm Assembly

1 - CAPSCREWS
2 - BRIDGE
3 - PIVOT ASSEMBLY
4 - PUSH RODS
5 - ROCKER ARMS

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.

ROCKER ARMS (Continued)

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 (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

ENGINE 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. 23).

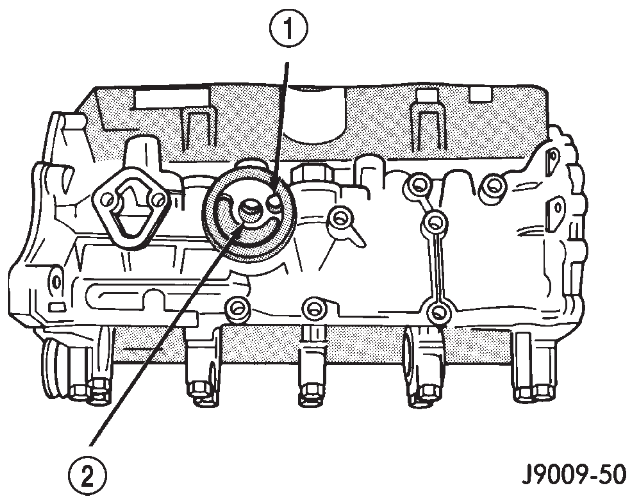


Fig. 23 Oil Filter Adaptor Hole

1 - FILTER BYPASS HOLE
2 - OIL FILTER ADAPTOR HOLE

- The front and rear oil galley holes (Fig. 24) (Fig. 25).

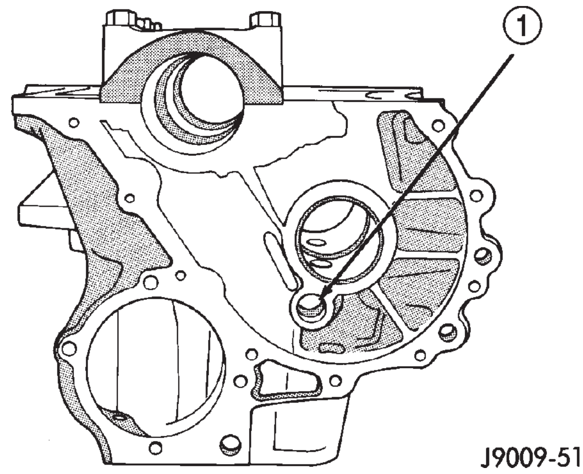


Fig. 24 Front Oil Galley Hole

1 - FRONT OIL GALLEY HOLE

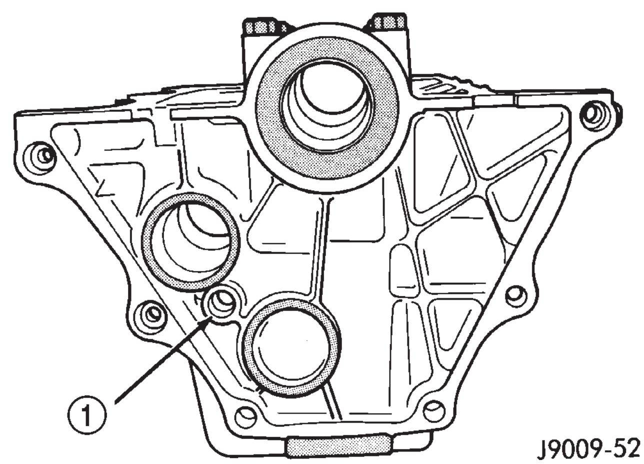


Fig. 25 Rear Oil Galley Hole

1 - REAR OIL GALLEY HOLE

- 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.

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.

CAMSHAFT & BEARINGS (IN BLOCK)

REMOVAL

REMOVAL—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.

NOTE: This procedure must be done with the engine removed and completely disassembled.

(1) Remove the camshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK)- REMOVAL)

(2) Using Special tool 8544 or equivalent, remove the camshaft bearings.

REMOVAL—CAMSHAFT

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 (Refer to 7 - COOLING - STANDARD PROCEDURE). DO NOT waste reusable coolant. If the solution is clean, drain it into a clean container for reuse.

(3) Remove the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL) 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 air in-let hose and resonator assembly.

(9) Remove the engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(10) Remove the rocker arms, bridges and pivots.

(11) Remove the push rods.

(12) Remove the hydraulic valve tappets from the engine cylinder head.

(13) Remove the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(14) Remove the timing case cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(15) Remove the timing chain and sprockets (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(16) Remove the camshaft (Fig. 26).

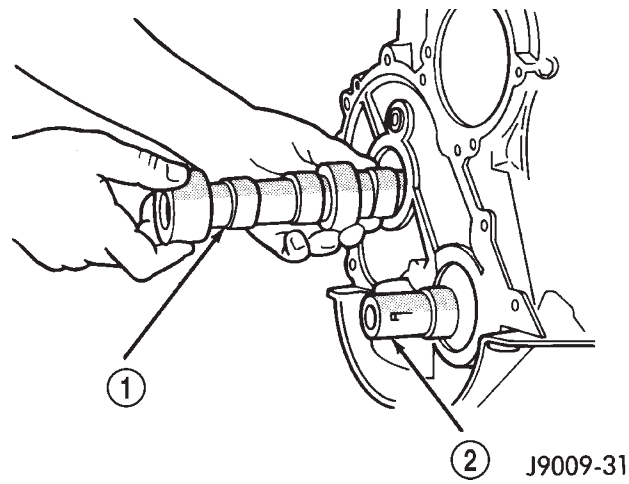


Fig. 26 Camshaft

1 - CAMSHAFT
2 - CRANKSHAFT

INSTALLATION

INSTALLATION—CAMSHAFT BEARINGS

(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 journal. The relief holes must be clean and free of debris.

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

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 8544 Camshaft Bushing Remover Installer or equivalent, install new camshaft bearings.

(5) Lubricate the camshaft with Mopar® engine oil supplement, or equivalent.

(6) Install the camshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - INSTALLATION).

INSTALLATION—CAMSHAFT

(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. 26).

(8) Turn the tensioner lever to the unlocked (down) position (Fig. 27).

(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. 27).

(10) Install the timing chain and sprockets (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/ CHAIN AND SPROCKETS - INSTALLATION).

(11) Release the timing chain tensioner by moving the lever to the unlock position (Fig. 27).

(12) Install the timing case cover with a replacement oil seal (Fig. 28) (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(13) Install the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(14) Install the hydraulic valve tappets.

(15) Install the push rods.

(16) Install the rocker arms, bridges and pivots.

(17) Install the engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(18) Install the distributor and ignition wires. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ DISTRIBUTOR - INSTALLATION).

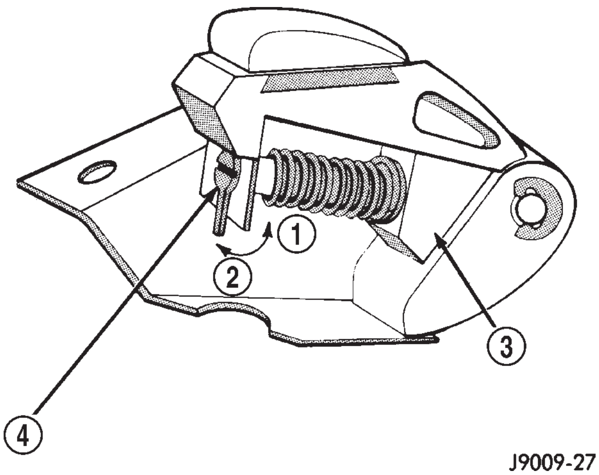


Fig. 27 Loading Timing Chain Tensioner

1 - LOCK
2 - UNLOCK
3 - TENSIONER BLOCK
4 - TENSIONER LEVER

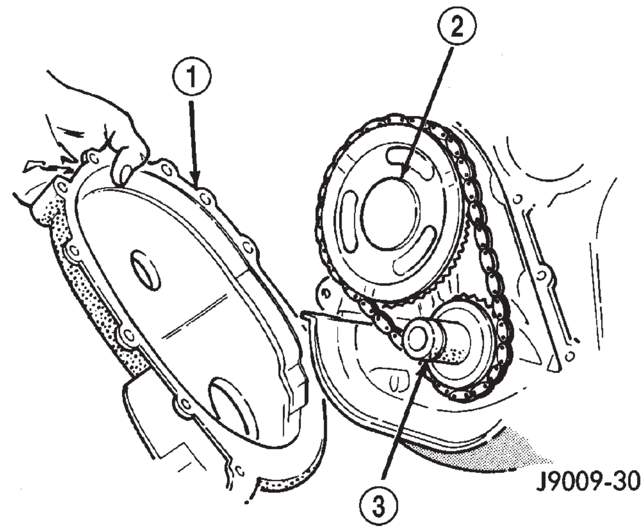


Fig. 28 Timing Case Cover

1 - TIMING CASE COVER
2 - CAMSHAFT
3 - CRANKSHAFT

(19) Install the resonator assembly and air in-let hose. Tighten clamps to 4 N·m (35 in. lbs.).

(20) Install the radiator or radiator and condenser, if equipped with A/C.

(21) Fill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(22) Connect negative cable to battery.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE

STANDARD PROCEDURE CONNECTING ROD BEARING - FITTING

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 29) (Fig. 30). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 31). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

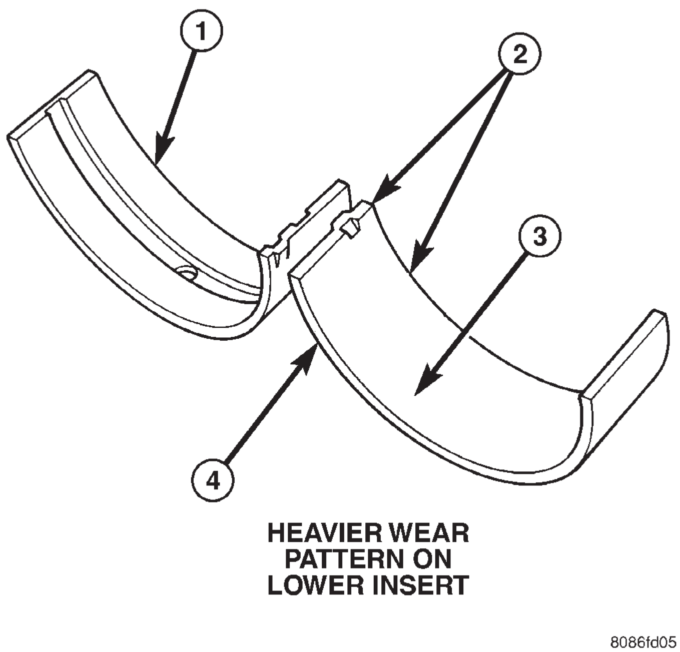


Fig. 29 Connecting Rod Bearing Inspection

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

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.

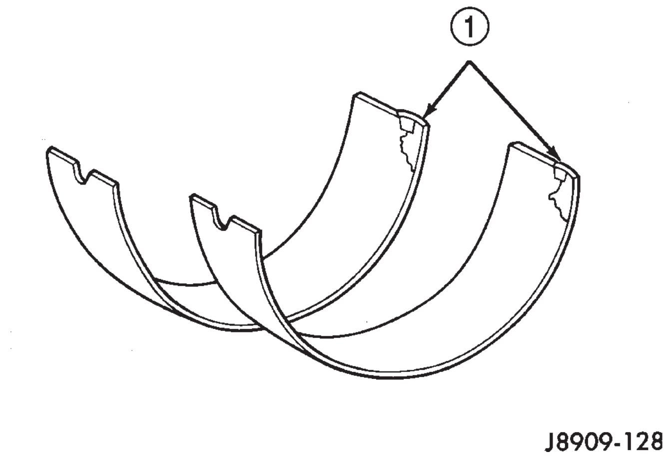


Fig. 30 Locking Tab Inspection

1 - ABNORMAL CONTACT AREA CAUSED BY LOCKING TABS NOT FULLY SEATED OR BEING BENT

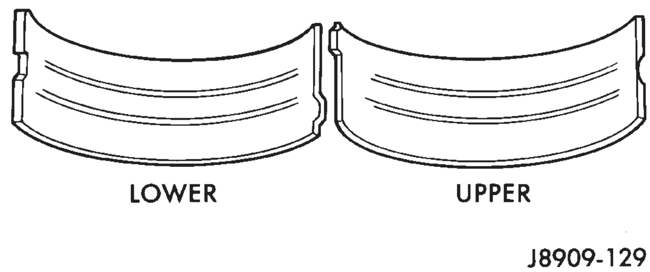


Fig. 31 Scoring Caused by Insufficient Lubrication

(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. 32). 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.

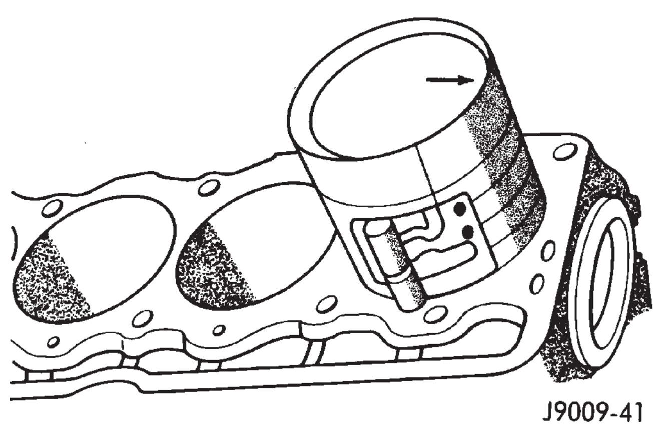


Fig. 32 Rod and Piston Assembly Installation

CONNECTING ROD BEARINGS (Continued)

(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. 33). (Refer to 9 - ENGINE - SPECIFICATIONS) for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

(8) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(9) If bearing-to-journal clearance exceeds the specification, install a pair of 0.0254 mm (0.001 inch) undersize bearing inserts. All the odd size inserts must be on the bottom. The sizes of the service replacement bearing inserts are stamped on the backs of the inserts. Measure the clearance as described in the previous steps.

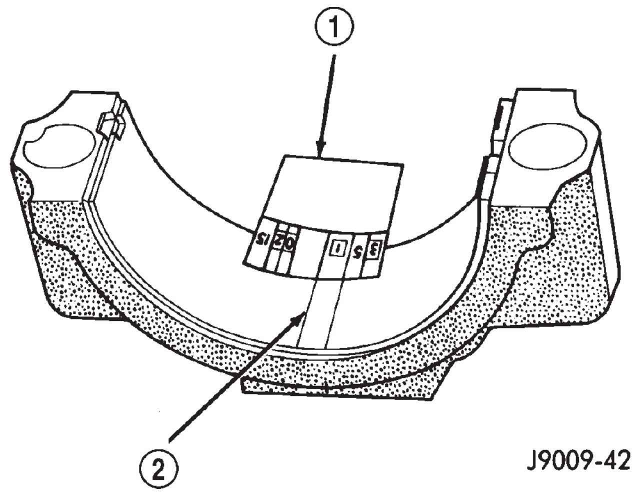


Fig. 33 Measuring Bearing Clearance

1 - PLASTIGAGE SCALE
2 - COMPRESSED PLASTIGAGE

(10) The clearance is measured with a pair of 0.0254 mm (0.001 inch) undersize bearing inserts installed. This will determine if two 0.0254 mm (0.001 inch) undersize inserts or another combination is needed to provide the correct clearance Refer to CONNECTING ROD BEARING FITTING CHART .

CONNECTING ROD BEARING FITTING CHART

CRANKSHAFT JOURNAL		CORRESPONDING CONNECTING ROD BEARING INSERT	
Color Code	**Diameter**	**Upper Insert Size**	**Lower Insert Size**
Yellow	53.2257-53.2079 mm (2.0955-2.0948 in.)	Yellow - Standard	Yellow - Standard
Orange	53.2079 - 53.1901 mm (2.0948 - 2.0941 in.) 0.0178 mm (0.0007 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.)

CONNECTING ROD BEARINGS (Continued)

(11) **FOR EXAMPLE:** If the initial clearance was 0.0762 mm (0.003 inch), 0.025 mm (0.001 inch) undersize inserts would reduce the clearance by 0.025 mm (0.001 inch). The clearance would be 0.002 inch and within specification. A 0.051 mm (0.002 inch) undersize insert would reduce the initial clearance an additional 0.013 mm (0.0005 inch). The clearance would then be 0.038 mm (0.0015 inch).

(12) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(13) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 45 N·m (33 ft. lbs.) torque. Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 34). (Refer to 9 - ENGINE - SPECIFICATIONS) for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

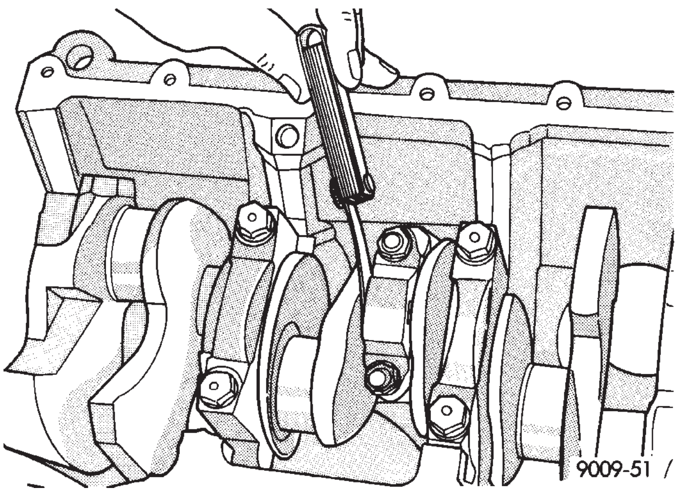


Fig. 34 Checking Connecting Rod Side Clearance - Typical

CRANKSHAFT

DESCRIPTION

The crankshaft (Fig. 35) is of a forged steel design, with five main bearing journals and eight counter balance weights.The crankshaft is located at the bottom of the engine block and is held in place with five main bearing caps.

OPERATION

The crankshaft transfers force generated by combustion within the cylinder bores to the flywheel or flexplate.

REMOVAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump from the rear main bearing cap.

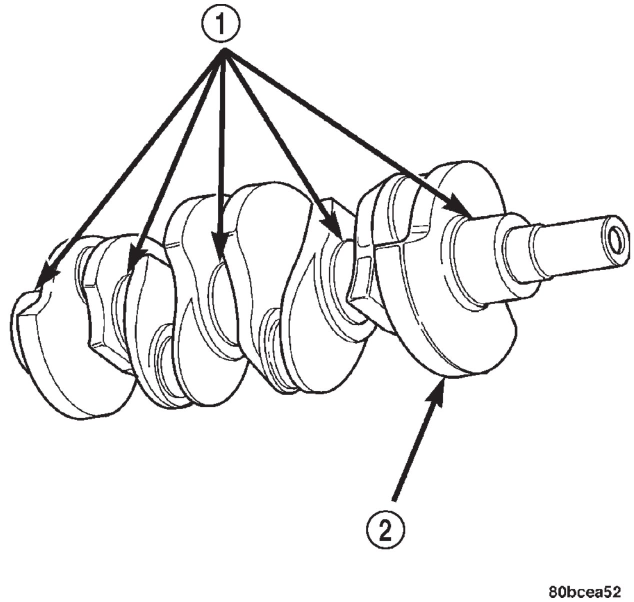


Fig. 35 Crankshaft 3.9L Engine

1 - MAIN BEARING JOURNALS
2 - COUNTER BALANCE WEIGHTS

(3) Remove the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(4) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(5) Identify bearing caps before removal. Remove bearing caps and bearings one at a time.

(6) Lift the crankshaft out of the block.

(7) Remove and discard the crankshaft rear oil seals.

(8) Remove and discard the front crankshaft oil seal.

INSTALLATION

(1) Lightly oil the new upper seal lips with engine oil.

(2) Install the new upper rear bearing oil seal with the white paint facing towards the rear of the engine.

(3) Position the crankshaft into the cylinder block.

(4) Lightly oil the new lower seal lips with engine oil.

(5) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(6) Apply 5 mm (0.20 in) drop of Mopar® Gasket Eliminator, or equivalent, on each side of the rear main bearing cap (Fig. 36). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

CRANKSHAFT (Continued)

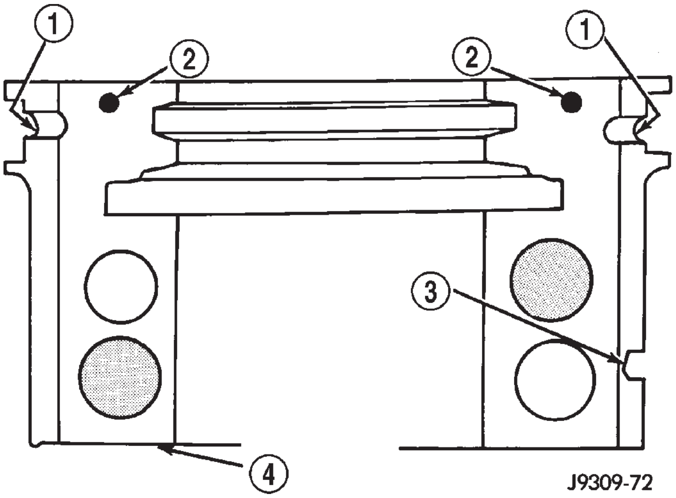


Fig. 36 Sealant Application to Bearing Cap

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT SLOTS
2 - LOCTITE 518 (OR EQUIVALENT)
3 - CAP ALIGNMENT SLOT
4 - REAR MAIN BEARING CAP

(7) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(8) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(9) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(10) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(11) Install the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(12) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 37). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(13) Install new front crankshaft oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION).

(14) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

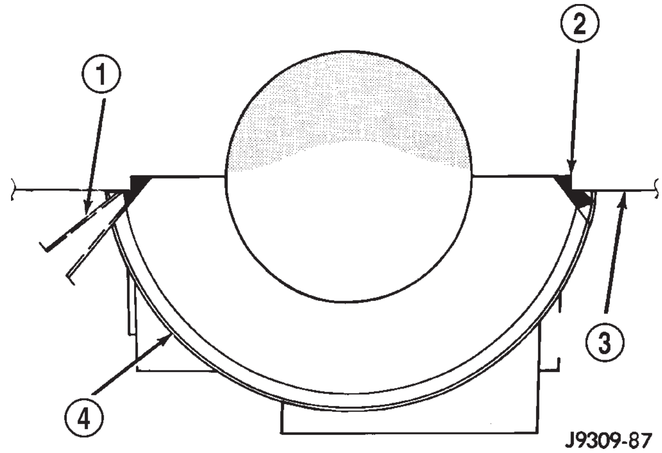


Fig. 37 Apply Sealant to Bearing Cap to Block

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 - SEALANT APPLIED
3 - CYLINDER BLOCK
4 - REAR MAIN BEARING CAP

CRANKSHAFT MAIN BEARINGS

DESCRIPTION

Main bearings (Fig. 38) are located in the cylinder block. One half of the main bearing is located in the crankshaft main bore the other half of the matching bearing is located in the main bearing cap. there are five main bearings. Number two main bearing is flanged, this flange controls crankshaft thrust.

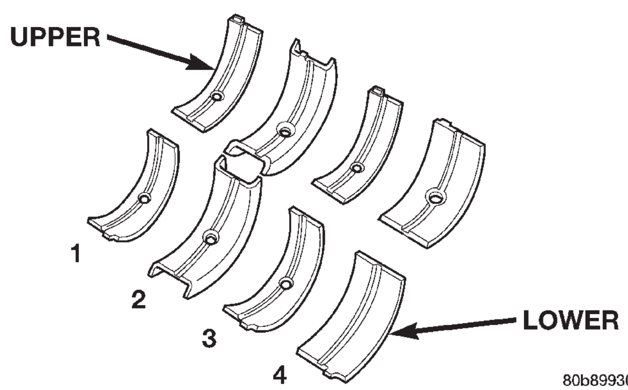


Fig. 38 Main Bearing Orientation

OPERATION

The main bearings encircle the crankshaft main bearing journals, this aligns the crankshaft to the centerline of the engine and allows the crankshaft to turn without wobbling or shaking therefore eliminating vibration. The main bearings are available in standard and undersizes.

STANDARD PROCEDURE—CRANKSHAFT MAIN BEARINGS - FITTING

CRANKSHAFT INSTALLED

The main bearing caps, numbered (front to rear) from 1 through 5 have an arrow to indicate the forward position. The upper main bearing inserts are grooved to provide oil channels while the lower inserts are smooth.

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 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.**

BEARING INSERT PAIR CHART

INSERT	CORRECT	INCORRECT
UPPER	STANDARD	STANDARD
LOWER	0.025 mm U/S (0.001 in.)	0.051 mm U/S (0.002 in.)

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, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - INSTALLATION).

CRANKSHAFT REMOVED

Remove the crankshaft from the cylinder block.

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, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - INSTALLATION).

CRANKSHAFT MAIN BEARINGS (Continued)

MAIN BEARING FITTING CHART

Crankshaft Journals #1 - #4			
Color Code	**Diameter**	**Upper Insert Size**	**Lower Insert Size**
Yellow	63.5025 - 63.4898 mm (2.5001 - 2.4996 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4898 - 63.4771 mm (2.4996 - 2.4991 in.) 0.0127 mm (0.0005 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Yellow - Standard
Blue	63.4771 - 63.4644 mm (2.4991 - 2.4986 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4644 - 63.4517 mm (2.4986 - 2.4981 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2485 - 63.2358 mm (2.4901 - 2.4896 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

Crankshaft Journal #5 Only			
Color Code	**Diameter**	**Upper Insert Size**	**Lower Insert Size**
Yellow	63.4873 - 63.4746 mm (2.4995 - 2.4990 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4746 - 63.4619 mm (2.4990 - 2.4985 in.) 0.0127 mm (0.0005 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Yellow - Standard
Blue	63.4619 - 63.4492 mm (2.4985 - 2.4980 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4492 - 63.4365 mm (2.4980 - 2.4975 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2333 - 63.2206 mm (2.4895 - 2.4890 in.) 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

CRANKSHAFT MAIN BEARINGS (Continued)

MEASURING 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. 39). Refer to Engine Specifications for the proper clearance.

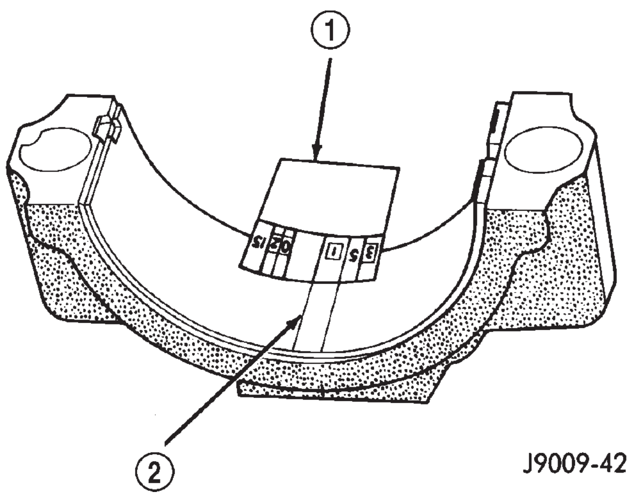


Fig. 39 Measuring Bearing Clearance with Plastigage

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.

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. Install bearings (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - 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, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - INSTALLATION).

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the spark plugs.

(3) Raise the vehicle.

(4) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL) and oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(5) Remove only one main bearing cap and lower insert at a time (Fig. 40).

(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. 41). With the cotter pin tool in place, rotate the crankshaft so that the upper bear-

CRANKSHAFT MAIN BEARINGS (Continued)

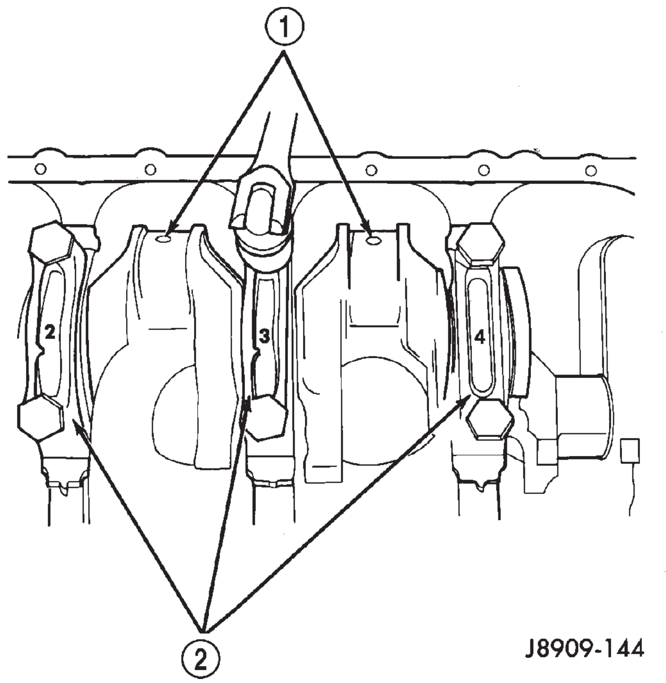


Fig. 40 Removing Main Bearing Caps and Lower Inserts

1 - CONNECTING ROD JOURNAL
2 - MAIN BEARING CAPS

ing 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. 41). After moving the insert approximately 25 mm (1 inch), it can be removed by applying pressure under the tab.

(8) Using the same procedure described above, remove the remaining bearing inserts one at a time for inspection.

INSPECTION

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated (Fig. 42).

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.

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.

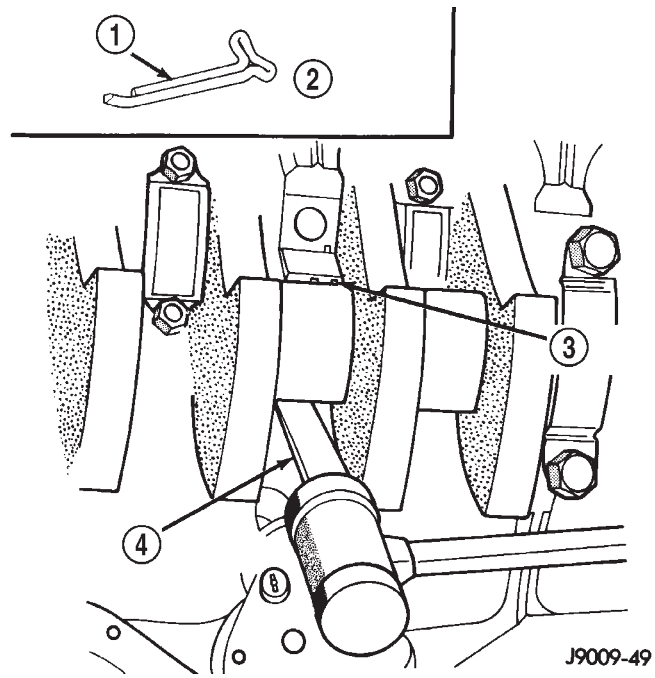


Fig. 41 Removing Upper Inserts

1 - COTTER PIN
2 - FABRICATED TOOL
3 - BEARING INSERT
4 - TONGUE DEPRESSOR

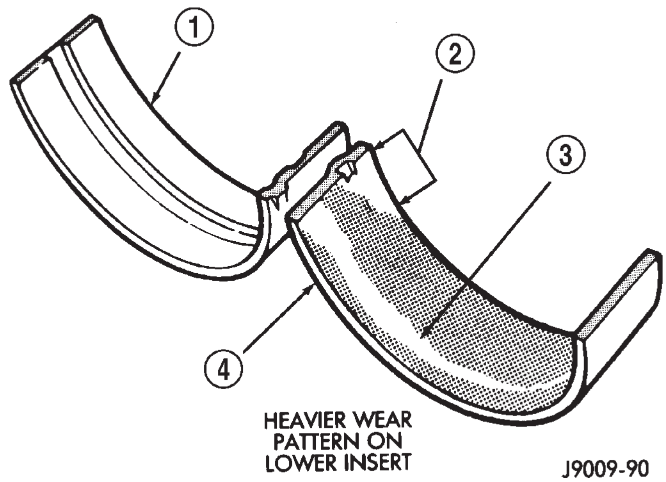


Fig. 42 Main Bearing Wear Patterns

1 - UPPER INSERT
2 - NO WEAR IN THIS AREA
3 - LOW AREA IN BEARING LINING
4 - LOWER INSERT

(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.

CRANKSHAFT MAIN BEARINGS (Continued)

(6) Apply Mopar® Gasket Maker, or equivalent on the rear bearing cap (Fig. 43). The bead should be 3 mm (0.125 in) thick. DO NOT apply Mopar® Gasket Maker, or equivalent to the lip of the seal.

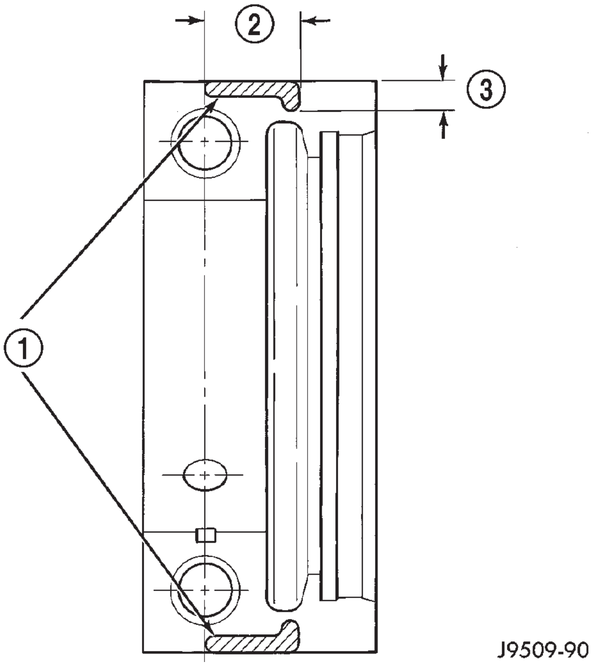


Fig. 43 Location of Mopar® Gasket Maker

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. 44). 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.

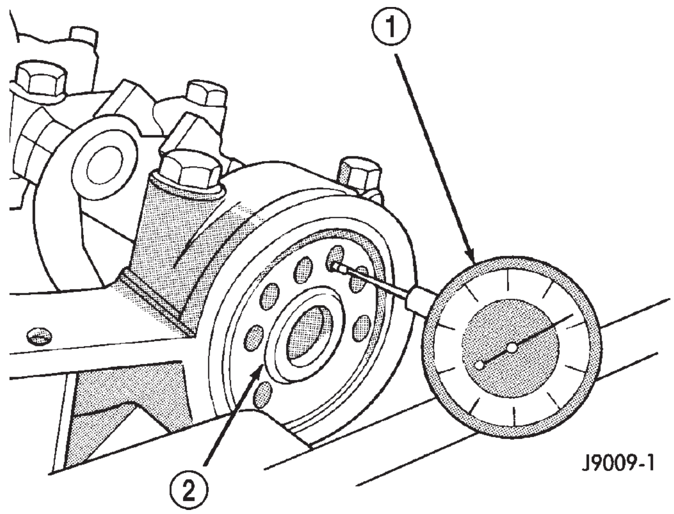


Fig. 44 Crankshaft End Play Measurement

1 - DIAL INDICATOR
2 - CRANKSHAFT

(12) If the crankshaft was removed, install the crankshaft into the cylinder block.

(13) Install the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(14) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(15) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(16) Install new rear main seal. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - INSTALLATION).

(17) Lower the vehicle.

(18) Install the spark plugs. Tighten the plugs to 37 N·m (27 ft. lbs.) torque.

(19) Fill the oil pan with engine oil to the safe mark on the dipstick level.

(20) Connect negative cable to battery.

CRANKSHAFT OIL SEAL - FRONT

DESCRIPTION

Both the crankshaft front seal and rear main seal are a one piece viton seal with a steel housing. The front seal is located in the engine front cover. The rear seal is located in a bore at the rear of the engine block, the crankshaft protrudes through the rear main seal.

OPERATION

The crankshaft seals prevent oil from leaking from around the crankshaft, either from the rear of the engine or from the engine front cover.

REMOVAL

The oil seal can be replaced without removing the timing chain cover, provided that the cover is not misaligned.

(1) Disconnect the negative cable from the battery.

(2) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(3) If front seal is suspected of leaking, check front oil seal alignment to crankshaft. The seal installation/alignment Tool 6635, should fit with minimum interference. If tool does not fit, the cover must be removed and installed properly.

(4) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal bore of cover.

INSTALLATION

(1) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635. Seat the oil seal in the groove of the tool.

(2) Position the seal and tool onto the crankshaft.

(3) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 45).

(4) Remove the vibration damper bolt and seal installation tool.

(5) Inspect the seal flange on the vibration damper.

(6) Install the vibration damper(Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(7) Connect the negative cable to the battery.

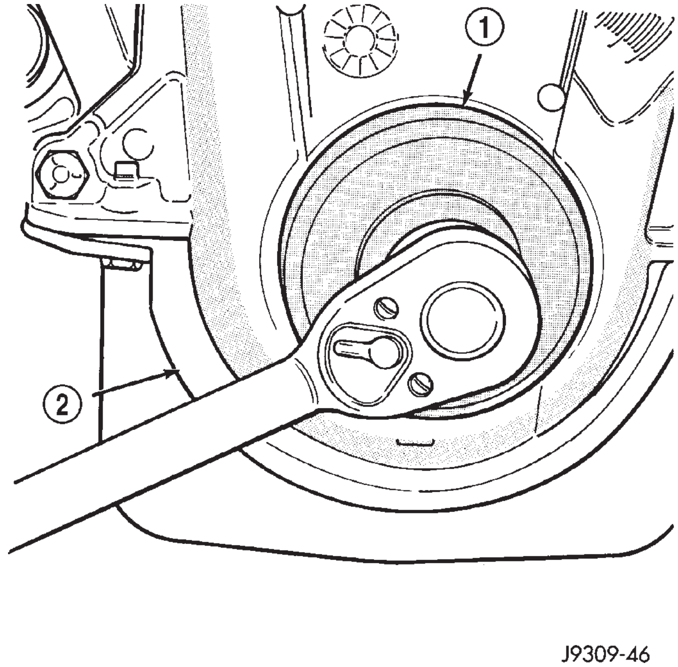


Fig. 45 Installing Oil Seal

1 - SPECIAL TOOL 6635
2 - TIMING CHAIN COVER

CRANKSHAFT OIL SEAL - REAR

DIAGNOSIS AND TESTING—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, pressurized the crankcase as outlined in (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)

CRANKSHAFT OIL SEAL - REAR (Continued)

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 or scratches. The crankshaft seal flange is specially 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. Refer to the service Diagnosis—Mechanical, under the Oil Leak row, for components inspections on possible causes and corrections.

(7) After the oil leak root cause and appropriate corrective action have been identified, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - REMOVAL), for proper replacement procedures.

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. 46).

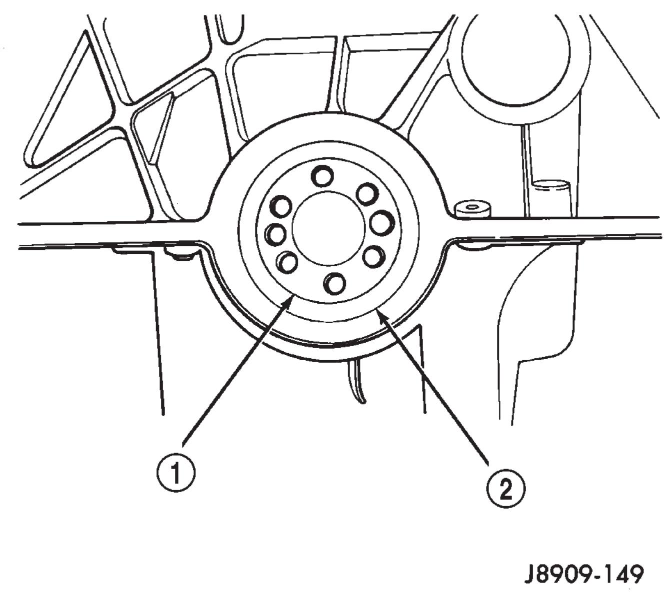


Fig. 46 Replacement of Rear Crankshaft Oil Seal

1 - CRANKSHAFT
2 - CRANKSHAFT OIL SEAL

INSTALLATION

(1) Wipe the seal surface area of the crankshaft until it is clean.

(2) Coat the outer lip of the replacement rear main bearing seal with engine oil.

(3) Carefully position the seal into place. Use rear main Seal Installer Tool 6271A to install the seal flush with the cylinder block.

CAUTION: The felt lip must be located inside the flywheel mounting surface. If the lip is not positioned correctly the flywheel could tear the seal.

(4) Install the flywheel or converter drive plate. New bolts MUST be used when installing the flywheel or converter plate. Tighten the new bolts to 68 N·m (50 ft. lbs.) torque. Turn the bolts an additional 60°.

HYDRAULIC LIFTERS (CAM IN BLOCK)

DIAGNOSIS AND TESTING—HYDRAULIC TAPPETS

Before disassembling any part of the engine to correct tappet noise, check the oil pressure. If vehicle has no oil pressure gauge, install a reliable gauge at the pressure sending-unit. The pressure should be between 207-552 kPa (30-80 psi) at 3,000 RPM.

Check the oil level after the engine reaches normal operating temperature. Allow 5 minutes to stabilize oil level, check dipstick. The oil level in the pan should never be above the FULL mark or below the ADD OIL mark on dipstick. Either of these two conditions could be responsible for noisy tappets.

OIL LEVEL

HIGH

If oil level is above the FULL mark, it is possible for the connecting rods to dip into the oil. With the engine running, this condition could create foam in the oil pan. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

LOW

Low oil level may allow oil pump to take in air. When air is fed to the tappets, they lose length, which allows valves to seat noisily. Any leaks on intake side of oil pump through which air can be drawn will create the same tappet action. Check the lubrication system from the intake strainer to the pump cover, including the relief valve retainer cap. When tappet noise is due to aeration, it may be

HYDRAULIC LIFTERS (CAM IN BLOCK) (Continued)

intermittent or constant, and usually more than one tappet will be noisy. When oil level and leaks have been corrected, operate the engine at fast idle. Run engine for a sufficient time to allow all of the air inside the tappets to be bled out.

TAPPET NOISE DIAGNOSIS

(1) To determine source of tappet noise, operate engine at idle with cylinder head covers removed.

(2) Feel each valve spring or rocker arm to detect noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

NOTE: Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on the valve spring. If noise is not appreciably reduced, it can be assumed the noise is in the tappet. Inspect the rocker arm push rod sockets and push rod ends for wear.

(3) Valve tappet noise ranges from light noise to a heavy click. A light noise is usually caused by excessive leak-down around the unit plunger, or by the plunger partially sticking in the tappet body cylinder. The tappet should be replaced. A heavy click is caused by a tappet check valve not seating, or by foreign particles wedged between the plunger and the tappet body. This will cause the plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between the valve stem and rocker arm as valve closes. In either case, tappet assembly should be removed for inspection and cleaning.

(4) The valve train generates a noise very much like a light tappet noise during normal operation. Care must be taken to ensure that tappets are making the noise. If more than one tappet seems to be noisy, it's probably not the tappets.

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 47).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Universal Leak-Down Tester.

(1) Place a 7.925-7.950 mm (0.312-0.313 inch) diameter ball bearing on the plunger cap of the tappet.

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

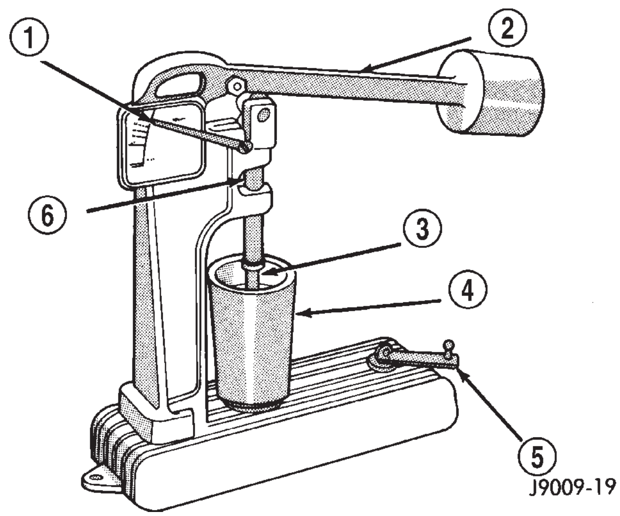


Fig. 47 Leak-Down Tester

1 - POINTER
2 - WEIGHTED ARM
3 - RAM
4 - CUP
5 - HANDLE
6 - PUSH ROD

REMOVAL

Retain all the components in the same order as removed.

(1) Remove the engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Remove the bridge and pivot assemblies and rocker arms by removing the capscrews at each bridge. Alternately loosen each capscrew, one turn at a time, to avoid damaging the bridges.

HYDRAULIC LIFTERS (CAM IN BLOCK) (Continued)

(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. 48).

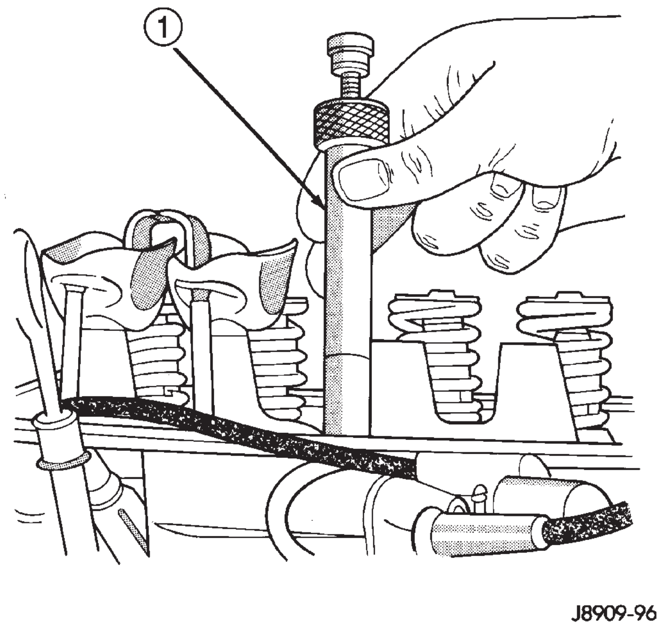


Fig. 48 Hydraulic Valve Tappet Removal/Installation Tool

1 - HYDRAULIC VALVE TAPPET REMOVAL/INSTALLATION TOOL

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.

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 (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

PISTON & CONNECTING ROD

DESCRIPTION

The pistons are made of aluminum and have three ring grooves, the top two grooves are for the compression rings and the bottom groove is for the oil control ring. The connecting rods are forged steel and are coined prior to heat treat. The piston pins are press fit.

STANDARD PROCEDURE—PISTON FITTING

(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. 50).

(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. 49). 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 & CONNECTING ROD (Continued)

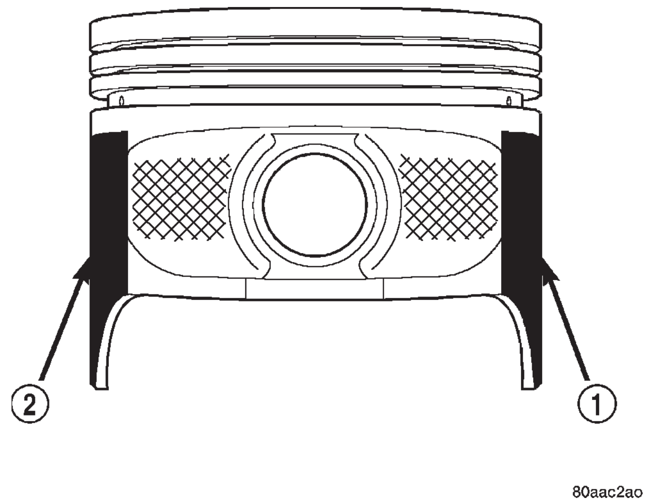


Fig. 49 Moly Coated Piston

1 - MOLY COATED
2 - MOLY COATED

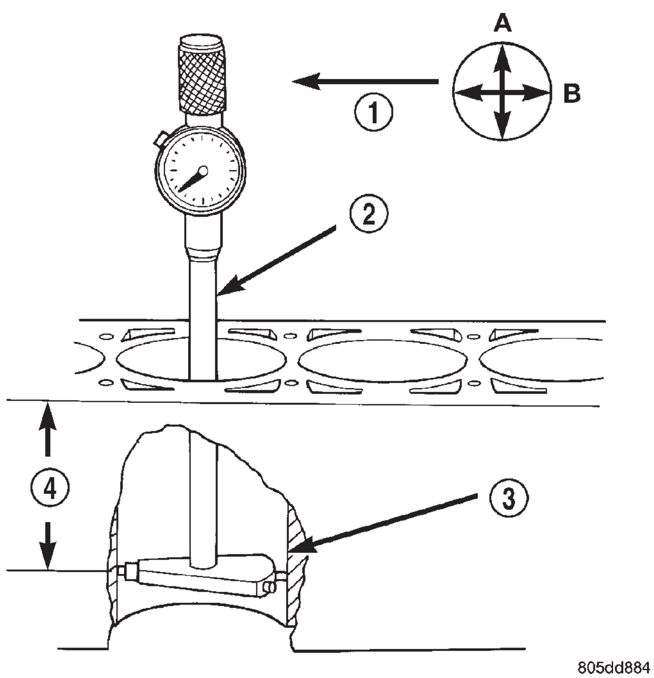


Fig. 50 Bore Gauge

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 49.5 MM (1–15/16 in)

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

REMOVAL

(1) Remove the engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Remove the rocker arms, bridges and pivots.

(3) Remove the push rods.

(4) Remove the engine cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(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 (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL) 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. 51).

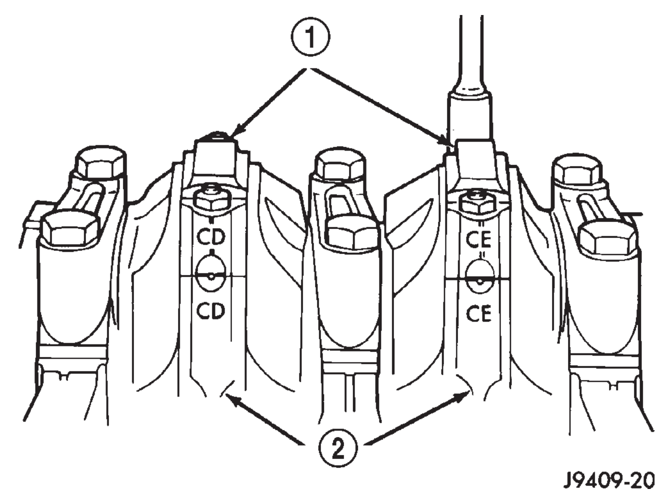


Fig. 51 Stamped Connecting Rods and Caps

1 - CONNECTING ROD CAP
2 - CONNECTING ROD

PISTON & CONNECTING ROD (Continued)

(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. 52).

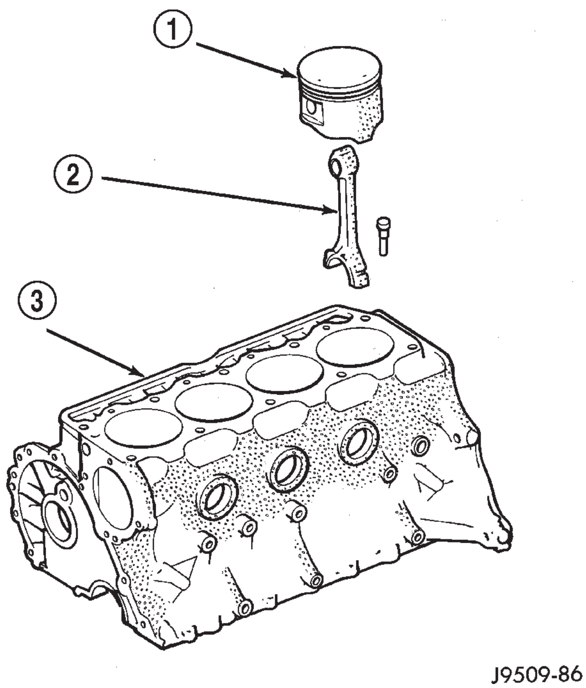


Fig. 52 Removal of Connecting Rod and Piston Assembly

1 - PISTON
2 - CONNECTING ROD
3 - CYLINDER BLOCK

CLEANING

Clean the piston and connecting rod assembly using a suitable solvent.

INSPECTION

Check the connecting rod journal for excessive wear, taper and scoring. Refer to Connecting Rod Bearings in the Service Procedures portion of this Section.

Check the connecting rod for signs of twist or bending.

Check the piston for taper and elliptical shape before it is fitted into the cylinder bore. Refer to Fitting Pistons in the Service Procedures portion of this Section.

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

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 (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE).

(3) Lubricate the piston and rings with clean engine oil.

CAUTION: Ensure that connecting rod bolts do not scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose slipped over the connecting rod bolts will provide protection during installation.

(4) Use a piston ring compressor to install the connecting rod and piston assemblies through the top of the cylinder bores (Fig. 53).

(5) Ensure the arrow on the piston top points to the front of the engine (Fig. 53).

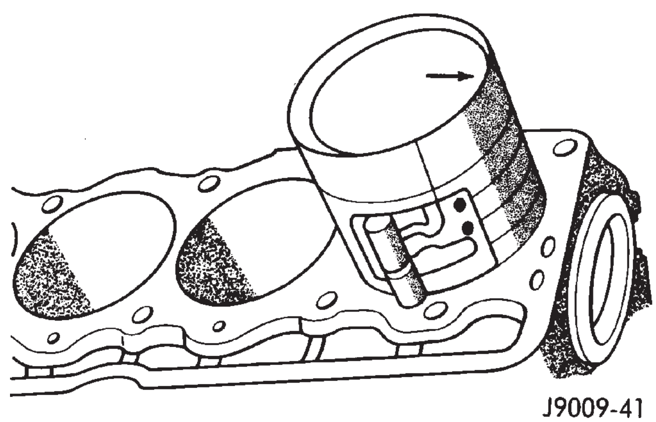


Fig. 53 Rod and Piston Assembly Installation

(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 (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE). 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 indi-

PISTON & CONNECTING ROD (Continued)

cate 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 (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE). A standard size insert is sometimes used in combination with a 0.025 mm (0.001 inch) undersize insert to reduce clearance 0.013 mm (0.0005 inch).

CAUTION: DO NOT intermix bearing caps. Each connecting rod and bearing cap are stamped with the cylinder number. The stamp is located on a machined surface adjacent to the oil squirt hole that faces the camshaft side of the cylinder block.

(10) Install the connecting rod bearing caps and inserts in the same positions as removed.

CAUTION: Verify that the oil squirt holes in the rods face the camshaft and that the arrows on the pistons face the front of the engine.

(11) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION) and gasket.

(12) Lower the vehicle.

(13) Install the engine cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION), push rods, rocker arms, bridges, pivots and engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(14) Fill the crankcase with engine oil.

PISTON RINGS

STANDARD PROCEDURE - 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. 54) (Fig. 55). Rotate the ring in the groove. It must move freely around circumference of the groove.

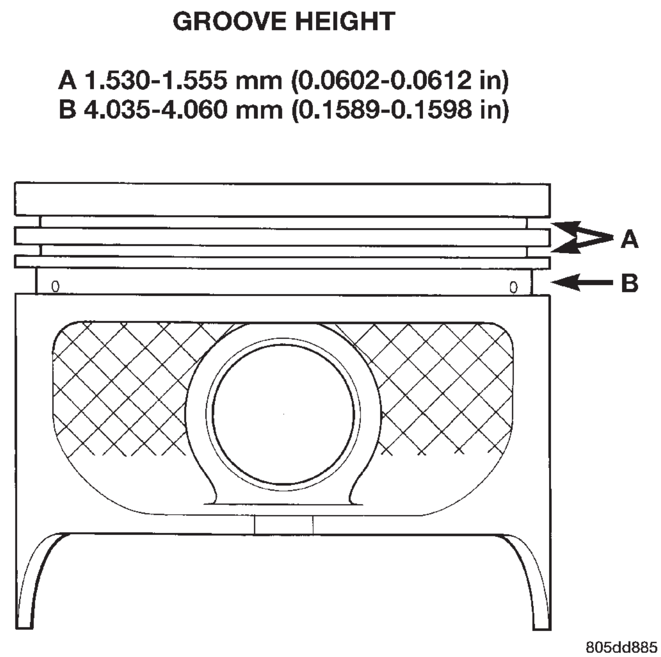


Fig. 54 Piston Dimensions

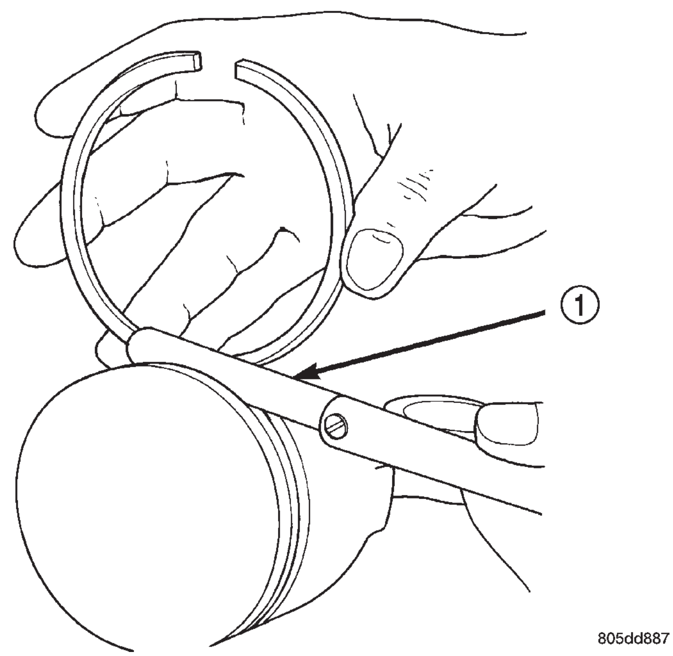


Fig. 55 Ring Side Clearance Measurement

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.)

PISTON RINGS (Continued)

(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. 56).

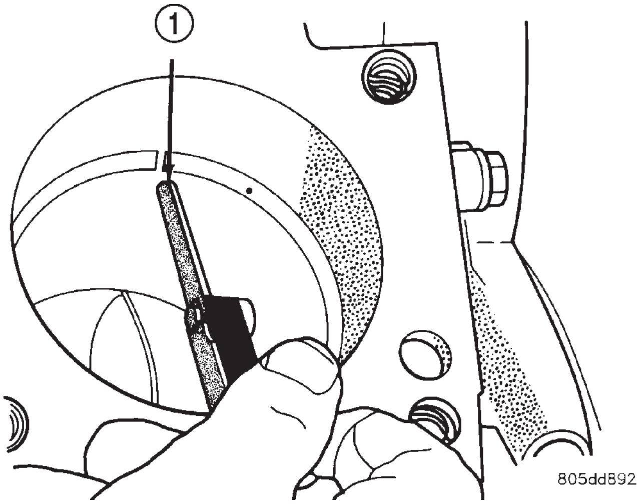


Fig. 56 Gap Measurement

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.)

(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. 57).

(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. 59).

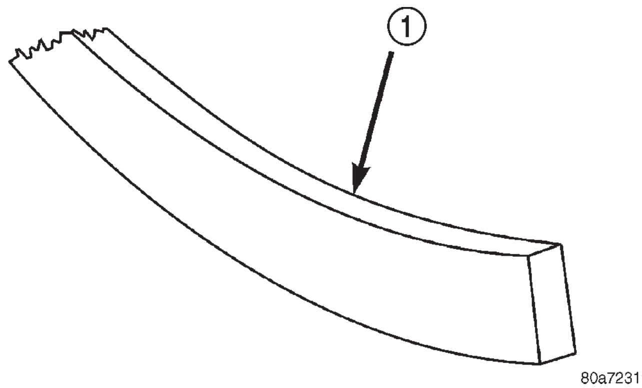


Fig. 57 Top Compression ring

1 - TOP COMPRESSION RING

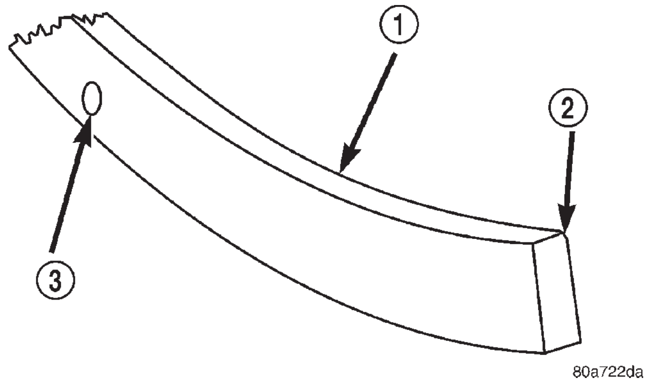


Fig. 58 Second Compression Ring Identification

1 - SECOND COMPRESSION RING
2 - CHAMFER
3 - ONE DOT

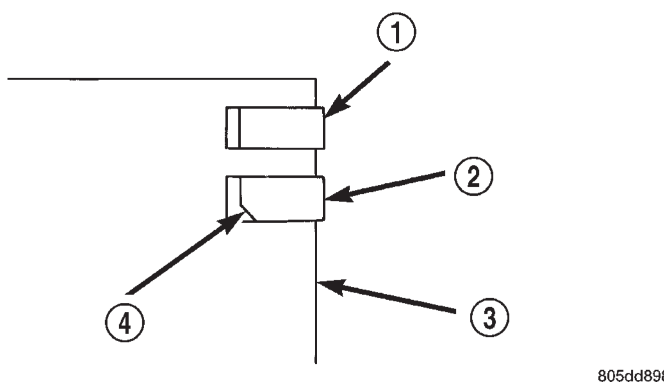


Fig. 59 Compression Ring Chamfer Location

1 - TOP COMPRESSION RING
2 - SECOND COMPRESSION RING
3 - PISTON
4 - CHAMFER

PISTON RINGS (Continued)

(8) Using a ring installer, install the second compression ring with the dot facing up (Fig. 58) (Fig. 60).

(9) Using a ring installer, install the top compression ring (either side up).

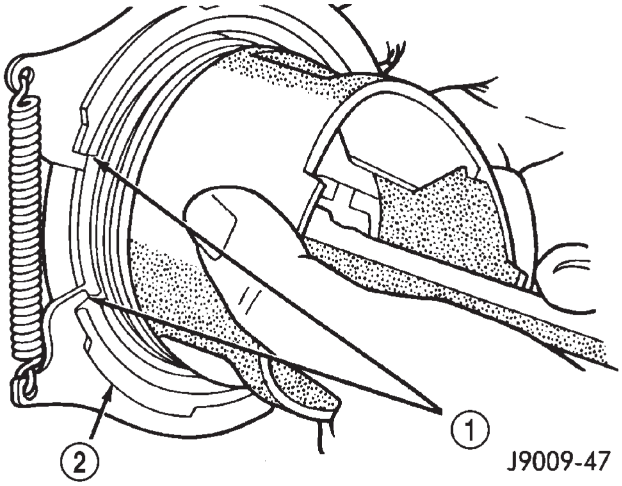


Fig. 60 Compression Ring

1 - COMPRESSION RING
2 - RING EXPANDER RECOMMENDED

Ring Gap Orientation

- Position the gaps on the piston as shown (Fig. 61).
- Oil spacer - Gap on center line of piston skirt.
- Oil rails - gap 180° apart on centerline of piston pin bore.
- No. 2 Compression ring - Gap 180° from top oil rail gap.
- No. 1 Compression ring - Gap 180° from No. 2 compression ring gap.

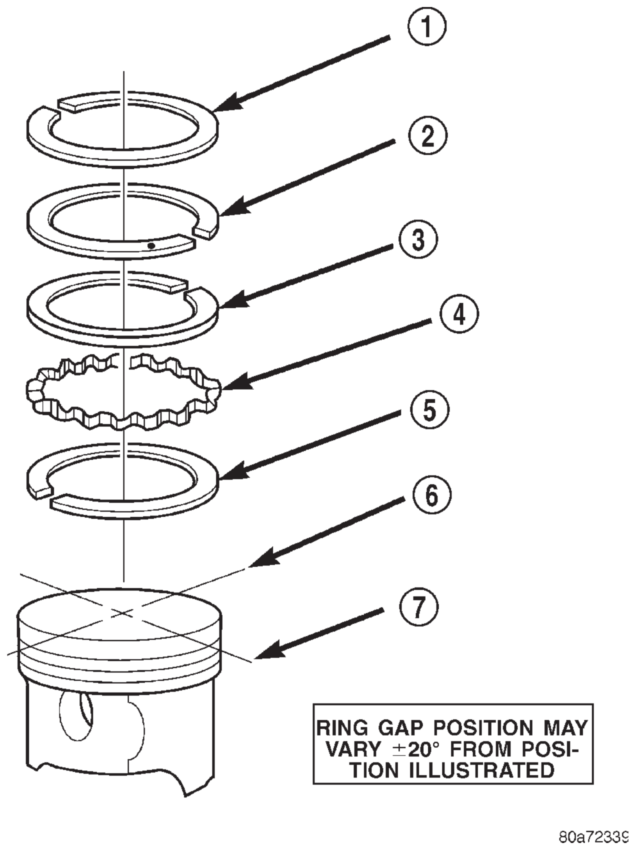


Fig. 61 Ring Gap Orientation

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

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL) 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. 62).

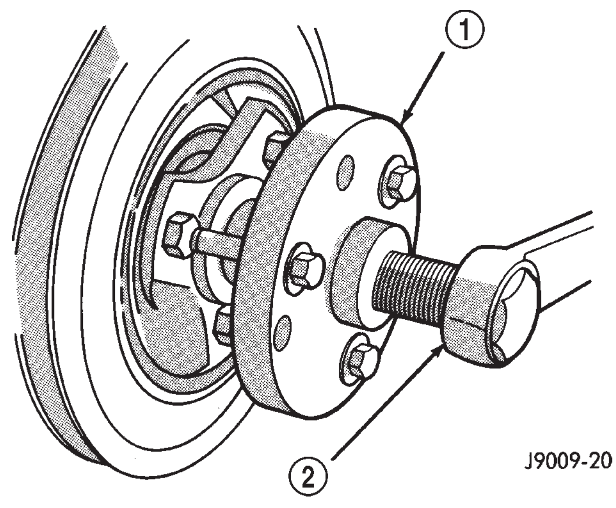


Fig. 62 Vibration Damper Removal Tool 7697

1 - VIBRATION DAMPER REMOVAL TOOL
2 - WRENCH

VIBRATION DAMPER (Continued)

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 (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION) and tighten to the specified tension (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - ADJUSTMENTS).

(5) Connect negative cable to battery.

FRONT MOUNT

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

(3) Support the engine.

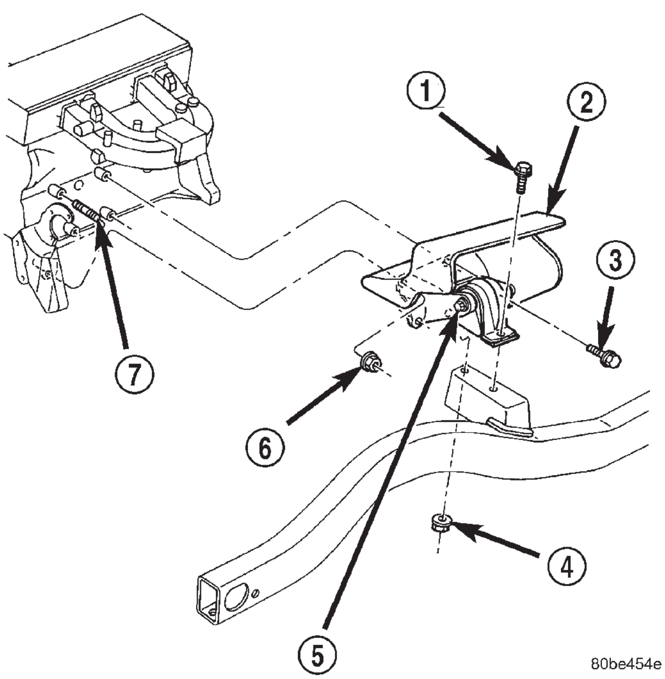


Fig. 63 Left Front Mount—2.5L Engine

1 - **BOLT (2)**
2 - **LEFT HAND ENGINE MOUNT ASSEMBLY**
3 - **BOLT (3)**
4 - **NUT (2)**
5 - **THROUGH BOLT**
6 - **LOCKNUT**
7 - **STUD**

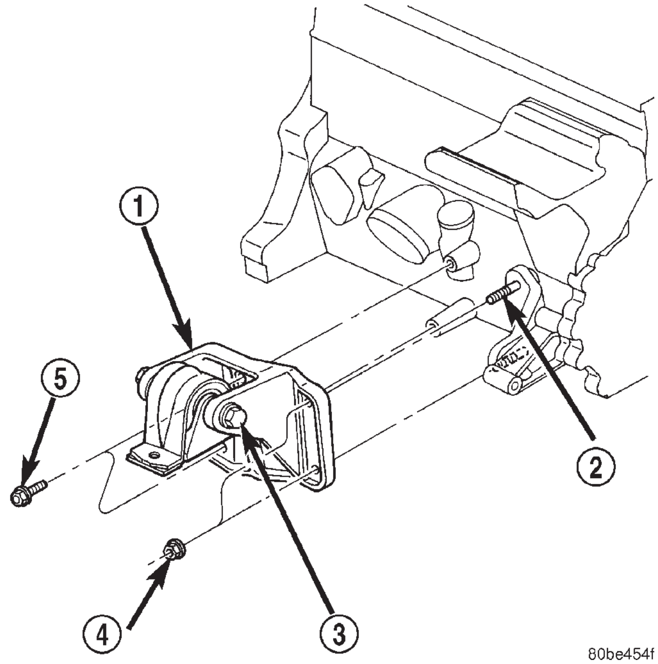


Fig. 64 Right Front Mount—2.5L Engine

1 - **RIGHT HAND ENGINE MOUNT ASSEMBLY**
2 - **STUD (2)**
3 - **THROUGH BOLT**
4 - **LOCKNUT (2)**
5 - **BOLT (2)**

(4) Remove through bolt nut (Fig. 63) (Fig. 64). 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. 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.

REAR MOUNT

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise the vehicle and support the transmission.

(3) Remove the nuts holding the support cushion to the skid plate (Fig. 65) (Fig. 66).

(4) Remove the skid plate bolts and the skid plate.

MANUAL TRANSMISSION

(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.

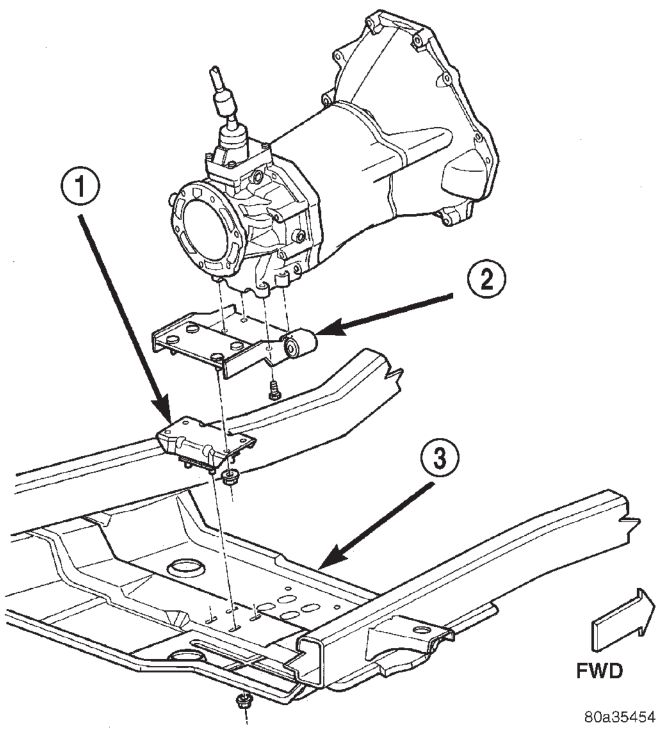


Fig. 65 Rear Mount (Manual Transmission)

1 - CUSHION
2 - BRACKET
3 - SKID PLATE

AUTOMATIC TRANSMISSION

(1) Remove nuts holding support cushion to transmission support bracket (Fig. 66). Remove the support cushion.

(2) Remove the bolts holding the transmission support bracket to transmission.

(3) Remove the transmission support bracket.

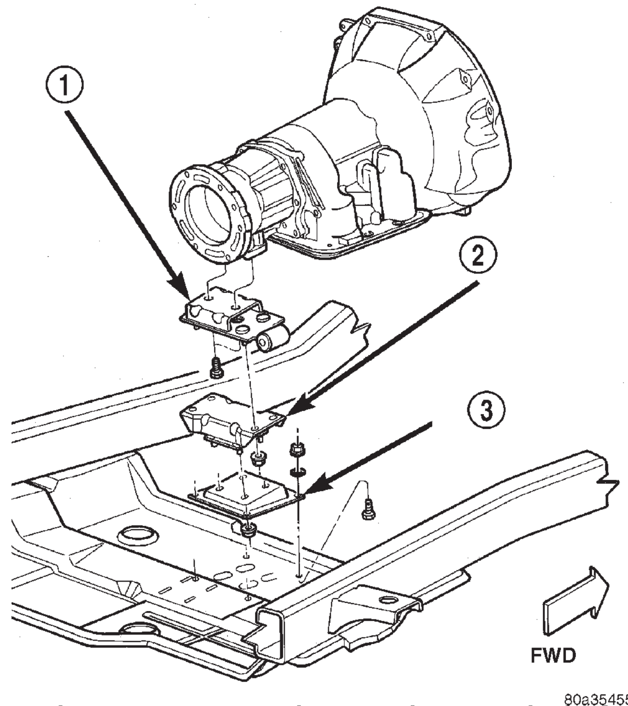


Fig. 66 Rear Mount (AutomaticTransmission)

1 - BRACKET
2 - CUSHION
3 - BRACKET

INSTALLATION

MANUAL TRANSMISSION

(1) Position the transmission mount bracket to the transmission and install the bolts (Fig. 65).

(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. 65).

(4) Tighten the nuts to 41 N·m (30 ft. lbs.) torque.

AUTOMATIC TRANSMISSION

(1) Position the transmission mount bracket to the transmission and install the bolts. Tighten the bolts to 54 N·m (40 ft. lbs.) torque.

(2) Position the support cushion to the transmission mount bracket and install nuts. Tighten the nuts to 41 N·m (30 ft. lbs.) torque (Fig. 66).

(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.

(4) Position the skid plate to the studs of the support cushion and install the nuts (Fig. 65) (Fig. 66). Tighten the nuts to 28 N·m (21 ft. lbs.) torque.

(5) Install the skid plate bolts to the sill and tighten to 75 N·m (55 ft. lbs.) torque.

(6) Remove the transmission support.

(7) Lower the vehicle.

(8) Connect negative cable to battery.

LUBRICATION

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, 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 (Fig. 67).

LUBRICATION (Continued)

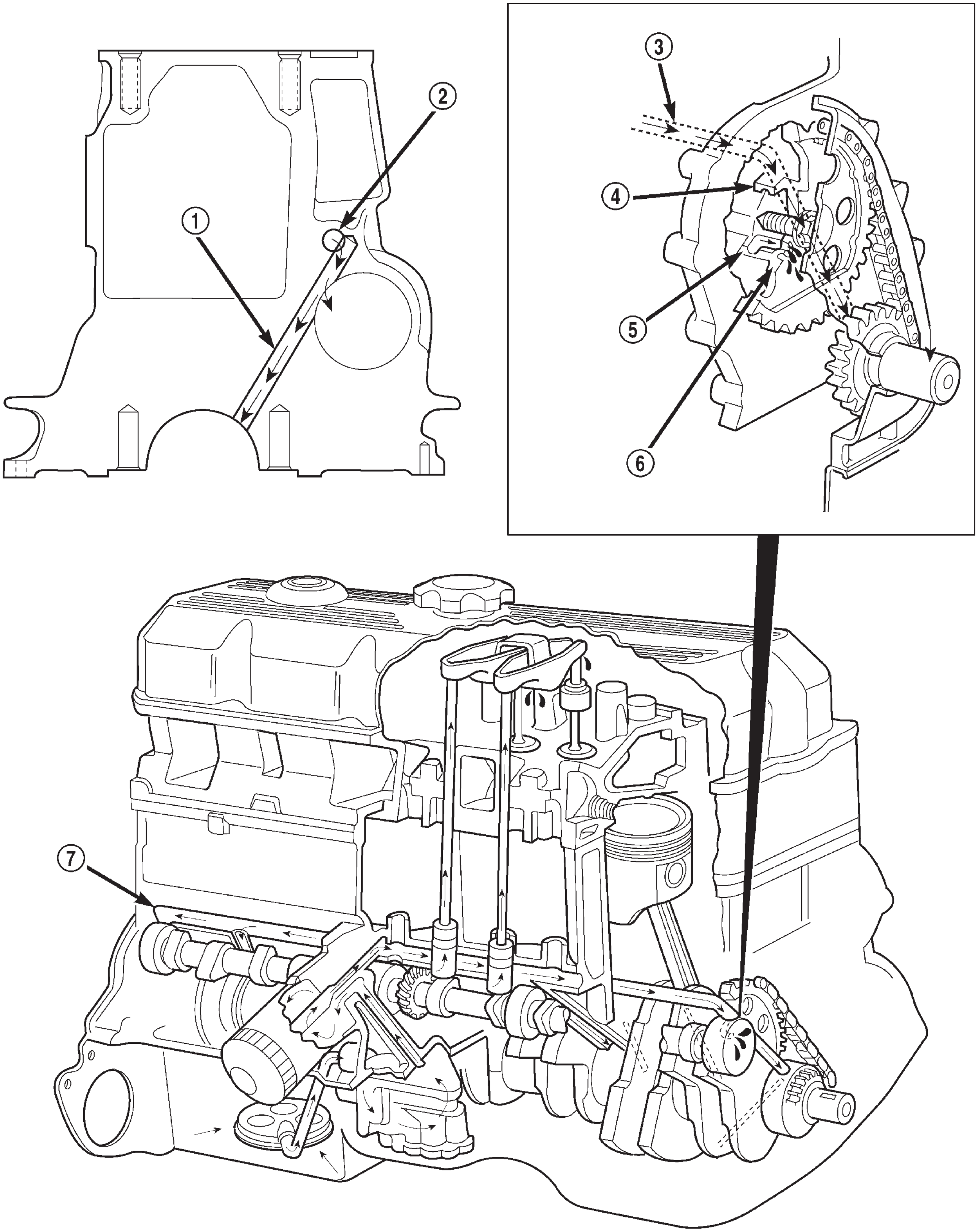


Fig. 67 Oil Lubrication System—2.5L Engine

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

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING—ENGINE OIL LEAKS

Begin with a through visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil-soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to be sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light source.

(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 previous step.

(5) If the oil leak source is not positively identified at this time, proceed with the air leak detection test method as follows:

(6) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(7) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(8) 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.

(9) 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.

(10) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(11) 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. Proceed to next step.

(12) 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.

DIAGNOSIS AND TESTING—ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit.

(2) Install Oil Pressure Line and Gauge Tool C-3292. Start engine and record pressure. (Refer to 9 - ENGINE - SPECIFICATIONS).

OIL

STANDARD PROCEDURE - ENGINE OIL SERVICE

ENGINE OIL CHANGE

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. CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA.

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. DaimlerChrysler Corporation recommends a Mopar® or equivalent oil filter be used.

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) Position a drain pan under the oil filter.

(8) Using a suitable oil filter wrench loosen filter.

OIL (Continued)

(9) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss or filter adapter housing (Fig. 68).

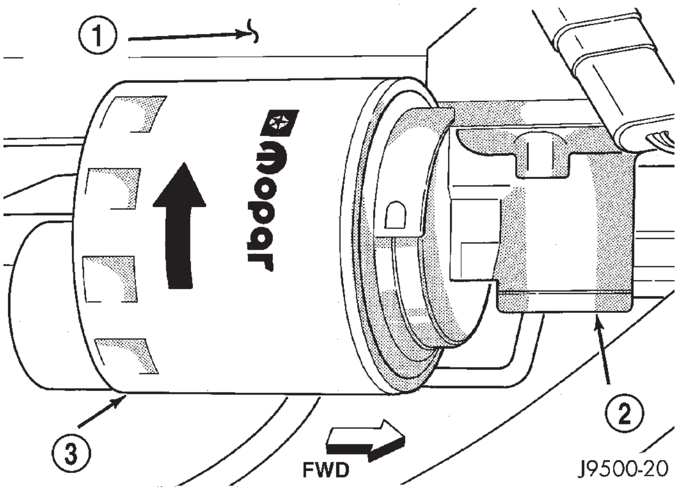


Fig. 68 Oil Filter—4.0L Engine

1 - CYLINDER BLOCK
2 - ADAPTER
3 - OIL FILTER

(10) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(11) Make sure old gasket comes off with oil filter. With a wiping cloth, clean the gasket sealing surface (Fig. 69) of oil and grime.

(12) Lightly lubricate oil filter gasket with engine oil or chassis grease.

(13) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 69)hand tighten filter one full turn, do not over tighten.

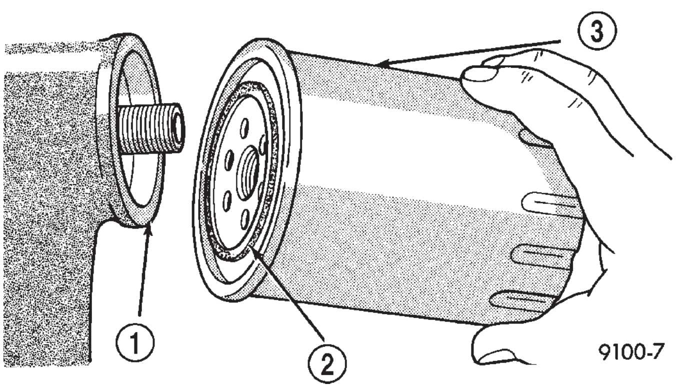


Fig. 69 Oil Filter Sealing Surface—Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

(14) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(15) Install oil fill cap.

(16) Start engine and inspect for leaks.

(17) Stop engine and inspect oil level.

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 4.0L 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. 70).

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading (Fig. 70).

(6) Add oil only if level is below the ADD mark on dipstick.

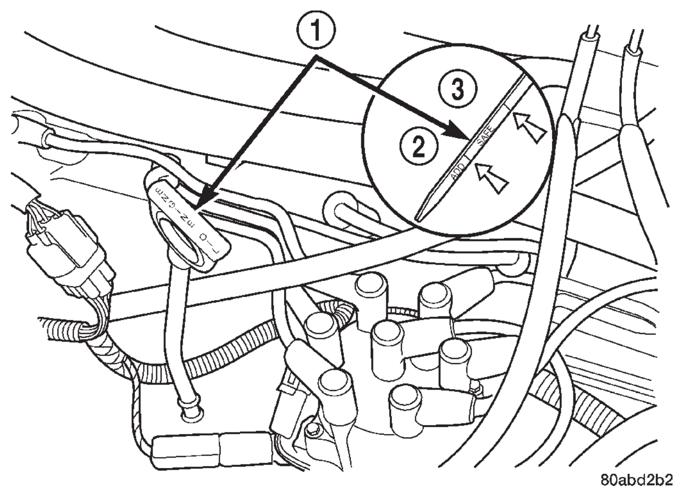


Fig. 70 Engine Oil Dipstick—4.0L Engine

1 - DIPSTICK
2 - ADD
3 - SAFE

OIL (Continued)

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING at beginning of this procedure.

OIL FILTER

REMOVAL

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. DaimlerChrysler Corporation recommends a Mopar® or equivalent oil filter be used.

(1) Position a drain pan under the oil filter.

(2) Using a suitable oil filter wrench loosen filter.

(3) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss or filter adapter housing (Fig. 71).

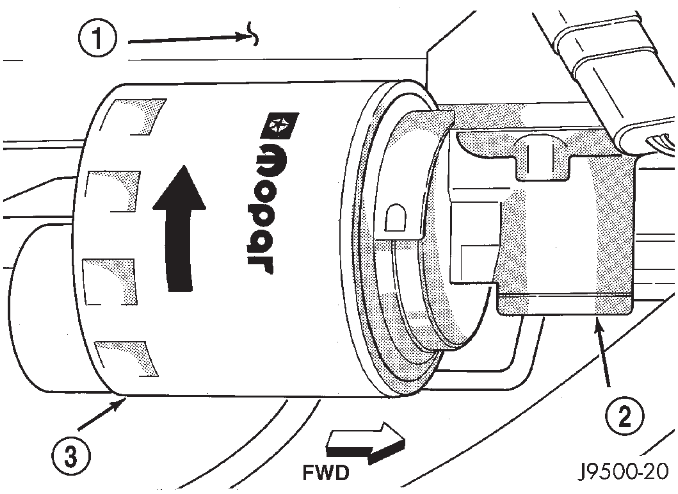


Fig. 71 Oil Filter—4.0L Engine

1 - CYLINDER BLOCK
2 - ADAPTER
3 - OIL FILTER

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) Make sure old gasket comes off with oil filter. With a wiping cloth, clean the gasket sealing surface (Fig. 69) of oil and grime.

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. 72) hand tighten filter one full turn, do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

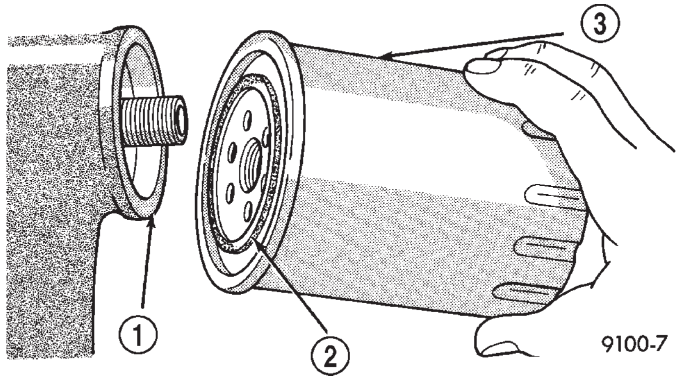


Fig. 72 Oil Filter Sealing Surface—Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

(3) Remove the oil pan drain plug and drain the engine oil.

(4) Disconnect the exhaust pipe at the engine exhaust manifold.

(5) Disconnect the exhaust hanger at the catalytic converter and lower the pipe.

(6) Remove the engine starter motor.

(7) Remove the flywheel/torque converter housing access cover.

(8) Position a jack stand directly under the engine vibration damper.

(9) Place a piece of wood (2 x 2) between the jack stand and the engine vibration damper.

(10) Remove the engine mount through bolts.

(11) Using the jack stand, raise the engine until adequate clearance is obtained to remove the oil pan.

(12) If equipped, disconnect the transmission cooler lines and oxygen sensor harness from oil pan mounting studs.

(13) Remove the oil pan bolts and studs. Carefully remove the oil pan and gasket.

CLEANING

Clean the block and pan gasket surfaces.

Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**

OIL PAN (Continued)

If present, trim excess sealant from inside the engine.

Clean oil pan in solvent and wipe dry with a clean cloth.

Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSPECTION

Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

INSTALLATION

(1) 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. 73).

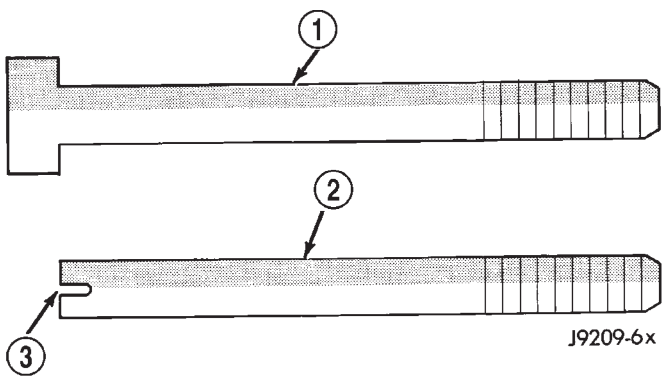


Fig. 73 Fabrication of Alignment Dowels

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. 74).

(4) Apply Mopar® Silicone Adhesive Sealant onto the cylinder block in four location as shown (Fig. 75)

(5) Slide the one-piece gasket over the dowels and onto the block and timing case cover.

(6) Position the oil pan over the dowels and onto the gasket.

(7) Install the 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque. Install the 5/16 inch oil pan bolts (Fig. 76). 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.

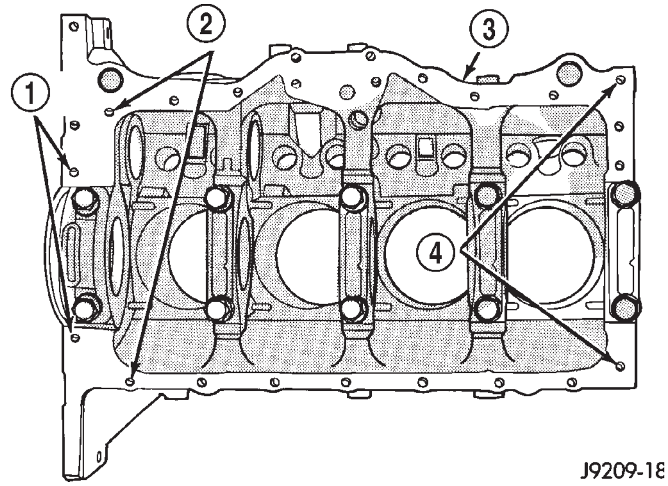


Fig. 74 Position of Dowels in Cylinder Block

1 - 5/16′′ HOLES
2 - DOWEL HOLES
3 - CYLINDER BLOCK
4 - 5/16′′ HOLES

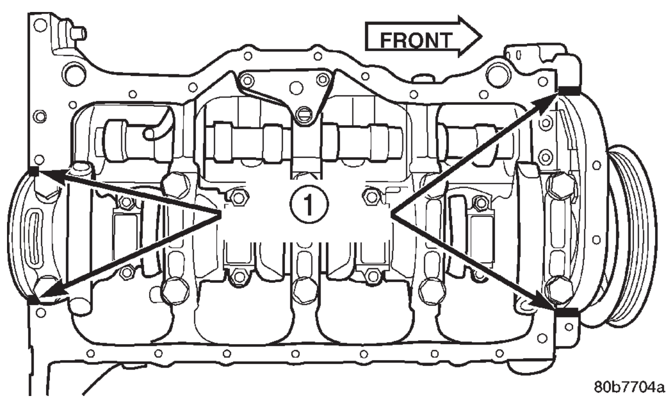


Fig. 75 Location of Mopar® Silicone Adhesive Sealant on

1 - SEALER LOCATIONS

(11) Lower the jack stand and remove the piece of wood.

(12) Install the flywheel and torque converter housing access cover.

(13) Install the engine starter motor.

(14) Connect the exhaust pipe to the hanger and to the engine exhaust manifold.

(15) Install the oil pan drain plug (Fig. 76). Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(16) Lower the vehicle.

(17) Connect negative cable to battery.

(18) Fill the oil pan with engine oil to the specified level.

OIL PAN (Continued)

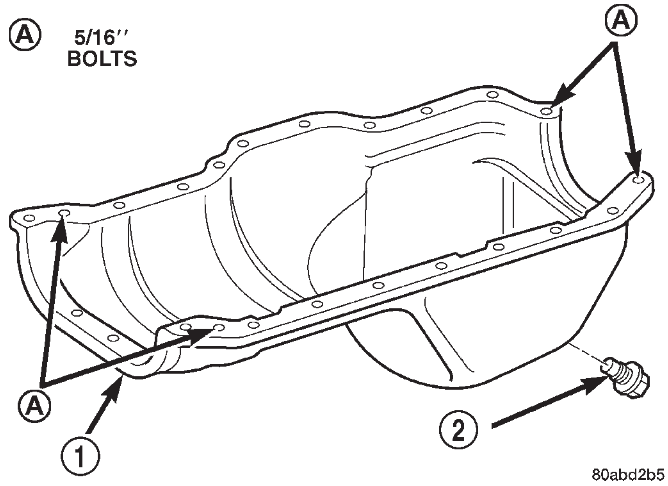


Fig. 76 Position of 5/16 inch Oil Pan Bolts

1 - OIL PAN
2 - OIL PAN DRAIN PLUG

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(19) Start the engine and inspect for leaks.

OIL PUMP

REMOVAL

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.

(1) Drain the engine oil.

(2) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(3) Remove the pump-to-cylinder block attaching bolts. Remove the pump assembly with gasket (Fig. 77).

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.

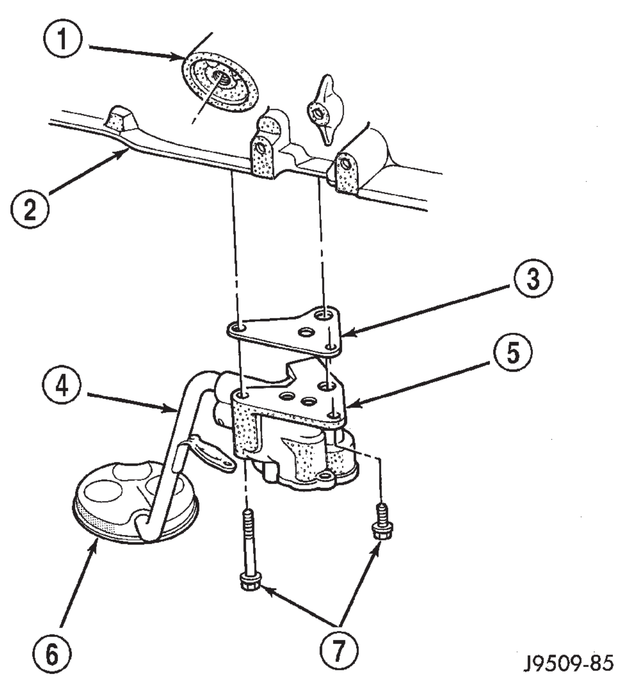


Fig. 77 Oil Pump Assembly

1 - OIL FILTER ADAPTOR
2 - BLOCK
3 - GASKET
4 - OIL INLET TUBE
5 - OIL PUMP
6 - STRAINER ASSEMBLY
7 - ATTACHING BOLTS

INSTALLATION

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.

(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 (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(3) Fill the oil pan with oil to the specified level.

ENGINE OIL PRESSURE SENSOR

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)
- 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.

INTAKE MANIFOLD

DESCRIPTION

The aluminum intake manifold is a single plane design.

The intake manifold and the exhaust manifold share a common one piece sealing gasket.

DIAGNOSIS AND TESTING - INTAKE MANIFOLD

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.

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the air inlet hose and resonator from the throttle body and air cleaner housing (Fig. 78).

(4) remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(5) 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.

(6) Perform the fuel pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(7) Disconnect fuel supply tube from the fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(8) Disconnect the accelerator cable from the throttle body and cable bracket.

(9) 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.

(10) 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.
- The manifold air temperature sensor at the intake manifold.
- The fuel injectors.
- The oxygen sensor.

(11) Disconnect the crankcase ventilation (CCV) vacuum hose and manifold absolute pressure (MAP) sensor vacuum hose connector at the intake manifold.

(12) Disconnect HVAC supply vacuum hose from intake manifold.

(13) Disconnect CCV hose at the cylinder head cover (Fig. 78).

(14) Remove the molded vacuum harness.

(15) Disconnect the vacuum brake booster hose at the intake manifold.

INTAKE MANIFOLD (Continued)

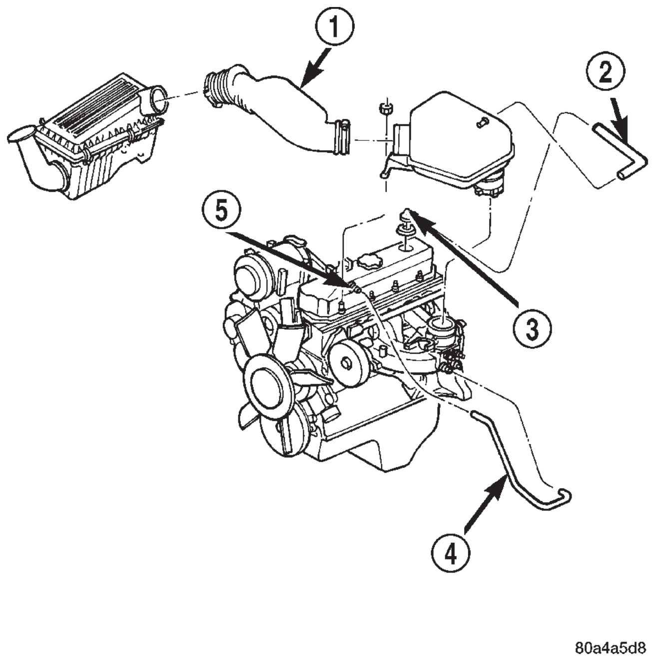


Fig. 78 Air Inlet/CCV System—2.5L Engine

1 - AIR TUBE
2 - CCV TUBE
3 - AIR INLET FITTING
4 - CCV TUBE
5 - FIXED ORIFICE FITTING

(16) Remove bolts 2 through 5 securing the intake manifold to the cylinder head (Fig. 79). LOOSEN BUT DO NOT REMOVE exhaust manifold bolt No. 1 and nuts 6 and 7.

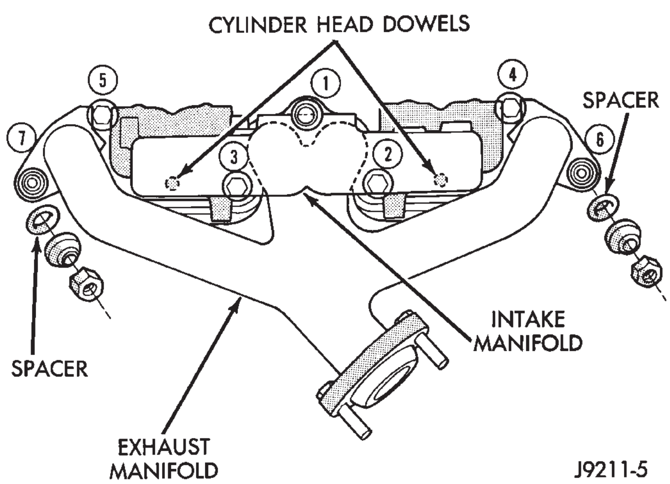


Fig. 79 Intake/Exhaust Manifold—2.5L Engine

(17) Remove the intake manifold and gaskets. Drain the coolant from the manifold.

CLEANING

CAUTION: DO NOT allow foreign material to enter either the intake manifold ports, or the cylinder head ports.

Clean the intake manifold to cylinder head mating surfaces.

INSPECTION

Inspect manifold to cylinder head mating surfaces for cracks and/or pitting. Inspect manifold for warp or twist.

INSTALLATION

(1) Clean the intake manifold and cylinder head mating surfaces. **DO NOT allow foreign material to enter either the intake manifold or the ports in the cylinder head.**

(2) Install the new intake manifold gasket over the locating dowels.

(3) Position the manifold in place and finger tighten the mounting bolts.

(4) Tighten the fasteners in sequence and to the specified torque (Fig. 79).

- 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 (Refer to 14 - FUEL SYSTEM/ FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(6) Connect the molded vacuum hoses to the vacuum port on the intake manifold and the cylinder head cover.

(7) Connect the electrical connectors.

- The throttle position sensor.
- The 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.

(8) Connect the brake booster vacuum supply hose.

(9) Connect the CCV hose and MAP sensor vacuum hose connectors to the throttle body.

(10) Install the power steering pump and bracket assembly to the water pump and intake manifold. 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.).

INTAKE MANIFOLD (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.

(11) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(12) Connect the accelerator cable to the bracket and the throttle lever.

(13) Connect the speed control and transmission line pressure cable (if equipped) to the bracket and throttle lever.

(14) Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(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.

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifold is constructed of cast iron and has a ball flange designed exhaust pipe mounting flange.

The exhaust manifold and the intake manifold share a common one piece sealing gasket.

OPERATION

The exhaust manifold collects the engine exhaust exiting the combustion chambers, then channels the exhaust gases to the exhaust pipe attached to the manifold.

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Raise the vehicle.

(4) Disconnect the exhaust pipe from the engine exhaust manifold.

(5) Lower the vehicle.

(6) Remove intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(7) Remove fasteners 2 through 5 and remove the intake manifold (Fig. 80).

(8) Remove fasteners 1, 6 and 7 and remove the engine exhaust manifold (Fig. 80).

CLEANING

Clean mating surfaces on cylinder head and manifold, wash with solvent and blow dry with compressed air.

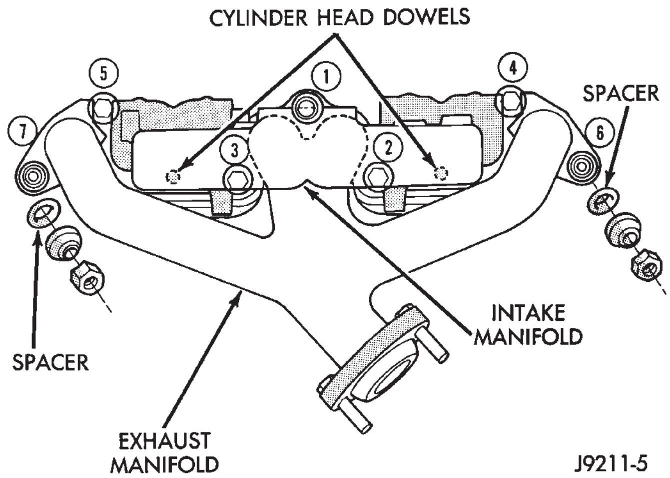


Fig. 80 Intake/Exhaust Manifold Removal/Installation

INSPECTION

Inspect manifold for cracks, Inspect mating surfaces of manifold for flatness with a straight edge. Seal surfaces must be flat within 0.1 mm (0.004 inch) overall.

INSTALLATION

(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. 80).**

(4) Tighten bolt No.1 to 41 N·m (30 ft. lbs.) torque (Fig. 80).

(5) Install the intake manifold on the cylinder head dowels (Fig. 80).

(6) Install bolts 2 through 5 (Fig. 80). 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. 80).

(8) Tighten nuts 6 and 7 to 23 N·m (17 ft. lbs.) torque (Fig. 80).

(9) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(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) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(14) Connect the battery negative cable.

(15) Start the engine and check for leaks.

VALVE TIMING

STANDARD PROCEDURE - CHECKING TIMING CHAIN WEAR

NOTE: Timing chain tensioner must be removed for this operation.

(1) Place a scale next to the timing chain so that any movement of the chain can be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt. Apply torque in the direction of crankshaft rotation to take up slack; 41 N·m (30 ft. lbs.) torque with cylinder head installed or 20 N·m (15 ft. lbs.) torque with cylinder head removed. With torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block the crankshaft to prevent rotation.

(3) Hold a scale with dimensional reading even with the edge of a chain link. With cylinder heads installed, apply 14 N·m (30 ft. lbs.) torque in the reverse direction. With the cylinder heads removed, apply 20 N·m (15 ft. lbs.) torque in the reverse direction. Note the amount of chain movement (Fig. 81).

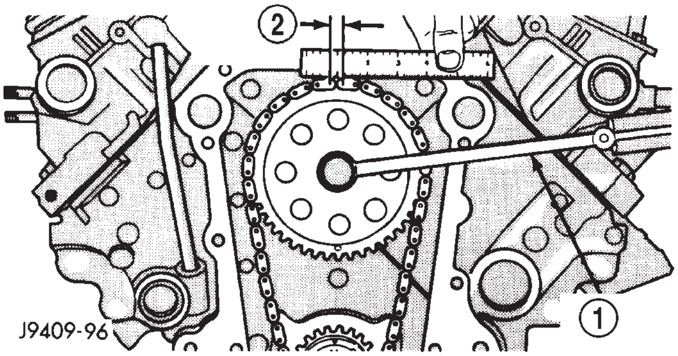


Fig. 81 Measuring Timing Chain Wear and Stretch

1 - TORQUE WRENCH
2 - 3.175 MM (0.125 IN.)

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(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) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL) and generator bracket assembly from the engine cylinder head and move to one side.

(6) Remove the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) (Fig. 82).

(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. 82).

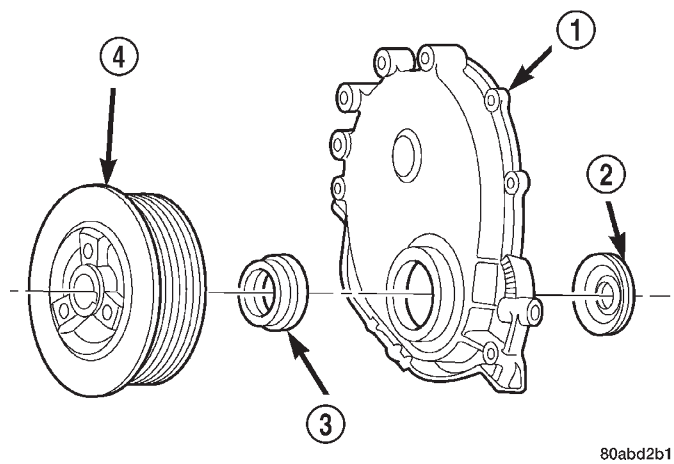


Fig. 82 Timing Case Cover Components

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 (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION). The open end of the seal should be toward the inside of the cover. Support the cover at the seal

TIMING BELT / CHAIN COVER(S) (Continued)

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. 83).

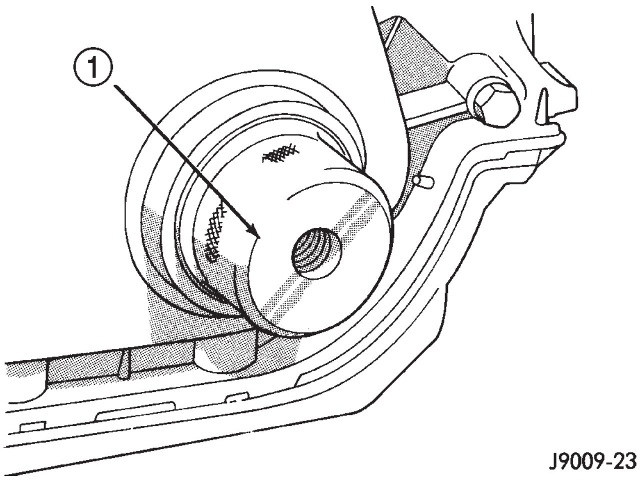


Fig. 83 Timing Case Cover Alignment and Seal Installation Tool 6139

1 - TIMING CASE COVER ALIGNMENT AND SEAL INSTALLATION TOOL

(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) Install the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(11) Install the A/C compressor (if equipped) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION) and generator bracket assembly.

(12) Install the engine fan and hub assembly and shroud.

(13) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION) and tighten to obtain the specified tension.

(14) Connect negative cable to battery.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

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.

(1) Disconnect negative cable from battery.

(2) Remove the fan and shroud.

(3) Remove the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove the crankshaft vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(5) Remove the timing case cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(6) Rotate crankshaft until the “0” timing mark is closest to and on the center line with camshaft sprocket timing mark (Fig. 84).

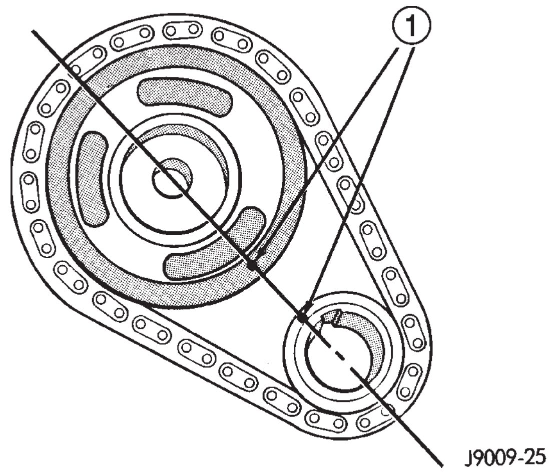


Fig. 84 Crankshaft—Camshaft Alignment

1 - TIMING MARKS

TIMING BELT/CHAIN AND SPROCKETS (Continued)

(7) Remove the oil slinger from the crankshaft.

(8) Remove the camshaft retaining bolt and remove the sprockets and chain as an assembly (Fig. 85).

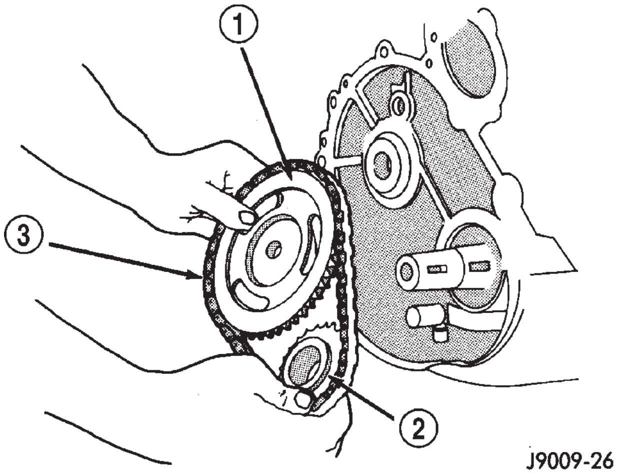


Fig. 85 Camshaft and Crankshaft Sprockets and Chain

1 - CAMSHAFT SPROCKET
2 - CRANKSHAFT SPROCKET
3 - CHAIN

INSTALLATION

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.

(1) Turn the tensioner lever to the unlocked (down) position (Fig. 86).

(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. 86).

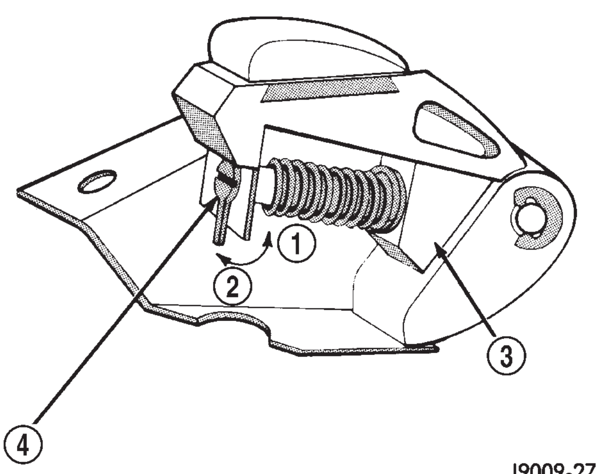


Fig. 86 Loading Timing Chain Tensioner

1 - LOCK
2 - UNLOCK
3 - TENSIONER BLOCK
4 - TENSIONER LEVER

(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. 84).

(4) Install the camshaft sprocket retaining bolt and washer. Tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(5) To verify correct installation of the timing chain, turn the crankshaft to position the camshaft sprocket timing mark as shown in (Fig. 87). Count the number of chain pins between the timing marks of both sprockets. There must be 20 pins.

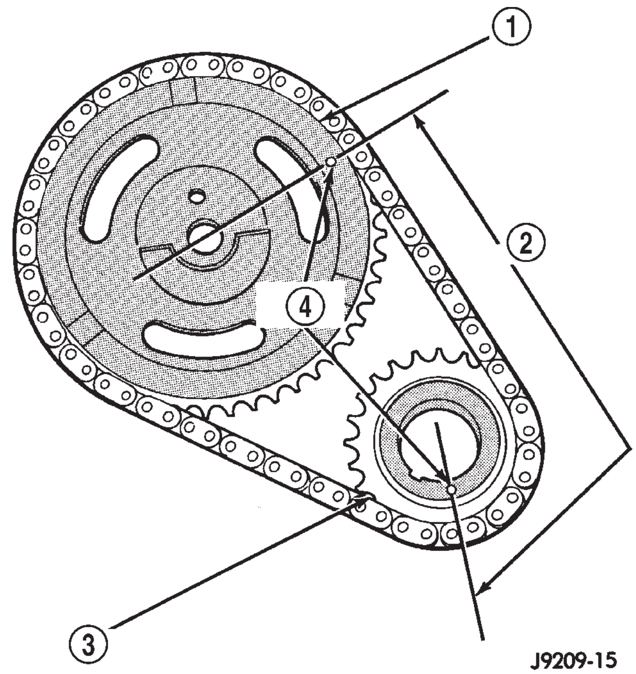


Fig. 87 Verify Sprocket—Chain Installation

1 - CAMSHAFT SPROCKET
2 - 20 PINS
3 - CRANKSHAFT SPROCKET
4 - TIMING MARKS

(6) Turn the chain tensioner lever to the unlocked (down) position (Fig. 86).

(7) Install the oil slinger.

(8) Replace the oil seal in the timing case cover (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION).

(9) Install the timing case cover and gasket (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(10) With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(11) Install the fan and shroud.

(12) Connect negative cable to battery.

ENGINE 4.0L

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ENGINE 4.0L

DESCRIPTION

DESCRIPTION - ENGINE BLOCK

The cylinder block is a cast iron inline six cylinder design. The cylinder block is drilled forming galleries for both oil and coolant (Fig. 1).

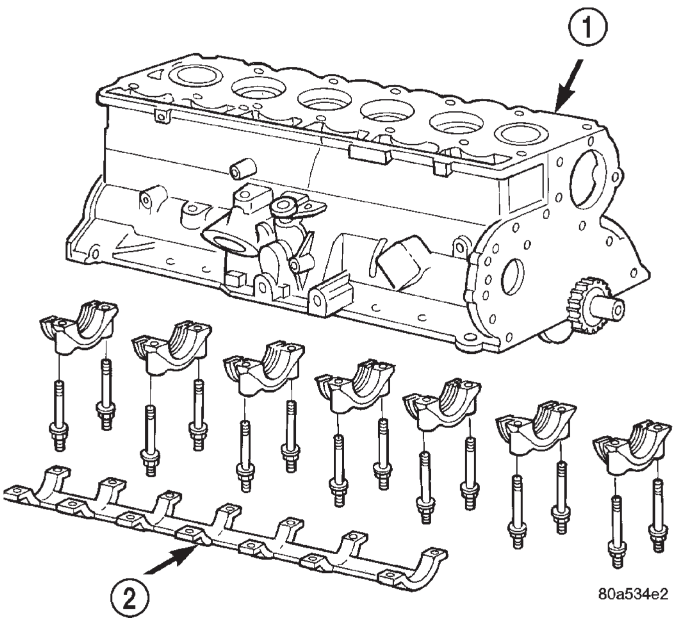

Fig. 1 4.0L Cylinder Block with Main Bearing Caps and Cap Brace

1 - BLOCK
2 - MAIN BEARING CAP BRACE

DESCRIPTION - ENGINE

The 4.0 Liter (242 CID) six-cylinder engine is an In-line, lightweight, overhead valve engine.

This engine is designed for unleaded fuel. The engine cylinder head has dual quench-type combustion chambers that create turbulence and fast burning of the air/fuel mixture. This results in good fuel economy.

The cylinders are numbered 1 through 6 from front to rear. The firing order is 1-5-3-6-2-4 (Fig. 2).

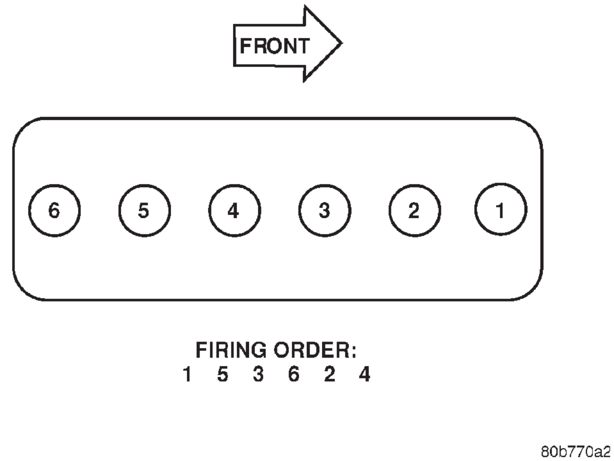

Fig. 2 Engine Firing Order

The crankshaft rotation is clockwise, when viewed from the front of the engine. The crankshaft rotates within seven main bearings. The camshaft rotates within four bearings.

BUILD DATE CODE

The engine Build Date Code is located on a machined surface on the right side of the cylinder block between the No.2 and No.3 cylinders (Fig. 3).

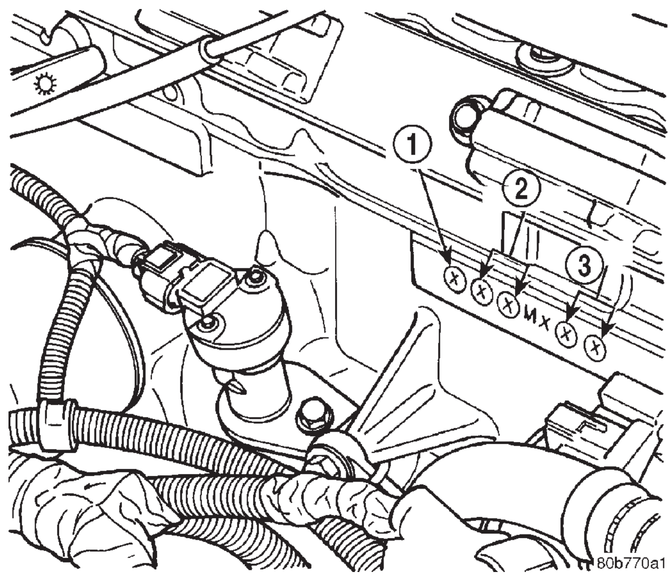

Fig. 3 Build Date Code Location

1 - YEAR
2 - MONTH
3 - DAY

The digits of the code identify:

- 1st Digit—The year (0 = 2000).
- 2nd & 3rd Digits—The month (01 - 12).
- 4th & 5th Digits—The engine type/fuel system/compression ratio (MX = A 4.0 Liter (242 CID) engine with a multi-point fuel injection system).
- 6th & 7th Digits—The day of engine build (01 - 31).

(1) **FOR EXAMPLE:** Code * 001MX12 * identifies a 4.0 Liter (242 CID) engine with a multi-point fuel injection system, and built on January 12, 2000.

DIAGNOSIS AND TESTING

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 9 - ENGINE - DIAGNOSIS AND TESTING) (PERFORMANCE) or (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING) (MECHANICAL) for possible causes and corrections of malfunctions.

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:

- (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING) (PERFORMANCE)
- (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING) (MECHANICAL)

DIAGNOSIS AND TESTING - ENGINE 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 8 - ELECTRICAL/BATTERY SYSTEM/ BATTERY - STANDARD PROCEDURE), for correct procedures. Check charging system. (Refer to 8 - ELECTRICAL/ CHARGING - DIAGNOSIS AND TESTING), 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 8 - ELECTRICAL/STARTING - DIAGNOSIS AND TESTING), 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 9 - ENGINE - DIAGNOSIS AND TESTING), for correct diagnostics/ procedures

ENGINE 4.0L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE CRANKS BUT WILL NOT START	1. No spark	1. Check for spark. (Refer to 8 - ELECTRICAL/IGNITION CONTROL - SPECIFICATIONS), for correct procedures.
	2. No fuel	2. Perform fuel pressure test (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING), and if necessary, inspect fuel injector(s) and driver circuits. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - DIAGNOSIS AND TESTING), for correct procedures.
	3. Low or no engine compression	3. Perform cylinder compression pressure test. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
ENGINE LOSS OF POWER	1. Worn or burned distributor rotor	1. Install new distributor rotor
	2. Worn camshaft position sensor shaft	2. Remove and repair camshaft position sensor.(Refer to 8 - ELECTRICAL/ IGNITION CONTROL/CAMSHAFT POSITION SENSOR - REMOVAL).
	3. Worn or incorrect gapped spark plugs	3. Clean plugs and set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ SPARK PLUG - CLEANING).
	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. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
	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 coil rail	11. Test and replace, as necessary. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/COIL RAIL - REMOVAL).
ENGINE STALLS OR ROUGH IDLE	1. Carbon build-up on throttle plate	1. Remove throttle body and de-carbon. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL) for correct procedure.
	2. Engine idle speed too low	2. Check Idle Air Control circuit.
	3. Worn or incorrectly gapped spark plugs	3. Replace or clean and re-gap spark plugs. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING)
	4. Faulty coil rail	4. Test and replace, if necessary. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/COIL RAIL - REMOVAL)

ENGINE 4.0L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	5. Intake manifold vacuum leak	5. Inspect intake manifold gasket and vacuum hoses. Replace if necessary. (Refer to 9 - ENGINE/MANIFOLDS/ INTAKE MANIFOLD - DIAGNOSIS AND TESTING).
ENGINE MISSES ON ACCELERATION	1. Worn or incorrectly gapped spark plugs	1. Replace spark plugs or clean and set gap.
2. Spark plug cables defective or crossed	2. Replace spark plug cables.	
	3. Dirt in fuel system	3. Clean fuel system
	4. Burned, warped or pitted valves	4. Install new valves
	5. Faulty coil rail	5. Test and replace as necessary. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/COIL RAIL - REMOVAL)

DIAGNOSIS AND TESTING— ENGINE 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 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) for engine oil pressure test/ specifications
	4. Dirt in tappets/lash adjusters	4. Clean/replace hydraulic tappets/lash adjusters
	5. Bent push rod(s)	5. Install new push rods
	6. Worn rocker arms	6. Inspect oil supply to rocker arms and replace worn arms as needed
	7. Worn tappets/lash adjusters	7. Install new hydraulic tappets/lash adjusters
	8. Worn valve guides	8. Inspect all valve guides and replace as necessary
	9. Excessive runout of valve seats or valve faces	9. Grind valves and seats

ENGINE 4.0L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. (Refer to 9 - ENGINE/ LUBRICATION/OIL - STANDARD PROCEDURE) 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.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)
	3. Thin or diluted oil	3. Change oil to correct viscosity.
	4. Excessive main bearing clearance	4. Measure bearings for correct clearance. Repair as necessary
	5. Excessive end play	5. Check crankshaft thrust bearing for excessive wear on flanges
	6. Crankshaft main journal out of round or worn	6. Grind journals or replace crankshaft
	7. Loose flywheel or torque converter	7. Inspect crankshaft, flexplate/ flywheel and bolts for damage. Tighten to correct torque
LOW OIL PRESSURE	1. Low oil level	1. Check oil level and fill if necessary
	2. Faulty oil pressure sending unit	2. Install new sending unit
	3. Clogged oil filter	3. Install new oil filter
	4. Worn oil pump	4. Replace oil pump assembly.
	5. Thin or diluted oil	5. Change oil to correct viscosity.
	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

ENGINE 4.0L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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. CCV System malfunction	1. (Refer to 25 - EMISSIONS CONTROL/EVAPORATIVE EMISSIONS - DESCRIPTION) 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

DIAGNOSIS AND TESTING—CYLINDER COMPRESSION PRESSURE

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 (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL).

(3) Secure the throttle in the wide-open position.

(4) Disconnect the ignition coil.

(5) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(6) Record the compression pressure on the third revolution. Continue the test for the remaining cylinders.

(Refer to 9 - ENGINE - SPECIFICATIONS) for the correct engine compression pressures.

DIAGNOSIS AND TESTING - CYLINDER COMBUSTION PRESSURE LEAKAGE

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 (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL).

(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

ENGINE 4.0L (Continued)

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 CYLINDER COMBUSTION PRESSURE LEAKAGE 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

STANDARD PROCEDURE

STANDARD PROCEDURE - 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

ENGINE 4.0L (Continued)

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.

STANDARD PROCEDURE - 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 .

(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.

(15) Connect the negative cable to the battery.

(16) Start the engine and check for any leaks.

STANDARD PROCEDURE - 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.

STANDARD PROCEDURE - 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.

STANDARD PROCEDURE - 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 8 - ELECTRICAL/STARTING - DIAGNOSIS AND TESTING).

(2) Check intake manifold bolt torque (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(3) Perform cylinder compression test. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).

(4) Clean (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING) or replace spark plugs (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL) as necessary.

(5) Test coil output voltage and primary resistance. (Refer to 8 - ELECTRICAL/IGNITION CONTROL - SPECIFICATIONS) Replace parts as necessary.

ENGINE 4.0L (Continued)

(6) Test fuel pump for pressure. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING).

(7) The air filter elements should be replaced as specified.

(8) Inspect crankcase ventilation system.

(9) Road test vehicle as a final test.

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) Drain engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE), drain the coolant into a clean container for reuse.

(4) Remove the upper radiator hose and coolant recovery hose (Fig. 4).

(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 (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(8) Remove the fan shroud (Fig. 4).

(9) Disconnect the transmission fluid cooler lines (automatic transmission).

(10) Discharge the A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(11) Remove the service valves and cap the compressor ports.

(12) Remove the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL) or radiator/condenser (if equipped with A/C).

(13) Disconnect the heater hoses at the engine thermostat housing and water pump (Fig. 4).

(14) Disconnect the accelerator cable, transmission line pressure cable and speed control cable (if equipped) from the throttle body (Fig. 5).

(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
- Map sensor
- Crankshaft position sensor
- Oxygen sensor
- Camshaft position sensor
- Generator connector and B+ terminal wire

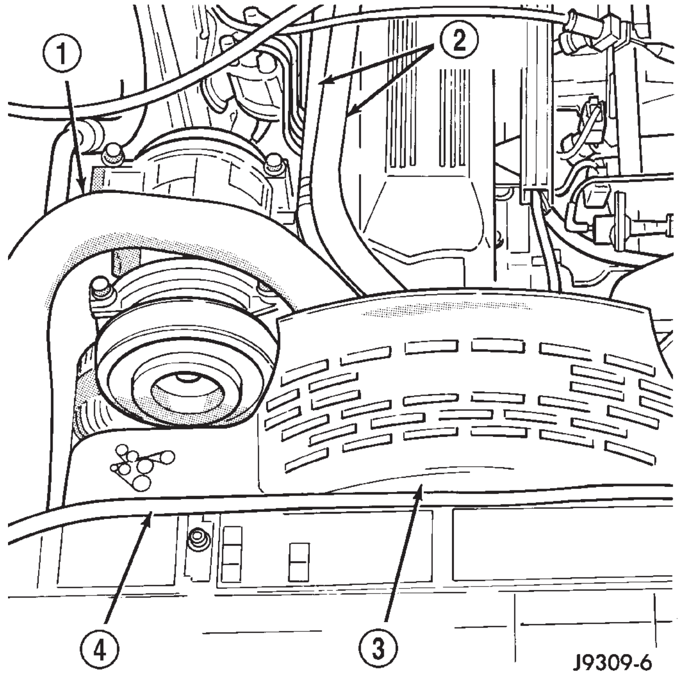

Fig. 4 Upper Radiator Hose, Coolant Recovery Hose, Fan Shroud

1 - UPPER RADIATOR HOSE
2 - HEATER HOSES
3 - FAN SHROUD
4 - COOLANT RECOVERY HOSE

(18) Disconnect the coil rail electrical connections and the oil pressure switch connector.

(19) Perform the fuel pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(20) Disconnect the fuel supply line at the injector rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(21) Remove the fuel line bracket from the intake manifold.

(22) Remove the air cleaner assembly (Fig. 6).

(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 (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(29) Disconnect the oxygen sensor from the exhaust pipe.

ENGINE 4.0L (Continued)

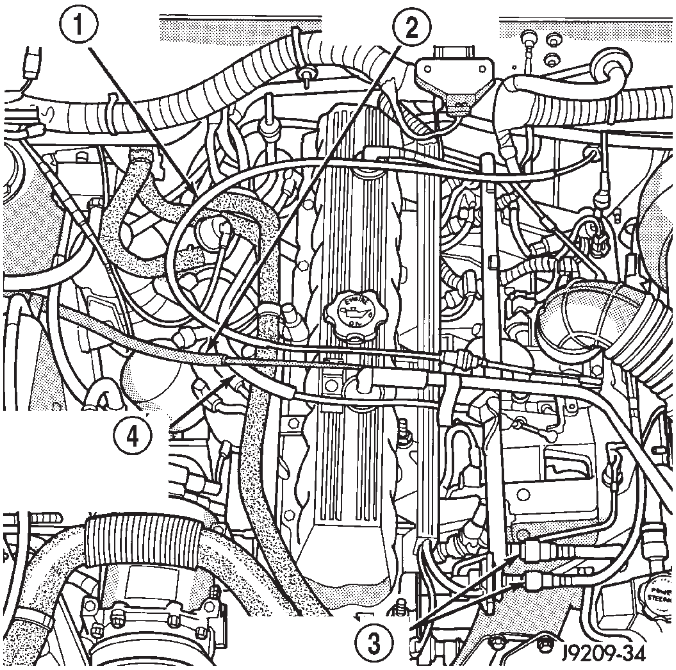

Fig. 5 Accelerator Cable, Vehicle Speed Control Cable, Automatic Transmission

1 - ACCELERATOR CABLE
2 - SPEED CONTROL CABLE
3 - QUICK-CONNECT FUEL LINES
4 - AUTOMATIC TRANSMISSION CONTROL CABLE

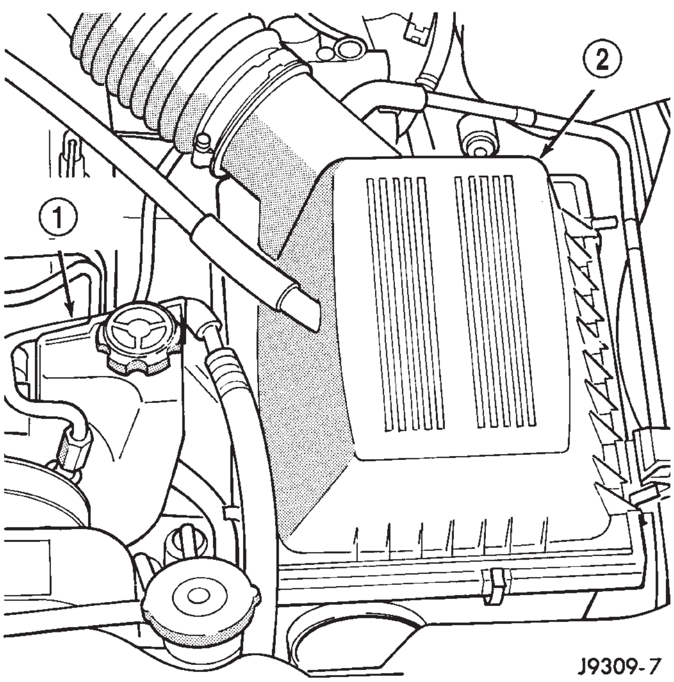

Fig. 6 Air Cleaner Assembly & Power Steering Pump

1 - POWER STEERING PUMP
2 - AIR CLEANER ASSEMBLY

(30) Disconnect the exhaust pipe from the manifold.

(31) Remove the exhaust pipe support.

(32) Remove the bending brace (Refer to 9 - ENGINE/ENGINE BLOCK/WINDAGE TRAY / STRUCT SUPPORT - REMOVAL).

(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.

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.

ENGINE 4.0L (Continued)

(13) Install the exhaust pipe support and tighten the screw.

(14) Install the engine bending brace (Refer to 9 - ENGINE/ENGINE BLOCK/WINDAGE TRAY / STRUCT SUPPORT - INSTALLATION).

(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 (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(19) Connect the wires to the engine starter motor solenoid.

(20) Lower the vehicle.

(21) Connect vacuum hoses and wire connectors disconnected 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 (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

(25) Inspect the fuel supply line o-ring(s) and replace if necessary. Connect fuel supply line to injection 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 (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(34) Place the fan shroud in position over the fan.

(35) Install the radiator or radiator/condenser (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).

(36) Connect the service valves to the A/C compressor ports, if equipped with A/C.

(37) Charge the air conditioner system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(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 LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(44) Fill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(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.

SPECIFICATIONS

ENGINE - 4.0L

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.)

DESCRIPTION	SPECIFICATION
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.°
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.)

ENGINE 4.0L (Continued)

DESCRIPTION	SPECIFICATION
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.)
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.)

DESCRIPTION	SPECIFICATION
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)
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.)

ENGINE 4.0L (Continued)

DESCRIPTION	SPECIFICATION
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.)
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°

DESCRIPTION	SPECIFICATION
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 to Piston Top)	40.61 to 40.72 mm (1.599 to 1.603 in.)
Piston-to-Bore Clearance	0.018 to 0.038 mm (0.0008 to 0.0015 in.)
Ring Gap Clearance	
Top Compression Ring	0.229 to 0.610 mm (0.0090 to 0.0240 in.)
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.)

ENGINE 4.0L (Continued)

DESCRIPTION	SPECIFICATION
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.)
OIL PUMP	
Gear-to-Body Clearance (Radial)	0.051 to 0.102 mm (0.002 to 0.004 in.)
Gear-to-Body Clearance (Radial) Preferred	0.051 mm (0.002 in.)
Gear End Clearance Plastigage	0.051 to 0.152 mm (0.002 to 0.006 in.)
Gear End Clearance Plastigage (Preferred)	0.051 mm (0.002 in.)
Gear End Clearance Feeler Gauge	0.1016 to 0.2032 mm (0.004 to 0.008 in.)
Gear End Clearance Feeler Gauge (Preferred)	0.1778 mm (0.007 in.)
Oil Pressure	
At Idle Speed	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 - 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
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			

ENGINE 4.0L (Continued)

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
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	—
Idler Pulley to Cylinder Head—Bolt	47	35	—
Main Bearing Cap—Bolts	108	80	—
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	—

AIR CLEANER ELEMENT

REMOVAL

(1) Loosen air tube clamp at housing cover (Fig. 7) .

(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.

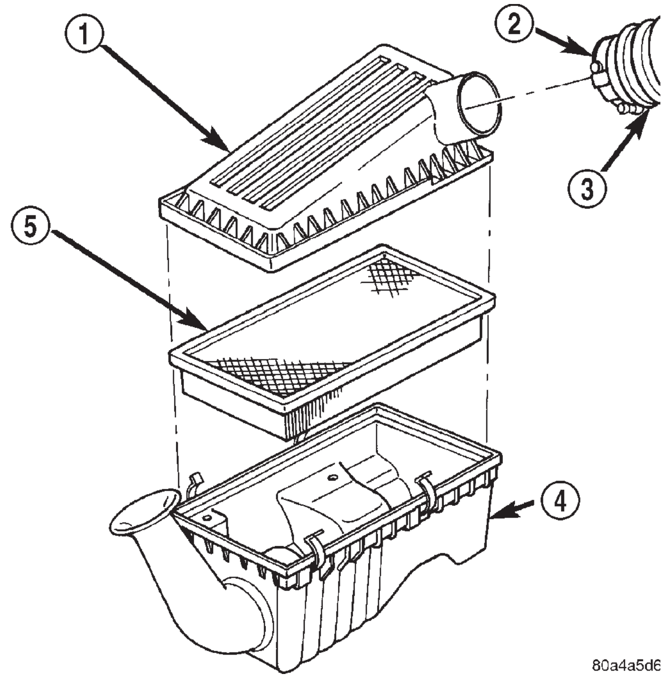

Fig. 7 AIR CLEANER ELEMENT

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.

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. 8).

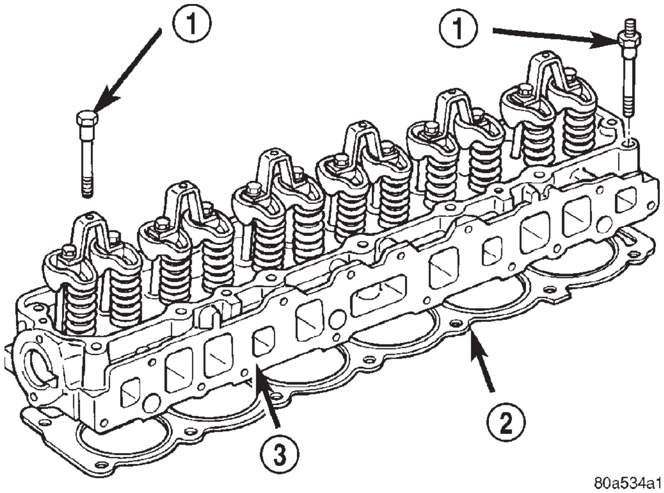

Fig. 8 Cylinder Head 4.0L Engine

1 - CYLINDER HEAD BOLTS
2 - CYLINDER HEAD GASKET
3 - CYLINDER HEAD

DIAGNOSIS AND TESTING - ENGINE CYLINDER HEAD GASKET FAILURE

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 . 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.

REMOVAL

NOTE: This procedure can be done with the engine in or out of the vehicle.

(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 (Refer to 7 - COOLING - STANDARD PROCEDURE) 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 cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(5) Remove the capscrews, bridge and pivot assemblies and rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL).

(6) Remove the push rods.**Retain the push rods, bridges, pivots and rocker arms in the same order as removed.**

(7) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

CYLINDER HEAD (Continued)

(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 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(11) Disconnect the fuel supply line at the fuel rail.

(12) Remove the intake and exhaust manifolds from the engine cylinder head (Refer to 9 - ENGINE/ MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(13) Disconnect the coil rail electrical connectors and remove the coil rail (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/COIL RAIL - REMOVAL).

(14) Remove spark plugs (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL).

(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. 9). Pull bolt No.14 out as far as it will go and then suspend the bolt in this position (tape around the bolt).

(17) Remove the engine cylinder head and gasket (Fig. 9).

(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.

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.

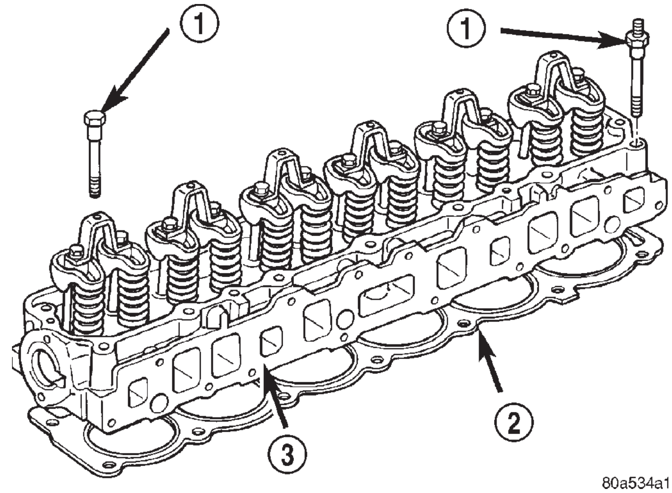

Fig. 9 Engine Cylinder

1 - CYLINDER HEAD BOLTS
2 - CYLINDER HEAD GASKET
3 - CYLINDER HEAD

INSTALLATION

NOTE: This procedure can be done with the engine in or out of the vehicle.

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. 10).

CYLINDER HEAD (Continued)

CAUTION: During the final tightening sequence, bolt No.11 will be tightened to a lower torque than the rest of the bolts. DO NOT overtighten bolt No.11.

(a) Tighten all bolts in sequence (1 through 14) to 30 N·m (22 ft. lbs.) torque.

(b) Tighten all bolts in sequence (1 through 14) to 61 N·m (45 ft. lbs.) torque.

(c) Check all bolts to verify they are set to 61 N·m (45 ft. lbs.) torque.

(d) Tighten bolts in sequence:

- Bolts 1 through 10 to 149 N·m (110 ft. lbs.) torque.
- Bolt 11 to 135 N·m (100 ft. lbs.) torque.
- Bolts 12 through 14 to 149 N·m (110 ft. lbs.) torque.

(e) Check all bolts in sequence to verify the correct torque.

(f) If not already done, clean and mark each bolt with a dab of paint after tightening. Should you encounter bolts which were painted in an earlier service operation, replace them.

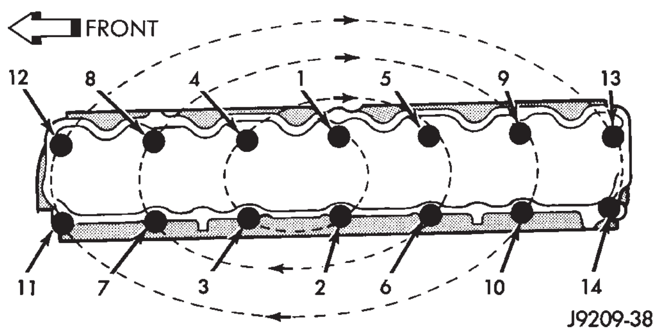

Fig. 10 Engine Cylinder Head Bolt Tightening Sequence

(6) Install the spark plugs (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - INSTALLATION).

(7) Connect the temperature sending unit wire connector.

(8) Install the ignition coil rail and coil rail electrical connectors (Refer to 8 - ELECTRICAL/IGNITION CONTROL/COIL RAIL - INSTALLATION).

(9) Install the intake and exhaust manifolds (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(10) Install the fuel line and the vacuum advance hose.

(11) Attach the power steering pump and bracket.

(12) Install the push rods, rocker arms, pivots and bridges in the order they were removed (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(13) Install the engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(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 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(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 7 - COOLING - STANDARD PROCEDURE).

(19) The automatic transmission throttle linkage and cable must be adjusted after completing the engine cylinder head installation (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 30RH/THROTTLE VALVE CABLE - ADJUSTMENTS) or (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 32RH/THROTTLE VALVE CABLE - ADJUSTMENTS).

(20) Install the temperature sending unit and connect the wire connector.

(21) If equipped with air conditioning, install A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION) and charge A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(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.

CYLINDER HEAD COVER(S)

DESCRIPTION

The cylinder head cover (Fig. 11) is made of stamped steel and incorporates the Crankcase Ventilation (CCV) Hoses and the oil fill opening.

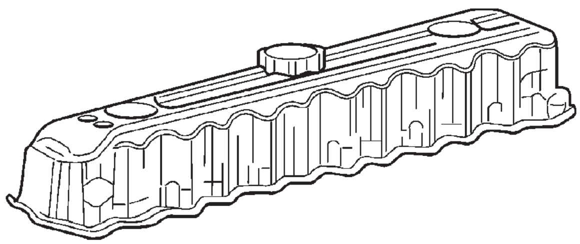

Fig. 11 Cylinder Head Cover

REMOVAL

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.

(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. 12).

(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.

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.

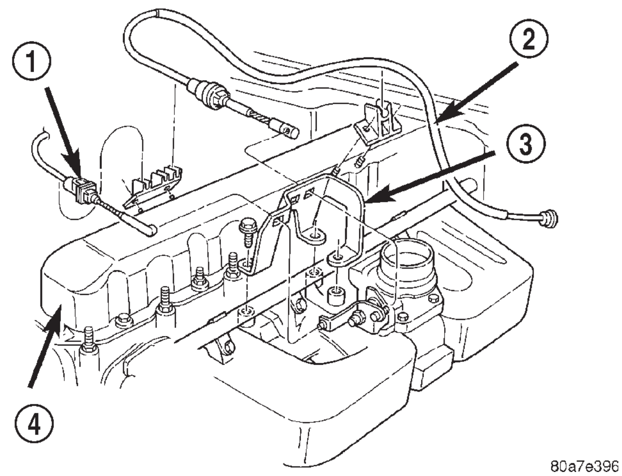

Fig. 12 Engine Cylinder Head Cover

1 - TRANS CONTROL CABLE
2 - ACCELERATOR CABLE
3 - CONTROL CABLE BRACKET
4 - CYLINDER HEAD COVER

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.

INSTALLATION

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.

(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 (Fig. 13). Tighten the mounting bolts to 10 N·m (85 in. lbs.) torque.

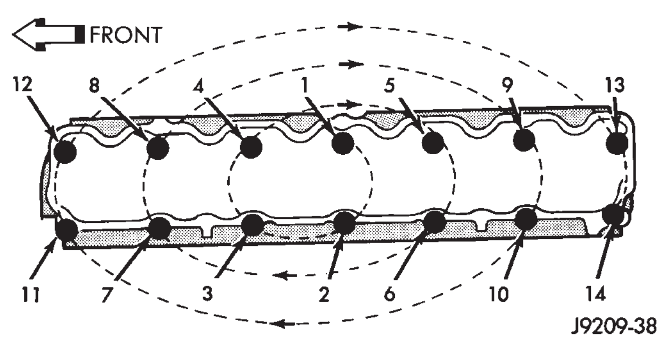

Fig. 13 Cylinder Head Cover Gasket Locator Pins at #8 & #9

CYLINDER HEAD COVER(S) (Continued)

(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.

INTAKE/EXHAUST VALVES & SEATS

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. 14).

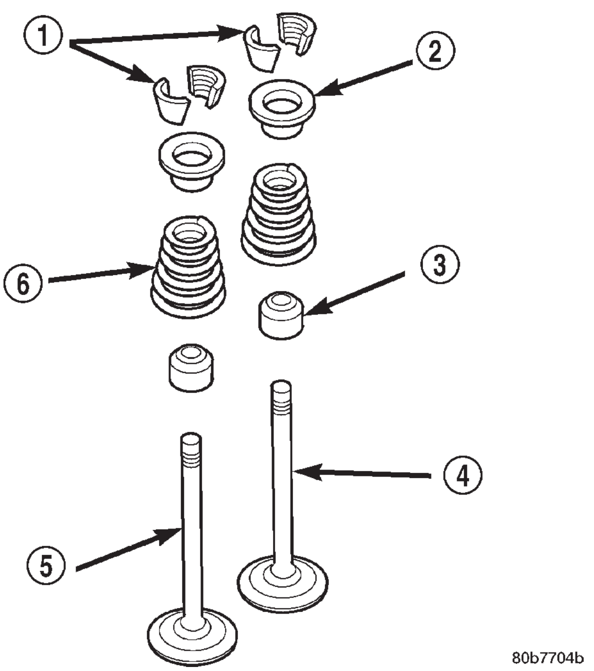

Fig. 14 VALVE AND KEEPER CONFIGURATION 4.0L

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

STANDARD PROCEDURE - VALVE SERVICE

VALVE REFACING

Clean all carbon deposits from the combustion chambers, valve ports, valve stems, valve stem guides and head.

(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. 15). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

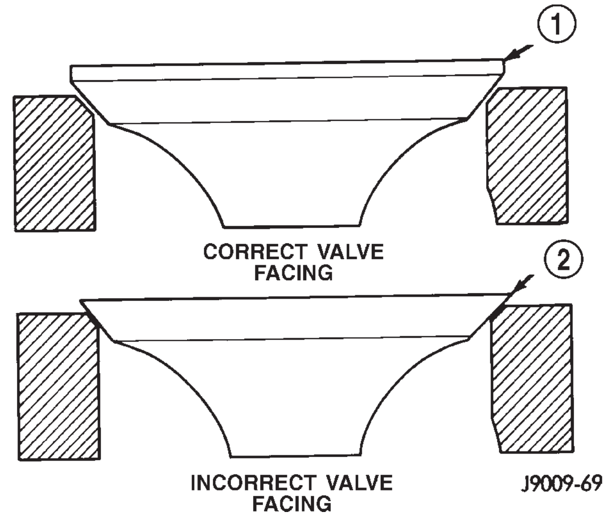

Fig. 15 Valve Facing

1 - VALVE MARGIN
2 - NO MARGIN

VALVE SEAT REFACING

Clean all carbon deposits from the combustion chambers, valve ports, valve stems, valve stem guides and head.

(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. 16).

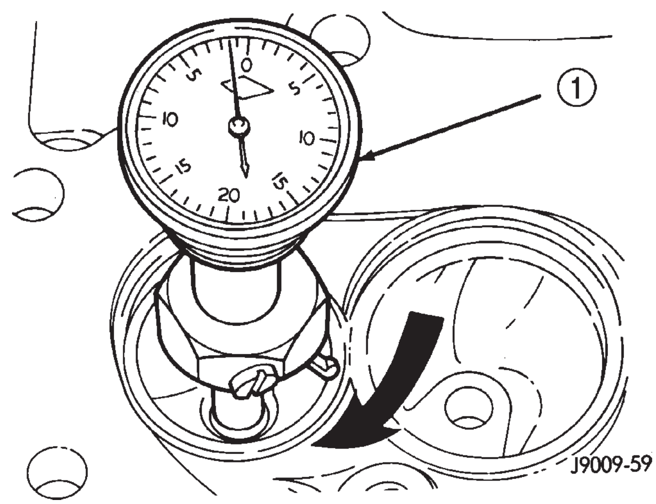

Fig. 16 Measurement of Valve Seat Runout

1 - DIAL INDICATOR

VALVE STEM-TO-GUIDE CLEARANCE MEASUREMENT

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. 17).

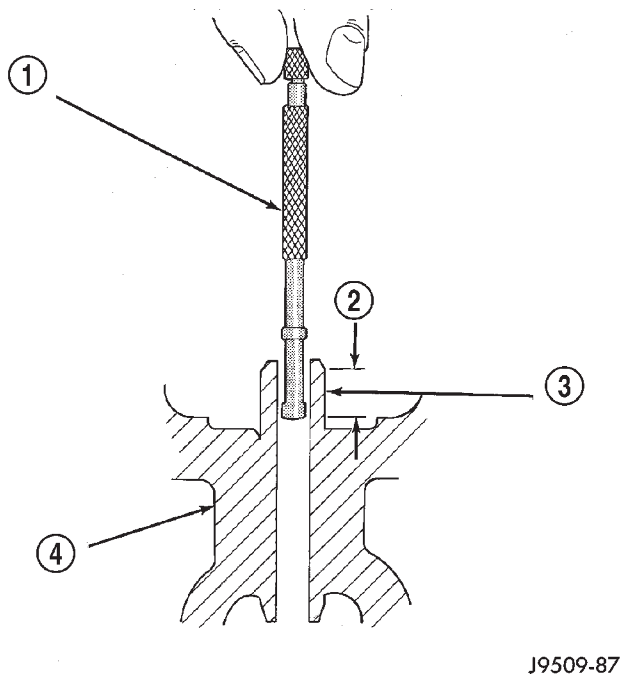

Fig. 17 Measurement of Valve Guide Bore Diameter

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. 18).

(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.

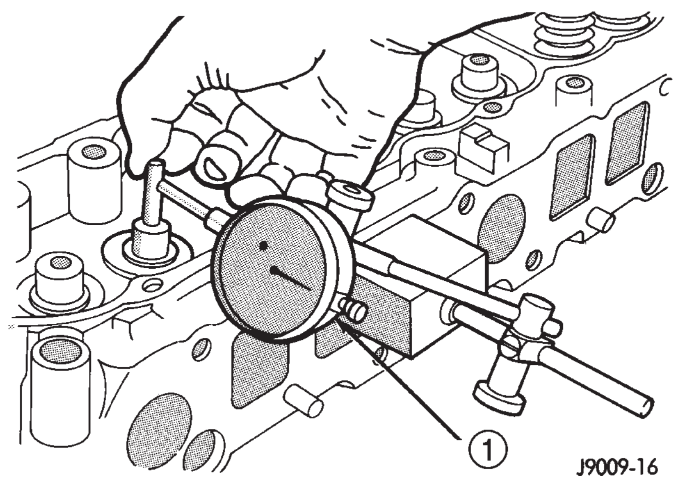

Fig. 18 Measurement of Lateral Movement Of Valve Stem

1 - DIAL INDICATOR

INTAKE/EXHAUST VALVES & SEATS (Continued)

REMOVAL

NOTE: This procedure is done with the engine cylinder head removed from the block.

(1) Remove the engine cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL) 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 (Fig. 19).

(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.

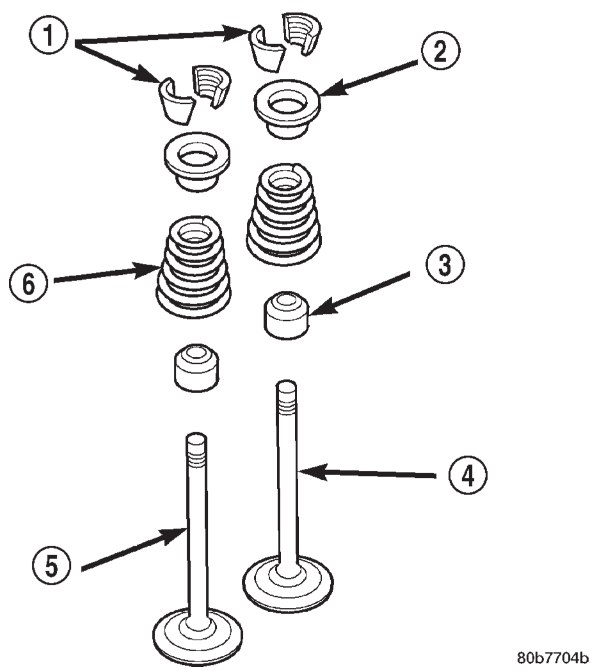

Fig. 19 Valve and Valve Components

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

INSTALLATION

NOTE: This procedure is done with the engine cylinder head removed from the block.

(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 (Fig. 20). 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 (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

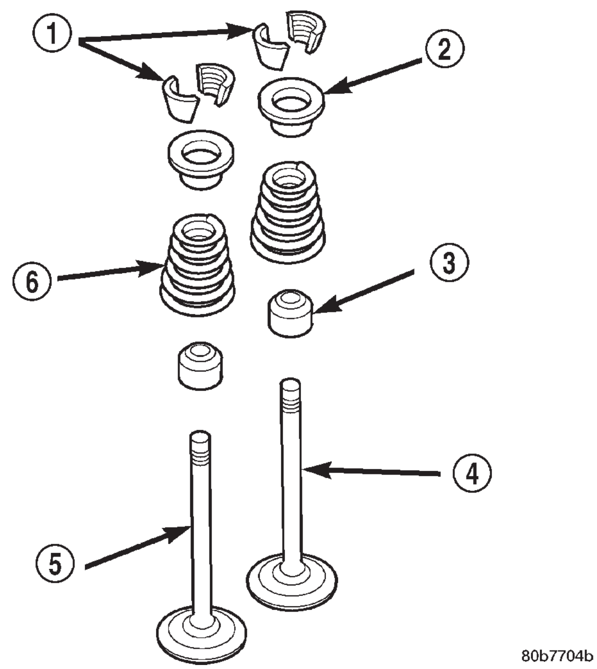

Fig. 20 Valve and Valve Components

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

ROCKER ARM / ADJUSTER ASSEMBLY

DESCRIPTION

The rocker arms are made of stamped steel and have a operational ratio of 1.6:1 (Fig. 21).

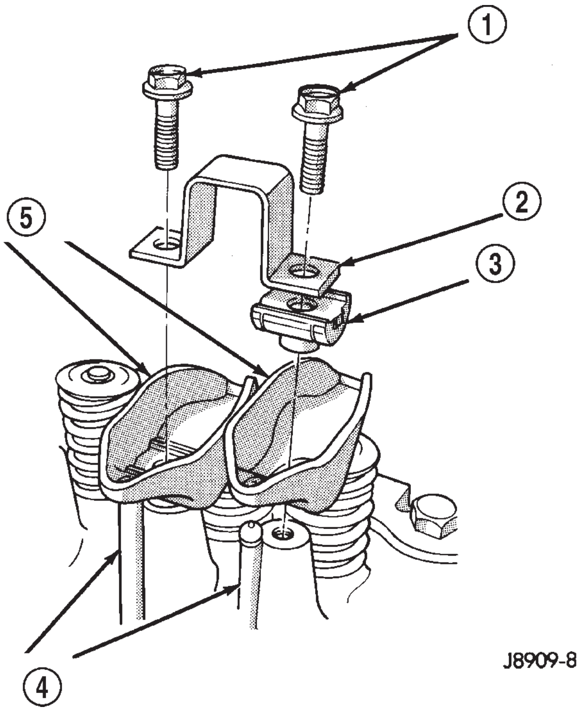

Fig. 21 Rocker Arms—Typical

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.

REMOVAL

NOTE: This procedure can be done with the engine in or out of the vehicle.

(1) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(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. 22). 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. 22). 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.

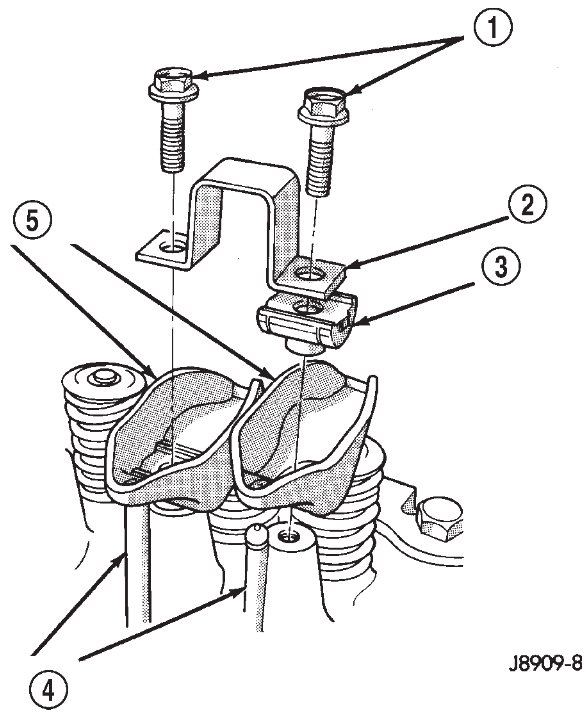

Fig. 22 Rocker Arm

1 - CAPSCREWS
2 - BRIDGE
3 - PIVOT ASSEMBLY
4 - PUSH RODS
5 - ROCKER ARMS

ROCKER ARM / ADJUSTER ASSEMBLY (Continued)

CLEANING

Clean all the components with cleaning solvent.

Use compressed air to blow out the oil passages in the rocker arms and push rods.

INSPECTION

Inspect the pivot surface area of each rocker arm. Replace any that are scuffed, pitted, cracked or excessively worn.

Inspect the valve stem tip contact surface of each rocker arm and replace any rocker arm that is deeply pitted.

Inspect each push rod end for excessive wear and replace as required. If any push rod is excessively worn because of lack of oil, replace it and inspect the corresponding hydraulic tappet for excessive wear.

Inspect the push rods for straightness by rolling them on a flat surface or by shining a light between the push rod and the flat surface.

A wear pattern along the length of the push rod is not normal. Inspect the engine cylinder head for obstruction if this condition exists.

INSTALLATION

NOTE: This procedure can be done with the engine in or out of the vehicle.

(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 (Fig. 23).

(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 (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

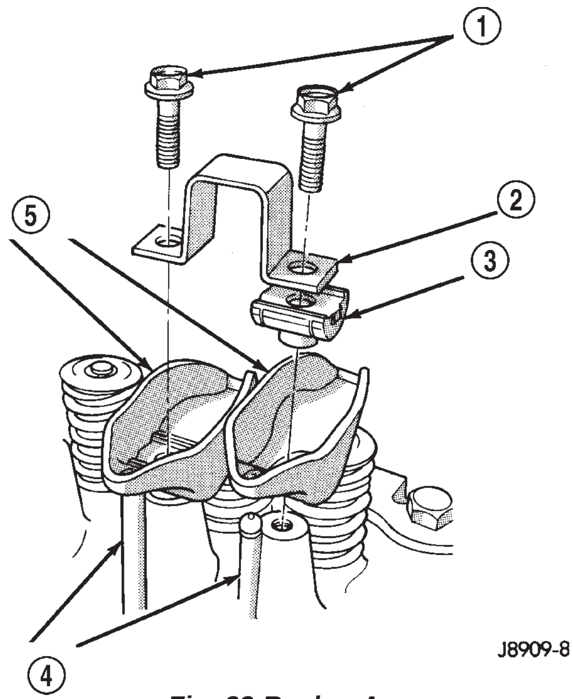

Fig. 23 Rocker Arm

1 - CAPSCREWS
2 - BRIDGE
3 - PIVOT ASSEMBLY
4 - PUSH RODS
5 - ROCKER ARMS

VALVE STEM SEALS

DESCRIPTION

The valve stem seals (Fig. 24) are made of rubber and incorporate a garter spring to maintain consistent lubrication control.

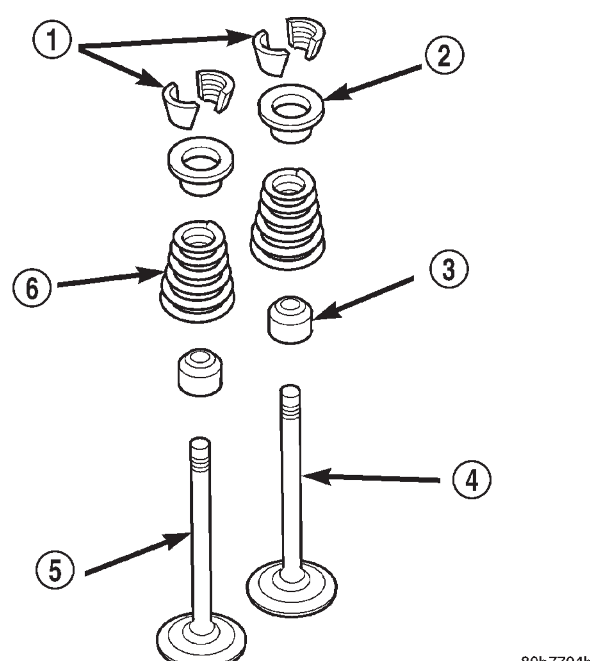

Fig. 24 Valve

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

VALVE SPRINGS

DESCRIPTION

The valve springs (Fig. 25) are made of high strength silicon chrome spring steel. The springs are common for both intake and exhaust valves.

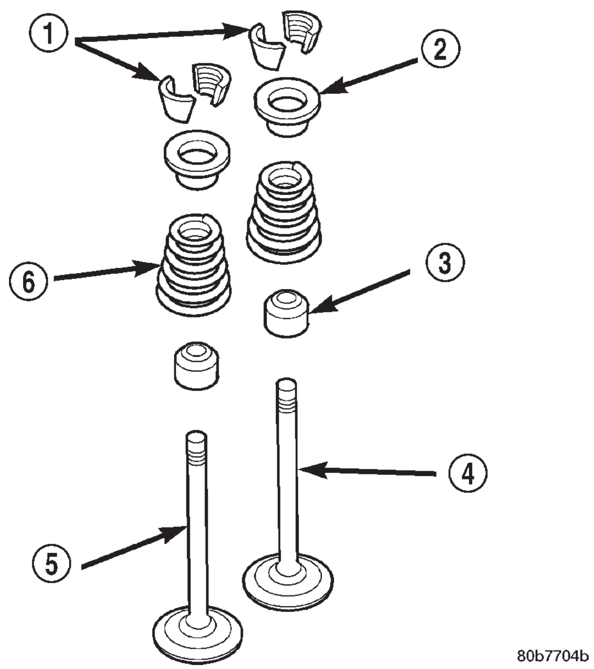

Fig. 25 VALVE AND KEEPER CONFIGURATION 4.0L

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

STANDARD PROCEDURE - VALVE SPRING TENSION TEST

Clean all carbon deposits from the combustion chambers, valve ports, valve stems, valve stem guides and head.

Use a universal Valve Spring Tester and a torque wrench to test each valve spring for the specified tension value (Fig. 26).

Replace valve springs that are not within specifications.

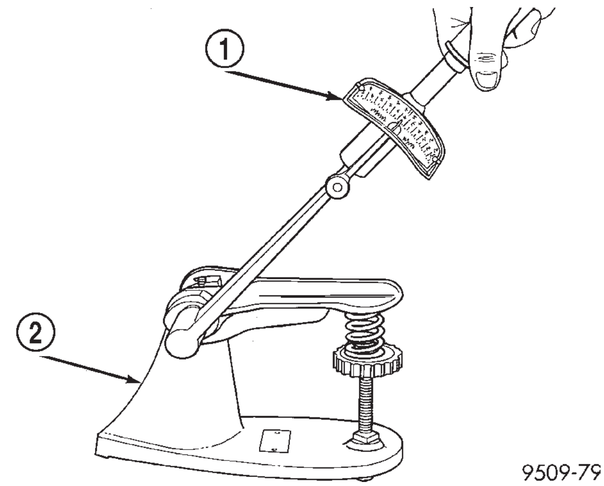

Fig. 26 Valve Spring Tester

1 - TORQUE WRENCH
2 - VALVE SPRING TESTER

REMOVAL

NOTE: This procedure can be done with the engine cylinder head installed on the block.

Inspect the valve stems, especially the grooves. An Arkansas smooth stone should be used to remove nicks and high spots.

Each valve spring is held in place by a retainer and a set of conical valve locks. The locks can be removed only by compressing the valve spring.

(1) Remove the engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Remove cap screws, bridge and pivot assemblies and rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL) 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. 27).

(8) Remove valve spring and retainer (Fig. 27).

(9) Remove valve stem oil seals (Fig. 27). 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.

VALVE SPRINGS (Continued)

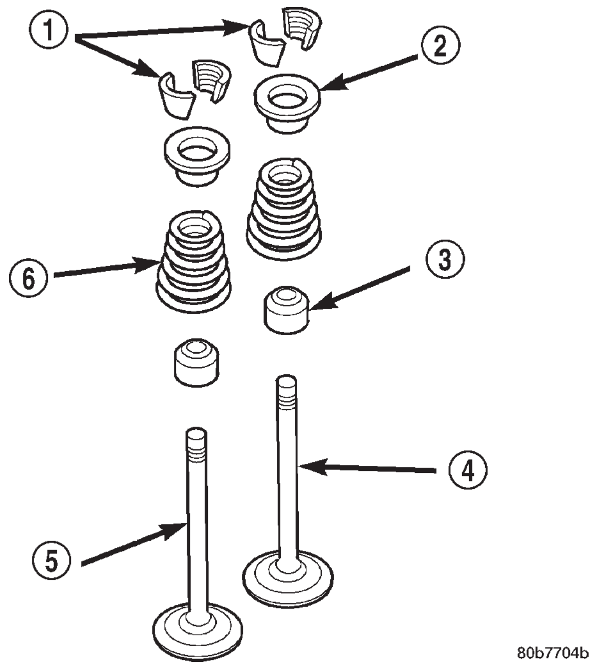

Fig. 27 Valve and Valve Components

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

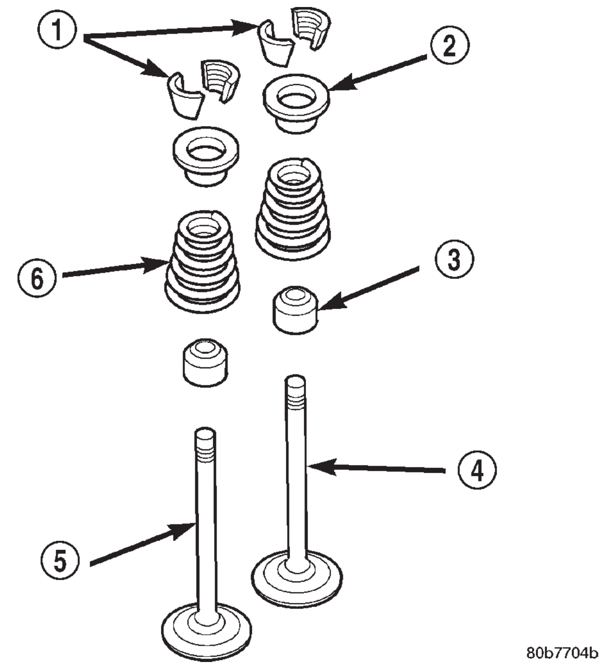

Fig. 28 Valve and Valve

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

INSTALLATION

NOTE: This procedure can be done with the engine cylinder head installed on the block.

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 (Fig. 28).

(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 (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION) at their original location.

(8) Install the engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

ENGINE 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.

ENGINE BLOCK (Continued)

INSPECTION

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter (Fig. 29). 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.

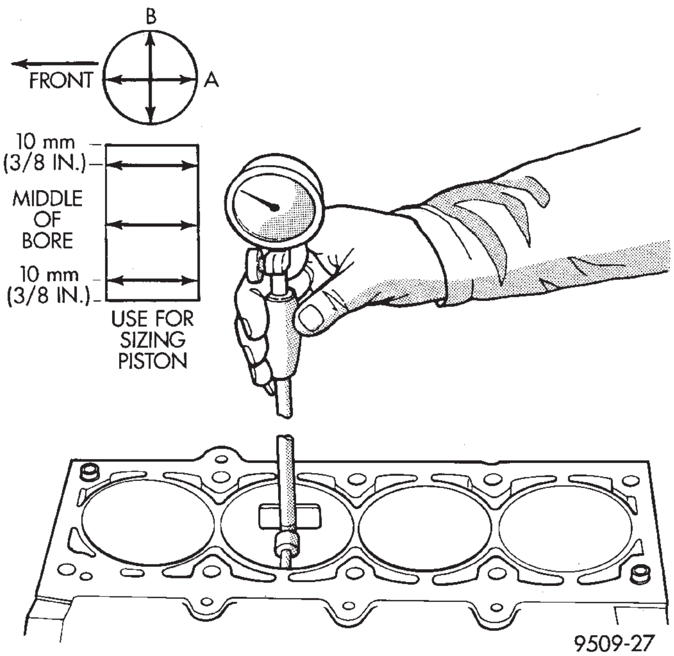

Fig. 29 Cylinder Bore Measurement

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

(3) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.

(4) Determine taper by subtracting the smaller diameter from the larger diameter.

(5) Rotate measuring device 90° and repeat steps above.

(6) Determine out-of-roundness by comparing the difference between each measurement.

(7) If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out- of-round condition exceeds these maximum limits, the cylinder must be bored and then honed to accept an oversize piston. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

CAMSHAFT & BEARINGS (IN BLOCK)

DESCRIPTION

The camshaft is made of gray cast iron with twelve machined lobes and four bearing journals (Fig. 30). 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.

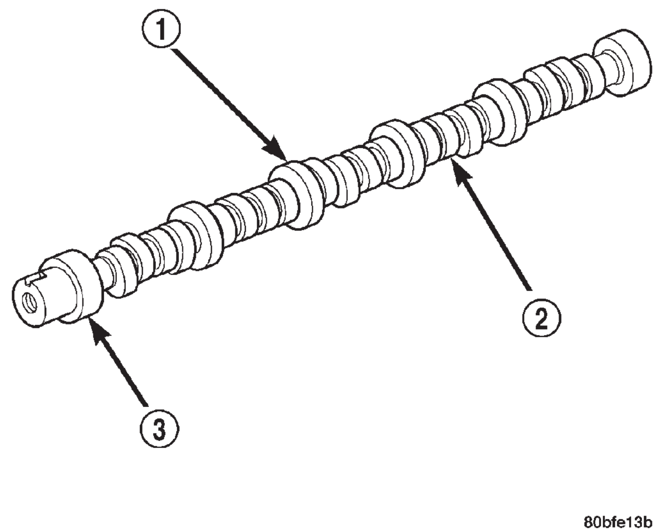

Fig. 30 Camshaft—Typical

1 - CAMSHAFT
2 - LOBES
3 - BEARING JOURNAL

REMOVAL

REMOVAL - 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. Camshaft end play is maintained by the thrust plate.

(1) Remove the camshaft (Refer to 9 - ENGINE/ ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - REMOVAL).

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

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 8544 Camshaft Bushing Remover Installer, remove the camshaft bearings.

REMOVAL - CAMSHAFT

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 (Refer to 7 - COOLING - STANDARD PROCEDURE).
(3) Remove the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL) and condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL), if equipped with A/C.
(4) Remove the engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
(5) Remove the rocker arms, bridges and pivots (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL).
(6) Remove the push rods.
(7) Remove the engine cylinder head and gasket (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).
(8) Remove the hydraulic valve tappets from the engine cylinder block (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - REMOVAL).
(9) Remove the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
(10) Remove the timing case cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(11) Rotate the crankshaft until the crankshaft sprocket timing mark is aligned on centerline with the camshaft sprocket timing mark (Fig. 32).
(12) Remove the timing chain and sprockets (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
(13) Remove the front bumper and/or grille, as required.
(14) Remove the two thrust plate retaining screws, thrust plate and camshaft (Fig. 31).

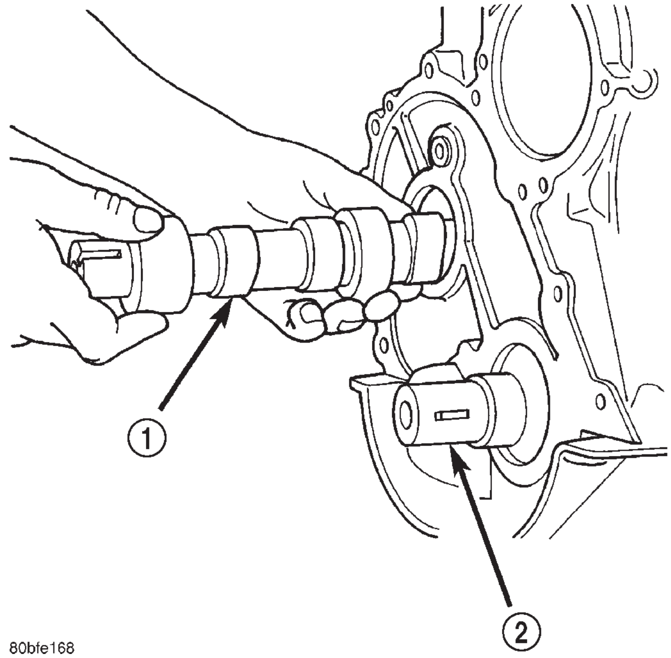

Fig. 31 Camshaft Removal

1 - CAMSHAFT
2 - CRANKSHAFT

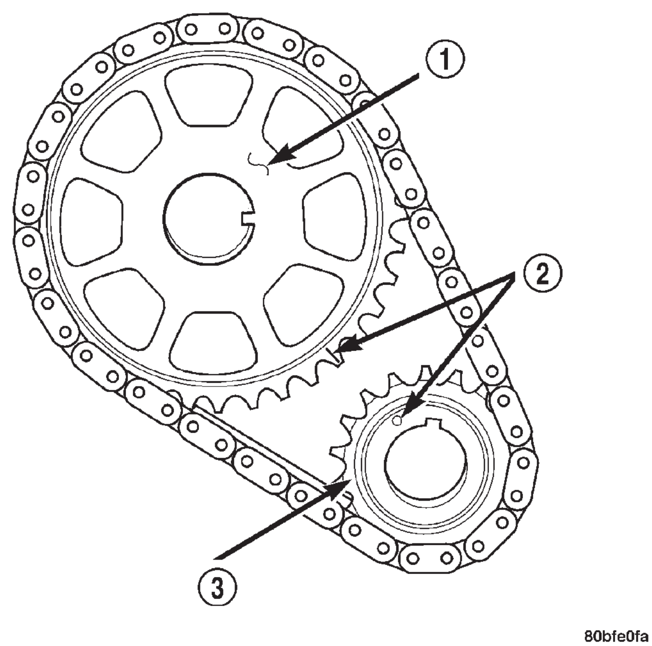

Fig. 32 Crankshaft / Camshaft Sprocket Timing Mark Alignment

1 - CAMSHAFT SPROCKET
2 - TIMING MARKS
3 - CRANKSHAFT SPROCKET

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

INSTALLATION

INSTALLATION - CAMSHAFT BEARINGS

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.

(1) Using recommended special tool 8544 Camshaft Bearing Remover/Installer, install new camshaft bearings.

INSTALLATION - CAMSHAFT

(1) Lubricate the camshaft with Mopar® Engine Oil Supplement, or equivalent.

(2) Carefully install the camshaft to prevent damage to the camshaft bearings.

(3) Position thrust plate and install retaining screws. Tighten screws to 24 N·m (18 ft. lbs.).

(4) Lubricate the camshaft with Mopar® engine oil supplement, or equivalent.

(5) Install the camshaft sprocket, crankshaft sprocket and timing chain (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(6) Tighten the camshaft sprocket bolt and washer to 68 N·m (50 ft. lbs.).

(7) 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. 33).

(8) Install the timing case cover with a replacement oil seal (Fig. 34). (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(9) Install the vibration damper (Fig. 34) (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(10) Install the hydraulic valve tappets (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - INSTALLATION).

(11) Install the cylinder head gasket with the numbers facing up.

(12) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(13) Install the push rods.

(14) Install the rocker arms and pivot and bridge assemblies (Refer to 9 - ENGINE/CYLINDER HEAD/ ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(15) Install the engine cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

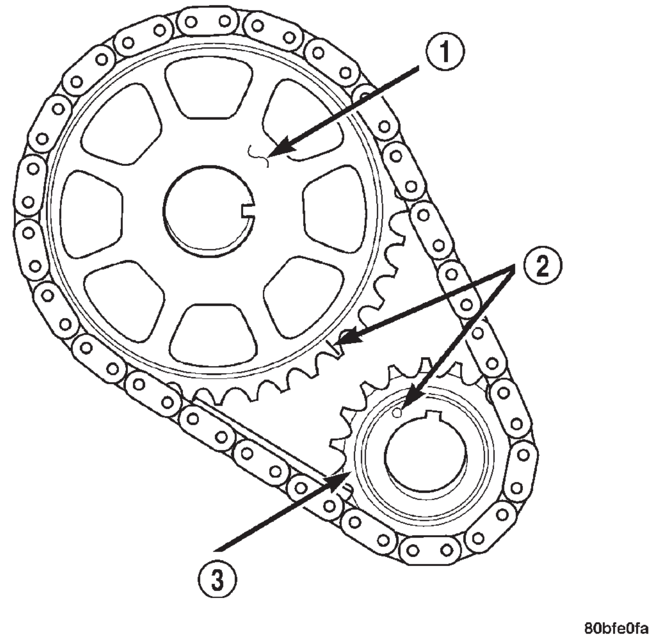

Fig. 33 Crankshaft / Camshaft Chain Drive Installation—Typical

1 - CAMSHAFT SPROCKET
2 - TIMING MARKS
3 - CRANKSHAFT SPROCKET

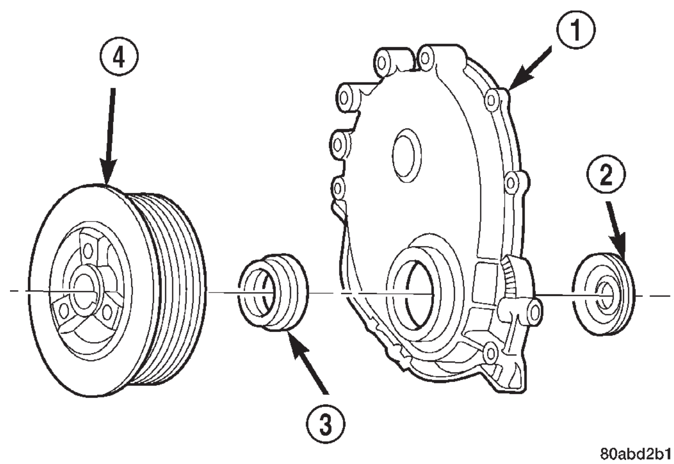

Fig. 34 Timing Case Cover Components

1 - TIMING CASE COVER
2 - OIL SLINGER
3 - CRANKSHAFT OIL SEAL
4 - VIBRATION DAMPER PULLEY

(16) Install the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

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.

(17) Install the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).

(18) Check the ignition timing and adjust as necessary.

(19) Install the grille and bumper, if removed.

(20) Connect negative cable to battery.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - FITTING CONNECTING ROD BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 35) (Fig. 36). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 37). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

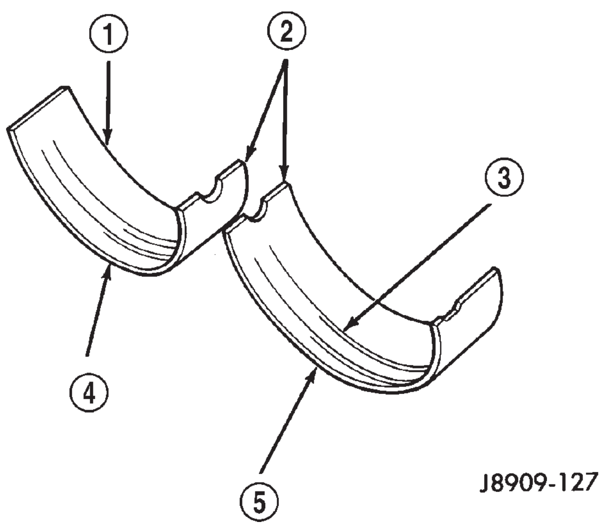

Fig. 35 Connecting Rod Bearing Inspection

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

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

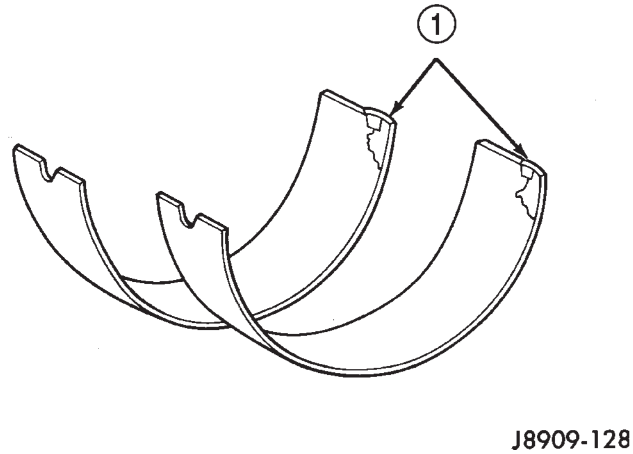

Fig. 36 Locking Tab Inspection

1 - ABNORMAL CONTACT AREA CAUSED BY LOCKING TABS NOT FULLY SEATED OR BEING BENT

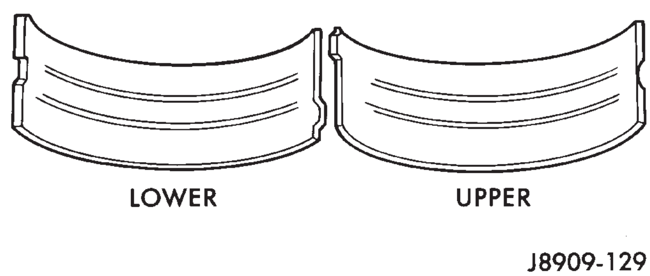

Fig. 37 Scoring Caused by Insufficient Lubrication or Damaged Crankshaft Journal

any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

BEARING-TO-JOURNAL CLEARANCE

(1) Wipe the oil from the connecting rod journal.

(2) Use short rubber hose sections over rod bolts during installation.

(3) Lubricate the upper bearing insert and install in connecting rod.

(4) Use piston ring compressor to install the rod and piston assemblies. The oil squirt holes in the rods must face the camshaft. The arrow on the piston crown should point to the front of the engine (Fig. 38). Verify that the oil squirt holes in the rods face the camshaft and that the arrows on the pistons face the front of the engine.

(5) Install the lower bearing insert in the bearing cap. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.

(6) Install bearing cap and connecting rod on the journal and tighten nuts to 45 N·m (33 ft. lbs.)

CONNECTING ROD BEARINGS (Continued)

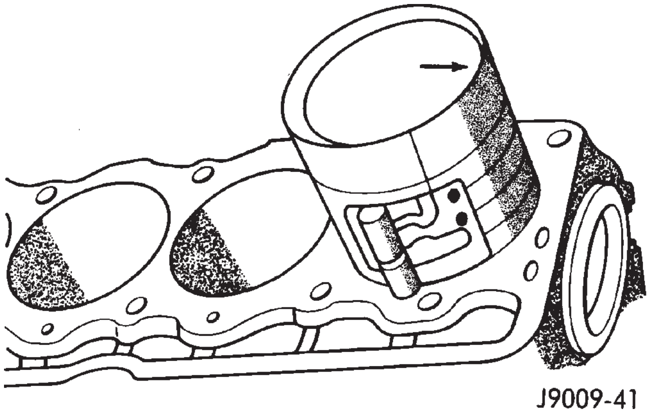

Fig. 38 Rod and Piston Assembly Installation

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. 39). **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

(8) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(9) If bearing-to-journal clearance exceeds the specification, install a pair of 0.0254 mm (0.001 inch) undersize bearing inserts. All the odd size inserts must be on the bottom. The sizes of the service replacement bearing inserts are stamped on the backs of the inserts. Measure the clearance as described in the previous steps.

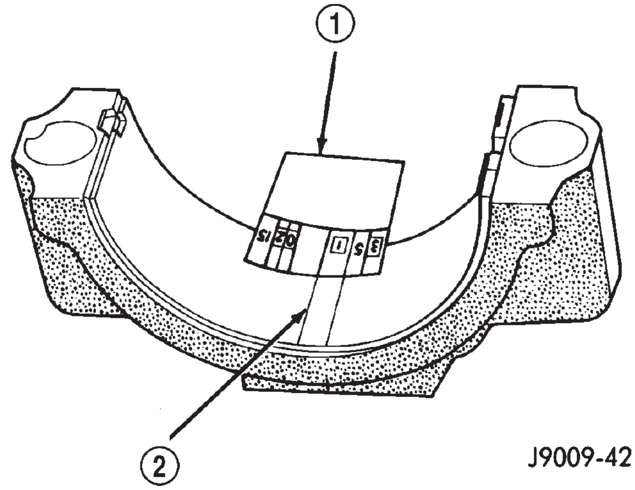

Fig. 39 Measuring Bearing Clearance with Plastigage

1 - PLASTIGAGE SCALE
2 - COMPRESSED PLASTIGAGE

(10) The clearance is measured with a pair of 0.0254 mm (0.001 inch) undersize bearing inserts installed. This will determine if two 0.0254 mm (0.001 inch) undersize inserts or another combination is needed to provide the correct clearance. Refer to CONNECTING ROD BEARING FITTING CHART .

CONNECTING ROD BEARING FITTING CHART

CRANKSHAFT JOURNAL		CORRESPONDING ROD BEARING INSERT	
Color Code	**Diameter**	**Upper Insert Size**	**Lower Insert Size**
Yellow	53.2257 - 53.2079 mm (2.0955 - 2.0948 in.)	Yellow - Standard	Yellow - Standard
Orange	53.2079 - 53.1901 mm (2.0948 - 2.0941 in.) 0.0178 mm (0.0007 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	53.1901 - 53.1724 mm (2.0941 - 2.0934 in.) 0.0356 mm (0.0014 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Red	52.9717 - 52.9539 mm (2.0855 - 2.0848 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

CONNECTING ROD BEARINGS (Continued)

(11) **FOR EXAMPLE:** If the initial clearance was 0.0762 mm (0.003 inch), 0.025 mm (0.001 inch) undersize inserts would reduce the clearance by 0.025 mm (0.001 inch). The clearance would be 0.002 inch and within specification. A 0.051 mm (0.002 inch) undersize insert would reduce the initial clearance an additional 0.013 mm (0.0005 inch). The clearance would then be 0.038 mm (0.0015 inch).

(12) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(13) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 45 N·m (33 ft. lbs.) torque.

SIDE CLEARANCE MEASUREMENT

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 40). (Refer to 9 - ENGINE - SPECIFICATIONS). Replace the connecting rod if the side clearance is not within specification.

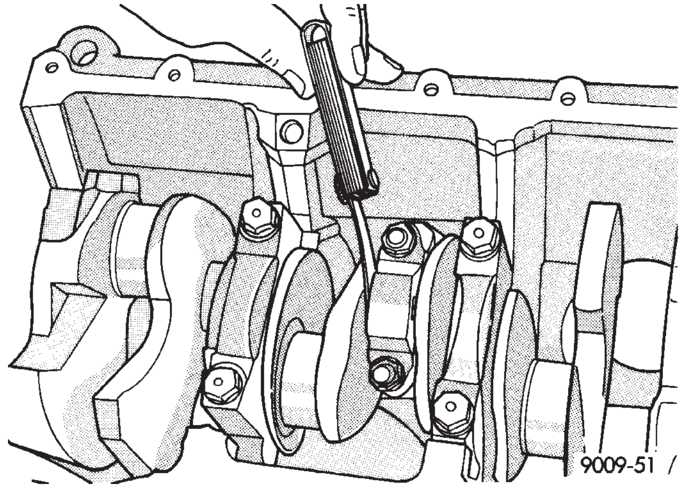

Fig. 40 Checking Connecting Rod Side Clearance - Typical

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. 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. 41).

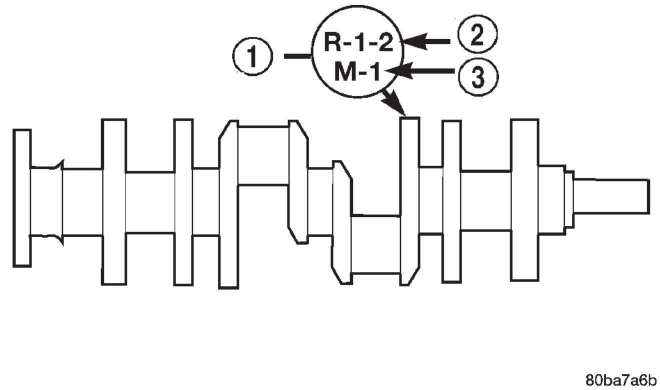

Fig. 41 Crankshaft with Select Fit Marking Location

1 - 1/4” LETTERS
2 - (ROD)
3 - (MAIN)

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE - FITTING CRANKSHAFT MAIN BEARINGS

FITTING BEARINGS (CRANKSHAFT INSTALLED)

The main bearing caps, numbered (front to rear) from 1 through 7 have an arrow to indicate the forward position. The upper main bearing inserts are grooved to provide oil channels while the lower inserts are smooth.

Each bearing insert pair is selectively fitted to its respective journal to obtain the specified operating clearance. In production, the select fit is obtained by using various-sized color-coded bearing insert pairs as listed in the Main Bearing Fitting Chart. The bearing color code appears on the edge of the insert. **The size is not stamped on bearing inserts used for engine production.**

The main bearing journal size (diameter) is identified by a color-coded paint mark (Fig. 42)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, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - 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. 43). (Refer to 9 - ENGINE - SPECIFICATIONS) for the proper clearance.

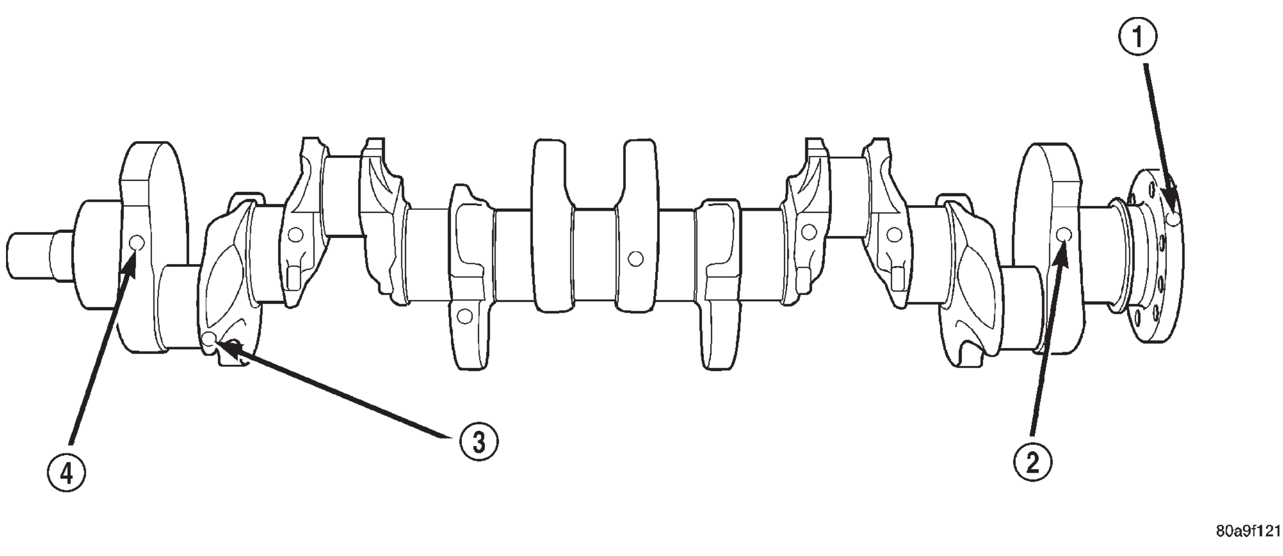

Fig. 42 Crankshaft Journal Size Paint I.D. Location

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

CRANKSHAFT MAIN BEARINGS (Continued)

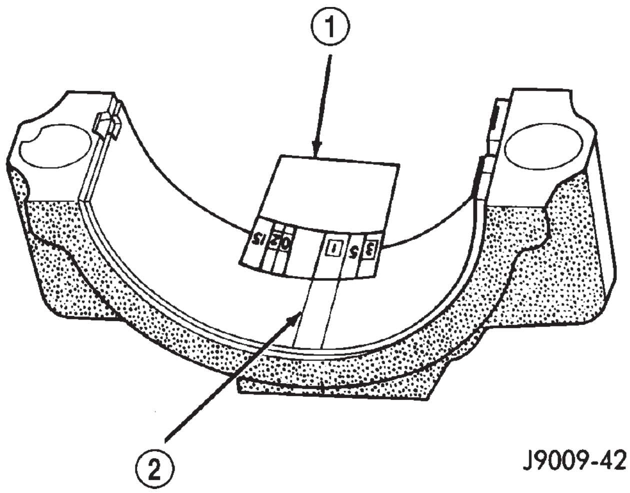

Fig. 43 Measuring Bearing Clearance with Plastigage

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.

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 (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT MAIN BEARINGS - 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.

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 (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT MAIN BEARINGS - INSTALLATION).

JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Remove the crankshaft from the cylinder block.

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.

CRANKSHAFT MAIN BEARINGS (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 (2.4990 - 2.4985 in.) 0.0127 mm (0.0005 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	63.4619 - 63.4492 mm (2.4985 - 2.4980 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4492 - 63.4365 mm (2.4980 - 2.4975 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2333 - 63.2206 mm (2.4895 - 2.4890 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

CRANKSHAFT MAIN BEARINGS (Continued)

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the spark plugs (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL).

(3) Raise the vehicle.

(4) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL) and oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(5) Remove main bearing cap brace (Fig. 44).

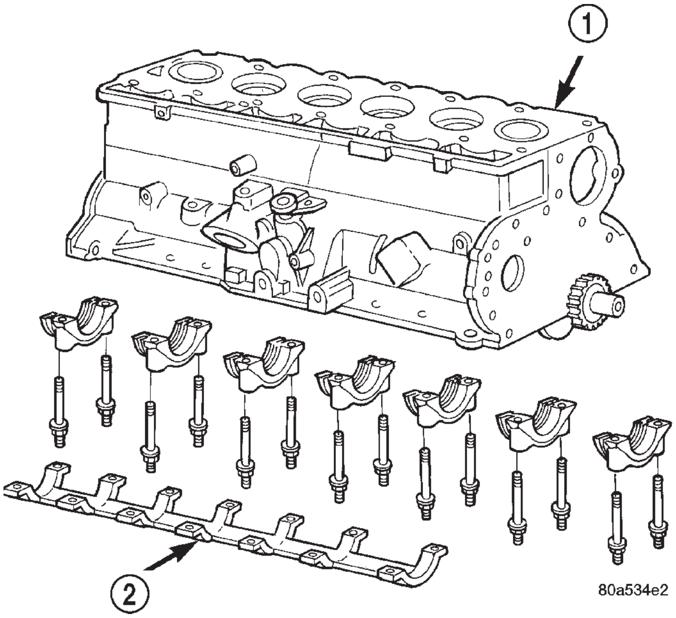

Fig. 44 Main Bearing Caps and Brace.

1 - BLOCK
2 - MAIN BEARING CAP BRACE

(6) Remove only one main bearing cap and lower insert at a time (Fig. 45).

(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. 46). 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. 46). After moving the insert approximately 25 mm (1 inch), it can be removed by applying pressure under the tab.

(9) Using the same procedure described above, remove the remaining bearing inserts one at a time for inspection.

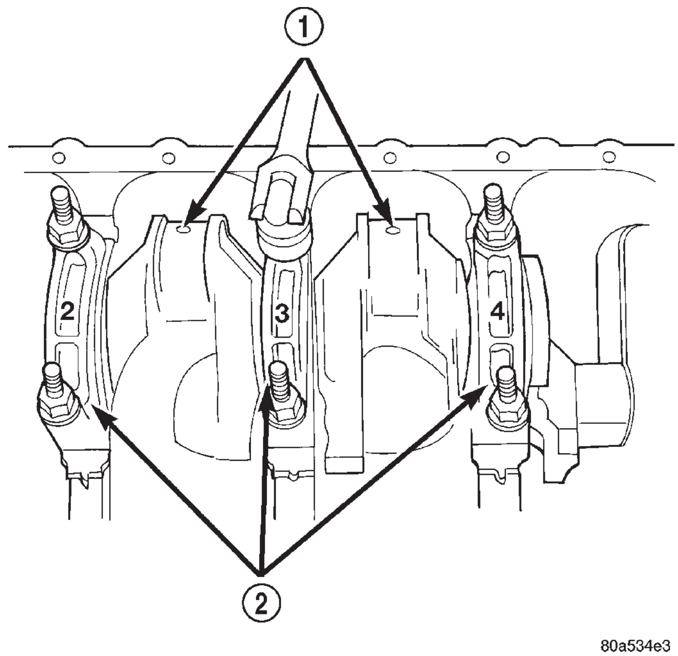

Fig. 45 Removing Main Bearing Caps and Lower Inserts

1 - CONNECTING ROD JOURNAL
2 - MAIN BEARING CAPS

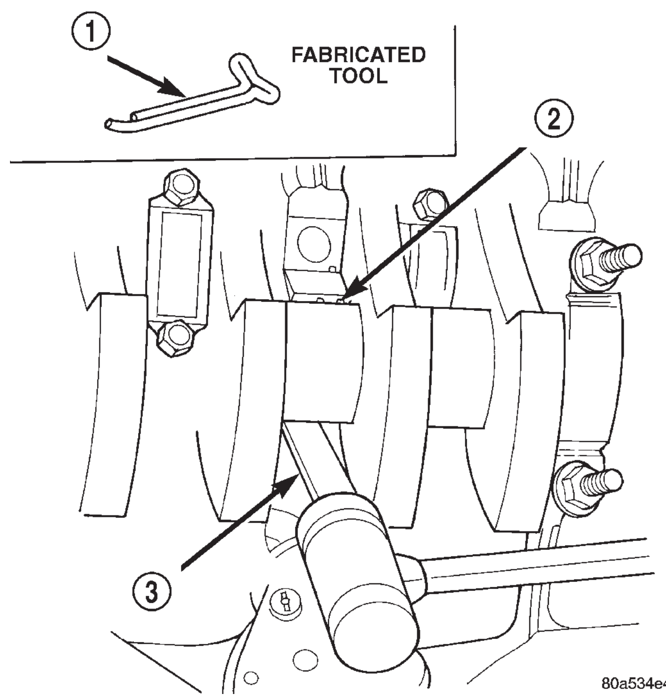

Fig. 46 Removing Upper Inserts

1 - COTTER PIN
2 - BEARING INSERT
3 - TONGUE DEPRESSOR

CRANKSHAFT MAIN BEARINGS (Continued)

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. 47). In general the lower bearing half will have a heaver wear pattern.

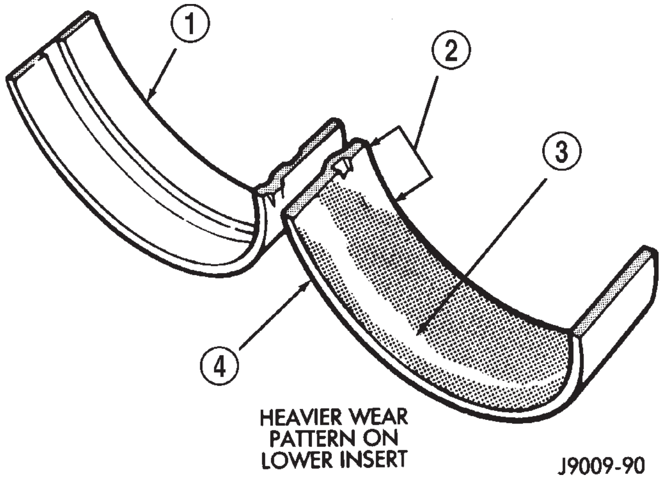

Fig. 47 Main Bearing Wear Patterns

1 - UPPER INSERT
2 - NO WEAR IN THIS AREA
3 - LOW AREA IN BEARING LINING
4 - LOWER INSERT

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.

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. 48). 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.

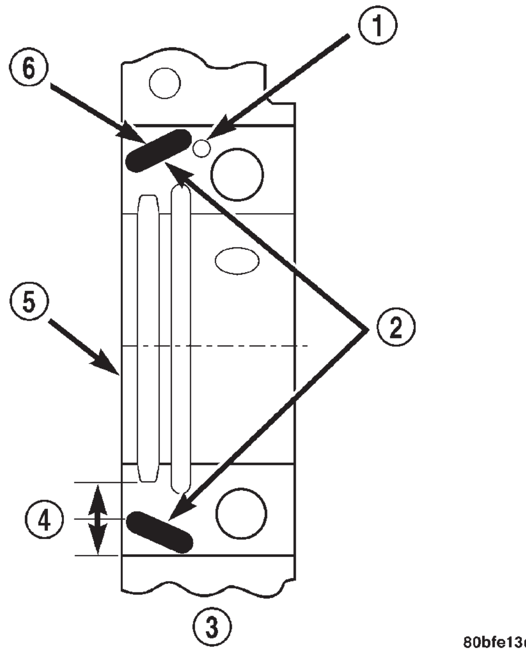

Fig. 48 Location of Sealer

1 - **DOWEL**
2 - **SEALER LOCATIONS**
3 - **CYLINDER BLOCK**
4 - **HALFWAY BETWEEN**
5 - **REAR FACE OF CYLINDER BLOCK**
6 - **3mm (0.125 in.)**

(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.

(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. 49). Correct end play is 0.038-0.165 mm (0.0015-0.0065 inch). The desired specifications are 0.051-0.064 mm (0.002-0.0025 inch).

CRANKSHAFT MAIN BEARINGS (Continued)

(e) If end play is not within specification, inspect crankshaft thrust faces for wear. If no wear is apparent, replace the thrust bearing and measure end play. If end play is still not within specification, replace the crankshaft.

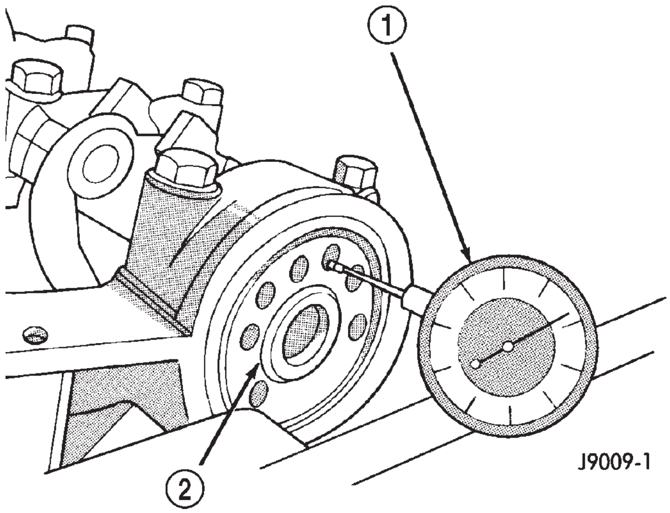

Fig. 49 Crankshaft End Play Measurement

1 - DIAL INDICATOR
2 - CRANKSHAFT

(11) If the crankshaft was removed, install the crankshaft into the cylinder block.

(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 (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(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.

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

This procedure is done with the timing case cover installed.

(1) Disconnect negative cable from battery.

(2) Remove the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(3) Remove the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(4) Remove the radiator shroud.

(5) Carefully remove the oil seal. Make sure seal bore is clean.

INSTALLATION

This procedure is done with the timing case cover installed.

(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. 50). Tighten the nut against the tool until it contacts the cover.

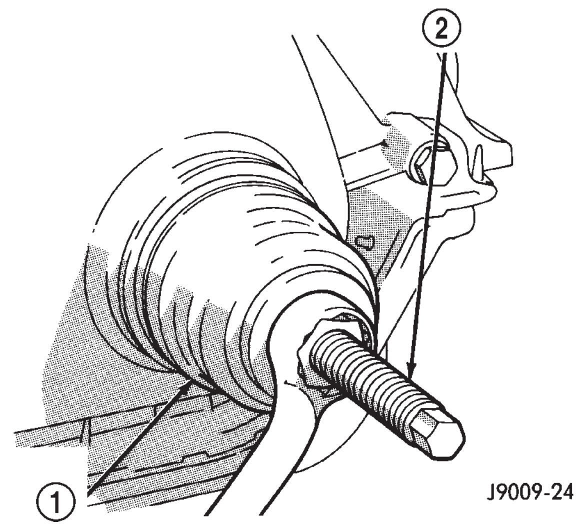

Fig. 50 Timing Case Cover Oil Seal Installation

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 (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(5) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(6) Install the radiator shroud.

(7) Connect negative cable to battery.

CRANKSHAFT OIL SEAL - REAR

REMOVAL

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.

(1) Remove transmission inspection cover.

(2) Remove oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL)

(3) Remove main bearing cap brace.

(4) Remove rear main bearing cap (No.7).

(5) Push upper seal out of the groove. Ensure that the crankshaft and seal groove are not damaged.

(6) Remove lower half of the seal from the bearing cap.

INSTALLATION

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.

(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. 51). The dab of sealer should be 3 mm (0.125 in.) in diameter.

(6) Apply Mopar® Gasket Maker on the rear bearing cap (Fig. 51). 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.

(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 (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

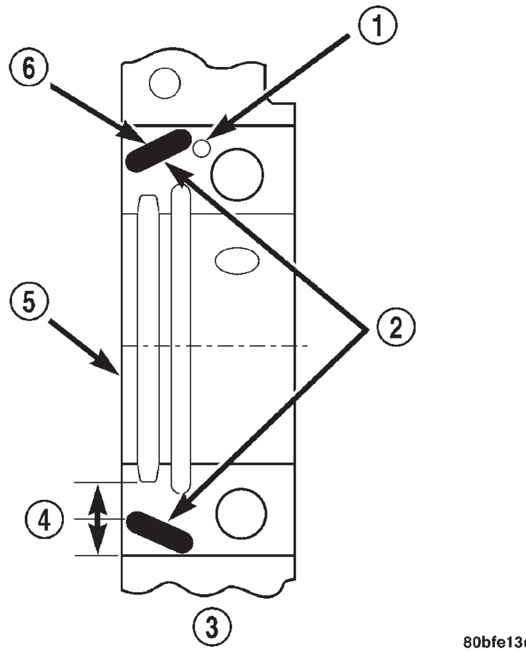

Fig. 51 Location of Sealer

1 - DOWEL
2 - SEALER LOCATIONS
3 - CYLINDER BLOCK
4 - HALFWAY BETWEEN
5 - REAR FACE OF CYLINDER BLOCK
6 - 3mm (0.125 in.)

(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. 52)

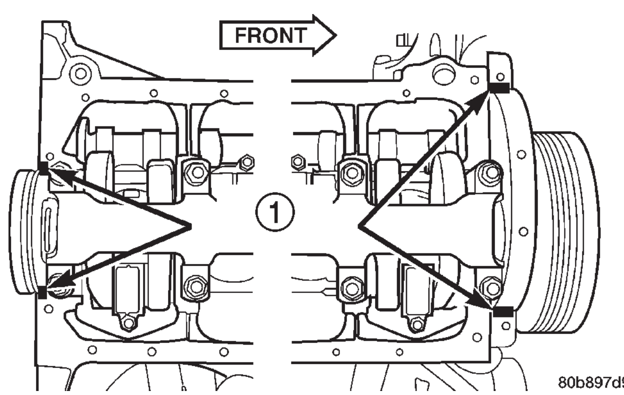

Fig. 52 Oil Pan

1 - SEALER LOCATIONS

(14) Install transmission inspection cover.

HYDRAULIC LIFTERS

DESCRIPTION

Valve lash is controlled by hydraulic tappets located inside the cylinder block, in tappet bores above the camshaft.

REMOVAL

NOTE: Retain all the components in the same order as removed.

(1) Remove the engine cylinder head(Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(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. 53).

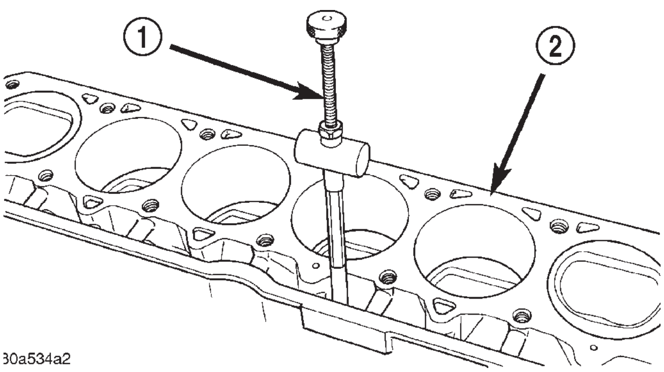

Fig. 53 HYDRAULIC VALVE TAPPET REMOVAL - 4.0L

1 - HYDRAULIC TAPPET REMOVAL TOOL
2 - CYLINDER BLOCK

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 tappets.

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 54).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Leak-Down Tester.

(1) Place a 7.925-7.950 mm (0.312-0.313 inch) diameter ball bearing on the plunger cap of the tappet.

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

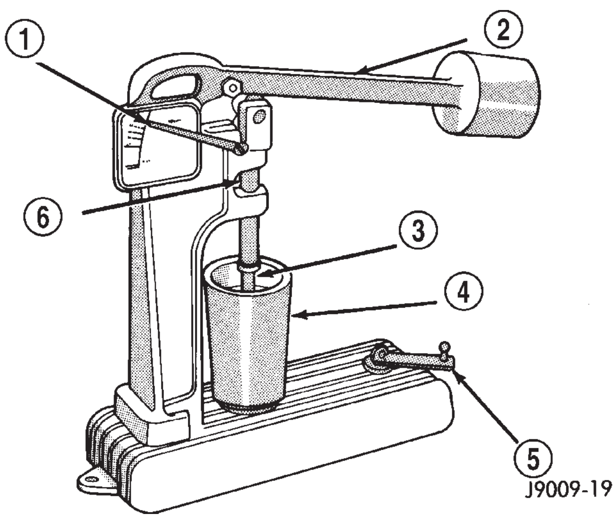

Fig. 54 Leak-Down Tester

1 - POINTER
2 - WEIGHTED ARM
3 - RAM
4 - CUP
5 - HANDLE
6 - PUSH ROD

INSTALLATION

Retain all the components in the same order as removed.

HYDRAULIC LIFTERS (Continued)

It is not necessary to charge the tappets with engine oil. They will charge themselves within a very short period of engine operation.

(1) Dip each tappet in Mopar® Engine Oil Supplement, or equivalent.

(2) Use Hydraulic Valve Tappet Removal/Installation Tool to install each tappet in the same bore from where it was originally removed.

(3) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(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 cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

PISTON & CONNECTING ROD

DESCRIPTION

The pistons (Fig. 55) 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.

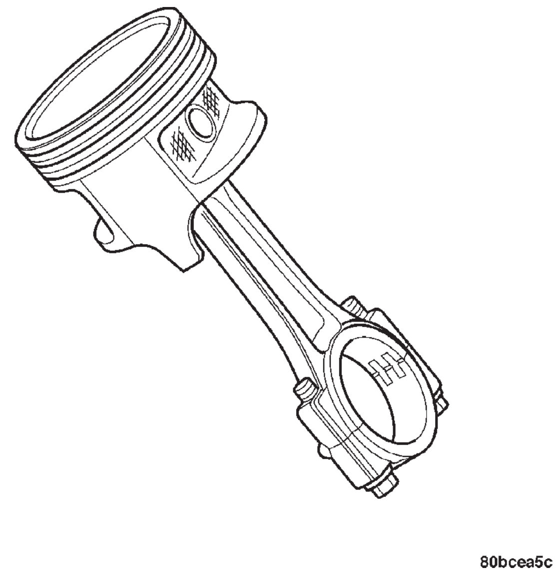

Fig. 55 Piston and Connecting Rod Assembly

STANDARD PROCEDURE - PISTON FITTING

(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. 57).

(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. 56). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

(5) Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

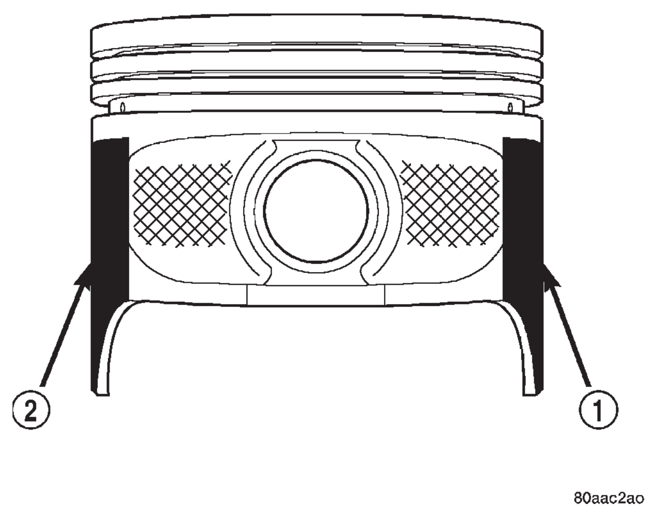

Fig. 56 Moly Coated Piston

1 - MOLY COATED
2 - MOLY COATED

PISTON & CONNECTING ROD (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

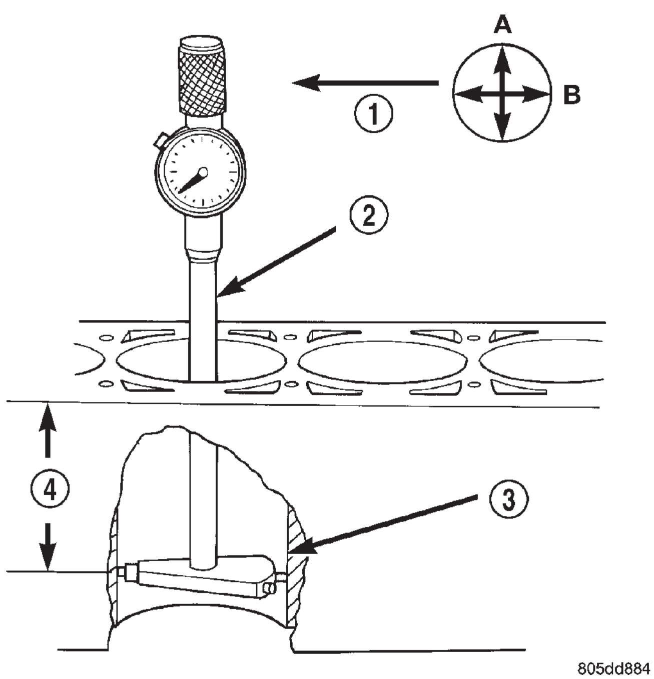

Fig. 57 Bore Gauge

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 49.5 MM (1-15/16 in.)

REMOVAL

(1) Remove the engine cylinder head cover. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Remove the rocker arms, bridges and pivots.

(3) Remove the push rods.

(4) Remove the engine cylinder head. (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(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. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(9) Remove main bearing cap brace (Fig. 58).

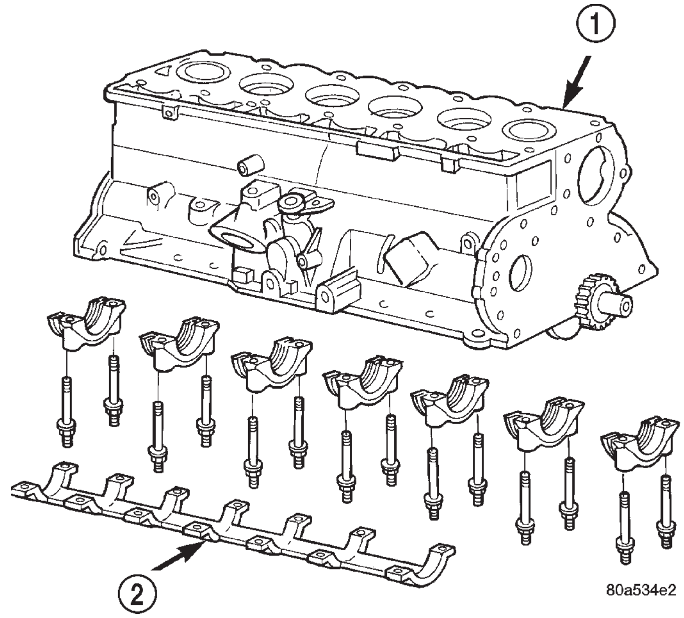

Fig. 58 Main Bearings Caps and Brace

1 - BLOCK
2 - MAIN BEARING CAP BRACE

(10) Remove the connecting rod bearing caps and inserts. Mark the caps and rods with the cylinder bore location. The connecting rods and caps are stamped with a two letter combination (Fig. 59).

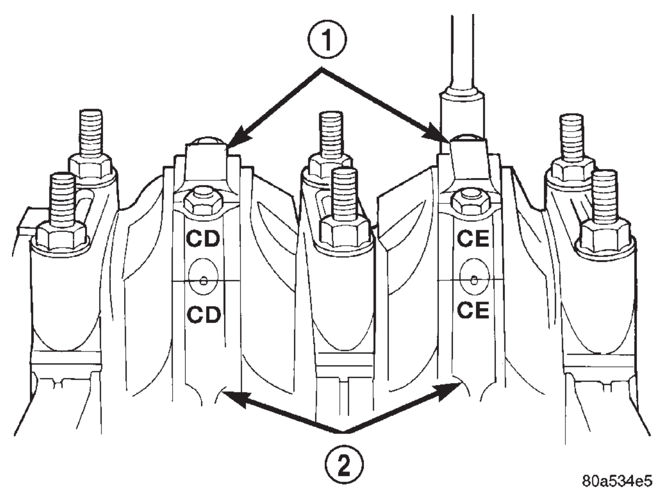

Fig. 59 Stamped Connecting Rods and Caps

1 - CONNECTING ROD CAP
2 - CONNECTING ROD

PISTON & CONNECTING ROD (Continued)

(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. 60).

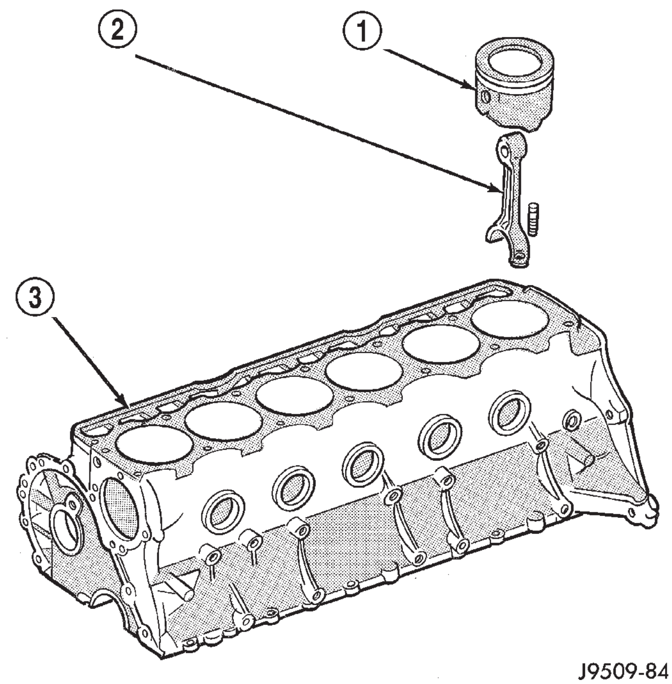

Fig. 60 Removal of Connecting Rod and Piston Assembly

1 - PISTON
2 - CONNECTING ROD
3 - BLOCK

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 (Refer to 9 - ENGINE/ENGINE BLOCK/ PISTON RINGS - STANDARD PROCEDURE).

(3) Lubricate the piston and rings with clean engine oil.

CAUTION: Ensure that connecting rod bolts DO NOT scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose slipped over the connecting rod bolts will provide protection during installation.

(4) Use a piston ring compressor to install the connecting rod and piston assemblies through the top of the cylinder bores (Fig. 61).

(5) Ensure the arrow on the piston top points to the front of the engine (Fig. 61).

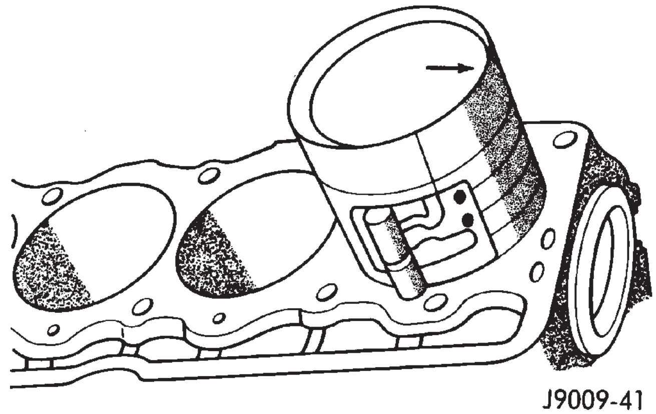

Fig. 61 Rod and Piston Assembly Installation

(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. 58). Tighten nuts to 47 N·m (35 ft. lbs.).

PISTON & CONNECTING ROD (Continued)

(12) Install the oil pan and gasket (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(13) Lower the vehicle.

(14) Install the engine cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION), push rods, rocker arms, bridges, pivots and engine cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(15) Fill the crankcase with engine oil.

PISTON RINGS

STANDARD PROCEDURE - 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. 62) (Fig. 63). Rotate the ring in the groove. It must move freely around circumference of the groove.

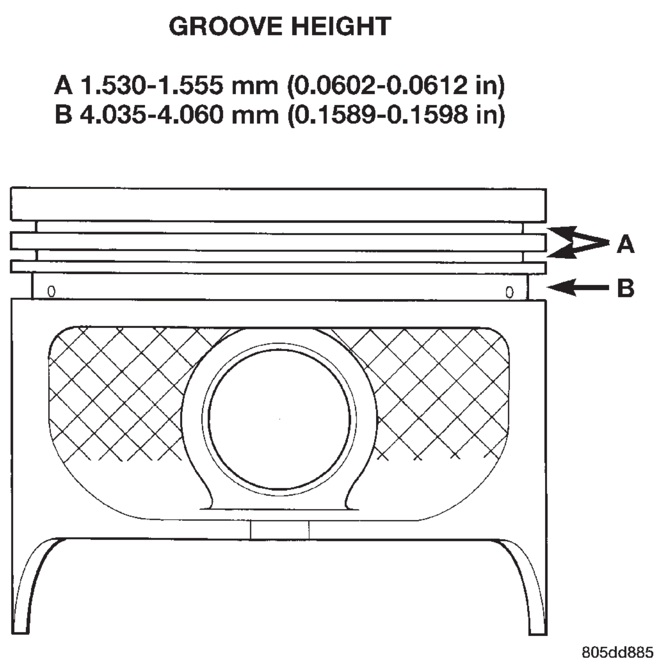

Fig. 62 Piston Dimensions

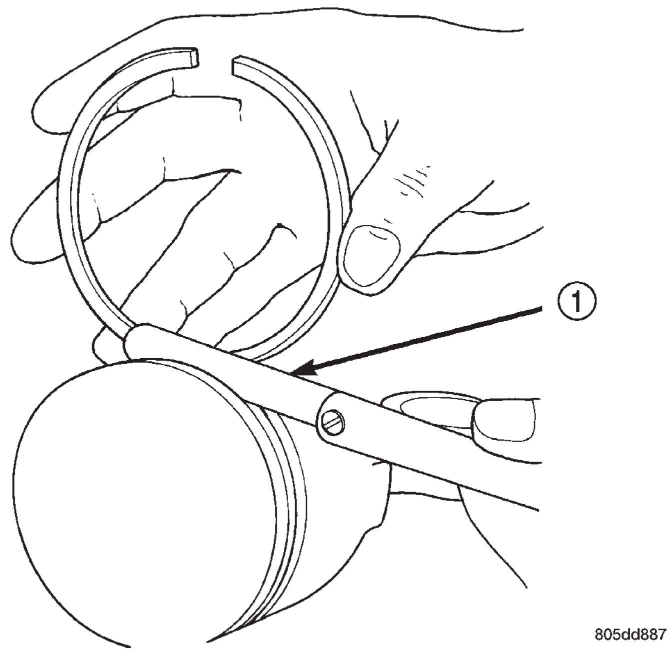

Fig. 63 Ring Side Clearance Measurement

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.)

PISTON RINGS (Continued)

(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. 64).

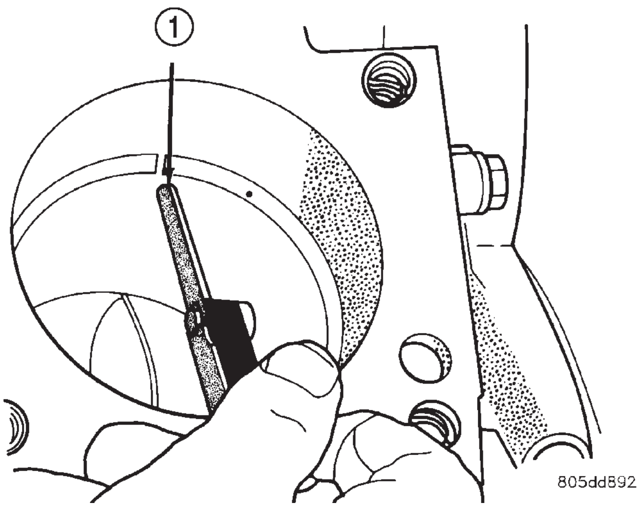

Fig. 64 Gap Measurement

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.)

(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. 65).

(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. 66) and (Fig. 67).

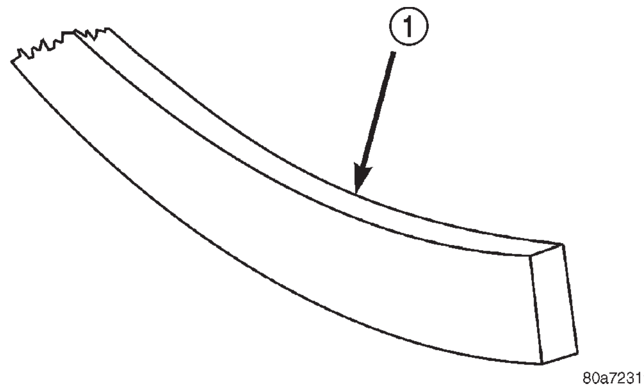

Fig. 65 Top Compression ring identification

1 - TOP COMPRESSION RING

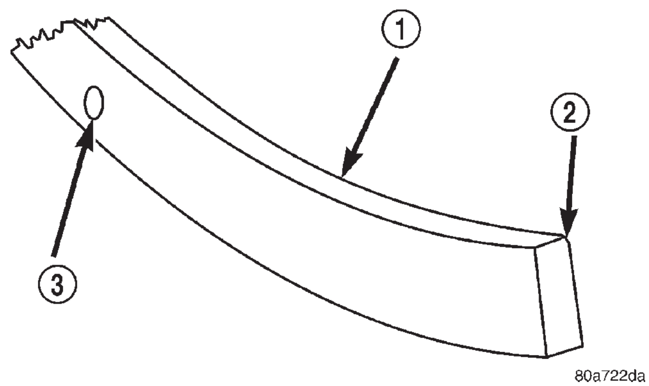

Fig. 66 Second Compression Ring Identification

1 - SECOND COMPRESSION RING
2 - CHAMFER
3 - ONE DOT

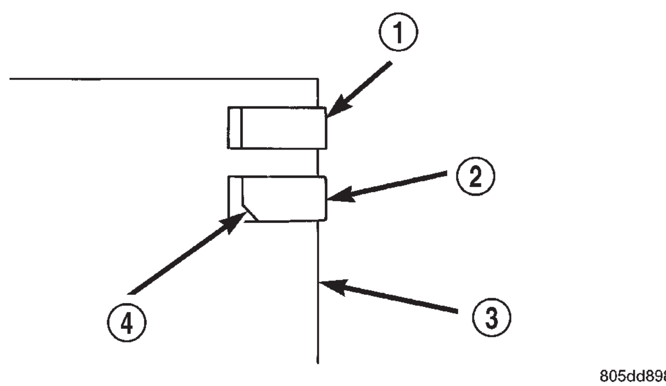

Fig. 67 Compression Ring Chamfer Location

1 - TOP COMPRESSION RING
2 - SECOND COMPRESSION RING
3 - PISTON
4 - CHAMFER

PISTON RINGS (Continued)

(8) Using a ring installer, install the second compression ring with the dot facing up (Fig. 66) (Fig. 68).

(9) Using a ring installer, install the top compression ring (either side up).

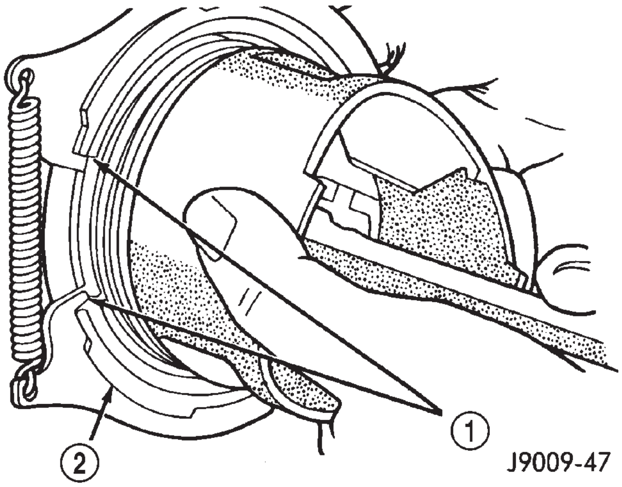

Fig. 68 Compression Ring Installation

1 - COMPRESSION RING
2 - RING EXPANDER RECOMMENDED

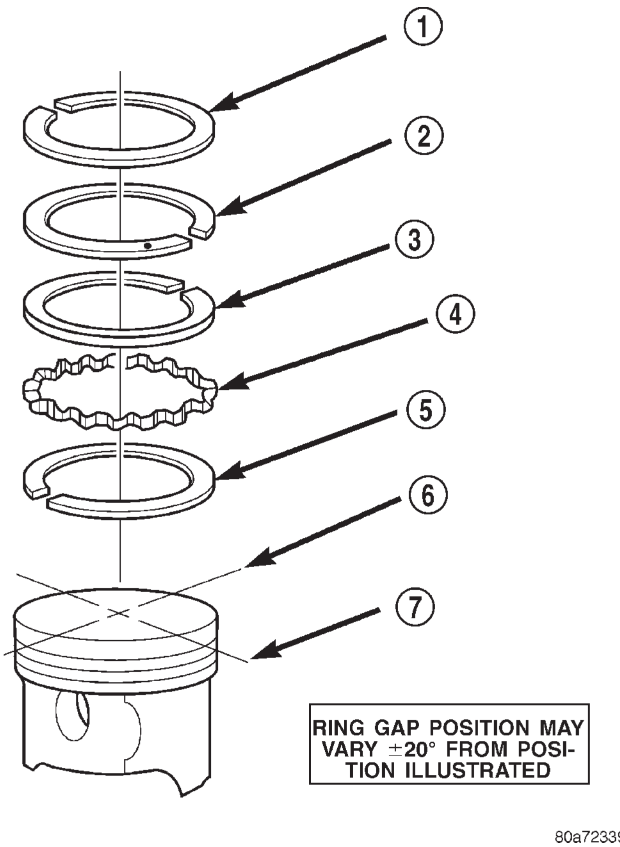

Fig. 69 Ring Gap Orientation

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

Ring Gap Orientation

- Position the gaps on the piston as shown (Fig. 69).
- Oil spacer - Gap on center line of piston skirt.
- Oil rails - gap 180° apart on centerline of piston pin bore.
- No. 2 Compression ring - Gap 180° from top oil rail gap.
- No. 1 Compression ring - Gap 180° from No. 2 compression ring gap.

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL) 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. 70).

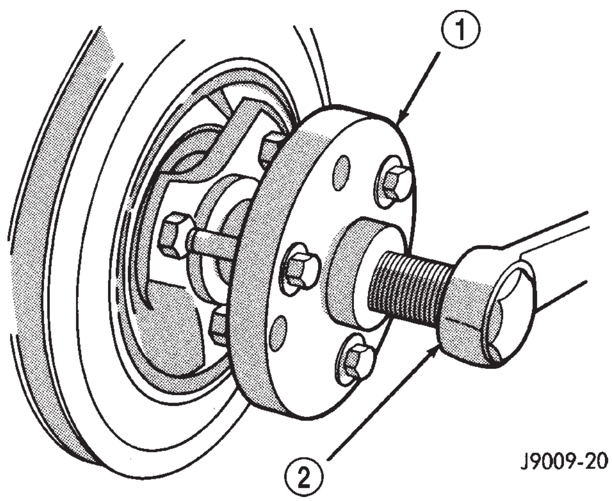

Fig. 70 Vibration Damper Removal Tool 7697

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.

VIBRATION DAMPER (Continued)

(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 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION) and fan shroud.

(5) Connect negative cable to battery.

STRUCTURAL SUPPORT

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.

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. 72).

(4) Tighten engine-to-transmission brace retaining bolt (Fig. 71)to 40 N·m (30 ft. lbs.).

(5) Tighten transmission brace retaining bolts (Fig. 72)to 40 N·m (30 ft. lbs.), then tighten transmission brace retaining lock nuts (Fig. 72) to 108 N·m (80 ft. lbs.).

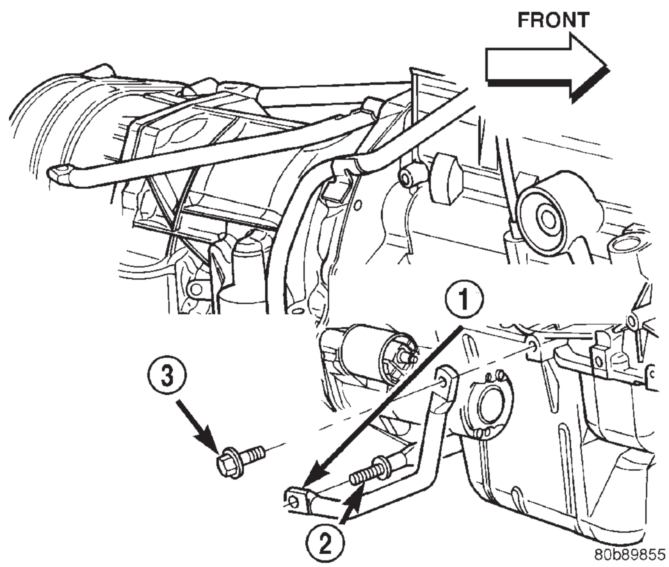

Fig. 71 Engine-to-Transmission Bending Braces

1 - ENGINE-TO-TRANSMISSION BENDING BRACE
2 - CROSS BRACE
3 - ENGINE-TO-TRANSMISSION BENDING BRACE RETAINING BOLT

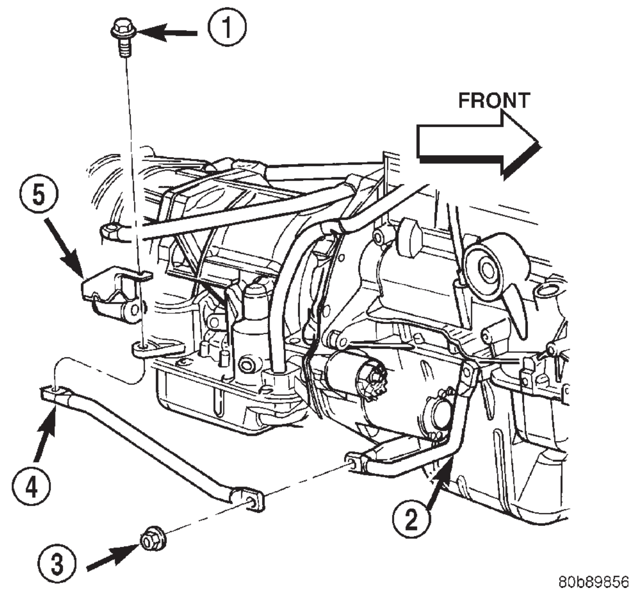

Fig. 72 Transmission Bending Braces and Exhaust Hanger

1 - TRANSMISSION BENDING BRACE RETAINING BOLT
2 - ENGINE-TO-TRANSMISSION BENDING BRACE
3 - LOCKNUT
4 - TRANSMISSION BRACE
5 - EXHAUST HANGER

FRONT MOUNT

REMOVAL

The front mounts support the engine at each side. These supports are made of resilient rubber.

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

(3) Support the engine.

(4) Remove the nut from the through bolt (Fig. 73) (Fig. 74). DO NOT remove the through bolt.

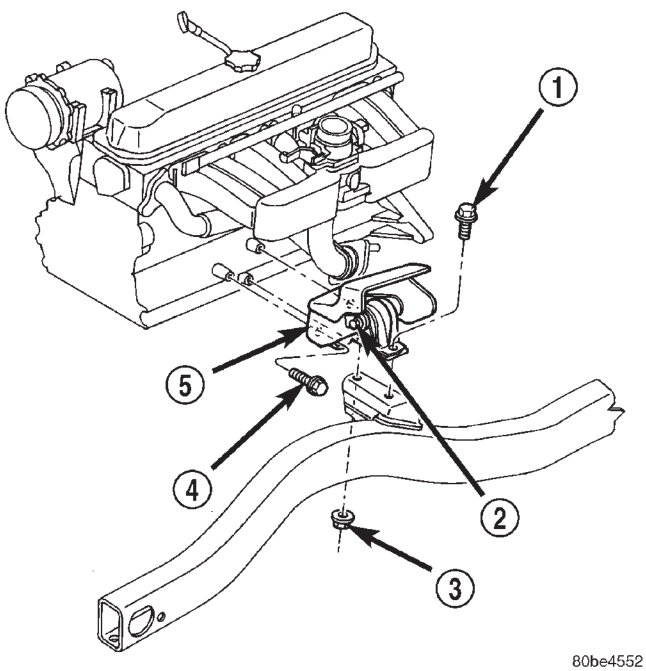

Fig. 73 Left Front Engine Mount

1 - **BOLT (2)**
2 - **THROUGH BOLT**
3 - **NUT (2)**
4 - **BOLT (3)**
5 - **LEFT HAND ENGINE MOUNT ASSEMBLY**

(5) Remove the retaining bolts and nuts from the insulator.

(6) Remove the through bolt.

(7) Remove the insulator.

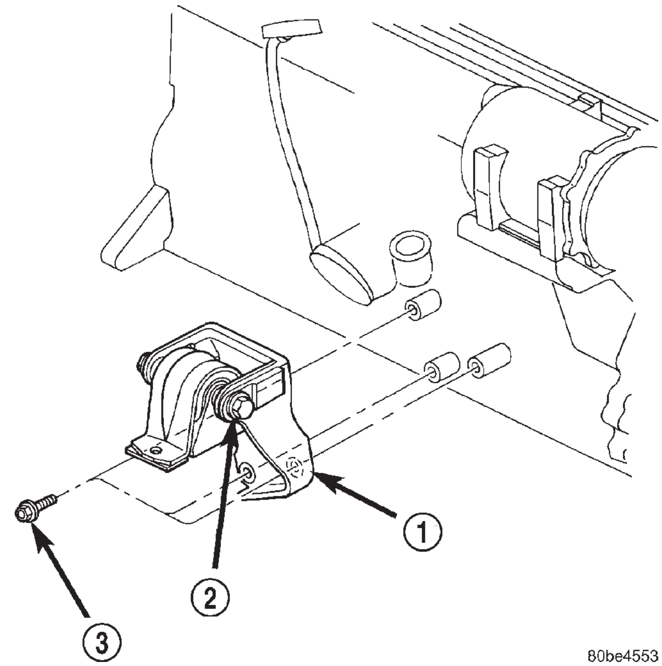

Fig. 74 Right Front Engine Mount

1 - **RIGHT HAND ENGINE MOUNT ASSEMBLY**
2 - **THROUGH BOLT**
3 - BOLT (3)

INSTALLATION

The front mounts support the engine at each side. These supports are made of resilient rubber.

(1) If the engine support bracket was removed, position the bracket onto the block and install the attaching bolts (Fig. 73) (Fig. 74). 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.

REAR MOUNT

REMOVAL

A resilient rubber cushion supports the transmission at the rear between the transmission extension housing and the rear support crossmember or skid plate.

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. 75) (Fig. 76).

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.

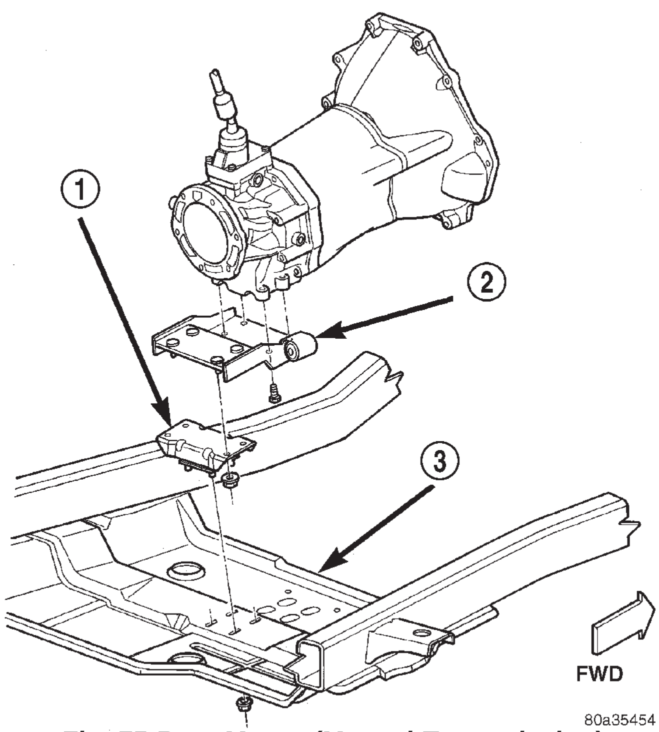

Fig. 75 Rear Mount (Manual Transmission)

1 - CUSHION
2 - BRACKET
3 - SKID PLATE

AUTOMATIC TRANSMISSIONS

(1) Remove nuts holding support cushion to transmission support bracket (Fig. 76). Remove the support cushion.
(2) Remove the bolts holding the transmission support bracket to transmission.
(3) Remove the transmission support bracket.

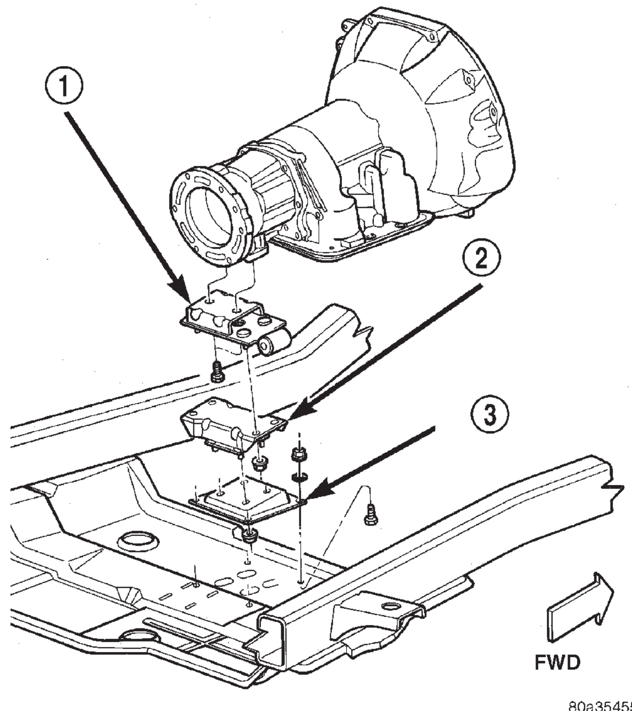

Fig. 76 Rear Mount (AutomaticTransmission)

1 - BRACKET
2 - CUSHION
3 - BRACKET

INSTALLATION

MANUAL TRANSMISSION

(1) Position the transmission mount bracket to the transmission and install the bolts (Fig. 65).
(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. 65).

AUTOMATIC TRANSMISSION

(1) Position the transmission mount bracket to the transmission and install the bolts. Tighten the bolts to 54 N·m (40 ft. lbs.) torque.
(2) Position the support cushion to the transmission mount bracket and install nuts. Tighten the nuts to 41 N·m (30 ft. lbs.) torque (Fig. 66).
(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. 65) (Fig. 66). 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.

LUBRICATION

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, 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 (Fig. 77).

LUBRICATION (Continued)

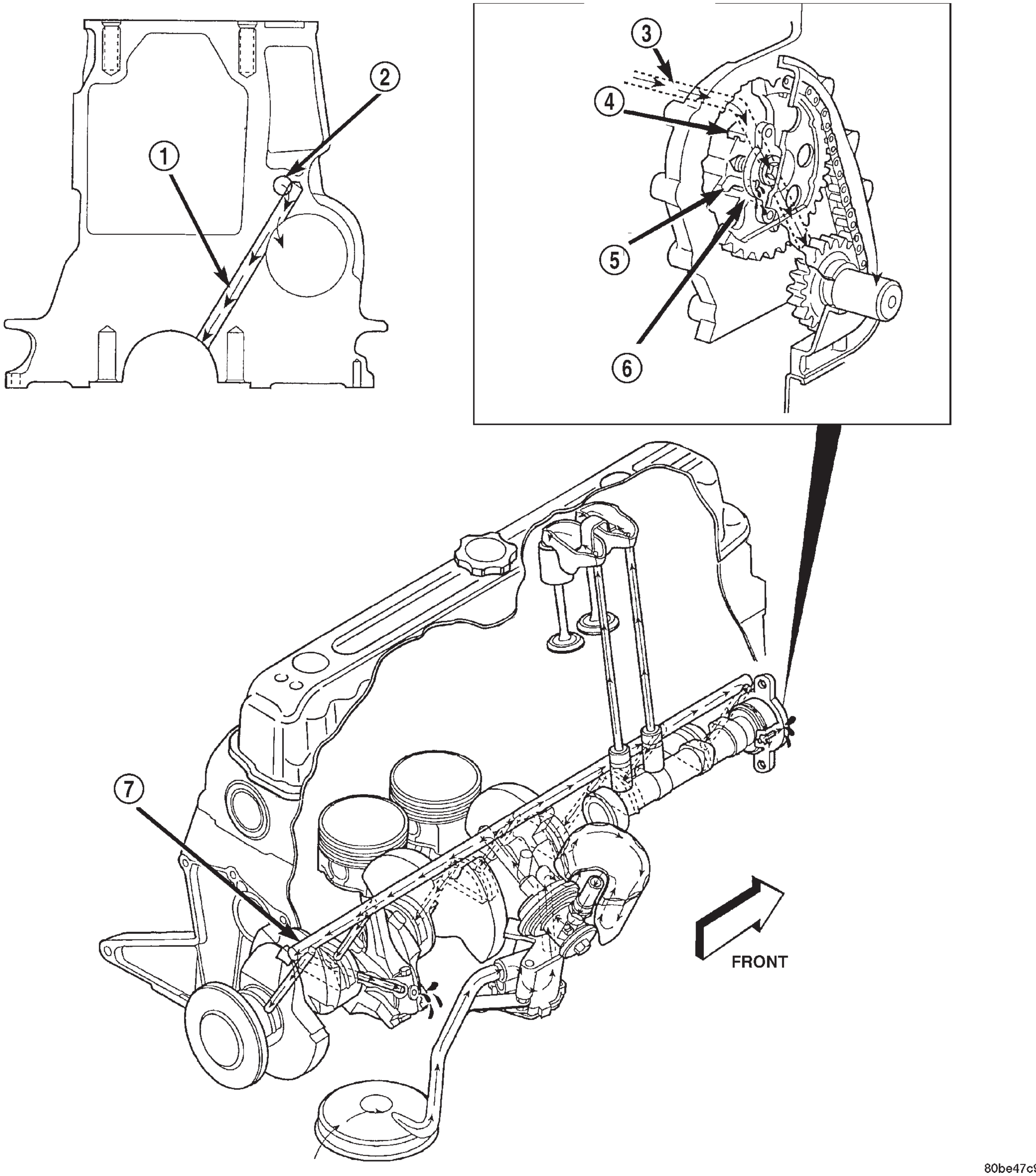

Fig. 77 Oil Lubrication System—4.0L Engine

1 - CAM/CRANK MAIN GALLERY (7)
2 - TAPPET GALLERY
3 - TAPPET GALLERY
4 - CAMSHAFT BEARING
5 - NUMBER 1 CAMSHFT BEARING JOURNAL
6 - CAMSHAFT SPROCKET
7 - TAPPET GALLERY

LUBRICATION (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - 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 9 - ENGINE - SPECIFICATIONS) for the correct pressures.

DIAGNOSIS AND TESTING - ENGINE OIL LEAK

Begin with a thorough visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.

(3) Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24km (15 miles), and repeat inspection.**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 CCV valve from the cylinder head cover. Cap or plug the CCV 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 information procedures.

(5) If the leakage occurs at the rear oil seal area, INSPECTION FOR REAR SEAL AREA LEAKS .

(6) If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the CCV 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.

OIL

STANDARD PROCEDURE - ENGINE OIL SERVICE

ENGINE OIL CHANGE

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. CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA.

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. DaimlerChrysler Corporation recommends a Mopar® or equivalent oil filter be used.

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) Position a drain pan under the oil filter.

(8) Using a suitable oil filter wrench loosen filter.

(9) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss or filter adapter housing (Fig. 78).

(10) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

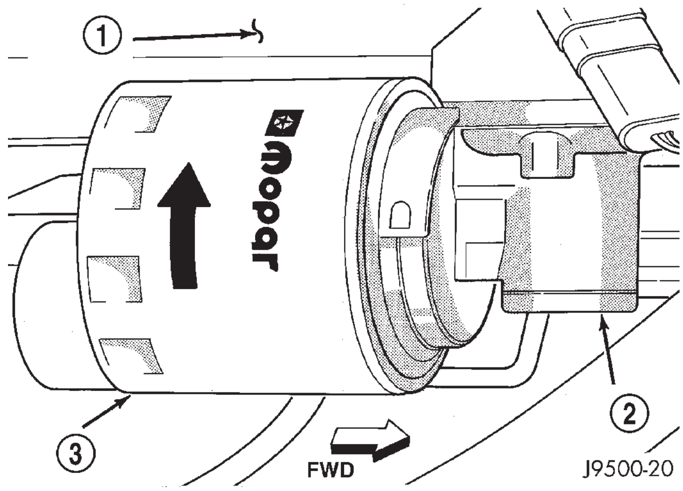

Fig. 78 Oil Filter—4.0L Engine

1 - CYLINDER BLOCK
2 - ADAPTER
3 - OIL FILTER

(11) Make sure old gasket comes off with oil filter. With a wiping cloth, clean the gasket sealing surface (Fig. 79) of oil and grime.

(12) Lightly lubricate oil filter gasket with engine oil or chassis grease.

(13) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 79)hand tighten filter one full turn, do not over tighten.

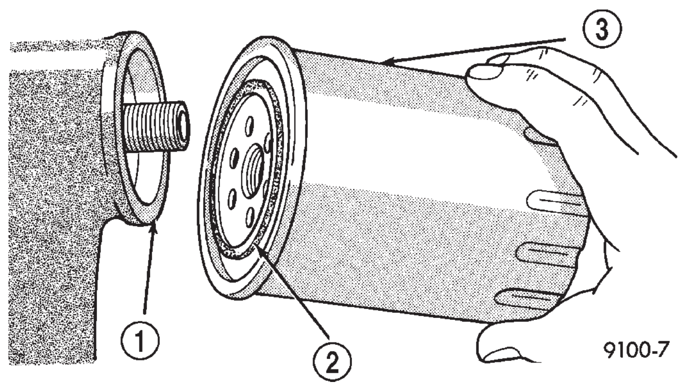

Fig. 79 Oil Filter Sealing Surface—Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

(14) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(15) Install oil fill cap.

(16) Start engine and inspect for leaks.

(17) Stop engine and inspect oil level.

OIL (Continued)

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 4.0L 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. 80).

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading (Fig. 80).

(6) Add oil only if level is below the ADD mark on dipstick.

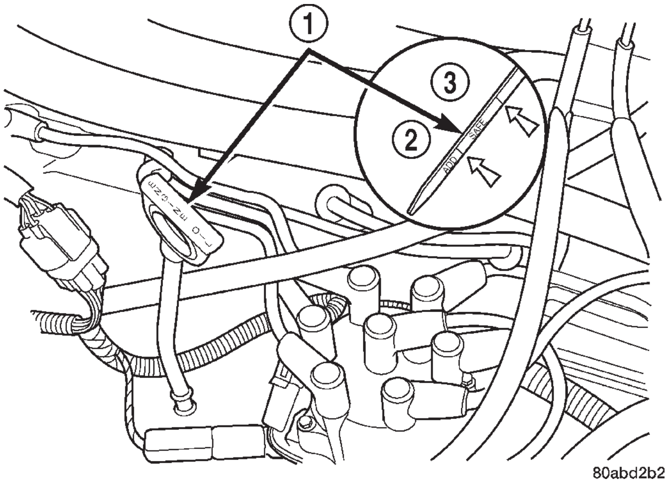

Fig. 80 Engine Oil Dipstick—4.0L Engine

1 - DIPSTICK
2 - ADD
3 - SAFE

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 procedure.

OIL FILTER

REMOVAL

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. DaimlerChrysler Corporation recommends a Mopar® or equivalent oil filter be used.

(1) Position a drain pan under the oil filter.

(2) Using a suitable oil filter wrench loosen filter.

(3) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss or filter adapter housing (Fig. 81).

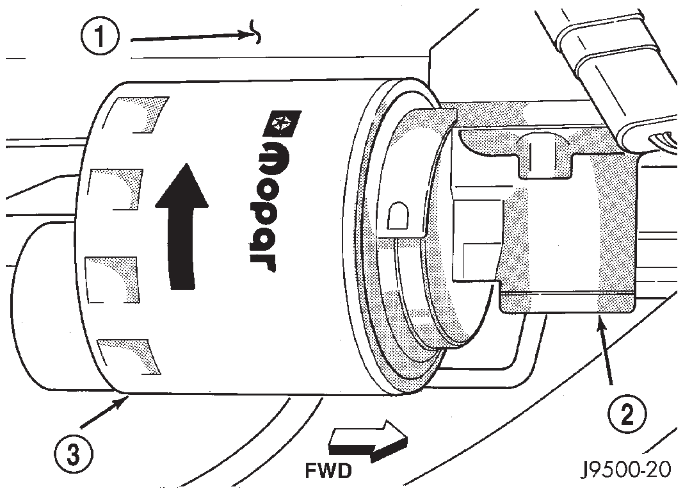

Fig. 81 Oil Filter—4.0L Engine

1 - CYLINDER BLOCK
2 - ADAPTER
3 - OIL FILTER

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) Make sure old gasket comes off with oil filter. With a wiping cloth, clean the gasket sealing surface (Fig. 69) of oil and grime.

OIL FILTER (Continued)

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. 82) hand tighten filter one full turn, do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

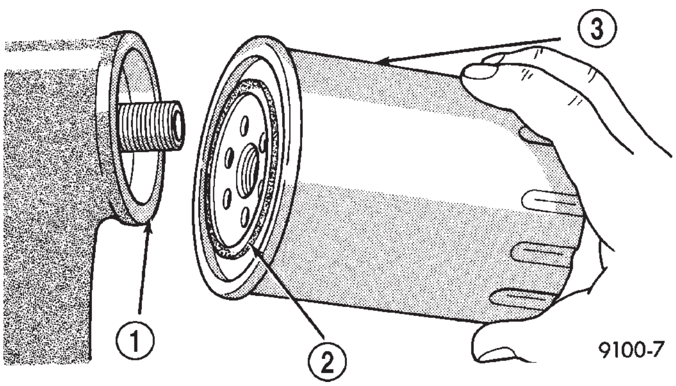

Fig. 82 Oil Filter Sealing Surface—Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

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. 83).

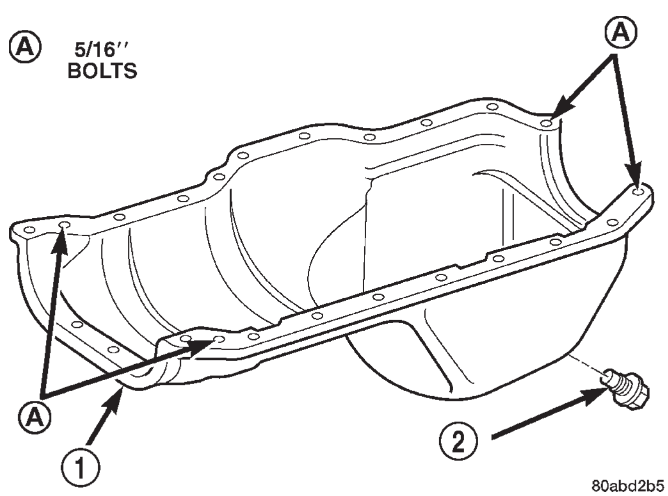

Fig. 83 Oil Pan

1 - OIL PAN
2 - OIL PAN DRAIN PLUG

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. (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(7) Remove the engine flywheel and transmission torque converter housing access cover.

(8) If equipped with an oil level sensor, disconnect the sensor.

(9) Position a jack stand directly under the engine vibration damper.

(10) Place a piece of wood (2 x 2) between the jack stand and the engine vibration damper.

(11) Remove the engine mount through bolts.

(12) Using the jack stand, raise the engine until adequate clearance is obtained to remove the oil pan.

(13) Remove transmission oil cooling lines (if equipped) and oxygen sensor wiring supports that are attached to the oil pan studs.

(14) Remove the oil pan bolts and studs. Carefully slide the oil pan and gasket to the rear. If equipped with an oil level sensor, take care not to damage the sensor.

INSTALLATION

(1) Clean the block and pan gasket surfaces.

(2) Fabricate 4 alignment dowels from 1 1/2 x 1/4 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 84).

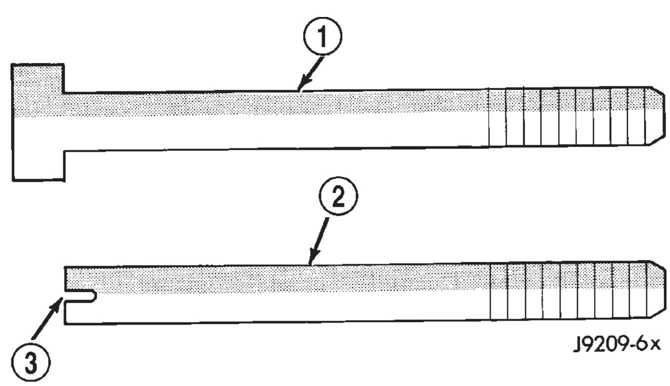

Fig. 84 Fabrication of Alignment Dowels

1 - 1/4'' × 1 1/2'' BOLT
2 - DOWEL
3 - SLOT

OIL PAN (Continued)

(3) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 85).

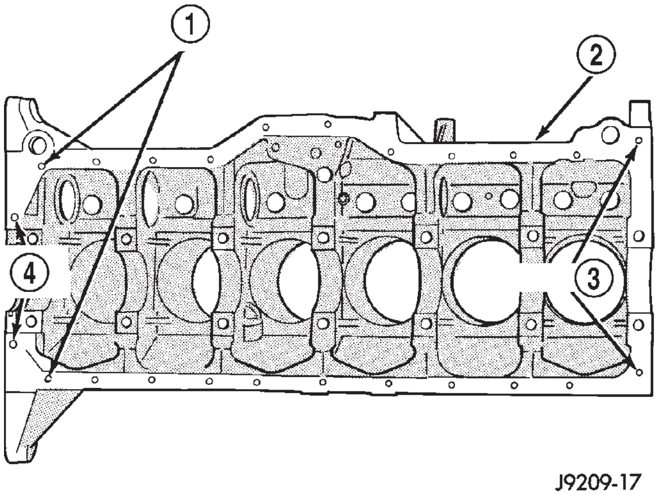

Fig. 85 Position of Dowels in Cylinder Block

1 - DOWEL HOLES
2 - CYLINDER BLOCK
3 - 5/16'' HOLES
4 - 5/16'' HOLES

(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. 86).

(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. 87). Tighten these bolts to 15 N·m (132 in. lbs.) torque.

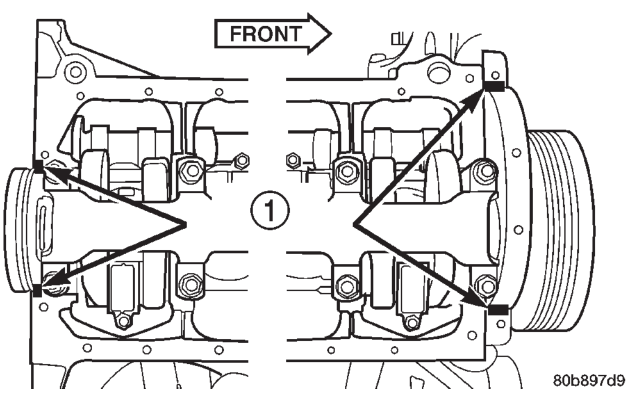

Fig. 86 Oil Pan Sealer Location

1 - SEALER LOCATIONS

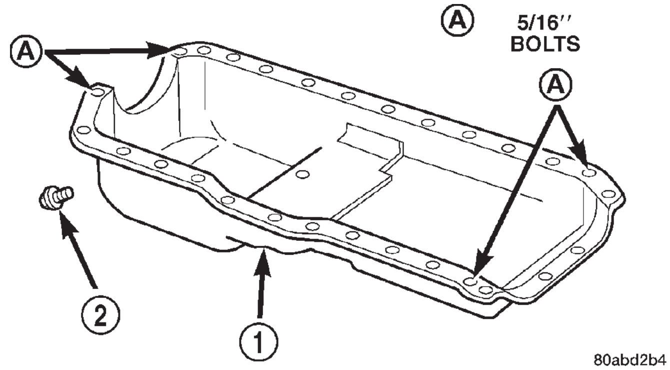

Fig. 87 Position of 5/16 inch Oil Pan Bolts

1 - OIL PAN
2 - OIL PAN DRAIN PLUG

(8) Remove the dowels. Install the remaining 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque.

(9) Lower the engine until it is properly located on the engine mounts.

(10) Install the through bolts and tighten the nuts.

(11) Lower the jack stand and remove the piece of wood.

(12) Install the engine flywheel and transmission torque converter housing access cover.

(13) Install the engine starter motor. (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(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. 87). 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.

ENGINE OIL PRESSURE SENSOR

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)
- 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.

OIL PUMP

REMOVAL

A gear-type oil pump is mounted at the underside of the cylinder block opposite the No.4 main bearing.

(1) Drain the engine oil.

(2) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(3) Remove the pump-to-cylinder block attaching bolts. Remove the pump assembly with gasket (Fig. 88).

CAUTION: If the oil pump is not to be serviced, DO NOT disturb position of oil inlet tube and strainer assembly in pump body. If the tube is moved within the pump body, a replacement tube and strainer assembly must be installed to assure an airtight seal.

INSTALLATION

A gear-type oil pump is mounted at the underside of the cylinder block opposite the No.4 main bearing.

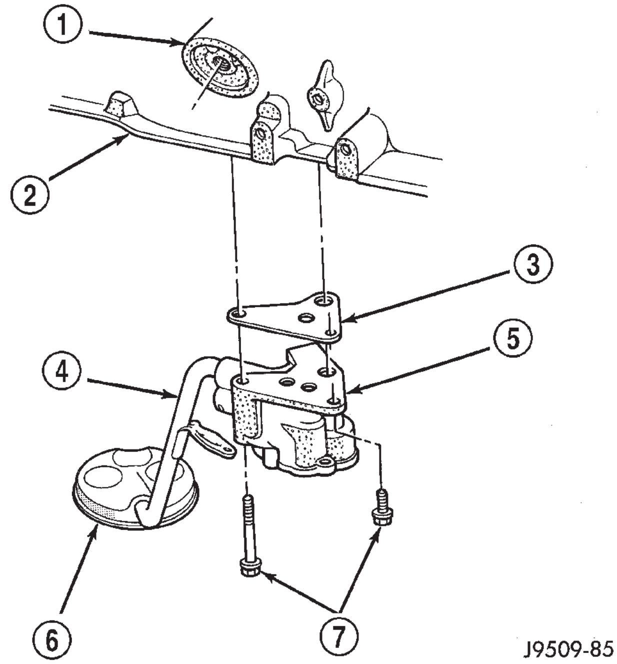

Fig. 88 Oil Pump Assembly

1 - OIL FILTER ADAPTOR
2 - BLOCK
3 - GASKET
4 - OIL INLET TUBE
5 - OIL PUMP
6 - STRAINER ASSEMBLY
7 - ATTACHING BOLTS

(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 (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(3) Fill the oil pan with oil to the specified level.

VALVE TIMING

STANDARD PROCEDURE - VALVE TIMING

(1) Disconnect the spark plug wires and remove the spark plugs.

(2) Remove the engine cylinder head cover .

(3) Remove the capscrews, bridge and pivot assembly, and rocker arms from above the No.1 cylinder.

(4) Alternately loosen each capscrew, one turn at a time, to avoid damaging the bridge.

(5) Rotate the crankshaft until the No.6 piston is at top dead center (TDC) on the compression stroke.

(6) Rotate the crankshaft counterclockwise (viewed from the front of the engine) 90°.

(7) 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.

VALVE TIMING (Continued)

(8) Set the dial indicator pointer at zero.

(9) 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).

(10) The timing notch index on the vibration damper should be aligned with the TDC mark on the timing degree scale.

(11) 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.

NOTE: 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.

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(3) Remove the fan, hub assembly and fan shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(4) Remove the accessory drive brackets that are attached to the timing case cover.

(5) Remove the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL) (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. 89).

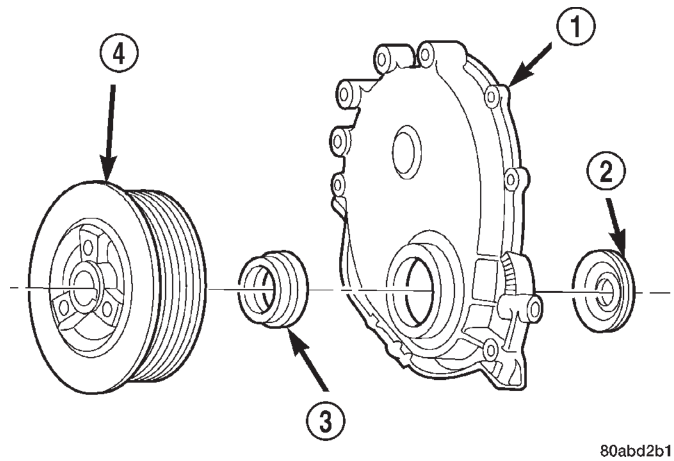

Fig. 89 Timing Case Cover Components

1 - TIMING CASE COVER
2 - OIL SLINGER
3 - CRANKSHAFT OIL SEAL
4 - VIBRATION DAMPER PULLEY

INSTALLATION

Clean the timing case cover, oil pan and cylinder block gasket surfaces.

(1) Install a new crankshaft oil seal in the timing case cover. The open end of the seal should be toward the inside of the cover. Support the cover at the seal area while installing the seal. Force it into position with Seal Installation Tool 6139.

(2) Position the gasket on the cylinder block.

(3) Position the timing case cover on the oil pan gasket and the cylinder block.

(4) Insert Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening in the cover (Fig. 90).

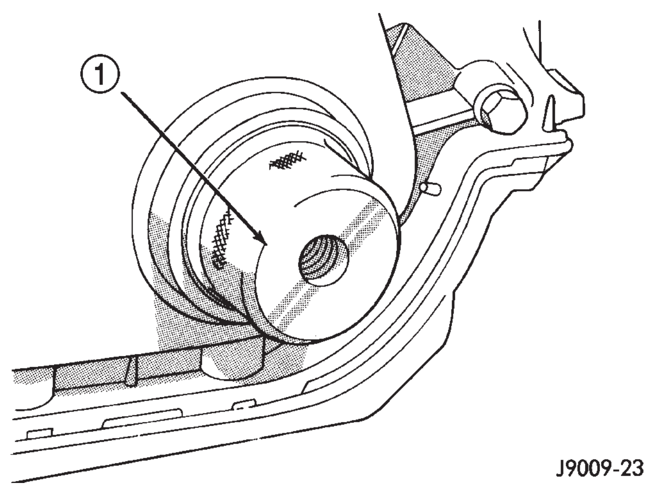

Fig. 90 Timing Case Cover Alignment

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

TIMING BELT / CHAIN COVER(S) (Continued)

key. With the key inserted in the keyway in the crankshaft, install the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(10) Install the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION) (if equipped) and generator bracket assembly.

(11) Install the engine fan, hub assembly and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(12) Install the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(13) Connect negative cable to battery.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(3) Remove the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove the crankshaft vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(5) Remove the timing case cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(6) Rotate crankshaft until the “0” timing mark is closest to and on the center line with camshaft sprocket timing mark (Fig. 91).

(7) Remove the oil slinger from the crankshaft.

(8) Remove the camshaft sprocket bolt and washer (Fig. 92).

(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. 91).

(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.

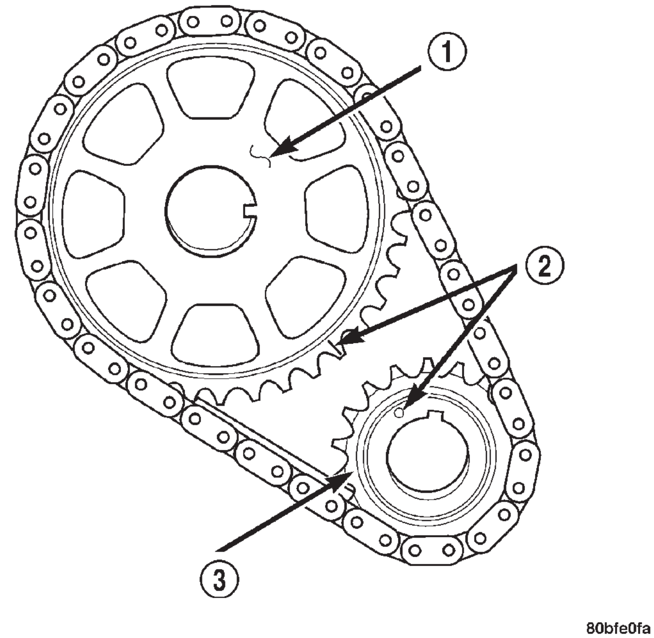

Fig. 91 Crankshaft—Camshaft Alignment

1 - CAMSHAFT SPROCKET
2 - TIMING MARKS
3 - CRANKSHAFT SPROCKET

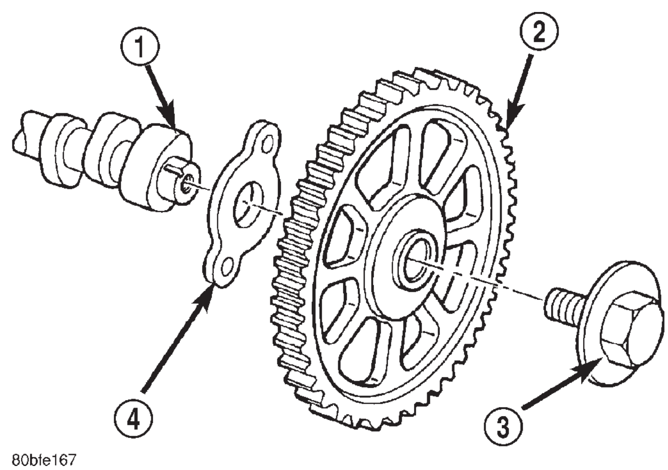

Fig. 92 Camshaft Sprocket and Thrust Plate

1 - CAMSHAFT
2 - CAMSHAFT SPROCKET W/INTEGRAL KEY
3 - BOLT AND WASHER
4 - THRUST PLATE

(2) Install the camshaft sprocket bolt and washer (Fig. 92). 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. 91).

(4) Install the crankshaft oil slinger.

TIMING BELT/CHAIN AND SPROCKETS (Continued)

(5) Replace the oil seal in the timing case cover (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - REMOVAL).

(6) Install the timing case cover and gasket (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(7) With the key installed in the crankshaft keyway, install the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(8) Install the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(9) Install the fan, hub assembly and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(10) Connect negative cable to battery.

INTAKE MANIFOLD

DESCRIPTION

The intake manifold (Fig. 93) 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.

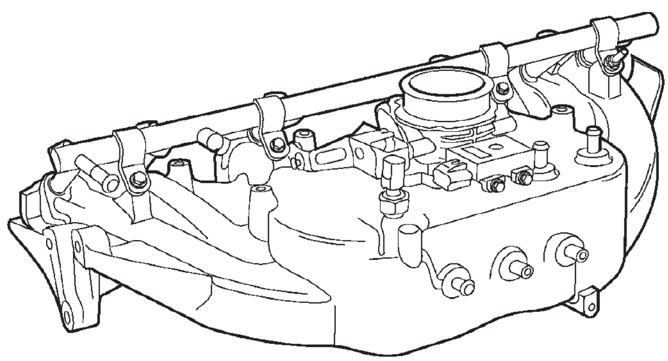

Fig. 93 Intake Manifold 4.0L Engine

DIAGNOSIS AND TESTING - INTAKE MANIFOLD LEAKAGE

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.

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 the resonator assembly.

(3) Remove the air cleaner assembly.

(4) Remove the throttle cable, vehicle speed control cable (if equipped) and the transmission line pressure cable (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - AW4/THROTTLE VALVE CABLE - REMOVAL).

(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
- Manifold Absolute Pressure (MAP) Sensor.

(6) Disconnect HVAC, and Brake Booster vacuum supply hoses at the intake manifold.

(7) Perform the fuel pressure release procedure. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(8) Disconnect and remove the fuel system supply line from the fuel rail assembly.

(9) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(10) Remove the power steering pump 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 exhaust manifold bolts and manifolds (Fig. 94).

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.

INTAKE MANIFOLD (Continued)

(2) Position the engine exhaust manifolds to the cylinder head. Install fastener Number 3 and finger tighten at this time (Fig. 94).

(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. 94).

(5) Install washer and fastener Numbers 6 and 7 (Fig. 94).

(6) Tighten the fasteners in sequence and to the specified torque (Fig. 94).

- Fastener Numbers 1 through 5—Tighten to 33 N·m (24 ft. lbs.) torque.
- Fastener Numbers 6 and 7—Tighten to 31 N·m (23 ft. lbs.) torque.
- Fastener Numbers 8 through 11—Tighten to 33 N·m (24 ft. lbs.) torque.

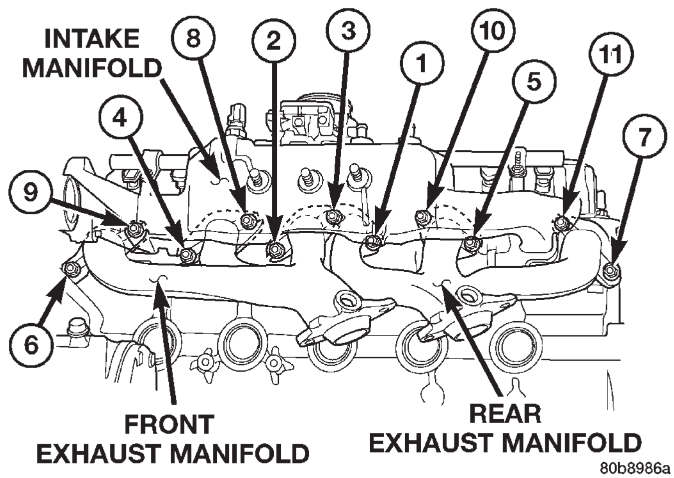

Fig. 94 Intake and Exhaust Manifolds Installation

(7) Install the power steering pump to the intake manifold.

(8) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(9) Install the fuel system supply line to the fuel rail assembly.

(10) Connect all electrical connections on the intake manifold.

(11) Connect the vacuum hoses previously removed.

(12) Install throttle cable, vehicle speed control cable (if equipped).

(13) Install the transmission line pressure cable (if equipped) (Refer to 21 - TRANSMISSION/TRANS-AXLE/AUTOMATIC - AW4/THROTTLE VALVE CABLE - INSTALLATION).

(14) Install air cleaner assembly.

(15) Connect air inlet hose to the resonator assembly.

(16) Raise the vehicle.

(17) Connect the exhaust pipes to the engine exhaust manifolds. Tighten the bolts to 31 N·m (23 ft. lbs.)

(18) Lower the vehicle.

(19) Connect the battery negative cable.

(20) Start the engine and check for leaks.

EXHAUST MANIFOLD

DESCRIPTION

The two exhaust manifolds (Fig. 95) 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.

REMOVAL

The intake and engine exhaust manifolds on the 4.0L engine must be removed together. The manifolds use a common gasket at the cylinder head.

(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

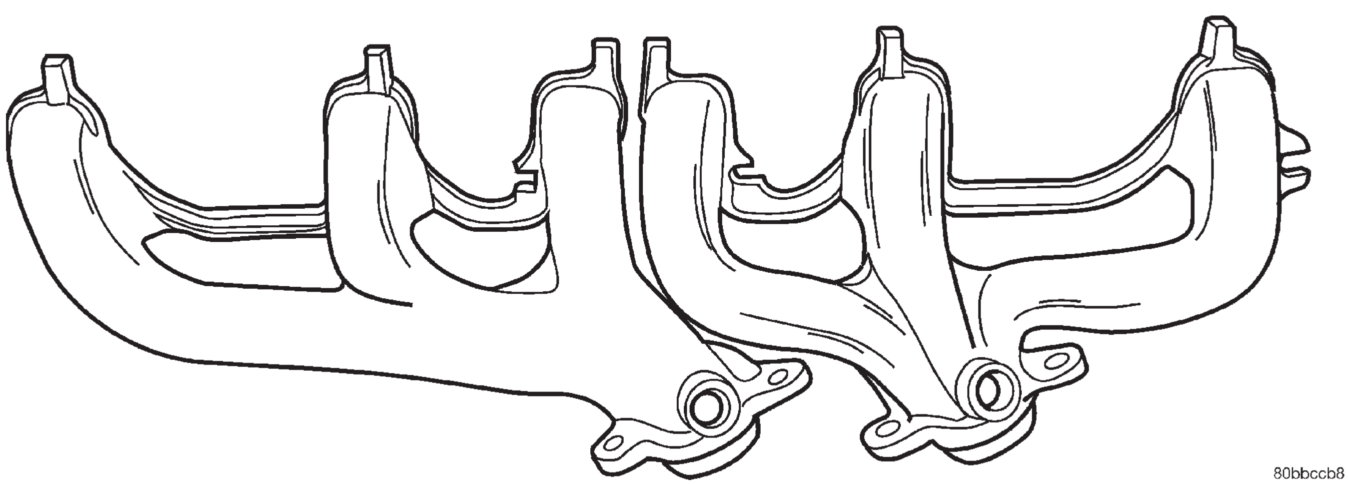

Fig. 95 EXHAUST MANIFOLDS 4.0L ENGINE

EXHAUST SYSTEM

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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 (Fig. 1) and (Fig. 2)

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.

EXHAUST SYSTEM (Continued)

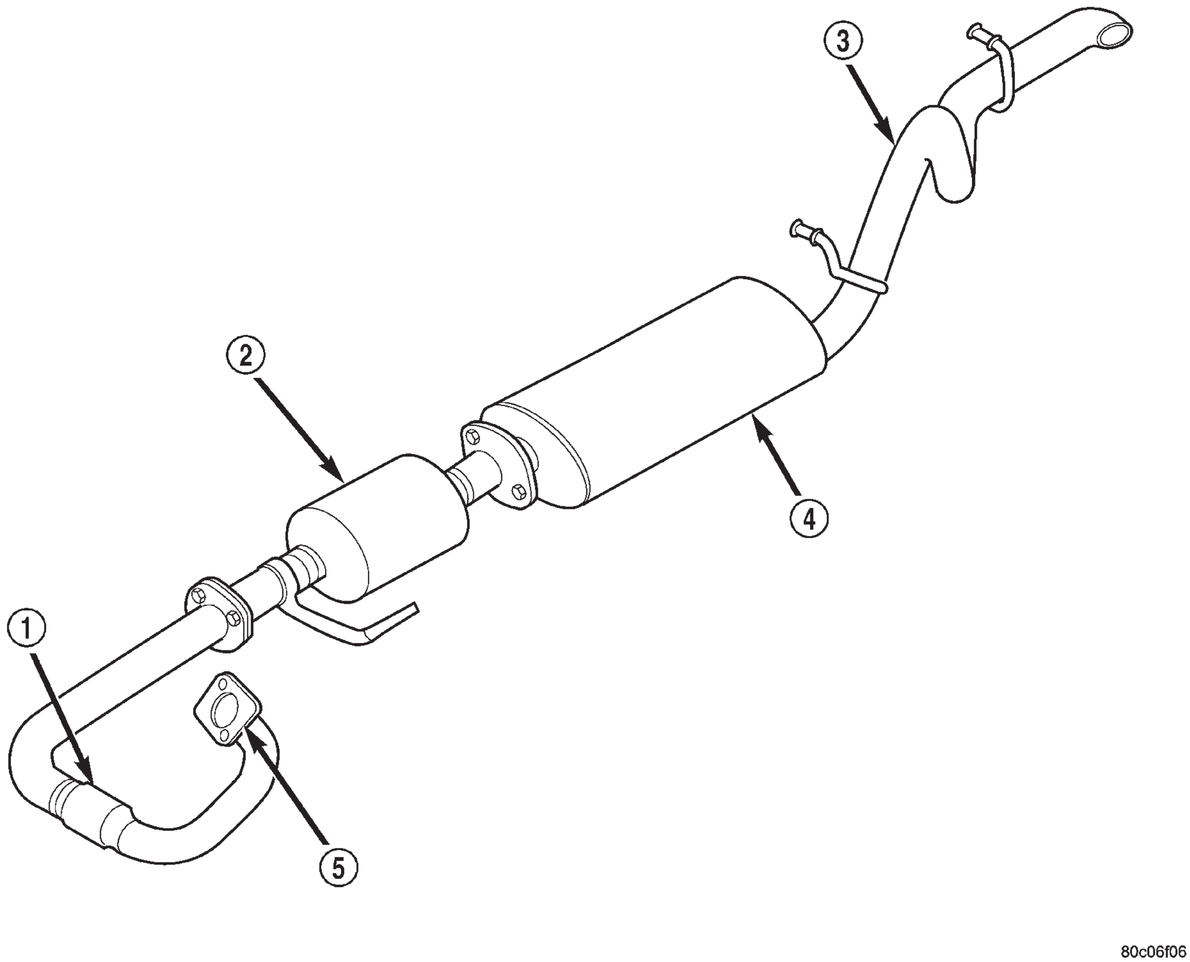

Fig. 1 EXHAUST SYSTEM - 2.5L ENGINE

1 - MINI CATALYTIC CONVERTER
2 - CATALYTIC CONVERTER
3 - TAILPIPE
4 - MUFFLER
5 - EXHAUST PIPE TO EXHAUST MANIFOLD FLANGE

EXHAUST SYSTEM (Continued)

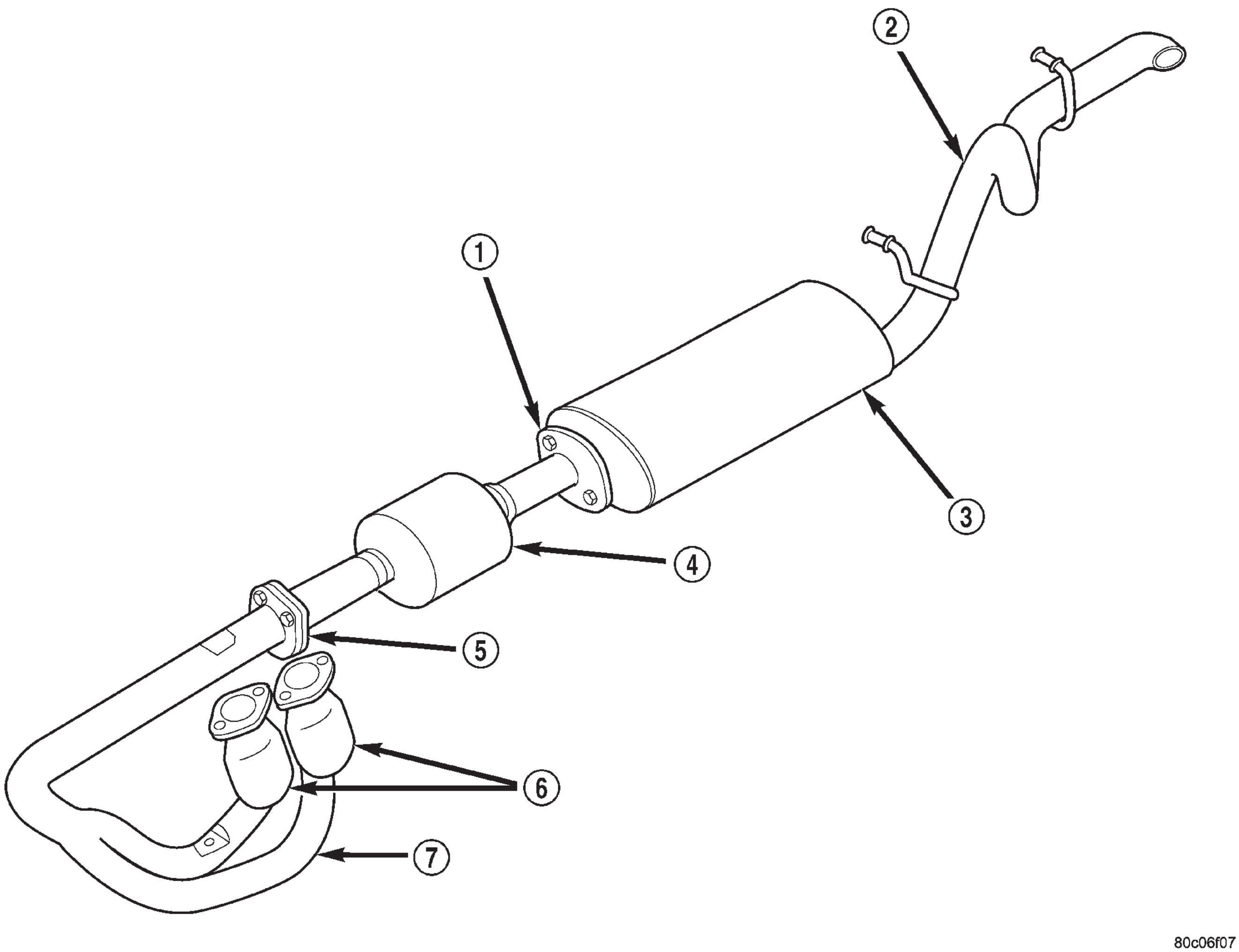

Fig. 2 EXHAUST SYSTEM - 4.0L

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

EXHAUST SYSTEM (Continued)

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.
CAUTION: 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.		

SPECIFICATIONS

TORQUE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Crossmember to Sill—Bolts	42	31	—
Crossmember to Transmission Mount—Nuts	22	16	—
Exhaust Pipe to Manifold—Nuts	31	23	—
Exhaust Manifold to Engine—			
Nuts #6&7	31	23	—
Nuts/Bolts #1,2,3,4,5,8,9,10&11	33	24	—
Exhaust Pipe to Catalytic Converter Flange—Nuts	28.5	21	—
Muffler to Catalytic Converter Flange—Nuts	28.5	21	—
Tailpipe to Rear Tailpipe			
Hanger—Clamp	27	20	—
Oxygen Sensors	27	20	—
Heat Shields	45	33	—

CATALYTIC CONVERTER - 2.5L

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.

The stainless steel catalytic converter body (Fig. 1) 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.

CATALYTIC CONVERTER - 2.5L (Continued)

Unleaded gasoline must be used to avoid contaminating the catalyst core.

REMOVAL

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.

(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. 3).
(5) Remove catalytic converter to muffler flange retaining nuts (Fig. 3).
(6) Slide exhaust pipe foward until exhaust pipe hanger disengages from transmission support. Remove exhaust pipe and catalytic converter from vehicle.

INSTALLATION

(1) Position exhaust pipe and catalytic converter into vehicle.
(2) Insert exhaust pipe hanger into transmission support (Fig. 3).
(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 (Fig. 3). **DO NOT** tighten nuts at this time.
(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.).

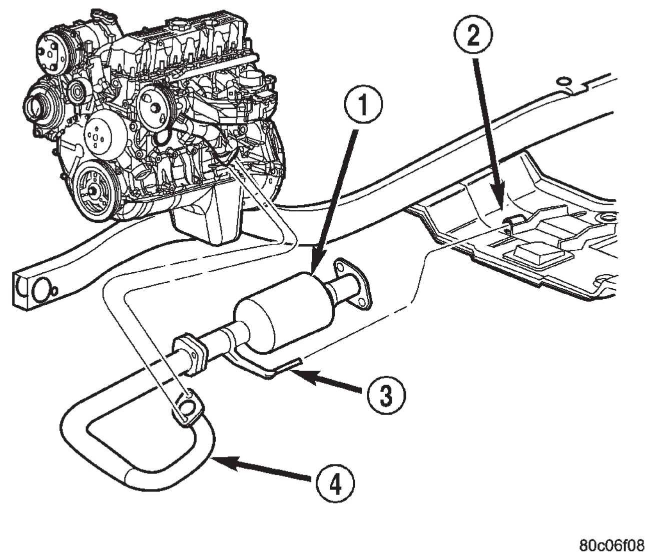

Fig. 3 EXHAUST PIPE AND CALALYTIC CONVERTER

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.

CATALYTIC CONVERTER - 4.0L

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.

The stainless steel catalytic converter body (Fig. 2) 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.

CATALYTIC CONVERTER - 4.0L (Continued)

REMOVAL

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.

(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. 4).
(5) Remove catalytic converter to muffler flange retaining nuts (Fig. 4).
(6) Slide exhaust pipe foward until exhaust pipe hanger disengages from transmission support. Remove exhaust pipe and catalytic converter from vehicle.

INSTALLATION

(1) Position exhaust pipe and catalytic converter into vehicle.
(2) Insert exhaust pipe hanger into transmission support (Fig. 4).
(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 (Fig. 4). **DO NOT** tighten nuts at this time.
(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.).
(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.

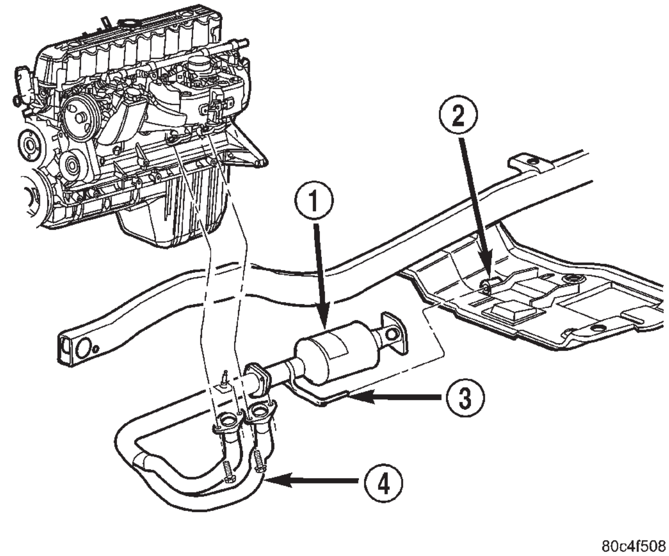

Fig. 4 EXHAUST PIPE AND CATALYTIC CONVERTER 4.0L

1 - CATALYTIC CONVERTER
2 - TRANSMISSION SUPPORT
3 - EXHAUST HANGER
4 - EXHAUST PIPE

(9) Lower vehicle.
(10) Start engine check for leaks.

EXHAUST PIPE - 2.5L

REMOVAL

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.

(1) Raise and support the vehicle.

EXHAUST PIPE - 2.5L (Continued)

(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. 5).

(5) Remove catalytic converter to muffler flange retaining nuts (Fig. 5).

(6) Slide exhaust pipe foward until exhaust pipe hanger disengages from transmission support. Remove exhaust pipe and catalytic converter from vehicle.

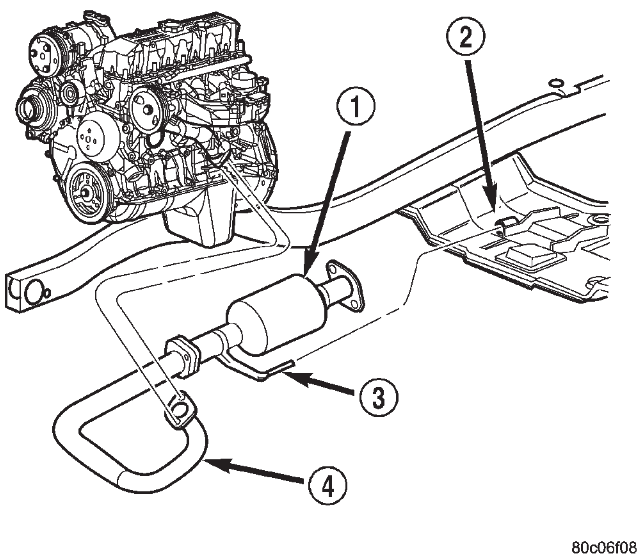

Fig. 5 EXHAUST PIPE AND CALALYTIC CONVERTER

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. 5).

(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 (Fig. 5). **DO NOT** tighten nuts at this time.

(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.).

(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.

EXHAUST PIPE - 4.0L

REMOVAL

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.

(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).

(5) Remove catalytic converter to muffler flange retaining nuts (Fig. 6).

(6) Slide exhaust pipe foward until exhaust pipe hanger disengages from transmission support. Remove exhaust pipe and catalytic converter from vehicle.

EXHAUST PIPE - 4.0L (Continued)

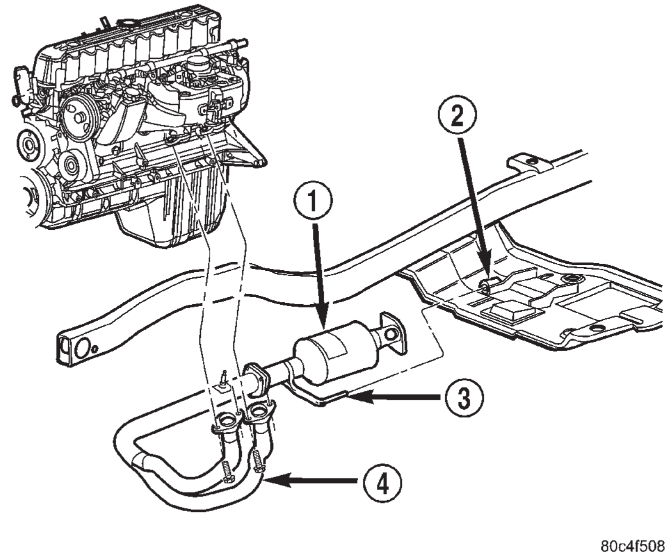

Fig. 6 EXHAUST PIPE AND CATALYTIC CONVERTER 4.0L

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).

(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 (Fig. 6). **DO NOT** tighten nuts at this time.

(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.).

(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.

HEAT SHIELDS

DESCRIPTION

Heat shields (Fig. 7) 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.

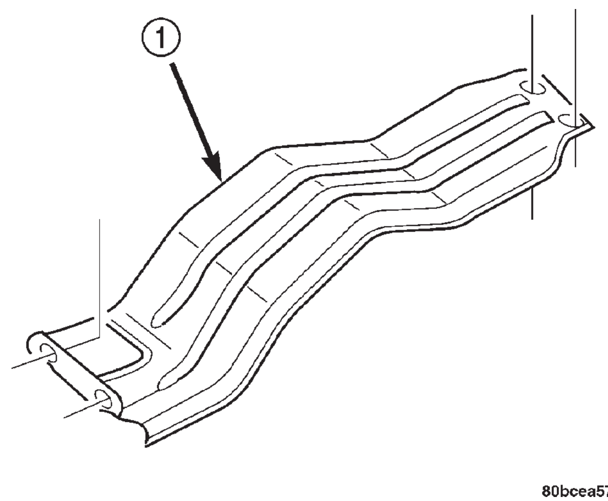

Fig. 7 EXHAUST HEAT SHIELD - TYPICAL

1 - HEAT SHIELD

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. 8) and (Fig. 9).

(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. 8) and (Fig. 9).

(2) Tighten the nuts and/or screws to 45 N·m (33 ft. lbs.).

(3) Lower the vehicle.

HEAT SHIELDS (Continued)

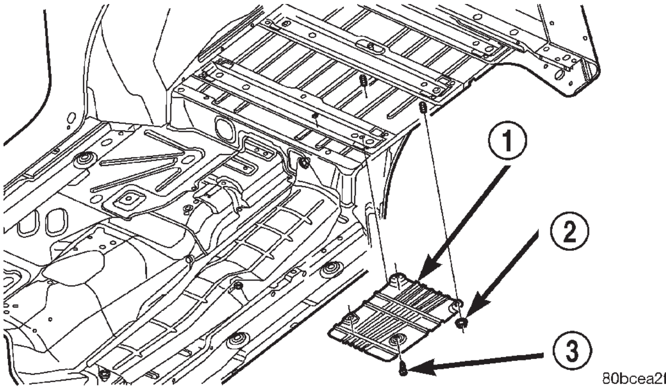

Fig. 8 MUFFLER HEAT SHIELD - REAR

1 - MUFFLER HEAT SHIELD - REAR
2 - NUTS
3 - SELF TAPPING SCREWS

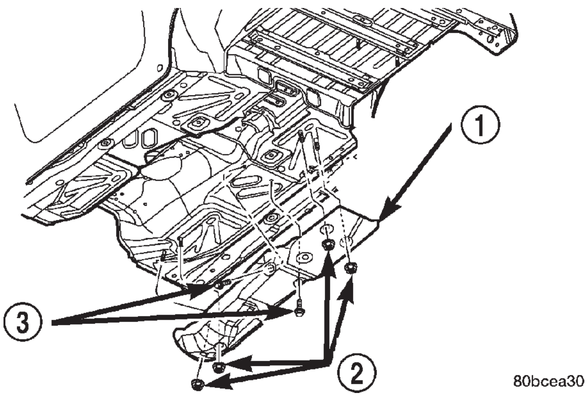

Fig. 9 MUFFLER HEAT SHIELD - MIDDLE

1 - MUFFLER HEAT SHIELD - MIDDLE
2 - NUTS
3 - SELF TAPPING SCREWS

MUFFLER

DESCRIPTION

Both the 2.5L and 4.0L engines use a galvanized steel muffler (Fig. 10) to control exhaust noise levels and exhaust back pressure.

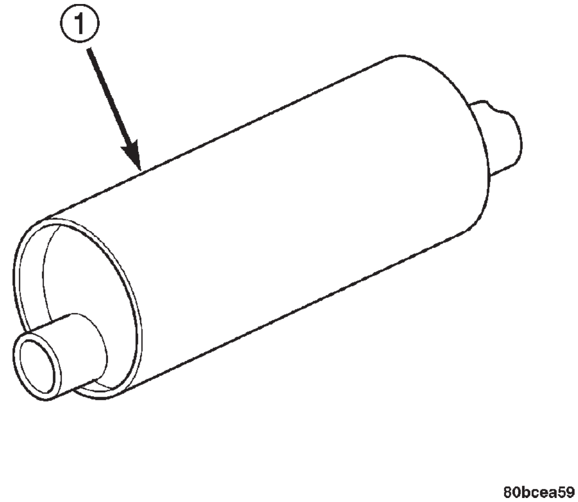

Fig. 10 MUFFLER

1- MUFFLER

REMOVAL

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.

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.

(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. 11).

(3) Remove muffler to catalytic converter flange retaining nuts (Fig. 11).

(4) Remove muffler and tailpipe assembly from vehicle.

MUFFLER (Continued)

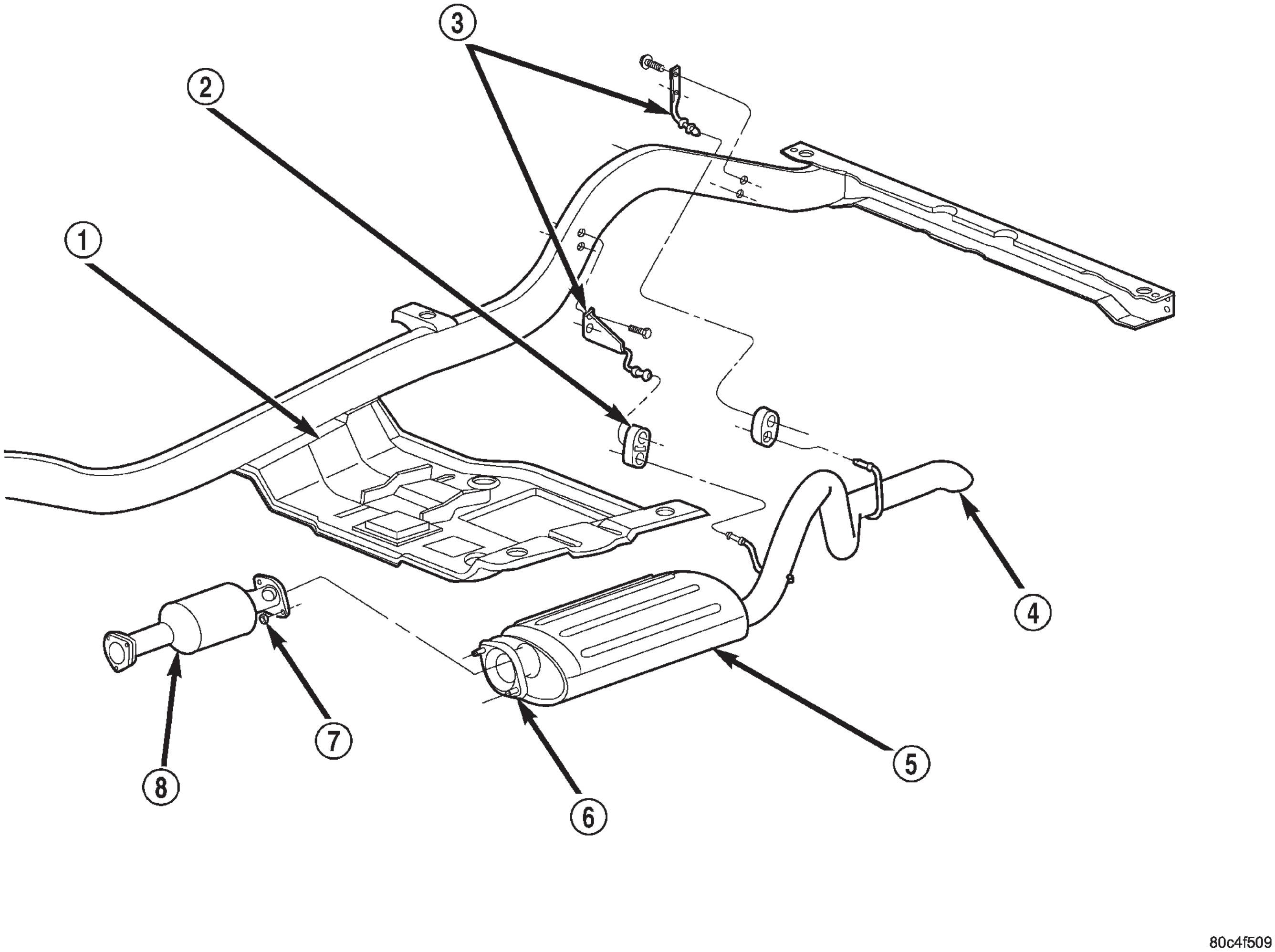

Fig. 11 MUFFLER AND TAILPIPE

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

INSTALLATION

(1) Position muffler and tailpipe assembly into vehicle.

(2) Position muffler and catalytic converter flanges togather and install nuts (Fig. 11). **DO NOT** tighten nuts at this time.

(3) Install tailpipe hangers into the insulators (Fig. 11).

(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.

TAILPIPE

DESCRIPTION

TAILPIPE

DESCRIPTION The tailpipe (Fig. 12) is made of galvanized steel

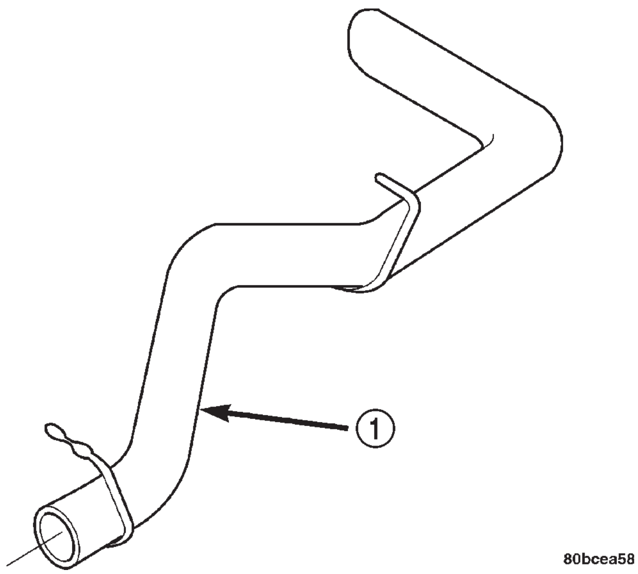

Fig. 12 Tailpipe—Typical

1 - TAILPIPE

OPERATION

The tailpipe channels the exhaust out of the muffler and out from under the vehicle to control noise and prevent exhaust gas fumes from entering the passenger compartment.

FRAME & BUMPERS

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FRAME & BUMPERS

SPECIFICATIONS

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
FRONT BUMPER SCREW	104	77	—
FRONT TOW HOOK SCREW	108	80	—
FUEL TANK SKID PLATE NUTS	16	12	138
FUEL TANK STRAP NUTS	5	—	40
MAIN FLOOR TO HOLD DOWN BOLT	68	50	—
RADIATOR TO FRAME HOLD DOWN BOLT	47	35	—
REAR BUMPER BOLT	67	50	—
REAR FLOOR TO FRAME BOLT	47	35	—
TRANFER CASE SKID PLATE BOLTS	74	55	—
TRANSMISSION MOUNT NUTS	28	21	—

FRONT EXTENSION

REMOVAL

(1) Remove the screws attaching the bumper extension to the bumper (Fig. 1).

(2) Separate the extension from the bumper.

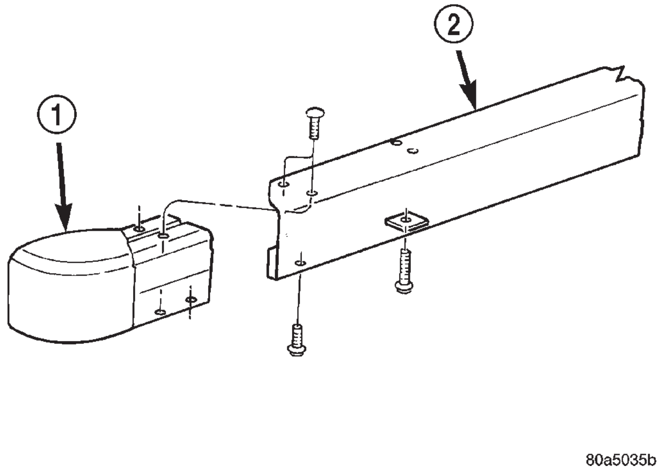


Fig. 1 Bumper Extension

1 - BUMPER EXTENSION
2 - FRONT BUMPER

INSTALLATION

(1) Position the extension to the bumper

(2) Install the screws retaining the front bumper extension. (Fig. 3)

FRONT BUMPER

REMOVAL

(1) If equipped, disconnect the fog lamp harness connector.

(2) Remove the screws that attach the bumper to the frame rail (Fig. 2).

(3) If equipped, remove the tow hook.

(4) Separate the bumper from the vehicle.

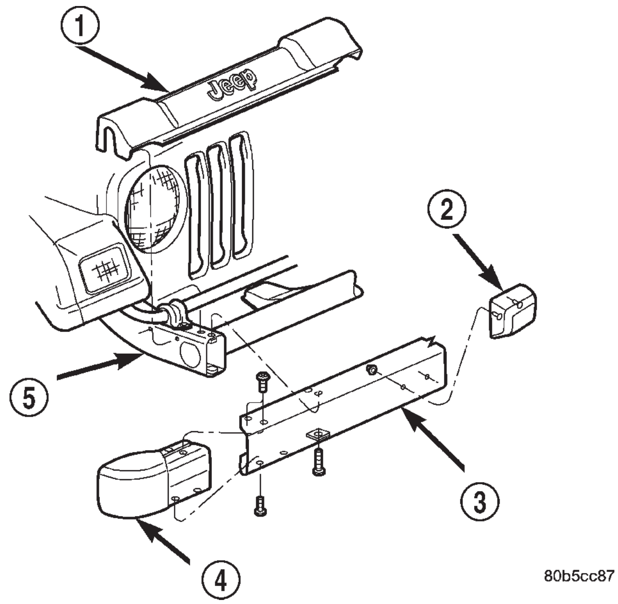


Fig. 2 Front Bumper Components

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 EXTENSION

REMOVAL

(1) Remove the screws attaching the bumper extension to the bumper (Fig. 3).

(2) Separate the extension from the bumper.

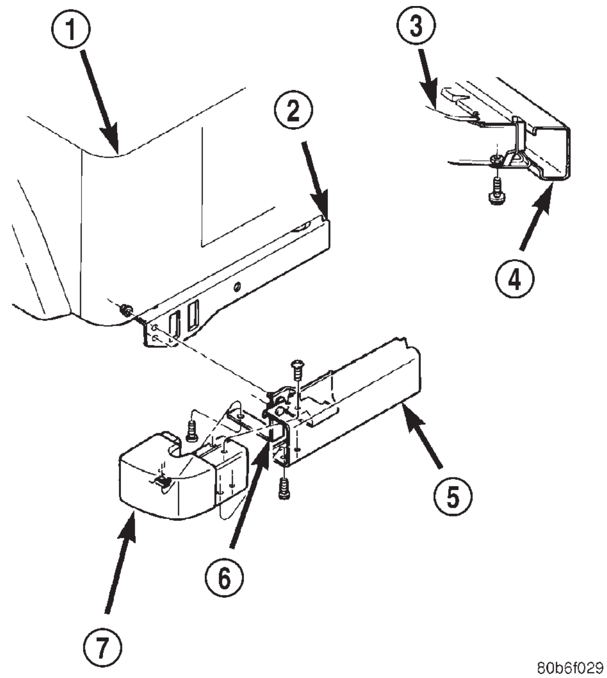


Fig. 3 Rear Bumper Components

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. 1) .

(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.

FRAME

STANDARD PROCEDURE - 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.

FRAME (Continued)

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. 4) 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. 5). Reinforcing this area may effect energy management.

NOTE: If a reinforcement is required, it should completely cover the repaired area. The reinforcement should also overlap the top and bottom of the frame by more than 50% of its width. Weld as indicated (Fig. 4).

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.

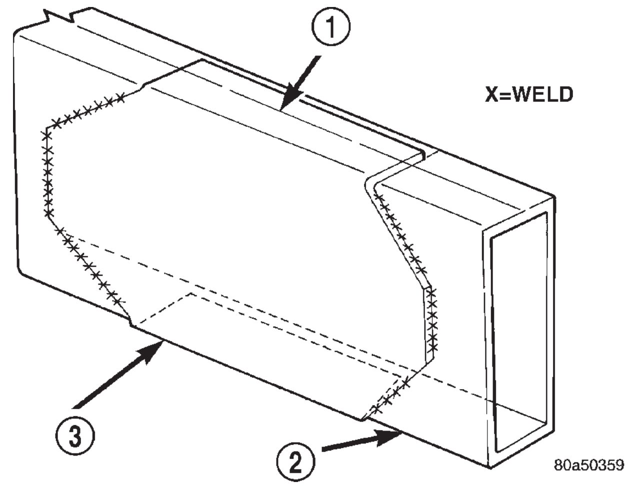


Fig. 4 Frame Reinforcement

1 - FRAME CENTER LINE
2 - FRAME
3 - FRAME REPAIR REINFORCEMENT

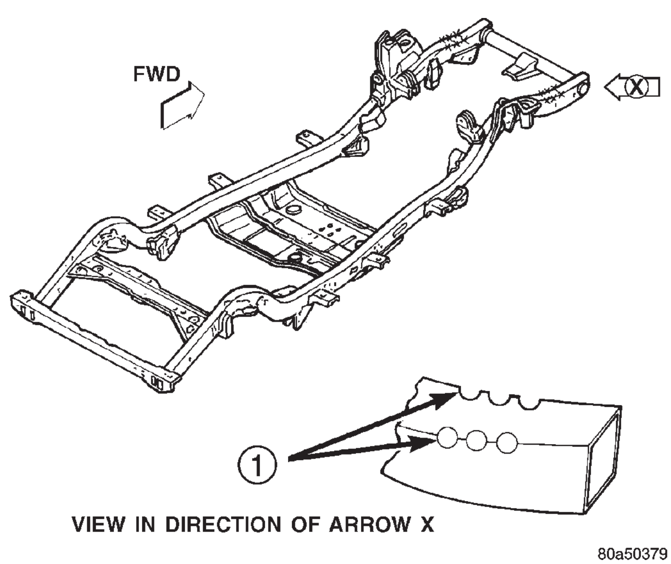


Fig. 5 Energy Management Holes

1 - ENERGY MANAGEMENT HOLES

SPECIFICATIONS

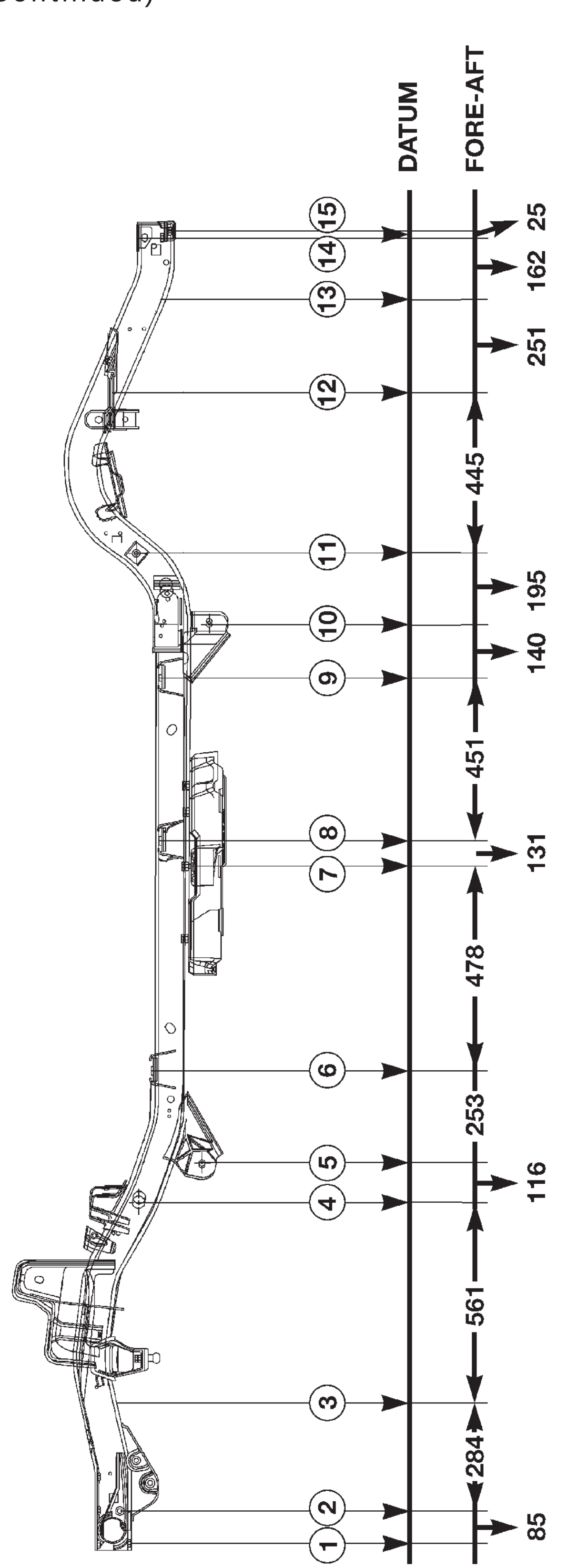
FRAME DIMENSIONS

Frame dimensions are listed in metric scale. All dimensions are from center to center of Principal Locating Point (PLP), or from center to center of PLP and fastener location.

VEHICLE PREPARATION

Position the vehicle on a level work surface. Using screw or bottle jacks, adjust the vehicle PLP heights to the specified dimension above a level work surface. Vertical dimensions can be taken from the work surface to the locations indicated were applicable.

FRAME (Continued)

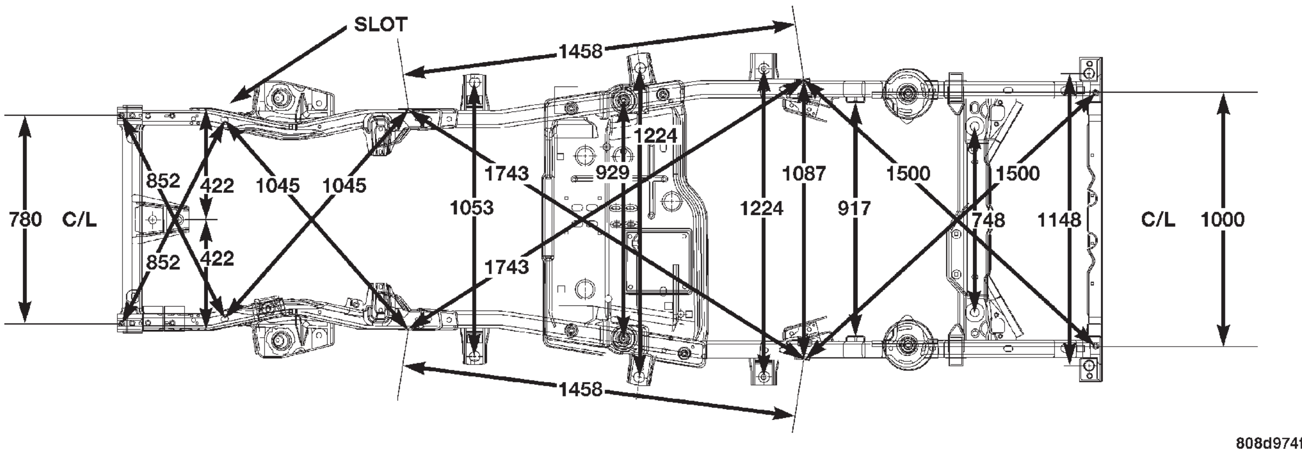


POINT #		DISTANCE TO DATUM (mm)
1.	500	BOTTOM OF SIDERAIL
2.	534	CENTER OF HOLE
3.	543	BOTTOM OF SIDERAIL, CENTER OF SLOT
4.	494	CENTER OF HOLE, OUTBOARD
5.	317	CENTER OF HOLE, OUTBOARD
6.	460	BOTTOM OF BRACKET
7.	359	BOTTOM OF SIDERAIL

POINT #		DISTANCE TO DATUM (mm)
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

FRAME SIDE VIEW

FRAME (Continued)



FRAME TOP VIEW

TRANSFER CASE SKID PLATE

REMOVAL

The transmission and transfer case crossmember is integrated with the transfer case skid plate.

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. 6) and (Fig. 7).
(4) Remove the bolts attaching the skid plate to the frame (Fig. 8).
(5) Separate the skid plate from the vehicle.

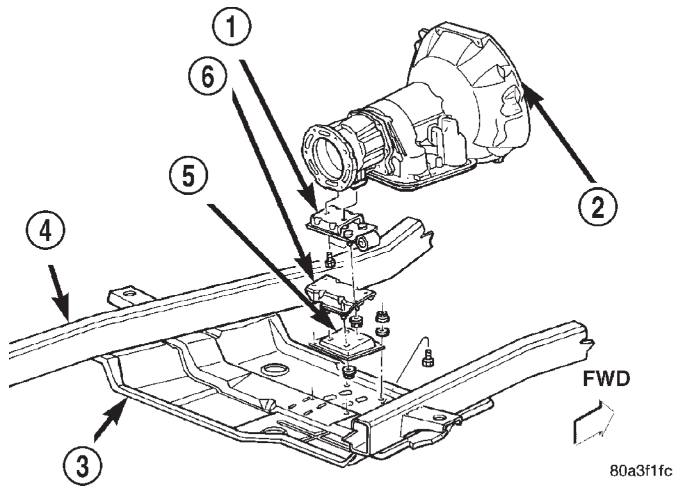


Fig. 6 Transmission Mount—Automatic Transmission

1 - TRANSMISSION SUPPORT BRACKET
2 - AUTOMATIC TRANSMISSION
3 - SKID PLATE
4 - FRAME
5 - TRANSMISSION MOUNT SUPPORT BRACKET
6 - CUSHION

TRANSFER CASE SKID PLATE (Continued)

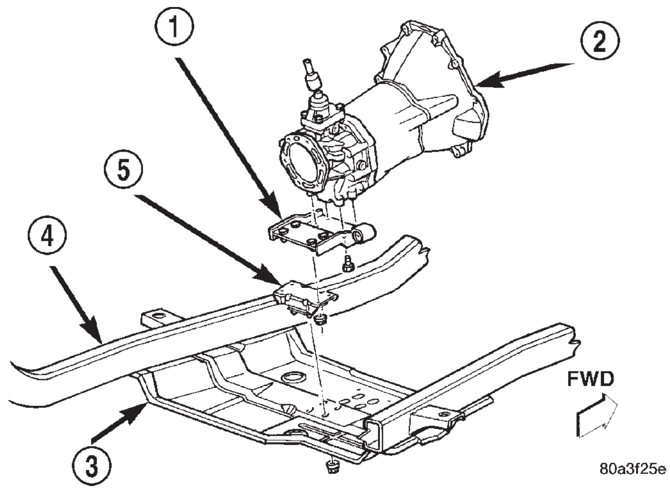


Fig. 7 Transmission Mount—Manual Transmission

1 - TRANSMISSION SUPPORT BRACKET
2 - MANUAL TRANSMISSION
3 - SKID PLATE
4 - FRAME
5 - CUSHION

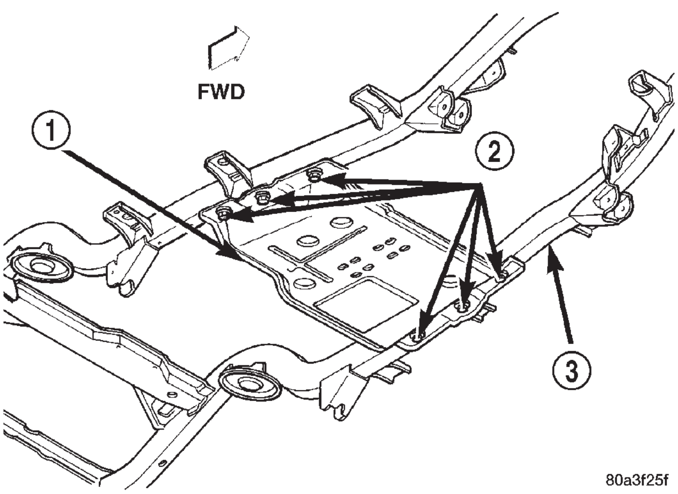


Fig. 8 Transfer Case Skid Plate

1 - SKID PLATE
2 - BOLTS
3 - FRAME

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.

(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. 9).

(4) Separate the fuel tank strap from the skid plate.

(5) Support the fuel tank and remove the skid plate from the vehicle.

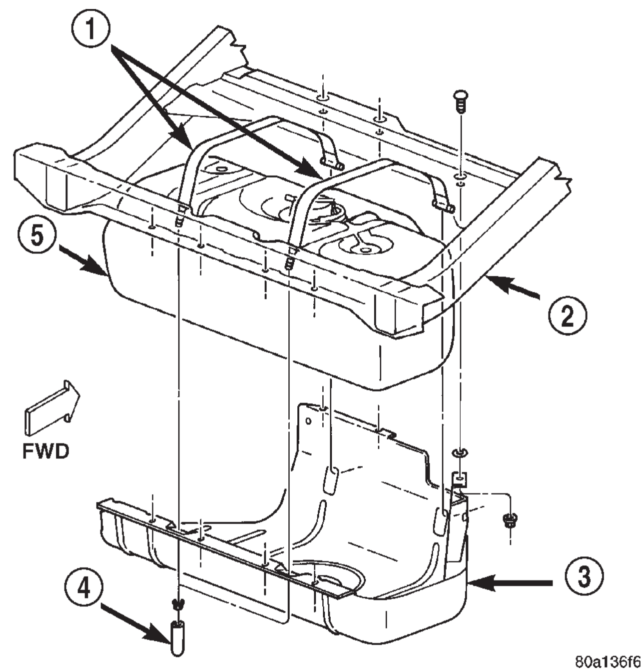


Fig. 9 Fuel Tank Skid Plate

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.

FRONT TOW HOOK

REMOVAL

(1) Remove the torx bolts that attach the tow hook to the bumper (Fig. 10).

(2) Separate the tow hook from the bumper.

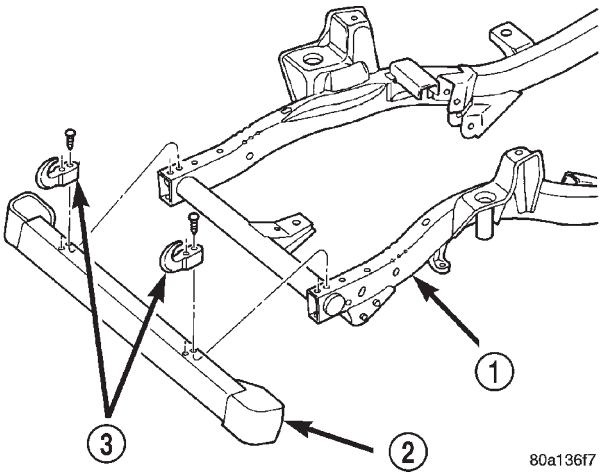


Fig. 10 Front Tow Hook

1 - FRAME
2 - BUMPER
3 - 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. 11).

(2) Separate the tow hook from the frame.

