GROUP TAB LOCATOR

INTRODUCTION

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VEHICLE SAFETY CERTIFICATION LABEL

DESCRIPTION

A vehicle safety certification label 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 shut-face (Fig. 1).

All communications or inquiries regarding the vehicle should include the Month-Day-Hour and Vehicle Identification Number.

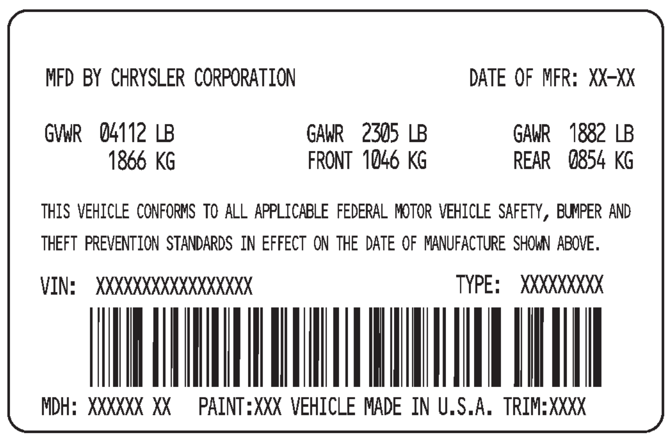

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Fig. 1 Vehicle Safety Certification Label

VEHICLE IDENTIFICATION NUMBER

DESCRIPTION

The Vehicle Identification Number (VIN) plate is attached to the top left side of the instrument panel (Fig. 2). The VIN contains 17 characters that provide data concerning the vehicle. Refer to the decoding chart to determine the identification of a vehicle.

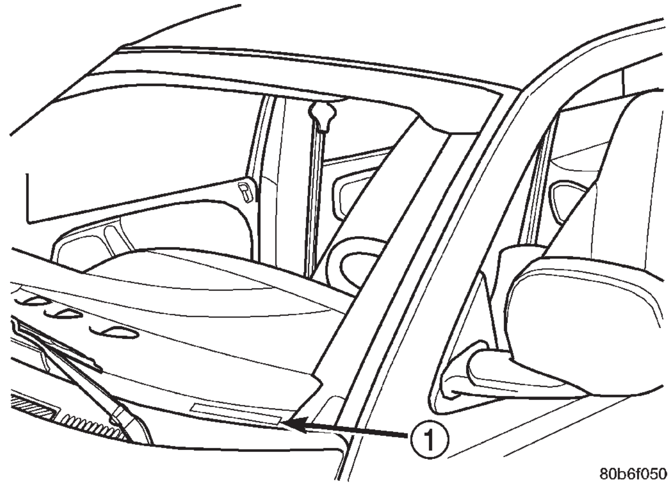


Fig. 2 Vehicle Identification Number (VIN)

1 - VIN

VIN DECODING INFORMATION

POSITION	INTERPRETATION	CODE = DESCRIPTION
1	Country of Origin	1= USA
2	Make	B = Dodge
3	Vehicle Type	7 = Truck
4	Gross Vehicle Weight Rating	F = 4001-5000 lbs. G = 5001-6000 lbs. H = 6001-7000 lbs.
5	Vehicle Line	G = Dakota Dakota Sport Dakota 4x4 L = Dakota Dakota Sport Dakota 4x2
6	Series	2 = Dakota Dakota Sport Dakota SLT
7	Body Style	2 = Club Cab A = Quad Cab 6 = Conventional Cab
8	Engine	P = 2.5L X = 3.9L N=4.7L Y = 5.2L Z = 5.9L
9	Check Digit	
10	Model Year	1=2001
11	Assembly Plant	S = Warren Truck Assembly
12 Thru 17	Vehicle Build Sequence	Assembly Sequence

VECI LABEL

DESCRIPTION

All vehicles are equipped with a combined VECI label. This label is located in the engine compartment (Fig. 3).

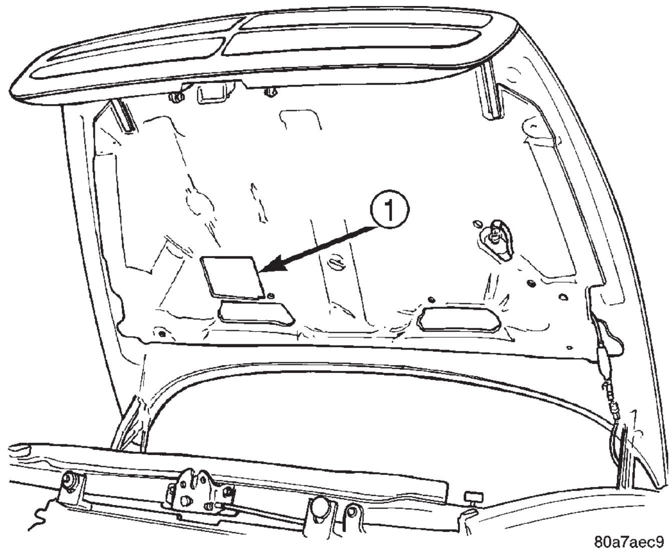


Fig. 3 VECI Label Location

1 - VEHICLE EMISSION CONTROL INFORMATION (VECI) 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.

BODY CODE PLATE

DESCRIPTION

LOCATION AND DECODING

A metal body code plate is attached to the floor pan under the passenger seat. Remove the passenger seat, door sill scuff plate and pull back the carpet to access the body code plate. There are seven lines of information on the body code plate. Lines 5, 6, and 7 are not used to define service information. Information reads from left to right, starting with line 4 in the center of the plate to line 1 at the bottom of the plate (Fig. 4).

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

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

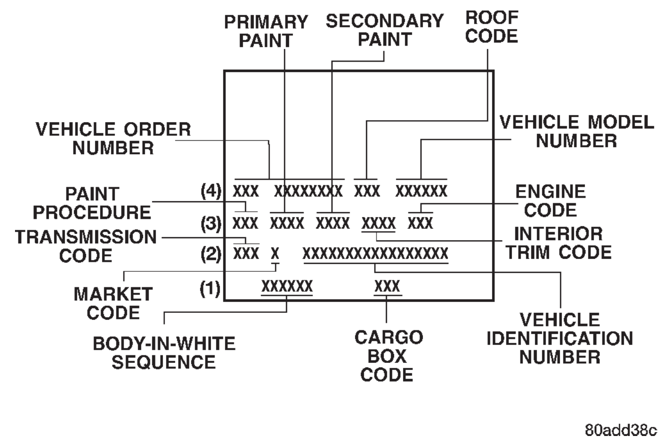


Fig. 4 Body Code

BODY CODE PLATE—LINE 4

DIGITS 1 THROUGH 12

Vehicle Order Number

DIGITS 13, 14, AND 15

Open Space

DIGITS 16, 17, AND 18

Car Line Shell
- AN1 = Dakota 4 X 2
- AN5 = Dakota 4 X 4

DIGIT 19

Price Class
- L = Dakota (All)

DIGITS 20 AND 21

Body Type
- 31 = Dakota Club Cab (130.9 in. Wheel Base)
- 61 = Dakota (111.9 in. Wheel Base)
- 62 = Dakota (123.9 in. Wheel Base)

BODY CODE PLATE—LINE 3

DIGITS 1,2, AND 3

Paint Procedure

BODY CODE PLATE (Continued)

DIGIT 4
Open Space

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

DIGIT 9
Open Space

DIGITS 10 THROUGH 13
Secondary Paint

DIGIT 14
Open Space

DIGITS 15 THROUGH 18
Interior Trim Code

DIGIT 19
Open Space

DIGITS 20, 21, AND 22
Engine Code
- EPE = 2.5 L 4 cyl. MPI Gasoline
- EHC = 3.9 L 6 cyl. MPI Gasoline
- ELF = 5.2 L 8 cyl. MPI Gasoline
- ELM = 5.9 L 8 cyl. MPI Gasoline

BODY CODE PLATE—LINE 2

DIGITS 1, 2, AND 3
Transmission Codes
- DDK = 5–Speed Manual (NVG 1500)
- DDQ = 5–Speed Manual (AX15)
- DDC = 5–Speed Manual (NVG 3500)
- DGK = 4–Speed Automatic (42RE)
- DGW = 4–Speed Automatic (44RE)
- DGT = 4–Speed Automatic (46RE)

DIGIT 4
Open Space

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

DIGIT 6
Open Space

DIGITS 7 THROUGH 23
Vehicle Identification Number (VIN)
Refer to Vehicle Identification Number (VIN) paragraph for proper breakdown of VIN code.

BODY CODE PLATE—LINE 1

DIGITS 1 THROUGH 6 Body-in-white assembly sequence.

DIGITS 7 THROUGH 9
Open Space

DIGITS 10 THROUGH 12 Cargo box code
- XBS = Sweptline

DIGITS 13 THROUGH 16
Open Space

EQUIPMENT IDENTIFICATION PLATE

DESCRIPTION

The Equipment Identification Plate (Fig. 5) is located at the left, front of the inner hood panel. The plate lists information concerning the vehicle as follows:
- The model.
- The wheelbase.
- The VIN (Vehicle Identification Number).
- The T.O.N. (order number).
- The optional and special equipment installed on the vehicle.

Refer to the information listed on the plate when ordering replacement parts.

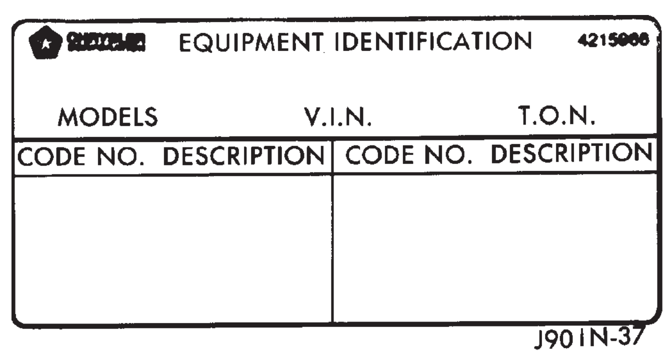


Fig. 5 Equipment Identification Plate—Typical

INTERNATIONAL SYMBOLS

DESCRIPTION

The graphic symbols illustrated in the following International Control and Display Symbols Chart (Fig. 6) are used to identify various instrument controls. The symbols correspond to the controls and displays that are located on the instrument panel.

INTERNATIONAL SYMBOLS (Continued)

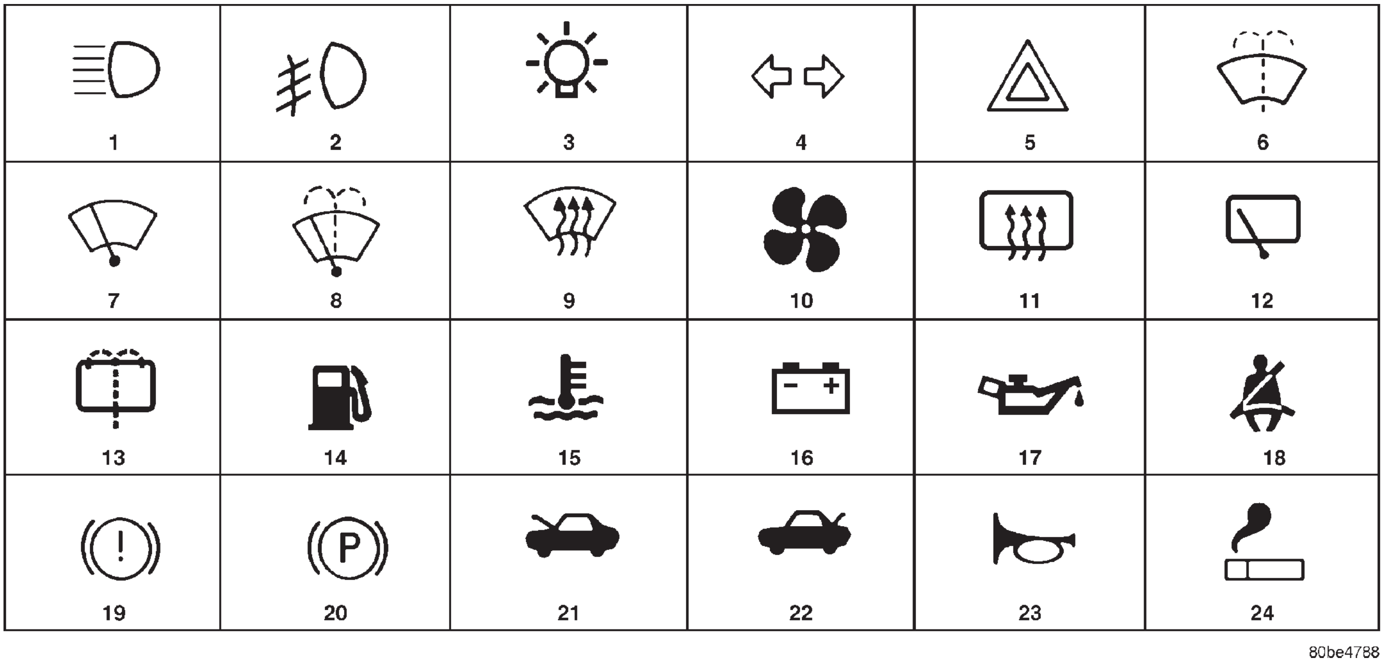


Fig. 6 INTERNATIONAL SYMBOLS

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

GRADE/CLASS 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 (Fig. 7) and Fastener Strength Charts (Fig. 8).

FASTENER USAGE

DESCRIPTION

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

Figure art, specifications and tightening torque references in this 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 use.

DESCRIPTION

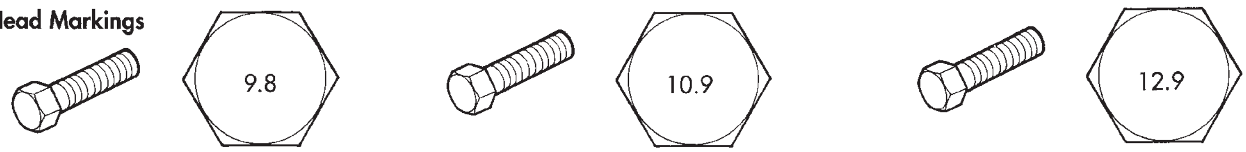
Most stripped threaded holes can be repaired using a Helicoil ®. Follow the manufacture recommendation for application and repair procedures.

FASTENER USAGE (Continued)

Bolt Markings and Torque - Metric

Commercial Steel Class: 9.8, 10.9, 12.9

Bolt Head Markings

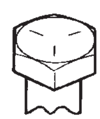


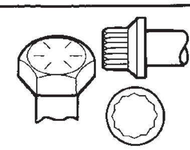
Body Size Diam. mm	9.8 Torque Cast Iron N•m	9.8 Torque Cast Iron ft-lb	9.8 Torque Aluminum N•m	9.8 Torque Aluminum ft-lb	10.9 Torque Cast Iron N•m	10.9 Torque Cast Iron ft-lb	10.9 Torque Aluminum N•m	10.9 Torque Aluminum ft-lb	12.9 Torque Cast Iron N•m	12.9 Torque Cast Iron ft-lb	12.9 Torque Aluminum N•m	12.9 Torque Aluminum 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	Grade 5 Cast Iron ft-lb	Grade 5 Aluminum N•m	Grade 5 Aluminum ft-lb	Bolt Torque - Grade 8 Bolt Cast Iron N•m	Grade 8 Cast Iron ft-lb	Grade 8 Aluminum N•m	Grade 8 Aluminum 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. 7 FASTENER IDENTIFICATION

FASTENER USAGE (Continued)

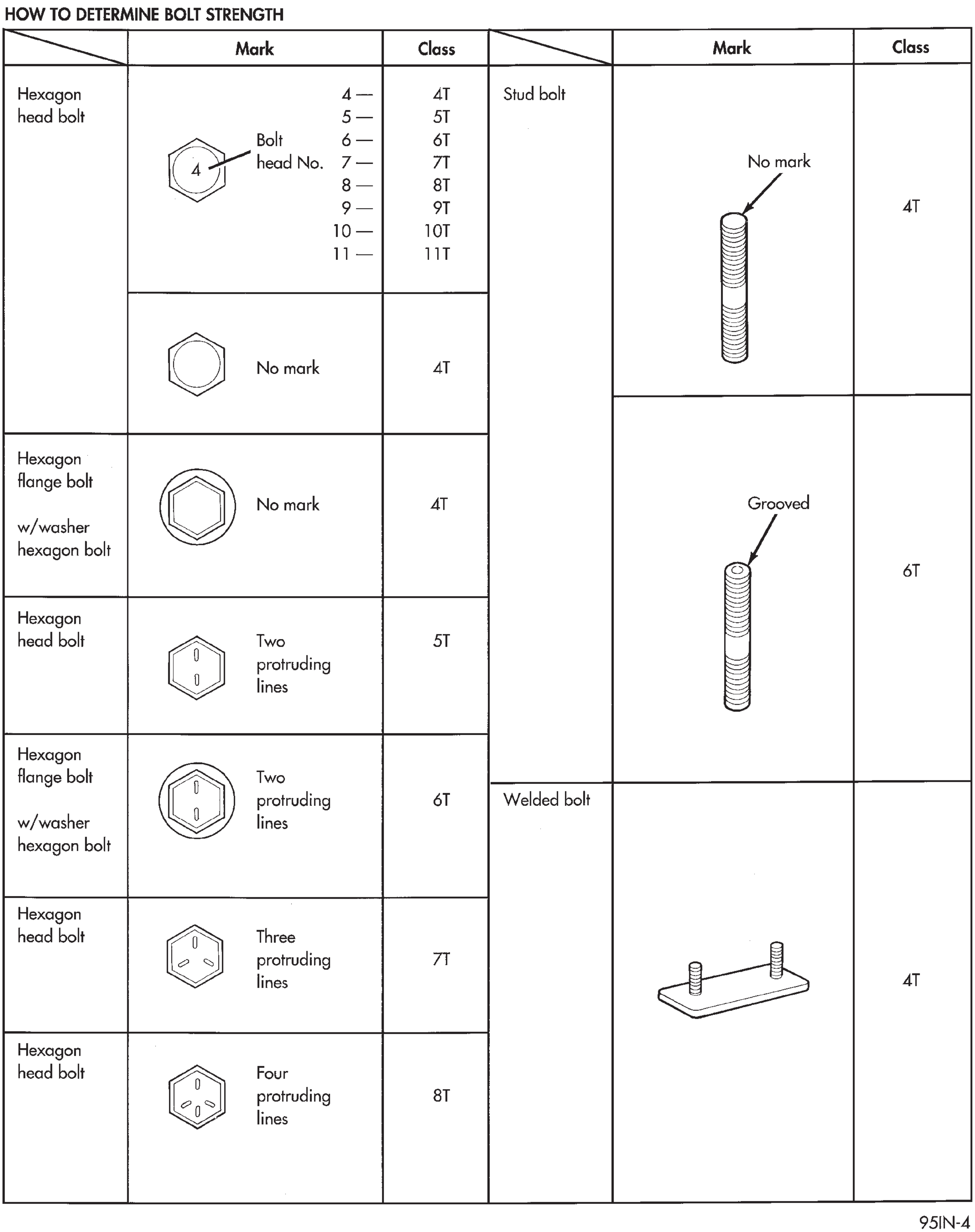

Fig. 8 FASTENER STRENGTH

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.

Refer to the Metric Conversion Chart (Fig. 9) to convert torque values listed in metric Newton-meters (N·m). Also, use the chart to convert between millimeters (mm) and inches (in.)

CONVERSION FORMULAS AND EQUIVALENT VALUES

MULTIPLY	BY	TO GET	MULTIPLY	BY	TO GET
in-lbs	x 0.11298	= Newton Meters (N·m)	N·m	x 8.851	= in-lbs
ft-lbs	x 1.3558	= Newton Meters (N·m)	N·m	x 0.7376	= ft-lbs
Inches Hg (60° F)	x 3.377	= Kilopascals (kPa)	kPa	x 0.2961	= Inches Hg
psi	x 6.895	= Kilopascals (kPa)	kPa	x 0.145	= psi
Inches	x 25.4	= Millimeters (mm)	mm	x 0.03937	= Inches
Feet	x 0.3048	= Meters (M)	M	x 3.281	= Feet
Yards	x 0.9144	= Meters	M	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	

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. 9 METRIC CONVERSION CHART

TORQUE REFERENCES

DESCRIPTION

Individual Torque Charts appear at the end of many Groups. Refer to the Standard Torque Specifications Chart for torque references not listed in the individual torque charts (Fig. 10).

SPECIFIED TORQUE FOR STANDARD BOLTS

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

Fig. 10 TORQUE SPECIFICATIONS

LUBRICATION & MAINTENANCE

TABLE OF CONTENTS

LUBRICATION & MAINTENANCE

SPECIFICATIONS

SPECIFICATIONS - FLUID CAPACITIES

DESCRIPTION	SPECIFICATION
FUEL TANK	2-Door: 83L (22 U.S. Gallons)**** 4-Door: 91L (24 U.S. Gallons)****
ENGINE OIL - WITH FILTER	
2.5L Engine	4.3L (4.5 qts.)
3.9L Engine	3.8L (4.0 qts.)
4.7L Engine	5.7L (6.0 qts.)
5.9L Engine	4.7L (5.0 qts.)
COOLING SYSTEM	
2.5L Engine	9.3L (9.8 qts.)***
3.9L Engine	13.3L (14.0 qts.)***
4.7L Engine	12.3L (13.0 qts.)***
5.9L Engine	13.7L (14.6 qts.)***
AUTOMATIC TRANSMISSION	
Service Fill - 42RE	3.8L (4.0 qts)
O-haul Fill - 42RE	9.1-9.5L (19-20 pts)
Service Fill - 46RE	3.8L (4.0 qts)
O-haul Fill - 46RE	9.1-9.5L (19-20 pts)
O-haul Fill - 45RFE	13.33L (28.0 pts)
MANUAL TRANSMISSION	
NV3500	2.28L (4.8 pts.)
TRANSFER CASE	
NV233	1.18L (2.5 pts.)
NV244	1.35L (2.85 pts.)
FRONT AXLE	
C205F	1.66L (3.5 pts.)
REAR AXLE	
9 1/4	2.32L (4.9 pts.)**
8 1/4	2.22L (4.7 pts.)**
** When equipped with Trac-lok, include 148 ml (5 oz.) of Friction Modifier.	
*** Includes 0.9L (1.0 qts.) for coolant reservoir.	
****Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.	

INTERNATIONAL SYMBOLS

DESCRIPTION

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

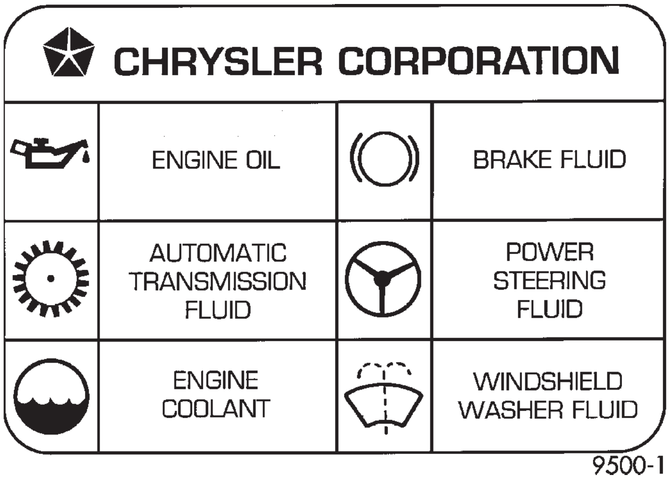

Fig. 1 International Symbols

PARTS & LUBRICANT

STANDARD PROCEDURE—CLASSIFICATION OF LUBRICANTS

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

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

ENGINE OIL

SAE VISCOSITY RATING INDICATES ENGINE OIL VISCOSITY

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

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

DaimlerChrysler Corporation only recommends multiple grade engine oils.

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

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

Fig. 2 API Symbol

GEAR LUBRICANTS

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

LUBRICANTS AND GREASES

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

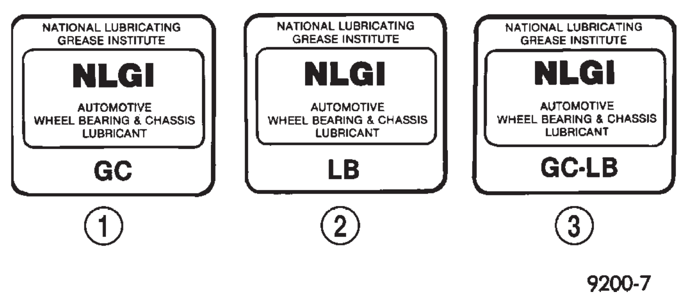

Fig. 3 NLGI Symbol

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.

PARTS & LUBRICANT (Continued)

RECOMMENDATIONS

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

FLUID TYPES

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

NOTE: Refer to the vehicle's coolant bottle cap to identify HOAT or Non-HOAT coolant. Non-HOAT coolant is green in color.

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 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) and (Fig. 5).

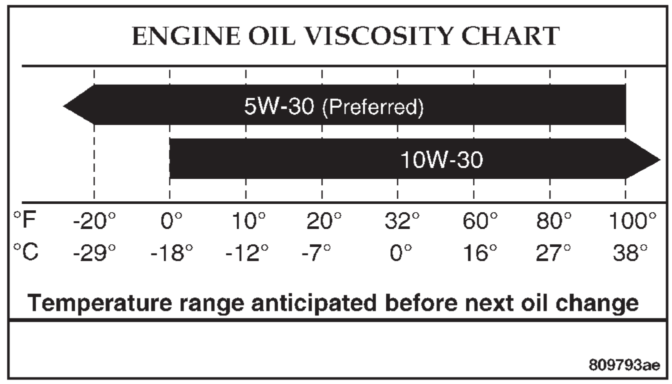

Fig. 4 Temperature/Engine Oil Viscosity

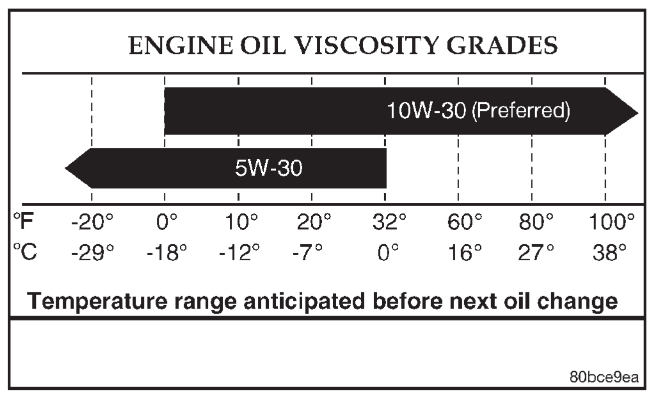

Fig. 5 Temperature/Engine Oil Viscosity

ENERGY CONSERVING OIL

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

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. 6).

This symbol 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.

FLUID TYPES (Continued)

9400-9

Fig. 6 Engine Oil Container Standard Notations

DESCRIPTION - TRANSFER CASE - NV233

Recommended lubricant for the NV233 transfer case is Mopar® ATF +4, type 9602, Automatic Transmission Fluid.

DESCRIPTION - TRANSFER CASE - NV244

Recommended lubricant for the NV244 transfer case is Mopar® ATF +4, type 9602, Automatic Transmission Fluid.

DESCRIPTION - AXLE

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

FRONT AXLE

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

REAR AXLE

- The lubricant should have MIL-L-2105C and API GL 5 quality specifications.
- 8 1/4 axle lubricant is a thermally stable SAE 80W-90 gear lubricant.
- 9 1/4 axle lubricant is a thermally stable SAE 75W-90 gear lubricant.

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

DESCRIPTION - MANUAL TRANSMISSION

Mopar® Manual Transmission Lubricant is the only lubricant recommended for use in the manual transmissions.

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.** A dark brown/black fluid accompanied with a burnt odor and/or deterioration in shift quality may indicate fluid deterioration or transmission component failure.

FLUID ADDITIVES

DaimlerChrysler strongly recommends against the addition of any fluids to the transmission, other than those automatic transmission fluids listed above. Exceptions to this policy are the use of special dyes to aid in detecting fluid leaks.

Various “special” additives and supplements exist that claim to improve shift feel and/or quality. These additives and others also claim to improve converter clutch operation and inhibit overheating, oxidation, varnish, and sludge. These claims have not been supported to the satisfaction of DaimlerChrysler and these additives **must not be used.** The use of transmission “sealers” should also be avoided, since they may adversely affect the integrity of transmission seals.

OPERATION - 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.

FLUID FILL/CHECK LOCATIONS

DESCRIPTION

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

MAINTENANCE SCHEDULES

DESCRIPTION

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

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

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

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

Use the schedule that best describes the driving conditions.

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

MAINTENANCE SCHEDULES

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

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

Second is Schedule **“B”**. It is a schedule for vehicles that are operated under the conditions listed at the beginning of that schedule.

Use the schedule that best describes the driving conditions.

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

At Each Stop For Gasoline

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

Once A Month

- Check tire pressure and look for unusual wear or damage.
- Inspect battery and clean and tighten terminals as required.
- Check fluid levels of coolant reservoir, power steering and transmission and add as needed.
- Check all lights and all other electrical items for correct operation.
- Inspect and clean wiper blades. Replace if required.

At Each Oil Change

- Inspect exhaust system.
- Inspect brake hoses.
- Rotate the tires at each oil change interval shown on Schedule “A”: (7,500 miles) or every other interval shown on Schedule “B” (6,000 miles).
- Check engine coolant level, hoses, and clamps.

EMISSION CONTROL SYSTEM MAINTENANCE

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

FLUID FILL LOCATIONS AND LUBRICATION POINTS

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

SCHEDULE “A”

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

- Change engine oil.
- Replace engine oil filter.

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

- Change engine oil.
- Replace engine oil filter.

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate front suspension ball joints if required.
- Inspect front wheel bearings.
- Inspect brake linings.

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

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

MAINTENANCE SCHEDULES (Continued)

- Drain and refill automatic transmission fluid and change filter (4.7L only).

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

- Change engine oil.
- Replace engine oil filter.
- Drain and refill transfer case fluid.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L, and 5.9L only).

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate front suspension ball joints if required.
- Inspect front wheel bearings.
- Inspect brake linings.
- Flush and replace engine coolant at 36 months, regardless of mileage.

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

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

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

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables (2.5L, 3.9L, 5.9L).**
- **Inspect PCV valve, replace as necessary. (3.9L, 4.7L, and 5.9L)***
- **Replace spark plugs.**
- Inspect auto tension drive belt and replace if required (3.9L, & 5.9L).
- Inspect and adjust tension on drive belt (2.5L).
- Drain and refill automatic transmission fluid and change filter (4.7L only).

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

- Change engine oil.
- Replace engine oil filter.
- Lubricate front suspension ball joints if required.
- Inspect front wheel bearings.
- Inspect brake linings.

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

- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L).
- Drain and refill transfer case.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) or 24 months since last change.
- Inspect auto tension drive belt and replace if required (3.9L, & 5.9L).

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

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

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

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Inspect PCV valve, replace as necessary. (3.9L, 4.7L, and 5.9L)***
- **Replace spark plugs.**
- Lubricate front suspension ball joints if required.
- Inspect front wheel bearings.
- Inspect brake linings.
- Inspect auto tension drive belt and replace if required (3.9L, 4.7L, & 5.9L).Δ

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

- Change engine oil.
- Replace engine oil filter.

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

- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant if it has been 30,000 Miles (48 000km) or 24 months since last change.
- Inspect auto tension drive belt and replace if required (3.9L, 4.7L, & 5.9L).Δ

112,500 Miles (181 000 km) or at 90 months

- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L only).
- Drain and refill transfer case fluid.
- Lubricate front suspension ball joints if required.
- Inspect front wheel bearings.
- Inspect brake linings.
- Flush and replace engine coolant if it has been 30,000 Miles (48 000km) or 24 months since last change.

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

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables (2.5L, 3.9L & 5.9L).**

MAINTENANCE SCHEDULES (Continued)

- **Inspect PCV valve, replace as necessary. (3.9L, 4.7L, and 5.9L)***
- **Replace spark plugs.**
- Inspect auto tension drive belt and replace if required (3.9L, 4.7L, & 5.9L).∆
- Drain and refill automatic transmission fluid and change filter (4.7L only).

*This maintenance is recommended by Daimler-Chrysler Corporation to the owner but is not required to maintain the warranty on the PCV valve.

∆This maintenance is not required if the belt was previously replaced.

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

SCHEDULE "B"

Use schedule "B" if the vehicle is usually operated under the following conditions:

- Frequent short trip driving less than 5 miles (8 km)
- Frequent driving in dusty conditions
- Trailer towing
- Extensive idling
- More than 50% of the driving is at sustained high speeds during hot weather, above 90°F (32°C)

3,000 Miles (5 000 km)

- Change engine oil.
- Replace engine oil filter.

6,000 Miles (10 000 km)

- Change engine oil.
- Replace engine oil filter.

9,000 Miles (14 000 km)

- Change engine oil.
- Replace engine oil filter.

12,000 Miles (19 000 km)

- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L).‡
- Drain and refill automatic transmission fluid and change filter (4.7L only).
- Lubricate front suspension ball joints if required.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.

15,000 Miles (24 000 km)

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

18,000 Miles (29 000 km)

- Change engine oil.
- Replace engine oil filter.
- Drain and refill manual transmission fluid (3.9L only).

21,000 Miles (34 000 km)

- Change engine oil.
- Replace engine oil filter.
- Inspect front wheel bearings.

24,000 Miles (38 000 km)

- Change engine oil.
- Replace engine oil filter.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L).‡
- Drain and refill automatic transmission fluid and change filter (4.7L only).
- Lubricate front suspension ball joints if required.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.

27,000 miles (43 000 km)

- Change engine oil.
- Replace engine oil filter.

30,000 Miles (48 000 km)

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- **Inspect PCV valve, replace as necessary. (3.9L, 4.7L and 5.9L)***
- Inspect and adjust drive tension on drive belt (2.5L).

33,000 Miles (53,000 km)

- Change engine oil.
- Replace engine oil filter.

36,000 Miles (58 000 km)

- Change engine oil.
- Replace engine oil filter.
- Lubricate front suspension ball joints if required.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L).‡
- Drain and refill automatic transmission fluid and change filter (4.7L only).
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.

MAINTENANCE SCHEDULES (Continued)

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

42,000 Miles (67 000 km)
- Change engine oil.
- Replace engine oil filter.
- Inspect front wheel bearings.

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

48,000 Miles (77 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate front suspension ball joints if required.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L).‡
- Drain and refill automatic transmission fluid and change filter (4.7L only).
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.

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

54,000 Miles (86 000 km)
- Change engine oil.
- Replace engine oil filter.
- Drain and refill manual transmission fluid (3.9L only).

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

60,000 Miles (96 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Inspect PCV valve, replace as necessary. (3.9L, 4.7L, and 5.9L)***
- **Replace spark plugs.**
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L).‡
- Drain and refill automatic transmission fluid and change filter (4.7L only).
- Lubricate front suspension ball joints if required.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Inspect auto tension drive belt and replace if required (3.9L & 5.9L).

63,000 Miles (101 000 km)
- Change engine oil.
- Replace engine oil filter.
- Inspect front wheel bearings.

66,000 Miles (106,000 km)
- Change engine oil.
- Replace engine oil filter.

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

72,000 Miles (115 000 km)
- Change engine oil.
- Replace engine oil filter.
- Lubricate front suspension ball joints if required.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L).‡
- Drain and refill automatic transmission fluid and change filter (4.7L only).
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.

75,000 Miles (120 000 km)
- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air cleaner element, replace as necessary.**
- Inspect auto tension drive belt and replace if required (3.9L, 4.7L & 5.9L).Δ

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

81,000 Miles (130 000 km)
- Change engine oil.
- Replace engine oil filter.
- Flush and replace engine coolant if it has been 30,000 miles (48 000 km) since last change.

84,000 Miles (134 000 km)
- Change engine oil.
- Replace engine oil filter.
- Inspect front wheel bearings.
- Lubricate front suspension ball joints if required.

MAINTENANCE SCHEDULES (Continued)

- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L).‡
- Drain and refill automatic transmission fluid and change filter (4.7L only).
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.

87,000 Miles (139 000 km)

- Change engine oil.
- Replace engine oil filter.

90,000 Miles (144 000 km)

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace spark plugs.**
- **Inspect PCV valve, replace as necessary. (3.9L, 4.7L, and 5.9L)***
- Inspect auto tension drive belt and replace if required (3.9L, 4.7L, & 5.9L).∆
- Inspect and adjust tension on drive belt (2.5L).

93,000 Miles (149 000 km)

- Change engine oil.
- Replace engine oil filter.

96,000 Miles (154 000 km)

- Change engine oil.
- Replace engine oil filter.
- Lubricate front suspension ball joints if required.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L).‡
- Drain and refill automatic transmission fluid and change filter (4.7L only).
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.

99,000 Miles (158 000 km)

- Change engine oil
- Replace engine oil filter.

102,000 Miles (163 000 km)

- Change engine oil.
- Replace engine oil filter.

105,000 Miles (168 000 km)

- Change engine oil.
- Replace engine oil filter.
- **Inspect engine air cleaner element, replace as necessary.**
- Inspect front wheel bearings.
- Inspect auto tension drive belt and replace if required (3.9L, 4.7L, & 5.9L).∆

108,000 Miles (173 000 km)

- Change engine oil.
- Replace engine oil filter.
- Lubricate front suspension ball joints if required.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L).‡
- Drain and refill automatic transmission fluid and change filter (4.7L only).
- Drain and refill transfer case fluid.
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.

111,000 Miles (178 000 km)

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

114,000 Miles (182 000 km)

- Change engine oil.
- Replace engine oil filter.

117,000 Miles (187 000 km)

- Change engine oil.
- Replace engine oil filter.

120,000 Miles (192 000 km)

- Change engine oil.
- Replace engine oil filter.
- **Replace engine air cleaner element.**
- **Replace ignition cables.**
- **Inspect PCV valve, replace as necessary. (3.9L, 4.7L, and 5.9L)***
- **Replace spark plugs.**
- Lubricate front suspension ball joints if required.
- Drain and refill automatic transmission fluid. Replace filter and adjust bands (3.9L & 5.9L).‡
- Drain and refill automatic transmission fluid and change filter (4.7L only).
- Change rear axle fluid.
- Change front axle fluid (4x4).
- Inspect brake linings.
- Inspect auto tension drive belt and replace if required (3.9L, 4.7L, & 5.9L).∆
- Inspect and adjust tension on drive belt (2.5L).

*This maintenance is recommended by Chrysler Corporation to the customer but is not required to maintain warranty on the PCV valve.

∆This maintenance is not required if the belt was previously replaced.

‡Prolonged operation with heavy loading, especially in hot weather, use of vehicle for off-the-highway operation, and trailer towing require the more

MAINTENANCE SCHEDULES (Continued)

frequent transmission service indicated with a ‡ in Schedule “B”. Perform these services if the vehicle is usually operated under these conditions.

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

HOISTING

STANDARD PROCEDURE—HOISTING RECOMMENDATIONS

FLOOR JACK

CAUTION: Do not attempt to lift a vehicle with a floor jack positioned under:
- **An axle tube.**
- **Aluminum differential.**
- **A body side sill.**
- **A steering linkage component.**
- **A drive shaft.**
- **The engine or transmission oil pan.**
- **The fuel tank.**
- **A front suspension arm.**

When properly positioned, a floor jack can be used to lift a Dakota vehicle (Fig. 7). Support the vehicle in the raised position with jack stands at the front and rear ends of the frame rails.

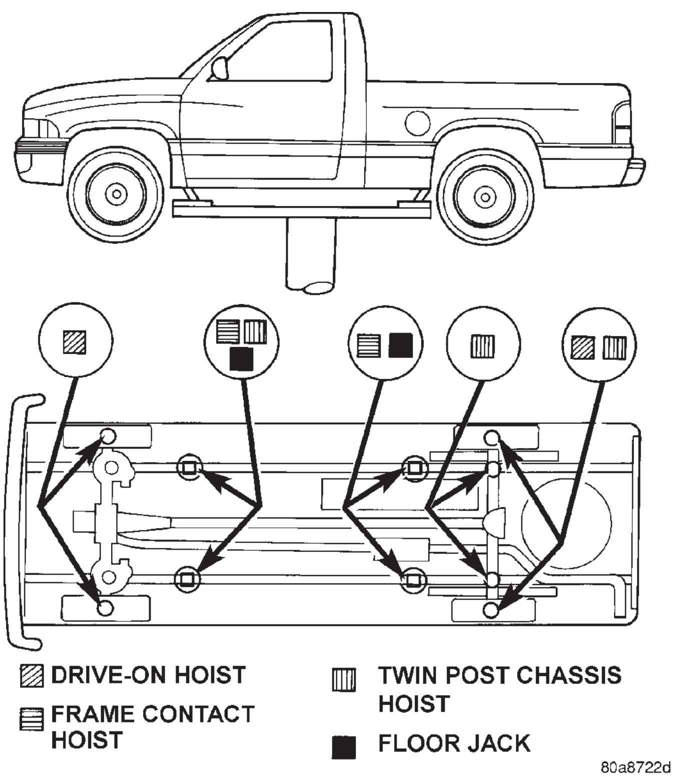

Fig. 7 Correct Vehicle Lifting Locations—Typical

HOIST

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.

CAUTION: DO NOT LET THE REAR WHEELS/AXLE HANG UNSUPPORTED WHEN THE VEHICLE IS LIFTED WITH THE PARKING BRAKE APPLIED.

NOTE: When a frame-contact type hoist is used, verify that the lifting pads are positioned properly (Fig. 7).

A vehicle can be lifted with:
- A single-post, frame-contact hoist.
- A twin-post, chassis hoist.
- A ramp-type, drive-on hoist.

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 MAINTENANCE FREE BATTERY INDICATOR DOT IS YELLOW OR BRIGHT COLOR. DO NOT JUMP START A VEHICLE WHEN THE BATTERY FLUID IS BELOW THE TOP OF LEAD PLATES. DO NOT ALLOW JUMPER CABLE CLAMPS TO TOUCH EACH OTHER WHEN CONNECTED TO A BOOSTER SOURCE. DO NOT USE OPEN FLAME NEAR BATTERY. REMOVE METALLIC JEWELRY WORN ON HANDS OR WRISTS TO AVOID INJURY BY ACCIDENTAL ARCING OF BATTERY CURRENT. WHEN USING A HIGH OUTPUT BOOSTING DEVICE, DO NOT ALLOW BATTERY VOLTAGE TO EXCEED 16 VOLTS. REFER TO INSTRUCTIONS PROVIDED WITH DEVICE BEING USED.

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

JUMP STARTING (Continued)

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

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

(2) When using another vehicle as a booster source, park the booster vehicle within cable reach. Turn off all accessories, set the parking brake, place the automatic transmission in PARK or the manual transmission in NEUTRAL and turn the ignition OFF.

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

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

(5) On disabled vehicle, connect RED jumper cable clamp to positive (+) terminal. Connect BLACK jumper cable clamp to engine ground as close to the ground cable attaching point as possible (Fig. 8).

(6) Start the engine in the vehicle which has the booster battery, let the engine idle a few minutes, then start the engine in the vehicle with the discharged battery.

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

(7) 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.

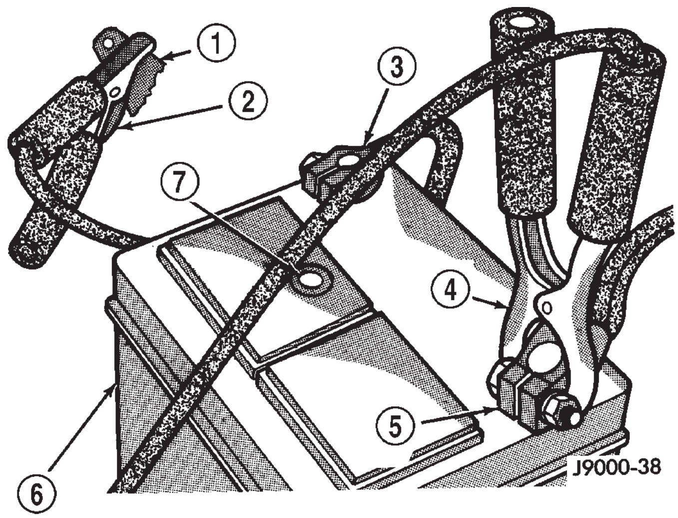

Fig. 8 Jumper Cable Clamp Connections

1 - ENGINE GROUND
2 - NEGATIVE JUMPER CABLE
3 - BATTERY NEGATIVE CABLE
4 - POSITIVE JUMPER CABLE
5 - BATTERY POSITIVE CABLE
6 - BATTERY
7 - TEST INDICATOR

TOWING

STANDARD PROCEDURE—TOWING RECOMMENDATIONS

A vehicle equipped with an SAE approved Wheel-lift towing device can be used to tow all **Short Bed DAKOTA** vehicles. Long Bed vehicles must be towed with a Flat-bed device (Fig. 9). When towing a 4WD vehicle, use tow dollies under the opposite end of the vehicle.

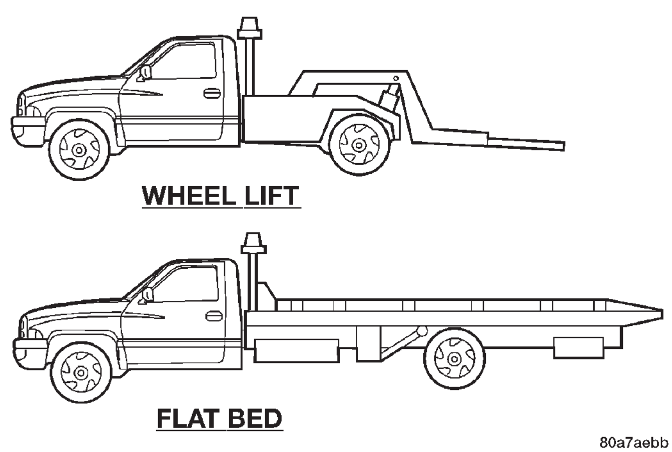

Fig. 9 Tow Vehicles With Approved Equipment

TOWING (Continued)

SAFETY PRECAUTIONS

NOTE: The following safety precautions must be observed when towing a vehicle.

- 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, or J-hooks to a bumper, steering linkage, drive shafts or a non-reinforced frame hole.
- Do not tow a heavily loaded vehicle. Damage to the cab, cargo box or frame may result. Use a flat bed device to transport a loaded vehicle.

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.

RAMP ANGLE

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

TOWING WHEN KEYS ARE NOT AVAILABLE

When the vehicle is locked and keys are not available, use a flat bed hauler. A Sling-type device can be used on 4WD vehicles provided **all the wheels are lifted off the ground using tow dollies.**

STANDARD PROCEDURE—TWO WHEEL DRIVE VEHICLE TOWING

TOWING-REAR END LIFTED

CAUTION:
Short bed vehicles must be towed with a Wheel-lift device (Fig. 10) or transported on a flat bed (Fig. 11). Long bed vehicles must be transported on a flat bed.

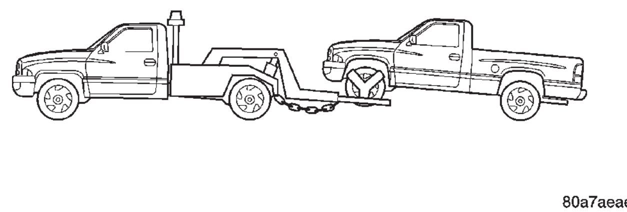

Fig. 10 Short Bed Vehicle Towing—Typical

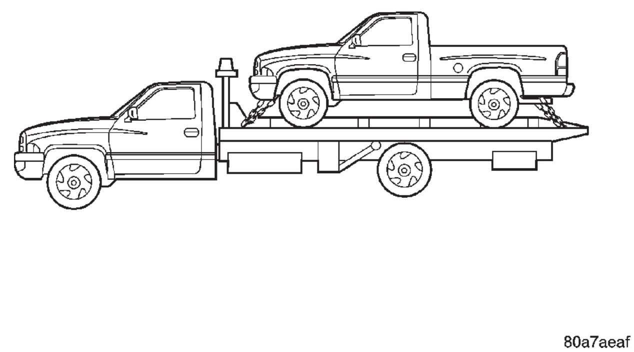

Fig. 11 Long Bed Vehicle Towing—Typical

2WD vehicles can be towed with the front wheels on the surface for extended distances at speeds not exceeding 48 km/h (30 mph).

(1) Attach wheel lift device to rear wheels.

(2) Attach safety chains to frame rails. Route chains so not to interfere with tail pipe when vehicle is lifted.

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

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

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

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

(6) Shift the transmission to NEUTRAL.

TOWING-FRONT END LIFTED

When lifting from the front end, all vehicles must be towed with a Wheel-lift device or transported on a flat bed.

(1) Attach Wheel-lift device to front wheels.

TOWING (Continued)

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

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

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

TWO WHEEL DRIVE—MANUAL AND AUTOMATIC TRANSMISSION

Provided the transmission is operable, tow only in **NEUTRAL** at speeds not to exceed 30 mph (50 km/h) and distances less than 15 miles (25km/h).

If the vehicle is to be towed more than 15 miles, the propeller shaft should be disconnected or place tow dollies under rear wheels.

STANDARD PROCEDURE—FOUR WHEEL DRIVE VEHICLE TOWING

FOUR WHEEL DRIVE TOWING—REAR END LIFTED

CAUTION:
Short bed vehicles must be towed with a Wheel-lift device (Fig. 10) or transported on a flat bed. Long bed vehicles must be transported on a flat bed (Fig. 11). When using a Wheel-lift device, all wheels must be lifted off the ground using tow dollies.

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

(2) Attach wheel lift device to rear wheels.

(3) Attach safety chains to frame rails. Route chains so not to interfere with tail pipe when vehicle is lifted.

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

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

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

(6) Shift the transfer case to NEUTRAL.

FOUR WHEEL DRIVE TOWING—FRONT END LIFTED

When lifting from the front end, all vehicles must be towed with a wheel-lift device or transported on a flat bed.

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

(2) Attach wheel lift device to front wheels.

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

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

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

(5) Shift the transfer case to NEUTRAL.

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 (Fig. 1).

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

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

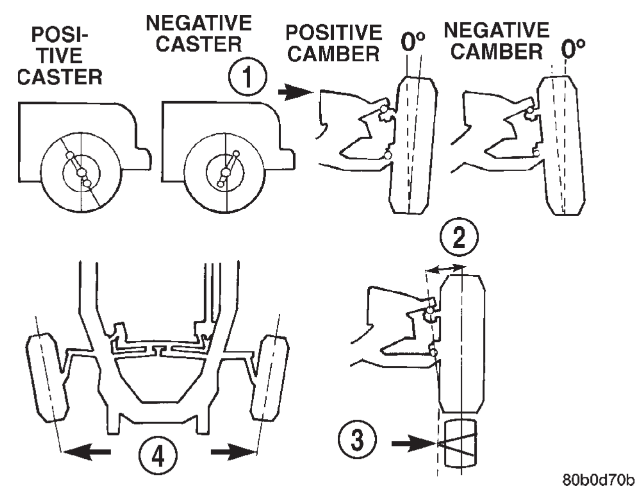


Fig. 1 Wheel Alignment Measurements

1 - FRONT OF VEHICLE
2 - STEERING AXIS INCLINATION
3 - PIVOT POINT
4 - TOE-IN

OPERATION

• **CASTER** is the forward or rearward tilt of the steering knuckle from vertical. Tilting the top of the knuckle forward provides negative caster. Tilting the top of the knuckle rearward provides positive caster. Positive caster promotes directional stability. This angle enables the front wheels to return to a straight ahead position after turns (Fig. 2).

• **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.

WHEEL ALIGNMENT (Continued)

Tilting the top of the wheel outward provides positive camber. Incorrect camber will cause wear on the inside or outside edge of the tire (Fig. 2).

- **TOE** is the difference between the leading inside edges and trailing inside edges of the front tires. Wheel toe position out of specification cause's unstable steering, uneven tire wear and steering wheel off-center. The wheel toe position is the **final** front wheel alignment adjustment (Fig. 2).
- **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. 2).

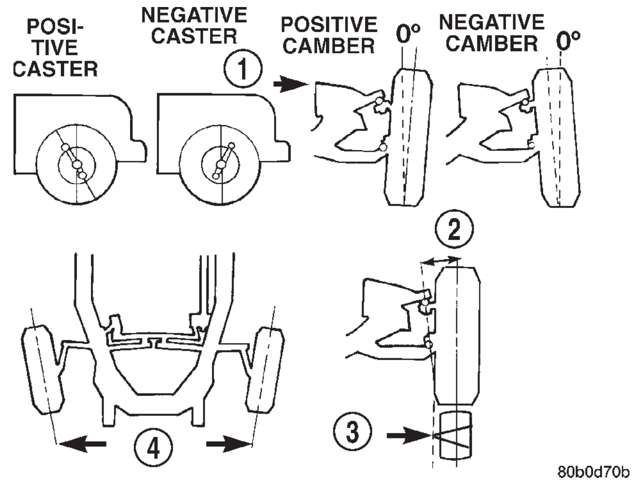


Fig. 2 Wheel Alignment

1 - FRONT OF VEHICLE
2 - STEERING AXIS INCLINATION
3 - PIVOT POINT
4 - TOE-IN

DIAGNOSIS AND TESTING - PRE-ALIGNMENT INSPECTION

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

(1) Inspect tires for size, air pressure and tread wear.
(2) Inspect front wheel bearings for wear.
(3) Inspect front wheels for excessive radial or lateral runout and balance.
(4) Inspect ball studs, linkage pivot points and steering gear for looseness, roughness or binding.
(5) Inspect suspension components for wear and noise.
(6) On 4x4 vehicles check suspension height.
(7) Road test the vehicle.

SUSPENSION AND STEERING SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
FRONT END NOISE	1. Loose or worn wheel bearing.	1. Replace wheel bearing.
	2. Loose or worn steering or suspension components.	2. Tighten or replace components as necessary.
	3. Lower ball joint (4x4).	3. Gease joint and perform diagnosis and testing.
EXCESSIVE PLAY IN STEERING	1. Loose or worn wheel bearing.	1. Replace wheel bearing.
	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 bearing.	1. Replace wheel bearing.
	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.

WHEEL ALIGNMENT (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
VEHICLE INSTABILITY	1. Loose or worn wheel bearing.	1. Replace wheel bearing.
	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. Column coupler binding.	2. Replace coupler.
	3. Tire pressure.	3. Adjust tire pressure.
	4. Alignment.	4. Align vehicle to specifications.
VEHICLE PULLS TO ONE SIDE	1. Tire pressure.	1. Adjust tire pressure.
	2. Alignment.	2. Align vehicle to specifications.
	3. Loose or worn steering or suspension components.	3. Tighten or replace components as necessary.
	4. Radial tire lead.	4. Rotate or replace tire as necessary.
	5. Brake pull.	5. Repair brake as necessary.
	6. Weak or broken spring.	6. Replace spring.
	7. Ride height 4WD only.	7. Measure and adjust ride height.

STANDARD PROCEDURE - HEIGHT MEASUREMENT 4WD

The vehicle suspension height must be measured and adjusted if necessary before performing wheel alignment on a 4x4 vehicle. Also when front suspension components have be replaced. This measure must be performed with the vehicle supporting it's own weight and taken on both sides of the vehicle.

(1) Inspect tires for the correct size and air pressure.

(2) Jounce the front of the vehicle.

(3) Measure and record the distance between the ground and the center of the lower suspension arm rear mounting bolt head (Fig. 3).

(4) Measure and record the distance between the ground and the center of the front wheel (Fig. 3).

(5) Subtract the first measurement from the second measurement. The difference between the two measurement should be 47 mm (1.85 inches) ± 3.25 mm (0.125 inches).

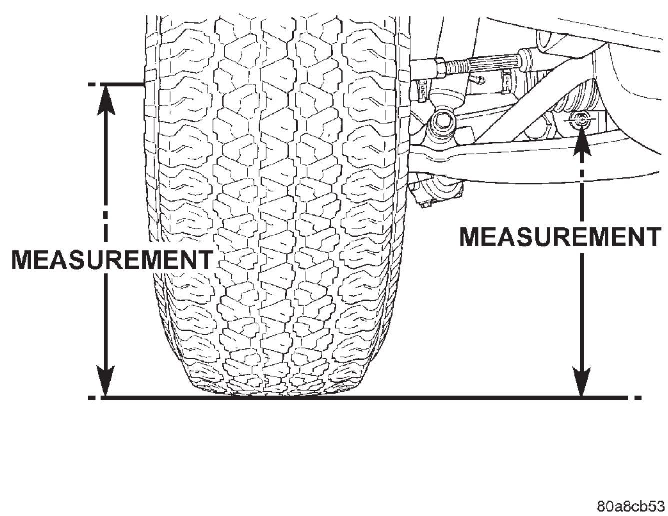


Fig. 3 Height

STANDARD PROCEDURE - HEIGHT ADJUSTMENT 4WD

The vehicle suspension height must be measured and adjusted if necessary before performing wheel alignment on a 4x4 vehicle. Also when front suspension components have be replaced. This measure must be performed with the vehicle supporting it's own weight and taken on both sides of the vehicle.

To adjust the vehicle height turn the torsion bar adjustment bolt CLOCKWISE to raise the vehicle and COUNTER CLOCKWISE to lower the vehicle.

WHEEL ALIGNMENT (Continued)

CAUTION: ALWAYS raise the vehicle to the correct suspension height, NEVER lower the vehicle to obtain the correct suspension height. If the vehicle suspension height is too high, lower the vehicle below the height specification. Then raise the vehicle to the correct suspension height specification. This will insure the vehicle maintains the proper suspension height.

NOTE: If a height adjustment has been made, perform height measurement again on both sides of the vehicle.

STANDARD PROCEDURE - CAMBER AND CASTER ADJUSTMENT

NOTE: 4x4 suspension height measurement must be performed before alignment.

Camber and caster angle adjustments involve changing the position of the upper suspension arm pivot bar (Fig. 4).

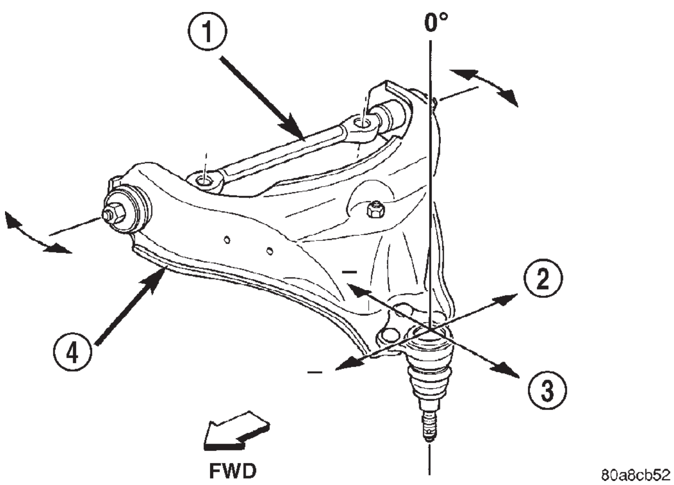


Fig. 4 Caster & Camber Adjustment-Typical

1 - PIVOT BAR
2 - + CASTER
3 - + CAMBER
4 - UPPER ARM SUSPENSION

NOTE: On 4x2 vehicles use Alignment Tool 8393 for alignment. The tool attaches to the pivot bar on the upper control arm.

STANDARD PROCEDURE - CASTER

NOTE: 4x4 suspension height measurement must be performed before alignment.

Moving the rear position of the pivot bar in or out, will change the caster angle significantly and camber angle only slightly. To maintain the camber angle while adjusting caster, move the rear of the pivot bar in or out. Then move the front of the pivot bar slightly in the opposite direction.

For example, to increase a positive caster angle, move the rear position of the pivot bar inward (toward the engine). Move the front of pivot bar outward (away from the engine) slightly until the original camber angle is obtained.

STANDARD PROCEDURE - CAMBER

NOTE: 4x4 suspension height measurement must be performed before alignment.

Move the front of the pivot bar in or out. This will change the camber angle significantly and caster angle slightly.

After adjustment is made tighten the pivot bar nuts to proper torque specification.

STANDARD PROCEDURE - TOE ADJUSTMENT

NOTE: 4x4 suspension height measurement must be performed before alignment.

The wheel toe position adjustment is the final adjustment.

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

(2) Loosen the tie rod jam nuts.

NOTE: Each front wheel should be adjusted for one-half of the total toe position specification. This will ensure the steering wheel will be centered when the wheels are positioned straight-ahead.

WHEEL ALIGNMENT (Continued)

(3) Adjust the wheel toe position by turning the tie rod as necessary (Fig. 5).

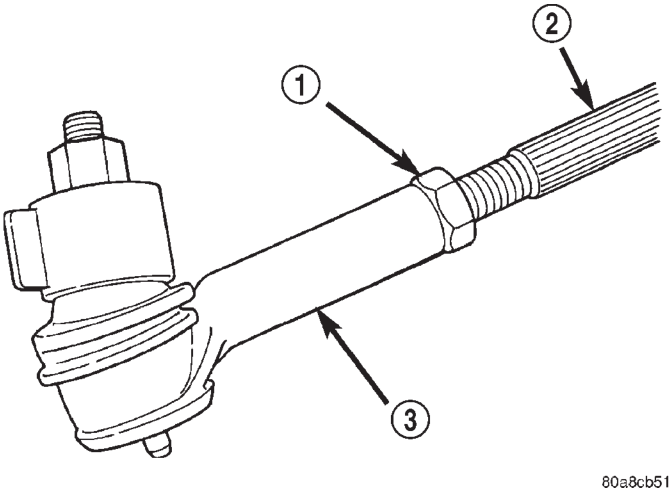


Fig. 5 Toe

1 - JAM NUT
2 - TIE ROD
3 - TIE ROD END

(4) Tighten the tie rod jam nut to 75 N·m (55 ft. lbs.).
(5) Verify the specifications.
(6) Turn off engine.

SPECIFICATIONS

ALIGNMENT

NOTE: All alignment specifications are in degrees.

DESCRIPTION		SPECIFICATION		
VEHICLE	WHEEL BASE	CASTER (± 0.50°)	CAMBER (± 0.50°)	TOTAL TOE (± 0.06°)
4x2	111.9	2.99°	−0.25°	0.10°
	130.9	3.13°	−0.25°	0.10°
4x4	111.9	3.16°	−0.25°	0.10°
	130.9	3.27°	−0.25°	0.10°
MAXIMUM RT to LT DIFFERENCE		0.50°	0.50°	0.06

DAKOTA RT

DESCRIPTION		SPECIFICATION		
VEHICLE	WHEEL BASE	CASTER (± 0.50°)	CAMBER (± 0.50°)	TOTAL TOE (± 0.06°)
4x2	111.9	3.67°	−0.34°	0.10°
	130.9	3.81°	−0.34°	0.10°
MAXIMUM RT to LT DIFFERENCE		0.50°	0.50°	0.06

FRONT - 2WD

TABLE OF CONTENTS

FRONT - 2WD

DESCRIPTION - 2WD

The front suspension is designed to allow each wheel to adapt to different road surfaces independently. The wheels are mounted to hub bearings on the cast iron steering knuckle spindles. The double-row hub bearings are sealed and lubricated for life. The steering knuckles turn (pivot) on ball joints riveted to the outboard portion of the suspension arms. The ball joints are lubricated for life.

The 4x2 front suspension is comprised of (Fig. 1):

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

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

- Shock absorbers
- Coil springs
- Suspension arms
- Stabilizer bar
- Jounce/Rebound Bumpers
- Steering Knuckle
- Hub/Bearing
- Ball Joints

FRONT - 2WD (Continued)

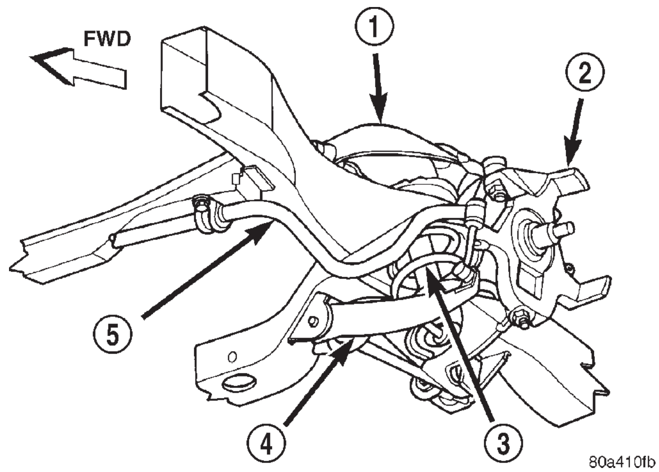


Fig. 1 Front Suspension - 4X2

1 - UPPER SUSPENSION ARM
2 - STEERING KNUCKLE
3 - COIL SPRING
4 - LOWER SUSPENSION ARM
5 - STABILIZER BAR

DESCRIPTION - SUSPENSION ARMS

The upper suspension arm bolts on frame brackets through the arm pivot shaft. The frame brackets have slotted holes which allow the arms to be adjusted for caster and camber. Pivot shaft bushings are not replaceable.

The lower suspension arms bolt to the lower frame brackets and pivot through bushings, these bushings are not replaceable.

The suspension arms have lube for life riveted ball studs. The suspension arm travel (jounce) is limited through the use of urethane bumpers. Rebound travel is limited by the shock absorber.

SPECIFICATIONS

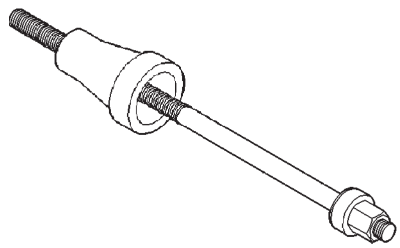
TORQUE CHART

TORQUE SPECIFICATIONS

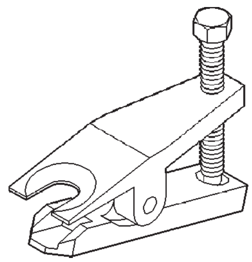
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Shock Absorber Upper Nut	26	19	—
Shock Absorber Lower Bolts	28	21	—
Lower Suspension Arm Front Nut	175	130	—
Lower Suspension Arm Rear Nut	108	80	—
Lower Suspension Arm Ball Joint Nut	127	94	—
Upper Suspension Arm Pivot Shaft Nuts	167	130	—
Upper Suspension Arm Pivot Shaft to Frame Nuts	210	155	—
Upper Suspension Arm Ball Joint Nut	81	60	—
Stabilizer Bar Link Upper Nut	37	27	—
Stabilizer Bar Link Ball Stud Nut	47	35	—
Stabilizer Bar Retainer Bolts	60	45	—
Hub/Bearing Spindle Nut	251	185	—

SPECIAL TOOLS

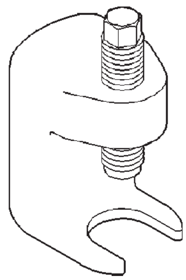
FRONT SUSPENSION



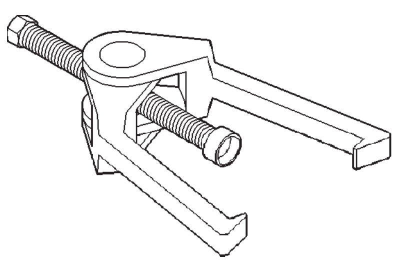
Compressor, Coil Spring DD-1278



Remover Ball Joint MB-991113



Remover Ball Joint C-4150A



Puller Tie Rod C-3894-A

BUSHINGS - CONTROL ARM

REMOVAL

(1) Remove the control arm from the vehicle,(Refer to 2 - SUSPENSION/FRONT/UPPER CONTROL ARM - REMOVAL).

(2) Mount the control arm securely in a vise.

(3) Remove the nut and washer from the control arm shaft.

(4) Install the bushing tool (Fig. 2).

(5) Press out the old bushings.

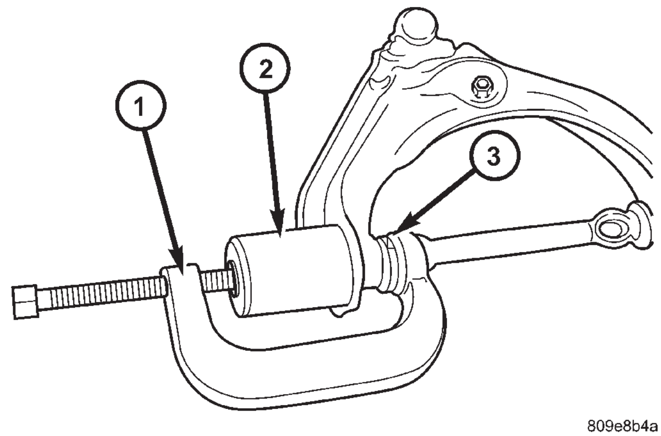


Fig. 2 BUSHING REMOVAL

1 - 8441-1
2 - 8441-2
3 - 8441-3

INSTALLATION

(1) Install the bushing in the control arm and inserted over the shaft.

(2) Install the bushing tool (Fig. 3).

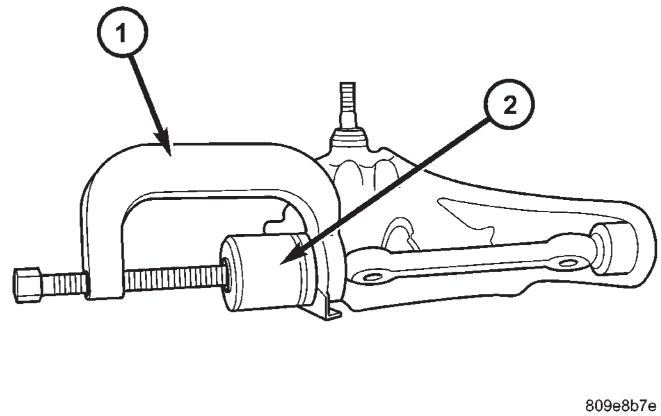


Fig. 3 BUSHING INSTALLATION

1 - 8441-1
2 - 8441-4

(3) Press the bushing into the control arm.

(4) Install the washer and nut to the control arm shaft. Tighten the nut to 167 N·m (130 ft. lbs.).

(5) Remove the control arm from the vise.

(6) Install the control arm in the vehicle, (Refer to 2 - SUSPENSION/FRONT/UPPER CONTROL ARM - INSTALLATION).

HUB / BEARING

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove brake caliper, rotor, and ABS wheel speed sensor if equipped, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(4) Remove hub/bearing spindle nut and discard nut (Fig. 4).

CAUTION: The hub/bearing spindle nut can not be re-used.

(5) Slide hub/bearing off spindle.

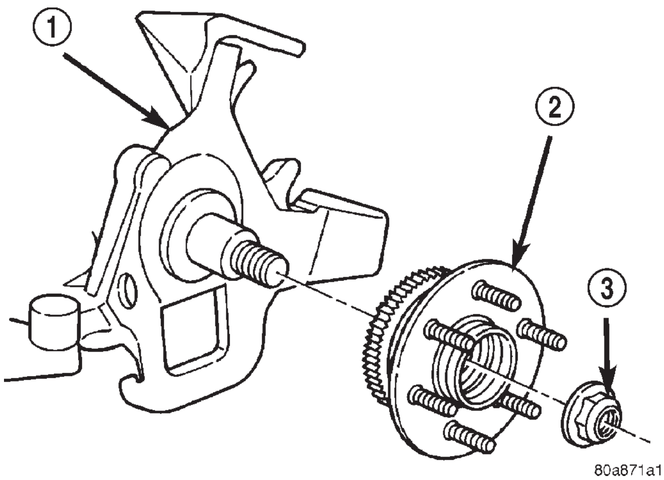


Fig. 4 Hub/Bearing

1 - KNUCKLE
2 - HUB/BEARING
3 - SPINDLE NUT

INSTALLATION

(1) Slide hub/bearing on spindle.

(2) Install **new** spindle nut and tighten to 251 N·m (185 ft. lbs.).

(3) Install brake rotor, caliper, and ABS wheel speed sensor if equipped, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

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

(5) Remove support and lower vehicle.

KNUCKLE

DESCRIPTION

The knuckle is a single casting with legs machined for the upper and lower ball joints. The knuckle also has machined mounting locations for the front brake calipers and hub bearing.

OPERATION

The steering knuckle pivot between the upper and lower ball joint. Steering linkage attached to the knuckle allows the vehicle to be steered.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove disc brake caliper, rotor, shield and ABS speed sensor, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(4) Remove tie-rod from steering knuckle arm, (Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL).

(5) Remove the hub/bearing. (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - REMOVAL).

(6) Remove the shock absorber. (Refer to 2 - SUSPENSION/FRONT/SHOCK - REMOVAL).

(7) Install Spring Compressor DD-1278 up through the lower suspension arm, coil spring and upper shock mounting hole (Fig. 9).

(8) Tighten the tool lower nut to compress the coil spring.

(9) Remove the lower ball joint nut and separate the ball joint from the knuckle with Remover C-4150A (Fig. 10).

(10) Remove the upper ball joint nut and separate the ball joint from the knuckle with Remover MB-991113 (Fig. 5).

CAUTION: When install Remover MB-991113 to separate the ball joint, be careful not to damage the ball joint seal.

(11) Remove steering knuckle.

INSTALLATION

(1) Position steering knuckle on upper and lower ball joints and install nuts. Tighten lower nut to 127 N·m (94 ft. lbs.). Tighten upper nut to 81 N·m (60 ft. lbs.) and install new cotter pins.

(2) Remove the spring compressor.

(3) Install the shock absorber. (Refer to 2 - SUSPENSION/FRONT/SHOCK - INSTALLATION).

(4) Install the hub/bearing. (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - INSTALLATION).

(5) Install ABS speed sensor, brake dust shield, rotor and caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(6) Install tie rod to steering knuckle arm, (Refer to 19 - STEERING/LINKAGE/TIE ROD END - INSTALLATION).

KNUCKLE (Continued)

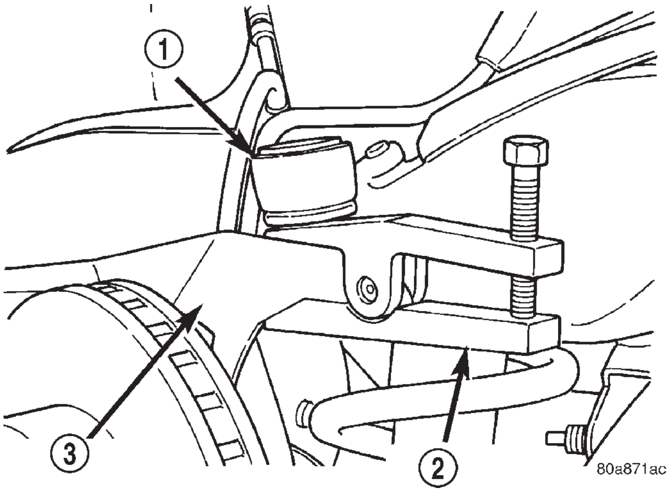


Fig. 5 Upper Ball Joint

1 - UPPER BALL JOINT
2 - REMOVER
3 - KNUCKLE

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

(8) Remove support and lower the vehicle

LOWER BALL JOINT

DIAGNOSIS AND TESTING - LOWER BALL JOINT

(1) Raise the front of the vehicle. Place safety floor stands under both lower suspension arms as far outboard as possible. Lower the vehicle to allow the stands to support some or all of the vehicle weight.

NOTE: The upper suspension arms must not contact the rebound bumpers.

(2) Remove the tire and wheel assemblies.

(3) Mount a dial indicator solidly under the lower suspension arm.

(4) Position indicator plunger against the bottom of the steering knuckle lower ball joint boss.

NOTE: The dial indicator plunger must be perpendicular to the machined surface of the steering knuckle lower ball joint boss (Fig. 6).

(5) Position a pry bar over the top of the upper suspension arm and under the pivot bar of the upper suspension arm. Pry down on the upper suspension arm and then zero the dial indicator.

(6) Reposition the pry bar under the upper suspension arm and on top of the frame rail. Pry up on the upper suspension arm and record the dial indicator reading.

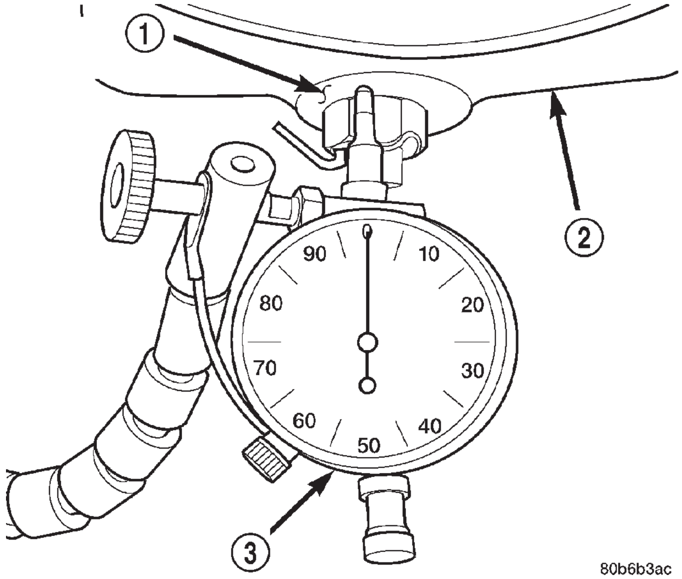


Fig. 6 Lower Ball Joint Boss

1 - BALL JOINT BOSS
2 - STEERING KNUCKLE
3 - DIAL INDICATOR

(7) If the travel exceeds 1.52 mm (0.060 in.), replace the lower suspension arm.

LOWER CONTROL ARM

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove disc brake caliper and rotor from steering knuckle, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(4) Remove shock absorber. (Refer to 2 - SUSPENSION/FRONT/SHOCK - REMOVAL).

(5) Remove stabilizer bar link from the lower suspension arm. (Refer to 2 - SUSPENSION/FRONT/STABILIZER BAR - REMOVAL).

(6) Remove the coil spring.

(7) Remove lower suspension arm mounting bolts (Fig. 7)from the frame mounts and remove the arm.

INSTALLATION

CAUTION: Frame mounting bolts must be installed to their original location and orientation to avoid damaging the steering rack boots.

(1) Loosely attach suspension arm to frame mounts.

(2) Install the coil spring.

LOWER CONTROL ARM (Continued)

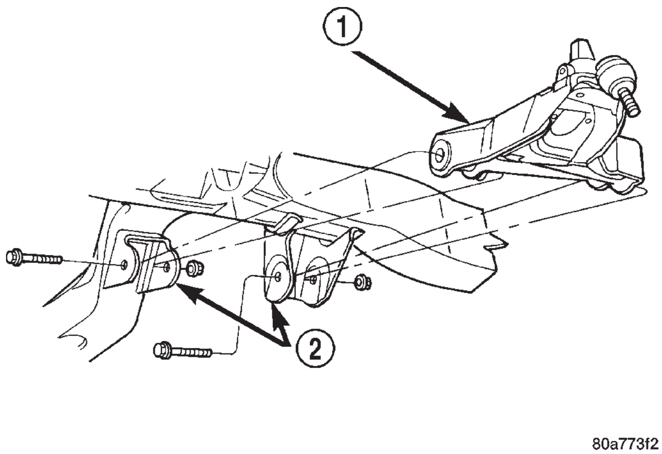


Fig. 7 Lower Suspension Arm

1 - LOWER SUSPENSION ARM
2 - FRAME MOUNTS

(3) Install the shock absorber. (Refer to 2 - SUSPENSION/FRONT/SHOCK - INSTALLATION).

(4) Install stabilizer bar link to the lower suspension arm and tighten nut to 47 N·m (35 ft. lbs.) (Refer to 2 - SUSPENSION/FRONT/STABILIZER BAR - INSTALLATION).

(5) Install brake rotor and caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

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

(7) Remove support and lower the vehicle.

(8) Tighten the front suspension arm mounting nut to 175 N·m (130 ft. lbs.) and the rear nut to 108 N·m (80 ft. lbs.).

SHOCK

DESCRIPTION

The top of the low-pressure gas charged shock are bolted to the frame. The bottom of the shock are bolted to the lower suspension arm.

OPERATION

The shock absorbers dampen jounce and rebound of the vehicle over various road conditions.

DIAGNOSIS AND TESTING - SHOCK

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 upper shock nut, retainer and grommet from the shock absorber stud (Fig. 8) .

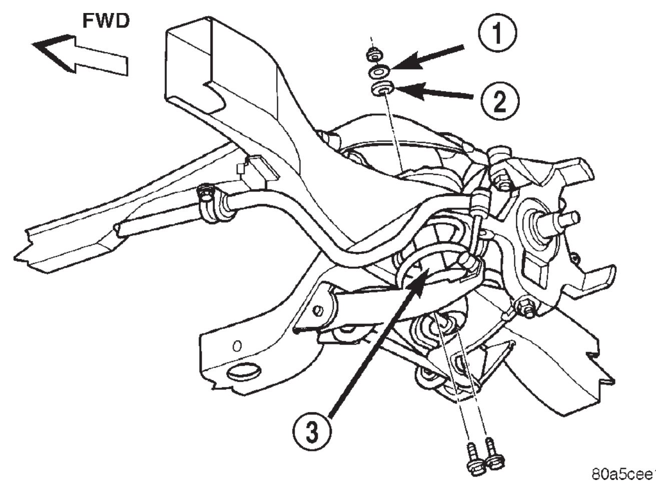


Fig. 8 Front Shock Absorber

1 - RETAINER
2 - GROMMET
3 - SHOCK ABSORBER

(2) Raise and support the vehicle.

(3) Remove the lower mounting bolts and remove shock absorber through the lower suspension arm (Fig. 8) .

INSTALLATION

NOTE: Upper shock nut must be replaced or use Mopar Lock ’N Seal or Loctite® 242 on existing nut.

(1) Install the lower retainer **(lower retainer is stamped with a L)** and grommet on the shock absorber stud and extend the shock. Insert the shock absorber through the lower suspension arm and upper mounting hole.

SHOCK (Continued)

(2) Install the lower mounting bolts and tighten to 28 N·m (21 ft. lbs.).

(3) Remove support and lower the vehicle.

(4) Install the upper grommet and retainer **(upper retainer is stamped with a U)** on the shock absorber stud. Install a new nut or use Mopar Lock 'N Seal or Loctite® 242 on existing nut and tighten to 26 N·m (19 ft. lbs.).

SPRING

DESCRIPTION

The springs mount between the lower suspension arms and frame rail spring seats. A rubber isolator seats on top off the spring to help prevent noise.

OPERATION

The coil springs control ride quality and maintain proper ride height.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove wheel and tire assembly.

(3) Remove the stabilizer bar link from the lower suspension arm. (Refer to 2 - SUSPENSION/FRONT/STABILIZER BAR - REMOVAL).

(4) Remove the shock absorber. (Refer to 2 - SUSPENSION/FRONT/SHOCK - REMOVAL).

(5) Install Spring Compressor DD-1278 up through the lower suspension arm, coil spring and upper shock mounting hole (Fig. 9).

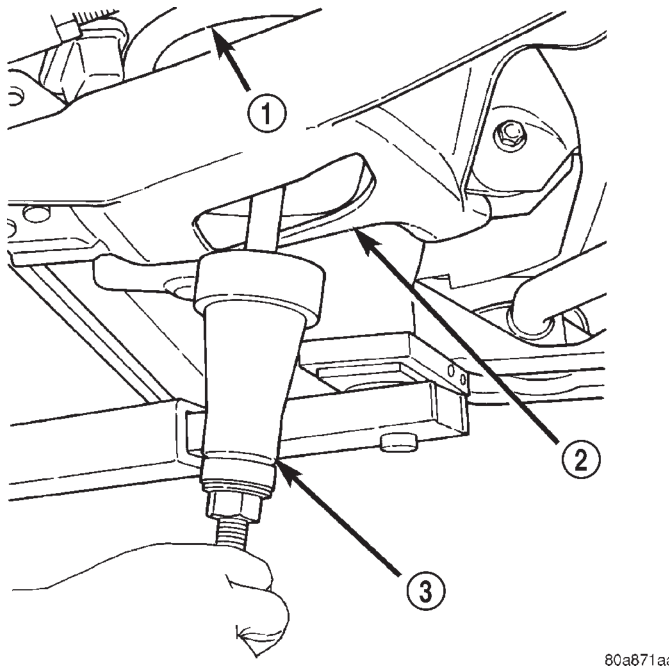


Fig. 9 Spring Compressor

1 - COIL SPRING
2 - LOWER SUSPENSION ARM
3 - SPRING COMPRESSOR

(6) Tighten the tool lower nut to compress the coil spring.

(7) Remove the lower ball joint nut and separate the ball joint from the knuckle with Remover C-4150A (Fig. 10).

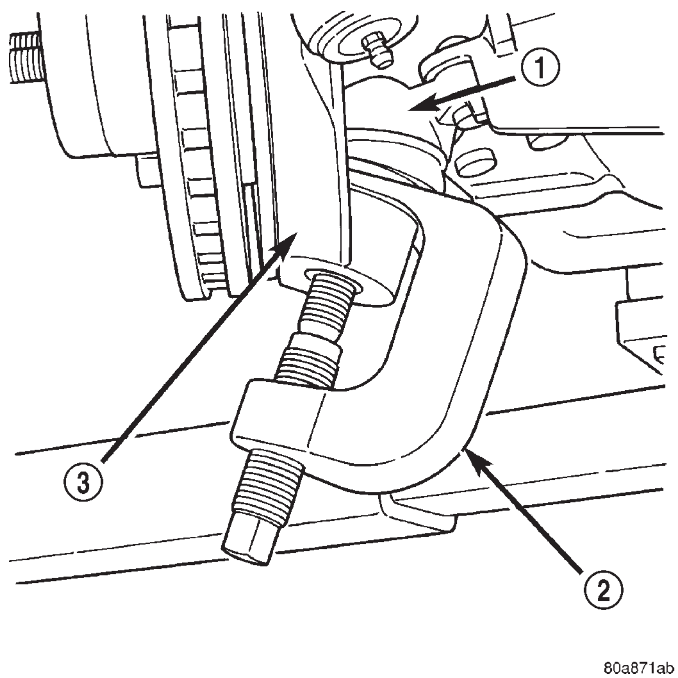


Fig. 10 Lower Ball Joint

1 - LOWER BALL JOINT
2 - REMOVER
3 - STEERING KNUCKLE

(8) Loosen the spring compressor lower nut to relieve spring tension.

(9) Remove the tool and pull down on the lower suspension arm to remove the spring.

INSTALLATION

NOTE: The ramped or open end of the coil spring is the bottom of the spring.

(1) Tape the isolator pad to the top of the coil spring. Position the spring in the lower suspension arm pocket. Be sure that the coil spring is seated in the pocket.

(2) Install Spring Compressor DD-1278 up through the lower suspension arm, coil spring upper shock mounting hole.

(3) Tighten the tool nut to compress the coil spring.

SPRING (Continued)

(4) Install the lower ball joint into the knuckle and tighten the nut to 127 N·m (94 ft. lbs.). Install cotter pin.

(5) Remove the spring compressor tool.

(6) Install the stabilizer bar link to the lower suspension arm and tighten nut to 47 N·m (35 ft. lbs.). (Refer to 2 - SUSPENSION/FRONT/STABILIZER BAR - INSTALLATION).

(7) Install the shock absorber. (Refer to 2 - SUSPENSION/FRONT/SHOCK - INSTALLATION).

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

(9) Remove support and lower the vehicle.

STABILIZER BAR

DESCRIPTION

The bar extends across the front underside of the chassis and mounts on the frame rails. Links connected the bar to the lower suspension arms. Stabilizer bar mounts are isolated by rubber bushings. Links are isolated with rubber grommets.

OPERATION

The stabilizer bar is used to minimize vehicle front sway during turns. The spring steel bar helps to control the vehicle body in relationship to the suspension.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the upper link nut, retainer and grommet from each link.

(3) Remove the lower link nut from the lower suspension arm on each side (Fig. 11).

(4) Remove the stabilizer bar retainer bolts and remove the retainers and stabilizer bar from the vehicle.

(5) Remove the bushings from the stabilizer bar.

INSTALLATION

(1) Install the bushings on the stabilizer bar.

(2) Install the stabilizer bar on the frame and install the retainers and the bolts.

(3) Tighten the bolts to 60 N·m (45 ft. lbs.).

NOTE: Ensure the bar is center with equal spacing on both sides.

(4) Install the link lower retainer and grommet on the links.

(5) Install the links into the stabilizer bar and lower suspension arm on each side.

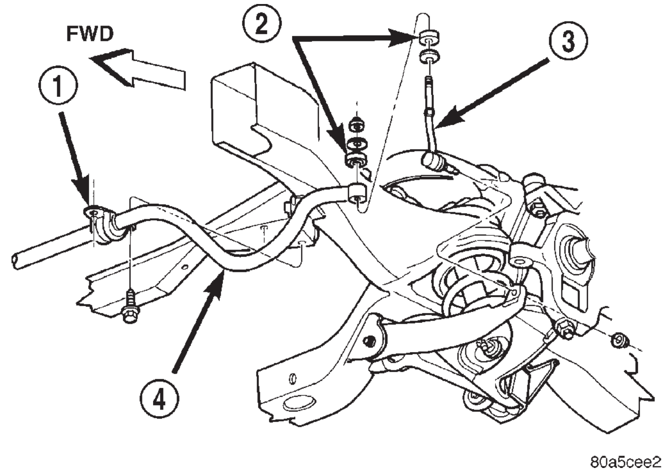


Fig. 11 Stabilizer Bar

1 - RETAINER
2 - GROMMET
3 - STABILIZER LINK
4 - STABILIZER BAR

(6) Install the lower link mounting nut and tighten to 47 N·m (35 ft. lbs.).

NOTE: Ensure both link end caps are facing straight forward.

(7) Install the upper link grommet, retainer and nut and tighten to 37 N·m (27 ft. lbs.).

(8) Remove support and lower vehicle.

UPPER BALL JOINT

DIAGNOSIS AND TESTING - UPPER BALL JOINT

(1) Position a floor jack under the lower suspension arm. Raise the wheel and allow the tire to lightly contact the floor (vehicle weight relieved from the tire).

(2) Mount a dial indicator solidly on the upper suspension arm.

(3) Position the indicator plunger against the upper ball joint boss of the steering knuckle.

(4) Grasp the top of the tire and apply force in and out. Look for movement at the ball joint between the upper suspension arm and steering knuckle.

(5) If lateral movement is greater than 1.52 mm (0.060 in.), replace upper suspension arm.

UPPER CONTROL ARM

REMOVAL

(1) Raise and support the vehicle.

(2) Remove wheel and tire assembly.

UPPER CONTROL ARM (Continued)

(3) Remove brake hose bracket from the arm.

(4) Position a hydraulic jack under the arm and raise the jack to unload the rebound bumper.

(5) Remove cotter pin and nut from upper ball joint.

(6) Separate upper ball joint from steering knuckle with Remover MB-991113 (Fig. 5).

CAUTION: When installing Remover MB-991113 to separate the ball joint, be careful not to damage the ball joint seal.

(7) Remove suspension arm pivot bar mounting nuts and remove suspension arm (Fig. 12).

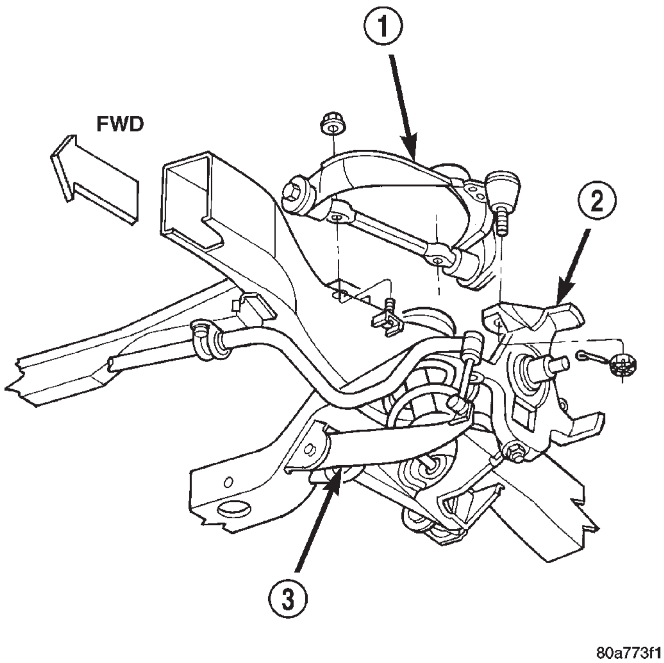


Fig. 12 Upper Suspension Arm

1 - UPPER SUSPENSION ARM
2 - STEERING KNUCKLE
3 - LOWER SUSPENSION ARM

INSTALLATION

NOTE: Before installation, insure pivot bar adjustment bolts are in their original location (Fig. 12).

(1) Position suspension arm pivot bar on adjustment bolts. Install nuts and tighten to 210 N·m (155 ft. lbs.).

(2) Position steering knuckle on upper ball joint. Tighten the upper ball joint nut to 81 N·m (60 ft. lbs.) and install a new cotter pin.

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

(4) Remove support and lower vehicle.

(5) Align front end to specifications. (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

FRONT - 4WD

TABLE OF CONTENTS

FRONT - 4WD

DESCRIPTION - 4WD

The front suspension is designed to allow each wheel to adapt to different road surfaces independently. The wheels are mounted to hub/bearings units bolted to cast steering knuckle. The double-row hub bearings are sealed and lubricated for life. The steering knuckles turn (pivot) on ball joints. The upper ball joint is riveted to the outboard portion of the suspension arm and lubricated for life. The lower ball joint is pressed into the lower suspension arm and requires lubrication.

The 4x4 front suspension is comprised of (Fig. 1):

- Shock absorbers
- Torsion-bar springs
- Suspension arms
- Steering knuckles
- Stabilizer bar
- Jounce/Rebound bumpers
- Hub/Bearing
- Ball Joints

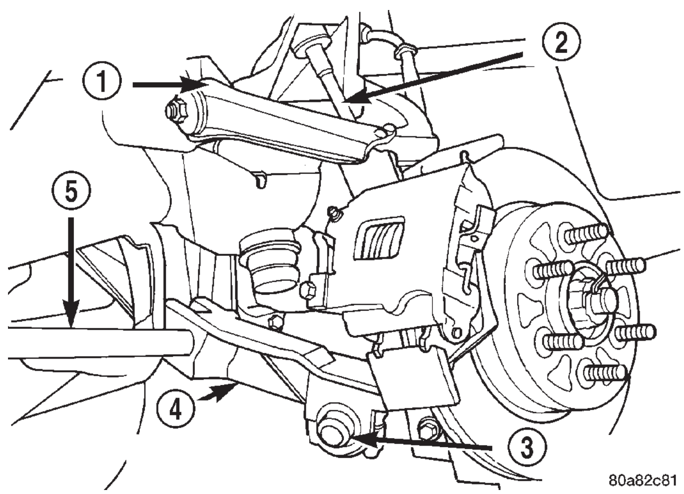


Fig. 1 Front Suspension - 4x4

1 - UPPER SUSPENSION ARM
2 - SHOCK ABSORBER
3 - STABILIZER BAR
4 - LOWER SUSPENSION ARM
5 - TORSION BAR

FRONT - 4WD (Continued)

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.

DESCRIPTION - SUSPENSION ARMS

The upper suspension arm bolts on frame brackets through the arm pivot shaft. The frame brackets have slotted holes which allow the arms to be adjusted for caster and camber. Pivot shaft bushings are not replaceable.

The lower suspension arms bolt to the lower frame brackets and pivot through bushings, these bushings are not replaceable.

The suspension arms have lube for life riveted ball studs. The suspension arm travel (jounce) is limited through the use of urethane bumpers. Rebound travel is limited by the shock absorber.

STANDARD PROCEDURE - LUBRICATION

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

SPECIFICATIONS

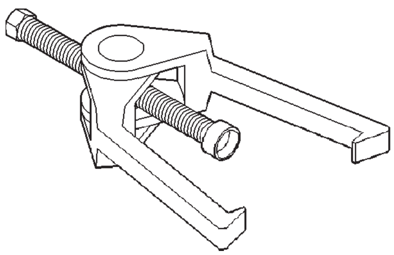
TORQUE CHART

TORQUE SPECIFICATIONS

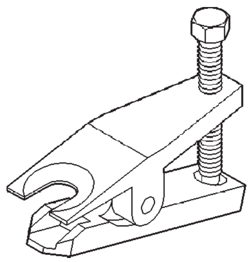
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Shock Absorber Upper Nut	26	19	—
Shock Absorber Lower Bolts	108	80	—
Lower Suspension Arm Front Bolt	108	80	—
Lower Suspension Arm Rear Bolt	190	140	—
Lower Suspension Arm Ball Joint Nut	183	135	—
Upper Suspension Arm Pivot Shaft Nuts	129	95	—
Upper Suspension Arm Pivot Shaft to Frame Nuts	224	165	—
Upper Suspension Arm Ball Joint Nut	81	60	—
Stabilizer Bar Frame Retainer Bolt	108	80	—
Stabilizer Bar Frame Retainer Nut	190	140	—
Stabilizer Bar Control Arm Retainer Bolts	34	25	—
Hub/Bearing olts	166	123	—

SPECIAL TOOLS

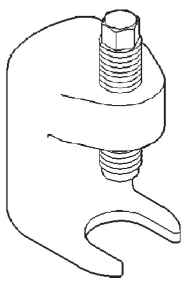
FRONT SUSPENSION



Puller Tie Rod C-3894-A



Remover MB-991113



Remover C-4150A

LOWER CONTROL ARM

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove the front halfshaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/HALF SHAFT/AXLE SHAFT - REMOVAL).

(4) Remove the torsion bar. (Refer to 2 - SUSPENSION/FRONT/TRACK BAR - REMOVAL).

(5) Remove the outer tie rod from the steering knuckle. (Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL).

(6) Remove the shock absorber lower bolt.

(7) Remove the stabilizer bar. (Refer to 2 - SUSPENSION/FRONT/STABILIZER BAR - REMOVAL).

(8) Remove the cotter pin and nut from lower ball joint. Separate ball joint from the steering knuckle with Remover C-4150A (Fig. 2).

(9) Remove the suspension arm pivot bolts and suspension arm from frame rail brackets (Fig. 3).

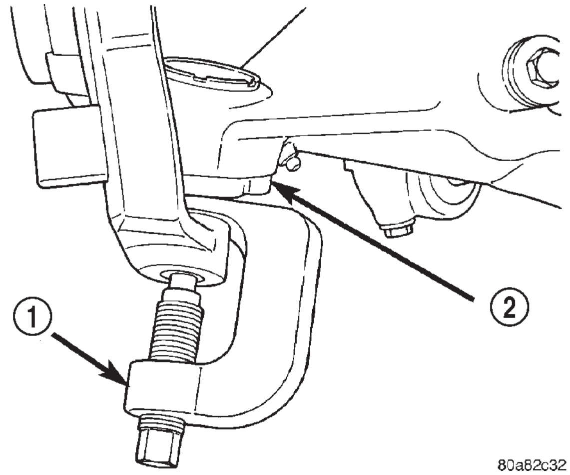


Fig. 2 Lower Ball Joint

1 - REMOVER
2 - LOWER BALL STUD

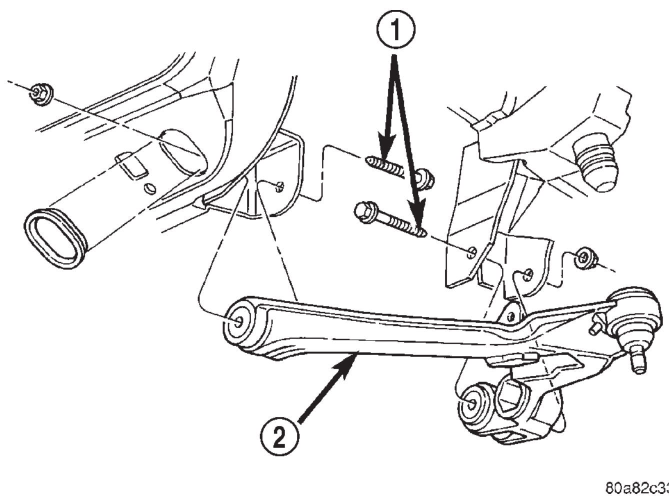


Fig. 3 Lower Suspension Arm

1 - PIVOT BOLTS
2 - LOWER SUSPENSION ARM

INSTALLATION

(1) Position the lower suspension arm at the frame rail brackets. Install the pivot bolts and nuts. Tighten the nuts finger-tight.

CAUTION: The ball joint stud taper must be CLEAN and DRY before installing the knuckle. Clean the stud taper with mineral spirits to remove dirt and grease.

(2) Insert the ball joint into steering knuckle. Install and tighten the retaining nut to 183 N·m (135 ft. lbs.) and install a new cotter pin.

(3) Install the torsion bar. (Refer to 2 - SUSPENSION/FRONT/TRACK BAR - INSTALLATION).

LOWER CONTROL ARM (Continued)

(4) Install shock absorber lower bolt and tighten to 108 N·m (80 ft. lbs.).

(5) Install the front halfshaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/HALF SHAFT/AXLE SHAFT - INSTALLATION).

(6) Install the stabilizer bar. (Refer to 2 - SUSPENSION/FRONT/STABILIZER BAR - INSTALLATION).

(7) Install the outer tie rod to the knuckle. (Refer to 19 - STEERING/LINKAGE/TIE ROD END - INSTALLATION).

(8) Tighten the lower suspension front pivot nut to 108 N·m (80 ft. lbs.). Tighten rear pivot bolt to 190 N·m (140 ft. lbs.).

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

(10) Remove the support and lower the vehicle.

(11) Adjust the front suspension height and align if necessary. (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

KNUCKLE

DESCRIPTION

The knuckle is a single casting with legs machined for the upper and lower ball joints. The knuckle also has machined mounting locations for the front brake calipers and hub bearing.

OPERATION

The steering knuckle pivot between the upper and lower ball joint. Steering linkage attached to the knuckle allows the vehicle to be steered.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove the brake caliper, rotor, shield and ABS wheel speed sensor if equipped. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(4) Remove the front halfshaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/HALF SHAFT/AXLE SHAFT - REMOVAL).

(5) Remove the tie rod end nut (Fig. 4). Separate the tie rod from the knuckle with Remover C-3894A. (Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL).

(6) Support the lower suspension arm with a hydraulic jack and raise the jack to unload the rebound bumper.

CAUTION: When installing Remover MB-991113 to separate the ball joint, be careful not to damage the ball joint seal.

(7) Remove the upper ball joint cotter pin and nut. Separate the ball joint from the knuckle with Remover MB-991113 (Fig. 5).

(8) Remove the lower ball joint cotter pin and nut. Separate the ball joint from the knuckle with Remover C-4150A (Fig. 6) and remove the knuckle.

(9) Remove the hub/bearing from the steering knuckle. (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - REMOVAL).

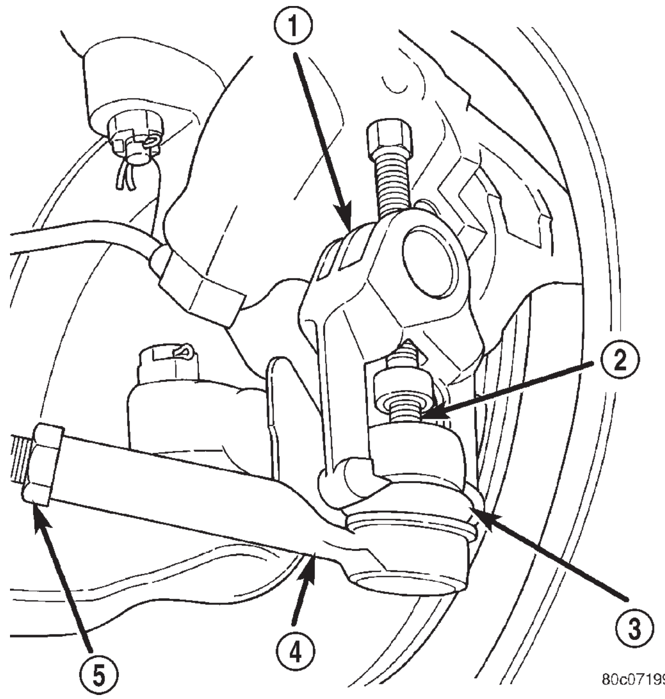


Fig. 4 Tie Rod End Puller

1 - TOOL C-3894-A
2 - BALL STUD
3 - SEAL
4 - TIE-ROD END
5 - LOCKNUT

INSTALLATION

NOTE: When installing hub/bearing with ABS brakes, position the speed sensor opening towards the front of the vehicle.

(1) Install the hub/bearing to the steering knuckle and tighten the bolts to 166 N·m (123 ft. lbs.).

KNUCKLE (Continued)

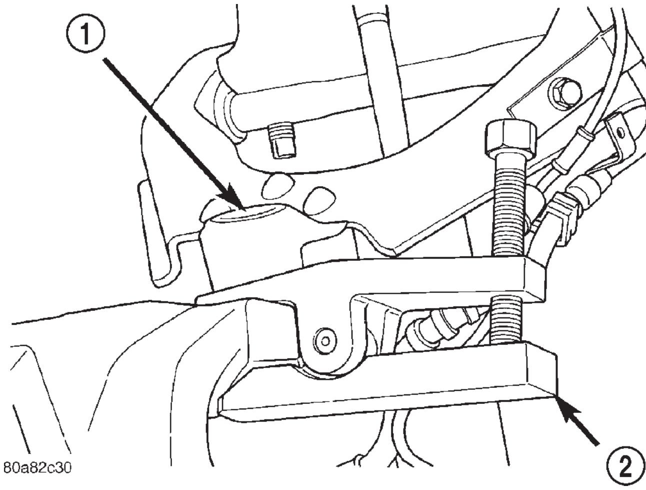


Fig. 5 Upper Ball Joint

1 - UPPER BALL STUD
2 - REMOVER

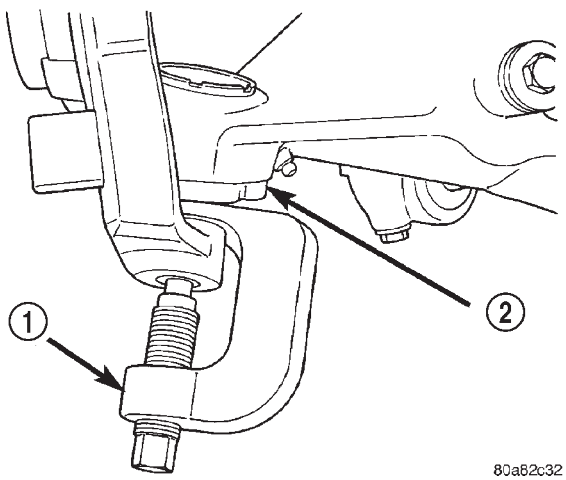


Fig. 6 Lower Ball Joint

1 - REMOVER
2 - LOWER BALL STUD

CAUTION: The ball joint stud tapers must be CLEAN and DRY before installing the knuckle. Clean the stud tapers with mineral spirits to remove dirt and grease.

(2) Install the knuckle onto the upper and lower ball joint.

(3) Install the upper and lower ball joint nuts. Tighten the upper ball joint nut to 81 N·m (60 ft. lbs.) and the lower ball joint nut to 183 N·m (135 ft. lbs.) then install cotter pins. Grease the lower ball joint.

(4) Remove the hydraulic jack from the lower suspension arm.

(5) Install the tie rod end and tighten the nut to 88 N·m (65 ft. lbs.). (Refer to 19 - STEERING/LINKAGE/TIE ROD END - INSTALLATION).

(6) Install the front halfshaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/HALF SHAFT/AXLE SHAFT - INSTALLATION).

(7) Install the ABS wheel speed sensor if equipped and brake shield, rotor and caliper. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

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

(9) Remove the support and lower the vehicle.

STABILIZER BAR

DESCRIPTION

The bar extends across the front underside of the chassis and connects to the frame crossmember. The ends of the bar mount to the lower suspension arm. All mounting points of the stabilizer bar are isolated by bushings.

OPERATION

The stabilizer bar is used to minimize vehicle front sway during turns. The bar helps to maintain a flat attitude to the road surface.

REMOVAL

NOTE: To service the stabilizer bar the vehicle must be on a drive on hoist. The vehicle suspension must be at curb height for stabilizer bar installation.

(1) Remove the stabilizer bar retainer bolts from the lower suspension arms (Fig. 7) and remove the retainers.