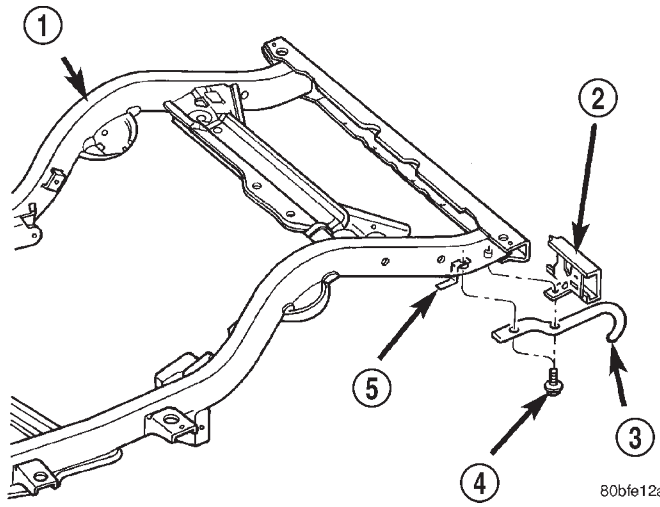


Fig. 11 Rear Tow Hook

1 - FRAME
2 - REAR BUMPER
3 - TOW HOOK
4 - BOLT
5 - NUT

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.).

FUEL SYSTEM

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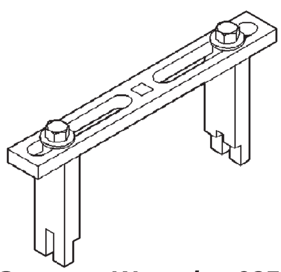
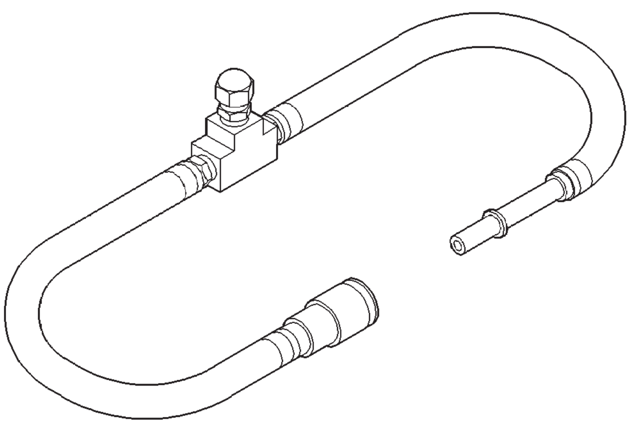
FUEL SYSTEM

SPECIAL TOOLS

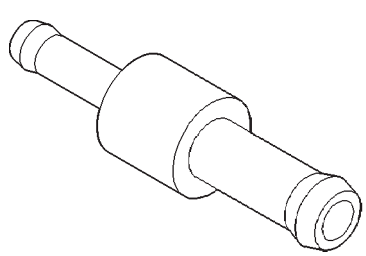
FUEL SYSTEM



Spanner Wrench—6856

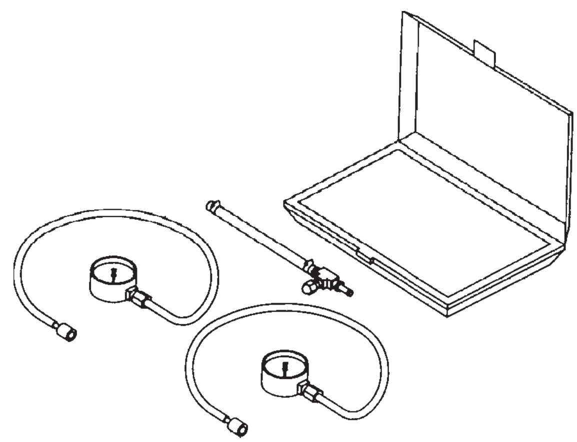


Adapters, Fuel Pressure Test—6539 and/or 6631

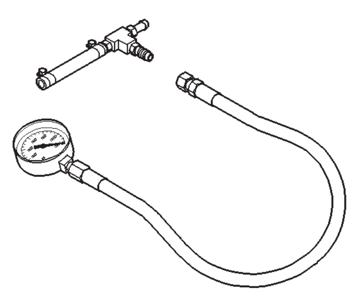


Fitting, Air Metering—6714

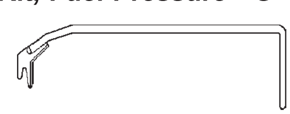
O2S (Oxygen Sensor) Remover/Installer—C-4907



Test Kit, Fuel



Test Kit, Fuel Pressure—C-4799-B



Fuel Line Removal Tool—6782

FUEL DELIVERY

TABLE OF CONTENTS

FUEL DELIVERY

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
- 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 lock-nut/gasket, and fuel tank check valve (refer to Emission Control System for fuel tank check valve information).

FUEL DELIVERY (Continued)

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 located in 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.

DIAGNOSIS AND TESTING - 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 for procedures. On some engines, air cleaner housing removal may be necessary before fuel line disconnection.

(2) Obtain correct Fuel Line Pressure Test Adapter Tool Hose. Tool number 6539 is used for 5/16” fuel lines and tool number 6631 is used for 3/8” fuel lines.

(3) Connect correct Fuel Line Pressure Test Adapter Tool Hose between disconnected fuel line and fuel rail (Fig. 1).

(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.**

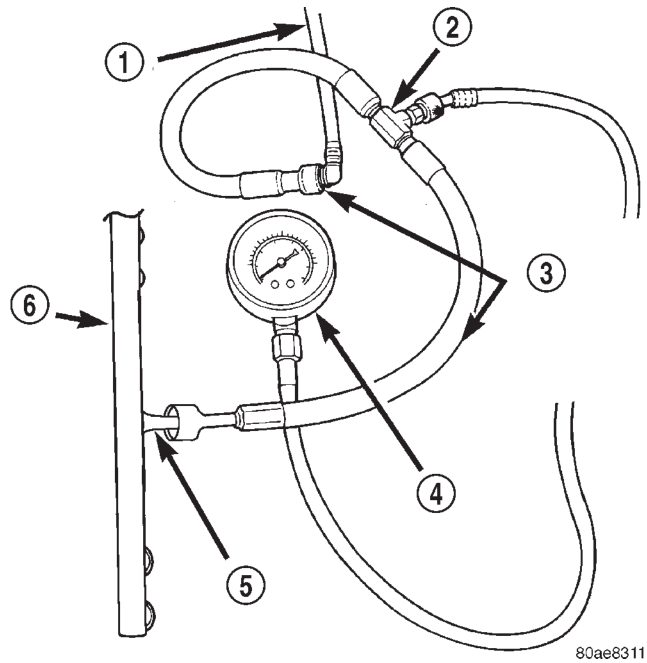


Fig. 1 CONNECTING ADAPTER TOOL—TYPICAL

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

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

FUEL DELIVERY (Continued)

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.

STANDARD PROCEDURE - FUEL SYSTEM PRESSURE RELEASE

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.

(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.

SPECIFICATIONS

FUEL SYSTEM PRESSURE

339 kPa +/- 34 kPa (49.2 psi +/- 2 psi).

TORQUE - FUEL DELIVERY

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Accelerator Pedal Bracket Mounting Nuts	8.5	-	75
Fuel Hose Clamps	3	-	25
Fuel Rail Mounting Bolts or Nuts	11	-	100
Fuel Tank Mounting Strap Bolts	Refer to service manual text.	-	-
Fuel Pump Module Locknut	74	55	-
Fuel Tank Skidplate Bolts	16	-	141

FUEL FILTER/PRESSURE REGULATOR

DESCRIPTION

The combination fuel filter and fuel pressure regulator is located on the top of fuel pump module (Fig. 12).

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. 4).

The regulator acts as a check valve to maintain some fuel pressure when the engine is not operating. This will help to start the engine. A second check valve is located at the outlet end of the electric fuel pump. **Refer to Fuel Pump—Description and Operation for more information. Also refer to the Fuel Pressure Leak Down Test and the Fuel Pump Pressure Tests.**

If fuel pressure at the pressure regulator exceeds approximately 49 psi, an internal diaphragm closes and excess fuel pressure is routed back into the tank through the pressure regulator. A separate fuel return line is not used with any engine.

REMOVAL

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.

(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. 2) . 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. 3) .

(7) Before discarding filter/regulator assembly, inspect assembly to verify that o-rings (Fig. 4) 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.

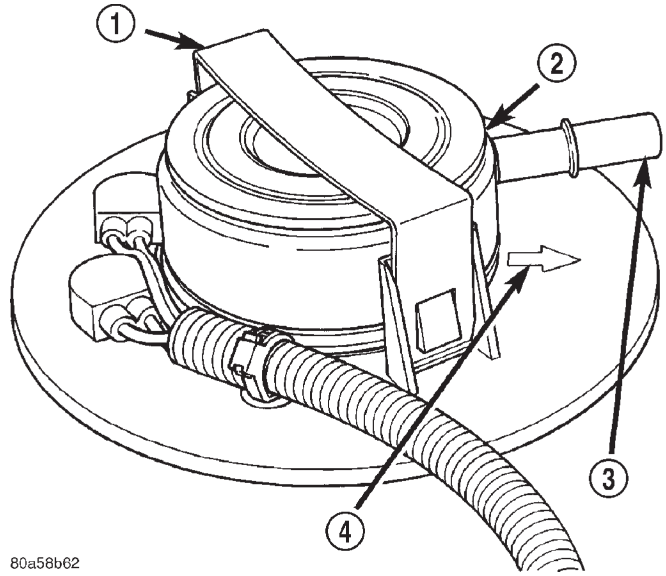


Fig. 2 Fuel Filter/Fuel Pressure Regulator

1 - RETAINER CLAMP
2 - FUEL FILTER/FUEL PRESSURE REGULATOR
3 - FUEL SUPPLY TUBE
4 - ALIGNMENT ARROW

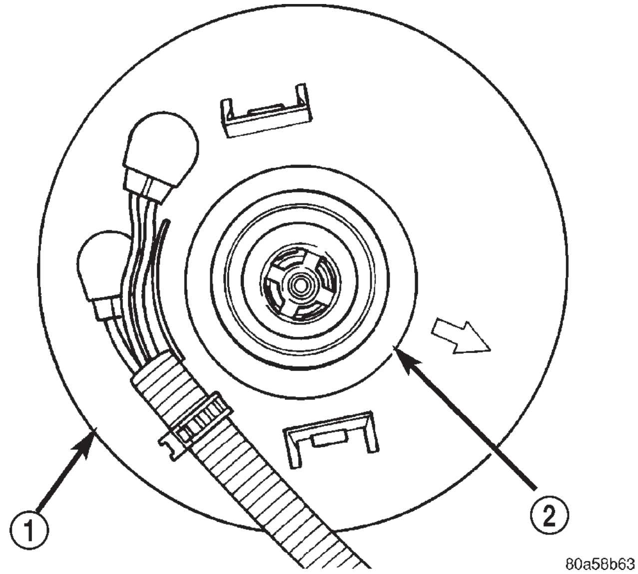


Fig. 3 Fuel Filter/Fuel Pressure Regulator Gasket

1 - TOP OF MODULE
2 - GASKET

FUEL FILTER/PRESSURE REGULATOR (Continued)

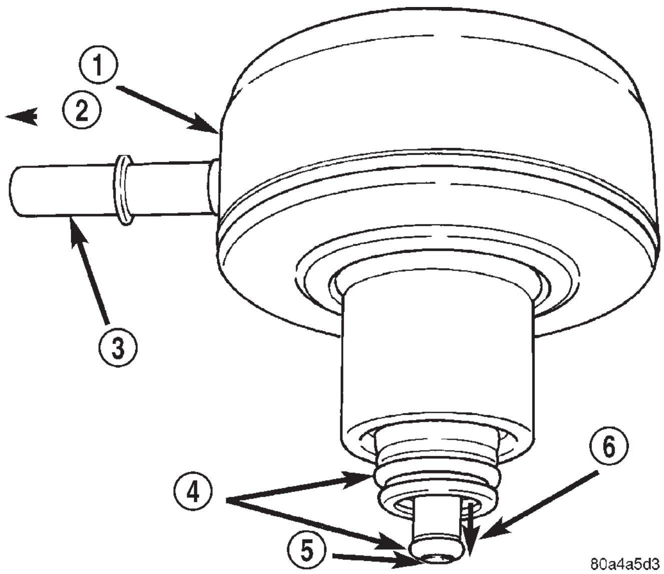


Fig. 4 Fuel Filter/Fuel Pressure Regulator

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

INSTALLATION

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.

(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. 2) 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 LEVEL SENDING UNIT / SENSOR

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 0.6 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 acti-

FUEL LEVEL SENDING UNIT / SENSOR (Continued)

vated if the fuel level in the tank is more than approximately 85 percent of its rated capacity.

DIAGNOSIS AND TESTING - FUEL LEVEL SENDING UNIT

The fuel level 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%).

REMOVAL

The fuel level sending unit (fuel level sensor) and float assembly is located on the side of fuel pump module (Fig. 5). The fuel pump module is located within the fuel tank.

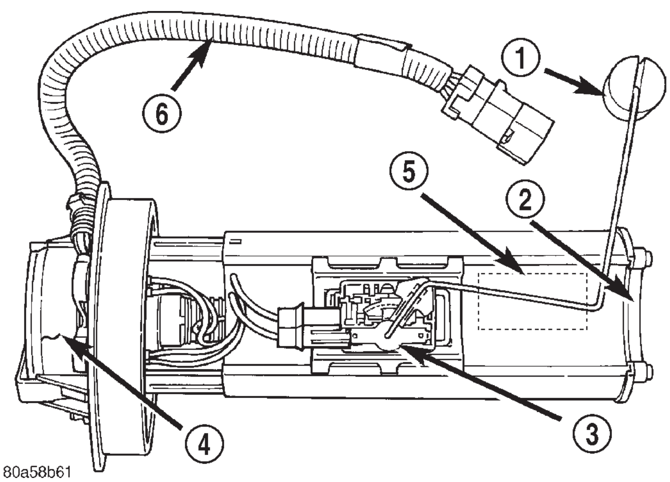


Fig. 5 Fuel Level Sending Unit Location

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

(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. 6) to remove sending unit from pump module.

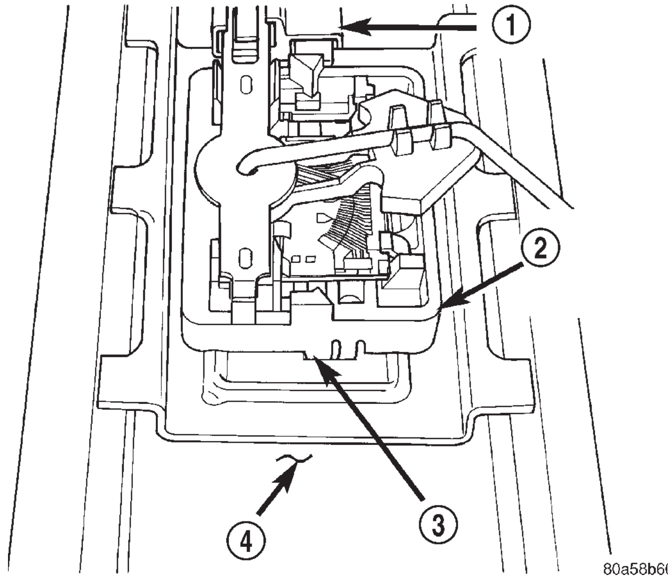


Fig. 6 Fuel Level Sending Unit Release Tab

1 - ELECTRICAL CONNECTOR
2 - FUEL GAUGE SENDING UNIT
3 - RELEASE TAB
4 - FUEL PUMP MODULE

INSTALLATION

(1) Position sending unit to pump module and snap into place.

(2) Connect electrical connector to terminals.

(3) Install fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(4) Install fuel tank. Refer to Fuel Tank Removal/Installation.

FUEL LINES

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

FUEL LINES (Continued)

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.

FUEL PUMP

DESCRIPTION

The electric fuel pump is located inside of the fuel pump module. A 12 volt, permanent magnet, electric motor powers the fuel pump. The electric fuel pump is not a separate, serviceable component.

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.

The electric fuel pump is not a separate, serviceable component.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - 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.

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.

FUEL PUMP (Continued)

(1) Remove protective cap at fuel rail test port. Connect the 0–414 kPa (0-60 psi) fuel pressure gauge (from gauge set 5069) to test port pressure fitting on fuel rail (Fig. 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.**

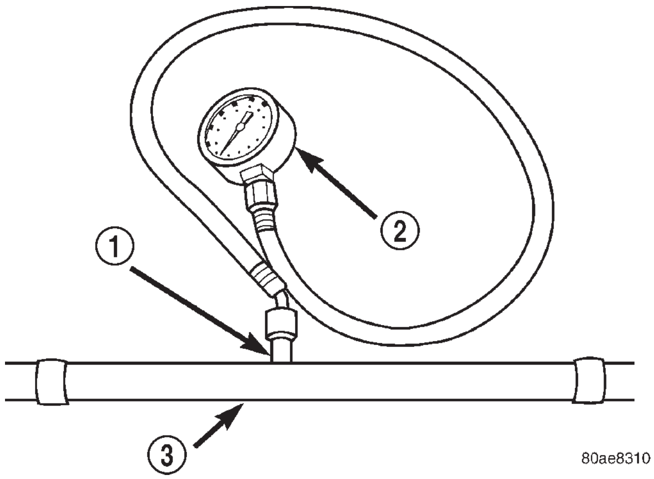


Fig. 7 FUEL PRESSURE TEST GAUGE (TYPICAL GAUGE INSTALLATION AT TEST PORT)

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.

DIAGNOSIS AND TESTING - 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. 8) and its test leads will be used to check fuel pump amperage specifications.

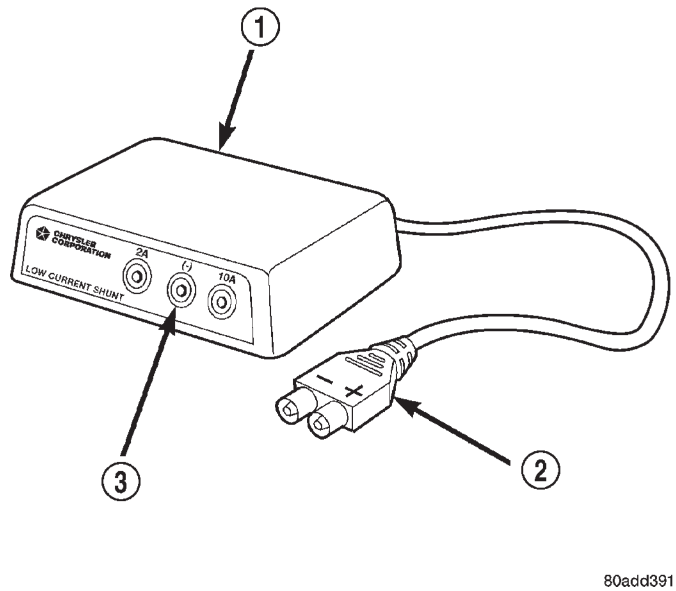


Fig. 8 LOW CURRENT SHUNT

1 - LOW CURRENT SHUNT ADAPTER
2 - PLUG TO DRB
3 - TEST LEAD RECEPTACLES

(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.

(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.

FUEL PUMP (Continued)

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. 9), 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. 9).

(15) If equipped with **type–2 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).

(16) If equipped with **type–3 relay** (Fig. 11), 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. 11).

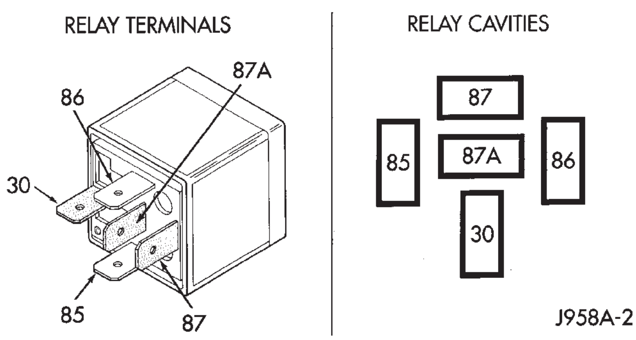


Fig. 9 FUEL PUMP RELAY - TYPE 1

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

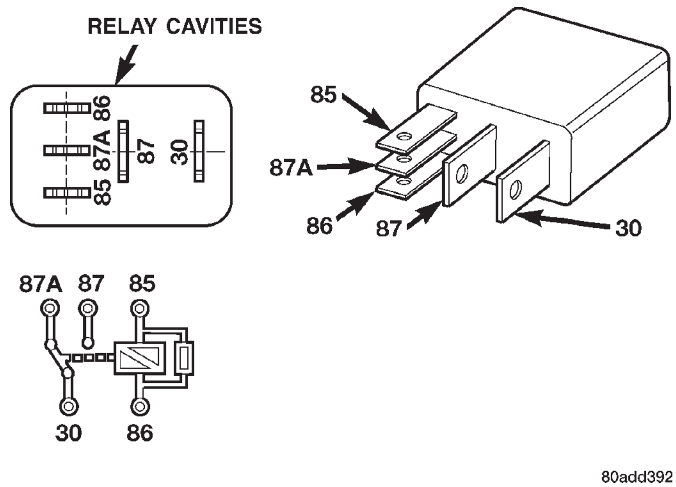


Fig. 10 FUEL PUMP RELAY - TYPE 2

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

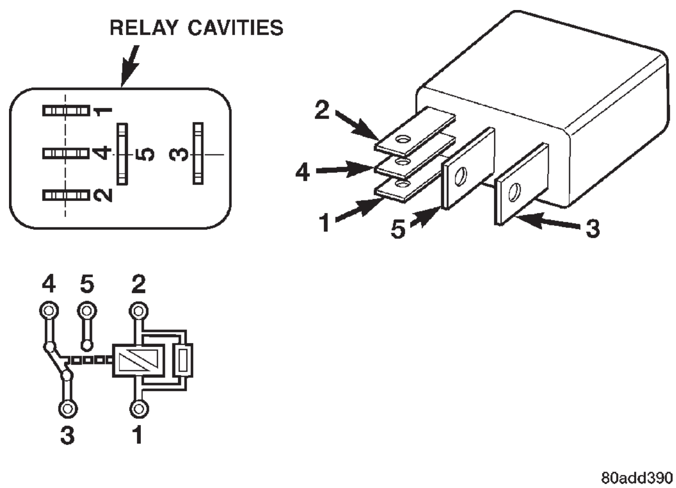


Fig. 11 FUEL PUMP RELAY - TYPE 3

TERMINAL LEGEND

NUMBER	IDENTIFICATION
1	COIL BATTERY
2	COIL GROUND
3	COMMON FEED
4	NORMALLY CLOSED
5	NORMALLY OPEN

(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.

FUEL PUMP (Continued)

(18) 2If 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 PUMP MODULE

DESCRIPTION

The fuel pump module on all models is installed into the top of the fuel tank (Fig. 12). The fuel pump module contains the following components (Fig. 12) or (Fig. 13):

- 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

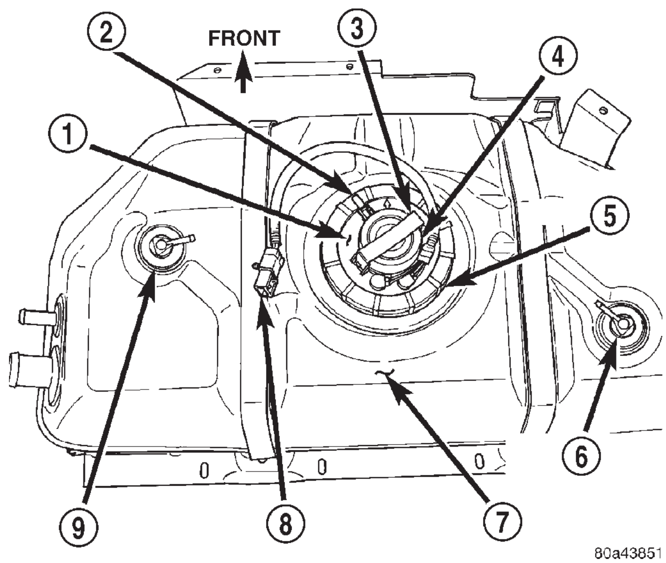


Fig. 12 Fuel Tank/Fuel Pump Module (Top View)

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

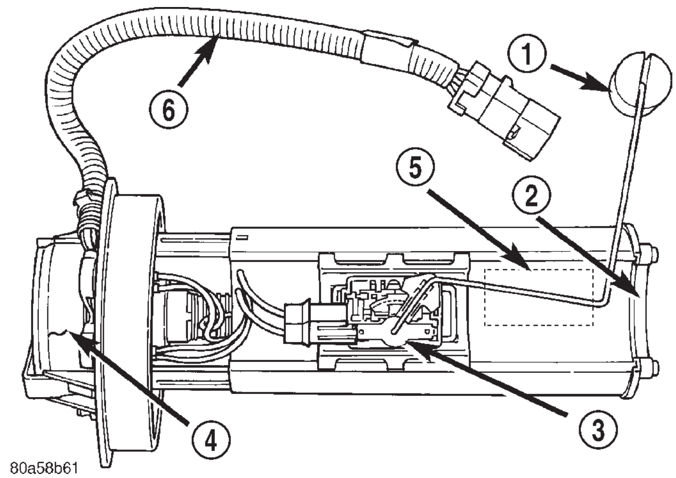


Fig. 13 Fuel Pump Module Components

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

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.

OPERATION

Refer to Fuel Pump, Fuel Filter/Fuel Pressure Regulator and Fuel Gauge Sending Unit.

FUEL PUMP MODULE (Continued)

REMOVAL

Fuel tank removal will be necessary for fuel pump module 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. 14) . Install Special Tool 6856 to fuel pump module locknut and remove locknut (Fig. 15) . The fuel pump module will spring up when locknut is removed.

(4) Remove module from fuel tank.

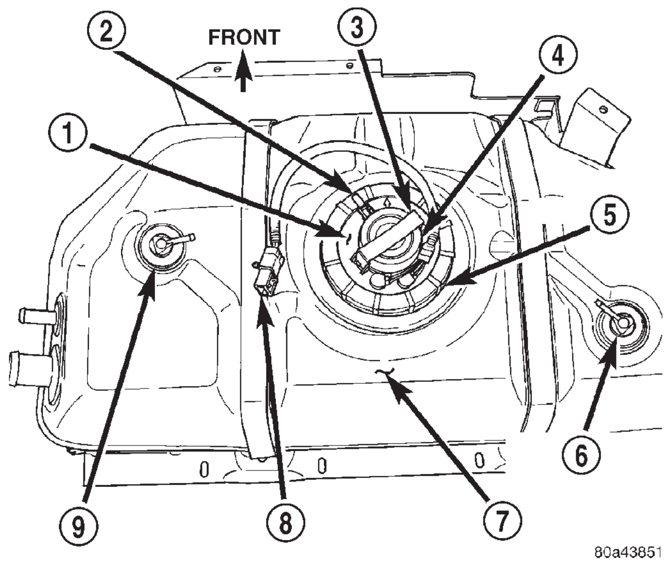


Fig. 14 Top View of Fuel Tank and Fuel Pump Module

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

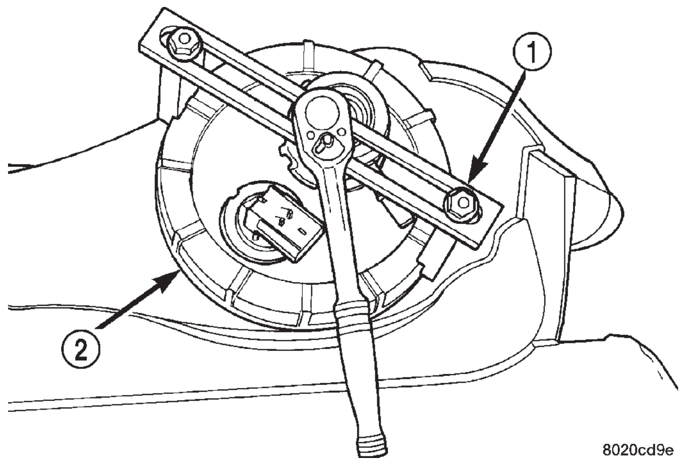


Fig. 15 Locknut Removal/Installation—Typical

1 - SPECIAL TOOL 6856
2 - LOCKNUT

INSTALLATION

Fuel tank removal will be necessary for fuel pump module removal.

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. 2) 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 RAIL - 2.5L ENGINE

DESCRIPTION

The fuel injector rail is used to mount the fuel injectors to the engine (Fig. 16). On the 2.5L 4–cylinder engine, a **fuel damper** is located at the front of the fuel rail (Fig. 16).

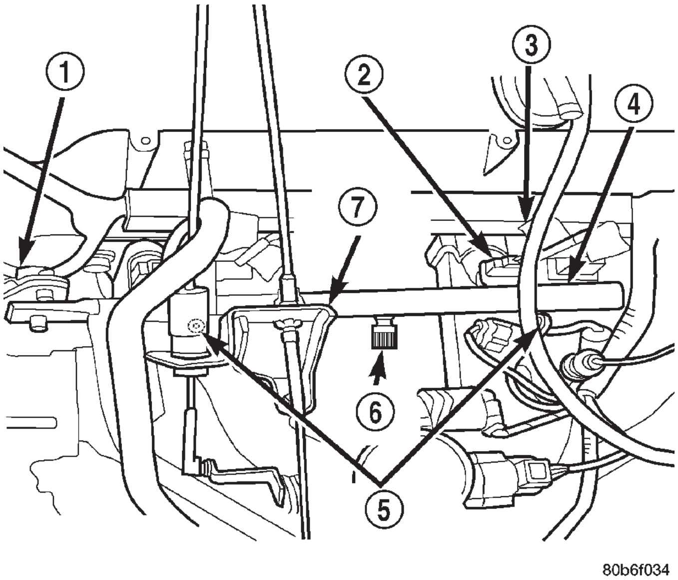


Fig. 16 Fuel Injector Rail/Fuel Damper—2.5L Engine

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.

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. 17). If not, identify each connector before removal.

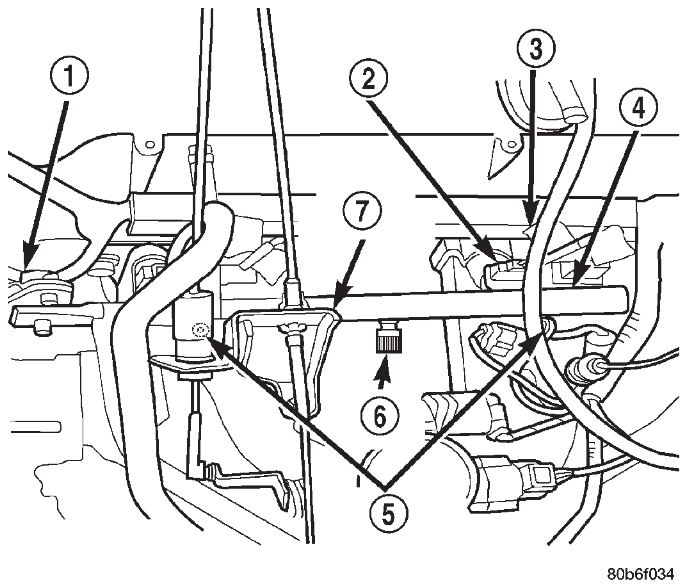


Fig. 17 Fuel Rail Mounting—2.5L Engine

1 - FUEL DAMPER
2 - FUEL INJECTOR
3 - NUMBERED TAG
4 - FUEL RAIL
5 - FUEL RAIL MOUNTING BOLTS/NUTS
6 - TEST PORT
7 - CABLE BRACKET

(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. 17) at intake manifold.

(11) Remove nut securing crankshaft position sensor pigtail harness to fuel rail mounting stud.

FUEL RAIL - 2.5L ENGINE (Continued)

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. 17).

(14) Remove fuel rail by gently rocking until all the fuel injectors are out of intake manifold.

INSTALLATION

(1) Clean each injector bore at intake manifold.

(2) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.

(3) Position tips of all fuel injectors into the corresponding injector bore in intake manifold. Seat injectors into manifold.

(4) Install and tighten fuel rail mounting bolts to 11 ±3 N·m (100 ±25 in. lbs.) torque.

(5) Position crankshaft position sensor pigtail wire harness clamp and wire harness to fuel rail 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 RAIL - 4.0L ENGINE

DESCRIPTION

The fuel rail is mounted to the intake manifold (Fig. 18) . 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. 18) .

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

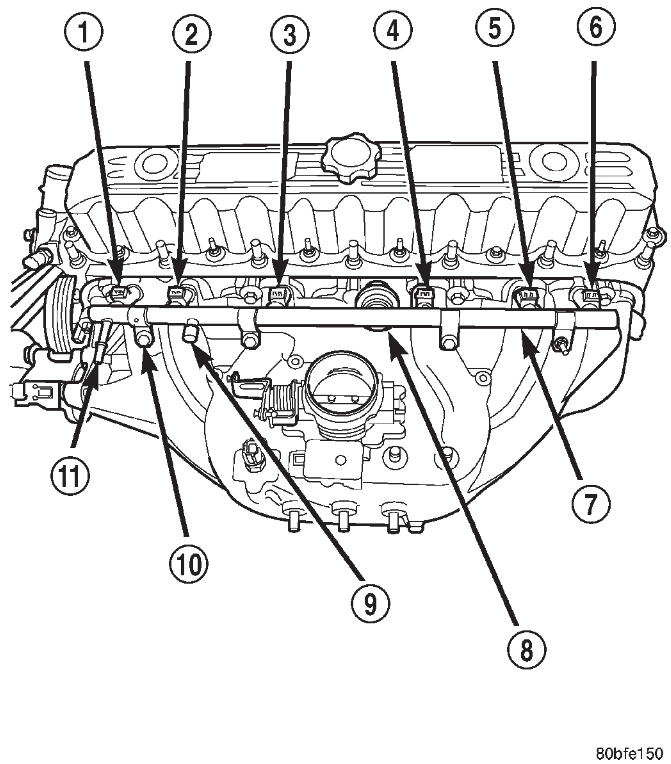


Fig. 18 Fuel Rail/Fuel Damper—4.0L Engine

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

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 for information.

The fuel rail is not repairable.

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.

FUEL RAIL - 4.0L ENGINE (Continued)

(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. 19). 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.

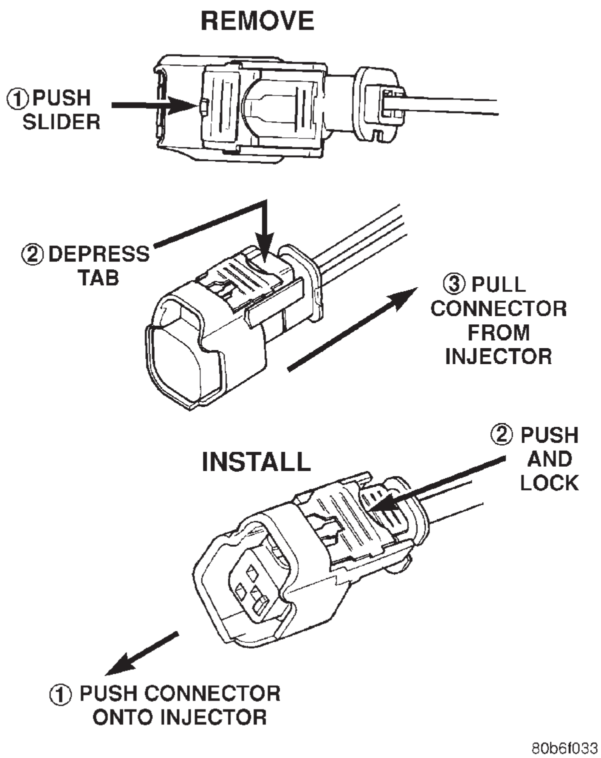


Fig. 19 Remove/Install Fuel Injector Connector—2.5L/4.0L Engine

(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.

(8) Disconnect speed control cable at throttle body (if equipped). Refer to Speed Control Cable in 8, 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. 20).

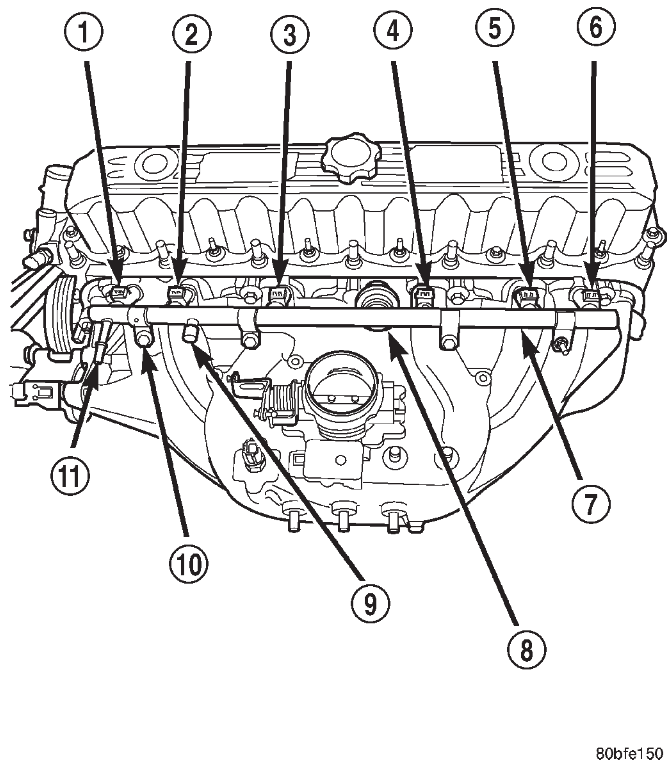


Fig. 20 Fuel Rail Mounting—4.0L Engine

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

(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.

(6) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 19). 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.

FUEL RAIL - 4.0L ENGINE (Continued)

(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 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 fuel tank check valve(s) is mounted into the top of the fuel tank (or pump module). Refer to Fuel Tank Check Valve for additional information.

An evaporation control system is connected to the check 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.

Refer to ORVR for On-Board Refueling Vapor Recovery system information.

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. 21) . 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. 22) .

(8) Disconnect EVAP hose from EVAP line at front of fuel tank (Fig. 22) .

(9) Disconnect quick-connect fitting from fuel line at front of fuel tank (Fig. 22) . 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. 24) . Remove one of the nuts through access hole on skid plate (Fig. 24) .

(12) Remove four skid plate-to-body nuts at rear of tank (Fig. 23) . **Do not loosen tank strap nuts (Fig. 23) .**

(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.

(17) To separate tank from skid plate, remove two protective caps at tank strap studs (Fig. 23) 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. 23) . **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.

FUEL TANK (Continued)

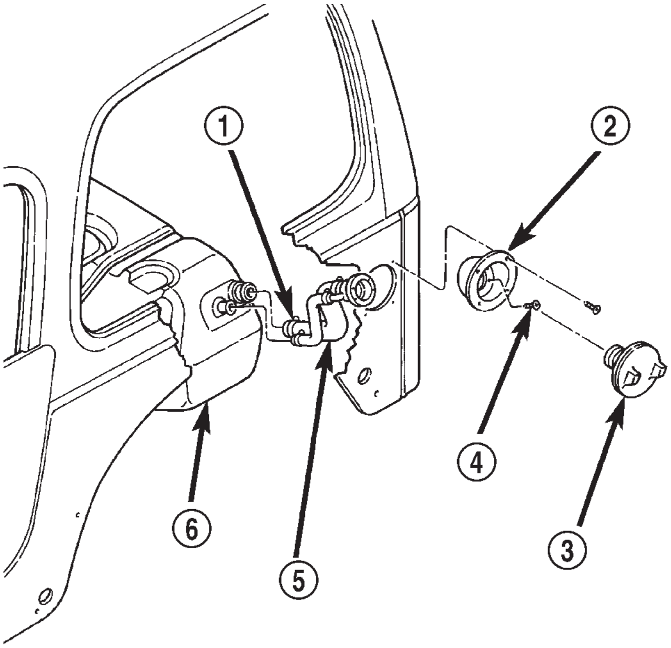


Fig. 21 Fuel Filler Hoses/Fuel Fill Cap

1 - FILLER HOSE CLAMPS (4)
2 - BEZEL
3 - BEZEL SCREWS (8)
4 - FUEL FILLER CAP
5 - FUEL FILLER HOSES
6 - FUEL TANK

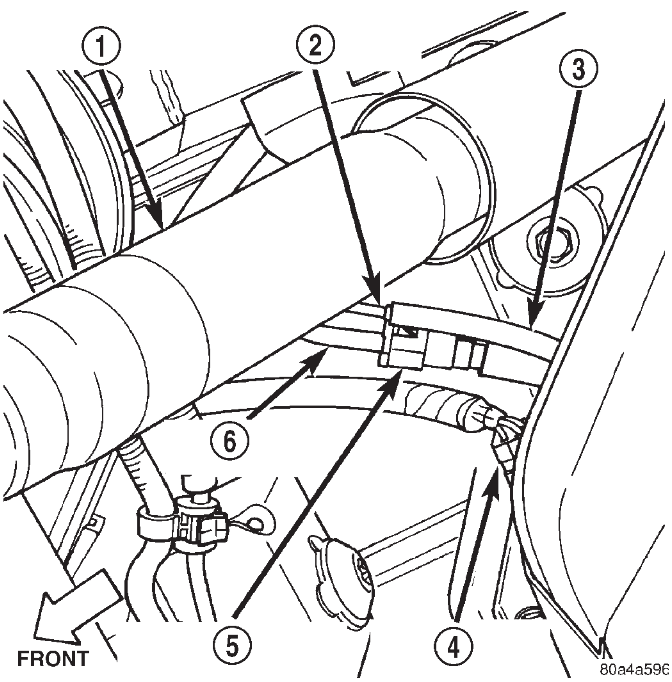


Fig. 22 Fuel Tank Connections

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)

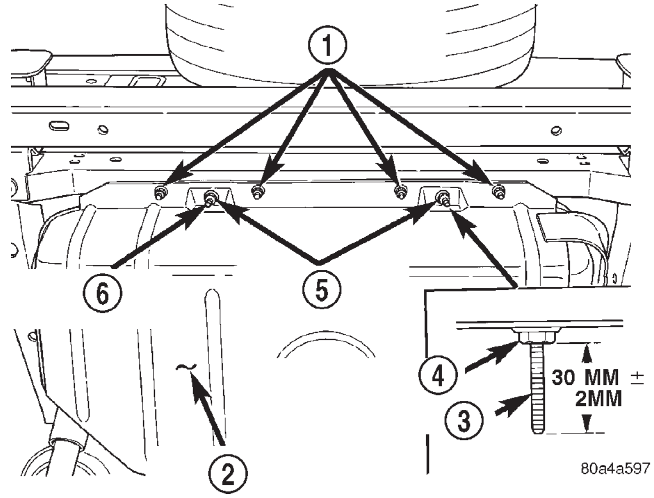


Fig. 23 Fuel Tank Mounting Nuts—Rear

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)

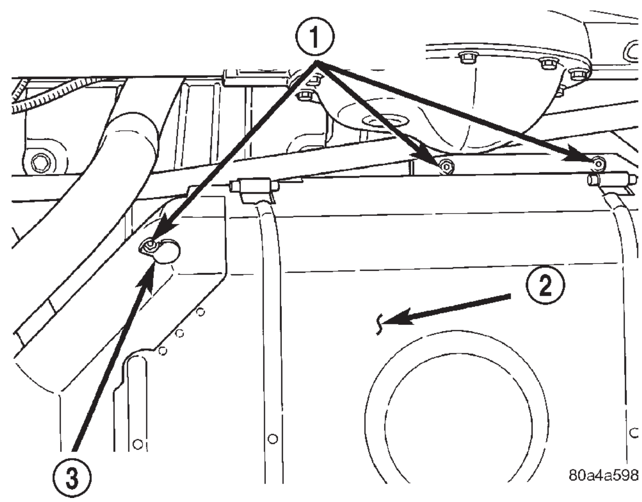


Fig. 24 Fuel Tank Mounting Nuts—Front

1 - FRONT SKID PLATE NUTS (3)
2 - SKID PLATE
3 - ACCESS HOLE

(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.

FUEL TANK CHECK VALVE

DESCRIPTION

The fuel tank is equipped with 2 fuel tank check valves. The valves are located on the top of the fuel tank (Fig. 25).

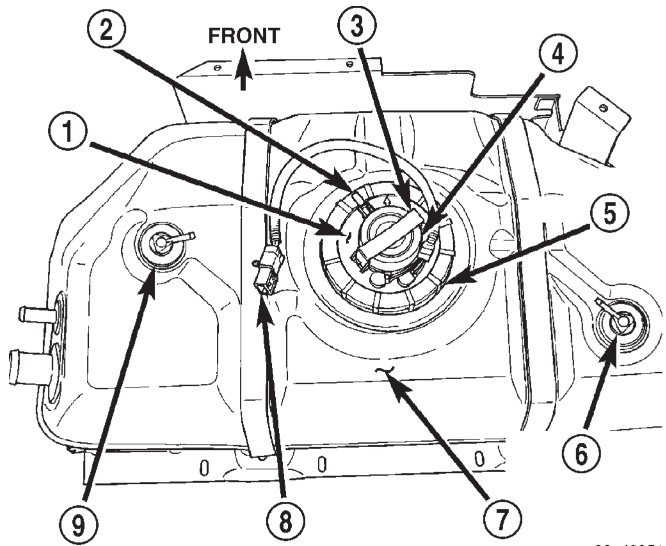


Fig. 25 Check Valve Location

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 fuel tank check 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.

INLET FILTER

REMOVAL

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.

(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.

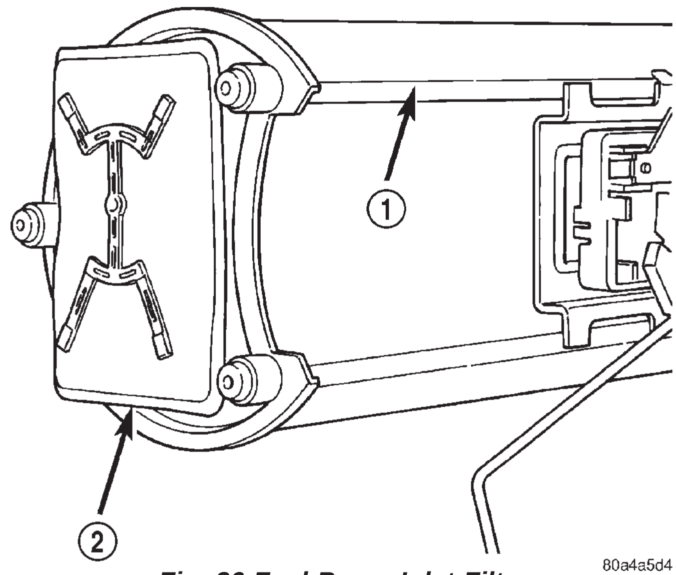


Fig. 26 Fuel Pump Inlet Filter

1 - FUEL PUMP MODULE
2 - FUEL PUMP INLET FILTER

(4) Clean bottom of pump module.

INSTALLATION

The fuel pump inlet filter (strainer) is located on the bottom of fuel pump module (Fig. 27). The fuel pump module is located on top of fuel tank.

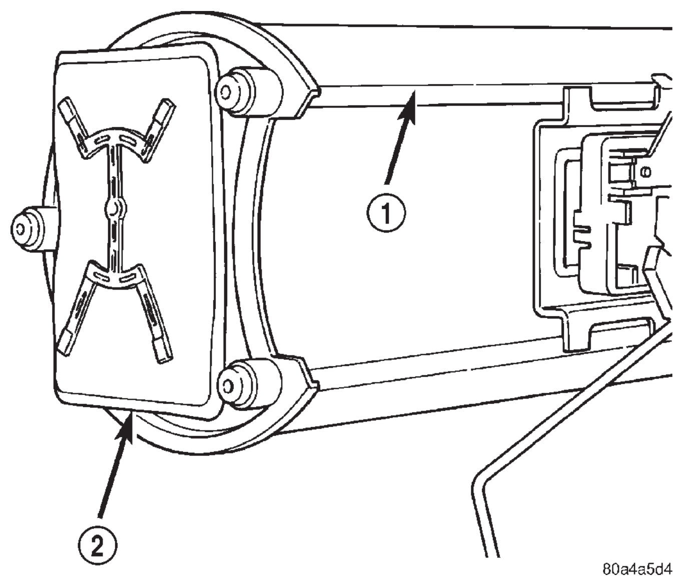


Fig. 27 Fuel Pump Inlet Filter

1 - FUEL PUMP MODULE
2 - FUEL PUMP INLET FILTER

(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.

QUICK CONNECT FITTING

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.

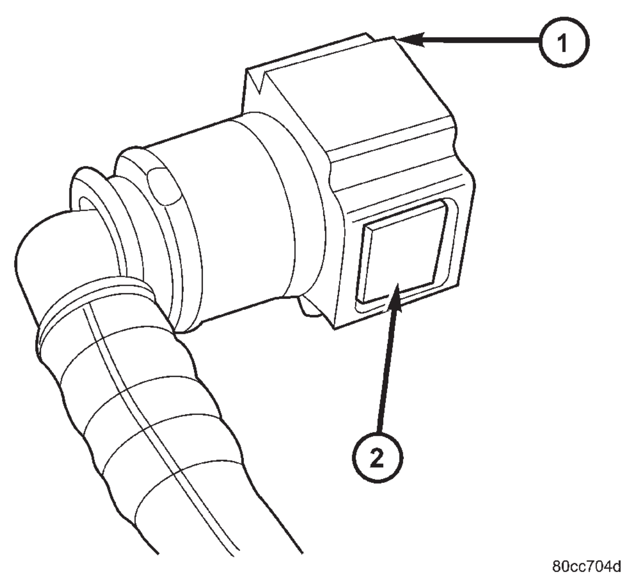


Fig. 28 2-BUTTON TYPE FITTING

1 - QUICK-CONNECT FITTING
2 - PUSH-BUTTONS (2)

STANDARD PROCEDURE - 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.

(2) Disconnect negative battery cable from battery.

(3) Clean fitting of any foreign material before disassembly.

(4) **2–Button Type Fitting:** This type of fitting is equipped with a push-button located on each side of quick-connect fitting (Fig. 28). Press on both buttons simultaneously for removal.

(5) **Single-Tab Type Fitting:** This type of fitting is equipped with a single pull tab (Fig. 29). 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. 30). **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. 30).

(c) Raise pull tab until it separates from quick-connect fitting (Fig. 31).

(6) **Two-Tab Type Fitting:** This type of fitting is equipped with tabs located on both sides of fitting

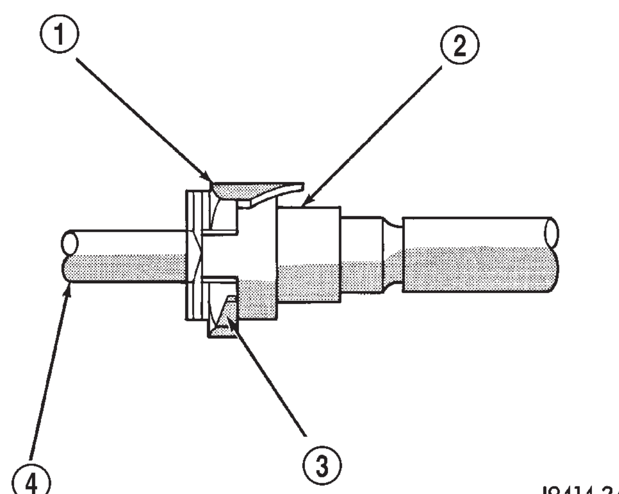


Fig. 29 SINGLE-TAB TYPE FITTING

1 - PULL TAB
2 - QUICK-CONNECT FITTING
3 - PRESS HERE TO REMOVE PULL TAB
4 - INSERTED TUBE END

QUICK CONNECT FITTING (Continued)

(Fig. 32). The tabs are supplied for disconnecting quick-connect fitting from component being serviced.

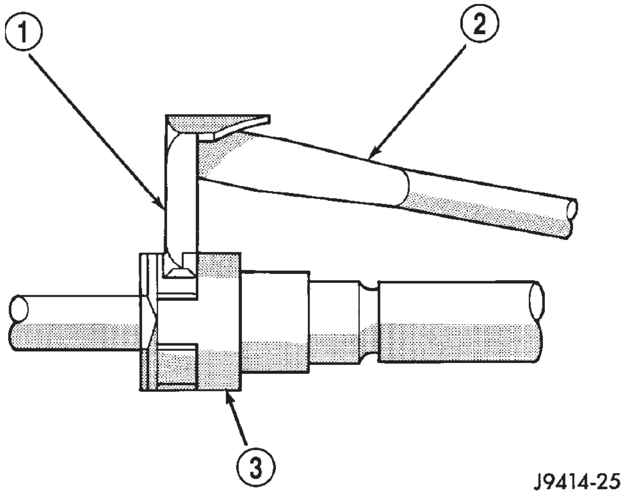


Fig. 30 DISCONNECTING SINGLE-TAB TYPE FITTING

1 - PULL TAB
2 - SCREWDRIVER
3 - QUICK-CONNECT FITTING

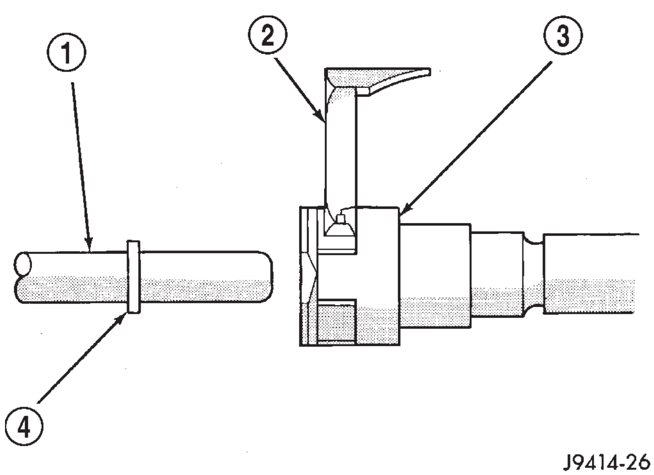


Fig. 31 REMOVING PULL TAB

1 - FUEL TUBE OR FUEL SYSTEM COMPONENT
2 - PULL TAB
3 - QUICK-CONNECT FITTING
4 - FUEL TUBE STOP

(a) To disconnect quick-connect fitting, squeeze plastic retainer tabs (Fig. 32) 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.

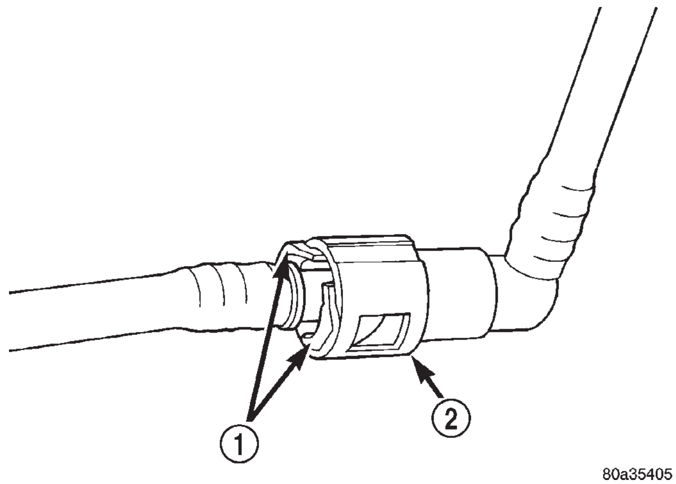


Fig. 32 TYPICAL 2–TAB TYPE FITTING

1 - TAB(S)
2 - QUICK-CONNECT FITTING

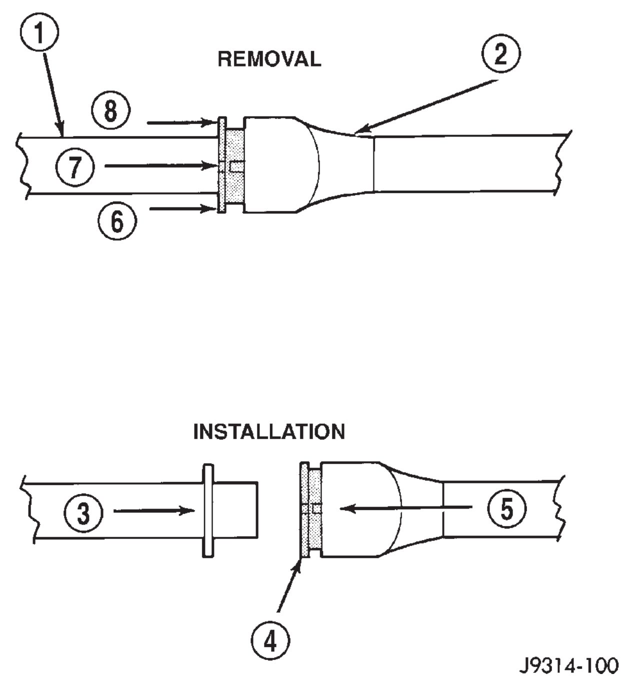


Fig. 33 PLASTIC RETAINER RING TYPE FITTING

1 - FUEL TUBE
2 - QUICK CONNECT FITTING
3 - PUSH
4 - PLASTIC RETAINER
5 - PUSH
6 - PUSH
7 - PUSH
8 - PUSH

The o-rings and spacer will remain in quick-connect fitting connector body.

(7) **Plastic Retainer Ring Type Fitting:** This type of fitting can be identified by the use of a full-

QUICK CONNECT FITTING (Continued)

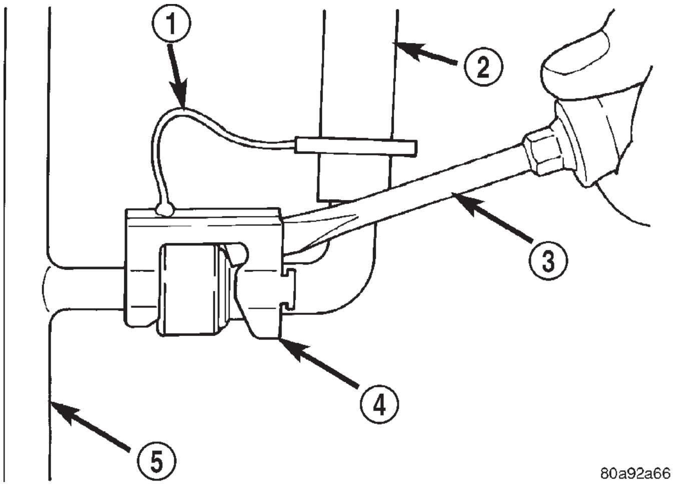


Fig. 34 LATCH CLIP-TYPE 1

1 - TETHER STRAP
2 - FUEL LINE
3 - SCREWDRIVER
4 - LATCH CLIP
5 - FUEL RAIL

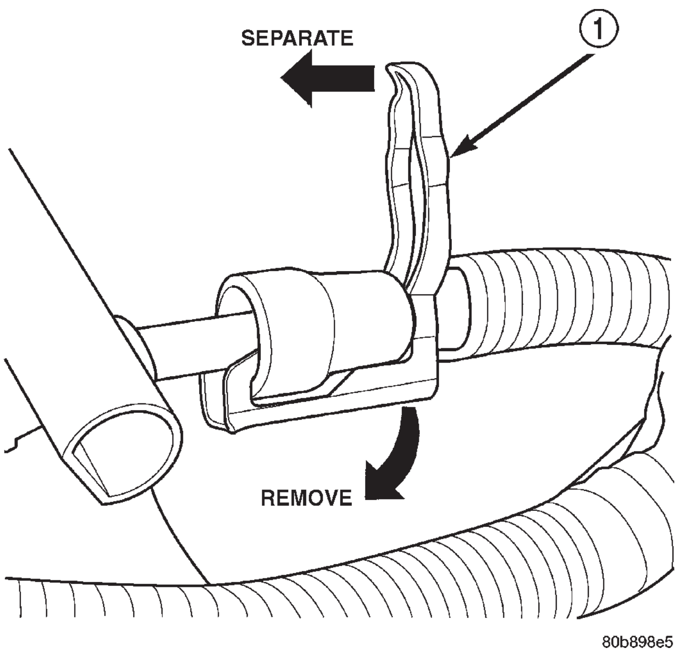


Fig. 35 LATCH CLIP-TYPE 2

1 - LATCH CLIP

round plastic retainer ring (Fig. 33) usually black in color.

(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. 33). 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.

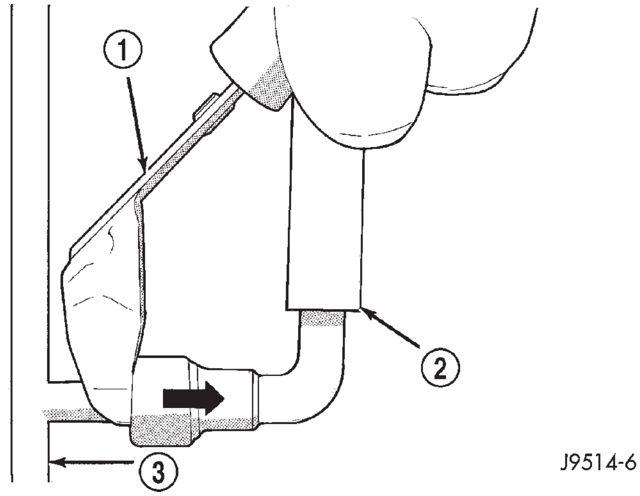


Fig. 36 FUEL LINE DISCONNECTION USING SPECIAL TOOL

1 - SPECIAL FUEL LINE TOOL
2 - FUEL LINE
3 - FUEL RAIL

(8) **Latch Clips:** Depending on vehicle model and engine, 2 different types of safety latch clips are used (Fig. 34) or (Fig. 35). 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. 34).

(b) Type 2: Separate and unlatch 2 small arms on end of clip (Fig. 35) 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. 36). 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.

(9) Disconnect quick-connect fitting from fuel system component being serviced.

QUICK CONNECT FITTING (Continued)

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.

FUEL INJECTION

TABLE OF CONTENTS

FUEL INJECTION

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. 1).

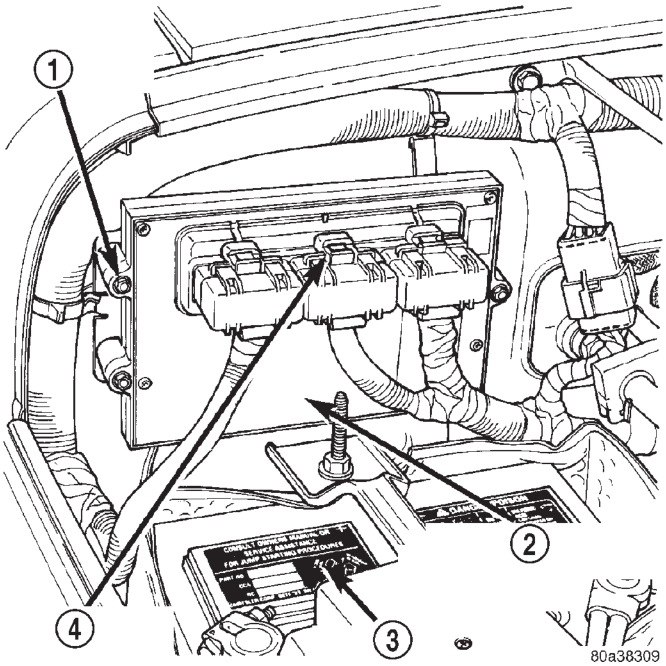


Fig. 1 Powertrain Control Module (PCM)

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. Inspect relays for signs of physical damage and corrosion. The relays are located in Power Distribution Center (PDC) (Fig. 2). Refer to label on PDC cover for relay location.

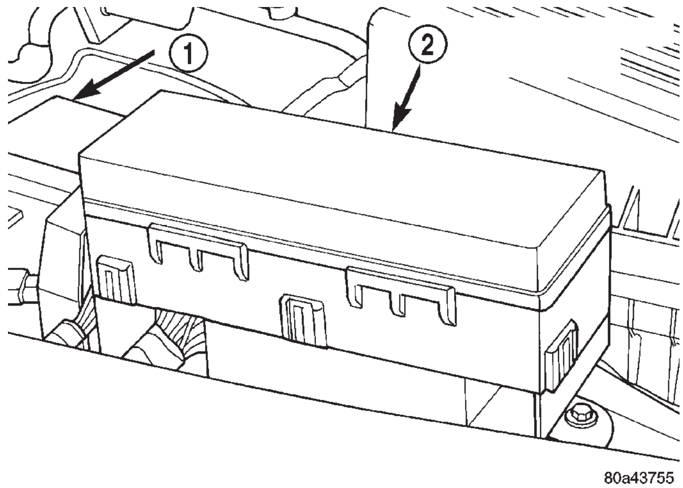


Fig. 2 Power Distribution Center (PDC)

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. 3).

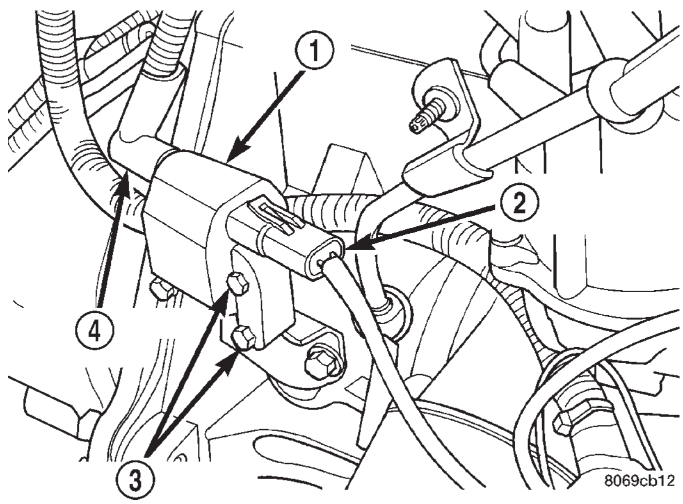


Fig. 3 Ignition Coil—2.5L Engine

1 - IGNITION COIL
2 - ELECTRICAL CONNECTOR
3 - MOUNTING BOLTS
4 - SECONDARY CABLE

(5) 4.0L Engine: Inspect ignition coil connection (Fig. 4).

(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.

FUEL INJECTION (Continued)

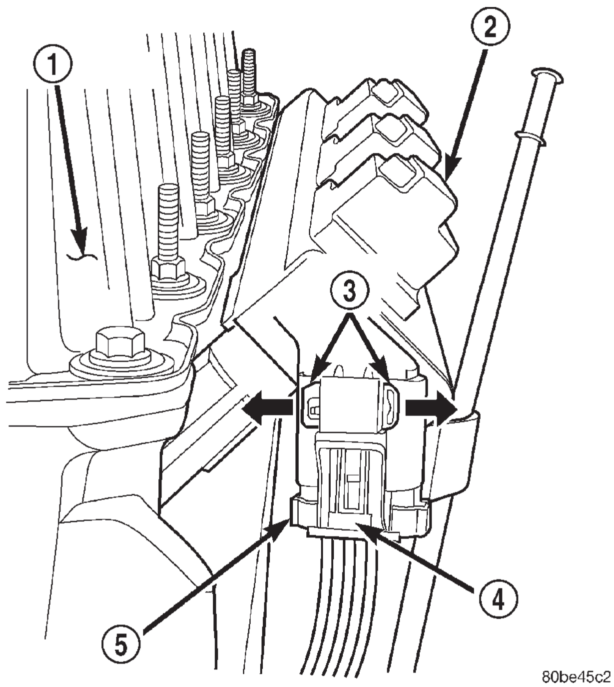


Fig. 4 Ignition Coil—4.0L Engine

1 - REAR OF VALVE COVER
2 - COIL RAIL
3 - SLIDE TAB
4 - RELEASE LOCK
5 - COIL CONNECTOR

(9) Inspect system body grounds for loose or dirty connections. Refer to 8, Wiring for ground locations.

(10) Verify Crankcase Ventilation (CCV) operation. Refer to 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.

(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. 5) or (Fig. 6).

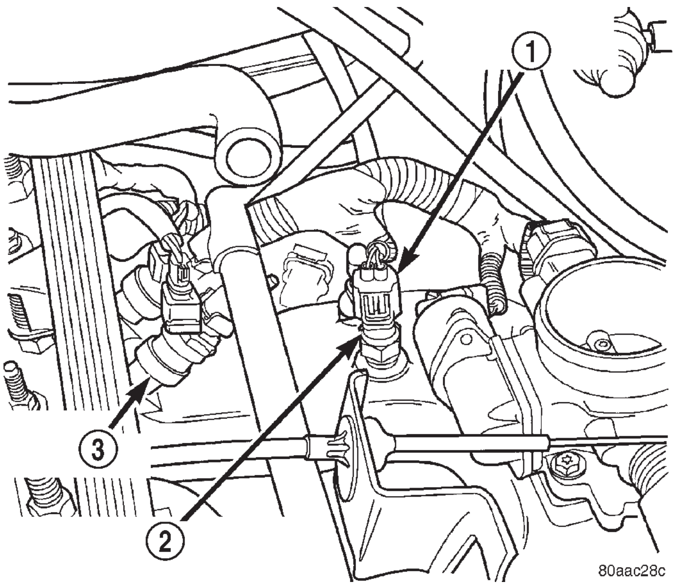


Fig. 5 Intake Manifold Air Temp. Sensor Location—2.5L Engine

1 - ELECTRICAL CONNECTOR
2 - INTAKE MANIFOLD TEMPERATURE SENSOR
3 - FUEL INJECTOR

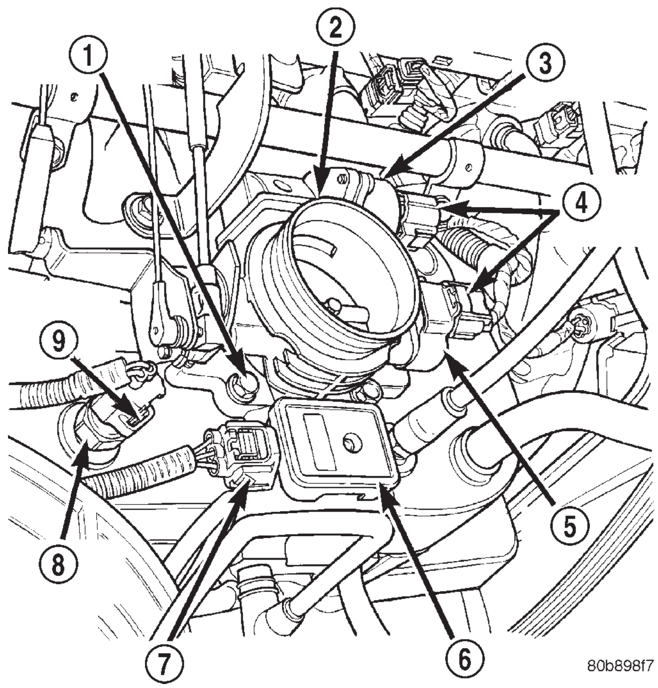


Fig. 6 Sensor Locations—4.0L Engine

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.

FUEL INJECTION (Continued)

(18) Verify MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 6). Also verify rubber L-shaped fitting from MAP sensor to throttle body is firmly connected (Fig. 7).

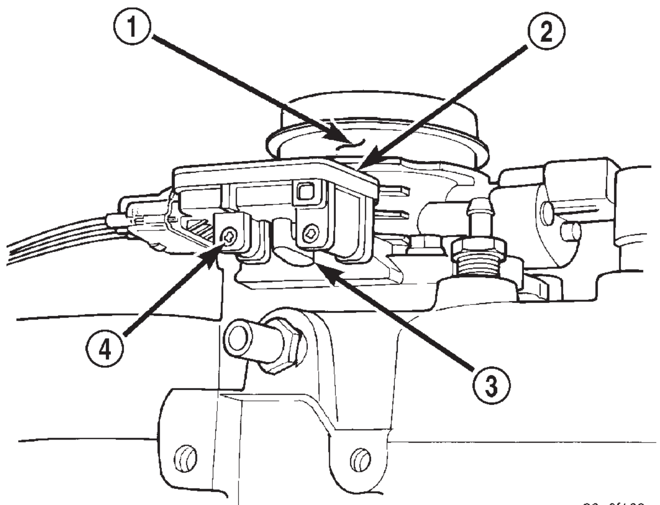


Fig. 7 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

1 - THROTTLE BODY
2 - MAP SENSOR
3 - RUBBER FITTING
4 - MOUNTING SCREWS (2)

(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. 6).

(21) Verify wire harness connector is firmly connected to engine coolant temperature sensor (Fig. 8).

(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. 9), (Fig. 10), (Fig. 11) or (Fig. 12).

(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.

(27) Verify that electrical harness connector is firmly connected to the vehicle speed sensor (Fig. 13).

(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.

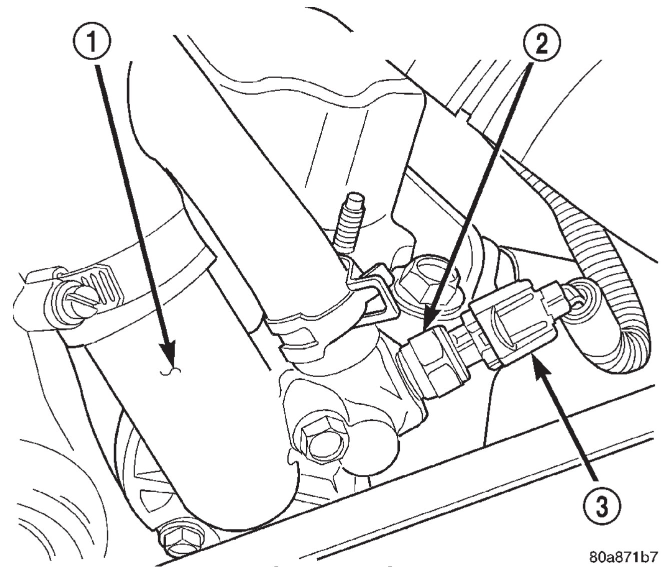


Fig. 8 Engine

1 - THERMOSTAT HOUSING
2 - ENGINE COOLANT TEMPERATURE SENSOR
3 - ELECTRICAL CONNECTOR

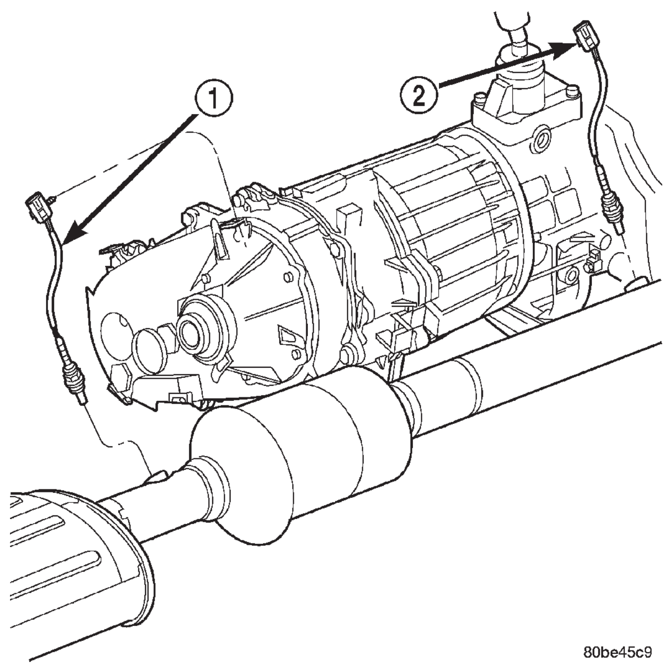


Fig. 9 Oxygen Sensors—4.0L—Federal Emissions

1 - 1/2 O2S
2 - 1/1 02S

(30) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

(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.

FUEL INJECTION (Continued)

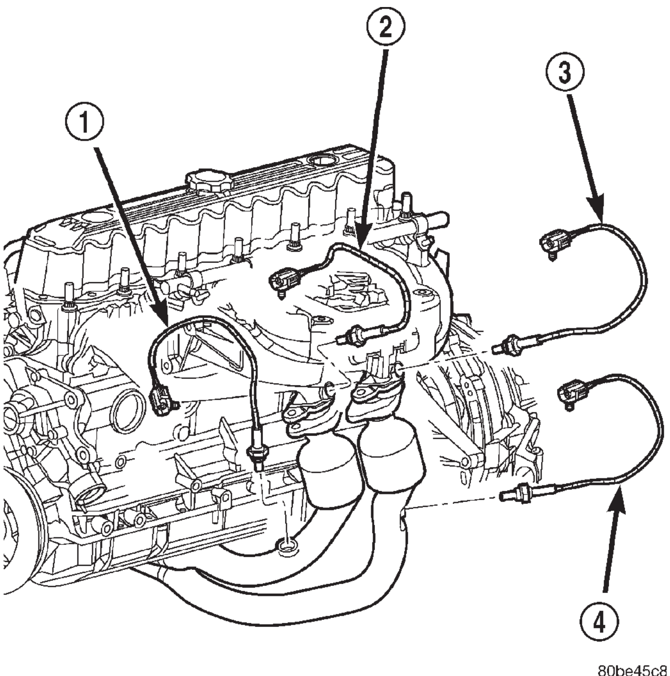


Fig. 10 Oxygen Sensors—4.0L—California Emissions

1 - 1/2 O2S
2 - 1/1 O2S
3 - 2/1 O2S
4 - 2/2 O2S

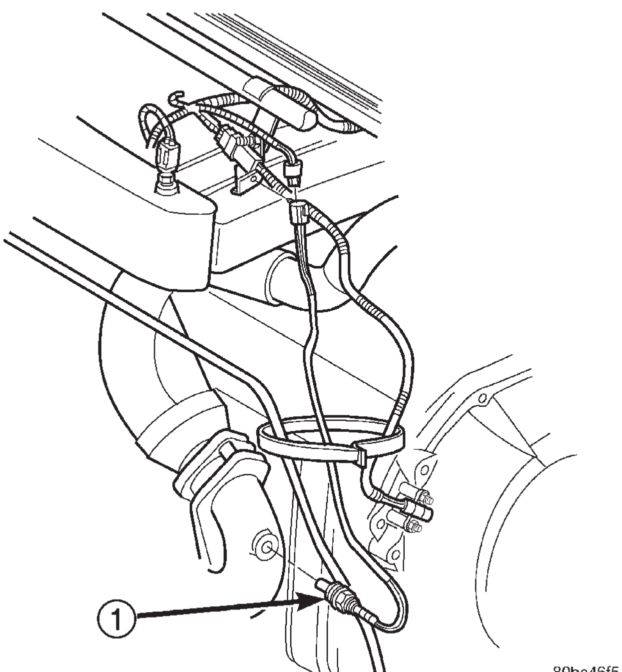


Fig. 11 Front Oxygen Sensor—2.5L—Federal Emissions

1 - 1/1 O2S

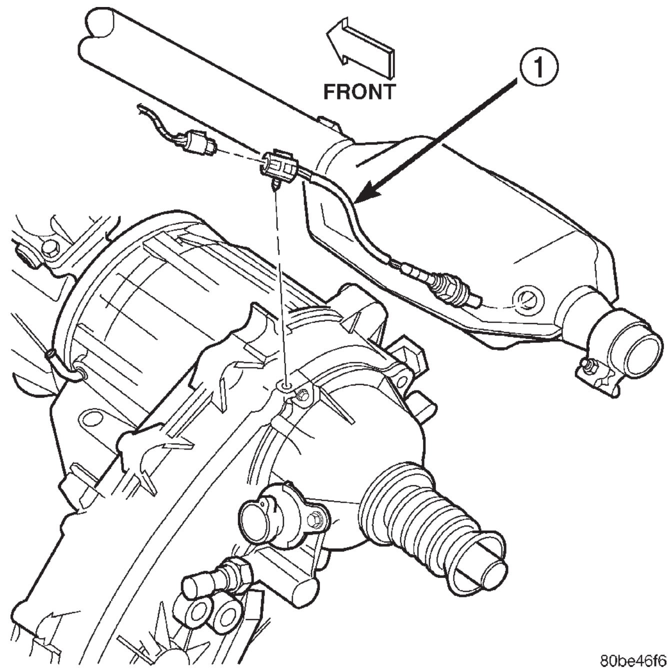


Fig. 12 Rear Oxygen Sensor—2.5L—Federal Emissions

1 - 1/2 O2S

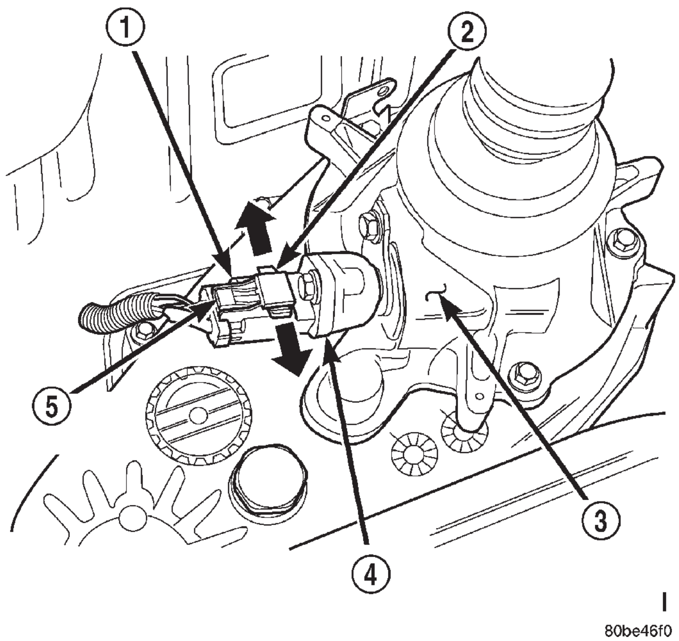


Fig. 13 Vehicle Speed Sensor—Typical—4WD Shown

1 - SENSOR ELECTRICAL CONNECTOR
2 - SLIDE TAB
3 - 4WD TRANSFER CASE EXTENSION
4 - VEHICLE SPEED SENSOR
5 - RELEASE LOCK

SPECIFICATIONS

TORQUE - FUEL INJECTION

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Accelerator Pedal Bracket Mounting Nuts	8.5	-	75
Engine Coolant Temperature Sensor	11	-	96
IAC Motor-To-Throttle Body Bolts	7	-	60
Intake Manifold Air Temp. Sensor	28	20	-
MAP Sensor Mounting Screws	3	-	25
Oxygen Sensor	30	22	-
PCM Mounting Screws	4	-	35
Power Steering Pressure Switch	14-22	-	124-195
Throttle Body Mounting Bolts	11	-	100
Throttle Position Sensor Mounting Screws	7	-	60
Vehicle Speed Sensor Mounting Bolt	2.2	-	20

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. 14) . This retainer (clip) snaps into the top of the accelerator pedal arm. Retainer tabs (built into the cable sheathing) (Fig. 14) fasten the cable to the dash panel.

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. 14) . Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove accelerator pedal mounting bracket nuts.

(3) Remove accelerator pedal assembly.

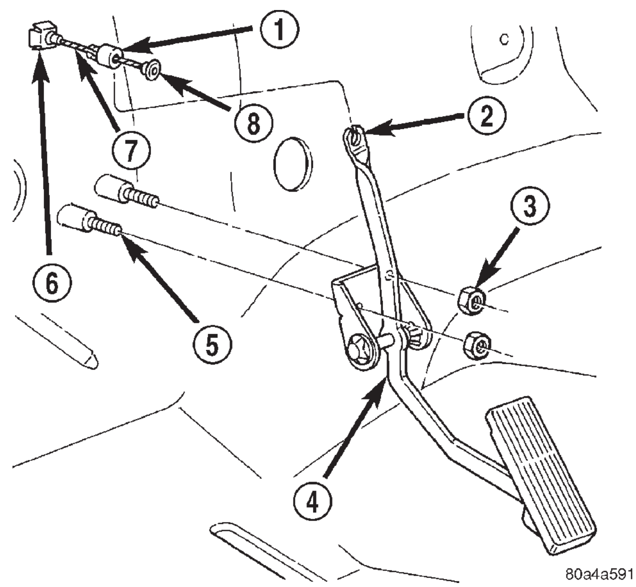


Fig. 14 Accelerator Pedal Mounting

1 - CABLE RETAINER
2 - SLOT
3 - MOUNTING STUDS (2)
4 - PEDAL/BRACKET ASSEMBLY
5 - MOUNTING STUDS
6 - RETAINER TABS
7 - CABLE
8 - CABLE STOP

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.

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. 15). On 4.0L 6-cylinder engines there are three sets of notches (Fig. 16).

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.

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. 17). If sensor is equipped with one mounting bolt, **it is adjustable.**.
- with two nuts (Fig. 18).
- with two bolts (Fig. 19).

(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:

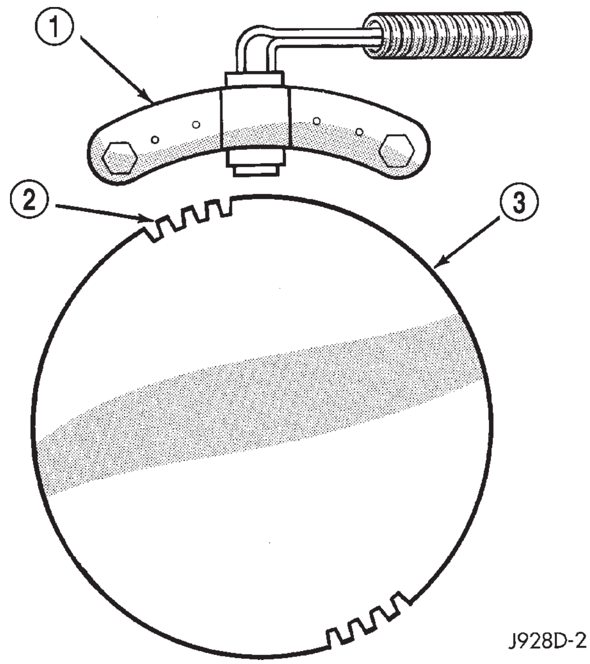


Fig. 15 Sensor Operation–2.5L Engine

1 - CRANKSHAFT POSITION SENSOR
2 - NOTCHES
3 - FLYWHEEL

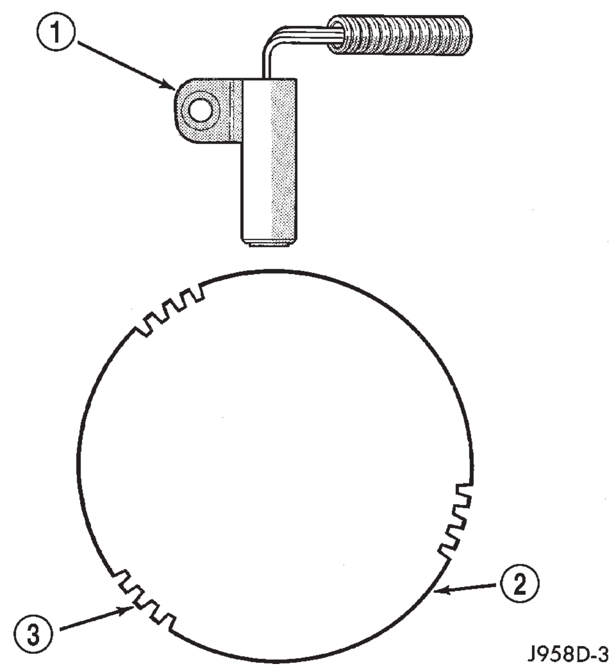


Fig. 16 Sensor Operation–4.0L Engine

1 - CRANKSHAFT POSITION SENSOR
2 - FLYWHEEL
3 - FLYWHEEL NOTCHES

(1) Install sensor flush against opening in transmission housing.

CRANKSHAFT POSITION SENSOR (Continued)

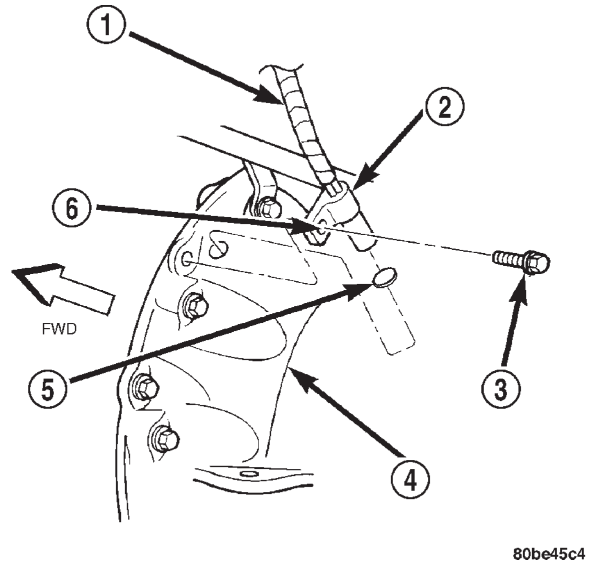


Fig. 17 Crankshaft Position Sensor—One-Bolt Mounting

1 - SENSOR PIGTAIL
2 - CRANKSHAFT POSITION SENSOR
3 - MOUNTING BOLT
4 - TRANSMISSION HOUSING
5 - PAPER SPACER
6 - SLOTTED HOLE

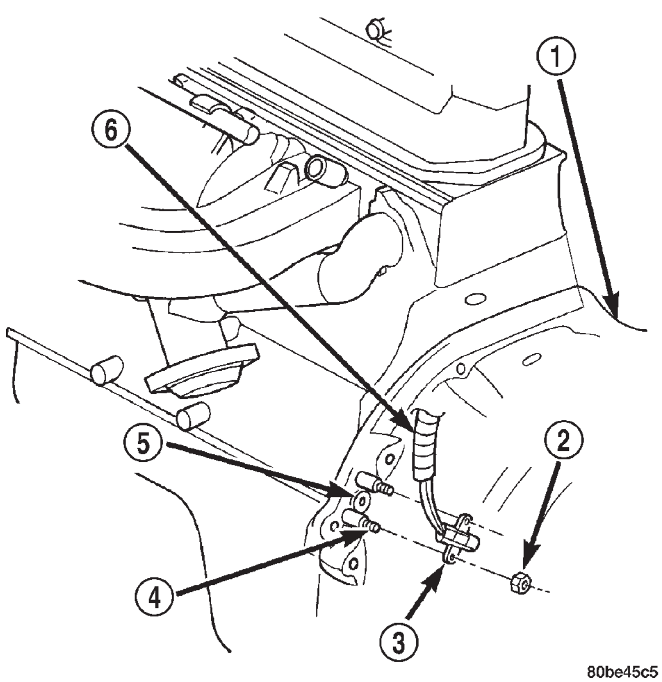


Fig. 18 Crankshaft Position Sensor—Two-Nut Mounting

1 - TRANSMISSION BELLHOUSING
2 - MOUNTING NUTS (2)
3 - CRANKSHAFT POSITION SENSOR
4 - MOUNTING STUDS (2)
5 - RUBBER GROMMET
6 - SENSOR PIGTAIL

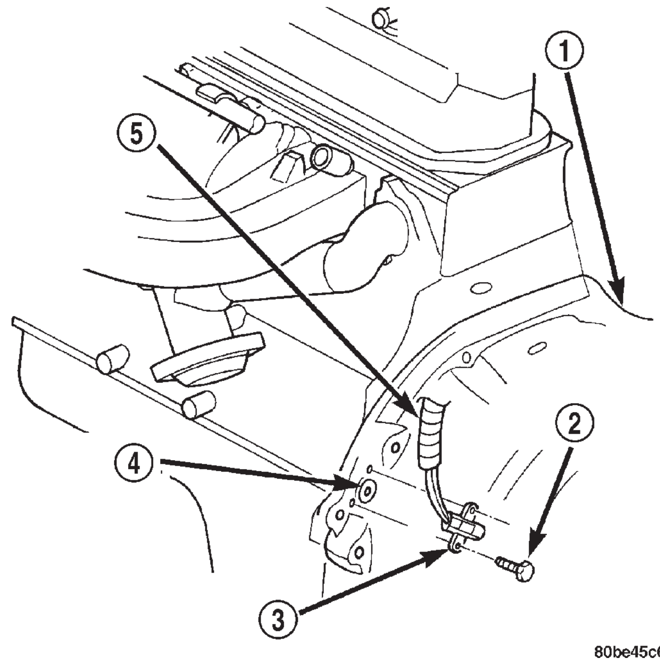


Fig. 19 Crankshaft Position Sensor—Two-Bolt Mounting

1 - TRANSMISSION BELLHOUSING
2 - MOUNTING BOLTS (2)
3 - CRANKSHAFT POSITION SENSOR
4 - RUBBER GROMMET
5 - SENSOR PIGTAIL

(2) Install and tighten two sensor mounting bolts to 12 N·m (9 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 12 N·m (9 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.

FUEL INJECTOR

DESCRIPTION

An individual fuel injector (Fig. 20) is used for each individual cylinder.

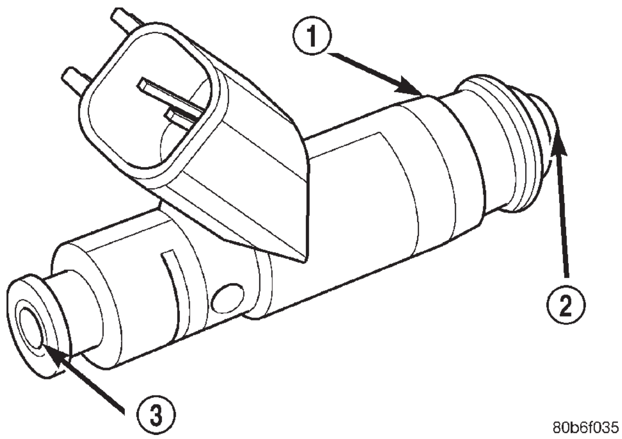


Fig. 20 Fuel Injector—Typical

1 - FUEL INJECTOR
2 - NOZZLE
3 - TOP (FUEL ENTRY)

OPERATION

OPERATION - PCM OUTPUT

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.

OPERATION - FUEL INJECTOR

The top (fuel entry) end of the injector (Fig. 20) 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 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.

DIAGNOSIS AND TESTING - FUEL INJECTOR

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).

FUEL INJECTOR (Continued)

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. 21) .

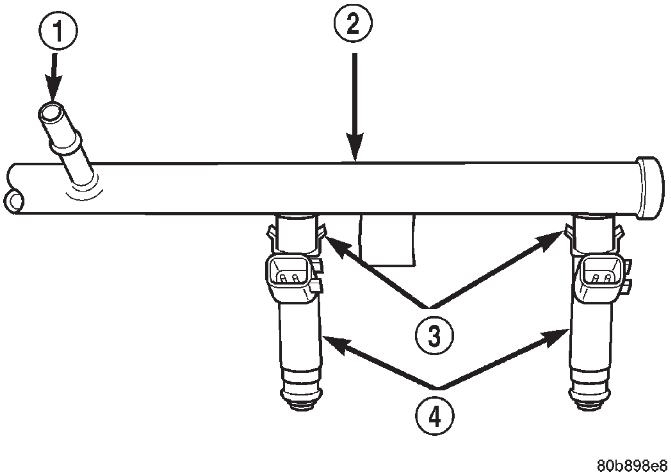


Fig. 21 Fuel Injector Mounting

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 PUMP RELAY

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.

REMOVAL

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 22). Refer to label on PDC cover for relay location.

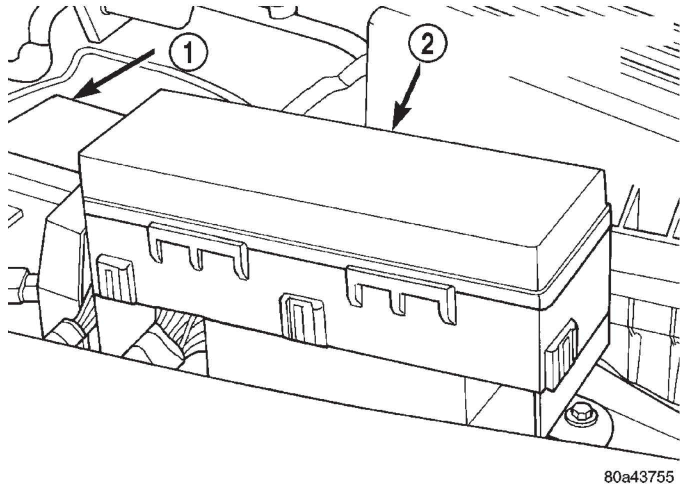


Fig. 22 Power Distribution Center (PDC)

1 - BATTERY
2 - POWER DISTRIBUTION CENTER (PDC)

(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

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 22) . Refer to label on PDC cover for relay location.

(1) Install relay to PDC.

(2) Install cover to PDC.

IDLE AIR CONTROL MOTOR

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.

IDLE AIR CONTROL MOTOR (Continued)

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
- 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.

REMOVAL

The IAC motor is located on the side of the throttle body (Fig. 33) or (Fig. 34).

(1) Remove air cleaner tube at throttle body.

(2) Disconnect electrical connector from IAC motor.

(3) Remove two mounting bolts (screws) (Fig. 23).

(4) Remove IAC motor from throttle body.

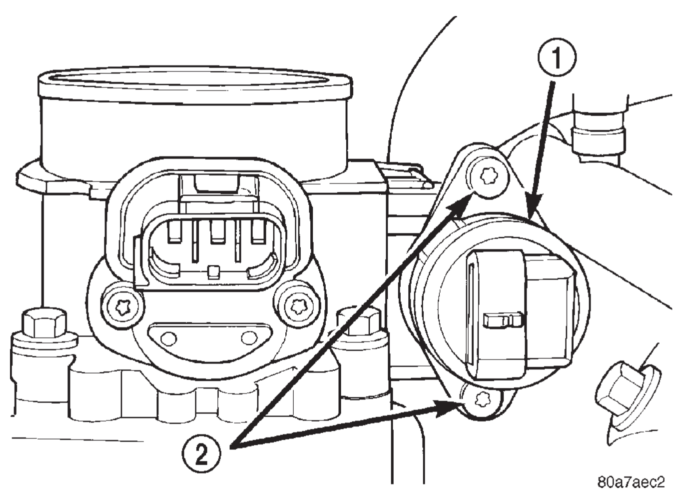


Fig. 23 Mounting Bolts

1 - IDLE AIR CONTROL MOTOR
2 - MOUNTING SCREWS

IDLE AIR CONTROL MOTOR (Continued)

INSTALLATION

The IAC motor is located on the side of the throttle body (Fig. 33) or (Fig. 34).

(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.

INTAKE AIR TEMPERATURE SENSOR

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)

The resistance values of the IAT sensor is the same as for the Engine Coolant Temperature (ECT) sensor.

REMOVAL

The intake manifold air temperature (IAT) sensor is installed into intake manifold plenum near throttle body (Fig. 24) or (Fig. 25).

(1) Disconnect electrical connector from IAT sensor.

(2) Remove sensor from intake manifold.

INSTALLATION

The intake manifold air temperature (IAT) sensor is installed into intake manifold plenum near throttle body (Fig. 26) or (Fig. 27).

(1) Install IAT sensor into intake manifold. Tighten sensor to 28 N·m (20 ft. lbs.) torque.

(2) Connect electrical connector to sensor.

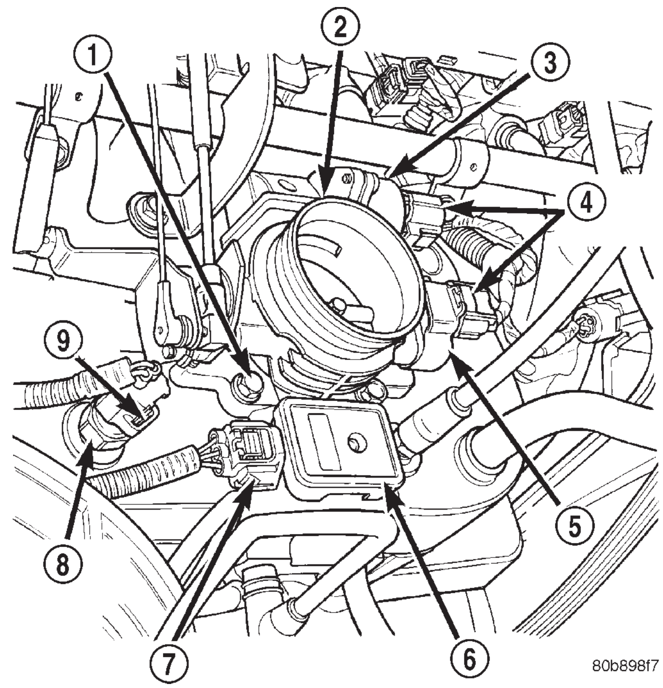


Fig. 24 IAT Sensor Locations - 4.0L Engine

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.

MAP SENSOR

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, MAP SENSOR (Continued)

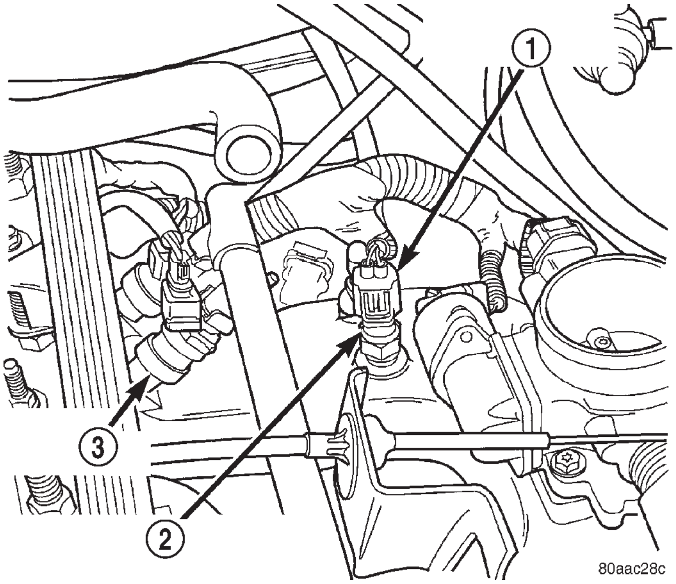


Fig. 25 IAT Sensor Location - 2.5L Engine

1 - ELECTRICAL CONNECTOR
2 - INTAKE MANIFOLD TEMPERATURE SENSOR
3 - FUEL INJECTOR

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.

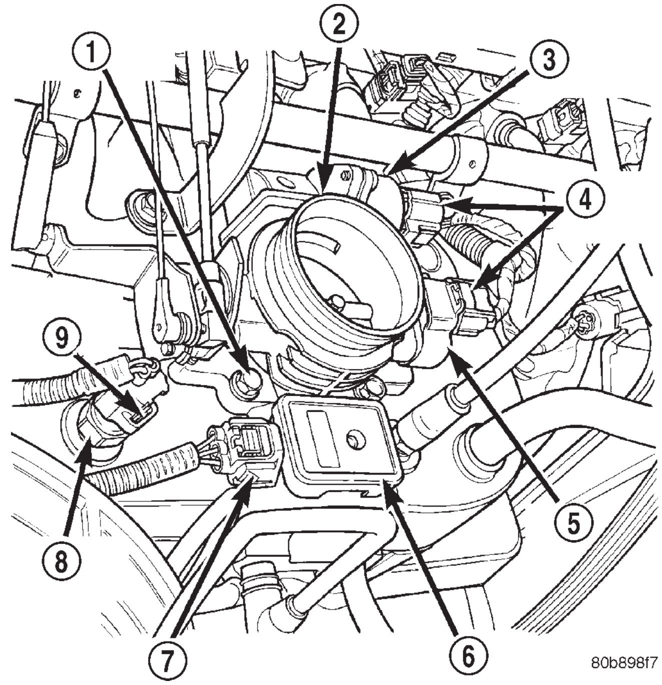


Fig. 26 IAT Sensor Locations - 4.0L Engine

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.

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.

MAP SENSOR (Continued)

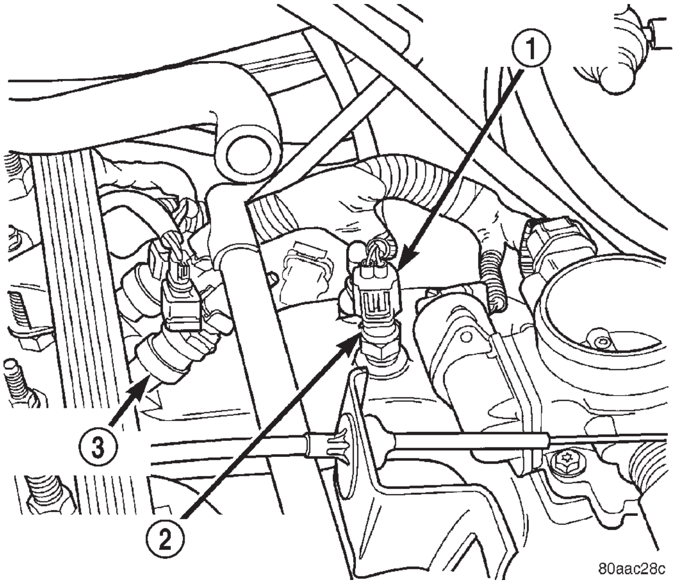


Fig. 27 IAT Sensor Location - 2.5L Engine

1 - ELECTRICAL CONNECTOR
2 - INTAKE MANIFOLD TEMPERATURE SENSOR
3 - FUEL INJECTOR

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 0.10 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.

REMOVAL

The MAP sensor is mounted to the side of the throttle body (Fig. 33) or (Fig. 34). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 28).

(1) Remove air cleaner intake tube at throttle body.

(2) Remove two MAP sensor mounting bolts (screws) (Fig. 28).

(3) While removing MAP sensor, slide the rubber L-shaped fitting (Fig. 28) from throttle body.

(4) Remove rubber L-shaped fitting from MAP sensor.

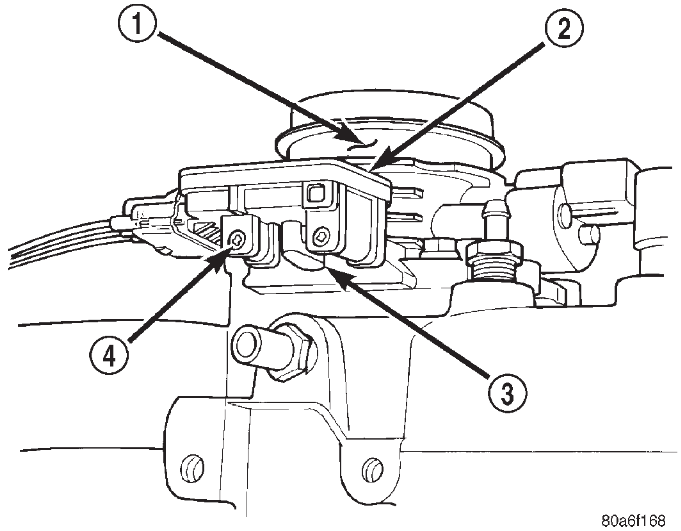


Fig. 28 MAP Sensor Mounting

1 - THROTTLE BODY
2 - MAP SENSOR
3 - RUBBER FITTING
4 - MOUNTING SCREWS (2)

INSTALLATION

The MAP sensor is mounted to the side of the throttle body (Fig. 33) or (Fig. 34). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 28).

(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.

O2 HEATER RELAY

DESCRIPTION

The oxygen (O2) sensor heater relay is located in the Powertrain Distribution Center (PDC).

OPERATION

Refer to Oxygen Sensor for oxygen sensor relay information.

REMOVAL

The oxygen sensor heater relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

(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.

O2 HEATER RELAY (Continued)

(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

The oxygen sensor heater relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

(1) Install relay to PDC.

(2) Install cover to PDC.

O2 SENSOR

DESCRIPTION

The Oxygen Sensors (O2S) are attached to, and protrude into the vehicle exhaust system. Four different 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.

The 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 O2 sensor case housing.

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 Heater Relay: If the vehicle is equipped with 4 oxygen sensors, a separate oxygen sensor relay is used to supply voltage to the sensor heating elements. This particular relay is used only for the 1/2 and 2/2 downstream sensors. Voltage for the other 2 sensor heating elements is supplied directly from the ASD relay. Refer to 8, Wiring Diagrams to determine which relay is used.

To avoid the large simultaneous current surge needed to operate all 4 sensors, power is delayed to the 2 downstream heater elements by the PCM for approximately 2 seconds.

Oxygen Sensor Heater Elements:

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 4.5 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.

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 - Engine Equipped With 2 Sensors: The upstream sensor (1/1) 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 catalytic convertor efficiency.

Downstream Sensor - Engine Equipped With 2 Sensors: The downstream oxygen sensor (1/2) is also used to determine the correct air-fuel ratio. As the oxygen content changes at the downstream sensor, 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 catalytic convertor efficiency.

Upstream Sensors - Engine Equipped With 4 Sensors: 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. 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

O2 SENSOR (Continued)

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. Main catalytic convertor efficiency is not calculated with this package.

Downstream Sensors - Engine Equipped With 4 Sensors: Two downstream sensors are used (1/2 and 2/2). The downstream sensors are used to determine the correct air-fuel ratio. As the oxygen content changes at the downstream sensor, 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. Main catalytic convertor efficiency is not calculated with this package.

Engines equipped with either a downstream sensor(s), or a post-catalytic sensor, will monitor catalytic convertor efficiency. If efficiency is below emission standards, the Malfunction Indicator Lamp (MIL) will be illuminated and a Diagnostic Trouble Code (DTC) will be set. Refer to Monitored Systems in Emission Control Systems for additional information.

REMOVAL

CAUTION: Never apply any type of grease to the oxygen sensor electrical connector, or attempt any soldering of the sensor wiring harness.

Refer to (Fig. 29), (Fig. 30), (Fig. 31) or (Fig. 32) for O2S (oxygen sensor) location.

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.

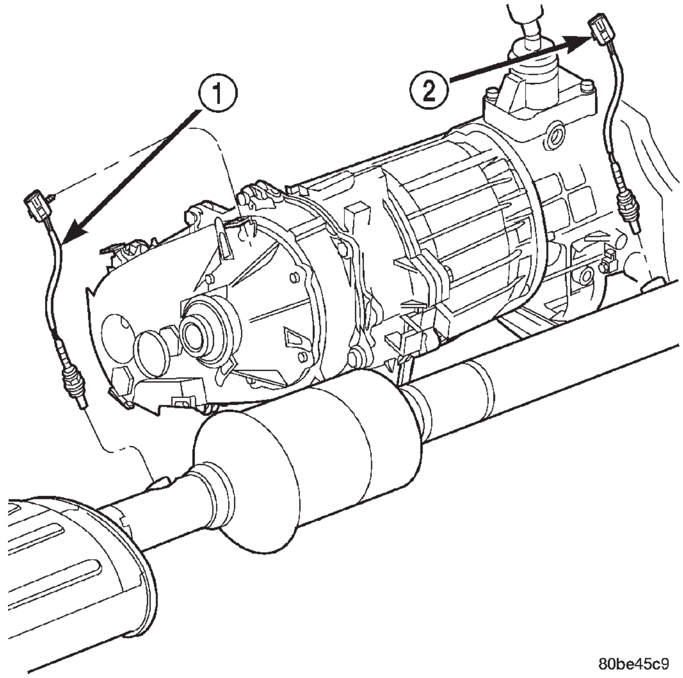


Fig. 29 Oxygen Sensors—4.0L—Federal Emissions

1 - 1/2 O2S
2 - 1/1 02S

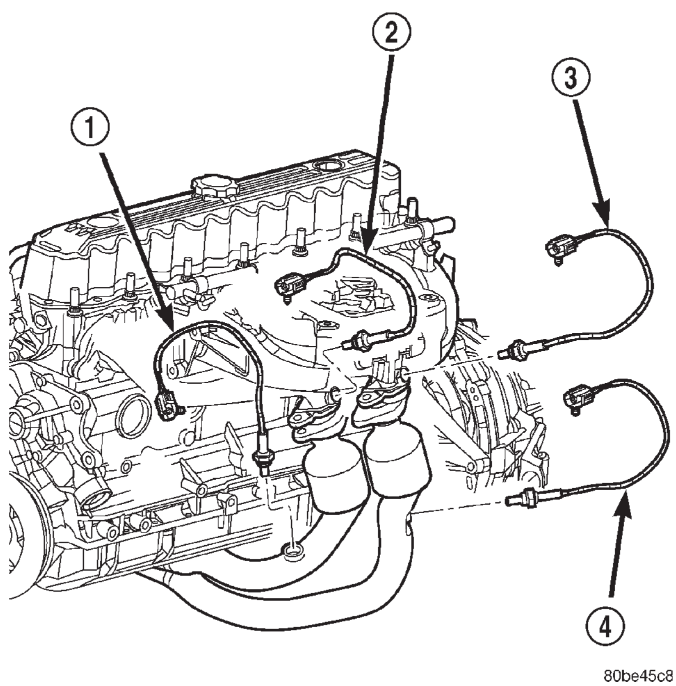


Fig. 30 Oxygen Sensors—4.0L—California Emissions

1 - 1/2 O2S
2 - 1/1 O2S
3 - 2/1 O2S
4 - 2/2 O2S

O2 SENSOR (Continued)

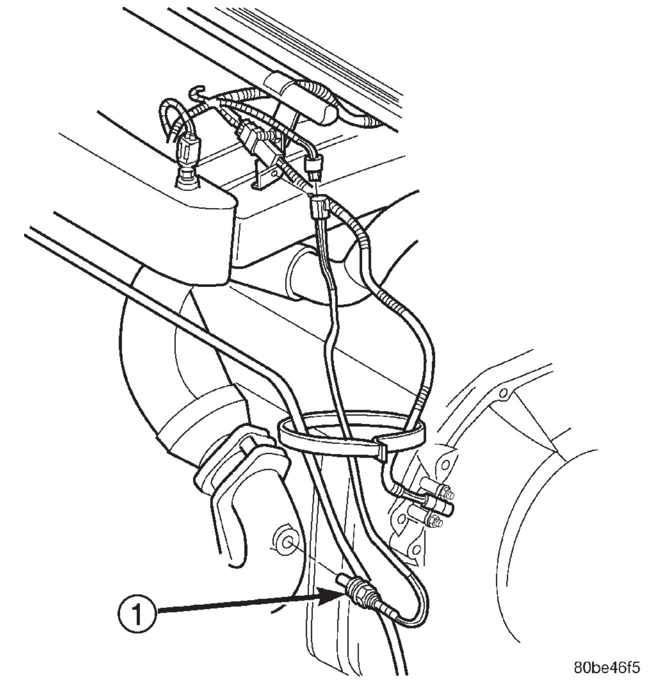


Fig. 31 Front Oxygen Sensor—2.5L—Federal Emissions

1 - 1/1 O2S

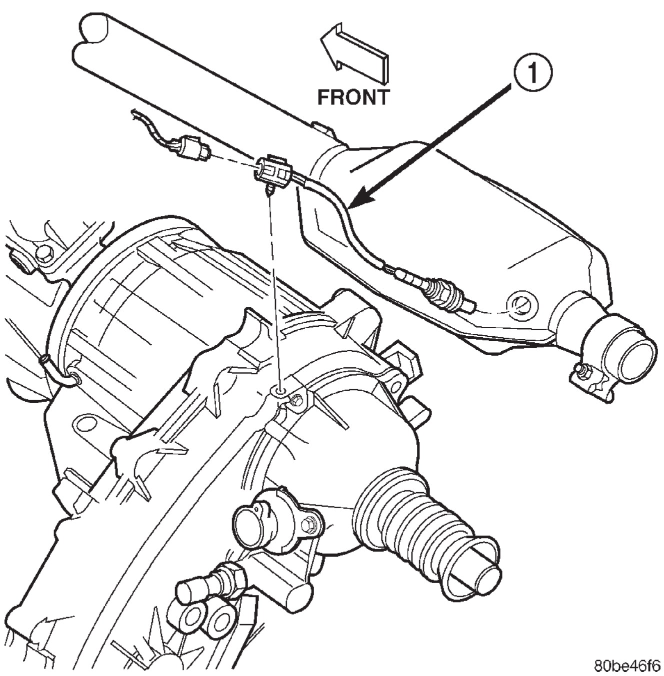


Fig. 32 Rear Oxygen Sensor—2.5L—Federal Emissions

1 - 1/2 O2S

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.

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.

REMOVAL

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).

(1) Remove air cleaner tube at throttle body.

(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 33) or (Fig. 34).

(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

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**

THROTTLE BODY (Continued)

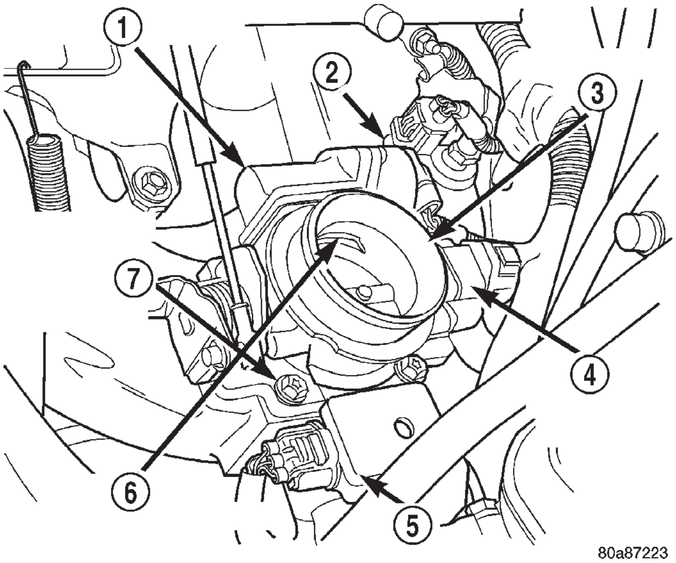


Fig. 33 THROTTLE BODY AND SENSOR LOCATIONS - 2.5L

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)

speed using this screw. All idle speed functions are controlled by the Powertrain Control Module (PCM).

(1) Clean mating surfaces of throttle body and intake manifold.

(2) Install new throttle body-to-intake manifold gasket.

(3) Install throttle body to intake manifold.

(4) Install four mounting bolts. Tighten bolts to 11 N·m (100 in. lbs.) torque.

(5) Install control cables.

(6) Install electrical connectors.

(7) Install air cleaner at throttle body.

THROTTLE CONTROL 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. 14) . 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. 14) at dash panel. Remove cable housing from dash panel and pull into engine compartment.

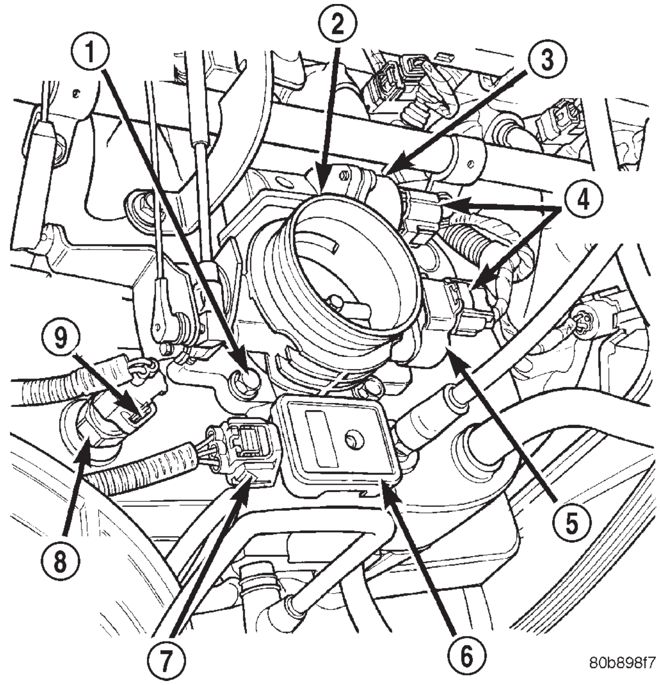


Fig. 34 THROTTLE BODY AND SENSOR LOCATIONS - 4.0L

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.

(4) Remove cable from clip guides on engine cylinder head (valve) cover (Fig. 35) .

(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. 36) .

(6) Remove throttle cable from throttle body mounting bracket by compressing release tabs (Fig. 36) and pushing cable through hole in bracket.

(7) Remove throttle cable from vehicle.

INSTALLATION

(1) Slide throttle cable through hole in throttle body bracket until retainer tabs lock into bracket. Connect cable ball end to throttle body linkage ball (snaps on).

(2) Snap cable into clip guides on engine cylinder head (valve) cover.

(3) Push other end of cable through opening in dash panel until retaining tabs lock into panel.

(4) From inside drivers compartment, slide throttle cable core wire into opening in top of accelerator pedal arm. An index tab is located on pedal arm.

THROTTLE CONTROL CABLE (Continued)

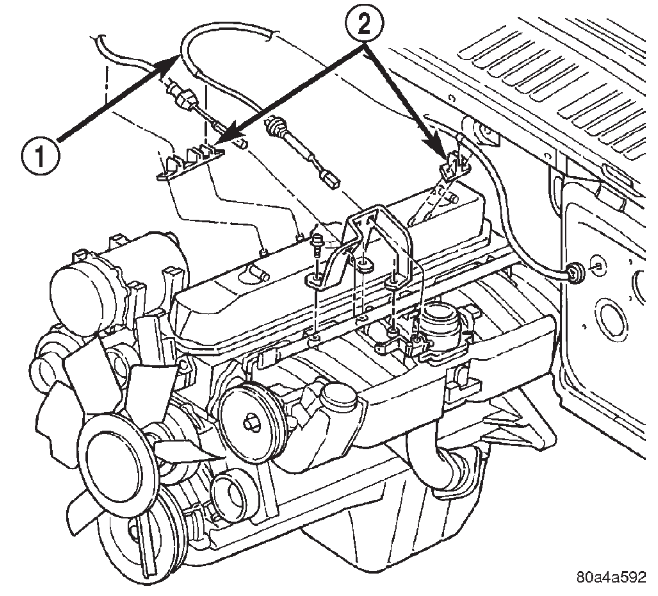


Fig. 35 Throttle Cable Routing

1 - THROTTLE CABLE
2 - GUIDE

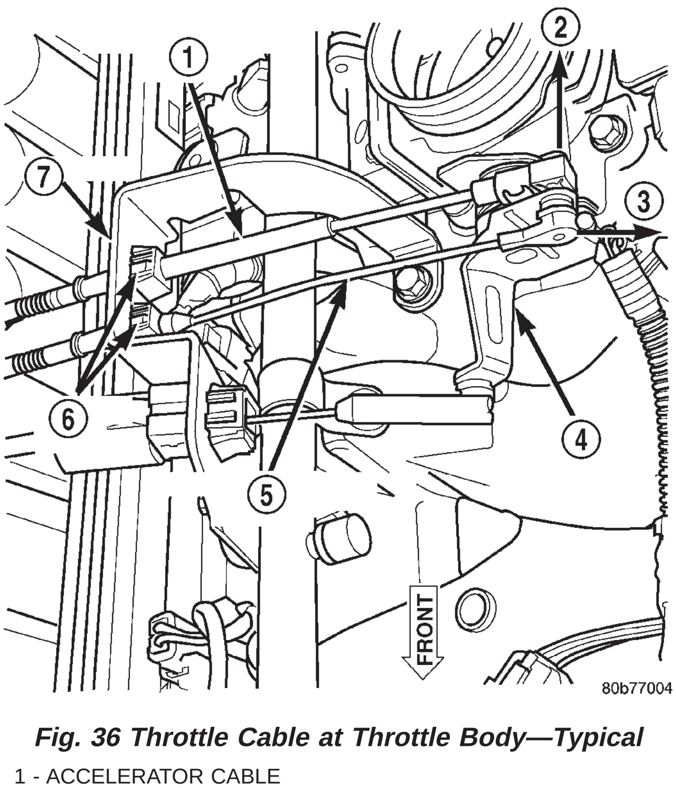


Fig. 36 Throttle Cable at Throttle Body—Typical

1 - ACCELERATOR CABLE
2 - OFF
3 - OFF
4 - THROTTLE BODY BELLCRANK
5 - SPEED CONTROL CABLE
6 - RELEASE TABS
7 - BRACKET

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.

THROTTLE POSITION SENSOR

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 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)

REMOVAL

The TPS is mounted to the throttle body (Fig. 33) or (Fig. 34) .

(1) Remove air cleaner tube at throttle body.

(2) Disconnect TPS electrical connector.

(3) Remove TPS mounting screws (Fig. 37) .

(4) Remove TPS.

THROTTLE POSITION SENSOR (Continued)

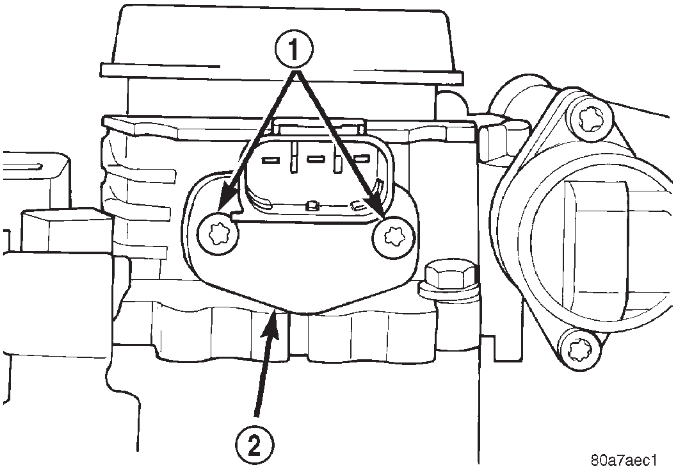


Fig. 37 TPS Mounting Screws

1 - MOUNTING SCREWS
2 - TPS

INSTALLATION

The TPS is mounted to the throttle body (Fig. 33) or (Fig. 34) .

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 38) . 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.

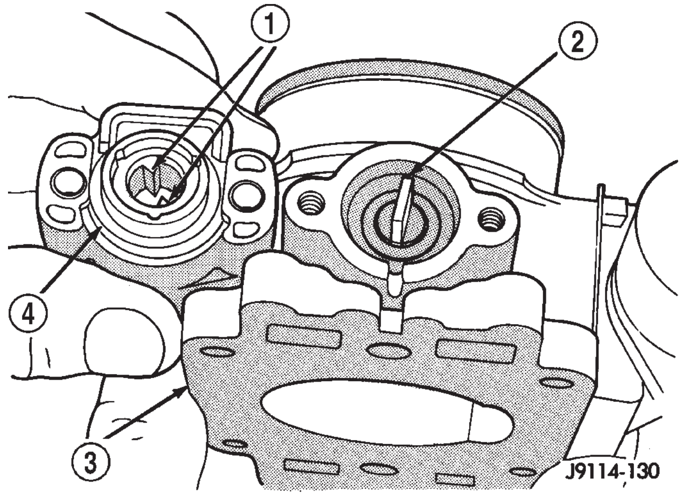


Fig. 38 Throttle Position Sensor—Installation

1 - TANGS
2 - THROTTLE SHAFT
3 - THROTTLE BODY
4 - TPS

(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.

STEERING

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STEERING

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.

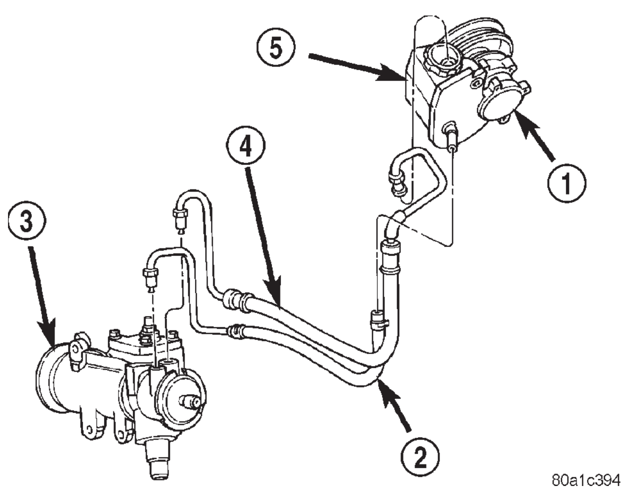

Fig. 1 Power Steering Gear & Pump – 4.0L

1 - 4.0 L PUMP
2 - RETURN HOSE
3 - STEERING GEAR
4 - PRESSURE HOSE
5 - RESERVOIR

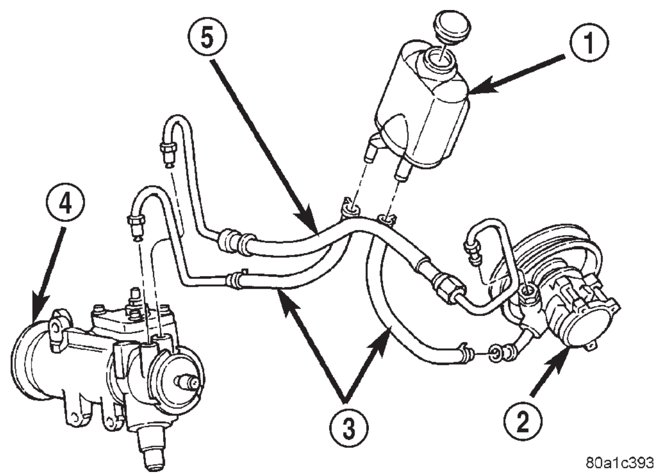

Fig. 2 Power Steering Gear & Pump – 2.5L

1 - REMOTE RESERVOIR
2 - 2.5 L PUMP
3 - RETURN HOSES
4 - STEERING GEAR
5 - PRESSURE HOSE

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.

STEERING (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - POWER STEERING SYSTEM DIAGNOSIS CHARTS

STEERING NOISE

There is some noise in all power steering systems. One of the most common is a hissing sound evident at a standstill parking. Or when the steering wheel is at the end of it's travel. Hiss is a high frequency noise similar to that of a water tap being closed slowly. The noise is present in all valves that have a high velocity fluid passing through an orifice. There is no relationship between this noise and steering performance.

CONDITION	POSSIBLE CAUSES	CORRECTION
OBJECTIONAL HISS OR WHISTLE	1. Steering intermediate shaft to dash panel seal. 2. Noisy valve in power steering gear.	1. Check and repair seal at dash panel. 2. Replace steering gear.
RATTLE OR CLUNK	1. Gear mounting bolts loose. 2. Loose or damaged suspension components/track bar. 3. Loose or damaged steering linkage. 4. Internal gear noise. 5. Pressure hose in contact with other components.	1. Tighten bolts to specification. 2. Inspect and repair suspension. 3. Inspect and repair steering linkage. 4. Replace gear. 5. Reposition hose.
CHIRP OR SQUEAL	1. Loose belt.	1. Adjust or replace.
WHINE OR GROWL	1. Low fluid level. 2. Pressure hose in contact with other components. 3. Internal pump noise. 4. Air in the system.	1. Fill to proper level. 2. Reposition hose. 3. Replace pump. 4. Perform pump initial operation.
SUCKING AIR SOUND	1. Loose return line clamp. 2. O-ring missing or damaged on hose fitting. 3. Low fluid level. 4. Air leak between pump and reservoir.	1. Replace clamp. 2. Replace o-ring. 3. Fill to proper level. 4. Repair as necessary.
SCRUBBING OR KNOCKING	1. Wrong tire size. 2. Wrong gear.	1. Verify tire size. 2. Verify gear.

STEERING (Continued)

BINDING AND STICKING

CONDITION	POSSIBLE CAUSE	CORRECTION
DIFFICULT TO TURN WHEEL STICKS OR BINDS	1. Low fluid level.	1. Fill to proper level.
	2. Tire pressure.	2. Adjust tire pressure.
	3. Steering component.	3. Inspect and lube.
	4. Loose belt.	4. Adjust or replace.
	5. Low pump pressure.	5. Pressure test and replace if necessary.
	6. Column shaft coupler binding.	6. Replace coupler.
	7. Steering gear worn or out of adjustment.	7. Repair or replace gear.
	8. Ball joints binding.	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.	1. Adjust tire pressure.
	2. Low fluid level.	2. Fill to proper level.
	3. Loose belt.	3. Adjust or replace.
	4. Lack of lubrication.	4. Inspect and lubricate steering and suspension compnents.
	5. Low pump pressure.	5. Pressure test and repair as necessary.
	6. Internal gear leak.	6. Pressure and flow test, and repair as necessary.
STEERING WHEEL DOES NOT WANT TO RETURN TO CENTER POSITION	1. Tire pressure.	1. Adjust tire pressure.
	2. Wheel alignment.	2. Align front end.
	3. Lack of lubrication.	3. Inspect and lubricate steering and suspension compnents.
	4. High friction in steering gear.	4. Test and adjust as necessary.
	5. Ball joints binding.	5. Inspect and repair as necessary.

NOTE:
Some roads will cause a vehicle to drift, due to the crown in the road.

STEERING (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.

DIAGNOSIS AND TESTING - 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.

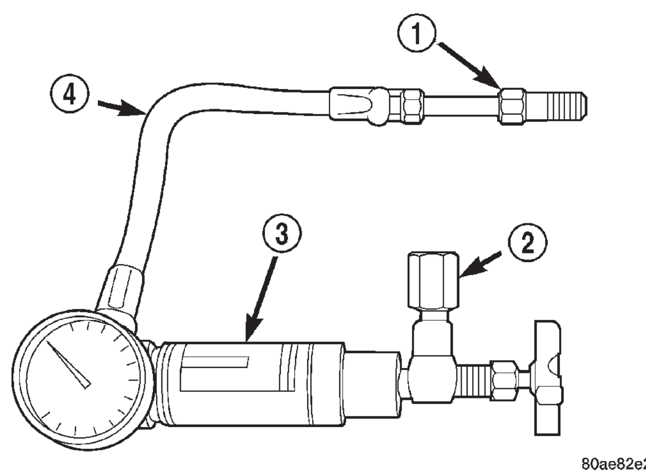

Fig. 3 Power Steering Analyzer

1 - TUBE
2 - ADAPTER FITTINGS
3 - ANALYZER
4 - GAUGE HOSE

(6) Connect the power steering hose from the steering gear to Adapter 6826.

(7) Open the test valve completely.

STEERING (Continued)

(8) Start engine and let idle long enough to circulate power steering fluid through flow/pressure test gauge.

(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)	

COLUMN

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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.

OPERATION - 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 Electrical - Restraints 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

(1) Position front wheels **straight ahead.**

(2) Remove and isolate the negative ground cable from the battery.

(3) Remove the airbag, (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

NOTE: If equipped with cruise control, disconnect clock spring harness from the cruise switch harness on the steering wheel.

COLUMN (Continued)

(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.

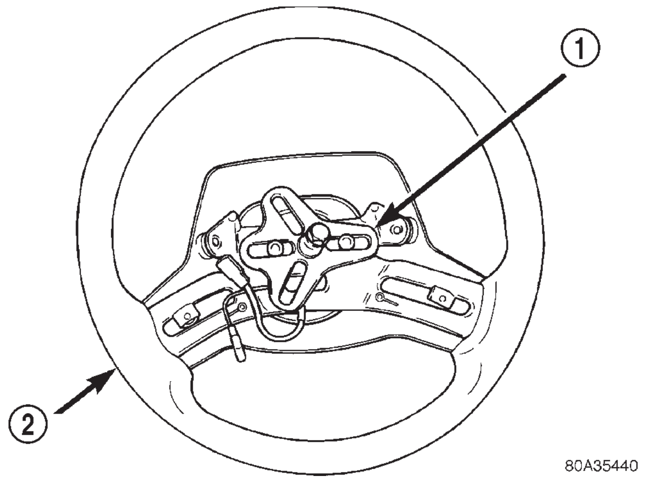


Fig. 1 Steering Wheel

1 - PULLER
2 - STEERING WHEEL

(5) Turn ignition cylinder to the on position and remove cylinder by pressing release through lower shroud access hole (Fig. 2) (Refer to 19 - STEERING/COLUMN/LOCK CYLINDER HOUSING - REMOVAL).

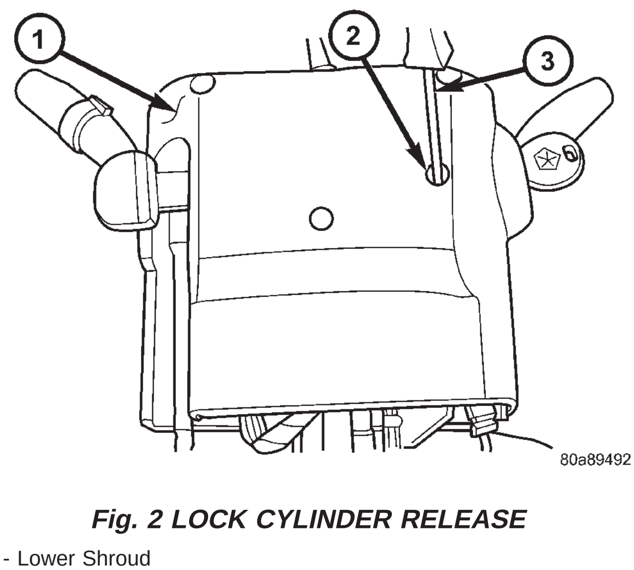


Fig. 2 LOCK CYLINDER RELEASE

1 - Lower Shroud
2 - Lock Cylinder Release Access Hole
3 - Pin Punch

(6) Remove knee blocker cover and knee blocker, (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - REMOVAL).

(7) Remove screws from the lower column shroud (Fig. 3) and remove the shroud.

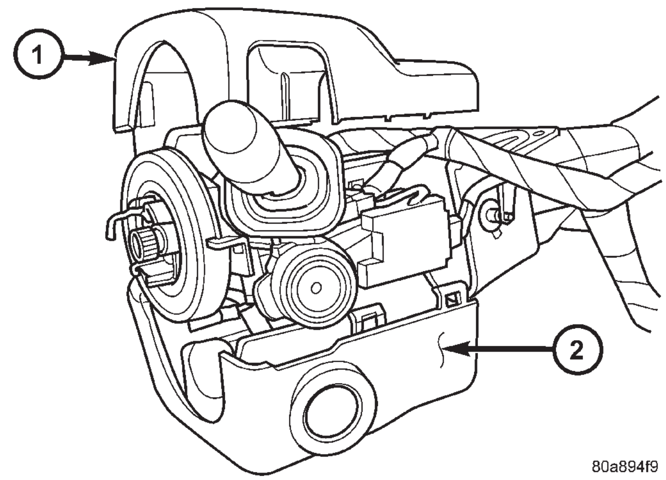


Fig. 3 SHROUD REMOVAL/INSTALL

1 - Upper Shroud
2 - Lower Shroud

(8) Remove the steering coupler bolt and column mounting nuts (Fig. 4) then lower column off the mounting studs.

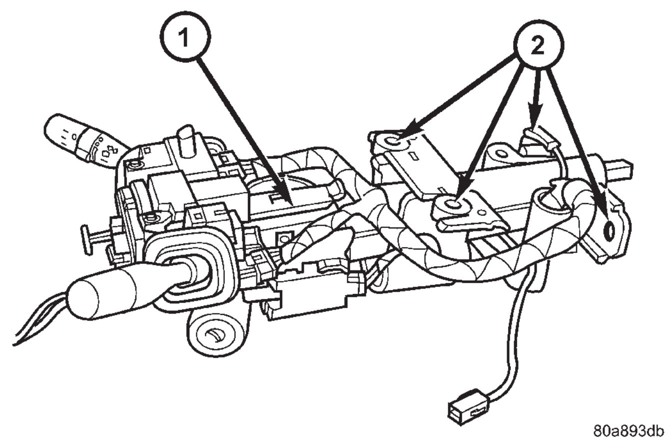


Fig. 4 STEERING COLUMN MOUNTING

1 - Steering Column
2 - Mounting Holes

(9) Remove upper column shroud (Fig. 3).

COLUMN (Continued)

(10) Disconnect and remove the wiring harness from the column (Fig. 5).

NOTE: If vehicle is equipped with automatic transmission, remove shifter interlock cable from the column. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 30RH/GEAR SHIFT CABLE - REMOVAL).

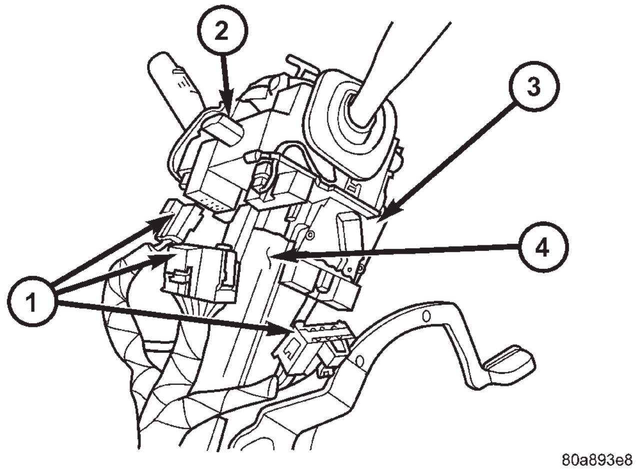


Fig. 5 WIRING HARNESS COLUMN

1 - Column Wiring Harness
2 - Multi-function Switch
3 - Ignition Switch
4 - Steering Column

(11) Remove column.

(12) Remove clock spring (Fig. 6), switches, (SKIM if equipped) (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

INSTALLATION

(1) Align and install column into the steering coupler.

(2) Install column harness and connect harness to switches.

NOTE: If vehicle is equipped with automatic transmission, install shifter interlock cable. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 30RH/GEAR SHIFT CABLE - ADJUSTMENTS).

(3) Install the upper column shroud.

(4) Install the column onto the mounting studs.

CAUTION: Lower nuts must be installed and tightened first then the upper nuts in order to prevent damage to the capsules.

(5) Install the lower mounting nuts and tighten to 17 N·m (150 in. lbs.).

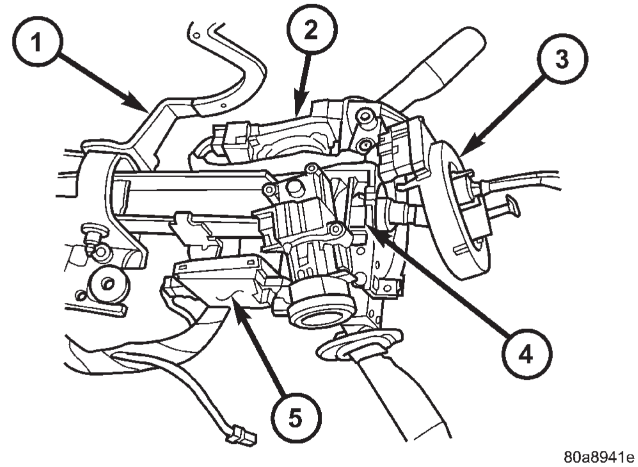


Fig. 6 CLOCK SPRING

1 - Tilt Lever
2 - Ignition Switch
3 - Clockspring
4 - Steering Column
5 - SKIM

(6) Install the upper mounting nuts and tighten to 17 N·m (150 in. lbs.).

(7) Install the steering column coupler bolt and tighten to 49 N·m (36 ft. lbs.).

(8) Center the clock spring (if necessary) and install it on the column, (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - INSTALLATION).

(9) Install the lower column shroud and install mounting screws.

(10) Install the ignition lock cylinder. (Refer to 19 - STEERING/COLUMN/LOCK CYLINDER HOUSING - INSTALLATION).

(11) Install the knee blocker and the knee blocker cover, (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - INSTALLATION).

NOTE: Do not reuse the old steering wheel bolt (a new bolt must be used)

(12) Install the steering wheel and tighten bolt 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.

(13) Install the airbag, (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

(14) Install the negative battery terminal.

COLUMN (Continued)

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Tilt Steering Column Steering Wheel Nut	54	40	—
Tilt Steering Column Mounting Nuts	17	—	150
Tilt Steering Column Coupler Bolt	49	36	—
Non-Tilt Steering Column Steering Wheel Nut	54	40	—
Non-Tilt Steering Column Mounting Nuts	17	—	150
Non-Tilt Steering Column Coupler Bolt	49	36	—

IGNITION SWITCH

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.

DIAGNOSIS AND TESTING - IGNITION SWITCH

ELECTRICAL DIAGNOSIS

For ignition switch electrical schematics, Refer to the appropriate section for the component.

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 system is used to lock the transmission shifter in the PARK position when the key lock cylinder is rotated to the LOCKED or ACCESSORY position. 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 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 30RH/GEAR SHIFT CABLE - ADJUSTMENTS). The interlock system within the steering column is not serviceable. If repair is necessary, the steering column assembly must be replaced. (Refer to 19 - STEERING/COLUMN - REMOVAL).

Vehicles equipped with a manual transmission and a floor mounted shifter: on certain models, a button is located on the steering column behind the ignition key lock cylinder. The button must be manually depressed 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 19 - STEERING/COLUMN - REMOVAL).

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 19 - STEERING/COLUMN - REMOVAL).

REMOVAL

The ignition key must be in the key cylinder for cylinder removal. The key cylinder must be removed first before removing ignition switch.

(1) Remove key cylinder. (Refer to 19 - STEERING/COLUMN/LOCK CYLINDER HOUSING - REMOVAL).

(2) Remove lower steering column cover screws and remove cover.

IGNITION SWITCH (Continued)

(3) Remove the multi-function switch.

(4) Disconnect the electrical connector at the rear of the ignition switch.

(5) Remove the ignition switch mounting screw (Fig. 7). Use tamper proof torx bit to remove the screw.

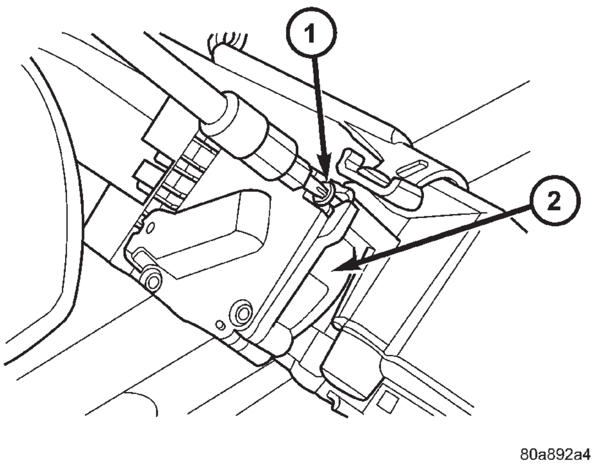


Fig. 7 IGNITION SWITCH MOUNTING SCREW

1 - Tamper Proof Torx Screw
2 - Ignition Switch

(6) Pull the ignition switch straight out to remove from the locking tabs (Fig. 8)

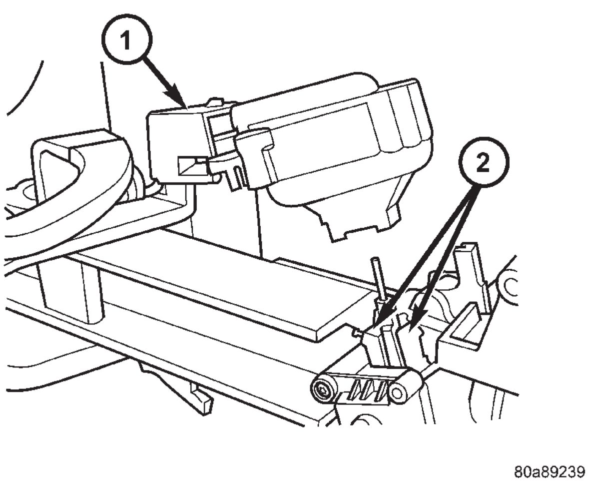


Fig. 8 IGNITION SWITCH TABS

1 - Ignition Switch
2 - Locking Tabs

INSTALLATION

The ignition key must be in the key cylinder for cylinder installation. The key cylinder must be aligned with the ignition switch for installation.

(1) Before installing ignition switch, rotate the slot in the switch to the ON position (Fig. 9).

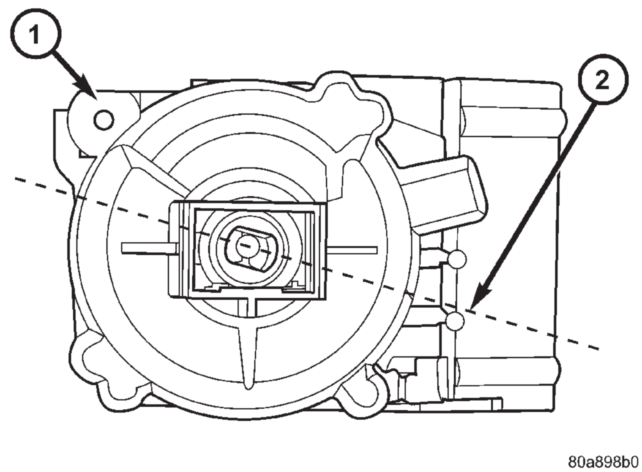


Fig. 9 IGNITION SWITCH ON POSITION

1 - Ignition Switch
2 - Rotate to On Position

(2) Connect the electrical connector to rear of ignition switch. Make sure that locking tab is fully seated into wiring connector.

(3) Position the switch to the column and install tamper proof screw. Tighten screw to 3 N·m (26 in. lbs.).

(4) Test the operation of the lock cylinder for smooth rotating.

(5) Install the multi-function switch.

(6) Install steering column lower cover.

KEY-IN IGNITION SWITCH

DESCRIPTION

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 19 - STEERING/COLUMN/IGNITION SWITCH - REMOVAL).

KEY-IN IGNITION SWITCH (Continued)

DIAGNOSIS AND TESTING - KEY-IN IGNITION SWITCH

For circuit descriptions and diagrams, Refer to the appropriate sections on the individual components.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO ELECTRICAL - 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. 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.

LOCK CYLINDER

REMOVAL

The ignition key must be in the key cylinder for cylinder removal. The key cylinder must be removed first before removing ignition switch.

(1) If equipped with an automatic transmission, place shifter in PARK position.

(2) Rotate key to ON position.

(3) A release tang is located on bottom of key cylinder (Fig. 10).

(4) Position a small screwdriver or pin punch into tang access hole on bottom of steering column lower cover (Fig. 11).

(5) Push the pin punch up while pulling key cylinder from steering column.

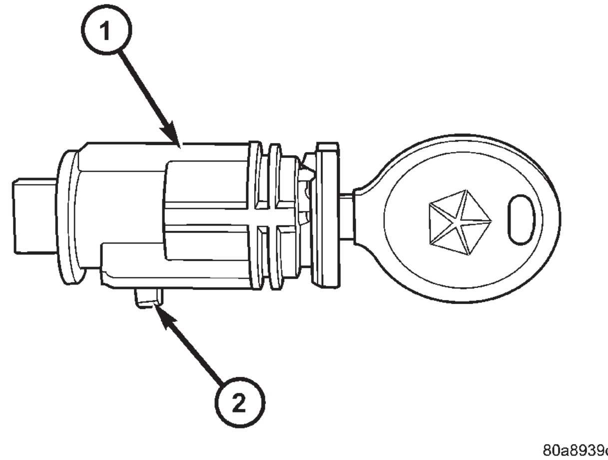


Fig. 10 LOCK CYLINDER RELEASE TANG

1 - Lock Cylinder
2 - Release Tang

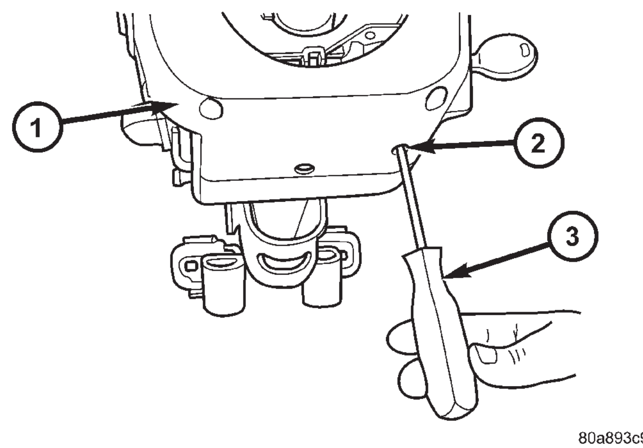


Fig. 11 LOCK CYLINDER RELEASE HOLE

1 - Lower Cover
2 - Access Hole
3 - Pin Punch

INSTALLATION

The ignition key must be in the key cylinder for cylinder installation.

(1) Install the lock cylinder into the housing using care to align the end of the lock cylinder with the ignition switch.

(2) Push the lock cylinder in until it clicks.

(3) Rotate the key to the lock position.

GEAR

TABLE OF CONTENTS

GEAR

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.

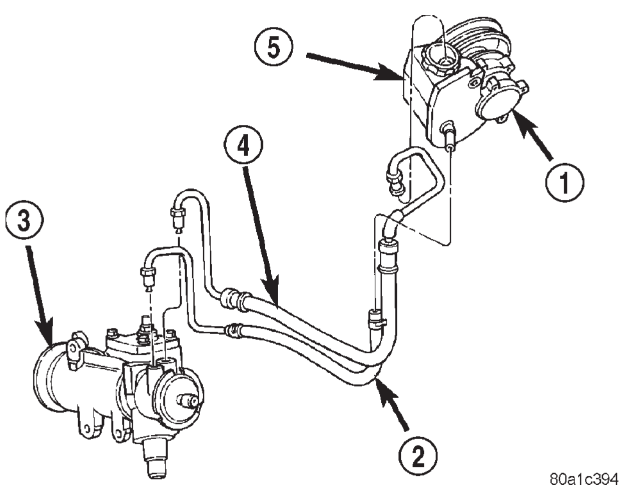


Fig. 1 Power Steering Gear & Pump – 4.0L

1 - 4.0 L PUMP
2 - RETURN HOSE
3 - STEERING GEAR
4 - PRESSURE HOSE
5 - RESERVOIR

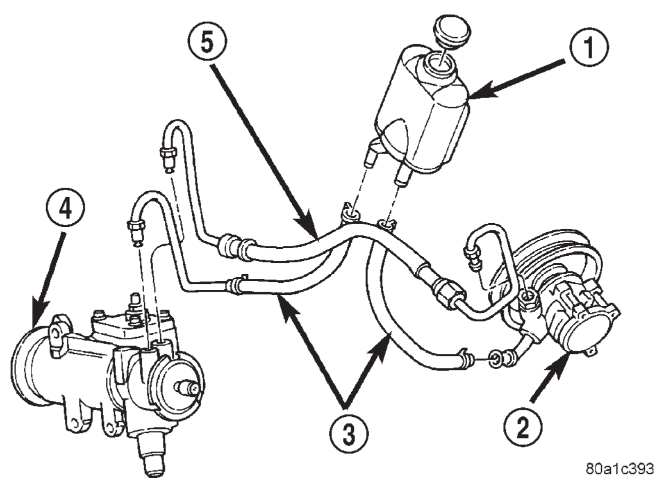


Fig. 2 Power Steering Gear & Pump – 2.5L

1 - REMOTE RESERVOIR
2 - 2.5 L PUMP
3 - RETURN HOSES
4 - STEERING GEAR
5 - PRESSURE HOSE

GEAR (Continued)

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) Possible power steering gear leakage areas. (Fig. 3).

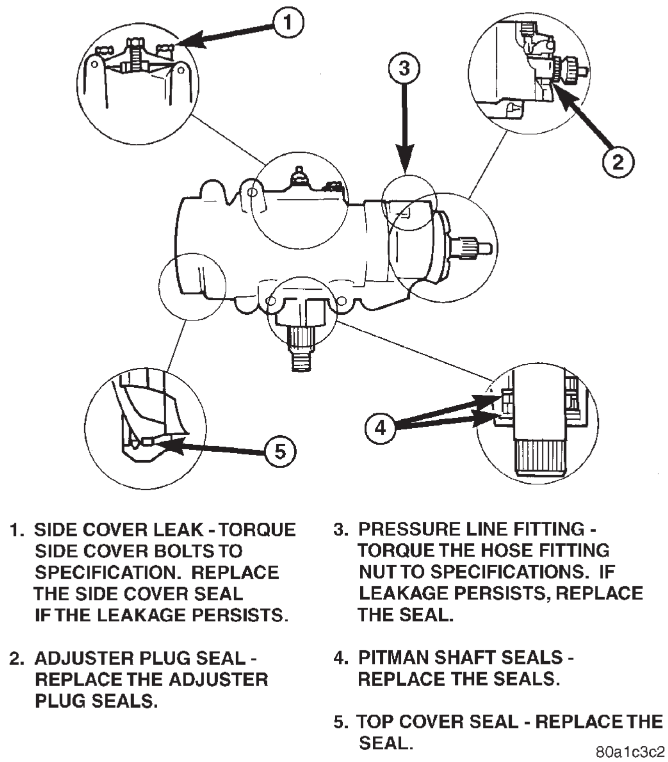


Fig. 3 STEERING GEAR

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. (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - REMOVAL).

(5) Remove the steering gear retaining bolts and remove the gear (Fig. 4).

(6) Remove power steering hoses/tubes from steering gear.

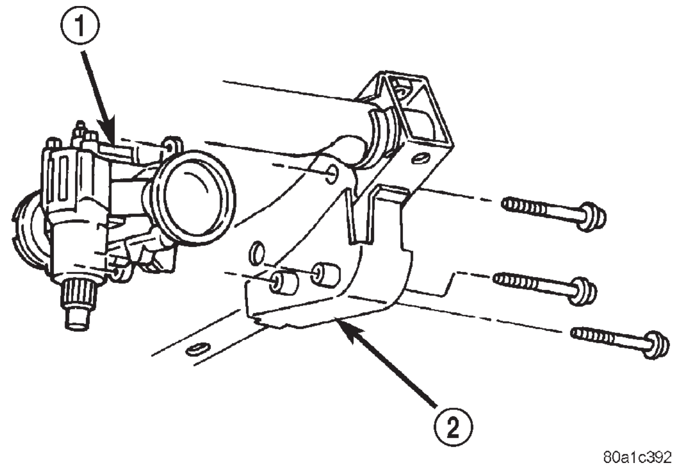


Fig. 4 Steering Gear Mounting

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 19 - STEERING/PUMP - STANDARD PROCEDURE).

ADJUSTMENTS

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.

GEAR (Continued)

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. 5).

(3) Rotate the stub shaft back and forth with a 12 point socket to drain the remaining fluid.

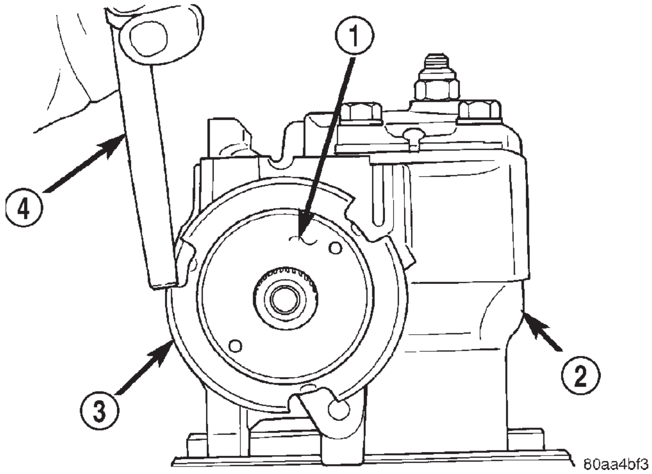


Fig. 5 Adjuster Lock Nut

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. 6).

(6) Measure back (counterclockwise) 5.08 mm (0.20 in) and mark housing (Fig. 7).

(7) Rotate adjustment cap back (counterclockwise) with spanner wrench until hole is aligned with the second mark (Fig. 8).

(8) Install and tighten locknut to 108 N·m (80 ft. lbs.). Be sure adjustment cap does not turn while tightening the locknut.

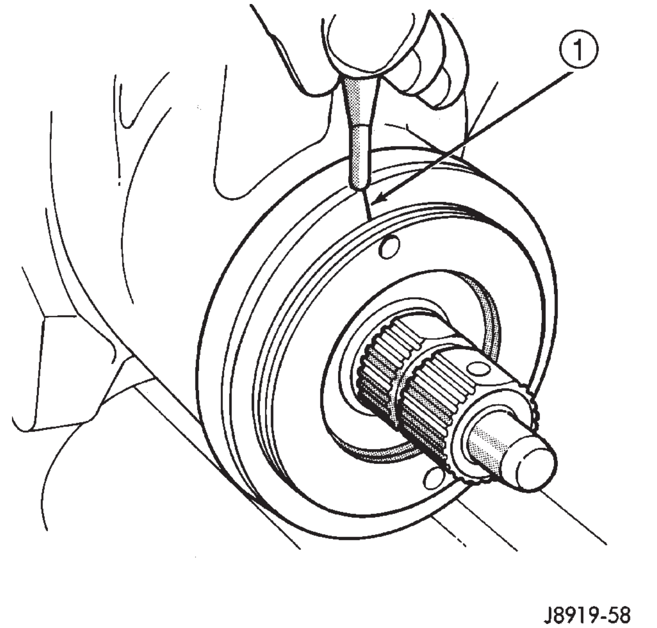


Fig. 6 Alignment Marking On Housing

1 - INDEX

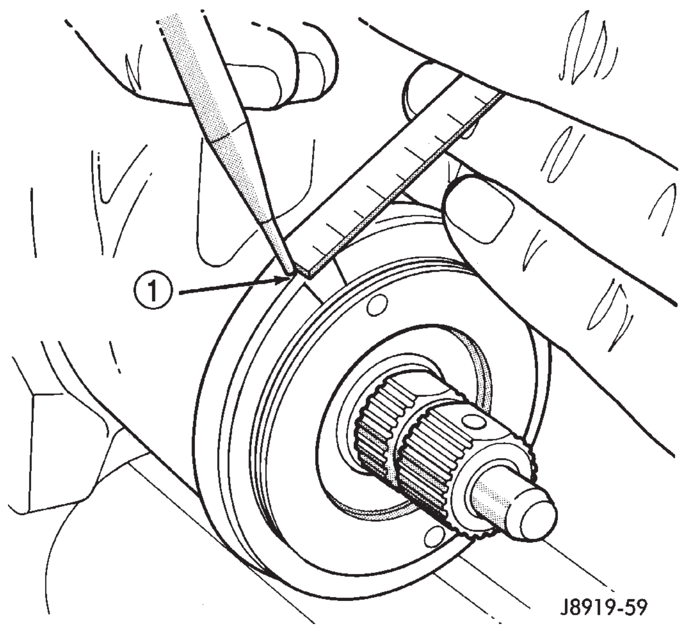


Fig. 7 Second Marking On Housing

1 - REFERENCE MARK

GEAR (Continued)

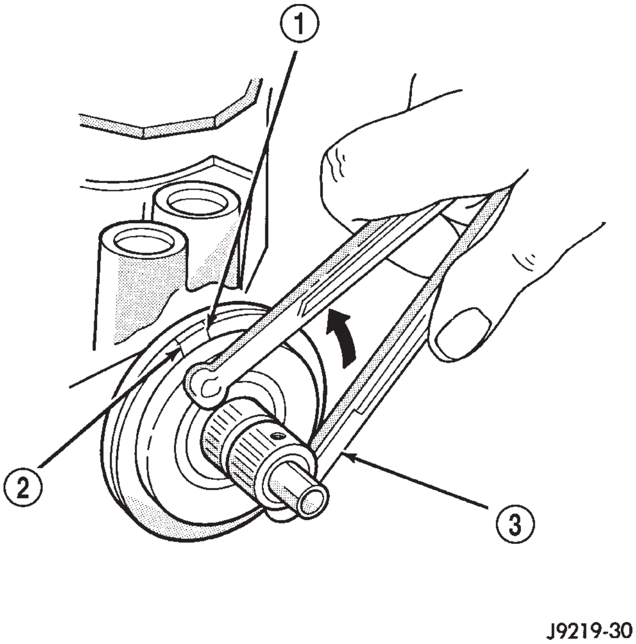


Fig. 8 Aligning To The Second Mark

1 - FIRST MARK
2 - SECOND MARK
3 - SPANNER WRENCH

OVER-CENTER ROTATING TORQUE

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. 9).

(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. 10). 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.

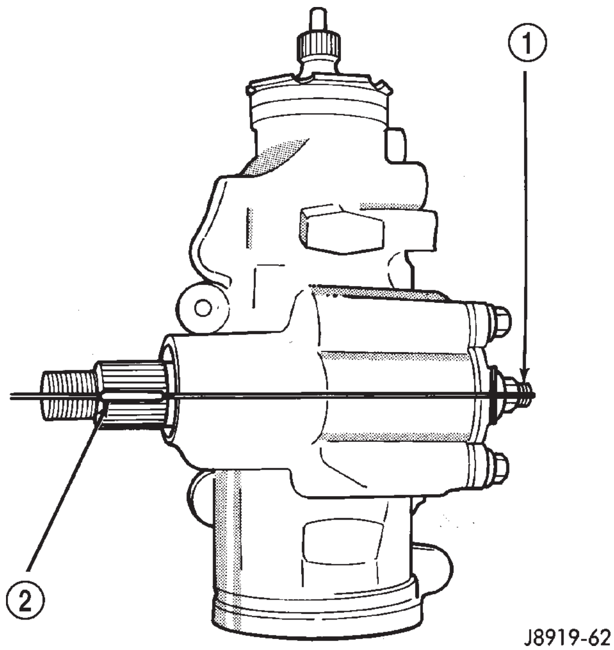


Fig. 9 Steering Gear Centered

1 - ADJUSTMENT SCREW
2 - MASTER SPLINE

(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.

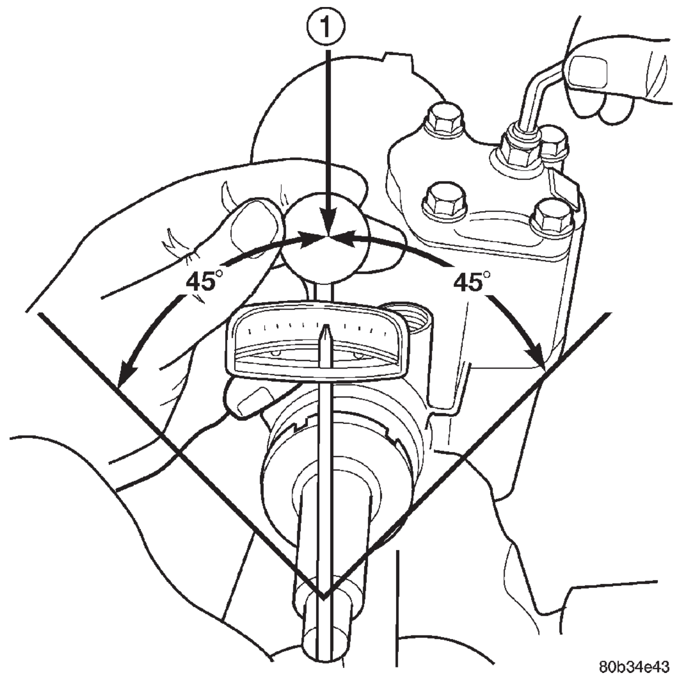


Fig. 10 Checking Over-center Rotation Torque

1 - CENTER

GEAR (Continued)

(7) Remeasure Over-Center Rotating Torque. If necessary turn the adjuster screw and repeat measurement until correct Over-Center Rotating Torque is reached.

NOTE: To increase the Over-Center Rotating Torque turn the screw CLOCKWISE.

(8) Prevent the adjuster screw from turning while tightening adjuster lock nut. Tighten the adjuster lock nut to 49 N·m (36 ft. lbs.).

SPECIFICATIONS

POWER STEERING GEAR

SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Steering Gear Type	Recirculating Ball
Steering Gear 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)	0.5–0.6 N·m (4–5 in. lbs.) + Worm Shaft Preload
Pitman Shaft Over-Center Drag Used Gear (over 400 miles)	0.5–0.6 N·m (4–5 in. lbs.) + Worm Shaft Preload

TORQUE CHART

TORQUE SPECIFICATIONS

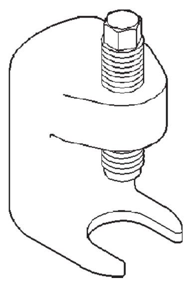
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Power Steering Gear Adjustment Cap Locknut	108	80	—
Power Steering Gear Adjustment Screw Locknut	49	36	—
Power Steering Gear Gear to Frame Bolts	95	70	—
Power Steering Gear Pitman Shaft Nut	251	185	—
Power Steering Gear Rack Piston Plug	102	75	—
Power Steering Gear Side Cover Bolts	60	44	—
Power Steering Gear Pressure Line	28	21	—
Power Steering Gear Return Line	28	21	—

GEAR (Continued)

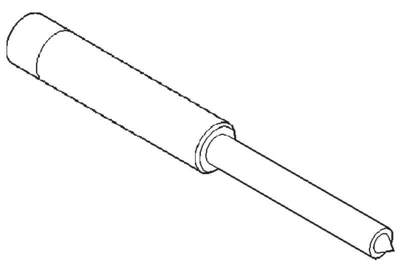
SPECIAL TOOLS

POWER STEERING GEAR

Remover/Installer, Steering Plug C-4381



Remover, Pitman Arm C-4150A



Remover/Installer Steering Rack Piston C-4175

PITMAN SHAFT

REMOVAL

(1) Clean exposed end of pitman shaft and housing with a wire brush.

(2) Remove preload adjuster nut (Fig. 11).

(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. 11).

NOTE: The pitman shaft will not clear the housing if it is not centered.

(6) Remove pitman shaft from the side cover.

(7) Remove dust seal from the housing with a seal pick (Fig. 12).

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.

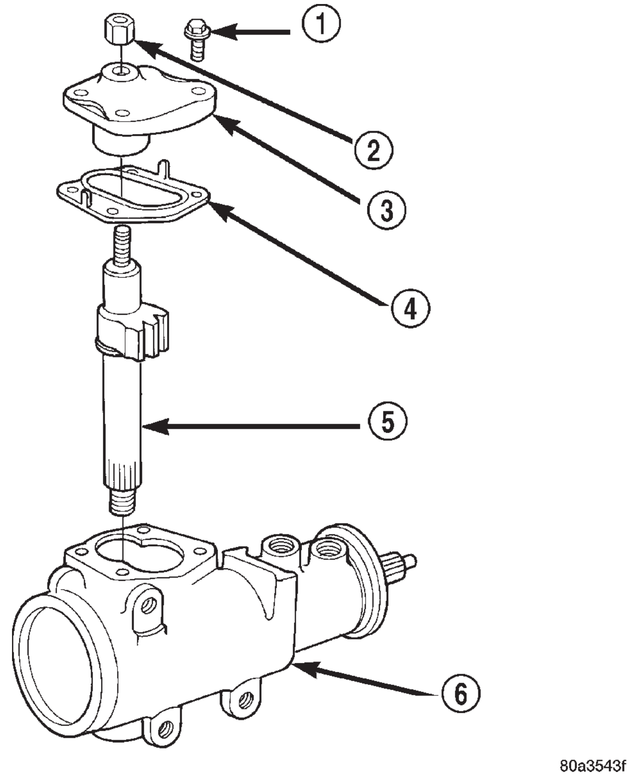


Fig. 11 Side Cover and Pitman Shaft

1 - SIDE COVER BOLTS
2 - PRELOAD ADJUSTER NUT
3 - SIDE COVER
4 - GASKET SEAL
5 - PITMAN SHAFT GEAR
6 - HOUSING ASSEMBLY

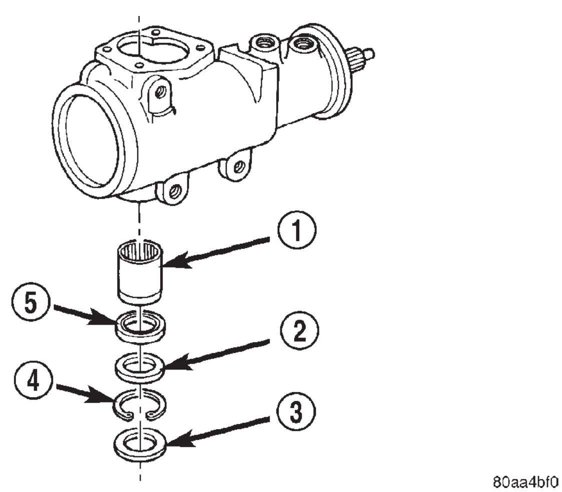


Fig. 12 Pitman Shaft Seals & Bearing

1 - BEARING
2 - WASHER
3 - DUST SEAL
4 - RETAINER
5 - OIL SEAL

PITMAN SHAFT (Continued)

(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. 13).

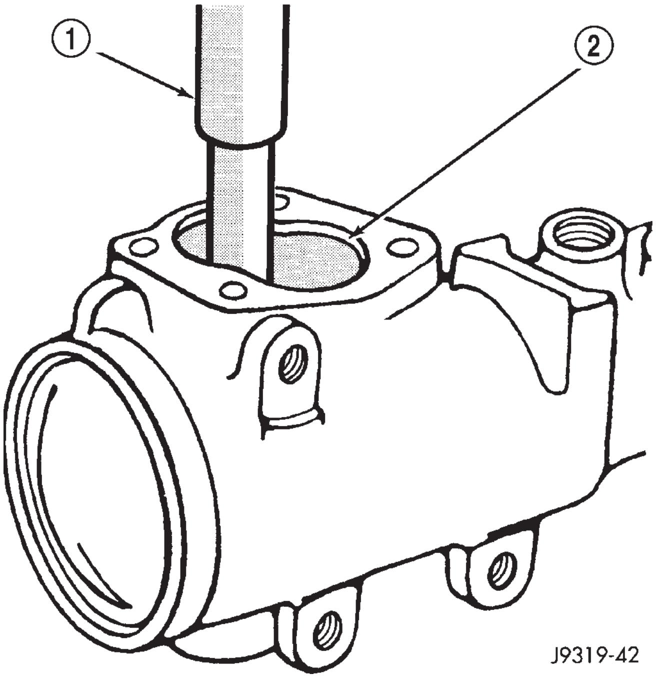


Fig. 13 Needle Bearing Removal

1 - REMOVER
2 - SIDE COVER AREA

INSTALLATION

(1) Install pitman shaft bearing into housing with a bearing driver and handle.

(2) Coat the oil seal and washer with **special grease** supplied with the new seal.

(3) Install the oil seal with a driver and handle.

(4) Install backup washer.

(5) Install the retainer ring with snap ring pliers.

(6) Coat the dust seal with **special grease** supplied with the new seal.

(7) Install dust seal with a driver and handle.

(8) Install pitman shaft to side cover by screwing shaft in until it fully seats to side cover.

(9) Install preload adjuster nut. **Do not tighten nut until after Over-Center Rotation Torque adjustment has been made.**

(10) Install gasket to side cover and bend tabs around edges of side cover (Fig. 11).

(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. (Refer to 19 - STEERING/GEAR - ADJUSTMENTS).

PITMAN BEARING

REMOVAL

(1) Clean exposed end of pitman shaft and housing with a wire brush.

(2) Remove preload adjuster nut (Fig. 14).

(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. 14).

NOTE: The pitman shaft will not clear the housing if it is not centered.

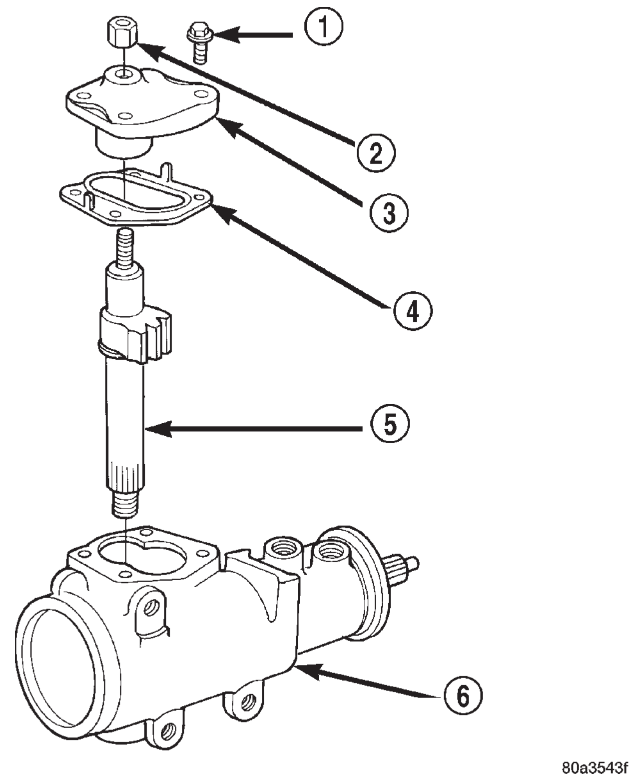


Fig. 14 Side Cover and Pitman Shaft

1 - SIDE COVER BOLTS
2 - PRELOAD ADJUSTER NUT
3 - SIDE COVER
4 - GASKET SEAL
5 - PITMAN SHAFT GEAR
6 - HOUSING ASSEMBLY

(6) Remove pitman shaft from the side cover.

(7) Remove dust seal from the housing with a seal pick (Fig. 15).

CAUTION: Use care not to score the housing bore when prying out seals and washer.

(8) Remove retaining ring with snap ring pliers.

PITMAN BEARING (Continued)

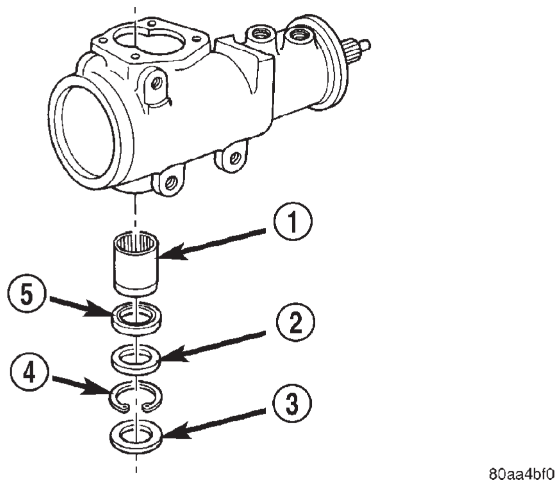


Fig. 15 Pitman Shaft Seals & Bearing

1 - BEARING
2 - WASHER
3 - DUST SEAL
4 - RETAINER
5 - OIL SEAL

(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. 16).

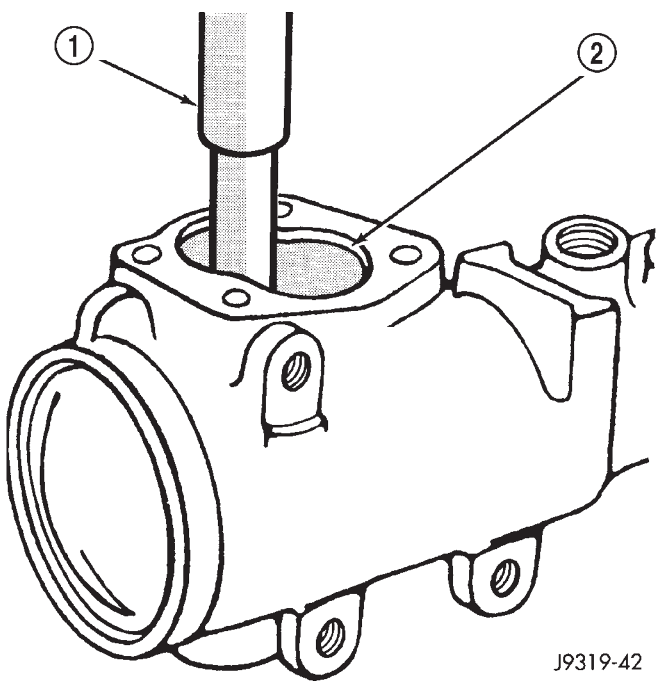


Fig. 16 Needle Bearing Removal

1 - REMOVER
2 - SIDE COVER AREA

INSTALLATION

(1) Install upper pitman shaft bearing, with Driver 8294 and Handle C-4171 (Fig. 17). Drive bearing into housing until the driver bottoms out.

NOTE: Install upper pitman shaft bearing with the part number/letters facing the driver.

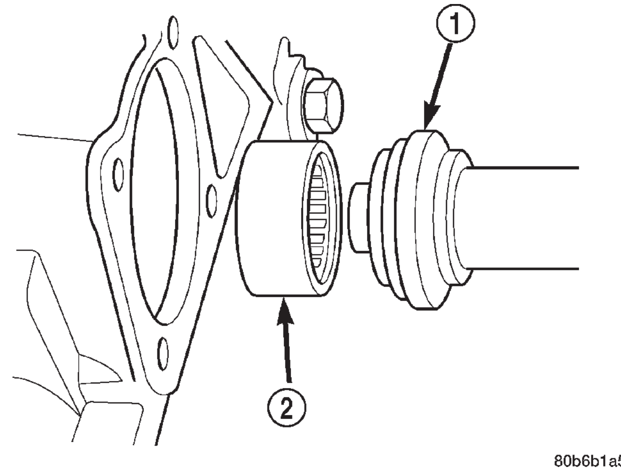


Fig. 17 Upper Pitman

1 - DRIVER
2 - UPPER BEARING

(2) Install lower pitman shaft bearing with the other side Driver 8294 and Handle C-4171 (Fig. 18). Drive bearing into housing until the bearing shoulder is seated against the housing.

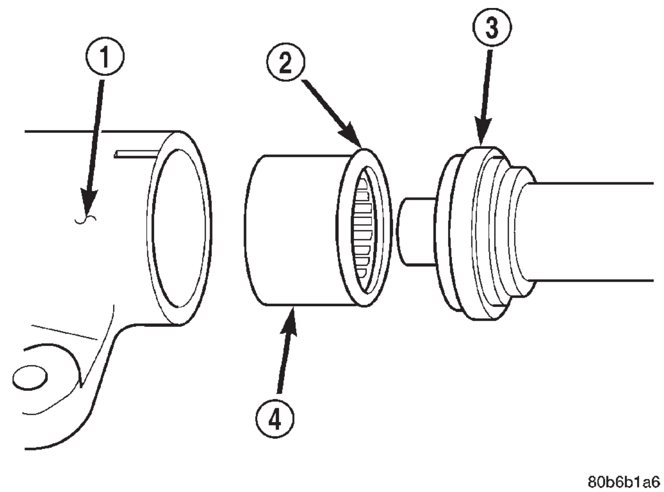


Fig. 18 Lower Pitman Shaft Bearing

1 - STEERING GEAR
2 - BEARING SHOULDER
3 - DRIVER
4 - LOWER BEARING

PITMAN BEARING (Continued)

(3) Coat the oil seal and backup washers with **special grease** supplied with the new seal.

(4) Install the oil seal with Driver 8294 and Handle C-4171.

(5) Install plastic backup washer.

NOTE: The plastic backup washer has a lip on the inside diameter that faces down towards the oil seal.

(6) Install metal backup washer.

(7) Install the retainer ring with snap ring pliers.

(8) Coat the dust seal with **special grease** supplied with the new seal.

(9) Install dust seal with Driver 8294 and Handle C-4171.

(10) Install new pitman shaft cover o-ring.

(11) Install pitman shaft assembly into the housing.

(12) Install cover bolts and tighten to 62 N·m (46 ft. lbs.).

(13) Perform over-center rotation torque adjustment. (Refer to 19 - STEERING/GEAR - ADJUSTMENTS).

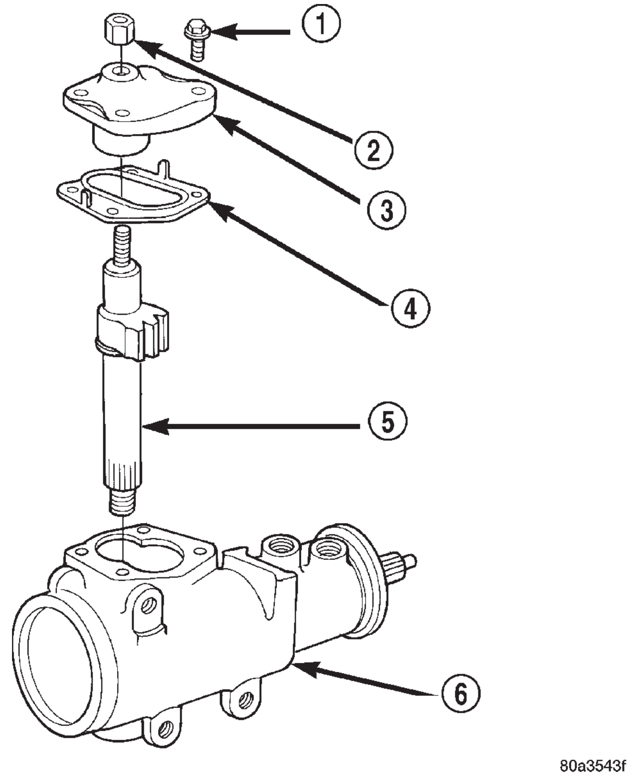


Fig. 19 Side Cover and Pitman Shaft

1 - SIDE COVER BOLTS
2 - PRELOAD ADJUSTER NUT
3 - SIDE COVER
4 - GASKET SEAL
5 - PITMAN SHAFT GEAR
6 - HOUSING ASSEMBLY

PITMAN SHAFT SEAL

REMOVAL

PITMAN SHAFT/SEALS/BEARING

(1) Clean exposed end of pitman shaft and housing with a wire brush.

(2) Remove preload adjuster nut (Fig. 19).

(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. 19).

NOTE: The pitman shaft will not clear the housing if it is not centered.

(6) Remove pitman shaft from the side cover.

(7) Remove dust seal from the housing with a seal pick (Fig. 20).

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.

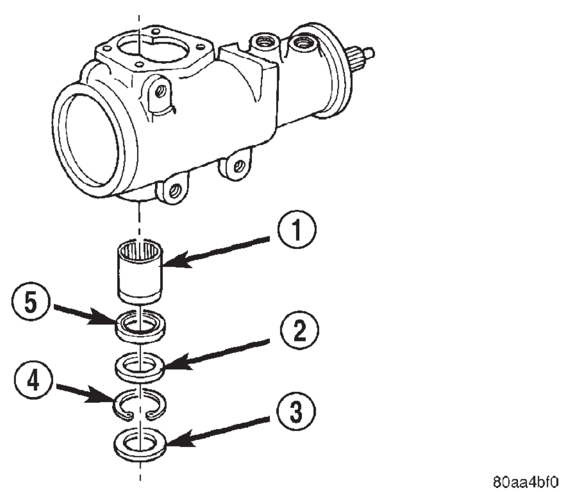


Fig. 20 Pitman Shaft Seals & Bearing

1 - BEARING
2 - WASHER
3 - DUST SEAL
4 - RETAINER
5 - OIL SEAL

PITMAN SHAFT SEAL (Continued)

(11) Remove pitman shaft bearing from housing with a bearing driver and handle (Fig. 21).

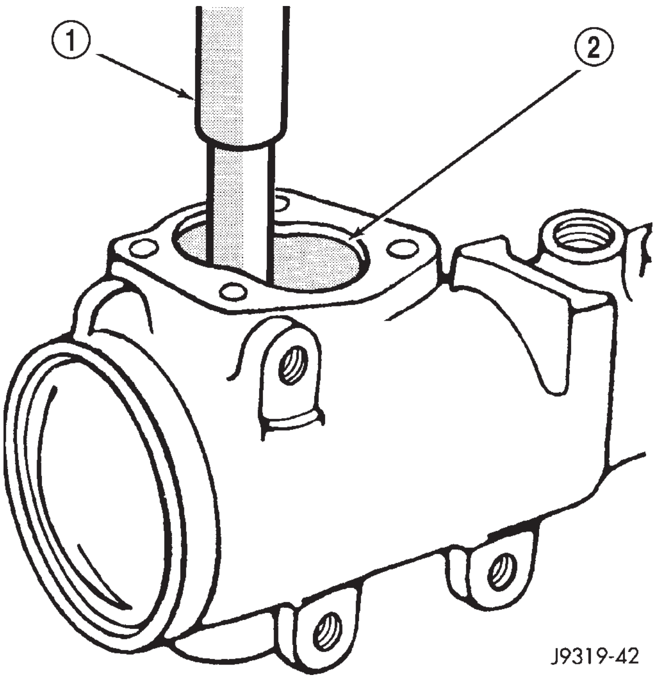


Fig. 21 Needle Bearing Removal

1 - REMOVER
2 - SIDE COVER AREA

INSTALLATION

(1) Install upper pitman shaft bearing, with Driver 8294 and Handle C-4171 (Fig. 22). Drive bearing into housing until the driver bottoms out.

NOTE: Install upper pitman shaft bearing with the part number/letters facing the driver.

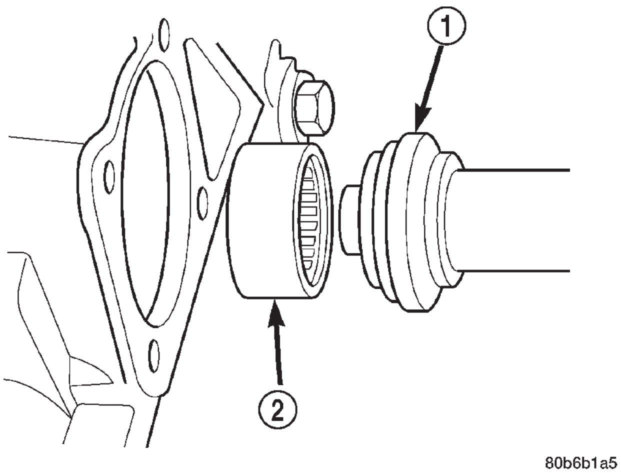


Fig. 22 Upper Pitman Shaft Bearing

1 - DRIVER
2 - UPPER BEARING

(2) Install lower pitman shaft bearing with the other side Driver 8294 and Handle C-4171 (Fig. 23). Drive bearing into housing until the bearing shoulder is seated against the housing.

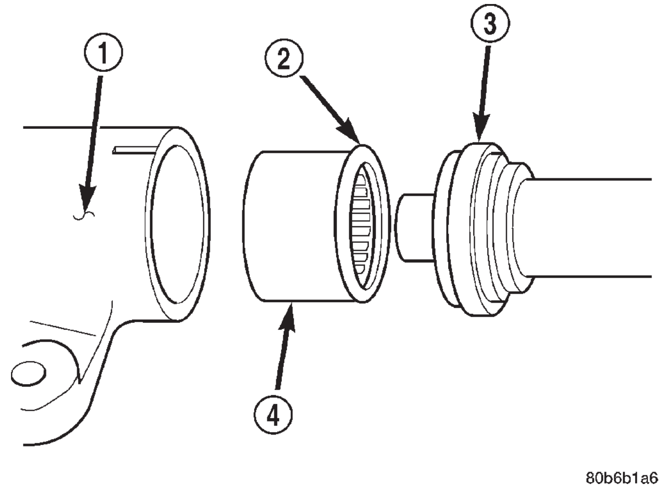


Fig. 23 Lower Pitman Shaft Bearing

1 - STEERING GEAR
2 - BEARING SHOULDER
3 - DRIVER
4 - LOWER BEARING

(3) Coat the oil seal and backup washers with **special grease** supplied with the new seal.

(4) Install the oil seal with Driver 8294 and Handle C-4171.

(5) Install plastic backup washer.

NOTE: The plastic backup washer has a lip on the inside diameter that faces down towards the oil seal.

(6) Install metal backup washer.

(7) Install the retainer ring with snap ring pliers.

(8) Coat the dust seal with **special grease** supplied with the new seal.

(9) Install dust seal with Driver 8294 and Handle C-4171.

(10) Install new pitman shaft cover o-ring.

(11) Install pitman shaft assembly into the housing.

(12) Install cover bolts and tighten to 62 N·m (46 ft. lbs.).

(13) Perform over-center rotation torque adjustment.

SPOOL VALVE

REMOVAL

(1) Remove lock nut (Fig. 24).

(2) Remove adjuster nut with Spanner Wrench C-4381.

(3) Remove thrust support assembly out of the housing (Fig. 25).

(4) Pull stub shaft and valve assembly from the housing (Fig. 26).

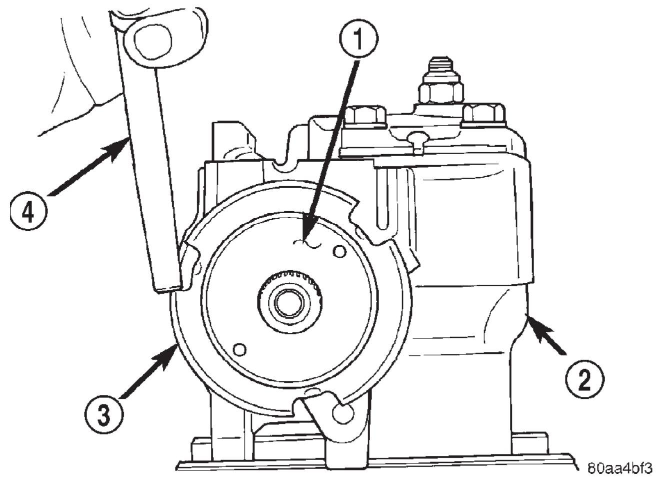


Fig. 24 Lock Nut and Adjuster Nut

1 - ADJUSTER NUT
2 - STEERING GEAR
3 - LOCK NUT
4 - PUNCH

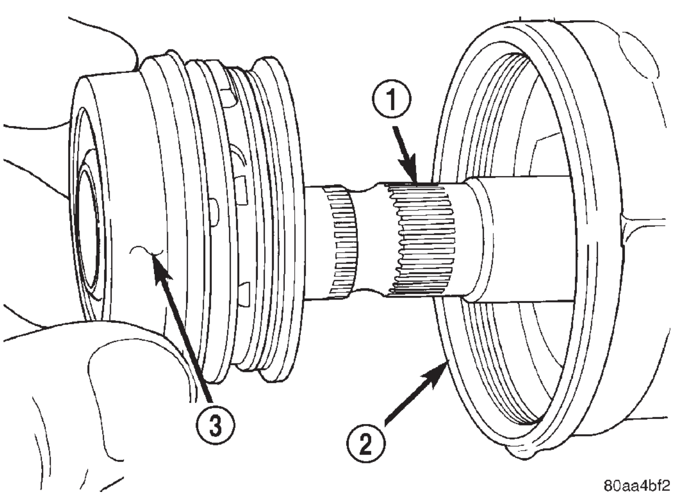


Fig. 25 Thrust Support Assembly

1 - STUB SHAFT
2 - HOUSING
3 - THRUST SUPPORT ASSEMBLY

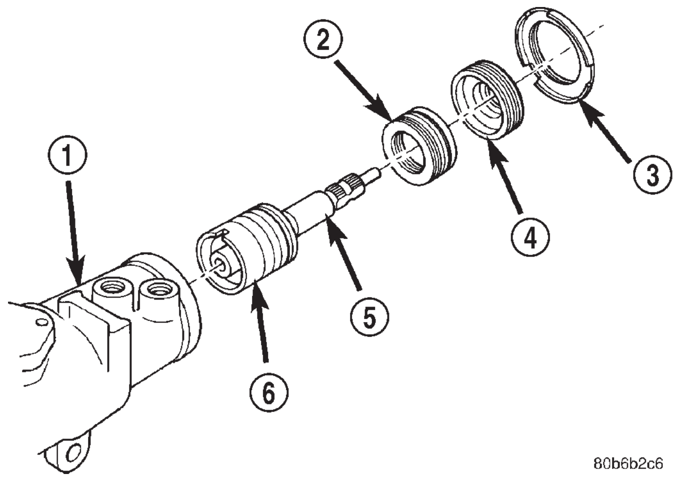


Fig. 26 Valve Assembly With Stub Shaft

1 - GEAR
2 - THRUST SUPPORT
3 - LOCK NUT
4 - ADJUSTER NUT
5 - STUB SHAFT
6 - VALVE ASSEMBLY

(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. 27).

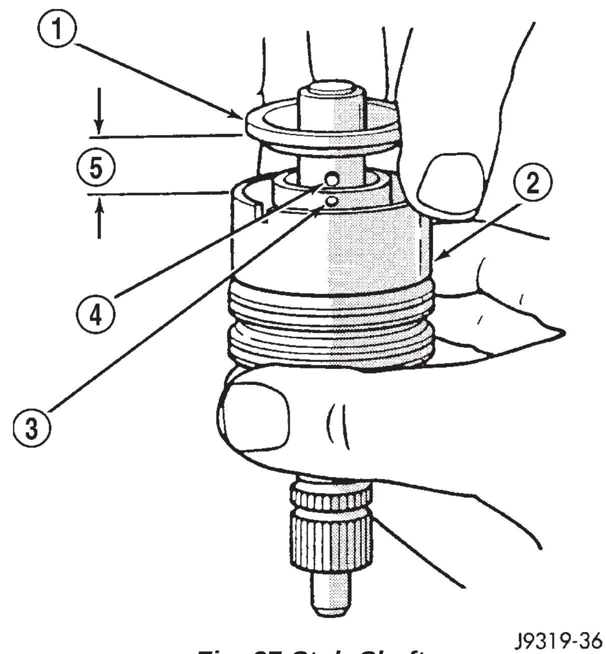


Fig. 27 Stub Shaft

1 - STUB SHAFT
2 - VALVE BODY
3 - HOLE IN SPOOL
4 - SHAFT PIN
5 - 6mm (1/4″)

SPOOL VALVE (Continued)

(6) Remove spool valve from valve body by pulling and rotating the spool valve from the valve body (Fig. 28).

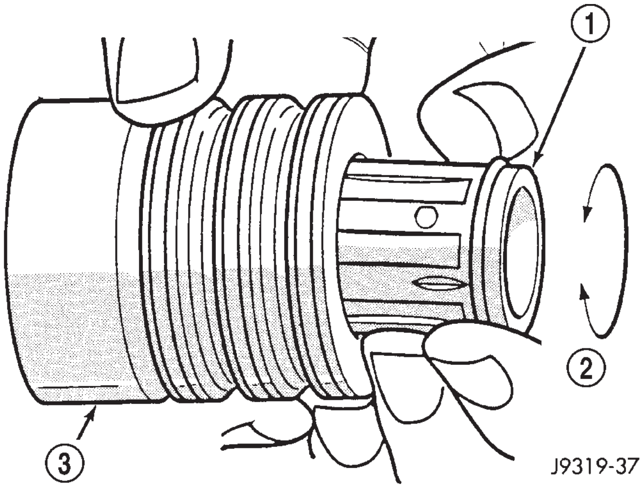


Fig. 28 Spool Valve

1 - SPOOL VALVE
2 - ROTATE VALVE TO REMOVE
3 - VALVE BODY

(7) Remove spool valve O-ring and valve body teflon rings and O-rings underneath the teflon rings (Fig. 29).

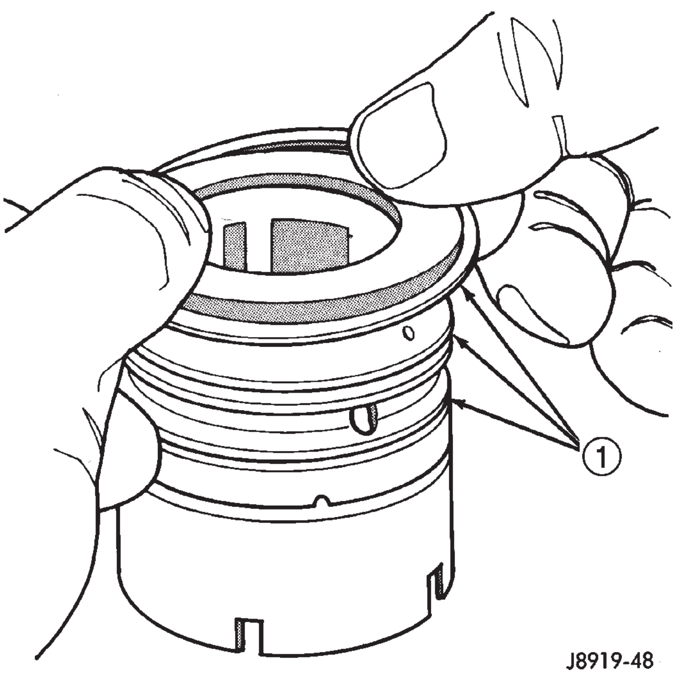


Fig. 29 Valve Seals

1 - O-RING SEALS

(8) Remove the O-ring between the worm shaft and the stub shaft.

INSTALLATION

NOTE: Clean and dry all components, then lubricate with power steering fluid.

(1) Install spool valve spool O-ring.
(2) Install spool valve in valve body by pushing and rotating. Hole in spool valve for stub shaft pin must be accessible from opposite end of valve body.
(3) Install stub shaft in valve spool and engage locating pin on stub shaft into spool valve hole (Fig. 30).

NOTE: Notch in stub shaft cap must fully engage valve body pin and seat against valve body shoulder.

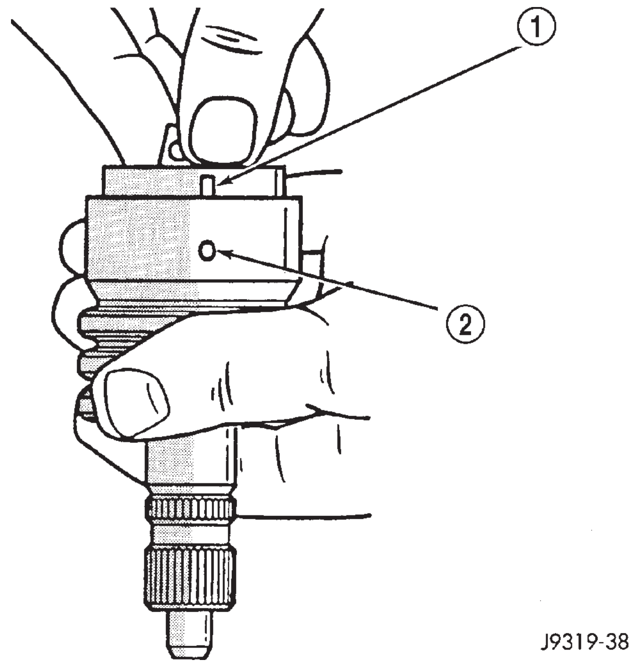


Fig. 30 Stub Shaft Installation

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. 31).
(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.

SPOOL VALVE (Continued)

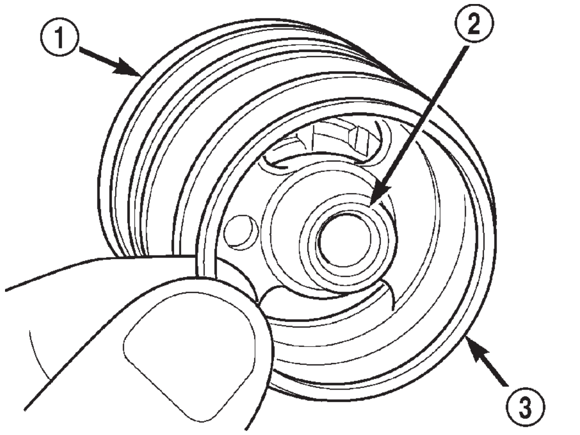


Fig. 31 Stub Shaft Cap O-Ring

1 - VALVE BODY
2 - STUB SHAFT CAP
3 - O-RING

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. (Refer to 19 - STEERING/GEAR - ADJUSTMENTS).

STEERING GEAR HOUSING PLUG

REMOVAL

(1) Unseat and remove retaining ring from groove with a punch through the hole in the end of the housing (Fig. 32).

(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. 33).

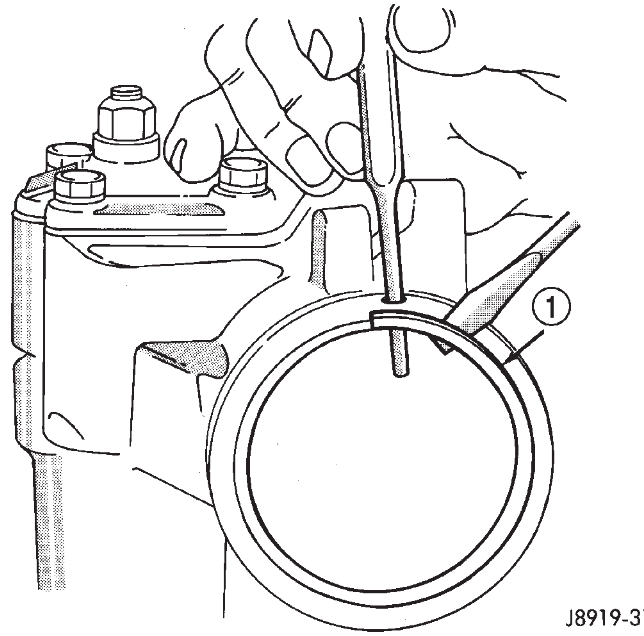


Fig. 32 End Plug Retaining Ring

1 - RETAINING RING

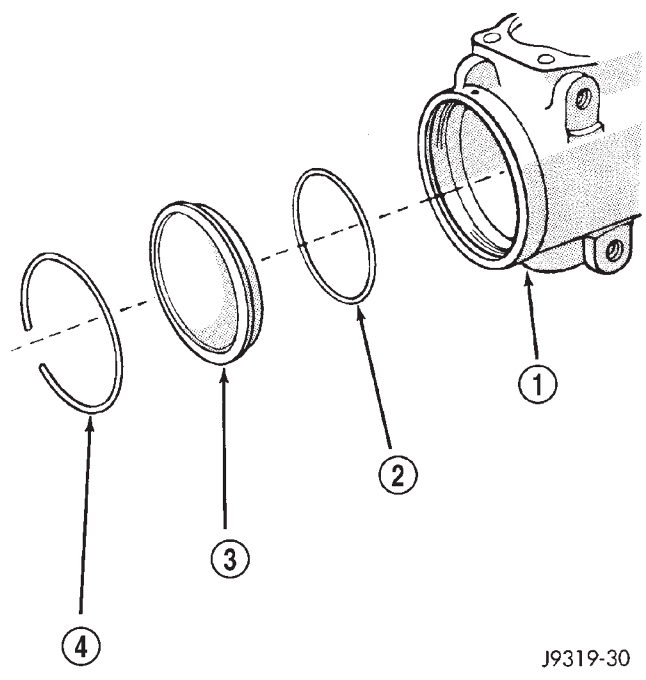


Fig. 33 End Plug Components

1 - HOUSING ASSEMBLY
2 - HOUSING END PLUG O-RING SEAL
3 - HOUSING END PLUG
4 - RETAINING RING

STEERING GEAR HOUSING PLUG (Continued)

INSTALLATION

(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. 34).

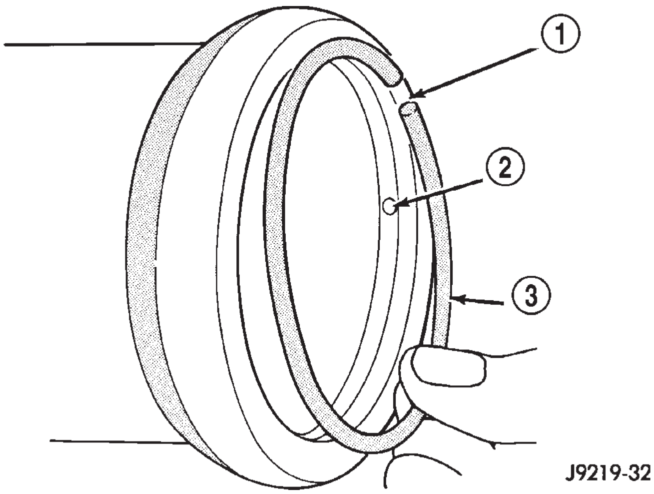


Fig. 34 Installing The

1 - RING CAP
2 - PUNCH ACCESS HOLE
3 - RETAINER RING

WORM SHAFT

REMOVAL

(1) Remove housing end plug. (Refer to 19 - STEERING/GEAR/STEERING GEAR HOUSING PLUG - REMOVAL).

(2) Remove rack piston plug (Fig. 35).

(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. 36) 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.

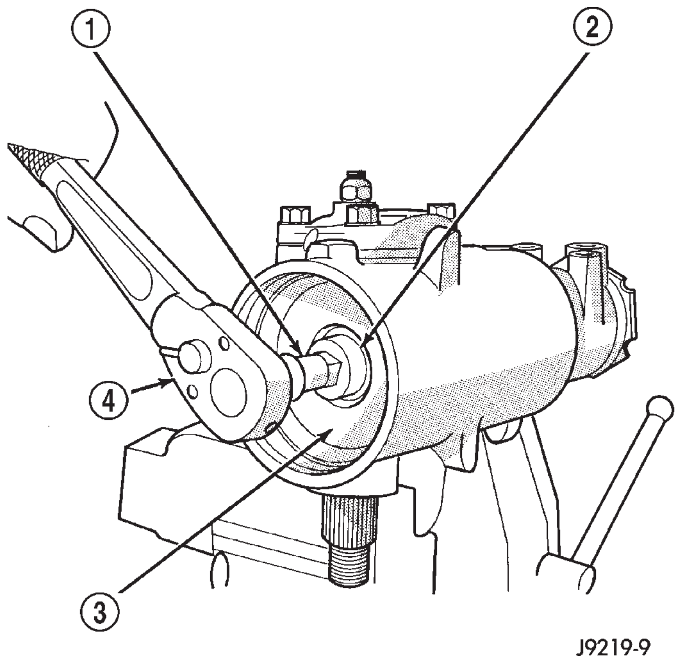


Fig. 35 Rack Piston End Plug

1 - EXTENSION
2 - END PLUG
3 - RACK PISTON
4 - RATCHET

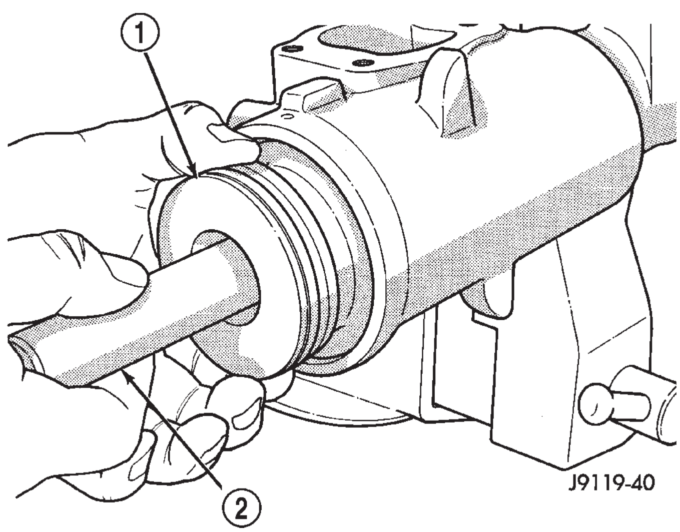


Fig. 36 Rack Piston with Arbor

1 - RACK PISTON
2 - SPECIAL TOOL C-4175

WORM SHAFT (Continued)

(10) Remove clamp bolts, clamp and ball guide (Fig. 37).

(11) Remove teflon ring and O-ring from the rack piston (Fig. 38).

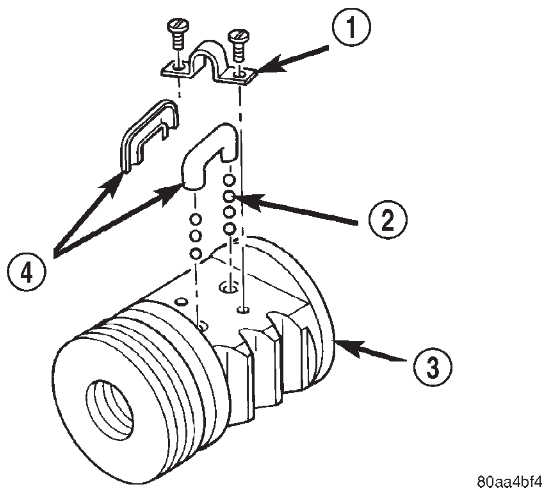


Fig. 37 Rack Piston

1 - CLAMP
2 - BALLS
3 - RACK PISTON
4 - BALL GUIDE

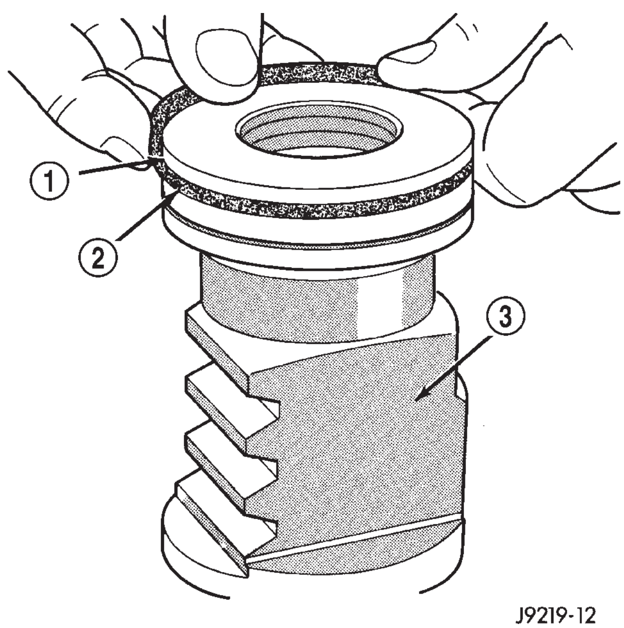


Fig. 38 Rack Piston Teflon Ring and O-Ring

1 - TEFLON SEAL
2 - BACK-UP O-RING MUST BE INSTALLED UNDER PISTON RING
3 - RACK PISTON NUT

(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. 39).

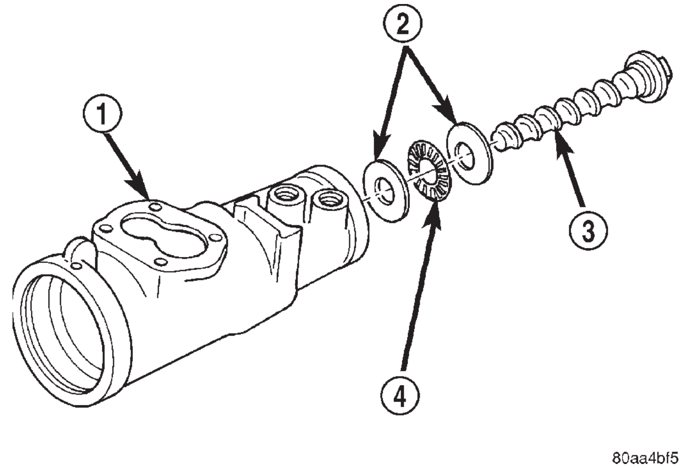


Fig. 39 Worm Shaft

1 - GEAR HOUSING
2 - BEARING RACE
3 - WORM SHAFT
4 - BEARING

INSTALLATION

NOTE: Clean and dry all components and lubricate with power steering fluid.

(1) Check for scores, nicks or burrs on the rack piston finished surface. Slight wear is normal on the worm gear surfaces.

(2) Install O-ring and teflon ring on the rack piston.

(3) Install worm shaft in the rack piston and align worm shaft spiral groove with rack piston ball guide hole (Fig. 40).

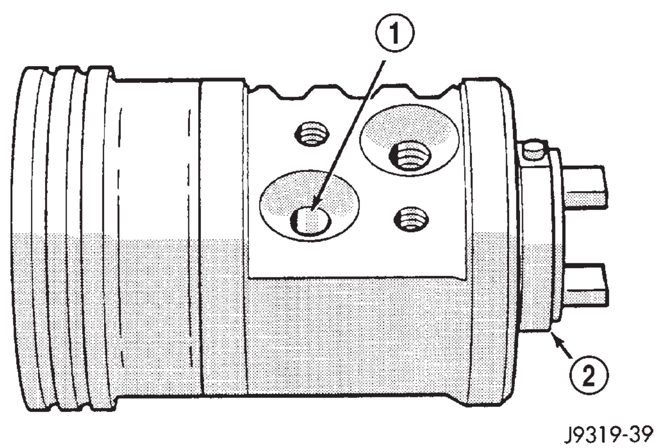


Fig. 40 Installing Balls in Rack Piston

1 - INSTALL BALLS IN THIS HOLE WHILE SLOWLY ROTATING WORM COUNTER CLOCKWISE
2 - WORM FLANGE

WORM SHAFT (Continued)

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. 40).

(5) Install remaining balls in guide using grease to hold the balls in place (Fig. 41).

(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. 39).

(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. (Refer to 19 - STEERING/GEAR/STEERING GEAR HOUSING PLUG - INSTALLATION).

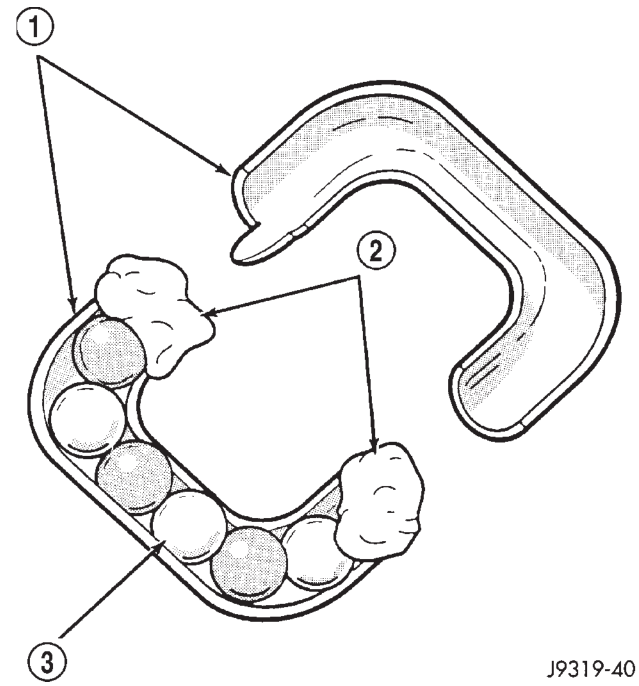


Fig. 41 Balls in the Return Guide

1 - GUIDE
2 - PETROLEUM JELLY
3 - BALLS

(16) Adjust worm shaft thrust bearing preload and over-center rotating torque. (Refer to 19 - STEERING/GEAR - ADJUSTMENTS).

LINKAGE

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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.

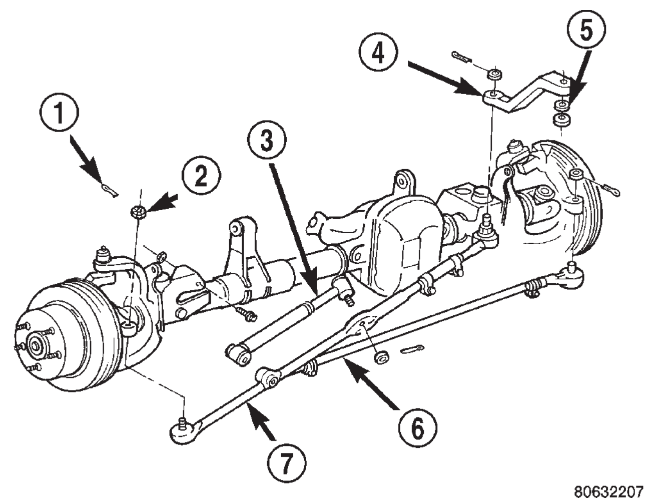


Fig. 1 Steering Linkage

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

STANDARD PROCEDURE

STANDARD PROCEDURE - LUBRICATION

Periodic lubrication of the steering system components is required. Refer to Lubrication And Maintenance for the recommended maintenance schedule.

The following components must be lubricated:

- Tie rod ends
- Drag link

STANDARD PROCEDURE - 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.

LINKAGE (Continued)

SPECIFICATIONS

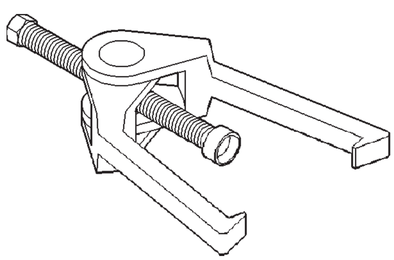
TORQUE CHART

TORQUE SPECIFICATIONS

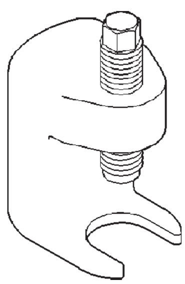
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Pitman Arm Shaft	251	185	—
Drag Link Ball Studs	74	55	—
Drag Link Clamp	49	36	—
Tie Rod Ends Ball Studs	74	55	—
Tie Rod Ends Clamp	27	20	—
Tie Rod Ball Stud	88	65	—
Steering Damper Frame	74	55	—
Steering Damper Drag Link	74	55	—

SPECIAL TOOLS

STEERING LINKAGE



Puller C-3894–A



Remover Pitman C-4150A

DAMPER

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.

DRAG LINK

REMOVAL

(1) Remove the cotter pins and nuts at the steering knuckle and drag link (Fig. 1) .

DRAG LINK (Continued)

(2) Remove the steering dampener ball stud from the drag link with a puller tool.

(3) Remove the drag link from the steering knuckle with a puller tool. Remove the same for tie rod and pitman arm.

(4) If necessary, loosen the end clamp bolts and remove the tie rod end from the link.

INSTALLATION

(1) Install the drag link adjustment sleeve and tie rod end. Position clamp bolts (Fig. 3) .

(2) Position the drag link at the steering linkage. Install the drag link to the steering knuckle nut. Do the same for the tie rod and pitman arm.

(3) Tighten the nut at the steering knuckle to 47 N·m (35 ft. lbs.). Tighten the pitman nut to 81 N·m (60 ft. lbs.) and tie rod ball stud nut to 47 N·m (35 ft. lbs.). Install new cotter pins and bend end 60°.

(4) Install the steering dampener onto the drag link and tighten the nut to 74 N·m (55 ft. lbs.). Install a new cotter pin and bend end 60°.

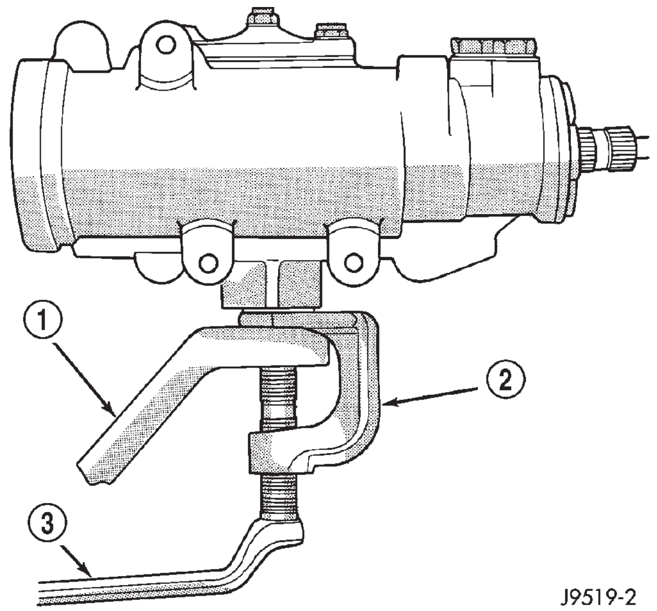


Fig. 2 Pitman Arm Removal

1 - PITMAN ARM
2 - SPECIAL TOOL C-4150-A
3 - WRENCH

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. 2) .

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.

TIE ROD END

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 C-4150R.

(3) If necessary, loosen the end clamp bolts and remove the tie rod ends from the tube.

INSTALLATION

(1) If necessary, install the tie rod ends in the tube. Position the tie rod clamp (Fig. 3) and tighten to 27 N·m (20 ft. lbs.).

(2) Install the tie rod on the drag link and steering knuckle.

(3) Tighten the ball stud nut on the steering knuckle to 47 N·m (35 ft. lbs.). Tighten the ball stud nut to drag link to 47 N·m (35 ft. lbs.) torque. Install new cotter pins.

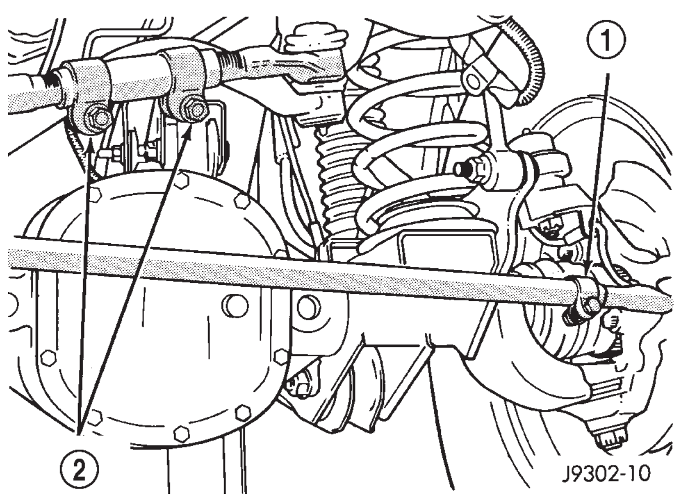


Fig. 3 Tie Rod

1 - TIE ROD CLAMP
2 - DRAG LINK CLAMPS

PUMP

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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.

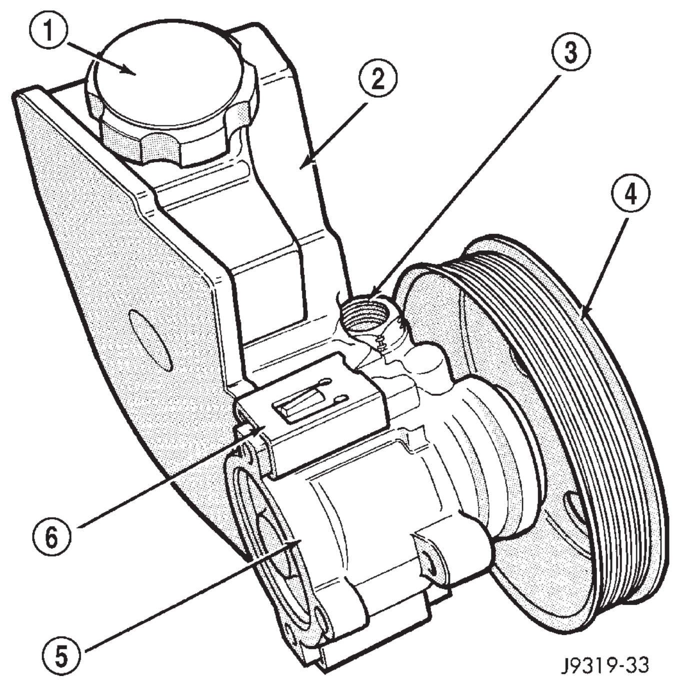


Fig. 1 Pump With Integral Reservoir

1 - CAP
2 - FLUID RESERVOIR (TYPICAL)
3 - HIGH-PRESSURE FITTING
4 - DRIVE PULLEY
5 - PUMP BODY
6 - RESERVOIR CLIP

PUMP (Continued)

DIAGNOSIS AND TESTING - PUMP LEAKAGE

(1) Possible areas of pump leakage (Fig. 2).

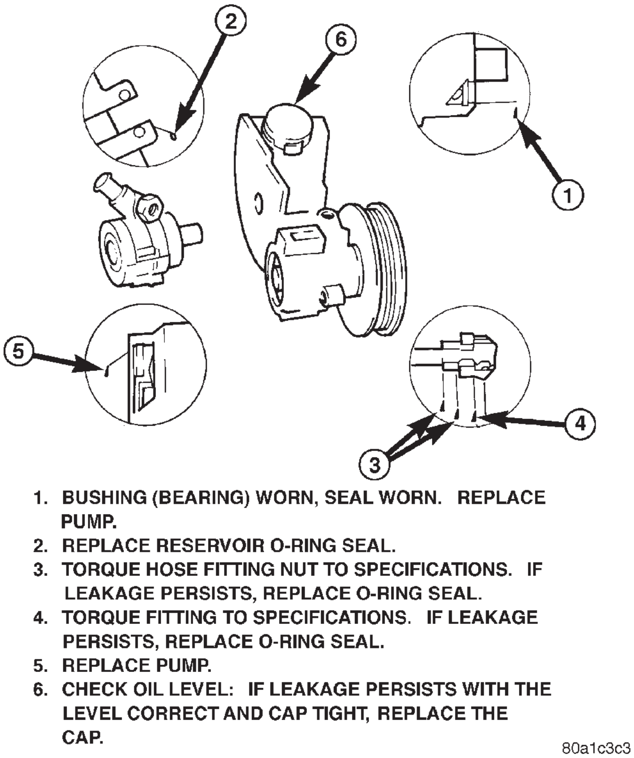


Fig. 2 Power Steering Pump

STANDARD PROCEDURE - 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

REMOVAL - 4.0L

(1) Remove serpentine drive belt, (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(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. 3) through pulley access holes.

(5) Tilt pump downward and remove from engine.

(6) Remove pulley from pump. (Refer to 19 - STEERING/PUMP/PULLEY - REMOVAL).

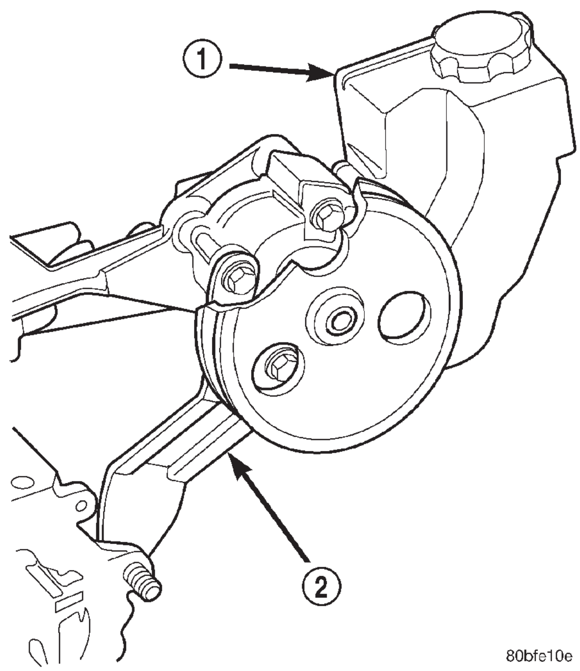


Fig. 3 Pump Mounting – 4.0L

1 - PUMP ASSEMBLY
2 - PUMP BRACKET

PUMP (Continued)

REMOVAL - 2.5L

(1) Remove serpentine drive belt, (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Remove pressure and return hoses from pump and drain the pump.

(3) Remove 3 pump mounting bolts (Fig. 4) through pulley access holes.

(4) Loosen the 3 pump bracket bolts.

(5) Tilt pump downward and remove from engine.

(6) Remove pulley from pump. (Refer to 19 - STEERING/PUMP/PULLEY - REMOVAL).

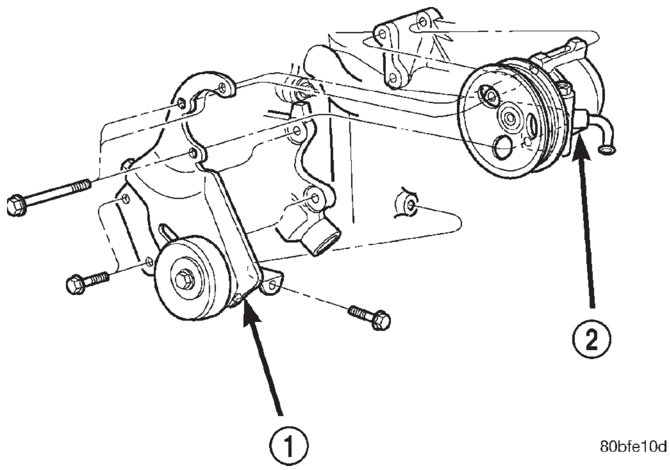


Fig. 4 Pump

1 - PUMP BRACKET
2 - PUMP ASSEMBLY 2.5L

INSTALLATION

INSTALLATION - 4.0L

(1) Install pulley on pump. (Refer to 19 - STEERING/PUMP/PULLEY - INSTALLATION).

(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 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(8) Add power steering fluid, refer to Power Steering Pump Initial Operation. (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

INSTALLATION - 2.5L

(1) Install pulley on pump. (Refer to 19 - STEERING/PUMP/PULLEY - INSTALLATION).

(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 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(8) Add power steering fluid, refer to Power Steering Pump Initial Operation. (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

SPECIFICATIONS

TORQUE CHART

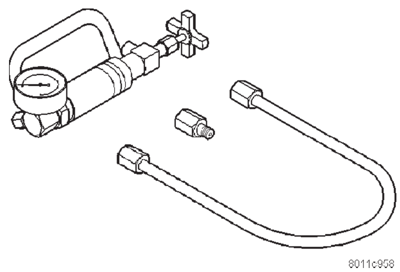
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Power Steering Pump Bracket to Pump	28	21	—
Power Steering Pump Bracket to 4.0L Engine	57	42	—
Power Steering Pump Bracket to 2.5L Engine	47	35	—
Power Steering Pump Flow Control Valve	75	55	—
Power Steering Pump Pressure Line	28	21	—

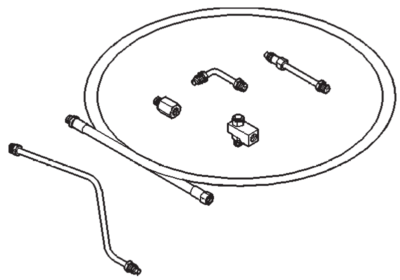
PUMP (Continued)

SPECIAL TOOLS

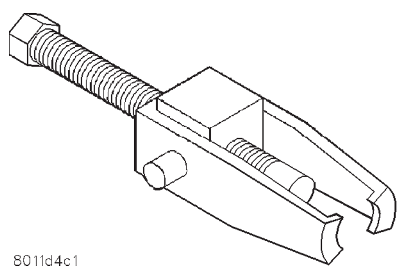
POWER STEERING PUMP



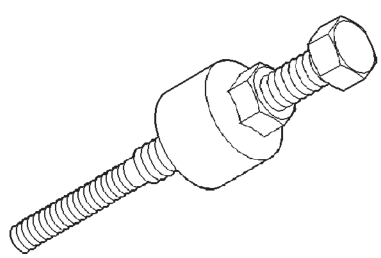
Analyzer Set, Power Steering Flow/Pressure 6815



Adapters, Power Steering Flow/Pressure Tester 6893



Puller C-4333



Installer, Power Steering Pulley C-4063B

HOSES

DESCRIPTION

DESCRIPTION - PRESSURE LINE

The hose consists of two metal ends and rubber center section that contains a tuning cable.

DESCRIPTION - RETURN LINE

Power steering return line is a hose which is clamped at the pump and the gear.

OPERATION

OPERATION - PRESSURE LINE

Power steering pressure line, is used to transfer high pressure power steering fluid, from the power steering pump to the power steering gear.

OPERATION - RETURN LINE

Power steering return line, is used to transfer low pressure power steering fluid, from the power steering gear to the power steering pump.

POWER STEERING PRESSURE SWITCH

DESCRIPTION

A pressure sensing switch (Fig. 5) 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

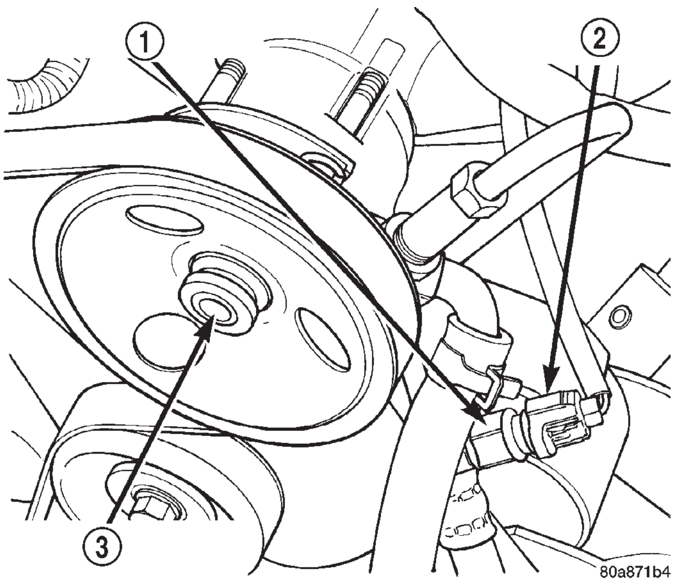


Fig. 5 Power Steering Pump Pressure Switch—2.5L Engine

1 - POWER STEERING PRESSURE SWITCH
2 - ELECTRICAL CONNECTOR
3 - POWER STEERING PUMP

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.

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.

REMOVAL

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. 5).

(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

This switch is not used with 4.0L six-cylinder engines.

(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.

PULLEY

REMOVAL

CAUTION: On vehicles equipped with the 4.0L, Do not reuse the old power steering pump pulley it is not intended for reuse. A new pulley must be installed if removed.

(1) Remove pump assembly.

(2) Remove pulley from pump with Puller C-4333 or equivalent puller (Fig. 6).

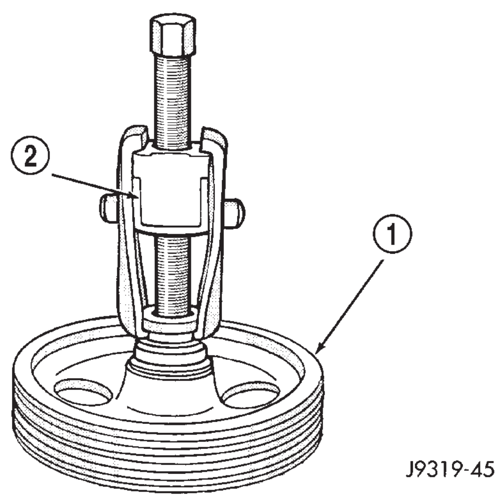


Fig. 6 Pulley Removal

1 - POWER STEERING PUMP DRIVE PULLEY
2 - SPECIAL TOOL C-4333

PULLEY (Continued)

INSTALLATION

NOTE: The pulley is marked front for installation.

CAUTION: On vehicles equipped with the 4.0L, Do not reuse the old power steering pump pulley it is not intended for reuse. A new pulley must be installed if removed.

(1) Replace pulley if bent, cracked, or loose.

(2) Install pulley on pump with Installer C-4063-B or equivalent installer (Fig. 7). The pulley must be flush with the end of the shaft. Ensure the tool and pulley are aligned with the pump shaft.

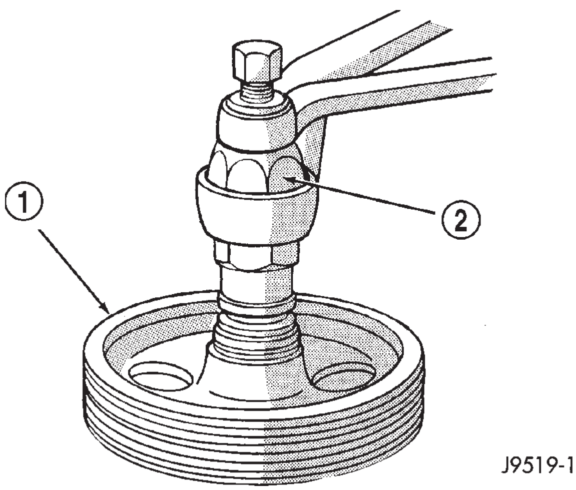


Fig. 7 Pulley Installation

1 - POWER STEERING PUMP DRIVE PULLEY
2 - SPECIAL TOOL C-4063–B

(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.**

RESERVOIR

REMOVAL

REMOVAL - 4.0L

(1) Remove power steering pump. (Refer to 19 - STEERING/PUMP - REMOVAL).

(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. 8).

NOTE: Use new retaining clips for installation.

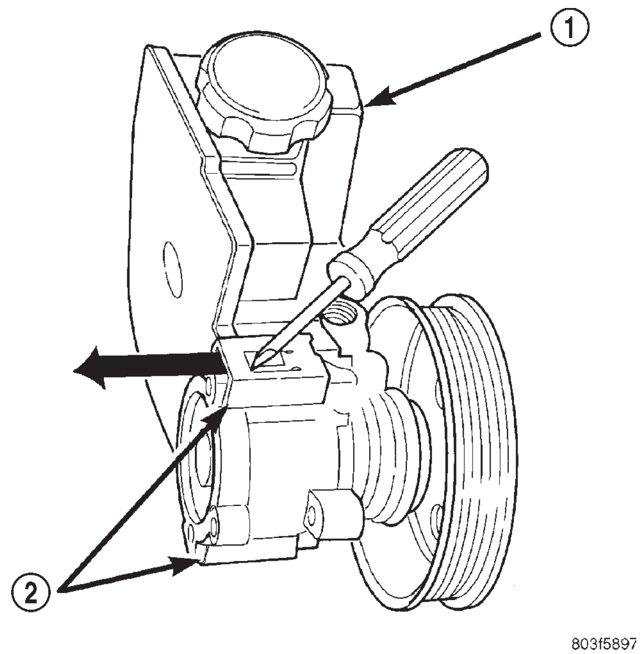


Fig. 8 Pump Reservoir Clips

1 - RESERVOIR
2 - RETAINING CLIPS

(5) Remove fluid reservoir from pump body. Remove and discard O-ring seal.

RESERVOIR (Continued)

REMOVAL - 2.5L

(1) Remove the pump return hoses from the reservoir and drain the reservoir.

(2) Remove the push-in fastener from the reservoir (Fig. 9).

(3) Slide the reservoir up out of the fan shroud mount.

INSTALLATION

INSTALLATION

(1) Lubricate new O-ring Seal with Mopar Power Steering Fluid or equivalent.

(2) Install O-ring seal in housing.

(3) Install reservoir onto housing.

(4) Slide and tap in **new** reservoir retainer clips until tab locks to housing.

(5) Install power steering pump. (Refer to 19 - STEERING/PUMP - INSTALLATION).

(6) Add power steering fluid, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

INSTALLATION - 2.5L

(1) Slide reservoir down onto the fan shroud mount until it clicks in place.

(2) Install the push-in fastener.

(3) Install the hoses.

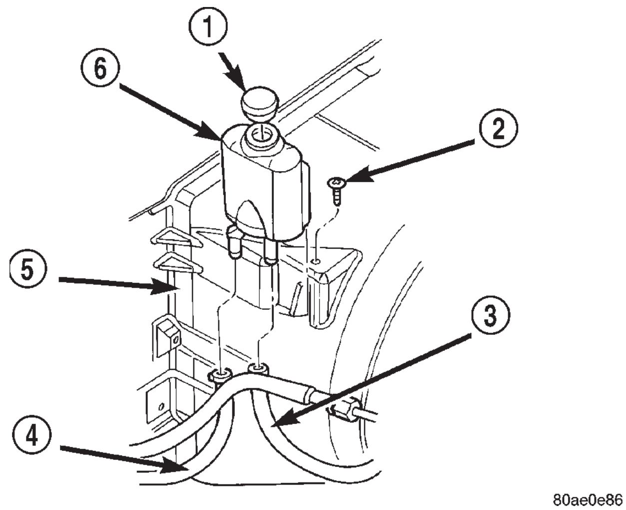


Fig. 9 Pump Reservoir – 2.5L

1 - CAP
2 - FASTENER
3 - PUMP SUPPLY HOSE
4 - RETURN HOSE
5 - FAN SHROUD
6 - RESERVOIR

(4) Fill reservoir to proper level, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

TRANSMISSION AND TRANSFER CASE

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MANUAL - NV3550

TABLE OF CONTENTS

MANUAL - NV3550

DESCRIPTION

The NV3550 is a medium-duty, 5-speed, constant mesh, fully synchronized manual transmission. The transmission is a 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.

The transmission drain plug is located on the bottom and fill plug on the side.

The NV3550 identification and part number bar code tags (Fig. 1) are located on the top of the transmission, forward of the shift tower.

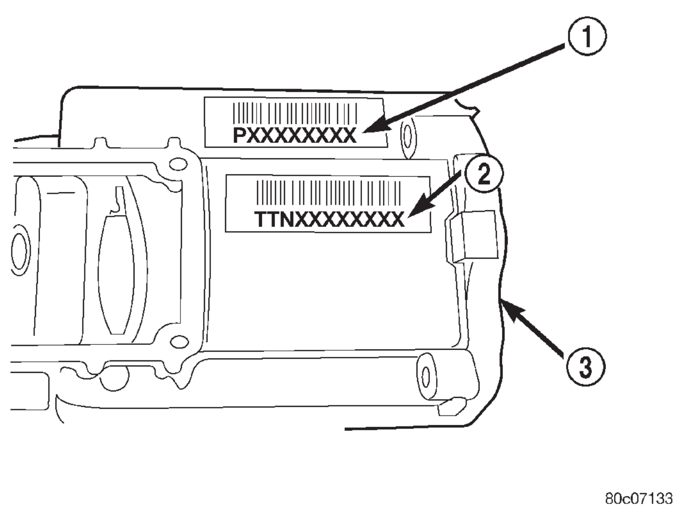


Fig. 1 NV3550 Identification

1 - PART NUMBER TAG
2 - IDENTIFICATION TAG
3 - FRONT OF REAR HOUSING

MANUAL - NV3550 (Continued)

OPERATION

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 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 through the synchronizer.

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 and adaptor 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

(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.

(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 skid plate, if equipped.

(9) Remove crossmember.

(10) Disconnect necessary exhaust system components.

MANUAL - NV3550 (Continued)

(11) Remove slave cylinder (Fig. 2) from clutch housing.

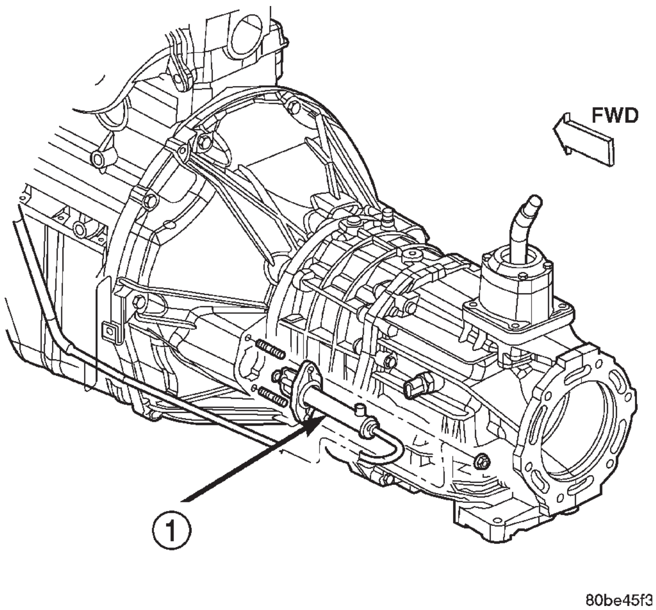


Fig. 2 Slave Cylinder

1 - CLUTCH SLAVE CYLINDER

(12) Mark rear propeller shaft and rear axle yokes for installation alignment (Fig. 3).

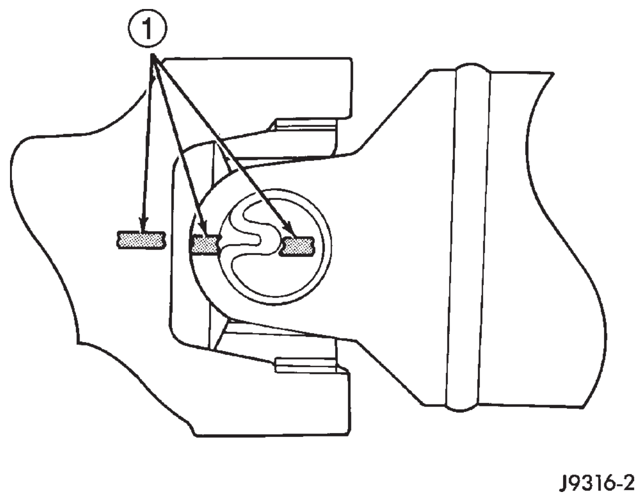


Fig. 3 Propeller Shaft And Axle Yokes

1 - REFERENCE MARKS

(13) Mark front propeller shaft, axle and transfer case yokes for installation alignment.

(14) Remove propeller shafts.

(15) Unclip wire harnesses from transmission and transfer case.

(16) Disconnect transfer case vent hose.

(17) Disengage any wire connectors attached to transmission and transfer case.

(18) Support transfer case, if equipped, with transmission jack.

(19) Secure transfer case, if equipped, to jack with safety chains.

(20) Disconnect transfer case shift linkage at transfer case.

(21) Remove nuts attaching transfer case to transmission.

(22) Remove transfer case.

(23) Remove crankshaft position sensor (Fig. 4).

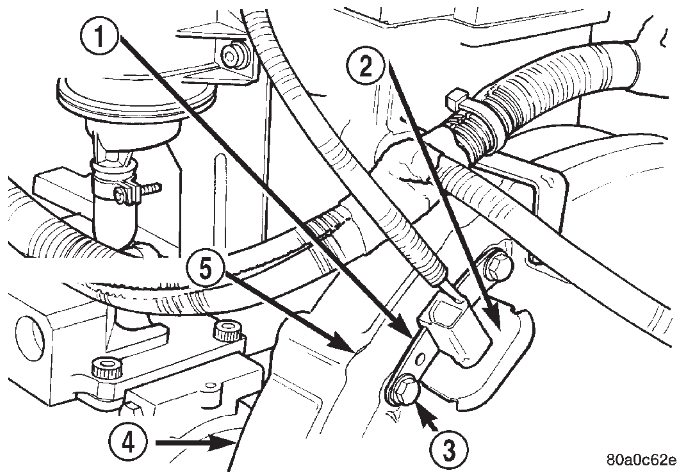


Fig. 4 Crankshaft Position Sensor

1 - CRANKSHAFT POSITION 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.

(24) Support engine with adjustable jack stand. Position wood block between jack and oil pan to avoid damaging pan.

(25) Support transmission with transmission jack.

(26) Secure transmission to jack with safety chains.

(27) Disconnect rear cushion and bracket from transmission.

(28) Remove rear crossmember.

(29) Remove clutch housing-to-engine bolts.

(30) Pull transmission jack rearward until input shaft clears clutch. Then slide transmission out from under vehicle.

(31) Remove clutch release bearing, release fork and retainer clip.

(32) Remove clutch housing from transmission.

MANUAL - NV3550 (Continued)

DISASSEMBLY

FRONT HOUSING

(1) Shift transmission into Neutral.
(2) Remove drain plug and drain lubricant.
(3) Inspect drain plug magnet for debris.
(4) Remove backup light switch. Switch is located on passenger side of rear housing (Fig. 5).

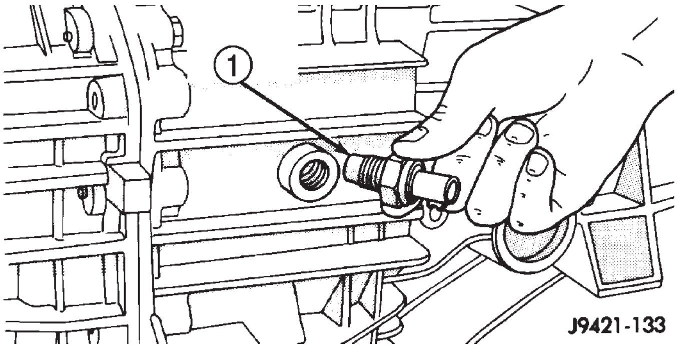


Fig. 5 BACKUP LIGHT SWITCH

1 - BACKUP LIGHT SWITCH

(5) Remove shift tower bolts and remove tower and lever assembly (Fig. 6).

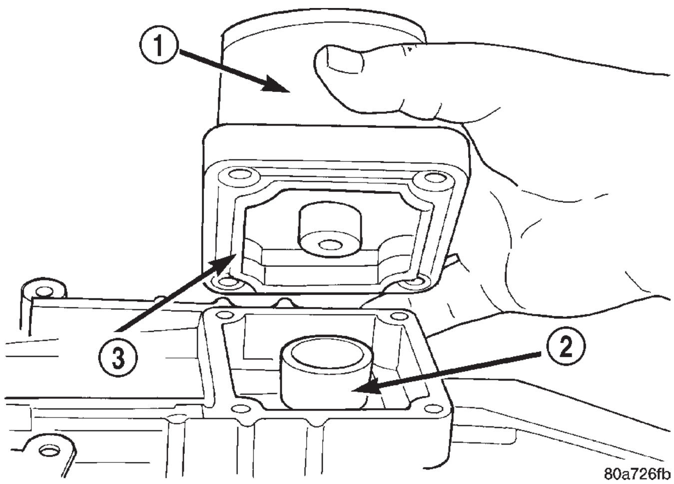


Fig. 6 SHIFT TOWER

1 - SHIFT TOWER AND LEVER ASSEMBLY
2 - SHIFT SOCKET
3 - SEAL

(6) Remove shift shaft lock bolt (Fig. 7) located on top of the housing just forward of shift tower.

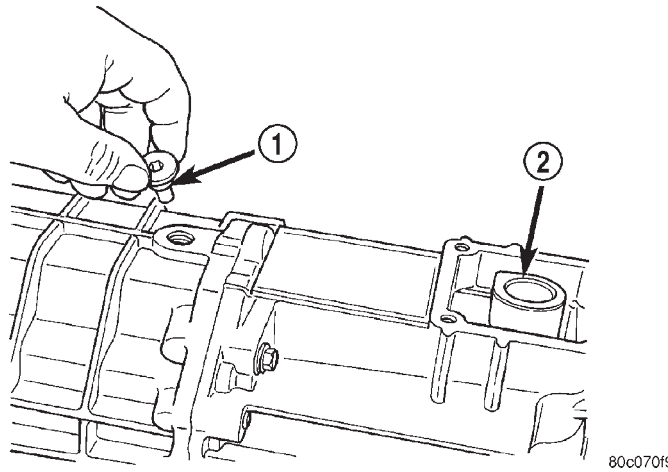


Fig. 7 SHIFT SHAFT LOCK BOLT

1 - SHIFT SHAFT LOCK BOLT
2 - SHAFT SOCKET

(7) Remove shift shaft detent plug with Remover 8117A. Attach the fingers of the remover to the detent plug (Fig. 8). Then push the cup down till it contacts the trans. Tighten the nut (Fig. 9) till it pulls the plug from the trans case.

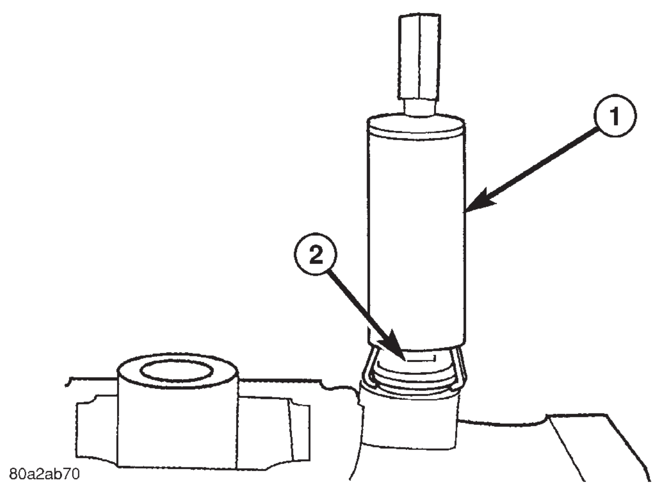


Fig. 8 DETENT PULLER

1 - REMOVER
2 - DETENT PLUG

MANUAL - NV3550 (Continued)

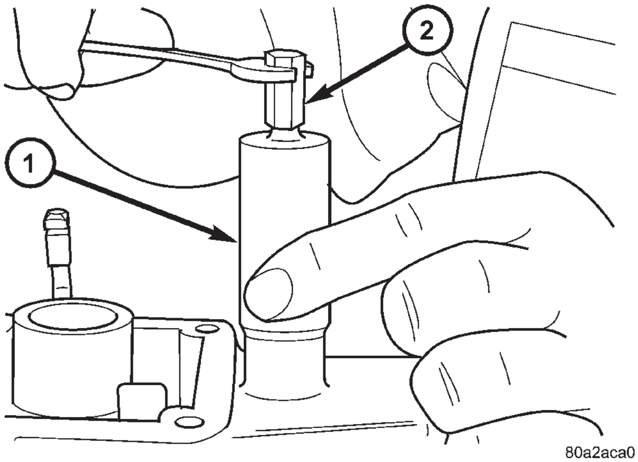


Fig. 9 PULL DETENT PLUG

1 - NUT
2 - REMOVER

(8) Remove shift shaft detent plunger and spring. Remove spring and plunger with a pencil magnet.

(9) Remove bolts attaching input shaft bearing retainer to front housing and remove retainer.

NOTE: Use pry tool to carefully lift retainer and break sealer bead (Fig. 10).

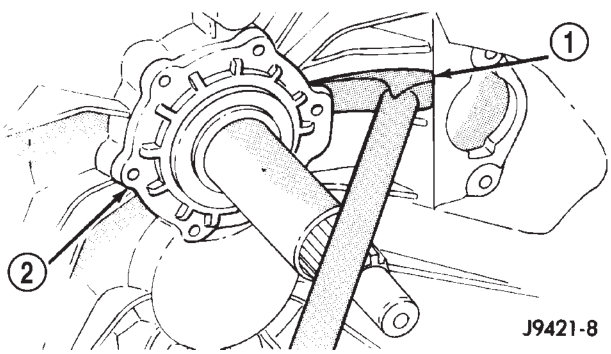


Fig. 10 BEARING RETAINER

1 - PRY TOOL
2 - BEARING RETAINER

(10) Remove bearing retainer from input shaft (Fig. 11).

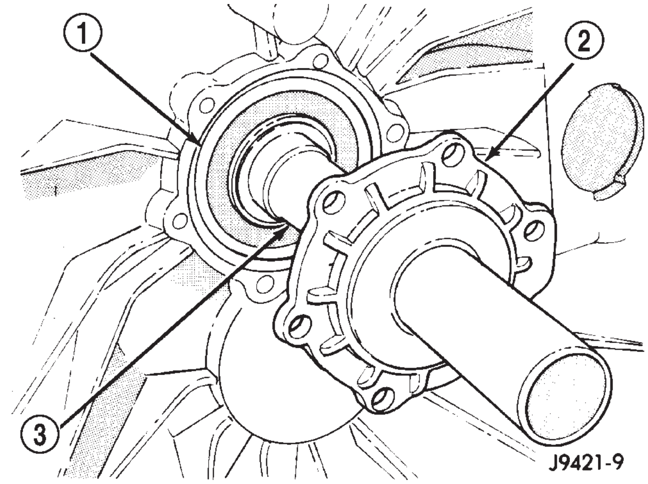


Fig. 11 INPUT SHAFT BEARING RETAINER

1 - SHAFT BEARING
2 - BEARING RETAINER
3 - INPUT SHAFT

(11) Remove snap ring that secures input shaft in front bearing (Fig. 12).

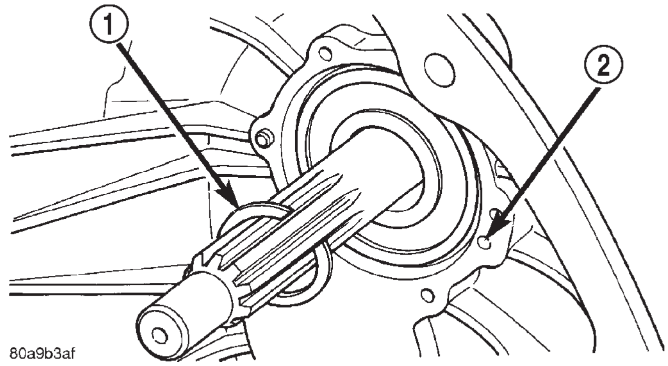


Fig. 12 INPUT SHAFT SNAP RING

1 - INPUT SHAFT SNAP RING
2 - OIL FEED

MANUAL - NV3550 (Continued)

(12) Remove bolts that attach front housing to rear housing.

(13) Separate front housing from rear housing (Fig. 13). With a plastic mallet tap the front housing off the alignment dowels.

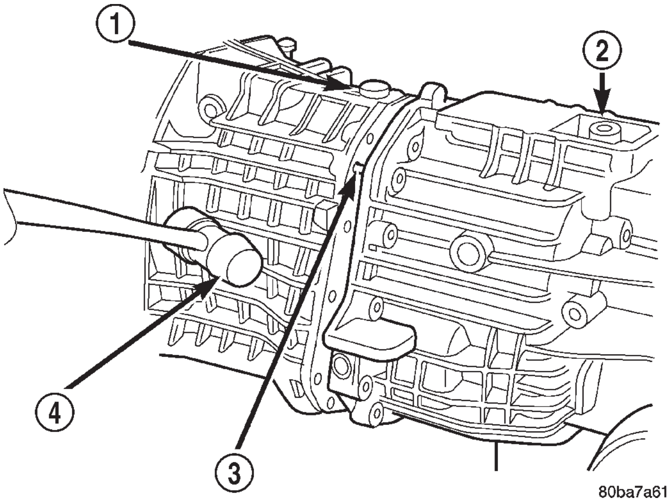


Fig. 13 FRONT HOUSING

1 - FRONT HOUSING
2 - REAR HOUSING
3 - DOWELS (2)
4 - PLASTIC MALLET

(14) Remove and inspect input shaft bearing and countershaft front bearing (Fig. 14).

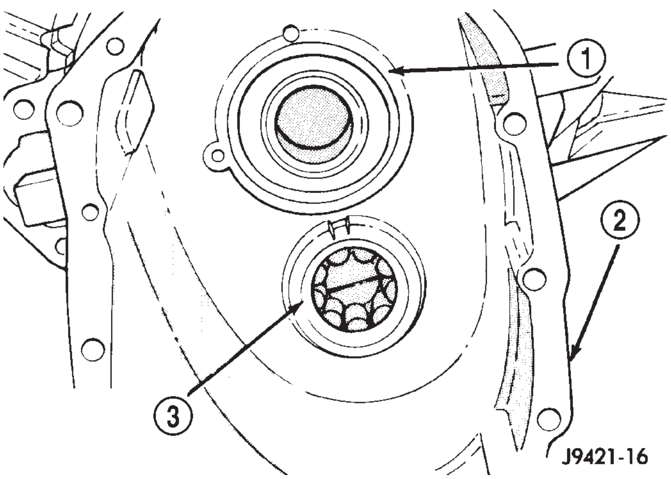


Fig. 14 INPUT AND COUNTERSHAFT BEARING RACE

1 - INPUT SHAFT BEARING
2 - FRONT HOUSING
3 - COUNTERSHAFT FRONT BEARING

(15) Remove screw from reverse blocker and remove blocker (Fig. 15) from case.

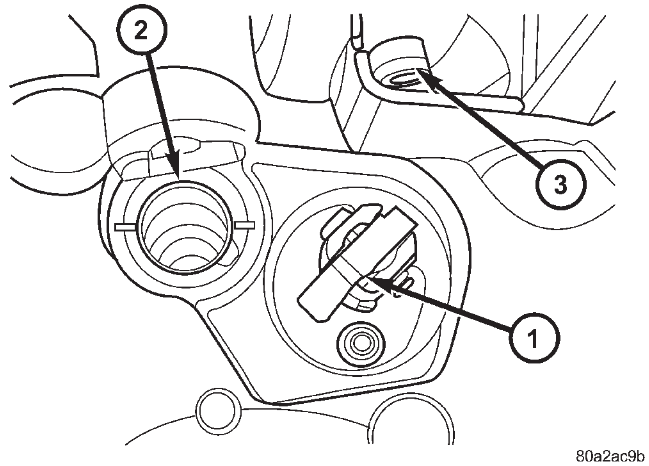


Fig. 15 REVERSE BLOCKER

1 - REVERSE BLOCKER
2 - SHIFTER SHAFT BUSHING
3 - VENT

(16) Note the loacation of the input shaft, shift shaft, shift forks and geartrain (Fig. 16).

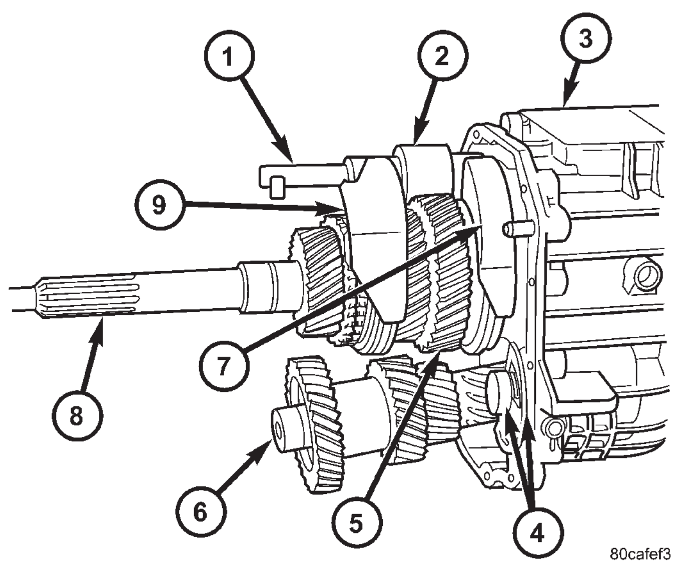


Fig. 16 GEARTRAIN AND SHIFT COMPONENTS

1 - SHIFT SHAFT
2 - BUSHING
3 - REAR HOUSING
4 - REVERSE IDLER ANSD SUPPORT
5 - OUTPUT SHAFT AND GEARS
6 - COUNTERSHAFT
7 - 1-2 SHIFT FORK
8 - INPUT SHAFT
9 - 3-4 SHIFT FORK

MANUAL - NV3550 (Continued)

SHIFT/FORK SHAFTS AND REVERSE IDLER SEGMENT

(1) Unseat the roll pin that secures the shift socket to the shift shaft with Remover 6858 as follows:

(a) Position remover 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. 17).

(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 to press the roll pin downward and out of the shift socket (Fig. 17).

NOTE: Press the roll pin just enough to clear the shift shaft. Be careful not to push the pin into the geartrain.

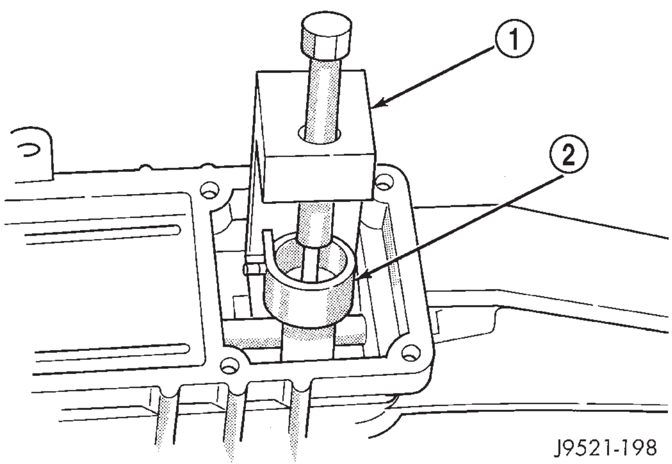


Fig. 17 SHIFT SOCKET ROLL PIN

1 - REMOVER
2 - SHIFT SOCKET

(2) Rotate lever and bushing upward and out of the shift forks and catch detent ball and spring (Fig. 18) as they exit the shaft lever.

NOTE: Place shop towel over shaft to contain detent ball and spring.

(3) With a hammer and punch drive out roll pin that secures shift bushing and lever to shift shaft (Fig. 19).

CAUTION: Use proper size punch to avoid bending the shift shaft.

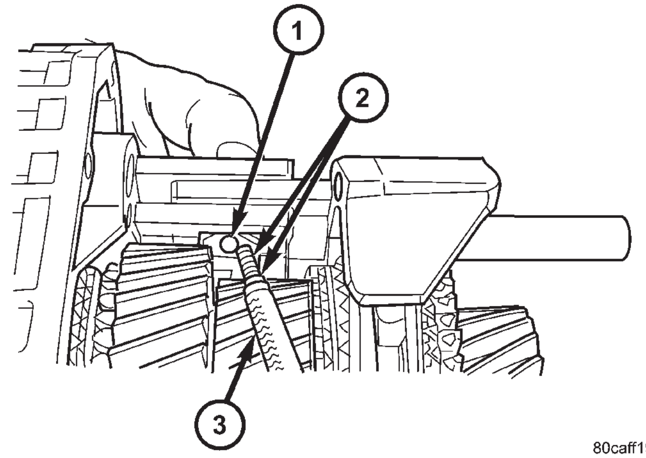


Fig. 18 DETENT SPRING AND BALL

1 - SHAFT LEVER
2 - SPRING AND BALL
3 - MAGNET

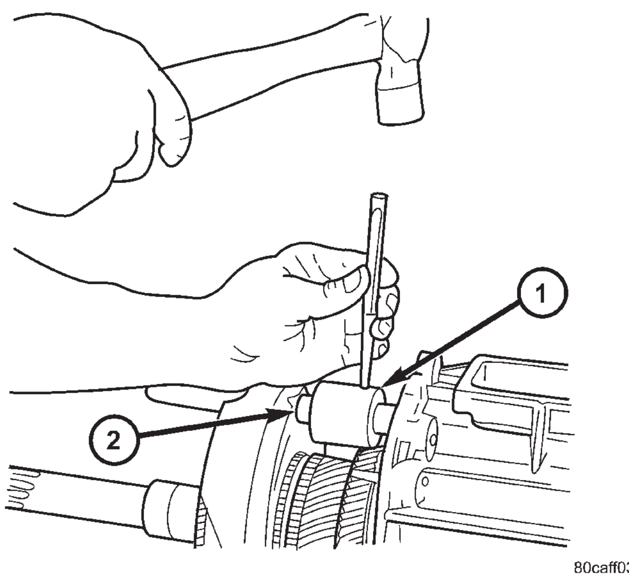


Fig. 19 SHIFT SHAFT LEVER AND BUSHING ROLL PIN

1 - LEVER AND BUSHING
2 - SHIFT SHAFT

MANUAL - NV3550 (Continued)

(4) Pull shift shaft straight (Fig. 20) out of rear housing.

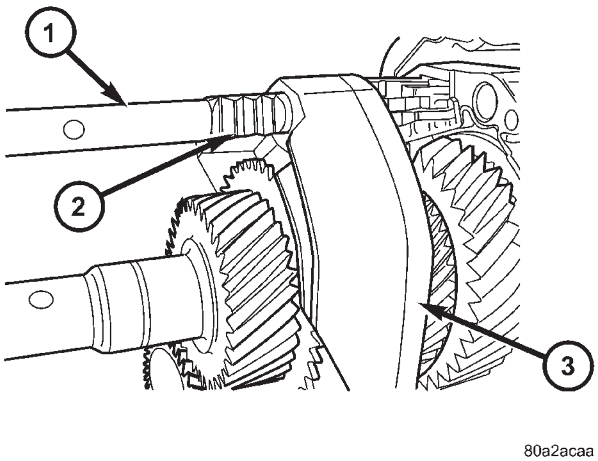


Fig. 20 SHIFT SHAFT

1 - SHIFTER SHAFT
2 - SHIFTER SHAFT DETENT
3 - 3-4 SHIFT FORK

(5) Remove shift socket from rear housing (Fig. 21).

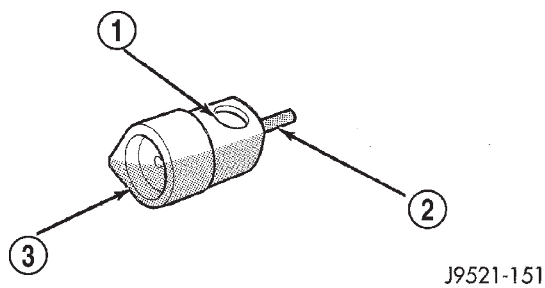


Fig. 21 SHIFT SOCKET AND ROLL PIN

1 - SHAFT BORE
2 - ROLL PIN
3 - SHIFT SOCKET

(6) Remove lever and bushing (Fig. 22).

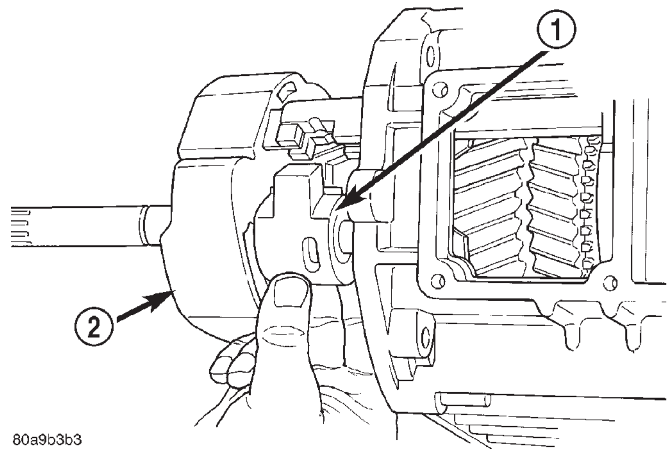


Fig. 22 SHIFT SHAFT LEVER AND BUSHING

1 - SHAFT LEVER AND BUSHING
2 - 3-4 FORK

(7) 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. 23).

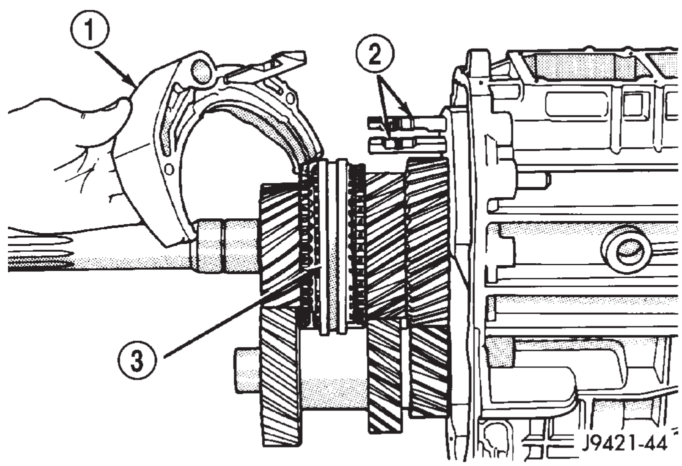


Fig. 23 3-4 SHIFT FORK

1 - 3-4 FORK
2 - 1-2 AND 5TH-REVERSE FORK ARMS
3 - 3-4 SYNCHRO SLEEVE

MANUAL - NV3550 (Continued)

(8) Remove the reverse idler shaft support bolt (front bolt) (Fig. 24).

(9) Loosen rear reverse idler shaft bolt (rear bolt) (Fig. 24).

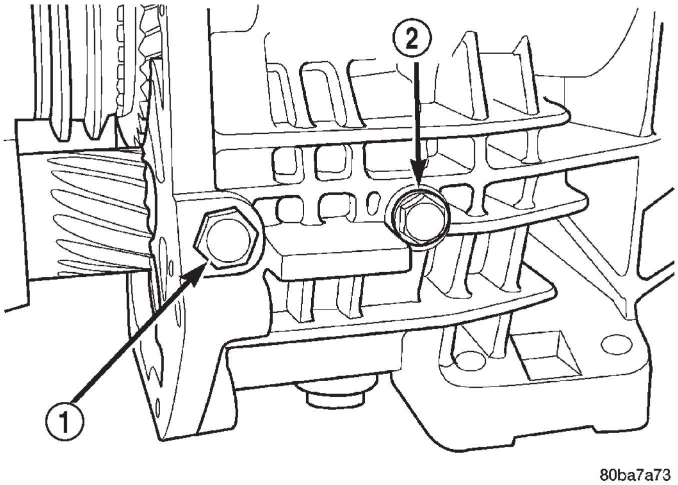


Fig. 24 REVERSE IDLER SHAFT/SUPPORT BOLT

1 - SUPPORT BOLT
2 - SHAFT BOLT

(10) Remove reverse idler shaft support (Fig. 25) segment by sliding it straight out of housing.

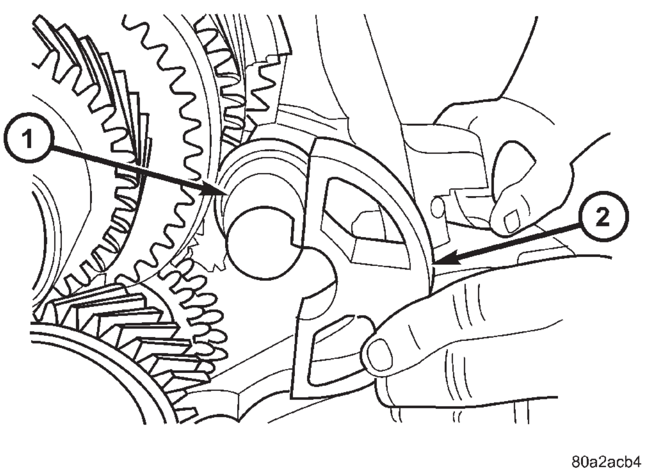


Fig. 25 IDLER SHAFT SUPPORT

1 - IDLER SHAFT
2 - IDLER SHAFT SUPPORT

(11) Support geartrain and rear housing on Fixture 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 6747-2B on Fixture 6747.

(c) Slide fixture tool onto input shaft, countershaft and idler gear (Fig. 26).

(d) Stand geartrain and rear housing upright on fixture (Fig. 27). Have helper hold fixture tool in place while housing and geartrain is being rotated into upright position.

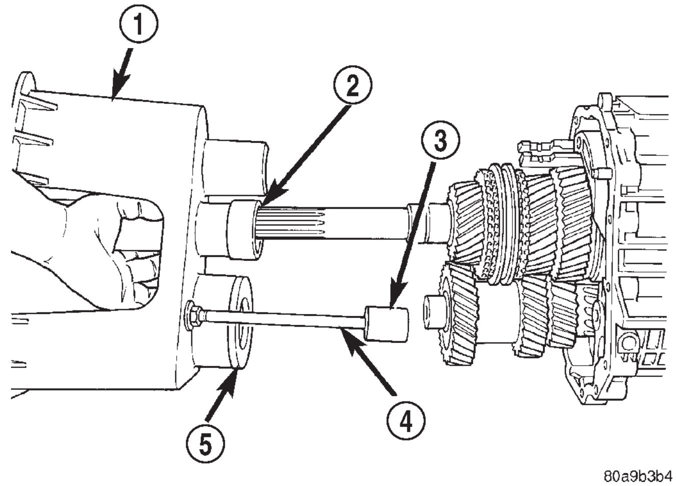


Fig. 26 FIXTURE ASSEMBLY

1 - FIXTURE
2 - ADAPTER 6747-1A
3 - CUP ADAPTER
4 - REVERSE IDLER PEDESTAL
5 - ADAPTER 6747-2B

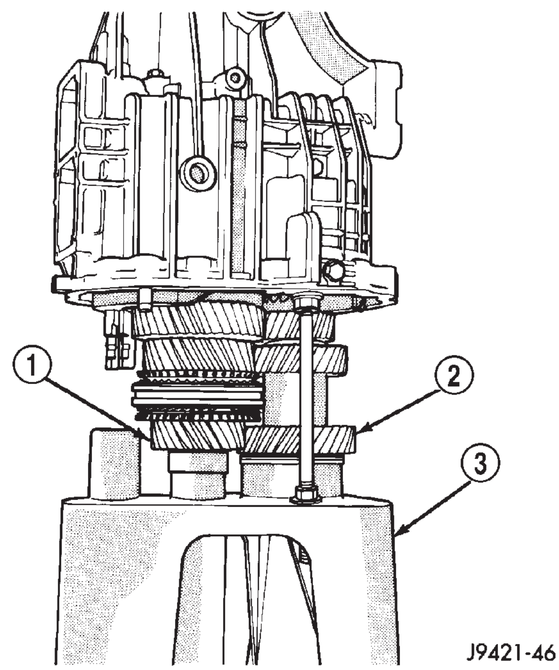


Fig. 27 GEARTRAIN/HOUSING FIXTURE

1 - INPUT SHAFT
2 - COUNTERSHAFT
3 - FIXTURE

(12) Remove rear bolt holding reverse idler shaft in housing.

MANUAL - NV3550 (Continued)

REAR ADAPTER HOUSING

(1) Locate rear seal dimples (Fig. 28). With slide hammer mounted screw, remove rear seal by inserting screw into one of the seal dimples (Fig. 29).

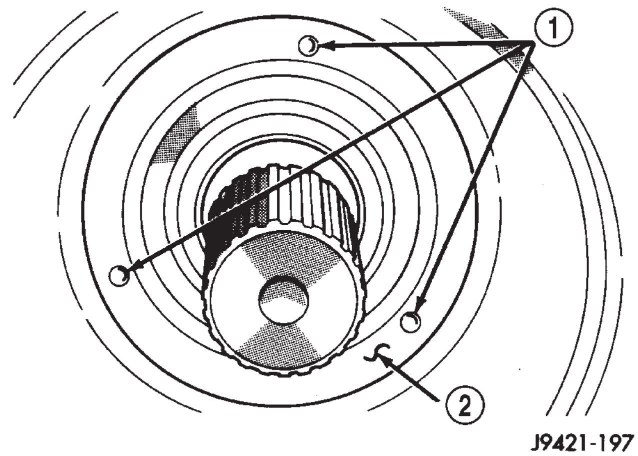


Fig. 28 SEAL DIMPLES

1 - LOCATION OF DIMPLES
2 - SEAL FACE

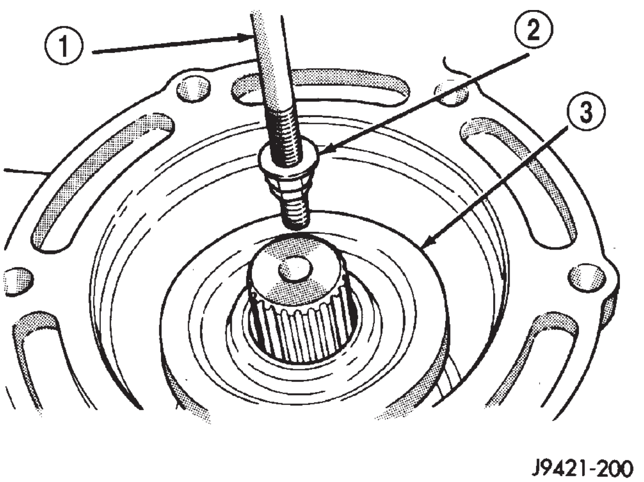


Fig. 29 REAR SEAL

1 - SLIDE HAMMER
2 - REMOVER
3 - REAR SEAL

(2) Remove rear bearing snap ring from output shaft with snap ring pliers (Fig. 30).

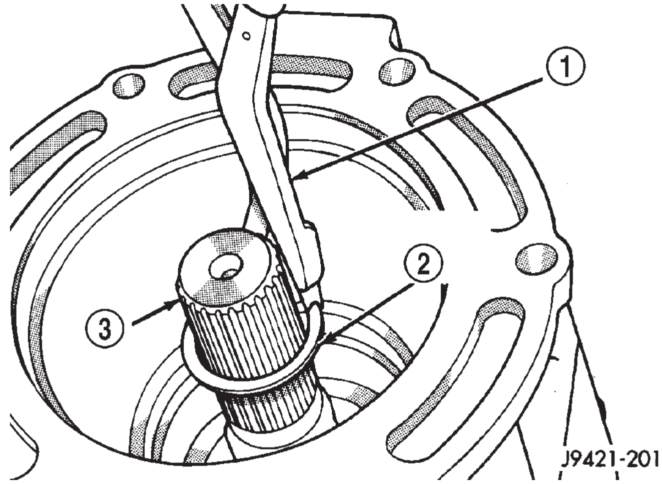


Fig. 30 REAR BEARING SNAP RING

1 - SNAP RING PLIERS
2 - REAR BEARING SNAP RING
3 - OUTPUT SHAFT

(3) Lift rear adapter housing upward and off geartrain (Fig. 31).

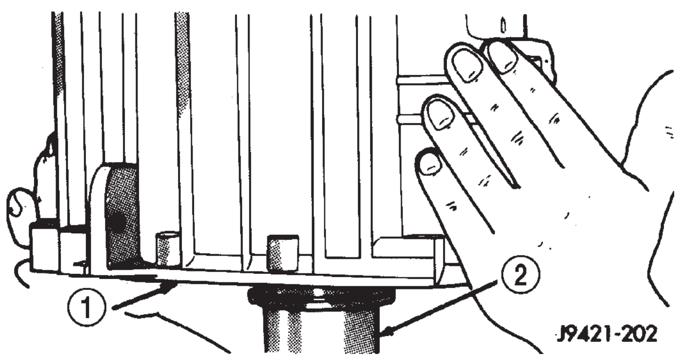


Fig. 31 REAR ADAPTER HOUSING

1 - REAR ADAPTER HOUSING
2 - OUTPUT SHAFT

(4) Remove bearing retainer bolts and remove rear bearing retainer and rear bearing (Fig. 32). If needed push or tap bearing out of the housing with a hammer.

(5) Examine condition of bearing bore, countershaft rear bearing race and idler shaft notch in rear housing. Replace housing if race, bore or notch are worn or damaged.

MANUAL - NV3550 (Continued)

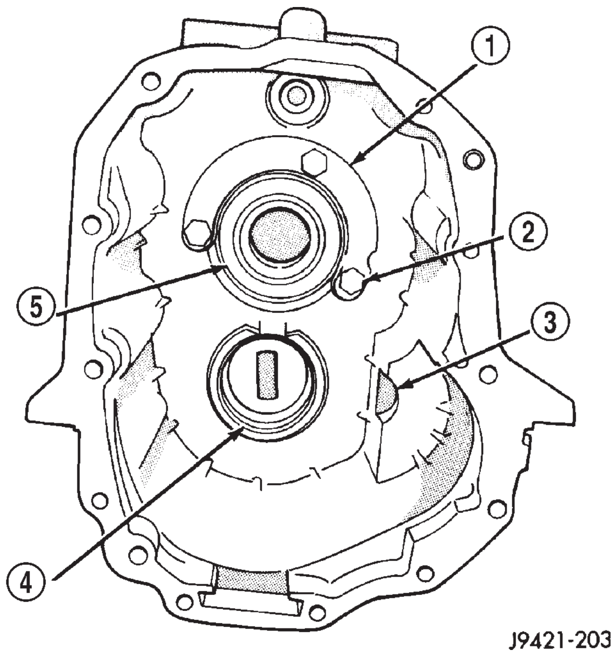


Fig. 32 REAR ADAPTER HOUSING COMPONENTS

1 - BEARING RETAINER
2 - RETAINER BOLTS (3)
3 - IDLER SHAFT NOTCH
4 - COUNTERSHAFT REAR BEARING RACE
5 - REAR BEARING

GEARTRAIN 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.

OUTPUT SHAFT

NOTE: The synchronizer hubs and sleeves are different and must not be intermixed. Remove each synchronizer unit as an assembly to avoid intermixing parts. Reference mark or tag each synchro hub and sleeve for correct assembly.

(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 Bearing Splitter 1130. Position splitter between second and third gears.

(3) Remove third gear needle bearing (Fig. 33).

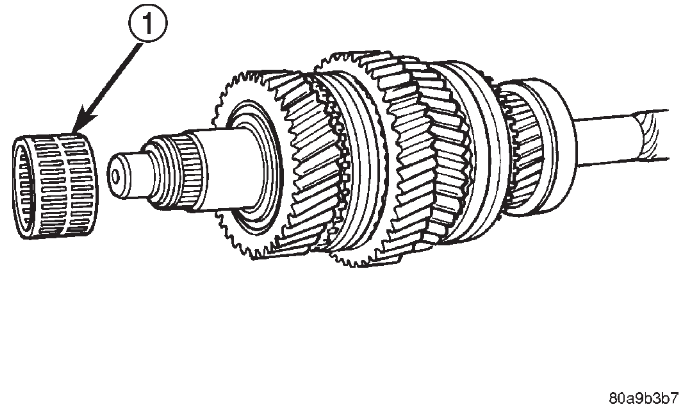


Fig. 33 THIRD GEAR NEEDLE BEARING

1 - THIRD GEAR NEEDLE BEARING

(4) Remove retaining ring that secures two-piece thrust washer on shaft (Fig. 34). Use a small pry tool to remove retaining ring.

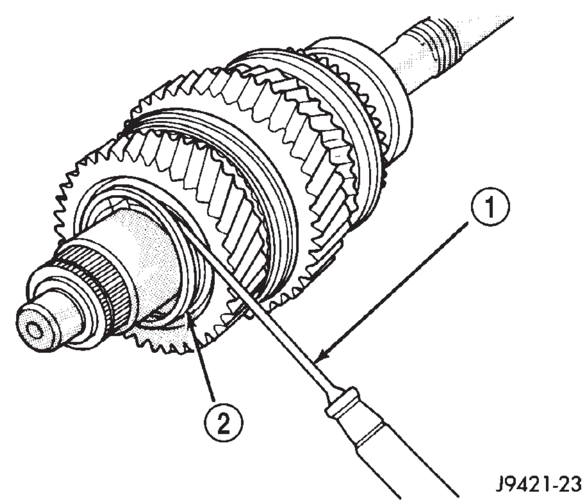


Fig. 34 THRUST WASHER

1 - PRY TOOL
2 - THRUST WASHER RETAINING RING

MANUAL - NV3550 (Continued)

(5) Remove two-piece thrust washer (Fig. 35). Note position of washer locating lugs in shaft notches for installation reference.

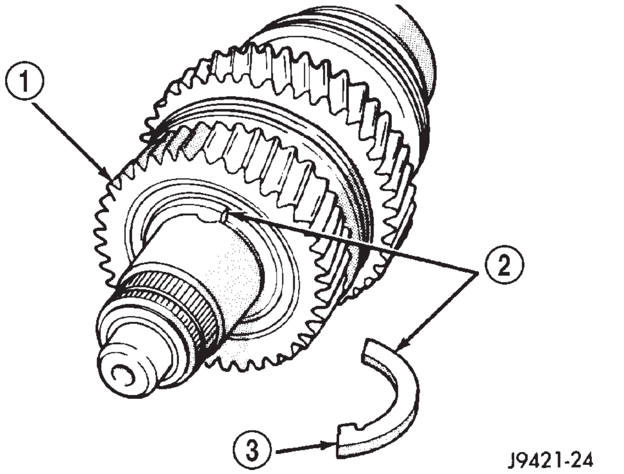


Fig. 35 TWO-PIECE THRUST WASHER

1 - SECOND GEAR
2 - THRUST WASHER (2-PIECE)
3 - WASHER LOCATING LUG

(6) Remove second gear and needle bearing (Fig. 36).

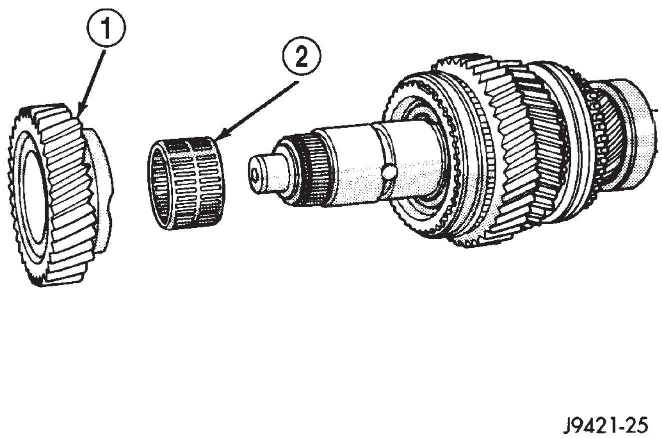


Fig. 36 SECOND GEAR AND NEEDLE BEARING

1 - SECOND GEAR
2 - SECOND GEAR NEEDLE BEARING

(7) Remove second gear synchro ring, synchro friction cone and synchro cone (Fig. 37).
(8) Remove interim ring.
(9) Remove 1-2 synchro hub snap ring.

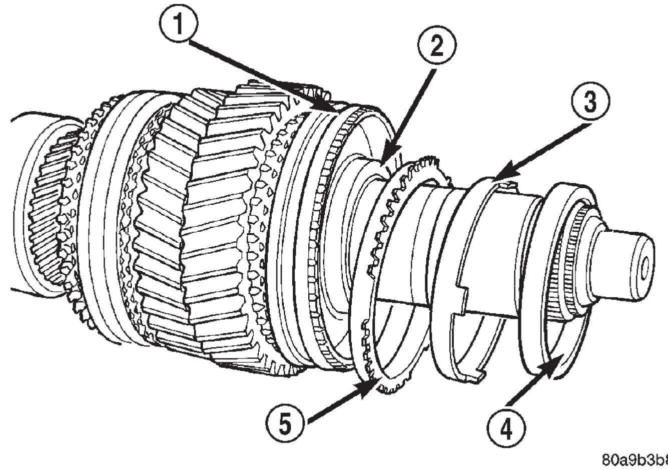


Fig. 37 SECOND GEAR SYNCHRO RING AND CONES

1 - 1-2 SYNCHRO HUB AND SLEEVE
2 - INTERM RING
3 - SYNCHRO FRICTION CONE
4 - SYNCHRO CONE
5 - SYNCHRO RING

(10) Remove 1-2 synchro hub and sleeve and first gear from output shaft with press and Bearing Splitter 1130 (Fig. 38). Position splitter between first and reverse gears.

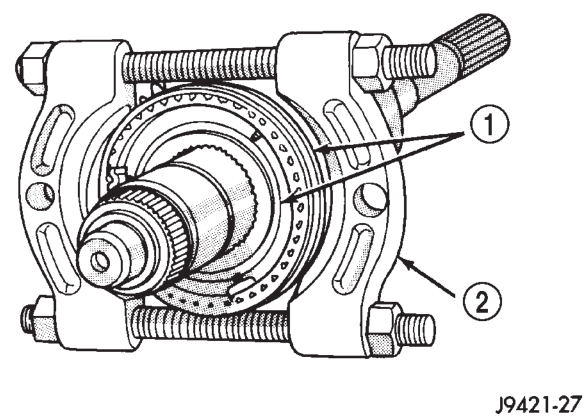


Fig. 38 HUB SLEEVE AND 1-2 SYNCHRO

1 - 1-2 SYNCHRO HUB AND SLEEVE
2 - SPLITTER

MANUAL - NV3550 (Continued)

(11) Remove first gear needle bearing (Fig. 39).

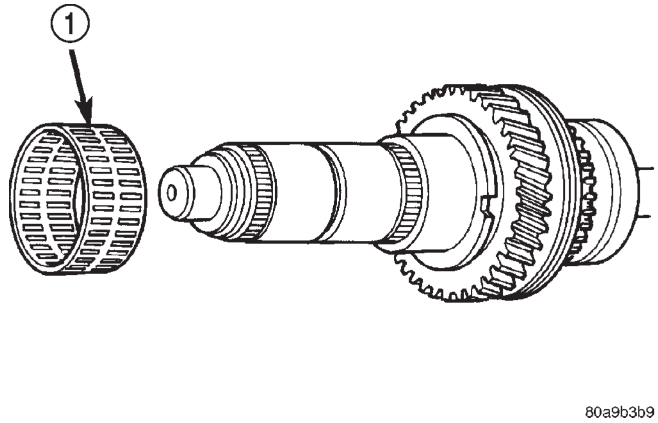


Fig. 39 FIRST GEAR NEEDLE BEARING

1 - FIRST GEAR NEEDLE BEARING

(12) Remove output shaft bearing snap ring (Fig. 40).

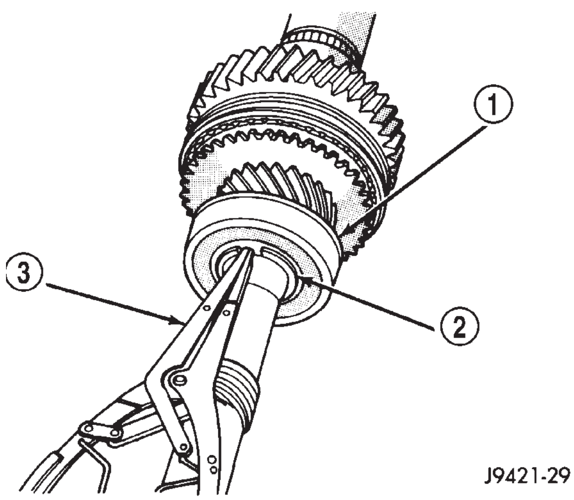


Fig. 40 OUTPUT SHAFT BEARING SNAP RING

1 - OUTPUT SHAFT BEARING
2 - BEARING SNAP RING
3 - SNAP RING PLIERS

(13) Remove fifth gear (Fig. 41).
(14) Remove fifth gear needle bearing.

NOTE: Spread bearing apart just enough to clear shoulder on output shaft (Fig. 42).

(15) Remove fifth-reverse synchro hub snap ring (Fig. 43).

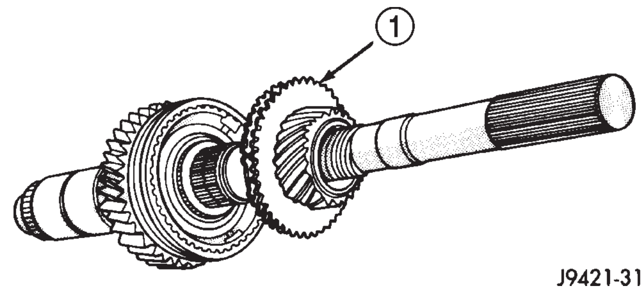


Fig. 41 FIFTH GEAR

1 - FIFTH GEAR AND SYNCHRO RING

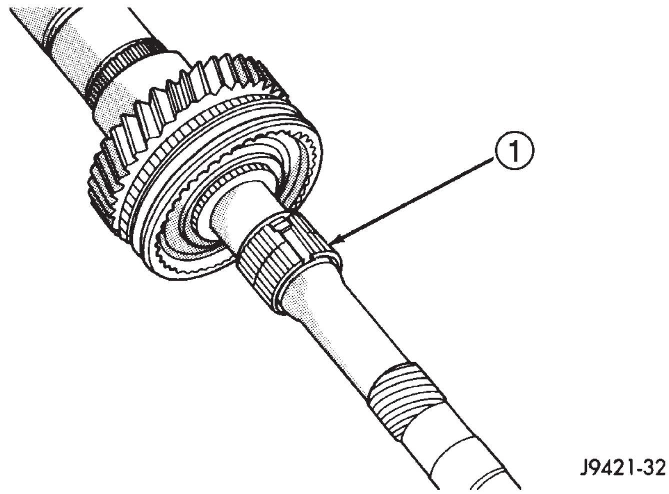


Fig. 42 FIFTH GEAR NEEDLE BEARING

1 - FIFTH GEAR NEEDLE BEARING

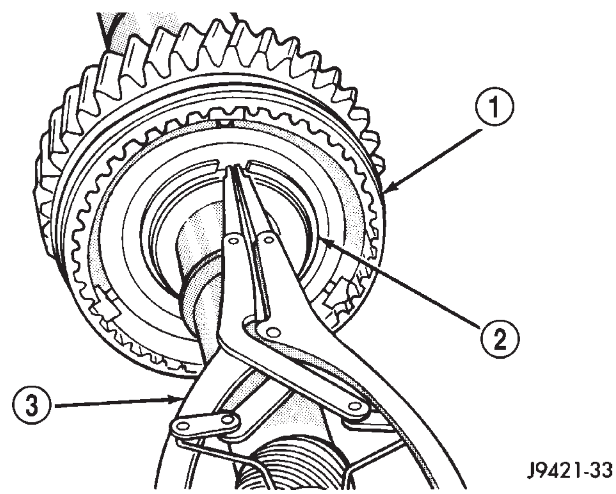


Fig. 43 FIFTH-REVERSE SYNCHRO HUB SNAP RING

1 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
2 - SYNCHRO HUB SNAP RING
3 - SNAP RING PLIERS

MANUAL - NV3550 (Continued)

(16) Remove fifth-reverse synchro hub and sleeve with a press (Fig. 44).

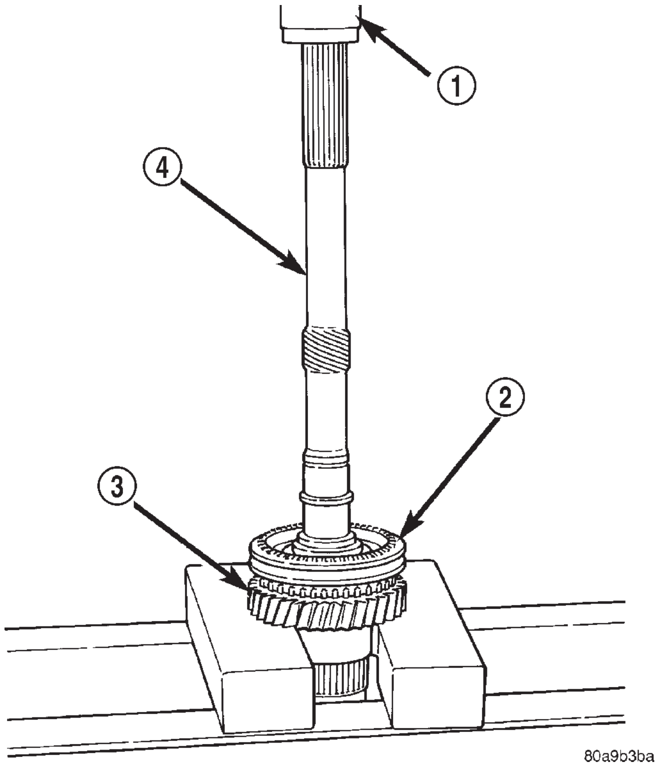


Fig. 44 FIFTH-REVERSE SYNCHRO HUB AND SLEEVE

1 - PRESS
2 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
3 - REVERSE GEAR
4 - OUTPUT SHAFT

(17) Remove reverse gear and needle bearing (Fig. 45).

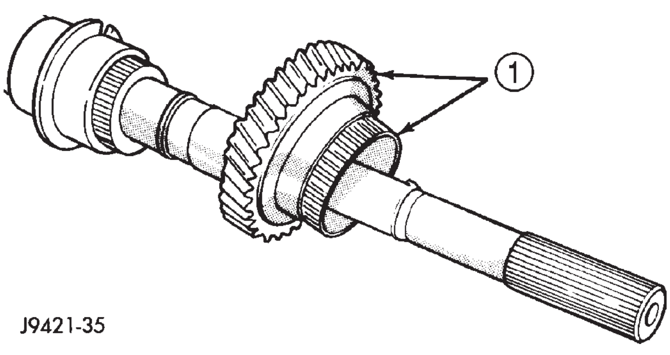


Fig. 45 REVERSE GEAR AND NEEDLE BEARING

1 - REVERSE GEAR AND NEEDLE BEARING

REVERSE IDLER

(1) Remove idler gear snap rings (Fig. 46).

(2) Remove thrust washer, wave washer, thrust plate and idler gear from shaft.

(3) Remove idler gear needle bearing from shaft.

CLEANING

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.

INSPECTION

NOTE: Minor nicks on component surfaces can be smoothed with 320/420 grit emery soaked in oil and final polished with crocus cloth.

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. 47). 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. 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. 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.

MANUAL - NV3550 (Continued)

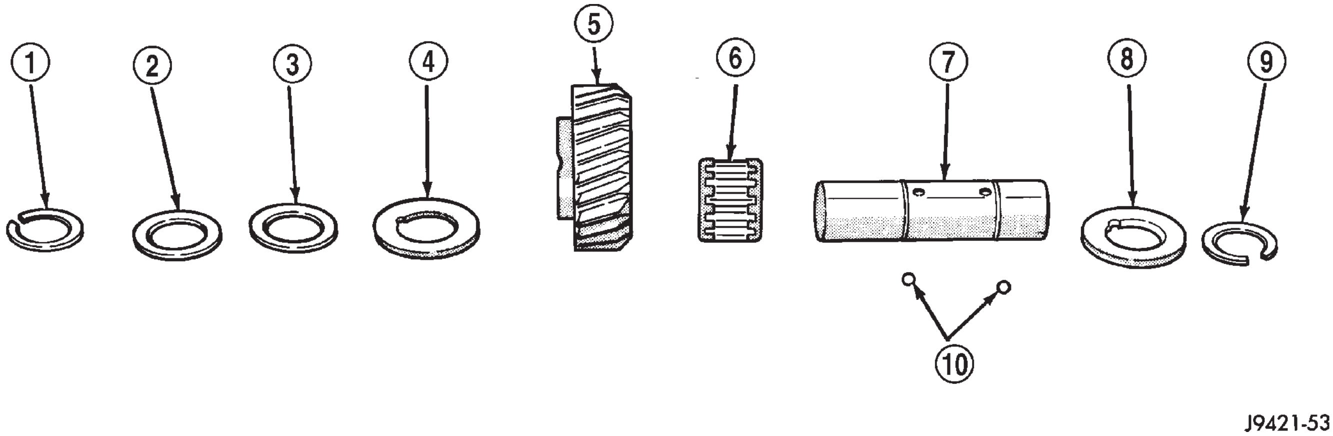


Fig. 46 REVERSE IDLER COMPONENTS

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 LOCKBALLS

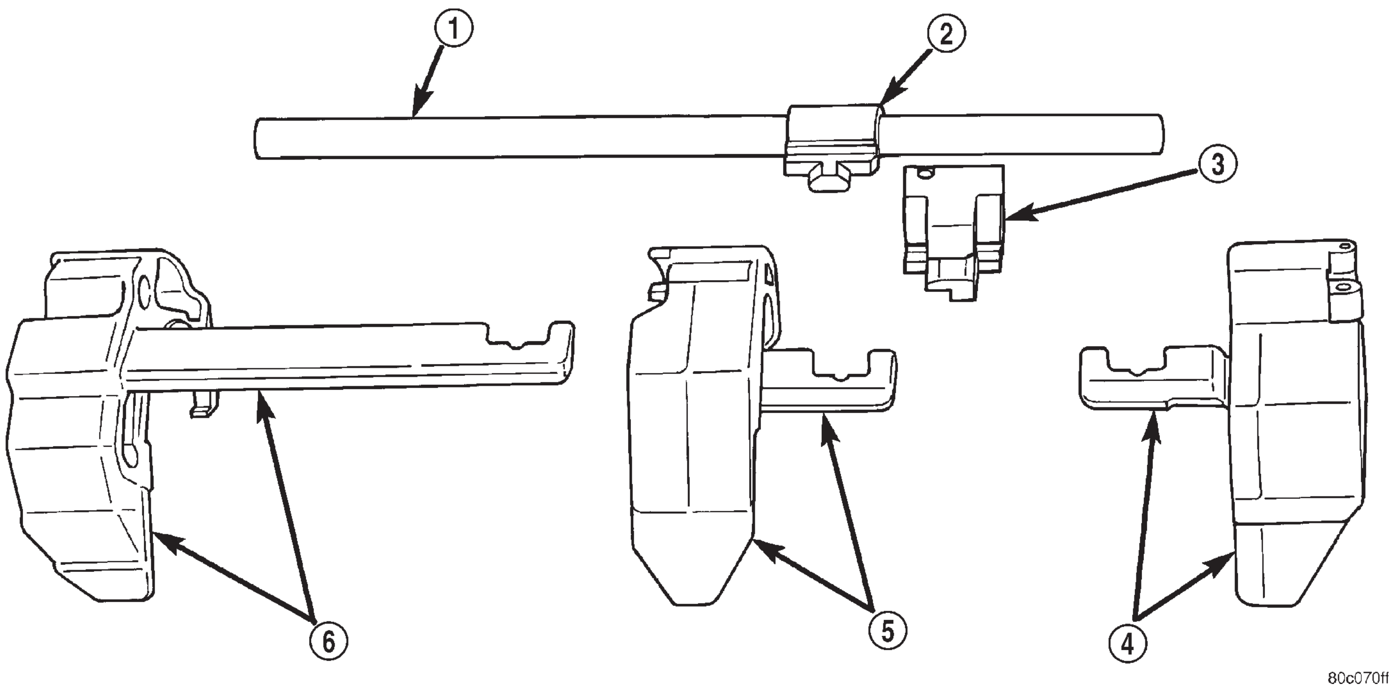


Fig. 47 SHIFT FORKS & SHAFT

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

MANUAL - NV3550 (Continued)

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.

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. 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. 48). 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.

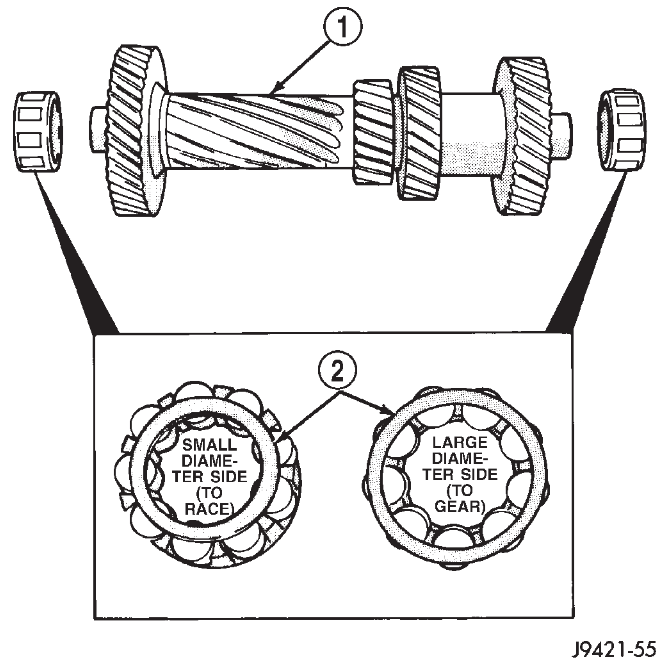


Fig. 48 COUNTERSHAFT & BEARINGS

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. 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. Replace the shaft if the splines are damaged or bearing surfaces are deeply scored, worn, or brinnelled.

ASSEMBLY

Sealers are used at all case joints. Usa 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.

MANUAL - NV3550 (Continued)

CAUTION: The transmission shift components must be in the Neutral position during assembly. This prevents damage to the synchro and shift components when the housings are installed.

SYNCHRONIZER

WARNING: WEAR SAFETY GLASSES WHILE ASSEMBLING THE SYNCHRONIZER. A BALL COULD JUMP OUT AND CAUSE INJURY.

To assemble each synchro install the springs, struts and detent balls one at a time as follows:

(1) Lubricate synchronizer components with Mopar Manual Transmission lubricant or equivalent.

(2) 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.

(3) 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.

(4) Slide the sleeve onto the hub just far enough to hold the first strut and spring in place.

(5) Place the detent ball in the top of the strut. Then carefully work the sleeve over the ball to hold it in place. Use a small flat blade screwdriver to press the ball into place while moving the sleeve over it.

(6) Repeat the procedure for the remaining springs, struts and balls. Tape or rubber band each strut and ball to temporarily secure as they are installed.

(7) Verify synchro springs, struts and detent balls are all in place (Fig. 49).

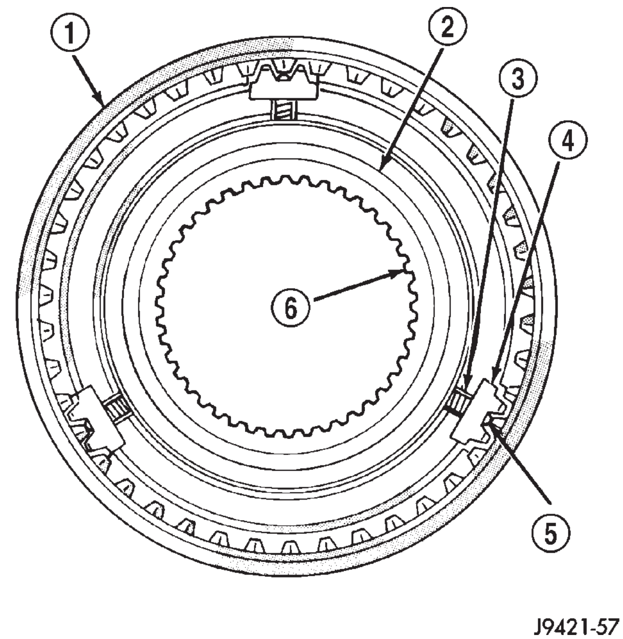


Fig. 49 SYNCHRONIZER COMPONENTS

1 - SLEEVE
2 - HUB SHOULDER
3 - SPRING (3)
4 - STRUT (3)
5 - DETENT BALL (3)
6 - HUB

OUTPUT SHAFT

NOTE: Lubricate all components with recommended lubricant during assembly. Petroleum jelly can be used to hold parts in place.

(1) Lubricate and install reverse gear needle bearing on shaft (Fig. 50). Slide bearing up against shoulder on output shaft.

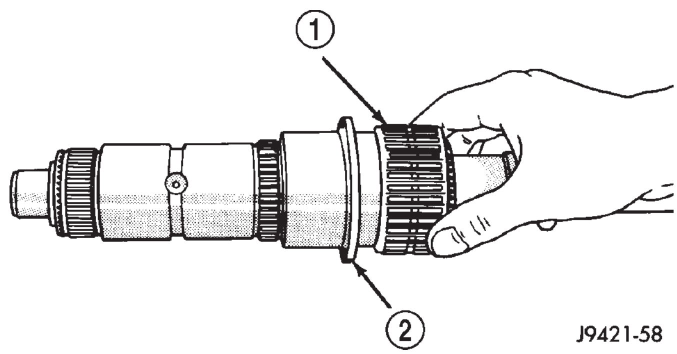


Fig. 50 REVERSE GEAR BEARING

1 - REVERSE GEAR BEARING
2 - SHOULDER

MANUAL - NV3550 (Continued)

(2) Install reverse gear over needle bearing (Fig. 51).

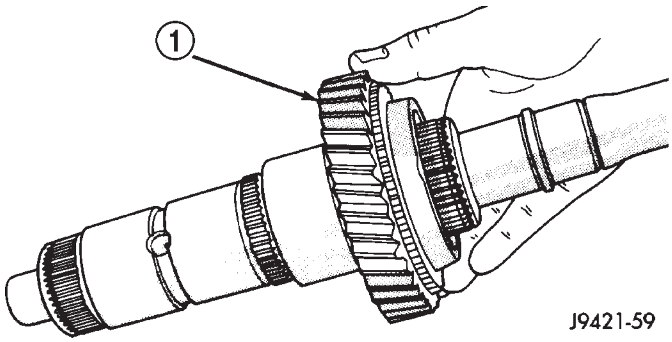


Fig. 51 REVERSE GEAR

1 - REVERSE GEAR

(3) Install brass synchro ring on reverse gear (Fig. 52).

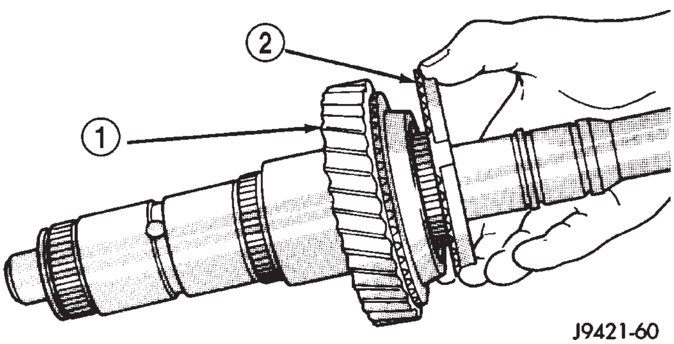


Fig. 52 REVERSE SYNCHRO

1 - REVERSE GEAR
2 - SYNCHRO RING

(4) Assemble fifth-reverse synchro hub, sleeve, struts, springs and detent balls, if not previously done.

CAUTION: One side of the hub has shoulders around the hub bore, this side of the hub faces the front of the shaft. One side of the sleeve is tapered. The tapered side faces the front of the shaft.

(5) Start fifth-reverse synchro assembly on output shaft splines by hand. Then seat synchro onto shaft with a press and Cup 6310-1 (Fig. 53).

NOTE: Lugs on the synchro ring must be aligned with the sleeve notches for installation.

(6) Install new fifth-reverse hub snap ring (Fig. 54) and verify the snap ring is seated.

NOTE: Snap rings are available in thicknesses from 2.00 mm to 2.20 mm (0.078 to 0.086 in.). Install thickest snap ring that will fit in shaft groove.

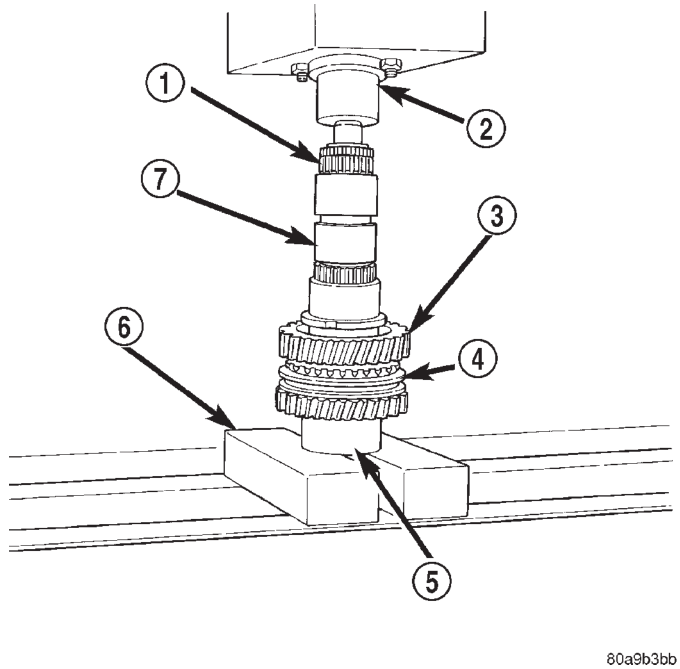


Fig. 53 FIFTH-REVERSE SYNCHRO ASSEMBLY

1 - SPACER
2 - PRESS RAM
3 - REVERSE GEAR
4 - FIFTH-REVERSE SYNCHRO ASSEMBLY
5 - CUP
6 - PRESS BLOCKS
7 - OUTPUT SHAFT

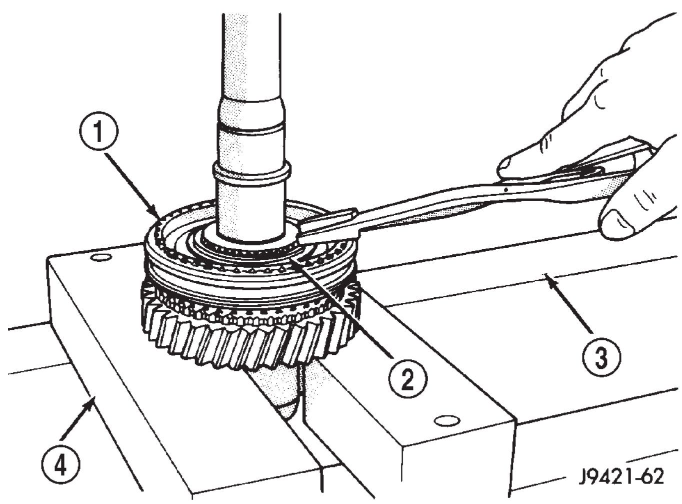


Fig. 54 FIFTH/REVERSE SYNCHRO HUB SNAP RING

1 - FIFTH-REVERSE SYNCHRO ASSEMBLY
2 - SNAP RING
3 - PRESS BED
4 - PRESS BLOCKS

MANUAL - NV3550 (Continued)

(7) Install fifth gear synchro ring in synchro hub and sleeve (Fig. 55).

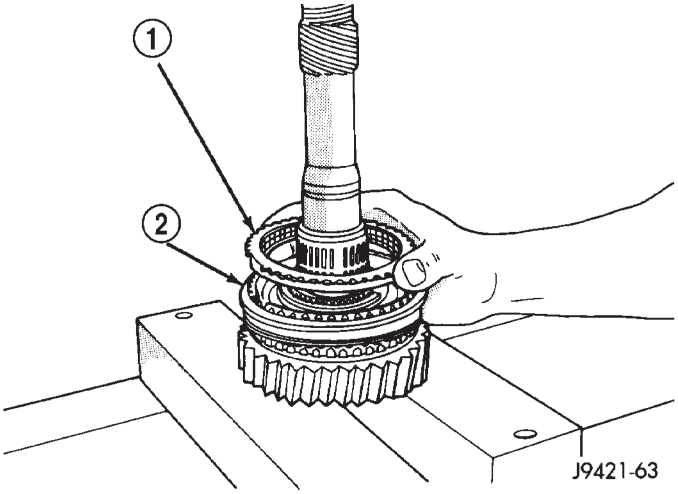


Fig. 55 FIFTH GEAR SYNCHRO RING

1 - FIFTH-SPEED SYNCHRO RING
2 - FIFTH-REVERSE SYNCHRO ASSEMBLY

(8) Install fifth gear bearing, spreading bearing only enough to clear shoulder on output shaft (Fig. 56). Verify bearing is properly seated.

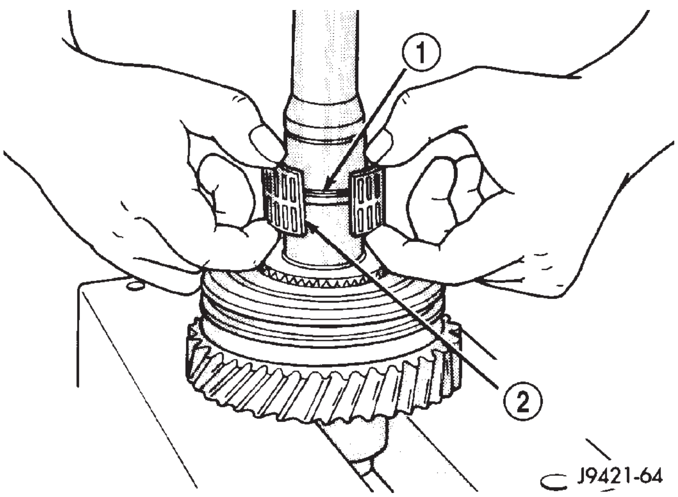


Fig. 56 FIFTH GEAR BEARING

1 - SHAFT SHOULDER
2 - FIFTH GEAR BEARING

(9) Install fifth gear on shaft and onto bearing (Fig. 57).

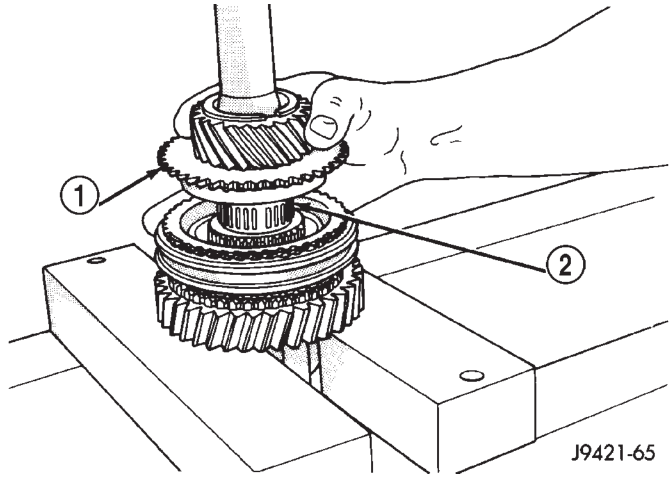


Fig. 57 FIFTH GEAR

1 - FIFTH GEAR
2 - BEARING

(10) Invert output shaft and set the shaft in Cup 6310-1 so that fifth gear is seated on the tool (Fig. 58).

(11) Install first gear bearing on output shaft (Fig. 58). Verify bearing is seated on shaft shoulder and is properly joined.

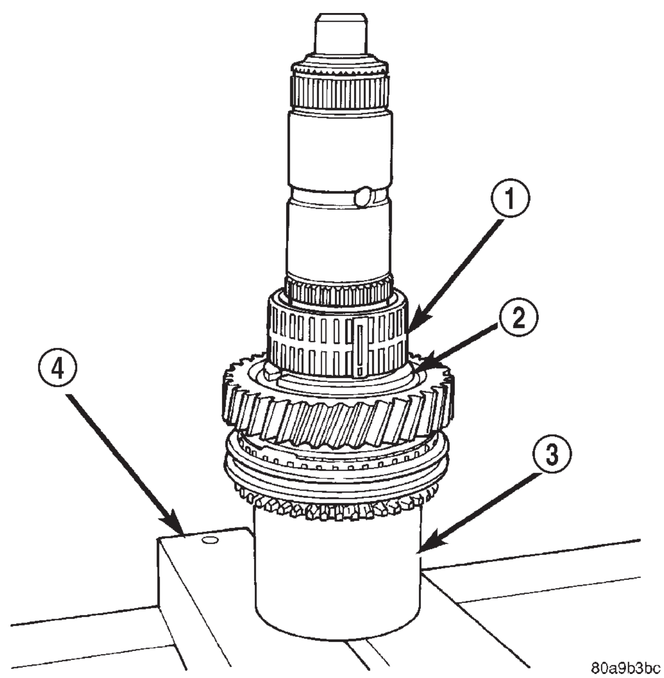


Fig. 58 FIRST GEAR BEARING

1 - FIRST GEAR BEARING
2 - SHAFT SHOULDER
3 - CUP
4 - PRESS BLOCKS

MANUAL - NV3550 (Continued)

(12) Install first gear on shaft and over bearing with synchro cone facing up (Fig. 59).

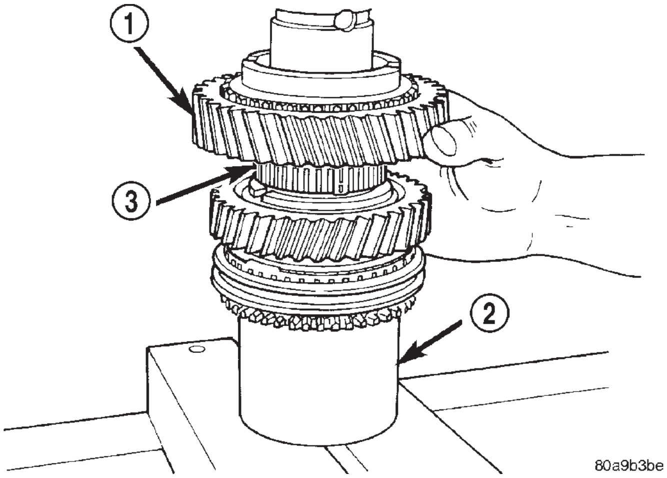


Fig. 59 FIRST GEAR

1 - FIRST GEAR
2 - CUP
3 - BEARING

(13) Install first gear synchro ring (Fig. 60).

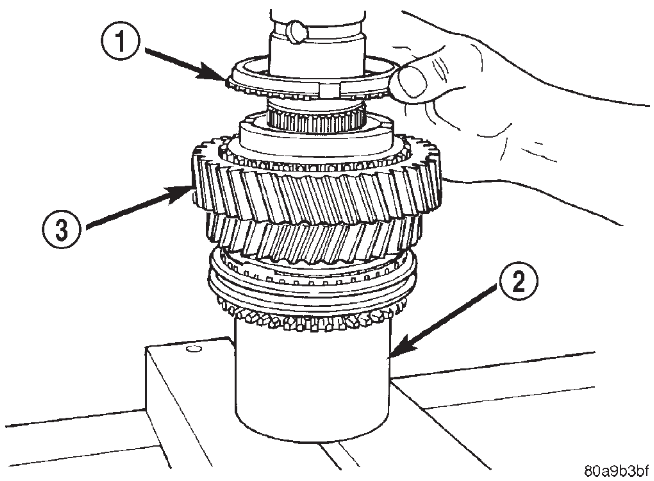


Fig. 60 FIRST GEAR SYNCHRO RING

1 - FIRST GEAR SYNCHRO RING
2 - CUP
3 - FIRST GEAR

(14) Assemble 1-2 synchro hub sleeve, springs, struts and detent balls.

CAUTION: The 1-2 synchro hub and sleeve can be installed backwards. One side of the synchro sleeve is marked First Gear Side. Verify this side of the sleeve is facing first gear.

(15) Start 1-2 synchro assembly on shaft by hand (Fig. 61). Verify synchro sleeve is properly positioned.

(16) Press 1-2 synchro onto output shaft using suitable size pipe tool and shop press (Fig. 62).

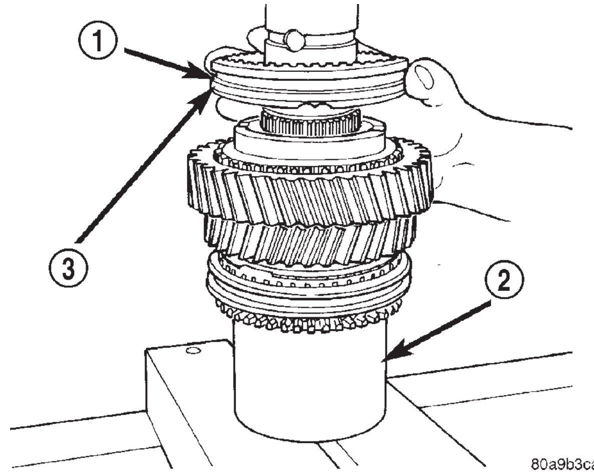


Fig. 61 STARTING 1-2 SYNCHRO

1 - 1–2 SYNCHRO ASSEMBLY
2 - CUP
3 - FIRST GEAR SIDE OF SYNCHRO SLEEVE

CAUTION: Align the synchro ring and sleeve as hub the is being pressed onto the shaft. The synchro ring can crack if not aligned.

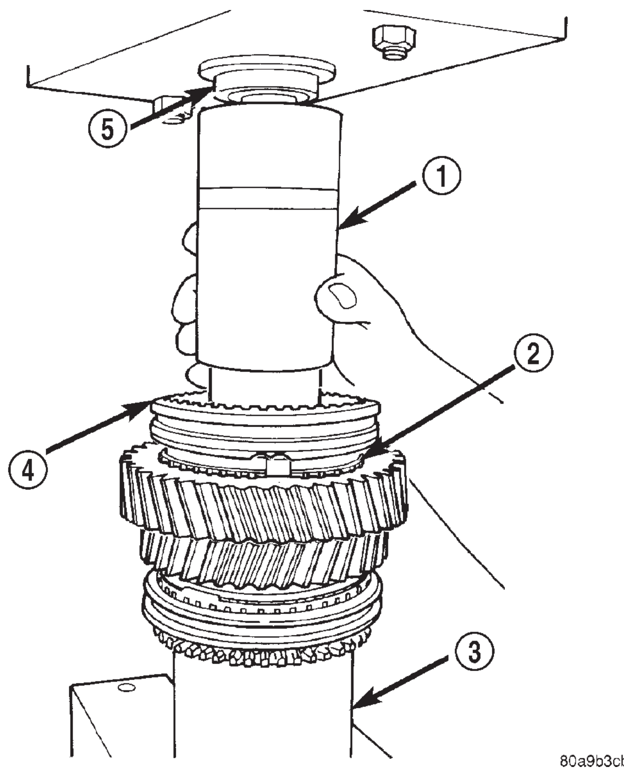


Fig. 62 PRESS 1-2 SYNCHRO

1 - SUITABLE SIZE PIPE TOOL
2 - SYNCHRO RING
3 - CUP
4 - 1-2 SYNCHRO ASSEMBLY
5 - PRESS RAM

MANUAL - NV3550 (Continued)

(17) Install interm ring.

(18) Install new 1-2 synchro hub snap ring (Fig. 63) and verfiy the snap ring is seated.

NOTE: Snap rings are available in thicknesses from 1.80 mm to 2.00 mm (0.070 to 0.078 in.). Install thickest snap ring that will fit in shaft groove.

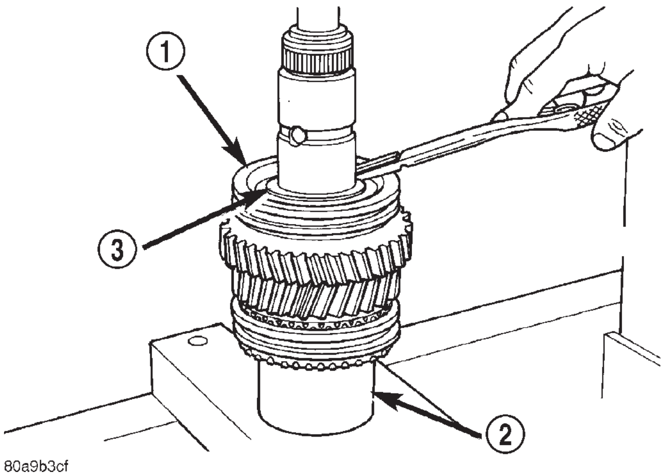


Fig. 63 1-2 SYNCHRO HUB SNAP RING

1 - 1-2 SYNCHRO
2 - CUP
3 - SYNCHRO SNAP RING

(19) Install second gear synchro ring in 1-2 synchro hub and sleeve (Fig. 64). Verify synchro ring is properly seated.

(20) Install synchro friction cone and synchro cone in synchro ring.

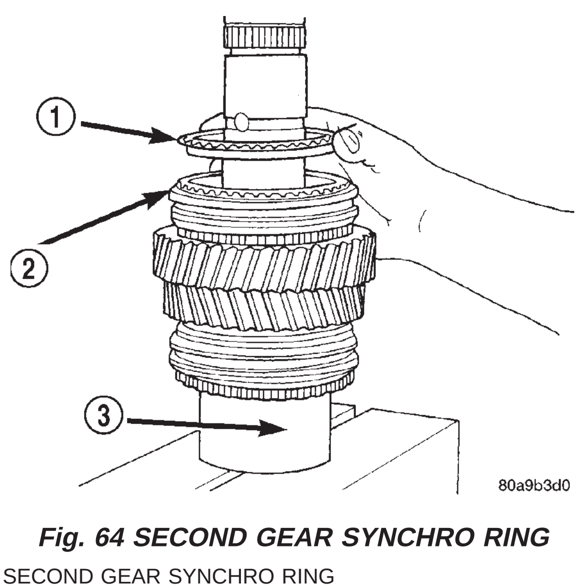


Fig. 64 SECOND GEAR SYNCHRO RING

1 - SECOND GEAR SYNCHRO RING
2 - 1-2 SYNCHRO
3 - CUP

(21) Install second gear needle bearing on shaft (Fig. 65).

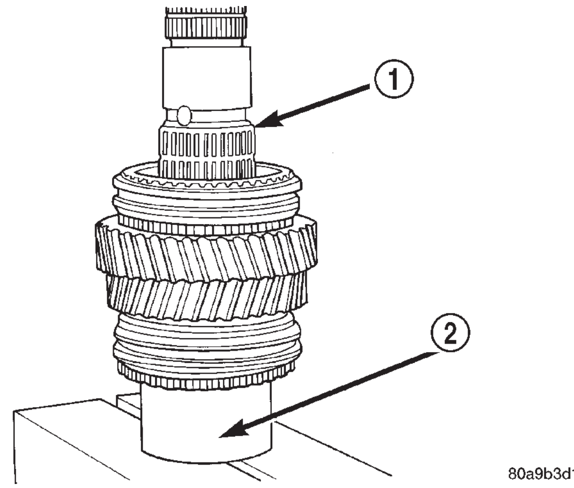


Fig. 65 SECOND GEAR BEARING

1 - SECOND GEAR BEARING
2 - CUP

(22) Install second gear onto shaft and bearing (Fig. 66). Verify second gear is fully seated on synchro components.

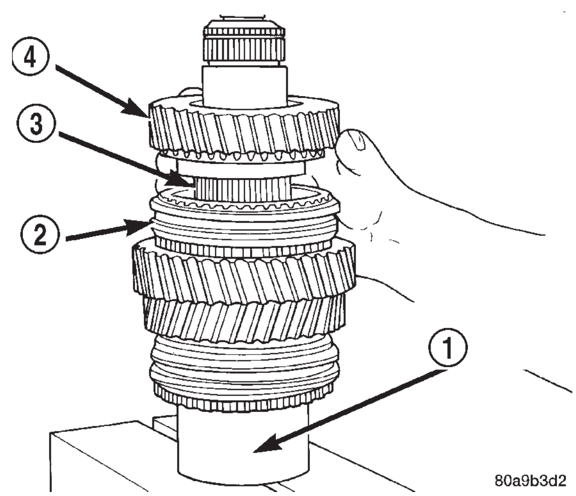


Fig. 66 SECOND GEAR

1 - CUP
2 - 1-2 SYNCHRO ASSEMBLY
3 - BEARING
4 - SECOND GEAR

MANUAL - NV3550 (Continued)

(23) Install two-piece thrust washer (Fig. 67). Ensure washer halves are seated in shaft groove and that washer lugs are seated in shaft lug bores.

NOTE: Dot or markings on the two-piece thrust washer go toward 3rd gear.

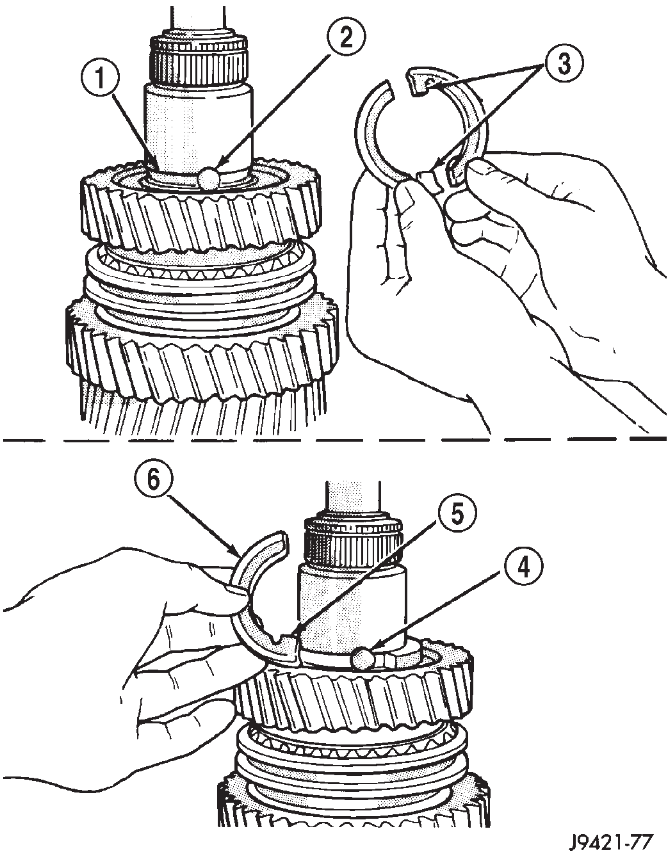


Fig. 67 TWO-PIECE THRUST WASH

1 - WASHER GROOVE IN SHAFT
2 - LUG BORE
3 - THRUST WASHER LUGS
4 - LUG BORE
5 - LUG
6 - WASHER HALF

(24) Start retaining ring around two-piece thrust washer (Fig. 68). Ensure locating dimple is between the thrust washer halves.

(25) Seat thrust washer retaining ring with plastic mallet (Fig. 69).

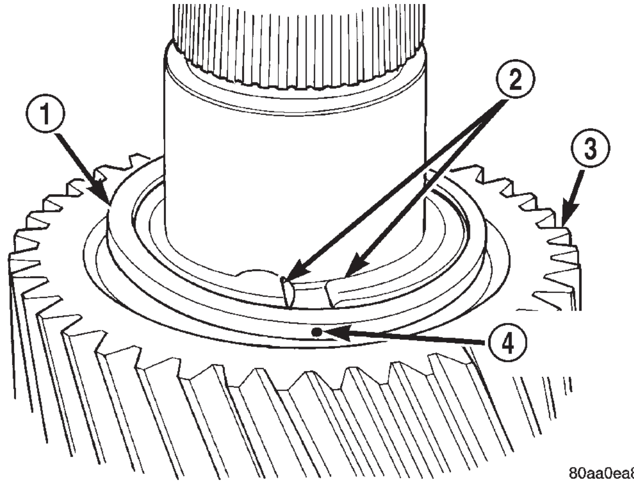


Fig. 68 RETAINING RING

1 - THRUST WASHER RETAINING RING
2 - THRUST WASHER HALVES
3 - SECOND GEAR
4 - LOCATING DIMPLE

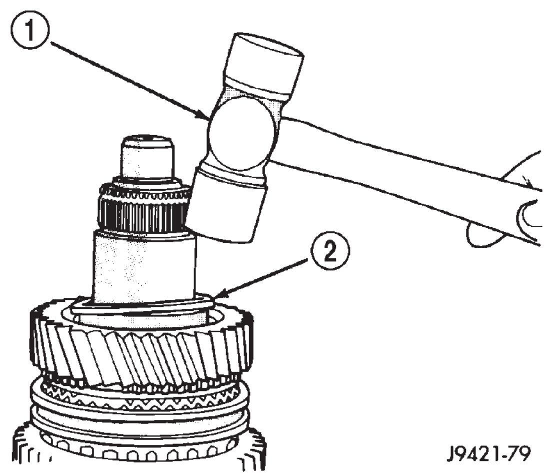


Fig. 69 THRUST RETAINER

1 - PLASTIC MALLET
2 - THRUST WASHER RETAINING RING

MANUAL - NV3550 (Continued)

(26) Install third gear needle bearing on shaft (Fig. 70).

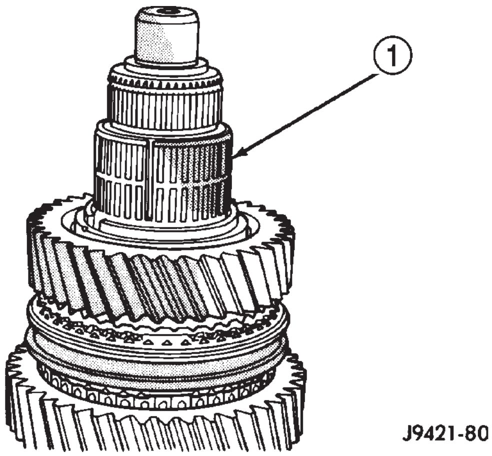


Fig. 70 THIRD GEAR BEARING

1 - THIRD GEAR BEARING

(27) Install third gear on shaft and bearing (Fig. 71).

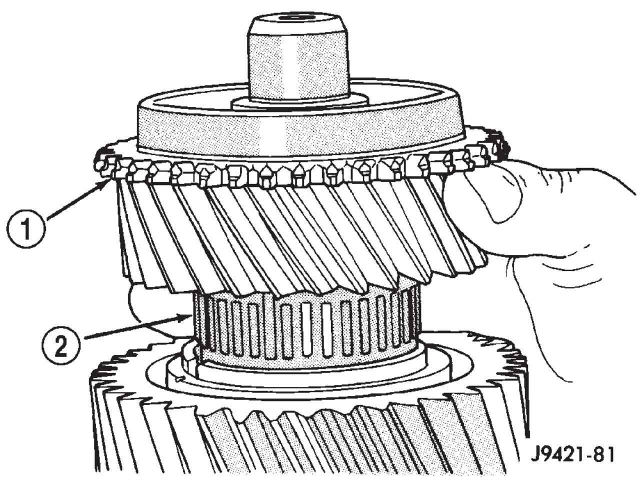


Fig. 71 THIRD GEAR

1 - THIRD GEAR
2 - BEARING

(28) Install third speed synchro ring on third gear (Fig. 72).

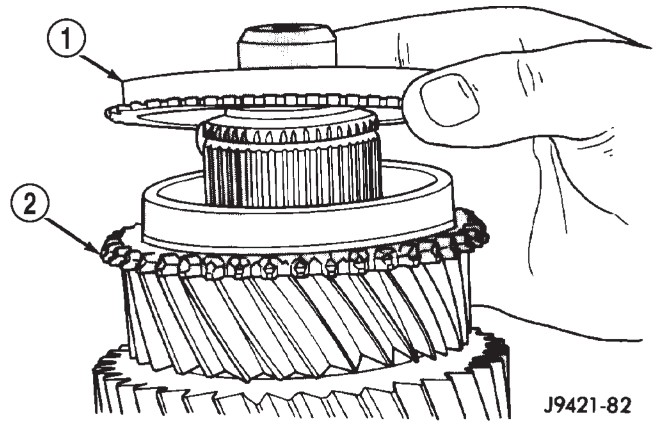


Fig. 72 THIRD SPEED SYNCHRO RING

1 - THIRD SPEED SYNCHRO RING
2 - THIRD GEAR

(29) Assemble 3-4 synchro hub, sleeve, springs, struts and detent balls.

(30) Start 3-4 synchro hub on output shaft splines by hand (Fig. 73).

CAUTION: The 3-4 synchro hub and sleeve can be installed backwards. One side of the sleeve has grooves in it. This side of sleeve faces the front of the shaft.

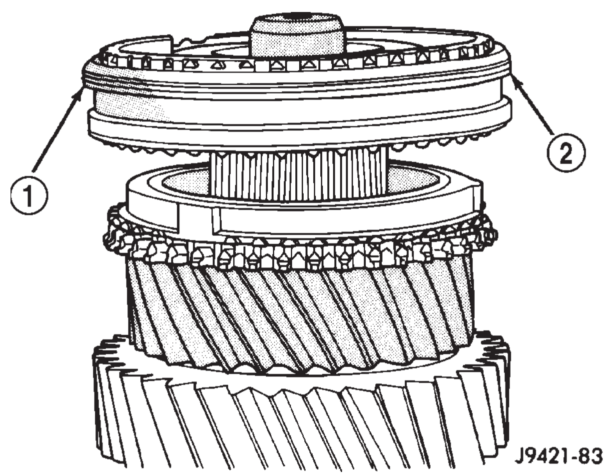


Fig. 73 3-4 SYNCHRO HUB ON OUTPUT SHAFT

1 - GROOVED SIDE OF SLEEVE (TO FRONT)
2 - 3-4 SYNCHRO ASSEMBLY

MANUAL - NV3550 (Continued)

(31) With the lug on the ring aligned with the slot on the synchro, press 3-4 synchro assembly onto output shaft with shop press and suitable size pipe tool (Fig. 74).

NOTE: Place the pipe on hub as close to output shaft as possible without contacting the shaft splines.

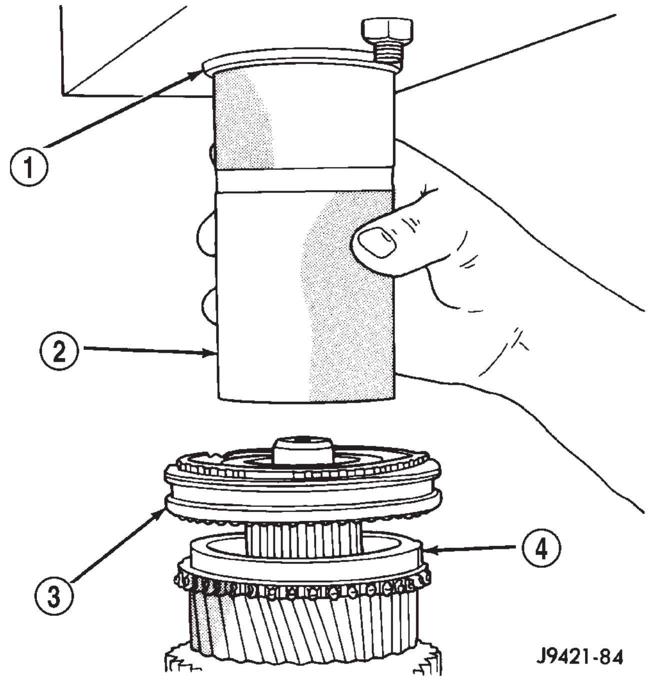


Fig. 74 3-4 SYNCHRO ON OUTPUT SHAFT

1 - PRESS RAM
2 - PIPE TOOL
3 - 3-4 SYNCHRO
4 - THIRD SPEED SYNCHRO RING

(32) Install 3-4 synchro hub snap ring (Fig. 75) and verify snap ring is seated.

NOTE: Snap rings are available in thicknesses from 2.00 mm to 2.30 mm (0.078 to 0.090 in.). Install thickest snap ring that will fit in shaft groove.

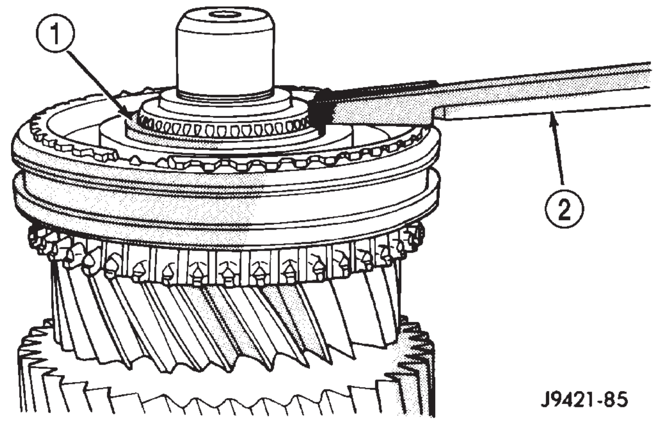


Fig. 75 3-4 SYNCHRO HUB SNAP RING

1 - 3-4 SYNCHRO HUB SNAP RING
2 - HEAVY DUTY SNAP RING PLIERS

(33) Verify position of synchro sleeves before proceeding with assembly operations (Fig. 76). 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.

REVERSE IDLER ASSEMBLY

(1) Lubricate idler components with Mopar Manual Transmission lubricant or equivalent.
(2) Slide idler gear bearing on shaft (Fig. 77). Bearing fits either way on shaft.
(3) Slide gear onto shaft. Side of gear with recess goes to rear (Fig. 77).
(4) Place first lock ball in dimple at rear end of idler shaft (Fig. 77). Hold ball in place with petroleum jelly.
(5) Slide thrust rear thrust washer onto shaft and over lock ball (Fig. 78).
(6) Install snap ring in groove at rear of shaft (Fig. 78).

MANUAL - NV3550 (Continued)

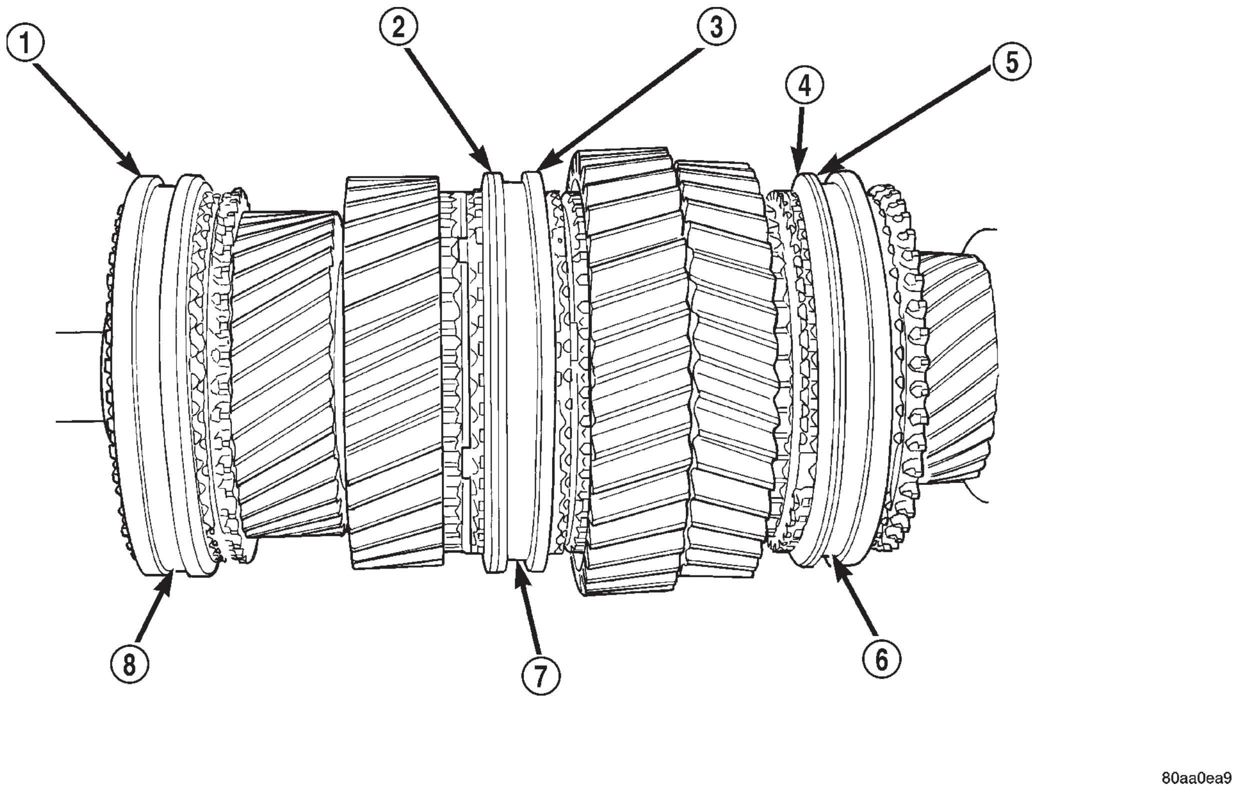


Fig. 76 SYNCHRO SLEEVE LOCATIONS

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

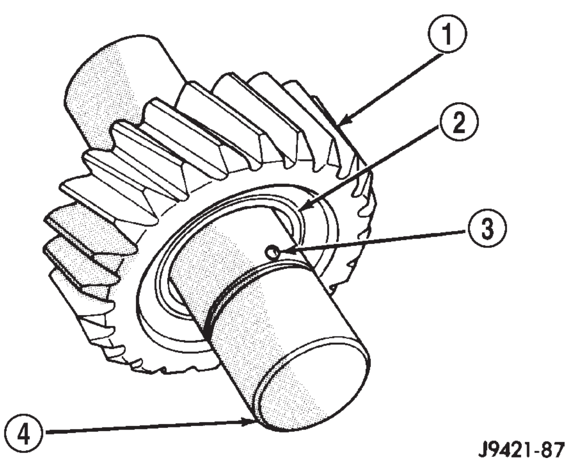


Fig. 77 IDLER GEAR AND BEARING

1 - IDLER GEAR
2 - BEARING
3 - LOCK BALL
4 - REAR OF SHAFT

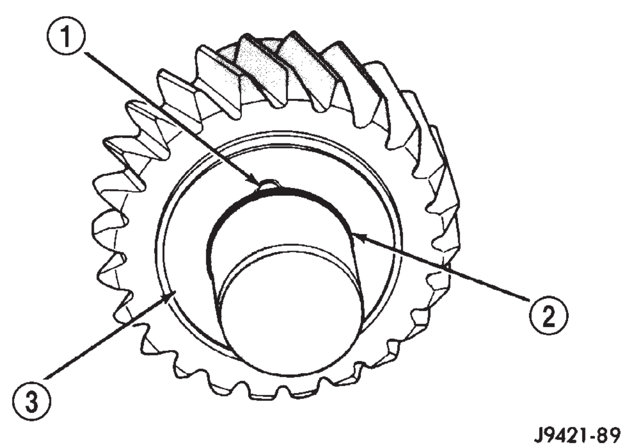


Fig. 78 IDLER GEAR REAR THRUST WASHER

1 - LOCK BALL
2 - SNAP RING GROOVE
3 - THRUST WASHER

MANUAL - NV3550 (Continued)

(7) Install lock ball in dimple at front of shaft. Hold ball in place with petroleum jelly.

(8) Install front thrust washer on shaft and slide washer up against gear and over lock ball (Fig. 79).

(9) Install wave washer, flat washer and remaining snap ring on idler shaft (Fig. 79). Verify snap ring is seated.

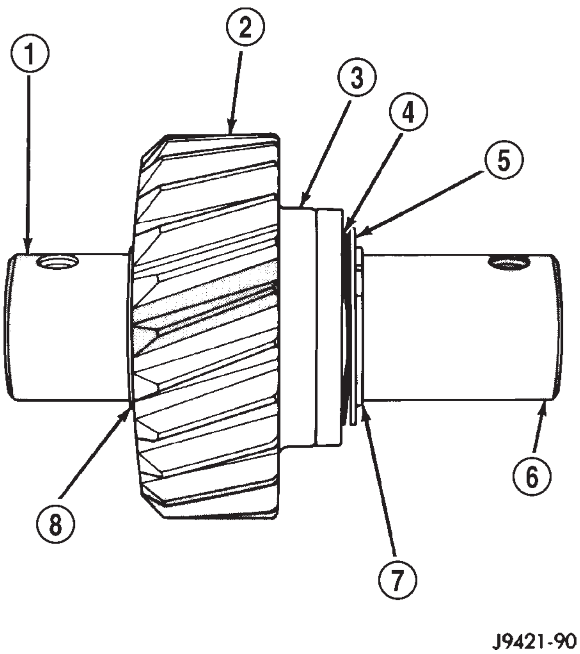


Fig. 79 IDLER GEAR AND SHAFT ASSEMBLY

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

SHIFT SHAFT AND BUSHINGS/BEARINGS

Inspect shift shaft bushing and bearing for damage and replace if necessary.

(1) Locate a bolt that will thread into the bushing without great effort.

(2) Thread the bolt into the bushing, allowing the bolt to make its own threads in the bushing.

(3) Attach a slide hammer or suitable puller to the bolt and remove bushing.

(4) Use the short end of Installer 8119 to install the new bushing.

(5) The bushing is correctly installed if the bushing is flush with the transmission case.

(6) To replace the bearing locate a bolt that will thread into the bearing without great effort.

(7) Thread the bolt into the bearing as much as possible.

(8) Attach a slide hammer or suitable puller to the bolt and remove the bearing.

(9) Use the short end of Installer 8119 to install the new bearing.

(10) The bearing is correctly installed if the bearing is flush with the transmission case.

DETENT PLUNGER BUSHING

Inspect detent plunger bushings for damage and replace if necessary.

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.

(1) Using the long end of Installer 8119, drive the detent bushings through the outer case and into the shift shaft bore.

(2) Remove the bushings from the shift shaft bore.

(3) Install a new detent plunger bushing on the long end of Installer 8118.

(4) Start the bushing in the detent plunger bore in the case.

(5) Drive the bushing into the bore until the tool contacts the transmission case.

(6) Install a new detent plunger bushing on the short end of Installer 8118.

(7) Start the bushing in the detent plunger bore in the case.

(8) Drive the bushing into the bore until the tool contacts the transmission case.

MANUAL - NV3550 (Continued)

GEARTRAIN ASSEMBLY

(1) Install Adapter 6747-1A on input shaft hub of Fixture 6747 (Fig. 80).

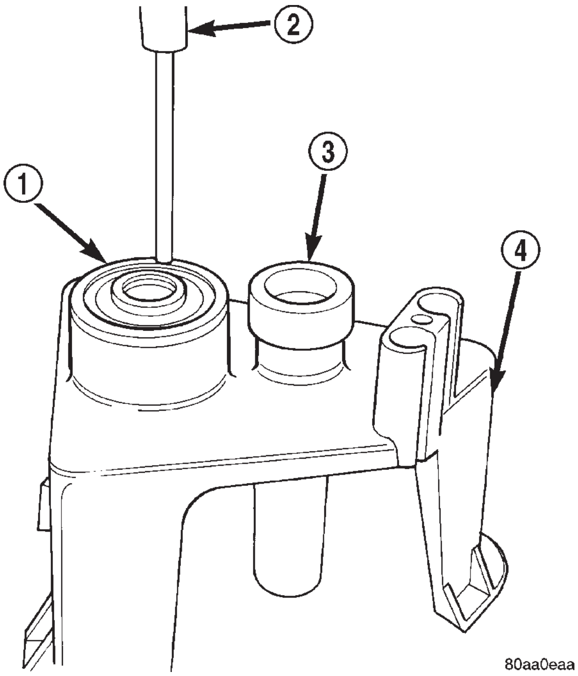


Fig. 80 ASSEMBLY FIXTURE

1 - ADAPTER 6747-2B (INSTALL ON COUNTERSHAFT FRONT HUB)
2 - CUP ADAPTER 8115
3 - ADAPTER 6747-A
4 - FIXTURE 6747

(2) Install input shaft in fixture tool. Make sure Adapter 6747-1A is positioned under shaft as shown (Fig. 81).

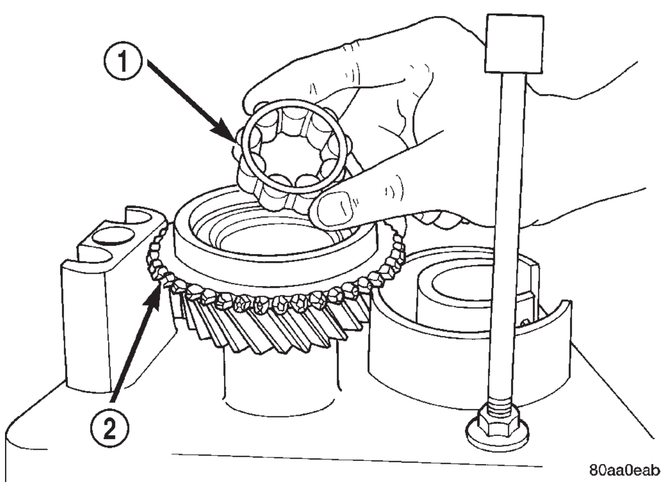


Fig. 81 PILOT BEARING AND INPUT SHAFT

1 - PILOT BEARING
2 - INPUT SHAFT

(3) Install pilot bearing in input shaft (Fig. 81).

NOTE: The side of the pilot bearing with the small diameter goes toward the input shaft.

(4) Install fourth gear synchro ring on input shaft (Fig. 82).

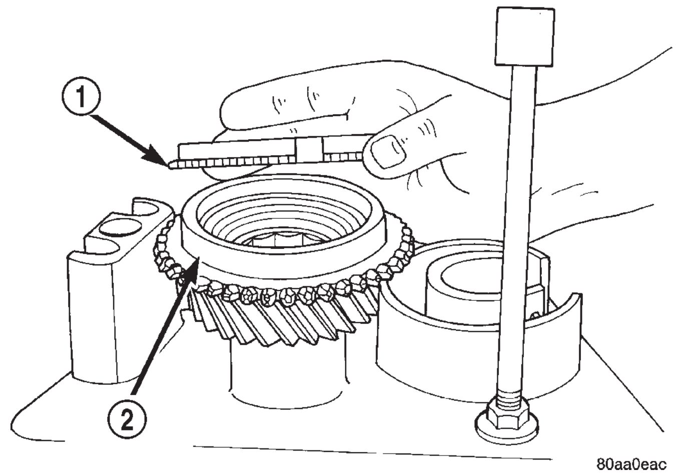


Fig. 82 FOURTH GEAR SYNCHRO

1 - FOURTH GEAR SYNCHRO RING
2 - INPUT SHAFT

(5) Adjust height of idler gear pedestal on assembly fixture (Fig. 83). Start with a basic height of 18.4 cm (7-1/4 in.). Final adjustment can be made after gear is positioned on pedestal.

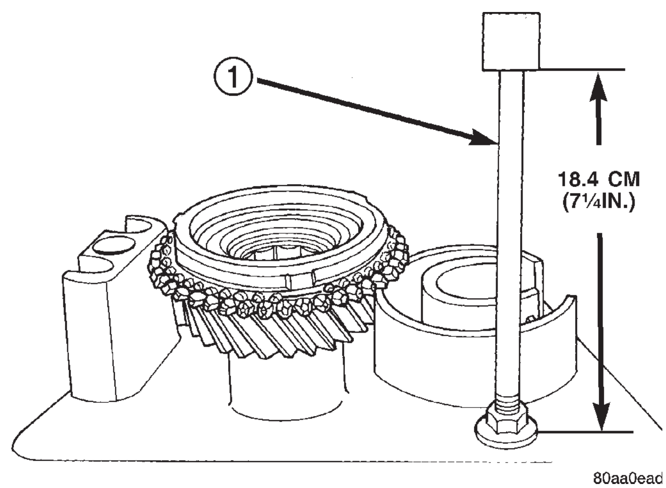


Fig. 83 IDLER PEDESTAL BASIC HEIGHT

1 - REVERSE IDLER PEDESTAL

MANUAL - NV3550 (Continued)

(6) Install assembled output shaft and geartrain in input shaft (Fig. 84). Carefully rotate output shaft until the 3-4 synchro ring seats in synchro hub and sleeve.

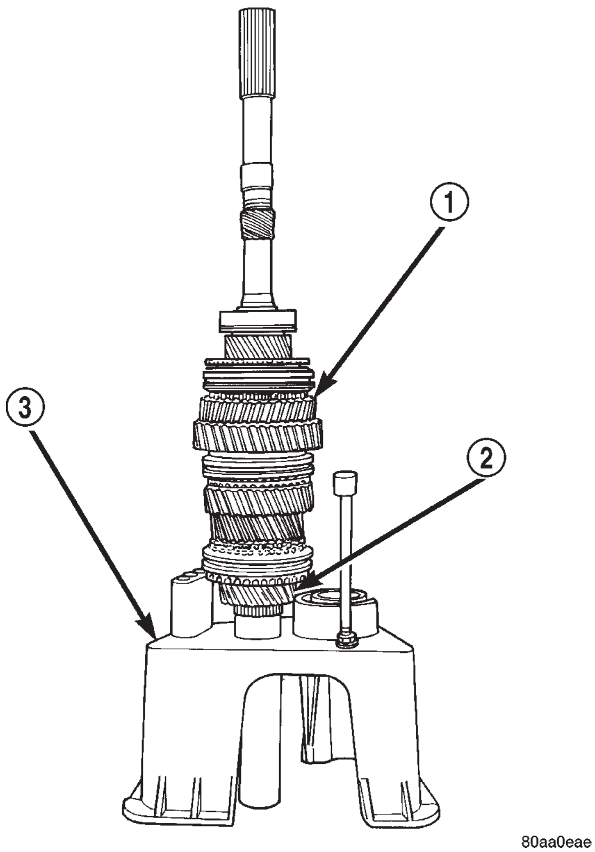


Fig. 84 OUTPUT SHAFT AND GEARTRAIN

1 - OUTPUT SHAFT AND GEARTRAIN
2 - INPUT SHAFT
3 - FIXTURE 6747

(7) Install Adapter 6747-2B on front bearing hub of countershaft. The adapter has a shoulder on one side that goes towards the countershaft.

(8) Slide countershaft (and adapter) into fixture slot. Verify countershaft and output shaft gears are fully meshed with the mainshaft gears (Fig. 85).

(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.

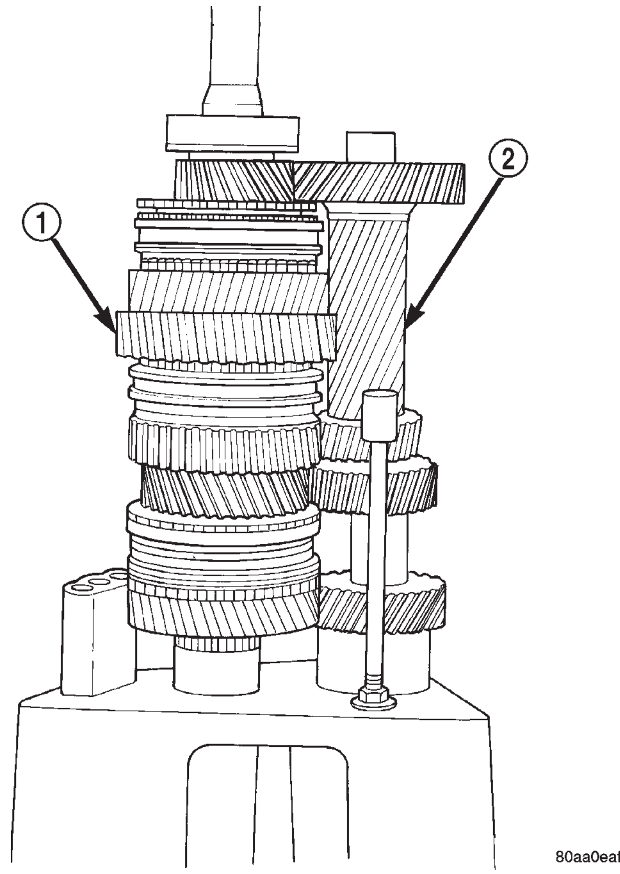


Fig. 85 COUNTERSHAFT ON FIXTURE

1 - OUTPUT SHAFT AND GEARTRAIN
2 - COUNTERSHAFT (SLIDE INTO PLACE ON FIXTURE TOOL)

MANUAL - NV3550 (Continued)

(10) Position reverse idler in support cup of assembly fixture (Fig. 86). Ensure 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.

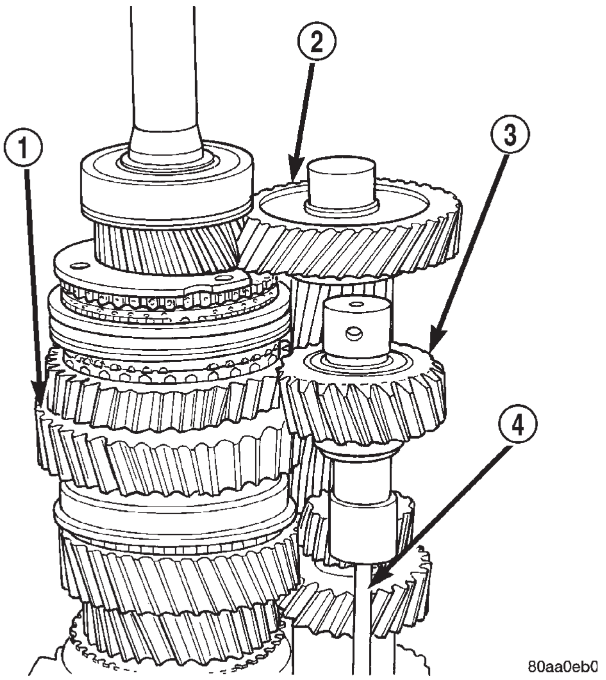


Fig. 86 REVERSE IDLER ASSEMBLY POSITION

1 - OUTPUT SHAFT AND GEARTRAIN
2 - COUNTERSHAFT
3 - REVERSE IDLER ASSEMBLY
4 - TOOL PEDESTAL

(11) Assemble 1-2 and fifth reverse-shift forks (Fig. 87). Arm of fifth-reverse fork goes through slot in 1-2 fork.

(12) Install assembled shift forks in synchro sleeves (Fig. 88). Verify forks are properly seated in sleeves.

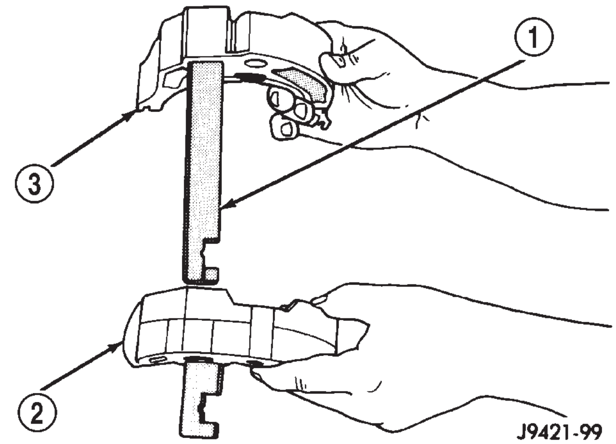


Fig. 87 1-2 AND FIFTH-REVERSE

1 - FIFTH-REVERSE FORK ARM
2 - 1-2 FORK
3 - FIFTH-REVERSE FORK

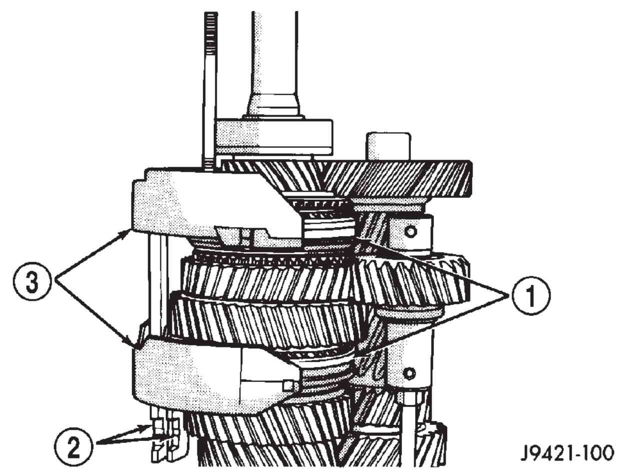


Fig. 88 SHIFT FORKS IN SYNCHRO

1 - SYNCHRO SLEEVES
2 - FORK ARMS
3 - SHIFT FORKS

MANUAL - NV3550 (Continued)

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. 89).

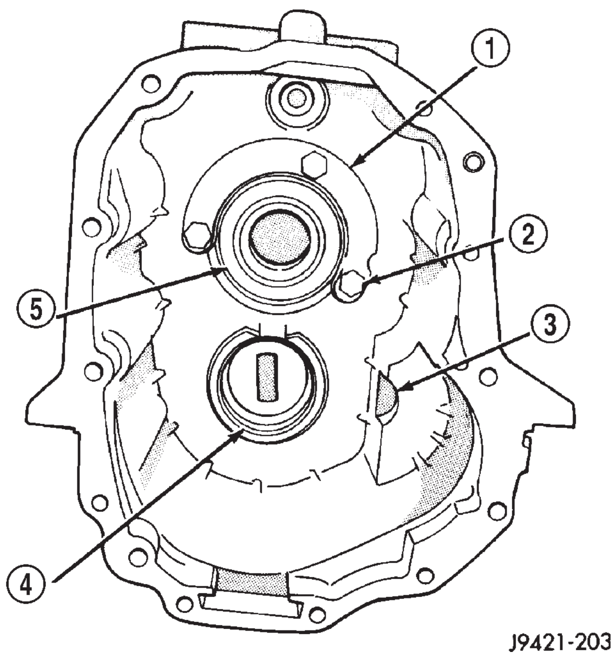


Fig. 89 ADAPTER HOUSING

1 - BEARING RETAINER
2 - RETAINER BOLT
3 - IDLER SHAFT NOTCH
4 - COUNTERSHAFT BEARING RACE
5 - REAR BEARING

(3) Apply Mopar Gasket Maker or equivalent, to threads, bolt shanks and under hex heads of bearing retainer bolts.

(4) Apply liberal quantity of petroleum jelly to countershaft rear bearing and bearing race.

(5) Install countershaft rear bearing in bearing race (Fig. 89).

CAUTION: Be sure the large diameter side of the roller retainer faces the countershaft and the small diameter side faces the race and housing.

(6) Apply extra petroleum jelly to hold countershaft rear bearing in place when housing is installed.

(7) Apply light coat of petroleum jelly to shift shaft bushing/bearing in adapter housing.

(8) Install adapter housing on geartrain.

(9) Install rear bearing snap ring on output shaft (Fig. 90).

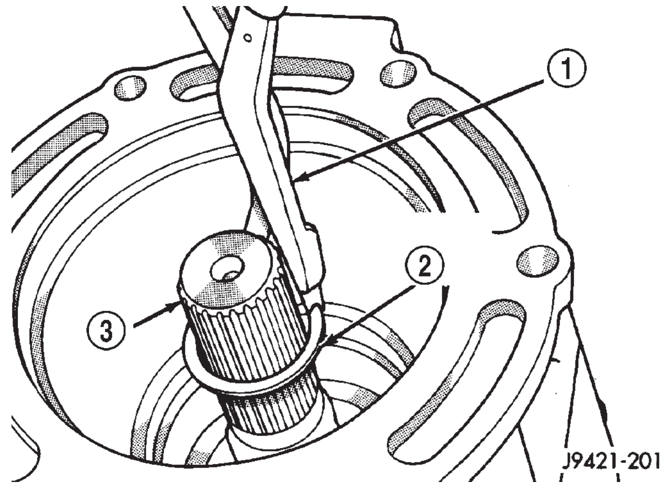


Fig. 90 REAR BEARING SNAP RING

1 - SNAP RING PLIERS
2 - SNAP RING
3 - OUTPUT SHAFT

(10) Lubricate lip of new rear seal (Fig. 91) with Mopar Door Ease or transmission fluid.

(11) Install new rear seal in adapter housing bore with Installer C-3860-A. Verify seal is seated in housing bore (Fig. 91).

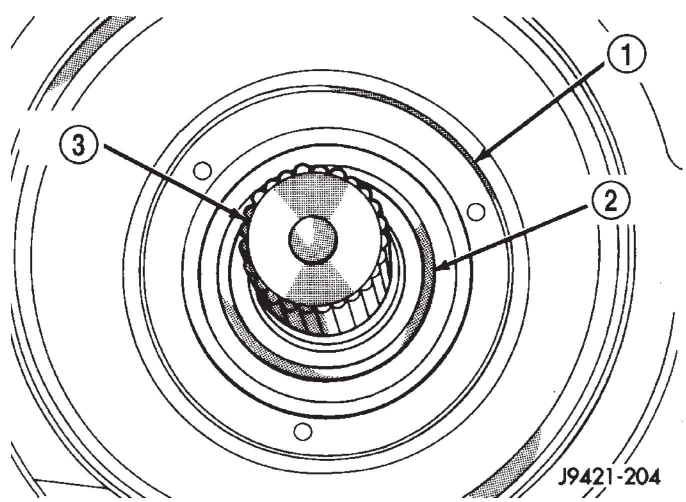


Fig. 91 REAR SEAL

1 - REAR SEAL
2 - SEAL LIP
3 - OUTPUT SHAFT

MANUAL - NV3550 (Continued)

(12) Slide reverse idler shaft support straight into the housing.

(13) Install reverse idler shaft support bolt and idler shaft bolt (Fig. 92). Tighten bolts to 19-25 N·m (14-18 ft. lbs.).

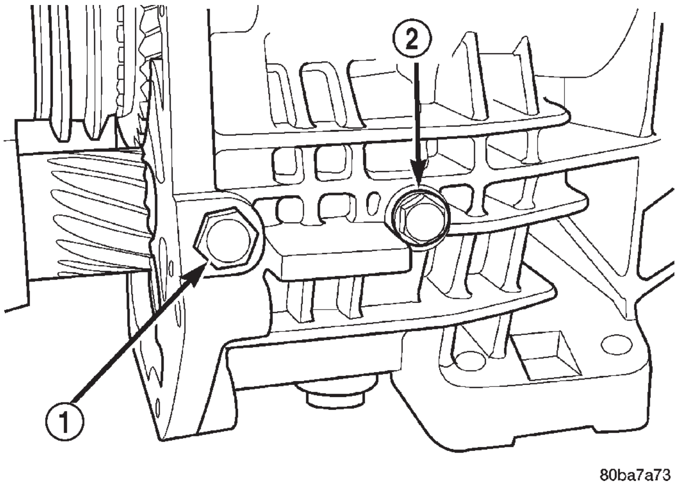


Fig. 92 REVERSE IDLER SHAFT/SUPPORT BOLT

1 - SUPPORT BOLT
2 - SHAFT BOLT

SHIFT SHAFT, SHAFT LEVER AND BUSHING AND SHIFT SOCKET

(1) Verify that all synchro sleeves are in Neutral position (centered on hub).

CAUTION: The transmission synchros must all be in Neutral position for assembly. 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. 93). Verify that groove in fork arm is aligned with grooves in 1-2 and fifth-reverse fork arms as shown.

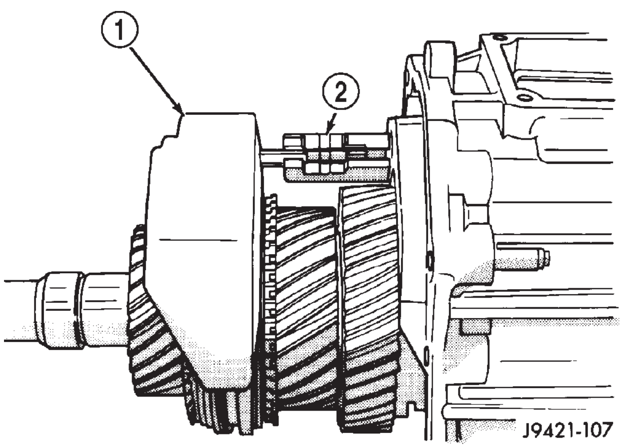


Fig. 93 3-4 SHIFT FORK

1 - 3-4 FORK
2 - ALIGN GROOVES IN FORK ARMS

(3) Slide the end of shift shaft with shaft detent notches through 3-4 shift fork.

(4) Assemble shift shaft shift lever and bushing (Fig. 94). Be sure slot in bushing is facing up and roll pin hole for lever is aligned with hole in shaft.

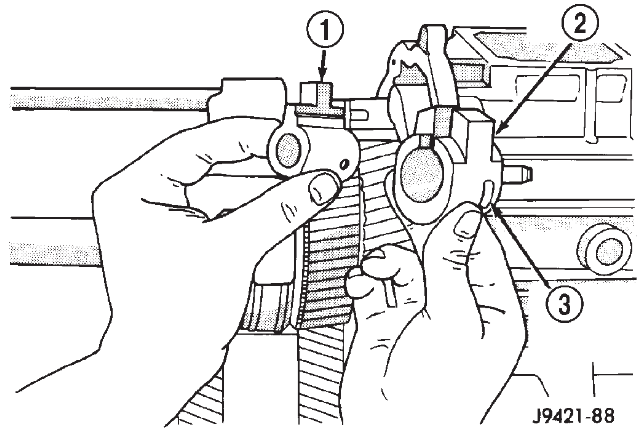


Fig. 94 LEVER AND BUSHING

1 - SHAFT LEVER
2 - LEVER BUSHING
3 - BUSHING LOCK PIN SLOT

(5) Install assembled lever and bushing on shift shaft (Fig. 95).

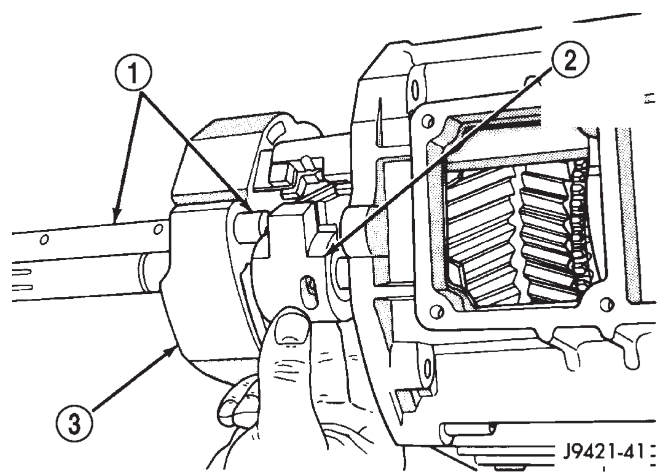


Fig. 95 LEVER AND BUSHING ASSENBLY

1 - SHIFT SHAFT
2 - SHAFT LEVER AND BUSHING
3 - 3-4 FORK

MANUAL - NV3550 (Continued)

(6) Slide shift shaft through shift forks (Fig. 96) and into shift lever opening in rear housing (Fig. 97).

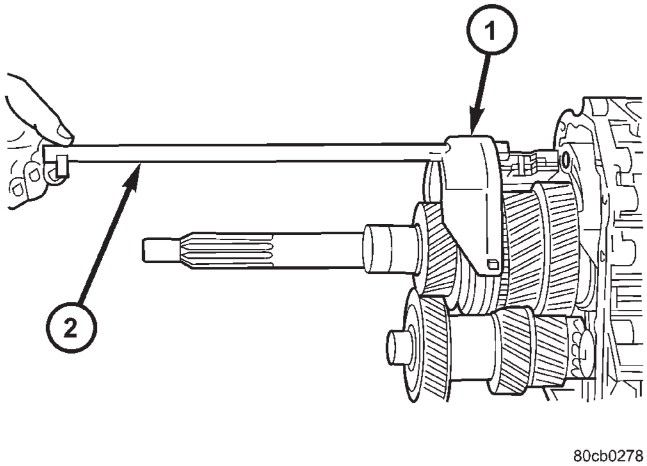


Fig. 96 SHIFT SHAFT

1 - SHIFT SHAFT
2 - 3-4 SHIFT FORK

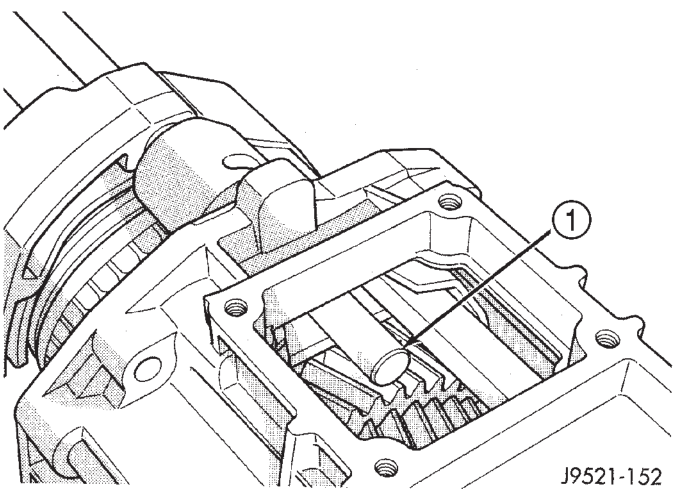


Fig. 97 SHAFT IN LEVER OPENING

1 - SHIFT SHAFT

(7) Align shift socket with shaft and slide shaft through socket and into shift shaft bearing in rear housing (Fig. 98).

(8) Rotate shift shaft so detent notches in shaft are facing the TOP of the transmission housing.

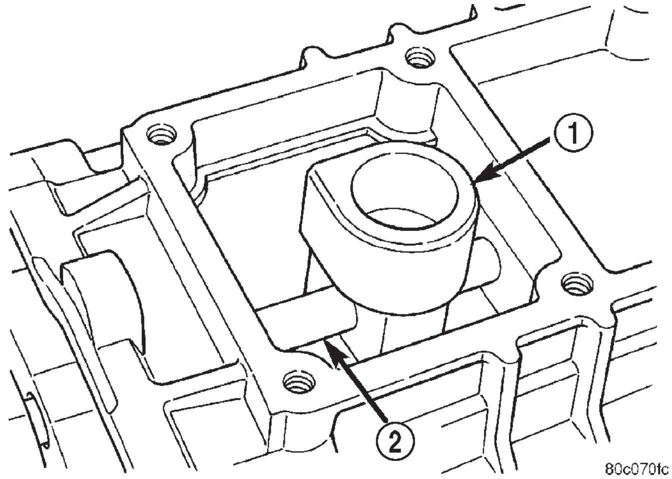


Fig. 98 SHIFT SOCKET

1 - SHIFT SOCKET
2 - SHIFT SHAFT

CAUTION: 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. 99). 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.

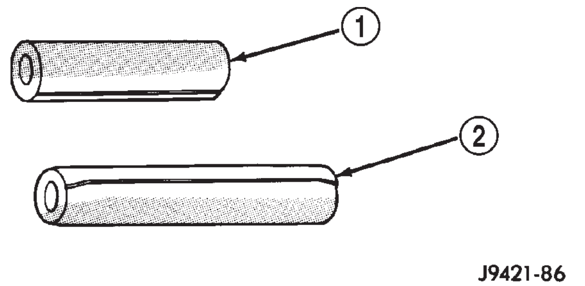


Fig. 99 ROLL PIN IDENTIFICATION

1 - SHAFT LEVER ROLL PIN
2 - SHIFT SOCKET ROLL PIN

MANUAL - NV3550 (Continued)

(10) Align roll pin holes in shift shaft, lever and bushing. Then start roll pin into shaft lever by hand (Fig. 100).

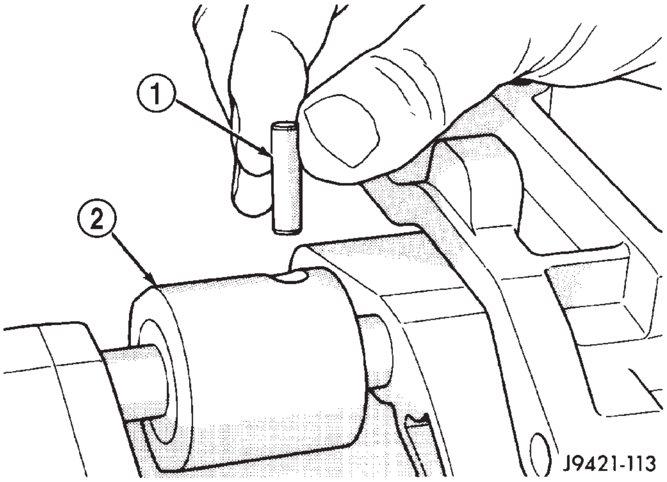


Fig. 100 ROLL PIN IN SHIFT SHAFT

1 - SHAFT LEVER ROLL PIN 22 mm (7/8 in.)
2 - LEVER AND BUSHING

(11) Seat shaft lever roll pin with pin punch (Fig. 101).

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) Verify that lock pin slot in lever bushing is positioned as shown (Fig. 101).

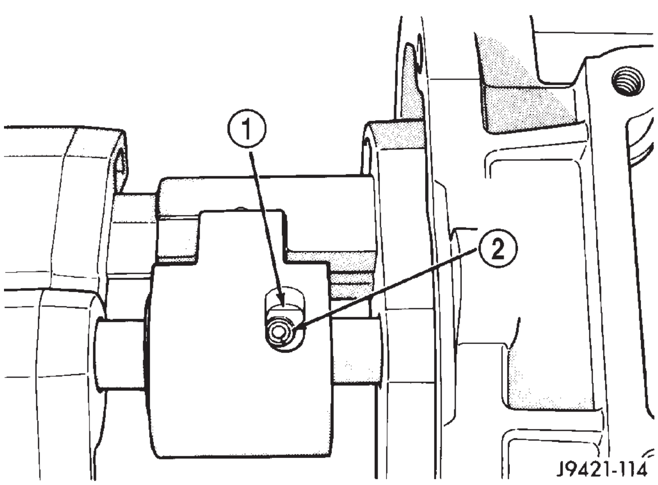


Fig. 101 SHIFT SHAFT LEVER ROLL

1 - BUSHING LOCK PIN SLOT
2 - 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. 102).

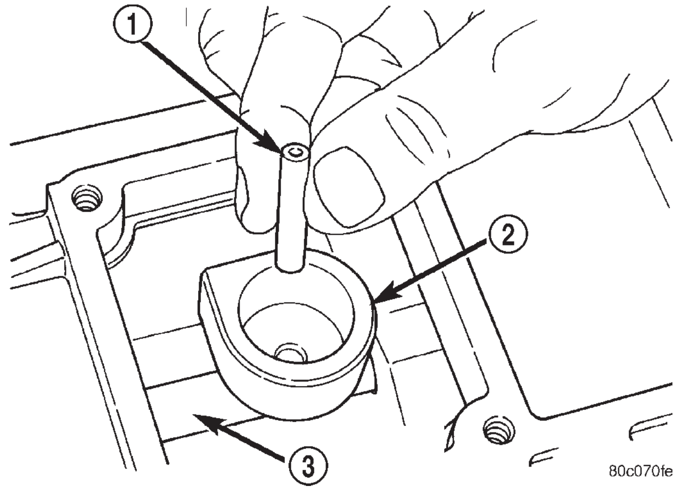


Fig. 102 ROLL PIN IN SHIFT SOCKET

1 - ROLL PIN 33 mm (1 1/4 in.)
2 - SHIFT SOCKET
3 - SHIFT SHAFT

(14) Seat roll pin in shift socket with pin punch. Roll pin must be flush with socket (Fig. 103).

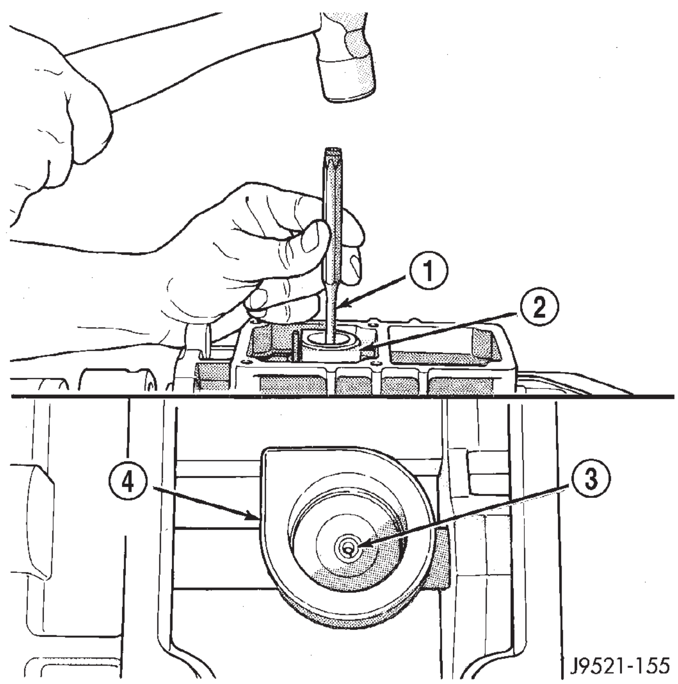


Fig. 103 SEATING SHIFT SOCKET ROLL PIN

1 - PIN PUNCH
2 - SHIFT SOCKET
3 - SEAT ROLL PIN FLUSH
4 - SHIFT SOCKET

MANUAL - NV3550 (Continued)

(15) Verify that notches in shift fork arms are aligned (Fig. 104). Realign arms if necessary.

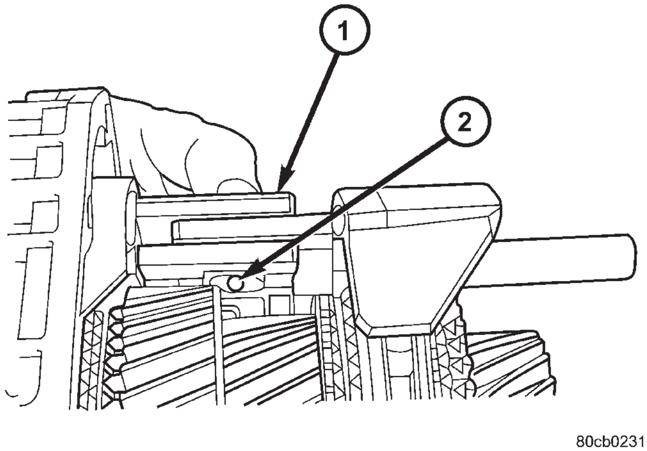


Fig. 104 SHIFT LEVER POSITION

1 - SHIFT FORK ARMS
2 - DETENT BORE

(16) Rotate shift lever and bushing downward to expose detent bore in the lever.

(17) Install detent spring then the ball into the detent bore (Fig. 105) and hold the ball in the lever. Then rotate the lever upward into the fork arm notches.

NOTE: Verify detent ball is seated in the fork arms before proceeding.

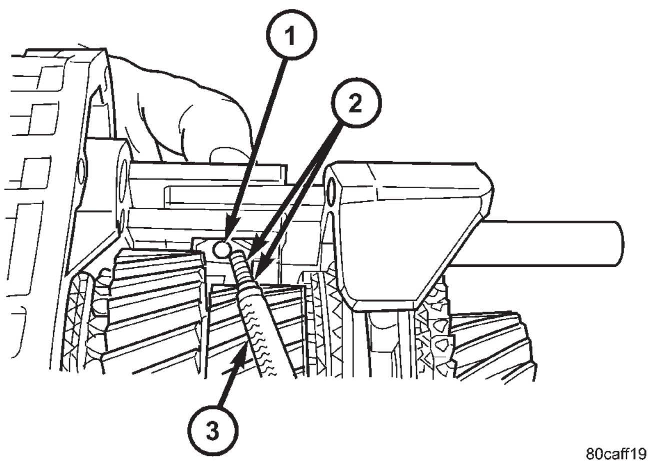


Fig. 105 DETENT SPRING AND BALL

1 - SHAFT LEVER
2 - SPRING AND BALL
3 - MAGNET

FRONT HOUSING AND INPUT SHAFT BEARING RETAINER

(1) Install reverse blocker, retainter and retainer bolt in front housing.

(2) If previously removed, input shaft bearing in front housing (Fig. 106). Install snap ring and use plastic mallet to seat bearing. Bearing goes in from front side of housing only.

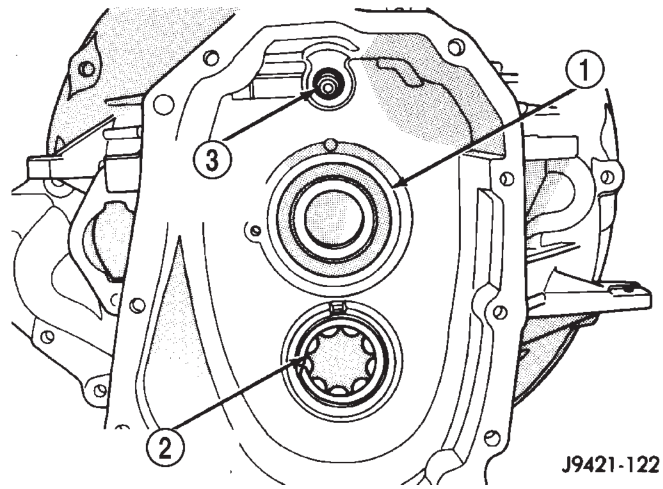


Fig. 106 INPUT SHAFT AND COUNTERSHAFT FRONT BEARING

1 - INPUT SHAFT BEARING
2 - COUNTERSHAFT FRONT BEARING
3 - SHIFT SHAFT BUSHING

(3) Apply liberal quantity of petroleum jelly to countershaft front bearing. Then insert bearing in front housing race (Fig. 106). Large diameter side of bearing cage goes toward countershaft (Fig. 107). Small diameter side goes toward bearing race in housing.

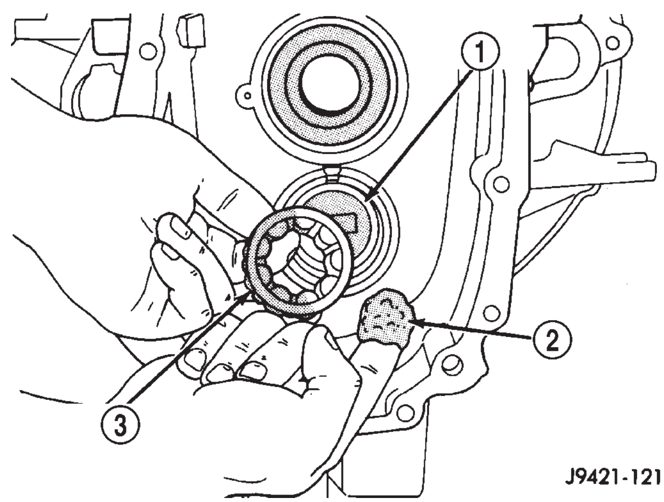


Fig. 107 COUNTERSHAFT FRONT BEARING

1 - BEARING RACE
2 - PETROLEUM JELLY
3 - COUNTERSHAFT FRONT BEARING

(4) Reach into countershaft front bearing with finger, and push each bearing roller outward against race. Then apply extra petroleum jelly to hold rollers

MANUAL - NV3550 (Continued)

in place. This avoids having rollers becoming displaced during housing installation.

(5) Apply small amount of petroleum jelly to shift shaft bushing in front housing.

(6) Apply 1/8 in. wide bead of Mopar Gasket Maker or equivalent, to mating surfaces of front and rear housings (Fig. 108).

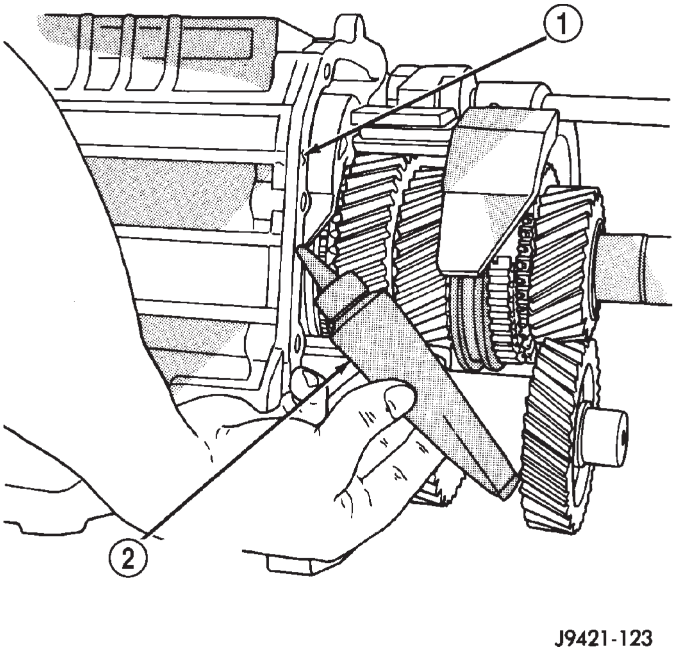


Fig. 108 SEAL FRONT/REAR HOUSINGS

1 - HOUSING FLANGE SURFACE
2 - GASKET MAKER

(7) Have helper hold rear housing and geartrain in upright position. Then install front housing on rear housing and geartrain.

(8) 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.

(9) 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.

(10) Place transmission in horizontal position.

(11) 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. 109).

(12) Install and start housing attaching bolts by hand (Fig. 109). Then tighten bolts to 34 N·m (25 ft. lbs.).

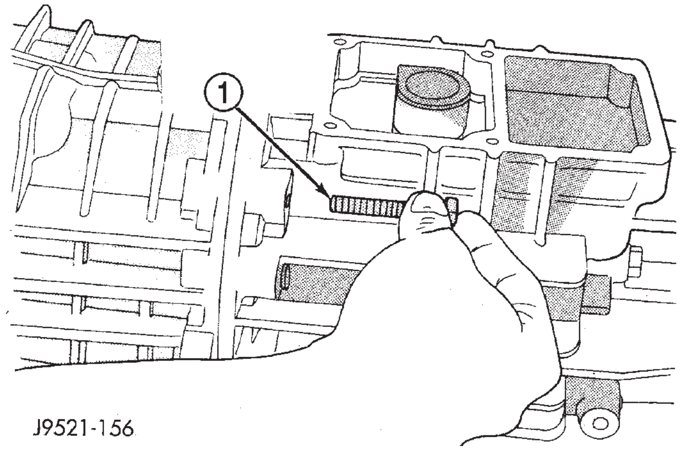


Fig. 109 HOUSING BOLTS

1 - HOUSING BOLTS

(13) Install shift shaft bushing lock bolt (Fig. 110). 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.

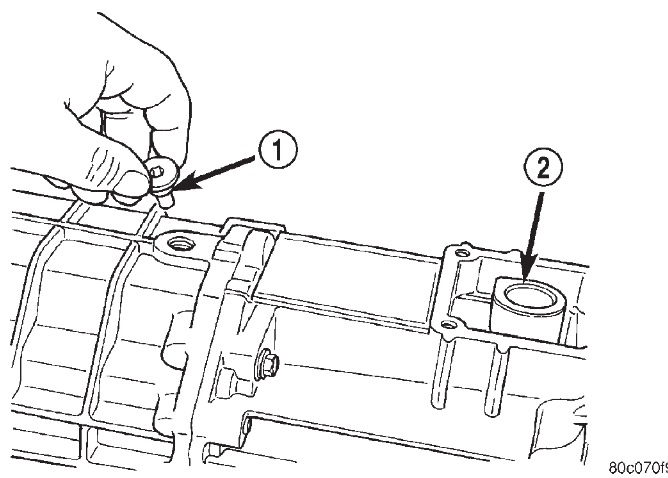


Fig. 110 SHIFT SHAFT BUSHING LOCK BOLT

1 - SHIFT SHAFT LOCK BOLT
2 - SHAFT SOCKET

(14) Lubricate then install shift shaft detent plunger in housing bore. Lubricate plunger with Valvoline Dura Blend® semi-synthetic/synthetic grease or equivalent. **Verify plunger is fully seated in detent notch in shift shaft.**

(15) Install detent spring inside plunger.

MANUAL - NV3550 (Continued)

(16) Install plug on detent spring and compress spring. Then drive detent plug into transmission case until plug seats.

(17) Install backup light switch (Fig. 111).

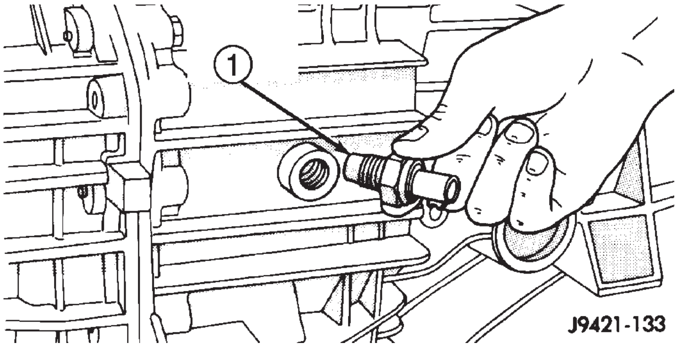


Fig. 111 BACKUP LIGHT SWITCH

1 - BACKUP LIGHT SWITCH

(18) Install input shaft snap ring (Fig. 112).

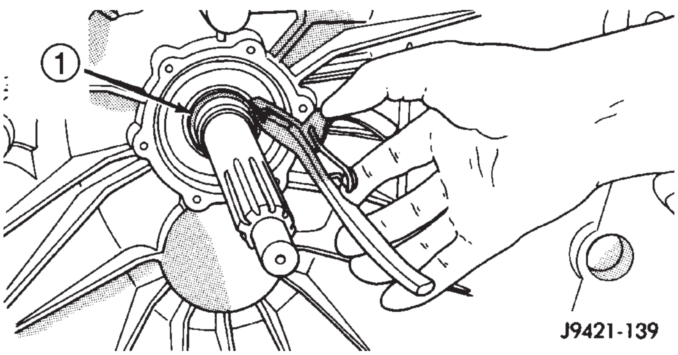


Fig. 112 SHAFT SNAP RING - TYPICAL

1 - INPUT SHAFT SNAP RING

(19) Install new oil seal in front bearing retainer with Installer 6448 (Fig. 113).

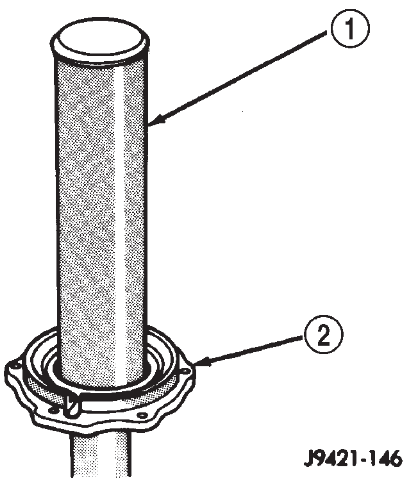


Fig. 113 OIL SEAL IN FRONT BEARING RETAINER

1 - INSTALLER
2 - FRONT BEARING RETAINER

(20) Apply bead of Mopar silicone sealer or equivalent to flange surface of front bearing retainer (Fig. 114).

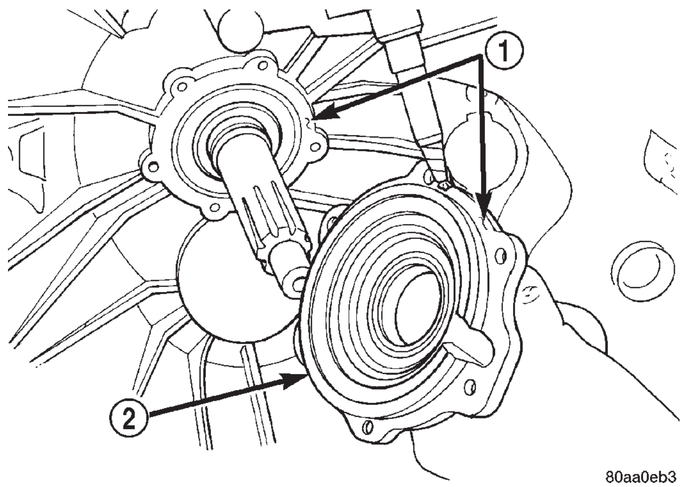


Fig. 114 SEAL BEARING RETAINER AND HOUSING

1 - APPLY SEALER BEAD
2 - INPUT SHAFT BEARING RETAINER

(21) Align and install front bearing retainer over input shaft and onto housing mounting surface (Fig. 115). Although retainer is one-way fit on housing, be sure bolt holes are aligned before seating retainer.

NOTE: Ensure no sealer gets in the transmission case oil feed hole and slot in bearing retainer is aligned with oil feed hole.

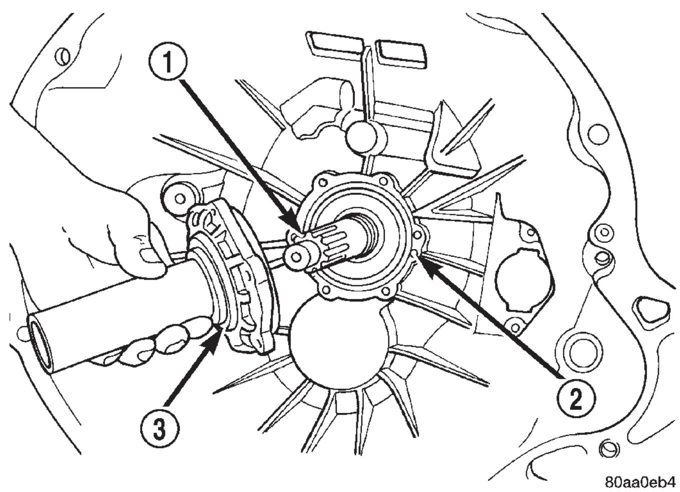


Fig. 115 INPUT SHAFT BEARING RETAINER

1 - INPUT SHAFT
2 - OIL FEED
3 - BEARING RETAINER

MANUAL - NV3550 (Continued)

(22) Install and tighten bearing retainer bolts to 9-14 N·m (7-10 ft. lbs.) (Fig. 116).

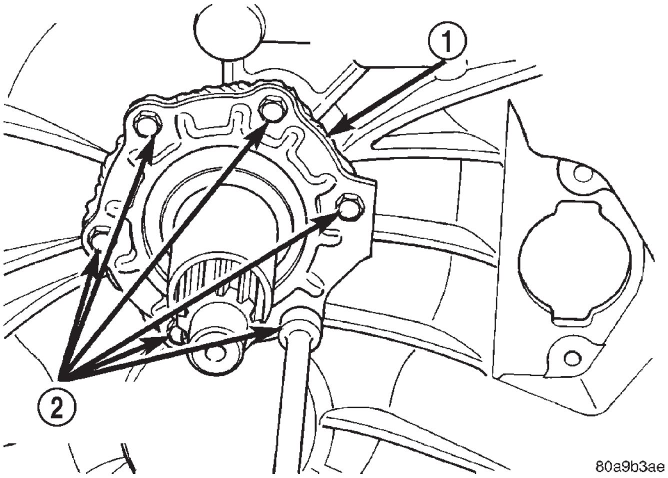


Fig. 116 BEARING RETAINER BOLTS

1 - RETAINER BOLTS

SHIFT TOWER AND LEVER

(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. 117). 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. 118). Tighten bolts to 8.5 N·m (75.2 in. lbs.).

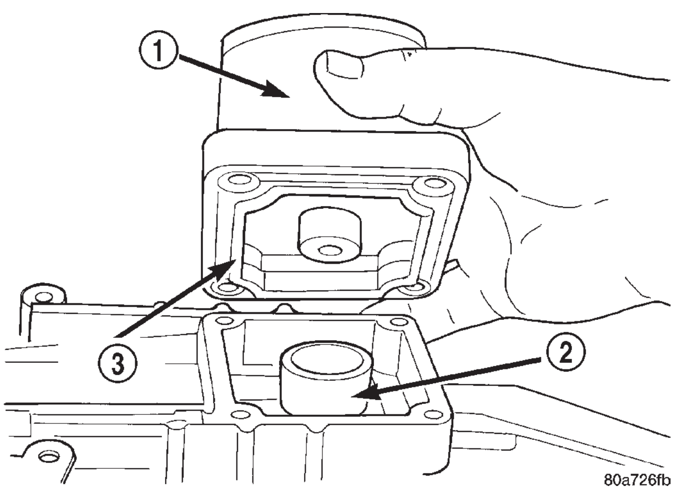


Fig. 117 SHIFT TOWER

1 - SHIFT TOWER

(5) Fill transmission to bottom edge of fill plug hole with Mopar Transmission Lubricant.

(6) Install and tighten fill plug to 34 N·m (25 ft. lbs.).

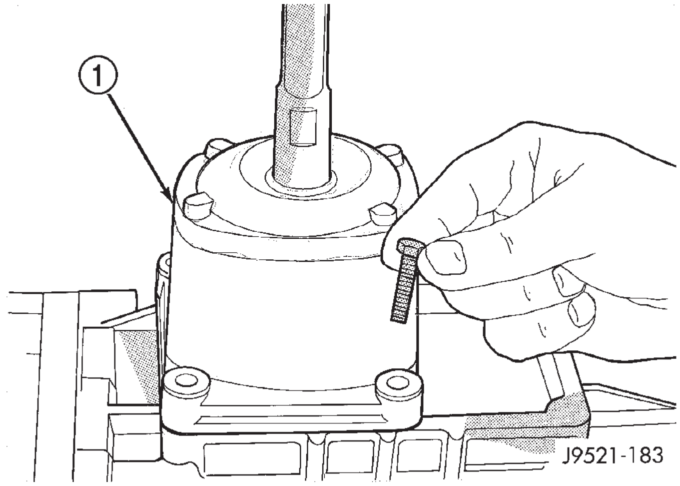


Fig. 118 SHIFT TOWER BOLTS

1 - SHIFT TOWER AND LEVER ASSEMBLY

(7) Check transmission vent. Be sure vent is open and not restricted.

INSTALLATION

(1) Install clutch housing on transmission and tighten housing bolts to 46 N·m (34 ft. lbs.).

(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:**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 rear crossmember and tighten crossmember-to-frame bolts to 41 N·m (31 ft. lbs.).

(10) 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.).

(11) Remove support stands from engine and transmission.

(12) Install and connect crankshaft position sensor.

(13) Position transfer case on transmission jack, if equipped.

MANUAL - NV3550 (Continued)

(14) Secure transfer case to jack with safety chains, if equipped.

(15) Raise transfer case if equipped and align transfer case input shaft to the transmission output shaft.

(16) Slide transfer case forward until case is seated on transmission, if necessary.

(17) Install nuts to attach transfer case to transmission, if equipped. Tighten transfer case-to-transmission nuts to 35 N·m (26 ft. lbs.).

(18) Connect transfer case shift linkage at transfer case, if equipped.

(19) Connect transfer case vent hose, if equipped.

(20) Secure wire harnesses in clips/tie straps on transmission and transfer case if equipped.

(21) Engage wire connectors attached to all necessary transmission or transfer case, if equipped, components.

(22) Install rear propeller shaft slip yoke to transmission or transfer case output shaft if equipped.

(23) Install rear propeller shaft with reference marks aligned (Fig. 119).

(24) Install and tighten propeller shaft U-joint clamp bolts to 19 N·m (170 in. lbs.).

(25) Align marks on front propeller shaft, axle and transfer case yokes, if equipped.

(26) Install and tighten propeller shaft U-joint clamp bolts to 19 N·m (170 in. lbs.).

(27) Install slave cylinder in clutch housing.

(28) Install skid plate, if equipped and tighten bolts to 42 N·m (31 ft. lbs.). Tighten stud nuts to 17 N·m (150 in. lbs.).

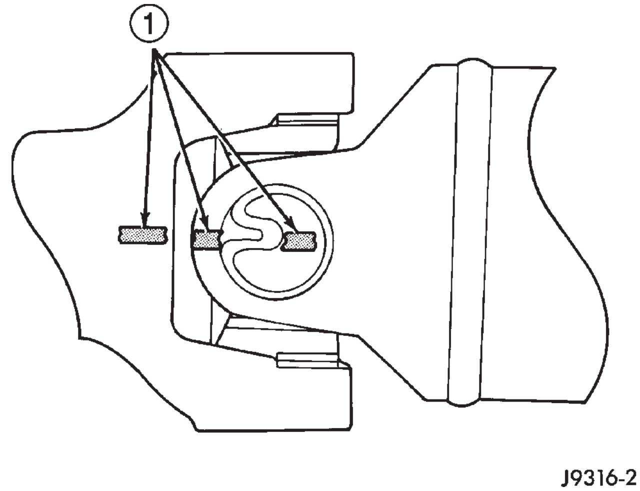


Fig. 119 Propeller Shaft

1 - REFERENCE MARKS

(29) Fill transmission and transfer case if equipped, with recommended lubricants. Refer to the Lubricant Recommendation sections 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.

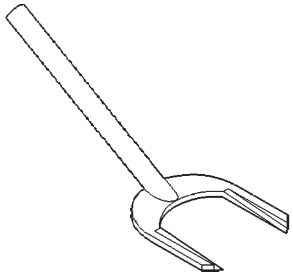
SPECIFICATIONS

TORQUE SPECIFICATIONS

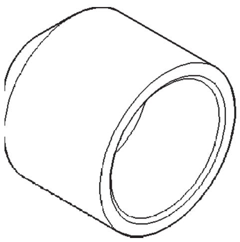
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Clutch Housing Bolts	54-61	40-45	-
Crossmember To Frame Bolts	61-75	44-55	-
Crossmember To Insulator Nuts	54-61	40-45	-
Drain/Fill Plug	9-27	14-20	-
Front To Rear Housing Bolts	30-35	22-26	-
Front Bearing Retainer Bolts	9-14	7-8	80-124
Idler Shaft Bolts	19-25	14-18	-
Rear Bearing Retainer Bolts	30-35	22-26	-
Shift Tower Bolts	7-10	5-7	62-88
Slave Cylinder Nuts	23	17	-
Transfer Case Nuts	47	35	-
U-Joint Clamp Bolts	19	14	-

MANUAL - NV3550 (Continued)

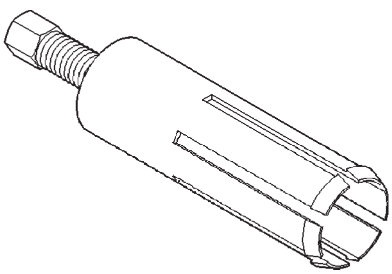
SPECIAL TOOLS



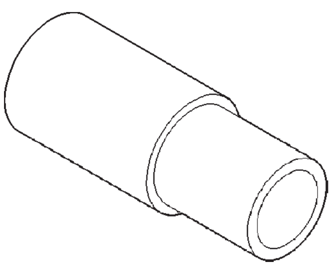
Remover C-3985-B



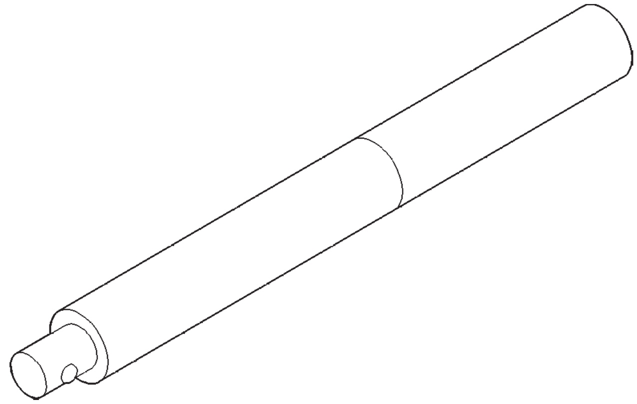
Installer C-3972-A



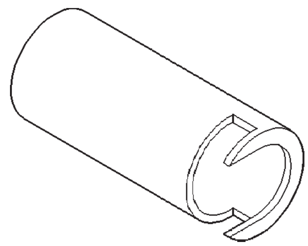
Remover Bushing 6957



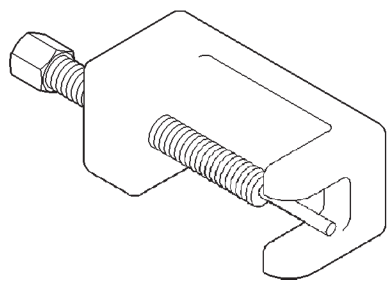
Installer Bushing 6951



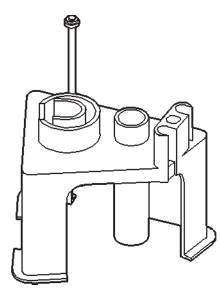
Handle C-4171



Remover 8117

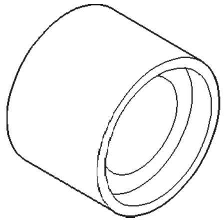


Remover/Installer 6858

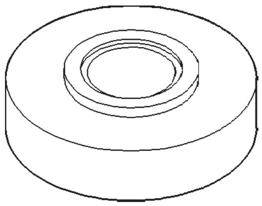


Fixture 6747

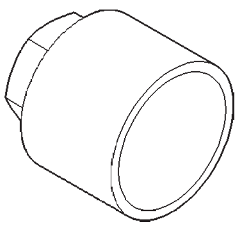
MANUAL - NV3550 (Continued)



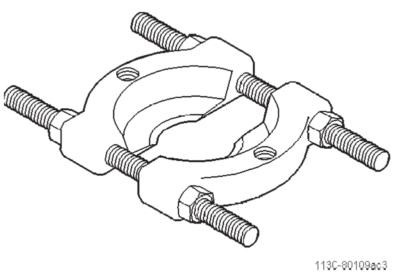
Adapter 6747-1A



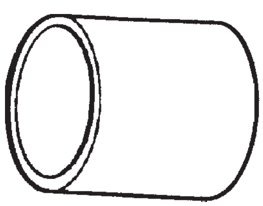
Adapter 6747-2B



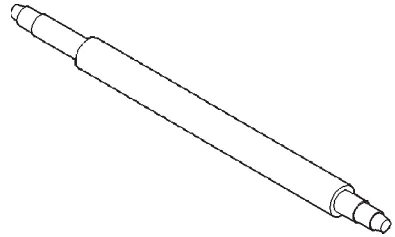
Cup 8115



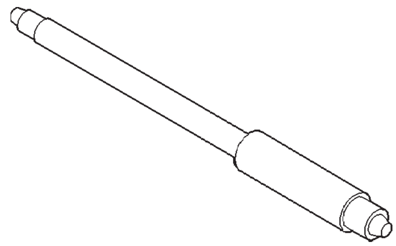
Splitter Bearing 1130



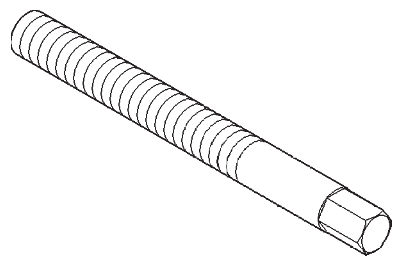
Tube 6310-1



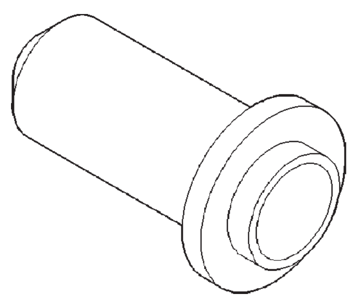
Installer 8118



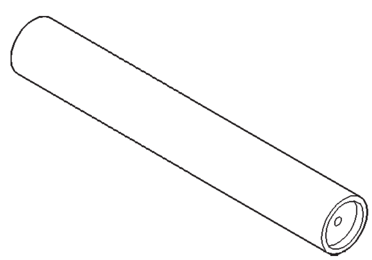
Remover/Installer 8119



Pin Alignment 8120

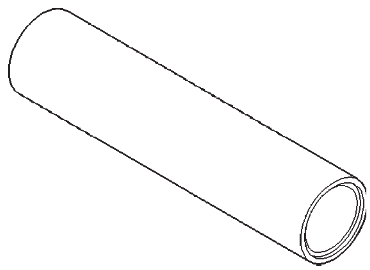


Installer C-3860-A



Installer 8123

MANUAL - NV3550 (Continued)



Installer Bearing Cone 6448

VEHICLE SPEED SENSOR

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.

REMOVAL

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. 120). If equipped with 2WD, this adapter is located on the extension housing of the transmission (left side).

(1) Raise and support vehicle.

(2) Disconnect electrical connector from sensor by pushing slide tab (Fig. 120). After slide tab has been positioned, push in on secondary release lock

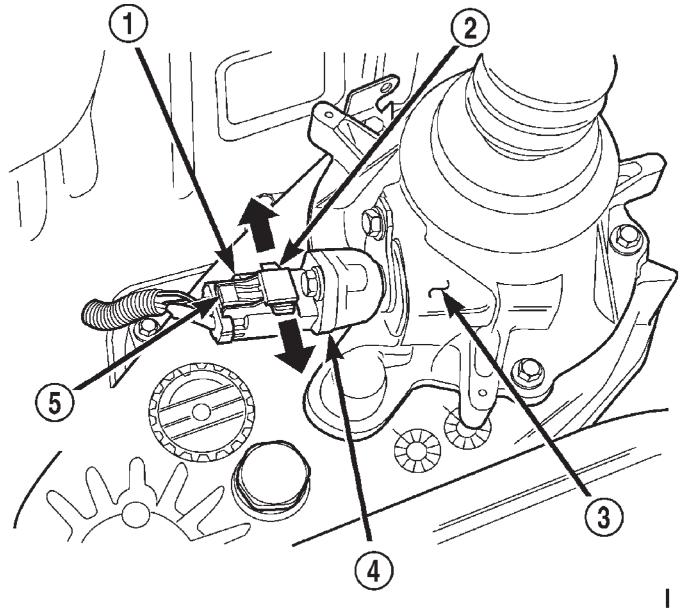


Fig. 120 VSS Location

1 - SENSOR ELECTRICAL CONNECTOR
2 - SLIDE TAB
3 - 4WD TRANSFER CASE EXTENSION
4 - VEHICLE SPEED SENSOR
5 - RELEASE LOCK

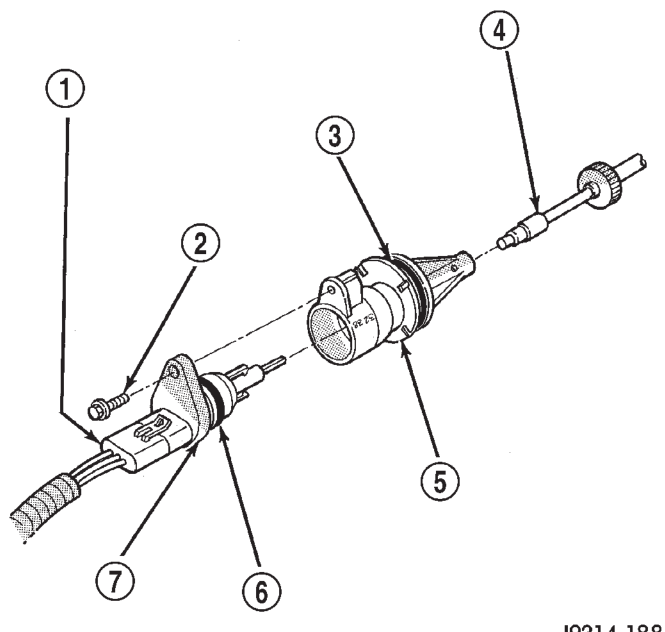


Fig. 121 VSS Removal/Installation

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

VEHICLE SPEED SENSOR (Continued)

(Fig. 120) on side of connector and pull connector from sensor.

(3) Remove sensor mounting bolt (Fig. 121).

(4) Remove sensor (pull straight out) from speedometer pinion gear adapter (Fig. 121). Do not remove gear adapter from transmission.

INSTALLATION

(1) Clean inside of speedometer pinion gear adapter before installing speed sensor.

(2) Install sensor into speedometer gear adapter and install mounting bolt. Before tightening bolt, verify speed sensor is fully seated (mounted flush) to speedometer pinion gear adapter.

(3) Tighten sensor mounting bolt to 2.2 N·m (20 in. lbs.) torque.

(4) Connect electrical connector to sensor.

MANUAL - AX5

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MANUAL - AX5

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).

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 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.

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 and adaptor 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.

MANUAL - AX5 (Continued)

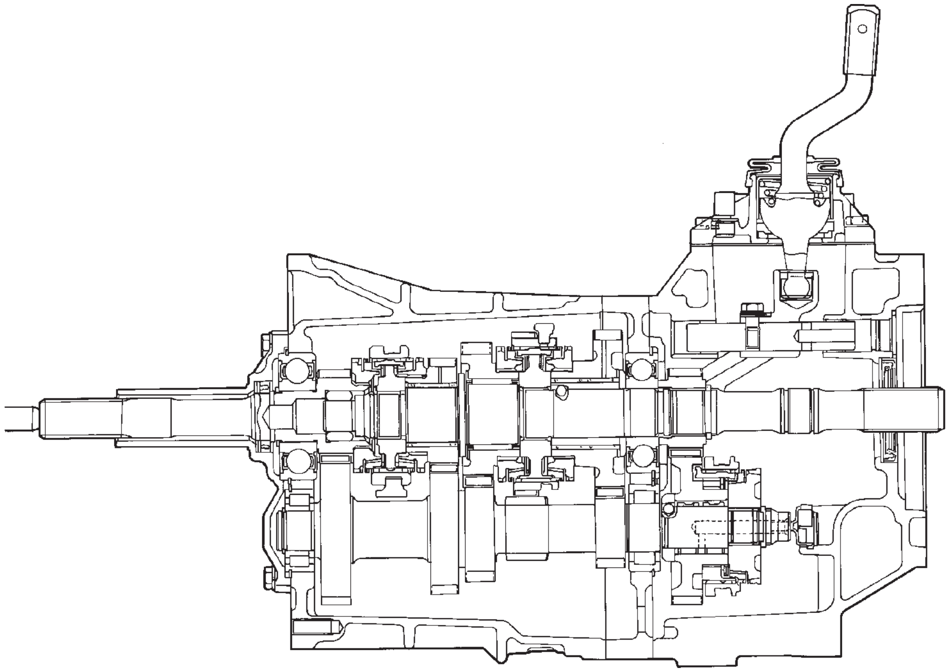


Fig. 1 AX5 Manual Transmission

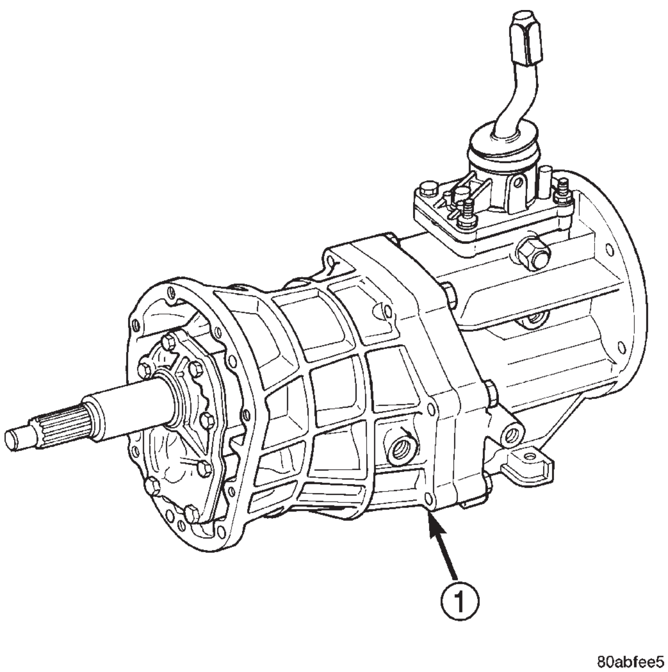


Fig. 2 Transmission Identification

1 - I.D. CODE ON CASE NEAR DRAIN PLUG

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,

MANUAL - AX5 (Continued)

forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

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. 3) from clutch housing.

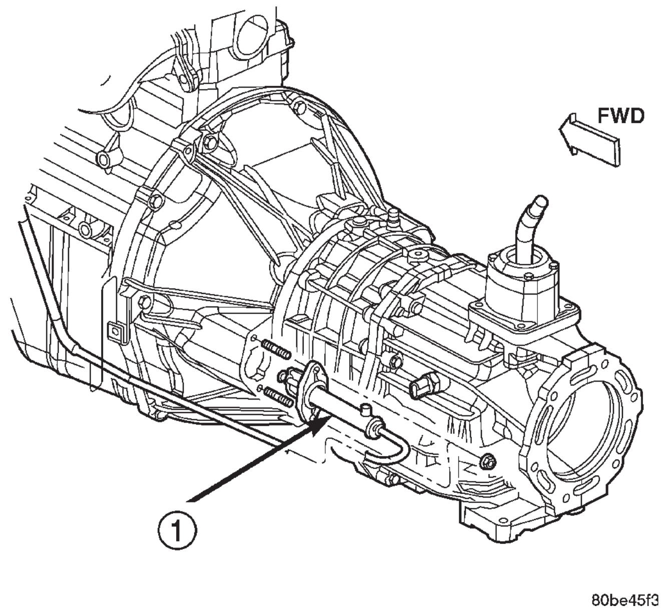


Fig. 3 Slave Cylinder - Typical

1 - CLUTCH SLAVE CYLINDER

(7) Mark rear propeller shaft and rear axle yokes for installation reference (Fig. 4).

(8) Mark front propeller shaft, axle, and transfer case yokes for installation reference.

(9) Remove propeller shaft(s).

(10) Unclip wire harnesses from transmission and transfer case.

(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.

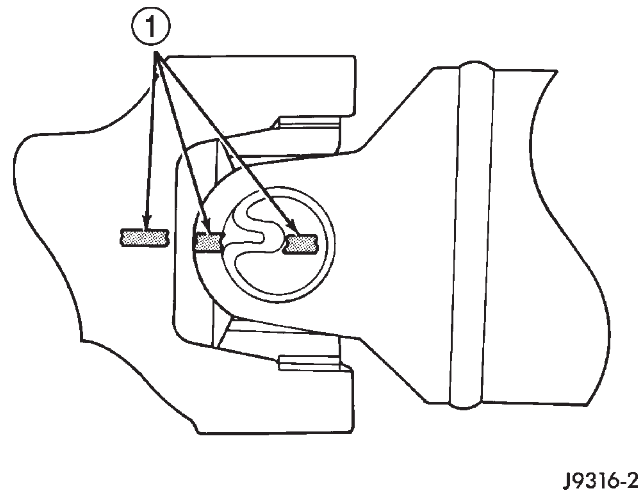


Fig. 4 Propeller Shaft And Axle Yokes

1 - REFERENCE MARKS

(18) Remove crankshaft position sensor (Fig. 5).

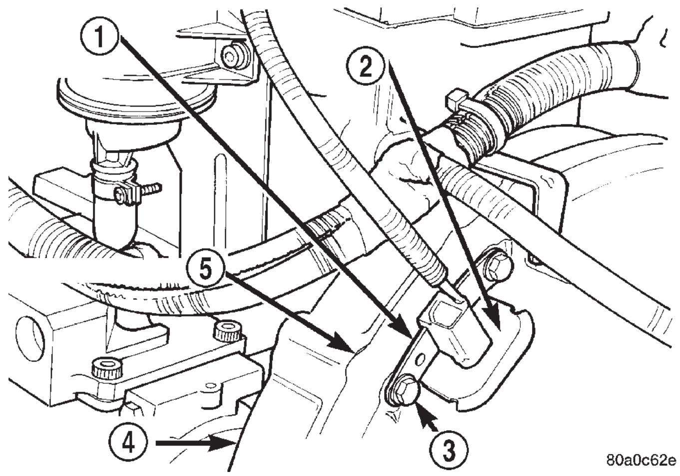


Fig. 5 Crankshaft Position Sensor - 2.5L and 4.0L

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.

MANUAL - AX5 (Continued)

(b) Reach up and around transmission case and unseat shift lever dust boot from transmission shift tower (Fig. 6). Move boot upward on shift lever for access to retainer that secures lever in shift tower.

(c) Reach up and around transmission case and press shift lever retainer downward with finger pressure. Turn retainer counterclockwise to release it.

(d) Lift lever and retainer out of shift tower (Fig. 6). Do not remove the shift lever from the floor console shifter boots. Leave the lever in place for transmission installation.

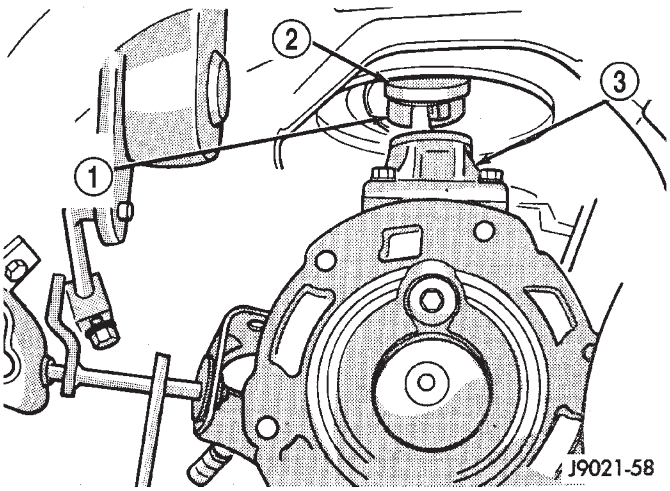


Fig. 6 Shift Lever

1 - SHIFT LEVER RETAINER
2 - DUST BOOT
3 - SHIFT TOWER

(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.

(27) Remove clutch housing from transmission (Fig. 7).

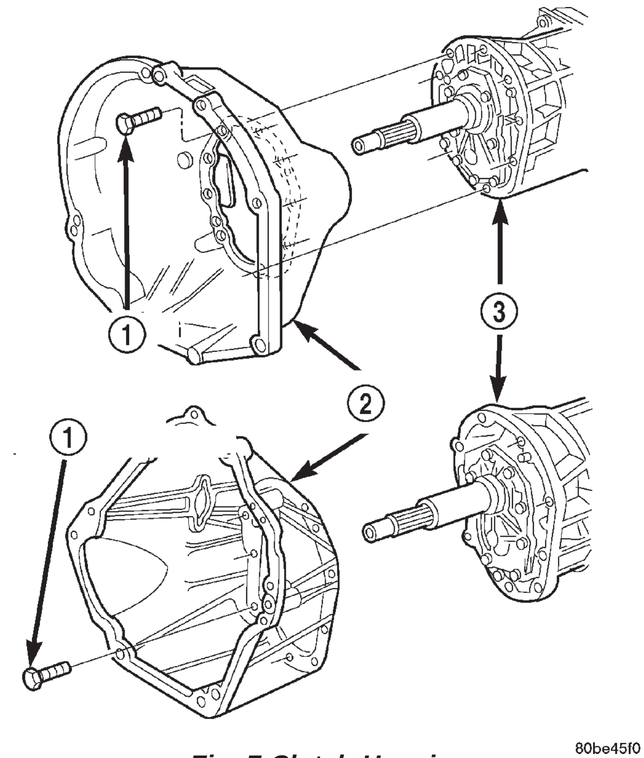


Fig. 7 Clutch Housing

1 - HOUSING-TO-TRANSMISSION BOLTS
2 - CLUTCH HOUSING
3 - TRANSMISSION

DISASSEMBLY

ADAPTER/EXTENSION HOUSING

(1) Drain transmission lubricant, if necessary.

(2) Remove release bearing and lever.

(3) Remove clutch housing bolts and remove housing (Fig. 8).

(4) Remove vehicle speed sensor and speedometer adapter, if necessary.

(5) Remove shift tower bolts and remove tower from transmission (Fig. 9).

(6) Remove shift tower gasket from shift tower or transmission (Fig. 10).

(7) Remove detent ball plug (Fig. 11).

MANUAL - AX5 (Continued)

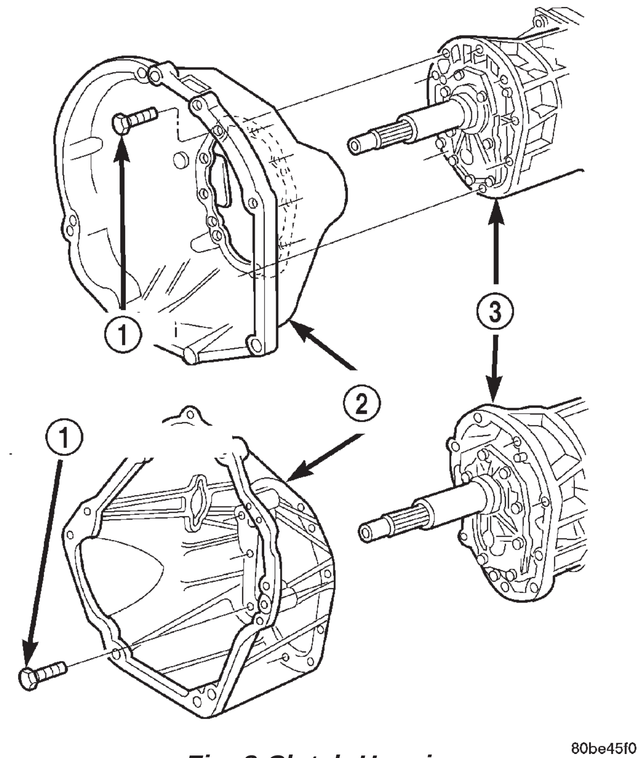


Fig. 8 Clutch Housing

1 - HOUSING-TO-TRANSMISSION BOLTS (46 N·m/34 ft. lbs.)
2 - CLUTCH HOUSING
3 - TRANSMISSION

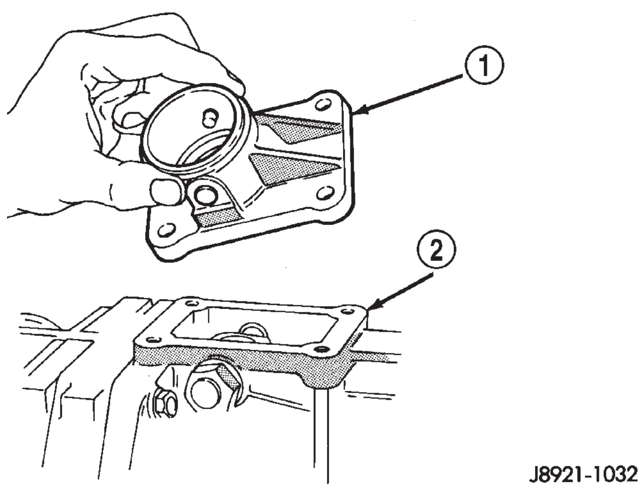


Fig. 9 Shift Tower

1 - SHIFT TOWER
2 - ADAPTER/EXTENSION HOUSING

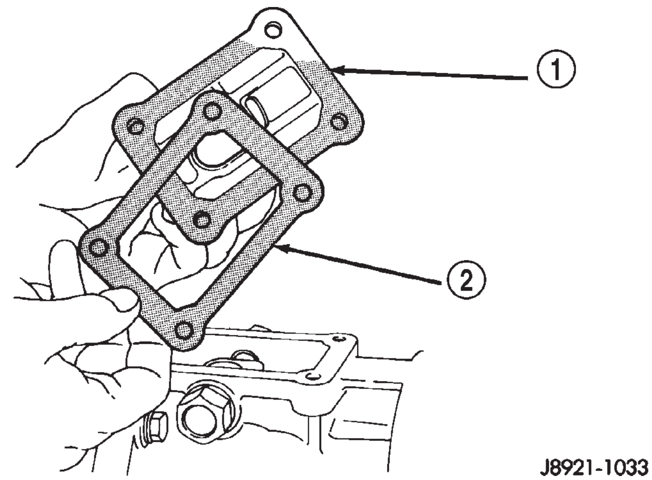


Fig. 10 Shift Tower Gasket

1 - SHIFT TOWER
2 - GASKET

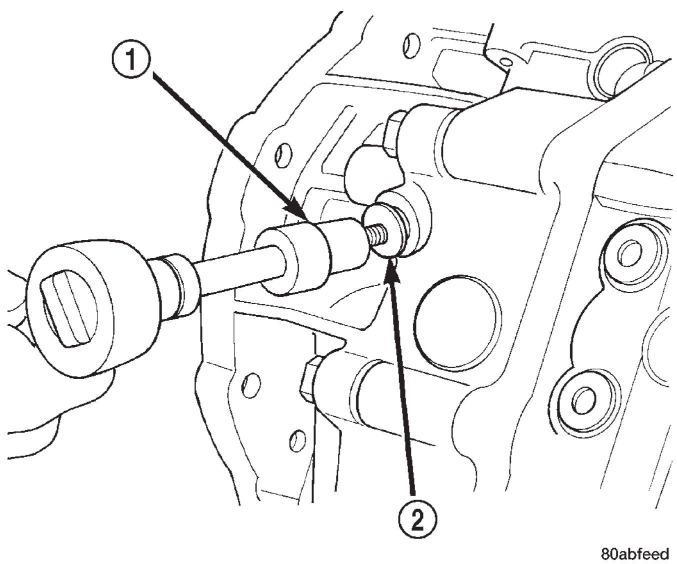


Fig. 11 Detent Ball Plug

1 - TORX BIT
2 - DETENT BALL PLUG

MANUAL - AX5 (Continued)

(8) Remove detent spring (Fig. 12) and ball (Fig. 13) with pencil magnet.

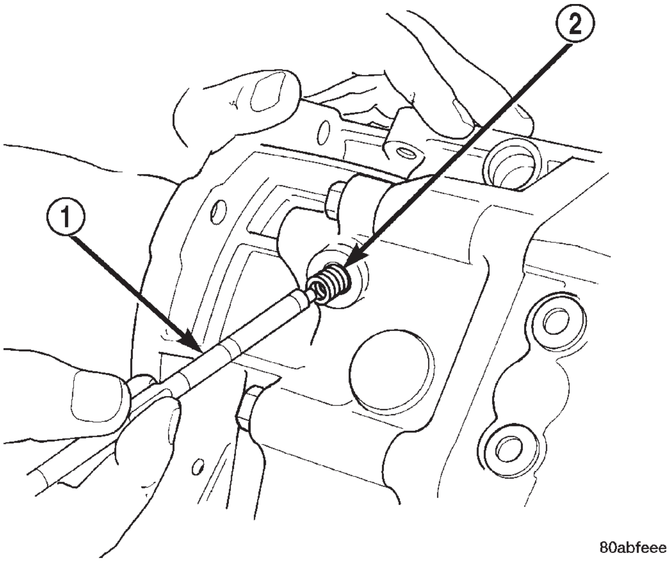


Fig. 12 Detent Spring

1 - PENCIL MAGNET
2 - DETENT BALL SPRING

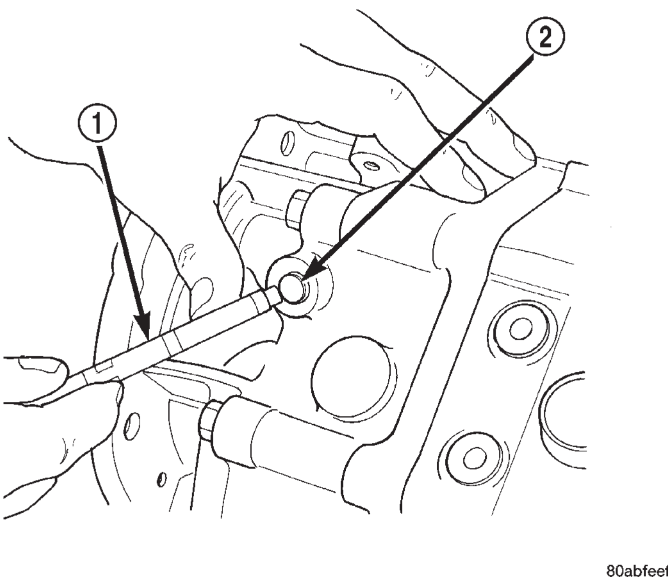


Fig. 13 Detent Ball

1 - PENCIL MAGNET
2 - SHIFT DETENT BALL

(9) Remove shift arm retainer bolt (Fig. 14).

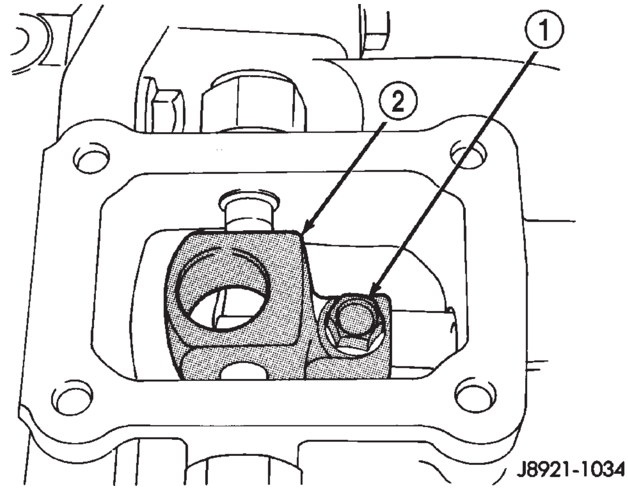


Fig. 14 Shift Arm Retainer Bolt

1 - RETAINER BOLT
2 - SHIFT ARM

(10) Remove shift arm restrictor pins (Fig. 15).

NOTE: Restrictor pins are not interchangeable, they are color coded. Note color and location of restrictor pins for installation reference.

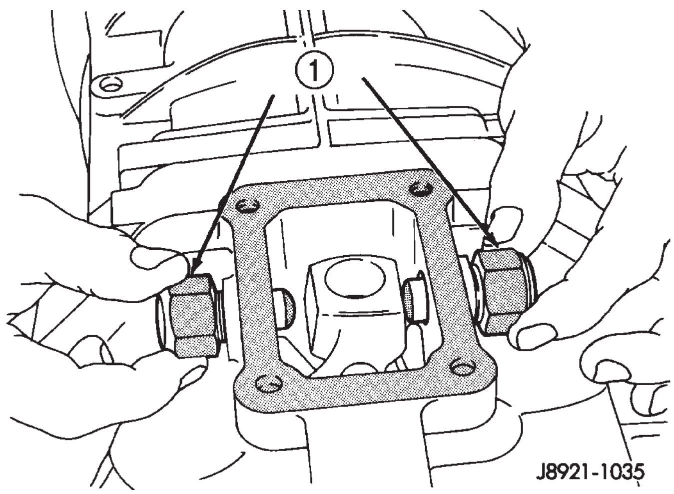


Fig. 15 Shift Arm Restrictor Pins

1 - RESTRICTOR PINS

MANUAL - AX5 (Continued)

(11) Remove shift lever shaft plug (Fig. 16).

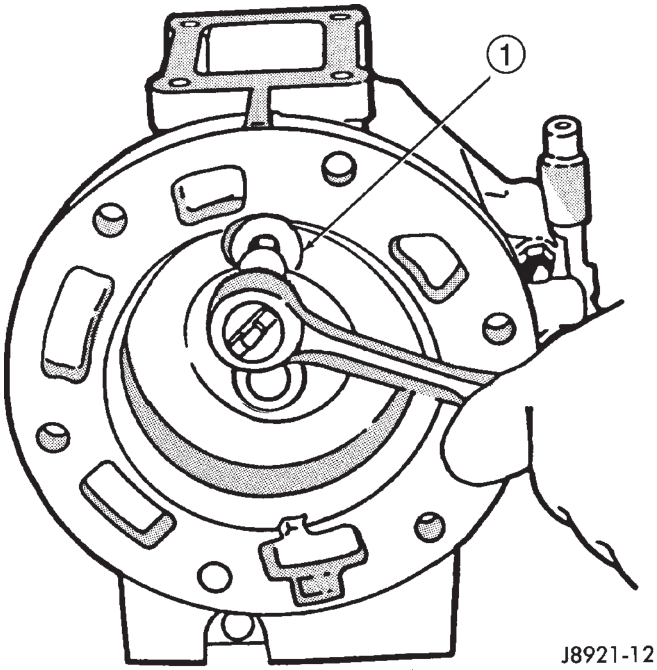


Fig. 16 Shift Lever Shaft Plug

1 - SHIFT LEVER SHAFT PLUG

(12) Remove shifter shaft with large magnet (Fig. 17).

(13) Remove shift arm from the adapter housing.

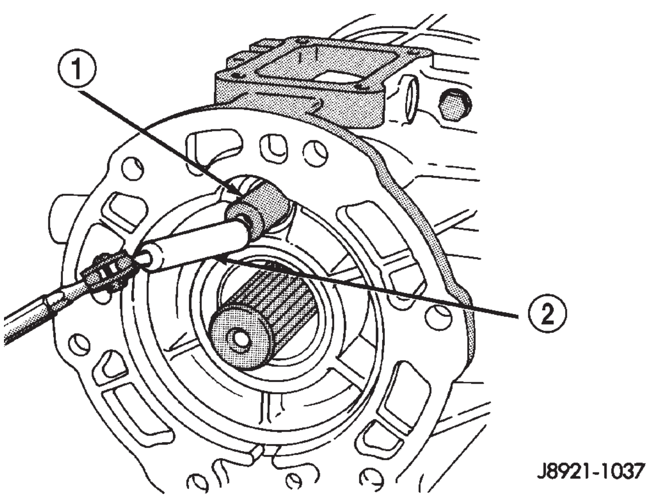


Fig. 17 Shifter Shaft

1 - SHIFT ARM SHAFT
2 - LARGE MAGNET

(14) Remove adapter/extension housing bolts.

(15) Loosen adapter/extension housing by tapping it loose with rawhide/rubber hammer (Fig. 18).

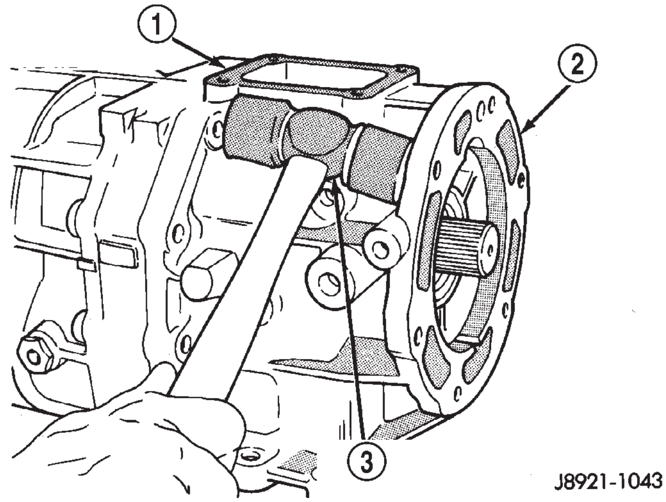


Fig. 18 Adapter/Extension Housing

1 - INTERMEDIATE PLATE
2 - ADAPTER HOUSING
3 - RUBBER FACED MALLET

(16) Remove adapter/extension housing (Fig. 19).

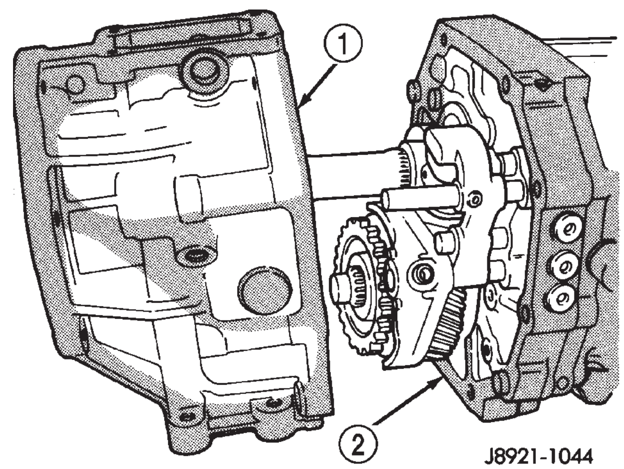


Fig. 19 Adapter/Extension Housing-Typical

1 - ADAPTER HOUSING
2 - INTERMEDIATE PLATE

MANUAL - AX5 (Continued)

(17) On 4x2 transmissions, remove speedometer gear retaining snap-ring from output shaft. Remove speedometer gear from output shaft and remove speedometer gear lock ball from output shaft. Remove speedometer drive gear locating snap-ring (Fig. 20).

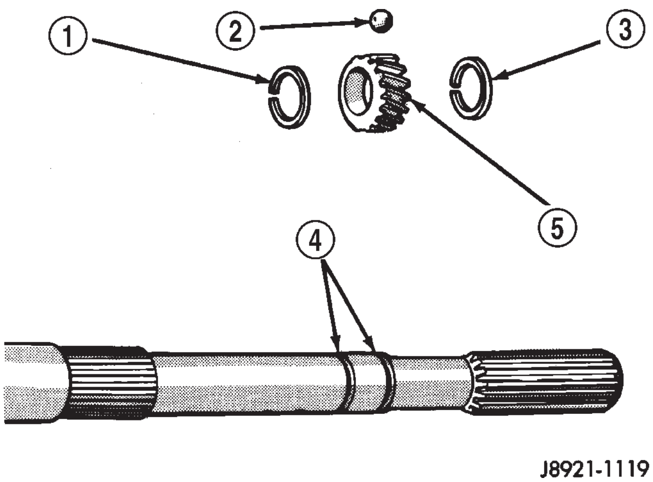


Fig. 20 Speedometer Drive Gear Assembly

1 - SNAP RING
2 - LOCK BALL
3 - SNAP RING
4 - OUTPUT SHAFT GROOVES
5 - SPEEDOMETER GEAR

(18) Remove bolts holding front bearing retainer to the transmission case.

(19) Remove bearing retainer from transmission case (Fig. 21).

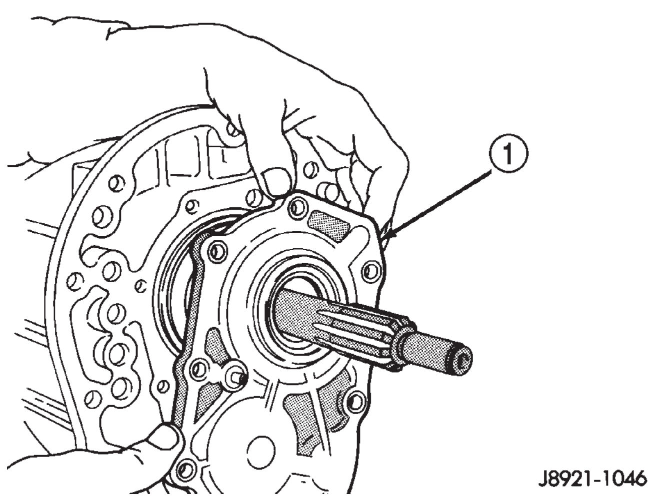


Fig. 21 Front Bearing Retainer

1 - FRONT BEARING RETAINER

(20) Remove input shaft bearing snap-ring (Fig. 22).

(21) Remove countershaft front bearing snap-ring.

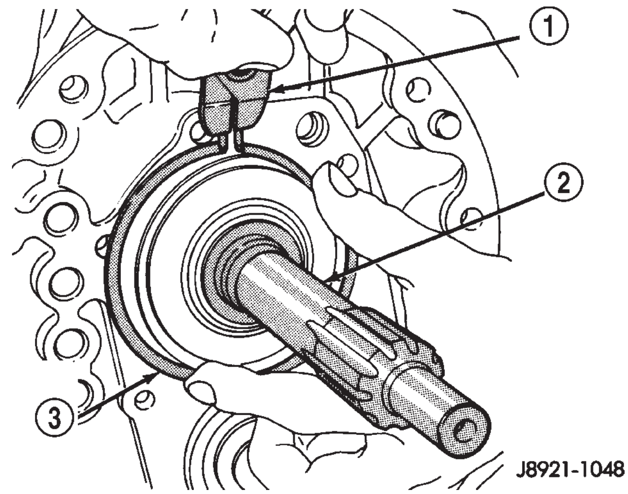


Fig. 22 Input Shaft

1 - SNAP RING PLIERS
2 - INPUT SHAFT
3 - INPUT SHAFT BEARING SNAP RING

(22) Separate intermediate plate and transmission case by tapping them loose with rawhide/rubber hammer (Fig. 23).

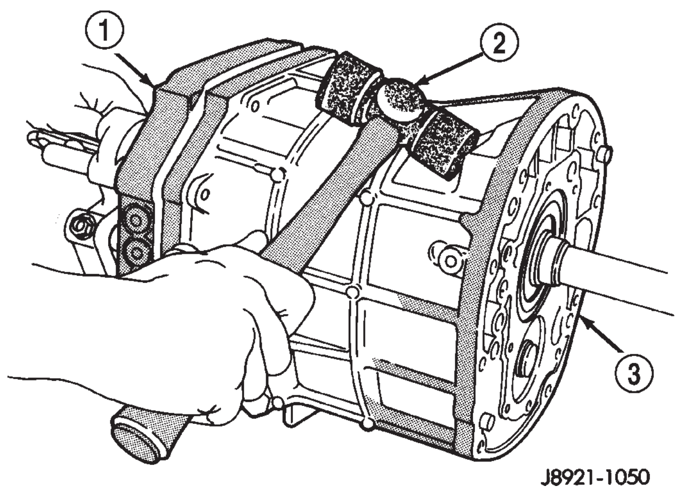


Fig. 23 Intermediate Plate and Transmission Case

1 - INTERMEDIATE PLATE
2 - RUBBER MALLET
3 - GEAR CASE

MANUAL - AX5 (Continued)

(23) Separate intermediate plate from the transmission case (Fig. 24).

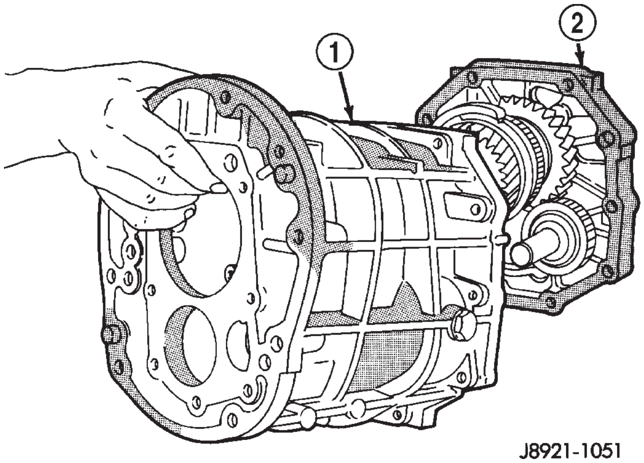


Fig. 24 Intermediate Plate from Transmission

1 - GEAR CASE
2 - INTERMEDIATE PLATE

GEARTRAIN AND SHIFT MECHANISM

(1) Install suitable bolts and washers in intermediate plate (Fig. 25). Then clamp plate and gear assembly in vise on bolt heads. Use enough washers to prevent bolts from touching.

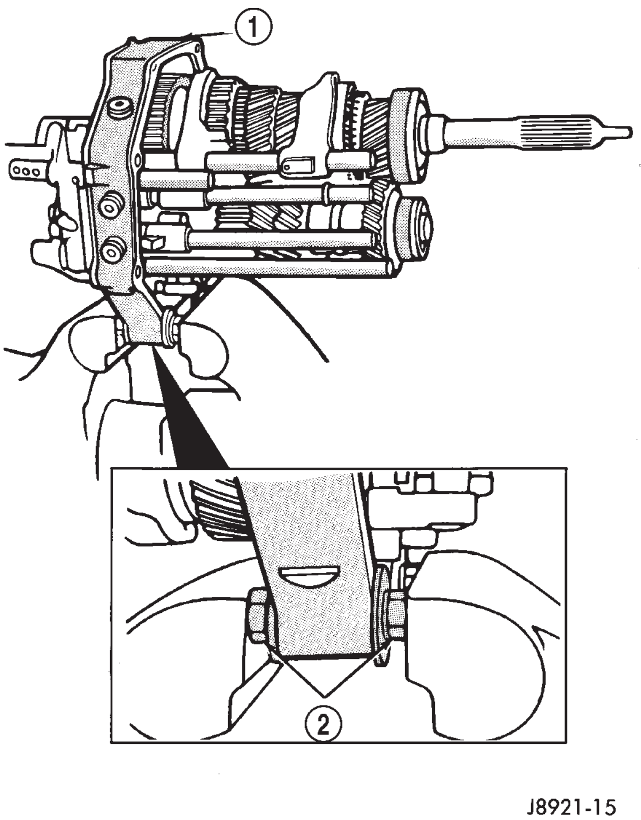


Fig. 25 Positioning Intermediate Plate In Vise

1 - INTERMEDIATE PLATE
2 - BOLTS

(2) Remove countershaft fifth gear retaining snap-ring (Fig. 26).

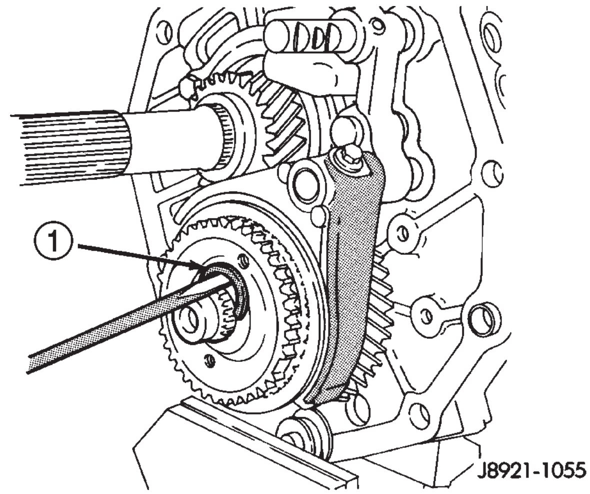


Fig. 26 Fifth Gear Snap-Ring

1 - FIFTH GEAR SNAP RING (SELECT FIT)

(3) Remove bolt holding fifth gear shift fork to shift rail (Fig. 27).

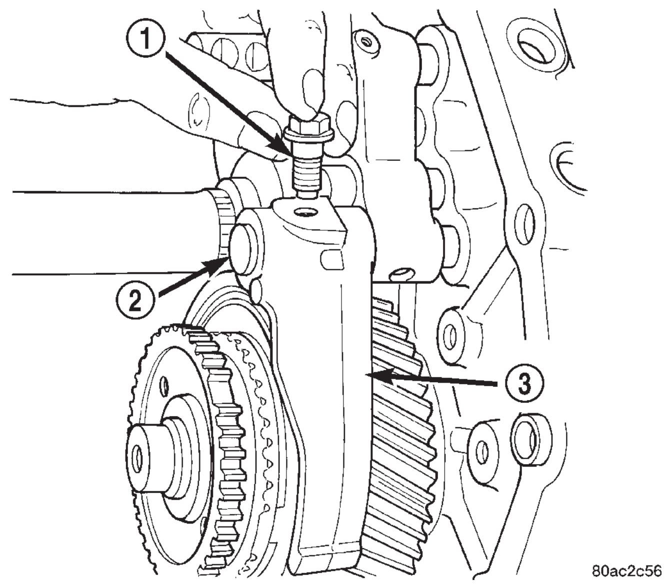


Fig. 27 Shift Fork Retainer Bolt

1 - SHIFT FORK RETAINER BOLT
2 - FIFTH GEAR SHIFT RAIL
3 - FIFTH GEAR SHIFT FORK

MANUAL - AX5 (Continued)

(4) Remove fifth gear blocker ring from countershaft assembly with Puller L-4407 (Fig. 28).

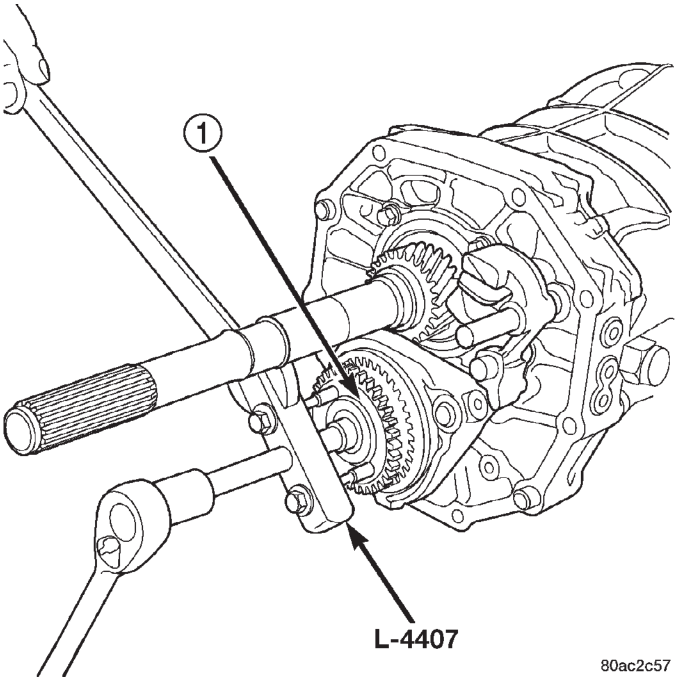


Fig. 28 Fifth Gear Blocker Ring

1 - FIFTH GEAR BLOCKER RING

(5) Remove fifth gear synchro ring (Fig. 29).

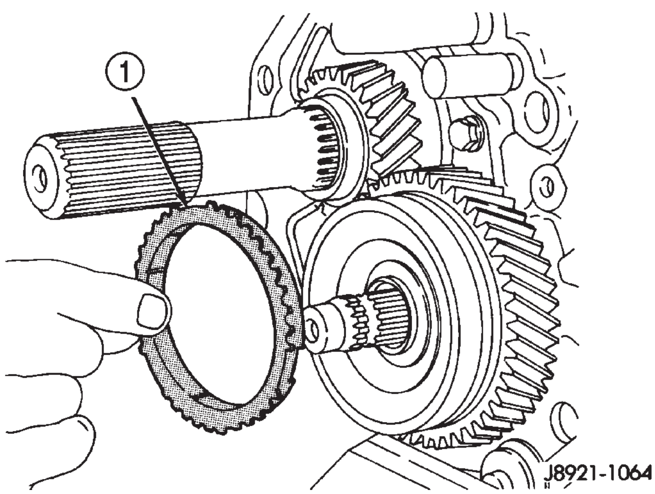


Fig. 29 Fifth Gear Synchro Ring

1 - FIFTH GEAR SYNCHRO RING

(6) Remove countershaft fifth gear assembly from countershaft (Fig. 30).

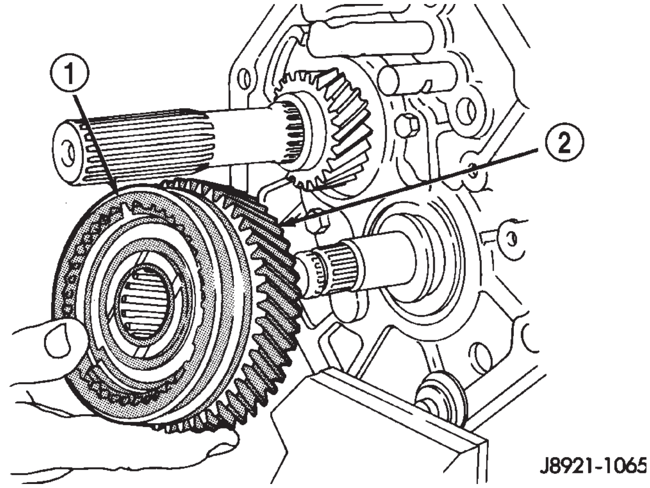


Fig. 30 Fifth Gear and Synchro

1 - FIFTH GEAR SYNCHRO SLEEVE ASSEMBLY
2 - COUNTER FIFTH GEAR

(7) Remove fifth gear thrust ring from countershaft (Fig. 31).

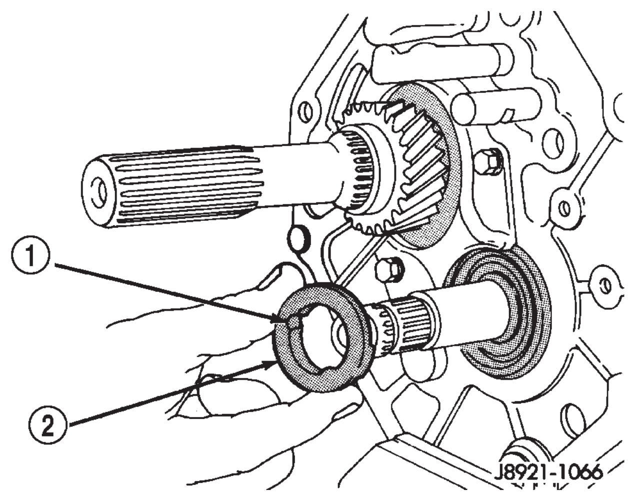


Fig. 31 Fifth Gear Thrust Ring

1 - LOCK BALL NOTCH
2 - FIFTH GEAR THRUST RING

MANUAL - AX5 (Continued)

(8) Remove fifth gear thrust ring lock ball from countershaft (Fig. 32).

CAUTION: Lock balls, check balls, interlock balls, and interlock pins are used in various places in the transmission. Pins or balls must be identified and marked for installation reference.

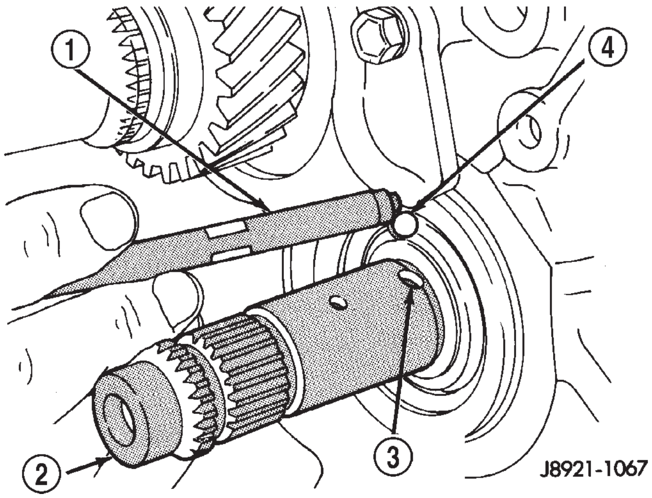


Fig. 32 Fifth Gear Thrust Ring Lock

1 - PENCIL MAGNET
2 - CLUSTER GEAR
3 - LOCK BALL RECESS
4 - THRUST RING LOCK BALL

(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. 33).

NOTE: Retrieve pin and compression spring from the reverse idler shaft.

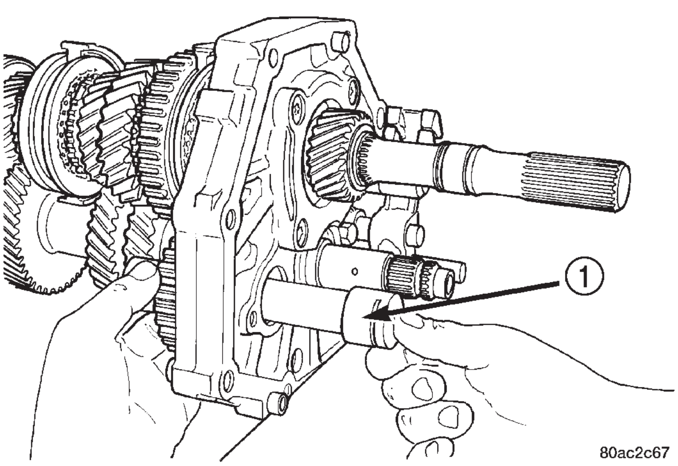


Fig. 33 Reverse Idler Shaft

1 - REVERSE IDLER SHAFT

(11) Remove output shaft rear bearing retainer bolts and remove retainer (Fig. 34).

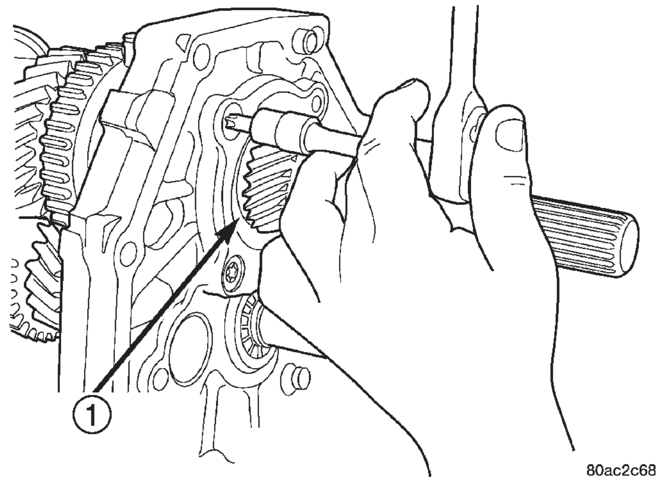


Fig. 34 Output Shaft Rear Bearing Retainer

1 - OUTPUT SHAFT REAR BEARING RETAINER

(12) Remove bolts holding 1-2 and 3-4 shift forks to the shift rails (Fig. 35) and discard bolts.

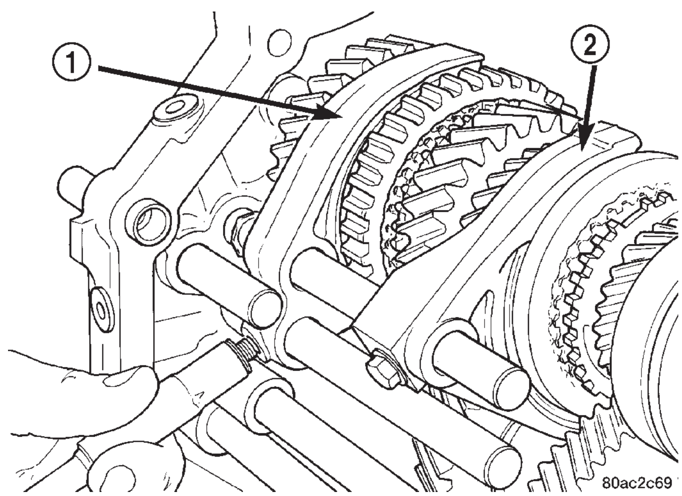


Fig. 35 Shift Fork Bolts

1 - 1–2 SHIFT FORK
2 - 3–4 SHIFT FORK

MANUAL - AX5 (Continued)

(13) Remove bolts holding reverse shift arm bracket to intermediate plate (Fig. 36).

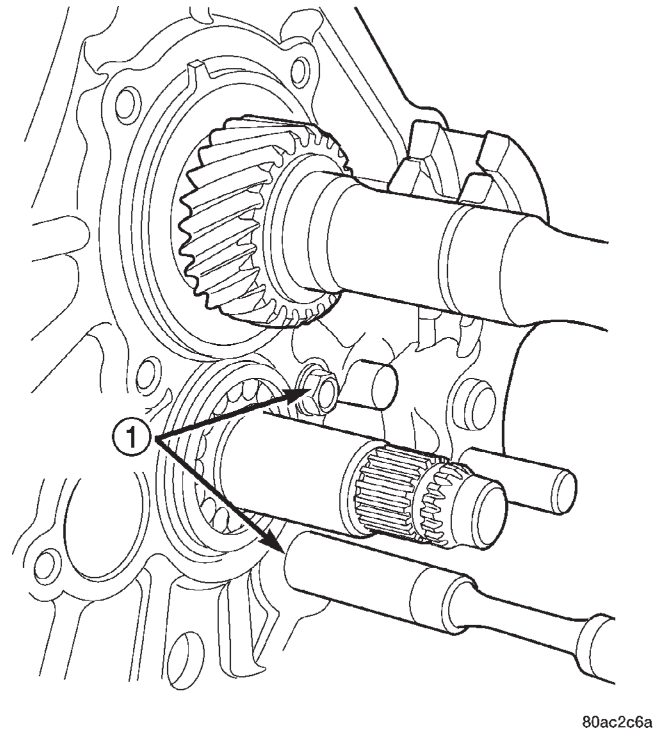


Fig. 36 Reverse Shift Arm Bracket Bolts

1 - REVERSE SHIFT ARM BOLTS

(14) Remove snap-ring holding output shaft rear bearing into the intermediate plate (Fig. 37).

(15) Remove countershaft rear bearing snap-ring.

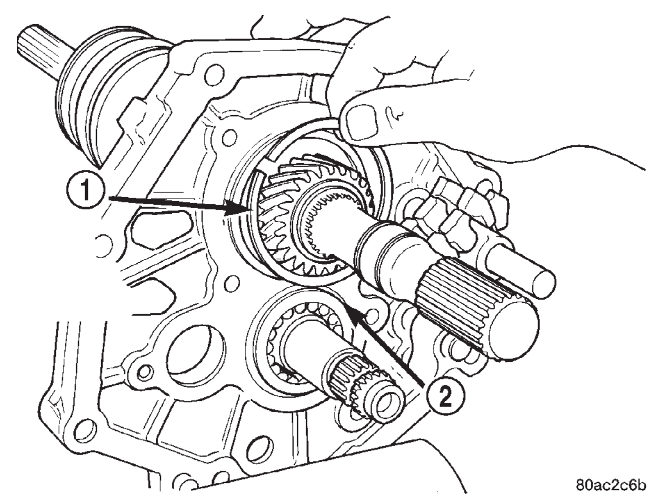


Fig. 37 Output Shaft Rear Bearing Snap-ring

1 - OUTPUT SHAFT REAR BEARING SNAP-RING
2 - COUNTERSHAFT REAR BEARING SNAP-RING

(16) With an assistant, support the mainshaft and countershaft. Tap on the rear of the mainshaft and countershaft with a plastic mallet. This will release the countershaft from the countershaft rear bearing and 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. 38).

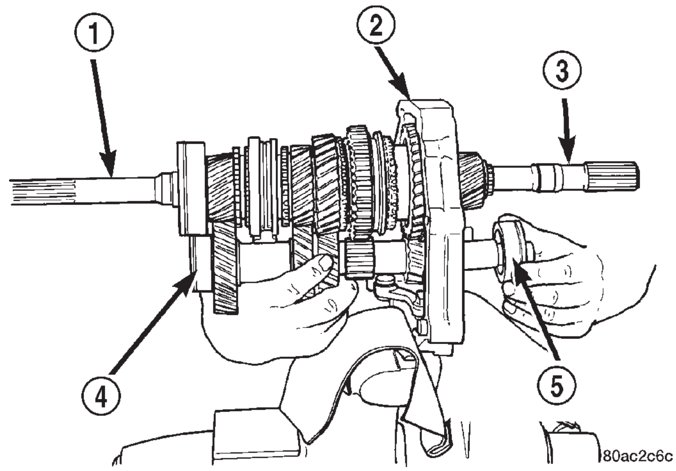


Fig. 38 Countershaft and Rear Bearing

1 - INPUT SHAFT
2 - INTERMEDIATE PLATE
3 - OUTPUT SHAFT
4 - COUNTERSHAFT
5 - COUNTERSHAFT REAR BEARING

(17) Remove 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. 39).

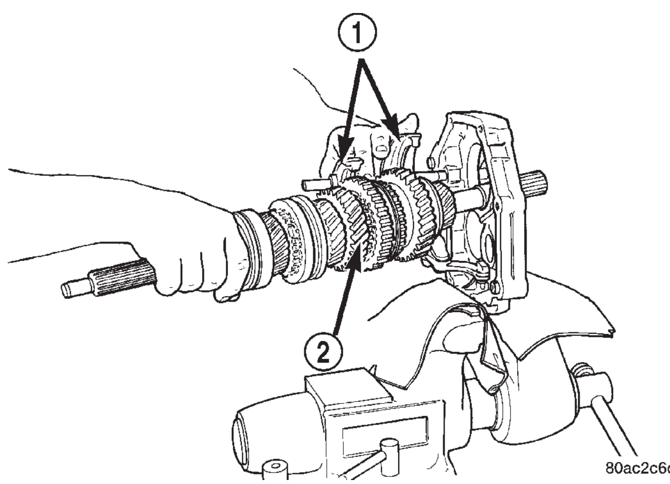


Fig. 39 Mainshaft

1 - SHIFT FORKS
2 - MAINSHAFT

(18) Remove 3-4 shift fork from the 3-4 shift rail (Fig. 40).

(19) Remove snap-ring from 1-2 shift rail to allow the removal of the 1-2 shift fork.

MANUAL - AX5 (Continued)

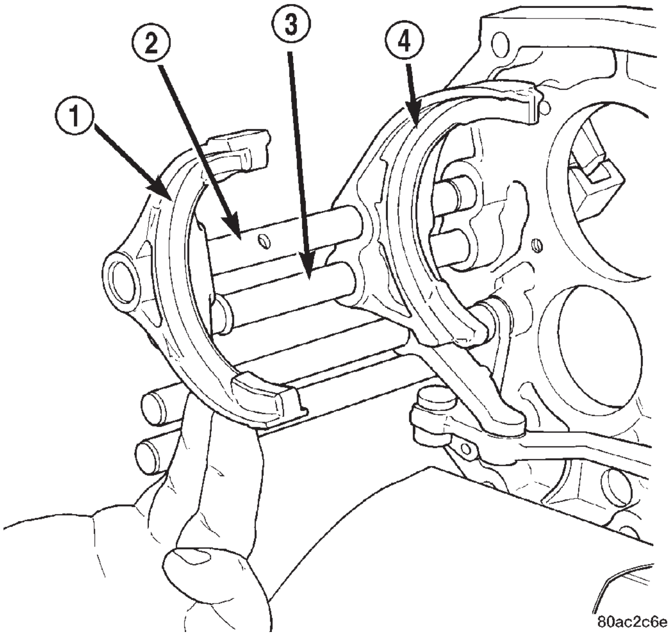


Fig. 40 Shift Rails and Forks

1 - 3–4 SHIFT FORK
2 - 3–4 SHIFT RAIL
3 - 1–2 SHIFT RAIL
4 - 1–2 SHIFT FORK

(20) Remove 1-2 shift fork from the 1-2 and the 3-4 shift rails (Fig. 41).

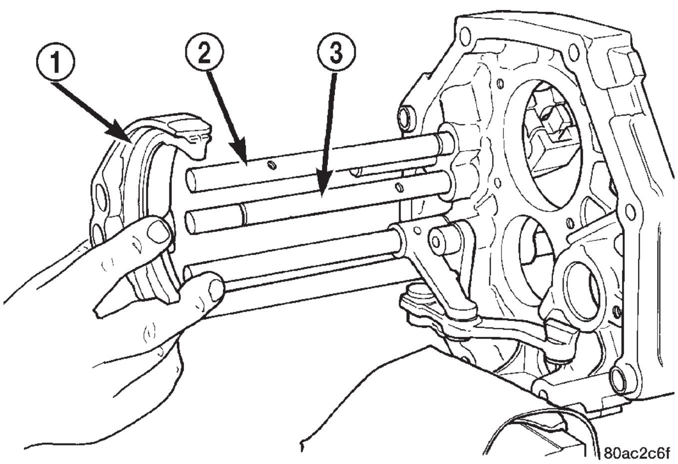


Fig. 41 1-2 Shift Fork

1 - 1–2 SHIFT FORK
2 - 3–4 SHIFT RAIL
3 - 1–2 SHIFT RAIL

(21) Remove threaded plugs from intermediate plate. Then remove lock ball and spring from with pencil magnet (Fig. 42).

NOTE: The bottom spring is shorter in length than the other two springs.

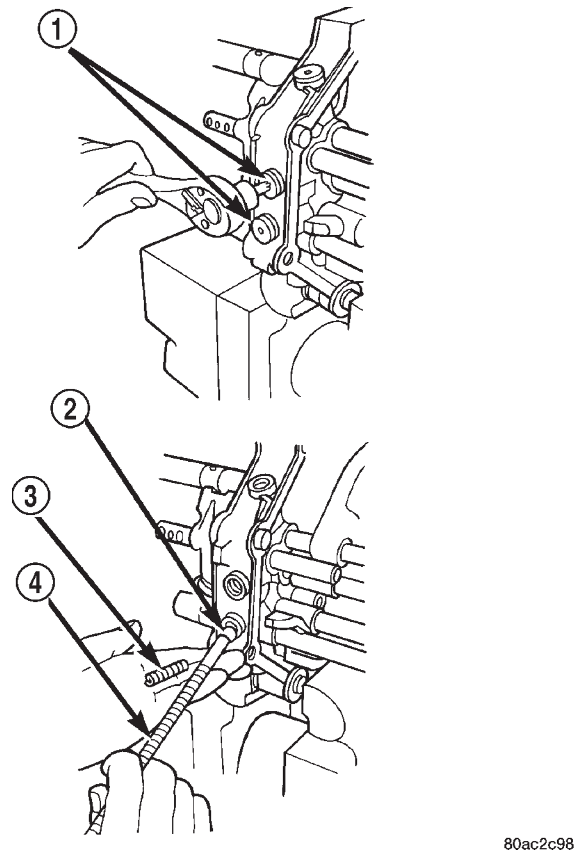


Fig. 42 Lock Ball And Spring

1 - THREADED PLUGS
2 - LOCK BALL
3 - SPRING
4 - PENCIL MAGNET

(22) Remove intermediate plate from the vise, rotate the plate 180°, and reinstall plate in the vise using the same bolt and washer mounting set-up.

CAUTION: Interlock balls and pins are different sizes and shapes. Pins and balls must be identified and marked for installation reference.

MANUAL - AX5 (Continued)

(23) Remove fifth gear shift rail (Fig. 43).

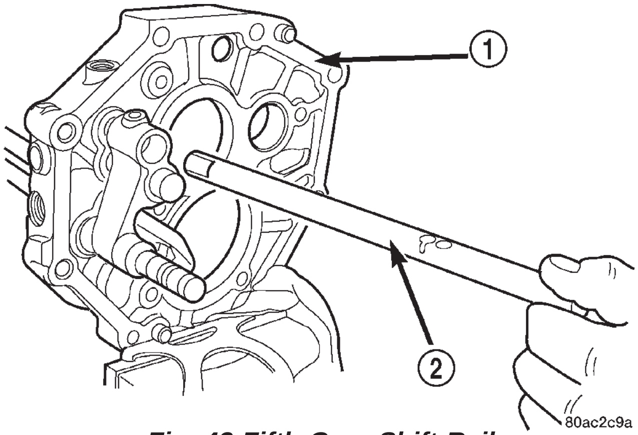


Fig. 43 Fifth Gear Shift Rail

1 - INTERMEDIATE PLATE
2 - FIFTH GEAR SHIFT RAIL

(24) Remove fifth gear check ball (Fig. 44) and interlock pin.

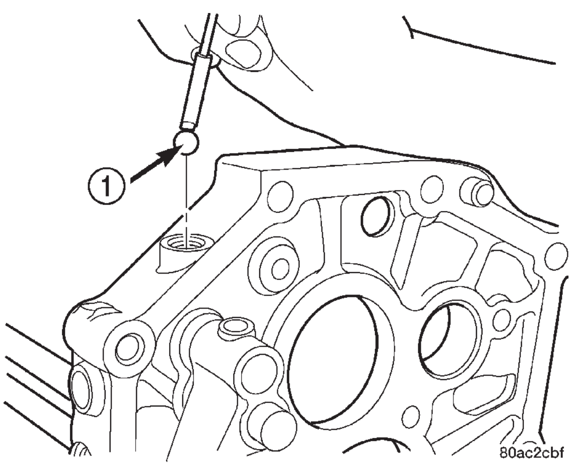


Fig. 44 Check Ball

1 - FIFTH GEAR CHECK BALL

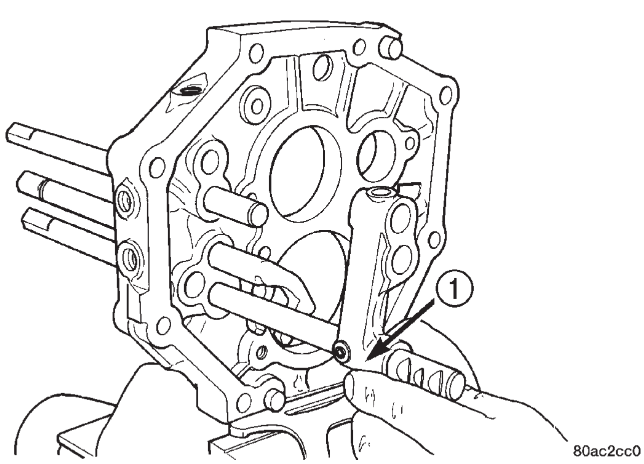


Fig. 45 Shift Head And Rail

1 - REVERSE SHIFT HEAD AND RAIL ASSEMBLY

(25) Remove reverse shift head and rail assembly (Fig. 45).

(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. 46).

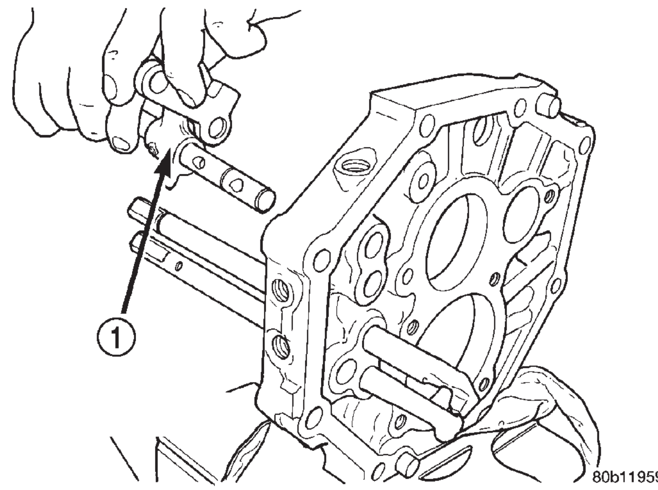


Fig. 46 Reverse Shift Rail

1 - REVERSE SHIFT RAIL AND REVERSE FORK ASSEMBLY

(28) Remove interlock pin from reverse shift rail (Fig. 47).

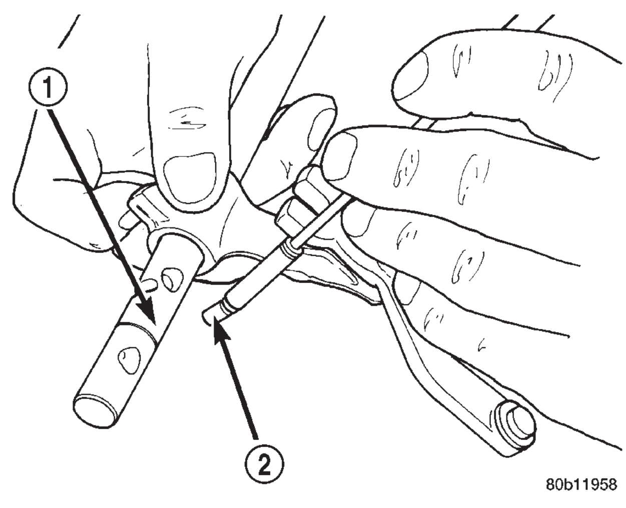


Fig. 47 Reverse Interlock Pin

1 - REVERSE SHIFT RAIL
2 - INTERLOCK PIN

MANUAL - AX5 (Continued)

(29) Remove reverse elongated check ball (Fig. 48).

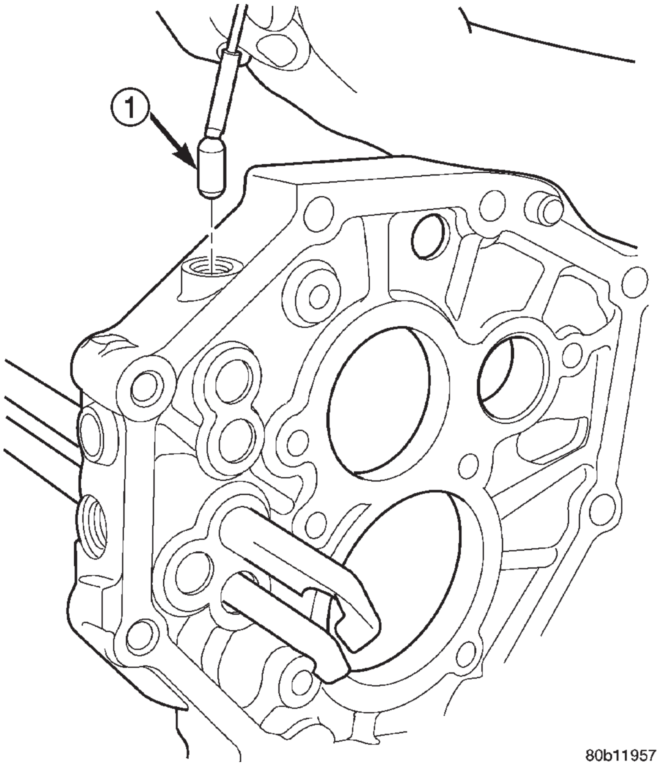


Fig. 48 Check Ball

1 - REVERSE CHECK BALL

(30) Remove snap-ring on 3-4 shift rail.

(31) Remove 1-2 shift rail from intermediate plate.

(32) Remove interlock pin from 1-2 shift rail (Fig. 49).

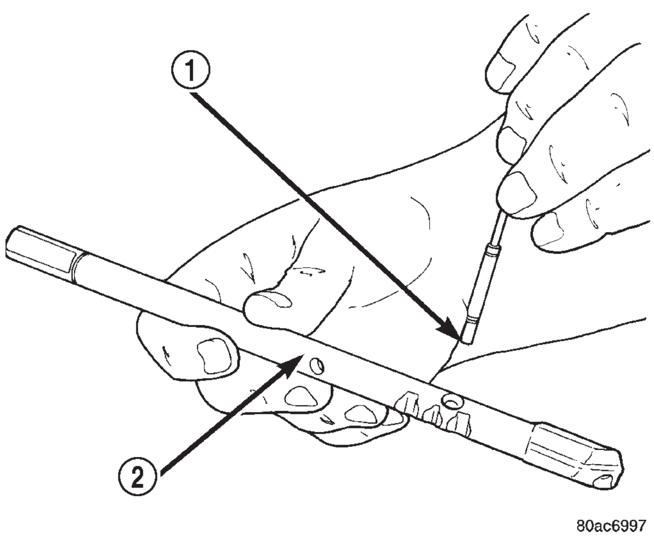


Fig. 49 1-2 SHIFT RAIL

1 - INTERLOCK PIN
2 - 1–2 SHIFT RAIL

(33) Remove 1-2 shift rail elongated check ball from intermediate plate (Fig. 50).

(34) Remove 3-4 shift rail from intermediate plate.

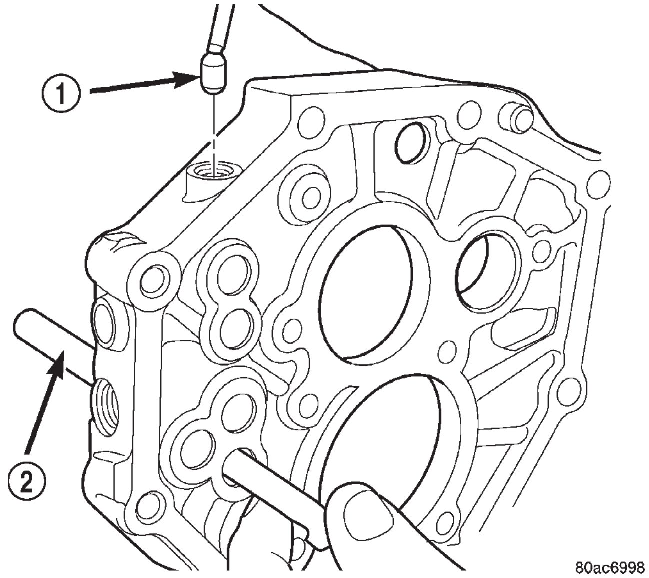


Fig. 50 1-2 Check Ball

1 - 1–2 CHECK BALL
2 - 3–4 SHIFT RAIL

CLEANING

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.

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.

MANUAL - AX5 (Continued)

INSPECTION

OUTPUT SHAFT

Check thickness of the output shaft and inner bearing race flanges (Fig. 51).

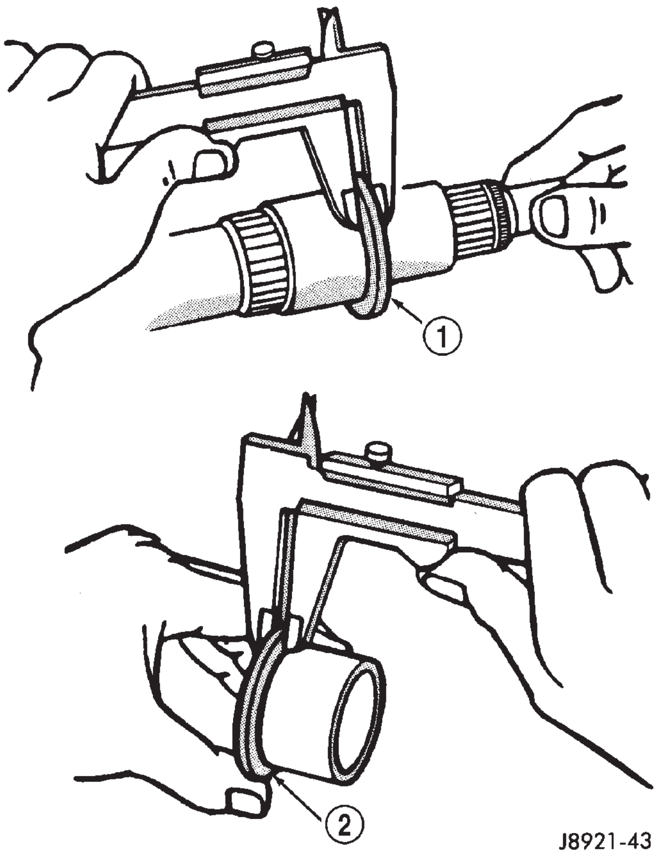


Fig. 51 Shaft And Bearing Race Flange

1 - OUTPUT SHAFT FLANGE
2 - INNER RACE FLANGE

- Shaft flange minimum thickness: 4.80 mm (0.189 in.)
- First gear bearing inner race flange minimum thickness: 3.99 mm (0.157 in.)

Measure diameter of the output shaft journal surfaces. Replace shaft if either of these surfaces are out of specification.

- Second gear surface minimum diameter: 37.964 mm (1.495 in.)
- Third gear surface minimum diameter: 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. 52). Runout should not exceed 0.05 mm (0.002 in.).

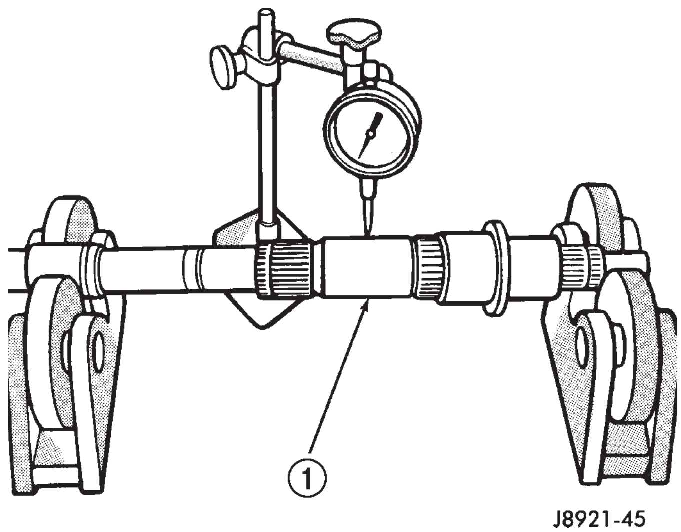


Fig. 52 Output Shaft Runout

1 - OUTPUT SHAFT JOURNAL

Replace output shaft or first gear inner bearing race if measurement of any surface is out of specification.

COUNTERSHAFT

Inspect countershaft gear teeth. Replace the countershaft if any teeth are worn or damaged. Inspect bearing surfaces and replace shaft if any surface shows damage or wear.

Check condition of the countershaft front bearing. Replace bearing if worn, noisy or damaged.

MANUAL - AX5 (Continued)

GEAR AND SYNCHRONIZER

Install needle bearing and inner race in the first gear. Then check oil clearance between the gear and inner race (Fig. 53). Clearance should be 0.009-0.032 mm (0.0004-0.0013 in.).

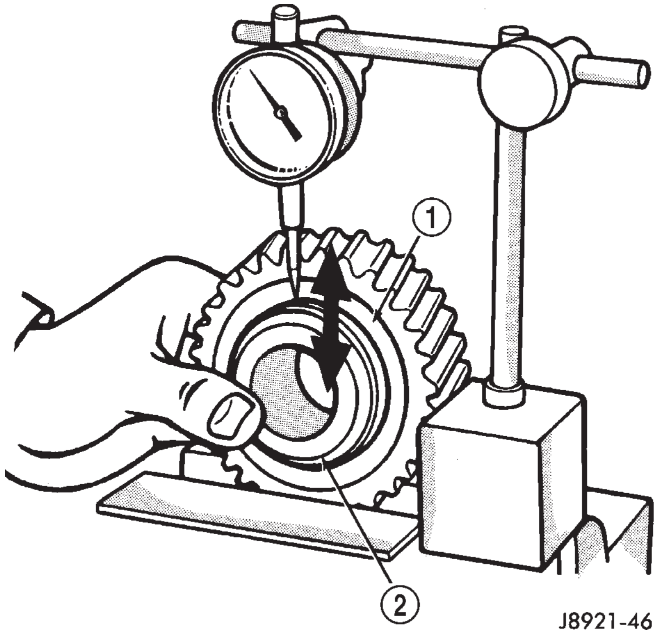


Fig. 53 Gear To Race Clearance

1 - GEAR
2 - INNER RACE

Install 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. 54). Oil clearance for all three gears is 0.009-0.0013 mm (0.0004-0.0013 in.).

Check synchronizer ring wear (Fig. 55). Insert each ring in matching gear. Measure clearance between each ring and gear with feeler gauge. Replace ring if clearance exceeds 2.0 mm (0.078 in.).

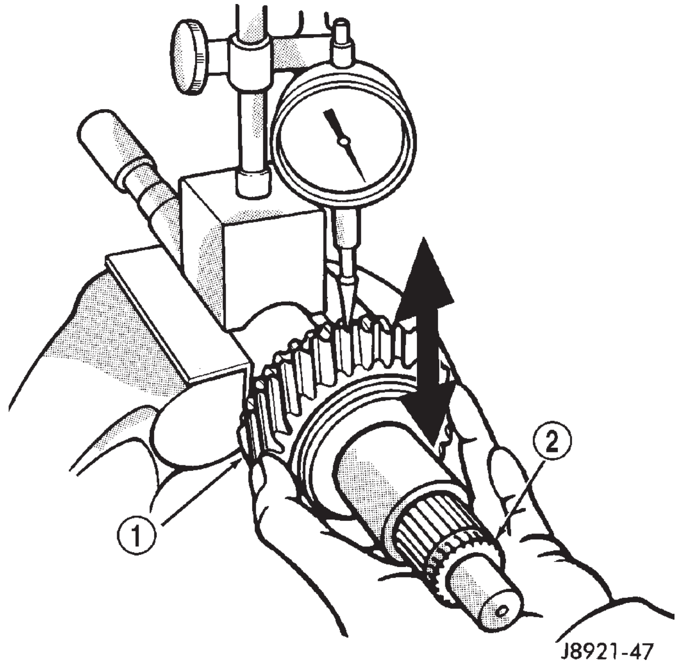


Fig. 54 Gear To Shaft Oil Clearance

1 - GEAR BEING CHECKED
2 - OUTPUT SHAFT

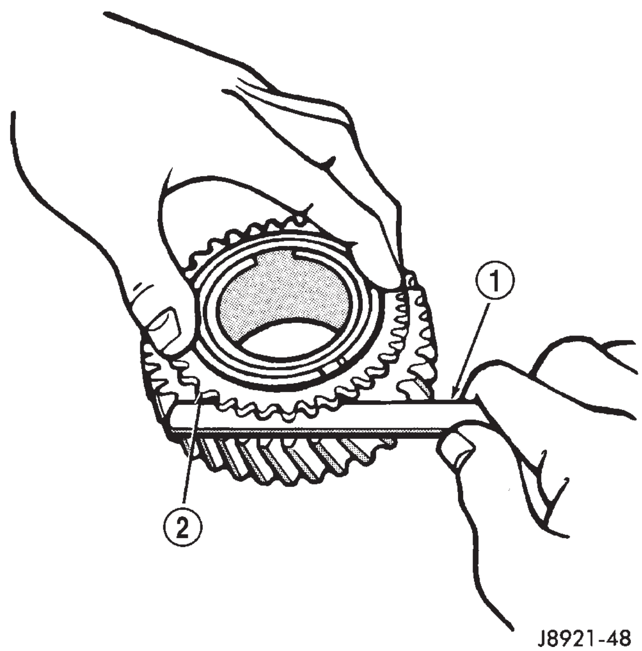


Fig. 55 Synchronizer Ring

1 - FEELER GAUGE
2 - SYNCHRONIZER RING

MANUAL - AX5 (Continued)

Check shift fork to synchronizer hub clearance with a feeler gauge (Fig. 56). Replace 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.

ASSEMBLY

GEARTRAIN AND SHIFT MECHANISM

Refer to (Fig. 57) while assembling and installing the shift rail components.

NOTE: Shift rail components must be in neutral position when installing check balls and interlock pins. Check balls and interlock pins must be installed in original location.

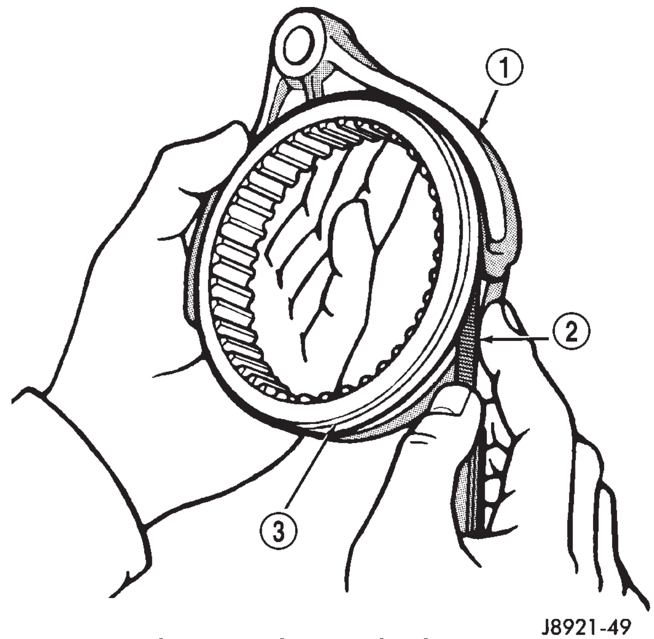


Fig. 56 Fork To Hub Clearance

1 - SHIFT FORK
2 - FEELER GAUGE
3 - SYNCHRONIZER SLEEVE

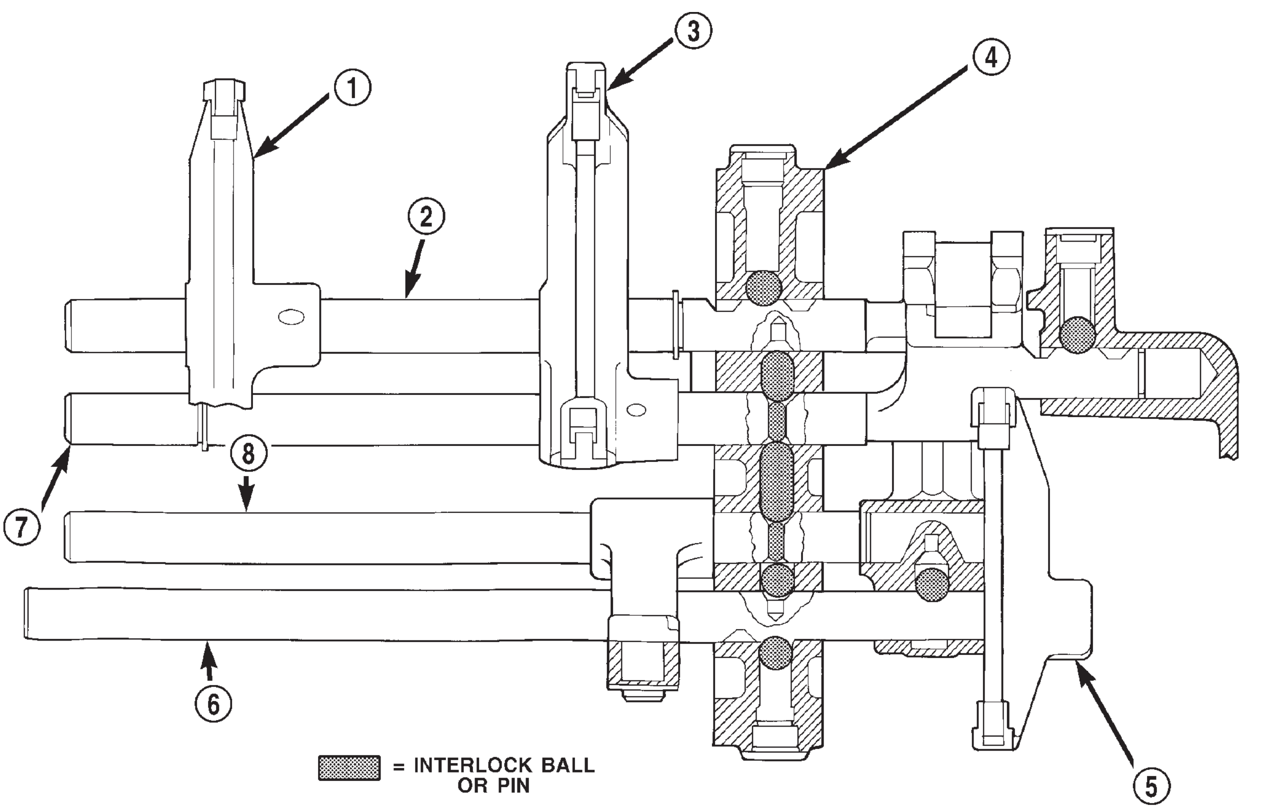


Fig. 57 Shift Rail Components

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

MANUAL - AX5 (Continued)

(1) Install 3-4 shift rail into the intermediate plate.

(2) Install 1-2 elongated check ball into the intermediate plate (Fig. 58).

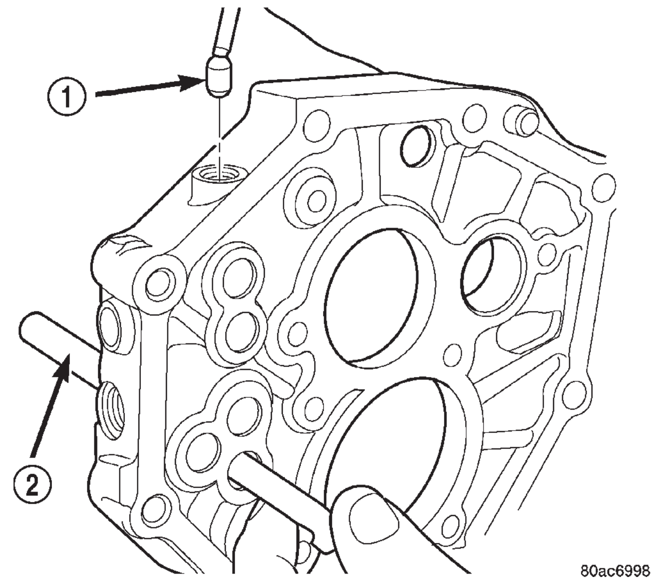


Fig. 58 1-2 Check Ball

1 - 1-2 CHECK BALL
2 - 3-4 SHIFT RAIL

(3) Install interlock pin into the 1-2 shift rail (Fig. 59).

(4) Install 1-2 shift rail into the intermediate plate.

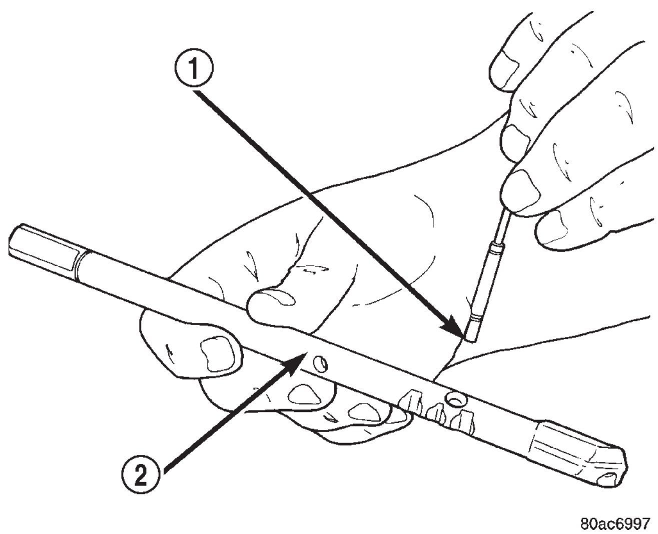


Fig. 59 1-2 Shift Rail Interlock Pin

1 - INTERLOCK PIN
2 - 1-2 SHIFT RAIL

(5) Install snap-ring onto 3-4 shift rail.

(6) Install reverse check ball into the intermediate plate (Fig. 60).

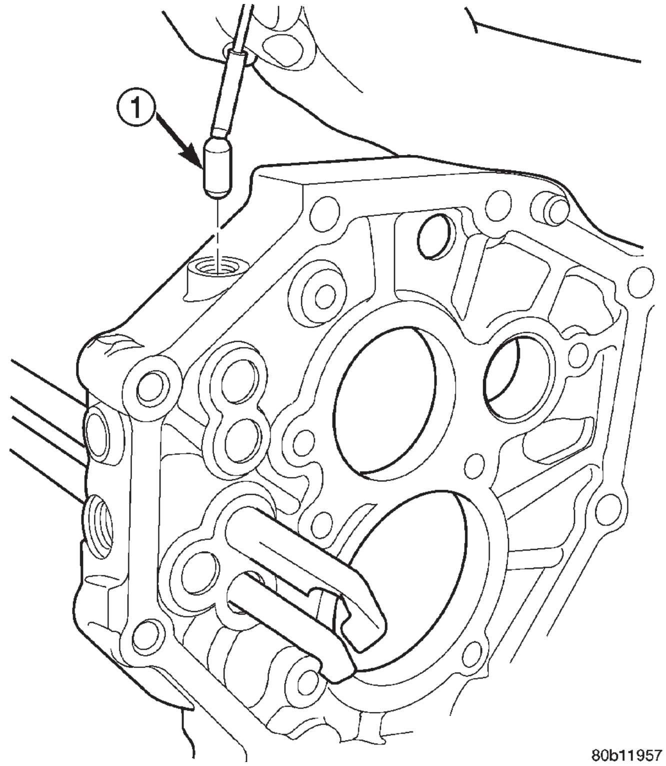


Fig. 60 Reverse Check Ball

1 - REVERSE CHECK BALL

(7) Install interlock pin into the reverse shift rail (Fig. 61).

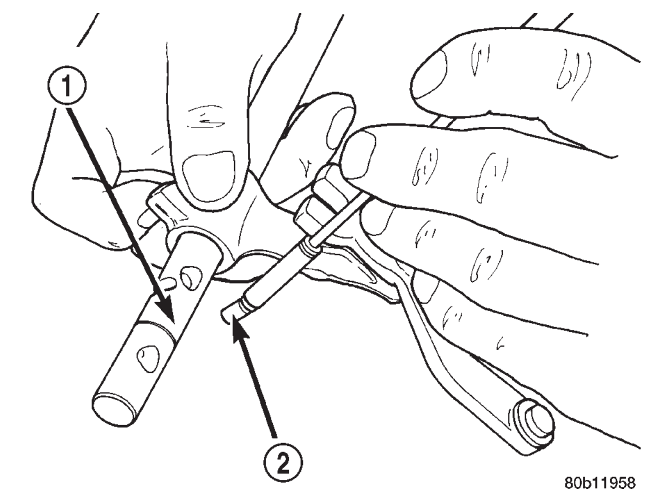


Fig. 61 Reverse Interlock Pin

1 - REVERSE SHIFT RAIL
2 - INTERLOCK PIN

MANUAL - AX5 (Continued)

(8) Assemble reverse arm bracket to the reverse fork (Fig. 62).

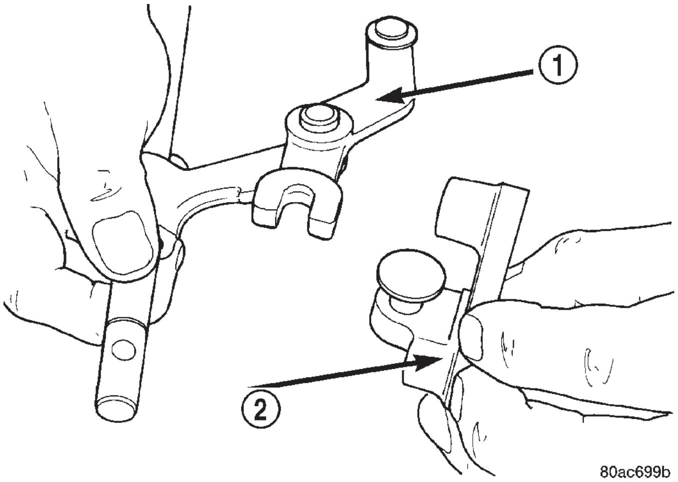


Fig. 62 Reverse Arm Bracket And Fork

1 - REVERSE SHIFT FORK
2 - REVERSE ARM BRACKET

(9) Install reverse shift rail into intermediate plate and position reverse arm bracket to intermediate plate (Fig. 63).

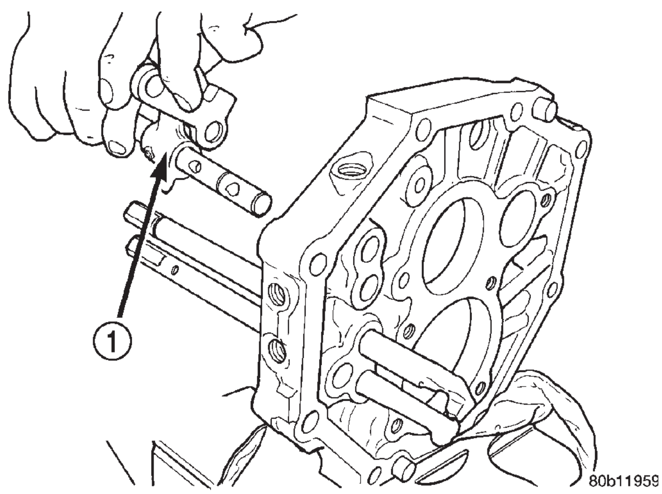


Fig. 63 Reverse Shift Rail

1 - REVERSE SHIFT RAIL AND FORK

(10) Install snap-ring onto reverse shift rail (Fig. 64).

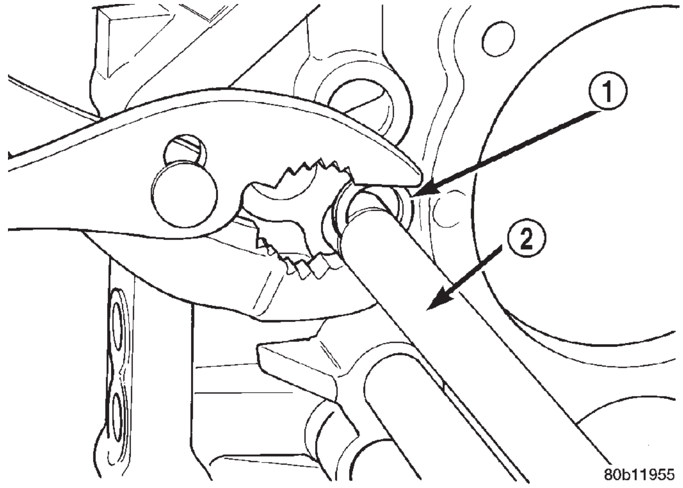


Fig. 64 Reverse Snap-ring

1 - SNAP RING
2 - REVERSE SHIFT RAIL

(11) Install reverse shift head and rail assembly into the intermediate plate.

(12) Install fifth gear interlock ball and check ball (Fig. 65).

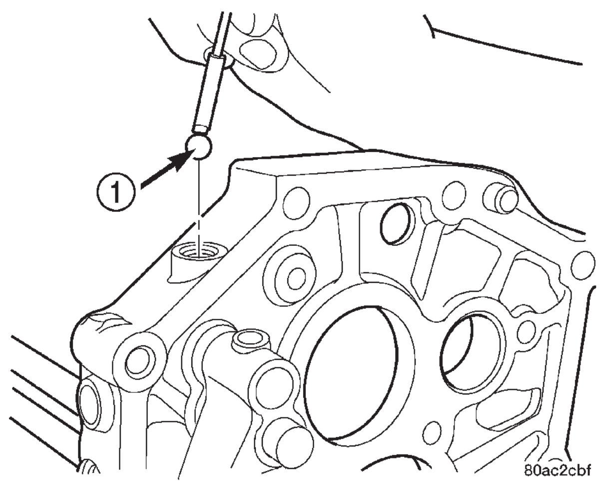


Fig. 65 Check Ball

1 - FIFTH GEAR CHECK BALL

MANUAL - AX5 (Continued)

(13) Install fifth gear shift rail (Fig. 66).

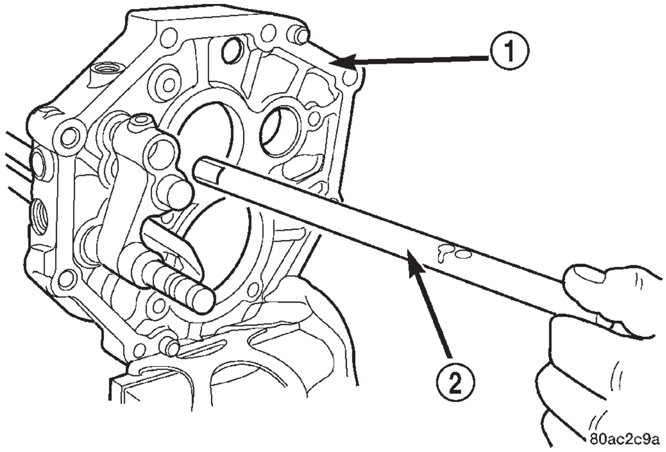


Fig. 66 Fifth Gear Shift Rail

1 - INTERMEDIATE PLATE
2 - FIFTH GEAR SHIFT RAIL

(14) Remove intermediate plate from the vise, rotate plate 180° and reinstall plate in the vise using the same bolt and washer mounting set-up.

(15) Install shift rail detent balls in the intermediate plate.

(16) Install shift rail detent springs in the intermediate plate.

NOTE: Bottom detent spring is shorter than the others.

(17) Install shift rail detent plugs in the intermediate plate.

(18) Install 1-2 shift fork onto the 1-2 and 3-4 shift rails (Fig. 67).

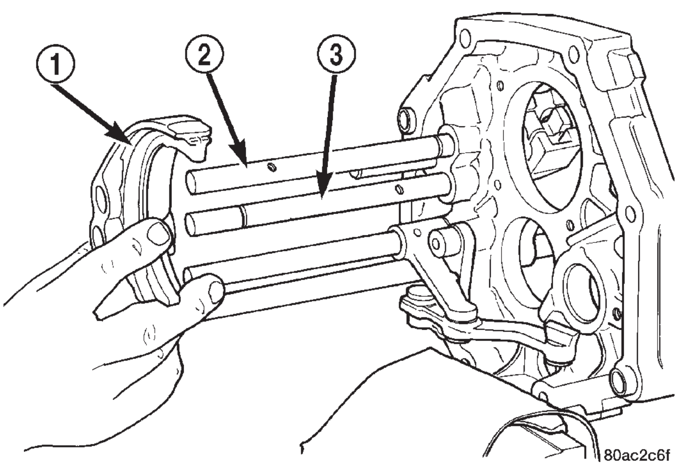


Fig. 67 1-2 Shift Fork

1 - 1-2 SHIFT FORK
2 - 3-4 SHIFT RAIL
3 - 1-2 SHIFT RAIL

(19) Install snap-ring onto the 1-2 shift rail.

(20) Install 3-4 shift fork onto the 3-4 shift rail (Fig. 68).

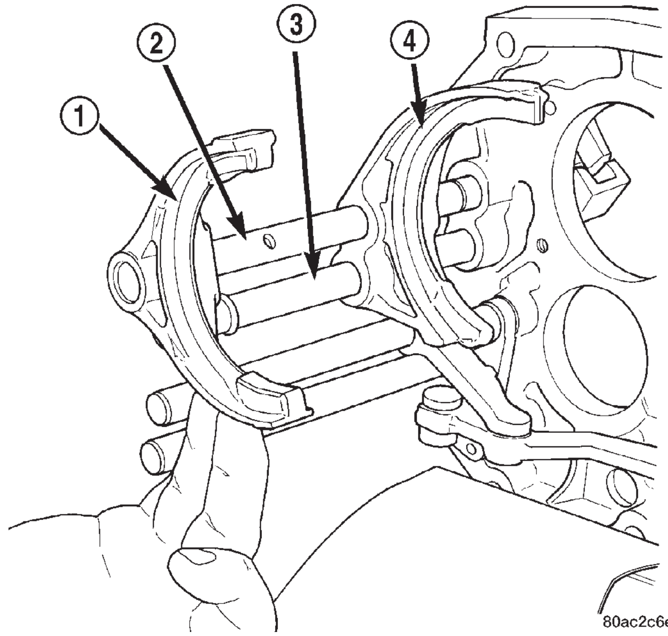


Fig. 68 3-4 SHIFT FORK

1 - 3–4 SHIFT FORK
2 - 3–4 SHIFT RAIL
3 - 1–2 SHIFT RAIL
4 - 1–2 SHIFT FORK

(21) Install mainshaft into intermediate plate. Guid 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) With a rubber mallet, tap on the input shaft and the front of the countershaft equally to install mainshaft rear bearing into intermediate plate and the rear of the countershaft into the rear countershaft bearing. It necessary hold 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 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. 69).

MANUAL - AX5 (Continued)

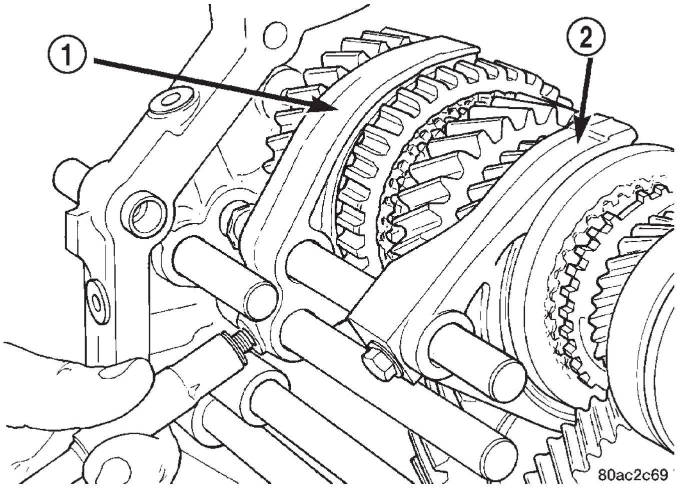


Fig. 69 Shift Fork Bolts

1 - 1-2 SHIFT FORK
2 - 3-4 SHIFT FORK

(28) Position mainshaft rear bearing retainer over the output shaft and onto the intermediate plate.

(29) Install **new** bearing retainer bolts into the intermediate plate.

(30) Move reverse shift arm into the reverse gear position. The reverse gear position is with the arm moved away from the intermediate plate (Fig. 70).

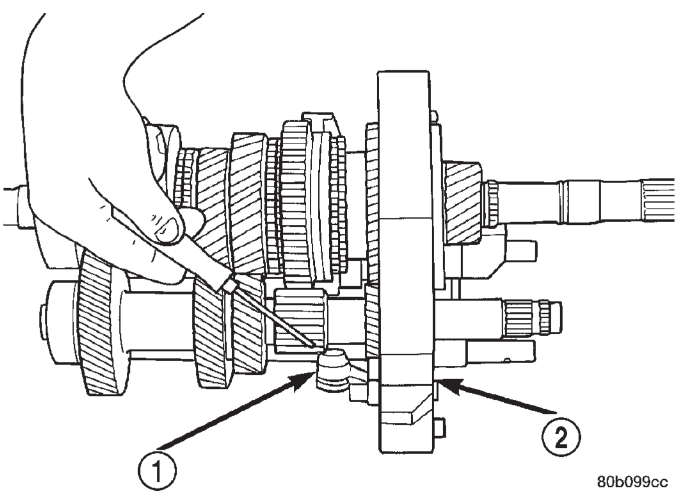


Fig. 70 Reverse Shift Arm Position

1 - REVERSE SHIFT ARM
2 - INTERMEDIATE PLATE

(31) Install reverse idler gear assembly into position on the mainshaft and reverse shift arm.

(32) Install compression spring and pin into the reverse idler gear shaft (Fig. 71).

(33) Install reverse idler shaft through the intermediate plate and reverse idler gear assembly (Fig. 72) until idler shaft pin contacts the gear assembly.

NOTE: The notched cut-out in the idler shaft goes toward the rear of the transmission.

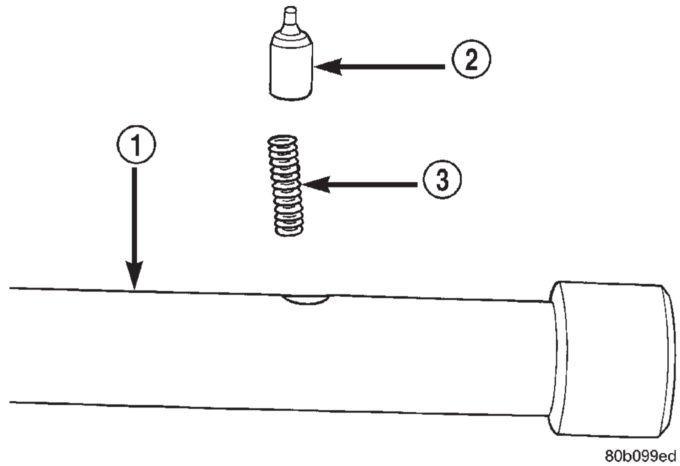


Fig. 71 Compression Spring And Pin

1 - REVERSE IDLER GEAR SHAFT
2 - PIN
3 - COMPRESSION SPRING

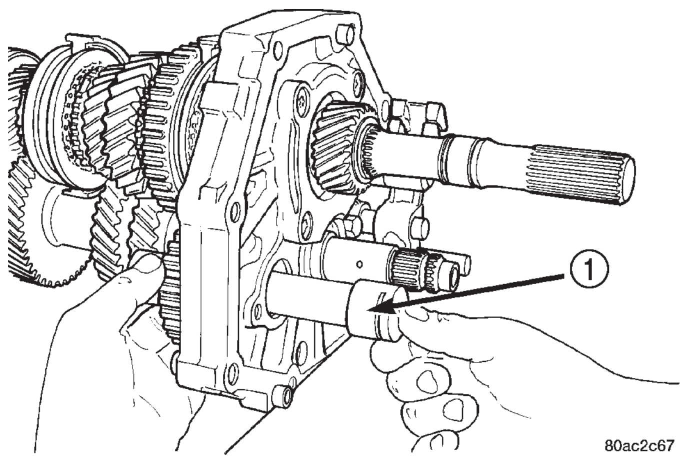


Fig. 72 Reverse Idler Shaft

1 - REVERSE IDLER SHAFT

(34) Align pin with the alignment notch in the reverse idler gear assembly (Fig. 73). Alignment notch in the reverse idler gear race/hub is a small relief cut above one of the main longitudinal slots. **Verify pin is aligned with proper slot.**

NOTE: The opposite slot has an oil drain hole which the pin could drop into. If this happens 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. 74).

(36) Install reverse idler gear shaft the remainder of the way through the reverse idler gear assembly.

MANUAL - AX5 (Continued)

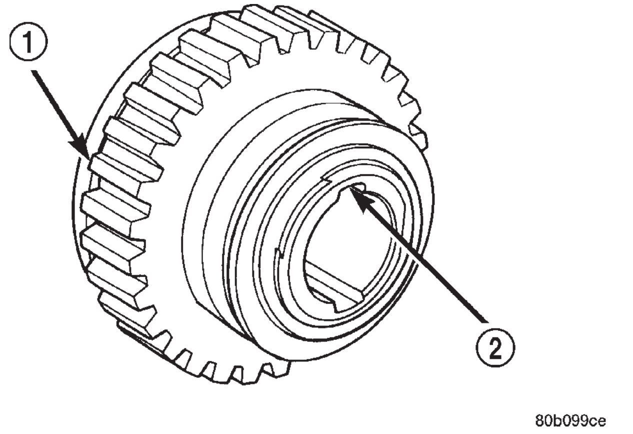


Fig. 73 Align Idler Shaft Pin

1 - REVERSE IDLER GEAR ASSEMBLY
2 - ALIGNMENT NOTCH

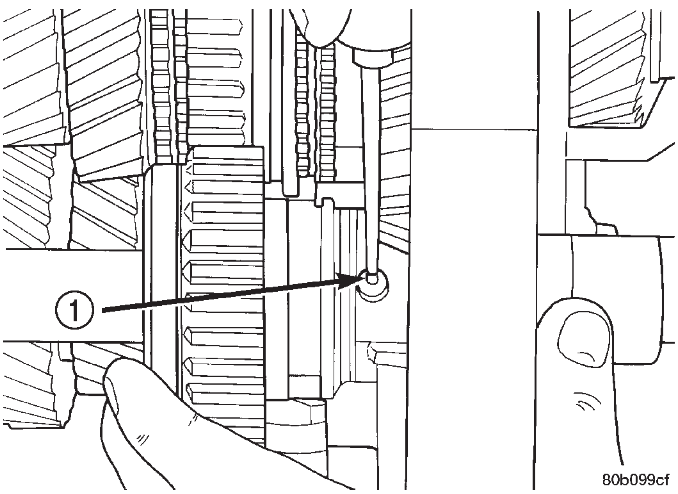


Fig. 74 Depress Pin In Reverse Idler Gear Shaft

1 - DEPRESS PIN

(37) Position reverse idler gear shaft lock plate onto the intermediate plate.

(38) Install a **new** bolt to hold the idler gear shaft lock plate to the intermediate plate.

(39) Install fifth gear thrust ring lock ball to the countershaft (Fig. 75).

(40) Install fifth gear thrust ring onto the countershaft and over the lock ball (Fig. 76).

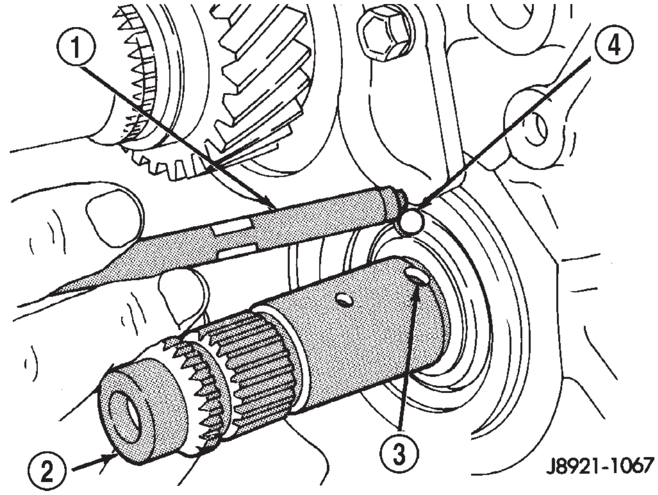


Fig. 75 Fifth Gear Thrust Ring Lock Ball

1 - PENCIL MAGNET
2 - CLUSTER GEAR
3 - LOCK BALL RECESS
4 - THRUST RING LOCK BALL

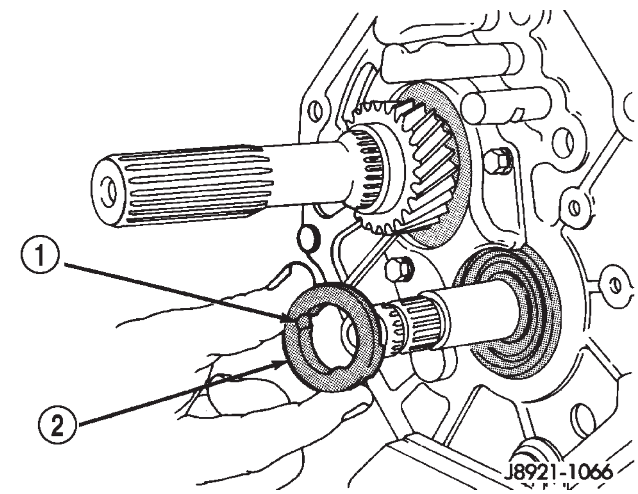


Fig. 76 Fifth Gear Thrust Ring

1 - LOCK BALL NOTCH
2 - FIFTH GEAR THRUST RING

MANUAL - AX5 (Continued)

(41) Install fifth gear shift fork to the countershaft fifth gear assembly.

(42) Install countershaft fifth gear bearings into the countershaft fifth gear assembly.

(43) Position countershaft fifth gear assembly on the countershaft. Verify fifth gear fork is installed onto the fifth gear shift rail.

(44) Install fifth gear synchro ring.

(45) Position fifth gear blocker ring onto the countershaft.

(46) With a mallet and spacer, tap fifth gear blocker ring onto the countershaft.

(47) Install **new** bolt to hold fifth gear shift fork to the fifth gear shift rail (Fig. 77).

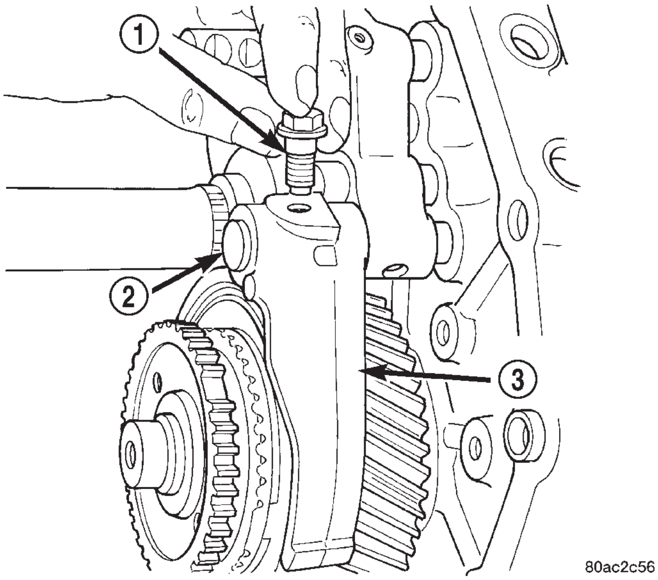


Fig. 77 Fifth Gear Retainer Bolt

1 - SHIFT FORK RETAINER BOLT
2 - FIFTH GEAR SHIFT RAIL
3 - FIFTH GEAR SHIFT FORK

(48) Measure countershaft fifth gear thrust clearance.

(49) Select a snap-ring that will provide a thrust clearance of 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.

EXTENSION AND ADAPTER HOUSING

(1) Remove any residual sealer from transmission case, intermediate plate, and adapter/extension housing.

(2) Apply a 1/8 to 3/16 inch wide bead of Threebond® Liquid Gasket TB1281. Make sure to keep sealer bead to inside of bolt holes (Fig. 78).

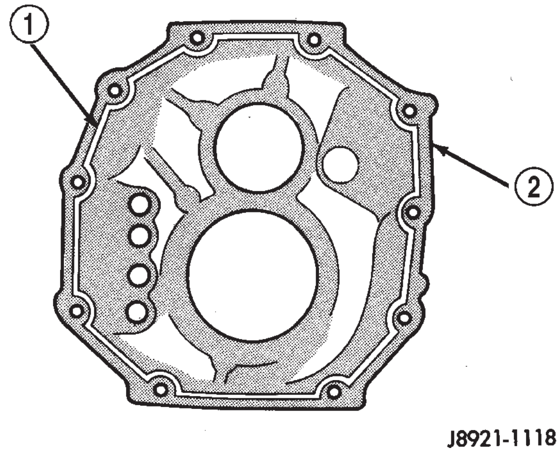


Fig. 78 Transmission Gear Case Sealer

1 - SEALER BEAD (1/8″ - 3/16″ WIDE)
2 - GEAR CASE

(3) Align geartrain and shift rails with mating holes in transmission case. Install transmission case to the intermediate plate (Fig. 79). Verify transmission case is seated on the intermediate plate locating pins.

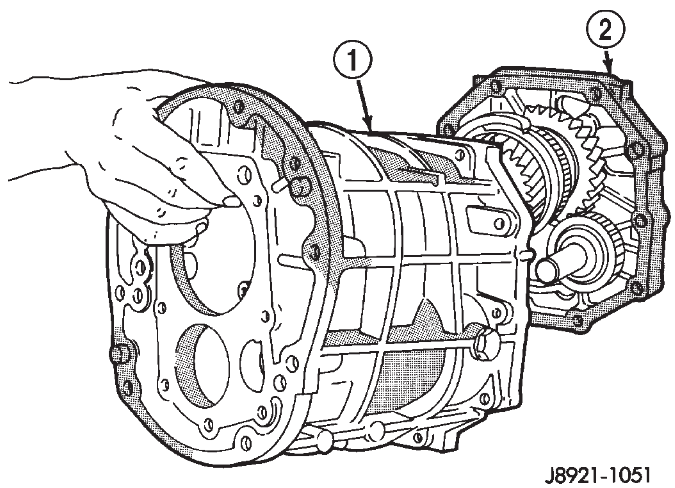


Fig. 79 Transmission Gear Case And Intermediate Plate

1 - GEAR CASE
2 - INTERMEDIATE PLATE

MANUAL - AX5 (Continued)

(4) Install **new** front bearing snap rings (Fig. 80).

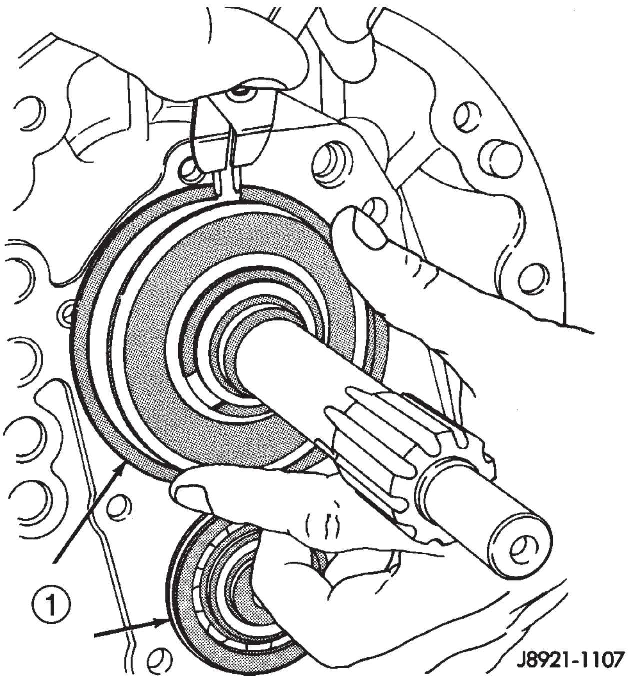


Fig. 80 Front Bearing

1 - FRONT BEARING SNAP RINGS

(5) Install front bearing retainer gasket to front bearing retainer.

(6) Install front bearing retainer (Fig. 81) and tighten bolts to 17 N·m (12 ft. lbs.).

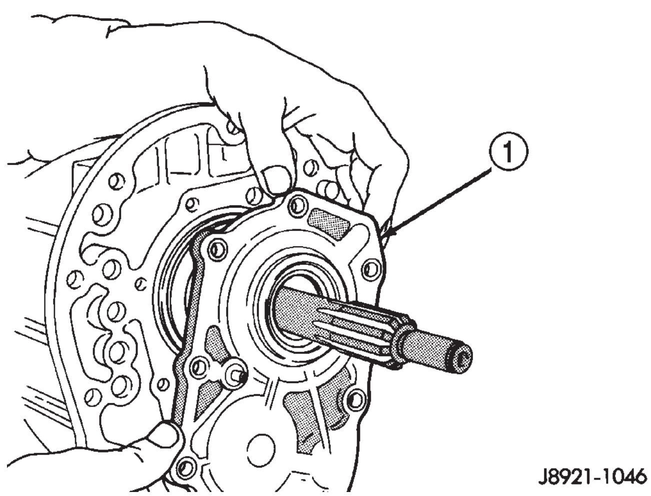


Fig. 81 Front Bearing Retainer

1 - FRONT BEARING RETAINER

(7) On 4x2 transmissions, install speedometer drive gear locating snap-ring (Fig. 82). Install speedometer gear lock ball in output shaft and install speedometer gear onto output shaft. Install speedometer gear retaining snap-ring onto output shaft.

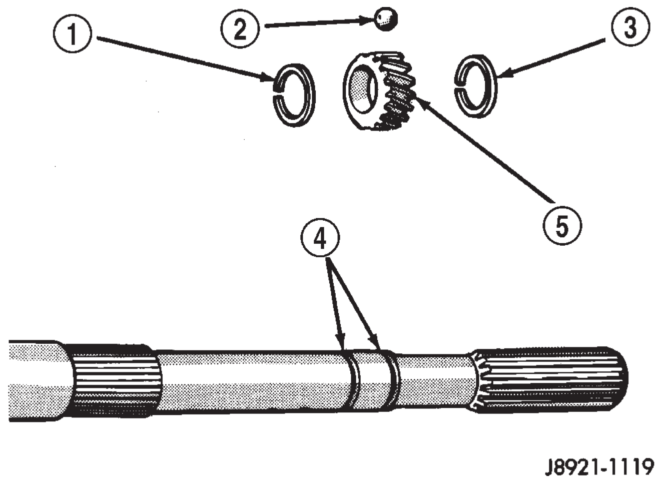


Fig. 82 Speedometer Drive Gear

1 - SNAP RING
2 - LOCK BALL
3 - SNAP RING
4 - OUTPUT SHAFT GROOVES
5 - SPEEDOMETER GEAR

(8) Apply a 1/8 to 3/16 inch wide bead of Threebond® Liquid Gasket TB1281 or equivalent, to sealing surface of adapter/extension housing. Keep sealer bead to inside of bolt holes.

(9) Install adapter or extension housing on intermediate plate (Fig. 83). Tighten housing bolts to 34 N·m (25 ft. lbs.).

(10) Position shift arm in shifter tower opening of adapter or extension housing (Fig. 84). Verify shifter arm is engaged into the shift rails.

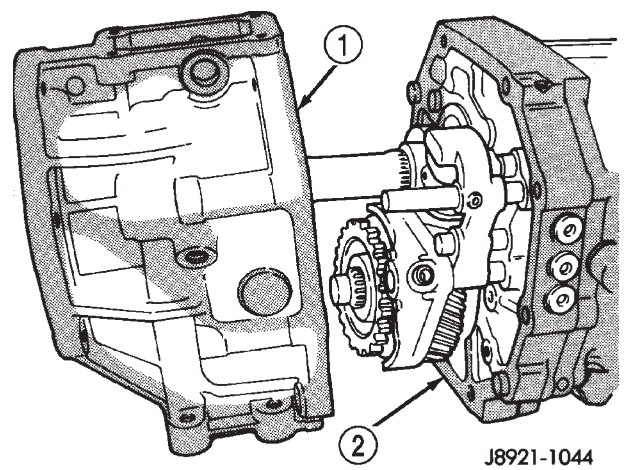


Fig. 83 Adapter/Extension Housing–Typical

1 - ADAPTER HOUSING
2 - INTERMEDIATE PLATE

MANUAL - AX5 (Continued)

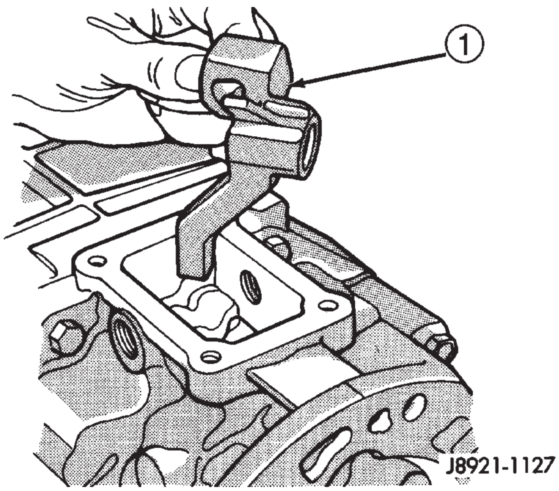


Fig. 84 Position Shift Arm

1 - SHIFT ARM

(11) Start shifter arm shaft in hole in back of adapter or extension housing. Align shift arm and shifter arm shaft. Insert shifter arm shaft through the shifter arm and into forward portion of the adapter or extension housing (Fig. 85).

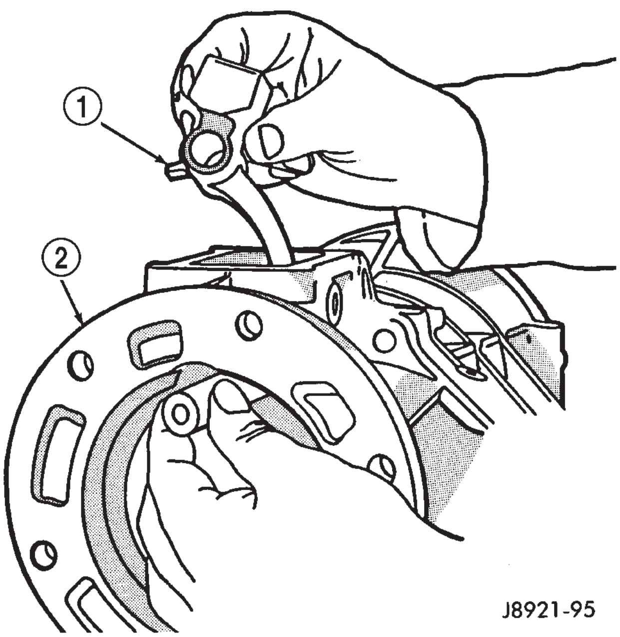


Fig. 85 Shifter Arm Shaft

1 - SHIFT ARM
2 - ADAPTER OR EXTENSION HOUSING

(12) Rotate shifter arm shaft until the hole in the shift arm is aligned with the hole in the shaft.

(13) Install shift arm retainer bolt and tighten to 38 N·m (28 ft. lbs.) (Fig. 86).

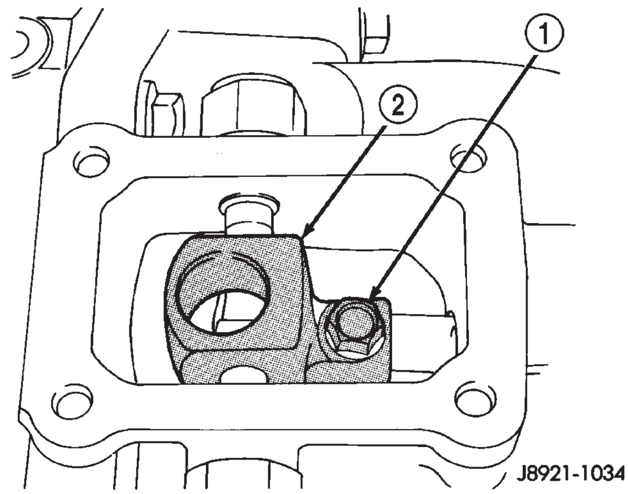


Fig. 86 Shift Arm Retainer Bolt

1 - RETAINER BOLT
2 - SHIFT ARM

(14) Install and tighten shifter arm shaft plug to 18 N·m (13 ft. lbs.) (Fig. 87).

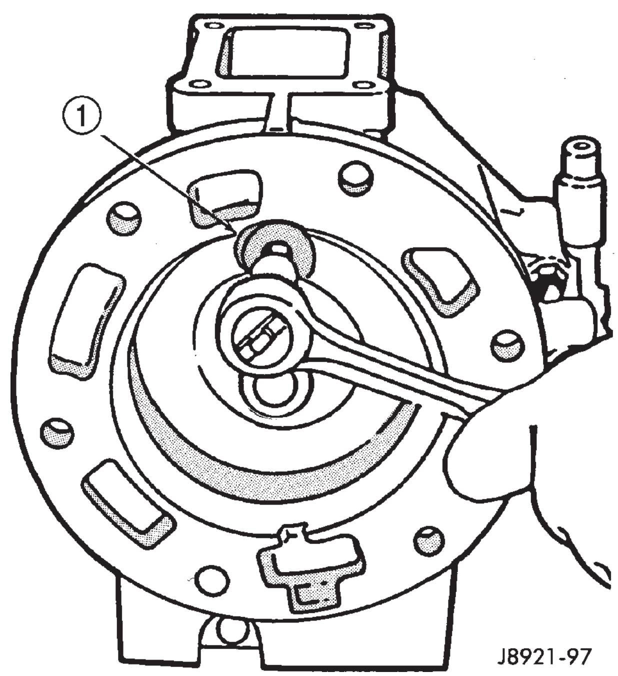


Fig. 87 Shifter Arm Shaft Plug

1 - SHAFT PLUG

MANUAL - AX5 (Continued)

(15) Install shift restrictor pins in shift tower and tighten to 27 N·m (20 ft. lbs.) (Fig. 88).

CAUTION: Restrictor pins are not interchangeable and are color coded. Verify pins are installed in the original locations.

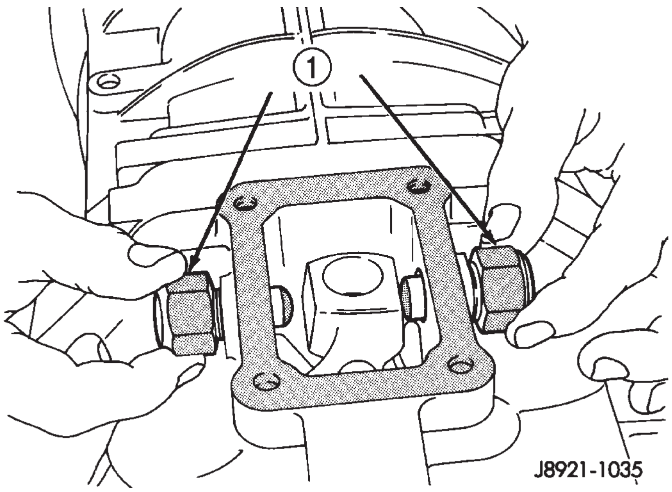


Fig. 88 Shifter Restrictor

1 - RESTRICTOR PINS

(16) Install shift detent ball in detent opening of case (Fig. 89).

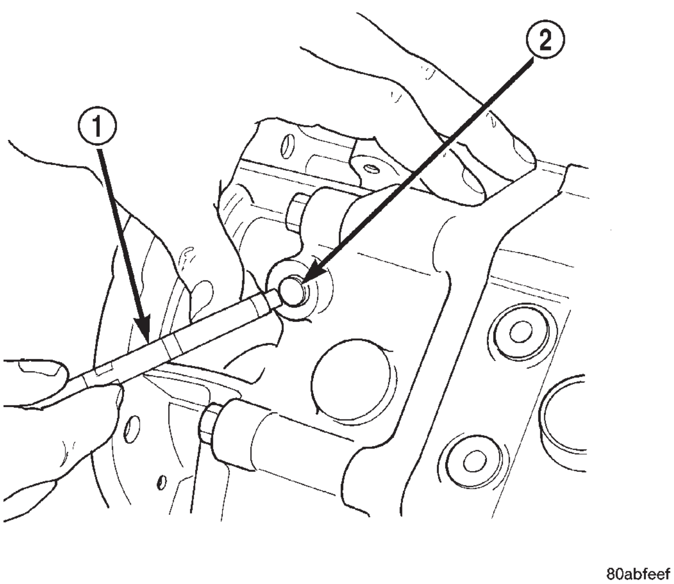


Fig. 89 Detent Ball

1 - PENCIL MAGNET
2 - SHIFT DETENT BALL

(17) Install detent spring in case (Fig. 90).

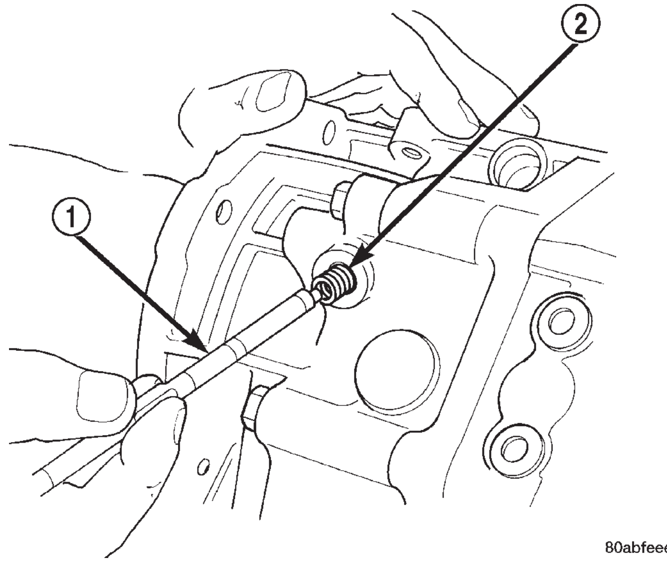


Fig. 90 Detent Spring

1 - PENCIL MAGNET
2 - DETENT BALL SPRING

(18) Install detent plug and tighten to 19 N·m (14 ft. lbs.) (Fig. 91).

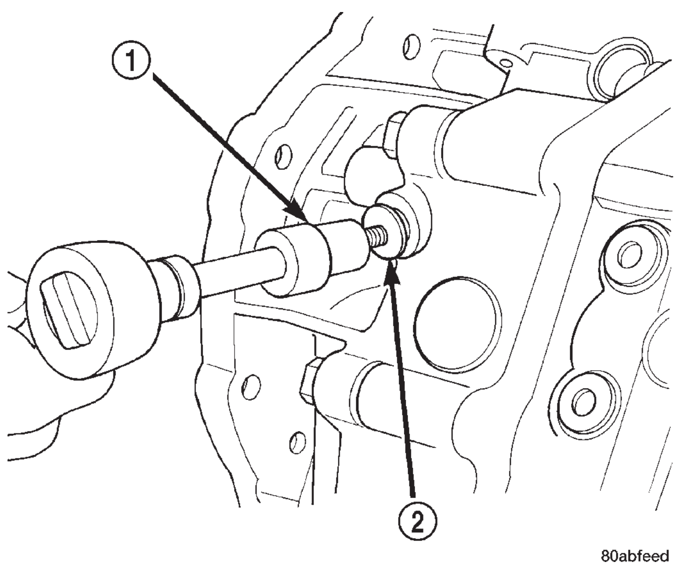


Fig. 91 Detent Ball Plug

1 - TORX BIT
2 - DETENT BALL PLUG

MANUAL - AX5 (Continued)

(19) Install shift tower gasket onto shift tower.

(20) Install shift tower oil deflector and gasket onto the adapter or extension housing.

(21) Install shift tower onto transmission case (Fig. 92).

(22) Install shift tower bolts and tighten to 18 N·m (13 ft. lbs.).

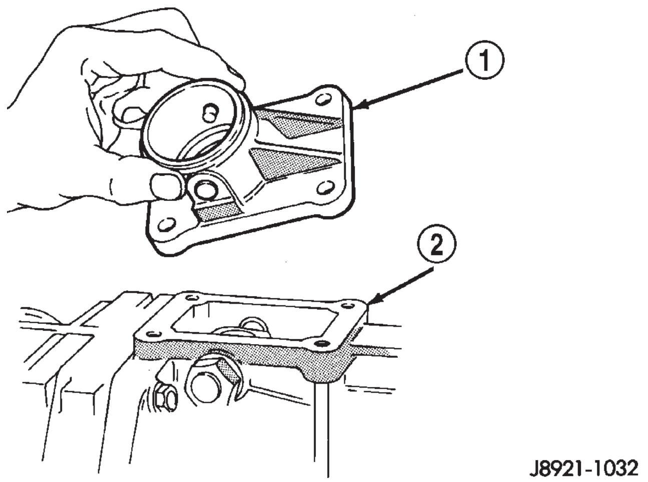


Fig. 92 Shift Tower

1 - SHIFT TOWER
2 - ADAPTER/EXTENSION HOUSING

(23) Install **new** metal o-ring onto the backup lamp switch.

(24) Install backup lamp switch (Fig. 93) and tighten to 44 N·m (32.5 ft. lbs.).

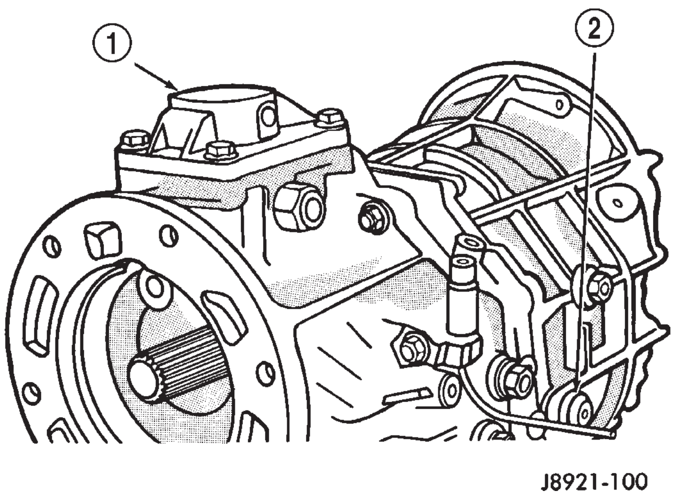


Fig. 93 Backup Lamp Switch

1 - SHIFT TOWER
2 - BACKUP LAMP SWITCH

(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.

INSTALLATION

(1) Install clutch housing on transmission and tighten housing bolts to 46 N·m (34 ft. lbs.) (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.

NOTE: Verify housing is seated on engine block before tightening bolts.

(7) Install and tighten clutch housing-to-engine bolts:

- 3/8 in. bolts: 37 N·m (27 ft.lbs.)
- 7/16 in. bolts: 58 N·m (43 ft.lbs.)
- M12 bolts: 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. Put transmission 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 bolts/nuts to 54 N·m (40 ft. lbs.).

(12) Install rear crossmember and tighten crossmember-to-frame bolts to 41 N·m (31 ft. lbs.).

(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 and tighten to 35 N·m (26 ft. lbs.).

(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.

(23) Engage wire connectors attached to all necessary transmission or transfer case components.

MANUAL - AX5 (Continued)

(24) Install rear propeller shaft slip yoke to transmission or transfer case output shaft.

(25) Install front and rear propeller shafts with reference marks aligned (Fig. 94).

(26) Install slave cylinder in clutch housing.

(27) Install skid plate if equipped.

(28) Fill transmission and transfer case with fluid.

(29) Lower vehicle.

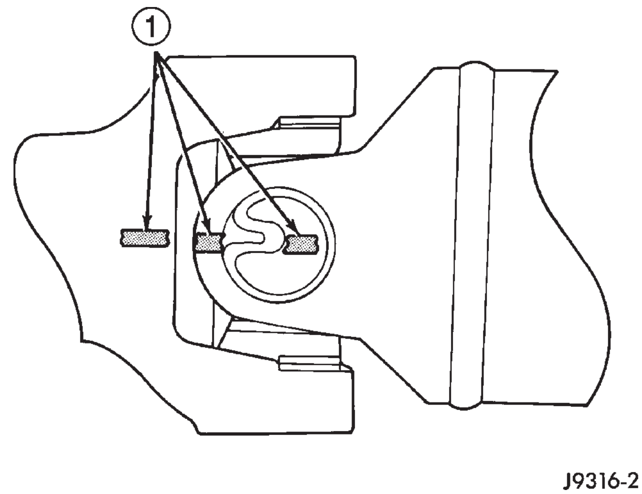


Fig. 94 Propeller Shaft And Rear Axle Yokes

1 - REFERENCE MARKS

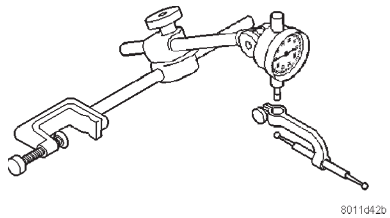
SPECIFICATIONS

TORQUE SPECIFICATIONS

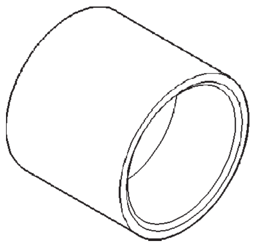
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Plugs, Access	19	14	-
Bolts, Adapter Housing	34	25	-
Switch, Back-up Light	44	32.5	-
Plugs, Drain and Fill	44	32.5	-
Bolts, Front Bearing Retainer	17	12	-
Plugs, Interlock and Detent	19	14	-
Screws, Propeller Shaft Clamp	16-23	-	140-200
Bolts, Rear Mount to Transmission	33-60	24-44	-
Nut, Rear Mount Clevis	54-75	40-55	-
Nuts, Rear Mount to Crossmember	41-68	30-50	-
Pins, Restrictor	24.7	20	-
Bolts, Reverse Shift Arm Bracket	18	13	-
Screw, Shift Arm Set	38	28	-
Screws, Shift Fork Set	20	15	-
Nut, Shift Knob	20-34	15-25	-
Screws, Shifter Floor Cover	2-3	-	17-30
Bolts, Shift Tower	18	13	-
Nuts, Transfer Case Mounting	30-41	22-30	-

MANUAL - AX5 (Continued)

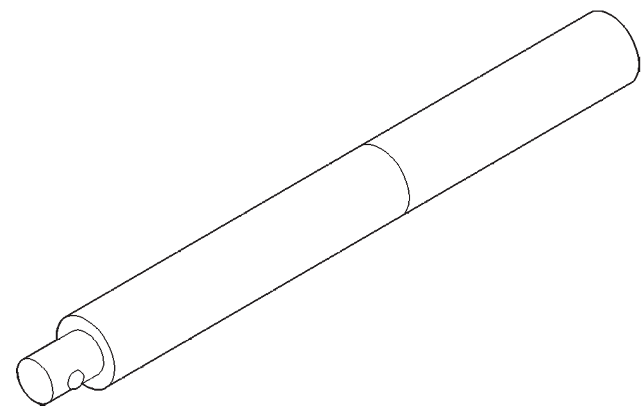
SPECIAL TOOLS



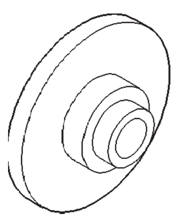
Dial Indicator C-3339



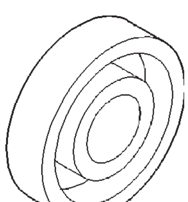
Installer C-3995-A



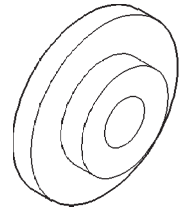
Handle C-4171



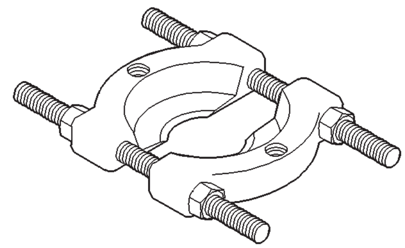
Installer 8211



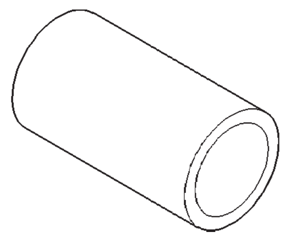
Installer 8212



Installer 8208

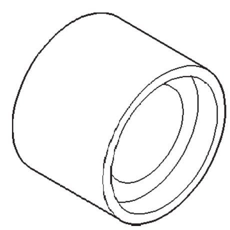


Splitter P-334

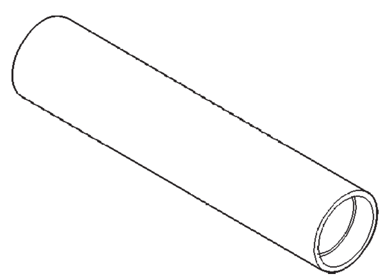


Installer 8109

Tube Driver L-4507



Adapter 6747-1A



Installer MD-998805

ADAPTER HOUSING SEAL

REMOVAL

(1) Hoist and support vehicle.

(2) Remove transfer case.

(3) With a pry tool or slide hammer mounted screw, remove the adapter housing seal (Fig. 95).

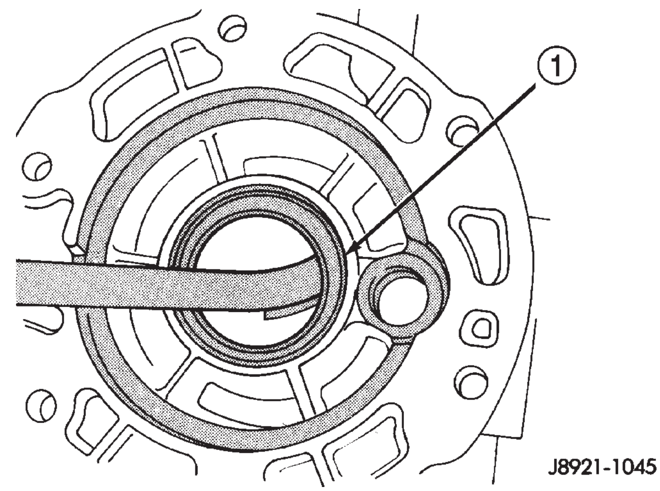


Fig. 95 Adapter Housing Seal

1 - ADAPTER HOUSING OIL SEAL

INSTALLATION

(1) Clean seal bore of adapter housing of any residual sealer material from original seal.

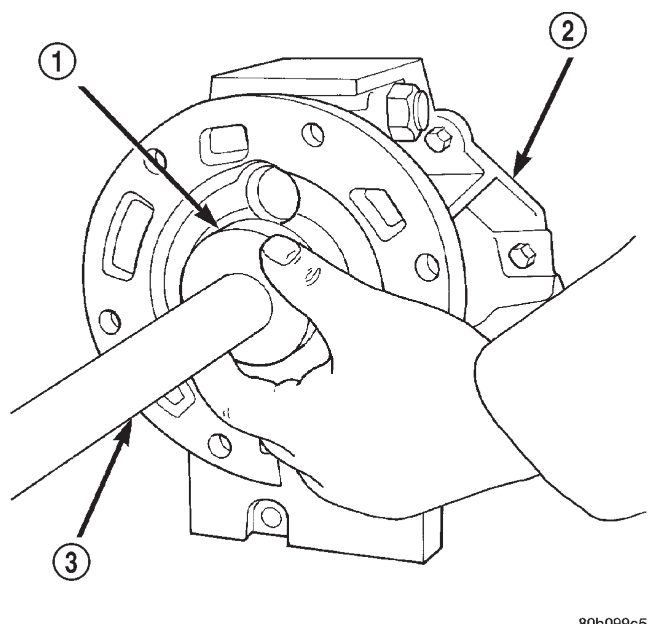


Fig. 96 Adapter Housing Seal

1 - INSTALLER
2 - ADAPTER HOUSING
3 - HANDLE

(2) Instal new seal with Handle C-4171 and 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. 96).

(3) Install transfer case.

(4) Check and add fluid to transmission as necessary.

(5) Lower vehicle.

BEARING RETAINER

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) With a pry tool, remove the front bearing retainer seal.

INSTALLATION

(1) Install new seal in the front bearing retainer with Tool Handle C-4171 and Installer 8211 (Fig. 97).

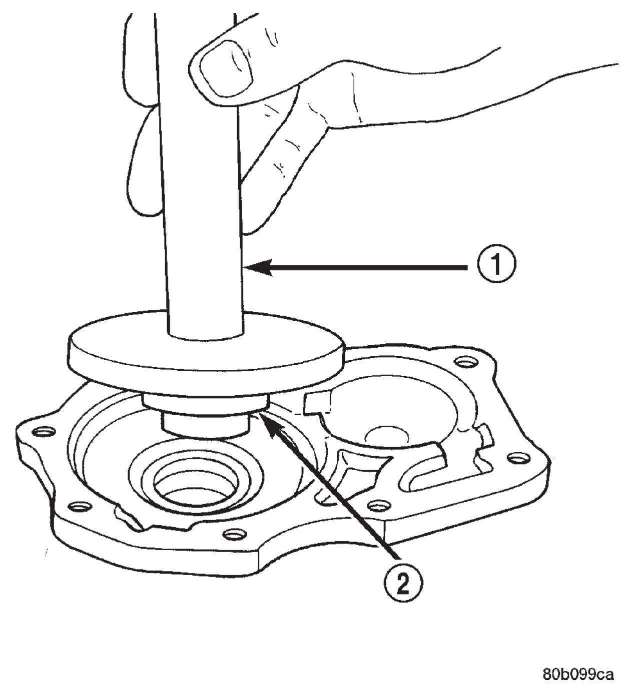


Fig. 97 Front Bearing Retainer Seal

1 - HANDLE
2 - INSTALLER

(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.

BEARING RETAINER (Continued)

(5) Install the bolts to hold the bearing retainer onto the transmission case.

(6) Tighten the bolts to 17 N·m (12 ft. lbs.).

(7) Install release bearing and lever onto the transmission.

COUNTERSHAFT

DISASSEMBLY

(1) Remove select fit snap-ring holding the countershaft front bearing onto the countershaft (Fig. 98).

(2) Remove countershaft front bearing from the countershaft with Bearing Splitter P-334 and a suitable spacer on center of countershaft and a press.

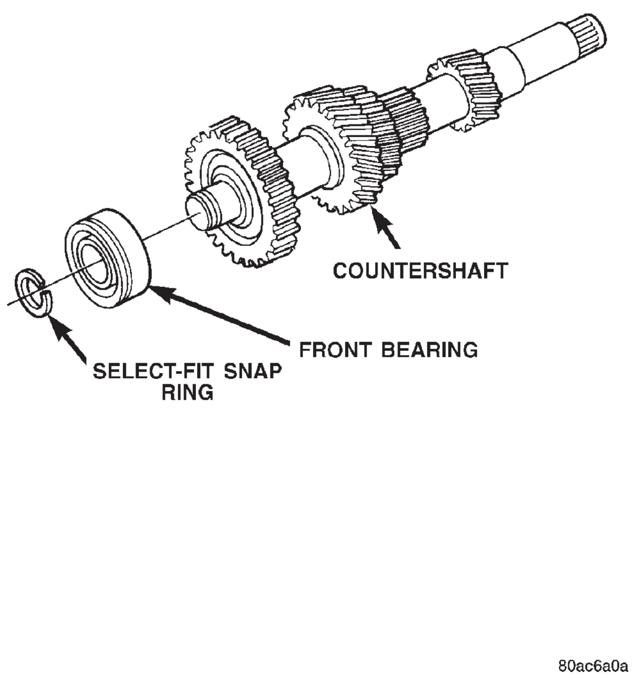


Fig. 98 Countershaft Front Bearing Snap-ring

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)

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. 98) .

(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. 99). Note that the output shaft pilot bearing is an uncaged roller type bearing.

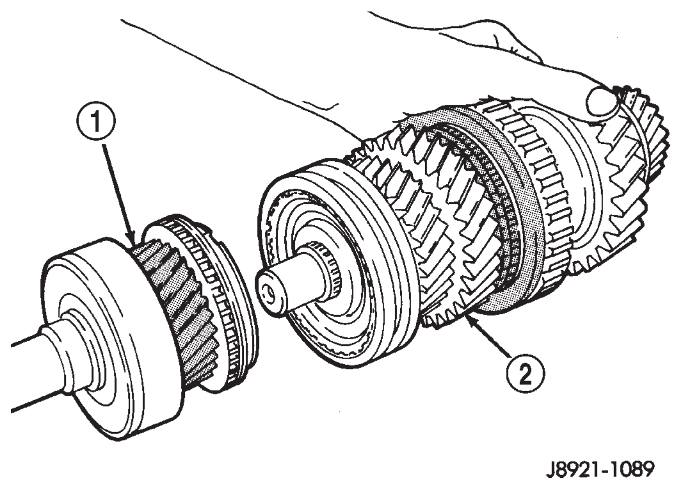


Fig. 99 Input and Output Shafts

1 - INPUT SHAFT ASSEMBLY
2 - OUTPUT SHAFT AND GEAR ASSEMBLY

(3) Remove output shaft pilot bearing rollers from the input shaft and the output shaft.

(4) Remove fourth gear synchronizer ring from the input shaft (Fig. 100).

(5) Remove select fit snap-ring holding the input shaft bearing onto the input shaft.

(6) Remove bearing from the input shaft with Bearing Splitter P-334 and a shop press.

INPUT SHAFT (Continued)

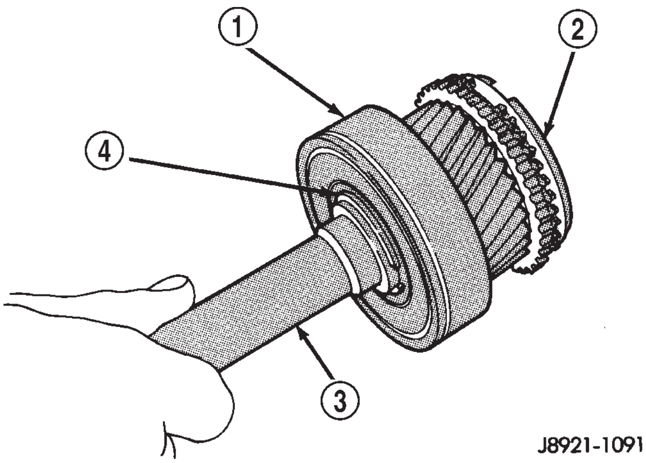


Fig. 100 Input Shaft Components

1 - BEARING
2 - SYNCHRO RING
3 - INPUT SHAFT
4 - BEARING SNAP RING

ASSEMBLY

(1) Position input shaft bearing onto input shaft.

(2) Drive bearing onto input shaft with Driver L-4507.

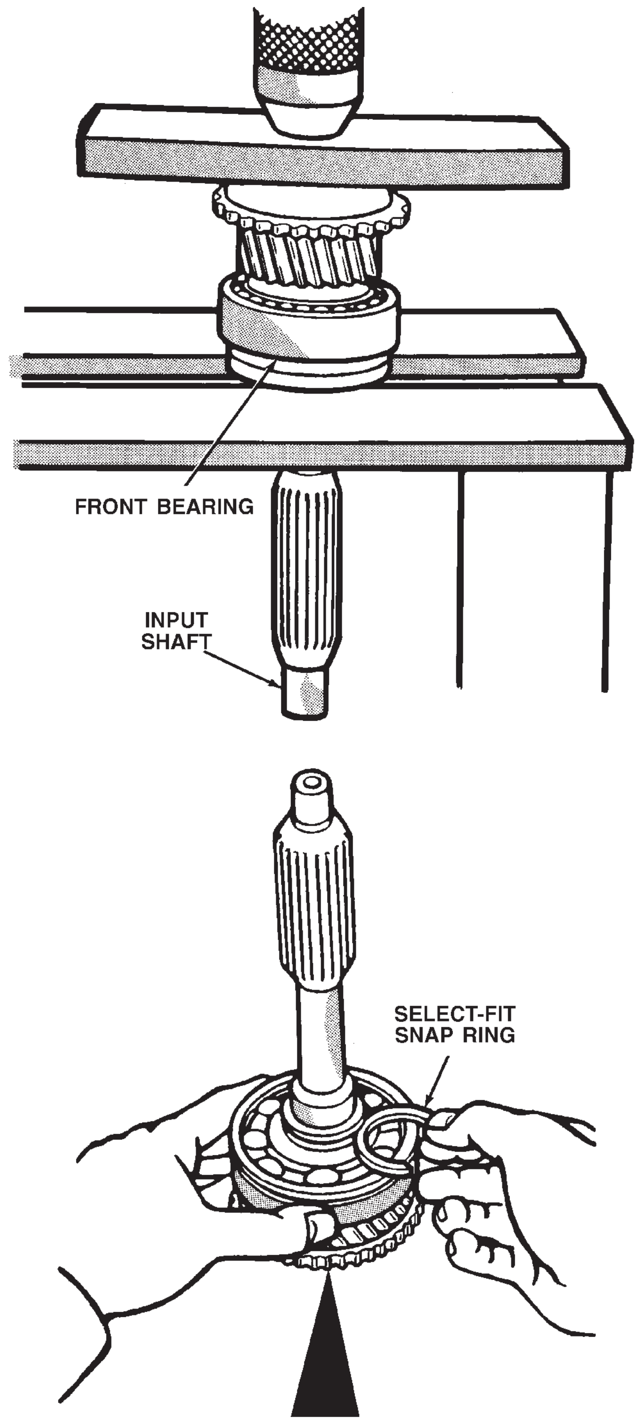
(3) Select the thickest snap-ring that will fit into the snap-ring groove of the input shaft (Fig. 101).

(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. 102). Ensure to use sufficient petroleum jelly to hold rollers in position.

(6) Install 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.



I.D. Mark	Snap Ring Thickness mm (in.)
0	2.05-2.10 (0.0807-0.0827)
1	2.10-2.15 (0.0827-0.0846)
2	2.15-2.20 (0.0846-0.0866)
3	2.20-2.25 (0.0866-0.0886)
4	2.25-2.30 (0.0886-0.0906)
5	2.30-2.35 (0.0906-0.0925)

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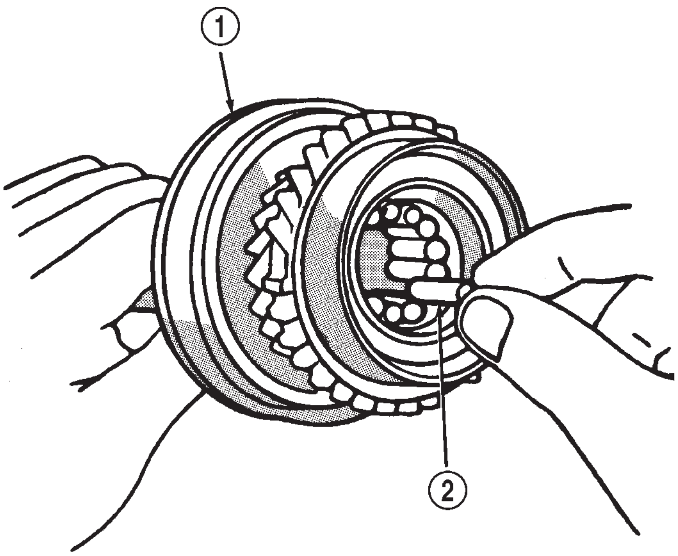
Fig. 101 Select Input Shaft Bearing Snap-ring

INPUT SHAFT (Continued)



J8921-64

Fig. 102 Install Output Shaft Pilot Bearing Rollers

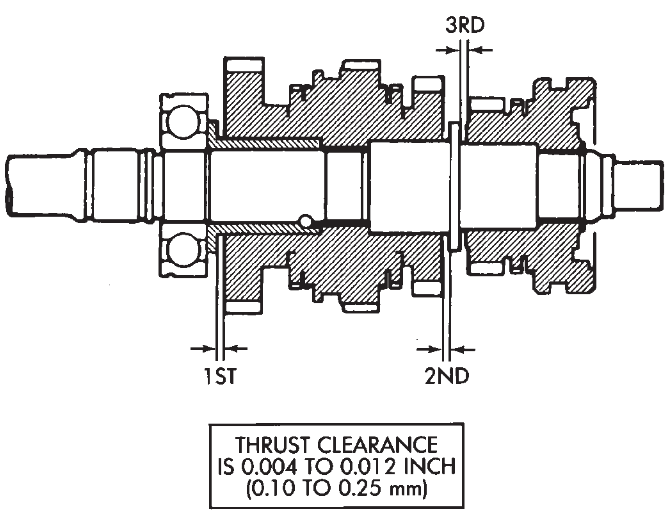
1 - INPUT SHAFT
2 - BEARING ROLLERS

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. 103). Clearance should be 0.10-0.25 mm (0.004-0.010 in.).

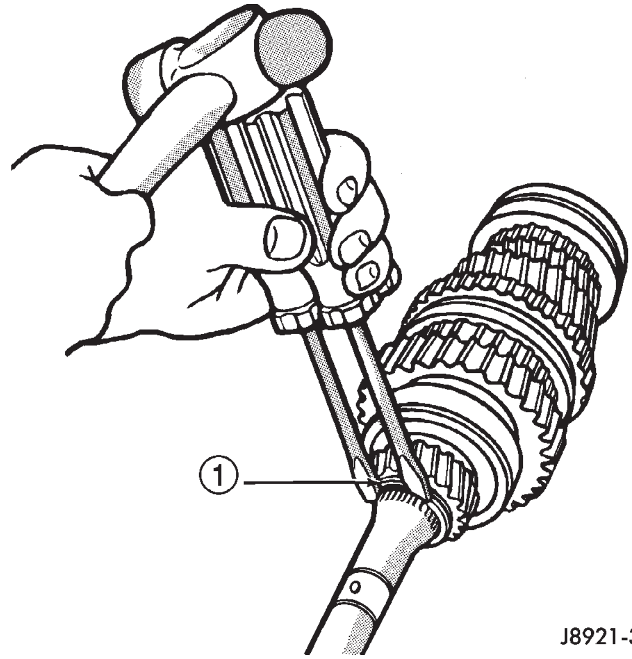


J8921-36

Fig. 103 Output Shaft Gear

(3) Remove output shaft fifth gear snap ring with two screwdrivers (Fig. 104).

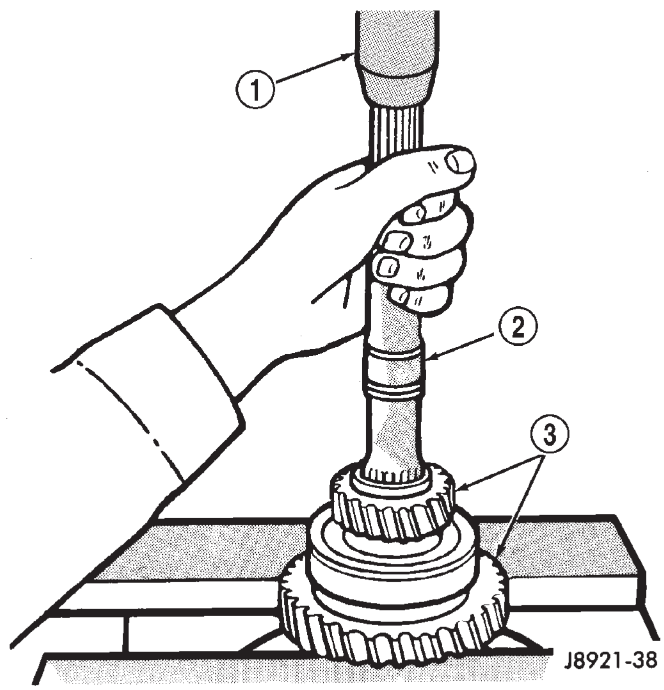
(4) With Bearing Splitter P-334 or press plates positioned under first gear, press fifth gear, rear bearing, first gear and first gear bearing inner race off output shaft (Fig. 105).



J8921-37

Fig. 104 Fifth Gear Snap-ring

1 - SNAP RING



J8921-38

Fig. 105 Fifth Gear, First Gear Bearing And Race

1 - PRESS RAM
2 - OUTPUT SHAFT
3 - FIRST-FIFTH GEAR-BEARING ASSEMBLY

(5) Remove first gear needle roller bearing from output shaft.

OUTPUT SHAFT (Continued)

(6) Remove first gear bearing inner race lock ball with pencil magnet (Fig. 106).

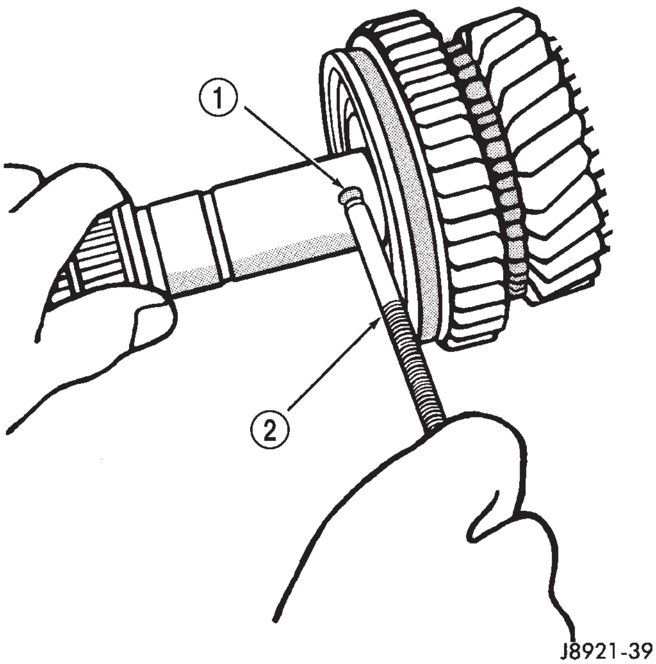


Fig. 106 First Gear Bearing Inner Race Lock Ball

1 - LOCK BALL
2 - PENCIL MAGNET

(7) Remove first gear synchronizer ring.

(8) With Bearing Splitter P-334 or press plates positioned under second gear, press 1-2 synchronizer, reverse gear, and second gear from output shaft (Fig. 107).

(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. 108).

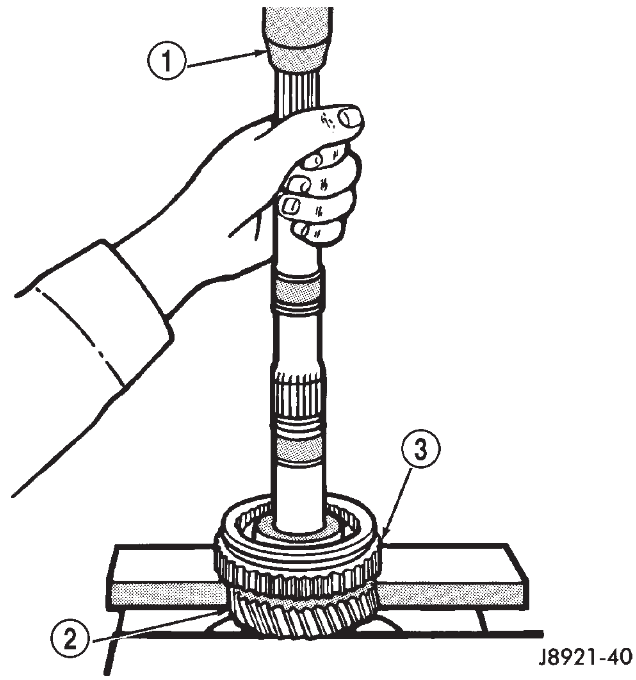


Fig. 107 Second Gear, Reverse Gear And 1-2 Synchronizer

1 - PRESS RAM
2 - SECOND GEAR
3 - 1-2 SYNCHRONIZER HUB

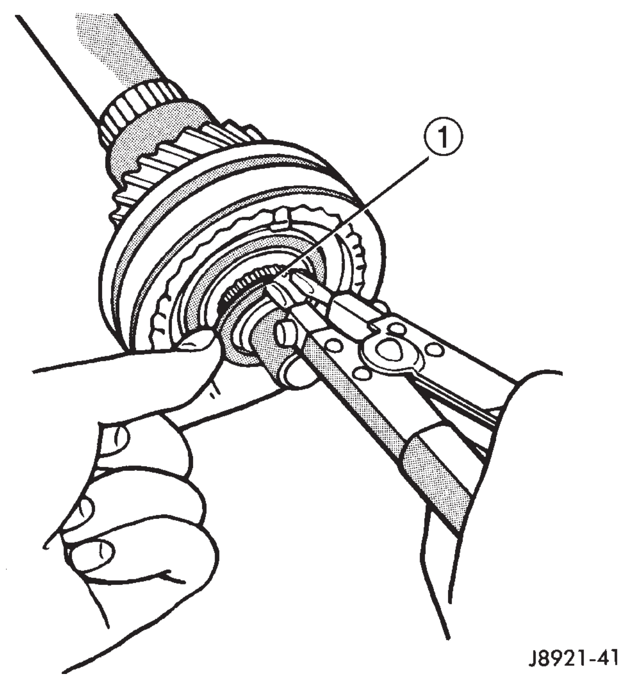


Fig. 108 3-4 Synchronizer Snap Ring

1 - 3-4 SYNCHRONIZER SNAP RING

OUTPUT SHAFT (Continued)

(11) With Bearing Splitter P-334 or press plates positioned under third gear, press the 3-4 synchronizer and third gear from output shaft (Fig. 109).

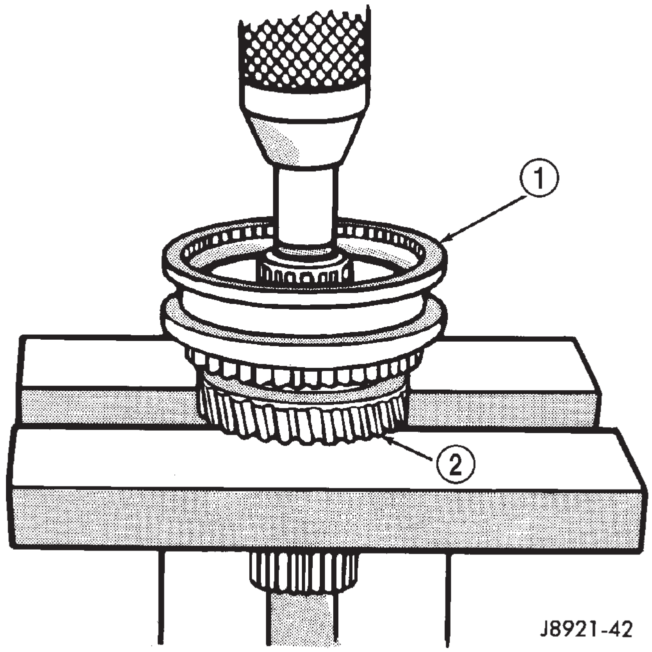


Fig. 109 3-4 Synchronizer And Third Gear

1 - 3-4 SYNCHRONIZER
2 - THIRD GEAR

(12) Remove third gear needle roller bearing from output shaft or gear.

ASSEMBLY

NOTE: 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. 110) during assembly for AX5 gear assembly identification.

(1) Lubricate transmission components with specified gear lubricant.

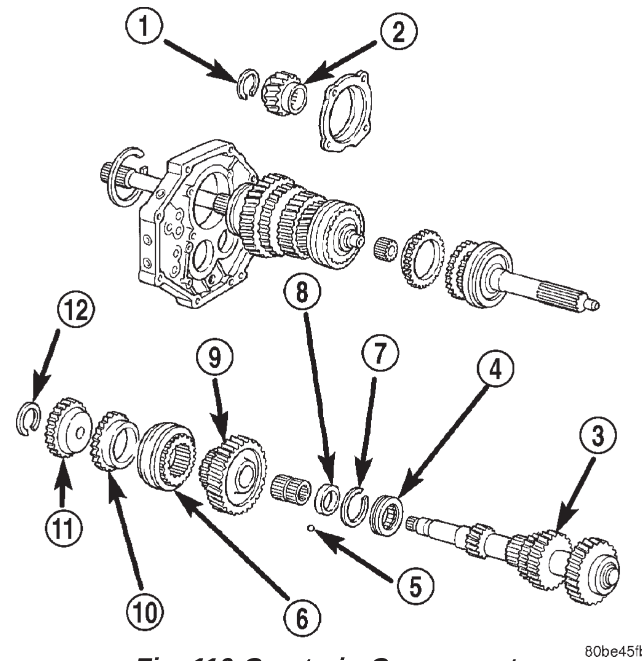


Fig. 110 Geartrain Components

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

OUTPUT SHAFT (Continued)

(2) If necessary, assemble 1-2 and 3-4 synchronizer hubs, sleeves, springs and key inserts (Fig. 111).

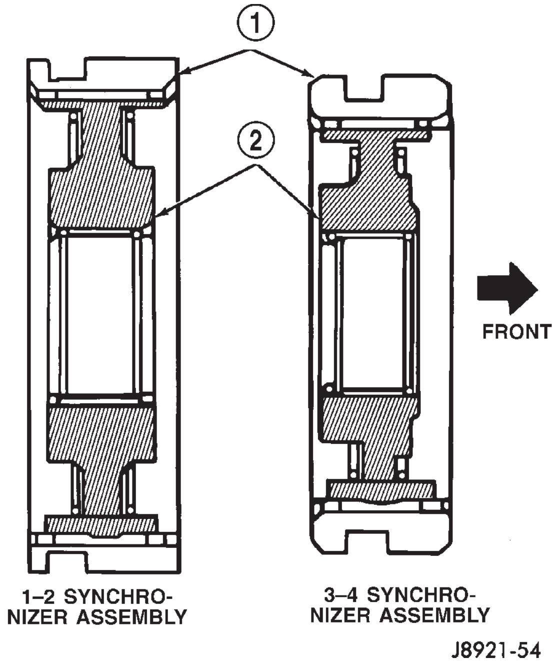


Fig. 111 Synchronizer Identification

1 - SLEEVES
2 - HUBS

(3) Install third gear needle bearing onto the output shaft.

(4) Install third gear over bearing and onto output shaft flange.

(5) Install third gear synchronizer ring to third gear.

(6) Position the 3-4 synchronizer onto the output shaft.

(7) Using Adapter 6747-1A and a shop press, press the 3-4 synchronizer onto the output shaft.

(8) Select the thickest snap-ring that will fit into the snap-ring groove of the output shaft (Fig. 112).

(9) Install snap-ring to hold 3-4 synchronizer onto output shaft.

(10) Verify third gear thrust clearance with feeler gauge (Fig. 113). Clearance should be 0.10 - 0.25 mm (0.004 - 0.010 in.). If clearance is out of specification, refer to Cleaning and Inspection.

(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) With Driver MD-998805, Adapter 6747-1A and a shop press, press the 1-2 synchronizer onto the output shaft.

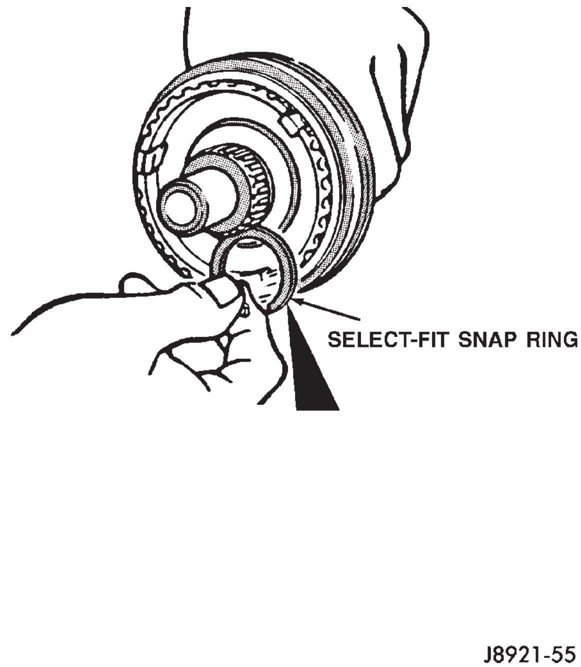


Fig. 112 Select 3-4 Synchronizer Snap-ring

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)

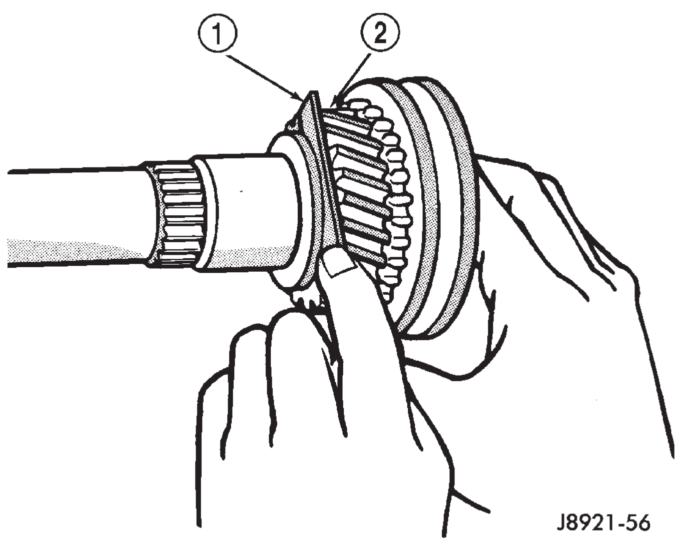


Fig. 113 Third Gear

1 - FEELER GAUGE
2 - THIRD GEAR

(16) Install first gear synchronizer ring into 1-2 synchronizer.

OUTPUT SHAFT (Continued)

(17) Install first gear bearing inner race lock ball in output shaft (Fig. 114).

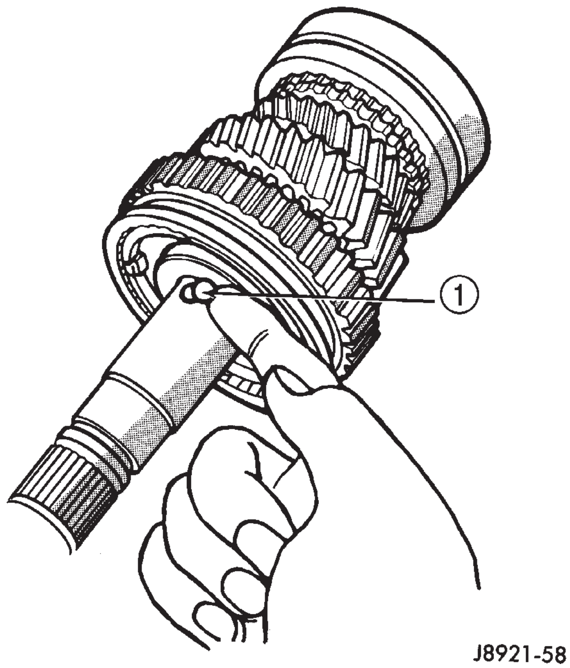


Fig. 114 First Gear Bearing Inner Race Lock Ball

1 - FIRST GEAR LOCK BALL

(18) Install first gear needle bearing onto output shaft (Fig. 115).

(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) With Driver L-4507 and mallet, drive bearing onto output shaft.

(23) Install snap-ring onto output shaft rear bearing outer race.

(24) Check first-second gear thrust clearance (Fig. 116). Standard clearance is 0.10 - 0.25 mm (0.004 - 0.010 in.). If clearance is out of specification, refer to Cleaning and Inspection.

(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.

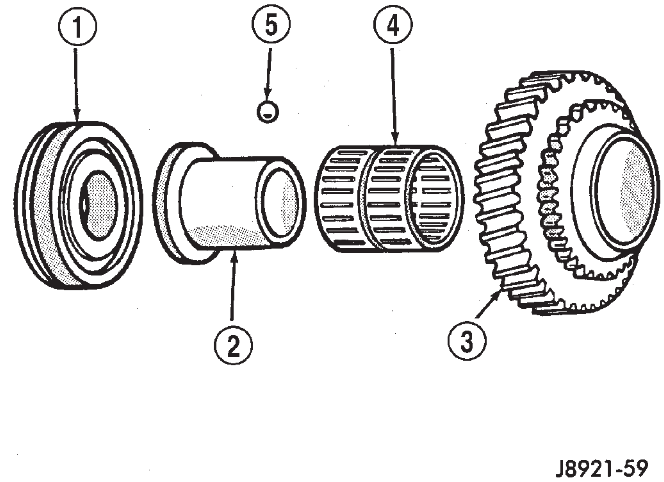


Fig. 115 First Gear Components

1 - REAR BEARING
2 - INNER RACE
3 - FIRST GEAR
4 - NEEDLE BEARING
5 - FIRST GEAR LOCK BALL

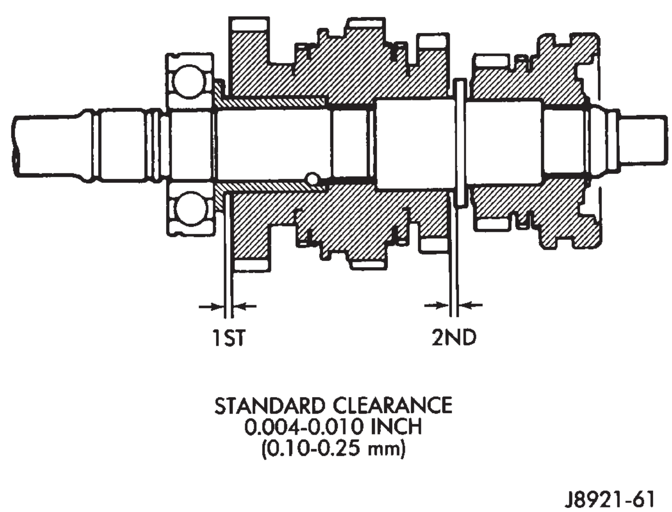


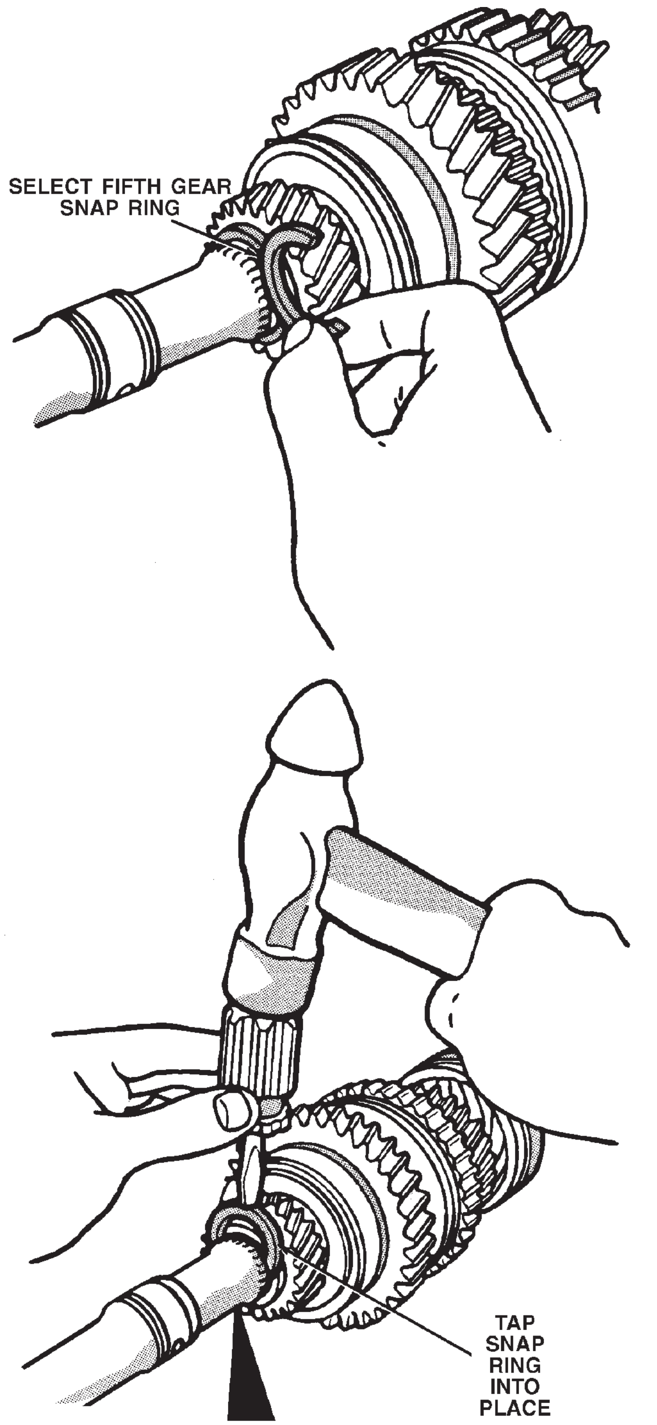
Fig. 116 First-Second Gear Thrust Clearance

(26) With 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. 117).

(28) Install snap-ring to hold fifth gear onto output shaft.

OUTPUT SHAFT (Continued)



I.D. Mark	Snap Ring Thickness mm (in.)
A	2.67-2.72 (0.1051-0.1071)
B	2.73-2.78 (0.1075-0.1094)
C	2.79-2.84 (0.1098-0.1118)
D	2.85-2.90 (0.1122-0.1142)
E	2.91-2.96 (0.1146-0.1165)
F	2.97-3.02 (0.1169-0.1189)
G	3.03-3.08 (0.1193-0.1213)
H	3.09-3.14 (0.1217-0.1236)
J	3.15-3.20 (0.1240-0.1260)
K	3.21-3.26 (0.1264-0.1283)
L	3.27-3.32 (0.1287-0.1307)

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Fig. 117 Select/Install Fifth Gear Snap Ring

AUTOMATIC TRANSMISSION - 30RH

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AUTOMATIC TRANSMISSION - 30RH

DESCRIPTION

The 30RH (Fig. 1) is a three speed automatic transmission with a lock-up clutch in the torque converter. The transmission contains a front and rear clutch which function as the input driving components. It also contains 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, to transfer the engine power from the input shaft through to the output shaft. The transmission contains 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 con-

AUTOMATIC TRANSMISSION - 30RH (Continued)

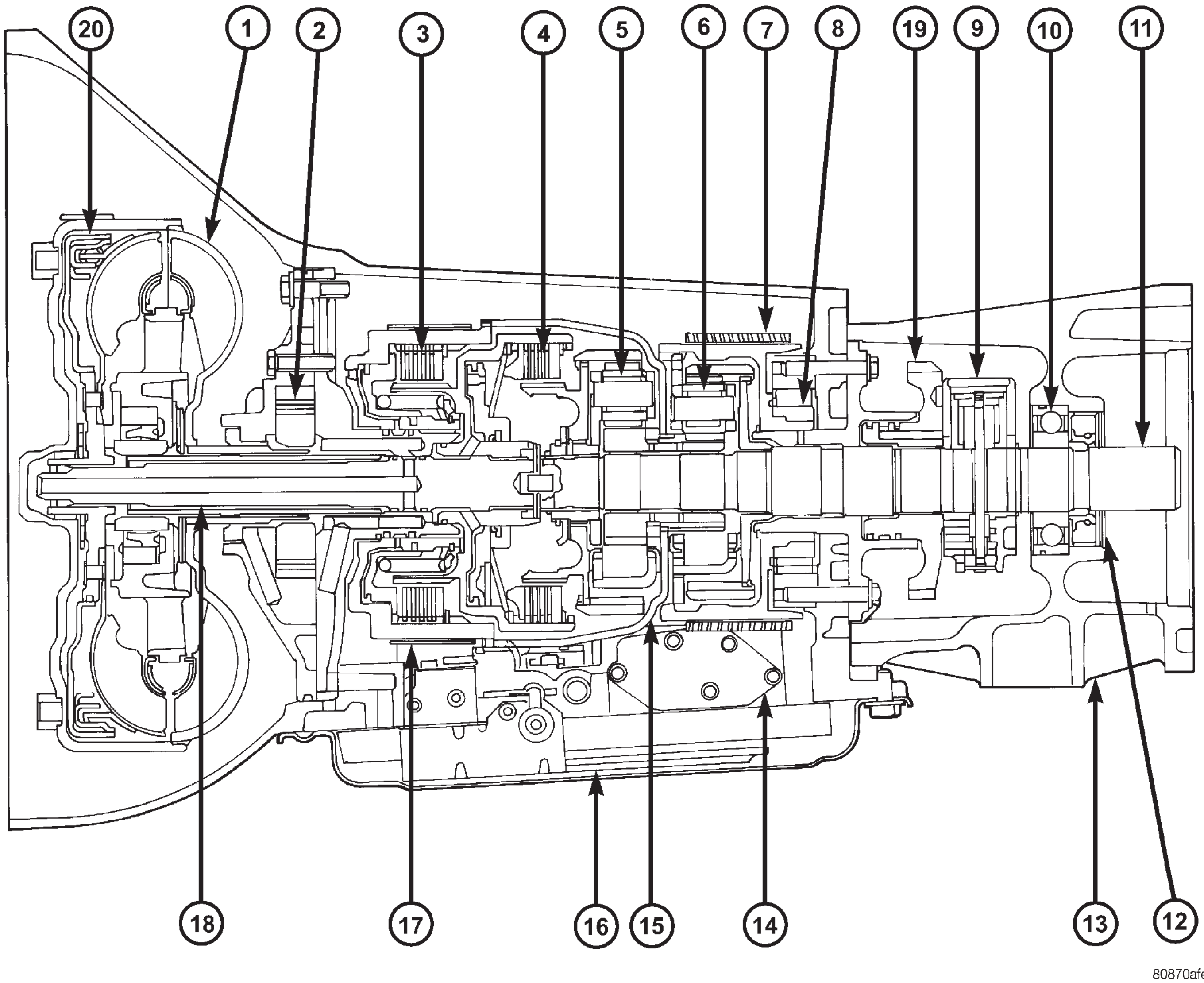

Fig. 1 30RH Automatic Transmission

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 - KICKDOWN (FRONT) BAND
18 - INPUT SHAFT
19 - PARK GEAR
20 - CONVERTER CLUTCH

verter hub. The pump supplies the oil pressure necessary for clutch/band actuation and transmission lubrication.

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.

AUTOMATIC TRANSMISSION - 30RH (Continued)

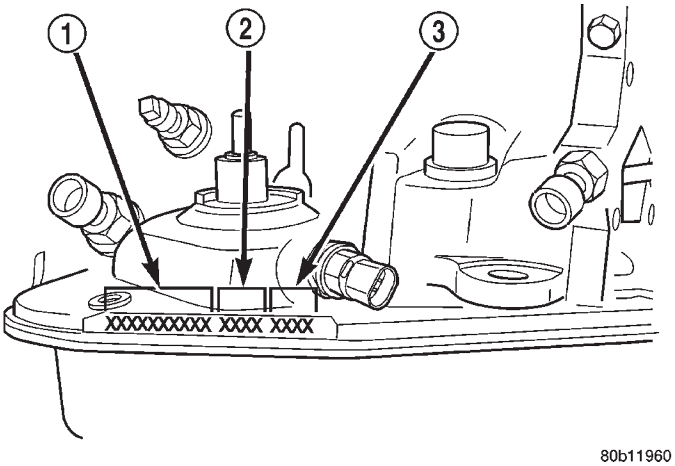

Fig. 2 Transmission Part Number And Serial Number Location

1 - PART NUMBER
2 - BUILD DATE
3 - SERIAL NUMBER

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,throttle pressure, 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.

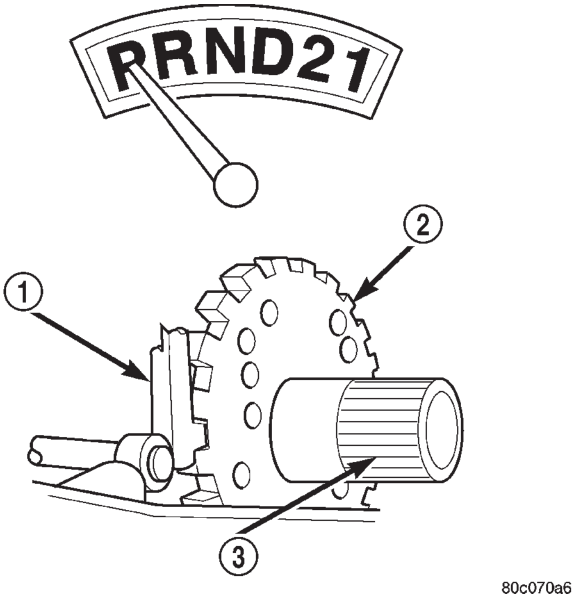

Fig. 3 Park Powerflow

1 - LEVER ENGAGED FOR PARK
2 - PARK SPRAG
3 - OUTPUT SHAFT

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.

AUTOMATIC TRANSMISSION - 30RH (Continued)

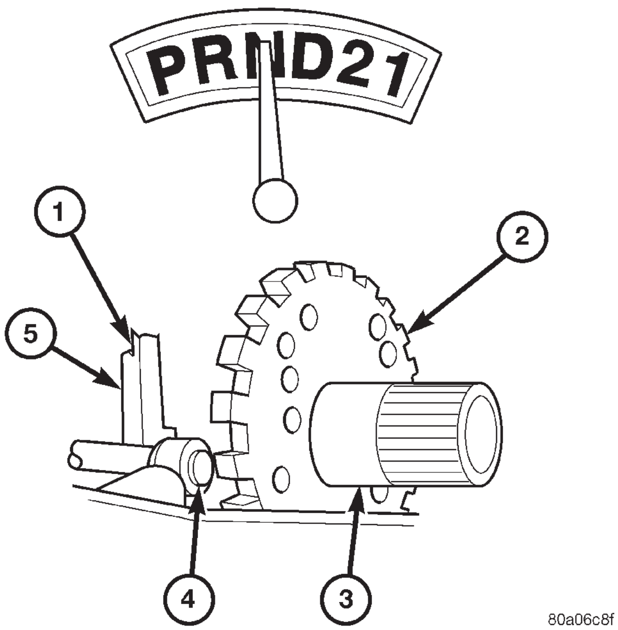

Fig. 4 Neutral Powerflow

1 - LEVER DISENGAGED FOR NEUTRAL
2 - PARK SPRAG
3 - OUTPUT SHAFT
4 - CAM
5 - LEVER

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 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). 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

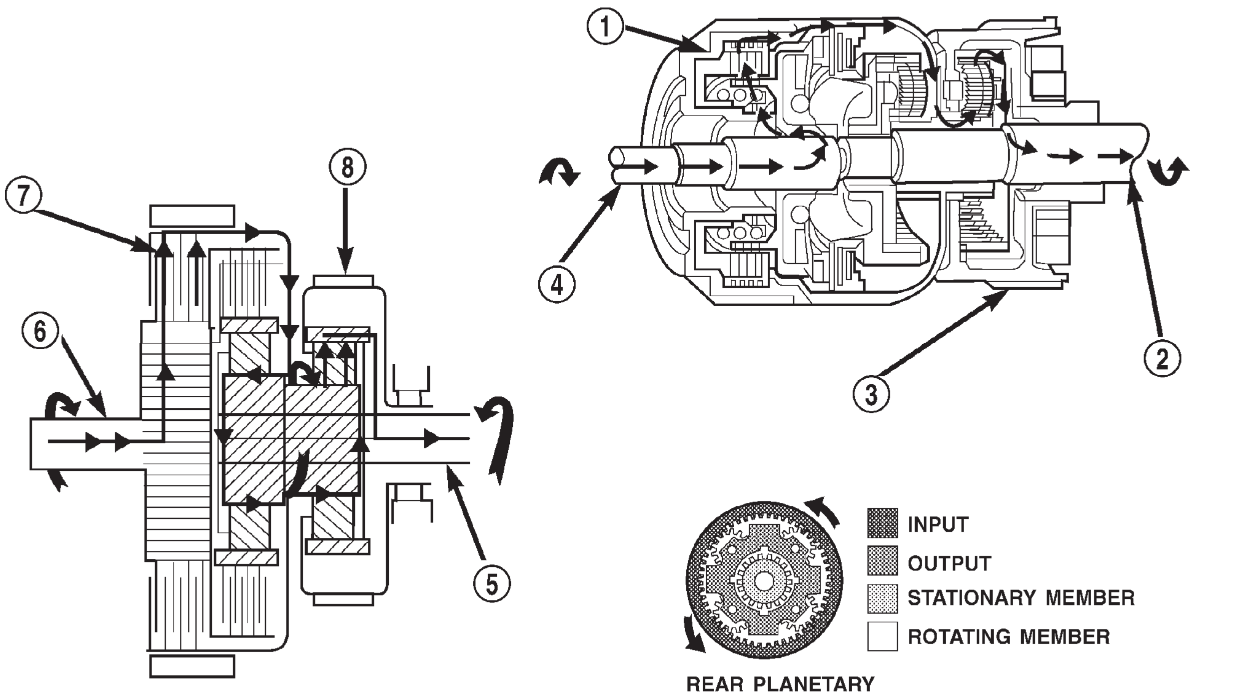

Fig. 5 Reverse Powerflow

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

AUTOMATIC TRANSMISSION - 30RH (Continued)

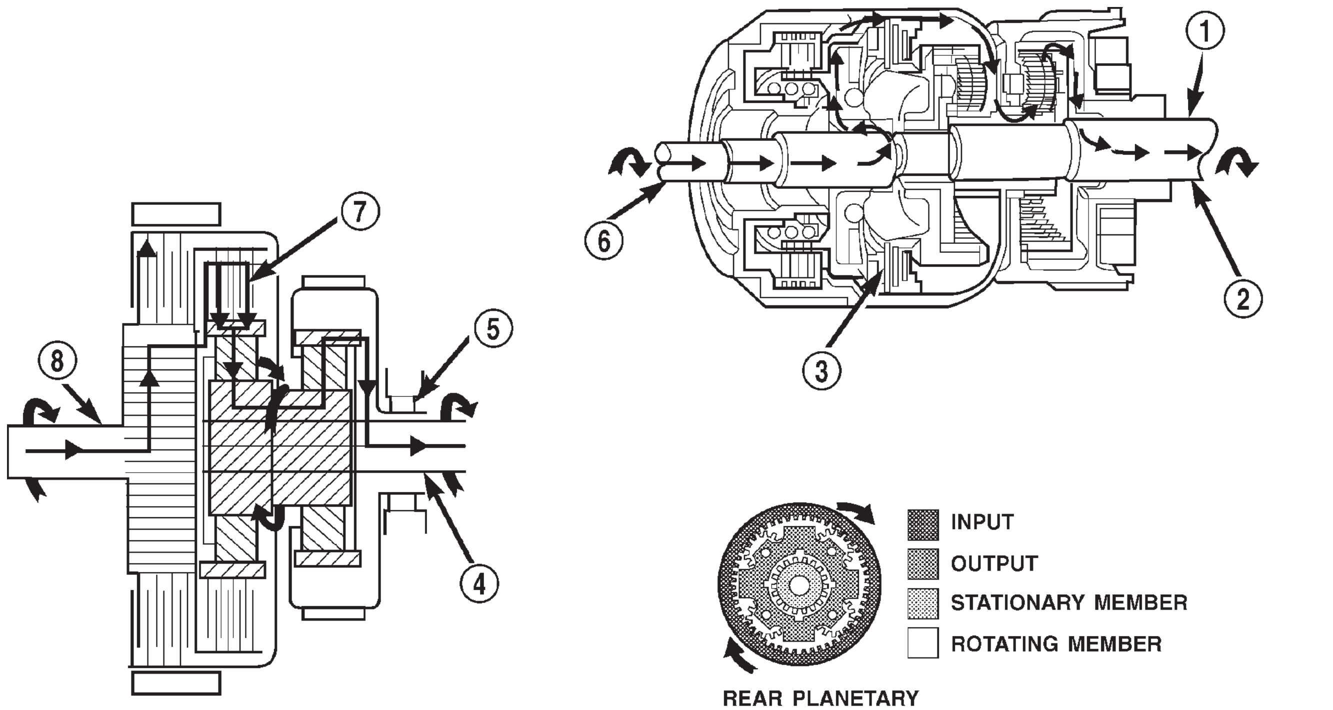

Fig. 6 First Gear Powerflow

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

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 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.

AUTOMATIC TRANSMISSION - 30RH (Continued)

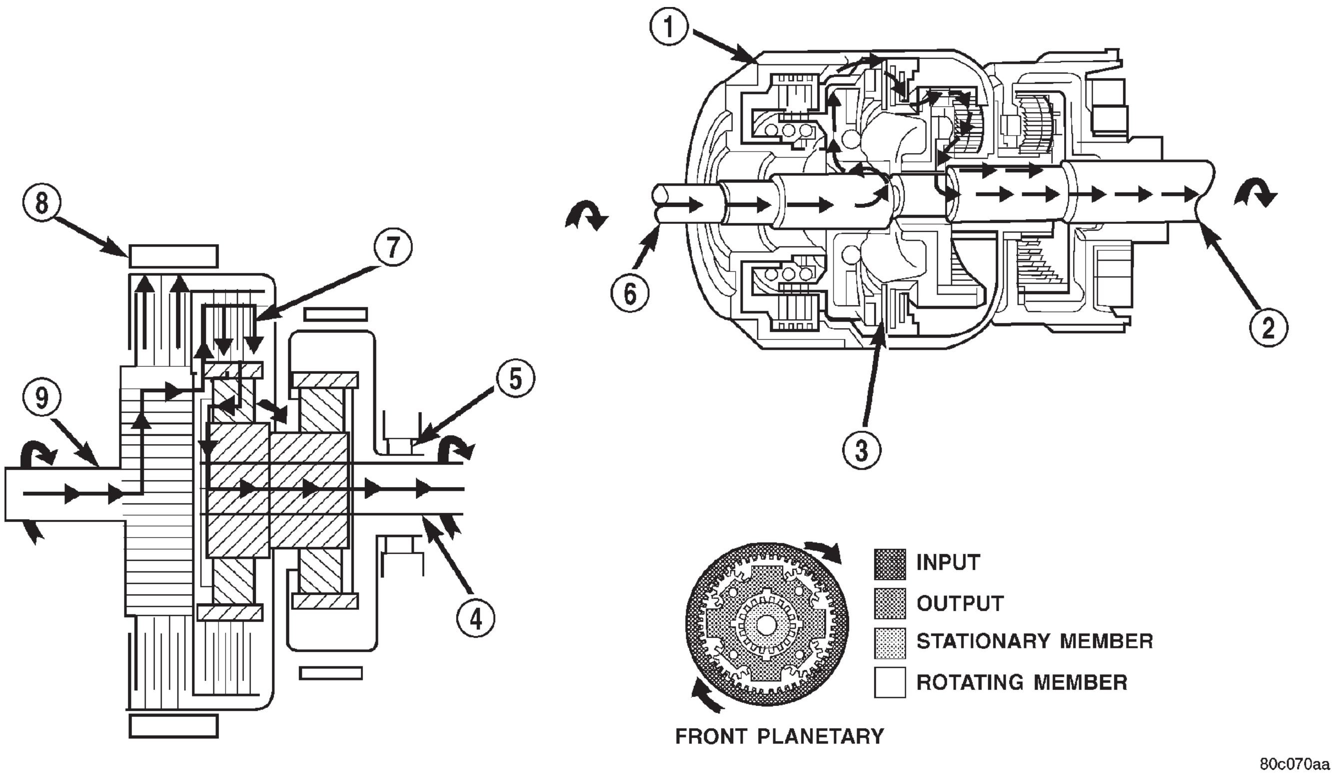

Fig. 7 Second Gear Powerflow

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

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.

AUTOMATIC TRANSMISSION - 30RH (Continued)

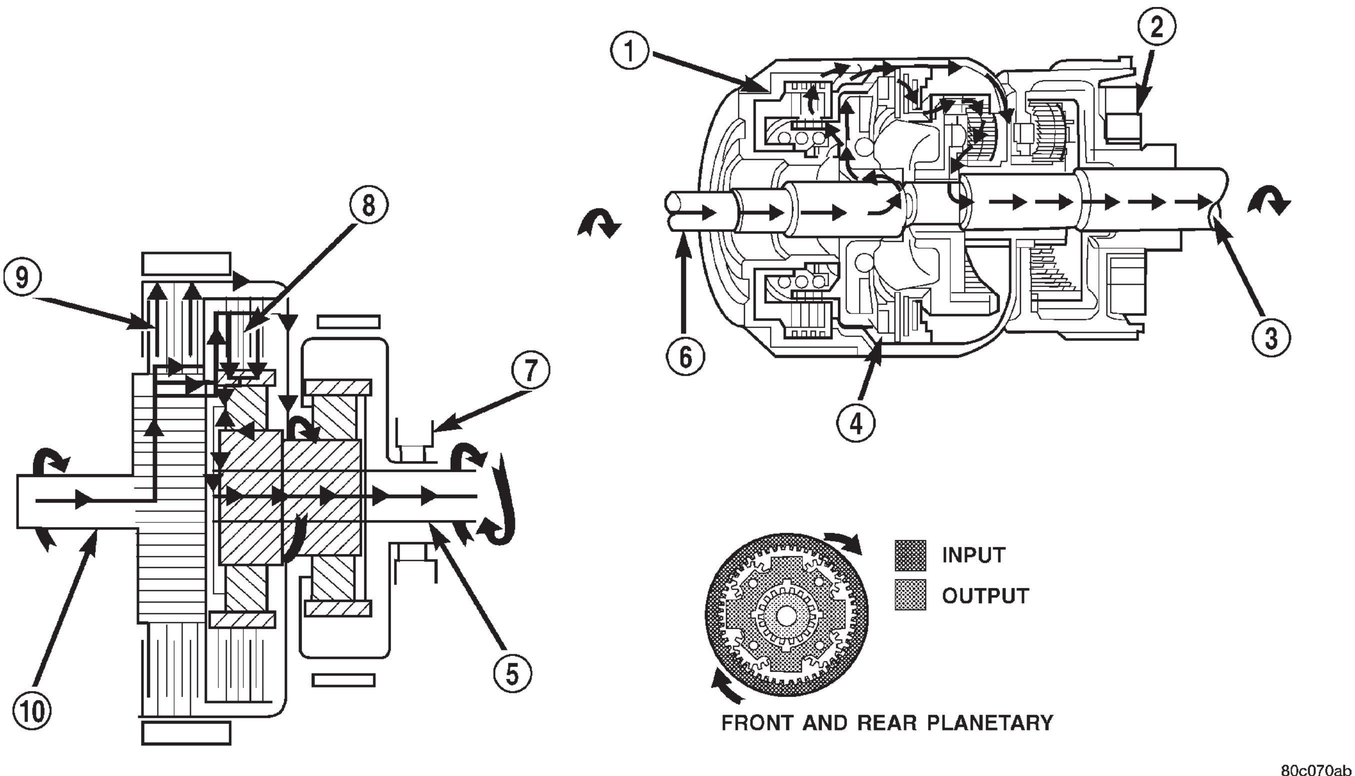

Fig. 8 Direct Drive Powerflow

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

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - AUTOMATIC TRANSMISSION

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.

DIAGNOSIS AND TESTING - PRELIMINARY

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 hydraulic pressure test if shift problems were noted during road test.

(6) Perform air-pressure test to check clutch-band operation.

VEHICLE IS DISABLED

(1) Check fluid level and condition.

(2) Check for broken or disconnected gearshift or throttle linkage.

(3) Check for cracked, leaking cooler lines, or loose or missing pressure-port plugs.

(4) Raise and support vehicle on safety stands, start engine, shift transmission into gear, and note following:

(a) If propeller shaft turns but wheels do not, problem is with differential or axle shafts.

(b) If propeller shaft does not turn and transmission is noisy, stop engine. Remove oil pan, and check for debris. If pan is clear, remove transmis-

AUTOMATIC TRANSMISSION - 30RH (Continued)

sion and check for damaged drive plate, converter, oil pump, or input shaft.

(c) If propeller shaft does not turn and transmission is not noisy, perform hydraulic-pressure test to determine if problem is hydraulic or mechanical.

DIAGNOSIS AND TESTING - 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 (Fig. 9) provides a basis for analyzing road test results.

	Gearshift Lever Position								
DRIVE ELEMENTS	P	R	N	D			2		1
				1	2	3	1	2	
FRONT CLUTCH		•				•			
FRONT BAND (KICKDOWN)					•			•	
REAR CLUTCH				•	•	•	•	•	•
REAR BAND (LOW-REV.)		•							•
OVER-RUNNING CLUTCH				•			•		•

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Fig. 9 Clutch And Band Application

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.

DIAGNOSIS AND TESTING - 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. 10), (Fig. 11) and (Fig. 12).

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.

Connect a tachometer to the engine. Position the tachometer so it can be observed from under the

AUTOMATIC TRANSMISSION - 30RH (Continued)

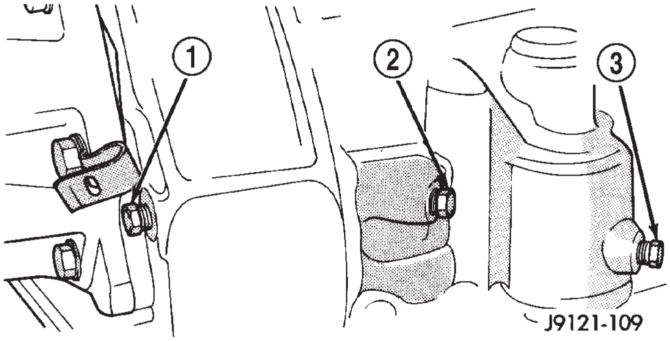


Fig. 10 Pressure Test Ports At Side Of Case

1 - REAR SERVO PORT
2 - LINE PRESSURE PORT
3 - FRONT SERVO PORT

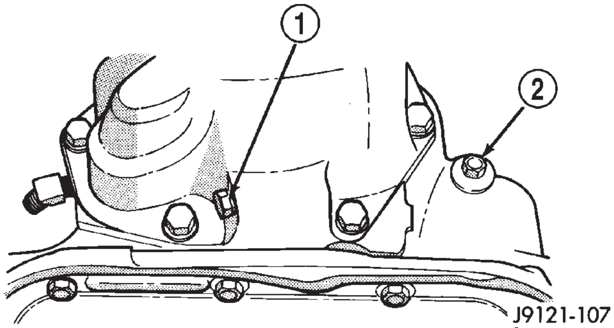


Fig. 11 Pressure Test Ports At Rear Of Case-2WD

1 - GOVERNOR PRESSURE PORT
2 - REAR SERVO PRESSURE PORT

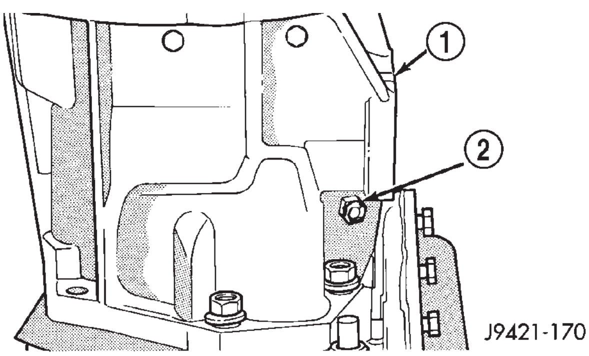


Fig. 12 Pressure Test Ports At Rear Of Case-4WD

1 - ADAPTER HOUSING
2 - GOVERNOR PRESSURE PORT PLUG

vehicle. Raise the vehicle on a hoist that will allow the wheels to rotate freely.

PRESSURE TEST PROCEDURE

Test One - Transmission In 1 Range

This test checks pump output, pressure regulation, and condition of the rear clutch and servo circuit. Test Gauges C-3292 and C-3293-SP are required for this test. Gauge C-3292 has a 100 psi range. Gauge C-3293-SP has a 300 psi range.

(1) Connect 100 psi Gauge C-3292 to accumulator port.

(2) Connect 300 psi Gauge C-3293-SP to rear servo port (Fig. 10) and (Fig. 11).

(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. 10) and (Fig. 11).

(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. 10) and (Fig. 11). 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.

AUTOMATIC TRANSMISSION - 30RH (Continued)

(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. 10) and (Fig. 11).

(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. 10) and (Fig. 11).

(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.

PRESSURE TEST ANALYSIS

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 area.
Front servo pressure in 2.	Leakage in servo (broken servo ring or cracked servo piston).
Pressure low in all positions.	Clogged filter, stuck pressure regulator valve, worn or defective pump.
Governor pressure too high at idle speed.	Governor valve sticking open.
Governor pressure low at all MPH figures.	Governor valve sticking closed.
Lubrication pressure low at all throttle positions.	Clogged drainback valve, oil cooler or lines, seal rings leaking, output shaft plugged with debris, worn bushings in pump or clutch retainer.

DIAGNOSIS AND TESTING - AIR CHECKING 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. 13).

Front Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Rear Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Front Servo Apply Air Test

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

Rear Servo Air Test

Apply air pressure to the rear servo apply passage. The servo rod should extend and cause the band to

AUTOMATIC TRANSMISSION - 30RH (Continued)

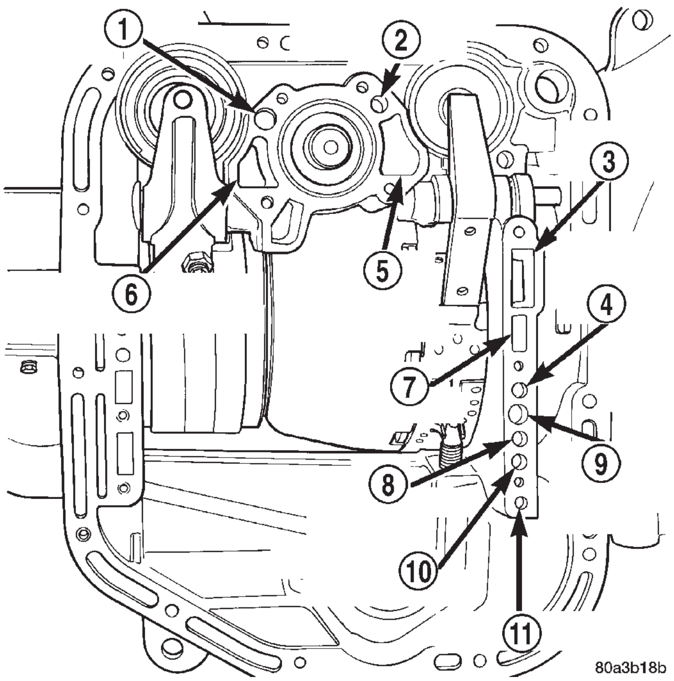


Fig. 13 Air Pressure Test Passages

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

tighten around the drum. Spring pressure should release the servo when air pressure is removed.

DIAGNOSIS AND TESTING - CONVERTER HOUSING FLUID LEAK

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 body leaks follow the same path as a seal leak (Fig. 14). Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 14). Pump o-ring 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.

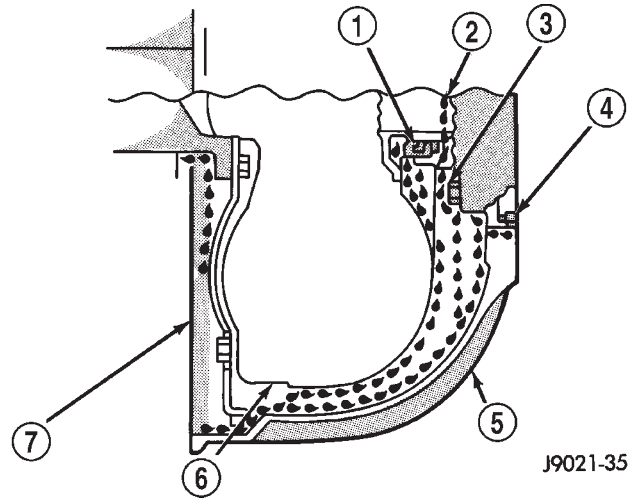


Fig. 14 Converter Housing Leak Paths

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. 15).

(2) Leaks at the converter hub weld (Fig. 15).

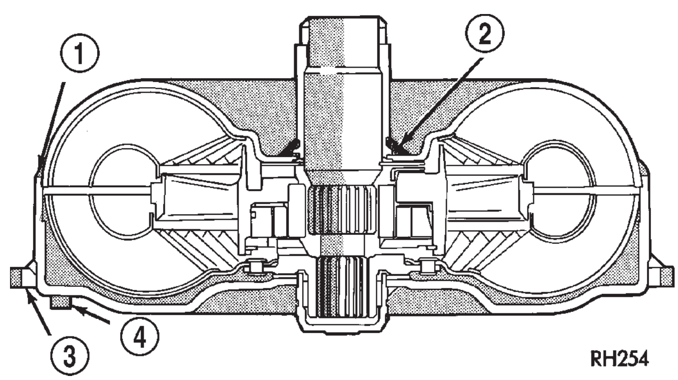


Fig. 15 Converter Leak Points - Typical

1 - OUTSIDE DIAMETER WELD
2 - TORQUE CONVERTER HUB WELD
3 - STARTER RING GEAR
4 - LUG

AUTOMATIC TRANSMISSION - 30RH (Continued)

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 - 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.

AUTOMATIC TRANSMISSION - 30RH (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.

AUTOMATIC TRANSMISSION - 30RH (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.

AUTOMATIC TRANSMISSION - 30RH (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.

AUTOMATIC TRANSMISSION - 30RH (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.

AUTOMATIC TRANSMISSION - 30RH (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.

AUTOMATIC TRANSMISSION - 30RH (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.

AUTOMATIC TRANSMISSION - 30RH (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.

AUTOMATIC TRANSMISSION - 30RH (Continued)

STANDARD PROCEDURE - 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

(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 (Fig. 16) and (Fig. 17). 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.

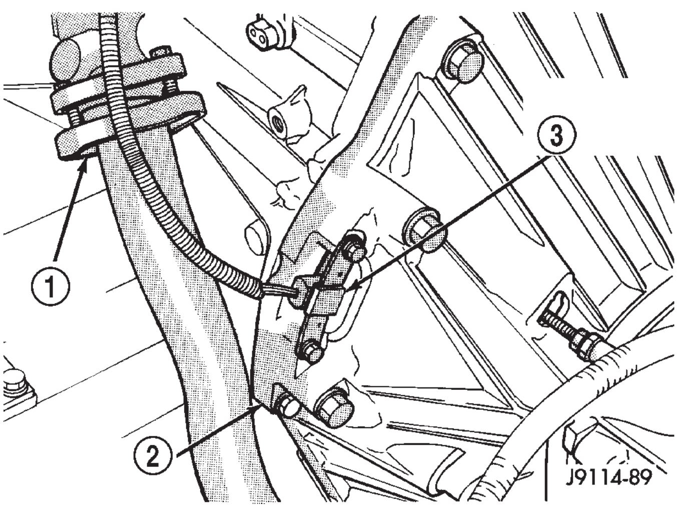


Fig. 16 Crankshaft Position Sensor - 2.5L Engine

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.

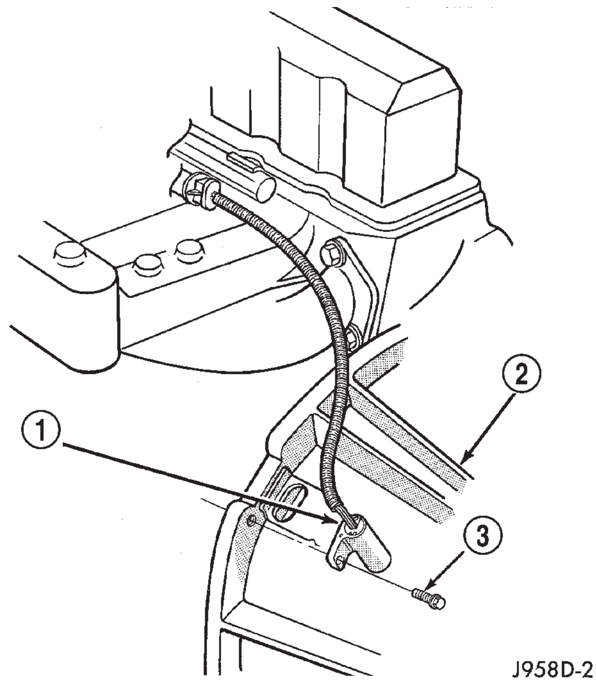


Fig. 17 Crankshaft Position Sensor - 4.0L Engine

1 - CRANKSHAFT POSITION SENSOR
2 - TRANSMISSION BELLHOUSING
3 - MOUNTING BOLT

(9) Remove skid plate for access.

(10) Remove fill tube bracket bolts and pull tube out of transmission. Retain fill tube seal. Remove the 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.

AUTOMATIC TRANSMISSION - 30RH (Continued)

(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.

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. 18).

(7) Remove extension housing.

(8) Remove fluid pan.

(9) Remove park/neutral position switch and seal (Fig. 19).

(10) Remove valve body.

(11) Remove accumulator spring and piston (Fig. 20).

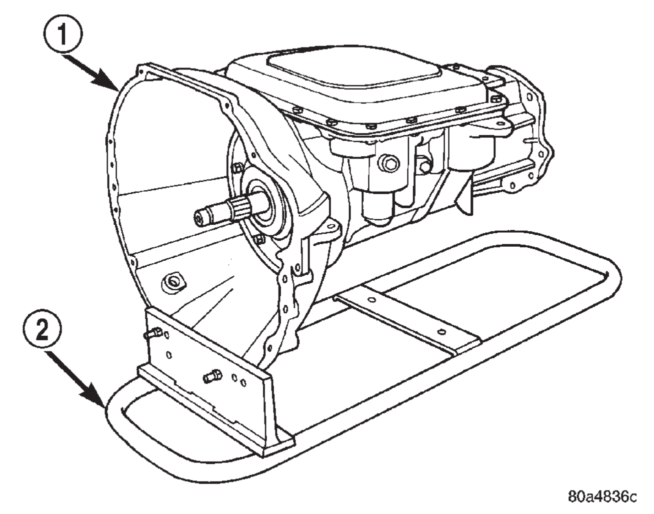


Fig. 18 Repair Stand

1 - TRANSMISSION
2 - STAND

(12) Measure input shaft end play (Fig. 21).

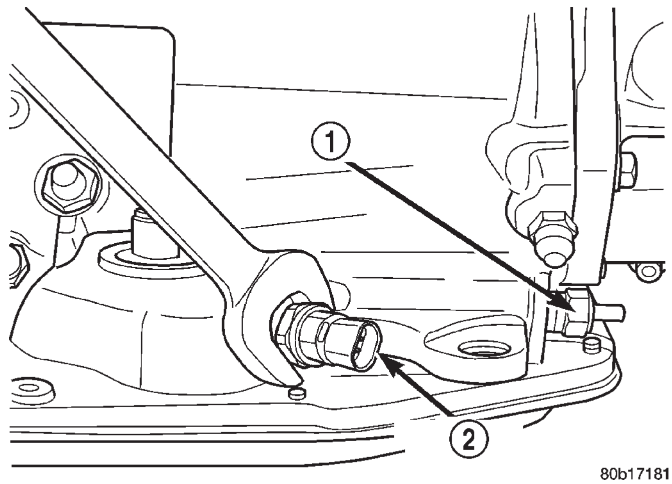


Fig. 19 Park/Neutral Position Switch

1 - SOLENOID CONNECTOR
2 - NEUTRAL SWITCH

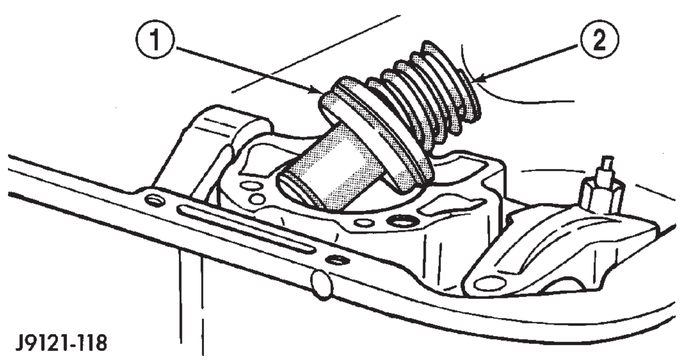


Fig. 20 Accumulator Piston And Spring

1 - ACCUMULATOR PISTON
2 - PISTON SPRING

(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.

(13) Loosen front band adjusting screw lock nut (Fig. 22) 4-5 turns. Then tighten band adjusting screw until band is tight around front clutch. This prevents front/rear clutches from coming out with pump and possibly damaging clutch or pump components.

(14) Remove oil pump bolts.

AUTOMATIC TRANSMISSION - 30RH (Continued)

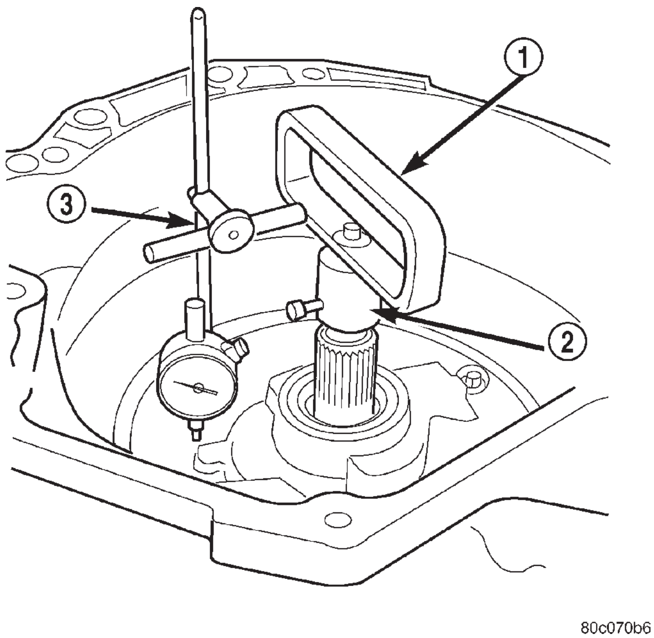


Fig. 21 Checking Input Shaft End Play

1 - TOOL 8266–8
2 - TOOL 8266–7
3 - TOOL C-3339

(15) Thread bolts of Slide Hammer Tools C-3752 into threaded holes in pump body flange (Fig. 23).

(16) Bump slide hammer weights outward to remove pump and reaction shaft support assembly from case (Fig. 23).

(17) Loosen front band adjusting screw until band is completely loose (Fig. 22).

(18) Squeeze front band together and remove band strut (Fig. 24).