(2) Remove the stabilizer bar retainer nuts, bolts and retainers from the frame crossmember (Fig. 7) and remove the bar.

(3) If necessary, remove the bushings from the stabilizer bar.

INSTALLATION

NOTE: To service the stabilizer bar the vehicle must be on a drive on hoist. The vehicle suspension must be at curb height for stabilizer bar installation.

(1) If removed, install the bushings on the stabilizer bar.

(2) Position the stabilizer bar on the frame crossmember brackets and install the retainers and nuts and bolts finger-tight (Fig. 7).

STABILIZER BAR (Continued)

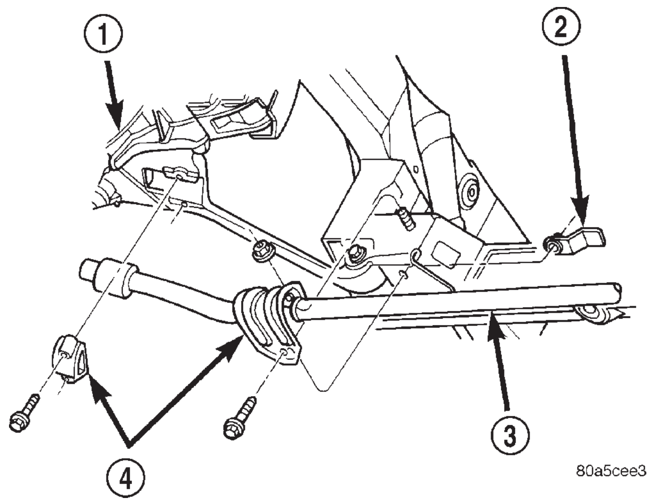


Fig. 7 Stabilizer Bar

1 - LOWER SUSPENSION ARM
2 - FLAG NUT
3 - STABILIZER BAR
4 - RETAINER

NOTE: Check the alignment of the bar to ensure there is no interference with the either frame rail or chassis component. Spacing should be equal on both sides.

(3) Install the stabilizer bar to the lower suspension arm.
(4) Install the retainers and bolts to the lower suspension arm and tighten to 34 N·m (25 ft. lbs.).
(5) Tighten the frame retainer nuts to 190 N·m (140 ft. lbs.).
(6) Tighten the frame retainer bolts to 108 N·m (80 ft. lbs.).

HUB / BEARING

REMOVAL

(1) Raise and support the vehicle.
(2) Remove the wheel and tire assembly.
(3) Remove the halfshaft nut.
(4) Remove the ABS wheel speed sensor if equipped, (Refer to 5 - BRAKES/ELECTRICAL/ FRONT WHEEL SPEED SENSOR - REMOVAL).
(5) Remove the brake caliper and rotor, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).
(6) Remove the hub/bearing mounting bolts from the steering knuckle (Fig. 8).
(7) Slid the hub/bearing out of the steering knuckle and off the halfshaft.

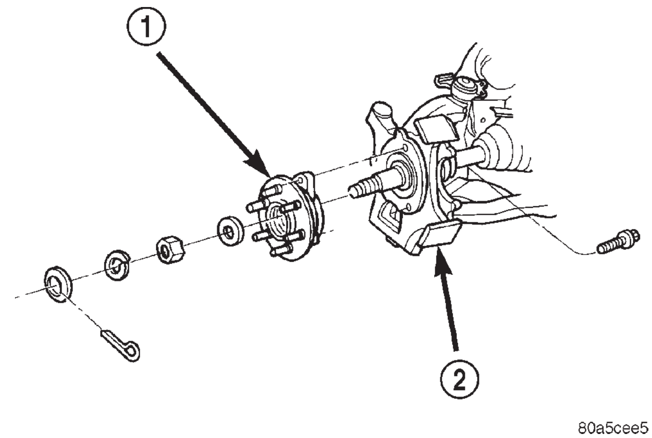


Fig. 8 Hub/Bearing

1 - HUB BEARING
2 - STEERING KNUCKLE

INSTALLATION

(1) Install the hub/bearing into the steering knuckle and tighten the bolts to 166 N·m (123 ft. lbs.).
(2) Install the brake rotor and caliper. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).
(3) Install the ABS wheel speed sensor if equipped. (Refer to 5 - BRAKES/ELECTRICAL/FRONT WHEEL SPEED SENSOR - INSTALLATION).
(4) Install the halfshaft nut and tighten to 235 N·m (173 ft. lbs.).
(5) Install the wheel and tire assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
(6) Remove the support and lower vehicle.

LOWER BALL JOINT

DIAGNOSIS AND TESTING - LOWER BALL JOINT

NOTE: If the ball joint is equipped with a lubrication fitting, grease the joint then road test the vehicle before performing test.

(1) Raise the front of the vehicle. Place safety floor stands under both lower suspension arms as far outboard as possible. Lower the vehicle to allow the stands to support some or all of the vehicle weight.

NOTE: The upper suspension arms must not contact the rebound bumpers.

(2) Remove the tire and wheel assemblies.
(3) Mount a dial indicator solidly to the underside of the lower suspension arm.

LOWER BALL JOINT (Continued)

(4) Position indicator plunger against the bottom surface of the steering knuckle lower ball joint boss.

NOTE: The dial indicator plunger must be perpendicular to the machined surface of the steering knuckle lower ball joint boss (Fig. 9).

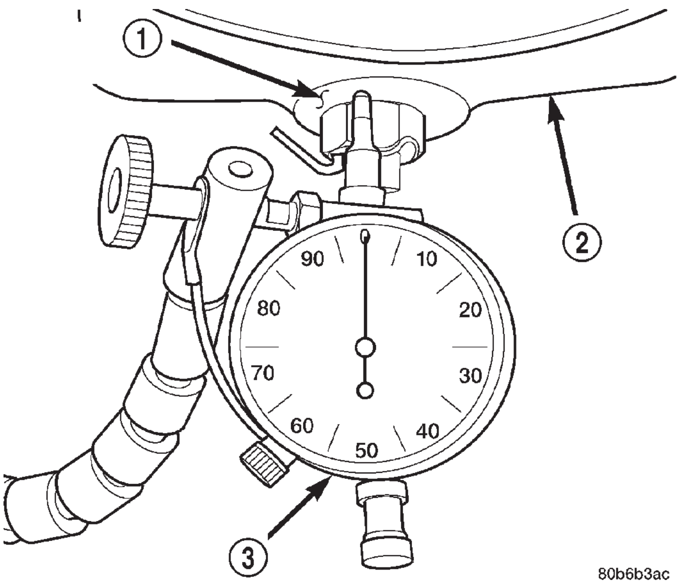


Fig. 9 Lower Ball Joint Boss

1 - BALL JOINT BOSS
2 - STEERING KNUCKLE
3 - DIAL INDICATOR

(5) Position a pry bar over the top of the upper suspension arm and under the pivot bar of the upper suspension arm. Pry down on the upper suspension arm and then zero the dial indicator.

(6) Reposition the pry bar under the upper suspension arm and on top of the jounce/rebound bracket. Pry up on the upper suspension arm and record the dial indicator reading.

(7) If the travel exceeds 1.52 mm (0.060 in.), replace the lower control arm.

UPPER BALL JOINT

DIAGNOSIS AND TESTING - UPPER BALL JOINT

(1) Position a floor jack under the lower suspension arm. Raise the wheel and allow the tire to lightly contact the floor (vehicle weight relieved from the tire).

(2) Mount a dial indicator solidly on the upper suspension arm.

(3) Position the indicator plunger against the back side of the upper ball joint boss of the steering knuckle (Fig. 10).

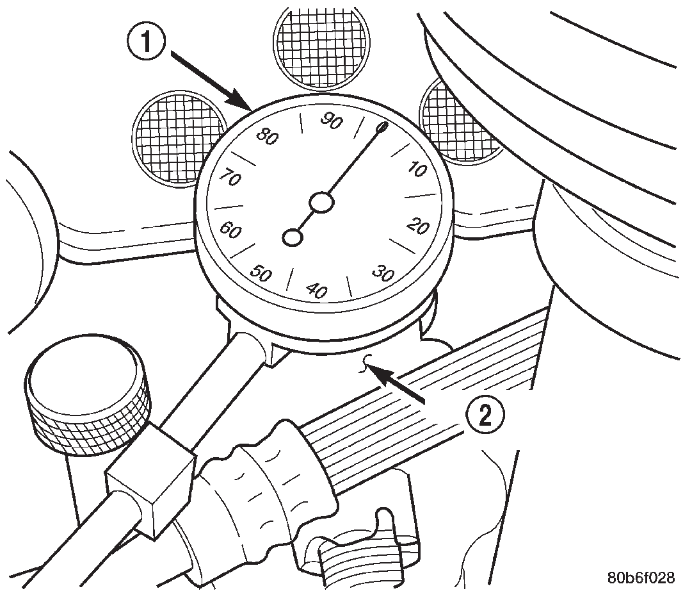


Fig. 10 Upper Ball Joint Boss

1 - DIAL INDICATOR
2 - BALL JOINT BOSS

(4) Grasp the top of the tire and pull outward, then zero the dial indicator.

(5) Grasp the top of the tire and push inward and record the dial indicator reading.

(6) If lateral movement is greater than 1.52 mm (0.060 in.), replace upper suspension arm.

UPPER CONTROL ARM

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove brake hose brackets from suspension arm.

(4) Position hydraulic jack under lower suspension arm and raise jack to unload rebound bumper.

(5) Remove shock absorber. (Refer to 2 - SUSPENSION/FRONT/SHOCK - REMOVAL).

(6) Remove the cotter pin and nut from upper ball joint.

(7) Separate upper ball joint from the steering knuckle with Remover MB-991113 (Fig. 11).

CAUTION: When installing Remover MB-991113 to separate the ball joint, be careful not to damage the ball joint seal.

(8) Remove suspension arm pivot bar bolts and remove suspension arm (Fig. 12).

UPPER CONTROL ARM (Continued)

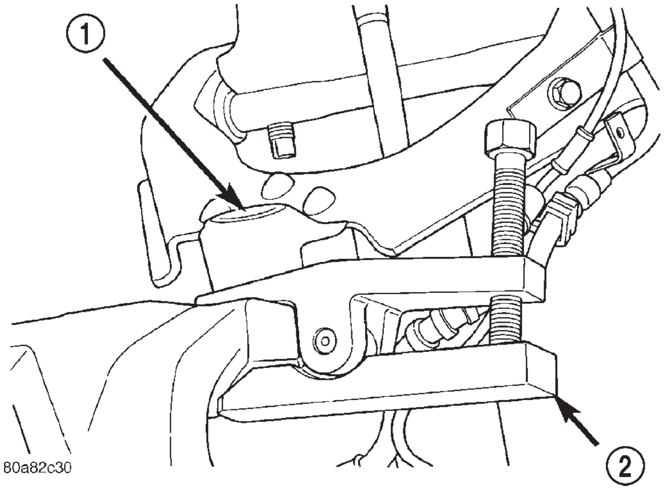


Fig. 11 Separate Upper Ball Joint

1 - UPPER BALL STUD
2 - REMOVER

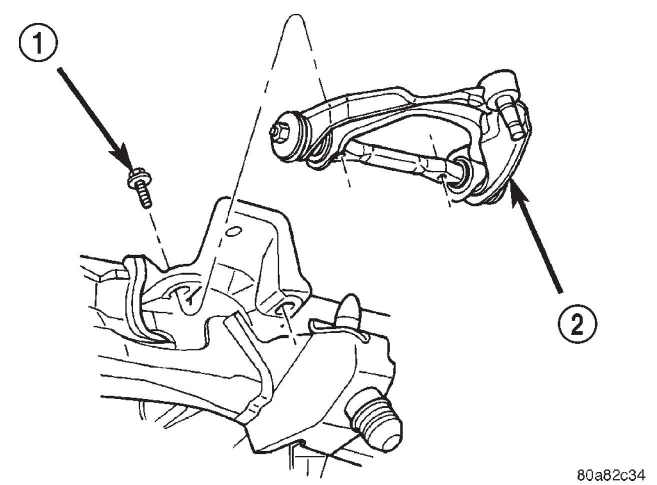


Fig. 12 Upper Suspension Arm

1 - PIVOT BAR BOLT
2 - UPPER SUSPENSION ARM

INSTALLATION

(1) Position suspension arm pivot bar on mounting bracket. Install bolts and tighten (temporarily) to 136 N·m (100 ft. lbs.).

(2) Insert ball joint in steering knuckle and tighten ball joint nut to 81 N·m (60 ft. lbs.) then install a new cotter pin.

(3) Install shock absorber. (Refer to 2 - SUSPENSION/FRONT/SHOCK - INSTALLATION).

NOTE: Upper shock nut must be replaced or use Mopar Lock 'N Seal or Loctite ® 242 on existing nut.

(4) Remove hydraulic jack.

(5) Attach brake hose brackets to suspension arm.

(6) Tighten upper suspension arm pivot bolts to 224 N·m (165 ft. lbs.).

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

(8) Remove support and lower vehicle.

(9) Align front suspension. (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

SHOCK

DESCRIPTION

The top of the low-pressure gas charged shock are bolted to the frame. The bottom of the shock are bolted to the lower suspension arm.

OPERATION

The shock absorbers dampen jounce and rebound of the vehicle over various road conditions.

DIAGNOSIS AND TESTING - SHOCK

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 vehicle.

(2) Remove the upper shock absorber nut, retainer and grommet (Fig. 13) .

(3) Remove the lower bolt and remove the shock absorber.

SHOCK (Continued)

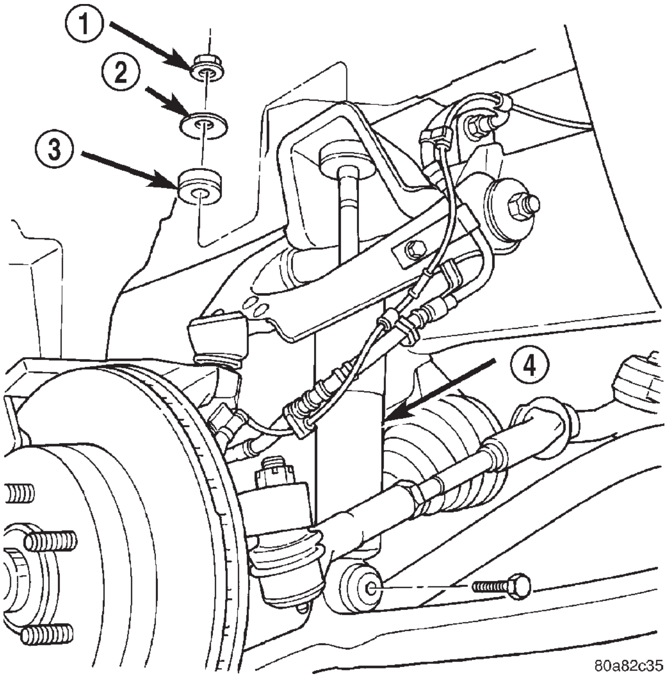


Fig. 13 Shock Absorber

1 - NUT
2 - RETAINER
3 - GROMMET
4 - SHOCK

INSTALLATION

NOTE: Upper shock nut must be replaced or use Mopar Lock ’N Seal or Loctite® 242 on existing nut.

(1) Install the lower retainer **(lower retainer is stamped with a L)** and grommet on the shock absorber stud. Insert the shock absorber through the frame bracket hole.

(2) Install the lower bolt and tighten the bolt to 108 N·m (80 ft. lbs.).

(3) Install the upper grommet, retainer **(upper retainer is stamped with a U)** and new nut or use Mopar Lock ’N Seal or Loctite® 242 on existing nut, on the shock absorber stud. Tighten nut to 26 N·m (19 ft. lbs.).

TORSION BAR

DESCRIPTION

The front of the bar mounts to the back side of the lower suspension arm. The rear end of the bar is mounted in a anchor that rests in the frame cross-member.

OPERATION

The torsion bars are used to control ride height and ride quality. The vehicle height is adjusted through an anchor adjustment bolt that increases or decreases the angle of the torsion bar. Increasing or decreasing the bar angle changes the angle of the suspension arms.

REMOVAL

CAUTION: The left and right side torsion bars are NOT interchangeable. The bars are identified and stamped R or L, for right or left. The bars do not have a front or rear end and can be installed with either end facing forward.

(1) Raise and support the vehicle with the front suspension hanging.

(2) Turn the adjustment bolt counterclockwise to release spring load (Fig. 14).

NOTE: Count and record the number of turns for installation reference.

(3) Remove the adjustment bolt from swivel.

(4) Remove torsion bar and anchor. Remove anchor from torsion bar.

(5) Remove all foreign material from torsion bar mounting in anchor and suspension arm.

(6) Inspect adjustment bolt, bearing and swivel for damage.

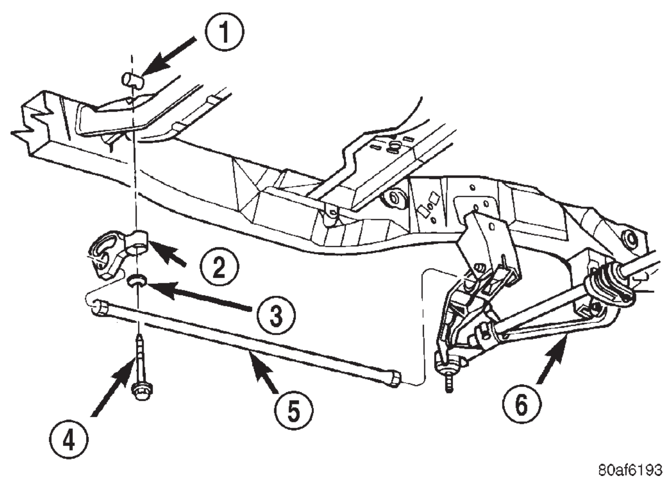


Fig. 14 Torsion Bar

1 - SWIVEL
2 - ANCHOR
3 - BEARING
4 - ADJUSTMENT BOLT
5 - TORSION BAR
6 - LOWER SUSPENSION ARM

TORSION BAR (Continued)

INSTALLATION

CAUTION: The left and right side torsion bars are NOT interchangeable. The bars are identified and stamped R or L, for right or left. The bars do not have a front or rear end and can be installed with either end facing forward.

(1) Insert torsion bar ends into anchor and suspension arm.

(2) Position anchor and bearing in frame crossmember. Install adjustment bolt through bearing, anchor and into the swivel.

(3) Turn adjustment bolt clockwise the recorded amount of turns.

(4) Lower vehicle and adjust the front suspension height. (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

BUSHINGS - CONTROL ARM

REMOVAL

(1) Remove the control arm from the vehicle. (Refer to 2 - SUSPENSION/FRONT/UPPER CONTROL ARM - REMOVAL),(Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - REMOVAL).

(2) Mount the control arm securely in a vise.

(3) Remove the nut and washer from the control arm shaft.

(4) Install the bushing tool.

(5) Press out the old bushings.

INSTALLATION

(1) Install the bushing in the control arm and inserted over the shaft.

(2) Install the bushing tool.

(3) Press the bushing into the control arm.

(4) Install the washer and nut to the control arm shaft. Torque the nut to 167 N·m (130 ft. lbs.) specification.

(5) Remove the control arm from the vise.

(6) Install the control arm in the vehicle. (Refer to 2 - SUSPENSION/FRONT/UPPER CONTROL ARM - INSTALLATION), (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - INSTALLATION).

REAR

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REAR

DESCRIPTION

The rear suspension is comprised of:

- Drive Axle
- Shock Absorbers
- Stabilizer Bar (optional)
- Leaf Springs

CAUTION: A vehicle should always be loaded so the vehicle weight center-line is located immediately forward of the rear axle. Correct vehicle loading provides proper front tire-to-road contact. This results in maximum vehicle handling stability and safety. Incorrect vehicle weight distribution can cause excessive tire tread wear, spring fatigue or failure, and erratic steering.

CAUTION: Suspension components with rubber/urethane bushings 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.

DIAGNOSIS AND TESTING - SPRING AND SHOCK

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

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

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

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

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

REAR (Continued)

SPRING AND SHOCK ABSORBER

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

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Shock Absorber Lower Bolt	95	70	—
Shock Absorber Upper Bolt	95	70	—
Stabilizer Bar Frame Bracket Nuts	54	40	—
Stabilizer Bar Link Nuts	54	40	—
Stabilizer Bar Retainer Bolts	54	40	—
Spring U-Bolt Nuts 2WD	149	110	—
Spring U-Bolt Nuts 4WD	149	110	—
Spring Eye Nut	163	120	—
Spring Shackle Nuts	163	120	—
Jounce Bumper Bolts	61	45	—

SHOCK

DESCRIPTION

The top of the shock absorbers are bolted to the body crossmember. The bottom of the shocks are bolted to the axle brackets. The axle brackets are staggered one ahead of the axle and one befind.

OPERATION

Ride control is accomplished through the use of dual-action shock absorbers. The shocks dampen the jounce and rebound as the vehicle travels over various road conditions.

SHOCK (Continued)

REMOVAL

(1) Raise vehicle and support rear axle.

(2) Remove shock absorber lower nut and bolt from the axle bracket (Fig. 1).

(3) Remove shock absorber upper nut and bolt from the frame bracket and remove the shock absorber.

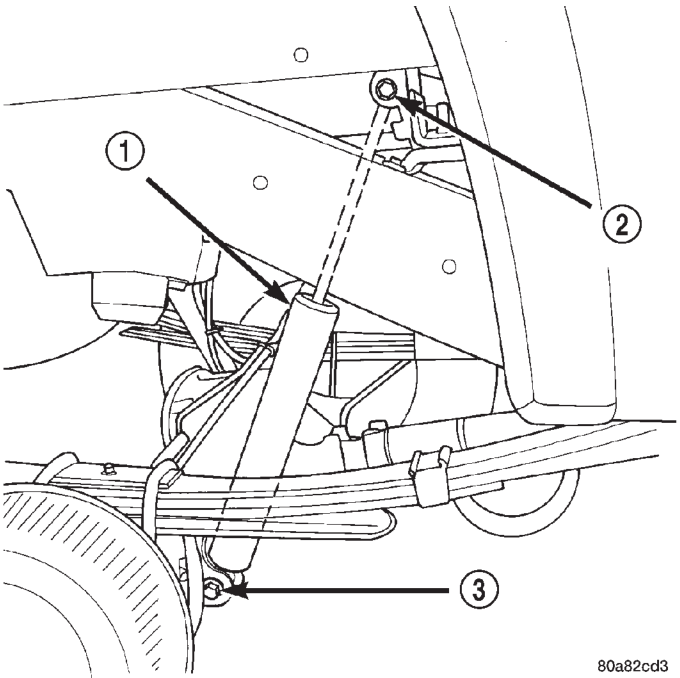

Fig. 1 Shock Absorber

1 - SHOCK ABSORBER
2 - MOUNTING BOLT
3 - MOUNTING BOLT

INSTALLATION

(1) Install shock absorber and upper mounting bolt and nut. Tighten nut to 95 N·m (70 ft. lbs.).

(2) Install shock absorber into the axle bracket. Install the bolt and nut and tighten nut to 95 N·m (70 ft. lbs.).

(3) Remove axle support and lower vehicle.

SPRING

DESCRIPTION

The 4x2 rear suspension system uses a 4-leaf two stage or 5-leaf single stage springs and a solid drive axle. The 4x4 rear suspension system uses only a 4-leaf two stage spring and solid drive axle. The forward end of the springs are mounted to the body rail hangers through rubber bushings. The rearward end of the springs are attached to the body by the use of shackles. The spring and shackles use rubber bushings. The bushing help to isolate road noise.

OPERATION

The springs control ride quality and maintain vehicle ride height. The shackles allow the springs to change their length as the vehicle moves over various road conditions.

REMOVAL

CAUTION: The rear of the vehicle must be lifted only with a jack or hoist. The lift must be placed under the frame rail crossmember located aft of the rear axle. Use care to avoid bending the side rail flange.

(1) Raise the vehicle at the frame.

(2) Use a hydraulic jack to relieve the axle weight.

(3) Remove the wheel and tire assemblies.

(4) Remove the nuts, the U-bolts and spring plate from the axle (Fig. 2) and (Fig. 3) .

(5) Remove the nut and bolt from the spring front eye.

(6) Remove the nut and bolt that attaches the spring shackle to the rear frame bracket.

(7) Remove the spring from the vehicle.

(8) Remove the shackle from the spring.

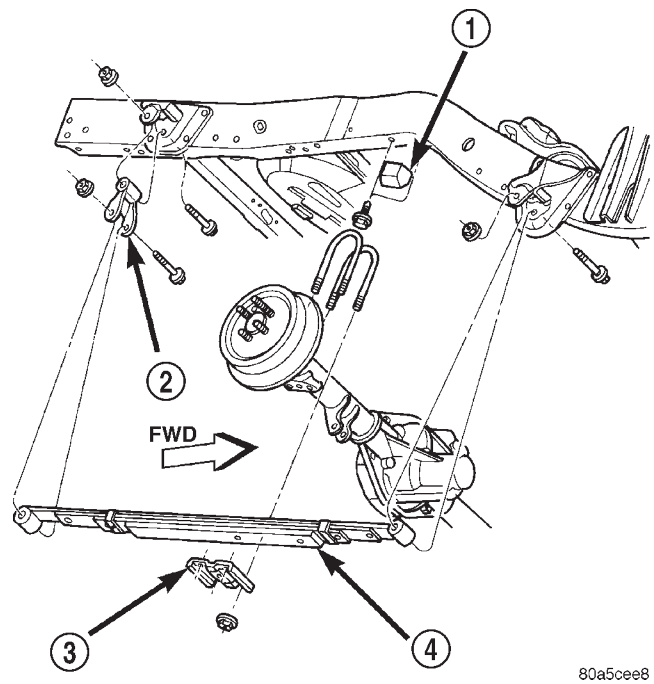

Fig. 2 Leaf Spring - 4x2

1 - JOUNCE BUMPER
2 - SHACKLE
3 - PLATE
4 - LEAF SPRING

SPRING (Continued)

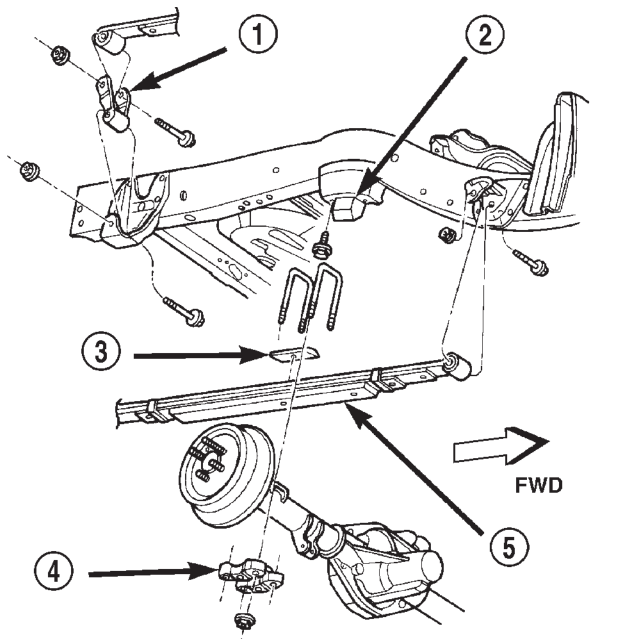

Fig. 3 Leaf Spring - 4x4

1 - SHACKLE
2 - JOUNCE BUMPER
3 - SEAT
4 - PLATE
5 - LEAF SPRING

INSTALLATION

CAUTION: The rear of the vehicle must be lifted only with a jack or hoist. The lift must be placed under the frame rail crossmember located aft of the rear axle. Use care to avoid bending the side rail flange.

(1) Install the spring shackle on the spring finger tight.

(2) Position the spring on the rear axle pad. Make sure the spring center bolt is inserted in the pad locating hole.

(3) Align front spring eye with the bolt hole in the front frame bracket. Install the spring eye bolt and nut and tighten the spring eye nut finger-tight.

(4) Align spring shackle eye with the bolt hole in the rear frame bracket. Install the bolt and nut and tighten the spring shackle eye nut finger-tight.

(5) Install the spring seat (4x4 only), U-bolts, spring plate and nuts.

(6) Tighten the U-bolt nuts to 149 N·m (110 ft. lbs.).

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

(8) Remove the support stands from under the frame rails. Lower the vehicle until the springs are supporting the weight of the vehicle.

(9) Tighten the spring eye pivot bolt nut and all shackle nuts to 163 N·m (120 ft. lbs.).

STABILIZER BAR

DESCRIPTION

The stabilizer bar (optional) extends across the underside of the vehicle and is bolted to the top of the axle. Links at the end of the bar are bolted to frame brackets.

OPERATION

The stabilizer bar is used to minimize vehicle body roll. The spring steel bar helps to control the vehicle body in relationship to the suspension.

REMOVAL

(1) Raise and support vehicle.

(2) Remove nuts and bolts from the links at the stabilizer bar.

(3) Remove stabilizer bar retainer bolts and retainers (Fig. 4).

(4) Remove stabilizer bar and replace worn, cracked or distorted bushings.

(5) Remove links upper mounting nuts and bolts and remove links.

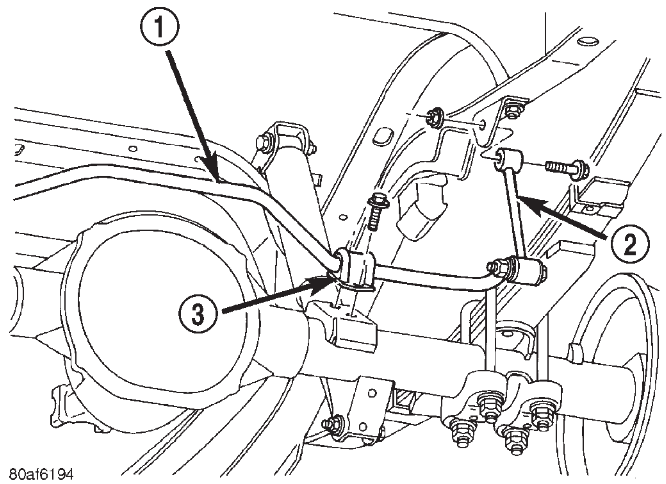

Fig. 4 Stabilizer Bar Mounting

1 - STABILIZER BAR
2 - LINK
3 - RETAINER

INSTALLATION

(1) Install the stabilizer bar and center it with equal spacing on both sides. Install stabilizer bar retainers and tighten bolts to 54 N·m (40 ft. lbs.).

(2) Install link into frame brackets and the stabilizer bar. Install mounting nuts and bolts.

(3) Remove support and lower vehicle.

(4) Tighten stabilizer link nuts to 54 N·m (40 ft. lbs.).

DIFFERENTIAL & DRIVELINE

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PROPELLER SHAFT

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PROPELLER SHAFT

DESCRIPTION

A propeller shaft (Fig. 1), (Fig. 2), and (Fig. 3) is the shaft which connects the transmission/transfer case to the axle differential. This is the link through which the engine power is transmitted to the axle.

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

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

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

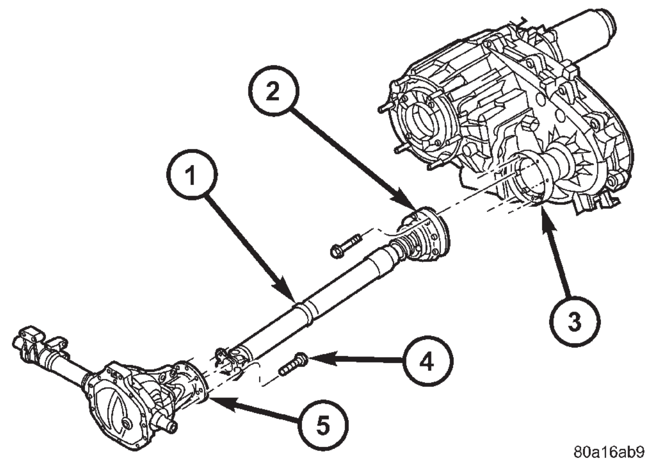


Fig. 1 FRONT PROPELLER SHAFT

1 - PROPELLER SHAFT
2 - CONSTANT VILOCITY JOINT
3 - COMPANION FLANGE
4 - BOLT
5 - COMPANION FLANGE

PROPELLER SHAFT (Continued)

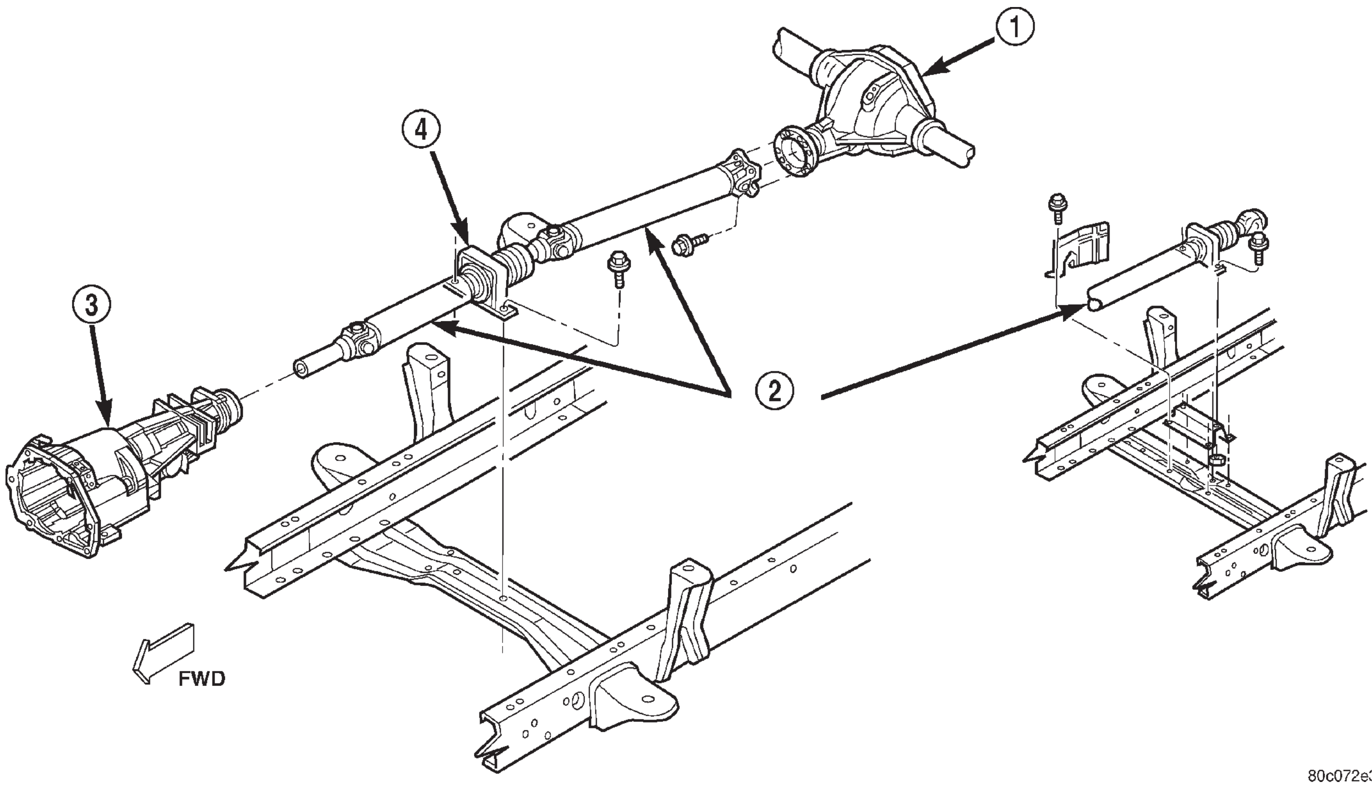


Fig. 2 Rear Propeller Shaft with Center Bearing

1 - REAR AXLE
2 - REAR PROPELLER SHAFT
3 - TRANSMISSION EXTENSION HOUSING
4 - CENTER BEARING

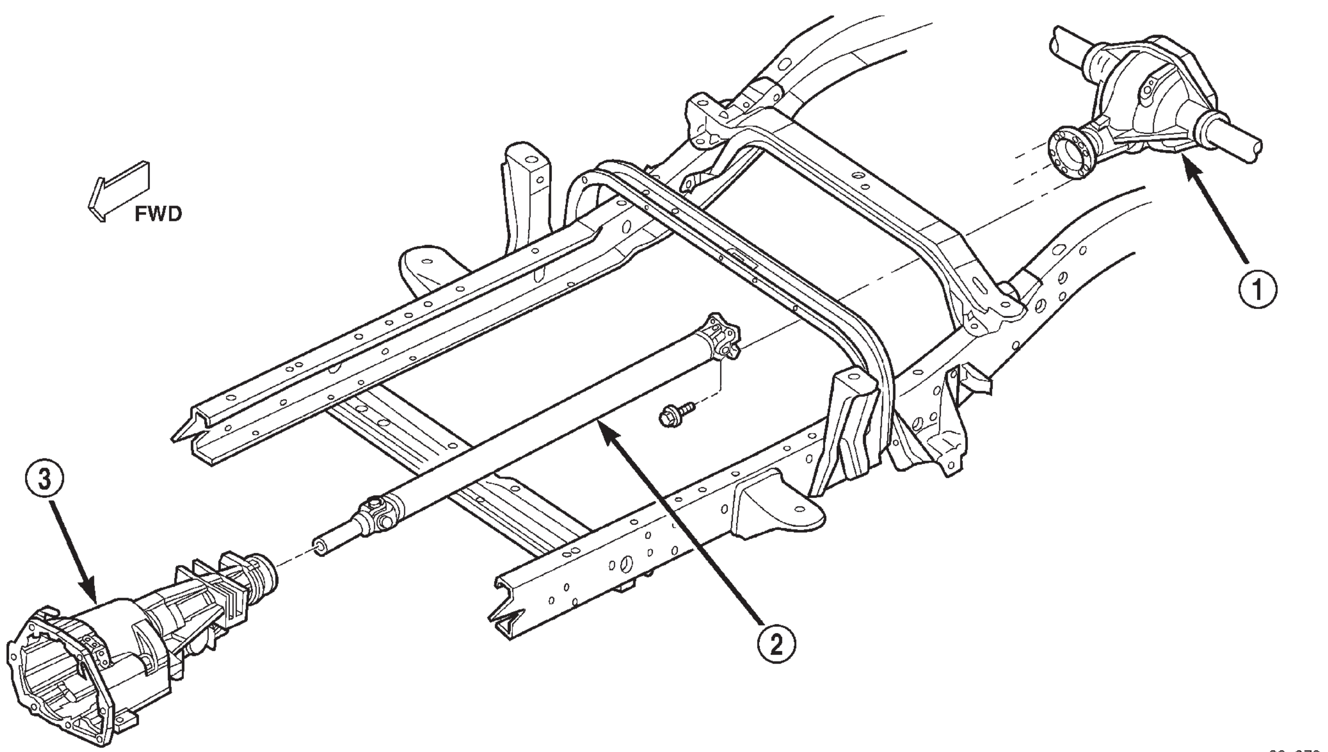


Fig. 3 Rear Propeller Shaft

1 - REAR AXLE
2 - REAR PROPELLER SHAFT
3 - TRANSMISSION EXTENSION HOUSING

PROPELLER SHAFT (Continued)

Also make alignment reference marks (Fig. 4)on the propeller shaft yoke and axle, or transmission, yoke prior to servicing. This helps to eliminate possible vibration.

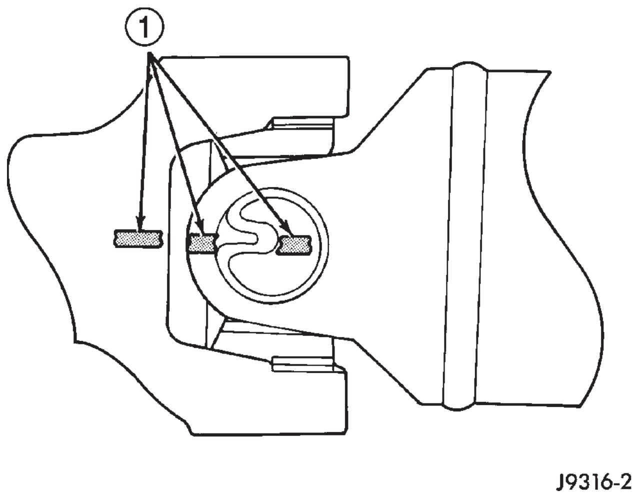


Fig. 4 Reference Marks on Yokes

1 - REFERENCE MARKS

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

OPERATION

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

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

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

DIAGNOSIS AND TESTING - PROPELLER SHAFT

VIBRATION

Tires that are out-of-round, or wheels that are unbalanced, will cause a low frequency vibration. (Refer to 22 - TIRES/WHEELS - DIAGNOSIS AND TESTING)

Brake drums that are unbalanced will cause a harsh, low frequency vibration. (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING)

Driveline vibration can also result from loose or damaged engine mounts.

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 as 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. 5).

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

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

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

(13) If the additional clamp causes an additional vibration, separate the clamps (1/2 inch above and below the mark). Repeat the vibration test (Fig. 7).

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

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

PROPELLER SHAFT (Continued)

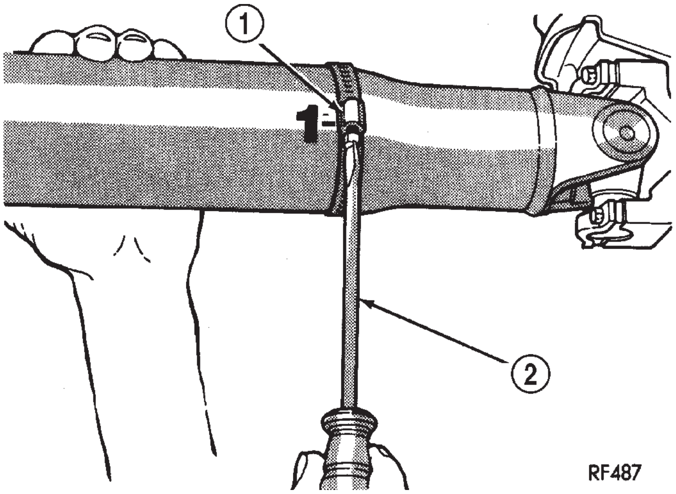


Fig. 5 Clamp Screw At Position 1

1 - CLAMP
2 - SCREWDRIVER

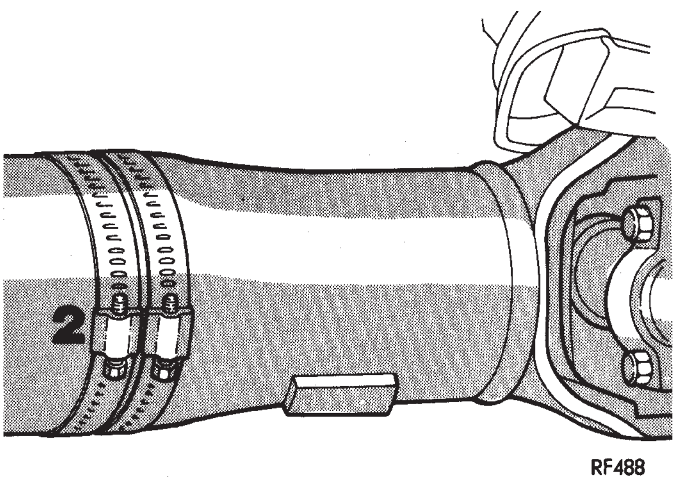


Fig. 6 Two Clamp Screws At The Same Position

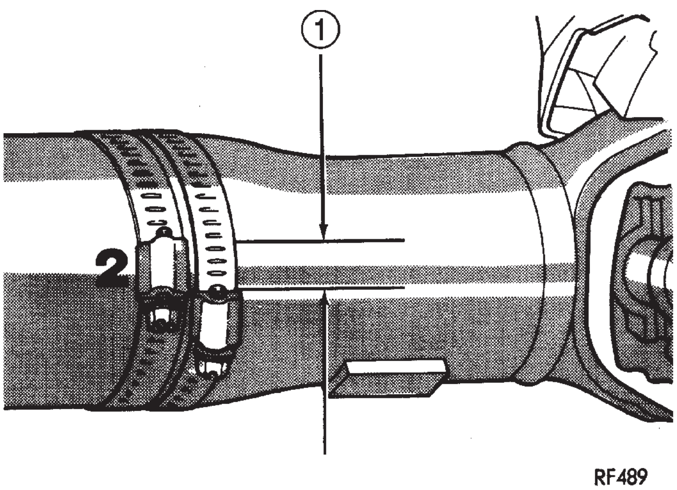


Fig. 7 Clamp Screws Separated

1 - ½ 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 PROCEDURES

To accurately check driveline alignment, raise and support the vehicle at the axles as level as possible. Allow the wheels and propeller shaft to turn.

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

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

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

PROPELLER SHAFT (Continued)

(3) Place Inclinometer 7663 (J-23498A) on yoke bearing (A) parallel to the shaft (Fig. 8). Center bubble in sight glass and record measurement.

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

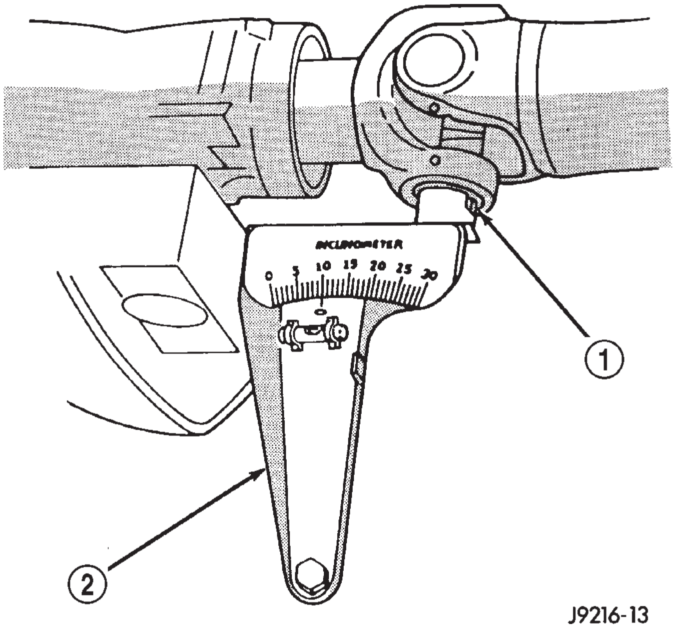


Fig. 8 Front (Output) Angle Measurement (A)

1 - SLIP YOKE BEARING CAP
2 - INCLINOMETER

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

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

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

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

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

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

Refer to rules given below and the example in (Fig. 11)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.

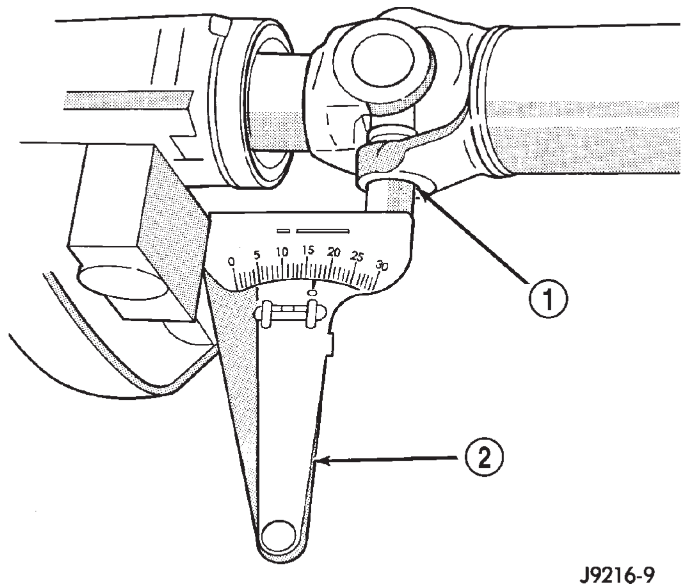


Fig. 9 Propeller Shaft Angle Measurement (C)

1 - SHAFT YOKE BEARING CAP
2 - INCLINOMETER

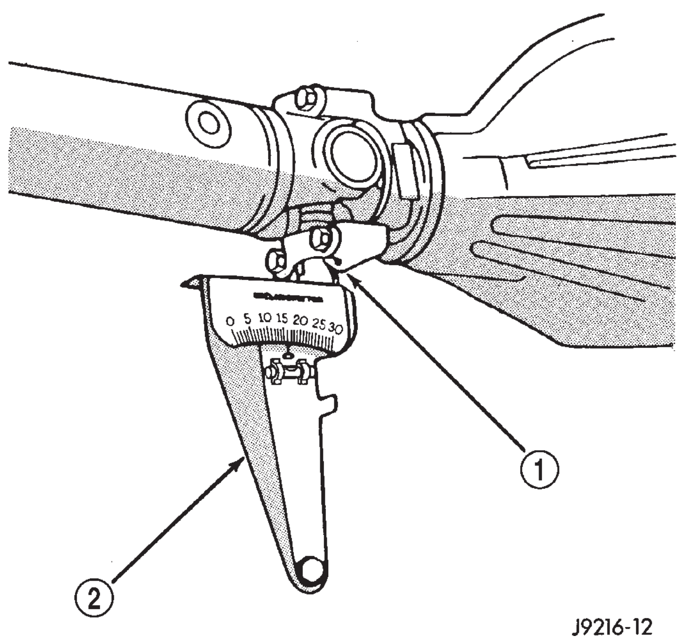


Fig. 10 Rear (Input) Angle Measurement (B)

1 - PINION YOKE BEARING CAP
2 - INCLINOMETER

TWO-PIECE PROPELLER SHAFT

The procedure to measure the propeller shaft angles involved with a two-piece (Fig. 12) propeller shaft is the same as those for a one-piece propeller shaft.

PROPELLER SHAFT (Continued)

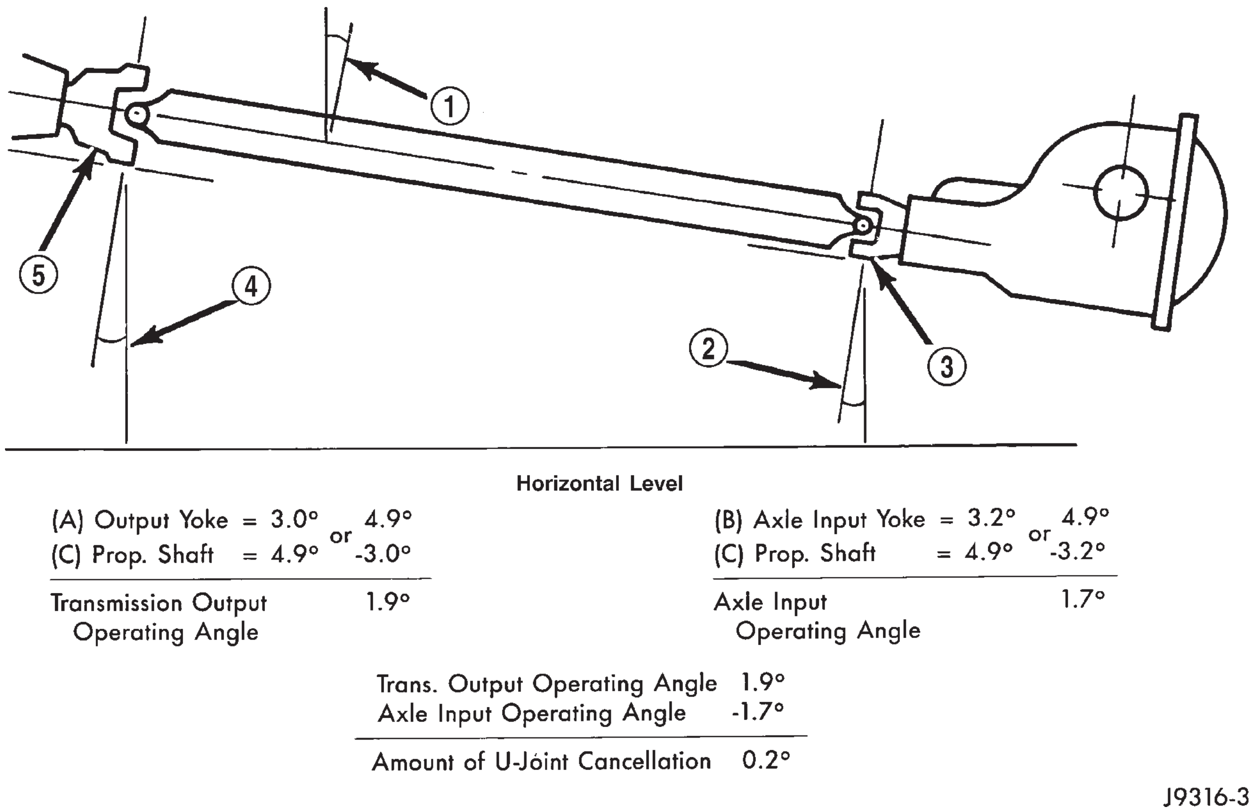


Fig. 11 Universal Joint Angle Example

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

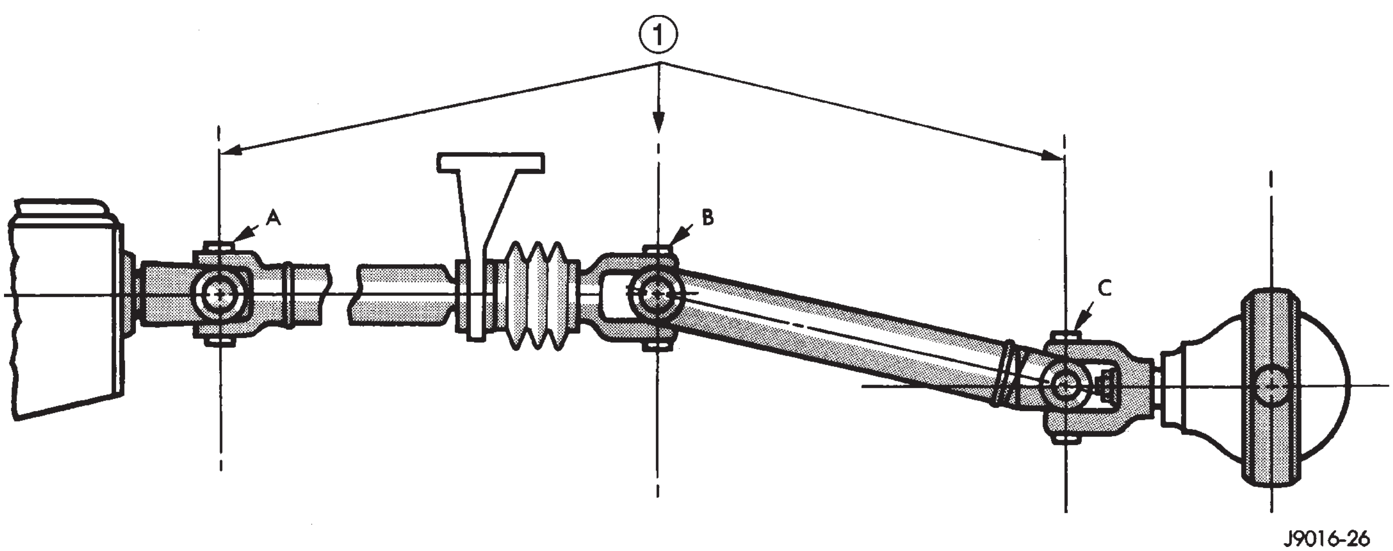


Fig. 12 Universal Joint Angle Two-Piece Shaft

1 - YOKES MUST BE IN SAME PLANE

SPECIFICATIONS

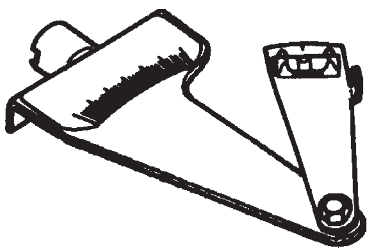
PROPELLER SHAFT

TORQUE SPECIFICATIONS

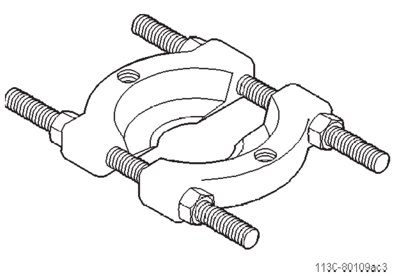
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Center Bearing Bolts	68	50	-
Transfer Case Flange Bolts	30.5	22.5	-
Companion Flange Bolts	108	80	-

SPECIAL TOOLS

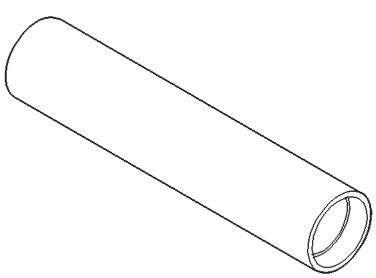
PROPELLER SHAFT



Inclinometer 7663



Bearing Splitter 1130



Installer Bearing 6052

PROPELLER SHAFT - FRONT

REMOVAL

(1) Position transmission and transfer case to their neutral positions. Raise and support vehicle. Remove skid plate, if equipped.

(2) Mark a line across the transfer case flange and C/V for installation reference.

(3) Mark a line across the propeller shaft flange yoke and front axle companion flange for installation reference.

(4) Remove companion flange bolts (Fig. 13).

(5) Remove transfer case flange bolts and remove propeller shaft.

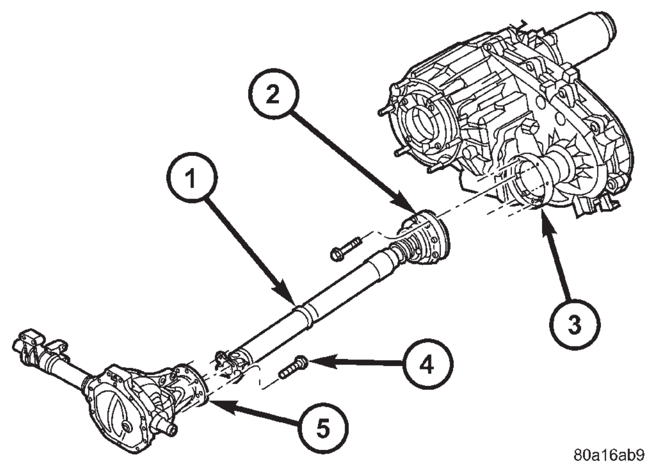


Fig. 13 Front Propeller Shaft

1 - PROPELLER SHAFT
2 - CONSTANT VILOCITY JOINT
3 - COMPANION FLANGE
4 - BOLT
5 - COMPANION FLANGE

INSTALLATION

(1) Install propeller shaft with with all reference marks aligned.

(2) Loosely install bolts to C/V and transfer case companion flange.

(3) Install bolts to companion flange and flange yoke and tighten to 108 N·m (80 ft. lbs.).

(4) Tighten bolts to transfer case companion flange to 30.5 N·m (22.5 ft. lbs.).

(5) Install skid plate, if equipped.

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

PROPELLER SHAFT - REAR

REMOVAL

(1) Place the transmission into the Neutral position.

(2) Raise and support vehicle on safety stands.

(3) Mark a line across the axle companion flange and flange yoke for installation reference.

(4) Mark an outline of the center bearing on the support bracket for installation reference, if equipped.

(5) Mark an outline of the heat shield on the center bearing for installation reference, if equipped.

(6) Remove center bearing and heat shield bolts, if equipped.

(7) Remove companion flange bolts.

(8) Slide slip yoke off of the transmission, or transfer case, output shaft and remove the propeller shaft (Fig. 14).

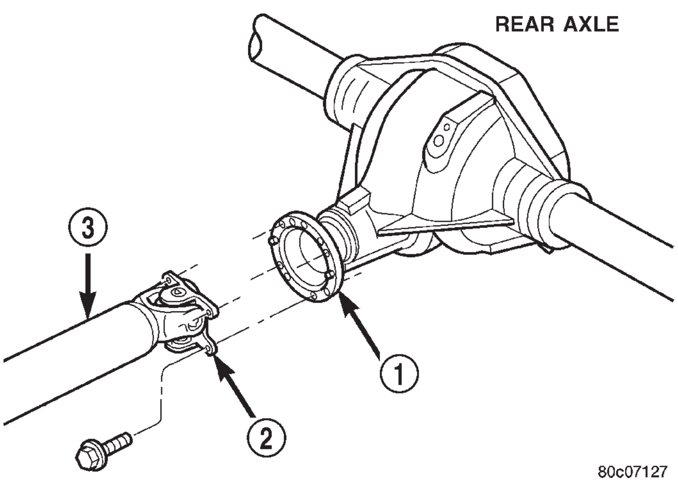


Fig. 14 Propeller Shaft

1 - COMPANION FLANGE
2 - FLANGE YOKE
3 - REAR PROPELLER SHAFT

INSTALLATION

(1) Slide the slip yoke onto the transmission, or transfer case, output shaft.

(2) Align and install the center bearing and heat shield to the support bracket, if necessary. Install the bolts and tighten to 68 N·m (50 ft. lbs.).

(3) Align companion flange reference mark with flange yoke mark.

(4) Install companion flange bolts and tighten to 108 N·m (80 ft. lbs.).

(5) Lower the vehicle.

CENTER BEARING

DESCRIPTION

The two-piece propeller shaft uses a center bearing to support the shafts. The bearing is used to support the shafts where they are joined together. The bearing is insulated in rubber and is mounted to the frame crossmember.

OPERATION

The propeller shaft center bearing serves to divide the required propeller shaft length into two smaller shafts, which has several inherent advantages. Having two short propeller shafts instead of one long shaft decreases the chance of unwanted noise and vibrations. The shorter shafts are easier to balance and serve to increase ground clearance while maintaining acceptable driveline angles.

REMOVAL

(1) Remove rear propeller shaft.

(2) Remove slip joint boot clamp and separate the two half-shafts.

(3) Use hammer and punch to tap slinger away from shaft to provide room for bearing splitter.

(4) Position Bearing Splitter Tool 1130 between slinger and shaft.

CAUTION: Do not damage shaft spline during removal of center bearing.

(5) Set shaft in press and press bearing off the shaft.

INSTALLATION

(1) Install new slinger on shaft and drive into position with appropriate installer tool.

(2) Install new center bearing on shaft with Bearing Installer Tool 6052. Drive on shaft with hammer until bearing is seated.

(3) Clean shaft splines and apply a coat of multi–purpose grease.

(4) Align master splines and slide front and rear half-shafts together. Reposition slip yoke boot and install new clamp.

(5) Install propeller shaft in vehicle.

CENTER BEARING (Continued)

CENTER BEARING ADJUSTMENT

Drive away shudder is a vibration that occurs at first acceleration from a stop. Shudder vibration usually peaks at the engines highest torque output. Shudder is a symptom associated with vehicles using a two-piece propeller shaft. To decrease shudder, lower the center bearing in 1/8 inch increments. Use shim stock or fabricated plates. Plate stock must be used to maintain compression of the rubber insulator around the bearing. Do not use washers. Replace the original bolts with the appropriate increased length bolts.

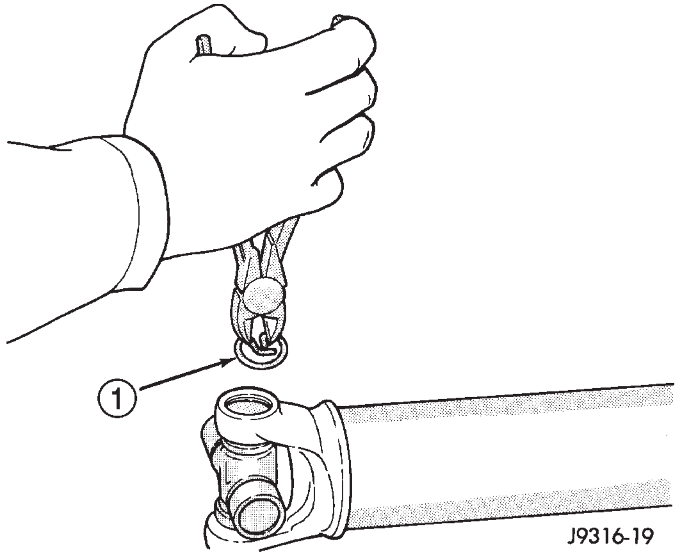


Fig. 15 Snap Ring

1 - SNAP RING

SINGLE CARDAN UNIVERSAL JOINTS

DISASSEMBLY

NOTE: The following procedure is described for a propeller shaft equipped with only a cardan joint in the tube yoke. If the propeller shaft is equipped with a companion yoke, simply repeat the following steps to remove the cardan joint from the companion yoke after removing the cardan joint from the tube yoke.

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

(1) Remove the propeller shaft.

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

(3) Remove snap rings from both sides of yoke (Fig. 15).

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

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

(6) Place a socket with an outside diameter smaller than the upper bearing cap on the upper bearing cap and press the cap through the yoke to release the lower bearing cap (Fig. 16).

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

(8) To remove the opposite bearing cap, turn the yoke over and straighten the cross in the open hole. Then, carefully press the end of the cross until the remaining bearing cap can be removed (Fig. 17).

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

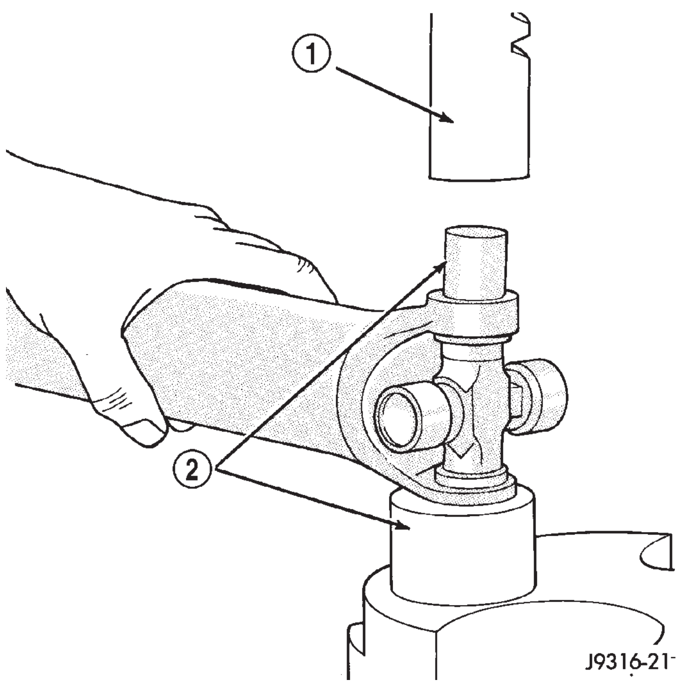


Fig. 16 Press Out Bearing

1 - PRESS
2 - SOCKET

SINGLE CARDAN UNIVERSAL JOINTS (Continued)

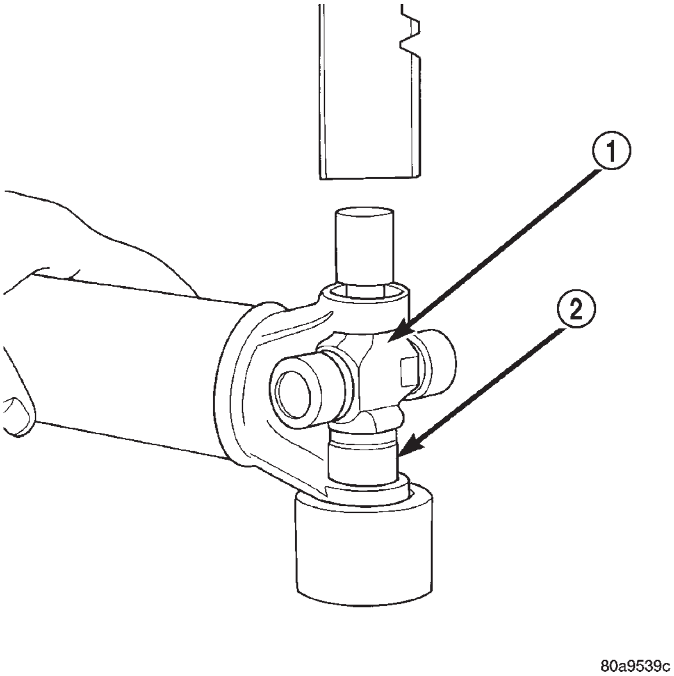


Fig. 17 Press Out Remaining Bearing

1 - CROSS
2 - BEARING CAP

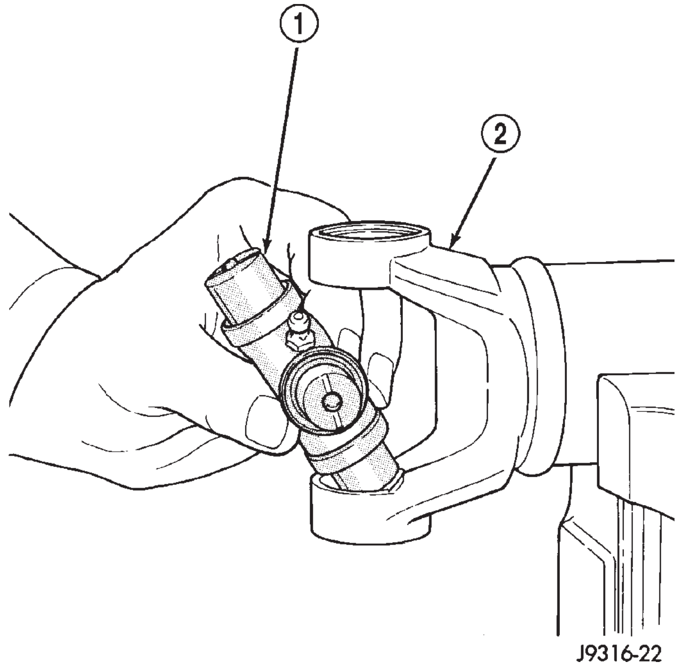


Fig. 18 Cross In Yoke

1 - CROSS
2 - YOKE

ASSEMBLY

NOTE: The following procedure is described for a propeller shaft equipped with only a cardan joint in the tube yoke. If the propeller shaft is equipped with a companion yoke, simply repeat the following steps to remove the cardan joint from the companion yoke after removing the cardan joint from the tube yoke.

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

(2) Position the cross in the yoke with its lube fitting, if equipped, pointing up (Fig. 18).

(3) Place a bearing cap over the trunnion and align the cap with the yoke bore (Fig. 19). Keep the needle bearings upright in the bearing assembly. A needle bearing lying at the bottom of the cap will prevent proper assembly.

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

(5) Install a snap ring.

(6) Repeat Step 3 and Step 4to install the opposite bearing cap. If the joint is stiff or binding, strike the yoke with a soft hammer to seat the needle bearings.

(7) Add grease to lube fitting, if equipped.

(8) Install the propeller shaft.

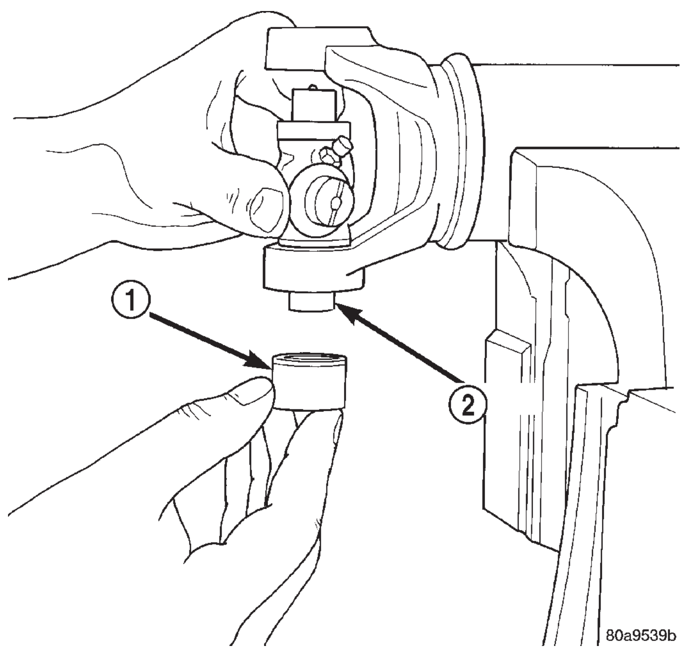


Fig. 19 Install Bearing On Trunnion

1 - BEARING CAP
2 - TRUNNION

HALF SHAFT

TABLE OF CONTENTS

HALF SHAFT

DESCRIPTION

The two constant velocity (C/V) drive shafts are identical and interchangeable. They are comprised of three major components (Fig. 1):

- An inner, tripod C/V joint
- A short, solid interconnecting shaft
- An outer, Rzeppa C/V joint with stub shaft

The inner tripod-joints are attached to the axle shaft splines (Fig. 1). The outer joint is splined and mates with the hub bearing on the knuckle.

The lubricant amounts included with replacement rubber boots are different for inner and outer C/V joints. Apply only the specified lubricant amount to each C/V joint.

CAUTION: Proper C/V joint boot sealing is critical for retaining the special lubricant. Prevent foreign material from entering and contaminating the C/V joints. Mishandling a C/V drive shaft can cause a boot to be punctured or damage within the joints. Always support both ends of the C/V drive shaft during removal and installation to avoid damage.

When replacing C/V drive shaft components, ensure that only exact replacements parts are installed.

OPERATION

The axle driveshafts are located on either side of the differential and transmits power to the drive wheels, while allowing for vertical movement in the vehicle's suspension.

DIAGNOSIS AND TESTING - HALF SHAFT

Check for grease in the vicinity of the inboard tripod joint and outboard C/V joint; this is a sign of inner or outer joint seal boot or seal boot clamp damage. A light film of grease may appear on the right inner tripod joint seal boot; this is considered normal and should not require replacement of the seal boot.

NOISE AND/OR VIBRATION IN TURNS

A clicking noise and/or a vibration in turns could be caused by one of the following conditions:

- Damaged outer C/V or inner tripod joint seal boot or seal boot clamps. This will result in the loss and/or contamination of the joint grease, resulting in inadequate lubrication of the joint.
- Noise may also be caused by another component of the vehicle coming in contact with the driveshafts.

CLUNKING NOISE DURING ACCELERATION

This noise may be a result of one of the following conditions:

- A torn seal boot on the inner or outer joint of the driveshaft assembly which has allowed the C/V joint to become damaged.
- A loose or missing clamp on the inner or outer joint of the driveshaft assembly which has allowed the C/V joint to become damaged.
- A damaged or worn driveshaft C/V joint.

SHUDDER OR VIBRATION DURING ACCELERATION

This problem could be a result of:

- A worn or damaged driveshaft inner tripod joint.
- A sticking tripod joint spider assembly (inner tripod joint only).
- Improper wheel alignment.

HALF SHAFT (Continued)

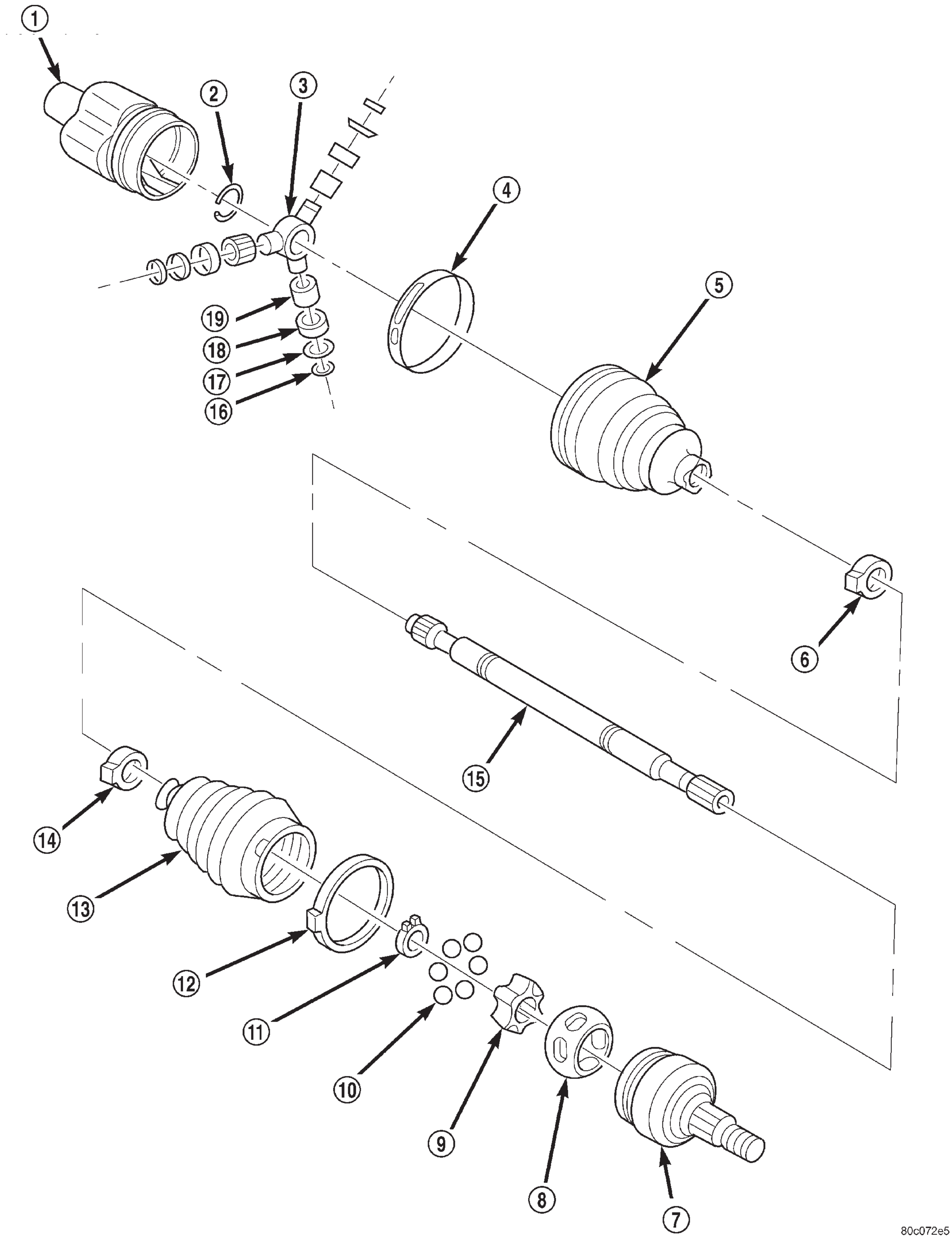


Fig. 1 C/V Drive Shaft Components

HALF SHAFT (Continued)

1 - RETAINER & HOUSING ASM
2 - C-CLIP
3 - TRIPOD JOINT SPIDER
4 - SEAL RETAINING CLAMP
5 - INNER BOOT
6 - SEAL RETAINING CLAMP
7 - C/V JOINT OUTER RACE
8 - C/V JOINT CAGE
9 - C/V JOINT INNER RACE
10 - CHROME ALLOY BALL
11 - RACE RETAINING RING
12 - SEAL RETAINING CLAMP
13 - DRIVE AXLE OUTBOARD SEAL
14 - SEAL RETAINING CLAMP
15 - AXLE SHAFT
16 - RETAINING RING
17 - BALL & ROLLER RETAINER
18 - TRIPOD JOINT BALL
19 - NEEDLE ROLLER

VIBRATION AT HIGHWAY SPEEDS

This problem could be a result of:

- Foreign material (mud, etc.) packed on the backside of the wheel(s).
- Out of balance front tires or wheels.
- Improper tire and/or wheel runout.

SPECIFICATIONS

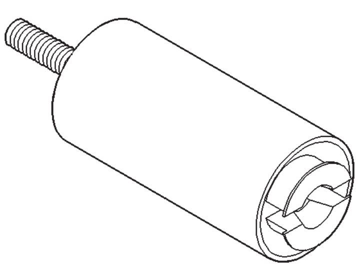
HALF SHAFT

TORQUE SPECIFICATIONS

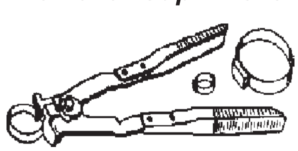
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Axle Flange Bolts	90	65	-
Axle Nut	244	180	-

SPECIAL TOOLS

SPECTIAL TOOLS



Remover Cup L-4518



Remover/Installer C-4124

AXLE SHAFT

REMOVAL

(1) Loosen the lug nuts and hub nut while the vehicle is on the surface with the brakes applied (Fig. 2).

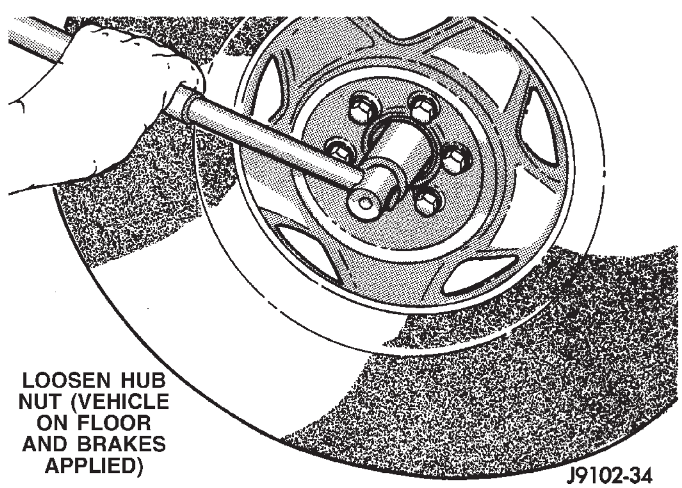


Fig. 2 Wheel Hub Nut

(2) Raise the vehicle.

(3) Remove the skid plate, if equipped.

AXLE SHAFT (Continued)

(4) Remove the cotter pin, nut lock, and spring washer from the stub shaft (Fig. 3).

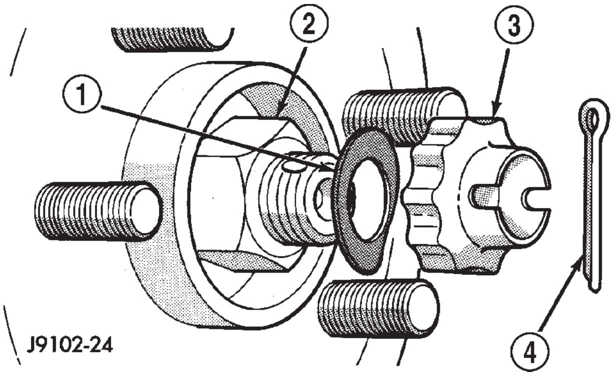


Fig. 3 Cotter Pin, Nut Lock & Spring

1 - SPRING WASHER
2 - HUB NUT
3 - NUT LOCK
4 - COTTER PIN

(5) Remove the hub nut and washer from the stub shaft (Fig. 4).

(6) Remove the wheel and tire.

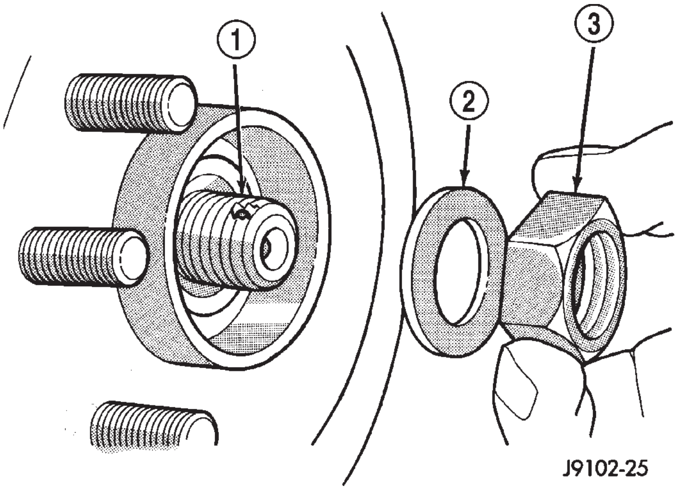


Fig. 4 Hub Nut & Washer

1 - DRIVE SHAFT
2 - HUB WASHER
3 - HUB NUT

(7) Remove the brake caliper and rotor, refer to Group 5 Brakes for procedures.

(8) Remove the ABS wheel speed sensor if equipped. Refer to Group 5 Brakes for procedures.

(9) Remove the bolts holding the hub bearing to the knuckle.

(10) Remove hub bearing from axle driveshaft and steering knuckle.

(11) Support the drive shaft at the C/V joint housings.

(12) Disengage the inner C/V joint from the axle shaft (Fig. 5). Position two pry bars between the inner C/V housing and the axle housing. Apply pressure away from the differential housing. This will disengage the axle shaft snap-ring from the groove on the inside of the C/V housing.

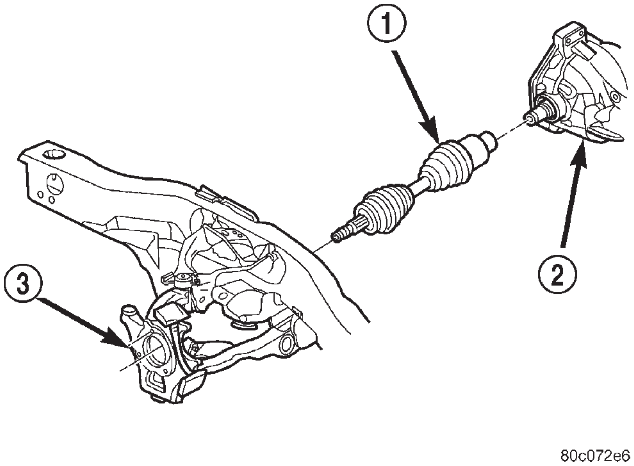


Fig. 5 Front

1 - DRIVESHAFT
2 - FRONT AXLE
3 - STEERING KNUCKLE

(13) Remove the driveshaft from the vehicle.

INSTALLATION

(1) Insert the C/V drive shaft stub into the hub bearing bore of the steering knuckle.

(2) Apply a light coating of wheel bearing grease on the axle shaft splines.

(3) Install the inner C/V joint onto the axle shaft flange. Push firmly on the shaft until the axle shaft snap-ring engages with the groove on the inside of the joint housing.

(4) Clean hub bearing bore, axle driveshaft splines, and hub bearing mating surface of all foreign materials. Apply light coating of grease to all mating surfaces.

(5) Install the hub bearing to the axle driveshaft and the steering knuckle.

(6) Install the bolts to hold the hub bearing to the steering knuckle. Refer to Group 2, Suspension, for the proper torque.

(7) Clean all foreign material from the stub shaft threads. Install the hub nut and washer.

(8) Install the ABS wheel speed sensor, if equipped. Refer to Group 5, Brakes, for proper procedures.

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

(10) Apply the brakes and tighten hub nut to 244 N·m (180 ft. lbs.) torque.

AXLE SHAFT (Continued)

(11) Install the spring washer, nut lock and cotter pin on the stub shaft (Fig. 6) .

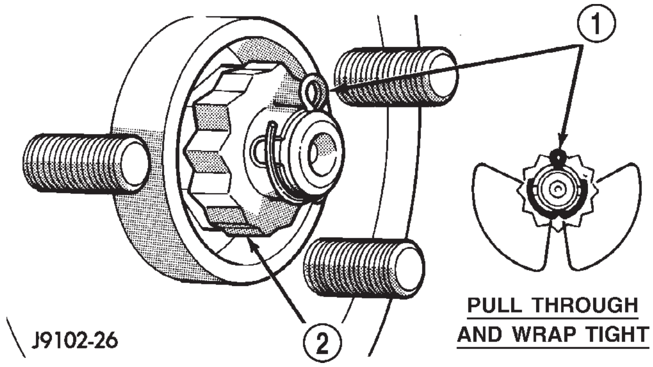


Fig. 6 Cotter Pin Installation

1 - COTTER PIN
2 - NUT LOCK

(12) Install the skid plate, if equipped.
(13) Install the wheel and tire.

CV BOOT

REMOVAL

(1) Remove axle driveshaft from vehicle.
(2) Remove outer C/V joint.
(3) Remove outer C/V joint small clamp and remove boot (Fig. 7).
(4) Remove inner C/V joint boot clamps and remove boot.

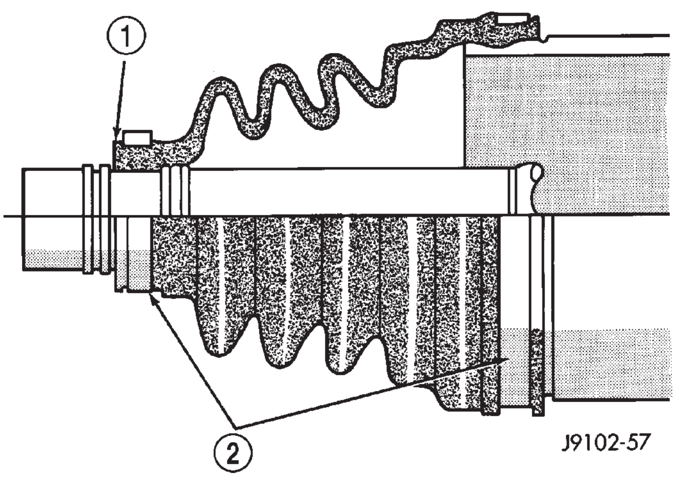


Fig. 7 Boot Retaining

1 - LOCATING SHOULDERS
2 - CLAMPS

INSTALLATION

The lubricant amounts included with replacement boots are different for inner and outer C/V joints. Apply only the specified lubricant amount to each C/V joint.

(1) Clean the C/V joints and shaft of all old grease and foreign matter.
(2) Slide the inner C/V joint boot up the shaft and insert the lip located within the small-diameter end of the boot into the shaft groove (Fig. 7).
(3) Retain the small–diameter of the boot on the shaft with a ladder-type clamp in the boot groove (Fig. 7). Verify that the boot and lip are properly positioned on the intermediate shaft. Position the clamp locating tabs in the slots and tighten the clamp.
(4) Compress the clamp bridge with Remover/Installer C-4124. Squeeze the tool handles to complete the tightening of the clamp (Fig. 8). **Care must be exercised when using the tool to avoid cutting through the clamp bridge or damaging the boot.**

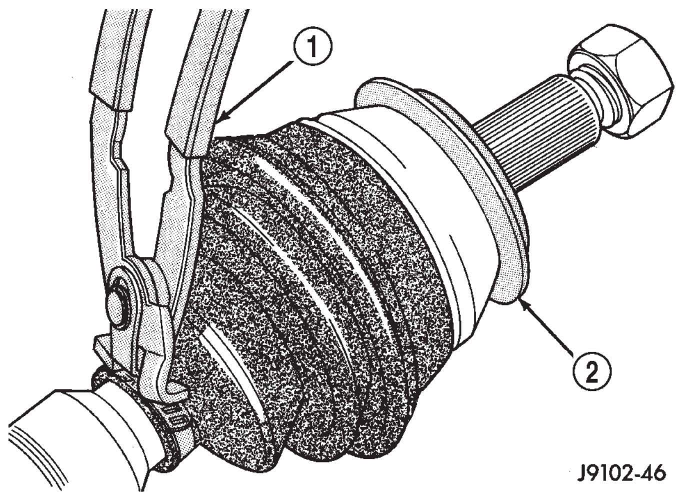


Fig. 8 Compressing Clamp Bridge

1 - BOOT CLAMP PLIERS
2 - SLINGER

(5) Position the large-diameter end of the boot on the C/V joint housing.
(6) After the inner joint boot small clamp is installed, the inboard hub must be set to a service build length.
(a) Compress the inner hub down the connector shaft.
(b) Use a small blunt drift between the large end and the boot seal to relieve the pressure.
(c) The distance edge of the lip to the edge of the flange should be 181.00 mm (7.13 in.). This will eliminate excess air that can cause a ballooning affect and possibly cause damage to the boot.
(7) Verify that the boot is not twisted and that it is correctly positioned on the housing.

CV BOOT (Continued)

(8) Install the large ladder clamp on the boot and secure as done with the small ladder clamps (Fig. 8).
(9) Slide the outer C/V joint boot small clamp onto shaft.
(10) Slide outer C/V joint boot onto shaft and into position on shaft.
(11) Install small clamp to boot as done above.
(12) Install large boot clamp over outer C/V joint.
(13) Install outer C/V joint to shaft.
(14) Install large boot clamp to boot and C/V joint.
(15) Install the C/V driveshaft.

CV JOINT - OUTER

REMOVAL

(1) Clamp shaft in a vise (with soft jaws) and support C/V joint.
(2) Remove clamps from the C/V joint and discard.
(3) Slide the boot off the outer joint and down the shaft.
(4) Remove lubricant to expose the C/V joint snap ring.
(5) Open snap ring and slide the joint off the shaft (Fig. 9).

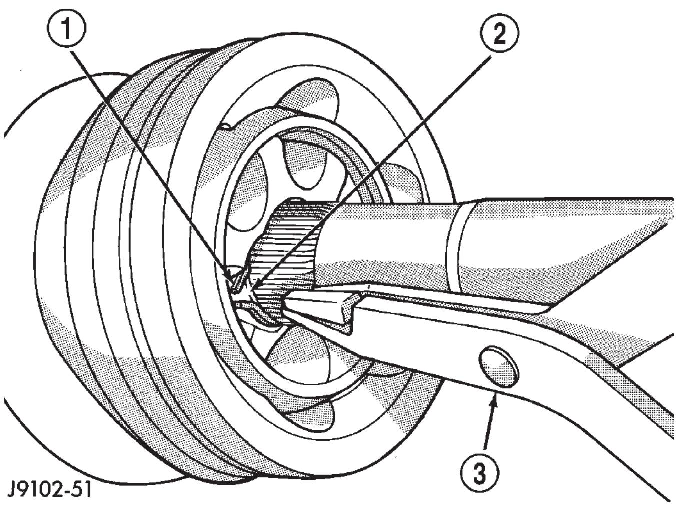


Fig. 9 Outer C/V Joint

1 - SNAP RING
2 - SNAP RING GROVE
3 - SNAP RING PLIERS

(6) Remove slinger from the joint if damaged. Use a brass drift and a hammer and tap slinger ring off the joint.
(7) Mark alignment marks on the bearing hub, bearing cage and housing with dabs of paint (Fig. 10).
(8) Clamp C/V joint in a vertical position in a in soft jawed vise.

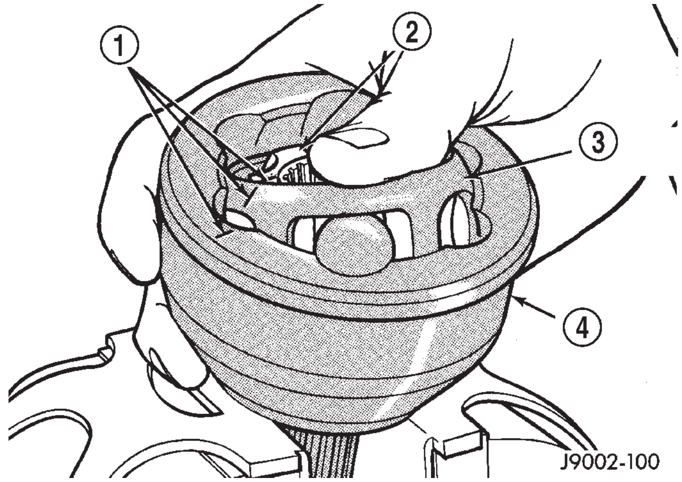


Fig. 10 Ball Access

1 - ALIGNMENT MARKS
2 - BEARING HUB
3 - BEARING CAGE
4 - HOUSING

(9) Press down one side of the bearing cage/hub to gain access to a ball at the opposite. If joint is tight, use a hammer and brass drift to loosen the bearing hub. **Do not contact the bearing cage with the drift.**
(10) Remove ball from the bearing cage (Fig. 11). If necessary, a small pry bar can be used to pry the ball loose from the cage.

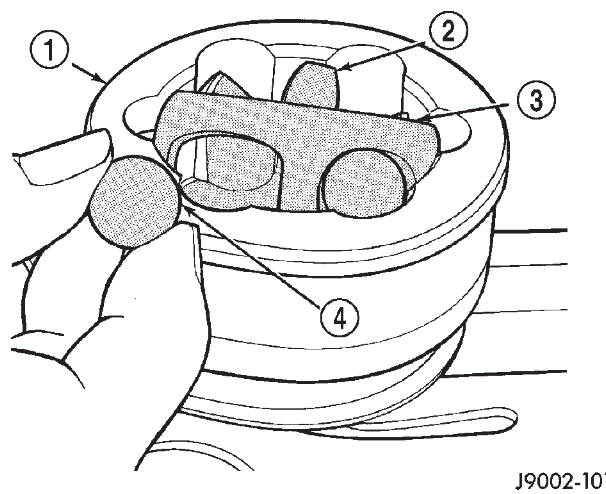


Fig. 11 Ball Removal

1 - HOUSING
2 - BEARING HUB
3 - BEARING CAGE
4 - BALL

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

CV JOINT - OUTER (Continued)

(12) Move bearing cage and hub to a vertical position. Pull cage upward and out from the housing (Fig. 12).

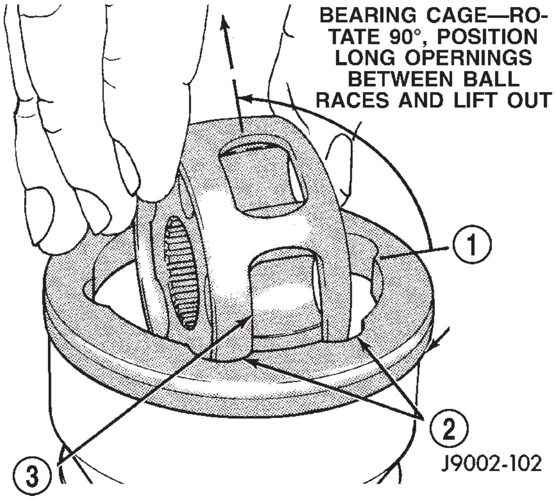


Fig. 12 Bearing Cage & Hub

1 - HOUSING
2 - BALL RACE
3 - BALL CAGE WINDOW

(13) Turn bearing hub 90° in the bearing cage. Align one pair of the hub lands with the cage windows. Raise and insert one of the lands into the adjacent cage window. Remove bearing hub by rolling it out of the cage (Fig. 13).

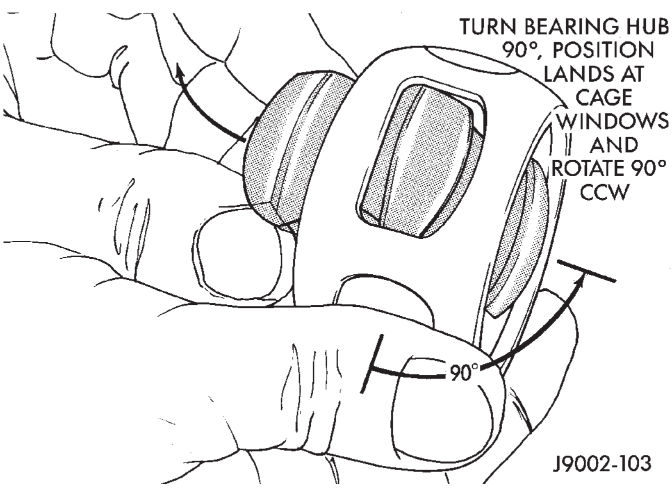


Fig. 13 Bearing Hub

INSTALLATION

If the outer C/V joint is excessively worn, replace the entire C/V joint and boot.

(1) Lightly apply lubricating oil to all the outer C/V joint components before assembling them.

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

(3) Insert one of the bearing hub lands into a bearing cage window. Roll the hub into the cage (Fig. 14). Rotate the bearing hub 90° to complete the installation (Fig. 15).

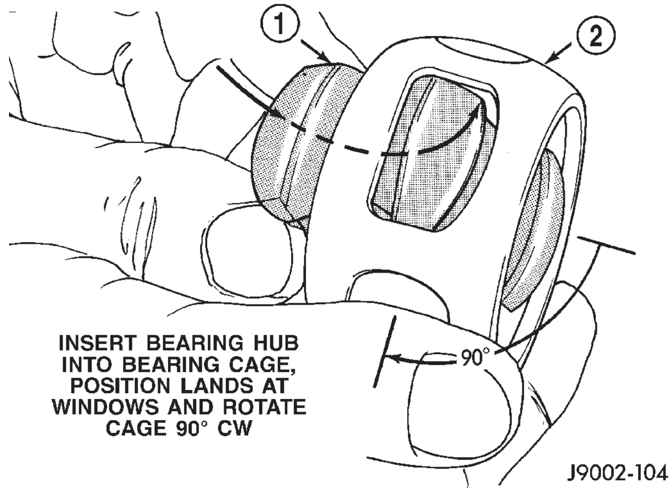


Fig. 14 Bearing Hub

1 - BEARING HUB
2 - BEARING CAGE

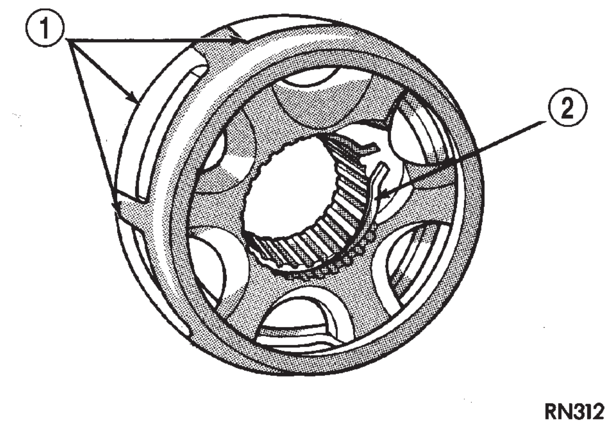


Fig. 15 Bearing Cage & Hub

1 - CAGE WINDOWS
2 - SNAP RING

(4) Insert bearing cage/hub into the housing (Fig. 16). Rotate the cage/hub 90° to complete the installation (Fig. 17).

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

(6) Tilt bearing hub and cage and install the balls in the raceways (Fig. 18).

CV JOINT - OUTER (Continued)

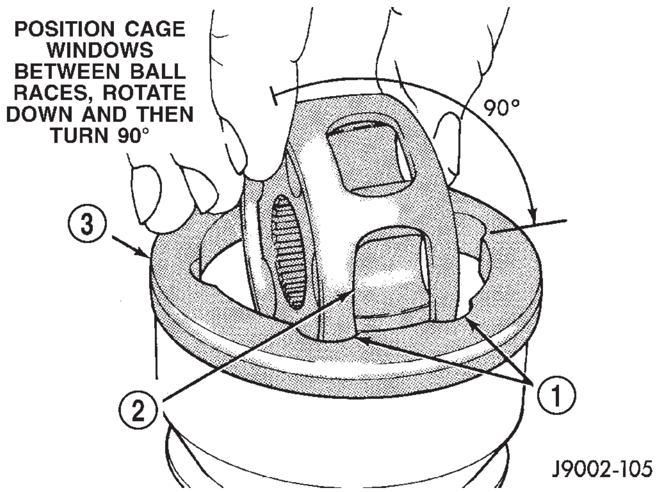


Fig. 16 Bearing Cage & Hub Installation

1 - BALL RACE
2 - BEARING CAGE WINDOW
3 - CV JOINT HOUSING

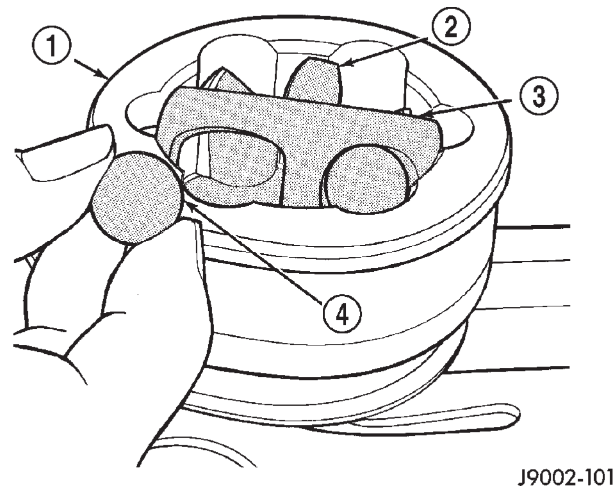


Fig. 18 Ball

1 - CV JOINT HOUSING
2 - BEARING HUB
3 - BEARING CAGE
4 - BALL

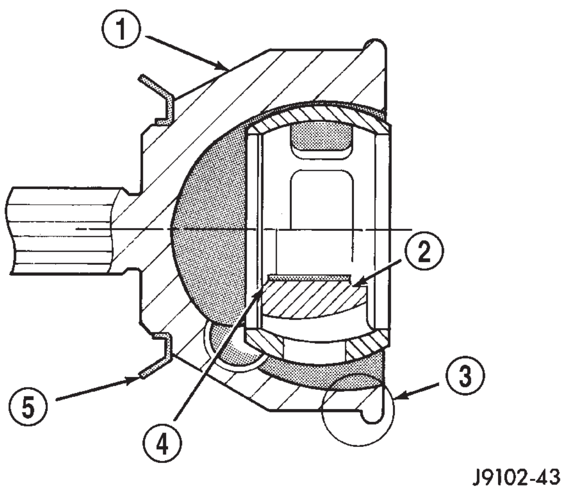


Fig. 17 Bearing Cage & Hub Installed In Housing

1 - CV JOINT HOUSING
2 - BEARING HUB LARGE COUNTERBORE OUTWARD
3 - BOOT RETAINING SHOULDER
4 - BEARING HUB SMALL COUNTERBORE INWARD
5 - SLINGER

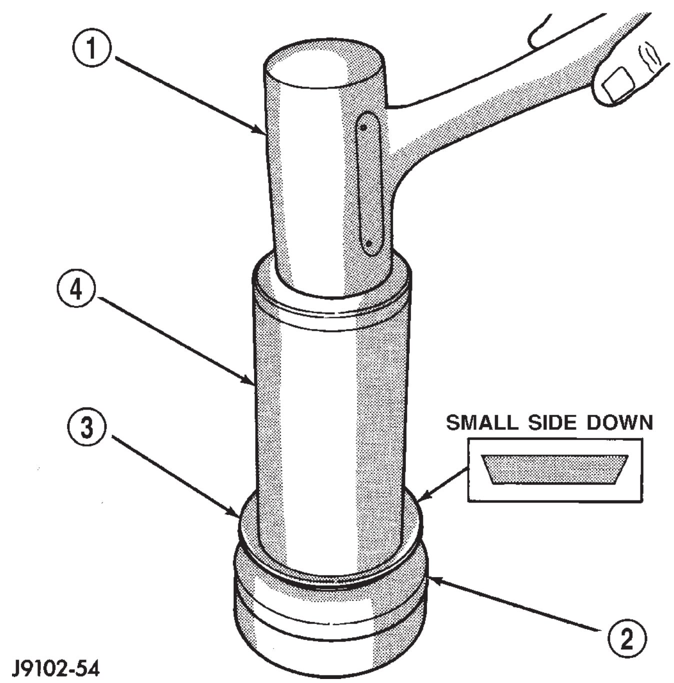


Fig. 19 Slinger Installation

1 - HAMMER
2 - OUTER CV JOINT
3 - SLINGER
4 - INSTALLER

(7) Apply a small amount of lubricant to inner diameter of slinger. Place slinger squarely on the outer C/V joint. Use installer tool L-4518-1 from tool set L-4518 and hammer slinger onto joint until it seats (Fig. 19).

CAUTION: Prevent damage to the slinger after installation or a when a replacement outer C/V joint is installed.

(8) Position the small-diameter end of the replacement boot on the interconnecting shaft. Retain the boot with a replacement clamp.

(9) Apply the required amount of lubricant to the outer C/V joint and boot.

CV JOINT - OUTER (Continued)

(10) Align the shaft splines to the outer C/V joint splines. Push the outer C/V joint until the snap ring seats in the groove (Fig. 20).

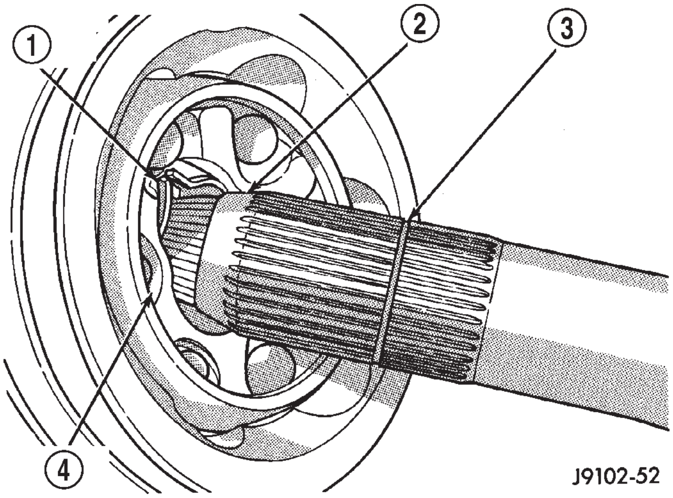


Fig. 20 Outer C/V

1 - SNAP RING
2 - SHAFT TAPER
3 - SNAP RING GROVE
4 - BEARING HUB

(11) Ensure that the snap ring is properly seated in the housing. Pull the outer C/V joint from the interconnecting shaft to test.