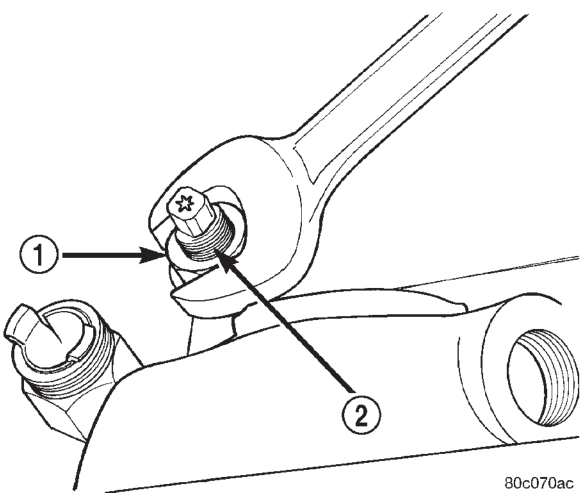


Fig. 22 Front Band Adjusting Screw Lock Nut

1 - LOCK-NUT
2 - FRONT BAND ADJUSTER

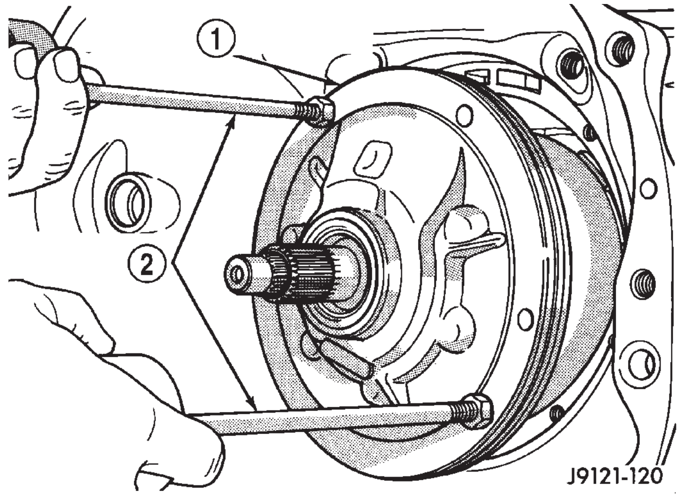


Fig. 23 Oil Pump/Reaction Shaft Support

1 - OIL PUMP AND REACTION SHAFT SUPPORT ASSEMBLY
2 - SLIDE HAMMER TOOLS C-3752

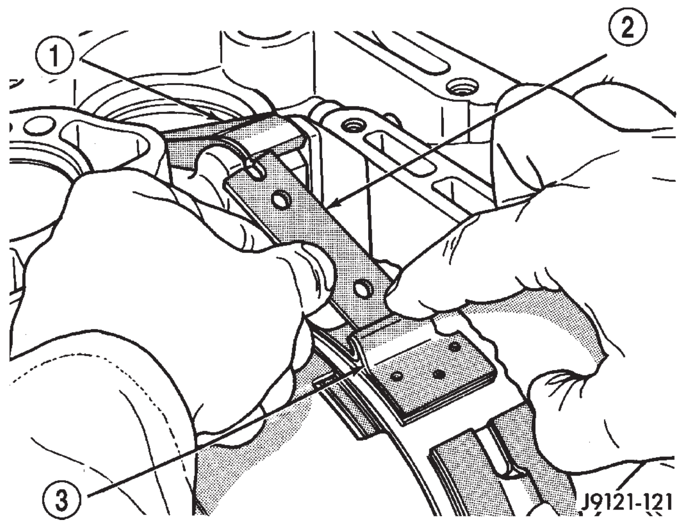


Fig. 24 Front Band Strut

1 - BAND LEVER
2 - BAND STRUT
3 - FRONT BAND

(19) Remove front and rear clutch units as an assembly. Grasp input shaft, hold clutch units together and remove them from case (Fig. 25).

(20) Lift front clutch off rear clutch (Fig. 26). Set clutch units aside for overhaul.

(21) Remove output shaft thrust washer from output shaft (or from rear clutch hub) (Fig. 27).

(22) Remove output shaft thrust plate and washer from output shaft hub (Fig. 27).

(23) Remove front band from case (Fig. 28).

(24) Remove extension housing from transmission case.

AUTOMATIC TRANSMISSION - 30RH (Continued)

(25) Remove governor body and park gear from output shaft.

(26) Remove output shaft and planetary geartrain as assembly (Fig. 29). Support geartrain with both hands during removal. Do not allow machined surfaces on output shaft to become nicked or scratched.

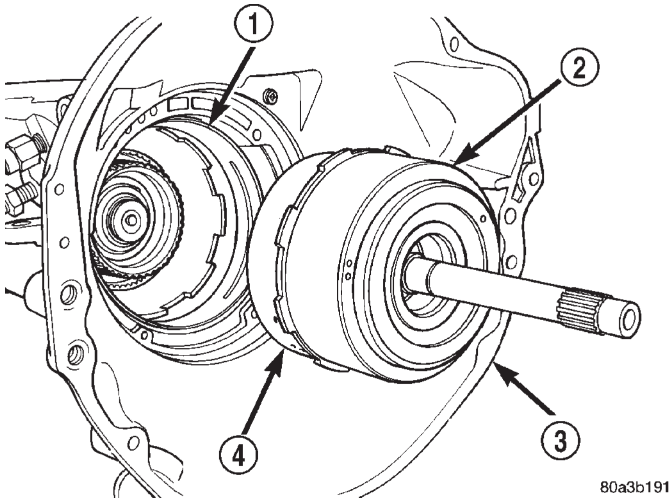


Fig. 25 Front/Rear Clutch Assemblies

1 - FRONT BAND
2 - FRONT CLUTCH AND DRUM
3 - TRANSMISSION HOUSING
4 - REAR CLUTCH

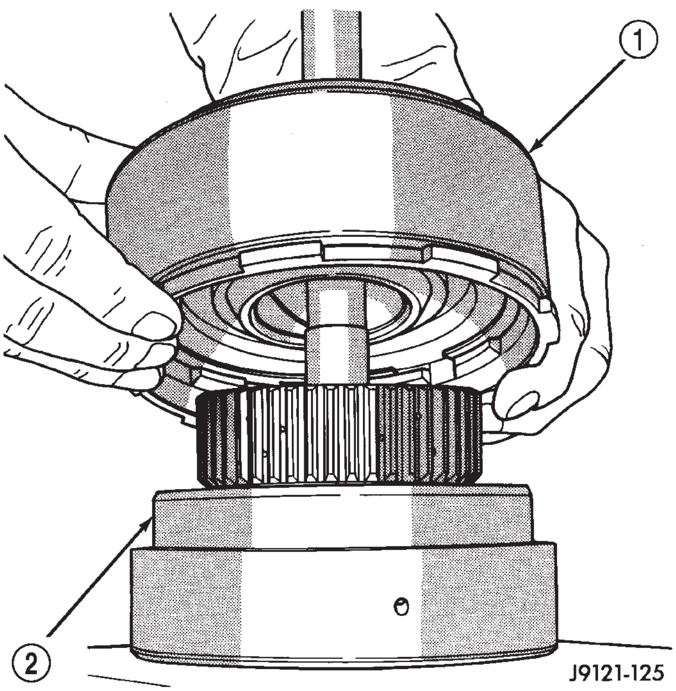


Fig. 26 Separating Front Clutch From Rear Clutch

1 - FRONT CLUTCH
2 - REAR CLUTCH

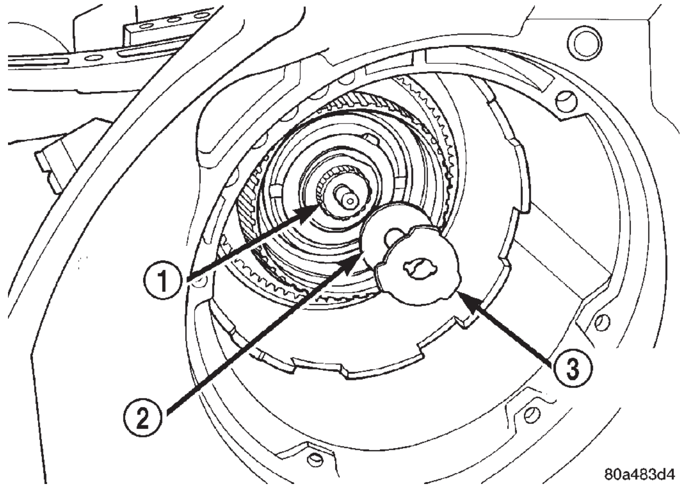


Fig. 27 Output Shaft Thrust Plate and Washer

1 - OUTPUT SHAFT
2 - THRUST PLATE
3 - THRUST WASHER

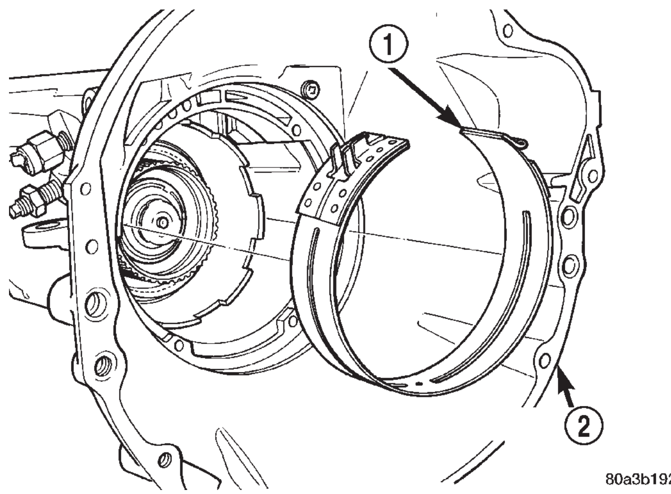


Fig. 28 Front Band

1 - FRONT BAND
2 - TRANSMISSION HOUSING

AUTOMATIC TRANSMISSION - 30RH (Continued)

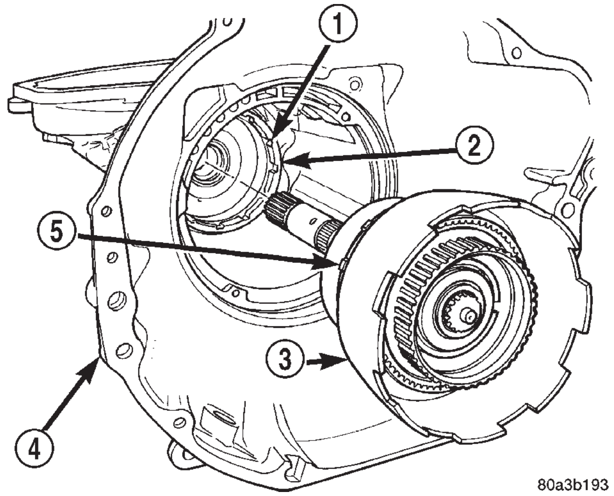


Fig. 29 Planetary Geartrain

1 - SLOTS
2 - LOW-REVERSE DRUM
3 - PLANETARY GEARTRAIN
4 - TRANSMISSION HOUSING
5 - LUGS

(27) Loosen rear band adjusting screw 4-5 turns (Fig. 30).

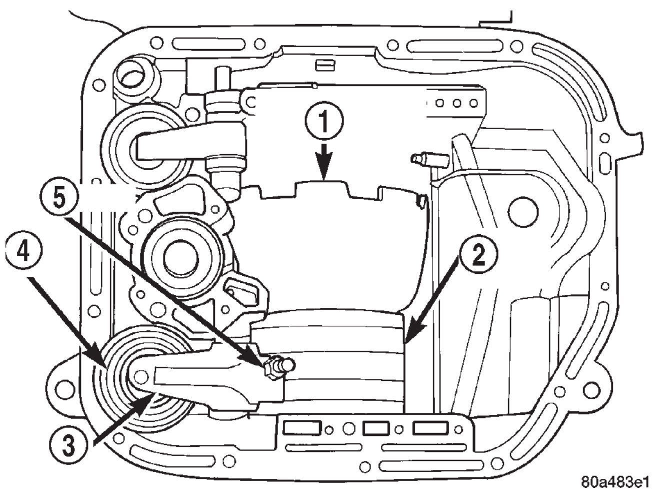


Fig. 30 Rear Band Adjuster Location

1 - PLANETARY GEARTRAIN
2 - REAR BAND
3 - LEVER
4 - SERVO
5 - ADJUSTER

(28) Remove snap-ring that secures low-reverse drum to rear support hub, however do not remove drum (Fig. 31).

(29) Remove bolts attaching rear support to transmission case and pull support from low-reverse drum (Fig. 32).

(30) Remove bolts attaching overrunning clutch cam and low-reverse drum to transmission case (Fig. 33).

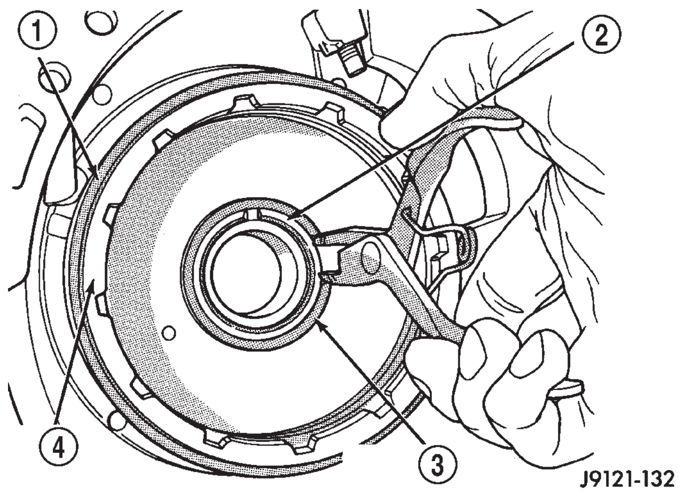


Fig. 31 Low-Reverse Drum Snap-Ring

1 - REAR BAND
2 - REAR SUPPORT HUB
3 - LOW-REVERSE DRUM SNAP RING
4 - LOW-REVERSE DRUM

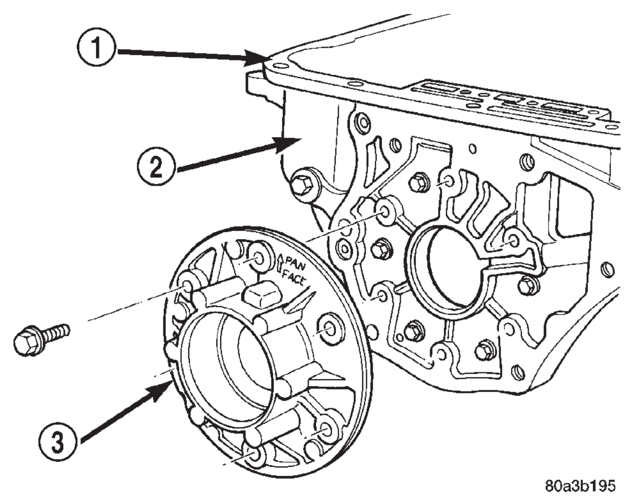


Fig. 32 Rear Support

1 - OIL PAN FACE
2 - TRANSMISSION HOUSING
3 - REAR SUPPORT

AUTOMATIC TRANSMISSION - 30RH (Continued)

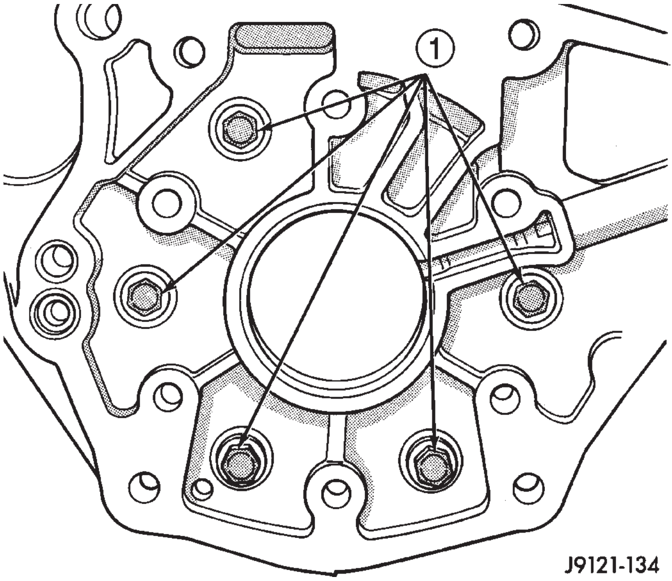


Fig. 33 Overrunning Clutch Cam Bolt Locations

1 - OVERRUNNING CLUTCH CAM BOLTS

(31) Using snap-ring plier, pull rear band anchor pin (located on the servo side of the rear support) from transmission case.

(32) Remove rear band and link from transmission (Fig. 34).

(33) Separate link from rear band (Fig. 35).

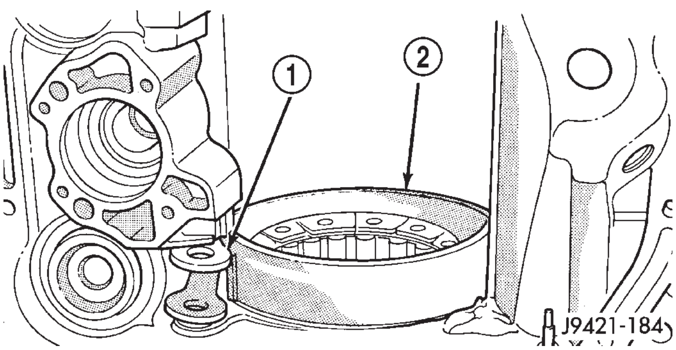


Fig. 34 Rear Band and Link

1 - LINK
2 - REAR BAND

(34) 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. 36).

(b) Remove front band reaction pin with pencil magnet. Pin is accessible from converter housing side of case (Fig. 37).

(c) Remove front band lever (Fig. 38).

(d) Using snap-ring plier, pull rear band lever pivot from transmission case (Fig. 39).

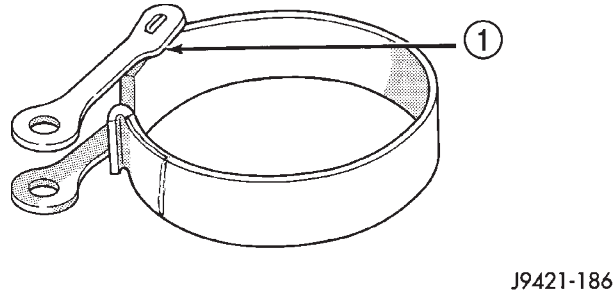


Fig. 35 Rear Band and Link

1 - NOTCHED SIDE OF LINK GOES TOWARD BAND

(e) Separate rear band servo lever from transmission.

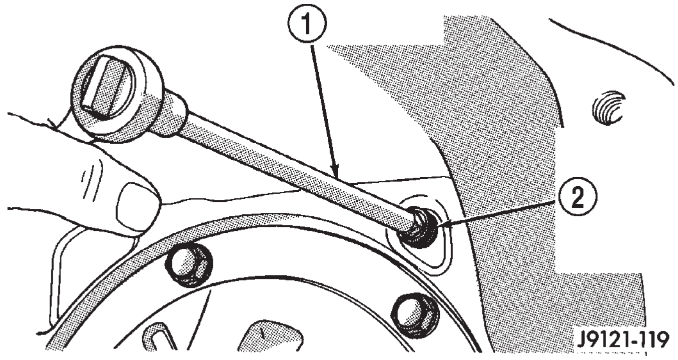


Fig. 36 Front Band Reaction Pin Access Plug

1 - 1/4″ DRIVE EXTENSION
2 - FRONT BAND REACTION PIN ACCESS PLUG

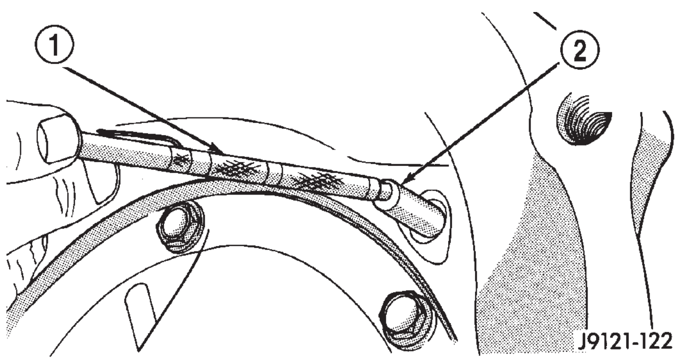


Fig. 37 Front Band Reaction Pin

1 - PENCIL MAGNET
2 - FRONT BAND REACTION PIN

(35) 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. 40).

(36) Remove front servo rod guide snap-ring (Fig. 40). **Exercise caution when removing snap-ring. Servo bore can be scratched or nicked if care is not exercised.**

AUTOMATIC TRANSMISSION - 30RH (Continued)

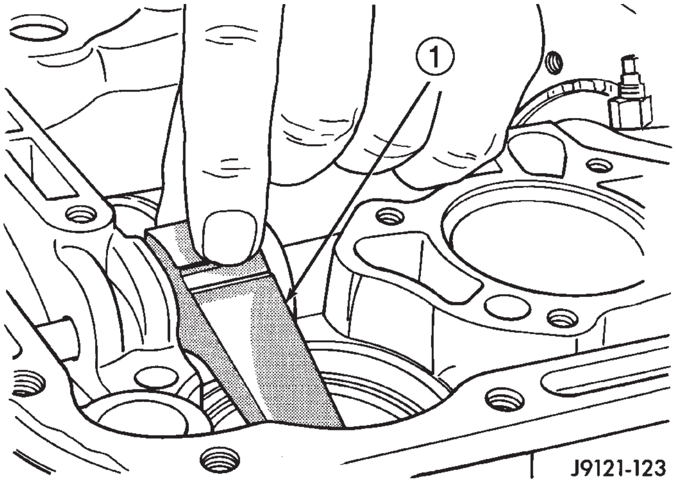


Fig. 38 Front Band Lever

1 - FRONT BAND LEVER

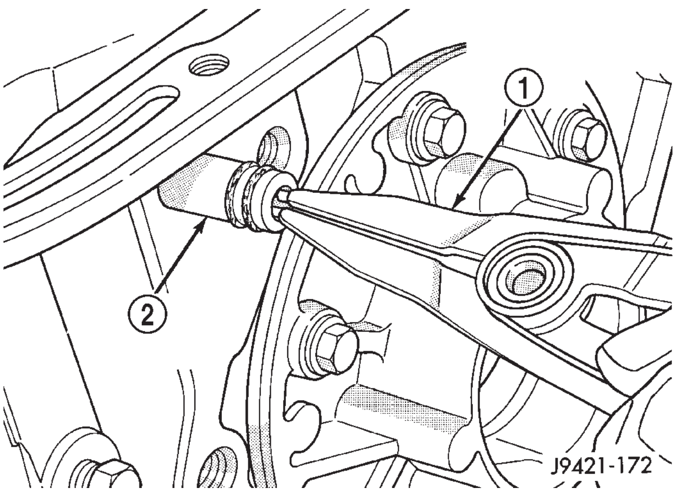


Fig. 39 Rear Band Servo Lever Pin

1 - PARALLEL JAW SNAP-RING PLIERS
2 - REAR BAND LEVER PIVOT PIN

(37) Remove compressor tools and remove front servo rod guide, spring and servo piston.

(38) Compress rear servo spring retainer about 1/16 in. with C-clamp and Tool C-4470 or SP-5560 (Fig. 41). Valve Spring Compressor C-3422-B can also be used to compress spring retainer.

(39) Remove rear servo spring retainer snap-ring. Then remove compressor tools and remove rear servo spring and piston.

CLEANING - AUTOMATIC 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.

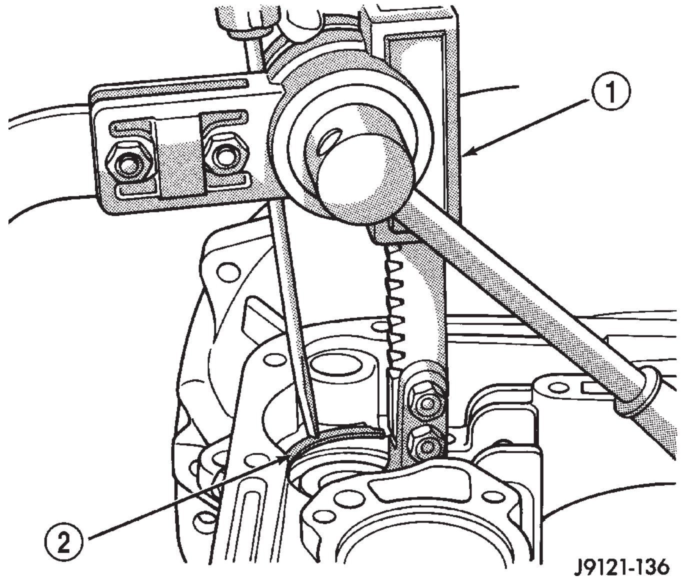


Fig. 40 Compressing Front Servo

1 - SPRING COMPRESSOR TOOL C-3422-B
2 - ROD GUIDE SNAP-RING

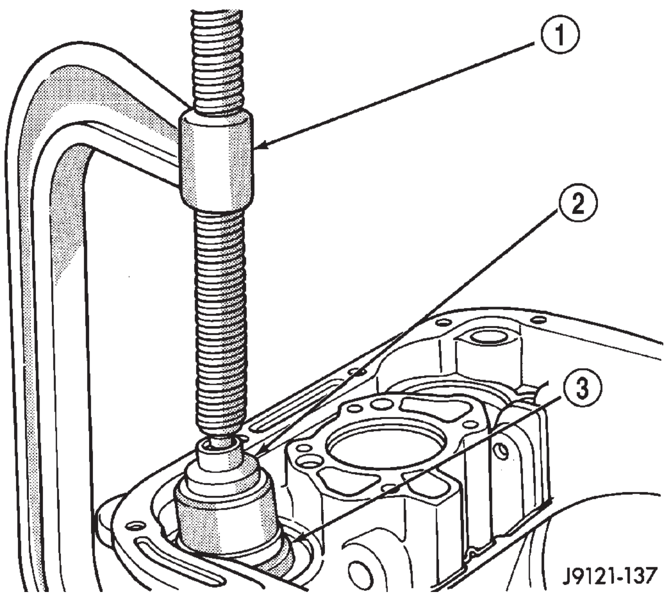


Fig. 41 Compressing Rear Servo Spring

1 - LARGE C-CLAMP
2 - TOOL C-4470 OR SP-5560
3 - SERVO SPRING RETAINER

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.

AUTOMATIC TRANSMISSION - 30RH (Continued)

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.

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 +4, Type 9602 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.

INSPECTION - AUTOMATIC TRANSMISSION

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.

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. Some of the bushings are not serviced. Be sure to check for bushing availability before removal. 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.

ASSEMBLY

(1) Install rear servo piston, spring and spring retainer. Compress rear servo spring and retainer with Compressor Tool C-3422-B (Fig. 42) 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. 43).

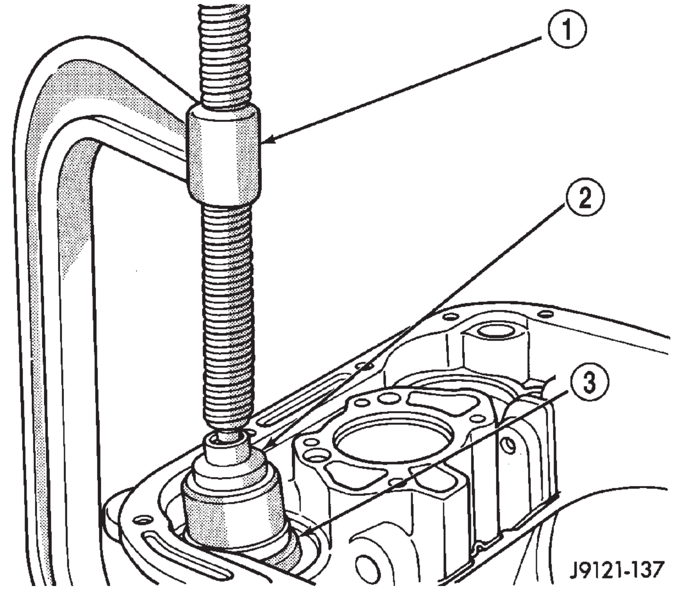


Fig. 42 Compressing Rear Servo Spring

1 - LARGE C-CLAMP
2 - TOOL C-4470 OR SP-5560
3 - SERVO SPRING RETAINER

(3) Assemble link bar to band. Notched side of link toward band (Fig. 44).

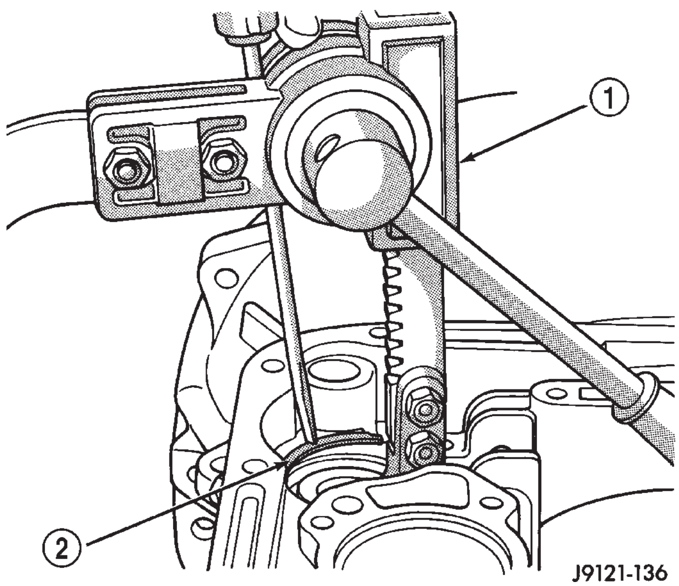


Fig. 43 Compressing Front Servo

1 - SPRING COMPRESSOR TOOL C-3422-B
2 - ROD GUIDE SNAP-RING

(4) Insert rear band through pan opening in transmission case.

(5) Insert hook on band onto adjuster lever.

(6) Align holes in link bar with hole in transmission case outboard of rear support opening (Fig. 45).

(7) Insert anchor pin into case through link bar.

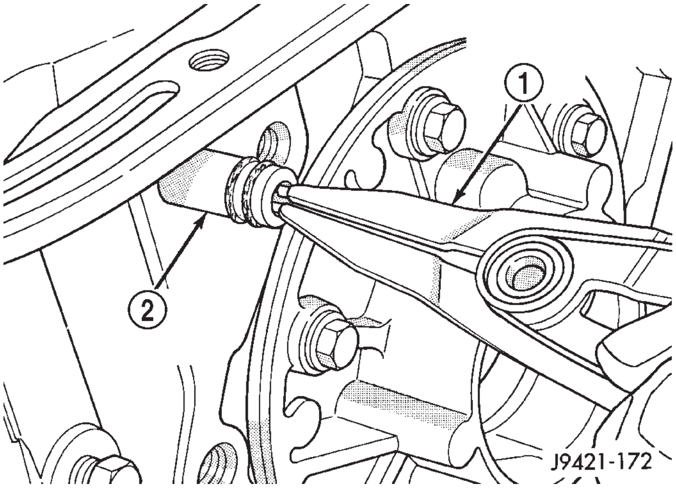


Fig. 44 Rear Band Servo Lever Pin

1 - PARALLEL JAW SNAP-RING PLIERS
2 - REAR BAND LEVER PIVOT PIN

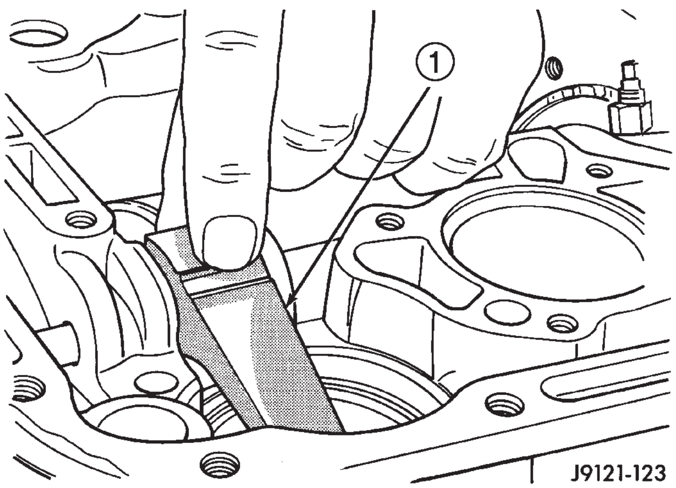


Fig. 45 Front Band Lever

1 - FRONT BAND LEVER

(8) Examine bolt holes in overrunning clutch cam. Note that one hole is **not threaded** (Fig. 46). 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).

(9) Lubricate overrunning clutch rollers, springs and cam with Mopar® ATF +4, type 9602, transmission fluid.

(10) Position overrunning clutch on a clean, flat work surface with countersunk holes downward.

(11) Place rear of low-reverse drum over overrunning clutch and align clutch rollers to hub of drum.

(12) While slightly pivoting low-reverse drum, push hub of drum into overrunning clutch. Verify that countersunk holes are facing outward. **Cam should be able to rotate in the drum clockwise only.**

(13) Insert a suitable awl through the rear support mounting hole closest to the pan sealing face. The awl should be next to the wide space area at the back of transmission case.

(14) Insert low-reverse drum and overrunning clutch into front of transmission case and into rear band.

(15) Insert awl tip into the threaded hole next to the non-threaded hole in the overrunning clutch cam. Verify that non-threaded hole is aligned with wide space area on transmission case.

(16) Push low-reverse drum rearward to close gap between cam and case.

(17) Install overrunning clutch cam bolts. **Clutch cam bolts are shorter than rear support bolts.** Tighten cam bolts to 17 N·m (150 in. lbs. or 13 ft. lbs.) torque.

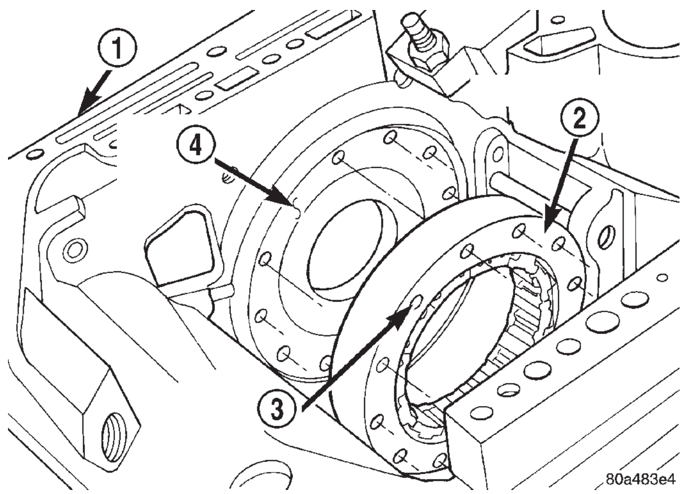


Fig. 46 Clutch Cam Alignment

1 - TRANSMISSION CASE
2 - OVERRUNNING CLUTCH
3 - NON-THREADER HOLE
4 - WIDE SPACE AREA

AUTOMATIC TRANSMISSION - 30RH (Continued)

(18) Hold low-reverse drum in position so rear support will not push it out of overrunning clutch.

(19) Insert rear support into opening at rear of transmission case (Fig. 47).

(20) Align support with the embossed arrow in the direction of the pan face.

(21) Install and tighten rear support bolts to 17 N·m (150 in. lbs.) torque.

(22) Install snap-ring to retain low-reverse drum to hub of rear support (Fig. 48).

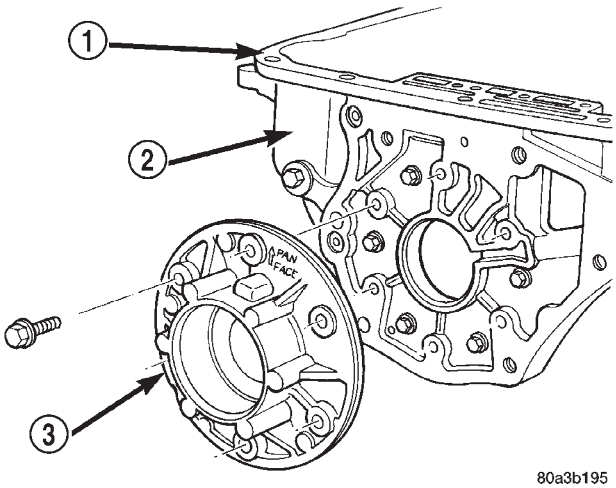


Fig. 47 Rear Support

1 - OIL PAN FACE
2 - TRANSMISSION HOUSING
3 - REAR SUPPORT

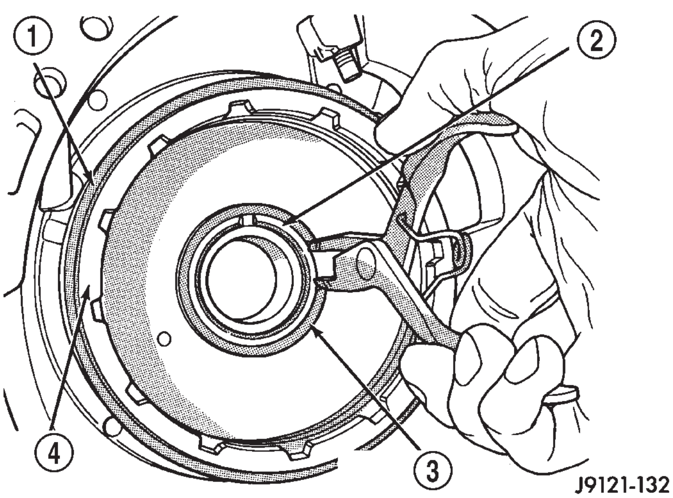


Fig. 48 Low-Reverse Drum Snap-Ring

1 - REAR BAND
2 - REAR SUPPORT HUB
3 - LOW-REVERSE DRUM SNAP RING
4 - LOW-REVERSE DRUM

(23) Lubricate output shaft, rear support bore and low-reverse drum hub with transmission fluid.

(24) Install assembled output shaft and planetary geartrain in case (Fig. 49).

(25) Align drive lugs on rear planetary gear with slots in low-reverse drum (Fig. 49). Then seat planetary assembly in drum.

(26) Install governor on output shaft.

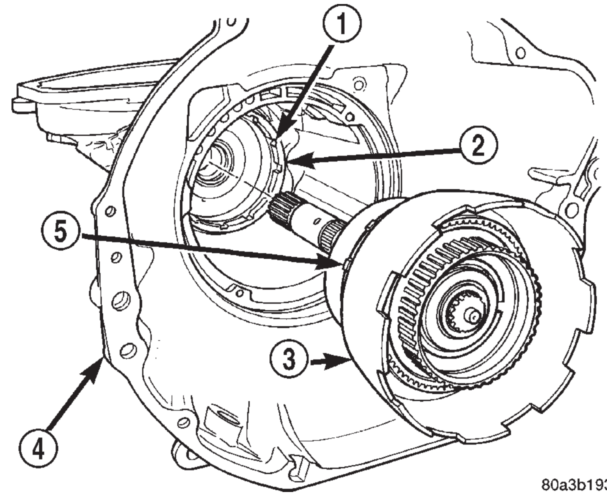


Fig. 49 Output Shaft And Planetary Geartrain

1 - SLOTS
2 - LOW-REVERSE DRUM
3 - PLANETARY GEARTRAIN
4 - TRANSMISSION HOUSING
5 - LUGS

(27) Turn and secure transmission so that front opening is upward.

(28) Assemble front and rear clutches together.

(a) Check input shaft seal rings (Fig. 50). 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. 51).

(d) Engage teeth on rear clutch hub into teeth on clutch (Fig. 53). Rotate front clutch retainer back and forth until completely seated on rear clutch.

(29) Install output shaft thrust plate on shaft hub in planetary geartrain driving shell (Fig. 52). Use petroleum jelly to hold thrust plate in place.

AUTOMATIC TRANSMISSION - 30RH (Continued)

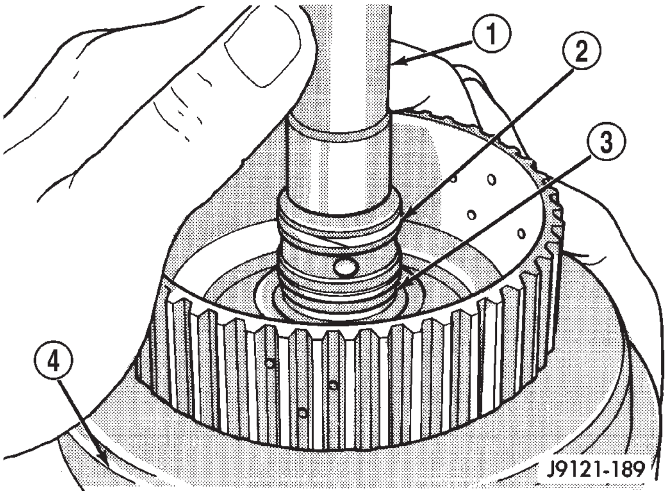


Fig. 50 Input Shaft Seal Ring Location

1 - INPUT SHAFT
2 - TEFLON SEAL RING
3 - METAL SEAL RING
4 - REAR CLUTCH RETAINER

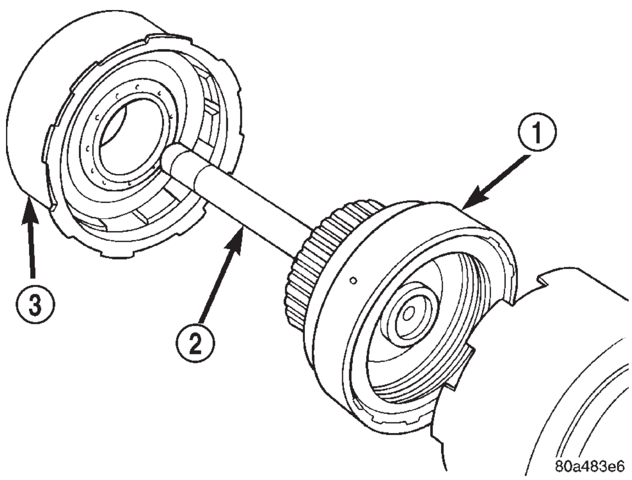


Fig. 51 Front and Rear Clutches

1 - REAR CLUTCH
2 - INPUT SHAFT
3 - FRONT CLUTCH

(30) Check rear clutch thrust washer. Use additional petroleum jelly to hold washer in place if necessary.

(31) Coat output shaft thrust washer with petroleum jelly. Install washer in rear clutch hub (Fig. 54). Use enough petroleum jelly to hold washer in place. **Be sure grooved side of washer faces rearward (toward output shaft) as shown. Also note that washer only fits one way in clutch hub.**

(32) Align drive teeth on rear clutch discs with small screwdriver (Fig. 55). This will make installation into front of planetary geartrain easier.

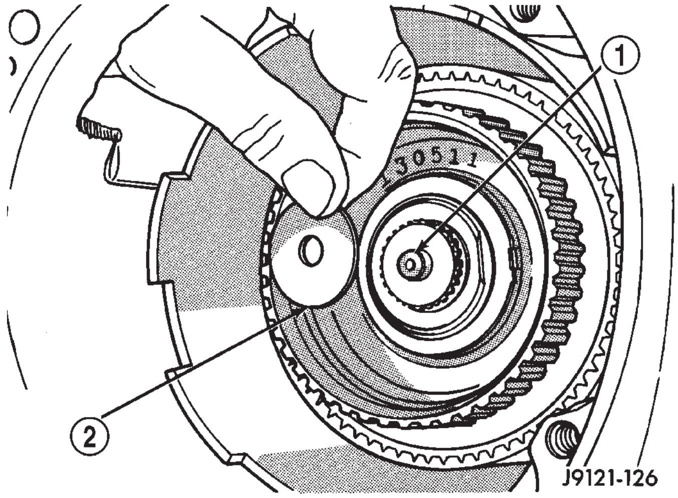


Fig. 52 Output Shaft Thrust Plate

1 - OUTPUT SHAFT HUB
2 - OUTPUT SHAFT THRUST PLATE

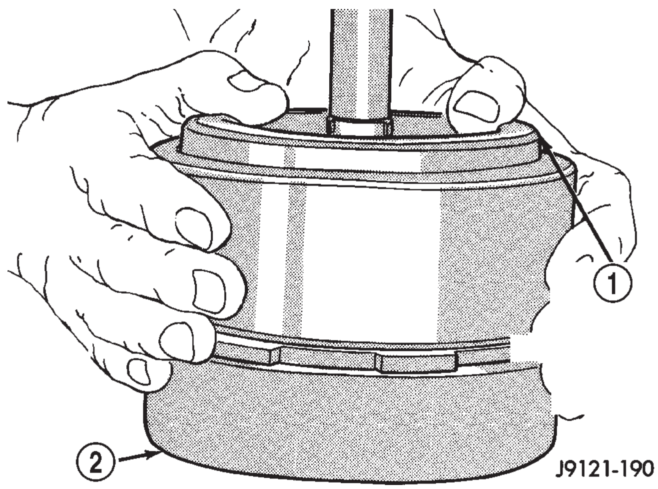


Fig. 53 Assembling Front And Rear Clutch Units

1 - TURN FRONT CLUTCH BACK & FORTH UNTIL SEATED
2 - REAR CLUTCH ASSEMBLY

(33) Insert front band into opening at front of transmission case (Fig. 56).

(34) Install front and rear clutch units as assembly (Fig. 57). 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.**

AUTOMATIC TRANSMISSION - 30RH (Continued)

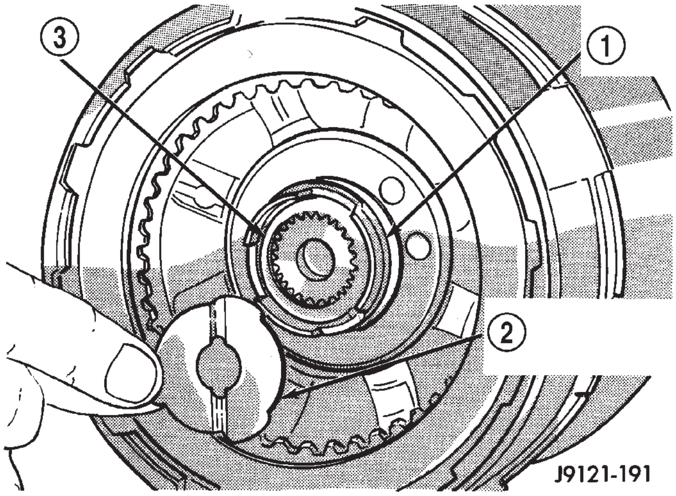


Fig. 54 Output Shaft Thrust Washer

1 - REAR CLUTCH HUB
2 - OUTPUT SHAFT THRUST WASHER
3 - OUTPUT SHAFT

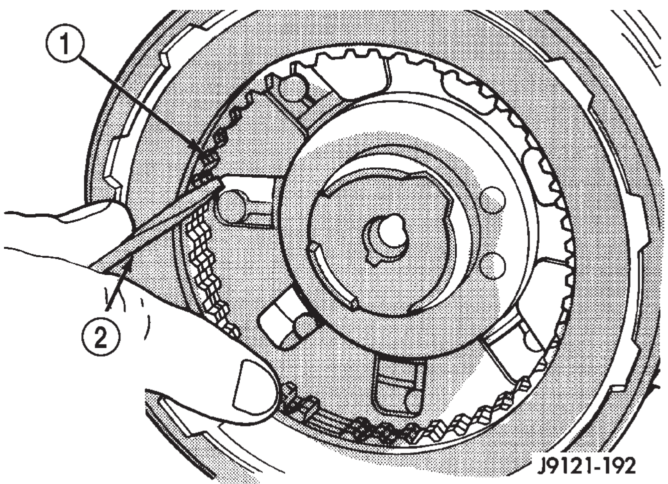


Fig. 55 Aligning Rear Clutch Disc Lugs

1 - REAR CLUTCH DISCS
2 - USE SMALL SCREWDRIVER TO ALIGN CLUTCH DISC TEETH

(35) Carefully work assembled clutches back and forth to engage and seat rear clutch discs on front annulus gear. Verify that front clutch drive lugs are fully engaged in slots of driving shell after installation.

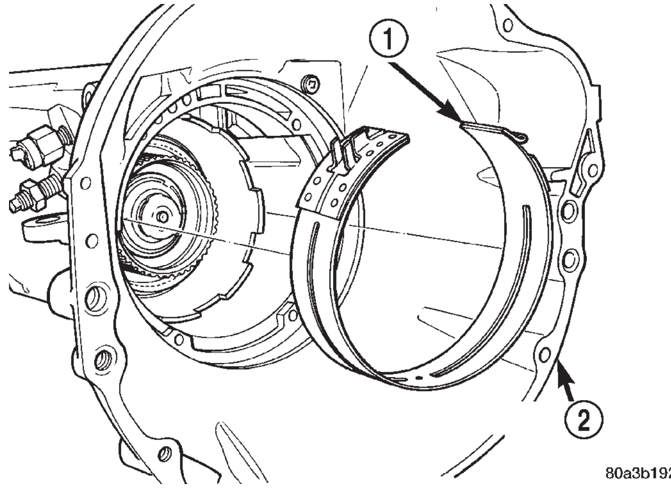


Fig. 56 Front Band

1 - FRONT BAND
2 - TRANSMISSION HOUSING

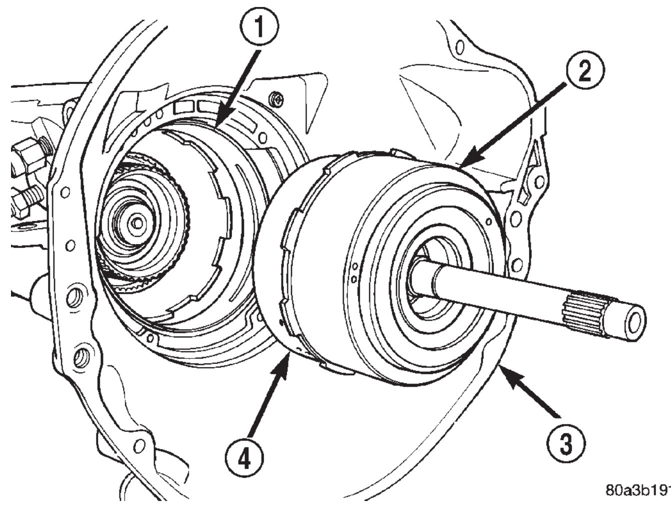


Fig. 57 Installing Front/Rear Clutch

1 - FRONT BAND
2 - FRONT CLUTCH AND DRUM
3 - TRANSMISSION HOUSING
4 - REAR CLUTCH

(36) Engage front band on adjusting screw and hold band in place.

(37) Install strut between band lever and front band (Fig. 58).

AUTOMATIC TRANSMISSION - 30RH (Continued)

(38) Tighten front band adjusting screw until band just grips clutch retainer. Verify that front/rear clutches are still seated before continuing.

(39) Verify that reaction shaft support hub seal rings are hooked together (Fig. 59).

(40) Coat the reaction shaft thrust washer with petroleum jelly to hold it in place. Then install washer over reaction shaft hub and seat it on pump (Fig. 60).

CAUTION: The thrust washer bore (I.D.), is chamfered on one side. Make sure the chamfered side is installed so it faces the pump.

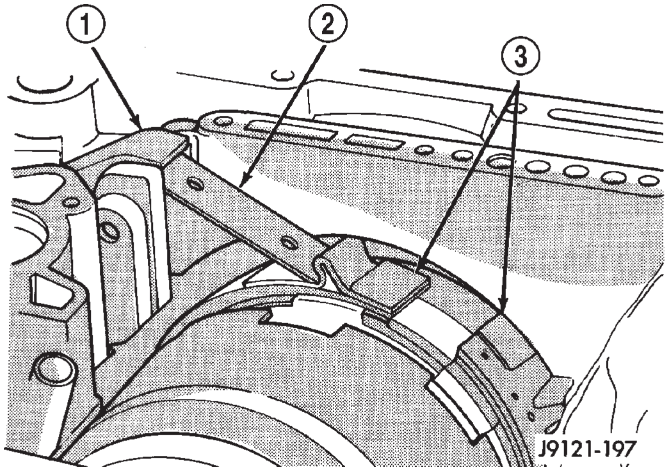


Fig. 58 Front Band Linkage Installation

1 - BAND LEVER
2 - BAND STRUT
3 - FRONT BAND

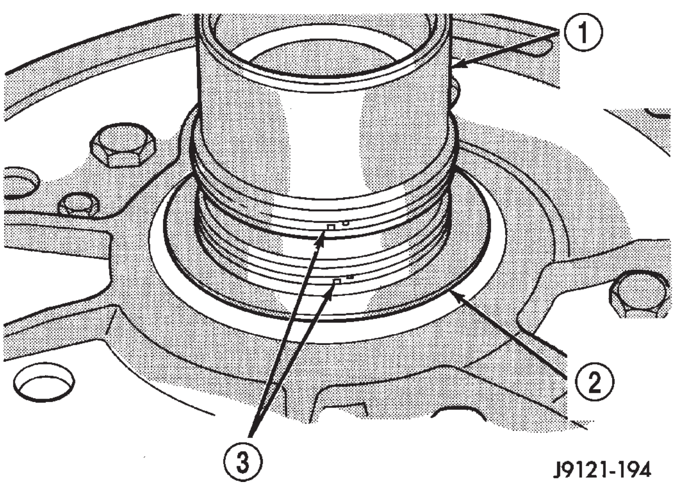


Fig. 59 Reaction Shaft Support Seal Rings

1 - REACTION SHAFT SUPPORT HUB
2 - THRUST WASHER
3 - SEAL RINGS

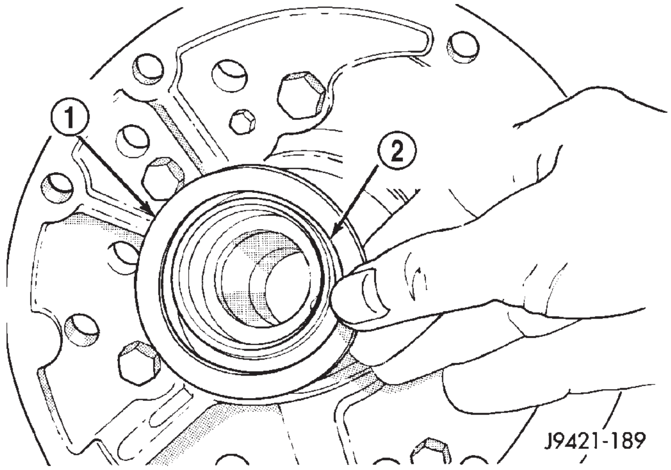


Fig. 60 Reaction Shaft Thrust Washer Installation

1 - THRUST WASHER
2 - CHAMFERED SIDE OF WASHER BORE GOES TOWARD PUMP

(41) Thread two Pilot Stud Tools C-3288-B into bolt holes in oil pump flange (Fig. 61).

(42) Align and install oil pump gasket (Fig. 61).

(43) Lubricate oil pump seals with Mopar® Door-Ease, or Ru-Glyde, Door Eze, or ATF +4.

(44) Install oil pump (Fig. 62). Align and position pump on pilot studs. Slide pump down studs and work it into front clutch hub and case by hand. Then install two or three pump bolts to hold pump in place.

(45) Remove pilot stud tools and install remaining oil pump bolts. Tighten bolts alternately in diagonal pattern to 20 N·m (15 ft. lbs.).

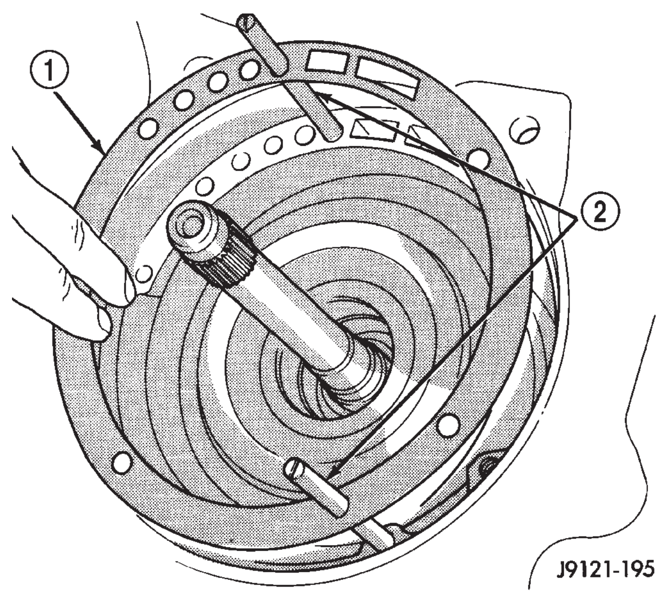


Fig. 61 Installing Pilot Studs And Oil Pump Gasket

1 - OIL PUMP GASKET
2 - PILOT STUD TOOLS C-3288-B

AUTOMATIC TRANSMISSION - 30RH (Continued)

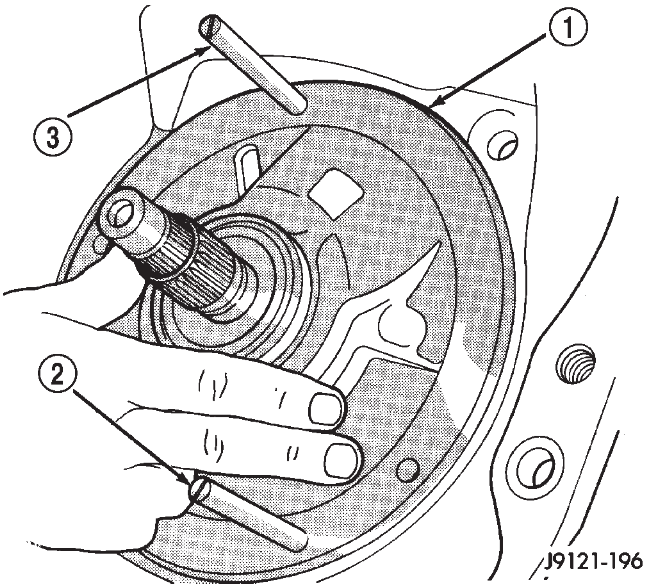


Fig. 62 Installing Oil Pump And Reaction Shaft Support

1 - OIL PUMP
2 - PILOT STUD TOOL
3 - PILOT STUD TOOL

(46) Measure input shaft end play (Fig. 63).

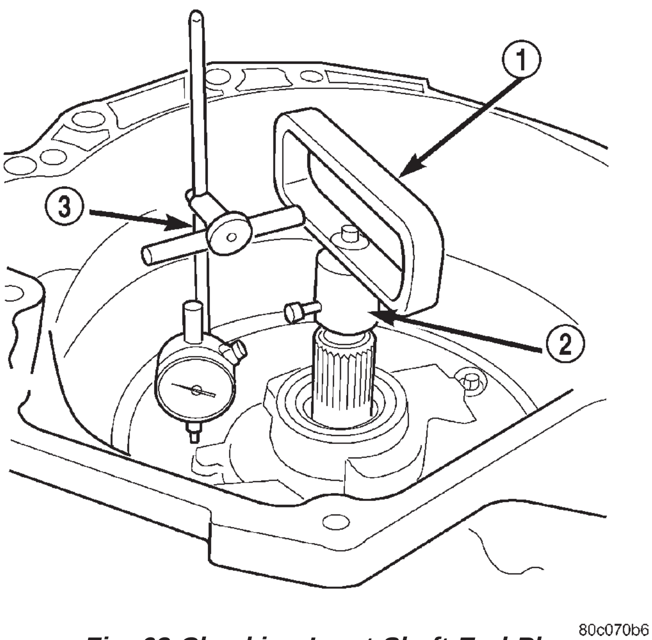


Fig. 63 Checking Input Shaft End Play

1 - TOOL 8266–8
2 - TOOL 8266–7
3 - TOOL C-3339

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.). Adjust as necessary.

(47) Position transmission on work surface with pan face upward.

(48) Install valve body.

(49) Install the park/neutral switch.

(50) Adjust front and rear bands.

(51) Install fluid filter and pan.

(52) Install rear extension housing.

(53) Install torque converter.

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. 64). 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.

AUTOMATIC TRANSMISSION - 30RH (Continued)

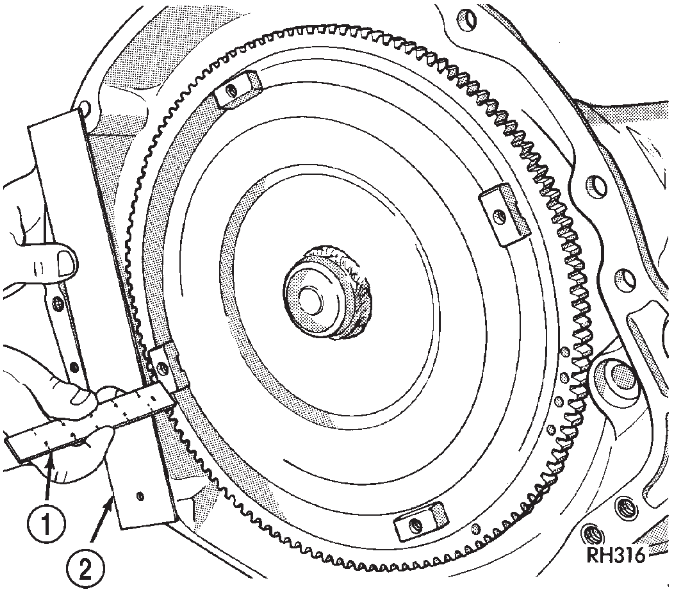


Fig. 64 Checking Converter Seating - Typical

1 - SCALE
2 - STRAIGHTEDGE

(7) Lightly grease crankshaft flange hole.

(8) Position transmission on jack and secure it with safety chains.

(9) Check condition of converter driveplate. Replace the plate if cracked, distorted or damaged. **Also be sure transmission dowel pins are seated in engine block and protrude far enough to hold transmission in alignment.**

(10) Raise transmission and align converter with drive plate and converter housing with engine block.

(11) Move transmission forward. Then raise, lower or tilt transmission to align converter housing with engine block dowels.

(12) 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. 65).

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 the 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).

(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 +4, type 9602 fluid.

AUTOMATIC TRANSMISSION - 30RH (Continued)

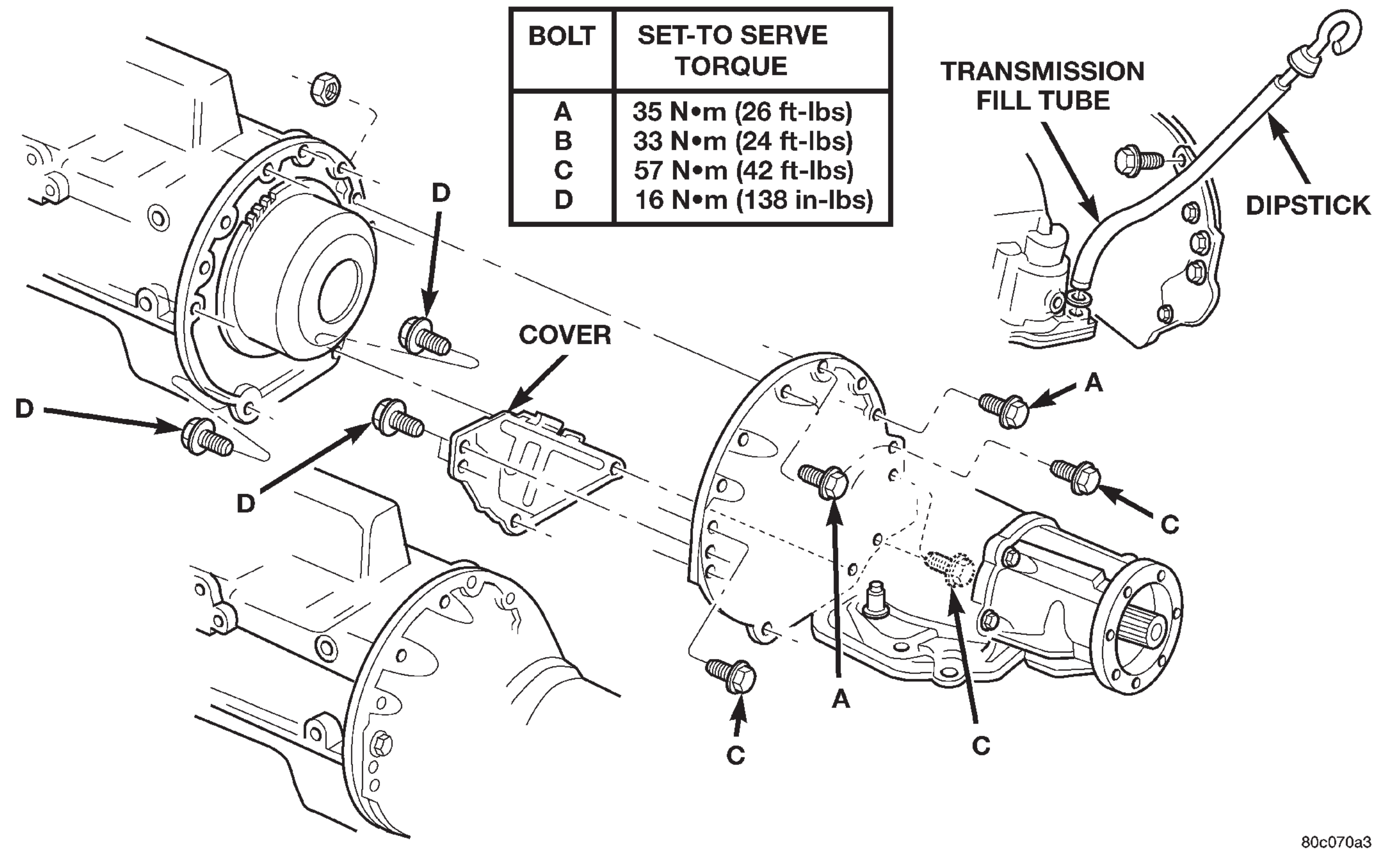
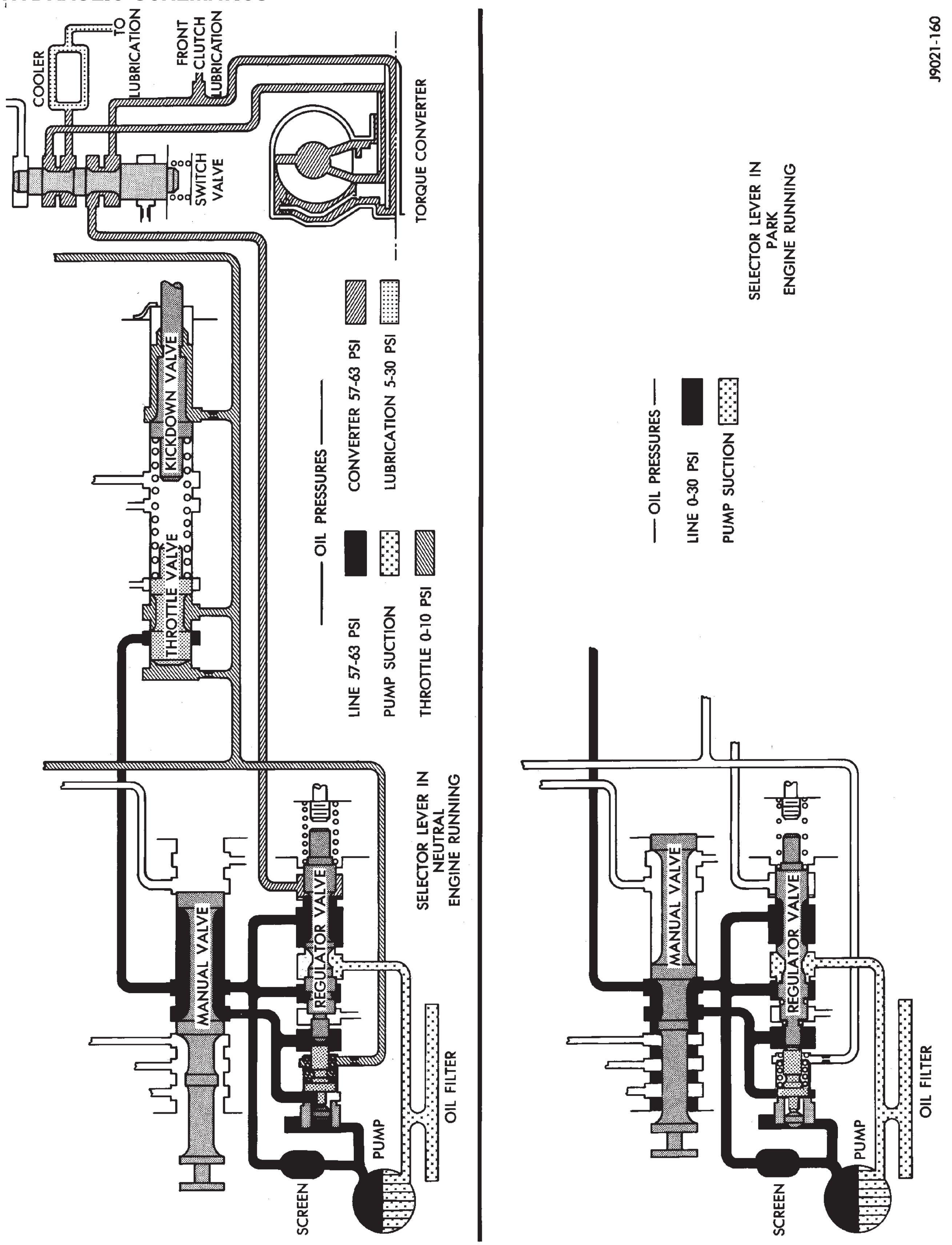


Fig. 65 Transmission Attachment

AUTOMATIC TRANSMISSION - 30RH (Continued)

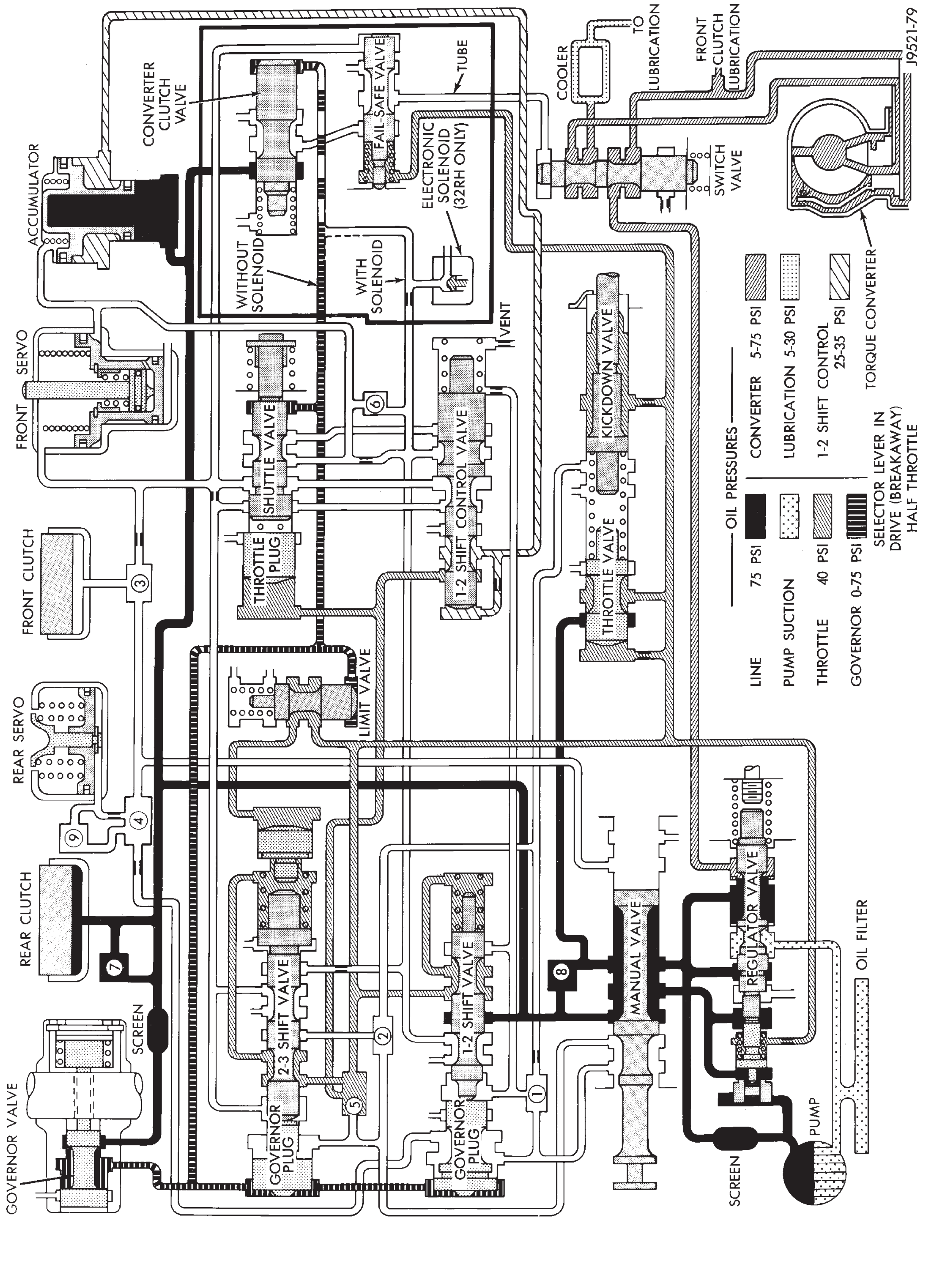
SCHEMATICS AND DIAGRAMS

HYDRAULIC SCHEMATICS



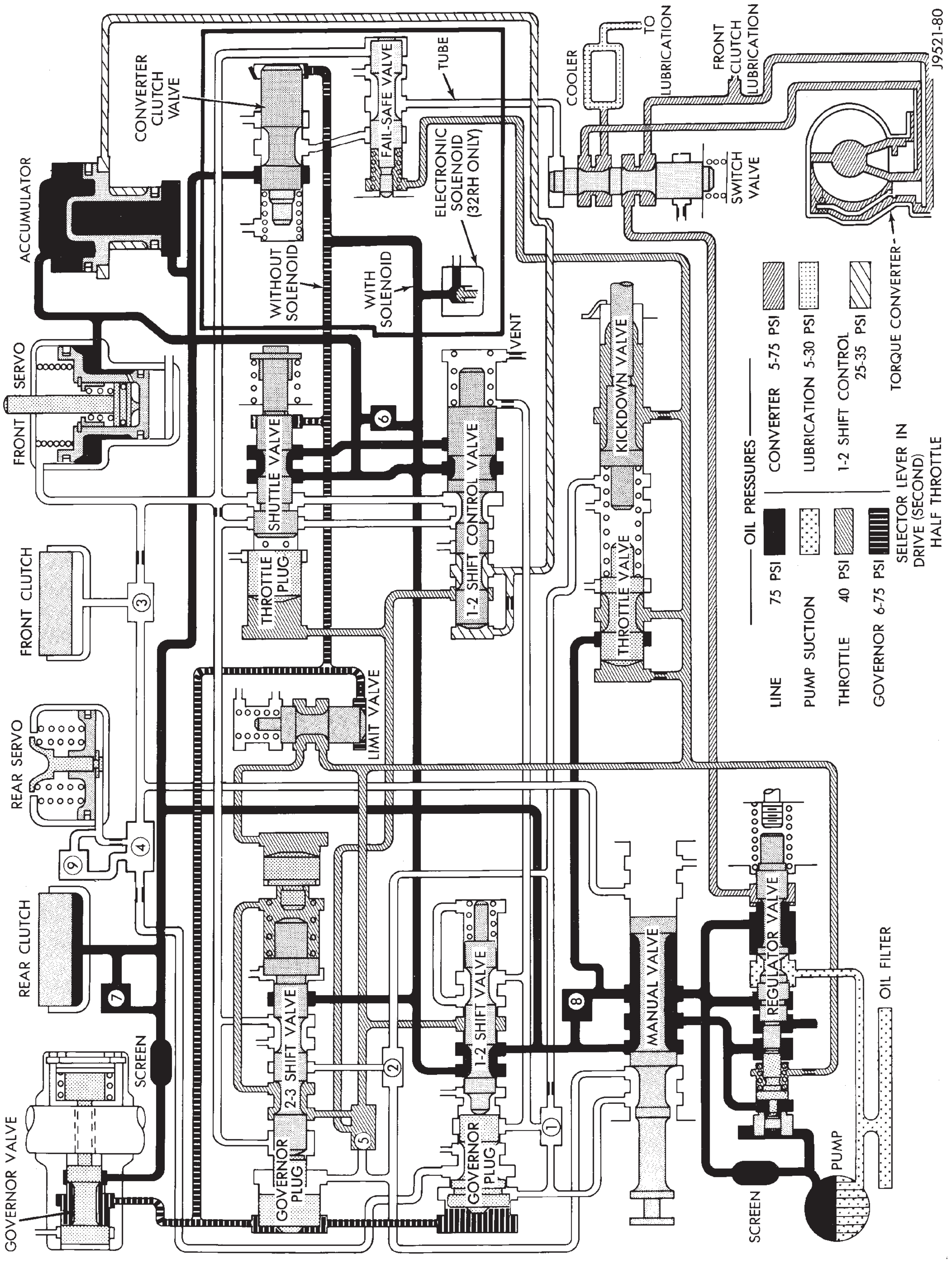
HYDRAULIC FLOW IN PARK/NEUTRAL

AUTOMATIC TRANSMISSION - 30RH (Continued)



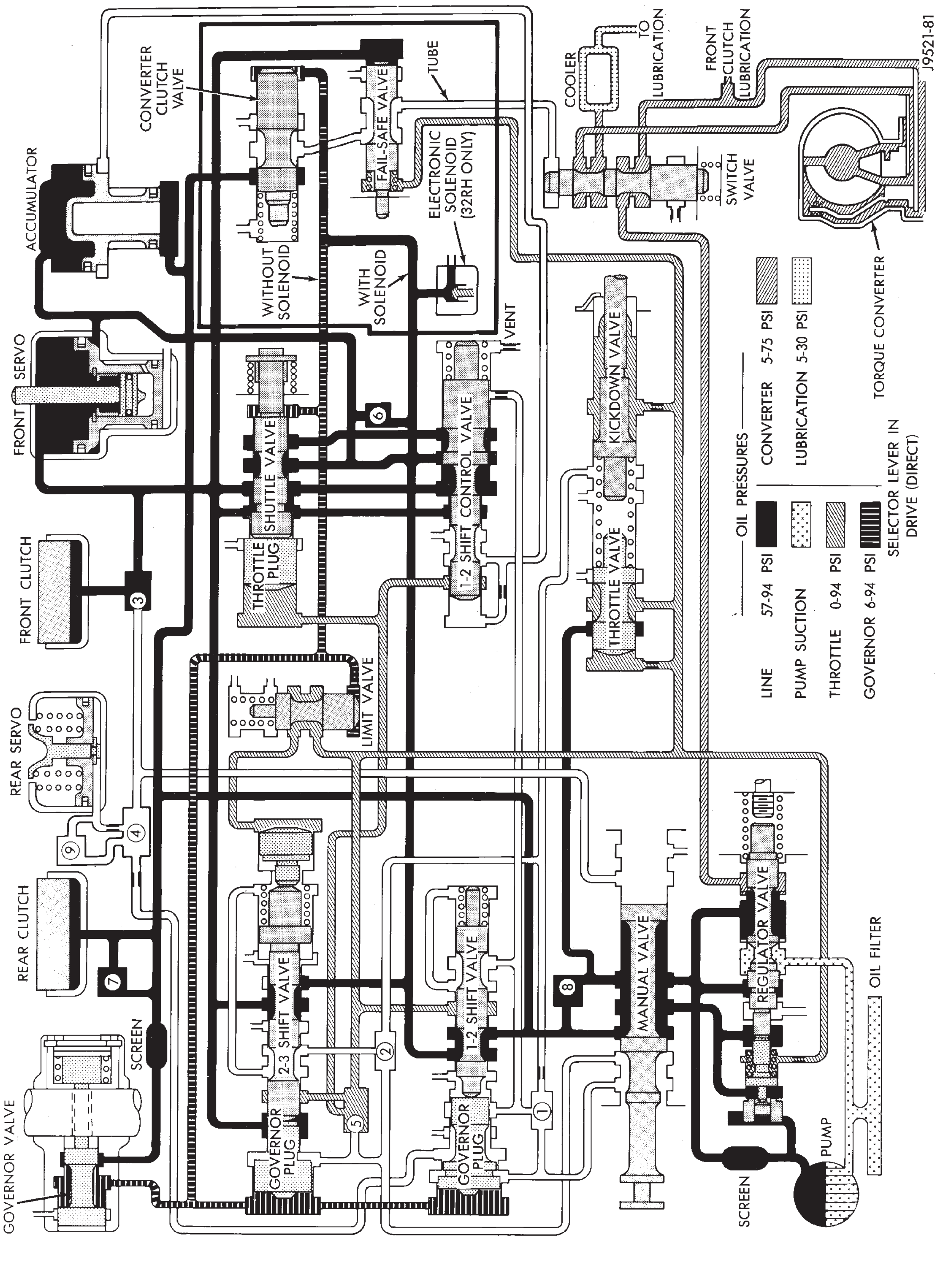
HYDRAULIC FLOW IN D-FIRST GEAR

AUTOMATIC TRANSMISSION - 30RH (Continued)



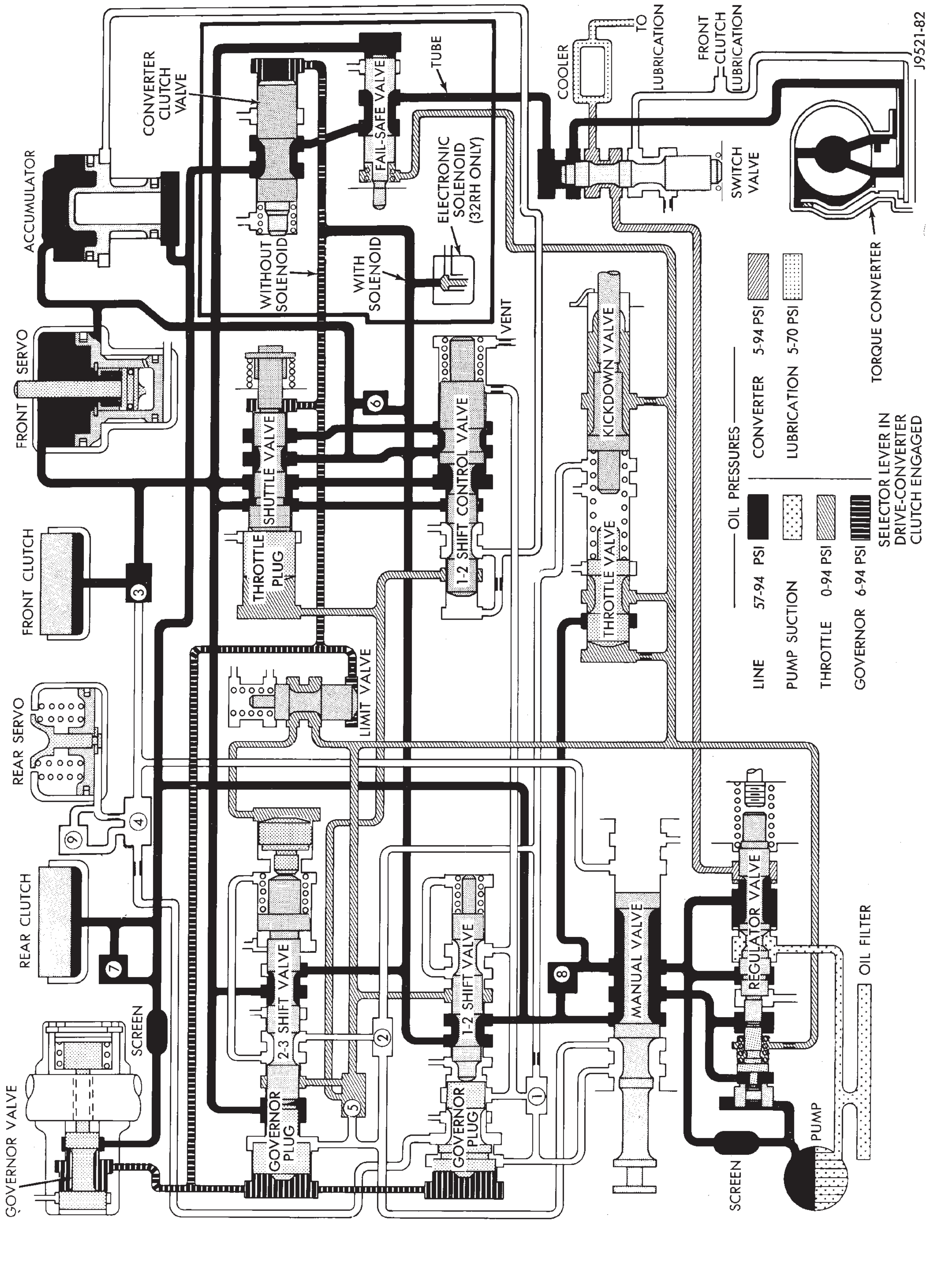
HYDRAULIC FLOW IN D-SECOND GEAR

AUTOMATIC TRANSMISSION - 30RH (Continued)



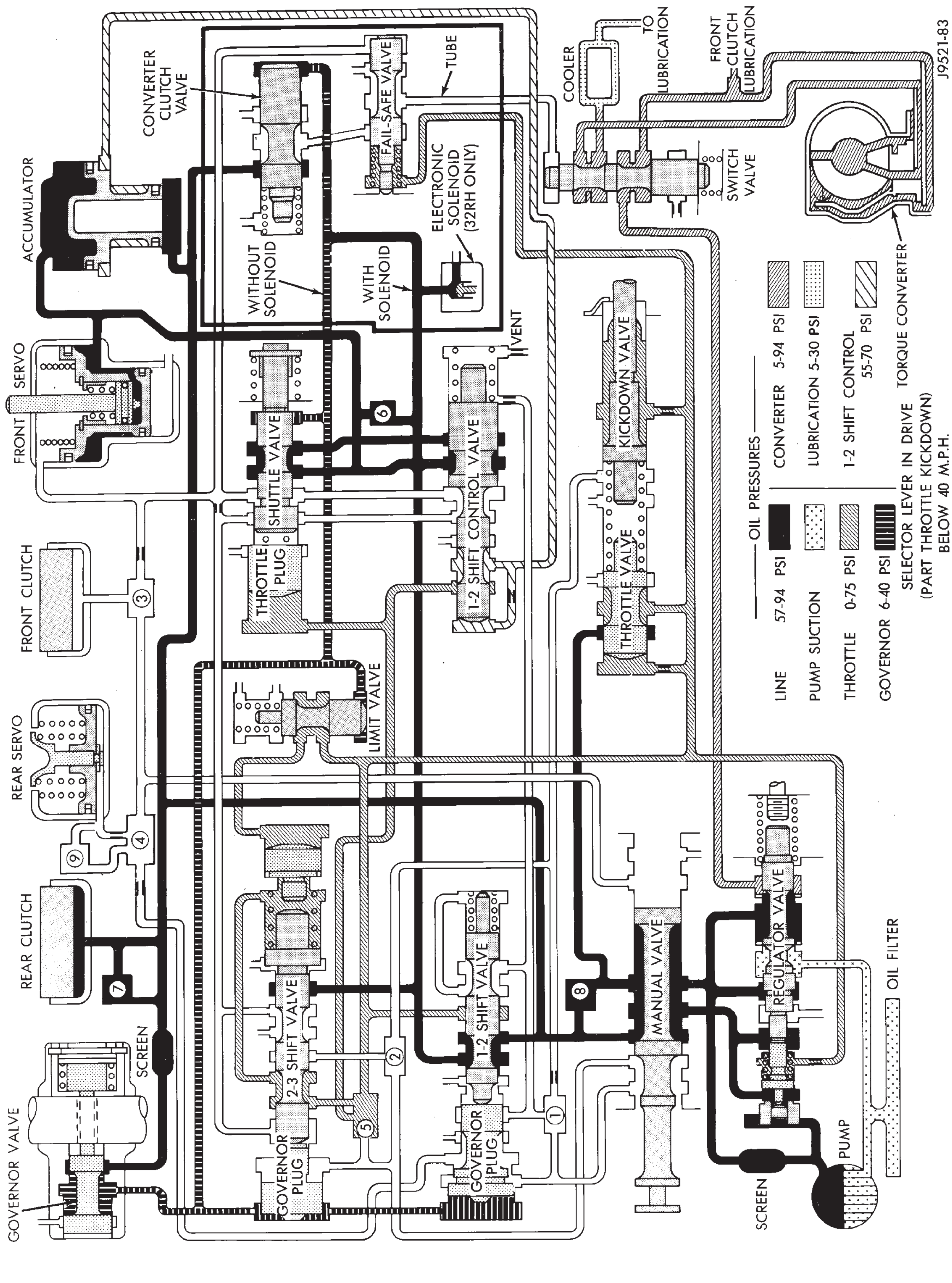
HYDRAULIC FLOW IN D-THIRD GEAR

AUTOMATIC TRANSMISSION - 30RH (Continued)



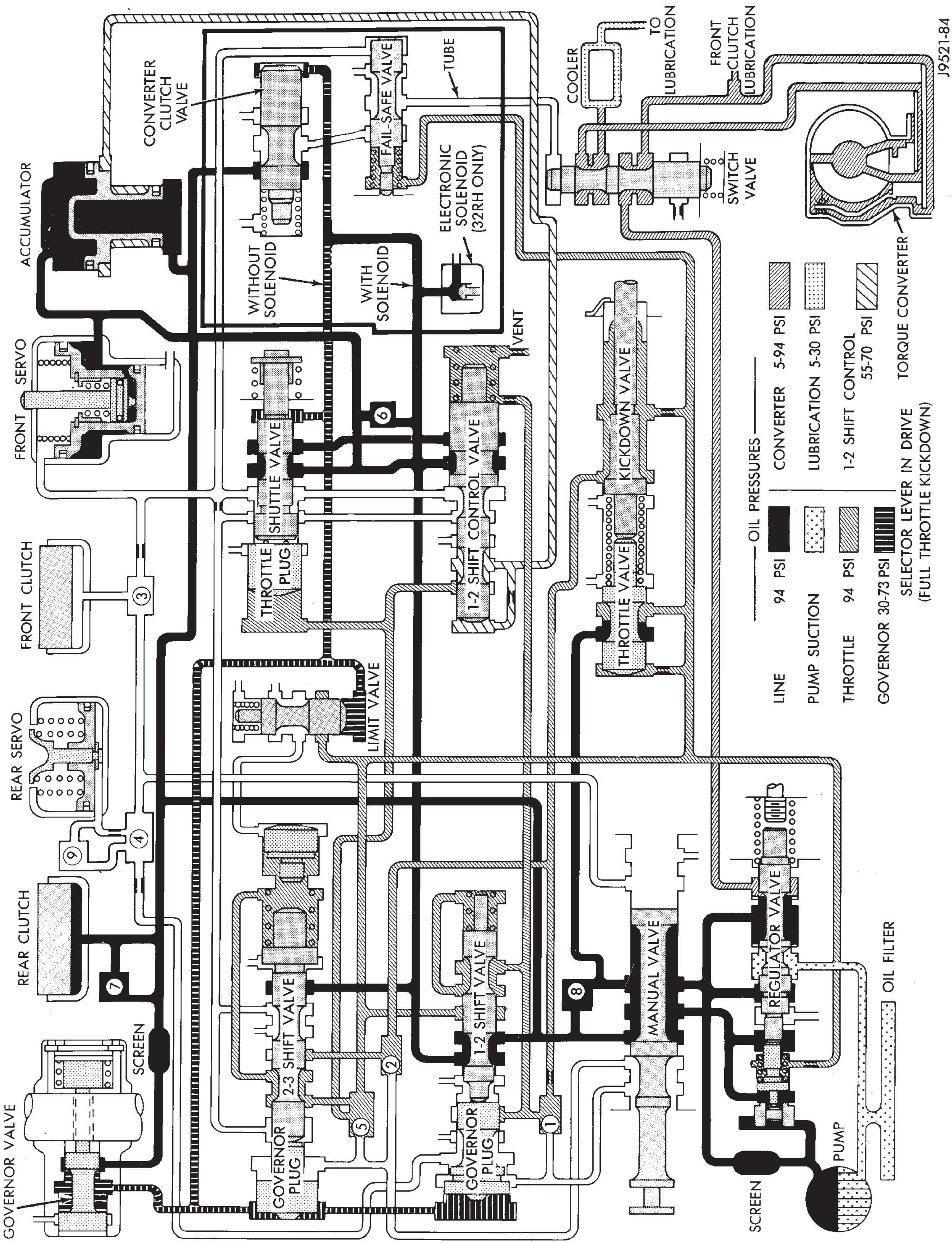
HYDRAULIC FLOW IN D-THIRD GEAR (CONVERTER CLUTCH APPLIED)

AUTOMATIC TRANSMISSION - 30RH (Continued)



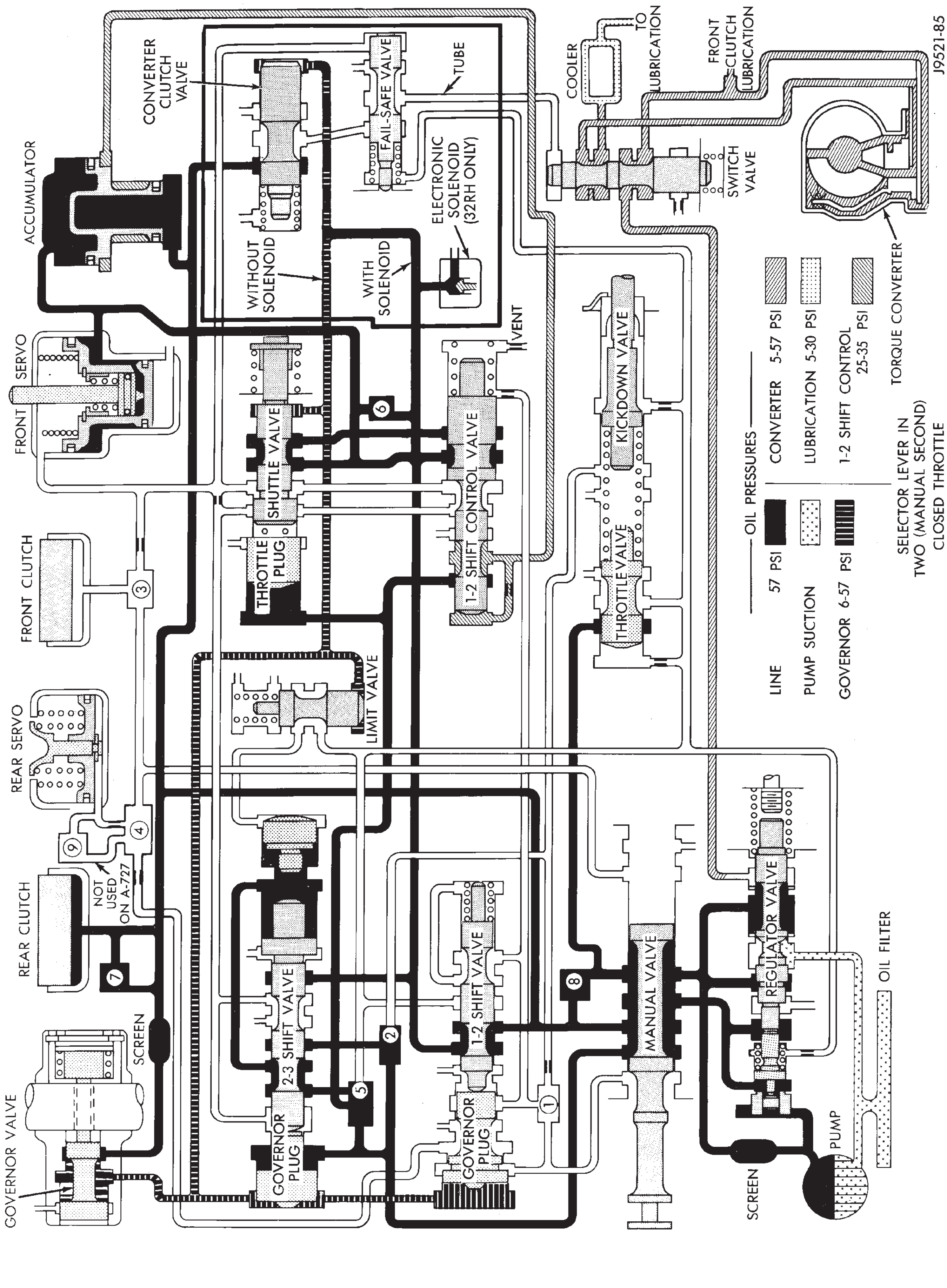
HYDRAULIC FLOW AT PART THROTTLE 3-2 KICKDOWN

AUTOMATIC TRANSMISSION - 30RH (Continued)



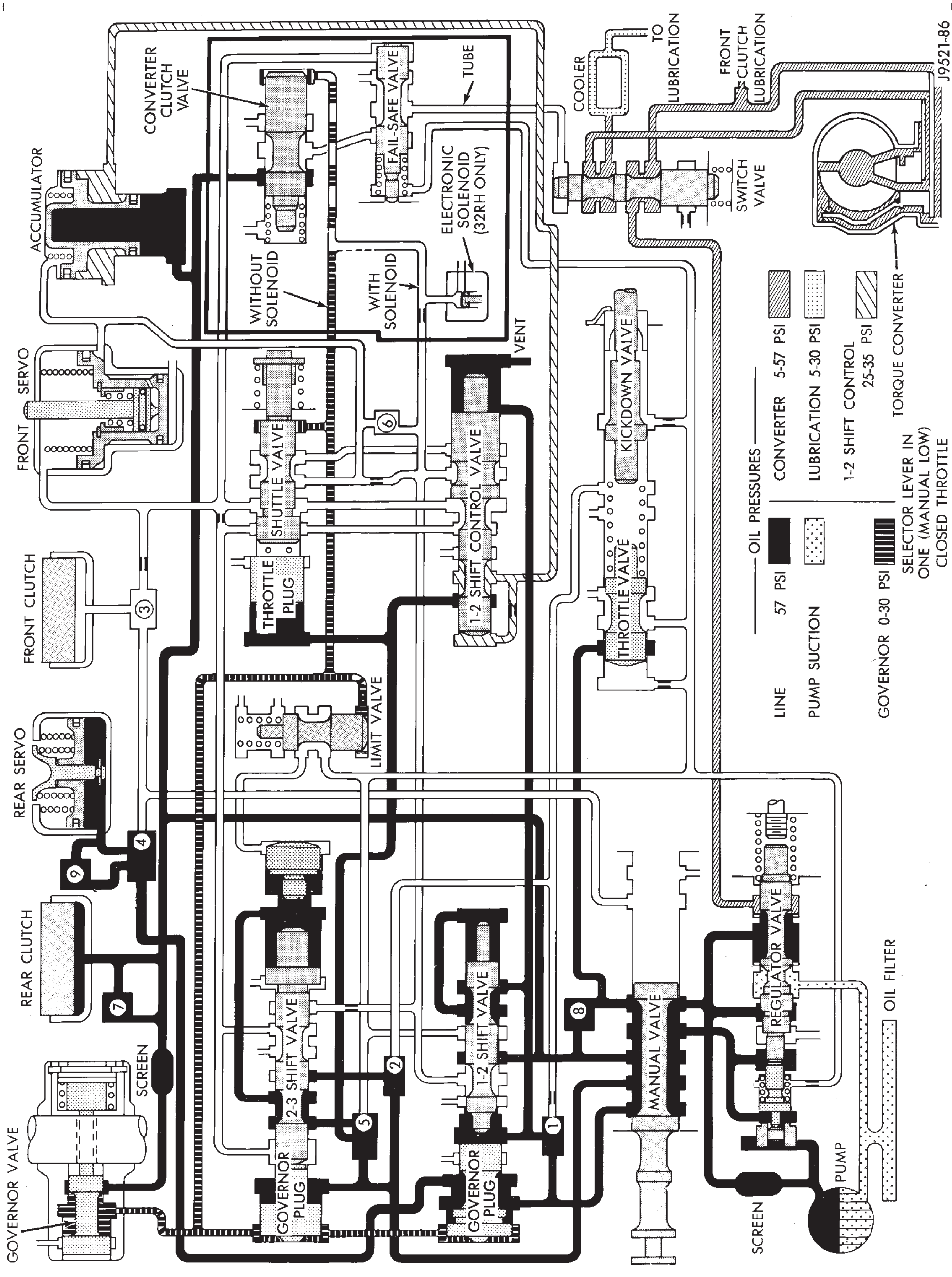
HYDRAULIC FLOW AT FULL THROTTLE

AUTOMATIC TRANSMISSION - 30RH (Continued)



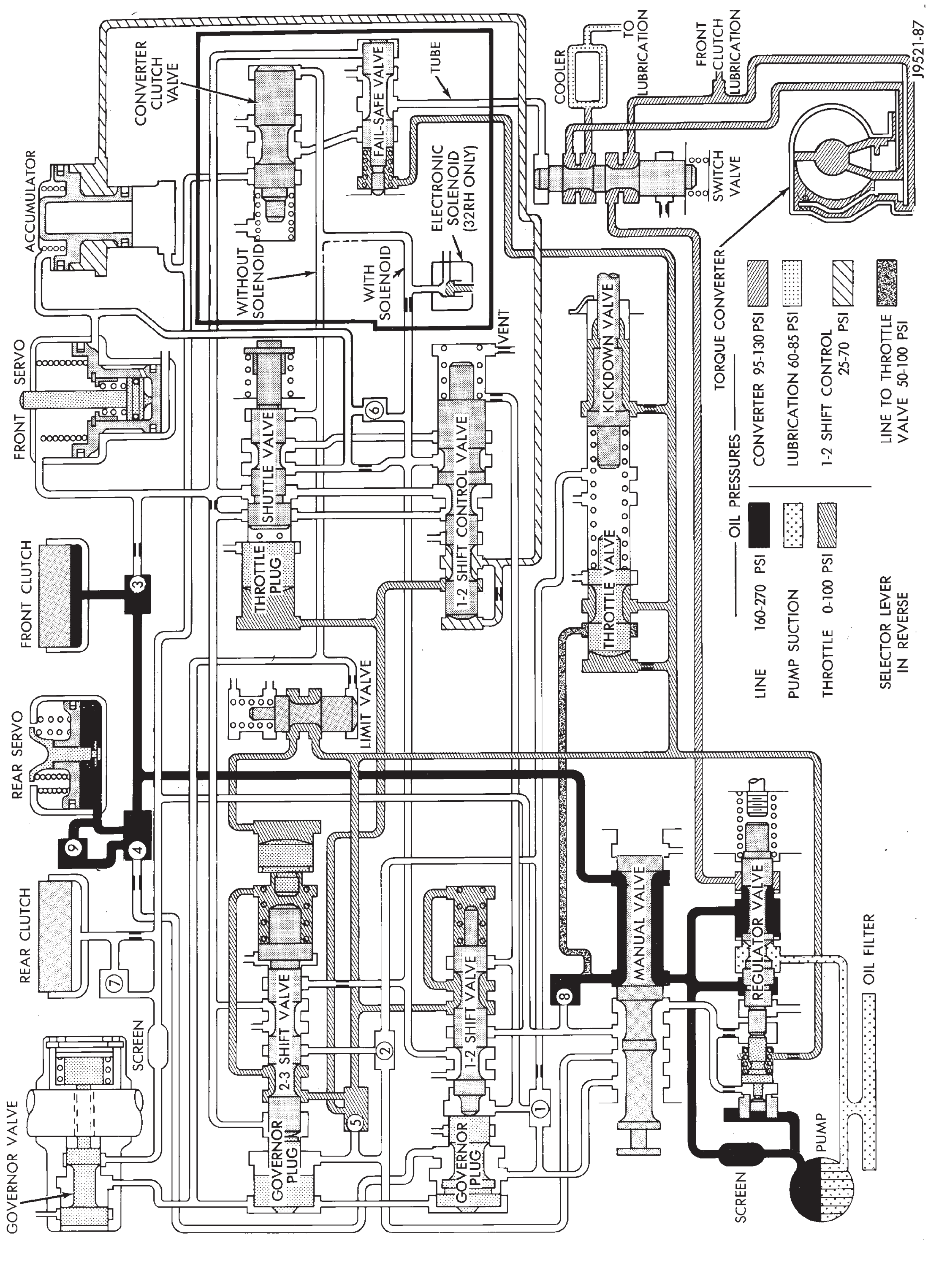
HYDRAULIC FLOW IN MANUAL SECOND

AUTOMATIC TRANSMISSION - 30RH (Continued)



HYDRAULIC FLOW IN MANUAL LOW

AUTOMATIC TRANSMISSION - 30RH (Continued)



HYDRAULIC FLOW IN REVERSE

AUTOMATIC TRANSMISSION - 30RH (Continued)

SPECIFICATIONS

AUTOMATIC TRANSMISSION - 30RH

SPECIFICATIONS

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	
Front Band adjustment from 72 in. lbs.	Back off 2.5 turns	
Rear Band adjustment from 41 in. lbs.	Back off 7 turns	
Recommended fluid	Mopar®, ATF +4, Type 9602	

THRUST WASHER/SPACER/SNAP-RING DIMENSIONS

COMPONENT	METRIC	INCH
Front clutch thrust washer (reaction shaft support hub)	1.55 mm	0.061 in.
Rear clutch thrust washer (clutch retainer)	1.55 mm	0.061 in.
Output shaft thrust plate (output shaft pilot hub)	1.5-1.6mm	0.060-0.063 in.
Output shaft thrust washer (rear clutch hub)	1.3-1.4 mm 1.7-1.8 mm 2.1-2.2 mm	0.052-0.054 in. 0.068-0.070 in. 0.083-0.086 in.
Rear clutch pack snap-ring	1.5-1.6 mm 1.7-1.8 mm 1.9-2.0 mm	0.060-0.062 in. 0.068-0.070 in. 0.076-0.078 in.
Planetary geartrain snap-ring (at front of output shaft)	1.0-1.1 mm 1.6-1.7 mm 2.1-2.2 mm	0.040-0.044 in. 0.062-0.066 in. 0.082-0.086 in.

PRESSURE TEST

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.

AUTOMATIC TRANSMISSION - 30RH (Continued)

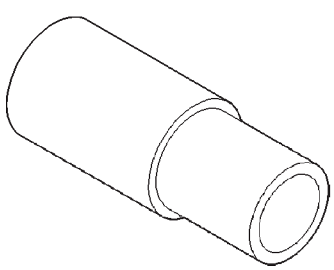
ITEM	RANGE	PRESSURE
Governor	D range closed throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1.5 psi) when stopped with transmission in D, 1, 2. Pressure above 7 kPa (1.5 psi) at stand still will prevent transmission from downshifting.

TORQUE SPECIFICATIONS

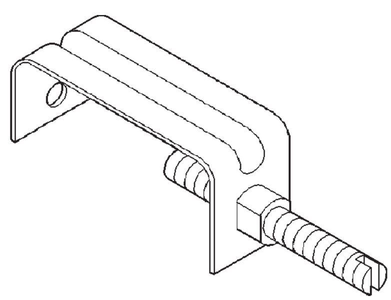
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Bolt/nut, crossmember	31	23	-
Bolt, driveplate to crankshaft	68	50	-
Plug, front band reaction	75	55	-
Locknut, front band adj.	34	25	-
Switch, park/neutral	34	25	-
Bolt, fluid pan	17	13	-
Bolt, oil pump	20	15	-
Bolt, overrunning clutch cam	17	13	-
Plug, pressure test port	14	10	-
Bolt, reaction shaft support	20	15	-
Locknut, rear band	41	30	-
Bolt. speedometer adapter	11	8	-
Screw, fluid filter	4	-	35
Bolt, valve body to case	12	-	100

SPECIAL TOOLS

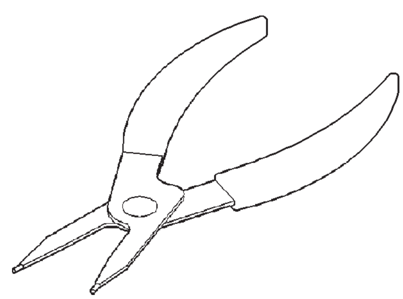
RH TRANSMISSIONS



Installer, Bushing - 6951

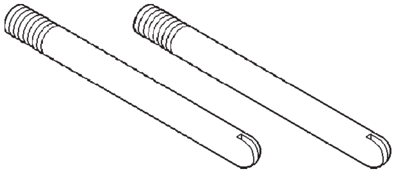


Retainer, Detent Ball and Spring - 6583

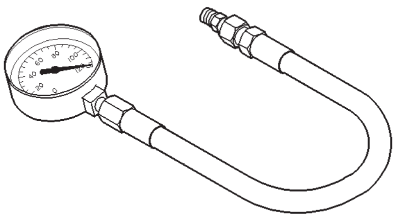


Plier, Snap-ring- 6823

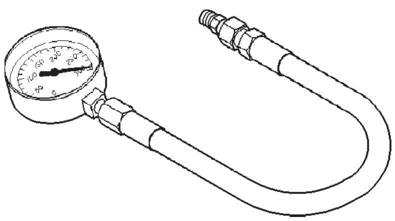
AUTOMATIC TRANSMISSION - 30RH (Continued)



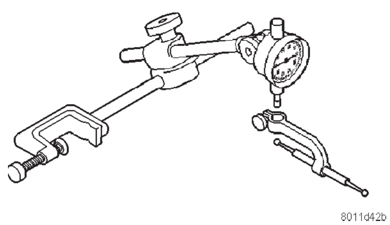
Stud, Pilot - C-3288-B



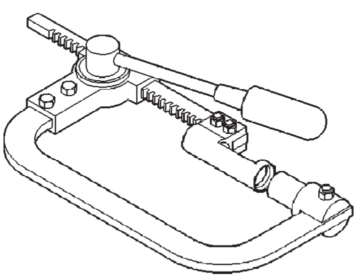
Gauge, Oil Pressure - C-3292



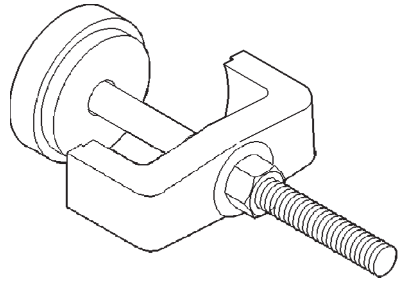
Gauge, Oil Pressure - C-3293SP



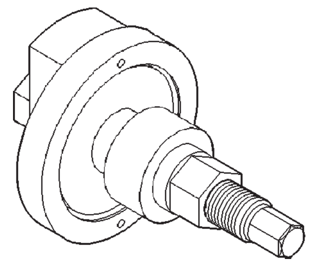
Kit, Dial Indicator - C-3339



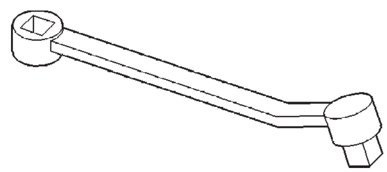
Compressor, Valve Spring - C-3422-C



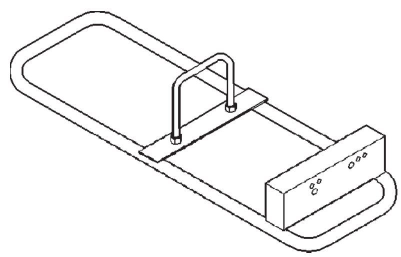
Compressor, Spring - C-3575-A



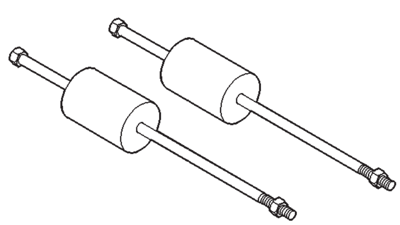
Compressor, Spring - C-3863-A



Adapter, Band Adjuster - C-3705

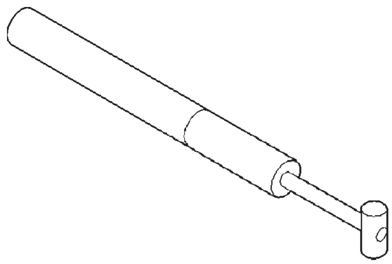


Stand, Transmission Repair - C-3750-B

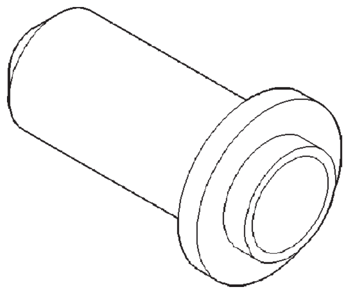


Puller, Slide - C-3752

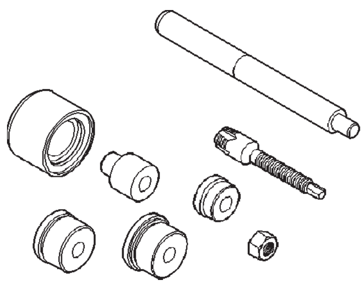
AUTOMATIC TRANSMISSION - 30RH (Continued)



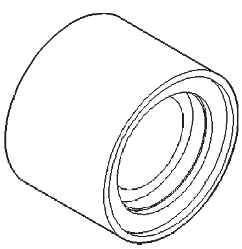
Gauge, Throttle Setting - C-3763



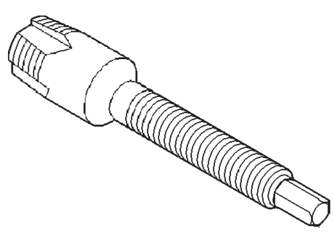
Installer, Seal - C-3860-A



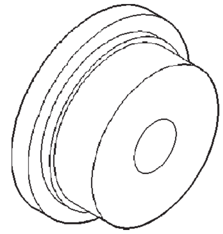
Remover/Installer, Bushing - C-3887-J



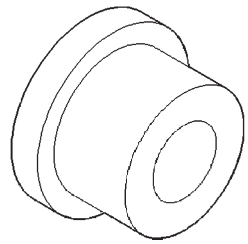
Cup, Bushing Remover - SP-3633



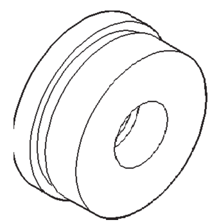
Remover, Reaction Shaft Bushing - SP-5301



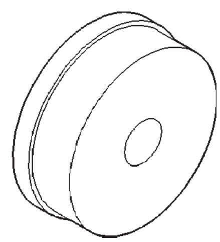
Installer, Oil Pump Bushing - SP-5118



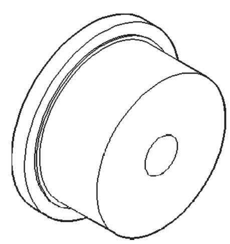
Installer, Reaction Shaft Bushing - SP-5302



Remover, Bushing - SP-3550

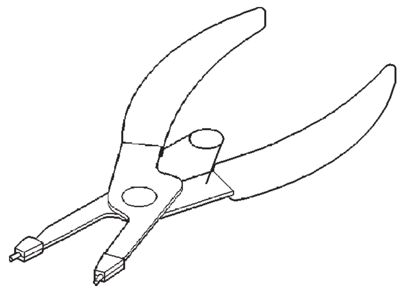


Remover, Front Clutch Bushing - SP-3629

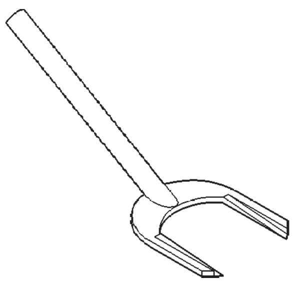


Installer, Front Clutch Bushing - SP-5511

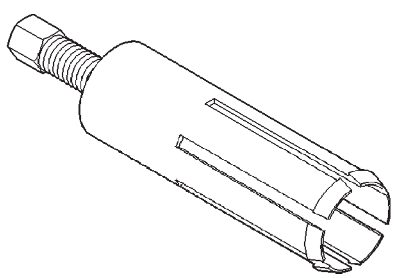
AUTOMATIC TRANSMISSION - 30RH (Continued)



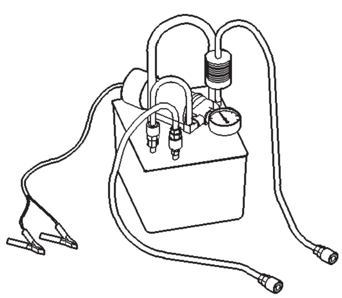
Plier, Snap-ring C-3915



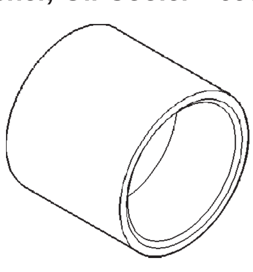
Remover, Seal C-3985-B



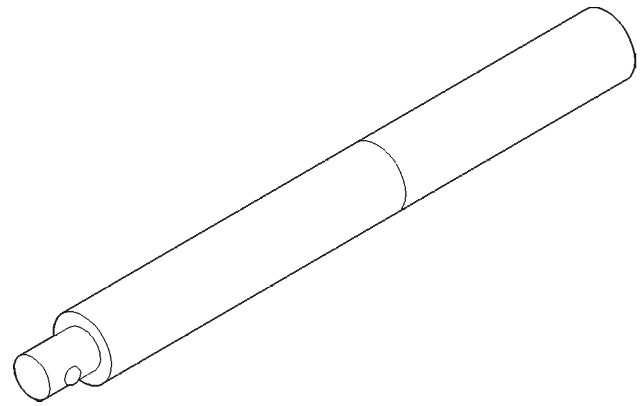
Bushing, Remover - 6957



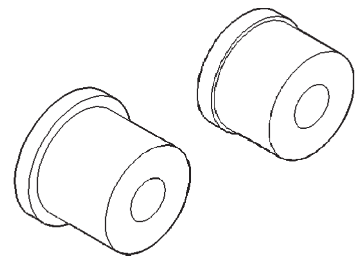
Flusher, Oil Cooler - 6906-B



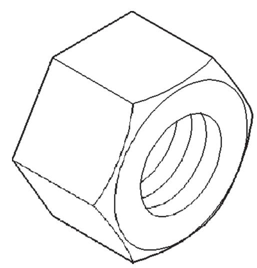
Installer, Seal - C-3995-A



Universal Handle - C-4171



Remover/Installer - C-4470



Nut, Bushing Remover - SP-1191

ACCUMULATOR

DESCRIPTION

The accumulator (Fig. 66) 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.

OPERATION

Line pressure is directed between the lands of the piston (Fig. 67), 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. 68), 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.

ACCUMULATOR (Continued)

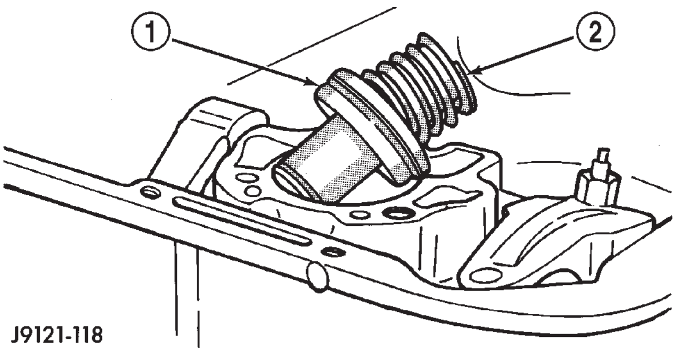


Fig. 66 Accumulator

1 - ACCUMULATOR PISTON
2 - PISTON SPRING

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.

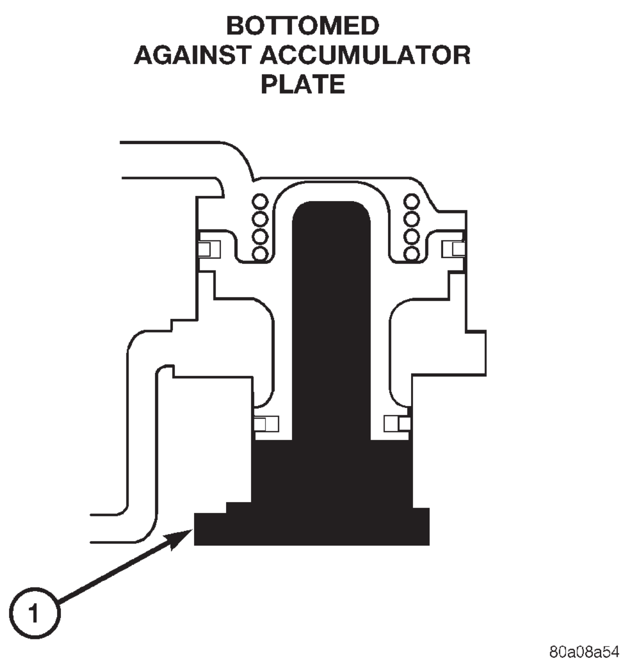


Fig. 67 Accumulator in DRIVE - FIRST Gear Position

1 - LINE PRESSURE

INSPECTION

Inspect the accumulator piston and seal rings (Fig. 69). Replace the seal rings if worn or cut. Replace the piston if chipped or cracked.

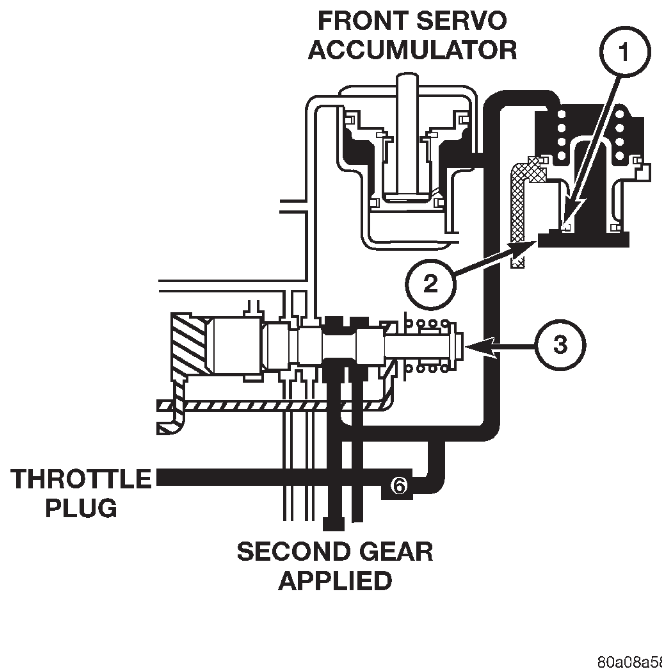


Fig. 68 Accumulator in SECOND Gear Position

1 - BOTTOM OF BORE
2 - LINE PRESSURE
3 - SHUTTLE VALVE

Check condition of the accumulator inner and outer springs (Fig. 69). Replace the springs if the coils are cracked, distorted or collapsed.

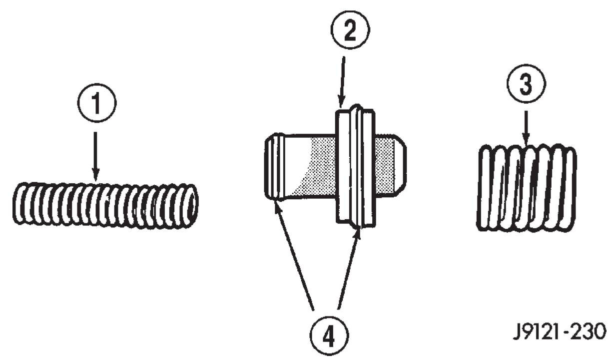


Fig. 69 Accumulator Components

1 - INNER SPRING
2 - ACCUMULATOR PISTON
3 - OUTER SPRING
4 - SEAL RINGS

ADAPTER HOUSING

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Support transmission with a suitable lifting device.

ADAPTER HOUSING (Continued)

(3) Remove transmission skid plate. (Refer to 13 - FRAMES & BUMPERS/FRAME/FRONT SKID PLATE - REMOVAL)

(4) Remove propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(5) Remove transfer case.

(6) Remove bolts holding adapter housing to transmission case (Fig. 70).

(7) Separate adapter housing from transmission.

(8) Slide adapter housing rearward and off output shaft (Fig. 70).

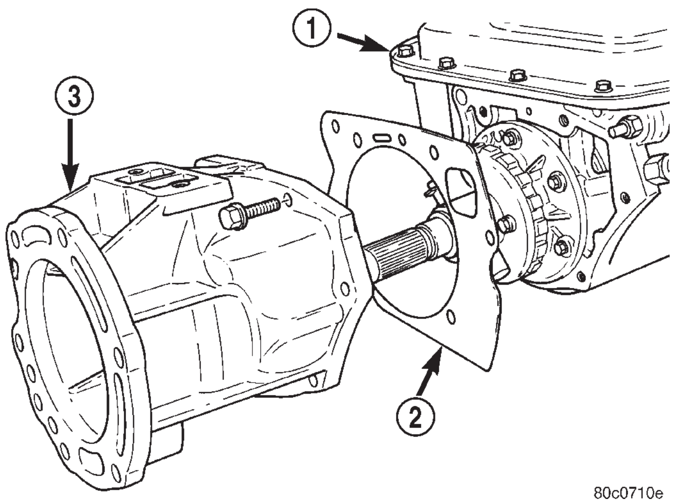


Fig. 70 Adapter Housing

1 - TRANSMISSION
2 - GASKET
3 - ADAPTER HOUSING

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. 70).

(4) Guide park shaft into park sprag and push adapter housing forward until rod passes through opening behind sprag. It may be necessary to use a wire to hold sprag to the side for rod to pass through.

(5) Install bolts to hold adapter housing to rear of transmission.

(6) Install transfer case.

(7) Install propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(8) Install rear transmission mount and skid plate. (Refer to 13 - FRAMES & BUMPERS/FRAME/FRONT SKID PLATE - REMOVAL)

(9) Lower vehicle and verify transmission fluid level. Add fluid as necessary.

BANDS

DESCRIPTION

KICKDOWN (FRONT) BAND

DESCRIPTION

The kickdown, or “front”, band (Fig. 71) 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).

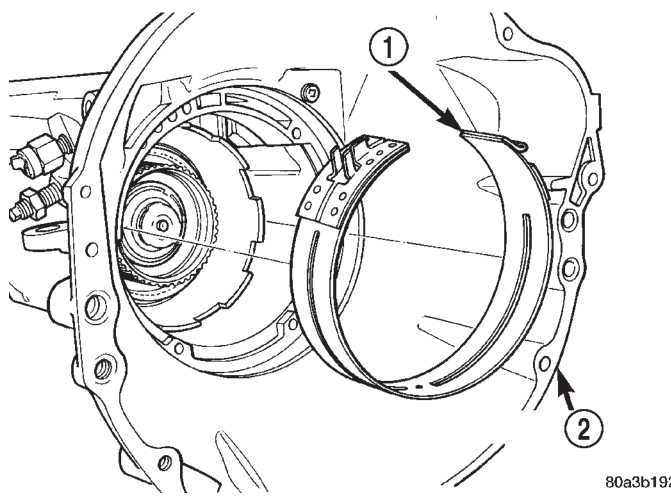


Fig. 71 Front Band

1 - FRONT BAND
2 - TRANSMISSION HOUSING

OPERATION

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.

BANDS (Continued)

OPERATION

LOW/REVERSE (REAR) BAND

DESCRIPTION

The low/reverse band, or "rear", band (Fig. 72) is similar in appearance and operation to the front band. The rear band is also a single-wrap design (the band does not completely encompass/wrap the drum that it holds).

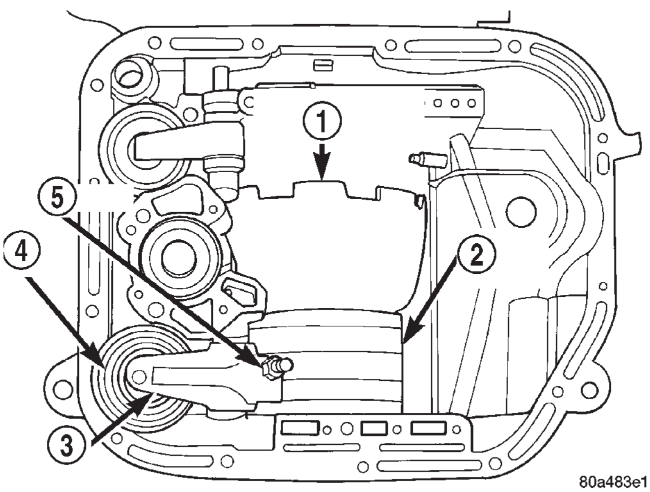


Fig. 72 Rear Band

1 - PLANETARY GEARTRAIN
2 - REAR BAND
3 - LEVER
4 - SERVO
5 - ADJUSTER

OPERATION

The rear band holds the rear planet carrier stationary by being mounted around and applied to the low/reverse drum.

ADJUSTMENTS

ADJUSTMENT - FRONT BAND

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. 73). 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 the 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.

(5) Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

(6) Lower vehicle.

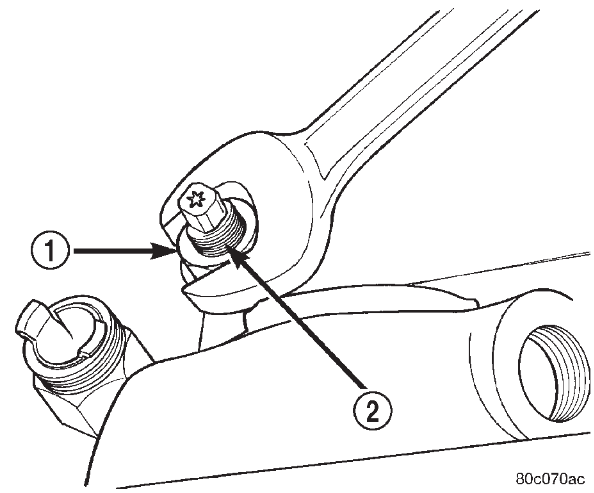


Fig. 73 Front Band Adjustment Screw Location

1 - LOCK-NUT
2 - FRONT BAND ADJUSTER

ADJUSTMENTS - REAR BAND

The transmission oil pan must be removed for access to the rear band adjusting screw.

(1) Raise vehicle.

(2) Remove transmission oil pan and drain fluid.

(3) Loosen band adjusting screw locknut 5-6 turns. Be sure adjusting screw turns freely in lever.

(4) Tighten adjusting screw to 5 N·m (41 in. lbs.) (Fig. 74).

(5) Back off adjusting screw 7 turns.

(6) Hold adjusting screw in place and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(7) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(8) Lower vehicle and refill transmission with Mopar® ATF +4, Type 9602, fluid.

BANDS (Continued)

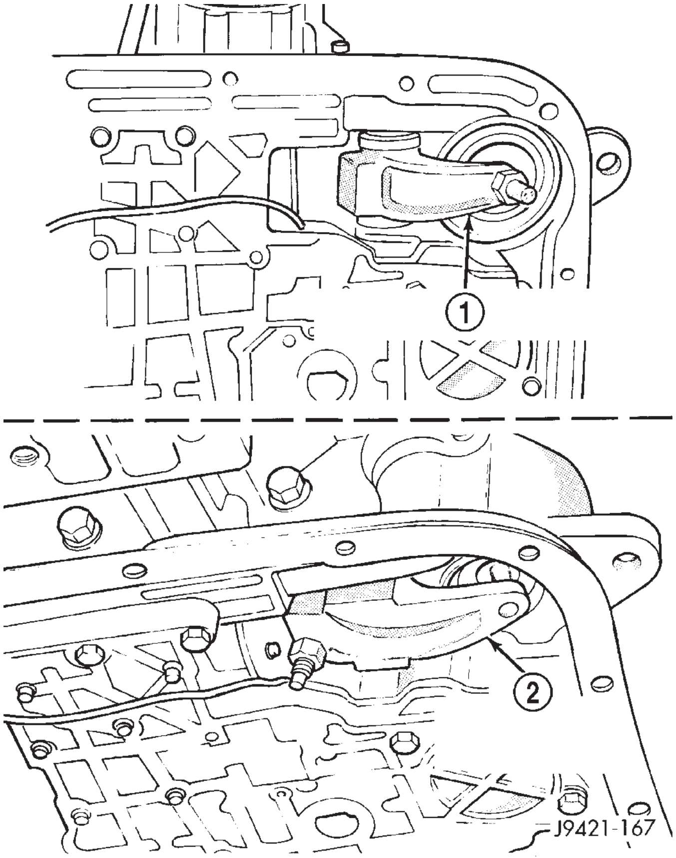


Fig. 74 Rear Band Adjustment Screw Location

1 - 30RH REAR BAND LEVER AND ADJUSTING SCREW
2 - 32RH REAR BAND LEVER AND ADJUSTING SCREW

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. 75).

BRAKE TRANSMISSION SHIFT INTERLOCK MECHANISM (Continued)

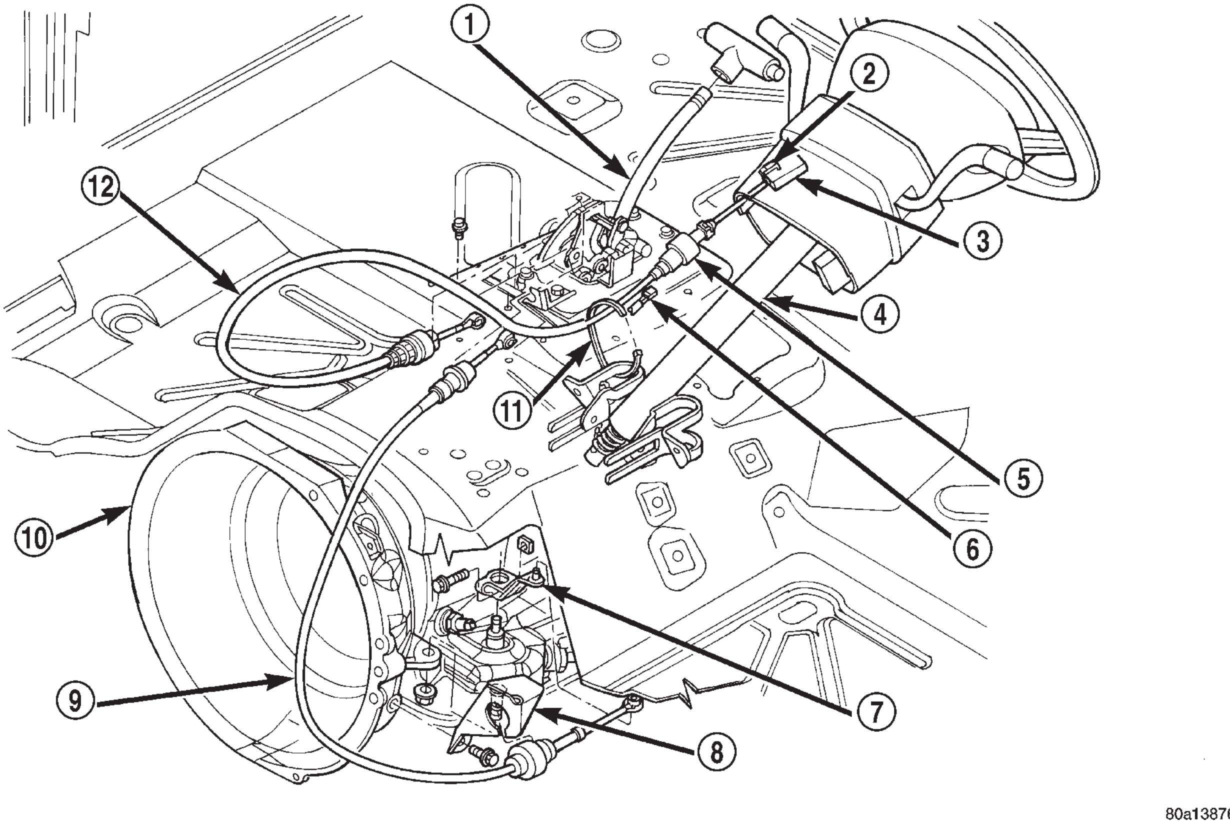


Fig. 75 Ignition Interlock Cable Routing

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

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 position and the brake pedal is depressed, the shifter is unlocked and will move into any position. The interlock system also prevents the ignition switch from being turned to the LOCK or ACCESSORY position (Fig. 76) unless the shifter is fully locked into the PARK position.

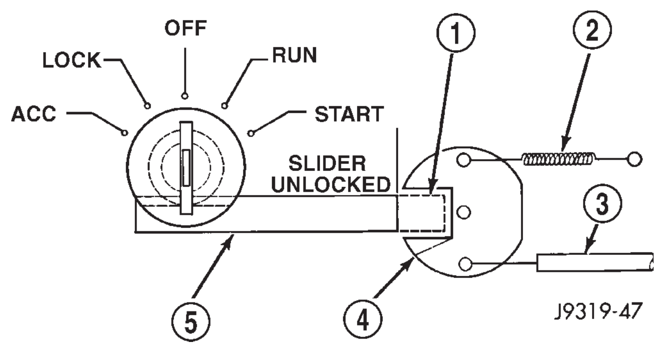


Fig. 76 Ignition Key Cylinder Actuation

1 - SLIDER LOCKED
2 - CAM RETURN SPRING
3 - INTERLOCK CABLE
4 - CAM
5 - SLIDER

BRAKE TRANSMISSION SHIFT INTERLOCK MECHANISM (Continued)

REMOVAL

(1) Remove lower steering column cover. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL)

(2) Remove lower steering column shroud.

(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. 77).

(6) Pull cable end from steering column.

(7) Remove the floor console and related trim. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

(8) Disconnect the cable eyelet from the bellcrank (Fig. 78).

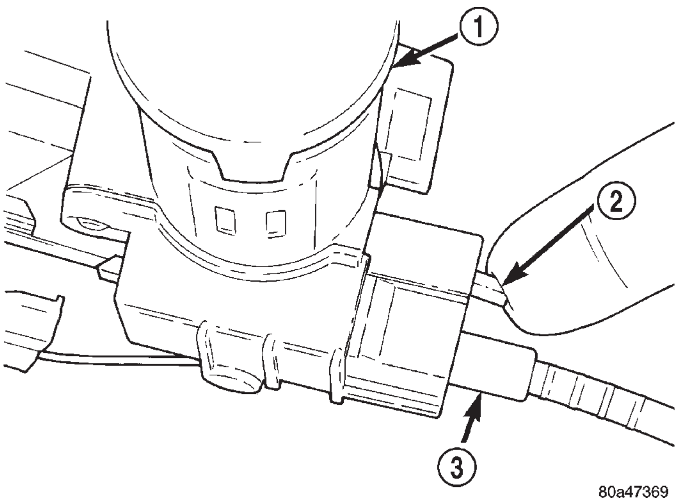


Fig. 77 Brake/Park Interlock Cable

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. 78).

(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.

(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.

BRAKE TRANSMISSION SHIFT INTERLOCK MECHANISM (Continued)

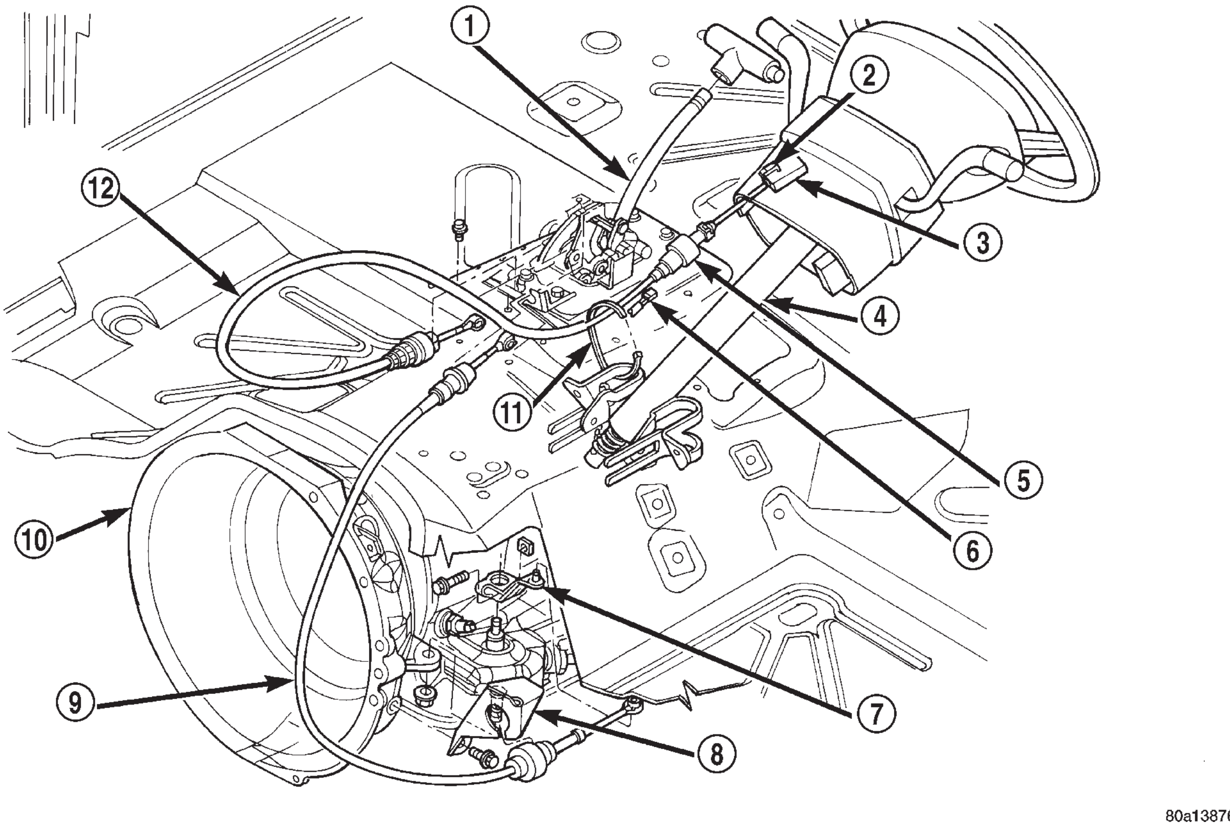


Fig. 78 Cable and Shifter

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

ADJUSTMENTS

ADJUSTMENT - BRAKE TRANSMISSION SHIFT INTERLOCK CABLE

(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. 79).

(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.

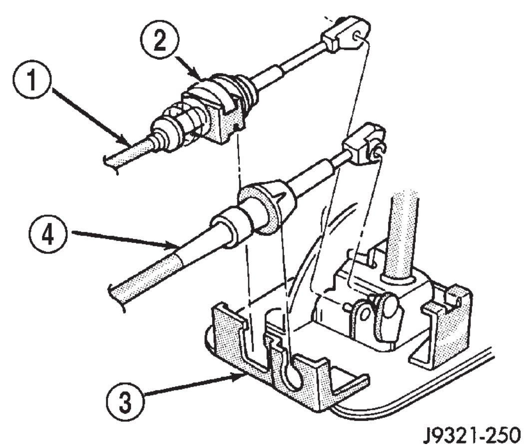


Fig. 79 Park Lock Cable Attachment

1 - PARK LOCK CABLE
2 - CABLE LOCK BUTTON
3 - SHIFT LEVER ASSEMBLY
4 - SHIFT CABLE

(c) Shifting out of park should not be possible.

(d) Apply the brake and attempt to shift out of PARK. Shifting should be possible.

(e) While the transmission is shifted out of PARK, release the brake and attempt to shift through all gears. Release the shift button at least once during this procedure. The ignition key should not go to the LOCK position.

(f) Return transmission to the PARK position without applying the brake.

(8) Move shift lever back to PARK and check ignition switch operation. You should be able to turn switch to LOCK position and shift lever release button/lever should not move.

FLUID AND FILTER

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - 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 and clutch 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.

DIAGNOSIS AND TESTING - 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.

DIAGNOSIS AND TESTING - 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, an overhaul is necessary.

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.

STANDARD PROCEDURE

STANDARD PROCEDURE - FLUID LEVEL CHECK

Low fluid level can cause a variety of conditions because it allows the pump to take in air along with the fluid. As in any hydraulic system, air bubbles make the fluid spongy, therefore, pressures will be low and build up slowly.

Improper filling can also raise the fluid level too high. When the transmssion has too much fluid, the

FLUID AND FILTER (Continued)

geartrain churns up foam and cause the same conditions which occur with a low fluid level.

In either case, air bubbles can cause overheating and/or fluid oxidation, and varnishing. This can interfere with normal valve, clutch, and accumulator operation. Foaming can also result in fluid escaping from the transmission vent where it may be mistaken for a leak.

After the fluid has been checked, seat the dipstick fully to seal out water and dirt.

The transmission has a dipstick to check oil level. It is located on the right side of the engine. Be sure to wipe all dirt from dipstick handle before removing.

Fluid level is checked with the engine running at curb idle speed, the transmission in NEUTRAL and the transmission fluid at normal operating temperature. **The engine should be running at idle speed for at least one minute, with the vehicle on level ground.**

(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. 80) 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 +4, type 9602, to restore correct level. Do not overfill.

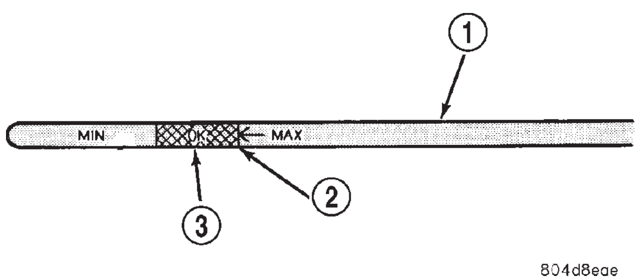


Fig. 80 Dipstick Fluid Level Marks - Typical

1 - DIPSTICK
2 - MAXIMUM CORRECT FLUID LEVEL
3 - ACCEPTABLE FLUID LEVEL

STANDARD PROCEDURE - TRANSMISSION FILL

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 +4, type 9602, to transmission:

(a) If only fluid and filter were changed, add **3 pints (1-1/2 quarts)** of ATF +4 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 +4 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.

STANDARD PROCEDURE - FLUID AND FILTER REPLACEMENT

For proper service intervals (Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION). The service fluid fill after a filter change is approximately 3.8 liters (4.0 quarts).

(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. 81).

FLUID AND FILTER (Continued)

(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. 82).

(11) Separate filter from valve body and pour fluid in filter into drain pan.

(12) Dispose used trans fluid and filter properly.

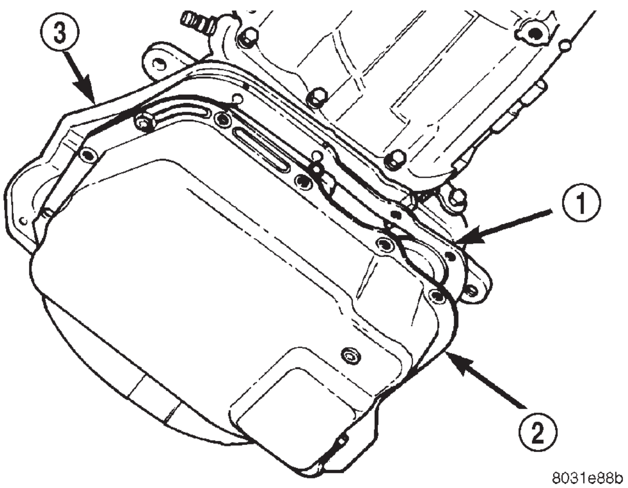


Fig. 81 Transmission Pan - Typical

1 - GASKET
2 - PAN
3 - TRANSMISSION

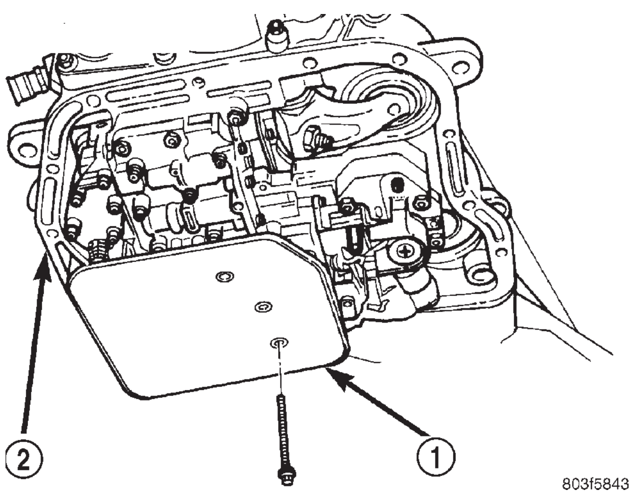


Fig. 82 Transmission Filter - Typical

1 - FILTER
2 - TRANSMISSION

(13) Inspect bottom of pan and magnet for excessive amounts of metal or fiber contamination. A light coating of clutch or band material on the bottom of the pan does not indicate a problem unless accompanied by slipping condition or shift lag. If fluid and pan are contaminated with excessive amounts or debris, refer to the diagnosis section of this group.

(14) Using a suitable solvent, clean pan and magnet.

(15) Using a suitable gasket scraper, clean gasket material from gasket surface of transmission case and the gasket flange around the pan.

(16) Place replacement filter in position on valve body.

(17) Install screws to hold filter to valve body (Fig. 82). Tighten screws to 4 N·m (35 in. lbs.) torque.

(18) Place new gasket in position on pan. and install pan on transmission.

(19) Place pan in position on transmission.

(20) Install screws to hold pan to transmission (Fig. 81). Tighten bolts to 17 N·m (150 in. lbs.) torque.

(21) Install the transmission/skip plate.

(22) Lower vehicle and fill transmission with Mopar® ATF Plus 4, type 9602 fluid.

FRONT CLUTCH

DESCRIPTION

The front clutch assembly (Fig. 83) is composed of the front clutch retainer, pressure plate, clutch plates, driving discs, piston, piston return spring, return spring retainer, and snap-rings. The front clutch is the forward-most 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.

FRONT CLUTCH (Continued)

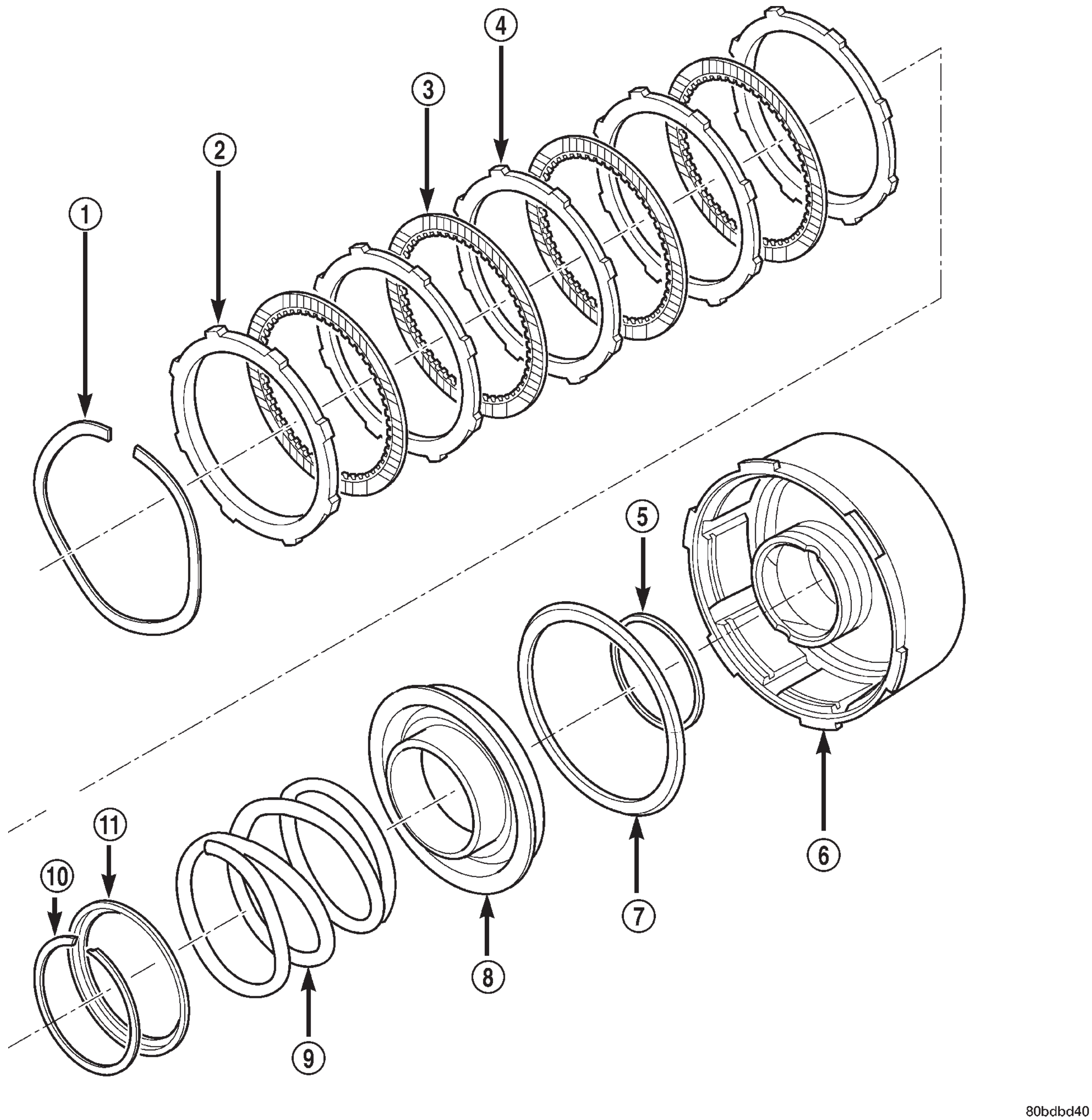


Fig. 83 Front Clutch Components

1 - SNAP-RING (WAVE)
2 - REACTION PLATE
3 - CLUTCH DISC
4 - CLUTCH PLATE
5 - SEAL
6 - CLUTCH RETAINER
7 - SEAL
8 - PISTON
9 - SPRING
10 - SNAP-RING
11 - SPRING RETAINER

FRONT CLUTCH (Continued)

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.

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.

DISASSEMBLY

(1) Remove waved snap-ring and remove pressure plate, clutch plates and clutch discs (Fig. 84).

(2) Compress clutch piston spring with Compressor Tool C-3575-A (Fig. 85). 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 retainer piston bore and clutch retainer hub. Discard both seals as they are not reusable.

FRONT CLUTCH (Continued)

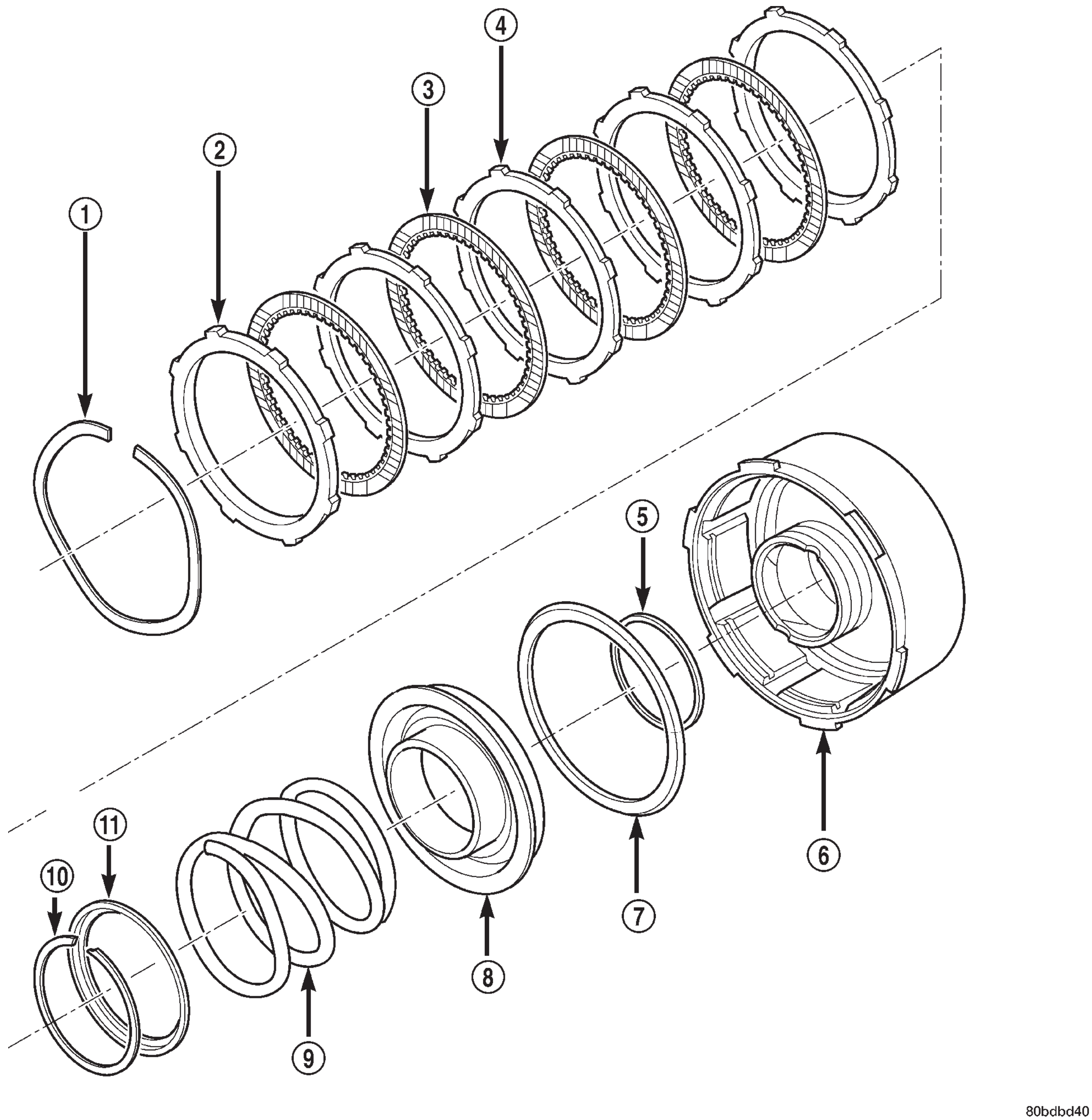


Fig. 84 Front Clutch Components - Typical

1 - SNAP-RING (WAVE)
2 - REACTION PLATE
3 - CLUTCH DISC
4 - CLUTCH PLATE
5 - SEAL
6 - CLUTCH RETAINER
7 - SEAL
8 - PISTON
9 - SPRING
10 - SNAP-RING
11 - SPRING RETAINER

FRONT CLUTCH (Continued)

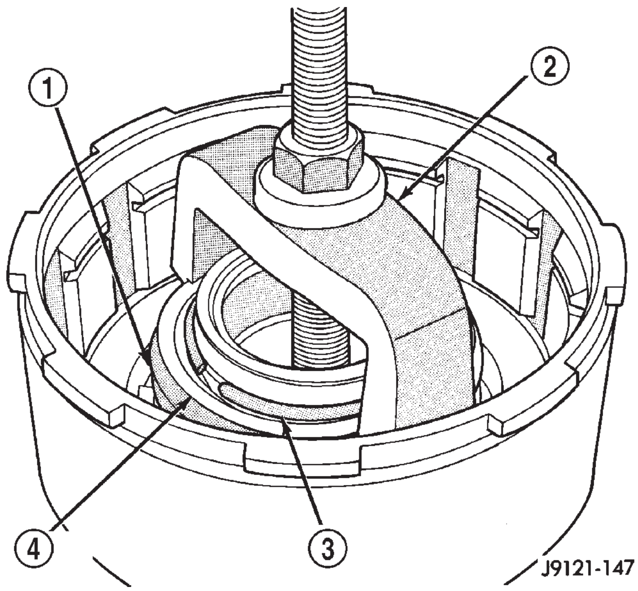


Fig. 85 Compressing Front Clutch Piston Spring

1 - FRONT CLUTCH SPRING
2 - COMPRESSOR TOOL C-3575-A
3 - RETAINER SNAP-RING
4 - SPRING RETAINER

INSPECTION

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. 86). The ball must move freely and not stick.

NOTE: Inspect the clutch retainer bushings carefully (Fig. 87). 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.

ASSEMBLY

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

(2) Install new seals in the clutch retainer lower groove and on the outer diameter of the retainer hub.

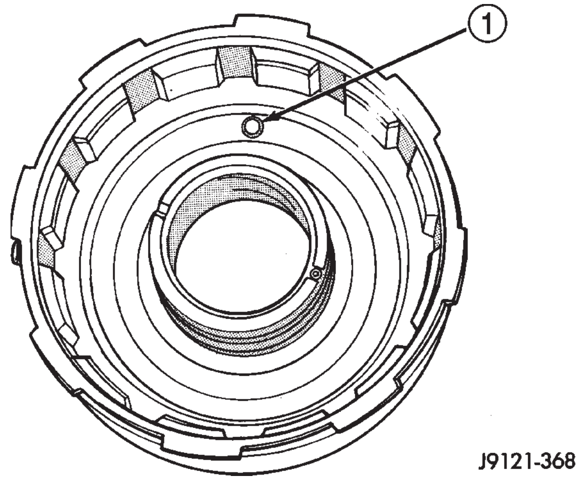


Fig. 86 Front Clutch Piston Retainer Check Ball Location

1 - RETAINER CHECK BALL

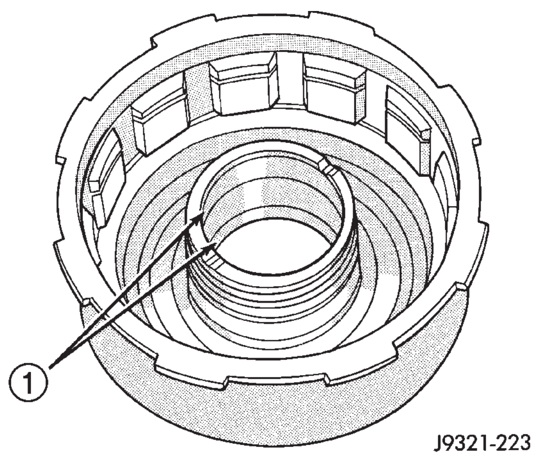


Fig. 87 Retainer Bushing Location/Inspection

1 - FRONT CLUTCH RETAINER BUSHINGS (NON-SERVICEABLE)

Be sure lip of each seal faces interior of clutch retainer.

(3) Lubricate lips of the retainer seals with liberal quantity of Mopar® Door Ease. Then lubricate retainer hub, bore, and piston with light coat of transmission fluid.

(4) Install clutch piston in retainer (Fig. 88). Use twisting motion to seat piston in bottom of retainer.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip.

(5) Position spring in clutch piston (Fig. 89).

(6) Position spring retainer on top of piston spring. Make sure retainer is properly installed (Fig. 84).

FRONT CLUTCH (Continued)

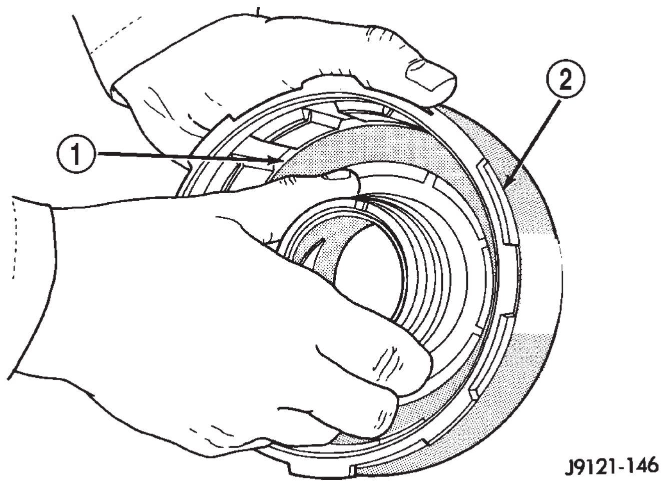


Fig. 88 Front Clutch Piston Installation

1 - CLUTCH PISTON
2 - FRONT CLUTCH RETAINER

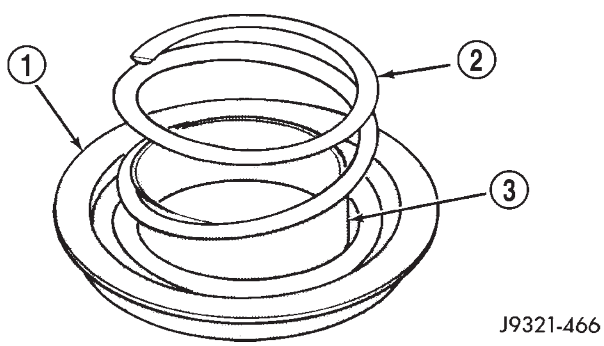


Fig. 89 Clutch Piston Spring Installation

1 - RETAINER
2 - CLUTCH SPRING
3 - PISTON

(7) Compress piston spring and retainer with Compressor Tool C-3575-A (Fig. 85). Then install new snap ring to secure spring retainer and spring.

(8) Install clutch plates and discs. Install steel plate then disc until all plates and discs are installed.

(9) Install pressure plate and waved snap-ring.

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.

FRONT SERVO

DESCRIPTION

The kickdown servo (Fig. 90) 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.

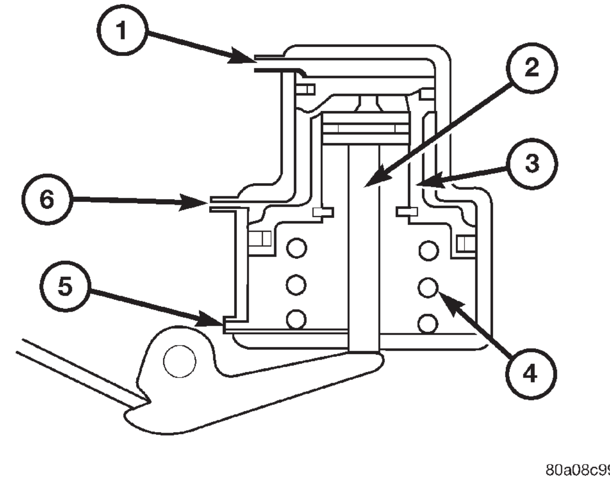


Fig. 90 Front Servo

1 - VENT
2 -PISTON ROD
3 - PISTON
4 - SPRING
5 - RELEASE PRESSURE
6 - APPLY PRESSURE

OPERATION

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.

DISASSEMBLY

(1) Remove seal ring from rod guide (Fig. 91).

(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.

FRONT SERVO (Continued)

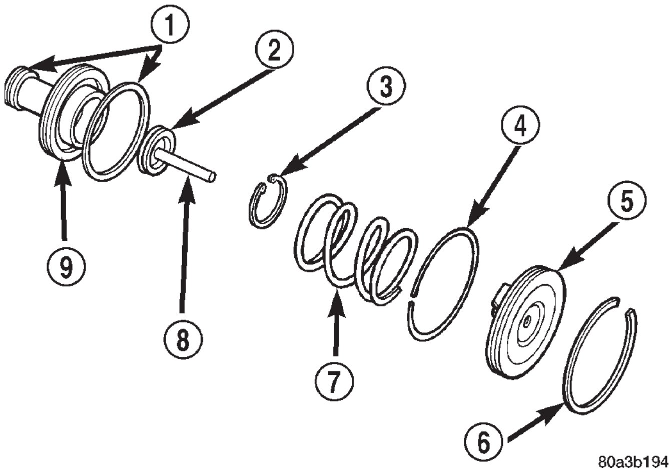


Fig. 91 Front Servo Piston

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

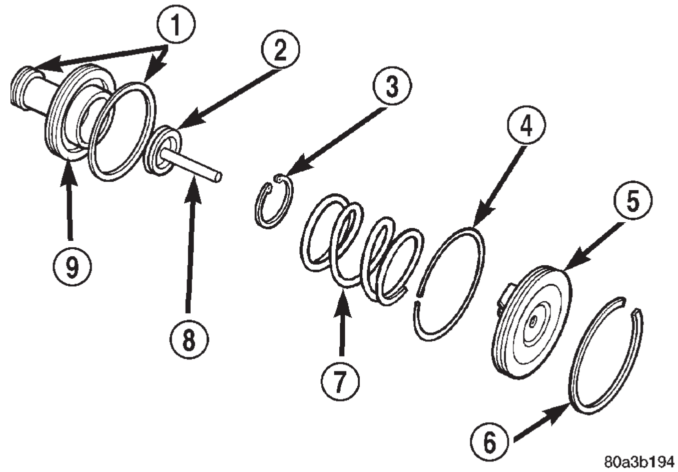


Fig. 92 Front Servo Piston

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

CLEANING

Clean the servo piston components (Fig. 92) 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.

Replace any servo component if doubt exists about condition. Do not reuse suspect parts.

INSPECTION

Inspect the servo components (Fig. 93). 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.

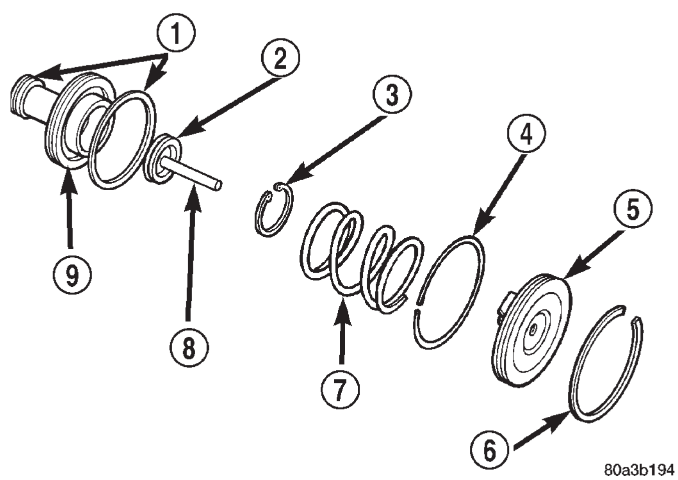


Fig. 93 Front Servo Piston

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

FRONT SERVO (Continued)

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. 94).

(3) Set servo components aside for installation during transmission reassembly.

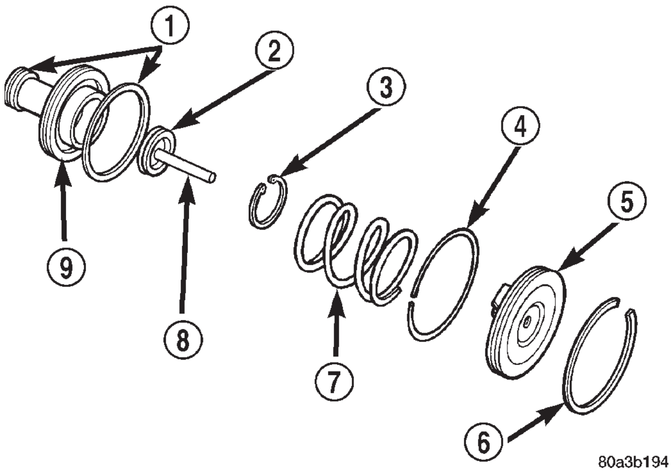


Fig. 94 Front Servo Piston

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

GEARSHIFT CABLE

DIAGNOSIS AND TESTING - 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.

REMOVAL

(1) Shift transmission into PARK.

(2) Remove shift lever bezel and necessary console parts for access to shift lever assembly. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

(3) Disconnect cable at shift lever and feed cable through dash panel opening to underside of vehicle.

(4) Raise vehicle.

(5) Disengage cable eyelet at transmission shift lever and pull cable adjuster out of mounting bracket. Then remove old cable from vehicle.

INSTALLATION

(1) Route cable through hole in dash panel. Fully seat cable grommet into dash panel.

(2) Place the auto transmission manual shift control lever in “PARK” detent (rearmost) position and rotate prop shaft to ensure transmission is in PARK.

(3) Connect shift cable to shifter mechanism by snapping cable retaining ears into shifter bracket and press cable end fitting onto lever ball stud.

(4) Place the floor shifter lever in PARK position. Ensure that the pawl is seated within the confines of the adjustment gauge clip.

(5) Snap the cable into the transmission bracket so the retaining ears are engaged and connect cable end fitting onto the manual control lever ball stud.

(6) Lock shift cable into position by pushing upward on the adjusting lock button.

(7) Remove and discard the shift cable adjustment gauge clip from the park gate of the shifter.

(8) Install any floor console components removed previously. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

GEARSHIFT CABLE (Continued)

ADJUSTMENTS

ADJUSTMENT - 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 transmission range sensor 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. 95).

(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.

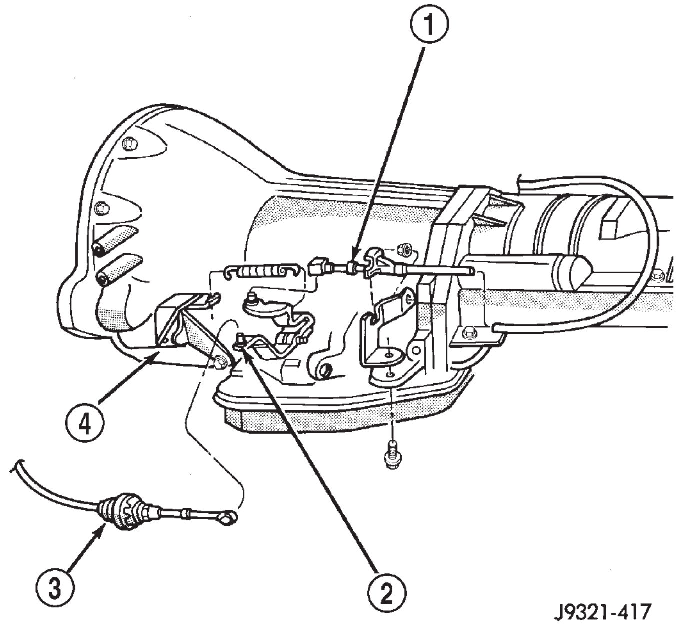


Fig. 95 Shift Cable Attachment At Transmission-Typical

1 - THROTTLE VALVE CABLE
2 - TRANSMISSION SHIFT LEVER
3 - SHIFT CABLE
4 - SHIFT CABLE BRACKET

GOVERNOR AND PARK GEAR

DESCRIPTION

The governor (Fig. 96) valve body is attached to the output shaft of the transmission.

OPERATION

The governor meters hydraulic pressure (Fig. 97), 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. 98), 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. 99), 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

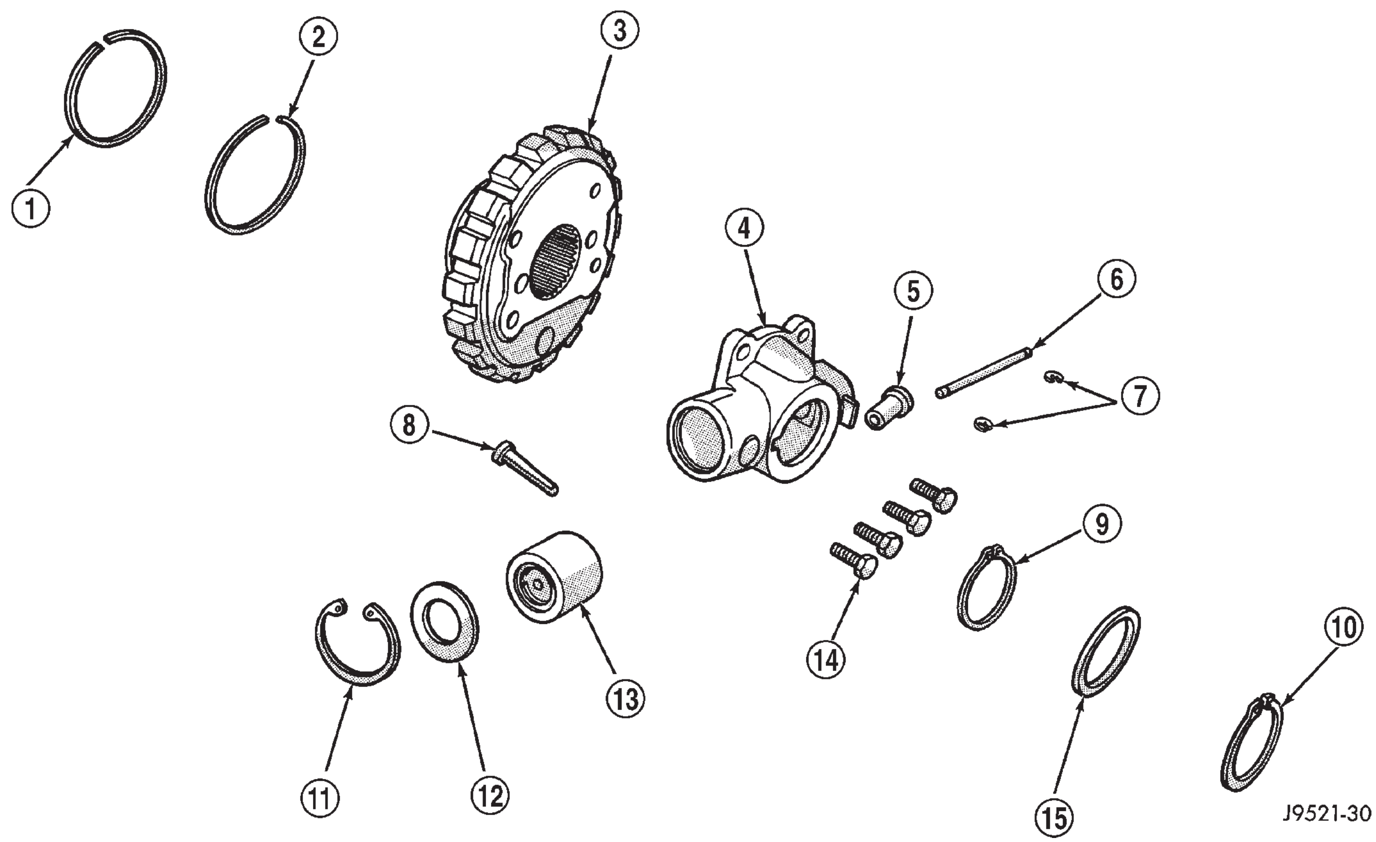


Fig. 96 Governor

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
8 - FILTER
9 - SNAP-RING (THIN)
10 - SNAP-RING (THICK)
11 - SNAP-RING
12 - RETAINER WASHER
13 - GOVERNOR WEIGHT ASSEMBLY
14 - GOVERNOR BODY BOLTS
15 - WASHER

GOVERNOR AND PARK GEAR (Continued)

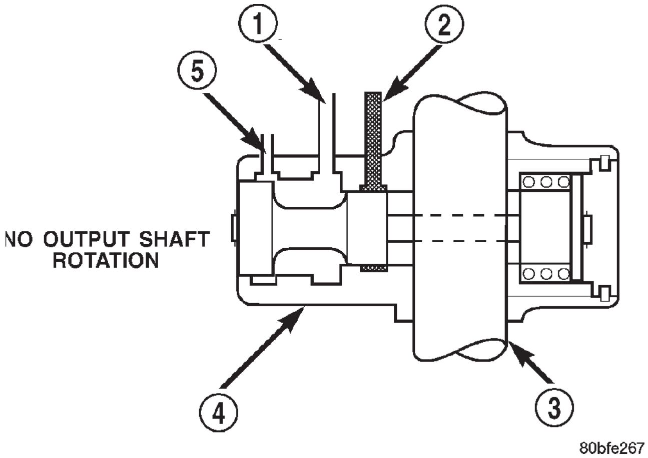


Fig. 97 Governor - No Output Shaft Rotation

1 - GOVERNOR PRESSURE
2 - LINE PRESSURE
3 - OUTPUT SHAFT
4 - GOVERNOR
5 - VENT

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.

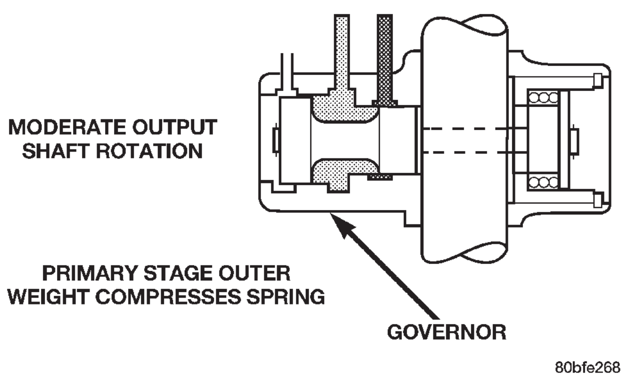


Fig. 98 Governor - Moderate Output Shaft Rotation

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.

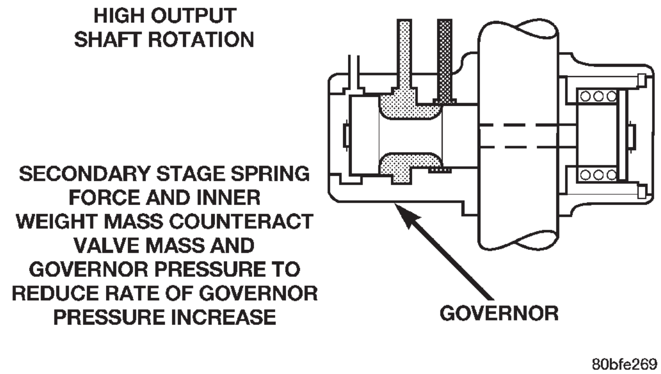


Fig. 99 Governor - High Output Shaft Rotation

(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. 100).

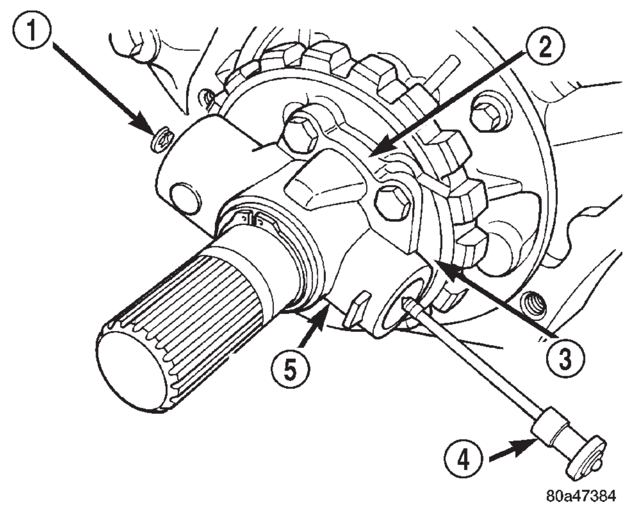


Fig. 100 Governor Valve

1 - E-CLIP
2 - PARK GEAR
3 - CURVER BOSS
4 - GOVERNOR VALVE
5 - GOVERNOR

(10) Remove governor valve and shaft from governor body (Fig. 100).

GOVERNOR AND PARK GEAR (Continued)

(11) Remove snap rings and spacer that retain governor body and park gear assembly on output shaft (Fig. 101).

(12) Remove bolts holding governor body to park gear (Fig. 102).

(13) Separate governor from park gear.

(14) Pull park gear from rear support.

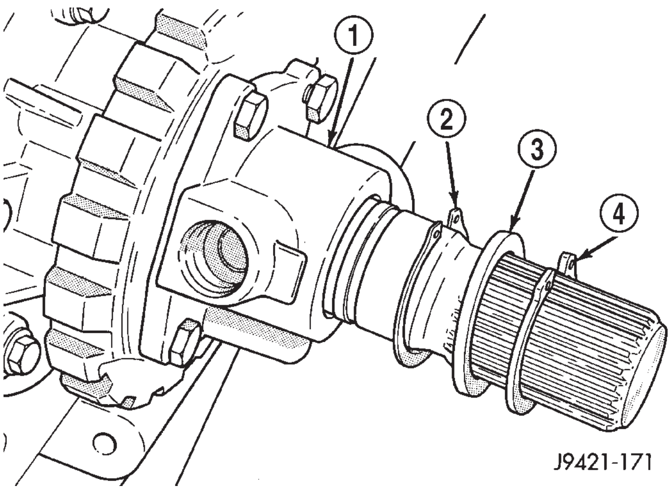


Fig. 101 Snap-Rings And Spacer

1 - GOVERNOR BODY
2 - THIN SNAP-RING
3 - THRUST WASHER
4 - THICK SNAP-RING

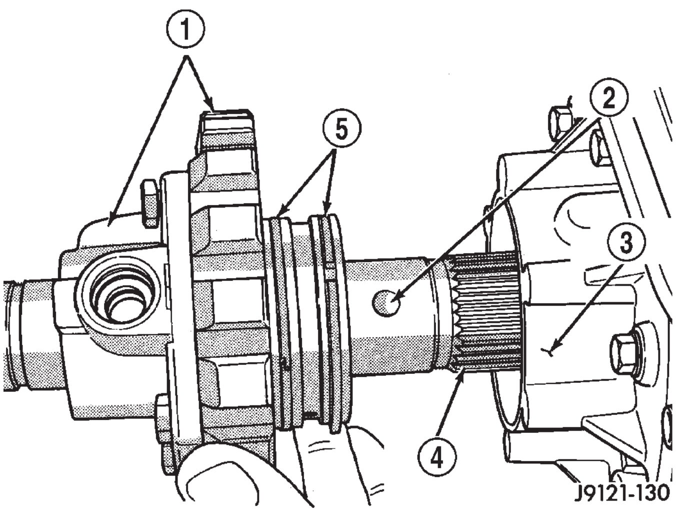


Fig. 102 Governor Body

1 - GOVERNOR/PARK ASSEMBLY
2 - GOVERNOR VALVE SHAFT BORE
3 - REAR SUPPORT
4 - OUTPUT SHAFT SPLINES
5 - SEAL RINGS

DISASSEMBLY

(1) Remove governor body from transmission.

(2) Clean and inspect governor filter (Fig. 103).

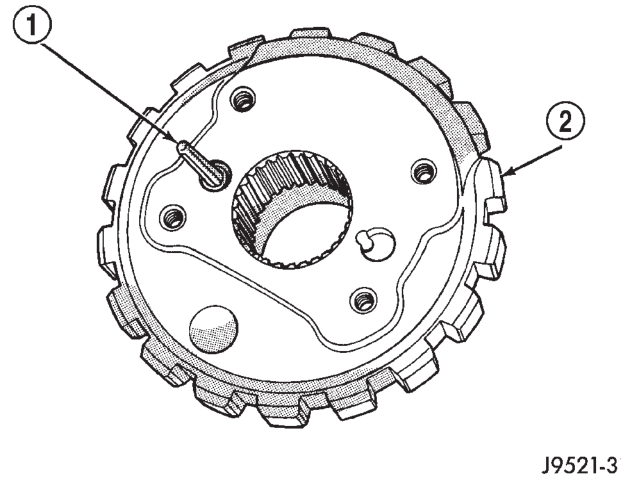


Fig. 103 Governor Filter

1 - GOVERNOR FILTER
2 - PARK GEAR

(3) Remove snap-ring and washer that secure governor weight assembly in body (Fig. 104).

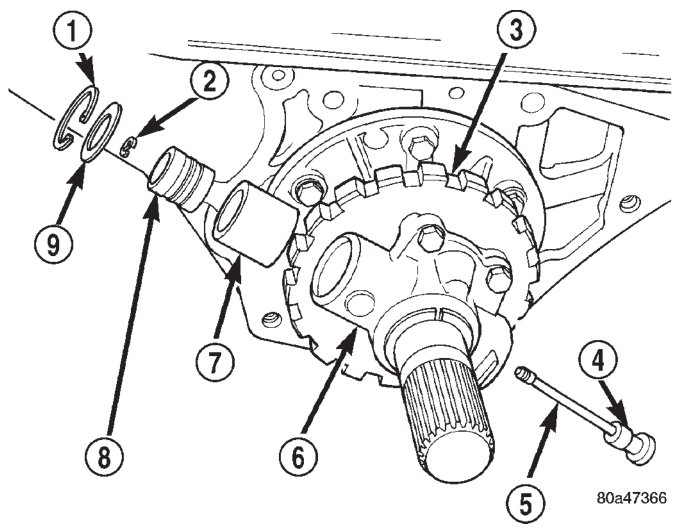


Fig. 104 Snap-Ring, Washer, and Outer Weight

1 - SNAP-RING
2 - E-CLIP
3 - PARK GEAR
4 - GOVERNOR VALVE
5 - SHAFT
6 - GOVERNOR
7 - OUTER WEIGHT
8 - INTERMEDIATE WEIGHT
9 - WASHER

GOVERNOR AND PARK GEAR (Continued)

(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. 105).

(7) Push inner weight downward with nut driver. Then remove inner weight snap-ring with Snap-Ring Pliers 6823 (Fig. 105).

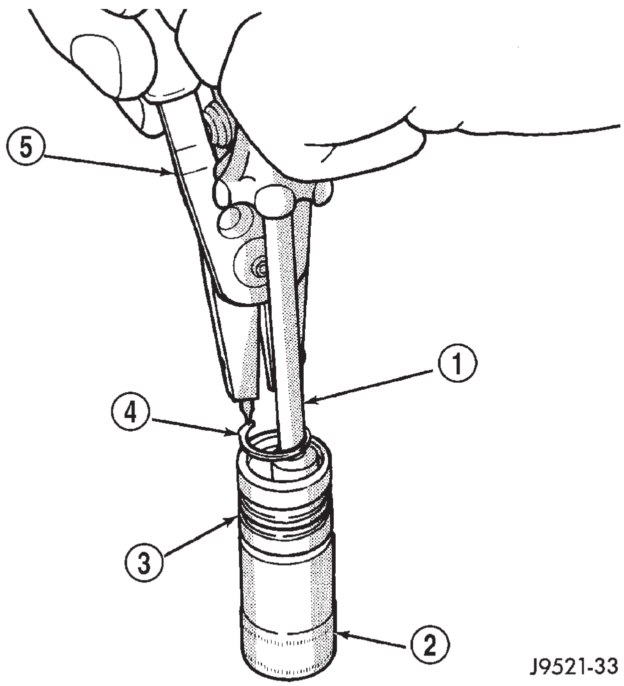


Fig. 105 Inner Weight Snap-Ring

1 - NUT DRIVER
2 - SUITABLE SIZE SOCKET
3 - INTERMEDIATE WEIGHT
4 - INNER WEIGHT SNAP-RING
5 - SPECIAL TOOL 6823

(8) Remove inner weight and spring from intermediate weight (Fig. 106).

CLEANING

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. 107) and the governor valve (Fig. 108), must slide freely in their bores when clean and dry. Minor surface scratches and burrs can be smoothed with crocus cloth.

INSPECTION

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.

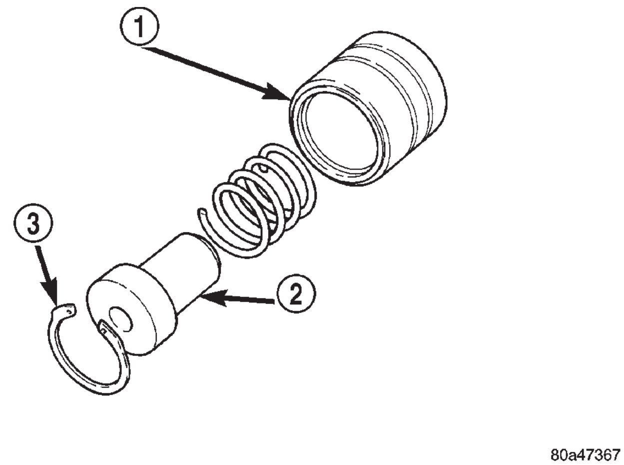


Fig. 106 Intermediate and Inner Governor Weights

1 - INTERMEDIATE WEIGHT
2 - INNER WEIGHT
3 - SNAP-RING

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.

ASSEMBLY

CAUTION: Exercise care when installing the seal 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 +4, Type 9602 transmission fluid before assembly.

(2) Clean and inspect governor weights and bores for scoring or wear. Replace the governor body and weights if damaged.

(3) Insert spring into intermediate weight.

(4) Insert inner weight into intermediate weight and install snap-ring (Fig. 106). Verify snap-ring is

GOVERNOR AND PARK GEAR (Continued)

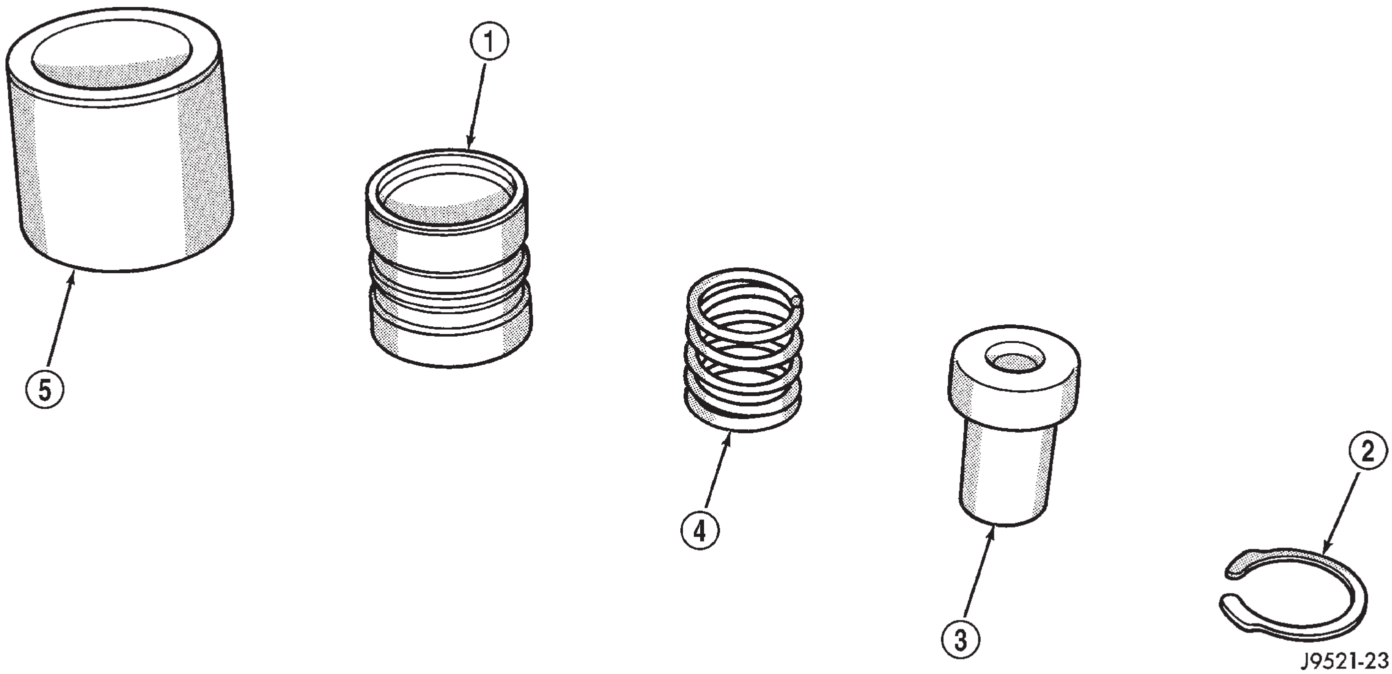


Fig. 107 Governor Weights

1 - INTERMEDIATE WEIGHT
2 - SNAP-RING
3 - INNER WEIGHT
4 - INNER WEIGHT SPRING
5 - OUTER WEIGHT

fully seated in groove in intermediate weight (Fig. 105).

(5) Assemble governor weights into governor body (Fig. 104).

(6) Install washer and snap-ring to hold weights in governor body.

(7) Install governor body in transmission

INSTALLATION

(1) Install park gear into rear support so crown on curved boss is in line with hole through output shaft.

(2) Install governor filter in park gear.

(3) Slip governor body over output shaft and align port to filter.

(4) Install bolts to hold governor body to park gear. Tighten bolts to 11 N·m (95 in. lbs.) torque (Fig. 102).

(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. 101).

(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. 100).

(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.

GOVERNOR AND PARK GEAR (Continued)

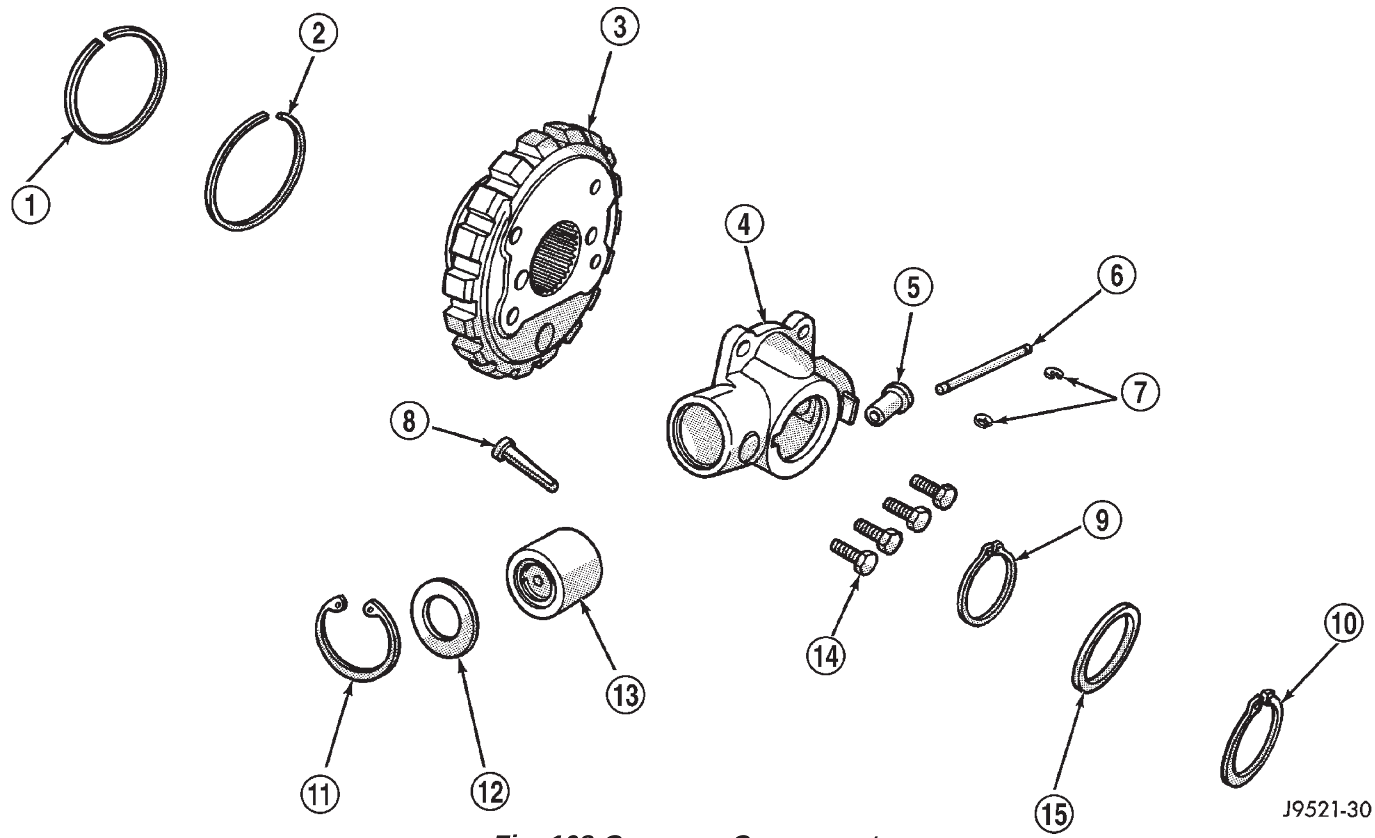


Fig. 108 Governor Components

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
8 - FILTER
9 - SNAP-RING (THIN)
10 - SNAP-RING (THICK)
11 - SNAP-RING
12 - RETAINER WASHER
13 - GOVERNOR WEIGHT ASSEMBLY
14 - GOVERNOR BODY BOLTS
15 - WASHER

OIL PUMP

DESCRIPTION

The oil pump (Fig. 109) is located in the pump housing inside the bell housing of the transmission case. The oil pump consists of an inner and outer gear (Fig. 110), a housing, and a cover that also serves as the reaction shaft support.

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.

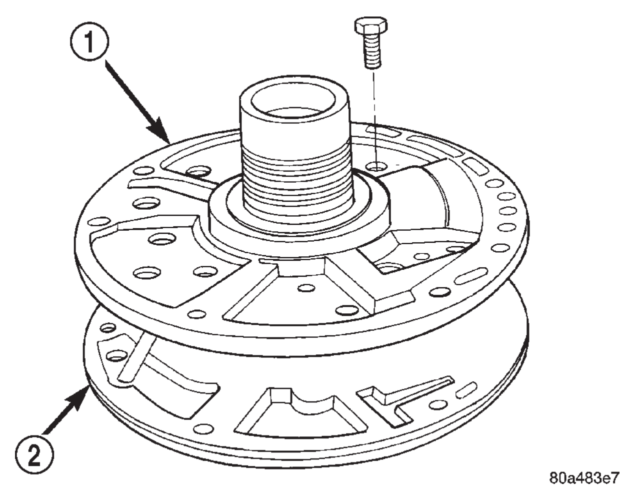


Fig. 109 Oil Pump and Reaction Shaft Support

1 - REACTION SHAFT SUPPORT
2 - PUMP

OIL PUMP (Continued)

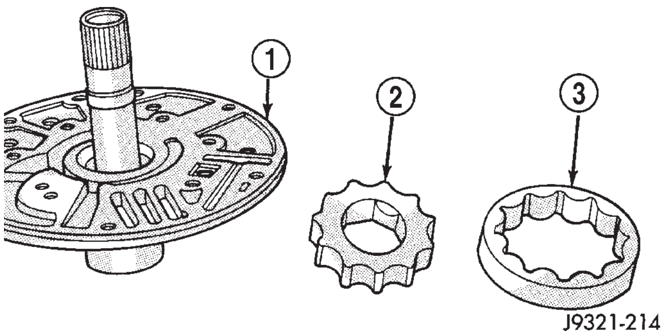


Fig. 110 Pump Gear Removal

1 - REACTION SHAFT SUPPORT
2 - INNER GEAR
3 - OUTER GEAR

STANDARD PROCEDURE - 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 +4, type 9602, 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.

DISASSEMBLY

(1) Remove seal ring from housing and reaction shaft support (Fig. 111).

(2) Mark pump housing and support assembly for alignment reference.

(3) Remove bolts attaching pump body to support (Fig. 112).

(4) Separate support from pump housing (Fig. 113).

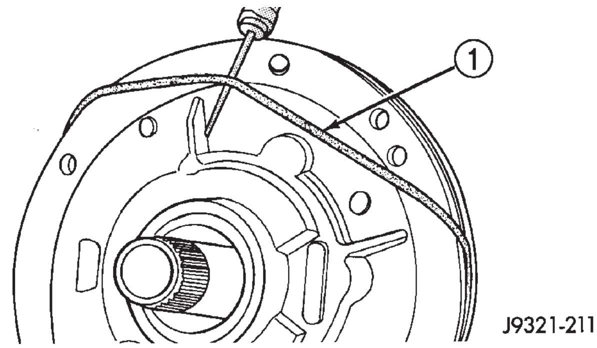


Fig. 111 Removing Pump Seal Ring

1 - PUMP HOUSING SEAL RING

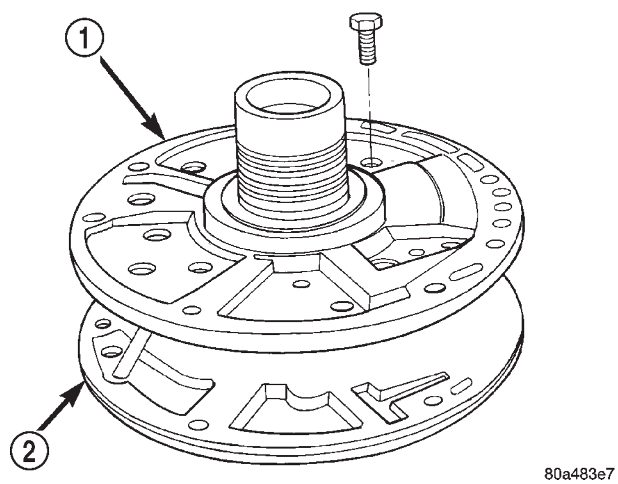


Fig. 112 Pump Support Bolts

1 - REACTION SHAFT SUPPORT
2 - PUMP

(5) Remove inner and outer gears from reaction shaft support (Fig. 114).

(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. 115).

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. 116).

(2) Install new pump bushing with Tool Handle C-4171 and Bushing Installer SP-5117 (Fig. 116). Bushing should be flush with pump housing bore.

(3) Stake new pump bushing in two places with blunt punch (Fig. 117). Remove burrs from stake points with knife blade afterward.

OIL PUMP (Continued)

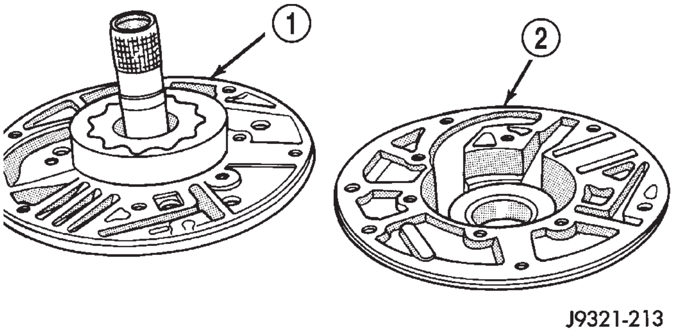


Fig. 113 Separating Pump Housing From Reaction Shaft Support

1 - REACTION SHAFT SUPPORT
2 - PUMP HOUSING

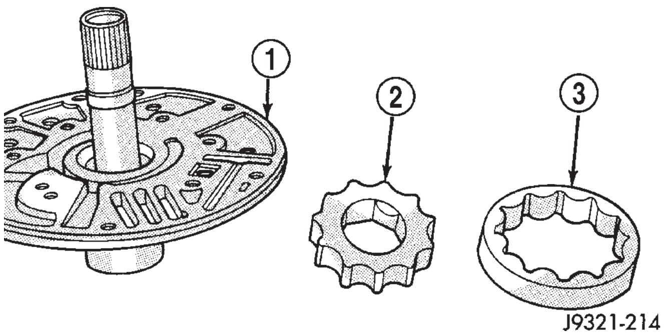


Fig. 114 Pump Gear Removal

1 - REACTION SHAFT SUPPORT
2 - INNER GEAR
3 - OUTER GEAR

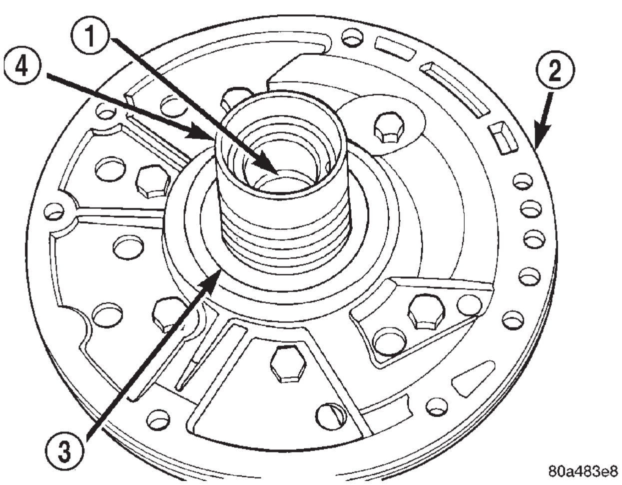


Fig. 115 Support Hub Thrust Washer

1 - BUSHING
2 - REACTION SHAFT SUPPORT
3 - THRUST WASHER
4 - HUB

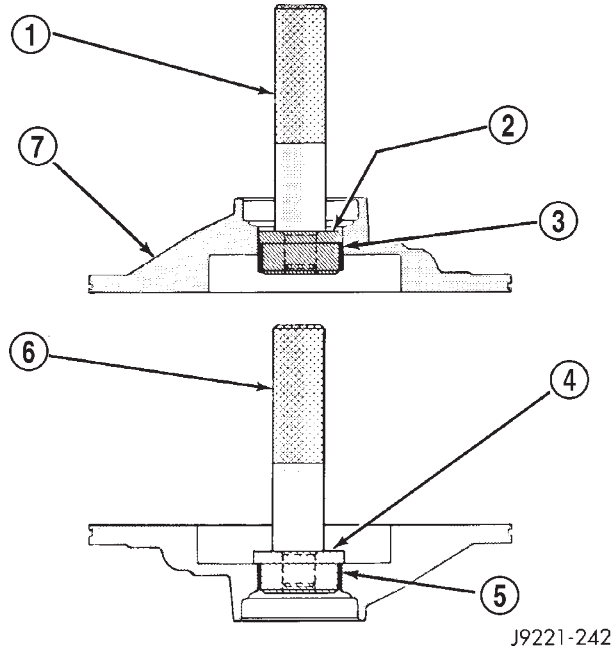


Fig. 116 Removing Oil Pump Bushing

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

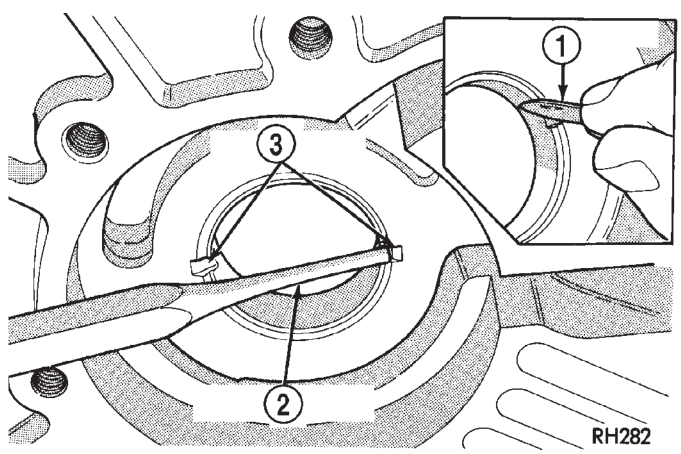


Fig. 117 Staking Oil Pump Bushing

1 - NARROW BLADE
2 - BLUNT PUNCH
3 - TWO STAKES

OIL PUMP (Continued)

REACTION SHAFT SUPPORT BUSHING REMOVAL

(1) Assemble Bushing Remover Tools SP-1191, 3633 and 5324 (Fig. 118). Do not clamp any part of reaction shaft or support in vise.

(2) Hold Cup Tool SP-3633 firmly against reaction shaft and thread remover SP-5324 into bushing as far as possible by hand. Then thread remover tool 3-4 additional turns into bushing with a wrench.

(3) Turn remover tool hex nut down against remover cup to pull bushing from shaft. Clean all chips from shaft after bushing removal.

(4) Lightly grip old bushing in vise or with pliers and back remover tool out of bushing.

(5) Assemble Bushing Installer Tools C-4171 and SP-5325 (Fig. 118).

(6) Slide new bushing onto Installer Tool SP-5325.

(7) Position reaction shaft support upright on a clean smooth surface.

(8) Align bushing in bore. Then tap bushing into place until Bushing Installer SP-5325 bottoms.

(9) Clean reaction shaft support thoroughly after installing bushing.

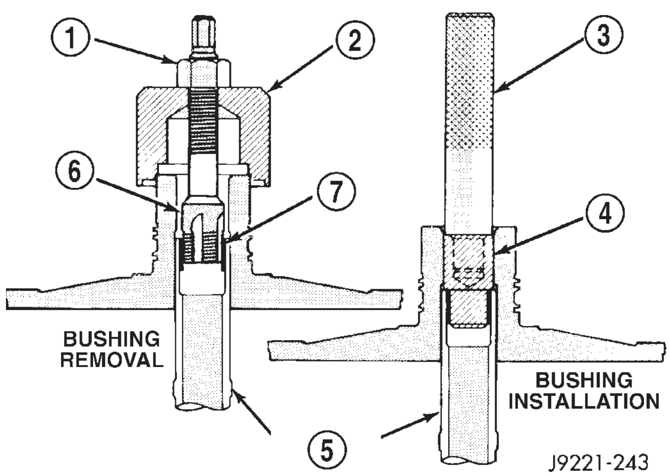


Fig. 118 Replacing Reaction Shaft Support Bushing

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

CLEANING

Clean pump and support components with solvent and dry them with compressed air.

INSPECTION

Check condition of the seal rings and thrust washer on the reaction shaft support. The seal rings do not need to be replaced unless cracked, broken, or severely worn.

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.

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.

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 installing the gears in the pump body and measure pump component clearances as follows:

(1) Position an appropriate piece of Plastigage™ across both gears.

(2) Align the plastigage to a flat area on the reaction shaft housing.

(3) Install the reaction shaft to the pump housing.

(4) Separate the reaction shaft housing from the pump housing and measure the Plastigage™ following the instructions supplied with it.

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.

Clearance between outer gear and pump housing should be 0.10 to 0.19 mm (0.004 to 0.0075 in.). Measure clearance with an appropriate feeler gauge.

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. 119).

(4) Install outer gear in pump housing (Fig. 119). Gear can be installed either way (it is not a one-way fit).

(5) Install pump inner gear (Fig. 120).

CAUTION: The pump inner gear is a one way fit. The bore on one side of the gear inside diameter (I.D.) is chamfered. Be sure the chamfered side faces forward (to front of pump).

(6) Install new thrust washer on hub of reaction shaft support. Lubricate washer with transmission fluid or petroleum jelly.

(7) If reaction shaft seal rings are being replaced, install new seal rings on support hub (Fig. 121). Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

OIL PUMP (Continued)

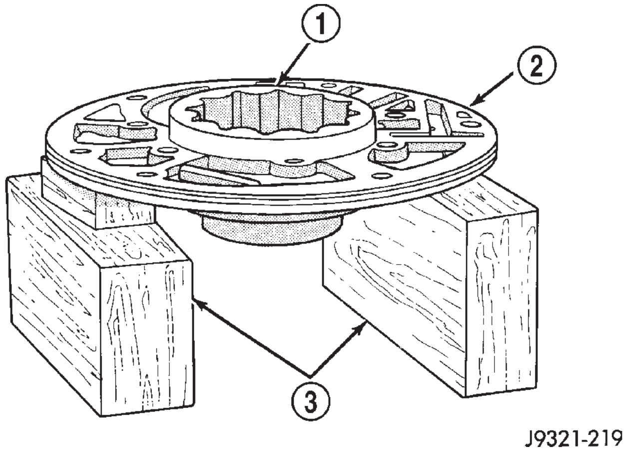


Fig. 119 Supporting Pump And Installing Outer Gear

1 - OUTER GEAR
2 - PUMP HOUSING
3 - WOOD BLOCKS

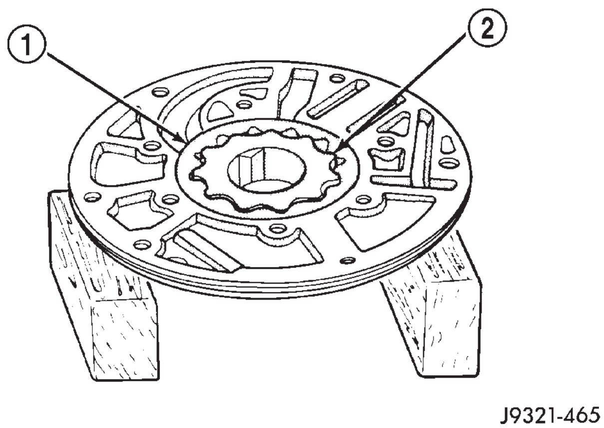


Fig. 120 Pump Inner Gear Installation

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.

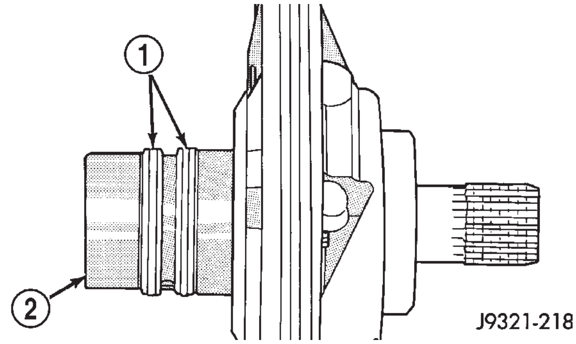


Fig. 121 Hub Seal Ring Position

1 - SEAL RINGS
2 - SUPPORT HUB

(8) Install reaction shaft support on pump housing (Fig. 122).

(9) Align reaction support on pump housing. Use alignment marks made at disassembly. Or, rotate support until bolt holes in support and pump housing are all aligned (holes are offset for one-way fit).

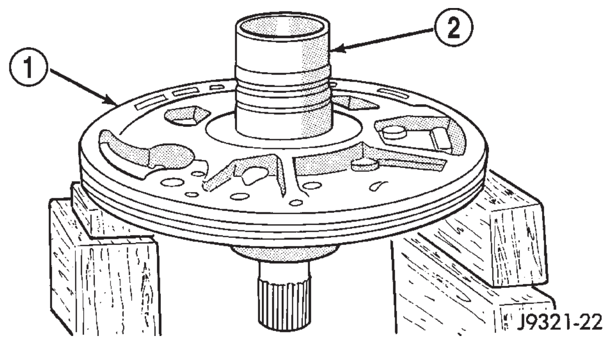


Fig. 122 Assembling Reaction Shaft Support And Pump Housing

1 - PUMP HOUSING
2 - REACTION SHAFT SUPPORT

(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.

OIL PUMP (Continued)

(b) Secure pump assembly in case with 2 or 3 bolts, or with pilot studs.

(c) Tighten support-to-pump bolts to 20 N·m (15 ft. lbs.).

(d) Remove pump assembly from transmission case.

(12) Install new oil seal in pump with Special Tool C-4193 and Tool Handle C-4171 (Fig. 123). 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.

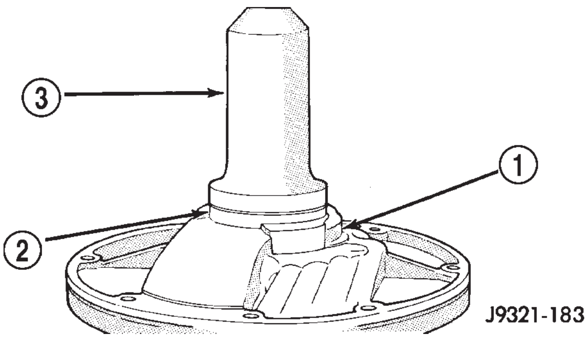


Fig. 123 Pump Oil Seal Installation

1 - PUMP BODY
2 - PUMP SEAL
3 - SPECIAL TOOL C-4193

OVERRUNNING CLUTCH

DESCRIPTION

The overrunning clutch (Fig. 124) 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.

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 free-wheeling 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.

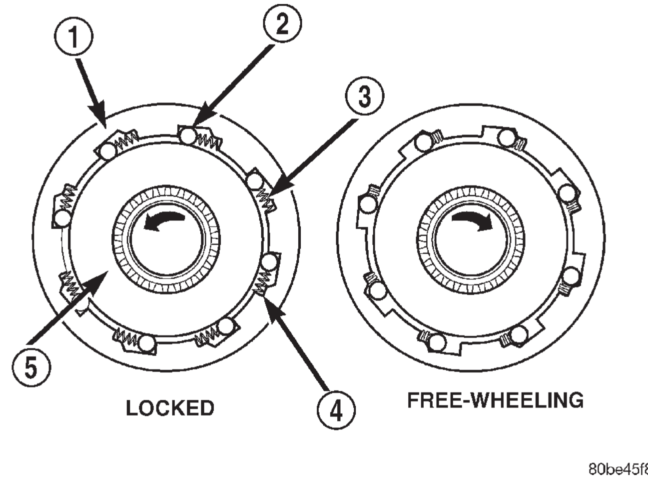


Fig. 124 Overrunning Clutch

1 - OUTER RACE (CAM)
2 - ROLLER
3 - SPRING
4 - SPRING RETAINER
5 - INNER RACE (HUB)

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. 125). Rotate the cam back and forth to ease removal if necessary.

(2) Remove the clutch roller and spring assembly from the overrunning clutch race.

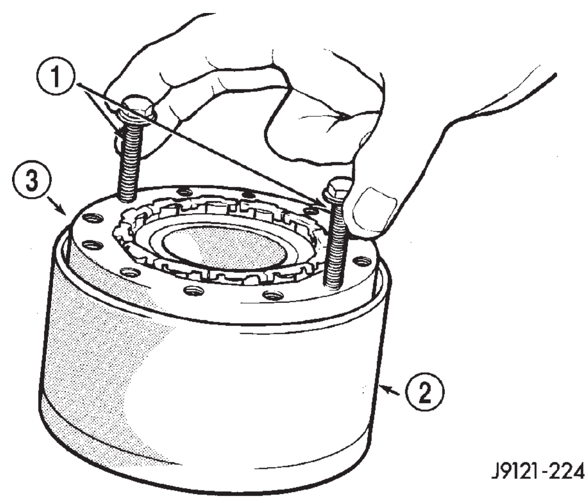


Fig. 125 Removing Overrunning Clutch From Low-Reverse Drum

1 - CAM BOLTS
2 - LOW-REVERSE DRUM
3 - OVERRUNNING CLUTCH AND CAM

OVERRUNNING CLUTCH (Continued)

CLEANING

Clean the overrunning clutch assembly, clutch cam, low-reverse drum, and overdrive piston retainer in solvent. Dry them with compressed air after cleaning.

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.**

INSPECTION

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.

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.

ASSEMBLY

(1) Assemble clutch rollers and springs in retainer if necessary (Fig. 126).

(2) Install overrunning clutch roller, spring and retainer assembly in clutch cam (Fig. 127).

(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. 128).

(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 (Fig. 129). **Drum should rotate freely in clockwise direction and lock when turned in counterclockwise direction (as viewed from front of case)**.

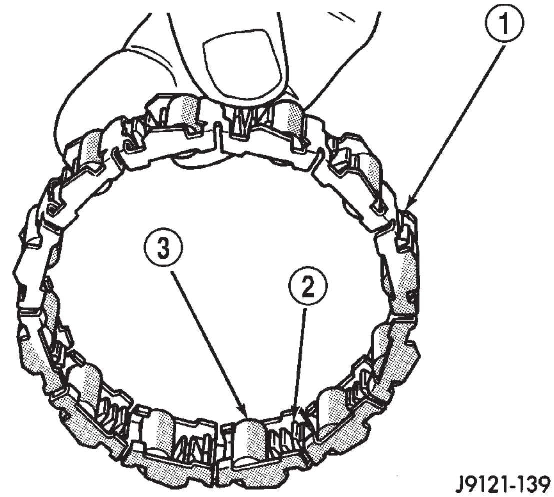


Fig. 126 Overrunning Clutch Rollers, Springs, Retainer

1 - RETAINER
2 - SPRING
3 - ROLLER

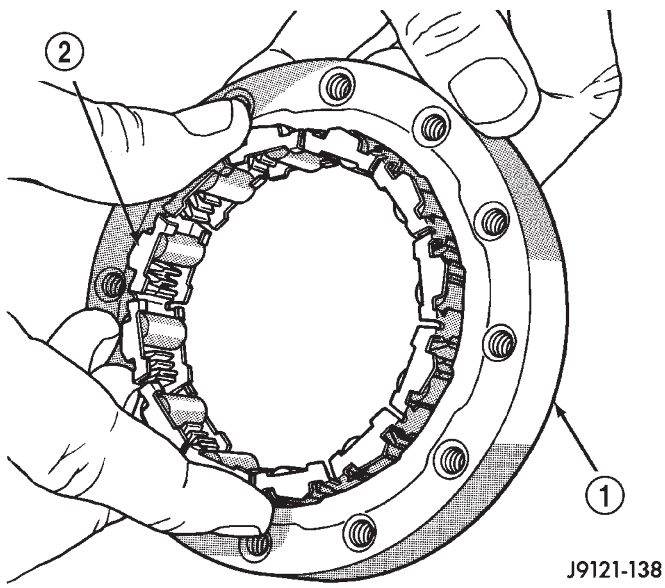


Fig. 127 Assembling Overrunning Clutch And Cam

1 - CLUTCH CAM
2 - CLUTCH ROLL ASSEMBLY

OVERRUNNING CLUTCH (Continued)

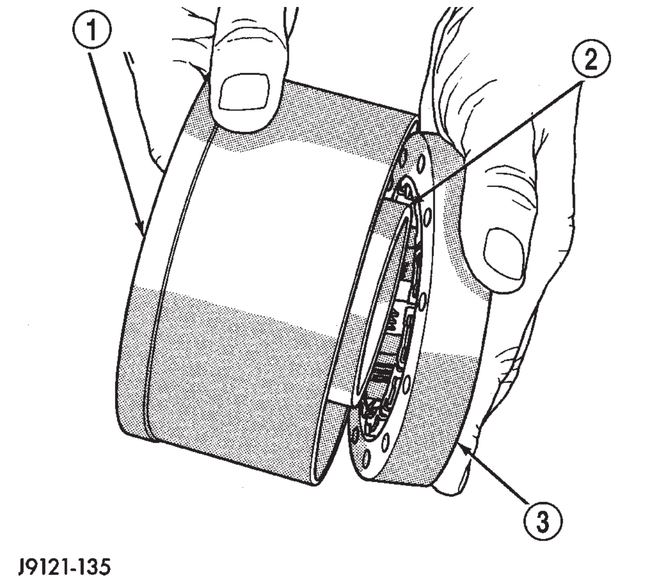


Fig. 128 Temporary Assembly Of Clutch And Drum To Check Operation

1 - LOW-REVERSE DRUM
2 - CLUTCH RACE (ON HUB OF DRUM)
3 - OVERRUNNING CLUTCH

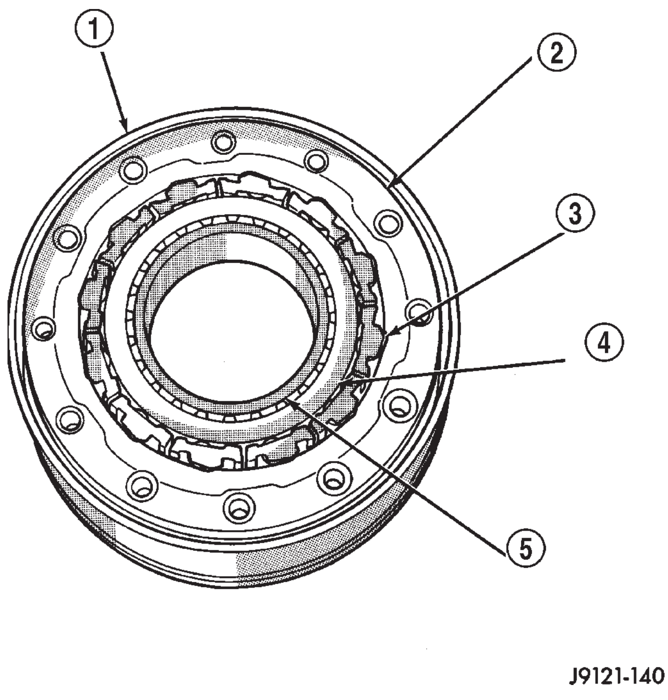


Fig. 129 Assembled Overrunning Clutch

1 - LOW-REVERSE DRUM
2 - OVERRUNNING CLUTCH CAM
3 - ROLLER AND SPRING ASSEMBLY
4 - CLUTCH RACE
5 - HUB OF LOW-REVERSE DRUM

PARK/NEUTRAL POSITION SWITCH

DESCRIPTION

The park/neutral position switch (Fig. 130) is threaded into the side of the transmission case, just above the transmission oil pan mounting surface. 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.

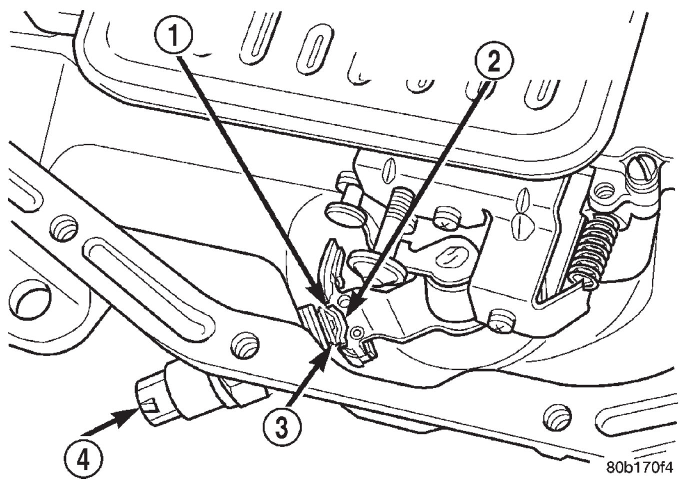


Fig. 130 Park/Neutral Position Switch

1 - NEUTRAL CONTACT
2 - MANUAL LEVER AND SWITCH PLUNGER IN REVERSE POSITION
3 - PARK CONTACT
4 - SWITCH

OPERATION

The park/netral position switch is operated by the manual lever of the valve body. When the valve body is in the PARK or NEUTRAL positions, the center terminal of the park/neutral position switch is grounded to the transmission case through the manual lever.

When the valve body is in the REVERSE position, the manual lever depresses the park/neutral position switch and connects the outer two terminals of the switch to provide continuity for the back-up lamp circuit.

DIAGNOSIS AND TESTING - 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.

PARK/NEUTRAL POSITION SWITCH (Continued)

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.

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. 131).

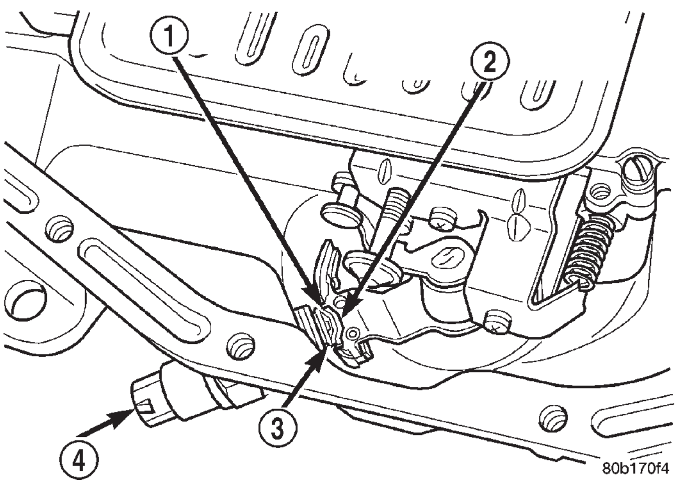


Fig. 131 Park/Neutral Position Switch

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.

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. 132).
(4) Remove snap-ring and slide reaction plug and pin assembly out of housing.
(5) If park rod requires service, it will be necessary to remove valve body.

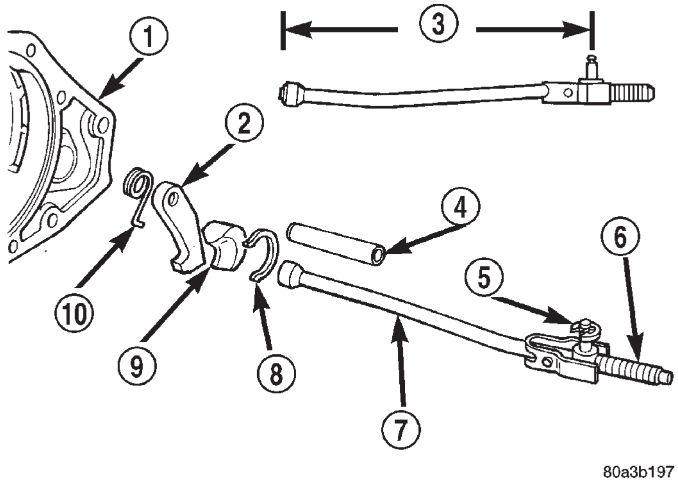


Fig. 132 Park Lock

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

CLEANING

Clean the park lock components in solvent and dry them with compressed air.

INSPECTION

Examine the park lock components in the housing. If replacement is necessary, remove the shaft with parallel jaw snap-ring pliers (Fig. 133) and remove the sprag and spring. Then remove the spring clip and reaction plug (Fig. 134). **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. 135). Also be sure the spring is correctly positioned as

PARK LOCK (Continued)

shown (Fig. 135). The sprag may not retract if the spring is improperly installed.

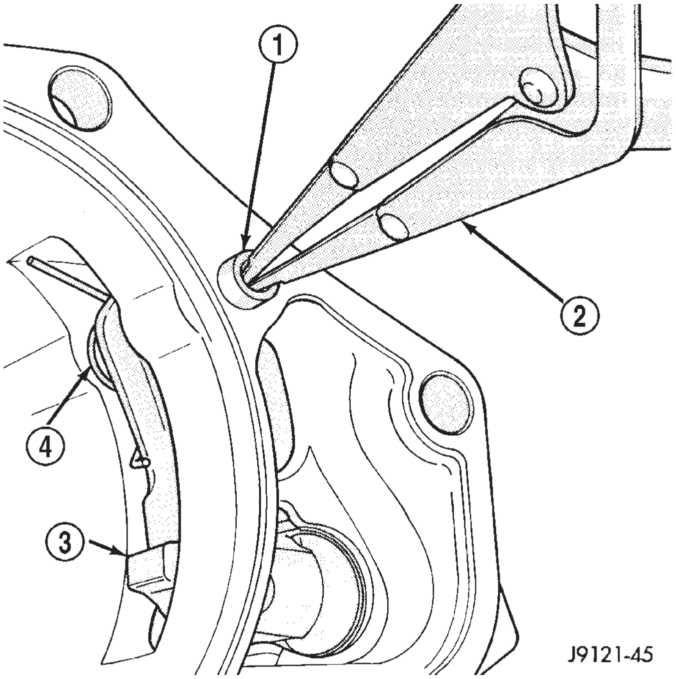


Fig. 133 Park Sprag, Shaft And Spring

1 - SPRAG SHAFT
2 - PARALLEL JAW SNAP-RING PLIERS
3 - SPRAG
4 - SPRING

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. 132).

(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.

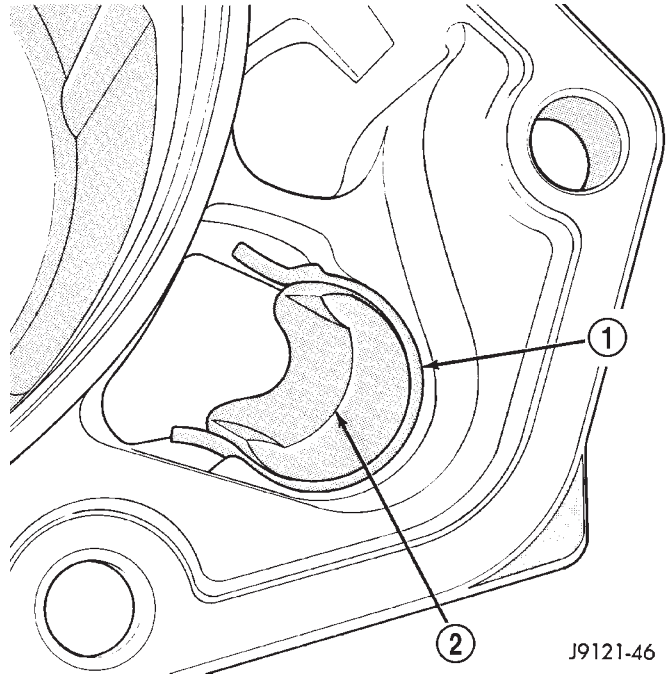


Fig. 134 Park Sprag Reaction Plug And Spring Location

1 - SPRING CLIP
2 - REACTION PLUG

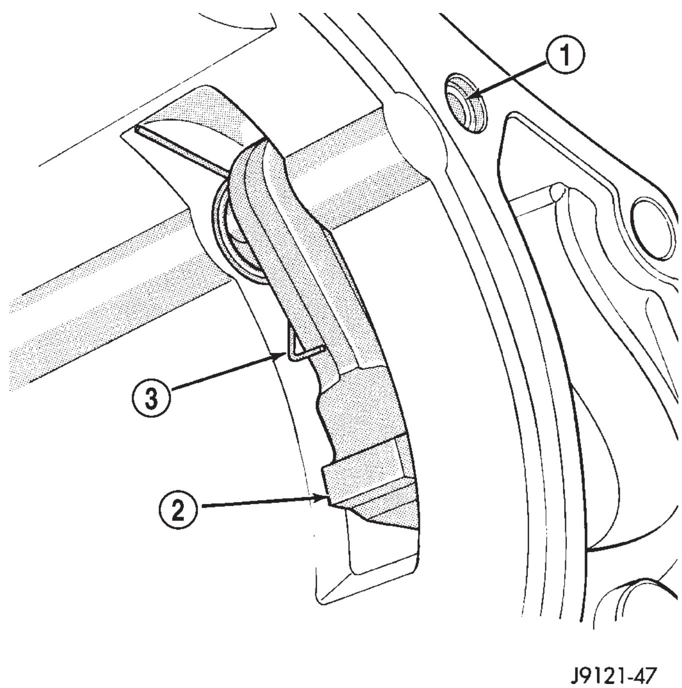


Fig. 135 Correct Position Of Sprag And Spring

1 - SPRAG SHAFT
2 - SPRAG LOCKING LUG
3 - SPRING

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. 136) 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.

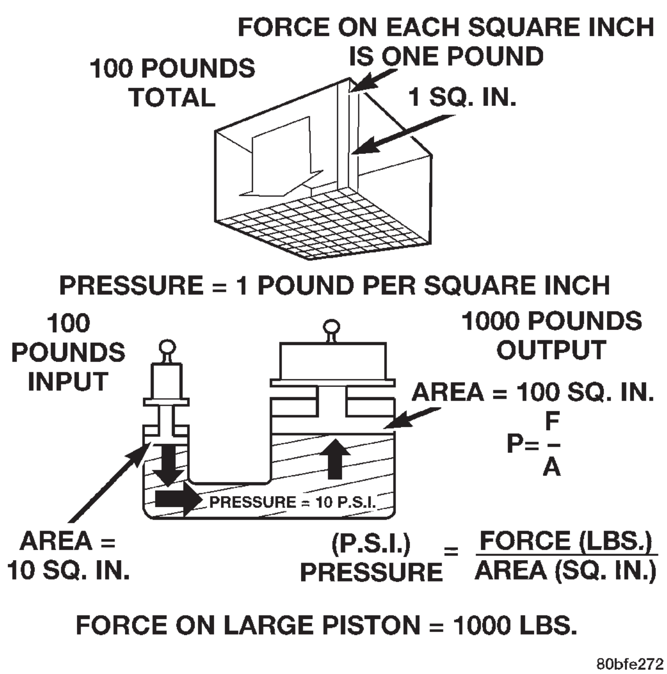


Fig. 136 Force and Pressure Relationship

PRESSURE ON A CONFINED FLUID

Pressure is exerted on a confined fluid (Fig. 137) 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 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.

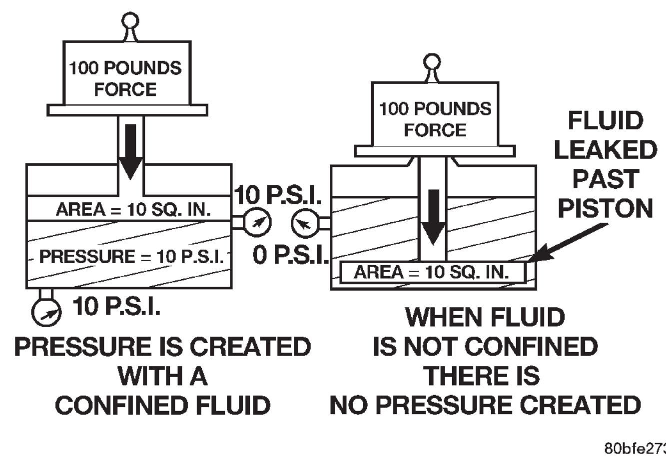


Fig. 137 Pressure on a Confined Fluid

FORCE MULTIPLICATION

Using the 10 PSI example used in the illustration (Fig. 138), 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. 138), 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

PISTONS (Continued)

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.

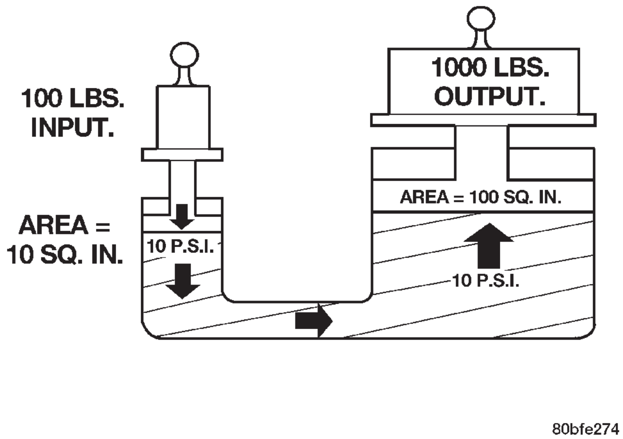


Fig. 138 Force Multiplication

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. 139) has to move ten times the distance required 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.

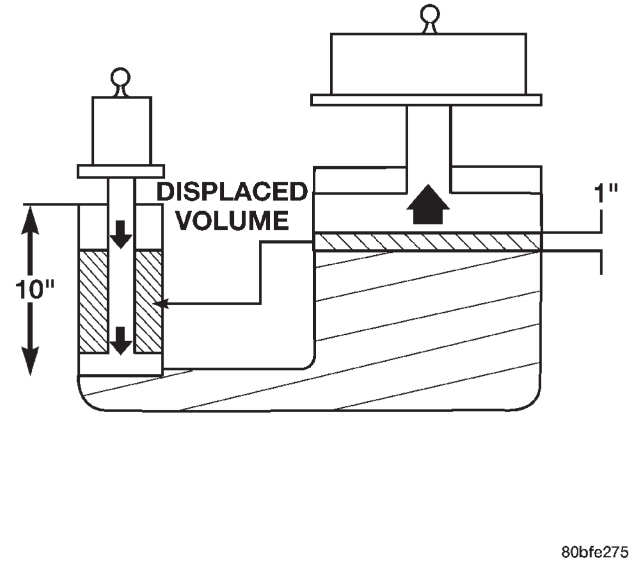


Fig. 139 Piston Travel

PLANETARY GEARTRAIN/ OUTPUT SHAFT

DESCRIPTION

The planetary gearsets (Fig. 140) are designated as the front and rear planetary gear assemblies and located in such order. A simple planetary gearset consists of three main members:

- 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.

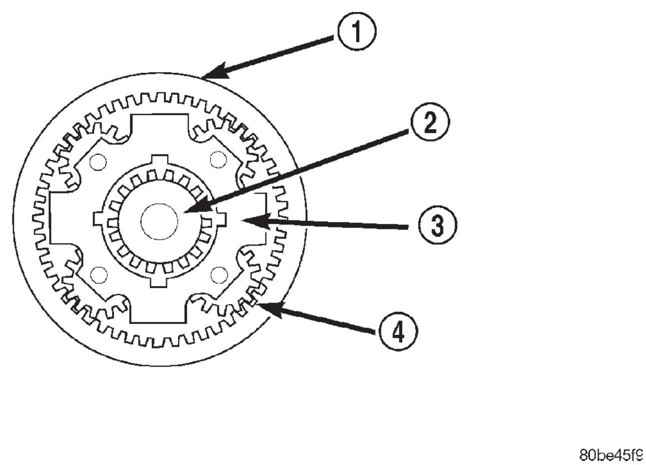


Fig. 140 Planetary Gearset

1 - ANNULUS GEAR
2 - SUN GEAR
3 - PLANET CARRIER
4 - PLANET PINIONS (4)

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.

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

• 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.

DISASSEMBLY

(1) Remove planetary snap-ring (Fig. 141).

(2) Remove front annulus and planetary assembly from driving shell (Fig. 141).

(3) Remove snap-ring that retains front planetary gear in annulus gear (Fig. 142).

(4) Remove tabbed thrust washer and tabbed thrust plate from hub of front annulus (Fig. 143).

(5) Separate front annulus and planetary gears (Fig. 143).

(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. 144).

(8) Remove front planetary rear thrust washer from driving shell.

(9) Remove tabbed thrust washers from rear planetary gear.

(10) Remove lock ring that retains sun gear in driving shell. Then remove sun gear, spacer and thrust plates.

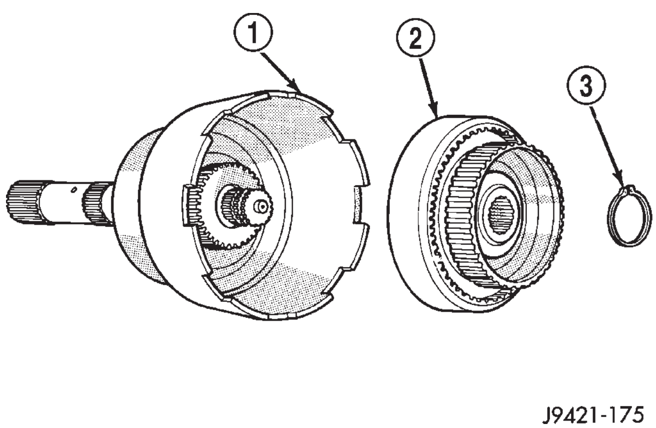


Fig. 141 Front Annulus And Planetary Assembly Removal

1 - DRIVING SHELL
2 - FRONT ANNULUS AND PLANETARY ASSEMBLY
3 - PLANETARY SNAP-RING

CLEANING

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.

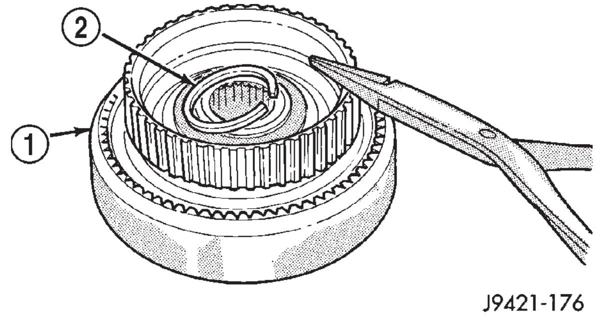


Fig. 142 Front Planetary Snap-Ring Removal

1 - FRONT ANNULUS GEAR
2 - PLANETARY SNAP-RING

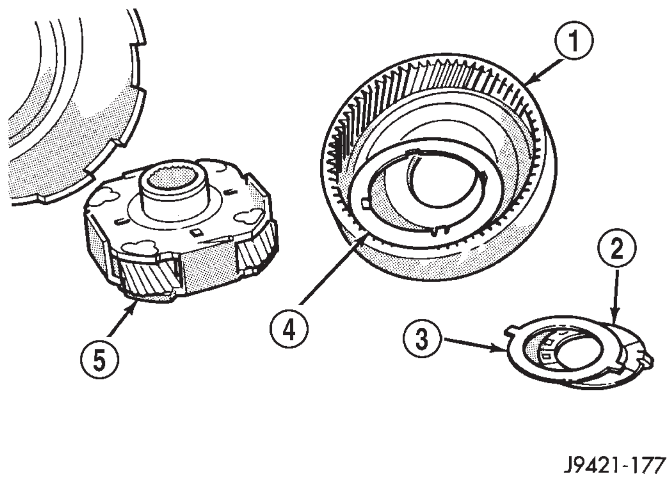


Fig. 143 Front Planetary And Annulus Gear Disassembly

1 - FRONT ANNULUS
2 - THRUST WASHER
3 - THRUST PLATE
4 - FRONT THRUST WASHER
5 - FRONT PLANETARY

INSPECTION

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

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

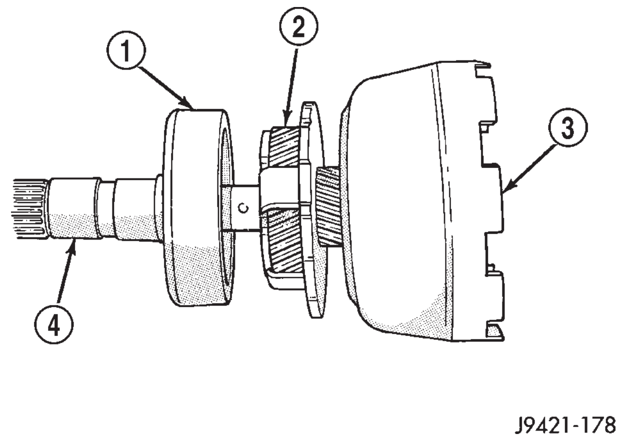


Fig. 144 Removing Driving Shell, Rear Planetary And Rear Annulus

1 - REAR ANNULUS
2 - REAR PLANETARY
3 - DRIVING SHELL
4 - OUTPUT SHAFT

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.

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. 145).

(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. 145).

(5) Install assembled rear planetary and annulus gear on output shaft (Fig. 146). Verify that assembly is fully seated on shaft.

(6) Install front thrust washer on rear planetary gear (Fig. 147). 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. 148).

(8) Install thrust plate on sun gear (Fig. 149). Note that driving shell thrust plates are interchangeable. Use either plate on sun gear and at front/rear of shell.

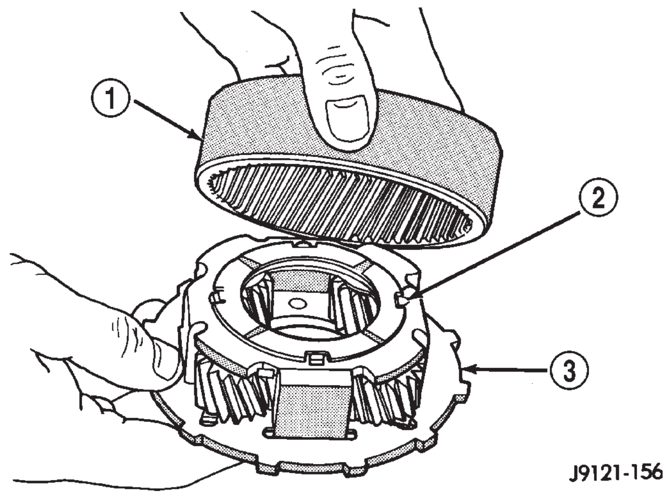


Fig. 145 Assembling Rear Annulus And Planetary Gear

1 - REAR ANNULUS GEAR
2 - TABBED THRUST WASHER
3 - REAR PLANETARY

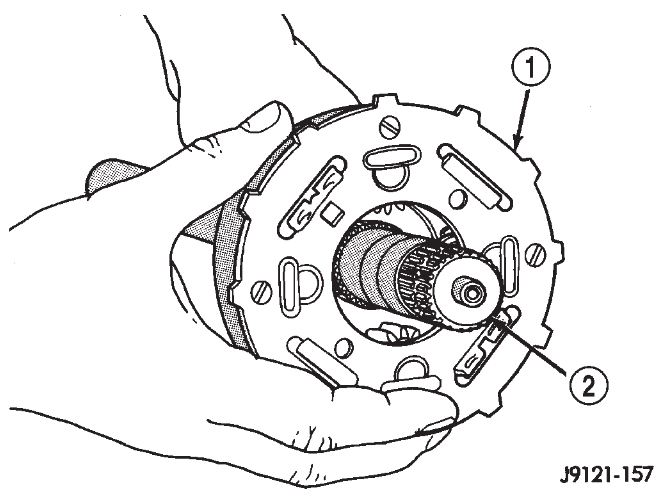


Fig. 146 Installing Rear Annulus And Planetary On Output Shaft

1 - REAR ANNULUS AND PLANETARY GEAR ASSEMBLY
2 - OUTPUT SHAFT

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

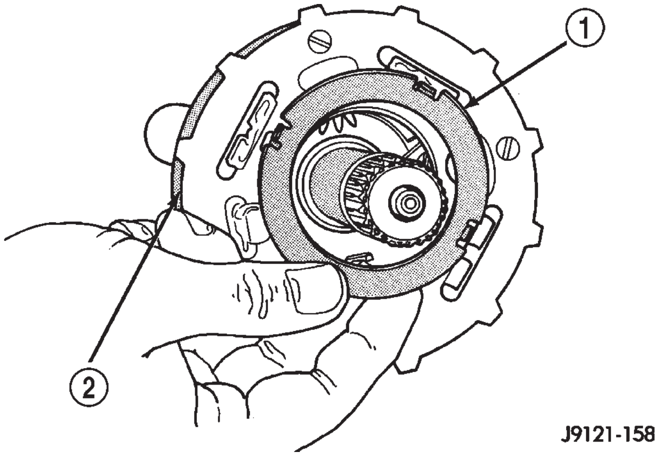


Fig. 147 Installing Rear Planetary Front Thrust Washer

1 - FRONT TABBED THRUST WASHER
2 - REAR PLANETARY GEAR

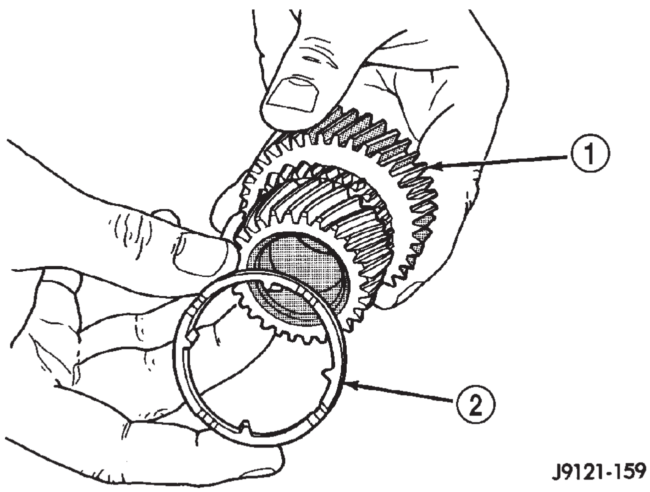


Fig. 148 Installing Spacer On Sun Gear

1 - SUN GEAR
2 - SUN GEAR SPACER

(9) Hold sun gear in place and install thrust plate over sun gear at rear of driving shell (Fig. 150).

(10) Position wood block on bench and support sun gear on block (Fig. 151). This makes it easier to align and install sun gear lock ring. Keep wood block handy as it will also be used for geartrain end play check.

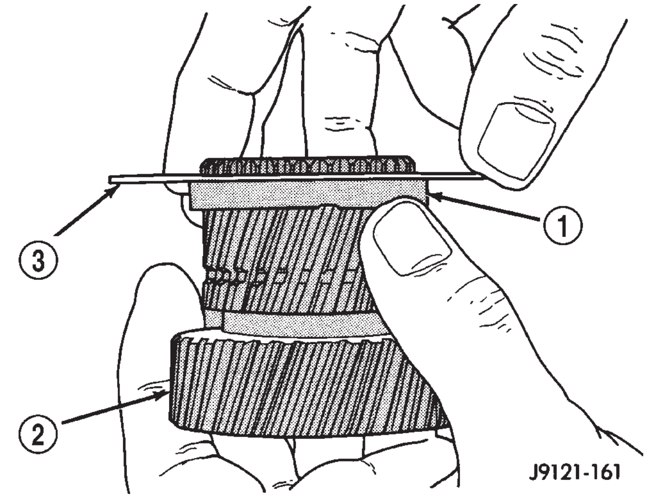


Fig. 149 Installing Driving Shell Front Thrust Plate On Sun Gear

1 - SPACER
2 - SUN GEAR
3 - THRUST PLATE

(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. 152).

(12) Install assembled driving shell and sun gear on output shaft (Fig. 153).

(13) Install rear thrust washer on front planetary gear (Fig. 154). Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

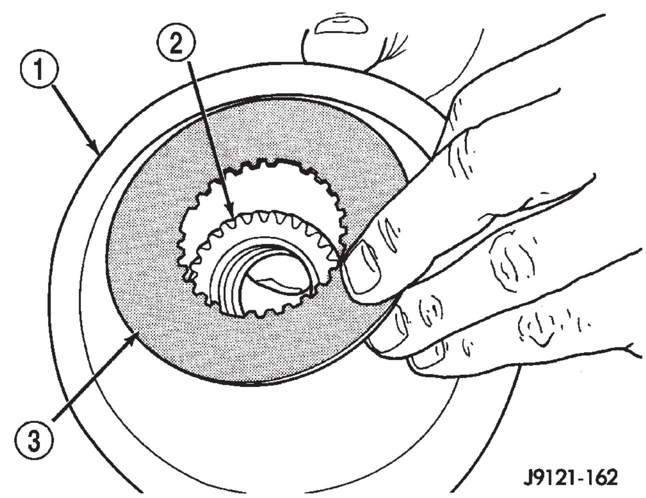


Fig. 150 Installing Driving Shell Rear Thrust Plate

1 - DRIVING SHELL
2 - SUN GEAR
3 - REAR THRUST PLATE

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

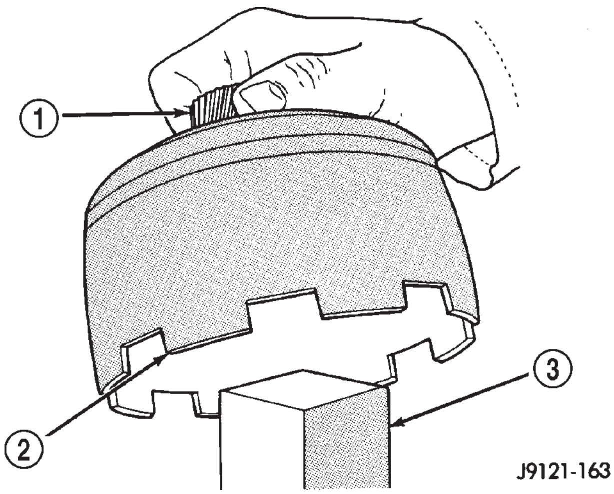


Fig. 151 Supporting Sun Gear On Wood Block

1 - SUN GEAR
2 - DRIVING SHELL
3 - WOOD BLOCK

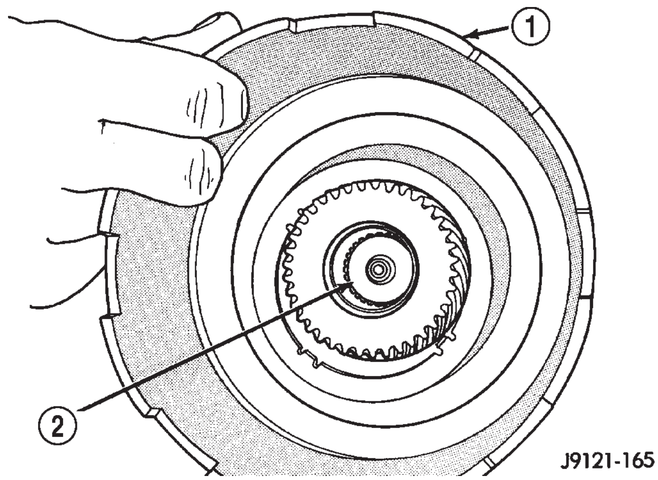


Fig. 153 Installing Assembled Sun Gear And Driving Shell On Output Shaft

1 - SUN GEAR/DRIVING SHELL ASSEMBLY
2 - OUTPUT SHAFT

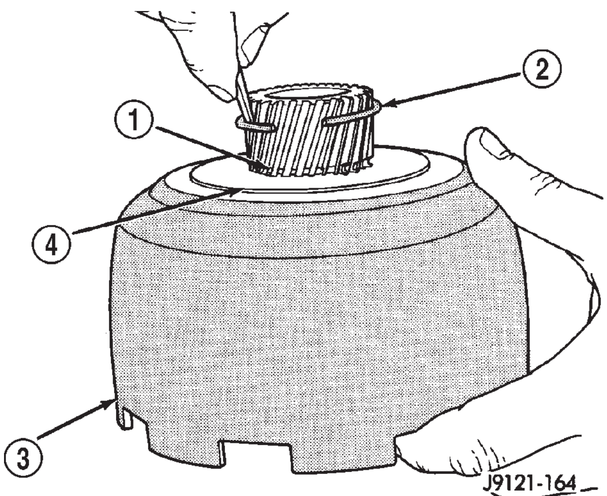


Fig. 152 Installing Sun Gear Lock Ring

1 - LOCK RING GROOVE
2 - SUN GEAR LOCK RING
3 - DRIVING SHELL
4 - REAR THRUST PLATE

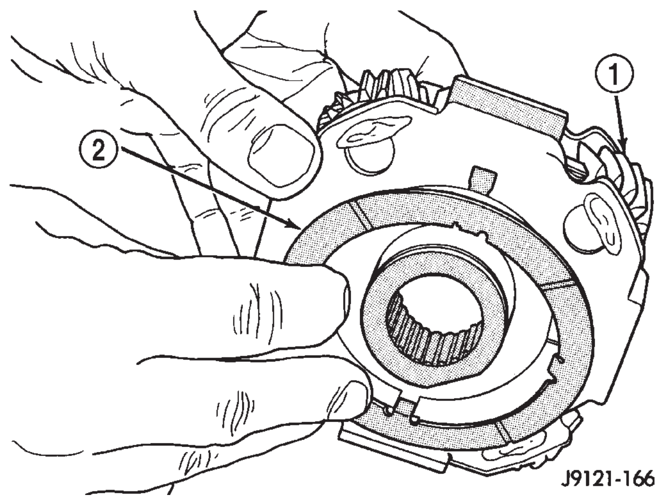


Fig. 154 Installing Rear Thrust Washer On Front Planetary Gear

1 - FRONT PLANETARY GEAR
2 - REAR TABBED THRUST WASHER

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

(14) Install front planetary gear on output shaft and in driving shell (Fig. 155).

(15) Install front thrust washer on front planetary gear. Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

(16) Assemble front annulus gear and support, if necessary. Be sure support snap-ring is seated.

(17) Install front annulus on front planetary (Fig. 155).

(18) Position thrust plate on front annulus gear support (Fig. 156). Note that plate has two tabs on it. These tabs fit in notches of annulus hub.

(19) Install thrust washer in front annulus (Fig. 157). Align flat on washer with flat on planetary hub. Also be sure washer tab is facing up.

(20) Install front annulus snap-ring (Fig. 158). 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. 159). 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. 160). 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-rings are available in three different thicknesses for adjustment purposes.

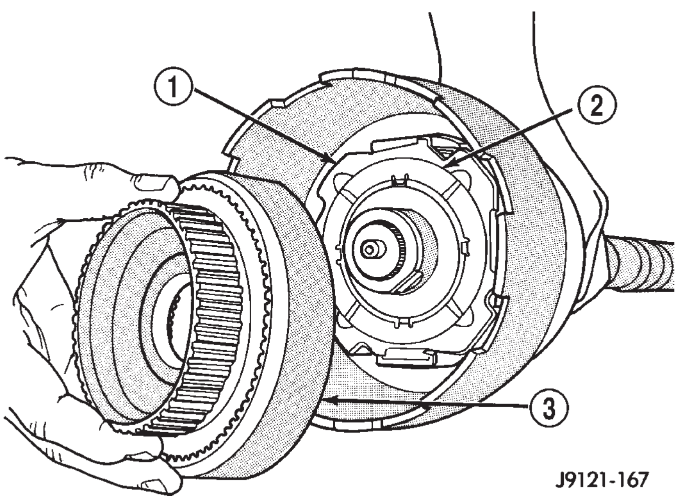


Fig. 155 Installing Front Planetary And Annulus Gears

1 - FRONT PLANETARY GEAR
2 - FRONT THRUST WASHER
3 - FRONT ANNULUS GEAR

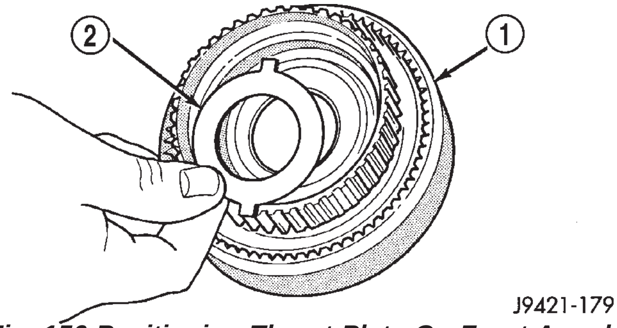


Fig. 156 Positioning Thrust Plate On Front Annulus Support

1 - FRONT ANNULUS
2 - THRUST PLATE

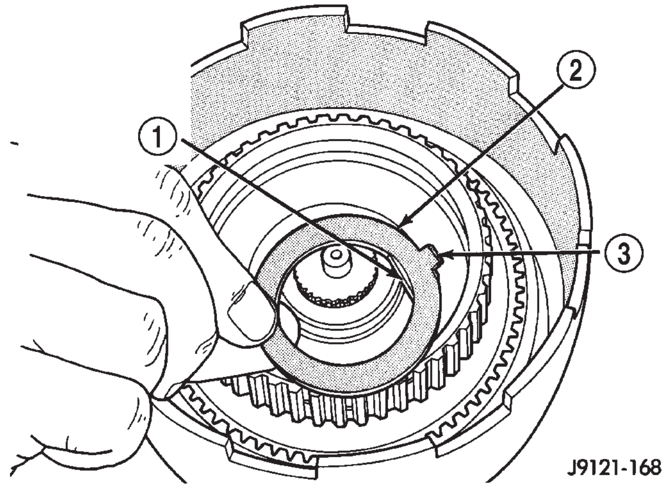


Fig. 157 Installing Front Annulus Thrust Washer

1 - WASHER FLAT ALIGNS WITH FLAT ON PLANETARY HUB
2 - FRONT ANNULUS THRUST WASHER
3 - TAB FACES FRONT

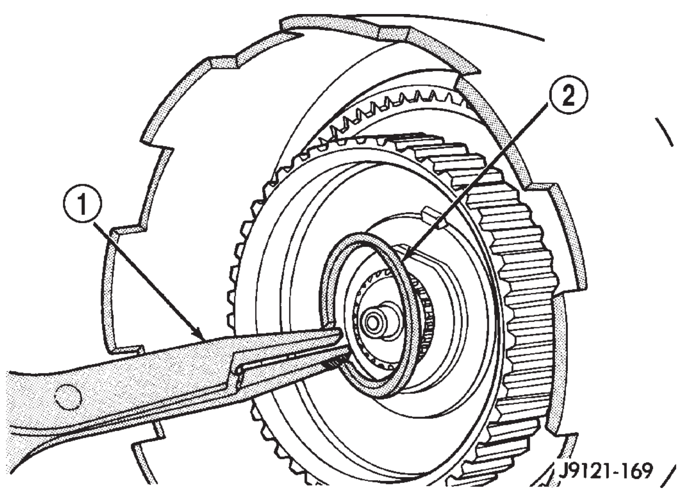


Fig. 158 Installing Front Annulus Snap-Ring

1 - SNAP-RING PLIERS
2 - FRONT ANNULUS SNAP-RING

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

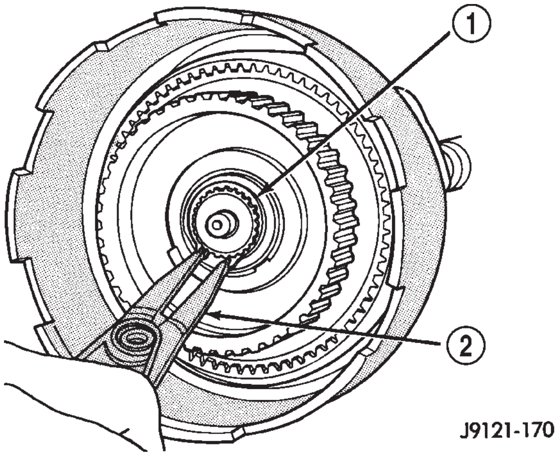


Fig. 159 Installing Planetary Selective Snap-Ring

1 - SELECTIVE SNAP-RING
2 - SNAP-RING PLIERS

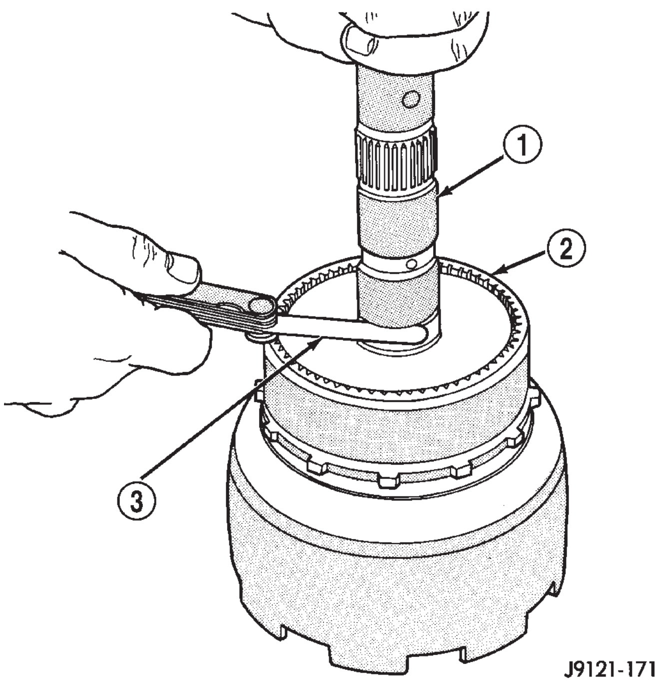


Fig. 160 Checking Planetary Geartrain End Play

1 - OUTPUT SHAFT
2 - REAR ANNULUS GEAR
3 - FEELER GAUGE

REAR CLUTCH

DESCRIPTION

The rear clutch assembly (Fig. 161) is composed of the rear clutch retainer, pressure plate, clutch plates, driving discs, piston, Belleville 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 spring is used to cushion the application of the clutch pack. 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 piston. 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.

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. 162).

(4) Remove top pressure plate, clutch discs, steel plates, bottom pressure plate and wave snap-ring and wave spring (Fig. 162).

(5) Remove clutch piston with rotating motion.

REAR CLUTCH (Continued)

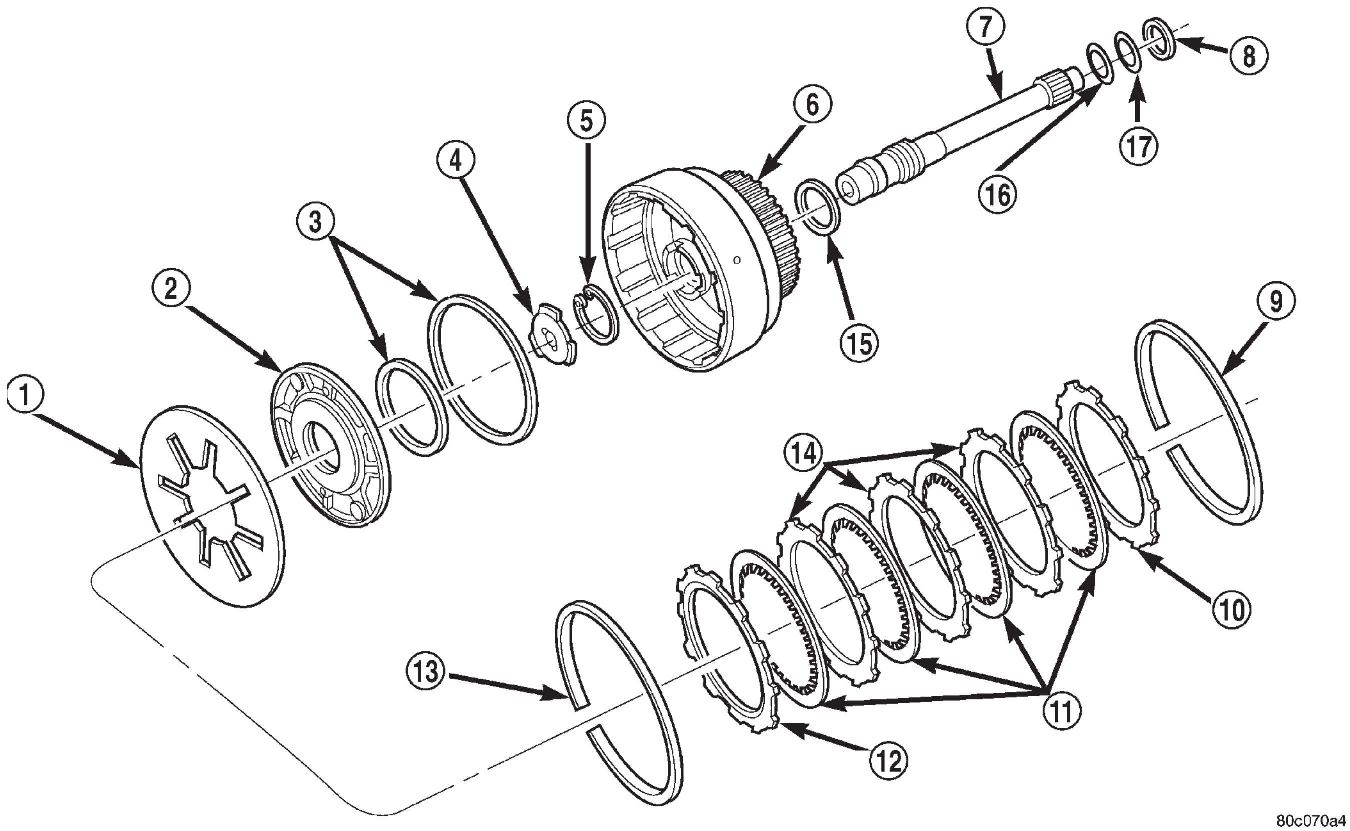


Fig. 161 Rear Clutch

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 - 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)

(6) Remove and discard piston seals.

(7) Remove input shaft snap-ring (Fig. 163). 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.

CLEANING

Clean the clutch components with solvent and dry them with compressed air.

INSPECTION

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

REAR CLUTCH (Continued)

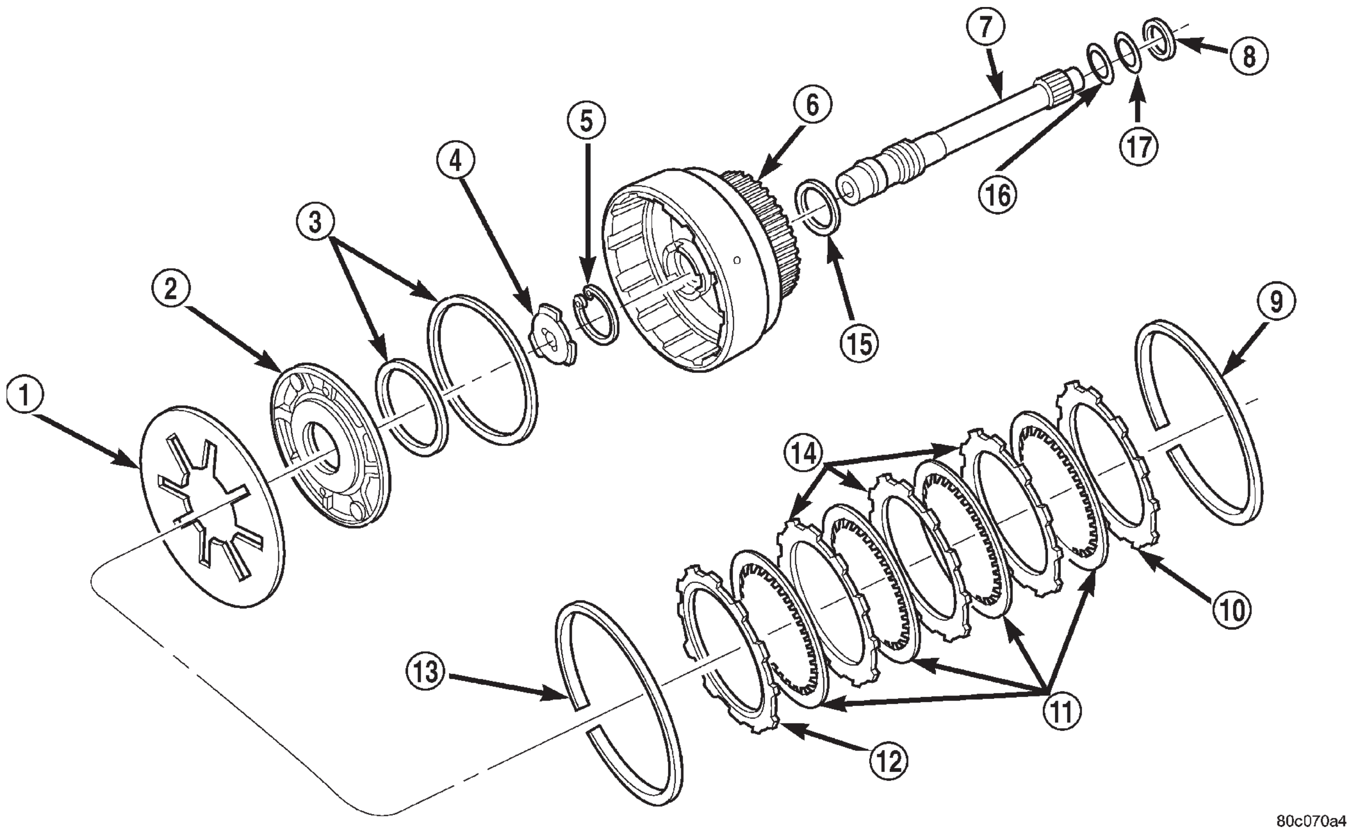


Fig. 162 Rear Clutch Components

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)

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.

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. 164) and (Fig. 165).

(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. 163).

(5) Invert retainer and press input shaft in opposite direction until snap-ring is seated (Fig. 166).

(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

REAR CLUTCH (Continued)

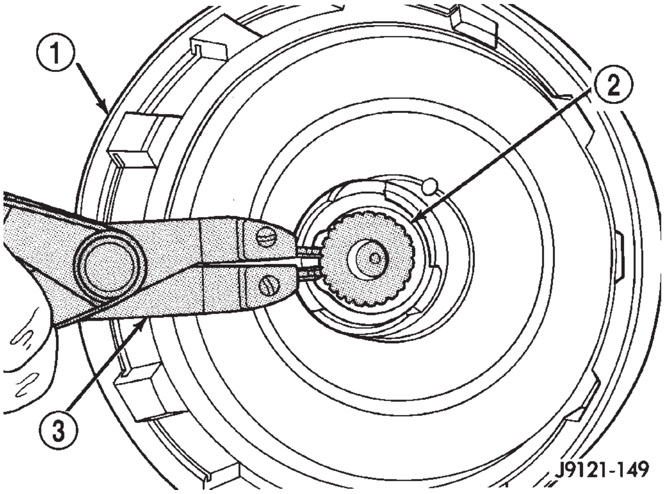


Fig. 163 Removing/Installing Input Shaft Snap-Ring

1 - REAR CLUTCH RETAINER
2 - INPUT SHAFT SNAP-RING
3 - SNAP-RING PLIERS

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.

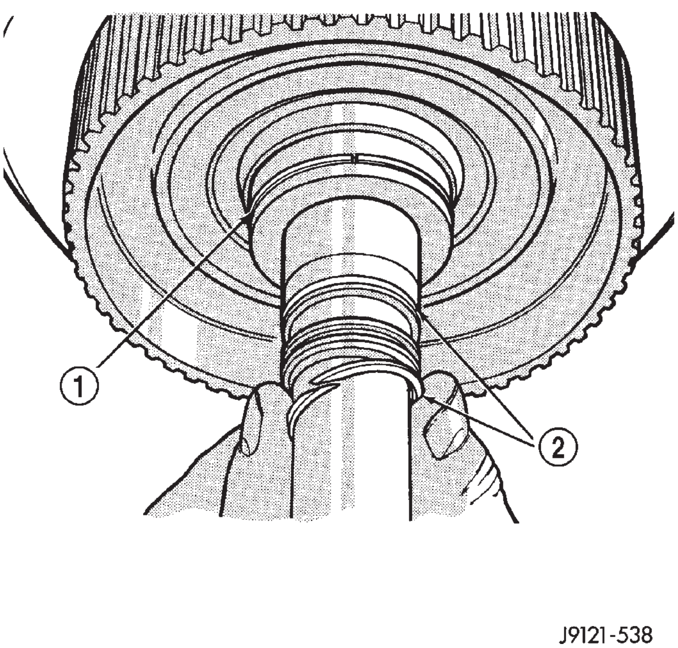


Fig. 164 Rear Clutch Retainer And Input Shaft Seal Ring Installation

1 - REAR CLUTCH RETAINER HUB SEAL RING
2 - INPUT SHAFT SEAL RINGS

(9) Install piston spring in retainer and on top of piston (Fig. 167). Concave side of spring faces downward (toward piston).

(10) Install wave spring in retainer (Fig. 167). Be sure spring is completely seated in retainer groove.

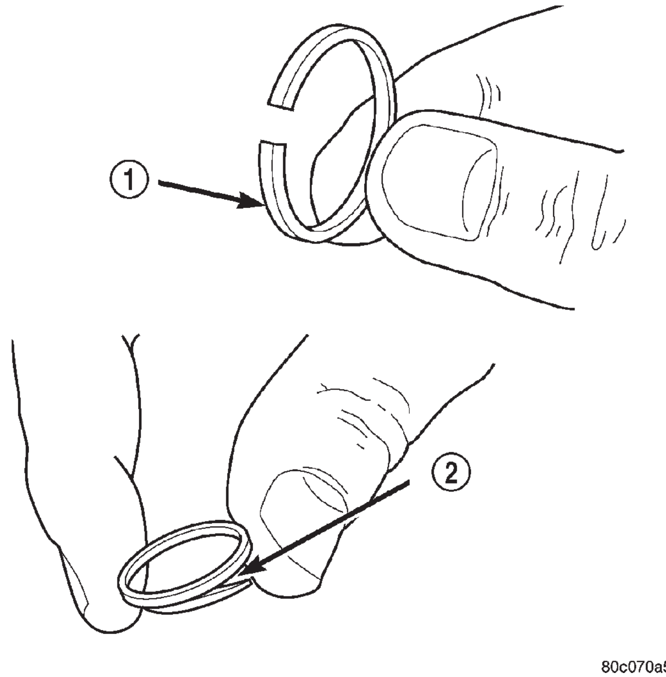


Fig. 165 Input Shaft Seal Ring Identification

1 - PLASTIC REAR SEAL RING
2 - TEFLON FRONT SEAL RING (SQUEEZE RING TOGETHER SLIGHTLY BEFORE INSTALLATION FOR BETTER FIT)

(11) Install bottom pressure plate (Fig. 162). 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. 162).

(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. 168).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 168).

(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.

REAR CLUTCH (Continued)

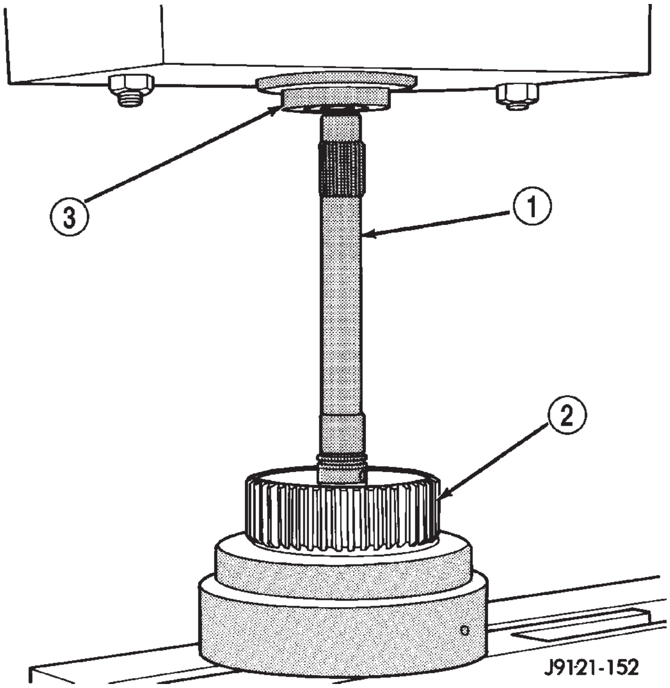


Fig. 166 Pressing Input Shaft Into Rear Clutch Retainer

1 - INPUT SHAFT
2 - REAR CLUTCH RETAINER
3 - PRESS RAM

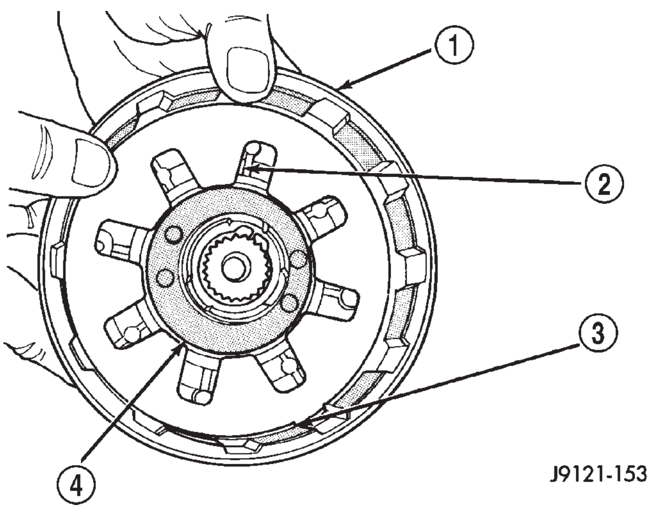


Fig. 167 Piston Spring/Wave Spring Position

1 - REAR CLUTCH RETAINER
2 - PISTON SPRING
3 - WAVE SPRING
4 - CLUTCH PISTON

(16) Clearance should be 0.559 - 0.914 mm (0.022 - 0.036 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:

- 0.107-0.109 in.
- 0.098-0.100 in.
- 0.095-0.097 in.
- 0.083-0.085 in.
- 0.076-0.078 in.
- 0.071-0.073 in.
- 0.060-0.062 in.

(17) Coat rear clutch thrust washer with petroleum jelly and install washer over input shaft and into clutch retainer (Fig. 169). Use enough petroleum jelly to hold washer in place.

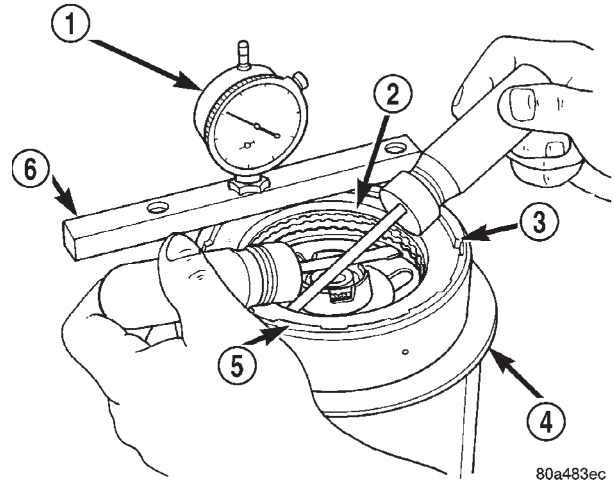


Fig. 168 Checking Rear Clutch Pack Clearance

1 - DIAL INDICATOR
2 - PRESSURE PLATE
3 - SNAP-RING
4 - STAND
5 - REAR CLUTCH
6 - GAUGE BAR

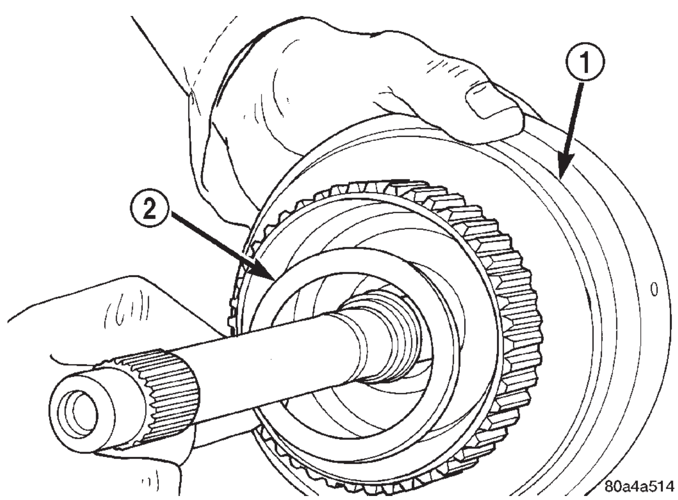


Fig. 169 Installing Rear Clutch Thrust Washer

1 - REAR CLUTCH RETAINER
2 - REAR CLUTCH THRUST WASHER

REAR SERVO

DESCRIPTION

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.

OPERATION

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.

DISASSEMBLY

(1) Remove small snap-ring and remove plug and spring from servo piston (Fig. 170).

(2) Remove and discard servo piston seal ring.

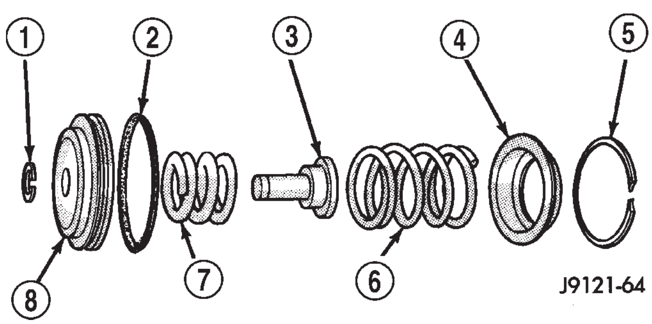


Fig. 170 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

CLEANING

Remove and discard the servo piston seal ring (Fig. 171). 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 new ones at assembly.

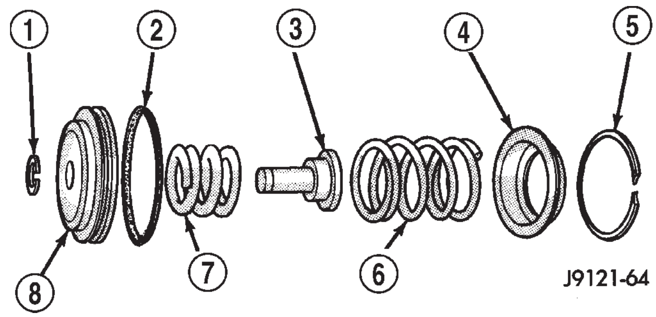


Fig. 171 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

ASSEMBLY

(1) Lubricate piston and guide seals (Fig. 172) with petroleum jelly. Lubricate other servo parts with Mopar® ATF +4, type 9602, 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.

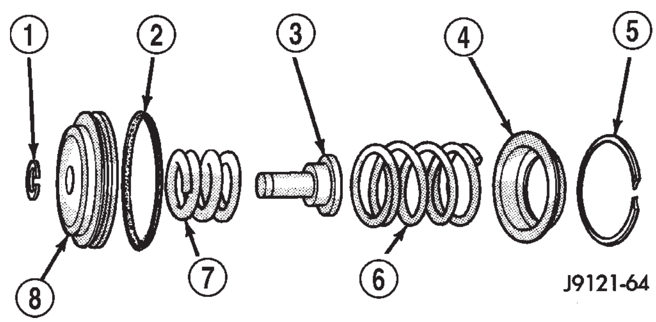


Fig. 172 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

SHIFT MECHANISM

DESCRIPTION

The shift mechanism is cable operated and provides six shift positions. The shift indicator is located

SHIFT MECHANISM (Continued)

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.

SOLENOID

DESCRIPTION

The typical electrical solenoid used in automotive applications is a linear actuator. It is a device that produces motion in a straight line. This straight line motion can be either forward or backward in direction, and short or long distance.

A solenoid is an electromechanical device that uses a magnetic force to perform work. It consists of a coil of wire, wrapped around a magnetic core made from steel or iron, and a spring loaded, movable plunger, which performs the work, or straight line motion.

The solenoids used in transmission applications are attached to valves which can be classified as **normally open** or **normally closed**. The **normally open** solenoid valve is defined as a valve which allows hydraulic flow when no current or voltage is applied to the solenoid. The **normally closed** solenoid valve is defined as a valve which does not allow hydraulic flow when no current or voltage is applied to the solenoid. These valves perform hydraulic control functions for the transmission and must therefore be durable and tolerant of dirt particles. For these reasons, the valves have hardened steel poppets and ball valves. The solenoids operate the valves directly, which means that the solenoids must have very high outputs to close the valves against the sizable flow areas and line pressures found in current transmissions. Fast response time is also necessary to ensure accurate control of the transmission.

The strength of the magnetic field is the primary force that determines the speed of operation in a particular solenoid design. A stronger magnetic field will cause the plunger to move at a greater speed than a weaker one. There are basically two ways to increase the force of the magnetic field:

1. Increase the amount of current applied to the coil or
2. Increase the number of turns of wire in the coil.

The most common practice is to increase the number of turns by using thin wire that can completely fill the available space within the solenoid housing. The strength of the spring and the length of the plunger also contribute to the response speed possible by a particular solenoid design.

A solenoid can also be described by the method by which it is controlled. Some of the possibilities include variable force, pulse-width modulated, constant ON, or duty cycle. The variable force and pulse-width modulated versions utilize similar methods to control the current flow through the solenoid to position the solenoid plunger at a desired position somewhere between full ON and full OFF. The constant ON and duty cycled versions control the voltage across the solenoid to allow either full flow or no flow through the solenoid's valve.

OPERATION

When an electrical current is applied to the solenoid coil, a magnetic field is created which produces an attraction to the plunger, causing the plunger to move and work against the spring pressure and the load applied by the fluid the valve is controlling. The plunger is normally directly attached to the valve which it is to operate. When the current is removed from the coil, the attraction is removed and the plunger will return to its original position due to spring pressure.

The plunger is made of a conductive material and accomplishes this movement by providing a path for the magnetic field to flow. By keeping the air gap between the plunger and the coil to the minimum necessary to allow free movement of the plunger, the magnetic field is maximized.

SPEEDOMETER DRIVE ADAPTER

REMOVAL

Rear axle gear ratio and tire size determine speedometer pinion requirements.

(1) Raise vehicle.

(2) Disconnect wires from vehicle speed sensor.

(3) Remove adapter clamp and screw (Fig. 173).

(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. 173). 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

SPEEDOMETER DRIVE ADAPTER (Continued)

oxidized. Replace sensor if faulty, or pins are loose, severely corroded, or damaged.

(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.

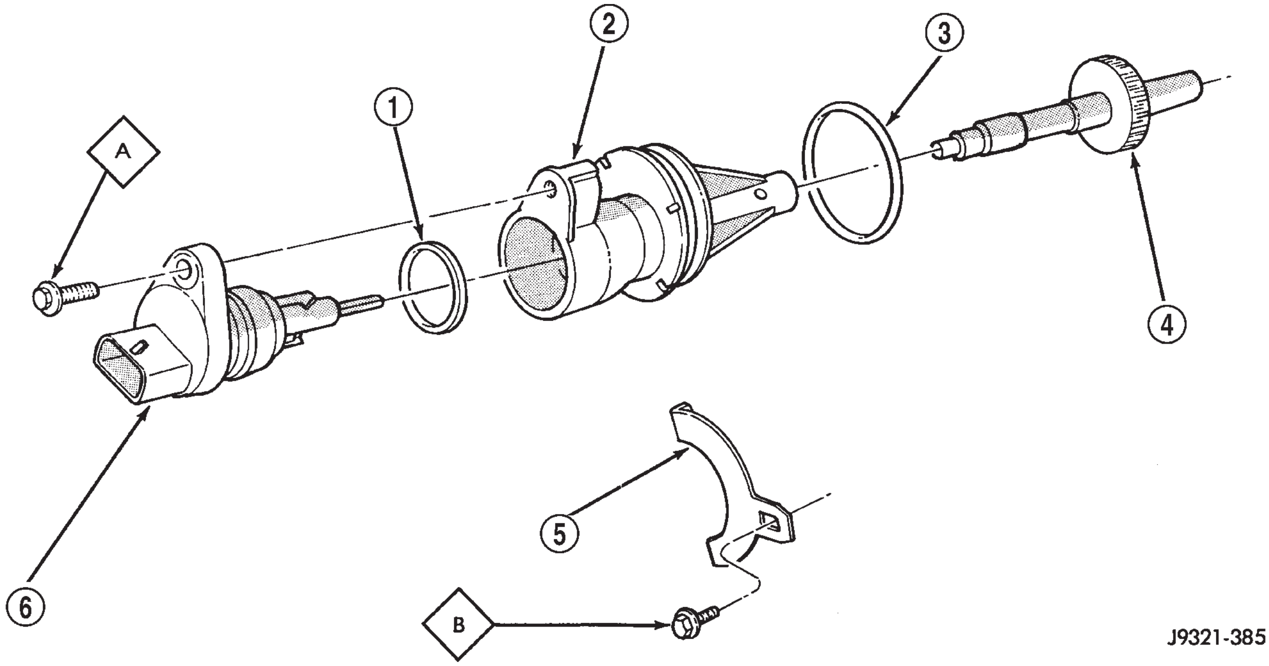


Fig. 173 Speedometer Pinion Adapter Components

1 - Sensor O-ring
2 - Speedometer Adapter
3 - Adapter O-ring
4 - Speedometer Pinion
5 - Adapter Clamp
6 - Vehicle Speed Sensor
A - 2-3 N·m (15-27 in. lbs.)
B - 10-12 N·m (90-110 in. lbs.)

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. 173).

(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. 174). 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.

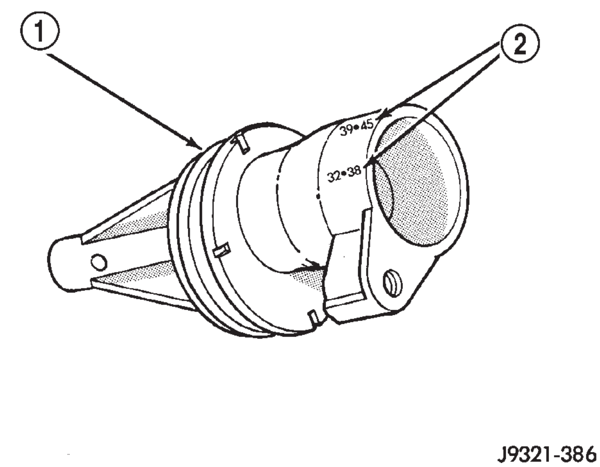


Fig. 174 Index Numbers On Speedometer Pinion Adapter

1 - SPEEDOMETER ADAPTER
2 - INDEX NUMBER LOCATION

THROTTLE VALVE CABLE

DESCRIPTION

Transmission throttle valve cable (Fig. 175) 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.

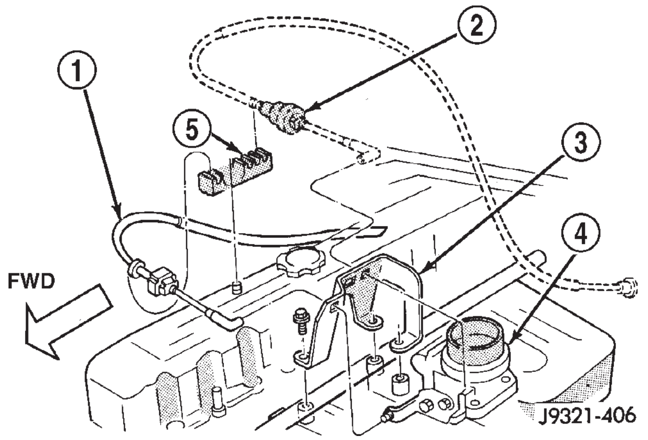


Fig. 175 Throttle Cable Attachment At Engine

1 - TRANSMISSION THROTTLE VALVE CABLE
2 - ACCELERATOR CABLE
3 - CABLE ENGINE BRACKET
4 - THROTTLE BODY
5 - CABLE GUIDE

The transmission throttle valve is operated by a cam on the throttle lever. The throttle lever is operated by an adjustable cable (Fig. 176). 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.

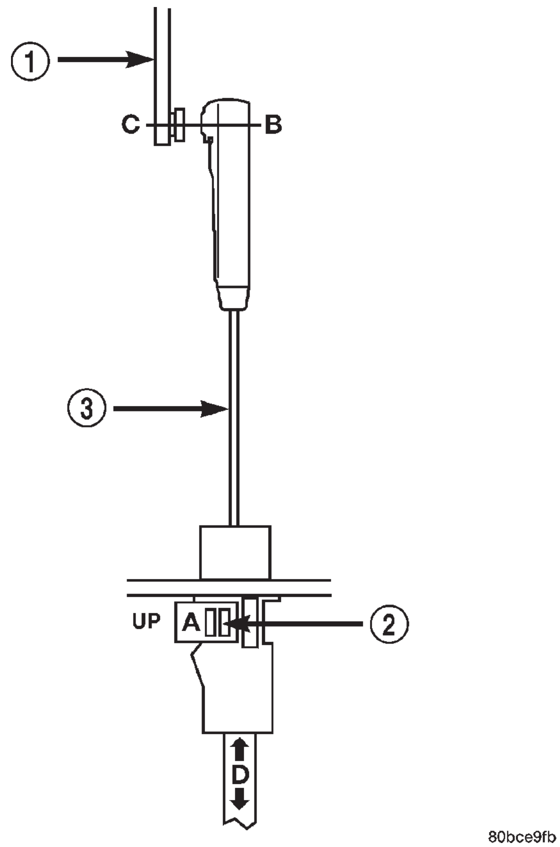


Fig. 176 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - THROTTLE VALVE CABLE

ADJUSTMENTS

ADJUSTMENT - THROTTLE VALVE CABLE

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.

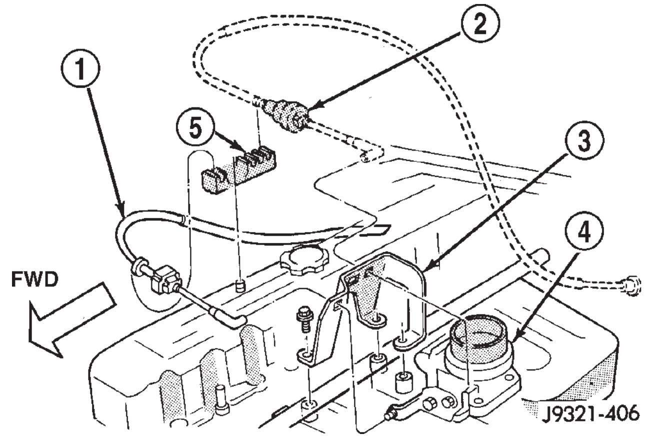


Fig. 177 Throttle Cable Attachment At Engine

1 - TRANSMISSION THROTTLE VALVE CABLE
2 - ACCELERATOR CABLE
3 - CABLE ENGINE BRACKET
4 - THROTTLE BODY
5 - CABLE GUIDE

THROTTLE VALVE CABLE (Continued)

ADJUSTMENT VERIFICATION

(1) Turn ignition key to OFF position.

(2) Remove air cleaner.

(3) Verify that lever on throttle body is at curb idle position (Fig. 177). Then verify that transmission throttle lever (Fig. 178) is also at idle (fully forward) position.

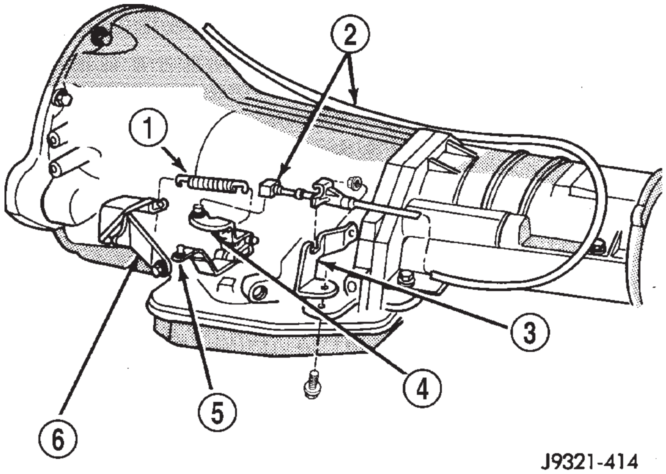


Fig. 178 Throttle Cable Attachment At Transmission

1 - RETURN SPRING
2 - THROTTLE VALVE CABLE
3 - THROTTLE VALVE CABLE BRACKET
4 - THROTTLE VALVE LEVER
5 - GEAR SELECTOR LEVER
6 - SHIFT CABLE BRACKET

(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. 179).

• 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.

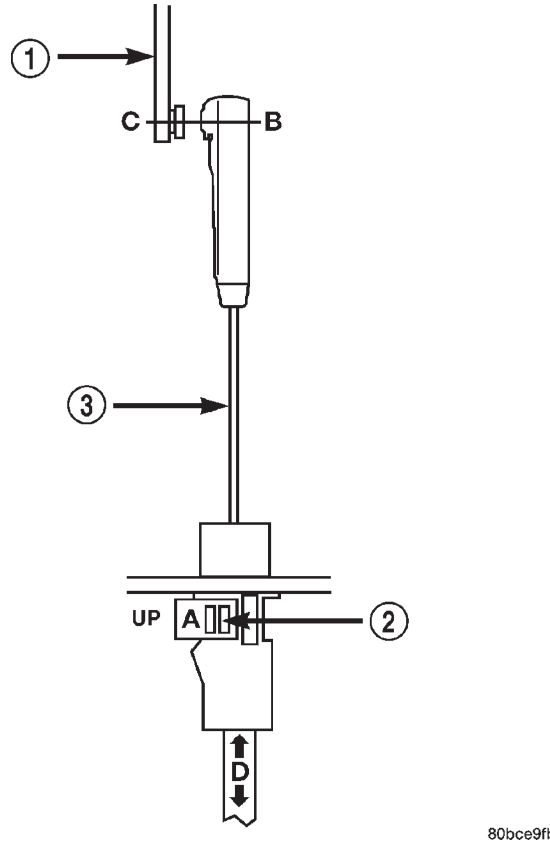


Fig. 179 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - 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) Pry the T.V. cable lock (A) into the UP position (Fig. 179). This will unlock the cable and allow for readjustment.

(6) Apply just enough tension on the T.V. cable (B) to remove any slack in the cable.**Pulling too tight will cause the T.V. lever on the transmission to move out of its idle position, which will result in an incorrect T.V. cable adjustment.** Slide the sheath of the T.V. cable (D) back and forth until the centerlines of the T.V. cable end (B) and the throttle bell crank lever (C) are aligned within one millimeter (1mm) (Fig. 179).

(7) While holding the T.V. cable in the set position push the T.V. cable lock (A) into the down position

THROTTLE VALVE CABLE (Continued)

(Fig. 179). This will lock the present T.V. cable adjustment.

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.

(8) Reconnect the T.V. cable (B) to the throttle bellcrank lever (C).

(9) Check cable adjustment. Verify transmission throttle lever and lever on throttle body move simultaneously.

TORQUE CONVERTER

DESCRIPTION

The torque converter (Fig. 180) 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.

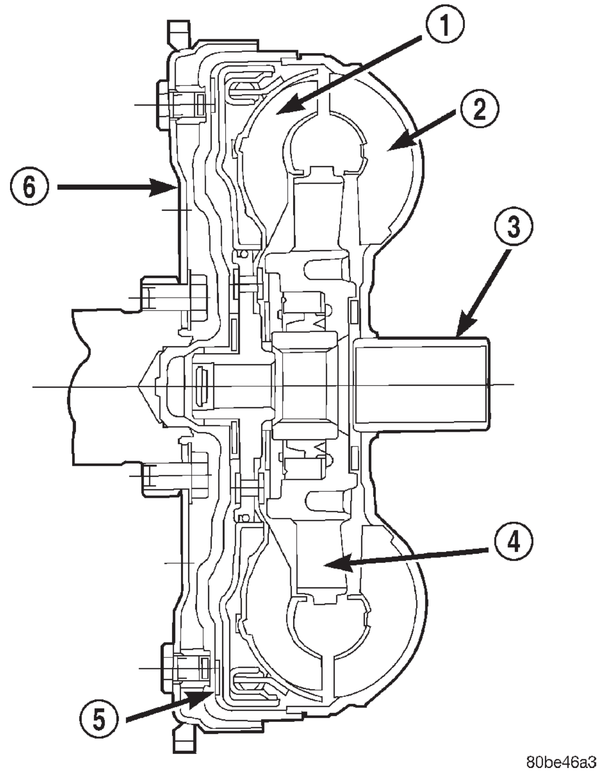


Fig. 180 Torque Converter Assembly

1 - TURBINE
2 - IMPELLER
3 - HUB
4 - STATOR
5 - CONVERTER CLUTCH DISC
6 - DRIVE PLATE

TORQUE CONVERTER (Continued)

IMPELLER

The impeller (Fig. 181) 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. 182) 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.

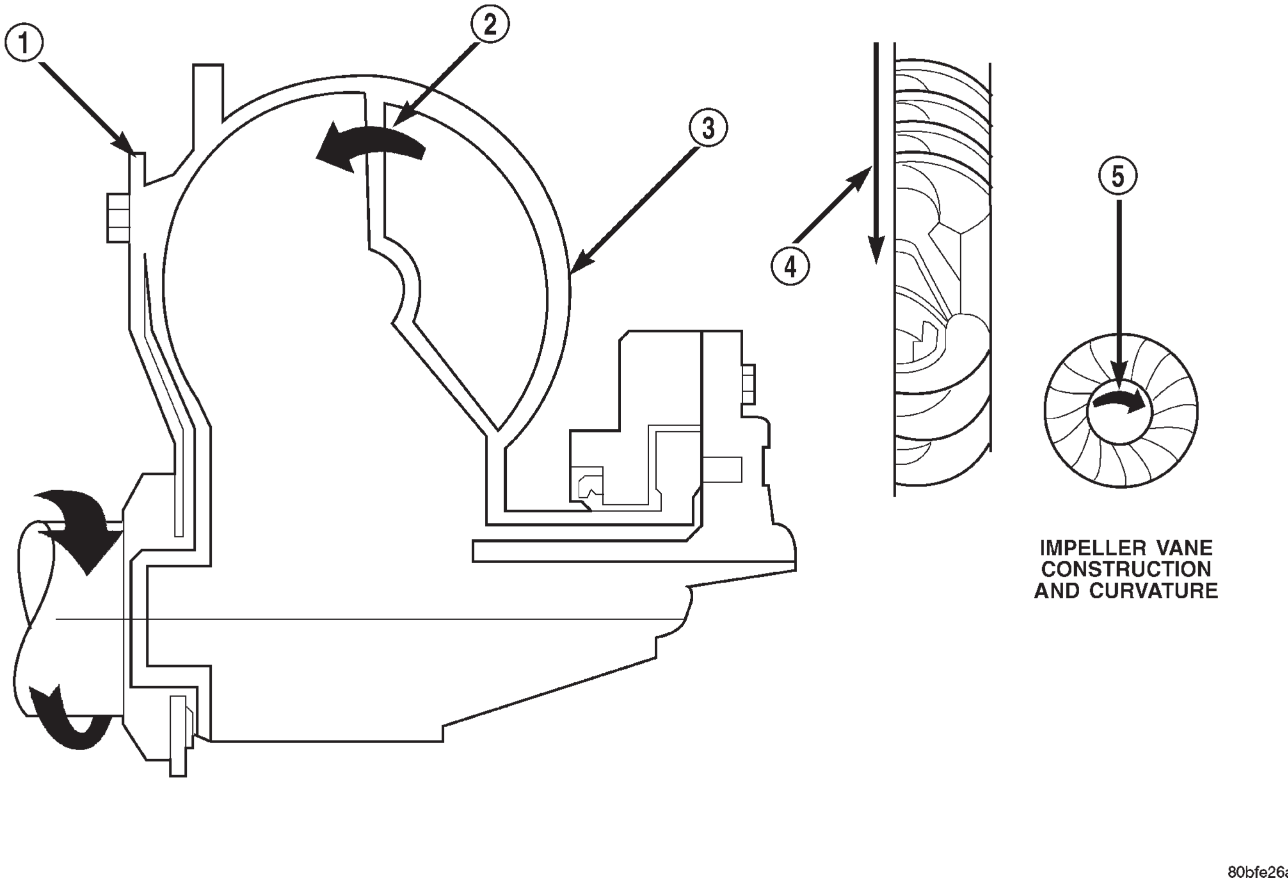


Fig. 181 Impeller

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

TORQUE CONVERTER (Continued)

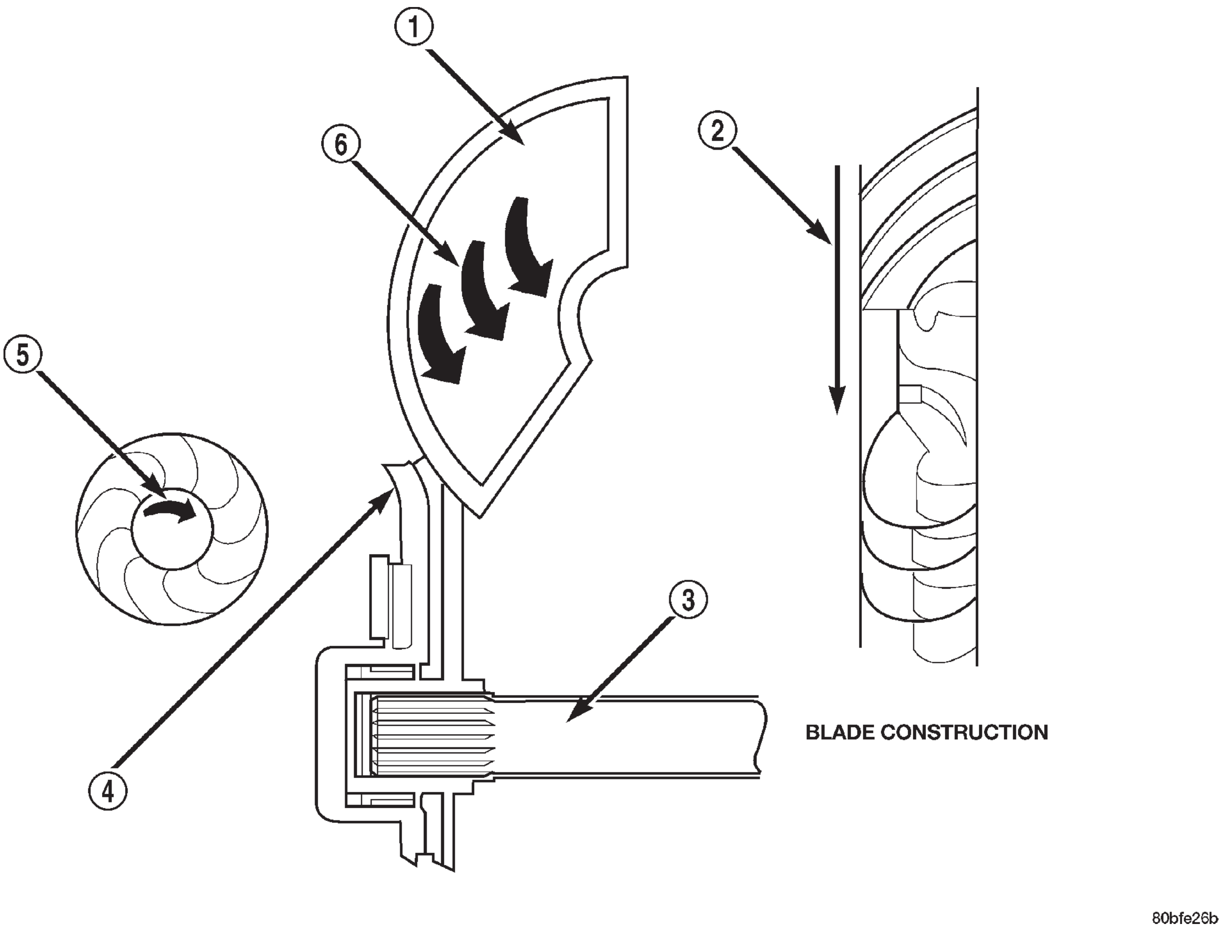


Fig. 182 Turbine

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. 183) 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. 184). 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.

TORQUE CONVERTER CLUTCH (TCC)

The TCC (Fig. 185) 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.

TORQUE CONVERTER (Continued)

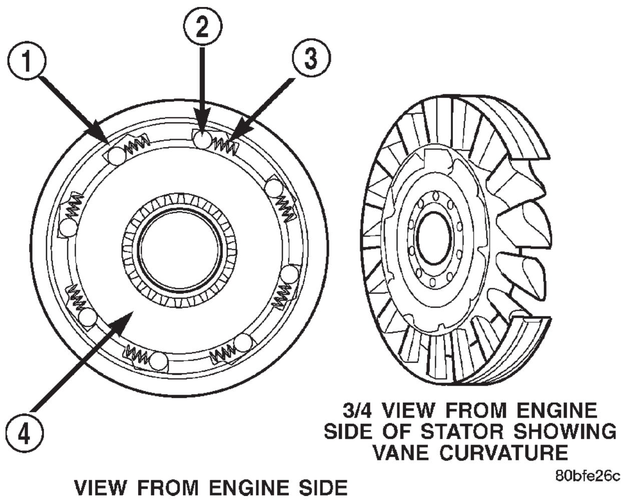


Fig. 183 Stator Components

1 - CAM (OUTER RACE)
2 - ROLLER
3 - SPRING
4 - INNER RACE

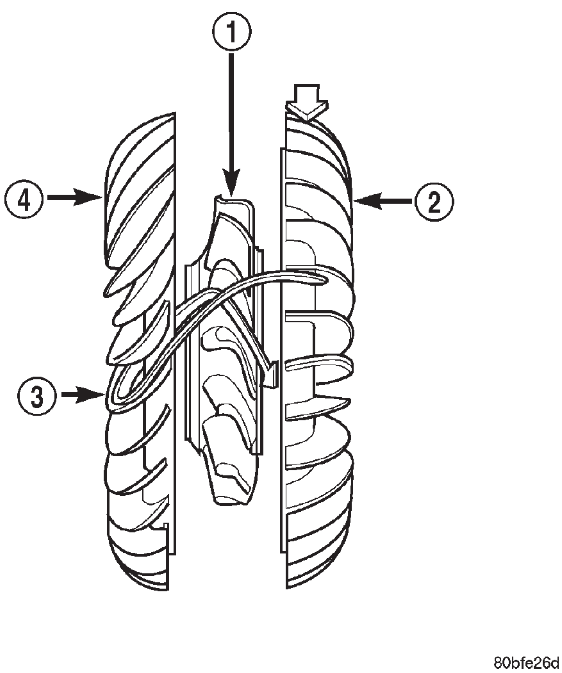


Fig. 184 Stator Location

1 - STATOR
2 - IMPELLER
3 - FLUID FLOW
4 - TURBINE

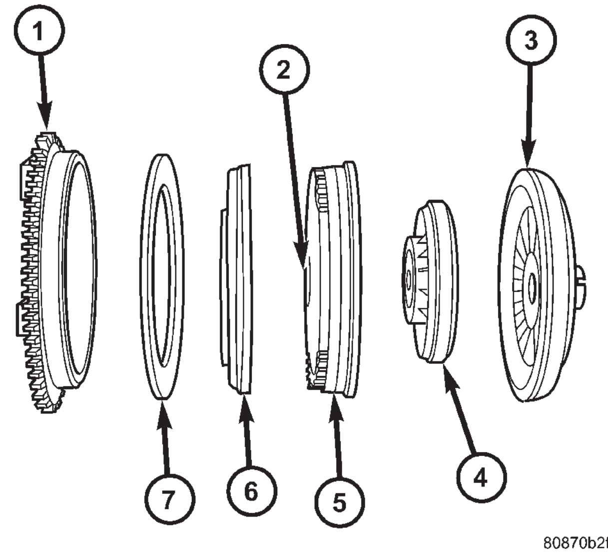


Fig. 185 Torque Converter Clutch (TCC)

1 - IMPELLER FRONT COVER
2 - THRUST WASHER ASSEMBLY
3 - IMPELLER
4 - STATOR
5 - TURBINE
6 - PISTON
7 - FRICTION DISC

OPERATION

The converter impeller (Fig. 186) (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.

STATOR

Torque multiplication is achieved by locking the stator's over-running clutch to its shaft (Fig. 187). 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–run-

TORQUE CONVERTER (Continued)

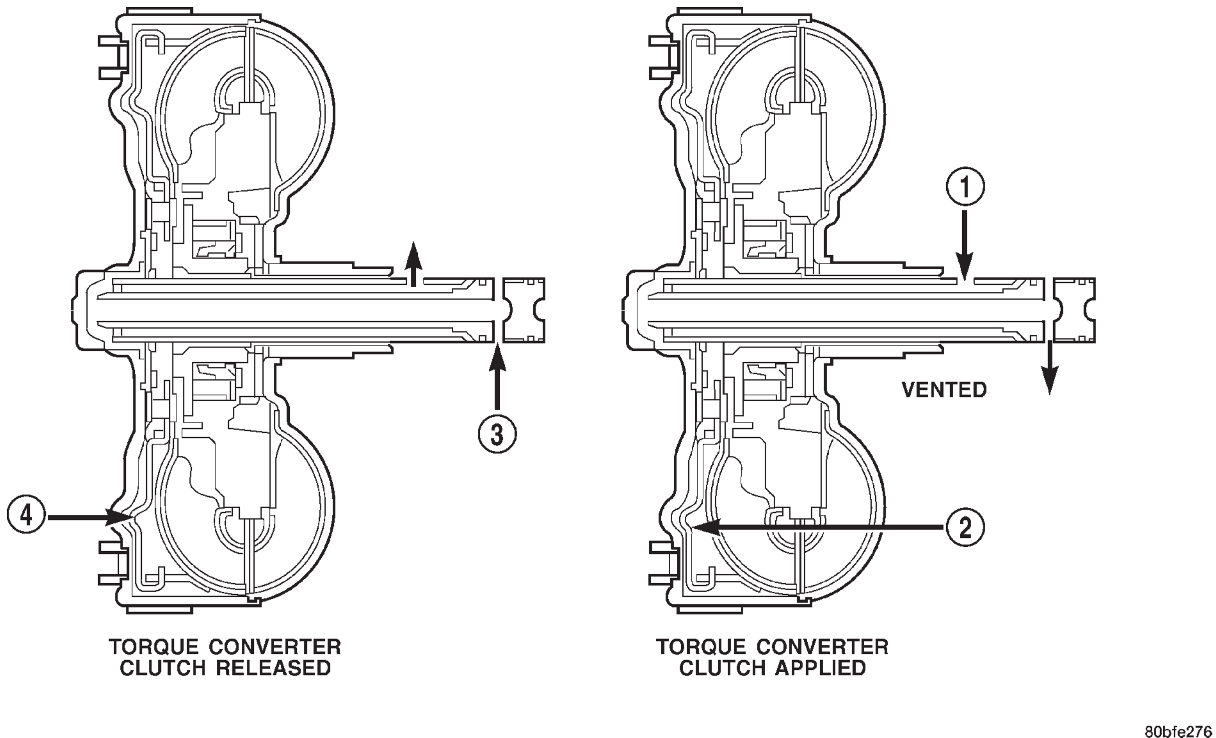


Fig. 186 Torque Converter Fluid Operation

1 - APPLY PRESSURE
2 - THE PISTON MOVES SLIGHTLY FORWARD
3 - RELEASE PRESSURE
4 - THE PISTON MOVES SLIGHTLY REARWARD

ning 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.

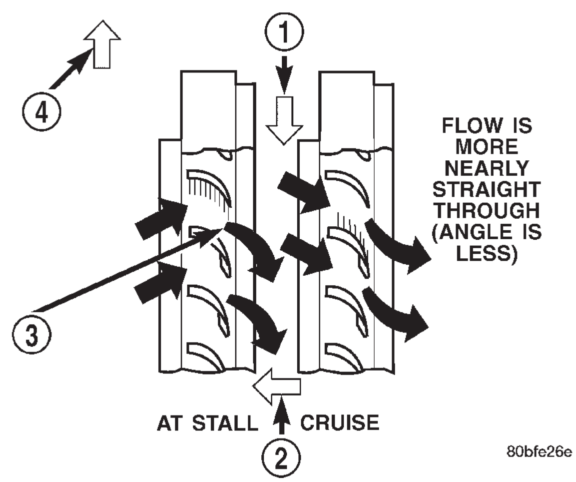


Fig. 187 Stator Operation

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 Control 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

TORQUE CONVERTER (Continued)

km/h (35 mph) with light throttle, after the shift to third gear.

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. 188). 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.

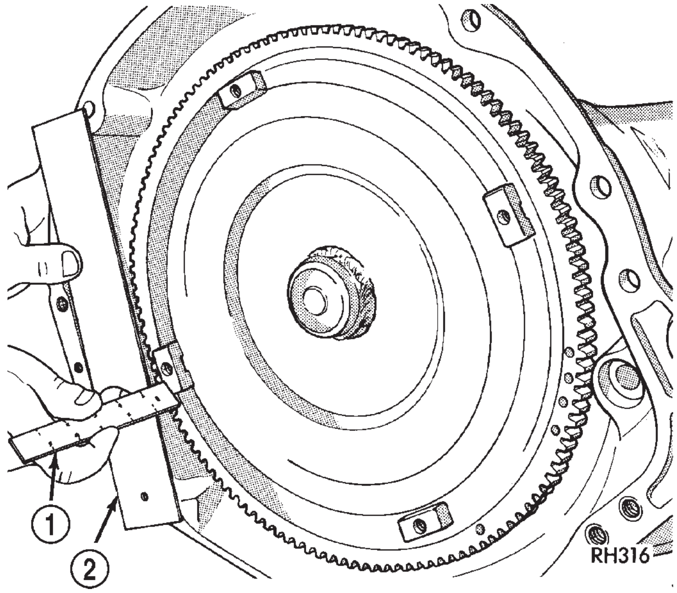


Fig. 188 Checking Torque Converter Seating

1 - SCALE
2 - STRAIGHTEDGE

TORQUE 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.

STANDARD PROCEDURE - TORQUE CONVERTER DRAINBACK VALVE

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.

TORQUE CONVERTER DRAINBACK VALVE (Continued)

The valve must be removed whenever the cooler and lines are reverse flushed. The valve can be flow tested when necessary. The procedure is exactly the same as for flow testing a cooler.

If the valve is restricted, installed backwards, or in the wrong line, it will cause an overheating condition and possible transmission failure.

CAUTION: The drainback valve is a one-way flow device. It must be properly oriented in terms of flow direction for the cooler to function properly. The valve must be installed in the pressure line. Otherwise flow will be blocked and would cause an overheating condition and eventual transmission failure.

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. 189) and (Fig. 190):

- 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.