(12) Place the large-diameter end of the replacement boot over the edge of the C/V joint housing. Ensure that the boot is not twisted.

(13) Retain the boot on the housing with a replacement retaining clamps.

CV JOINT - INNER

REMOVAL

(1) Remove the axle driveshaft.

(2) Place the C/V joint housing in a vise.

(3) Remove the inner boot retaining clamps. Pull the inner boot back onto the interconnecting shaft. Discard the retaining clamps.

(4) Pull tripod and shaft straight out from the inner C/V joint housing.

(5) Remove snap ring from behind the tripod and slide tripod toward the center of the shaft (Fig. 21).

(6) Remove C-clip from the end of the shaft (Fig. 22).

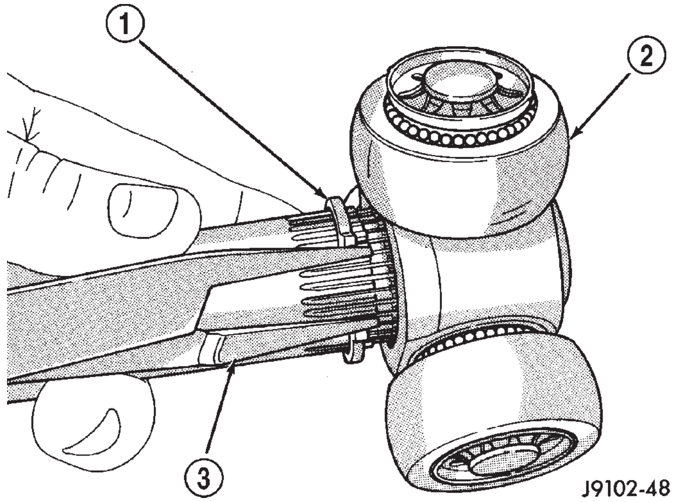


Fig. 21 Snap Retaining Ring

1 - SNAP RING
2 - TRIPOD JOINT
3 - SNAP RING PLIERS

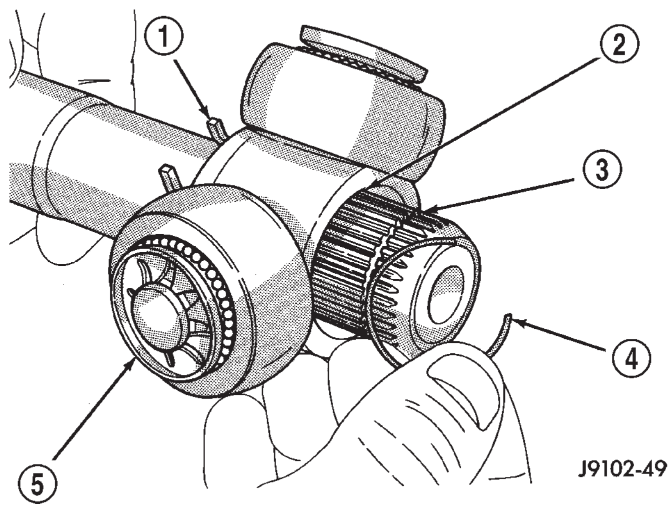


Fig. 22 Tripod C-Clip

1 - SNAP RING
2 - CHAMFERED EDGE
3 - GROOVE
4 - C-CLIP
5 - TRIPOD

CV JOINT - INNER (Continued)

(7) Remove tripod from the shaft and replace boot, if necessary.

(8) Remove lubricant from the interior of the housing and the tripod.

(9) Inspect needle bearing raceways in the housing and tripod components for excessive wear and damage. Replace the tripod as a unit only if necessary.

INSTALLATION

(1) Slide boot down on shaft for work access.

(2) Install snap ring past the ring groove. Slide the tripod onto the end of the shaft. Chamfered end of tripod is adjacent to the C-clip groove.

(3) Install C-clip and slide the tripod out against the clip. Install the snap ring in the inner groove. Be sure the snap ring and C-clip are seated.

(4) Apply the required quantity of lubricant to the housing and boot. Coat the interior of the joint housing and the tripod.

(5) Insert and seat the tripod and shaft in the housing.

(6) Position the large-diameter end of the boot over the edge of the housing. Insert lip of the boot into the locating groove at the edge of the housing (Fig. 23).

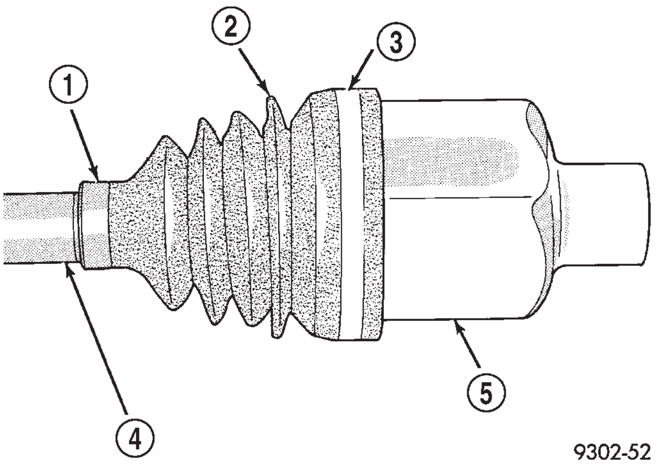


Fig. 23 Inner C/V Joint Boot

1 - CLAMP
2 - BOOT
3 - CLAMP
4 - SHAFT
5 - TRIPOD JOINT

(7) Insert small lip onto locating groove in shaft.

(8) Install small boot clamp in the boot groove. Verify that the boot and lip are properly positioned on the shaft. Position the clamp locating tabs in the slots and tighten the clamp tool (Fig. 24).

NOTE: Squeeze tool handles to complete tightening the clamp

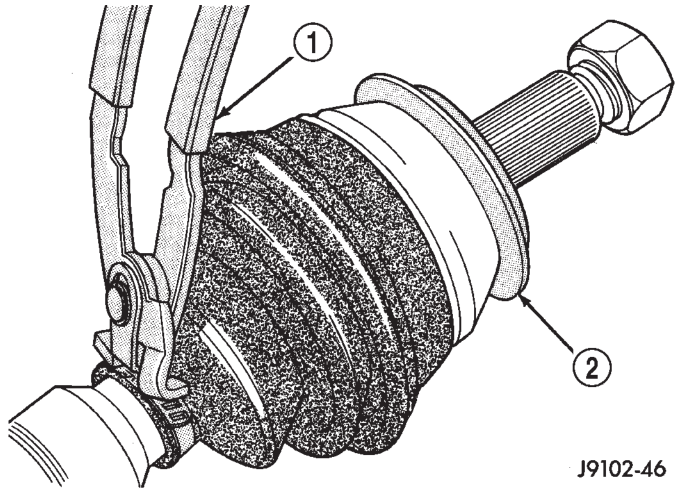


Fig. 24 Compressing Clamp

1 - CLAMP TOOL
2 - SLINGER

(9) Position the large-diameter end of the boot on the C/V joint housing.

(10) After the inner joint boot small clamp is installed, the inboard hub must be set to a service build length.

(a) Compress the inner hub down the connector shaft.

(b) Use a small blunt drift between the large end and the boot seal to relieve the pressure.

(c) The distance edge of the lip to the edge of the flange should be 181.00 mm (7.13 in.). This will eliminate excess air that can cause a ballooning affect and possibly cause damage to the boot.

(11) Verify that the boot is not twisted and that it is correctly positioned on the housing.

(12) Install large clamp on the boot and tighten the clamp with clamp tool (Fig. 24).

FRONT AXLE - C205F

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FRONT AXLE - C205F

DESCRIPTION

The C205F (**C**orporate **205**mm ring gear **F**ront) axle consists of an alumunum center section with an axle tube extending from one side. The tube is pressed into the differential housing.

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

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

The power is transferred from the axle through two constant velocity (C/V) drive shafts to the wheel hubs. The drive shafts are identical and interchangeable.

The cover provides a means for inspection and service without removing the axle from the vehicle.

The C205F axle has the assembly date and gear ratio listed on a tag. The tag is attached to the housing cover by a cover bolt.

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 cups and the axle housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer.

OPERATION

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

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

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

FRONT AXLE - C205F (Continued)

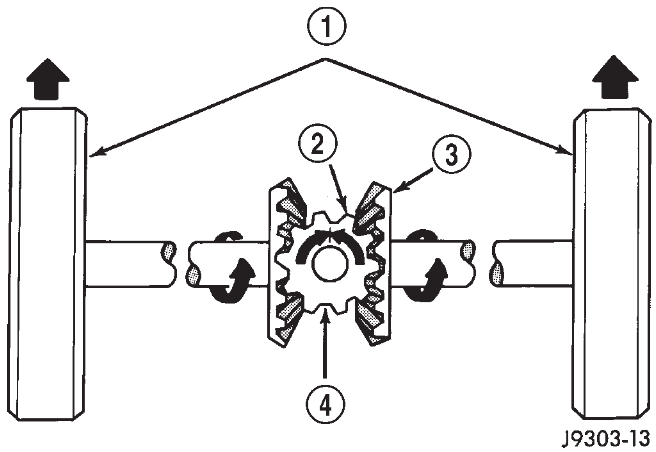


Fig. 1 Differential Operation-Straight Ahead Driving

1 - STRAIGHT AHEAD DRIVING
2 - PINION GEAR
3 - SIDE GEAR
4 - PINION GEARS ROTATE WITH CASE

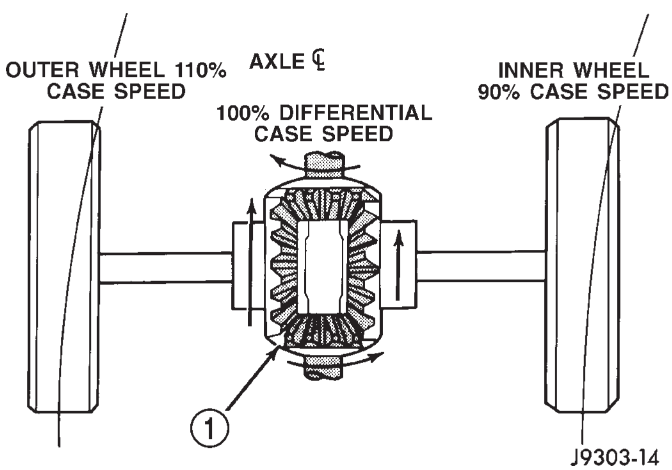


Fig. 2 Differential Operation-On Turns

1 - PINION GEARS ROTATE ON PINION SHAFT

DIAGNOSIS AND TESTING - AXLE

GEAR NOISE

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

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

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

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

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

BEARING NOISE

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

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

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

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

LOW SPEED KNOCK

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

VIBRATION

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

- 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).

FRONT AXLE - C205F (Continued)

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

All driveline components should be examined before starting any repair.

(Refer to 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 - C205F (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 - C205F (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) Remove the skid plate, if equipped.
(3) Remove skid plate support crossmember, if necessary.
(4) Remove both C/V driveshafts.
(5) Mark the propeller shaft, transfer case, and pinion companion flange for installation reference.
(6) Remove the front propeller shaft.
(7) Remove the axle vent tube.
(8) Use an adjustable and movable jack to support the differential housing.
(9) Remove bolts holding the axle to the engine mounts (Fig. 3).
(10) Remove bolts holding the axle to the pinion nose bracket (Fig. 4).
(11) Lower the jack and housing.
(12) Remove the axle from vehicle.

INSTALLATION

(1) Raise the axle into position. Loosely install the bolts and nuts to hold the axle to the engine mounts and pinion nose bracket.
(2) Tighten all the bolts finger-tight, then tighten all bolts to 95 N·m (70 ft. lbs.).
(3) Install the axle vent tube.
(4) Align the reference marks on the propeller shaft, transfer case, and pinion companion flange.
(5) Install propeller shaft.
(6) Install the C/V driveshafts.
(7) Install the skid plate support crossmember, if necessary.
(8) Install the skid plate, if necessary.
(9) Check differential lubricant level and add lubricant, if necessary.
(10) Remove the supports and lower the vehicle.

FRONT AXLE - C205F (Continued)

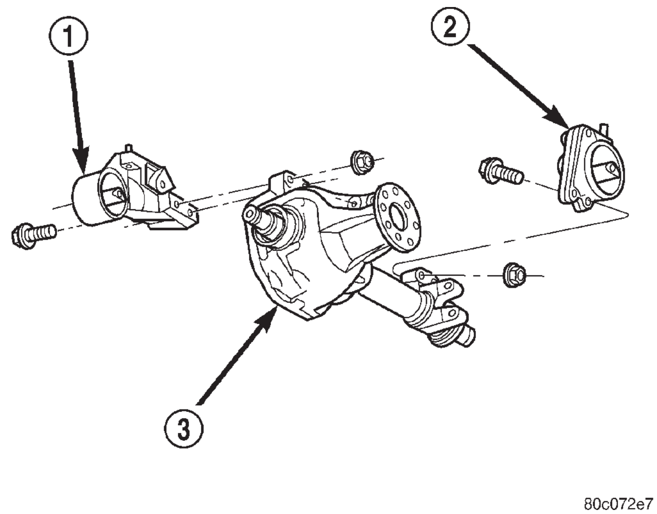


Fig. 3 Axle Mounting

1 - LEFT ENGINE MOUNT
2 - RIGHT ENGINE MOUNT
3 - FRONT AXLE

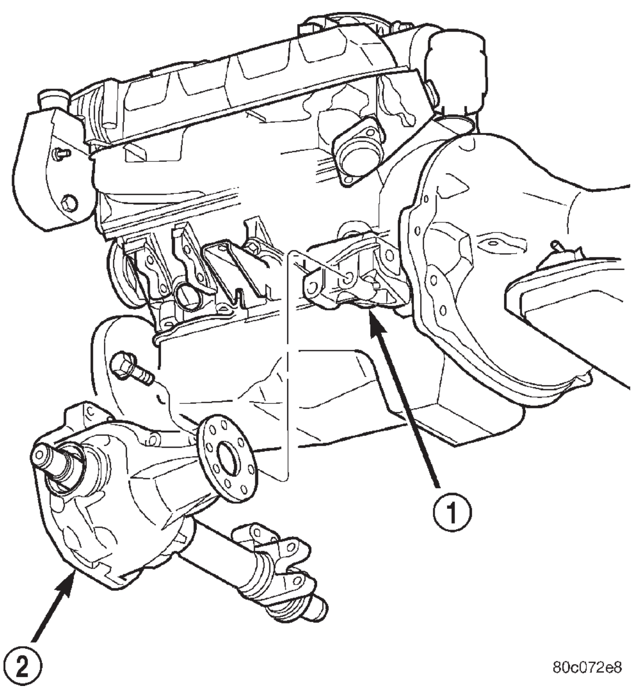


Fig. 4 Pinion Nose Mounting

1 - PINION NOSE BRACKET
2 - FRONT AXLE

ADJUSTMENTS

Ring gear and pinion are supplied as matched sets only. The identifying numbers for the ring gear and pinion are painted onto the pinion gear shaft and the side of the ring gear. A plus (+) number, minus (–) number or zero (0) along with the gear set sequence number (01 to 99) is on each gear. This first number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion marked with a (0). The next two numbers are the sequence number of the gear set. The standard setting from the center line of the ring gear to the back face of the pinion is 99.690 mm (3.925 in.). The standard depth provides the best teeth contact pattern. Refer to Backlash and Contact Pattern in this section for additional information.

Compensation for pinion depth variance is achieved with select shims. The shims are placed between the rear pinion bearing cone and the pinion gear head. (Fig. 5).

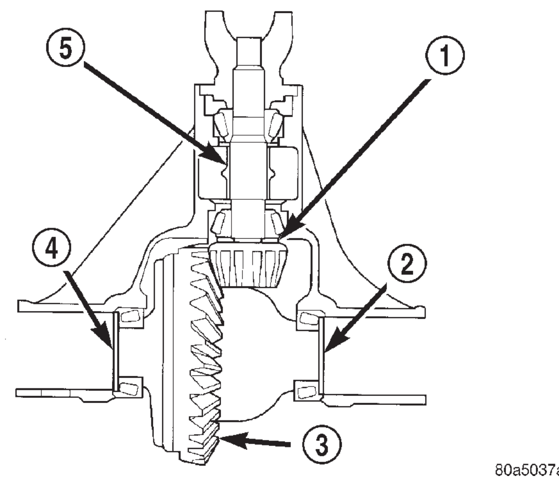


Fig. 5 Adjustment Shim

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

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

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

Note the painted number on the shaft of the drive pinion (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shim(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.

FRONT AXLE - C205F (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 cups and pinion bearings installed in housing. Take measurements with a Pinion Gauge Set, Pinion Block 8177, Arbor Discs 8541 and Dial Indicator C-3339 (Fig. 6).

(1) Assemble Pinion Height Block 6739, Pinion Block 8177 and rear pinion bearing onto Screw 6741 (Fig. 6).

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

(3) Install front pinion bearing and Cone 6740 onto the screw hand tight (Fig. 6).

(4) Place Arbor Discs 8541 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. Refer to the Torque Specifications in this section.

(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 the housing so dial probe and scooter block are flush against the surface of the pinion height block. Hold scooter block in place and zero the dial indicator. 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,

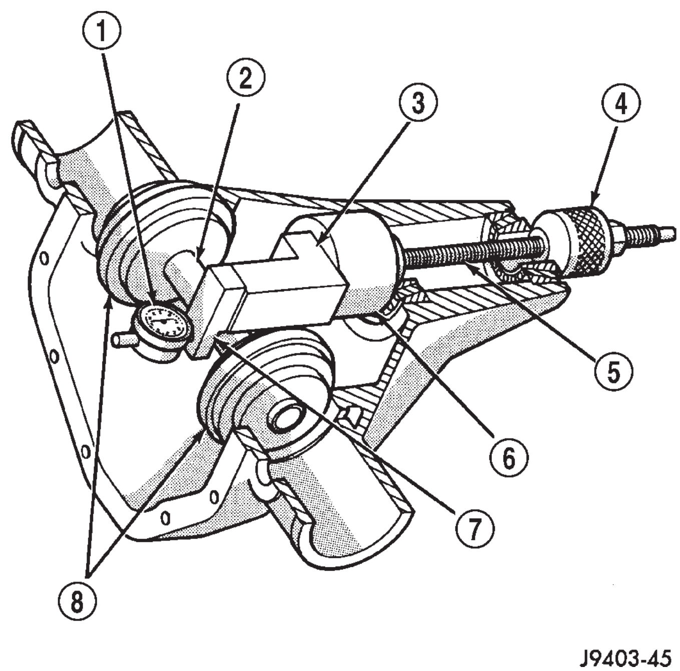


Fig. 6 Pinion Gear Depth Gauge Tools

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

FRONT AXLE - C205F (Continued)

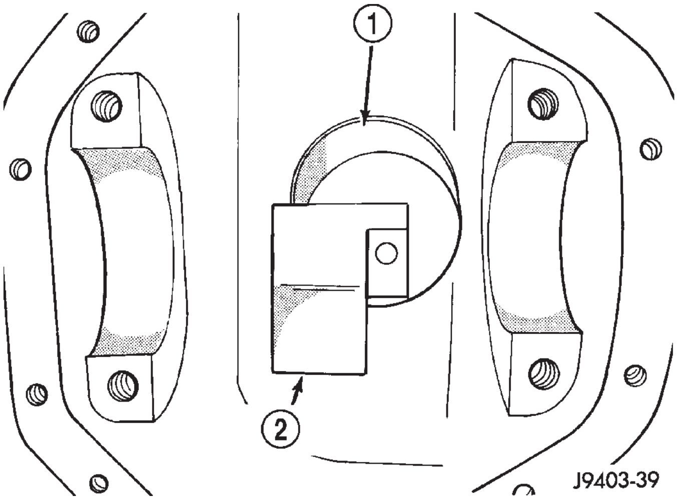


Fig. 7 Pinion Height Block

1 - PINION BLOCK
2 - PINION HEIGHT BLOCK

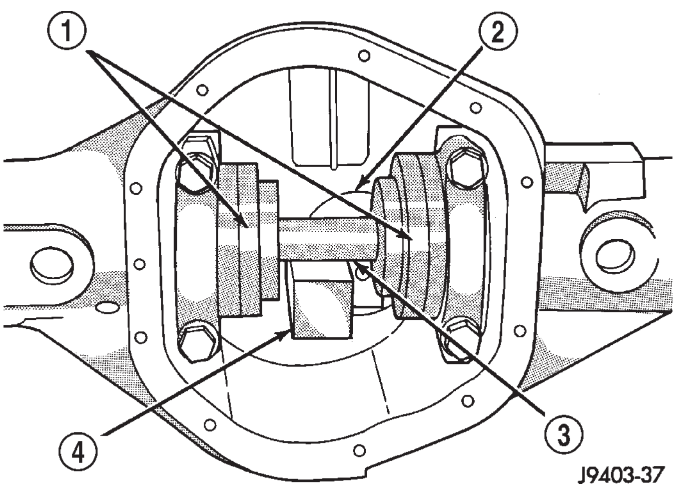


Fig. 8 Gauge Tools In

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

the rear bearing cup or the pinion depth gauge set is not installed correctly.

(9) Select a shim equal to the dial indicator reading plus the drive pinion gear depth variance number marked on the shaft of the pinion gear 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.

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

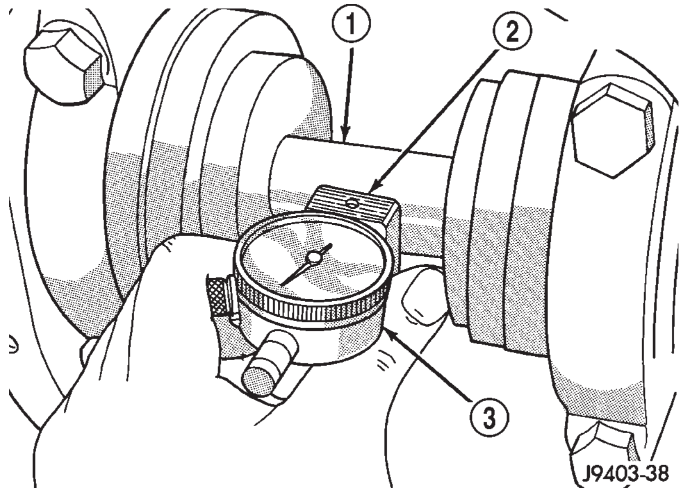


Fig. 9 Pinion Gear Depth Measurement

1 - ARBOR
2 - SCOOTER BLOCK
3 - DIAL INDICATOR

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

Differential side bearing preload and gear backlash is achieved by selective shims inserted between the bearing cup and the housing. The proper shim thickness can be determined using slip-fit Dummy Bearings 8398 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, starting point shim thicknesses, 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 side of the differential (Fig. 10).

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.

FRONT AXLE - C205F (Continued)

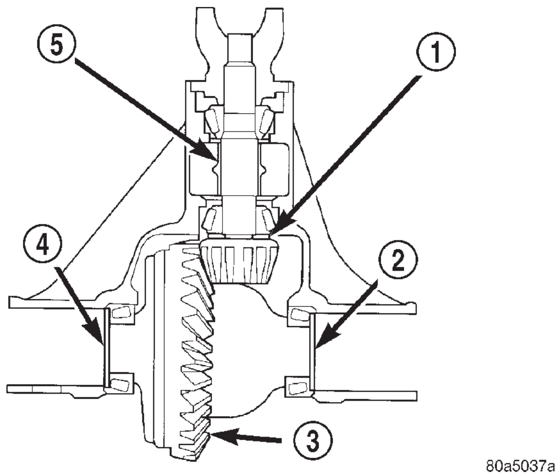


Fig. 10 Adjustment Shim

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

(3) Install Dummy Bearings 8398 on differential case.

(4) Install differential case in the housing.

(5) Insert Dummy Shims 8107 (0.118 in. (3.0 mm)) starting point shims between both dummy bearings and the housing (Fig. 11).

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

(7) Using a dead-blow hammer to seat the differential dummy bearings to each side of the differential housing (Fig. 12) and (Fig. 13).

(8) Thread Pilot Stud C-3288-B into rear cover bolt hole below ring gear (Fig. 14).

(9) Attach Dial Indicator C-3339 to post and position dial indicator plunger on a flat surface on a ring gear bolt head (Fig. 14).

(10) Push firmly and hold differential case to pinion side of axle housing (Fig. 15) and zero dial indicator.

(11) Push firmly and hold differential case to the ring gear side and record dial indicator reading (Fig. 16).

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

(13) Add 0.2 mm (0.008 in) to the zero end play total. This new total represents the thickness of shims necessary to compress, or preload the new bearings when the differential is installed.

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

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

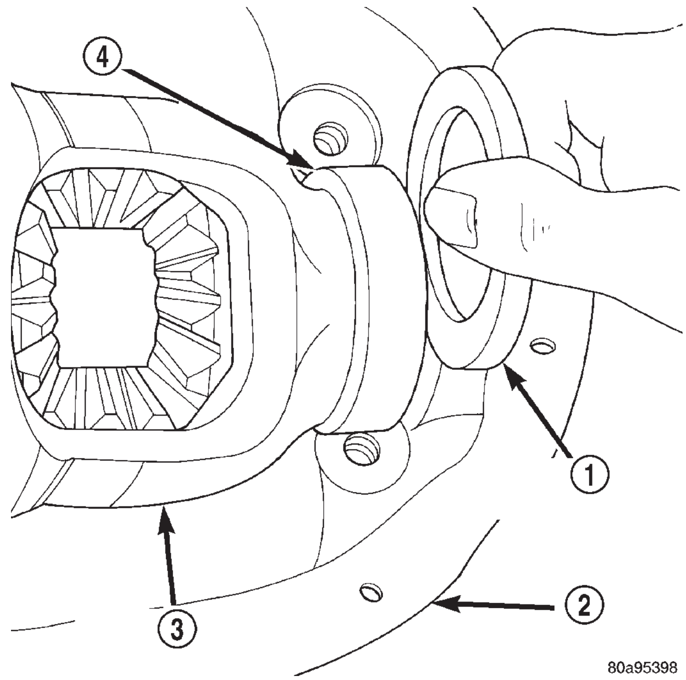


Fig. 11 Shim Starting Point

1 - DUMMY SHIM
2 - DIFFERENTIAL HOUSING
3 - DIFFERENTIAL CASE
4 - DUMMY BEARINGS

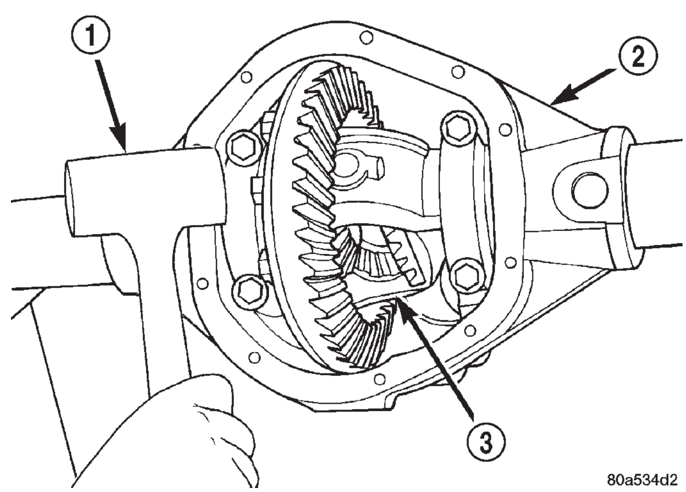


Fig. 12 Seat Pinion Side Dummy Bearing

1 - DEAD-BLOW HAMMER
2 - DIFFERENTIAL HOUSING
3 - DIFFERENTIAL CASE

(16) Install the pinion in the axle housing. Install the companion flange and establish the correct pinion rotating torque.

(17) Install differential case and Dummy Bearings in axle housing with a single dummy shim on the ring gear side of the axle and tighten retaining cap bolts.

FRONT AXLE - C205F (Continued)

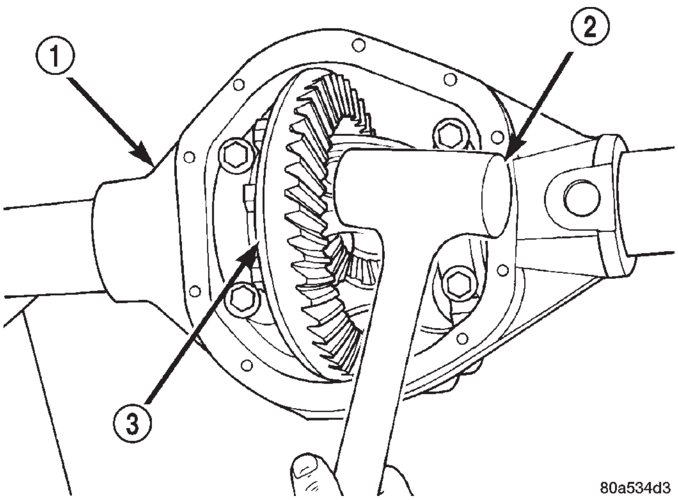


Fig. 13 Seat Ring Gear Side Dummy

1 - DIFFERENTIAL HOUSING
2 - DEAD-BLOW HAMMER
3 - DIFFERENTIAL CASE

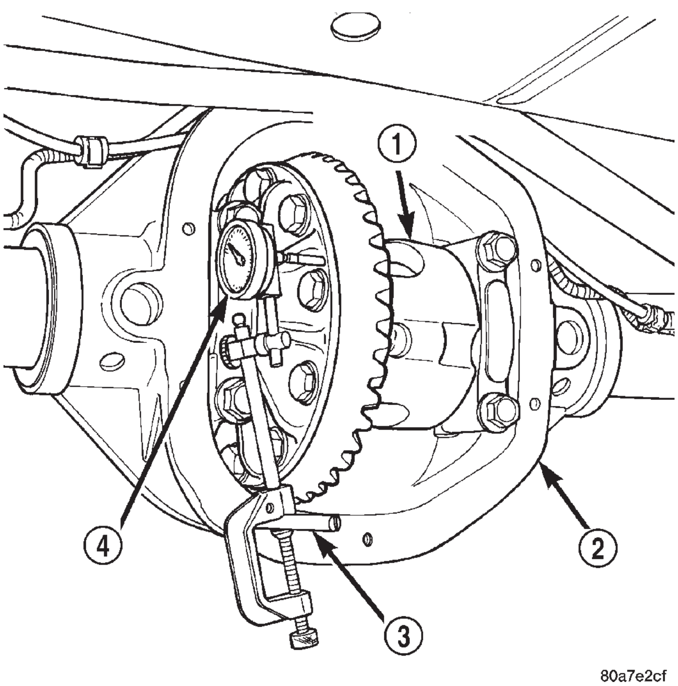


Fig. 14 Differential Side play

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

(18) Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 14).

(19) Push and hold differential case toward pinion.

(20) Zero dial indicator face to pointer.

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

(22) Record dial indicator reading.

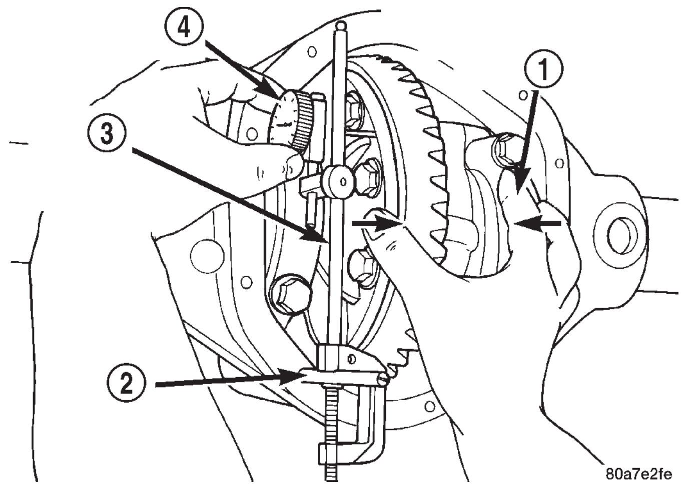


Fig. 15 Zero Dial Indicator

1 - CASE TO PINION SIDE
2 - PILOT STUD
3 - DIAL INDICATOR EXTENSION
4 - DIAL INDICATOR

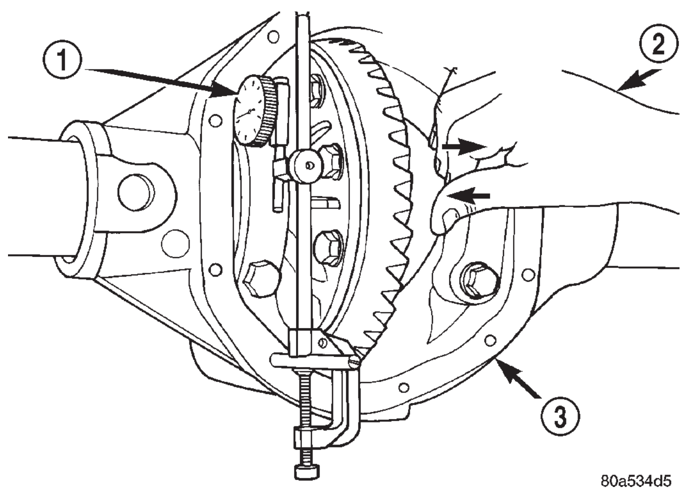


Fig. 16 Read Dial Indicator

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

(23) Subtract 0.05 mm (0.002 in.) from the dial indicator reading to compensate for backlash between ring and pinion gears. Add the resulting measurement to the thickness of the single starting point shim. This total is the thickness of shim required to achieve proper backlash.

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

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

FRONT AXLE - C205F (Continued)

(26) Remove differential case, dummy bearings and dummy shim from the housing.

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

(28) Install Spreader W-129-B and Adapter Plates 8142-A on the housing and spread open enough to receive differential case.

(29) Place the side bearing shims in the differential housing against the housing shoulder.

(30) Install the differential case in the housing.

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

(32) Position the indicator plunger against a ring gear tooth (Fig. 17).

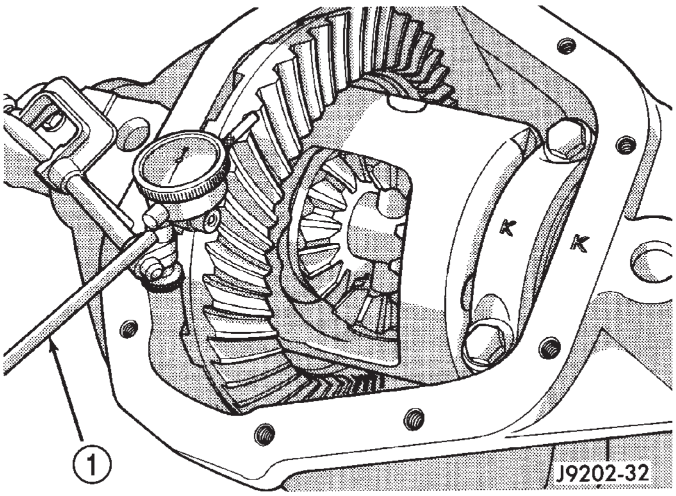


Fig. 17 Ring Gear Backlash

1 - DIAL INDICATOR

(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 differential housing to the other (Fig. 18).

(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 the Gear Contact Pattern procedure.

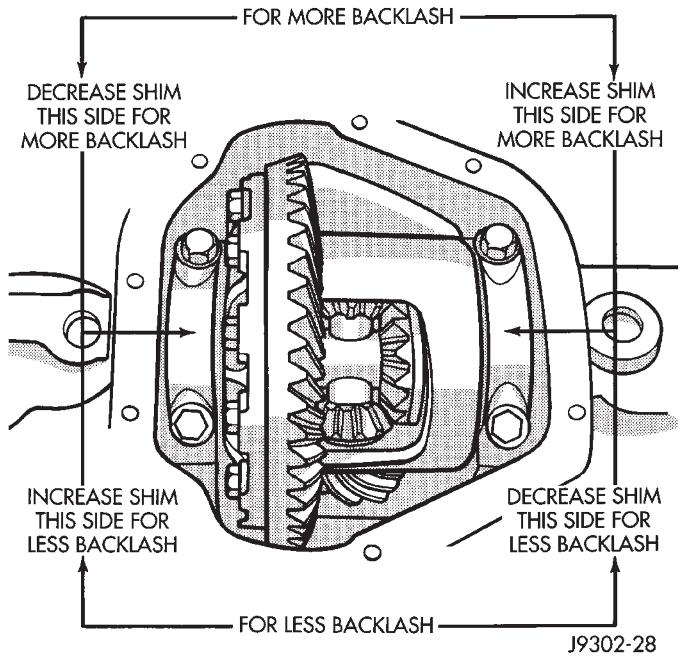


Fig. 18 Backlash Shim Adjustment

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.

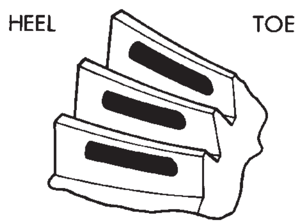
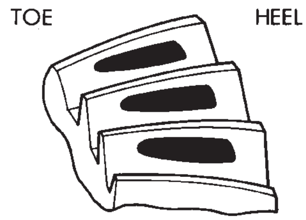
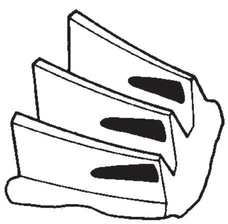
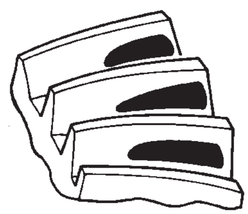
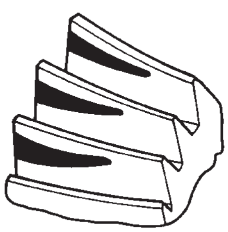
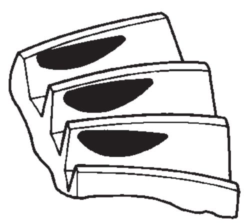
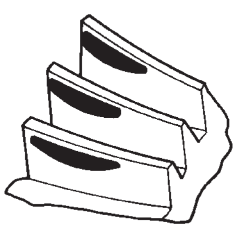
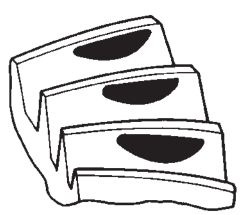
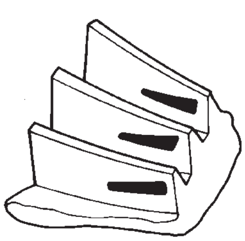
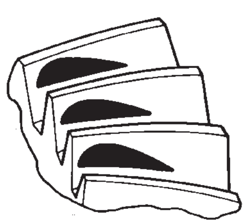
(1) Apply a thin coat of hydrated ferric oxide or equivalent to the drive and coast side of the ring gear teeth.

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

FRONT AXLE - C205F (Continued)

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

J9003-24

Fig. 19 Gear Tooth Contact Patterns

SPECIFICATIONS

FRONT AXLE - C205F

AXLE SPECIFICATIONS

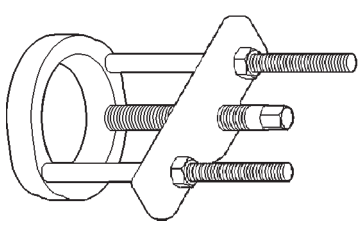
DESCRIPTION	SPECIFICATION
Axle Ratio	3.55, 3.92
Differential Case Flange Runout	0.076 mm (0.003 in.)
Differential Side Gear Clearance	0-0.15 mm (0-0.006 in.)
Ring Gear Diameter	205 mm (7.562 in.)
Ring Gear Backlash	0.12-0.20 mm (0.005-0.008 in.)
Ring Gear Runout	0.12 mm (0.005 in.)
Pinion Std. Depth	99.69 mm (3.925 in.)
Pinion Bearing Preload - Original Bearings	1-2 N·m (10-20 in. lbs.)
Pinion Bearing Preload - New Bearings	17-2.5 N·m (15-22 in. lbs.)

TORQUE SPECIFICATIONS

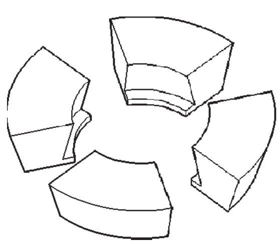
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Differential Fill Hole Plug	34	25	-
Differential Cover Bolts	41	30	-
Bearing Cap Bolts	61	45	-
Ring Gear Bolts	108	80	-
Pinion Nut	271-474	200-350	-

SPECIAL TOOLS

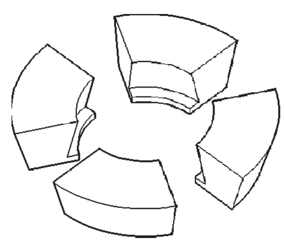
SPECIAL TOOLS



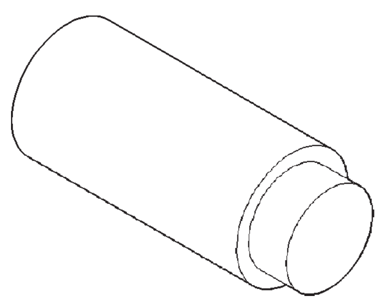
Puller C-293-PA



Adapter C-293-42

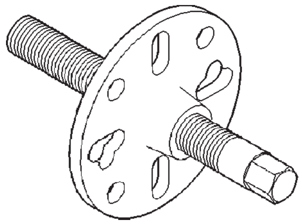


Adapter C-293-48

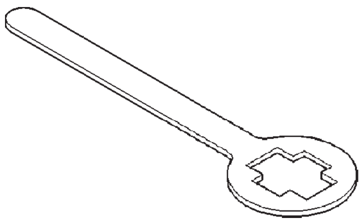


Plug C-293-3

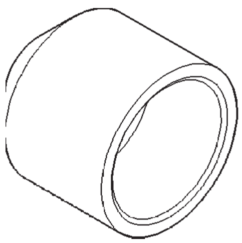
SPECIAL TOOLS (Continued)



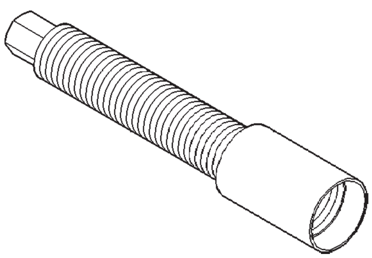
Puller C-452



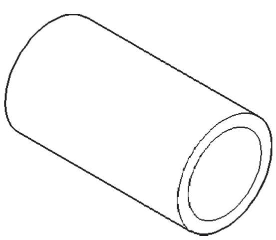
Holder 6719A



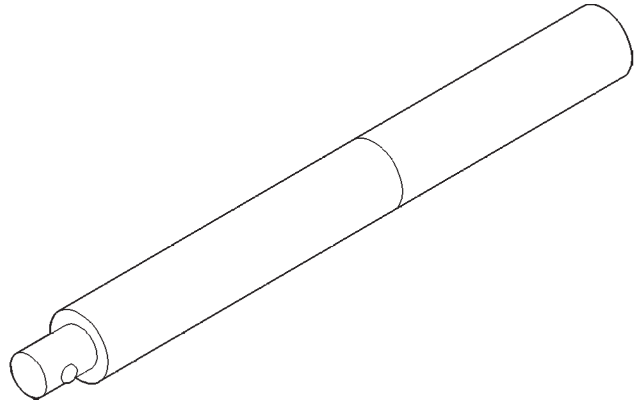
Installer C-3972-A



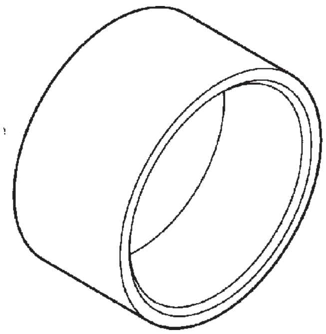
Installer Screw 8112



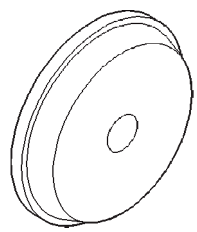
Cup 8109



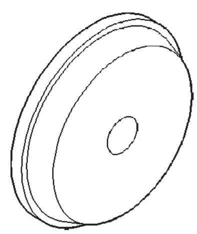
Handle C-4171



Installer 8236

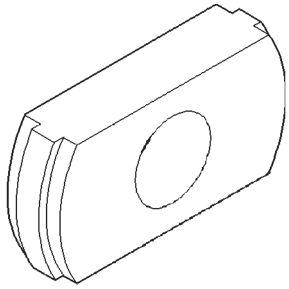


Installer D-145

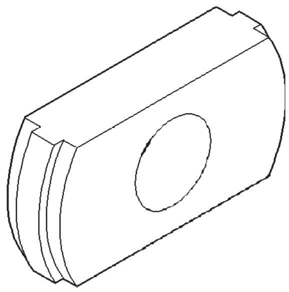


Installer D-145

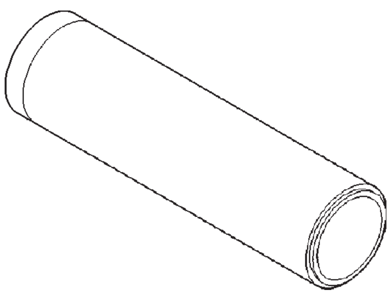
SPECIAL TOOLS (Continued)



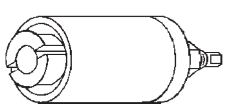
Remover 8401



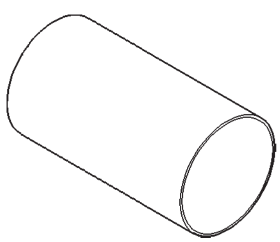
Remover 8401



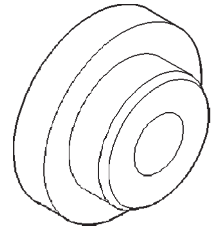
Installer 6448



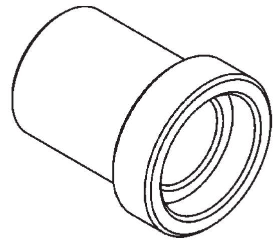
Bearing Remover C-4660



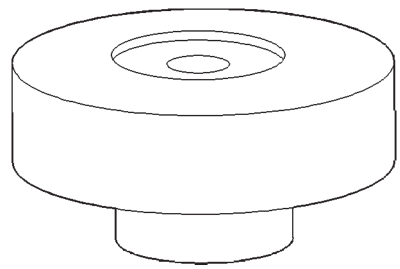
Cup 8150



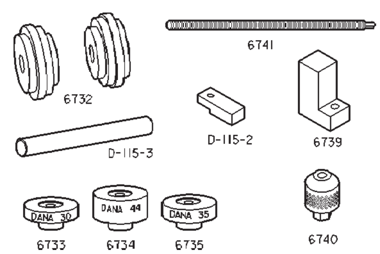
Installer 5063



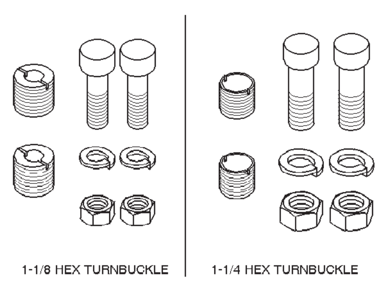
Installer 8402



Gauge Block 8177

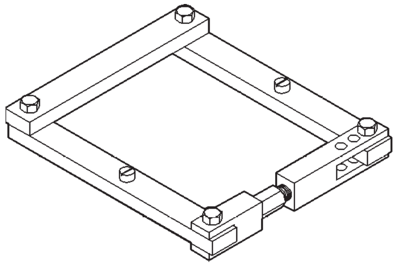


Pinion Depth Set

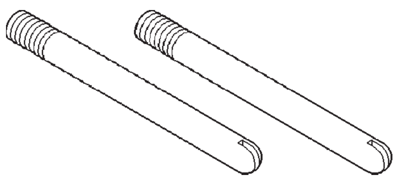


Adapter Kit 6987A

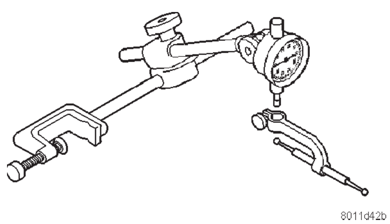
SPECIAL TOOLS (Continued)



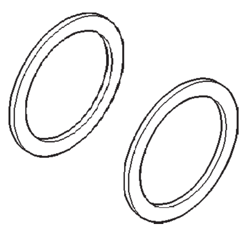
Spreader W-129-B



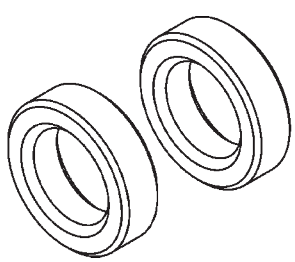
Guide Pin C-3288-B



Dial Indicator C-3339



Dummy Shim 8107



Dummy Bearing 8398

AXLE SHAFTS

REMOVAL

(1) Raise and support vehicle. Ensure that the transmission is in neutral.

(2) Remove the necessary C/V driveshaft from vehicle.

(3) Remove the skid plate, if equipped.

(4) Clean all foreign material from axle seal area.

(5) Install Puller Adapter 8420-A onto the axle shaft.

(6) Install Slide Hammer C-3752 to the puller adapter.

(7) Remove axle shaft. Use care to prevent damage to axle shaft bearing and seal, which will remain in axle shaft tube.

(8) Inspect axle shaft seal for leakage or damage. Replace the seal if there is any question as to its condition.

(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 and/or bearing and seal must be replaced.

INSTALLATION

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

NOTE: Use care to prevent shaft splines from damaging axle shaft seal lip.

(2) Push firmly on the axle shaft until the axle shaft snap-ring passes completely through the side gear and engages the snap-ring groove.

(3) Check the differential fluid level and add fluid if necessary. Refer to Lubricant in this group for lubricant requirements.

(4) Install skid plate, if necessary.

(5) Install C/V driveshaft.

(6) Lower vehicle.

AXLE SHAFT SEALS

REMOVAL

(1) Remove the axle shaft.

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

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

INSTALLATION

(1) Wipe the axle shaft tube bore clean.

(2) Install a **new** axle shaft seal with Installer 8402 and Handle C-4171.

(3) Install the axle shaft.

AXLE BEARINGS

REMOVAL

(1) Remove the axle shaft.
(2) Remove the axle shaft seal and bearing from the axle tube with Bearing Removal Tool C-4660-A.
(3) Inspect the axle shaft tube bore for roughness and burrs. Remove as necessary.

INSTALLATION

(1) Wipe the axle shaft tube bore clean.
(2) Install axle shaft bearing with Installer 5063 and Handle C-4171.
(3) Install a **new** axle shaft seal with Installer 8402 and Handle C-4171.
(4) Install the axle shaft.

PINION SEAL

REMOVAL

(1) Raise and support the vehicle.
(2) Remove skid plate, if equipped.
(3) Remove both C/V driveshafts.
(4) Mark the propeller shaft and pinion companion flange for installation reference.
(5) Remove the front propeller shaft.
(6) Rotate the pinion gear three or four times and verify pinion rotates smoothly.
(7) Record rotating torque at the pinion with an inch pound torque wrench, for installation reference (Fig. 20).
(8) Remove the companion flange with Remover C-452 (Fig. 21).
(9) Position Holder 6719 against the companion flange and install a four bolts and washers into the threaded holes and tighten the bolts.
(10) Remove the pinion nut.
(11) Remove the companion flange with Remover C-452 (Fig. 21).
(12) Remove pinion seal with a pry tool or a slide hammer mounted screw.

INSTALLATION

NOTE: Outer perimeter of pinion seal is pre-coated with a special sealant.

(1) Apply a light coating of gear lubricant on the lip of pinion seal.
(2) Install seal with Installer C-3972-A and Handle C-4171 (Fig. 22).
(3) Install the companion flange onto the pinion with Installer C-3718 and Holder 6719A.
(4) Position holder against the companion flange and install four bolts and washers into the threaded holes. Tighten the bolt and washer so that the holder is held to the flange.
(5) Install the new pinion nut onto the pinion shaft and tighten the pinion nut until there is zero bearing end-play (Fig. 23).

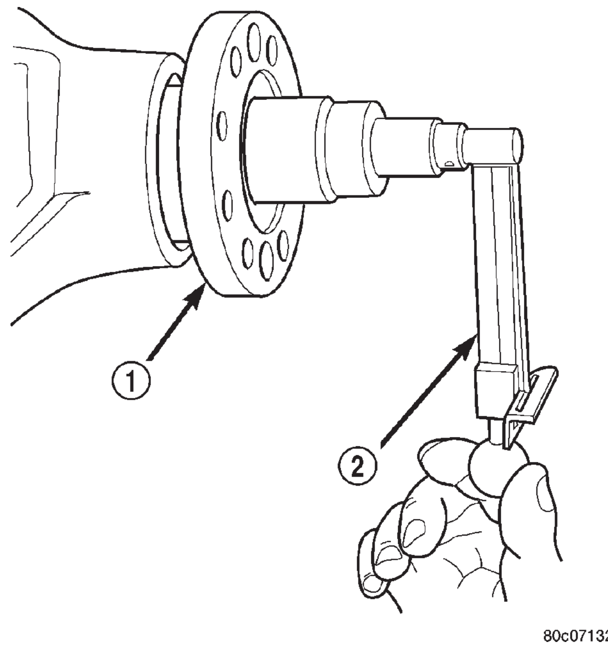


Fig. 20 Pinion Rotating Torque

1 - COMPANION FLANGE
2 - INCH POUND TORQUE WRENCH

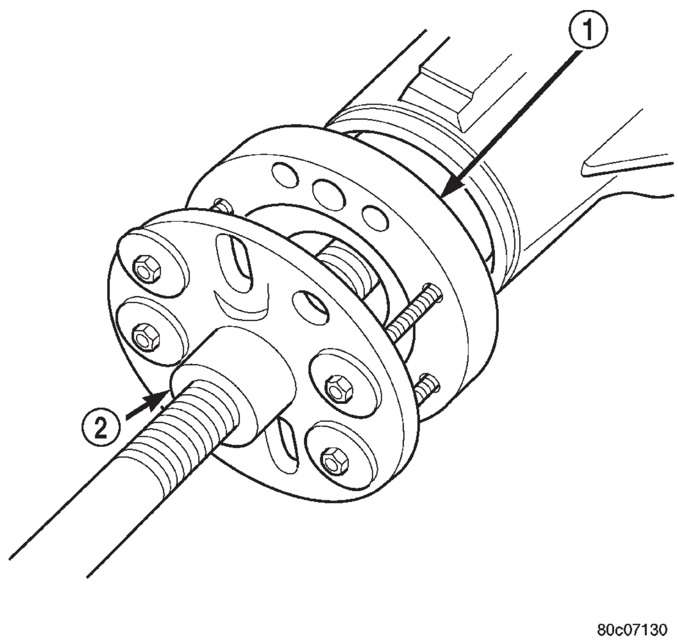


Fig. 21 Companion Flange Remover

1 - COMPANION FLANGE
2 - PULLER TOOL

PINION SEAL (Continued)

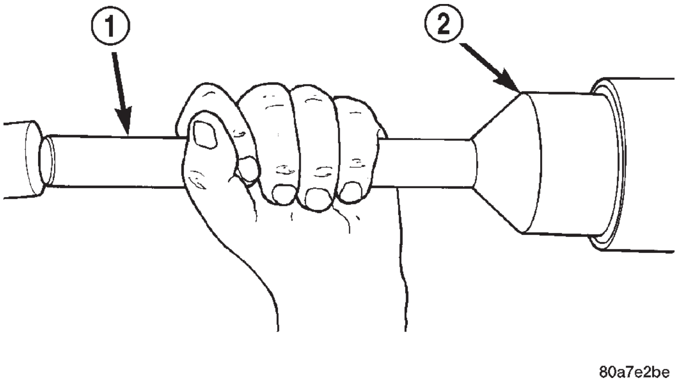


Fig. 22 Pinion Seal Installer

1 - HANDLE
2 - INSTALLER

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

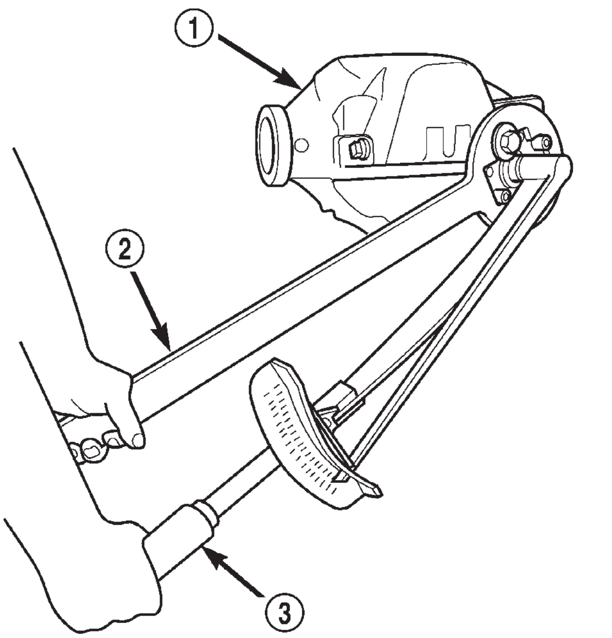


Fig. 23 Companion Flange Holder

1 - DIFFERENTIAL HOUSING
2 - COMPANION FLANGE HOLDER
3 - TORQUE WRENCH

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

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

(7) Rotate and record the axle rotating torque at the pinion shaft using a torque wrench. The rotating torque should be equal to the reading recorded during removal plus an additional 0.56 N·m (5 in. lbs.) (Fig. 24).

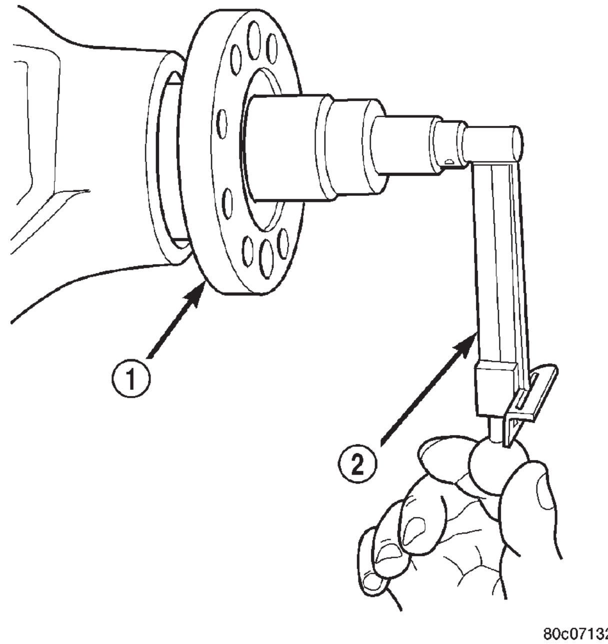


Fig. 24 Check Pinion Rotation Torque

1 - COMPANION FLANGE
2 - INCH POUND TORQUE WRENCH

(8) If the rotating torque is low, tighten the pinion nut in 6.8 N·m (5 ft. lbs.) increments until the proper rotating torque is achieved.

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

(9) Install the propeller shaft with reference marks aligned.
(10) Add gear lubricant to differential housing if necessary.
(11) Install C/V driveshafts.
(12) Install skid plate, if equipped.
(13) Lower the vehicle.

DIFFERENTIAL

REMOVAL

(1) Raise and support vehicle.
(2) Remove the differential housing cover and allow fluid to drain.
(3) Remove the axle shafts.

DIFFERENTIAL (Continued)

(4) Note differential bearing cape reference numbers stamped on caps and machined flat on the housing. If reference numbers cannot be found, make new marks for later reference.

(5) Loosen the bearing cap bolts.

(6) Install Adapter Plates 8142-A onto the axle housing.

(7) Position Spreader W-129-B onto the adapter plates and install the safety holddown clamps. Tighten the tool turnbuckle finger-tight.

(8) Install a Pilot Stud L-4438 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.

(9) Spread the housing to remove the differential case from the housing. Measure the distance with the dial indicator (Fig. 25).

CAUTION: Do not spread over 0.34 mm (0.013 in). If the housing is over-spread, it could be distorted or damaged.

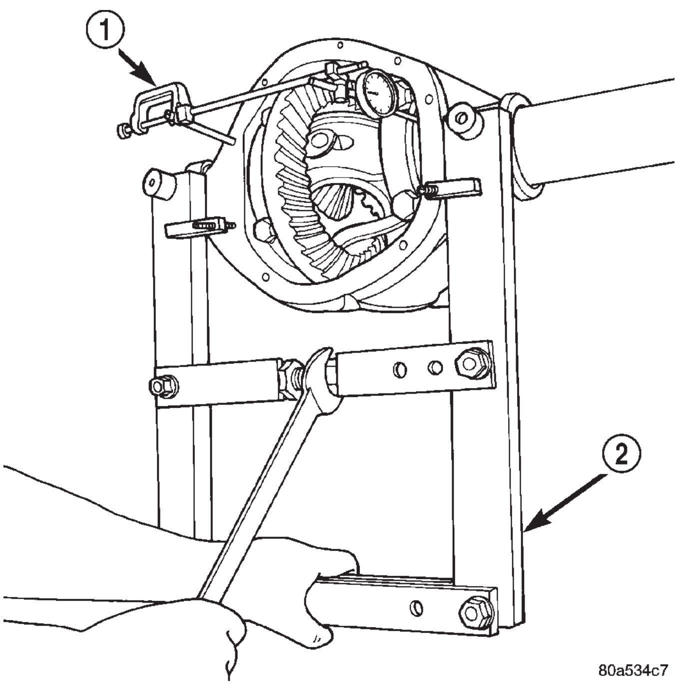


Fig. 25 Spread Axle Housing-Typical

1 - DIAL INDICATOR
2 - SPREADER

(10) Remove the dial indicator.

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

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

(13) Tag differential bearing cups and shims to indicate their location.

(14) Remove spreader from housing.

DISASSEMBLY

(1) Remove ring gear.

(2) Remove roll-pin holding mate shaft in housing.

(3) Remove pinion gear mate shaft.

(4) Rotate differential side gears and remove the pinion mate gears and thrust washers (Fig. 26).

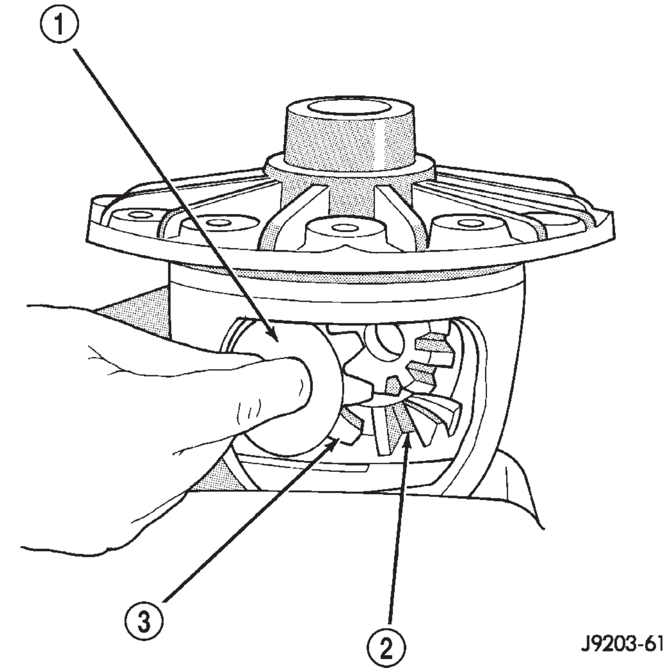


Fig. 26 Pinion Mate Gear

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

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

ASSEMBLY

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

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

(3) Install the pinion gear mate shaft.

(4) Align the hole in the pinion gear mate shaft with the hole in the differential case.

(5) Install the roll-pin in the differential case a punch and hammer (Fig. 27). Peen the edge of the roll-pin hole in the differential case in two places 180° apart.

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

(7) Install ring gear.

DIFFERENTIAL (Continued)

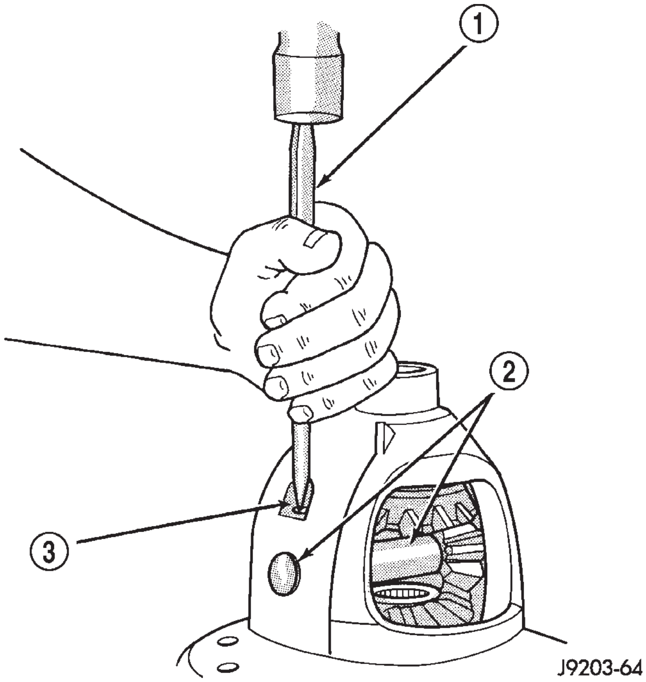


Fig. 27 Pinion Mate Shaft Roll-Pin

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

INSTALLATION

If replacement differential bearings or differential case are replaced, Refer to adjustments fore Differential Bearing Preload and Gear Backlash procedures.

(1) Install Spreader W-129-B, with the Adapter Plates 8142-A, on the axle and install the safety holddown clamps. Tighten the tool turnbuckle finger–tight.

(2) Install a Pilot Stud L-4438 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.

(3) Spread the housing to install the differential case and preload shims in the housing. Measure the distance with the dial indicator.

CAUTION: Do not spread over 0.34 mm (0.013 in). If the housing is over-spread, it could be distorted or damaged.

(4) Remove the dial indicator.

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

(6) Install bearing caps to their original locations and loosely install cap bolts.

(7) Remove axle housing spreader.

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

(9) Install the axle shafts.

(10) Install the differential housing cover and fill with the correct lubricant.

DIFFERENTIAL CASE BEARINGS

REMOVAL

(1) Remove differential from axle housing.

(2) Remove bearings from the differential case with Puller/Press C-293-PA , Adapters C-293-48 and Plug C-293-3 (Fig. 28).

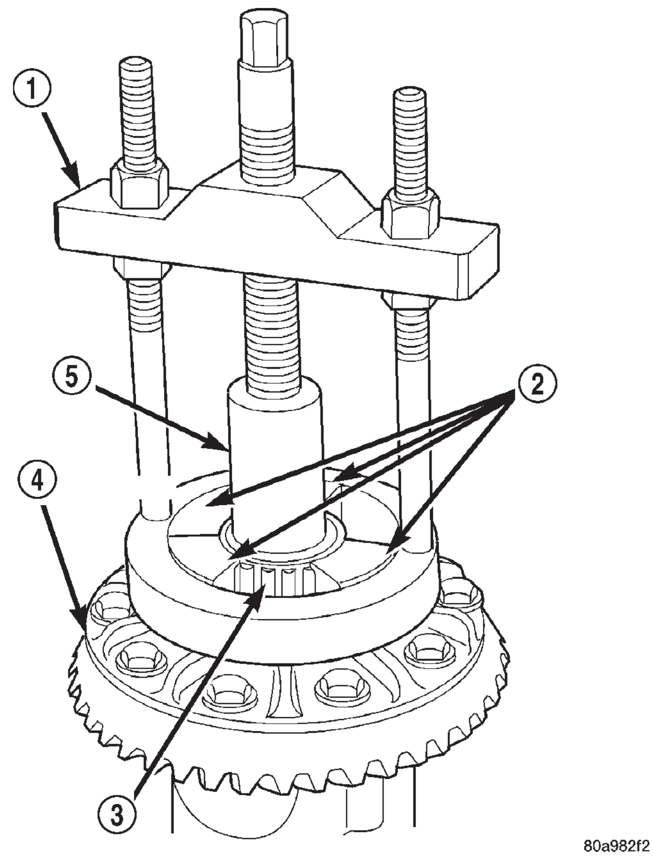


Fig. 28 Differential Bearing Puller

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

INSTALLATION

(1) Install differential side bearings with Installer C-3716-A and Handle C-4171 (Fig. 29).

(2) Install differential in axle housing.

DIFFERENTIAL CASE BEARINGS (Continued)

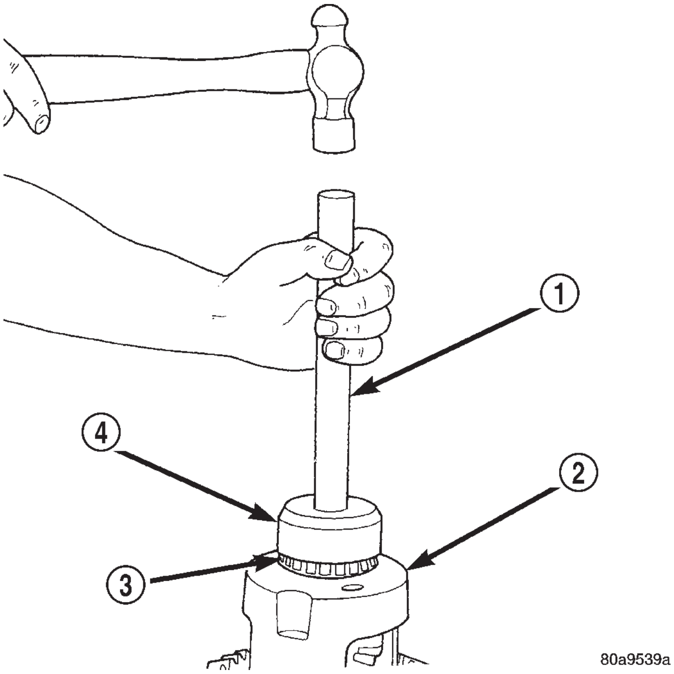


Fig. 29 Differential Side Bearings

1 - HANDLE
2 - DIFFERENTIAL
3 - BEARING
4 - INSTALLER

PINION GEAR/RING GEAR/ TONE RING

REMOVAL

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

(1) Remove differential from axle housing.
(2) Place differential case in a vise with soft jaw (Fig. 30).
(3) Remove bolts holding ring gear to differential case.
(4) Drive ring gear from differential case with a soft hammer (Fig. 30).
(5) Mark the companion yoke and companion flange for installation reference.
(6) Remove companion flange bolts and tie the propeller shaft to the vehicle underbody.
(7) Rotate the companion flange three or four times and verify flange rotates smoothly.
(8) Record rotating torque of the companion flange with an inch pound torque wrench for installation reference (Fig. 31).
(9) Install bolts into two of the threaded holes in the companion flange 180° apart.

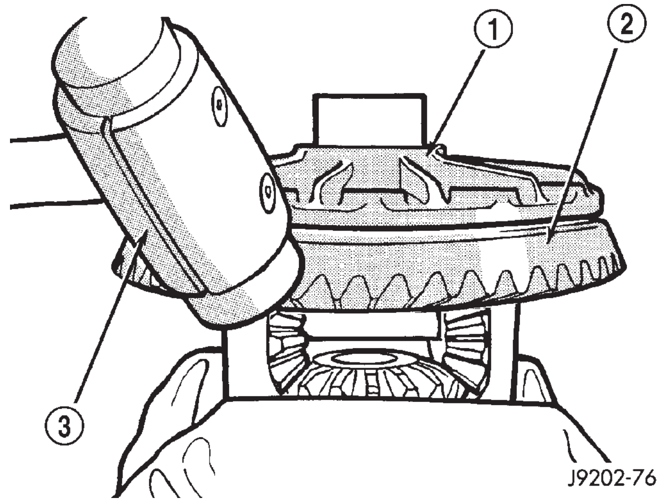


Fig. 30 Ring Gear

1 - DIFFERENTIAL CASE
2 - RING GEAR
3 - RAWHIDE HAMMER

(10) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so that the Holder 6719 is held to the flange.
(11) Remove the pinion nut.
(12) Remove the companion flange with Remover C-452 (Fig. 32).

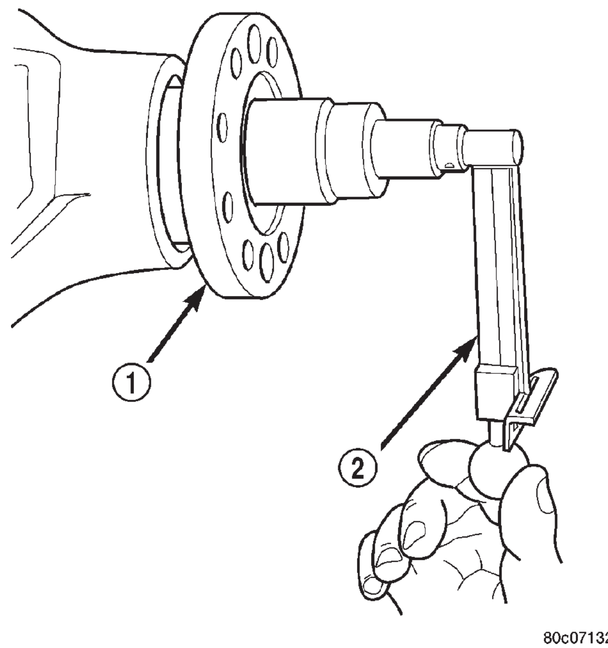


Fig. 31 Pinion Rotating Torque

1 - COMPANION FLANGE
2 - INCH POUND TORQUE WRENCH

PINION GEAR/RING GEAR/TONE RING (Continued)

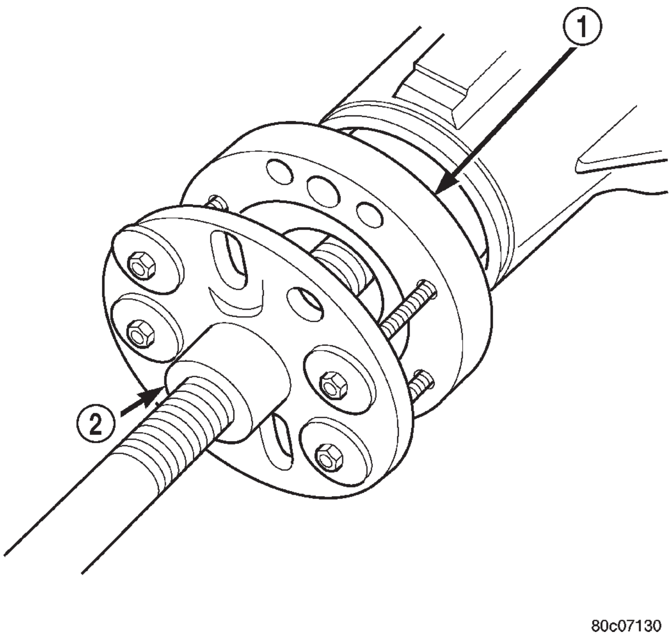


Fig. 32 Companion Flange Remover

1 - COMPANION FLANGE
2 - PULLER TOOL

(13) Remove pinion from differential housing (Fig. 33).

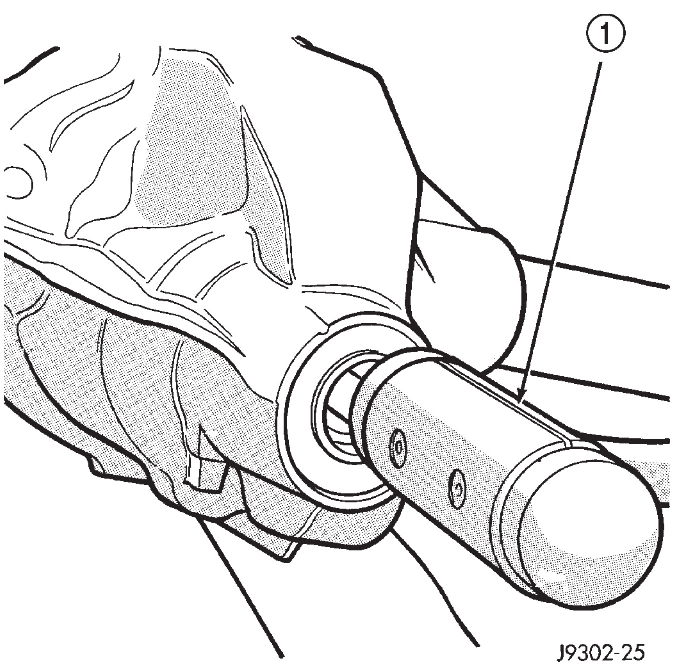


Fig. 33 Remove Pinion

1 - RAWHIDE HAMMER

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

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

(16) Remove front pinion bearing cup with Remover D-103 and Handle C-4171 (Fig. 34).

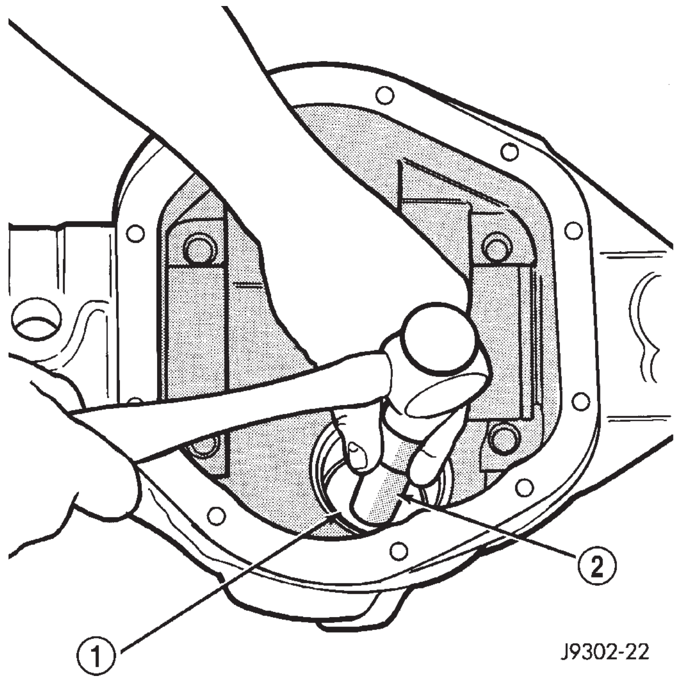


Fig. 34 Front Bearing Cup

1 - REMOVER
2 - HANDLE

(17) Remove rear bearing cup from housing (Fig. 35) with Remover 8401 and Handle C-4171.

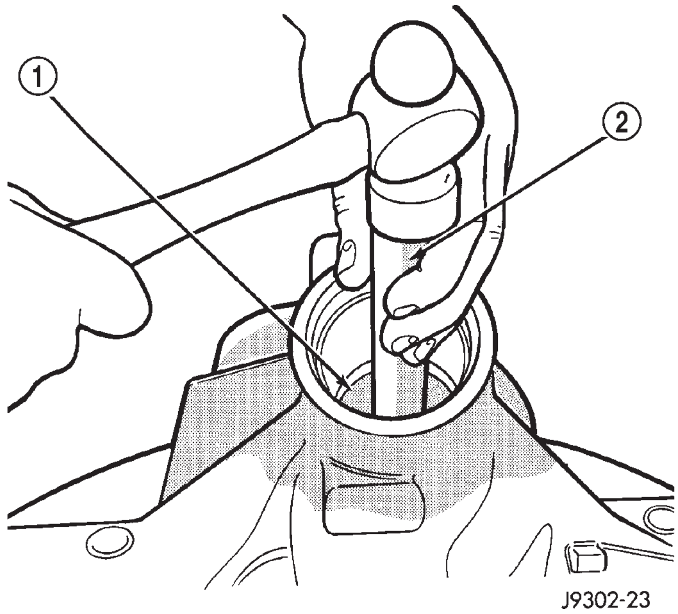


Fig. 35 Rear Bearing Cup

1 - DRIVER
2 - HANDLE

PINION GEAR/RING GEAR/TONE RING (Continued)

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

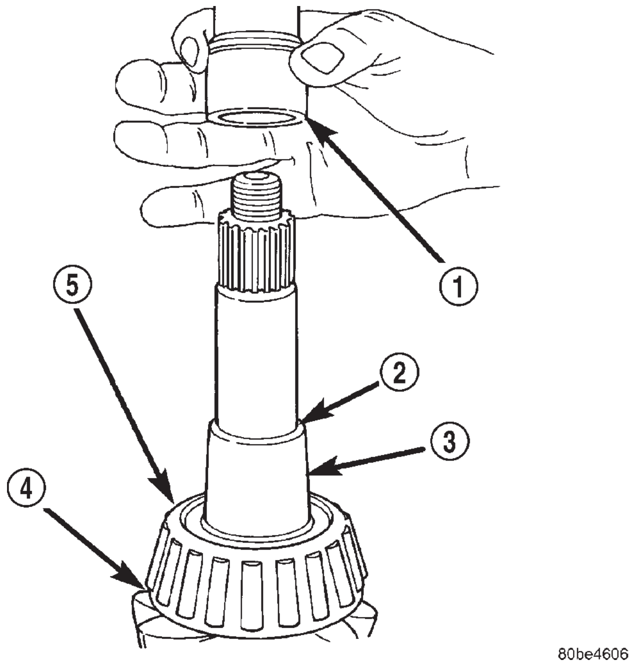


Fig. 36 Collapsible Spacer

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

(19) Remove rear pinion bearing with Puller/Press C-293-PA and Adapters C-293-42 (Fig. 37).

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

INSTALLATION

NOTE: The ring gear and pinion are serviced in a matched set. Never replace one gear without replacing the other. If ring and pinion gears or bearings are replaced, Refer to Adjustments for Pinion Gear Depth Setting.

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

(2) Install rear pinion bearing cup with Installer D-145 and Driver Handle C-4171 (Fig. 38) and verify cup is seated.

(3) Apply Mopar Door Ease or equivalent lubricant to outside surface of bearing cup.

(4) Install front pinion bearing cup with Installer D-129 and Handle C-4171 (Fig. 39) and verify cup is seated.

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

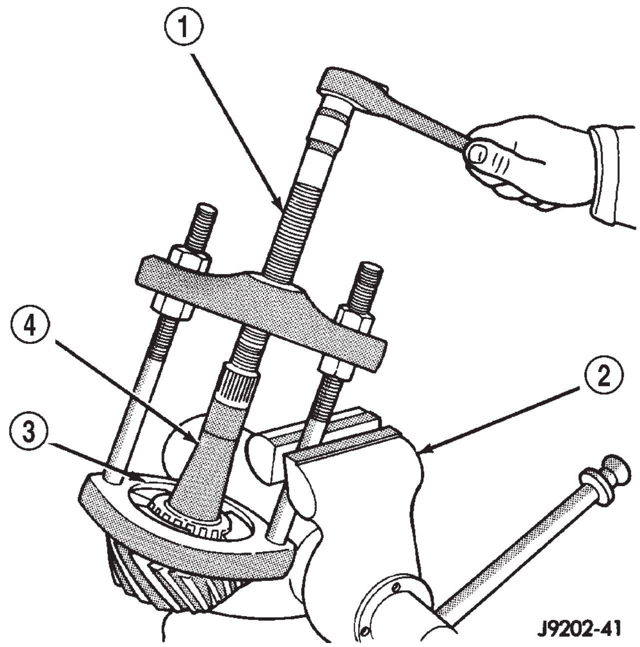


Fig. 37 Rear Pinion Bearing

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

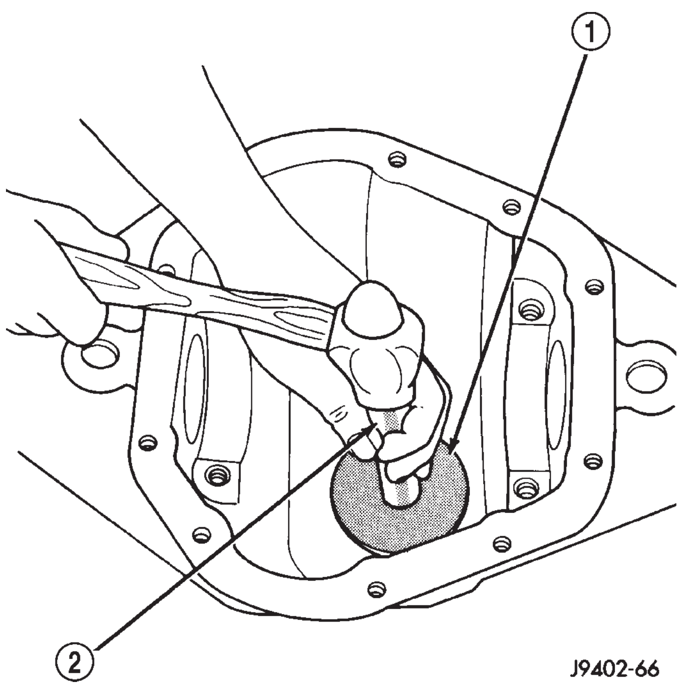


Fig. 38 Rear Pinion Bearing Cup

1 - INSTALLER
2 - HANDLE

(6) Apply a light coating of gear lubricant on the lip of pinion seal.

PINION GEAR/RING GEAR/TONE RING (Continued)

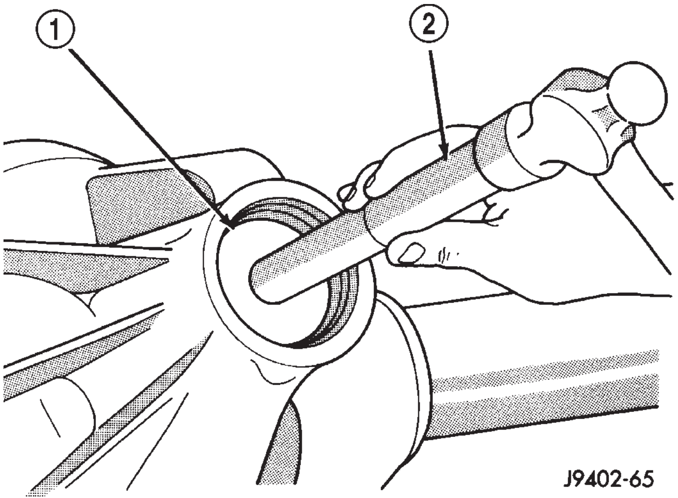


Fig. 39 Front Pinion Bearing Cup

1 - INSTALLER
2 - HANDLE

(7) Install pinion seal with Installer C-3972-A and Handle C-4171 (Fig. 40).

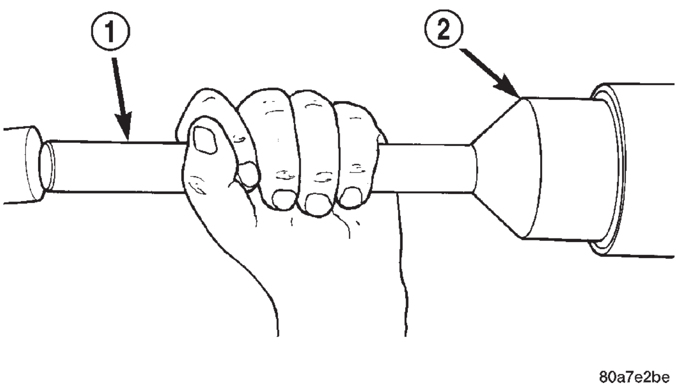


Fig. 40 Pinion Seal

1 - HANDLE
2 - INSTALLER

(8) Place the proper thickness depth shim on the pinion shaft.

(9) Install rear bearing and slinger if equipped, onto the pinion shaft with Installer 6448 (Fig. 41)and a press.

(10) Install **new**collapsible preload spacer onto the pinion shaft (Fig. 42).

(11) Install the pinion in the axle housing.

(12) Install the companion flange with Installer C-3718 and Holder 6719.

(13) Install new pinion nut and tighten to 271 N·m (200 ft. lbs.) (Fig. 43).

(14) Using Holder 6719 and a torque wrench set at 474 N·m (350 ft. lbs.). Tighten pinion nut until bearing end play is taken up.

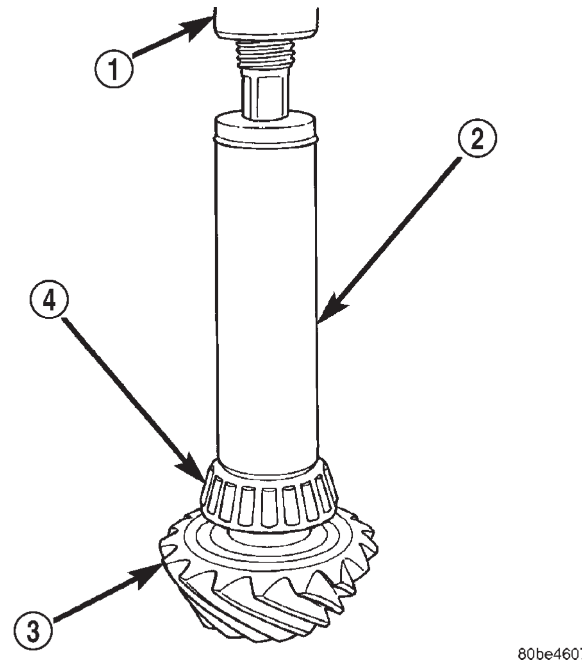


Fig. 41 Rear Pinion Bearing

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

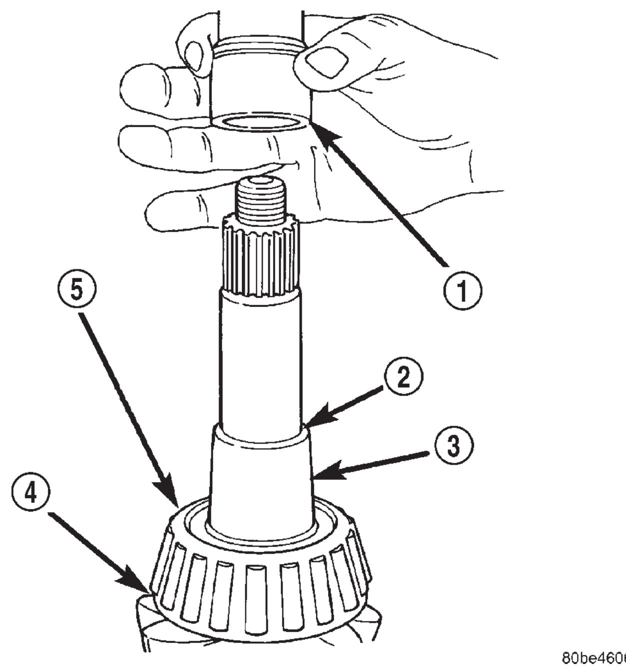


Fig. 42 Collapsible Preload Spacer

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

PINION GEAR/RING GEAR/TONE RING (Continued)

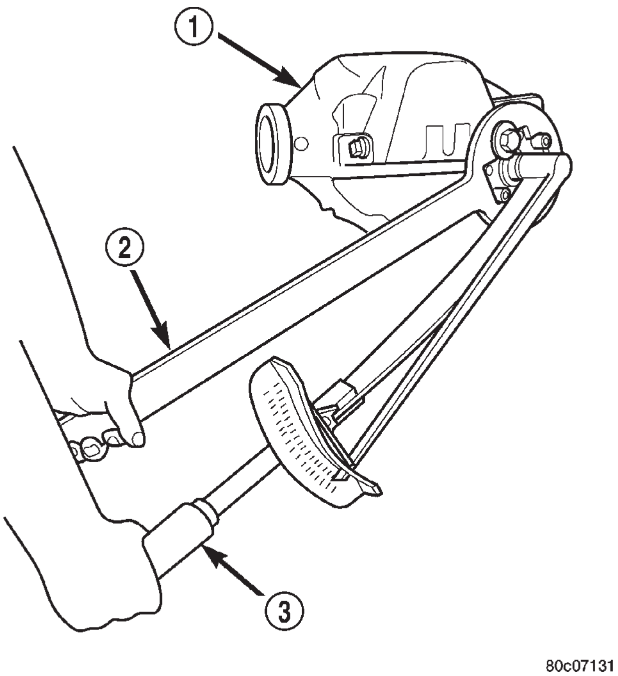


Fig. 43 Pinion Nut

1 - DIFFERENTIAL HOUSING
2 - COMPANION FLANGE HOLDER
3 - TORQUE WRENCH

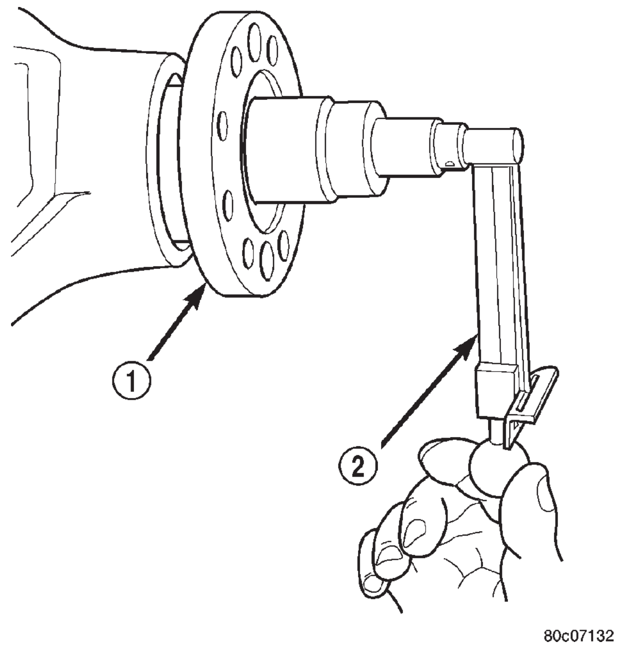


Fig. 44 Pinion Rotating Torque

1 - COMPANION FLANGE
2 - INCH POUND TORQUE WRENCH

(15) Slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until desired rotating torque is achieved. Measure the rotating torque frequently to avoid over-crushing the collapsible spacer (Fig. 44). The torque necessary to rotate the pinion should be:

- Original Bearings: 1 to 2.5 N·m (10 to 20 in. lbs.)
- New Bearings: 1.7 to 2.5 N·m (15 to 22 in. lbs.)

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

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

(17) Invert the differential case in the vise.

(18) Install **new** ring gear bolts and alternately tighten to 108 N·m (80 ft. lbs.) (Fig. 45).

CAUTION: Do not reuse the bolts that held the ring gear to the differential case. The bolts can fracture causing extensive damage.

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

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

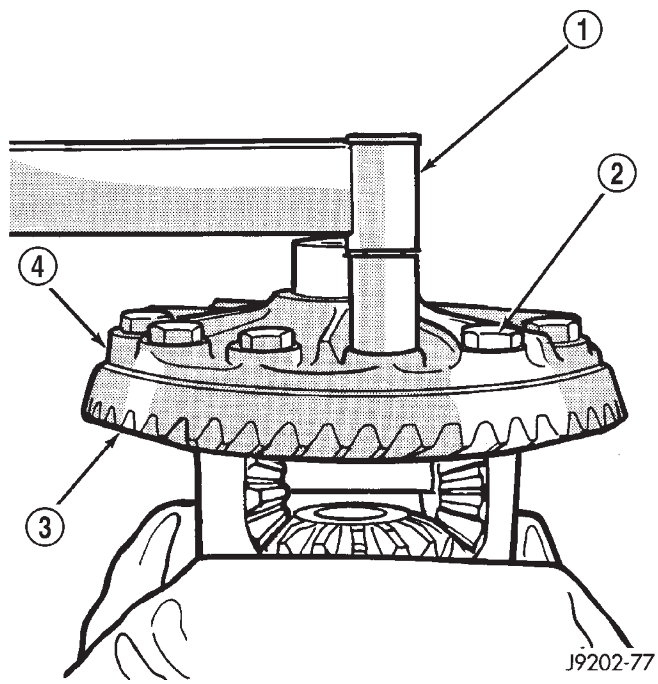


Fig. 45 Ring Gear Bolt

1 - TORQUE WRENCH
2 - BOLTS
3 - RING GEAR
4 - DIFFERENTIAL CASE

(21) Install propeller shaft wtih reference marks aligned.

(22) Remove support and lower vehicle.

REAR AXLE - 8 1/4

TABLE OF CONTENTS

REAR AXLE - 8 1/4

DESCRIPTION

The 8 1/4 inch axle housings consist of a cast iron center section with axle tubes extending from either side. The tubes are pressed into and welded to the differential housing to form a one-piece axle housing.

The axles have a vent hose to relieve internal pressure caused by lubricant vaporization and internal expansion.

The axles are equipped with semi-floating axle shafts, meaning vehicle loads are supported by the axle shaft and bearings. The axle shafts are retained by C-locks in the differential side gears.

The removable, stamped steel cover provides a means for inspection and service without removing the complete axle from the vehicle.

The 8 1/4 axle have a date tag and a gear ratio tag. The tags are attached to the differential housing by a cover bolt.

The differential case is a one-piece design. The differential pinion mate shaft is retained with a threaded pin. Differential bearing preload and ring gear backlash are set and maintained by threaded adjusters at the outside of the differential housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer.

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

AXLE IDENTIFICATION

The axle differential cover can be used for identification of the axle (Fig. 1). A tag is also attached to the cover.

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).

REAR AXLE - 8 1/4 (Continued)

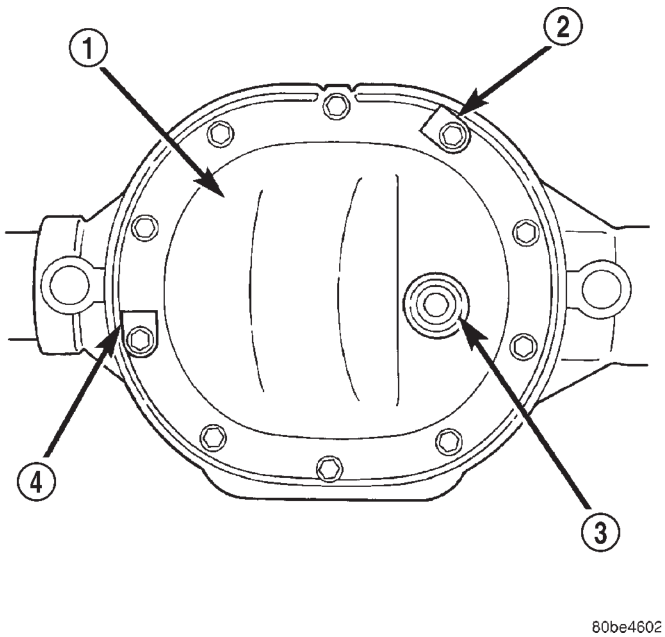


Fig. 1 Differential Cover

1 - DIFFERENTIAL COVER
2 - IDENTIFICATION TAG
3 - PUSH-IN FILL PLUG
4 - DATE TAG

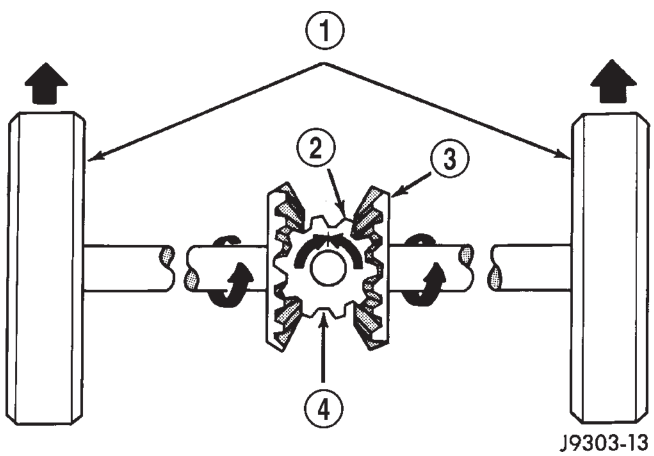


Fig. 2 Differential Operation - Straight Ahead Driving

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

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

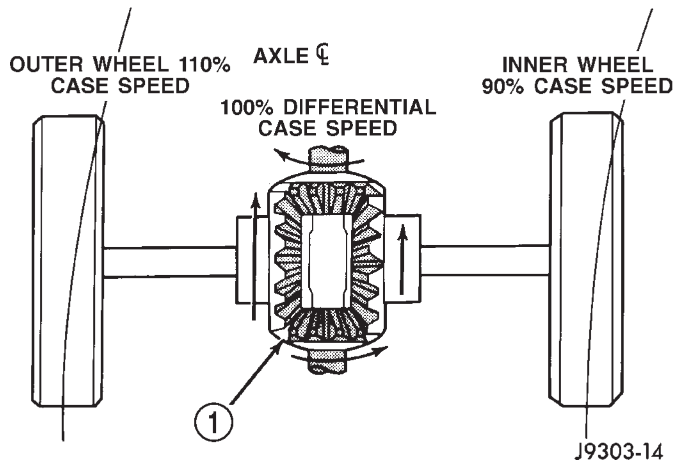


Fig. 3 Differential Operation - On Turns

1 - PINION GEARS ROTATE ON PINION SHAFT

TRAC-LOK™ DIFFERENTIAL

The Trac-lok™ clutches are engaged by two concurrent forces. The first being the preload force exerted through Belleville spring washers within the clutch packs. The second is the separating forces generated by the side gears as torque is applied through the ring gear (Fig. 4).

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

DIAGNOSIS AND TESTING - AXLE

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.

REAR AXLE - 8 1/4 (Continued)

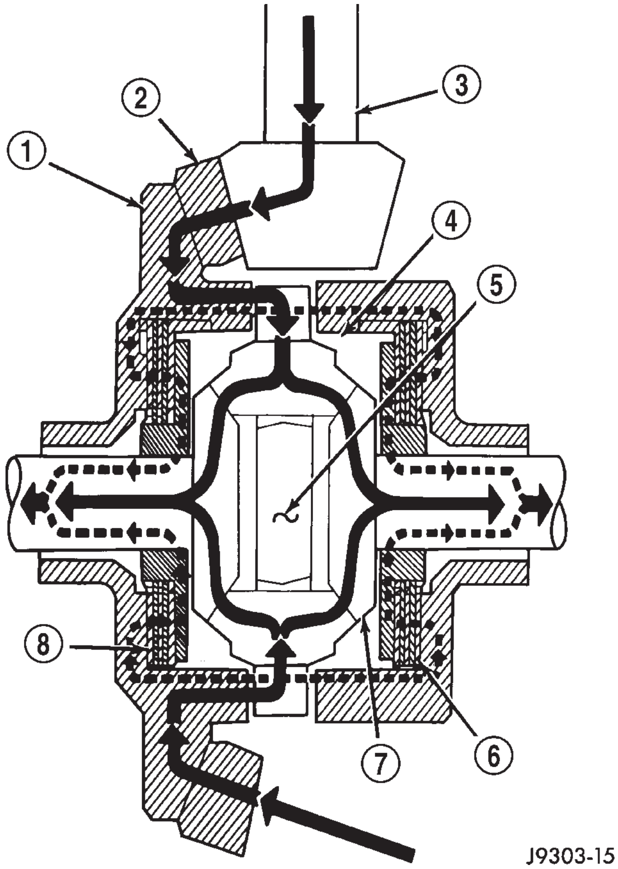


Fig. 4 Powr-lok™ Limited Slip Differential

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

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.

All driveline components should be examined before starting any repair.

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

REAR AXLE - 8 1/4 (Continued)

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.
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.

REAR AXLE - 8 1/4 (Continued)

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

REAR AXLE - 8 1/4 (Continued)

Condition	Possible Causes	Correction
Axle Noise	1. Insufficient lubricant.	1. Fill differential with the correct fluid type and quantity.
	2. Improper ring gear and pinion adjustment.	2. Check ring gear and pinion contact pattern. 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.

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) Secure brake drums to the axle shaft.

(6) Remove the RWAL sensor from the differential housing, if necessary. Refer to Brakes for procedures.

(7) Disconnect the brake hose at the axle junction block. Do not disconnect the brake hydraulic lines at the wheel cylinders. Refer to Brakes for procedures.

(8) Disconnect the parking brake cables and cable brackets.

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

(10) Mark the propeller shaft and companion flange for installation alignment reference.

(11) Remove propeller shaft.

(12) Disconnect shock absorbers from axle.

(13) Remove the spring clamps and spring brackets. Refer to Suspension for procedures.

(14) Separate the axle from the vehicle.

INSTALLATION

(1) Raise the axle with lifting device and align to the leaf spring centering bolts.

(2) Install spring clamps and spring brackets. Refer to Suspension for procedures.

(3) Install shock absorbers and tighten nuts to 82 N·m (60 ft. lbs.).

(4) Install RWAL sensor into the differential housing. Refer to Brakes for procedures.

(5) Install parking brake cables, cable brackets and brake drums. Refer to Brakes for procedures.

(6) Connect brake hose to axle junction block. Refer to Brakes for procedures.

(7) Install axle vent hose.

(8) Install propeller shaft with reference marks aligned. Tighten bolts to 108 N·m (80 ft. lbs.).

(9) Install the wheels and tires.

(10) Add gear lubricant, if necessary. Refer to Lubricant Specifications for lubricant requirements.

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

ADJUSTMENTS

Ring gear and pinion are supplied as matched sets only. The identifying numbers for the ring gear and pinion are painted onto the pinion gear shaft (Fig. 5) and the side of the ring gear. A plus (+) number, minus (–) number or zero (0) along with the gear set sequence number (01 to 99) is on each gear. This first number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion marked with a (0). The next two numbers are the sequence number of the gear set. The standard depth provides the best teeth contact pattern. Refer to Backlash and Contact Pattern in this section for additional information.

REAR AXLE - 8 1/4 (Continued)

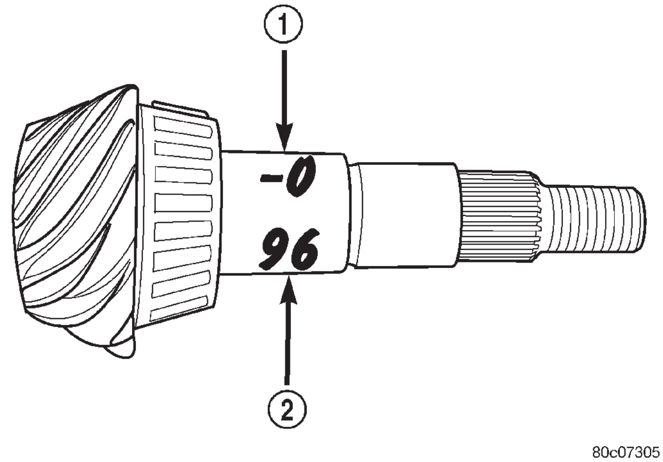


Fig. 5 Pinion ID Numbers

1 - VARIANCE NUMBER
2 - SEQUENCE NUMBER

Compensation for pinion depth variance is achieved with select shims. The shims are placed behind the rear pinion bearing (Fig. 6).

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

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

Note the painted number on the shaft of the drive pinion (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth 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.

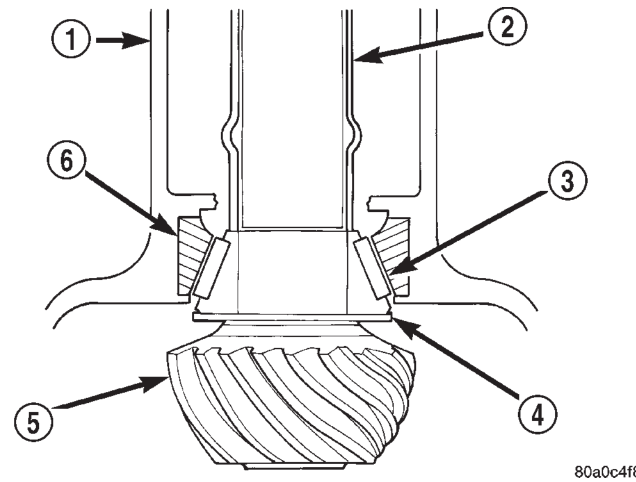


Fig. 6 Adjustment Shim Locations

1 - DIFFERENTIAL HOUSING
2 - COLLAPSIBLE SPACER
3 - PINION BEARING
4 - PINION DEPTH SHIM
5 - PINION GEAR
6 - BEARING CUP

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

REAR AXLE - 8 1/4 (Continued)

PINION DEPTH MEASUREMENT

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. 7).

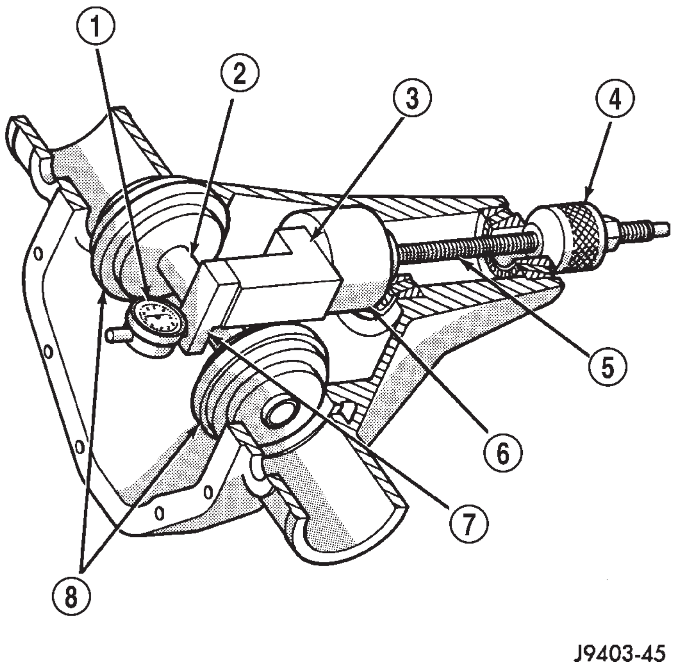


Fig. 7 Pinion Depth Gauge Tools

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 8540 and rear pinion bearing onto Screw 6741 (Fig. 7).

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

(3) Install front pinion bearing and Cone-Nut 6740 hand tight (Fig. 7).

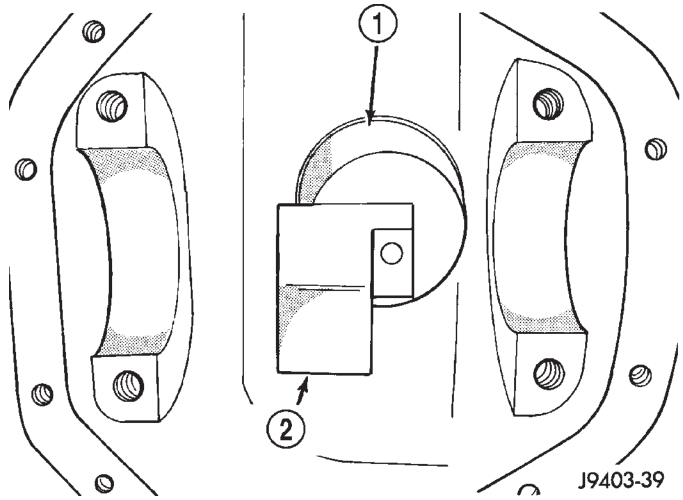


Fig. 8 Pinion Height Block

1 - PINION BLOCK
2 - PINION HEIGHT BLOCK

(4) Place Arbor Disc 8541 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 to 41 N·m (30 ft. lbs.).

NOTE: Arbor Discs 8541 has different step diameters to fit other axles. Choose proper step for axle being serviced.

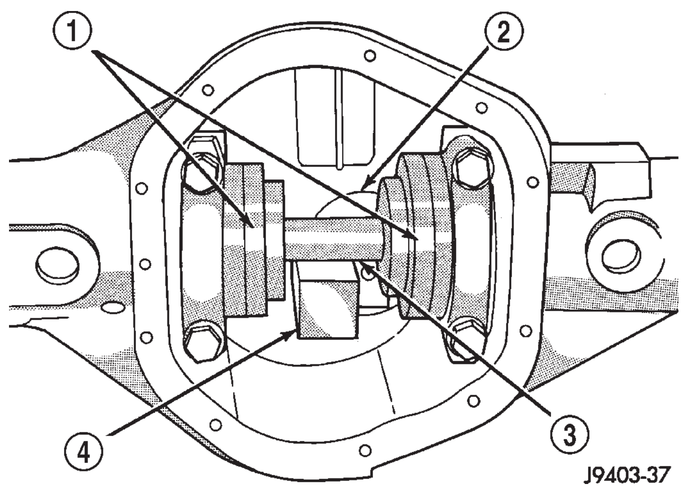


Fig. 9 Gauge Tools In Housing

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

REAR AXLE - 8 1/4 (Continued)

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

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are flush against the rearward surface of the pinion height block (Fig. 7). Hold scooter block in place and zero the dial indicator. Tighten dial indicator face lock screw.

(7) Slowly slide the dial indicator probe over the edge of the pinion height block.

(8) Slide the dial indicator probe across the gap between the pinion height block and the arbor bar with the scooter block against the pinion height block (Fig. 10). When dial probe contacts the arbor bar, the dial pointer will turn clockwise. Continue moving the dial probe to the crest of the arbor bar and record the highest reading. If the dial indicator can not achieve a zero reading, the rear bearing cup or the pinion depth gauge set is not installed correctly.

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

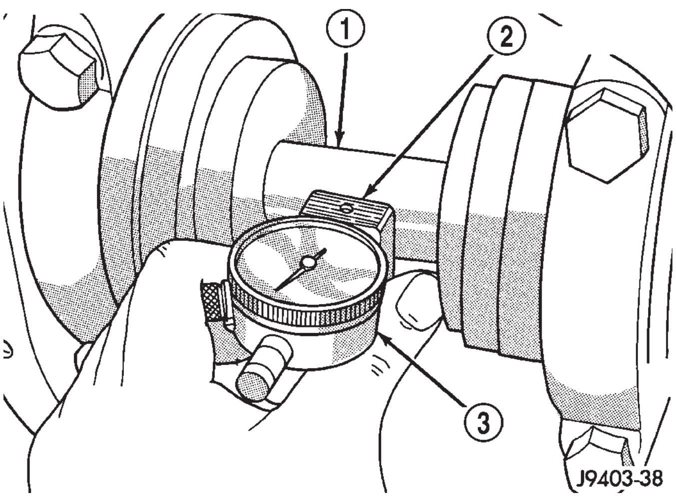


Fig. 10 Pinion Gear Depth

1 - ARBOR
2 - SCOOTER BLOCK
3 - DIAL INDICATOR

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

The following must be considered when adjusting bearing preload and gear backlash:

- The maximum ring gear backlash variation is 0.003 inch (0.076 mm).
- Mark the gears so the same teeth are meshed during all backlash measurements.
- Maintain the torque while adjusting the bearing preload and ring gear backlash.
- Excessive adjuster torque will introduce a high bearing load and cause premature bearing failure. Insufficient adjuster torque can result in excessive differential case free-play and ring gear noise.
- Insufficient adjuster torque will not support the ring gear correctly and can cause excessive differential case free-play and ring gear noise.

NOTE: The differential bearing cups will not always immediately follow the threaded adjusters as they are moved during adjustment. To ensure accurate bearing cup responses to the adjustments:

- Maintain the gear teeth engaged (meshed) as marked.
- The bearings must be seated by rapidly rotating the pinion gear a half turn back and forth.
- Do this five to ten times each time the threaded adjusters are adjusted.

(1) Use Wrench C-4164 to adjust each threaded adjuster inward until the differential bearing free-play is eliminated (Fig. 11). Allow some ring gear backlash (approximately 0.01 inch/0.25 mm) between the ring and pinion gear. Seat the bearing cups with the procedure described above.

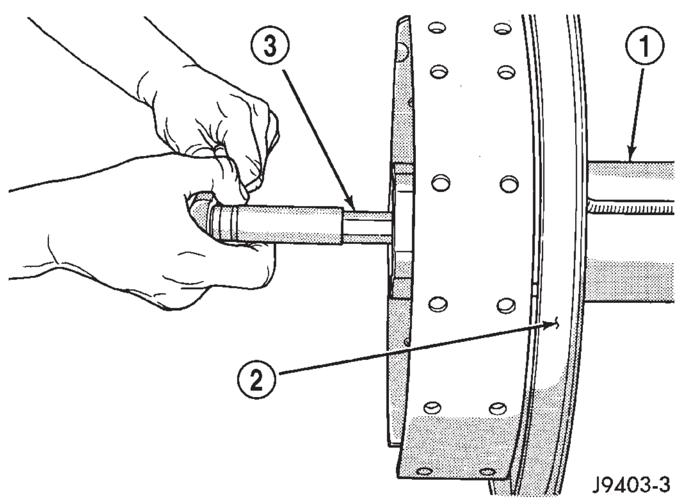


Fig. 11 Threaded Adjuster Tool

1 - AXLE TUBE
2 - BACKING PLATE
3 - THREAD ADJUSTER WRENCH

REAR AXLE - 8 1/4 (Continued)

(2) Install dial indicator and position the plunger against the drive side of a ring gear tooth (Fig. 12). Measure the backlash at 4 positions (90 degrees apart) around the ring gear. Locate and mark the area of minimum backlash.

(3) Rotate the ring gear to the position of the least backlash. Mark the gear so that all future backlash measurements will be taken with the same gear teeth meshed.

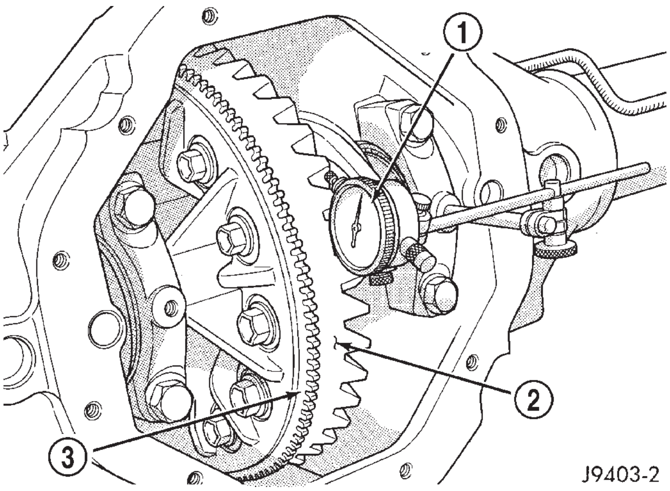


Fig. 12 Ring Gear Backlash

1 - DIAL INDICATOR
2 - RING GEAR
3 - EXCITER RING

(4) Loosen the right-side, tighten the left-side threaded adjuster. Obtain backlash of 0.003 to 0.004 inch (0.076 to 0.102 mm) with each adjuster tightened to 14 N·m (10 ft. lbs.). Seat the bearing cups with the procedure described above.

(5) Tighten the differential bearing cap bolts to 95 N·m (70 ft. lbs.).

(6) Tighten the right-side threaded adjuster to 102 N·m (75 ft. lbs.). Seat the bearing cups with the procedure described above. Continue to tighten the right-side adjuster and seat bearing cups until the torque remains constant at 102 N·m (75 ft. lbs.)

(7) Measure the ring gear backlash. The range of backlash is 0.006 to 0.008 inch (0.15 to 0.203 mm).

(8) Continue increasing the torque at the right-side threaded adjuster until the specified backlash is obtained.

NOTE: The left-side threaded adjuster torque should have approximately 102 N·m (75 ft. lbs.). If the torque is considerably less, the complete adjustment procedure must be repeated.

(9) Tighten the left-side threaded adjuster until 102 N·m (75 ft. lbs.) torque is indicated. Seat the bearing rollers with the procedure described above. Do this until the torque remains constant.

(10) Install the threaded adjuster locks and tighten the lock screws to 10 N·m (90 in. lbs.).

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

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 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. 13)and adjust pinion depth and gear backlash as necessary.

REAR AXLE - 8 1/4 (Continued)

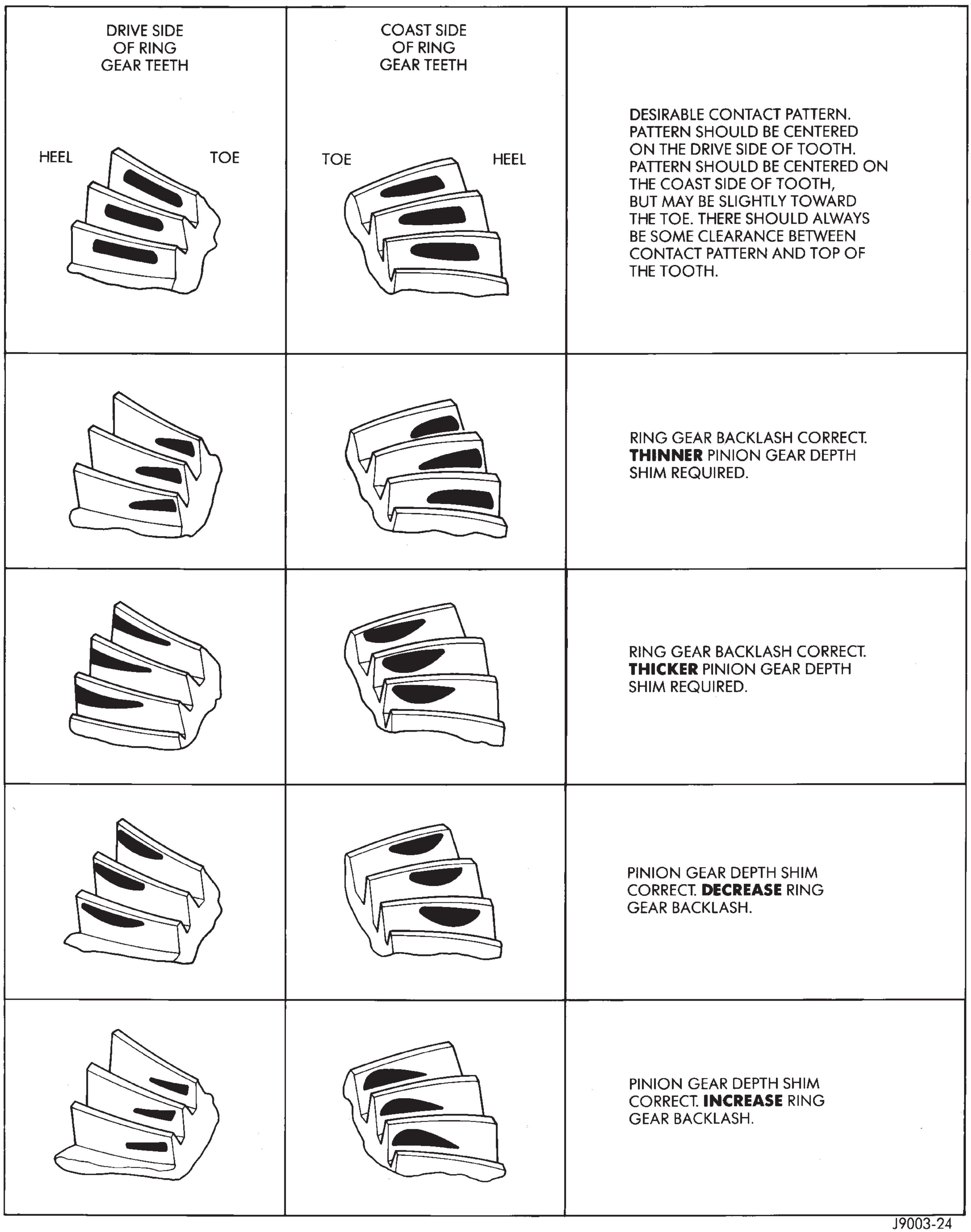


Fig. 13 Gear Tooth Contact Patterns

REAR AXLE - 8 1/4 (Continued)

SIDE GEAR CLEARANCE

When measuring side gear clearance, check each gear independently. If it necessary to replace a side gear, replace both gears as a matched set.

(1) Install the axle shafts and C-locks and pinion mate shaft.

(2) Measure each side gear clearance. Insert a matched pair of feeler gauge blades between the gear and differential housing on opposite sides of the hub (Fig. 14) .

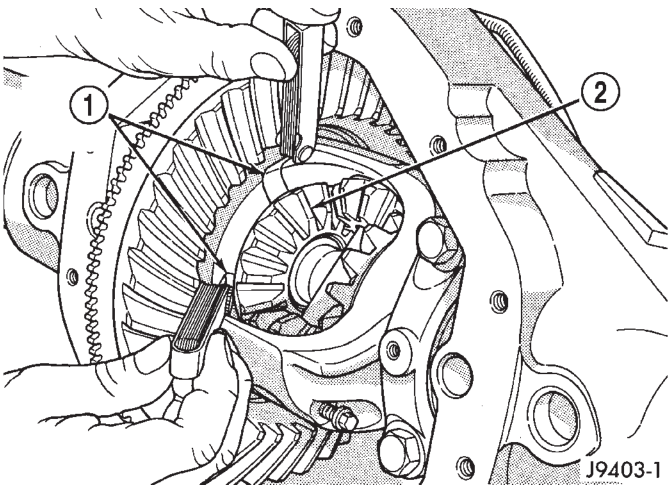


Fig. 14 Side Gear Clearance

1 - FEELER GAUGE
2 - SIDE GEARS

(3) If side gear clearances is no more than 0.005 inch. Determine if the axle shaft is contacting the pinion mate shaft. **Do not remove the feeler gauges, inspect the axle shaft with the feeler gauge inserted behind the side gear.** If the end of the axle shaft is not contacting the pinion mate shaft, the side gear clearance is acceptable.

(4) If clearance is more than 0.005 inch (axle shaft not contacting mate shaft), record the side gear clearance. Remove the thrust washer and measure its thickness with a micrometer. Add the washer thickness to the recorded side gear clearance. The sum of gear clearance and washer thickness will determine required thickness of replacement thrust washer (Fig. 15). In some cases, the end of the axle shaft will move and contact the mate shaft when the feeler gauge is inserted. The C-lock is preventing the side gear from sliding on the axle shaft.

SIDE GEAR CLEARANCE	0.007
THRUST WASHER THICKNESS	+ 0.033
TOTAL	0.040
	→ 0.040
REPLACEMENT WASHER THICKNESS	− 0.037
NEW SIDE GEAR CLEARANCE	0.003

J9203-31

Fig. 15 Side Gear

(5) If there is no side gear clearance, remove the C-lock from the axle shaft. Use a micrometer to measure the thrust washer thickness. Record the thickness and re-install the thrust washer. Assemble the differential case without the C-lock installed and re-measure the side gear clearance.

(6) Compare both clearance measurements. If the difference is less than 0.012 inch (0.305 mm), add clearance recorded when the C-lock was installed to thrust washer thickness measured. The sum will determine the required thickness of the replacement thrust washer.

(7) If clearance is 0.012 inch (0.305 mm) or greater, both side gears must be replaced (matched set) and the clearance measurements repeated.

(8) If clearance (above) continues to be 0.012 inch (0.305 mm) or greater, the case must be replaced.

SPECIFICATIONS

REAR AXLE - 8 1/4

AXLE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Axle Ratio	3.21, 3.55, 3.92
Differential Case Flange Runout	0.076 mm (0.003 in.)
Differential Case Clearance	0.12 mm (0.005 in.)
Ring Gear Diameter	209.5 mm (8.25 in.)
Ring Gear Backlash	0.12-0.20 mm (0.005-0.008 in.)
Ring Gear Runout	0.12 mm (0.005 in.)
Pinion Bearing Preload - Original Bearings	1-2 N·m (10-20 in. lbs.)
Pinion Bearing Preload - New Bearings	1.7-4 N·m (15-35 in. lbs.)

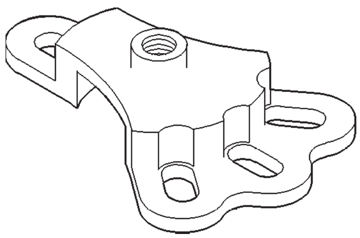
SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS

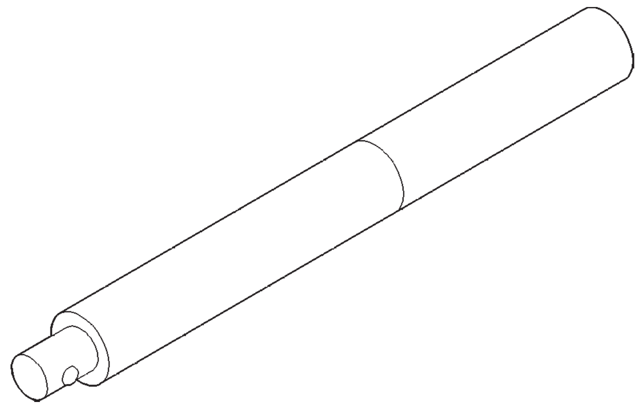
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Differential Cover Bolts	41	30	-
Bearing Cap Bolts	95	70	-
Ring Gear Bolts	102	75	-
Pinion Nut Minimum	285	210	-
Adjuster Lock Screw	10	7.5	90
Backing Plate Bolts	65	48	-

SPECIAL TOOLS

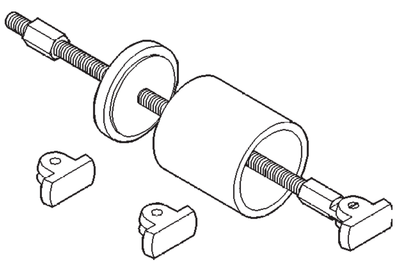
8 1/4 AXLE



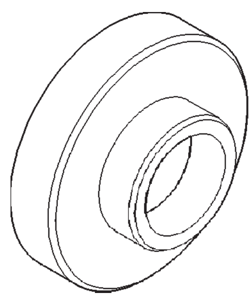
Puller 6790



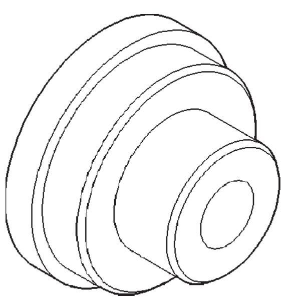
Handle C-4171



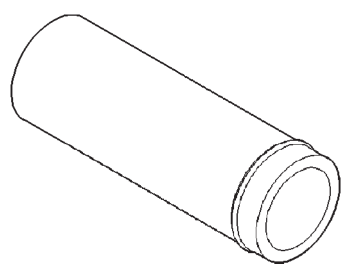
Remover 6310



Installer C-4076-B

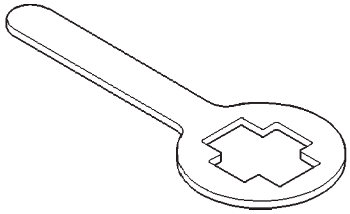


Installer C-4198

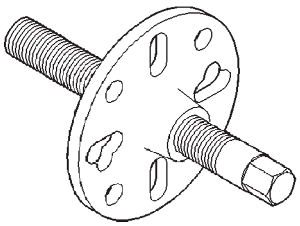


Handle C-4735-1

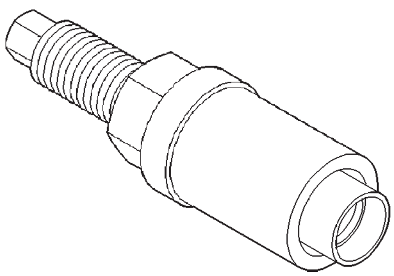
SPECIAL TOOLS (Continued)



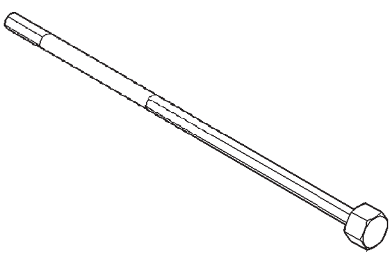
Holder 6719



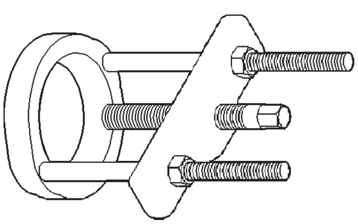
Puller C-452



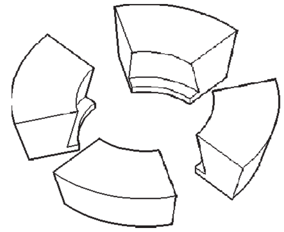
Installer C-3718



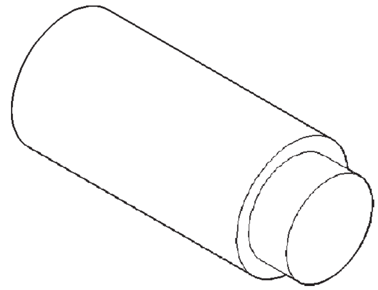
Adjustment Wrench C-4164



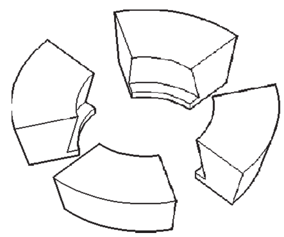
Puller/Press C-293–PA



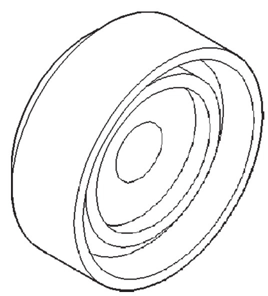
Adapters C-293-48



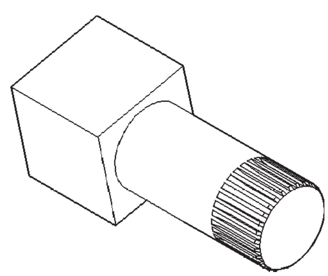
Adapter Plug SP-3289



Adapters C-293-47

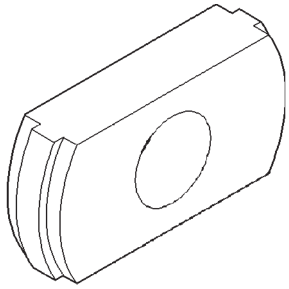


Installer C-4340

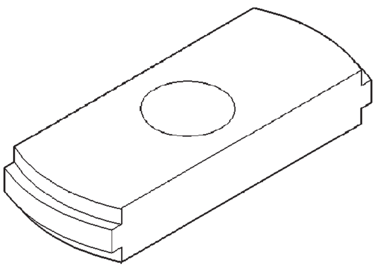


Fixture 8138

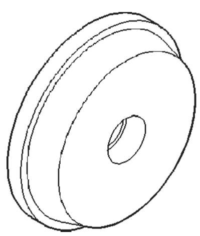
SPECIAL TOOLS (Continued)



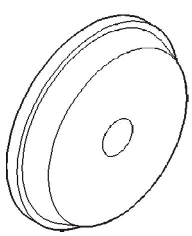
Installer C-4345



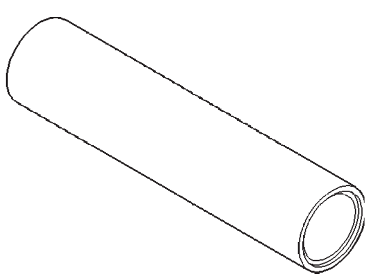
Remover C-4307



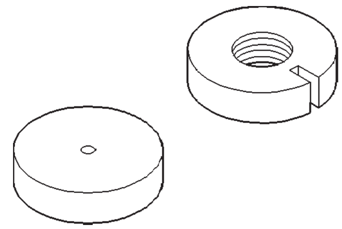
Installer C-4308



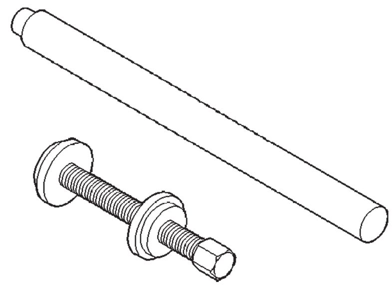
Installer D-130



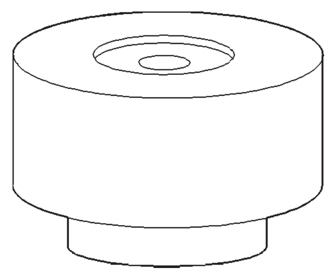
Installer 6448



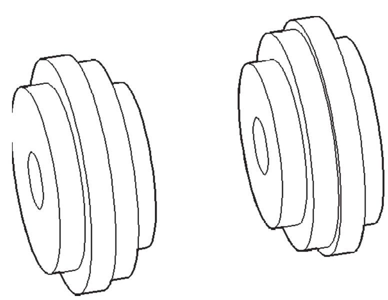
Trac-lok™ Tools 8140



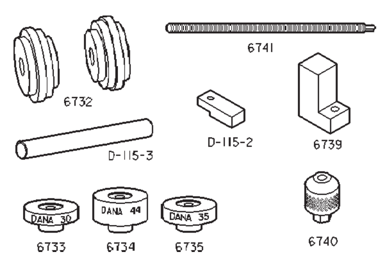
Trac-lok™ Tools 6960



Pinion Block 8540



Arbor Discs 8541



Pinion Gauge Set

AXLE SHAFTS

REMOVAL

(1) Place the transmission in NEUTRAL and raise and support vehicle.
(2) Remove wheel and tire assembly.
(3) Remove brake drum (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DRUM - REMOVAL) ..
(4) Clean all foreign material from housing cover area.
(5) Remove the housing cover and drain lubricant.
(6) Rotate differential case to access the pinion shaft lock screw. Remove lock screw and pinion shaft from differential case (Fig. 16).

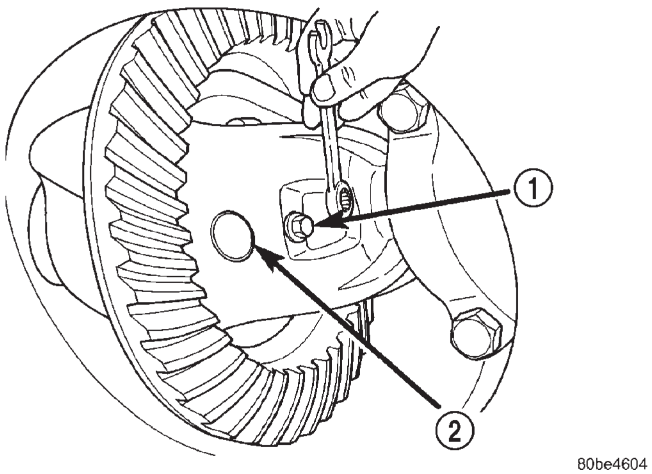


Fig. 16 Pinion Shaft Lock Screw

1 - LOCK SCREW
2 - PINION SHAFT

(7) Push axle shaft inward then remove axle shaft C-lock (Fig. 17).
(8) Remove axle shaft being carefull not to damage shaft bearing and seal.
(9) Inspect axle shaft seal for leakage or damage.
(10) Inspect axle shaft bearing contact surface for signs of brinelling, galling and pitting.

INSTALLATION

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

NOTE: Use care to prevent shaft splines from damaging axle shaft seal lip.

(2) Insert C-lock in end of axle shaft. Push axle shaft outward to seat C-lock in side gear.
(3) Insert pinion shaft into differential case and through thrust washers and differential pinions.

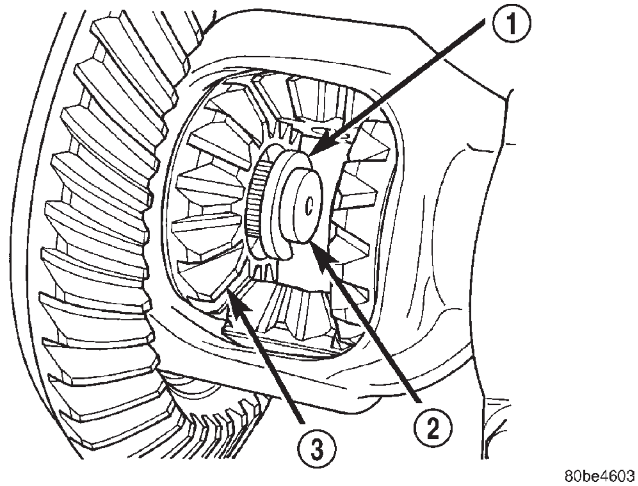


Fig. 17 Axle Shaft C-Lock

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

(4) Align hole in shaft with hole in the differential case and install lock screw with Loctite® on the threads. Tighten lock screw to 11 N·m (8 ft. lbs.).
(5) Install cover and fill with gear lubricant.
(6) Install brake drum (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DRUM - INSTALLATION) .
(7) Install wheel and tire assemblies.
(8) Remove support and lower vehicle.

AXLE SHAFT SEALS

REMOVAL

(1) Raise and support vehicle.
(2) Remove axle shaft.
(3) Remove axle shaft seal from the end of the axle tube with a small pry bar (Fig. 18).

INSTALLATION

(1) Wipe the axle tube bore clean. Remove any old sealer or burrs from the tube.
(2) Install a **new** axle seal with Installer C-4076-B and Handle C-4735-1. When the tool contacts the axle tube, the seal is installed to the correct depth.
(3) Coat the lip of the seal with axle lubricant for protection prior to installing the axle shaft.
(4) Install the axle shaft.
(5) Check and fill gear lubricant.
(6) Remove support and lower vehicle.

AXLE SHAFT SEALS (Continued)

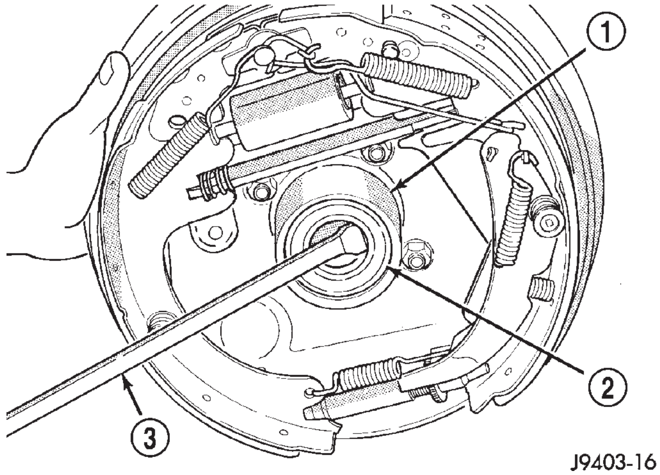


Fig. 18 Axle Seal

1 - AXLE TUBE
2 - AXLE SEAL
3 - PRY BAR

AXLE BEARINGS

REMOVAL

(1) Raise and support vehicle.
(2) Remove axle shaft.
(3) Remove axle shaft seal from the end of the axle tube with a small pry bar (Fig. 19).

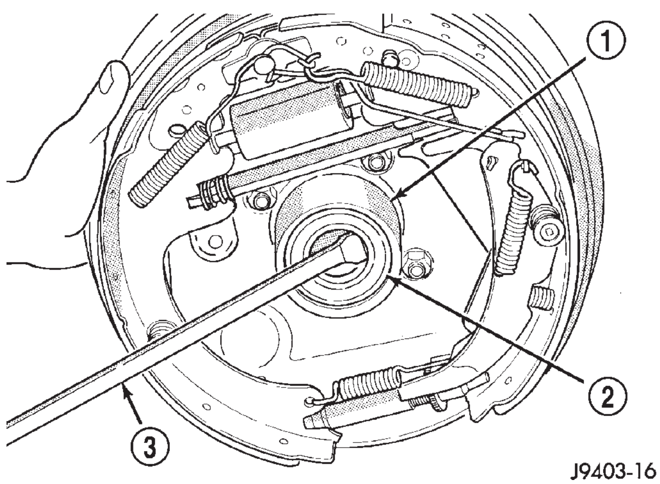


Fig. 19 Axle Seal

1 - AXLE TUBE
2 - AXLE SEAL
3 - PRY BAR

NOTE: The seal and bearing can be removed at the same time with the bearing removal tool.

(4) Remove axle shaft bearing with Bearing Removal Tool Set 6310 and Adapter Foot 6310-9 (Fig. 20).

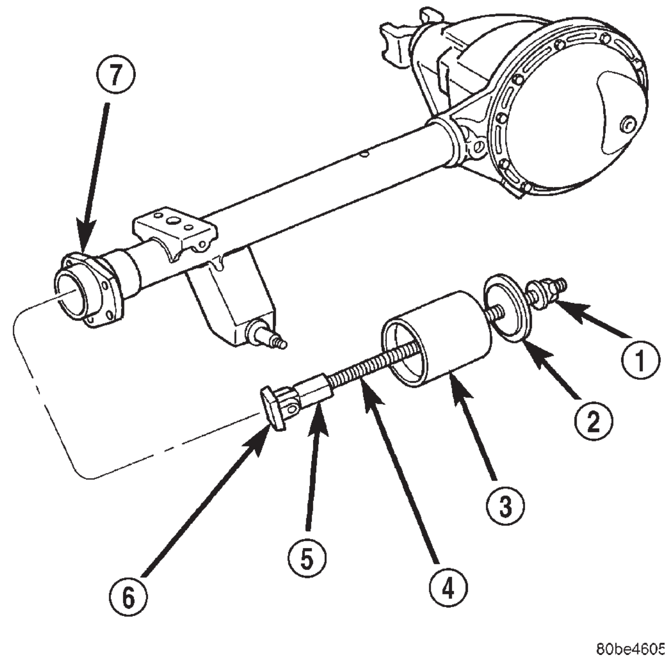


Fig. 20 Axle Shaft Bearing

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

INSTALLATION

(1) Wipe the axle tube bore clean. Remove any old sealer or burrs from the tube.
(2) Install the axle shaft bearing with Installer C-4198 and Handle C-4171. Ensure bearing is installed straight and the tool is in contacts with the axle tube when seating the bearing.

NOTE: Install bearing with part number against the installer.

(3) Install a **new** axle seal with Installer C-4076-B and Handle C-4735-1. When the tool contacts the axle tube, the seal is installed to the correct depth.
(4) Coat the lip of the seal with axle lubricant for protection prior to installing the axle shaft.
(5) Install the axle shaft.
(6) Check and fill gear lubricant.
(7) Remove support and lower vehicle.

PINION SEAL

REMOVAL

(1) Raise and support the vehicle.
(2) Mark the universal joint, companion flange and pinion shaft for installation reference.
(3) Remove companion flange bolts and secure the shaft in an upright position to prevent damage to the rear universal joint.
(4) Remove the wheel and tire assemblies.
(5) Remove brake drums to prevent any drag.
(6) Rotate companion flange three or four times and verify flange rotates smoothly.
(7) Measure rotating torque of the pinion with a inch pound torque wrench and record the reading for installation reference.
(8) Install bolts into two of the threaded holes in the companion flange 180° apart.
(9) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so the Holder 6719 is held to the flange.
(10) Remove the pinion nut and washer.
(11) Remove companion flange with Remover C-452 (Fig. 21).

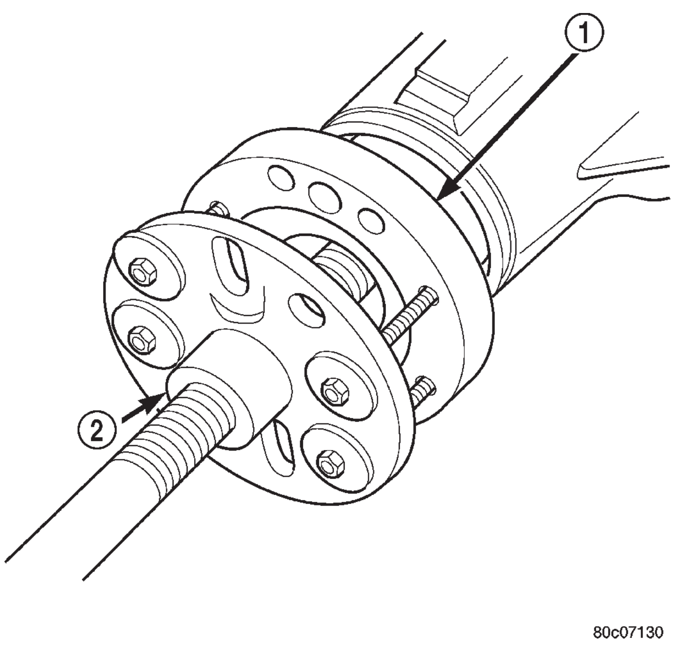


Fig. 21 Companion Flange

1 - COMPANION FLANGE
2 - PULLER

(12) Remove pinion seal with a pry tool or slide-hammer mounted screw.

INSTALLATION

NOTE: The outer perimeter of the seal is pre-coated with a special sealant.

(1) Apply a light coating of gear lubricant on the lip of pinion seal.
(2) Install **new** pinion seal with Installer C-4076-B and Handle C-4735-1 (Fig. 22)

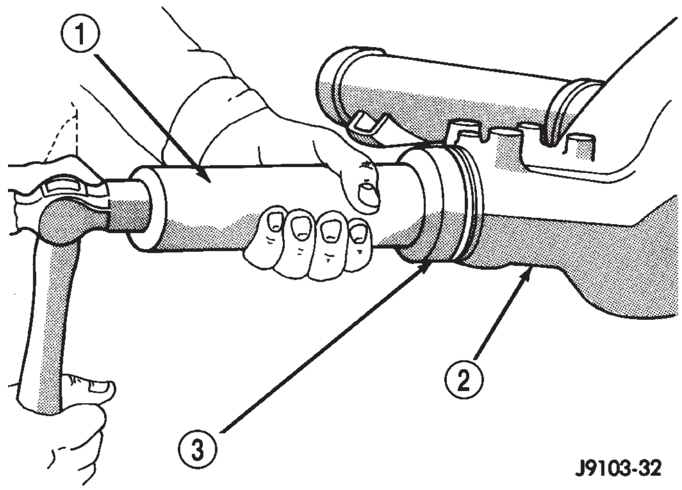


Fig. 22 Pinion Seal Installer

1 - HANDLE
2 - DIFFERENTIAL HOUSING
3 - INSTALLER

(3) Install companion flange on the end of the shaft with the reference marks aligned.
(4) Install bolts into two of the threaded holes in the companion flange 180° apart.
(5) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so Holder 6719 is held to the flange.
(6) Install companion flange on pinion shaft with Installer C-3718 and Holder 6719.
(7) Install the pinion washer and a **new** pinion nut. The convex side of the washer must face outward.

CAUTION: Do not exceed the minimum tightening torque when installing the companion flange retaining nut at this point. Damage to collapsible spacer or bearings may result.

(8) Hold companion flange with Holder 6719 and tighten the pinion nut to 285 N·m (210 ft. lbs.) (Fig. 23). Rotate pinion several revolutions to ensure the bearing rollers are seated.
(9) Rotate pinion with an inch pound torque wrench. Rotating torque should be equal to the read-

PINION SEAL (Continued)

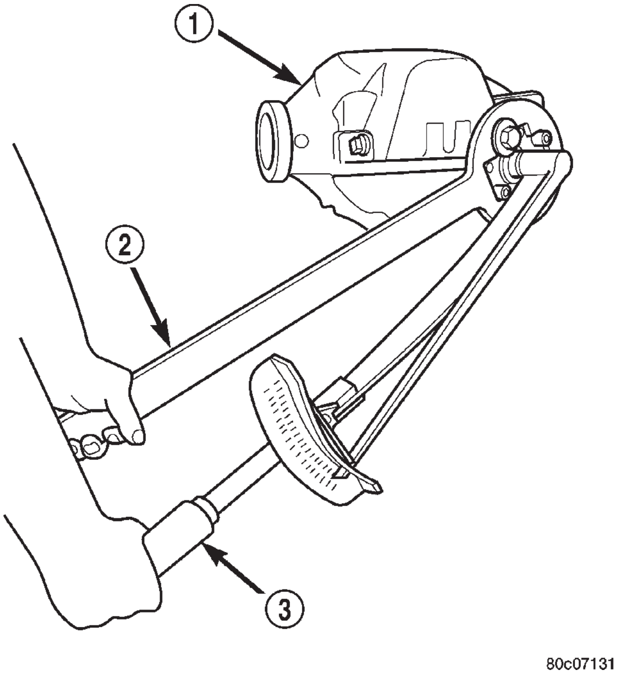


Fig. 23 Tightening Pinion Nut

1 - DIFFERENTIAL HOUSING
2 - COMPANION FLANGE HOLDER
3 - TORQUE WRENCH

ing recorded during removal plus an additional 0.56 N·m (5 in. lbs.) (Fig. 24).

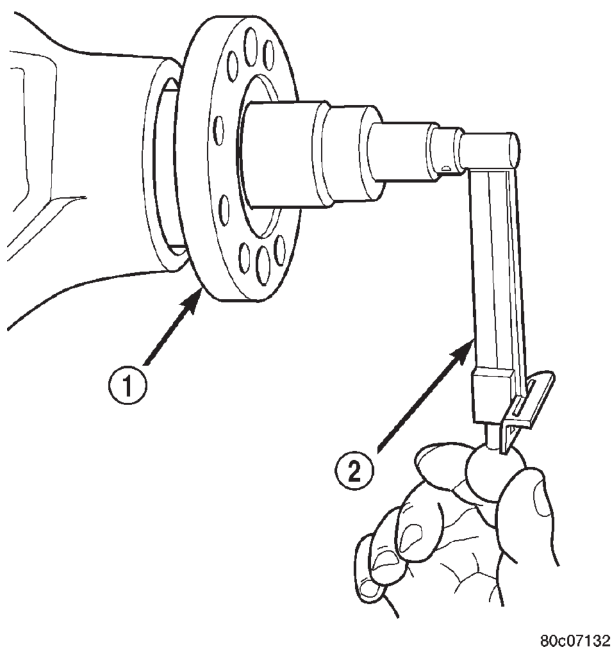


Fig. 24 Pinion Rotation Torque

1 - COMPANION FLANGE
2 - INCH POUND TORQUE WRENCH

CAUTION: Never loosen pinion nut to decrease pinion bearing rotating torque and never exceed specified preload torque. If rotating torque is exceeded, a new collapsible spacer must be installed.

(10) If rotating torque is low use Holder 6719 to hold the companion flange (Fig. 23) and tighten pinion nut in 6.8 N·m (5 ft. lbs.) increments until proper rotating torque is achieved.

NOTE: The seal replacement is unacceptable if final pinion nut torque is less than 285 N·m (210 ft. lbs.).

NOTE: The bearing rotating torque should be constant during a complete revolution of the pinion. If the rotating torque varies, this indicates a binding condition.

(11) Install propeller shaft with the installation reference marks aligned.
(12) Tighten companion flange bolts to 108 N·m (80 ft. lbs.).
(13) Install the brake drums.
(14) Check the differential housing lubricant level.
(15) Install wheel and tire assemblies and lower the 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 drain the lubricant from the housing.
(4) Clean the housing cavity with a flushing oil, light engine oil or lint free cloth. **Do not use water, steam, kerosene or gasoline for cleaning.**
(5) Remove the axle shafts.

NOTE: Side play resulting from bearing races being loose on case hubs requires replacement of the differential case.

(6) Mark the differential housing and bearing caps for installation reference (Fig. 25).
(7) Remove bearing threaded adjuster locks from each bearing cap.
(8) Loosen bearing cap bolts, them loosen the threaded adjusters with Wrench C-4164 (Fig. 26).
(9) Hold the differential case while removing bearing caps and adjusters.
(10) Remove the differential case.

NOTE: Tag bearing cups and threaded adjusters location, for installation reference.

DIFFERENTIAL (Continued)

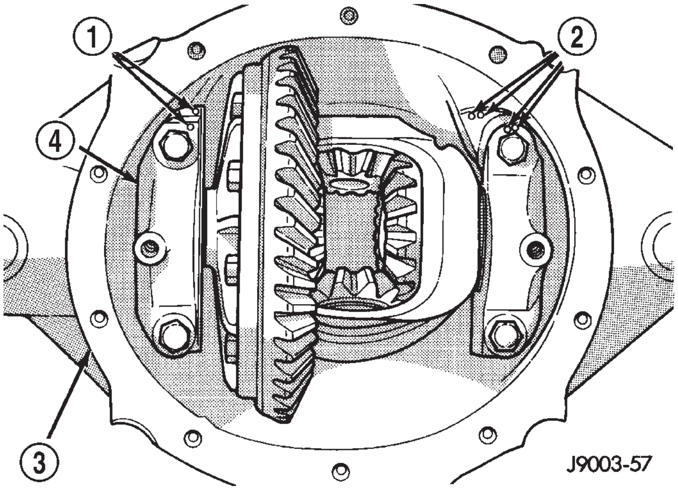


Fig. 25 Reference Mark

1 - REFERENCE MARKS
2 - REFERENCE MARKS
3 - DIFFERENTIAL HOUSING
4 - BEARING CAP

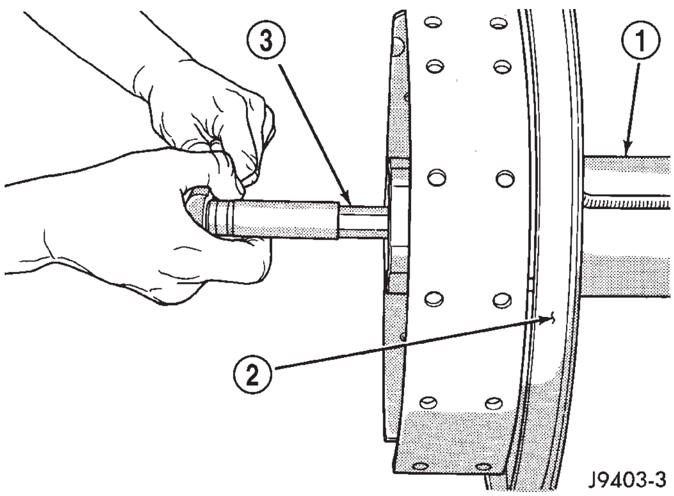


Fig. 26 Threaded Adjuster

1 - AXLE TUBE
2 - BACKING PLATE
3 - THREAD ADJUSTER WRENCH

DISASSEMBLY

(1) Remove pinion shaft lock screw (Fig. 27).

(2) Remove pinion shaft.

(3) Rotate differential side gears and remove the differential pinions and thrust washers (Fig. 28).

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

ASSEMBLY

(1) Install differential side gears and thrust washers.

(2) Install differential pinion and thrust washers.

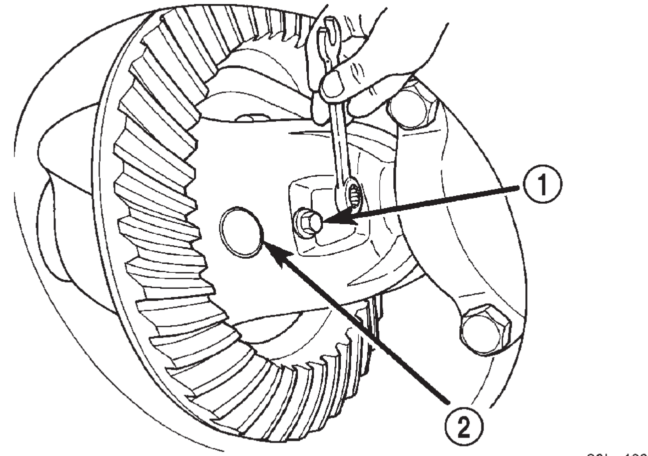


Fig. 27 Pinion Shaft Lock Screw

1 - LOCK SCREW
2 - PINION SHAFT

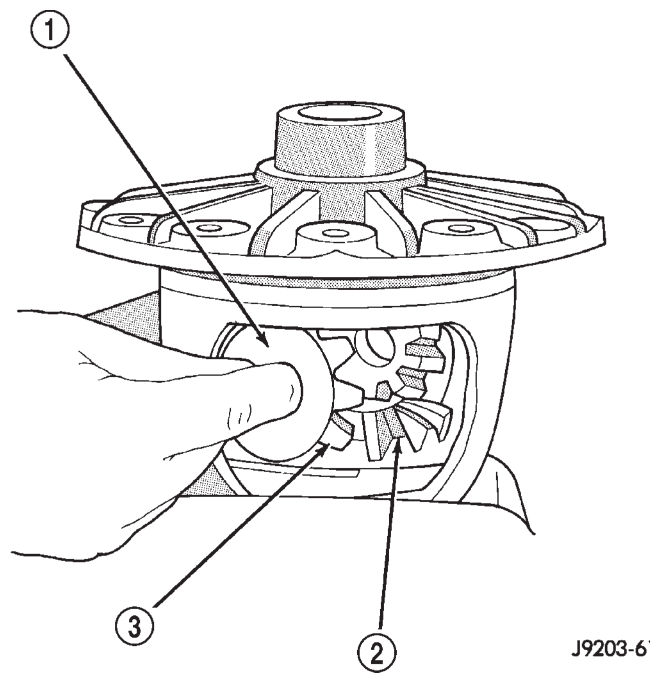


Fig. 28 Differential

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

(3) Install the pinion shaft.

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

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

DIFFERENTIAL (Continued)

INSTALLATION

(1) Apply a coating of hypoid gear lubricant to the differential bearings, bearing cups, and threaded adjusters. A dab of grease can be used to keep the adjusters in position. Carefully position the assembled differential case in the housing.

(2) Install the differential bearing caps in their original locations (Fig. 29).

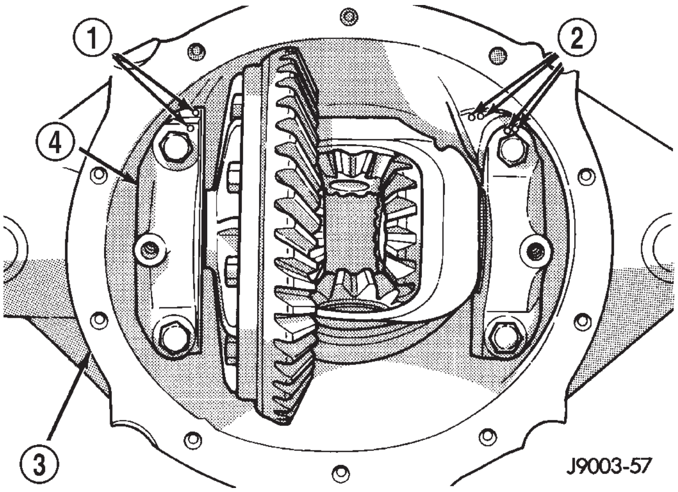


Fig. 29 Bearing Caps & Bolts

1 - REFERENCE MARKS
2 - REFERENCE MARKS
3 - DIFFERENTIAL HOUSING
4 - BEARING CAP

(3) Install bearing cap bolts and tighten the upper bolts to 14 N·m (10 ft. lbs.). Tighten the lower bolts finger-tight until the bolt head is seated.

(4) Perform the differential bearing preload and adjustment procedure.

(5) Tighten bearing cap bolts to 95 N·m (70 ft.lbs).

(6) Install adjuster locks on the bearing caps.

(7) Install axle shafts.

(8) Apply a bead of Mopar Silicone Rubber Sealant or equivalent to the housing cover (Fig. 30).

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

(9) Install the cover and any identification tag. Tighten the cover bolts to 41 N·m (30 ft. lbs.) torque.

(10) Fill differential with gear lubricant to bottom of the fill plug hole. Refer to the Lubricant Specifications for correct quantity.

(11) Install the fill hole plug.

(12) Install wheel and tire assemblies.

(13) Remove support and lower vehicle.

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

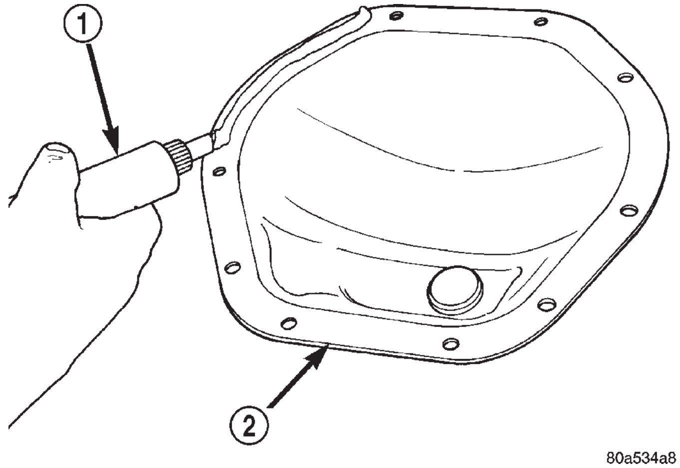


Fig. 30 Differential Cover Sealant

1 - SEALANT
2 - DIFFERNTIAL COVER

DIFFERENTIAL - TRAC-LOK

DIAGNOSIS AND TESTING - TRAC-LOK™

The most common problem is a chatter noise when turning corners. Before removing a Trac-lok™ unit for repair, drain, flush and refill the axle with the specified lubricant. 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. 31).

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

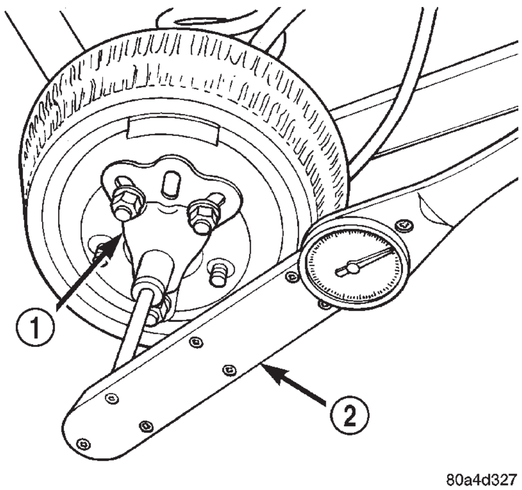


Fig. 31 Trac-lok™ Test -Typical

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

DISASSEMBLY

(1) Clamp side gear Holding Fixture 6965 in a vise and position the differential case on the Holding Fixture (Fig. 32).

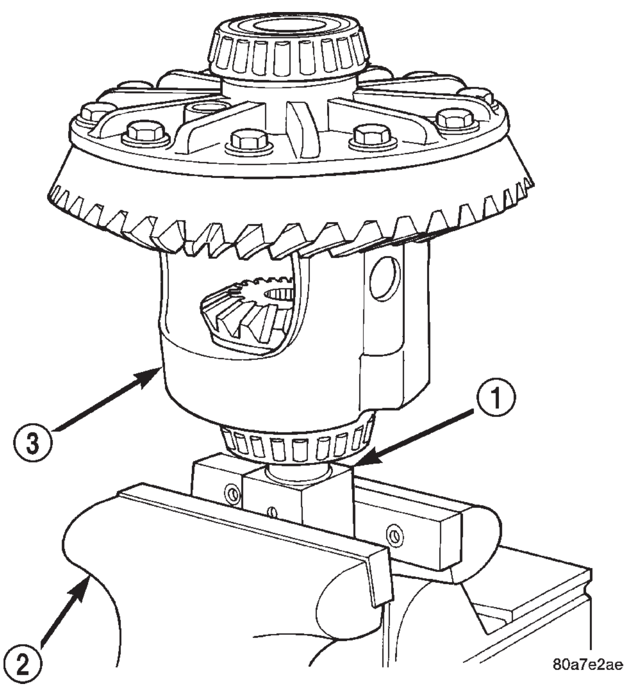


Fig. 32 Differential Case Holding Fixture

1 - FIXTURE
2 - VISE
3 - DIFFERENTIAL

(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 the pinion gear mate shaft lock screw (Fig. 33).

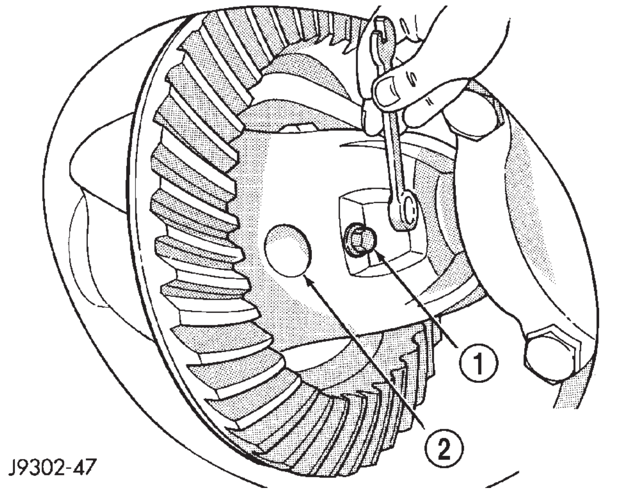


Fig. 33 Mate Shaft Lock Screw

1 - LOCK SCREW
2 - PINION GEAR MATE SHAFT

(4) Remove pinion gear mate shaft with a drift and hammer (Fig. 34).

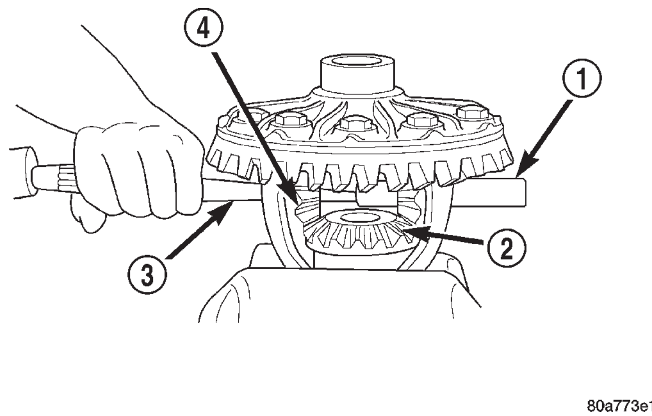


Fig. 34 Pinion Shaft

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

(5) Install and lubricate Step Plate C-6960-3 (Fig. 35).

(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. 36) to prevent adapter from turning.

DIFFERENTIAL - TRAC-LOK (Continued)

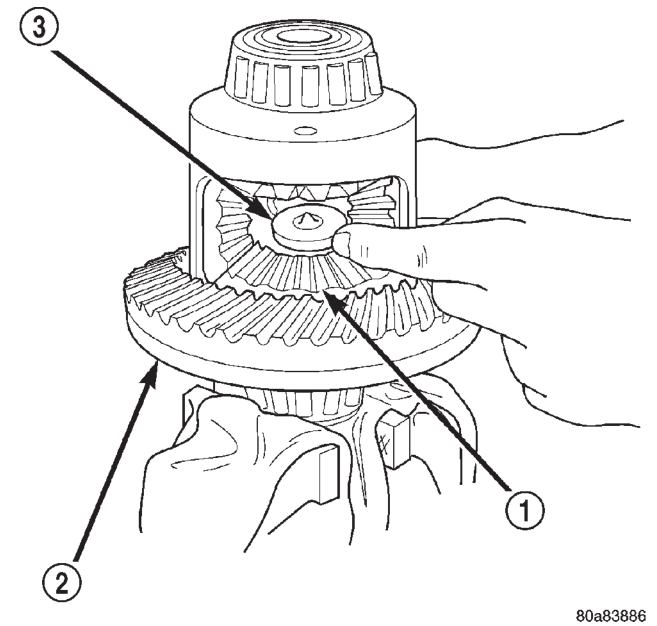


Fig. 35 Step Plate

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

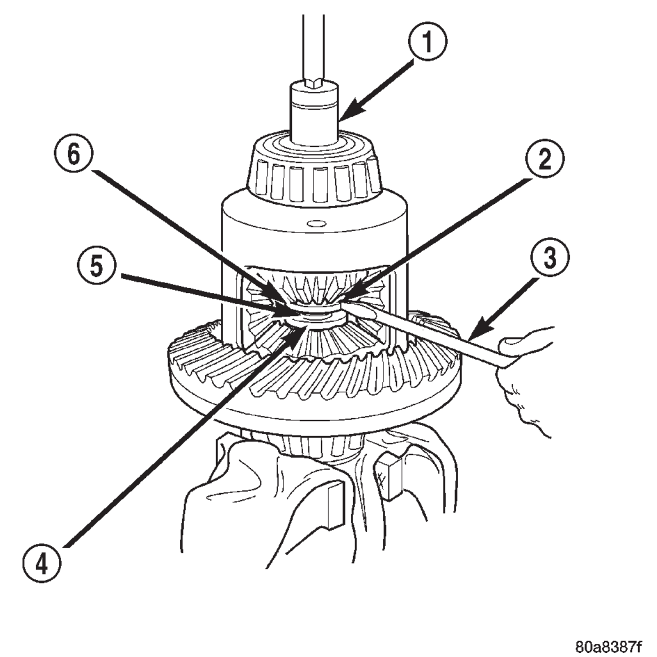


Fig. 36 Threaded Adapter Disc

1 - SOCKET
2 - SLOT IN ADAPTER
3 - SCREWDRIVER
4 - DISC
5 - FORCING SCREW
6 - THREADED 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. 37).

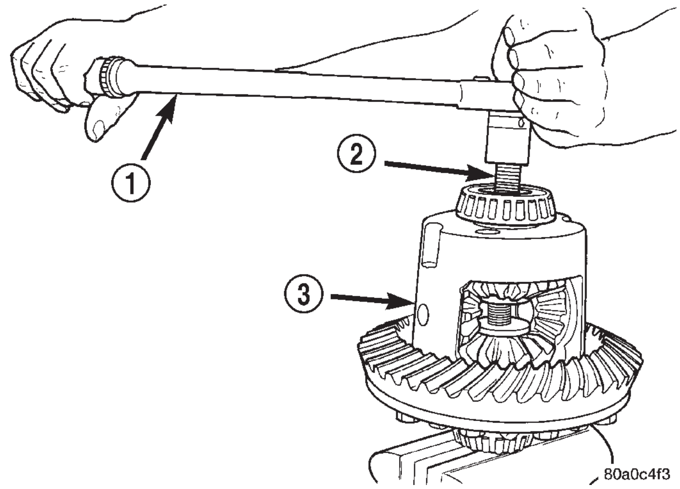


Fig. 37 Compress Belleville Spring

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

(9) With a feeler gauge remove thrust washers from behind the pinion gears (Fig. 38).

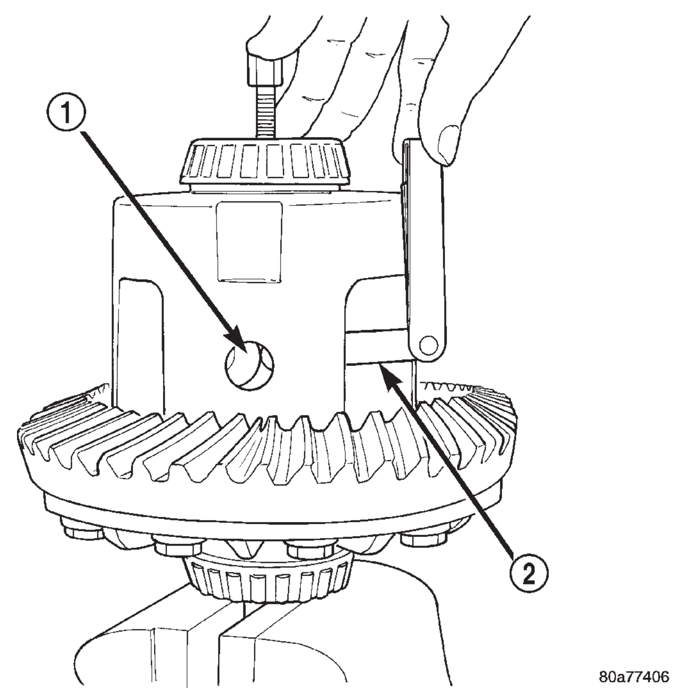


Fig. 38 Pinion Gear Thrust Washer

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. 39).

(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.

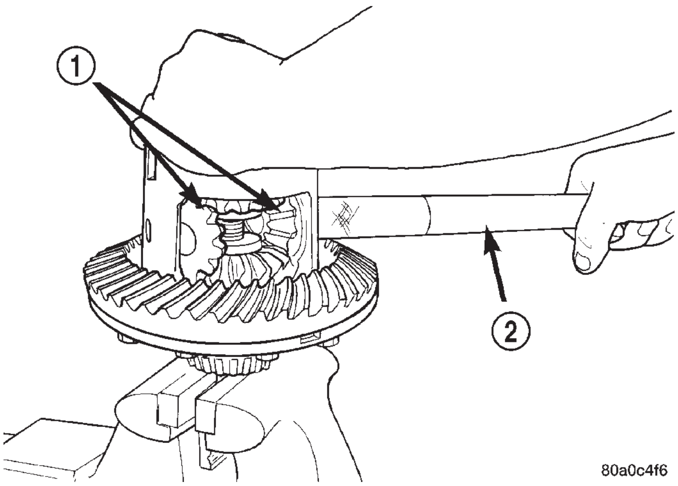


Fig. 39 Pinion Gear

1 - PINION GEARS
2 - TURNING BAR

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

(15) Remove top side gear, clutch pack retainer and clutch pack. Keep plates in correct order during removal (Fig. 40).

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

ASSEMBLY

Clean all components in cleaning solvent. Dry components with compressed air. Inspect clutch pack plates for wear, scoring or damage. Replace both clutch packs if any one component in either pack is damaged. Inspect side gears and pinions. Replace any gear that is worn, cracked, chipped or damaged. Inspect differential case and pinion shaft. Replace if worn or damaged.

Lubricate each component with gear lubricant before assembly.

(1) Assemble the clutch discs into packs and secure disc packs with retaining clips (Fig. 41).

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.

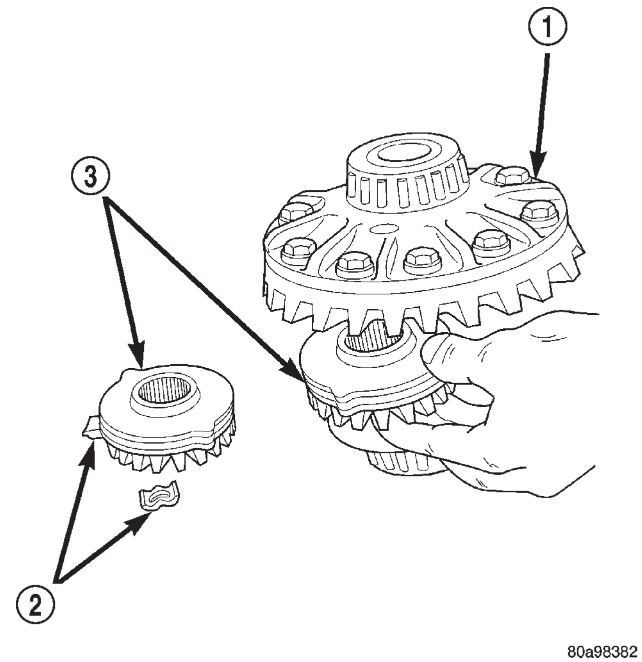


Fig. 40 Side Gear & Clutch Pack

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

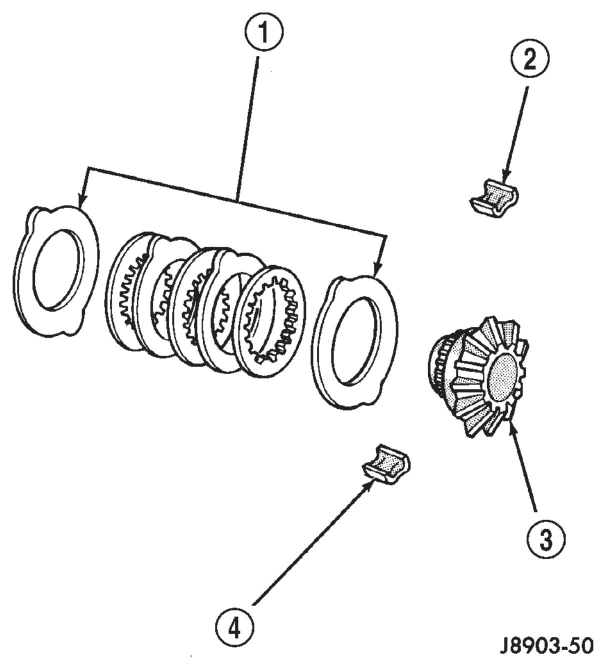


Fig. 41 Clutch Disc Pack

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

DIFFERENTIAL - TRAC-LOK (Continued)

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

(3) Install clutch pack and side gear in the ring gear side of the differential case (Fig. 42). **Be sure clutch pack retaining clips remain in position and are seated in the case pockets.**

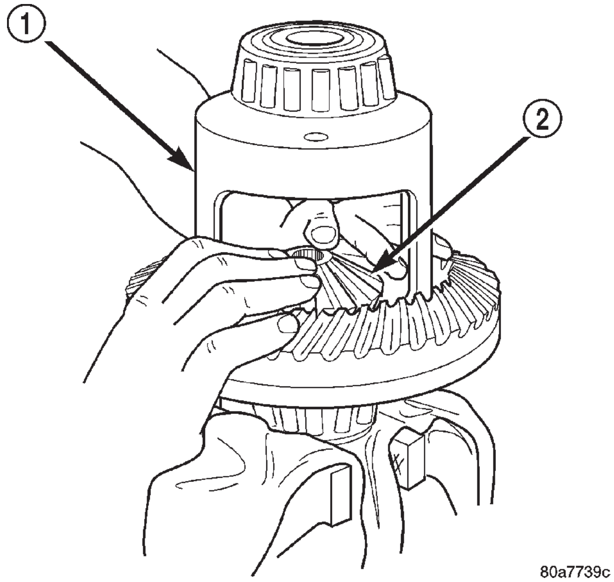


Fig. 42 Clutch Pack and Side Gear

1 - DIFFERENTIAL CASE
2 - SIDE GEAR AND CLUTCH PACK

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

(5) Install lubricated Step Plate C-6960-3 in lower side gear (Fig. 43).

(6) Install the upper side gear and clutch disc pack (Fig. 43).

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

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

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

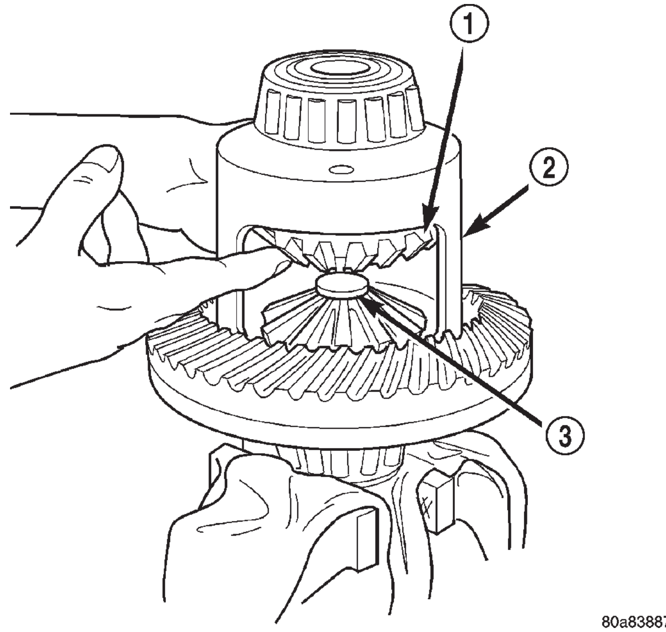


Fig. 43 Clutch Pack and Upper Side Gear

1 - SIDE GEAR AND CLUTCH PACK
2 - DIFFERENTIAL CASE
3 - STEP PLATE - C-6960-3

(10) 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.

(11) Tighten forcing screw to 122 N·m (90 ft. lbs.) maximum to compress the Belleville springs.

(12) 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.

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

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

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

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

DIFFERENTIAL CASE BEARINGS

REMOVAL

(1) Remove differential case from axle.

(2) Remove differential bearings from the case with Puller/Press C-293-PA and Adapters C-293-48 and Plug SP-3289 (Fig. 44).

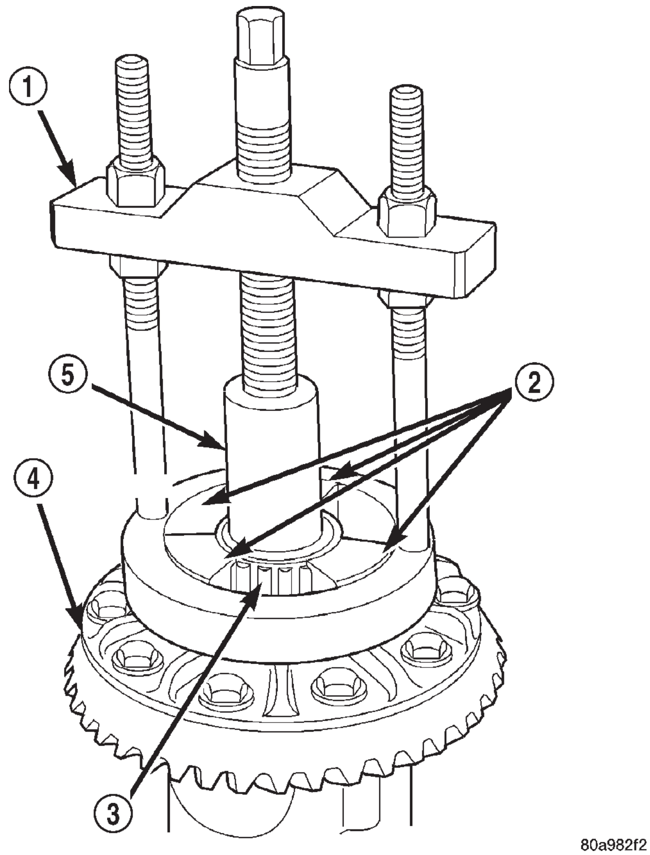


Fig. 44 Differential Bearing Puller

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

INSTALLATION

(1) Install differential side bearings with Installer C-4340 and Handle C-4171 (Fig. 45).

(2) Install differential case in axle.

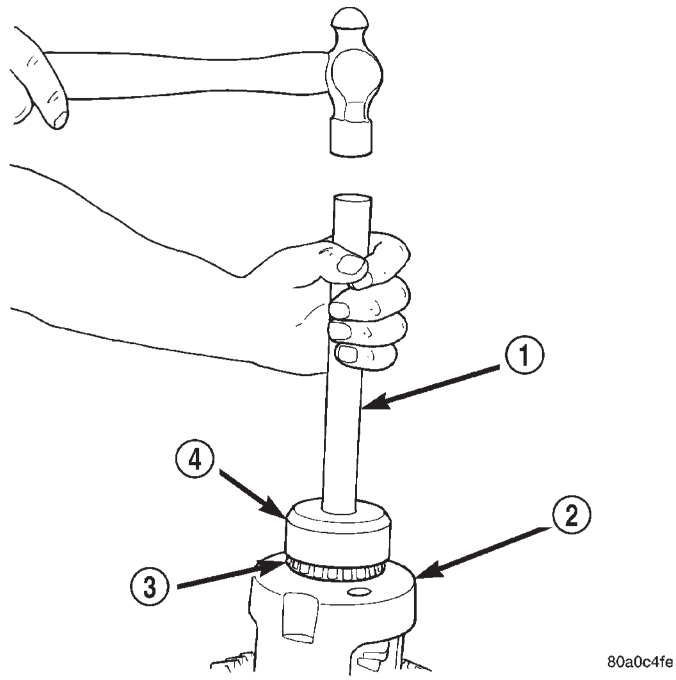


Fig. 45 Differential Bearing Installer

1 - HANDLE
2 - DIFFERENTIAL
3 - BEARING
4 - INSTALLER

PINION GEAR/RING GEAR/ TONE RING

REMOVAL

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

(1) Remove differential from the axle housing.

(2) Mark the companion flange and propeller shaft for installation alignment.

(3) Disconnect propeller shaft from the companion flange and tie propeller shaft to underbody.

(4) Place differential case in a suitable vise with soft metal jaw protectors. (Fig. 46).

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

(6) Drive ring gear off the differential case with a rawhide hammer (Fig. 46).

(7) Install bolts into two of the threaded holes in the companion flange 180° apart.

(8) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so the Holder 6719 is held to the flange.

PINION GEAR/RING GEAR/TONE RING (Continued)

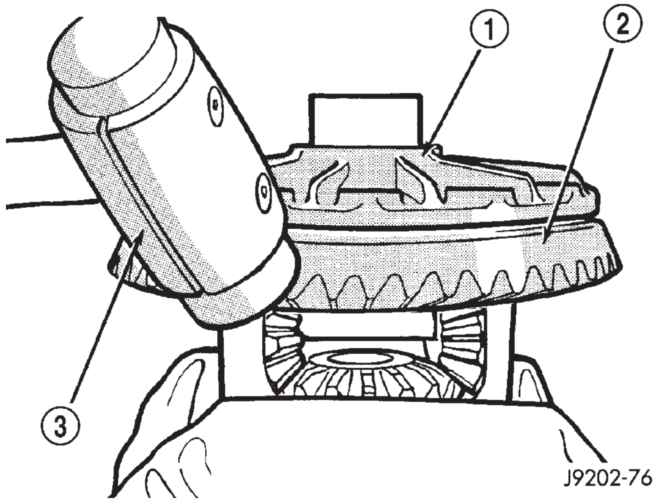


Fig. 46 Ring Gear

1 - CASE
2 - RING GEAR
3 - RAWHIDE HAMMER

(9) Hold companion flange with Holder 6719 and remove companion flange nut and washer.

(10) Remove the companion flange with Remover C-452 (Fig. 47).

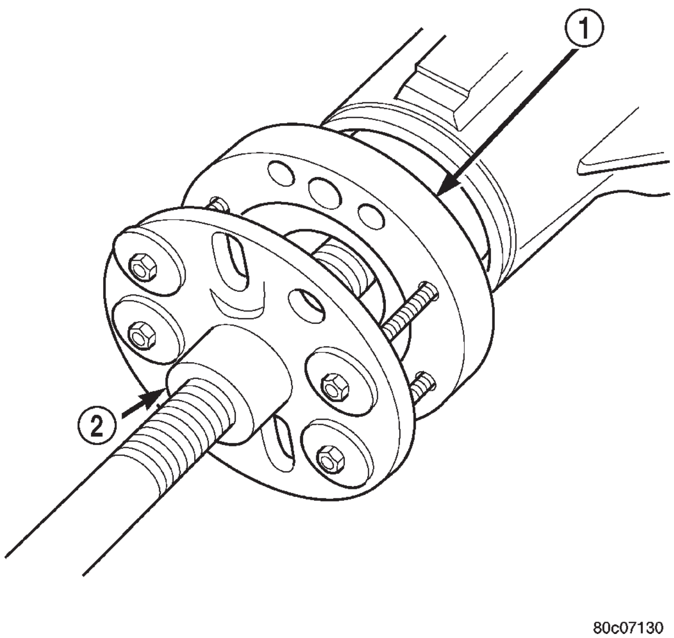


Fig. 47 Companion Flange

1 - COMPANION FLANGE
2 - PULLER

(11) Remove pinion from housing (Fig. 48).

(12) Remove pinion seal with a pry tool or slide-hammer mounted screw.

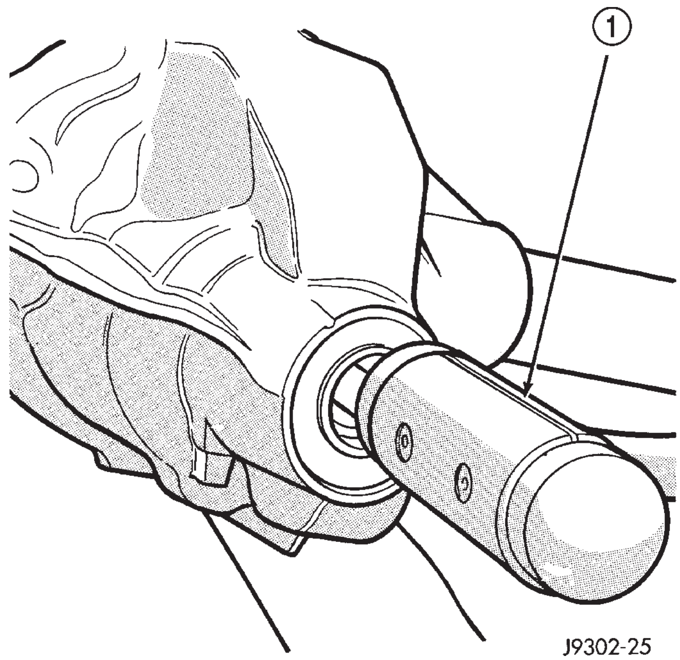


Fig. 48 Pinion Gear

1 - RAWHIDE HAMMER

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

(14) Remove front pinion bearing cup with Remover C-4345 and Handle C–4171 (Fig. 49).

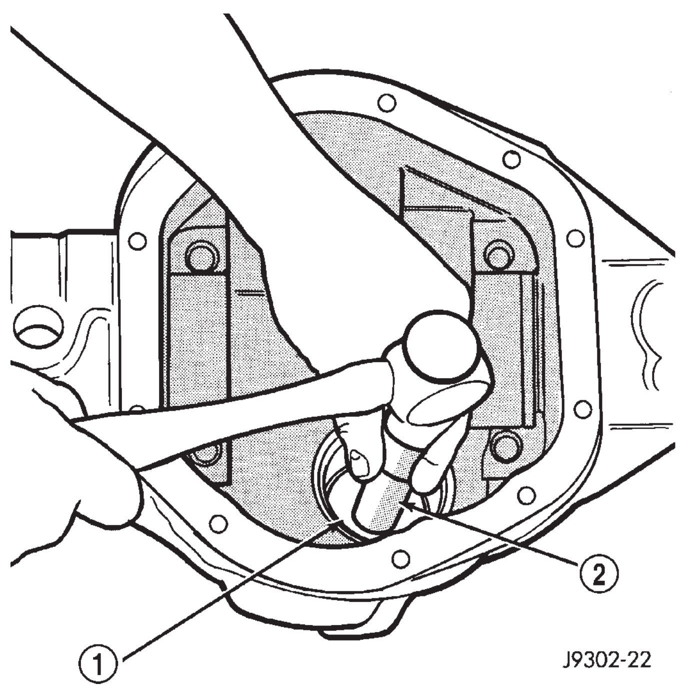


Fig. 49 Front Pinion Bearing Cup

1 - REMOVER
2 - HANDLE

PINION GEAR/RING GEAR/TONE RING (Continued)

(15) Remove the rear bearing cup from housing (Fig. 50) with Remover C-4307 and Handle C–4171.

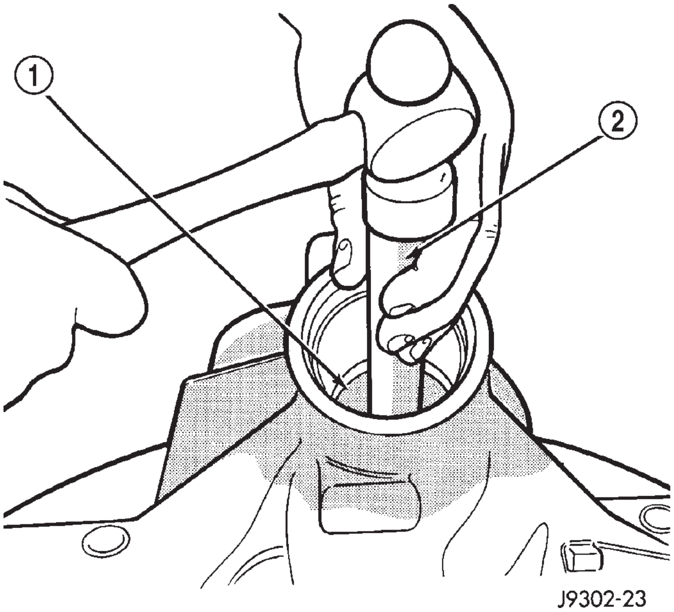


Fig. 50 Rear Pinion Bearing Cup

1 - REMOVER
2 - HANDLE

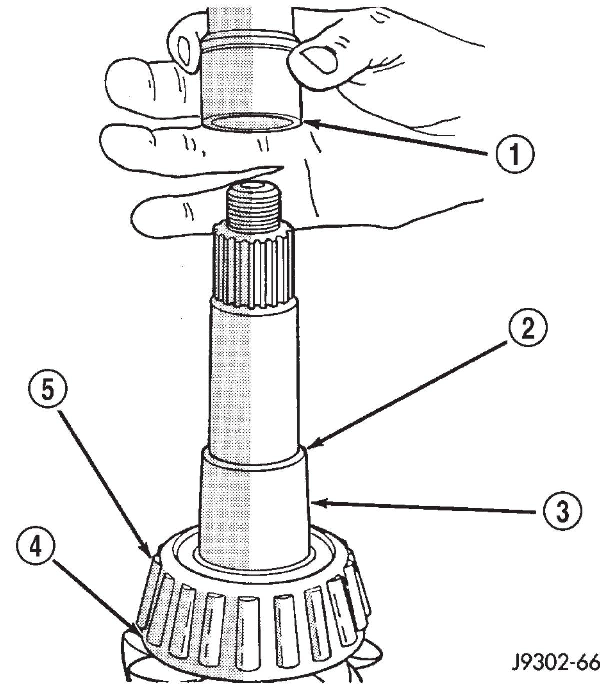


Fig. 51 Collapsible Spacer

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

(16) Remove collapsible preload spacer (Fig. 51).
(17) Remove rear bearing from pinion (Fig. 52) with Puller/Press C-293-PA and Adapters C-293-47.
(18) Remove depth shims from the pinion shaft and record shim thickness.

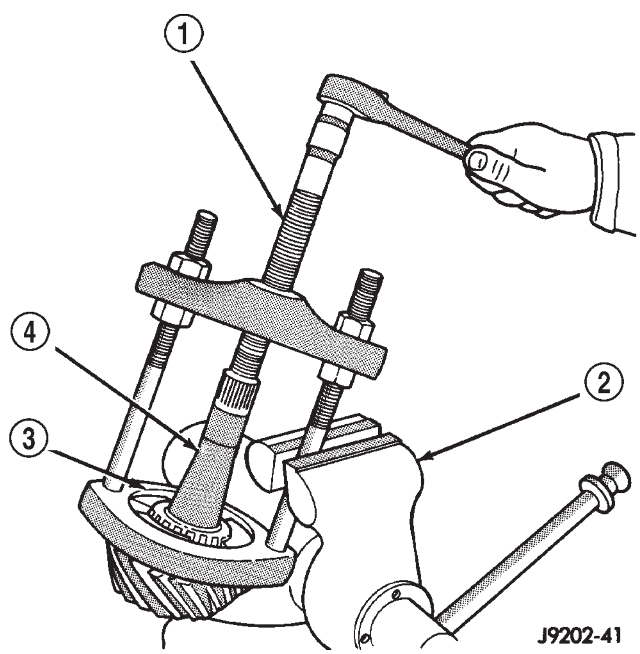


Fig. 52 Rear Pinion Bearing

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

INSTALLATION

NOTE: The ring gear and pinion are serviced in a matched set. Do not replace the pinion without replacing the ring gear. If ring and pinion gears or bearings are replaced, Refer to Adjustments for Pinion Gear Depth Setting.

(1) Apply Mopar Door Ease or stick lubricant to outside surface of bearing cup.
(2) Install rear pinion bearing cup (Fig. 53) with Installer C-4308 and Driver Handle C-4171 and verify cup is seated.
(3) Apply Mopar Door Ease or stick lubricant to outside surface of bearing cup.
(4) Install front pinion bearing cup (Fig. 54) with Installer D-130 and Handle C-4171 and verify cup is seated.

PINION GEAR/RING GEAR/TONE RING (Continued)

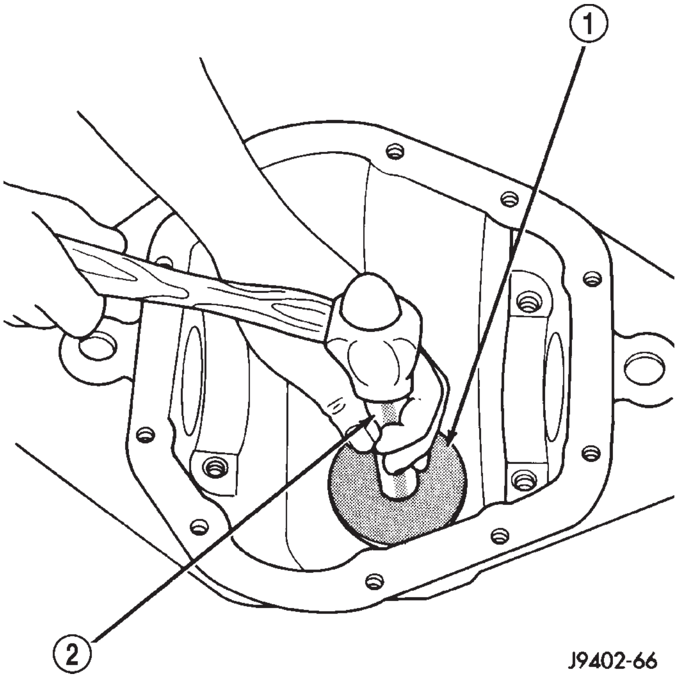


Fig. 53 Rear Pinion Bearing Cup

1 - INSTALLER
2 - HANDLE

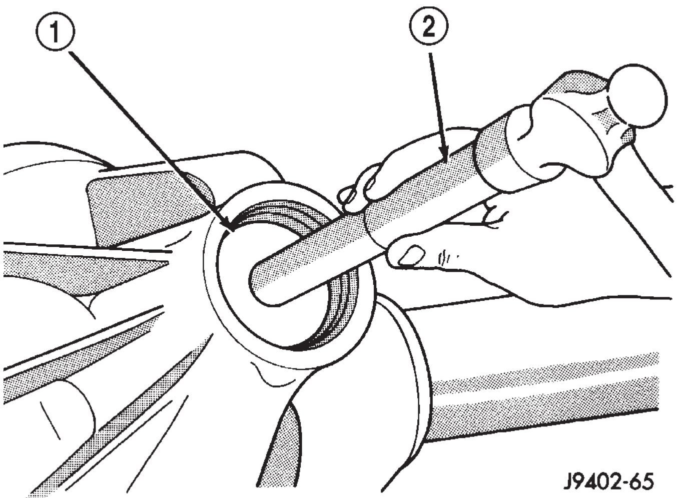


Fig. 54 Front Pinion Bearing Cup

1 - INSTALLER
2 - HANDLE

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

(6) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer C-4076–B and Handle C-4735-1 (Fig. 55).

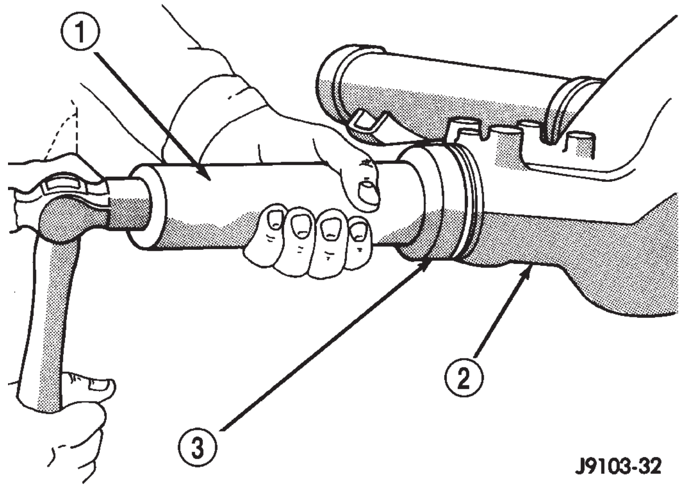


Fig. 55 Pinion Seal

1 - HANDLE
2 - DIFFERENTIAL HOUSING
3 - INSTALLER

(7) Place the proper thickness depth shim on the pinion shaft.

(8) Install the rear bearing and slinger if equipped, on the pinion (Fig. 56) with Installer 6448 and a press.

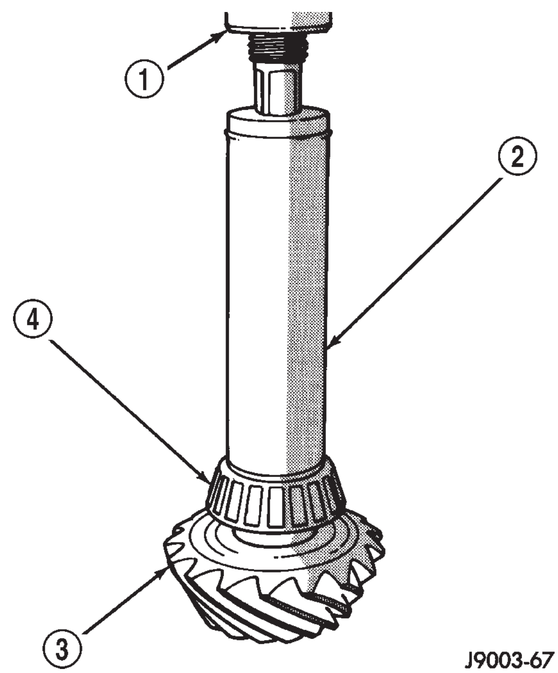


Fig. 56 Rear Pinion Bearing

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

PINION GEAR/RING GEAR/TONE RING (Continued)

(9) Install a **new** collapsible preload spacer on pinion shaft and install the pinion into the housing (Fig. 57).

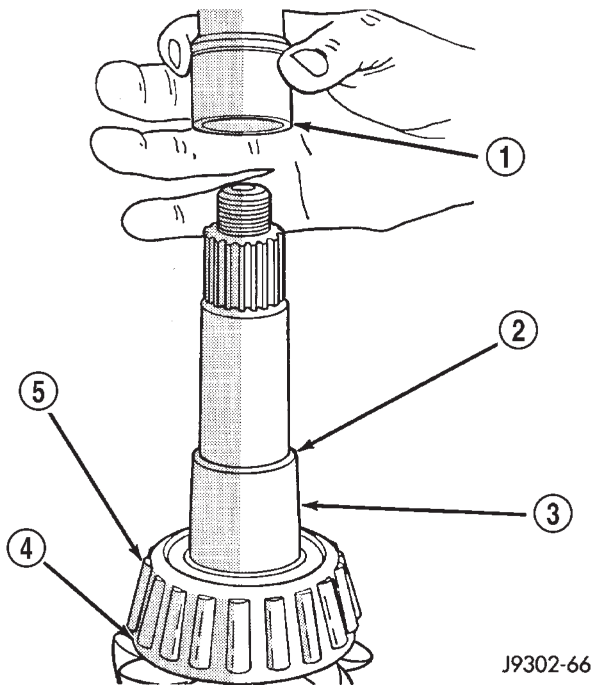


Fig. 57 Collapsible Preload Spacer

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

(10) Install companion flange with Installer C-3718 and Holder 6719.

(11) Install bolts into two of the threaded holes in the companion flange 180° apart.

(12) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so the Holder 6719 is held to the flange.

(13) Install the companion flange washer and a new nut on the pinion and tighten the pinion nut until there is zero bearing end-play.

(14) Tighten the nut to 285 N·m (210 ft. lbs.) (Fig. 58).

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

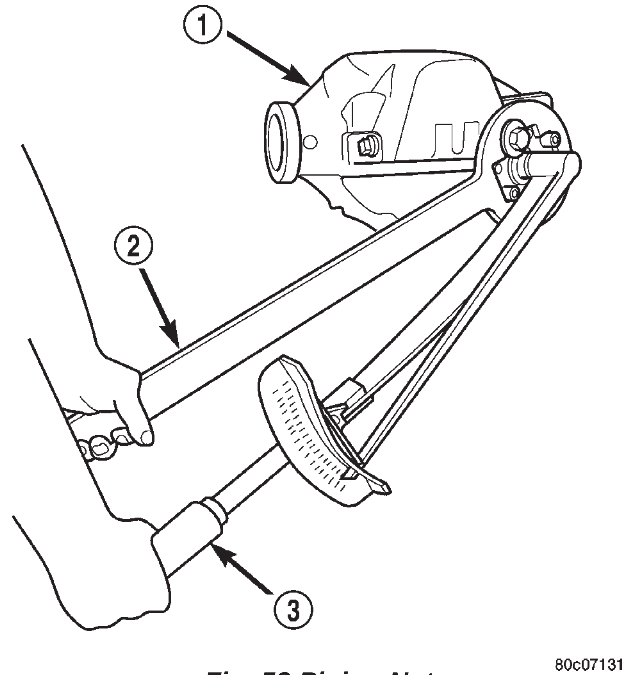


Fig. 58 Pinion Nut

1 - DIFFERENTIAL HOUSING
2 - HOLDER
3 - TORQUE WRENCH

(15) Slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until the desired rotating torque is achieved. Measure the rotating torque frequently to avoid over crushing the collapsible spacer (Fig. 59).

(16) Check bearing rotating torque with an inch pound torque wrench (Fig. 59). The torque necessary to rotate the pinion should be:

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

PINION GEAR/RING GEAR/TONE RING (Continued)

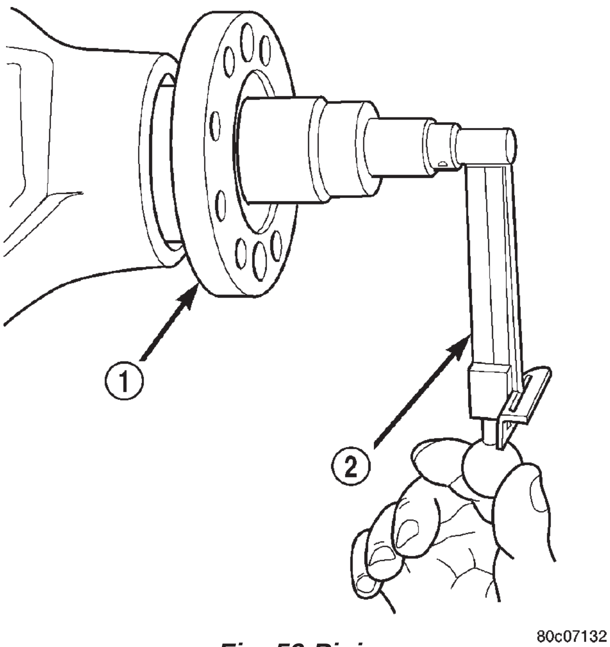


Fig. 59 Pinion

1 - COMPANION FLANGE
2 - TORQUE WRENCH

(17) Position exciter ring on differential case.

(18) Using a brass drift, slowly and evenly tap the exciter ring into position.

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

(20) Invert the differential case in the vise.

(21) Install **new** ring gear bolts and alternately tighten to 102 N·m (75 ft. lbs.) (Fig. 60).

CAUTION: Do not reuse the bolts that held the ring gear to the differential case. The bolts can fracture causing extensive damage.

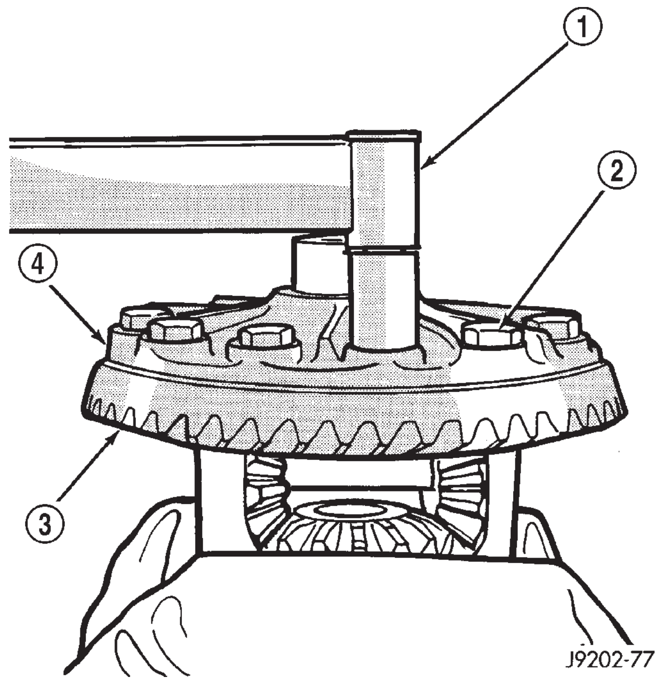


Fig. 60 Ring Gear Bolts

1 - TORQUE WRENCH
2 - RING GEAR BOLTS
3 - RING GEAR
4 - DIFFERENTIAL CASE

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

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

(24) Install propeller shaft wtih reference marks aligned.

(25) Remove support and lower vehicle.

REAR AXLE - 9 1/4

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REAR AXLE - 9 1/4

DESCRIPTION

The 9 1/4 Inch axle housings consist of a cast iron center section with axle tubes extending from either side. The tubes are pressed into and welded to the differential housing to form a one-piece axle housing (Fig. 1).

The axles have a vent hose to relieve internal pressure caused by lubricant vaporization and internal expansion.

The axles are equipped with semi-floating axle shafts, meaning vehicle loads are supported by the axle shaft and bearings. The axle shafts are retained by C-locks in the differential side gears.

The removable, stamped steel cover provides a means for inspection and service without removing the complete axle from the vehicle.

The axle has a date tag and a gear ratio tag. The tags are attached to the differential housing by a cover bolt.

The rear wheel anti-lock (RWAL) brake speed sensor is attached to the top, forward exterior of the differential housing. A seal is located between the sensor and the wire harness connector. The seal must be in place when the wire connector is connected to the sensor. The RWAL brake exciter ring is press-fitted onto the differential case against the ring gear flange.

The differential case is a one-piece design. The differential pinion mate shaft is retained with a threaded pin. Differential bearing preload and ring gear backlash are set and maintained by threaded adjusters at the outside of the differential housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer.

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

The axle differential cover can be used for identification of the axle and (Fig. 2). A ratio tag is attached to the differential cover.

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.

REAR AXLE - 9 1/4 (Continued)

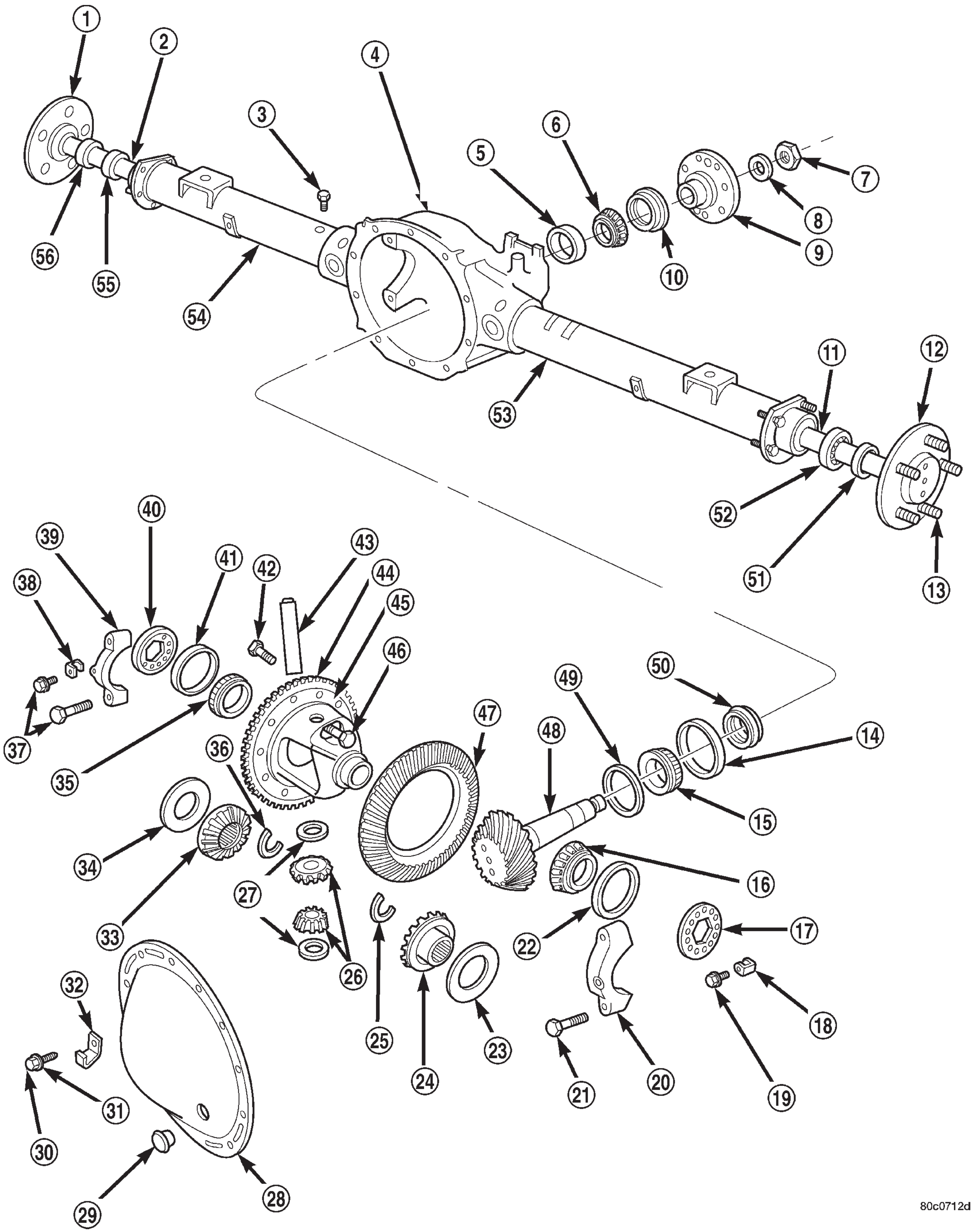


Fig. 1 9 1/4 Axle

REAR AXLE - 9 1/4 (Continued)

1 - HUB
2 - AXLE SHAFT
3 - VENT FITTING
4 - DIFFERENTIAL HOUSING
5 - CUP
6 - FRONT PINION BEARING CONE
7 - NUT
8 - WASHER
9 - COMPANION FLANGE
10 - SEAL
11 - AXLE SHAFT
12 - HUB
13 - STUD
14 - BEARING CUP
15 - REAR PINION BEARING CONE
16 - DIFFERENTIAL BEARING
17 - ADJUSTER
18 - LOCK
19 - BOLT
20 - BEARING CAP
21 - CAP BOLT
22 - BEARING CUP
23 - THRUST WASHER
24 - SIDE GEAR
25 - C-LOCK
26 - DIFFERENTIAL POSITIONS
27 - THRUST WASHER
28 - COVER
29 - PLUG
30 - COVER BOLT
31 - WASHER
32 - CLIP
33 - SIDE GEAR
34 - THRUST WASHER
35 - DIFFERENTIAL BEARING CONE
36 - C-LOCK
37 - BOLT
38 - LOCK
39 - BEARING CUP
40 - ADJUSTER
41 - BEARING CUP
42 - BOLT
43 - PINION MATE SHAFT
44 - EXCITER RING
45 - DIFFERENTIAL CASE
46 - RING GEAR BOLT
47 - RING GEAR
48 - PINION
49 - PINION GEAR DEPTH SHIM
50 - PRELOAD COLLAPSIBLE SPACER
51 - SEAL
52 - AXLE SHAFT BEARING
53 - AXLE SHAFT TUBE
54 - AXLE TUBE
55 - AXLE SHAFT BEARING
56 - SEAL

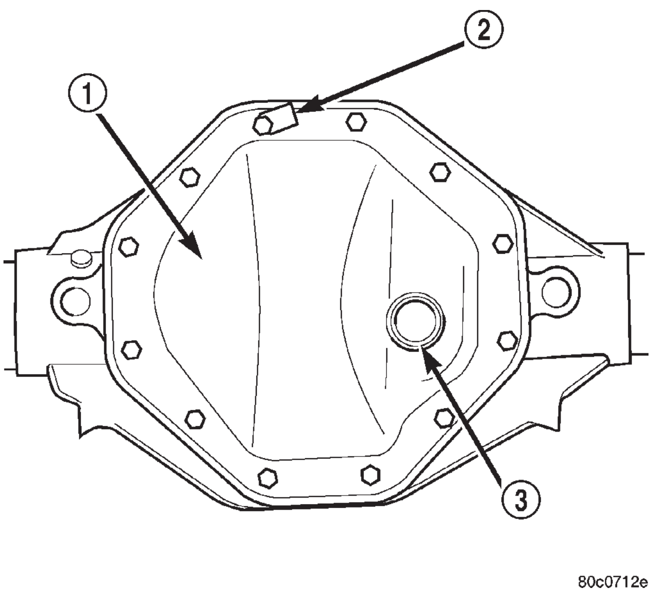


Fig. 2 Differential Cover

1 - DIFFERENTIAL COVER
2 - RATIO TAG
3 - FILL PLUG

DIAGNOSIS AND TESTING - AXLE

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 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.