VALVE BODY (Continued)

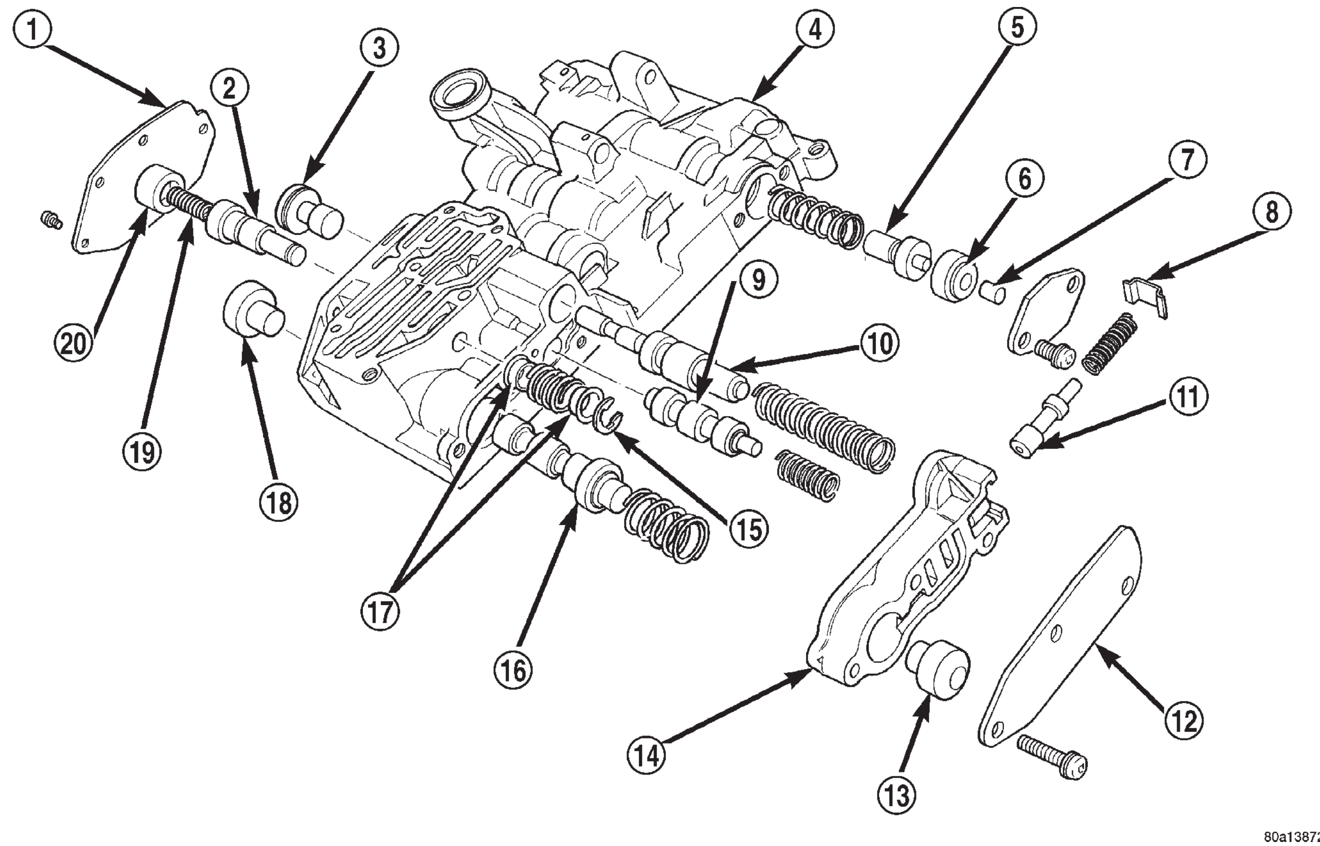


Fig. 189 Valve Body Assembly

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. 191) 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-

VALVE BODY (Continued)

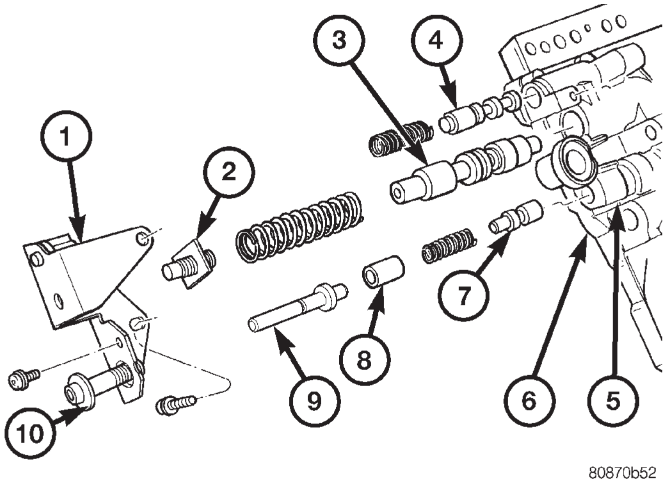


Fig. 190 Valve Body Assembly

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. 192), 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. 193). The regulated line pressure in reverse (Fig. 194) is held at much higher

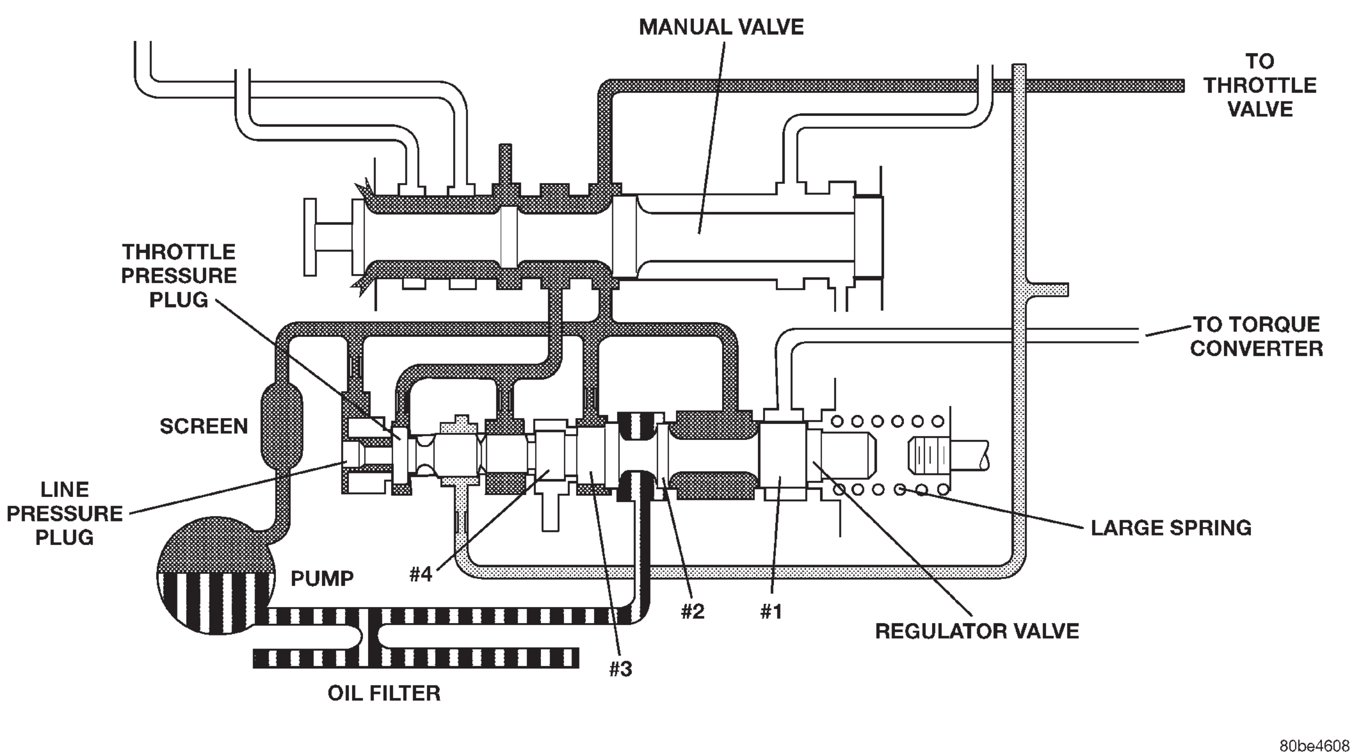


Fig. 191 Regulator Valve in Park Position

VALVE BODY (Continued)

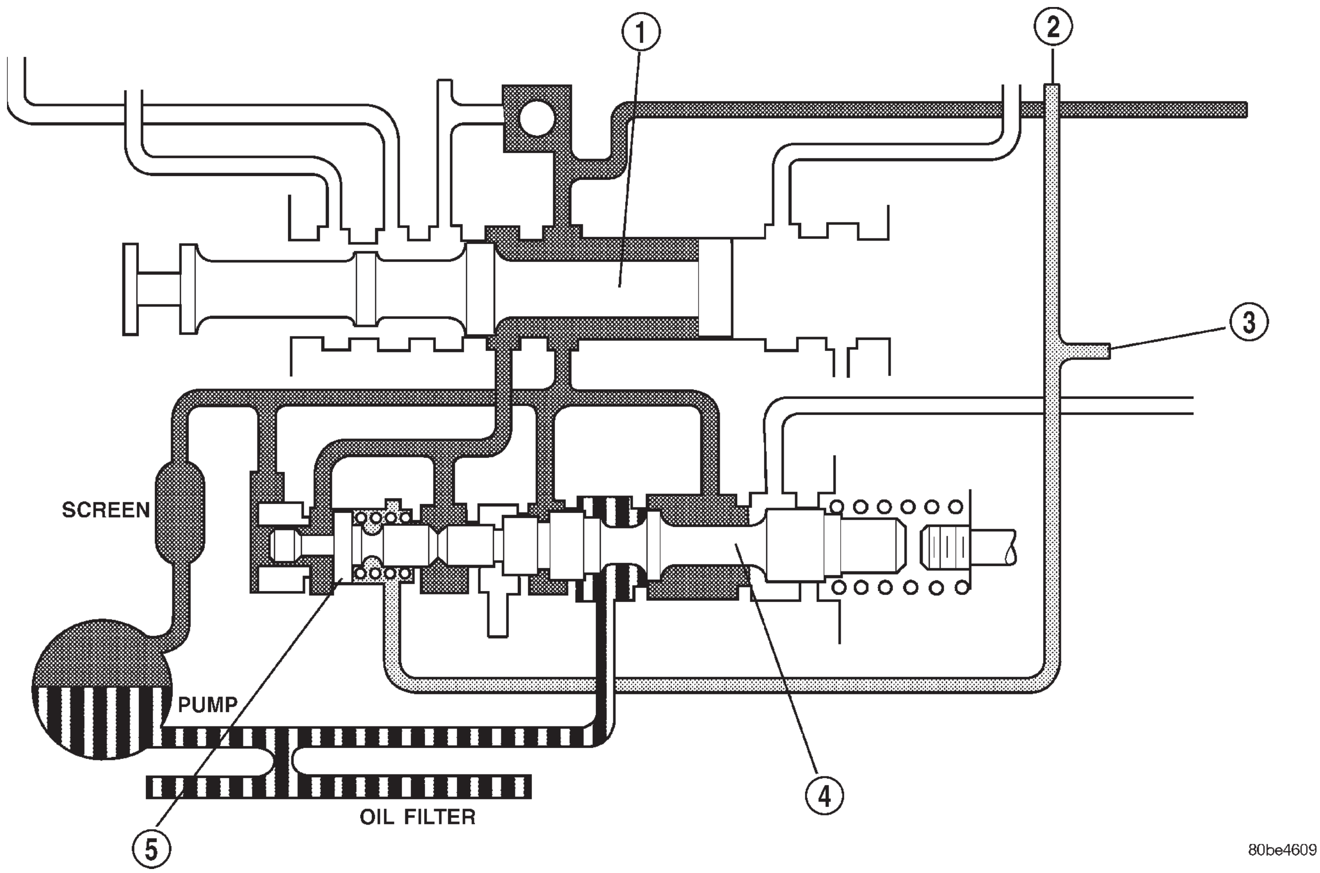


Fig. 192 Regulator Valve in Neutral Position

1 - MANUAL VALVE
2 - TO SHIFT VALVE
3 - FROM THROTTLE VALVE
4 - REGULATOR VALVE
5 - THROTTLE PRESSURE PLUG

pressures 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.

VALVE BODY (Continued)

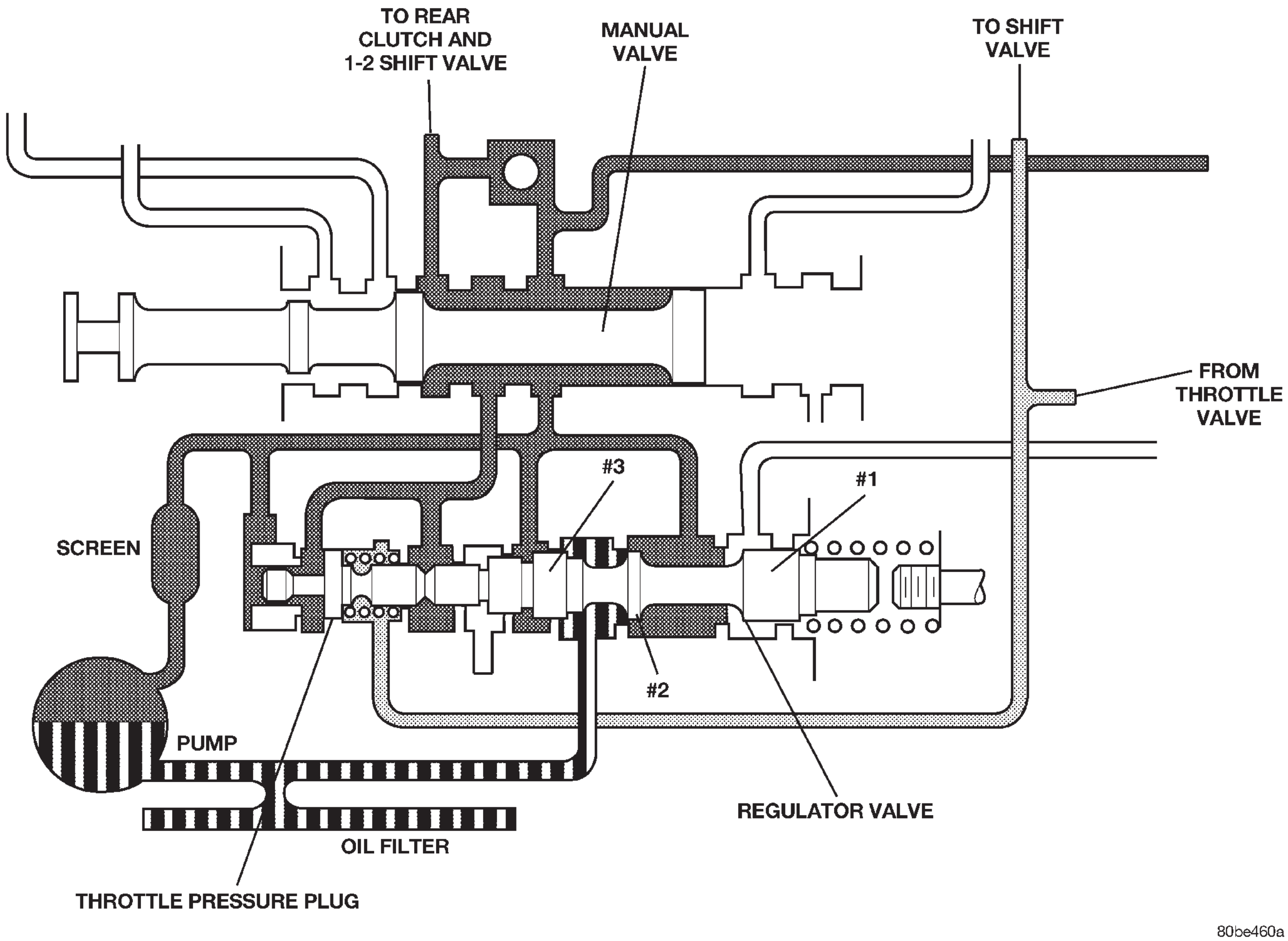


Fig. 193 Regulator Valve in Drive Position

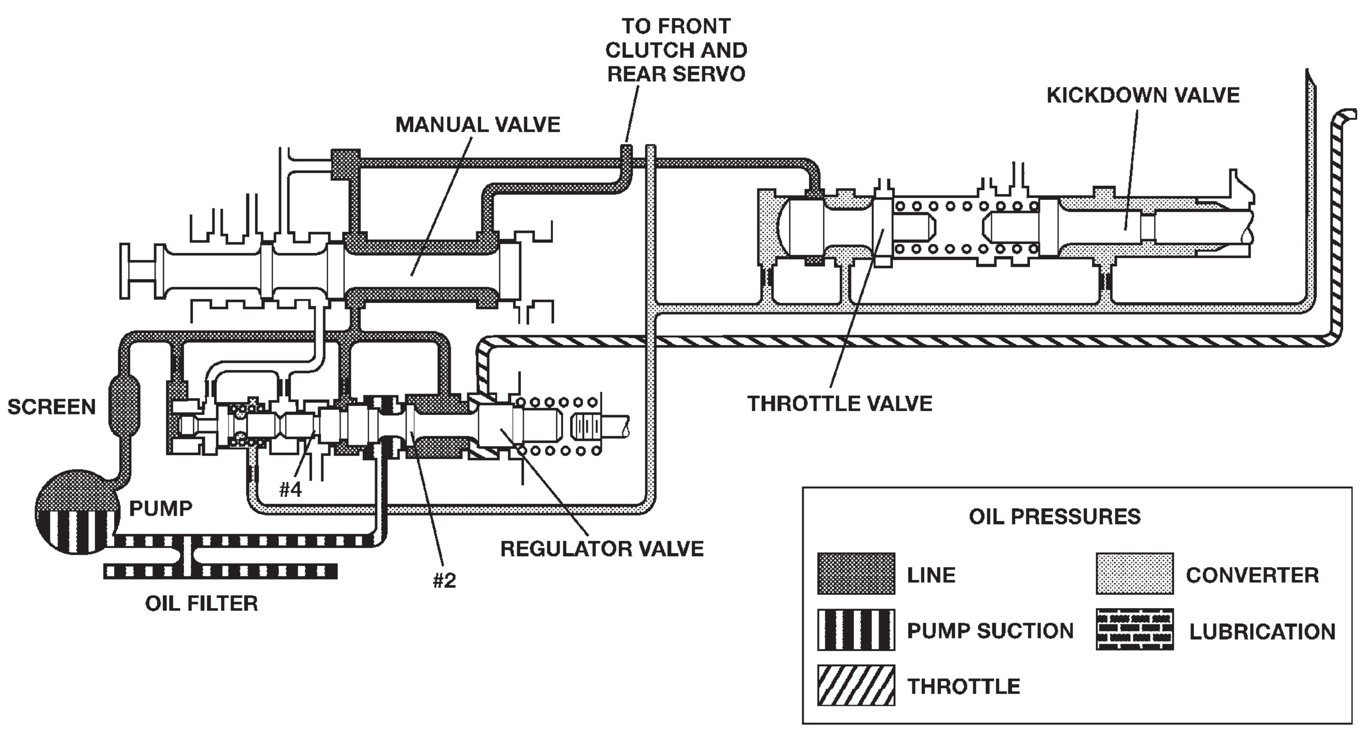


Fig. 194 Regulator Valve in Reverse Position

VALVE BODY (Continued)

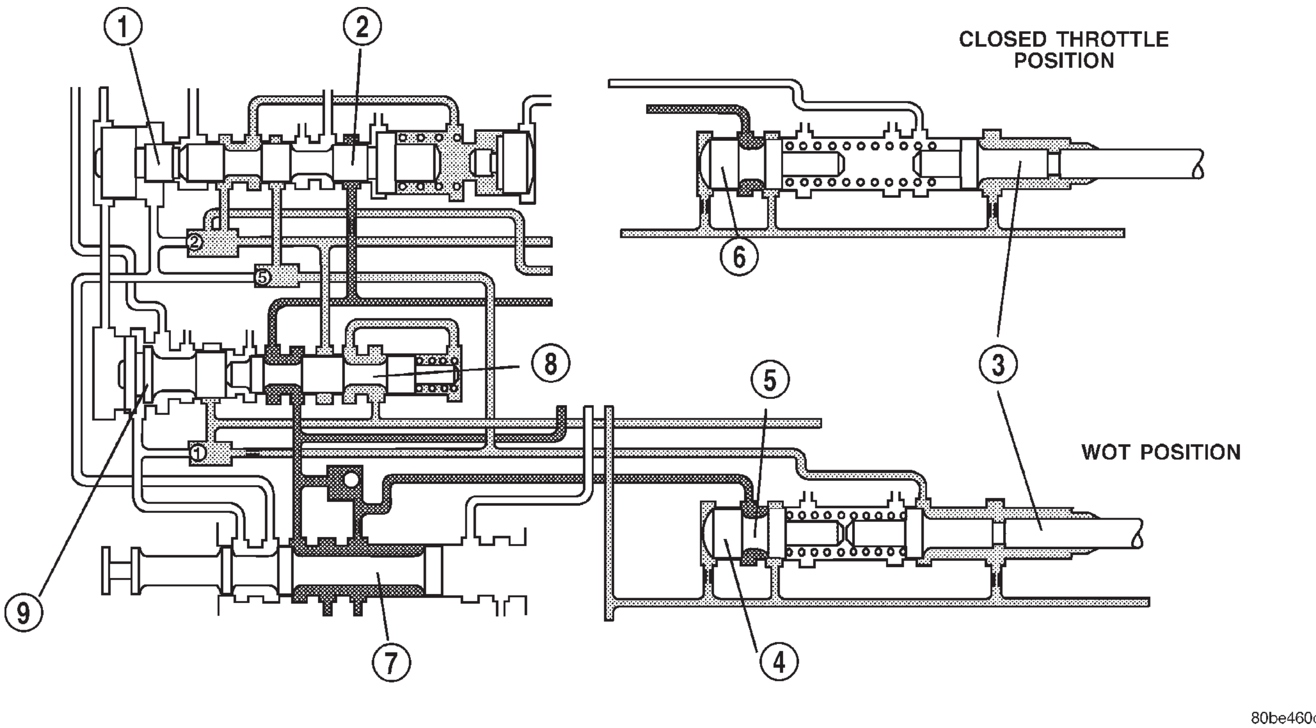


Fig. 195 Kickdown Valve

1 - 2-3 SHIFT VALVE
2 - GOVERNOR PLUG
3 - KICKDOWN VALVE
4 - THROTTLE VALVE
5 - MAXIMUM THROTTLE PRESSURE
6 - THROTTLE VALVE
7 - MANUAL VALVE
8 - 1-2 SHIFT VALVE
9 - GOVERNOR PLUG

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. 195) 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. 196) the limit valve does not come into play and does not affect the downshifts. As the vehicle's speed increases (Fig. 197), 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.

VALVE BODY (Continued)

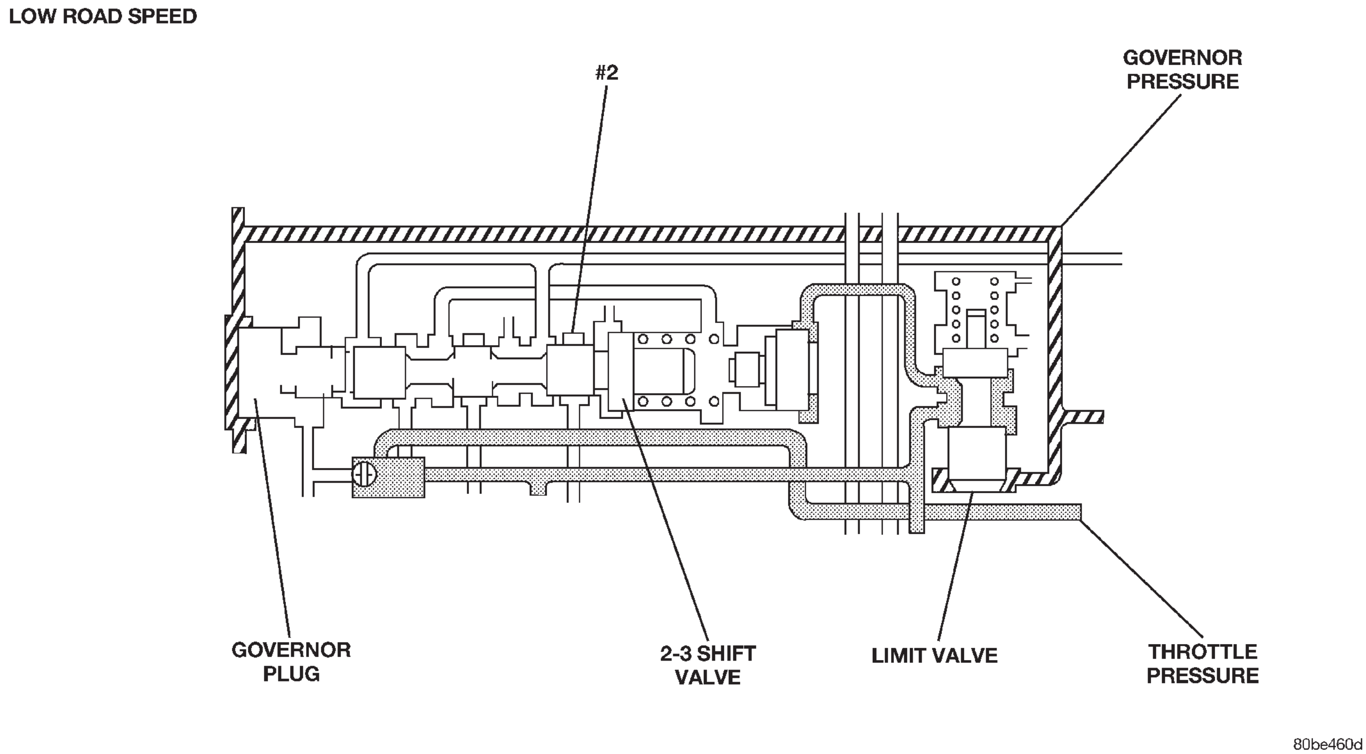


Fig. 196 Kickdown Limit Valve - Low Speeds

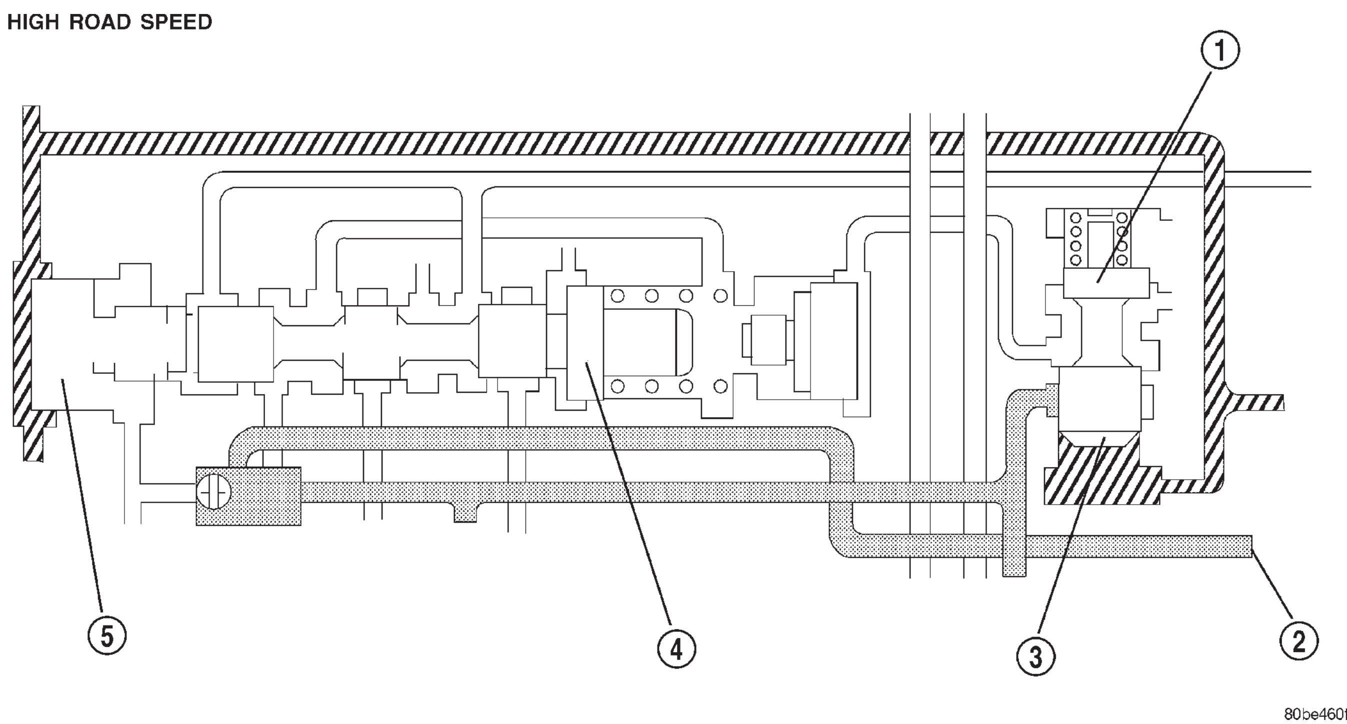


Fig. 197 Kickdown Limit Valve - High Speeds

1 - GOVERNOR PRESSURE CLOSES LIMIT VALVE
2 - THROTTLE PRESSURE
3 - LIMIT VALVE
4 - 2-3 SHIFT VALVE
5 - GOVERNOR PLUG

VALVE BODY (Continued)

1-2 SHIFT VALVE

The 1-2 shift valve assembly (Fig. 198), 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. 199).

The governor plug serves a dual purpose:

- 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.

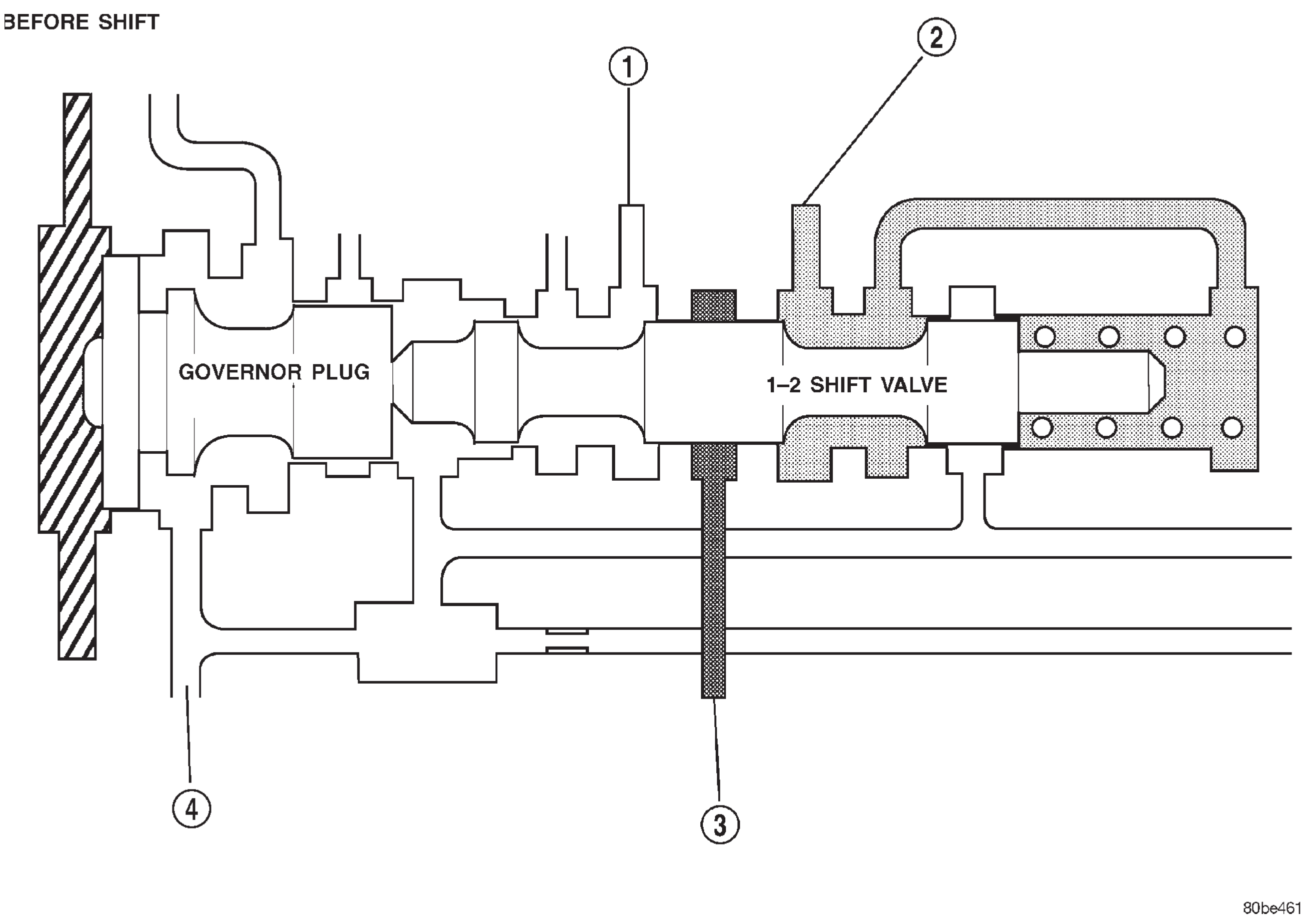


Fig. 198 1-2 Shift Valve - Before Shift

1 - TO FRONT SERVO AND 2-3 SHIFT VALVE
2 - THROTTLE PRESSURE
3 - LINE PRESSURE
4 - LINE PRESSURE PASSAGE FOR MANUAL LOW POSITION

VALVE BODY (Continued)

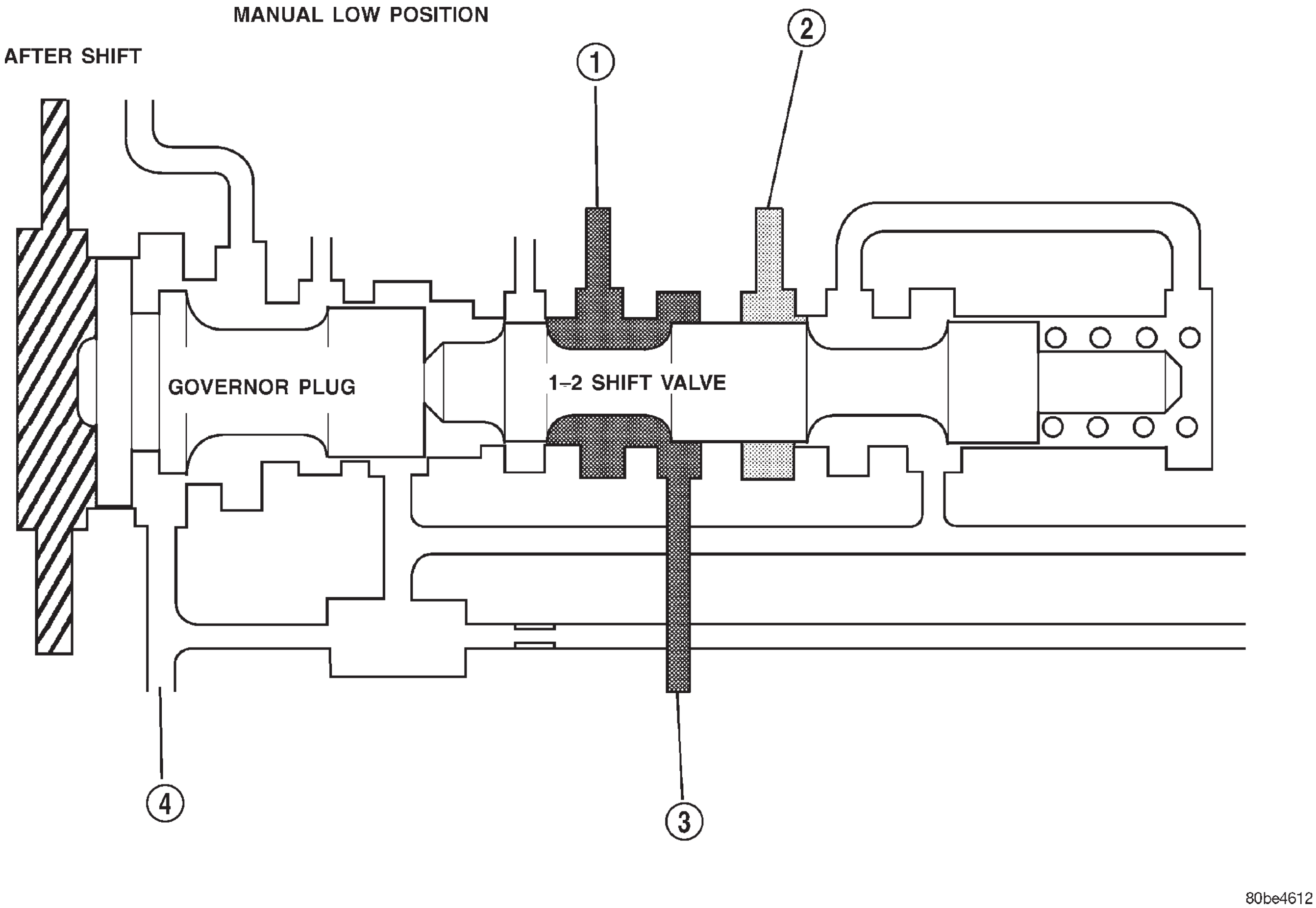


Fig. 199 1-2 Shift Valve - After Shift

1 - TO FRONT SERVO AND 2-3 SHIFT VALVE
2 - THROTTLE PRESSURE
3 - LINE PRESSURE
4 - LINE PRESSURE PASSAGE FOR MANUAL LOW POSITION

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. 200):

- Aid in quality of the 1-2 upshift.
- Aid in the quality and timing of the 3-2 kick-down 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 kick-down 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.

VALVE BODY (Continued)

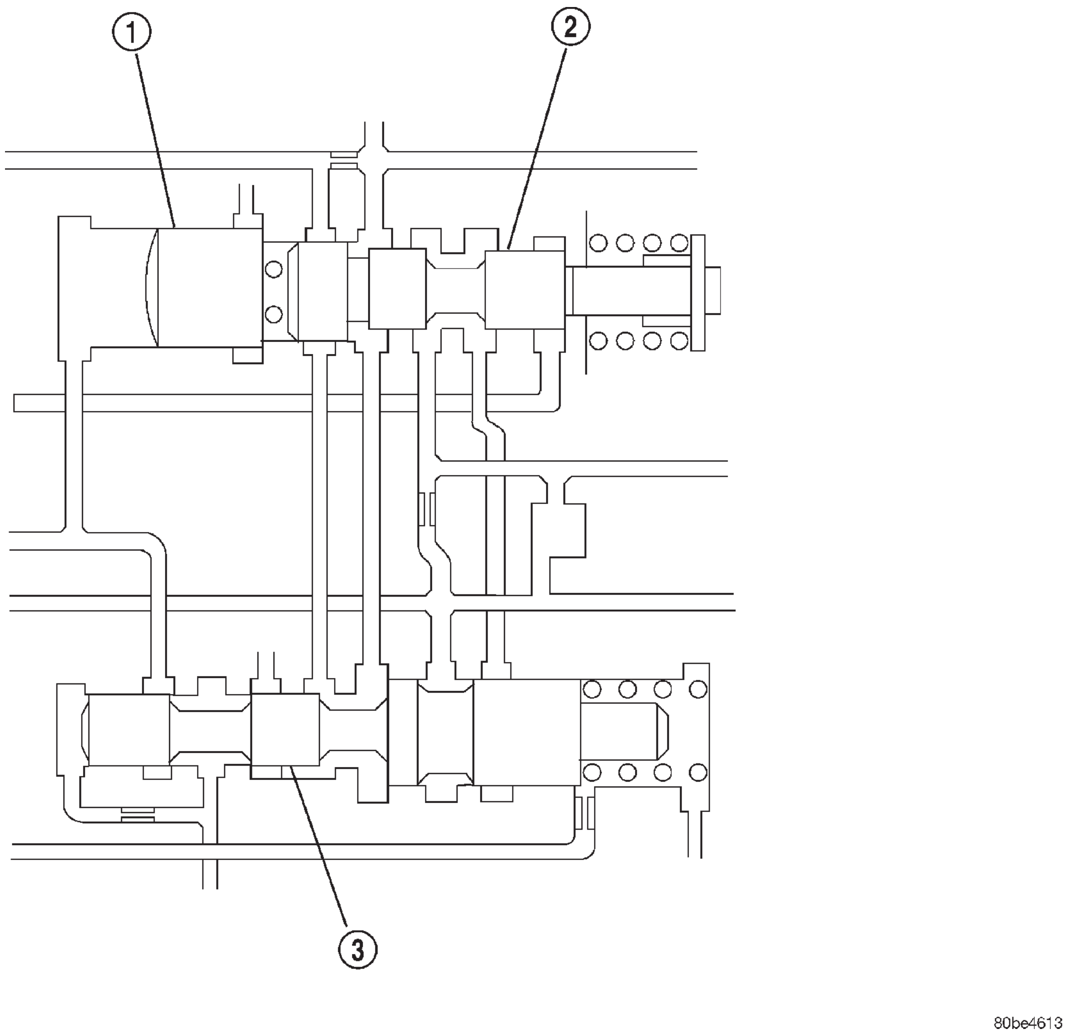


Fig. 200 1-2 Shift Control Valve

1 - THROTTLE PLUG
2 - SHUTTLE VALVE
3 - 1-2 SHIFT CONTROL VALVE

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. 200) 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 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. 201) 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

VALVE BODY (Continued)

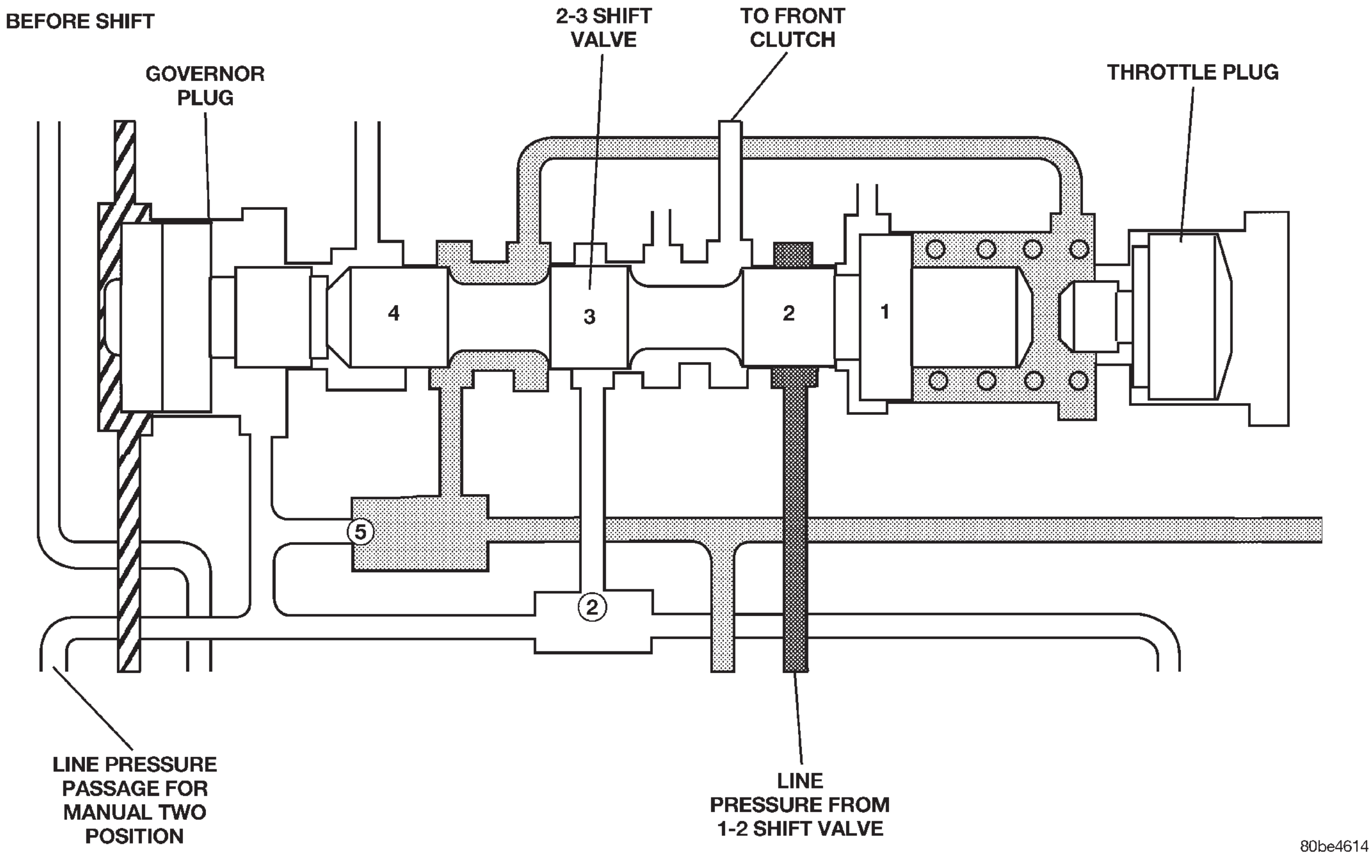


Fig. 201 2-3 Shift Valve - Before Shift

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. 202), 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.

THROTTLE VALVE

In all gear positions the throttle valve (Fig. 203) 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).

VALVE BODY (Continued)

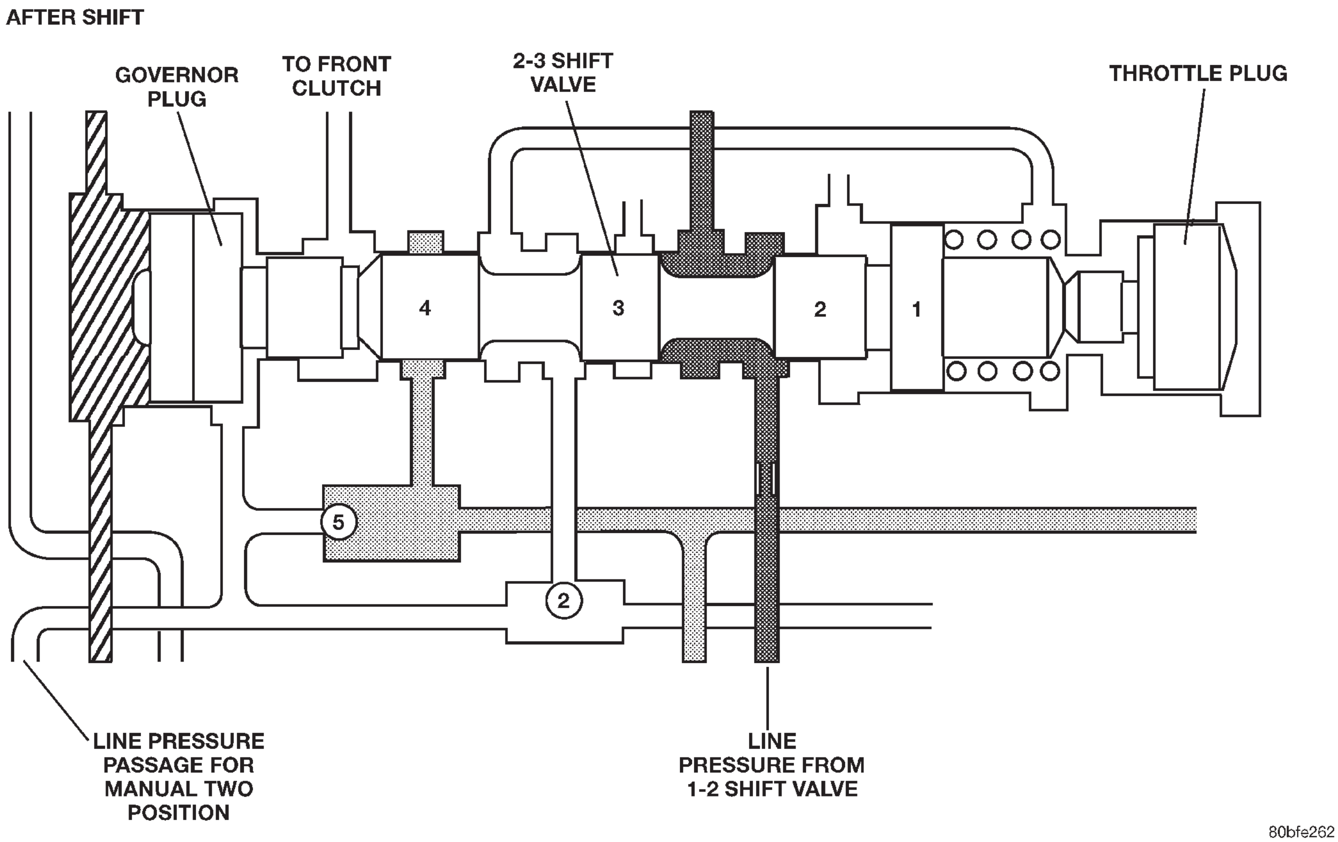


Fig. 202 2-3 Shift Valve - After Shift

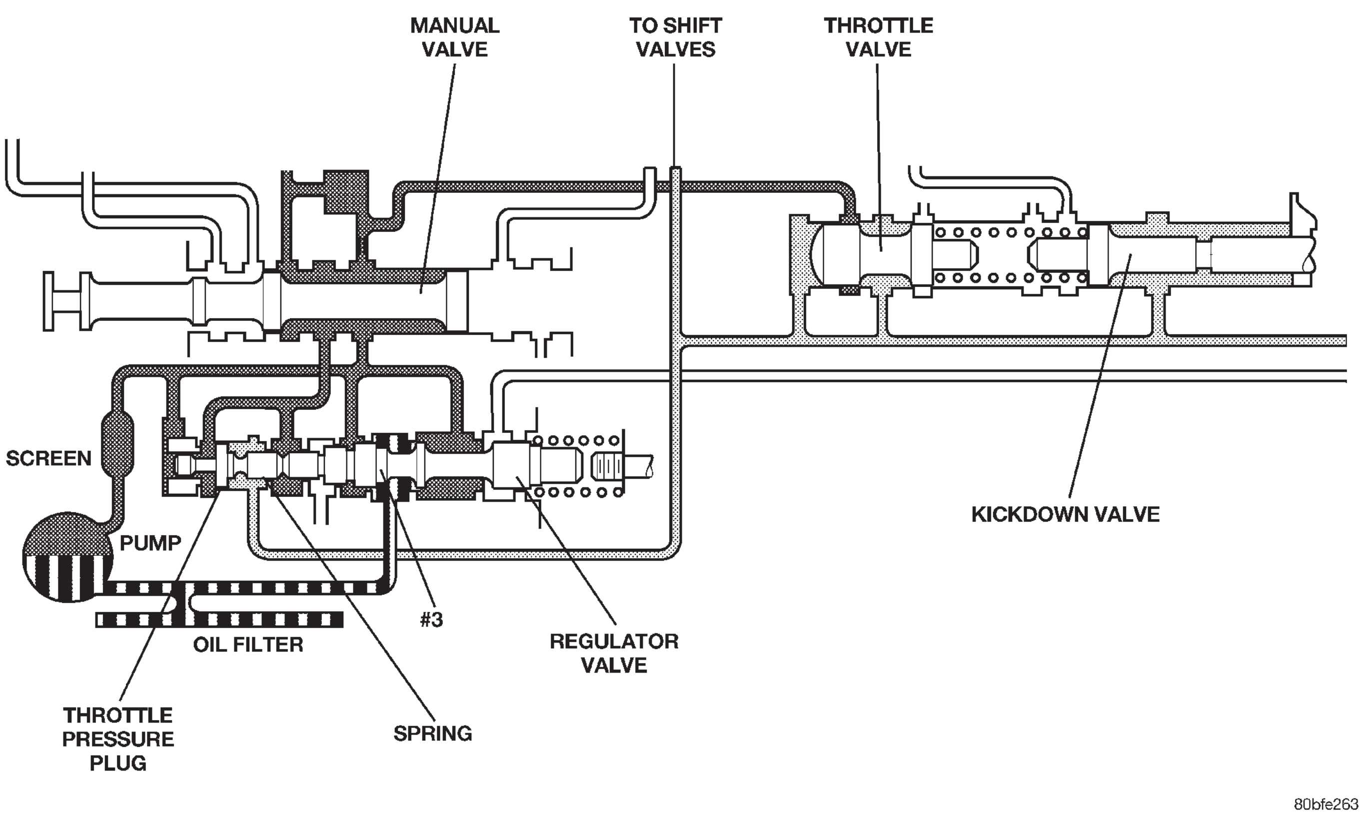


Fig. 203 Throttle Valve

VALVE BODY (Continued)

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.

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. 204), 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.

VALVE BODY (Continued)

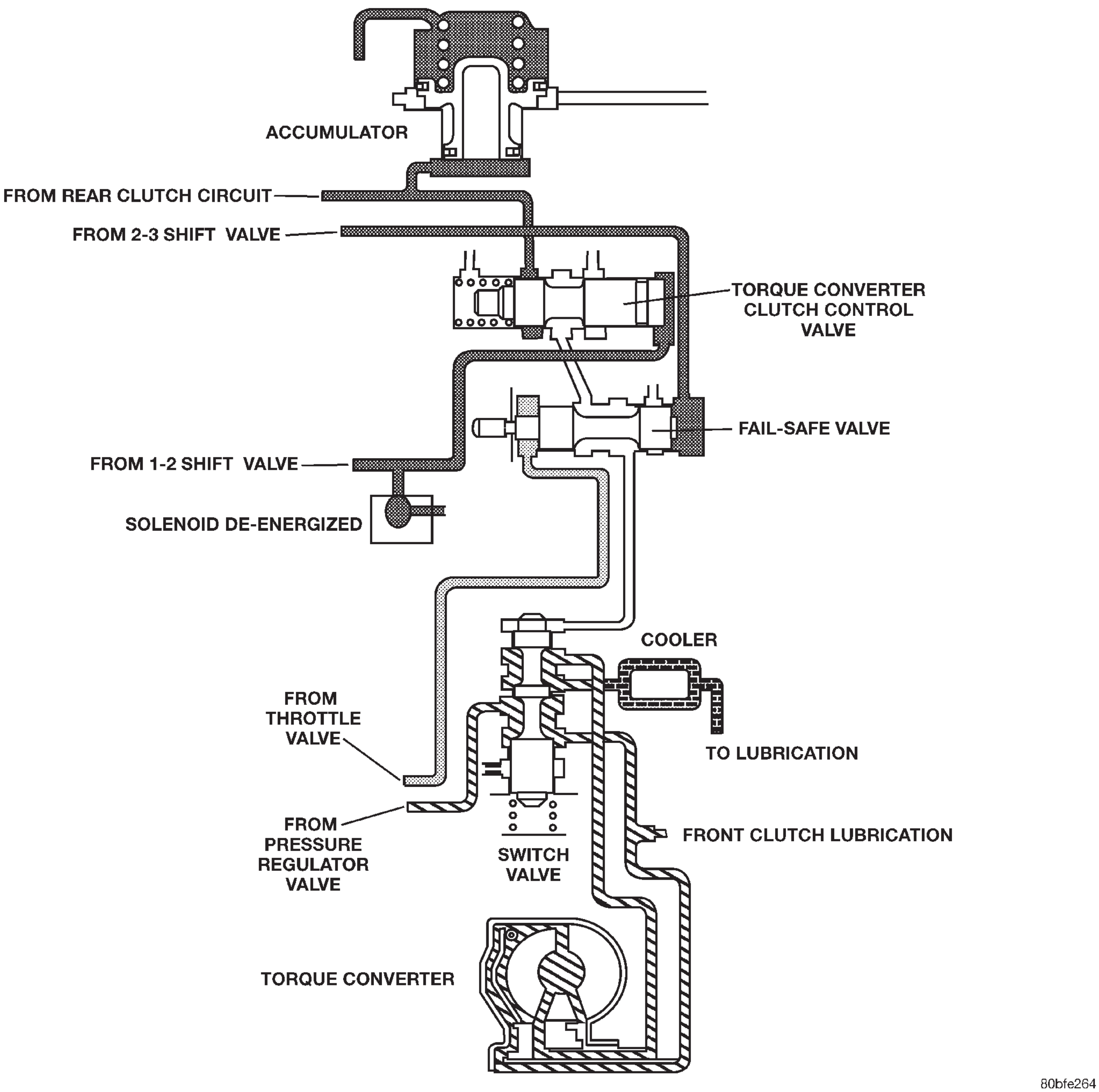


Fig. 204 Switch Valve - Torque Converter Unlocked

Once the TCC control valve has moved to the left (Fig. 205), 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.

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.

VALVE BODY (Continued)

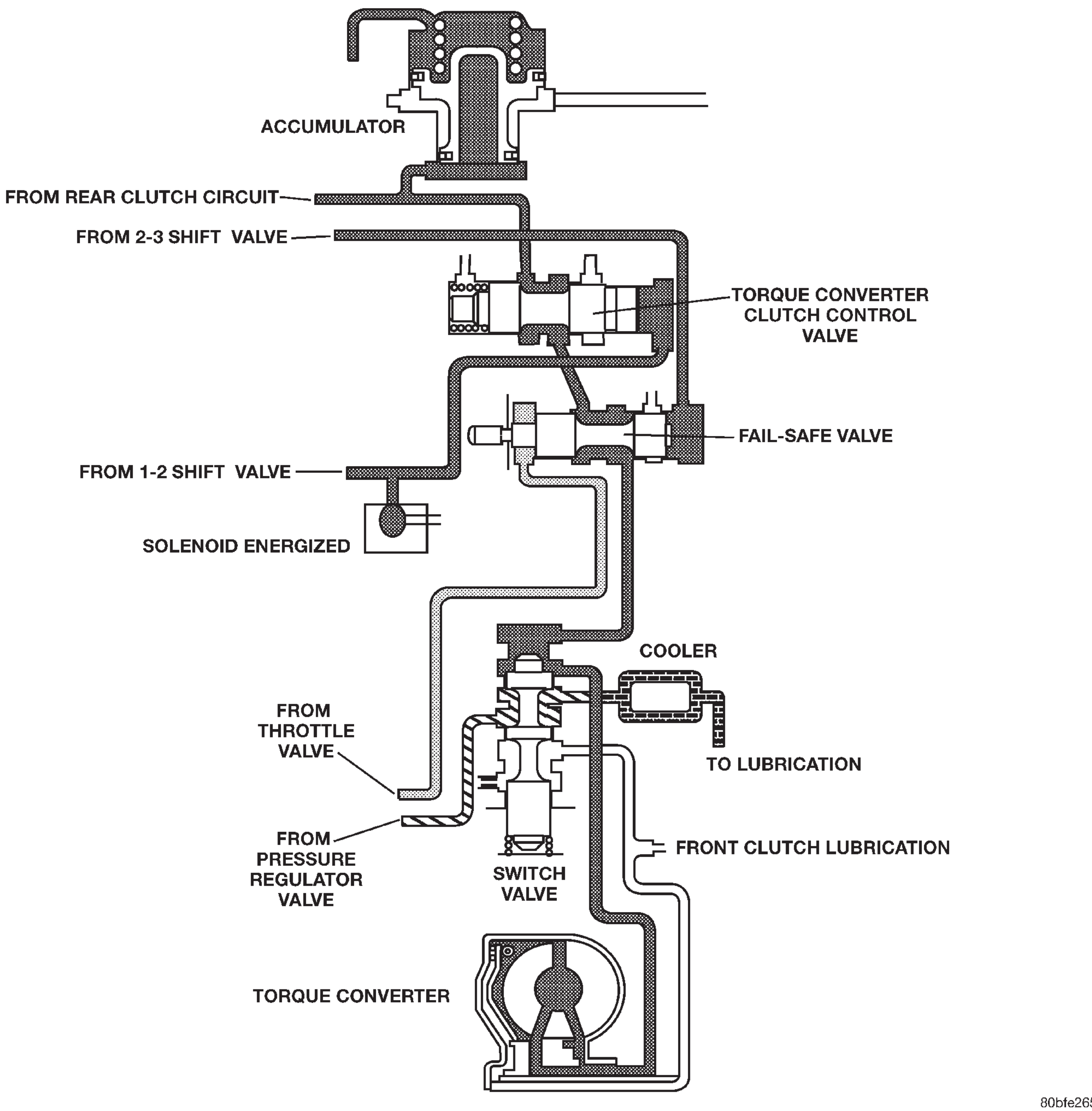


Fig. 205 Switch Valve - Torque Converter Locked

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. 206) 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.

VALVE BODY (Continued)

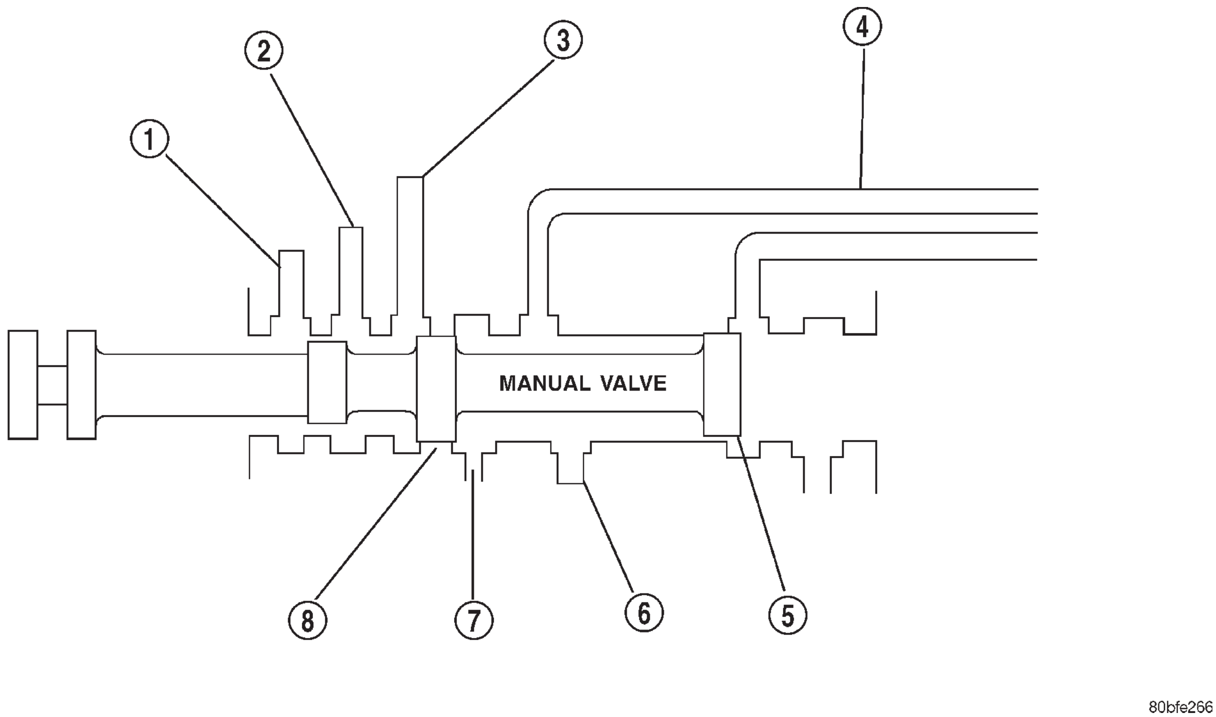


Fig. 206 Manual Valve

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

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. 207).
(7) Remove valve body attaching screws.
(8) Lower valve body enough to remove accumulator piston and piston spring (Fig. 208).
(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. 209).

DISASSEMBLY

Position the valve body on a clean work surface to avoid contamination.

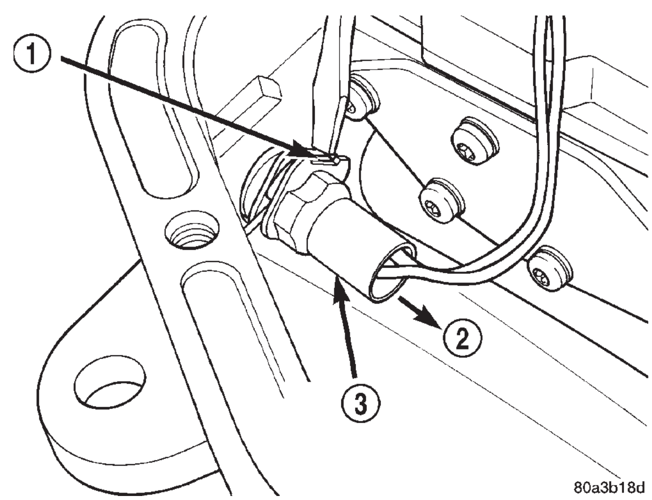


Fig. 207 Solenoid Wire Connector

1 - PUSH CLIP IN
2 - PULL
3 - CONVERTER CLUTCH SOLENOID CONNECTOR

VALVE BODY (Continued)

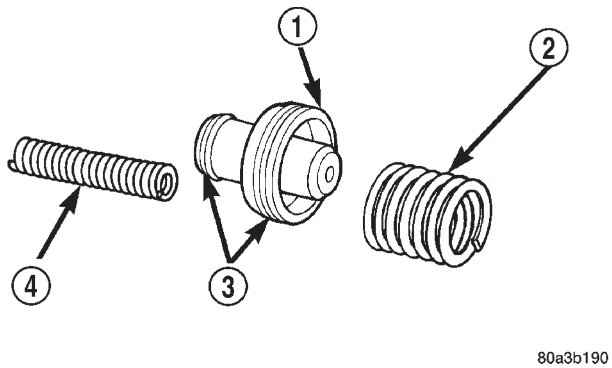


Fig. 208 Accumulator Piston And Springs

1 - ACCUMULATOR PISTON
2 - OUTER SPRING
3 - PISTON SEAL RINGS
4 - INNER SPRING (32RH)

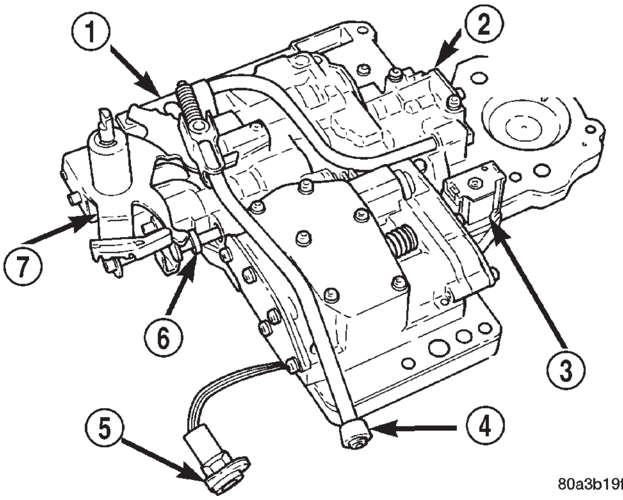


Fig. 209 Valve Body

1 - VALVE BODY
2 - CONVERTER CLUTCH MODULE
3 - SOLENOID
4 - PARK ROD
5 - CONVERTER CLUTCH SOLENOID CONNECTOR
6 - MANUAL VALVE
7 - MANUAL LEVER

CAUTION: Do not clamp any part of the valve body assembly (Fig. 210) 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.

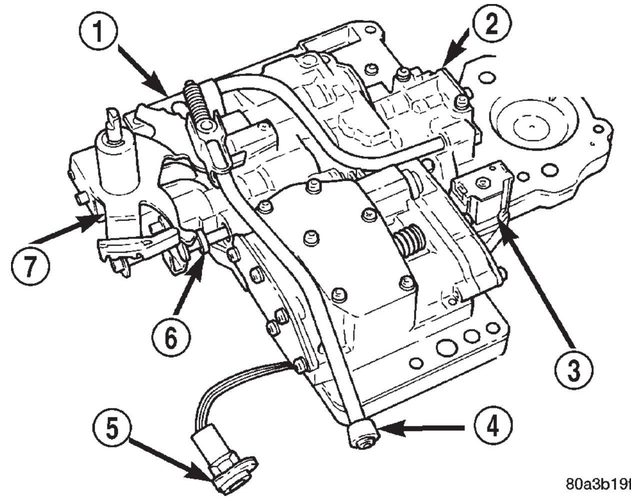


Fig. 210 Valve Body Assembly

1 - VALVE BODY
2 - CONVERTER CLUTCH MODULE
3 - SOLENOID
4 - PARK ROD
5 - CONVERTER CLUTCH SOLENOID CONNECTOR
6 - MANUAL VALVE
7 - MANUAL LEVER

(2) Remove adjusting screw bracket, line pressure adjusting screw (Fig. 211).

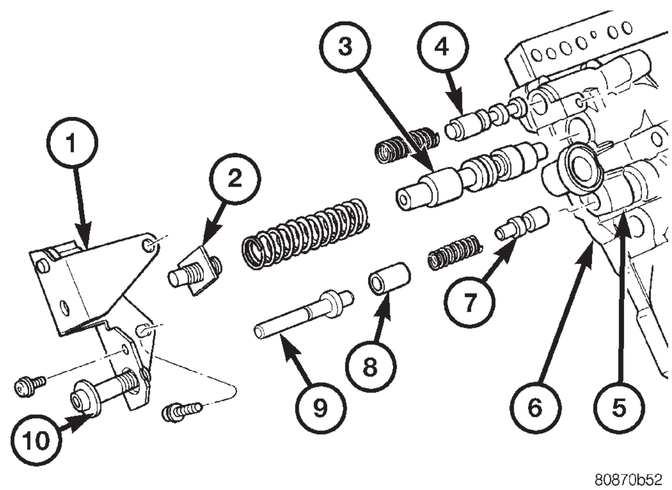


Fig. 211 Adjusting Screw Bracket, Springs, Valve Removal

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

VALVE BODY (Continued)

(3) Remove switch valve and spring, pressure regulator valve and spring, kickdown valve and spring, and throttle valve from valve body (Fig. 211).

(4) Secure detent ball and spring in housing with Retainer Tool 6583 (Fig. 212).

(5) Remove manual shaft E-clip, washer, and seal (Fig. 213).

(6) Pull manual shaft and park rod assembly upward out of valve body and off throttle lever (Fig. 213).

(7) Remove manual valve from valve body (Fig. 214)

(8) Remove Retainer Tool 6583. Then remove and retain detent ball and spring (Fig. 213).

(9) Remove throttle lever (Fig. 213).

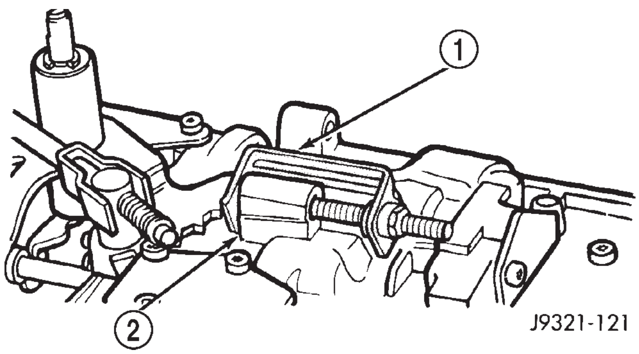


Fig. 212 Securing Detent Ball And Spring With Retainer Tool

1 - SPECIAL TOOL 6583
2 - DETENT BALL AND SPRING HOUSING

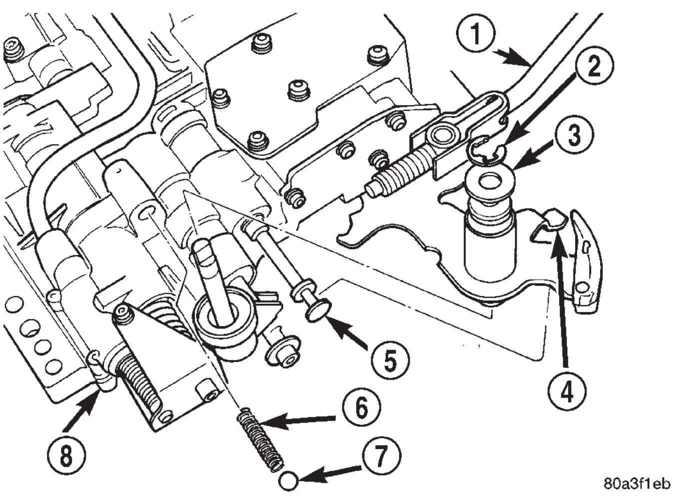


Fig. 213 Manual And Throttle Levers

1 - PARK ROD
2 - E-RING
3 - WASHER
4 - MANUAL LEVER
5 - MANUAL VALVE
6 - SPRING
7 - DETENT BALL
8 - VALVE BODY

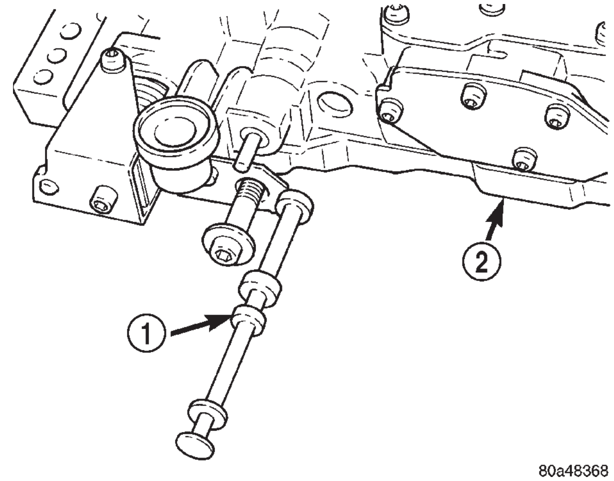


Fig. 214 Manual Valve

1 - MANUAL VALVE
2 - VALVE BODY

(10) Remove park rod E-clip and separate rod from manual lever (Fig. 215).

(11) Remove converter clutch solenoid from separator plate (Fig. 216). 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. 217).

(13) Remove screws attaching end cover plate to torque converter module (Fig. 218).

(14) Remove converter clutch valve, fail safe valve, and springs (Fig. 218)

(15) Turn valve body over so transfer plate is facing upward (Fig. 219). 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. 219).

(17) Remove transfer plate and separator plate from valve body (Fig. 219). 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.

VALVE BODY (Continued)

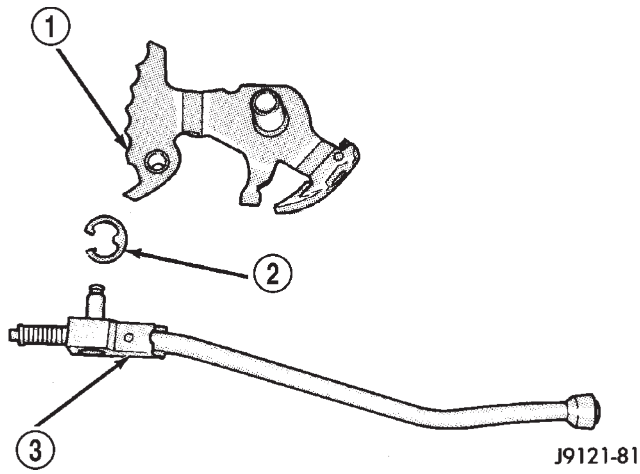


Fig. 215 Park Rod

1 - MANUAL LEVER
2 - E-CLIP
3 - PARK ROD

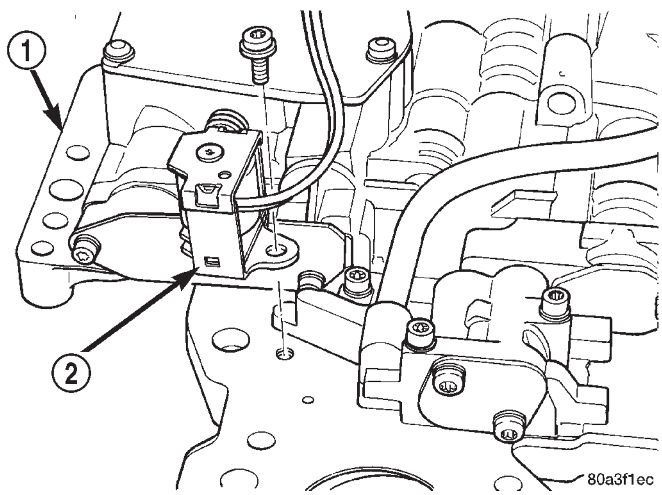


Fig. 216 Converter Clutch Solenoid

1 - VALVE BODY
2 - TORQUE CONVERTER CLUTCH SOLENOID

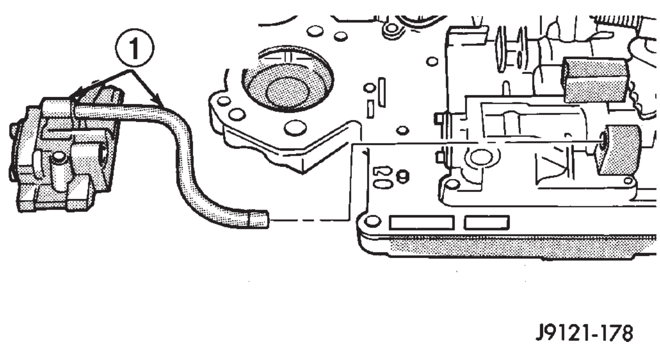


Fig. 217 Clutch Module And Connecting Tube

1 - MODULE AND CONNECTING TUBE

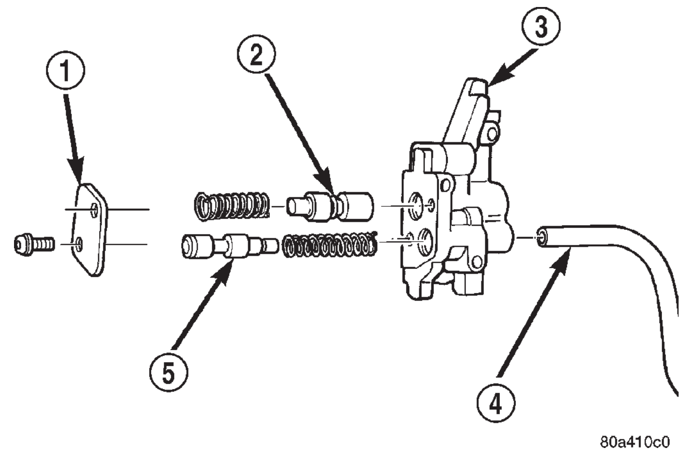


Fig. 218 Converter Clutch and Fail-Safe Valves

1 - COVER PLATE
2 - CONVERTER CLUTCH VALVE
3 - TORQUE CONVERTER CLUTCH MODULE
4 - MODULE CONNECTING TUBE
5 - FAIL-SAFE VALVE

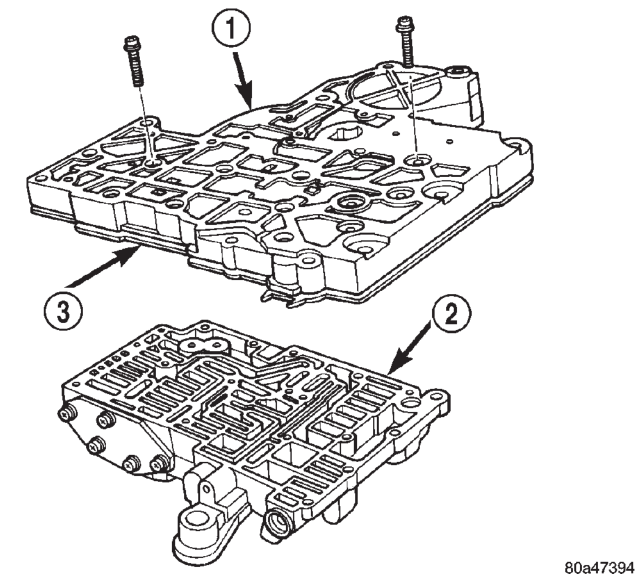


Fig. 219 Valve Body Transfer Plate Screws

1 - TRANSFER PLATE
2 - VALVE BODY
3 - SEPARATOR PLATE

VALVE BODY (Continued)

(19) Remove screws attaching separator plate to transfer plate (Fig. 220).

(20) Note position of filter, rear clutch servo and rear servo check balls for assembly reference (Fig. 220) and (Fig. 221).

(21) Remove shuttle valve end plate (Fig. 222).

(22) Remove shuttle valve E-clip and remove secondary spring and spring guides from end of valve (Fig. 223).

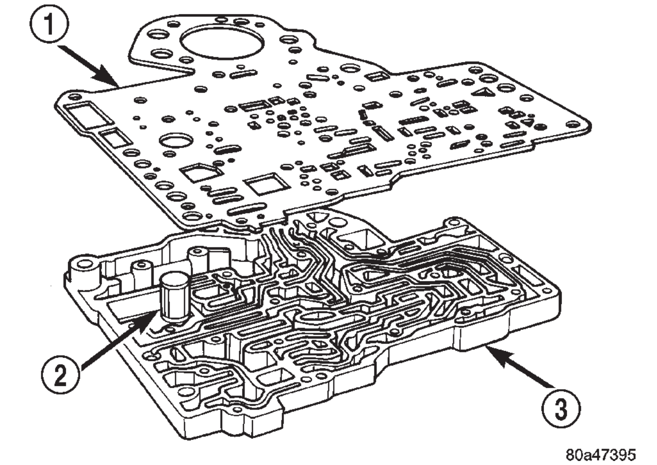


Fig. 220 Transfer And Separator Plates

1 - SEPARATOR PLATE
2 - FILTER
3 - TRANSFER PLATE

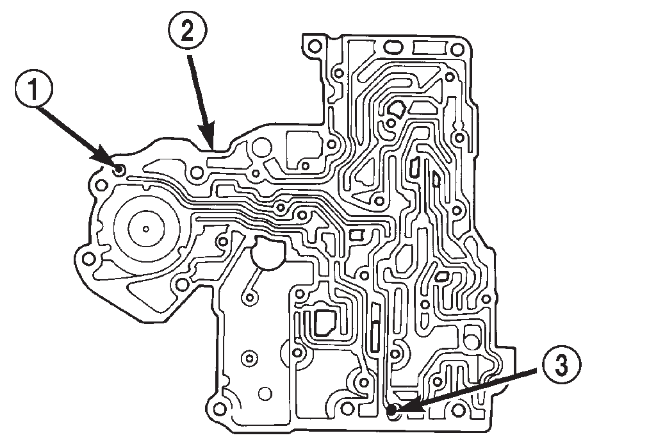


Fig. 221 Rear Servo and Rear Clutch Check Balls

1 - REAR SERVO CHECK BALL
2 - TRANSFER PLATE
3 - REAR CLUTCH CHECK BALL

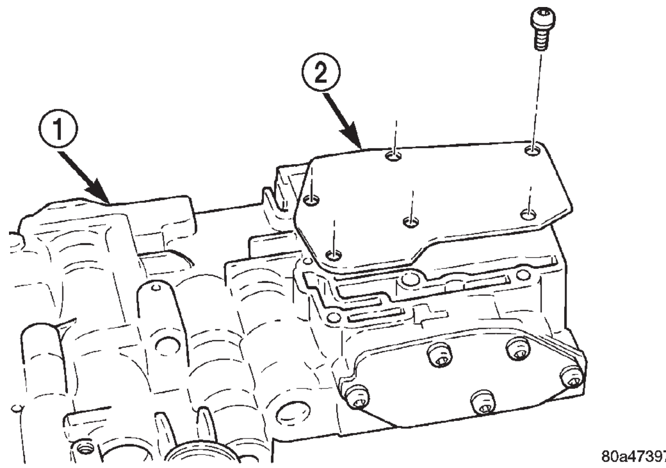


Fig. 222 Shuttle Valve

1 - VALVE BODY
2 - SHUTTLE VALVE END PLATE

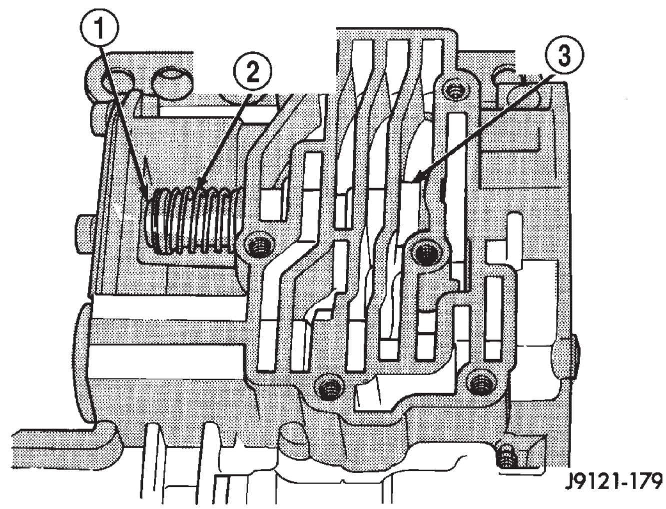


Fig. 223 Shuttle Valve E-Clip And Secondary Spring

1 - E-CLIP
2 - SECONDARY SPRING AND GUIDES
3 - SHUTTLE VALVE

(23) Remove governor plug end plate (Fig. 224).

(24) Remove 1-2 and 2-3 shift valve governor plugs from valve body (Fig. 224).

(25) Remove shuttle valve throttle plug, primary spring and shuttle valve from valve body (Fig. 224).

(26) Remove screws attaching kickdown limit valve body to valve body (Fig. 224).

(27) Remove 1-2 shift control valve and spring from valve body (Fig. 224).

(28) Remove 2-3 shift valve and spring from valve body (Fig. 224).

(29) Remove 1-2 shift valve and spring from valve body (Fig. 224).

(30) Remove throttle pressure plug from kickdown limit valve body (Fig. 224).

VALVE BODY (Continued)

(31) Remove retainer from end of kickdown limit valve body (Fig. 224).

(32) Remove kickdown limit valve and spring from kickdown limit valve body (Fig. 224).

(33) Remove regulator valve end plate from valve body (Fig. 224).

(34) Remove regulator valve line pressure plug, pressure plug sleeve, regulator valve throttle pressure plug and spring (Fig. 224).

CLEANING

Serviceable valve body components (Fig. 225) 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.

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.

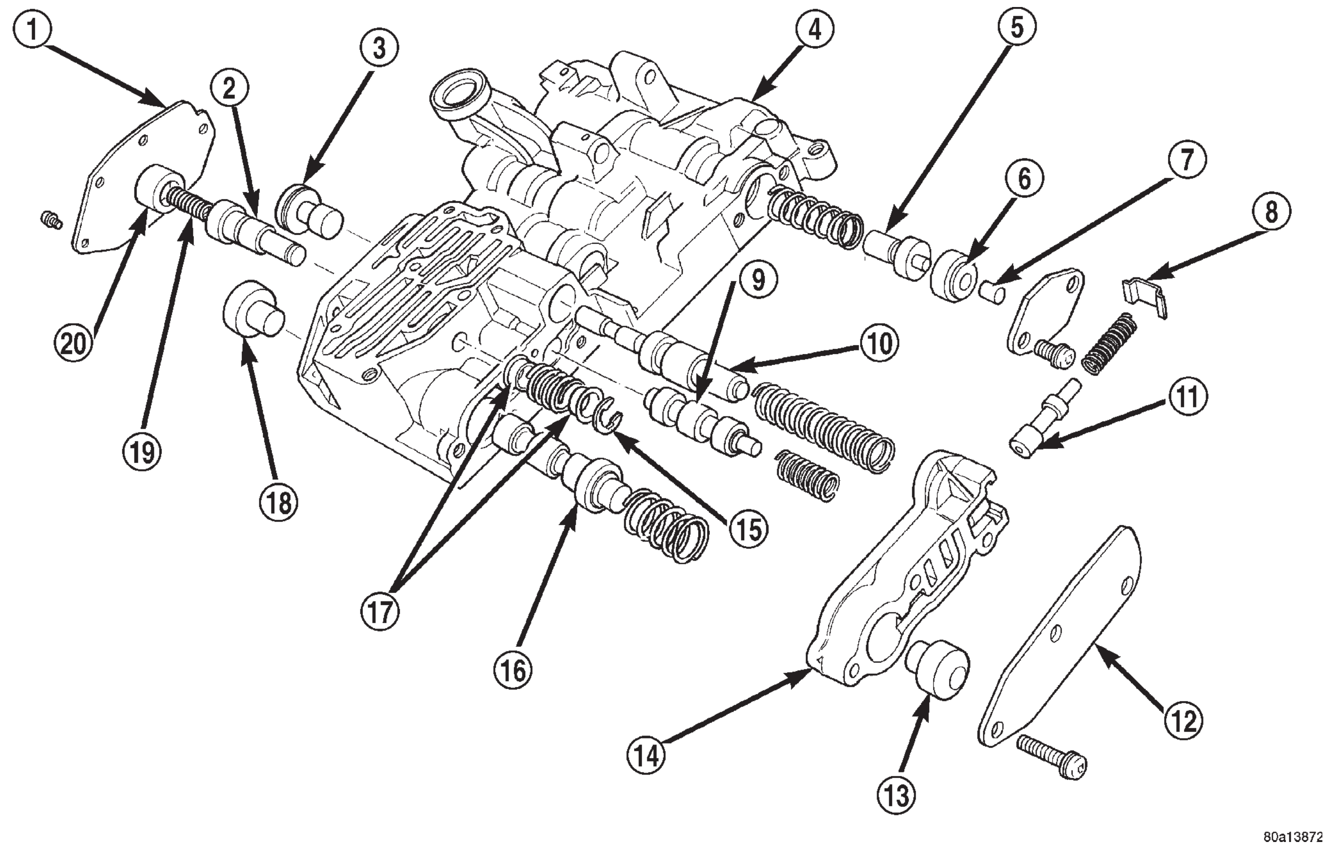


Fig. 224 Control Valves, Shift Valves, And Governor Plugs

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

VALVE BODY (Continued)

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with crocus cloth. The cloth should be in sheet form and be positioned on a surface plate, sheet of plate glass, or equally flat surface. However, if distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: Many of the valve body valves and plugs are made of coated aluminum. Aluminum components can be identified by the dark color of the special coating applied to the surface (or by testing with a magnet). DO NOT polish or sand aluminum valves or plugs with any type of material, or under any circumstances. This practice might damage the special coating and cause the valves and plugs to stick and bind.

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.

INSPECTION

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.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Also inspect the coating on the aluminum valves and plugs (Fig. 226). If the coating is damaged or worn through, the valve (or valve body) should be replaced.

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.

VALVE BODY (Continued)

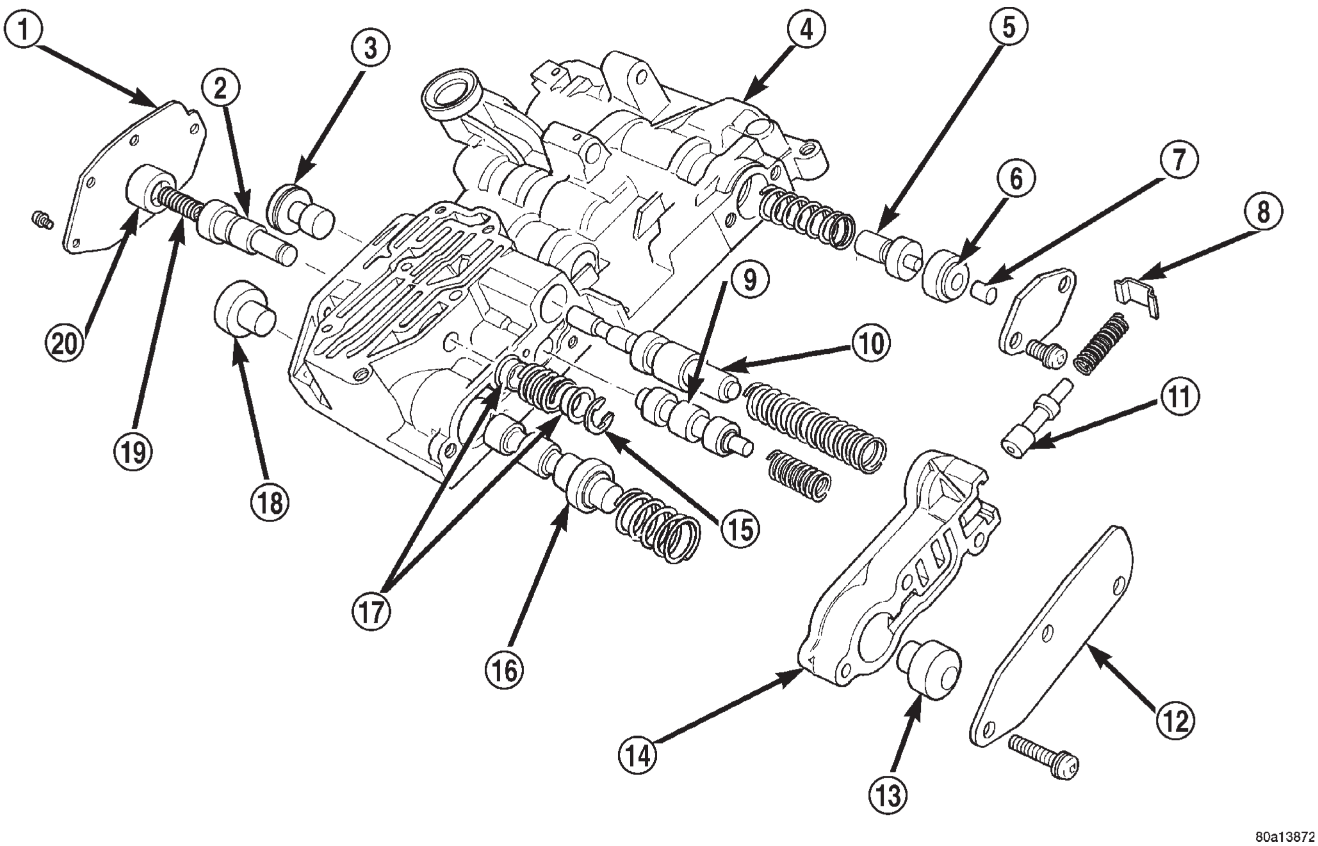


Fig. 225 Valve Body Components

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

ASSEMBLY

Clean and inspect all valve body components for damage or wear.

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 4, Type 9602, transmission fluid.

(2) Install regulator valve line pressure plug, pressure plug sleeve, regulator valve throttle pressure plug, and spring into valve body (Fig. 224). Verify valve components slide freely.

(3) Install regulator valve end plate on valve body (Fig. 224).

(4) Install kickdown limit valve and spring in kickdown limit valve body (Fig. 224). 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. 224).

VALVE BODY (Continued)

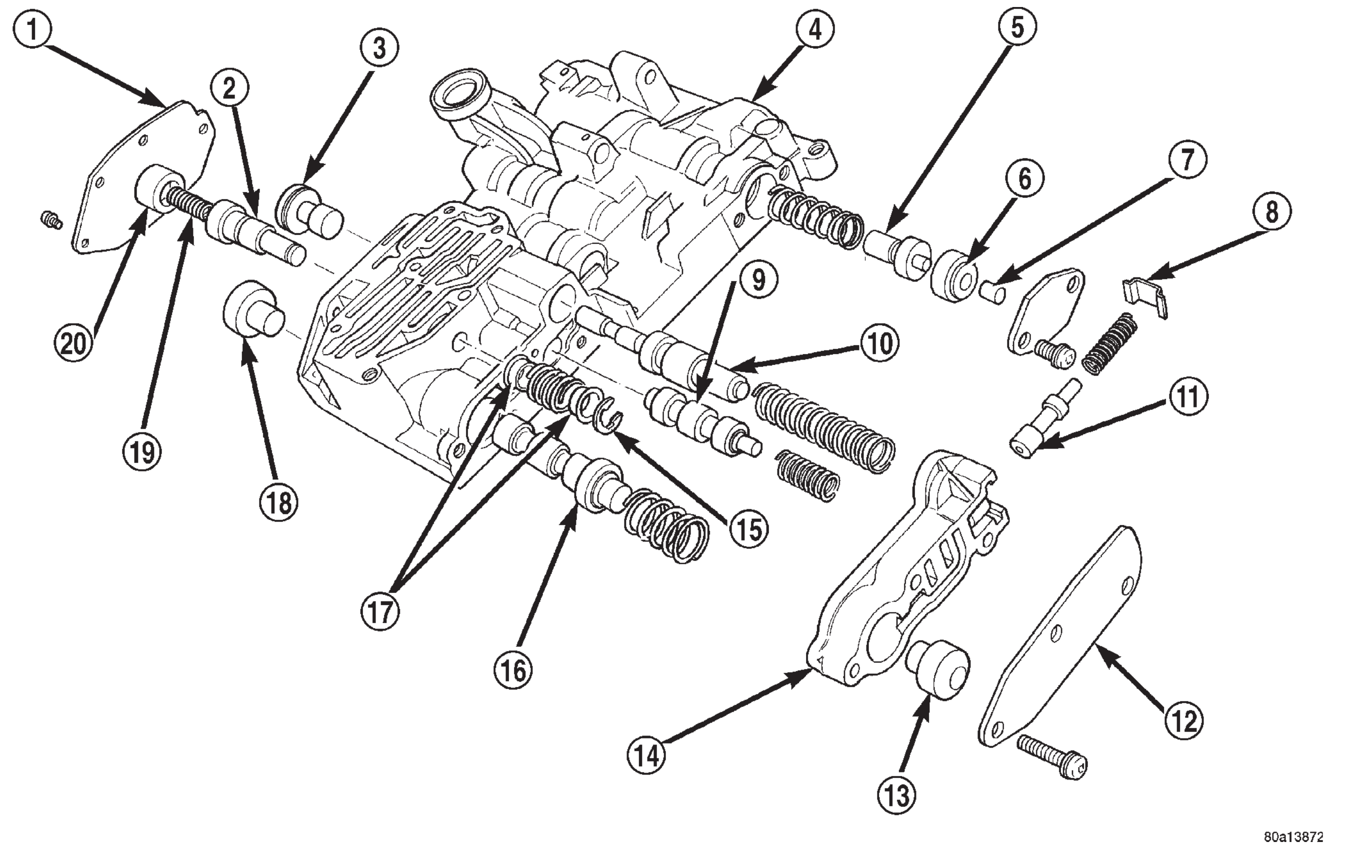


Fig. 226 Valve Body Components

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

(7) Install throttle pressure plug in kickdown limit valve body (Fig. 224).

(8) Install 1-2 shift valve and spring into valve body (Fig. 224).

(9) Install 2-3 shift valve and spring into valve body (Fig. 224).

(10) Install 1-2 shift control valve and spring into valve body (Fig. 224).

(11) Verify valve components slide freely.

(12) Place kickdown limit valve body and end plate in position on valve body and compress springs (Fig. 224).

(13) Install screws to attach kickdown limit valve body to valve body (Fig. 224).

(14) Install shuttle valve throttle plug, primary spring and shuttle valve into valve body (Fig. 224). Verify valve components slide freely.

(15) Install 1-2 and 2-3 shift valve governor plugs into valve body (Fig. 224). 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. 224).

(18) Assemble shuttle valve spring and guides (Fig. 224). Place spring and guides in position on shuttle valve stem.

(19) Compress spring and install E-clip in groove on shuttle valve stem (Fig. 227).

(20) Place shuttle valve end plate in position on valve body (Fig. 228).

(21) Install screws to attach shuttle valve end plate to valve body (Fig. 228).

VALVE BODY (Continued)

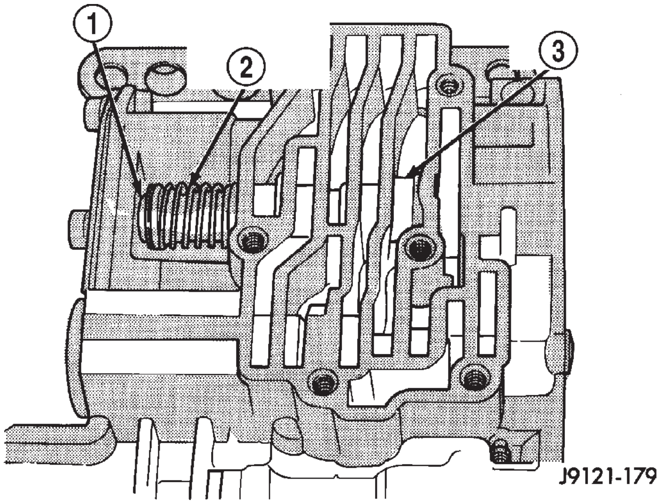


Fig. 227 Shuttle Valve E-Clip And Secondary Spring

1 - E-CLIP
2 - SECONDARY SPRING AND GUIDES
3 - SHUTTLE VALVE

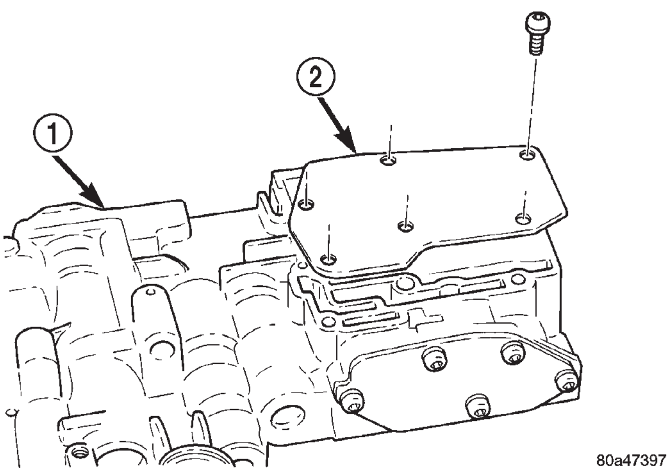


Fig. 228 Shuttle Valve End Plate

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. 229).

(23) Insert filter into opening in separator plate (Fig. 230).

(24) Place separator plate in position on transfer plate and install screws to attach separator plate to transfer plate (Fig. 230).

(25) Place one 11/32 in. check ball and six 1/4 in. check balls in the proper cavities in the valve body (Fig. 231).

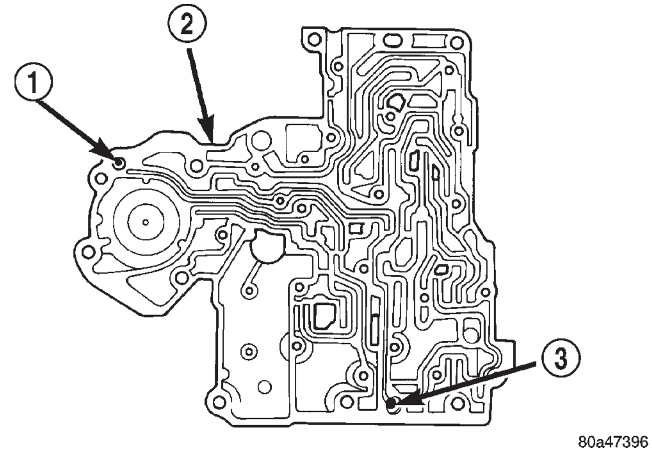


Fig. 229 Rear Servo and Rear Clutch Check Balls

1 - REAR SERVO CHECK BALL
2 - TRANSFER PLATE
3 - REAR CLUTCH CHECK BALL

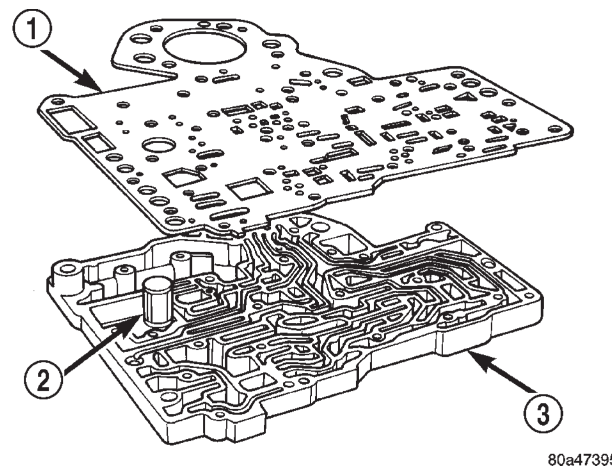


Fig. 230 Transfer And Separator Plates

1 - SEPARATOR PLATE
2 - FILTER
3 - TRANSFER PLATE

VALVE BODY (Continued)

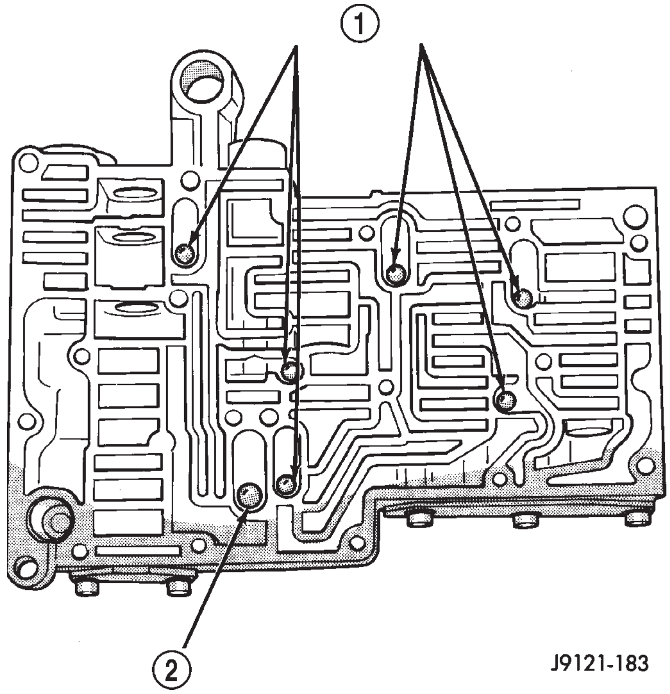


Fig. 231 Correct Position Of Valve Body Check Balls

1 - 1/4′′ CHECK BALLS (6)
2 - 11/32′′ CHECK BALL (1)

(26) Place transfer plate in position on valve body (Fig. 232).

(27) Install screws to attach transfer plate to valve body (Fig. 232).

(28) Turn valve body over to expose the separator plate.

(29) Insert converter clutch valve and spring into converter clutch valve module (Fig. 233). Verify valve components slide freely.

(30) Insert spring and fail-safe valve into converter clutch valve module (Fig. 233). Verify valve components slide freely.

(31) Place cover plate in position on converter clutch valve module (Fig. 233).

(32) Install screws to attach cover to converter clutch valve module (Fig. 233).

(33) Insert connecting tube into converter clutch valve module (Fig. 233).

(34) Insert connecting tube into valve body opening (Fig. 234).

(35) Place converter clutch valve module in position on separator plate. Install screws to attach converter clutch module to valve body (Fig. 234).

(36) If necessary, install a new O-ring on converter clutch solenoid (Fig. 235).

(37) Insert converter clutch solenoid into transfer plate (Fig. 235).

(38) Install screw to attach solenoid to transfer plate (Fig. 235).

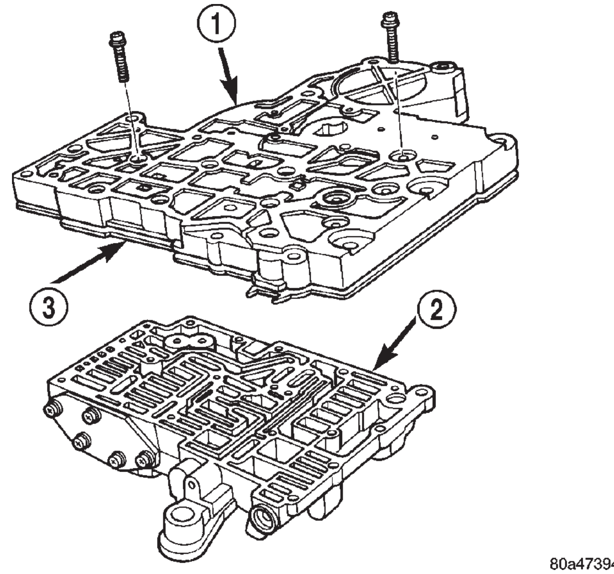


Fig. 232 Valve Body Transfer Plate Screws

1 - TRANSFER PLATE
2 - VALVE BODY
3 - SEPARATOR PLATE

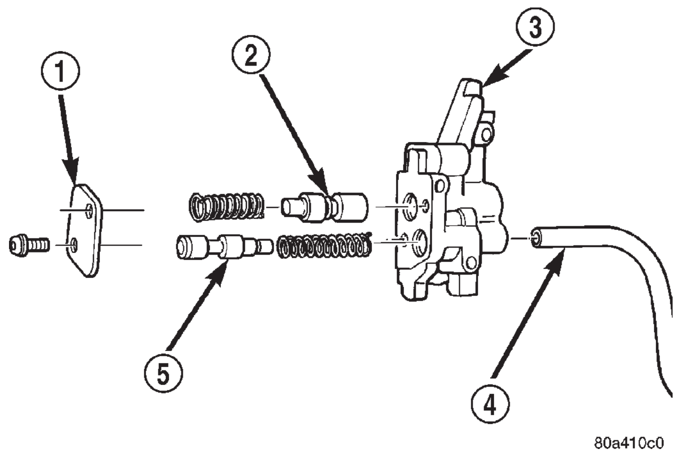


Fig. 233 Converter Clutch Valve Module

1 - COVER PLATE
2 - CONVERTER CLUTCH VALVE
3 - TORQUE CONVERTER CLUTCH MODULE
4 - MODULE CONNECTING TUBE
5 - FAIL-SAFE VALVE

(39) If necessary, insert park rod end into manual lever and install E-clip (Fig. 236).

(40) Insert detent spring and ball into opening in valve body and install Retainer Tool 6583 (Fig. 237).

(41) Install manual valve into valve body (Fig. 238).

(42) Insert throttle lever through transfer plate side of valve body and upward (Fig. 239).

(43) Insert throttle lever into groove in manual valve (Fig. 240).

VALVE BODY (Continued)

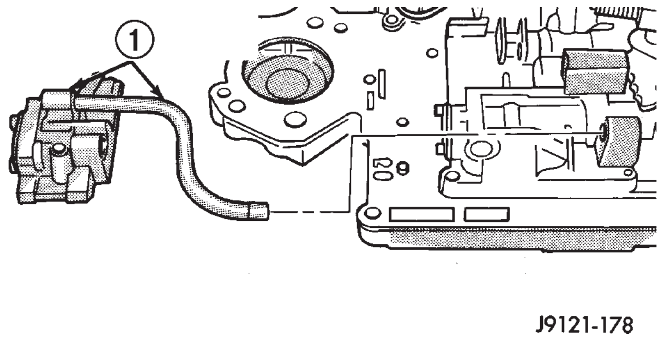


Fig. 234 Clutch Module And Connecting Tube

1 - MODULE AND CONNECTING TUBE

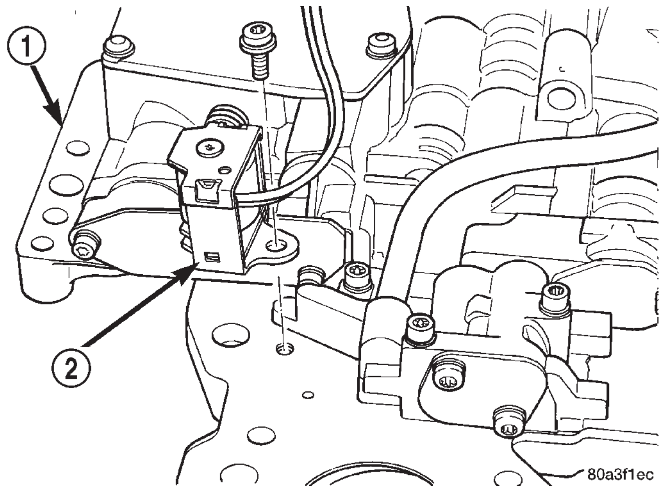


Fig. 235 Converter Clutch Solenoid

1 - VALVE BODY
2 - TORQUE CONVERTER CLUTCH SOLENOID

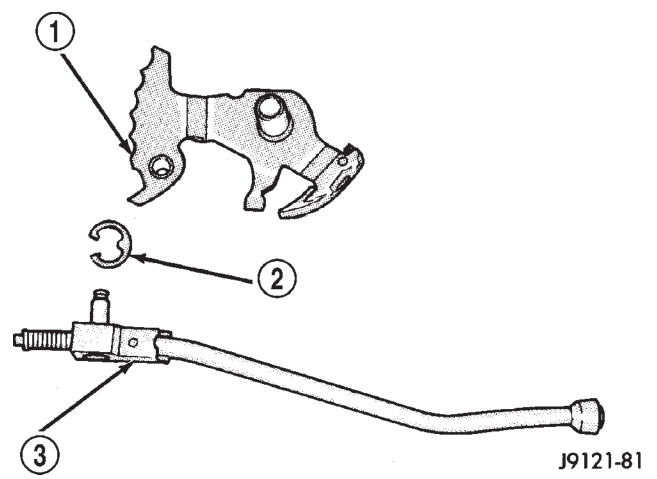


Fig. 236 Park Rod

1 - MANUAL LEVER
2 - E-CLIP
3 - PARK ROD

(44) Install seal, washer, and E-clip to retain manual shaft to valve body (Fig. 239).

(45) Install switch valve and spring, pressure regulator valve and spring, kickdown valve and spring, and throttle valve into valve body (Fig. 241).

(46) Place adjusting screw bracket and line pressure adjusting screw in position on valve body and compress springs (Fig. 211).

(47) Install screws to attach adjuster bracket to valve body.

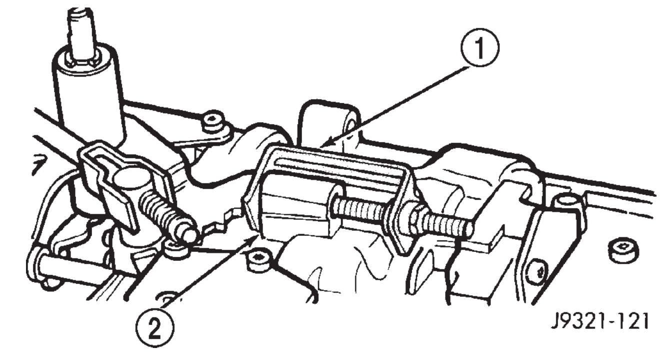


Fig. 237 Securing Detent Ball And Spring With Retainer Tool

1 - SPECIAL TOOL 6583
2 - DETENT BALL AND SPRING HOUSING

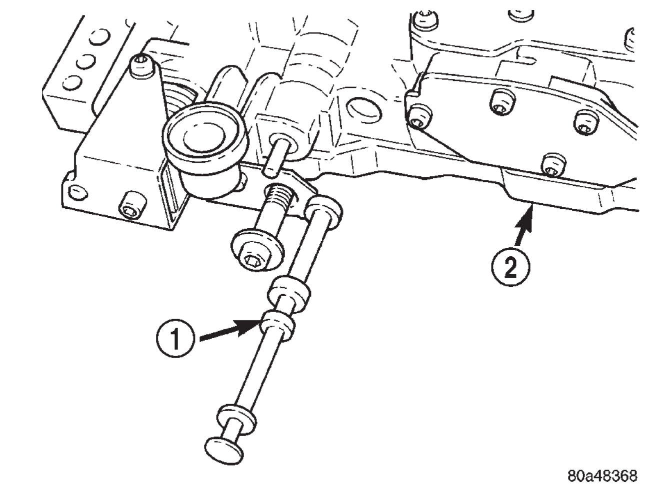


Fig. 238 Manual Valve

1 - MANUAL VALVE
2 - VALVE BODY

VALVE BODY (Continued)

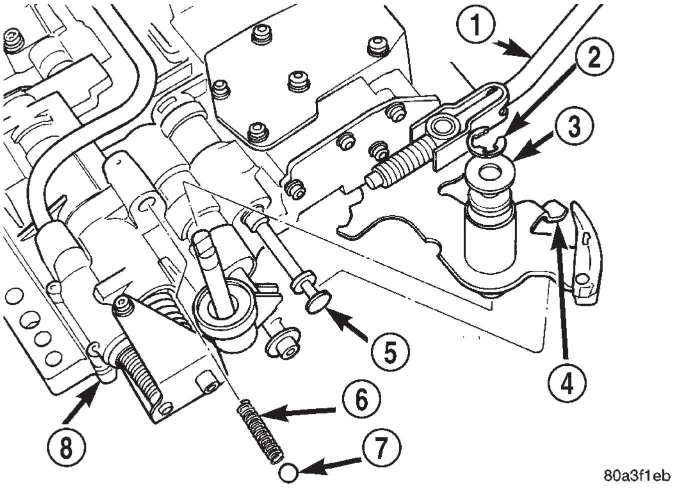


Fig. 239 Manual And Throttle Levers

1 - PARK ROD
2 - E-RING
3 - WASHER
4 - MANUAL LEVER
5 - MANUAL VALVE
6 - SPRING
7 - DETENT BALL
8 - VALVE BODY

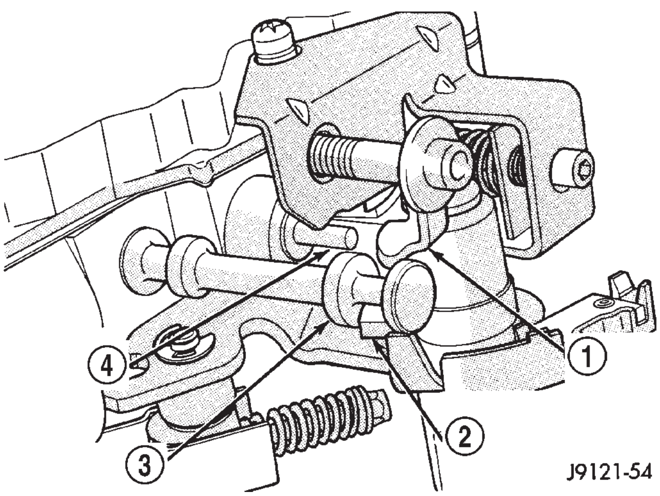


Fig. 240 Manual Valve And Throttle Lever Alignment

1 - THROTTLE LEVER
2 - MANUAL LEVER VALVE ARM
3 - MANUAL VALVE
4 - KICKDOWN VALVE

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.

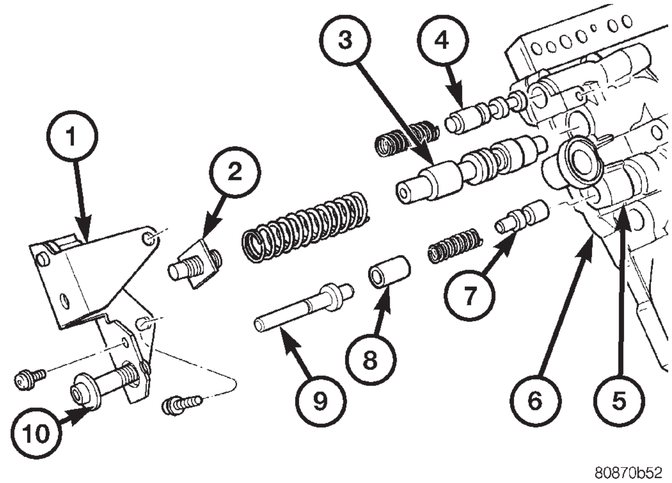


Fig. 241 Adjusting Screw Bracket, Springs, and Valves

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

(3) Place valve body manual lever in low (1 position) to ease inserting park rod into sprag.

(4) Use screwdriver to push park sprag into engagement with park gear. This makes clearance for knob on lock rod to move past sprag when valve body is installed. Rotate output shaft to verify sprag engagement.

(5) Position accumulator spring between accumulator piston and valve body.

(6) Position valve body on transmission and work knob on park lock rod past sprag. Be sure accumulator piston and spring remain in position.

(7) Hold valve body in position and install valve body screws finger tight.

(8) Install park/neutral position switch.

(9) Tighten valve body screws alternately and evenly to 11 N·m (100 in. lbs.) torque.

(10) Install new fluid filter on valve body. Install and tighten filter screws to 4 N·m (35 in. lbs.) torque.

(11) Connect solenoid wire to case connector.

(12) Install manual and throttle levers on throttle lever shaft. Tighten lever clamp screws and check for free operation. Shaft and levers must operate freely without any bind.

(13) Install oil pan and new gasket. Tighten pan bolts to 17 N·m (150 in. lbs.) torque. Install gasket dry; do not use sealer.

VALVE BODY (Continued)

(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 4, Type 9602, fluid.

(18) Adjust gearshift and throttle cable if necessary.

ADJUSTMENTS - 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. 242).

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. 243).

Push the gauge tool inward to compress the kickdown valve against the spring and bottom the throttle valve.

Maintain pressure against kickdown valve spring. Turn throttle lever stop screw until the screw head touches throttle lever tang and the throttle lever cam touches gauge tool.

NOTE: The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.

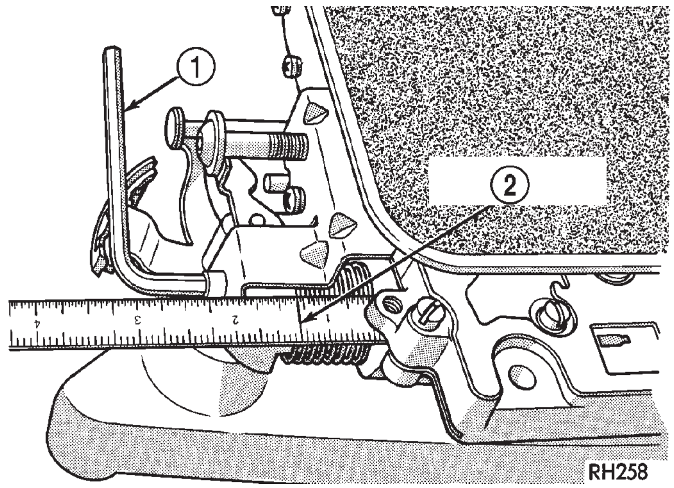


Fig. 242 Line Pressure Adjustment

1 - WRENCH
2 - 1–5/16 INCH

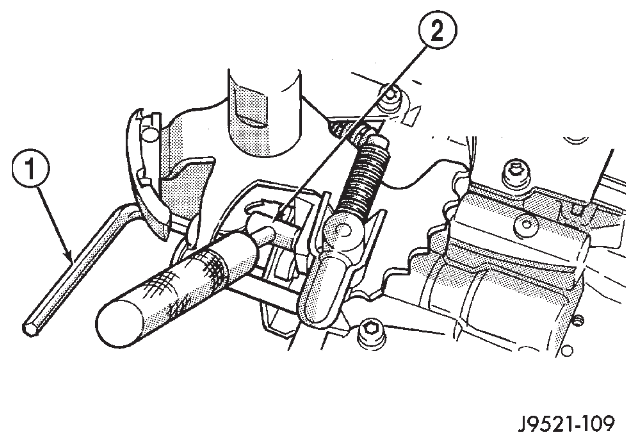


Fig. 243 Throttle Pressure Adjustment

1 - HEX WRENCH (IN THROTTLE LEVER ADJUSTING SCREW)
2 - SPECIAL TOOL C-3763 (POSITIONED BETWEEN THROTTLE LEVER AND KICKDOWN VALVE)

AUTOMATIC TRANSMISSION - 32RH

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AUTOMATIC TRANSMISSION - 32RH

DESCRIPTION

The 32RH (Fig. 1) is a three speed automatic transmission with a lock-up clutch in the torque converter. The transmission contains a front and rear clutch which function as the input driving components. It also contains 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 transmission contains 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 con-

AUTOMATIC TRANSMISSION - 32RH (Continued)

verter hub. The pump supplies the oil pressure necessary for clutch/band actuation and transmission lubrication.

TRANSMISSION IDENTIFICATION

Transmission identification numbers are stamped on the left side of the case just above the oil pan gasket surface (Fig. 2). Refer to this information when ordering replacement parts.

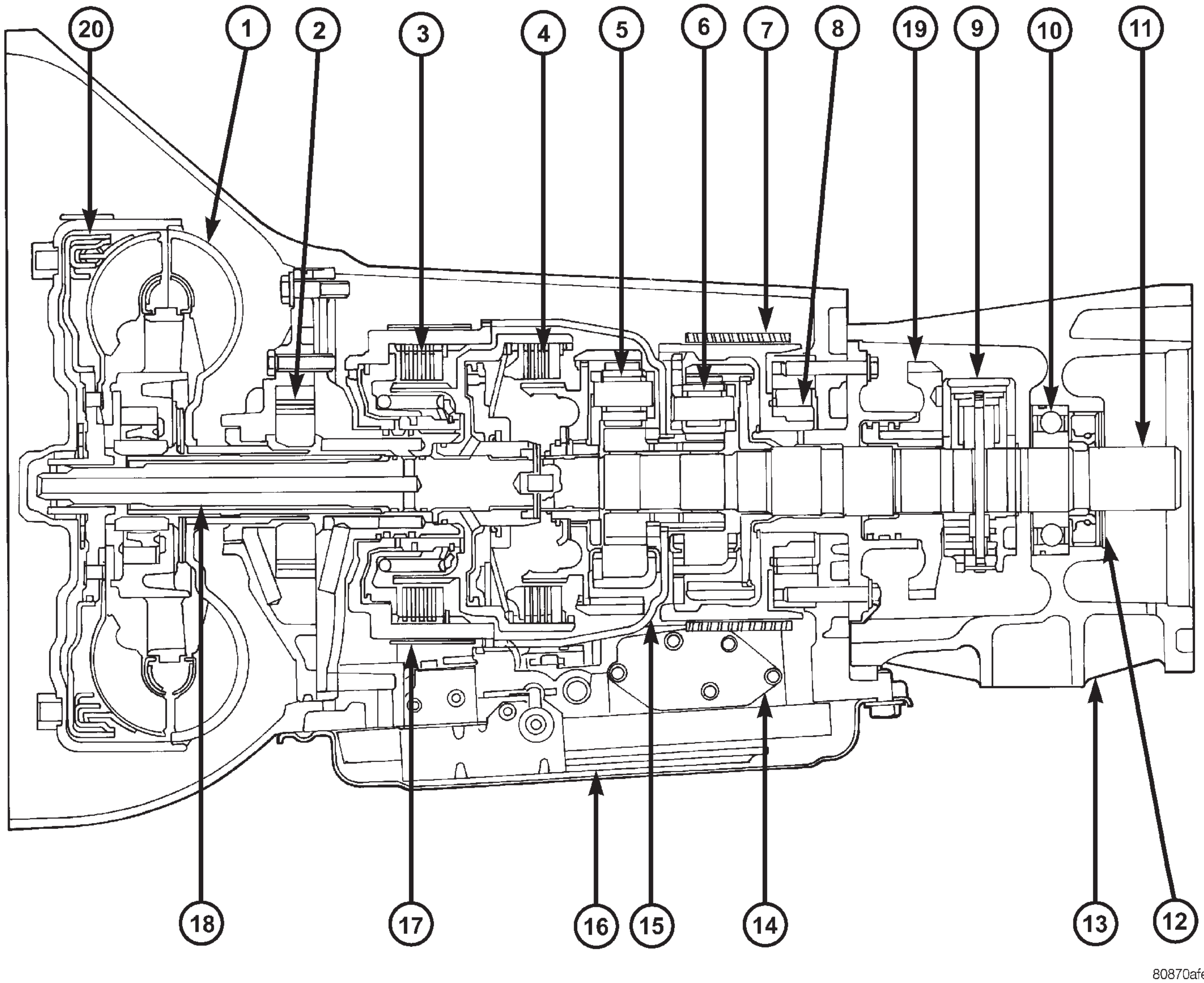

Fig. 1 32RH Automatic Transmission

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 - KICKDOWN (FRONT) BAND
18 - INPUT SHAFT
19 - PARK GEAR
20 - CONVERTER CLUTCH

AUTOMATIC TRANSMISSION - 32RH (Continued)

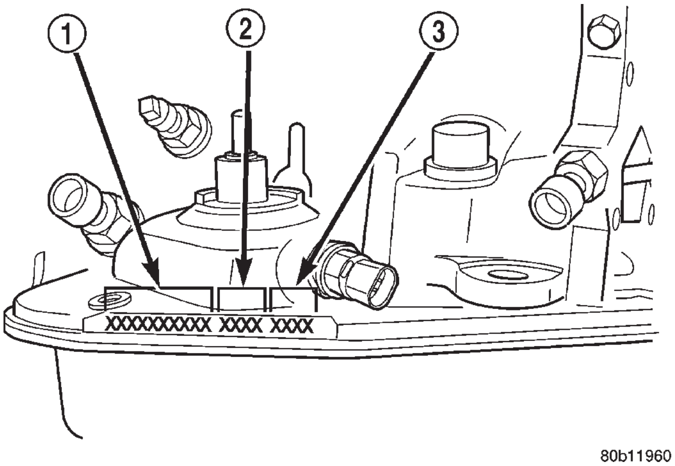

Fig. 2 Transmission Part Number And Serial Number Location

1 - PART NUMBER
2 - BUILD DATE
3 - SERIAL NUMBER

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,throttle pressure, 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.

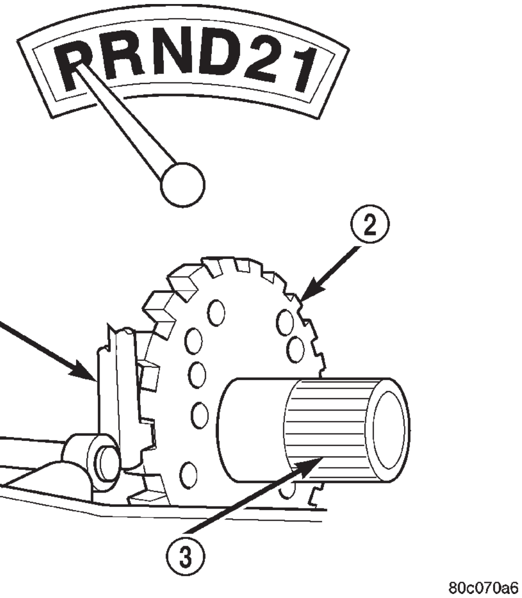

Fig. 3 Park Powerflow

1 - LEVER ENGAGED FOR PARK
2 - PARK SPRAG
3 - OUTPUT SHAFT

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.

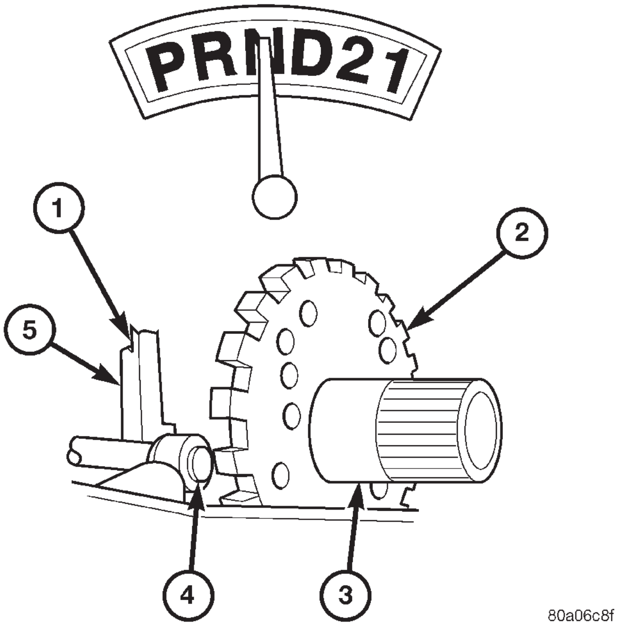

Fig. 4 Neutral Powerflow

1 - LEVER DISENGAGED FOR NEUTRAL
2 - PARK SPRAG
3 - OUTPUT SHAFT
4 - CAM
5 - LEVER

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 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.

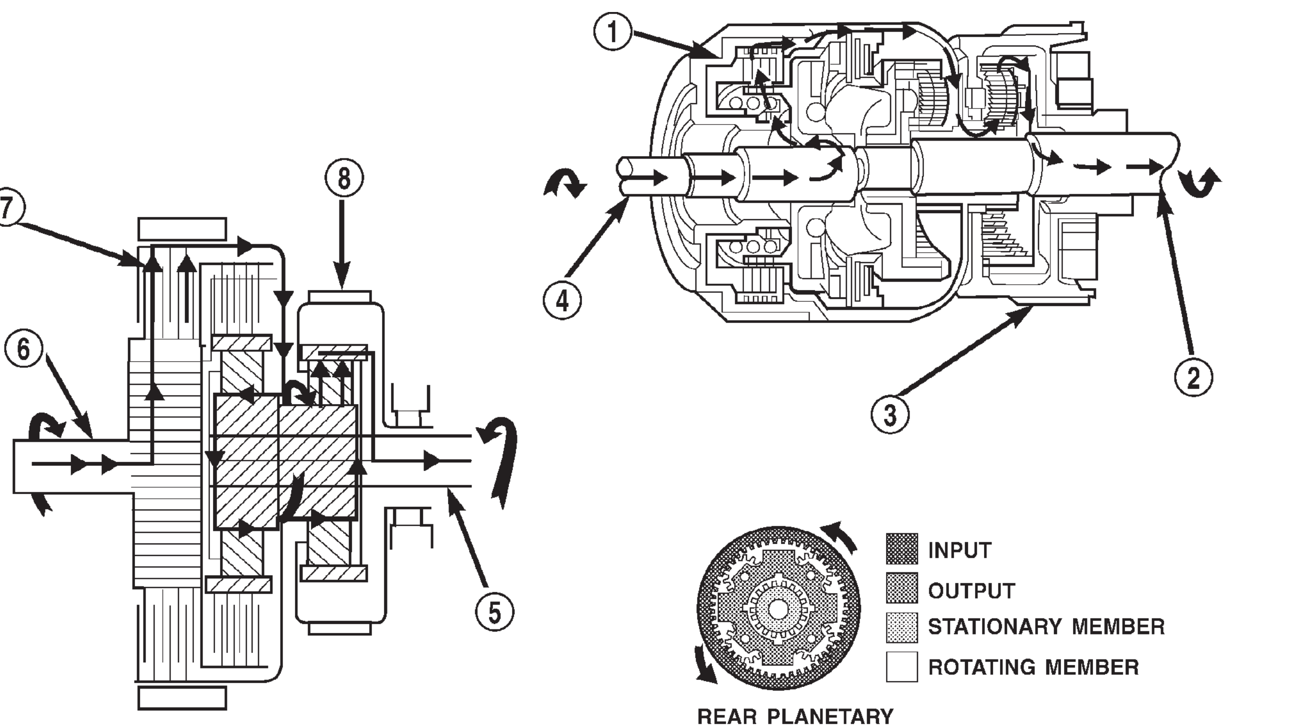

Fig. 5 Reverse Powerflow

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

AUTOMATIC TRANSMISSION - 32RH (Continued)

FIRST GEAR POWERFLOW

When the gearshift lever is moved into the drive position the transmission goes into first gear (Fig. 6). 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 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.

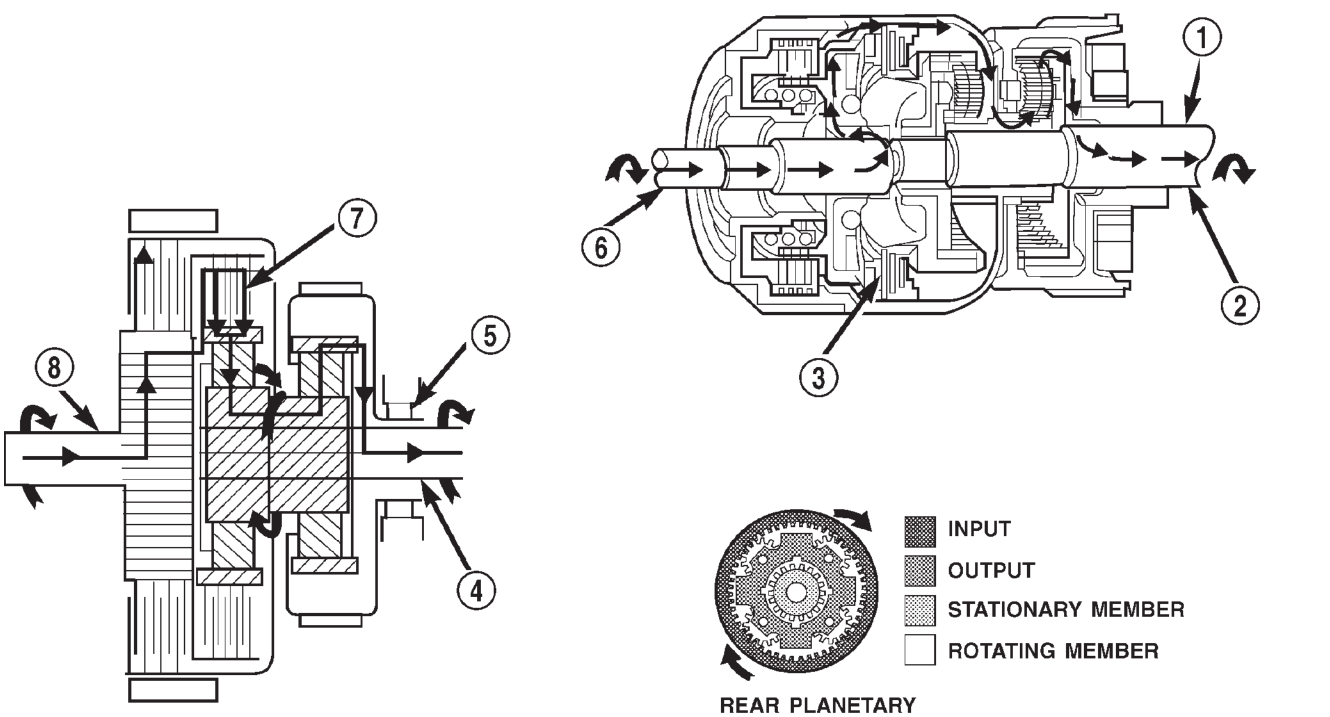

Fig. 6 First Gear Powerflow

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

AUTOMATIC TRANSMISSION - 32RH (Continued)

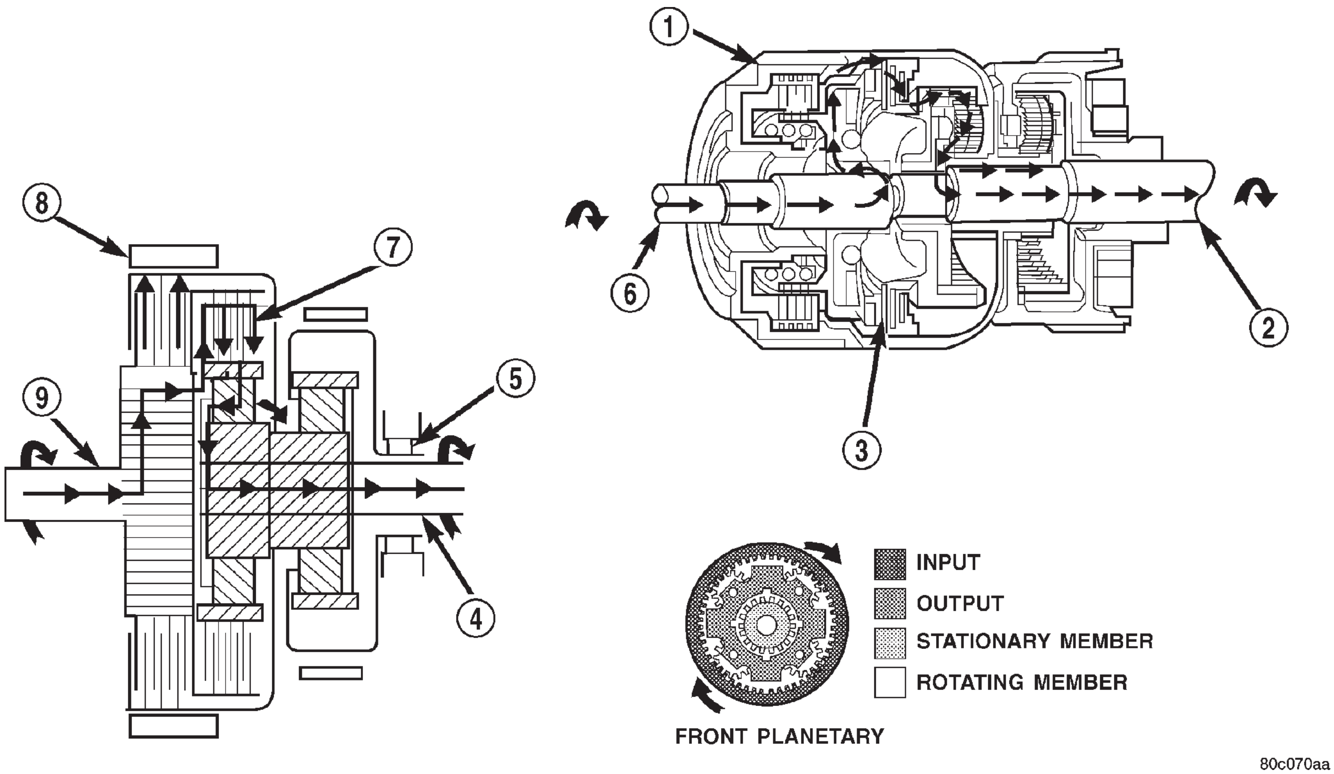

Fig. 7 Second Gear Powerflow

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

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.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - AUTOMATIC TRANSMISSION

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.

DIAGNOSIS AND TESTING - PRELIMINARY

Two basic procedures are required. One procedure for vehicles that are drivable and an alternate proce-

AUTOMATIC TRANSMISSION - 32RH (Continued)

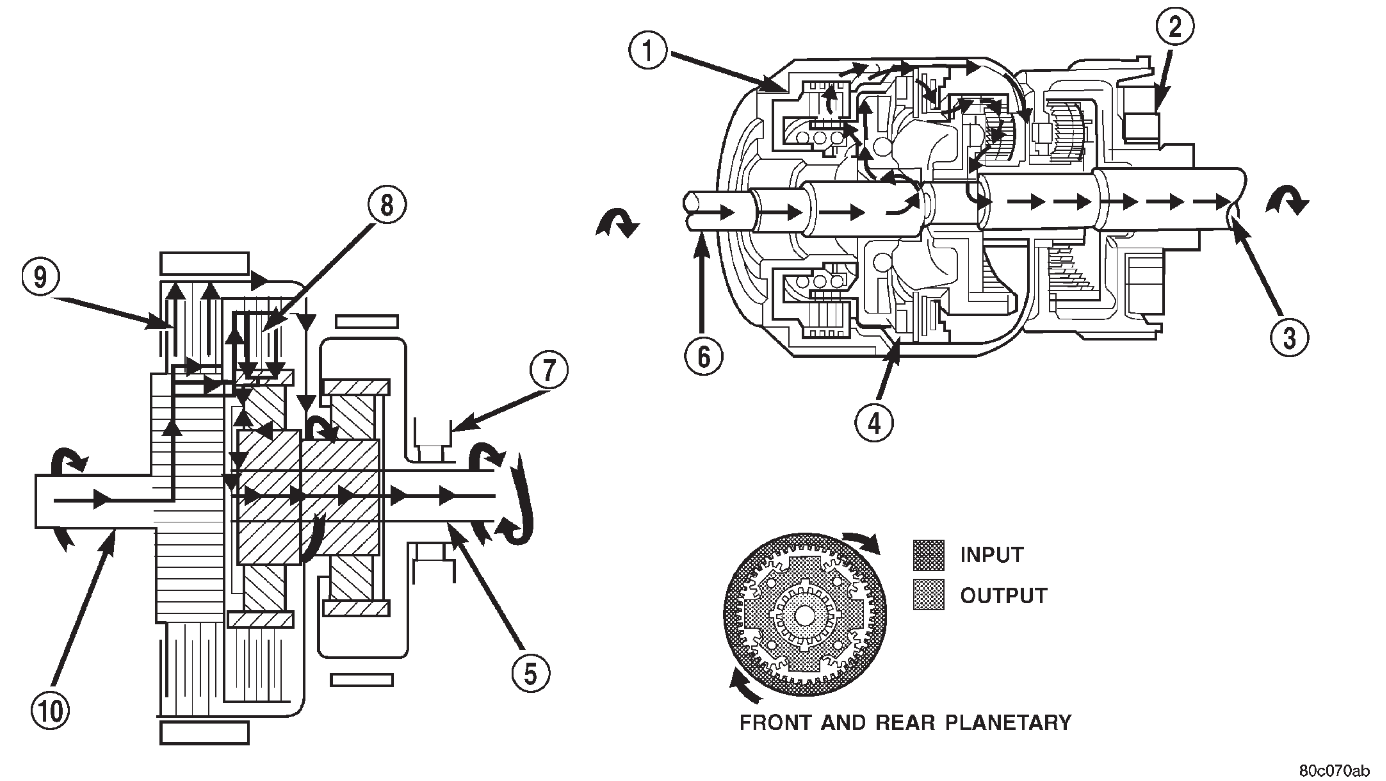

Fig. 8 Direct Drive Powerflow

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

dure 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 hydraulic pressure test if shift problems were noted during road test.

(6) Perform air-pressure test to check clutch-band operation.

VEHICLE IS DISABLED

(1) Check fluid level and condition.

(2) Check for broken or disconnected gearshift or throttle linkage.

(3) Check for cracked, leaking cooler lines, or loose or missing pressure-port plugs.

(4) Raise and support vehicle on safety stands, start engine, shift transmission into gear, and note following:

(a) If propeller shaft turns but wheels do not, problem is with differential or axle shafts.

(b) If propeller shaft does not turn and transmission is noisy, stop engine. Remove oil pan, and check for debris. If pan is clear, remove transmission and check for damaged drive plate, converter, oil pump, or input shaft.

(c) If propeller shaft does not turn and transmission is not noisy, perform hydraulic-pressure test to determine if problem is hydraulic or mechanical.

DIAGNOSIS AND TESTING - 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.

AUTOMATIC TRANSMISSION - 32RH (Continued)

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 (Fig. 9) provides a basis for analyzing road test results.

	Gearshift Lever Position								
DRIVE ELEMENTS	P	R	N	D			2		1
				1	2	3	1	2	
FRONT CLUTCH		•				•			
FRONT BAND (KICKDOWN)					•			•	
REAR CLUTCH				•	•	•	•	•	•
REAR BAND (LOW-REV.)		•							•
OVER-RUNNING CLUTCH				•			•		•

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Fig. 9 Clutch And Band Application

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.

DIAGNOSIS AND TESTING - 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. 10), (Fig. 11) and (Fig. 12).

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.

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.

AUTOMATIC TRANSMISSION - 32RH (Continued)

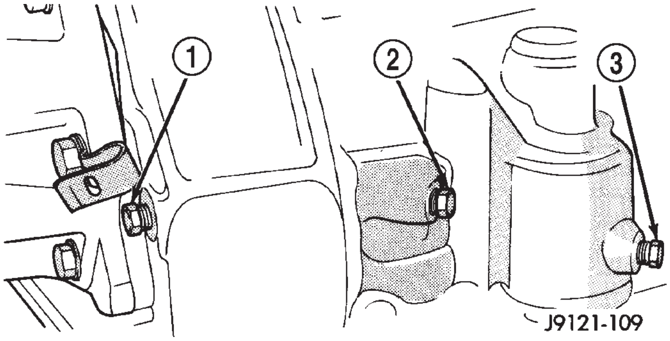


Fig. 10 Pressure Test Ports At Side Of Case

1 - REAR SERVO PORT
2 - LINE PRESSURE PORT
3 - FRONT SERVO PORT

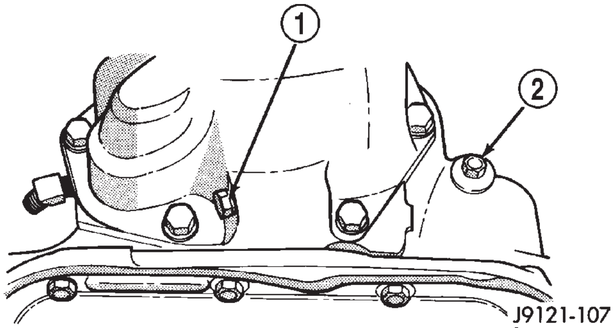


Fig. 11 Pressure Test Ports At Rear Of Case-2WD

1 - GOVERNOR PRESSURE PORT
2 - REAR SERVO PRESSURE PORT

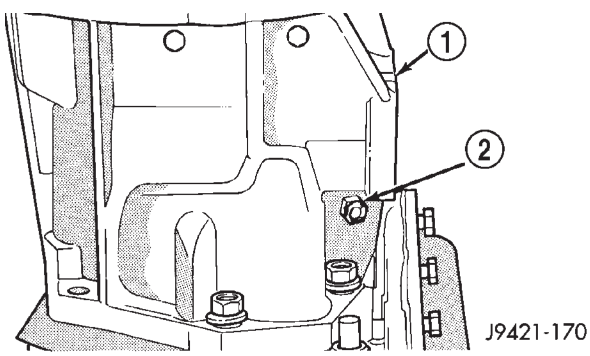


Fig. 12 Pressure Test Ports At Rear Of Case-4WD

1 - ADAPTER HOUSING
2 - GOVERNOR PRESSURE PORT PLUG

(2) Connect 300 psi Gauge C-3293-SP to rear servo port (Fig. 10) and (Fig. 11).

(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. 10) and (Fig. 11).

(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. 10) and (Fig. 11). 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. 10) and (Fig. 11).

(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.

AUTOMATIC TRANSMISSION - 32RH (Continued)

(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. 10) and (Fig. 11).

(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.

PRESSURE TEST ANALYSIS

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 area.
Front servo pressure in 2.	Leakage in servo (broken servo ring or cracked servo piston).
Pressure low in all positions.	Clogged filter, stuck pressure regulator valve, worn or defective pump.
Governor pressure too high at idle speed.	Governor valve sticking open.
Governor pressure low at all MPH figures.	Governor valve sticking closed.
Lubrication pressure low at all throttle positions.	Clogged drainback valve, oil cooler or lines, seal rings leaking, output shaft plugged with debris, worn bushings in pump or clutch retainer.

DIAGNOSIS AND TESTING - AIR CHECKING 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. 13).

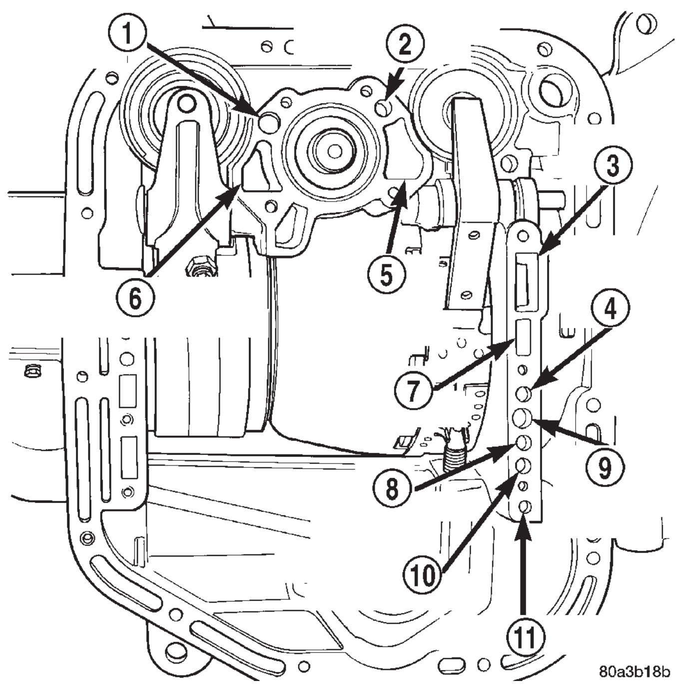


Fig. 13 Air Pressure Test Passages

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

AUTOMATIC TRANSMISSION - 32RH (Continued)

Front Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Rear Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Front Servo Apply Air Test

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

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 - CONVERTER HOUSING FLUID LEAK

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 body leaks follow the same path as a seal leak (Fig. 14). Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 14). Pump o-ring 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.

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are:

(1) Leaks at the weld joint around the outside diameter weld (Fig. 15).

(2) Leaks at the converter hub weld (Fig. 15).

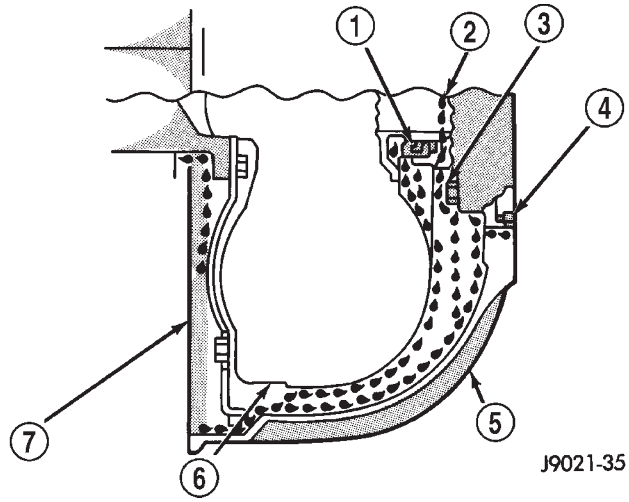


Fig. 14 Converter Housing Leak Paths

1 - PUMP SEAL
2 - PUMP VENT
3 - PUMP BOLT
4 - PUMP GASKET
5 - CONVERTER HOUSING
6 - CONVERTER
7 - REAR MAIN SEAL LEAK

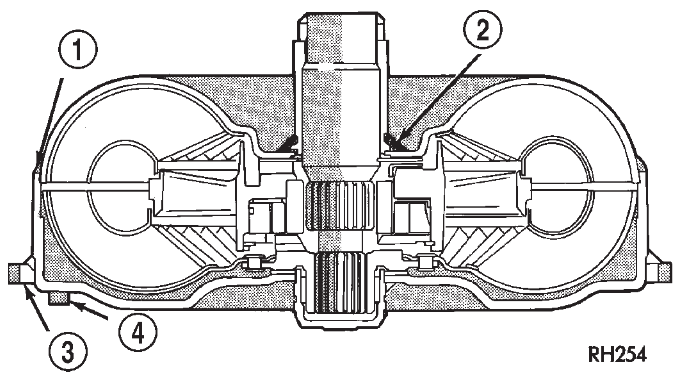


Fig. 15 Converter Leak Points - Typical

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

AUTOMATIC TRANSMISSION - 32RH (Continued)

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 - 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.

AUTOMATIC TRANSMISSION - 32RH (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.

AUTOMATIC TRANSMISSION - 32RH (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.

AUTOMATIC TRANSMISSION - 32RH (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.

AUTOMATIC TRANSMISSION - 32RH (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.

AUTOMATIC TRANSMISSION - 32RH (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.

AUTOMATIC TRANSMISSION - 32RH (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.

AUTOMATIC TRANSMISSION - 32RH (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.

AUTOMATIC TRANSMISSION - 32RH (Continued)

STANDARD PROCEDURE - 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

(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 (Fig. 16) and (Fig. 17). 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.

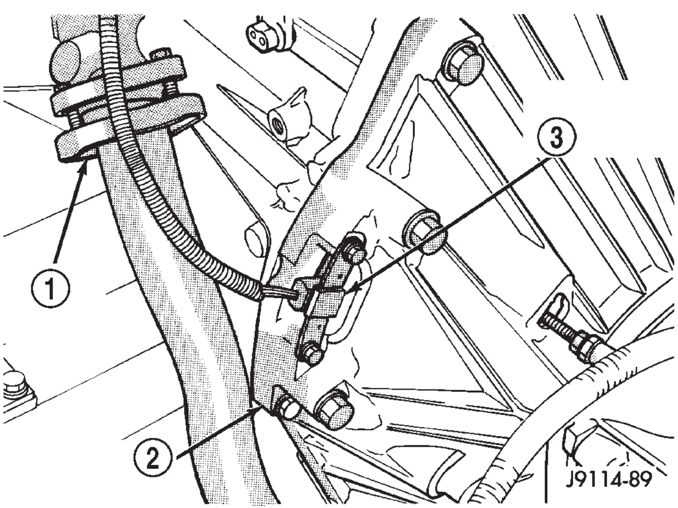


Fig. 16 Crankshaft Position Sensor - 2.5L Engine

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.

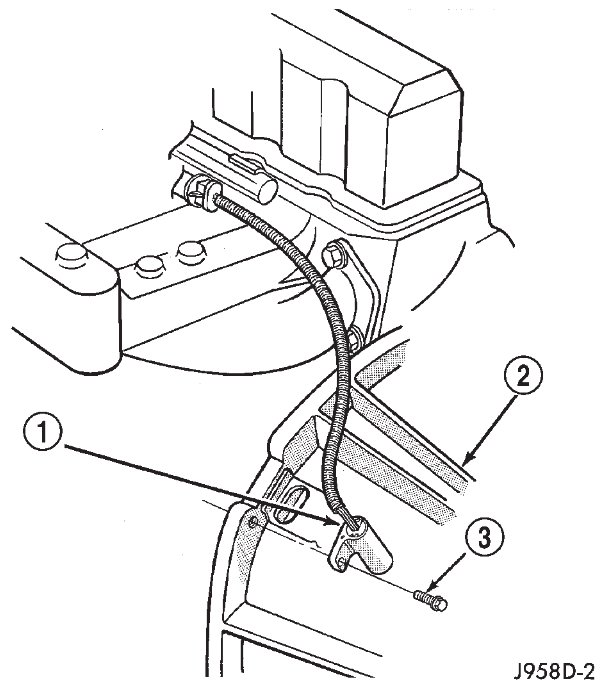


Fig. 17 Crankshaft Position Sensor - 4.0L Engine

1 - CRANKSHAFT POSITION SENSOR
2 - TRANSMISSION BELLHOUSING
3 - MOUNTING BOLT

(9) Remove skid plate for access.

(10) Remove fill tube bracket bolts and pull tube out of transmission. Retain fill tube seal. Remove the 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.

AUTOMATIC TRANSMISSION - 32RH (Continued)

(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.

DISASSEMBLY

(1) Drain fluid from transmission.

(2) Clean exterior of transmission with suitable solvent or pressure washer.

(3) Remove torque converter from front of transmission.

(4) Remove throttle and shift levers from valve body manual shaft and throttle lever shaft.

(5) Mount transmission in repair stand C-3750-B or similar type stand (Fig. 18).

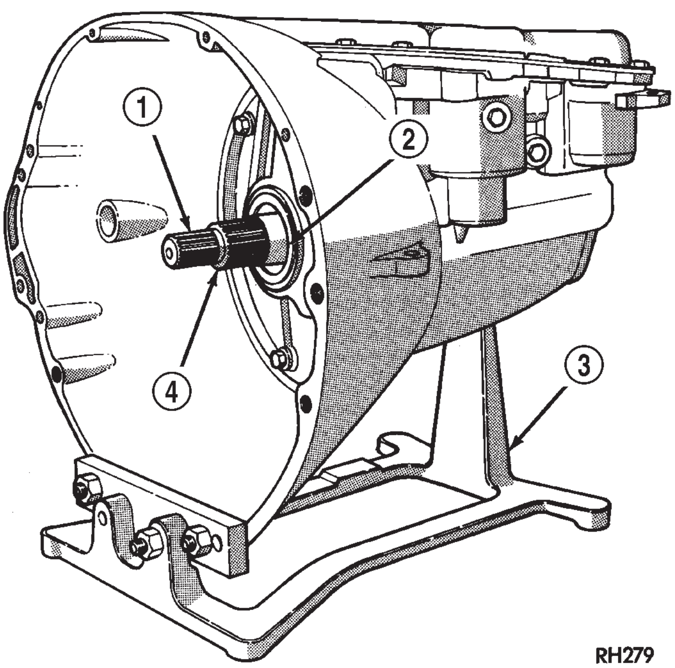


Fig. 18 Repair Stand

1 - INPUT SHAFT
2 - PUMP SEAL
3 - REPAIR STAND
4 - REACTION SHAFT

(6) Remove extension housing.

(7) Remove fluid pan.

(8) Remove park/neutral position switch and seal (Fig. 19).

(9) Remove valve body.

(10) Remove accumulator spring and piston (Fig. 20).

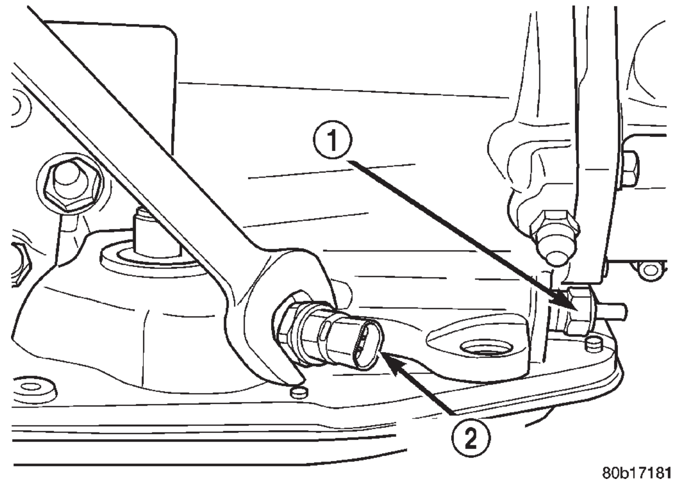


Fig. 19 Park/Neutral Position Switch

1 - SOLENOID CONNECTOR
2 - NEUTRAL SWITCH

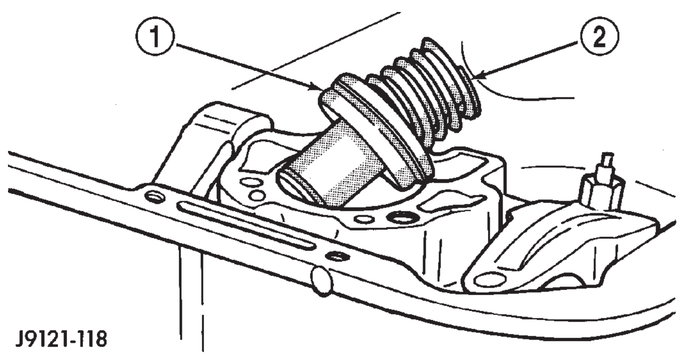


Fig. 20 Accumulator Piston And Spring

1 - ACCUMULATOR PISTON
2 - PISTON SPRING

(11) Measure input shaft end play (Fig. 21).

(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.

(12) Remove front band reaction pin access plug (Fig. 22). Plug is accessible through converter hous-

AUTOMATIC TRANSMISSION - 32RH (Continued)

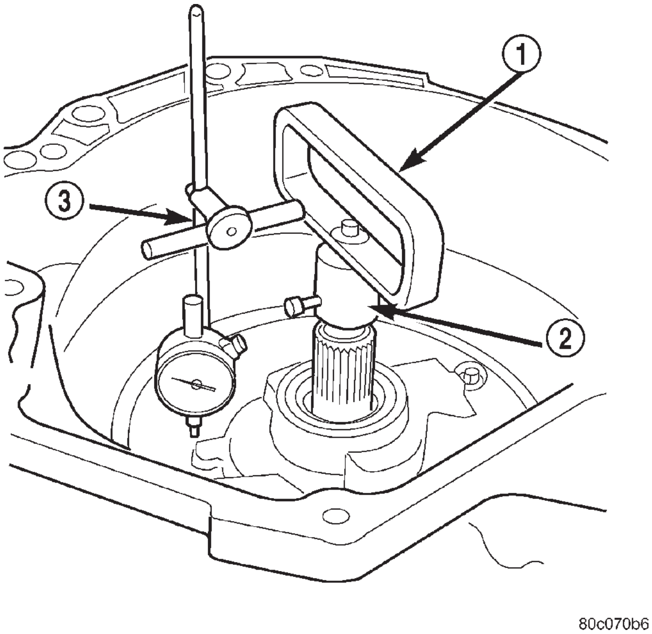


Fig. 21 Checking Input Shaft End Play

1 - TOOL 8266–8
2 - TOOL 8266–7
3 - TOOL C-3339

ing. Use 1/4 inch drive extension to remove plug as shown.

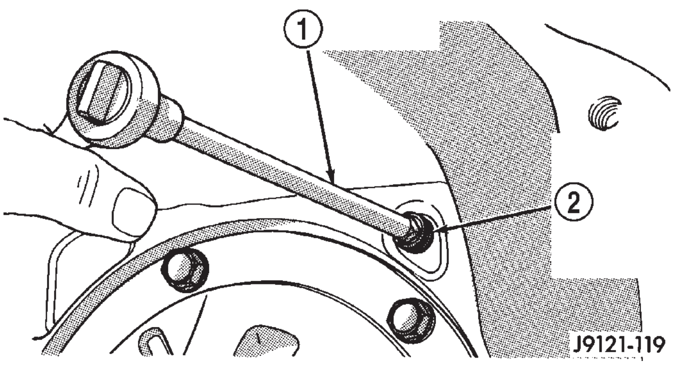


Fig. 22 Front Band Reaction Pin Access Plug

1 - 1/4'' DRIVE EXTENSION
2 - FRONT BAND REACTION PIN ACCESS PLUG

(13) Loosen front band adjusting screw lock nut (Fig. 23) 4-5 turns. Then tighten band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out with pump and possibly damaging clutch or pump components.

(14) Remove oil pump bolts.

(15) Thread bolts of Slide Hammer Tools C-3752 into threaded holes in pump body flange (Fig. 24).

(16) Bump slide hammer weights outward to remove pump and reaction shaft support assembly from case (Fig. 24).

(17) Loosen front band adjusting screw until band is completely loose.

(18) Squeeze front band together and remove band strut (Fig. 25).

(19) Remove front band reaction pin with pencil magnet. Pin is accessible from converter housing side of case (Fig. 26).

(20) Remove front band lever (Fig. 27).

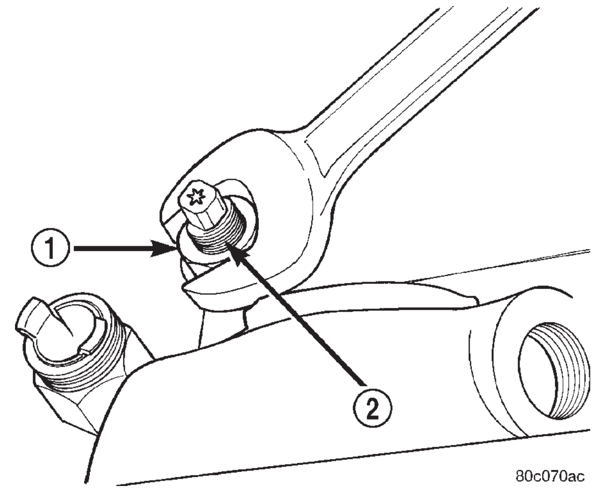


Fig. 23 Front Band Adjusting Screw Lock Nut

1 - LOCK-NUT
2 - FRONT BAND ADJUSTER

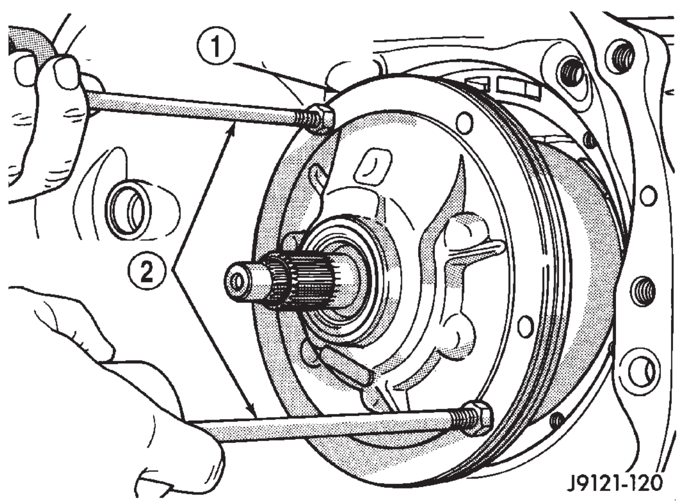


Fig. 24 Oil Pump/Reaction Shaft Support

1 - OIL PUMP AND REACTION SHAFT SUPPORT ASSEMBLY
2 - SLIDE HAMMER TOOLS C-3752

(21) Slide front band rearward and onto driving shell. Band will not be removed until after front/rear clutch removal.

(22) Remove front and rear clutch units as assembly. Grasp input shaft, hold clutch units together and remove them from case (Fig. 28).

AUTOMATIC TRANSMISSION - 32RH (Continued)

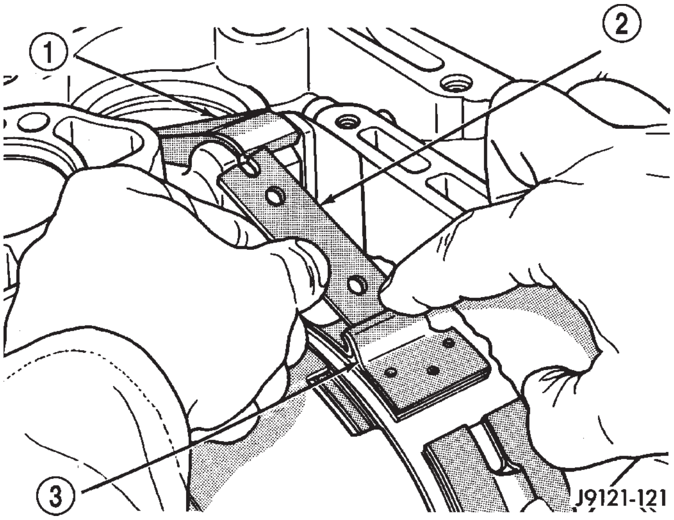


Fig. 25 Front Band Strut

1 - BAND LEVER
2 - BAND STRUT
3 - FRONT BAND

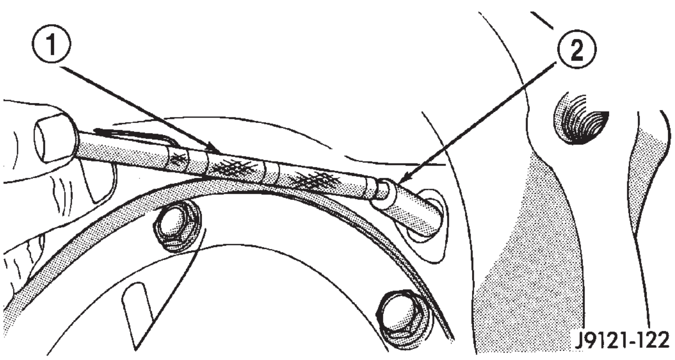


Fig. 26 Front Band Reaction Pin

1 - PENCIL MAGNET
2 - FRONT BAND REACTION PIN

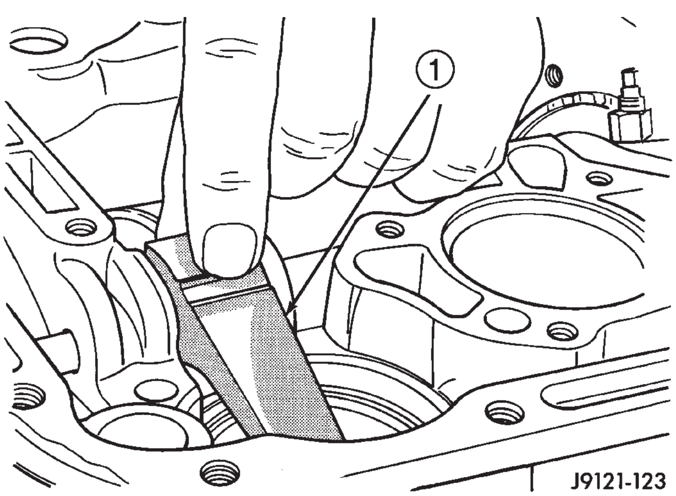


Fig. 27 Front Band Lever

1 - FRONT BAND LEVER

(23) Lift front clutch off rear clutch (Fig. 29). Set clutch units aside for overhaul.

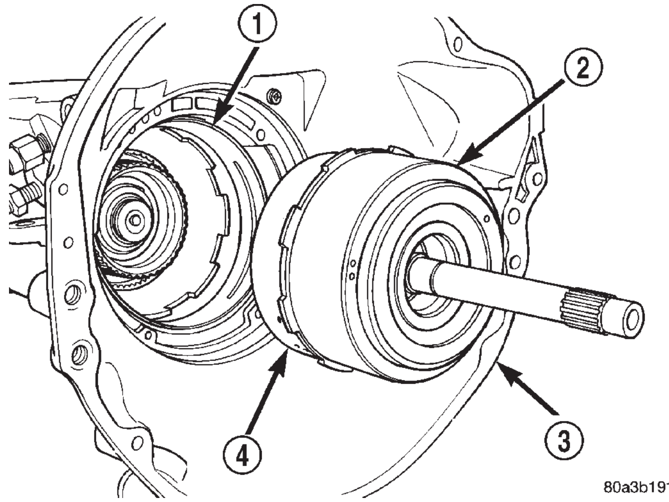


Fig. 28 Front/Rear Clutch Assemblies

1 - FRONT BAND
2 - FRONT CLUTCH AND DRUM
3 - TRANSMISSION HOUSING
4 - REAR CLUTCH

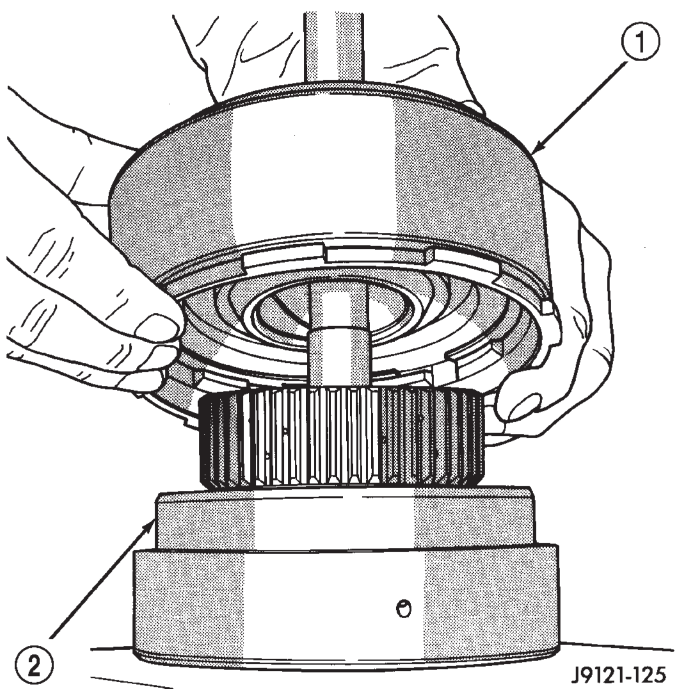


Fig. 29 Separating Front Clutch From Rear Clutch

1 - FRONT CLUTCH
2 - REAR CLUTCH

(24) Remove output shaft thrust washer from output shaft, or from rear clutch hub.

(25) Remove output shaft thrust plate from output shaft hub (Fig. 30).

AUTOMATIC TRANSMISSION - 32RH (Continued)

(26) Slide front band off driving shell (Fig. 31)and remove band from case.

(27) Remove governor body and park gear from output shaft.

(28) Remove output shaft and planetary geartrain as assembly (Fig. 32). Support geartrain with both hands during removal. Do not allow machined surfaces on output shaft to become nicked or scratched.

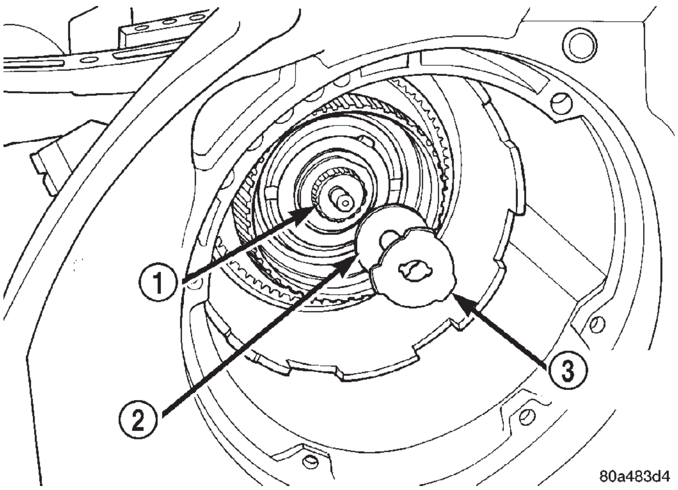


Fig. 30 Output Shaft Thrust Plate and Washer

1 - OUTPUT SHAFT
2 - THRUST PLATE
3 - THRUST WASHER

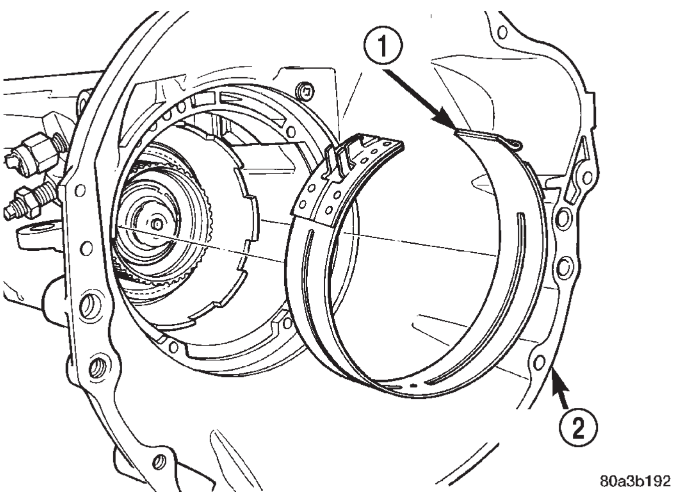


Fig. 31 Front Band

1 - FRONT BAND
2 - TRANSMISSION HOUSING

(29) Loosen rear band adjusting screw 4-5 turns (Fig. 33).

(30) Remove snap-ring that secures low-reverse drum to rear support hub, however do not remove drum at this time (Fig. 34).

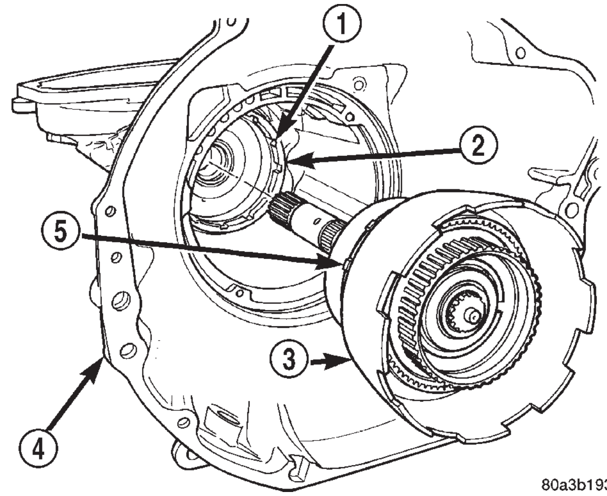


Fig. 32 Planetary Geartrain

1 - SLOTS
2 - LOW-REVERSE DRUM
3 - PLANETARY GEARTRAIN
4 - TRANSMISSION HOUSING
5 - LUGS

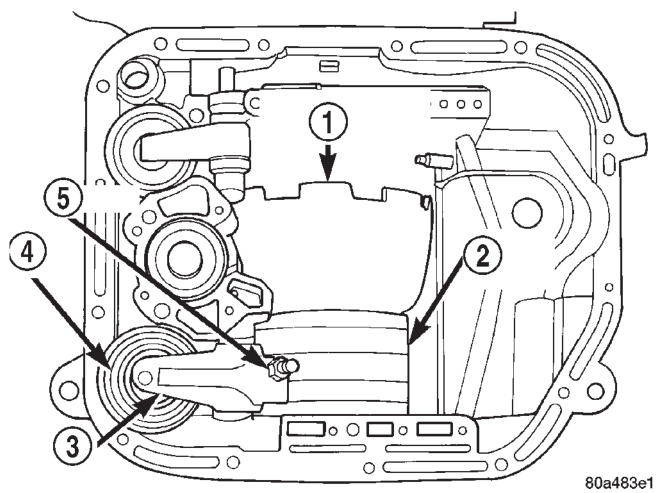


Fig. 33 Rear Band Adjustment Screw Location

1 - PLANETARY GEARTRAIN
2 - REAR BAND
3 - LEVER
4 - SERVO
5 - ADJUSTER

(31) Remove rear band upper and lower reaction pins with parallel jaw snap-ring pliers (Fig. 35). Spread plier jaws in pin bore to grip pin. Then twist and pull pins to remove them as shown.

(32) Remove rear band lever and strut.

(33) Mark position of rear support for assembly reference (Fig. 36). Use scriber or center punch to mark case and support.

AUTOMATIC TRANSMISSION - 32RH (Continued)

(34) Remove rear support bolts and remove support from low-reverse drum and case (Fig. 37). Keep rear support bolts together for assembly reference.

(35) Remove bolts attaching overrunning clutch cam to case (Fig. 38).

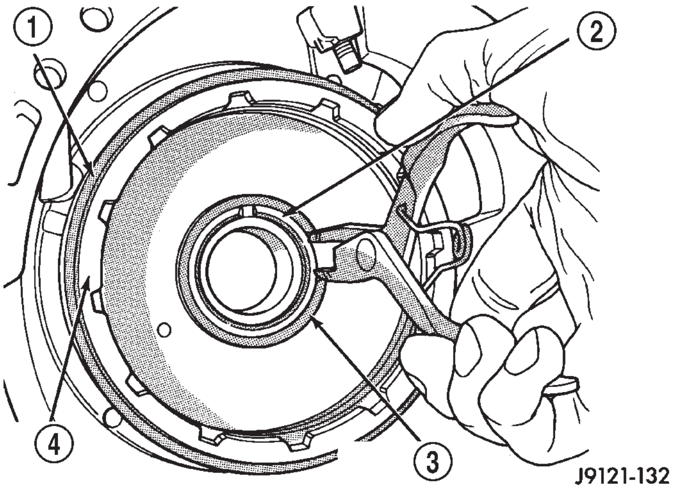


Fig. 34 Low-Reverse Drum Snap-Ring

1 - REAR BAND
2 - REAR SUPPORT HUB
3 - LOW-REVERSE DRUM SNAP RING
4 - LOW-REVERSE DRUM

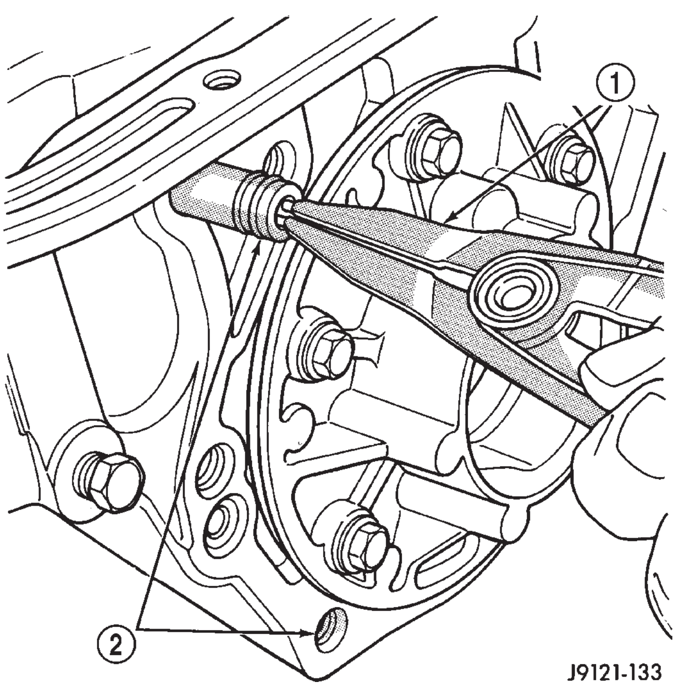


Fig. 35 Rear Band Pivot And Reaction Pins

1 - PARALLEL JAW SNAP-RING PLIERS
2 - REAR BAND PIVOT AND REACTION PINS

(36) Remove low-reverse drum and overrunning clutch as assembly. Slide drum and clutch through

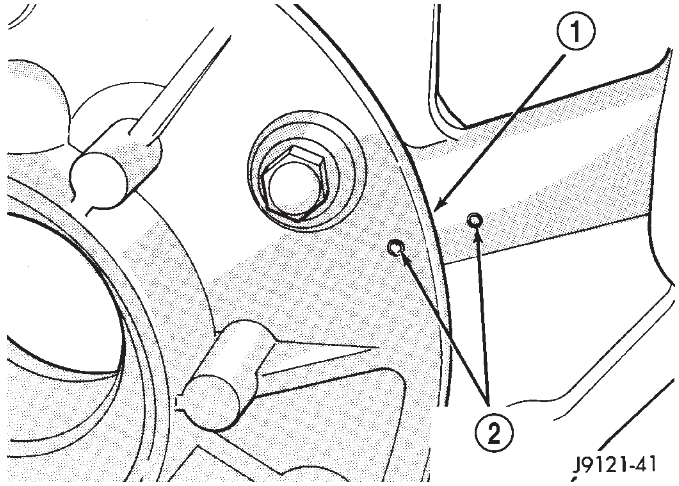


Fig. 36 Marking Rear Support To Aid Assembly

1 - REAR SUPPORT
2 - ASSEMBLY REFERENCE MARKS

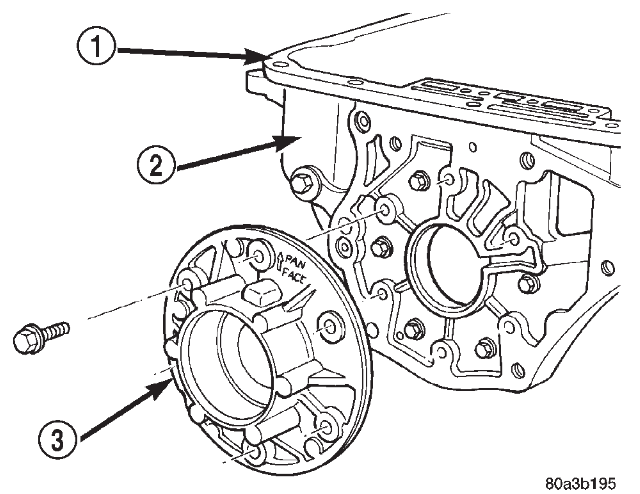


Fig. 37 Rear Support

1 - OIL PAN FACE
2 - TRANSMISSION HOUSING
3 - REAR SUPPORT

rear band and out of case. Set drum and clutch assembly aside for cleaning and inspection.

(37) Remove rear band from case.

(38) Compress front servo rod guide about 1/8 in. with Spring Compressor Tool C-3422-B (Fig. 39).

(39) Remove front servo rod guide snap-ring (Fig. 39). **Exercise caution when removing snap-ring. Servo bore can be scratched or nicked if care is not exercised.**

(40) Remove compressor tools and remove front servo rod guide, spring and servo piston.

(41) Compress rear servo spring retainer about 1/16 in. with Spring Compressor Tool C-3422-B.

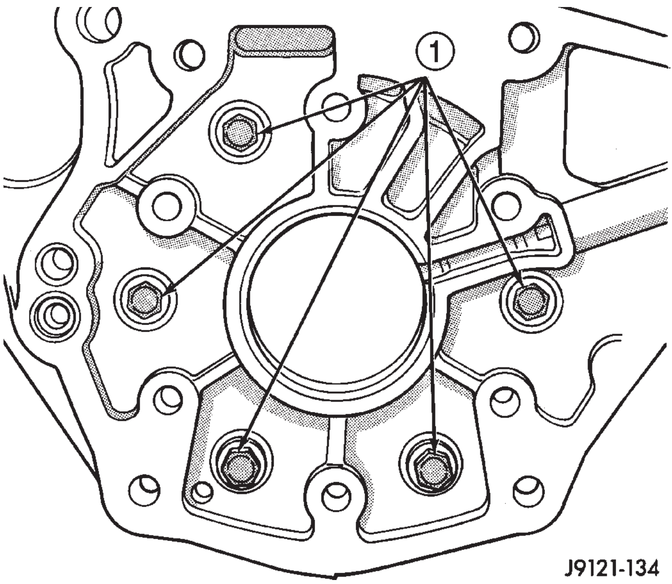


Fig. 38 Overrunning Clutch Cam Bolt Locations

1 - OVERRUNNING CLUTCH CAM BOLTS

(42) Remove rear servo spring retainer snap-ring. Then remove compressor tools and remove rear servo spring and piston.

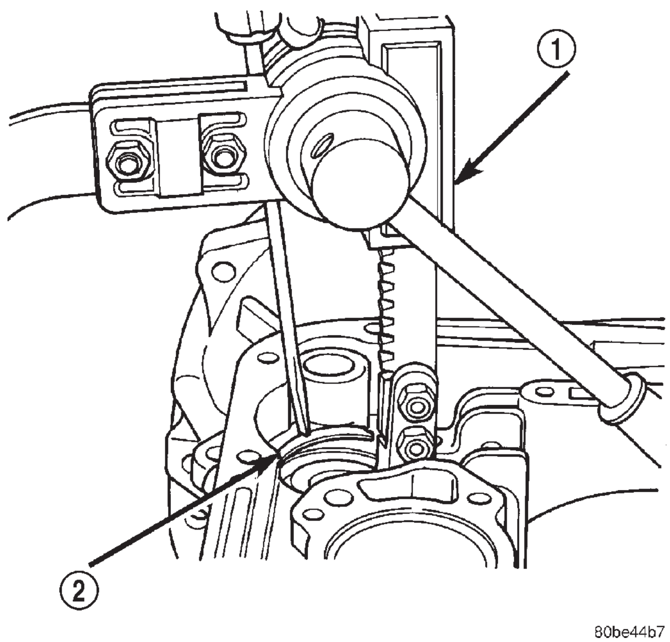


Fig. 39 Compressing Front Servo Rod Guide

1 - SPRING COMPRESSOR TOOL C-3422-B
2 - ROD GUIDE SNAP-RING

CLEANING - AUTOMATIC 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.

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.

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 +4, Type 9602 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.

INSPECTION - AUTOMATIC TRANSMISSION

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.

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. Some of the bushings are not serviced. Be sure to check for bushing availability before removal. Replace the gear as an assembly if the bushings are severely scored, or worn.

AUTOMATIC TRANSMISSION - 32RH (Continued)

Heli-Coil™ inserts are recommended for repairing damaged, stripped or worn threads in aluminum parts. Stainless steel inserts are preferred.

ASSEMBLY

SERVO

(1) Install rear servo piston, spring and spring retainer. Compress rear servo spring and retainer with Compressor Tool C-3422-B.

(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. 39).

OVERRUNNING CLUTCH

(1) Examine bolt holes in overrunning clutch cam. Note that one hole is **not threaded** (Fig. 40). This hole must align with blank area in clutch cam bolt circle (Fig. 41).

(2) Mark location of non threaded hole in clutch cam and blank area of case with paint stripe (Fig. 42).

(3) Align and install overrunning clutch cam in case (Fig. 42). **Be sure cam is correctly installed. Bolt holes in cam are slightly countersunk on one side. This side of cam faces rearward (toward rear support).**

(4) Partially install overrunning clutch in cam (Fig. 42).

(5) Verify that non threaded hole in clutch cam is properly aligned (Fig. 42). Check alignment by threading a clutch cam bolt into each hole. Adjust cam position if necessary before proceeding.

(6) Seat overrunning clutch in clutch cam after verifying correct cam alignment.

(7) Install overrunning clutch cam bolts. **Clutch cam bolts are shorter than rear support bolts.** Tighten cam bolts to 17 N·m (150 in. lbs. or 13 ft. lbs.) torque.

(8) Lubricate overrunning clutch rollers, springs and cam with Mopar® ATF +4 transmission fluid.

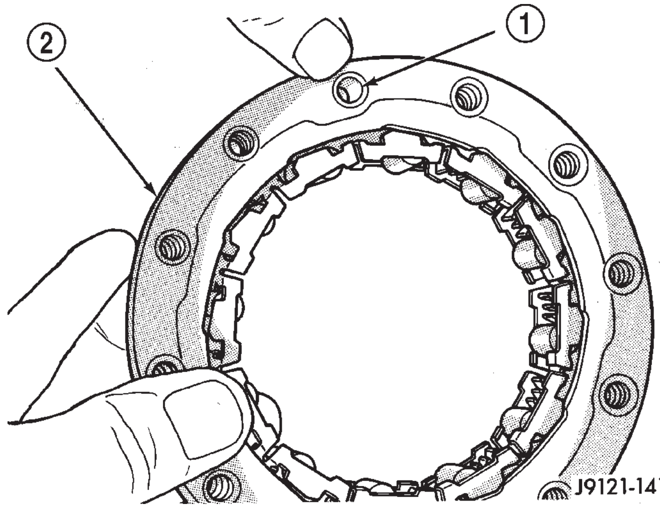


Fig. 40 Location Of Non-Threaded Hole In Clutch Cam

1 - NON-THREADED HOLE
2 - CLUTCH CAM

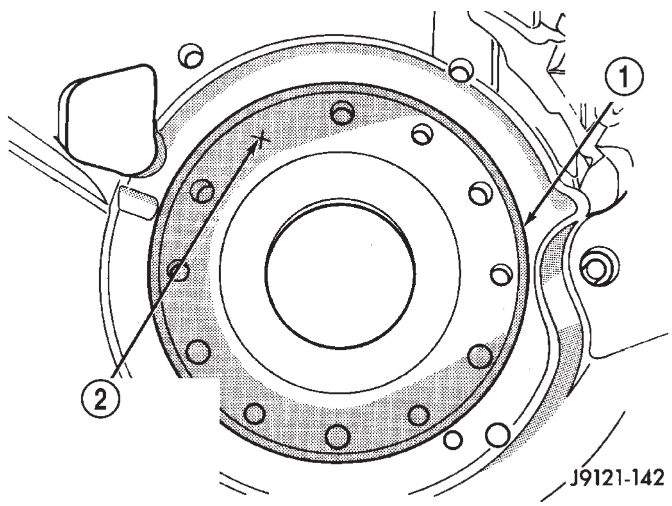


Fig. 41 Location Of Blank Area In Clutch Cam Seat Of Case

1 - CLUTCH CAM SEAT (IN CASE)
2 - NON-THREADED HOLE IN CLUTCH CAM ALIGNS HERE (BLANK AREA) OF SEAT

AUTOMATIC TRANSMISSION - 32RH (Continued)

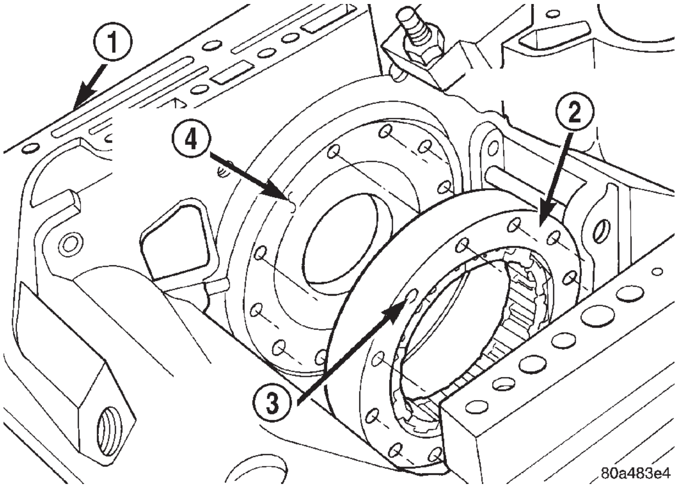


Fig. 42 Overrunning Clutch Cam Alignment

1 - TRANSMISSION CASE
2 - OVERRUNNING CLUTCH
3 - NON-THREADER HOLE
4 - WIDE SPACE AREA

REAR BAND

The 32RH transmission has a double wrap band, a pivot pin, and a reaction pin (Fig. 43). The band lever pivots against a lug on the band. The reaction pin functions as the stop, or locating mechanism for the band lower lug.

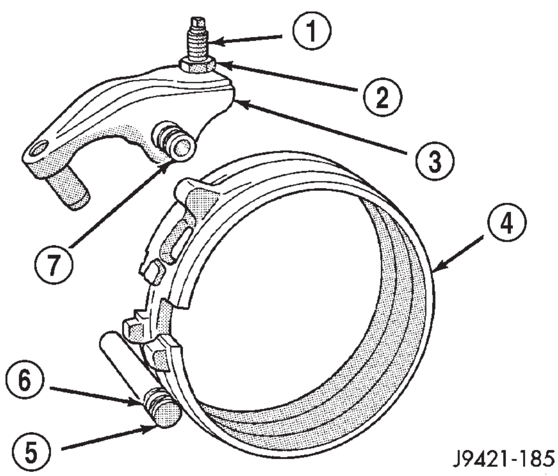


Fig. 43 Rear Band Components

1 - ADJUSTING SCREW
2 - LOCKNUT
3 - LEVER
4 - REAR BAND
5 - REACTION PIN
6 - O-RINGS
7 - PIVOT PIN

(1) Install band components and low-reverse drum as follows:

(2) Install reaction pin in case (Fig. 44).

(3) Position band in case and seat band lug against reaction pin.

(4) Slide low-reverse drum through band (Fig. 45). Then tilt drum slightly and start clutch race into overrunning clutch rollers.

(5) Rotate drum in clockwise direction and push drum inward until race is seated in overrunning clutch.

(6) Install rear band lever (Fig. 46). Be sure lever pivot pin is fully seated in case afterward.

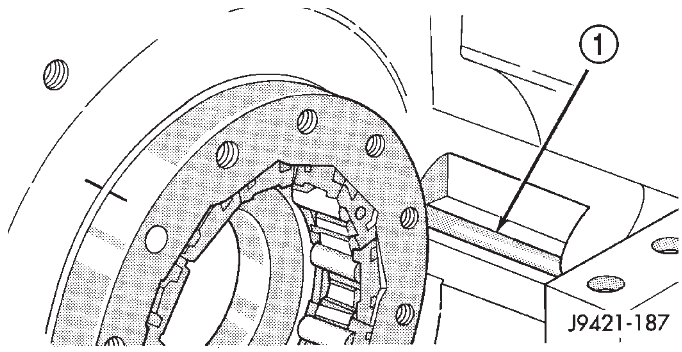


Fig. 44 Rear Band Reaction Pin

1 - REAR BAND REACTION PIN

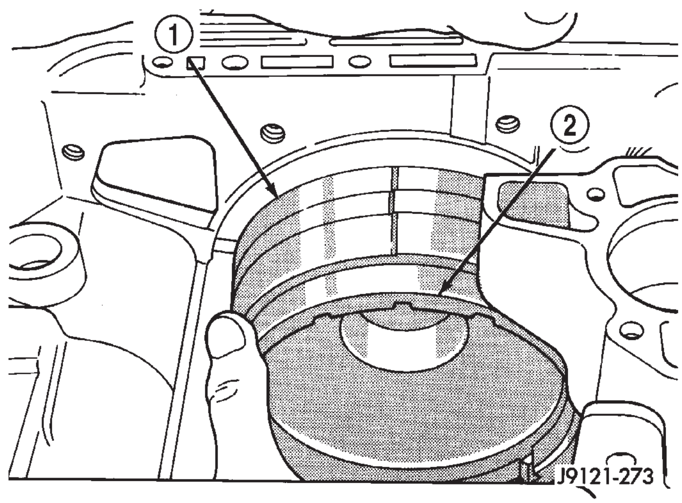


Fig. 45 Rear Band And Low-Reverse Drum

1 - REAR BAND
2 - LOW-REVERSE DRUM

REAR SUPPORT AND LOW-REVERSE DRUM

(1) Hold low-reverse drum in position and install rear support (Fig. 47).

(2) Align support with punch marks made during disassembly.

(3) Install and tighten rear support bolts to 17 N·m (150 in. lbs.) torque.

(4) Install snap-ring that retains low-reverse drum to hub of rear support (Fig. 48).

AUTOMATIC TRANSMISSION - 32RH (Continued)

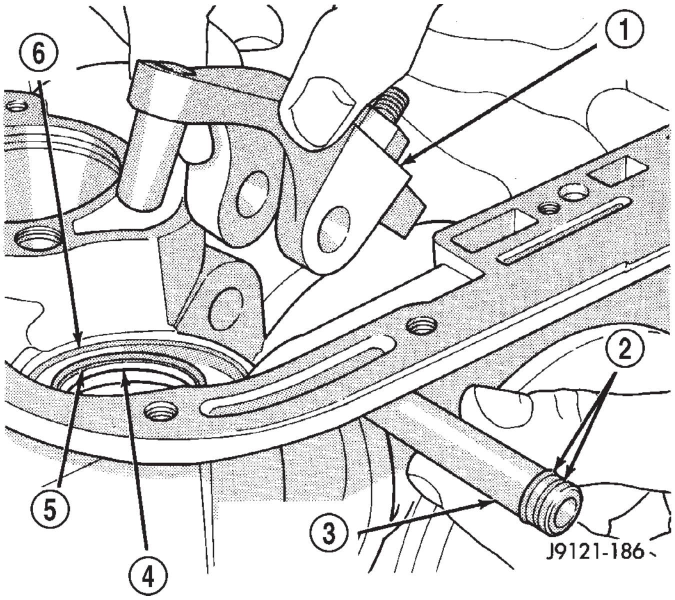


Fig. 46 Rear Band Lever And Pivot Pin

1 - REAR BAND LEVER
2 - O-RINGS
3 - BAND LEVER PIVOT PIN
4 - SPRING
5 - SPRING RETAINER
6 - SERVO SNAP-RING

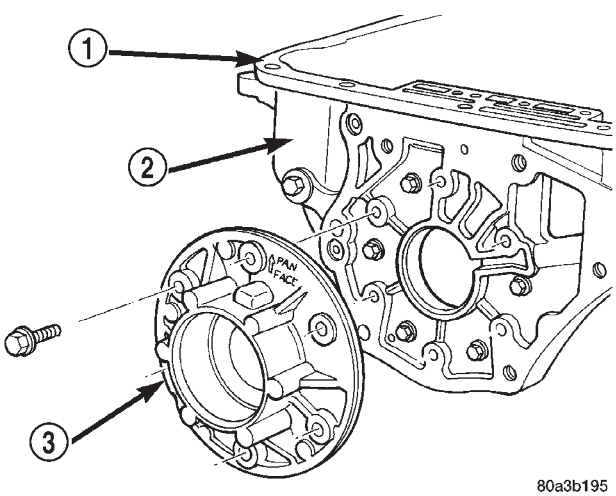


Fig. 47 Rear Support

1 - OIL PAN FACE
2 - TRANSMISSION HOUSING
3 - REAR SUPPORT

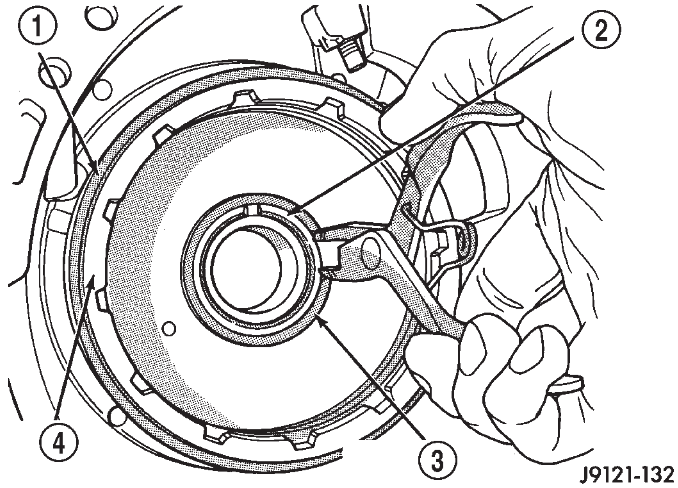


Fig. 48 Low-Reverse Drum Snap-Ring

1 - REAR BAND
2 - REAR SUPPORT HUB
3 - LOW-REVERSE DRUM SNAP RING
4 - LOW-REVERSE DRUM

PLANETARY GEARTRAIN AND OUTPUT SHAFT

(1) Lubricate output shaft, rear support bore and low-reverse drum hub with transmission fluid.

(2) Install assembled output shaft and planetary geartrain in case (Fig. 49).

(3) Align drive lugs on rear planetary gear with slots in low-reverse drum (Fig. 50). Then seat planetary assembly in drum.

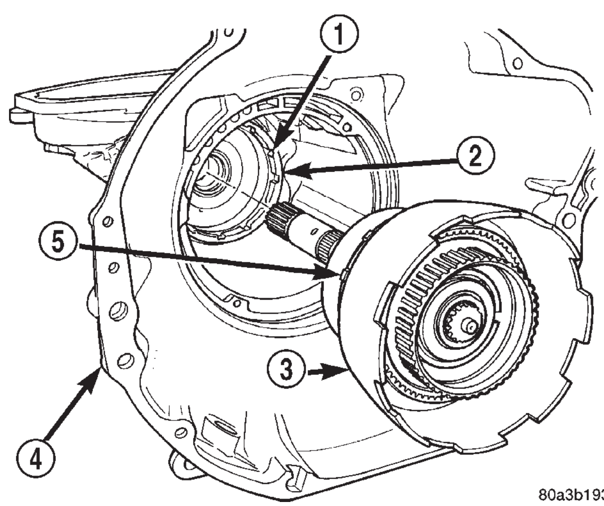


Fig. 49 Output Shaft And Planetary Geartrain

1 - SLOTS
2 - LOW-REVERSE DRUM
3 - PLANETARY GEARTRAIN
4 - TRANSMISSION HOUSING
5 - LUGS

AUTOMATIC TRANSMISSION - 32RH (Continued)

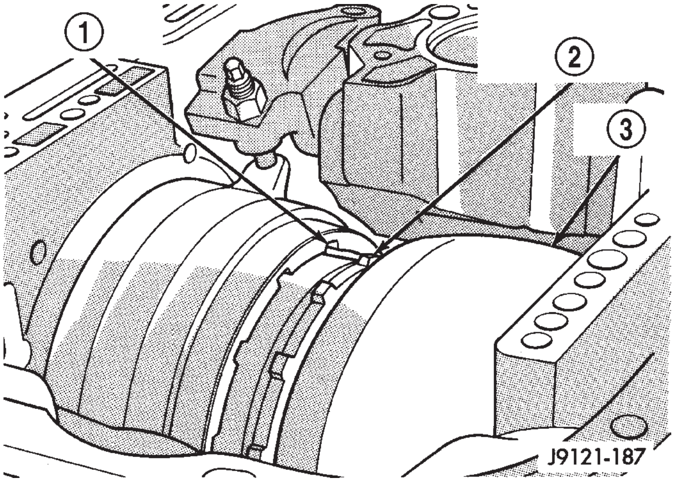


Fig. 50 Aligning/Seating Rear Planetary In Low-Reverse Drum

1 - LOW-REVERSE DRUM SLOTS
2 - REAR PLANETARY GEAR DRIVE LUGS
3 - DRIVING SHELL

GOVERNOR AND PARK GEAR

(1) Lubricate governor components and park gear seal rings with Mopar® ATF +4.

(2) Install governor filter in park gear and install governor body on gear. Align governor body on gear using marks made at disassembly.

(3) Install new seal rings on hub of park gear if necessary. Be sure ring with hooked ends is properly connected.

(4) Align and install governor/park gear assembly on output shaft as follows:

(a) **Note that output shaft in current transmission is spotfaced for governor valve end clearance (Fig. 51). Shaft must be indexed so that small end of governor valve will seat in this spotface. Install governor body and park as follows to ensure proper alignment and operation.**

(b) Rotate output shaft until spotface (at governor valve shaft hole) is facing upward (Fig. 51).

(c) Position valve bore in governor body over spotface on output shaft. Then align valve shaft holes in governor body and output shaft.

(d) Align splines in output shaft and park gear hub.

(e) Carefully push assembly into place in rear support (Fig. 52).

(f) Verify that governor valve shaft holes in output shaft and governor body are still in alignment. Reposition governor body and park gear if alignment is not correct.

(g) Tighten bolts attaching governor body to park gear to 11 N·m (95 in. lbs.) torque.

(5) Install first E-clip on governor valve shaft. Then install governor valve and shaft in governor body (Fig. 53). **Be sure valve shaft moves freely in valve and in output shaft. If valve shaft binds, governor/park gear is misaligned.**

(6) Rotate output shaft until opposite end of governor valve shaft is facing upward. Then install remaining E-clip on governor valve shaft (Fig. 54). **Be very sure both E-clips are firmly seated on shaft.**

(7) Install governor body-park gear retaining snap-rings and washer on output shaft as follows:

(a) On models with single snap-ring, install snap-ring. Be sure ring is seated in shaft.

(b) On models with thrust washer and two snap-rings, install thin snap-ring first. Then install thrust washer second, and thick snap-ring last (Fig. 55).

(c) Verify correct position of snap-rings. **Be sure flat side of each snap-ring is toward governor body.**

(8) Tighten bolts that attach governor body to park gear to 11 N·m (95 in. lbs.).

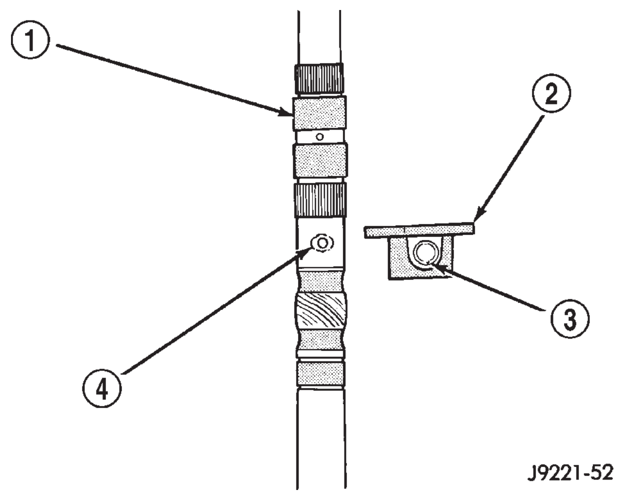


Fig. 51 Governor Valve And Output Shaft Spotface Alignment

1 - OUTPUT SHAFT
2 - GOVERNOR BODY
3 - GOVERNOR VALVE BORE
4 - SPOTFACE

AUTOMATIC TRANSMISSION - 32RH (Continued)

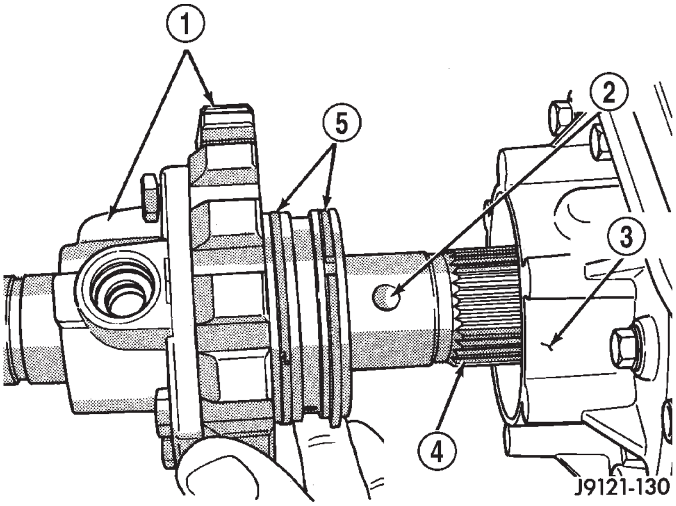


Fig. 52 Governor Body And Park Gear

1 - GOVERNOR/PARK ASSEMBLY
2 - GOVERNOR VALVE SHAFT BORE
3 - REAR SUPPORT
4 - OUTPUT SHAFT SPLINES
5 - SEAL RINGS

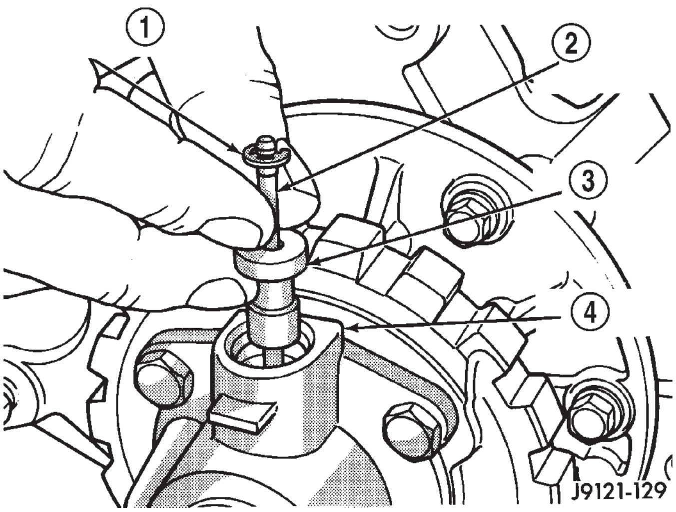


Fig. 53 Governor Valve And Shaft

1 - E-CLIP (2 REQ'D)
2 - GOVERNOR VALVE SHAFT
3 - GOVERNOR VALVE
4 - GOVERNOR BODY

FRONT/REAR CLUTCH

(1) Install output shaft thrust plate on shaft hub (Fig. 56). Use petroleum jelly to hold thrust plate in place.

(2) Check input shaft seal rings. Verify that diagonal-cut ends of teflon seal ring are properly joined and ends of plastic ring are correctly positioned. Also be sure rings are installed in sequence shown.

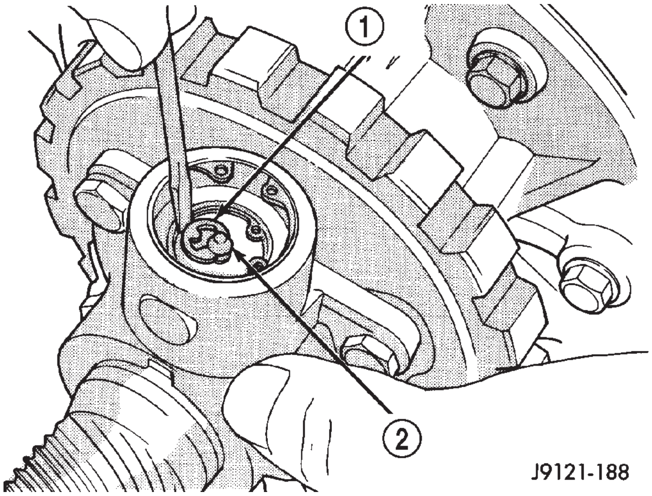


Fig. 54 Securing Governor Valve Shaft With New E-Clip

1 - SECOND E-CLIP
2 - GOVERNOR VALVE SHAFT

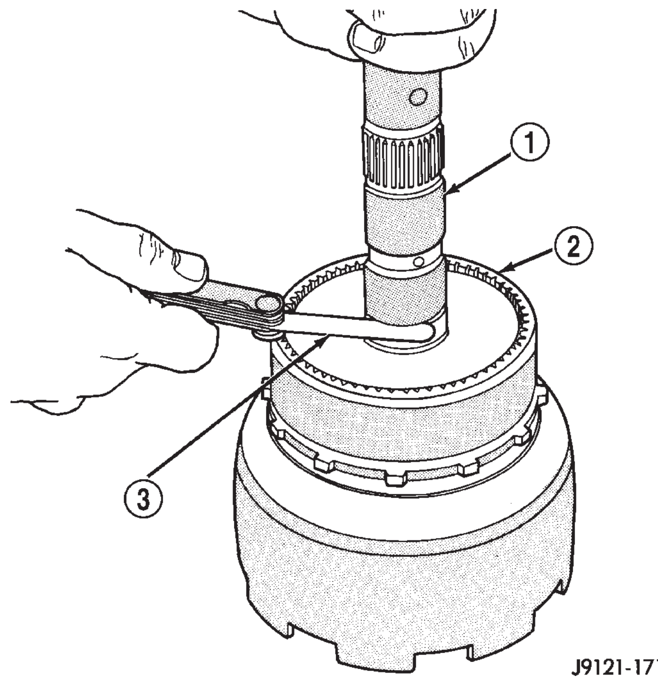


Fig. 55 Governor Body/Park Gear Retaining Snap-Rings And Thrust Washer Position

1 - OUTPUT SHAFT
2 - REAR ANNULUS GEAR
3 - FEELER GAUGE

(3) Check rear clutch thrust washer. Use additional petroleum jelly to hold washer in place if necessary.

(4) Align clutch discs in front clutch and install front clutch on rear clutch (Fig. 57). Rotate front clutch retainer back and forth until completely seated on rear clutch.

AUTOMATIC TRANSMISSION - 32RH (Continued)

(5) Coat output shaft thrust washer with petroleum jelly. Then install washer in rear clutch hub (Fig. 58). 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.**

(6) Align drive teeth on rear clutch discs with small screwdriver (Fig. 59). This will make installation on front planetary easier.

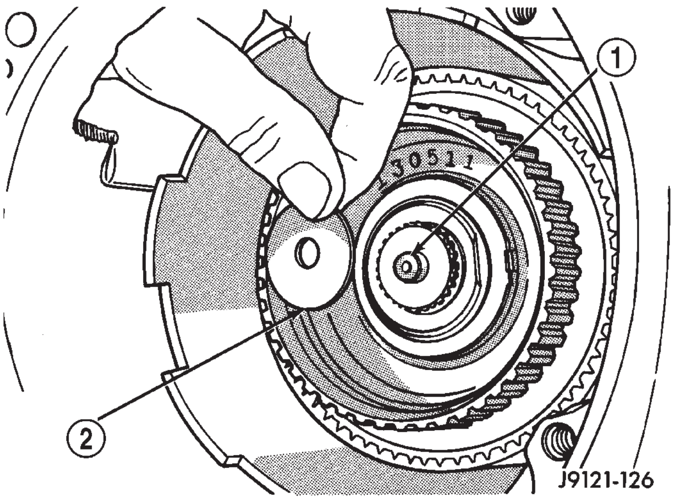


Fig. 56 Output Shaft Thrust Plate

1 - OUTPUT SHAFT HUB
2 - OUTPUT SHAFT THRUST PLATE

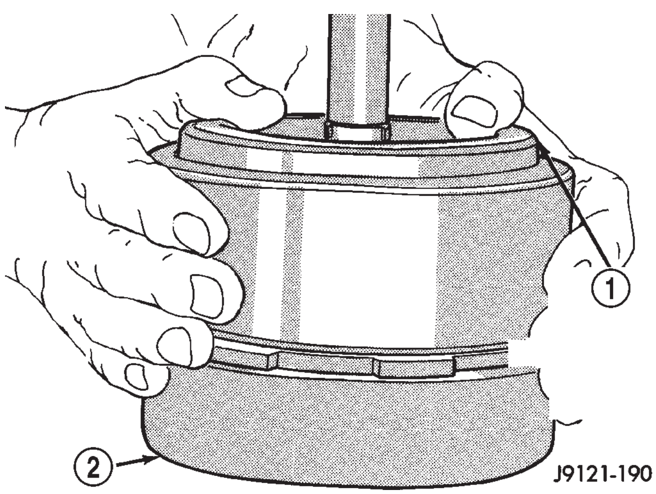


Fig. 57 Assembling Front And Rear Clutch Units

1 - TURN FRONT CLUTCH BACK & FORTH UNTIL SEATED
2 - REAR CLUTCH ASSEMBLY

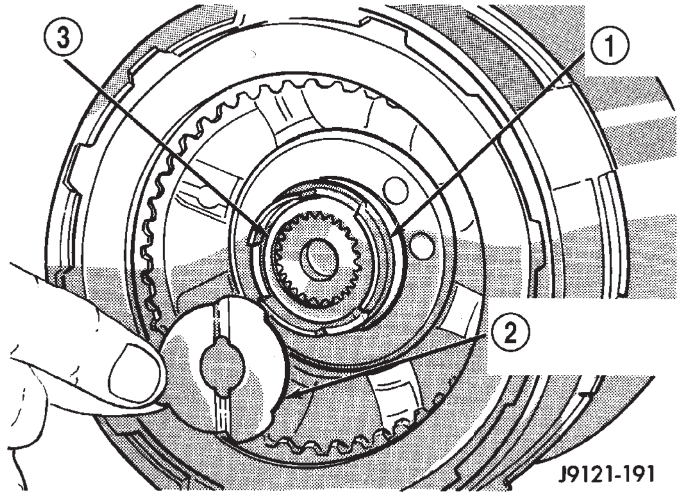


Fig. 58 Output Shaft Thrust Washer

1 - REAR CLUTCH HUB
2 - OUTPUT SHAFT THRUST WASHER
3 - OUTPUT SHAFT

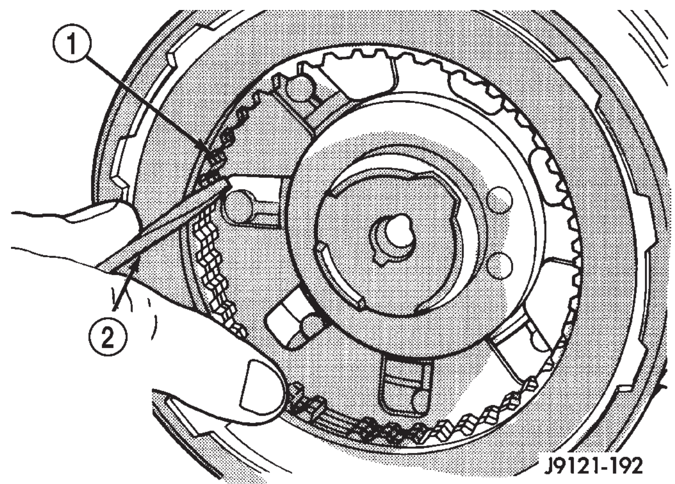


Fig. 59 Aligning Rear Clutch Disc Lugs

1 - REAR CLUTCH DISCS
2 - USE SMALL SCREWDRIVER TO ALIGN CLUTCH DISC TEETH

(7) Raise front end of transmission upward as far as possible and support case with wood blocks. Front/rear clutch and oil pump assemblies are easier to install if transmission is as close to upright position as possible.

(8) Install front and rear clutch units as assembly (Fig. 60). 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.**

AUTOMATIC TRANSMISSION - 32RH (Continued)

(9) Carefully work assembled clutches back and forth to engage and seat rear clutch discs on front annulus gear. Verify that front clutch drive lugs are fully engaged in slots of driving shell after installation.

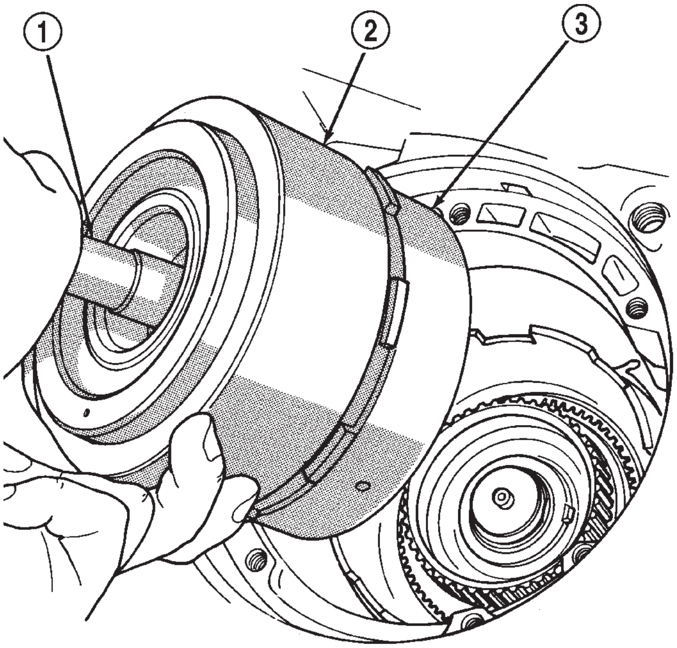


Fig. 60 Installing Front/Rear Clutch

1 - INPUT SHAFT
2 - FRONT CLUTCH
3 - REAR CLUTCH

FRONT BAND AND OIL PUMP

(1) Slide front band over front clutch retainer (Fig. 61).

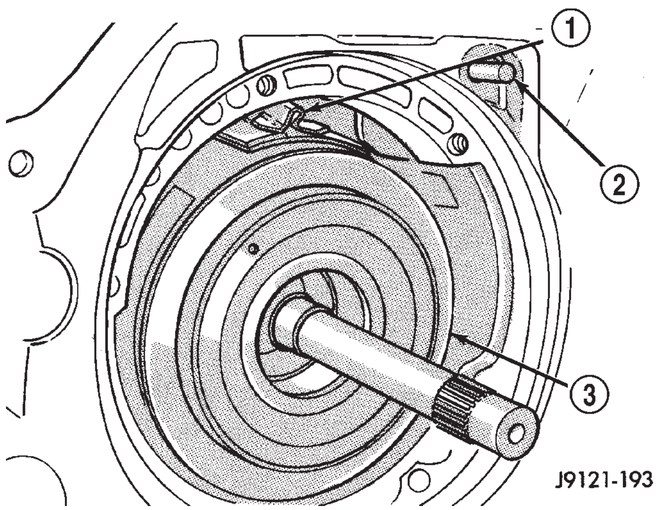


Fig. 61 Installing Front Band And Reaction Pin

1 - FRONT BAND
2 - FRONT BAND REACTION PIN
3 - FRONT CLUTCH RETAINER

(2) Insert front band reaction pin part way into case (Fig. 61).

(3) Install front band lever, strut, lever pin and adjusting screw (Fig. 62).

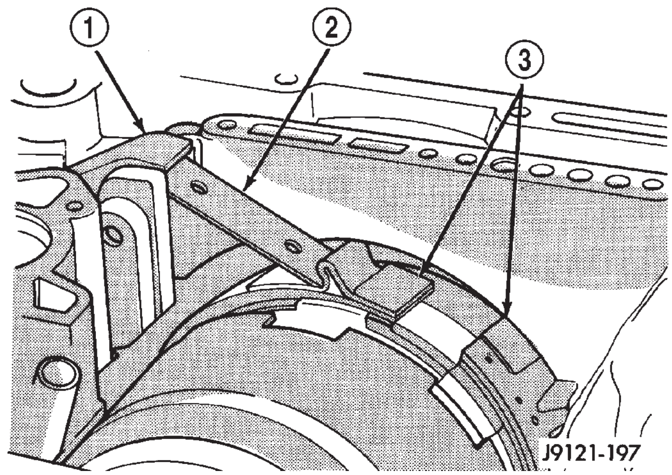


Fig. 62 Front Band Linkage Installation

1 - BAND LEVER
2 - BAND STRUT
3 - FRONT BAND

(4) Tighten front band adjusting screw until band just grips clutch retainer. Verify that front/rear clutches are still seated before continuing.

(5) Coat band lever pin access plug with sealer and install plug in converter housing (Fig. 63).

(6) Verify that reaction shaft support hub seal rings are hooked together (Fig. 64).

(7) Coat front clutch thrust washer with petroleum jelly to hold it in place. Then install washer over reaction shaft hub and seat it on pump (Fig. 65).

CAUTION: The thrust washer bore (I.D.), is chamfered on one side. Make sure the chamfered side is installed so it faces the pump.

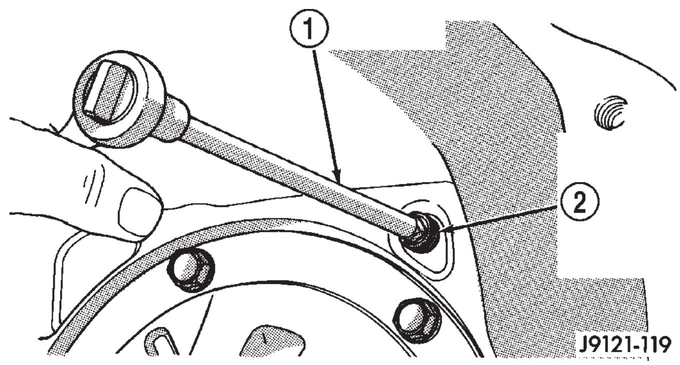


Fig. 63 Installing Front Band Pivot Pin Access Plug

1 - 1/4′′ DRIVE EXTENSION
2 - FRONT BAND REACTION PIN ACCESS PLUG

AUTOMATIC TRANSMISSION - 32RH (Continued)

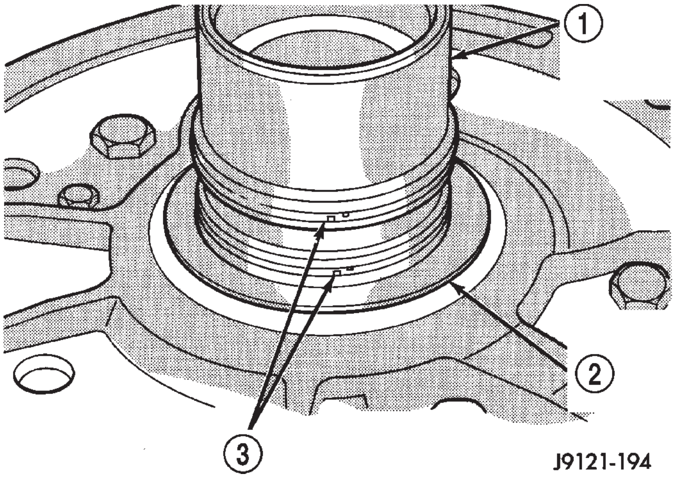


Fig. 64 Reaction Shaft Support Seal Rings

1 - REACTION SHAFT SUPPORT HUB
2 - THRUST WASHER
3 - SEAL RINGS

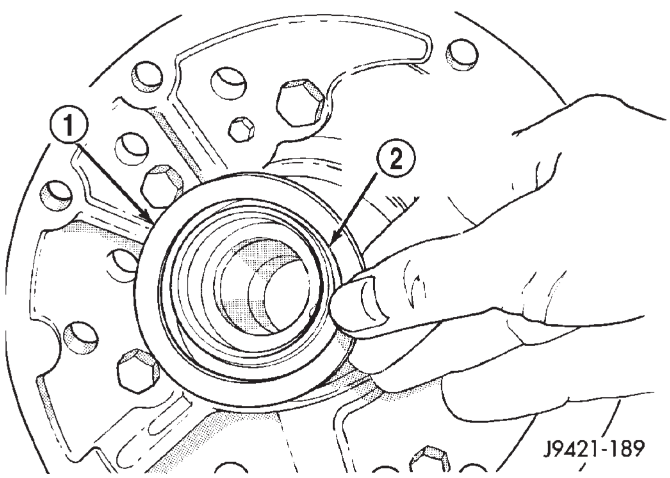


Fig. 65 Reaction Shaft Thrust Washer Installation

1 - THRUST WASHER
2 - CHAMFERED SIDE OF WASHER BORE GOES TOWARD PUMP

(8) Thread two Pilot Stud Tools C-3288-B into bolt holes in oil pump flange (Fig. 66).

(9) Align and install oil pump gasket (Fig. 66).

(10) Lubricate oil pump seals with Mopar® Door-Ease, or Ru-Glyde, Door Eze, or ATF Plus 4.

(11) Install oil pump (Fig. 67). Align and position pump on pilot studs. Slide pump down studs and work it into front clutch hub and case by hand. Then install two or three pump bolts to hold pump in place.

(12) Remove pilot stud tools and install remaining oil pump bolts. Tighten bolts alternately in diagonal pattern to 20 N·m (15 ft. lbs.).

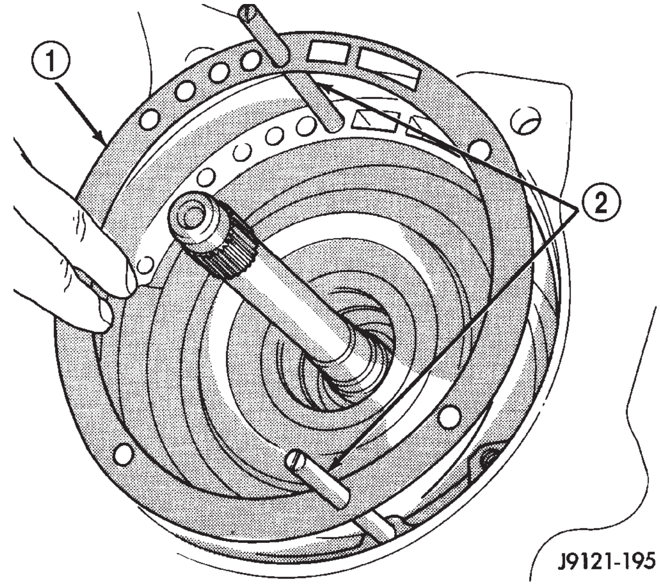


Fig. 66 Installing Pilot Studs And Gasket

1 - OIL PUMP GASKET
2 - PILOT STUD TOOLS C-3288-B

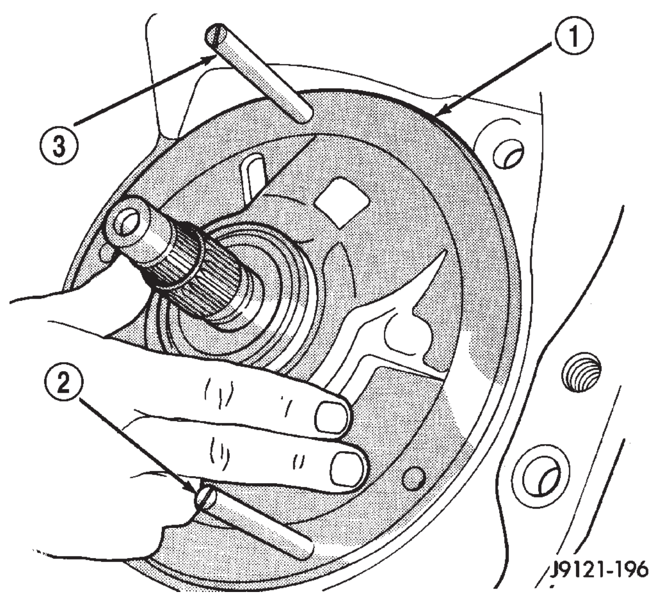


Fig. 67 Installing Oil Pump And Reaction Shaft Support

1 - OIL PUMP
2 - PILOT STUD TOOL
3 - PILOT STUD TOOL

CHECKING INPUT SHAFT END PLAY

(1) Measure input shaft end play (Fig. 68).

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.

AUTOMATIC TRANSMISSION - 32RH (Continued)

(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.).

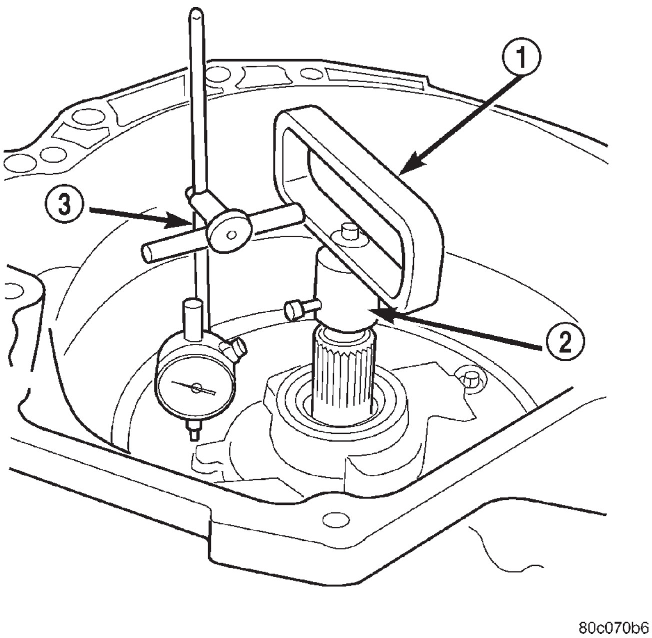


Fig. 68 Checking Input Shaft End Play

1 - TOOL 8266–8
2 - TOOL 8266–7
3 - TOOL C-3339

VALVE BODY

(1) Install new manual lever shaft seal in case. Use suitable deep well socket to install seal.

(2) Make sure neutral switch has **not** been installed in case. Remove switch if necessary as it will interfere with valve body installation.

(3) Install new seal rings on accumulator piston (Fig. 69). Lubricate accumulator piston, seals and accumulator bore with transmission fluid.

(4) Install accumulator piston and spring (Fig. 69)in case.

(5) Place valve body manual lever in low to move park lock rod rearward.

(6) Position valve body on case. Work park rod past sprag and install valve body-to-case bolts finger tight.

(7) Install park/neutral position switch in case. Tighten switch to 34 N·m (25 ft. lbs.) torque.

(8) Align valve body on case (Fig. 70).

(9) Install and tighten valve body-to-case bolts alternately and evenly to 12 N·m (105 in. lbs.) torque. Start at center and work outward when tightening bolts. **Do not overtighten valve body bolts. This could result in distortion and cross leakage after installation.**.

(10) Connect converter clutch solenoid wire to case connector (Fig. 70).

(11) Install new filter on valve body (Fig. 71). Tighten filter screws to 4 N·m (35 in. lbs.).

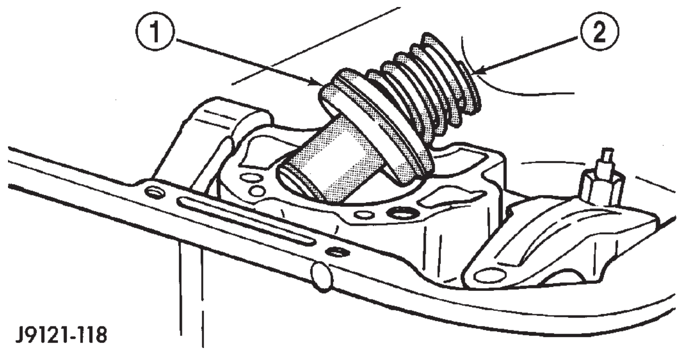


Fig. 69 Installing Accumulator Piston And Spring

1 - ACCUMULATOR PISTON
2 - PISTON SPRING

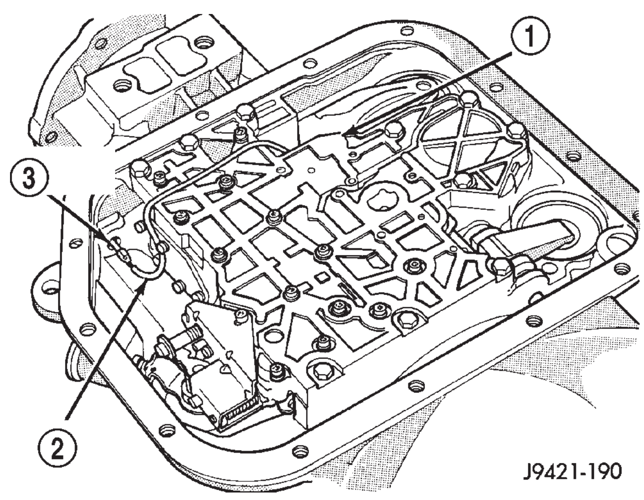


Fig. 70 Valve Body Installation

1 - VALVE BODY
2 - SOLENOID WIRE
3 - CONNECTOR PIN

EXTENSION HOUSING, CONTROL LEVER AND CONVERTER

(1) Install throttle valve and transmission shift levers on manual valve shaft. Tighten lever clamp screws securely.

AUTOMATIC TRANSMISSION - 32RH (Continued)

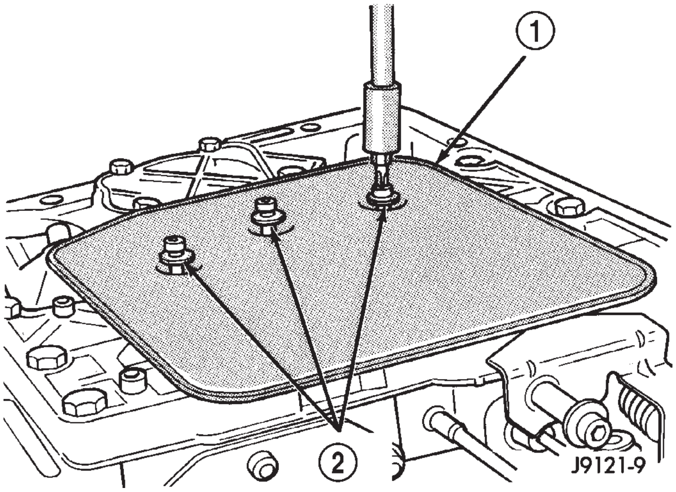


Fig. 71 Fluid Filter Installation

1 - FLUID FILTER
2 - FILTER SCREWS

(2) Position new extension housing gasket on transmission case. Use petroleum jelly to hold gasket in place.

(3) Install new rear seal in extension housing if required.

(4) Install extension housing on transmission case. Tighten housing fasteners to 33 N·m (24 ft. lbs.). Be sure park lock rod is properly engaged in sprag beforehand.

(5) Lubricate converter hub with transmission fluid and carefully install converter. Turn converter back and forth until seated.

(6) Secure converter in oil pump before mounting transmission on jack and before moving transmission back under vehicle. Use metal strapping, C-clamp, or locking pliers to hold converter in place. Attach holding tool to converter housing.

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. 72). 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.

(7) Lightly grease crankshaft flange hole.

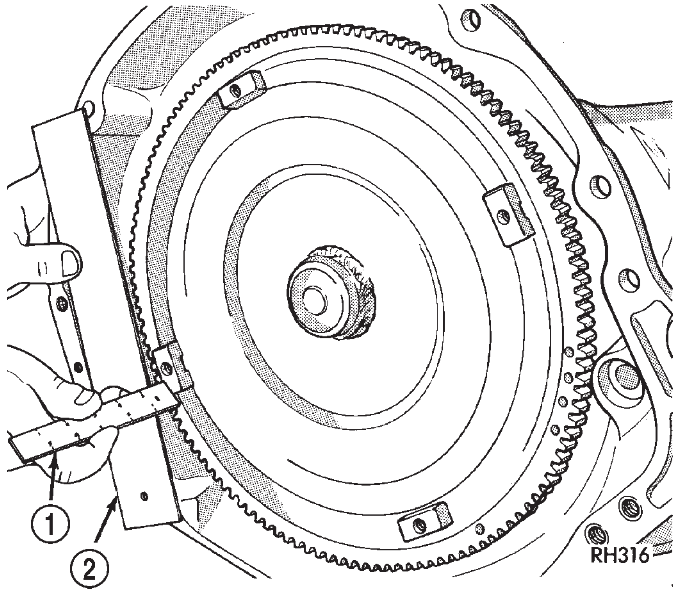


Fig. 72 Checking Converter Seating - Typical

1 - SCALE
2 - STRAIGHTEDGE

(8) Position transmission on jack and secure it with safety chains.

(9) Check condition of converter driveplate. Replace the plate if cracked, distorted or damaged. **Also be sure transmission dowel pins are seated in engine block and protrude far enough to hold transmission in alignment.**

(10) Raise transmission and align converter with drive plate and converter housing with engine block.

(11) Move transmission forward. Then raise, lower or tilt transmission to align converter housing with engine block dowels.

(12) 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. 73).

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 the crankshaft position sensor.

(16) Install transmission fill tube and seal. Install new fill tube seal in transmission before installation.

AUTOMATIC TRANSMISSION - 32RH (Continued)

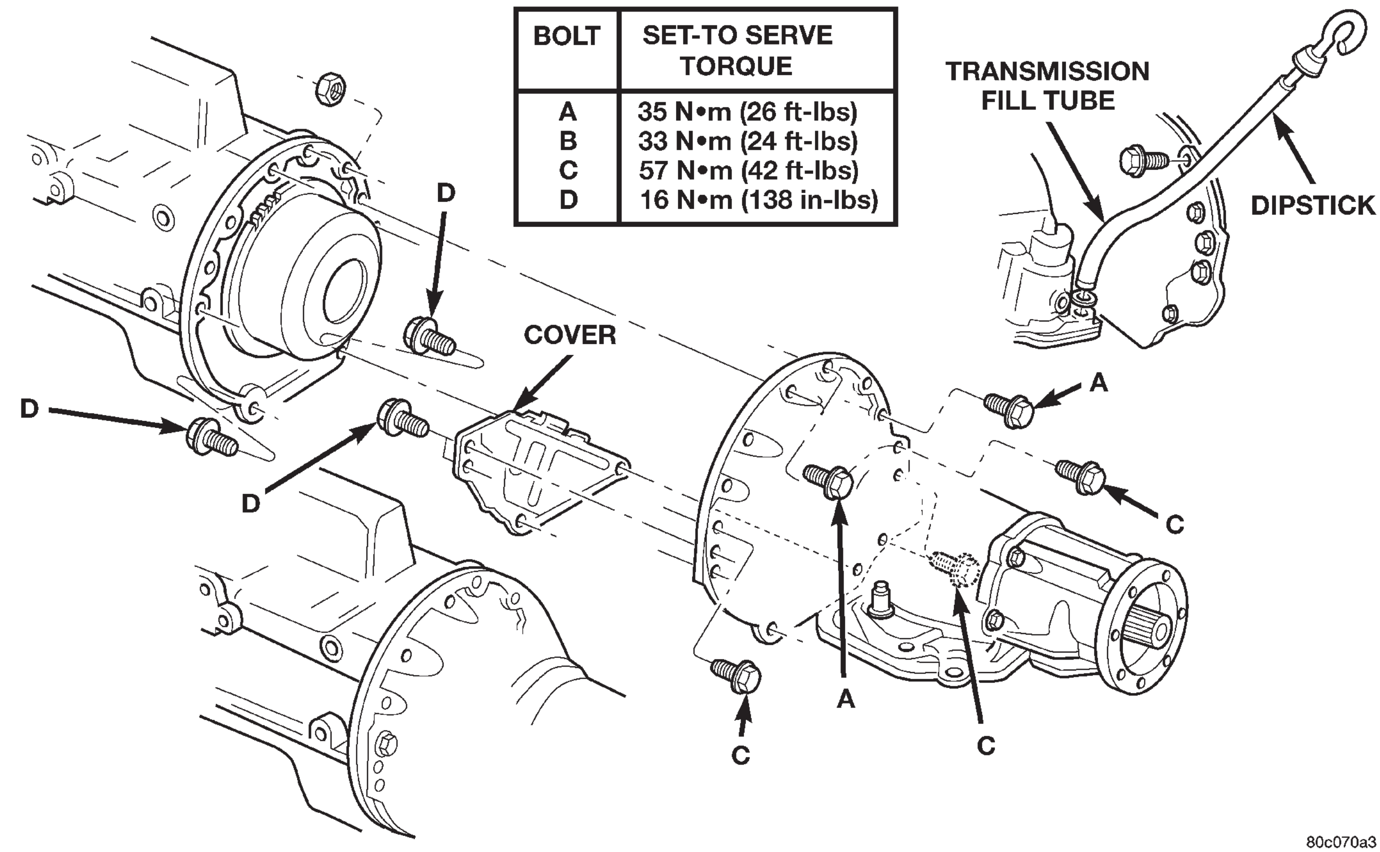


Fig. 73 Transmission Attachment

(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).

(33) Install skid plate, rear cushion and bracket, if removed.

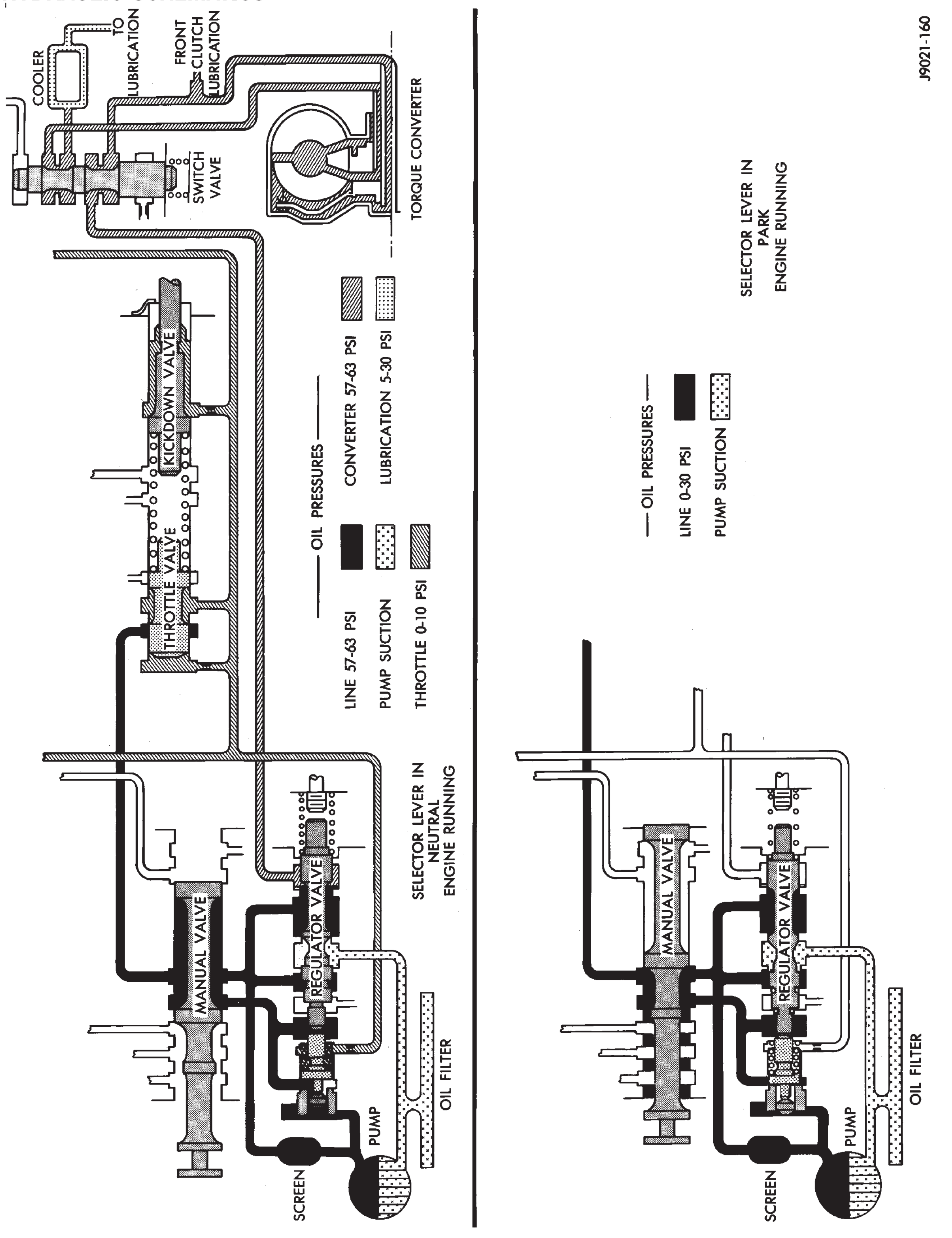
(34) Fill transfer case to bottom edge of fill plug hole.

(35) Lower vehicle and fill transmission to correct level with Mopar® ATF +4, type 9602 fluid.

AUTOMATIC TRANSMISSION - 32RH (Continued)

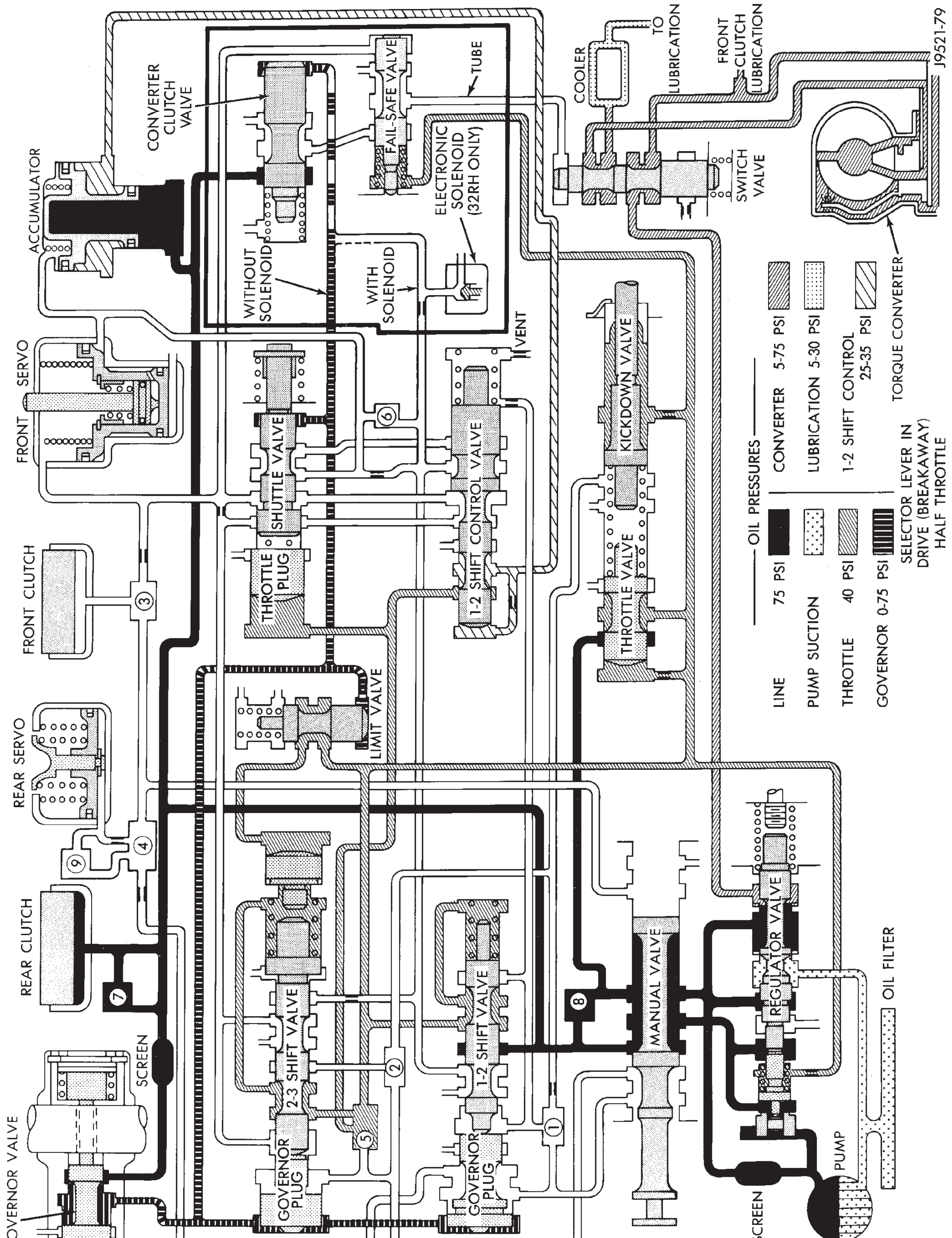
SCHEMATICS AND DIAGRAMS

HYDRAULIC SCHEMATICS



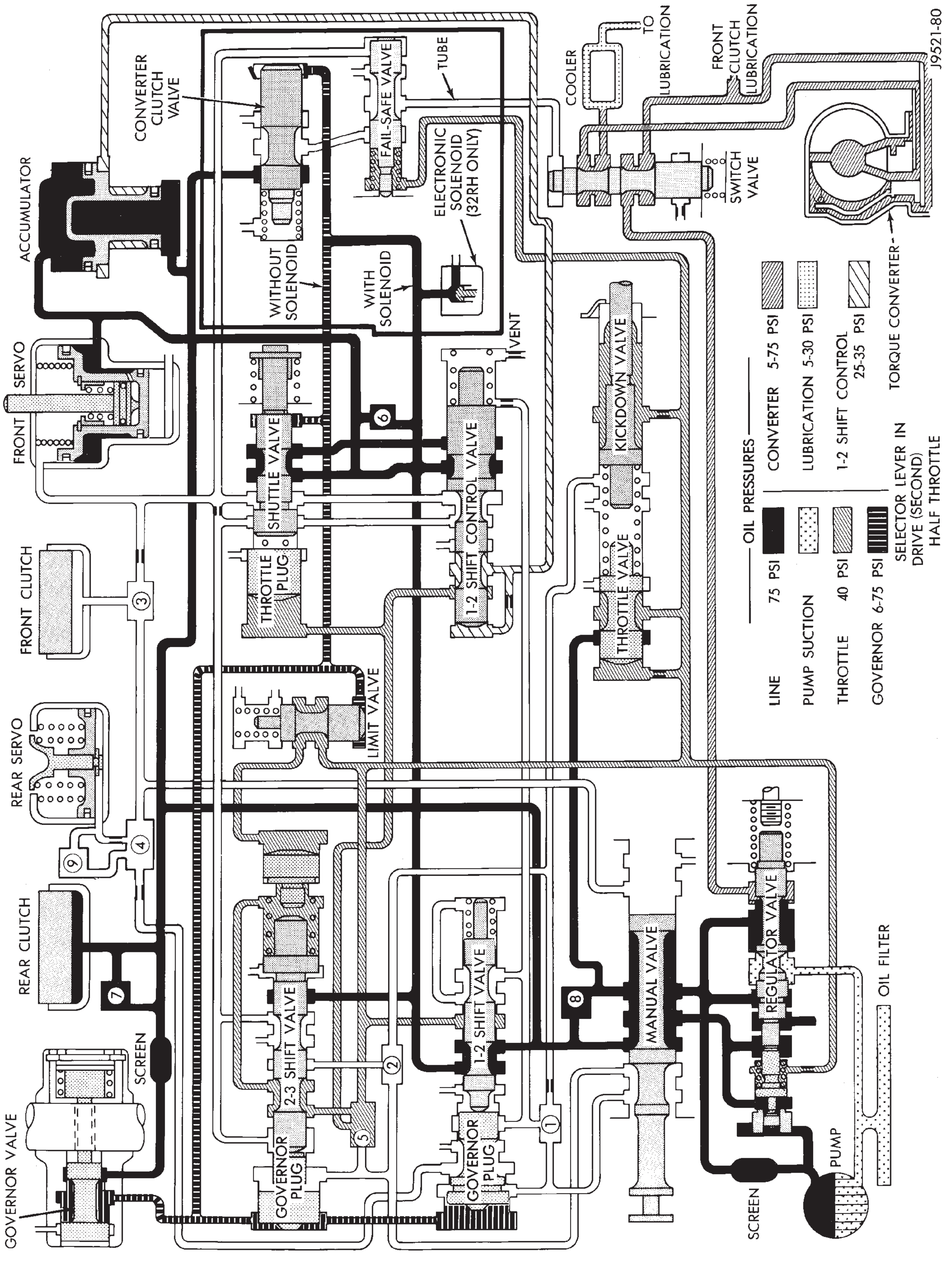
HYDRAULIC FLOW IN PARK/NEUTRAL

AUTOMATIC TRANSMISSION - 32RH (Continued)



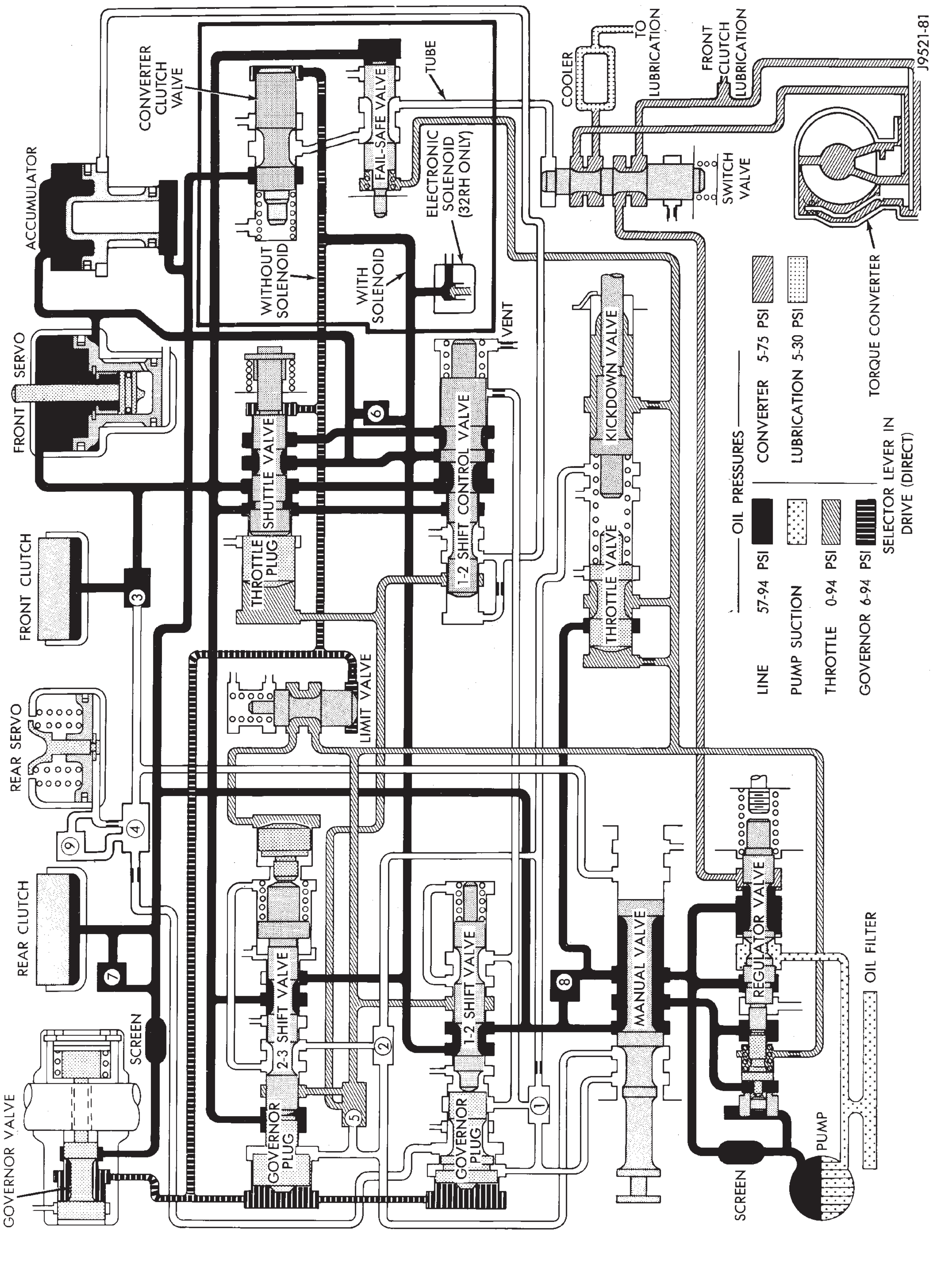
HYDRAULIC FLOW IN D-FIRST GEAR

AUTOMATIC TRANSMISSION - 32RH (Continued)



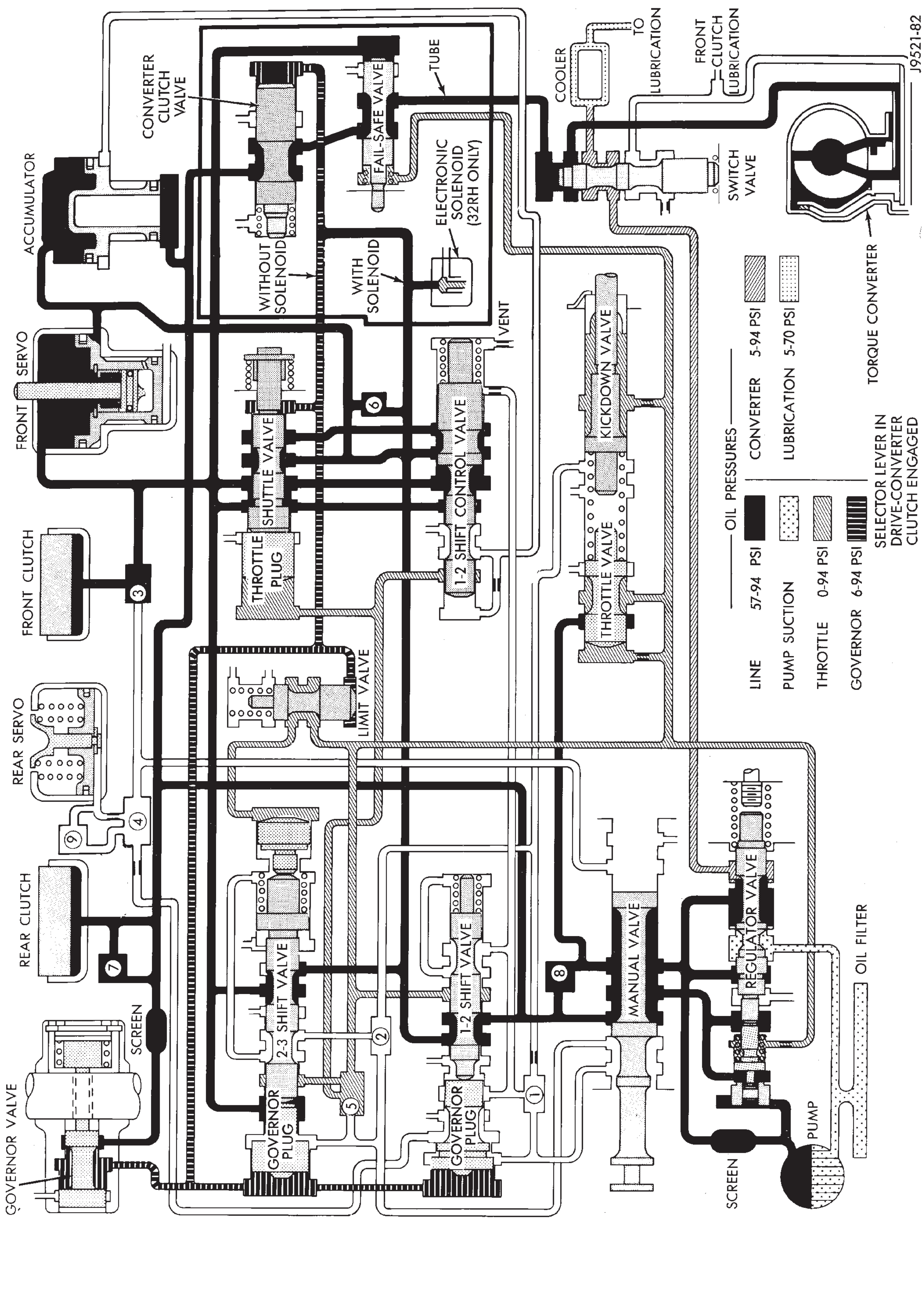
HYDRAULIC FLOW IN D-SECOND GEAR

AUTOMATIC TRANSMISSION - 32RH (Continued)



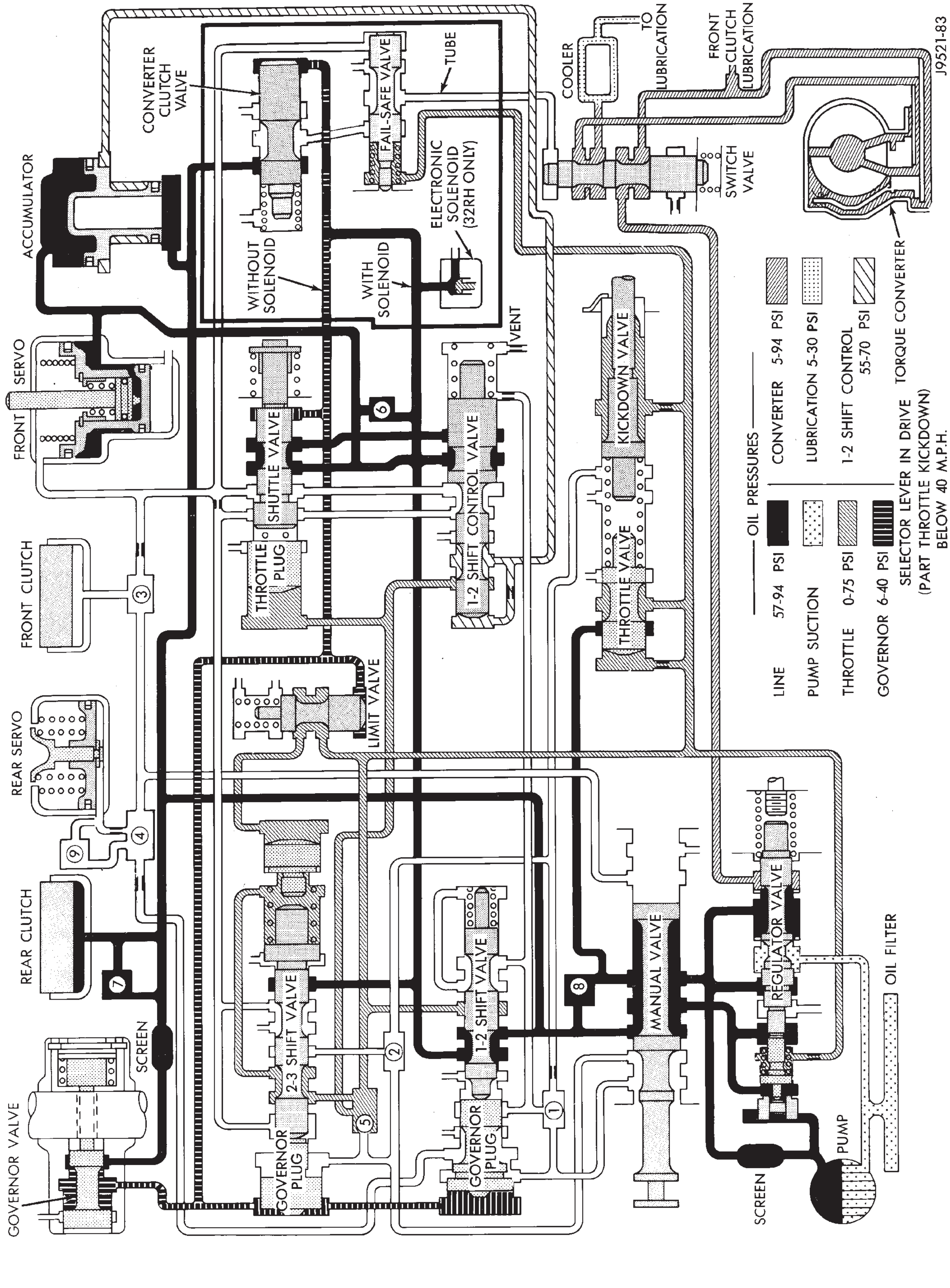
HYDRAULIC FLOW IN D-THIRD GEAR

AUTOMATIC TRANSMISSION - 32RH (Continued)



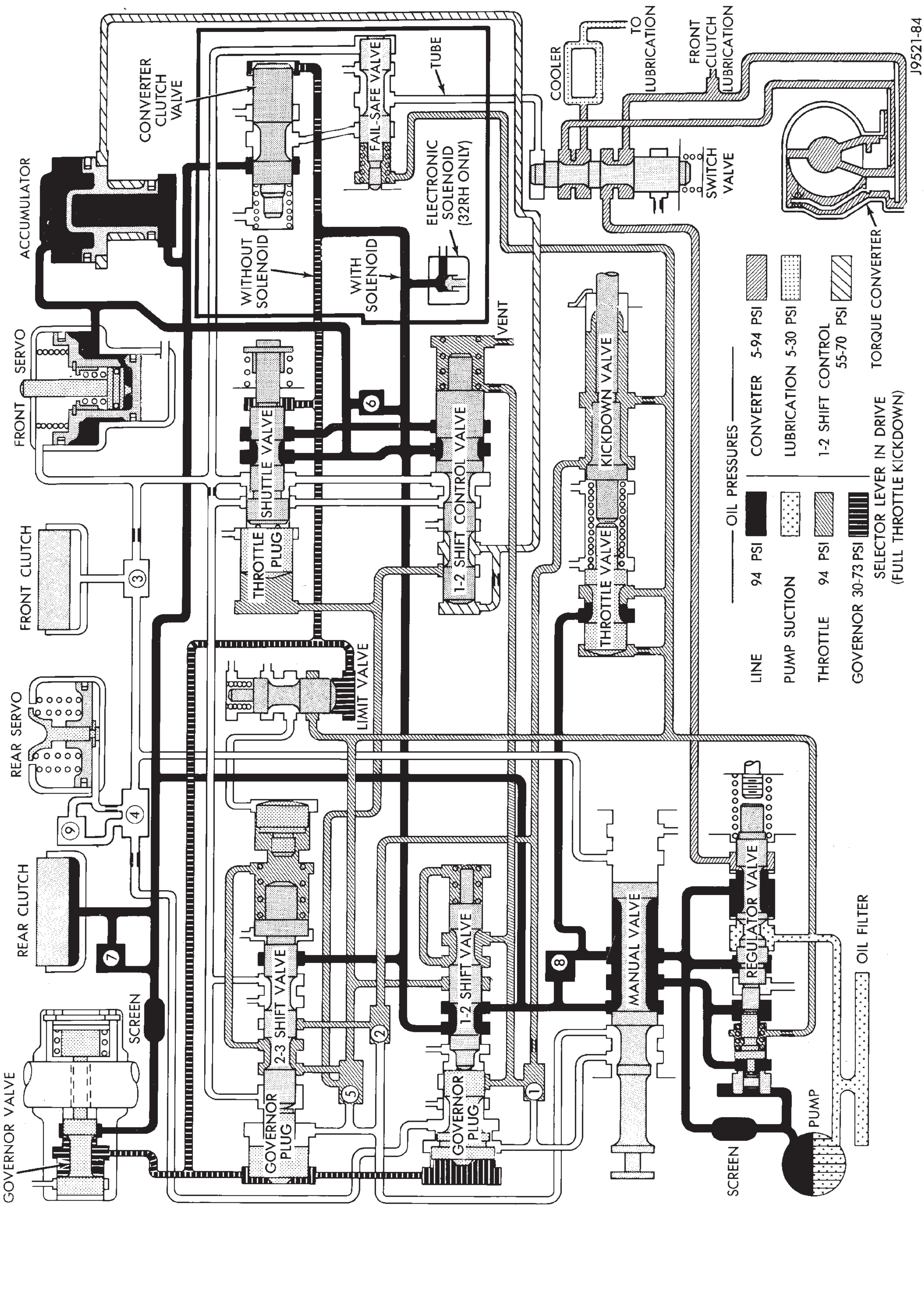
HYDRAULIC FLOW IN D-THIRD GEAR (CONVERTER CLUTCH APPLIED)

AUTOMATIC TRANSMISSION - 32RH (Continued)



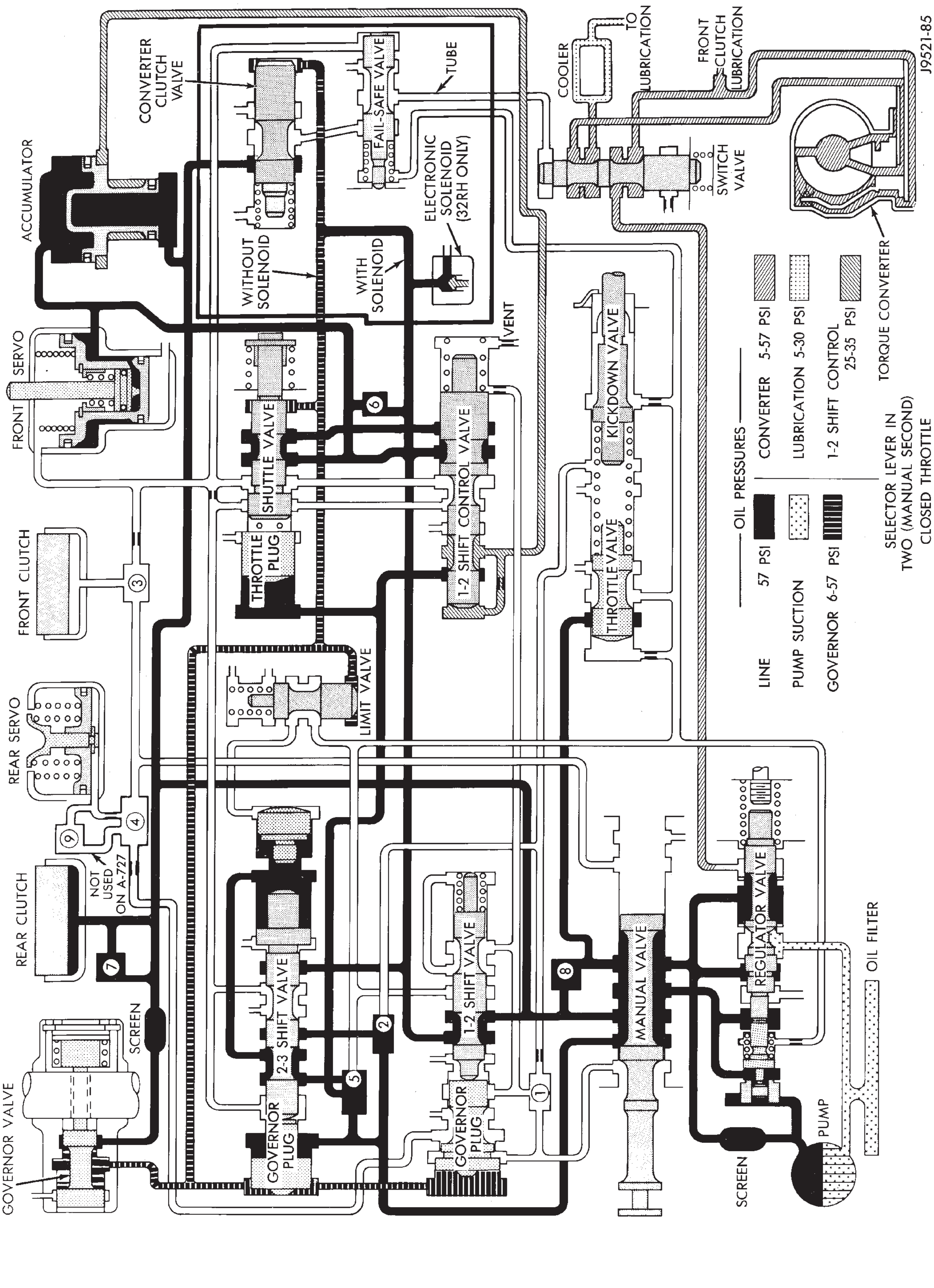
HYDRAULIC FLOW AT PART THROTTLE 3-2 KICKDOWN

AUTOMATIC TRANSMISSION - 32RH (Continued)



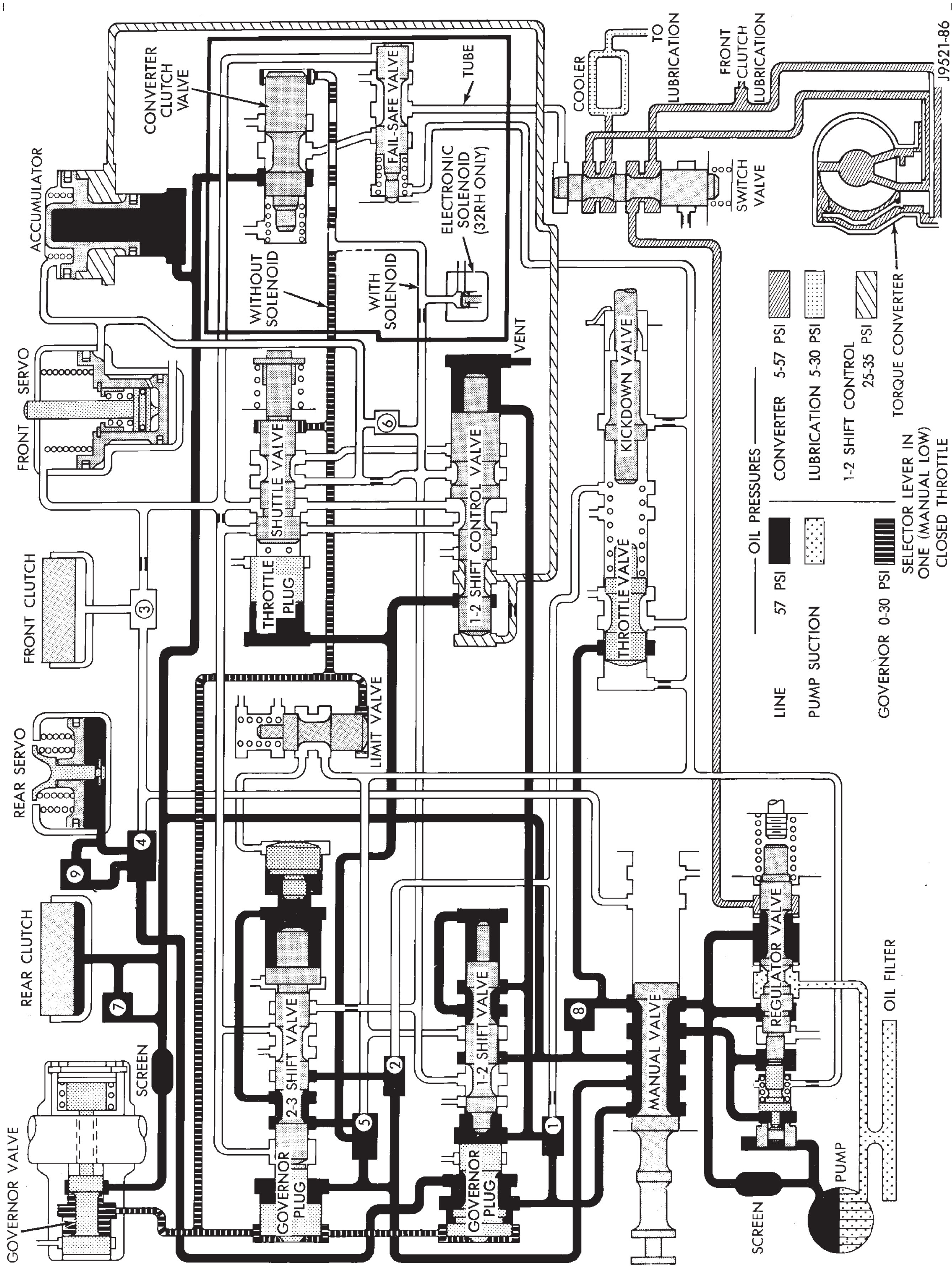
HYDRAULIC FLOW AT FULL THROTTLE

AUTOMATIC TRANSMISSION - 32RH (Continued)



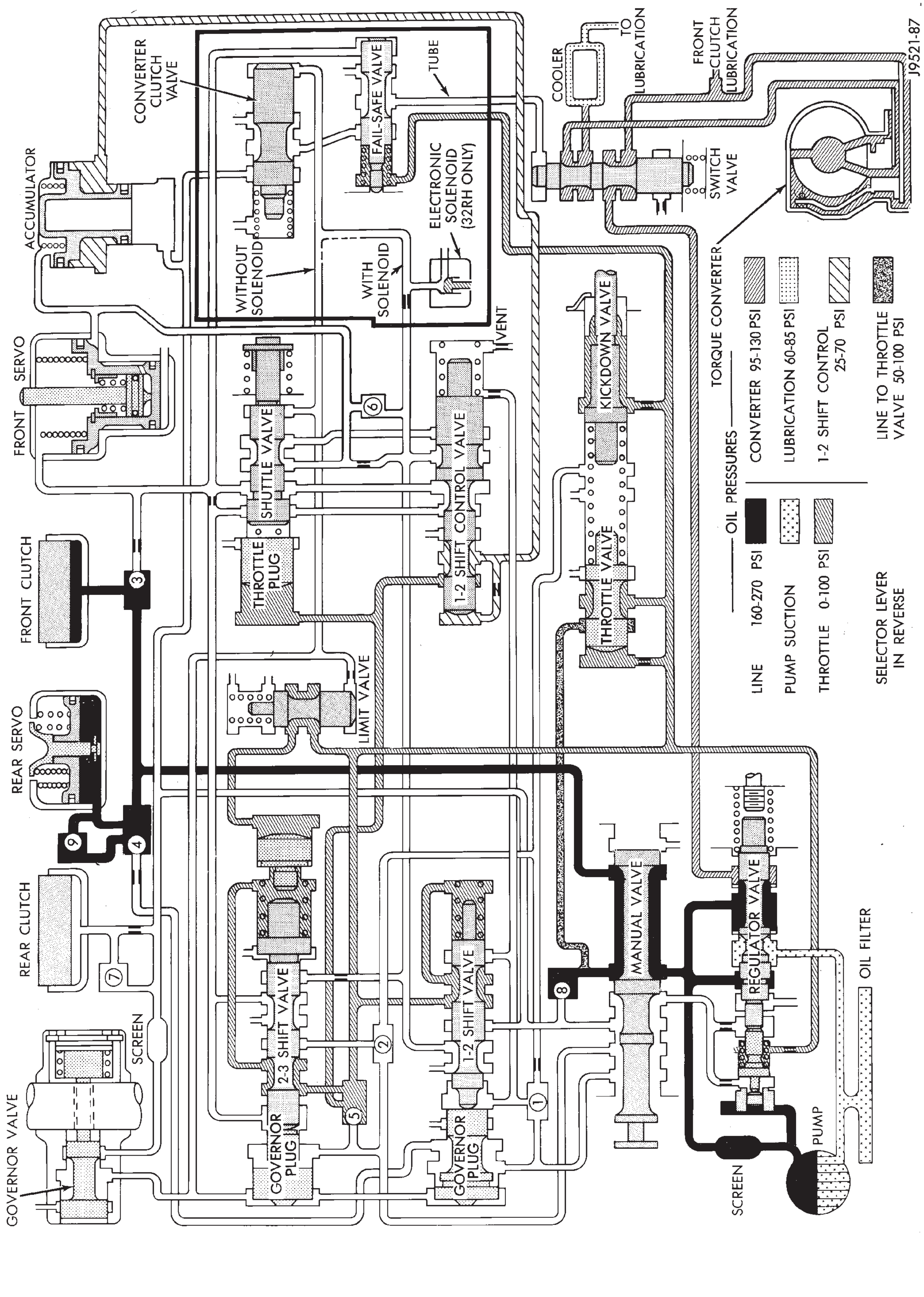
HYDRAULIC FLOW IN MANUAL SECOND

AUTOMATIC TRANSMISSION - 32RH (Continued)



HYDRAULIC FLOW IN MANUAL LOW

AUTOMATIC TRANSMISSION - 32RH (Continued)



HYDRAULIC FLOW IN REVERSE

AUTOMATIC TRANSMISSION - 32RH (Continued)

SPECIFICATIONS

32RH AUTOMATIC TRANSMISSION

SPECIFICATIONS

COMPONENT	METRIC	INCH
Oil pump gear tip clearance	0.089-0.190 mm	0.0035-0.0075 in.
Planetary end play	0.127-1.22 mm	0.005-0.048 in.
Input shaft end play	0.56-2.31 mm	0.022-0.091 in.
Clutch pack clearance/Front 4-disc.	1.70-3.40 mm	0.067-0.134 in.
Clutch pack clearance/Rear 4-disc.	0.81-1.40 mm	0.032-0.055 in.
Front clutch spring usage	1 spring	
Front Band adjustment from 72 in. lbs.	Back off 2.25 turns	
Rear Band adjustment from 41 in. lbs.	Back off 4 turns	
Recommended fluid	Mopar®, ATF +4, Type 9602	

THRUST WASHER/SPACER/SNAP-RING DIMENSIONS

COMPONENT	METRIC	INCH
Front clutch thrust washer (reaction shaft support hub)	1.55 mm	0.061 in.
Rear clutch thrust washer (clutch retainer)	1.55 mm	0.061 in.
Output shaft thrust plate (output shaft pilot hub)	1.5-1.6mm	0.060-0.063 in.
Output shaft thrust washer (rear clutch hub)	1.3-1.4 mm 1.7-1.8 mm 2.1-2.2 mm	0.052-0.054 in. 0.068-0.070 in. 0.083-0.086 in.
Rear clutch pack snap-ring	1.5 mm 1.7 mm 1.9 mm 2.5 mm	0.060 in. 0.068 in. 0.076 in. 0.098 in.
Planetary geartrain snap-ring (at front of output shaft)	1.0-1.1 mm 1.6-1.7 mm 2.1-2.2 mm	0.040-0.044 in. 0.062-0.066 in. 0.082-0.086 in.

PRESSURE TEST

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.

AUTOMATIC TRANSMISSION - 32RH (Continued)

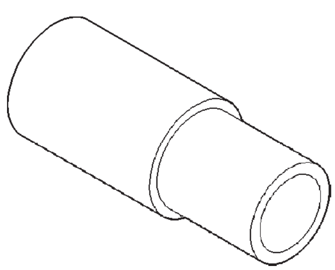
ITEM	RANGE	PRESSURE
Governor	D range closed throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1.5 psi) when stopped with transmission in D, 1, 2. Pressure above 7 kPa (1.5 psi) at stand still will prevent transmission from downshifting.

TORQUE SPECIFICATIONS

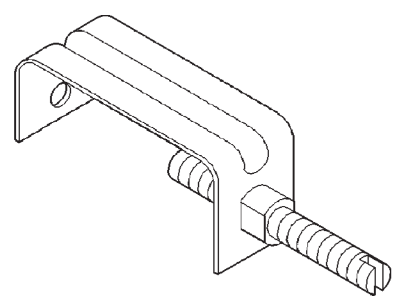
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Bolt/nut, crossmember	31	23	-
Bolt, driveplate to crankshaft	68	50	-
Plug, front band reaction	75	55	-
Locknut, front band adj.	34	25	-
Switch, park/neutral	34	25	-
Bolt, fluid pan	17	13	-
Bolt, oil pump	20	15	-
Bolt, overrunning clutch cam	17	13	-
Plug, pressure test port	14	10	-
Bolt, reaction shaft support	20	15	-
Locknut, rear band	41	30	-
Bolt. speedometer adapter	11	8	-
Screw, fluid filter	4	-	35
Bolt, valve body to case	12	-	100

SPECIAL TOOLS

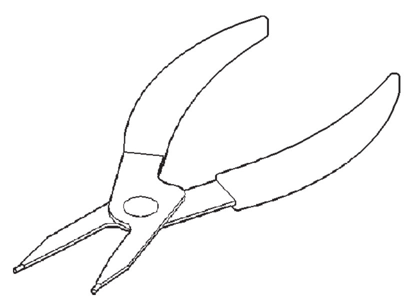
RH TRANSMISSIONS



Installer, Bushing - 6951

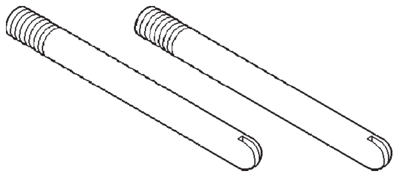


Retainer, Detent Ball and Spring - 6583

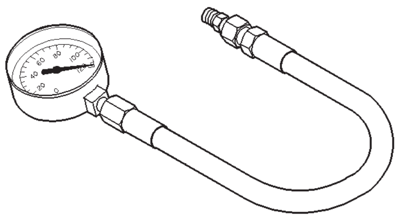


Plier, Snap-ring- 6823

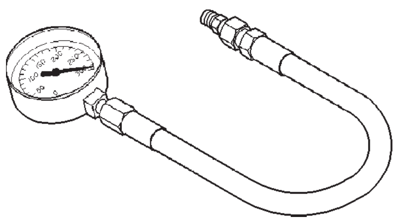
AUTOMATIC TRANSMISSION - 32RH (Continued)



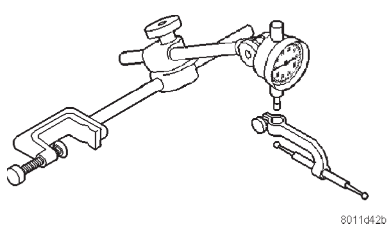
Stud, Pilot - C-3288-B



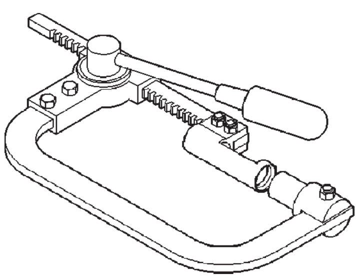
Gauge, Oil Pressure - C-3292



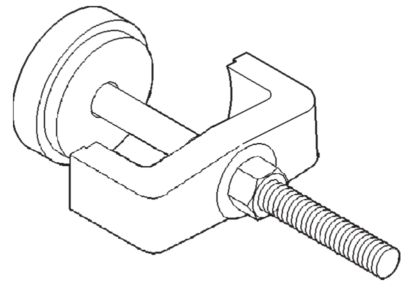
Gauge, Oil Pressure - C-3293SP



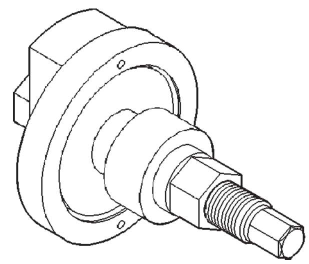
Kit, Dial Indicator - C-3339



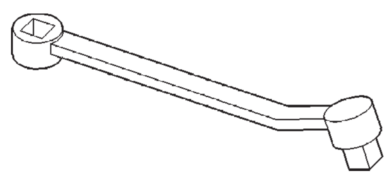
Compressor, Valve Spring - C-3422-C



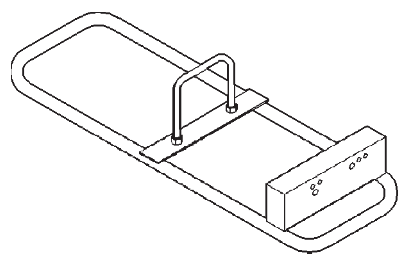
Compressor, Spring - C-3575-A



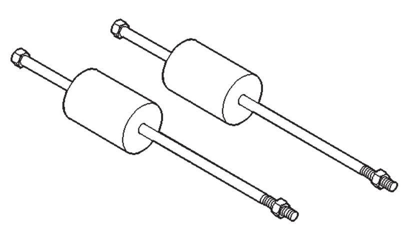
Compressor, Spring - C-3863-A



Adapter, Band Adjuster - C-3705

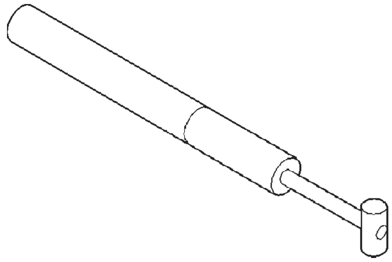


Stand, Transmission Repair - C-3750-B

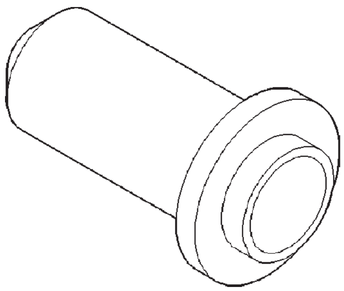


Puller, Slide - C-3752

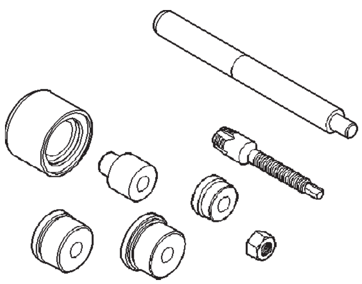
AUTOMATIC TRANSMISSION - 32RH (Continued)



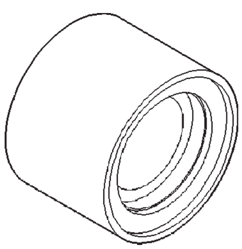
Gauge, Throttle Setting - C-3763



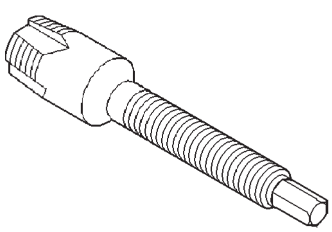
Installer, Seal - C-3860-A



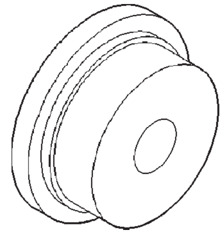
Remover/Installer, Bushing - C-3887-J



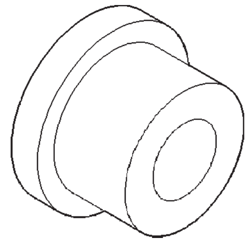
Cup, Bushing Remover - SP-3633



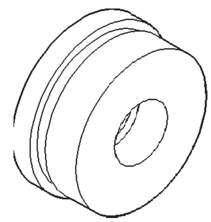
Remover, Reaction Shaft Bushing - SP-5301



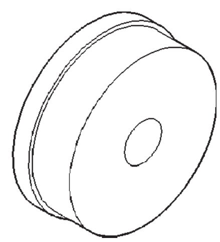
Installer, Oil Pump Bushing - SP-5118



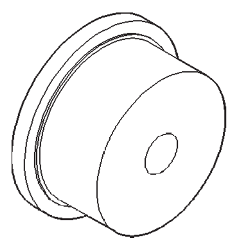
Installer, Reaction Shaft Bushing - SP-5302



Remover, Bushing - SP-3550

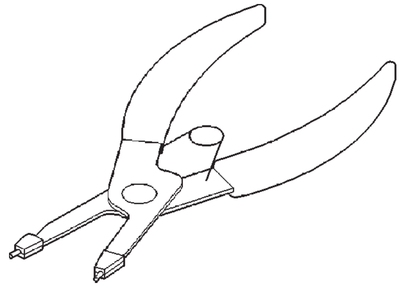


Remover, Front Clutch Bushing - SP-3629

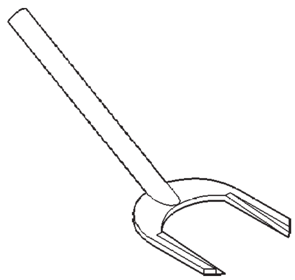


Installer, Front Clutch Bushing - SP-5511

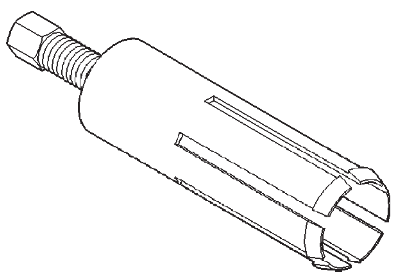
AUTOMATIC TRANSMISSION - 32RH (Continued)



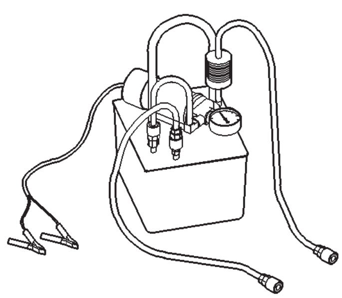
Plier, Snap-ring C-3915



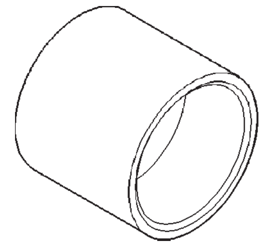
Remover, Seal C-3985-B



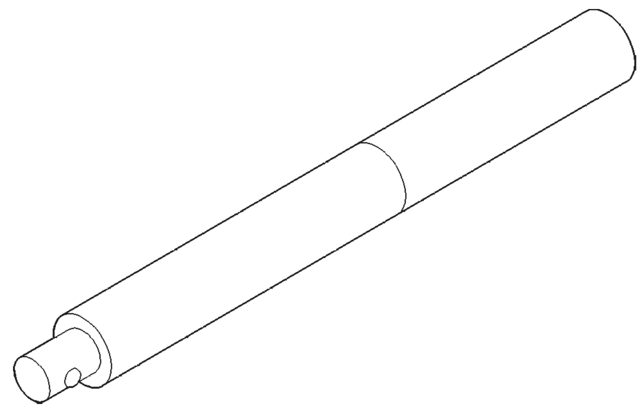
Bushing, Remover - 6957



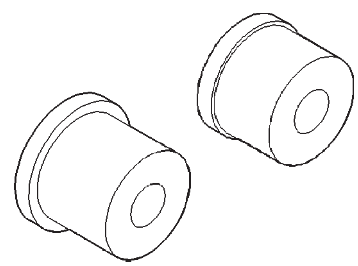
Flusher, Oil Cooler - 6906-B



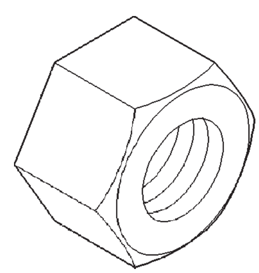
Installer, Seal - C-3995-A



Universal Handle - C-4171



Remover/Installer - C-4470



Nut, Bushing Remover - SP-1191

ACCUMULATOR

DESCRIPTION

The accumulator (Fig. 74) 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.

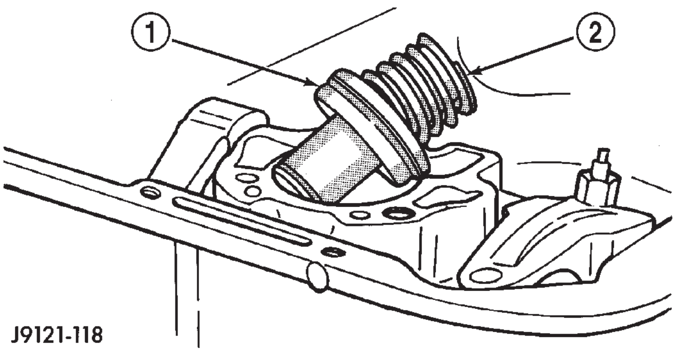


Fig. 74 Accumulator

1 - ACCUMULATOR PISTON
2 - PISTON SPRING

OPERATION

Line pressure is directed between the lands of the piston (Fig. 75), 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. 76), 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.

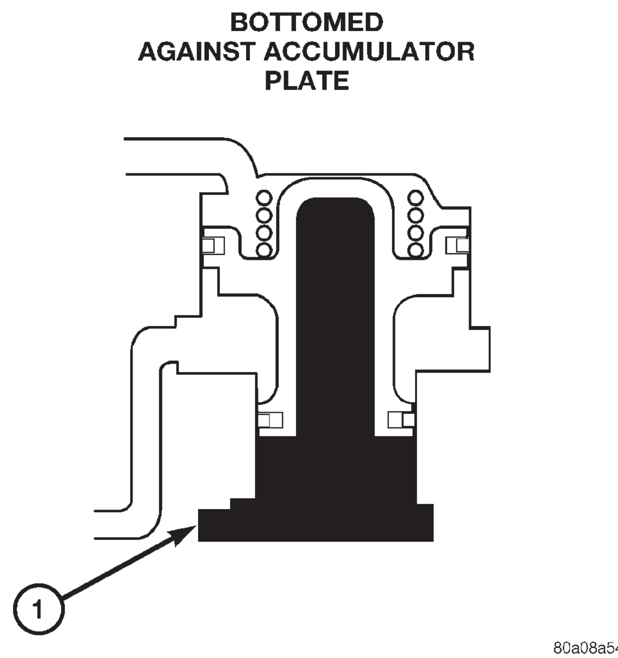


Fig. 75 Accumulator in DRIVE - FIRST Gear Position

1 - LINE PRESSURE

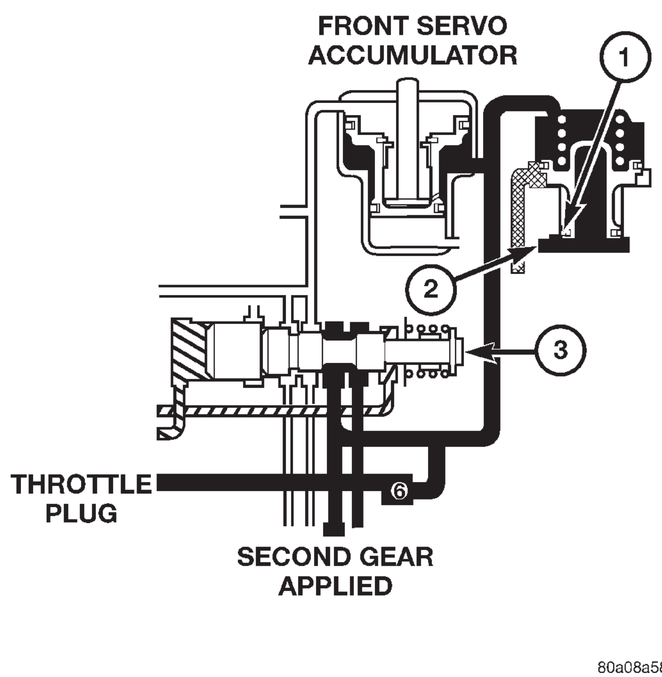


Fig. 76 Accumulator in SECOND Gear Position

1 - BOTTOM OF BORE
2 - LINE PRESSURE
3 - SHUTTLE VALVE

ACCUMULATOR (Continued)

INSPECTION

Inspect the accumulator piston and seal rings (Fig. 77). Replace the seal rings if worn or cut. Replace the piston if chipped or cracked.

Check condition of the accumulator inner and outer springs (Fig. 77). Replace the springs if the coils are cracked, distorted or collapsed.

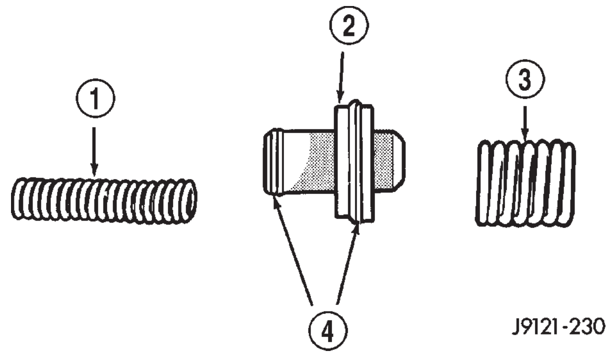


Fig. 77 Accumulator Components

1 - INNER SPRING
2 - ACCUMULATOR PISTON
3 - OUTER SPRING
4 - SEAL RINGS

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 13 - FRAMES & BUMPERS/FRAME/FRONT SKID PLATE - REMOVAL)

(4) Remove propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(5) Remove transfer case.

(6) Remove bolts holding adapter housing to transmission case (Fig. 78).

(7) Separate adapter housing from transmission.

(8) Slide adapter housing rearward and off output shaft (Fig. 78).

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. 78).

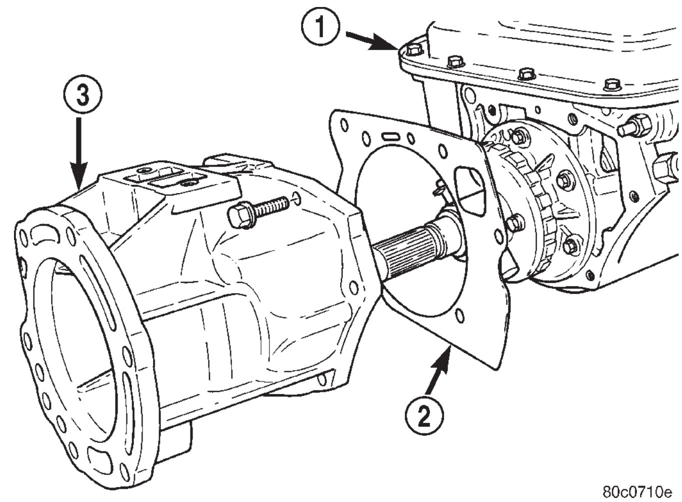


Fig. 78 Adapter Housing

1 - TRANSMISSION
2 - GASKET
3 - ADAPTER HOUSING

(4) Guide park shaft into park sprag and push adapter housing forward until rod passes through opening behind sprag. It may be necessary to use a wire to hold sprag to the side for rod to pass through.

(5) Install bolts to hold adapter housing to rear of transmission.

(6) Install transfer case.

(7) Install propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(8) Install rear transmission mount and skid plate. (Refer to 13 - FRAMES & BUMPERS/FRAME/FRONT SKID PLATE - REMOVAL)

(9) Lower vehicle and verify transmission fluid level. Add fluid as necessary.

BANDS

DESCRIPTION

KICKDOWN (FRONT) BAND

DESCRIPTION

The kickdown, or “front”, band (Fig. 79) 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).

BANDS (Continued)

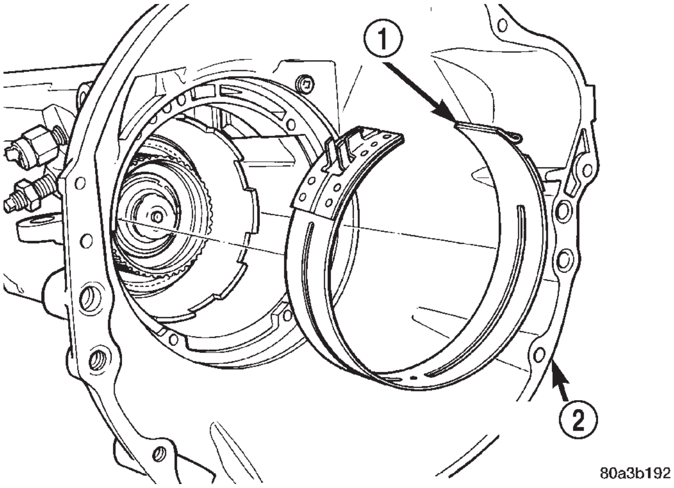


Fig. 79 Front Band

1 - FRONT BAND
2 - TRANSMISSION HOUSING

OPERATION

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.

OPERATION

LOW/REVERSE (REAR) BAND

DESCRIPTION

The low/reverse band, or "rear", band (Fig. 80) 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.

OPERATION

The rear band holds the rear planet carrier stationary by being mounted around and applied to the low/reverse drum.

ADJUSTMENTS

ADJUSTMENT - FRONT BAND

The front (kickdown) band adjusting screw is located on the left side of the transmission case above the manual valve and throttle valve levers.

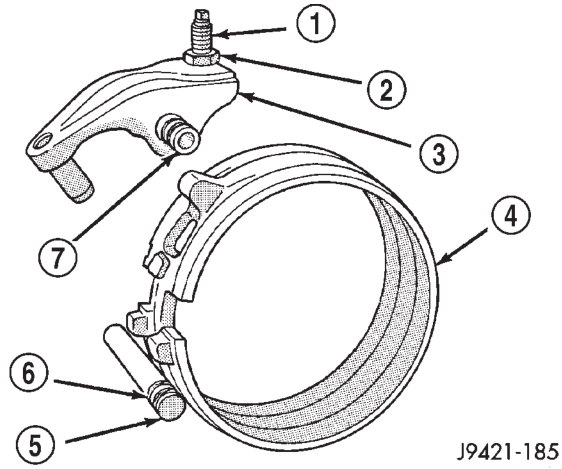


Fig. 80 Rear Band Components

1 - ADJUSTING SCREW
2 - LOCKNUT
3 - LEVER
4 - REAR BAND
5 - REACTION PIN
6 - O-RINGS
7 - PIVOT PIN

(1) Raise vehicle.
(2) Loosen band adjusting screw locknut (Fig. 81). 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 the 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 2-1/4 turns.
(5) Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.
(6) Lower vehicle.

ADJUSTMENTS - REAR BAND

The transmission oil pan must be removed for access to the rear band adjusting screw.
(1) Raise vehicle.
(2) Remove transmission oil pan and drain fluid.
(3) Loosen band adjusting screw locknut 5-6 turns. Be sure adjusting screw turns freely in lever.
(4) Tighten adjusting screw to 5 N·m (41 in. lbs.) (Fig. 82).
(5) Back off adjusting screw 4 turns.
(6) Hold adjusting screw in place and tighten locknut to 34 N·m (25 ft. lbs.) torque.

BANDS (Continued)

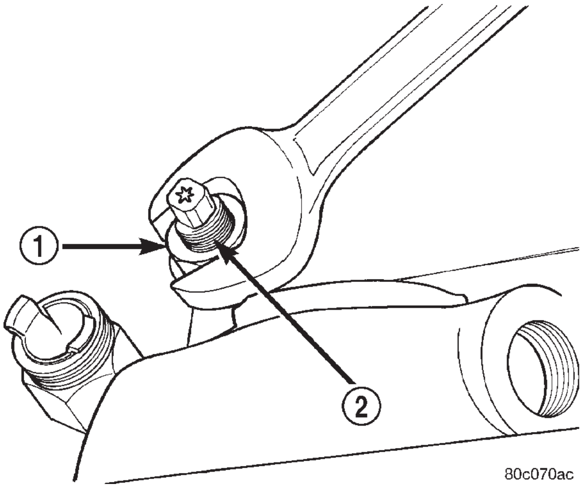


Fig. 81 Front Band Adjusting Screw Lock Nut

1 - LOCK-NUT
2 - FRONT BAND ADJUSTER

(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 +4, Type 9602, fluid.

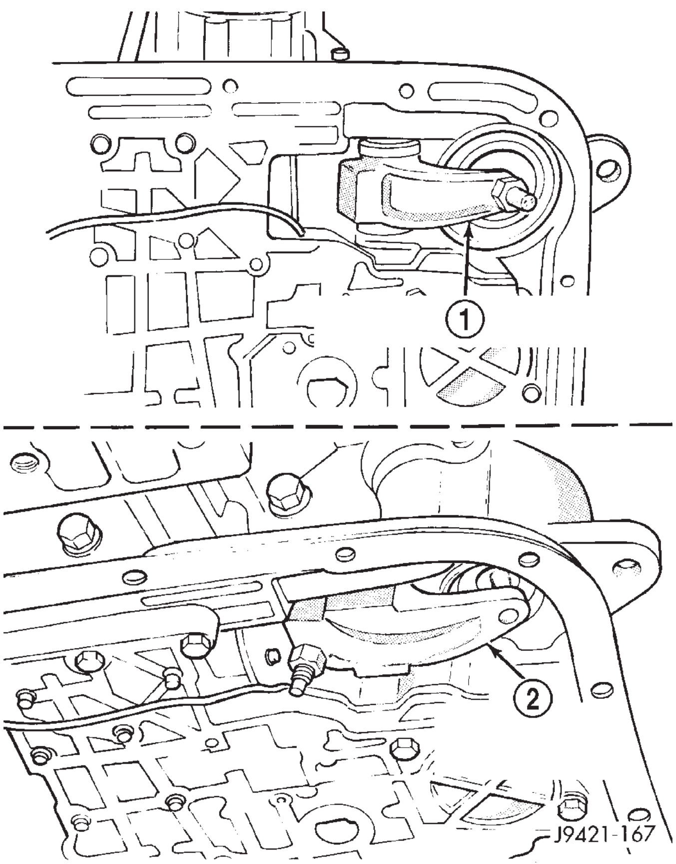


Fig. 82 Rear Band Adjustment Screw Location

1 - 30RH REAR BAND LEVER AND ADJUSTING SCREW
2 - 32RH REAR BAND LEVER AND ADJUSTING SCREW

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. 83).

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 position and the brake pedal is depressed, the shifter is unlocked and will move into any position. The interlock system also prevents the ignition switch from being turned to the LOCK or ACCESSORY position (Fig. 84) unless the shifter is fully locked into the PARK position.

BRAKE TRANSMISSION SHIFT INTERLOCK MECHANISM (Continued)

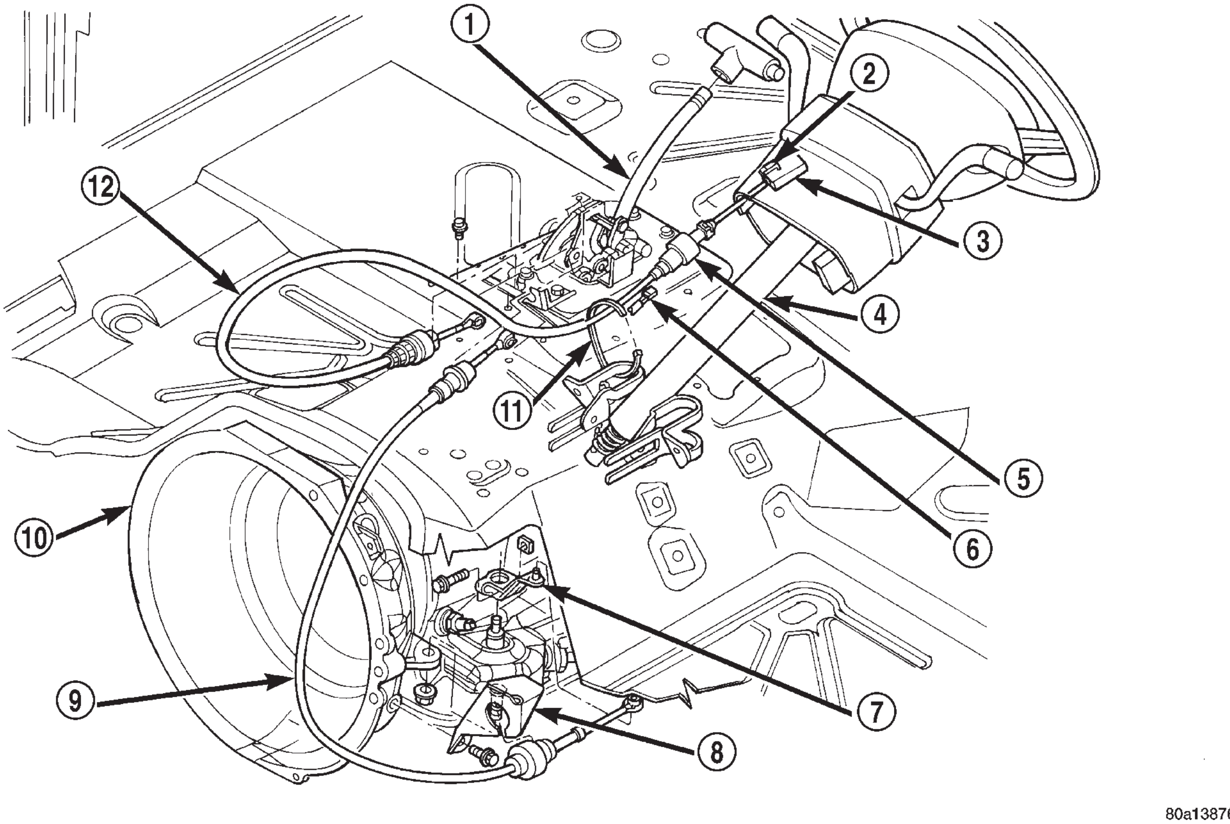


Fig. 83 Ignition Interlock Cable Routing

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

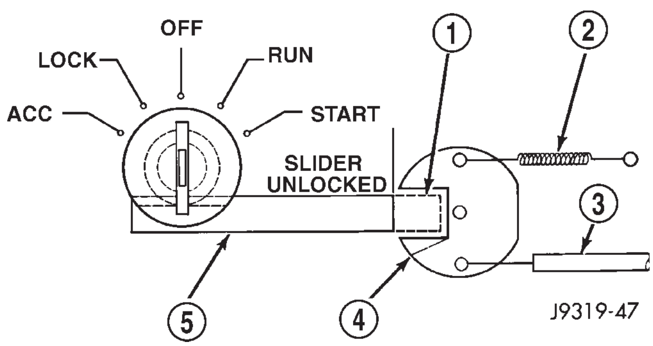


Fig. 84 Ignition Key Cylinder Actuation

1 - SLIDER LOCKED
2 - CAM RETURN SPRING
3 - INTERLOCK CABLE
4 - CAM
5 - SLIDER

REMOVAL

(1) Remove lower steering column cover. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL)

(2) Remove lower steering column shroud.

(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. 85).

(6) Pull cable end from steering column.

(7) Remove the floor console and related trim. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

(8) Disconnect the cable eyelet from the bellcrank (Fig. 86).

(9) Disconnect and remove the cable from the shift bracket.

BRAKE TRANSMISSION SHIFT INTERLOCK MECHANISM (Continued)

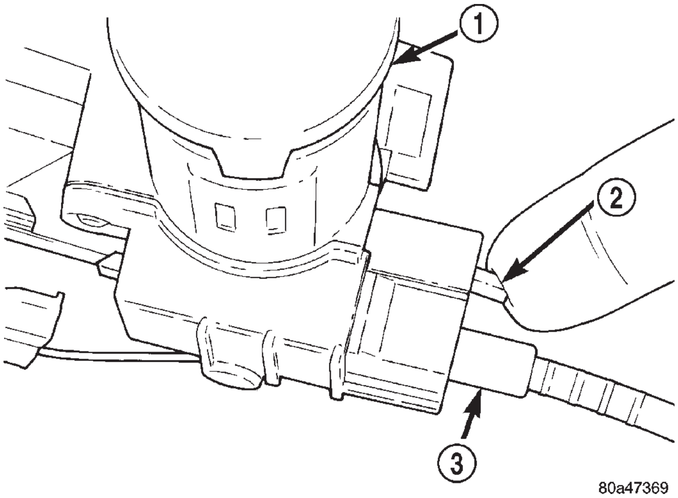


Fig. 85 Brake/Park Interlock Cable

1 - IGNITION LOCK
2 - LOCK TAB
3 - CABLE END

INSTALLATION

(1) Route replacement cable behind instrument panel and under floor console area to shift mechanism (Fig. 86).

(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.

(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.

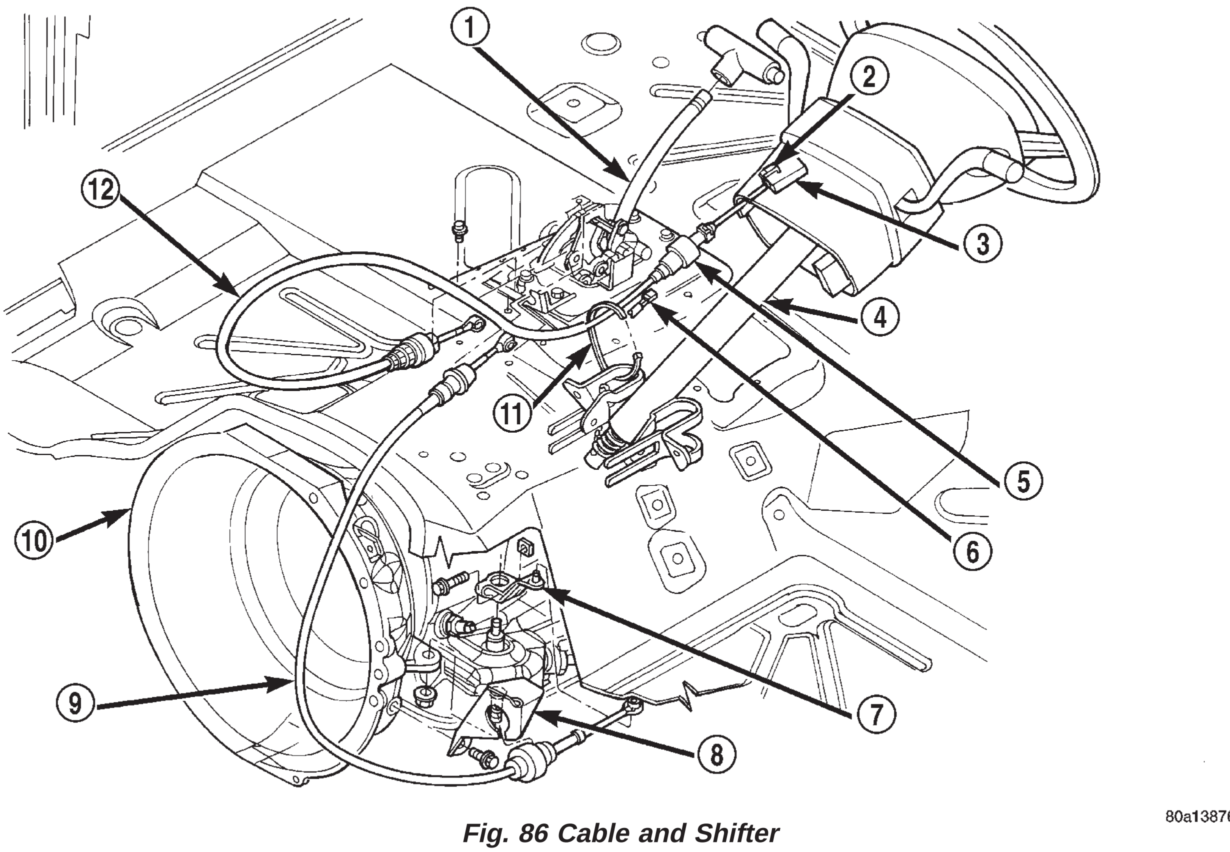


Fig. 86 Cable and Shifter

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

BRAKE TRANSMISSION SHIFT INTERLOCK MECHANISM (Continued)

(11) Install lower steering column shroud and ignition lock.

(12) Install lower steering column cover.

ADJUSTMENTS

ADJUSTMENT - BRAKE TRANSMISSION SHIFT INTERLOCK CABLE

(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. 87).

(4) Turn ignition switch to LOCK position.

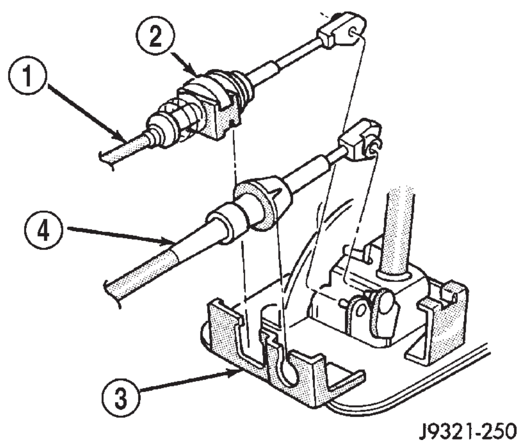


Fig. 87 Park Lock Cable Attachment

1 - PARK LOCK CABLE
2 - CABLE LOCK BUTTON
3 - SHIFT LEVER ASSEMBLY
4 - SHIFT CABLE

(5) Use a spacer to create a one millimeter gap between the shifter pawl and top of the shift gate.

(6) Pull cable forward. Then release cable and press cable lock button down until it snaps in place.

(7) Check adjustment as follows:

(a) Check movement of release shift handle button (floor shift) or release lever (column shift). You should not be able to press button inward or move column lever.

(b) Turn ignition switch to RUN position.

(c) Shifting out of park should not be possible.

(d) Apply the brake and attempt to shift out of PARK. Shifting should be possible.

(e) While the transmission is shifted out of PARK, release the brake and attempt to shift through all gears. Release the shift button at least once during this procedure. The ignition key should not go to the LOCK position.

(f) Return transmission to the PARK position without applying the brake.

(8) Move shift lever back to PARK and check ignition switch operation. You should be able to turn switch to LOCK position and shift lever release button/lever should not move.

FLUID AND FILTER

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - 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 and clutch 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.

DIAGNOSIS AND TESTING - 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.

DIAGNOSIS AND TESTING - 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)

FLUID AND FILTER (Continued)

• 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, an overhaul is necessary.

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.

STANDARD PROCEDURE

STANDARD PROCEDURE - FLUID LEVEL CHECK

Low fluid level can cause a variety of conditions because it allows the pump to take in air along with the fluid. As in any hydraulic system, air bubbles make the fluid spongy, therefore, pressures will be low and build up slowly.

Improper filling can also raise the fluid level too high. When the transmssion has too much fluid, the geartrain churns up foam and cause the same conditions which occur with a low fluid level.

In either case, air bubbles can cause overheating and/or fluid oxidation, and varnishing. This can interfere with normal valve, clutch, and accumulator operation. Foaming can also result in fluid escaping from the transmission vent where it may be mistaken for a leak.

After the fluid has been checked, seat the dipstick fully to seal out water and dirt.

The transmission has a dipstick to check oil level. It is located on the right side of the engine. Be sure to wipe all dirt from dipstick handle before removing.

Fluid level is checked with the engine running at curb idle speed, the transmission in NEUTRAL and the transmission fluid at normal operating temperature. **The engine should be running at idle speed for at least one minute, with the vehicle on level ground.**

(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. 88) 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 +4, type 9602, to restore correct level. Do not overfill.

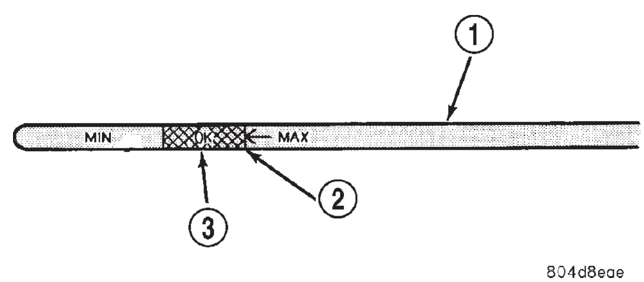


Fig. 88 Dipstick Fluid Level Marks - Typical

1 - DIPSTICK
2 - MAXIMUM CORRECT FLUID LEVEL
3 - ACCEPTABLE FLUID LEVEL

STANDARD PROCEDURE - TRANSMISSION FILL

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 +4, type 9602, to transmission:

(a) If only fluid and filter were changed, add **3 pints (1-1/2 quarts)** of ATF +4 to transmission.