REAR AXLE - 9 1/4 (Continued)

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.

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. 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.

REAR AXLE - 9 1/4 (Continued)

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

REAR AXLE - 9 1/4 (Continued)

Condition	Possible Causes	Correction
Axle Noise	1. Insufficient lubricant.	1. Fill differential with the correct fluid type and quantity.
	2. Improper ring gear and pinion adjustment.	2. Check ring gear and pinion contact pattern. 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.

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) Secure brake drums to the axle shaft.
(6) Remove the RWAL sensor from the differential housing. Refer to Brakes for procedures.
(7) Disconnect the brake hose at the axle junction block. Do not disconnect the brake hydraulic lines at the wheel cylinders. Refer to Brakes for procedures.
(8) Remove parking brake cables and cable brackets.
(9) Disconnect the vent hose from the axle shaft tube.
(10) Mark propeller shaft and companion flange for installation reference.
(11) Remove propeller shaft.
(12) Remove shock absorbers from axle.
(13) Remove spring clamps and spring brackets. Refer to Suspension for procedures.
(14) Separate the axle from the vehicle.

INSTALLATION

(1) Raise the axle with lifting device and align to leaf spring centering bolts.
(2) Install spring clamps and spring brackets. Refer to Suspension for procedures.
(3) Install shock absorbers and tighten nuts to 82 N·m (60 ft. lbs.).
(4) Install RWAL sensor to the differential housing. Refer to Brakes for procedures.
(5) Install parking brake cables and cable brackets.
(6) Install brake drums. Refer to Brakes for procedures.
(7) Connect brake hose to the axle junction block. Refer to Brakes for procedures.
(8) Install axle vent hose.
(9) Install propeller shaft with reference marks aligned. Install companion flange bolts and tighten to 108 N·m (80 ft. lbs.).
(10) Install the wheels and tires.
(11) Add gear lubricant, if necessary. Refer to Lubricant for lubricant requirements.
(12) Remove lifting device from axle and lower the vehicle.

REAR AXLE - 9 1/4 (Continued)

ADJUSTMENTS

Ring gear and pinion are supplied as matched sets only. The identifying numbers for the ring gear and pinion are painted onto the pinion gear shaft (Fig. 3) and the side of the ring gear. A plus (+) number, minus (–) number or zero (0) along with the gear set sequence number (01 to 99) is on each gear. This first number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion marked with a (0). The next two numbers are the sequence number of the gear set. The standard depth provides the best teeth contact pattern. Refer to Backlash and Contact Pattern for additional information.

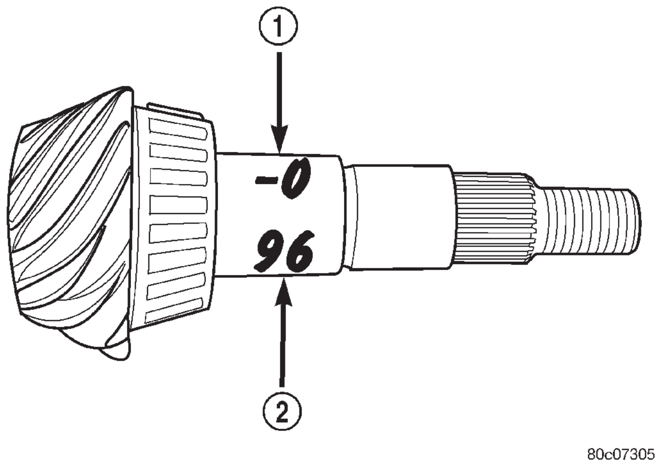


Fig. 3 Pinion ID Number

1 - VARIANCE NUMBER
2 - SEQUENCE NUMBER

Compensation for pinion depth variance is achieved with select shims. The shims are placed behind the rear pinion bearing. (Fig. 4).

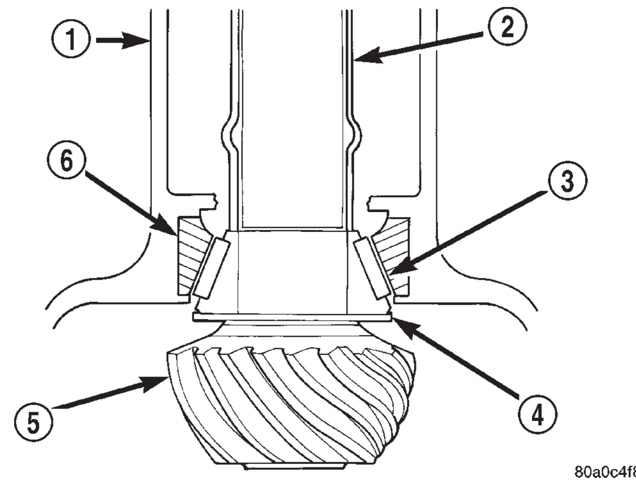


Fig. 4 Adjustment Shim Locations

1 - DIFFERENTIAL HOUSING
2 - COLLAPSIBLE SPACER
3 - PINION BEARING
4 - PINION DEPTH SHIM
5 - PINION GEAR
6 - BEARING CUP

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

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

Note the painted number on the shaft of the drive pinion (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth 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.

REAR AXLE - 9 1/4 (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

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).

(1) Assemble Pinion Height Block 6739, Pinion Block 8542 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. 5).

(4) Place Arbor Disc 8541 on Arbor D-115-3 in position in the 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 8541 has different step diameters to fit other axles. Choose proper step for axle being serviced.

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

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are flush against the rearward surface of the pinion height block (Fig. 5). Hold scooter block in place and zero the dial indicator. Tighten dial indicator face lock screw.

(7) Slowly slide the dial indicator probe over the edge of the pinion height block.

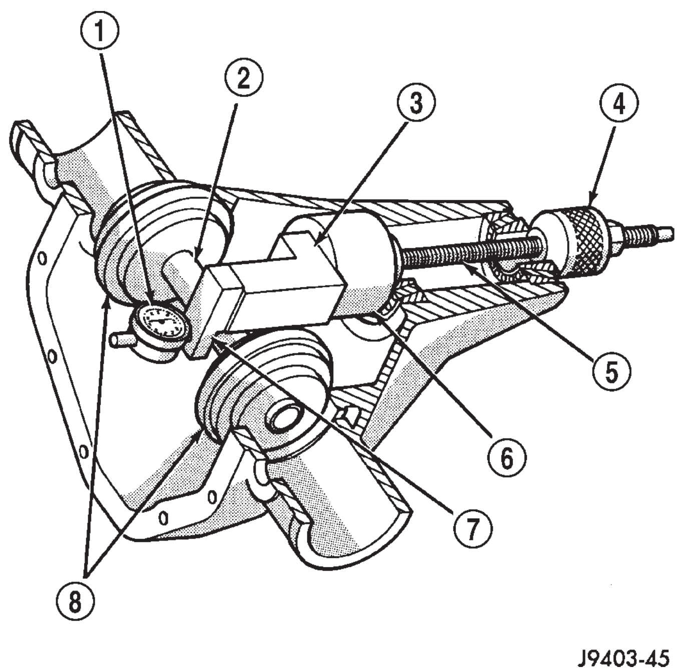


Fig. 5 Pinion Depth Gauge Tools

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

REAR AXLE - 9 1/4 (Continued)

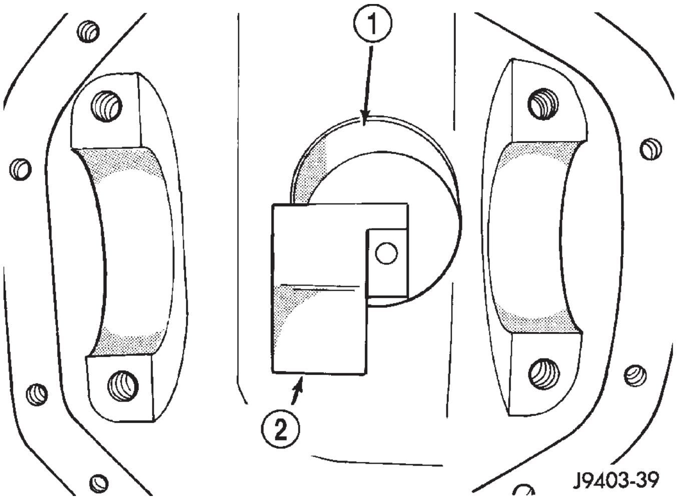


Fig. 6 Pinion Height Block

1 - PINION BLOCK
2 - PINION HEIGHT BLOCK

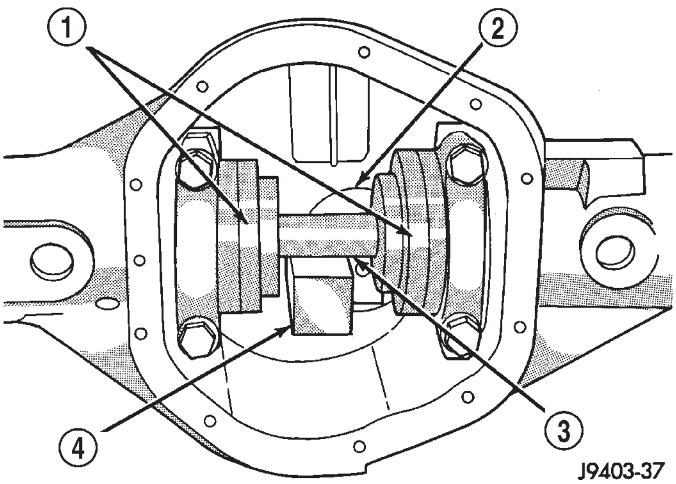


Fig. 7 Pinion Depth Tools

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

(8) Slide the dial indicator probe across the gap between the pinion height block and the arbor bar with the scooter block against the pinion height block (Fig. 8). When the dial probe contacts the arbor bar, the dial pointer will turn clockwise. Continue moving the dial probe to the crest of the arbor bar and record the highest reading. If the dial indicator can not achieve the zero reading, the rear bearing cup or the pinion depth gauge set is not installed correctly.

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

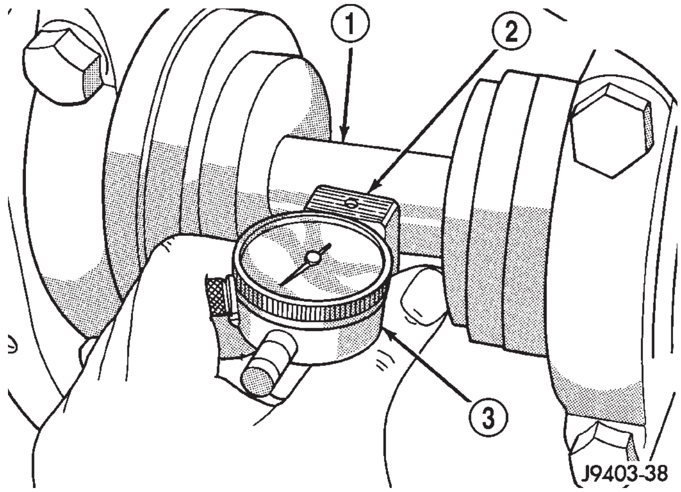


Fig. 8 Pinion Gear Depth Measurement

1 - ARBOR
2 - SCOOTER BLOCK
3 - DIAL INDICATOR

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

The following must be considered when adjusting bearing preload and gear backlash:

- The maximum ring gear backlash variation is 0.003 inch (0.076 mm).
- Mark the gears so the same teeth are meshed during all backlash measurements.
- Maintain the torque while adjusting the bearing preload and ring gear backlash.
- Excessive adjuster torque will introduce a high bearing load and cause premature bearing failure. Insufficient adjuster torque can result in excessive differential case free-play and ring gear noise.
- Insufficient adjuster torque will not support the ring gear correctly and can cause excessive differential case free-play and ring gear noise.

NOTE: The differential bearing cups will not always immediately follow the threaded adjusters as they are moved during adjustment. To ensure accurate bearing cup responses to the adjustments:

- Maintain the gear teeth engaged (meshed) as marked.
- The bearings must be seated by rapidly rotating the pinion gear a half turn back and forth.
- Do this five to ten times each time the threaded adjusters are adjusted.

(1) Use Wrench C-4164 to adjust each threaded adjuster inward until the differential bearing free-play is eliminated (Fig. 9). Allow some ring gear backlash (approximately 0.25 mm / 0.01 inch) between the ring and pinion gear. Seat the bearing cups with the procedure described above.

REAR AXLE - 9 1/4 (Continued)

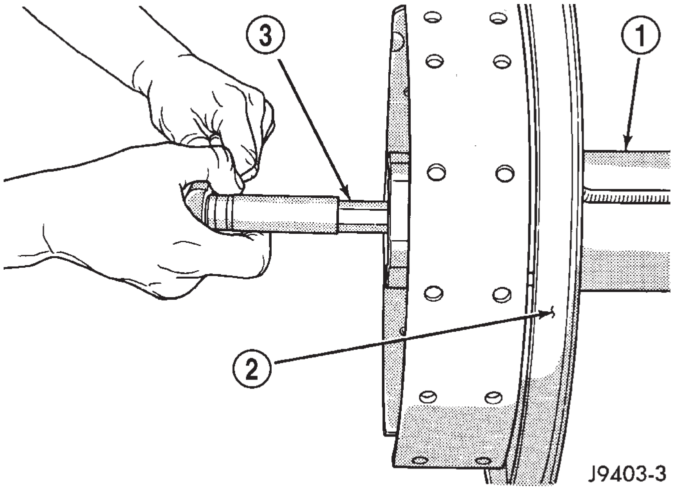


Fig. 9 Threaded Adjuster Tool

1 - AXLE TUBE
2 - BACKING PLATE
3 - THREAD ADJUSTER WRENCH

(2) Install dial indicator and position the plunger against the drive side of a ring gear tooth (Fig. 10). Measure the backlash at 4 positions (90 degrees apart) around the ring gear. Locate and mark the area of minimum backlash.

(3) Rotate the ring gear to the position of the least backlash. Mark the gear so that all future backlash measurements will be taken with the same gear teeth meshed.

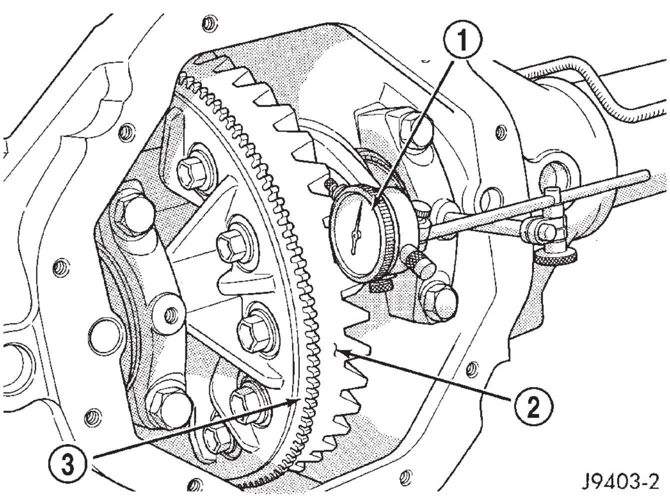


Fig. 10 Ring Gear Backlash

1 - DIAL INDICATOR
2 - RING GEAR
3 - EXCITER RING

(4) Loosen the right-side, tighten the left-side threaded adjuster. Obtain backlash of 0.003 to 0.004 inch (0.076 to 0.102 mm) with each adjuster tightened to 14 N·m (10 ft. lbs.). Seat the bearing cups with the procedure described above.

(5) Tighten the differential bearing cap bolts 136 N·m (100 ft. lbs.).

(6) Tighten the right-side threaded adjuster to 102 N·m (75 ft. lbs.). Seat the bearing cups with the procedure described above. Continue to tighten the right-side adjuster and seat bearing cups until the torque remains constant at 102 N·m (75 ft. lbs.)

(7) Measure the ring gear backlash. The range of backlash is 0.006 to 0.008 inch (0.15 to 0.203 mm).

(8) Continue increasing the torque at the right-side threaded adjuster until the specified backlash is obtained.

NOTE: The left-side threaded adjuster torque should have approximately 102 N·m (75 ft. lbs.). If the torque is considerably less, the complete adjustment procedure must be repeated.

(9) Tighten the left-side threaded adjuster until 102 N·m (75 ft. lbs.) torque is indicated. Seat the bearing rollers with the procedure described above. Do this until the torque remains constant.

(10) Install the threaded adjuster locks and tighten the lock screws to 10 N·m (90 in. lbs.).

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

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 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. 11)and adjust pinion depth and gear backlash as necessary.

REAR AXLE - 9 1/4 (Continued)

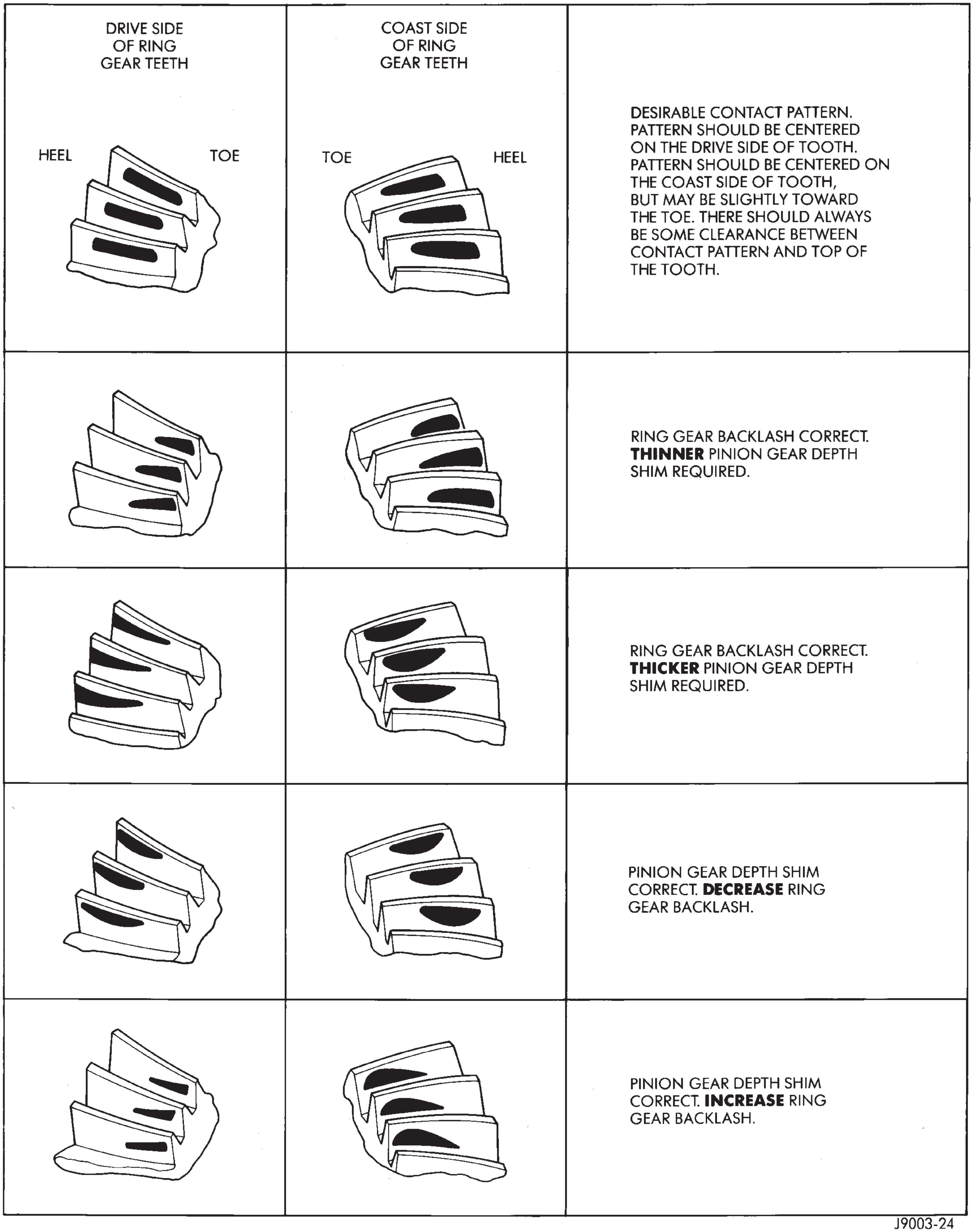


Fig. 11 Gear Tooth Contact Patterns

REAR AXLE - 9 1/4 (Continued)

SIDE GEAR CLEARANCE

When measuring side gear clearance, check each gear independently. If it necessary to replace a side gear, replace both gears as a matched set.

(1) Install the axle shafts and C-locks and pinion mate shaft.

(2) Measure each side gear clearance. Insert a matched pair of feeler gauge blades between the gear and differential housing on opposite sides of the hub (Fig. 12) .

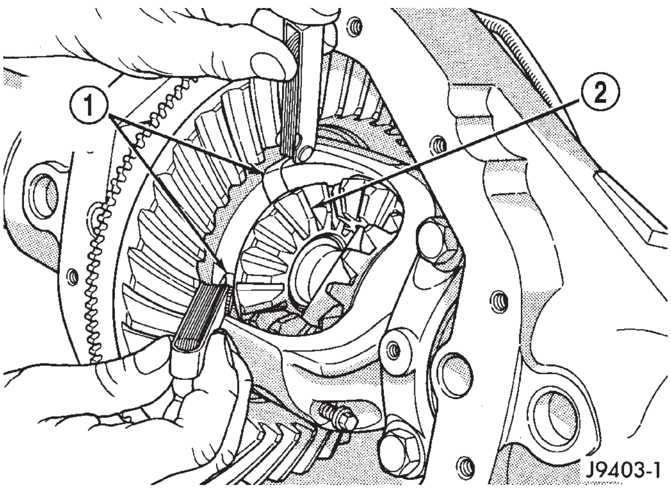


Fig. 12 Side Gear Clearance

1 - FEELER GAUGE
2 - SIDE GEAR

(3) If side gear clearances is no more than 0.005 inch. Determine if the axle shaft is contacting the pinion mate shaft. **Do not remove the feeler gauges, inspect the axle shaft with the feeler gauge inserted behind the side gear.** If the end of the axle shaft is not contacting the pinion mate shaft, the side gear clearance is acceptable.

(4) If clearance is more than 0.005 inch (axle shaft not contacting mate shaft), record the side gear clearance. Remove the thrust washer and measure its thickness with a micrometer. Add the washer thickness to the recorded side gear clearance. The sum of gear clearance and washer thickness will determine required thickness of replacement thrust washer (Fig. 13). In some cases, the end of the axle shaft will

SIDE GEAR CLEARANCE	0.007
THRUST WASHER THICKNESS	+ 0.033
TOTAL	0.040
	→ 0.040
REPLACEMENT WASHER THICKNESS	− 0.037
NEW SIDE GEAR CLEARANCE	0.003

J9203-31

Fig. 13 Side Gear Calculations

move and contact the mate shaft when the feeler gauge is inserted. The C-lock is preventing the side gear from sliding on the axle shaft.

(5) If there is no side gear clearance, remove the C-lock from the axle shaft. Use a micrometer to measure the thrust washer thickness. Record the thickness and re-install the thrust washer. Assemble the differential case without the C-lock installed and re-measure the side gear clearance.

(6) Compare both clearance measurements. If the difference is less than 0.012 inch (0.305 mm), add clearance recorded when the C-lock was installed to thrust washer thickness measured. The sum will determine the required thickness of the replacement thrust washer.

(7) If clearance is 0.012 inch (0.305 mm) or greater, both side gears must be replaced (matched set) and the clearance measurements repeated.

(8) If clearance (above) continues to be 0.012 inch (0.305 mm) or greater, the case must be replaced.

SPECIFICATIONS

REAR AXLE - 9 1/4

AXLE SPECIFICATIONS

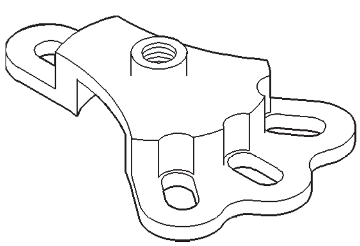
DESCRIPTION	SPECIFICATION
Axle Ratio	3.21, 3.55, 3.92
Differential Case Flange Runout	0.076 mm (0.003 in.)
Differential Case Clearance	0.12 mm (0.005 in.)
Ring Gear Diameter	235 mm (9.25 in.)
Ring Gear Backlash	0.12-0.20 mm (0.005-0.008 in.)
Ring Gear Runout	0.12 mm (0.005 in.)
Pinion Bearing Preload - Original Bearings	1-2 N·m (10-20 in. lbs.)
Pinion Bearing Preload - New Bearings	1.7-4 N·m (15-35 in. lbs.)

TORQUE SPECIFICATIONS

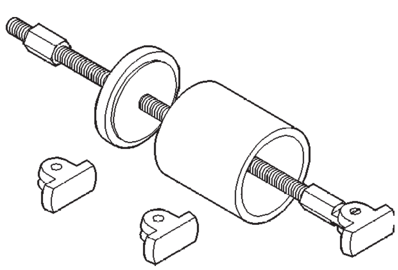
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Differential Cover Bolts	41	30	-
Bearing Cap Bolts	136	100	-
Ring Gear Bolts	157	115	-
Pinion Nut Minimum	285	210	-
Adjuster Lock Screw	10	7.5	90
Backing Plate Bolts	65	48	-

SPECIAL TOOLS

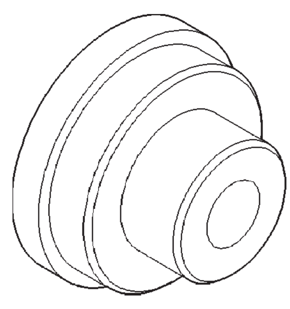
SPECIAL TOOLS



Puller, Hub 6790

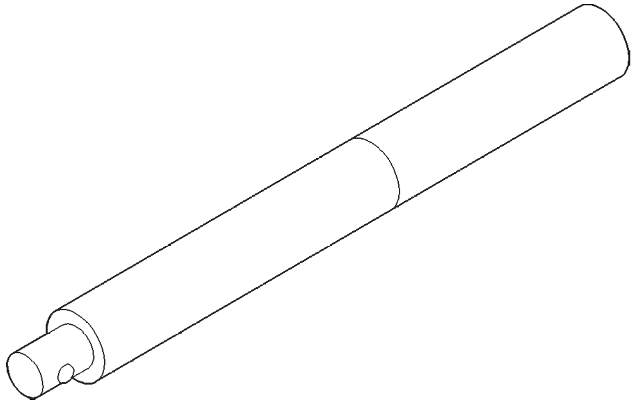


Remover 6310

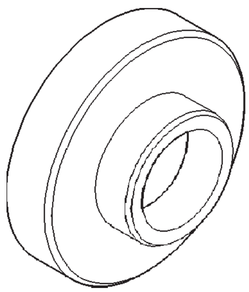


Installer C-4198

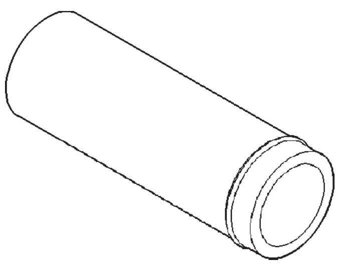
SPECIAL TOOLS (Continued)



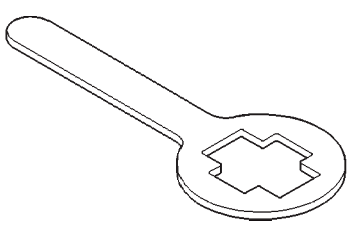
Handle C-4171



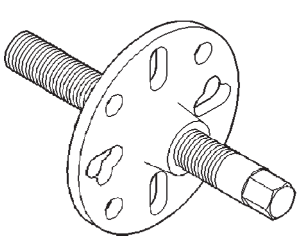
Installer C-4076-B



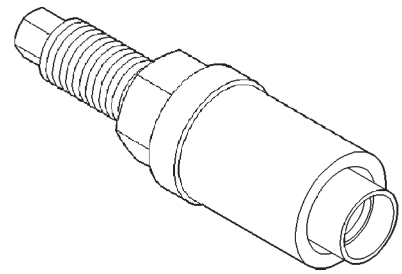
Handle C-4735-1



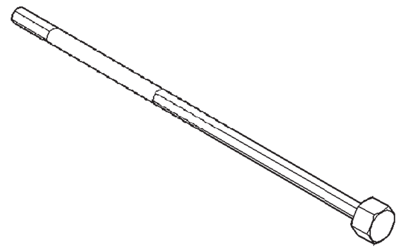
Holder 6719



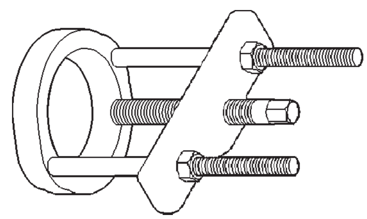
Puller C-452



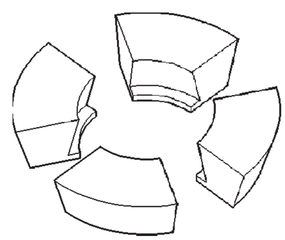
Installer C-3718



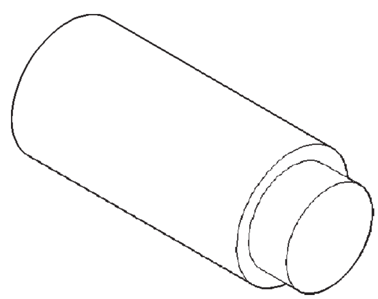
Adjustment Wrench C-4164



Puller/Press C-293–PA

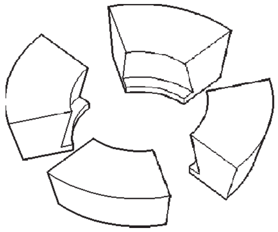


Adapters C-293-48

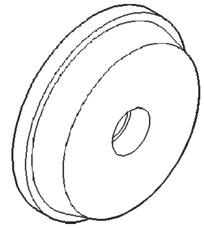


Plug SP-3289

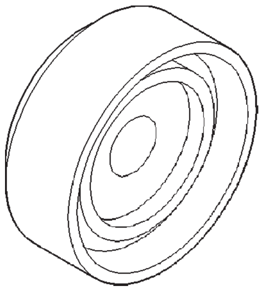
SPECIAL TOOLS (Continued)



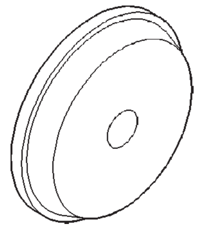
Adapters C-293-47



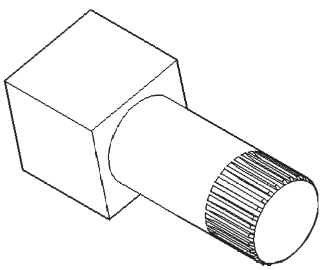
Installer C-4308



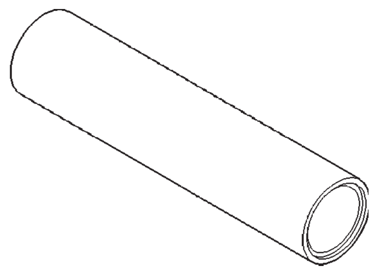
Installer C-4340



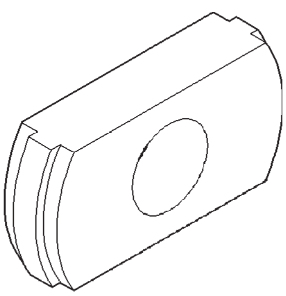
Installer D-130



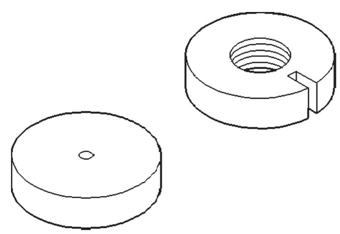
Fixture 8138



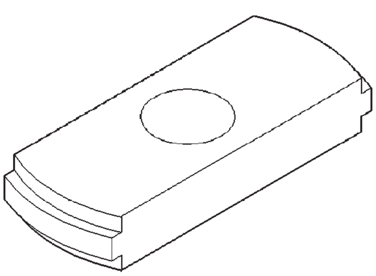
Installer 6448



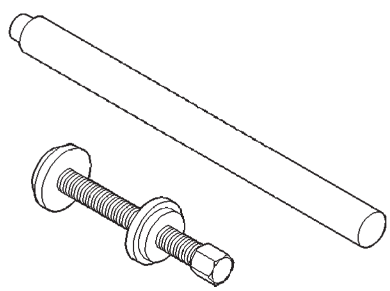
Installer C-4345



Trac-lok™ Tools 8140

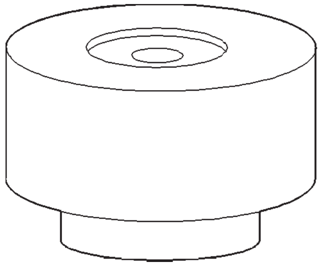


Remover C-4307

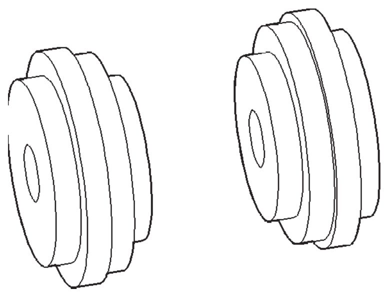


Trac-lok™ Tools 6960

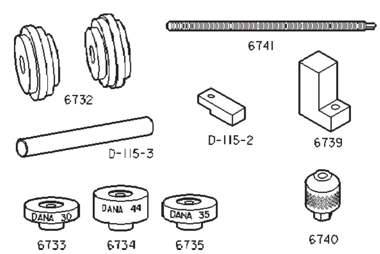
SPECIAL TOOLS (Continued)



Pinion Gauge Block 8540



Arbor Discs 8541



Pinion Gauge Set

AXLE SHAFTS

REMOVAL

(1) Place transmission in neutral.

(2) Raise and support the vehicle.

(3) Remove wheel and tire assembly.

(4) Remove brake drum, refer to Group 5 Brakes for procedure.

(5) Remove differential housing cover and drain lubricant.

(6) Rotate differential case so pinion mate shaft lock screw is accessible. Remove lock screw and pinion mate shaft from differential case (Fig. 14).

(7) Push axle shaft inward and remove axle shaft C-lock from the axle shaft (Fig. 15).

(8) Remove axle shaft. Use care to prevent damage to axle shaft bearing and seal in the axle tube.

INSTALLATION

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

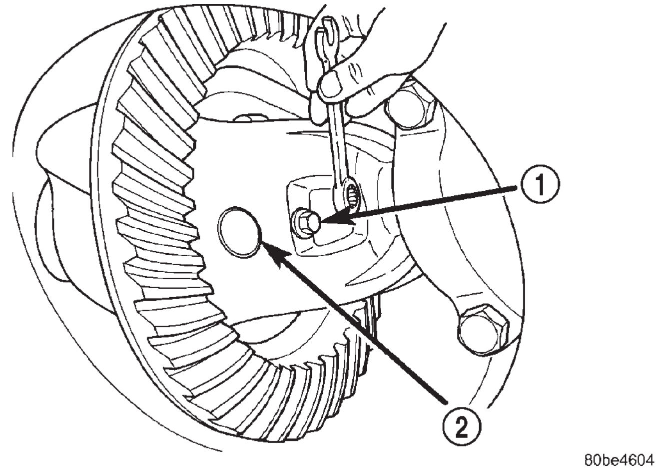


Fig. 14 Pinion Mate Shaft Lock Screw

1 - LOCK SCREW
2 - PINION MATE SHAFT

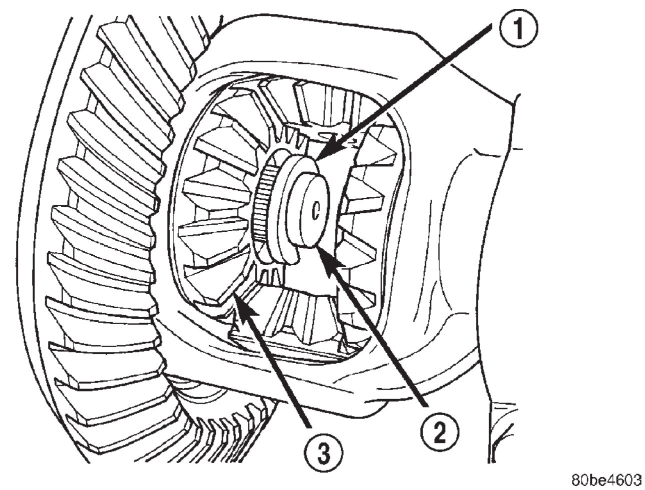


Fig. 15 Axle Shaft C-Lock

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

NOTE: Use care to prevent shaft splines from damaging axle shaft seal.

(2) Insert C-lock in end of axle shaft then push axle shaft outward to seat C-lock in side gear.

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

(4) Align hole in shaft with hole in the differential case and install lock screw with Loctite® on the threads. Tighten lock screw to 11 N·m (8 ft. lbs.).

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

(6) Install brake drum, refer to Group 5 Brakes for procedures.

(7) Install wheel and tire.

(8) Remove support and lower vehicle.

AXLE BEARINGS

REMOVAL

(1) Remove axle shaft.

(2) Remove axle shaft seal from the end of the axle tube with a small pry bar (Fig. 16).

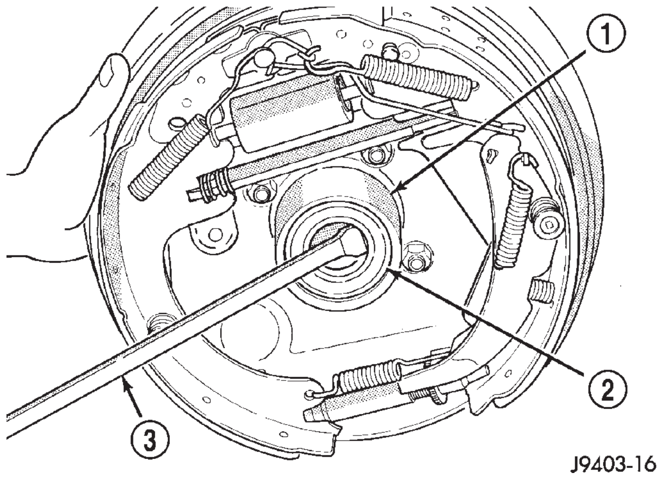


Fig. 16 Axle Seal

1 - AXLE TUBE
2 - AXLE SEAL
3 - PRY BAR

NOTE: The seal and bearing can be removed at the same time with the bearing removal tool.

(3) Remove the axle shaft bearing from the axle tube with Bearing Removal Tool Set 6310, using Adapter Foot 6310-9 (Fig. 17).

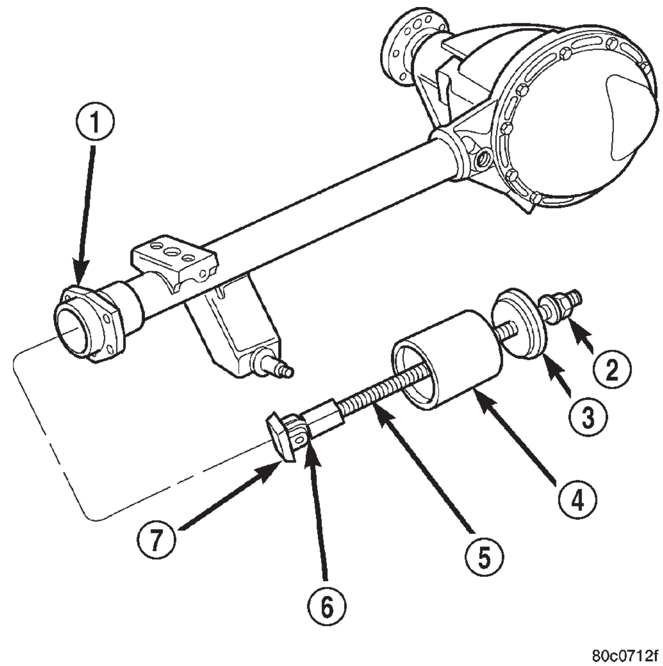


Fig. 17 Axle Shaft Bearing Tool

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

INSTALLATION

(1) Wipe the axle tube bore clean. Remove any old sealer or burrs from the tube.

(2) Install the axle shaft bearing with Installer C-4198 and Handle C-4171 (Fig. 18). Install the bearing with the bearing part number against the installer. Verify the bearing in installed straight and the tool fully contacts the axle tube when seating the bearing.

(3) Install a **new** axle seal with Installer C-4076-B and Handle C-4735-1. When the tool contacts the axle tube, the seal is installed to the correct depth.

(4) Coat the lip of the seal with axle lubricant for protection prior to installing the axle shaft.

(5) Install the axle shaft.

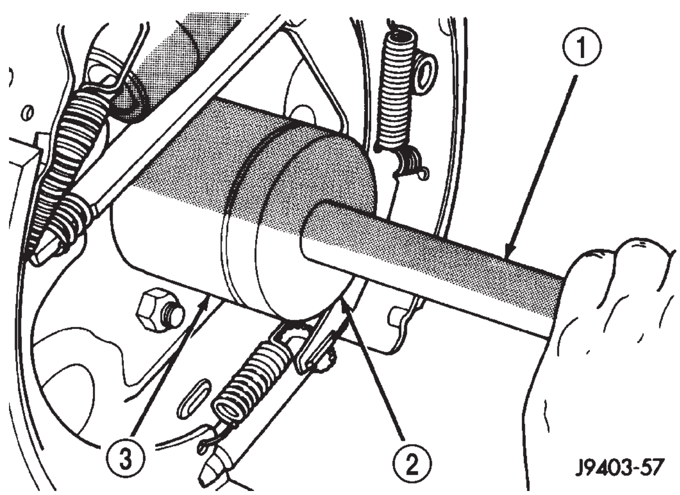


Fig. 18 Seal and Bearing Installer

1 - HANDLE
2 - INSTALLER
3 - AXLE TUBE

AXLE SHAFT SEALS

REMOVAL

(1) Remove axle shaft.

(2) Remove axle shaft seal from the end of the axle tube with a small pry bar (Fig. 19).

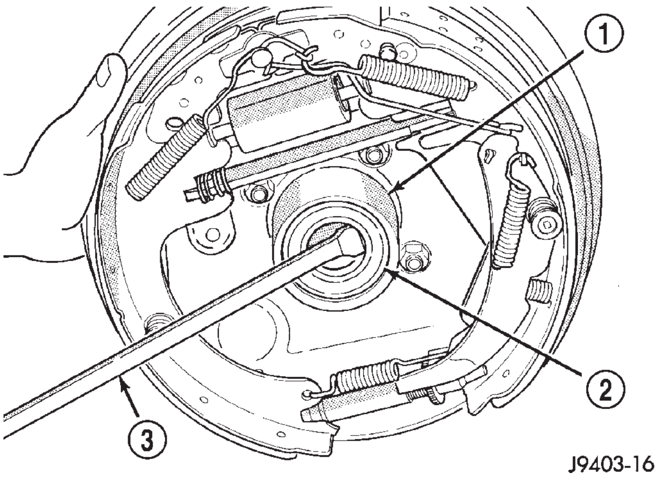


Fig. 19 Axle Seal

1 - AXLE TUBE
2 - AXLE SEAL
3 - PRY BAR

INSTALLATION

(1) Wipe the axle tube bore clean. Remove any old sealer or burrs from the tube.

(2) Install a **new** axle seal with Installer C-4076-B and Handle C-4735-1 (Fig. 20). When the tool contacts the axle tube, the seal is installed to the correct depth.

(3) Coat the lip of the seal with axle lubricant for protection prior to installing the axle shaft.

(4) Install the axle shaft.

PINION SEAL

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assemblies.

(3) Mark the universal joint, companion flange, and pinion shaft for installation reference.

(4) Remove propeller shaft from the companion flange. Secure the propeller shaft in an upright position to prevent damage to the rear universal joint.

(5) Remove the brake drums to prevent any drag.

(6) Rotate the companion flange three or four times.

(7) Record pinion rotating torque with an inch poundtorque wrench for installation reference.

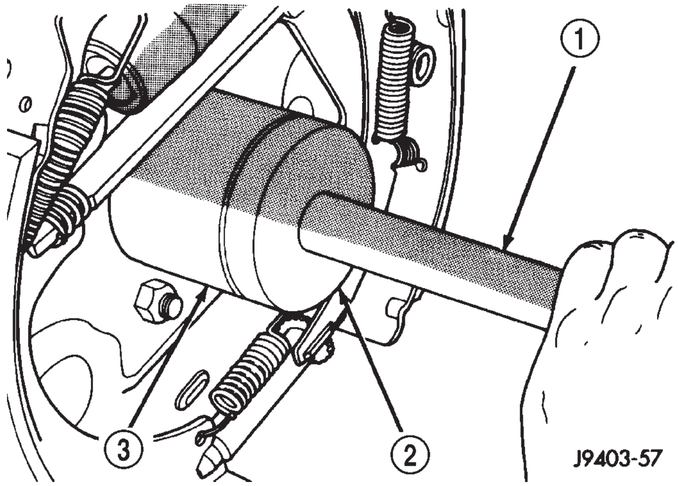


Fig. 20 Seal and Bearing Installer

1 - HANDLE
2 - INSTALLER
3 - AXLE TUBE

(8) Install socket head bolts into two of the threaded holes in the companion flange, 180° apart.

(9) Position Holder 6719A against the companion flange and install a hex head bolt and washer into one of the remaining threaded holes. Tighten the bolt and washer so that the Holder 6719 is held to the flange.

(10) Hold the flange with Holder 6719A and remove pinion nut and washer.

(11) Remove companion flange with Remover C-452 (Fig. 21).

(12) Remove pinion seal with pry tool or slide-hammer mounted screw.

INSTALLATION

NOTE: The outer perimeter of the seal is pre-coated with a special sealant.

(1) Apply a light coating of gear lubricant on the lip of pinion seal.

(2) Install **new** pinion seal with Installer C-3860-A and Handle C-4171 (Fig. 22)

(3) Install companion flange on the end of the shaft with the reference marks aligned.

(4) Install bolts into two of the threaded holes in the companion flange, 180° apart.

(5) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so holder is held to the flange.

(6) Install companion flange on pinion shaft with Installer C-3718 and Holder 6719.

(7) Install pinion washer and a **new** pinion nut. The convex side of the washer must face outward.

PINION SEAL (Continued)

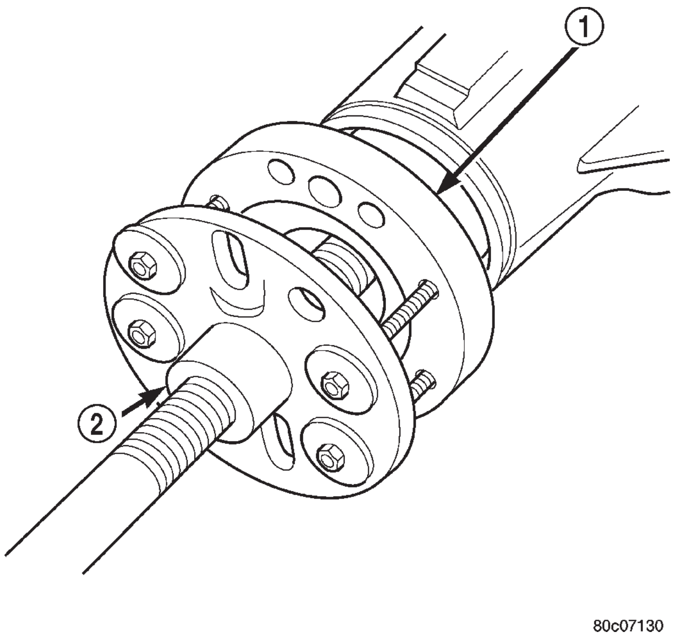


Fig. 21 Companion Flange

1 - COMPANION FLANGE
2 - PULLER

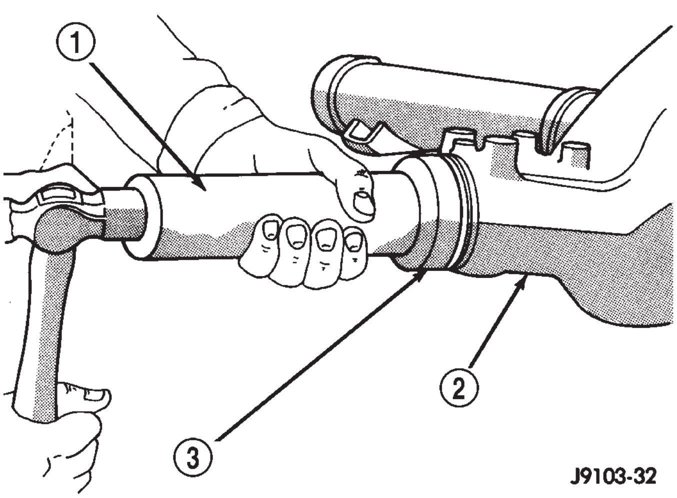


Fig. 22 Pinion Seal Installer

1 - HANDLE
2 - DIFFERENTIAL HOUSING
3 - INSTALLER

CAUTION: Do not exceed the minimum tightening torque when installing the companion flange retaining nut at this point. Damage to collapsible spacer or bearings may result.

(8) Hold companion flange with Holder 6719 and tighten the pinion nut to 285 N·m (210 ft. lbs.) (Fig. 23). Rotate pinion several revolutions to ensure the bearing rollers are seated.

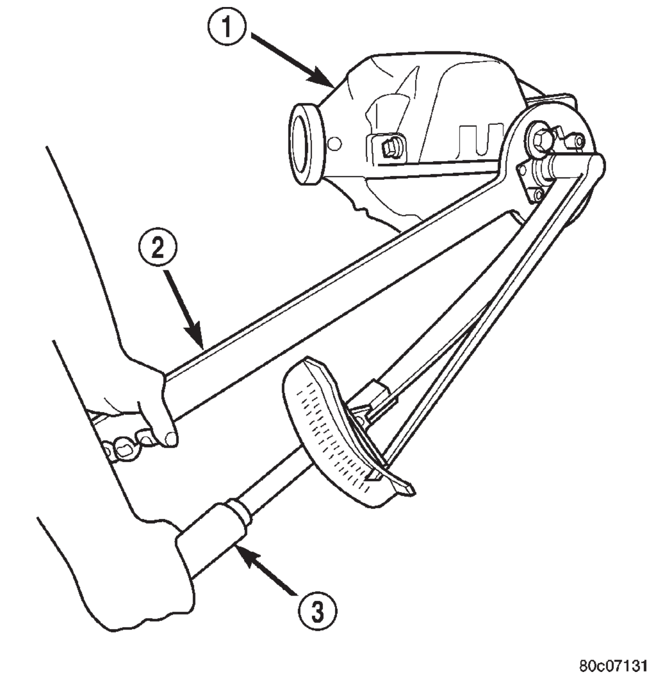


Fig. 23 Tightening Pinion Nut

1 - DIFFERENTIAL HOUSING
2 - COMPANION FLANGE HOLDER
3 - TORQUE WRENCH

(9) Rotatepinion 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. 24).

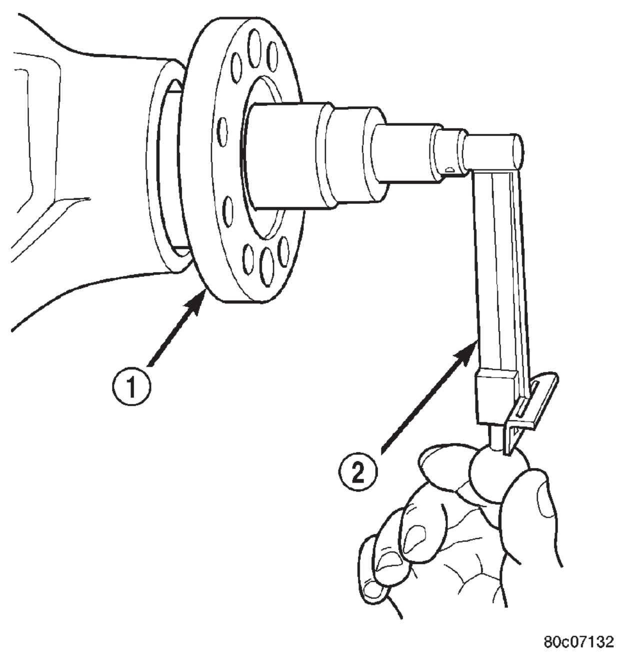


Fig. 24 Pinion Rotation Torque

1 - COMPANION FLANGE
2 - TORQUE WRENCH

PINION SEAL (Continued)

CAUTION: Never loosen pinion nut to decrease pinion bearing rotating torque and never exceed specified preload torque. If rotating torque is exceeded, a new collapsible spacer must be installed.

(10) If rotating torque is low, use Holder 6719 to hold the companion flange (Fig. 23) and tighten pinion nut in 6.8 N·m (5 ft. lbs.) increments until proper rotating torque is achieved.

NOTE: The bearing rotating torque should be constant during a complete revolution of the pinion. If the rotating torque varies, this indicates a binding condition.

NOTE: The seal replacement is unacceptable if the final pinion nut torque is less than 285 N·m (210 ft. lbs.).

(11) Install propeller shaft with the installation reference marks aligned.
(12) Tighten the companion flange bolts to 108 N·m (80 ft. lbs.).
(13) Install the brake drums.
(14) Install wheel and tire assemblies and lower the vehicle.
(15) Check the differential housing lubricant level.

DIFFERENTIAL

REMOVAL

(1) Raise and support vehicle.
(2) Remove filler plug from the differential cover.
(3) Remove the differential cover and drain the lubricant.
(4) Clean the housing cavity with a flushing oil, light engine oil or lint free cloth. **Do not use water, steam, kerosene, or gasoline for cleaning.**
(5) Remove the axle shafts.
(6) Remove RWAL/ABS sensor from housing.

NOTE: Side play resulting from bearing races being loose on case hubs requires replacement of the differential case.

(7) Mark the differential housing and differential bearing caps for installation reference (Fig. 25).
(8) Remove bearing threaded adjuster lock from each bearing cap.
(9) Loosen differential bearing cap bolts.
(10) Loosen differential bearing adjusters through the axle tubes with Wrench C-4164 (Fig. 26).
(11) Hold the differential case while removing bearing caps and adjusters.
(12) Remove the differential case.

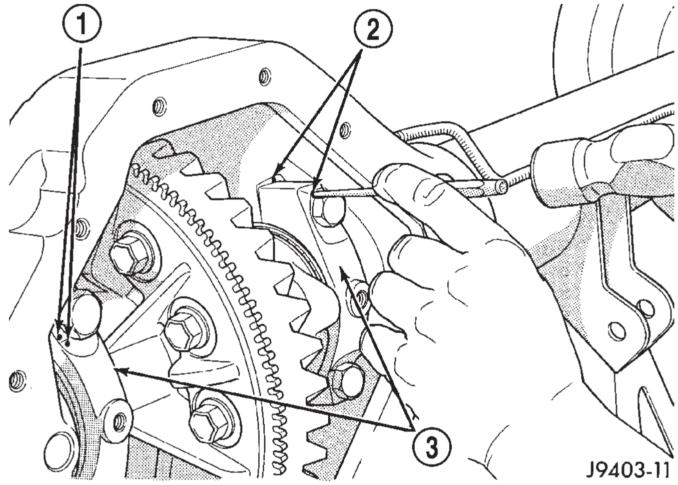


Fig. 25 Reference Marks

1 - REFERENCE MARKS
2 - REFERENCE MARK
3 - BEARING CAPS

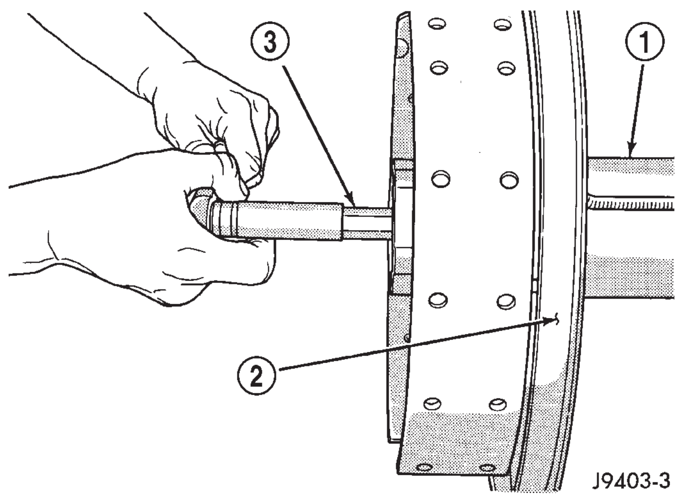


Fig. 26 Threaded Adjuster Tool

1 - AXLE TUBE
2 - BACKING PLATE
3 - THREAD ADJUSTER WRENCH

NOTE: Tag the differential bearing cups and threaded adjusters to indicate their location.

DISASSEMBLY

(1) Remove pinion shaft lock screw (Fig. 27).
(2) Remove pinion shaft.
(3) Rotate differential side gears and remove the differential pinions and thrust washers (Fig. 28).
(4) Remove the differential side gears and thrust washers.

DIFFERENTIAL (Continued)

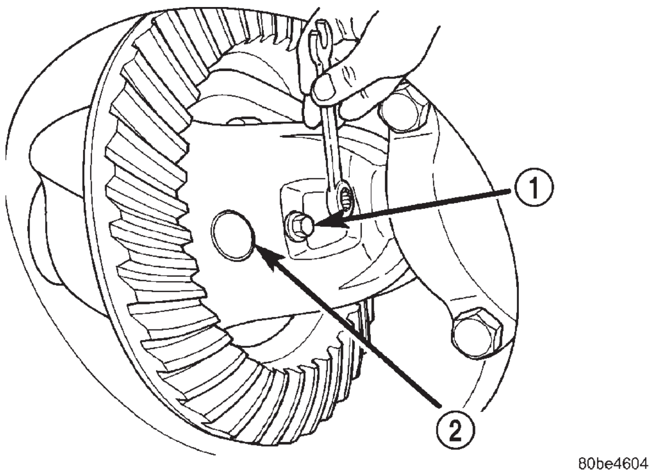


Fig. 27 Pinion Shaft Lock Screw

1 - LOCK SCREW
2 - PINION SHAFT

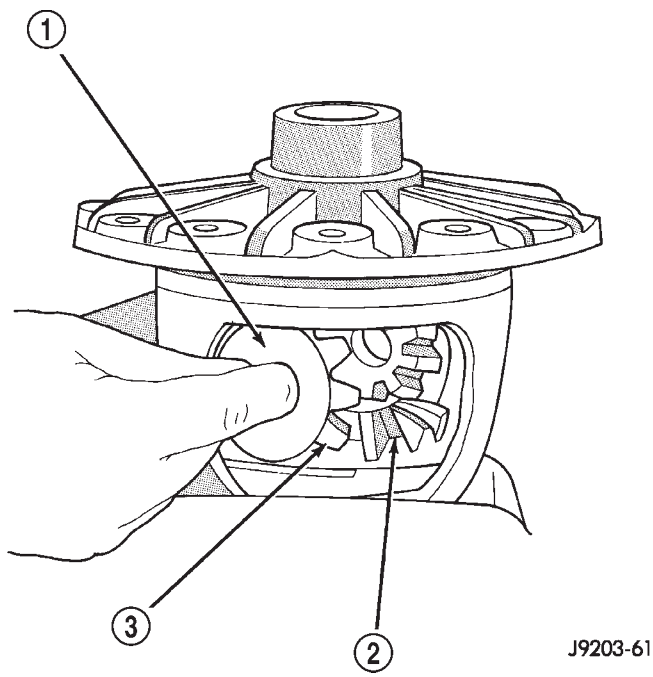


Fig. 28 Differential

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

ASSEMBLY

(1) Install differential side gears and thrust washers.

(2) Install differential pinion and thrust washers.

(3) Install the pinion shaft.

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

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

INSTALLATION

(1) Apply a coating of hypoid gear lubricant to the differential bearings, bearing cups, and threaded adjusters. A dab of grease can be used to keep the adjusters in position.

(2) Install the differential assembly into the housing.

(3) Install the differential bearing caps in their original locations (Fig. 29).

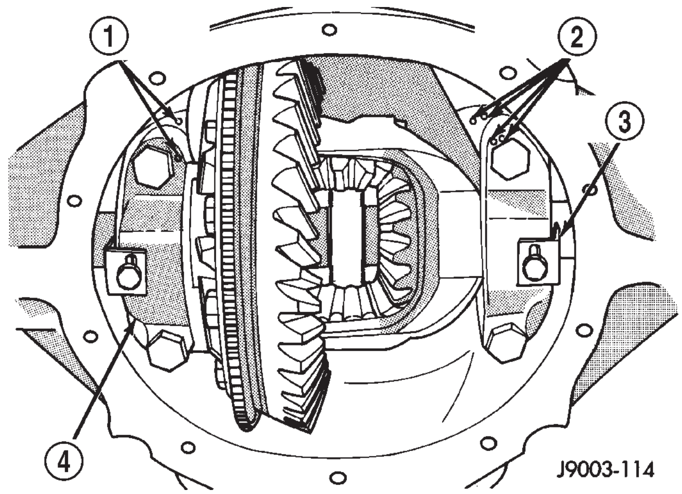


Fig. 29 Bearing Caps

1 - REFERENCE MARKS
2 - REFERENCE MARKS
3 - ADJUSTER LOCK
4 - BEARING CAP

(4) Install bearing cap bolts and tighten the upper bolts to 14 N·m (10 ft. lbs.). Tighten the lower bolts finger-tight until the bolt head is seated.

(5) Perform the differential bearing preload and adjustment procedure.

NOTE: Be sure that all bearing cap bolts are tightened to their final torque of 136 N·m (100 ft.lbs.) before proceeding.

(6) Install axle shafts.

(7) Apply a 1/4 inch bead of Mopar Silicone Rubber Sealant or equivalent to the housing cover (Fig. 30). **Install the housing cover within 5 minutes after applying the sealant.**

(8) Install the cover and any identification tag and tighten cover bolts to 41 N·m (30 ft. lbs.).

(9) Fill differential with lubricant to bottom of the fill plug hole. Refer to the Lubricant Specifications for the correct quantity and type.

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

DIFFERENTIAL (Continued)

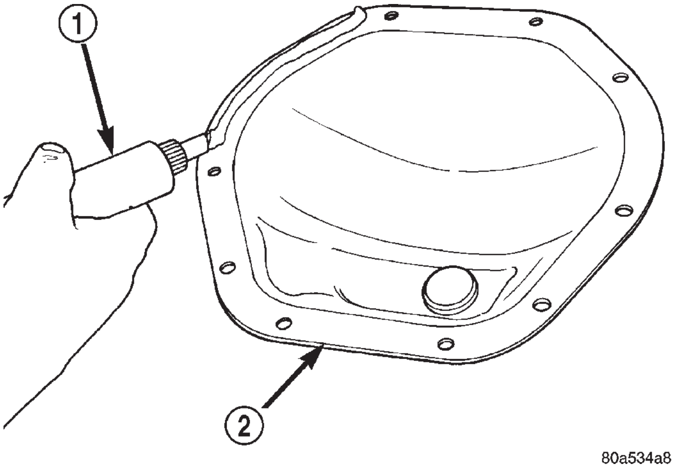


Fig. 30 Cover Sealant

1 - SEALANT
2 - DIFFERENTIAL COVER

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

DIFFERENTIAL - TRAC-LOK

DIAGNOSIS AND TESTING - TRAC-LOK™

The most common problem is a chatter noise when turning corners. Before removing a Trac-lok™ unit for repair, drain, flush and refill the axle with the specified lubricant. 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. 31).

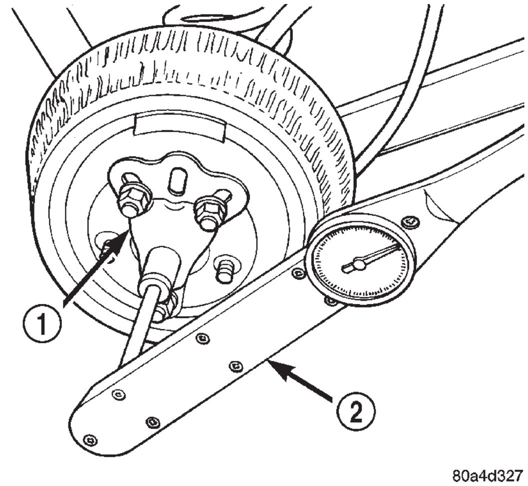


Fig. 31 Trac-lok™ Test -Typical

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

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

DISASSEMBLY

(1) Clamp side gear Holding Fixture 6965 in a vise and position the differential case on the Holding Fixture (Fig. 32).

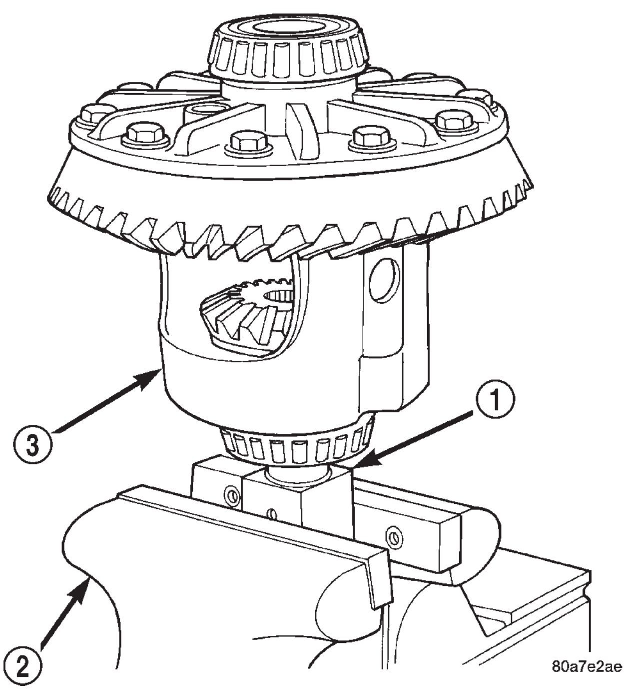


Fig. 32 Differential Case Holding Fixture

1 - HOLDING FIXTURE
2 - VISE
3 - DIFFERENTIAL

DIFFERENTIAL - TRAC-LOK (Continued)

(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 the pinion gear mate shaft lock screw (Fig. 33).

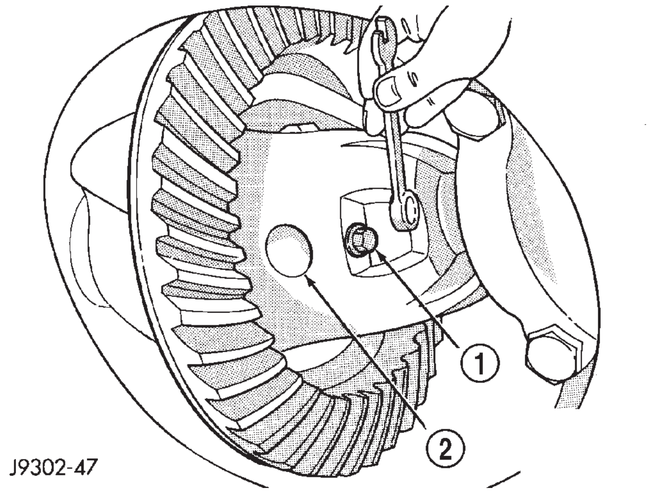


Fig. 33 Mate Shaft Lock Screw

1 - LOCK SCREW
2 - PINION GEAR MATE SHAFT

(4) Remove pinion gear mate shaft with a drift and hammer (Fig. 34).

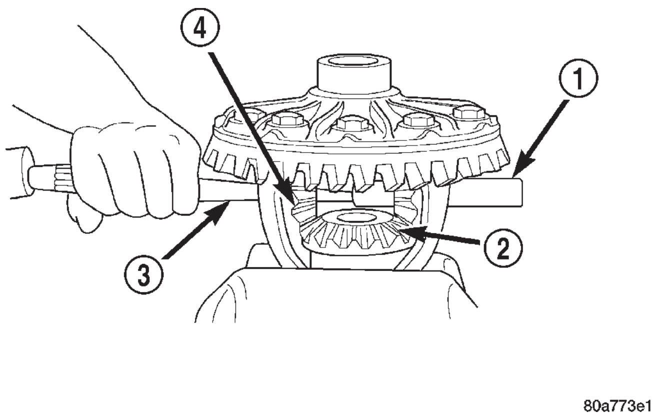


Fig. 34 Mate Shaft

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

(5) Install and lubricate Step Plate C-6960-3 (Fig. 35).

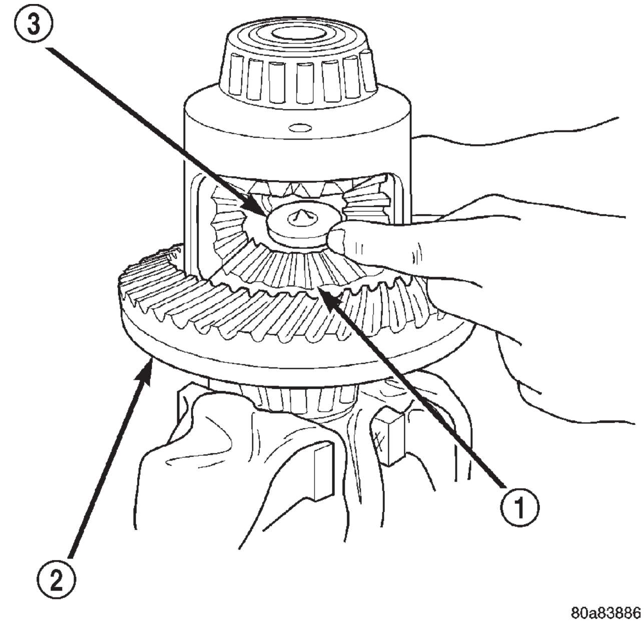


Fig. 35 Step Plate

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-6960-1 (Fig. 36) 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. 37).

(9) With a feeler gauge remove thrust washers from behind the pinion gears (Fig. 38).

(10) Insert Turning Bar C-6960-2 into the pinion mate shaft hole in the case (Fig. 39).

(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.

DIFFERENTIAL - TRAC-LOK (Continued)

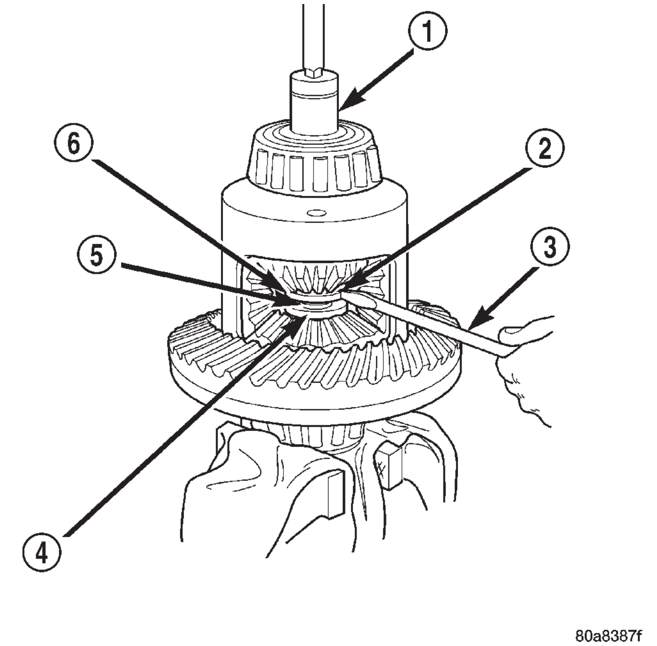


Fig. 36 Threaded Adapter Disc

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

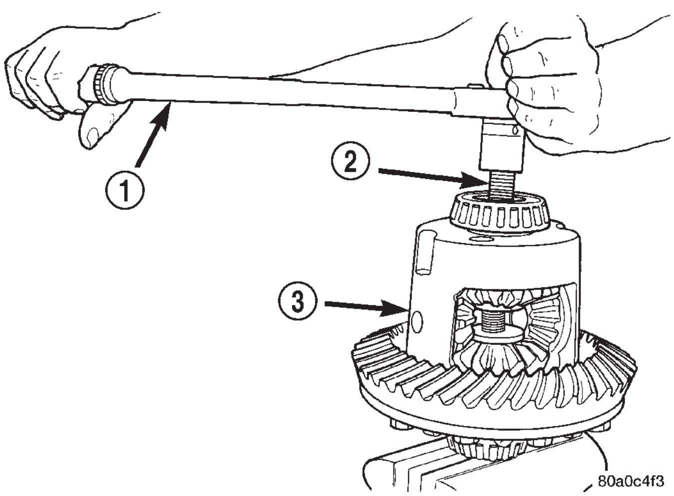


Fig. 37 Compress Belleville Spring

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

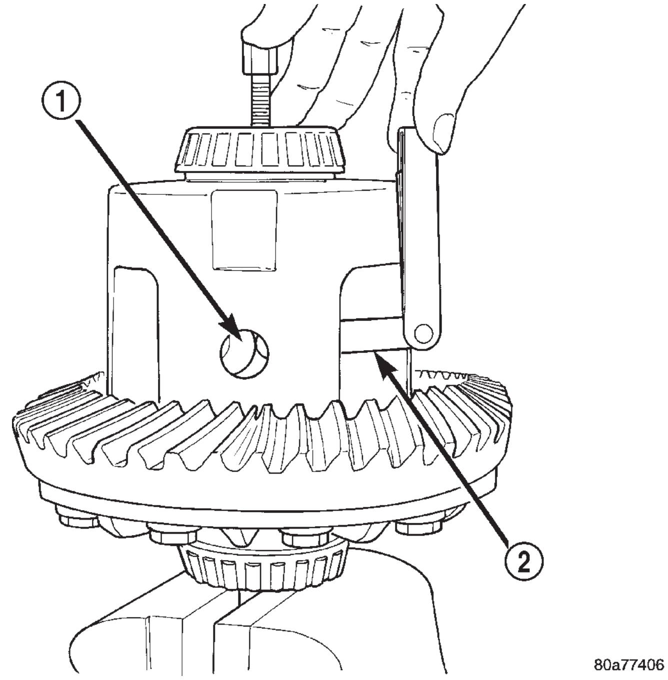


Fig. 38 Pinion Gear Thrust Washer

1 - THRUST WASHER
2 - FEELER GAUGE

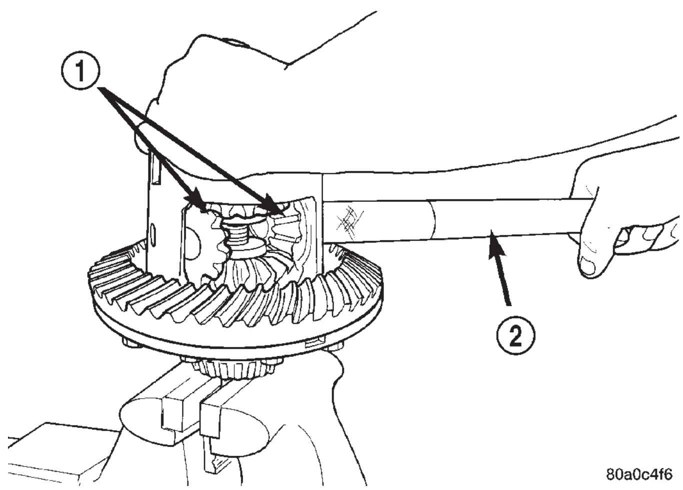


Fig. 39 Differential Pinion Gear

1 - PINION GEARS
2 - TURNING BAR

DIFFERENTIAL - TRAC-LOK (Continued)

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

(15) Remove top side gear, clutch pack retainer and clutch pack. Keep plates in correct order during removal (Fig. 40).

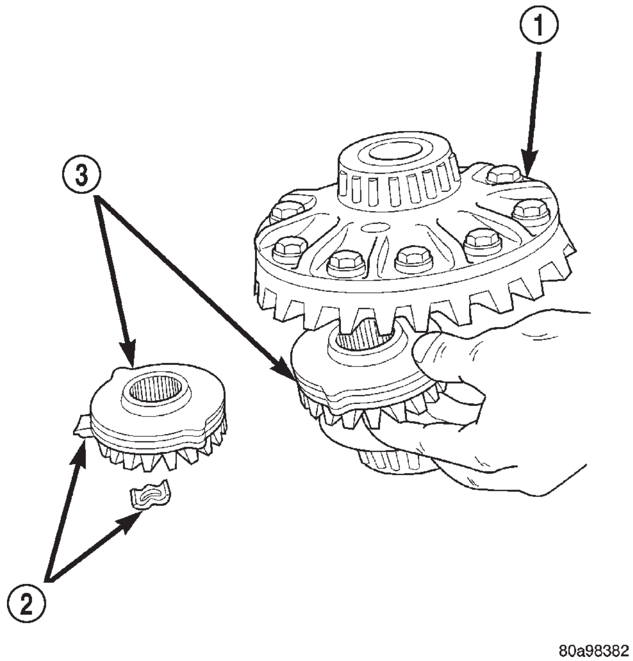


Fig. 40 Side Gear & Clutch Pack

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

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

ASSEMBLY

Clean all components in cleaning solvent. Dry components with compressed air. Inspect clutch pack plates for wear, scoring or damage. Replace both clutch packs if any one component in either pack is damaged. Inspect side gears and pinions. Replace any gear that is worn, cracked, chipped or damaged. Inspect differential case and pinion shaft. Replace if worn or damaged.

Lubricate each component with gear lubricant before assembly.

(1) Assemble the clutch discs into packs and secure disc packs with retaining clips (Fig. 41).

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.

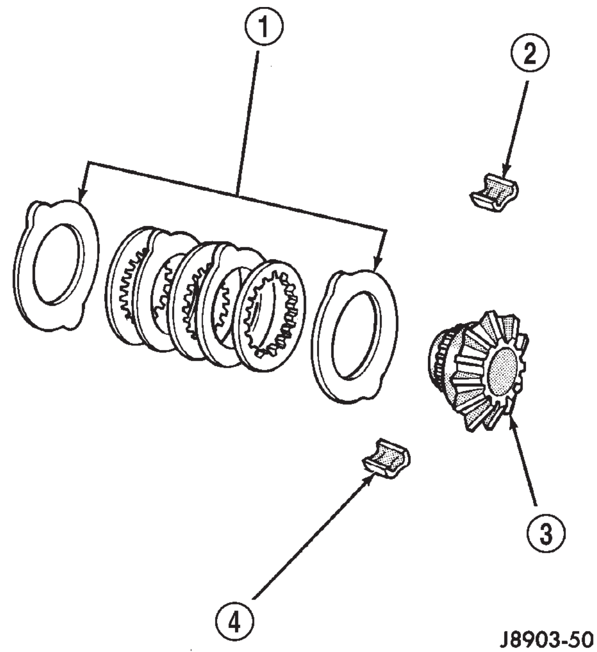


Fig. 41 Clutch Disc Pack

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

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

(3) Install clutch pack and side gear in the ring gear side of the differential case (Fig. 42). **Be sure clutch pack retaining clips remain in position and are seated in the case pockets.**

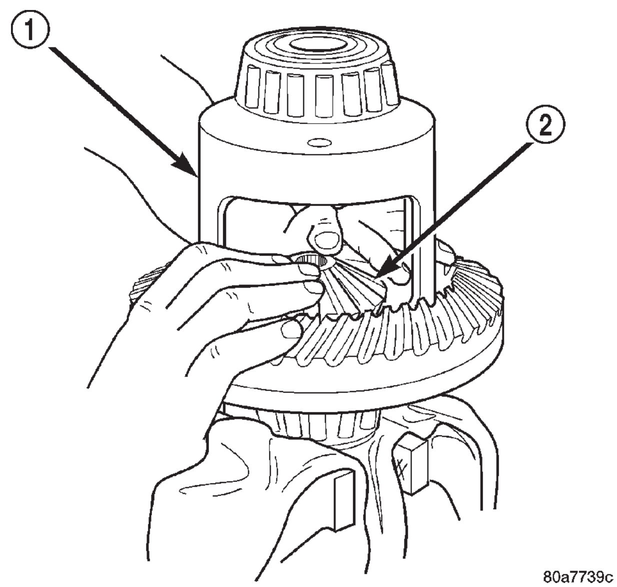


Fig. 42 Clutch Pack & Lower Side Gear

1 - DIFFERENTIAL CASE
2 - LOWER SIDE GEAR AND CLUTCH PACK

DIFFERENTIAL - TRAC-LOK (Continued)

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

(5) Install lubricated Step Plate C-6960-3 in lower side gear (Fig. 43).

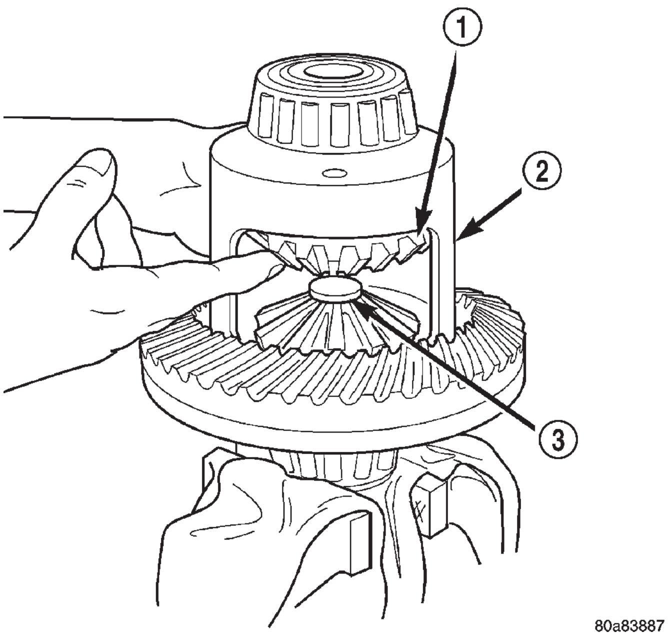


Fig. 43 Clutch Pack & Upper Side Gear

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

(6) Install the upper side gear and clutch disc pack (Fig. 43).

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

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

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

(10) 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.

(11) Tighten forcing screw to 122 N·m (90 ft. lbs.) maximum to compress the Belleville springs.

(12) 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.

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

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

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

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

DIFFERENTIAL CASE BEARINGS

REMOVAL

(1) Remove differential case from axle housing.

(2) Remove differential bearings from the case with Puller/Press C-293-PA and Adapters C-293-47 and Plug C-293-3 (Fig. 44).

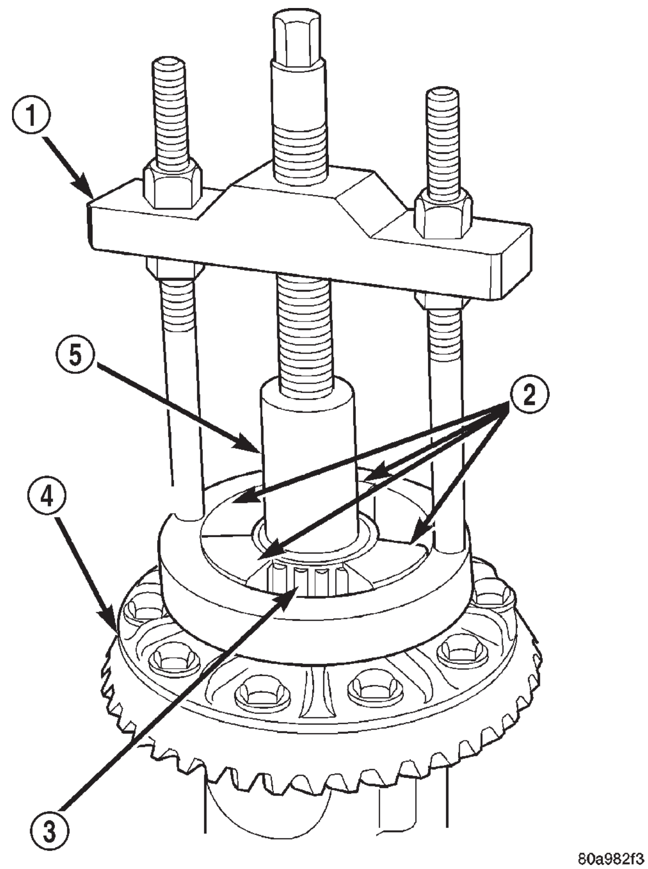


Fig. 44 Differential Bearing Puller

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

INSTALLATION

(1) Install differential side bearings with Installer C-4213 and Handle C-4171 (Fig. 45).

(2) Install differential case into housing.

DIFFERENTIAL CASE BEARINGS (Continued)

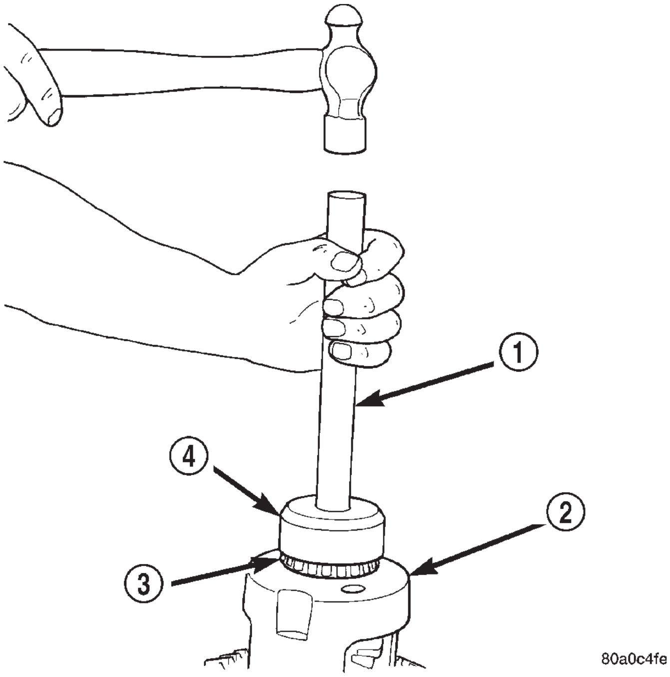


Fig. 45 Differential Bearing Installer

1 - HANDLE
2 - DIFFERENTIAL
3 - BEARING
4 - INSTALLER

PINION GEAR/RING GEAR/ TONE RING

REMOVAL

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

(1) Raise and support vehicle.
(2) Remove wheel and tire assemblies.
(3) Mark companion flange and propeller shaft for installation reference.
(4) Disconnect propeller shaft from the companion flange and tie propeller shaft to underbody.
(5) Remove axle shafts.
(6) Remove differential from the differential housing.
(7) Place differential case in a vise with soft metal jaw protectors. (Fig. 46).
(8) Remove ring gear bolts from the differential case.
(9) Drive ring gear off the differential case with a rawhide hammer (Fig. 46).
(10) Install bolts into two of the threaded holes in the companion flange 180° apart.

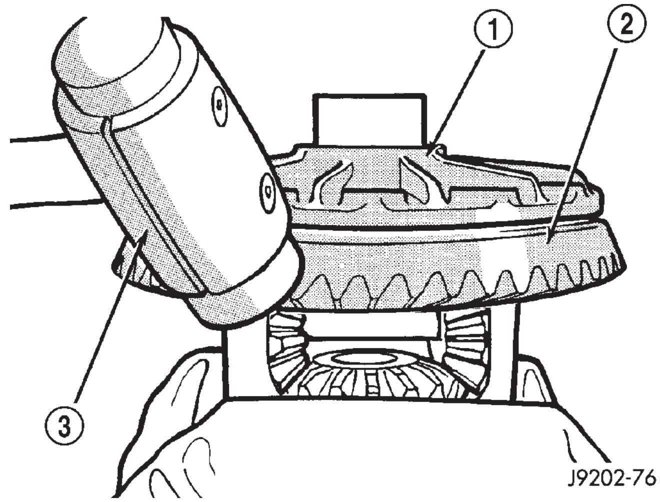


Fig. 46 Ring Gear

1 - CASE
2 - RING GEAR
3 - RAWHIDE HAMMER

(11) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so the Holder 6719 is held to the flange.
(12) Use Holder 6719 to hold companion flange and remove the companion flange nut and washer.
(13) Remove the companion flange from the pinion with Remover C-452 (Fig. 47).

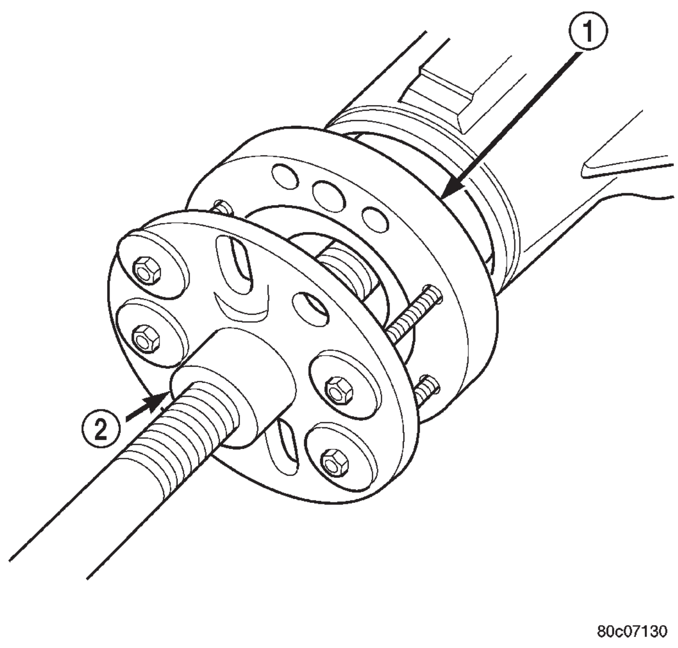


Fig. 47 Companion Flange

1 - COMPANION FLANGE
2 - REMOVER

(14) Remove the pinion from housing (Fig. 48).

PINION GEAR/RING GEAR/TONE RING (Continued)

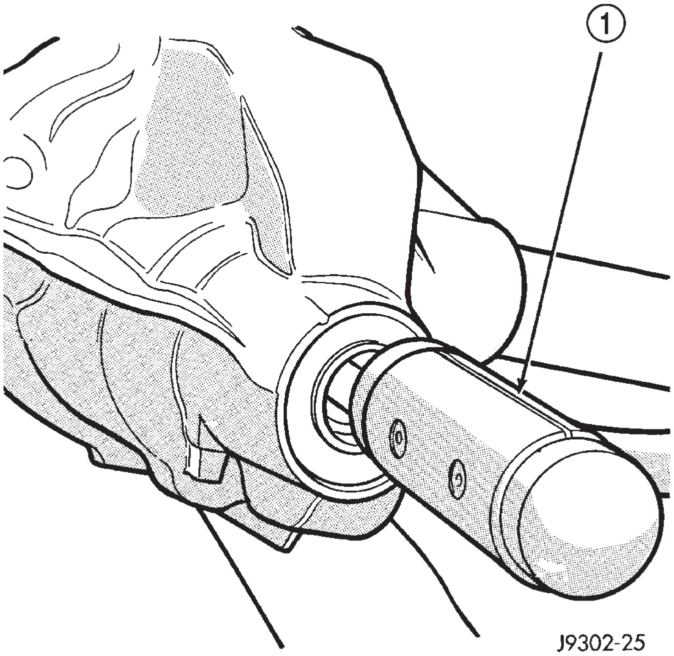


Fig. 48 Pinion Gear

1 - RAWHIDE HAMMER

(15) Remove pinion seal with a pry tool or slide-hammer mounted screw.

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

(17) Remove front pinion bearing cup with Remover C-4345 and Handle C–4171 (Fig. 49).

(18) Remove the rear bearing cup from housing (Fig. 50) with Remover C-4307 and Handle C–4171.

(19) Remove the collapsible preload spacer (Fig. 51).

(20) Remove rear bearing from the pinion (Fig. 52) with Puller/Press C-293-PA and Adapters C-293-47.

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

INSTALLATION

NOTE: The ring gear and pinion are serviced in a matched set. Do not replace the pinion without replacing the ring gear. If ring and pinion gears or bearings are replaced, Refer to Adjustments for Pinion Gear Depth Setting.

(1) Apply Mopar Door Ease or stick lubricant to outside surface of bearing cup.

(2) Install rear pinion bearing cup (Fig. 53) with Installer C-4308 and Driver Handle C-4171 and verify cup is seated.

(3) Apply Mopar Door Ease or stick lubricant to outside surface of bearing cup.

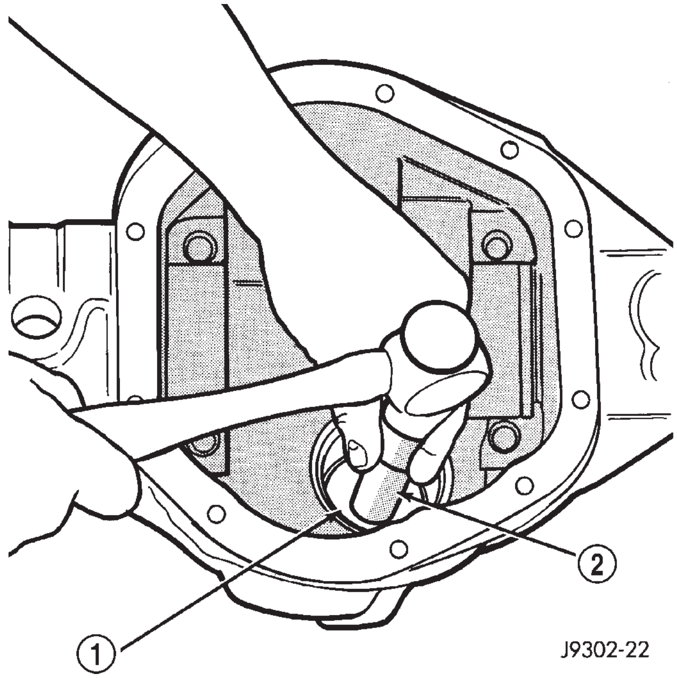


Fig. 49 Front Pinion Bearing Cup

1 - REMOVER
2 - HANDLE

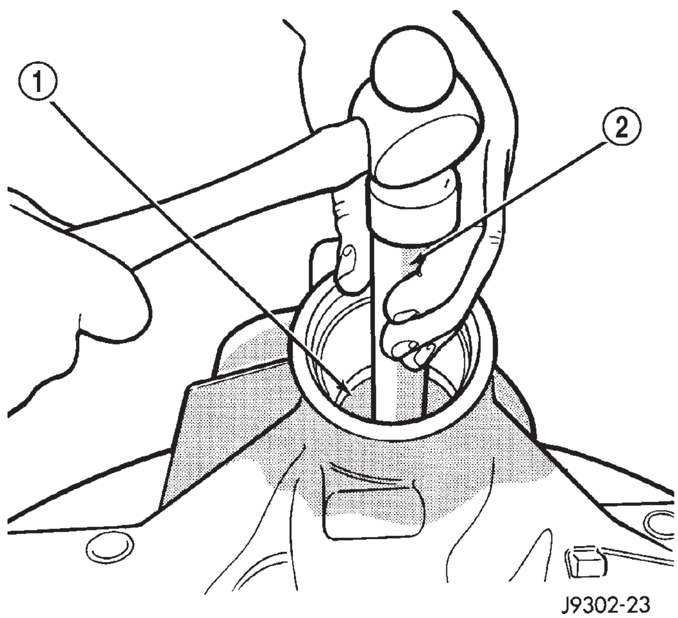


Fig. 50 Rear Pinion Bearing Cup

1 - DRIVER
2 - HANDLE

(4) Install front pinion bearing cup (Fig. 54) with Installer D-130 and Handle C-4171 and verify cup is seated.

(5) Install front pinion bearing.

PINION GEAR/RING GEAR/TONE RING (Continued)

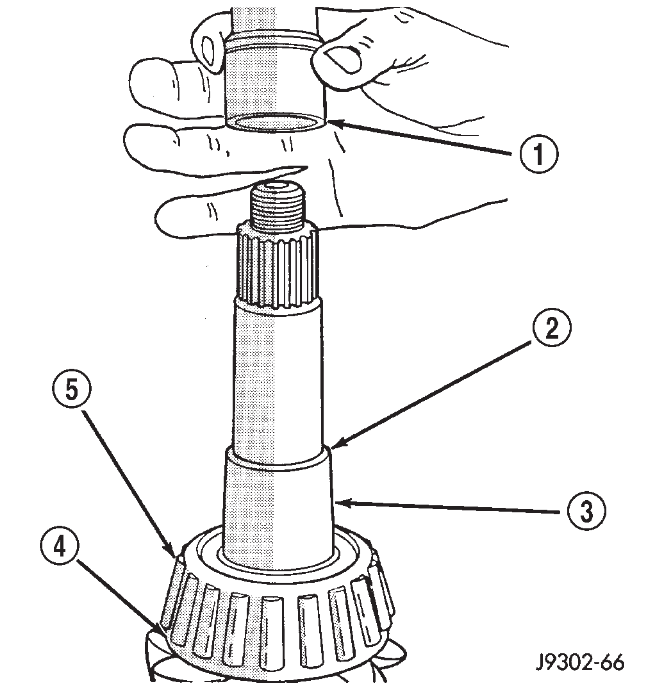


Fig. 51 Collapsible Spacer

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

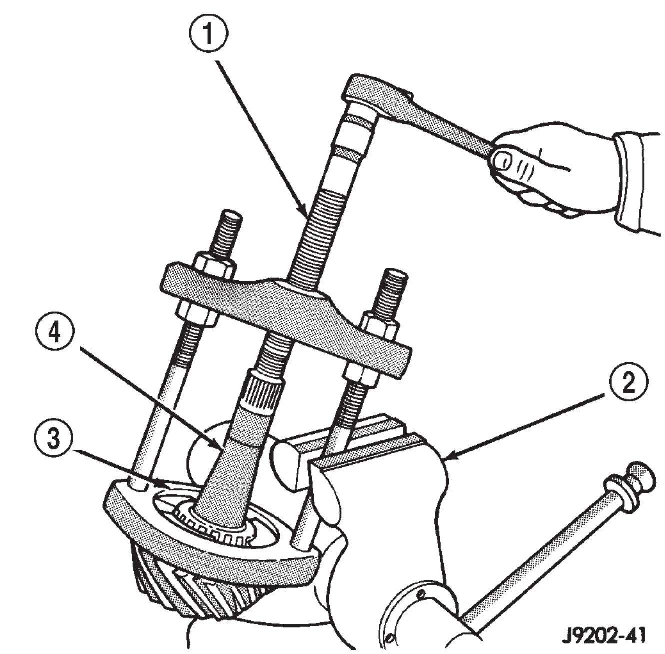


Fig. 52 Rear Pinion Bearing

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

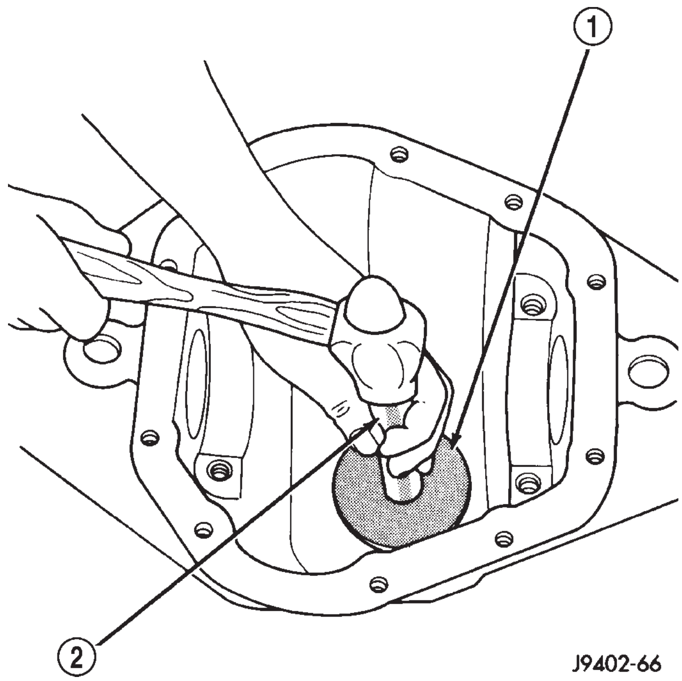


Fig. 53 Rear Pinion Bearing Cup

1 - INSTALLER
2 - HANDLE

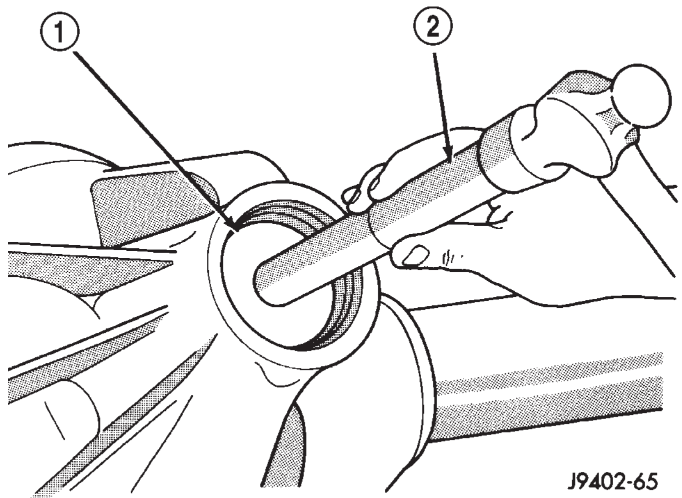


Fig. 54 Front Pinion Bearing Cup

1 - INSTALLER
2 - HANDLE

(6) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer C-4076–B and Handle C-4735-1 (Fig. 55).

(7) Place the proper thickness depth shim on the pinion shaft.

(8) Install the rear bearing on the pinion (Fig. 56) with Installer 6448 and a press.

PINION GEAR/RING GEAR/TONE RING (Continued)

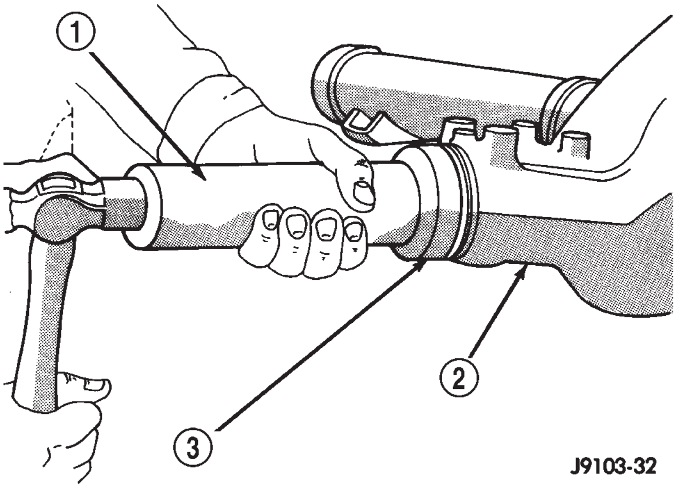


Fig. 55 Pinion Seal

1 - HANDLE
2 - DIFFERENTIAL HOUSING
3 - INSTALLER

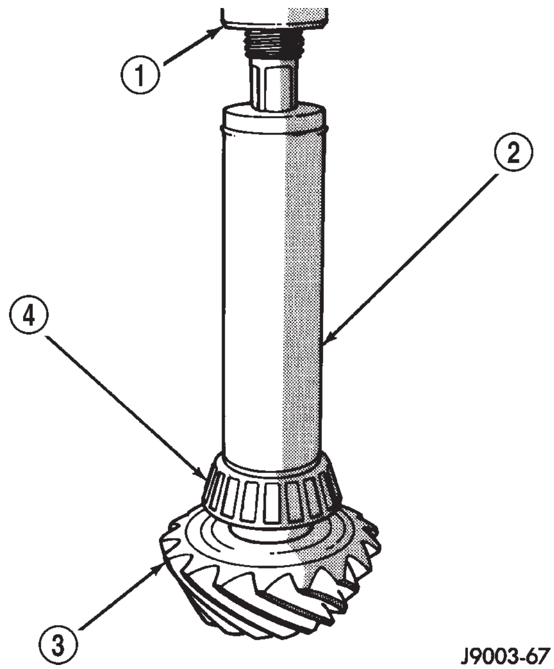


Fig. 56 Rear Pinion Bearing

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

(9) Install a **new** collapsible preload spacer on pinion shaft and install the pinion into the housing (Fig. 57).

(10) Install companion flange with Installer C-3718 and Holder 6719.

(11) Install bolts into two of the threaded holes in the companion flange 180° apart.

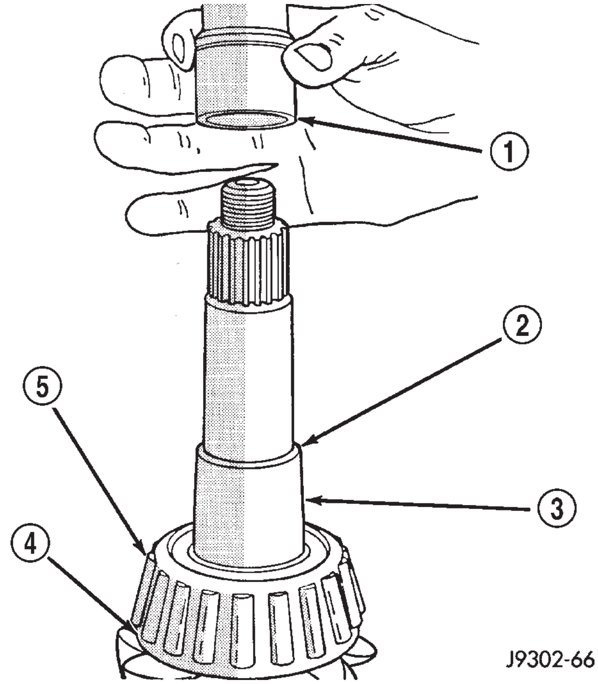


Fig. 57 Collapsible Preload Spacer

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

(12) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so the Holder 6719 is held to the flange.