(b) If transmission was completely overhauled, torque converter was replaced or drained, and

FLUID AND FILTER (Continued)

cooler was flushed, add **12 pints (6 quarts)** of ATF +4 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.

STANDARD PROCEDURE - FLUID AND FILTER REPLACEMENT

For proper service intervals (Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION). The service fluid fill after a filter change is approximately 3.8 liters (4.0 quarts).

(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. 89).

(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. 90).

(11) Separate filter from valve body and pour fluid in filter into drain pan.

(12) Dispose used trans fluid and filter properly.

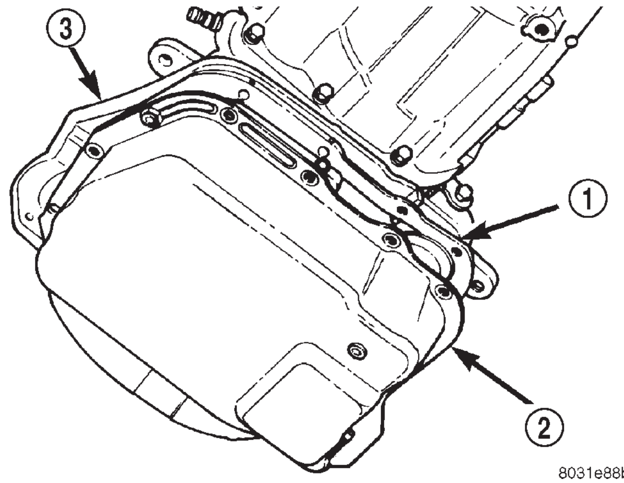


Fig. 89 Transmission Pan - Typical

1 - GASKET
2 - PAN
3 - TRANSMISSION

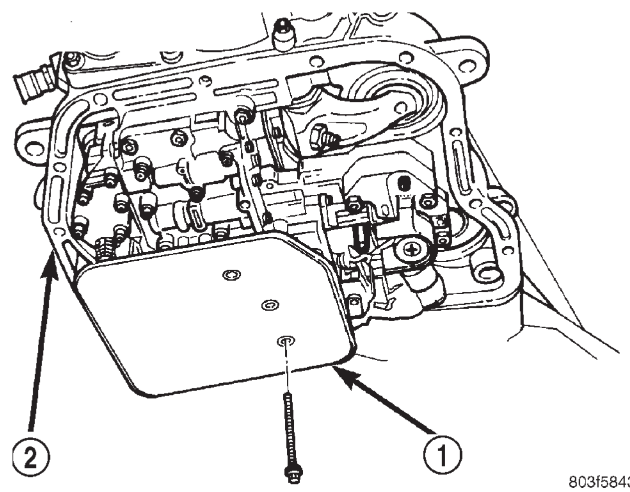


Fig. 90 Transmission Filter - Typical

1 - FILTER
2 - TRANSMISSION

(13) Inspect bottom of pan and magnet for excessive amounts of metal or fiber contamination. A light coating of clutch or band material on the bottom of the pan does not indicate a problem unless accompanied by slipping condition or shift lag. If fluid and pan are contaminated with excessive amounts or debris, refer to the diagnosis section of this group.

(14) Using a suitable solvent, clean pan and magnet.

(15) Using a suitable gasket scraper, clean gasket material from gasket surface of transmission case and the gasket flange around the pan.

FLUID AND FILTER (Continued)

(16) Place replacement filter in position on valve body.

(17) Install screws to hold filter to valve body (Fig. 90). Tighten screws to 4 N·m (35 in. lbs.) torque.

(18) Place new gasket in position on pan. and install pan on transmission.

(19) Place pan in position on transmission.

(20) Install screws to hold pan to transmission (Fig. 89). Tighten bolts to 17 N·m (150 in. lbs.) torque.

(21) Install the transmission/skip plate.

(22) Lower vehicle and fill transmission with Mopar® ATF Plus 4, type 9602 fluid.

FRONT CLUTCH

DESCRIPTION

The front clutch assembly (Fig. 91) is composed of the front clutch retainer, pressure plate, clutch plates, driving discs, piston, piston return spring, return spring retainer, and snap-rings. The front clutch is the forward-most 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.

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.

DISASSEMBLY

(1) Remove waved snap-ring and remove pressure plate, clutch plates and clutch discs (Fig. 92).

(2) Compress clutch piston spring with Compressor Tool C-3575-A (Fig. 93). 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 retainer piston bore and clutch retainer hub. Discard both seals as they are not reusable.

FRONT CLUTCH (Continued)

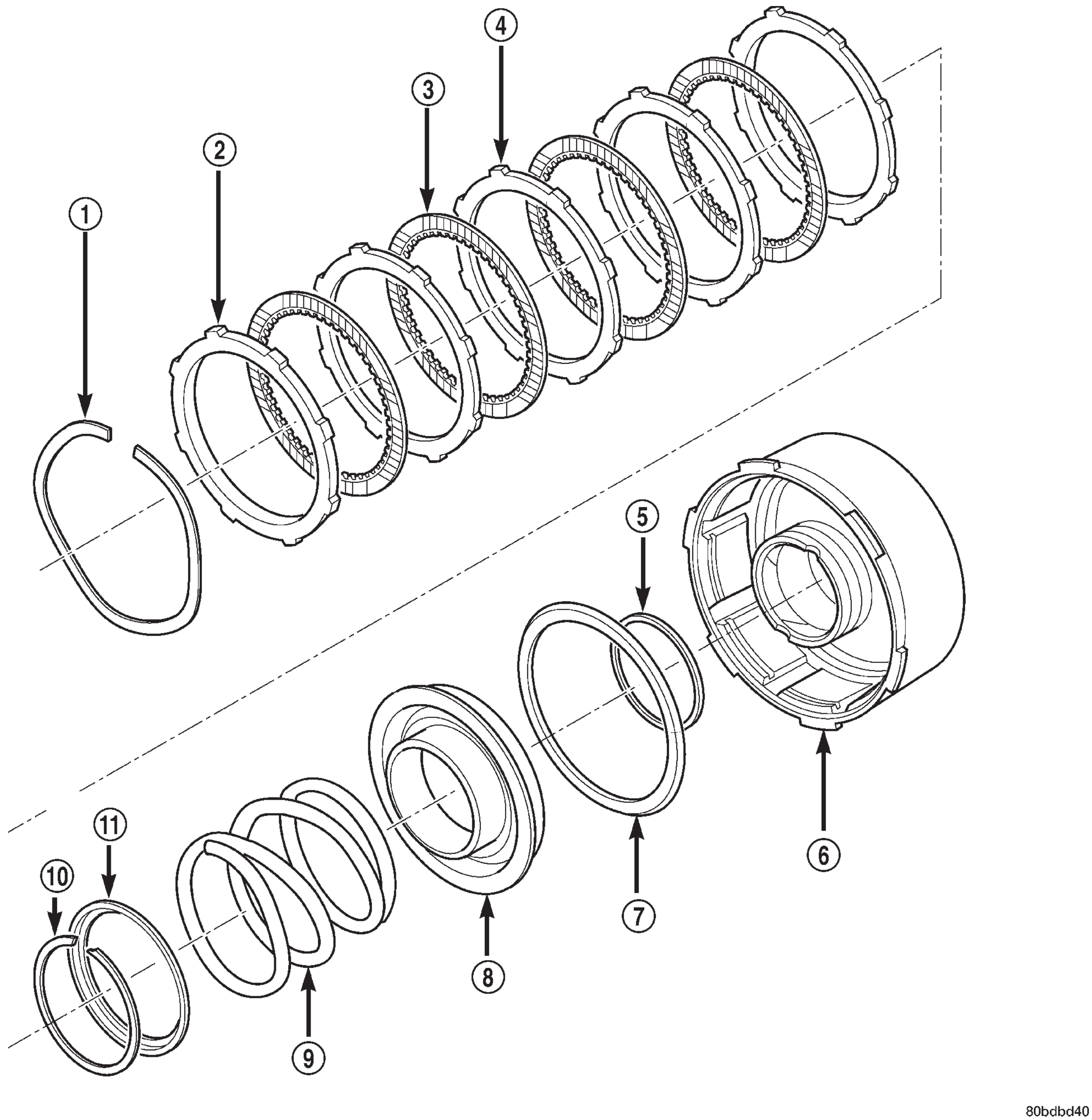


Fig. 91 Front Clutch Components

1 - SNAP-RING (WAVE)
2 - REACTION PLATE
3 - CLUTCH DISC
4 - CLUTCH PLATE
5 - SEAL
6 - CLUTCH RETAINER
7 - SEAL
8 - PISTON
9 - SPRING
10 - SNAP-RING
11 - SPRING RETAINER

FRONT CLUTCH (Continued)

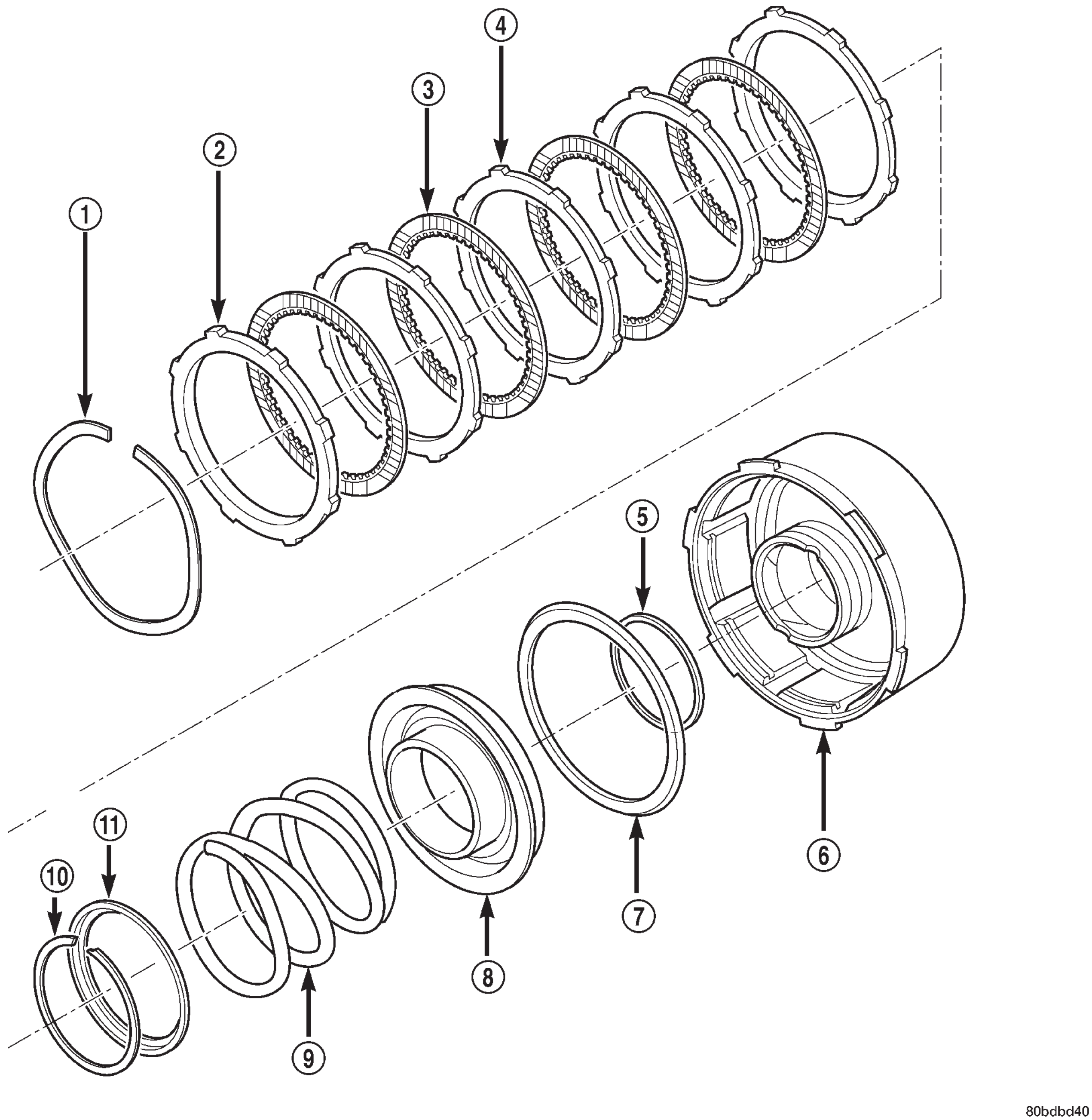


Fig. 92 Front Clutch Components - Typical

1 - SNAP-RING (WAVE)
2 - REACTION PLATE
3 - CLUTCH DISC
4 - CLUTCH PLATE
5 - SEAL
6 - CLUTCH RETAINER
7 - SEAL
8 - PISTON
9 - SPRING
10 - SNAP-RING
11 - SPRING RETAINER

FRONT CLUTCH (Continued)

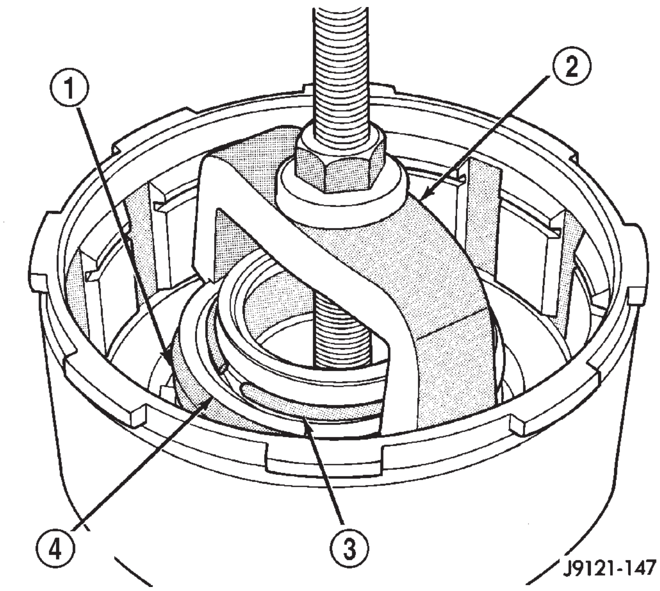


Fig. 93 Compressing Front Clutch Piston Spring

1 - FRONT CLUTCH SPRING
2 - COMPRESSOR TOOL C-3575-A
3 - RETAINER SNAP-RING
4 - SPRING RETAINER

INSPECTION

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. 94). The ball must move freely and not stick.

NOTE: Inspect the clutch retainer bushings carefully (Fig. 95). The retainer bushings are NOT serviceable. It will be necessary to replace the retainer if either bushing is scored, or worn.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

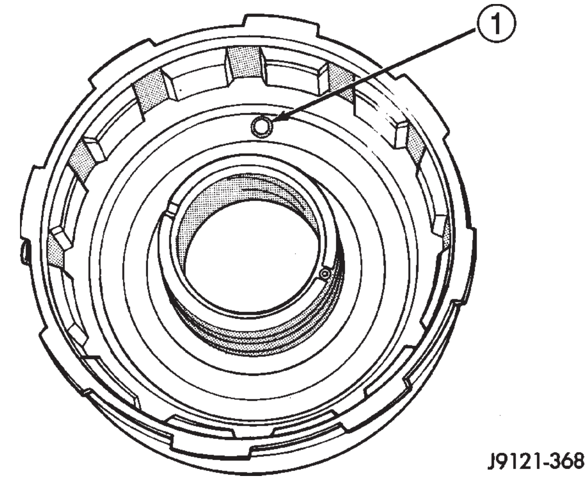


Fig. 94 Front Clutch Piston Retainer Check Ball Location

1 - RETAINER CHECK BALL

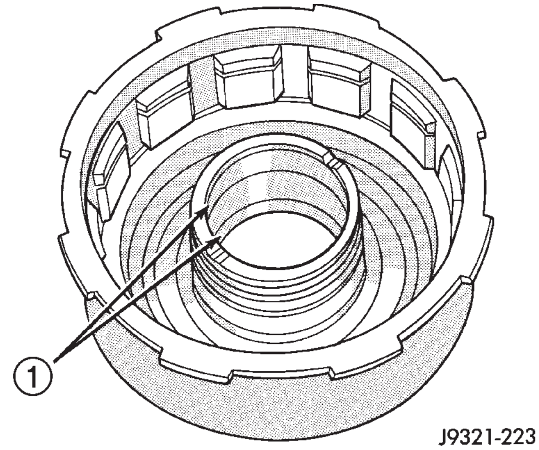


Fig. 95 Retainer Bushing Location/Inspection

1 - FRONT CLUTCH RETAINER BUSHINGS (NON-SERVICEABLE)

ASSEMBLY

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

(2) Install new seals in the clutch retainer lower groove and on the outer diameter of the retainer hub. Be sure lip of each seal faces interior of clutch retainer.

(3) Lubricate lips of the retainer seals with liberal quantity of Mopar® Door Ease. Then lubricate retainer hub, bore, and piston with light coat of transmission fluid.

(4) Install clutch piston in retainer (Fig. 96). Use twisting motion to seat piston in bottom of retainer.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip.

FRONT CLUTCH (Continued)

(5) Position spring in clutch piston (Fig. 97).

(6) Position spring retainer on top of piston spring. Make sure retainer is properly installed (Fig. 92).

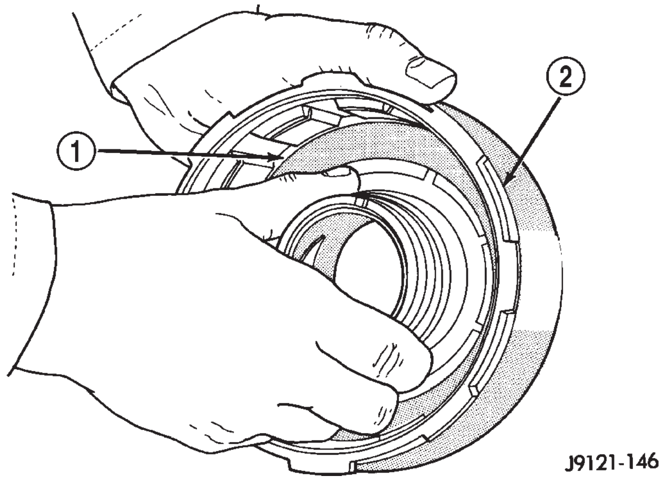


Fig. 96 Front Clutch Piston Installation

1 - CLUTCH PISTON
2 - FRONT CLUTCH RETAINER

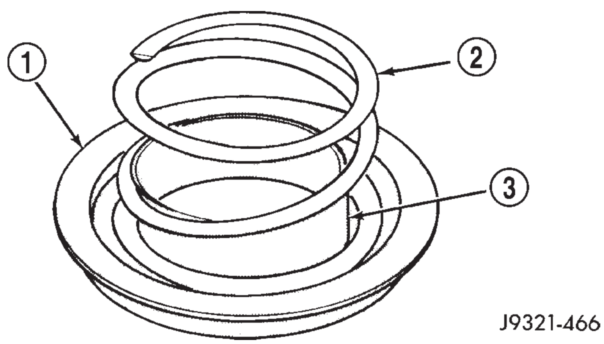


Fig. 97 Clutch Piston Spring Installation

1 - RETAINER
2 - CLUTCH SPRING
3 - PISTON

(7) Compress piston spring and retainer with Compressor Tool C-3575-A (Fig. 93). Then install new snap ring to secure spring retainer and spring.

(8) Install clutch plates and discs. Install steel plate then disc until all plates and discs are installed.

(9) Install pressure plate and waved snap-ring.

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.

FRONT SERVO

DESCRIPTION

The kickdown servo (Fig. 98) 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.

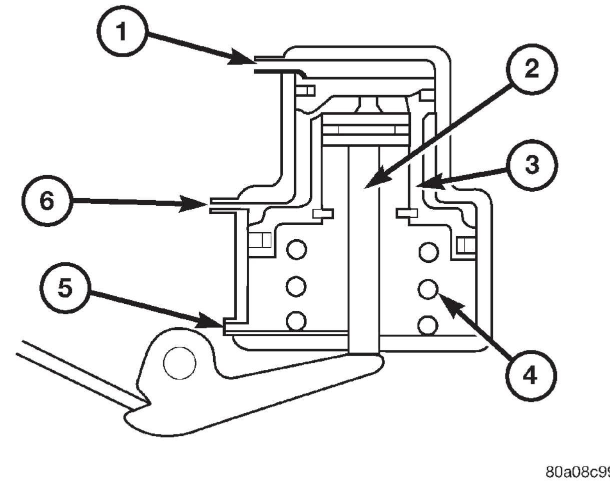


Fig. 98 Front Servo

1 - VENT
2 -PISTON ROD
3 - PISTON
4 - SPRING
5 - RELEASE PRESSURE
6 - APPLY PRESSURE

OPERATION

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.

DISASSEMBLY

(1) Remove seal ring from rod guide (Fig. 99).

FRONT SERVO (Continued)

(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.

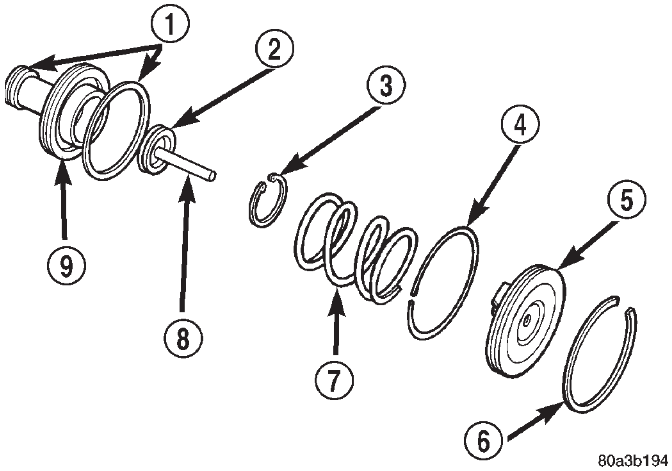


Fig. 99 Front Servo Piston

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

CLEANING

Clean the servo piston components (Fig. 100) 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.

Replace any servo component if doubt exists about condition. Do not reuse suspect parts.

INSPECTION

Inspect the servo components (Fig. 101). 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.

ASSEMBLY

(1) Lubricate new O-ring and seal rings with petroleum jelly and install them on piston, guide and rod.

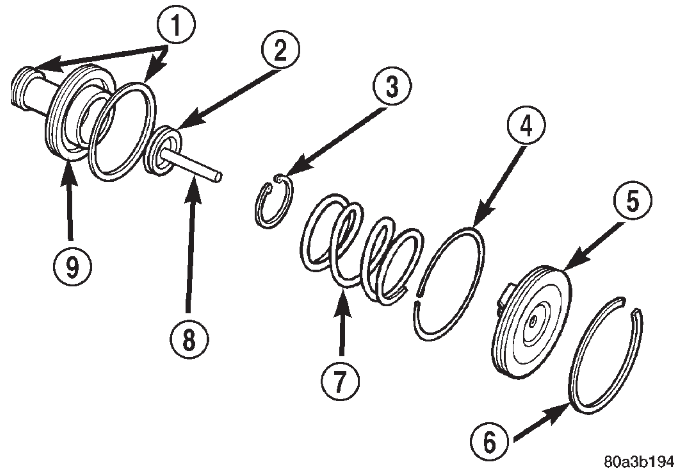


Fig. 100 Front Servo Piston

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

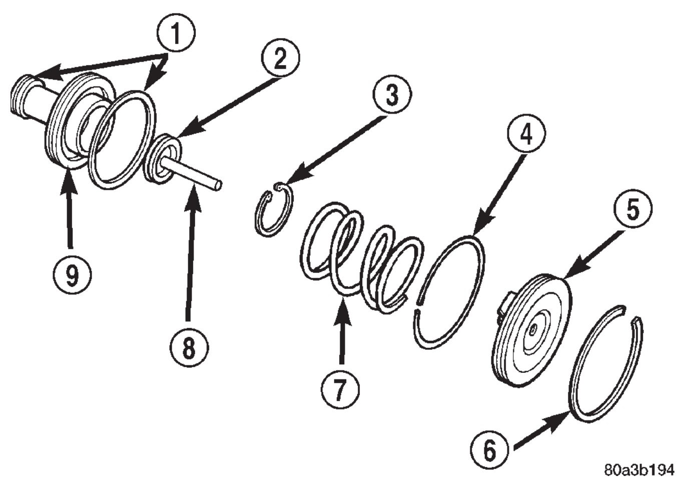


Fig. 101 Front Servo Piston

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

(2) Install rod in piston. Install spring and washer on rod. Compress spring and install snap-ring (Fig. 102).

(3) Set servo components aside for installation during transmission reassembly.

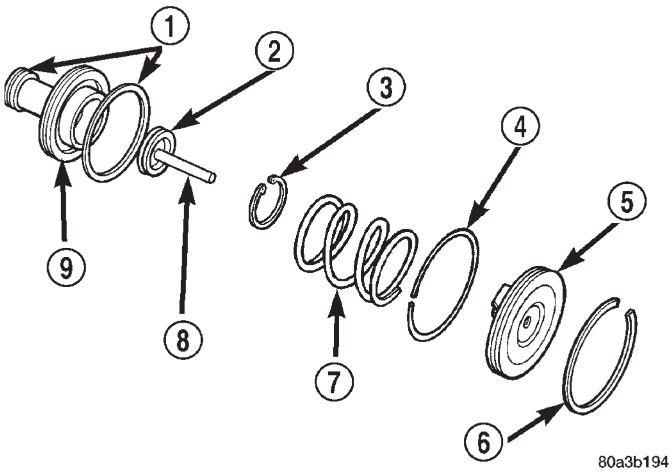


Fig. 102 Front Servo Piston

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

GEARSHIFT CABLE

DIAGNOSIS AND TESTING - 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.

REMOVAL

(1) Shift transmission into PARK.

(2) Remove shift lever bezel and necessary console parts for access to shift lever assembly. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

(3) Disconnect cable at shift lever and feed cable through dash panel opening to underside of vehicle.

(4) Raise vehicle.

(5) Disengage cable eyelet at transmission shift lever and pull cable adjuster out of mounting bracket. Then remove old cable from vehicle.

INSTALLATION

(1) Route cable through hole in dash panel. Fully seat cable grommet into dash panel.

(2) Place the auto transmission manual shift control lever in “PARK” detent (rearmost) position and rotate prop shaft to ensure transmission is in PARK.

(3) Connect shift cable to shifter mechanism by snapping cable retaining ears into shifter bracket and press cable end fitting onto lever ball stud.

(4) Place the floor shifter lever in PARK position. Ensure that the pawl is seated within the confines of the adjustment gauge clip.

(5) Snap the cable into the transmission bracket so the retaining ears are engaged and connect cable end fitting onto the manual control lever ball stud.

(6) Lock shift cable into position by pushing upward on the adjusting lock button.

(7) Remove and discard the shift cable adjustment gauge clip from the park gate of the shifter.

(8) Install any floor console components removed previously. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

ADJUSTMENTS

ADJUSTMENT - 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 transmission range sensor 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. 103).

(5) Slide cable eyelet off transmission shift lever.

GEARSHIFT CABLE (Continued)

(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.

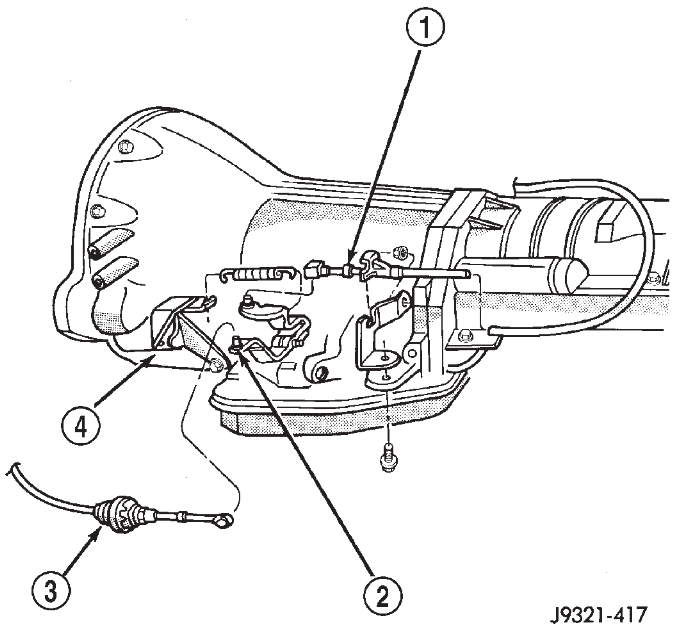


Fig. 103 Shift Cable Attachment At Transmission-Typical

1 - THROTTLE VALVE CABLE
2 - TRANSMISSION SHIFT LEVER
3 - SHIFT CABLE
4 - SHIFT CABLE BRACKET

GOVERNOR AND PARK GEAR

DESCRIPTION

The governor (Fig. 104) valve body is attached to the output shaft of the transmission.

OPERATION

The governor meters hydraulic pressure (Fig. 105), 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. 106), 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. 107), 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.

GOVERNOR AND PARK GEAR (Continued)

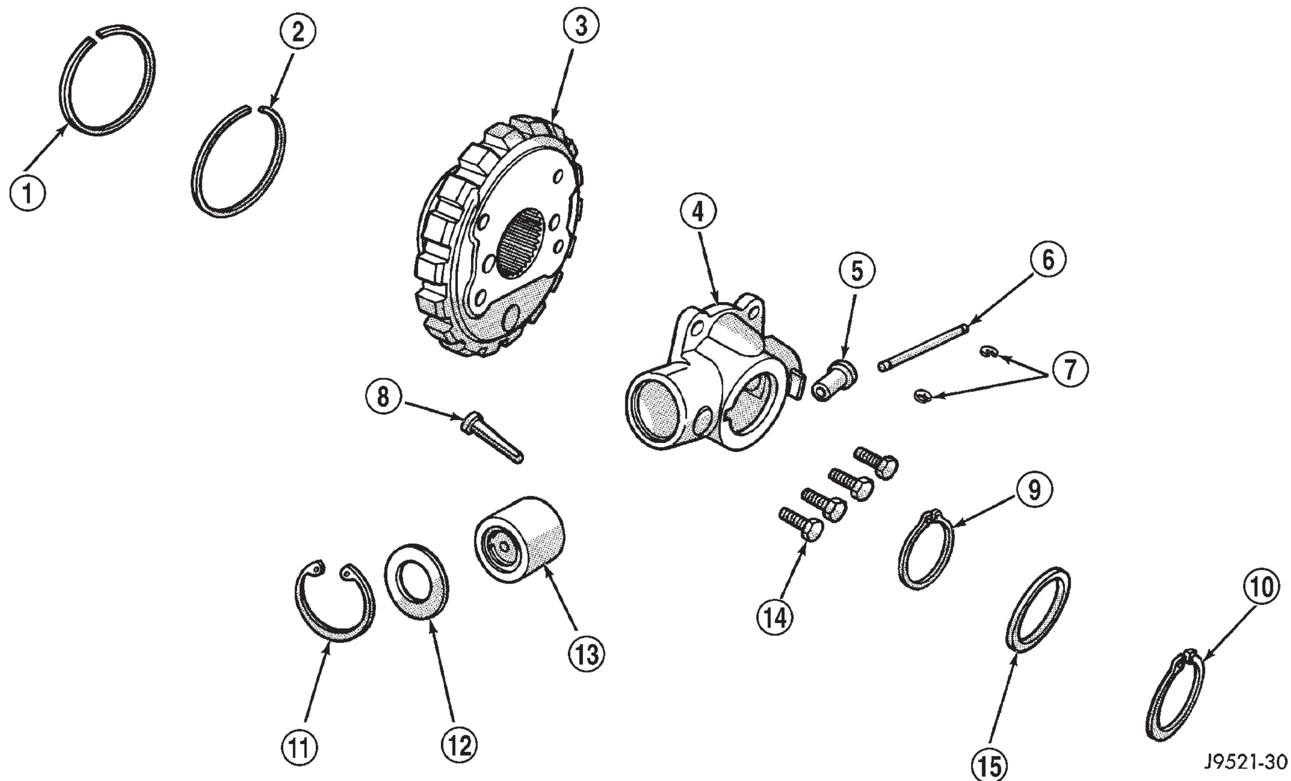


Fig. 104 Governor

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
8 - FILTER
9 - SNAP-RING (THIN)
10 - SNAP-RING (THICK)
11 - SNAP-RING
12 - RETAINER WASHER
13 - GOVERNOR WEIGHT ASSEMBLY
14 - GOVERNOR BODY BOLTS
15 - WASHER

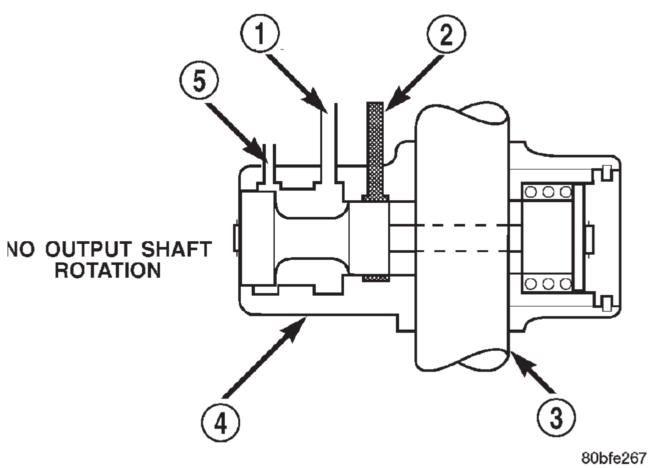


Fig. 105 Governor - No Output Shaft Rotation

1 - GOVERNOR PRESSURE
2 - LINE PRESSURE
3 - OUTPUT SHAFT
4 - GOVERNOR
5 - VENT

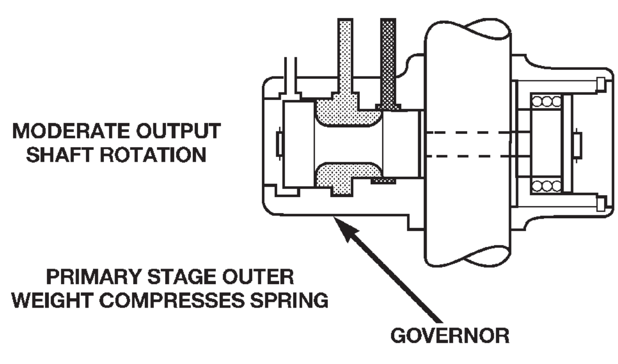


Fig. 106 Governor - Moderate Output Shaft Rotation

GOVERNOR AND PARK GEAR (Continued)

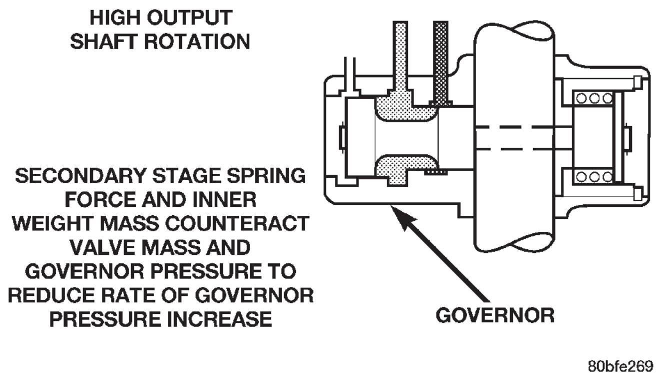


Fig. 107 Governor - High Output Shaft Rotation

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. 108).

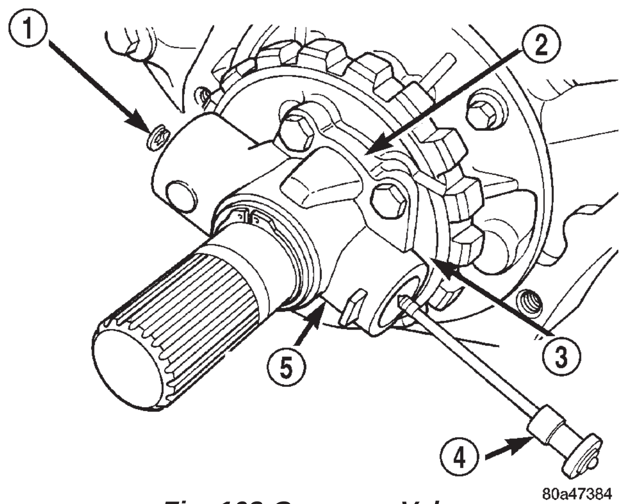


Fig. 108 Governor Valve

1 - E-CLIP
2 - PARK GEAR
3 - CURVER BOSS
4 - GOVERNOR VALVE
5 - GOVERNOR

(10) Remove governor valve and shaft from governor body (Fig. 108).

(11) Remove snap rings and spacer that retain governor body and park gear assembly on output shaft (Fig. 109).

(12) Remove bolts holding governor body to park gear (Fig. 110).

(13) Separate governor from park gear.

(14) Pull park gear from rear support.

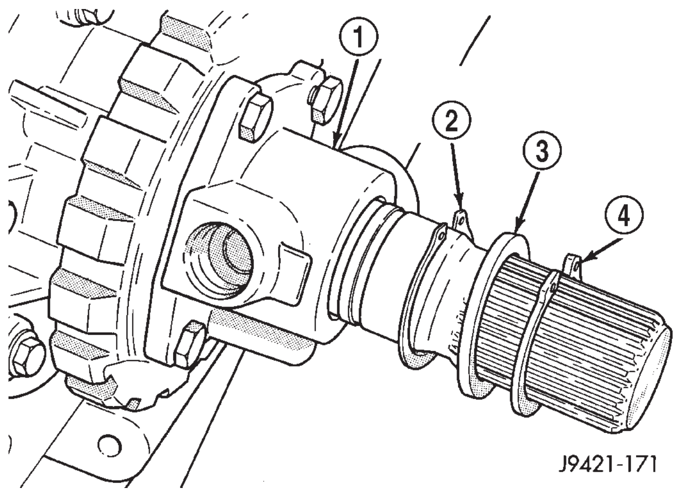


Fig. 109 Snap-Rings And Spacer

1 - GOVERNOR BODY
2 - THIN SNAP-RING
3 - THRUST WASHER
4 - THICK SNAP-RING

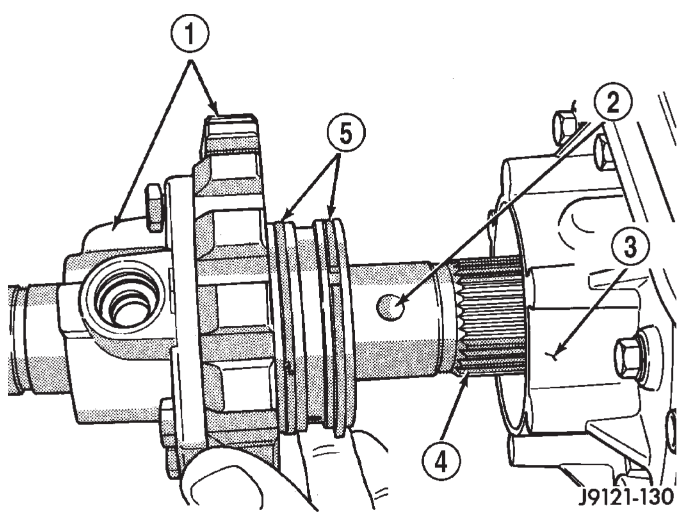


Fig. 110 Governor Body

1 - GOVERNOR/PARK ASSEMBLY
2 - GOVERNOR VALVE SHAFT BORE
3 - REAR SUPPORT
4 - OUTPUT SHAFT SPLINES
5 - SEAL RINGS

GOVERNOR AND PARK GEAR (Continued)

DISASSEMBLY

(1) Remove governor body from transmission.

(2) Clean and inspect governor filter (Fig. 111).

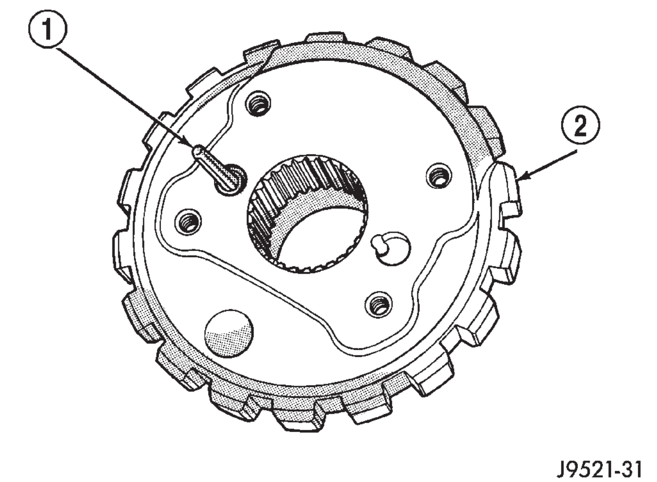


Fig. 111 Governor Filter

1 - GOVERNOR FILTER
2 - PARK GEAR

(3) Remove snap-ring and washer that secure governor weight assembly in body (Fig. 112).

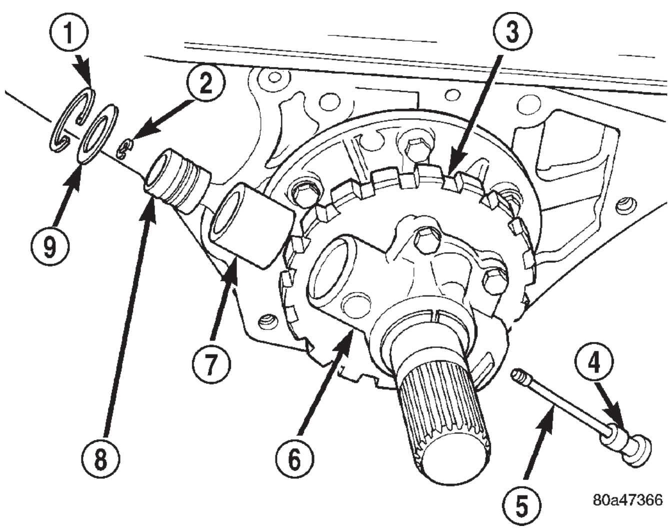


Fig. 112 Snap-Ring, Washer, and Outer Weight

1 - SNAP-RING
2 - E-CLIP
3 - PARK GEAR
4 - GOVERNOR VALVE
5 - SHAFT
6 - GOVERNOR
7 - OUTER WEIGHT
8 - INTERMEDIATE WEIGHT
9 - WASHER

(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. 113).

(7) Push inner weight downward with nut driver. Then remove inner weight snap-ring with Snap-Ring Pliers 6823 (Fig. 113).

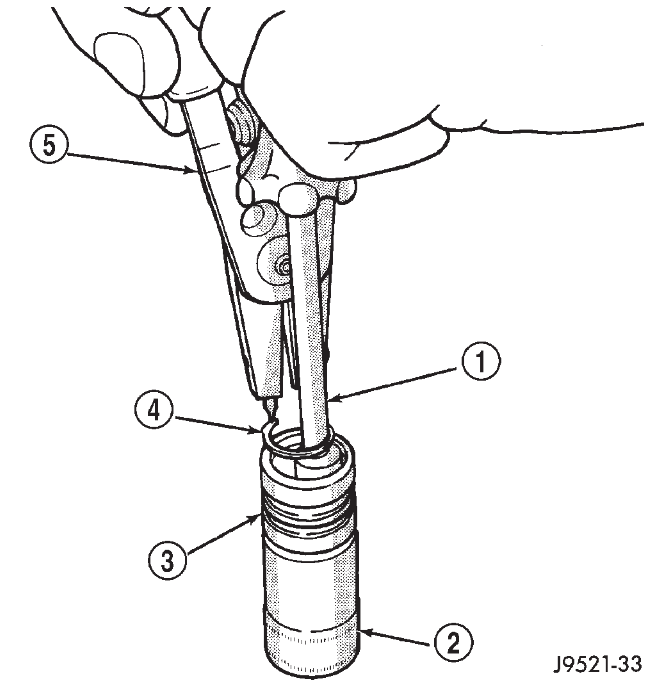


Fig. 113 Inner Weight Snap-Ring

1 - NUT DRIVER
2 - SUITABLE SIZE SOCKET
3 - INTERMEDIATE WEIGHT
4 - INNER WEIGHT SNAP-RING
5 - SPECIAL TOOL 6823

(8) Remove inner weight and spring from intermediate weight (Fig. 114).

CLEANING

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. 115) and the governor valve (Fig. 116), must slide freely in their bores when clean and dry. Minor surface scratches and burrs can be smoothed with crocus cloth.

GOVERNOR AND PARK GEAR (Continued)

INSPECTION

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.

ASSEMBLY

CAUTION: Exercise care when installing the seal 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 +4, Type 9602 transmission fluid before assembly.

(2) Clean and inspect governor weights and bores for scoring or wear. Replace the governor body and weights if damaged.

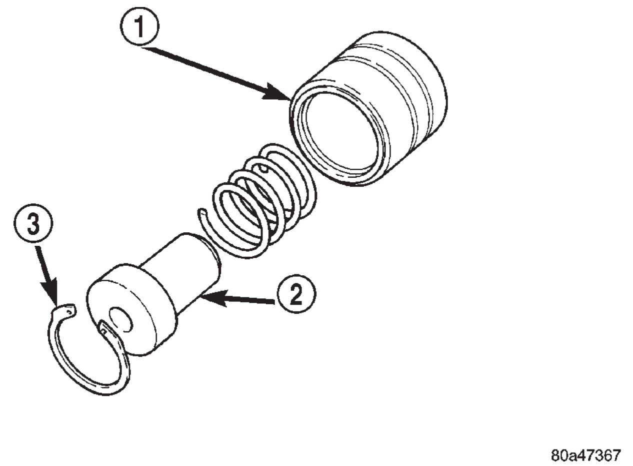


Fig. 114 Intermediate and Inner Governor Weights

1 - INTERMEDIATE WEIGHT
2 - INNER WEIGHT
3 - SNAP-RING

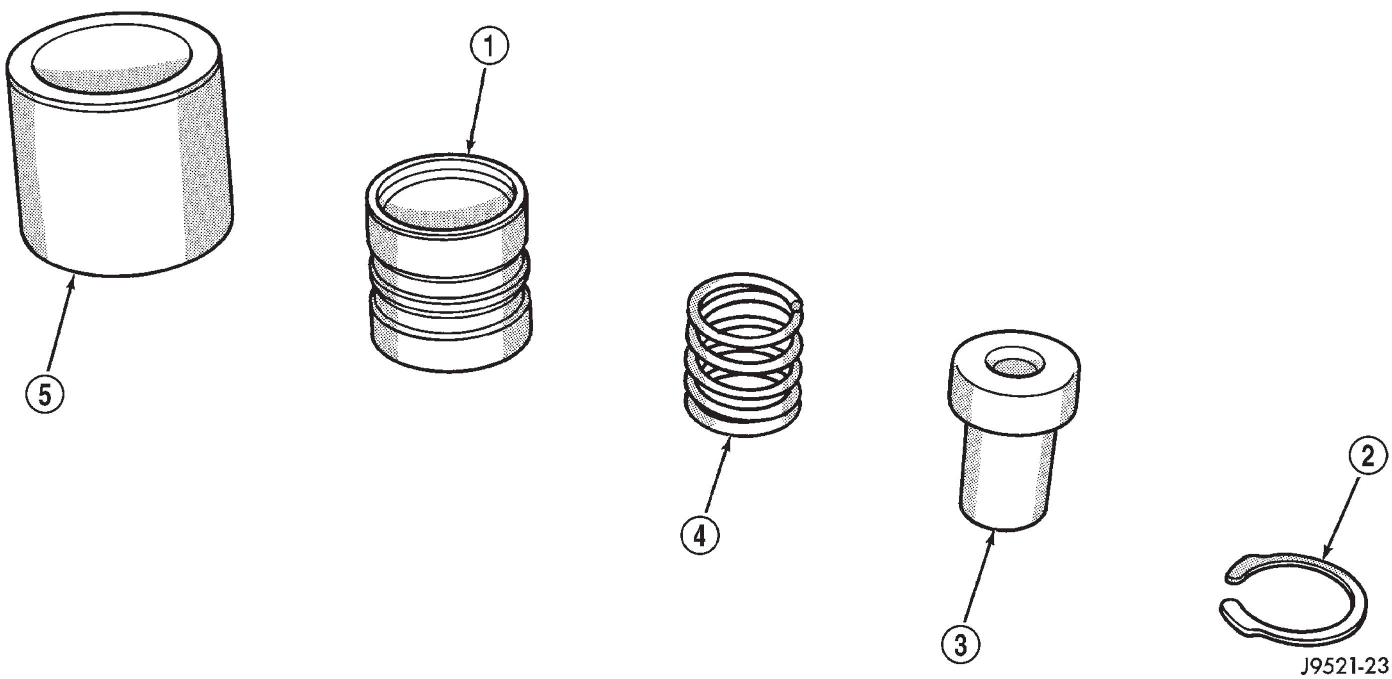


Fig. 115 Governor Weights

1 - INTERMEDIATE WEIGHT
2 - SNAP-RING
3 - INNER WEIGHT
4 - INNER WEIGHT SPRING
5 - OUTER WEIGHT

GOVERNOR AND PARK GEAR (Continued)

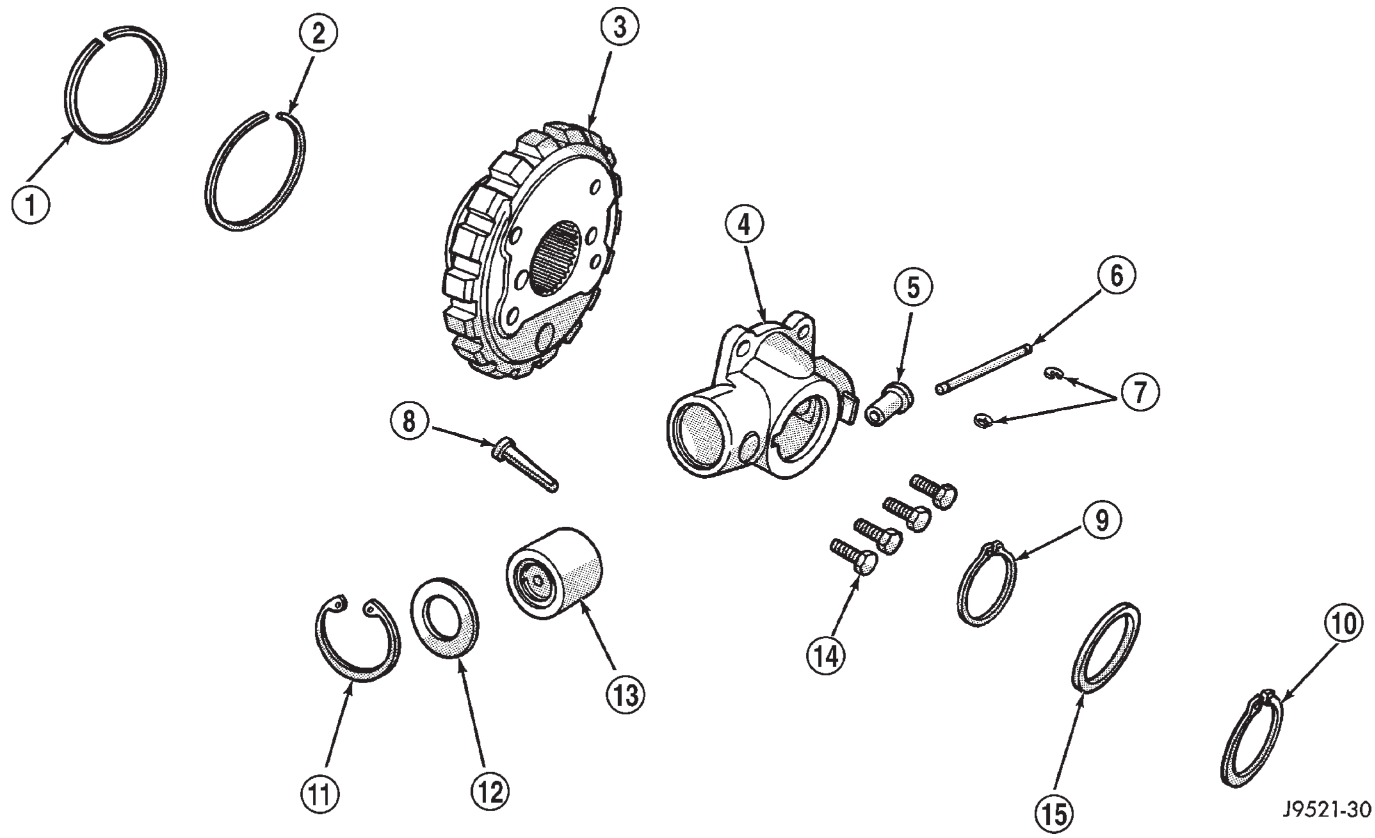


Fig. 116 Governor Components

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
8 - FILTER
9 - SNAP-RING (THIN)
10 - SNAP-RING (THICK)
11 - SNAP-RING
12 - RETAINER WASHER
13 - GOVERNOR WEIGHT ASSEMBLY
14 - GOVERNOR BODY BOLTS
15 - WASHER

(3) Insert spring into intermediate weight.

(4) Insert inner weight into intermediate weight and install snap-ring (Fig. 114). Verify snap-ring is fully seated in groove in intermediate weight (Fig. 113).

(5) Assemble governor weights into governor body (Fig. 112).

(6) Install washer and snap-ring to hold weights in governor body.

(7) Install governor body in transmission

INSTALLATION

(1) Install park gear into rear support so crown on curved boss is in line with hole through output shaft.

(2) Install governor filter in park gear.

(3) Slip governor body over output shaft and align port to filter.

(4) Install bolts to hold governor body to park gear. Tighten bolts to 11 N·m (95 in. lbs.) torque (Fig. 110).

(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. 109).

(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. 108).

(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.

GOVERNOR AND PARK GEAR (Continued)

(13) Check transmission fluid level. Add fluid if necessary.

OIL PUMP

DESCRIPTION

The oil pump (Fig. 117) is located in the pump housing inside the bell housing of the transmission case. The oil pump consists of an inner and outer gear (Fig. 118), a housing, and a cover that also serves as the reaction shaft support.

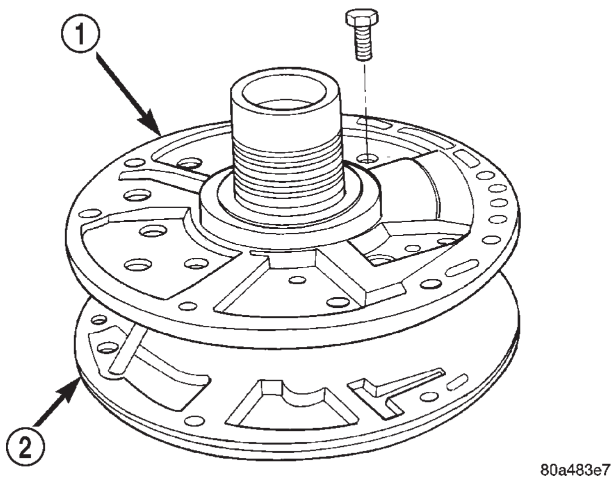


Fig. 117 Oil Pump and Reaction Shaft Support

1 - REACTION SHAFT SUPPORT
2 - PUMP

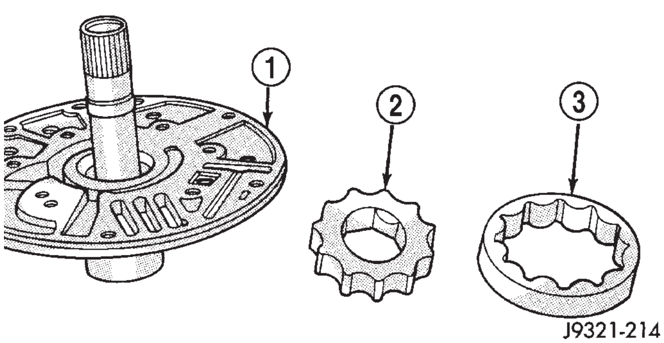


Fig. 118 Pump Gear Removal

1 - REACTION SHAFT SUPPORT
2 - INNER GEAR
3 - OUTER GEAR

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.

STANDARD PROCEDURE - 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 +4, type 9602, 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.

DISASSEMBLY

(1) Remove seal ring from housing and reaction shaft support (Fig. 119).

(2) Mark pump housing and support assembly for alignment reference.

(3) Remove bolts attaching pump body to support (Fig. 120).

(4) Separate support from pump housing (Fig. 121).

(5) Remove inner and outer gears from reaction shaft support (Fig. 122).

(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. 123).

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. 124).

OIL PUMP (Continued)

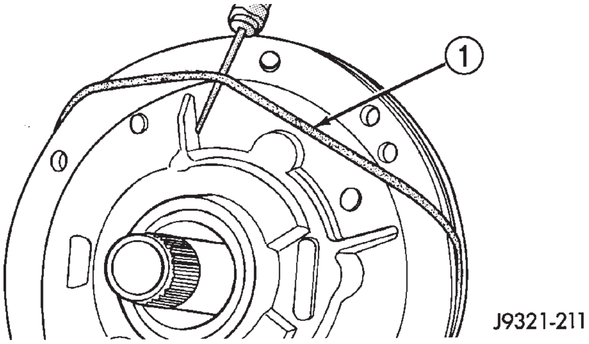


Fig. 119 Removing Pump Seal Ring

1 - PUMP HOUSING SEAL RING

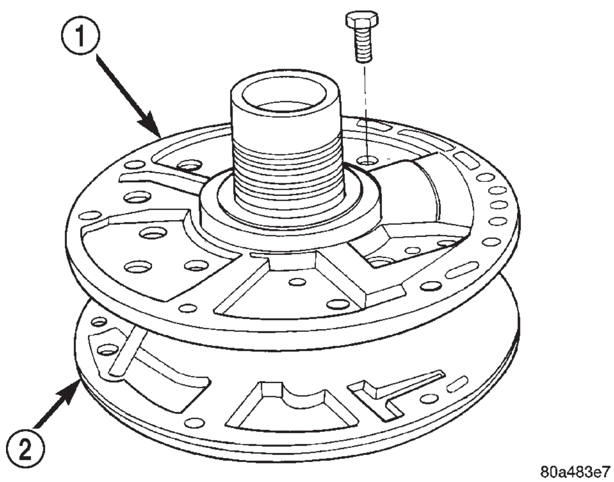


Fig. 120 Pump Support Bolts

1 - REACTION SHAFT SUPPORT
2 - PUMP

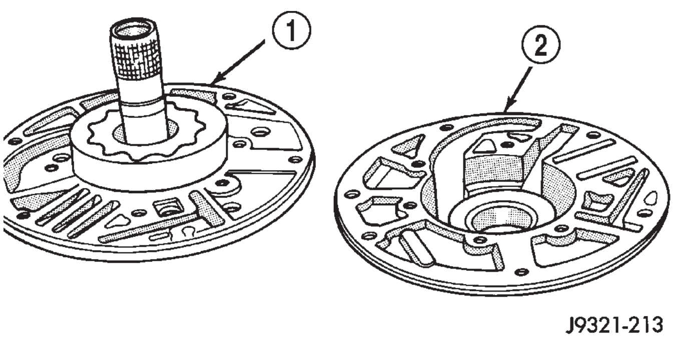


Fig. 121 Separating Pump Housing From Reaction Shaft Support

1 - REACTION SHAFT SUPPORT
2 - PUMP HOUSING

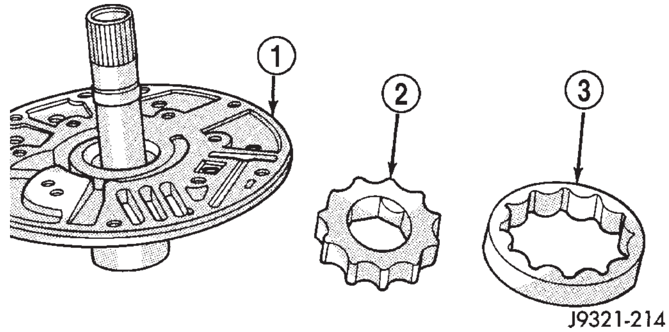


Fig. 122 Pump Gear Removal

1 - REACTION SHAFT SUPPORT
2 - INNER GEAR
3 - OUTER GEAR

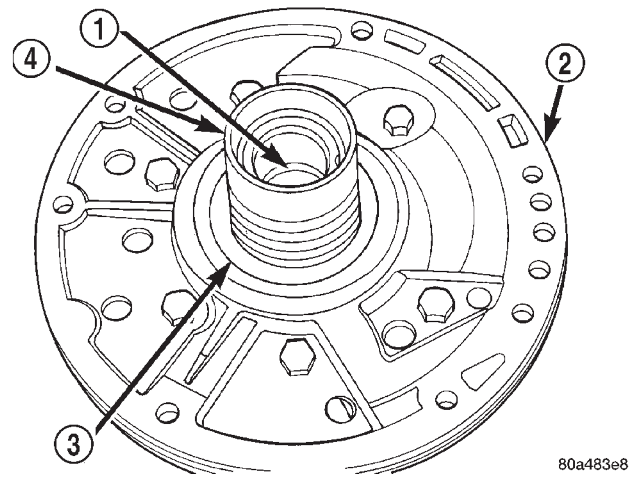


Fig. 123 Support Hub Thrust Washer

1 - BUSHING
2 - REACTION SHAFT SUPPORT
3 - THRUST WASHER
4 - HUB

(2) Install new pump bushing with Tool Handle C-4171 and Bushing Installer SP-5117 (Fig. 124). Bushing should be flush with pump housing bore.

(3) Stake new pump bushing in two places with blunt punch (Fig. 125). Remove burrs from stake points with knife blade afterward.

REACTION SHAFT SUPPORT BUSHING REMOVAL

(1) Assemble Bushing Remover Tools SP-1191, 3633 and 5324 (Fig. 126). Do not clamp any part of reaction shaft or support in vise.

(2) Hold Cup Tool SP-3633 firmly against reaction shaft and thread remover SP-5324 into bushing as far as possible by hand. Then thread remover tool 3-4 additional turns into bushing with a wrench.

(3) Turn remover tool hex nut down against remover cup to pull bushing from shaft. Clean all chips from shaft after bushing removal.

OIL PUMP (Continued)

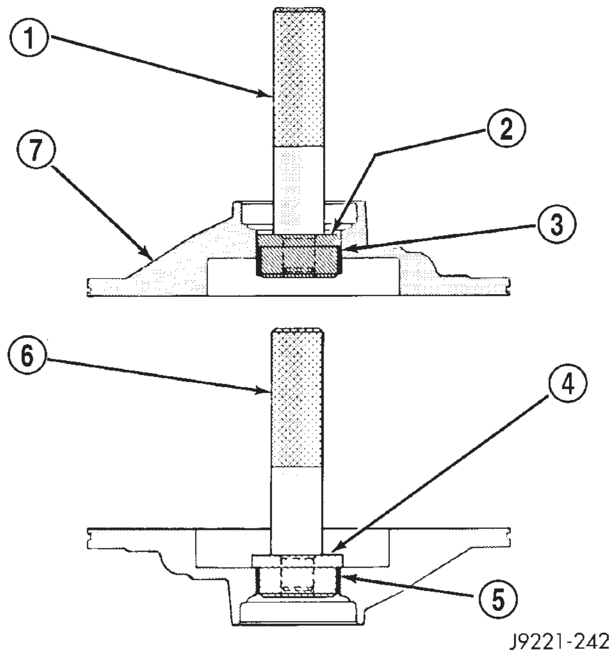


Fig. 124 Removing Oil Pump Bushing

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

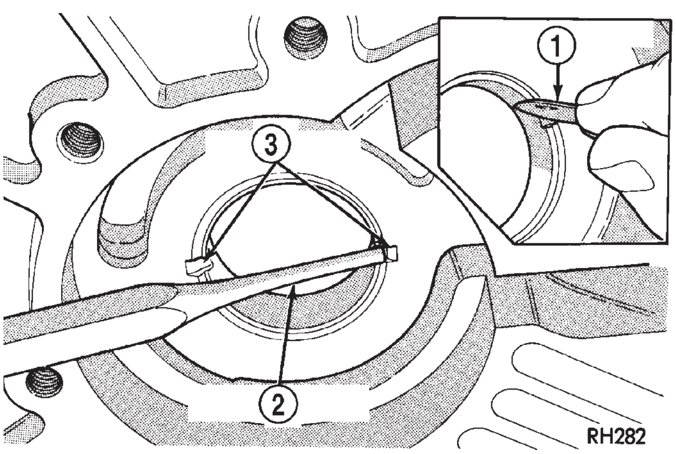


Fig. 125 Staking Oil Pump Bushing

1 - NARROW BLADE
2 - BLUNT PUNCH
3 - TWO STAKES

(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. 126).

(6) Slide new bushing onto Installer Tool SP-5325.

(7) Position reaction shaft support upright on a clean smooth surface.

(8) Align bushing in bore. Then tap bushing into place until Bushing Installer SP-5325 bottoms.

(9) Clean reaction shaft support thoroughly after installing bushing.

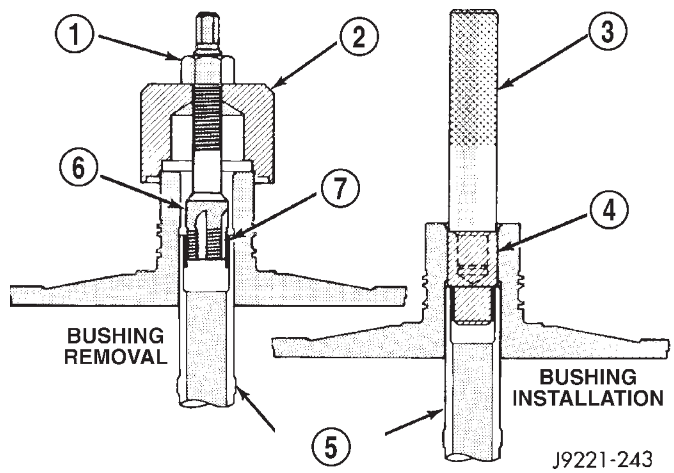


Fig. 126 Replacing Reaction Shaft Support Bushing

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

CLEANING

Clean pump and support components with solvent and dry them with compressed air.

INSPECTION

Check condition of the seal rings and thrust washer on the reaction shaft support. The seal rings do not need to be replaced unless cracked, broken, or severely worn.

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.

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.

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 installing the gears in the

OIL PUMP (Continued)

pump body and measure pump component clearances as follows:

(1) Position an appropriate piece of Plastigage™ across both gears.

(2) Align the plastigage to a flat area on the reaction shaft housing.

(3) Install the reaction shaft to the pump housing.

(4) Separate the reaction shaft housing from the pump housing and measure the Plastigage™ following the instructions supplied with it.

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.

Clearance between outer gear and pump housing should be 0.10 to 0.19 mm (0.004 to 0.0075 in.). Measure clearance with an appropriate feeler gauge.

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. 127).

(4) Install outer gear in pump housing (Fig. 127). Gear can be installed either way (it is not a one-way fit).

(5) Install pump inner gear (Fig. 128).

CAUTION: The pump inner gear is a one way fit. The bore on one side of the gear inside diameter (I.D.) is chamfered. Be sure the chamfered side faces forward (to front of pump).

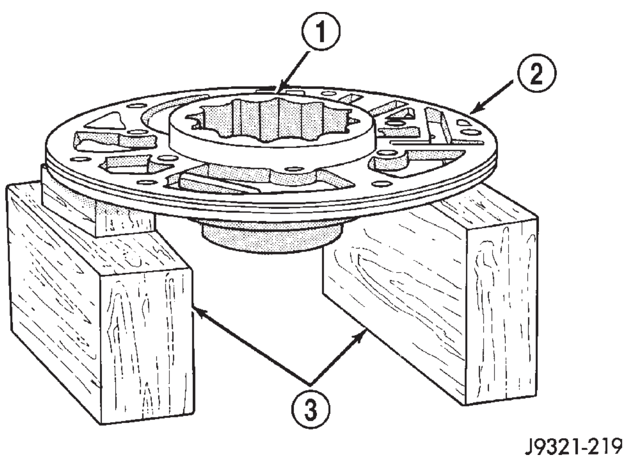


Fig. 127 Supporting Pump And Installing Outer Gear

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.

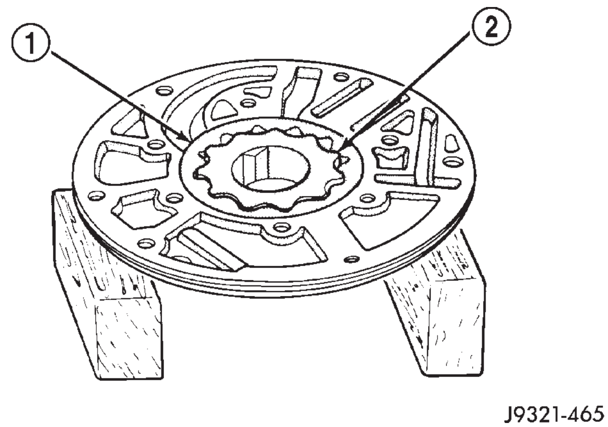


Fig. 128 Pump Inner Gear Installation

1 - OUTER GEAR
2 - INNER GEAR

(7) If reaction shaft seal rings are being replaced, install new seal rings on support hub (Fig. 129). Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

CAUTION: The reaction shaft support seal rings will break if overspread, or twisted. If new rings are being installed, spread them only enough for installation. Also be very sure the ring ends are securely hooked together after installation. Otherwise, the rings will either prevent pump installation, or break during installation.

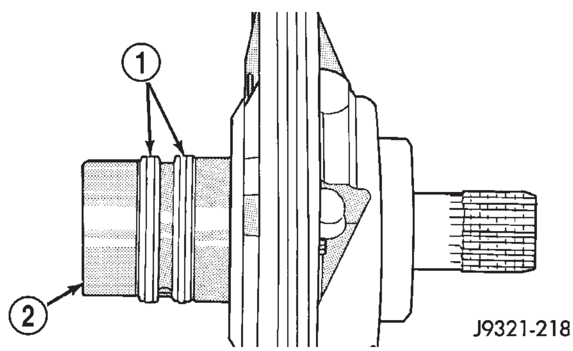


Fig. 129 Hub Seal Ring Position

1 - SEAL RINGS
2 - SUPPORT HUB

(8) Install reaction shaft support on pump housing (Fig. 130).

(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.

OIL PUMP (Continued)

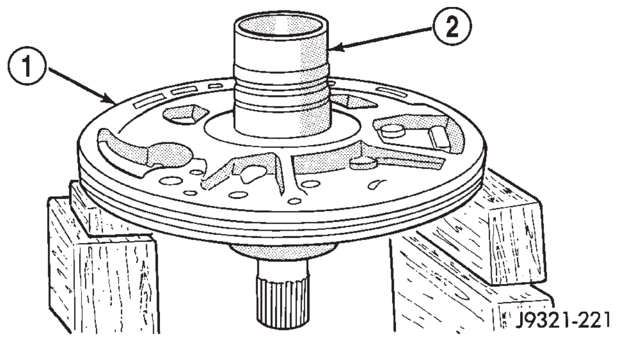


Fig. 130 Assembling Reaction Shaft Support And Pump Housing

1 - PUMP HOUSING
2 - REACTION SHAFT SUPPORT

(11) Tighten support-to-pump bolts to required torque as follows:

(a) Reverse pump assembly and install it in transmission case. Position pump so bolts are facing out and are accessible.

(b) Secure pump assembly in case with 2 or 3 bolts, or with pilot studs.

(c) Tighten support-to-pump bolts to 20 N·m (15 ft. lbs.).

(d) Remove pump assembly from transmission case.

(12) Install new oil seal in pump with Special Tool C-4193 and Tool Handle C-4171 (Fig. 131). 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.

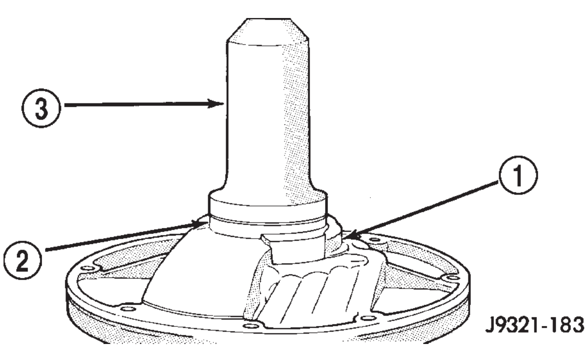


Fig. 131 Pump Oil Seal Installation

1 - PUMP BODY
2 - PUMP SEAL
3 - SPECIAL TOOL C-4193

OVERRUNNING CLUTCH

DESCRIPTION

The overrunning clutch (Fig. 132) 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.

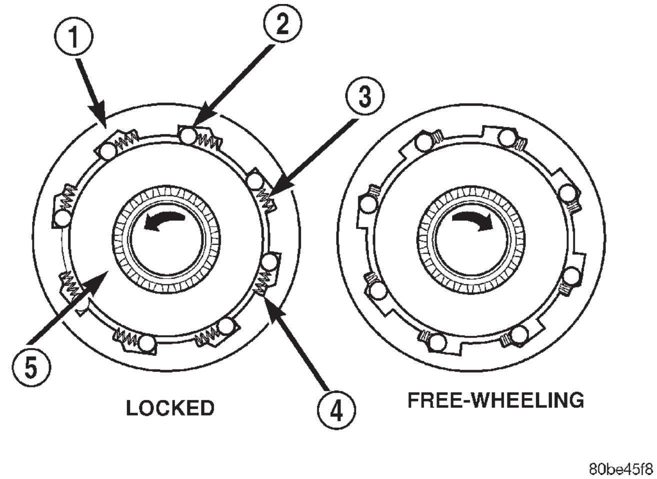


Fig. 132 Overrunning Clutch

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.

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. 133). Rotate the cam back and forth to ease removal if necessary.

OVERRUNNING CLUTCH (Continued)

(2) Remove the clutch roller and spring assembly from the overrunning clutch race.

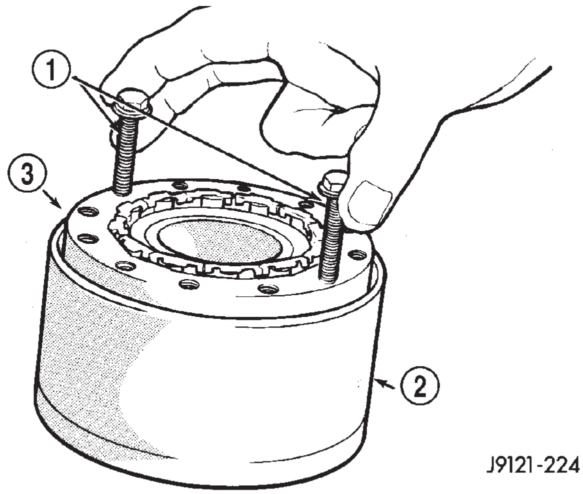


Fig. 133 Removing Overrunning Clutch From Low-Reverse Drum

1 - CAM BOLTS
2 - LOW-REVERSE DRUM
3 - OVERRUNNING CLUTCH AND CAM

CLEANING

Clean the overrunning clutch assembly, clutch cam, low-reverse drum, and overdrive piston retainer in solvent. Dry them with compressed air after cleaning.

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.**

INSPECTION

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.

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.

ASSEMBLY

(1) Assemble clutch rollers and springs in retainer if necessary (Fig. 134).

(2) Install overrunning clutch roller, spring and retainer assembly in clutch cam (Fig. 135).

(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. 136).

(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 (Fig. 137). **Drum should rotate freely in clockwise direction and lock when turned in counterclockwise direction (as viewed from front of case)**.

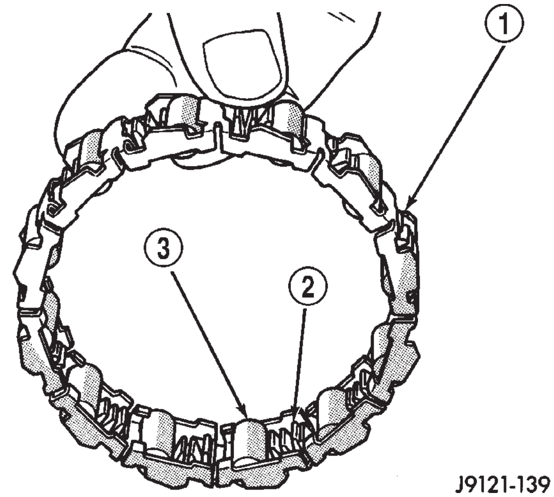


Fig. 134 Overrunning Clutch Rollers, Springs, Retainer

1 - RETAINER
2 - SPRING
3 - ROLLER

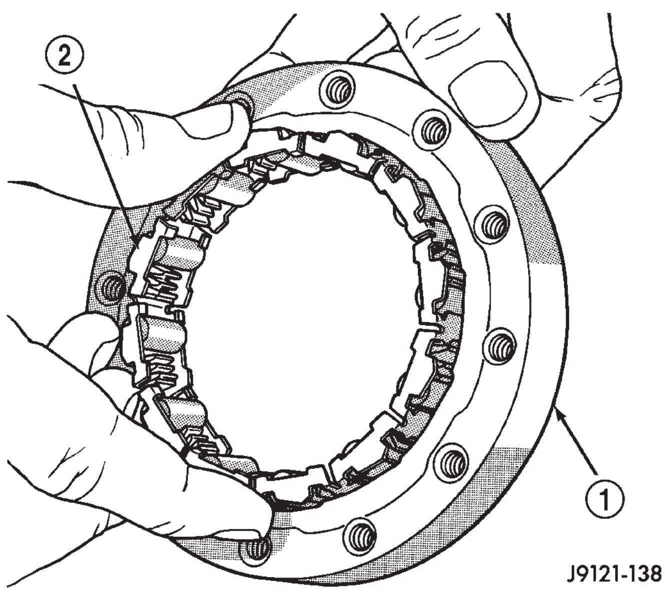


Fig. 135 Assembling Overrunning Clutch And Cam

1 - CLUTCH CAM
2 - CLUTCH ROLL ASSEMBLY

OVERRUNNING CLUTCH (Continued)

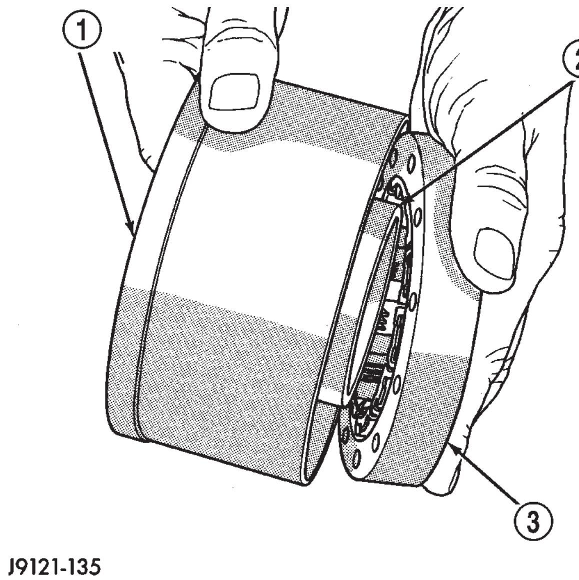


Fig. 136 Temporary Assembly Of Clutch And Drum To Check Operation

1 - LOW-REVERSE DRUM
2 - CLUTCH RACE (ON HUB OF DRUM)
3 - OVERRUNNING CLUTCH

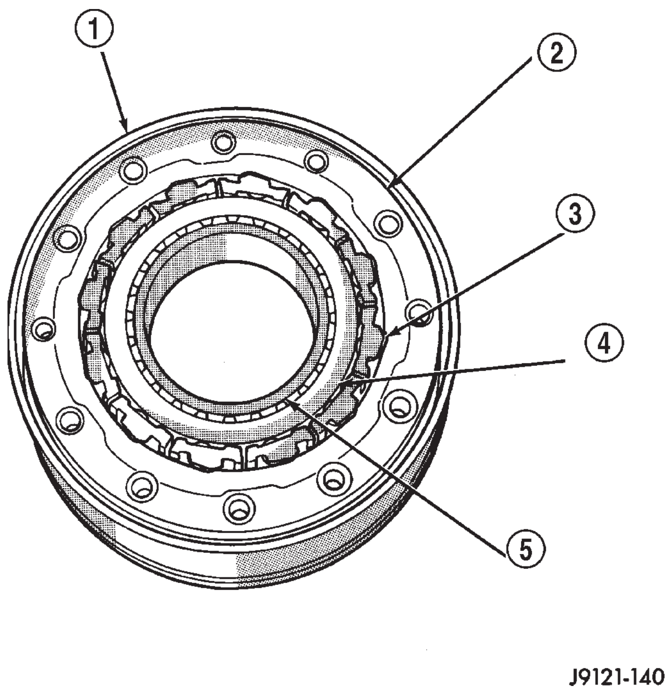


Fig. 137 Assembled Overrunning Clutch

1 - LOW-REVERSE DRUM
2 - OVERRUNNING CLUTCH CAM
3 - ROLLER AND SPRING ASSEMBLY
4 - CLUTCH RACE
5 - HUB OF LOW-REVERSE DRUM

PARK/NEUTRAL POSITION SWITCH

DESCRIPTION

The park/neutral position switch (Fig. 138) is threaded into the side of the transmission case, just above the transmission oil pan mounting surface. 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.

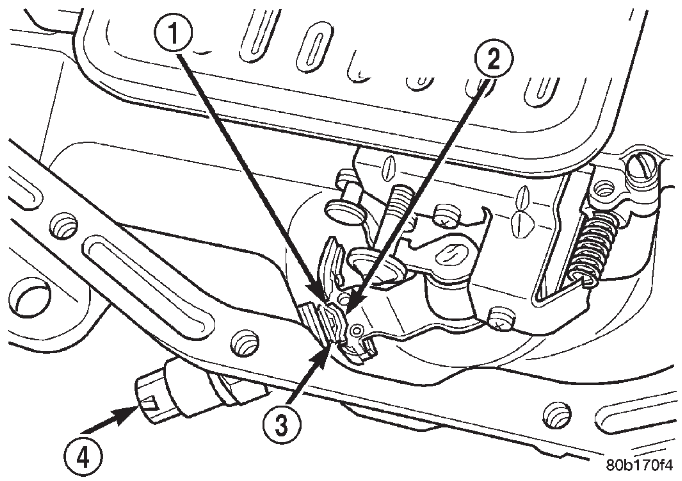


Fig. 138 Park/Neutral Position Switch

1 - NEUTRAL CONTACT
2 - MANUAL LEVER AND SWITCH PLUNGER IN REVERSE POSITION
3 - PARK CONTACT
4 - SWITCH

OPERATION

The park/netral position switch is operated by the manual lever of the valve body. When the valve body is in the PARK or NEUTRAL positions, the center terminal of the park/neutral position switch is grounded to the transmission case through the manual lever.

When the valve body is in the REVERSE position, the manual lever depresses the park/neutral position switch and connects the outer two terminals of the switch to provide continuity for the back-up lamp circuit.

DIAGNOSIS AND TESTING - 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.

PARK/NEUTRAL POSITION SWITCH (Continued)

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.

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. 139).

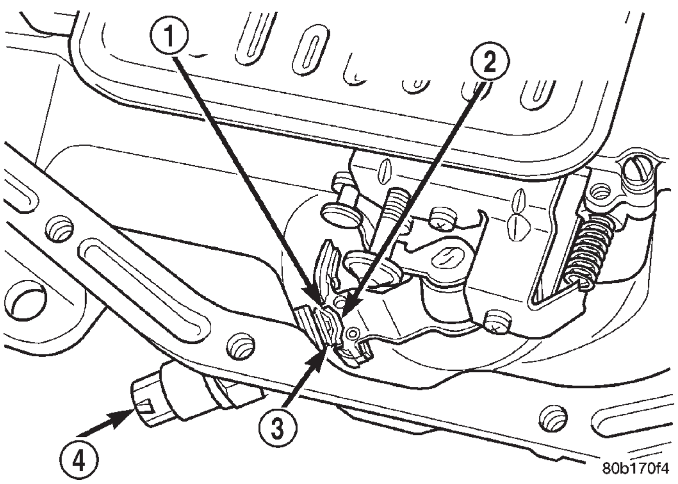


Fig. 139 Park/Neutral Position Switch

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.

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. 140).
(4) Remove snap-ring and slide reaction plug and pin assembly out of housing.
(5) If park rod requires service, it will be necessary to remove valve body.

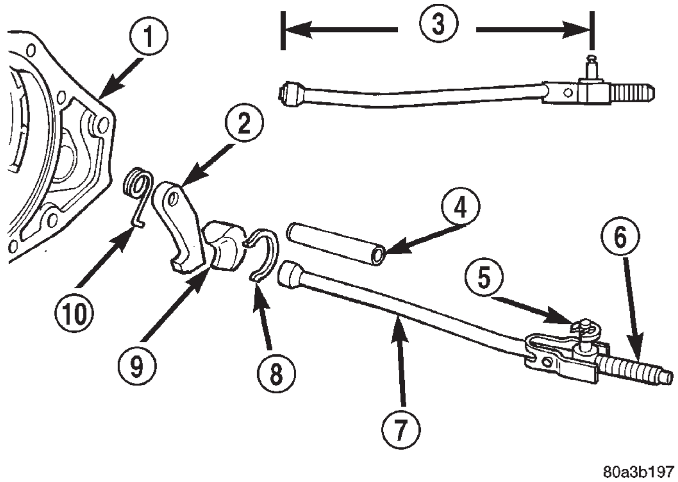


Fig. 140 Park Lock

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

CLEANING

Clean the park lock components in solvent and dry them with compressed air.

INSPECTION

Examine the park lock components in the housing. If replacement is necessary, remove the shaft with parallel jaw snap-ring pliers (Fig. 141) and remove the sprag and spring. Then remove the spring clip and reaction plug (Fig. 142). **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. 143). Also be sure the spring is correctly positioned as

PARK LOCK (Continued)

shown (Fig. 143). The sprag may not retract if the spring is improperly installed.

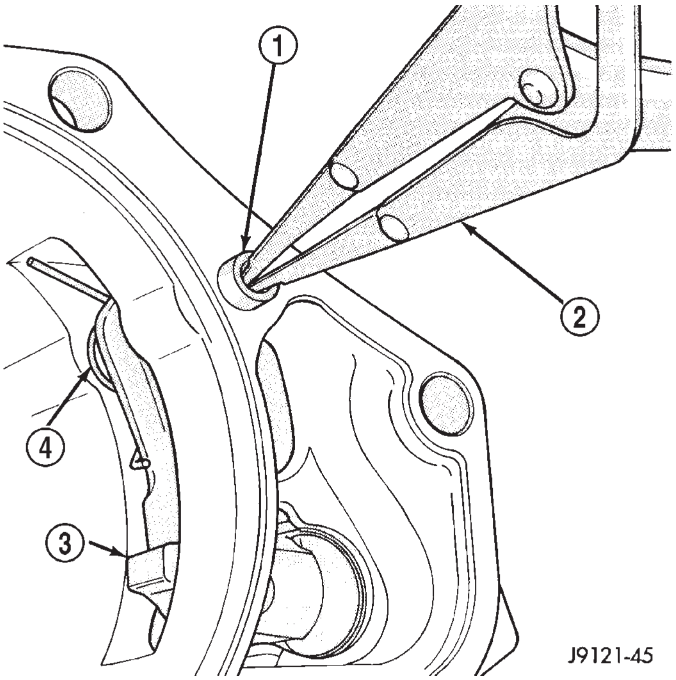


Fig. 141 Park Sprag, Shaft And Spring

1 - SPRAG SHAFT
2 - PARALLEL JAW SNAP-RING PLIERS
3 - SPRAG
4 - SPRING

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. 140).

(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.

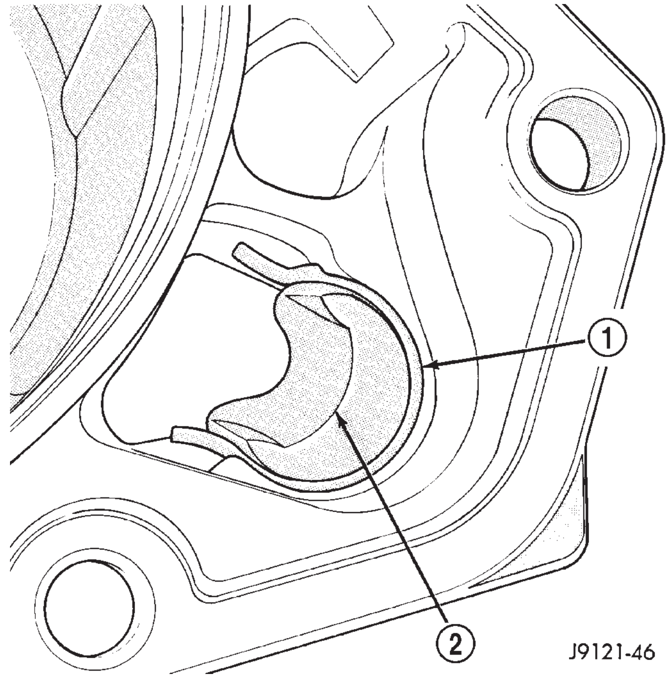


Fig. 142 Park Sprag Reaction Plug And Spring Location

1 - SPRING CLIP
2 - REACTION PLUG

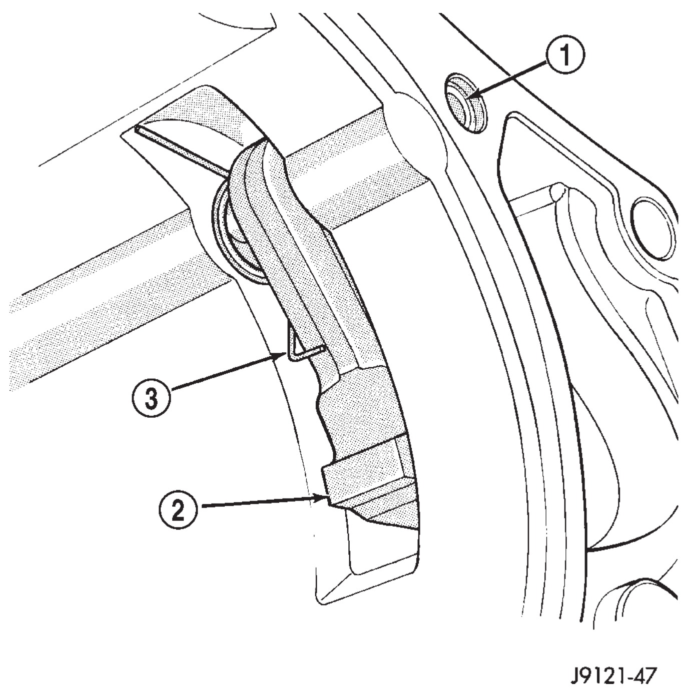


Fig. 143 Correct Position Of Sprag And Spring

1 - SPRAG SHAFT
2 - SPRAG LOCKING LUG
3 - SPRING

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. 144) 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.

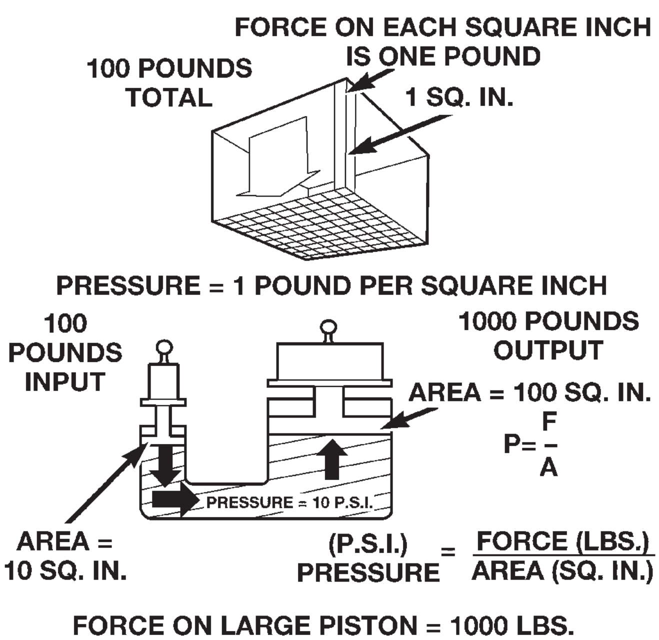


Fig. 144 Force and Pressure Relationship

PRESSURE ON A CONFINED FLUID

Pressure is exerted on a confined fluid (Fig. 145) 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 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.

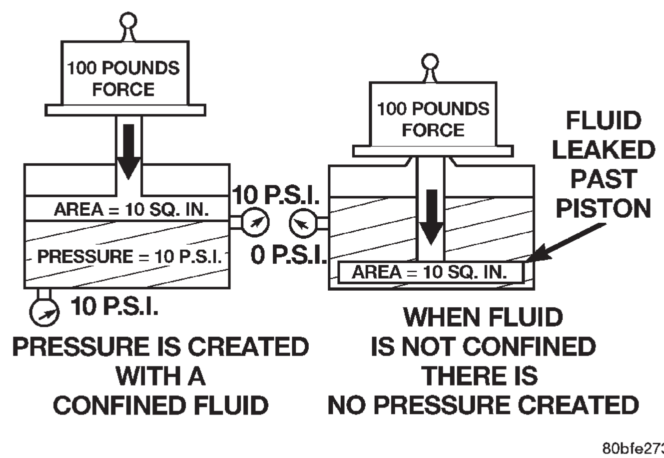


Fig. 145 Pressure on a Confined Fluid

FORCE MULTIPLICATION

Using the 10 PSI example used in the illustration (Fig. 146), 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. 146), 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

PISTONS (Continued)

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.

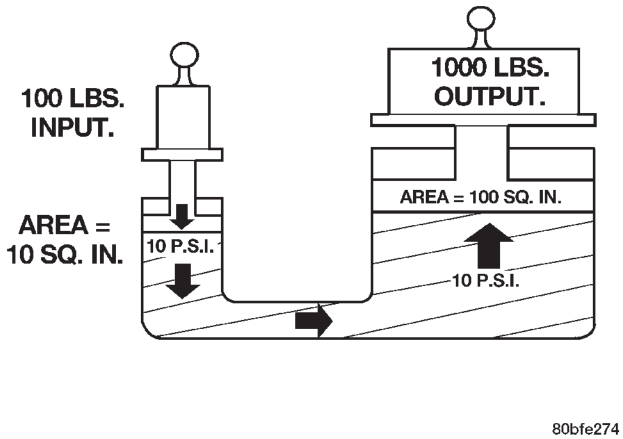


Fig. 146 Force Multiplication

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. 147) has to move ten times the distance required 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.

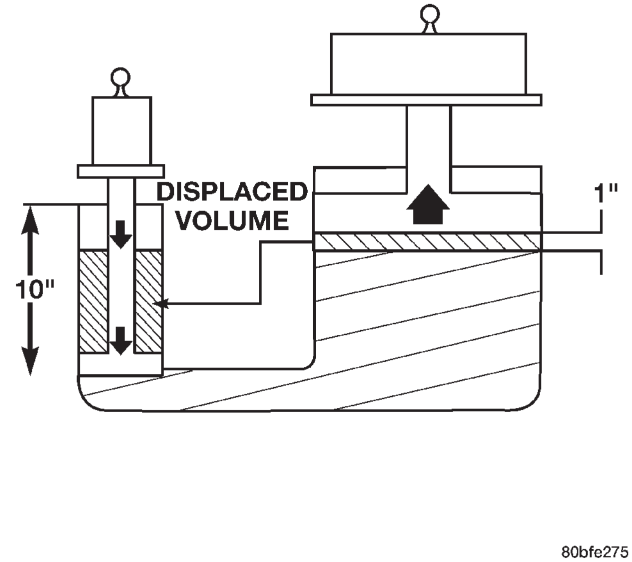


Fig. 147 Piston Travel

PLANETARY GEARTRAIN/ OUTPUT SHAFT

DESCRIPTION

The planetary gearsets (Fig. 148) are designated as the front and rear planetary gear assemblies and located in such order. A simple planetary gearset consists of three main members:

- 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.

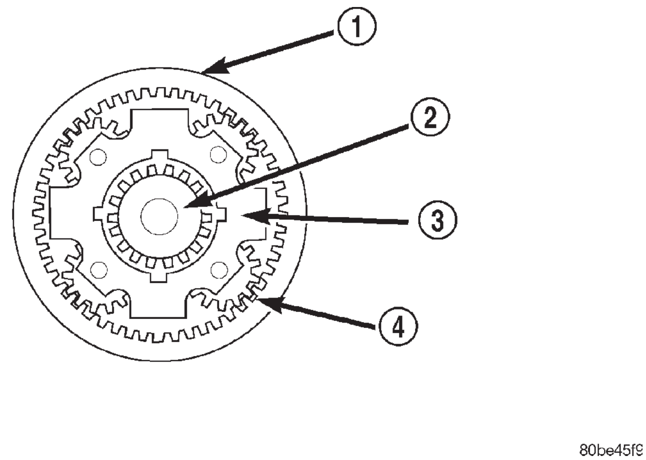


Fig. 148 Planetary Gearset

1 - ANNULUS GEAR
2 - SUN GEAR
3 - PLANET CARRIER
4 - PLANET PINIONS (4)

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.

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

• 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.

DISASSEMBLY

(1) Remove planetary snap-ring (Fig. 149).

(2) Remove front annulus and planetary assembly from driving shell (Fig. 149).

(3) Remove snap-ring that retains front planetary gear in annulus gear (Fig. 150).

(4) Remove tabbed thrust washer and tabbed thrust plate from hub of front annulus (Fig. 151).

(5) Separate front annulus and planetary gears (Fig. 151).

(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. 152).

(8) Remove front planetary rear thrust washer from driving shell.

(9) Remove tabbed thrust washers from rear planetary gear.

(10) Remove lock ring that retains sun gear in driving shell. Then remove sun gear, spacer and thrust plates.

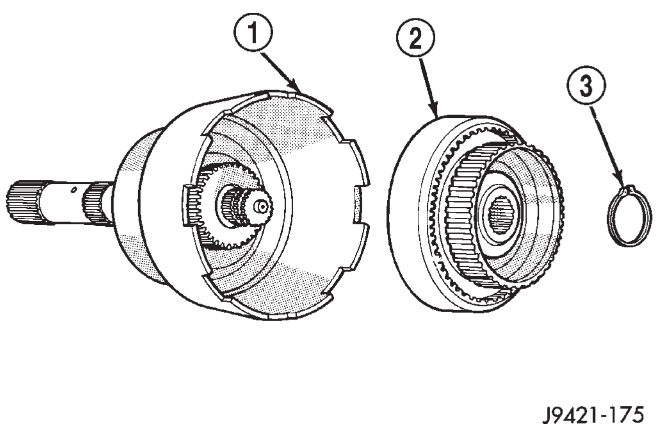


Fig. 149 Front Annulus And Planetary Assembly Removal

1 - DRIVING SHELL
2 - FRONT ANNULUS AND PLANETARY ASSEMBLY
3 - PLANETARY SNAP-RING

CLEANING

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.

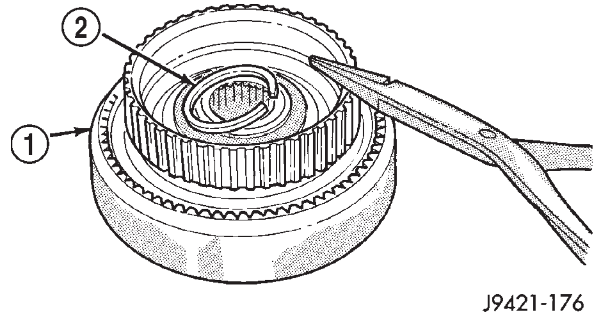


Fig. 150 Front Planetary Snap-Ring Removal

1 - FRONT ANNULUS GEAR
2 - PLANETARY SNAP-RING

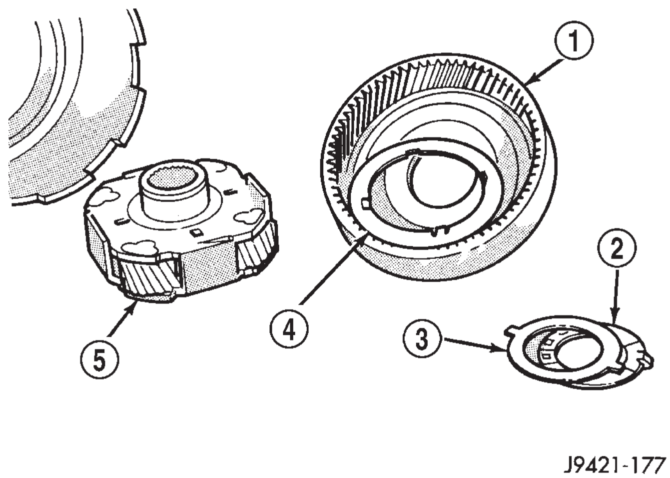


Fig. 151 Front Planetary And Annulus Gear Disassembly

1 - FRONT ANNULUS
2 - THRUST WASHER
3 - THRUST PLATE
4 - FRONT THRUST WASHER
5 - FRONT PLANETARY

INSPECTION

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

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

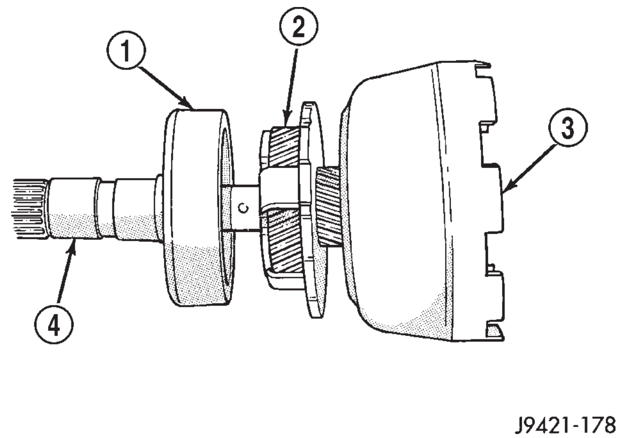


Fig. 152 Removing Driving Shell, Rear Planetary And Rear Annulus

1 - REAR ANNULUS
2 - REAR PLANETARY
3 - DRIVING SHELL
4 - OUTPUT SHAFT

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.

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. 153).

(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. 153).

(5) Install assembled rear planetary and annulus gear on output shaft (Fig. 154). Verify that assembly is fully seated on shaft.

(6) Install front thrust washer on rear planetary gear (Fig. 155). 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. 156).

(8) Install thrust plate on sun gear (Fig. 157). Note that driving shell thrust plates are interchangeable. Use either plate on sun gear and at front/rear of shell.

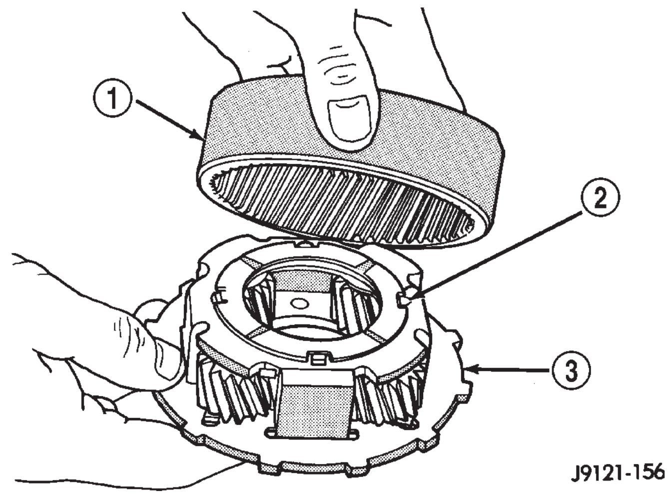


Fig. 153 Assembling Rear Annulus And Planetary Gear

1 - REAR ANNULUS GEAR
2 - TABBED THRUST WASHER
3 - REAR PLANETARY

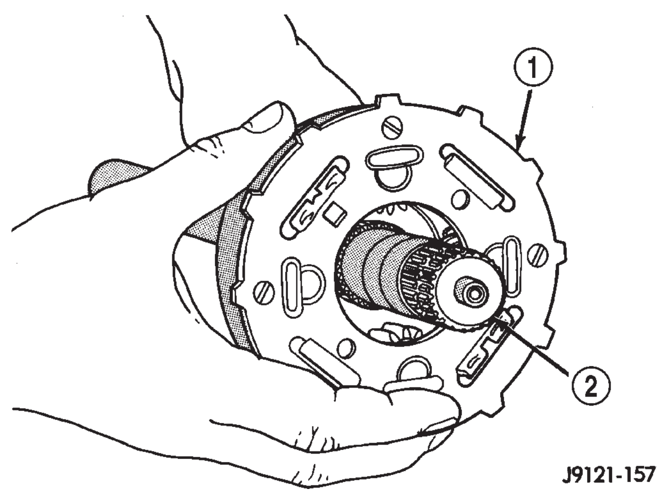


Fig. 154 Installing Rear Annulus And Planetary On Output Shaft

1 - REAR ANNULUS AND PLANETARY GEAR ASSEMBLY
2 - OUTPUT SHAFT

(9) Hold sun gear in place and install thrust plate over sun gear at rear of driving shell (Fig. 158).

(10) Position wood block on bench and support sun gear on block (Fig. 159). 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.

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

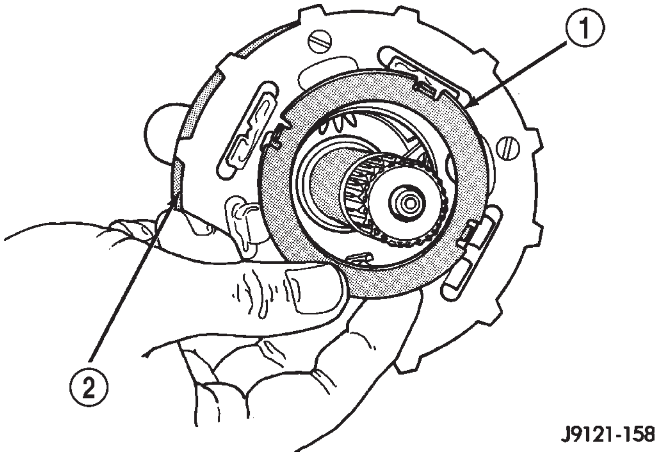


Fig. 155 Installing Rear Planetary Front Thrust Washer

1 - FRONT TABBED THRUST WASHER
2 - REAR PLANETARY GEAR

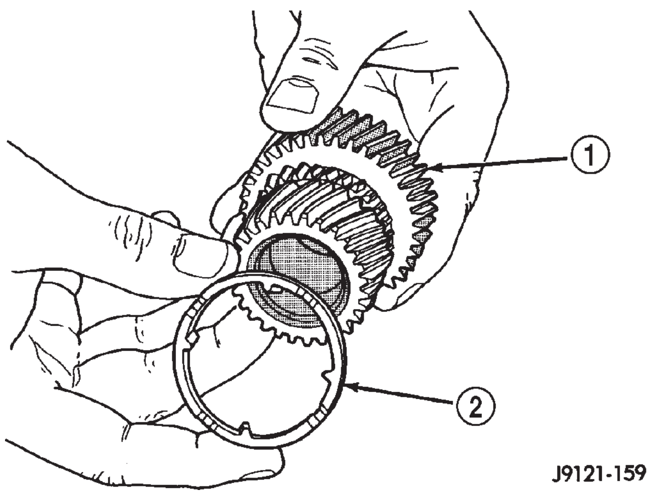


Fig. 156 Installing Spacer On Sun Gear

1 - SUN GEAR
2 - SUN GEAR SPACER

(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. 160).

(12) Install assembled driving shell and sun gear on output shaft (Fig. 161).

(13) Install rear thrust washer on front planetary gear (Fig. 162). Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

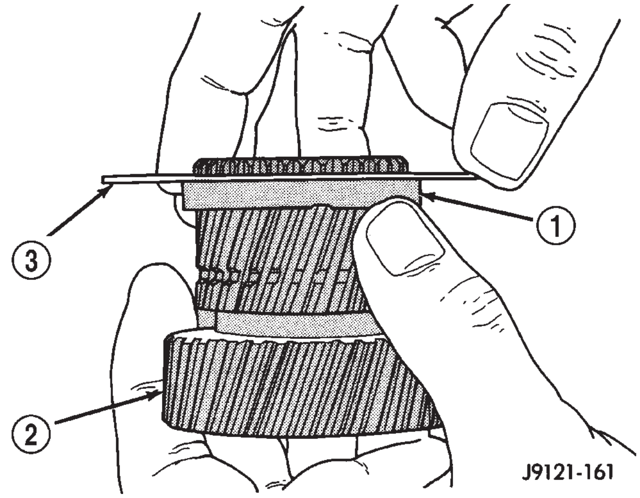


Fig. 157 Installing Driving Shell Front Thrust Plate On Sun Gear

1 - SPACER
2 - SUN GEAR
3 - THRUST PLATE

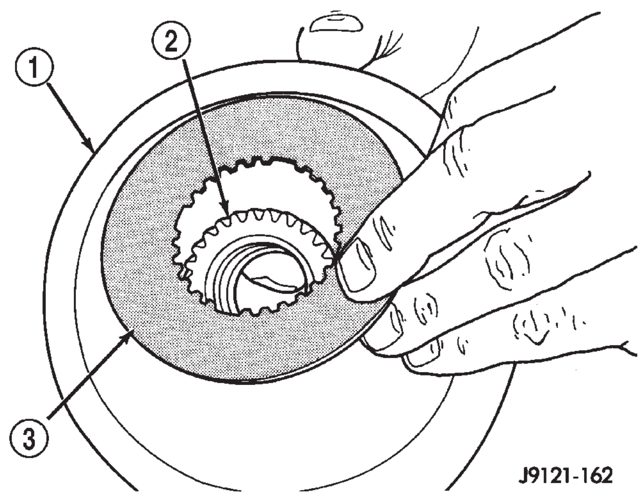


Fig. 158 Installing Driving Shell Rear Thrust Plate

1 - DRIVING SHELL
2 - SUN GEAR
3 - REAR THRUST PLATE

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

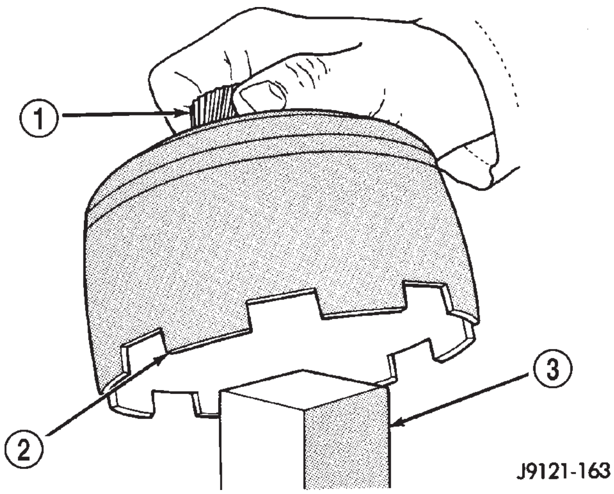


Fig. 159 Supporting Sun Gear On Wood Block

1 - SUN GEAR
2 - DRIVING SHELL
3 - WOOD BLOCK

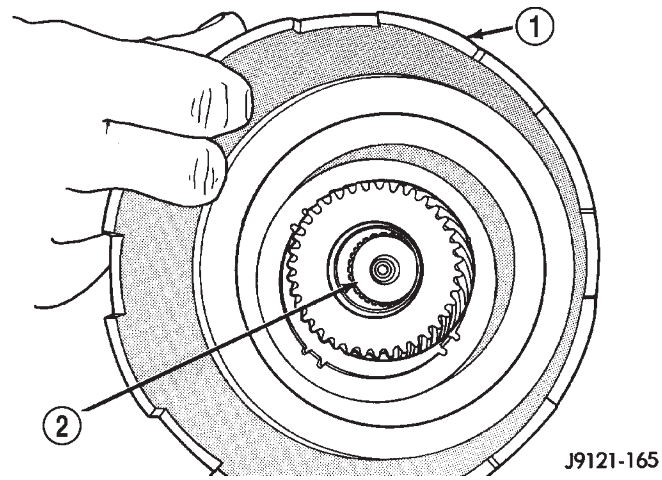


Fig. 161 Installing Assembled Sun Gear And Driving Shell On Output Shaft

1 - SUN GEAR/DRIVING SHELL ASSEMBLY
2 - OUTPUT SHAFT

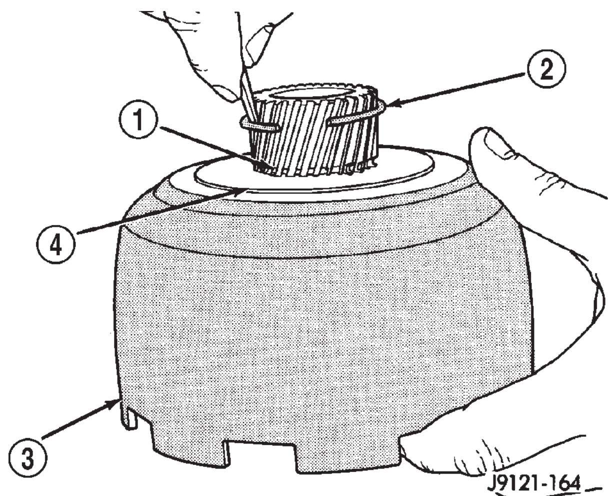


Fig. 160 Installing Sun Gear Lock Ring

1 - LOCK RING GROOVE
2 - SUN GEAR LOCK RING
3 - DRIVING SHELL
4 - REAR THRUST PLATE

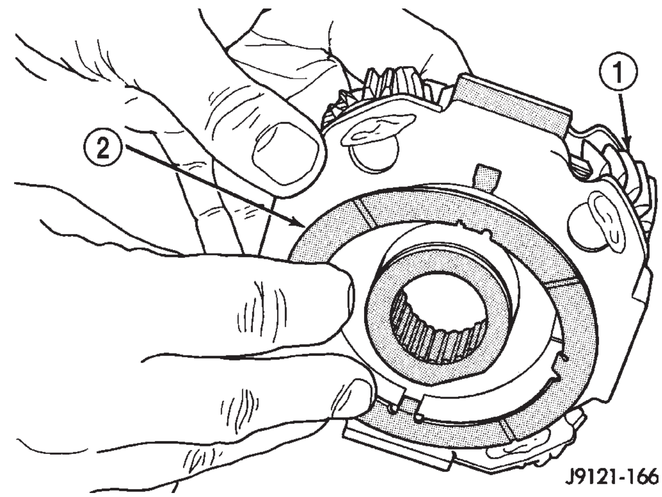


Fig. 162 Installing Rear Thrust Washer On Front Planetary Gear

1 - FRONT PLANETARY GEAR
2 - REAR TABBED THRUST WASHER

(14) Install front planetary gear on output shaft and in driving shell (Fig. 163).

(15) Install front thrust washer on front planetary gear. Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

(16) Assemble front annulus gear and support, if necessary. Be sure support snap-ring is seated.

(17) Install front annulus on front planetary (Fig. 163).

(18) Position thrust plate on front annulus gear support (Fig. 164). Note that plate has two tabs on it. These tabs fit in notches of annulus hub.

(19) Install thrust washer in front annulus (Fig. 165). Align flat on washer with flat on planetary hub. Also be sure washer tab is facing up.

(20) Install front annulus snap-ring (Fig. 166). 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. 167). 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.

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

(23) Check planetary geartrain end play with feeler gauge (Fig. 168). 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-rings are available in three different thicknesses for adjustment purposes.

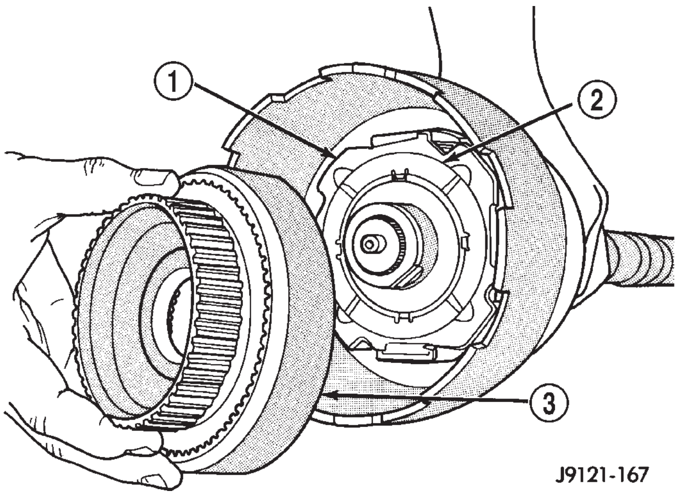


Fig. 163 Installing Front Planetary And Annulus Gears

1 - FRONT PLANETARY GEAR
2 - FRONT THRUST WASHER
3 - FRONT ANNULUS GEAR

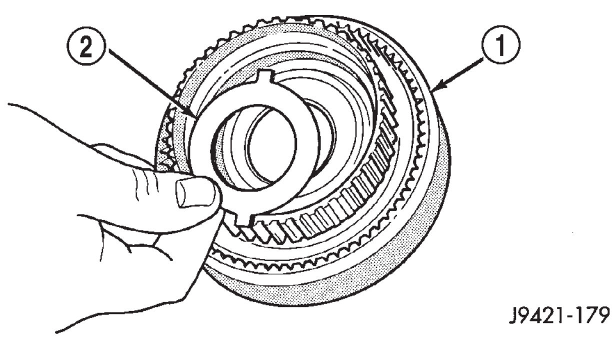


Fig. 164 Positioning Thrust Plate On Front Annulus Support

1 - FRONT ANNULUS
2 - THRUST PLATE

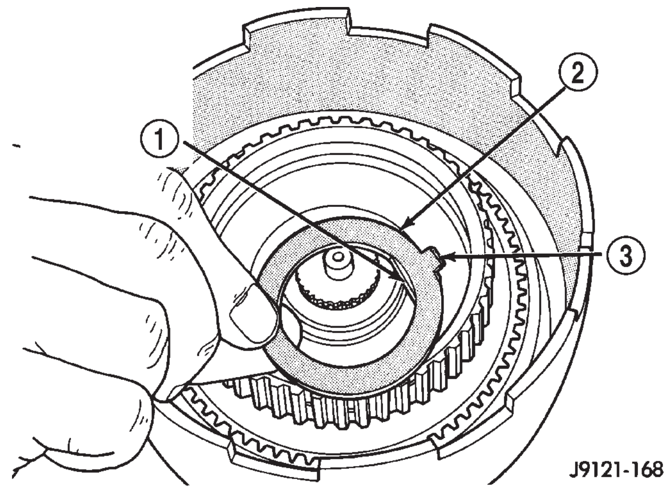


Fig. 165 Installing Front Annulus Thrust Washer

1 - WASHER FLAT ALIGNS WITH FLAT ON PLANETARY HUB
2 - FRONT ANNULUS THRUST WASHER
3 - TAB FACES FRONT

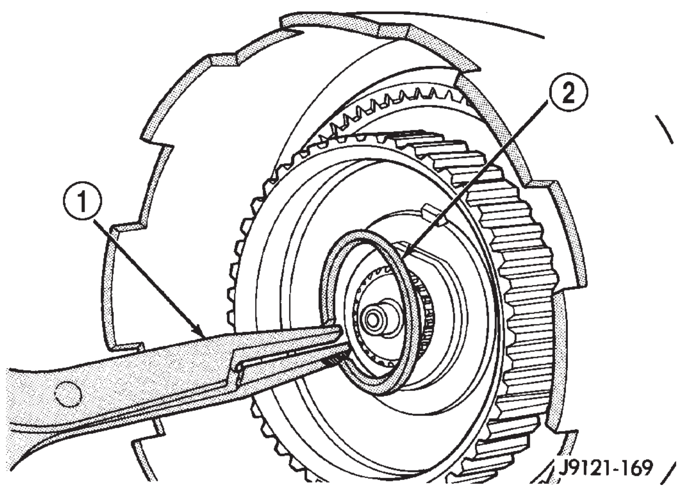


Fig. 166 Installing Front Annulus Snap-Ring

1 - SNAP-RING PLIERS
2 - FRONT ANNULUS SNAP-RING

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

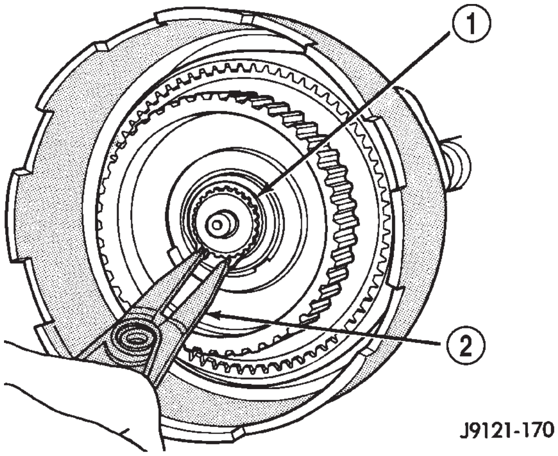


Fig. 167 Installing Planetary Selective Snap-Ring

1 - SELECTIVE SNAP-RING
2 - SNAP-RING PLIERS

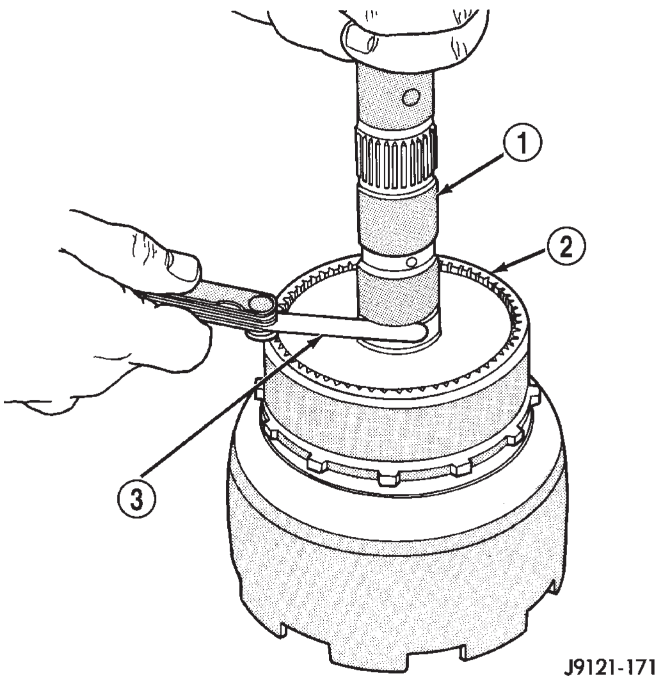


Fig. 168 Checking Planetary Geartrain End Play

1 - OUTPUT SHAFT
2 - REAR ANNULUS GEAR
3 - FEELER GAUGE

REAR CLUTCH

DESCRIPTION

The rear clutch assembly (Fig. 169) is composed of the rear clutch retainer, pressure plate, clutch plates, driving discs, piston, Belleville 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 spring is used to cushion the application of the clutch pack. 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 piston. 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 (Continued)

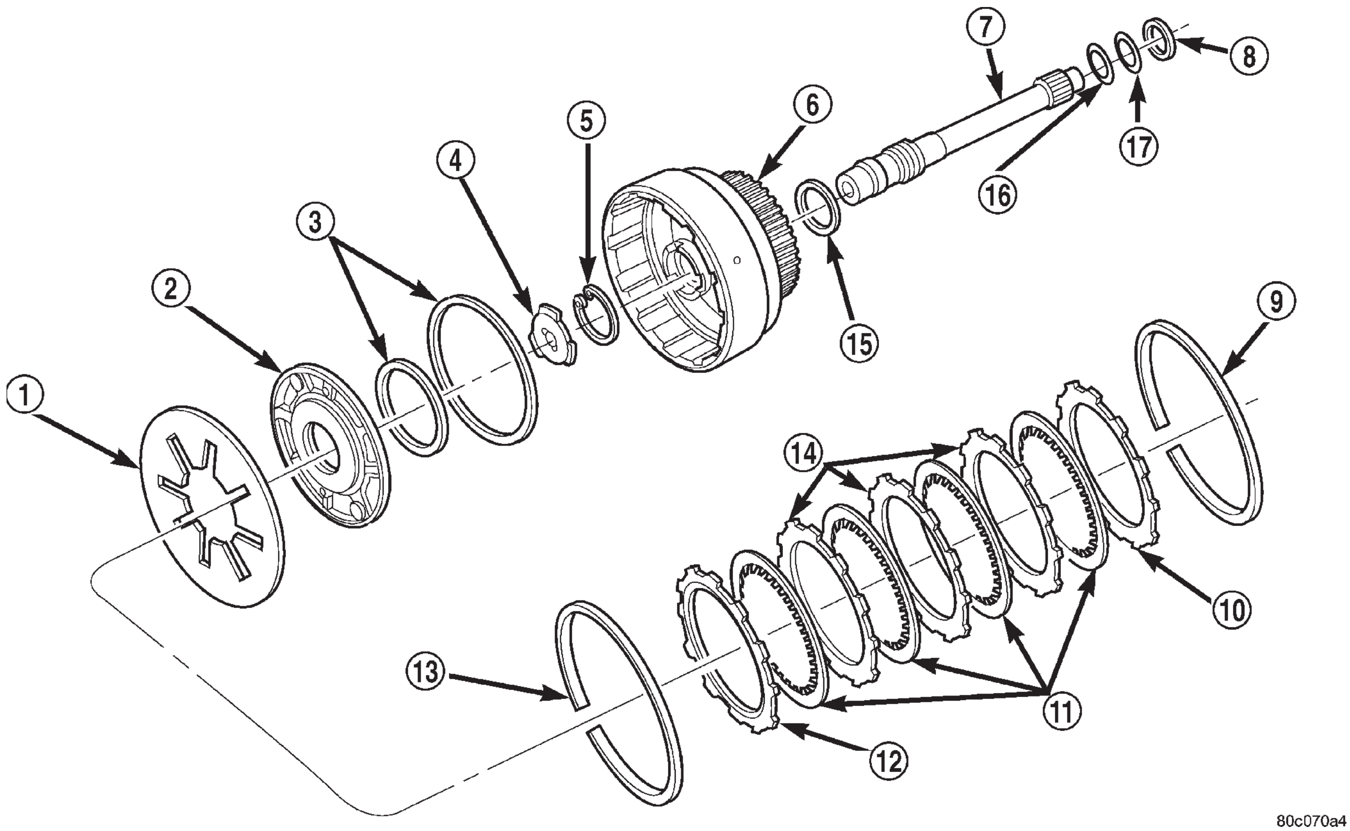


Fig. 169 Rear Clutch

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 - 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)

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. 170).

(4) Remove top pressure plate, clutch discs, steel plates, bottom pressure plate and wave snap-ring and wave spring (Fig. 170).

(5) Remove clutch piston with rotating motion.

(6) Remove and discard piston seals.

(7) Remove input shaft snap-ring (Fig. 171). 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.

CLEANING

Clean the clutch components with solvent and dry them with compressed air.

INSPECTION

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.

REAR CLUTCH (Continued)

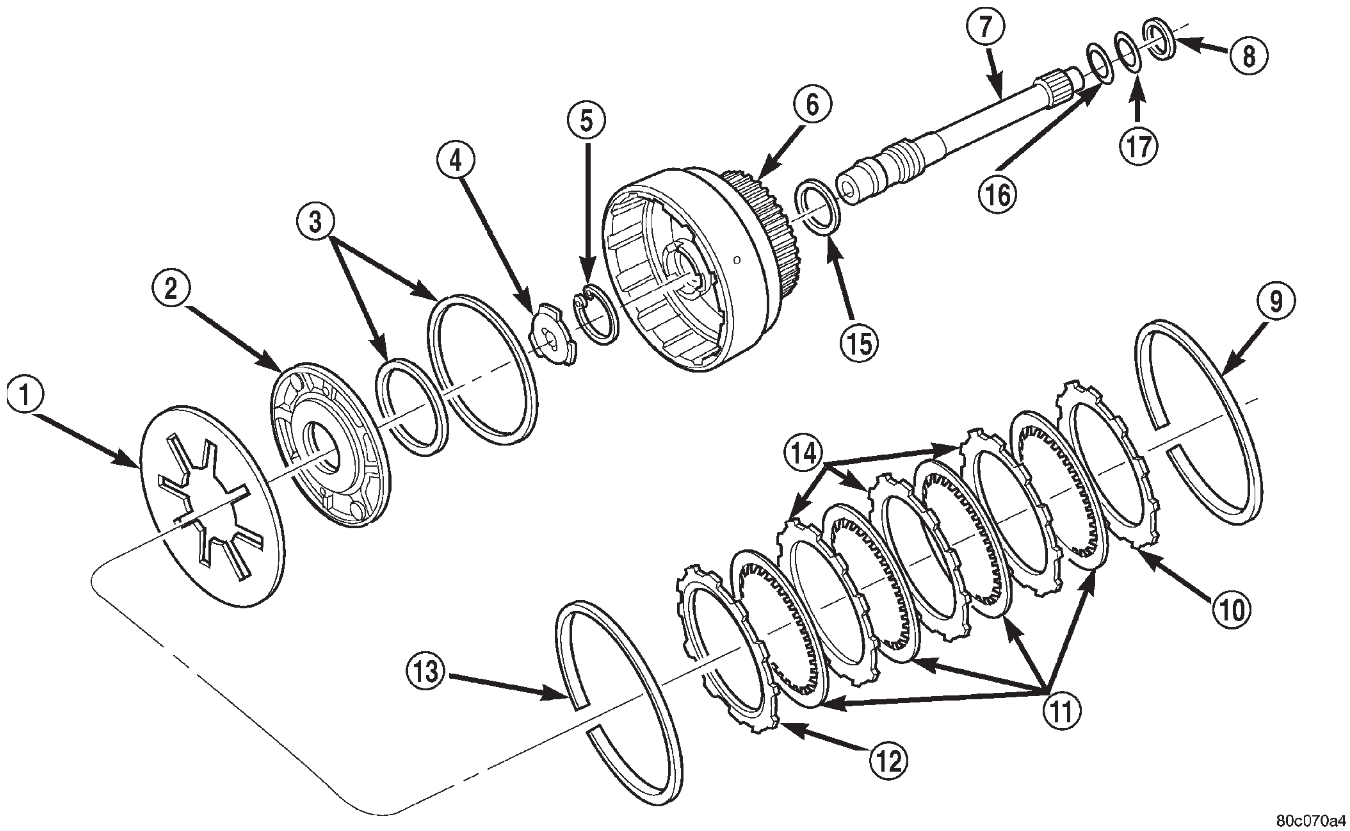


Fig. 170 Rear Clutch Components

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)

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.

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. 172) and (Fig. 173).

(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

REAR CLUTCH (Continued)

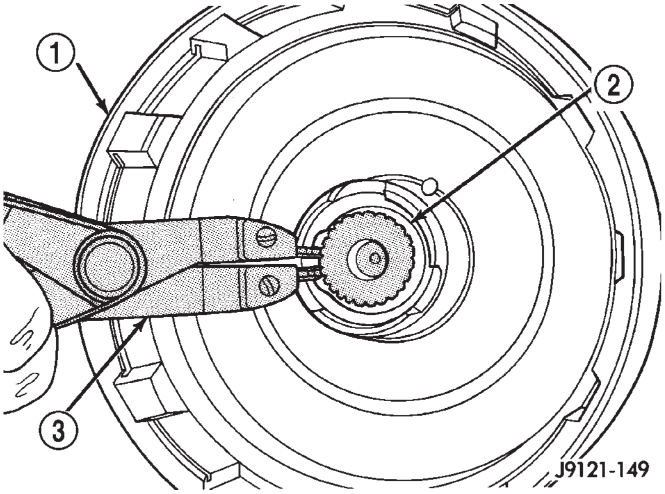


Fig. 171 Removing/Installing Input Shaft Snap-Ring

1 - REAR CLUTCH RETAINER
2 - INPUT SHAFT SNAP-RING
3 - SNAP-RING PLIERS

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. 171).

(5) Invert retainer and press input shaft in opposite direction until snap-ring is seated (Fig. 174).

(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. 175). Concave side of spring faces downward (toward piston).

(10) Install wave spring in retainer (Fig. 175). Be sure spring is completely seated in retainer groove.

(11) Install bottom pressure plate (Fig. 170). 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. 170).

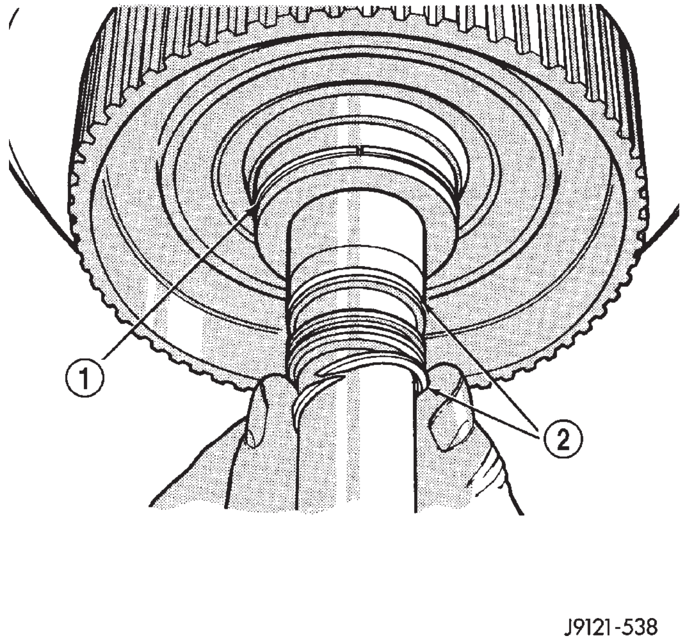


Fig. 172 Rear Clutch Retainer And Input Shaft Seal Ring Installation

1 - REAR CLUTCH RETAINER HUB SEAL RING
2 - INPUT SHAFT SEAL RINGS

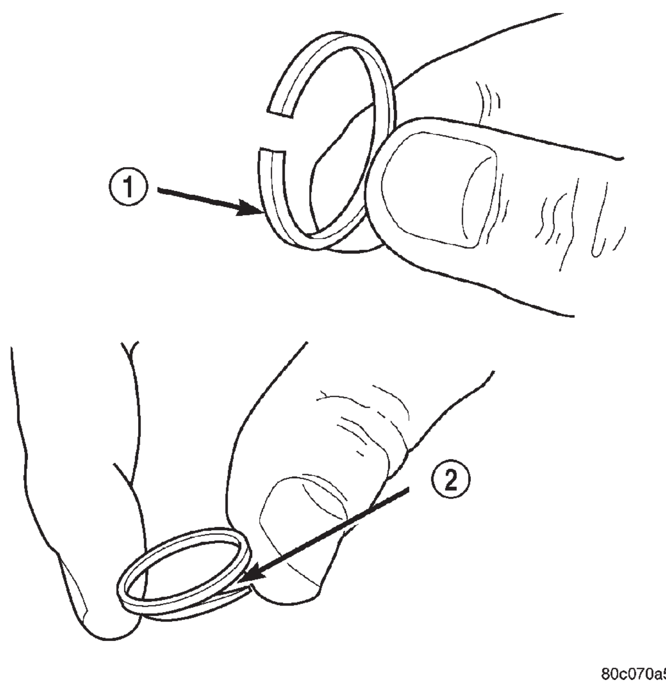


Fig. 173 Input Shaft Seal Ring Identification

1 - PLASTIC REAR SEAL RING
2 - TEFLON FRONT SEAL RING (SQUEEZE RING TOGETHER SLIGHTLY BEFORE INSTALLATION FOR BETTER FIT)

(13) Install top pressure plate.

(14) Install selective snap-ring. Be sure snap-ring is fully seated in retainer groove.

REAR CLUTCH (Continued)

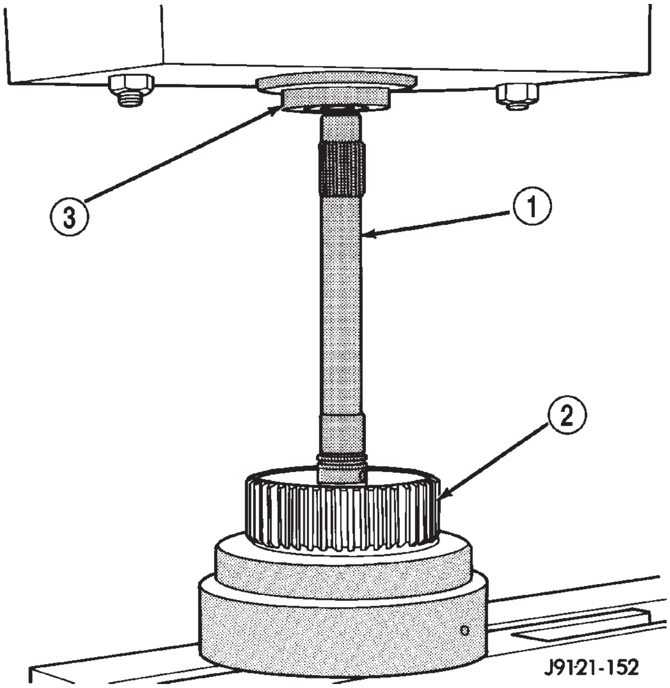


Fig. 174 Pressing Input Shaft Into Rear Clutch Retainer

1 - INPUT SHAFT
2 - REAR CLUTCH RETAINER
3 - PRESS RAM

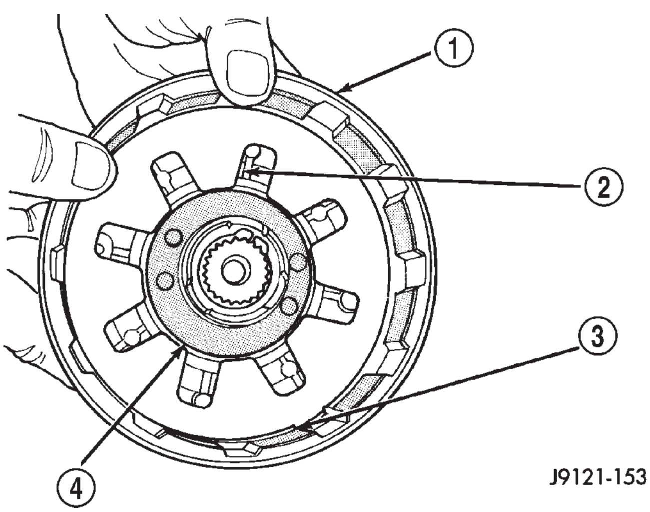


Fig. 175 Piston Spring/Wave Spring Position

1 - REAR CLUTCH RETAINER
2 - PISTON SPRING
3 - WAVE SPRING
4 - CLUTCH PISTON

(15) Using a suitable gauge bar and dial indicator, measure clutch pack clearance (Fig. 176).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 176).

(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.

(16) Clearance should be 0.559 - 0.914 mm (0.022 - 0.036 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:

- 0.107-0.109 in.
- 0.098-0.100 in.
- 0.095-0.097 in.
- 0.083-0.085 in.
- 0.076-0.078 in.
- 0.071-0.073 in.
- 0.060-0.062 in.

(17) Coat rear clutch thrust washer with petroleum jelly and install washer over input shaft and into clutch retainer (Fig. 177). Use enough petroleum jelly to hold washer in place.

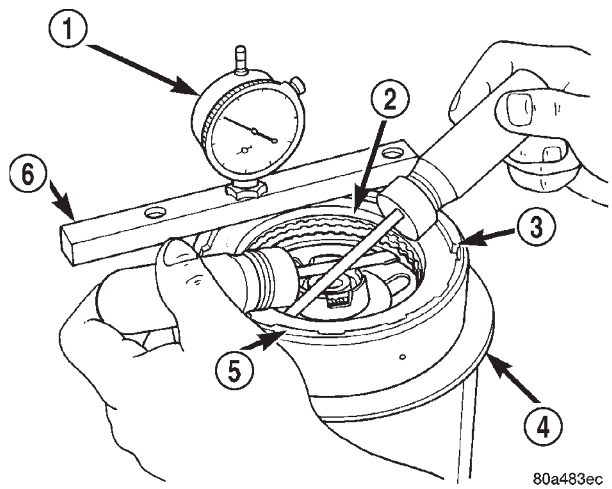


Fig. 176 Checking Rear Clutch Pack Clearance

1 - DIAL INDICATOR
2 - PRESSURE PLATE
3 - SNAP-RING
4 - STAND
5 - REAR CLUTCH
6 - GAUGE BAR

REAR CLUTCH (Continued)

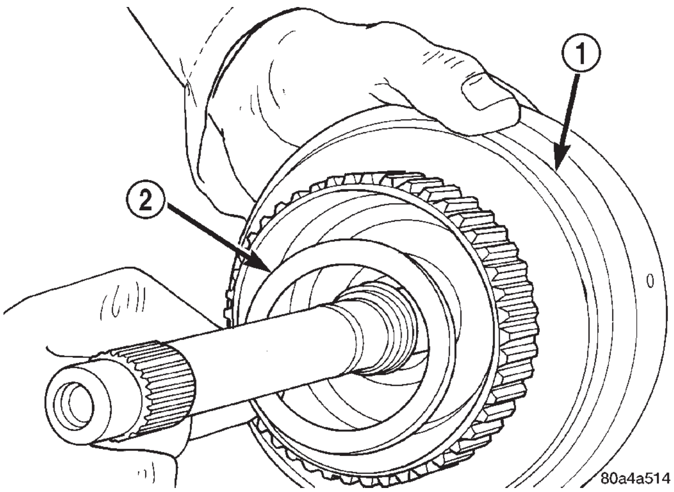


Fig. 177 Installing Rear Clutch Thrust Washer

1 - REAR CLUTCH RETAINER
2 - REAR CLUTCH THRUST WASHER

REAR SERVO

DESCRIPTION

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.

OPERATION

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.

DISASSEMBLY

(1) Remove small snap-ring and remove plug and spring from servo piston (Fig. 178).

(2) Remove and discard servo piston seal ring.

CLEANING

Remove and discard the servo piston seal ring (Fig. 179). 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 new ones at assembly.

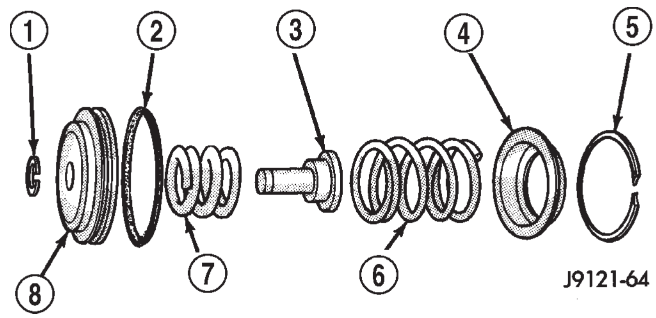


Fig. 178 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

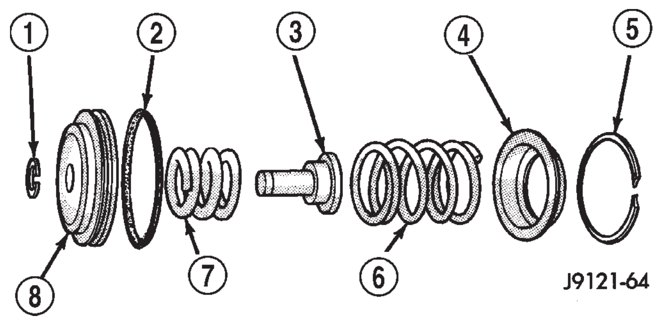


Fig. 179 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

ASSEMBLY

(1) Lubricate piston and guide seals (Fig. 180) with petroleum jelly. Lubricate other servo parts with Mopar® ATF +4, type 9602, 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.

REAR SERVO (Continued)

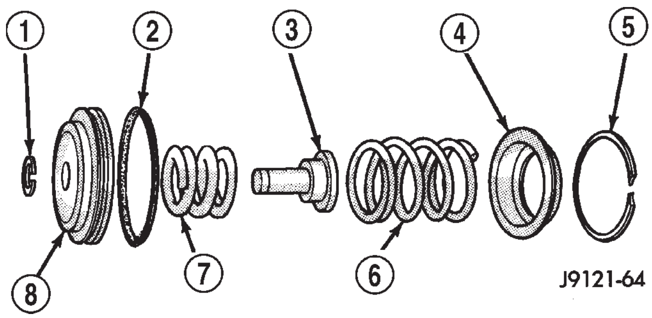


Fig. 180 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

SHIFT 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.

SOLENOID

DESCRIPTION

The typical electrical solenoid used in automotive applications is a linear actuator. It is a device that produces motion in a straight line. This straight line motion can be either forward or backward in direction, and short or long distance.

A solenoid is an electromechanical device that uses a magnetic force to perform work. It consists of a coil of wire, wrapped around a magnetic core made from steel or iron, and a spring loaded, movable plunger, which performs the work, or straight line motion.

The solenoids used in transmission applications are attached to valves which can be classified as **normally open** or **normally closed**. The **normally open** solenoid valve is defined as a valve which allows hydraulic flow when no current or voltage is applied to the solenoid. The **normally closed** solenoid valve is defined as a valve which does not allow hydraulic flow when no current or voltage is applied to the solenoid. These valves perform hydraulic control functions for the transmission and must therefore be durable and tolerant of dirt particles. For these reasons, the valves have hardened steel poppets and ball valves. The solenoids operate the valves directly, which means that the solenoids must have very high outputs to close the valves against the sizable flow areas and line pressures found in current transmissions. Fast response time is also necessary to ensure accurate control of the transmission.

The strength of the magnetic field is the primary force that determines the speed of operation in a particular solenoid design. A stronger magnetic field will cause the plunger to move at a greater speed than a weaker one. There are basically two ways to increase the force of the magnetic field:

1. Increase the amount of current applied to the coil or
2. Increase the number of turns of wire in the coil.

The most common practice is to increase the number of turns by using thin wire that can completely fill the available space within the solenoid housing. The strength of the spring and the length of the plunger also contribute to the response speed possible by a particular solenoid design.

A solenoid can also be described by the method by which it is controlled. Some of the possibilities include variable force, pulse-width modulated, constant ON, or duty cycle. The variable force and pulse-width modulated versions utilize similar methods to control the current flow through the solenoid to position the solenoid plunger at a desired position somewhere between full ON and full OFF. The constant ON and duty cycled versions control the voltage across the solenoid to allow either full flow or no flow through the solenoid's valve.

OPERATION

When an electrical current is applied to the solenoid coil, a magnetic field is created which produces an attraction to the plunger, causing the plunger to move and work against the spring pressure and the load applied by the fluid the valve is controlling. The plunger is normally directly attached to the valve which it is to operate. When the current is removed from the coil, the attraction is removed and the plunger will return to its original position due to spring pressure.

SOLENOID (Continued)

The plunger is made of a conductive material and accomplishes this movement by providing a path for the magnetic field to flow. By keeping the air gap between the plunger and the coil to the minimum necessary to allow free movement of the plunger, the magnetic field is maximized.

SPEEDOMETER DRIVE ADAPTER

REMOVAL

Rear axle gear ratio and tire size determine speedometer pinion requirements.

(1) Raise vehicle.

(2) Disconnect wires from vehicle speed sensor.

(3) Remove adapter clamp and screw (Fig. 181).

(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. 181). 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. 181).

(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. 182). 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.

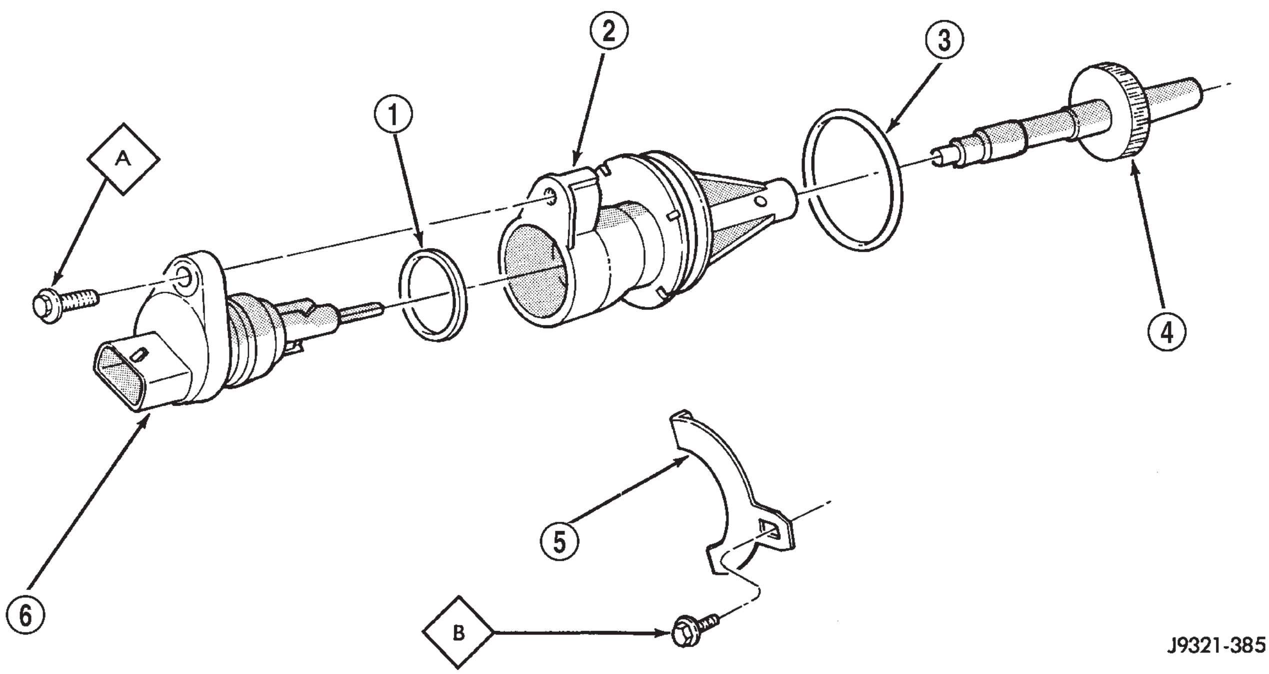


Fig. 181 Speedometer Pinion Adapter Components

1 - Sensor O-ring
2 - Speedometer Adapter
3 - Adapter O-ring
4 - Speedometer Pinion
5 - Adapter Clamp
6 - Vehicle Speed Sensor
A - 2-3 N·m (15-27 in. lbs.)
B - 10-12 N·m (90-110 in. lbs.)

SPEEDOMETER DRIVE ADAPTER (Continued)

(12) Lower vehicle and top off transmission fluid level.

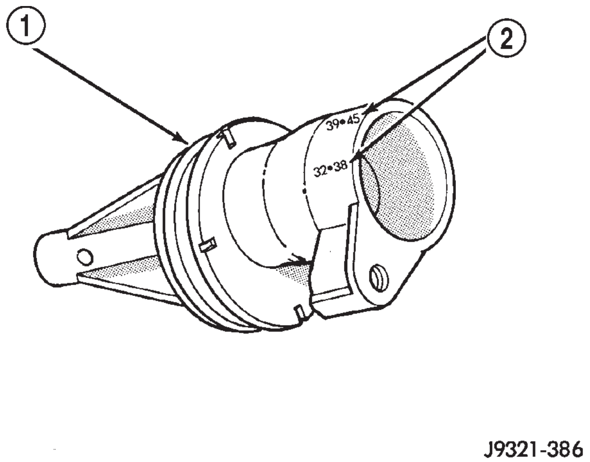


Fig. 182 Index Numbers On Speedometer Pinion Adapter

1 - SPEEDOMETER ADAPTER
2 - INDEX NUMBER LOCATION

THROTTLE VALVE CABLE

DESCRIPTION

Transmission throttle valve cable (Fig. 183) 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.

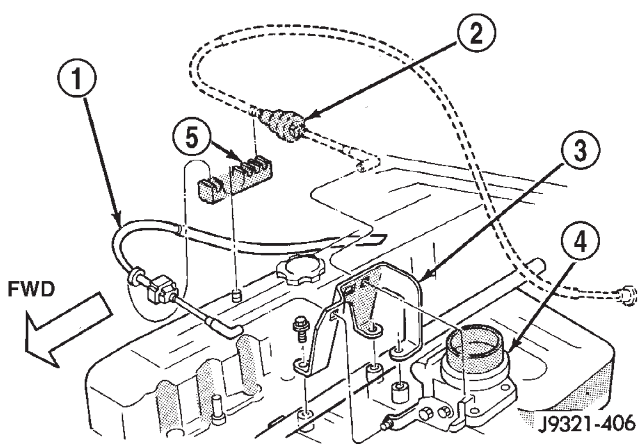


Fig. 183 Throttle Cable Attachment At Engine

1 - TRANSMISSION THROTTLE VALVE CABLE
2 - ACCELERATOR CABLE
3 - CABLE ENGINE BRACKET
4 - THROTTLE BODY
5 - CABLE GUIDE

The transmission throttle valve is operated by a cam on the throttle lever. The throttle lever is operated by an adjustable cable (Fig. 184). 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.

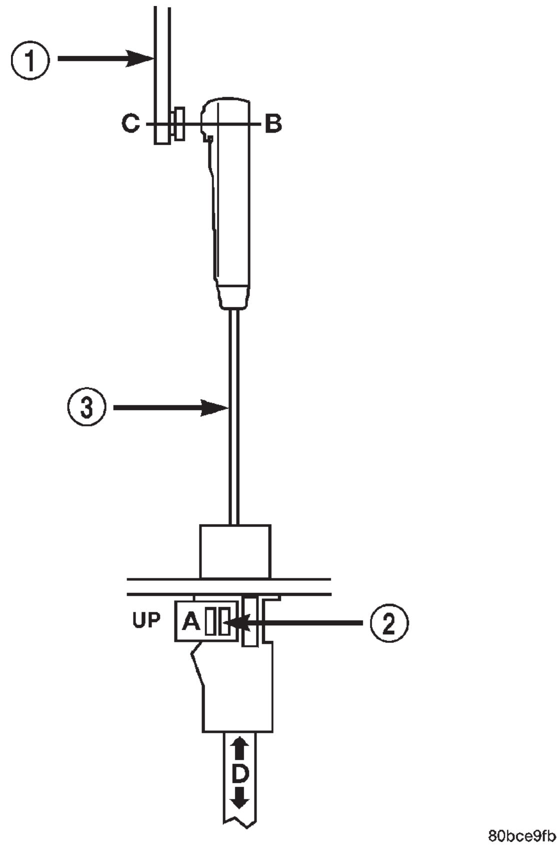


Fig. 184 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - THROTTLE VALVE CABLE

ADJUSTMENTS

ADJUSTMENT - THROTTLE VALVE CABLE

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.

THROTTLE VALVE CABLE (Continued)

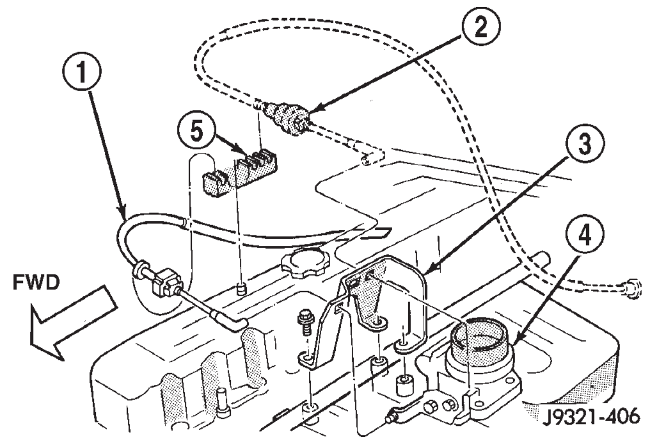


Fig. 185 Throttle Cable Attachment At Engine

1 - TRANSMISSION THROTTLE VALVE CABLE
2 - ACCELERATOR CABLE
3 - CABLE ENGINE BRACKET
4 - THROTTLE BODY
5 - CABLE GUIDE

ADJUSTMENT VERIFICATION

(1) Turn ignition key to OFF position.

(2) Remove air cleaner.

(3) Verify that lever on throttle body is at curb idle position (Fig. 185). Then verify that transmission throttle lever (Fig. 186) is also at idle (fully forward) position.

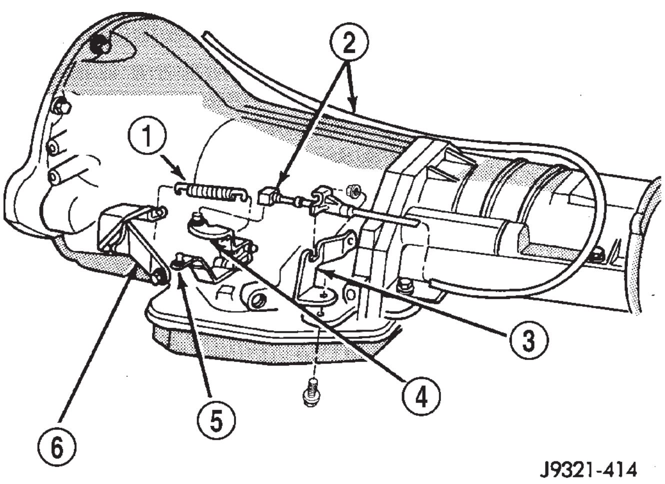


Fig. 186 Throttle Cable Attachment At Transmission

1 - RETURN SPRING
2 - THROTTLE VALVE CABLE
3 - THROTTLE VALVE CABLE BRACKET
4 - THROTTLE VALVE LEVER
5 - GEAR SELECTOR LEVER
6 - SHIFT CABLE BRACKET

(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. 187).

• If cable end and attachment stud are misaligned (off center), cable will have to be adjusted as described in Throttle Valve Cable Adjustment procedure.

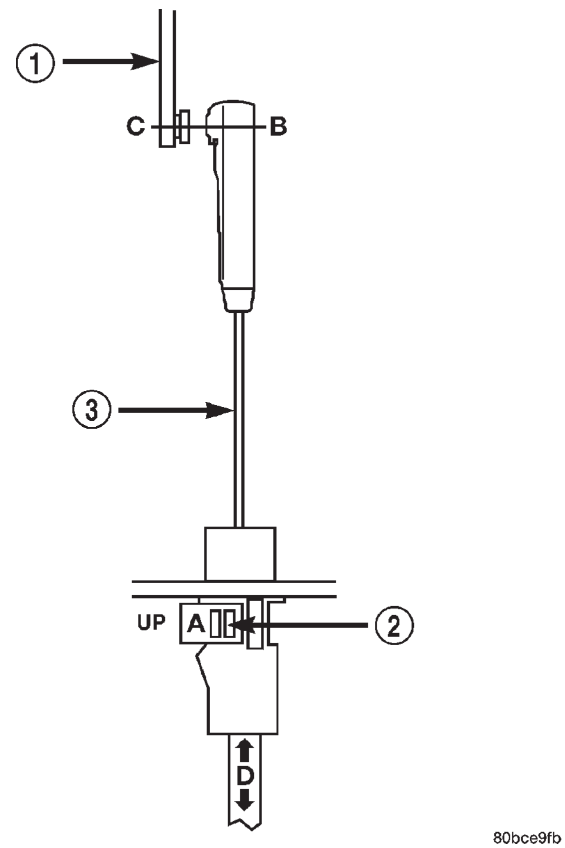


Fig. 187 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - THROTTLE VALVE CABLE

(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.

ADJUSTMENT PROCEDURE

(1) Turn ignition switch to OFF position.

(2) Remove air cleaner if necessary.

THROTTLE VALVE CABLE (Continued)

(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) Pry the T.V. cable lock (A) into the UP position (Fig. 187). This will unlock the cable and allow for readjustment.

(6) Apply just enough tension on the T.V. cable (B) to remove any slack in the cable.**Pulling too tight will cause the T.V. lever on the transmission to move out of its idle position, which will result in an incorrect T.V. cable adjustment.** Slide the sheath of the T.V. cable (D) back and forth until the centerlines of the T.V. cable end (B) and the throttle bell crank lever (C) are aligned within one millimeter (1mm) (Fig. 187).

(7) While holding the T.V. cable in the set position push the T.V. cable lock (A) into the down position (Fig. 187). This will lock the present T.V. cable adjustment.

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.

(8) Reconnect the T.V. cable (B) to the throttle bellcrank lever (C).

(9) Check cable adjustment. Verify transmission throttle lever and lever on throttle body move simultaneously.

TORQUE CONVERTER

DESCRIPTION

The torque converter (Fig. 188) 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.

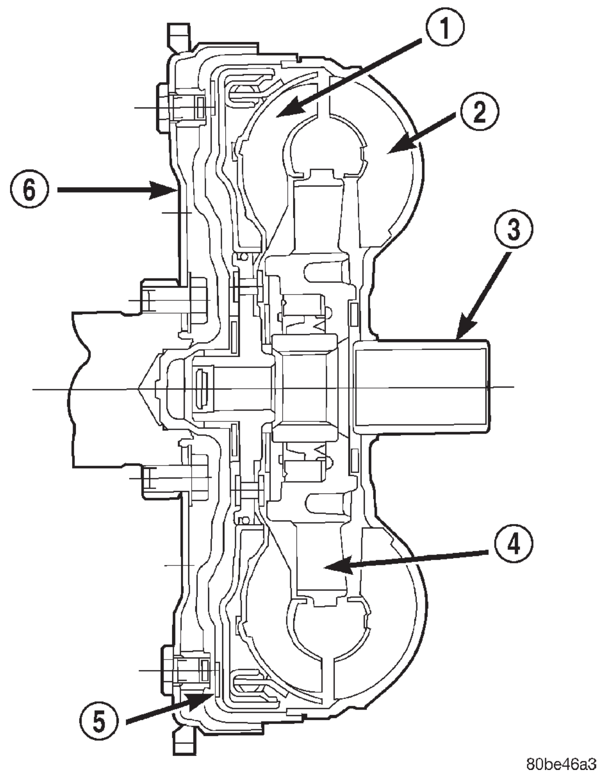


Fig. 188 Torque Converter Assembly

1 - TURBINE
2 - IMPELLER
3 - HUB
4 - STATOR
5 - CONVERTER CLUTCH DISC
6 - DRIVE PLATE

IMPELLER

The impeller (Fig. 189) 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. 190) 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.

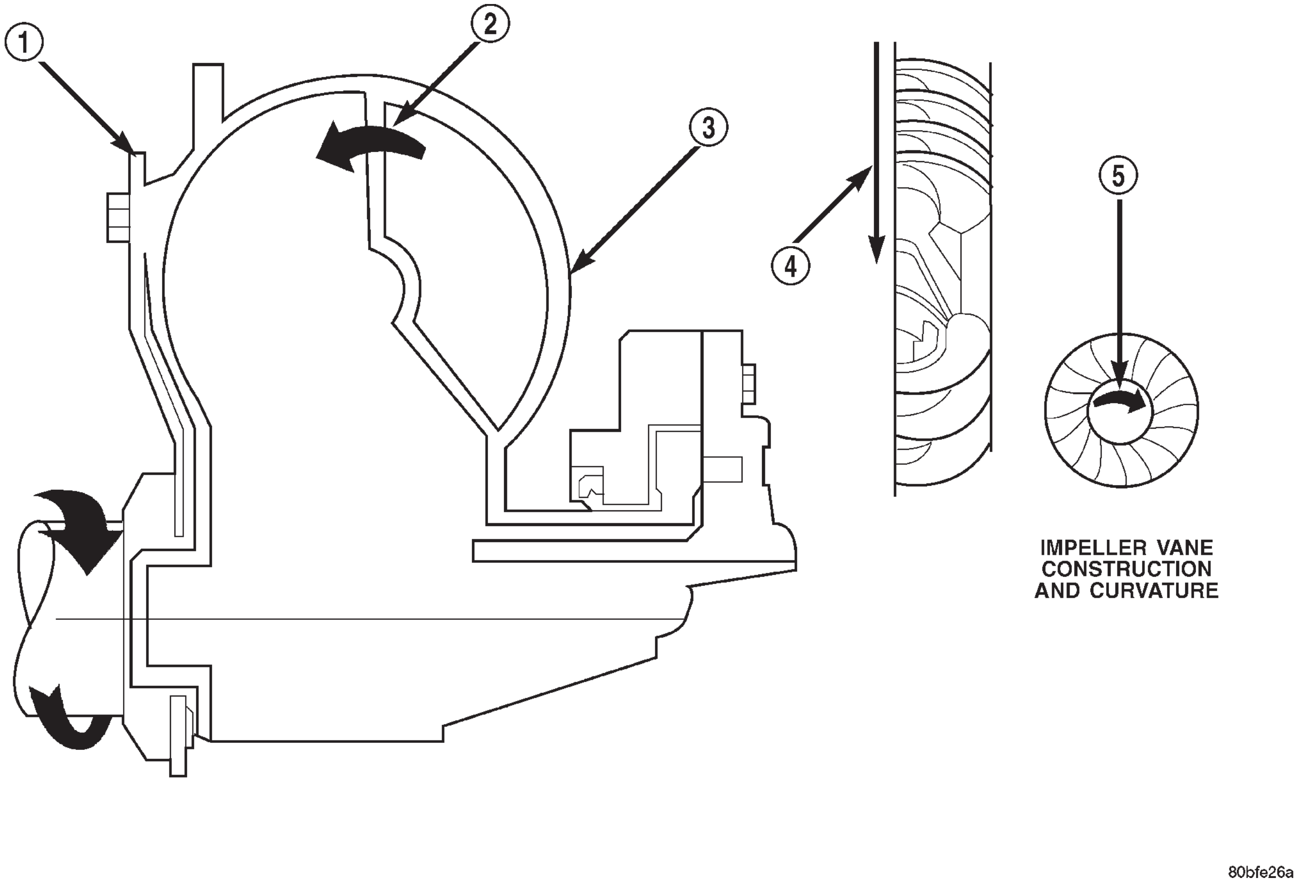


Fig. 189 Impeller

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

STATOR

The stator assembly (Fig. 191) 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. 192). 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.

TORQUE CONVERTER CLUTCH (TCC)

The TCC (Fig. 193) 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.

OPERATION

The converter impeller (Fig. 194) (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.

TORQUE CONVERTER (Continued)

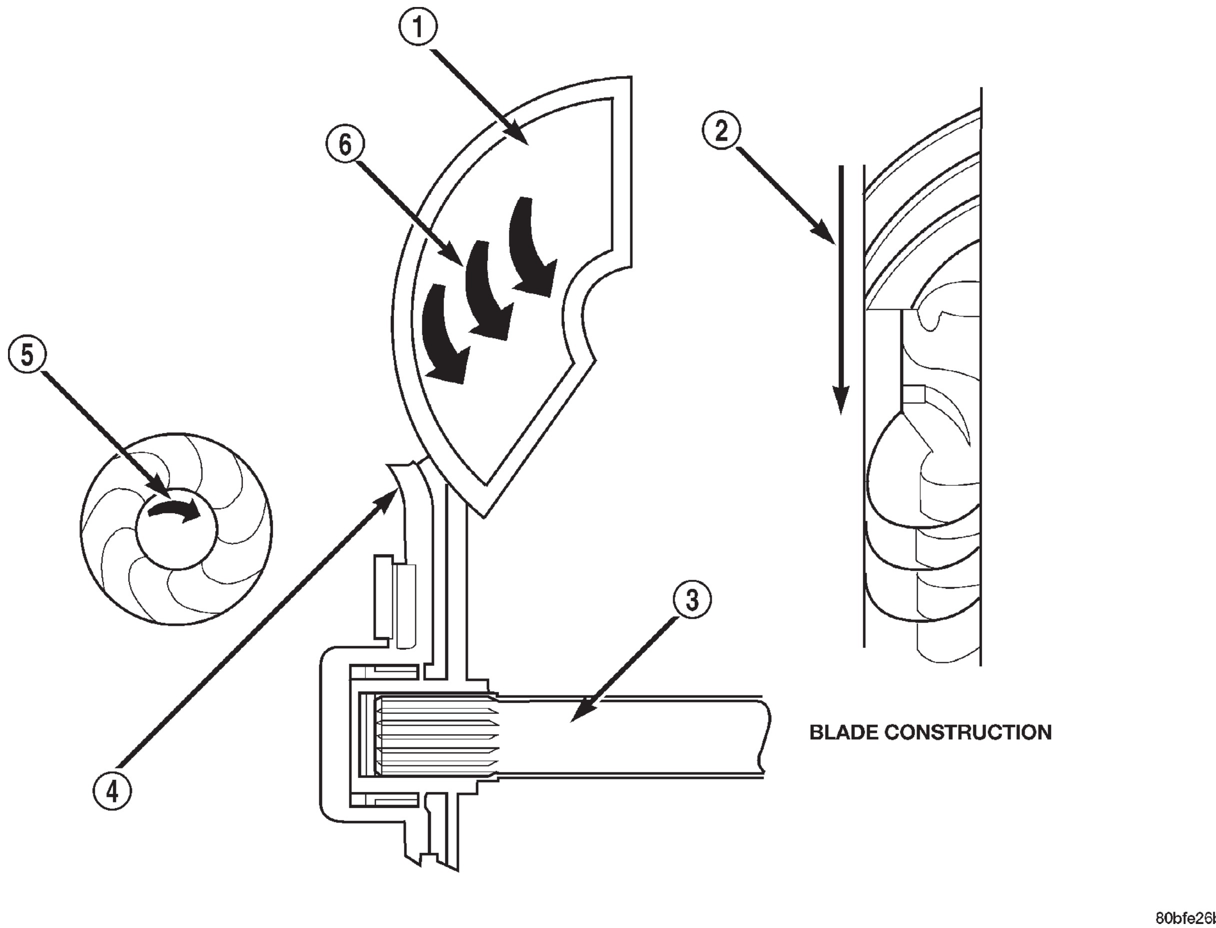


Fig. 190 Turbine

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

Torque multiplication is achieved by locking the stator's over-running clutch to its shaft (Fig. 195). 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.

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 Control 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.

TORQUE CONVERTER (Continued)

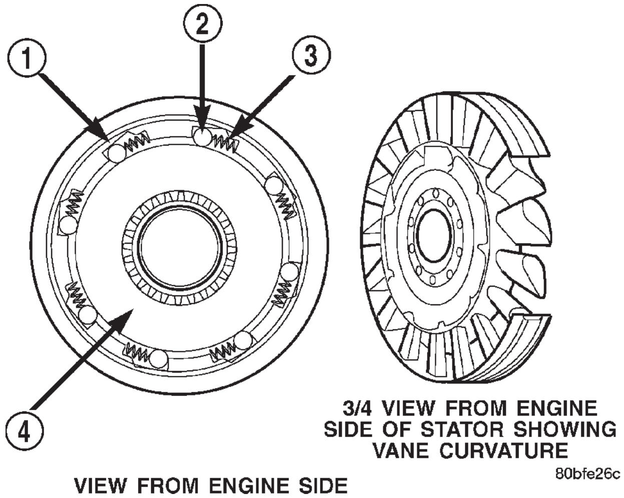


Fig. 191 Stator Components

1 - CAM (OUTER RACE)
2 - ROLLER
3 - SPRING
4 - INNER RACE

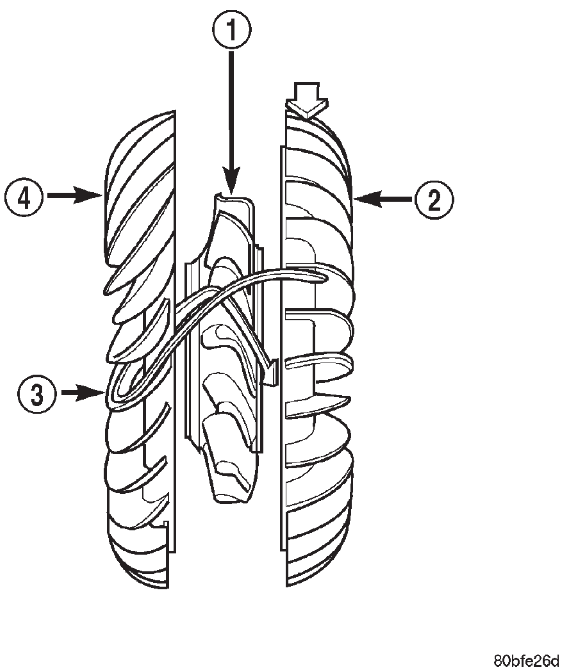


Fig. 192 Stator Location

1 - STATOR
2 - IMPELLER
3 - FLUID FLOW
4 - TURBINE

REMOVAL

(1) Remove transmission and torque converter from vehicle.

(2) Place a suitable drain pan under the converter housing end of the transmission.

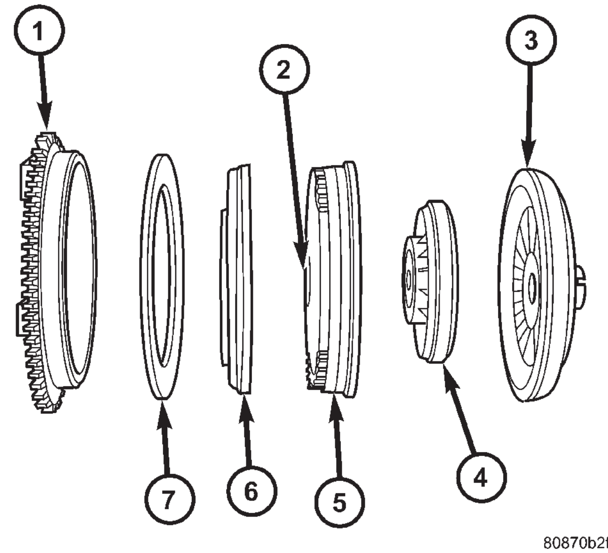


Fig. 193 Torque Converter Clutch (TCC)

1 - IMPELLER FRONT COVER
2 - THRUST WASHER ASSEMBLY
3 - IMPELLER
4 - STATOR
5 - TURBINE
6 - PISTON
7 - FRICTION DISC

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.

TORQUE CONVERTER (Continued)

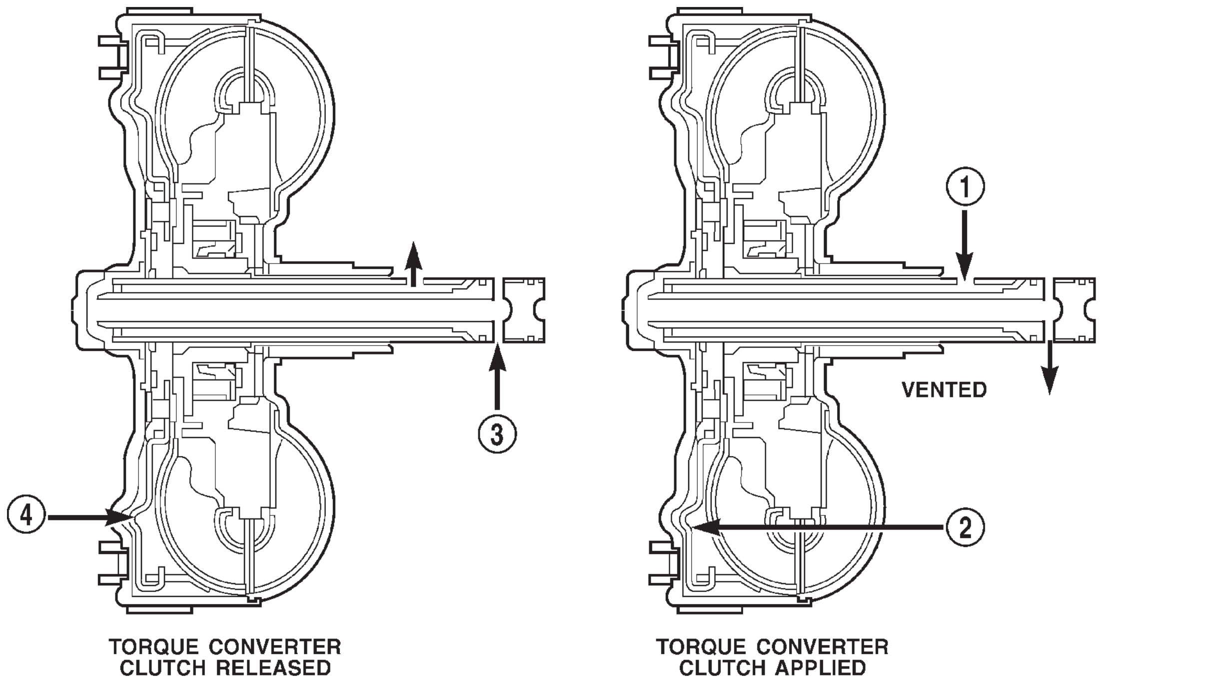


Fig. 194 Torque Converter Fluid Operation

1 - APPLY PRESSURE
2 - THE PISTON MOVES SLIGHTLY FORWARD
3 - RELEASE PRESSURE
4 - THE PISTON MOVES SLIGHTLY REARWARD

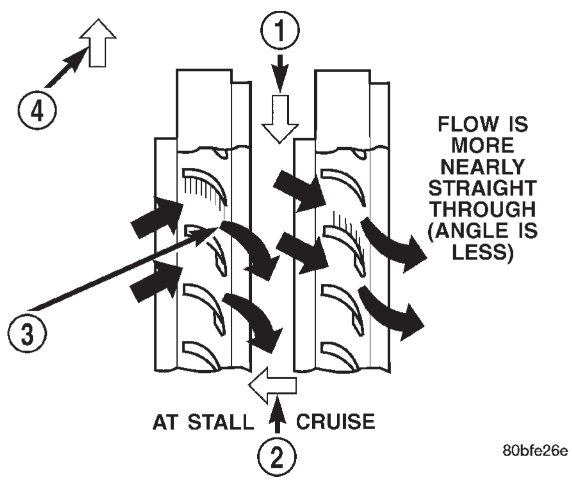


Fig. 195 Stator Operation

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

(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. 196). 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.

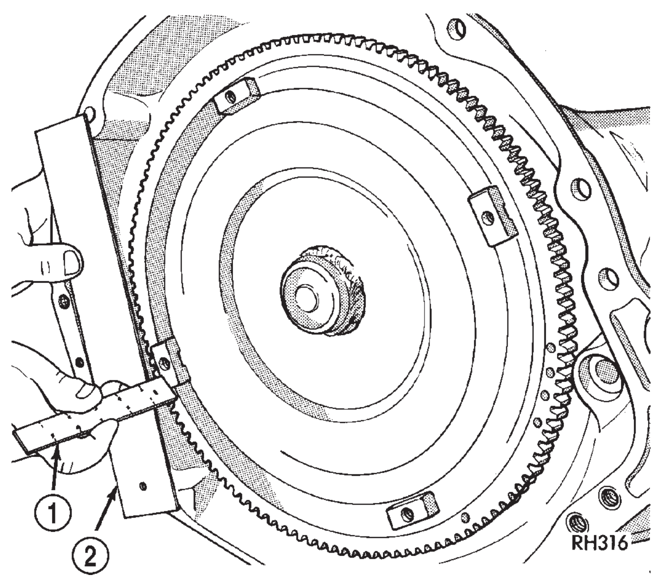


Fig. 196 Checking Torque Converter Seating

1 - SCALE
2 - STRAIGHTEDGE

TORQUE 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.

STANDARD PROCEDURE - TORQUE CONVERTER DRAINBACK VALVE

The converter drainback check valve is located in the cooler outlet (pressure) line near the radiator tank. The valve prevents fluid drainback when the vehicle is parked for lengthy periods. The valve check ball is spring loaded and has an opening pressure of approximately 2 psi.

The valve is serviced as an assembly; it is not repairable. Do not clean the valve if restricted, or contaminated by sludge, or debris. If the valve fails, or if a transmission malfunction occurs that generates significant amounts of sludge and/or clutch particles and metal shavings, the valve must be replaced.

The valve must be removed whenever the cooler and lines are reverse flushed. The valve can be flow tested when necessary. The procedure is exactly the same as for flow testing a cooler.

If the valve is restricted, installed backwards, or in the wrong line, it will cause an overheating condition and possible transmission failure.

CAUTION: The drainback valve is a one-way flow device. It must be properly oriented in terms of flow direction for the cooler to function properly. The valve must be installed in the pressure line. Otherwise flow will be blocked and would cause an overheating condition and eventual transmission failure.

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. 197) and (Fig. 198):

- 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.

VALVE BODY (Continued)

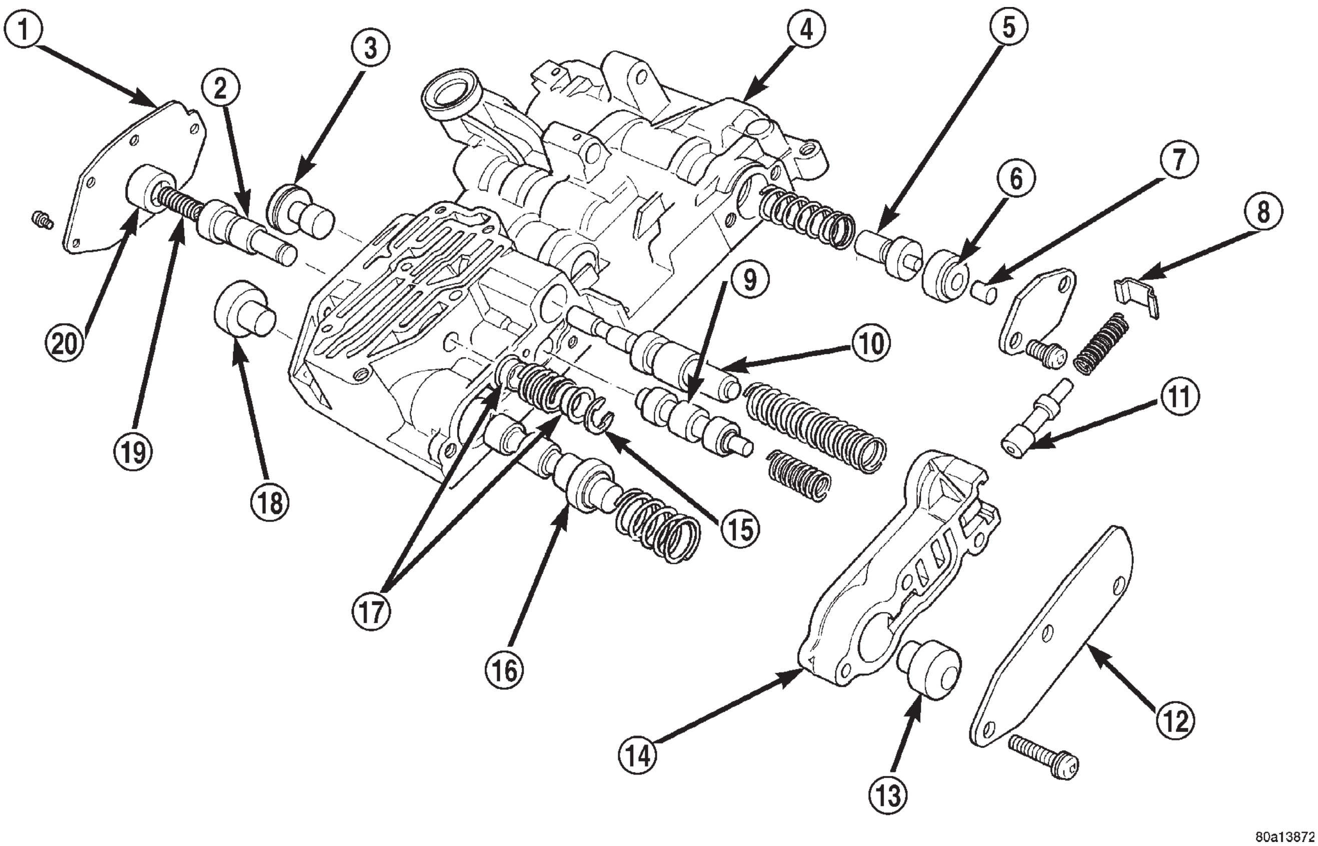


Fig. 197 Valve Body Assembly

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

VALVE BODY (Continued)

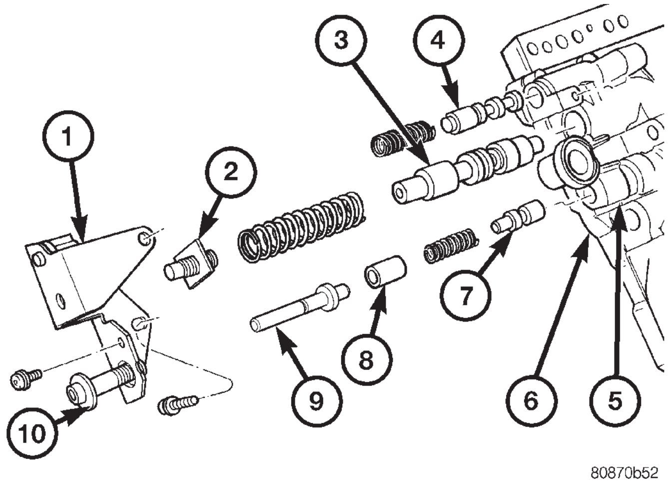


Fig. 198 Valve Body Assembly

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

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. 199) 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 selector in the park position, fluid recirculates through the regulator and manual valves back to the sump.

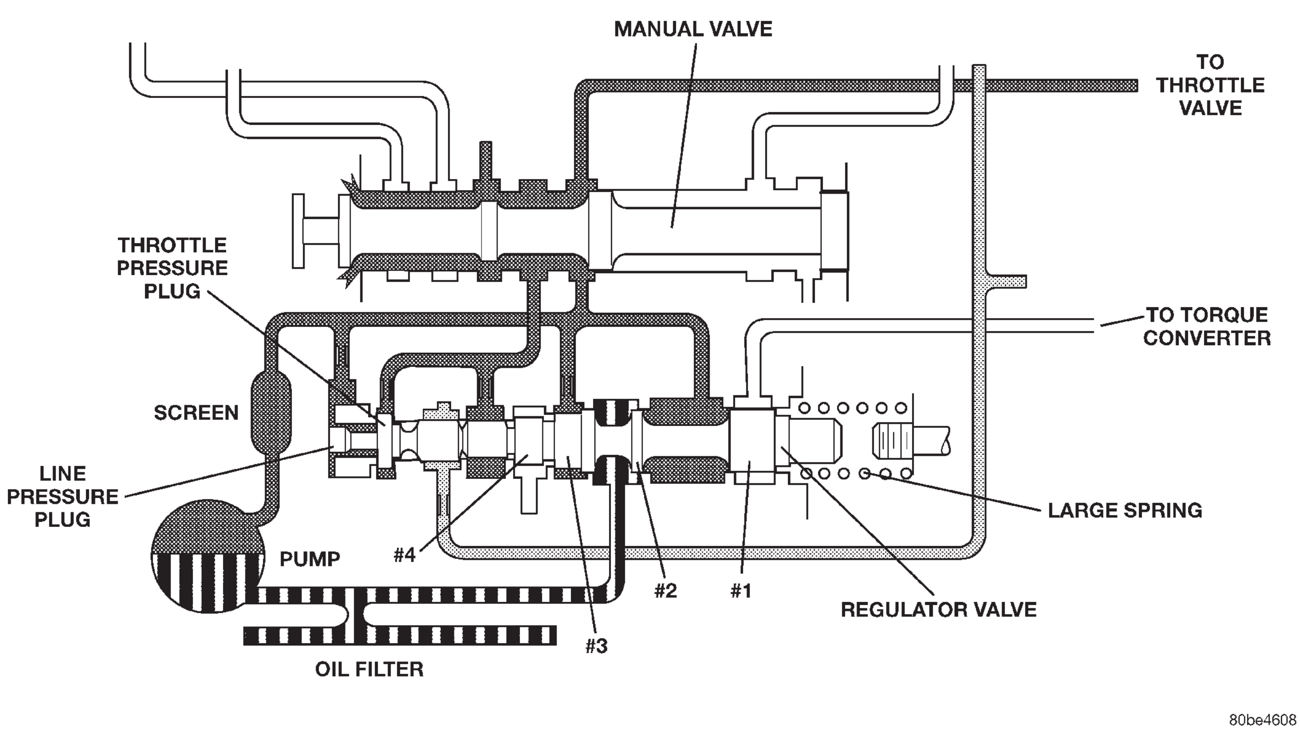


Fig. 199 Regulator Valve in Park Position

VALVE BODY (Continued)

Meanwhile, the torque converter is filled slowly. In all other gear positions (Fig. 200), 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. 201). The regulated line pressure in reverse (Fig. 202) is held at much higher pressures 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.

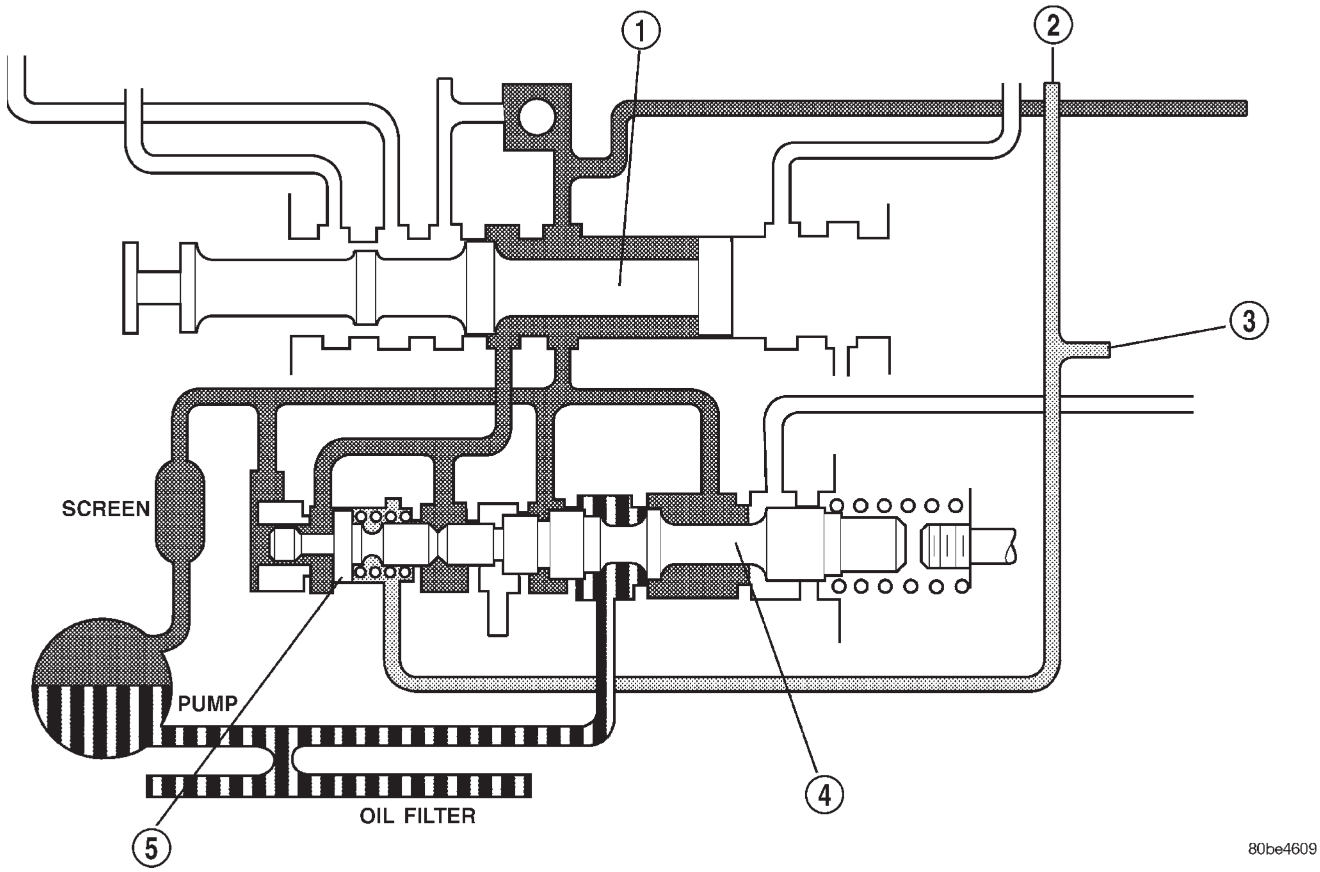


Fig. 200 Regulator Valve in Neutral Position

1 - MANUAL VALVE
2 - TO SHIFT VALVE
3 - FROM THROTTLE VALVE
4 - REGULATOR VALVE
5 - THROTTLE PRESSURE PLUG

VALVE BODY (Continued)

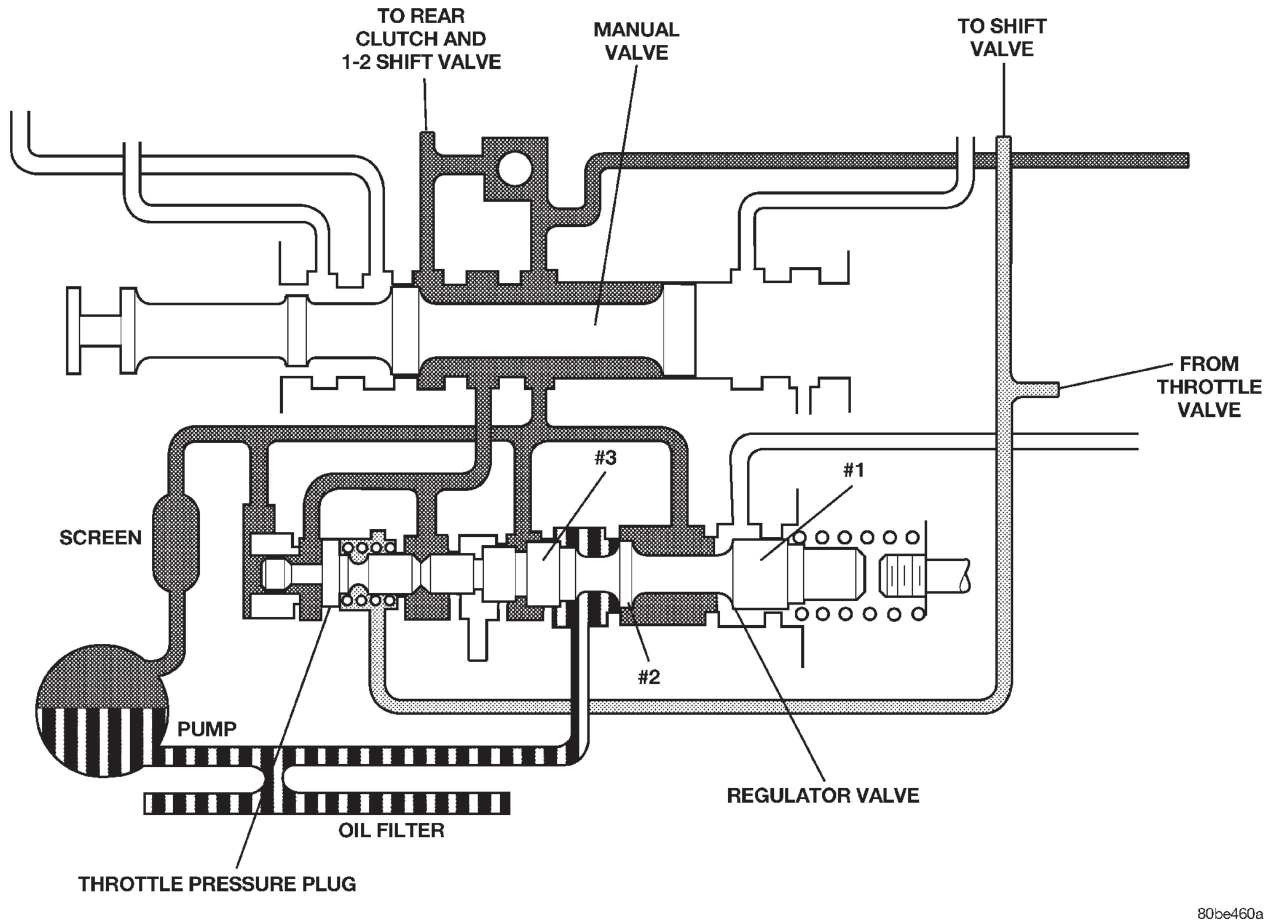


Fig. 201 Regulator Valve in Drive Position

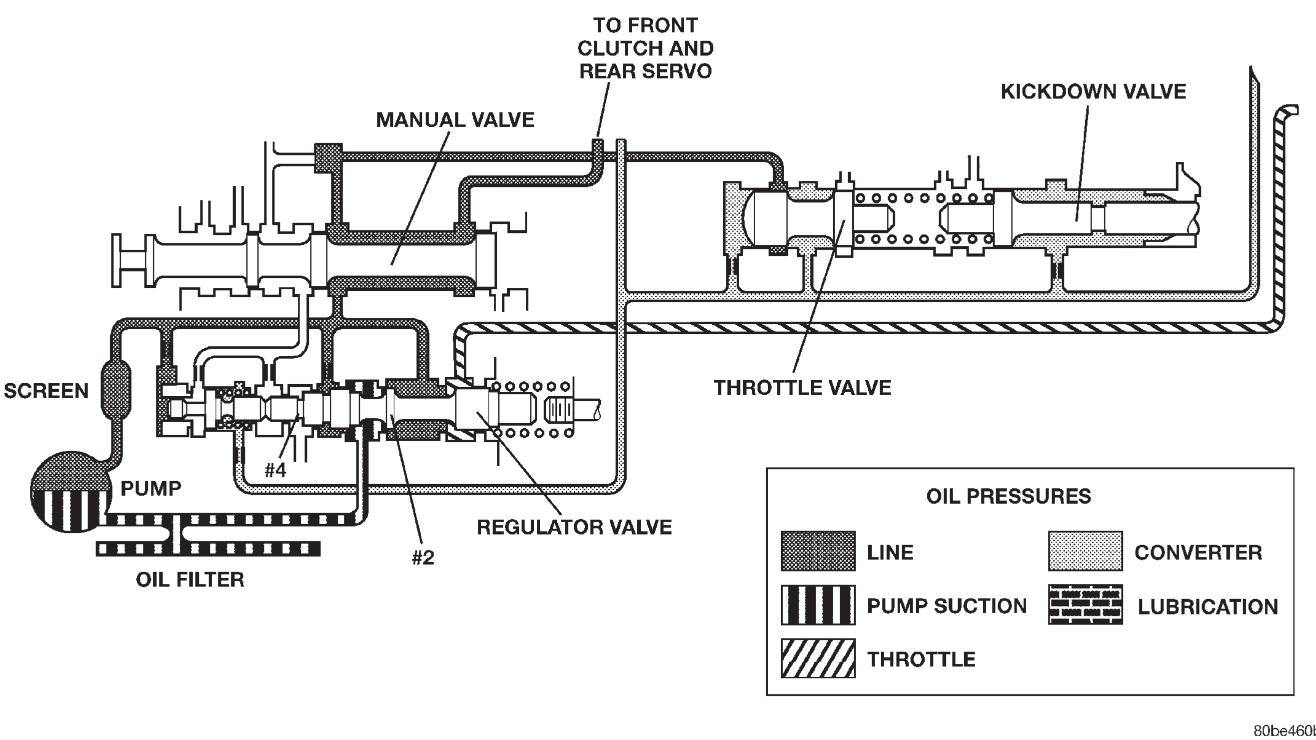


Fig. 202 Regulator Valve in Reverse Position

VALVE BODY (Continued)

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. 203) 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. 204) the limit valve does not come into play and does not affect the downshifts. As the vehicle's speed increases (Fig. 205), 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.

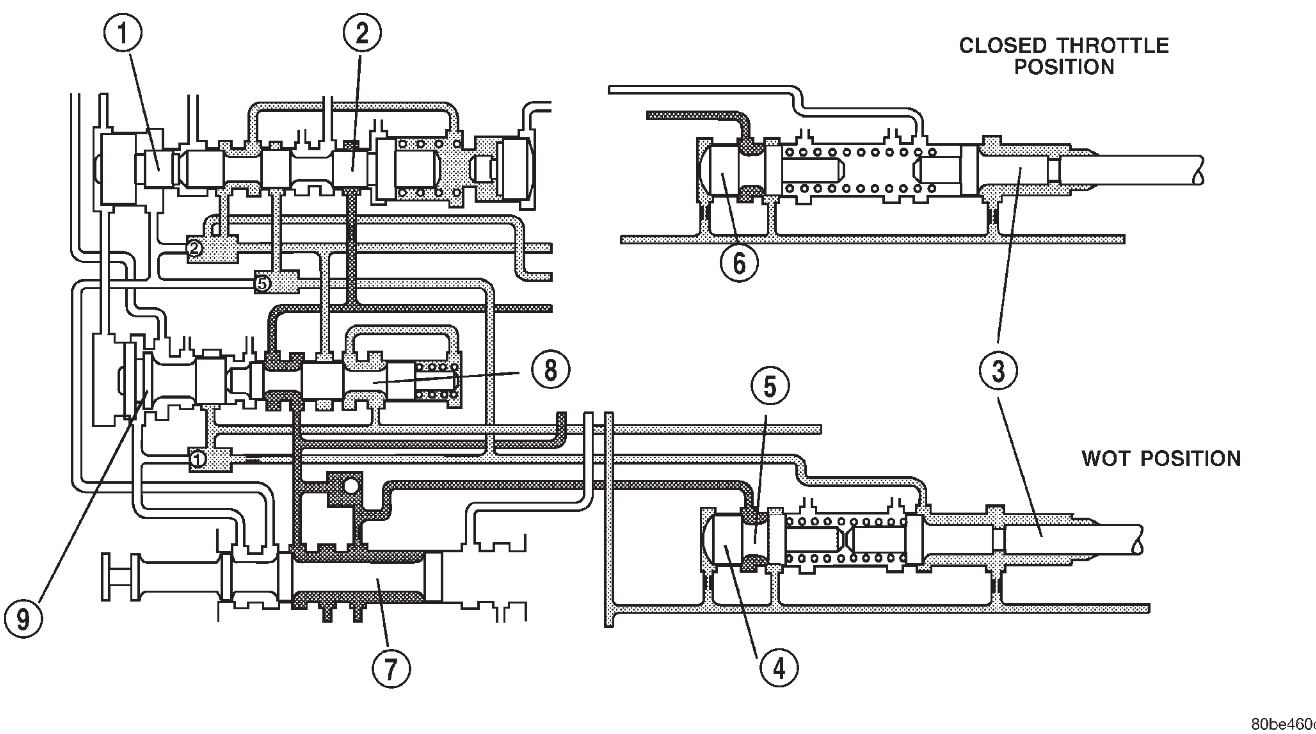


Fig. 203 Kickdown Valve

1 - 2-3 SHIFT VALVE
2 - GOVERNOR PLUG
3 - KICKDOWN VALVE
4 - THROTTLE VALVE
5 - MAXIMUM THROTTLE PRESSURE
6 - THROTTLE VALVE
7 - MANUAL VALVE
8 - 1-2 SHIFT VALVE
9 - GOVERNOR PLUG

VALVE BODY (Continued)

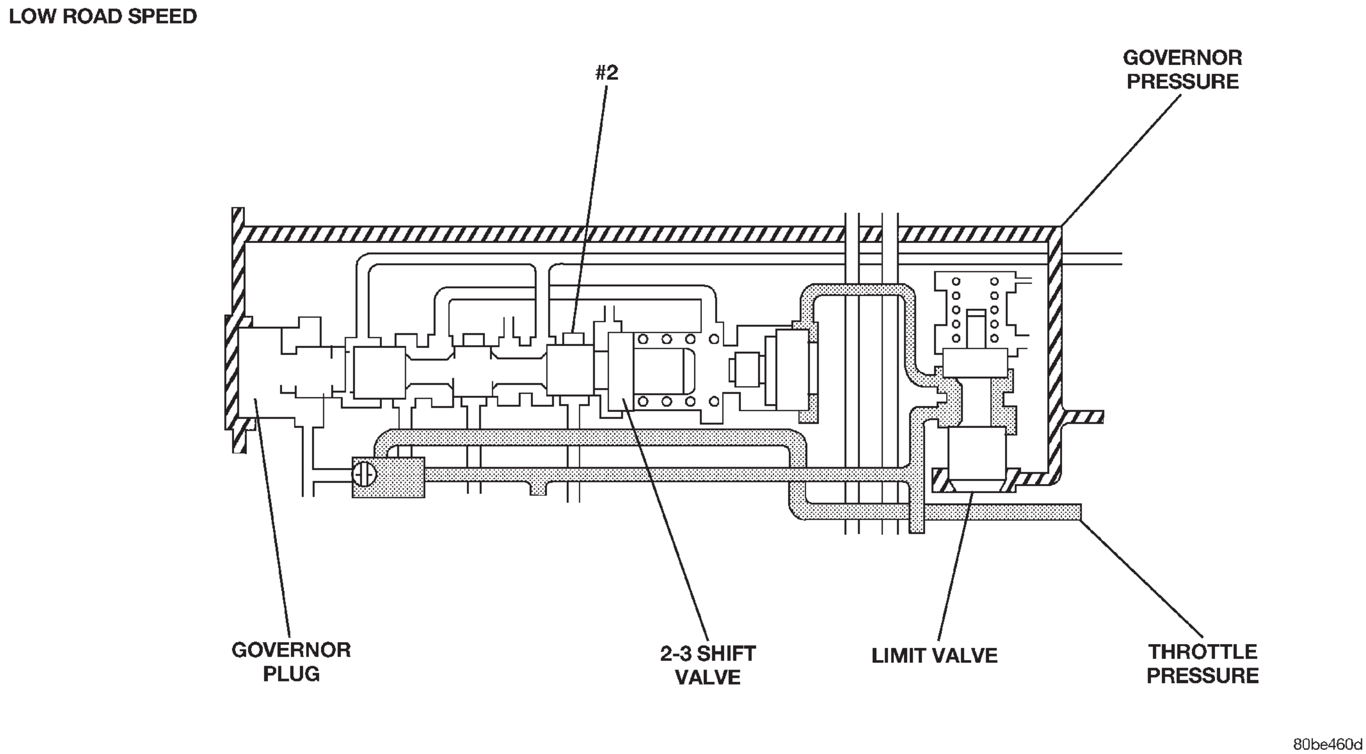


Fig. 204 Kickdown Limit Valve - Low Speeds

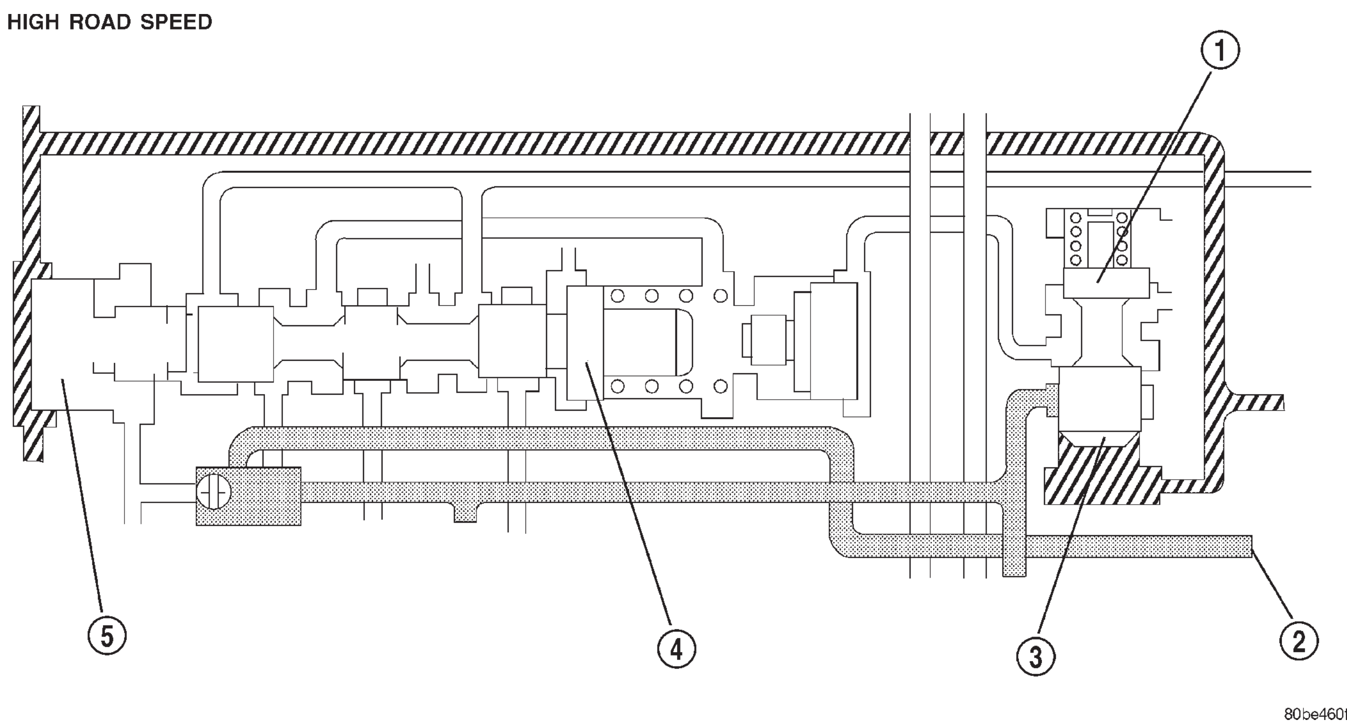


Fig. 205 Kickdown Limit Valve - High Speeds

1 - GOVERNOR PRESSURE CLOSES LIMIT VALVE
2 - THROTTLE PRESSURE
3 - LIMIT VALVE
4 - 2-3 SHIFT VALVE
5 - GOVERNOR PLUG

VALVE BODY (Continued)

1-2 SHIFT VALVE

The 1-2 shift valve assembly (Fig. 206), 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. 207).

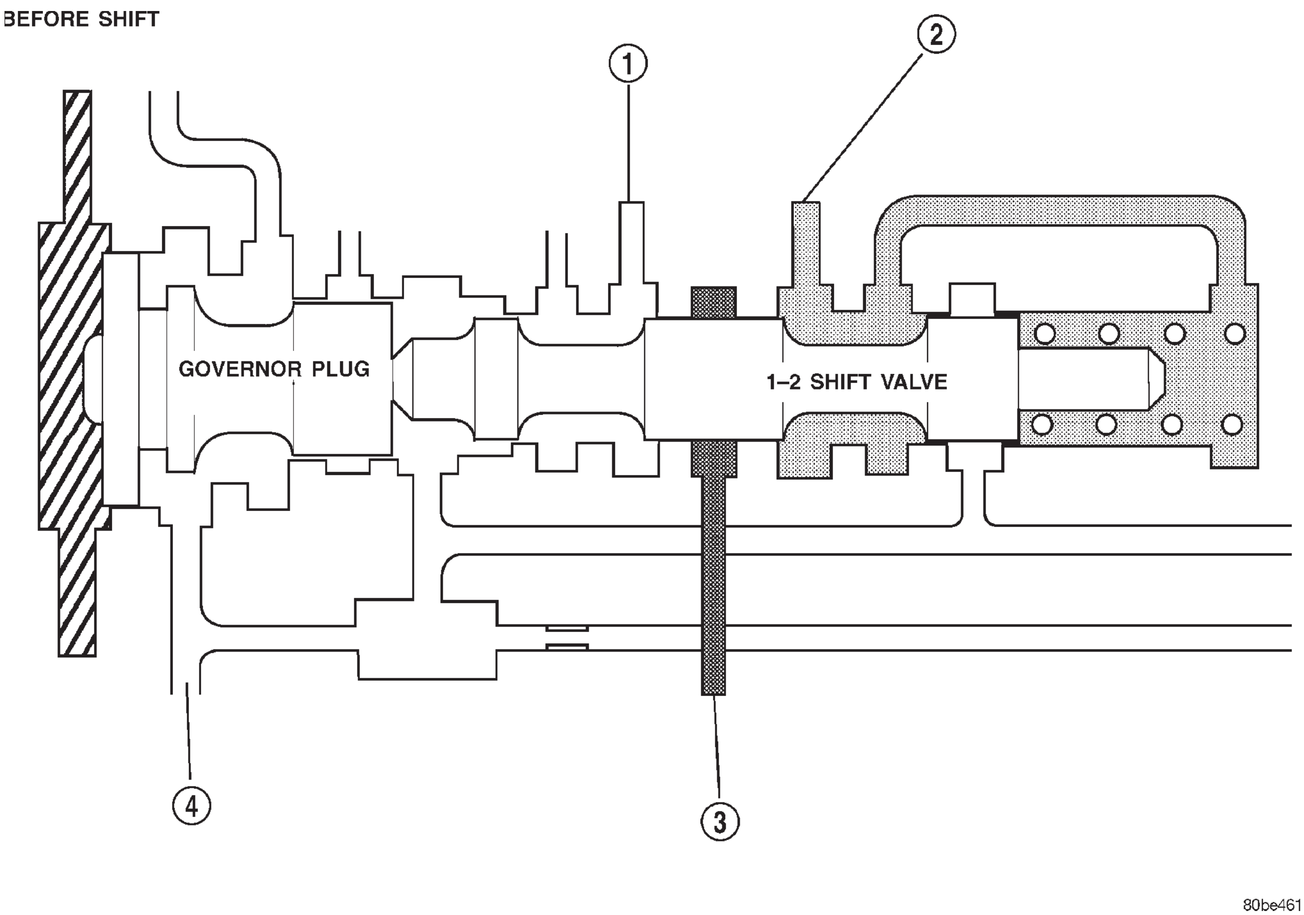


Fig. 206 1-2 Shift Valve - Before Shift

1 - TO FRONT SERVO AND 2-3 SHIFT VALVE
2 - THROTTLE PRESSURE
3 - LINE PRESSURE
4 - LINE PRESSURE PASSAGE FOR MANUAL LOW POSITION

VALVE BODY (Continued)

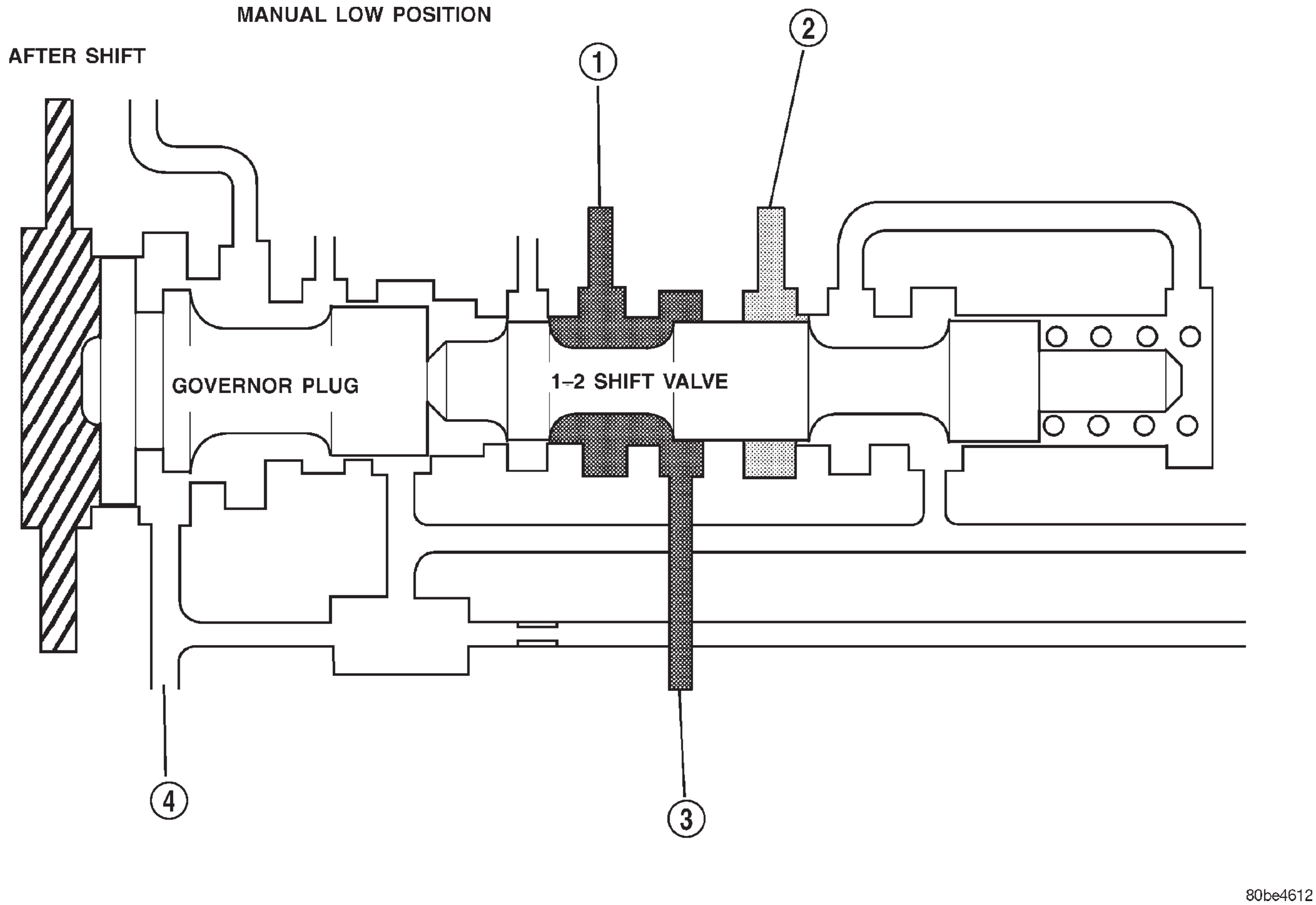


Fig. 207 1-2 Shift Valve - After Shift

1 - TO FRONT SERVO AND 2-3 SHIFT VALVE
2 - THROTTLE PRESSURE
3 - LINE PRESSURE
4 - LINE PRESSURE PASSAGE FOR MANUAL LOW POSITION

The governor plug serves a dual purpose:

- 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. 208):

- 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.

VALVE BODY (Continued)

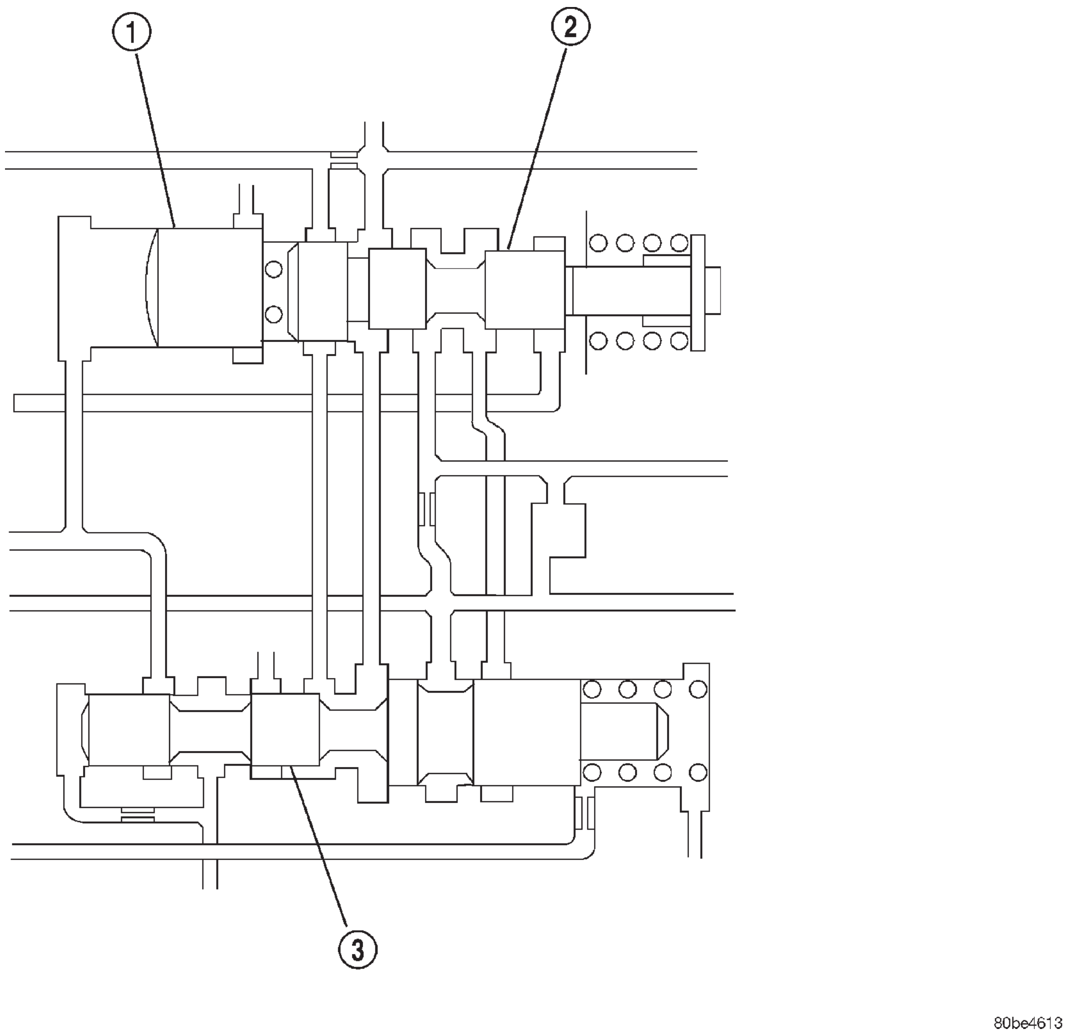


Fig. 208 1-2 Shift Control Valve

1 - THROTTLE PLUG
2 - SHUTTLE VALVE
3 - 1-2 SHIFT CONTROL VALVE

208) 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 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. 209) 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.

VALVE BODY (Continued)

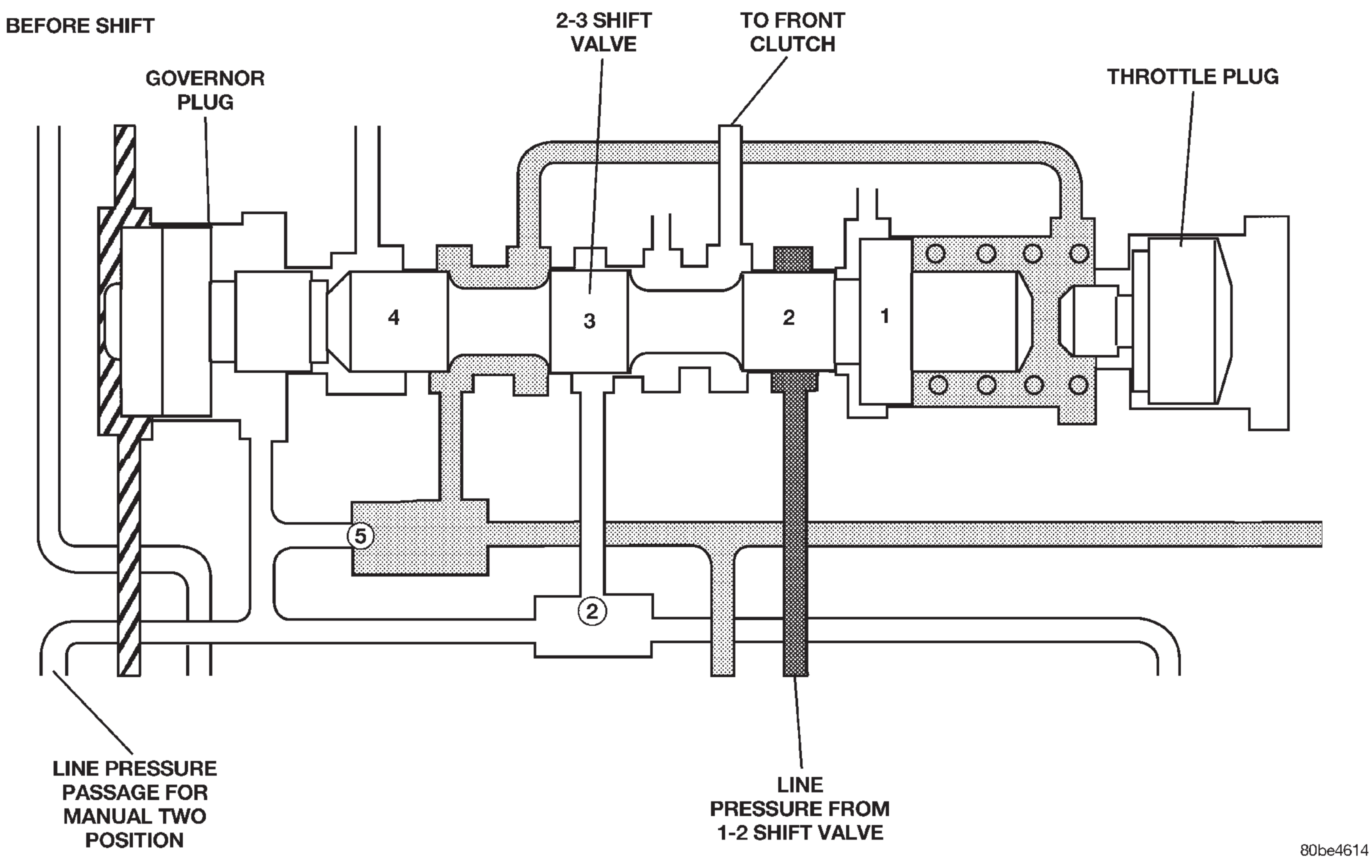


Fig. 209 2-3 Shift Valve - Before Shift

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. 210), 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.

VALVE BODY (Continued)

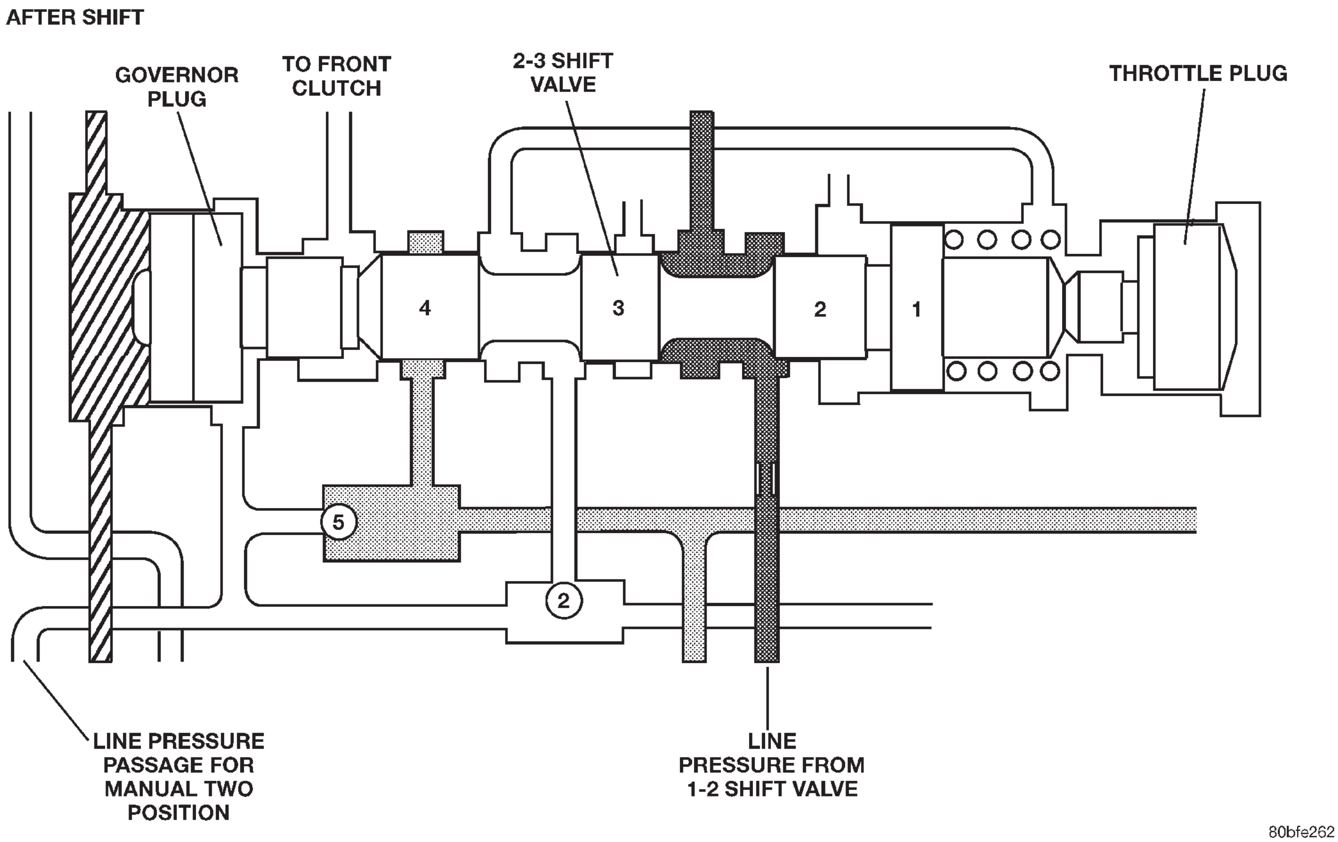


Fig. 210 2-3 Shift Valve - After Shift

THROTTLE VALVE

In all gear positions the throttle valve (Fig. 211) 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.

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. 212), the pressure regulator valve is supplying torque con-

VALVE BODY (Continued)

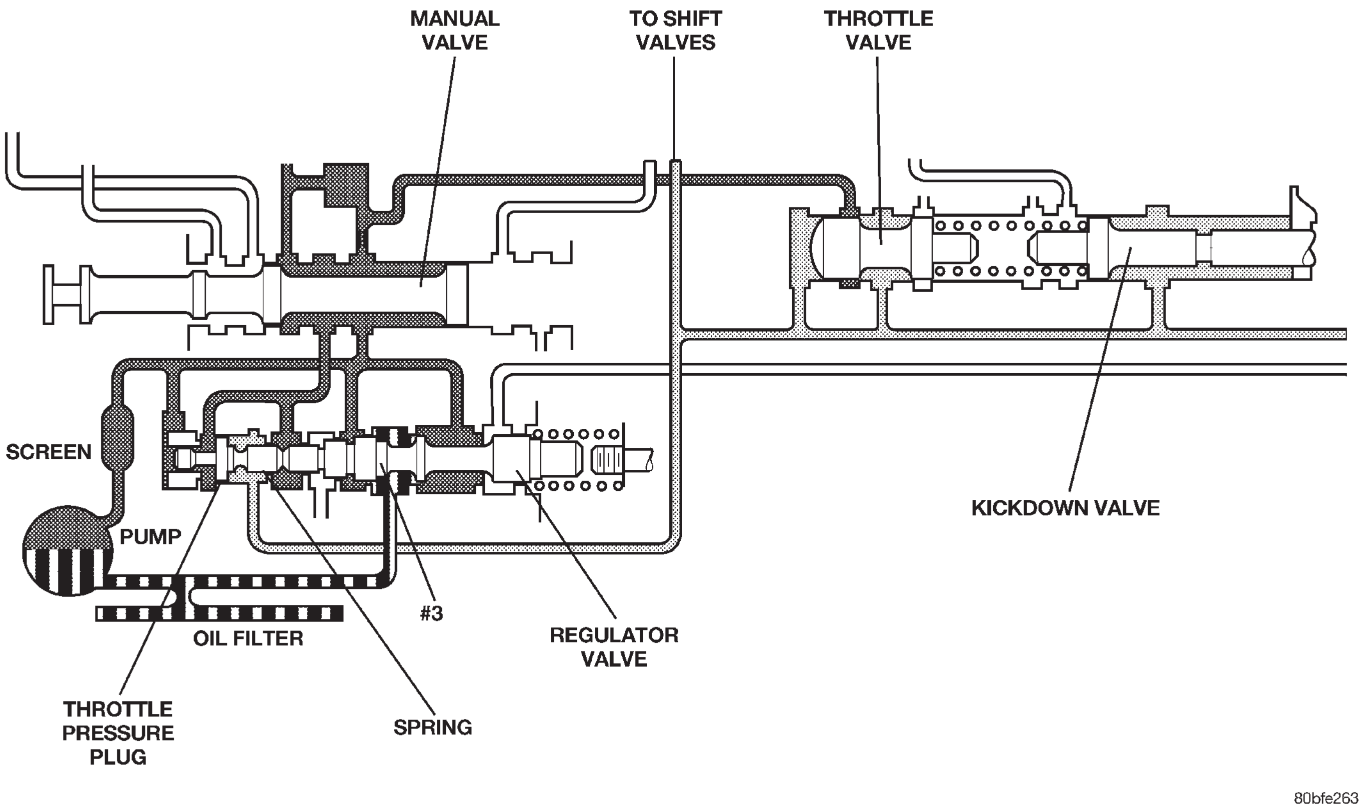


Fig. 211 Throttle Valve

verter 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. 213), 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.

VALVE BODY (Continued)

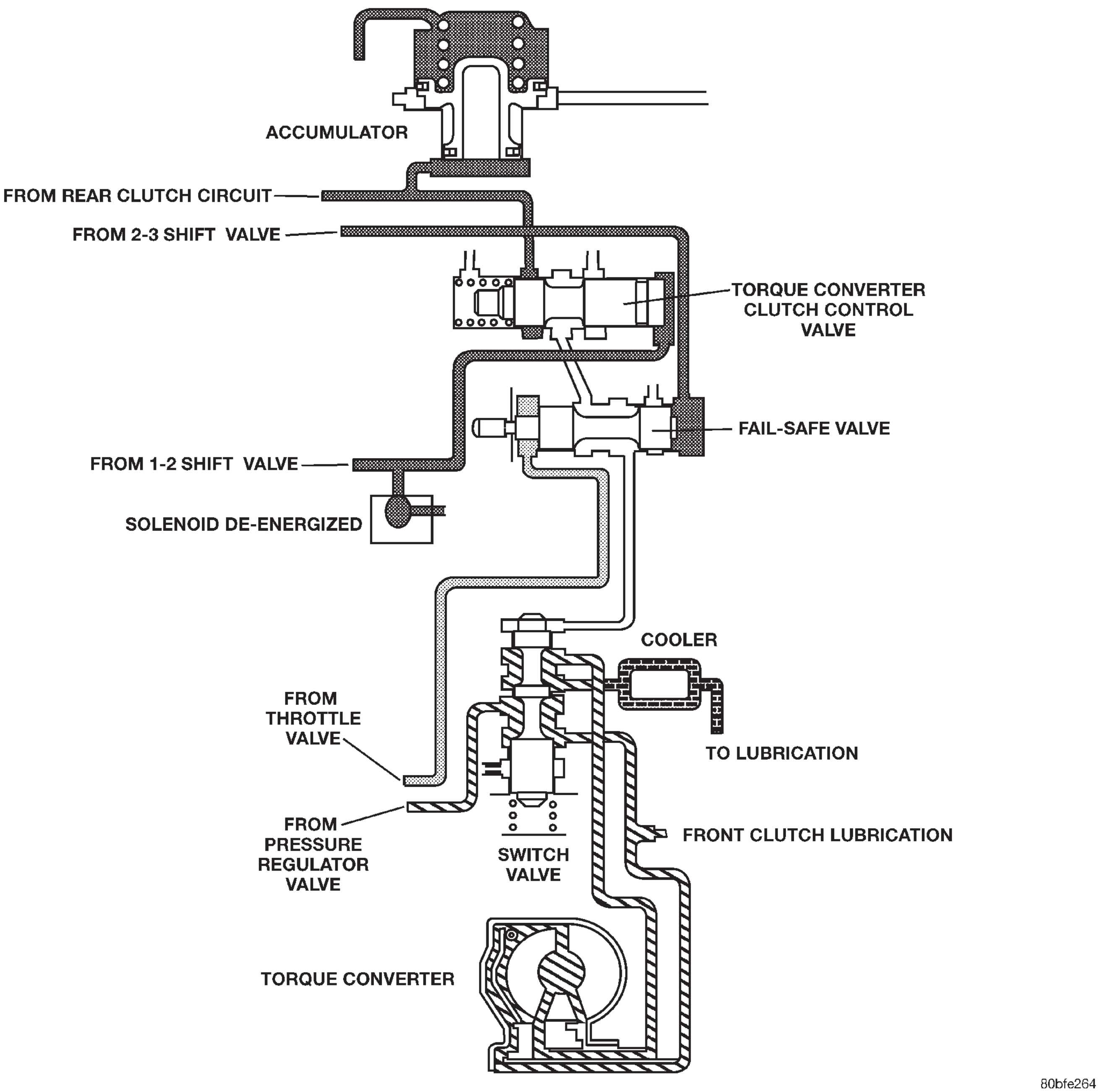


Fig. 212 Switch Valve - Torque Converter Unlocked

VALVE BODY (Continued)

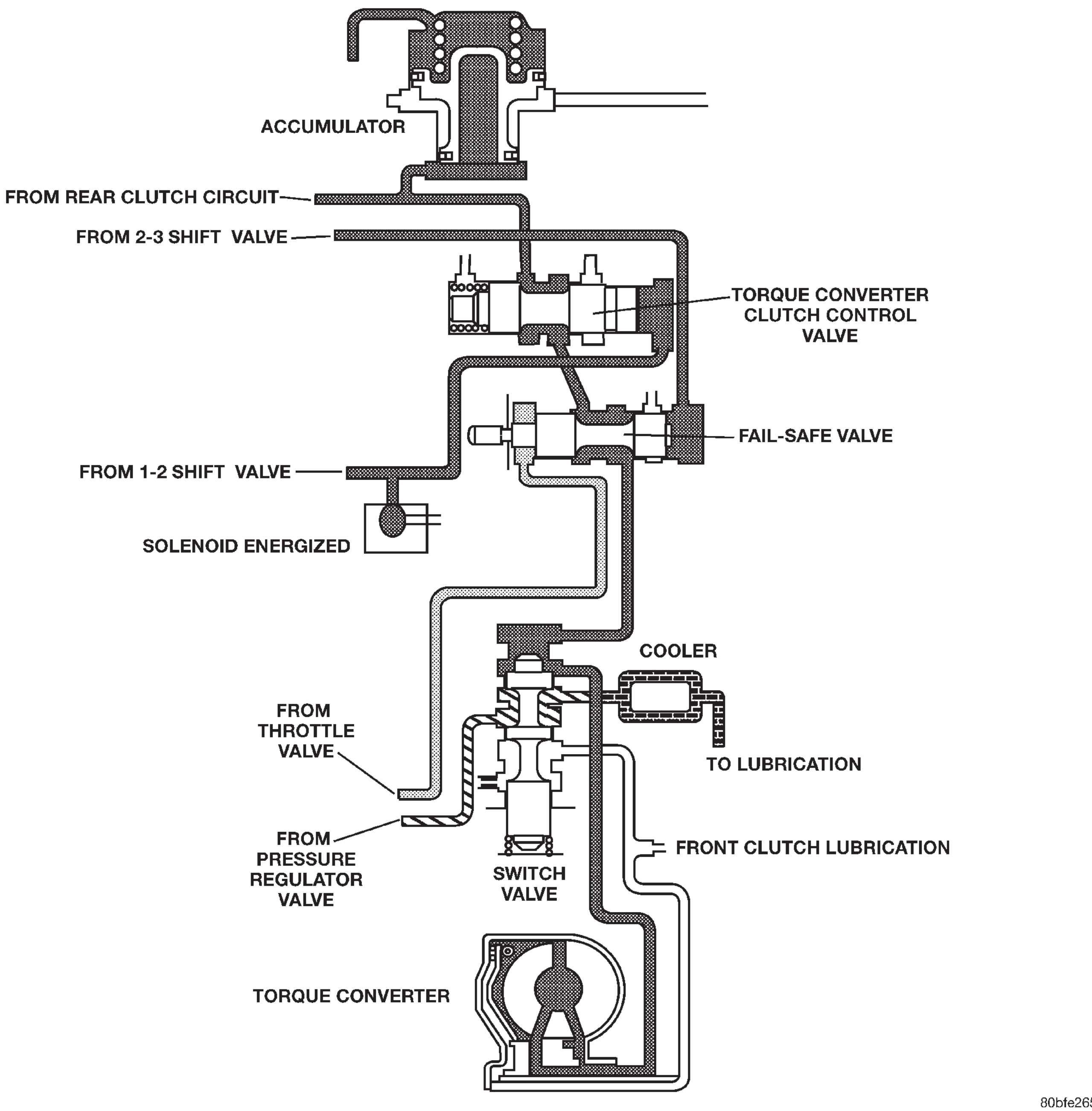


Fig. 213 Switch Valve - Torque Converter Locked

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. 214) 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

VALVE BODY (Continued)

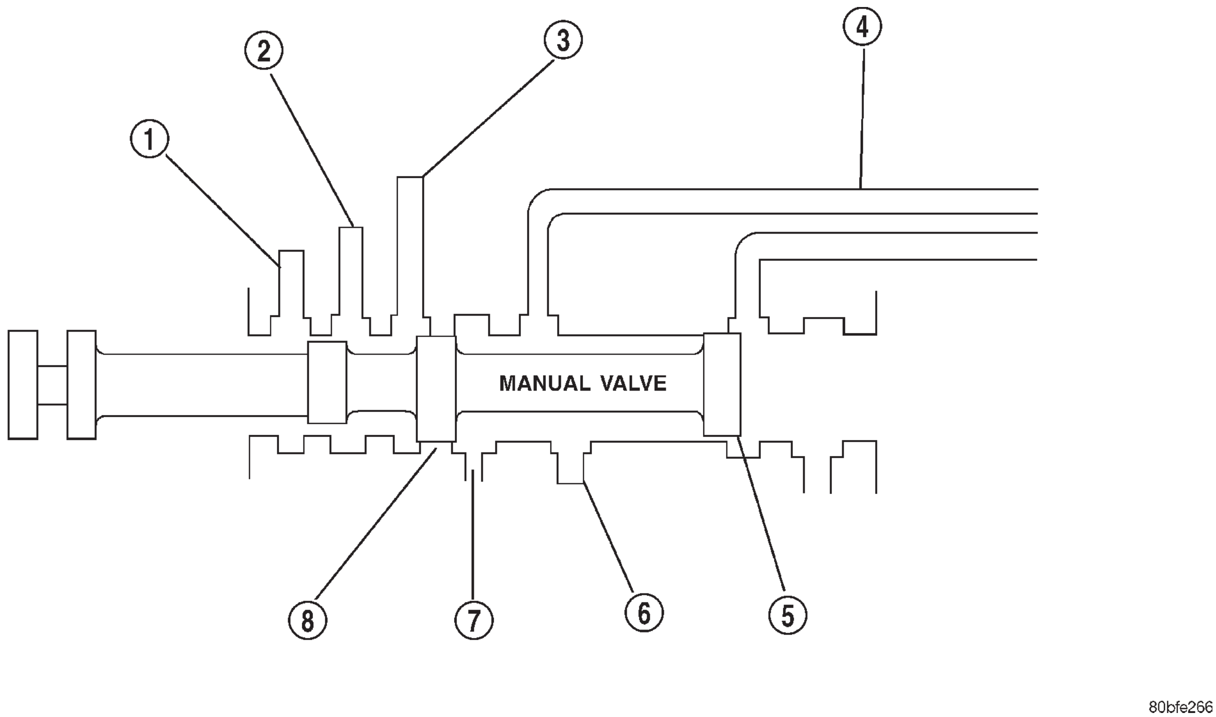


Fig. 214 Manual Valve

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

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.

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. 215).
(7) Remove valve body attaching screws.
(8) Lower valve body enough to remove accumulator piston and piston spring (Fig. 216).
(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. 217).

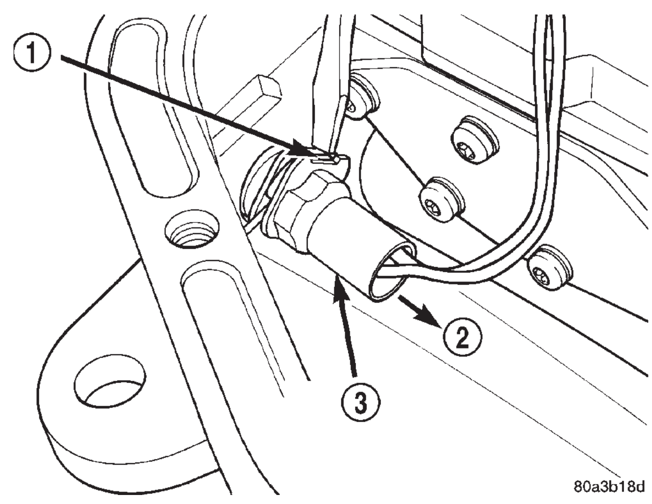


Fig. 215 Solenoid Wire Connector

1 - PUSH CLIP IN
2 - PULL
3 - CONVERTER CLUTCH SOLENOID CONNECTOR

DISASSEMBLY

Position the valve body on a clean work surface to avoid contamination.

VALVE BODY (Continued)

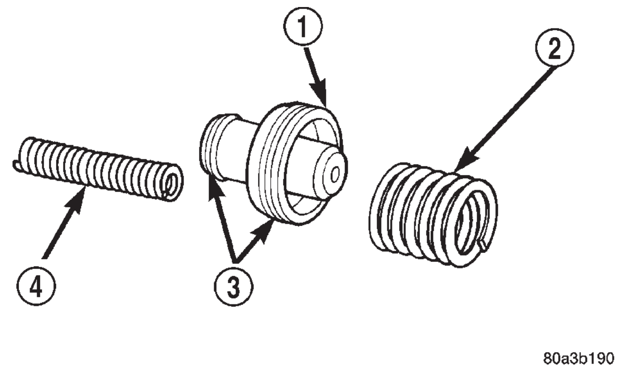


Fig. 216 Accumulator Piston And Springs

1 - ACCUMULATOR PISTON
2 - OUTER SPRING
3 - PISTON SEAL RINGS
4 - INNER SPRING (32RH)

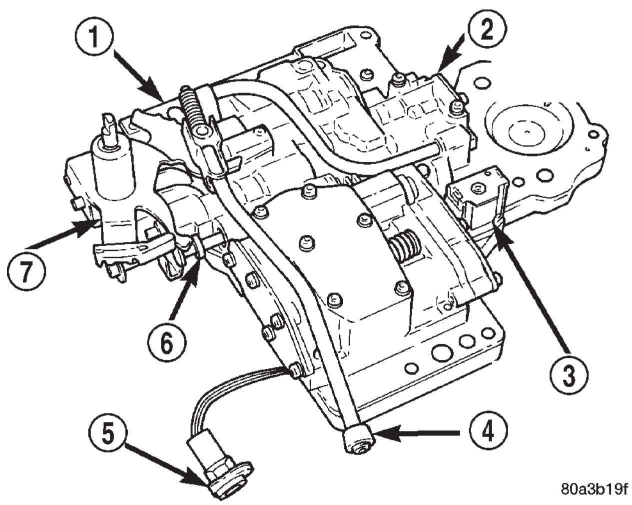


Fig. 217 Valve Body

1 - VALVE BODY
2 - CONVERTER CLUTCH MODULE
3 - SOLENOID
4 - PARK ROD
5 - CONVERTER CLUTCH SOLENOID CONNECTOR
6 - MANUAL VALVE
7 - MANUAL LEVER

CAUTION: Do not clamp any part of the valve body assembly (Fig. 218) 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. 219).

(3) Remove switch valve and spring, pressure regulator valve and spring, kickdown valve and spring, and throttle valve from valve body (Fig. 219).

(4) Secure detent ball and spring in housing with Retainer Tool 6583 (Fig. 220).

(5) Remove manual shaft E-clip, washer, and seal (Fig. 221).

(6) Pull manual shaft and park rod assembly upward out of valve body and off throttle lever (Fig. 221).

(7) Remove manual valve from valve body (Fig. 222)

(8) Remove Retainer Tool 6583. Then remove and retain detent ball and spring (Fig. 221).

(9) Remove throttle lever (Fig. 221).

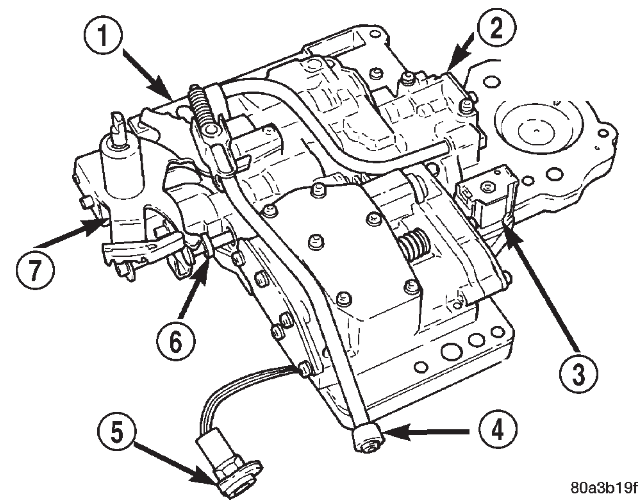


Fig. 218 Valve Body Assembly

1 - VALVE BODY
2 - CONVERTER CLUTCH MODULE
3 - SOLENOID
4 - PARK ROD
5 - CONVERTER CLUTCH SOLENOID CONNECTOR
6 - MANUAL VALVE
7 - MANUAL LEVER

VALVE BODY (Continued)

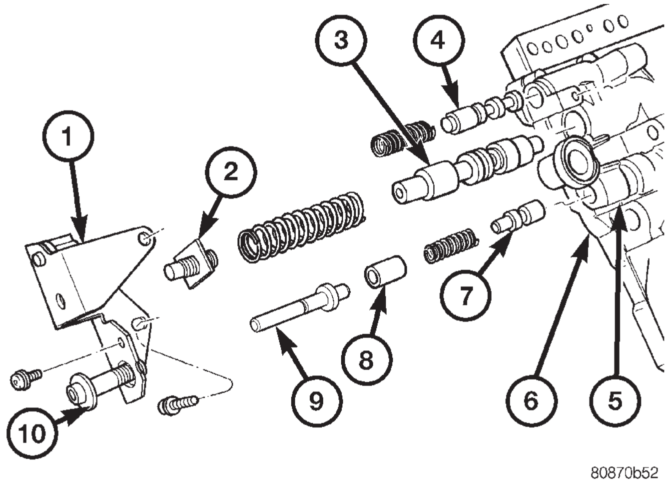


Fig. 219 Adjusting Screw Bracket, Springs, Valve Removal

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

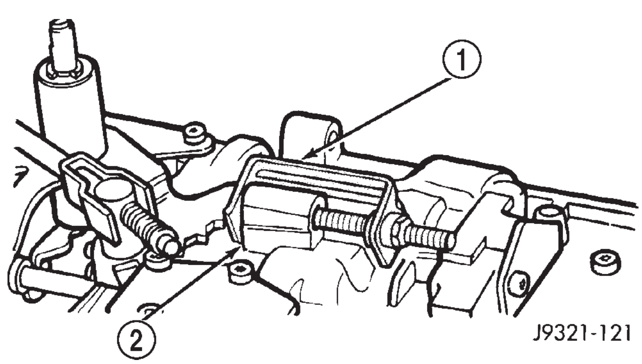


Fig. 220 Securing Detent Ball And Spring With Retainer Tool

1 - SPECIAL TOOL 6583
2 - DETENT BALL AND SPRING HOUSING

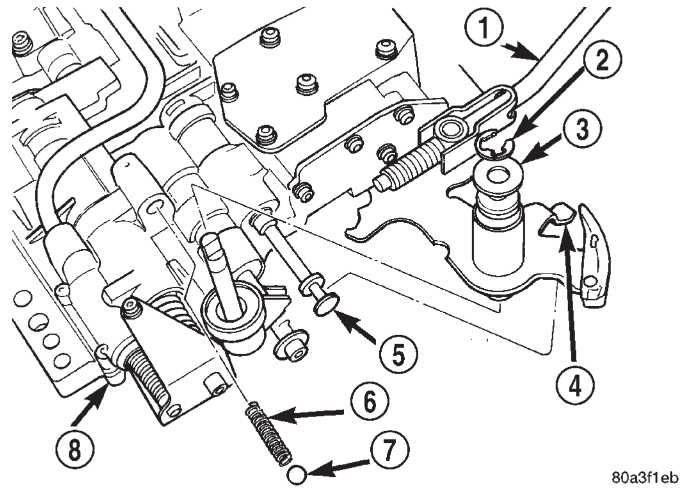


Fig. 221 Manual And Throttle Levers

1 - PARK ROD
2 - E-RING
3 - WASHER
4 - MANUAL LEVER
5 - MANUAL VALVE
6 - SPRING
7 - DETENT BALL
8 - VALVE BODY

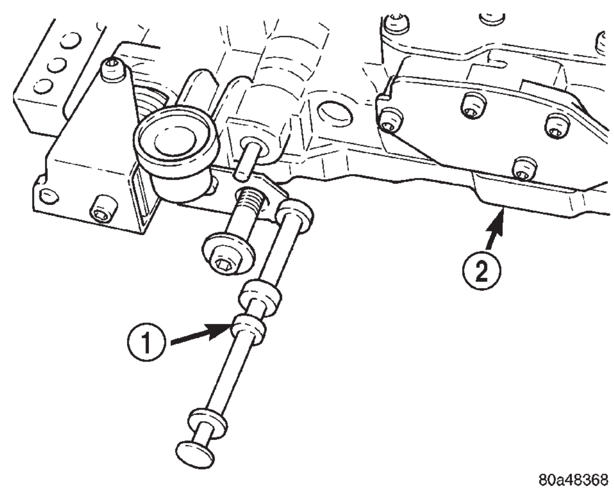


Fig. 222 Manual Valve

1 - MANUAL VALVE
2 - VALVE BODY

VALVE BODY (Continued)

(10) Remove park rod E-clip and separate rod from manual lever (Fig. 223).

(11) Remove converter clutch solenoid from separator plate (Fig. 224). 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. 225).

(13) Remove screws attaching end cover plate to torque converter module (Fig. 226).

(14) Remove converter clutch valve, fail safe valve, and springs (Fig. 226)

(15) Turn valve body over so transfer plate is facing upward (Fig. 227). 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. 227).

(17) Remove transfer plate and separator plate from valve body (Fig. 227). 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.

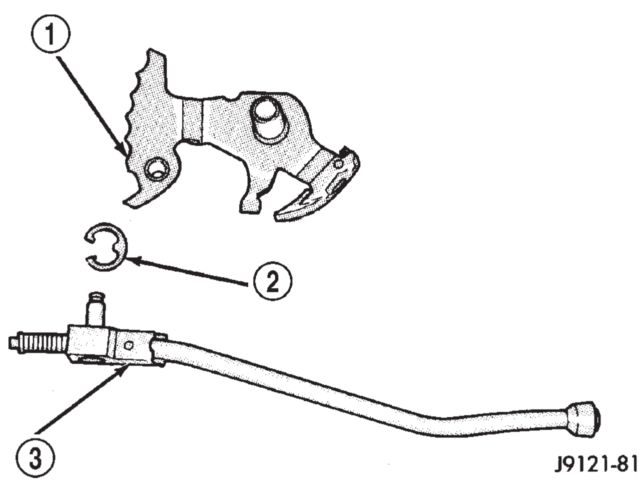


Fig. 223 Park Rod

1 - MANUAL LEVER
2 - E-CLIP
3 - PARK ROD

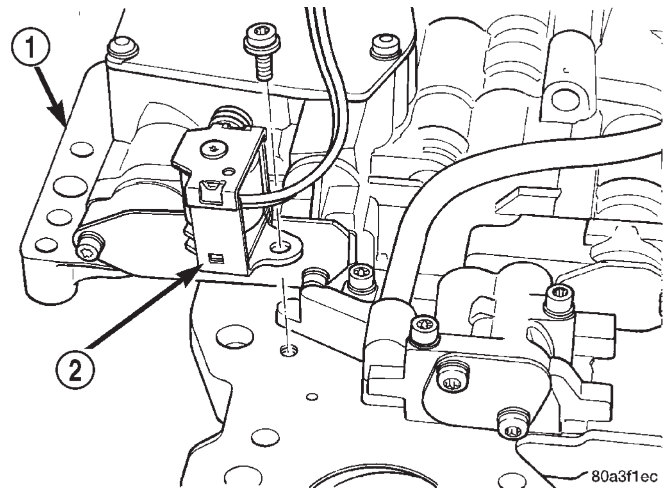


Fig. 224 Converter Clutch Solenoid

1 - VALVE BODY
2 - TORQUE CONVERTER CLUTCH SOLENOID

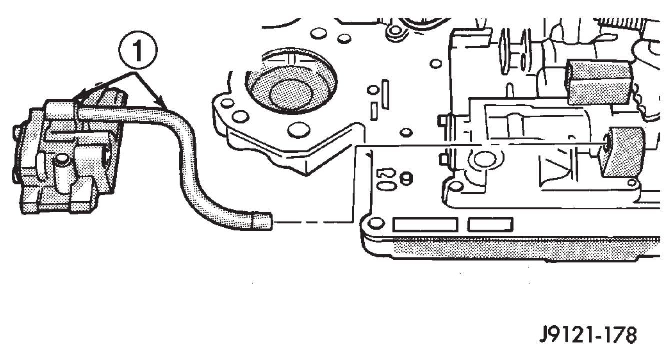


Fig. 225 Clutch Module And Connecting Tube

1 - MODULE AND CONNECTING TUBE

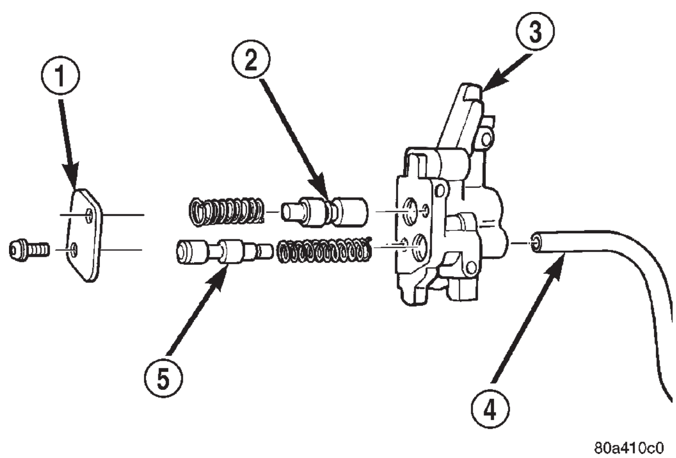


Fig. 226 Converter Clutch and Fail-Safe Valves

1 - COVER PLATE
2 - CONVERTER CLUTCH VALVE
3 - TORQUE CONVERTER CLUTCH MODULE
4 - MODULE CONNECTING TUBE
5 - FAIL-SAFE VALVE

VALVE BODY (Continued)

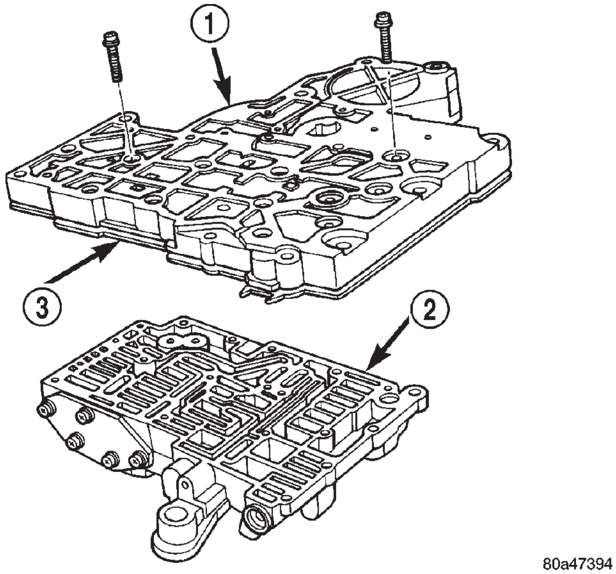


Fig. 227 Valve Body Transfer Plate Screws

1 - TRANSFER PLATE
2 - VALVE BODY
3 - SEPARATOR PLATE

(19) Remove screws attaching separator plate to transfer plate (Fig. 228).

(20) Note position of filter, rear clutch servo and rear servo check balls for assembly reference (Fig. 228) and (Fig. 229).

(21) Remove shuttle valve end plate (Fig. 230).

(22) Remove shuttle valve E-clip and remove secondary spring and spring guides from end of valve (Fig. 231).

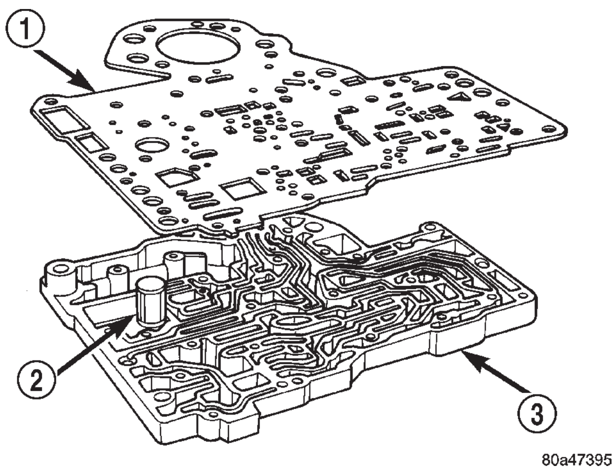


Fig. 228 Transfer And Separator Plates

1 - SEPARATOR PLATE
2 - FILTER
3 - TRANSFER PLATE

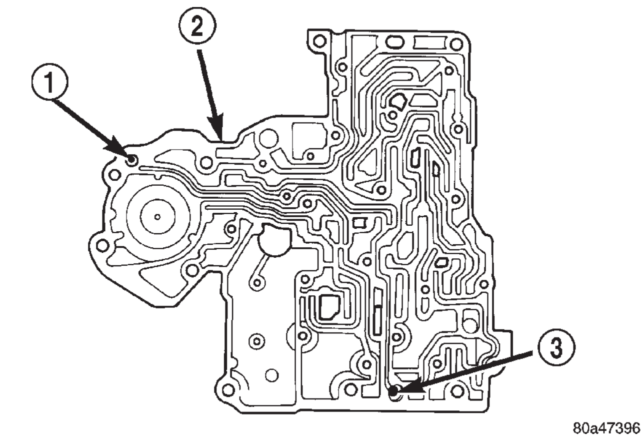


Fig. 229 Rear Servo and Rear Clutch Check Balls

1 - REAR SERVO CHECK BALL
2 - TRANSFER PLATE
3 - REAR CLUTCH CHECK BALL

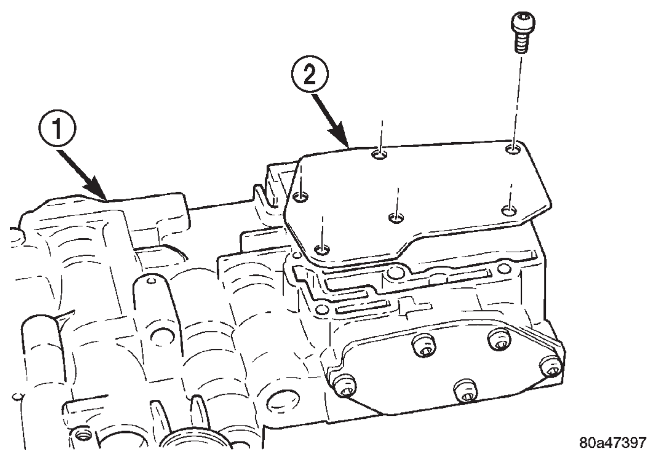


Fig. 230 Shuttle Valve

1 - VALVE BODY
2 - SHUTTLE VALVE END PLATE

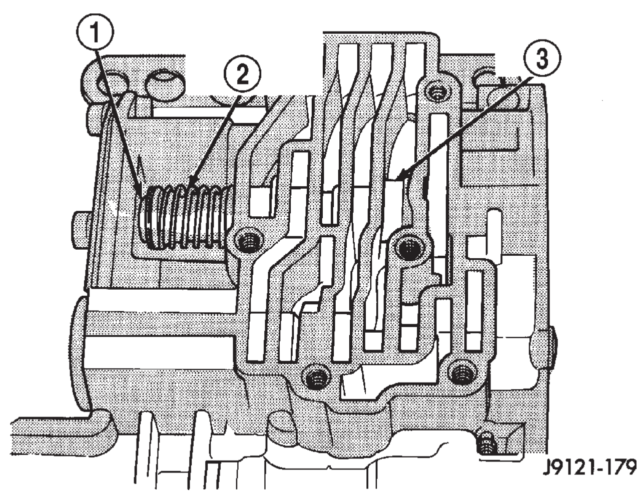


Fig. 231 Shuttle Valve E-Clip And Secondary Spring

1 - E-CLIP
2 - SECONDARY SPRING AND GUIDES
3 - SHUTTLE VALVE

VALVE BODY (Continued)

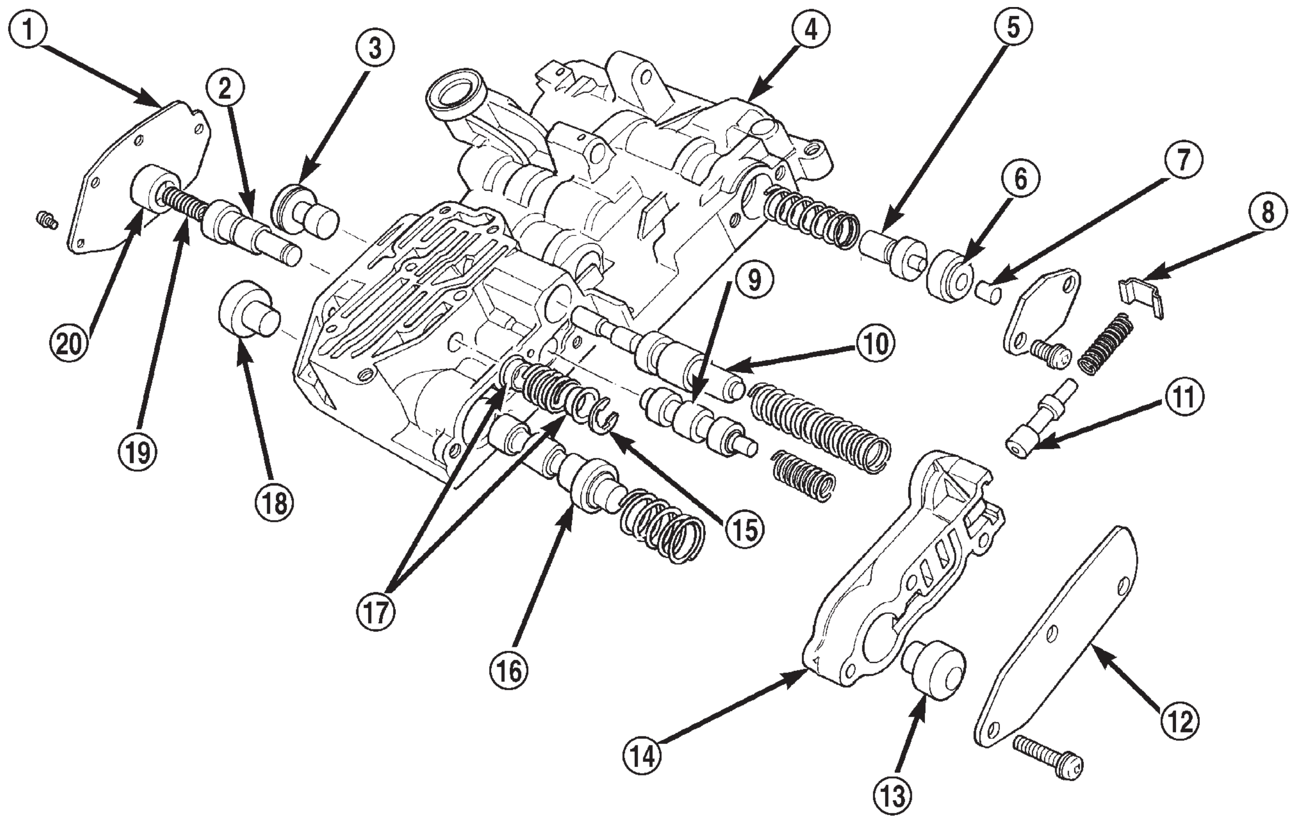


Fig. 232 Control Valves, Shift Valves, And Governor Plugs

1 - GOVERNOR PLUG END PLATE	11 - KICKDOWN LIMIT VALVE
2 - SHUTTLE VALVE	12 - END PLATE
3 - 1-2 GOVERNOR PLUG	13 - THROTTLE PRESSURE PLUG
4 - VALVE BODY	14 - KICKDOWN LIMIT VALVE BODY
5 - REGULATOR VALVE THROTTLE PRESSURE PLUG	15 - E-RING
6 - SLEEVE	16 - 2-3 SHIFT VALVE
7 - LINE PRESSURE PLUG	17 - GUIDES
8 - RETAINER	18 - 2-3 GOVERNOR PLUG
9 - 1-2 SHIFT VALVE	19 - PRIMARY SPRING
10 - 1-2 SHIFT CONTROL VALVE	20 - SHUTTLE VALVE THROTTLE PLUG

(23) Remove governor plug end plate (Fig. 232).

(24) Remove 1-2 and 2-3 shift valve governor plugs from valve body (Fig. 232).

(25) Remove shuttle valve throttle plug, primary spring and shuttle valve from valve body (Fig. 232).

(26) Remove screws attaching kickdown limit valve body to valve body (Fig. 232).

(27) Remove 1-2 shift control valve and spring from valve body (Fig. 232).

(28) Remove 2-3 shift valve and spring from valve body (Fig. 232).

(29) Remove 1-2 shift valve and spring from valve body (Fig. 232).

(30) Remove throttle pressure plug from kickdown limit valve body (Fig. 232).

(31) Remove retainer from end of kickdown limit valve body (Fig. 232).

(32) Remove kickdown limit valve and spring from kickdown limit valve body (Fig. 232).

(33) Remove regulator valve end plate from valve body (Fig. 232).

(34) Remove regulator valve line pressure plug, pressure plug sleeve, regulator valve throttle pressure plug and spring (Fig. 232).

VALVE BODY (Continued)

CLEANING

Serviceable valve body components (Fig. 233) 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.

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.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with crocus cloth. The cloth should be in sheet form and be positioned on a surface plate, sheet of plate glass, or equally flat surface. However, if distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: Many of the valve body valves and plugs are made of coated aluminum. Aluminum components can be identified by the dark color of the special coating applied to the surface (or by testing with a magnet). DO NOT polish or sand aluminum valves or plugs with any type of material, or under any circumstances. This practice might damage the special coating and cause the valves and plugs to stick and bind.

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.

VALVE BODY (Continued)

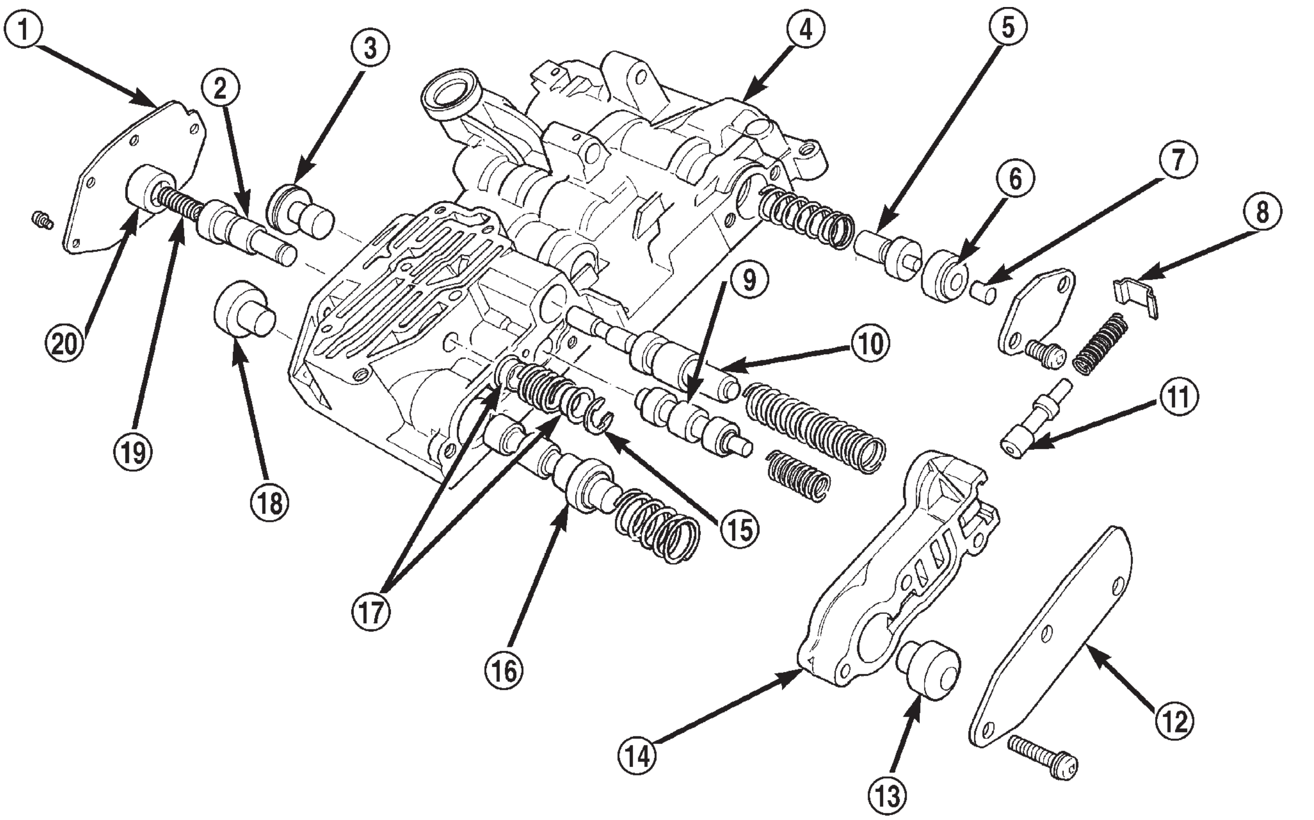


Fig. 233 Valve Body Components

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

INSPECTION

Inspect the throttle and manual valve levers and shafts. Do not attempt to straighten a bent shaft or correct a loose lever. Replace these components if worn, bent, loose or damaged in any way.

Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straight-edge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Also inspect the coating on the aluminum valves and plugs (Fig. 234). If the coating is damaged or worn through, the valve (or valve body) should be replaced.

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.

VALVE BODY (Continued)

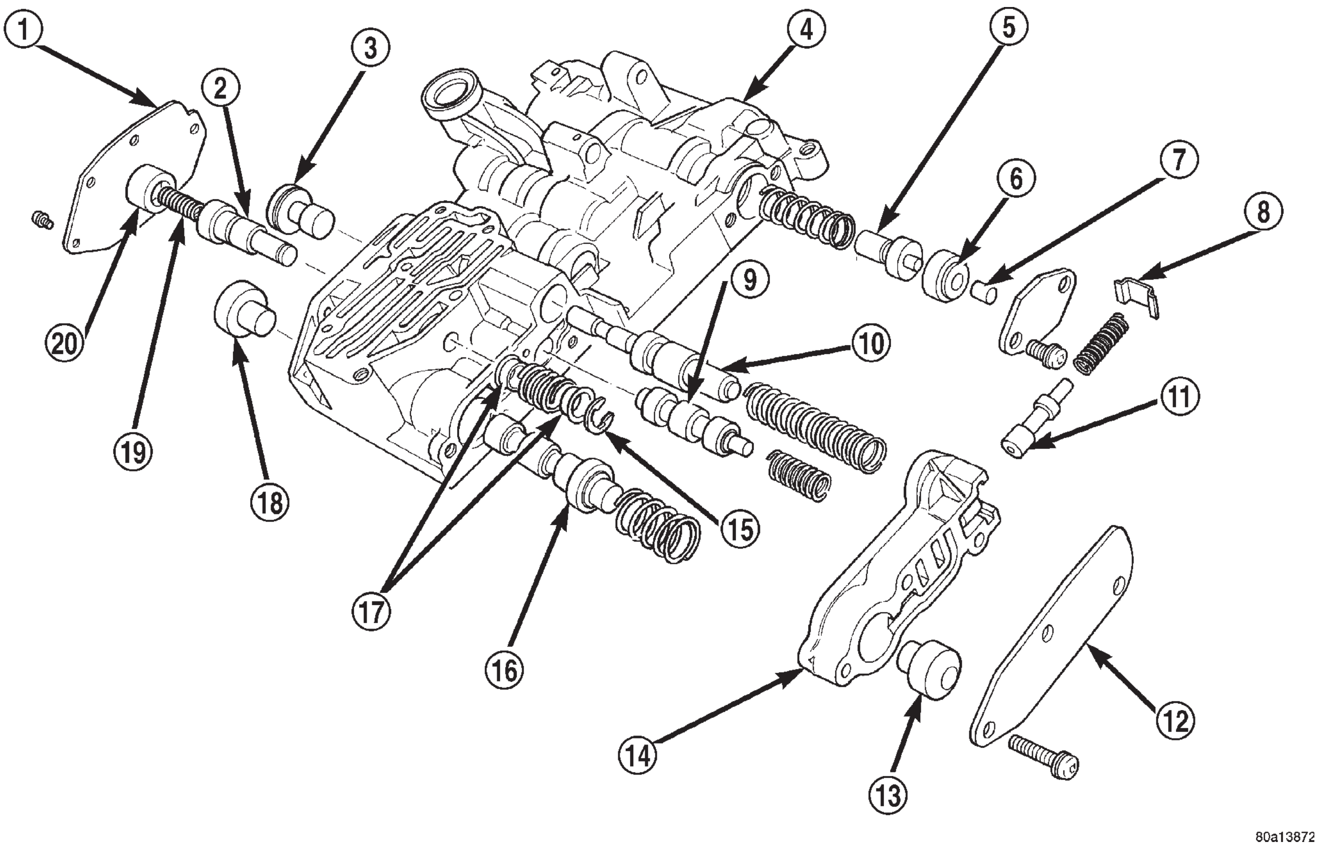


Fig. 234 Valve Body Components

1 - GOVERNOR PLUG END PLATE	11 - KICKDOWN LIMIT VALVE
2 - SHUTTLE VALVE	12 - END PLATE
3 - 1-2 GOVERNOR PLUG	13 - THROTTLE PRESSURE PLUG
4 - VALVE BODY	14 - KICKDOWN LIMIT VALVE BODY
5 - REGULATOR VALVE THROTTLE PRESSURE PLUG	15 - E-RING
6 - SLEEVE	16 - 2-3 SHIFT VALVE
7 - LINE PRESSURE PLUG	17 - GUIDES
8 - RETAINER	18 - 2-3 GOVERNOR PLUG
9 - 1-2 SHIFT VALVE	19 - PRIMARY SPRING
10 - 1-2 SHIFT CONTROL VALVE	20 - SHUTTLE VALVE THROTTLE PLUG

ASSEMBLY

Clean and inspect all valve body components for damage or wear.

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 4, Type 9602, transmission fluid.

(2) Install regulator valve line pressure plug, pressure plug sleeve, regulator valve throttle pressure plug, and spring into valve body (Fig. 232). Verify valve components slide freely.

(3) Install regulator valve end plate on valve body (Fig. 232).

(4) Install kickdown limit valve and spring in kickdown limit valve body (Fig. 232). 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. 232).

VALVE BODY (Continued)

(7) Install throttle pressure plug in kickdown limit valve body (Fig. 232).

(8) Install 1-2 shift valve and spring into valve body (Fig. 232).

(9) Install 2-3 shift valve and spring into valve body (Fig. 232).

(10) Install 1-2 shift control valve and spring into valve body (Fig. 232).

(11) Verify valve components slide freely.

(12) Place kickdown limit valve body and end plate in position on valve body and compress springs (Fig. 232).

(13) Install screws to attach kickdown limit valve body to valve body (Fig. 232).

(14) Install shuttle valve throttle plug, primary spring and shuttle valve into valve body (Fig. 232). Verify valve components slide freely.

(15) Install 1-2 and 2-3 shift valve governor plugs into valve body (Fig. 232). 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. 232).

(18) Assemble shuttle valve spring and guides (Fig. 232). Place spring and guides in position on shuttle valve stem.

(19) Compress spring and install E-clip in groove on shuttle valve stem (Fig. 235).

(20) Place shuttle valve end plate in position on valve body (Fig. 236).

(21) Install screws to attach shuttle valve end plate to valve body (Fig. 236).

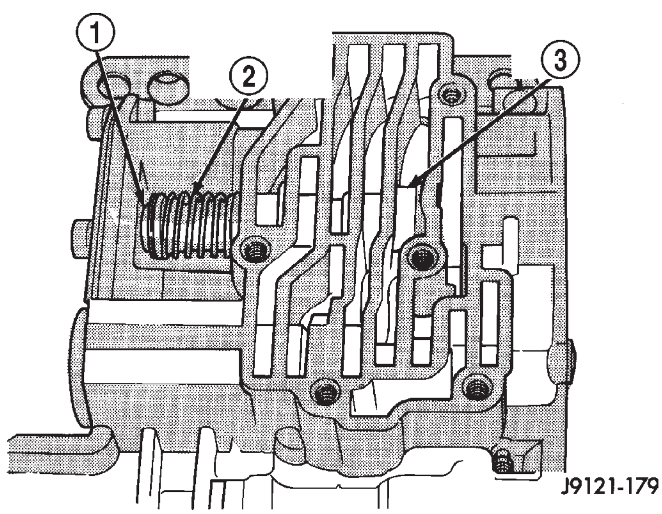


Fig. 235 Shuttle Valve E-Clip And Secondary Spring

1 - E-CLIP
2 - SECONDARY SPRING AND GUIDES
3 - SHUTTLE VALVE

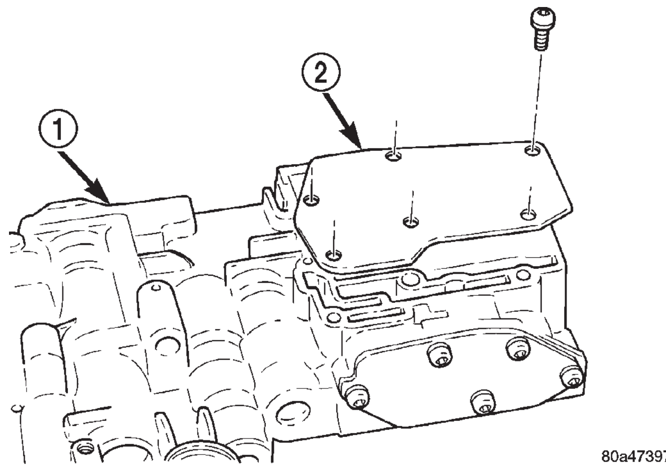


Fig. 236 Shuttle Valve End Plate

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. 237).

(23) Insert filter into opening in separator plate (Fig. 238).

(24) Place separator plate in position on transfer plate and install screws to attach separator plate to transfer plate (Fig. 238).

(25) Place one 11/32 in. check ball and six 1/4 in. check balls in the proper cavities in the valve body (Fig. 239).

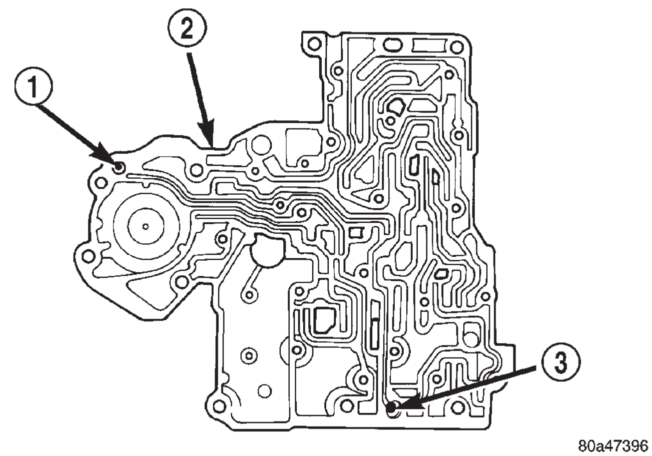


Fig. 237 Rear Servo and Rear Clutch Check Balls

1 - REAR SERVO CHECK BALL
2 - TRANSFER PLATE
3 - REAR CLUTCH CHECK BALL

(26) Place transfer plate in position on valve body (Fig. 240).

(27) Install screws to attach transfer plate to valve body (Fig. 240).

(28) Turn valve body over to expose the separator plate.

VALVE BODY (Continued)

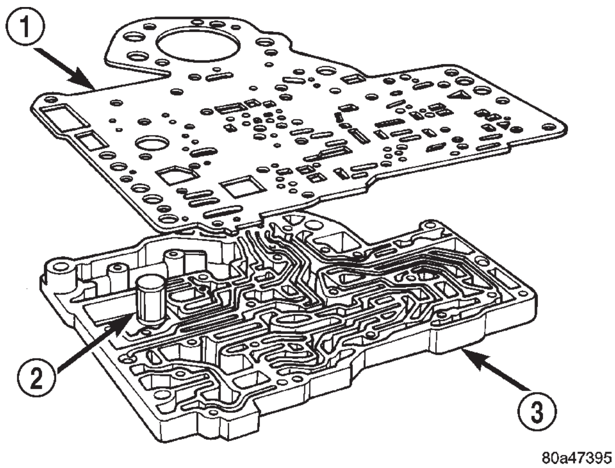


Fig. 238 Transfer And Separator Plates

1 - SEPARATOR PLATE
2 - FILTER
3 - TRANSFER PLATE

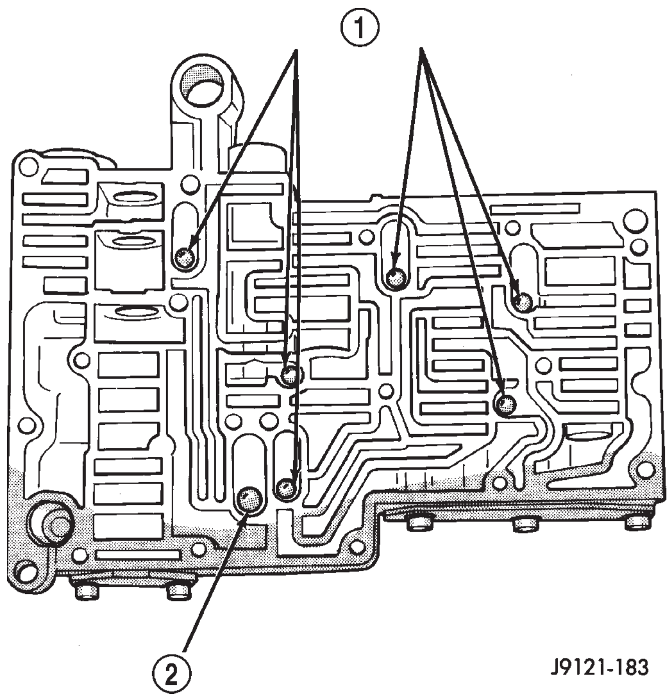


Fig. 239 Correct Position Of Valve Body Check Balls

1 - 1/4'' CHECK BALLS (6)
2 - 11/32'' CHECK BALL (1)

(29) Insert converter clutch valve and spring into converter clutch valve module (Fig. 241). Verify valve components slide freely.

(30) Insert spring and fail-safe valve into converter clutch valve module (Fig. 241). Verify valve components slide freely.

(31) Place cover plate in position on converter clutch valve module (Fig. 241).

(32) Install screws to attach cover to converter clutch valve module (Fig. 241).

(33) Insert connecting tube into converter clutch valve module (Fig. 241).

(34) Insert connecting tube into valve body opening (Fig. 242).

(35) Place converter clutch valve module in position on separator plate. Install screws to attach converter clutch module to valve body (Fig. 242).

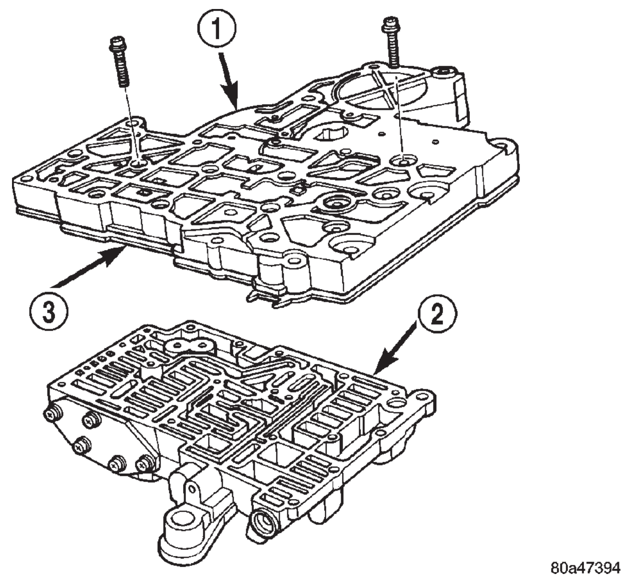


Fig. 240 Valve Body Transfer Plate Screws

1 - TRANSFER PLATE
2 - VALVE BODY
3 - SEPARATOR PLATE

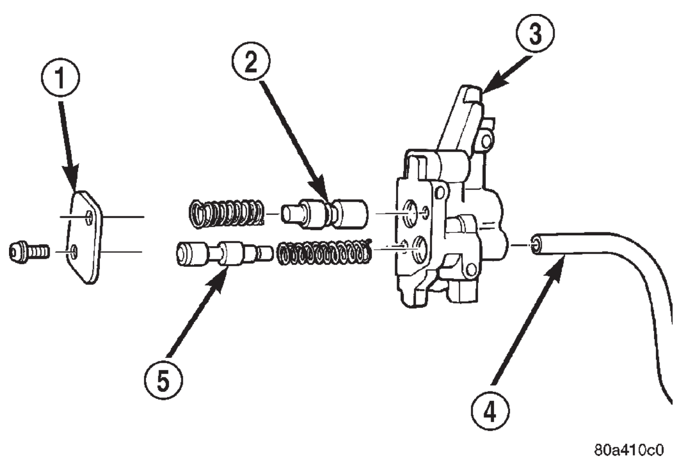


Fig. 241 Converter Clutch Valve Module

1 - COVER PLATE
2 - CONVERTER CLUTCH VALVE
3 - TORQUE CONVERTER CLUTCH MODULE
4 - MODULE CONNECTING TUBE
5 - FAIL-SAFE VALVE

VALVE BODY (Continued)

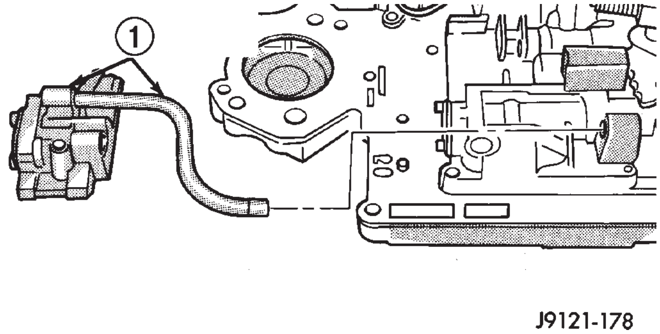


Fig. 242 Clutch Module And Connecting Tube

1 - MODULE AND CONNECTING TUBE

(36) If necessary, install a new O-ring on converter clutch solenoid (Fig. 243).

(37) Insert converter clutch solenoid into transfer plate (Fig. 243).

(38) Install screw to attach solenoid to transfer plate (Fig. 243).

(39) If necessary, insert park rod end into manual lever and install E-clip (Fig. 244).

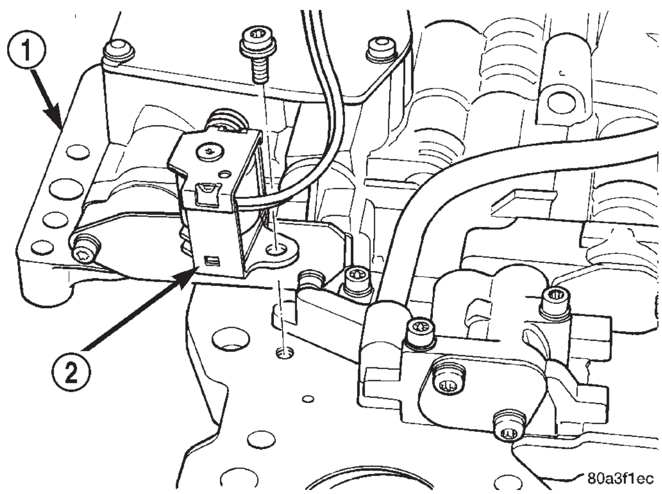


Fig. 243 Converter Clutch Solenoid

1 - VALVE BODY
2 - TORQUE CONVERTER CLUTCH SOLENOID

(40) Insert detent spring and ball into opening in valve body and install Retainer Tool 6583 (Fig. 245).

(41) Install manual valve into valve body (Fig. 246).

(42) Insert throttle lever through transfer plate side of valve body and upward (Fig. 247).

(43) Insert throttle lever into groove in manual valve (Fig. 248).

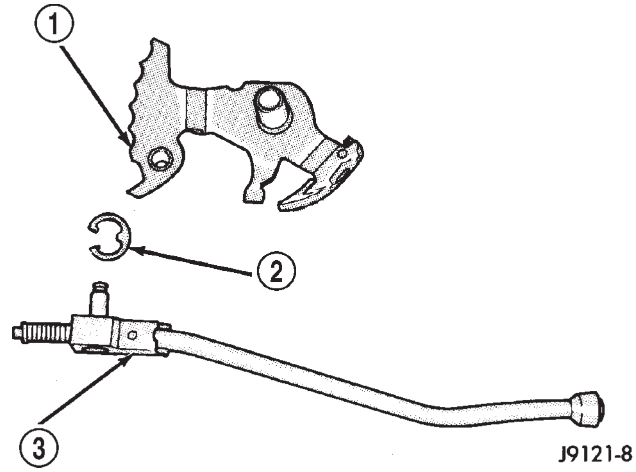


Fig. 244 Park Rod

1 - MANUAL LEVER
2 - E-CLIP
3 - PARK ROD

(44) Install seal, washer, and E-clip to retain manual shaft to valve body (Fig. 247).

(45) Install switch valve and spring, pressure regulator valve and spring, kickdown valve and spring, and throttle valve into valve body (Fig. 249).

(46) Place adjusting screw bracket and line pressure adjusting screw in position on valve body and compress springs (Fig. 219).

(47) Install screws to attach adjuster bracket to valve body.

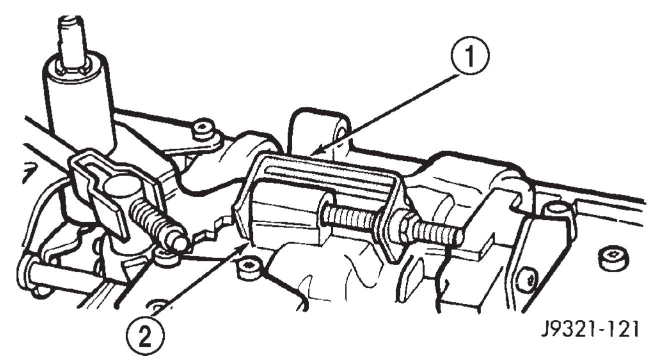


Fig. 245 Securing Detent Ball And Spring With Retainer Tool

1 - SPECIAL TOOL 6583
2 - DETENT BALL AND SPRING HOUSING

VALVE BODY (Continued)

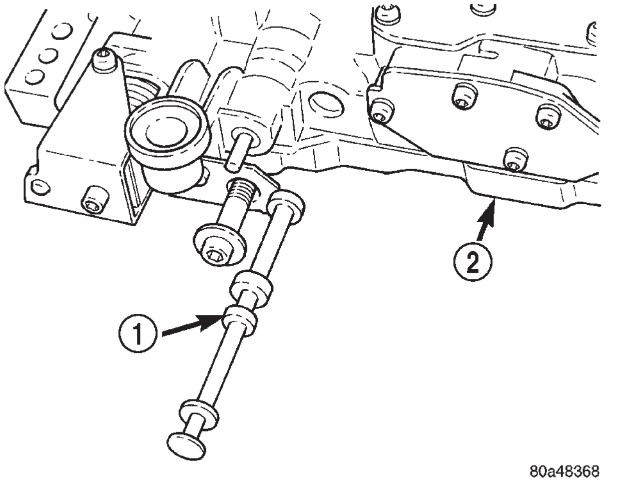


Fig. 246 Manual Valve

1 - MANUAL VALVE
2 - VALVE BODY

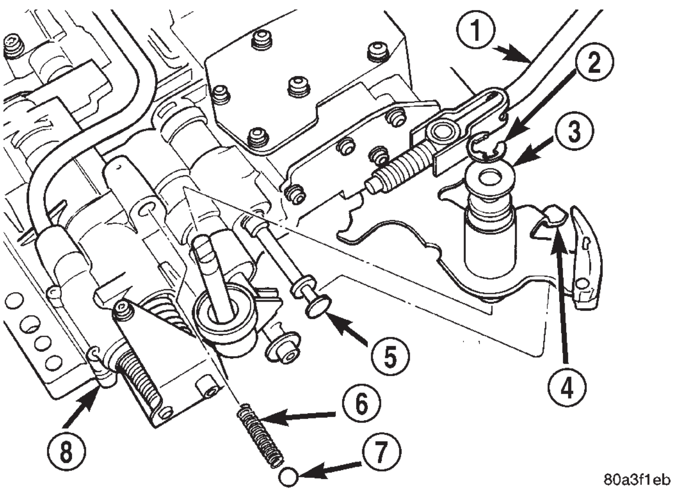


Fig. 247 Manual And Throttle Levers

1 - PARK ROD
2 - E-RING
3 - WASHER
4 - MANUAL LEVER
5 - MANUAL VALVE
6 - SPRING
7 - DETENT BALL
8 - VALVE BODY

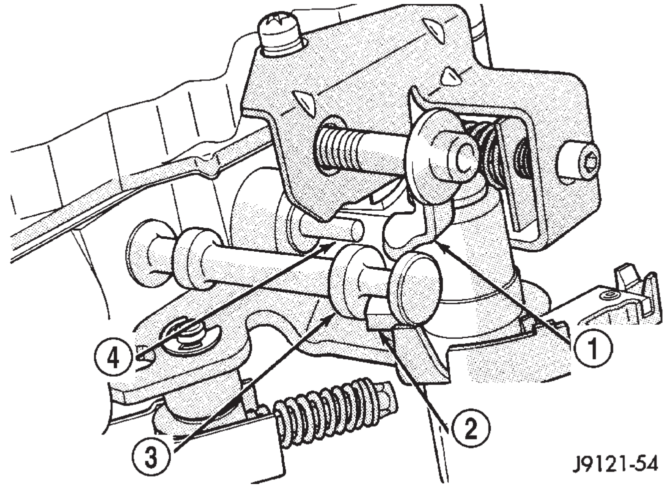


Fig. 248 Manual Valve And Throttle Lever Alignment

1 - THROTTLE LEVER
2 - MANUAL LEVER VALVE ARM
3 - MANUAL VALVE
4 - KICKDOWN VALVE

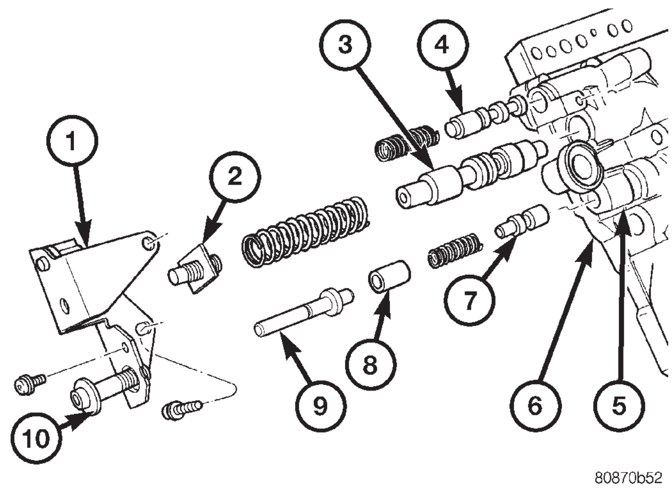


Fig. 249 Adjusting Screw Bracket, Springs, and Valves

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

VALVE BODY (Continued)

INSTALLATION

(1) Verify that park/neutral position switch is **NOT** installed. Valve body cannot be installed with switch in place. Remove switch if necessary.

(2) Install new seals on accumulator piston if necessary, and install piston in case. Use small amount of petroleum jelly to hold piston in place.

(3) Place valve body manual lever in low (1 position) to ease inserting park rod into sprag.

(4) Use screwdriver to push park sprag into engagement with park gear. This makes clearance for knob on lock rod to move past sprag when valve body is installed. Rotate output shaft to verify sprag engagement.

(5) Position accumulator spring between accumulator piston and valve body.

(6) Position valve body on transmission and work knob on park lock rod past sprag. Be sure accumulator piston and spring remain in position.

(7) Hold valve body in position and install valve body screws finger tight.

(8) Install park/neutral position switch.

(9) Tighten valve body screws alternately and evenly to 11 N·m (100 in. lbs.) torque.

(10) Install new fluid filter on valve body. Install and tighten filter screws to 4 N·m (35 in. lbs.) torque.

(11) Connect solenoid wire to case connector.

(12) Install manual and throttle levers on throttle lever shaft. Tighten lever clamp screws and check for free operation. Shaft and levers must operate freely without any bind.

(13) Install oil pan and new gasket. Tighten pan bolts to 17 N·m (150 in. lbs.) torque. Install gasket dry; do not use sealer.

(14) Connect park/neutral position switch and converter clutch solenoid wires.

(15) Install speedometer pinion gear, adapter and speed sensor.

(16) Lower vehicle.

(17) Fill transmission with Mopar® ATF Plus 4, Type 9602, fluid.

(18) Adjust gearshift and throttle cable if necessary.

ADJUSTMENTS - 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. 250).

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.

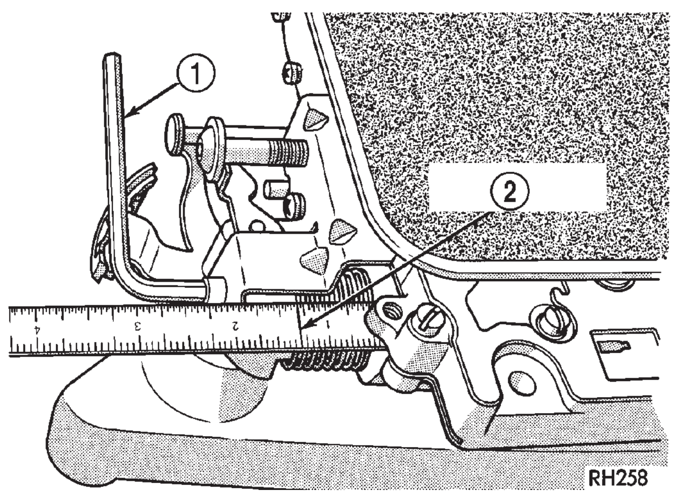


Fig. 250 Line Pressure Adjustment

1 - WRENCH
2 - 1–5/16 INCH

VALVE BODY (Continued)

THROTTLE PRESSURE ADJUSTMENT

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 251).

Push the gauge tool inward to compress the kickdown valve against the spring and bottom the throttle valve.

Maintain pressure against kickdown valve spring. Turn throttle lever stop screw until the screw head touches throttle lever tang and the throttle lever cam touches gauge tool.

NOTE: The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.

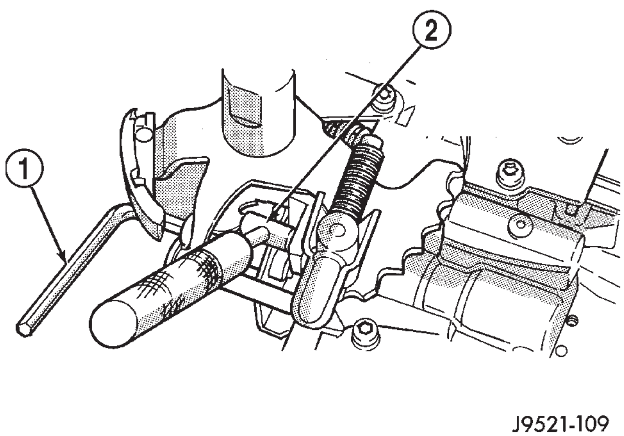


Fig. 251 Throttle Pressure Adjustment

1 - HEX WRENCH (IN THROTTLE LEVER ADJUSTING SCREW)

2 - SPECIAL TOOL C-3763 (POSITIONED BETWEEN THROTTLE LEVER AND KICKDOWN VALVE)

TRANSFER CASE - NV231

TABLE OF CONTENTS

TRANSFER CASE - NV231

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.

TRANSFER CASE - NV231 (Continued)

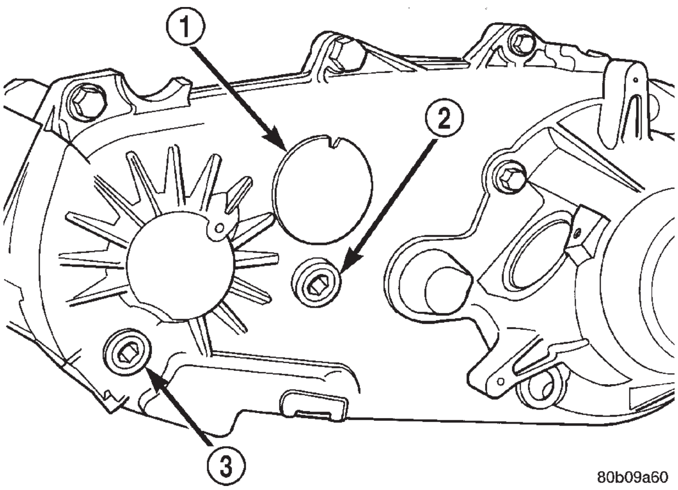


Fig. 1 Fill/Drain Plug And I.D. Tag Locations - Typical

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 hub. The sleeve and hub are not equipped with a synchronizer mechanism for shifting.

DIAGNOSIS AND TESTING - TRANSFER CASE - NV231

DIAGNOSIS CHART

Condition	Possible Cause	Correction
Transfer case difficult to shift or will not shift into desired range.	1) Vehicle speed to great to permit shifting.	1) Slow vehicle and shift into desired range.
	2) If vehicle was operated for an extended period in 4H mode on dry surface, driveline torque load may cause difficulty.	2) Stop vehicle and shift transfer case to Neutral position. Transfer case can then be shifted to the desired mode.
	3) Transfer case shift linkage binding.	3) Repair or replace linkage as necessary.
	4) Insufficient or incorrect lubricant.	4) Drain and refill transfer case with the correct type and quantity of lubricant.
	5) Internal transfer case components binding, worn, or damaged.	5) Repair or replace components as necessary.
Transfer case noisy in all drive modes.	1) Insufficient or incorrect lubricant.	1) Drain and refill transfer case with the correct type and quantity of lubricant.

TRANSFER CASE - NV231 (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

(1) Shift transfer case into NEUTRAL.
(2) Raise vehicle.
(3) Drain transfer case lubricant.
(4) Mark front and rear propeller shaft yokes for alignment reference.
(5) Support transmission with jack stand.
(6) Remove rear crossmember, or skid plate.
(7) Disconnect front/rear propeller shafts at transfer case.
(8) Disconnect vehicle speed sensor wires.
(9) Disconnect transfer case linkage rod from range lever.
(10) Disconnect transfer case vent hose (Fig. 2) and indicator switch harness, if necessary.
(11) Support transfer case with transmission jack.
(12) Secure transfer case to jack with chains.
(13) Remove nuts attaching transfer case to transmission.
(14) Pull transfer case and jack rearward to disengage transfer case.
(15) Remove transfer case from under vehicle.

DISASSEMBLY

Position transfer case on shallow drain pan. Remove drain plug and drain lubricant remaining in case.

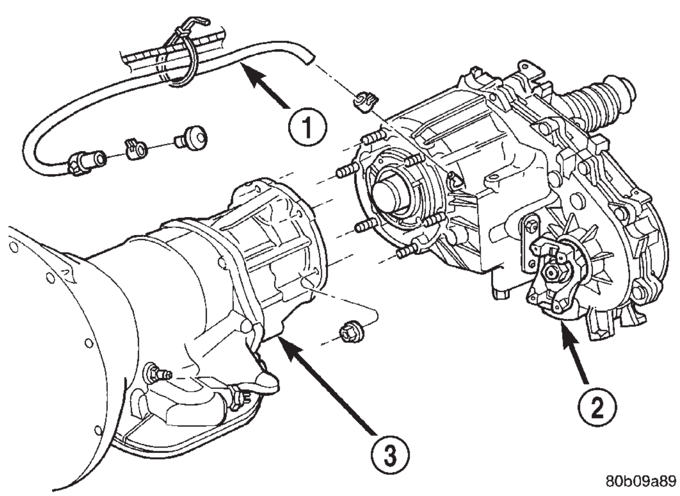


Fig. 2 Transfer Case Mounting

1 - VENT TUBE
2 - TRANSFER CASE
3 - TRANSMISSION

REAR RETAINER AND OIL PUMP

(1) Remove the speedometer adapter.
(2) Spread band clamp which holds output shaft boot to the output shaft slinger, or output shaft damper, with a suitable awl, or equivalent.

TRANSFER CASE - NV231 (Continued)

NOTE: Vehicles built with a 4.0L engine and a manual transmission use a damper weight on the transfer case output shaft. Be sure to identify the transfer case before proceeding.

(3) Remove output shaft boot from slinger, or output shaft damper, and output shaft.

(4) If the vehicle is not equipped with an output shaft damper, remove the output shaft rear slinger using Puller MD-998056-A (Fig. 3).

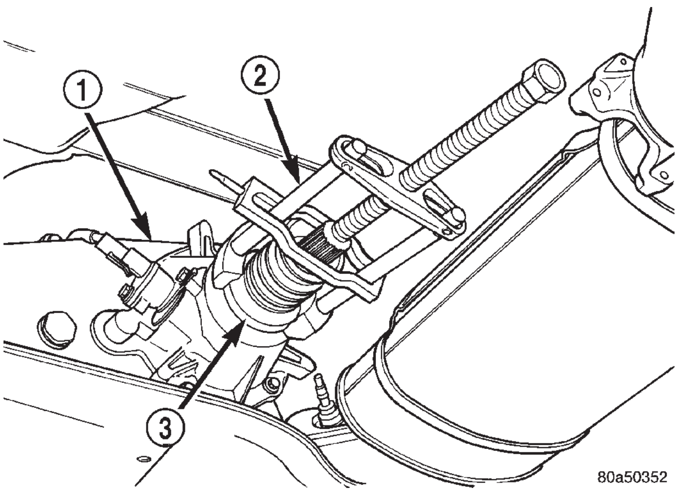


Fig. 3 Rear Slinger Removal

1 - TRANSFER CASE
2 - SPECIAL TOOL MD-998056-A
3 - SLINGER

(5) If the vehicle is equipped with an output shaft damper, use Screws 8421 and the puller yoke and forcing screw from a bolt-grip puller set, such as those used to remove steering wheels and harmonic balancers, to remove the transfer case output shaft damper.

(6) Use a suitable pry tool, or a slide hammer mounted screw, to remove the seal from the rear retainer (Fig. 4).

(7) Remove the rear output bearing I.D. retaining ring (Fig. 5).

(8) Remove the bolts holding the rear retainer to the rear case half.

(9) Tap rear retainer with rawhide or rubber mallet to loosen sealer bead.

(10) Remove rear retainer from rear case half (Fig. 6).

(11) Remove snap-ring holding oil pump in position on output shaft.

(12) Disengage oil pickup tube from oil pump and remove oil pump assembly. Remove oil pump by tilting the edge of the oil pump from under the edge of the rear case half and sliding the pump (Fig. 7).

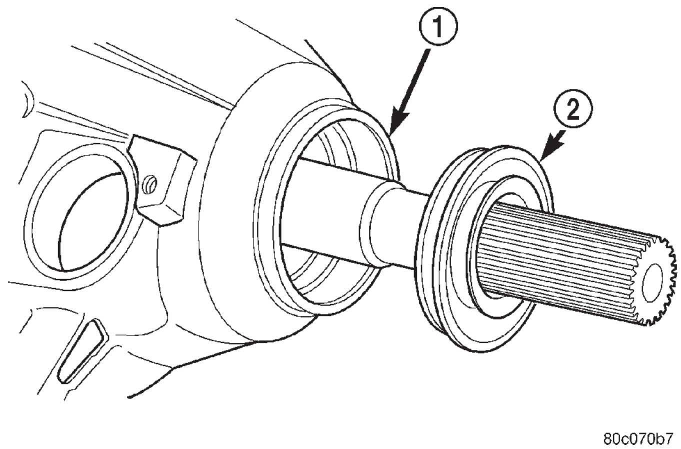


Fig. 4 Rear Retainer Seal

1 - REAR RETAINER
2 - OUTPUT SHAFT SEAL

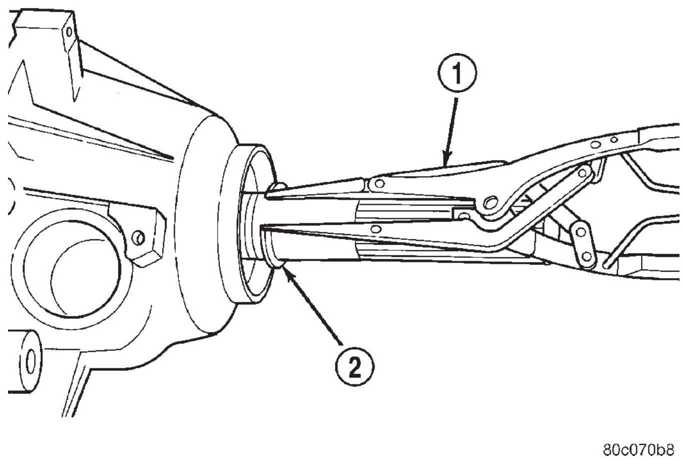


Fig. 5 Output Shaft Rear Bearing Retaining Ring

1 - SNAP-RING PLIERS
2 - REAR BEARING I.D. RETAINING RING

(13) Remove pick-up tube o-ring from oil pump (Fig. 8), if necessary. Do not disassemble the oil pump, it is not serviceable.

YOKE AND RANGE LEVER

(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. 9).

(3) Remove yoke. If yoke is difficult to remove by hand, remove it with bearing splitter, or with standard two jaw puller (Fig. 10). Be sure puller tool is positioned on yoke and not on slinger as slinger will be damaged.

(4) Remove seal washer from front output shaft. Discard washer as it should not be reused.

TRANSFER CASE - NV231 (Continued)

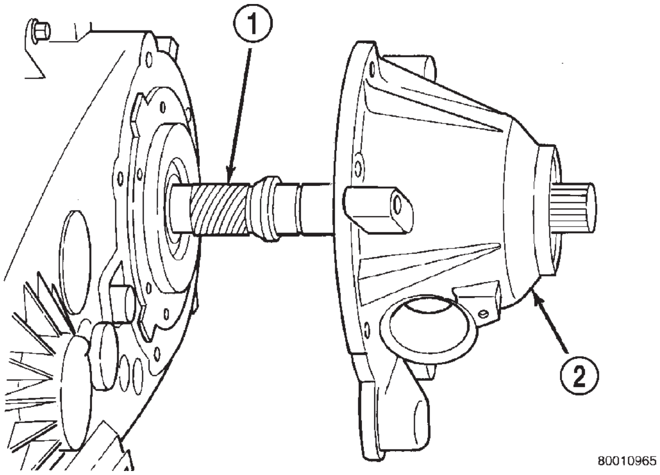


Fig. 6 Rear Retainer Removal

1 - MAINSHAFT
2 - REAR RETAINER

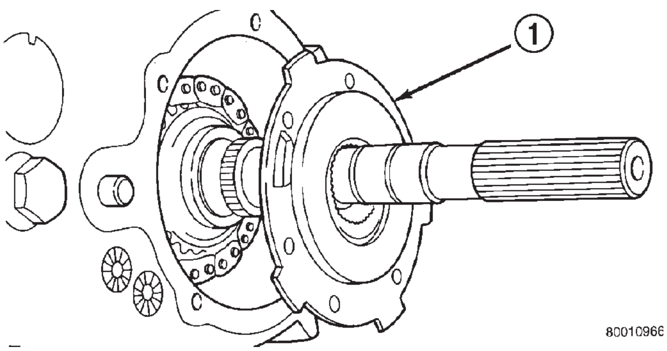


Fig. 7 Oil Pump Removal

1 - OIL PUMP

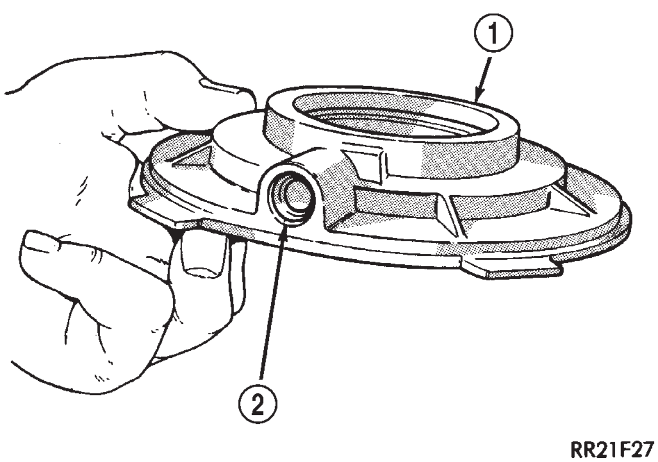


Fig. 8 Pick-up Tube O-ring Location

1 - OIL PUMP
2 - O-RING

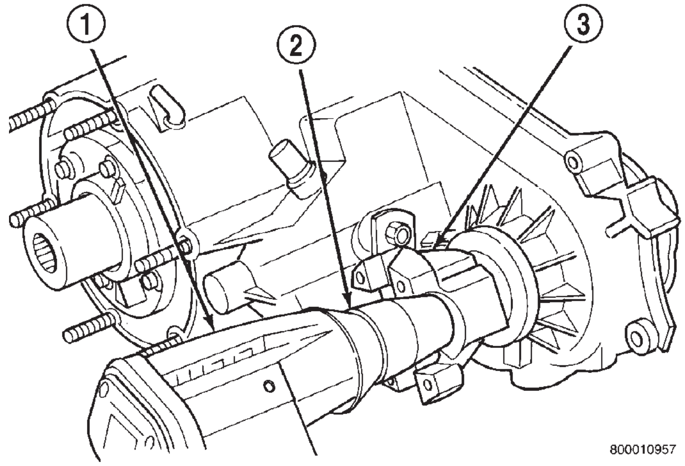


Fig. 9 Yoke Nut Removal

1 - IMPACT WRENCH
2 - SOCKET
3 - YOKE

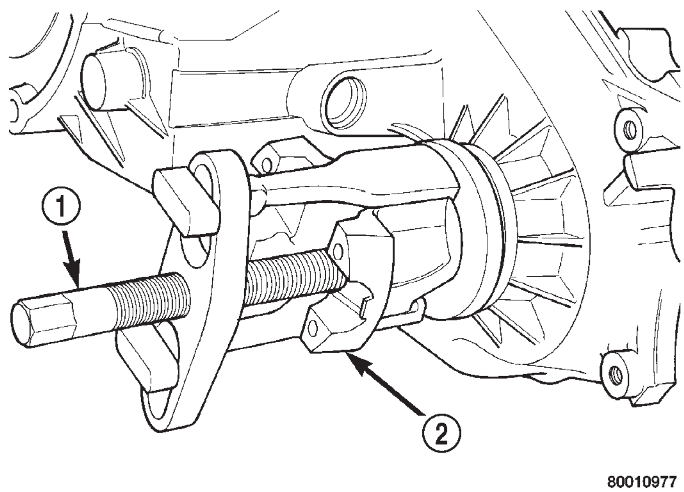


Fig. 10 Yoke Removal

1 - PULLER TOOL
2 - YOKE

(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. 11).

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(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. 12).

(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. 13).

(4) Remove rear case from front case.

TRANSFER CASE - NV231 (Continued)

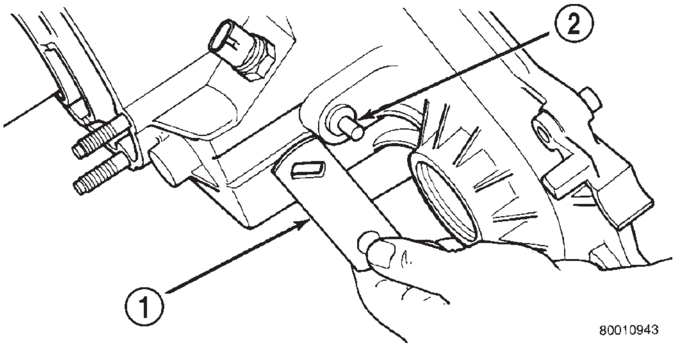


Fig. 11 Range Lever Removal

1 - RANGE LEVER
2 - SECTOR SHAFT

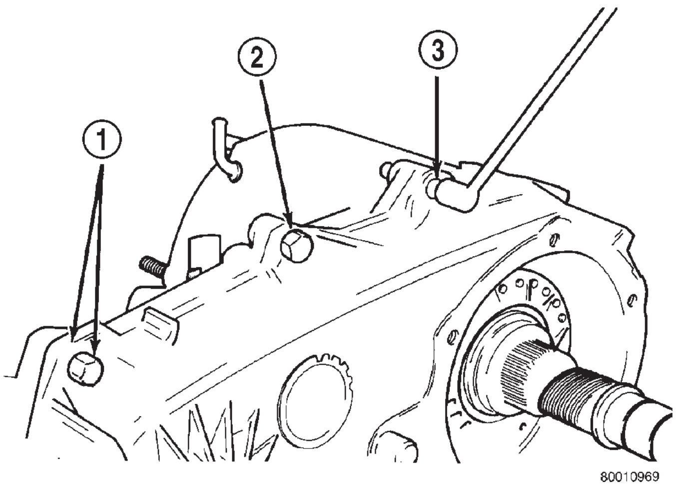


Fig. 12 Rear Case Alignment Bolt Locations

1 - DOWEL BOLT AND WASHER (2)
2 - CASE BOLT (5)
3 - SPLINE HEAD BOLT (1)

(5) Remove oil pickup tube from rear case (Fig. 14).

(6) Remove mode fork spring (Fig. 15).

(7) Pull front output shaft upward and out of front output shaft bearing (Fig. 16).

(8) Remove front output shaft and chain.

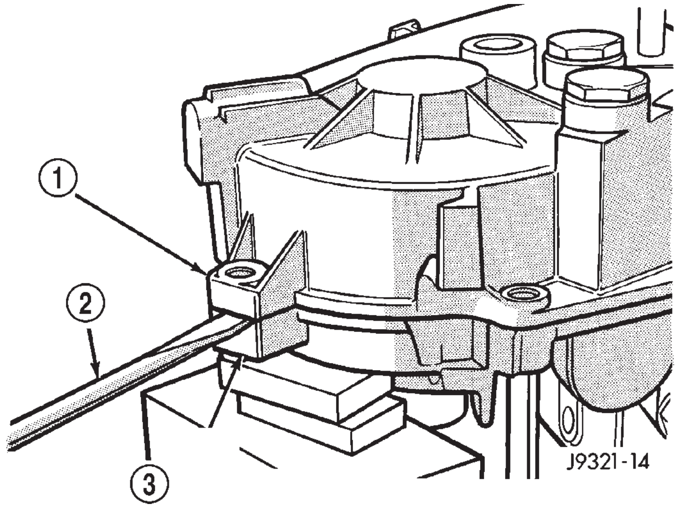


Fig. 13 Loosening Rear Case - Typical

1 - REAR CASE
2 - PRY TOOL (IN CASE SLOT)
3 - FRONT CASE

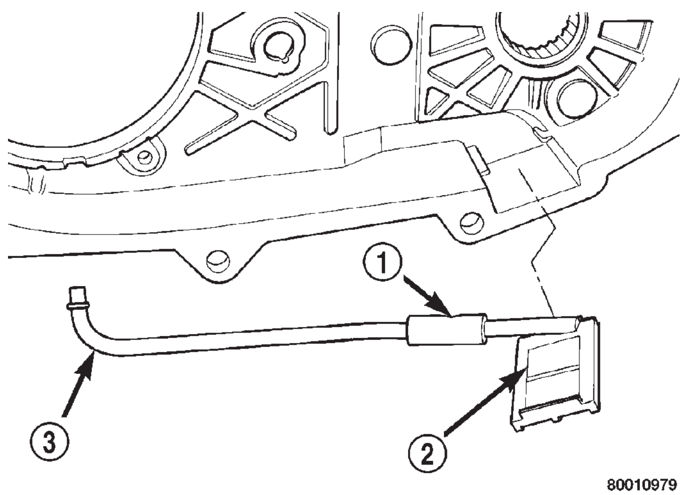


Fig. 14 Oil Pickup Tube Removal

1 - CONNECTING HOSE
2 - PICKUP SCREEN
3 - PICKUP TUBE

TRANSFER CASE - NV231 (Continued)

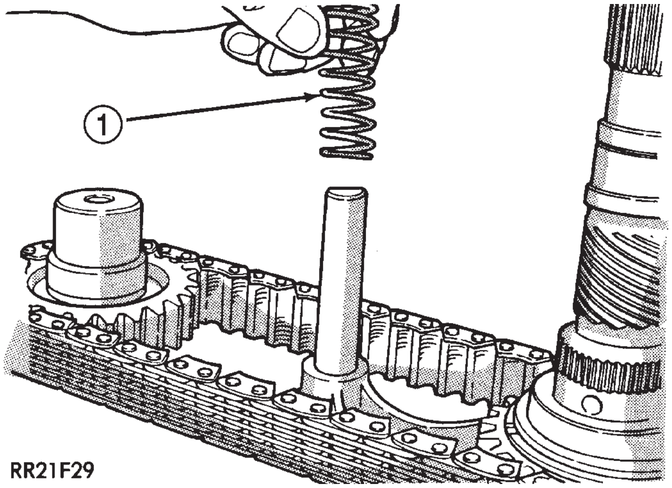


Fig. 15 Mode Fork Spring Removal

1 - MODE SPRING

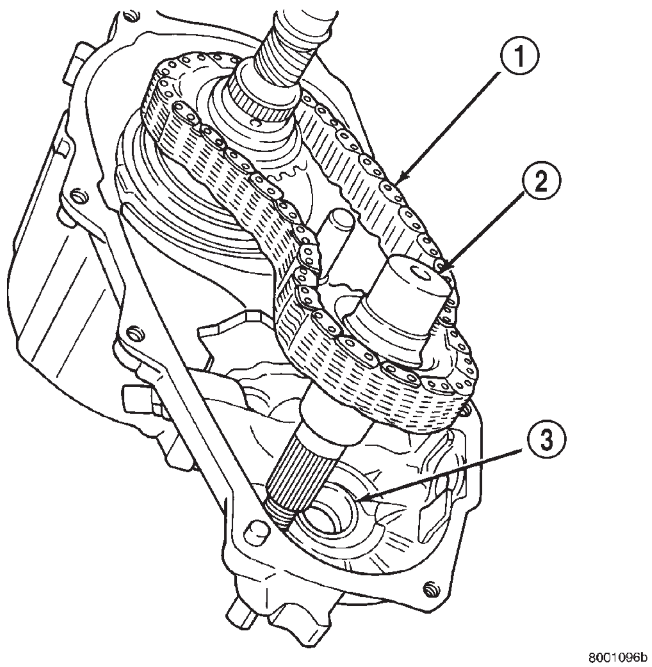


Fig. 16 Remove Front Output Shaft And Chain

1 - DRIVE CHAIN
2 - FRONT OUTPUT SHAFT
3 - SHAFT FRONT BEARING

SHIFT FORKS AND MAINSHAFT

(1) Remove detent plug, O-ring, detent spring and detent plunger (Fig. 17).