(13) Install the companion flange washer and a new nut on the pinion and tighten the pinion nut until there is zero bearing end-play.

(14) Tighten the nut to 285 N·m (210 ft. lbs.) (Fig. 58).

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

(15) Slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until the desired rotating torque is achieved. Measure the rotating torque frequently to avoid over crushing the collapsible spacer (Fig. 59).

(16) Check bearing rotating torque with an inch pound torque wrench (Fig. 59). The torque necessary to rotate the pinion should be:

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

(17) Position exciter ring on differential case.

PINION GEAR/RING GEAR/TONE RING (Continued)

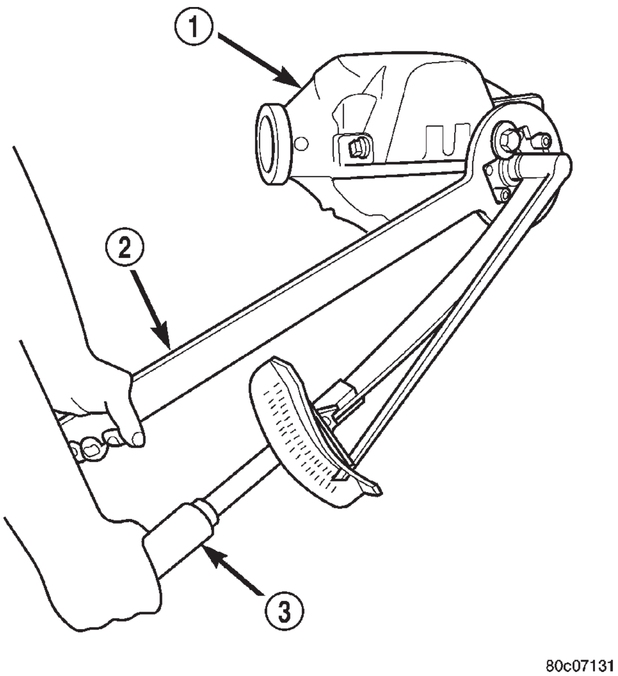


Fig. 58 Pinion Nut

1 - DIFFERENTIAL HOUSING
2 - HOLDER
3 - TORQUE WRENCH

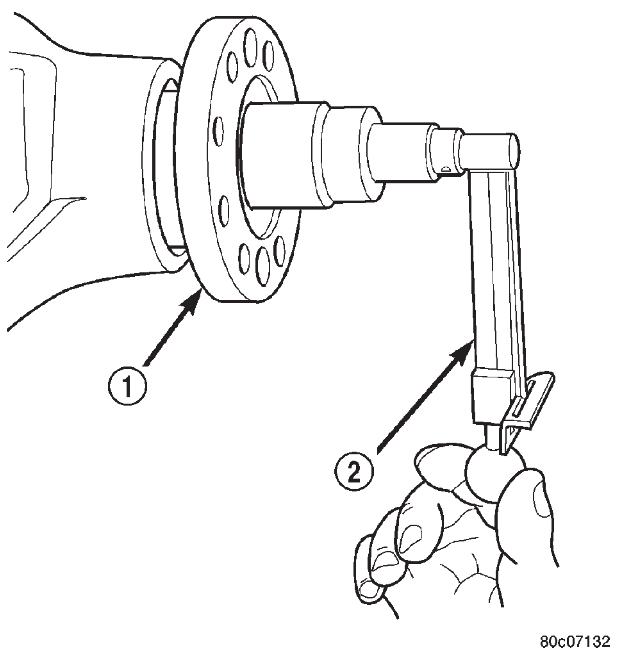


Fig. 59 Pinion

1 - COMPANION FLANGE
2 - TORQUE WRENCH

(18) Using a brass drift, slowly and evenly tap the exciter ring into position.

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

(20) Invert the differential case in the vise.

(21) Install **new** ring gear bolts and alternately tighten to 156 N·m (115 ft. lbs.) (Fig. 60).

CAUTION: Do not reuse the bolts that held the ring gear to the differential case. The bolts can fracture causing extensive damage.

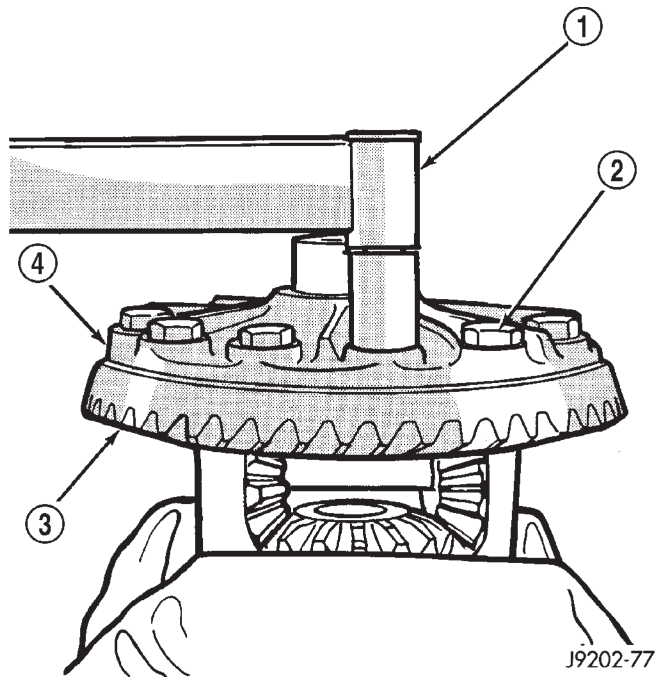


Fig. 60 Ring Gear Bolts

1 - TORQUE WRENCH
2 - RING GEAR BOLTS
3 - RING GEAR
4 - DIFFERENTIAL CASE

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

(23) Install axle shafts.

(24) Install wheel and tire assemblies.

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

(26) Install propeller shaft wtih reference marks aligned.

(27) Remove support and lower vehicle.

BRAKES

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BRAKES - BASE

DESCRIPTION

This vehicle is equipped with front disc brakes and rear drum brakes. The front disc brakes consist of single piston calipers and ventilated rotors. The rear brakes are dual brake shoe, internal expanding units with cast brake drums. The parking brake mechanism is cable operated and connected to the rear brake secondary shoes. Power brake assist is standard equipment. A vacuum operated power brake booster is used for all applications.

Two antilock brake systems are used on this vehicle. A rear wheel antilock (RWAL) brake system is standard. An all-wheel antilock brake system (ABS) is available as an option.

DESCRIPTION

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

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

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

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

DIAGNOSIS AND TESTING - BASE BRAKE SYSTEM

Base brake components consist of the brake shoes, calipers, wheel cylinders, brake drums, rotors, brake

BRAKES - BASE (Continued)

lines, master cylinder, booster, and parking brake components.

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

The first diagnosis step is the preliminary check.

PRELIMINARY BRAKE CHECK

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

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

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

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

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

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

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

(6) Check booster vacuum check valve and hose.

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

ROAD TESTING

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

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

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

(4) Attempt to stop the vehicle with the parking brake only and note grab, drag, noise, etc.

PEDAL FALLS AWAY

A brake pedal that falls away under steady foot pressure is generally the result of a system leak. The leak point could be at a brake line, fitting, hose, or caliper/wheel cylinder. If leakage is severe, fluid will be evident at or around the leaking component.

Internal leakage (seal by-pass) in the master cylinder caused by worn or damaged piston cups, may also be the problem cause.

An internal leak in the ABS or RWAL system may also be the problem with no physical evidence.

LOW PEDAL

If a low pedal is experienced, pump the pedal several times. If the pedal comes back up worn linings, rotors, drums, or rear brakes out of adjustment are the most likely causes. The proper course of action is to inspect and replace all worn component and make the proper adjustments.

SPONGY PEDAL

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

HARD PEDAL OR HIGH PEDAL EFFORT

A hard pedal or high pedal effort may be due to lining that is water soaked, contaminated, glazed, or badly worn. The power booster or check valve could also be faulty.

PEDAL PULSATION

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

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.

BRAKES - BASE (Continued)

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

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

Common causes of brake drag are:

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

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

BRAKE FADE

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

BRAKE PULL

Front brake pull condition could result from:

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

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

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

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

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

REAR BRAKE GRAB OR PULL

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

BRAKES DO NOT HOLD AFTER DRIVING THROUGH DEEP WATER PUDDLES

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

BRAKE LINING CONTAMINATION

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

WHEEL AND TIRE PROBLEMS

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

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

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

BRAKE NOISES

Some brake noise is common with rear drum brakes and on some disc brakes during the first few stops after a vehicle has been parked overnight or stored. This is primarily due to the formation of trace corrosion (light rust) on metal surfaces. This light corrosion is typically cleared from the metal surfaces after a few brake applications causing the noise to subside.

BRAKES - BASE (Continued)

BRAKE SQUEAK/SQUEAL

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

A very loud squeak or squeal is frequently a sign of severely worn brake lining. If the lining has worn through to the brake shoes in spots, metal-to-metal contact occurs. If the condition is allowed to continue, rotors and drums can become so scored that replacement is necessary.

BRAKE CHATTER

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

THUMP/CLUNK NOISE

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

STANDARD PROCEDURES - BRAKE FLUID LEVEL

Always clean the master cylinder reservoir and caps before checking fluid level. If not cleaned, dirt could enter the fluid.

The fluid fill level is indicated on the side of the master cylinder reservoir (Fig. 1).

The correct fluid level is to the FULL indicator on the side of the reservoir. If necessary, add fluid to the proper level.

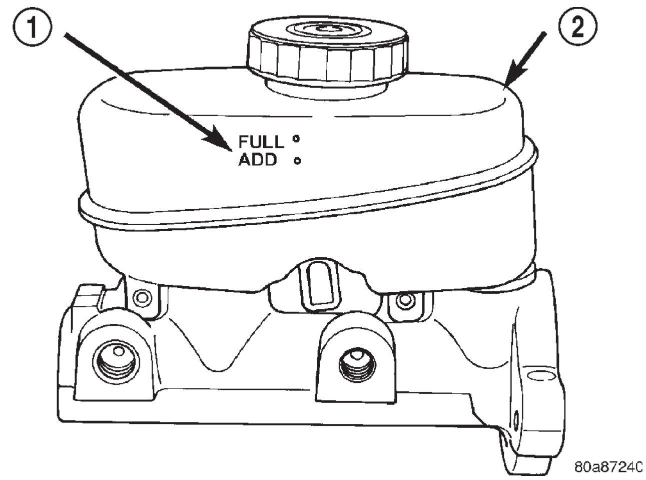


Fig. 1 Master Cylinder Fluid

1 - INDICATOR
2 - RESERVOIR

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.

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

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

Bleed only one brake component at a time in the following sequence:

(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. 2). Be sure end of bleed hose is immersed in fluid.

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

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.

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

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

BRAKES - BASE (Continued)

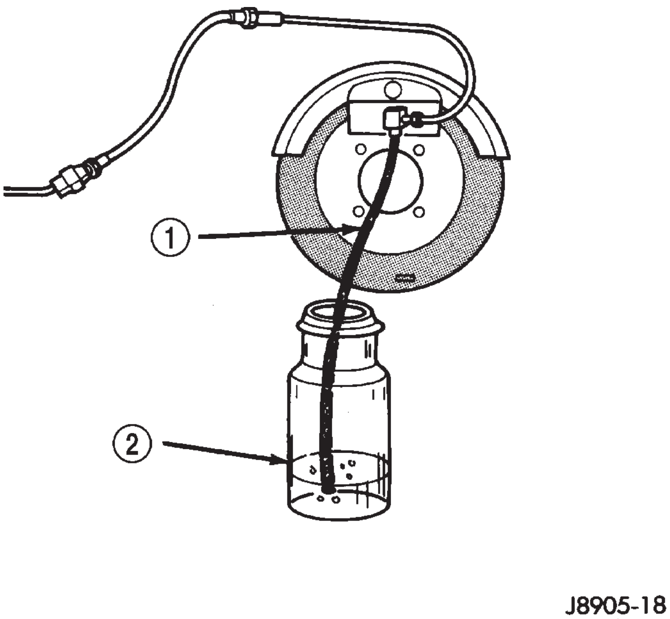


Fig. 2 Bleed Hose Setup

1 - BLEED HOSE
2 - FLUID CONTAINER PARTIALLY FILLED WITH FLUID

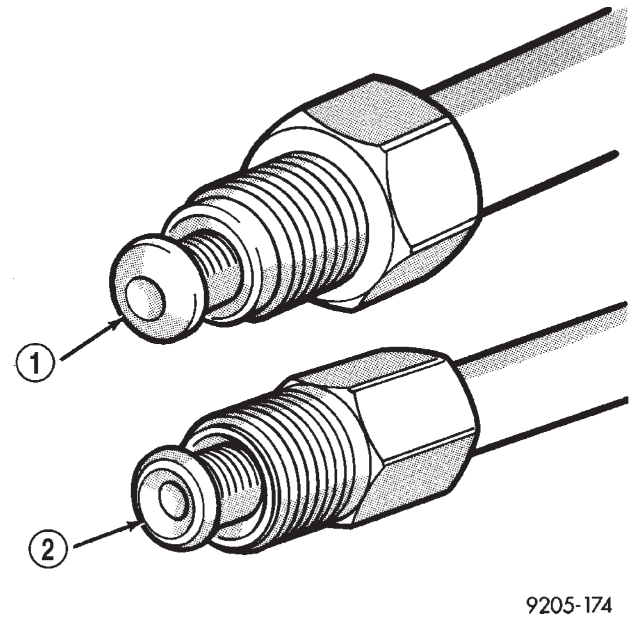


Fig. 3 Inverted Flare And ISO Flare

1 - ISO-STYLE FLARE
2 - DOUBLE INVERTED-STYLE FLARE

Bleed only one brake component at a time in the following sequence:

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.

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.

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. 3).

(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. 4).

(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.

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.

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. 3).

To make a ISO flare use an ISO 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. 5). Then tighten the tool bar on the tube.

(5) Install the correct size adaptor on the flaring tool yoke screw.

(6) Lubricate the adaptor.

BRAKES - BASE (Continued)

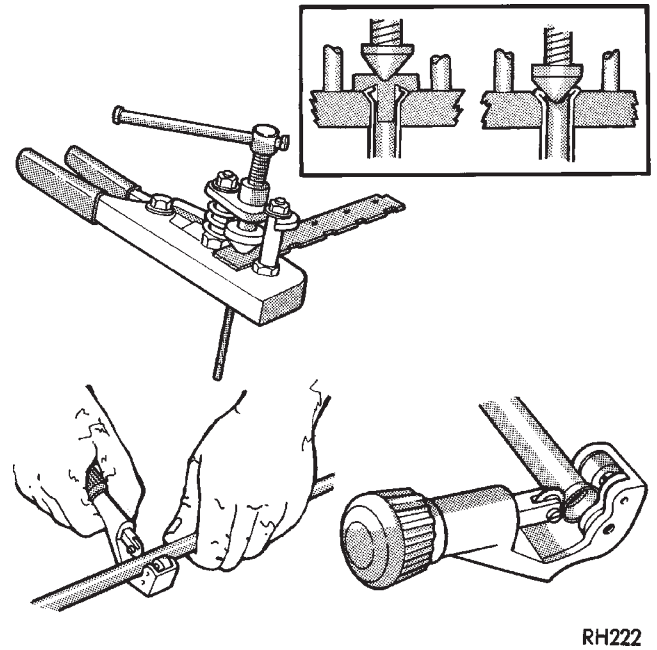


Fig. 4 Inverted

(7) Align the adaptor and yoke screw over the tube (Fig. 5).

(8) Turn the yoke screw in until the adaptor is squarely seated on the tool bar.

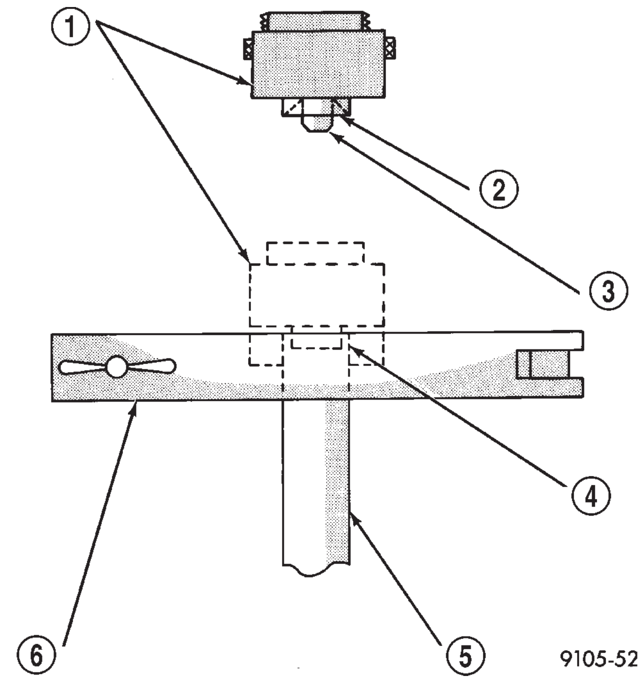


Fig. 5 ISO Flaring

1 - ADAPTER
2 - LUBRICATE HERE
3 - PILOT
4 - FLUSH WITH BAR
5 - TUBING
6 - BAR ASSEMBLY

SPECIFICATIONS

BASE BRAKES

SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Disc Brake Caliper Type	Sliding
Disc Brake Caliper Bore	70 mm (2.75 in.)
Disc Brake Rotor Type	Ventilated
Disc Brake Rotor Size	287 x 24 mm (11.3 x 0.944 in.)
Disc Brake Rotor Max. Runout	0.102 mm (0.004)
Disc Brake Rotor Max. Thickness Varaition	0.013 mm (0.0005 in.)
Disc Brake Rotor Min.Rotor Thickness	22.6 mm (0.8898 in.)
Drum Brake Size	228.6 x 63.5 mm (9 x 2.50 in
Drum Brake Size	279 x 57 mm (11 x 2.25 in.)
Drum Brake Max. Runout	0.20 mm (0.008 in.)
Drum Brake Max. Diameter Variation	0.076 mm (0.003 in.)
Brake Booster Type	Tandem Diaphragm

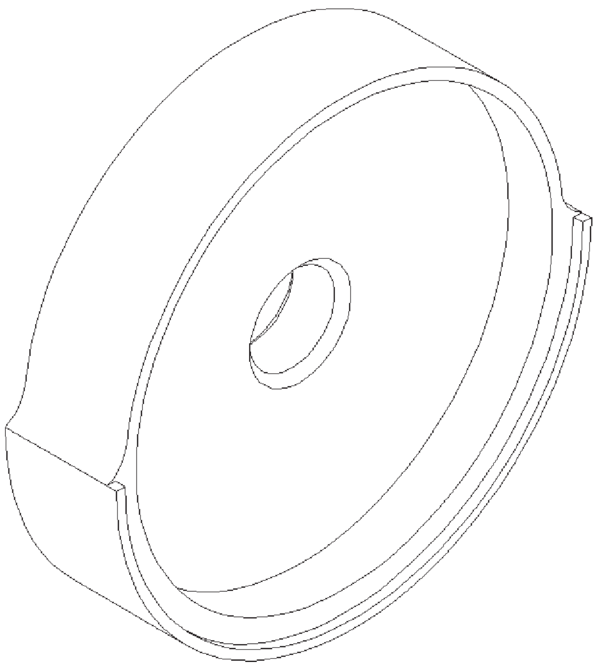
TORQUE CHART

TORQUE SPECIFICATIONS

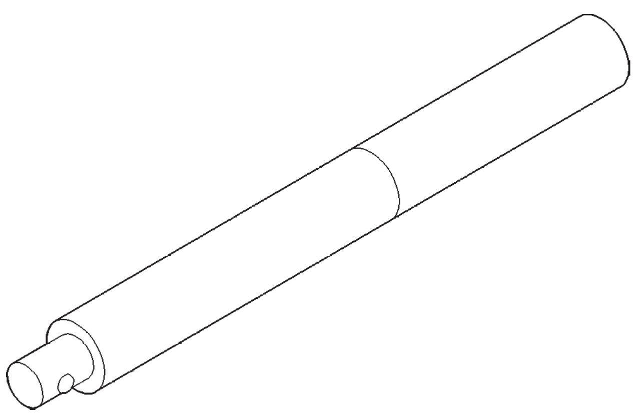
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Brake Booster Mounting Nuts	28	—	250
Master Cylinder Mounting Nuts	18	—	160
Caliper Mounting Pins	30	22	—
Wheel Cylinder Bolts 1/4-20	15	11	—
Wheel Cylinder Bolts 5/16-18	22	16	—
Support Plate Mounting Bolts/Nuts	64	47	—
Brake Line Fittings Master Cylinder	19	—	170
Brake Line Fittings Combination Valve	19	—	170
Brake Line Fittings Wheel Cylinder	16	—	145
Brake Hose Front Fitting	16	—	145
Brake Hose Front Bolt	28	—	250
Brake Hose Rear Fitting	19	—	170

SPECIAL TOOLS

BASE BRAKES



Install Dust Boot 8248



Universal Handle C-4171

RED BRAKE WARNING INDICATOR SWITCH

DESCRIPTION

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

OPERATION

The red warning light alerts the driver if a pressure differential exists between the front and rear hydraulic systems or the parking brakes are applied. The lamp is turned on momentarily when the ignition switch is turn to the on position. This is a self test to verify the lamp is operational.

HYDRAULIC/MECHANICAL

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. 6).

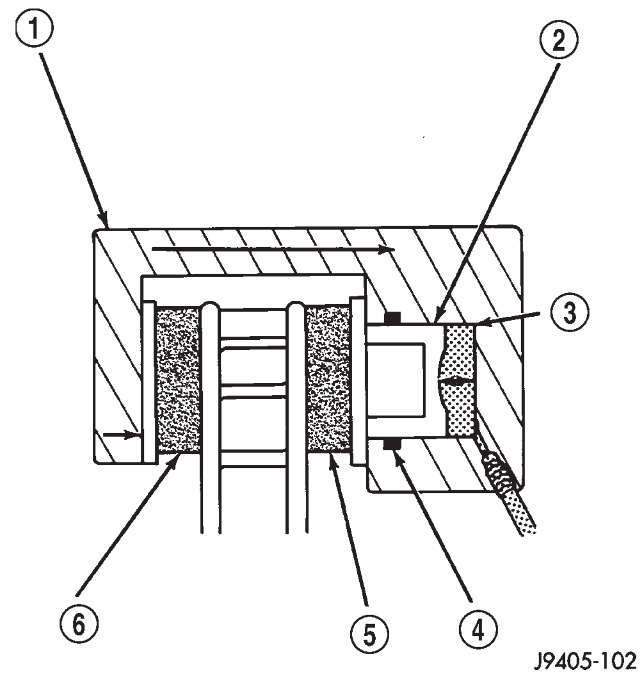


Fig. 6 Brake Caliper Operation

1 - CALIPER
2 - PISTON
3 - PISTON BORE
4 - SEAL
5 - INBOARD SHOE
6 - OUTBOARD SHOE

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

HYDRAULIC/MECHANICAL (Continued)

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. 7). When the brakes (and fluid pressure) are released, the seal relaxes and retracts the piston.

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

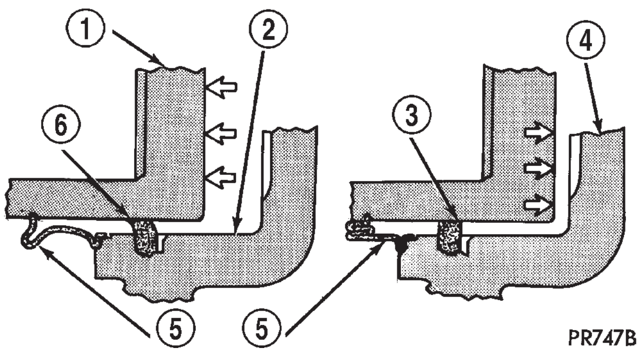


Fig. 7 Lining Wear Compensation By Piston Seal

1 - PISTON
2 - CYLINDER BORE
3 - PISTON SEAL BRAKE PRESSURE OFF
4 - CALIPER HOUSING
5 - DUST BOOT
6 - PISTON SEAL BRAKE PRESSURE ON

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 PADS/SHOES

REMOVAL

(1) Clean master cylinder reservoir and filler caps.

(2) Remove reservoir filler cap and drain approximately 1/4 of fluid from reservoir. Use clean suction gun or similar device to drain fluid.

(3) Raise and support vehicle.

(4) Remove front wheel and tire assemblies.

(5) Bottom caliper pistons in bores with large C-clamp. Position clamp frame on rear of caliper and clamp screw on outboard brake shoe.

(6) With a screw driver pry up on the caliper spring and pull the spring out of the caliper holes.

(7) Remove caliper slide pins.

(8) Remove caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL) and brake shoes (Fig. 8).

BRAKE PADS/SHOES (Continued)

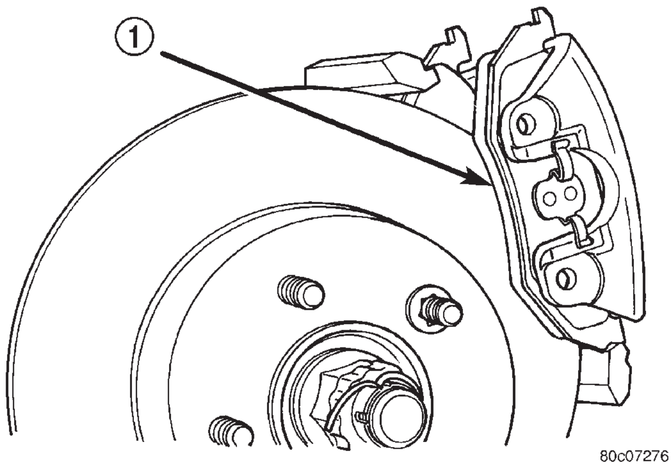


Fig. 8 Removing Caliper Assembly

1 - CALIPER AND BRAKE SHOES

(9) Remove outboard brake shoe (Fig. 9). Pry one end of shoe retainer spring away from caliper. Then tilt shoe upward and rotate it out of caliper.

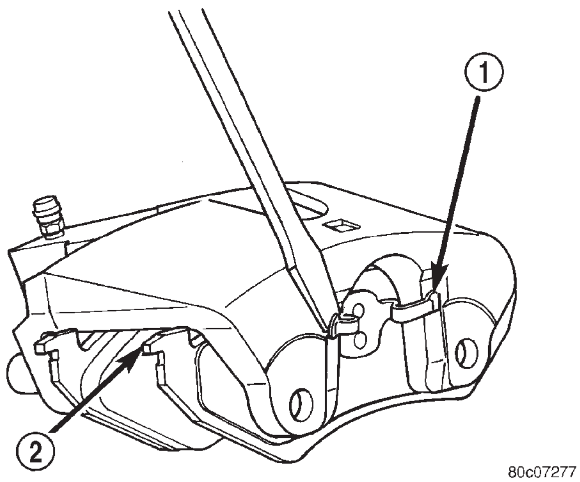


Fig. 9 Outboard Brake Shoe

1 - SHOE SPRING
2 - OUTBOARD SHOE

(10) Remove inboard shoe by tilting shoe outward until retainer spring is clear of caliper piston (Fig. 10).

(11) Support caliper with wire from suspension component. Do not allow brake hose to support caliper weight.

INSTALLATION

(1) Clean slide surfaces of adapter ledges with a wire brush. Then lubricate surfaces with a thin coat of high temperature grease.

(2) Install new slide pin bushings if necessary.

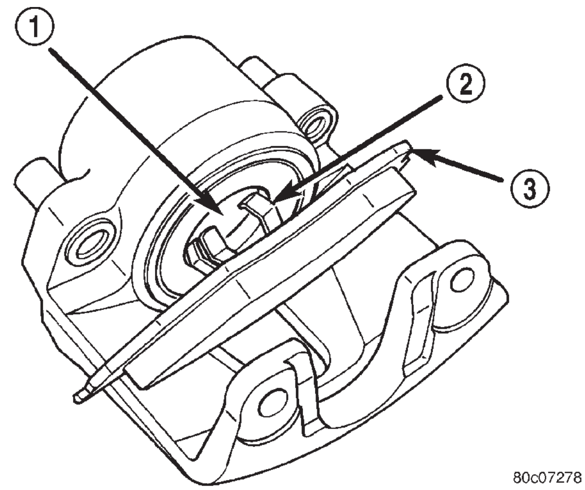


Fig. 10 Inboard Brake Shoe

1 - CALIPER PISTON
2 - RETAINER SPRING
3 - INBOARD SHOE

(3) Install inboard shoe. Be sure retainer spring is firmly seated in caliper piston.

(4) Insert outboard brake shoe in caliper (Fig. 11).

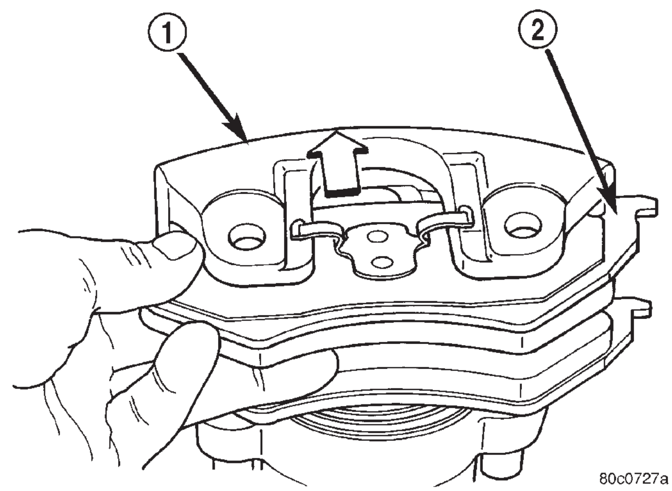


Fig. 11 Installing Outboard Shoe

1 - CALIPER
2 - OUTBOARD SHOE

(5) Insure the outboard shoe retainer spring are seated in the caliper (Fig. 12).

(6) Install caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION) and brake shoes over rotor and into adapter.

(7) Install and tighten caliper slide pins to 30 N·m (22 ft. lbs.). **Start the slide pins by hand before tightening. Do not cross thread the pins.**

(8) Install caliper spring into one caliper hole and under the adapter. Pull down on the opposite end of

BRAKE PADS/SHOES (Continued)

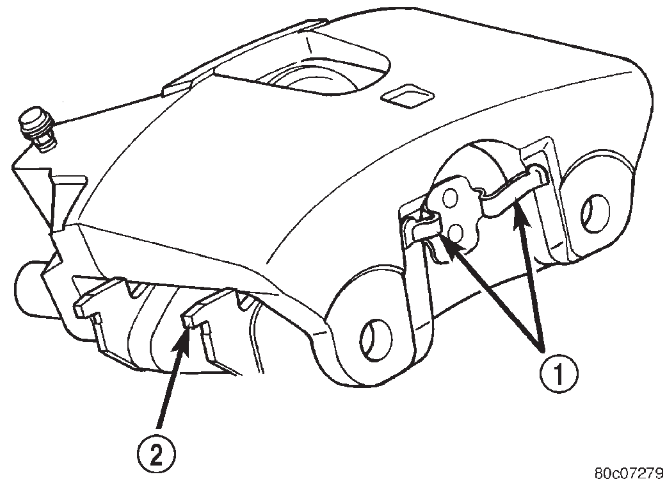


Fig. 12 Outboard Shoe Retainer Spring

1 - SEAT RETAINER SPRING ENDS IN CALIPER
2 - OUTBOARD SHOE

the spring (Fig. 13) and hold the end under the adapter. With a screw driver pry up on the spring (Fig. 14) to seat the spring into the other caliper hole.

NOTE: Verify the spring is seated properly into the caliper holes.

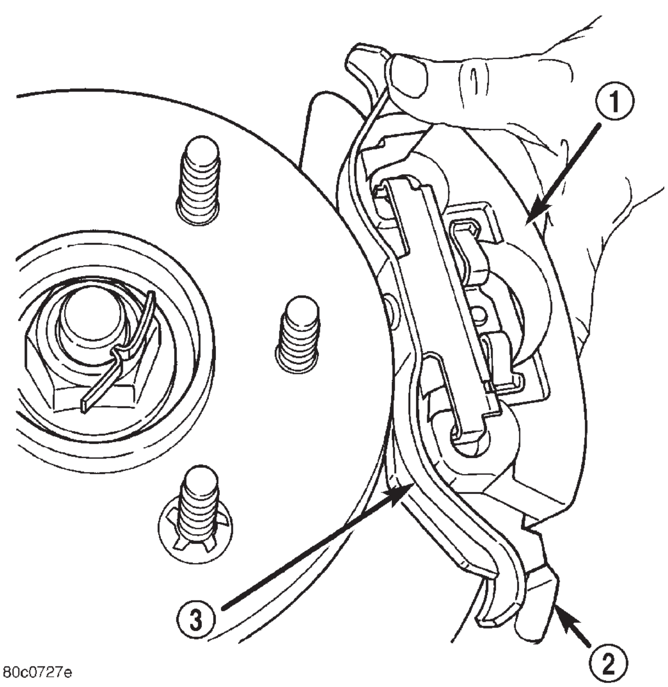


Fig. 13 Caliper Spring

1 - CALIPER
2 - ADAPTER
3 - CALIPER SPRING

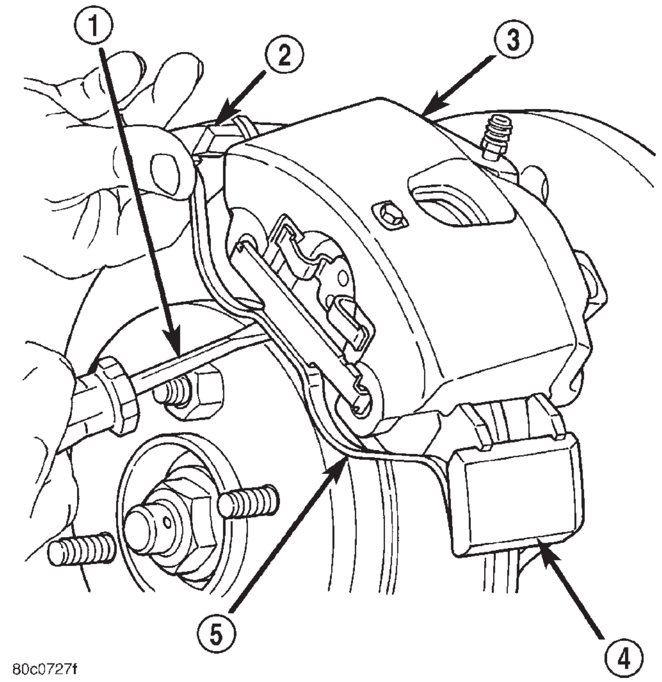


Fig. 14 Seat Caliper Spring

1 - SCREWDRIVER
2 - ADAPTER
3 - CALIPER
4 - ADAPTER
5 - CALIPER SPRING

(9) Install wheel and tire assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
(10) Remove support and lower vehicle.
(11) Pump brake pedal to seat brake shoes.
(12) Fill brake fluid reservoir.
(13) Verify a firm brake pedal before moving vehicle.

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.

COMBINATION VALVE (Continued)

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.

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) Disconnect wire from the pressure differential switch.

(2) Disconnect rear brake lines from combination valve.

(3) Remove the bolt from the combination valve and remove the valve.

INSTALLATION

(1) Install the combination valve to the bracket and tighten the mounting bolt to 20-27 N·m (15-20 ft. lbs.). If vehicle is equipped with ABS brakes tighten the bolt to 10-13 N·m (7-10 ft. lbs.).

(2) Install the brake lines to the combination valve.

(3) Tighten the brake line to 19 N·m (170 in. lbs.).

(4) Connect the wire to the pressure differential switch.

(5) Bleed brakes system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

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. 15).

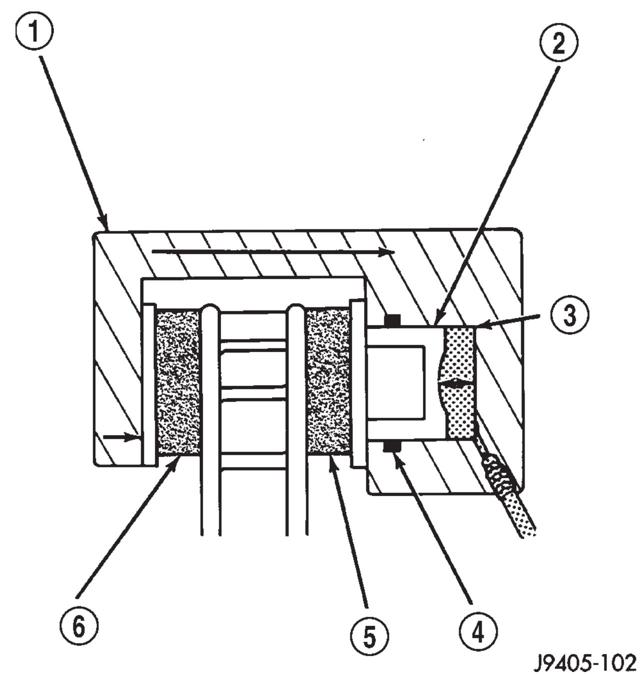


Fig. 15 Brake Caliper Operation

1 - CALIPER
2 - PISTON
3 - PISTON BORE
4 - SEAL
5 - INBOARD SHOE
6 - OUTBOARD SHOE

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

DISC BRAKE CALIPERS (Continued)

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. 16). When the brakes (and fluid pressure) are released, the seal relaxes and retracts the piston.

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

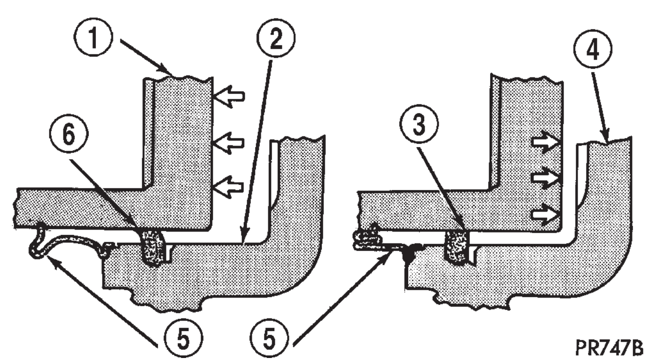


Fig. 16 Lining Wear Compensation By Piston Seal

1 - PISTON
2 - CYLINDER BORE
3 - PISTON SEAL BRAKE PRESSURE OFF
4 - CALIPER HOUSING
5 - DUST BOOT
6 - PISTON SEAL BRAKE PRESSURE ON

REMOVAL

(1) Clean master cylinder reservoir and filler caps.

(2) Remove reservoir filler cap and drain approximately 1/4 of fluid from reservoir. Use clean suction gun or similar device to drain fluid.

(3) Raise and support vehicle.

(4) Remove front wheel and tire assemblies.

(5) Bottom caliper pistons in bores with large C-clamp. Position clamp frame on rear of caliper and clamp screw on outboard brake shoe.

(6) Disconnect brake hose at caliper. Discard hose fitting washers if worn, or damaged (Fig. 17).

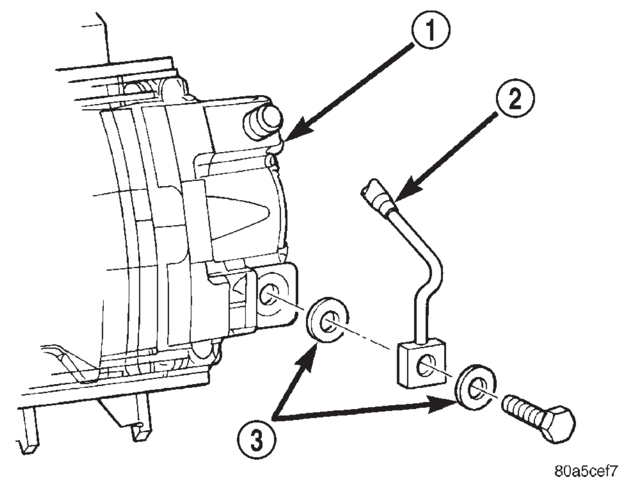


Fig. 17 Caliper Brake Hose Connection

1 - CALIPER
2 - FRONT BRAKE HOSE
3 - FITTING WASHERS

(7) With a screw driver pry up on the caliper spring and pull the spring out of the caliper holes.

(8) Remove caliper and brake shoes from caliper.

DISASSEMBLY

(1) Drain old brake fluid out of caliper into drain pan.

(2) Remove piston dust boot (Fig. 18). Use screwdriver to push boot out of groove.

(3) Pad outboard shoe side of caliper interior with a minimum 1 inch thickness of shop towels (Fig. 19). Towels will prevent piston damage when piston comes out of the caliper bore.

(4) Remove caliper piston with short bursts of compressed air. Apply air pressure through fluid inlet port of caliper (Fig. 19).

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 seal with wood pencil or plastic tool (Fig. 20). Do not use metal tools as they will scratch piston bore.

(6) Remove caliper slide pin bushings and boots.

DISC BRAKE CALIPERS (Continued)

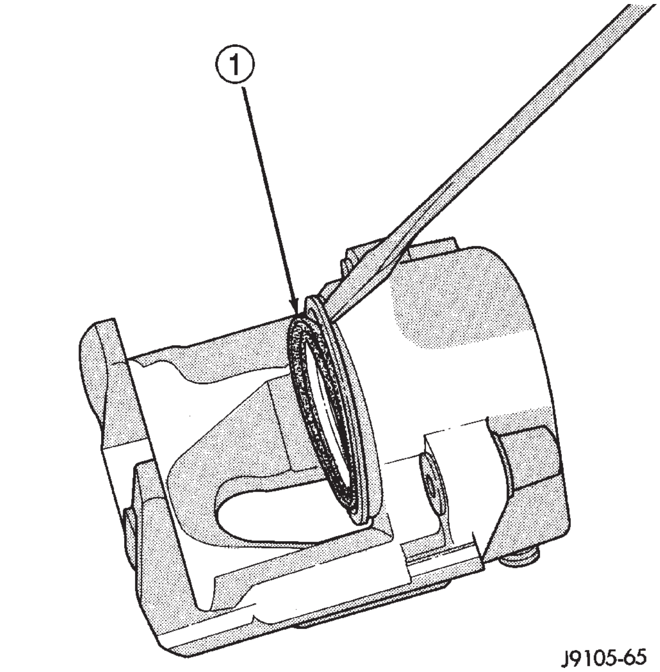


Fig. 18 Piston Dust Boot

1 - PISTON BOOT DUST

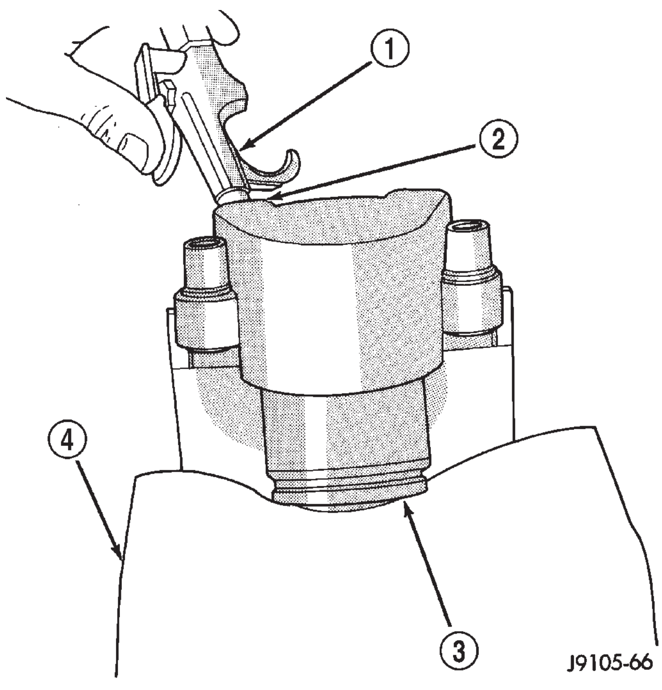


Fig. 19 Caliper Piston

1 - AIR GUN NOZZLE
2 - FLUID INLET PORT
3 - CALIPER PISTON
4 - PADDING MATERIAL (TO PROTECT PISTON)

(7) Remove caliper bleed screw and cap.

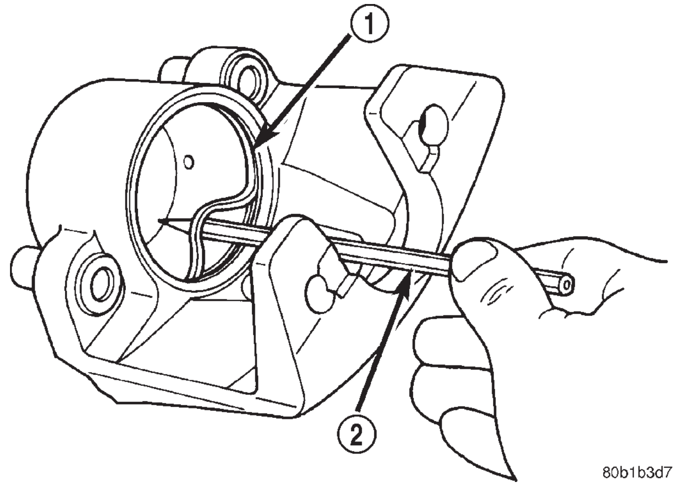


Fig. 20 Caliper Piston Seal

1 - PISTON SEAL
2 - WOOD PENCIL

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. 21). 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).

INSTALLATION

(1) Install brake shoes in caliper. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/BRAKE PADS/SHOES - INSTALLATION).

DISC BRAKE CALIPERS (Continued)

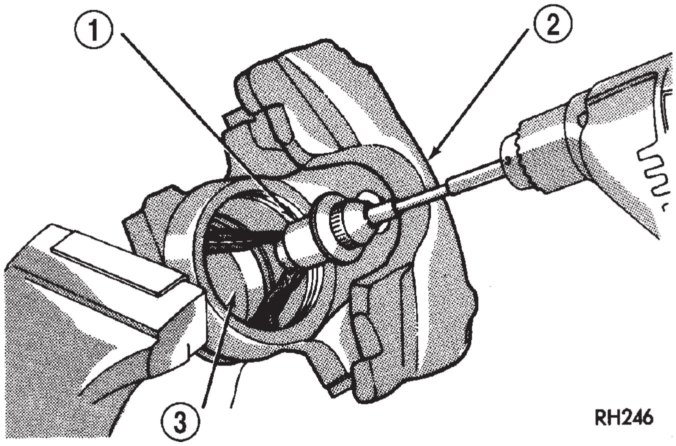


Fig. 21 Polishing Piston Bore

1 - SPECIAL HONE
2 - CALIPER
3 - PISTON BORE

(2) Install caliper and shoes over rotor and into ledges in steering knuckle. Be sure ends of brake shoes are properly seated on slide surfaces of ledges.

(3) Install and tighten caliper slide pins to 30 N·m (22 ft. lbs.). **Start the slide pins by hand before tightening. Do not cross thread the pins.**

(4) Install caliper spring into one caliper hole and under the adapter. Pull down on the opposite end of the spring (Fig. 22) and hold the end under the adapter. With a scew driver pry up on the spring (Fig. 23) to seat the spring into the other caliper hole.

NOTE: Verify the spring is seated properly into the caliper holes.

(5) Install brake hose to caliper with **new seal washers** and tighten fitting bolt to 24 N·m (18 ft. lbs.).

CAUTION: Verify brake hose is not twisted or kinked before tightening fitting bolt.

(6) Bleed base brake system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

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

(8) Remove supports and lower vehicle.

(9) Pump brake pedal to seat brake shoes.

(10) Fill brake fluid reservoir.

(11) Verify firm pedal before moving vehicle.

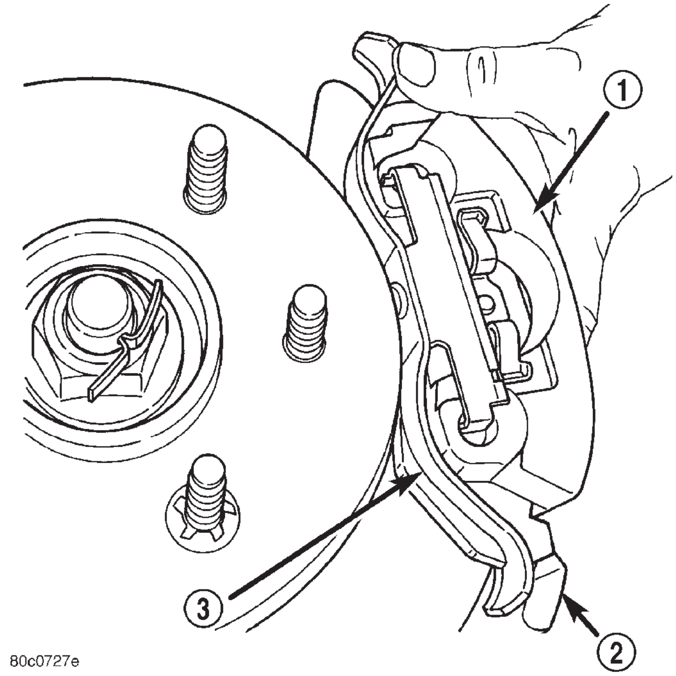


Fig. 22 Caliper

1 - CALIPER
2 - ADAPTER
3 - CALIPER SPRING

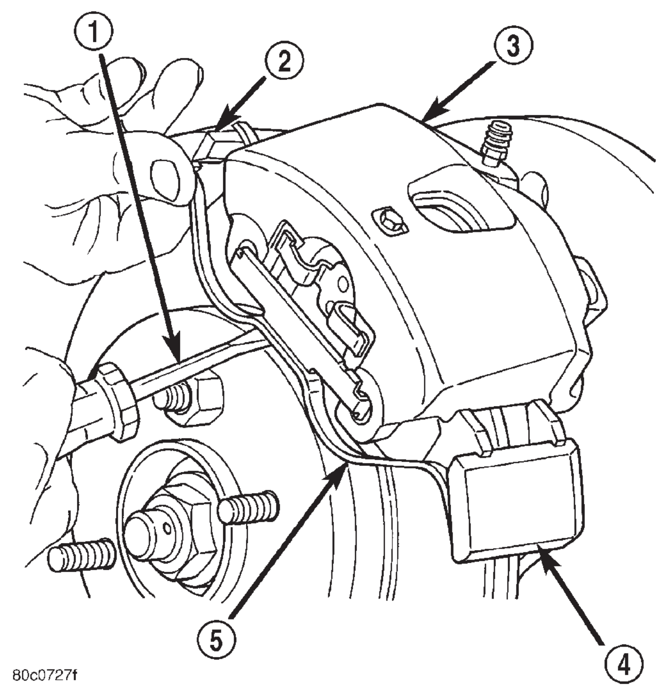


Fig. 23 Seat Caliper Spring

1 - SCREWDRIVER
2 - ADAPTER
3 - CALIPER
4 - ADAPTER
5 - CALIPER SPRING

DRUM

DESCRIPTION

Drum brakes on all models are dual shoe, internal expanding units with an automatic self adjusting mechanism (Fig. 24). Nine inch and eleven inch brakes are used.

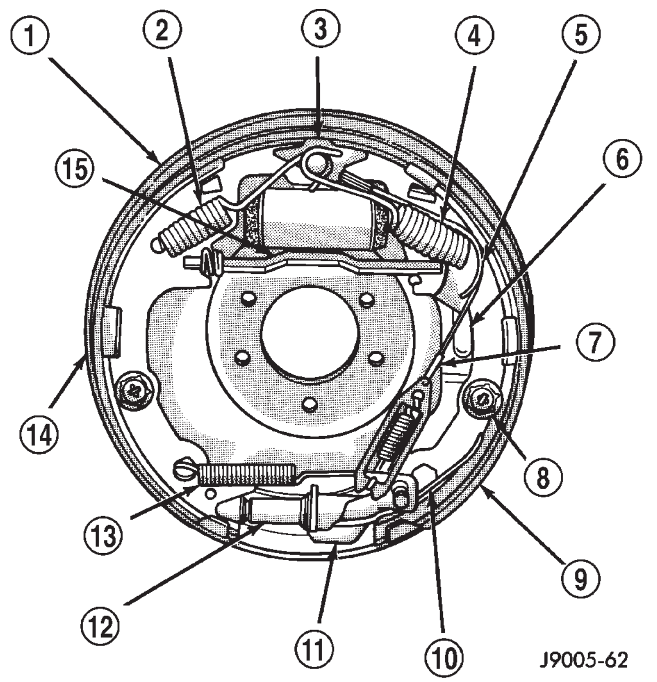


Fig. 24 Brake Assembly

1 - SUPPORT PLATE
2 - RETURN SPRING
3 - ANCHOR PLATE
4 - RETURN SPRING
5 - CABLE GUIDE
6 - PARKING BRAKE LEVER
7 - ADJUSTER CABLE AND SPRING
8 - SHOE RETAINER, SPRING AND PIN
9 - SECONDARY SHOE AND LINING
10 - LEVER SPRING
11 - ADJUSTER LEVER
12 - ADJUSTER SCREW ASSEMBLY
13 - SHOE SPRING
14 - PRIMARY SHOE AND LINING
15 - PARKING BRAKE STRUT AND SPRING

OPERATION

When the brake pedal is depressed hydraulic pressure pushes the rear 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.

DIAGNOSIS AND TESTING - BRAKE DRUM

The maximum allowable diameter of the drum braking surface is indicated on the drum outer edge. Generally, a drum can be machined to a maximum of 1.52 mm (0.060 in.) oversize. Always replace the drum if machining would cause drum diameter to exceed the size limit indicated on the drum.

BRAKE DRUM RUNOUT

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

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

STANDARD PROCEDURES - 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.

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove clip nuts securing brake drum to wheel studs.

(4) Remove drum. If drum is difficult to remove, remove rear plug from access hole in support plate. Back-off self adjusting by inserting a thin screwdriver into access hole and push lever away from adjuster screw star wheel. Then insert an adjuster tool into brake adjusting hole rotate adjuster star wheel to retract brake shoes.

DRUM (Continued)

(5) Vacuum brake components to remove brake lining dust.

(6) Remove shoe return springs with brake spring plier tool (Fig. 25).

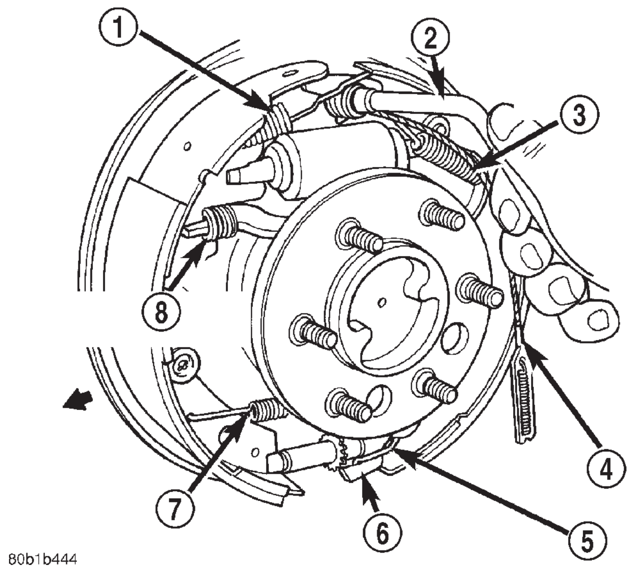


Fig. 25 Shoe Return Springs

1 - SHOE RETURN SPRING
2 - SPECIAL TOOL (REMOVING AND INSTALLING)
3 - SHOE RETURN SPRING
4 - ADJUSTER CABLE
5 - LEVER SPRING
6 - ADJUSTER LEVER
7 - SHOE TO SHOE SPRING
8 - ANTI-RATTLE SPRING

(7) Remove adjuster cable. Slide cable eye off anchor pin. Then unhook and remove cable from adjuster lever.

(8) Remove cable guide from secondary shoe and anchor plate from anchor pin.

(9) Remove adjuster lever. Disengage lever from spring by sliding lever forward to clear pivot and work lever out from under spring.

(10) Remove adjuster lever spring from pivot.

(11) Disengage and remove shoe spring from brake shoes.

(12) Disengage and remove adjuster screw assembly from brake shoes.

(13) Remove brake shoe retainers, springs (Fig. 26).

(14) Remove secondary brake shoe from support plate.

(15) Remove strut and spring (Fig. 26).

(16) Remove parking brake lever retaining clip from the secondary shoe and remove the lever.

(17) Remove primary shoe from support plate.

(18) Disengage parking brake lever from parking brake cable.

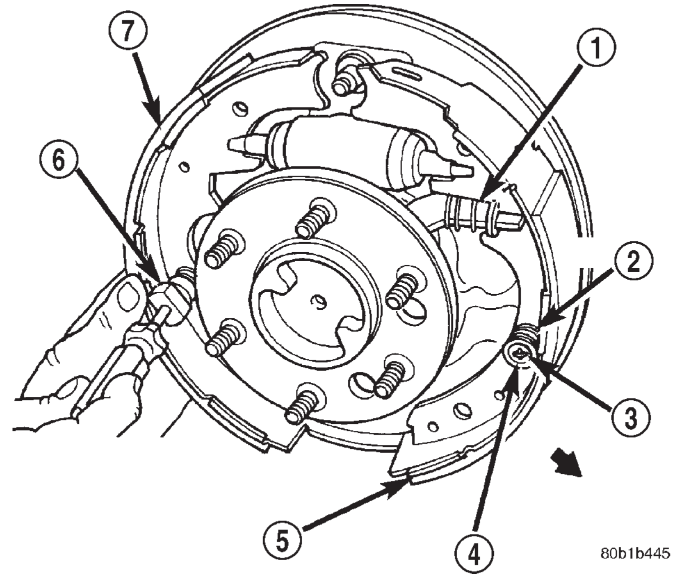


Fig. 26 Shoe Retainers, Springs and Pins

1 - STRUT AND SPRING
2 - SPRING
3 - PIN
4 - RETAINER
5 - PRIMARY SHOE AND LINING
6 - TOOL C-4070
7 - SECONDARY SHOE AND LINING

CLEANING

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

INSPECTION

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

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

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

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

Inspect the brake shoe contact pads on the support plate, replace the support plate if any of the pads are

DRUM (Continued)

worn or rusted through. Also replace the plate if it is bent or distorted (Fig. 27).

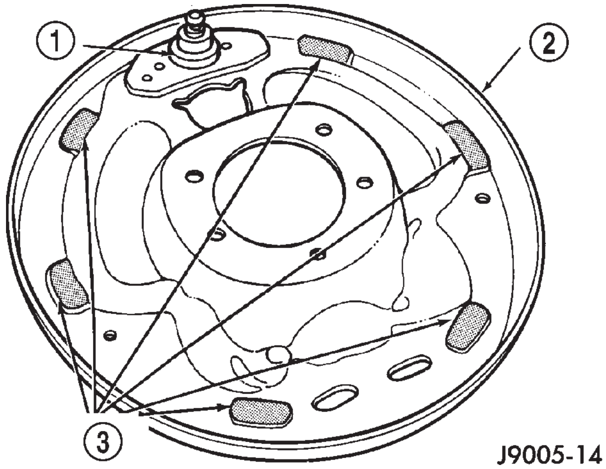


Fig. 27 Shoe Contact Surfaces

1 - ANCHOR PIN
2 - SUPPORT PLATE
3 - SHOE CONTACT SURFACES

INSTALLATION

(1) Clean and inspect individual brake components, refer to Cleaning and Inspection Section.

(2) Lubricate anchor pin and brake shoe contact pads on support plate with high temperature grease or Lubriplate (Fig. 28).

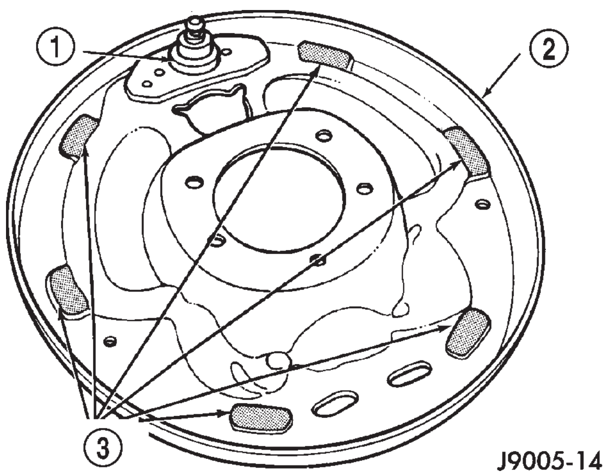


Fig. 28 Shoe Contact Surfaces

1 - ANCHOR PIN
2 - SUPPORT PLATE
3 - SHOE CONTACT SURFACES

(3) Lubricate adjuster screw socket, nut, button and screw thread surfaces with grease or Lubriplate.

(4) Install the parking brake cable to the parking brake lever.

(5) Install parking brake lever to the secondary shoe and install retaining clip.

(6) Install primary shoe on support plate. Secure shoe with new spring retainers and pin.

(7) Install spring on parking brake strut and engage strut in primary.

(8) Install secondary shoe on support plate (Fig. 29). Insert strut in shoe and guide shoe onto anchor pin. Temporarily secure shoe with retaining pin.

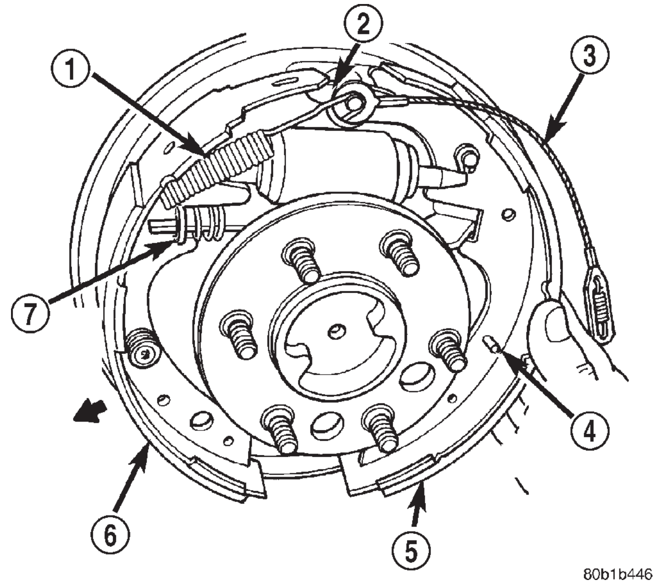


Fig. 29 Brake Shoe Installation

1 - SHOE RETURN SPRING
2 - ANCHOR PLATE
3 - ADJUSTER CABLE
4 - SHOE RETAINING PIN
5 - SECONDARY SHOE AND LINING
6 - PRIMARY SHOE AND LINING
7 - STRUT AND SPRING

(9) Install anchor plate and adjuster cable eyelet on support plate anchor pin.

(10) Install cable guide in secondary shoe and position cable in guide.

(11) Assemble adjuster screw (Fig. 30). Then install and adjuster screw between the brake shoes.

CAUTION: Be sure the adjuster screws are installed on the correct brake unit. The adjuster screws are marked L (left) and R (right) for identification.

(12) Install adjuster lever and spring and connect adjuster cable to lever.

(13) Install secondary shoe retainers and spring.

(14) Install shoe spring. Connect spring to secondary shoe first. Then to primary shoe.

(15) Verify adjuster operation. Pull adjuster cable upward, cable should lift lever and rotate star wheel. Be sure adjuster lever properly engages star wheel teeth.

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

DRUM (Continued)

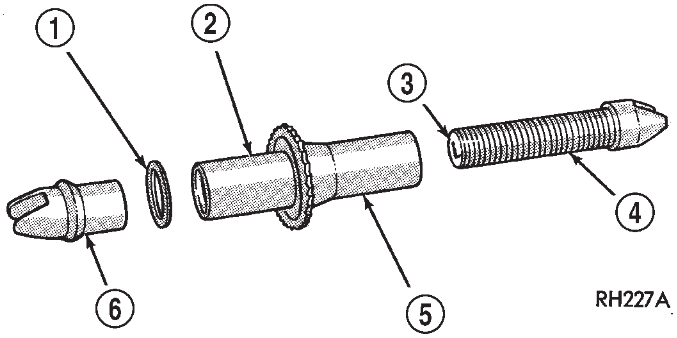


Fig. 30 Adjuster Screw

1 - WASHER
2 - SOCKET
3 - STAMPED LETTER
L-LEFT BRAKE
R-RIGHT BRAKE
4 - SCREW THREADS
5 - NUT
6 - BUTTON

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

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. 31).

(5) Reverse gauge and install it on brake shoes. Position gauge legs at shoe centers as shown (Fig. 32). If gauge does not fit (too loose/too tight), adjust shoes.

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

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

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

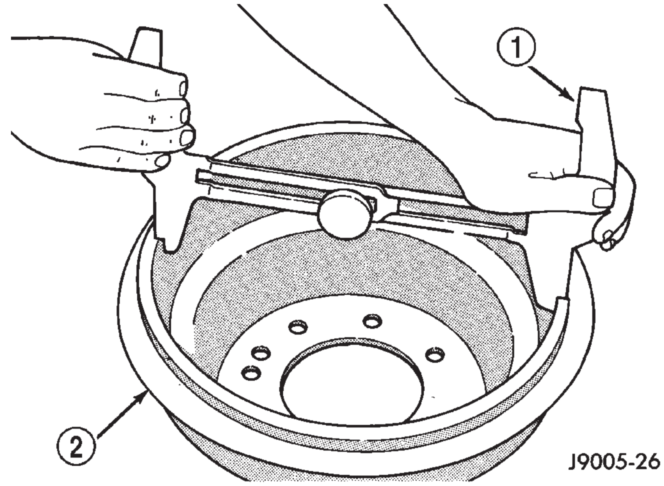


Fig. 31 Adjusting Gauge On Drum

1 - BRAKE GAUGE
2 - BRAKE DRUM

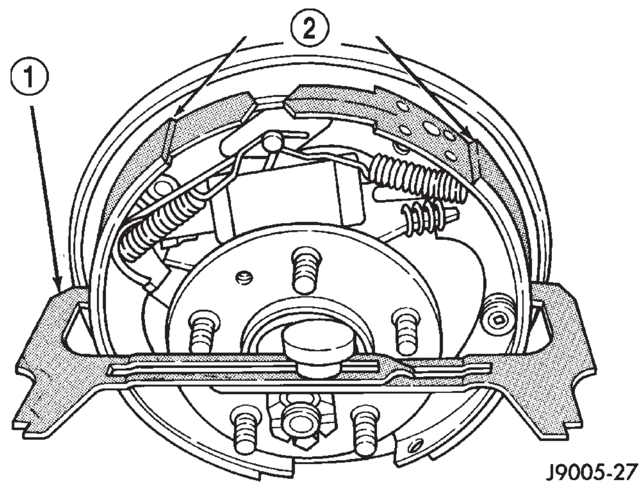


Fig. 32 Adjusting Gauge On Brake Shoes

1 - BRAKE GAUGE
2 - BRAKE SHOES

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

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

ADJUSTMENT WITH ADJUSTING TOOL

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

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

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

DRUM (Continued)

(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. 33).

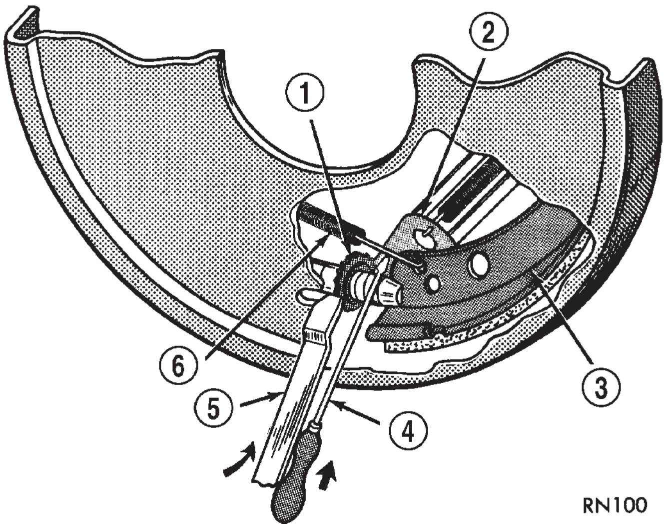


Fig. 33 Brake Adjustment

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.

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) Clamp cylinder body in vise with brass protective jaws.

(3) Remove pins that retain reservoir to master cylinder. Use hammer and pin punch to remove pins (Fig. 34).

(4) Loosen reservoir from grommets with pry tool (Fig. 35).

FLUID RESERVOIR (Continued)

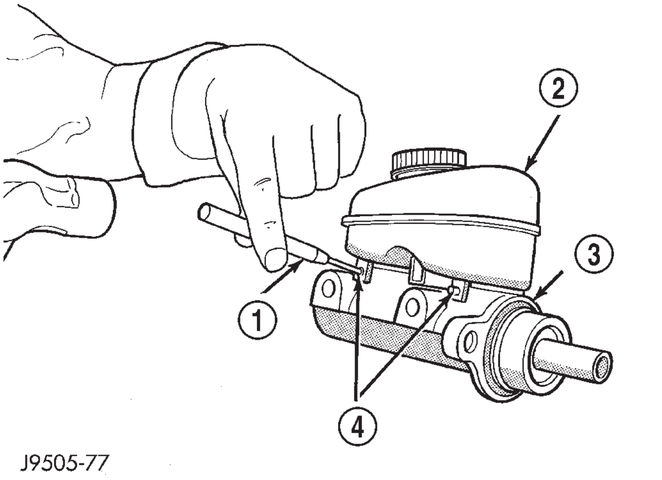


Fig. 34 Reservoir Retaining Pins

1 - PIN PUNCH
2 - RESERVOIR
3 - BODY
4 - ROLL PINS

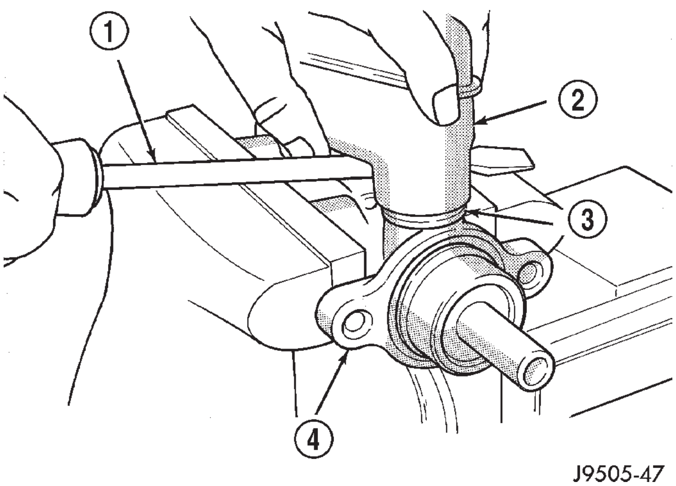


Fig. 35 Loosening Reservoir

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).

(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.

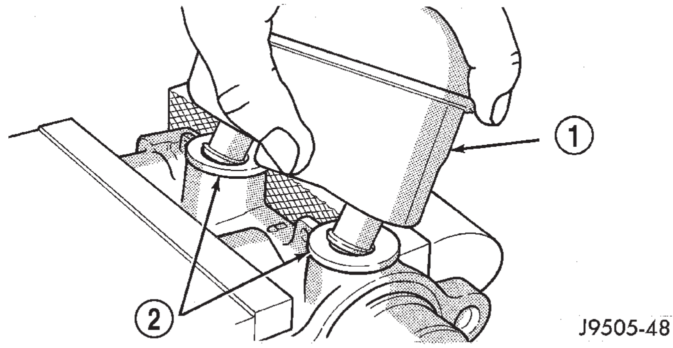


Fig. 36 Reservoir Removal

1 - RESERVOIR
2 - GROMMETS

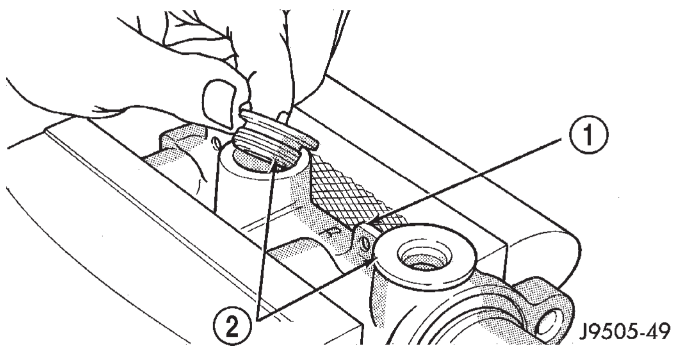


Fig. 37 Grommet Removal

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.

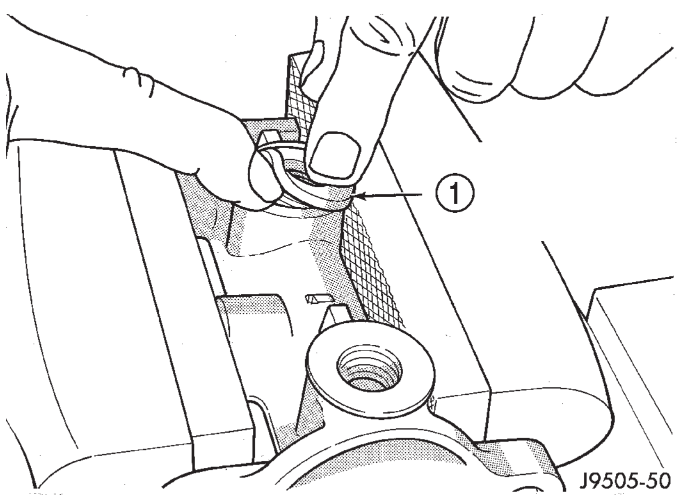


Fig. 38 Grommet Installation

1 - WORK NEW GROMMETS INTO PLACE USING FINGER PRESSURE ONLY

FLUID RESERVOIR (Continued)

(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

A two-piece master cylinder is used on all models. The cylinder body containing the primary and secondary pistons is made of aluminum. The removable fluid reservoir is made of nylon reinforced with glass fiber. The reservoir stores reserve brake fluid for the hydraulic brake circuits. The reservoir is the only serviceable component.

The fluid compartments of the nylon reservoir are interconnected to permit fluid level equalization. However, the equalization feature does not affect circuit separation in the event of a front or rear brake malfunction. The reservoir compartments will retain enough fluid to operate the functioning hydraulic circuit.

Care must be exercised when removing/installing the master cylinder connecting lines. The threads in the cylinder fluid ports can be damaged if care is not exercised. Start all brake line fittings by hand to avoid cross threading.

The cylinder reservoir can be replaced when necessary. However, the aluminum body section of the master cylinder is not a repairable component.

NOTE: If diagnosis indicates that an internal malfunction has occurred, the aluminum body section must be replaced as an assembly.

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.

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.

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.

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.

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 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

MASTER CYLINDER (Continued)

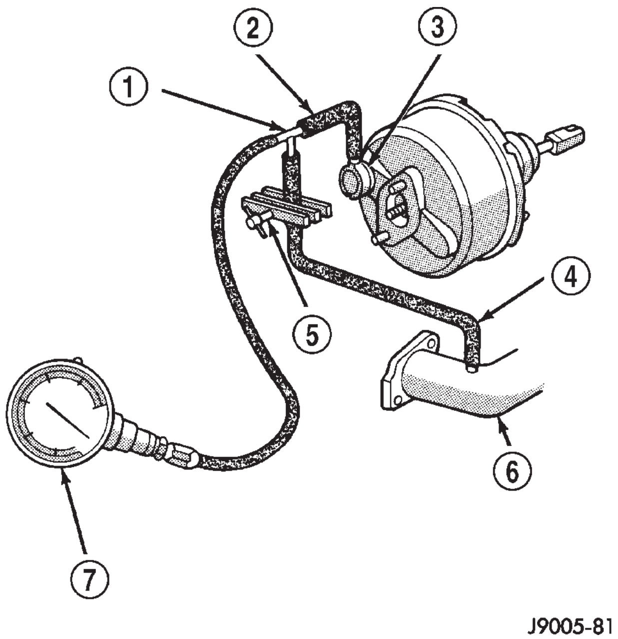


Fig. 39 Typical Booster Vacuum Test Connections

1 - TEE FITTING
2 - SHORT CONNECTING HOSE
3 - CHECK VALVE
4 - CHECK VALVE HOSE
5 - CLAMP TOOL
6 - INTAKE MANIFOLD
7 - VACUUM GAUGE

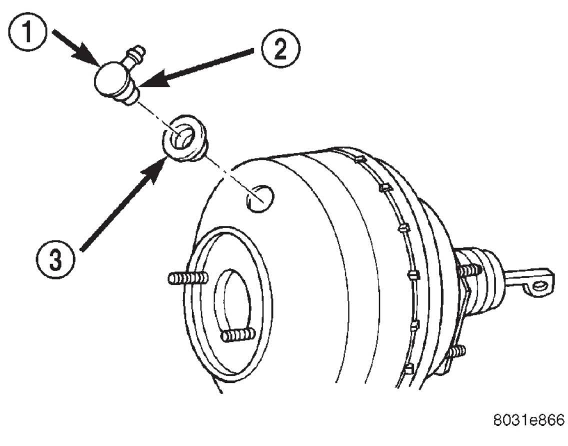


Fig. 40 Vacuum Check Valve And Seal

1 - BOOSTER CHECK VALVE
2 - APPLY TEST VACUUM HERE
3 - VALVE SEAL

spring pressure. Continue bleeding operations until air bubbles are no longer visible in fluid.

REMOVAL

(1) Remove brake lines from the master cylinder (Fig. 42).

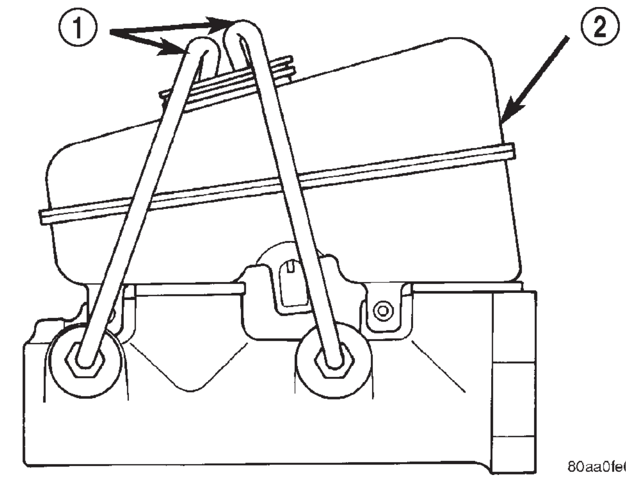


Fig. 41 Master Cylinder Bleeding–Typical

1 - BLEEDING TUBES
2 - RESERVOIR

(2) Remove mounting nuts from the master cylinder (Fig. 42).

(3) Remove master cylinder.

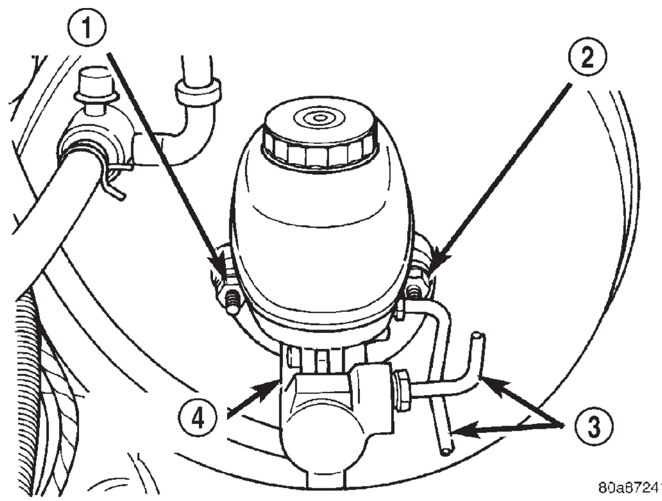


Fig. 42 Master Cylinder

1 - MOUNTING NUT
2 - MOUNTING NUT
3 - BRAKE LINES
4 - MASTER CYLINDER

INSTALLATION

NOTE: If master cylinder is replaced bleed cylinder before installation.

(1) Install master cylinder on booster mounting studs.

(2) Install mounting nuts and tighten to 18 N·m (160 in. lbs.).

MASTER CYLINDER (Continued)

(3) Install brake lines and tighten to 19 N·m (170 in. lbs.)

(4) Fill and bleed base brake system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

PEDAL

DESCRIPTION

A suspended-type brake pedal is used. The pedal is attached to the pedal support bracket with a pivot bolt and bushings. The booster push rod is attached to the pedal with a clip. The pedal, bushings, pivot pin and support bracket are all serviceable components.

OPERATION

The brake pedal is attached to the booster push rod. When the pedal is depressed, the primary booster push rod is depressed which move the booster secondary rod. The booster secondary rod depress the master cylinder piston.

REMOVAL

(1) Remove stop lamp switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/BRAKE LAMP SWITCH - REMOVAL).

(2) Remove clip securing booster push rod to brake pedal (Fig. 43).

(3) Remove pedal pivot pin C-clip and slide pin out of support bracket and pedal.

(4) Remove pedal and bushings.

INSTALLATION

(1) Replace bushings if worn or damaged.

(2) Lubricate pedal bushings and pivot pin with Mopar multi mileage grease, Lubriplate, or a silicone grease.

(3) Install bushings in pedal and position pedal in support.

(4) Insert pivot pin through support and pedal bushings and install C-clip.

(5) Install booster push rod on brake pedal and install push rod retainer clip.

(6) Install stop lamp switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/BRAKE LAMP SWITCH - INSTALLATION).

POWER BRAKE BOOSTER

DESCRIPTION

All models use a tandem diaphragm, power brake booster.

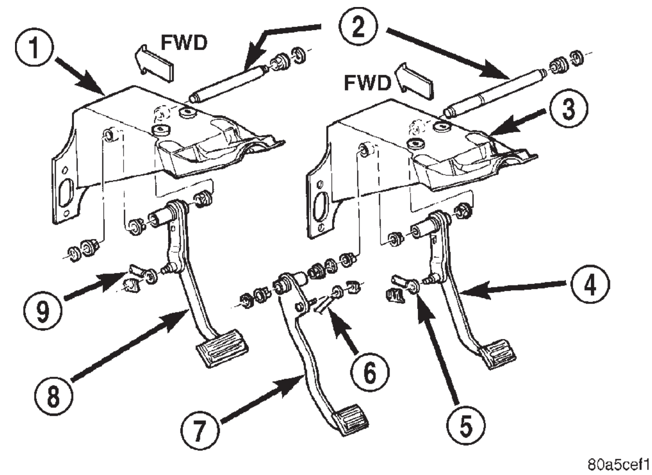


Fig. 43 Brake Pedal Mounting

1 - PEDAL SUPPORT
2 - PIVOT ROD
3 - PEDAL SUPPORT
4 - BRAKE PEDAL
5 - BOOSTER ROD
6 - CLUTCH ROD
7 - CLUTCH PEDAL
8 - BRAKE PEDAL
9 - BOOSTER ROD

NOTE: The power brake booster is not a repairable component. The booster must be replaced as an assembly if diagnosis indicates a malfunction has occurred.

OPERATION

The booster unit consists of a single housing divided into two by a tandem diaphragm. The outer edge of the diaphragm is secured to the housing. The booster push rod, which connects the booster to the brake pedal and master cylinder, is attached to the center of the diaphragm. A check valve is used in the booster outlet connected to the engine intake manifold. Power assist is generated by utilizing a combination of vacuum and atmospheric pressure to boost brake assist.

REMOVAL

(1) Remove master cylinder. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/MASTER CYLINDER - REMOVAL).

(2) Disconnect vacuum lines at booster.

(3) Remove clip securing booster push rod to brake pedal (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/PEDAL - REMOVAL). (Fig. 44).

(4) Remove nuts from booster mounting studs (Fig. 45).

(5) Remove booster, spacer and gaskets from front cowl panel.

POWER BRAKE BOOSTER (Continued)

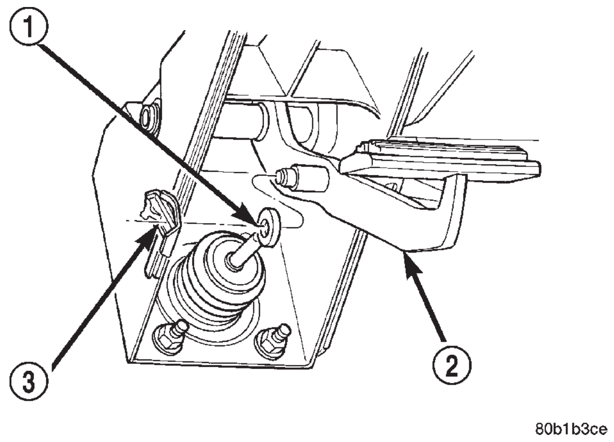


Fig. 44 Booster Rod Clip

1 - BOOSTER ROD
2 - BRAKE PEDAL
3 - CLIP

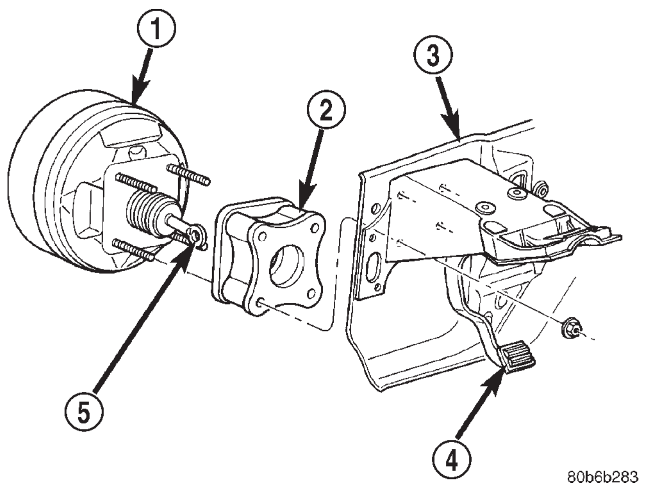


Fig. 45 Power Brake Booster Mounting

1 - BRAKE BOOSTER
2 - SPACER
3 - FRONT COWL PANEL
4 - BRAKE PEDAL
5 - BRAKE BOOSTER ROD

INSTALLATION

(1) Position spacer and gaskets on booster studs.

(2) Guide booster studs into cowl panel holes and seat booster on panel.

(3) Install and tighten booster attaching nuts to 28 N·m (250 in. lbs.).

(4) Install booster push rod on brake pedal and install clip. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/PEDAL - INSTALLATION).

(5) Install booster check valve if removed and connect vacuum hose to check valve.

(6) Install master cylinder. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/MASTER CYLINDER - INSTALLATION).

(7) Fill and bleed brake system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

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

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. 46). Excessive lateral runout will cause brake pedal pulsation and rapid, uneven wear of the brake shoes. Position the dial indicator plunger approximately 25.4 mm (1 in.) inward from the rotor edge. Maximum allowable rotor runout is 0.102 mm (0.004 in.).

ROTOR THICKNESS VARIATION

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

Measure rotor thickness at 6 to 12 points around the rotor face (Fig. 47).

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.

ROTORS (Continued)

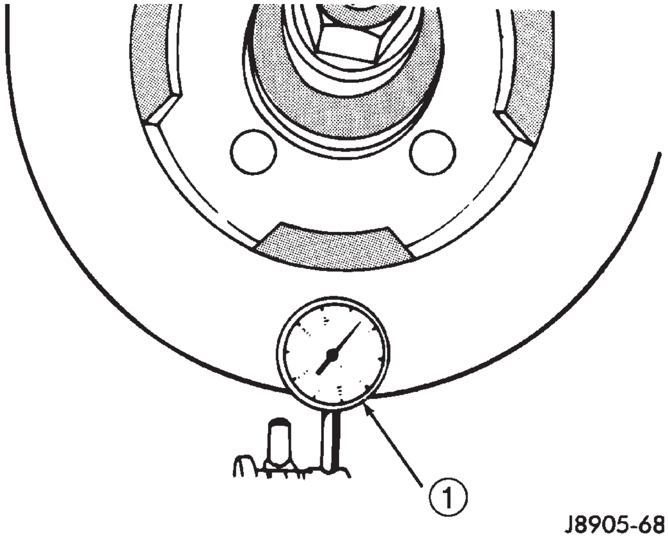


Fig. 46 Checking Rotor Runout And Thickness Variation

1 - DIAL INDICATOR

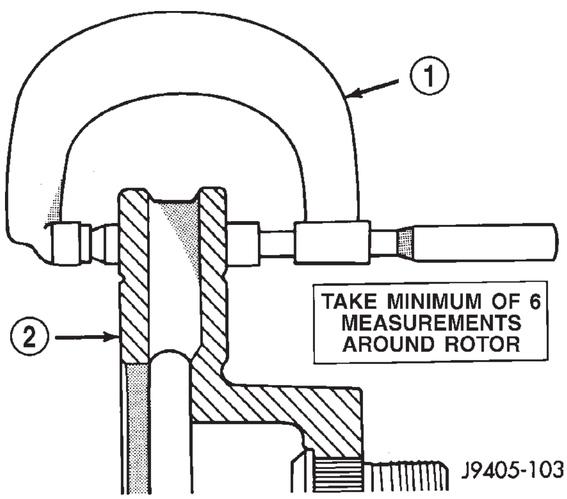


Fig. 47 Measuring Rotor Thickness

1 - MICROMETER
2 - ROTOR

STANDARD PROCEDURES - 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) Raise and support vehicle.
(2) Remove wheel and tire assembly.
(3) Remove brake caliper. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).
(4) Remove retainers on wheel studs and remove rotor.

INSTALLATION

(1) Install rotor hub and install retainers.
(2) Install brake caliper. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).
(3) Install wheel and tire assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
(4) Remove support and lower vehicle.
(5) Depress brake pedal several time to seat brake shoes.

WHEEL CYLINDERS

REMOVAL

(1) Remove wheel and tire assembly.
(2) Remove brake drum.
(3) Disconnect wheel cylinder brake line.
(4) Remove brake shoe return springs and move shoes out of engagement with cylinder push rods.
(5) Remove cylinder attaching bolts and remove cylinder from support plate.

DISASSEMBLY

(1) Remove push rods and boots (Fig. 48).
(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.

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.

WHEEL CYLINDERS (Continued)

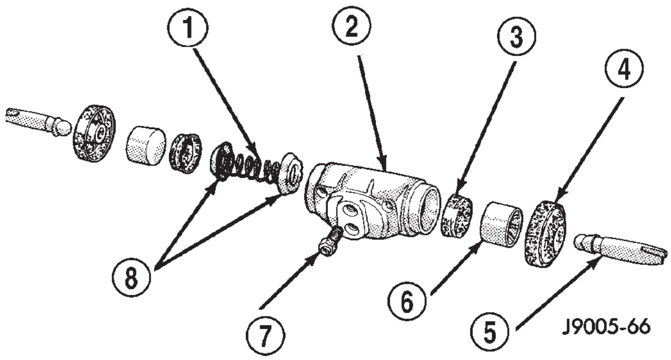


Fig. 48 Wheel Cylinder Components–Typical

1 - SPRING
2 - CYLINDER
3 - PISTON CLIP
4 - BOOT
5 - PUSH ROD
6 - PISTON
7 - BLEED SCREW
8 - CUP EXPANDERS

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.

(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 20 N·m (15 ft. lbs.).

(3) Connect brake line to cylinder.

(4) Install brake shoe return spring.

(5) Install brake drum.

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

(7) Bleed base brake system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

SUPPORT PLATE

REMOVAL

(1) Remove wheel and tire assembly and brake drum.

(2) Remove brake shoe assembly. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DRUM - REMOVAL).

(3) Remove parking brake cable from parking brake lever. (Refer to 5 - BRAKES/PARKING BRAKE/CABLES - REMOVAL).

(4) Compress parking brake cable retainer tabs. Then push retainer and cable through and out of support plate.

(5) Disconnect brake line at wheel cylinder.

(6) Remove wheel cylinder from support plate. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/WHEEL CYLINDERS - REMOVAL).

(7) Remove axle shaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE - 9 1/4/AXLE SHAFTS - REMOVAL).

(8) Remove bolts attaching support plate to axle and remove support plate.

INSTALLATION

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

(2) Install support plate on axle flange. Tighten attaching bolts to 115 N·m (85 ft. lbs.).

(3) Apply bead of silicone sealer around wheel cylinder mounting surface and install wheel cylinder. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/WHEEL CYLINDERS - INSTALLATION).

(4) Install brake line in wheel cylinder.

(5) Install parking brake cable in support plate.

(6) Install axle shaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE - 9 1/4/AXLE SHAFTS - INSTALLATION).

(7) Connect parking brake cable to lever on secondary shoe and install brake shoes on support plate.

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

SUPPORT PLATE (Continued)

(9) Install brake drum and wheel and tire assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE) (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(10) Bleed brake system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

CABLES

REMOVAL - FRONT PARK BRAKE CABLE

(1) Raise and support the vehicle.

(2) Loosen cable adjusting nut.

(3) Disengage front cable (Fig. 49) from cable tensioner.

(4) Remove support cable from the front cable (Fig. 50).

(5) Remove support and lower vehicle.

(6) Remove left kick panel.

(7) Fold left front edge of floor covering rearward and remove cable grommet from floor pan (Fig. 50).

(8) Remove cable from park brake pedal assembly. (Refer to 5 - BRAKES/PARKING BRAKE/PEDAL - REMOVAL).

(9) Work cable and housing assembly up through floor pan.

(10) Remove front cable from vehicle.

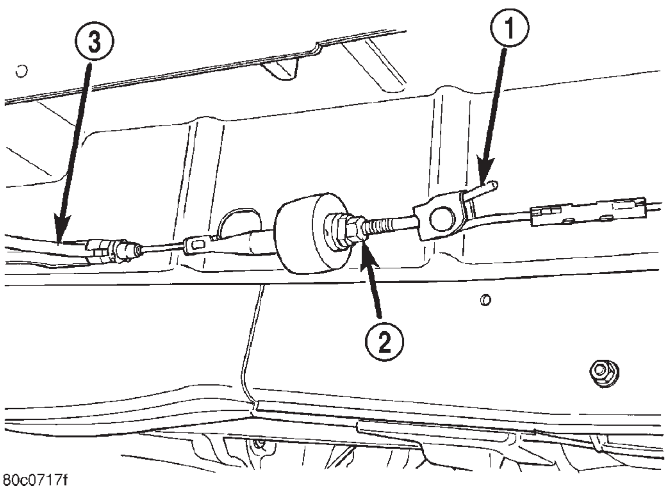


Fig. 49 Front Cable & Tensioner

1 - TENSIONER
2 - ADJUSTER NUT
3 - FRONT CABLE

REMOVAL - REAR PARK BRAKE CABLES

(1) Raise and support the vehicle.

(2) Remove the rear wheel and tire assemblies.

(3) Loosen tensioner adjuster nut.

(4) Remove the right cable (Fig. 51) from the extension cable.

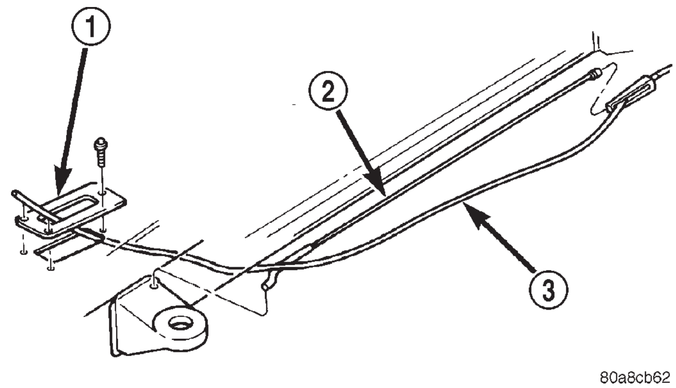


Fig. 50 Support Cable

1 - GROMMET
2 - SUPPORT CABLE
3 - FRONT CABLE

(5) Remove the right cable from the frame clip and pull the cable housing through the left cable connector.

(6) Remove the left cable connector from the left cable.

(7) Pull both cables (Fig. 51) through the cable bracket.

(8) Remove the right cable mounting retainers from the from the differential housing.

(9) Remove the brake drums.

(10) Disconnect each cable from park brake lever.

(11) Compress tabs on each cable housing retainer at the brake support plate.

(12) Remove the cables from the brake support plates.

INSTALLATION - FRONT PARK BRAKE CABLE

(1) Insert front cable through floor pan and install grommet.

(2) Insert cable retainer into hole at bottom of pedal assembly bracket and connect cable end.

(3) Fold floor covering down and install kick panel.

(4) Raise and support vehicle.

(5) Install support cable to the front cable.

(6) Attach front cable to tensioner.

(7) Adjust parking brakes.

(8) Remove support and lower vehicle.

INSTALLATION - REAR PARK BRAKE CABLES

(1) Push each cable housing through the brake support plate hole until cable housing retainer tabs lock into place.

NOTE: Pull on the cable housing to ensure it is lock into place.

CABLES (Continued)

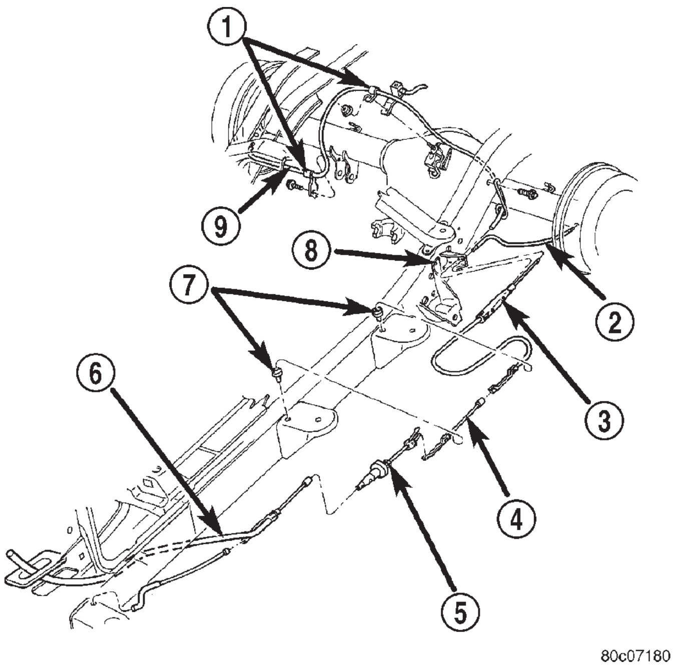


Fig. 51 Park Brake Cables

1 - CABLE RETAINERS
2 - LEFT CABLE
3 - LEFT CABLE CONNECTOR
4 - EXTENSION CABLE
5 - TENSIONER
6 - FRONT CABLE
7 - FRAME CLIPS
8 - CABLE BRACKET
9 - RIGHT CABLE

(2) Pull back on the end of the cable. Then push the cable in to engage the cable in the park brake lever.

NOTE: Pull on the cable end to ensure it is attached it the park brake lever.

(3) Install the brake drums.
(4) Install right cable mounting retainers.
(5) Push the cables housing through the cable bracket.
(6) Install the left cable onto the cable connector.
(7) Push the right cable housing through the left cable connector and connect the cable to the extension cable.
(8) Install the wheel and tire assemblies. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
(9) Perform park brake adjustment procedure. (Refer to 5 - BRAKES/PARKING BRAKE/CABLES - ADJUSTMENTS).
(10) Remove support and lower the vehicle.

PARK BRAKE CABLE TENSIONER

NOTE: Tensioner adjustment is only necessary when the tensioner, or a cable has been replaced or disconnected for service. When adjustment is necessary, perform adjustment only as described in the following procedure. This is necessary to avoid faulty park brake operation.

(1) Raise vehicle.
(2) Back off cable tensioner adjusting nut at equalizer to create slack in cables.
(3) Remove rear wheel/tire assemblies. Then remove brake drums.
(4) Verify brakes are in good condition and operating properly.
(5) Verify park brake cables operate freely and are not binding, or seized.
(6) Check rear brake shoe adjustment with standard brake gauge.
(7) Install drums and verify that drums rotate freely without drag.
(8) Reinstall wheel/tire assemblies after brake shoe adjustment is complete.
(9) Lower vehicle enough for access to park brake foot pedal. Then fully apply park brakes.

NOTE: Leave park brakes applied until adjustment is complete.

(10) Raise vehicle again.
(11) Mark tensioner rod 6.35 mm (1/4 in.) from edge of tensioner bracket (Fig. 52).
(12) Tighten adjusting nut at equalizer until mark on tensioner rod moves into alignment with tensioner bracket.

CAUTION: Do not loosen, or tighten the tensioner adjusting nut for any reason after completing adjustment.

(13) Lower vehicle until rear wheels are 15-20 cm (6-8 in.) off shop floor.
(14) Release park brake foot pedal and verify that rear wheels rotate freely without drag. Then lower vehicle.

PEDAL

DESCRIPTION

The rear drum brake shoes serve as the parking brakes. The parking brakes are operated by a system of cables and levers attached to the rear brake secondary shoes.

PEDAL (Continued)

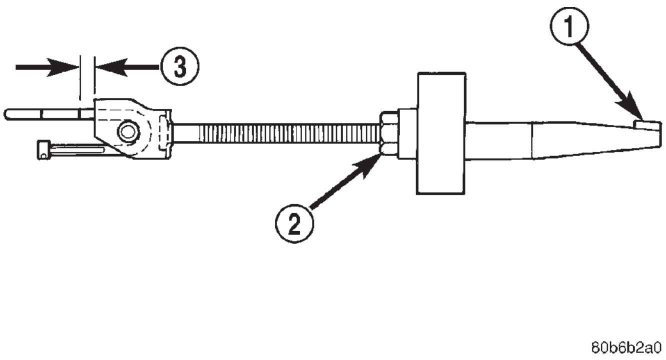


Fig. 52 Adjustment Mark On Cable Tensioner Rod

1 - CABLE CONNECTOR
2 - ADJUSTER NUT
3 - 6.35MM (1/4 IN.)

OPERATION

The shoes make contact with the brake drum surface by a cable and lever mechanism attached to the secondary brake shoe. The front parking brake cable is connected to the parking brake pedal and to the rear cables. An intermediate cable is used on some vehicles to connect the front and rear cables.

The parking brake pedal assembly is mounted on the driver side cowl panel. The front cable is directly attached to the assembly. The pedal assembly contains a spring loaded mechanism to hold the pedal in the applied position. A rod and spring are used to release the ratchet mechanism and return the pedal to normal position.

REMOVAL

(1) Remove left side kick panel.
(2) Remove brake release rod from pedal assembly (Fig. 53).
(3) Disconnect brake warning lamp switch.
(4) Remove front parking brake cable. (Refer to 5 - BRAKES/PARKING BRAKE/CABLES - REMOVAL).
(5) Remove mounting nuts and mounting bolt.
(6) Slide assembly rearward off the mounting studs (Fig. 53).

INSTALLATION

(1) Install assembly on the mounting studs.
(2) Install mounting bolt and nuts.
(3) Install front parking brake cable. (Refer to 5 - BRAKES/PARKING BRAKE/CABLES - INSTALLATION).
(4) Connect brake warning lamp switch.
(5) Install brake release rod to pedal assembly.
(6) Install left side kick panel.

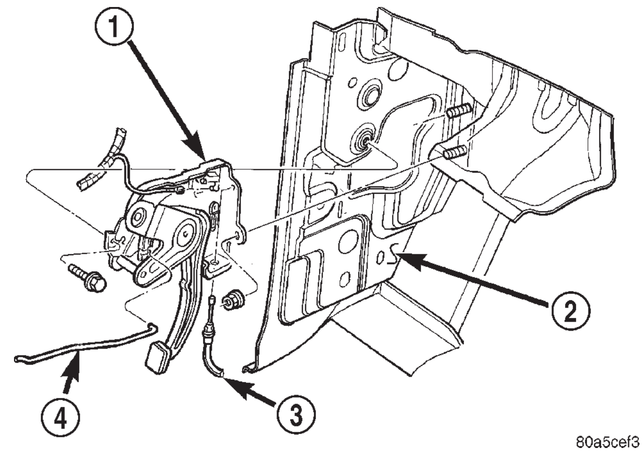


Fig. 53 Parking Brake Pedal Assembly

1 - PARKING BRAKE ASSEMBLY
2 - LEFT COWL PANEL
3 - FRONT CABLE
4 - RELEASE ROD

RELEASE

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.
(2) Reach under the driver side outboard end of the instrument panel to access and unsnap the plastic retainer clip that secures the park brake release linkage rod to the lever on the back side of the park brake release handle.
(3) Disengage the park brake release linkage rod end from the lever on the back of the park brake release handle.
(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry one of the park brake handle hinge tabs away from its pivot pin on the instrument panel (Fig. 54).
(5) While prying the park brake release handle hinge tab with one hand, use the other hand to pull the handle firmly down and away from the pivot pin.
(6) Remove the park brake release handle from the instrument panel.

RELEASE (Continued)

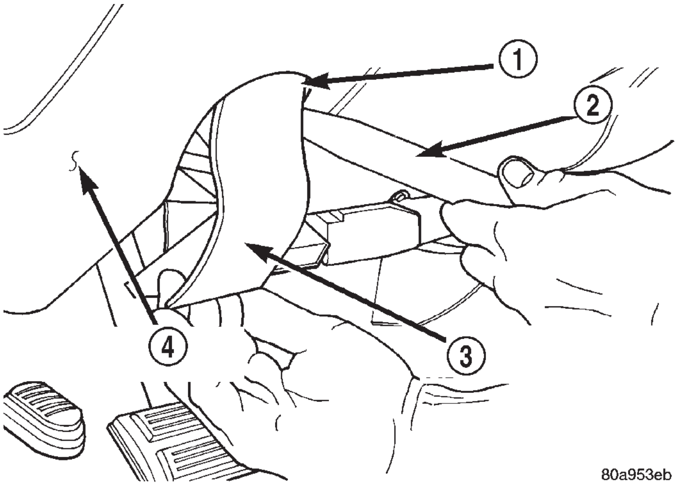


Fig. 54 Park Brake Release Handle Remove/Install

1 - INSERT BETWEEN HINGE TAB AND PIVOT PIN
2 - TRIM STICK
3 - PARK BRAKE RELEASE HANDLE
4 - INSTRUMENT PANEL

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO - 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) Position the park brake release handle to the instrument panel.

(2) Engage one of the park brake release handle hinge tabs with one of the pivot pins on the instrument panel.

(3) Align the second park brake release handle hinge tab hinge over the second pivot pin on the instrument panel.

(4) Press firmly on the park brake release handle over the second hinge tab until it snaps over the second pivot pin on the instrument panel.

(5) Reach under the driver side outboard end of the instrument panel to access and engage the park brake release linkage rod end from the lever on the back of the park brake release handle.

(6) Snap the plastic retainer clip that secures the park brake release linkage rod to the lever on the back side of the park brake release handle over the linkage rod.

(7) Reconnect the battery negative cable.

BRAKES - ABS

TABLE OF CONTENTS

BRAKES - ABS

DESCRIPTION

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

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

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

ABS system major components include:

- Controller Antilock Brakes (CAB)
- Hydraulic Control Unit (HCU)
- Wheel Speed Sensors (WSS)
- ABS Warning Light

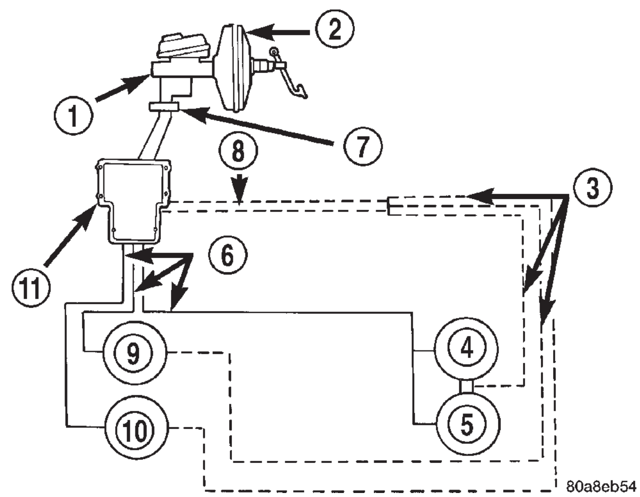


Fig. 1 Antilock Brake System

1 - MASTER CYLINDER AND RESERVOIR
2 - POWER BRAKE BOOSTER
3 - WIRES TO WHEEL SPEED SENSORS
4 - RIGHT REAR WHEEL
5 - LEFT REAR WHEEL
6 - HYDRAULIC BRAKE LINES TO WHEELS
7 - COMBINATION VALVE
8 - HARNESS
9 - RIGHT FRONT WHEEL
10 - LEFT FRONT WHEEL
11 - CAB/HCU

BRAKES - ABS (Continued)

DESCRIPTION

COMPONENT	LOCATION	FUNCTION
RWAL CONTROLLER	Driver side inner fender on a bracket.	Tests, monitors and controls the rear brake system.
HYDRAULIC CONTROL UNIT/ RWAL VALVE	Driver side inner fender on a bracket.	Modulates hydraulic pressure to rear brakes during an RWAL stop.
REAR WHEEL SPEED SENSOR	Top of the rear axle housing.	Sends an AC voltage sinewave to the CAB whose frequency is proportional to vehicle speed.
EXCITER RING	Ring gear inside the differential housing.	Used to pull the magnetic field across the wheel speed sensor’s windings.
RED BRAKE WARNING LAMP	Instrument cluster.	Indicator for park brake engagement, hydraulic brake malfunction, or RWAL malfunction.
AMBER ABS WARNING LAMP	Instrument cluster.	Indicator of an RWAL malfunction.
BRAKE WARNING LAMP DIODE	Instrument panel harness near the parking brake switch.	Isolates the park brake switch circuit from the CAB for proper red brake warning lamp operation.
ISOLATION AND DUMP VALVE FUSE	Inside the CAB.	Fail-safe device for unwanted control of the isolation and dump solenoid/valves
ISOLATION AND DUMP SOLENOID/VALVES	Inside the HCU/RWAL valve.	Used to modulation hydraulic pressure to the rear brakes during an RWAL stop.