(2) Remove mainshaft from mode sleeve and input gear pilot bearing.

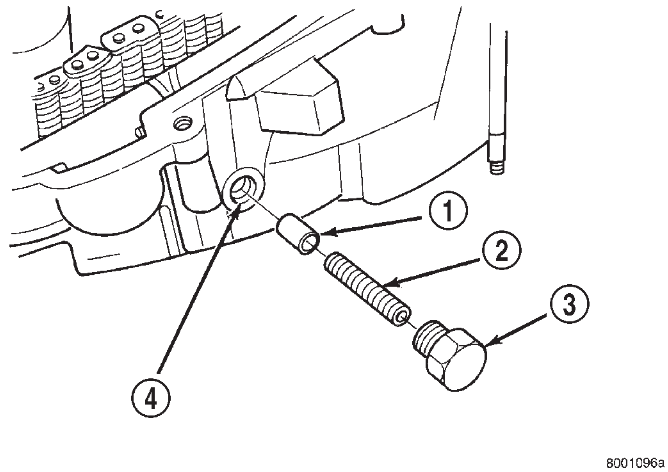


Fig. 17 Detent Plug, Spring And Plunger Removal

1 - POPPET
2 - SPRING
3 - SCREW
4 - POPPET BORE (IN CASE)

(3) Remove mode fork and sleeve as an assembly (Fig. 18). 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. 19). Note fork position for installation reference.

(5) Remove shift sector from front case (Fig. 20).

(6) Remove shift sector bushing and O-ring (Fig. 21).

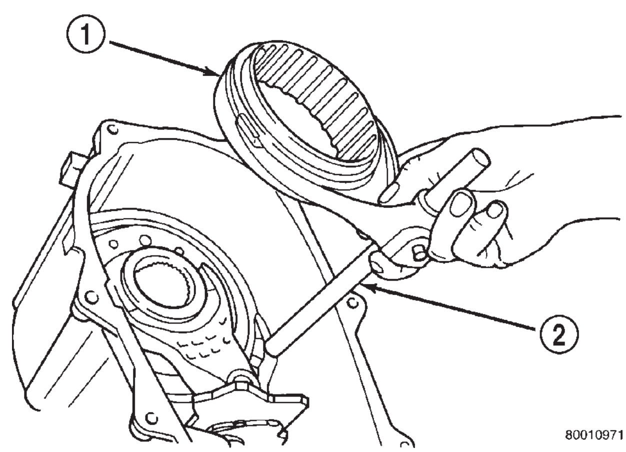


Fig. 18 Mode Fork And Sleeve Removal

1 - MODE SLEEVE
2 - MODE FORK AND RAIL

TRANSFER CASE - NV231 (Continued)

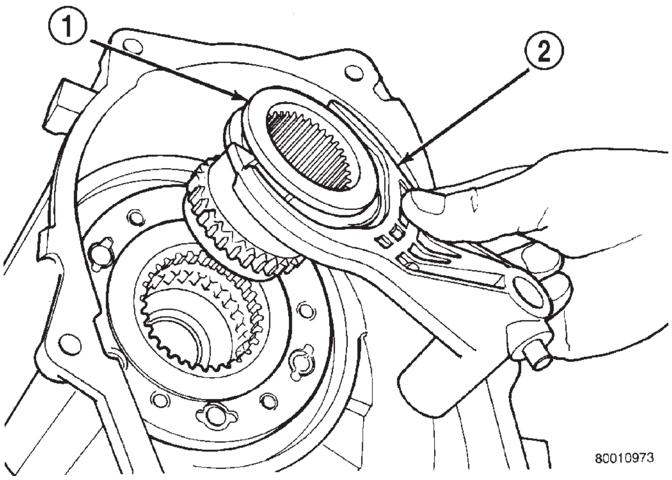


Fig. 19 Range Fork And Sleeve Removal

1 - RANGE HUB
2 - RANGE FORK

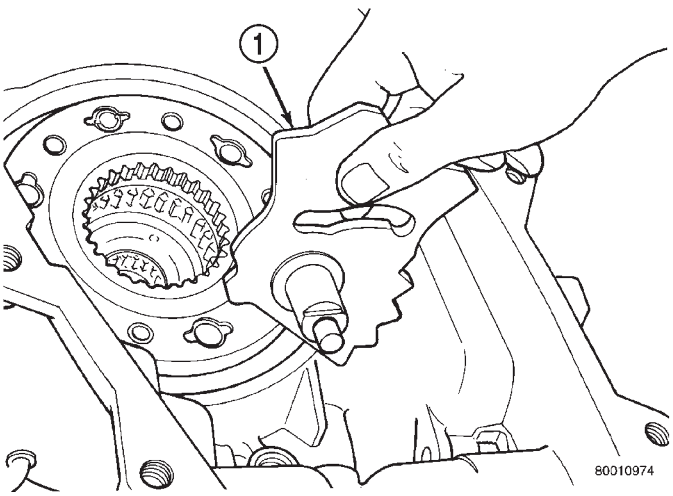


Fig. 20 Shift Sector Removal

1 - SHIFT SECTOR

MAINSHAFT

(1) Remove mode hub retaining ring with heavy duty snap-ring pliers (Fig. 22).

(2) Slide mode hub off mainshaft (Fig. 23).

(3) Slide drive sprocket off mainshaft (Fig. 24).

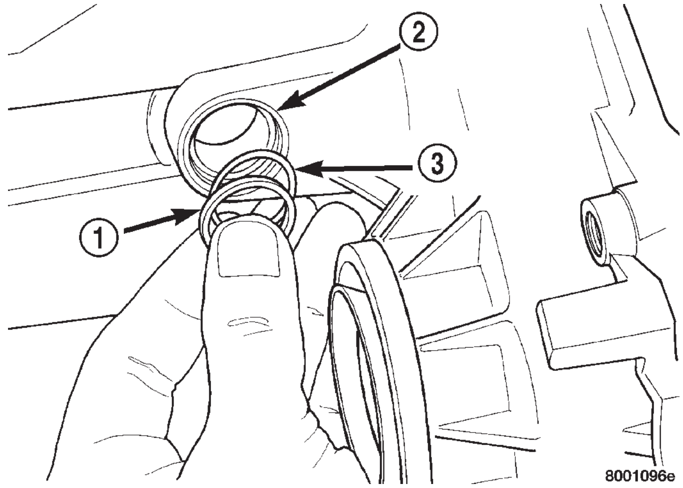


Fig. 21 Sector Bushing And O-Ring Removal

1 - SEAL RETAINER
2 - SECTOR SHAFT BORE
3 - O-RING SEAL

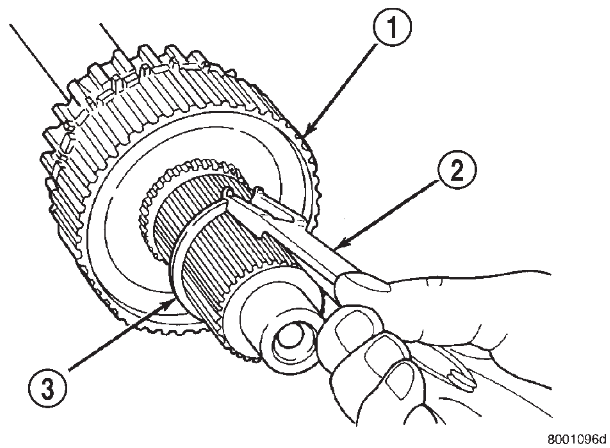


Fig. 22 Mode Hub Retaining Ring Removal

1 - MODE HUB
2 - SNAP-RING PLIERS (HEAVY DUTY)
3 - MODE HUB RETAINING RING

TRANSFER CASE - NV231 (Continued)

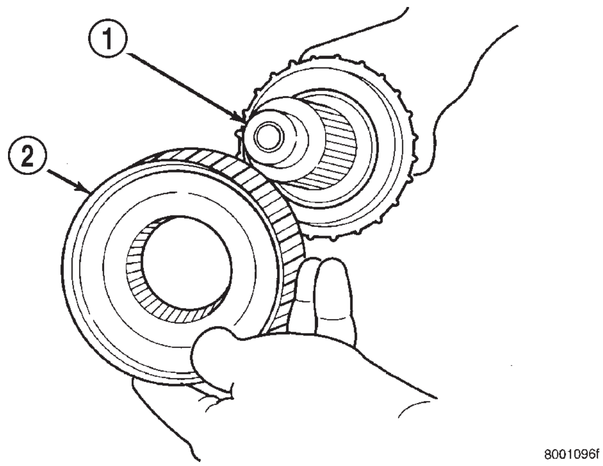


Fig. 23 Mode Hub Removal

1 - MAINSHAFT
2 - MODE HUB

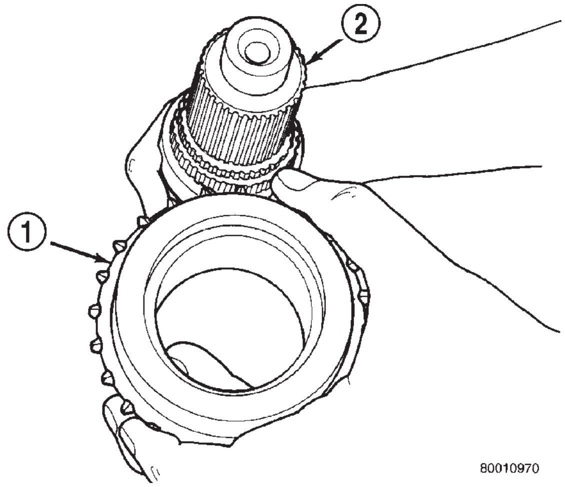


Fig. 24 Drive Sprocket Removal

1 - DRIVE SPROCKET
2 - MAINSHAFT

INPUT GEAR AND LOW RANGE GEAR

(1) Remove front bearing retainer attaching bolts (Fig. 25).

(2) Remove front bearing retainer. Pry retainer loose with pry tool positioned in slots at each end of retainer (Fig. 26).

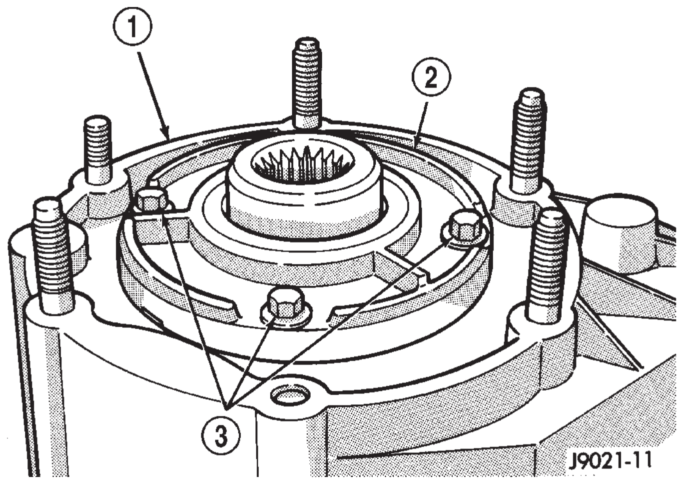


Fig. 25 Front Bearing Retainer Bolts

1 - FRONT CASE
2 - FRONT BEARING RETAINER
3 - RETAINER BOLTS

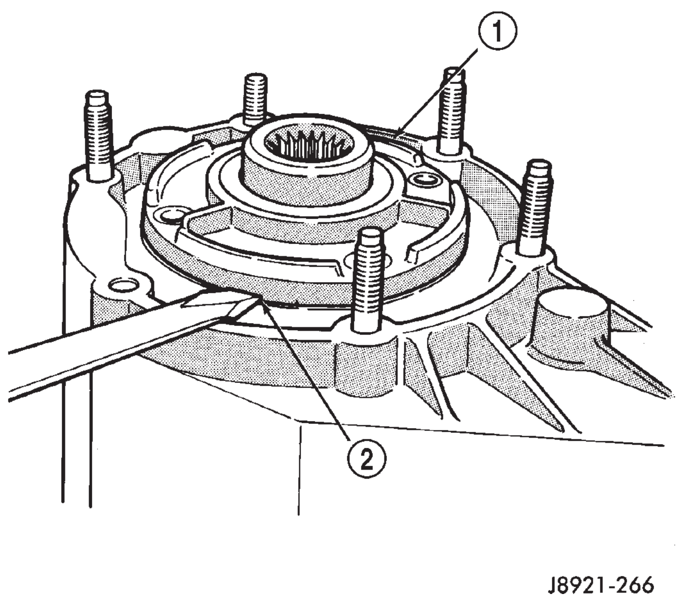


Fig. 26 Front Bearing Retainer Removal

1 - FRONT BEARING RETAINER
2 - RETAINER SLOT

TRANSFER CASE - NV231 (Continued)

(3) Remove front bearing retainer seal. Tap seal out with drift and hammer.

(4) Remove input gear retaining ring with heavy duty snap-ring pliers (Fig. 27)

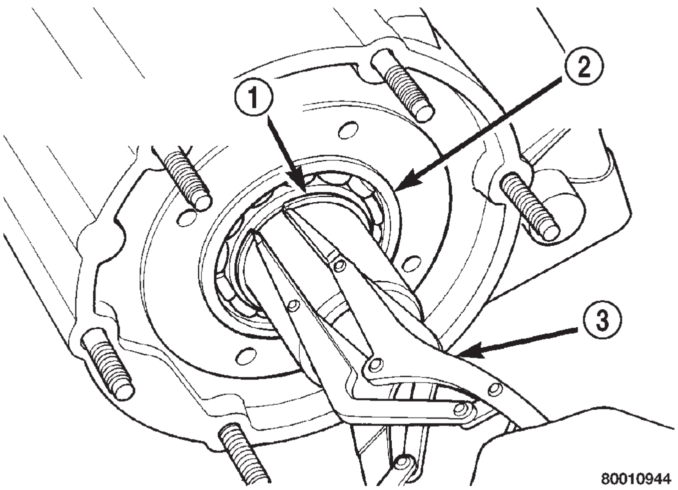


Fig. 27 Removing Input Gear Retaining Ring

1 - INPUT GEAR BEARING RETAINING RING
2 - INPUT GEAR BEARING
3 - SNAP-RING PLIERS

(5) Place front case in horizontal position. Then remove input gear and low range gear as an assembly (Fig. 28). Tap gear out of bearing with plastic mallet if necessary.

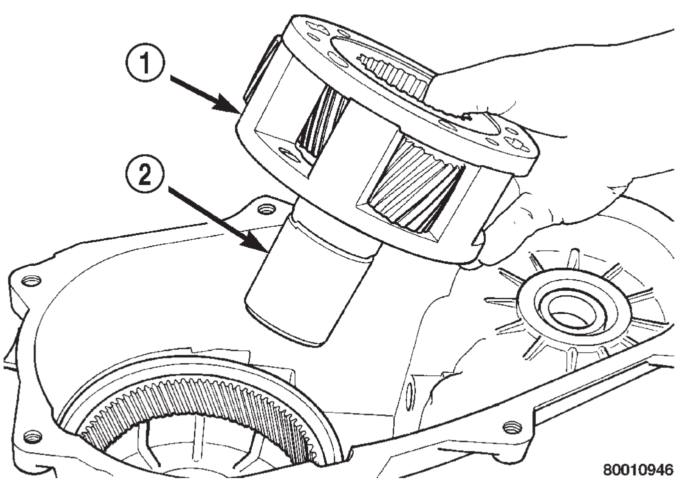


Fig. 28 Input Gear And Planetary Carrier Removal

1 - PLANETARY ASSEMBLY
2 - INPUT GEAR

INPUT AND LOW RANGE GEAR

(1) Remove snap-ring that retains input gear in low range gear (Fig. 29).

(2) Remove retainer (Fig. 30).

(3) Remove front tabbed thrust washer (Fig. 31).

(4) Remove input gear (Fig. 32).

(5) Remove rear tabbed thrust washer from low range gear (Fig. 33).

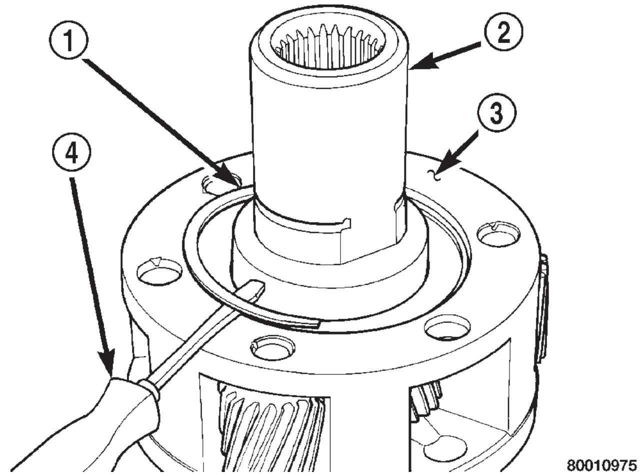


Fig. 29 Input Gear Snap-Ring Removal

1 - CARRIER LOCK RETAINING RING
2 - INPUT GEAR
3 - PLANETARY CARRIER
4 - SCREWDRIVER

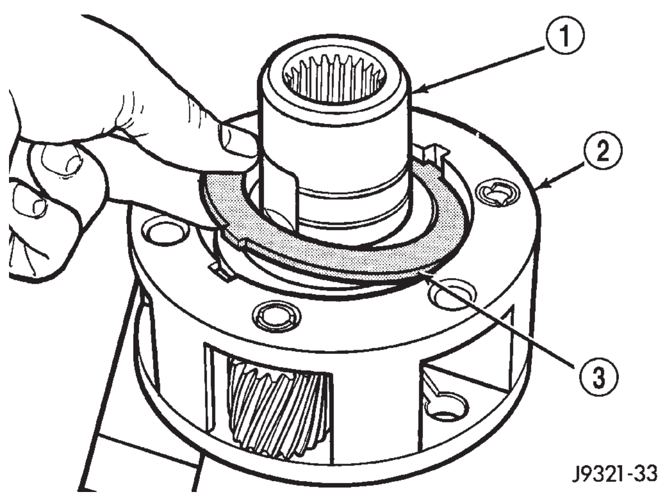


Fig. 30 Input Gear Retainer Removal

1 - INPUT GEAR
2 - LOW RANGE GEAR
3 - RETAINER

TRANSFER CASE - NV231 (Continued)

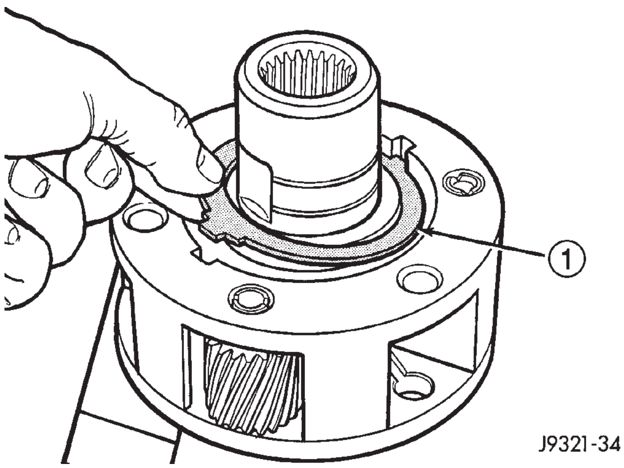


Fig. 31 Front Tabbed Thrust Washer Removal

1 - FRONT TABBED THRUST WASHER

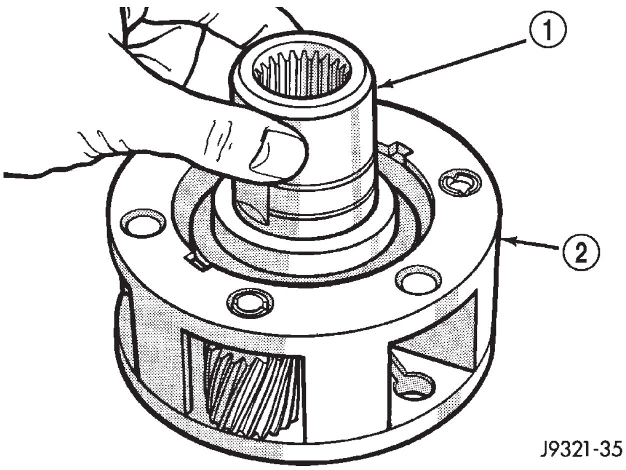


Fig. 32 Input Gear Removal

1 - INPUT GEAR
2 - LOW RANGE GEAR

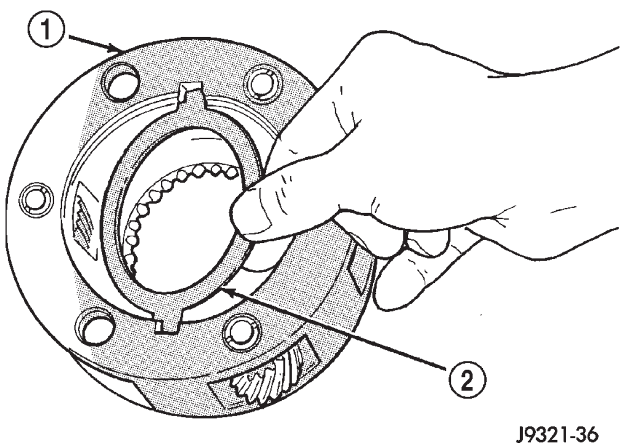


Fig. 33 Rear Tabbed Thrust Washer Removal

1 - LOW RANGE GEAR
2 - REAR TABBED THRUST WASHER

CLEANING

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.

INSPECTION

MAINSHAFT/SPROCKET/HUB

Inspect the splines on the hub and shaft and the teeth on the sprocket (Fig. 34). 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. 35). Minor nicks can be dressed off with an oilstone but replace the gear if any teeth are broken, cracked, or chipped. The bearing surface on the gear can be smoothed with 300-400 grit emery cloth if necessary.

Examine the carrier body and pinion gears for wear or damage. The carrier will have to be replaced as an assembly if the body, pinion pins, or pinion gears are damaged.

Check the lock ring and both thrust washers for wear or cracks. Replace them if necessary. Also replace the lock retaining ring if bent, distorted, or broken.

SHIFT FORKS/HUBS/SLEEVES

Check condition of the shift forks and mode fork shift rail (Fig. 36). Minor nicks on the shift rail can be smoothed with 320-400 grit emery cloth.

Inspect the shift fork wear pads (Fig. 37). The mode fork pads are serviceable and can be replaced if necessary. The range fork pads are not serviceable. The fork must be replaced as an assembly if the pads are worn or damaged.

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

REAR RETAINER/BEARING/ SEAL/SLINGER/BOOT

Inspect the retainer components (Fig. 38). 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.

TRANSFER CASE - NV231 (Continued)

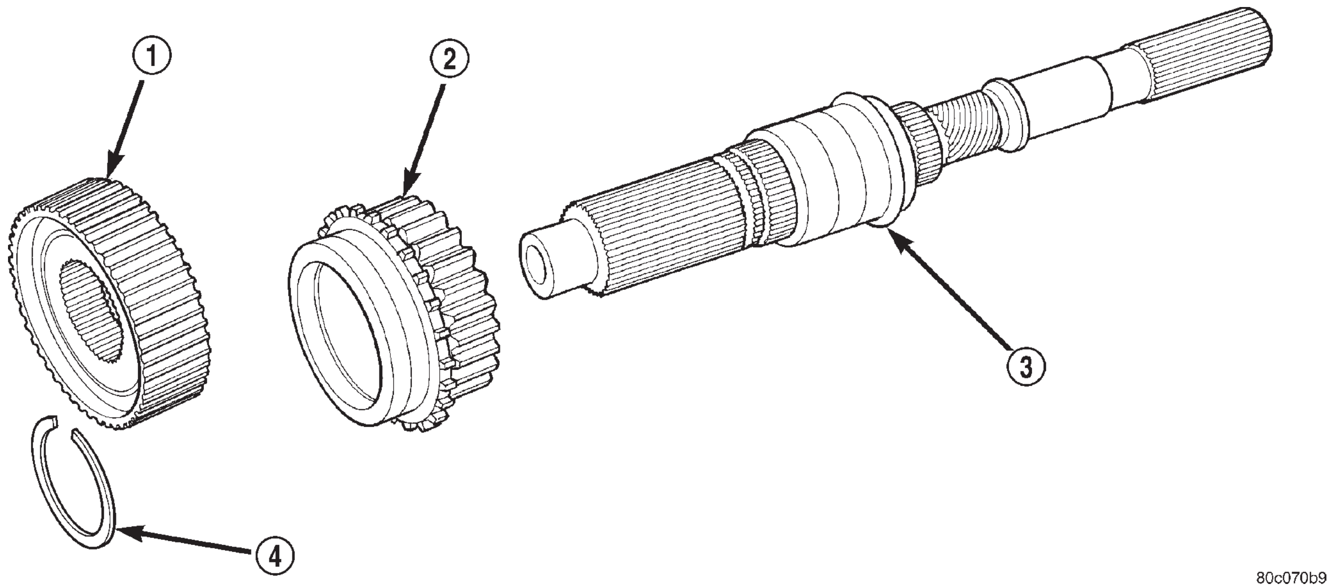


Fig. 34 Mainshaft, Mode Hub, And Drive Sprocket

1 - MODE HUB
2 - DRIVE SPROCKET
3 - MAINSHAFT
4 - MODE HUB RETAINING RING

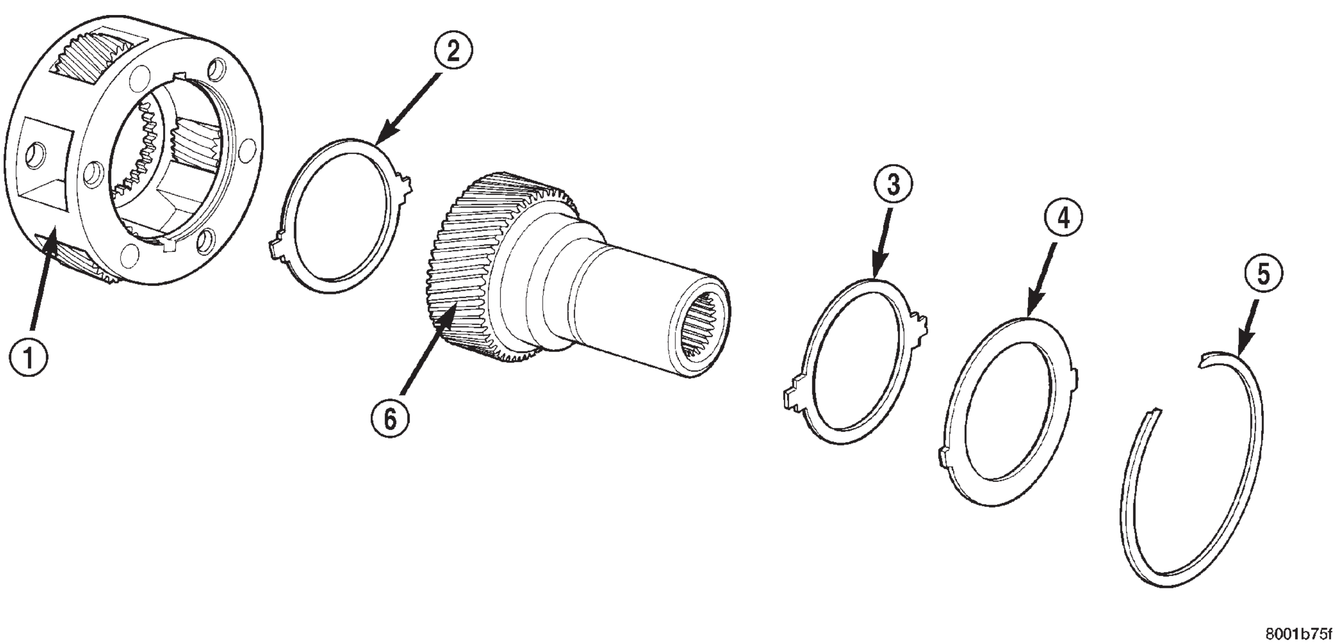


Fig. 35 Input Gear And Carrier Components

1 - PLANETARY CARRIER
2 - REAR THRUST WASHER
3 - FRONT THRUST WASHER
4 - CARRIER LOCK RING
5 - CARRIER LOCK RETAINING RING
6 - INPUT GEAR

An output shaft slinger is used on some vehicles, while an output shaft damper is used on other vehicles. The output shaft slinger and seal should be replaced 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.

TRANSFER CASE - NV231 (Continued)

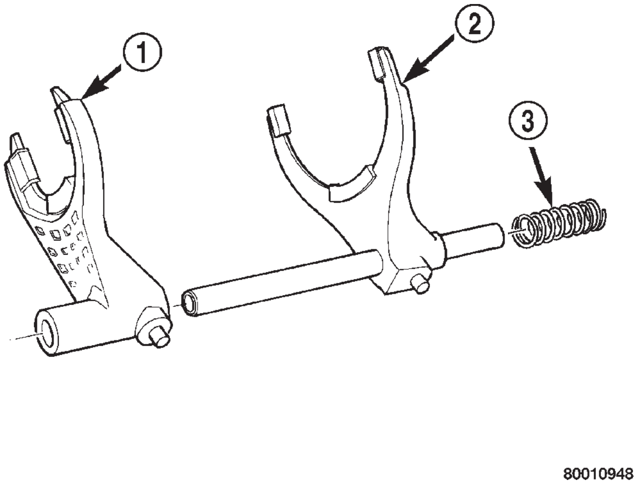


Fig. 36 Shift Forks

1 - RANGE FORK
2 - MODE FORK AND RAIL
3 - MODE SPRING

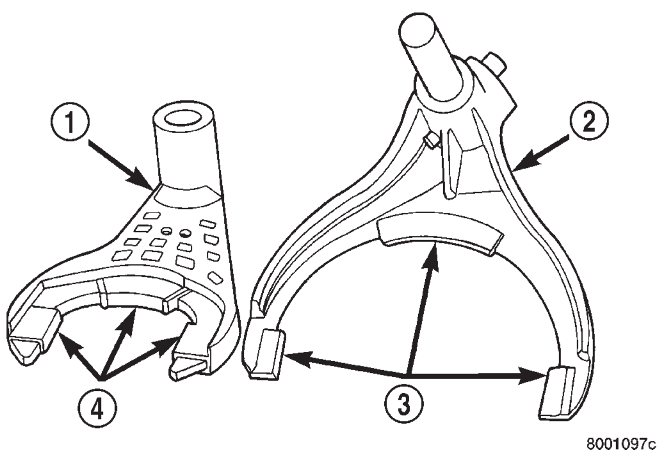


Fig. 37 Shift Fork And Wear Pad Locations

1 - RANGE FORK
2 - MODE FORK
3 - WEAR PADS (SERVICEABLE)
4 - WEAR PADS (NON-SERVICEABLE)

REAR OUTPUT SHAFT/YOKE/DRIVE CHAIN

Check condition of the seal contact surfaces of the yoke slinger (Fig. 39). 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. 40)

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.

ASSEMBLY

Lubricate transfer case components with Mopar® ATF +4, type 9602, Automatic Transmission Fluid or petroleum jelly (where indicated) during assembly.

TRANSFER CASE - NV231 (Continued)

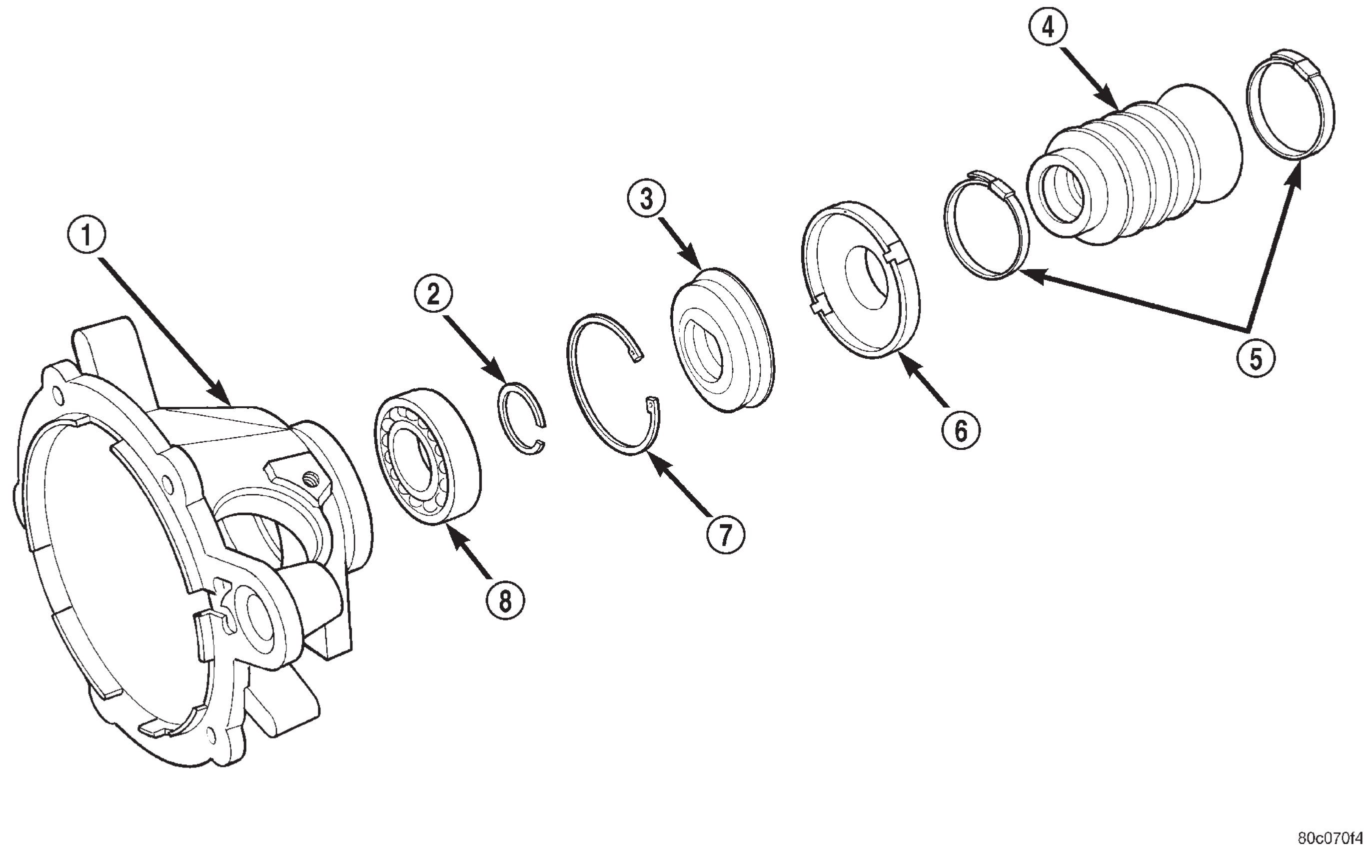


Fig. 38 Rear Retainer Without Output Shaft Damper

1 - REAR RETAINER
2 - REAR BEARING I.D. MAINSHAFT RETAINING RING
3 - REAR SEAL
4 - BOOT
5 - BAND CLAMPS
6 - REAR SLINGER
7 - REAR BEARING O.D. RETAINING RING
8 - REAR BEARING

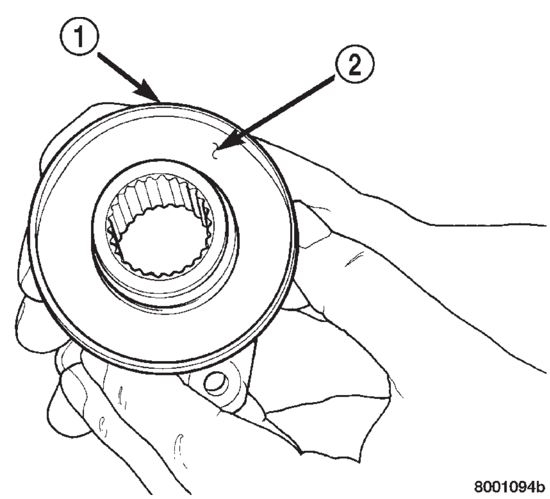


Fig. 39 Seal Contact Surface Of Yoke Slinger

1 - FRONT SLINGER (PART OF YOKE)
2 - SEAL CONTACT SURFACE MUST BE CLEAN AND SMOOTH

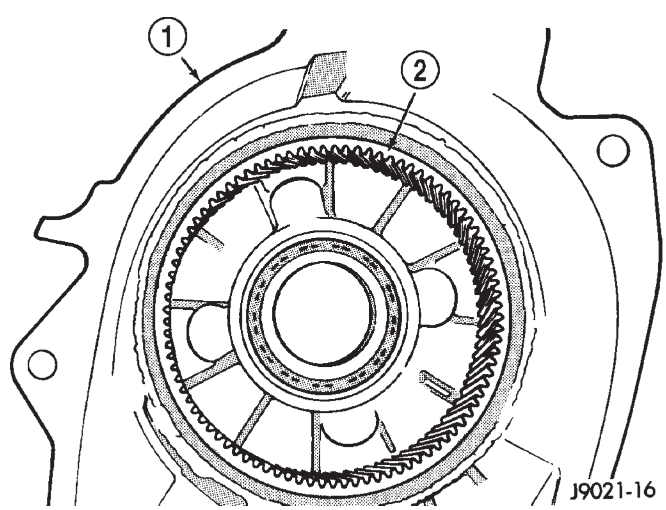


Fig. 40 Low Range Annulus Gear

1 - FRONT CASE
2 - LOW RANGE ANNULUS GEAR

TRANSFER CASE - NV231 (Continued)

BEARINGS AND SEALS

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. 41).

(2) Remove the front output shaft bearing retaining ring with screwdriver (Fig. 42).

(3) Remove bearing with Tool Handle C-4171 and Tool 5065 (Fig. 43).

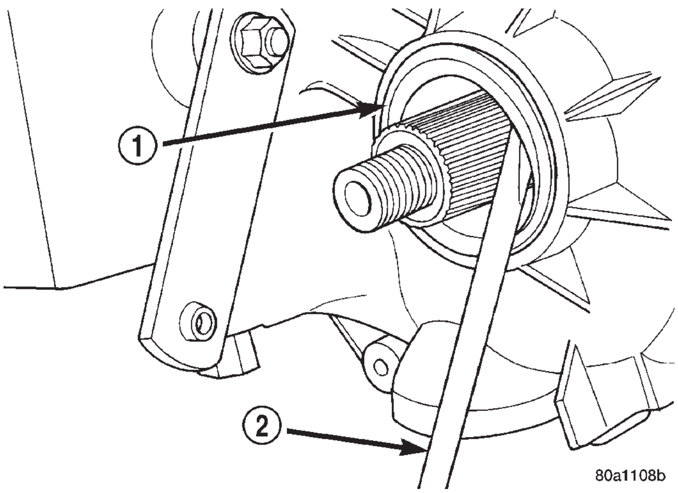


Fig. 41 Front Output Seal Removal - Typical

1 - OUTPUT SHAFT SEAL
2 - PRYBAR

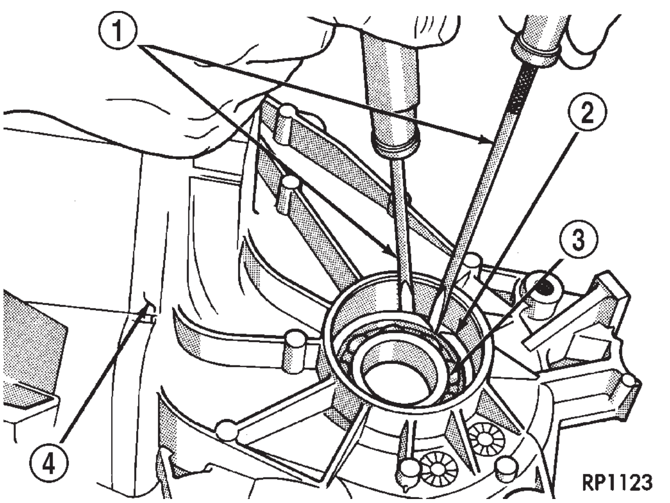


Fig. 42 Front Output Shaft Bearing Retaining Ring Removal

1 - SCREWDRIVERS
2 - SNAP-RING
3 - FRONT OUTPUT SHAFT BEARING
4 - FRONT CASE

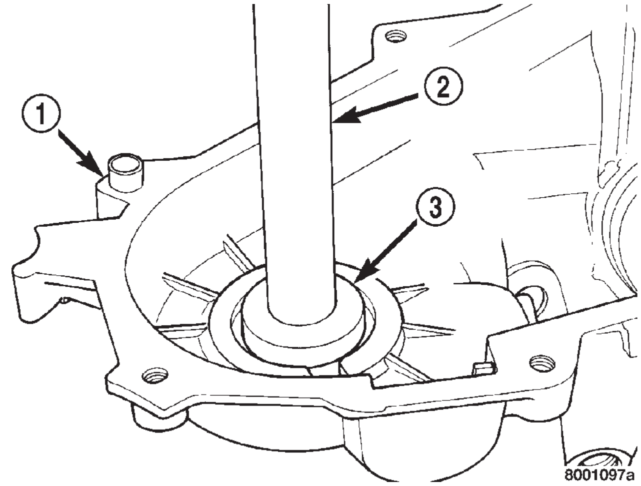


Fig. 43 Front Output Shaft Bearing Removal

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. 44).

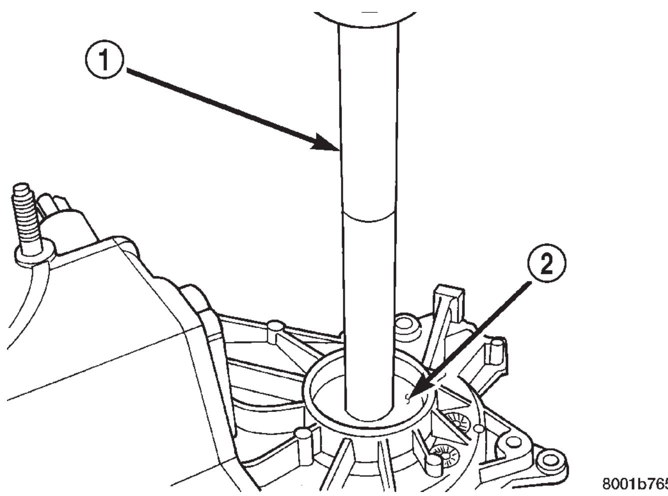


Fig. 44 Front Output Shaft Bearing Installation

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL 5064

(5) Install output shaft front bearing retaining ring (Fig. 45). Start ring into place by hand. Then use small screwdriver to work ring into case groove. Be sure ring is fully seated before proceeding.

(6) Install new front output seal in front case with Installer Tool 8143-A as follows:

(a) Place new seal on tool. **Garter spring on seal goes toward interior of case.**

(b) Start seal in bore with light taps from hammer (Fig. 46). Once seal is started, continue tapping seal into bore until installer tool bottoms against case.

TRANSFER CASE - NV231 (Continued)

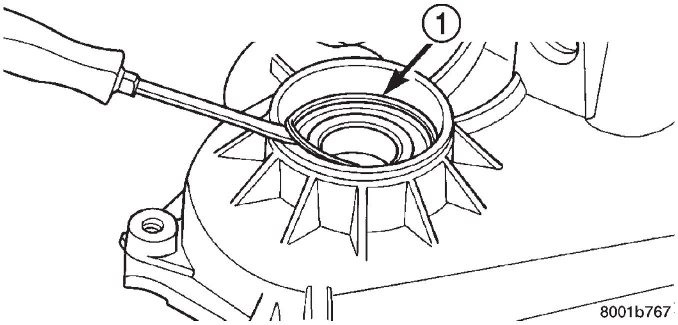


Fig. 45 Installing Output Shaft Front Bearing Retaining Ring

1 - WORK RETAINING RING INTO BORE GROOVE WITH SMALL SCREWDRIVER

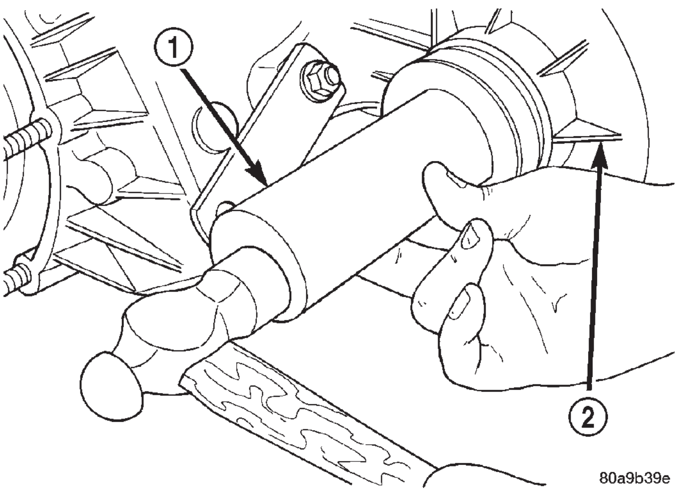


Fig. 46 Front Output Seal Installation - Typical

1 - INSTALLER 8143-A
2 - TRANSFER CASE

(7) Remove the output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 47).

(8) Install new bearing with Tool Handle C-4171 and Installer 5066 (Fig. 48). The bearing bore is chamfered at the top. Install the bearing so it is flush with the lower edge of this chamfer (Fig. 49).

(9) Using Remover C-4210 and Handle C-4171, drive input shaft bearing from inside the annulus gear opening in the case (Fig. 50).

(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. 51).

(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. 52).

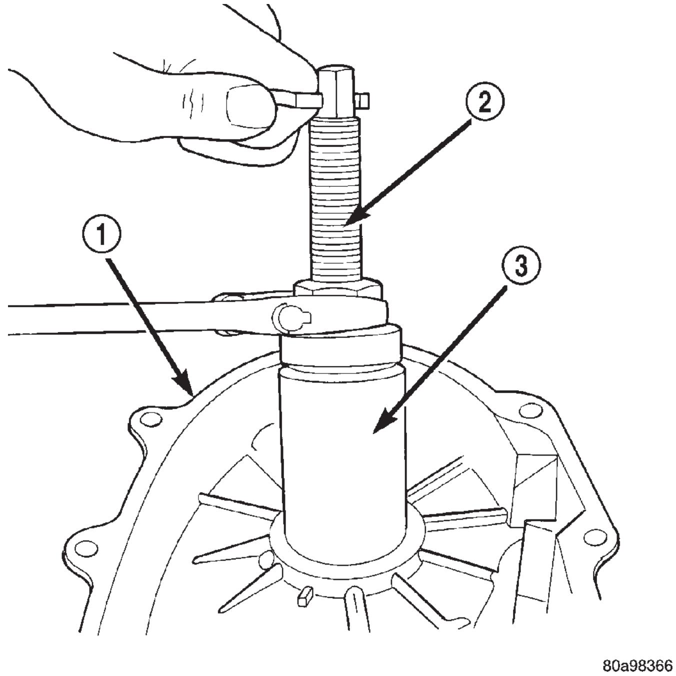


Fig. 47 Output Shaft Rear Bearing Removal

1 - REAR CASE
2 - SPECIAL TOOL L-4454-1 AND L-4454-3
3 - SPECIAL TOOL 8148

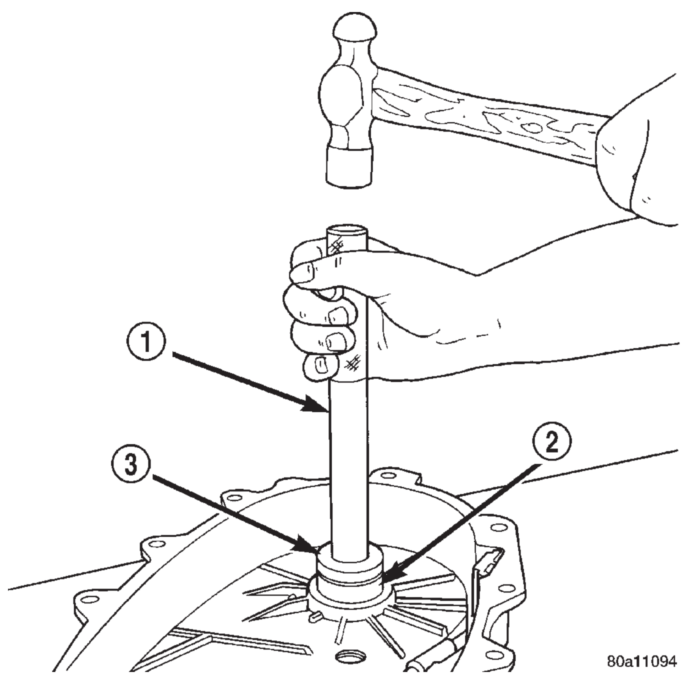


Fig. 48 Output Shaft Rear Bearing Installation

1 - HANDLE C-4171
2 - OUTPUT SHAFT INNER BEARING
3 - INSTALLER 5066

(14) Install new pilot bearing with Installer 5065 and Handle C-4171 (Fig. 53).

TRANSFER CASE - NV231 (Continued)

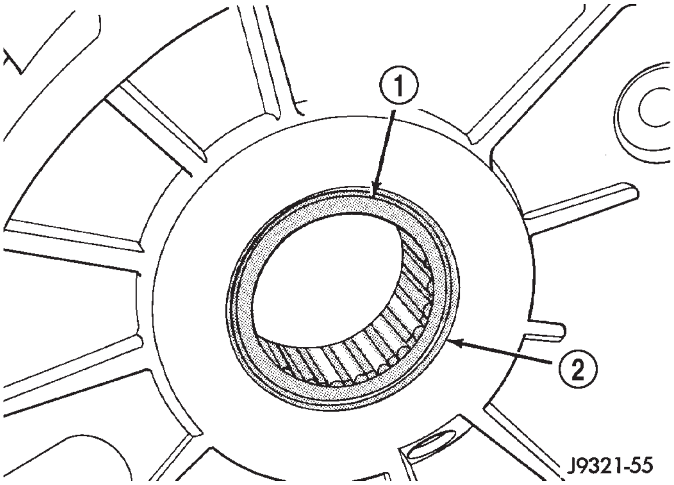


Fig. 49 Output Shaft Rear Bearing Installation Depth

1 - BEARING (SEATED) AT LOWER EDGE OF CHAMFER
2 - CHAMFER

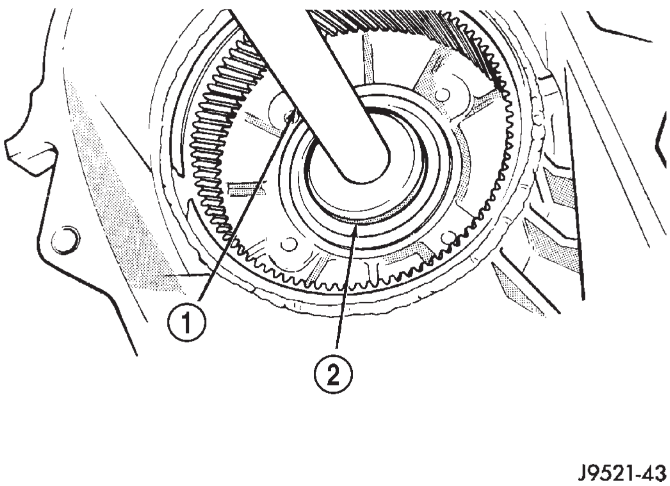


Fig. 50 Input Shaft Bearing Removal

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL C-4210

(15) Remove front bearing retainer seal with suitable pry tool.

(16) Install new front bearing retainer seal with Installer 7884 (Fig. 54).

(17) Remove seal from oil pump housing with a suitable pry tool

(18) Install new seal in oil pump housing with Installer 7888 (Fig. 55).

(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. 56).

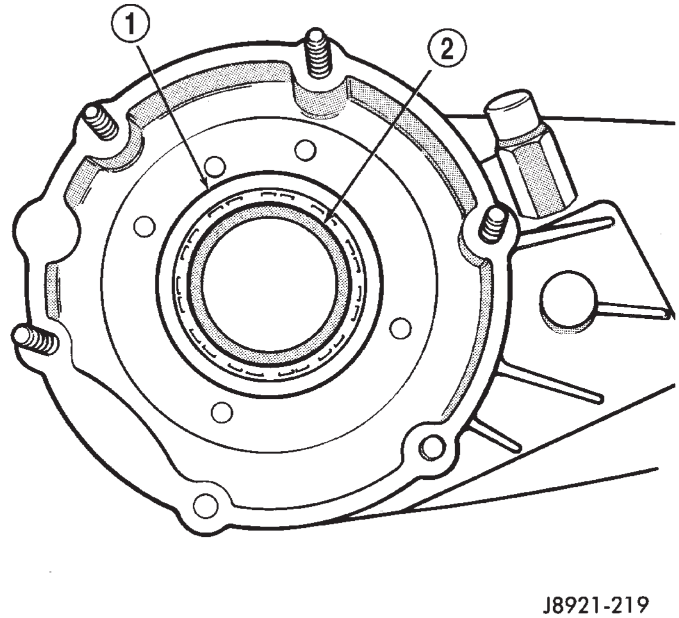


Fig. 51 Seating Input Shaft Bearing

1 - SNAP-RING
2 - INPUT SHAFT BEARING

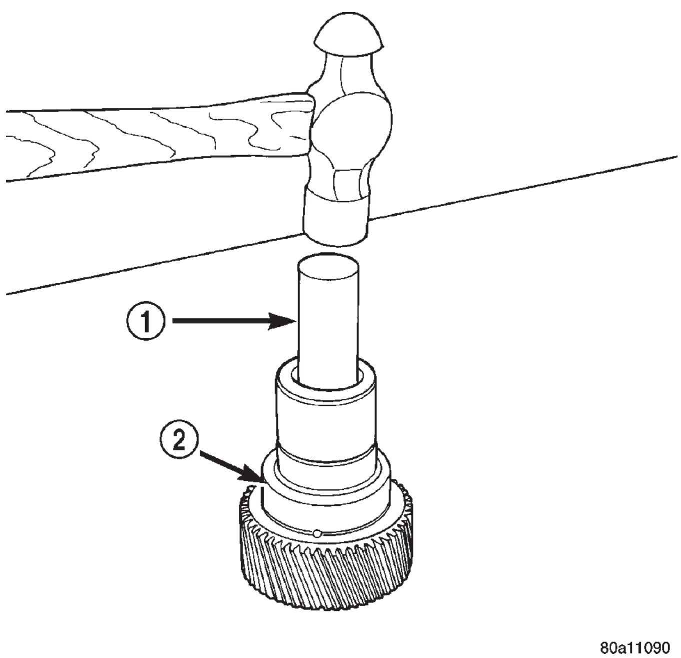


Fig. 52 Remove Input Gear Pilot Bearing

1 - DRIFT
2 - INPUT GEAR

INPUT AND LOW RANGE GEAR

(1) Install first thrust washer in low range gear (Fig. 57). Be sure washer tabs are properly aligned in gear notches.

(2) Install input gear in low range gear. Be sure input gear is fully seated.

TRANSFER CASE - NV231 (Continued)

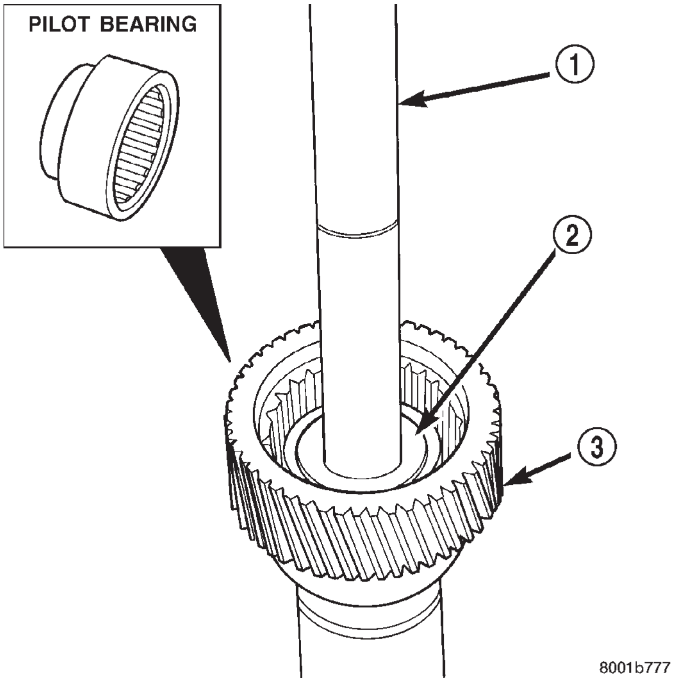


Fig. 53 Install Input Gear Pilot Bearing

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL 5065
3 - INPUT GEAR

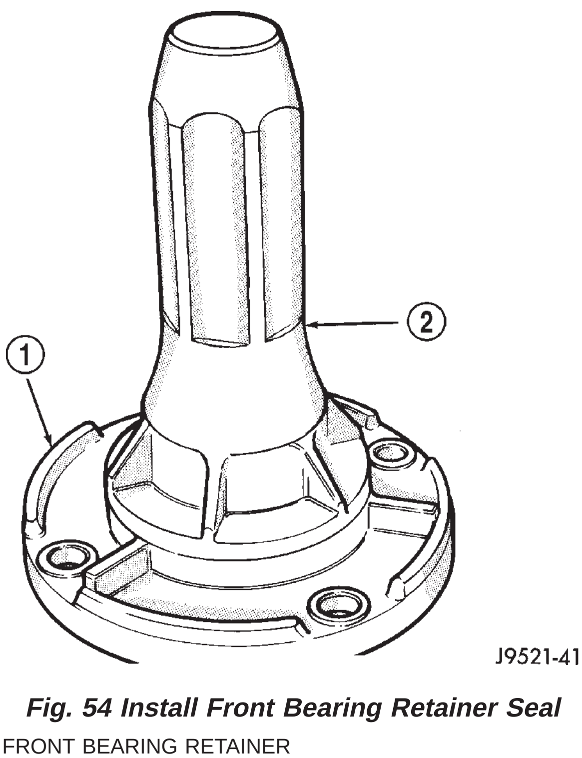


Fig. 54 Install Front Bearing Retainer Seal

1 - FRONT BEARING RETAINER
2 - SPECIAL TOOL 7884

(3) Install remaining thrust washer in low range gear and on top of input gear. Be sure washer tabs are properly aligned in gear notches.

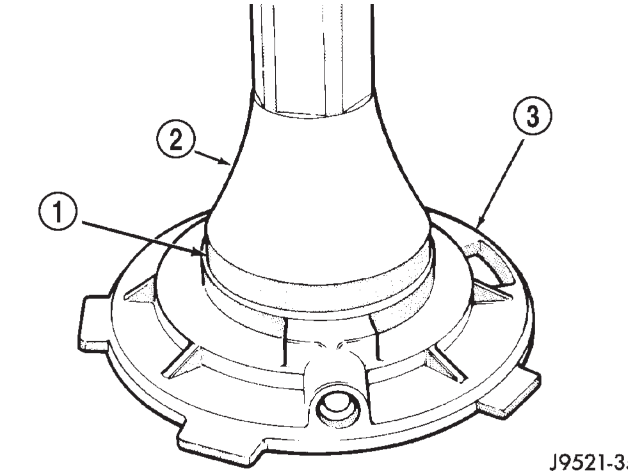


Fig. 55 Oil Pump Seal Installation

1 - HOUSING SEAL
2 - SPECIAL TOOL 7888
3 - OIL PUMP FEED HOUSING

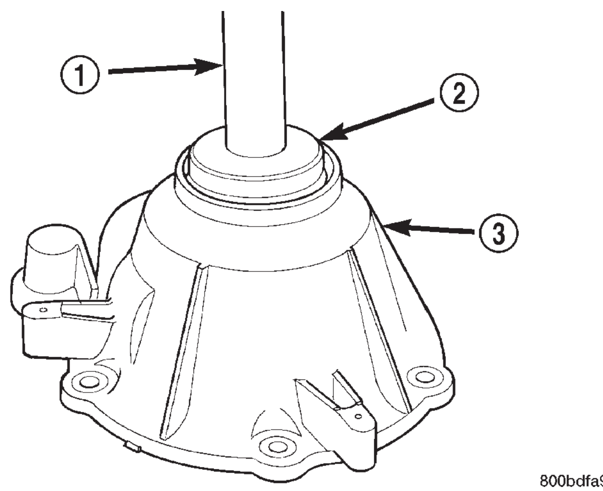


Fig. 56 Installing Rear Bearing In Retainer

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL 5064
3 - REAR RETAINER

(4) Install retainer on input gear and install snap-ring.

INPUT GEAR AND LOW RANGE GEAR

(1) Align and install low range/input gear assembly in front case (Fig. 58). 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. 59).

(3) Clean gasket sealer residue from retainer and inspect retainer for cracks or other damage.

TRANSFER CASE - NV231 (Continued)

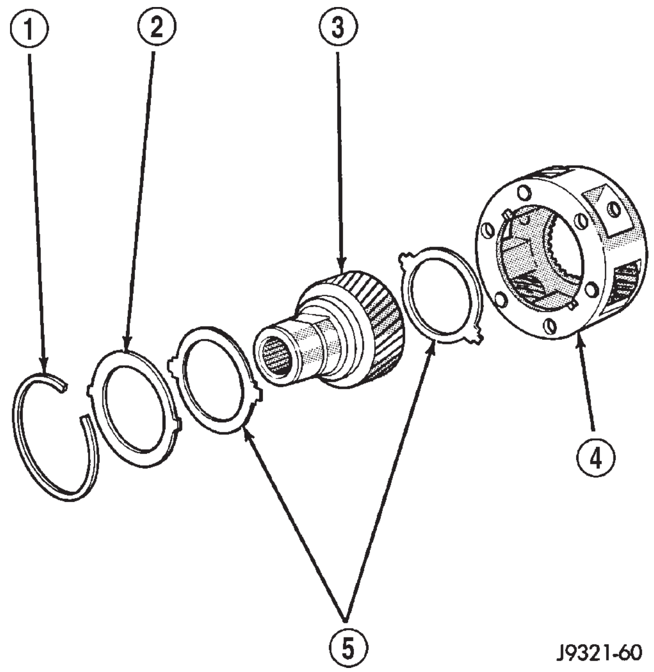


Fig. 57 Input/Low Range Gear Components

1 - SNAP-RING
2 - RETAINER PLATE
3 - INPUT GEAR
4 - LOW RANGE GEAR
5 - THRUST WASHERS

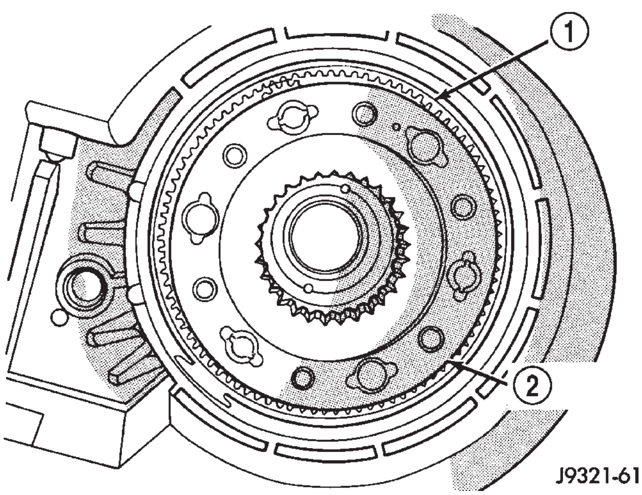


Fig. 58 Input/Low Range Gear Installation

1 - ANNULUS GEAR
2 - INPUT/LOW RANGE GEAR

(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.

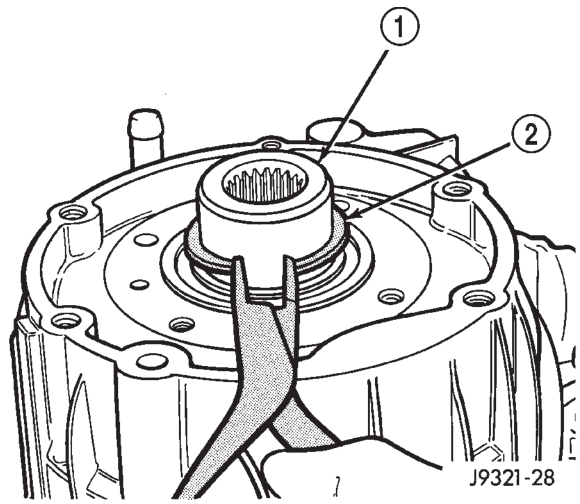


Fig. 59 Install Snap-Ring

1 - INPUT GEAR
2 - SNAP-RING

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. 60). Tighten to 21 N·m (16 ft. lbs.) of torque.

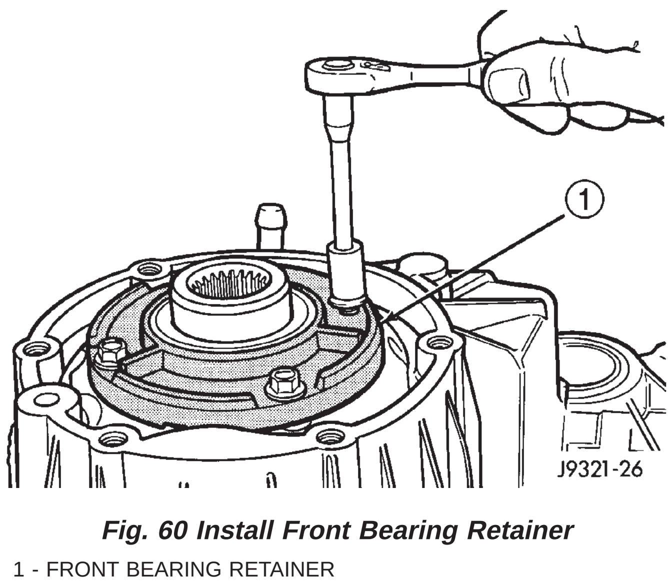


Fig. 60 Install Front Bearing Retainer

1 - FRONT BEARING RETAINER

MAINSHAFT

(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.

TRANSFER CASE - NV231 (Continued)

SHIFT FORKS AND MAINSHAFT

(1) Install new sector shaft O-ring and bushing (Fig. 61).

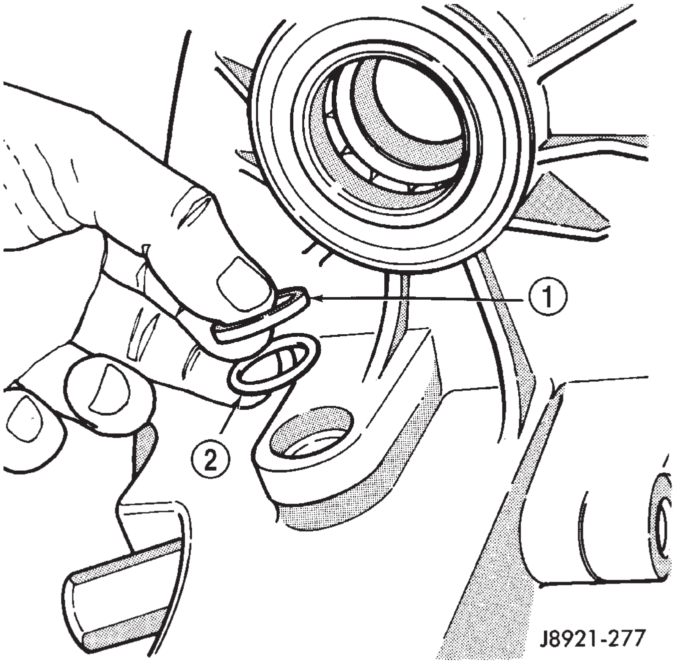


Fig. 61 Sector O-Ring And Bushing Installation

1 - SECTOR BUSHING
2 - O-RING

(2) Install shift sector in case (Fig. 62). Lubricate sector shaft with transmission fluid before installation.

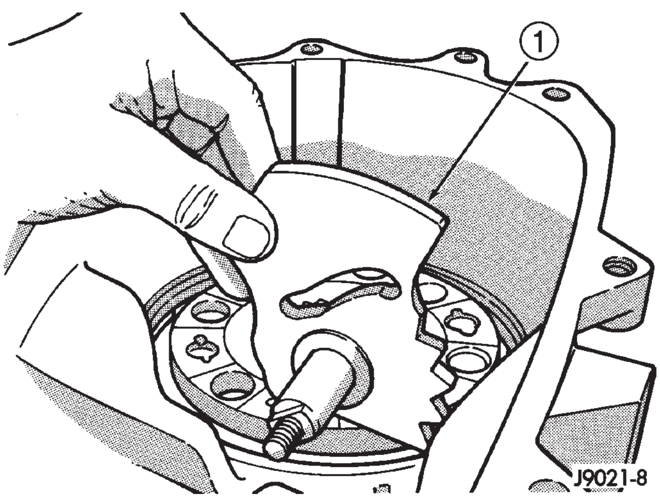


Fig. 62 Shift Sector Installation

1 - SHIFT SECTOR

(3) Install range lever, washer, and nut on sector shaft (Fig. 63). Tighten range lever nut to 27-34 N·m (20-25 ft. lbs.) torque.

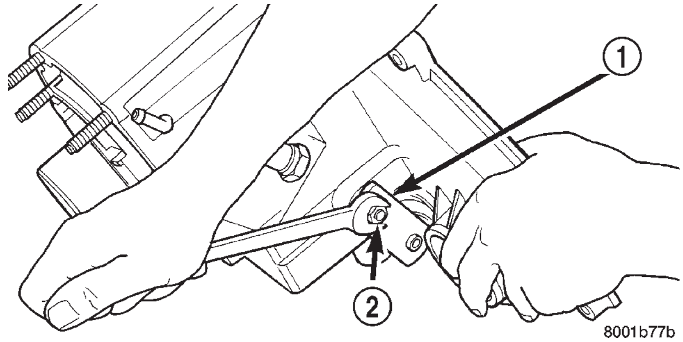


Fig. 63 Range Lever Installation

1 - RANGE LEVER
2 - LEVER NUT

(4) Assemble and install range fork and hub (Fig. 64). 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.

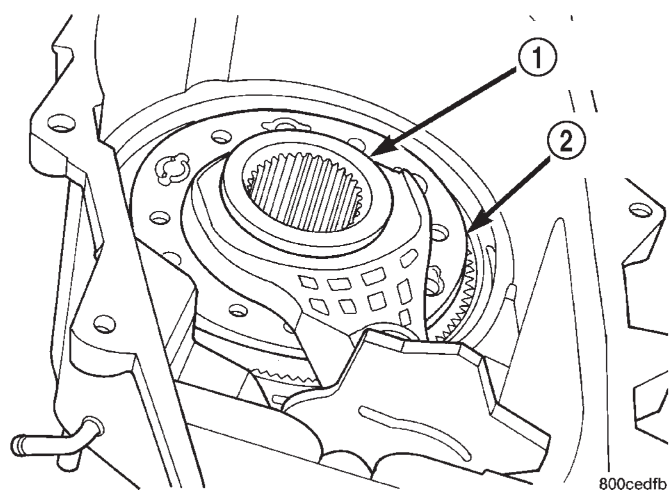


Fig. 64 Install Range Fork And Sleeve Assembly

1 - RANGE HUB
2 - RANGE FORK

(6) Install assembled mainshaft (Fig. 65). Be sure shaft is seated in pilot bearing and input gear.

(7) Install new pads on mode fork if necessary.

(8) Insert mode sleeve in mode fork mode fork. Be sure long side of sleeve is toward long end of shift rail (Fig. 66).

(9) Install assembled mode fork and sleeve (Fig. 67). 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. 68).

(12) Lubricate detent plunger with transmission fluid or light coat of petroleum jelly.

TRANSFER CASE - NV231 (Continued)

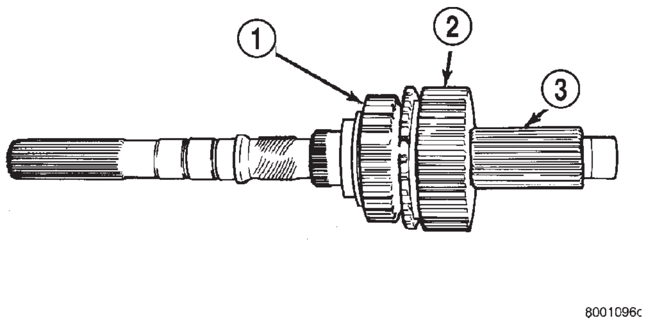


Fig. 65 Mainshaft Assembly Installation

1 - DRIVE SPROCKET
2 - MODE HUB
3 - MAINSHAFT

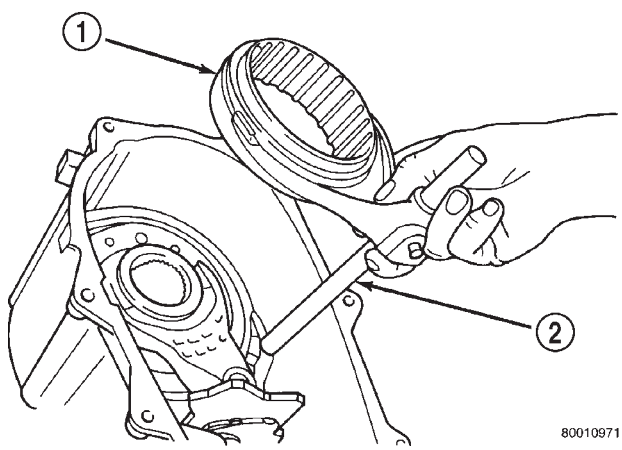


Fig. 66 Assembling Mode Fork And Sleeve

1 - MODE SLEEVE
2 - MODE FORK AND RAIL

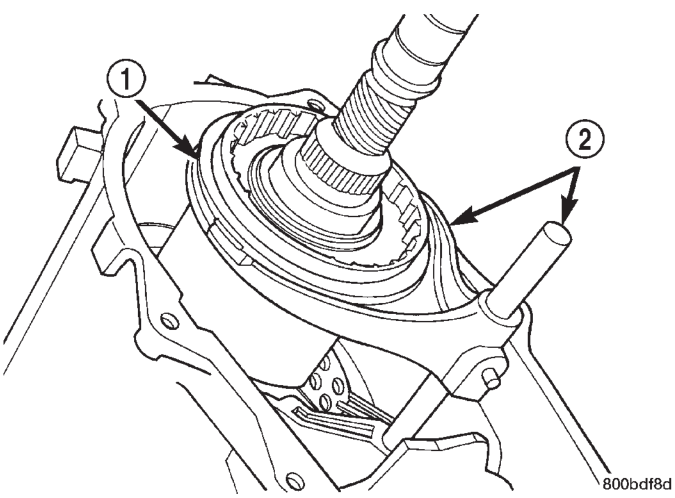


Fig. 67 Mode Fork And Sleeve Installation

1 - MODE SLEEVE
2 - MODE FORK AND RAIL

(13) Install detent plunger, spring and plug (Fig. 68).

(14) Verify that plunger is properly engaged in sector.

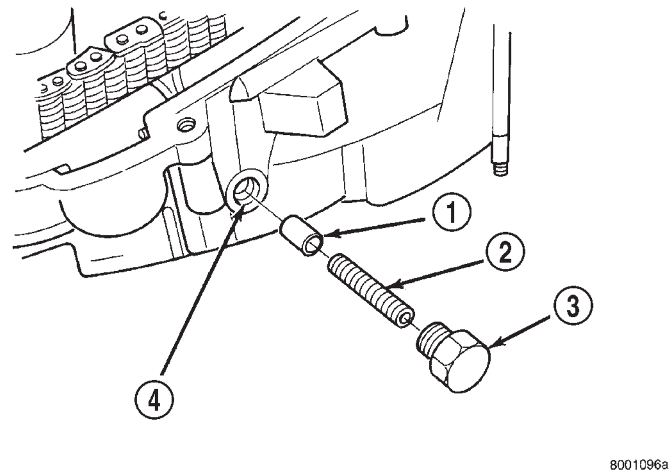


Fig. 68 Shift Detent Components

1 - POPPET
2 - SPRING
3 - SCREW
4 - POPPET BORE (IN CASE)

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(1) Lubricate front output shaft-sprocket assembly, drive chain, and drive sprocket with transmission fluid.

(2) Assemble drive chain and front output shaft (Fig. 69).

(3) Start chain on mainshaft drive sprocket.

(4) Guide front shaft into bearing and drive sprocket onto mainshaft drive gear (Fig. 69).

(5) Install mode spring on upper end of mode fork shift rail (Fig. 70).

OIL PUMP AND REAR CASE

(1) Install magnet in front case pocket (Fig. 71).

(2) Assemble oil pickup screen, connecting hose, and tube.

(3) Install new pickup tube O-ring in oil pump (Fig. 72).

(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. 73).

(6) Apply 3 mm (1/8 in.) wide bead of Mopar® gasket maker or silicone adhesive sealer to mounting flange of front case. Work sealer bead around bolt holes.

(7) Lift rear case and oil pump and carefully position assembly on front case. Be sure case dowels are

TRANSFER CASE - NV231 (Continued)

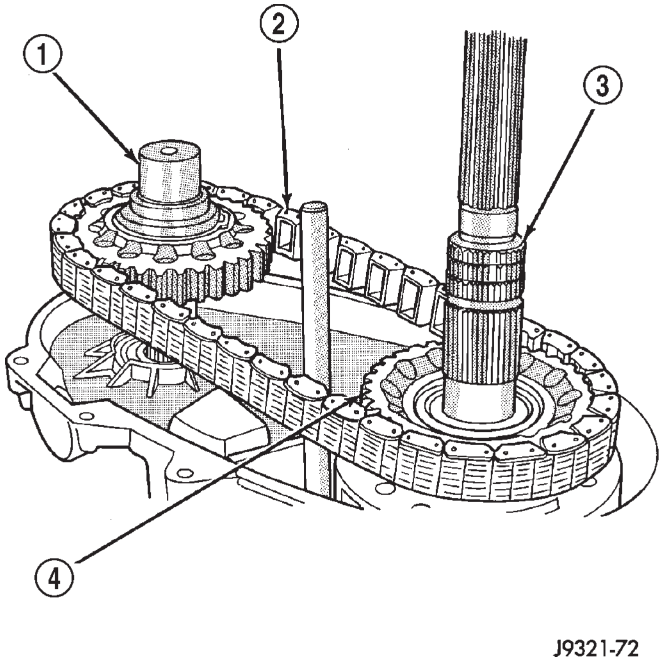


Fig. 69 Installing Drive Chain And Front Output Shaft

1 - FRONT OUTPUT SHAFT
2 - DRIVE CHAIN
3 - MAINSHAFT
4 - DRIVE SPROCKET

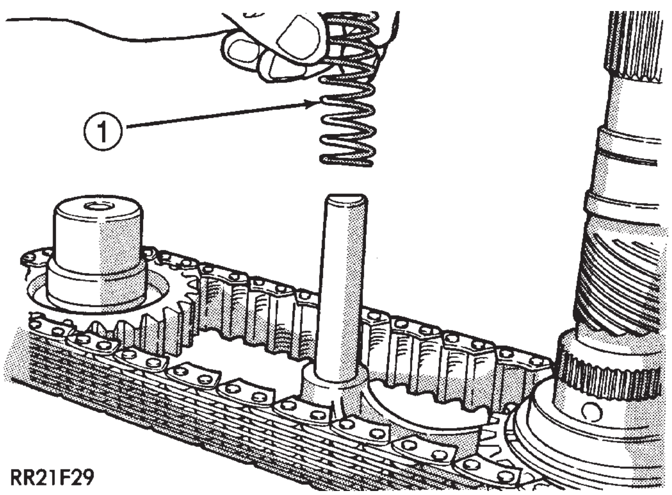


Fig. 70 Install Mode Fork Spring

1 - MODE SPRING

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. 74).

(9) Tighten case bolts to 27-34 N·m (20-25 ft. lbs.) torque.

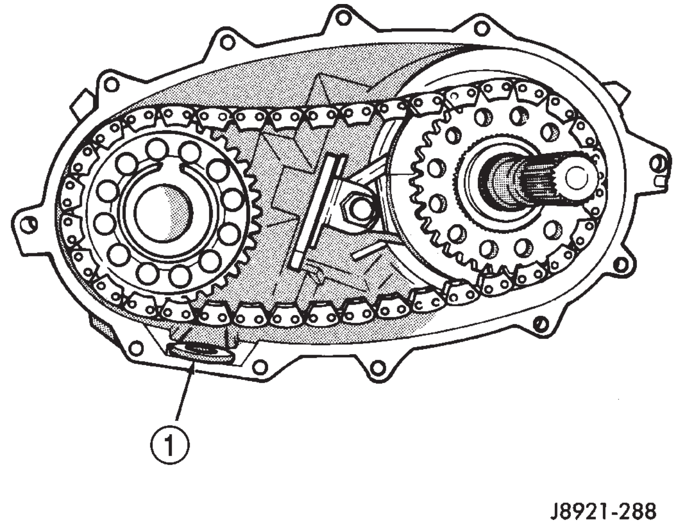


Fig. 71 Installing Case Magnet

1 - MAGNET

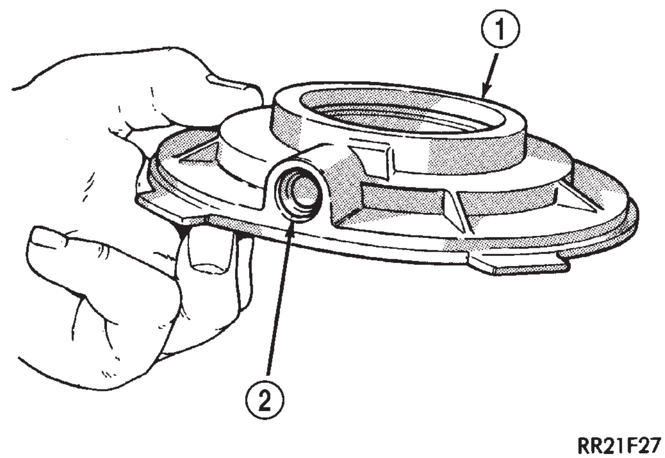


Fig. 72 Pickup Tube O-Ring Position

1 - OIL PUMP
2 - O-RING

YOKE AND RANGE LEVER

(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. 75). Tighten locknut to 27-34 N·m (20-25 ft. lbs.) torque.

(3) Install new seal washer on front output shaft (Fig. 77).

(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. 76).

(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.

TRANSFER CASE - NV231 (Continued)

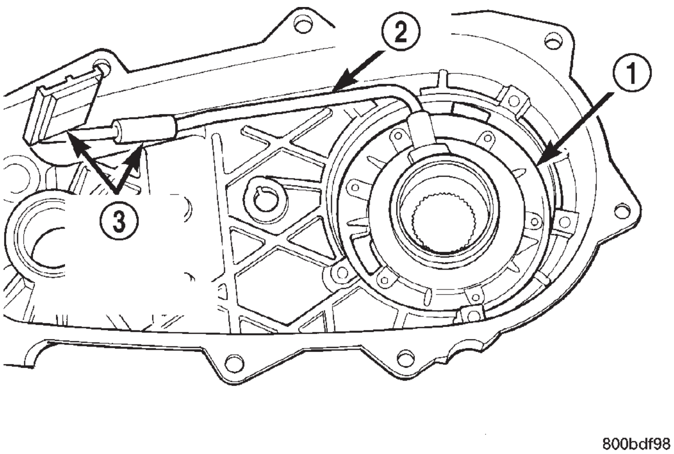


Fig. 73 Oil Pump And Pickup Tube Installation

1 - OIL PUMP
2 - PICKUP TUBE
3 - PICKUP SCREEN AND CONNECTOR

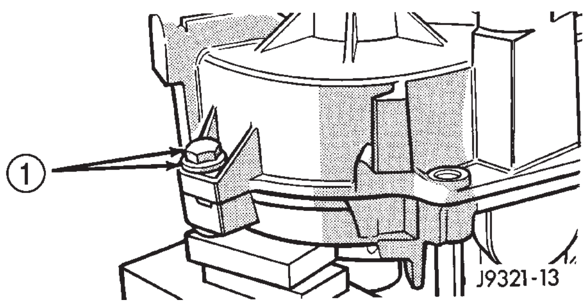


Fig. 74 Alignment Bolt Location

1 - ALIGNMENT BOLT AND WASHER (AT EACH END OF CASE)

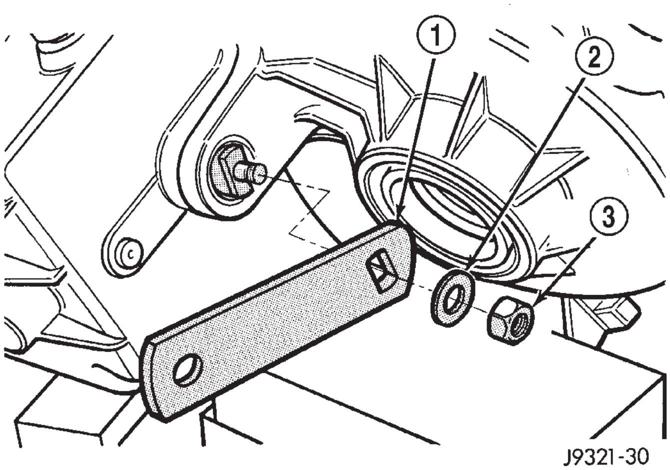


Fig. 75 Range Lever Installation

1 - RANGE LEVER
2 - WASHER
3 - LOCKNUT

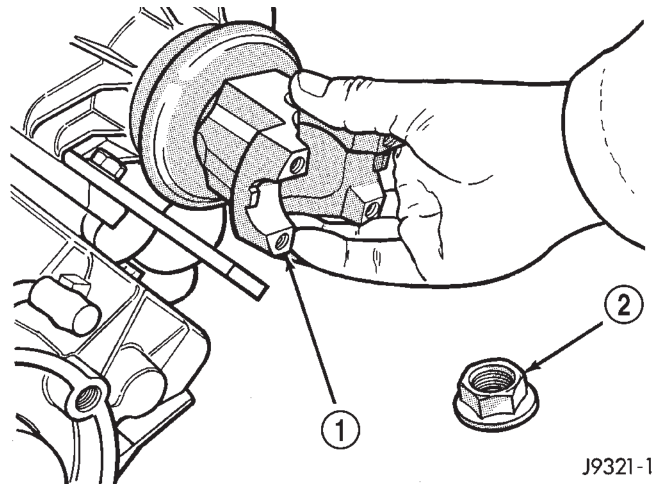


Fig. 76 Output Shaft Yoke Installation

1 - OUTPUT SHAFT YOKE
2 - YOKE NUT

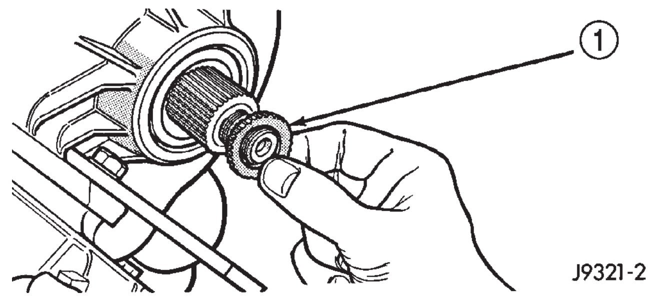


Fig. 77 Seal Washer Installation

1 - YOKE SEAL WASHER

REAR RETAINER

(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. 78). 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. 79).

NOTE: Vehicles built with a 4.0L engine and a manual transmission use a damper weight on the transfer case output shaft. Be sure to identify the transfer case before proceeding.

TRANSFER CASE - NV231 (Continued)

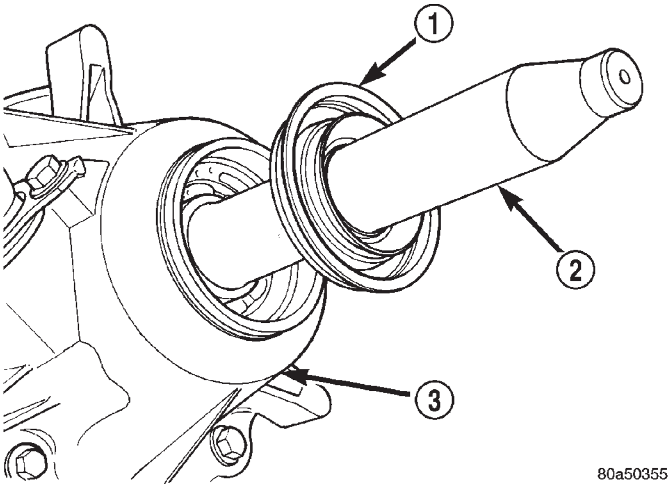


Fig. 78 Output Shaft Seal and Protector

1 - OUTPUT SHAFT SEAL
2 - SPECIAL TOOL 6992
3 - TRANSFER CASE

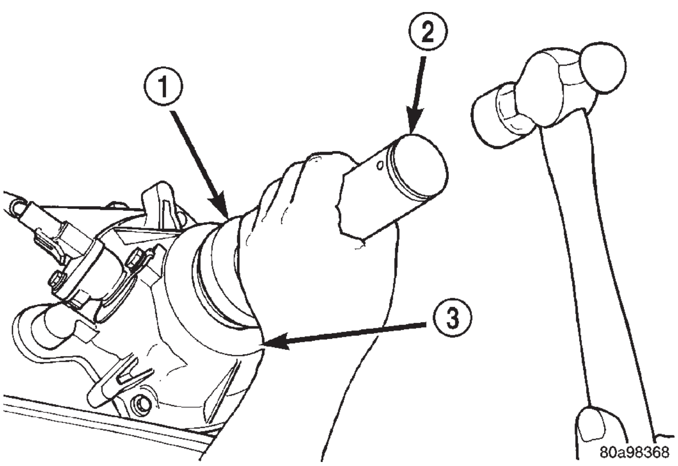


Fig. 79 Rear Seal Installation

1 - SPECIAL TOOL C-4076-B
2 - SPECIAL TOOL MD-998323
3 - TRANSFER CASE

(7) Install a new output shaft rear slinger with Installer 8408, if the vehicle is not equipped with an output shaft damper.

(8) If the vehicle is equipped with an output shaft damper, install the output shaft damper as follows:

(a) Position the damper weight on the output shaft. Start the damper onto the output shaft chamfer, being careful to keep the weight square to the output shaft. (Fig. 80)

(b) Position the driver portion of Installer 8422 (Fig. 81) onto the damper, making sure the legs of the damper are positioned through the slots of the damper.

(c) Thread the puller screw of Installer 8422 into the output shaft by hand only. Make sure the screw is fully threaded into the output shaft.

(d) Using a wrench to hold the pulling screw stationary (Fig. 82), turn the pulling screw nut until the driver legs contact the rear face of the transfer case rear retainer. When the legs contact the retainer, the damper is properly positioned on the output shaft.

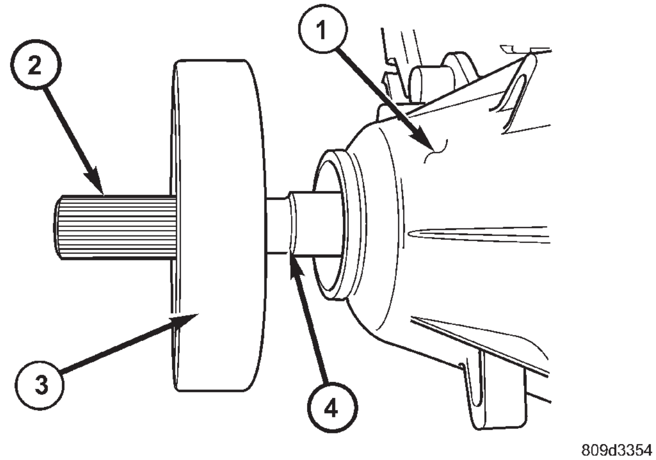


Fig. 80 Position Damper on Output Shaft

1 - Transfer Case
2 - Output Shaft
3 - Damper Weight
4 - Chamfer

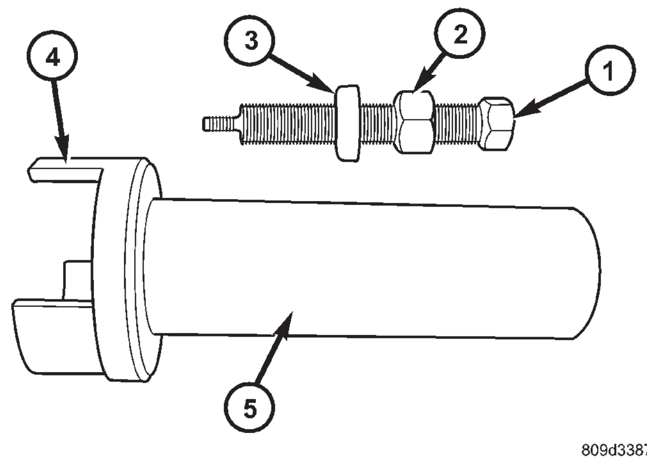


Fig. 81 Driver Installer 8680 and Puller Screw from 8422

1 - Pulling Screw
2 - Pulling Screw Nut
3 - Bearing
4 - Driver Legs
5 -Installer Driver

TRANSFER CASE - NV231 (Continued)

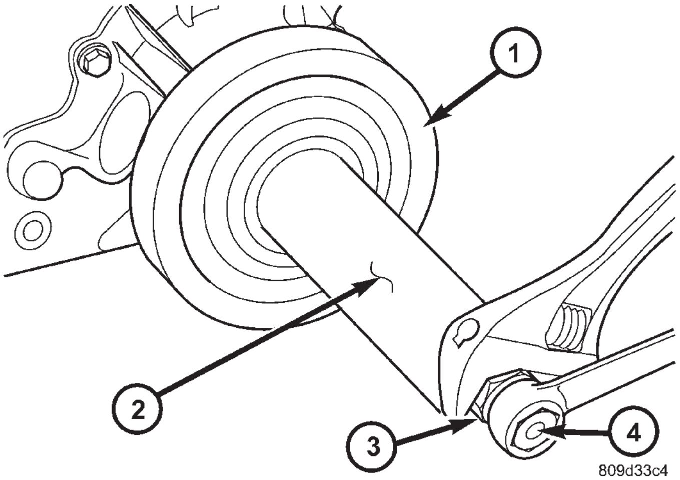


Fig. 82 Install Damper

1 - Damper
2 - Installer Driver
3 - Pulling Screw Nut
4 - Pulling Screw

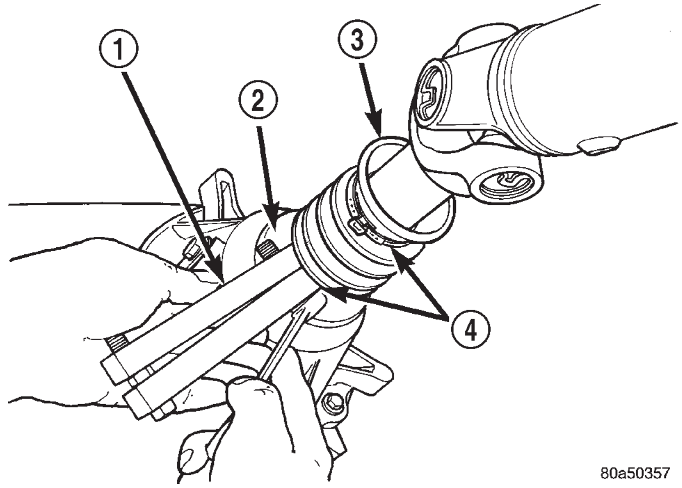


Fig. 83 Slinger Boot Installation - Typical

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

(9) Install boot on output shaft slinger, or output shaft damper, and crimp retaining clamp with tool C-4975-A (Fig. 83).

INSTALLATION

(1) Mount transfer case on a transmission jack.
(2) Secure transfer case to jack with chains.
(3) Position transfer case under vehicle.
(4) Align transfer case and transmission shafts and install transfer case on transmission.
(5) Install and tighten transfer case attaching nuts to 35 N·m (26 ft. lbs.) torque (Fig. 2).
(6) Connect vehicle speed sensor wires, and vent hose.
(7) Connect indicator switch harness to transfer case switch, if necessary. Secure wire harness to clips on transfer case.
(8) Align and connect propeller shafts. Refer to Differential and Driveline for proper procedures and specifications.
(9) Fill transfer case with correct fluid. Check transmission fluid level. Correct as necessary.
(10) Install rear crossmember, or skid plate. Tighten crossmember bolts to 41 N·m (30 ft. lbs.) torque.
(11) Remove transmission jack and support stand.
(12) Connect shift rod to transfer case range lever.
(13) Adjust transfer case shift linkage.
(14) Lower vehicle and verify transfer case shift operation.

TRANSFER CASE - NV231 (Continued)

SPECIFICATIONS

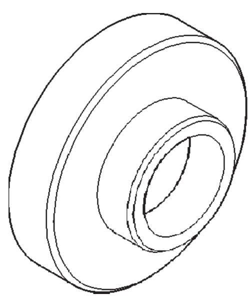
TRANSFER CASE - NV231

TORQUE

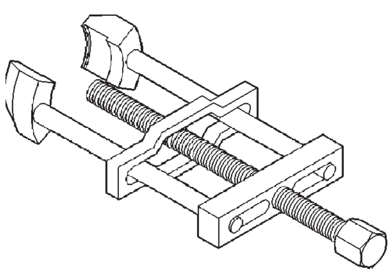
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Plug, Detent	16-24	12-18	-
Plug, Drain/Fill	20-34	15-25	-
Bolt, Front Brg. Retainer	21	16	-
Bolt, Case Half	27-34	20-25	-
Nut, Front Yoke	122-176	90-130	-
Nut, Range Lever	27-34	20-25	-
Bolt, Rear Retainer	35-46	26-34	-
Nuts, Mounting	35-47	26-35	-
Switch, Indicator	20-34	15-25	-

SPECIAL TOOLS

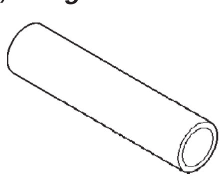
NV231



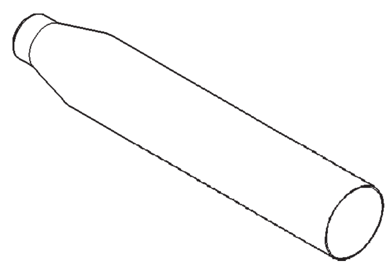
Installer - C-4076-B



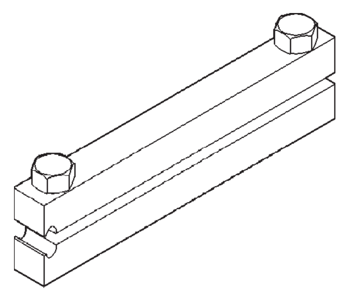
Puller, Slinger - MD-998056-A



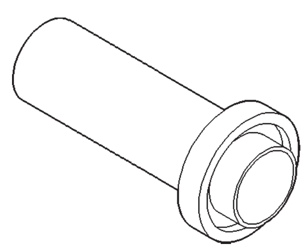
Installer - MD-998323



Protector, Seal - 8824

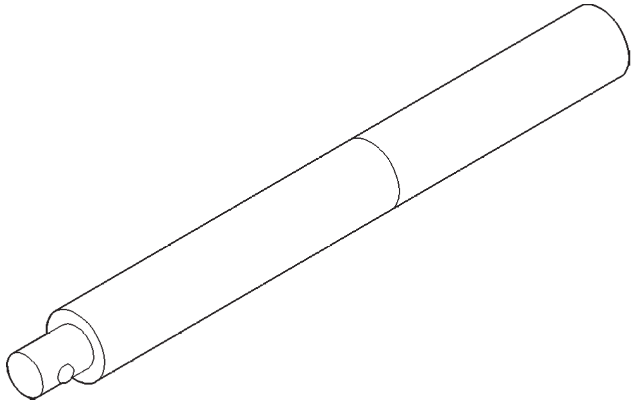


Installer, Boot Clamp - C-4975-A

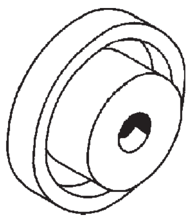


Installer, Seal - 8143-A

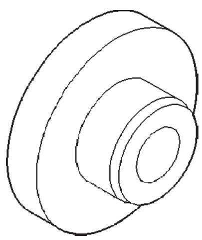
TRANSFER CASE - NV231 (Continued)



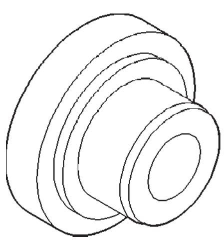
Handle, Universal - C-4171



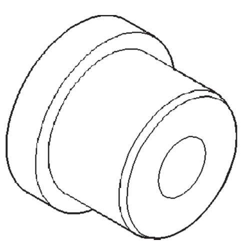
Installer, Seal - C-4210



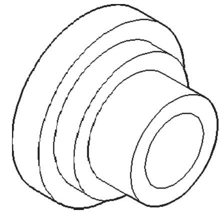
Installer, Bearing - 5052



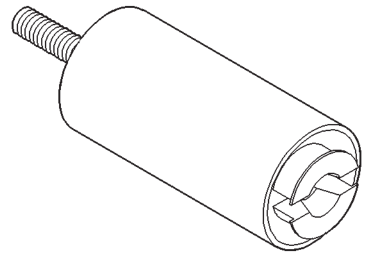
Installer, Bearing - 5065



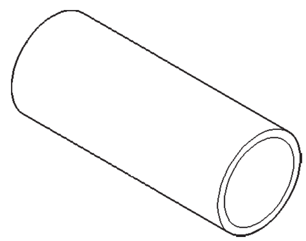
Installer, Bushing - 5066



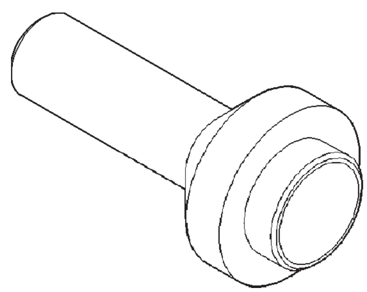
Installer, Bearing - 8128



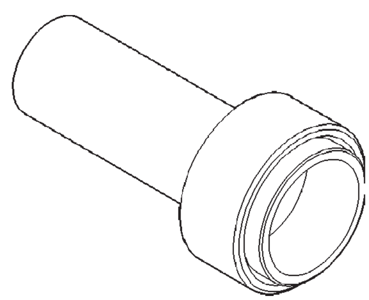
Remover - L-4454



Cup - 8148

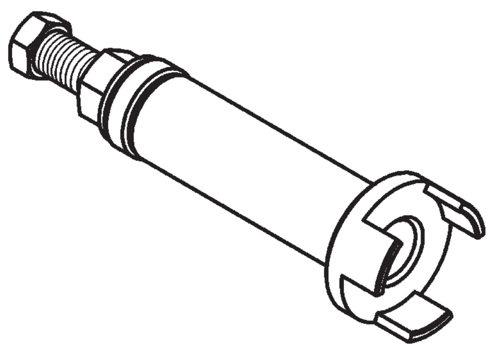


Installer, Seal - 7884

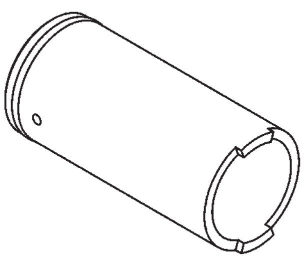


Installer, Pump Housing Seal - 7888

TRANSFER CASE - NV231 (Continued)



Installer, Transfer Case Damper Driver - 8680 and Screw Assembly from 8422



Installer, Output Shaft Slinger - 8408

FLUID

STANDARD PROCEDURE - FLUID DRAIN AND FILL

The fill and drain plugs are both in the rear case (Fig. 84). 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.

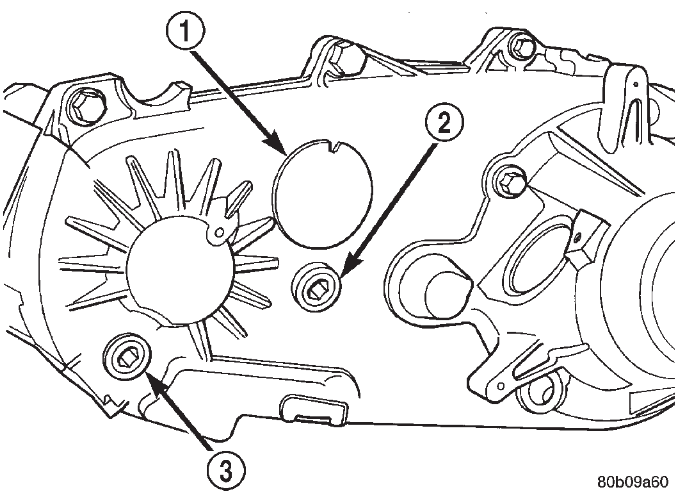


Fig. 84 Fill/Drain Plug and I.D. Tag Location - Typical

1 - I.D. TAG
2 - FILL PLUG
3 - DRAIN PLUG

FRONT OUTPUT SHAFT SEAL

REMOVAL

(1) Raise vehicle.

(2) Remove front propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(3) Remove front output shaft yoke.

(4) Remove seal from front case with pry tool (Fig. 85).

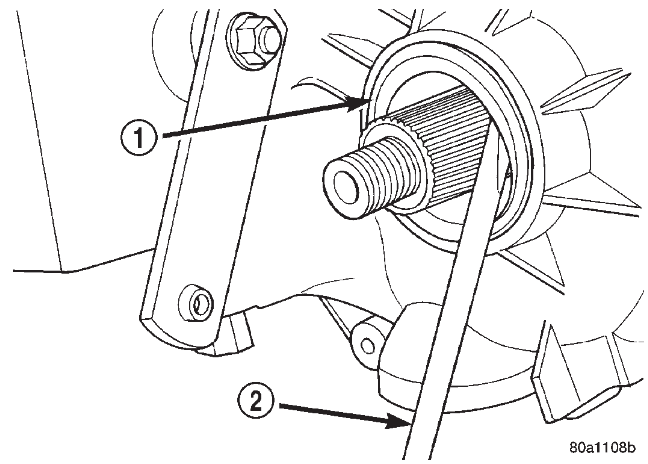


Fig. 85 Remove Front Output Shaft Seal - Typical

1 - OUTPUT SHAFT SEAL
2 - PRYBAR

INSTALLATION

(1) Install new front output seal in front case with Installer Tool 8143-A as follows:

(a) Place new seal on tool. Garter spring on seal goes toward interior of case.

(b) Start seal in bore with light taps from hammer (Fig. 86). Once seal is started, continue tapping seal into bore until installer tool seats against case.

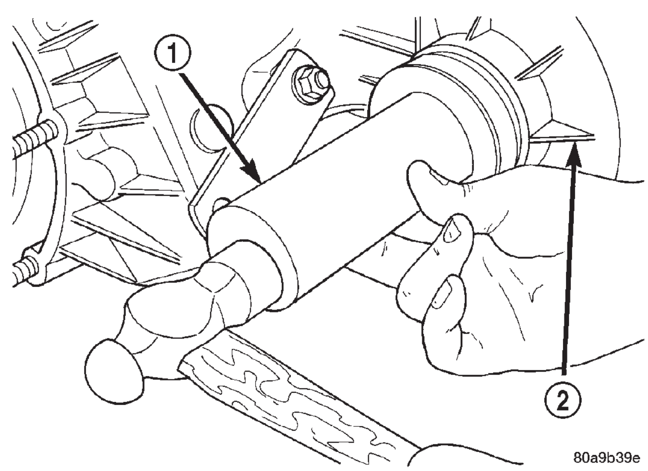


Fig. 86 Front Output Seal Installation - Typical

1 - INSTALLER 8143-A
2 - TRANSFER CASE

REAR OUTPUT SHAFT SEAL

REMOVAL

(1) Shift the transmission and transfer case into NEUTRAL.

(2) Raise and support vehicle.

(3) Mark a line across the pinion shaft and at each end of the propeller shaft 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. 87).

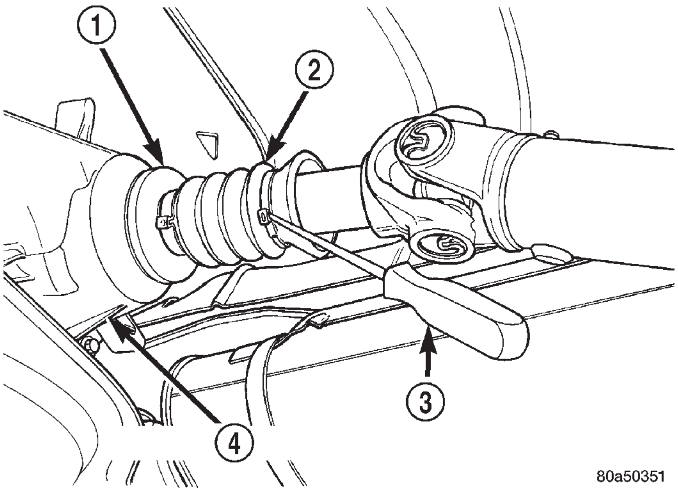


Fig. 87 Dust Boot Clamp

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

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

(7) Spread band clamp which holds output shaft boot to the output shaft slinger, or output shaft damper, with a suitable awl, or equivalent.

NOTE: Vehicles built with a 4.0L engine and a manual transmission use a damper weight on the transfer case output shaft. Be sure to identify the transfer case before proceeding.

(8) Remove output shaft boot from slinger, or output shaft damper, and output shaft.

(9) If the vehicle is not equipped with an output shaft damper, remove the output shaft rear slinger using Puller MD-998056-A (Fig. 88).

(10) If the vehicle is equipped with an output shaft damper, use Screws 8421 and the puller yoke and forcing screw from a bolt-grip puller set, such as those used to remove steering wheels and harmonic

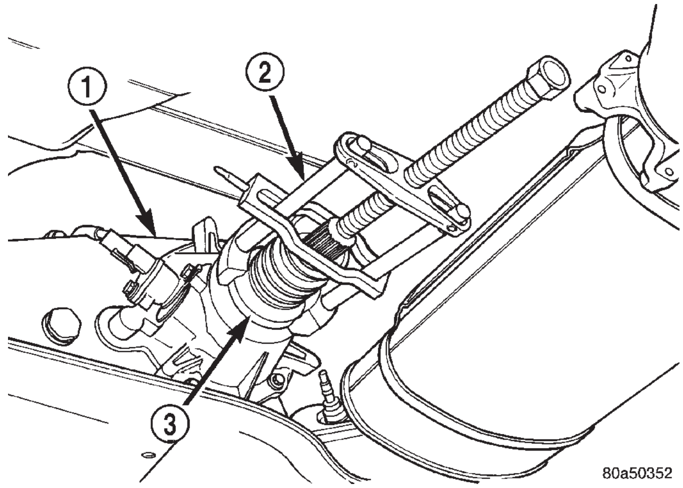


Fig. 88 Rear Slinger Removal

1 - TRANSFER CASE
2 - SPECIAL TOOL MD-998056-A
3 - SLINGER

balancers, to remove the transfer case output shaft damper.

(11) Use a suitable pry tool, or a slide hammer mounted screw, to remove the seal from the rear retainer (Fig. 89).

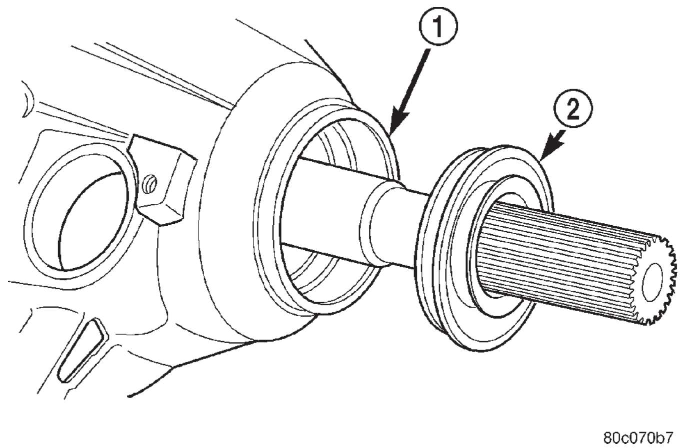


Fig. 89 Rear Output Shaft Seal

1 - REAR RETAINER
2 - OUTPUT SHAFT SEAL

INSTALLATION

(1) Apply liberal quantity of petroleum jelly to new rear seal and to output shaft. Petroleum jelly is needed to protect seal lips during installation.

(2) Slide seal onto Seal Protector 6992 (Fig. 90). Slide seal protector and seal onto output shaft.

(3) 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. 91).

REAR OUTPUT SHAFT SEAL (Continued)

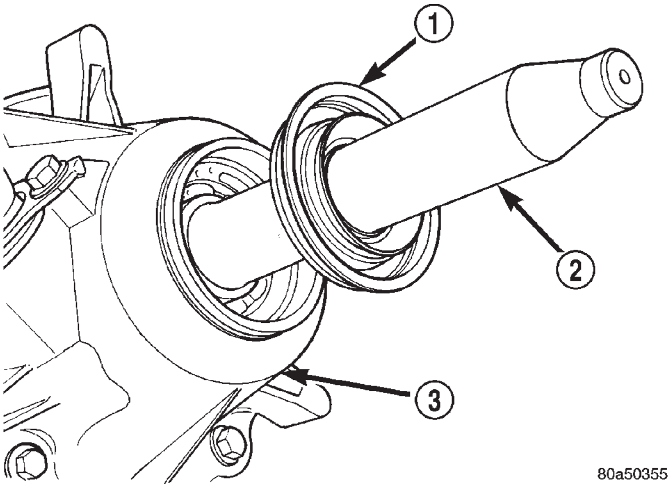


Fig. 90 Output Shaft Seal and Protector

1 - OUTPUT SHAFT SEAL
2 - SPECIAL TOOL 6992
3 - TRANSFER CASE

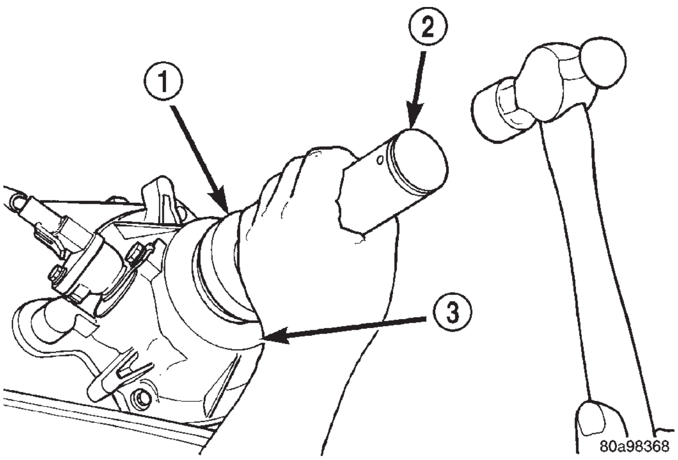


Fig. 91 Rear Seal Installation

1 - SPECIAL TOOL C-4076-B
2 - SPECIAL TOOL MD-998323
3 - TRANSFER CASE

NOTE: Vehicles built with a 4.0L engine and a manual transmission use a damper weight on the transfer case output shaft. Be sure to identify the transfer case before proceeding.

(4) Install a new output shaft rear slinger with Installer 8408, if the vehicle is not equipped with an output shaft damper.

(5) If the vehicle is equipped with an output shaft damper, install the output shaft damper as follows:

(a) Position the damper weight on the output shaft. Start the damper onto the output shaft chamfer, being careful to keep the weight square to the output shaft. (Fig. 92)

(b) Position the driver portion of Installer 8422 (Fig. 93) onto the damper, making sure the legs of the damper are positioned through the slots of the damper.

(c) Thread the puller screw of Installer 8422 into the output shaft by hand only. Make sure the screw is fully threaded into the output shaft.

(d) Using a wrench to hold the pulling screw stationary (Fig. 94), turn the pulling screw nut until the driver legs contact the rear face of the transfer case rear retainer. When the legs contact the retainer, the damper is properly positioned on the output shaft.

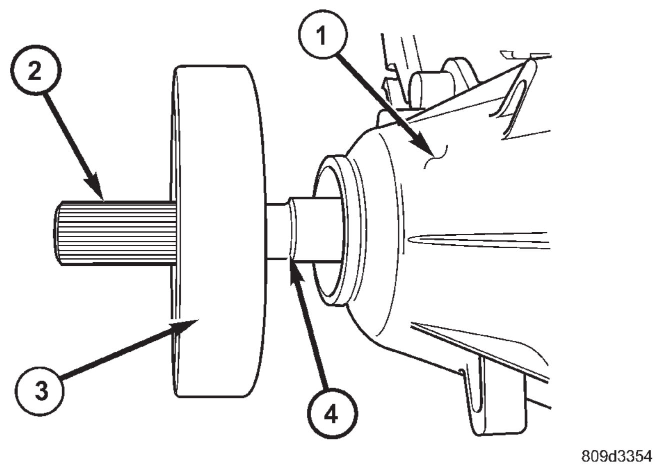


Fig. 92 Position Damper on Output Shaft

1 - Transfer Case
2 - Output Shaft
3 - Damper Weight
4 - Chamfer

(6) Install boot on output shaft slinger, or output shaft damper, and crimp retaining clamp with tool C-4975-A (Fig. 95).

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

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

(9) Crimp clamp with Clamp Tool C-4975A to hold dust boot to propeller shaft yoke.

(10) Remove support and lower the vehicle.

REAR OUTPUT SHAFT SEAL (Continued)

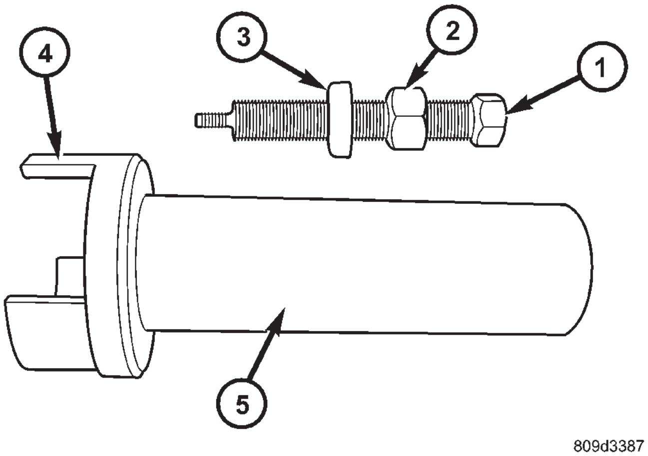


Fig. 93 Driver Installer 8680 and Screw Assembly from 8422

1 - Pulling Screw
2 - Pulling Screw Nut
3 - Bearing
4 - Driver Legs
5 -Installer Driver

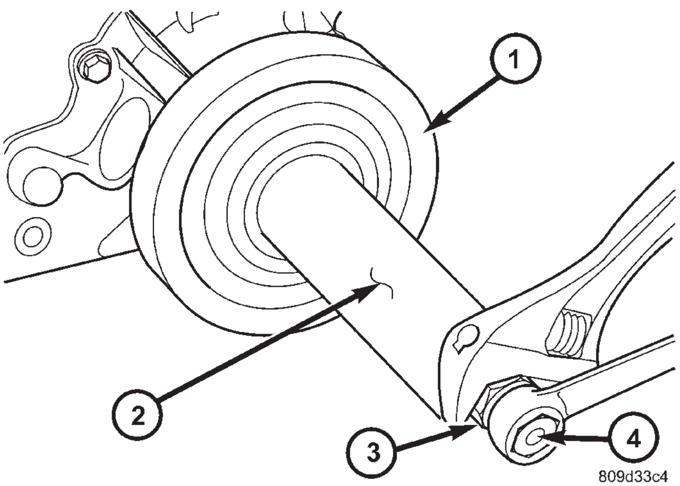


Fig. 94 Install Damper

1 - Damper
2 - Installer Driver
3 - Pulling Screw Nut
4 - Pulling Screw

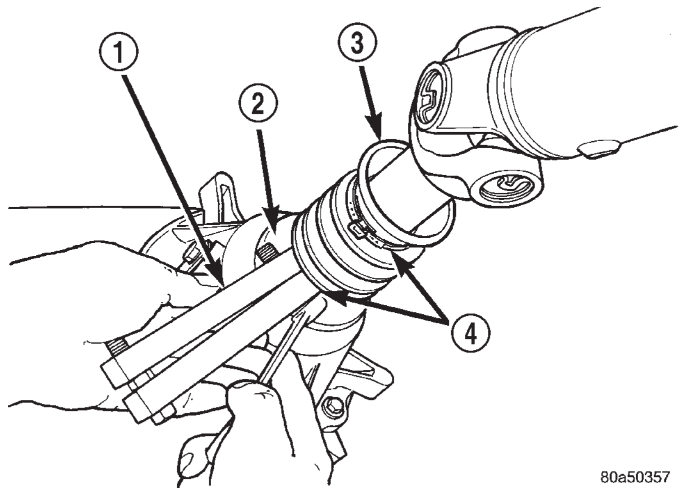


Fig. 95 Slinger Boot Installation - Typical

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

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. 96). If rod lacks enough travel to come out of trunnion, push trunnion out of torque shaft.

(4) Lower vehicle.

(5) Remove console. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

(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 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

(3) Raise vehicle.

(4) Connect trunnion to torque shaft arm. Or, slide shift rod into trunnion on range lever. Be sure shift rod slides freely in trunnion.

(5) Verify that range lever is in 4L position. Then tighten trunnion lock bolt.

(6) Lower vehicle and check transfer case shift operation.

SHIFT LEVER (Continued)

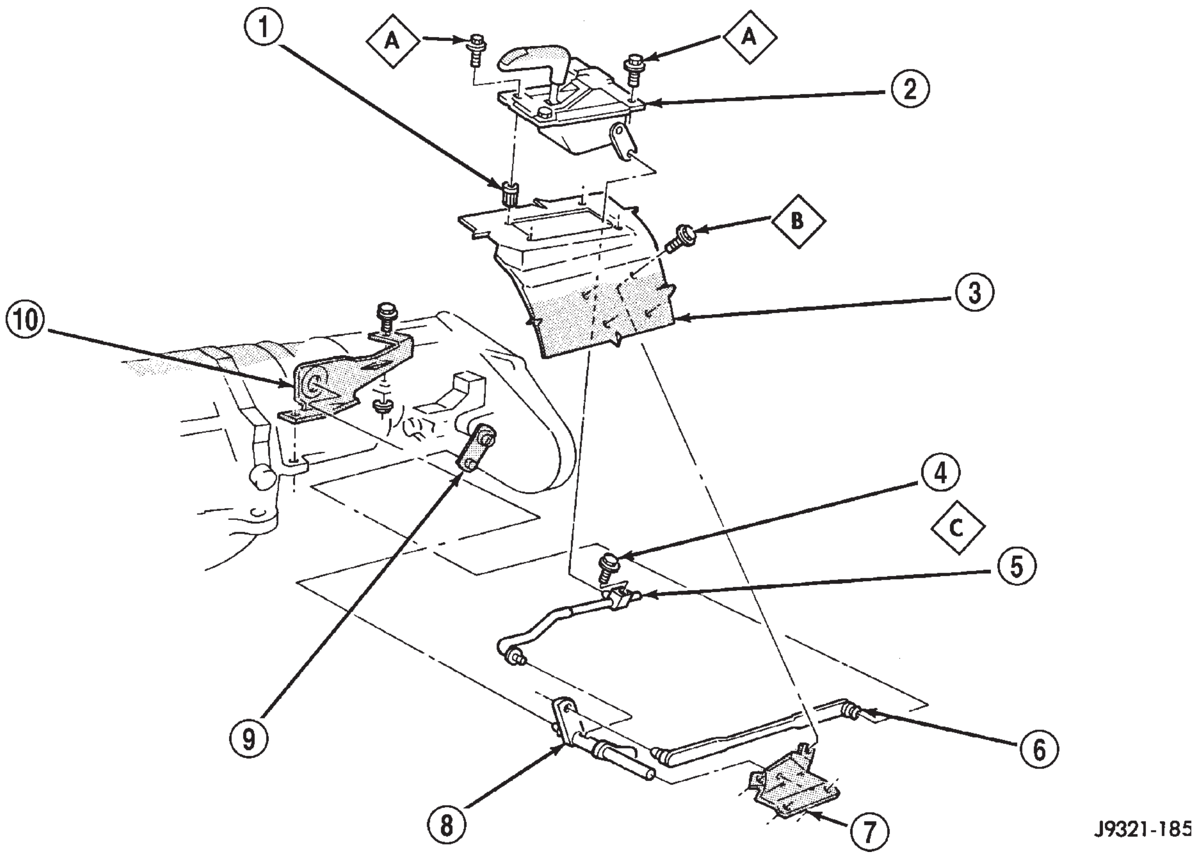


Fig. 96 Shift Linkage

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
A - 3-4 N·m (27-35 in. lbs.)
B - 11-14 N·m (97-123 in. lbs.)
C - 8-14 N·m (72-120 in. lbs.)

ADJUSTMENTS - SHIFT LINKAGE

(1) Shift transfer case into 4L position.
(2) Raise vehicle.
(3) Loosen lock bolt on adjusting trunnion (Fig. 97).
(4) Be sure linkage rod slides freely in trunnion. Clean rod and apply spray lube if necessary.
(5) Verify that transfer case range lever is fully engaged in 4L position.
(6) Tighten adjusting trunnion lock bolt.
(7) Lower vehicle.

SHIFT LEVER (Continued)

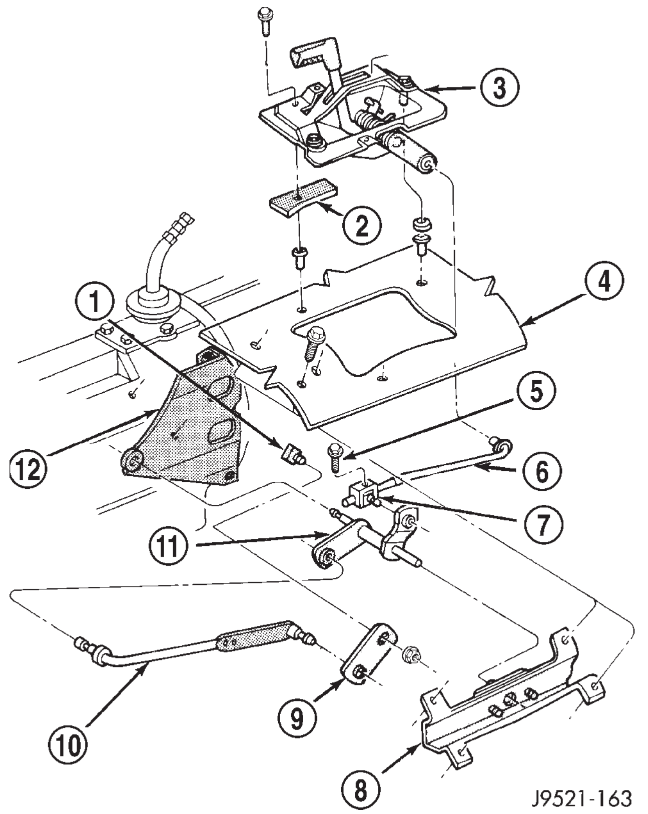


Fig. 97 Shift Linkage

1 - TRANSFER CASE SHIFT 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

SPEEDOMETER DRIVE ADAPTER

REMOVAL

(1) Raise vehicle.

(2) Disconnect wires from vehicle speed sensor.

(3) Remove adapter clamp and screw (Fig. 98).

(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. 98). 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

(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. 98), 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. 99). 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.

SPEEDOMETER DRIVE ADAPTER (Continued)

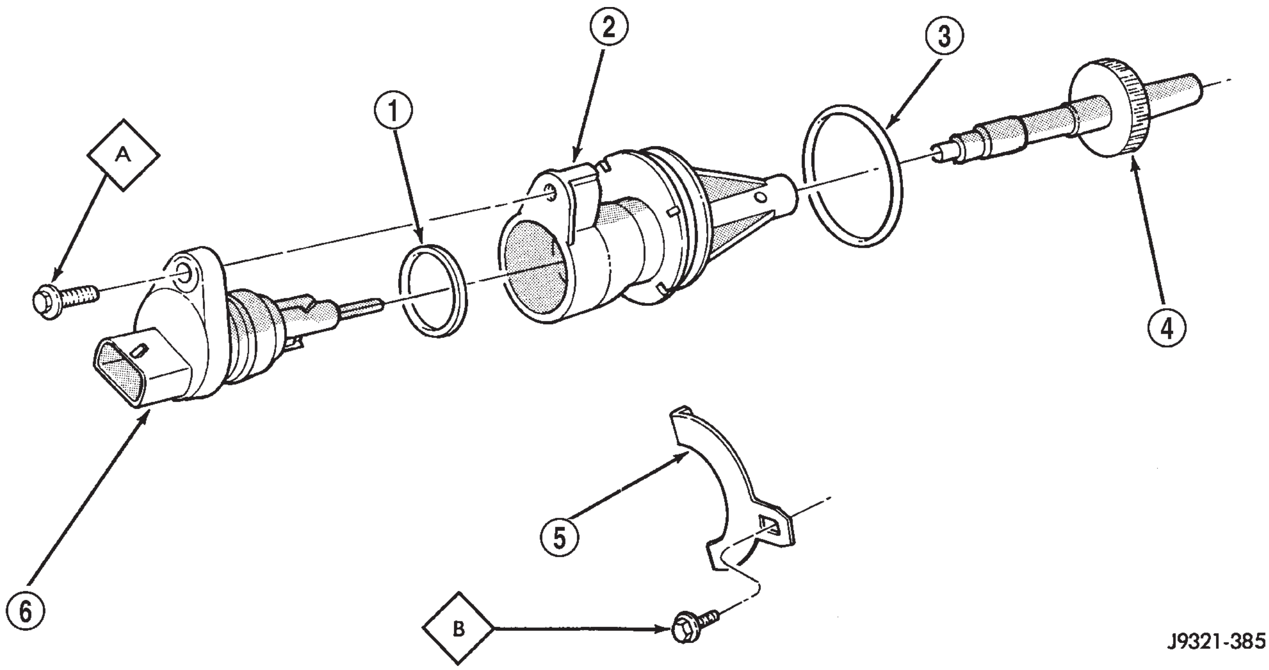


Fig. 98 Speedometer

1 - Sensor O-ring
2 - Speedometer Adapter
3 - Adapter O-ring
4 - Speedometer Pinion
5 - Adapter Clamp
6 - Vehicle Speed Sensor
A - 2-3 N·m (15-27 in. lbs.)
B - 10-12 N·m (90-110 in. lbs.)

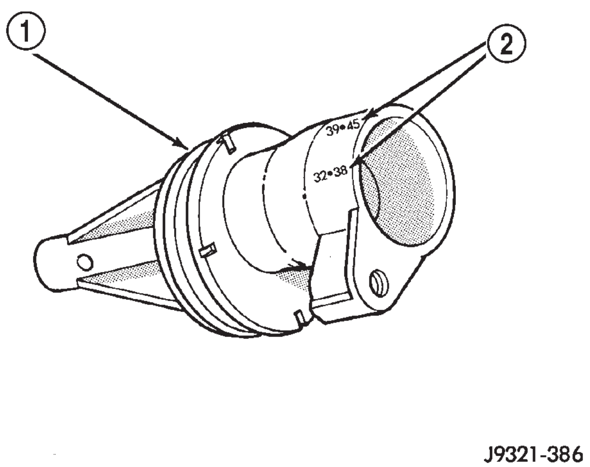


Fig. 99 Location Of Index Numbers On Speedometer Adapter

1 - SPEEDOMETER ADAPTER
2 - INDEX NUMBER LOCATION

VEHICLE SPEED SENSOR

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).

VEHICLE SPEED SENSOR (Continued)

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.

REMOVAL

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. 100). If equipped with 2WD, this adapter is located on the extension housing of the transmission (left side).

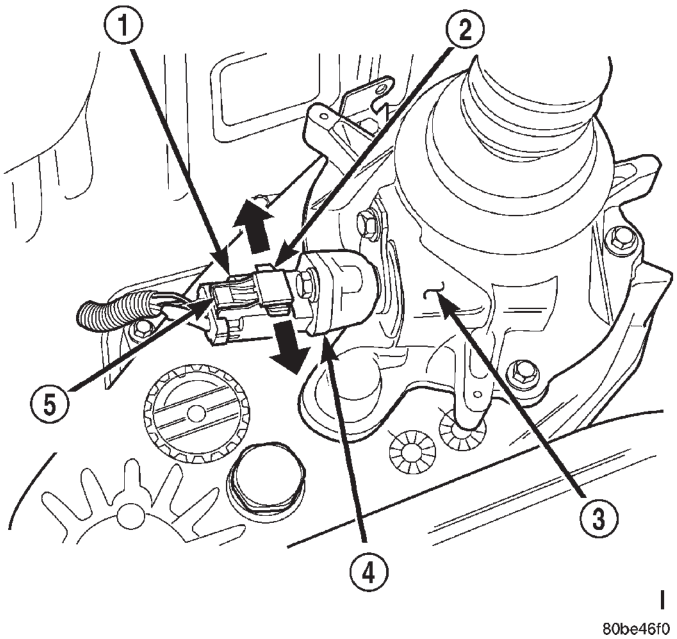


Fig. 100 VSS Location

1 - SENSOR ELECTRICAL CONNECTOR
2 - SLIDE TAB
3 - 4WD TRANSFER CASE EXTENSION
4 - VEHICLE SPEED SENSOR
5 - RELEASE LOCK

(1) Raise and support vehicle.

(2) Disconnect electrical connector from sensor by pushing slide tab (Fig. 100). After slide tab has been positioned, push in on secondary release lock (Fig. 100) on side of connector and pull connector from sensor.

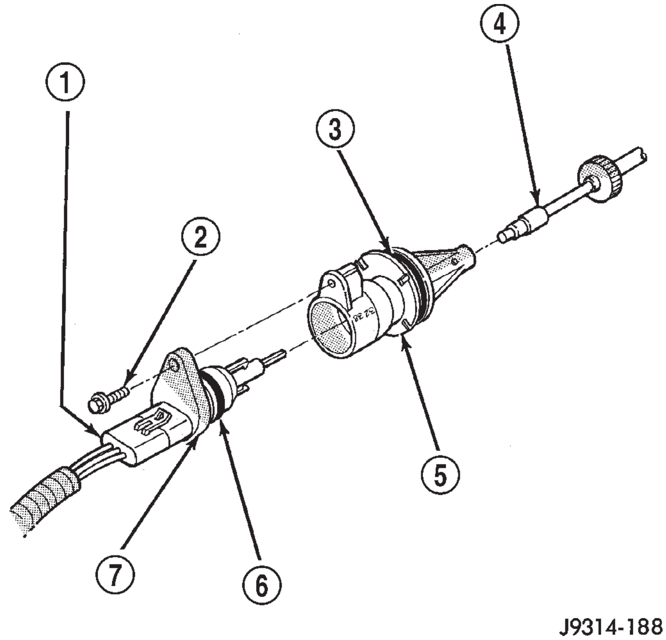


Fig. 101 VSS Removal/Installation

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

(3) Remove sensor mounting bolt (Fig. 101).

(4) Remove sensor (pull straight out) from speedometer pinion gear adapter (Fig. 101). Do not remove gear adapter from transmission.

INSTALLATION

(1) Clean inside of speedometer pinion gear adapter before installing speed sensor.

(2) Install sensor into speedometer gear adapter and install mounting bolt. Before tightening bolt, verify speed sensor is fully seated (mounted flush) to speedometer pinion gear adapter.

(3) Tighten sensor mounting bolt to 2.2 N·m (20 in. lbs.) torque.

(4) Connect electrical connector to sensor.

TIRES/WHEELS

TABLE OF CONTENTS

TIRES/WHEELS

DIAGNOSIS AND TESTING - TIRE AND WHEEL RUNOUT

Radial runout is the difference between the high and low points on the tire or wheel (Fig. 1).

Lateral runout is the **wobble** of the tire or wheel.

Radial runout of more than 1.5 mm (.060 inch) measured at the center line of the tread may cause the vehicle to shake.

Lateral runout of more than 2.0 mm (.080 inch) measured near the shoulder of the tire may cause the vehicle to shake.

Sometimes radial runout can be reduced. Relocate the wheel and tire assembly on the mounting studs (See Method 1). If this does not reduce runout to an acceptable level, the tire can be rotated on the wheel. (See Method 2).

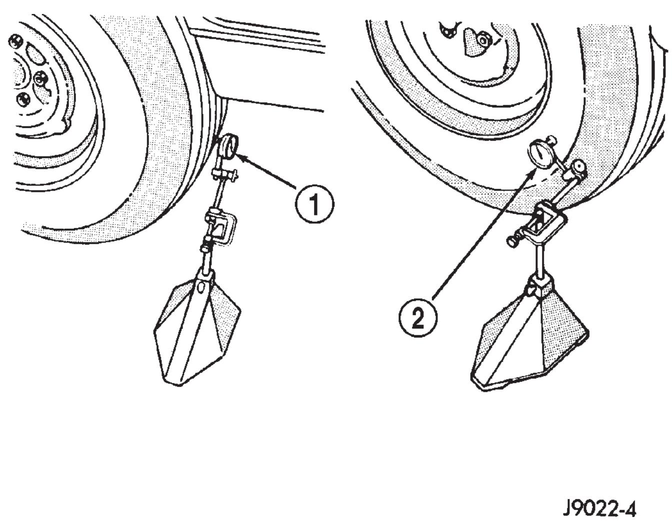


Fig. 1 Checking Tire/Wheel/Hub Runout

1 - RADIAL RUNOUT
2 - LATERAL RUNOUT

TIRES/WHEELS (Continued)

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. 2) and lateral runout (Fig. 3).

- 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 or match mount, (Refer to 22 - TIRES/WHEELS - STANDARD PROCEDURE).

STANDARD PROCEDURE

STANDARD PROCEDURE - 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. 4). Other rotation methods can be used, but they will not provide all the tire longevity benefits.

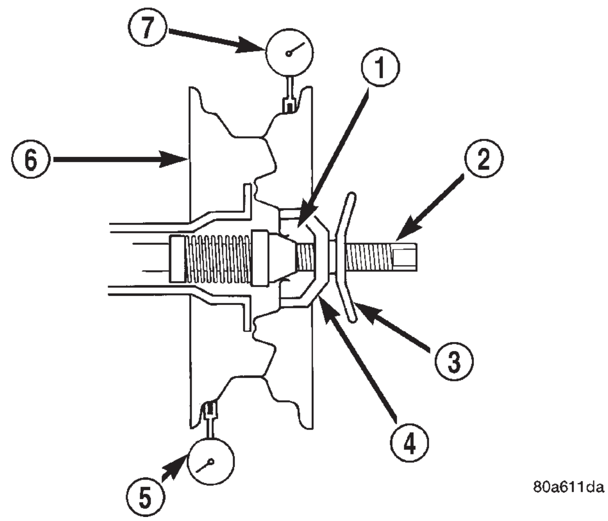


Fig. 2 Radial Runout

1 - MOUNTING CONE
2 - SPINDLE SHAFT
3 - WING NUT
4 - PLASTIC CUP
5 - DIAL INDICATOR
6 - WHEEL
7 - DIAL INDICATOR

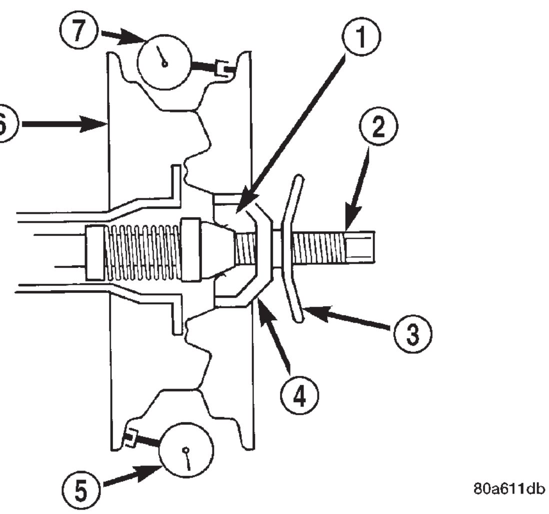


Fig. 3 Lateral Runout

1 - MOUNTING CONE
2 - SPINDLE SHAFT
3 - WING NUT
4 - PLASTIC CUP
5 - DIAL INDICATOR
6 - WHEEL
7 - DIAL INDICATOR

TIRES/WHEELS (Continued)

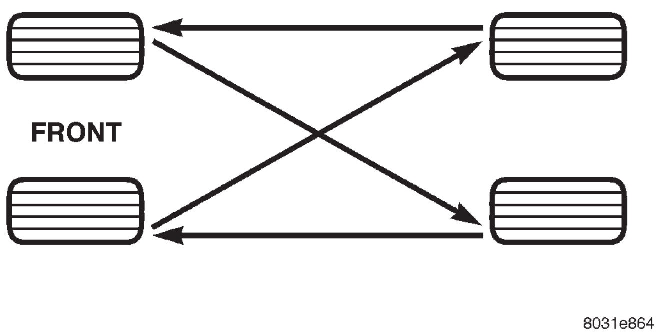


Fig. 4 Tire Rotation Pattern

STANDARD PROCEDURE - MATCH MOUNTING

Tires and wheels are currently match mounted at the factory. Match mounting is a technique used to reduce runout in the wheel/tire assembly. This means that the high spot of the tire is aligned with the low spot on the wheel rim. The high spot on the tire is marked with a paint mark or a bright colored adhesive label on the outboard sidewall. The low spot on the rim is identified with a label on the outside of the rim and a dot on the inside of the rim. If the outside label has been removed the tire will have to be removed to locate the dot on the inside of the rim.

Before dismounting a tire from its wheel, a reference mark should be placed on the tire at the valve stem location. This reference will ensure that it is remounted in the original position on the wheel.

(1) Use a dial indicator to locate the high spot of the tire on the center tread rib (Fig. 5). Record the indicator reading and mark the high spot on the tire. Place a mark on the tire at the valve stem location (Fig. 6).

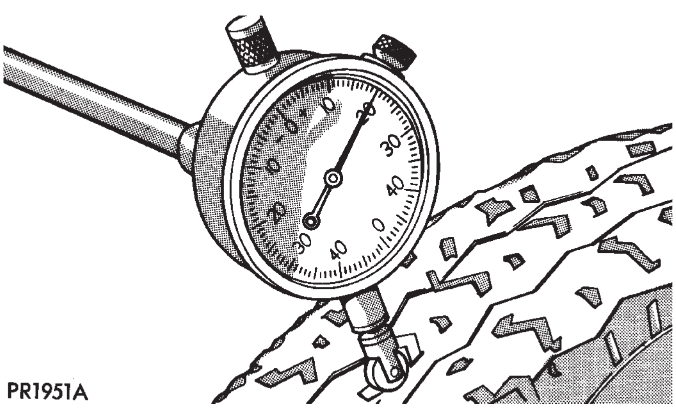


Fig. 5 Dial Indicator

(2) Break down the tire and remount it 180 degrees on the rim (Fig. 7).

(3) Measure the total runout again and mark the tire to indicate the high spot.

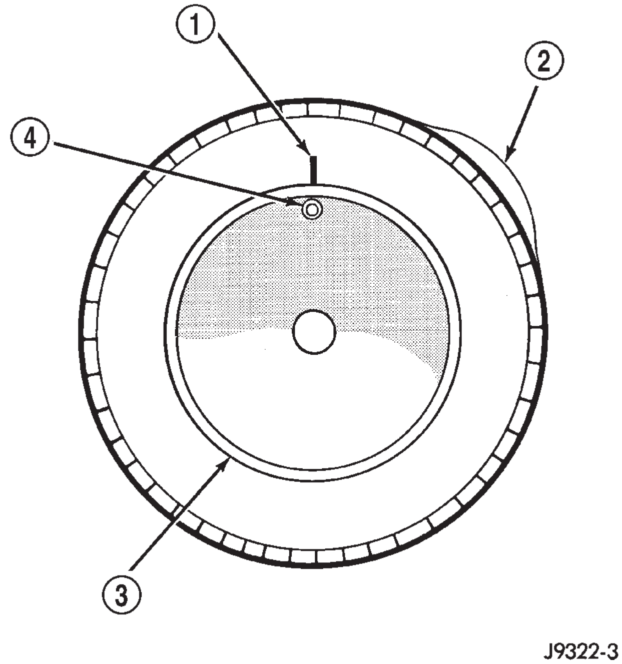


Fig. 6 First Measurement On Tire

1 - REFERENCE MARK
2 - 1ST MEASUREMENT HIGH SPOT MARK TIRE AND RIM
3 - WHEEL
4 - VALVE STEM

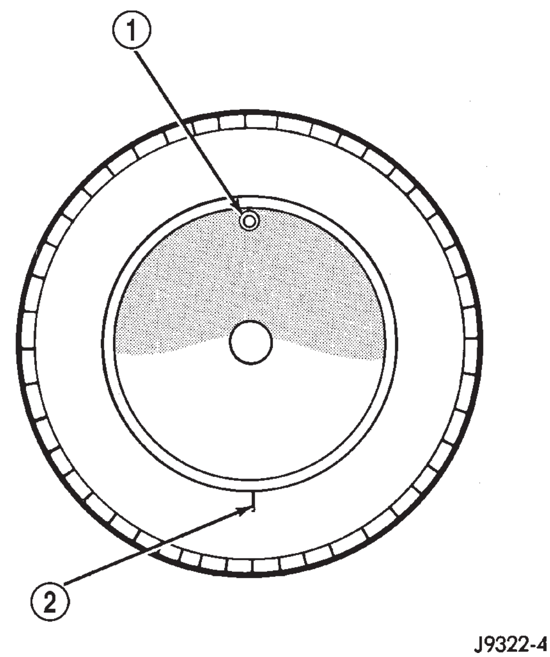


Fig. 7 Remount Tire 180 Degrees

1 - VALVE STEM
2 - REFERENCE MARK

TIRES/WHEELS (Continued)

(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 22 - TIRES/WHEELS - DIAGNOSIS AND TESTING).

(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. 8). This procedure will normally reduce the runout to an acceptable amount.

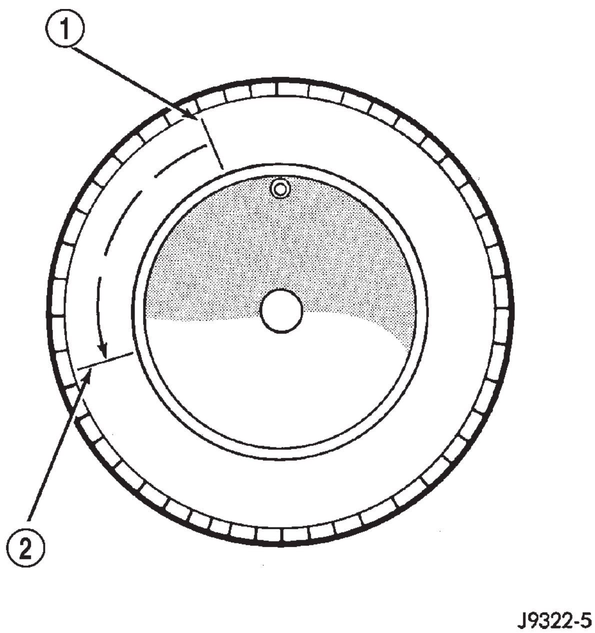


Fig. 8 Remount Tire 90 Degrees In Direction of Arrow

1 - 2ND HIGH SPOT ON TIRE
2 - 1ST HIGH SPOT ON TIRE

STANDARD PROCEDURE - 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. 9).

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. 10).

TIRES/WHEELS (Continued)

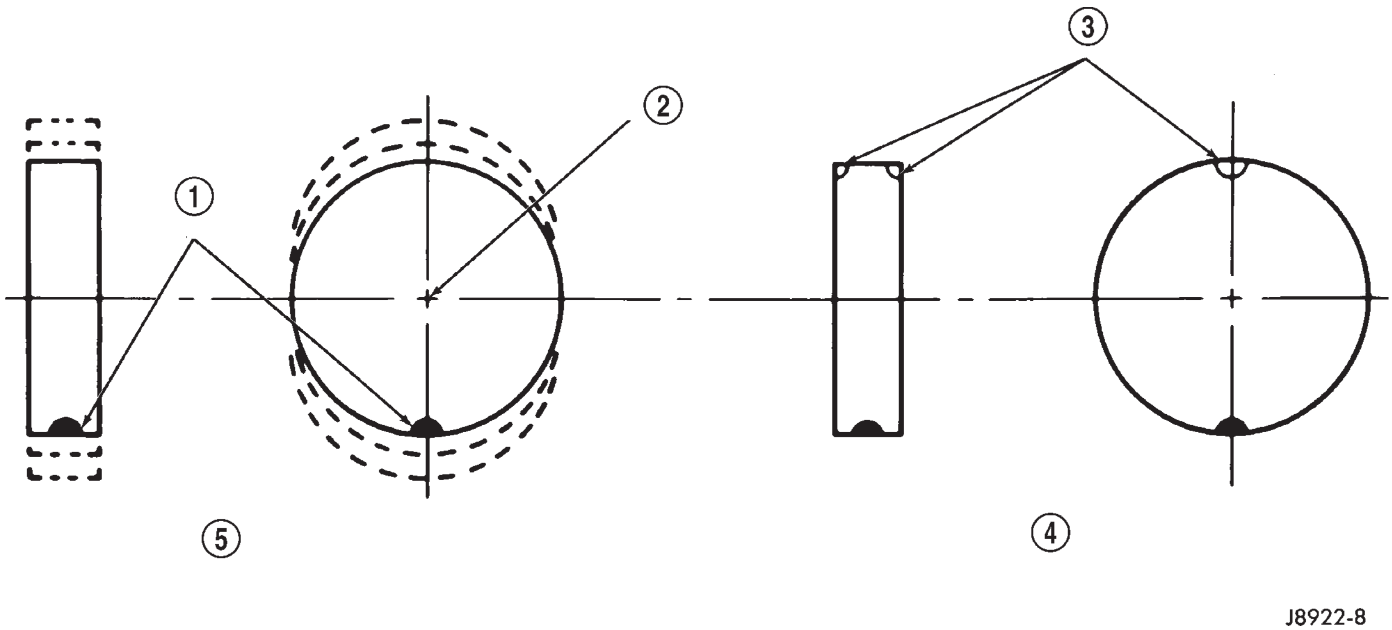


Fig. 9 Static Unbalance & Balance

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

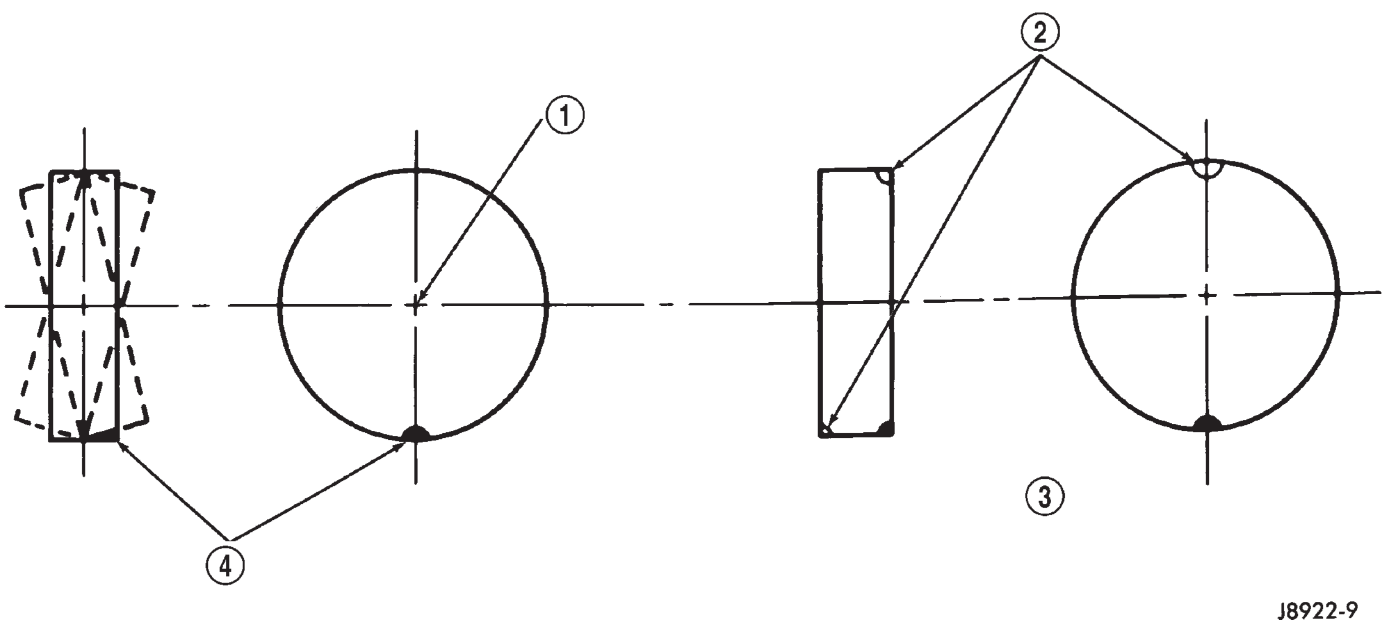


Fig. 10 Dynamic Unbalance & Balance

1 - CENTER LINE OF SPINDLE
2 - ADD BALANCE WEIGHTS HERE
3 - CORRECTIVE WEIGHT LOCATION
4 - HEAVY SPOT WHEEL SHIMMY AND VIBRATION

TIRES

DESCRIPTION

DESCRIPTION - TIRES

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 (Refer to 22 - TIRES/WHEELS - STANDARD PROCEDURE). 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. 11).

Performance tires have a speed rating letter after the aspect ratio number.

LETTER	SPEED RATING
S	180 km/h (112 mph)
T	190 km/h (118 mph)
U	200 km/h (124 mph)
H	210 km/h (130 mph)
V	240 km/h (149 mph)
W	270 km/h (168 mph)
Y	300 km/h (186 mph)

The speed rating is not always printed on the tire sidewall.

TIRE CHAINS

Tire snow chains may be used on **certain** models. Refer to the Owner's Manual for more information.

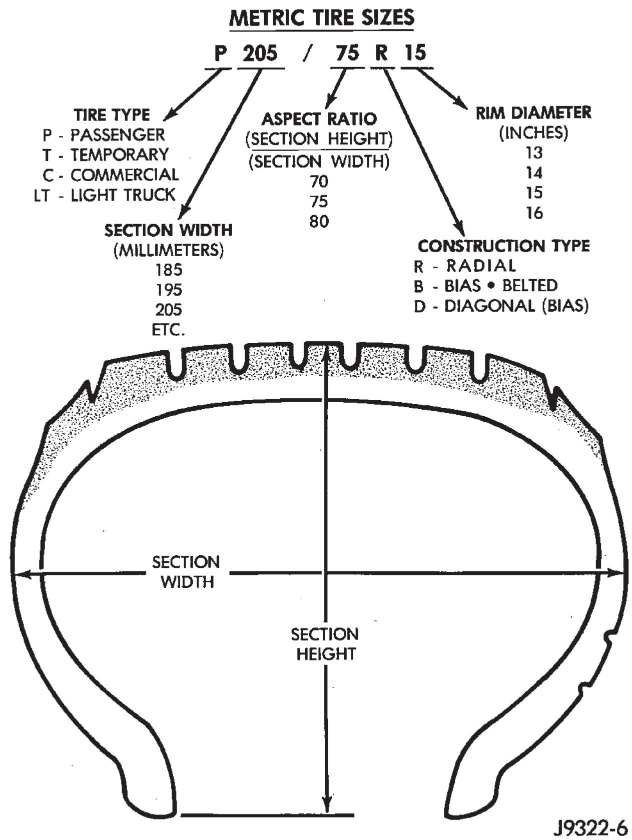


Fig. 11 Tire Identification

DESCRIPTION - RADIAL-PLY TIRES

Radial-ply tires improve handling, tread life and ride quality, and decrease rolling resistance.

Radial-ply tires must always be used in sets of four. Under no circumstances should they be used on the front only. They may be mixed with temporary spare tires when necessary. A maximum speed of 50 MPH is recommended while a temporary spare is in use.

Radial-ply tires have the same load-carrying capacity as other types of tires of the same size. They also use the same recommended inflation pressures.

The use of oversized tires, either in the front or rear of the vehicle, can cause vehicle drive train failure. This could also cause inaccurate wheel speed signals when the vehicle is equipped with Anti-Lock Brakes.

The use of tires from different manufactures on the same vehicle is NOT recommended. The proper tire pressure should be maintained on all four tires.

TIRES (Continued)

DESCRIPTION - TIRE INFLATION PRESSURES

Under inflation will cause rapid shoulder wear, tire flexing, and possible tire failure (Fig. 12).

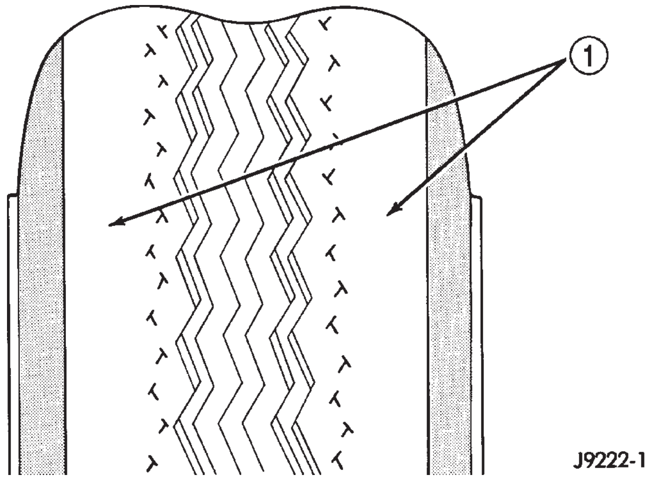


Fig. 12 Under Inflation Wear

1 - THIN TIRE THREAD AREAS

Over inflation will cause rapid center wear and loss of the tire's ability to cushion shocks (Fig. 13).

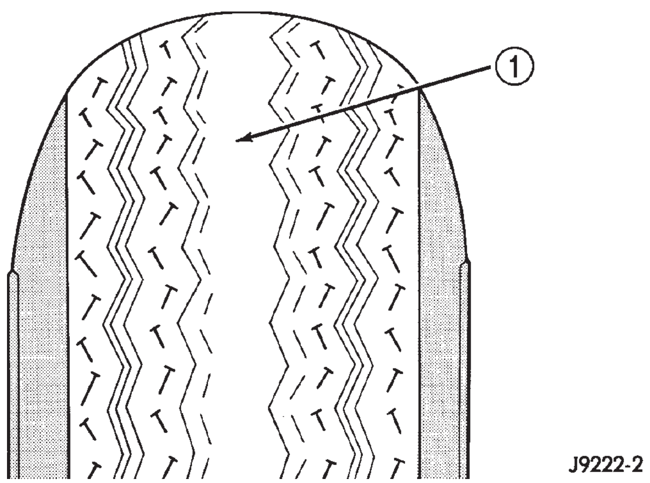


Fig. 13 Over Inflation Wear

1 - THIN TIRE THREAD AREA

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.

DESCRIPTION - TIRE PRESSURE FOR HIGH SPEED

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.

DESCRIPTION - REPLACEMENT TIRES

The original equipment tires provide a proper balance of many characteristics such as:
- Ride
- Noise
- Handling
- Durability
- Tread life
- Traction
- Rolling resistance
- Speed capability

It is recommended that tires equivalent to the original equipment tires be used when replacement is needed.

TIRES (Continued)

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

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.

DIAGNOSIS AND TESTING - 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. 14).

Tire replacement is necessary when indicators appear in two or more grooves or if localized balding occurs.

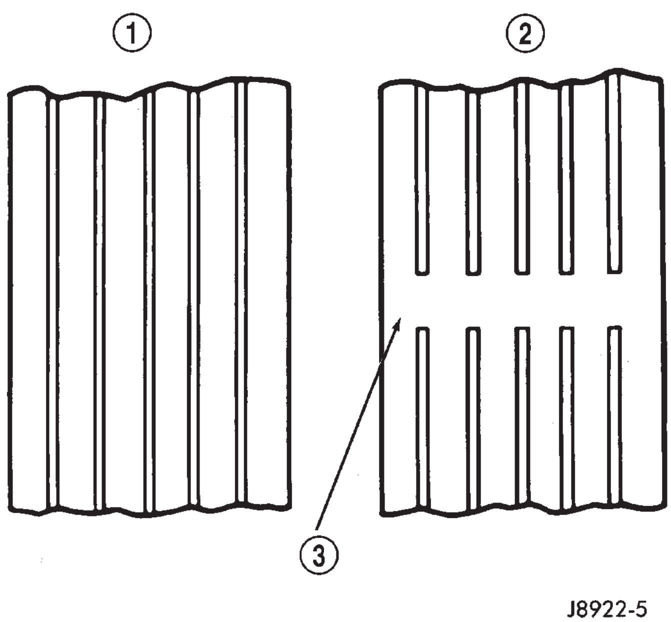


Fig. 14 Tread Wear Indicators

1 - TREAD ACCEPTABLE
2 - TREAD UNACCEPTABLE
3 - WEAR INDICATOR

DIAGNOSIS AND TESTING - 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. 15).

Excessive toe-in or toe-out causes wear on the tread edges and a feathered effect across the tread (Fig. 15).

DIAGNOSIS AND TESTING - 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.

STANDARD PROCEDURE - 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. 16). 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. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

CLEANING

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.

TIRES (Continued)

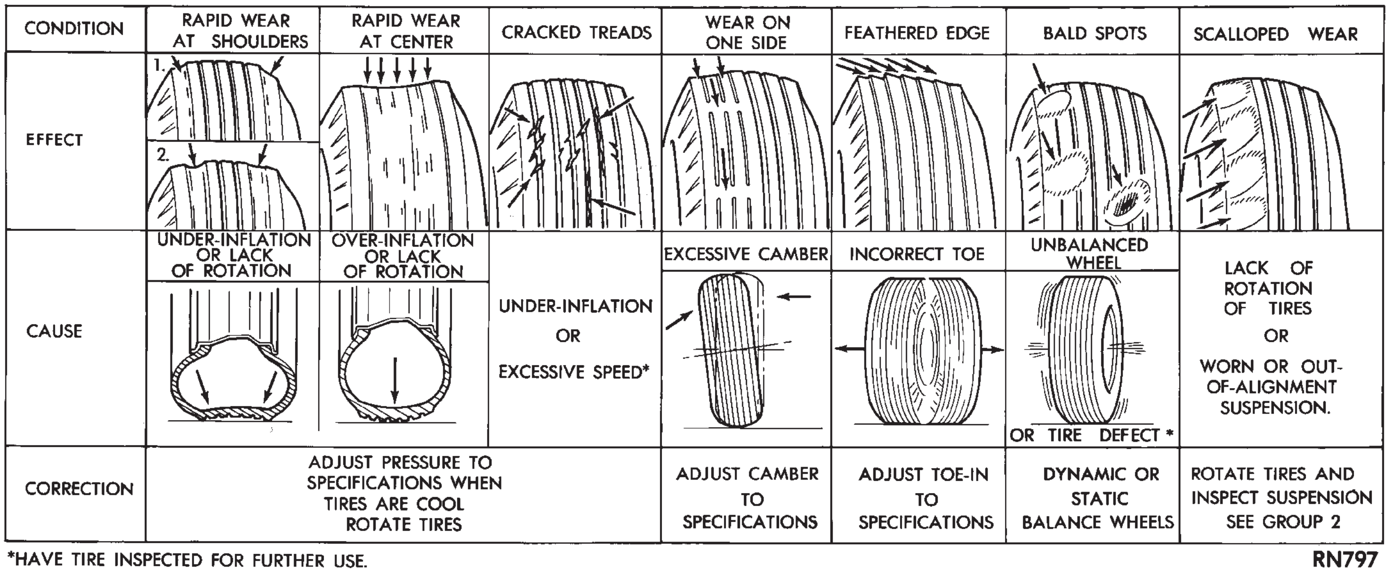


Fig. 15 Tire Wear Patterns

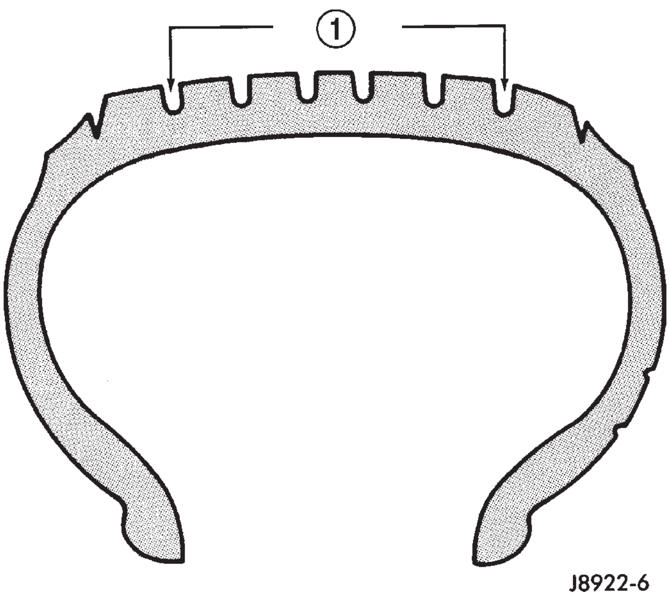


Fig. 16 Tire Repair Area

1 - REPAIRABLE AREA

SPECIFICATIONS

TIRE SIZE

DESCRIPTION	SPECIFICATION
TIRE	P205/75R15
TIRE	P215/75R15
TIRE	P225/75R15
TIRE	P225/70R16
TIRE	30x9.50R15

SPARE TIRE

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.

SPARE TIRE CARRIER

REMOVAL

(1) Remove the spare tire from the wheel bracket (Fig. 17).

(2) Remove the bolts that attach the tire bracket to the tailgate (Fig. 18).

(3) Disconnect CHMSL.

(4) Remove the bracket and the gaskets from the tailgate.

INSTALLATION

(1) Position the gaskets and the tire bracket on the tailgate and install the bolts. Tighten the bolts to 24 N·m (17 ft. lbs.) torque.

(2) Connect CHMSL connector.

(3) Install the spare tire on the tire bracket.

WHEELS

DESCRIPTION

The rim size is on the vehicle safety certification label located on the drivers door shut face. The size

WHEELS (Continued)

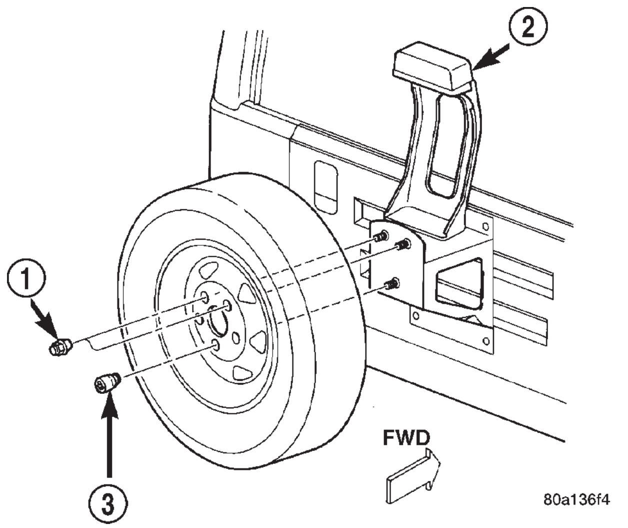


Fig. 17 Spare Tire

1 - WHEEL NUT
2 - CHMSL
3 - LOCK NUT

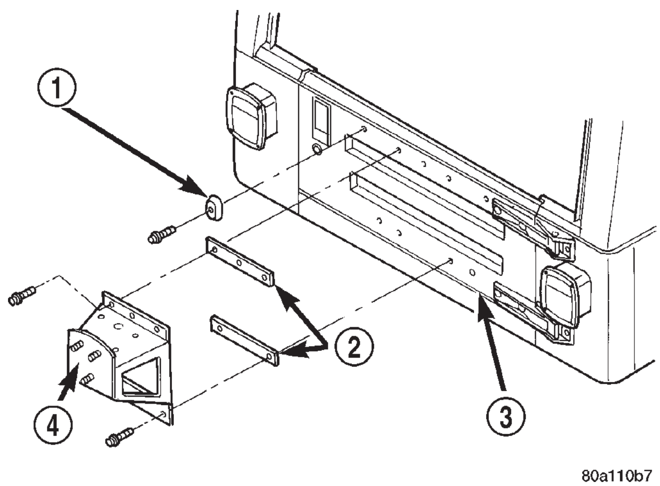


Fig. 18 Spare Tire Bracket

1 - BUMPER
2 - GASKET
3 - TAILGATE
4 - SPARE TIRE BRACKET

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. 19).

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.

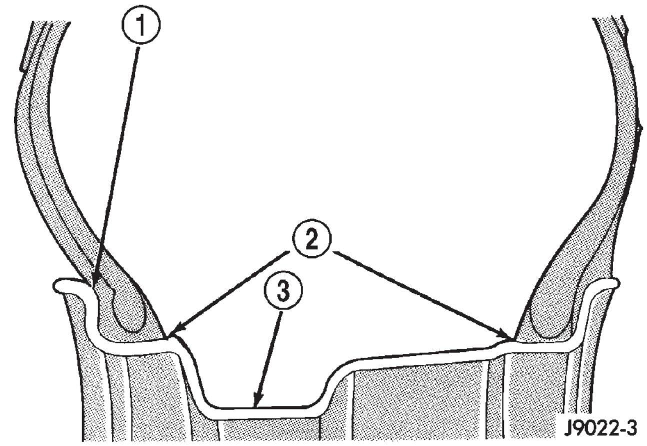


Fig. 19 Safety Rim

1 - FLANGE
2 - RIDGE
3 - WELL

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.

WHEELS (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - 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. 20).

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.

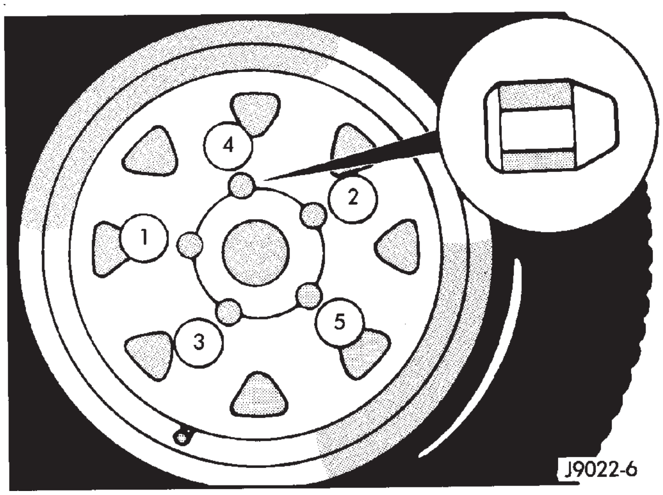


Fig. 20 Lug Nut Tightening Pattern

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.

STANDARD PROCEDURE - WHEEL REPLACEMENT

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.

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WHEELS (Continued)

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Lug Nut 1/2 X 20 with 60° Cone	115-156	85-115	—

STUDS

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove brake caliper, caliper adapter and rotor, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(4) Remove stud from hub with Remover C-4150A (Fig. 21).

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 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(6) Install wheel and tire assembly, use new lug nut on stud or studs that were replaced. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(7) Remove support and lower vehicle.

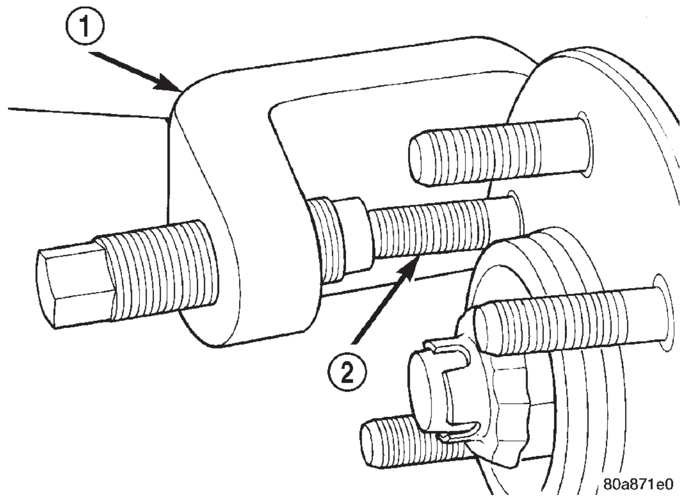

Fig. 21 Wheel Stud Removal

1 - REMOVER
2 - WHEEL STUD

BODY

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BODY

STANDARD PROCEDURE - 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.

BODY (Continued)

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		

BODY (Continued)

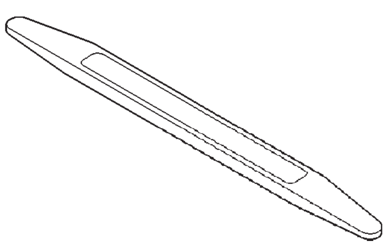
SPECIFICATIONS - TORQUE

TORQUE SPECIFICATIONS

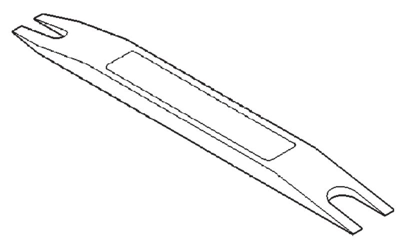
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Hood assist spring bolt	3	—	25
Hood catch nuts	18	13	—
Hood catch bracket nuts	11	8	—
Hood hinge screws	17	13	—
Hood safety latch bolt	9	—	80
Bucket seat front anchor bolt	47	35	—
Bucket seat rear inboard anchor bolt	74	55	—
Bucket seat rear outboard anchor bolt	33	25	—
Lifgate glass ball stud nut	13	10	—
Liftgate glass hinge nut	6	—	53
Liftgate hinge to hardtop bolt	11	—	95
Front turning loop bolt	47	35	—
Front retractor bolt	47	35	—
Rear retractor bolt	47	35	—
Rear turning loop bolt	47	35	—
Rear belt anchor bolt	47	35	—
Rearview mirror set screw	1	—	9
Rear buckle anchor bolt	43	32	—
Side support bar to sport bar bolts	71	53	—
Sport bar to wheelhouse bolts	40	30	—
Sport bar to cargo floor bolts	40	30	—
Sport bar to winshield frame bolts	32	24	—
Tailgate hinge screws	23	17	—
Tailgate striker	71	52	—

SPECIAL TOOLS

BODY



Trim Stick C-4755



Remover, Moldings C-4829

DECKLID/HATCH/LIFTGATE/TAILGATE

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TAILGATE OUTSIDE HANDLE

REMOVAL

(1) Remove the latch from the tailgate. (Refer to 23 - BODY/DECKLID/HATCH/LIFTGATE/TAILGATE/LATCH - REMOVAL)

(2) Remove the screws attaching the outside handle to the tailgate (Fig. 1).

(3) Separate the outside handle and seal from the tailgate.

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. (Refer to 23 - BODY/DECKLID/HATCH/LIFTGATE/TAILGATE/LATCH - INSTALLATION)

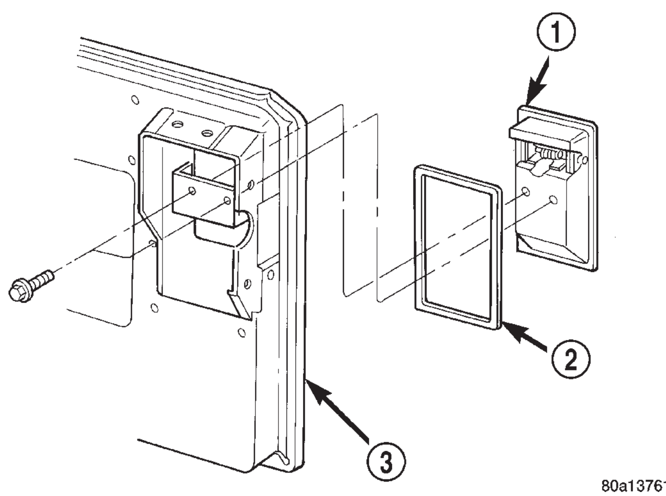

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Fig. 1 Tailgate Outside Handle

1 - OUTSIDE HANDLE
2 - SEAL
3 - TAILGATE

TAILGATE HINGE

DESCRIPTION

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. 2).
(3) Separate the hinge from the tailgate.

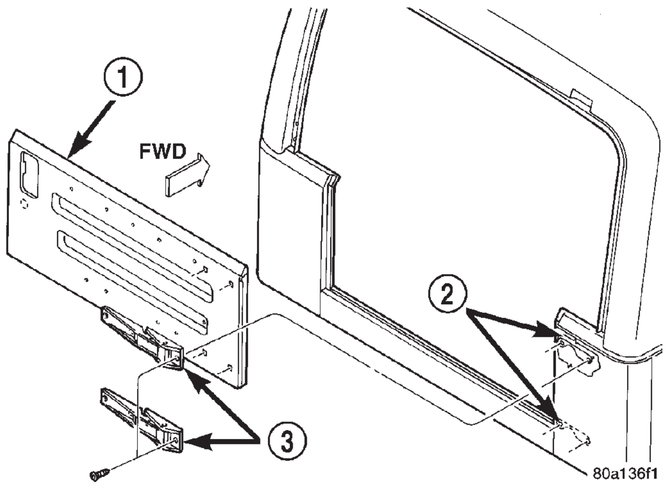

Fig. 2 Tailgate Hinge

1 - TAILGATE
2 - NUT PLATE
3 - HINGE

INSTALLATION

Hinges may be serviced individually. If both are to be serviced, remove/install hinges one at a time.
(1) Prepare and paint the replacement hinge to match the body paint color.
(2) Lubricate the hinge with spray lubricant.
(3) Align and position the hinge on the body and tailgate.
(4) Install the screws. Tighten the screws to 23 N·m (200 in. lbs.) torque.

TAILGATE LATCH

REMOVAL

(1) Open the tailgate and remove the latch trim cover (Fig. 3).
(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.

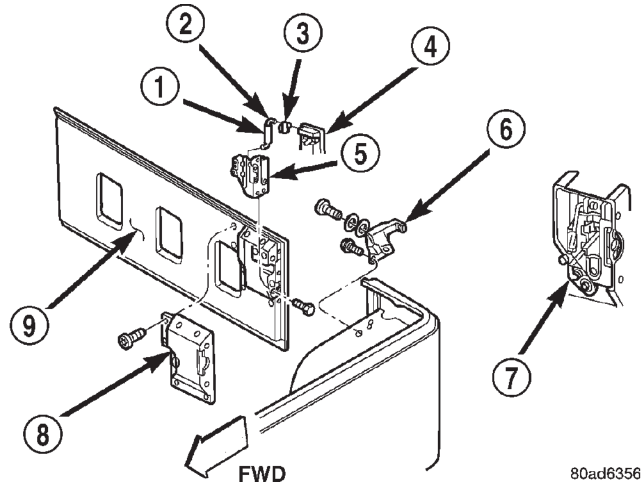

Fig. 3 Tailgate Latch Cover

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

INSTALLATION

(1) Position the latch in the tailgate.
(2) Install the screw attaching latch to tailgate. Do not tighten screw.
(3) Connect the lock cylinder to latch rod.
(4) Connect the outside handle to latch rod.
(5) Install the latch trim cover. Tighten all screws.

TAILGATE LATCH STRIKER

REMOVAL

(1) Remove the striker from the bracket with a Torx bit.
(2) Remove the shim washers from the bracket.
(3) Remove the screws attaching the striker bracket to the body.

INSTALLATION

(1) Position the striker bracket on the body and install the screws.
(2) Position the striker and shim washers on the striker bracket.
(3) Install the striker in the bracket with a Torx bit. Tighten the striker to 71 N·m (52 ft. lbs.) torque.

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. 4).

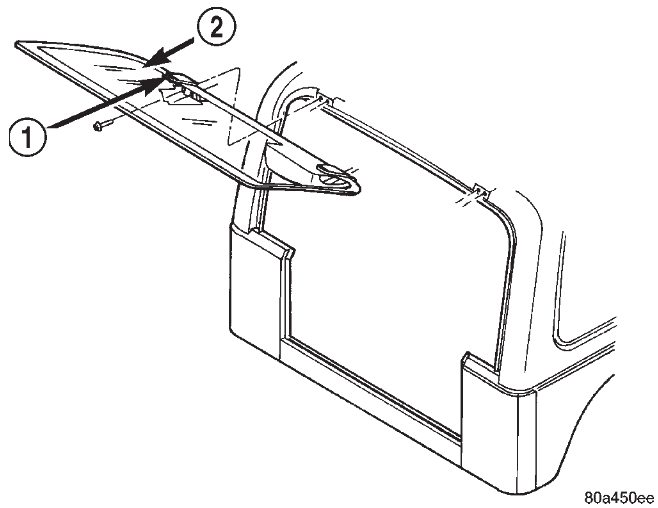

Fig. 4 Liftgate Hinge

1 - LIFTGATE HINGE
2 - LIFTGATE GLASS

INSTALLATION

(1) Align and position the hinge on the top and install the bolts.
(2) Install the nut attaching the liftgate hinge to the liftgate glass. Tighten the nut to 6 N·m (53 in. lbs.) torque.
(3) If removed, install wiper motor cover.

LIFTGATE GLASS

REMOVAL

(1) If equipped, disconnect the rear defroster harness connectors (Fig. 5).
(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. (Refer to 23 - BODY/DECKLID/HATCH/LIFTGATE/TAILGATE/SUPPORT CYLINDER - REMOVAL)
(5) Remove the bolts attaching the liftgate hinge to the hardtop (Fig. 6).
(6) Separate the liftgate glass from the hard top.

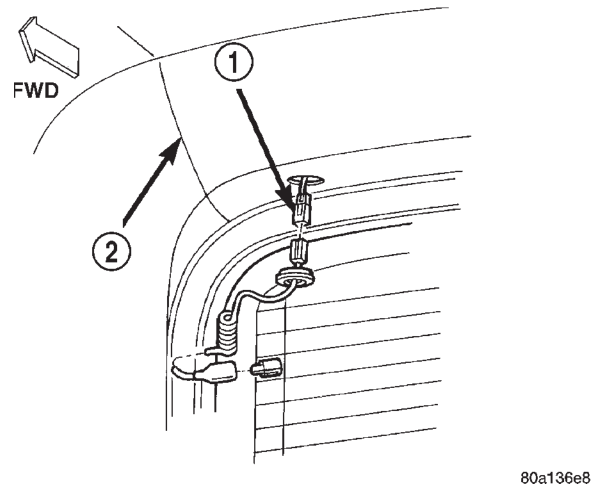

Fig. 5 Rear Defroster Connectors

1 - CONNECTOR
2 - HARD TOP

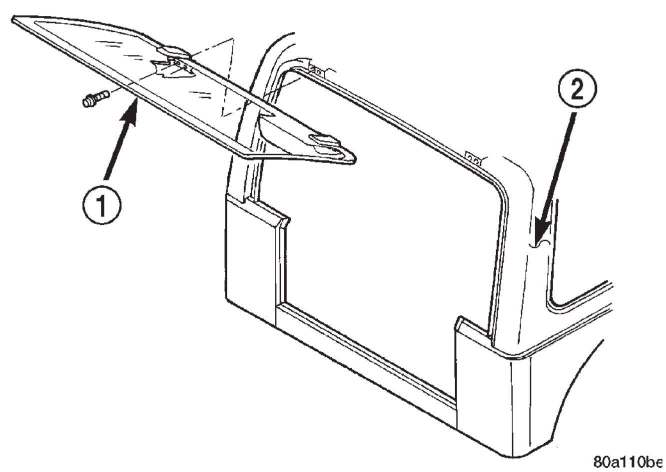

Fig. 6 Liftgate Glass

1 - LIFTGATE REAR WINDOW
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.

LIFTGATE GLASS (Continued)

(3) Install the bolts attaching the liftgate hinge to the hardtop. Tighten the bolts to 10 N·m (95 in. lbs.) torque.

(4) Install the support rod cylinders. (Refer to 23 - BODY/DECKLID/HATCH/LIFTGATE/TAILGATE/SUPPORT CYLINDER - INSTALLATION)

LIFTGATE GLASS WEATHERSTRIP

DESCRIPTION

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.

TAILGATE LOCK CYLINDER

REMOVAL

(1) Open the tailgate.
(2) Remove the latch cover.
(3) Remove the lock cylinder retainer clip.
(4) 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.

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. 7).
(3) Pull the support rods off the ball studs (Fig. 8).

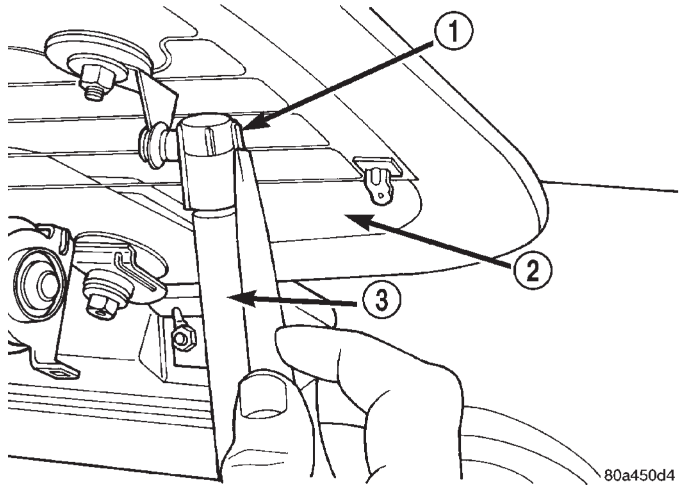

Fig. 7 Support Rod Cylinder

1 - CLIP
2 - LIFTGATE GLASS
3 - SUPPORT CYLINDER

INSTALLATION

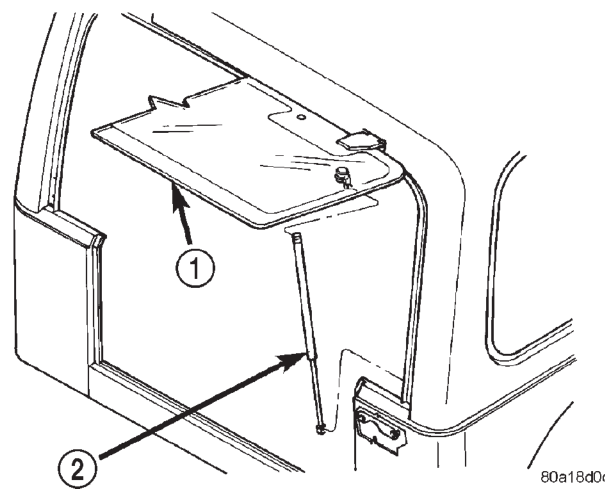

Fig. 8 Support Rod Cylinder Removal

1 - REAR WINDOW LIFT GLASS
2 - SUPPORT CYLINDER

(1) Position the support rod cylinders on the ball studs.
(2) Install the support rod cylinder retainer clips.

TAILGATE

REMOVAL

(1) Remove the spare tire.

(2) Open the tailgate and remove the CHMSL contact cover (Fig. 9).

(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.

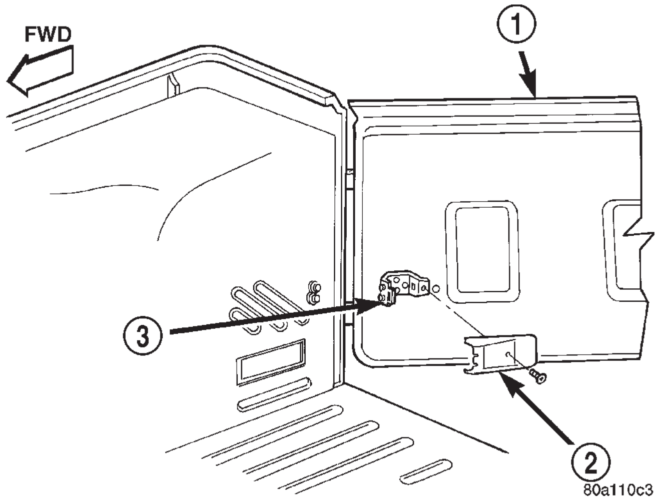

Fig. 9 CHMSL Contact Cover

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.

ADJUSTMENTS

ADJUSTMENT

(1) Loosen the tailgate hinge-to-body screws.

(2) Align the tailgate in the body opening and tighten the hinge screws.

FULL DOOR

TABLE OF CONTENTS

DOOR

REMOVAL

(1) Open the door.

(2) Disconnect the door restraint strap from the pin (Fig. 1).

(3) Remove the nuts at the door hinge pivots and lift the door from the body.

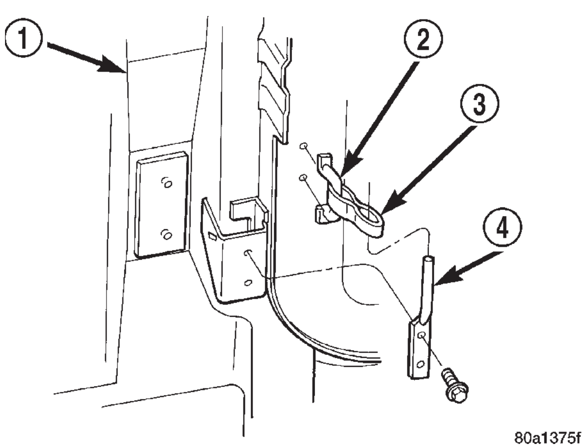

Fig. 1 Restraint Strap

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.

ADJUSTMENTS

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.

DOOR GLASS

REMOVAL

(1) Remove the door trim panel and the waterdam. (Refer to 23 - BODY/FULL DOOR/TRIM PANEL - REMOVAL)

DOOR GLASS (Continued)

(2) Pull the door glass run channel from the door sail.

(3) Roll glass fully downward.

(4) Using a trim stick C-4755 or equivalent, remove the screws and remove the door sail panel (Fig. 2) and (Fig. 3).

(5) Roll glass 1/4 upward to access regulator arm guide.

(6) Remove the screws that attach the regulator arm guide to the glass.

(7) Lift the glass upward while tilting inward and remove from the door.

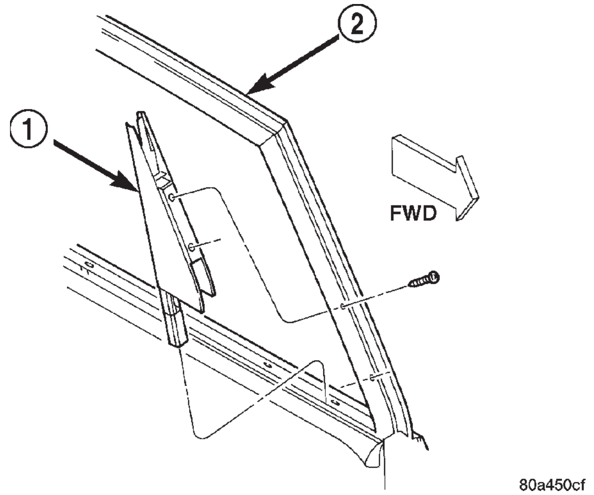

Fig. 2 Door Sail Screws

1 - DOOR SAIL
2 - DOOR

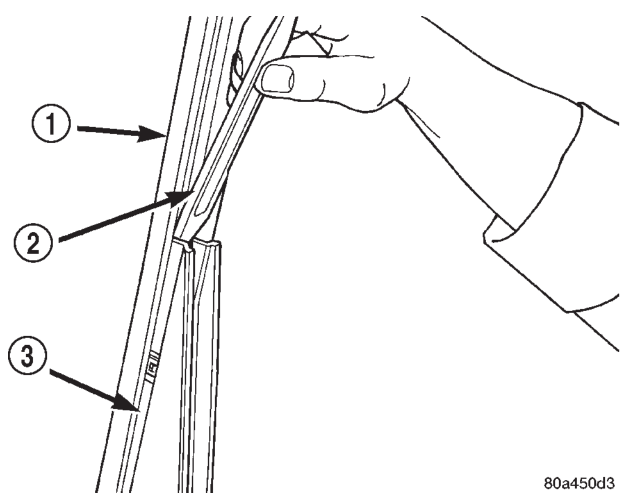

Fig. 3 Door Sail Removal

1 - DOOR FRAME
2 - TRIM STICK
3 - DOOR SAIL

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. (Refer to 23 - BODY/FULL DOOR/TRIM PANEL - INSTALLATION)

WINDOW REGULATOR

REMOVAL

(1) Remove door glass. (Refer to 23 - BODY/FULL DOOR/DOOR GLASS - REMOVAL)

(2) Loosen the bolts in the slotted holes (Fig. 4).

(3) Remove the bolts attaching the regulator to the door inner panel.

(4) Lift the regulator upward to free it from the slotted holes in the door inner panel.

(5) Lower the regulator and remove it through the access hole in the door inner panel (Fig. 5).

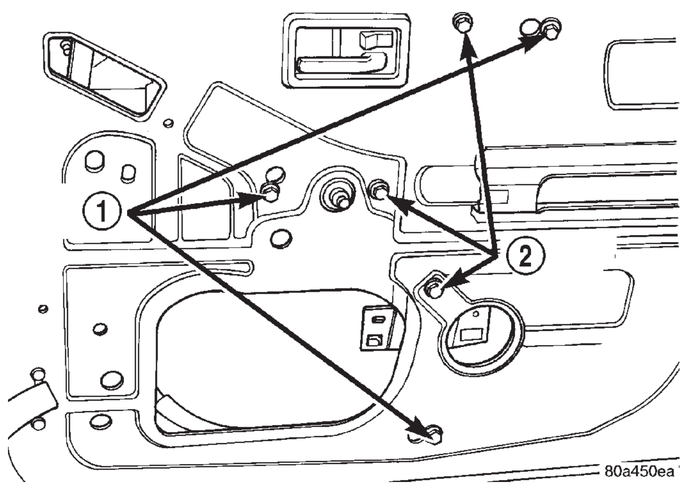

Fig. 4 Window Regulator Bolts

1 - LOOSEN BOLTS
2 - REMOVE BOLTS

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. (Refer to 23 - BODY/FULL DOOR/DOOR GLASS - INSTALLATION)

WINDOW REGULATOR (Continued)

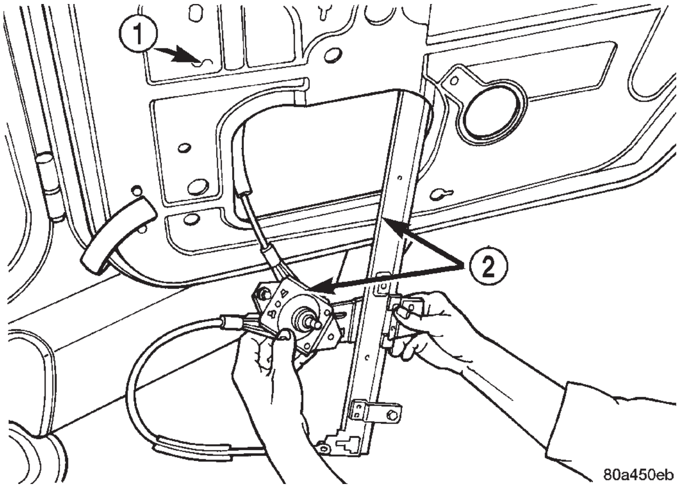

Fig. 5 Regulator Removal

1 - DOOR
2 - REGULATOR ASSEMBLY

EXTERIOR HANDLE

REMOVAL

(1) Remove the door trim panel. (Refer to 23 - BODY/FULL DOOR/TRIM PANEL - REMOVAL)

(2) Position the window in the full upward position.

(3) Remove the grab handle support bracket (Fig. 6).

(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. 7).

(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. 8).

(8) Remove the latch release rod from the door handle.

(9) Separate the handle and gasket from the 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.

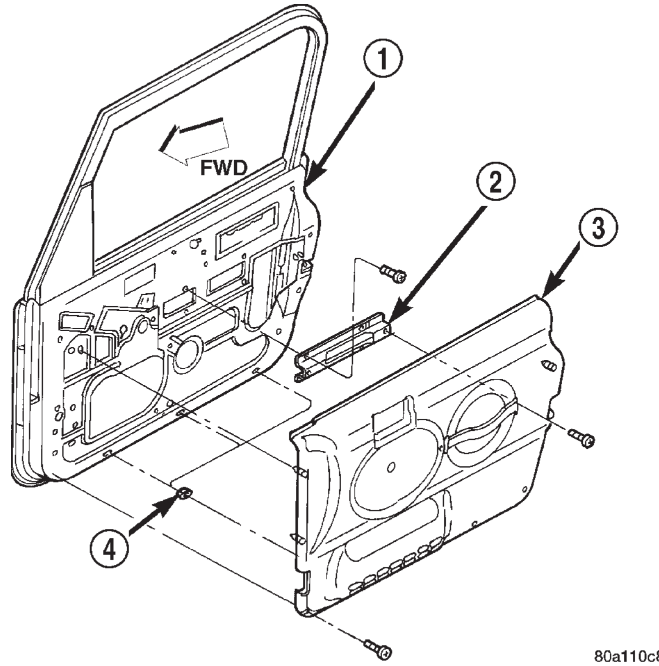

Fig. 6 Grab Handle Support Bracket

1 - FULL DOOR
2 - GRAB HANDLE BRACKET
3 - TRIM PANEL
4 - NUT

(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) Reposition the waterdam

(9) Install the grab handle support bracket.

(10) Install the door trim panel. (Refer to 23 - BODY/FULL DOOR/TRIM PANEL - INSTALLATION)

EXTERIOR HANDLE (Continued)

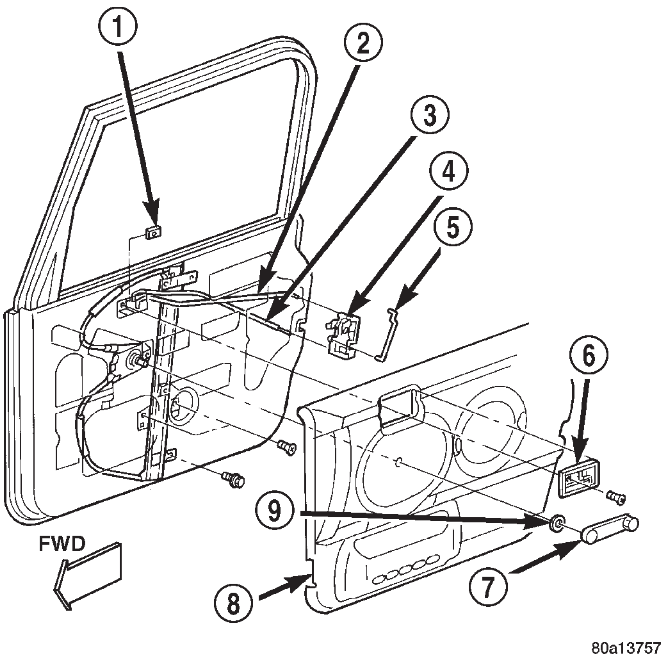

Fig. 7 Latch Rods

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

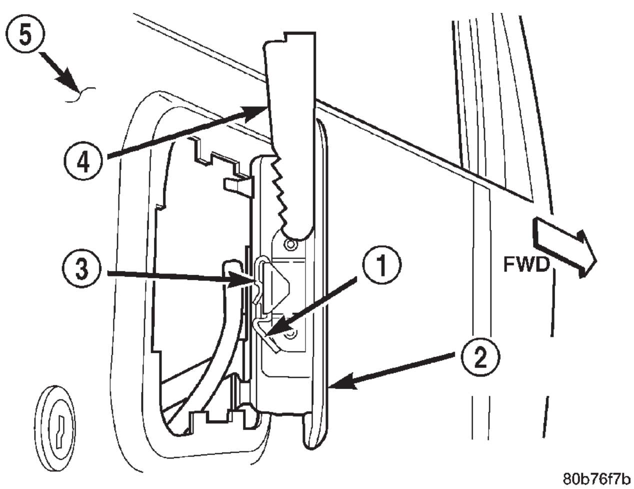

Fig. 8 Outside Door Handle Removal

1 - TAIL
2 - OUTSIDE HANDLE
3 - RETAINER
4 - HANDLE KEEPER
5 - DOOR

GLASS RUN CHANNEL

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. (Refer to 23 - BODY/ FULL DOOR/DOOR GLASS - REMOVAL)
(4) Grasp the glass run channel weatherstrip in the door (Fig. 9) and pull from the channel.

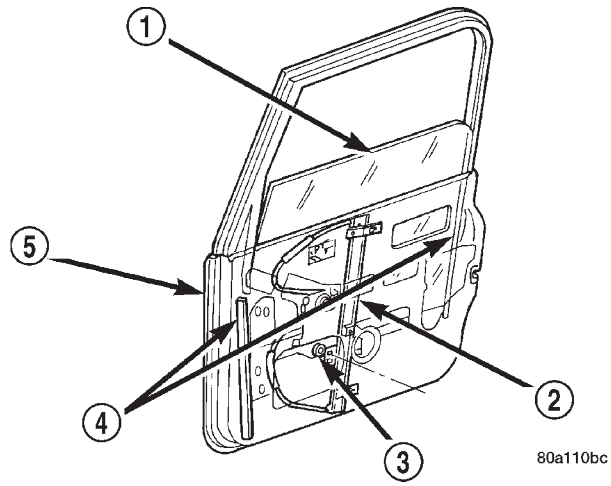

Fig. 9 Full Door Glass Run Channel Weatherstrip

1 - WINDOW GLASS
2 - REGULATOR
3 - GROMMET
4 - GLASS RUN CHANNEL WEATHERSTRIP
5 - DOOR

INSTALLATION

NOTE: Applying a small amount of lubricant to the weatherstrip may ease the installation.

(1) Position the weatherstrip in the door channels and press into place.
(2) Install the door glass.
(3) Position the weatherstrip in the window opening frame and press into place.

NOTE: Ensure that the glass is seated properly. Improperly seated door glass will result in high glass roll-up/roll-down effort.

HINGE

REMOVAL

(1) Remove the door. (Refer to 23 - BODY/FULL DOOR/DOOR - REMOVAL)

(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. 10).

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.

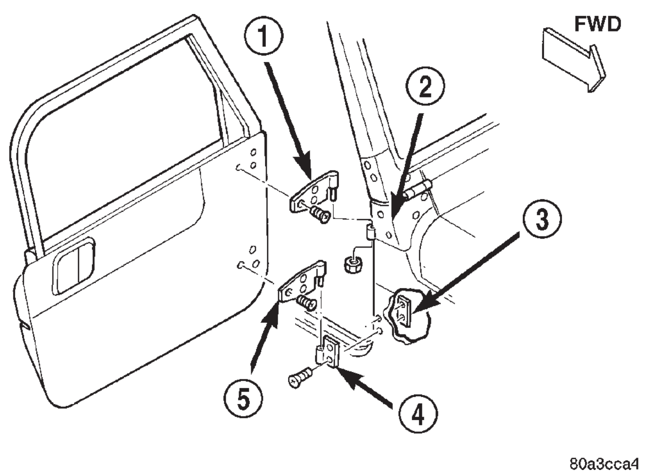

Fig. 10 Full Door Hinge

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. (Refer to 23 - BODY/FULL DOOR/DOOR - INSTALLATION)

(7) Inspect the windshield alignment after hinge installation.

(8) Inspect the door alignment and adjust, if necessary. (Refer to 23 - BODY/FULL DOOR/DOOR - ADJUSTMENTS)

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. 11) .

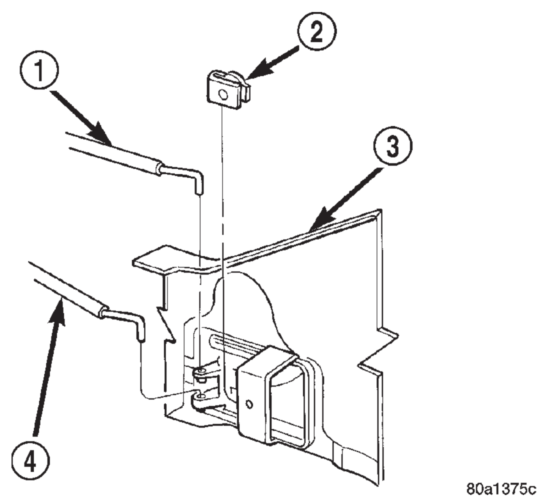

Fig. 11 Inside Handle Actuator

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.

LATCH

REMOVAL

(1) Remove trim panel. (Refer to 23 - BODY/FULL DOOR/TRIM PANEL - REMOVAL)

(2) Roll window to full upward position.

(3) Disconnect the lock cylinder to latch rod (Fig. 12).

(4) Disconnect the lock knob to latch rod.

(5) Disconnect the outside handle to latch rod.

(6) Remove the screws attaching the latch to the door (Fig. 13).

(7) Lower the latch in the door and disconnect the inside handle to latch rod.

(8) Remove the latch from the door.

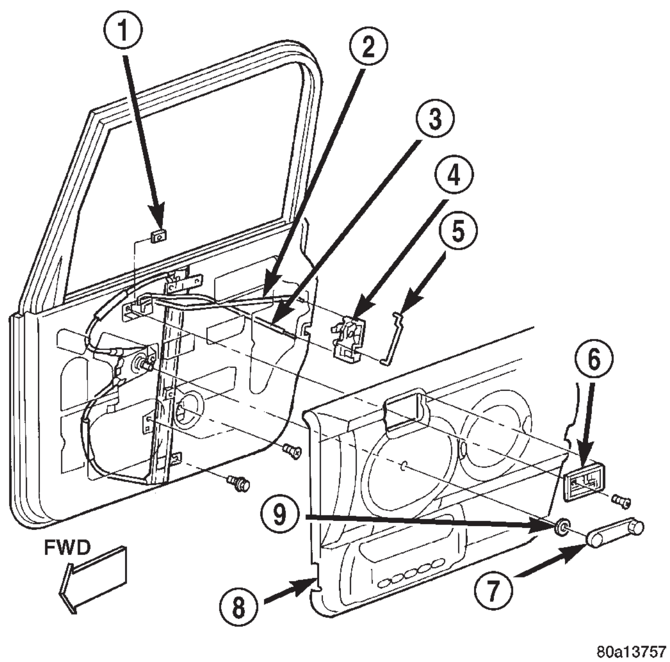

Fig. 12 Latch Rods

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

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.

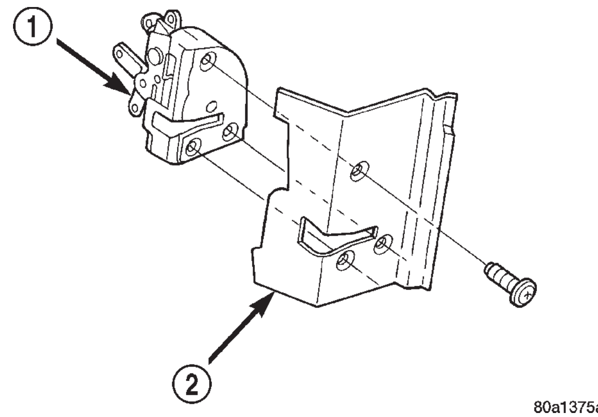

Fig. 13 Full Door Latch

1 - LATCH
2 - FULL DOOR

(6) Connect the lock knob to latch rod.

(7) Connect the lock cylinder to latch rod.

(8) Install trim panel. (Refer to 23 - BODY/FULL DOOR/TRIM PANEL - INSTALLATION)

LATCH STRIKER

REMOVAL

(1) Remove the screws attaching the striker to the body.

(2) Separate the striker and the spacer from the body (Fig. 14).

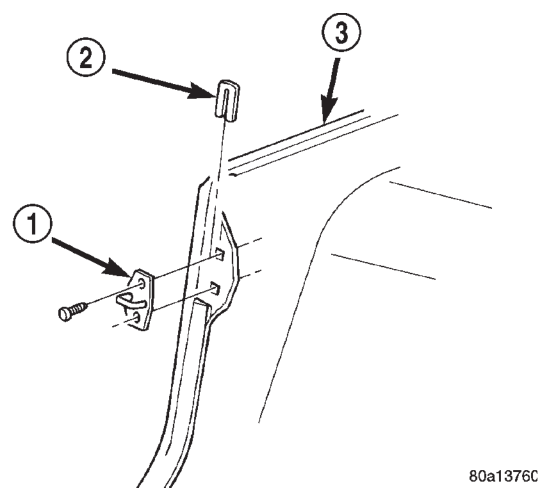

Fig. 14 LATCH STRIKER

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.

LOCK CYLINDER

DESCRIPTION

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.

REMOVAL

(1) Remove trim panel. (Refer to 23 - BODY/FULL DOOR/TRIM PANEL - REMOVAL)
(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.
(2) Install lock cylinder retaining clip.
(3) Connect lock cylinder to latch rod.
(4) Secure the waterdam to the door.
(5) Install trim panel. (Refer to 23 - BODY/FULL DOOR/LOCK CYLINDER - INSTALLATION)

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. 15).
(4) Remove push-in fasteners attaching trim panel to door with special tool C-4829.
(5) Lift the trim panel upward and separate the trim panel from the door.

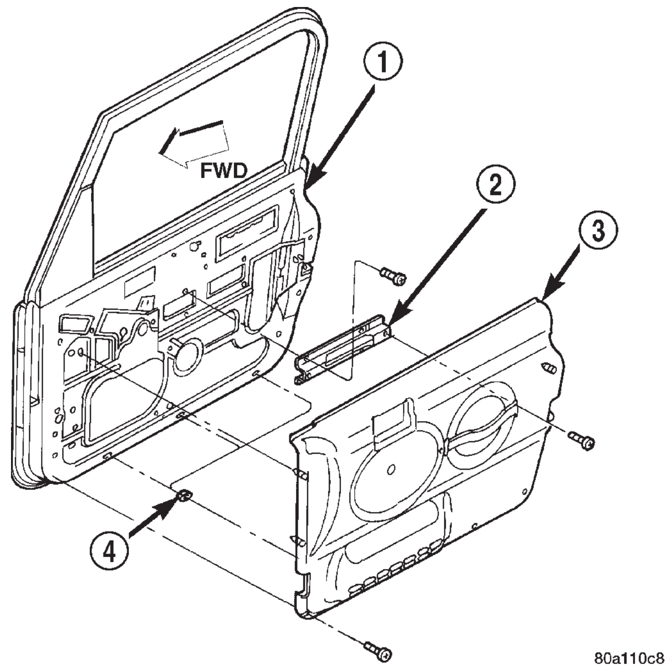

Fig. 15 Full

1 - FULL DOOR
2 - GRAB HANDLE BRACKET
3 - TRIM PANEL
4 - NUT

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.

HALF DOOR

TABLE OF CONTENTS

DOOR

REMOVAL

(1) Open the door.

(2) Disconnect the door restraint strap from the pin (Fig. 1).

(3) Remove the nuts at the door hinge pivots and lift the door from the body.

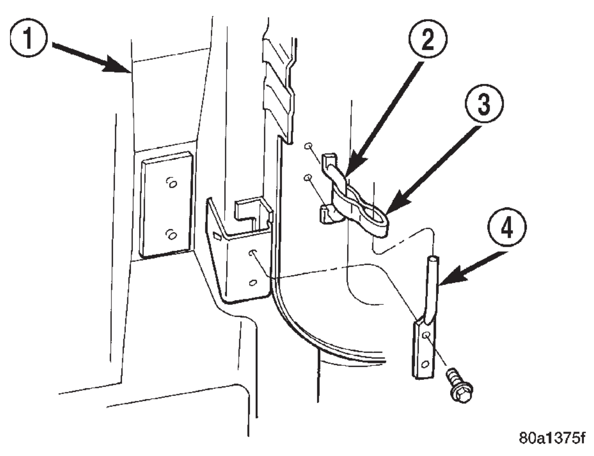

Fig. 1 Restraint Strap

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.

(3) Check for proper operation.

WINDOW

REMOVAL

(1) Open the door.

(2) Grasp the window at both front and rear edges and firmly lift upward (Fig. 2) .

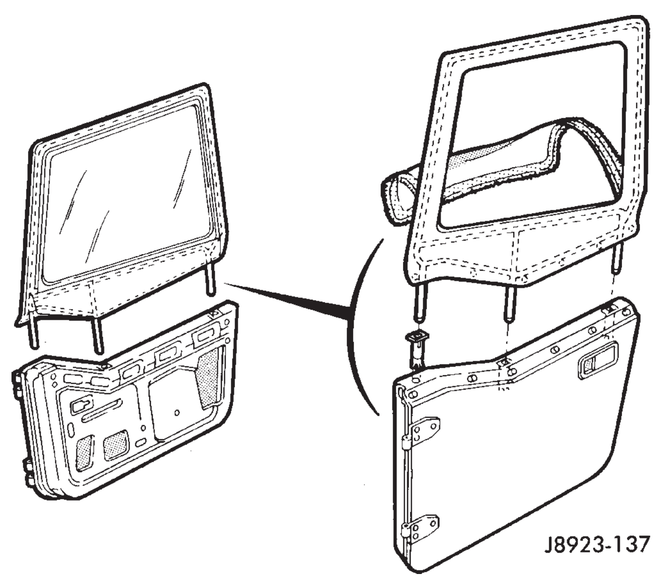

Fig. 2 Half Window

INSTALLATION

(1) Starting at the most forward alignment pin, position the window alignment pins into the restraint sleeves and push downward until seated.

EXTERIOR HANDLE

REMOVAL

(1) Remove trim panel. (Refer to 23 - BODY/HALF DOOR/TRIM PANEL - REMOVAL)

(2) Disconnect the outside handle to latch rod (Fig. 3).

(3) Remove screws attaching the outside handle to the door.

(4) Separate the outside handle and seal from the door.

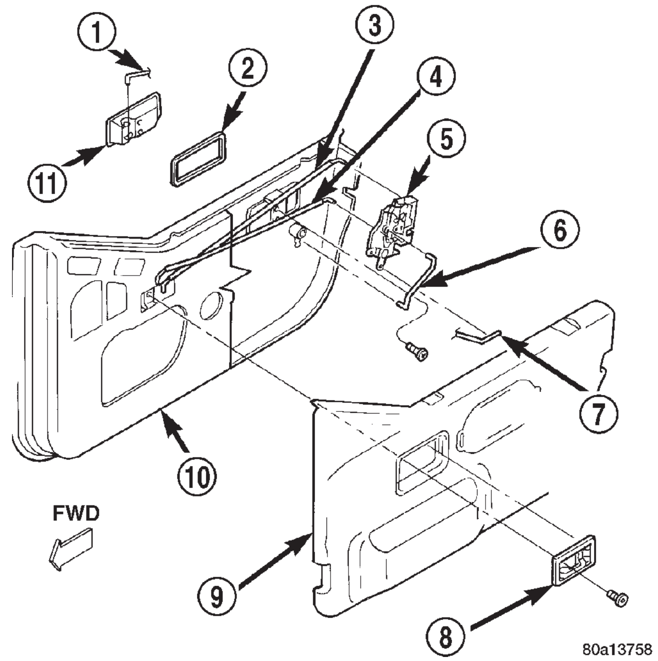

Fig. 3 Outside Handle

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. (Refer to 23 - BODY/HALF DOOR/TRIM PANEL - INSTALLATION)

HINGE

DESCRIPTION

The service procedures for the half door hinge are the same as the full door hinge. (Refer to 23 - BODY/FULL DOOR/HINGE - REMOVAL) and (Refer to 23 - BODY/FULL DOOR/HINGE - INSTALLATION).

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. 4).

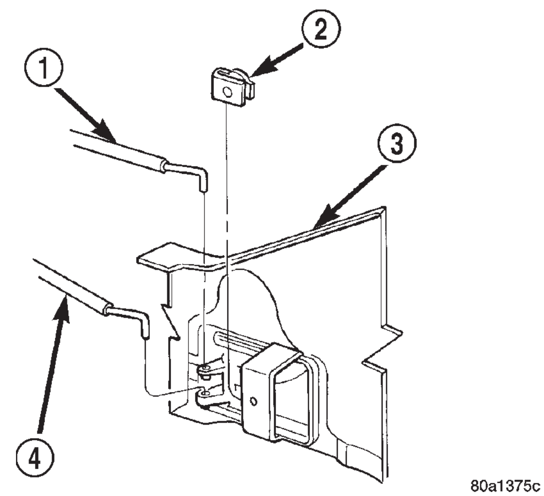

Fig. 4 Inside Handle Actuator

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.

LATCH

REMOVAL

(1) Remove trim panel. (Refer to 23 - BODY/HALF DOOR/TRIM PANEL - REMOVAL)

(2) Disconnect the lock cylinder to latch rod (Fig. 5).

(3) Disconnect the lock knob to latch rod.

(4) Disconnect the outside handle to latch rod.

LATCH (Continued)

(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. 6).

(7) Lower the latch in the door and disconnect the inside handle to latch rod.

(8) Remove the latch from the door.

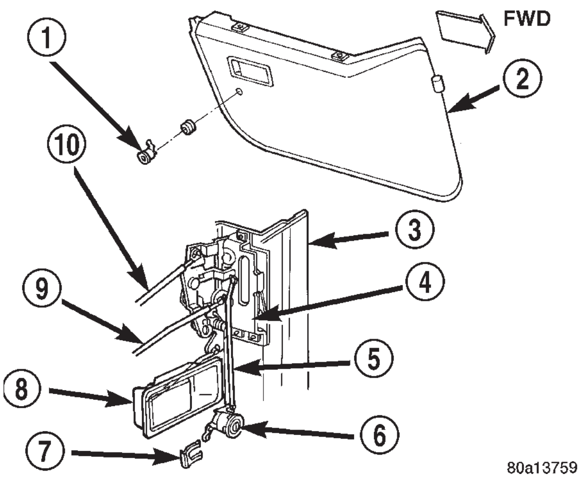

Fig. 5 Half Door Latch Rods

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

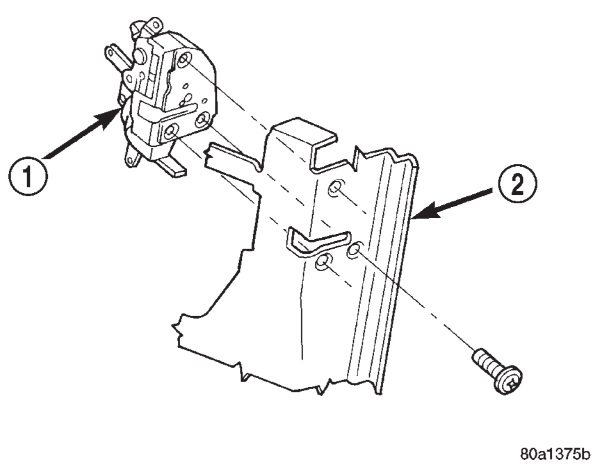

Fig. 6 Door Latch

1 - LATCH
2 - HALF 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 (Fig. 5).

(8) Install trim panel. (Refer to 23 - BODY/HALF DOOR/TRIM PANEL - INSTALLATION)

LATCH STRIKER

REMOVAL

(1) Remove the screws attaching the striker to the body.

(2) Separate the striker and the spacer from the body (Fig. 7) .

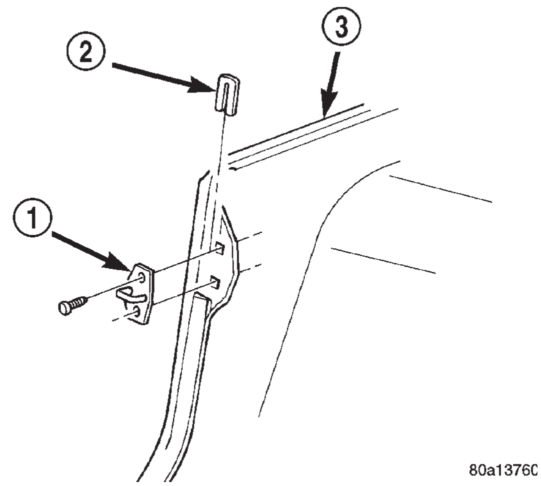

Fig. 7 Latch Striker

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.

LOCK CYLINDER

REMOVAL

(1) Remove trim panel. (Refer to 23 - BODY/HALF DOOR/TRIM PANEL - REMOVAL)

(2) Disconnect lock cylinder to latch rod (Fig. 5).

(3) Remove lock cylinder retaining clip.

(4) Remove the lock cylinder from the door.

INSTALLATION

(1) Install the lock cylinder in the door.

(2) Install lock cylinder retaining clip.

(3) Connect lock cylinder to latch rod.

(4) Install trim panel. (Refer to 23 - BODY/HALF DOOR/TRIM PANEL - INSTALLATION)

TRIM PANEL

REMOVAL

(1) Remove half door window. (Refer to 23 - BODY/HALF DOOR/WINDOW - REMOVAL)

(2) Rotate window retainer sleeves 90°. Using a trim stick, pry sleeve retainers from door.

(3) Remove the screws attaching trim panel to door.

(4) Remove push-in fasteners attaching trim panel to door with special tool C-4829.

(5) Separate the trim panel from the door.

INSTALLATION

(1) Position the trim panel on the door.

(2) Press the push-in fasteners attaching trim panel to door into place.

(3) Install the screws attaching trim panel to door.

(4) Position retainer sleeves into door. Rotate retainer sleeves 90° to secure into place.

(5) Install half door window. (Refer to 23 - BODY/HALF DOOR/WINDOW - INSTALLATION)

EXTERIOR

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BODY SIDE MOLDING

REMOVAL

(1) Remove the bolts from underside of the body side molding (Fig. 1).

(2) Lift the molding upward to release it from the molding support.

(3) Remove the molding support by drilling out the rivets.

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.

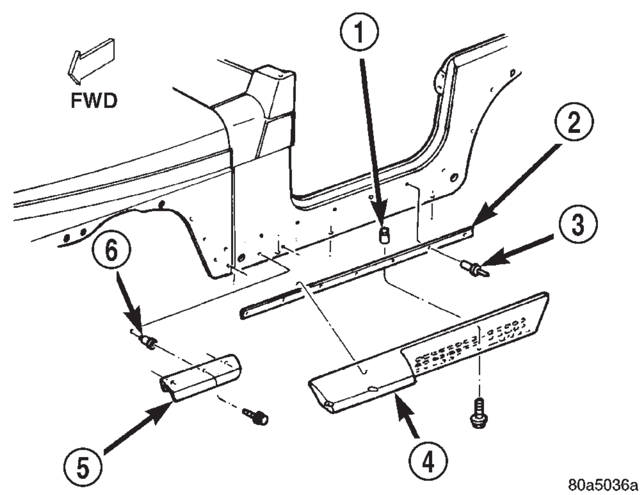

Fig. 1 Body Side Molding

1 - NUTSERT
2 - MOLDING SUPPORT
3 - RIVET
4 - BODY SIDE MOLDING
5 - FENDER FLARE EXTENSION
6 - NUTSERT

BODY DECALS

DESCRIPTION

TJ decals (Fig. 2) 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.

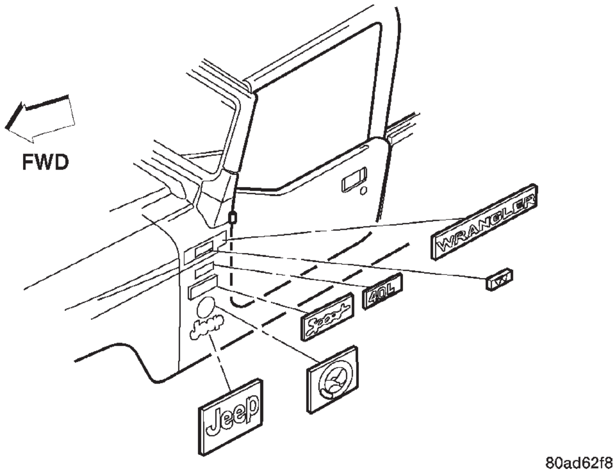

Fig. 2 TJ—Decals

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.

COWL GRILLE AND SCREEN

REMOVAL

(1) Open the hood and remove the screws that attach the cowl grille and screen to the cowl (Fig. 3).

(2) Remove the grille and screen from the cowl.

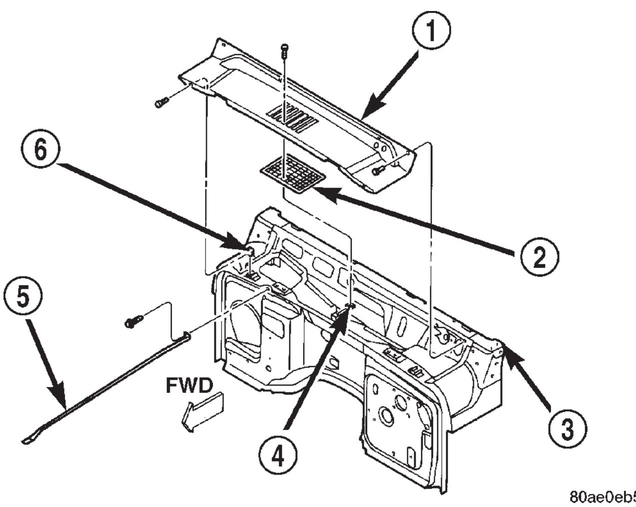

Fig. 3 Cowl Grille And Screen

1 - COWL GRILLE
2 - COWL GRILLE SCREEN
3 - COWL
4 - U NUT
5 - DASH PANEL TIE ROD
6 - U NUT

INSTALLATION

NOTE: When installing the cowl grille, ensure the snorkels on the cowl 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.

RIGHT FRONT FENDER

REMOVAL

(1) Remove the battery tray. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - REMOVAL)

(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) Disengage the battery temperature sensor connector.

(9) Disengage the vacuum line at the reservoir under the battery tray reinforcement bracket.

(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 fender flare extension and body side molding (Fig. 4).

(13) Remove the bolts attaching the fender to the cowl (Fig. 5).

(14) Remove the bolts attaching the fender to the battery tray reinforcement bracket.

(15) Remove the bolts attaching the fender to the grille.

(16) Separate the fender from the vehicle.

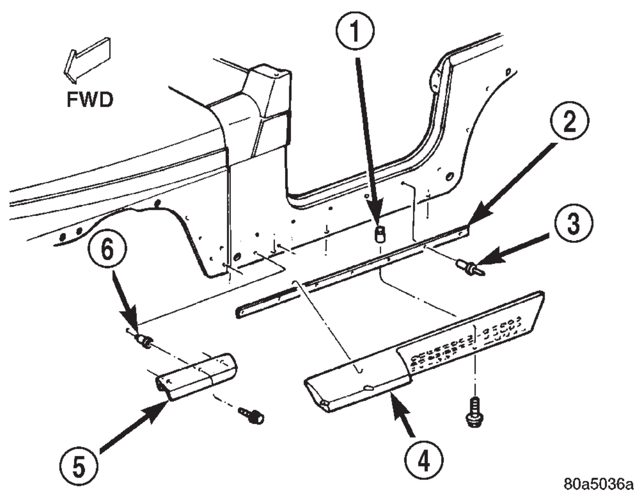

Fig. 4 Body Side Molding

1 - NUTSERT
2 - MOLDING SUPPORT
3 - RIVET
4 - BODY SIDE MOLDING
5 - FENDER FLARE EXTENSION
6 - NUTSERT

INSTALLATION

Transfer all related components. Replace harness retainers if damaged.

(1) Position the fender on the vehicle.

(2) Install the bolts attaching the fender to the grille.

(3) Install the bolts attaching the fender to the battery tray reinforcement bracket.

(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) Position the front end lighting wire harness into the retainers on the fender. Engage the retainers to secure.

(11) Position the high pressure air conditioning line into the retainer on the fender. Engage the retainer to secure.

(12) Position the PDC on the fender and install the bolts.

(13) Position the PDC wire harness into the retainers on the fender and battery tray. Engage the retainers to secure.

(14) Install the air cleaner housing.

(15) Install the battery tray. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - INSTALLATION)

RIGHT FRONT FENDER (Continued)

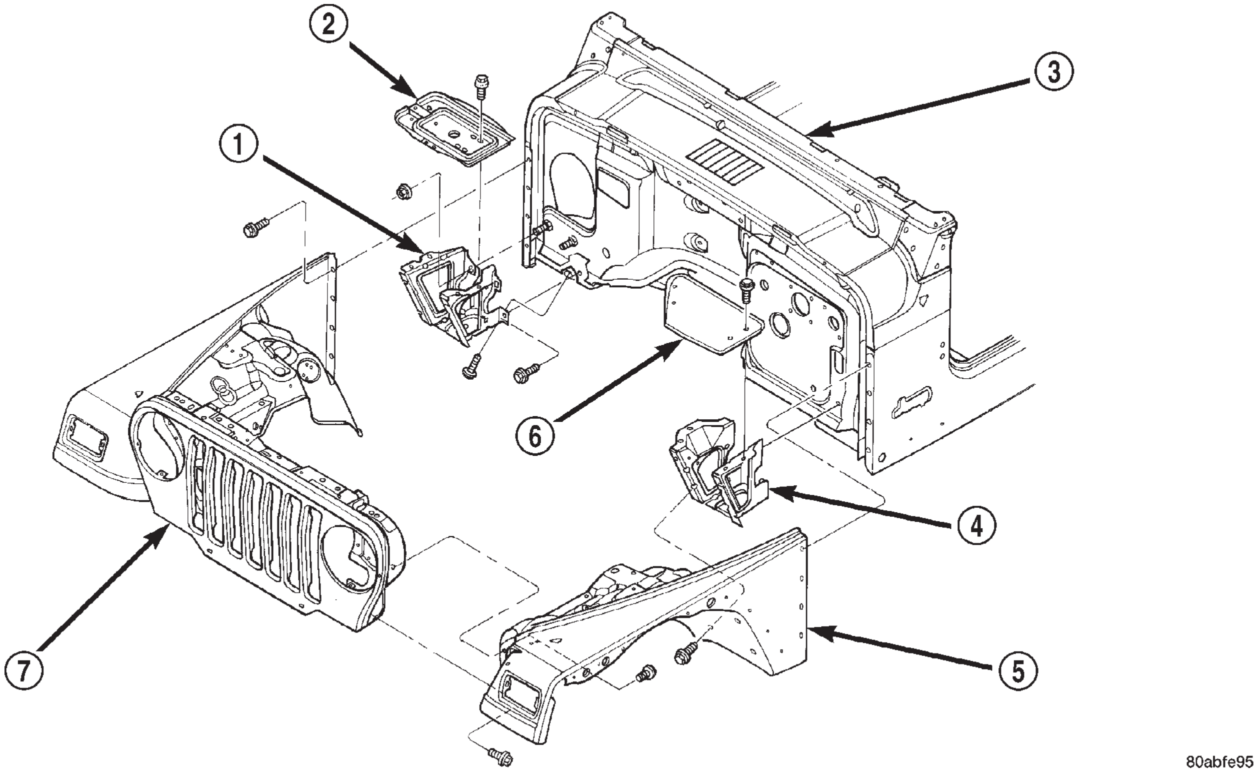

Fig. 5 Front Fender

1 - REINFORCEMENT
2 - BATTERY TRAY
3 - BODY
4 - REINFORCEMENT
5 - FENDER
6 - TRAY
7 - RADIATOR GRILLE PANEL

LEFT FRONT FENDER

REMOVAL

(1) Disconnect the negative terminal on the battery. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/CABLES - REMOVAL)

(2) Remove the windshield washer reservoir.

(3) Remove horns. (Refer to 8 - ELECTRICAL/HORN/HORN - REMOVAL)

(4) Remove EVAP canister.

(5) Remove the bolts attaching the ABS Hydraulic Control Unit (HCU) to the support tray.

(6) Secure the HCU.

(7) Remove the HCU tray.

(8) Disengage the front end lighting wire harness retainers on the fender.

(9) Disengage the headlamp wire connector.

(10) Route the fog lamp (if equipped), park lamp and side marker wire harness through the access hole in the fender well.

(11) If equipped, remove the body side molding (Fig. 6).

(12) Remove the bolts attaching the fender to the cowl (Fig. 7).

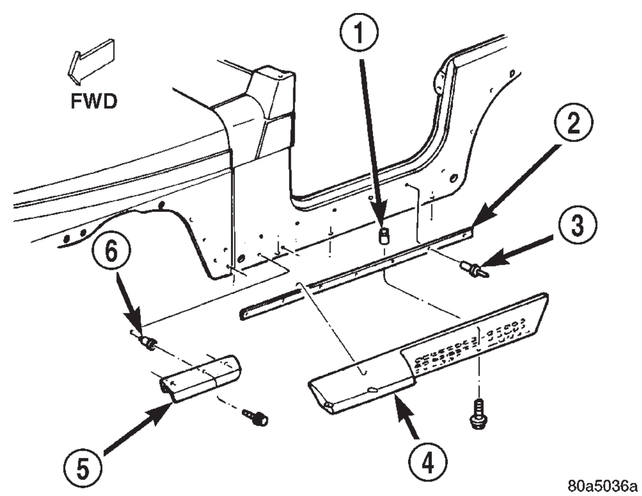

Fig. 6 Body Side Molding

1 - NUTSERT
2 - MOLDING SUPPORT
3 - RIVET
4 - BODY SIDE MOLDING
5 - FENDER FLARE EXTENSION
6 - NUTSERT

LEFT FRONT FENDER (Continued)

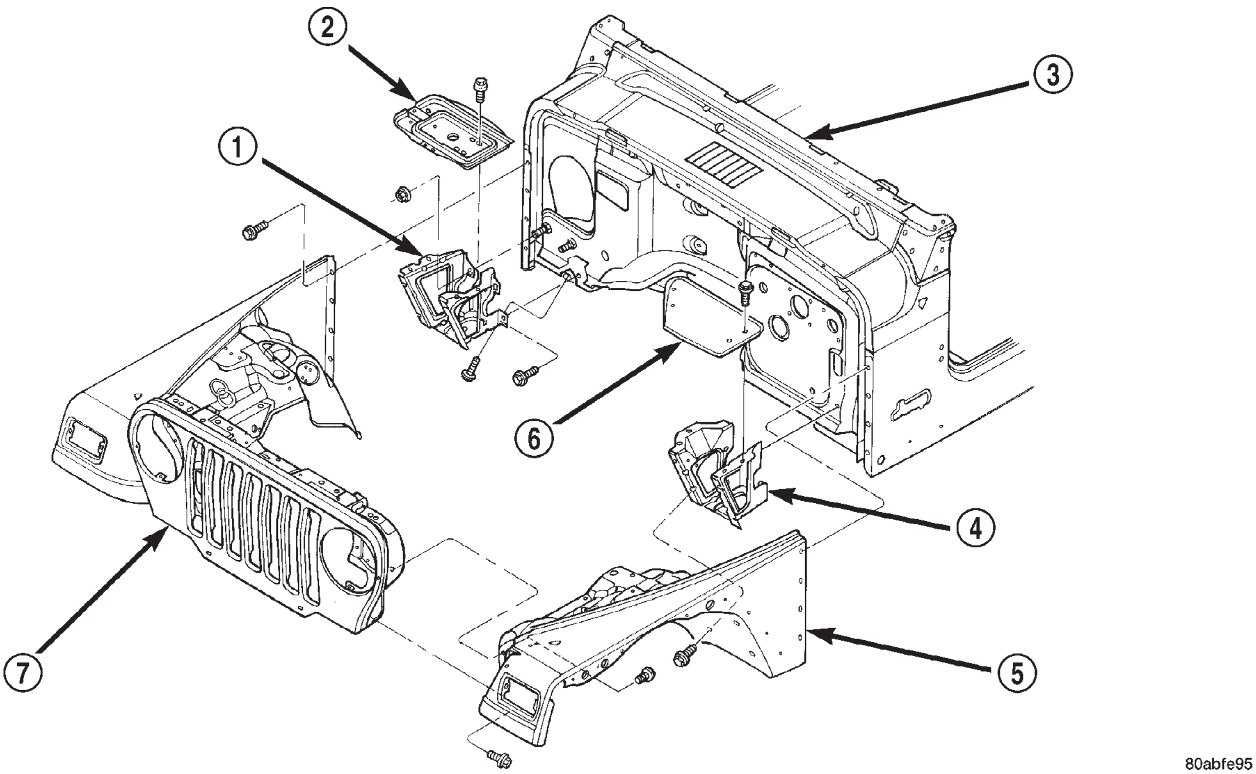

Fig. 7 Front Fender

1 - REINFORCEMENT
2 - BATTERY TRAY
3 - BODY
4 - REINFORCEMENT
5 - FENDER
6 - TRAY
7 - RADIATOR GRILLE PANEL

(13) Remove the bolts attaching the fender to the HCU tray reinforcement bracket.

(14) Remove the bolts attaching the fender to the grille.

(15) Separate the fender from the vehicle.

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. (Refer to 8 - ELECTRICAL/HORN/HORN - INSTALLATION)

(13) Engage horn wire connectors.

(14) Install the windshield washer reservoir.

(15) Connect the negative terminal on the battery. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/CABLES - 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.

RADIATOR GRILLE PANEL (Continued)

(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. 8) .

(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.

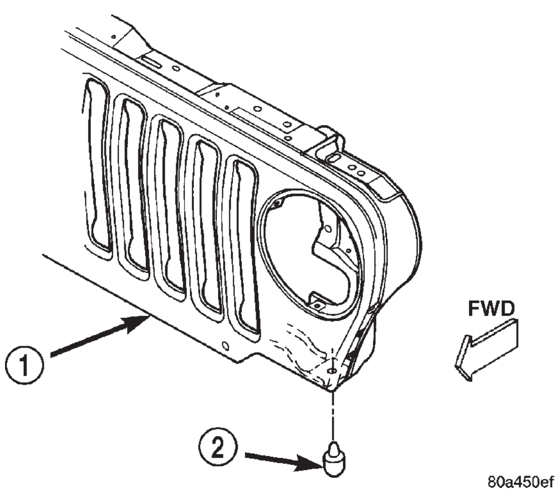

Fig. 8 Grille Bumpers

1 - GRILLE PANEL
2 - BUMPER

LICENSE PLATE BRACKET

REMOVAL

(1) If installed, remove the license plate.

(2) Remove the screws attaching the license plate bracket to the body (Fig. 9).

(3) Separate the bracket from the body.

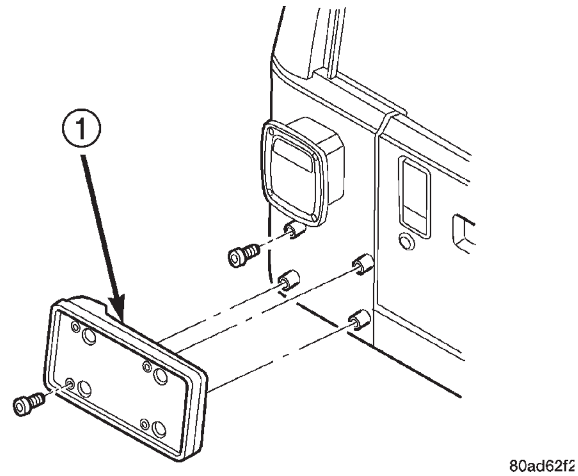

Fig. 9 License Plate Bracket

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.

WHEELHOUSE SPLASH SHIELD

REMOVAL

(1) Remove the plastic push pins that attach the splash shield to the wheelhouse (Fig. 10).

(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.

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.

WHEELHOUSE SPLASH SHIELD (Continued)

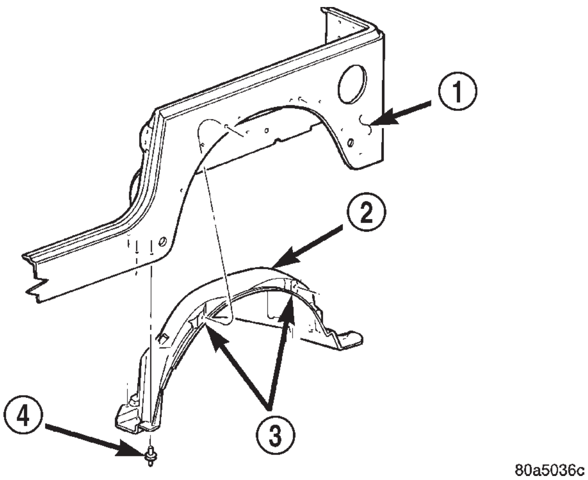

Fig. 10 Wheelhouse Splash Shield

1 - BODY
2 - WHEELHOUSE SPLASH SHIELD
3 - PUSH-IN FASTENERS
4 - RIVET

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.

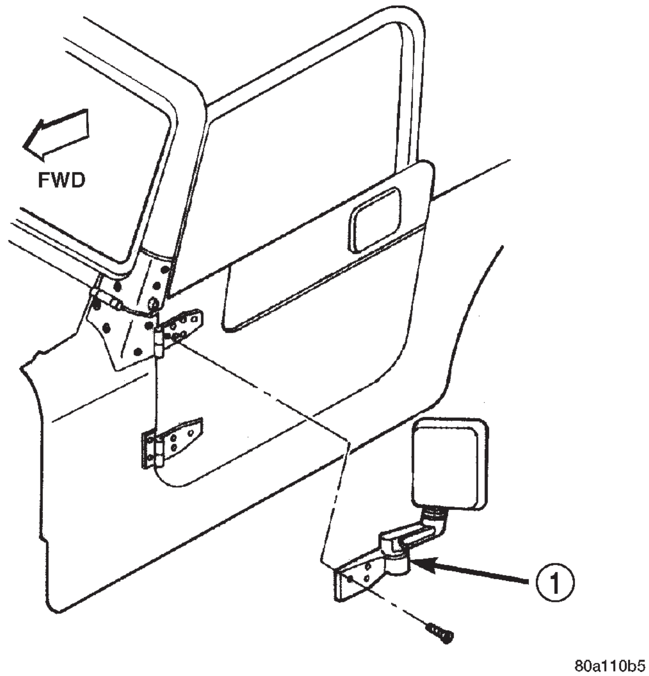

Fig. 11 Side View Mirror

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.

SIDE STEP

REMOVAL

(1) Remove the bolts that attach the side step to the frame (Fig. 12).

(2) Tilt the step down and disengage the tabs from the frame slots.

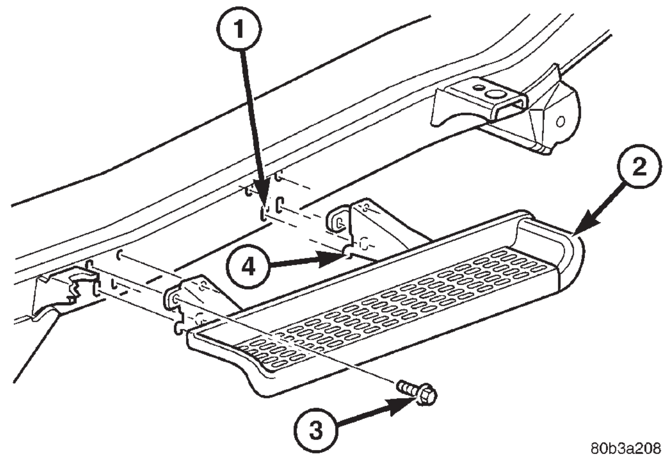

Fig. 12 SIDE STEP

1 - FRAME SLOTS
2 - SIDE STEP
3 - BOLTS
4 - STEP MOUNTING TABS

INSTALLATION

(1) Position the side step on the frame and engage the mounting tabs into the frame slots.

(2) Install the bolts that attach the side step to the frame and tighten to 21 N·m (15 ft. lbs.).

WHEEL OPENING FLARE MOLDING

REMOVAL

(1) Remove the side marker lamp. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/ MARKER LAMP UNIT - REMOVAL)

(2) Remove the screws that attach the flare to the front fender or rear wheelhouse (Fig. 13).

(3) Separate the flare from the body.

WHEEL OPENING FLARE MOLDING (Continued)

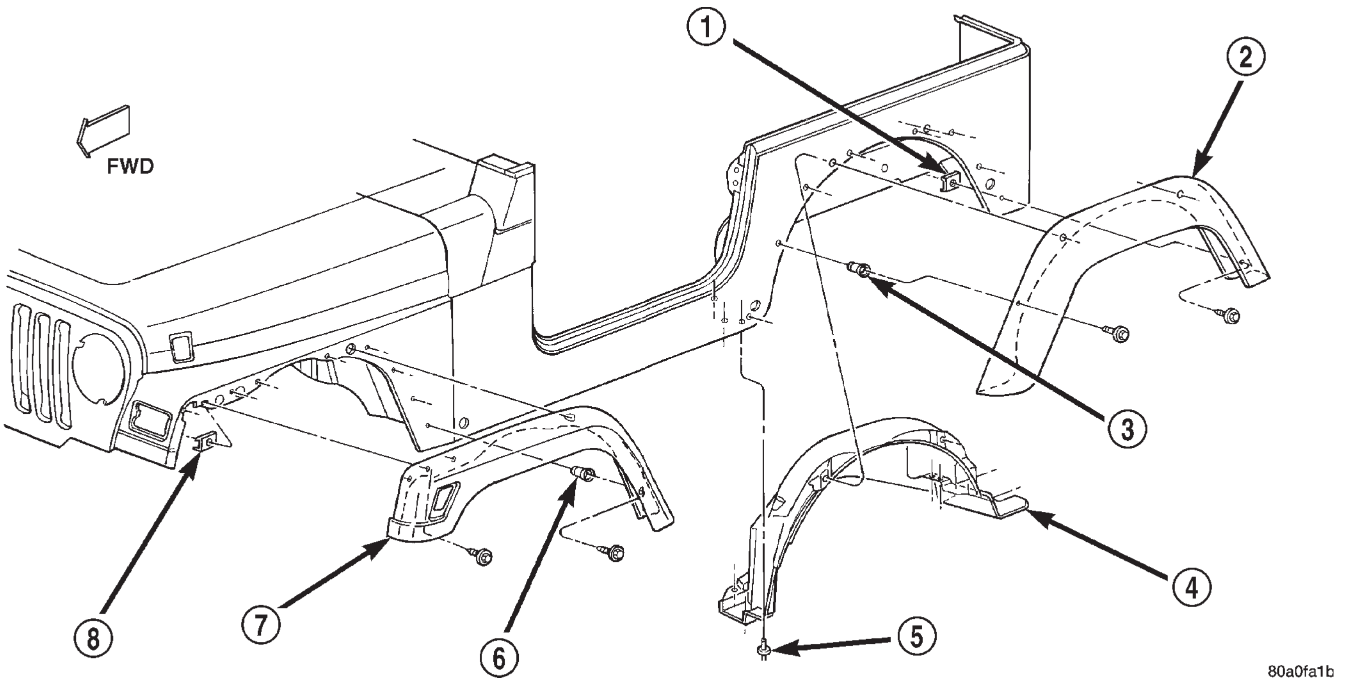

Fig. 13 FENDER FLARES

1 - U-NUT
2 - FENDER FLARE
3 - NUTSERT
4 - SPLASH SHIELD
5 - RIVET
6 - NUTSERT
7 - FENDER FLARE
8 - U-NUT

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.

HOOD

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HINGE

REMOVAL

(1) Remove the wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - REMOVAL)

(2) Remove the cowl panel and screen. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE AND SCREEN - REMOVAL)

(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. 1).

(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 (13 ft. lbs.) torque.

(4) Install the bolts attaching the hinge to the cowl.

(5) Install the cowl panel and screen. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE AND SCREEN - INSTALLATION)

(6) Install the wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - INSTALLATION)

HOOD

REMOVAL

(1) Raise and support the hood.

(2) Disconnect the underhood lamp wire harness connector.

(3) Disconnect the windshield washer nozzles.

(4) Disconnect the ground strap.

(5) Mark the position of the hinges on the hood for installation alignment reference.

(6) Remove the screws attaching the hood to the hinge and remove the hood (Fig. 1).

(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. 1).

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 (Continued)

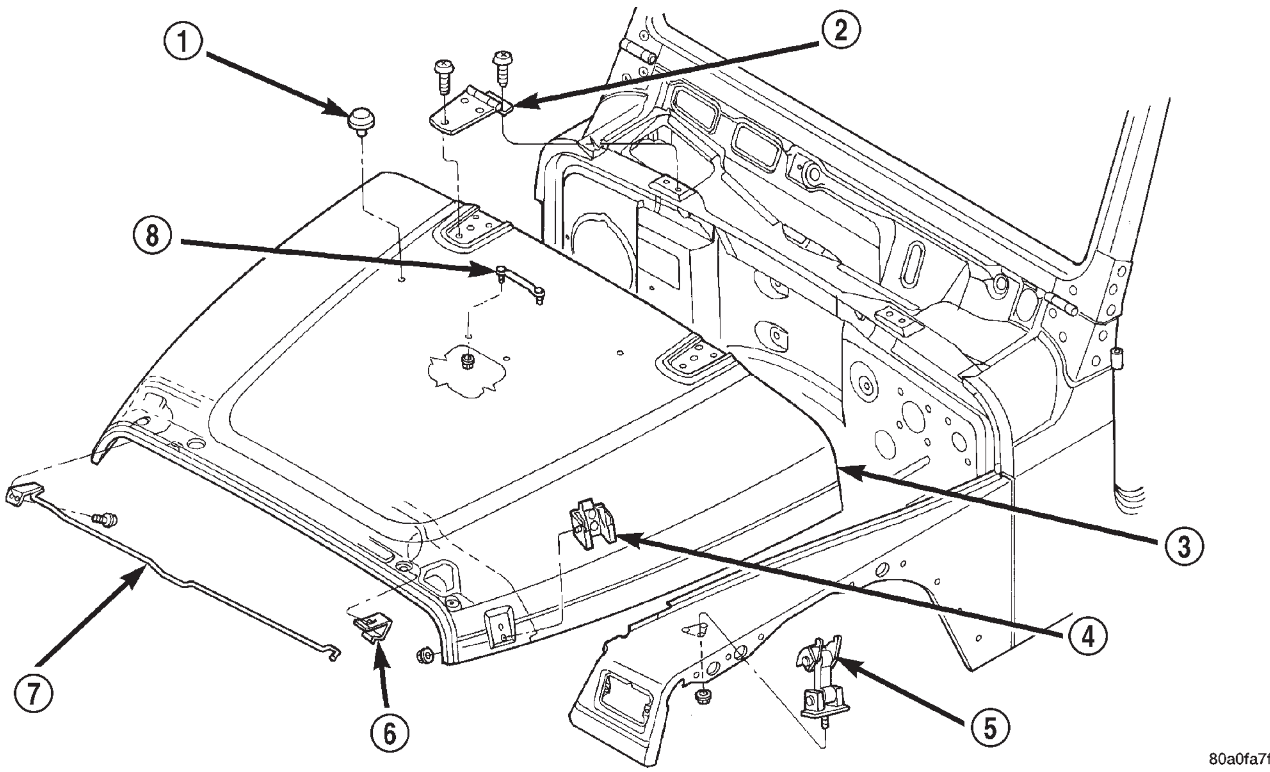

Fig. 1 Hood Components

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

ADJUSTMENTS

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.

HOOD SAFETY LATCH

REMOVAL

(1) Raise and support the hood.

(2) Remove the bolt attaching the safety latch to the hood (Fig. 2).

(3) Remove the latch from the hood.

INSTALLATION

(1) Position the latch on the hood.

(2) Install the bolt attaching the safety latch to the hood and tighten to 9 N·m (80 in. lbs.).

(3) Remove the support rod and close the hood.

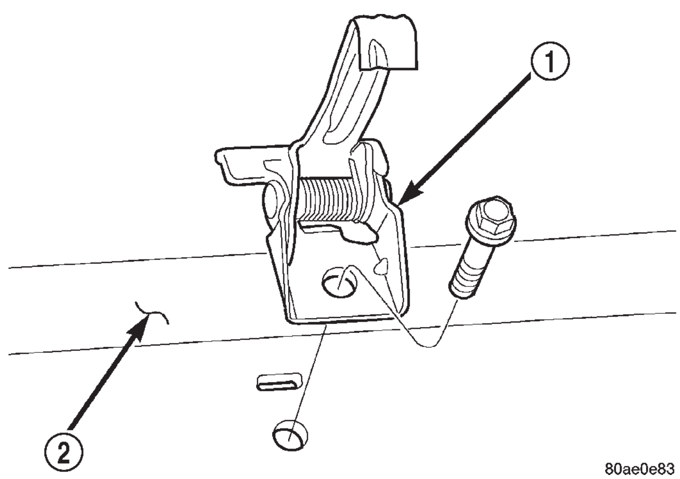

Fig. 2 Hood Safety Latch

1 - SAFETY LATCH
2 - HOOD

INSTRUMENT PANEL

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ACCESSORY SWITCH BEZEL

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the center bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CENTER BEZEL - REMOVAL).

(3) Remove the four screws that secure the accessory switch bezel to the instrument panel (Fig. 1).

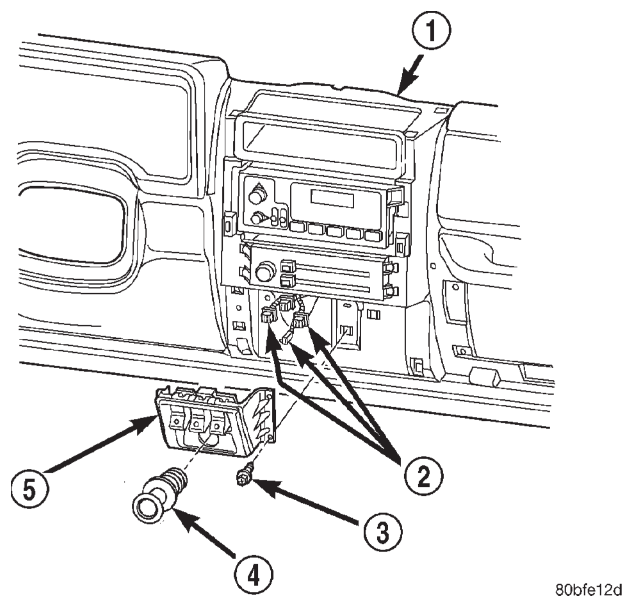

Fig. 1 Accessory Switch Bezel Remove/Install

1 - INSTRUMENT PANEL
2 - WIRE HARNESS CONNECTORS
3 - SCREW (4)
4 - CIGAR LIGHTER
5 - ACCESSORY SWITCH BEZEL

ACCESSORY SWITCH BEZEL (Continued)

(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 for 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

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.

(1) Position the accessory switch bezel to the instrument panel (Fig. 1).

(2) Reconnect the instrument panel wire harness connectors to the connector receptacles for 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 N·m (20 in. lbs.).

(5) Reinstall the center bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CENTER BEZEL - INSTALLATION).

(6) Reconnect the battery negative cable.

BASE TRIM

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) Remove the accessory switch bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/ACCESSORY SWITCH BEZEL - REMOVAL).

(4) Remove the grab handle bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GRAB HANDLE BEZEL - REMOVAL).

(5) Remove the speakers from the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/SPEAKER - REMOVAL).

(6) Remove the radio from the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - REMOVAL).

(7) Remove the heater-A/C control from the instrument panel. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C-HEATER CONTROL - REMOVAL).

(8) Remove the outboard heater-A/C panel outlet barrels from the instrument panel. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/PANEL OUTLET BARRELS - REMOVAL).

(9) Remove the instrument panel from the vehicle. (Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL).

(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 airbag door from the instrument panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG DOOR - REMOVAL).

(12) Remove the two screws that secure the 16-way data link connector to the instrument panel.

(13) Remove all of the screws around the perimeter of the instrument panel that secure the base trim to the structural support.

(14) Remove the base trim from the instrument panel structural support.

BASE TRIM (Continued)

INSTALLATION

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.

(1) Position the base trim onto the instrument panel structural support.

(2) Install and tighten all of the screws around the perimeter of the instrument panel that secure the base trim to the structural support. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Install and tighten the two screws that secure the 16-way data link connector to the instrument panel. Tighten the screws to 2 N·m (20 in. lbs.).

(4) Reinstall the passenger airbag door into the instrument panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG DOOR - INSTALLATION).

(5) Reinstall the instrument panel into the vehicle. (Refer to 23 - BODY/INSTRUMENT PANEL - INSTALLATION).

(6) Reinstall the outboard heater-A/C panel outlet barrels into the instrument panel. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/PANEL OUTLET BARRELS - INSTALLATION).

(7) Reinstall the heater-A/C control into the instrument panel. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C-HEATER CONTROL - INSTALLATION).

(8) Reinstall the radio into the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - INSTALLATION).

(9) Reinstall the speakers into the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/SPEAKER - INSTALLATION).

(10) Reinstall the grab handle bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GRAB HANDLE BEZEL - INSTALLATION).

(11) Reinstall the accessory switch bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/ACCESSORY SWITCH BEZEL - INSTALLATION).

(12) Reinstall the instrument cluster into the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(13) Reconnect the battery negative cable.

CENTER BEZEL

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the top cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/TOP COVER - REMOVAL).

(3) Remove the ash receiver from the ash receiver housing integral to the lower portion of the center bezel.

(4) Remove the one screw in the back of the ash receiver housing that secures the bottom of the center bezel to the instrument panel structural support (Fig. 2).

(5) Remove the two screws that secure the top of the center bezel to the top of the instrument panel structural support.

(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 to the receptacles in the instrument panel base trim.

(8) Remove the center bezel from the instrument panel.

CENTER BEZEL (Continued)

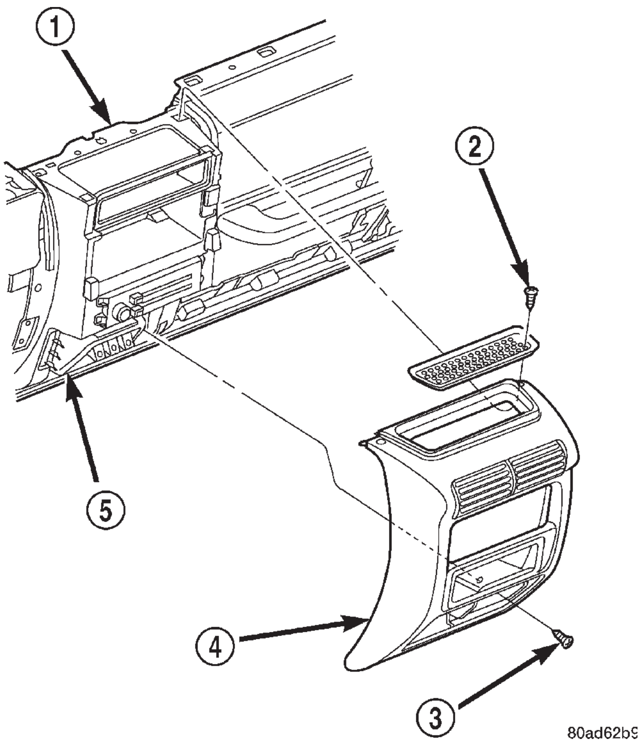

Fig. 2 Center Bezel Remove/Install

1 - INSTRUMENT PANEL
2 - SCREW
3 - SCREW
4 - CENTER BEZEL
5 - ACCESSORY SWITCH BEZEL

INSTALLATION

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(1) Position the center bezel onto the instrument panel (Fig. 2).

(2) Align the snap clips on the center bezel with the receptacles in the instrument panel base trim.

(3) Using hand pressure, 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 in the instrument panel base trim.

(4) Install and tighten the two screws that secure the top of the center bezel to the top of the instrument panel structural support. Tighten the screws to 2 N·m (20 in. lbs.).

(5) Install and tighten the one screw through the back of the ash receiver housing that secures the bottom of the center bezel to the instrument panel structural support. Tighten the screw to 2 N·m (20 in. lbs.).

(6) Install the ash receiver into the ash receiver housing integral to the lower portion of the center bezel.

(7) Reinstall the top cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/TOP COVER - INSTALLATION).

(8) Reconnect the battery negative cable.

CLUSTER BEZEL

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the top cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/TOP COVER - REMOVAL).

CLUSTER BEZEL (Continued)

(4) Remove the two screws that secure the lower mounting tabs of the cluster bezel to the instrument panel (Fig. 3).

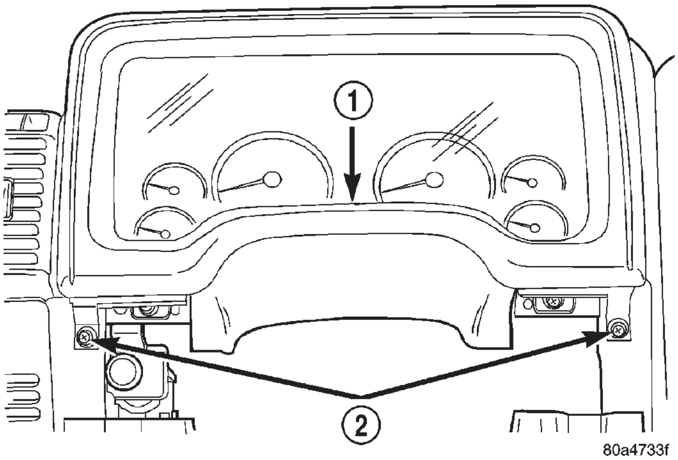

Fig. 3 Cluster Bezel Lower Screws Remove/Install

1 - CLUSTER BEZEL
2 - SCREW (2)

(5) Remove the three screws that secure the upper mounting flange of the cluster bezel to the top of the instrument panel (Fig. 4).

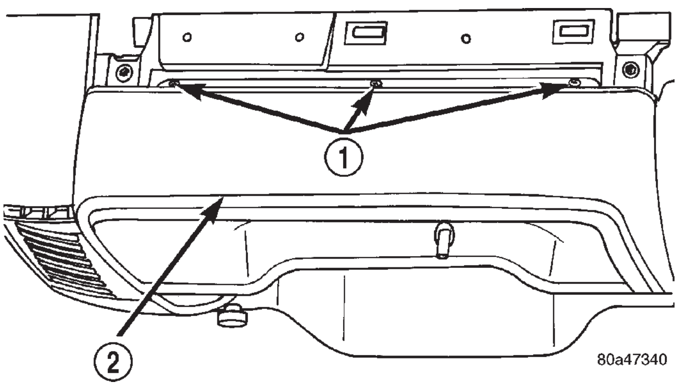

Fig. 4 Cluster Bezel Upper Screws Remove/Install

1 - SCREW (3)
2 - CLUSTER BEZEL

(6) Remove the cluster bezel from the instrument panel.

INSTALLATION

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(1) Position the cluster bezel onto the instrument panel.

(2) Install and tighten the three screws that secure the upper mounting flange of the cluster bezel to the top of the instrument panel (Fig. 4). Tighten the screws to 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 (Fig. 3). Tighten the screws to 2 N·m (20 in. lbs.).

(4) Reinstall the top cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/TOP COVER - INSTALLATION).

(5) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(6) Reconnect the battery negative cable.

GLOVE BOX

REMOVAL

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(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. 5).

(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.

GLOVE BOX (Continued)

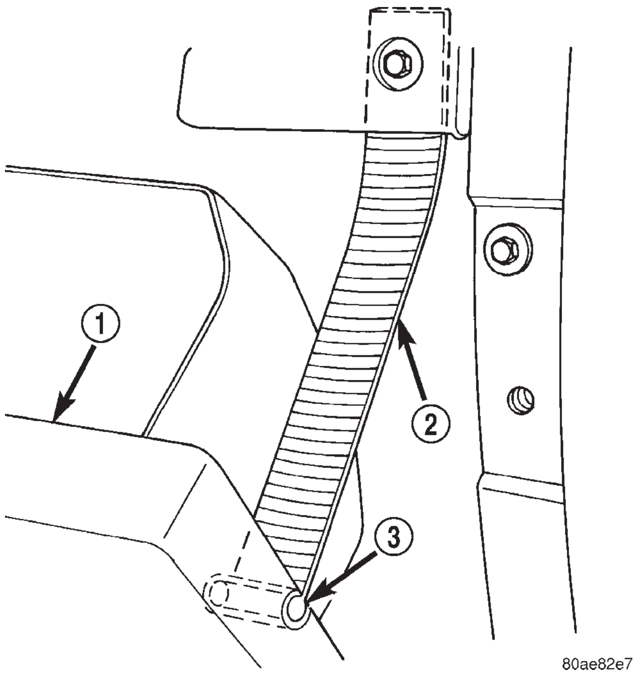

Fig. 5 Glove Box Remove/Install

1 - GLOVE BOX DOOR
2 - CHECK STRAP
3 - SLOT

(5) Remove the glove box from the instrument panel.

DISASSEMBLY

Some of the components of the glove box used in this vehicle are serviced individually. The serviced components include the glove box latch and handle unit, and the glove box lock cylinder (Fig. 6). Following are the procedures for disassembling these components from the glove box.

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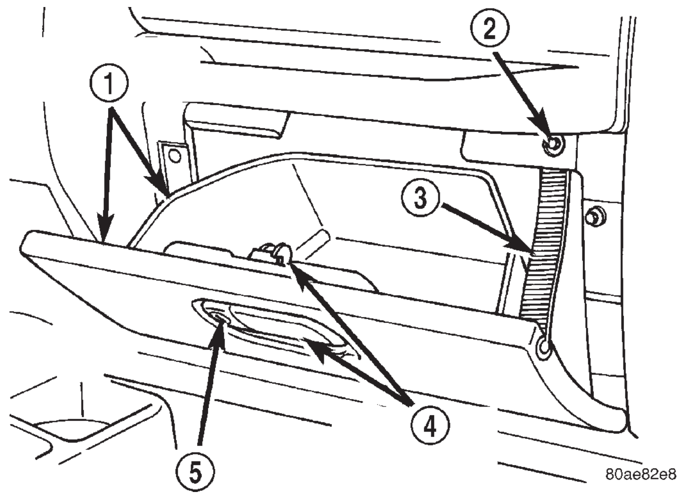

Fig. 6 Glove Box Components

1 - GLOVE BOX DOOR AND BIN
2 - SCREW
3 - CHECK STRAP
4 - LATCH AND HANDLE
5 - LOCK CYLINDER

GLOVE BOX LATCH AND HANDLE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(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 inside of the glove box door.

GLOVE BOX LOCK CYLINDER

(1) Remove the glove box latch and handle unit from the glove box. Refer to GLOVE BOX LATCH AND HANDLE .

(2) Insert the key into the glove box lock cylinder.

(3) Insert a small screwdriver into the retaining tumbler release slot and depress the retaining tumbler (Fig. 7).

(4) Using a gentle twisting and pulling action with the key, pull the lock cylinder out of the glove box latch and handle unit.

ASSEMBLY

Some of the components of the glove box used in this vehicle are serviced individually. The serviced components include the glove box latch and handle unit, and the glove box lock cylinder (Fig. 6). Following are the procedures for assembling these components onto the glove box.

GLOVE BOX (Continued)

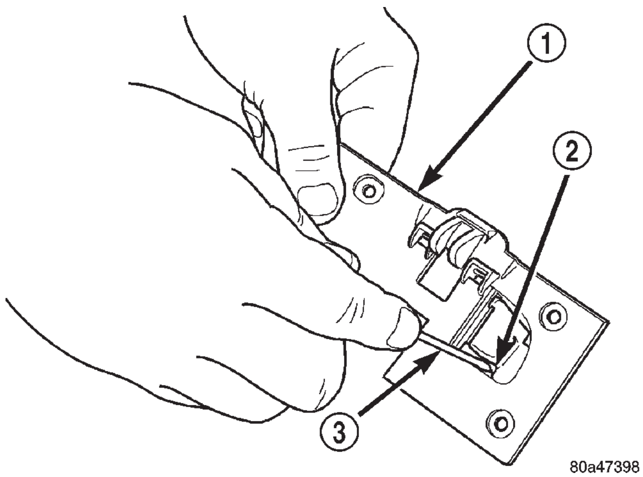

Fig. 7 Glove Box Lock Cylinder Remove/Install

1 - GLOVE BOX LATCH
2 - RELEASE SLOT
3 - SMALL SCREWDRIVER

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GLOVE BOX LATCH AND HANDLE

(1) Position the latch and handle onto the inside of 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 N·m (20 in. lbs.).

(3) Reinstall the glove box onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/ GLOVE BOX - INSTALLATION).

(4) Reconnect the battery negative cable.

GLOVE BOX LOCK CYLINDER

(1) Insert the key into the glove box lock cylinder.

(2) Using a gentle twisting and pushing action on the key, push the lock cylinder into the glove box latch and handle unit.

(3) Reinstall the glove box latch and handle onto the glove box. Refer to GLOVE BOX LATCH AND HANDLE .

INSTALLATION

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(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 (Fig. 5).

(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 and latch the glove box door.

(6) Reconnect the battery negative cable.

GLOVE BOX CHECK STRAP

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/ GLOVE BOX - REMOVAL).

GLOVE BOX CHECK STRAP (Continued)

(3) Remove the screw that secures the glove box check strap to the instrument panel on the upper glove box opening reinforcement (Fig. 8).

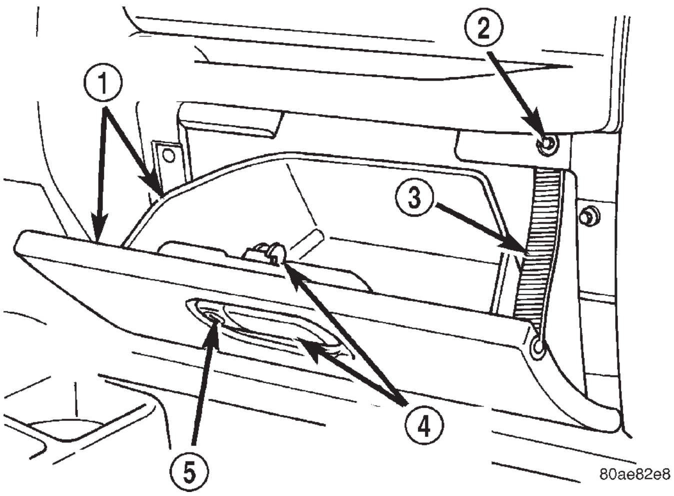

Fig. 8 Glove Box Check Strap

1 - GLOVE BOX DOOR AND BIN
2 - SCREW
3 - CHECK STRAP
4 - LATCH AND HANDLE
5 - LOCK CYLINDER

(4) Remove the check strap from the upper glove box opening reinforcement.

INSTALLATION

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(1) Position the check strap to the upper glove box opening reinforcement (Fig. 8).

(2) Install and tighten the screw that secures the glove box check strap to the upper glove box opening reinforcement. Tighten the screw to 2 N·m (20 in. lbs.).

(3) Reinstall the glove box onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/ GLOVE BOX - INSTALLATION).

(4) Reconnect the battery negative cable.

GLOVE BOX LATCH STRIKER

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/ GLOVE BOX - REMOVAL).

(3) Remove the two screws that secure the latch striker to the upper glove box opening reinforcement (Fig. 9).

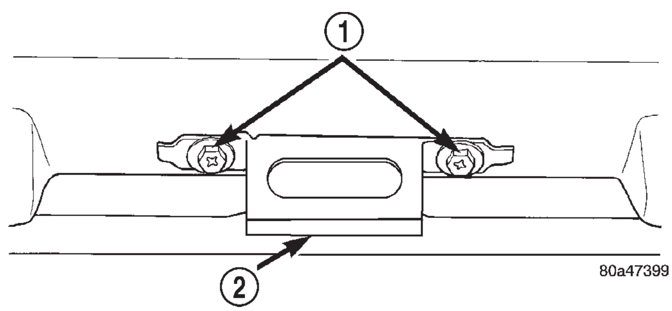

Fig. 9 Glove Box Latch Striker Remove/Install

1 - SCREW (2)
2 - LATCH STRIKER

(4) Remove the latch striker from the upper glove box opening reinforcement.

GLOVE BOX LATCH STRIKER (Continued)

INSTALLATION

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(1) Position the latch striker onto the upper glove box opening reinforcement (Fig. 9).

(2) Install and tighten the two screws that secure the latch striker to the upper glove box opening reinforcement. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Reinstall the glove box onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION).

(4) Reconnect the battery negative cable.

GRAB HANDLE

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(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 structural support (Fig. 10). Discard the used grab handle mounting nuts.

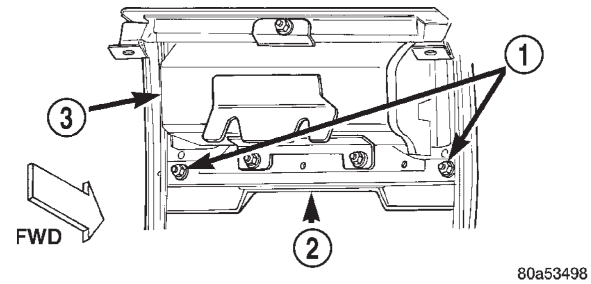

Fig. 10 Grab Handle Remove/Install

1 - NUT (2)
2 - GLOVE BOX OPENING
3 - PASSENGER AIRBAG

(4) Remove the grab handle from the face of the instrument panel.

INSTALLATION

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(1) Position the grab handle onto the face of the instrument panel.

NOTE: Always use new fasteners to install the grab handle. The removed grab handle fasteners should be discarded.

(2) Reach through and above the glove box opening to install and tighten two new nuts to secure the stud on each end of the grab handle to the instrument panel structural support (Fig. 10). Tighten the nuts to 6 N·m (50 in. lbs.).

(3) Reinstall the glove box into the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION).

(4) Reconnect the battery negative cable.

GRAB HANDLE BEZEL

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the grab handle from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GRAB HANDLE - REMOVAL).

(3) Remove the glove box latch striker from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX LATCH STRIKER - REMOVAL).

(4) Remove the two screws that secure the grab handle bezel to the upper glove box opening reinforcement (Fig. 11).

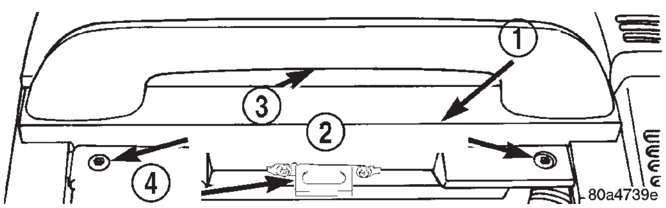

Fig. 11 Grab Handle Bezel Remove/Install

1 - GRAB HANDLE BEZEL
2 - SCREW (2)
3 - GRAB HANDLE
4 - LATCH STRIKER

(5) Remove the grab handle bezel from the instrument panel.

INSTALLATION

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(1) Position the grab handle bezel onto the instrument panel (Fig. 11).

(2) Install and tighten the two screws that secure the grab handle bezel to the upper glove box opening reinforcement. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Reinstall the glove box latch striker onto the glove box opening upper reinforcement (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX LATCH STRIKER - INSTALLATION).

(4) Reinstall the grab handle onto the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/GRAB HANDLE - INSTALLATION).

(5) Reconnect the battery negative cable.

INSTRUMENT PANEL ASSEMBLY

REMOVAL

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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) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

INSTRUMENT PANEL ASSEMBLY (Continued)

(3) Remove the steering column from the vehicle, but do not remove the driver airbag, 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 19 - STEERING/COLUMN - REMOVAL).

(4) From beneath the driver side end of the instrument panel, perform the following:

(a) Disconnect the instrument panel wire harness connectors from the 100-way cross body wire harness connector near the left cowl side inner panel.

(b) Disconnect the driver side window demister hose at the heater-A/C housing demister/defroster duct.

(5) Remove the glove box from the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(6) Reach through the instrument panel glove box opening to perform the following:

(a) Disconnect the heater-A/C control vacuum harness connector from the heater-A/C housing vacuum harness connector.

(b) Disconnect the instrument panel wire harness connector from the heater-A/C housing wire harness connector.

(c) Disconnect the cross body wire harness connector from the passenger airbag pigtail wire connector.

(d) Disconnect the passenger side window demister hose at the heater-A/C housing demister/defroster duct.

(e) Disconnect the two halves of the radio antenna coaxial cable connector.

(f) Remove the two nuts that secure the passenger airbag lower bracket to the studs on the dash panel (Fig. 12).

(7) Remove the top cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/TOP COVER - REMOVAL).

(8) Remove the three screws that secure each end of the instrument panel structural support to the cowl side inner panels at the front of each door opening (Fig. 13).

(9) Remove the four nuts that secure the top of the instrument panel structural support to the studs on the top of the dash panel.

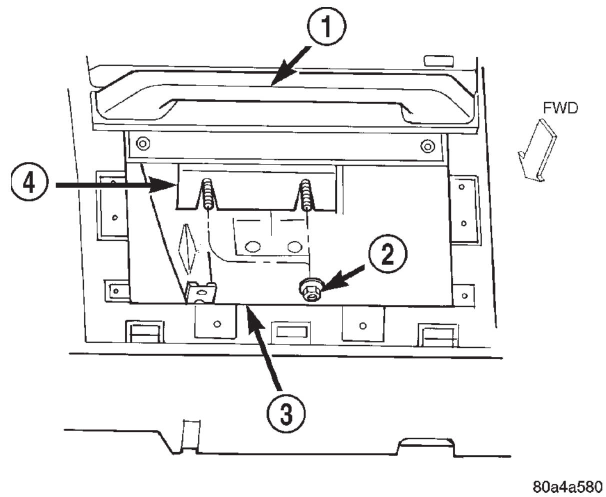

Fig. 12 Passenger Airbag Lower Bracket Nuts Remove/Install

1 - GRAB HANDLE
2 - NUT (2)
3 - GLOVE BOX OPENING
4 - PASSENGER AIRBAG LOWER BRACKET

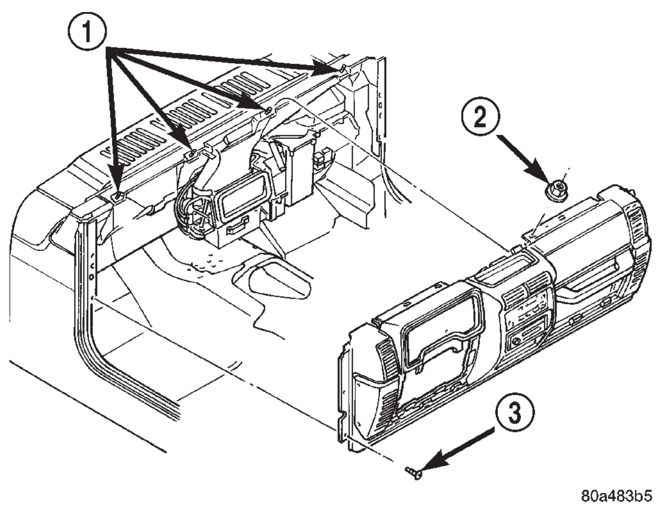

Fig. 13 Instrument Panel Remove/Install

1 - STUD (4)
2 - NUT (4)
3 - SCREW (6)

(10) With the aid of an assistant, lift the instrument panel off of the dash panel studs and remove it from the vehicle.

INSTRUMENT PANEL ASSEMBLY (Continued)

INSTALLATION

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.

(1) With the aid of an assistant, position the instrument panel into the vehicle and onto the dash panel studs (Fig. 13).

(2) Install and tighten the four nuts that secure the top of the instrument panel structural support 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 structural support to the cowl side inner panels at the front of each door opening. Tighten the screws to 12 N·m (105 in. lbs.).

(4) Reinstall the top cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/TOP COVER - INSTALLATION).

(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 airbag bracket to the studs on the dash panel (Fig. 12). Tighten the nuts to 28 N·m (21 ft. lbs.).

(b) Reconnect the two halves of the radio antenna coaxial cable connector.

(c) Reconnect the passenger side window demister hose to the heater-A/C housing demister/defroster duct.

(d) Reconnect the cross body wire harness connector to the passenger airbag pigtail wire connector.

(e) Reconnect the instrument panel wire harness connector to the heater-A/C housing wire harness connector.

(f) Reconnect the heater-A/C control vacuum harness connector to the heater-A/C housing vacuum harness connector.

(6) Reinstall the glove box onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION).

(7) From beneath the driver side of the instrument panel, perform the following:

(a) Reconnect the driver side window demister hose to the heater-A/C housing demister/defroster duct.

(b) Reconnect the instrument panel wire harness connectors to the 100-way cross body wire harness connector near the left cowl side inner panel.

(8) Reinstall 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 19 - STEERING/COLUMN - INSTALLATION).

(9) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(10) Reconnect the battery negative cable.

STEERING COLUMN OPENING COVER

REMOVAL

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.

(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 two screws that secure the steering column opening cover to the instrument panel structural support (Fig. 14).

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the top of the steering column opening cover away from the instrument panel on each side of the steering column far enough to disengage the two snap clip retainers from their receptacles in the instrument panel base trim.

STEERING COLUMN OPENING COVER (Continued)

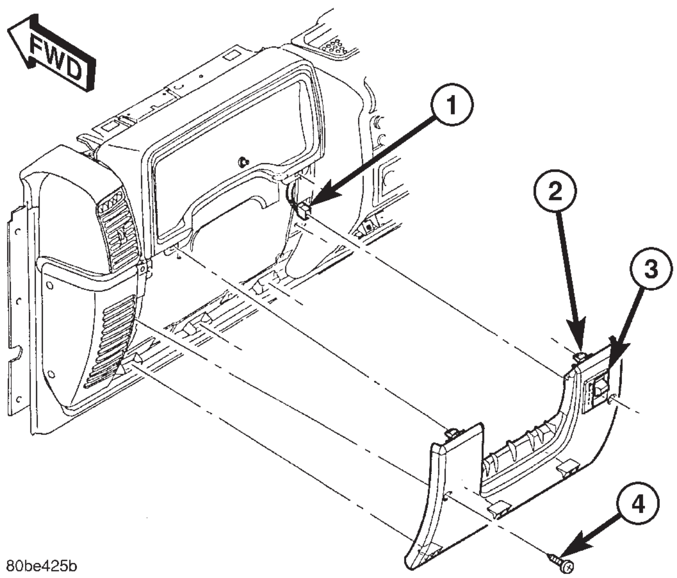

Fig. 14 Steering Column Opening Cover Remove/ Install

1 - WIRE HARNESS CONNECTOR
2 - STEERING COLUMN OPENING COVER
3 - HEADLAMP LEVELING SWITCH
4 - SCREW (2)

(5) If the vehicle is so equipped, roll the top of the steering column opening cover downward far enough to access and disconnect the wire harness connector for the headlamp leveling switch from the switch connector receptacle.

(6) Pull the top of the steering column opening cover rearward far enough 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

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.

(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 (Fig. 14).

(3) If the vehicle is so equipped, roll the top of the steering column opening cover upward far enough to reconnect the wire harness connector for the headlamp leveling switch to the switch connector receptacle.

(4) Tilt the upper edge of the steering column opening cover up and align the two snap clip retainers on the cover with their receptacles in the instrument panel base trim.

(5) Using hand pressure, press firmly on the steering column opening cover over each of the snap clip locations until each of the snap clips is fully engaged in its receptacle in the instrument panel base trim.

(6) Install and tighten the two screws that secure the steering column opening cover to the instrument panel structural support. Tighten the screws to 2 N·m (20 in. lbs.).

(7) Reconnect the battery negative cable.

TOP COVER

REMOVAL

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.

(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 structural support (Fig. 15).

(3) Remove the top cover from the instrument panel.

TOP COVER (Continued)

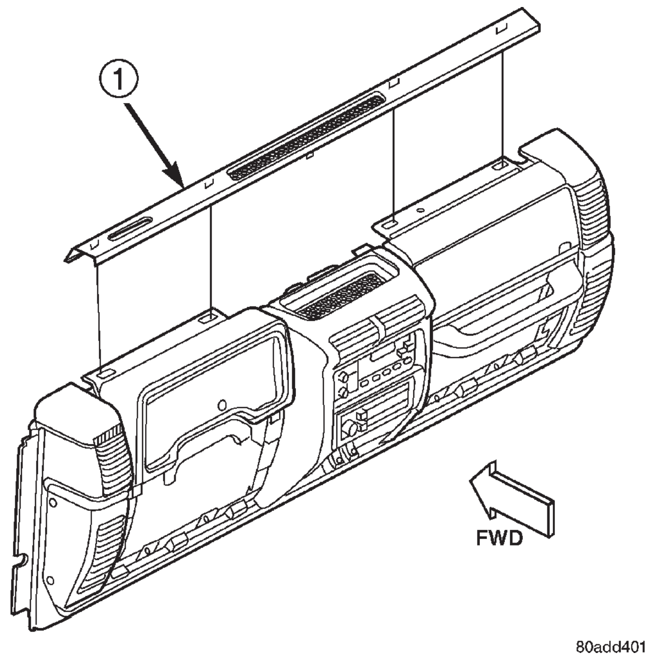

Fig. 15 Top Cover Remove/Install

1 - TOP COVER

INSTALLATION

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.

(1) Position the top cover onto the instrument panel (Fig. 15).

(2) Align the snap clips on the top cover with the snap clip receptacles in the instrument panel structural support.

(3) Using hand pressure, press firmly downward on the top cover over each of the snap clip locations until each of the snap clips is fully seated in its receptacle in the instrument panel structural support.

(4) Reconnect the battery negative cable.

INTERIOR

TABLE OF CONTENTS

ADD-A-TRUNK

REMOVAL

(1) Release latches under trunk panel and lift panel up.

(2) Remove bolts attaching trunk to inner body panel (Fig. 1).

(3) Separate trunk from vehicle.

INSTALLATION

(1) Position the trunk in the cargo space.

(2) Install the bolts.

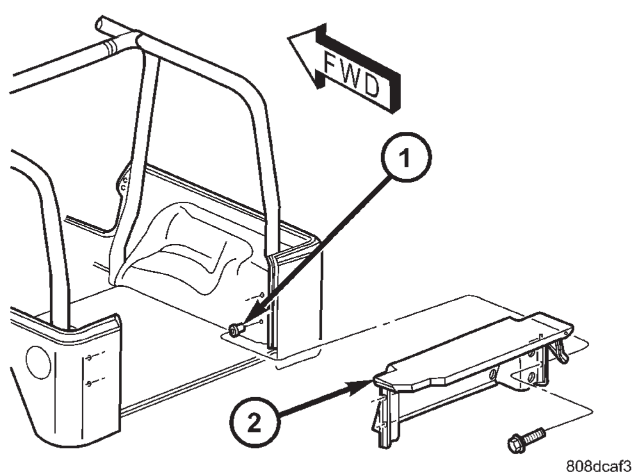

Fig. 1 Add-A-Trunk

1 - SCREW
2 - ADD-A-TRUNK PANEL

FRONT CARPET

REMOVAL

(1) If necessary, remove the center console. (Refer to 23 - BODY/INTERIOR/CENTER CONSOLE - REMOVAL)

(2) Remove the retainers attaching the carpet to the dash panel (Fig. 2).

(3) Disengage the snaps under front seats.

(4) Remove carpet from the vehicle

FRONT CARPET (Continued)

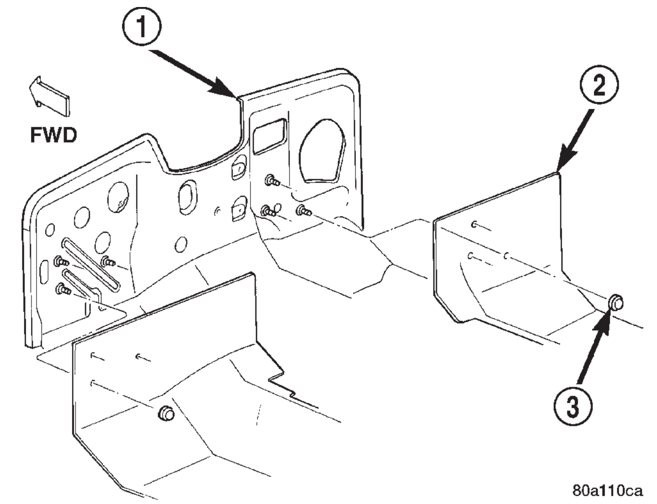

Fig. 2 Front Carpet

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) Install the retainers attaching the carpet to the dash panel.

(4) If previously removed, install the center console. (Refer to 23 - BODY/INTERIOR/CENTER CONSOLE - INSTALLATION)

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.

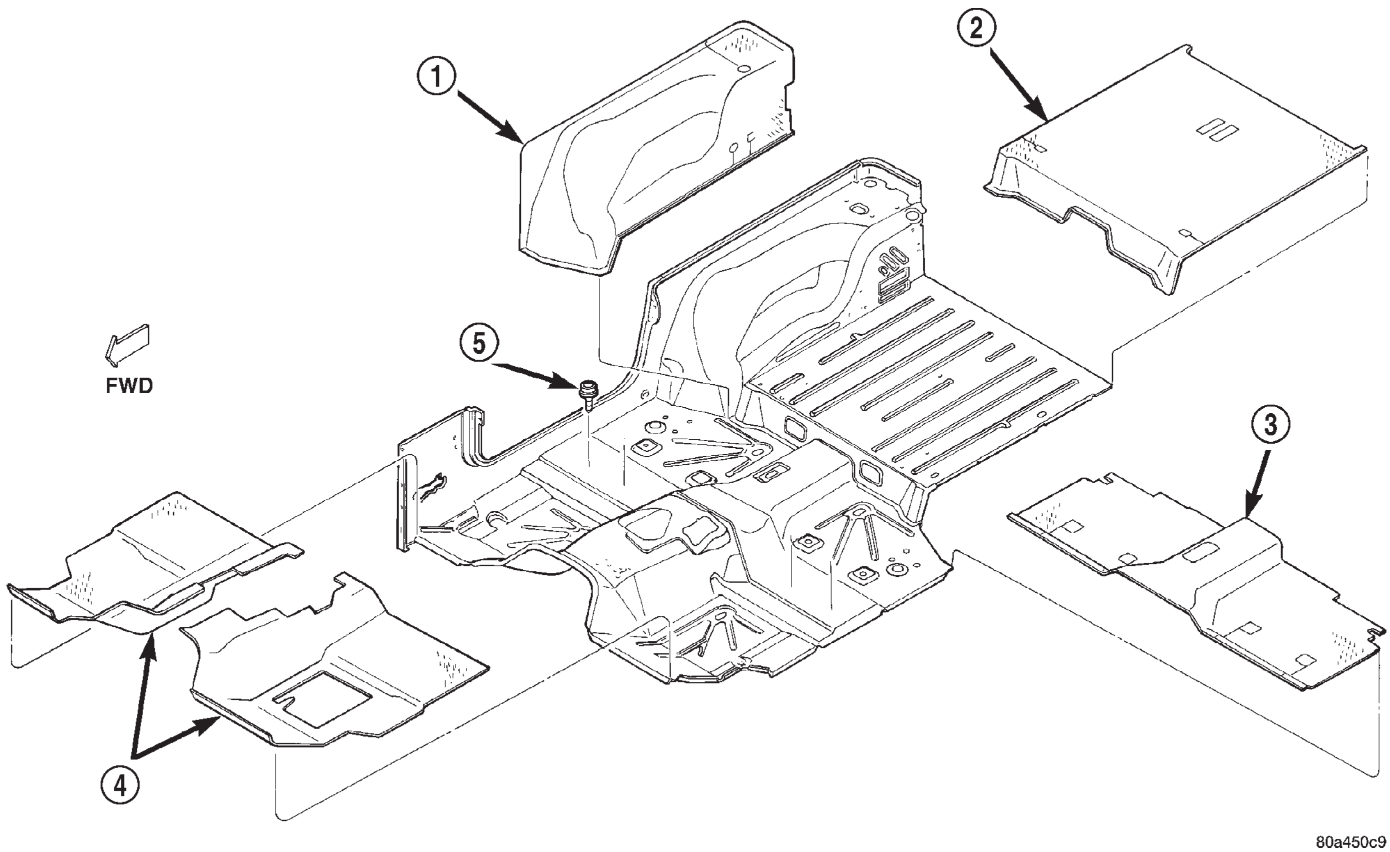

Fig. 3 Vehicle Carpet

1 - WHEEL HOUSE CARPET
2 - CARGO AREA CARPET
3 - CENTER FLOOR CARPET
4 - FRONT FLOOR CARPET
5 - SNAP

CARGO AREA CARPET

REMOVAL

(1) Position the rear seat in the fold and tumbled position.
(2) Pull the carpet from under the rear seat.
(3) Remove the Add-A-Trunk, if equipped. (Refer to 23 - BODY/INTERIOR/ADD-A-TRUNK - REMOVAL)
(4) Route the rear seat belt buckles through the cargo area carpet.
(5) Separate the carpet from the vehicle (Fig. 3).

INSTALLATION

(1) Position the carpet in the vehicle.
(2) Route the rear seat belt buckles through the cargo area carpet.
(3) Install the Add-A-Trunk, if equipped. (Refer to 23 - BODY/INTERIOR/ADD-A-TRUNK - INSTALLATION)
(4) Return the rear seat to the full rearward position.

WHEELHOUSE CARPET

REMOVAL

(1) Position the rear seat in the full forward position.
(2) Remove the Add-A-trunk, if equipped. (Refer to 23 - BODY/INTERIOR/ADD-A-TRUNK - REMOVAL)
(3) Grasp wheelhouse carpet and remove from vehicle (Fig. 3).

INSTALLATION

(1) Position wheelhouse carpet in vehicle and adjust as necessary.
(2) Install the Add-A-trunk, if equipped. (Refer to 23 - BODY/INTERIOR/ADD-A-TRUNK - INSTALLATION)
(3) Return the rear seat to the full rearward position.

REAR VIEW MIRROR

REMOVAL

(1) Loosen the mirror set screw.
(2) Slide the mirror up and off the support button (bracket) (Fig. 4).

INSTALLATION

(1) Slide the mirror onto the support button (bracket).

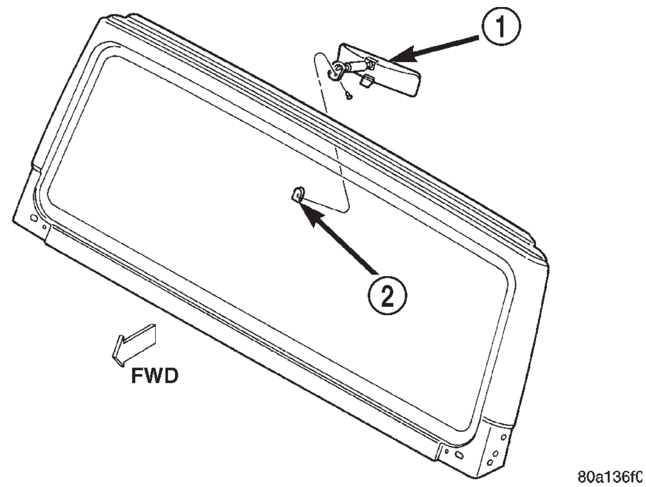

Fig. 4 Rear View Mirror

1 - REAR VIEW MIRROR
2 - SUPPORT BUTTON

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.

REAR VIEW 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.

REAR VIEW MIRROR SUPPORT BRACKET (Continued)

(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. 5).

(2) Remove the sunvisor from the windshield frame

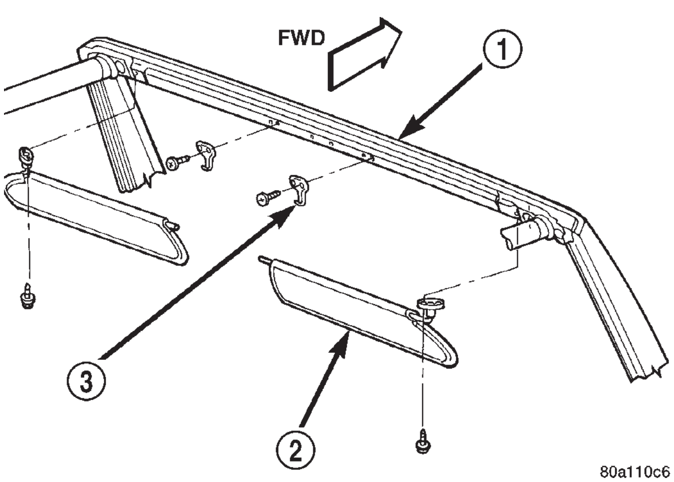

Fig. 5 Sunvisor

1 - WINDSHIELD FRAME
2 - SUNVISOR
3 - SUNVISOR SUPPORT

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.

SHIFT BEZEL - AUTOMATIC TRANSMISSION

REMOVAL

(1) Pull shift lever handle off of shift lever (Fig. 6).

(2) Using a trim stick C-7455 or equivalent, remove the shift bezel.

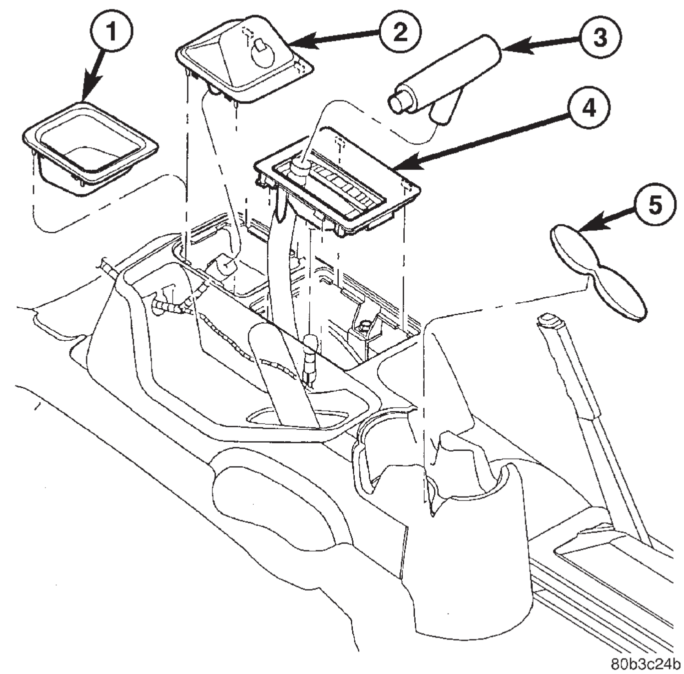

Fig. 6 01 SHIFT BEZEL

1 - SWITCH OPENING COVER
2 - AIR BAG DEACTIVATION SWITCH
3 - TRANSMISSION SHIFT LEVER HANDLE
4 - SHIFT BEZEL
5 - CUP HOLDER MAT

INSTALLATION

(1) Position the shift bezel over the shift lever and install onto the console.

(2) Align the shifter handle keyways and push handle onto the shifter until fully seated.

SHIFT BOOT

REMOVAL

(1) Using a trim stick C-4755 or equivalent, 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. 7).

(4) Remove the knob and slide the shift boot from the shift lever.

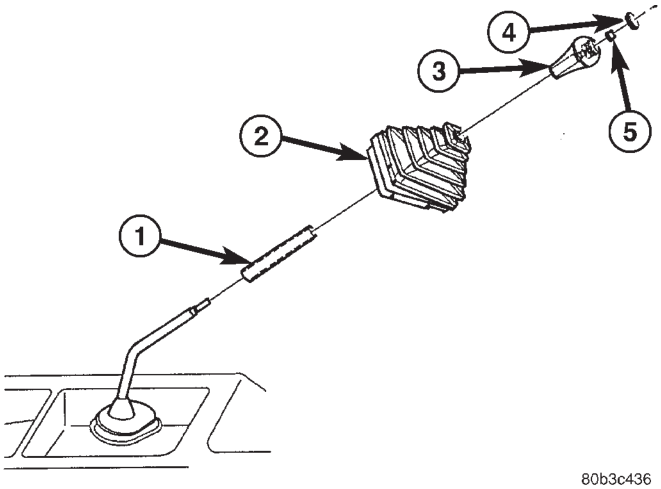

Fig. 7 SHIFT BOOT

1 - BOOT SUPPORT TUBE
2 - SHIFT BOOT
3 - SHIFT KNOB
4 - SHIFT PATTERN CAP
5 - NUT

INSTALLATION

(1) Slide the shift boot over the shift lever.

(2) Snap the shift boot into place in the center console.

(3) Position the shift knob on the lever, install the nut and tighten to 34 N·m (25 ft. lbs.).

(4) Position the shift pattern insert on the knob and press into place.

CENTER CONSOLE

REMOVAL

(1) Remove the cup holder, if equipped. (Refer to 23 - BODY/INTERIOR/CENTER CONSOLE CUPHOLDER ASSEMBLY - REMOVAL)

(2) On full console models remove the trim disc from the bottom of the cup holder (Fig. 10).

(3) Remove the automatic transmission shift bezel, if equipped. (Refer to 23 - BODY/INTERIOR/SHIFT BEZEL - REMOVAL)

(4) Using a trim stick C-7455 or equivalent, remove the air bag deactivation switch and disconnect the electrical connector, if equipped (Fig. 6).

(5) Remove the bolt(s) attaching the console to the floor pan (Fig. 8) and (Fig. 9).

(6) Shift transfer case to four low position.

(7) Shift transmission to L (2nd gear for manual transmission) and remove the console assembly.

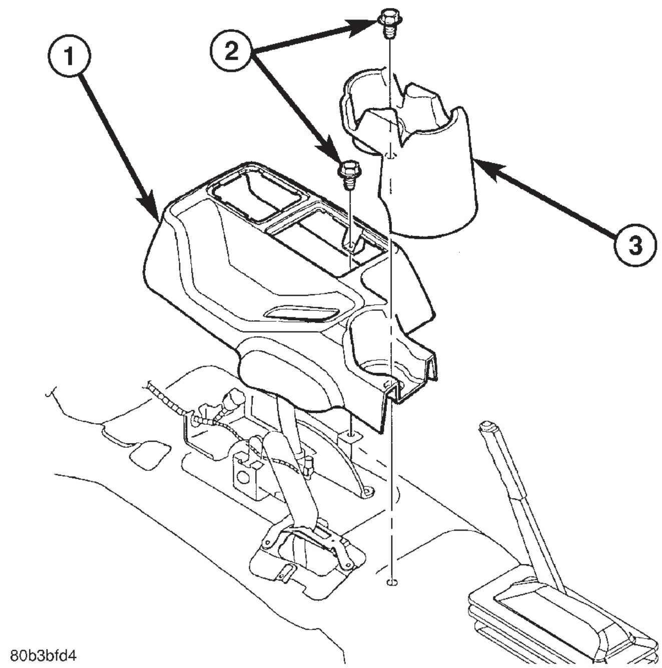

Fig. 8 MINI CONSOLE

1 - MINI CONSOLE
2 - BOLTS
3 - CUPHOLDER

INSTALLATION

(1) Connect the electrical connector and install console tower assembly over the park brake lever, if equipped.

(2) Install the tower bolts.

(3) Install the mini console assembly over the transmission and transfer case shifters.

(4) Install the console bolts.

(5) Connect the air bag deactivation switch electrical connector and install the switch, if equipped.

(6) Connect the air bag deactivation switch electrical connector and install the switch, if equipped.

(7) Install the auto transmission shift bezel, if equipped. (Refer to 23 - BODY/INTERIOR/SHIFT BEZEL - INSTALLATION)

(8) Install the manual transmission shift boot, if equipped. (Refer to 23 - BODY/INTERIOR/SHIFT BOOT - INSTALLATION)

CENTER CONSOLE (Continued)

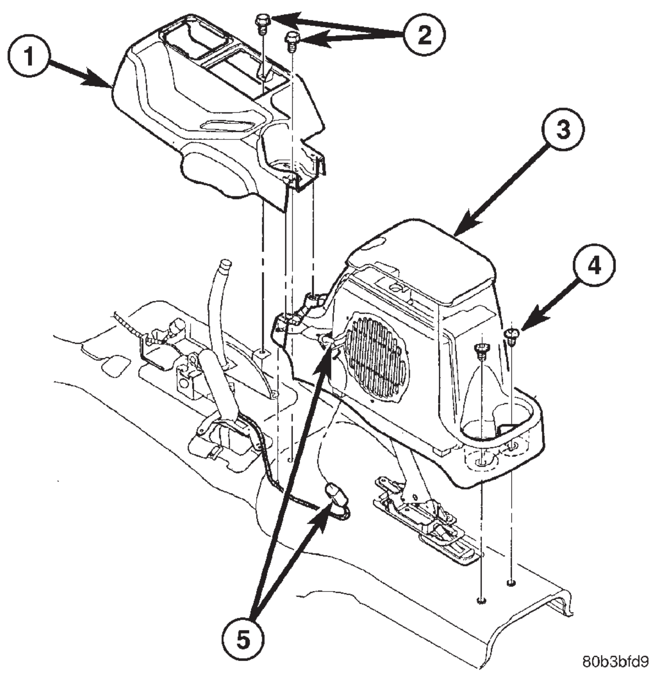

Fig. 9 FULL CONSOLE

1 - FRONT CONSOLE
2 - BOLTS
3 - REAR TOWER
4 - ELECTRICAL CONNECTOR

(9) Install the cup holder and trim disc, if equipped. (Refer to 23 - BODY/INTERIOR/CENTER CONSOLE CUPHOLDER ASSEMBLY - INSTALLATION)

CENTER CONSOLE CUP HOLDER

REMOVAL

(1) Using a trim stick C-4755 or equivalent, remove the cup holder insert (Fig. 10) and (Fig. 6).

(2) On mini console equipped models remove the bolt and remove the cup holder (Fig. 8).

INSTALLATION

(1) On mini console equipped models install the cup holder and install the bolt.

(2) Tighten the bolt to 4 N·m (35 in lbs.).

(3) Install the cup holder insert.

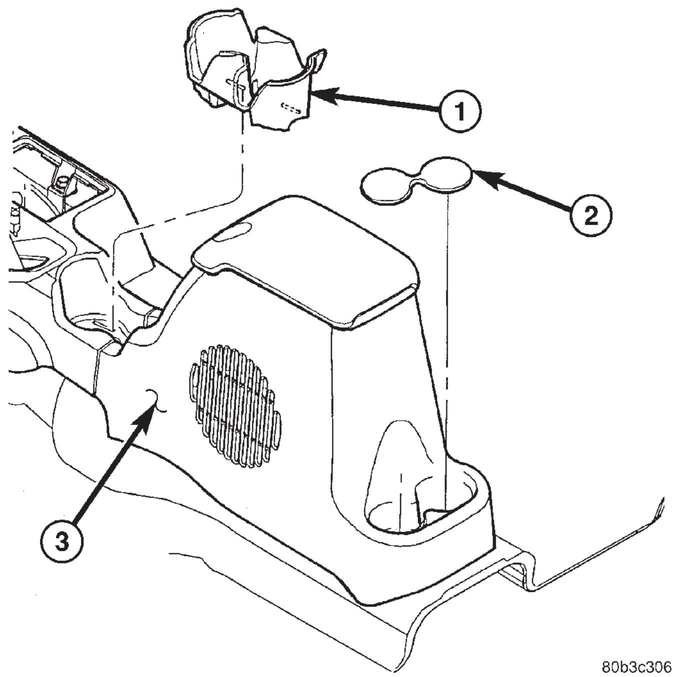

Fig. 10 FULL CONSOLE CUP HOLDER

1 - FULL CONSOLE CUP HOLDER
2 - TRIM PIECE
3 - CONSOLE TOWER

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. 11).

(3) Remove the lock cylinder from the console cover.

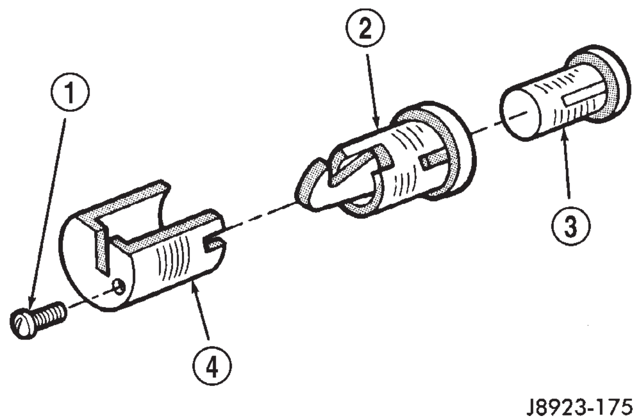

Fig. 11 Console Lock Cylinder

1 - ATTACHING SCREW
2 - LOCK
3 - LOCK CYLINDER
4 - RETAINER

CONSOLE LOCK CYLINDER (Continued)

INSTALLATION

(1) Insert the assembled lock in the console cover hole and position the retainer on the lock and install the screw.

SPORT BAR

REMOVAL

(1) Remove hard top and/or soft top. (Refer to 23 - BODY/REMOVEABLE TOP/HARD TOP - REMOVAL) or (Refer to 23 - BODY/REMOVEABLE TOP/SOFT TOP - REMOVAL).
(2) Remove the door opening frames. (Refer to 23 - BODY/INTERIOR/DOOR OPENING FRAME - REMOVAL)
(3) Remove the sunvisors. (Refer to 23 - BODY/INTERIOR/SUN VISOR - REMOVAL)
(4) Remove the A-pillar weatherstrips strips (Fig. 12).
(5) Disengage center support bar cover zipper.
(6) Remove the bolts attaching the side support bars to the center support bar (Fig. 13).
(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 8 - ELECTRICAL/AUDIO/SPEAKER - REMOVAL)
(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.

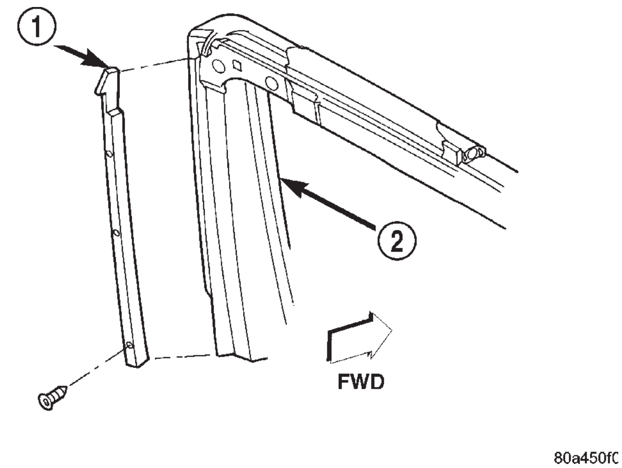

Fig. 12 A-Pillar Weatherstrip

1 - A-PILLAR WEATHERSTRIP
2 - WINDSHIELD FRAME

INSTALLATION

(1) If necessary, transfer all attached components.
(2) Clean the base plate contact surface areas on the floor and wheelhouse panels.
(3) Apply epoxy chromate primer to the attaching hole edges for protection against corrosion.
(4) Position the sport bar base plates on the floor and wheelhouse panels with the holes aligned.

NOTE: To prevent water seepage, apply 3M Drip-Chek Sealant (or an equivalent product) to the underside of the sport bar base flanges and all the bolt heads before installation.

(5) Connect sound bar. (Refer to 8 - ELECTRICAL/AUDIO/SPEAKER - INSTALLATION)
(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.

SPORT BAR (Continued)

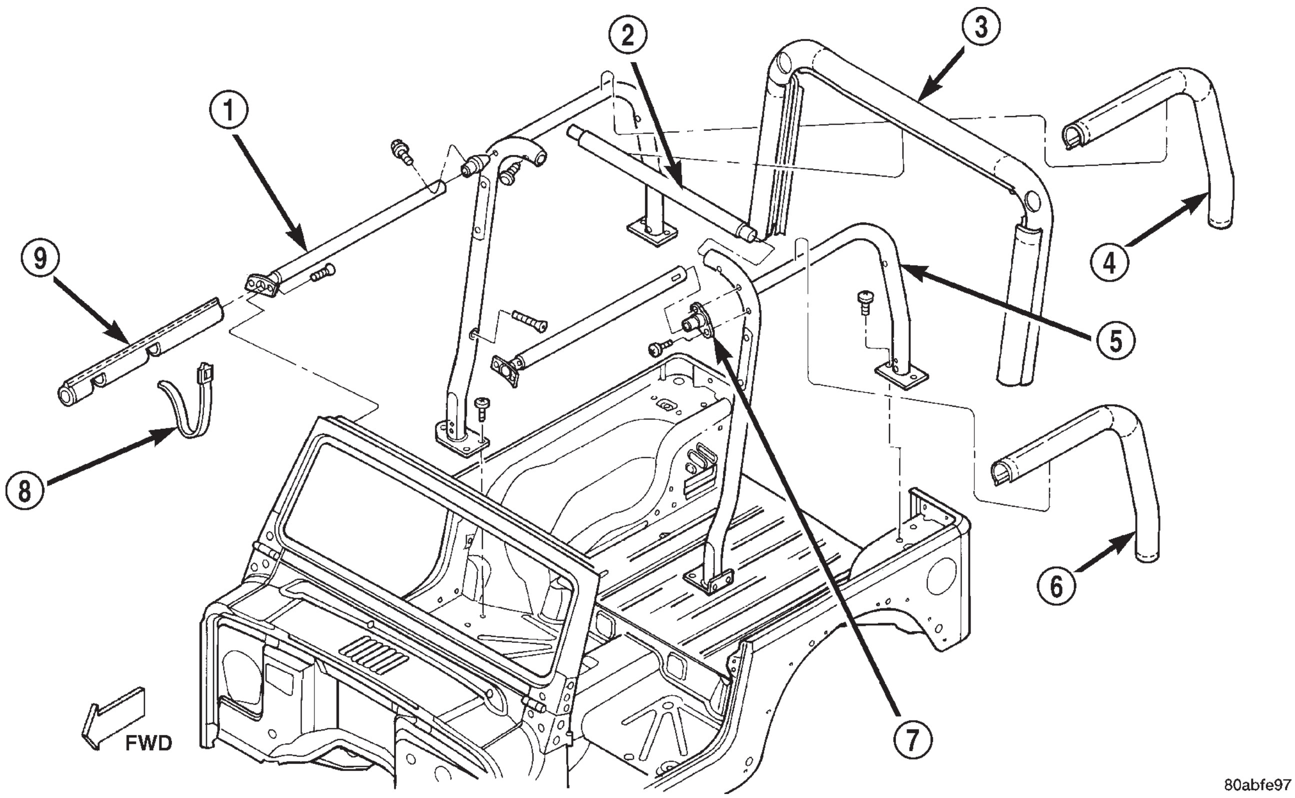

Fig. 13 Sport Bar

1 - SIDE SUPPORT BAR
2 - CENTER SUPPORT BAR
3 - COVER
4 - COVER
5 - DIRECTIONAL CROSS BAR
6 - COVER
7 - BRACKET
8 - STRAP
9 - COVER

(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 sun visors(Refer to 23 - BODY/INTERIOR/SUN VISOR - INSTALLATION)

(15) Install the door opening frames. (Refer to 23 - BODY/INTERIOR/DOOR OPENING FRAME - INSTALLATION)

(16) Install hard top and/or soft top. (Refer to 23 - BODY/REMOVEABLE TOP/HARD TOP - INSTALLATION) or (Refer to 23 - BODY/REMOVEABLE TOP/SOFT TOP - INSTALLATION).

PAINT

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PAINT

SPECIFICATIONS - PAINT CODES

EXTERIOR COLORS

EXTERIOR COLOR	DAIMLERCHRYSLER CODE
Amber Fire Pearlcoat	XV3
Flame Red Clearcoat	PR4
Solar Yellow Clearcoat	VYH
Patriot Blue Pearlcoat	WBT
Stone White	SW1
Sienna Pearlcoat	WU7
Shale Green Clearcoat	XGR
Steel Blue Pearlcoat	XBQ
Silverstone Pearlcoat	XS5
Black Clearcoat	DX8

INTERIOR COLORS

INTERIOR COLOR	DAIMLERCHRYSLER CODE
Agate	AZ
Camel/Dark Green	KG
Camel	K5

EXTERIOR HARD AND SOFT TOP COLORS

EXTERIOR HARD TOP COLORS	DAIMLERCHRYSLER CODE
Black	HCX
Dark Tan	VK9

PAINT CODE

DESCRIPTION

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

DESCRIPTION

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.

PAINT TOUCH-UP

STANDARD PROCEDURE - PAINT TOUCH-UP

When a painted metal surface has been scratched or chipped, it should be touched-up as soon as possible to avoid corrosion. For best results, use Mopar® Scratch Filler/Primer, Touch-Up Paints and Clear Top Coat. Refer to Introduction group of this manual for Body Code Plate information.

WARNING: USE AN OSHA APPROVED BREATHING FILTER WHEN SPRAYING PAINT OR SOLVENTS IN A CONFINED AREA. PERSONAL INJURY CAN RESULT.

(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.

PAINT TOUCH-UP (Continued)

(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. AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL – BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT.

FINESSE SANDING, BUFFING & POLISHING

STANDARD PROCEDURE - FINESSE SANDING, BUFFING & 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.

REMOVEABLE TOP

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REMOVEABLE TOP

STANDARD PROCEDURE

STANDARD PROCEDURE - HARD TOP HOLE REPAIR

The hard top fiberglass material can be repaired. The required repair materials include:

(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.

STANDARD PROCEDURE - HARD TOP FRACTURE REPAIR

The hard top fiberglass material can be repaired. The required repair materials include:

(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.

HARD TOP AIR EXHAUSTER

DESCRIPTION

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 or equivalent 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.

HARD TOP

REMOVAL

(1) Disengage latches at windshield frame (Fig. 1).

(2) Remove the bolts that attach the hard top to the body (Fig. 2).

(3) Depress tab on rear wiper motor connector and pull downward to disengage (Fig. 3).

(4) Disconnect the rear washer fluid hose. Cap the hose to prevent washer fluid leakage (Fig. 4).

(5) Remove the hard top from the vehicle.

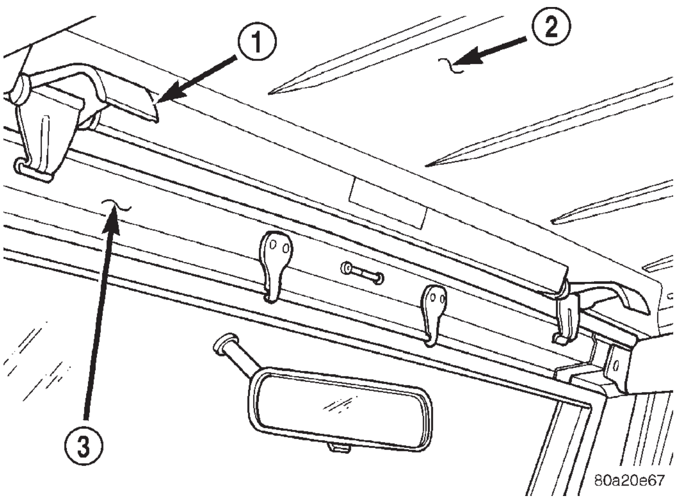

Fig. 1 Hard Top Latch

1 - LATCH
2 - HARD TOP
3 - WINDSHIELD FRAME

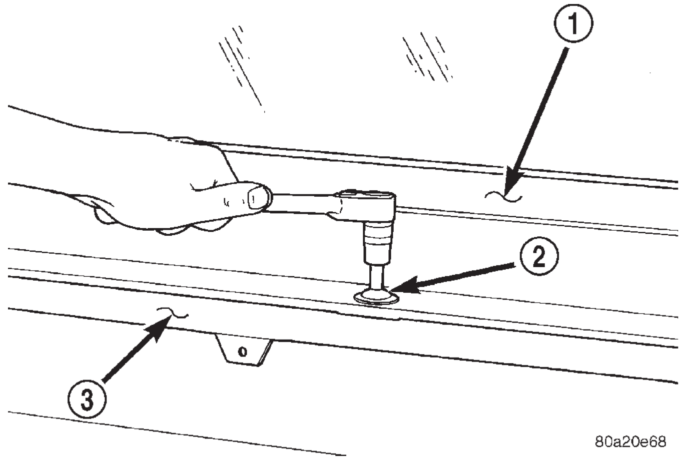

Fig. 2 Hard Top Removal

1 - HARD TOP
2 - HOLD DOWN BOLT
3 - BODY RAIL

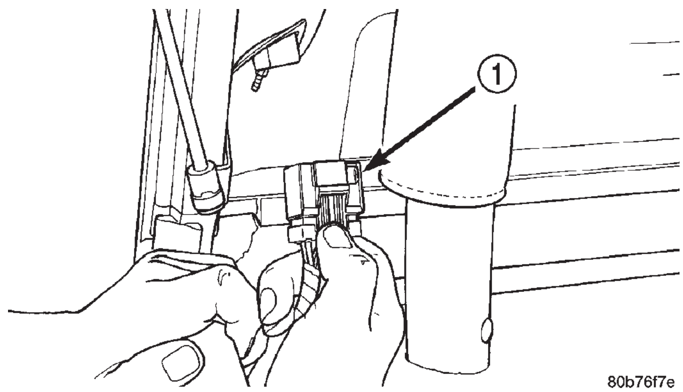

Fig. 3 Rear Wiper Wire Harness Connector

1 - WIPER MOTOR CONNECTOR

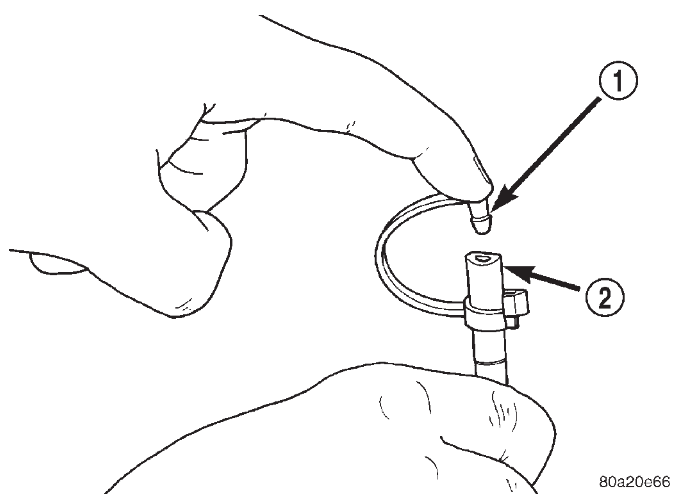

Fig. 4 Rear Washer Fluid Tube

1 - WASHER HOSE CAP
2 - REAR WASHER SUPPLY HOSE - BODY HALF

HARD TOP (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.

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. 5).

(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 drip rail 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. 6).

(9) Lift up bows at pivot bracket to disengage from pivot bracket.

(10) Remove the top (Fig. 7).

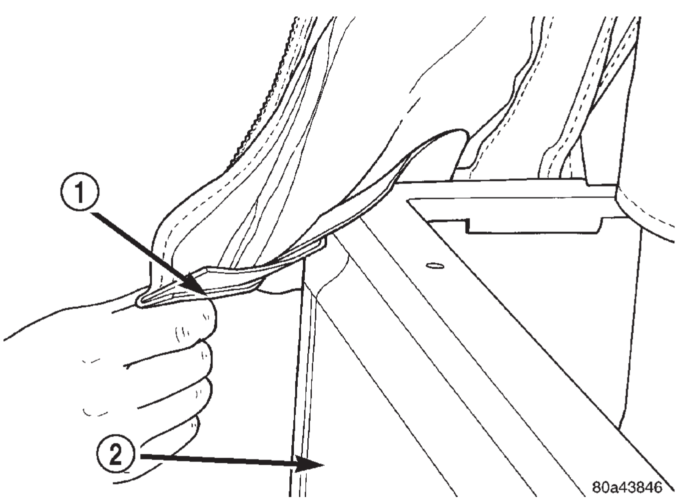

Fig. 5 Soft Top J-Straps

1 - SOFT TOP CORNER J-STRAP
2 - QUARTER PANEL

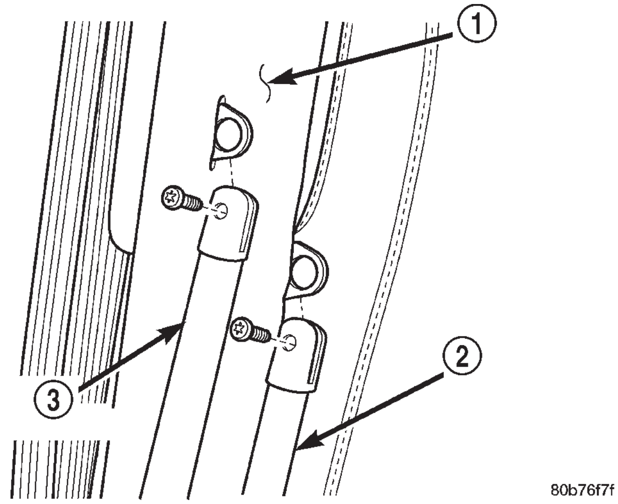

Fig. 6 Roof Bow Removal

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 drip rail retainers above door opening frame.

(9) Working from front to rear, engage J-straps at soft top rear corners.

(10) Engage the retainers attaching the rear window to the body.

(11) Close latch at windshield frame.