DESCRIPTION

Rear Wheel Antilock (RWAL) brake system is standard equipment. The RWAL brake system is designed to prevent rear wheel lock-up under heavy braking conditions on virtually all types of road surfaces. RWAL braking is desirable because a vehicle which is stopped without locking the wheels will retain directional stability. This allows the driver to retain greater control of the vehicle during braking.

The RWAL components include:

- RWAL Valve
- Controller Antilock brake (CAB)
- Rear Wheel Speed Sensor (WSS)

OPERATION

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 and dynamic checks occurs at ignition start up. During the dynamic check, the CAB briefly cycles the pump and solenoids to verify operation. An audible noise may be heard during this self check. This noise should be considered normal.

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.

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

During normal braking, the master cylinder, power booster and wheel brake units all function as they would in a vehicle without ABS. The HCU components are not activated.

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.

BRAKES - ABS (Continued)

The antilock system prevents lockup during high slip conditions by modulating fluid apply pressure to the wheel brake units.

Brake fluid apply pressure is modulated according to wheel speed, degree of slip and rate of deceleration. Sensors at each front wheel convert 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.

OPERATION

When the brakes are applied, hydraulic fluid is routed from the master cylinder's secondary circuit, through the combination valve, to the RWAL valve. From there hydraulic fluid is routed to the rear brake wheel cylinders. The Controller Antilock Brake monitors rear wheel speed through the rear wheel speed sensor. If a wheel is about to lock-up, the CAB signals the RWAL valve. The RWAL valve modulates the hydraulic brake pressure to the rear wheels to prevent wheel lock-up.

NORMAL BRAKING

During light brake application, rear wheel deceleration is not sufficient to activate the antilock system components. During a normal stop hydraulic brake fluid flows unrestricted to the rear wheel cylinders to stop the vehicle. The antilock solenoid valves are inactive. The isolation valve is open and the dump valve is closed allowing normal fluid flow to the rear wheel cylinders.

REAR WHEEL ANTILOCK BRAKING

If the CAB senses impending rear wheel lock-up, it will energize the isolation solenoid. This prevents a further increase of driver induced brake pressure to the rear wheels. If this initial action is not enough to prevent rear wheel lock-up, the CAB will momentarily energize a dump solenoid. This opens the dump valve to vent a small amount of isolated rear brake pressure to an accumulator. The action of fluid moving to the accumulator reduces the isolated brake pressure at the wheel cylinders. The dump (pressure venting) cycle is limited to very short time periods (milliseconds). The CAB will pulse the dump valve until rear wheel deceleration reaches the desired slip rate programmed into the CAB. The system will switch to normal braking once wheel locking tendencies are no longer present.

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 EDT with J-1850 is used to diagnose the ABS system. For additional information refer to the Antilock Brake section.

DIAGNOSIS AND TESTING - REAR WHEEL ANTILOCK

Diagnosis of base brake conditions which are mechanical in nature should be performed first. This includes brake noise, lack of power assist, parking brake, or vehicle vibration during normal braking.

The RWAL brake system performs several self-tests every time the ignition switch is turned on and the vehicle is driven. The CAB monitors the system inputs and outputs circuits to verify the system is operating properly. If the CAB senses a malfunction in the system it will set a DTC into memory and trigger the warning lamp.

NOTE: The MDS or EDT with J-1850 is used to diagnose the RWAL system.

STANDARD PROCEDURES - RWAL SERVICE PRECAUTIONS

The RWAL uses an electronic control module, the CAB. This module is designed to withstand normal current draws associated with vehicle operation. Care must be taken to avoid overloading the CAB circuits. **In testing for open or short circuits, do not ground or apply voltage to any of the circuits unless instructed to do so for a diagnostic procedure.** These circuits should only be tested

BRAKES - ABS (Continued)

using a high impedance multi-meter or the DRB tester as described in this section. Power should never be removed or applied to any control module with the ignition in the ON position. Before removing or connecting battery cables, fuses, or connectors, always turn the ignition to the OFF position.

CAUTION: Use only factory wiring harnesses. Do not cut or splice wiring to the brake circuits. The addition of after-market electrical equipment (car phone, radar detector, citizen band radio, trailer lighting, trailer brakes, ect.) on a vehicle equipped with antilock brakes may affect the function of the antilock brake system.

STANDARD PROCEDURES - BLEEDING ABS BRAKE SYSTEM

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

(1) Perform base brake bleeding. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

(2) Connect scan tool to the Data Link Connector.

(3) Select ANTILOCK BRAKES, followed by MISCELLANEOUS, then BLEED 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 5 - BRAKES - STANDARD PROCEDURE).

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

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
ABS Assembly Bracket bolts	14-15	10-12	—
ABS Assembly Mounting Nuts	12	—	102
ABS Assembly CAB Screws	4-4.7	—	36-42
ABS Assembly Brake Line Fittings	19	—	170
Controller Mounting Screws	6	—	53
RWAL Valve Mounting Bolt	20-27	15-20	—
RWAL Valve Brake Line Fittings	19	—	170
Wheel Speed Sensor Mounting Bolt	24	—	200
Wheel Speed Sensors Front Sensor Bolt	21	—	190
Wheel Speed Sensors Rear Sensor Bolt	22.5	—	195

FRONT WHEEL SPEED SENSOR

DESCRIPTION

The ABS brake system uses 3 wheel speed sensors. A sensor is mounted to each front steering knuckles. The third sensor is mounted on top of the rear axle differential housing.

OPERATION

The WSS consists of a magnet surrounded by windings from a single strand of wire. The sensor sends a small AC signal to the CAB. This signal is generated by magnetic induction. The magnetic induction is created when a toothed sensor ring (exciter ring or tone wheel) passes the stationary magnetic WSS.

When the ring gear is rotated, the exciter ring passes the tip of the WSS. As the exciter ring tooth approaches the tip of the WSS, the magnetic lines of force expand, causing the magnetic field to cut across the sensor's windings. This, in turn causes current to flow through the WSS circuit (Fig. 2) in one direction. When the exciter ring tooth moves away from the sensor tip, the magnetic lines of force collapse cutting the winding in the opposite direction. This causes the current to flow in the opposite direction. Every time a tooth of the exciter ring passes the tip of the WSS, an AC signal is generated. Each AC signal (positive to negative signal or sinewave) is interpreted by the CAB. It then compares the frequency of the sinewave to a time value to calculate vehicle speed. The CAB continues to monitor the frequency to determine a deceleration rate that would indicate a possible wheel-locking tendency.

The signal strength of any magnetic induction sensor is directly affected by:

- Magnetic field strength; the stronger the magnetic field, the stronger the signal
- Number of windings in the sensor; more windings provide a stronger signal
- Exciter ring speed; the faster the exciter ring/tone wheel rotates, the stronger the signal will be
- Distance between the exciter ring teeth and WSS; the closer the WSS is to the exciter ring/tone wheel, the stronger the signal will be

The rear WSS is not adjustable. A clearance specification has been established for manufacturing tolerances. If the clearance is not within these specifications, then either the WSS or other components may be damaged. The clearance between the WSS and the exciter ring is 0.005 – 0.050 in.

The assembly plant performs a "Rolls Test" on every vehicle that leaves the assembly plant. One of the test performed is a test of the WSS. To properly test the sensor, the assembly plant connects test equipment to the Data Link Connector (DLC). This connector is located to the right of the steering column and attached to the lower portion of the instrument panel (Fig. 3). The rolls test terminal is spliced to the WSS circuit. The vehicle is then driven on a set of rollers and the WSS output is monitored for proper operation.

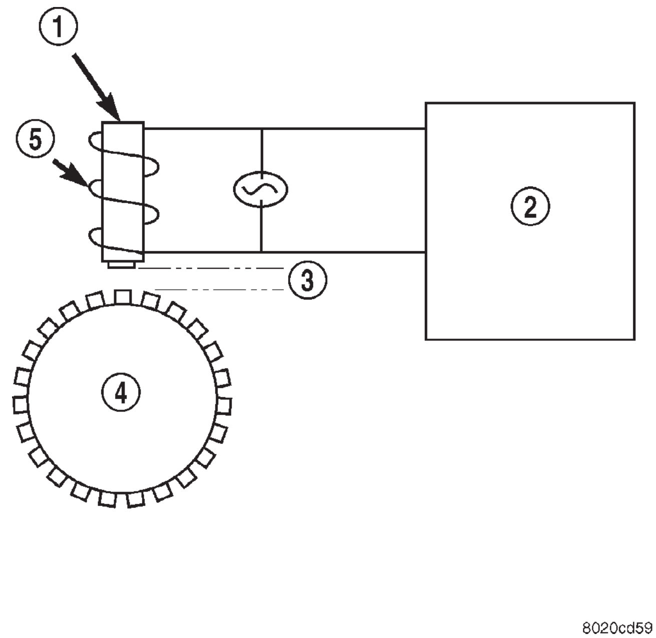


Fig. 2 Operation of the Wheel Speed Sensor

1 - MAGNETIC CORE
2 - CAB
3 - AIR GAP
4 - EXCITER RING
5 - COIL

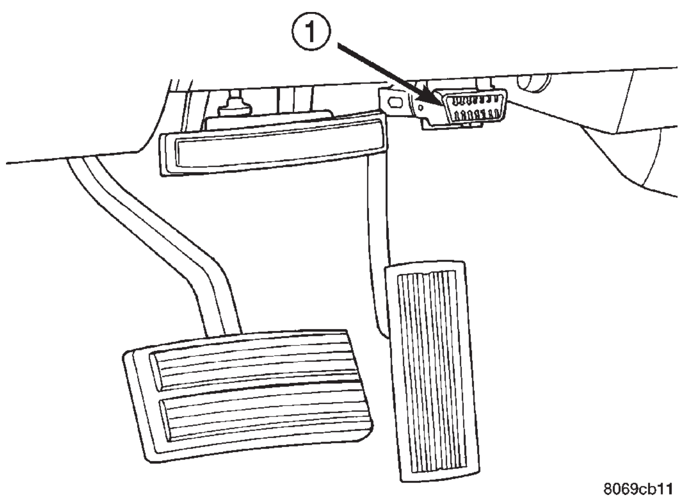


Fig. 3 Data Link Connector - Typical

1 - 16–WAY DATA LINK CONNECTOR

FRONT WHEEL SPEED SENSOR (Continued)

REMOVAL - 4X2

CAUTION: Special bolts are used to attach the front sensor. The bolts have a special shoulder, thread length and surface treatment. If the original bolts must be replaced, use only factory replacement part. Do not use substitute bolts under any circumstances.

(1) Raise and support vehicle.
(2) Remove bolt attaching sensor to the steering knuckle (Fig. 4).
(3) Remove clamps securing sensor wire to control arm and inner fender panel.
(4) In engine compartment, disconnect sensor wire from harness and remove sensor.

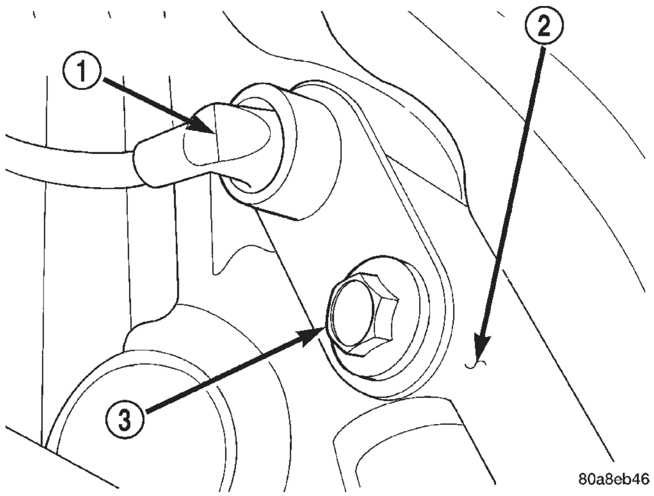


Fig. 4 Front Wheel Speed Sensor - 4x2

1 - WHEEL SPEED SENSOR
2 - KNUCKLE
3 - MOUNTING BOLT

REMOVAL - 4X4

CAUTION: Special bolts are used to attach the front sensor. The bolts have a special shoulder, thread length and surface treatment. If the original bolts must be replaced, use only factory replacement bolts. Do not use substitute bolt under any circumstances.

(1) Raise and support vehicle.
(2) Remove wheel and tire assembly.
(3) Remove brake caliper and rotor. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).
(4) Remove bolts attaching sensor to hub/bearing (Fig. 5).
(5) Remove clamps securing sensor wire to control arm and inner fender panel.
(6) In engine compartment, disconnect sensor wire and remove sensor.

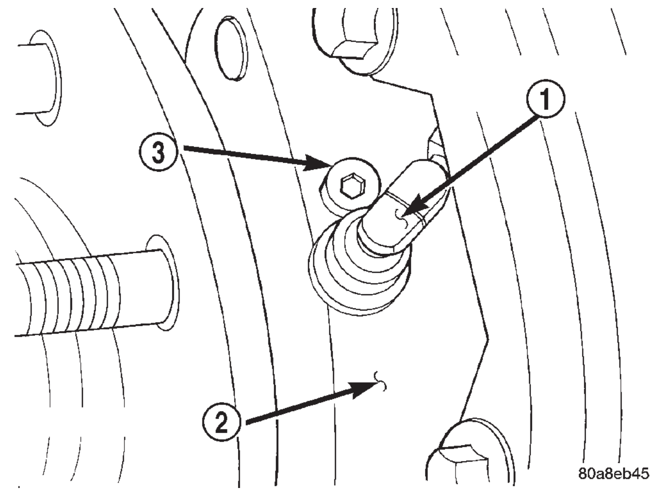


Fig. 5 Front Wheel Speed Sensor - 4x4

1 - WHEEL SPEED SENSOR
2 - HUB/BEARING
3 - MOUNTING BOLTS

INSTALLATION - 4X2

CAUTION: Special bolts are used to attach the front sensor. The bolts have a special shoulder, thread length and surface treatment. If the original bolts must be replaced, use only factory replacement part. Do not use substitute bolts under any circumstances.

(1) Position sensor in the knuckle and install sensor attaching bolts. Tighten bolts to 21 N·m (190 in. lbs.).
(2) Secure sensor wire retaining clamps to control arm and fender panel.
(3) In engine compartment, connect sensor wire to harness connector. Make sure wire is routed away from hot or rotating underhood components.
(4) Turn steering wheel back and forth to verify that wire is clear of steering and suspension components.
(5) Remove supports and lower vehicle.

INSTALLATION - 4X4

CAUTION: Special bolts are used to attach the front sensor. The bolts have a special shoulder, thread length and surface treatment. If the original bolts must be replaced, use only factory replacement bolts. Do not use substitute bolt under any circumstances.

(1) Guide sensor wire around upper control arm.

FRONT WHEEL SPEED SENSOR (Continued)

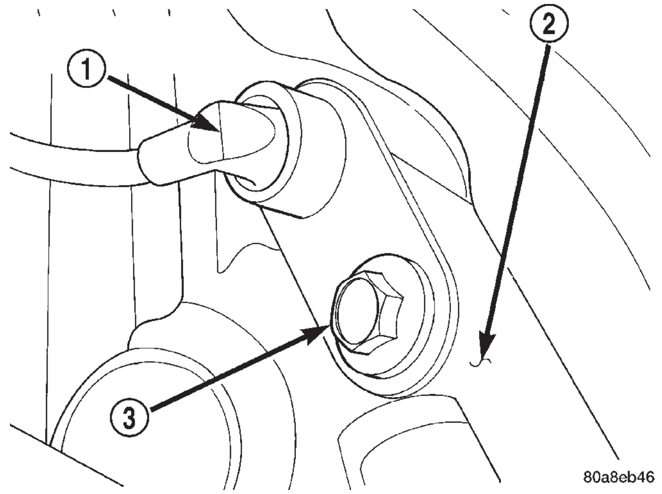


Fig. 6 Front Wheel Speed Sensor - 4x2

1 - WHEEL SPEED SENSOR
2 - KNUCKLE
3 - MOUNTING BOLT

(2) Position sensor on hub/bearing and install attaching bolts. Tighten bolt to 18-25 N·m (160-220 in. lbs.).

(3) Secure sensor wire retaining clamps to control arm and fender panel with original hardware.

(4) In engine compartment, connect sensor wire to harness connector. Insure wire is routed away from hot or rotating underhood components.

(5) Install brake rotor and caliper. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

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

(7) Turn steering wheel back and forth to verify that wire is clear of steering and suspension components.

(8) Remove supports and lower vehicle.

REAR WHEEL SPEED SENSOR

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove brake line mounting nut and remove the brake line from the sensor stud.

(3) Remove mounting stud from the sensor and shield (Fig. 7).

(4) Remove sensor and shield from differential housing.

(5) Disconnect sensor wire harness and remove sensor.

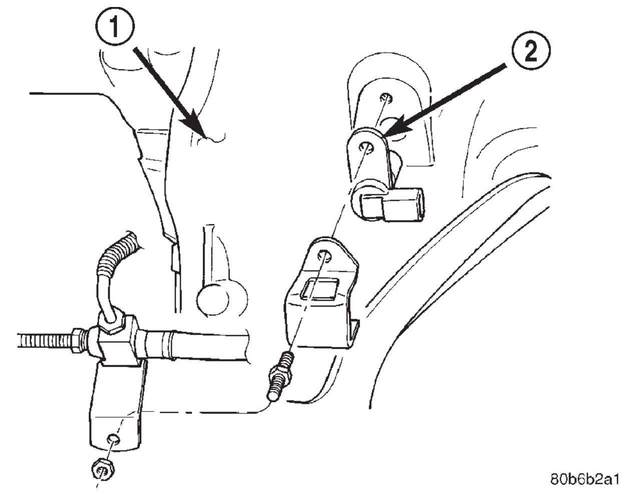


Fig. 7 Rear Speed Sensor Mounting

1 - DIFFERENTIAL HOUSING
2 - WHEEL SPEED SENSOR

INSTALLATION

(1) Connect harness to sensor. **Be sure seal is securely in place between sensor and wiring connector.**

(2) Install O-ring on sensor (if removed).

(3) Insert sensor in differential housing.

(4) Install sensor shield.

(5) Install the sensor mounting stud and tighten to 24 N·m (200 in. lbs.).

(6) Install the brake line on the sensor stud and install the nut.

(7) Lower vehicle.

TONE WHEEL

DESCRIPTION

The rear Wheel Speed Sensor (WSS) is mounted in the rear differential housing (Fig. 8).

The exciter ring is press fitted onto the differential carrier next to the final drive ring gear (Fig. 9).

REMOVAL- EXCITER RING

The exciter ring is mounted on the differential case. If the ring is damaged (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE - 8 1/4/PINION GEAR/RING GEAR/TONE RING - REMOVAL).

REMOVAL - TONE WHEEL

The tone wheel for the front speed sensor is located on the hub/bearing on 2-wheel drive models (Fig. 10). On 4-wheel drive models, the tone wheel is located in the hub/bearing housing.

The tone wheel is not a serviceable component. To replace the tone wheel the hub/bearing must be

TONE WHEEL (Continued)

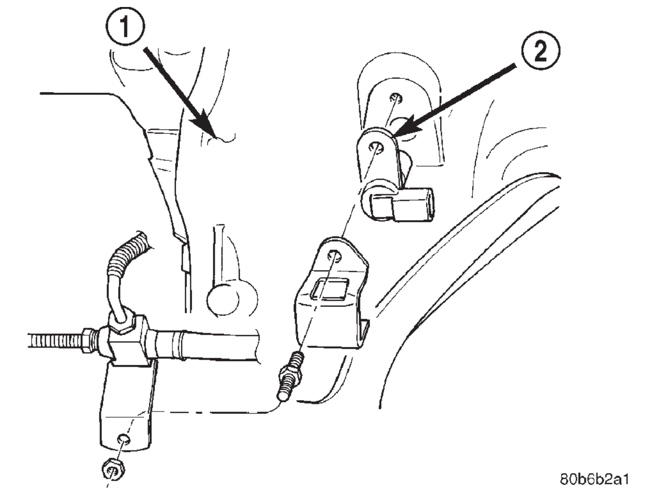


Fig. 8 Rear Wheel Speed Sensor Location

1 - DIFFERENTIAL HOUSING
2 - WHEEL SPEED SENSOR

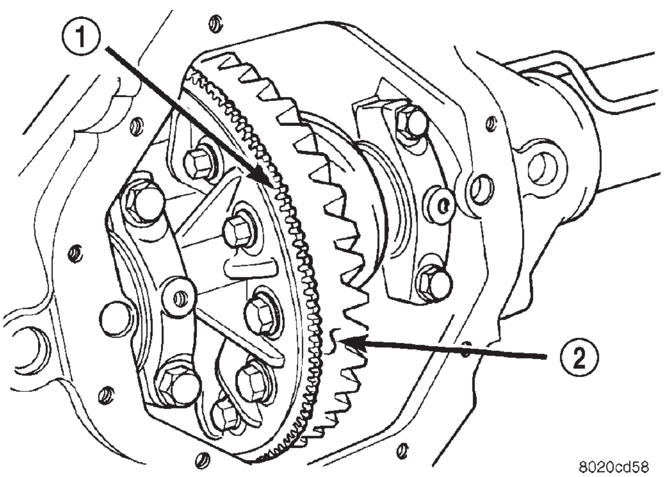


Fig. 9 Exciter Ring Location

1 - EXCITER RING
2 - RING GEAR

replaced. (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - REMOVAL).

HCU (HYDRAULIC CONTROL UNIT)

DESCRIPTION

The hydraulic control unit (HCU) consists of a valve body, pump, two accumulators and a motor (Fig. 11). The assembly is mounted on the driverside inner fender under the hood.

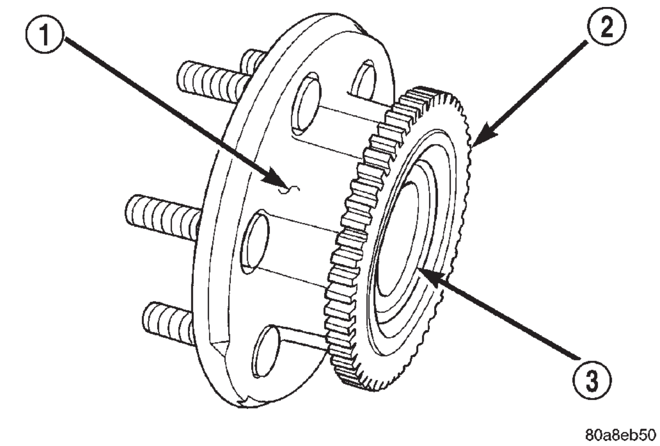


Fig. 10 Tone Wheel 4x2

1 - HUB
2 - TONE WHEEL
3 - BEARING

OPERATION

The pump, motor, and accumulators are combined into an assembly attached to the valve body. The accumulators store the extra fluid which had to be dumped from the brakes. This is done to prevent the wheels from locking up. The pump provides the fluid volume needed and is operated by a DC type motor. The motor is controlled by the CAB.

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.

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

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

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

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

PRESSURE DECREASE

The inlet valve is closed and the outlet valve is opened 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 to prevent the driver from further increasing the

HCU (HYDRAULIC CONTROL UNIT) (Continued)

brake pressure and locking the brakes. The CAB 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

NOTE: If the antilock control assembly needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Differential and Driveline. For tire revolutions per mile (Refer to 22 - TIRES/WHEELS/ TIRES - SPECIFICATIONS). To program the CAB refer to the Chassis Diagnostic Manual.

(1) Disconnect battery negative cable.
(2) Remove the brake lines from HCU (Fig. 11).
(3) Push the harness connector locks to release the locks, (Fig. 11) then remove the connectors from the CAB.
(4) Remove the nuts which attaches the assembly to the mounting bracket (Fig. 12).
(5) Remove the assembly from the vehicle.

INSTALLATION

NOTE: If the antilock control assembly needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Differential and Driveline. For tire revolutions per mile (Refer to 22 - TIRES/WHEELS/ TIRES - SPECIFICATIONS). To program the CAB refer to the Chassis Diagnostic Manual.

(1) Install the antilock assembly into the bracket and tighten bolts to 14-15 N·m (10-12 ft. lbs.).
(2) Connect the CAB harnesses.

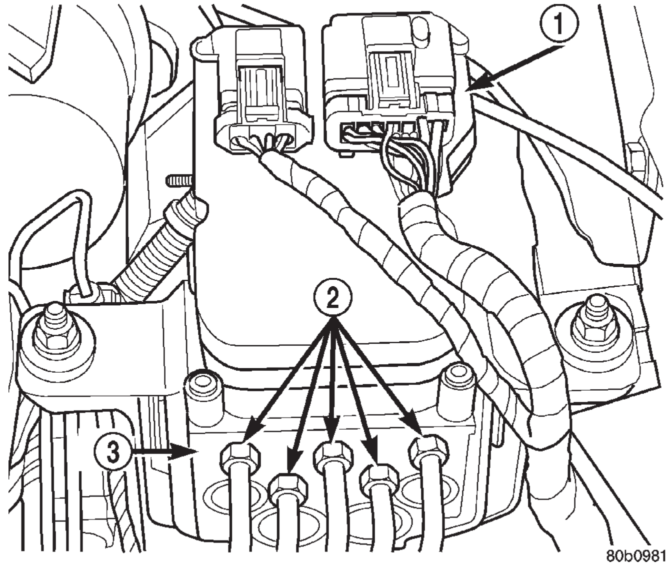


Fig. 11 HCU Brake Lines

1 - CAB
2 - BRAKE LINES
3 - HCU

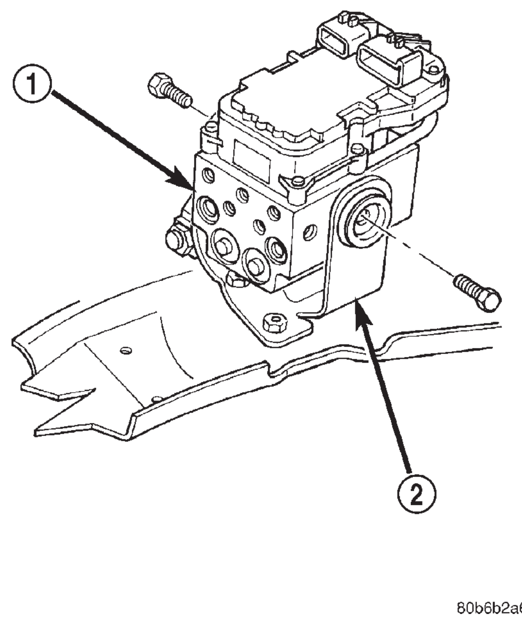


Fig. 12 Mounting Bracket

1 - ANTILOCK CONTROL ASSEMBLY
2 - MOUNTING BRACKET

(3) Connect the brake lines to the HCU. Tighten brake line fittings to 19 N·m (170 in. lbs.).
(4) Connect battery.
(5) Bleed brake system, (Refer to 5 - BRAKES - STANDARD PROCEDURE).

RWAL VALVE

DESCRIPTION

The valve is located on the drivers side inner fender under the hood. The valve modulates hydraulic pressure to the rear brakes during an RWAL stop.

OPERATION

If the CAB senses that rear wheel speed deceleration is excessive, it will energize an isolation solenoid by providing battery voltage to the solenoid. This prevents a further increase of driver induced brake pressure to the rear wheels. If this initial action is not enough to prevent rear wheel lock-up, the CAB will momentarily energize a dump solenoid (the CAB energizes the dump solenoid by providing battery voltage to the solenoid). This opens the dump valve to vent a small amount of isolated rear brake pressure to an accumulator. The action of fluid moving to the accumulator reduces the isolated brake pressure at the wheel cylinders. The dump (pressure venting) cycle is limited to very short time periods (milliseconds). The CAB will pulse the dump valve until rear wheel deceleration matches the desired slip rate programmed into the CAB. The system will switch to normal braking once wheel locking tendencies are no longer present.

A predetermined maximum number of consecutive dump cycles can be performed during any RWAL stop. If excessive dump cycles occur, a DTC will be set and stored in the CAB memory. If during a RWAL stop, the driver releases the brake pedal, the reset switch contacts will open. This signal to the CAB is an indication that pressure has equalized across the RWAL valve. The CAB will then reset the dump cycle counter in anticipation of the next RWAL stop. Additionally, any fluid stored in the accumulator will force its way past the dump valve, back into the hydraulic circuit and return to the master cylinder.

A fuse internal to the CAB, provides a fail-safe device which prevents unwanted control over the isolation and dump solenoids. The fuse is in series with the isolation and dump solenoids output circuits. If the internal fuse is open, the CAB cannot provide voltage to energize either solenoid and RWAL stops are prevented. If the fuse is open, the braking system will operate normally but without antilock control over rear brake pressure.

REMOVAL

(1) Remove RWAL valve harness connector from the RWAL controller.

(2) Remove the brake lines from the valve.

(3) Remove the valve mounting bolt (Fig. 13) and remove the valve from the bracket.

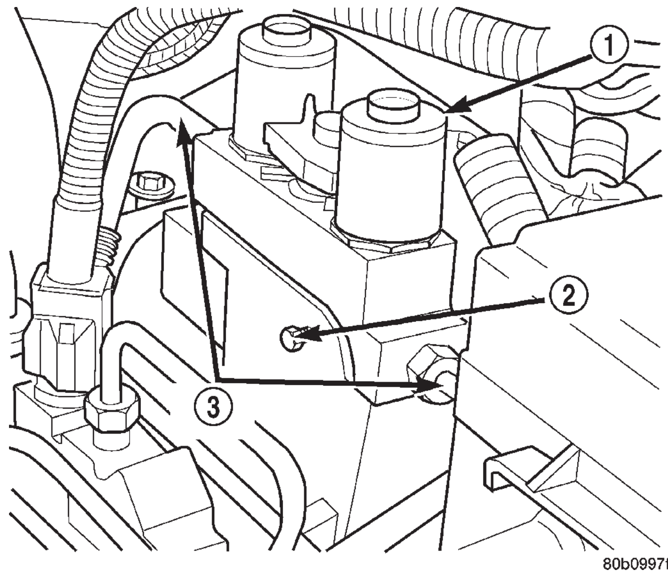


Fig. 13 RWAL Valve

1 - RWAL VALVE
2 - MOUNTING BOLT
3 - BRAKE LINES

INSTALLATION

(1) Position the valve on the bracket and install the mounting bolt. Tighten the mounting bolt to 20-27 N·m (15-20 ft. lbs.).

(2) Install the brake lines and tighten to 19 N·m (170 in. lbs.).

(3) Install the RWAL valve harness connector into the RWAL controller.

(4) Bleed base brake system, (Refer to 5 - BRAKES - STANDARD PROCEDURE).

CLUTCH

TABLE OF CONTENTS

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.

CLUTCH (Continued)

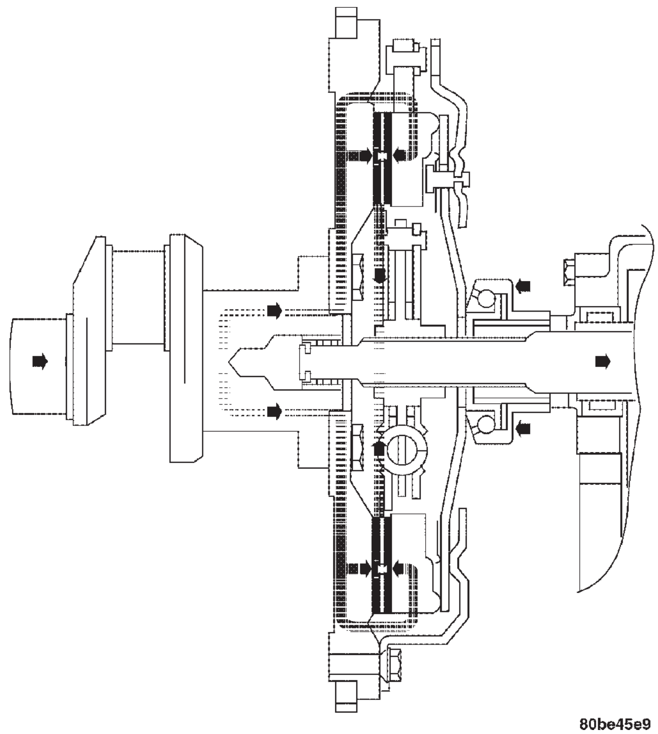


Fig. 1 Engine Powerflow

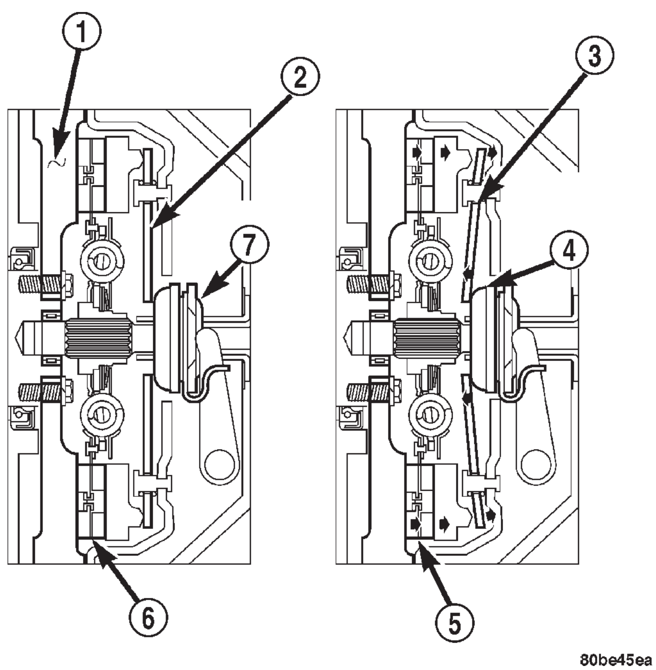


Fig. 2 Clutch Operation

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

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).

WARNING

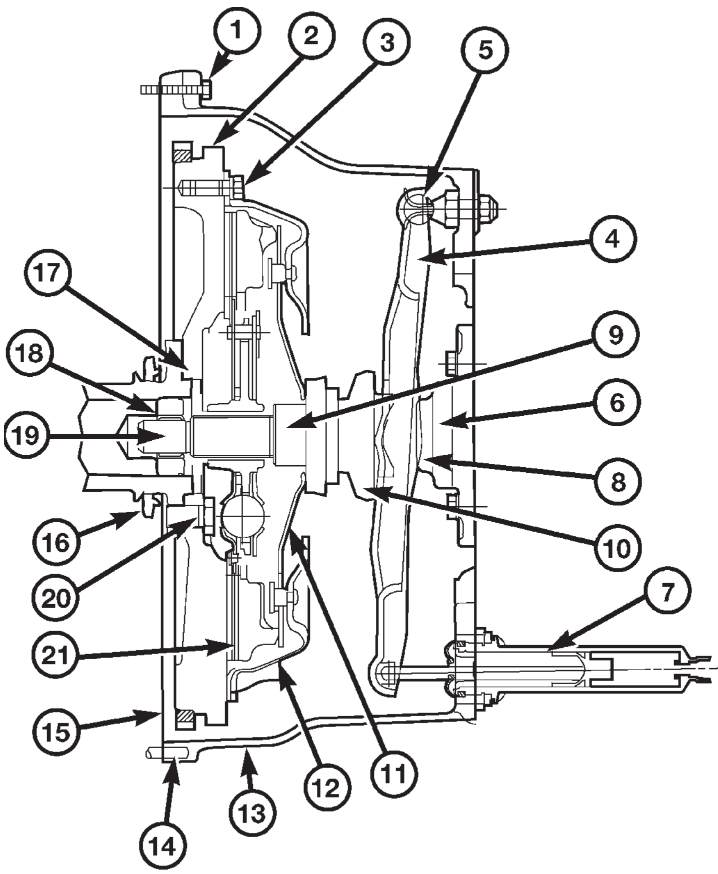
WARNING:: EXERCISE CARE WHEN SERVICING CLUTCH COMPONENTS. FACTORY INSTALLED CLUTCH DISCS DO NOT CONTAIN ASBESTOS FIBERS. DUST AND DIRT ON CLUTCH PARTS MAY CONTAIN ASBESTOS FIBERS FROM AFTERMARKET COMPONENTS. BREATHING EXCESSIVE CONCENTRATIONS OF THESE FIBERS CAN CAUSE SERIOUS BODILY HARM. WEAR A RESPIRATOR 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.

DIAGNOSTIC AND TESTING - CLUTCH

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 (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 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.

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 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.

CLUTCH (Continued)

DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
Disc facing worn out	1. Normal wear.	1. Replace cover and disc.
	2. Driver frequently rides (slips) the clutch. Results in rapid overheating and wear.	2. Replace cover and disc.
	3. Insufficient clutch cover diaphragm spring tension.	3. Replace cover and disc.
Clutch disc facing contaminated with oil, grease, or clutch fluid.	1. Leak at rear main engine seal or transmission input shaft seal.	1. Replace appropriate seal.
	2. Excessive amount of grease applied to the input shaft splines.	2. Remove grease and apply the correct amount of grease.
	3. Road splash, water entering housing.	3. Replace clutch disc. Clean clutch cover and reuse if in good condition.
	4. Slave cylinder leaking.	4. Replace hydraulic clutch linkage.
Clutch is running partially disengaged.	1. Release bearing sticking or binding and does not return to the normal running position.	1. Verify failure. Replace the release bearing and transmission front bearing retainer as necessary.
Flywheel below minimum thickness specification.	1. Improper flywheel machining. Flywheel has excessive taper or excessive material removal.	1. Replace flywheel.
Clutch disc, cover and/or diaphragm spring warped or distorted.	1. Rough handling. Impact bent cover, spring, or disc.	1. Replace disc or cover as necessary.
	2. Improper bolt tightening procedure.	2. Tighten clutch cover using proper procedure.
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 (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
Clutch disc binds on input shaft splines.	1. Clutch disc hub splines damaged during installation.	1. Clean, smooth, and lubricate hub splines if possible. Replace disc if necessary.
	2. Input shaft splines rough, damaged, or corroded.	2. Clean, smooth, and lubricate shaft splines if possible. Replace input shaft if necessary.
Clutch disc rusted to flywheel and/or pressure plate.	1. Clutch not used for and extended period of time (e.g. long term vehicle storage).	1. Sand rusted surfaces with 180 grit sanding paper. Replace clutch cover and flywheel if necessary.
Pilot bearing seized, loose, or rollers are worn.	1. Bearing cocked during installation.	1. Install and lubricate a new bearing.
	2. Bearing defective.	2. Install and lubricate a new bearing.
	3. Bearing not lubricated.	3. Install and lubricate a new bearing.
	4. Clutch misalignment.	4. Inspect clutch and correct as necessary. Install and lubricate a new bearing.
Clutch will not disengage properly.	1. Low clutch fluid level.	1. Replace hydraulic linkage assembly.
	2. Clutch cover loose.	2. Follow proper bolt tightening procedure.
	3. Clutch disc bent or distorted.	3. Replace clutch disc.
	4. Clutch cover diaphragm spring bent or warped.	4. Replace clutch cover.
	5. Clutch disc installed backwards.	5. Remove and install clutch disc correctly.
	6. Release fork bent or fork pivot loose or damaged.	6. Replace fork or pivot as necessary.
	7. Clutch master or slave cylinder failure.	7. Replace hydraulic linkage assembly.
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 and/or binding	1. Master or slave cylinder components worn or corroded.	1. Replace clutch hydraulic linkage assembly.

CLUTCH (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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, and/or clutch housing. Correct as necessary.

SPECIFICATIONS

SPECIFICATIONS - CLUTCH

SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Clutch Diameter 2.5L	232mm (9.13 in.)
Clutch Diameter 3.9L	265mm (10.4 in.)
Clutch Diameter 5.2L	280mm (11.02 in.)

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Clutch Cover Bolts-2.5L	28	21	-
Clutch Cover Bolts-5/16	23	17	-
Clutch Cover Bolts-3/8	41	30	-
Master Cylinder Reservoir Screws	5	-	40
Master Cylinder Nuts	54	40	-
Slave Cylinder Nuts	23	17	-
Dust Shield Bolt	12	-	105

SPECIFICATIONS (Continued)

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Flywheel Bolts-2.5L	95	70	-
Flywheel Bolts-3.9/5.2L	75	55	-

CLUTCH DISC

DESCRIPTION

The clutch disc friction material is riveted to the disc hub (Fig. 4) . The hub bore is splined for installation on the transmission input shaft. The clutch disc has cushion springs in the disc hub to dampen disc vibrations during application and release of the clutch.

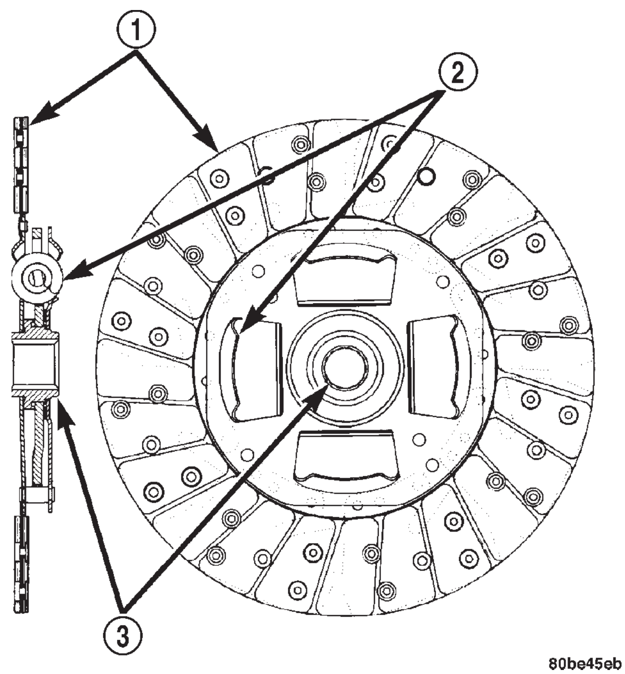


Fig. 4 Clutch Disc-Typical

1 - FACING MATERIAL
2 - DAMPER SPRINGS
3 - HUB

OPERATION

The clutch disc is held onto the surface of the flywheel by the force exerted by the pressure plate's diaphragm spring. The friction material of the clutch disc then transfers the engine torque from the flywheel and pressure plate to the input shaft of the transmission.

REMOVAL

(1) Raise vehicle.

(2) Remove transmission and clutch housing as assembly. Refer to 21 Transmission and Transfer Case for procedures.

(3) If clutch cover is only being removed for access to another component, mark position of cover on flywheel with small punch marks (Fig. 5).

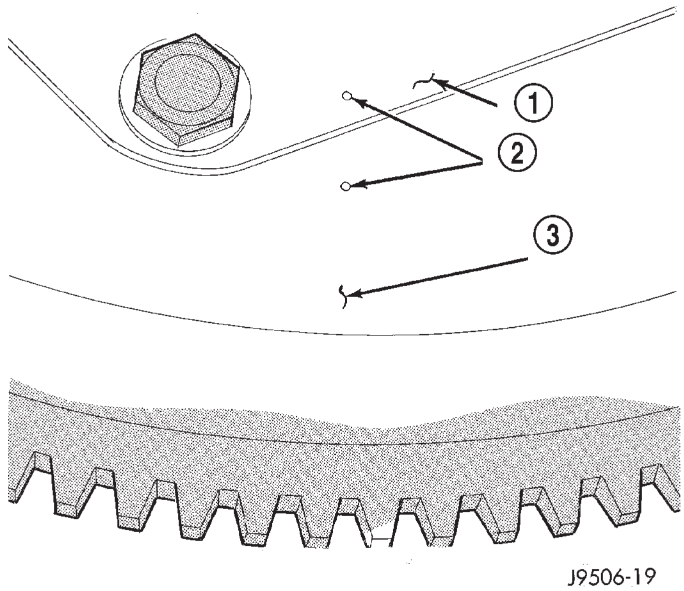


Fig. 5 Mark Clutch Cover Position

1 - CLUTCH COVER
2 - PUNCH MARKS
3 - FLYWHEEL

(4) Loosen clutch cover bolts evenly and in rotation to relieve spring tension. Loosen bolts a few threads at a time to avoid warping cover.

(5) Remove cover bolts, clutch cover and clutch disc.

INSTALLATION

(1) Clean flywheel surface with solvent. Scuff sand surface with 120/180 grit emery cloth to remove minor scratches and glazing.

(2) Check new clutch disc for runout and free operation on input shaft splines.

(3) Lubricate crankshaft pilot bearing with Mopar® high temperature bearing grease or equivalent.

(4) Position clutch disc to flywheel.

(5) Insert alignment tool or spare input shaft through clutch disc and into pilot bearing (Fig. 6).

(6) Verify that disc hub is positioned correctly. The raised portion of the hub faces away from the flywheel (Fig. 7).

(7) Position clutch cover over disc and on flywheel.

(8) Install clutch cover bolts finger tight.

CLUTCH DISC (Continued)

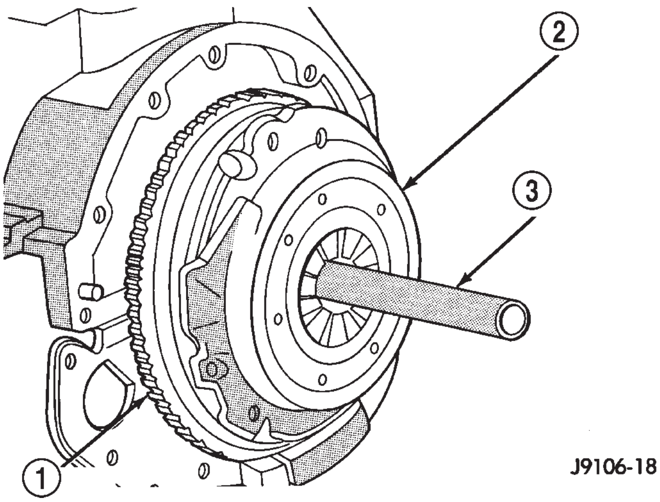


Fig. 6 Aligning Clutch Disc

1 - FLYWHEEL
2 - CLUTCH COVER AND DISC
3 - CLUTCH DISC ALIGNMENT TOOL

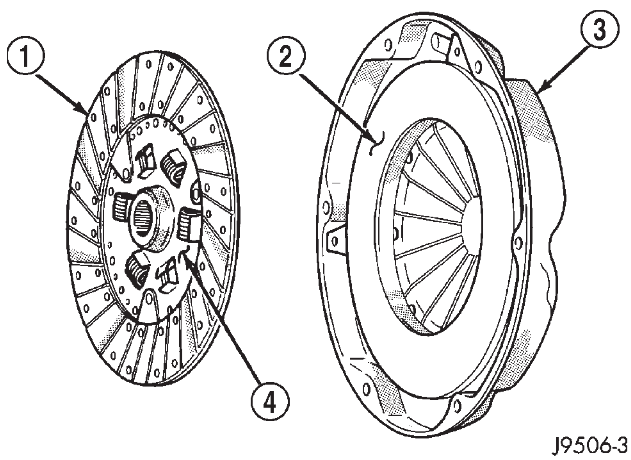


Fig. 7 Clutch Disc Position

1 - DISC
2 - INSPECT THIS SURFACE
3 - CLUTCH COVER
4 - "FLYWHEEL SIDE" STAMPED ON THIS SURFACE

(9) Tighten cover bolts evenly (and in rotation) a few threads at a time. Cover bolts must be tightened evenly and to specified torque to avoid distorting cover.

(10) Tighten clutch cover bolts to following torque:

- 2.5L bolts to 28 N·m (21 ft. lbs.).
- 5/16 in. bolts to 23 N·m (17 ft. lbs.).
- 3/8 in. bolts to 41 N·m (30 ft. lbs.).

(11) Apply light coat of Mopar high temperature bearing grease to splines of transmission input shaft and to release bearing slide surface of front bearing retainer. Do not overlubricate shaft splines. This could result in grease contamination of disc.

(12) Install transmission and clutch housing as assembly. Refer to 21 Transmission and Transfer Case for procedures.

CLUTCH HOUSING

DIAGNOSIS AND TESTING - CLUTCH HOUSING

Clutch housing alignment is important to proper clutch operation. The housing maintains alignment between the crankshaft and transmission input shaft. Misalignment can cause clutch noise, hard shifting, incomplete release and chatter. It can also result in premature wear of the pilot bearing, cover release fingers and clutch disc. In severe cases, misalignment can also cause premature wear of the transmission input shaft and front bearing.

Housing misalignment is generally caused by incorrect seating on the engine or transmission, loose housing bolts, missing alignment dowels, or housing damage. Infrequently, misalignment may also be caused by housing mounting surfaces that are not completely parallel. Misalignment can be corrected with shims.

REMOVAL

(1) Raise vehicle and support vehicle.

(2) Remove transmission and clutch housing as assembly. Refer to 21 Transmission and Transfer Case for procedures.

(3) Remove release bearing, release fork and fork boot from input shaft and clutch housing.

(4) Remove bolts attaching clutch housing to transmission (Fig. 8).

INSTALLATION

(1) Clean mounting surfaces of transmission and clutch housing. Use a wire brush if necessary followed by a wax and grease remover, or similar solvent. Also clean engine block surface as well.

(2) Position clutch housing on transmission and install housing attaching bolts. Tighten A bolts to 38 N·m (28 ft. lbs.).

(3) Install release fork pivot ball stud to housing, if necessary.

(4) Lubricate release bearing bore, release fork contact surfaces, and release fork pivot stud with Mopar® high temperature bearing grease. Also lubricate transmission input shaft splines, pilot hub and bearing retainer slide surface with light coat of same grease.

(5) Install release fork, bearing, and boot in housing. Be sure release fork boot is properly seated in housing.

(6) Install transmission. Refer to 21 Transmission and Transfer Case for proper procedures. Tighten the

CLUTCH HOUSING (Continued)

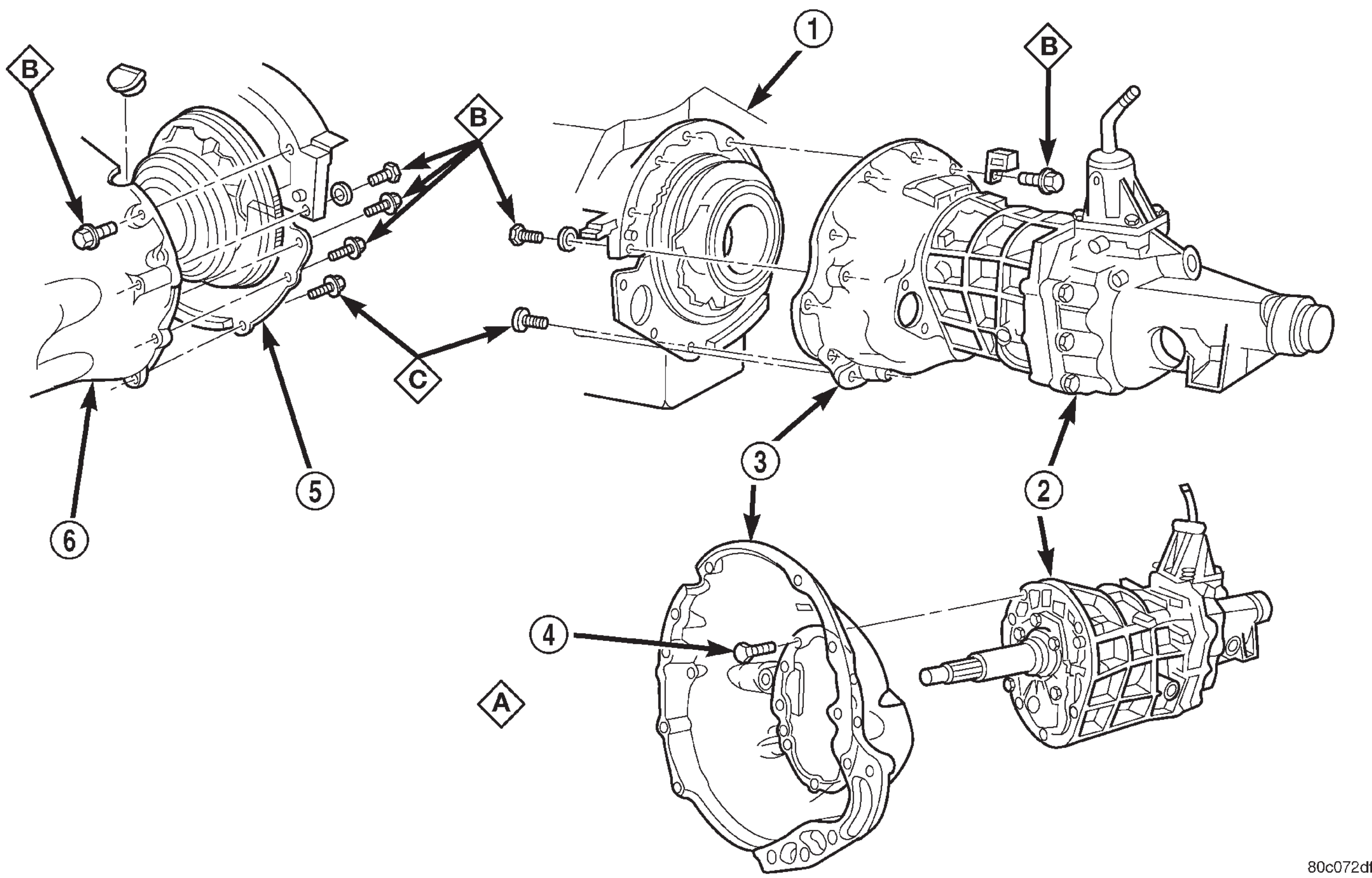


Fig. 8 Clutch Housing

1 - ENGINE
2 - TRANSMISSION
3 - CLUTCH HOUSING
4 - CLUTCH HOUSING BOLTS
5 - ENGINE
6 - CLUTCH HOUSING

upper transmission B bolts to 75 N·m (55 ft.lbs). Tighten all lower transmission C bolts to 50 N·m (37 ft.lbs.).

CLUTCH RELEASE BEARING

DESCRIPTION

A conventional release bearing (Fig. 9) is used to engage and disengage the clutch pressure plate assembly. The clutch release bearing is mounted on the transmission front bearing retainer. The bearing is attached to the release fork, which moves the bearing into contact with the clutch cover diaphragm spring.

OPERATION

The release bearing is operated by a release fork in the clutch housing. Slave cylinder force causes the release lever to move the release bearing into contact with the diaphragm spring. As additional force is applied, the bearing presses the diaphragm spring fingers inward on the fulcrums. This action moves the pressure plate rearward relieving clamp force on the disc. Releasing pedal pressure removes clutch hydraulic pressure. The release bearing then moves away from the diaphragm spring which allows the pressure plate to exert clamping force on the clutch disc.

REMOVAL

(1) Remove transmission. Refer to 21 Transmission and Transfer Case for procedures.

CLUTCH RELEASE BEARING (Continued)

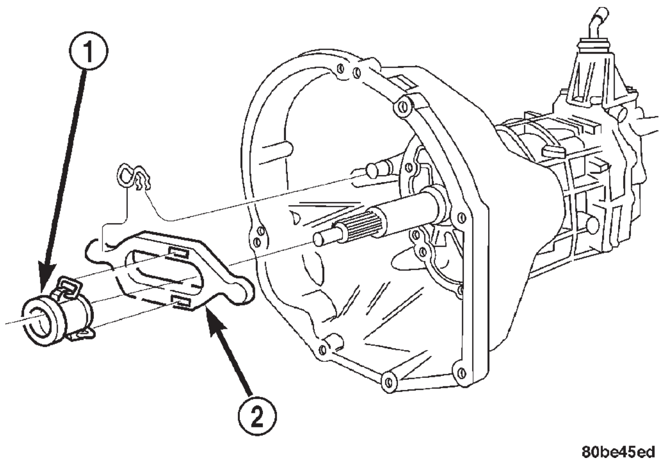


Fig. 9 Clutch Release Bearing

1 - RELEASE BEARING
2 - RELEASE FORK

(2) Disconnect release bearing from fork and remove bearing (Fig. 10).

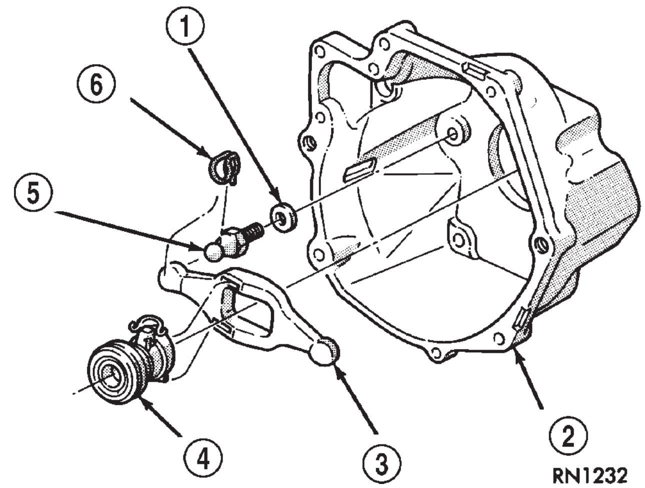


Fig. 10 Release Bearing And Fork Mounting

1 - CONED WASHER
2 - CLUTCH HOUSING
3 - RELEASE FORK
4 - RELEASE BEARING AND SLEEVE
5 - PIVOT 23 N·m (200 IN. LBS.)
6 - SPRING

INSTALLATION

(1) Inspect release bearing slide surface of transmission front bearing retainer. Replace retainer if slide surface is scored, worn or cracked.

(2) Inspect release fork and fork pivot (Fig. 10). Be sure pivot is secure and in good condition. Be sure fork is not distorted or worn. Replace release fork retainer spring if bent or damaged in any way.

(3) Lightly lubricate pilot bearing, input shaft splines, bearing retainer slide surface, fork pivot and release fork pivot surface with Mopar® high temperature bearing grease.

(4) Install release fork and bearing. Verify fork and bearing are properly secured.

(5) Install transmission. Refer to 21 Transmission and Transfer Case for procedures.

PRESSURE PLATE

DESCRIPTION

The clutch pressure plate assembly is a diaphragm type with a one-piece spring and multiple release fingers (Fig. 11) . The pressure plate release fingers are preset during manufacture and are not adjustable. The assembly also contains the cover, pressure plate, and fulcrum components.

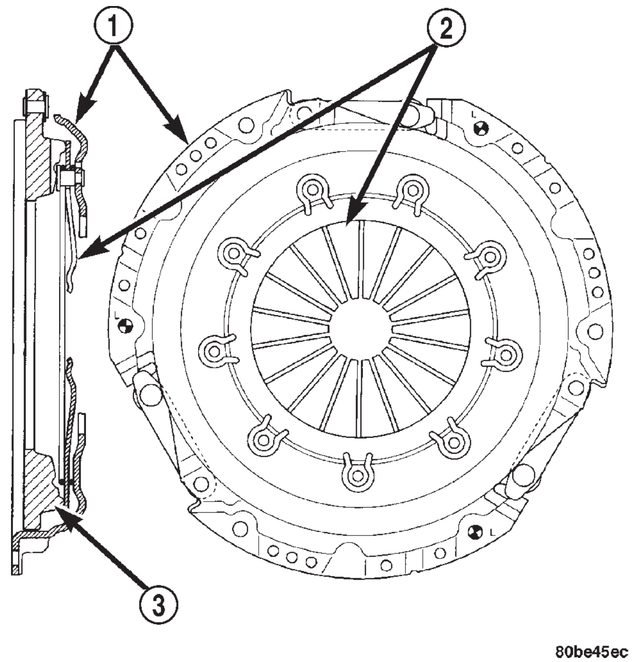


Fig. 11 Clutch Pressure Plate-Typical

1 - COVER
2 - RELEASE FINGERS
3 - PRESSURE PLATE

OPERATION

The clutch pressure plate assembly clamps the clutch disc against the flywheel. When the release bearing is depressed by the shift fork, the pressure exerted on the clutch disc by the pressure plate spring is decreased. As additional force is applied, the bearing presses the diaphragm spring fingers inward on the fulcrums. This action moves the pressure plate rearward relieving clamp force on the disc. The clutch disc is disengaged and freewheeling at this point.

FLYWHEEL

DESCRIPTION

The flywheel (Fig. 12) is a heavy plate bolted to the rear of the crankshaft. The flywheel incorporates the ring gear around the outer circumference to mesh with the starter to permit engine cranking. The rear face of the flywheel serves as the driving member to the clutch disc.

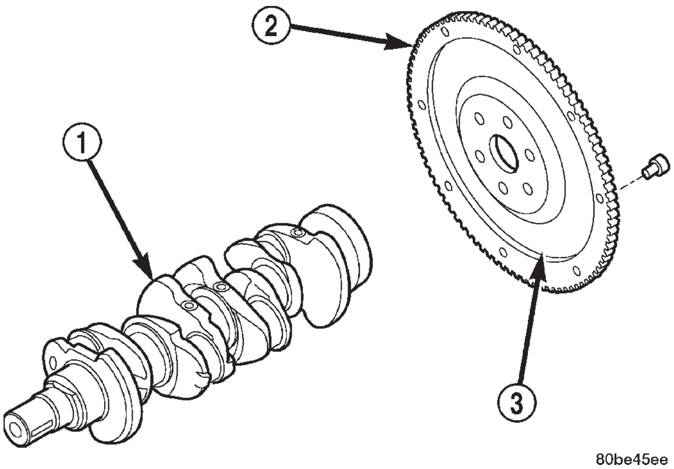


Fig. 12 Flywheel

1 - CRANKSHAFT
2 - RING GEAR
3 - FLYWHEEL

OPERATION

The flywheel serves to dampen the engine firing pulses. The heavy weight of the flywheel relative to the rotating mass of the engine components serves to stabilize the flow of power to the remainder of the drivetrain. The crankshaft has the tendency to attempt to speed up and slow down in response to the cylinder firing pulses. The flywheel dampens these impulses by absorbing energy when the crankshaft speeds and releasing the energy back into the system when the crankshaft slows down.

DIAGNOSIS AND TESTING - FLYWHEEL

Check flywheel runout whenever misalignment is suspected. Flywheel runout should not exceed 0.08 mm (0.003 in.). Measure runout at the outer edge of the flywheel face with a dial indicator. Mount the indicator on a stud installed in place of one of the flywheel bolts.

Common causes of runout are:

- heat warpage
- improper machining
- incorrect bolt tightening
- improper seating on crankshaft flange shoulder
- foreign material on crankshaft flange

Flywheel machining is not recommended. The flywheel clutch surface is machined to a unique contour and machining will negate this feature. However, minor flywheel scoring can be cleaned up by hand with 180 grit emery, or with surface grinding equipment. Remove only enough material to reduce scoring (approximately 0.001 - 0.003 in.). Heavy stock removal is **not recommended.** Replace the flywheel if scoring is severe and deeper than 0.076 mm (0.003 in.). Excessive stock removal can result in flywheel cracking or warpage after installation; it can also weaken the flywheel and interfere with proper clutch release.

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing excessive runout. Use new bolts when remounting a flywheel and secure the bolts with Mopar® Lock And Seal. Tighten flywheel bolts to specified torque only. Overtightening can distort the flywheel hub causing runout.

PILOT BEARING

DESCRIPTION

Vehicles equipped with a manual transmission utilize a pilot bearing. This bearing is located in the back of the engine crankshaft. Depending on the type of engine or application, the pilot bearing can be a solid soft metallic bushing or a fully caged needle bearing. The pilot bearing's main functions are to support the transmission input shaft, maintain proper alignment of the clutch assembly and allow the transmission main shaft to rotate at a different speed than the engine mounted crankshaft.

OPERATION

The pilot bearing supports the transmission input shaft, maintains proper clutch assembly alignment and allows the transmission input shaft to rotate at a different speed (RPM) than the engine mounted crankshaft.

When the clutch pedal is depressed (with vehicle in drive mode) the clutch disc slows and stops therefore, the transmission input shaft slows and stops as well. The pilot bearing allows the engine crankshaft to continue to rotate even though the transmission input shaft is stationary.

REMOVAL

(1) Remove transmission, transfer case, if equipped, and clutch housing. Refer to 21 Transmission and Transfer Case for procedures.

(2) Remove clutch cover and disc.

(3) Using a suitable blind hole puller, remove pilot bearing.

PILOT BEARING (Continued)

INSTALLATION

(1) Clean bearing bore with solvent and wipe dry with shop towel.

(2) Install new bearing with clutch alignment tool (Fig. 13). Keep bearing straight during installation. Do not allow bearing to become cocked. Tap bearing into place until flush with edge of bearing bore. Do not recess bearing.

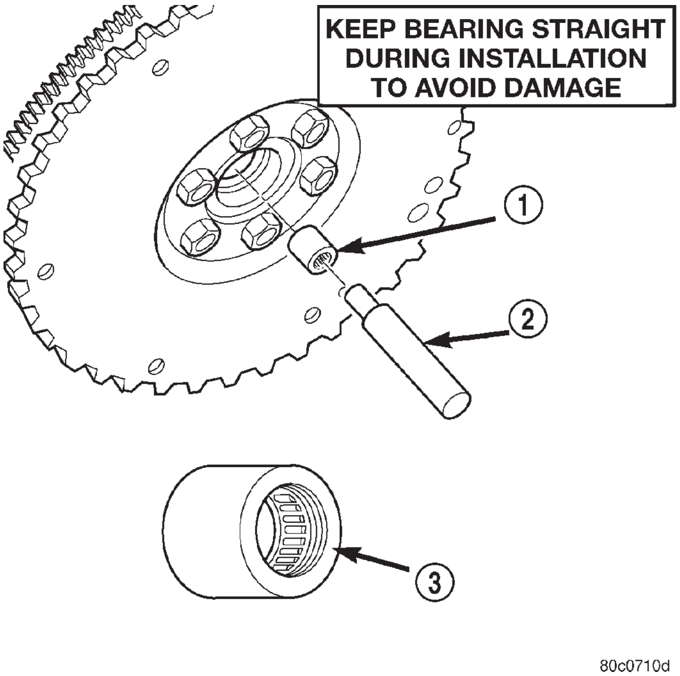


Fig. 13 Pilot Bearing

1 - PILOT BEARING
2 - ALIGNMENT TOOL
3 - LETTER SIDE MUST FACE TRANSMISSION

(3) Install clutch cover and disc.

(4) Install clutch housing, transmission and transfer case, if equipped. Refer to 21 Transmission and Transfer Case for procedures.

LINKAGE

DESCRIPTION

The hydraulic linkage consists of a clutch master cylinder, reservoir, a clutch slave cylinder and an interconnecting fluid line (Fig. 14).

The clutch master cylinder push rod is connected to the clutch pedal. The slave cylinder push rod is connected to the clutch release fork. The master cylinder is mounted on the driver side of the dash panel adjacent to the brake master cylinder and booster assembly.

The factory installed hydraulic linkage has a quick disconnect at the slave cylinder. This fitting should not be disconnected or tampered with. The hydraulic linkage is serviced as an assembly only. The individual components that form the linkage assembly cannot be overhauled or serviced separately.

OPERATION

The clutch linkage uses hydraulic pressure to operate the clutch. Depressing the clutch pedal develops fluid pressure in the clutch master cylinder. This pressure is transmitted to the slave cylinder through a connecting line. In turn, the slave cylinder operates the clutch release lever.

The slave cylinder has an integral spring which preloads the release bearing against the clutch diaphragm fingers to maintain zero free-play.

Slave cylinder force causes the release lever to move the release bearing into contact with the diaphragm spring. As additional force is applied, the bearing presses the diaphragm spring fingers inward on the fulcrums. This action moves the pressure plate rearward relieving clamp force on the disc.

REMOVAL

NOTE: The hydraulic linkage is serviced as a complete assembly only. The individual components must not be overhauled or serviced separately.

(1) Raise and support vehicle.

(2) Remove nuts attaching slave cylinder to clutch housing (Fig. 15).

CAUTION: Do not disconnect slave cylinder quick disconnect. If disconnected hydraulic linkage must be replaced.

(3) Remove slave cylinder from housing.

(4) Remove hydraulic fluid line clip from the lower dash panel flange.

(5) Lower vehicle.

(6) Remove clip holding clutch master cylinder push rod to clutch pedal (Fig. 15).

(7) Slide clutch master cylinder push rod off clutch pedal pin.

(8) Disconnect clutch pedal position switch connector from wiring harness.

(9) Remove nuts holding clutch master cylinder to dash panel.

(10) Verify that cap on clutch master cylinder reservoir is tight to avoid undue spillage during removal.

(11) Remove screws attaching clutch fluid reservoir to dash panel.

(12) Pull clutch master cylinder from dash panel.

(13) Remove hydraulic linkage components from vehicle as an assembly.

LINKAGE (Continued)

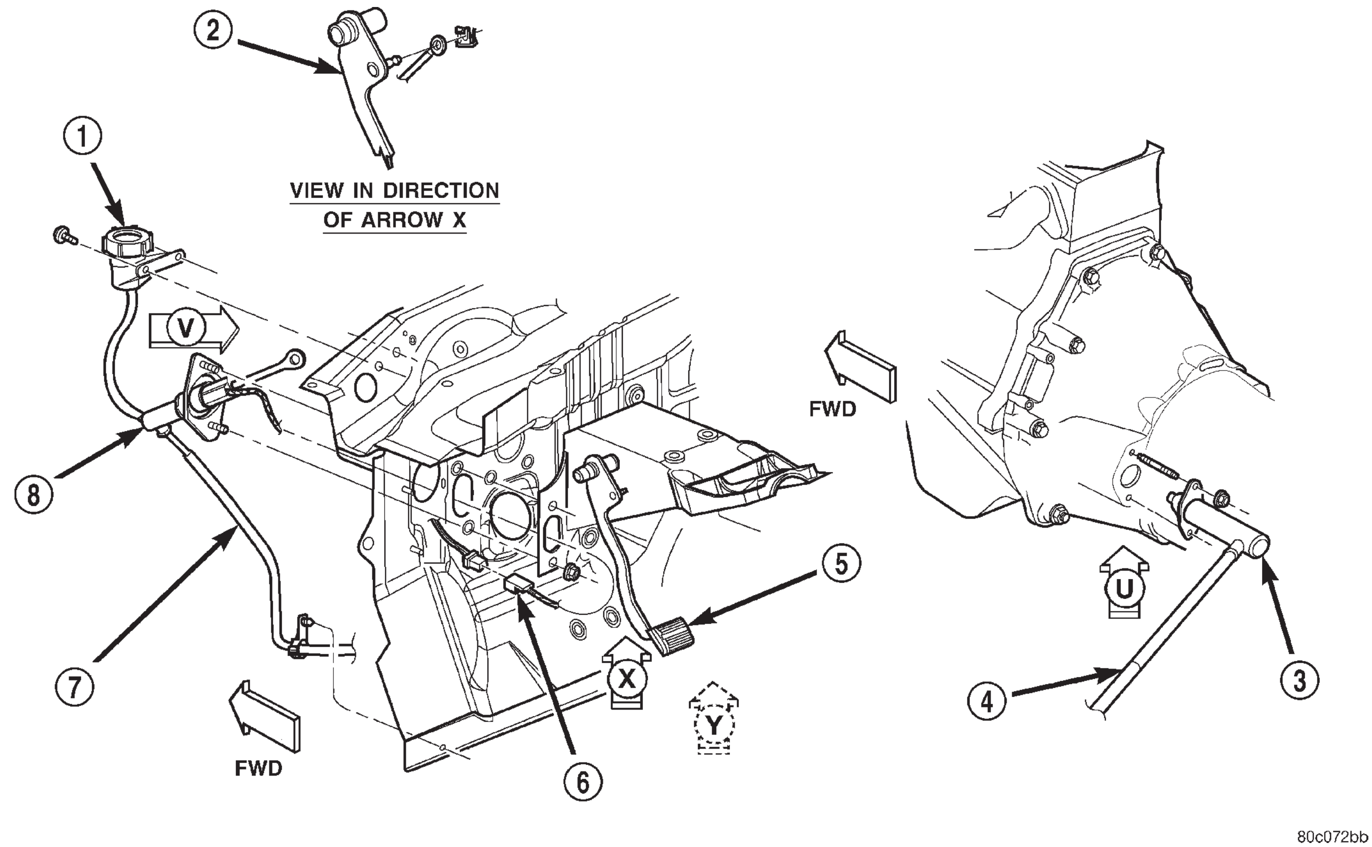


Fig. 14 Clutch

1 - CLUTCH FLUID RESERVOIR
2 - CLUTCH PEDAL
3 - CLUTCH SAVE CYLINDER
4 - CLUTCH HYDRAULIC LINE
5 - CLUTCH PEDAL
6 - CLUTCH PEDAL POSITION SWITCH CONNECTOR
7 - CLUTCH HYDRAULIC LINE
8 - CLUTCH MASTER CYLINDER

INSTALLATION

NOTE: The hydraulic linkage is serviced as a complete assembly only. The individual components must not be serviced separately.

(1) Tighten cap on clutch fluid reservoir to avoid spillage during installation.

(2) Position cylinders, connecting lines and reservoir in vehicle.

(3) Insert clutch master cylinder in dash panel.

(4) Position reservoir on dash panel and install reservoir screws. Tighten screws to 5 N·m (40 in. lbs.).

(5) Install nuts that hold clutch master cylinder to dash panel. Tighten nuts to 54 N·m (40 ft. lbs.).

(6) Apply light coating of grease to the inner diameter of the master cylinder push–rod and the outer diameter of the clutch pedal pin.

(7) Install clutch master cylinder push rod on clutch pedal pin. Secure rod with retaining clip.

(8) Connect clutch pedal position switch connector from wiring harness.

(9) Raise vehicle.

(10) Insert slave cylinder push rod through clutch housing opening and into release lever. Be sure end of rod is securely engaged in release lever. Check this before installing cylinder attaching nuts.

NOTE: If new clutch linkage is being installed, do not remove plastic shipping strap from the slave cylinder push rod. The strap will break on its own upon first clutch application.

(11) Install and tighten slave cylinder attaching nuts to 23 N·m (200 in. lbs.).

(12) Install hydraulic fluid line clip into the hole in the lower dash panel flange.

LINKAGE (Continued)

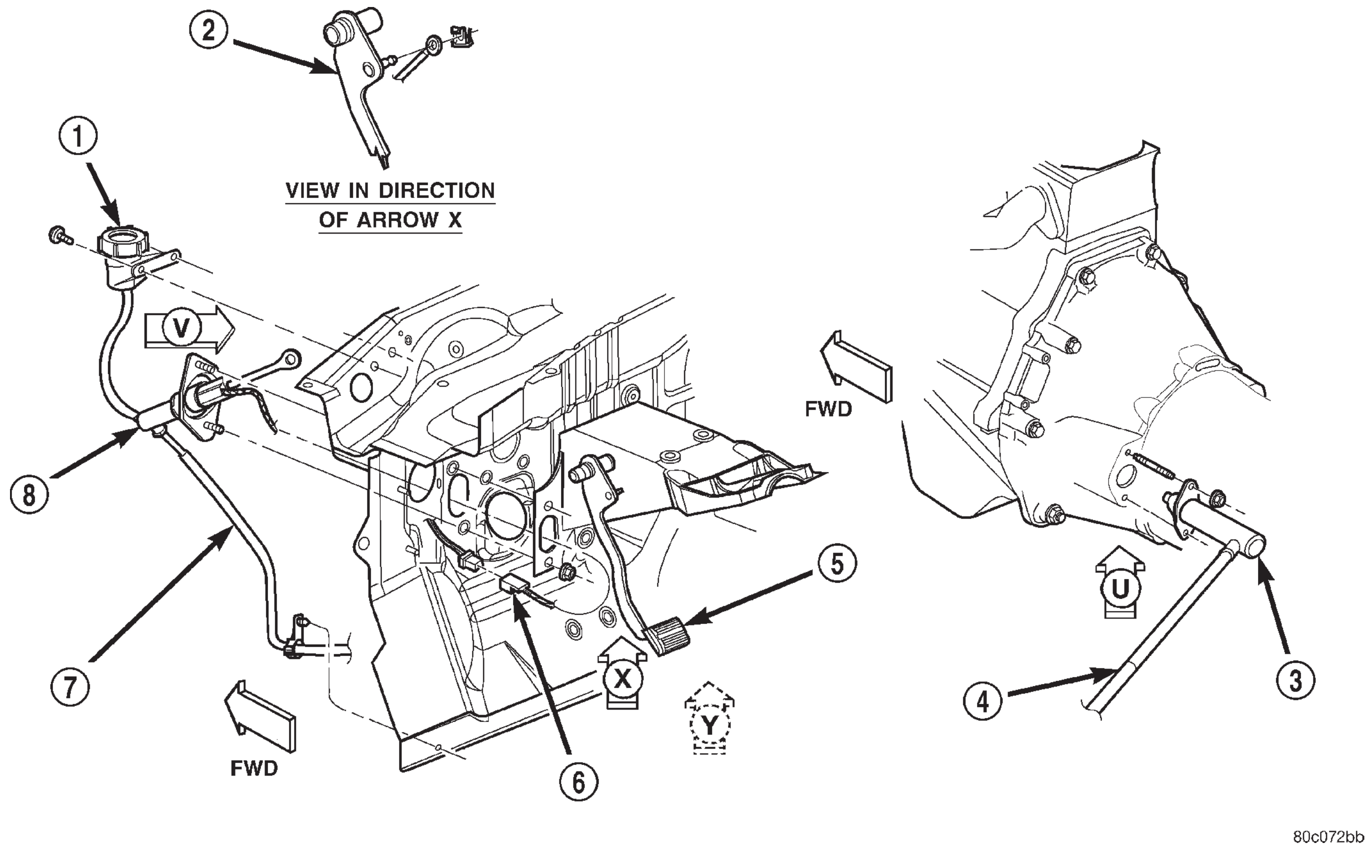


Fig. 15 Clutch Hydraulic Linkage

1 - CLUTCH FLUID RESERVOIR
2 - CLUTCH PEDAL
3 - CLUTCH SAVE CYLINDER
4 - CLUTCH HYDRAULIC LINE
5 - CLUTCH PEDAL
6 - CLUTCH PEDAL POSITION SWITCH CONNECTOR
7 - CLUTCH HYDRAULIC LINE
8 - CLUTCH MASTER CYLINDER

(13) Verify that fluid line from master cylinder to slave cylinder is properly routed.

CLUTCH PEDAL

REMOVAL

(1) Remove retaining clip securing push rod on clutch pedal (Fig. 16).
(2) Slide push rod off clutch pedal pin.
(3) Remove snap ring and washer attaching clutch pedal to the pivot shaft.
(4) Slide pedal off pivot shaft and remove pedal.
(5) Remove and inspect bushings in pedal bore. Replace bushings if worn or cracked.

INSTALLATION

(1) Lubricate pedal bushings and shaft with a silicone grease or with Mopar® multi-mileage grease.
(2) Install bushings in pedal bore and on pin.
(3) Install pedal on pivot shaft.
(4) Secure pedal on shaft with washer and snap ring.
(5) Apply light coating of grease to the inner diameter of the master cylinder push-rod and the outer diameter of the clutch pedal pin.
(6) Connect push rod to pedal and secure rod with retaining clip.

CLUTCH PEDAL POSITION SWITCH

DESCRIPTION

A clutch pedal position switch is in the starter circuit. The switch is located on the clutch master cylinder push rod.

CLUTCH PEDAL POSITION SWITCH (Continued)

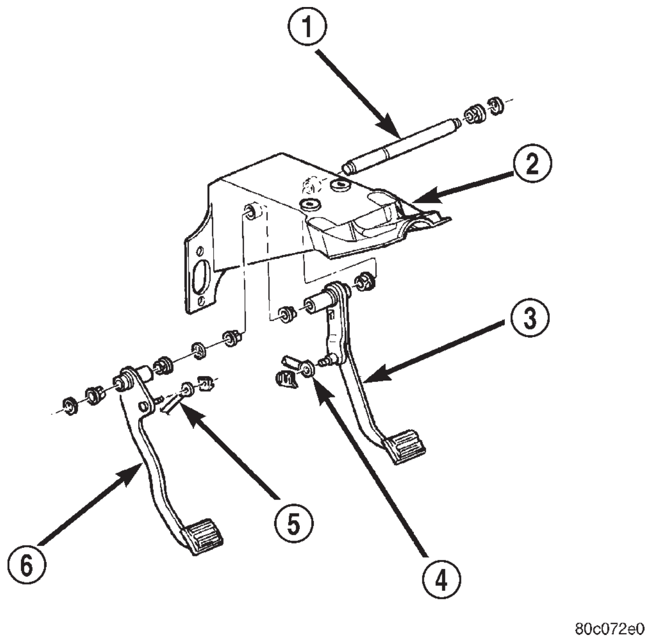


Fig. 16 Clutch Pedal

1 - PIVOT ROD
2 - PEDAL SUPPORT
3 - BRAKE PEDAL
4 - BOOSTER ROD
5 - CLUTCH ROD
6 - CLUTCH PEDAL

OPERATION

The switch, which is in circuit with the starter solenoid, requires that the clutch pedal be fully depressed in order to start the engine. Switch circuitry and operation is provided in section 8 Electrical.

COOLING

TABLE OF CONTENTS

COOLING

DESCRIPTION—COOLING SYSTEM FLOW 2.5L ENGINE

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible. It also maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid (if equipped). The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system.

An optional factory installed maximum duty cooling package is available on most models. This package will provide additional cooling capacity for vehicles used under extreme conditions such as trailer towing in high ambient temperatures (Fig. 1).

DESCRIPTION—COOLING SYSTEM FLOW - 3.9L/5.9L ENGINE

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible. It also maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid (if equipped). The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system.

An optional factory installed maximum duty cooling package is available on most models. This package will provide additional cooling capacity for vehicles used under extreme conditions such as trailer towing in high ambient temperatures (Fig. 2).

COOLING (Continued)

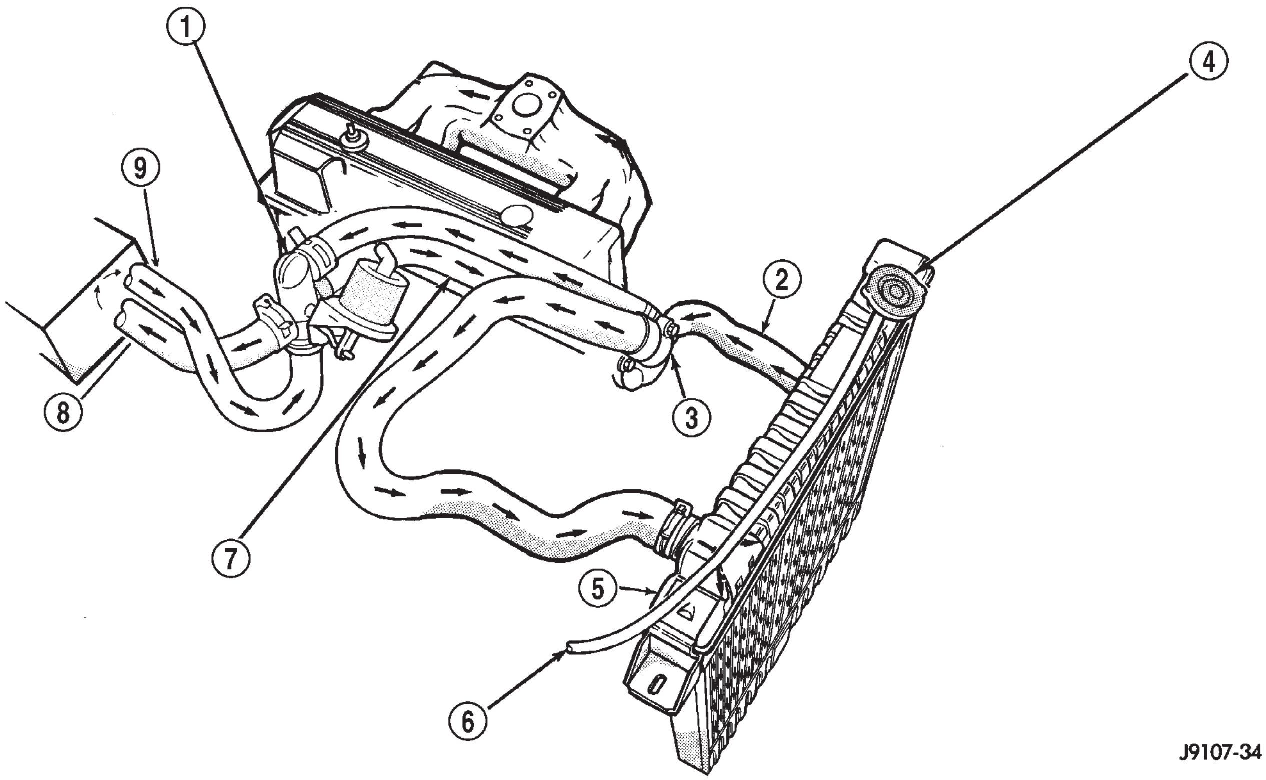


Fig. 1 Engine Cooling System Flow

1 - WATER CONTROL VALVE
2 - TO WATER PUMP
3 - THERMOSTAT HOUSING
4 - RADIATOR CAP
5 - RADIATOR
6 - TO COOLANT RESERVE BOTTLE
7 - TO WATER PUMP
8 - TO HEATER CORE
9 - FROM HEATER CORE

COOLING (Continued)

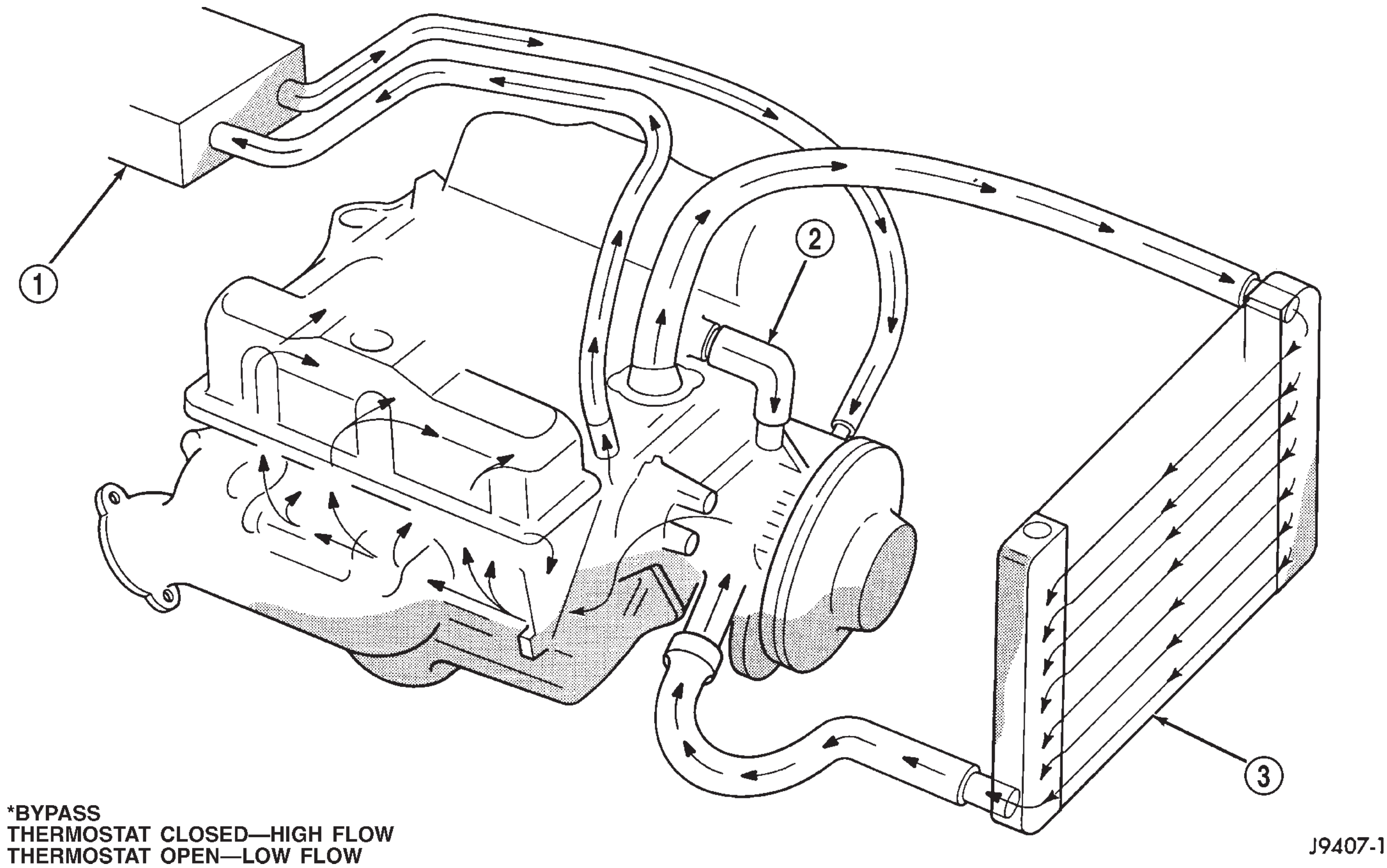


Fig. 2 Engine Cooling System Flow

1 - HEATER
2 - BYPASS*
3 - CROSSFLOW RADIATOR

COOLING (Continued)

DESCRIPTION—COOLING SYSTEM FLOW 4.7L ENGINE

The cooling system consists of (Fig. 3):

- Radiator
- Cooling fan (mechanical/Electrical)
- Thermal viscous fan drive
- Fan shroud
- Radiator pressure cap
- Thermostat
- Coolant reserve/overflow system (integral to upper fan shroud)
- Transmission oil cooler (if equipped with an automatic transmission)
- Coolant
- Water pump
- Hoses and hose clamps

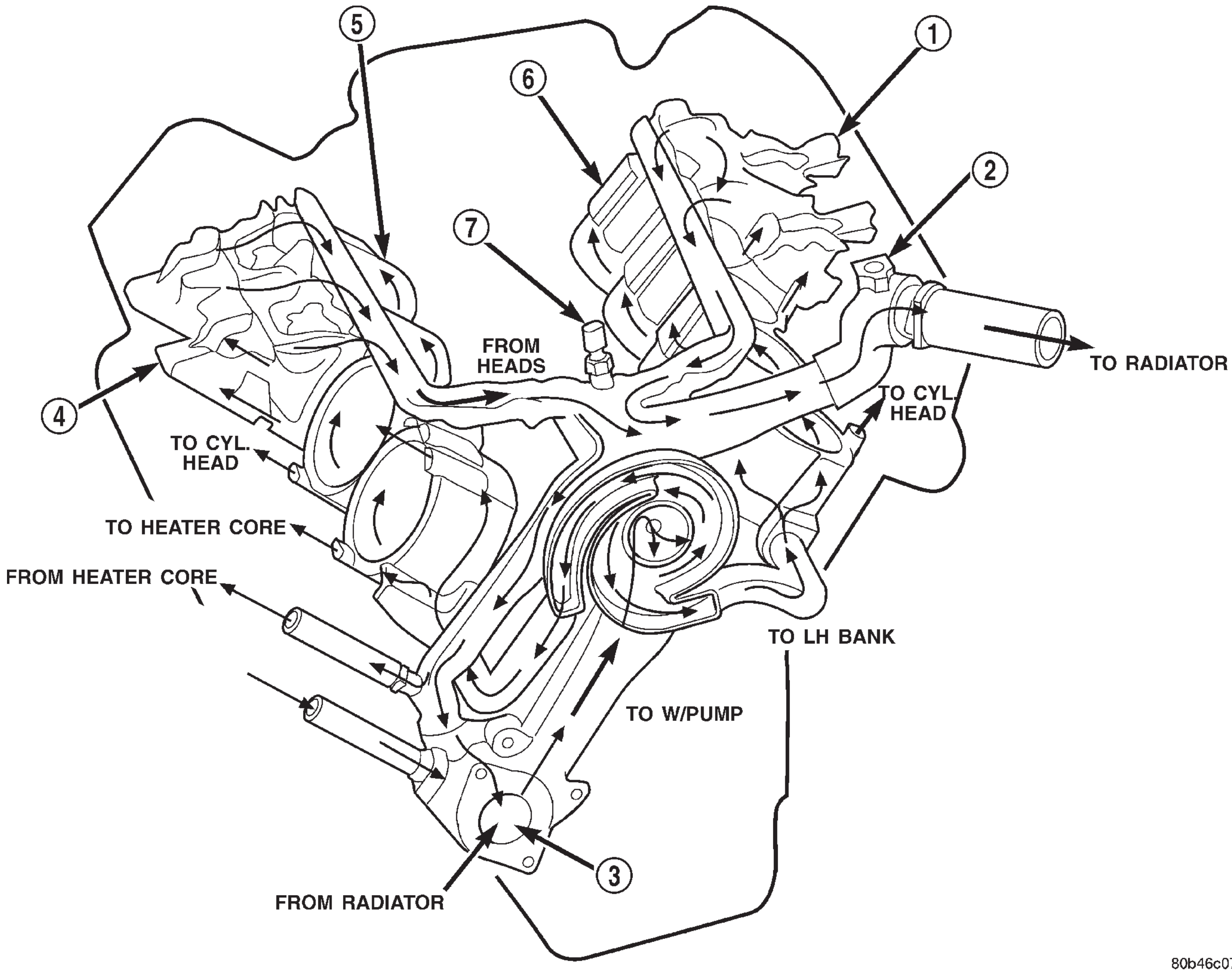


Fig. 3 Engine Cooling System Flow

1 - LH CYL. HEAD
2 - BLEED
3 - THERMOSTAT LOCATION
4 - RH CYL. HEAD
5 - RH BANK CYL. BLOCK
6 - LH BANK CYL. BLOCK
7 - COOLANT TEMP. SENSOR

COOLING (Continued)

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. 4).

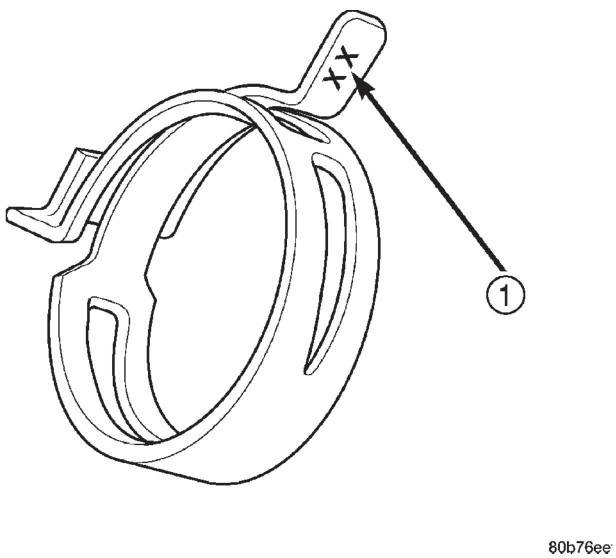


Fig. 4 Spring Clamp Size Location

1 - SPRING CLAMP SIZE LOCATION

OPERATION—COOLING SYSTEM

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible. It also maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid (if equipped). The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system.

An optional factory installed maximum duty cooling package is available on most models. This package will provide additional cooling capacity for vehicles used under extreme conditions such as trailer towing in high ambient temperatures.

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, only use constant tension clamp pliers designed 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 certain 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 indicated an actual problem, a DTC is stored. The DTC will be stored in the PCM memory for eventual display to the service technician. (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION).

ACCESSING DIAGNOSTIC TROUBLE CODES

To read DTC's and to obtain cooling system data, (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION).

ERASING TROUBLE CODES

After the problem has been repaired, use the DRB scan tool to erase a DTC. Refer to the appropriate Powertrain Diagnostic Procedures service information for operation of the DRB scan tool.

DIAGNOSIS AND TESTING—COOLING SYSTEM - TESTING FOR LEAKS

ULTRAVIOLET LIGHT METHOD

A leak detection additive is available through the parts department that can be added to cooling system. The additive is highly visible under ultraviolet light (black light). Pour one ounce of additive into cooling system. Place heater control unit in HEAT position. Start and operate engine until radiator upper hose is warm to touch. Aim the commercially available black light tool at components to be checked. If leaks are present, black light will cause additive to glow a bright green color.

The black light can be used in conjunction with a pressure tester to determine if any external leaks exist (Fig. 5).

COOLING (Continued)

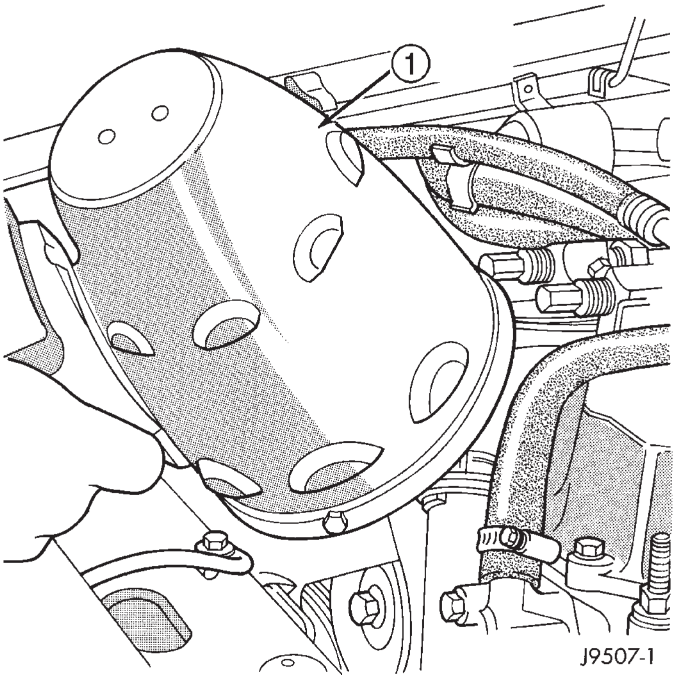


Fig. 5 Leak Detection Using Black Light—Typical

1 - TYPICAL BLACK LIGHT TOOL

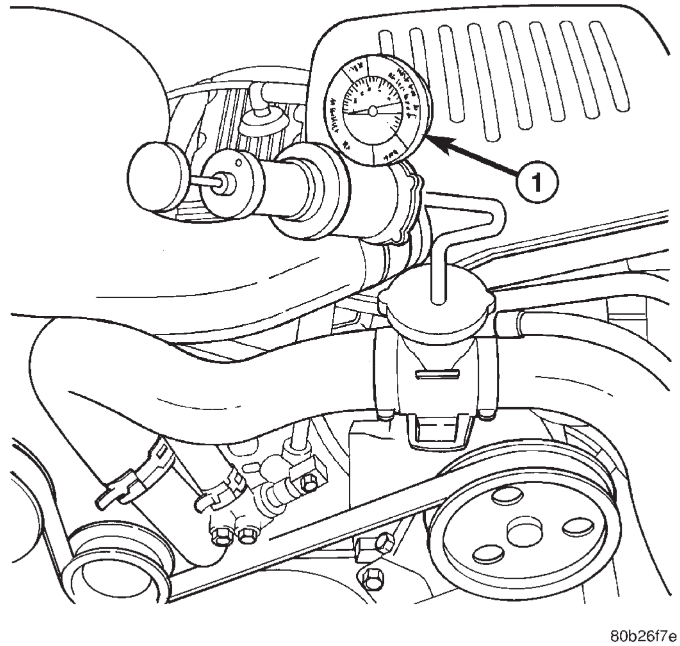


Fig. 6 PRESSURE TEST POINT 2.5L ENGINE

1 - TYPICAL COOLING SYSTEM PRESSURE TESTER

PRESSURE TESTER METHOD

The engine should be at normal operating temperature. Recheck the system cold if cause of coolant loss is not located during the warm engine examination.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING.

Carefully remove radiator pressure cap from filler neck and check coolant level. Push down on cap to disengage it from stop tabs. Wipe inside of filler neck and examine lower inside sealing seat for nicks, cracks, paint, dirt and solder residue. Inspect radiator-to- reserve/overflow tank hose for internal obstructions. Insert a wire through the hose to be sure it is not obstructed.

Inspect cams on outside of filler neck. If cams are damaged, seating of pressure cap valve and tester seal will be affected.

Attach pressure tester (7700 or an equivalent) to radiator filler neck (Fig. 6) or (Fig. 7).

Operate tester pump to apply 103.4 kPa (15 psi) pressure to system. If hoses enlarge excessively or bulges while testing, replace as necessary. Observe gauge pointer and determine condition of cooling system according to following criteria:

Holds Steady: If pointer remains steady for two minutes, serious coolant leaks are not present in system. However, there could be an internal leak that does not appear with normal system test pressure. If it is certain that coolant is being lost and leaks cannot be detected, inspect for interior leakage or perform Internal Leakage Test. Refer to INTERNAL LEAKAGE INSPECTION.

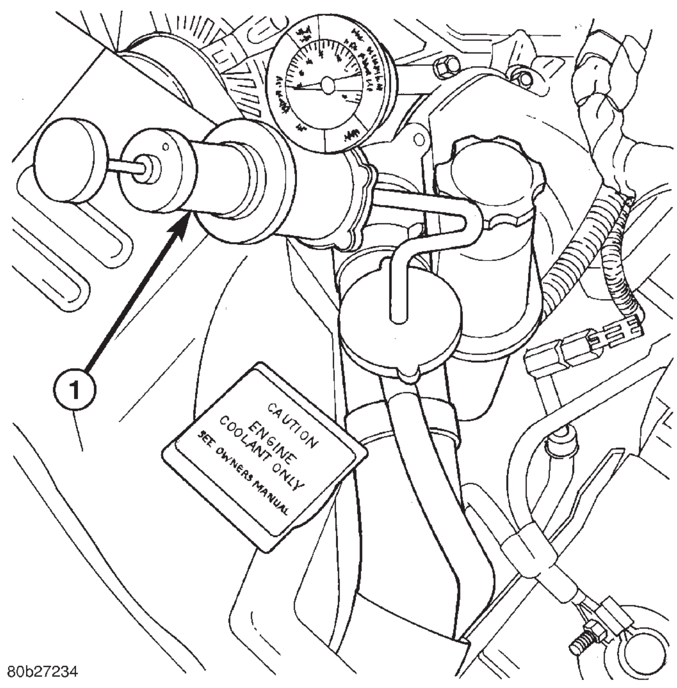


Fig. 7 PRESSURE TEST POINT 5.2L, 5.9L AND 4.7L ENGINES

1 - TYPICAL COOLING SYSTEM PRESSURE TESTER

COOLING (Continued)

Drops Slowly: Indicates a small leak or seepage is occurring. Examine all connections for seepage or slight leakage with a flashlight. Inspect radiator, hoses, gasket edges and heater. Seal small leak holes with a Sealer Lubricant (or equivalent). Repair leak holes and inspect system again with pressure applied.

Drops Quickly: Indicates that serious leakage is occurring. Examine system for external leakage. If leaks are not visible, inspect for internal leakage. Large radiator leak holes should be repaired by a reputable radiator repair shop.

INTERNAL LEAKAGE INSPECTION

Remove engine oil pan drain plug and drain a small amount of engine oil. If coolant is present in the pan, it will drain first because it is heavier than oil. An alternative method is to operate engine for a short period to churn the oil. After this is done, remove engine dipstick and inspect for water globules. Also inspect transmission dipstick for water globules and transmission fluid cooler for leakage.

WARNING: WITH RADIATOR PRESSURE TESTER TOOL INSTALLED ON RADIATOR, DO NOT ALLOW PRESSURE TO EXCEED 145 KPA (21 PSI). PRESSURE WILL BUILD UP QUICKLY IF A COMBUSTION LEAK IS PRESENT. TO RELEASE PRESSURE, ROCK TESTER FROM SIDE TO SIDE. WHEN REMOVING TESTER, DO NOT TURN TESTER MORE THAN 1/2 TURN IF SYSTEM IS UNDER PRESSURE.

Operate engine without pressure cap on radiator until thermostat opens. Attach a Pressure Tester to filler neck. If pressure builds up quickly it indicates a combustion leak exists. This is usually the result of a cylinder head gasket leak or crack in engine. Repair as necessary.

If there is not an immediate pressure increase, pump the Pressure Tester. Do this until indicated pressure is within system range of 145 kPa (21 psi). Fluctuation of gauge pointer indicates compression or combustion leakage into cooling system.

Because the vehicle is equipped with a catalytic converter, **do not** remove spark plug cables or short out cylinders to isolate compression leak.

If the needle on dial of pressure tester does not fluctuate, race engine a few times to check for an abnormal amount of coolant or steam. This would be emitting from exhaust pipe. Coolant or steam from exhaust pipe may indicate a faulty cylinder head gasket, cracked engine cylinder block or cylinder head.

A convenient check for exhaust gas leakage into cooling system is provided by a commercially available Block Leak Check tool. Follow manufacturers instructions when using this product.

COMBUSTION LEAKAGE TEST—WITHOUT PRESSURE TESTER

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: DO NOT REMOVE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

Drain sufficient coolant to allow thermostat removal. (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 radiator to bring level to within 6.3 mm (1/4 in) of top of thermostat housing.

CAUTION: Avoid overheating. Do not operate engine for an excessive period of time. Open draincock immediately after test to eliminate boil over.

Start engine and accelerate rapidly three times, to approximately 3000 rpm while observing coolant. If internal engine combustion gases are leaking into cooling system, bubbles will appear in coolant. If bubbles do not appear, internal combustion gas leakage is not present.

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.

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	8. Incorrect coolant concentration	8. Check coolant. (Refer to LUBRICATION & MAINTENANCE/ FLUID TYPES - DESCRIPTION).
	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)

STANDARD PROCEDURE

STANDARD PROCEDURE—DRAINING COOLING SYSTEM 2.5L ENGINE

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

DO NOT remove the radiator cap when draining the coolant from the reserve/overflow tank. Open the radiator draincock and when the tank is empty, remove the radiator cap. The coolant does not have to be removed from the tank unless the system is being refilled with a fresh mixture.

(1) Drain the coolant from the radiator by loosening the draincock.

(2) Drain coolant from engine block by removing drain plug at left rear side of block (Fig. 8).

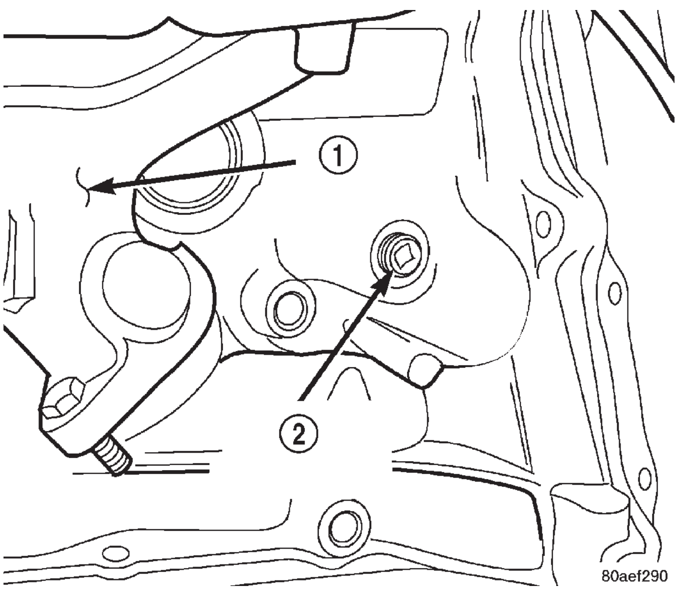


Fig. 8 Draining Coolant From Block

1 - EXHAUST MANIFOLD
2 - CYLINDER BLOCK COOLANT DRAIN PLUG

STANDARD PROCEDURE—REFILLING COOLING SYSTEM 2.5L ENGINE

(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—DRAINING COOLING SYSTEM 3.9L/5.9L ENGINE

WARNING: DO NOT REMOVE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(1) Remove radiator pressure cap.