SOFT TOP (Continued)

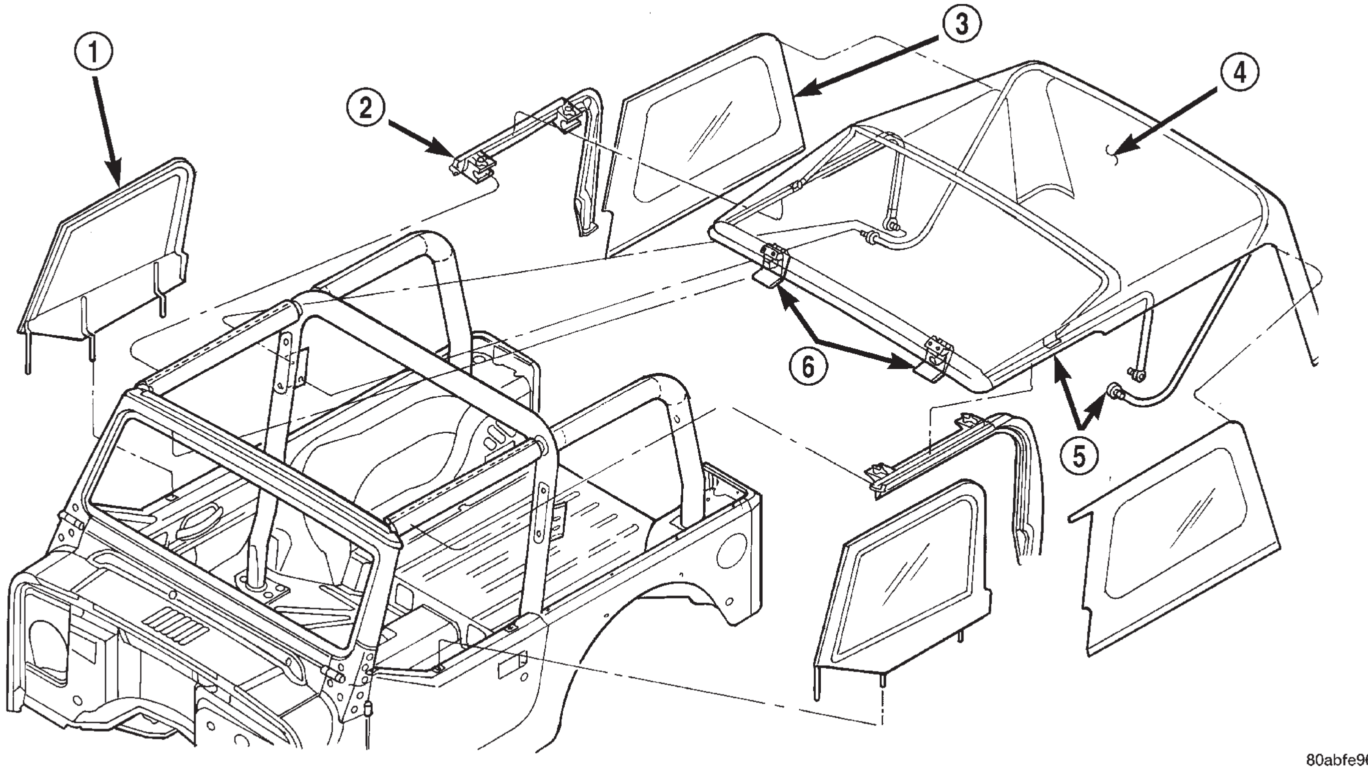

Fig. 7 Soft Top

1 - HALF DOOR WINDOW
2 - DOOR OPENING FRAME
3 - QUARTER WINDOW
4 - SOFT TOP
5 - ROOF BOW
6 - LATCH REINFORCEMENT

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.

DOOR OPENING FRAME

REMOVAL

Vehicles equipped with a soft top require a door opening frame to complete the seal for the soft top door assembly.

(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. 8).

(3) Pull door opening frame outward and up. Separate from vehicle.

INSTALLATION

Vehicles equipped with a soft top require a door opening frame to complete the seal for the soft top door assembly.

(1) Install the alignment pin at the base of the door opening frame into the hole at the top of the quarter panel.

DOOR OPENING FRAME (Continued)

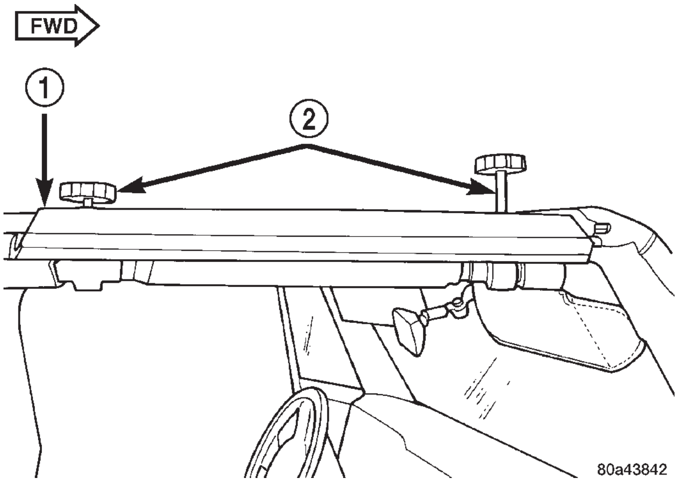

Fig. 8 Door Opening Frame

1 - DOOR OPENING FRAME
2 - KNOBS

(2) Position the door opening frame on the side support bar and install the knobs.
(3) Raise and secure the top.

HARD/SOFT TOP LATCH

REMOVAL

(1) Unlatch the top (Fig. 9).
(2) Using a wax pencil, mark the position of the latch on the top.
(3) Remove the screws attaching the latch to the top.

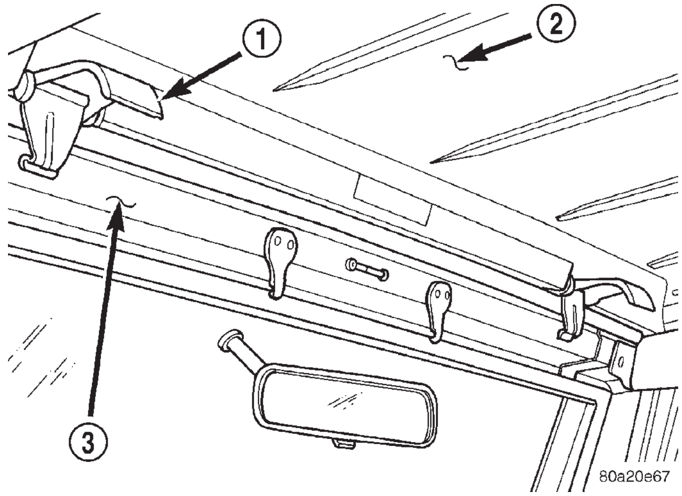

Fig. 9 Hard/Soft Top Latch

1 - LATCH
2 - HARD TOP
3 - WINDSHIELD FRAME

INSTALLATION

(1) Position the latch on the top and install the screws.

SEATS

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RECLINER RELEASE CABLE

REMOVAL

(1) Remove seat back cover. (Refer to 23 - BODY/SEATS/FRONT SEAT BACK COVER - REMOVAL)
(2) Disengage seat track release cable from bottom of cushion and pivot bracket.
(3) Disengage cable from recliner release.
(4) Route cable through seat back pad.
(5) 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) Engage seat track release cable to bottom of cushion and pivot bracket.
(5) Install seat back cover. (Refer to 23 - BODY/SEATS/FRONT SEAT BACK COVER - INSTALLATION)

FRONT SEAT

REMOVAL

(1) Disengage seat belt electrical connector (Fig. 1).
(2) Remove the bolts attaching the seat adjuster to the floor panel (Fig. 2).
(3) Remove the seat from the vehicle.

INSTALLATION

(1) Position the seat in the vehicle.

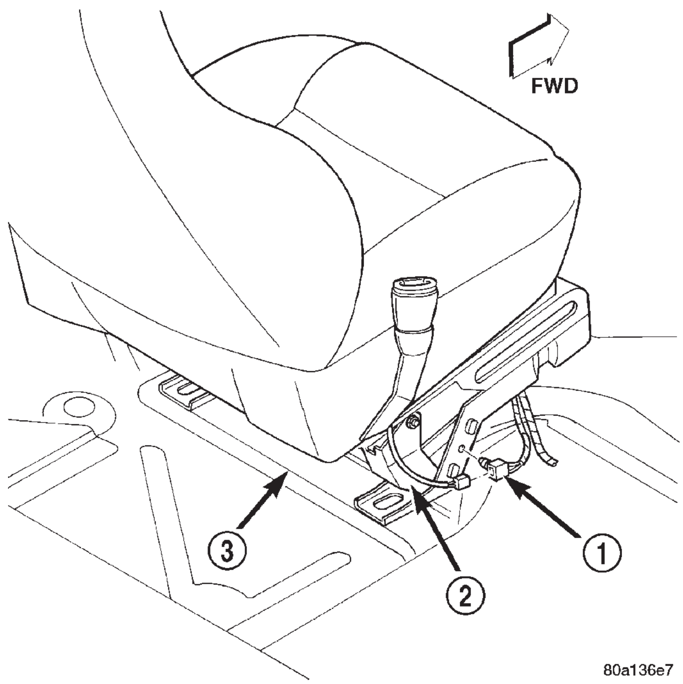

Fig. 1 Bucket Seat

1 - CONNECTOR
2 - SEAT
3 - BODY

(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.

FRONT SEAT (Continued)

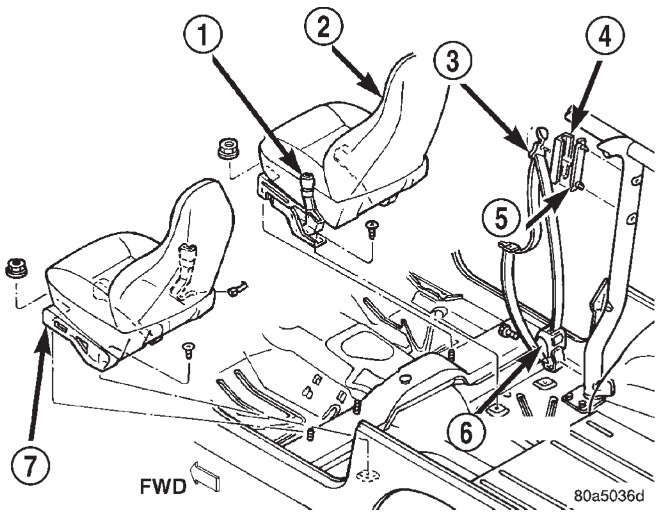

Fig. 2 Bucket Seat Removal

1 - BUCKLE
2 - SEAT
3 - TURNING LOOP
4 - COVER
5 - ADJUSTER
6 - RETRACTOR
7 - MOUNTING BRACKET

(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.

FRONT SEAT BACK

REMOVAL

(1) Remove seat. (Refer to 23 - BODY/SEATS/FRONT SEAT - REMOVAL)

(2) Remove the inboard seatback pivot bolt.

(3) Disengage the retainers attaching the cushion cover to the outboard seat cushion frame (Fig. 3).

(4) Disengage the seat cushion corner cover zipper.

(5) Remove the bolts attaching the recliner to the seat cushion frame (Fig. 4).

(6) Passenger seat and driver dumping seat:

(a) Disengage seat track release cable from back inboard U-nut (Fig. 4).

(7) Route the recliner handle through the seat cushion cover and separate the seatback from the seat cushion.

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

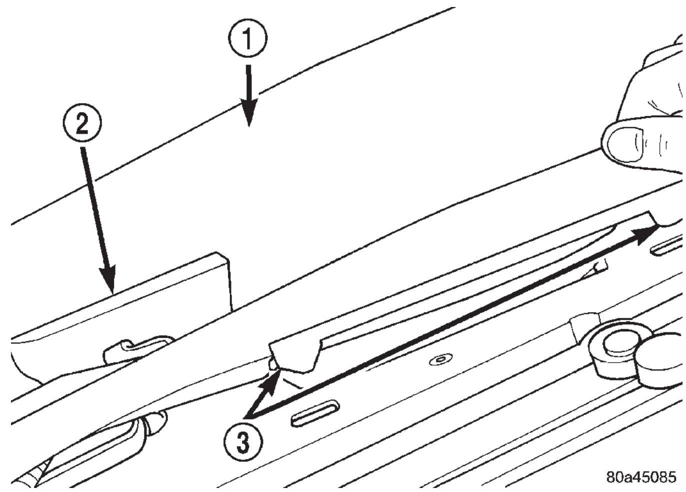

Fig. 3 Cushion Cover Retainers

1 - CUSHION COVER
2 - RECLINER HANDLE
3 - RETAINER

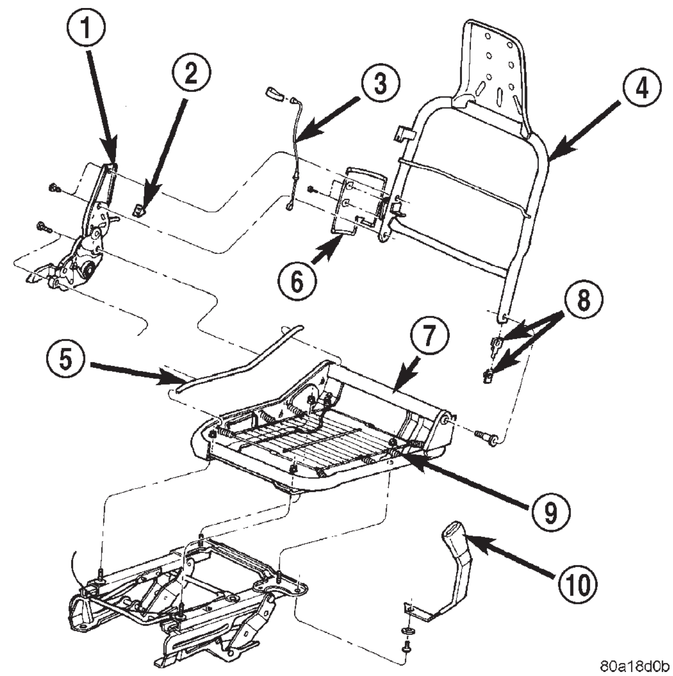

Fig. 4 Passenger Seat

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

(3) Install the bolts attaching the recliner to the seat cushion frame.

FRONT SEAT BACK (Continued)

(4) Engage the seat cushion corner cover zipper.

(5) Engage the retainers attaching the cushion cover to the outboard seat cushion frame.

(6) Install the inboard seatback pivot bolt.

(7) Install seat. (Refer to 23 - BODY/SEATS/ FRONT SEAT - INSTALLATION)

FRONT SEAT BACK COVER

REMOVAL

(1) Remove seat back. (Refer to 23 - BODY/SEATS/ SEAT BACK - REMOVAL)

(2) Disengage zipper at seatback base.

(3) Roll cover upward and over tilt release lever.

(4) Continue to roll cover upward and disengage hook and loop fastener (Fig. 5).

(5) Passenger seat and driver dumping seat:

(a) Route recliner release cable/strap through cover.

(6) Separate cover from seatback.

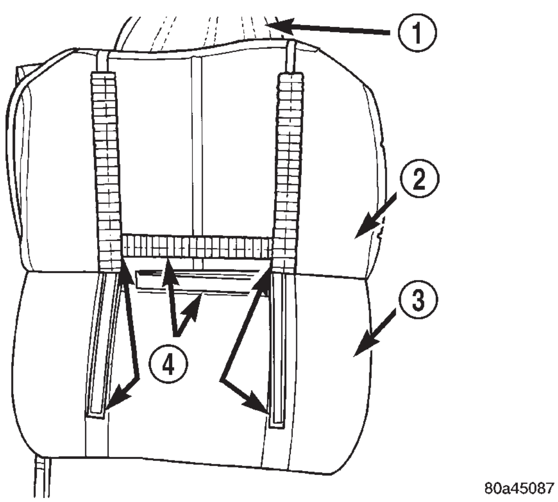

Fig. 5 Seat Back Cover

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 seat back. (Refer to 23 - BODY/SEATS/ FRONT SEAT BACK - INSTALLATION)

FRONT SEAT CUSHION COVER

REMOVAL

(1) Remove seat back. (Refer to 23 - BODY/SEATS/ FRONT SEAT BACK - REMOVAL)

(2) Disengage inboard J-strap.

(3) Disengage front J-strap.

(4) Roll cover up to access hog rings.

(5) Disengage inboard, outboard and front hog rings.

(6) From the underside of the cushion, disengage the rear hog rings (Fig. 6).

(7) Separate cover from cushion.

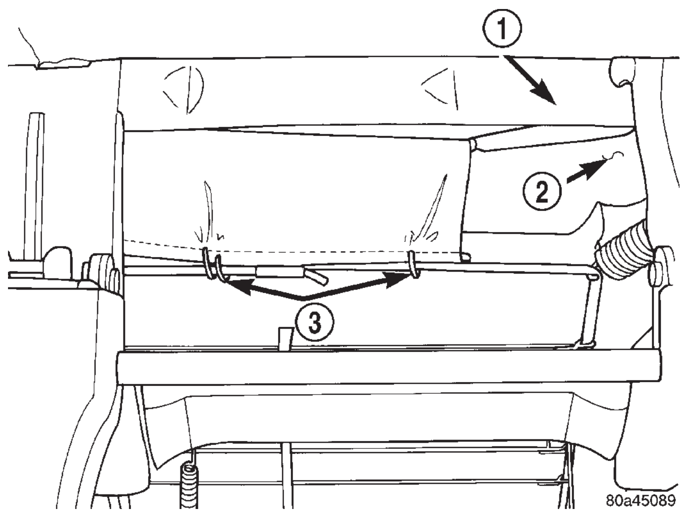

Fig. 6 Rear Hog Rings

1 - SEAT CUSHION FRAME
2 - SEAT CUSHION
3 - HOG RINGS

INSTALLATION

(1) Position cover on cushion and align seams.

(2) From the underside of the cushion, engage the rear hog rings.

(3) Engage inboard, outboard and front hog rings.

(4) Roll cover over cushion edges.

(5) Engage inboard J-strap.

(6) Engage front J-strap.

(7) Install seat back. (Refer to 23 - BODY/SEATS/ FRONT SEAT BACK - INSTALLATION)

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. 7).

(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.

REAR SEAT BACK

REMOVAL

(1) Remove rear seat. (Refer to 23 - BODY/SEATS/REAR SEAT - REMOVAL)

(2) Remove torx bolts attaching seatback to seat cushion (Fig. 8).

(3) Separate the seat back from the seat cushion.

INSTALLATION

(1) Position the seat back on the seat cushion.

(2) Install the torx bolts attaching seatback to seat cushion.

(3) Install rear seat. (Refer to 23 - BODY/SEATS/REAR SEAT - INSTALLATION)

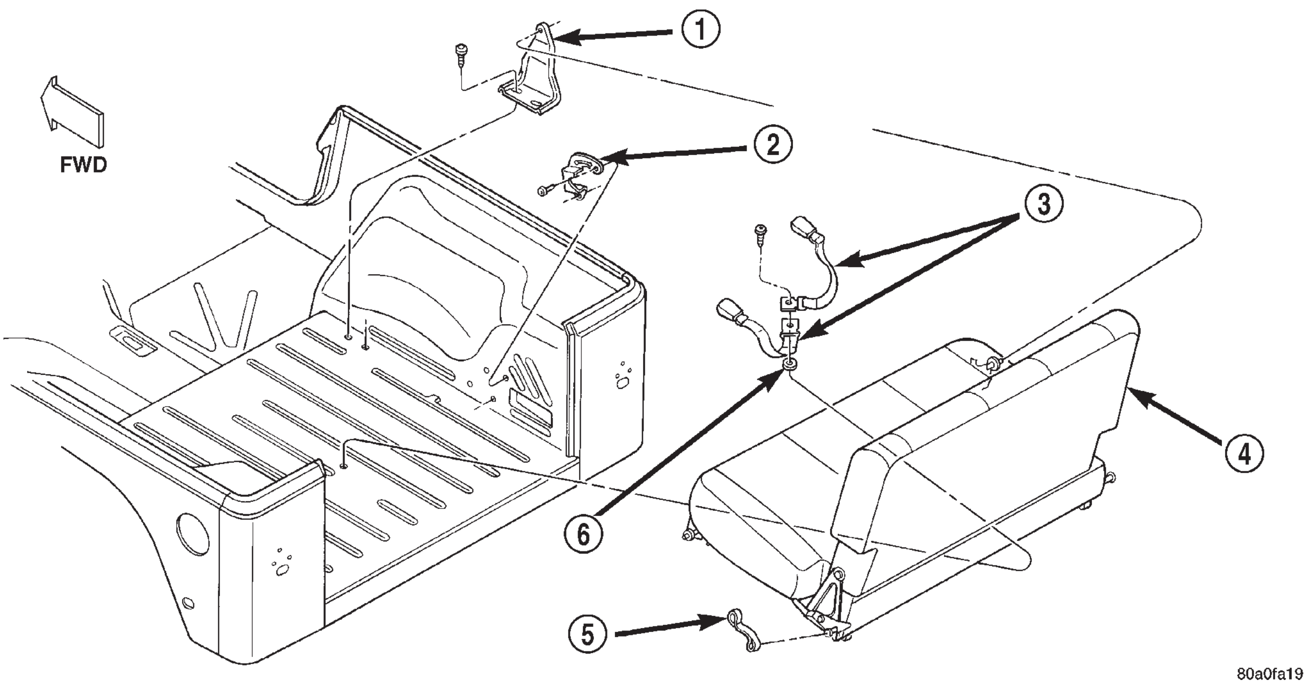

Fig. 7 Rear Seat

1 - PIVOT BRACKET
2 - SEAT LATCH STRIKER
3 - REAR BUCKLE
4 - REAR SEAT
5 - STRAP
6 - WASHER

REAR SEAT BACK (Continued)

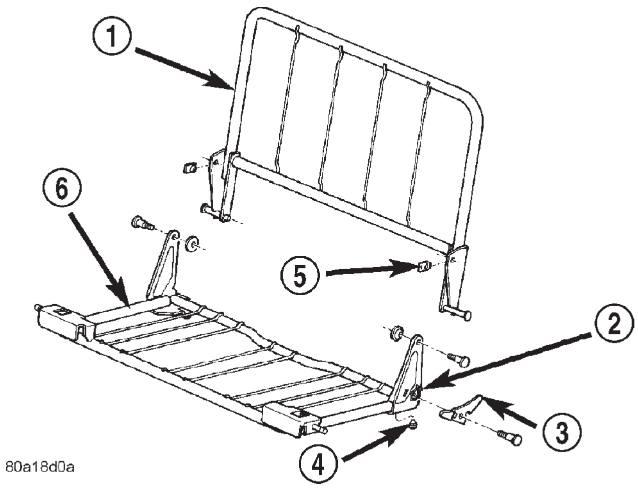

Fig. 8 Rear Seat Components

1 - SEAT BACK FRAME
2 - SPRING
3 - SEAT BACK RELEASE LEVER
4 - BUMPER
5 - U-NUT
6 - SEAT CUSHION FRAME

REAR SEAT BACK COVER

REMOVAL

(1) Remove the rear seat back. (Refer to 23 - BODY/SEATS/REAR SEAT BACK - REMOVAL)

(2) Disengage the hook and loop fasteners at the seatback lower corners (Fig. 9).

(3) Disengage the seat back cover zipper.

(4) Roll the seat back cover upward and disengage the hook and loop fasteners.

INSTALLATION

(1) Position the cover on the seatback cushion.

(2) Roll the seatback cover downward over the cushion.

(3) Engage the seatback cover zipper.

(4) Engage the hook and loop fasteners at the seat-back lower corners.

(5) Install the rear seat back. (Refer to 23 - BODY/SEATS/REAR SEAT BACK - INSTALLATION)

REAR SEAT CUSHION COVER

REMOVAL

(1) Remove the rear seat back. (Refer to 23 - BODY/SEATS/REAR SEAT BACK - REMOVAL)

(2) Disengage the J-straps at the rear cushion corners.

(3) Disengage the seat cushion cover zipper.

(4) Roll the cover from seat cushion and disengage the hook and loop fasteners (Fig. 10).

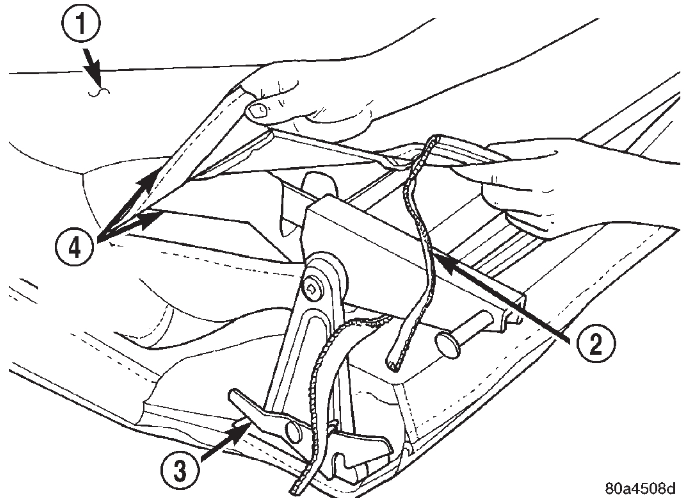

Fig. 9 Seat Back Cover

1 - SEAT BACK
2 - ZIPPER
3 - REAR SEAT RELEASE LEVER
4 - HOOK AND LOOP FASTENER

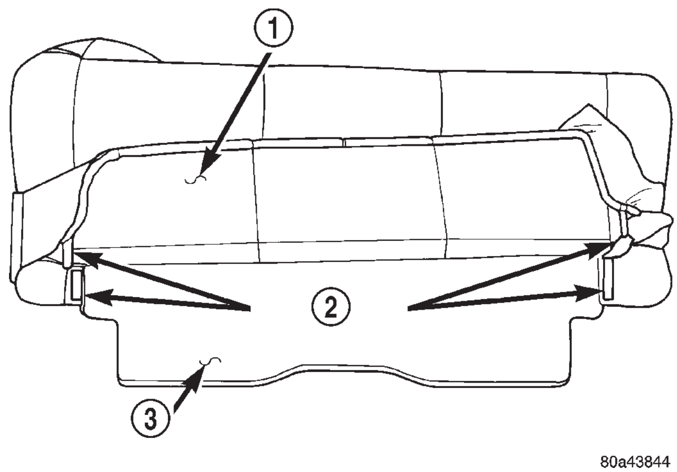

Fig. 10 Hook And Loop Fasteners

1 - REAR SEAT CUSHION COVER
2 - HOOK AND LOOP FASTENER
3 - REAR SEAT CUSHION

INSTALLATION

(1) Position the cover on the cushion and roll cover downward over the corners.

(2) Engage the seat cushion cover zipper.

(3) Engage the J-straps at the rear cushion corners.

(4) Install the rear seat back. (Refer to 23 - BODY/SEATS/REAR SEAT BACK - INSTALLATION)

STATIONARY GLASS

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STATIONARY GLASS

DESCRIPTION

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.

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.

QUARTER GLASS (Continued)

(4) Using a cold knife, cut the urethane around the perimeter of the quarter glass.

(5) Remove the quarter glass from the opening (Fig. 1) .

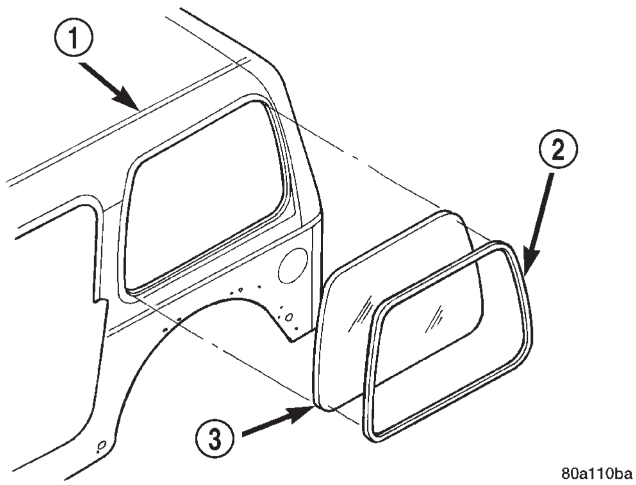

Fig. 1 Hard Top Quarter Glass

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.

(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.

WINDSHIELD

REMOVAL

The windshield is positioned in the reveal molding and is bonded to the windshield frame with urethane adhesive. The windshield interior trim molding is positioned onto the inner windshield frame pinchweld.

(1) Cover body surface areas with protective covering to avoid paint damage and extra clean-up time.

(2) Remove the windshield wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - REMOVAL)

(3) Remove the rear view mirror. (Refer to 23 - BODY/INTERIOR/REAR VIEW MIRROR - REMOVAL)

(4) Using a razor knife, slide the blade between the windshield glass and the inboard edge of the reveal molding.

(5) Cut around the interior perimeter of the reveal molding and sever the cap of the reveal molding.

WINDSHIELD (Continued)

(6) Using a cold knife, cut the urethane around the perimeter of the windshield (Fig. 2).

(7) Remove the windshield glass from the frame (Fig. 3).

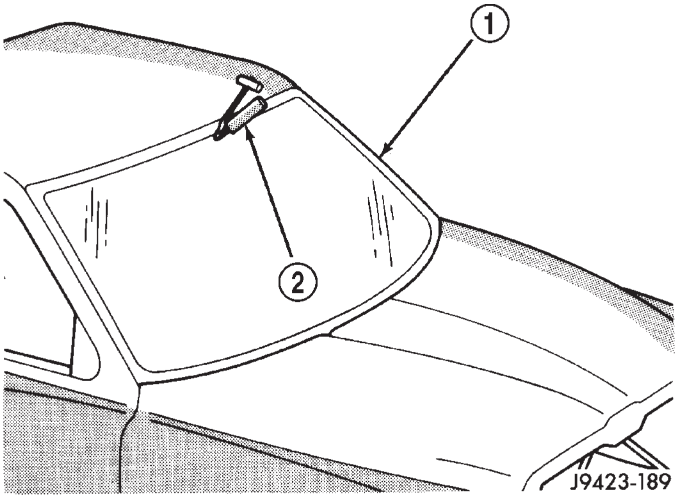

Fig. 2 Cutting Urethane Around Windshield—Typical

1 - WINDSHIELD
2 - COLD KNIFE

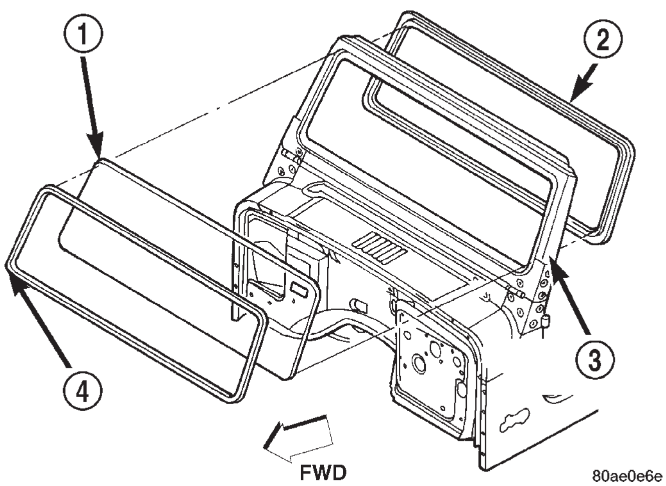

Fig. 3 Windshield

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. 4).

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. 5) 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.

WINDSHIELD (Continued)

(16) Install the rear view mirror support bracket. (Refer to 23 - BODY/INTERIOR/REAR VIEW MIRROR SUPPORT BRACKET - INSTALLATION)

(17) Install the rear view mirror. (Refer to 23 - BODY/INTERIOR/REAR VIEW MIRROR - INSTALLATION)

(18) Install the wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - INSTALLATION)

(19) After urethane has cured, remove tape strips and water test windshield to verify repair.

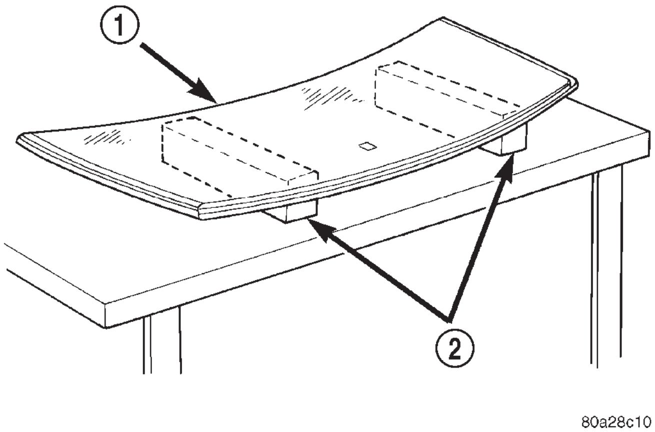

Fig. 4 Work Surface Set up and Molding Installation

1 - WINDSHIELD AND MOLDINGS
2 - BLOCKS

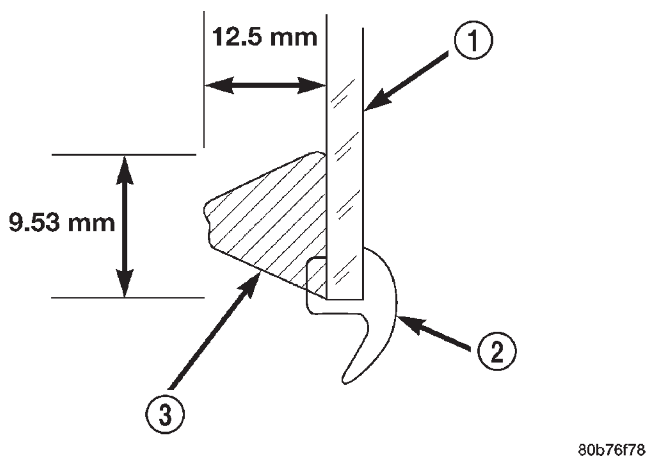

Fig. 5 Urethane Bead

1 - WINDSHIELD
2 - MOLDING
3 - URETHANE BEAD

WINDSHIELD HINGE

REMOVAL

NOTE: If both hinges are to be replaced, the windshield must be tilted to the full forward position. (Refer to 23 - BODY/STATIONARY GLASS/WINDSHIELD - REMOVAL)

(1) Remove door. (Refer to 23 - BODY/DOOR - FRONT/DOOR - REMOVAL)

(2) Remove the bolts attaching the hinge to the cowl (Fig. 6).

(3) Remove the bolts attaching the hinge to the windshield frame.

(4) Separate the hinge from the vehicle.

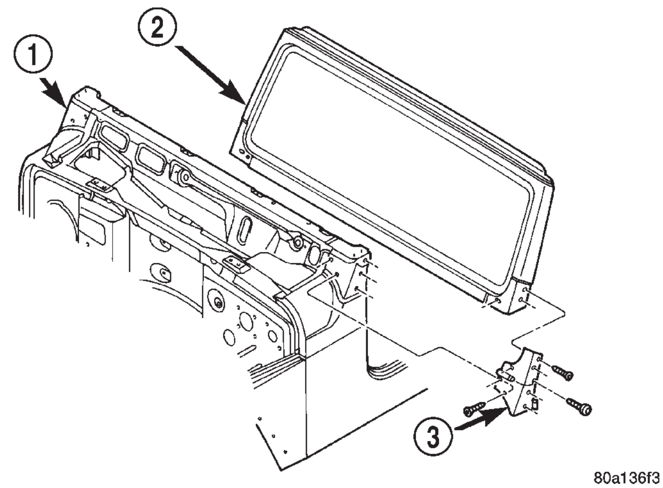

Fig. 6 Windshield Hinge

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. (Refer to 23 - BODY/DOOR - FRONT/DOOR - INSTALLATION)

WINDSHIELD FRAME

REMOVAL

(1) Unlatch top.

(2) Remove the bolts attaching the sport bar to the windshield frame.

(3) Remove the windshield wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - REMOVAL)

(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. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - INSTALLATION)

(6) Install the bolts attaching the sport bar to the windshield frame.

(7) Latch top.

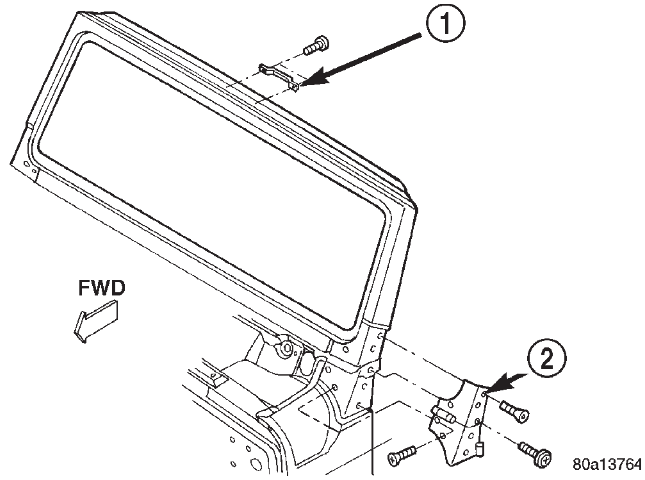

Fig. 7 Windshield Frame

1 - WINDSHIELD HOLD DOWN LOOP
2 - WINDSHIELD HINGE

WEATHERSTRIP/SEALS

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COWL WEATHERSTRIP

REMOVAL

(1) Carefully separate the weatherstrip from the cowl flange (Fig. 1).

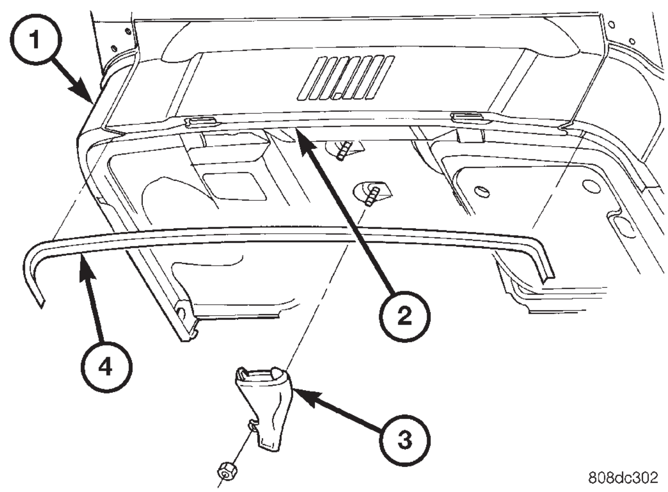

Fig. 1 Cowl Weatherstrip

1 - COWL
2 - COWL FLANGE
3 - COWL PLENUM DRAIN
4 - COWL WEATHERSTRIP

INSTALLATION

(1) Position the weatherstrip on the cowl flange and press it into place.

FULL DOOR INNER BELT WEATHERSTRIP

DESCRIPTION - FULL DOOR INNER BELT WEATHERSTRIP

The inner belt weatherstrip is attached to the door trim panel and is not serviceable. If the inner belt weatherstrip needs to be replaced, replace the door trim panel.

FULL DOOR OUTER BELT SEAL

REMOVAL

(1) Remove the door sail panel.
(2) Disengage the clips attaching the outer belt seal to the door (Fig. 2).
(3) Separate the seal from the door.

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 OUTER BELT SEAL (Continued)

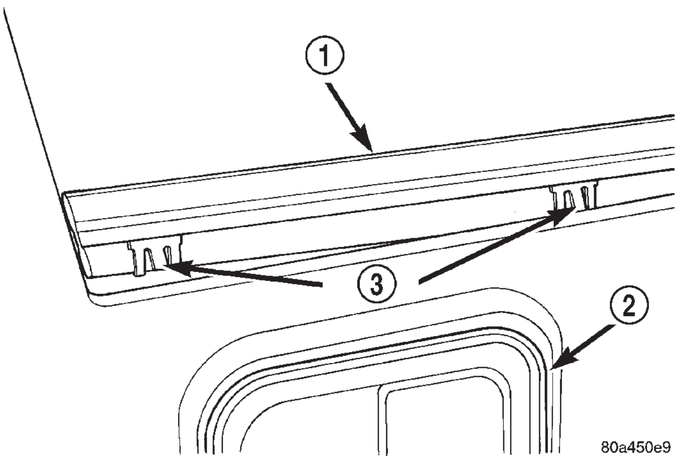

Fig. 2 Full Door Outer Belt Seal

1 - OUTER BELTLINE WEATHERSTRIP
2 - OUTSIDE DOOR HANDLE
3 - CLIPS

FULL DOOR WEATHERSTRIP

REMOVAL

NOTE: The upper portion of the weatherstrip is seated into a channel around the window opening frame. The lower portion of the weatherstrip is attached to the door with push-in fasteners.

(1) Peel the weatherstrip from the channel.
(2) Remove the push-in fasteners attaching the weatherstrip to the door (Fig. 3).

INSTALLATION

(1) Position the lower part of the weatherstrip and seat the push-in fasteners fully.
(2) Install the weatherstrip in the upper weather-strip channel seat fully.

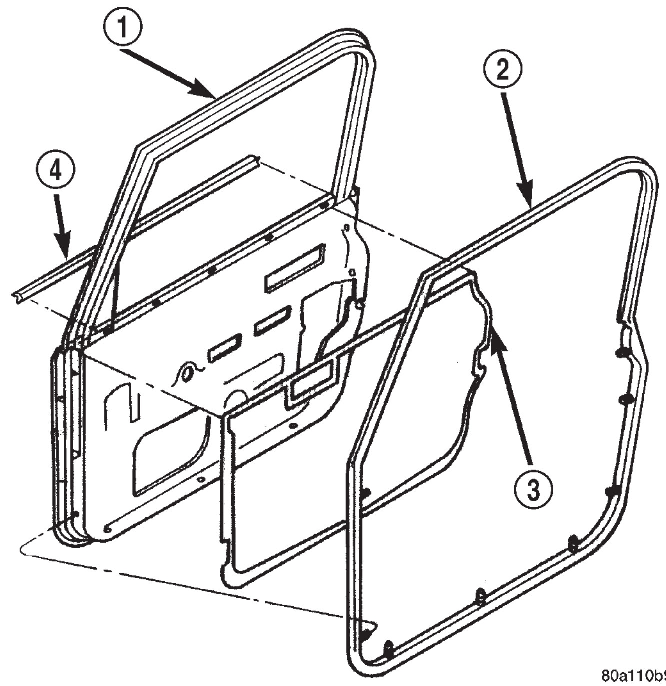

Fig. 3 Full Door Weatherstrip

1 - FULL DOOR
2 - WEATHERSTRIP
3 - WATERDAM
4 - OUTER DOOR BELT SEAL

HALF DOOR WEATHERSTRIP

REMOVAL

NOTE: The weatherstrip is attached to the door with push-in fasteners.

(1) Remove trim panel. (Refer to 23 - BODY/HALF DOOR/TRIM PANEL - REMOVAL)
(2) Remove window retaining sleeve.
(3) Remove the push-in fasteners attaching the weatherstrip to the door. (Fig. 4)

INSTALLATION

NOTE: The weatherstrip is attached to the door with push-in fasteners.

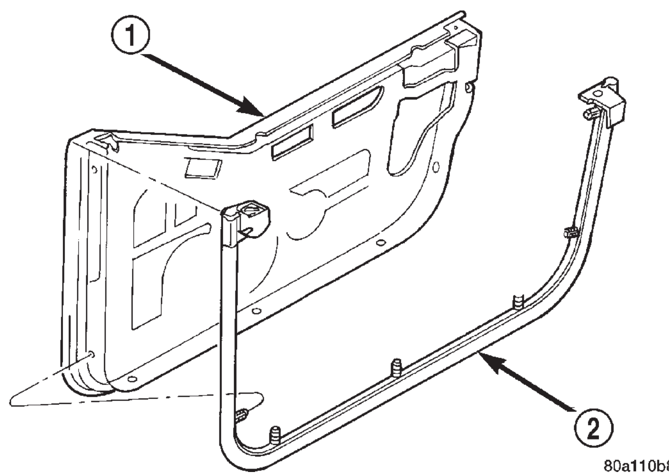

Fig. 4 Half Door Weatherstrip

1 - HALF DOOR
2 - WEATHERSTRIP

(1) Position the weatherstrip onto the door and seat the push-in fasteners fully.
(2) Install window retaining sleeve.
(3) Install trim panel. (Refer to 23 - BODY/HALF DOOR/TRIM PANEL - INSTALLATION)

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. 5).

(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.

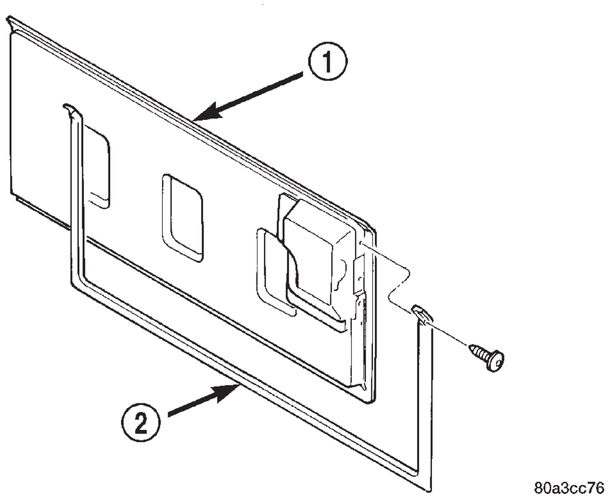

Fig. 5 Tailgate Weatherstrip

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.

WINDSHIELD FRAME WEATHERSTRIP

REMOVAL

UPPER

(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.

LOWER

NOTE: The lower windshield frame weatherstrip can be removed with the frame tilted forward to the full horizontal position.

(1) Remove the wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - REMOVAL)

(2) Disconnect the top from the windshield frame.

(3) Remove the cowl grille. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE AND SCREEN - REMOVAL)

(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 on each hinge pillar (Fig. 6).

(6) Disengage the push-in fastener at the center of cowl.

(7) Remove the weatherstrip from the cowl.

INSTALLATION

UPPER

(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. 6).

(3) Remove adhesive backing from the bottom of the weatherstrip.

WINDSHIELD FRAME WEATHERSTRIP (Continued)

(4) Using forceful hand pressure, seat the adhesive on the contact surface.

NOTE: If tape surface becomes contaminated, it will not adhere to the windshield frame.

(5) Connect the top to the windshield frame.

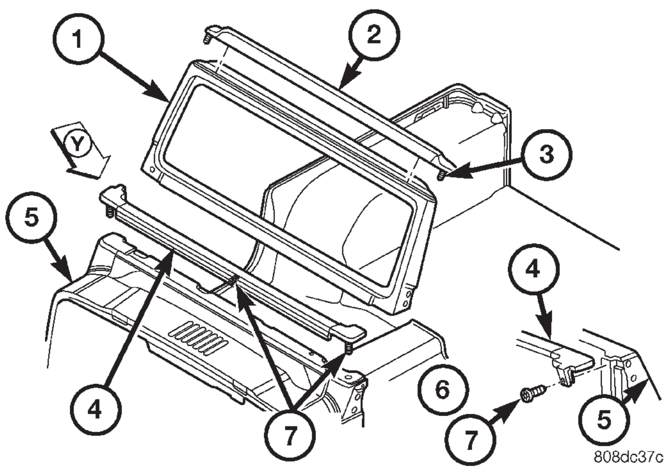

Fig. 6 Windshield Frame Weatherstrip

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

(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 them into place.
(3) Tilt the windshield frame rearward to the full vertical position.
(4) Install the torx screws on each side of the windshield securing the windshield frame.
(5) Connect the top to the windshield frame.
(6) Install cowl grille. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE AND SCREEN - INSTALLATION)
(7) Install the wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - INSTALLATION)

BODY STRUCTURE

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OPENING DIMENSIONS

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BODY OPENING DIMENSIONS

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- A & B. Center of radius at bottom to center of radius top.
- 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.
- 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.

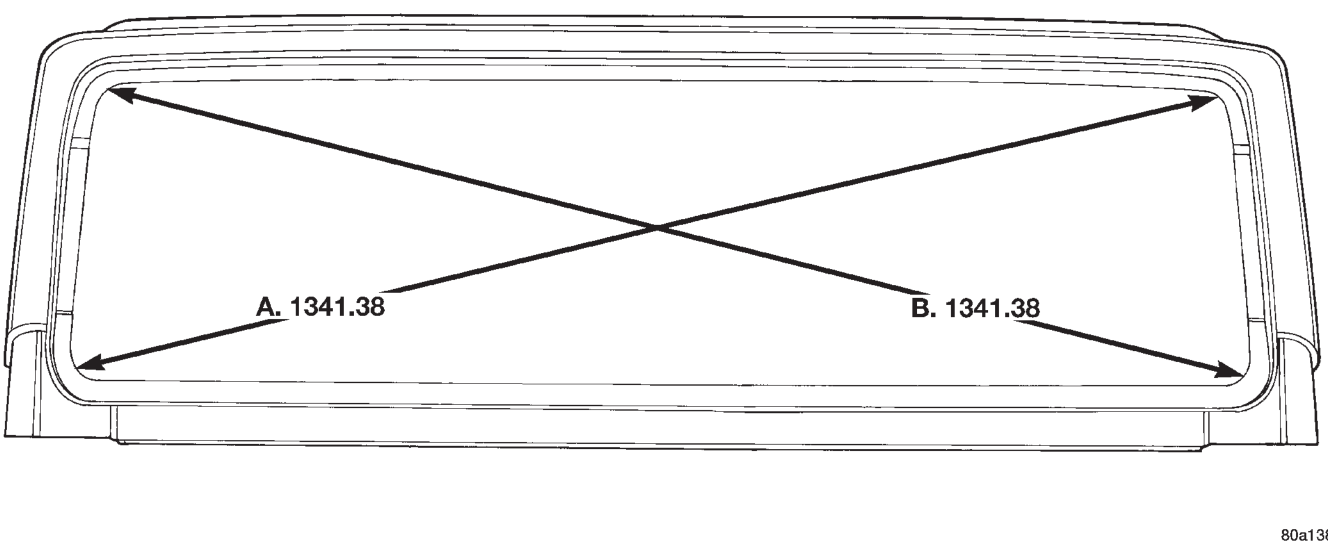

Fig. 1 WINDSHIELD OPENING

OPENING DIMENSIONS (Continued)

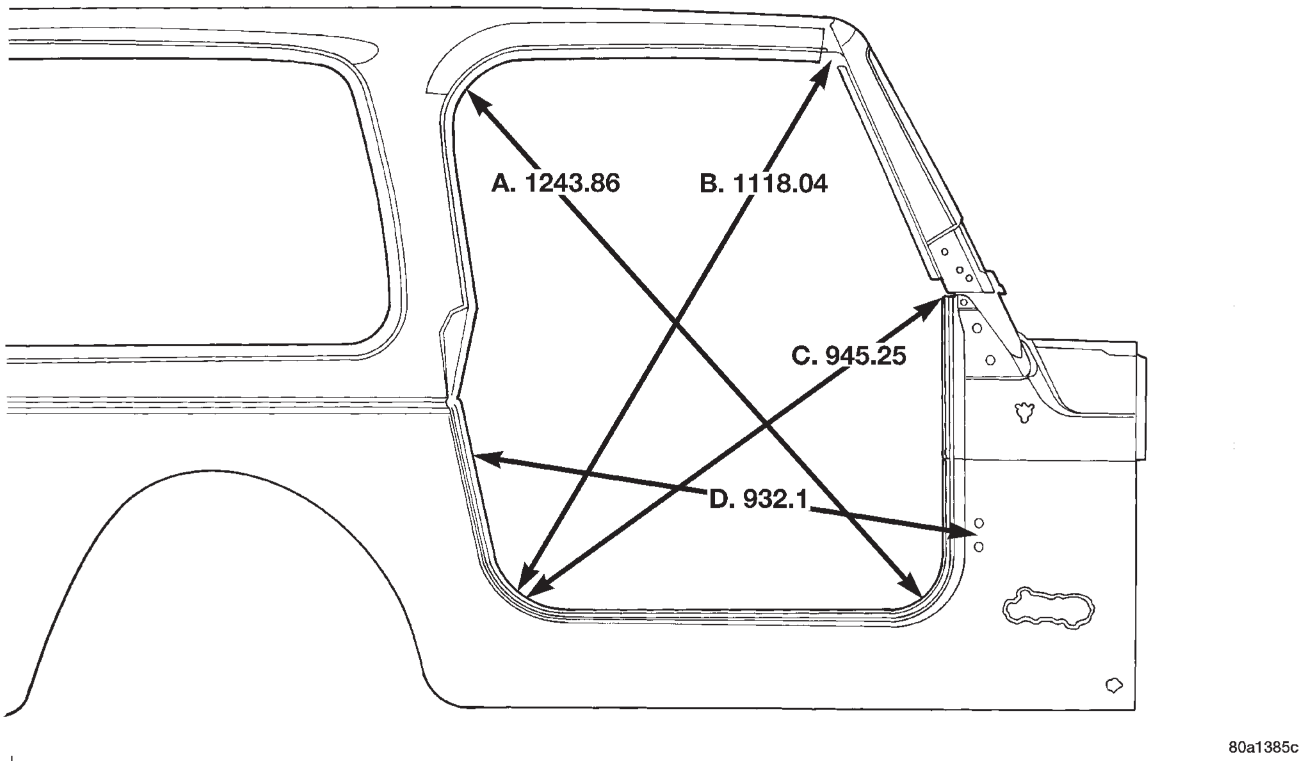

Fig. 2 DOOR OPENING

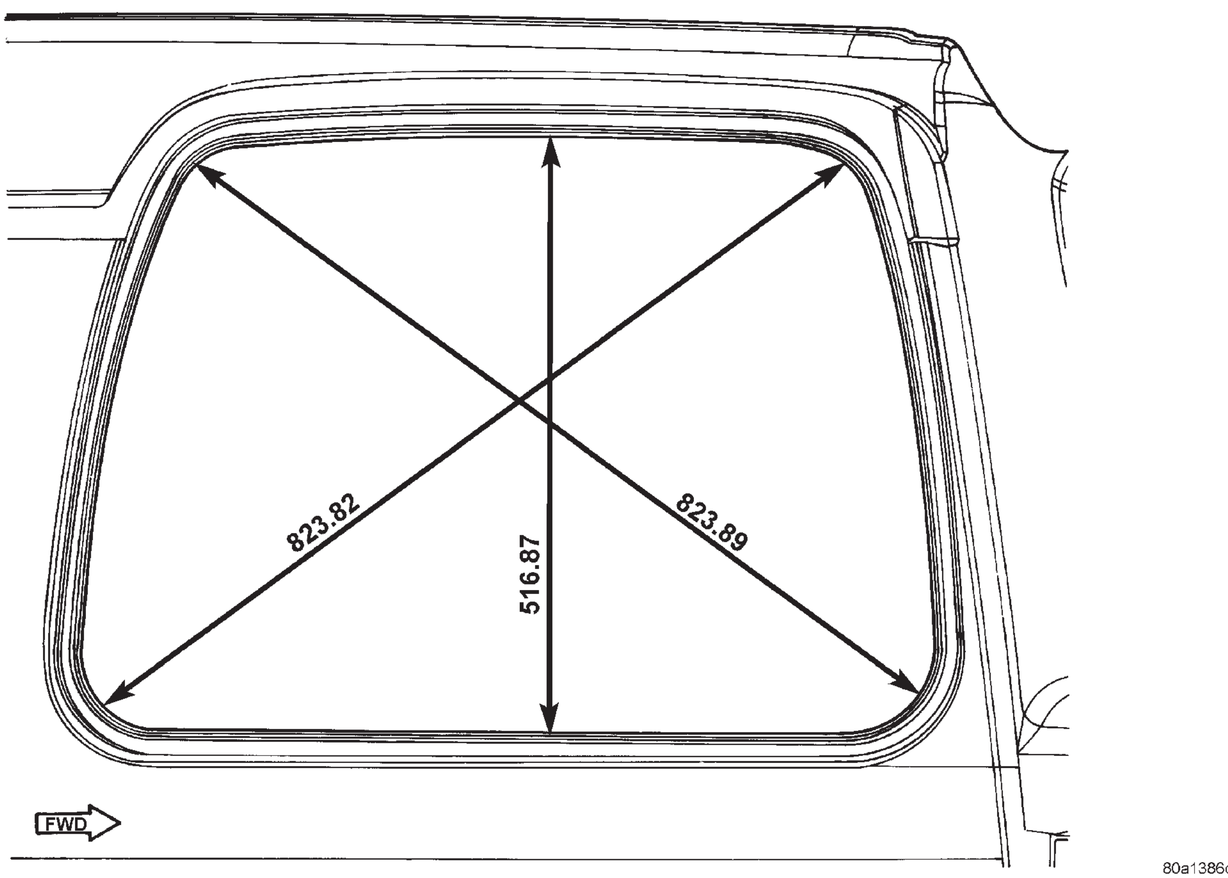

Fig. 3 QUARTER WINDOW OPENING

OPENING DIMENSIONS (Continued)

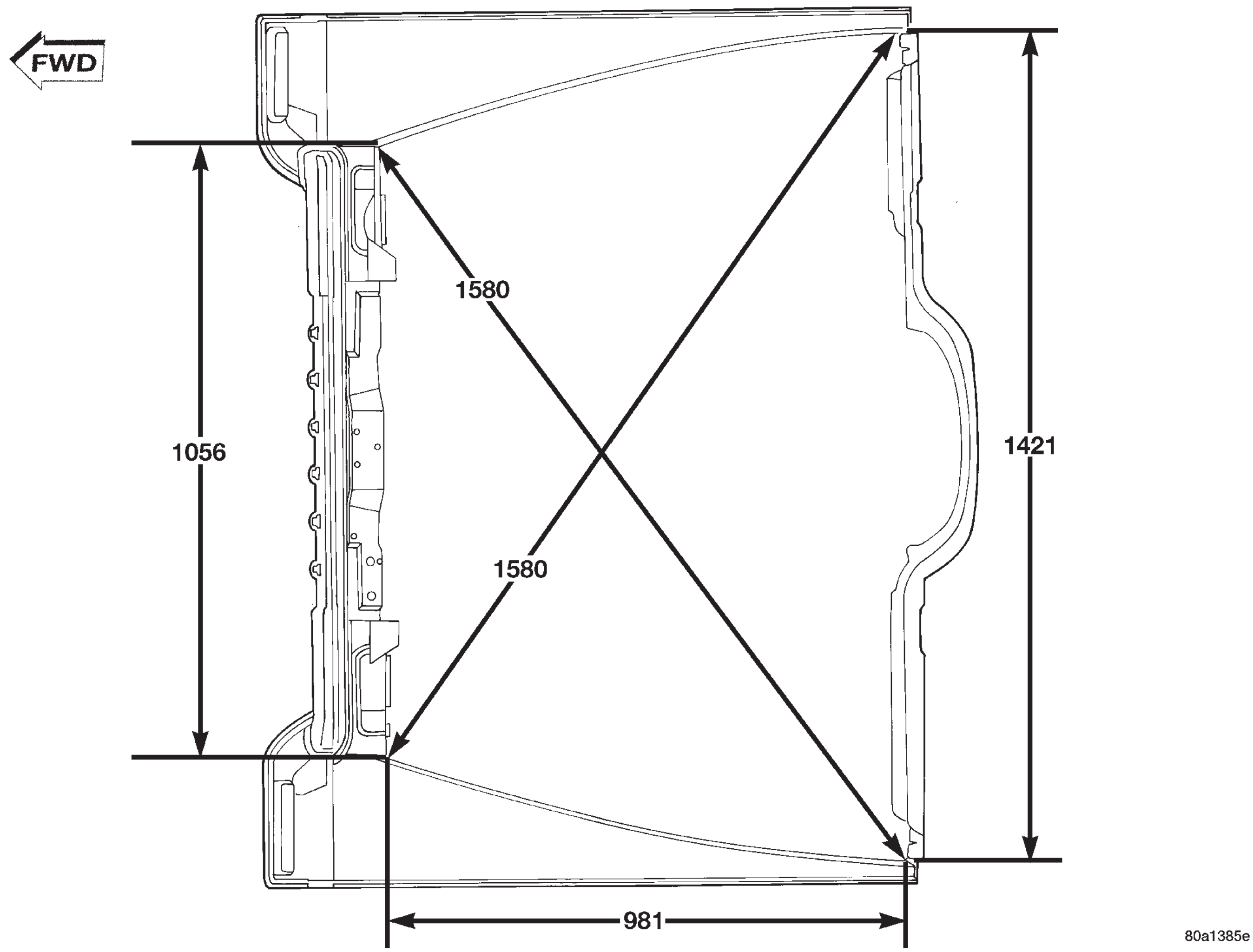

Fig. 4 ENGINE COMPARTMENT

OPENING DIMENSIONS (Continued)

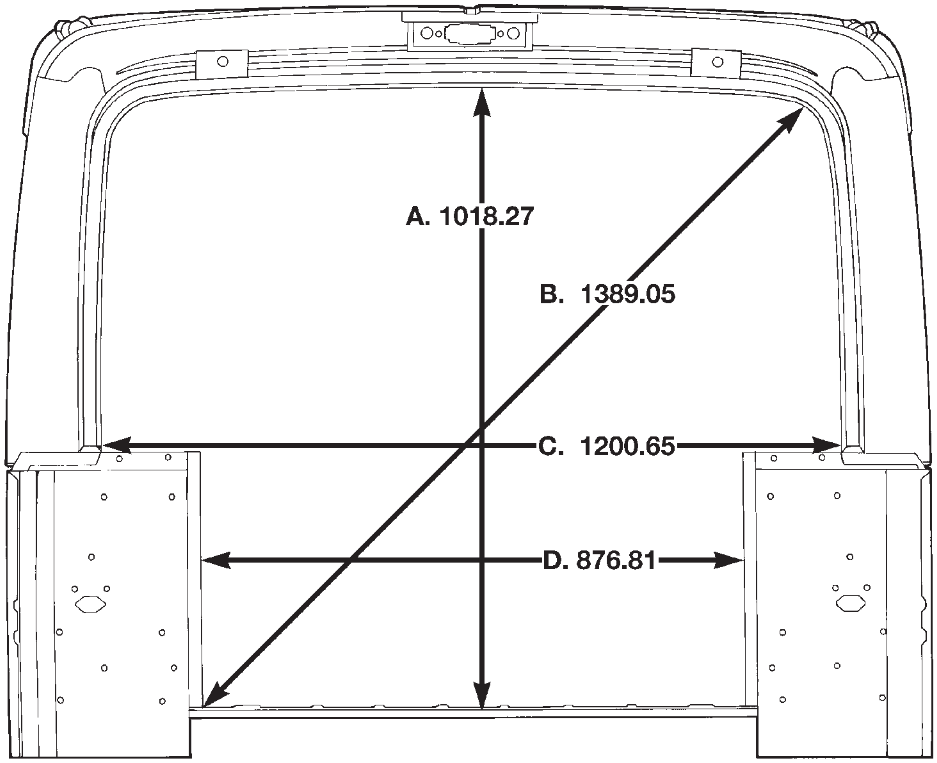

Fig. 5 TAILGATE AND LIFTGATE OPENING

SEALER LOCATIONS

SPECIFICATIONS

SEALER LOCATIONS

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SEALER LOCATIONS (Continued)

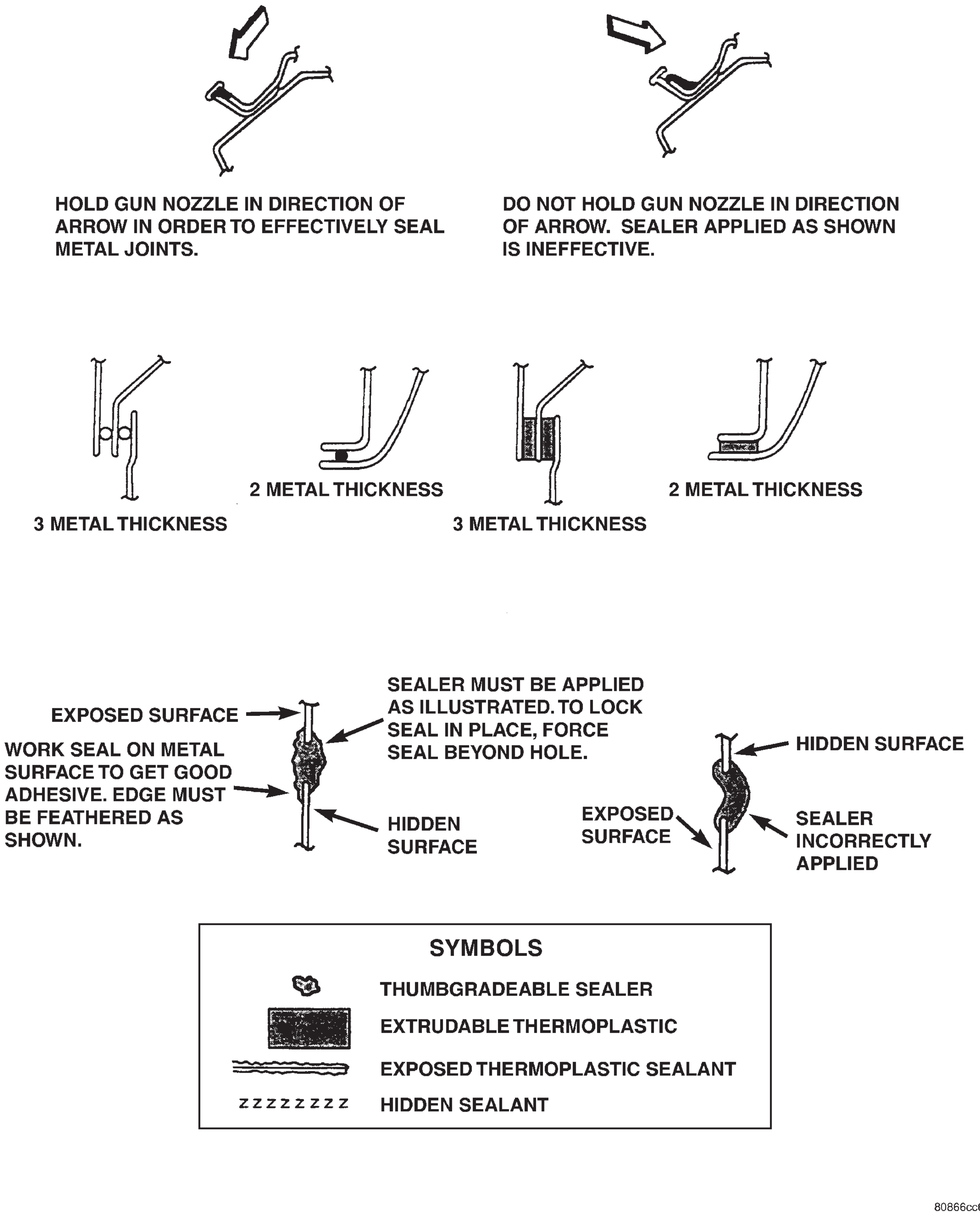

Fig. 6 APPLICATION METHODS

SEALER LOCATIONS (Continued)

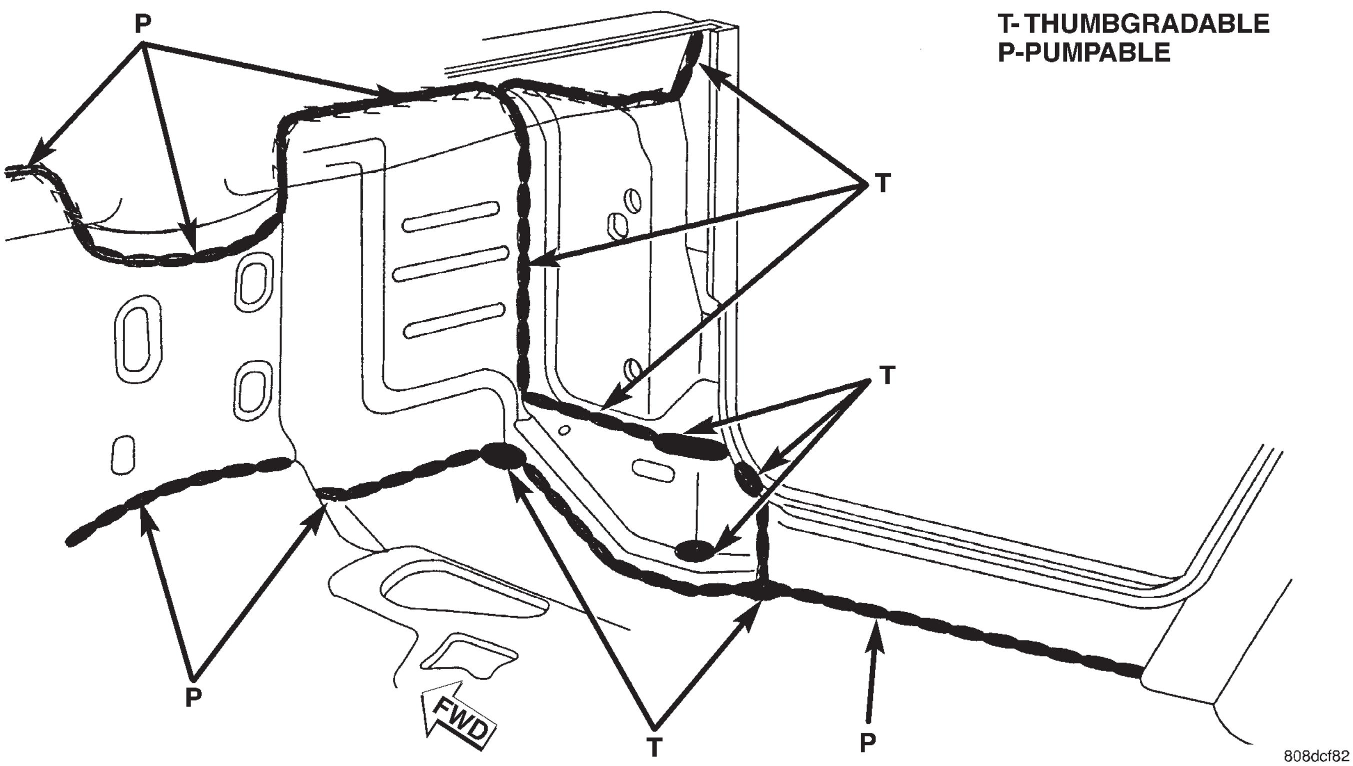

Fig. 7 COWL AND PLENUM

SEALER LOCATIONS (Continued)

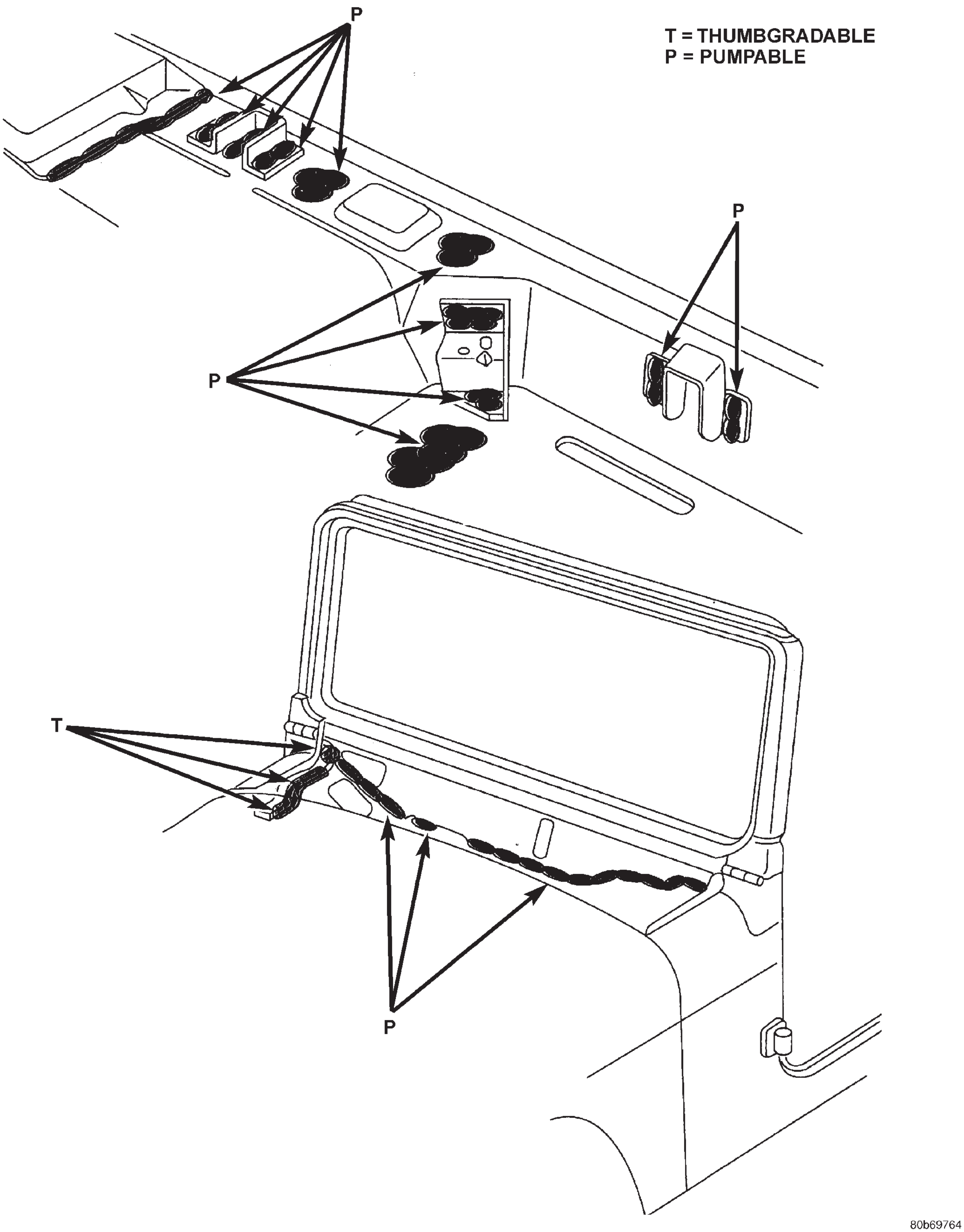

Fig. 8 COWL TOP END AND PLENUM

SEALER LOCATIONS (Continued)

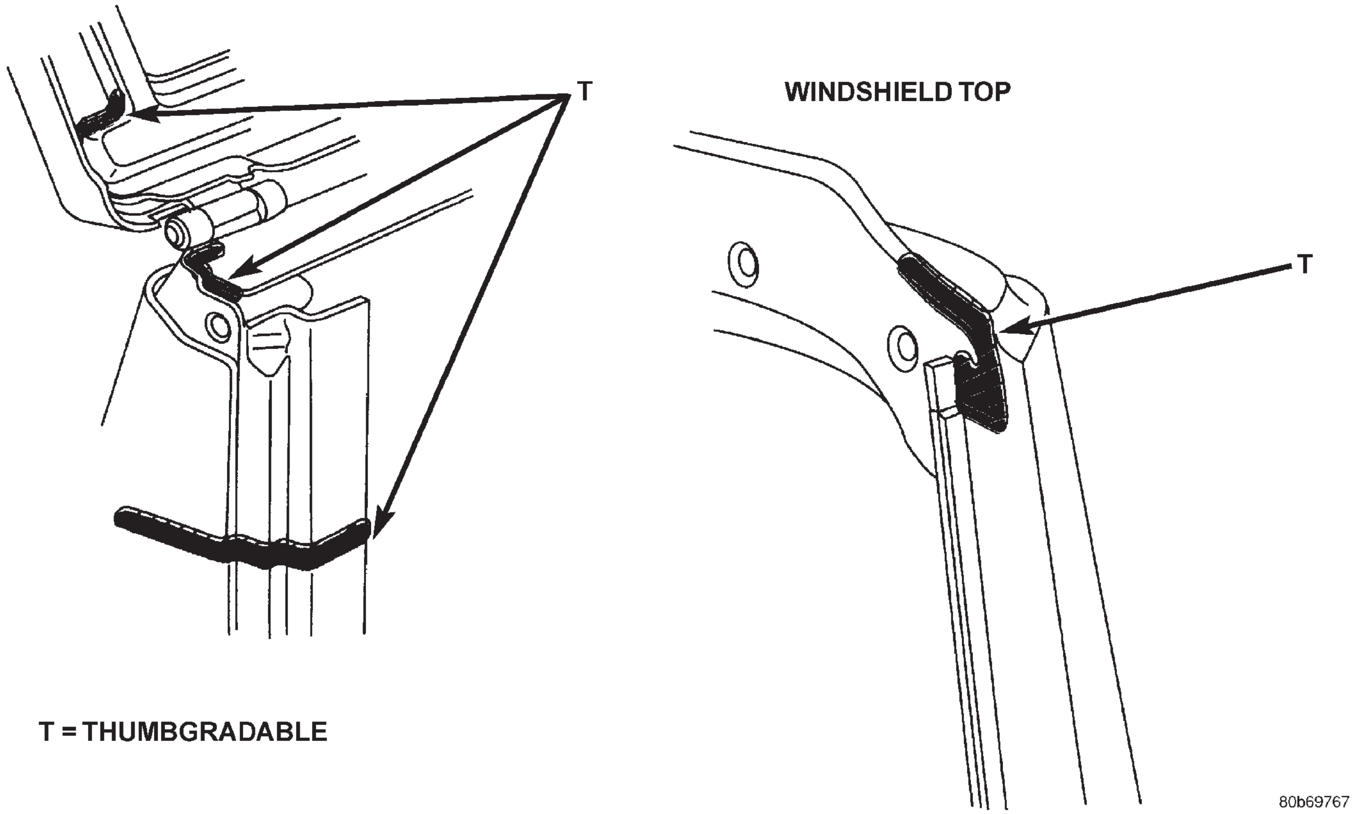

Fig. 9 COWL AND WINDSHIELD OUTER PANEL

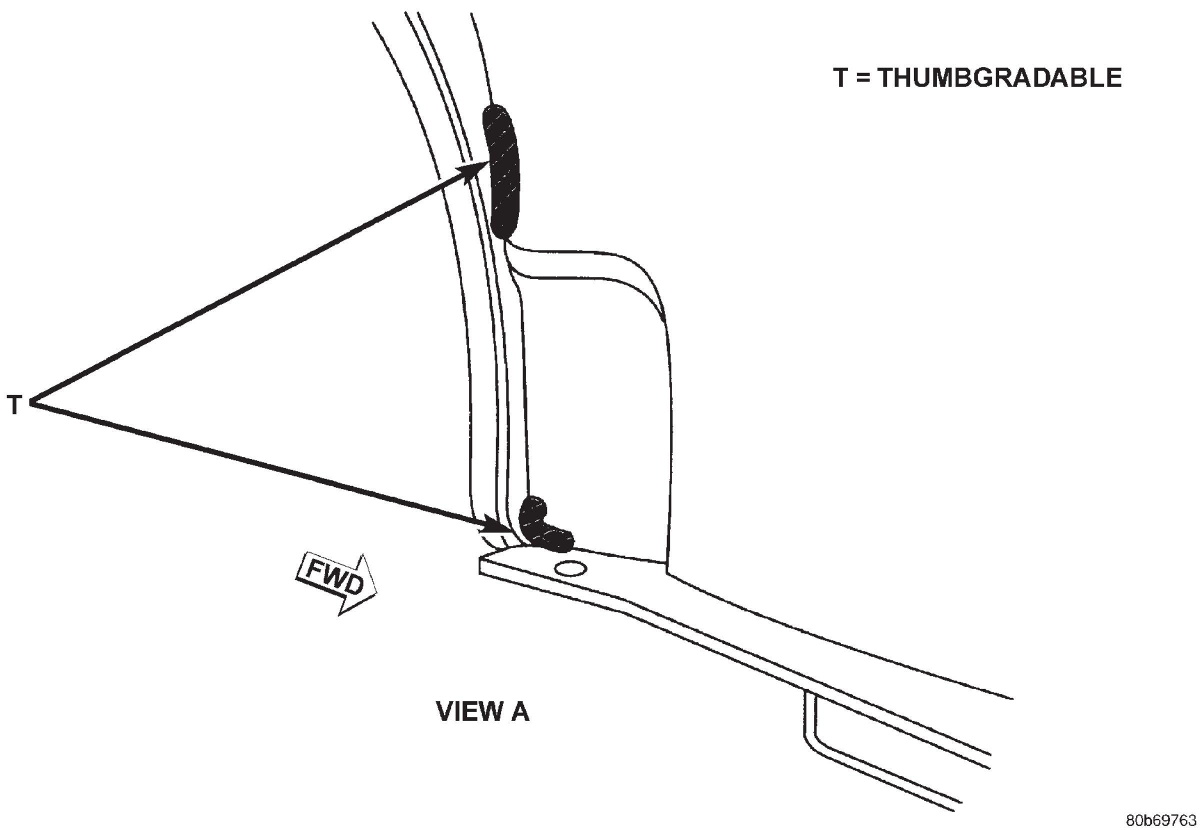

Fig. 10 INNER WHEELHOUSE

SEALER LOCATIONS (Continued)

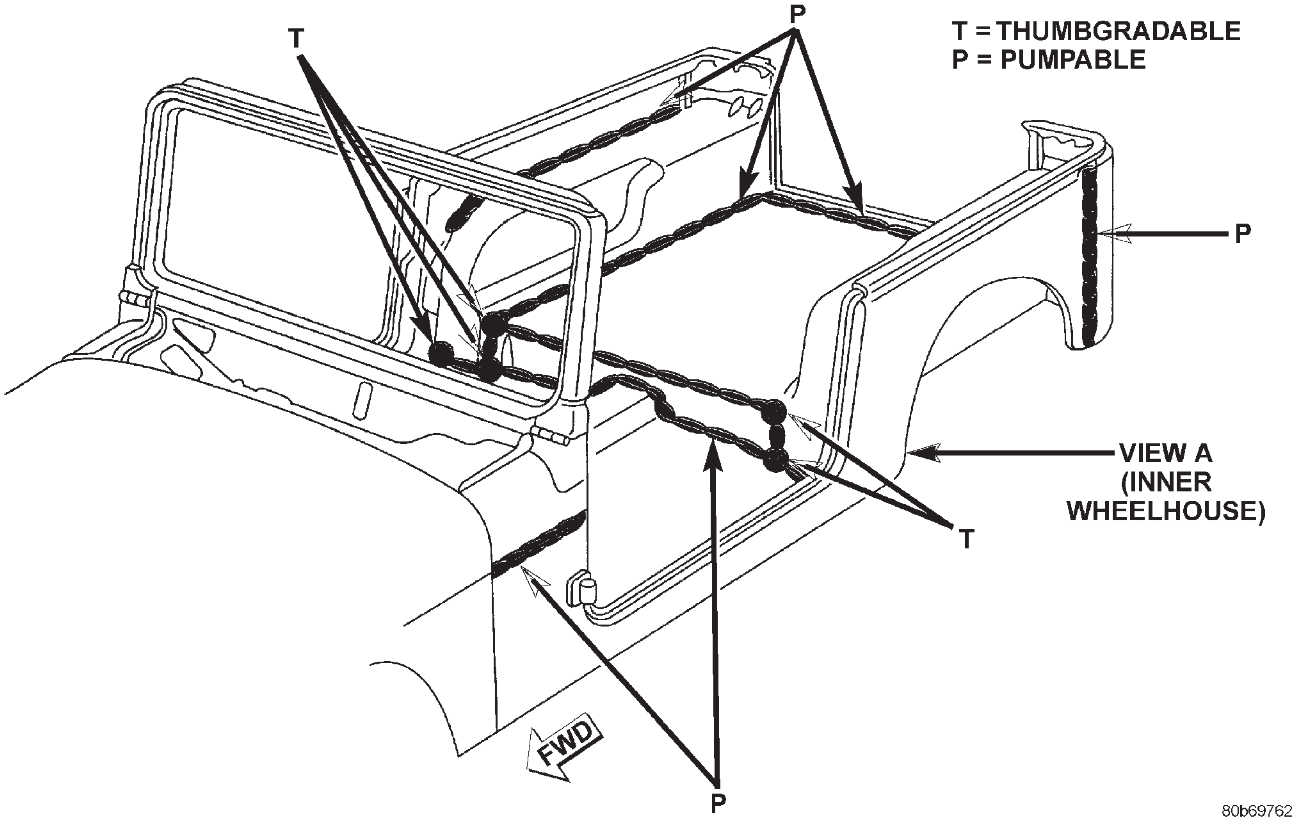

Fig. 11 REAR FLOOR RISER AND OUTER BODY SEAMS

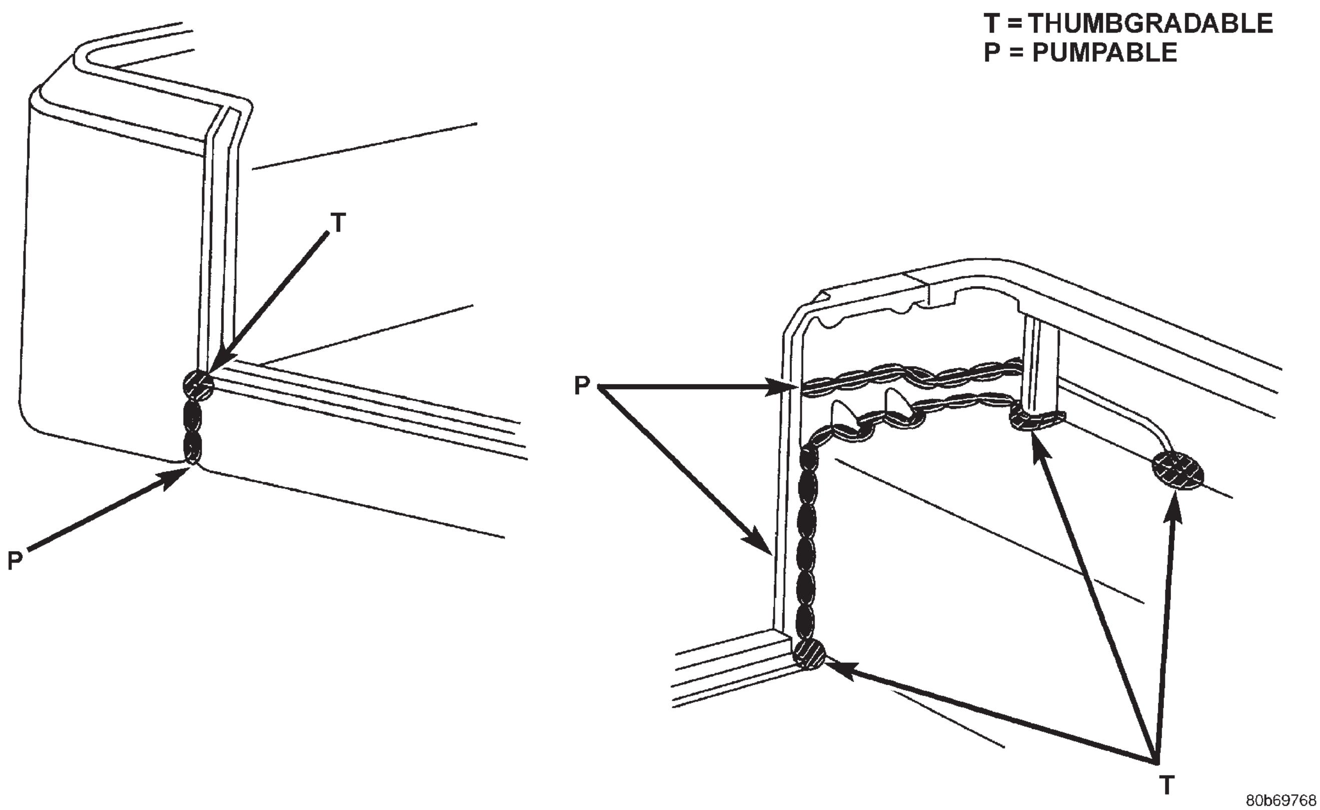

Fig. 12 REAR CORNER PANEL

SEALER LOCATIONS (Continued)

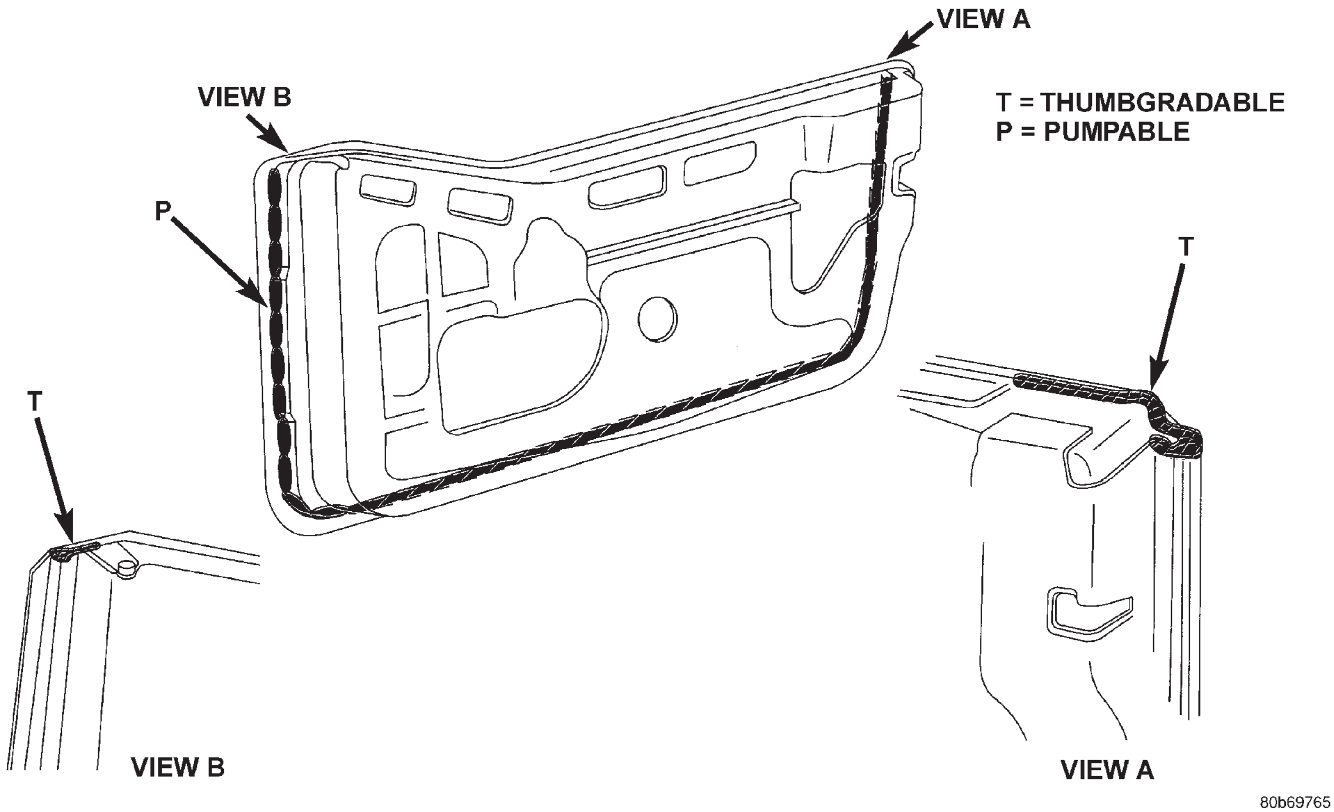

Fig. 13 HALF DOOR

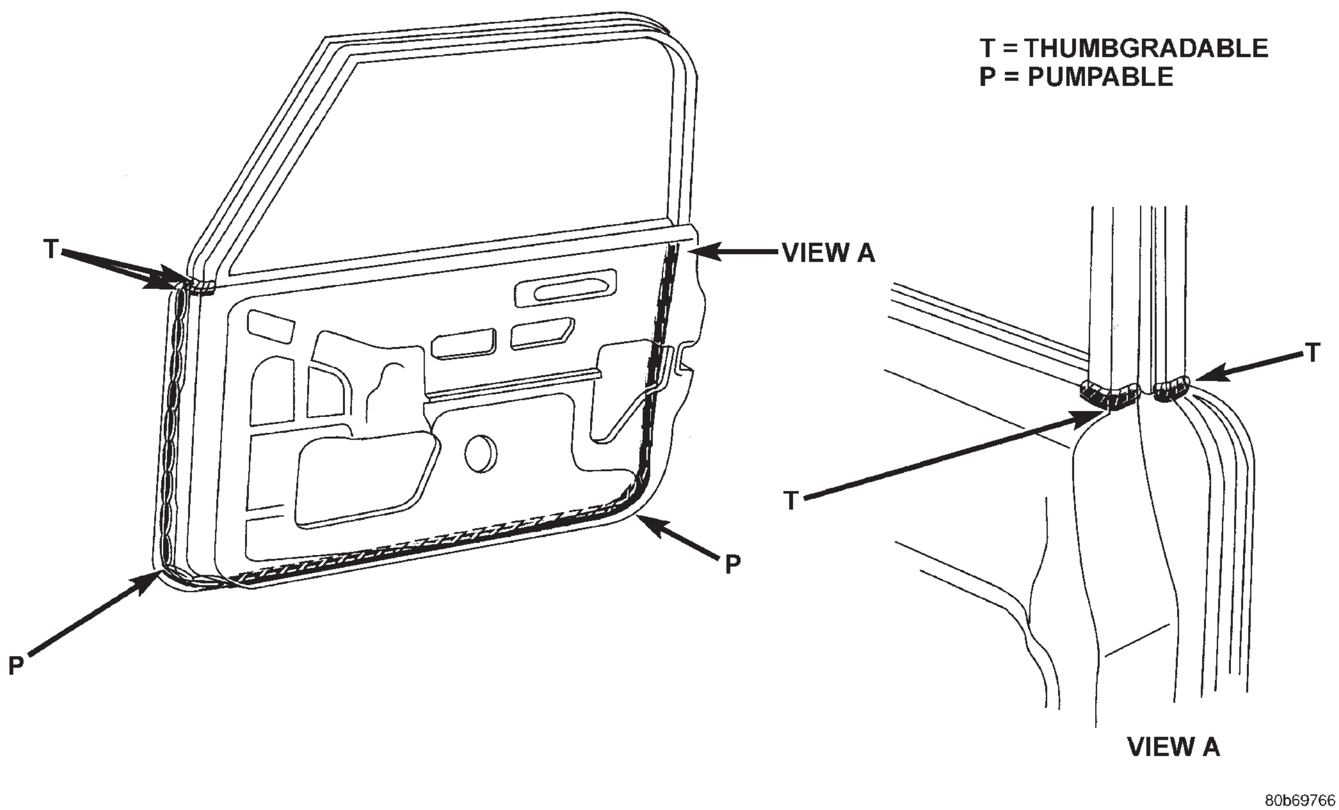

Fig. 14 FULL DOOR

WELD LOCATIONS

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WELD LOCATIONS

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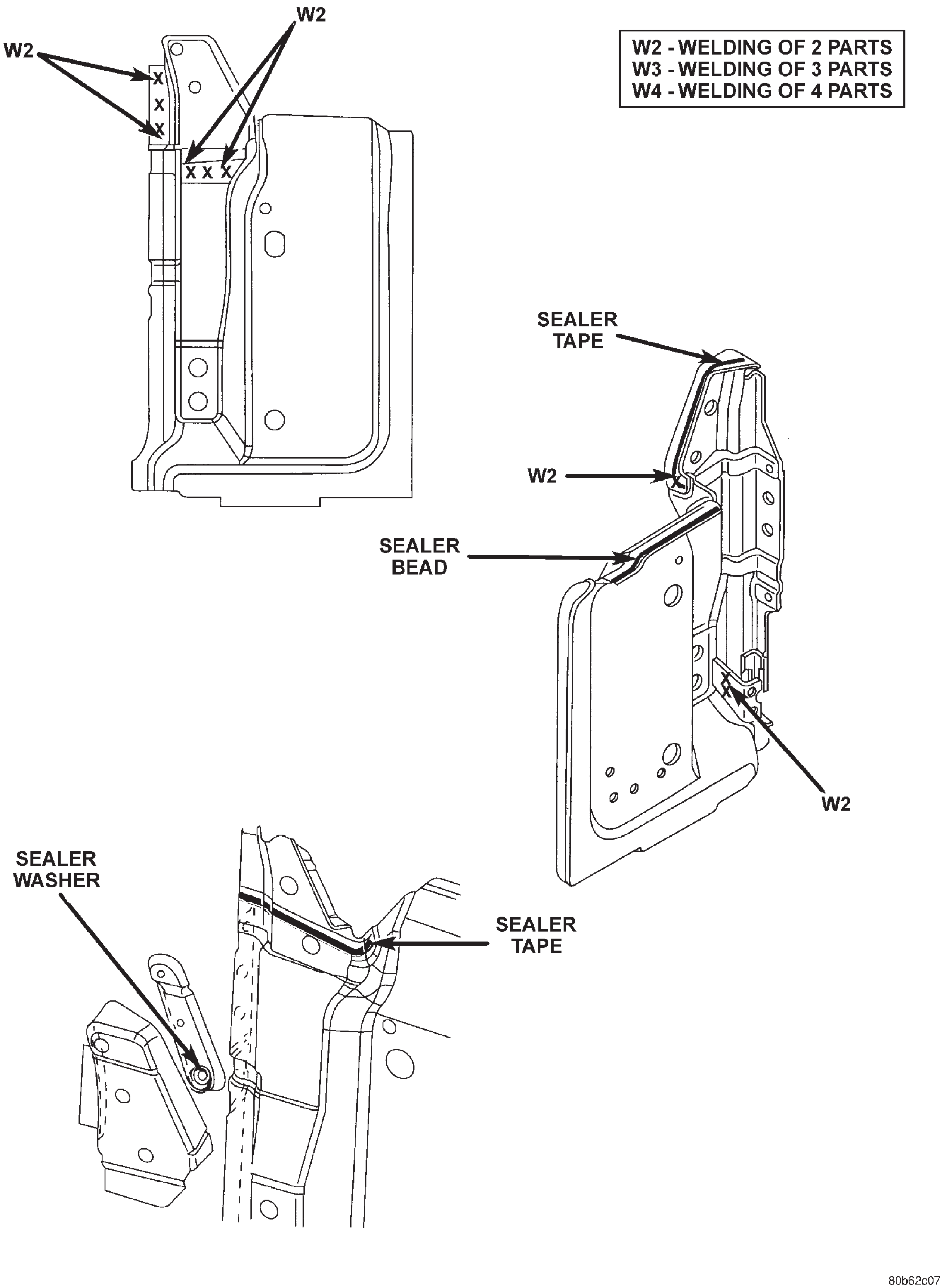


Fig. 15 DASH, COWL AND PLENUM

WELD LOCATIONS (Continued)

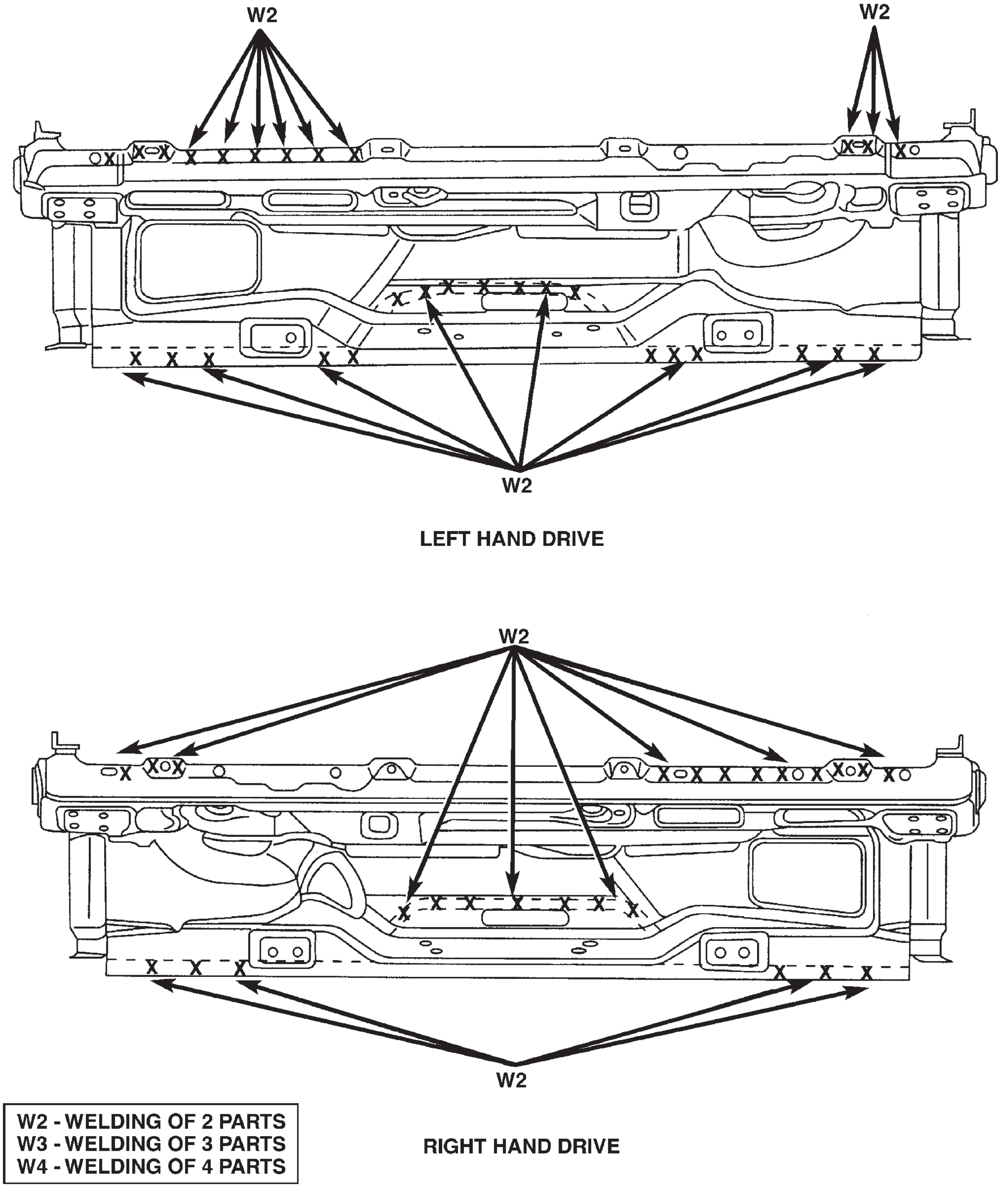


Fig. 16 DASH, COWL AND PLENUM

WELD LOCATIONS (Continued)

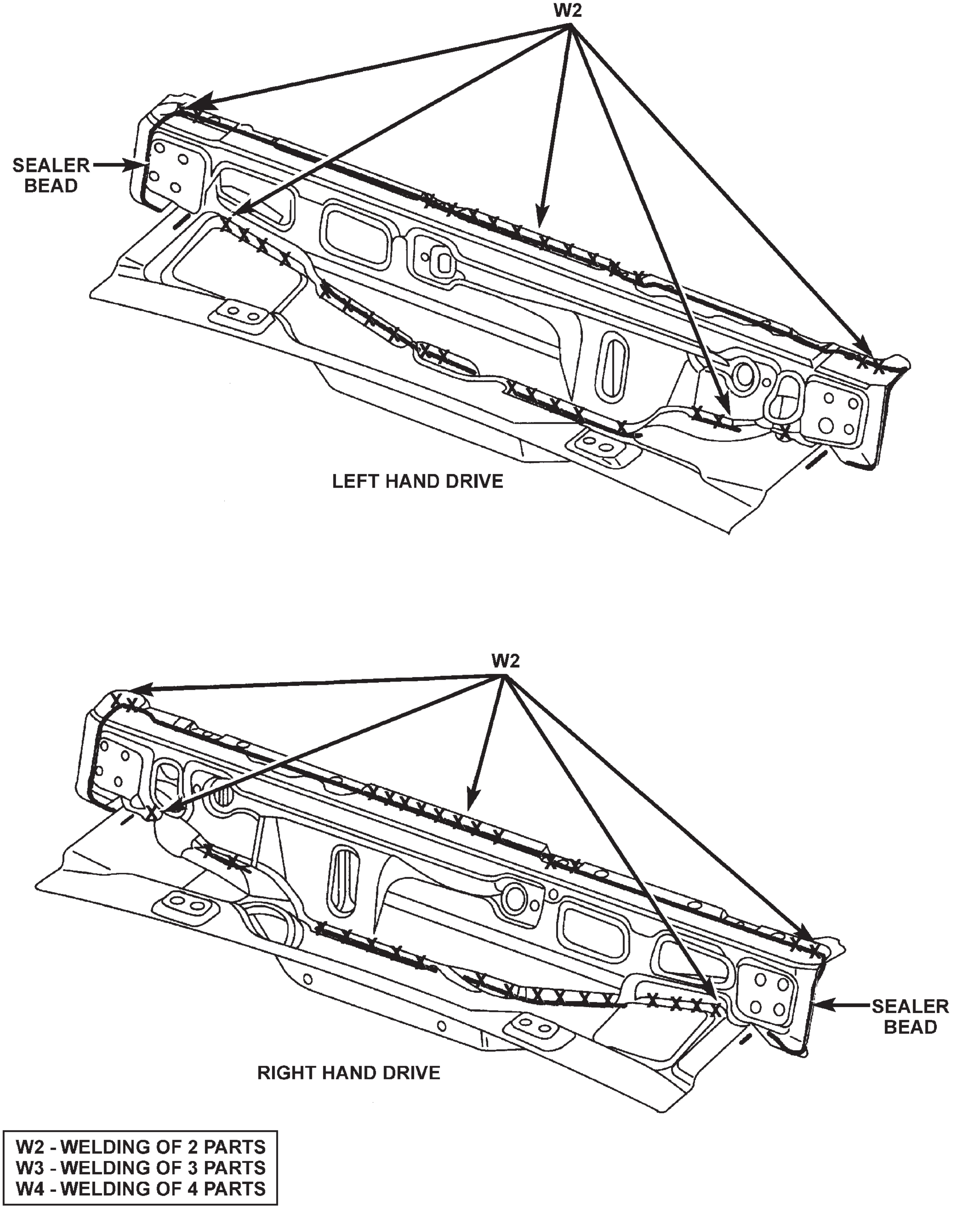


Fig. 17 DASH, COWL AND PLENUM

WELD LOCATIONS (Continued)

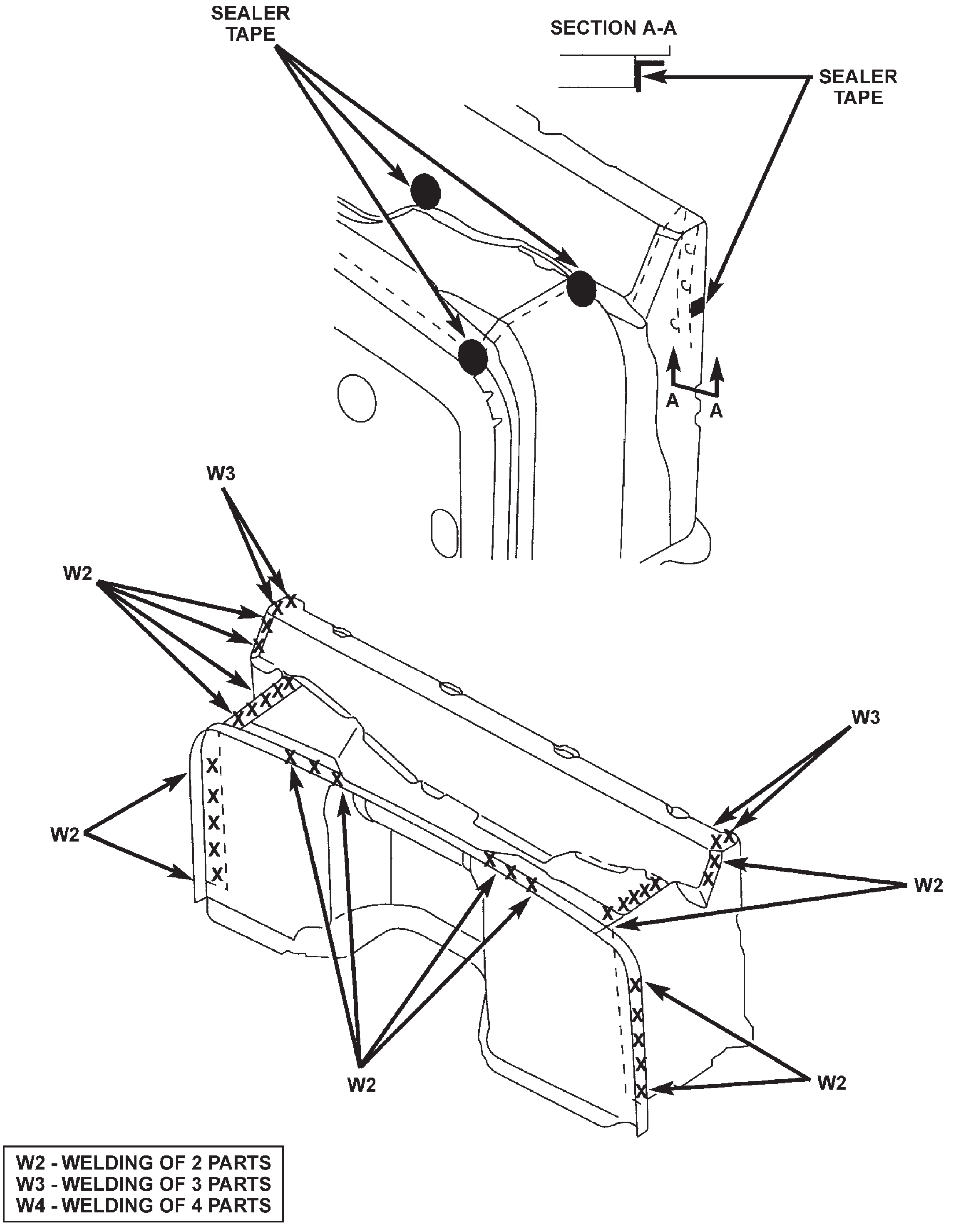


Fig. 18 DASH, COWL AND PLENUM

WELD LOCATIONS (Continued)

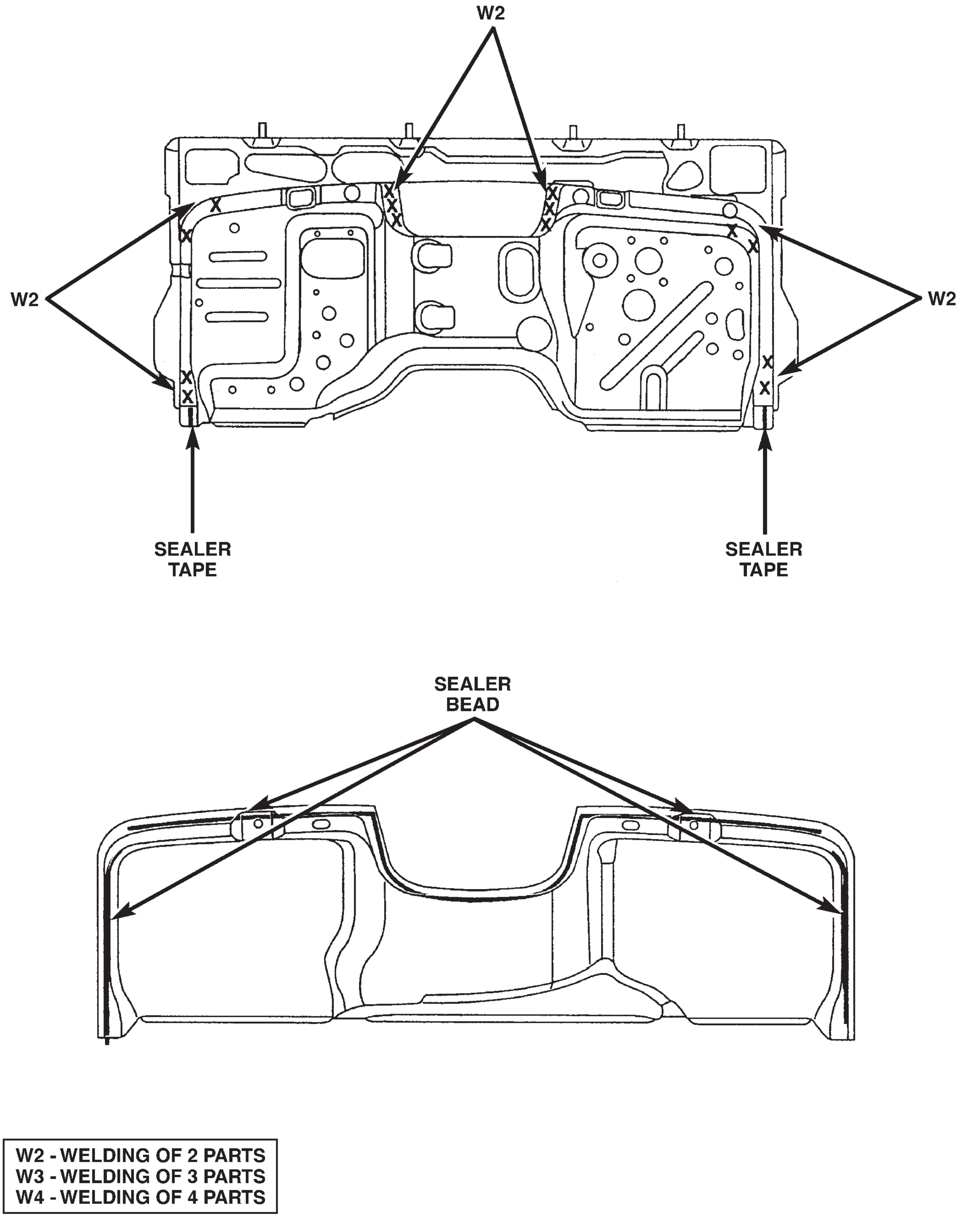


Fig. 19 DASH, COWL AND PLENUM

WELD LOCATIONS (Continued)

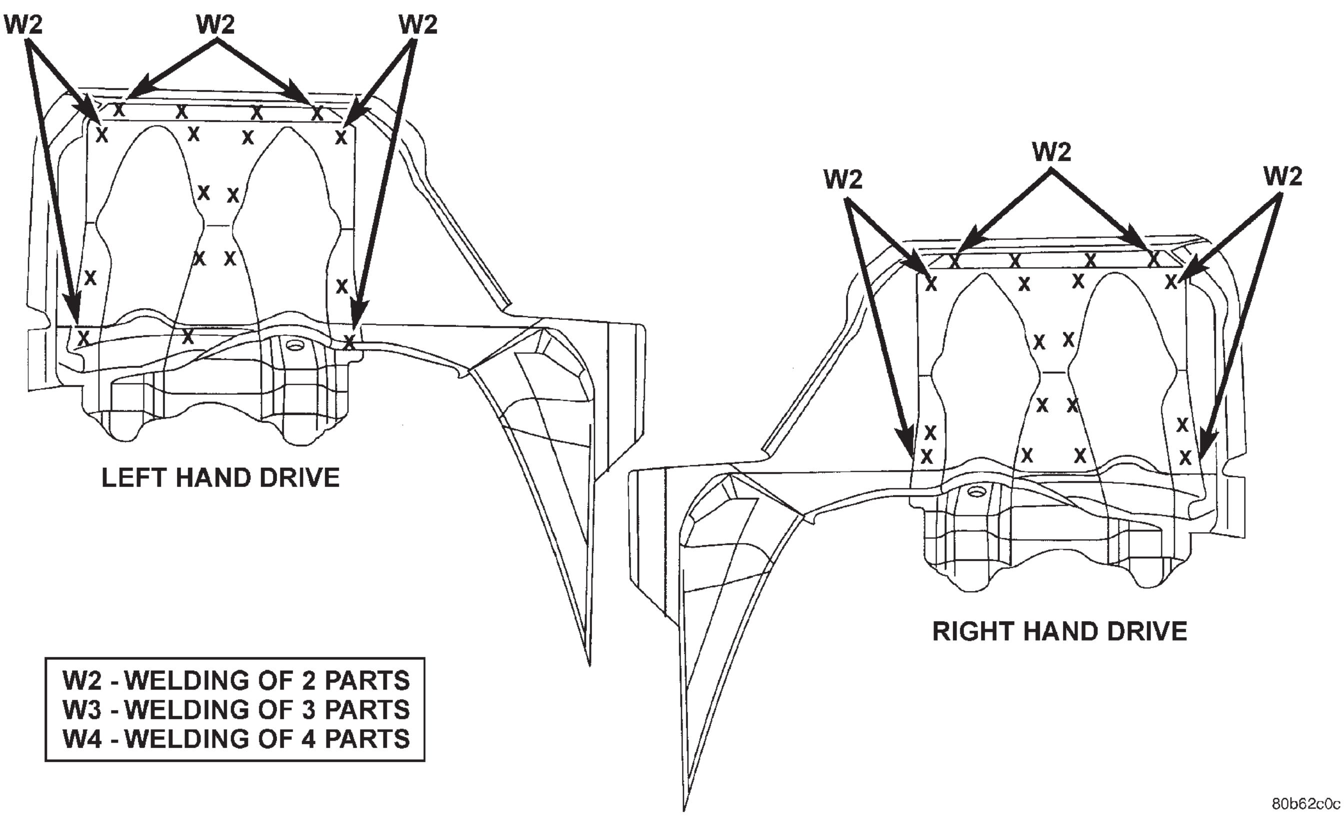


Fig. 20 DASH, COWL AND PLENUM SUPPORTS AND REINFORCEMENTS

WELD LOCATIONS (Continued)

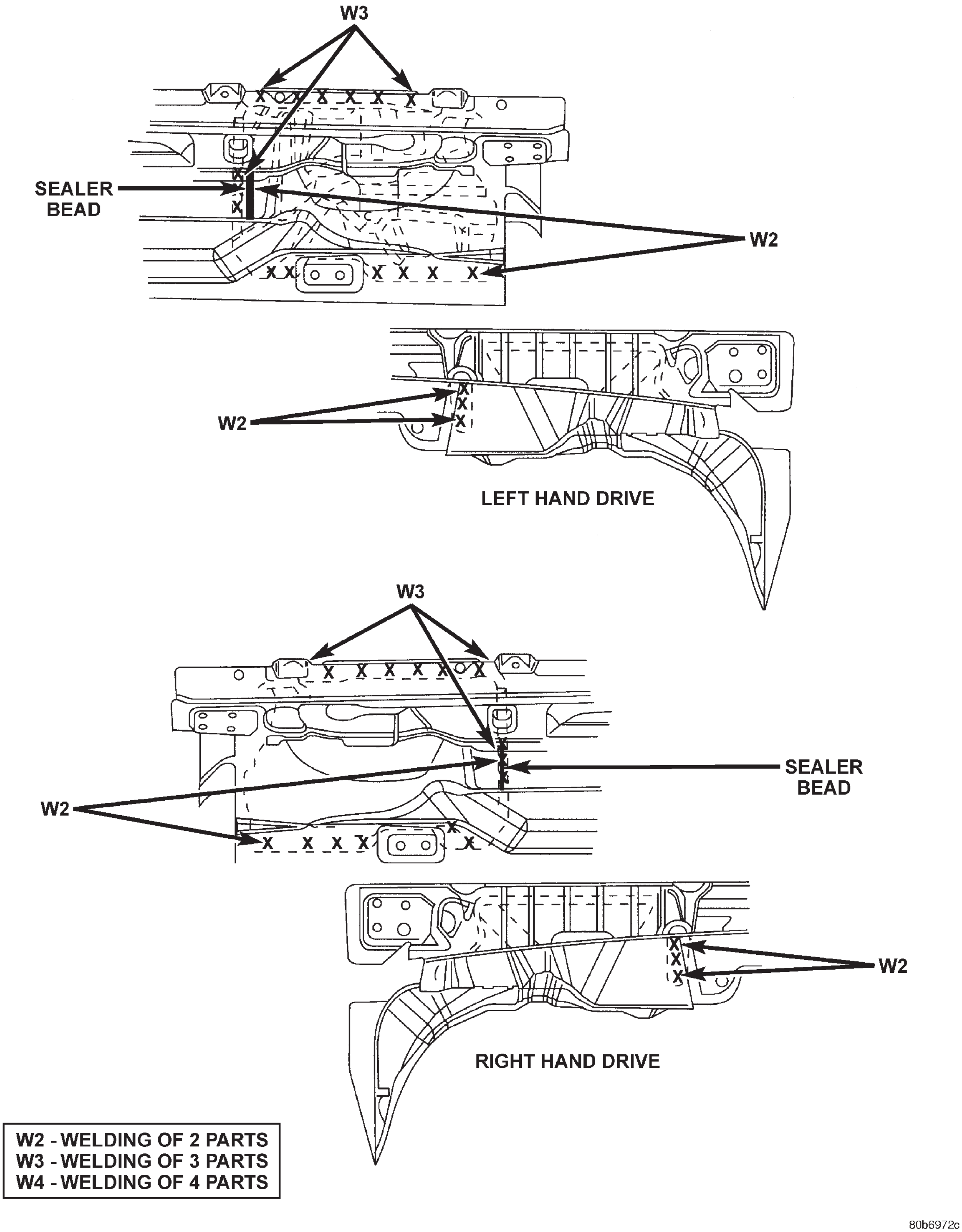


Fig. 21 DASH, COWL AND PLENUM SUPPORTS AND REINFORCEMENTS

WELD LOCATIONS (Continued)

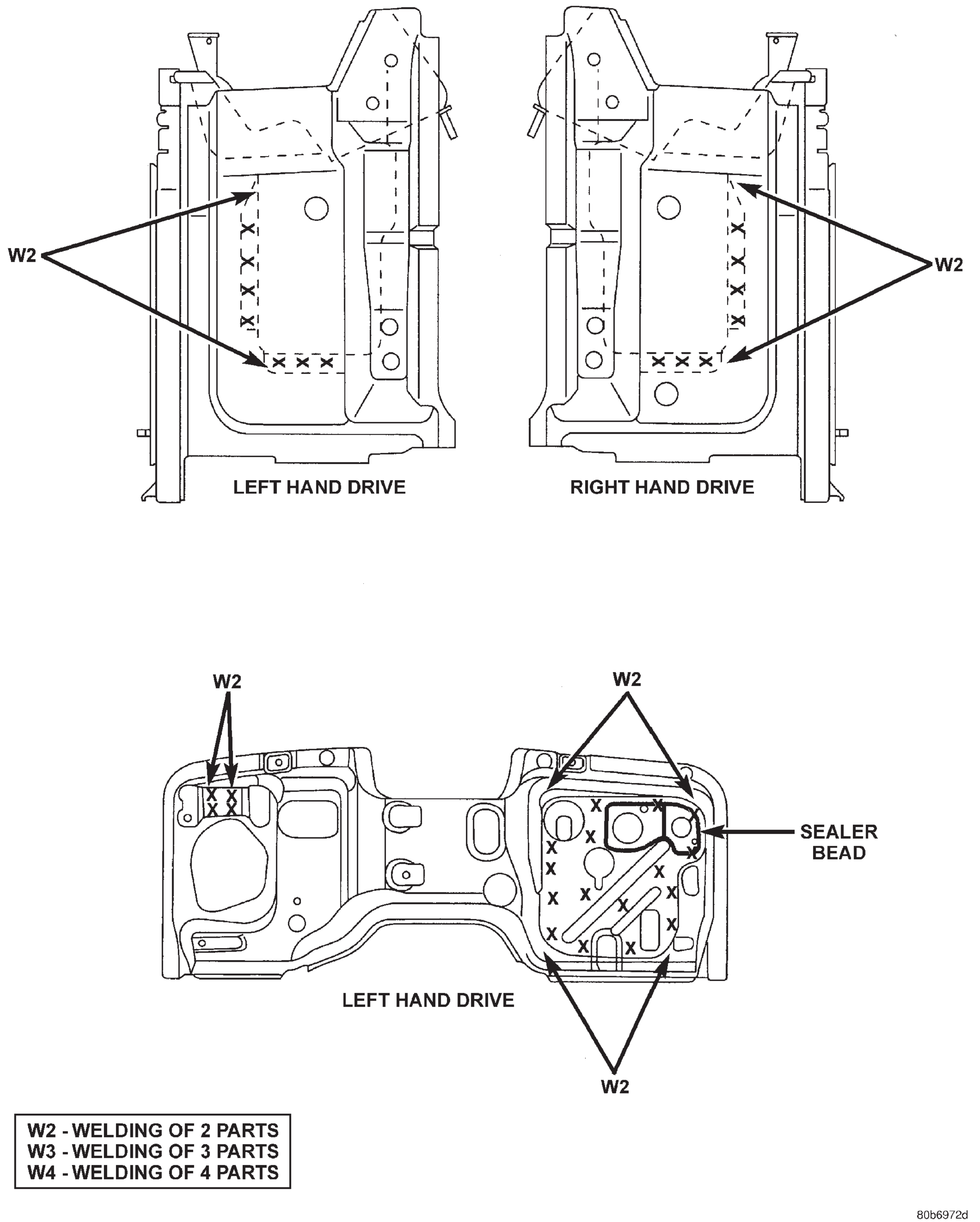


Fig. 22 DASH, COWL AND PLENUM SUPPORTS AND REINFORCEMENTS

WELD LOCATIONS (Continued)

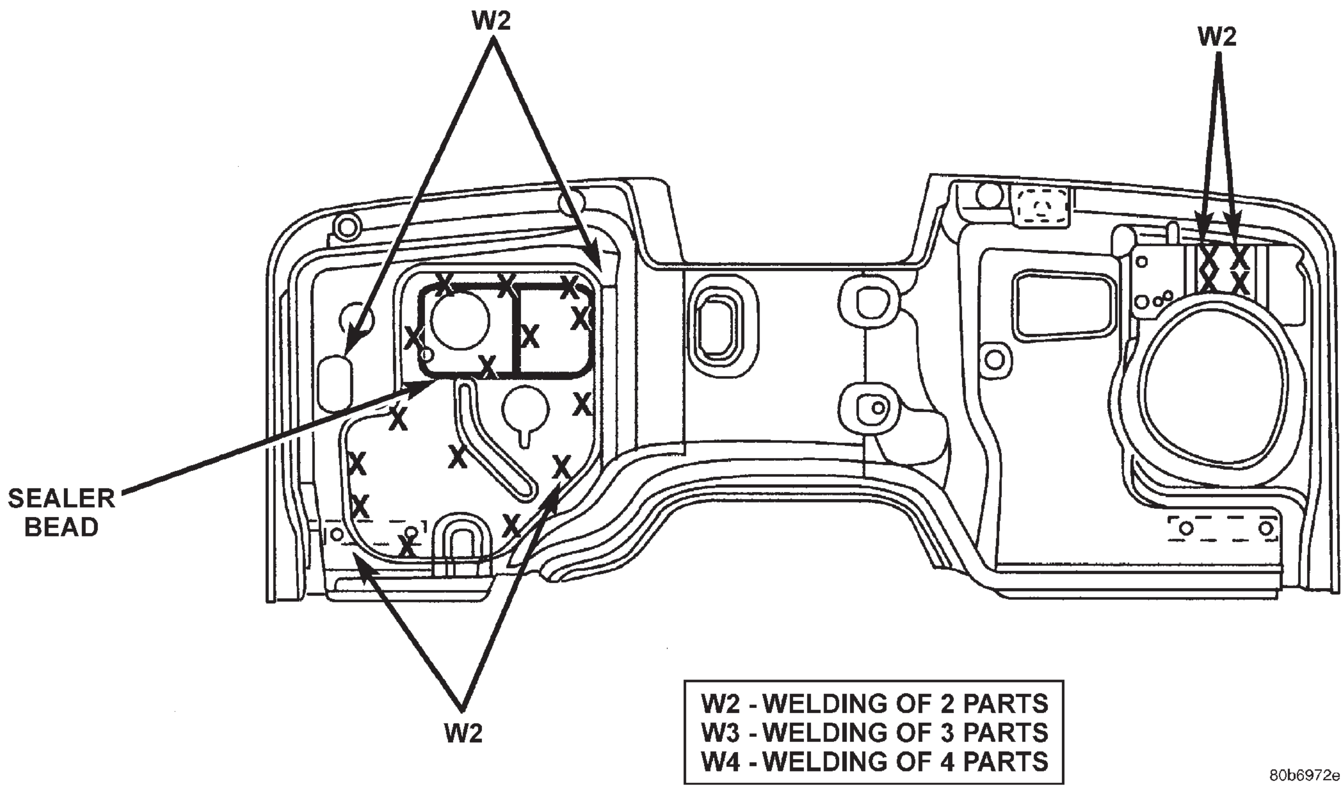


Fig. 23 DASH, COWL AND PLENUM SUPPORTS AND REINFORCEMENTS

WELD LOCATIONS (Continued)

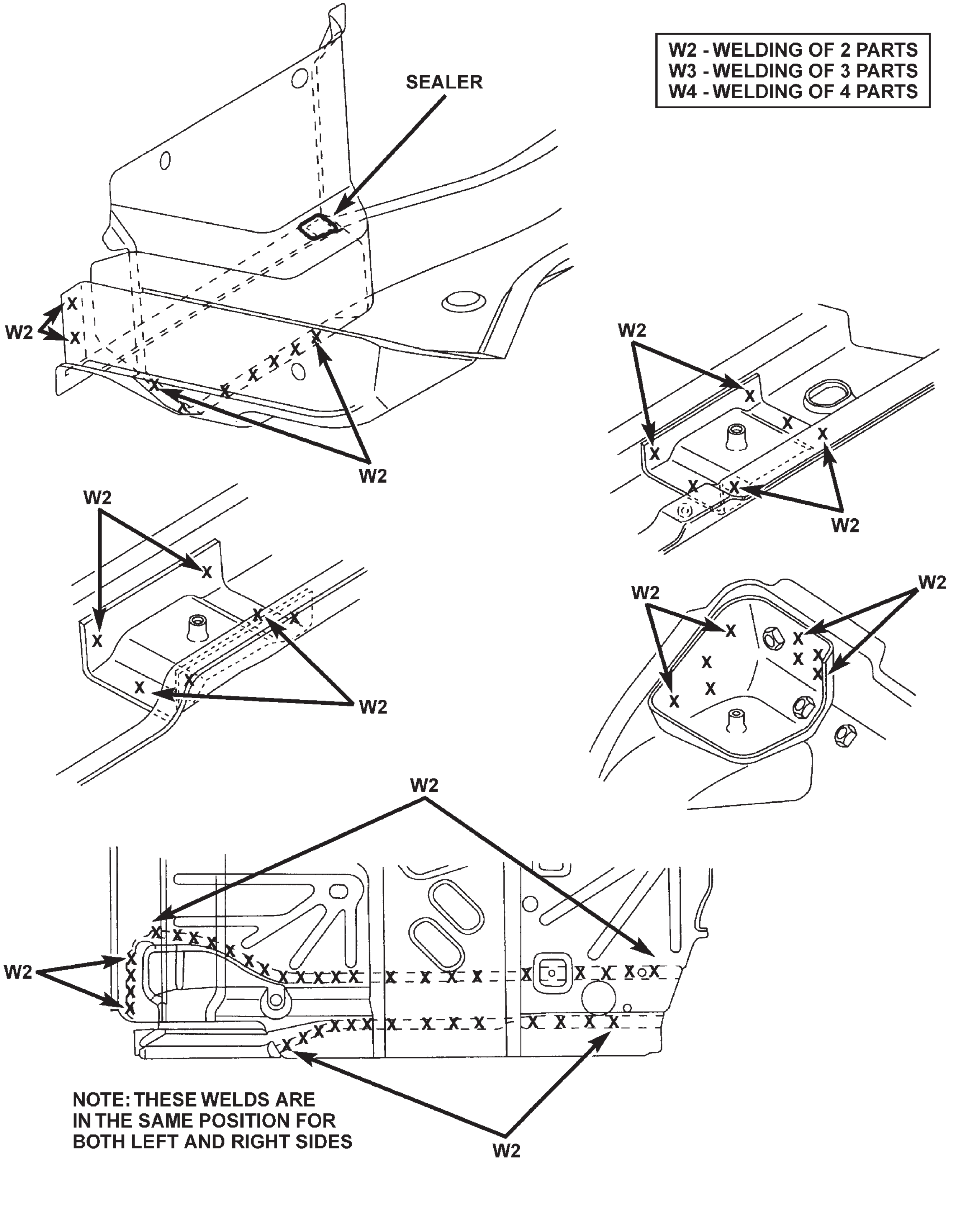


Fig. 24 FRONT FLOOR, STRAINER, REINFORCEMENT AND COWL SIDE LOWER

WELD LOCATIONS (Continued)

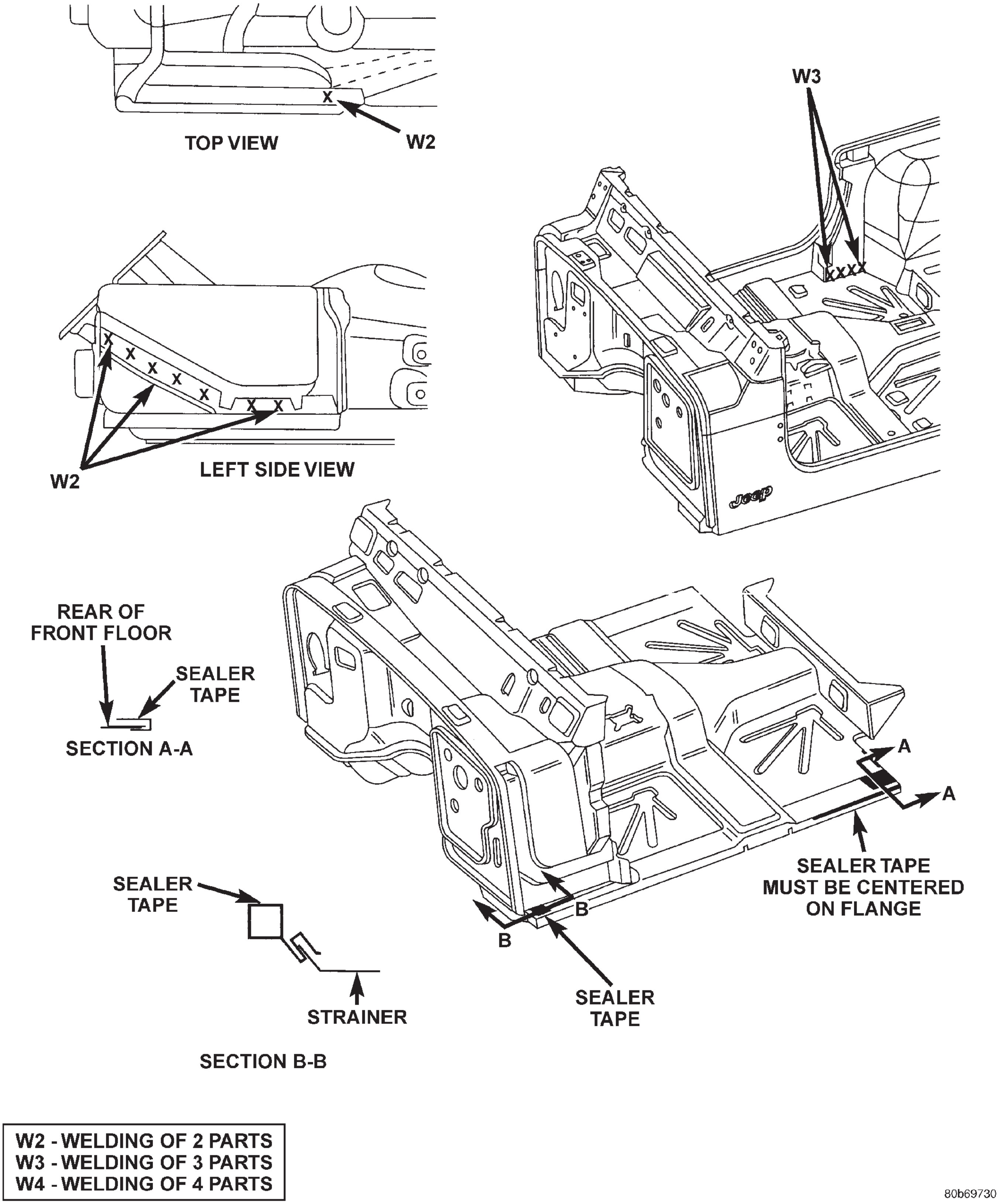
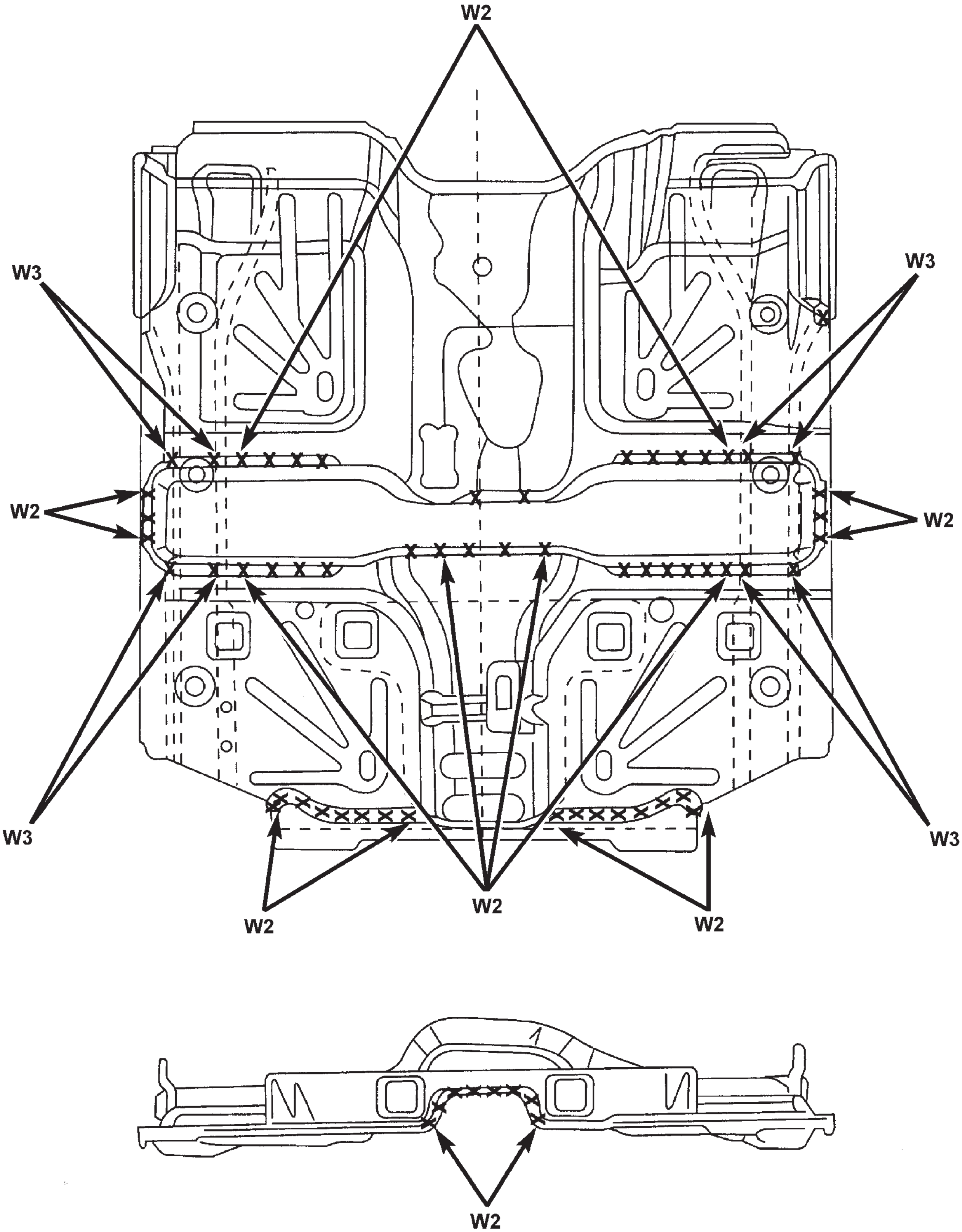


Fig. 25 FRONT FLOOR, STRAINER, REINFORCEMENT AND COWL SIDE LOWER

WELD LOCATIONS (Continued)



W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

REAR VIEW

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Fig. 26 FRONT FLOOR, STRAINER, REINFORCEMENT AND COWL SIDE LOWER

WELD LOCATIONS (Continued)

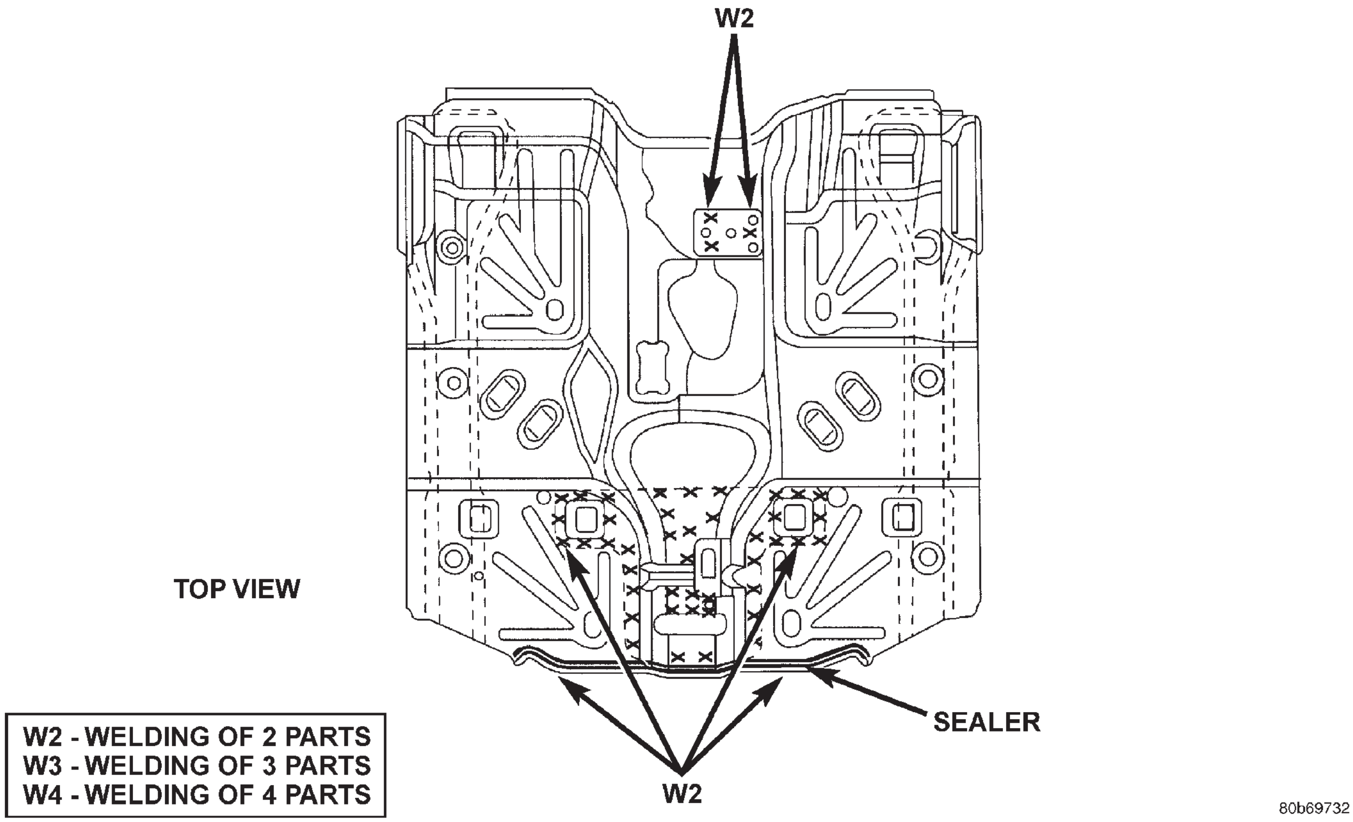

Fig. 27 FRONT FLOOR, STRAINER, REINFORCEMENT AND COWL SIDE LOWER

WELD LOCATIONS (Continued)

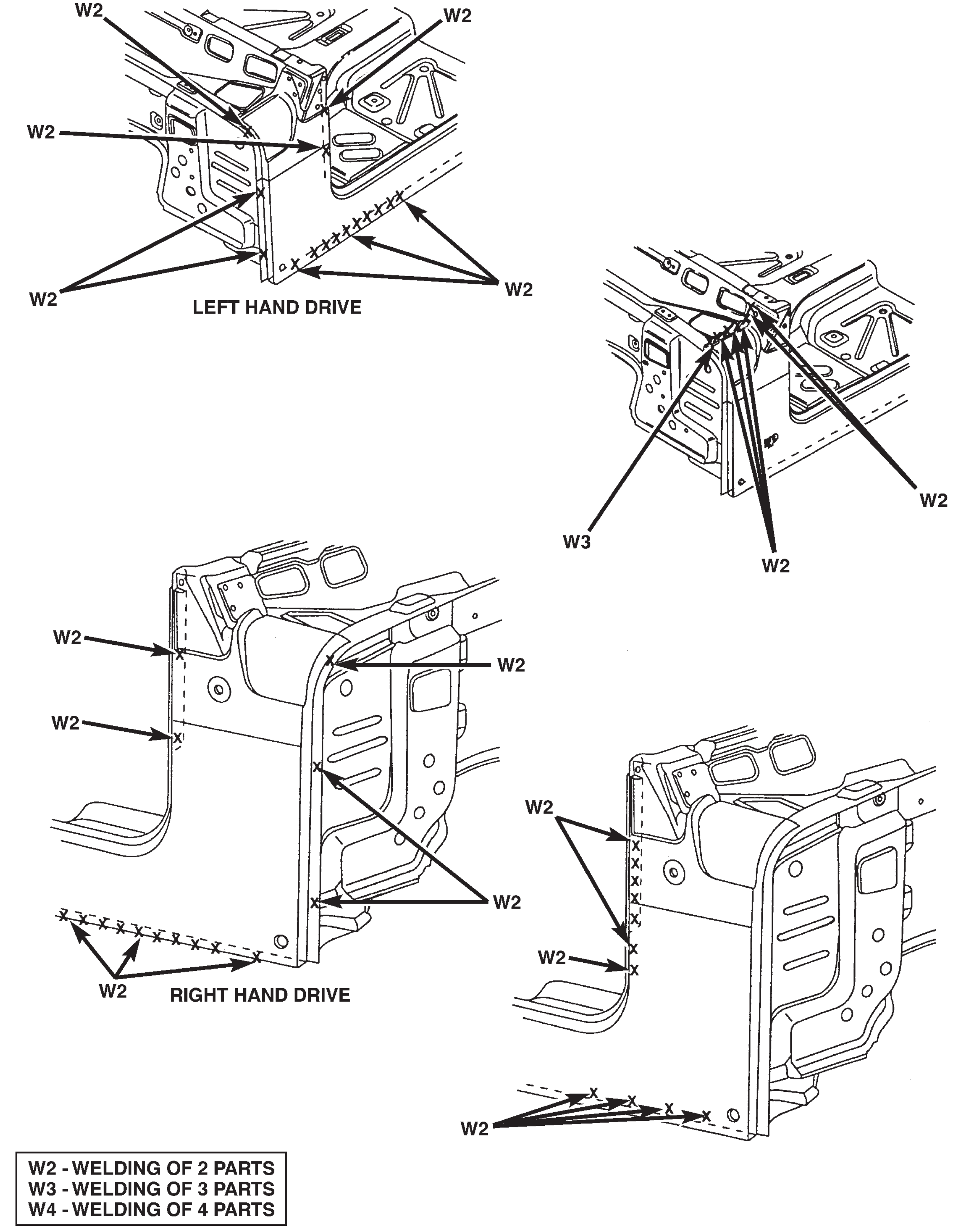

Fig. 28 SIDE APERTURE

WELD LOCATIONS (Continued)

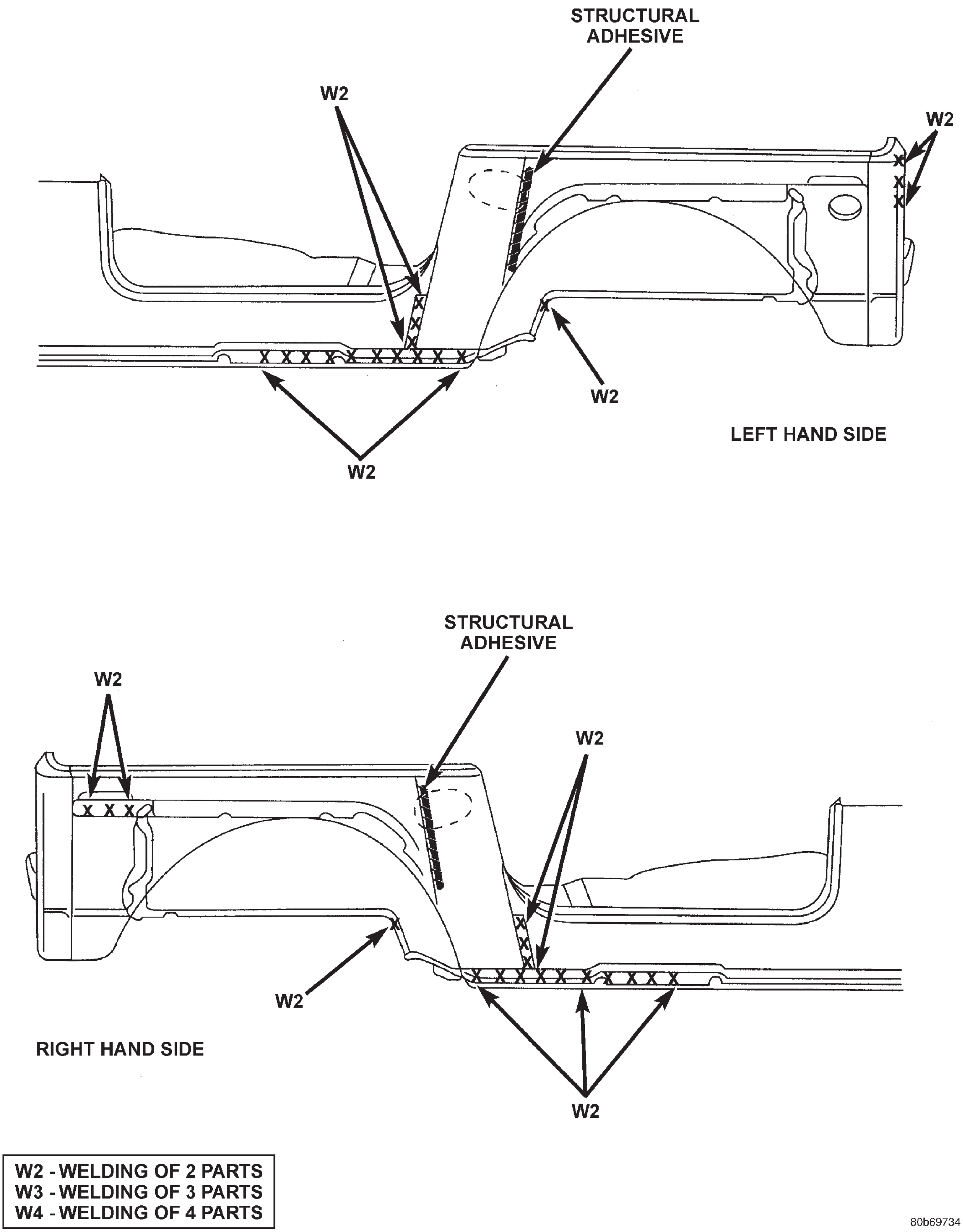

Fig. 29 SIDE APERTURE

WELD LOCATIONS (Continued)

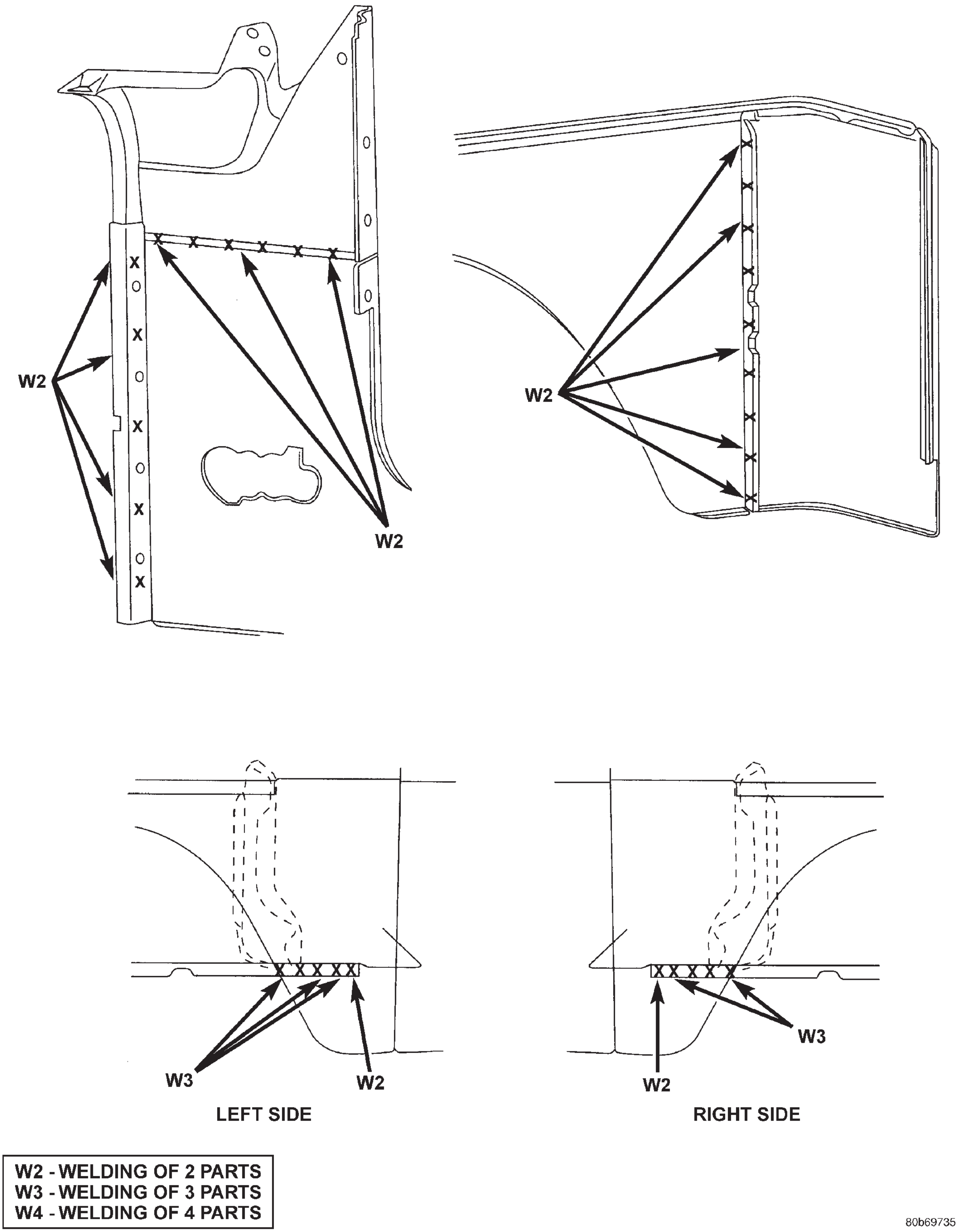

Fig. 30 SIDE APERTURE

WELD LOCATIONS (Continued)

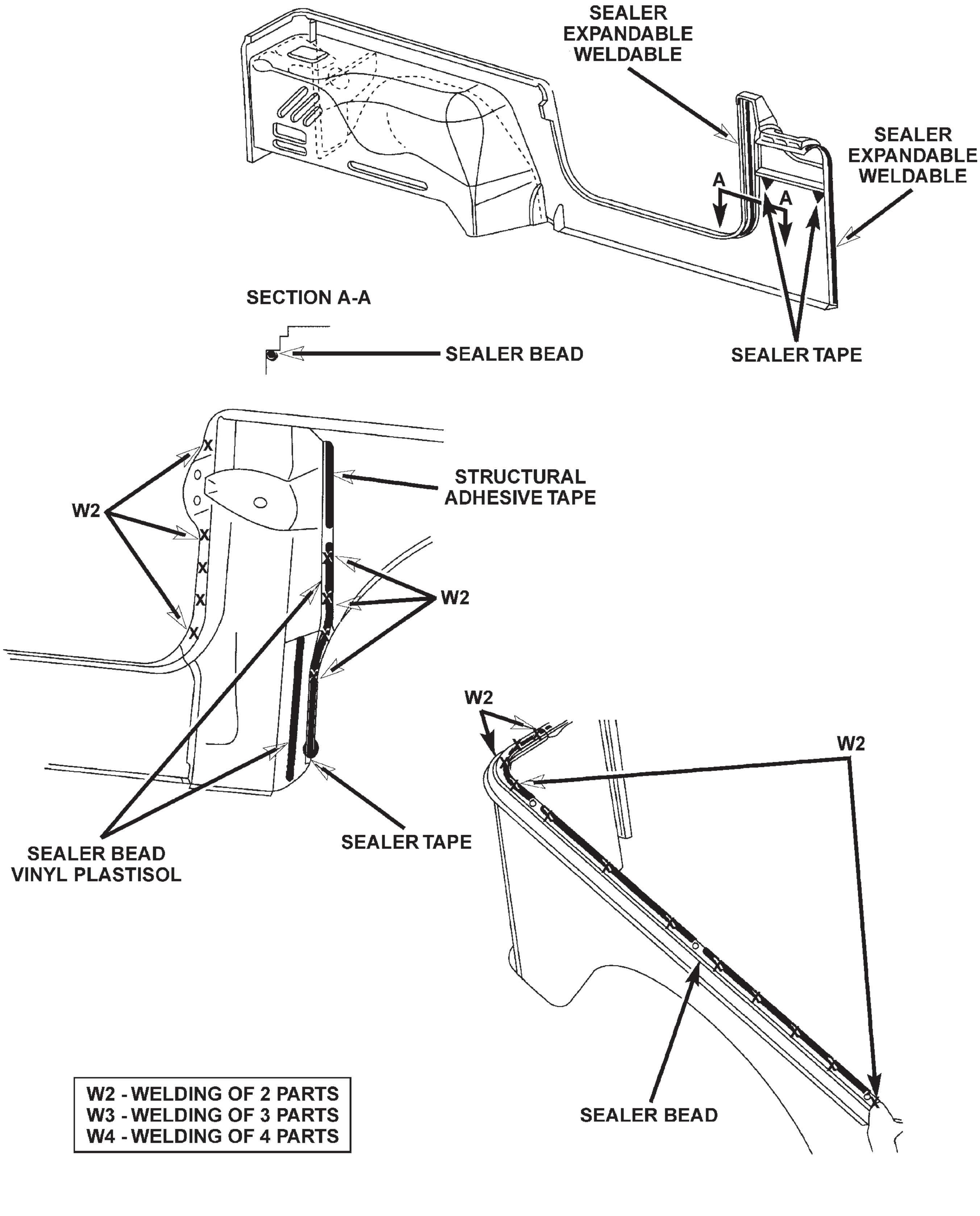

Fig. 31 SIDE APERTURE

WELD LOCATIONS (Continued)

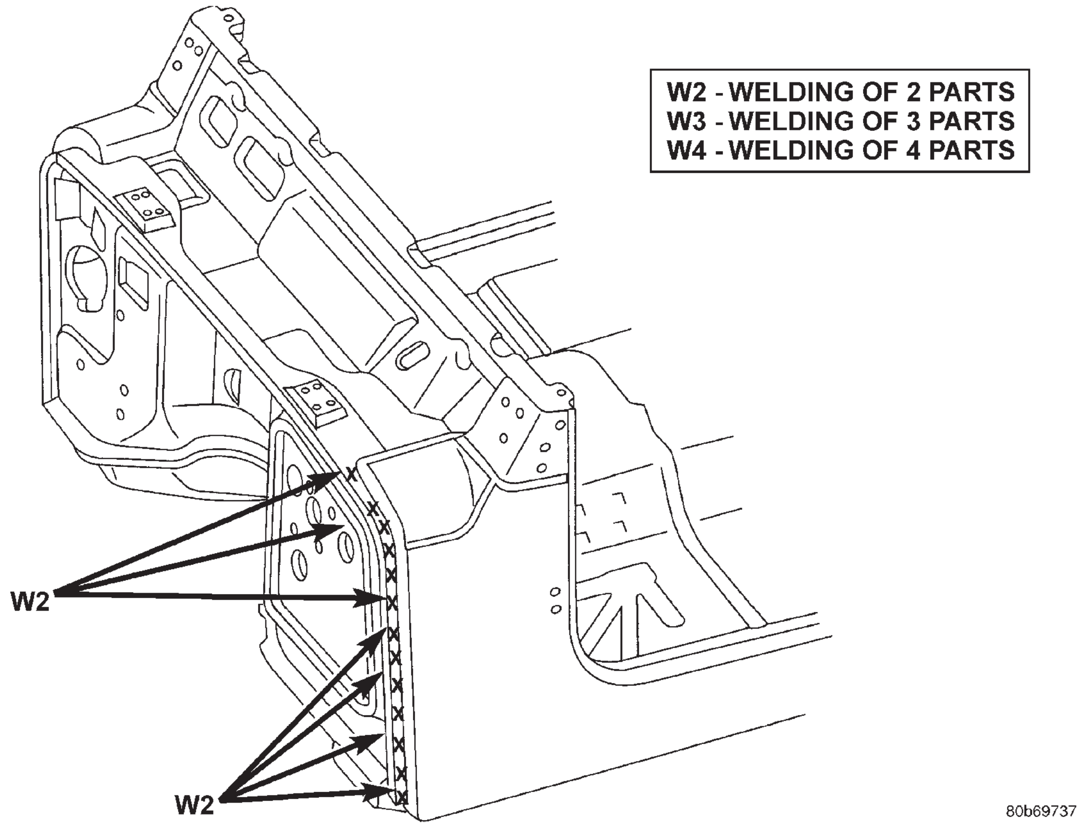

Fig. 32 SIDE APERTURE

WELD LOCATIONS (Continued)

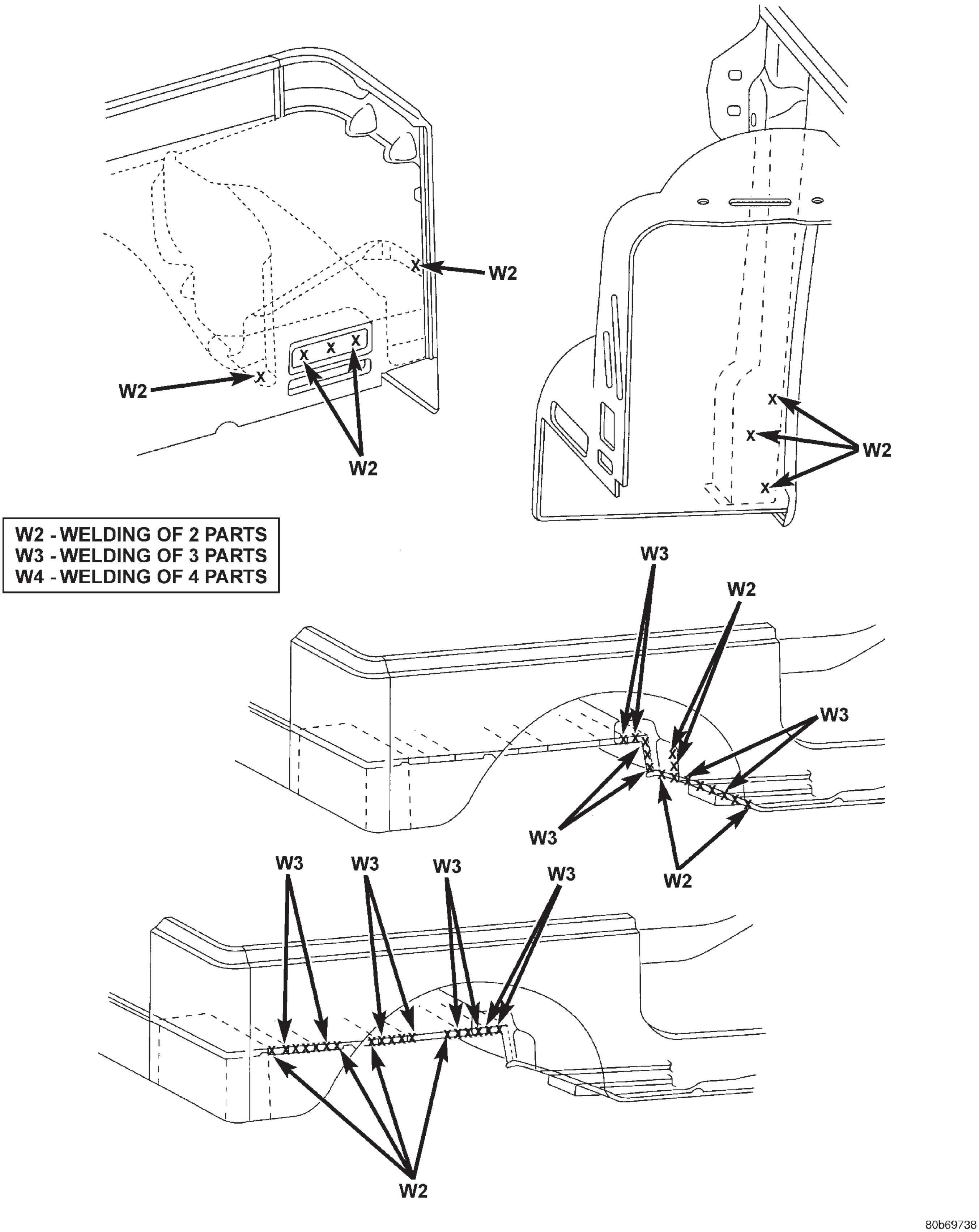

Fig. 33 WHEELHOUSE

WELD LOCATIONS (Continued)

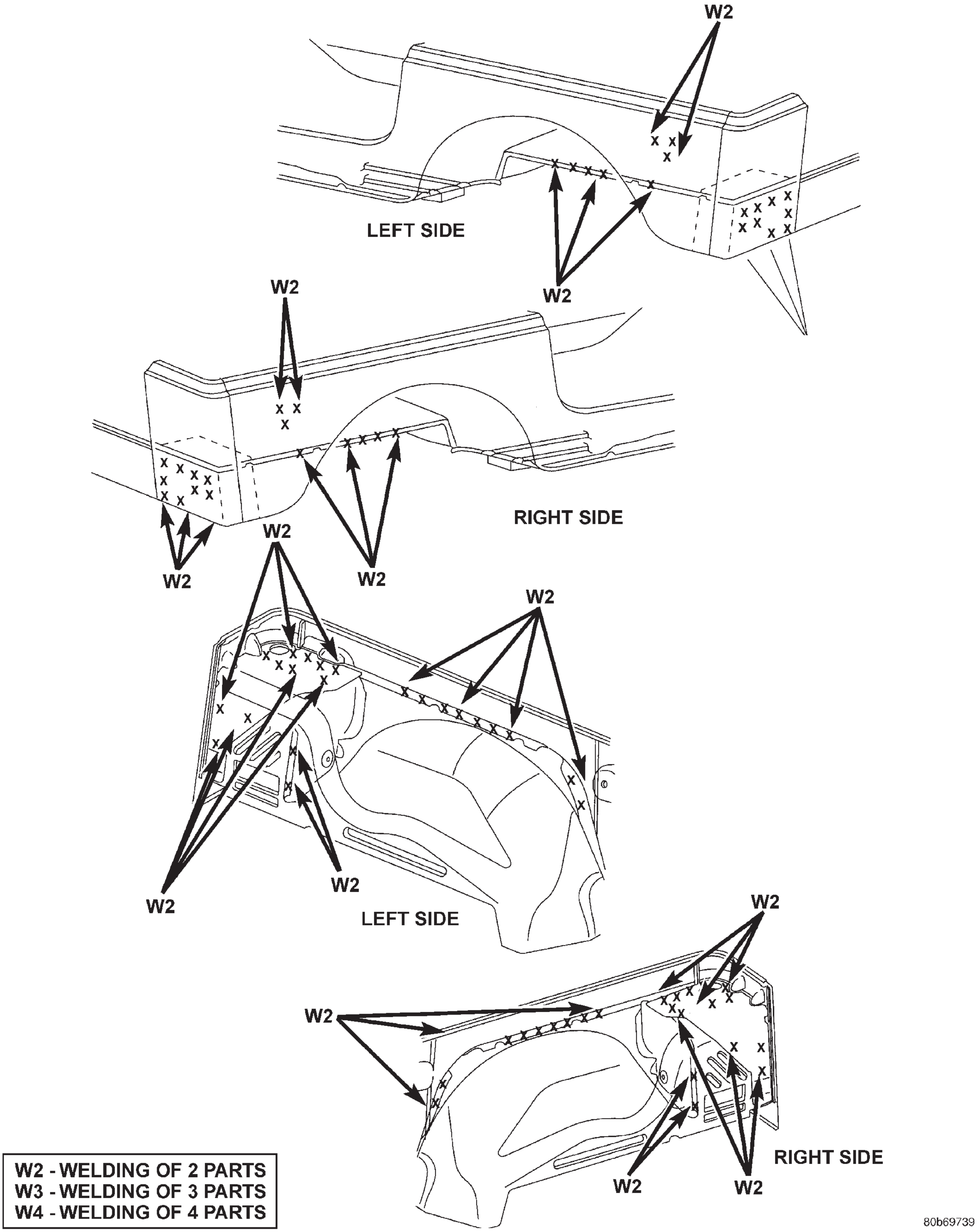

Fig. 34 WHEELHOUSE

WELD LOCATIONS (Continued)

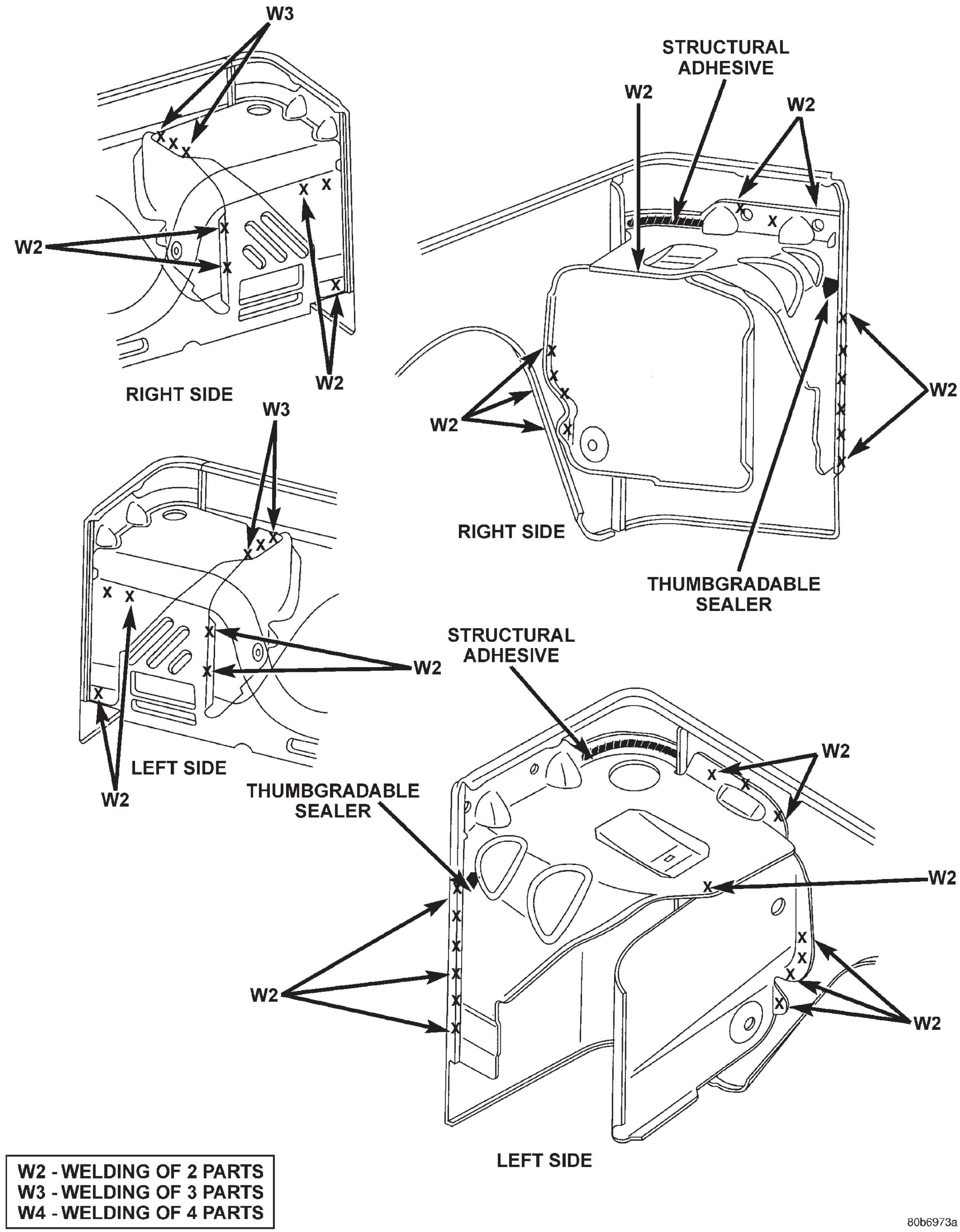

Fig. 35 WHEELHOUSE

WELD LOCATIONS (Continued)

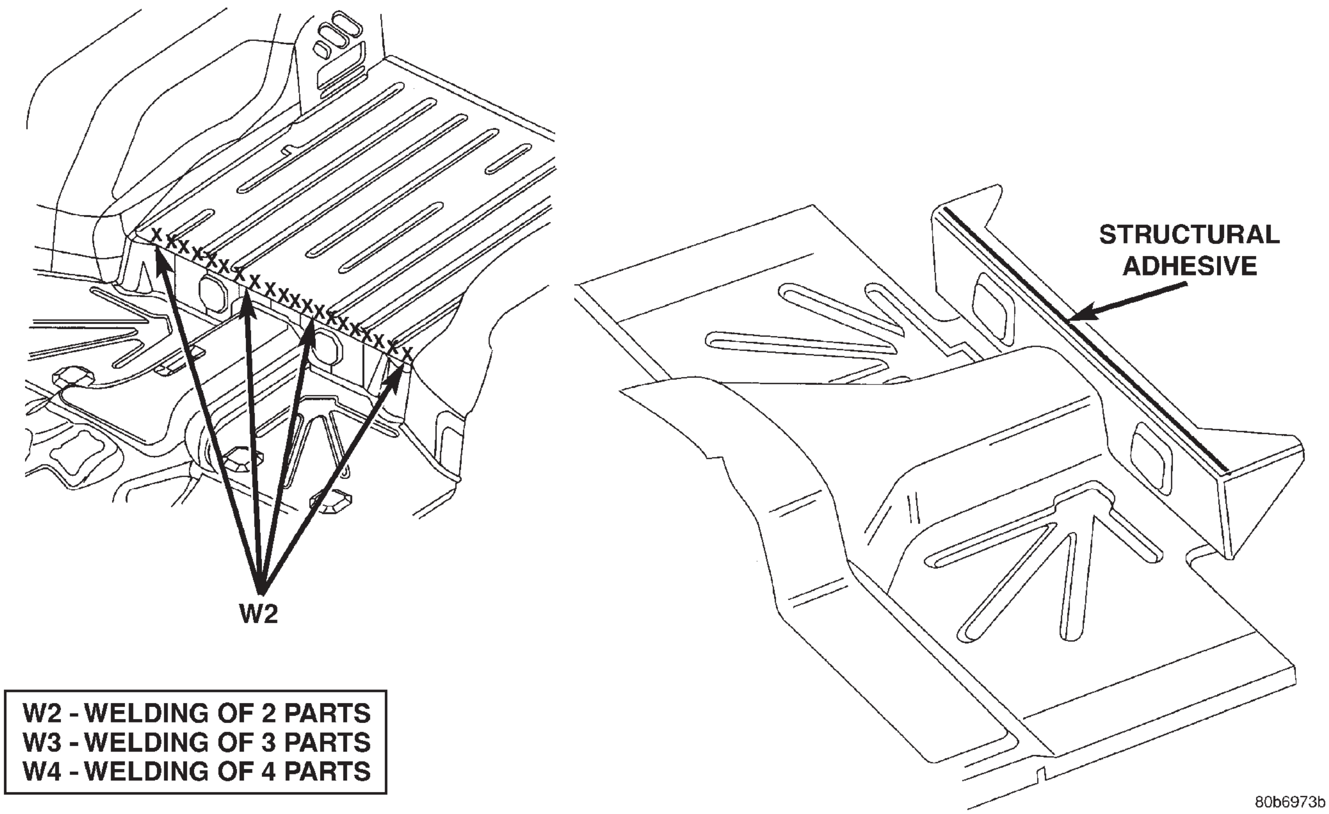

Fig. 36 REAR FLOOR PAN AND REINFORCEMENTS

WELD LOCATIONS (Continued)

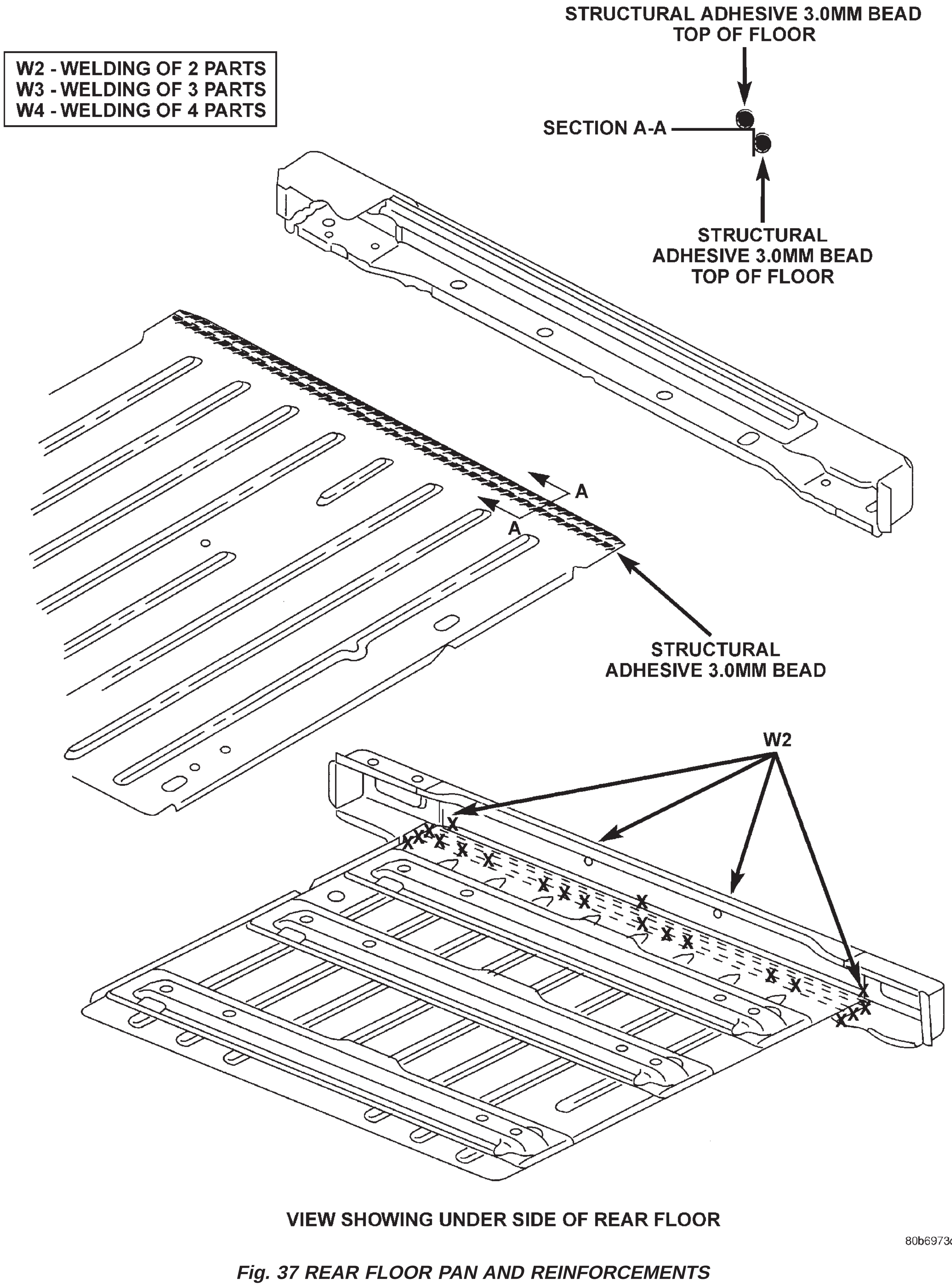

Fig. 37 REAR FLOOR PAN AND REINFORCEMENTS

WELD LOCATIONS (Continued)

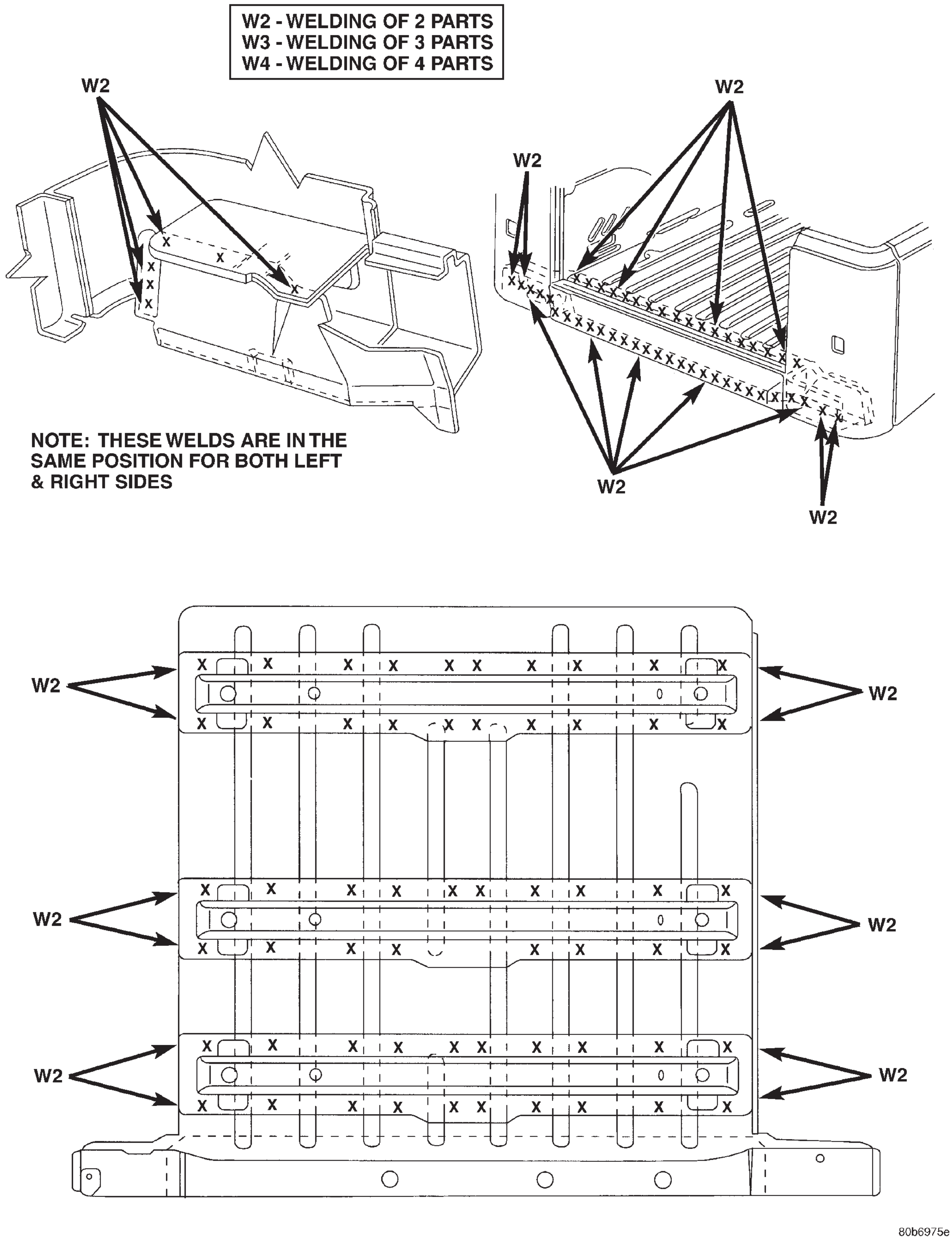

Fig. 38 REAR FLOOR PAN AND REINFORCEMENTS

WELD LOCATIONS (Continued)

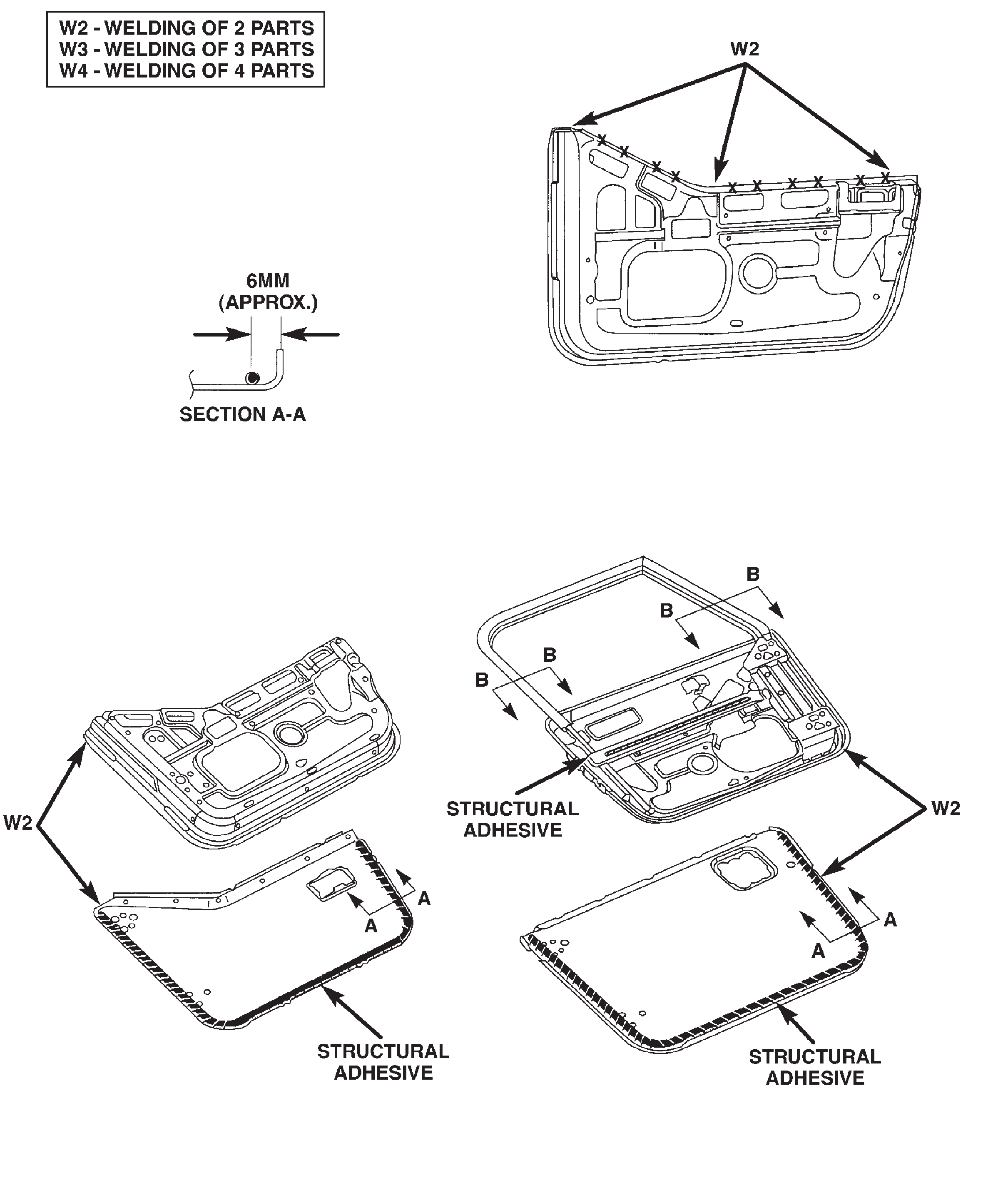

Fig. 39 DOOR OUTER PANELS

WELD LOCATIONS (Continued)

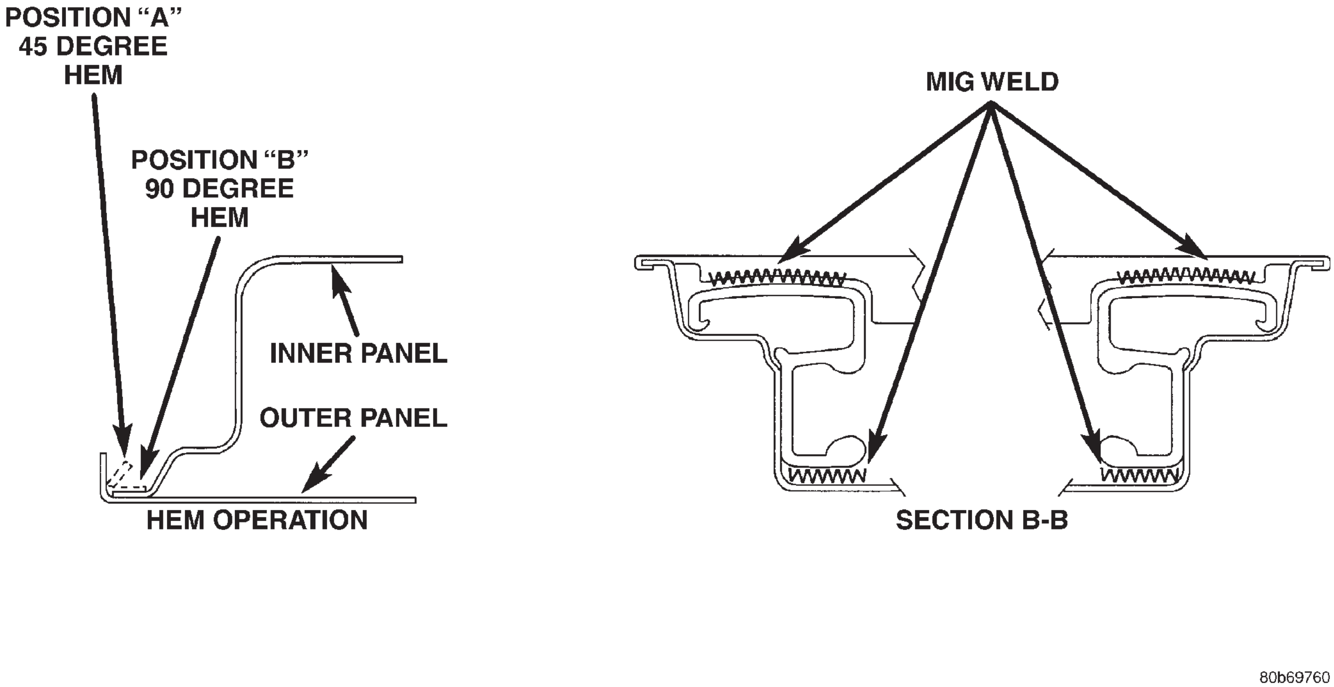

Fig. 40 DOOR OUTER PANELS

HEATING & AIR CONDITIONING

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HEATING & AIR CONDITIONING

DESCRIPTION

DESCRIPTION - HEATER AND AIR CONDITIONER

All vehicles are equipped with a common heater-A/C housing assembly (Fig. 1). The system combines air conditioning, heating, and ventilating capabilities in a single unit housing mounted under the instrument panel. On heater-only systems, the evaporator coil and recirculating air door are omitted from the housing.

Outside fresh air enters the vehicle through the cowl top opening at the base of the windshield, and 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.

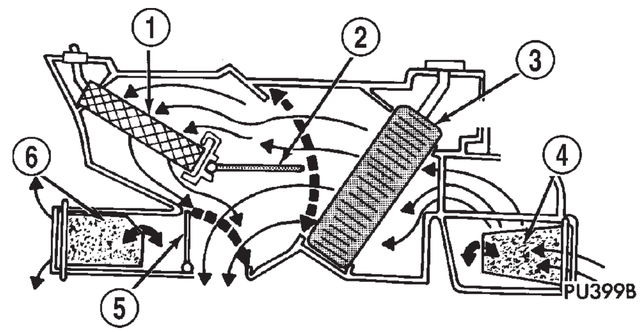

Fig. 1 Common Blend-Air Heater-Air Conditioner System - Typical

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

DESCRIPTION - REFRIGERANT SYSTEM SERVICE PORT

The two refrigerant system service ports are used to charge, recover/recycle, evacuate, and test the air conditioning refrigerant system. Unique service port coupler sizes are used on the R-134a system, to ensure that the refrigerant system is not accidentally contaminated by the use of the wrong refrigerant (R-12), or refrigerant system service equipment.

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.

OPERATION

OPERATION - HEATER AND AIR CONDITIONER

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.

OPERATION - REFRIGERANT SYSTEM SERVICE PORT

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.

WARNING

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.

HEATING & AIR CONDITIONING (Continued)

CAUTION: Liquid refrigerant is corrosive to metal surfaces. Follow the operating instructions supplied with the service equipment being used.

Never add R-12 to a refrigerant system designed to use R-134a. Damage to the system will result.

R-12 refrigerant oil must not be mixed with R-134a refrigerant oil. They are not compatible.

Do not use R-12 equipment or parts on the R-134a system. Damage to the system will result.

Do not overcharge the refrigerant system. This will cause excessive compressor head pressure and can cause noise and system failure.

Recover the refrigerant before opening any fitting or connection. Open the fittings with caution, even after the system has been discharged. Never open or loosen a connection before recovering the refrigerant.

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Recover the refrigerant before opening any fitting or connection. Open the fittings with caution, even after the system has been discharged. Never open or loosen a connection before recovering the refrigerant.

The refrigerant system must always be evacuated before charging.

Do not open the refrigerant system or uncap a replacement component until you are ready to service the system. This will prevent contamination in the system.

Before disconnecting a component, clean the outside of the fittings thoroughly to prevent contamination from entering the refrigerant system.

Immediately after disconnecting a component from the refrigerant system, seal the open fittings with a cap or plug.

Before connecting an open refrigerant fitting, always install a new seal or gasket. Coat the fitting and seal with clean refrigerant oil before connecting.

Do not remove the sealing caps from a replacement component until it is to be installed.

When installing a refrigerant line, avoid sharp bends that may restrict refrigerant flow. Position the refrigerant lines away from exhaust system components or any sharp edges, which may damage the line.

Tighten refrigerant fittings only to the specified torque. The aluminum fittings used in the refrigerant system will not tolerate overtightening.

When disconnecting a refrigerant fitting, use a wrench on both halves of the fitting. This will prevent twisting of the refrigerant lines or tubes.

Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open a container of refrigerant oil until you are ready to use it. Replace the cap on the oil container immediately after using. Store refrigerant oil only in a clean, airtight, and moisture-free container.

Keep service tools and the work area clean. Contamination of the refrigerant system through careless work habits must be avoided.

COOLING SYSTEM REQUIREMENTS

To maintain the performance level of the heating-air conditioning system, the engine cooling system must be properly maintained. The use of a bug screen is not recommended. Any obstructions in front of the radiator or condenser will reduce the performance of the air conditioning and engine cooling systems.

The engine cooling system includes the heater core and the heater hoses (Refer to 7 - COOLING - STANDARD PROCEDURE) 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.

CAUTION

SERVICE CAUTIONS

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.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - HEATER PERFORMANCE

Before performing the following tests (Refer to 7 - COOLING - STANDARD PROCEDURE), to check the radiator coolant level. 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

HEATING & AIR CONDITIONING (Continued)

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)

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.

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.

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

HEATING & AIR CONDITIONING (Continued)

control knob in the full cool position, and the blower motor switch knob in the highest speed position.

(3) Start the engine and hold the idle at 1,000 rpm with the compressor clutch engaged.

(4) The engine should be at operating temperature. The doors and windows must be open.

(5) Insert a thermometer in the driver side center A/C (panel) outlet. Operate the engine for five minutes.

(6) The compressor clutch may cycle, depending upon the ambient temperature and humidity. If the clutch cycles, unplug the low pressure cycling clutch switch wire harness connector from the switch located on the accumulator (Fig. 2). 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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

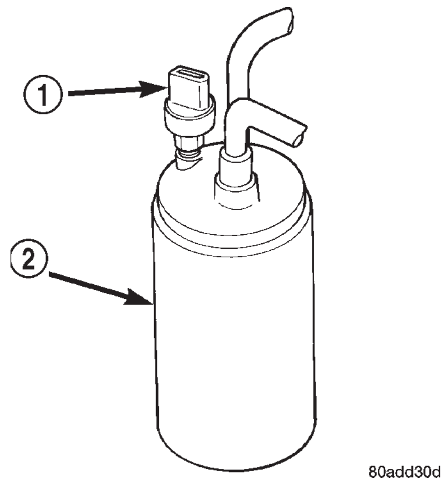

Fig. 2 Low Pressure Cycling Clutch Switch - Typical

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.

HEATING & AIR CONDITIONING (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.	1. See Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required.
	2. Faulty fuse.	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. Faulty compressor clutch coil.	3. See Compressor Clutch Coil in this group. Test the compressor clutch coil and replace, if required.
	4. Faulty compressor clutch relay.	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. Improperly installed or faulty low pressure cycling clutch switch.	5. See Low Pressure Cycling Clutch Switch in this group. Test the low pressure cycling clutch switch and tighten or replace, if required.
	6. Faulty high pressure cut-off switch.	6. See High Pressure Cut-Off Switch in this group. Test the high pressure cut-off switch and replace, if required.
	7. Faulty Powertrain Control Module (PCM).	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.	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. Temperature control cable improperly installed or faulty.	2. See Temperature Control Cable in this group. Inspect the temperature control cable for proper routing and operation and correct, if required.
	3. Blend-air door inoperative or sealing improperly.	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.	1. See Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required.
	2. Refrigerant flow through the accumulator is restricted.	2. See Accumulator in this group. Replace the restricted accumulator, if required.
	3. Refrigerant flow through the evaporator coil is restricted.	3. See Evaporator Coil in this group. Replace the restricted evaporator coil, if required.

HEATING & AIR CONDITIONING (Continued)

Pressure Diagnosis		
Condition	Possible Causes	Correction
	4. Faulty compressor.	4. See Compressor in this group. Replace the compressor, if required.
The low side pressure is normal or slightly high, and the high side pressure is too high.	1. Condenser air flow restricted.	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 7 - COOLING/ENGINE/RADIATOR - REMOVAL). Clean, repair, or replace components as required.
	2. Inoperative cooling fan.	2. (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL). Test the cooling fan and replace, if required.
	3. Refrigerant system overcharged.	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. Air in the refrigerant system.	4. See Refrigerant System Leaks in this group. Test the refrigerant system for leaks. repair, evacuate and charge the refrigerant system, if required.
	5. Engine overheating.	5. Test the cooling system and repair, if required (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
The low side pressure is too high, and the high side pressure is too low.	1. Accessory drive belt slipping.	1. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - DIAGNOSIS AND TESTING) Inspect the accessory drive belt condition and tension. Tighten or replace the accessory drive belt, if required.
	2. Fixed orifice tube not installed.	2. See Fixed Orifice Tube in this group. Install the missing fixed orifice tube, if required.
	3. Faulty compressor.	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.	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. Restricted refrigerant flow through the fixed orifice tube.	2. See Fixed Orifice Tube in this group. Replace the restricted fixed orifice tube, if required.
	3. Restricted refrigerant flow through the condenser.	3. See Condenser in this group. Replace the restricted condenser, if required.

STANDARD PROCEDURE

STANDARD PROCEDURE - DIODE REPLACEMENT

(1) Disconnect the battery negative cable and isolate it.

(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. 3).

(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.**

HEATING & AIR CONDITIONING (Continued)

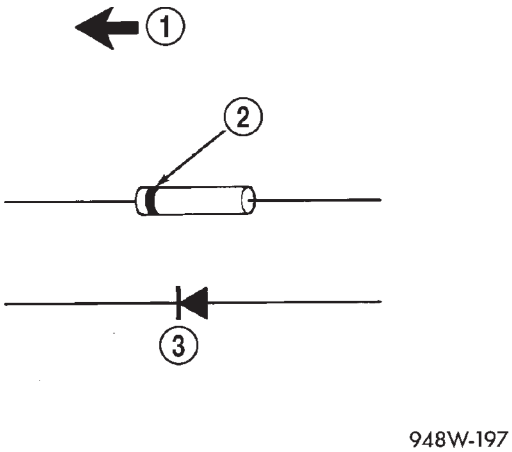

Fig. 3 Diode Identification

1 - CURRENT FLOW
2 - BAND AROUND DIODE INDICATES CURRENT FLOW
3 - DIODE AS SHOWN IN THE DIAGRAMS

(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 negative cable and test affected systems.

STANDARD PROCEDURE - 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. 4). The service hoses on the gauge set being used should have manual (turn wheel), or automatic back-flow valves at the service port connector ends. This will prevent refrigerant from being released into the atmosphere.

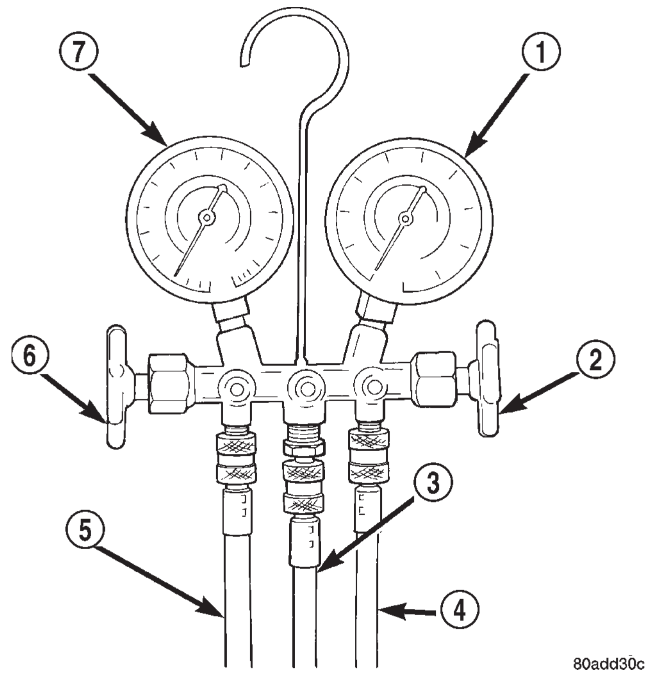

Fig. 4 Manifold Gauge Set - Typical

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

MANIFOLD GAUGE SET CONNECTIONS

CAUTION: Do not use an R-12 manifold gauge set on an R-134a system. The refrigerants are not compatible and system damage will result.

LOW PRESSURE GAUGE HOSE The low pressure hose (Blue with Black stripe) attaches to the suction service port. This port is located on the 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.

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	

CONTROLS

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CONTROLS

DIAGNOSIS AND TESTING - 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. 1), 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.

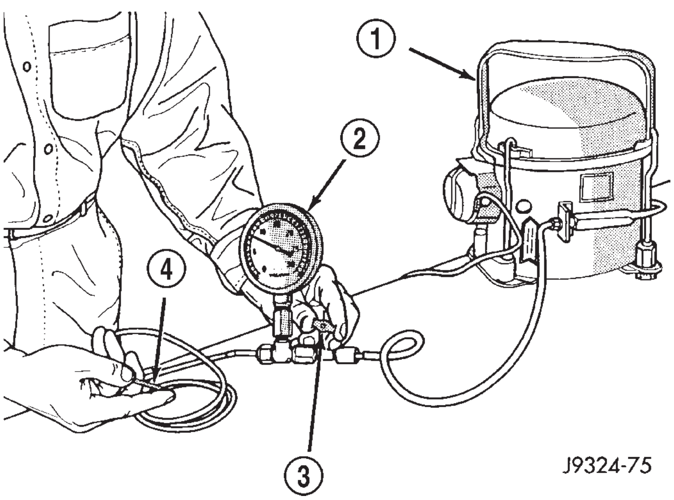

Fig. 1 Adjust Vacuum Test Bleed Valve

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.

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, 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.

CONTROLS (Continued)

(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. 2). 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.

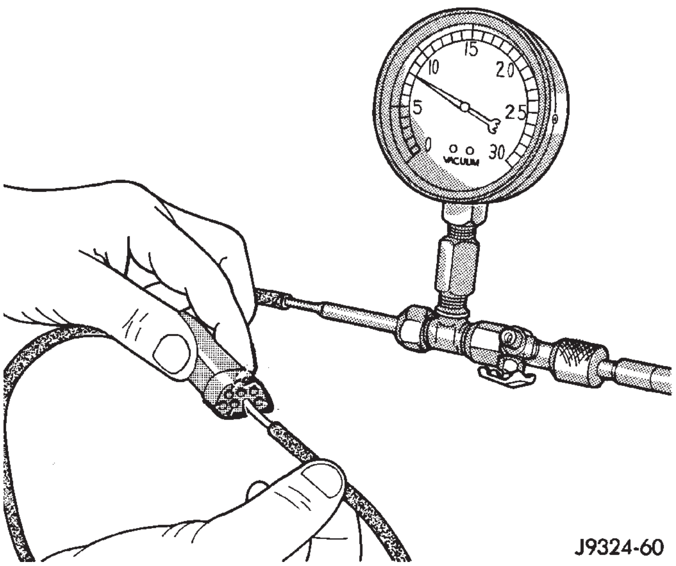

Fig. 2 Vacuum Circuit Test

(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. 3).

(4) Disconnect and plug the vacuum line from the component (fitting, actuator, valve, switch, or reservoir) on the other end of the leaking circuit. Instrument panel disassembly or removal may be necessary to gain access to some components.

(5) Connect the test set hose or probe to the open end of the leaking circuit. The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty disconnected component. If not OK, go to Step 6.

(6) To locate a leak in a vacuum line, leave one end of the line plugged and connect the test set hose or probe to the other end. Run your fingers slowly along the line while watching the test set gauge. The 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.

CONTROLS (Continued)

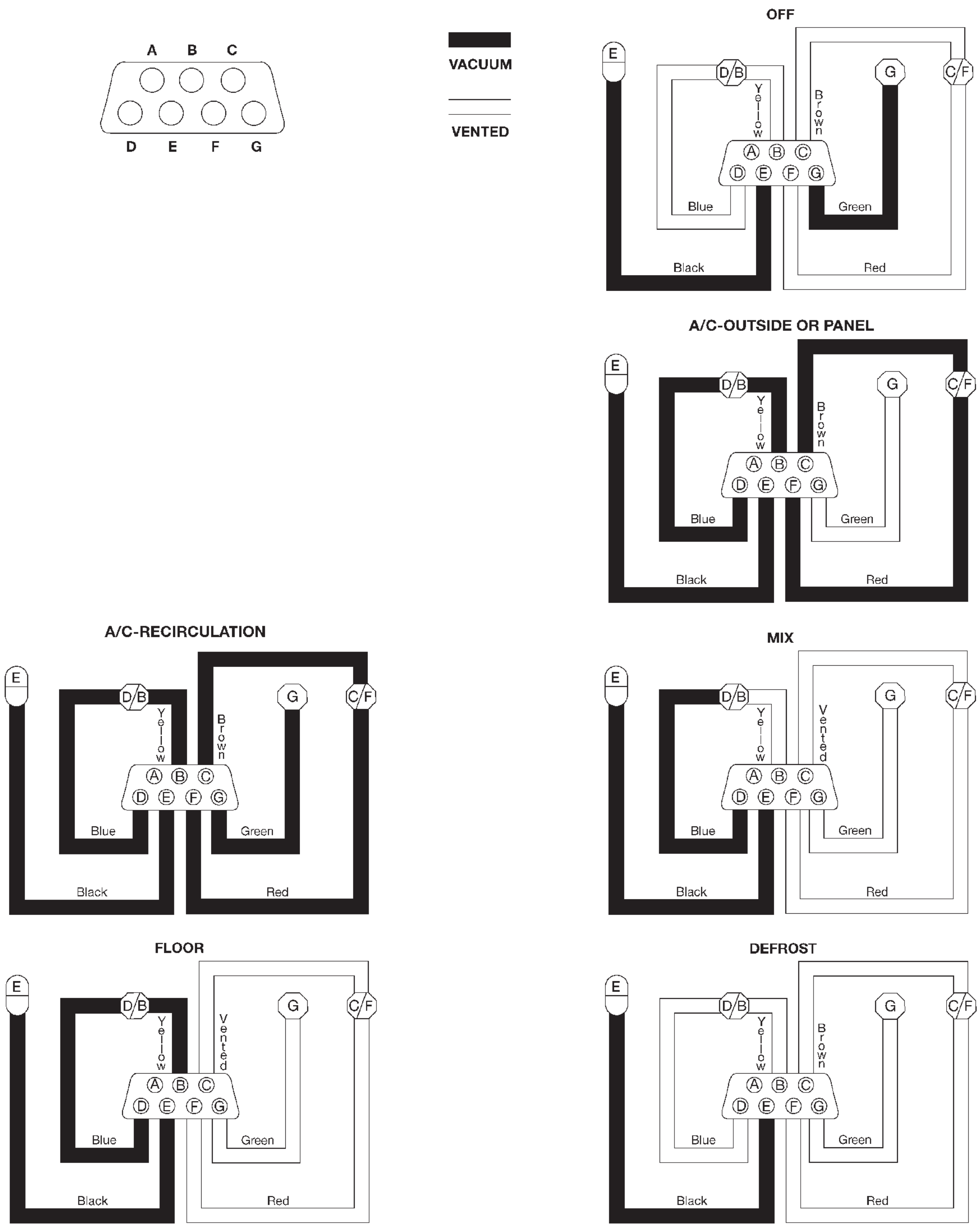

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Fig. 3 Vacuum Circuits - Heater-A/C

VACUUM CIRCUIT LEGEND

I.D.	Function	Color
A	Not Used	N/A
B	Defrost Actuator	Yellow
C	Floor Actuator	Brown
D	Defrost Actuator (Mid-Position)	Blue
E	Vacuum Supply (Reservoir)	Black
F	Panel Actuator	Red
G	Recirculation Acutator	Green

A/C COMPRESSOR CLUTCH/ COIL

DESCRIPTION

The compressor clutch assembly consists of a stationary electromagnetic coil, a hub bearing and pulley assembly, and a clutch plate (Fig. 4). 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.

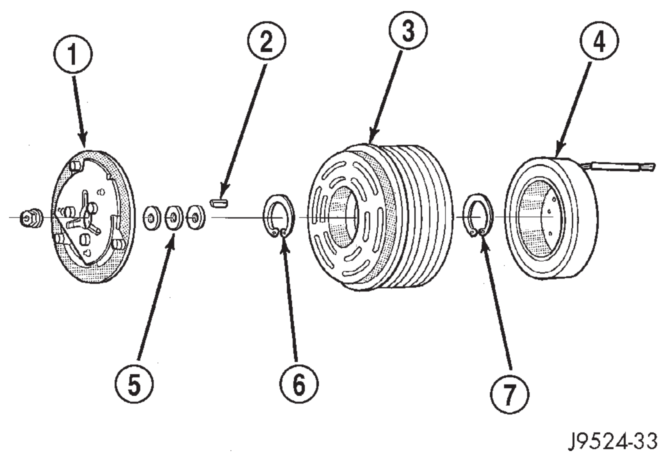

Fig. 4 Compressor Clutch

1 - CLUTCH PLATE
2 - SHAFT KEY
3 - PULLEY
4 - COIL
5 - CLUTCH SHIMS
6 - SNAP RING
7 - SNAP RING

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.

DIAGNOSIS AND TESTING - A/C COMPRESSOR CLUTCH/COIL

For circuit descriptions and diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds. The battery must be fully-charged before performing the following tests.

(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 fuse block 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.

REMOVAL

The refrigerant system can remain fully-charged during compressor clutch, pulley, or coil replacement. The compressor clutch can be serviced in the vehicle.

A/C COMPRESSOR CLUTCH/COIL (Continued)

(1) Disconnect and isolate the battery negative cable.

(2) Remove the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL) 2.5L(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL) 4.0L.

(3) Remove the bolt that secures the compressor clutch to the compressor shaft (Fig. 5). A band-type oil filter wrench may be used to secure the clutch during bolt removal.

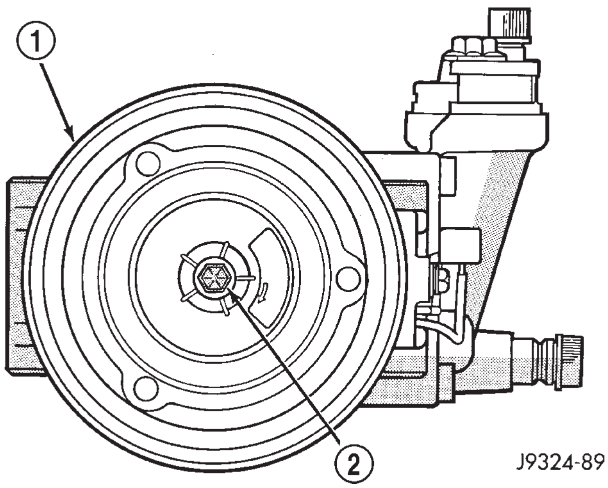

Fig. 5 Compressor Shaft Bolt

1 - COMPRESSOR CLUTCH PLATE
2 - COMPRESSOR SHAFT BOLT

(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. 6).

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) or equivalent and slide the pulley assembly off of the compressor (Fig. 7).

(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. 8).

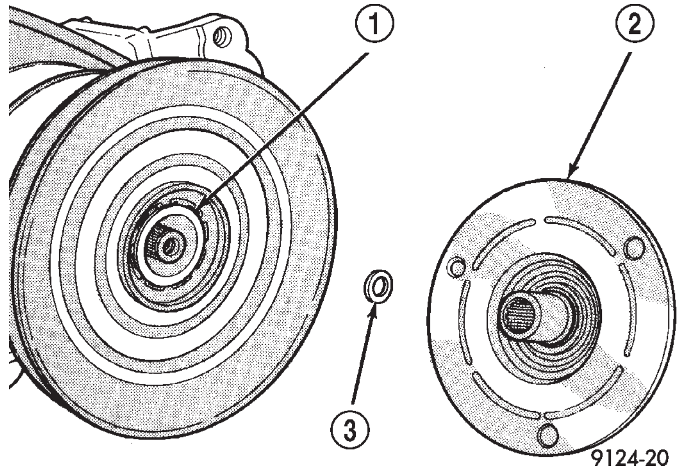

Fig. 6 Clutch Plate and Shim

1 - COMPRESSOR SHAFT
2 - CLUTCH PLATE
3 - CLUTCH PLATE SHIM

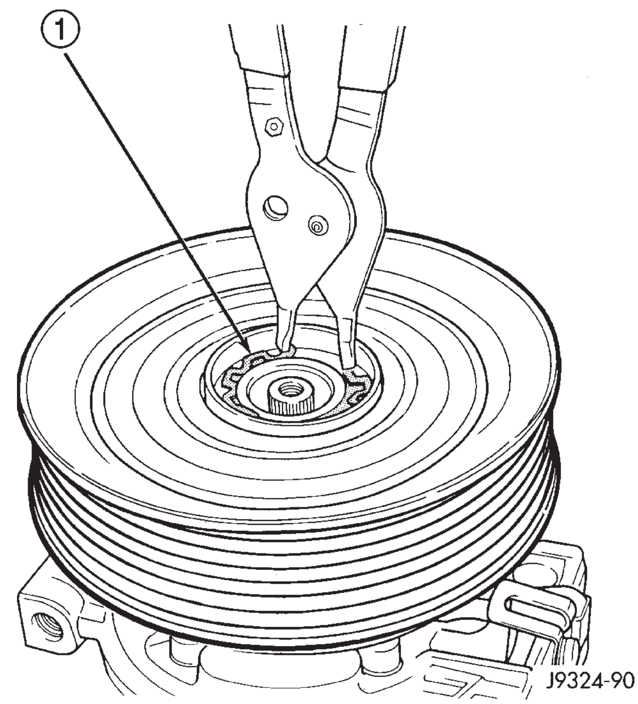

Fig. 7 Pulley Snap Ring

1 - SNAP RING

INSPECTION

The refrigerant system can remain fully-charged during compressor clutch, pulley, or coil replacement. The compressor clutch can be serviced in the vehicle.

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.

A/C COMPRESSOR CLUTCH/COIL (Continued)

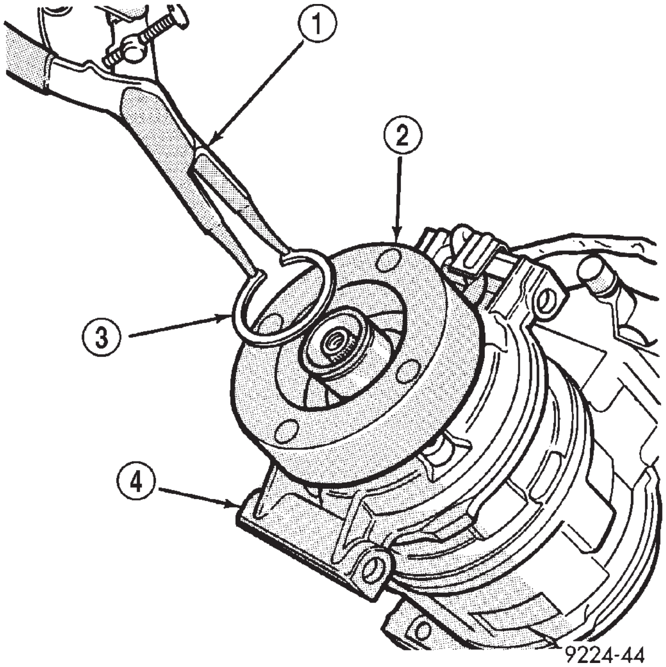

Fig. 8 Clutch Coil Snap Ring

1 - SNAP RING PLIERS
2 - CLUTCH COIL
3 - SNAP RING
4 - COMPRESSOR

If the friction surfaces are oily, inspect the shaft and nose area of the compressor for refrigerant oil. 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 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

The refrigerant system can remain fully-charged during compressor clutch, pulley, or coil replacement. The compressor clutch can be serviced in the vehicle.

(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. 9).

CAUTION: Do not mar the pulley friction surface.

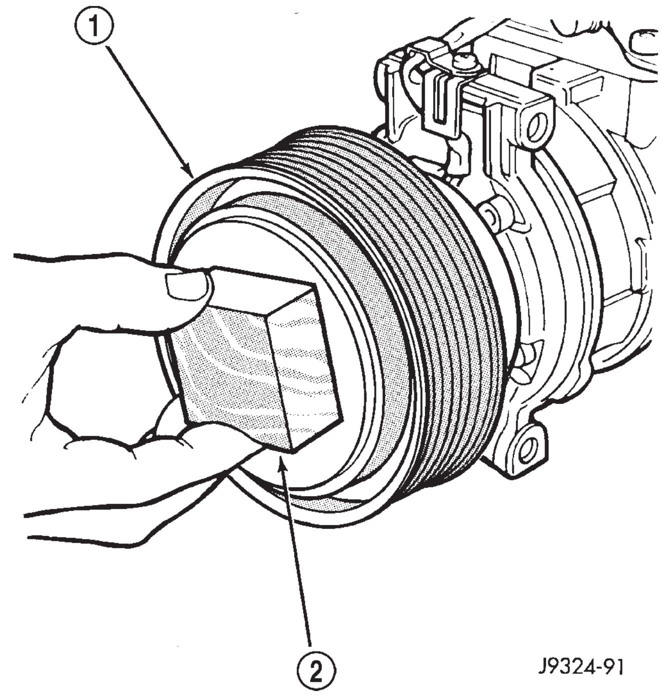

Fig. 9 Pulley Assembly Install

1 - PULLEY ASSEMBLY
2 - WOOD BLOCK

(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.

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.

(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

A/C COMPRESSOR CLUTCH/COIL (Continued)

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.).

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.

A/C 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.

DIAGNOSIS AND TESTING - A/C COMPRESSOR CLUTCH RELAY

For circuit descriptions and diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

RELAY TEST

The compressor clutch relay (Fig. 10)is located in the Power Distribution Center (PDC). Refer to the PDC label for relay identification and location. Remove the relay from the PDC to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see the Relay Circuit Test procedure in this group. If not OK, replace the faulty relay.

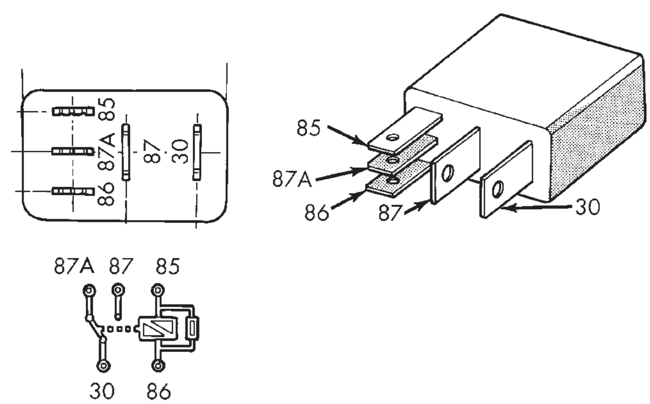

Fig. 10 Compressor Clutch Relay

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

RELAY CIRCUIT TEST

For circuit descriptions and diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

(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.

A/C COMPRESSOR CLUTCH RELAY (Continued)

(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 fuse block 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.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 11).

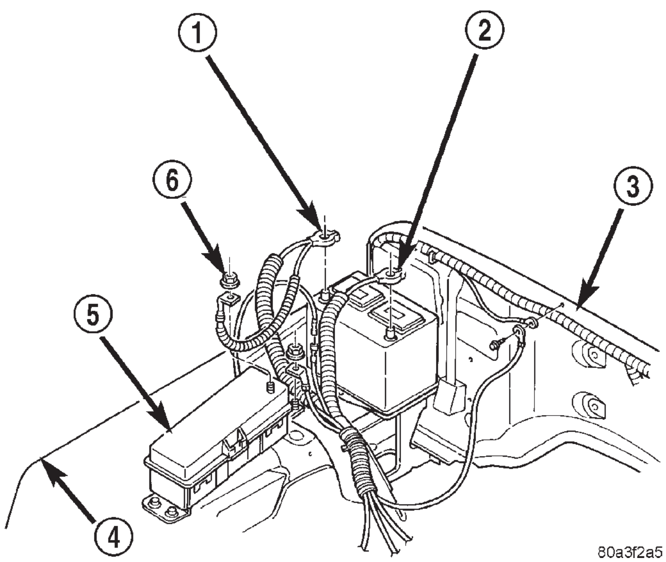

Fig. 11 Power Distribution Center

1 - POSITIVE CABLE
2 - NEGATIVE CABLE
3 - DASH PANEL
4 - FENDER
5 - POWER DISTRIBUTION CENTER
6 - NUT

(3) Refer to the label on the PDC for compressor clutch relay identification and location.

(4) Unplug the compressor clutch relay from the PDC and remove the relay.

INSTALLATION

(1) Install the compressor clutch relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(2) Install the PDC cover.

(3) Connect the battery negative cable.

(4) Test the relay operation.

A/C HEATER 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.

REMOVAL

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.

A/C HEATER CONTROL (Continued)

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/ GLOVE BOX - REMOVAL).

(3) Remove the center bezel from the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/ INSTRUMENT PANEL CENTER BEZEL - REMOVAL).

(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. 12).

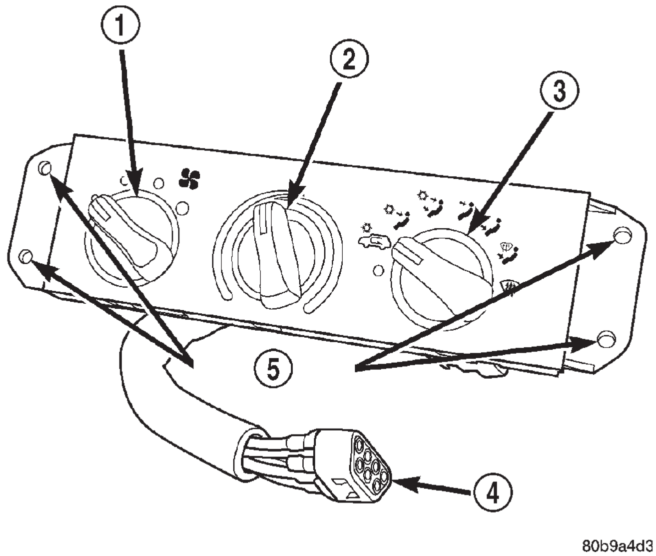

Fig. 12 Heater-A/C Control Remove/Install

1 - BLOWER MOTOR SWITCH
2 - TEMPERATURE CONTROL
3 - MODE SWITCH
4 - VACUUM HARNESS
5 - MOUNTING POINTS

(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. 13).

(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.

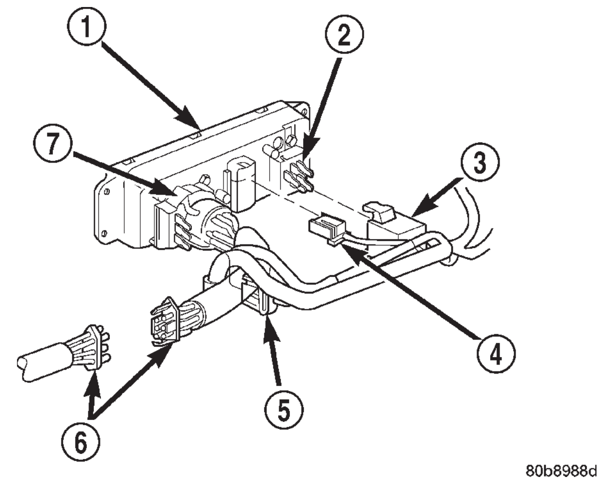

Fig. 13 Heater-A/C Control Connections

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

(4) Reinstall the glove box in the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION).

(5) Reinstall the center bezel onto the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/ INSTRUMENT PANEL CENTER BEZEL - INSTALLATION).

(6) Connect the battery negative cable.

A/C HIGH PRESSURE 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 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 switch contacts are open when the discharge line pressure rises above 3100 to 3375

A/C HIGH PRESSURE SWITCH (Continued)

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 switch is a factory-calibrated unit. The switch cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING - A/C HIGH PRESSURE SWITCH

Before performing diagnosis of the high pressure switch, verify that the refrigerant system has the correct refrigerant charge (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

For circuit descriptions and diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the high pressure 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.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the high pressure switch, which is mounted to a fitting on the non-flexible section of the discharge line nearest the compressor.

(3) Unscrew the high pressure switch from the discharge line fitting.

(4) Remove the high pressure 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 switch on the discharge line fitting.

(3) Plug the wire harness connector into the high pressure switch.

(4) Connect the battery negative cable.

A/C LOW PRESSURE SWITCH

DESCRIPTION

The low pressure 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

TheA/C low pressure switch is connected in series electrically with the A/C high pressure 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 A/C low pressure switch contacts are open when the suction pressure is approximately 172 kPa (25 psi) or lower. The switch contacts will close when the suction pressure rises to approximately 276 kPa (40 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 A/C 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.

DIAGNOSIS AND TESTING - A/C LOW PRESSURE SWITCH

Before performing diagnosis of the A/C low pressuse 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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

For circuit descriptions and diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and con-

A/C LOW PRESSURE SWITCH (Continued)

nector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the A/C low pressure switch wire harness connector from the switch on the accumulator fitting.

(3) Install a jumper wire between the two cavities of the A/C low pressure switch wire harness connector.

(4) Connect a manifold gauge set to the refrigerant system service ports (Refer to 24 - HEATING & AIR CONDITIONING - STANDARD PROCEDURE).

(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 A/C low pressure switch. There should be continuity with a suction pressure reading of 276 kPa (40 psi) or above, and no continuity with a suction pressure reading of 172 kPa (25 psi) or below. If OK, test and repair the A/C switch sense circuit as required. If not OK, replace the faulty switch.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the A/C low pressure switch on the top of the accumulator (Fig. 14).

(3) Unscrew the A/C low pressure 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 A/C low pressure switch on the accumulator fitting. The switch should be hand-tightened onto the accumulator fitting.

(3) Plug the wire harness connector into the A/C low pressure switch.

(4) Connect the battery negative cable.

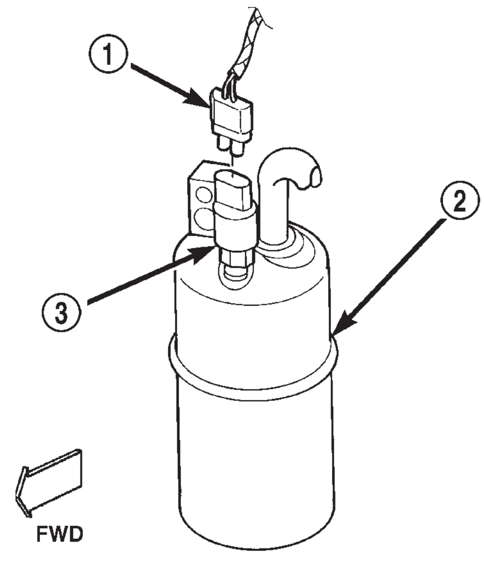

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Fig. 14 Low Pressure Cycling Clutch Switch Remove/Install - Typical

1 - WIRE HARNESS CONNECTOR
2 - ACCUMULATOR
3 - A/C LOW PRESSURE SWITCH

BLEND-AIR DOOR MOTOR

REMOVAL

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.

(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).

(4) Remove the blend-air door motor.

INSTALLATION

(1) Position the blend air door motor over the actuator shaft.on the housing.

BLEND-AIR DOOR MOTOR (Continued)

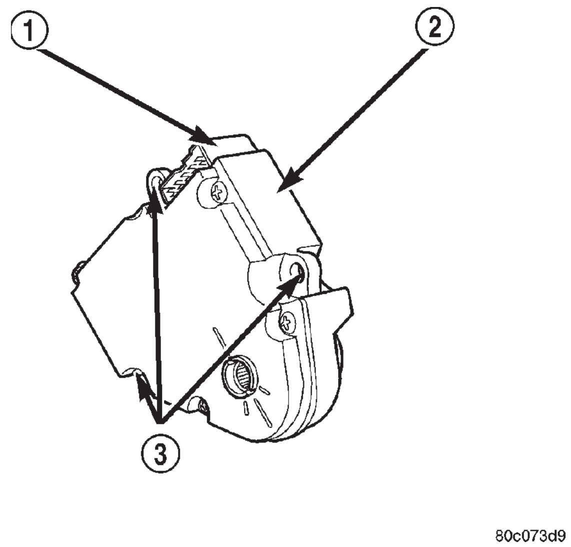

Fig. 15 Blend-Air Door Motor

1 - ELECTRICAL CONNECTOR
2 - BLEND-AIR DOOR MOTOR
3 - SCREW MOUNTING POINTS

(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 wire harness connector.

(4) Connect the battery negative cable.

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 fuse block module through the blower motor resistor.

The blower motor relay coil is controlled by a voltage signal from the blower motor switch (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/ BLOWER MOTOR RELAY - DIAGNOSIS AND TESTING).

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.

DIAGNOSIS AND TESTING - BLOWER MOTOR RELAY

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.

RELAY TEST

The blower motor relay (Fig. 16) is located in a wire harness connector that is secured to the heater-A/C housing behind the glove box on the passenger side of the vehicle, next to the heater-A/C wire harness connector in the passenger compartment. Remove the relay from its connector to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see the Relay Circuit Test procedure in this group. If not OK, replace the faulty relay.

RELAY CIRCUIT TEST

(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 fuse block 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

BLOWER MOTOR RELAY (Continued)

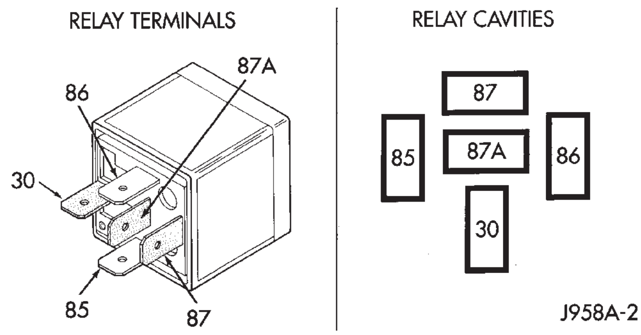

Fig. 16 Blower Motor Relay

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

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 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.

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(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. 17).

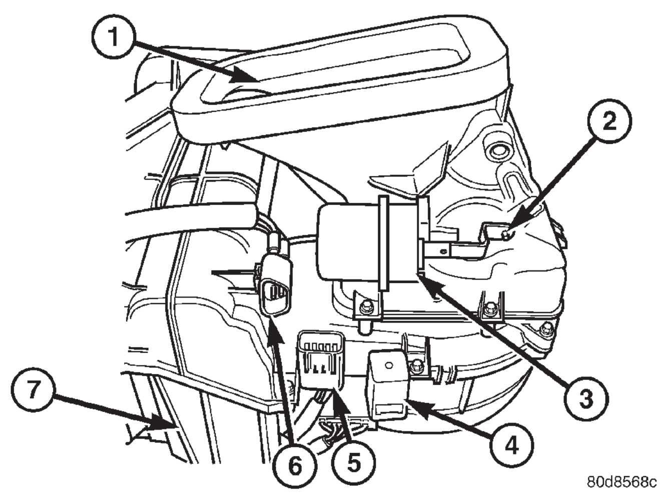

Fig. 17 Blower Motor Relay and Vacuum Actuator

1 - AIR INTAKE
2 - RECIRCULATION DOOR LINKAGE
3 - VACUUM DOOR ACTUATOR
4 - BLOWER MOTOR RELAY
5 - HVAC ELECTRICAL CONNECTOR
6 - HVAC VACUUM CONNECTOR
7 - HVAC HOUSING

(4) Unplug the blower motor relay from its wire harness connector.

BLOWER MOTOR RELAY (Continued)

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 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION).

(3) Connect the battery negative cable.

(4) Test the relay operation.

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 Instrument Panel glove box.

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.

DIAGNOSIS AND TESTING - BLOWER MOTOR RESISTOR

For circuit descriptions and diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the Instrument Panel and unplug the wire harness connector from the blower motor resistor(Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(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.

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the Instrument Panel(Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(3) Pull out the lock on the blower motor resistor wire harness connector to unlock the connector latch.

(4) Depress the latch on the blower motor resistor wire harness connector and unplug the connector from the resistor.

(5) Remove the two screws that secure the resistor to the heater-A/C housing.

(6) Remove the resistor from the heater-A/C housing.

INSTALLATION

(1) Position the resistor in the heater-A/C housing

(2) Install the retainer screws Tighten the mounting screws to 2.2 N·m (20 in lbs.).

(3) Connect the wire harness connector.

(4) Install the kick panel.

(5) Connect the battery negative cable.

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 fuse block 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.

DIAGNOSIS AND TESTING - BLOWER MOTOR SWITCH

For circuit descriptions and diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

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.

(1) Turn the ignition switch to the On position and check for battery voltage at the fuse in the fuse block 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 fuse block 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.

REMOVAL

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.

(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 (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C HEATER CONTROL - REMOVAL).

BLOWER MOTOR SWITCH (Continued)

(4) Remove the screw that secures the blower motor switch to the rear of the heater-A/C control (Fig. 18).

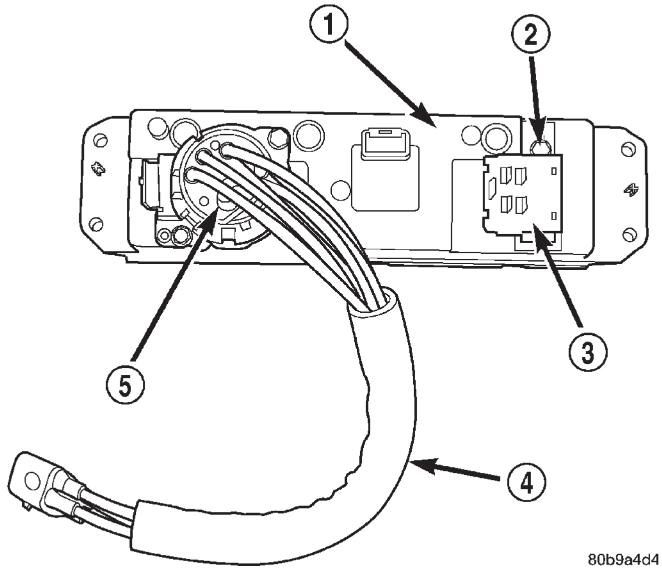

Fig. 18 Blower Motor Switch Remove/Install

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) Position the switch into the rear of the heater-A/C control panel.

(2) Tighten the heater-A/C control and switch mounting screws to 2.2 N·m (20 in. lbs.).

(3) Install the screws. Tighten the heater-A/C control and switch mounting screws to 2.2 N·m (20 in. lbs.).

Position the heater and A/C control and install the screws.

(4) Install the blower motor switch.

DEFROST DOOR ACTUATOR

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the knee blocker from the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - REMOVAL).

(3) Unplug the two vacuum harness connectors from the defrost door actuator (Fig. 19).

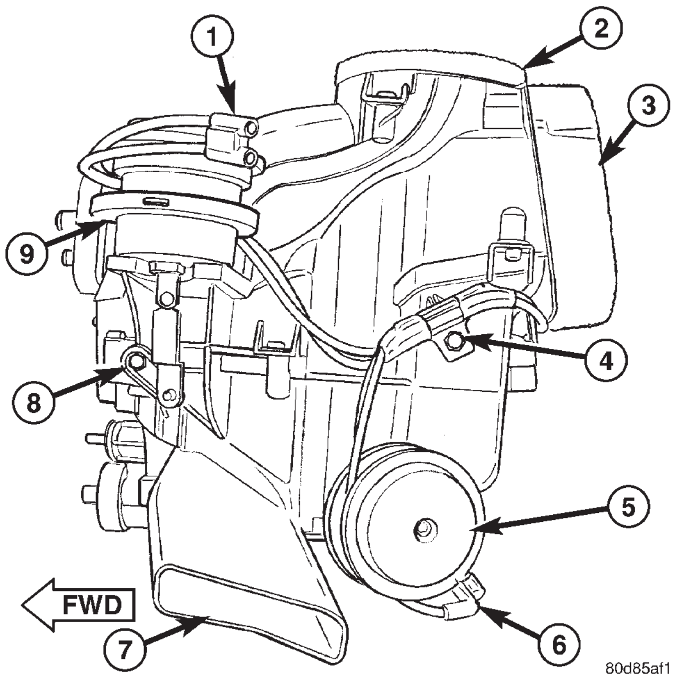

Fig. 19 Vacuum Actuators

1 - VACUUM LINE AND CONNECTOR
2 - HVAC DEFROSTER OUTPUT
3 - HVAC DASH VENT OUTPUT
4 - VACUUM LINE RETAINER AND SCREW
5 - VACUUM ACTUATOR - FLOOR
6 - VACUUM LINE AND CONNECTOR
7 - FLOOR VENT
8 - PANEL-DEFROSTER BLEND DOOR LEVER
9 - VACUUM ACTUATOR- DEFROSTER AND PANEL

(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. 20). Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(5) Remove push pin from link and depress barbed pin.

(6) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the

DEFROST DOOR ACTUATOR (Continued)

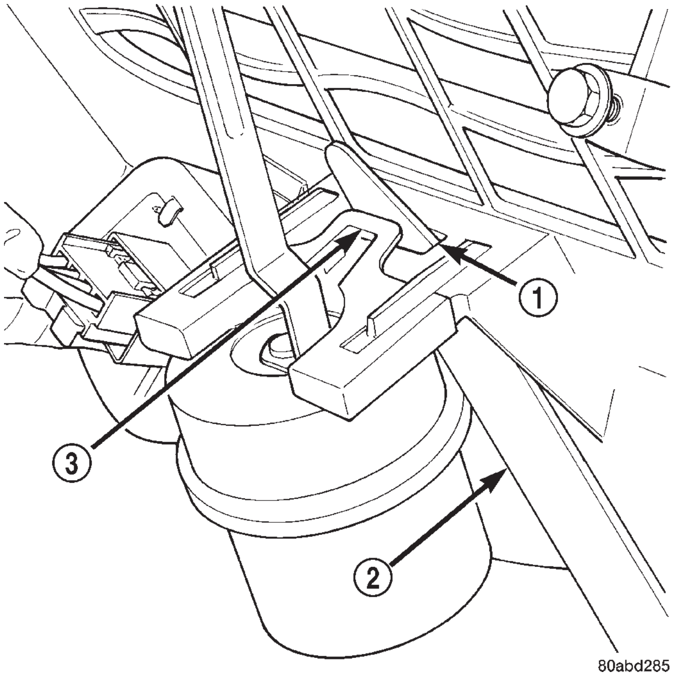

Fig. 20 Vacuum Actuator Remove/Install - Typical

1 - ACTUATOR MOUNT LATCH HOLE
2 - TRIM STICK
3 - ACTUATOR LATCH

actuator link from the hooked pin on the end of the defrost door lever.

(7) Remove the defrost door vacuum actuator from the vehicle.

INSTALLATION

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.

(1) Rotate and tilt the vacuum actuator as required to engage the hole on the end of the actuator link from the hooked pin on the end of the defrost door lever.

(2) Push the actuator over the mounting boss until its snaps over the locking tab.

(3) Connect the two vacuum hoses to the actuator nipples.

(4) Install the instrument panel knee bolster.

(5) Connect the battery negative cable.

PANEL ACTUATOR

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the knee blocker from the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - REMOVAL).

(3) Unplug the vacuum harness connector from the panel door actuator.

(4) Remove the push nut fastening the panel door vacuum actuator linkage to the panel door lever.

(5) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount. Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(6) Remove the panel door vacuum actuator from the vehicle.

INSTALLATION

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.

PANEL ACTUATOR (Continued)

(1) Push actuator on to mount until it snaps into locked position.

(2) Install actuator linkage and push nut.

(3) Connect the vacuum harness to the actuator.

(4) Install the knee bolster (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - INSTALLATION).

(5) Connect the battery negative cable.

FLOOR/DEMIST DEFROST DOOR ACTUATOR

REMOVAL

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.

(1) Remove the defrost door actuator from the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/DEFROST DOOR ACTUATOR - REMOVAL).

(2) Unplug the vacuum harness connector from the floor/demist door actuator.

(3) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount. 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 floor/demist door lever.

(5) Remove the floor/demist door vacuum actuator from the vehicle.

INSTALLATION

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.

(1) Rotate and tilt the vacuum actuator as required to engage the hole on the end of the actuator link from the pin on the end of the floor/demist door lever.

(2) Push the actuator onto the mounting boss until it snaps into the locked position.

(3) Connect the vacuum hoses to the nipples.

(4) Install the defrost door actuator(Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/DEFROST DOOR ACTUATOR - INSTALLATION).

(5) Connect the battery negative cable.

RECIRCULATION AIR DOOR ACTUATOR

REMOVAL

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.

A recirculation air door and vacuum actuator are used on models heater only and air conditioning system.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box(Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(3) Remove the dash side panel (end cap).

(4) Remove the speaker.

(5) Remove the right vent duct.

(6) Unplug the vacuum harness connector from the recirculation air door actuator (Fig. 21).

(7) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the heater-A/C housing actuator mount. Gently pry the actuator

RECIRCULATION AIR DOOR ACTUATOR (Continued)

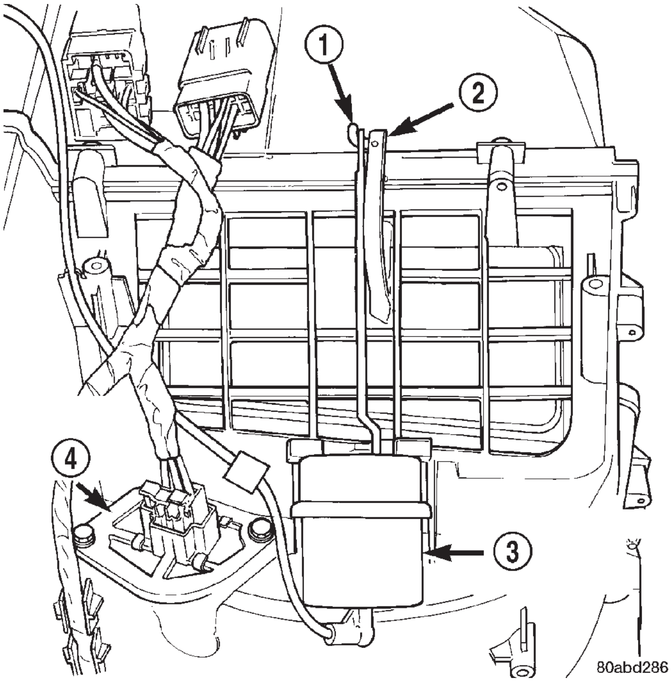

Fig. 21 Recirculation Air Door Vacuum Actuator Remove/Install (typical)

1 - HOOK
2 - LEVER
3 - RECIRCULATION AIR DOOR ACTUATOR
4 - BLOWER MOTOR RESISTOR

latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(8) 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.

(9) Remove the recirculation air door vacuum actuator from the vehicle.

INSTALLATION

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.

(1) Rotate and tilt the vacuum actuator as required to engage the hole on the end of the actuator link from the hooked pin on the end of the recirculation air door lever.

(2) Push the actuator onto the mount until it snaps into the locked position.

(3) Connect the vacuum hoses to the actuator.

(4) Install the right vent duct.

(5) Install the speaker.

(6) Install the dash side panel (end cap).

(7) Install the glove box(Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION).

(8) Connect the battery negative cable.

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.

REMOVAL

(1) Unplug the heater-A/C vacuum supply line connector at the vacuum check valve near the engine intake manifold vacuum adapter fitting (Fig. 22).

(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.

INSTALLATION

(1) Using the orientation noted when removed, plug the new check valve into the vacuum harness fitting.

(2) Connect the heater a/c supply line on to the vacuum check valve.

VACUUM CHECK VALVE (Continued)

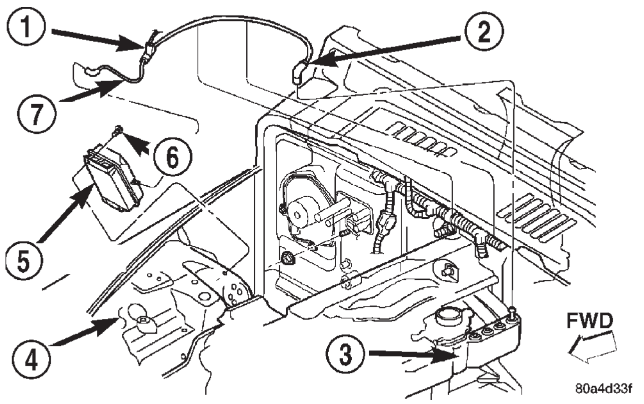

Fig. 22 Vacuum Reservoir Remove/Install - Typical

1 - TEE
2 - VACUUM CHECK VALVE
3 - INTAKE MANIFOLD
4 - INNER FENDER
5 - RESERVOIR
6 - SCREW
7 - VACUUM SUPPLY LINE

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.

REMOVAL

(1) Remove the battery and battery tray from the engine compartment (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - REMOVAL) and (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - REMOVAL).

(2) Unplug the vacuum supply line connector from the vacuum reservoir (Fig. 23).

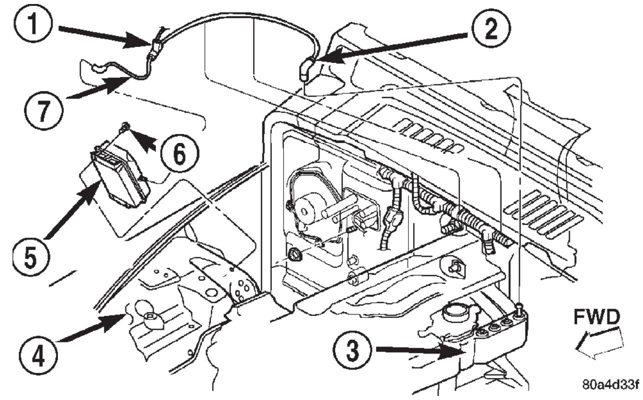

Fig. 23 Vacuum Reservoir Remove/Install

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.

INSTALLATION

(1) Position the reservoir in the engine compartment.

(2) Install the one screw securing the reservoir to the inner fender panel under the battery tray and behind the right front wheel house.

(3) Connect the vacuum supply line to the vacuum reservoir.

(4) Install the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - INSTALLATION).

(5) Install the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - INSTALLATION).

DISTRIBUTION

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DISTRIBUTION

DESCRIPTION

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.

DEFROST/DEMIST DUCT

REMOVAL

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.

(1) Remove the instrument panel assembly from the vehicle (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - REMOVAL).

(2) Remove the two push-nuts that secure the defrost/demist duct to the studs on the dash panel (Fig. 1).

(3) Remove the defrost/demist duct from the studs on the dash panel.

DEFROST/DEMIST DUCT (Continued)

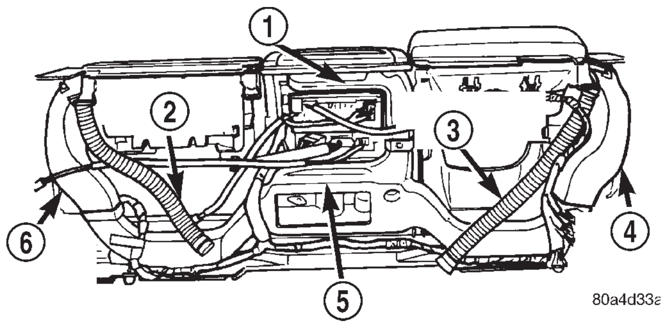

Fig. 1 Instrument Panel Ducts and Outlets Remove/ Install

1 - CENTER PANEL DUCT
2 - DEMISTER HOSE
3 - DEMISTER HOSE
4 - END PANEL DUCT
5 - MAIN PANEL DUCT
6 - END PANEL DUCT

INSTALLATION

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.

(1) Install the defrost/demist duct to the studs on the dash panel.

(2) Install the two push-nuts that secure the defrost/demist duct to the studs on the dash panel.

(3) Install the instrument panel assembly (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

DEMISTER HOSES

REMOVAL

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.

(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 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL). Remove the knee blocker from the instrument panel to service the driver side demister hose (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - REMOVAL).

(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.

INSTALLATION

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.

(1) Reach through the glove box opening or the steering column opening of the instrument panel to connect the ends of the demister hose to the demister outlet and the defrost/demist duct.

(2) Install the knee blocker (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - INSTALLATION).

(3) Install the glove box.

(4) Connect the battery negative cable.

FLOOR DUCTS

REMOVAL

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.

(1) Remove the instrument panel from the vehicle (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - REMOVAL).

(2) Remove the three screws that secure the floor duct to the bottom of the heater-A/C housing.

(3) Remove the screw that secures the floor duct to the dash panel side of the heater-A/C housing.

(4) Slide the floor duct out from under the heater-A/C housing (Fig. 2).

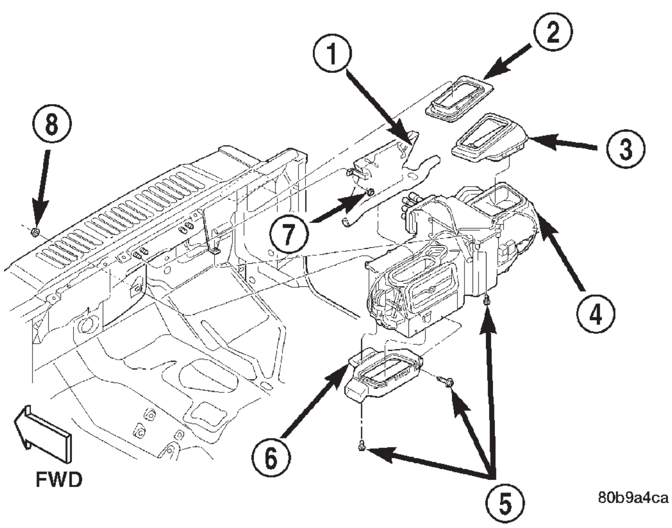

Fig. 2 Heater-A/C Housing Ducts Remove/Install

1 - DEFROST/DEMIST DUCT
2 - COLLAR
3 - FRESH AIR DUCT
4 - HEATER-A/C HOUSING
5 - SCREWS
6 - FLOOR DUCT
7 - NUT
8 - NUT

INSTALLATION

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(1) Position the floor duct under the heater-A/C housing.

(2) Secure the screw that attaches the duct to the dash panel.

(3) Install the three screws that secure the floor duct to the bottom of the heater-A/C housing. Tighten the screws to 2.2 N·m (20 in. lbs.).

(4) Install the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(5) Connect the battery negative cable.

PANEL DUCTS

REMOVAL

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(1) Remove the instrument panel from the vehicle (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - REMOVAL).

(2) Remove the demister hoses from the demister outlets.

(3) Remove the two screws from the center of the rearward facing side of the instrument panel that

PANEL DUCTS (Continued)

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 (Fig. 3).

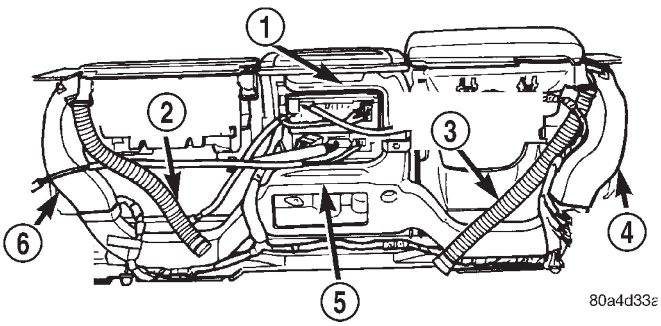

Fig. 3 Instrument Panel Ducts and Outlets Remove/ Install

1 - CENTER PANEL DUCT
2 - DEMISTER HOSE
3 - DEMISTER HOSE
4 - END PANEL DUCT
5 - MAIN PANEL DUCT
6 - END PANEL DUCT

INSTALLATION

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(1) Position the panel ducts to the instrument panel.

(2) Install the one screw that secures each end panel duct and/or the center panel duct to the instrument panel base

(3) Install the two screws to the center of the rearward facing side of the instrument panel that secure the main panel duct to the instrument panel base. Tighten the screws to 2.2 N·m (20 in. lbs.).

(4) Install the demister hoses to the demister outlets.

(5) Install the instrument panel in the vehicle (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(6) Connect the battery negative cable.

PANEL OUTLET BARRELS

REMOVAL

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.

(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.

INSTALLATION

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(1) Position and push in the barrels until snapped into position.

HVAC HOUSING

REMOVAL

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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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel from the vehicle (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - REMOVAL).

(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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(4) Disconnect the liquid line refrigerant line fitting from the evaporator inlet tube (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT LINE COUPLER - REMOVAL). 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(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT LINE COUPLER - REMOVAL). Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Drain the engine cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(7) Disconnect the heater hoses from the heater core tubes. 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. If necessary, loosen the battery hold-downs and reposition the battery for additional access (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - REMOVAL).

(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 (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/FLOOR DISTRIBUTION DUCTS - REMOVAL).

(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

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.

(1) Remove the heater-A/C housing from the vehicle and place it on a work bench (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL).

(2) Unplug the vacuum harness connectors from the demist/floor door actuator, the recirculation air door actuator and panel actuator.

(3) Disengage the vacuum harness from any routing clips located on the lower half of the heater-A/C housing.

(4) Disengage the heater-A/C wire harness connector and the blower motor relay wire harness connector push-in retainers from their mounting holes on the heater-A/C housing.

(5) Remove the blower motor and blower wheel unit from the heater-A/C housing (Refer to 24 -

HVAC HOUSING (Continued)

HEATING & AIR CONDITIONING/DISTRIBUTION/BLOWER MOTOR - REMOVAL).

(6) 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.

(7) 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.

(8) 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.

(9) Remove the screws that secure the upper and lower heater-A/C housing halves to each other and those that hold the recirculation housing to the upper housing.

(10) Carefully separate the recirculation housing and the upper heater-A/C housing half from the lower half.

ASSEMBLY

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(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.

(b) If the unit is equipped with air conditioning, that the evaporator coil tube rubber seal is properly positioned in the grooves in both the upper and lower heater-A/C housing halves.

(2) Install the 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 (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/BLOWER MOTOR - INSTALLATION).

(4) Install the foam seals on the flanges on the heater core and evaporator coil tube mounting flange of the heater-A/C housing and drain tube.

(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.

INSTALLATION

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(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 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 (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/FLOOR DISTRIBUTION DUCTS - INSTALLATION).

(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.).

HVAC HOUSING (Continued)

(6) If the battery was repositioned during the removal procedure, position the battery and tighten the hold-downs (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - INSTALLATION).

(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 24 - HEATING & AIR CONDITIONING/PLUMBING/HEATER CORE - INSTALLATION).

(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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT LINE COUPLER - INSTALLATION).

(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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT LINE COUPLER - INSTALLATION).

(11) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(12) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(13) Install the instrument panel in the vehicle (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(14) Connect the battery negative cable.

(15) Start the engine and check for proper operation of the heating and air conditioning systems.

BLEND-AIR DOOR

REMOVAL

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(1) Remove the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL).

(2) Disassemble the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY).

(3) 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. 4).

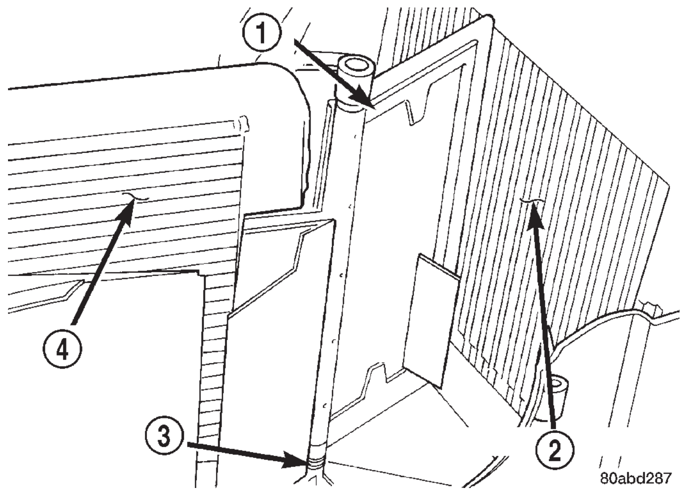

Fig. 4 Blend-Air Door - (typical)

1 - BLEND-AIR DOOR
2 - EVAPORATOR COIL
3 - PIVOT HOLE
4 - HEATER CORE

INSTALLATION

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(1) Install the blend-air door pivot shaft into the pivot hole in the bottom of the lower half of the heater-A/C housing (Fig. 4).

(2) Reassemble the heater HVAC housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY).

BLEND-AIR DOOR (Continued)

(3) Install the HVAC housing into the vehicle.

(4) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(5) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

PANEL DOOR AND LEVER

REMOVAL

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(1) Remove the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/ HVAC HOUSING - REMOVAL).

(2) Disassemble the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY).

(3) Remove the floor/defrost and panel door vacuum actuators from the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/ DEFROST DOOR ACTUATOR - REMOVAL).

(4) Insert a screwdriver into the latch hole (Fig. 5)of the panel door pivot shaft to release the latch of the panel door lever, and pull the lever out of the pivot shaft from the outside of the lower half of the heater-A/C housing.

(5) Reach inside the lower half of the heater-A/C housing and lift out the panel door.

INSTALLATION

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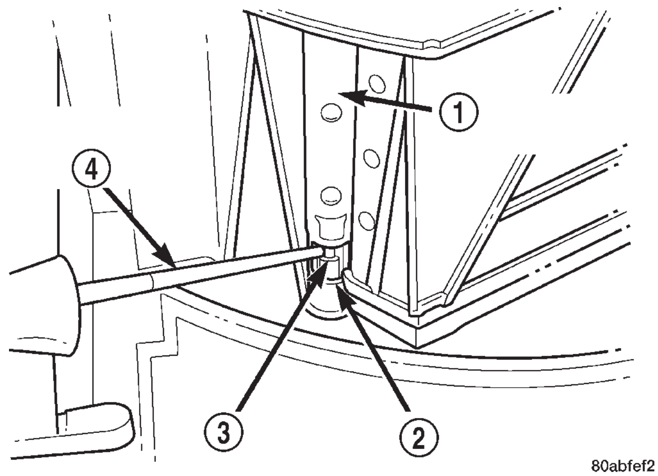

Fig. 5 Mode Door Lever Remove/Install - Typical

1 - DOOR PIVOT SHAFT
2 - LATCH HOLE
3 - CRANK ARM LATCH
4 - FLAT BLADE PRY TOOL

(1) Reach inside the lower half of the heater-A/C housing and position the door shaft into the pivot hole in the housing.

(2) Push in the panel lever into the pivot shaft of the panel door in the lower half of the heater-A/C housing.

(3) Install the floor/ defrost and panel door vacuum actuators to the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/DEFROST DOOR ACTUATOR - INSTALLATION).

(4) Assemble the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/ HVAC HOUSING - ASSEMBLY).

(5) Install the heater-A/C housing in the vehicle (Refer to 24 - HEATING & AIR CONDITIONING/ DISTRIBUTION/HVAC HOUSING - INSTALLATION).

(6) Connect the battery negative cable.

FLOOR/DEFROST DOOR AND LEVER

REMOVAL

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(1) Remove the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL).

(2) Remove the floor defrost actuator.

(3) Disassemble the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY).

(4) Remove the floor/defrost door from the heater-A/C housing.

INSTALLATION

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(1) Position the floor/defrost door into the lower A/C housing half bearings.

(2) Assemble the heating-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY).

(3) Attach the floor/defrost vacuum actuator to the floor/defrost lever and snap the actuator onto the upper housing.

(4) Install the heater-A/C housing into the vehicle (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION).

RECIRCULATION AIR DOOR

REMOVAL

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NOTE: The recirculation air door is only servicable by replacing the complete air intake housing assembly.

INSTALLATION

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NOTE: The recirculation actuator is only servicable by replacing the air intake housing.

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 from inside the passenger side of the vehicle.

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 fuse block 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.

DIAGNOSIS AND TESTING - BLOWER MOTOR

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.

For circuit descriptions and diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds. 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
- 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.

REMOVAL

(1) Disconnect the battery negative cable.

(2) Unplug the blower motor wire harness connector.

(3) Release blower motor retaining tab and rotate blower motor assembly counter clock wise.

(4) Remove blower motor assembly from HVAC housing.

INSTALLATION

(1) Align and install the blower motor and wheel assembly into the heater-A/C housing.

(2) Turn the blower motor assembly clockwise until the locking tab is engaged.

(3) Plug in the blower motor wire harness connector.

(4) Connect the battery negative cable.

PLUMBING

TABLE OF CONTENTS

PLUMBING

STANDARD PROCEDURE

STANDARD PROCEDURE - REFRIGERANT RECOVERY

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING - CAUTION) BEFORE PERFORMING THIS OPERATION.

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.

PLUMBING (Continued)

STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

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).

STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - DIAGNOSIS AND TESTING).

(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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

A/C COMPRESSOR

DESCRIPTION

DESCRIPTION - COMPRESSOR

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.

DESCRIPTION - HIGH PRESSURE RELIEF VALVE

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

OPERATION - COMPRESSOR

The compressor is driven by the engine through an electric clutch, drive pulley and belt arrangement. The compressor is lubricated by refrigerant oil that is circulated throughout the refrigerant system with the refrigerant.

The compressor draws in low-pressure refrigerant vapor from the evaporator through its suction port. It then compresses the refrigerant into a high-pressure, high-temperature refrigerant vapor, which is then pumped to the condenser through the compressor discharge port.

The compressor cannot be repaired. If faulty or damaged, the entire compressor assembly must be

A/C COMPRESSOR (Continued)

replaced. The compressor clutch, pulley and clutch coil are available for service.

OPERATION - HIGH PRESSURE RELIEF VALVE

The high pressure relief valve vents the system when a discharge pressure of 3445 to 4135 kPa (500 to 600 psi) or above is reached. The valve closes when a minimum discharge pressure of 2756 kPa (400 psi) is reached.

The high pressure relief valve vents only enough refrigerant to reduce the system pressure, and then re-seats itself. The majority of the refrigerant is conserved in the system. If the valve vents refrigerant, it does not mean that the valve is faulty.

The high pressure relief valve is a factory-calibrated unit. The valve cannot be adjusted or repaired, and must not be removed or otherwise disturbed. The valve is only serviced as a part of the compressor assembly.

DIAGNOSIS AND TESTING - A/C COMPRESSOR

When investigating an air conditioning related noise, you must first know the conditions under which the noise occurs. These conditions include: weather, vehicle speed, transmission in gear or neutral, engine speed, engine temperature, and any other special conditions. Noises that develop during air conditioning operation can often be misleading. For example: What sounds like a failed front bearing or connecting rod, may be caused by loose bolts, nuts, mounting brackets, or a loose compressor clutch assembly.

Drive belts are speed sensitive. At different engine speeds and depending upon belt tension, belts can develop noises that are mistaken for a compressor noise. Improper belt tension can cause a misleading noise when the compressor clutch is engaged, which may not occur when the compressor clutch is disengaged. Check the serpentine drive belt condition and tension (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - DIAGNOSIS AND TESTING) 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(Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C COMPRESSOR CLUTCH - INSTALLATION).

(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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/SUCTION LINE - REMOVAL).

(5) If the noise is from opening and closing of the high pressure relief valve, evacuate and recharge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE). 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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/ACCUMULATOR - REMOVAL). Check the refrigerant oil level and the refrigerant system charge (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - STANDARD PROCEDURE). If the liquid slugging condition continues following accumulator replacement, replace the compressor.

(7) If the noise continues, replace the compressor and repeat Step 1.

REMOVAL

NOTE: 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: (Refer to 24 - HEATING & AIR CONDITIONING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(1) Recover the refrigerant from the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(2) Disconnect and isolate the battery negative cable.

(3) Remove the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS -

A/C COMPRESSOR (Continued)

REMOVAL) 2.5L(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL) 4.0L.

(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. 1) and (Fig. 2). Install plugs in, or tape over all of the opened refrigerant fittings.

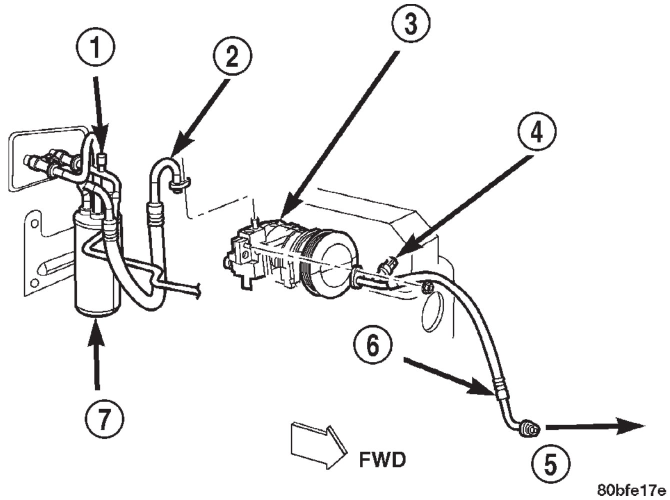

Fig. 1 Compressor Lines - 4 Cylinder Engine

1 - SERVICE PORT
2 - SUCTION LINE
3 - COMPRESSOR
4 - HIGH PRESSURE CUT-OFF SWITCH
5 - TO CONDENSER
6 - DISCHARGE LINE
7 - ACCUMULATOR

(6) Remove the screws that secure the compressor (Fig. 3) and (Fig. 4).

(7) Remove the compressor.

INSTALLATION

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.

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.).

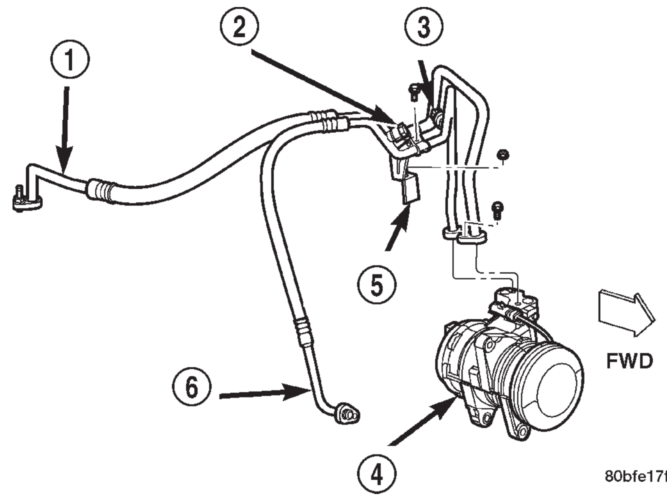

Fig. 2 Compressor Lines

1 - SUCTION LINE
2 - SERVICE PORT
3 - HIGH PRESSURE CUT-OFF SWITCH
4 - COMPRESSOR
5 - ENGINE MOUNTING BRACKET
6 - DISCHARGE LINE

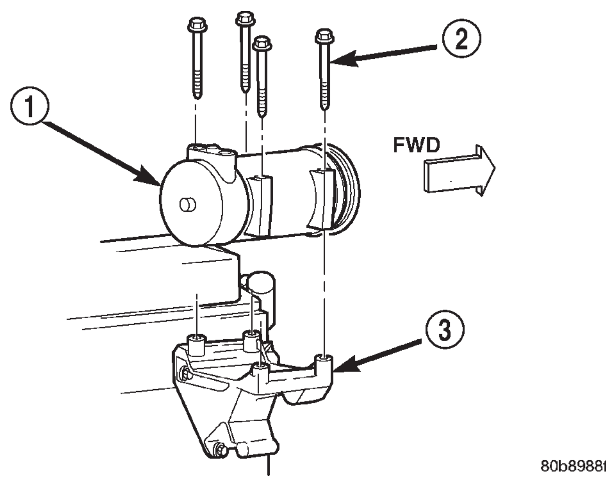

Fig. 3 Compressor - 4 Cylinder Engine

1 - A/C COMPRESSOR
2 - MOUNTING BOLTS
3 - A/C COMPRESSOR MOUNTING BRACKET

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 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION) 2.5L (Refer to 7 - COOLING/AC-

A/C COMPRESSOR (Continued)

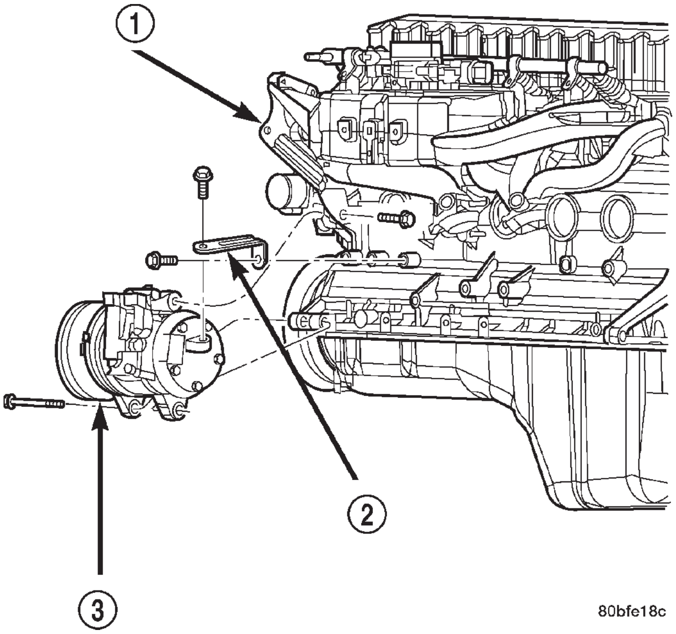

Fig. 4 Compressor - 6 Cylinder Engine

1 - POWER STEERING PUMP MOUNTING BRACKET
2 - BRACE
3 - A/C COMPRESSOR

CESSORY DRIVE/DRIVE BELTS - INSTALLATION) 4.0L.

(4) Plug in the compressor clutch coil wire harness connector.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(7) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

A/C 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.

REMOVAL

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING - CAUTION) 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.

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(3) Remove the three retainers that secure the upper condenser air seal to the grille panel and remove the upper air seal (Fig. 5).

(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.

A/C CONDENSER (Continued)

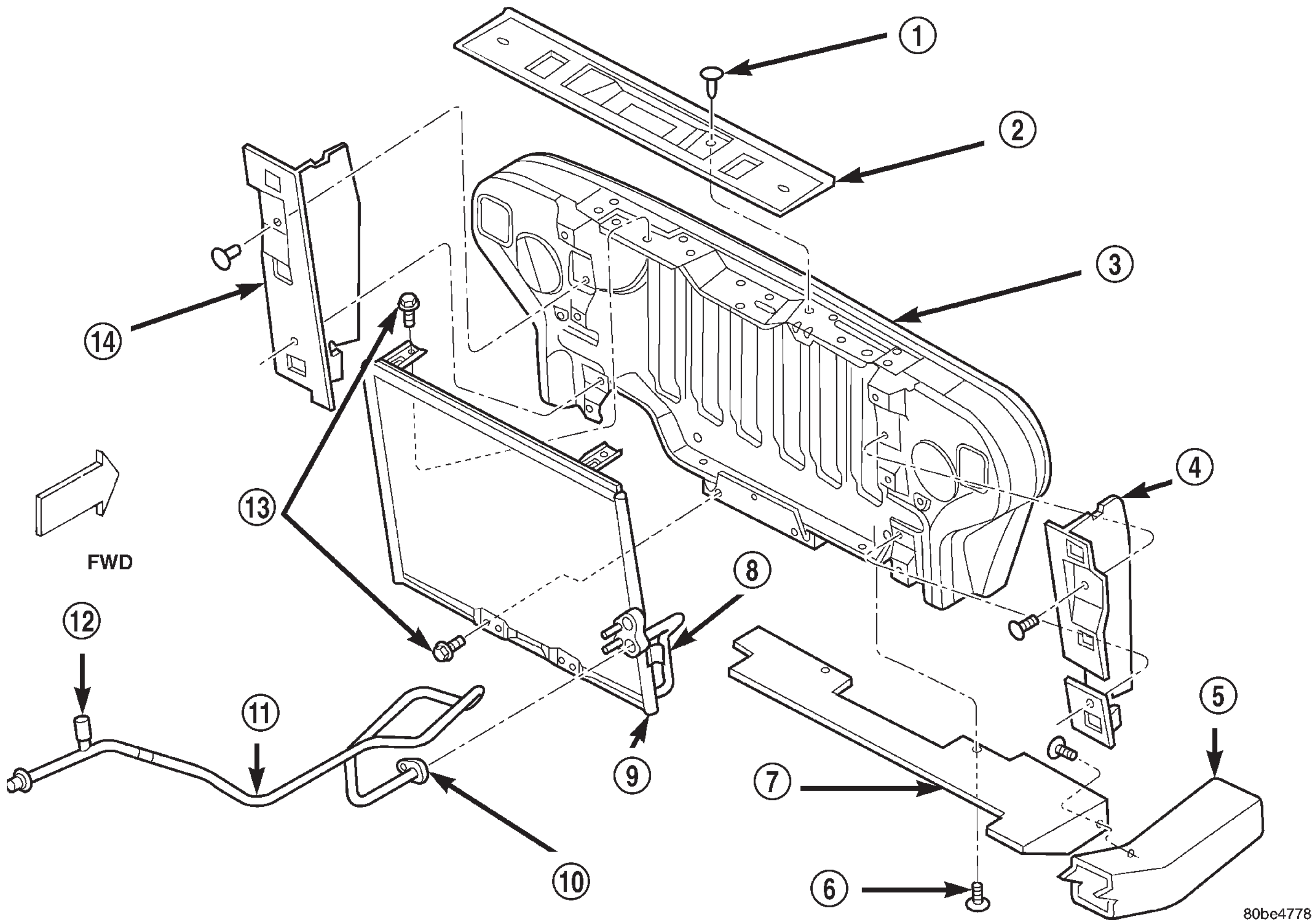

Fig. 5 Condenser Remove/Install

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

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.

A/C CONDENSER (Continued)

(8) Connect the battery negative cable.

(9) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(10) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

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.

A/C 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.

REMOVAL

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.

(1) Remove the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL).

(2) Disassemble the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY).

(3) Lift the evaporator coil unit out of the lower half of the heater-A/C housing.

INSTALLATION

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.

(1) Place the evaporator coil unit into the lower half of the heater-A/C housing.

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.

(2) Assemble the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY).

(3) Install the heater-A/C housing into the vehicle (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION).

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

ACCUMULATOR (Continued)

any moisture which may have entered and become trapped within the refrigerant system (Fig. 6).

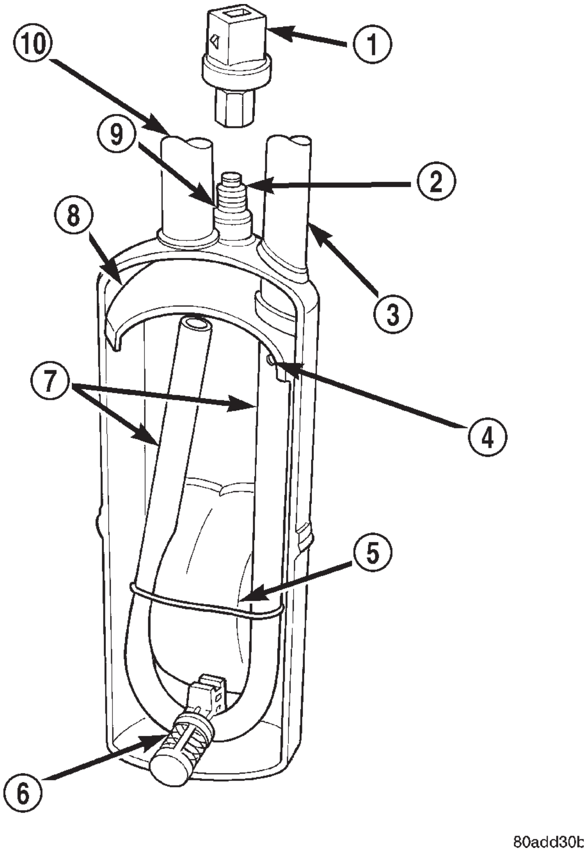

Fig. 6 Accumulator - Typical

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

REMOVAL

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING - CAUTION) AND (Refer to 24 - HEATING & AIR CONDITIONING - WARNING) BEFORE PERFORMING THE FOLLOWING OPERATION.

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(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.

(6) Disconnect the suction line from the accumulator outlet tube refrigerant line fitting (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT LINE COUPLER - REMOVAL). 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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT LINE COUPLER - REMOVAL). 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.

INSTALLATION

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT LINE COUPLER - INSTALLATION).

(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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT LINE COUPLER - INSTALLATION).

(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.

ACCUMULATOR (Continued)

(8) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(9) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

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.

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.

REMOVAL

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.

(1) Remove the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL).

(2) Disassemble the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY).

(3) Lift the heater core out of the lower half of the heater-A/C housing.

INSTALLATION

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.

(1) Position the heater core in the lower HVAC housing.

(2) Assemble the heater-A/C housing(Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY).

(3) Install the heater-A/C housing into the vehicle(Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION).

A/C 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. 7). The outlet end of the tube has a nylon mesh diffuser screen. The O-rings on the plastic body of the fixed orifice tube seal the tube to the inside of the liquid line and prevent the refrigerant from bypassing the fixed metering orifice.

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

A/C FIXED ORIFICE TUBE (Continued)

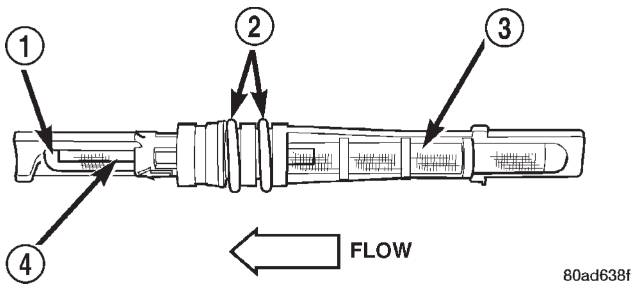

Fig. 7 Fixed Orifice Tube - Typical

1 - DIFFUSER SCREEN
2 - “O” RINGS
3 - INLET FILTER SCREEN
4 - ORIFICE

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.

LIQUID LINE

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 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.

REMOVAL

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(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. 8).

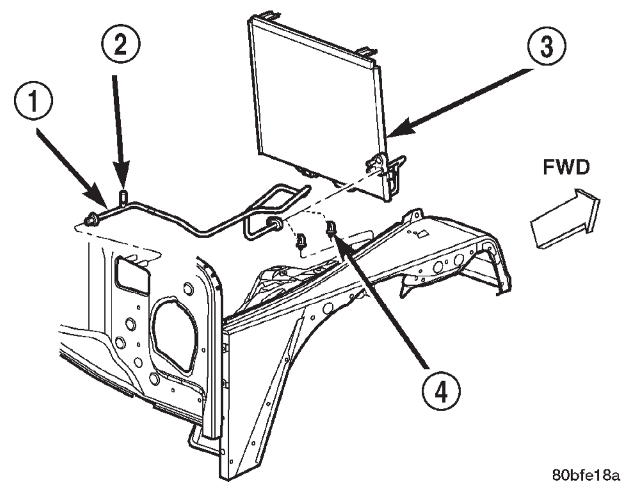

Fig. 8 Liquid Line Mounting

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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT LINE COUPLER - REMOVAL). 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.

LIQUID LINE (Continued)

(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 (Refer to 24 - HEATING & AIR CONDITIONING/ PLUMBING/REFRIGERANT LINE COUPLER - INSTALLATION).

(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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(7) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

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.

DIAGNOSIS AND TESTING - REFRIGERANT SYSTEM LEAKS

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

If the air conditioning system is not cooling properly, determine if the refrigerant system is fully-charged (Refer to 24 - HEATING & AIR CONDITIONING - DIAGNOSIS AND TESTING). If the refrigerant system is low or empty; a leak at a refrigerant line, connector fitting, component, or component seal is likely.

An electronic leak detector designed for R-134a refrigerant, or a fluorescent R-134a leak detection dye and a black light are recommended for locating and confirming refrigerant system leaks. Refer to the operating instructions supplied by the equipment manufacturer for proper care and use of this equipment.

An oily residue on or near refrigerant system lines, connector fittings, components, or component seals can indicate the general location of a possible refrigerant leak. However, the exact leak location should be confirmed with an electronic leak detector prior to component repair or replacement.

To detect a leak in the refrigerant system with an electronic leak detector, perform one of the following procedures:

SYSTEM EMPTY

(1) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(2) Connect and dispense 0.283 kilograms (0.625 pounds or 10 ounces) of R-134a refrigerant into the evacuated refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(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 detec-

REFRIGERANT (Continued)

tor 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.

REFRIGERANT LINE COUPLER

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. 9). When the two coupler halves are connected, the flared end of the female fitting slips behind the garter spring inside the cage on the male fitting. The garter spring and cage prevent the flared end of the female fitting from pulling out of the cage.

Two O-rings on the male half of the fitting are used to seal the connection. These O-rings are 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.

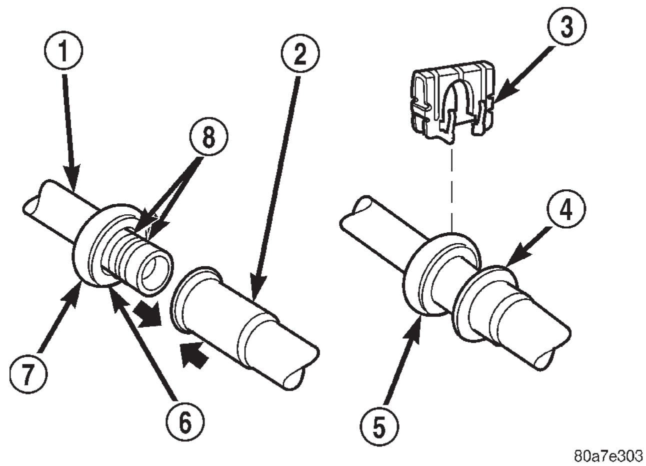

Fig. 9 Spring-Lock Coupler - Typical

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

REMOVAL

(1) Recover the refrigerant from the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(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. 10).

(4) Close the two halves of the A/C line disconnect tool around the spring-lock coupler.

(5) Push the A/C line disconnect tool into the open side of the coupler cage to expand the garter spring. Once the garter spring is expanded and while still pushing the disconnect tool into the open side of the coupler cage, pull on the refrigerant line attached to the female half of the coupler fitting until the flange on the female fitting is separated from the garter spring and cage on the male fitting within the disconnect tool.

NOTE: The garter spring may not release if the A/C line disconnect tool is cocked while pushing it into the coupler cage opening.

(6) Open and remove the A/C line disconnect tool from the disconnected spring-lock coupler.

REFRIGERANT LINE COUPLER (Continued)

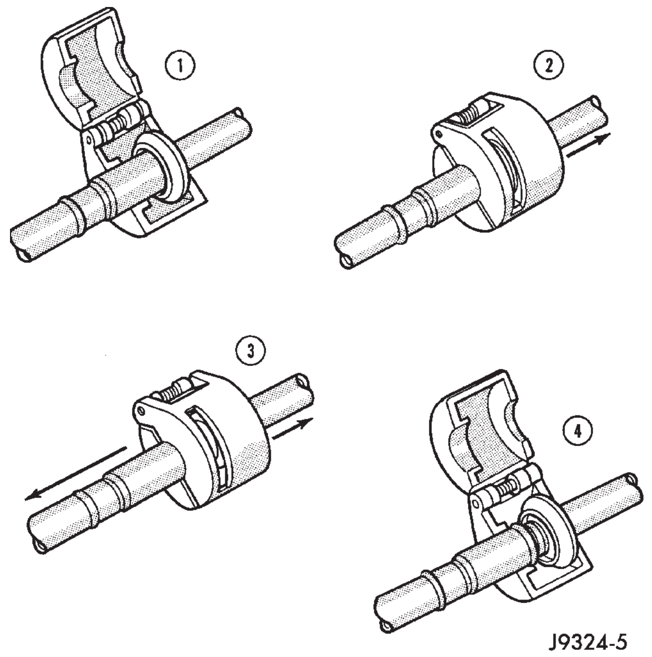

Fig. 10 Refrigerant Line Spring-Lock Coupler Disconnect

(7) Complete the separation of the two halves of the coupler fitting.

INSTALLATION

(1) Check to ensure that the garter spring is located within the cage of the male coupler fitting, and that the garter spring is not damaged.

(a) If the garter spring is missing, install a new spring by pushing it into the coupler cage opening.

(b) If the garter spring is damaged, remove it from the coupler cage with a small wire hook (DO NOT use a screwdriver) and install a new garter spring.

(2) Clean any dirt or foreign material from both halves of the coupler fitting.

(3) Install new O-rings on the male half of the coupler fitting.

CAUTION: Use only the specified O-rings as they are made of a special material for the R-134a system. The use of any other O-rings may allow the connection to leak intermittently during vehicle operation.

(4) Lubricate the male fitting and O-rings, and the inside of the female fitting with clean R-134a refrigerant oil. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(5) Fit the female half of the coupler fitting over the male half of the fitting.

(6) Push together firmly on the two halves of the coupler fitting until the garter spring in the cage on the male half of the fitting snaps over the flanged end on the female half of the fitting.

(7) Ensure that the spring-lock coupler is fully engaged by trying to separate the two coupler halves. This is done by pulling the refrigerant lines on either side of the coupler away from each other.

(8) Reinstall the secondary clip over the spring-lock coupler cage.

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.

STANDARD PROCEDURE - 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

REFRIGERANT OIL (Continued)

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	

SUCTION LINE

DESCRIPTION

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: (Refer to 24 - HEATING & AIR CONDITIONING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

REMOVAL

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.

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(3) Unplug the wire harness connector from the high pressure cut-off switch (Fig. 11).

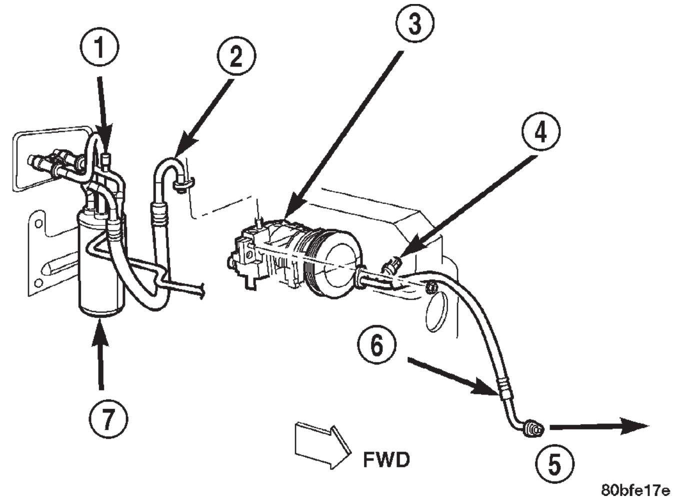

Fig. 11 Suction and Discharge Line 2.5 L

1 - SERVICE PORT
2 - SUCTION LINE
3 - COMPRESSOR
4 - HIGH PRESSURE CUT-OFF SWITCH
5 - TO CONDENSER
6 - DISCHARGE LINE
7 - ACCUMULATOR

(4) Remove the bolt that secures the refrigerant line support bracket to the engine (4.0 L) (Fig. 12).

(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

SUCTION LINE (Continued)

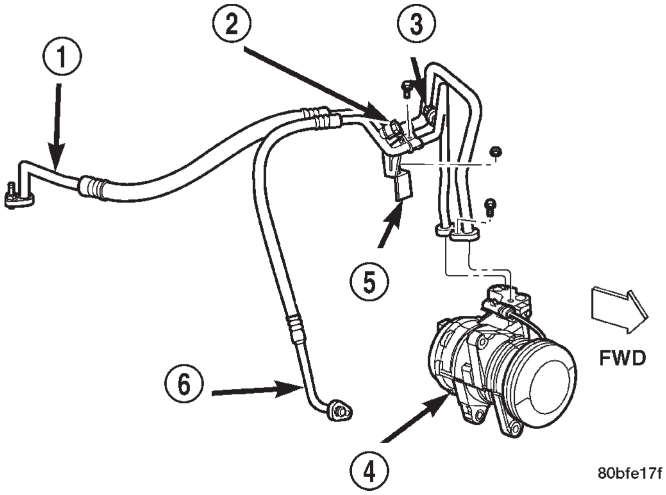

Fig. 12 Suction and Discharge Line 4.0 L

1 - SUCTION LINE
2 - SERVICE PORT
3 - HIGH PRESSURE CUT-OFF SWITCH
4 - COMPRESSOR
5 - ENGINE MOUNTING BRACKET
6 - DISCHARGE LINE

in, or tape over all of the opened refrigerant line fittings.

(8) Remove the suction and discharge lines from the vehicle.

INSTALLATION

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.

(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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/ REFRIGERANT LINE COUPLER - INSTALLATION).

(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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT LINE COUPLER - INSTALLATION).

(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 (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(8) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

EMISSIONS CONTROL

TABLE OF CONTENTS

EMISSIONS CONTROL

DESCRIPTION

DESCRIPTION - EMISSION CONTROL SYSTEM

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.

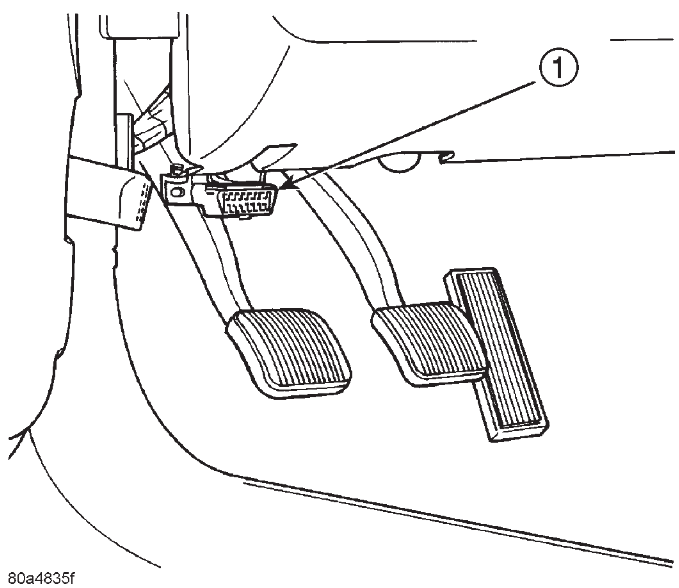

Fig. 1 Data Link (Diagnostic) Connector Location
1 - 16–WAY DATA LINK CONNECTOR

EMISSIONS CONTROL (Continued)

DESCRIPTION - STATE DISPLAY TEST MODE

The switch inputs to the Powertrain Control Module (PCM) have two recognized states; HIGH and LOW. For this reason, the PCM cannot recognize the difference between a selected switch position versus an open circuit, a short circuit, or a defective switch. If the State Display screen shows the change from HIGH to LOW or LOW to HIGH, assume the entire switch circuit to the PCM functions properly. Connect the DRB scan tool to the data link connector and access the state display screen. Then access either State Display Inputs and Outputs or State Display Sensors.

DESCRIPTION - CIRCUIT ACTUATION TEST MODE

The Circuit Actuation Test Mode checks for proper operation of output circuits or devices the Powertrain Control Module (PCM) may not internally recognize. The PCM attempts to activate these outputs and allow an observer to verify proper operation. Most of the tests provide an audible or visual indication of device operation (click of relay contacts, fuel spray, etc.). Except for intermittent conditions, if a device functions properly during testing, assume the device, its associated wiring, and driver circuit work correctly. Connect the DRB scan tool to the data link connector and access the Actuators screen.

DESCRIPTION - DIAGNOSTIC TROUBLE CODES

A Diagnostic Trouble Code (DTC) indicates the PCM has recognized an abnormal condition in the system.

Remember that DTC's are the results of a system or circuit failure, but do not directly identify the failed component or components.

NOTE: For a list of DTC's, refer to the charts in this section.

BULB CHECK

Each time the ignition key is turned to the ON position, the malfunction indicator (check engine) lamp on the instrument panel should illuminate for approximately 2 seconds then go out. This is done for a bulb check.

OBTAINING DTC'S USING DRB SCAN TOOL

(1) Connect the DRB scan tool to the data link (diagnostic) connector. This connector is located in the passenger compartment; at the lower edge of instrument panel; near the steering column.

(2) Turn the ignition switch on and access the "Read Fault" screen.

(3) Record all the DTC's and "freeze frame" information shown on the DRB scan tool.

(4) To erase DTC's, use the "Erase Trouble Code" data screen on the DRB scan tool. **Do not erase any DTC's until problems have been investigated and repairs have been performed.**

(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 Circuit Malfunction	Problem detected in oxygen sensor heater relay circuit.
P0031 (M)	1/1 O2 Sensor Heater Circuit Low	Problem detected in oxygen sensor heater relay circuit.
P0032 (M)	1/1 O2 Sensor Heater Circuit High	Problem detected in oxygen sensor heater relay circuit.
P0036 (M)	1/2 O2 Sensor Heater Circuit Malfunction	Problem detected in oxygen sensor heater relay circuit.
P0037 (M)	1/2 O2 Sensor Heater Circuit Low	Problem detected in oxygen sensor heater relay circuit.
P0038 (M)	1/2 O2 Sensor Heater Circuit High	Problem detected in oxygen sensor heater relay circuit.
P0043 (M)	1/3 O2 Sensor Heater Circuit Low	Problem detected in oxygen sensor heater relay circuit.
P0044 (M)	1/3 O2 Sensor Heater Circuit High	Problem detected in oxygen sensor heater relay circuit.
P0051 (M)	2/1 O2 Sensor Heater Circuit Low	Problem detected in oxygen sensor heater relay circuit.
P0052 (M)	2/1 O2 Sensor Heater Circuit High	Problem detected in oxygen sensor heater relay circuit.
P0057 (M)	2/2 O2 Sensor Heater Circuit Low	Problem detected in oxygen sensor heater relay circuit.
P0058 (M)	2/2 O2 Sensor Heater Circuit High	Problem detected in oxygen sensor heater relay circuit.

EMISSIONS CONTROL (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
P0071 (M)	Amb/Bat Temp Sensor Performance	
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.
PO111 (M)	Intake Air Temp Sensor Performance	
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	Coolant Temp Sensor Performance	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.
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.

EMISSIONS CONTROL (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
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.
P0161 (M)	2/2 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
PO165	Starter Relay Circuit	Problem detected in starter relay circuit.
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.

EMISSIONS CONTROL (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
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.
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.

EMISSIONS CONTROL (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
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.
PO243	Wastegate Solenoid Circuit	
P0251 (M)	Fuel Inj. Pump Mech. Failure Fuel Valve Feedback Circuit	Problem sensed with fuel circuit internal to fuel injection pump.
P0253 (M)	Fuel Injection Pump Fuel Valve Open Circuit	Problem sensed with fuel circuit internal to fuel injection pump.
P0254	Fuel Injection Pump Fuel Valve Current Too High	Problem caused by internal fuel injection pump failure.
P0300 (M)	Multiple Cylinder Mis-fire	Misfire detected in multiple cylinders.
P0301 (M)	CYLINDER #1 MISFIRE	Misfire detected in cylinder #1.
P0302 (M)	CYLINDER #2 MISFIRE	Misfire detected in cylinder #2.
P0303 (M)	CYLINDER #3 MISFIRE	Misfire detected in cylinder #3.
P0304 (M)	CYLINDER #4 MISFIRE	Misfire detected in cylinder #4.
P0305 (M)	CYLINDER #5 MISFIRE	Misfire detected in cylinder #5.
P0306 (M)	CYLINDER #6 MISFIRE	Misfire detected in cylinder #6.
P0307 (M)	CYLINDER #7 MISFIRE	Misfire detected in cylinder #7
P0308 (M)	CYLINDER #8 MISFIRE	Misfire detected in cylinder #8.
P0309 (M)	CYLINDER #9 MISFIRE	Misfire detected in cylinder #9.
P0310 (M)	CYLINDER #10 MISFIRE	Misfire detected in cylinder #10.
P0320 (M)	No Crank Referance Signal at PCM	No reference signal (crankshaft position sensor) detected during engine cranking.
P0320 (M)	No RPM Signal to PCM (Crankshaft Position Sensor Signal to JTEC)	A CKP signal has not been detected at the PCM.
P0325	Knock Sensor #1 Circuit	Knock sensor (#1) signal above or below minimum acceptable threshold voltage at particular engine speeds.
P0330	Knock Sensor #2 Circuit	Knock sensor (#2) signal above or below minimum acceptable threshold voltage at particular engine speeds.

EMISSIONS CONTROL (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
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.
PO0400	Diesel EGR System Failure	
P0401	EGR System Failure	Required change in air/fuel ration not detected during diagnostic test.
P0403	EGR Solenoid Circuit	An open or shorted condition detected in the EGR solenoid control circuit.
P0404	EGR Position Sensor Rationality	EGR position sensor signal does not correlate to EGR duty cycle.
P0405	EGR Position Sensor Volts Too Low	EGR position sensor input below the acceptable voltage range.

EMISSIONS CONTROL (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
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.
PO061	Fuel Level Unit No Change Over Time	
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	
P0508 (M)	IAC Motor Sense Circuit Low	
P0509 (M)	IAC Motor Sense Circuit High	
P0521	Oil Pressure Switch Rationality	
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.

EMISSIONS CONTROL (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
P0545	A/C Clutch Relay Circuit	Problem detected in air conditioning clutch relay control circuit.
P0551	Power Steering Switch Failure	Incorrect input state detected for the power steering switch circuit. PL: High pressure seen at high speed.
P0562	Charging System Voltage Too Low	Supply voltage sensed at ECM too low.
P0563	Charging System Voltage Too High	Supply voltage sensed at ECM too high.
P0572	Brake Switch Input #1 Signal Missing	
P0573	Brake Switch Input #2 Signal Missing	
P0575	Cruise Control Switch Voltage Low	
P0576	Cruise Control Switch Voltage High	
P0577	Cruise Control Switch Voltage 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)
P0703	Brake Switch Sense Circuit	
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.

EMISSIONS CONTROL (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
P0712 (M)	Trans Temp Sensor Voltage Too Low	Voltage less than 1.55 volts (4-speed auto. trans. only).
P0713	Trans Temp Sensor Voltage Too High	Transmission fluid temperature sensor input above acceptable voltage. Was MIL code 37.
P0713 (M)	Trans Temp Sensor Voltage Too High	Voltage greater than 3.76 volts (4-speed auto. trans. only).
P0720 (M)	Low Output SPD Sensor RPM, Above 15 MPH	The relationship between the Output Shaft Speed Sensor and vehicle speed is not within acceptable limits.
P0720 (M)	Low Output Spd Sensor RPM Above 15 mph	Output shaft speed is less than 60 rpm with vehicle speed above 15 mph (4-speed auto. trans. only).
P0740 (M)	Torq Con Clu, No RPM Drop at Lockup	Relationship between engine and vehicle speeds indicated failure of torque convertor clutch lock-up system (TCC/PTU solenoid)
P0743 (M)	Torque Converter Clutch Solenoid/ Trans Relay Circuits	An open or shorted condition detected in the torque converter clutch (part throttle unlock) solenoid control circuit. Shift solenoid C electrical fault - Aisin transmission
P0743 (M)	Torque Converter Clutch Solenoid/ Trans Relay Circuits	An open or shorted condition detected in the torque converter part throttle unlock solenoid control circuit (3 or 4-speed auto. trans. only).
P0748 (M)	Governor Pressur Sol Control/Trans Relay Circuits	An open or shorted condition detected in the Governor Pressure Solenoid circuit or Trans Relay Circuit in JTEC RE transmissions.
P0748 (M)	Governor Pressure Sol Control/Trans Relay Circuits	An open or shorted condition detected in the governor pressure solenoid or relay circuits (4-speed auto. trans. only).
P0751 (M)	O/D Switch Pressed (Lo) More Than 5 Minutes	Overdrive override switch input is in a prolonged depressed state.
P0751 (M)	O/D Switch Pressed (LO) More Than 5 Min	Overdrive Off switch input too low for more than 5 minutes (4-speed auto. trans. only).
P0753 (M)	Trans 3-4 Shift Sol/Trans Relay Circuits	An open or shorted condition detected in the overdrive solenoid control circuit or Trans Relay Circuit in JTEC RE transmissions. Was MIL code 45.
P0753 (M)	Trans 3-4 Shift Sol/Trans Relay Circuits	An open or shorted condition detected in the transmission 2-4 shift solenoid circuit (4-speed auto. trans. only).
P0756	AW4 Shift Sol B (2-3) Functional Failure	Shift solenoid B (2-3) functional fault - Aisin transmission
P0783 (M)	3-4 Shift Sol, No RPM Drop at Lockup	The overdrive solenoid is unable to engage the gear change from 3rd gear to the overdrive gear.
P0801	Reverse Gear Lockout Circuit Open or Short	An open or shorted condition detected in the transmission reverse gear lock-out solenoid control circuit.
P0830	Clutch Depressed Switch Circuit	Problem detected in clutch switch circuit.
P0833	Clutch Released Switch Circuit	Problem detected in clutch switch circuit.
P0836	4WD Mux Switch Circuit	
P0837	4WD Mux Switch Performance	

EMISSIONS CONTROL (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
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.
P1192	Intake Air Temp Sensor Voltage Low	
P1193	Intake Air Temp Sensor Voltage High	
P1194	O2 Heater Performance	
P1195 (M)	1/1 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 1/1 during catalyst monitor test. (Also see SCI DTC $66) (was P0133)
P1196 (M)	2/1 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 2/1 during catalyst monitor test. (Also see SCI DTC $7A) (was P0153)
P1197	1/2 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 1/2 during catalyst monitor test. (Also see SCI DTC $68) (was P0139)
P1198	Radiator Temperature Sensor Volts Too High	Radiator coolant temperature sensor input above the maximum acceptable voltage.
P1199	Radiator Temperature Sensor Volts Too Low	Radiator coolant temperature sensor input below the minimum acceptable voltage.
P1280	Fuel System Relay Circuit	
P1281	Engine is Cold Too Long	Engine coolant temperature remains below normal operating temperatures during vehicle travel (Thermostat).
P1282	Fuel Pump/System 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	High Pressure Solenoid Relay Ckt.	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.

EMISSIONS CONTROL (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
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.
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 Sensor	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).

EMISSIONS CONTROL (Continued)

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(G) Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
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.
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)

EMISSIONS CONTROL (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
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.
P1499	Hydraulic cooling fan solenoid circuit	An open or shorted condition detected in the cooling fan control solenoid circuit.
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.
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.
P1602	PCM not programmed	
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 (disconnected) in last 50 Starts	The battery has been disconnected within the last 50 starts
P1685	SKIM Invalid Key - (Wrong or Invalid Key MSG Received From SKIM)	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).

EMISSIONS CONTROL (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
P1687	No MIC BUS Message (No Cluster 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.
P1694	Fault In Companion Module	No CCD/J1850 messages received from the powertrain control module-Aisin transmission
P1694 (M)	No BUS (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.
P1699	No Climate Control Bus Messages	
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).

EMISSIONS CONTROL (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
P1756 (M)	GOV Press Not Equal to Target @ 15-20 PSI	The requested pressure and the actual pressure are not within a tolerance band for the Governor Control System which is used to regulate governor pressure to control shifts for 1st, 2nd, and 3rd gear. (Mid Pressure Malfunction)
P1756 (M)	Governor Pressure Not Equal to Target @ 15-20 PSI	Governor sensor input not between 10 and 25 psi when requested (4-speed auto. trans. only).
P1757	GOV Press Not Equal to Target @ 15-20 PSI	The requested pressure and the actual pressure are not within a tolerance band for the Governor Control System which is used to regulate governor pressure to control shifts for 1st, 2nd, and 3rd gear (Zero Pressure Malfunction)
P1757 (M)	Governor Pressure Above 3 PSI In Gear With 0 MPH	Governor pressure greater than 3 psi when requested to be 0 psi (4-speed auto. trans. only).
P1762 (M)	Gov Press Sen Offset Volts Too Lo or High	The Governor Pressure Sensor input is greater than a calibration limit or is less than a calibration limit for 3 consecutive park/neutral calibrations.
P1762 (M)	Governor Press Sen Offset Volts Too Low or High	Sensor input greater or less than calibration for 3 consecutive Neutral/Park occurrences (4-speed auto. trans. only).
P1763	Governor Pressure Sensor Volts Too Hi	The Governor Pressure Sensor input is above an acceptable voltage level.
P1763 (M)	Governor Pressure Sensor Volts Too HI	Voltage greater than 4.89 volts (4-speed auto. trans. only).
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).
P1830	Clutch Override Relay Circuit	Problem detected in clutch pedal switch override relay circuit.
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).

EMISSIONS CONTROL (Continued)

DESCRIPTION - TASK MANAGER

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 referred to as the 'Task Manager'.

DESCRIPTION - MONITORED SYSTEMS

There are new electronic circuit monitors that check fuel, emission, engine and ignition performance. These monitors use information from various sensor circuits to indicate the overall operation of the fuel, engine, ignition and emission systems and thus the emissions performance of the vehicle.

The fuel, engine, ignition and emission systems monitors do not indicate a specific component problem. They do indicate that there is an implied problem within one of the systems and that a specific problem must be diagnosed.

If any of these monitors detect a problem affecting vehicle emissions, the Malfunction Indicator 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.

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 evapora-

EMISSIONS CONTROL (Continued)

tive 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” water. The cycle rate of pump strokes is quite rapid as the system begins to pump up to this pressure. As the pressure increases, the cycle rate starts to drop off. If there is no leak in the system, the pump would eventually stop pumping at the equalized pressure. If there is a leak, it will continue to pump at a rate representative of the flow characteristic of the size of the leak. From this information we can determine if the leak is larger than the required detection limit (currently set at .040” orifice by CARB). If a leak is revealed during the leak test portion of the test, the test is terminated at the end of the test mode and no further system checks will be performed.

After passing the leak detection phase of the test, system pressure is maintained by turning on the LDP’s solenoid until the purge system is activated. Purge activation in effect creates a leak. The cycle rate is again interrogated and when it increases due to the flow through the purge system, the leak check portion of the diagnostic is complete.

The canister vent valve will unseal the system after completion of the test sequence as the pump diaphragm assembly moves to the full travel position.

Evaporative system functionality will be verified by using the stricter evap purge flow monitor. At an appropriate warm idle the LDP will be energized to seal the canister vent. The purge flow will be clocked up from some small value in an attempt to see a shift in the 02 control system. If fuel vapor, indicated by a shift in the 02 control, is present the test is passed. If not, it is assumed that the purge system is not functioning in some respect. The LDP is again turned off and the test is ended.

MISFIRE MONITOR

Excessive engine misfire results in increased catalyst temperature and causes an increase in HC emissions. Severe misfires could cause catalyst damage. To prevent catalytic convertor damage, the PCM monitors engine misfire.

The Powertrain Control Module (PCM) monitors for misfire during most engine operating conditions (positive torque) by looking at changes in the crankshaft speed. If a misfire occurs the speed of the crankshaft will vary more than normal.

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. This can increase vehicle emissions

EMISSIONS CONTROL (Continued)

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.

DESCRIPTION - TRIP DEFINITION

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 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. These will include the following:

- Oxygen Sensor
- Catalyst Monitor
- Purge Flow Monitor
- Leak Detection Pump Monitor (if equipped)
- EGR Monitor (if equipped)
- Oxygen Sensor Heater Monitor

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.

DESCRIPTION - COMPONENT MONITORS

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

EMISSIONS CONTROL (Continued)

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.

DESCRIPTION - NON-MONITORED CIRCUITS

The PCM does not monitor the following circuits, systems and conditions that could have malfunctions causing driveability problems. The PCM might not store diagnostic trouble codes for these conditions. However, problems with these systems may cause the PCM to store diagnostic trouble codes for other systems or components. For example, a fuel pressure problem will not register a fault directly, but could cause a rich/lean condition or misfire. This could cause the PCM to store an oxygen sensor or misfire diagnostic trouble code

FUEL PRESSURE

The fuel pressure regulator controls fuel system pressure. The PCM cannot detect a clogged fuel pump inlet filter, clogged in-line fuel filter, or a pinched fuel supply or return line. However, these could result in a rich or lean condition causing the PCM to store an oxygen sensor or fuel system diagnostic trouble code.

SECONDARY IGNITION CIRCUIT

The PCM cannot detect an inoperative ignition coil, fouled or worn spark plugs, ignition cross firing, or open spark plug cables.

CYLINDER COMPRESSION

The PCM cannot detect uneven, low, or high engine cylinder compression.

EXHAUST SYSTEM

The PCM cannot detect a plugged, restricted or leaking exhaust system, although it may set a fuel system fault.

FUEL INJECTOR MECHANICAL MALFUNCTIONS

The PCM cannot determine if a fuel injector is clogged, the needle is sticking or if the wrong injector is installed. However, these could result in a rich or lean condition causing the PCM to store a diagnostic trouble code for either misfire, an oxygen sensor, or the fuel system.

EXCESSIVE OIL CONSUMPTION

Although the PCM monitors engine exhaust oxygen content when the system is in closed loop, it cannot determine excessive oil consumption.

THROTTLE BODY AIRFLOW

The PCM cannot detect a clogged or restricted air cleaner inlet or filter element.

VACUUM ASSIST

The PCM cannot detect leaks or restrictions in the vacuum circuits of vacuum assisted engine control system devices. However, these could cause the PCM to store a MAP sensor diagnostic trouble code and cause a high idle condition.

PCM SYSTEM GROUND

The PCM cannot determine a poor system ground. However, one or more diagnostic trouble codes may be generated as a result of this condition. The module should be mounted to the body at all times, also during diagnostic.

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.

DESCRIPTION - HIGH AND LOW LIMITS

The PCM compares input signal voltages from each input device with established high and low limits for the device. If the input voltage is not within limits and other criteria are met, the PCM stores a diagnostic trouble code in memory. Other diagnostic trouble code criteria might include engine RPM limits or input voltages from other sensors or switches that must be present before verifying a diagnostic trouble code condition.

DESCRIPTION - LOAD VALUE

ENGINE	IDLE/NEUTRAL	2500 RPM/NEUTRAL
All Engines	2% to 8% of Maximum Load	9% to 17% of Maximum Load

EMISSIONS CONTROL (Continued)

OPERATION - TASK MANAGER

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 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 MIL 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.

EMISSIONS CONTROL (Continued)

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

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

EMISSIONS CONTROL (Continued)

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.
- **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.

EVAPORATIVE EMISSIONS

TABLE OF CONTENTS

EVAPORATIVE EMISSIONS

DESCRIPTION

DESCRIPTION - EVAPORATION CONTROL SYSTEM

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.

EVAPORATIVE EMISSIONS (Continued)

DESCRIPTION - CCV SYSTEM

All 2.5L 4–cylinder and 4.0L 6–cylinder engines are equipped with a Closed Crankcase Ventilation (CCV) system (Fig. 1) or (Fig. 2).

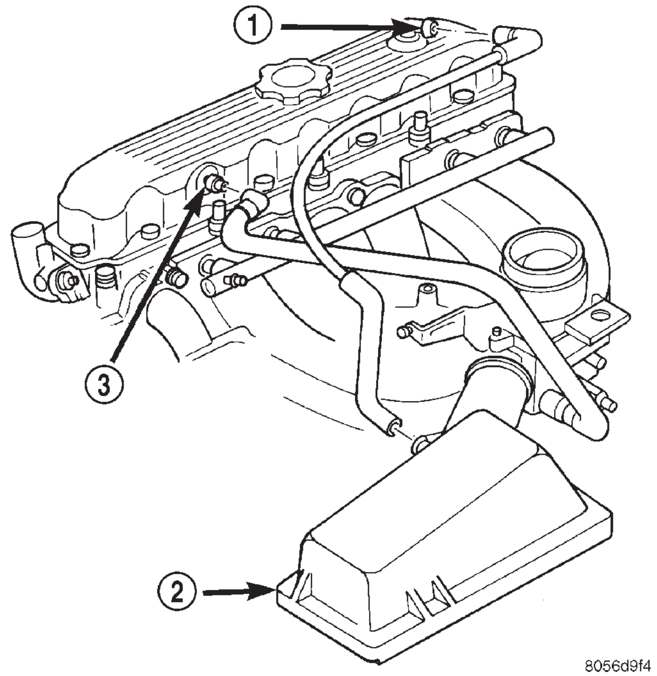

Fig. 1 CCV System—2.5L Engine—Typical

1 - AIR INLET FITTING
2 - AIR FILTER COVER
3 - FIXED ORIFICE FITTING

OPERATION - CCV SYSTEM

The CCV system performs the same function as a conventional PCV system, but does not use a vacuum controlled valve.

On 4.0L 6 cylinder engines, a molded vacuum tube connects manifold vacuum to top of cylinder head (valve) cover at dash panel end. The vacuum fitting contains a fixed orifice of a calibrated size. It meters the amount of crankcase vapors drawn out of the engine.

On 2.5L 4 cylinder engines, a fitting on drivers side of cylinder head (valve) cover contains the metered orifice. It is connected to manifold vacuum.

A fresh air supply hose from the air cleaner is connected to front of cylinder head cover on 4.0L engines. It is connected to rear of cover on 2.5L engines.

When the engine is operating, fresh air enters the engine and mixes with crankcase vapors. Manifold vacuum draws the vapor/air mixture through the fixed orifice and into the intake manifold. The vapors are then consumed during combustion.

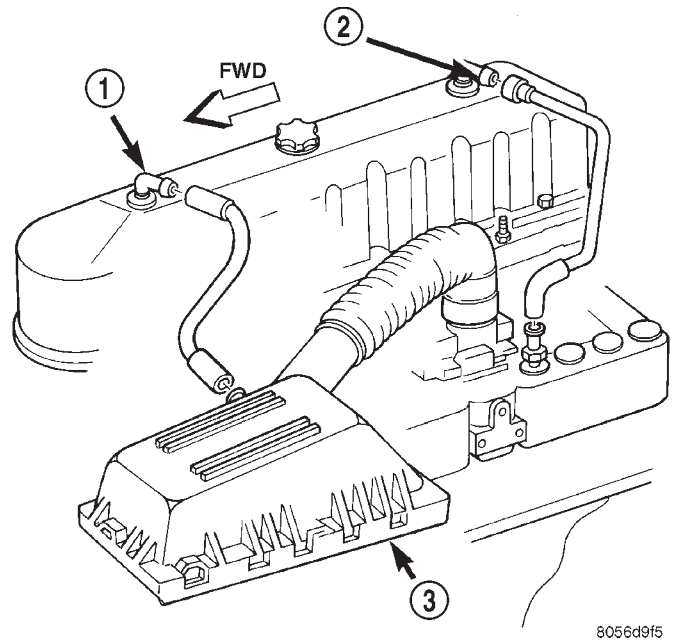

Fig. 2 CCV System—4.0L Engine—Typical

1 - AIR INLET FITTING
2 - FIXED ORIFICE FITTING
3 - AIR FILTER COVER

DIAGNOSIS AND TESTING - 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.**

EVAPORATIVE EMISSIONS (Continued)

SPECIFICATIONS

TORQUE - EMISSIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
EVAP Canister Mounting Bolt	9	—	80
Leak Detection Pump Filter Mounting Bolts	7	—	65
LDP Pump Mounting Screws	1	—	11

EVAP/PURGE SOLENOID

DESCRIPTION

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.

OPERATION

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.

REMOVAL

The duty cycle EVAP canister purge solenoid is located in the engine compartment on the EVAP canister mounting bracket (Fig. 5) .

(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.

FUEL FILLER 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.

REMOVAL

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.

LEAK DETECTION PUMP

DESCRIPTION

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.

OPERATION

Immediately after a cold start, engine temperature between 40°F and 86°F, the 3 port solenoid is briefly energized. This initializes the pump by drawing air into the pump cavity and also closes the vent seal. During non-test test conditions, the vent seal is held open by the pump diaphragm assembly which pushes it open at the full travel position. The vent seal will remain closed while the pump is cycling. This is due to the operation of the 3 port solenoid which prevents the diaphragm assembly from reaching full travel. After the brief initialization period, the solenoid is de-energized, allowing atmospheric pressure to enter the pump cavity. This permits the spring to drive the diaphragm which forces air out of the pump cavity and into the vent system. When the solenoid is energized and de-energized, the cycle is repeated creating flow in typical diaphragm pump fashion. The pump is controlled in 2 modes:

PUMP MODE: The pump is cycled at a fixed rate to achieve a rapid pressure build in order to shorten the overall test time.

TEST MODE: The solenoid is energized with a fixed duration pulse. Subsequent fixed pulses occur when the diaphragm reaches the switch closure point.

The spring in the pump is set so that the system will achieve an equalized pressure of about 7.5 inches of water.

When the pump starts, the cycle rate is quite high. As the system becomes pressurized pump rate drops. If there is no leak the pump will quit. If there is a leak, the test is terminated at the end of the test mode.

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.

REMOVAL

The LDP is located in the engine compartment near the EVAP canister (Fig. 5). The LDP filter is also located near the EVAP canister (Fig. 5). The LDP and LDP filter are replaced (serviced) as one unit.

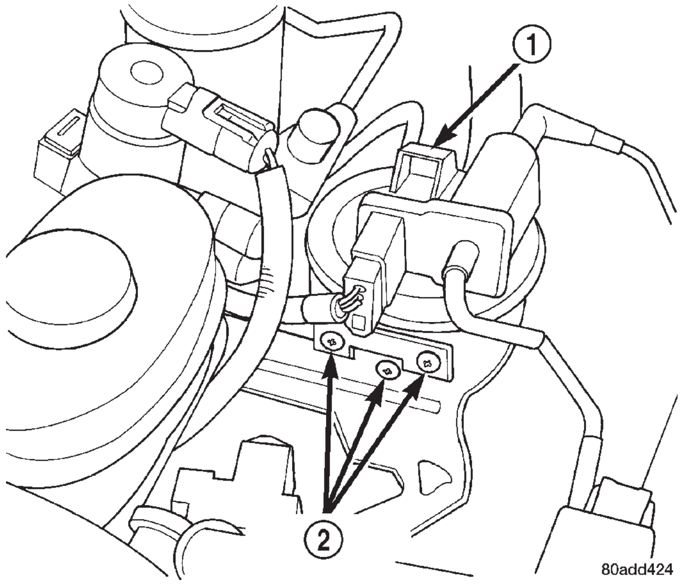

Fig. 3 Leak Detection Pump (LDP) Mounting Screws

1 - LEAK DETECTION PUMP (LDP)
2 - MOUNTING SCREWS

(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. 3) and remove from vehicle.

(5) Carefully separate hose at bottom of LDP filter.

INSTALLATION

The LDP is located in the engine compartment near the EVAP canister (Fig. 5). The LDP filter is also located near the EVAP canister (Fig. 5). The LDP and LDP filter are replaced (serviced) as one unit.

(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.

(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.

VACUUM LINES

DESCRIPTION

A vacuum schematic for emission related items can be found on the VECI label. Refer to Vehicle Emission Control Information (VECI) Label for label location.

VAPOR CANISTER

DESCRIPTION

The evaporative (EVAP) canister is located in the engine compartment on the left inner fender (Fig. 4) .

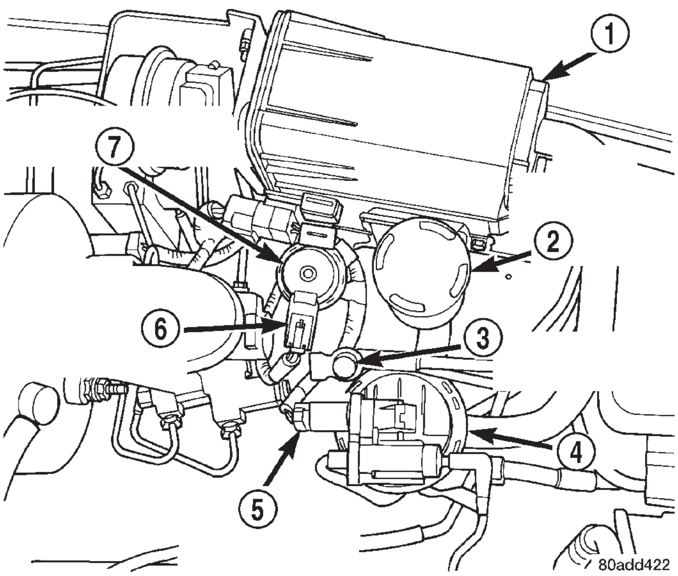

Fig. 4 EVAP Canister, EVAP Canister Purge Solenoid and LDP Location

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.

REMOVAL

The EVAP canister is mounted to a bracket, located in the engine compartment, on the left front inner fender (Fig. 5).

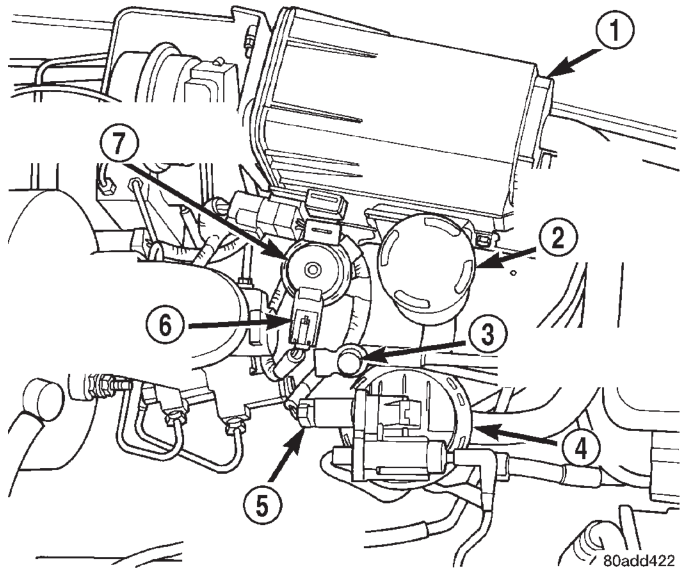

Fig. 5 EVAP Canister, Purge Solenoid and LDP Location

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

(1) Disconnect vacuum lines/hoses at EVAP canister. Note location of lines/hoses before removal.

(2) Remove canister mounting bolt (Fig. 6).

(3) Disengage canister from vehicle by slipping 2 canister dowel pins from rubber mounting bracket bushings.

VAPOR CANISTER (Continued)

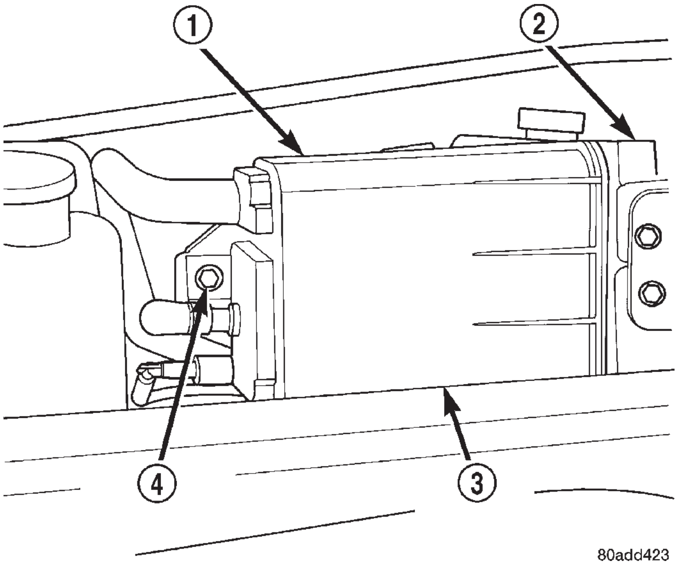

Fig. 6 EVAP Canister Removal/Installation

1 - EVAP CANISTER
2 - MOUNTING BRACKET
3 - L. F. FENDER
4 - MOUNTING BOLT

INSTALLATION

The EVAP canister is mounted to a bracket, located in the engine compartment, on the left front inner fender (Fig. 5).

(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.

SERVICE MANUAL COMMENTS

What errors(s) have you found?

____

____

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____

In order for us to assist you, please include as much details as possible when reporting an error

Comments / Suggestions

____

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