(2) Loosen radiator petcock.

(3) Remove cylinder block drain plugs. Refer to (Fig. 9).

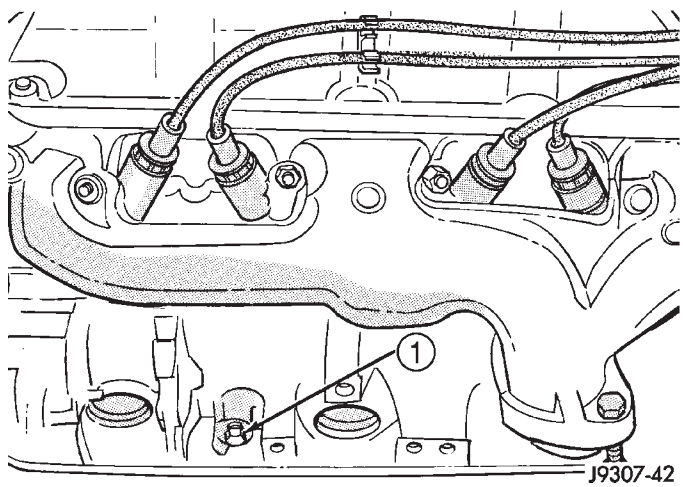


Fig. 9 Cylinder Block Drain Plug—5.2L/5.9L Engines

1 - BLOCK DRAIN PLUG

STANDARD PROCEDURE—REFILLING COOLING SYSTEM 3.9L/5.9L ENGINE

WARNING: DO NOT REMOVE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

Clean cooling system prior to refilling. (Refer to 7 - COOLING - STANDARD PROCEDURE).

COOLING (Continued)

(1) Install cylinder block drain plugs. Coat the threads with Mopar® Thread Sealant with Teflon.

(2) Close radiator petcock.

(3) Fill cooling system with a 50/50 mixture of water and antifreeze.

(4) Fill coolant reserve/overflow tank to FULL mark on indicator stick.

(5) Start and operate engine until thermostat opens (upper radiator hose warm to touch).

(6) If necessary, add a 50/50 water and antifreeze mixture to the coolant reserve/overflow tank. This is done to maintain coolant level between the FULL and ADD marks. The level in the reserve/overflow tank may drop below the ADD mark after three or four warm-up and cool-down cycles.

STANDARD PROCEDURE—DRAINING COOLING SYSTEM 4.7L ENGINE

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS (Fig. 10) OR LOOSEN THE RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

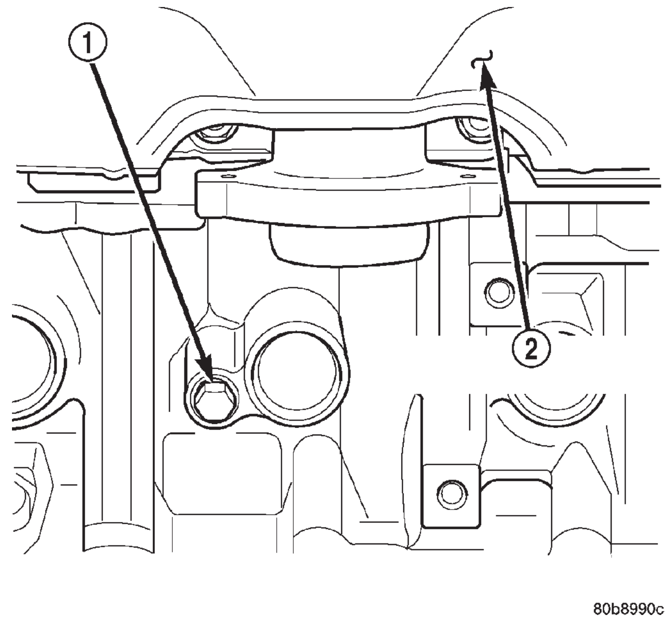


Fig. 10 Drain Plug—4.7L Engine

1 - CYLINDER BLOCK DRAIN PLUG
2 - EXHAUST MANIFOLD AND HEAT SHIELD

(1) DO NOT remove radiator cap first. With engine cold, raise vehicle on a hoist and locate radiator draincock.

NOTE: Radiator draincock is located on the left/ lower side of radiator facing to rear of vehicle.

(2) Attach one end of a hose to the draincock. Put the other end into a clean container. Open draincock and drain coolant from radiator. This will empty the coolant reserve/overflow tank. The coolant does not have to be removed from the tank unless the system is being refilled with a fresh mixture. When tank is empty, remove radiator cap and continue draining cooling system.

STANDARD PROCEDURE - REFILLING COOLING SYSTEM 4.7L ENGINE

(1) Tighten the radiator draincock and the cylinder block drain plug(s) (if removed).

CAUTION: Failure to purge air from the cooling system can result in an overheating condition and severe engine damage.

(2) Remove the cooling system bleed plug from the radiator upper hose inlet housing. (Fig. 11)Fill system using a 50/50 mixture of ethylene-glycol antifreeze and low mineral content water, until coolant begains coming out of the cooling system bleed hole. Install the cooling system bleed plug. Fill radiator to top and install radiator cap. Add sufficient coolant to the reserve/overflow tank to raise level to FULL mark.

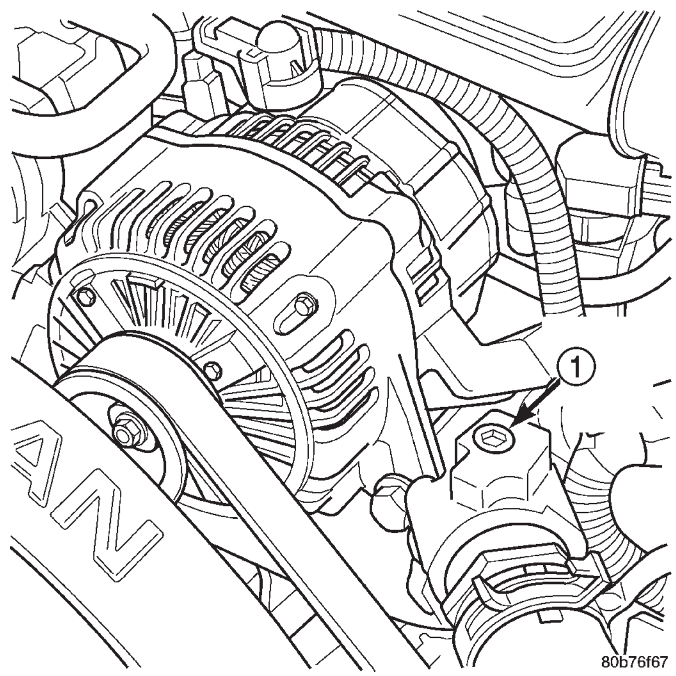


Fig. 11 Cooling System Bleed Plug—4.7L

1 - COOLING SYSTEM BLEED PLUG

(3) With heater control unit in the HEAT position, operate engine with radiator cap in place.

(4) After engine has reached normal operating temperature, shut engine off and allow it to cool.

COOLING (Continued)

When engine is cooling down, coolant will be drawn into the radiator from the reserve/overflow tank.

(5) Add coolant to reserve/overflow tank as necessary. **Only add coolant to the reserve/overflow tank when the engine is cold. Coolant level in a warm engine will be higher due to thermal expansion.**

STANDARD PROCEDURE—ADDING ADDITIONAL COOLANT

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 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.

STANDARD PROCEDURE—COOLANT LEVEL CHECK

NOTE: Do not remove radiator cap for routine coolant level inspections. The coolant level can be checked at coolant recovery bottle (Fig. 12).

The coolant reserve/overflow system provides a quick method for determining coolant level without removing radiator pressure cap. With engine not running, open the coolant recovery bottle cap and remove coolant level indicator dipstick to observe coolant level in coolant recovery bottle. The coolant level should be between ADD and FULL marks. If the coolant level is at or below the ADD mark, fill the recovery bottle with a 50/50 mixture of antifreeze and water ONE QUART AT A TIME. Repeat this procedure until the coolant level is at the FULL mark.

STANDARD PROCEDURE—COOLING SYSTEM CLEANING/REVERSE FLUSHING

CLEANING

Drain cooling system and refill with water. Run engine with radiator cap installed until upper radiator hose is hot. Stop engine and drain water from system. If water is dirty, fill system with water, run engine and drain system. Repeat until water drains clean.

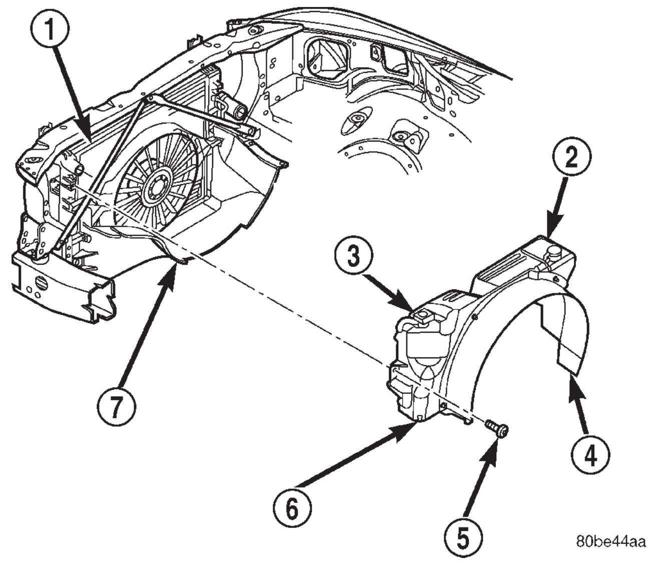


Fig. 12 Coolant Recovery Bottle Location

1 - RADIATOR
2 - WASHER FLUID RESERVOIR
3 - COOLANT OVERFLOW/RESERVOIR
4 - FAN SHROUD (UPPER)
5 - SCREW
6 - INTERLOCKING PINS
7 - FAN SHROUD (LOWER)

REVERSE FLUSHING

Reverse flushing of cooling system is the forcing of water through the cooling system. This is done using air pressure in the opposite direction of normal coolant flow. It is usually only necessary with very dirty systems with evidence of partial plugging.

REVERSE FLUSHING RADIATOR

Disconnect radiator hoses from radiator inlet and outlet. Attach a section of radiator hose to radiator bottom outlet fitting and insert flushing gun. Connect a water supply hose and air supply hose to flushing gun.

CAUTION: Internal radiator pressure must not exceed 138 kPa (20 psi) as damage to radiator may result.

Allow radiator to fill with water. When radiator is filled, apply air in short blasts. Allow radiator to refill between blasts. Continue this reverse flushing until clean water flows out through rear of radiator cooling tube passages. Have radiator cleaned more extensively by a radiator repair shop.

REVERSE FLUSHING ENGINE

Drain cooling system. Remove thermostat housing and thermostat. Install thermostat housing. Disconnect radiator upper hose from radiator and attach flushing gun to hose. Disconnect radiator lower hose

COOLING (Continued)

from water pump and attach a lead-away hose to water pump inlet fitting.

CAUTION: On vehicles equipped with a heater water control valve, be sure heater control valve is closed (heat off). This will prevent coolant flow with scale and other deposits from entering heater core.

Connect water supply hose and air supply hose to flushing gun. Allow engine to fill with water. When engine is filled, apply air in short blasts, allowing system to fill between air blasts. Continue until clean water flows through the lead away hose.

Remove lead away hose, flushing gun, water supply hose and air supply hose. Remove thermostat housing and install thermostat. Install thermostat housing with a replacement gasket. Refer to Thermostat Replacement. Connect radiator hoses. Refill cooling system with correct antifreeze/water mixture. Refer to Refilling the Cooling System.

CHEMICAL CLEANING

In some instances, use a radiator cleaner (Mopar Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid flushing operation.

CAUTION: Follow manufacturers instructions when using these products.

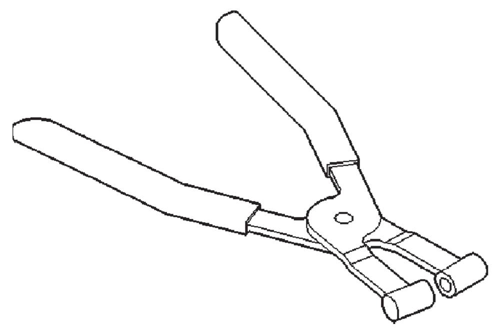
SPECIFICATIONS

TORQUE

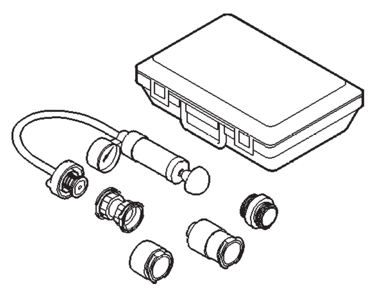
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Automatic Belt Tensioner to Block—Bolts	41	30	—
Automatic Belt Tensioner Pulley—Bolt	61	45	—
Block Heater—Bolt	2	—	17
Generator/Compressor Mounting Bracket—Bolts			
# 1 and 2	54	40	—
# 3	40	30	—
Fan Shroud Mounting—Bolts	6	—	50
Fan Blade to Fan Drive—Bolts	23	17	—
Idler Pulley—Bolt	54	40	—
Radiator to Support—Bolts	23	—	200
Thermostat Housing—Bolts - All Except 4.7L	23	—	200
Thermostat Housing—Bolts - 4.7L	13	—	112
Transmission Auxiliary Oil Cooler—Bolts	10	—	90
Upper Radiator Closure Panel—Bolts	10	—	90
Water Pump—Bolts	40	30	—

SPECIAL TOOLS

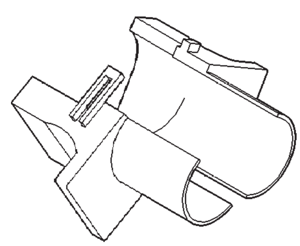
COOLING



Pliers Constant Pressure Hose Clamp—6094



Cooling System Pressure Tester—7700A



3/8” Quick Connect Release Tool—6935

ACCESSORY DRIVE

TABLE OF CONTENTS

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.

(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 - 3.9L/5.9L

DESCRIPTION

Correct drive belt tension is required to ensure optimum performance of the belt driven engine accessories. If specified tension is not maintained, belt slippage may cause; engine overheating, lack of power steering assist, loss of air conditioning capacity, reduced generator output rate, and greatly reduced belt life.

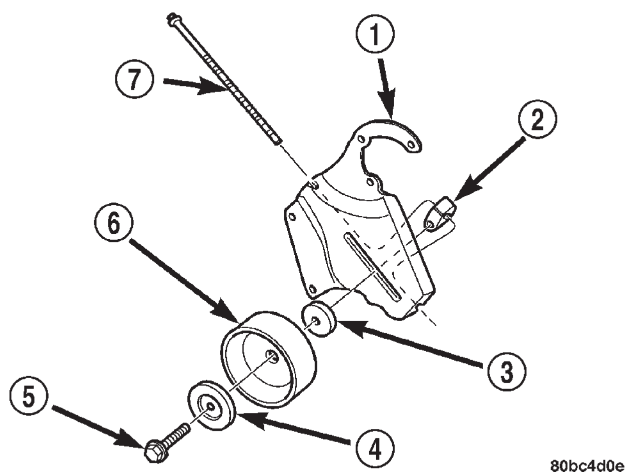


Fig. 1 Accessory Drive Belt Tensioner—2.5L Engine

1 - TENSIONER BRACKET
2 - TENSIONER COLLAR
3 - SPACER
4 - BUSHING
5 - BOLT
6 - IDLER PULLEY
7 - TENSIONER ADJUSTMENT BOLT

It is not necessary to adjust belt tension on the 3.9L or 5.9L engines. These engines are equipped with an automatic belt tensioner (Fig. 2). The tensioner maintains correct belt tension at all times. Due to use of this belt tensioner, do not attempt to use a belt tension gauge on 3.9L or 5.9L engines.

BELT TENSIONERS - 3.9L/5.9L (Continued)

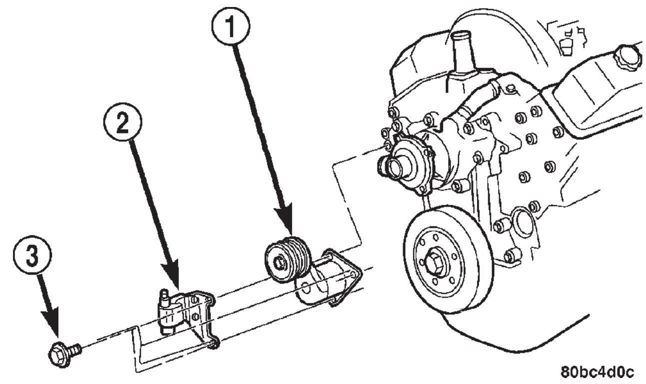


Fig. 2 Automatic Belt Tensioner—5.2L and 5.9L Engines

1 - AUTOMATIC TENSIONER
2 - COIL AND BRACKET
3 - SCREW AND WASHER

OPERATION

The automatic belt tensioner maintains belt tension by using internal spring pressure, a pivoting arm and pulley to press against the drive belt.

REMOVAL

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY (EXCEPT FOR PULLEY).

(1) Remove accessory drive belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Disconnect wiring and secondary cable from ignition coil.

(3) Remove ignition coil from coil mounting bracket (two bolts). Do not remove coil mounting bracket from cylinder head.

(4) Remove tensioner assembly from mounting bracket (one nut) (Fig. 3).

(5) Remove pulley bolt. Remove pulley from tensioner.

INSTALLATION

(1) Install pulley and pulley bolt to tensioner. Tighten bolt to 61 N·m (45 ft. lbs.) torque.

(2) Install tensioner assembly to mounting bracket. An indexing tab is located on back of tensioner. Align this tab to slot in mounting bracket. Tighten nut to 67 N·m (50 ft. lbs.) torque.

(3) Connect all wiring to ignition coil.

CAUTION: To prevent damage to coil case, coil mounting bolts must be torqued.

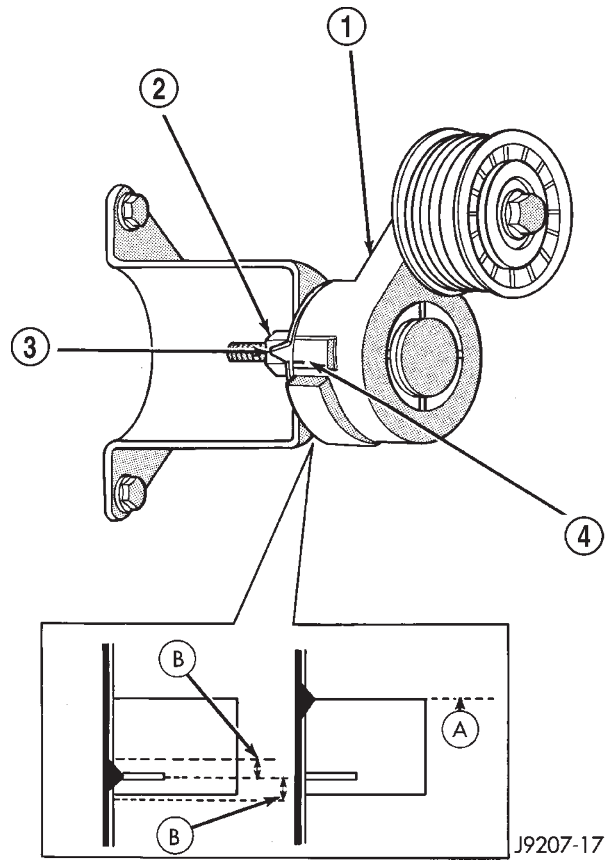


Fig. 3 Tensioner Indexing Marks and Mounting Nut

1 - TENSIONER ASSEMBLY
2 - TENSIONER MOUNTING NUT
3 - INDEXING ARROW
4 - INDEXING MARK

(4) Install coil to coil bracket. If nuts and bolts are used to secure coil to coil bracket, tighten to 11 N·m (100 in. lbs.) torque. If coil mounting bracket has been tapped for coil mounting bolts, tighten bolts to 5 N·m (50 in. lbs.) torque.

(5) Install drive belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(6) Check belt indexing marks (Fig. 3).

BELT TENSIONERS - 4.7L

DESCRIPTION

Correct drive belt tension is required to ensure optimum performance of the belt driven engine accessories. If specified tension is not maintained, belt slippage may cause; engine overheating, lack of power steering assist, loss of air conditioning capacity, reduced generator output rate, and greatly reduced belt life.

BELT TENSIONERS - 4.7L (Continued)

It is not necessary to adjust belt tension on the 4.7L engine. These engines are equipped with an automatic belt tensioner (Fig. 4). The tensioner maintains correct belt tension at all times. Due to use of this belt tensioner, do not attempt to use a belt tension gauge on 4.7L engines.

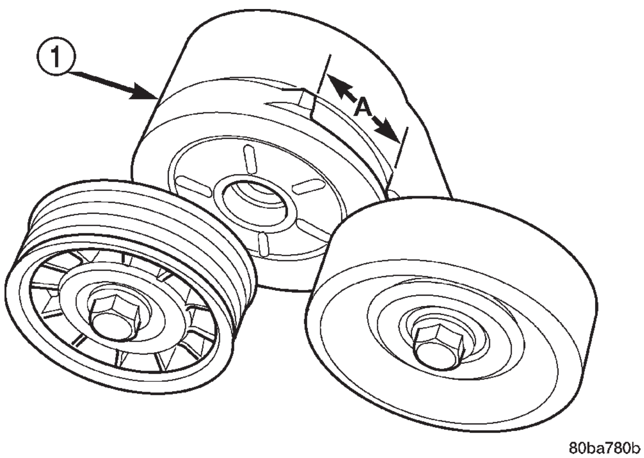


Fig. 4 Automatic Belt Tensioner

1 - AUTOMATIC TENSIONER ASSEMBLY

OPERATION

The automatic belt tensioner maintains belt tension by using internal spring pressure, a pivoting arm and pulley to press against the drive belt.

REMOVAL

On 4.7L engines, the tensioner is equipped with an indexing tang on back of tensioner and an indexing stop on tensioner housing. If a new belt is being installed, tang must be within approximately 24 mm (.94 inches) of indexing stop. Belt is considered new if it has been used 15 minutes or less.

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 tension 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. 5).

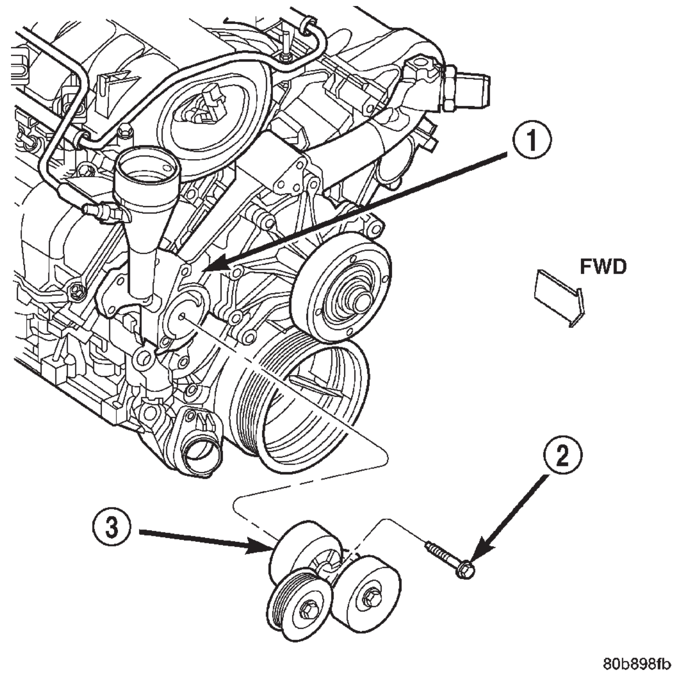


Fig. 5 Automatic Belt Tensioner—4.7L Engine

1 - TIMING CHAIN COVER
2 - BOLT TORQUE TO 41 N·m (30 FT LBS)
3 - AUTOMATIC BELT TENSIONER

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY EXCEPT FOR PULLEY ON TENSIONER.

(3) Remove pulley bolt. Remove pulley from tensioner.

INSTALLATION

(1) Install pulley and pulley bolt to tensioner. Tighten bolt to 61 N·m (45 ft. lbs.) torque.

(2) An indexing slot is located on back of tensioner. Align this slot to the head of the bolt on the front cover. Install the mounting bolt. Tighten bolt to 41 N·m (30 ft. lbs.).

(3) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(4) Check belt indexing marks (Fig. 4).

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. 6), 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. 6). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to 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.

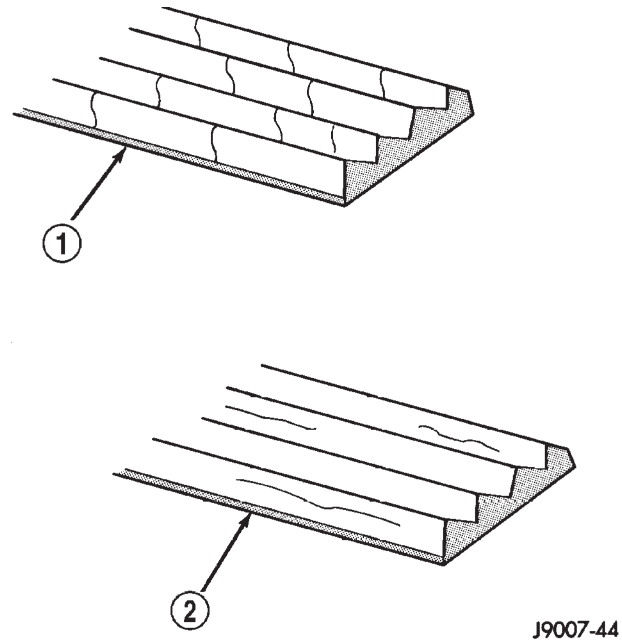


Fig. 6 Belt Wear Patterns

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. Inspect/Replace tensioner if 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.

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. Incorrect belt tension 2. Pulley(s) not within design tolerance 3. Foreign object(s) in grooves 4. Pulley misalignment 5. Belt cordline is broken	1. Inspect/Replace tensioner if necessary 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. Incorrect belt tension 2. Tensile member damaged during belt installation 3. Severe misalignment 4. Bracket, pulley, or bearing failure	1. Replace Inspect/Replace tensioner if necessary 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. Incorrect belt tension 2. Bearing noise 3. Belt misalignment 4. Belt to pulley mismatch 5. Driven component induced vibration	1. Inspect/Replace tensioner if necessary 2. Locate and repair 3. Align belt/pulley(s) 4. Install correct belt 5. Locate defective driven component and repair
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. Incorrect belt tension 2. Belt contacting stationary object 3. Pulley(s) out of tolerance 4. Insufficient adhesion between tensile member and rubber matrix	1. Inspect/Replace tensioner if necessary 2. Replace belt 3. Replace pulley 4. Replace belt

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. 7).

(3) Loosen tension adjusting bolt (Fig. 7) and remove accessory drive belt.

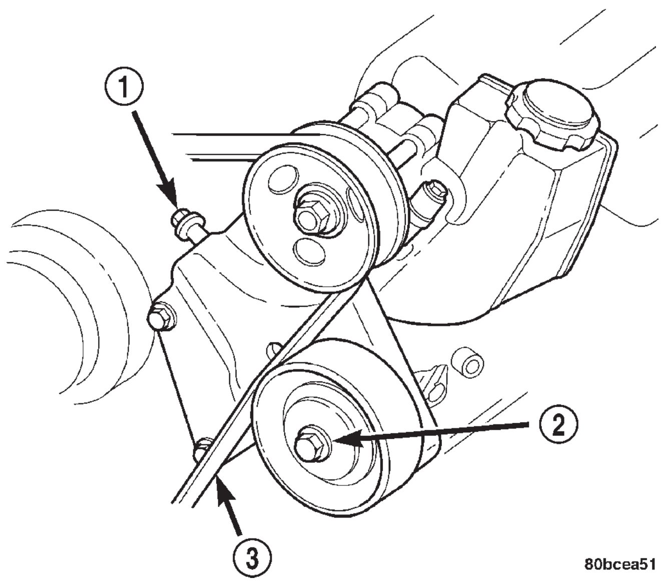


Fig. 7 Power Steering Pump Bracket and Idler Pulley—2.5L

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. 8) or (Fig. 9) for correct belt routing, or refer to Belt Routing Label located in the vehicle engine compartment.

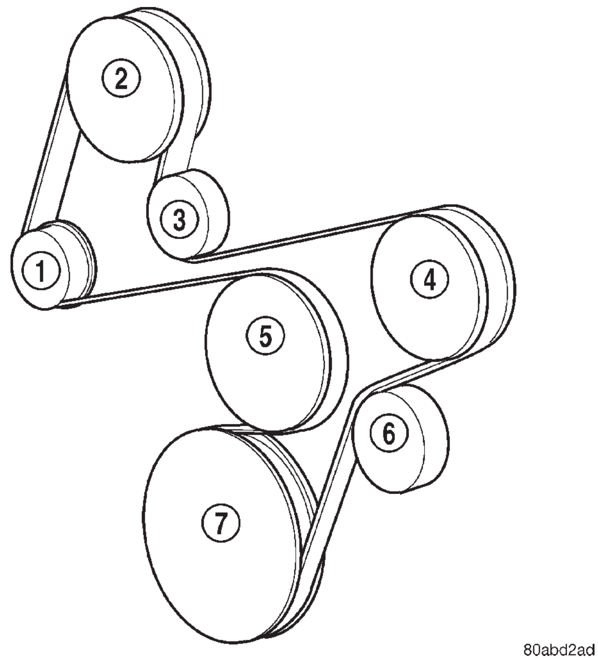


Fig. 8 2.5L – With A/C

1 - GENERATOR PULLEY
2 - AIR CONDITIONER COMPRESSOR PULLEY
3 - IDLER PULLEY
4 - POWER STEERING PUMP PULLEY
5 - WATER PUMP AND FAN PULLEY
6 - IDLER PULLEY
7 - CRANKSHAFT PULLEY

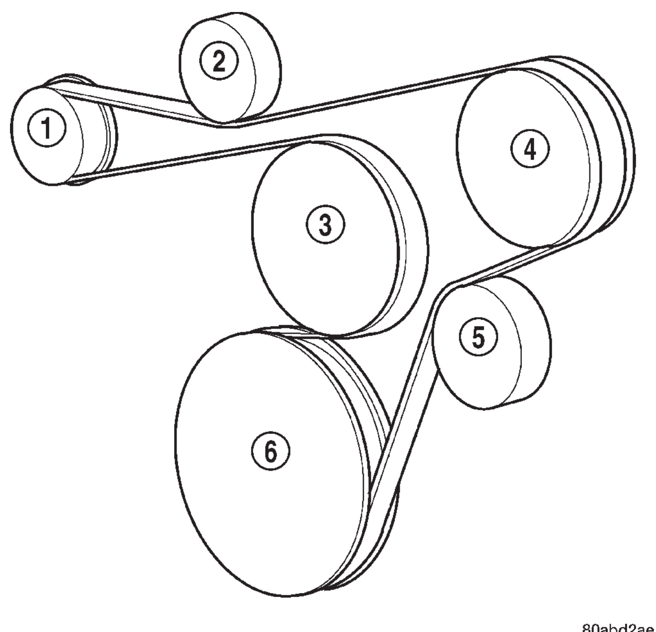


Fig. 9 2.5L Engines – Without A/C

1 - GENERATOR PULLEY
2 - IDLER PULLEY
3 - WATER PUMP AND FAN PULLEY
4 - POWER STEERING PUMP PULLEY
5 - IDLER PULLEY
6 - CRANKSHAFT PULLEY

DRIVE BELTS - 2.5L (Continued)

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. 10) or (Fig. 11) for correct belt routing.

(2) Install new belt. Install belt tension gauge C-4162 and tighten adjustment bolt (Fig. 7) 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.

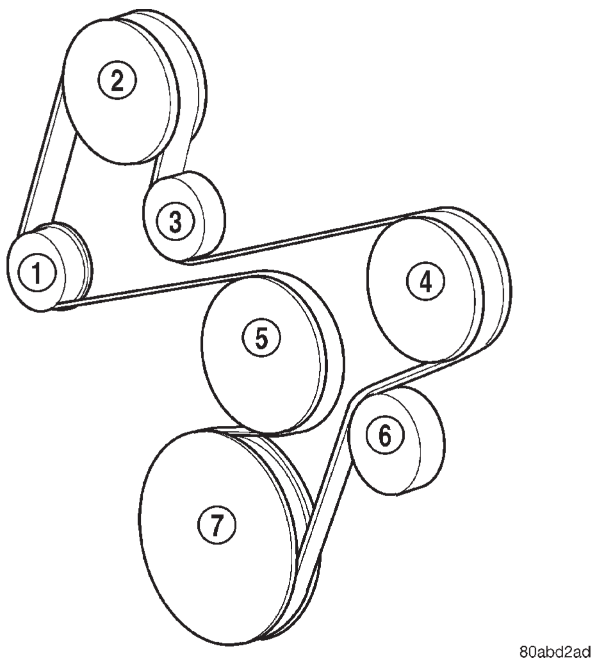


Fig. 10 2.5L - With A/C

1 - GENERATOR PULLEY
2 - AIR CONDITIONER COMPRESSOR PULLEY
3 - IDLER PULLEY
4 - POWER STEERING PUMP PULLEY
5 - WATER PUMP AND FAN PULLEY
6 - IDLER PULLEY
7 - CRANKSHAFT PULLEY

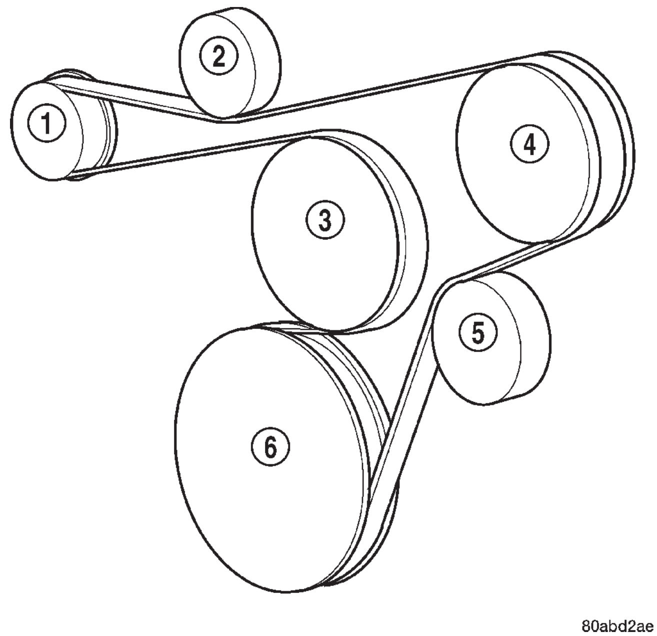


Fig. 11 2.5L Engines - Without A/C

1 - GENERATOR PULLEY
2 - IDLER PULLEY
3 - WATER PUMP AND FAN PULLEY
4 - POWER STEERING PUMP PULLEY
5 - IDLER PULLEY
6 - CRANKSHAFT PULLEY

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.

DRIVE BELTS - 2.5L (Continued)

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.

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. 12).

(4) Adjust tension adjusting bolt (Fig. 12) until reading is within specification.

(5) Tighten idler pulley bolt and re-check belt tension. Adjust if necessary.

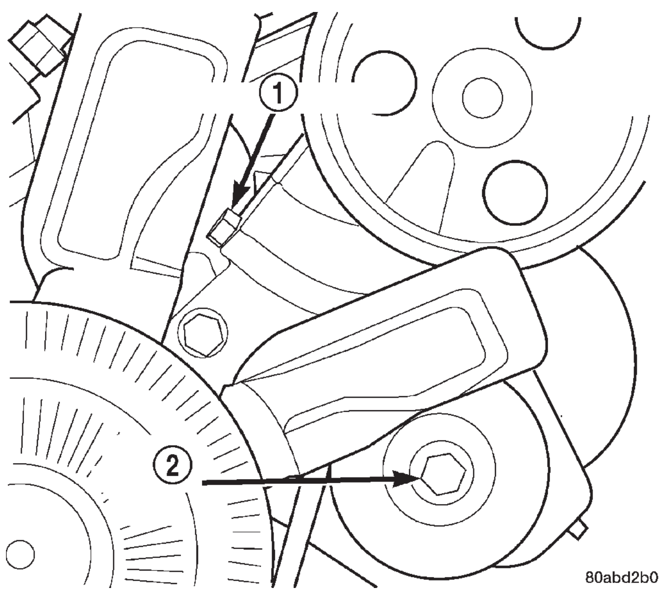


Fig. 12 Power Steering Pump Bracket and Idler Pulley

1 - ADJUSTING BOLT
2 - IDLER PULLEY BOLT

DRIVE BELTS - 3.9L/5.9L

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. 13), 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. 13). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to ACCESSORY DRIVE BELT DIAGNOSIS CHART for further belt diagnosis.

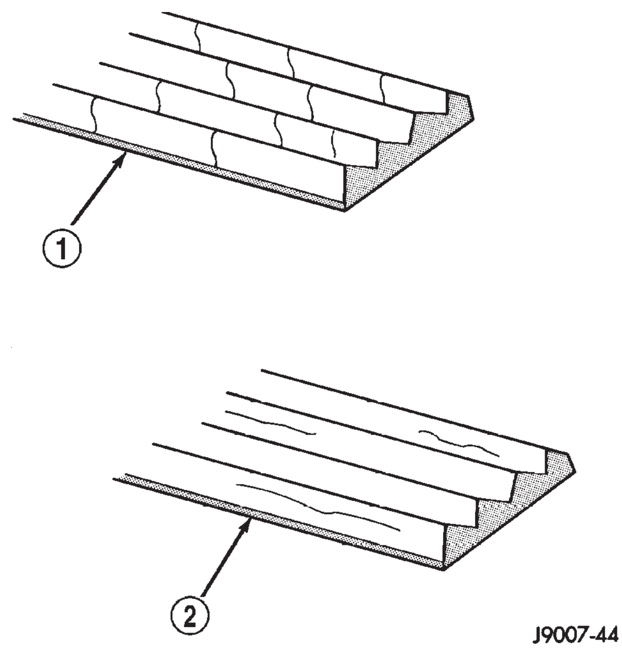


Fig. 13 Belt Wear Patterns

1 - NORMAL CRACKS BELT OK
2 - NOT NORMAL CRACKS REPLACE BELT

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 - 3.9L/5.9L (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. 2. Installation damage	1. Remove foreign objects from pulley grooves. Replace belt. 2. Replace belt
RIB OR BELT WEAR	1. Pulley misaligned 2. Abrasive environment 3. Rusted pulley(s) 4. Sharp or jagged pulley groove tips 5. Belt rubber deteriorated	1. Align pulley(s) 2. Clean pulley(s). Replace belt if necessary 3. Clean rust from pulley(s) 4. Replace pulley. Inspect belt. 5. Replace belt
BELT SLIPS	1. Belt slipping because of insufficient tension 2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol) 3. Driven component bearing failure (seizure) 4. Belt glazed or hardened from heat and excessive slippage	1. Inspect/Replace tensioner if necessary 2. Replace belt and clean pulleys 3. Replace faulty component or bearing 4. Replace belt.
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. Incorrect belt tension 2. Pulley(s) not within design tolerance 3. Foreign object(s) in grooves 4. Pulley misalignment 5. Belt cordline is broken	1. Inspect/Replace tensioner if necessary 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. Incorrect belt tension 2. Tensile member damaged during belt installation 3. Severe misalignment 4. Bracket, pulley, or bearing failure	1. Replace Inspect/Replace tensioner if necessary 2. Replace belt 3. Align pulley(s) 4. Replace defective component and belt

DRIVE BELTS - 3.9L/5.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISE (Objectionable squeal, squeak, or rumble is heard or felt while drive belt is in operation)	1. Incorrect belt tension	1. Inspect/Replace tensioner if 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
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. Incorrect belt tension	1. Inspect/Replace tensioner if 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

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 attempt to check belt tension with a belt tension gauge on vehicles equipped with an automatic belt tensioner. Refer to Automatic Belt Tensioner in this group.

Drive belts on these engines are equipped with a spring loaded automatic belt tensioner (Fig. 14). This belt tensioner will be used on all belt configurations, such as with or without power steering or air conditioning. For more information, (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - DESCRIPTION).

(1) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 14).

(2) Rotate tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(3) Remove belt from idler pulley first.

(4) Remove belt from vehicle.

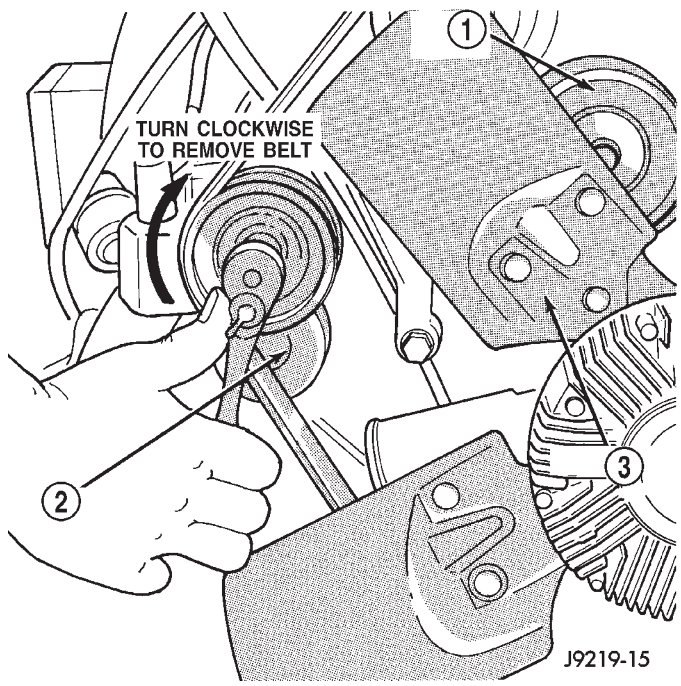


Fig. 14 Belt Tensioner—5.2L/5.9L Gas Engines

1 - IDLER PULLEY
2 - TENSIONER
3 - FAN BLADE

INSTALLATION

CAUTION: When installing the accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 15) (Fig. 16) for correct engine belt routing. The correct belt with correct length must be used.

(1) Position drive belt over all pulleys **except** idler pulley. This pulley is located between generator and A/C compressor.

(2) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 14).

(3) Rotate socket/wrench clockwise. Place belt over idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

(4) Check belt indexing marks (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - DESCRIPTION).

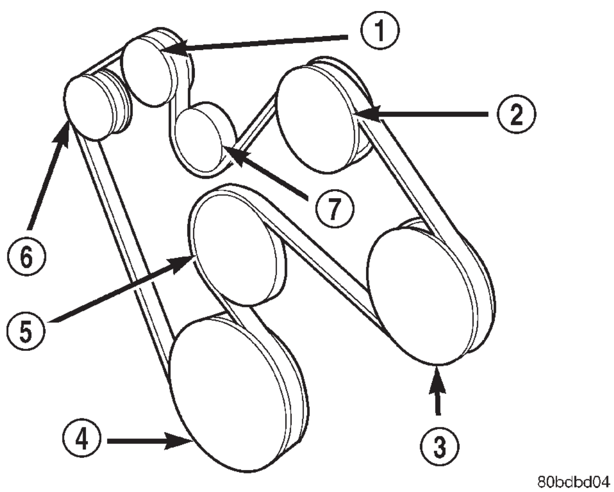


Fig. 15 Belt Routing—5.2L/5.9L Engines with A/C

1 - GENERATOR PULLEY
2 - A/C PULLEY
3 - POWER STEERING PULLEY
4 - CRANKSHAFT PULLEY
5 - WATER PUMP PULLEY
6 - TENSIONER PULLEY
7 - IDLER PULLEY

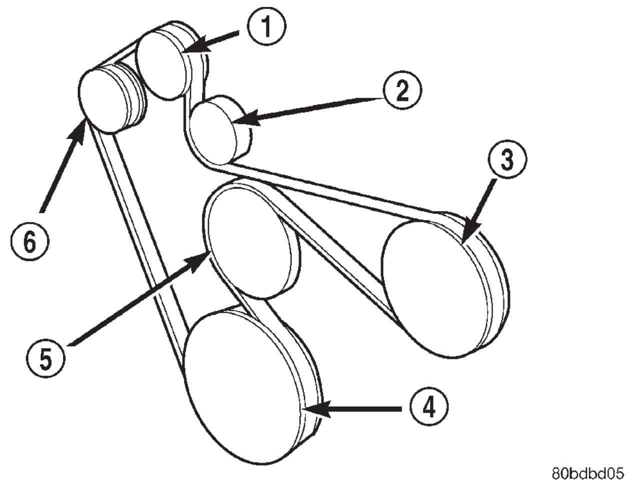


Fig. 16 Belt Routing—5.2L/5.9L Engines Without A/C

1 - GENERATOR PULLEY
2 - IDLER PULLEY
3 - POWER STEERING PULLEY
4 - CRANKSHAFT PULLEY
5 - WATER PUMP PULLEY
6 - TENSIONER PULLEY

DRIVE BELTS - 4.7L

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. 17), 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. 17). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to ACCESSORY DRIVE BELT DIAGNOSIS CHART for further belt diagnosis.

DRIVE BELTS - 4.7L (Continued)

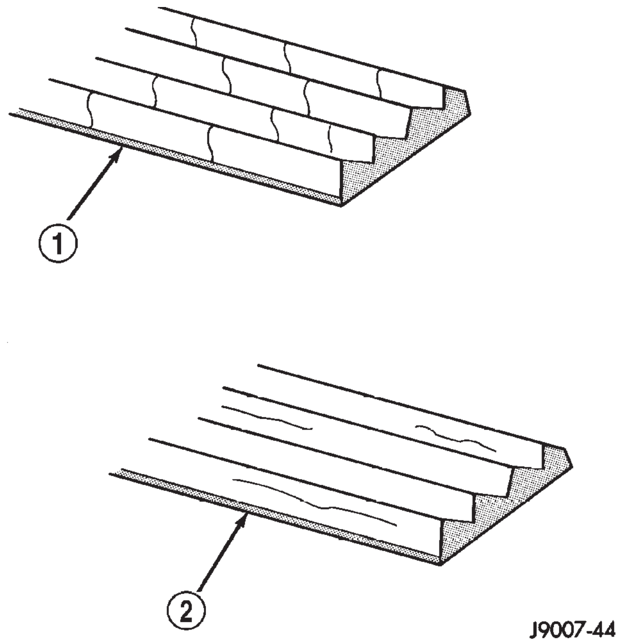


Fig. 17 Belt Wear Patterns

1 - NORMAL CRACKS BELT OK
2 - NOT NORMAL CRACKS REPLACE BELT

NOISE DIAGNOSIS

Noises generated by the accessory drive belt are most noticeable at idle. Before replacing a belt to resolve a noise condition, inspect all of the accessory drive pulleys for alignment, glazing, or excessive end play.

ACCESSORY DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (One or more ribs has separated from belt body)	1. Foreign objects imbedded in pulley grooves. 2. Installation damage	1. Remove foreign objects from pulley grooves. Replace belt. 2. Replace belt
RIB OR BELT WEAR	1. Pulley misaligned 2. Abrasive environment 3. Rusted pulley(s) 4. Sharp or jagged pulley groove tips 5. Belt rubber deteriorated	1. Align pulley(s) 2. Clean pulley(s). Replace belt if necessary 3. Clean rust from pulley(s) 4. Replace pulley. Inspect belt. 5. Replace belt
BELT SLIPS	1. Belt slipping because of insufficient tension 2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol) 3. Driven component bearing failure (seizure) 4. Belt glazed or hardened from heat and excessive slippage	1. Inspect/Replace tensioner if necessary 2. Replace belt and clean pulleys 3. Replace faulty component or bearing 4. Replace belt.

DRIVE BELTS - 4.7L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
LONGITUDAL BELT CRACKING	1. Belt has mistracked from pulley groove	1. Replace belt
	2. Pulley groove tip has worn away rubber to tensile member	2. Replace belt
″GROOVE JUMPING″ (Belt does not maintain correct position on pulley)	1. Incorrect belt tension	1. Inspect/Replace tensioner if 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
BELT BROKEN (Note: Identify and correct problem before new belt is installed)	1. Incorrect belt tension	1. Replace Inspect/Replace tensioner if necessary
	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. Incorrect belt tension	1. Inspect/Replace tensioner if 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
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. Incorrect belt tension	1. Inspect/Replace tensioner if 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

DRIVE BELTS - 4.7L (Continued)

REMOVAL

CAUTION: DO NOT LET TENSIONER ARM SNAP BACK TO THE FREEARM POSITION, SEVER 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 it's stop. Remove belt, then slowly rotate the tensioner into the freearm position. (Fig. 18).

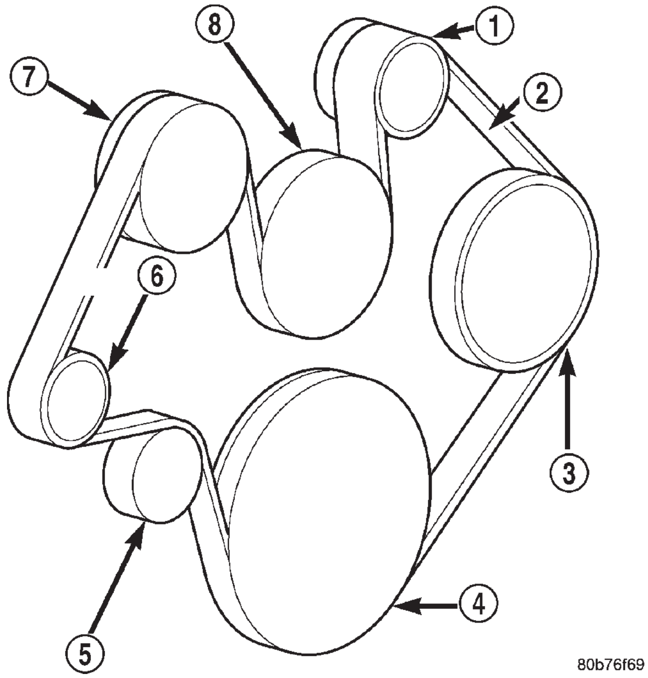


Fig. 18 Belt Routing—4.7L

1 - GENERATOR PULLEY
2 - ACCESSORY DRIVE BELT
3 - POWER STEERING PUMP PULLEY
4 - CRANKSHAFT PULLEY
5 - IDLER PULLEY
6 - TENSIONER
7 - A/C COMPRESSOR PULLEY
8 - WATER PUMP PULLEY

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. 18).

(2) Install new belt (Fig. 18). Route the belt around all pulleys except the idler pulley. Rotate the tensioner arm until it contacts it's 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. 19). On 4.7L Engines only, the gap between the tang and the housing stop (measurement A) must not exceed 24 mm (.94 inches). If the measurement exceedes this specification replace the serpentine accessory drive belt.

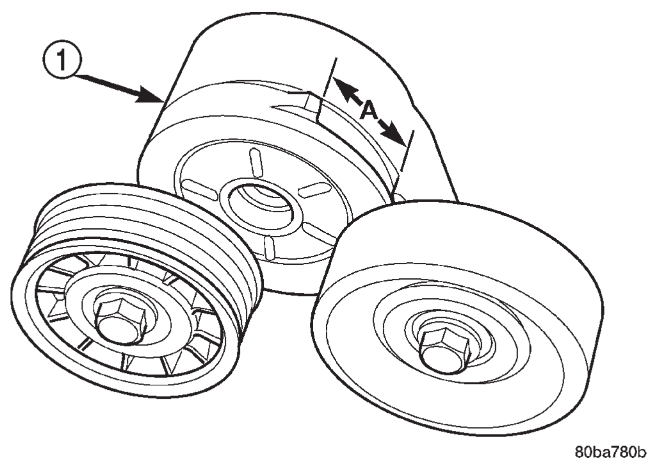


Fig. 19 Accessory Drive Belt Wear Indicator—4.7L Engine

1 - AUTOMATIC TENSIONER ASSEMBLY

ENGINE

TABLE OF CONTENTS

COOLANT RECOVERY CONTAINER

DESCRIPTION

The coolant recovery containeris integral to the upper fan shroud assembly and is made of high temperature plastic (Fig. 1).

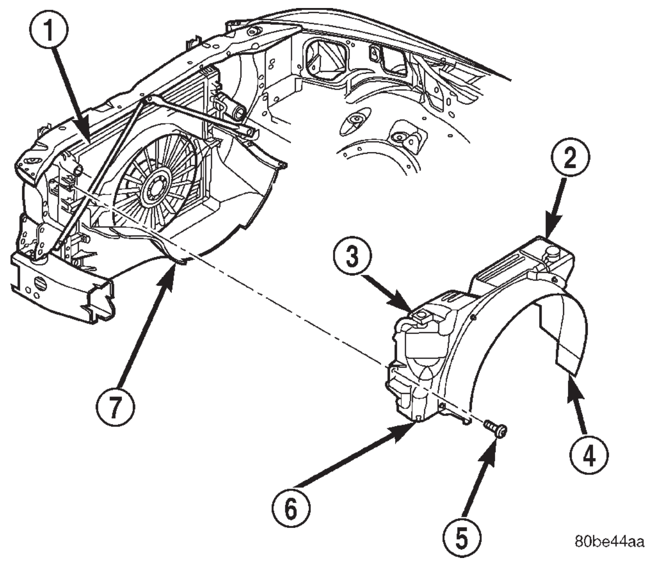


Fig. 1 Upper Fan Shroud with Integral Coolant Recovery Container

1 - RADIATOR
2 - WASHER FLUID RESERVOIR
3 - COOLANT OVERFLOW/RESERVOIR
4 - FAN SHROUD (UPPER)
5 - SCREW
6 - INTERLOCKING PINS
7 - FAN SHROUD (LOWER)

OPERATION

The coolant recovery container works in conjunction with the radiator pressure cap. It utilizes thermal expansion and contraction of coolant to keep coolant free of trapped air. It provides a volume for expansion and contraction of coolant. It also provides a convenient and safe method for checking coolant level and adjusting level at atmospheric pressure. This is done without removing the radiator pressure cap. The system also provides 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.

ENGINE BLOCK HEATER - 3.9L/5.9L

DESCRIPTION

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE. THE POWER CORD MUST BE SECURED IN ITS RETAINING CLIPS AND ROUTED AWAY FROM EXHAUST MANIFOLDS AND MOVING PARTS.

An optional engine block heater is available on all models. The heater is equipped with a power cord. 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. The cord is attached to an engine compartment component with tie-straps.

The 3.9L and 5.9L gas powered engine has the block heater located on the right side of engine next to the oil filter (Fig. 2).

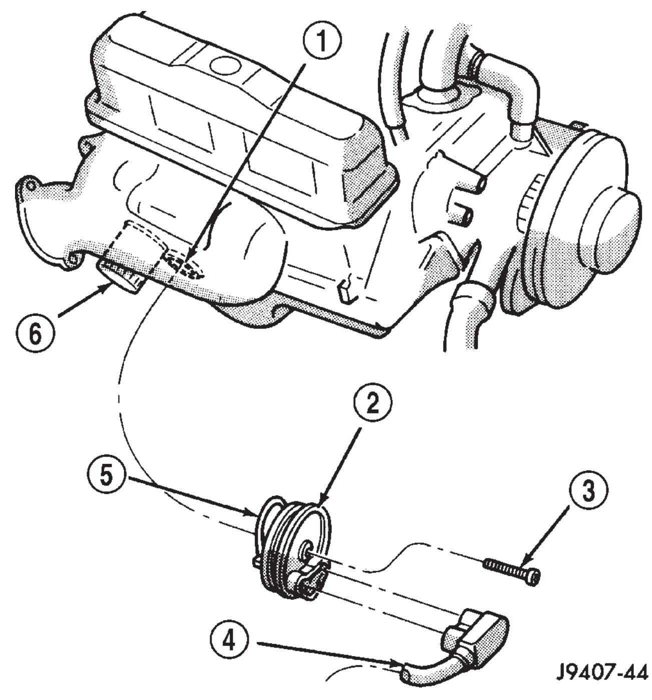


Fig. 2 Engine Block Heater

1 - FREEZE PLUG HOLE
2 - BLOCK HEATER
3 - SCREW
4 - POWER CORD (120V AC)
5 - HEATING COIL
6 - OIL FILTER

ENGINE BLOCK HEATER - 3.9L/5.9L (Continued)

OPERATION

The heater warms the engine coolant providing easier engine starting and faster warm-up in low temperatures. Connecting the power cord to a grounded 110-120 volt AC electrical outlet with a grounded three wire extension cord provides the electricity needed to heat the element..

REMOVAL

(1) Disconnect battery negative cable.

(2) Drain coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove power cord from heater by unplugging (Fig. 3).

(4) Loosen (but do not completely remove) the screw at center of block heater (Fig. 3).

(5) Remove block heater by carefully prying from side-to-side. Note direction of heating element coil (up or down). Element coil must be installed correctly to prevent damage.

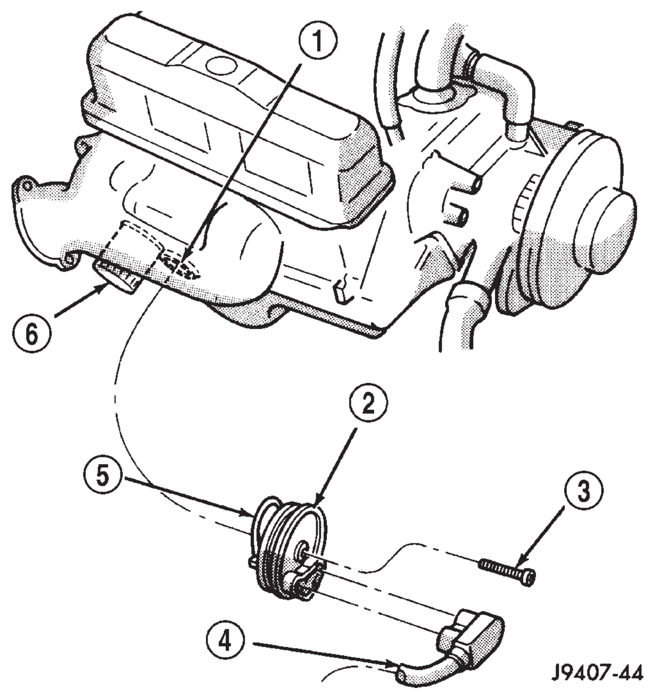


Fig. 3 Engine Block Heater

1 - FREEZE PLUG HOLE
2 - BLOCK HEATER
3 - SCREW
4 - POWER CORD (120V AC)
5 - HEATING COIL
6 - OIL FILTER

INSTALLATION

(1) Clean and inspect the block heater hole.

(2) Install new O-ring seal(s) to heater in gasoline engines.

(3) Insert block heater into cylinder block.

(4) With heater fully seated, tighten center screw to 2 N·m (17 in. lbs.).

(5) Fill cooling system with recommended coolant. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(6) Start and warm the engine.

(7) Check block heater for leaks.

ENGINE BLOCK HEATER - 4.7L

DESCRIPTION

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE. THE POWER CORD MUST BE SECURED IN ITS RETAINING CLIPS AND ROUTED AWAY FROM EXHAUST MANIFOLDS AND MOVING PARTS.

An optional engine block heater (Fig. 4) is available with 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.

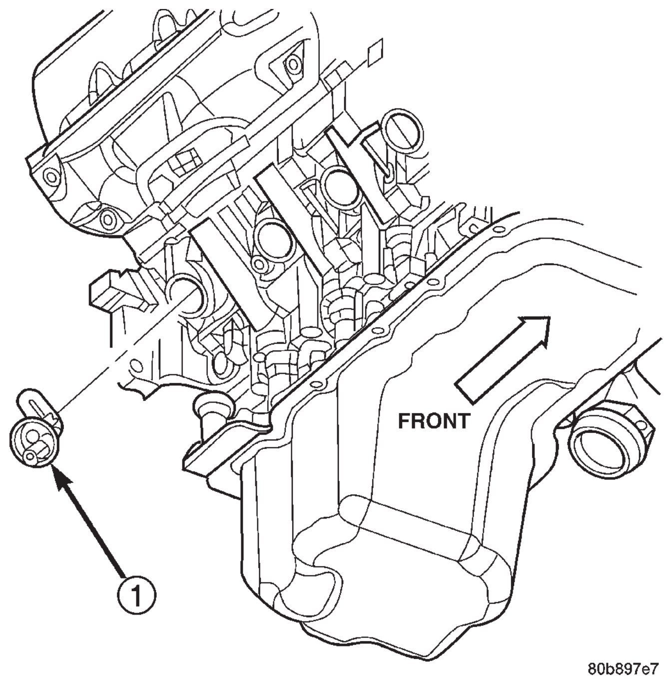


Fig. 4 Engine Block Heater—4.7L

1 - ENGINE BLOCK HEATER

ENGINE BLOCK HEATER - 4.7L (Continued)

OPERATION

Connecting the power cord to a grounded 110-120 volt AC electrical outlet with a grounded, three wire extension cord activates the heating element warming the engine coolant.

DIAGNOSIS AND TESTING—ENGINE BLOCK HEATER

If the unit does not operate (Fig. 5), possible causes can be either the power cord or the heater element. Test the power cord for continuity with a 110-volt voltmeter or 110-volt test light. Test heater element continuity with an ohmmeter or a 12-volt test light.

CAUTION: To prevent damage, the power cord must be secured in it's retainer clips and away from any components that may cause abrasion or damage, such as linkages, exhaust components, etc.

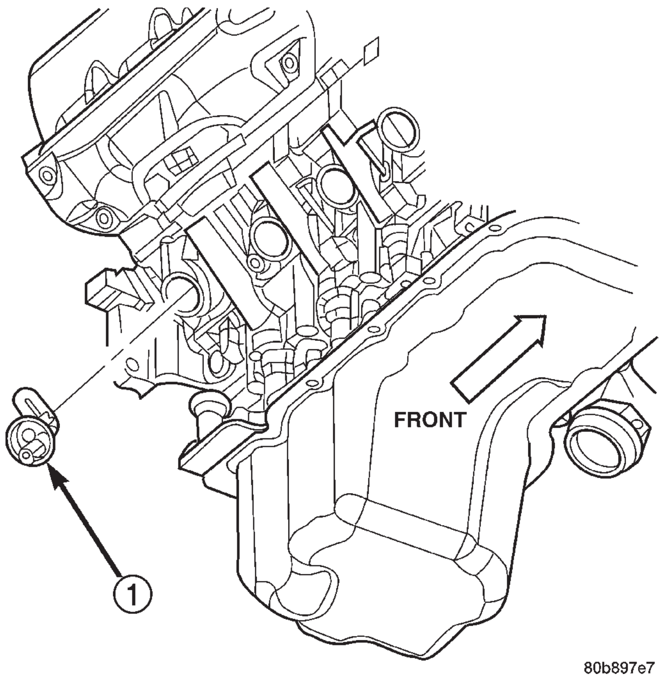


Fig. 5 Engine Block Heater 4.7L Engine

1 - ENGINE BLOCK HEATER

REMOVAL

(1) Disconnect negative battery cable from battery.

(2) Drain coolant from radiator (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Raise vehicle.

(4) Remove engine cylinder block drain plug(s) located on the sides of cylinder block above the oil pan rail (Fig. 6).

(5) Remove power cord from block heater.

(6) Loosen screw at center of block heater. Remove heater assembly (Fig. 7).

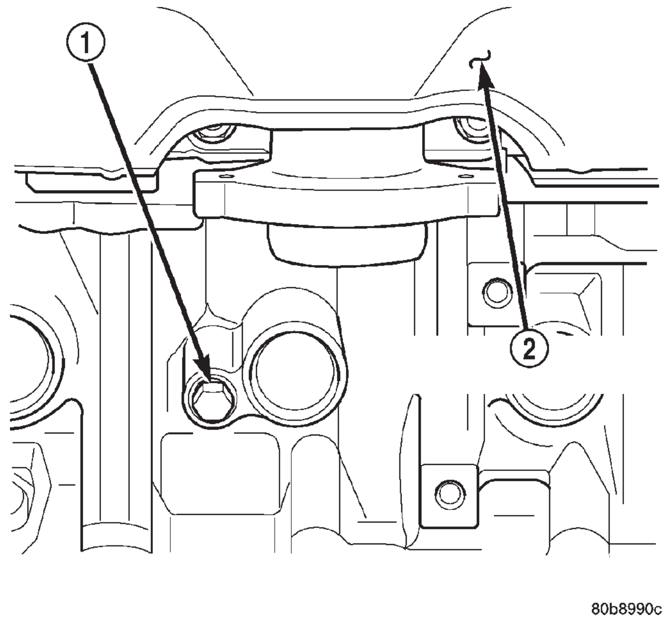


Fig. 6 Drain Plug - 4.7L Engine

1 - CYLINDER BLOCK DRAIN PLUG

2 - EXHAUST MANIFOLD AND HEAT SHIELD

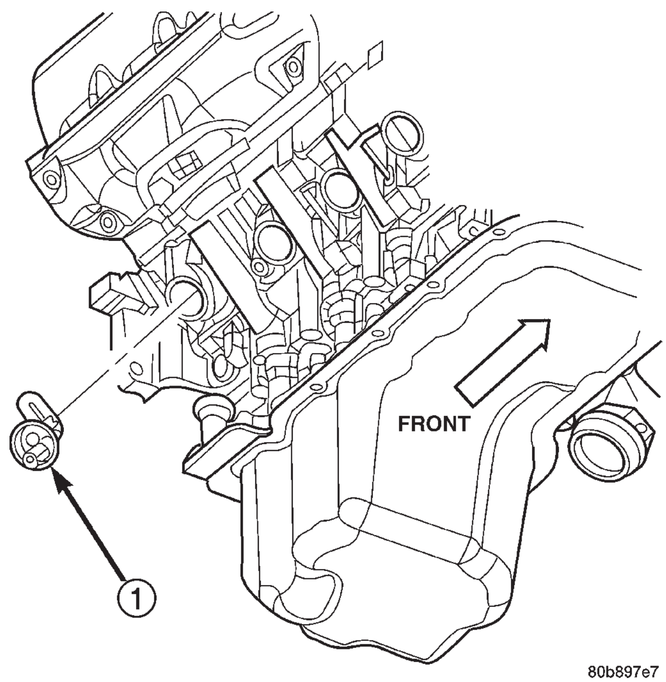


Fig. 7 Engine Block Heater - 4.7L

1 - ENGINE BLOCK HEATER

INSTALLATION

(1) Thoroughly clean cylinder block core hole and block heater seat.

ENGINE BLOCK HEATER - 4.7L (Continued)

(2) Insert block heater assembly with element loop pointing at twelve o'clock (Fig. 7).

(3) With block heater fully seated, tighten center screw to 2 N·m (17 in. lbs.) torque.

(4) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(5) Start and warm the engine. Check for leaks.

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 - 3.9L/5.2L/5.9L

The engine coolant temperature sensor is installed into a water jacket at front of intake manifold near rear of generator (Fig. 8).

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR.

(1) Partially drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(2) Disconnect electrical connector from sensor (Fig. 8).

(3) **Engines with air conditioning:** When removing the connector from sensor, do not pull directly on wiring harness. Fabricate an L-shaped hook tool from a coat hanger (approximately eight inches long). Place the hook part of tool under the connector for removal. The connector is snapped onto the sensor. It is not equipped with a lock type tab.

(4) Remove sensor from intake manifold.

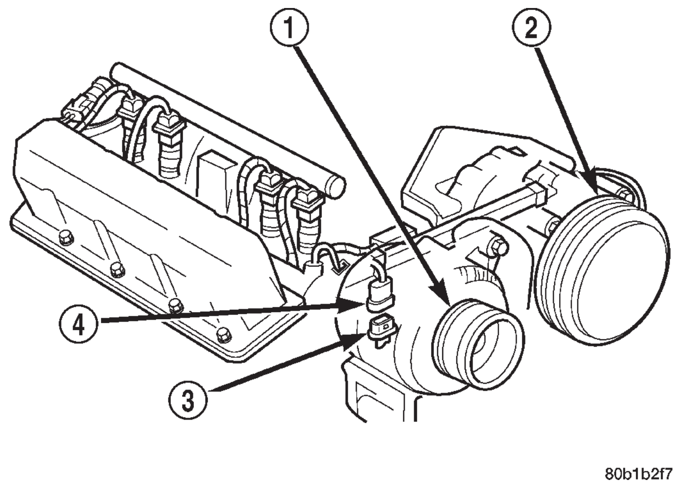


Fig. 8 Engine Coolant Temperature Sensor—5.2L/5.9L Engines—Typical

1 - GENERATOR
2 - A/C COMPRESSOR
3 - ENGINE COOLANT TEMPERATURE SENSOR
4 - ELEC. CONN.

REMOVAL - 4.7L

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE ENGINE COOLANT TEMPERATURE (ECT) SENSOR.

The ECT sensor is located near the front of the intake manifold (Fig. 9).

(1) Partially drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(2) Disconnect electrical connector from ECT sensor.

(3) Remove sensor from intake manifold.

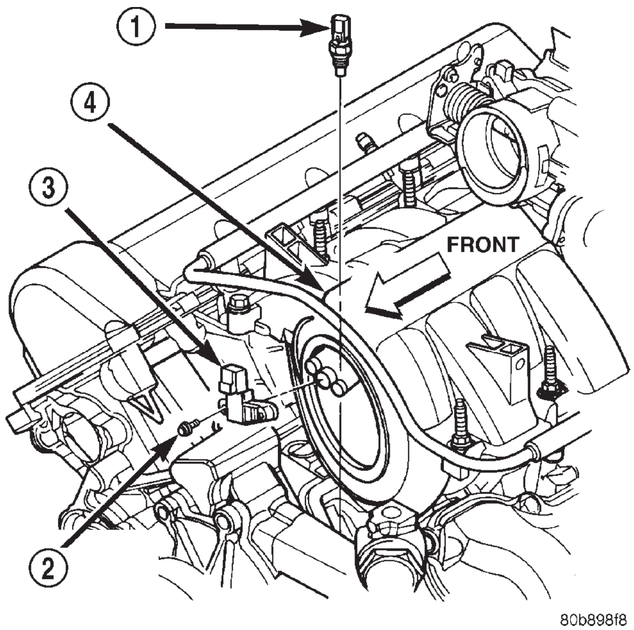


Fig. 9 Engine Coolant Temperature Sensor—4.7L V–8 Engine

1 - ECT SENSOR
2 - MOUNTING BOLTS (2)
3 - MAP SENSOR
4 - INTAKE MANIFOLD

REMOVAL - 2.5L

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR.

(1) Partially drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(2) Disconnect electrical connector from sensor (Fig. 10).

(3) Remove sensor from thermostat housing.

INSTALLATION - 3.9L/5.2L/5.9L

The engine coolant temperature sensor is installed into a water jacket at front of intake manifold near rear of generator (Fig. 8).

(1) Install sensor.

(2) Tighten to 11 N·m (8 ft. lbs.) torque.

(3) Use long needlenose pliers to connect electrical connector to sensor. The sensor connector is symmetrical (not indexed). It can be installed to the sensor in either direction.

(4) Replace any lost engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

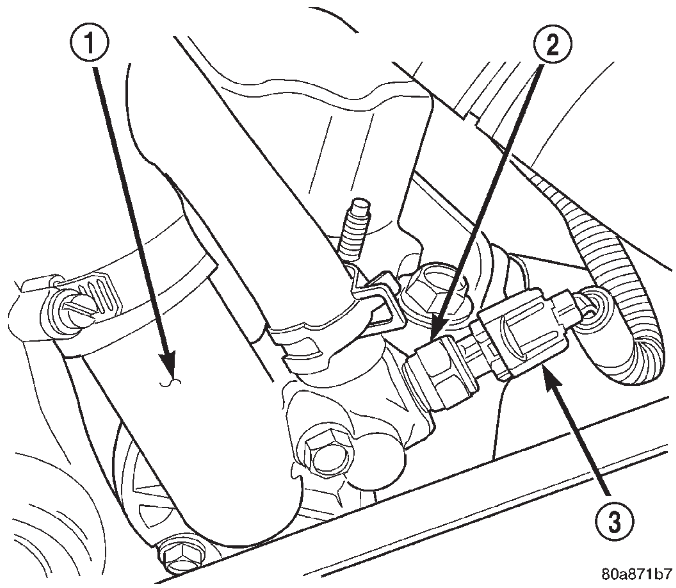


Fig. 10 Engine Coolant Temperature Sensor—2.5L Engines

1 - THERMOSTAT HOUSING
2 - ENGINE COOLANT TEMPERATURE SENSOR
3 - ELECTRICAL CONNECTOR

INSTALLATION - 4.7L

(1) Install sensor.

(2) Tighten to 11 N·m (8 ft. lbs.) torque.

(3) Connect electrical connector to sensor.

(4) Replace any lost engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

INSTALLATION - 2.5L

(1) Install sensor.

(2) Tighten to 11 N·m (8 ft. lbs.) torque.

(3) Replace any lost engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

ENGINE COOLANT THERMOSTAT - 2.5L

DESCRIPTION

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

The thermostat (Fig. 11) 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.

ENGINE COOLANT THERMOSTAT - 2.5L (Continued)

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.

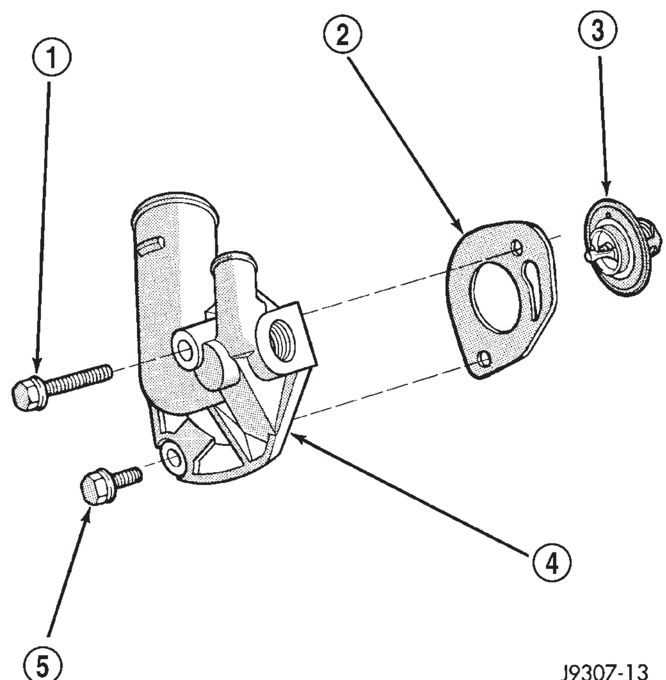


Fig. 11 Thermostat—Typical

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.

DIAGNOSIS AND TESTING—THERMOSTAT

ON-BOARD DIAGNOSTICS

All **gasoline powered models** are equipped with On-Board Diagnostics for certain cooling system components. Refer to On-Board Diagnostics (OBD) in the Diagnosis section of this group for additional information. If the powertrain control module (PCM) detects low engine coolant temperature, it will record a Diagnostic Trouble Code (DTC) in the PCM memory. Do not change a thermostat for lack of heat as indicated by the instrument panel gauge or by poor heater performance unless a DTC is present. Refer to the Diagnosis section of this group for other probable causes. For other DTC numbers, (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION).

The DTC can also be accessed through the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures information for diagnostic information and operation of the DRB scan tool.

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) Disconnect battery negative cable.

(2) Drain the coolant from the radiator until the level is below the thermostat housing (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove radiator upper hose and heater hose at thermostat housing.

(4) Disconnect wiring connector at engine coolant temperature sensor.

(5) Remove thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 12). Discard old gasket.

(6) Clean the gasket mating surfaces.

INSTALLATION

(1) Install the replacement thermostat so that the pellet, which is encircled by a coil spring, faces the engine. All thermostats are marked on the outer flange to indicate the proper installed position.

(a) Observe the recess groove in the engine cylinder head (Fig. 13).

(b) Position thermostat into this groove with arrow and air bleed hole on outer flange pointing up.

(2) Install replacement gasket and thermostat housing.

CAUTION: Tightening the thermostat housing unevenly or with the thermostat out of its recess may result in a cracked housing.

(3) Tighten the housing bolts to 20 N·m (15 ft. lbs.) torque.

(4) Install hoses to thermostat housing.

(5) Install electrical connector to coolant temperature sensor.

(6) Connect battery negative cable.

ENGINE COOLANT THERMOSTAT - 2.5L (Continued)

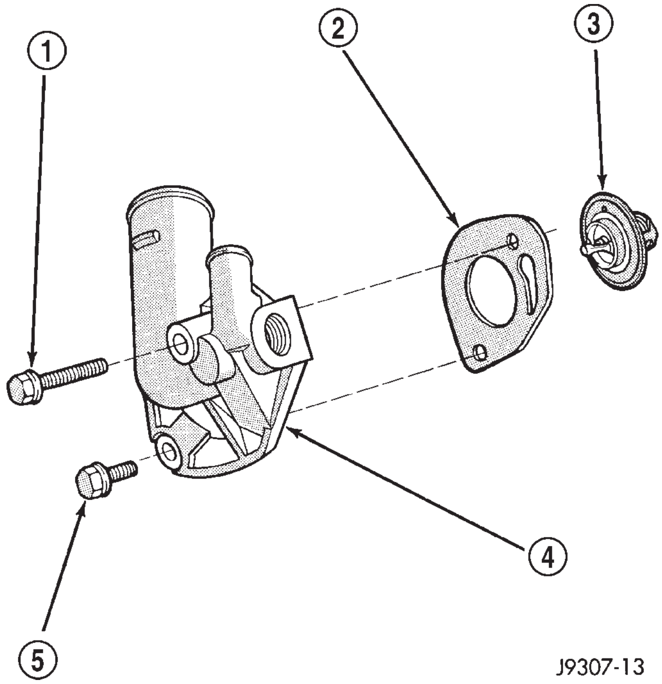


Fig. 12 2.5LThermostat Removal/Installation

1 - LONG BOLT
2 - GASKET
3 - THERMOSTAT
4 - THERMOSTAT HOUSING
5 - SHORT BOLT

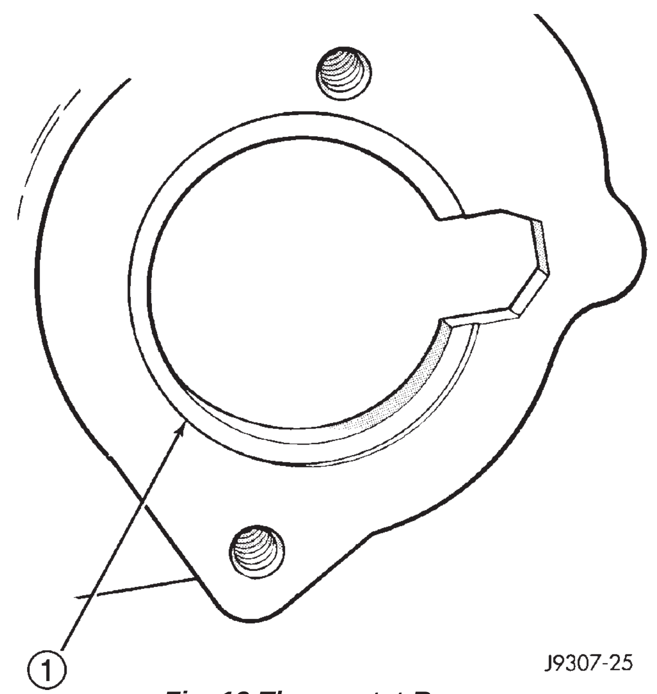


Fig. 13 Thermostat Recess

1 - GROOVE

(7) Be sure that the radiator draincock is tightly closed. Fill the cooling system to the correct level with the required coolant mixture (Refer to 7 - COOLING - STANDARD PROCEDURE).

(8) Start and warm the engine. Check for leaks.

ENGINE COOLANT THERMOSTAT - 3.9L/5.9L

DESCRIPTION

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

The thermostat on the 3.9L and 5.9L gas powered engines is located beneath the thermostat housing at the front of the intake manifold (Fig. 14).

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.

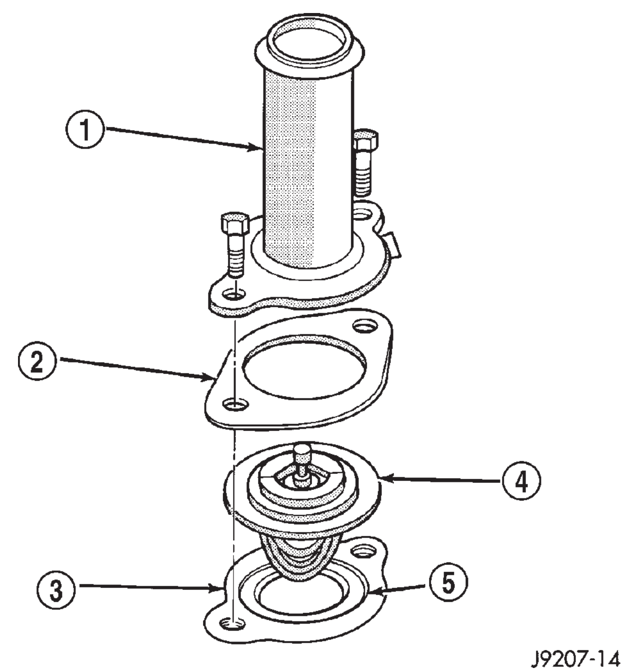


Fig. 14 Thermostat—5.2L and 5.9L Gas Powered Engines

1 - THERMOSTAT HOUSING
2 - GASKET
3 - INTAKE MANIFOLD
4 - THERMOSTAT
5 - MACHINED GROOVE

ENGINE COOLANT THERMOSTAT - 3.9L/5.9L (Continued)

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.

DIAGNOSIS AND TESTING—THERMOSTAT

ON-BOARD DIAGNOSTICS

All **gasoline powered models** are equipped with On-Board Diagnostics for certain cooling system components. Refer to On-Board Diagnostics (OBD) in the Diagnosis section of this group for additional information. If the powertrain control module (PCM) detects low engine coolant temperature, it will record a Diagnostic Trouble Code (DTC) in the PCM memory. Do not change a thermostat for lack of heat as indicated by the instrument panel gauge or by poor heater performance unless a DTC is present. Refer to the Diagnosis section of this group for other probable causes. For other DTC numbers, (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION).

The DTC can also be accessed through the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures information for diagnostic information and operation of the DRB scan tool.

REMOVAL

WARNING: DO NOT LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM COOLANT CAN OCCUR.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

If thermostat is being replaced, be sure that replacement is specified thermostat for vehicle model and engine type.

Factory installed thermostat housings on 3.9L and 5.9L engines are installed on a gasket with an anti-stick coating. This will aid in gasket removal and clean-up.

(1) Disconnect negative battery cable at battery.

(2) Drain cooling system until coolant level is below thermostat (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Air Conditioned vehicles: Remove support bracket (generator mounting bracket-to-intake manifold) located near rear of generator (Fig. 15).

NOTE: On air conditioning equipped vehicles, the generator must be partially removed.

(4) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL) (Fig. 16).

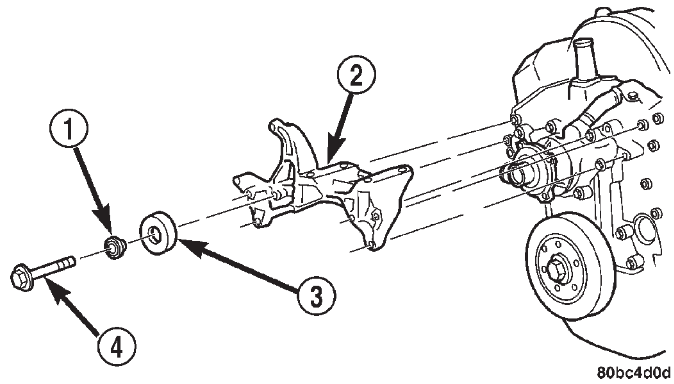


Fig. 15 Generator Support Bracket—3.9L and 5.9L Engine

1 - IDLER PULLEY BUSHING
2 - A/C AND/OR GENERATOR MOUNTING BRACKET
3 - IDLER PULLEY
4 - SCREW AND WASHER

(5) Remove two generator mounting bolts. Do not remove any wiring at generator. If equipped with 4WD, unplug 4WD indicator lamp wiring harness (located near rear of generator).

(6) Remove generator. Position generator to gain access for thermostat gasket removal.

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). 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. 17). If replacement is necessary, use only an original equipment clamp with matching number or letter.

(7) Remove radiator upper hose clamp and upper hose at thermostat housing.

(8) Position wiring harness (behind thermostat housing) to gain access to thermostat housing.

(9) Remove thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 18). Discard old gasket.

INSTALLATION

(1) Clean mating areas of intake manifold and thermostat housing.

ENGINE COOLANT THERMOSTAT - 3.9L/5.9L (Continued)

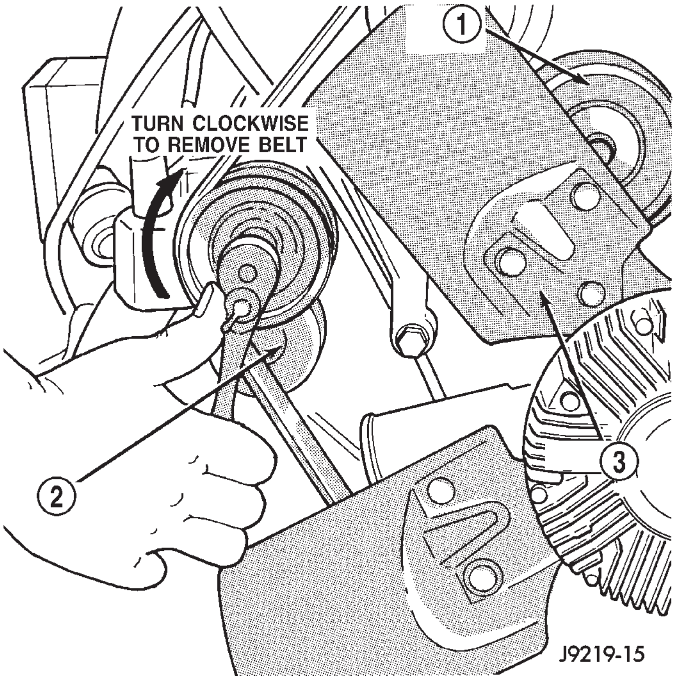


Fig. 16 Automatic Belt Tensioner—3.9L and 5.9L Engines

1 - IDLER PULLEY
2 - TENSIONER
3 - FAN BLADE

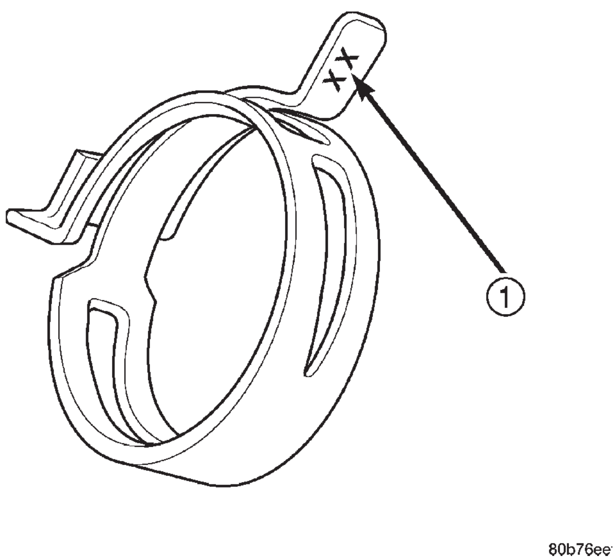


Fig. 17 SPRING CLAMP SIZE LOCATION

1 - SPRING CLAMP SIZE LOCATION

(2) Install thermostat (spring side down) into recessed machined groove on intake manifold (Fig. 18).

(3) Install gasket on intake manifold and over thermostat (Fig. 18).

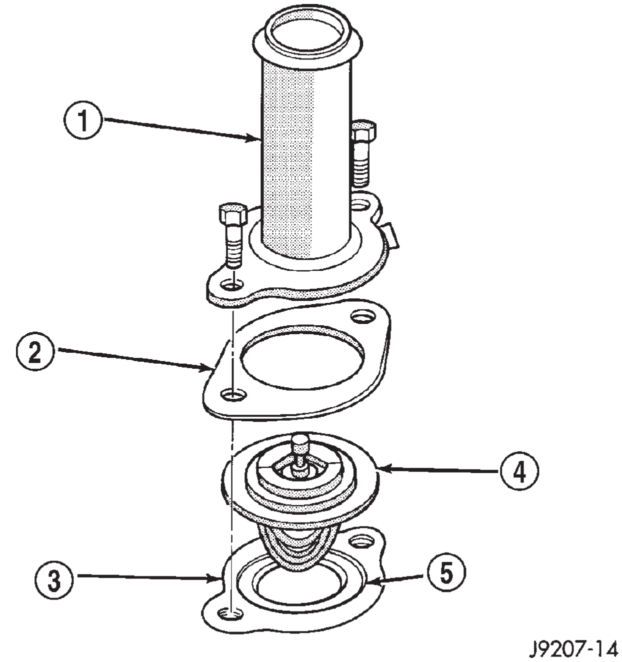


Fig. 18 Thermostat—3.9L and 5.9L Engines

1 - THERMOSTAT HOUSING
2 - GASKET
3 - INTAKE MANIFOLD
4 - THERMOSTAT
5 - MACHINED GROOVE

(4) Position thermostat housing to intake manifold. Note the word FRONT stamped on housing (Fig. 19). For adequate clearance, this **must** be placed towards front of vehicle. The housing is slightly angled forward after installation to intake manifold.

(5) Install two housing-to-intake manifold bolts. Tighten bolts to 23 N·m (200 in. lbs.) torque.

(6) Install radiator upper hose to thermostat housing.

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 20) for correct 3.9L and 5.9L engine belt routing. The correct belt with correct length must be used.

(7) Air Conditioned vehicles; Install generator. Tighten bolts to 41 N·m (30 ft. lbs.).

(8) Install support bracket (generator mounting bracket-to-intake manifold) (Fig. 15). Tighten bolts to 54 N·m (40 ft. lbs.) torque.

(9) Install accessory drive belt (Fig. 16)(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(10) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(11) Connect battery negative cable.

ENGINE COOLANT THERMOSTAT - 3.9L/5.9L (Continued)

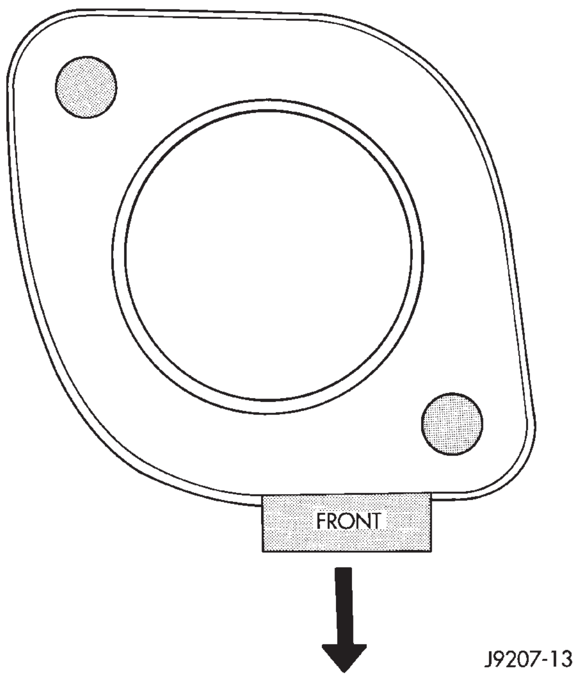


Fig. 19 Thermostat Position—5.2L and 5.9L Engines

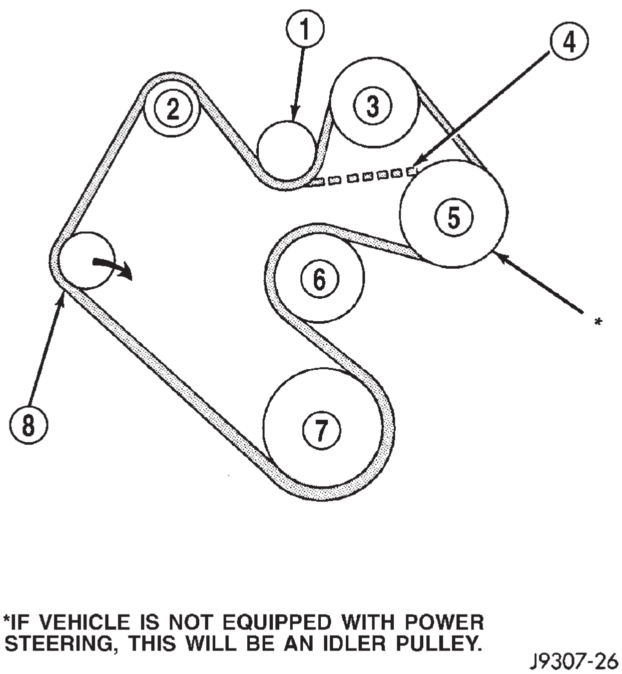


Fig. 20 Belt Routing—5.2L and 5.9L Engines

1 - IDLER PULLEY
2 - GENERATOR PULLEY
3 - A/C COMPRESSOR PULLEY
4 - IF W/OUT A/C
5 - POWER STEERING PUMP PULLEY
6 - WATER PUMP PULLEY
7 - CRANKSHAFT PULLEY
8 - AUTOMATIC TENSIONER

(12) Start and warm the engine. Check for leaks.

ENGINE COOLANT THERMOSTAT - 4.7L

DESCRIPTION

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

A pellet-type thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. On all engines the thermostat is closed below 195°F (90°C). Above this temperature, coolant is allowed to flow to the radiator. This provides quick engine warm up and overall temperature control. On the 4.7L engine the thermostat is designed to block the flow of the coolant bypass journal by 50% instead of completely blocking the flow. This design controls coolant temperature more accurately (Fig. 21) .

The same thermostat is used for winter and summer seasons. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes other problems. These are: longer engine warmup time, unreliable warmup performance, increased exhaust emissions and crankcase condensation. This condensation can result in sludge formation.

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.

DIAGNOSIS AND TESTING—THERMOSTAT

ON-BOARD DIAGNOSTICS

All **gasoline powered models** are equipped with On-Board Diagnostics for certain cooling system components. Refer to On-Board Diagnostics (OBD) in the Diagnosis section of this group for additional information. If the powertrain control module (PCM) detects low engine coolant temperature, it will record a Diagnostic Trouble Code (DTC) in the PCM memory. Do not change a thermostat for lack of heat as indicated by the instrument panel gauge or by poor heater performance unless a DTC is present. Refer to the Diagnosis section of this group for other probable causes. For other DTC numbers, (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION).

ENGINE COOLANT THERMOSTAT - 4.7L (Continued)

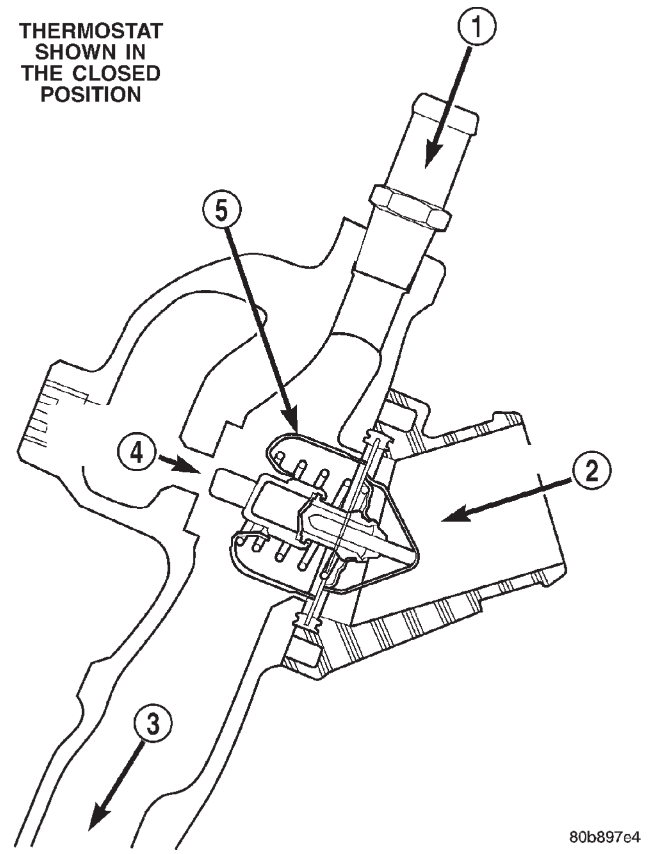


Fig. 21 Thermostat Cross Section View 4.7L

1 - FROM HEATER
2 - FROM RADIATOR
3 - TO WATER PUMP
4 - ENGINE BYPASS
5 - THERMOSTAT

The DTC can also be accessed through the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures information for diagnostic information and operation of the DRB scan tool.

REMOVAL

WARNING: DO NOT LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM COOLANT CAN OCCUR.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

If thermostat is being replaced, be sure that replacement is specified thermostat for vehicle model and engine type.

(1) Disconnect negative battery cable at battery.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Raise vehicle on hoist.

(4) Remove splash shield.

(5) Remove lower radiator hose clamp and lower radiator hose at thermostat housing.

(6) Remove thermostat housing mounting bolts, thermostat housing and thermostat (Fig. 22).

INSTALLATION

(1) Clean mating areas of timing chain cover and thermostat housing.

(2) Install thermostat (spring side down) into recessed machined groove on timing chain cover (Fig. 22).

(3) Position thermostat housing on timing chain cover.

(4) Install two housing-to-timing chain cover bolts. Tighten bolts to 13 N·m (112 in. lbs.) torque.

CAUTION: Housing must be tightened evenly and thermostat must be centered into recessed groove in timimg chain cover. If not, it may result in a cracked housing, damaged timing chain cover threads or coolant leaks.

(5) Install lower radiator hose on thermostat housing.

(6) Install splash shield.

(7) Lower vehicle.

(8) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(9) Connect negative battery cable to battery.

(10) Start and warm the engine. Check for leaks.

ENGINE COOLANT THERMOSTAT - 4.7L (Continued)

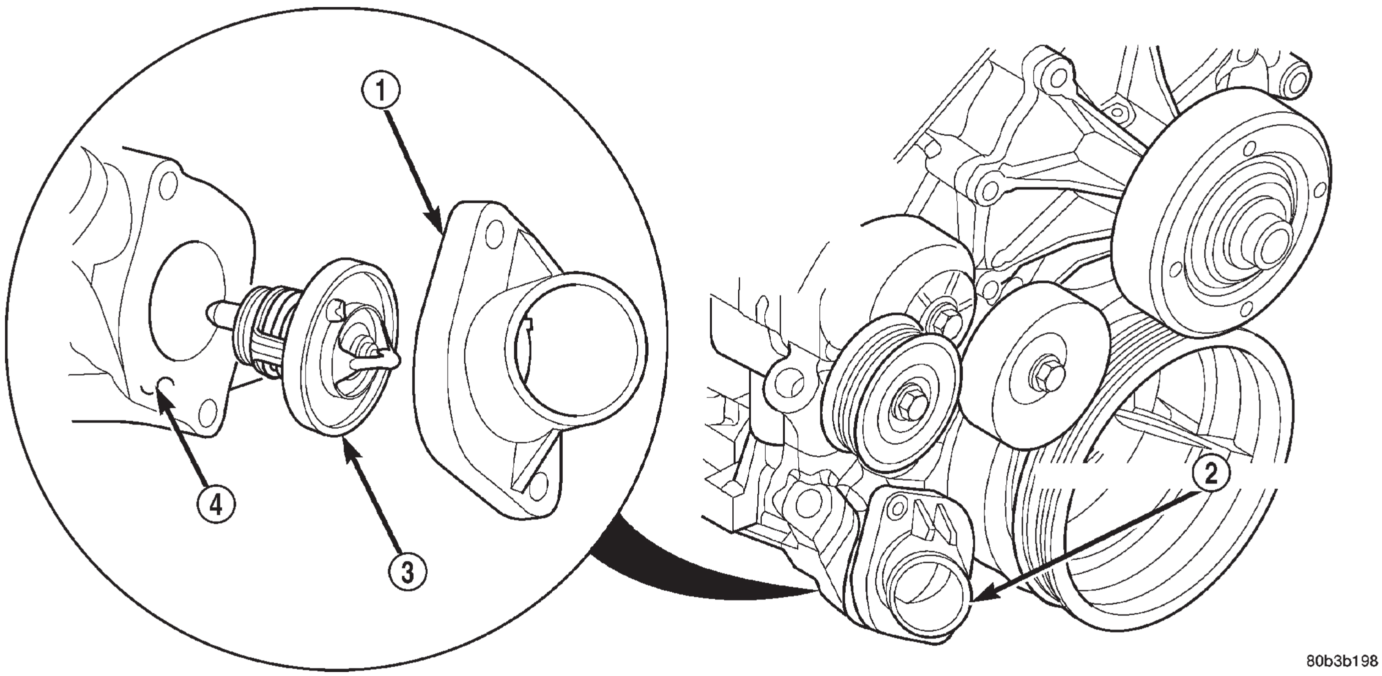


Fig. 22 Thermostat and Thermostat Housing 4.7L

1 - THERMOSTAT HOUSING
2 - THERMOSTAT LOCATION
3 - THERMOSTAT AND GASKET
4 - TIMING CHAIN COVER

FAN DRIVE VISCOUS CLUTCH - 3.9L/4.7L/5.9L

DESCRIPTION

CAUTION: Engines equipped with accessory drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

The thermal viscous fan drive (Fig. 23) and (Fig. 24) 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.

On all engines an electrical cooling fan located in the fan shroud aids in low speed cooling, It is designed to augment the viscous fan, However, it does not replace the viscous fan.

A thermostatic bimetallic spring coil is located on the front face of the viscous fan drive unit. This spring coil reacts to the temperature of the radiator discharge air. It engages the viscous fan drive for higher fan speed if the air temperature from the radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced rpm regardless of engine speed.

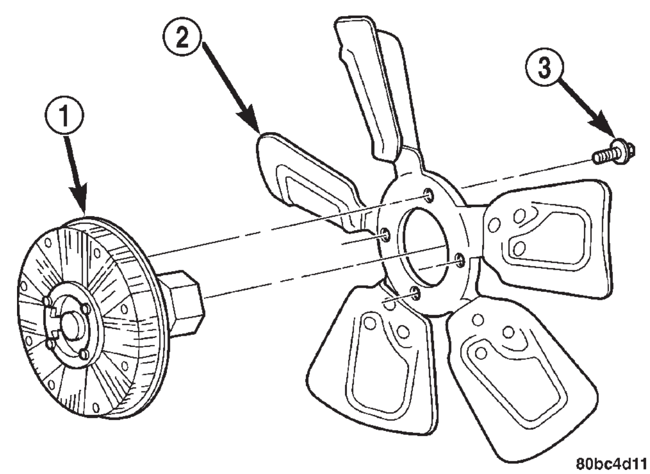


Fig. 23 Fan Blade/Viscous Fan Drive

1 - VISCOUS FAN DRIVE
2 - FAN BLADE
3 - SCREW AND WASHER

FAN DRIVE VISCOUS CLUTCH - 3.9L/4.7L/5.9L (Continued)

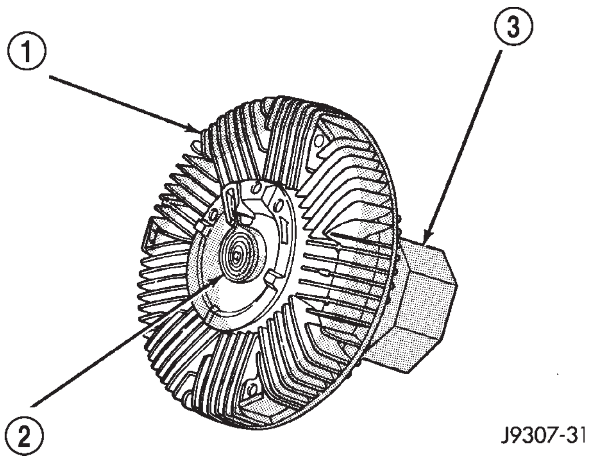


Fig. 24 Viscous Fan Drive—Typical

1 - VISCOUS FAN DRIVE
2 - THERMOSTATIC SPRING
3 - MOUNTING NUT TO WATER PUMP HUB

OPERATION

When sufficient heat is present, the viscous fan drive will 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.

DIAGNOSIS AND TESTING—VISCOUS FAN DRIVE

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 82° C (165° to 180° F). Engagement is distinguishable by a definite **increase** in fan flow noise (roaring). The timing light also will indicate an increase in the speed of the fan.

(7) When the air temperature reaches 88° C (190° F), remove the plastic sheet. Fan drive **disengagement** should have started to occur at between 57° to 79° C (135° to 175° F). A definite **decrease** of fan flow noise (roaring) should be noticed. If not, replace the defective viscous fan drive unit.

REMOVAL

(1) Disconnect battery negative cable.

(2) The thermal viscous fan drive/fan blade assembly is attached (threaded) to water pump hub shaft (Fig. 26). Remove fan blade/viscous fan drive assembly from water pump by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT HAND.** A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) and Special Tool 6958 Spanner Wrench with Adapter Pins 8346 can be used to hold the pulley still. (Fig. 25) to prevent pulley from rotating.

FAN DRIVE VISCOUS CLUTCH - 3.9L/4.7L/5.9L (Continued)

(3) Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

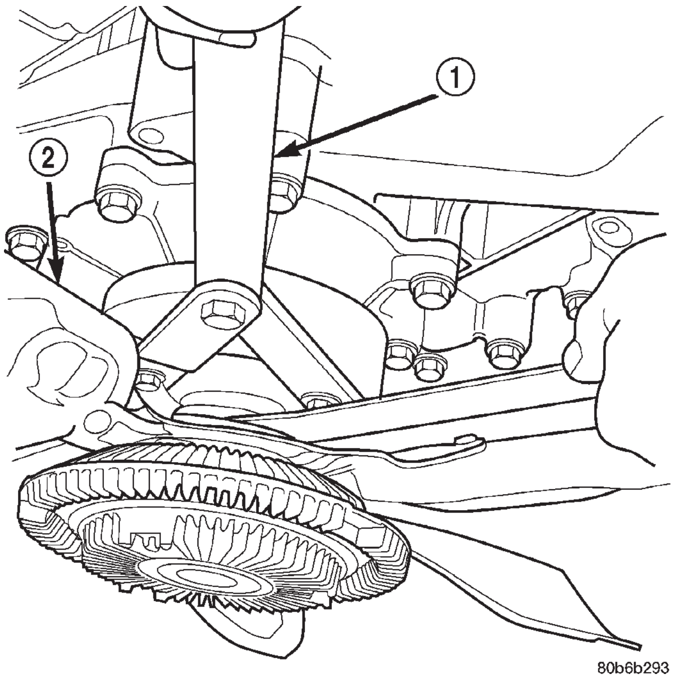


Fig. 25 Fan Blade and Viscous Fan Drive Removal

1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 - FAN

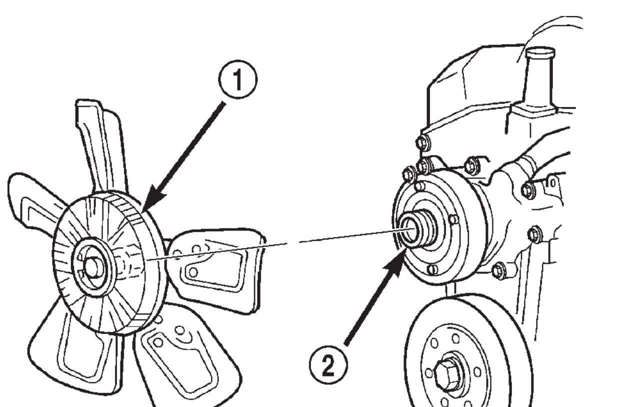


Fig. 26 Fan Blade/Viscous Fan Drive

1 - FAN AND VISCOUS DRIVE
2 - WATER PUMP THREADED SHAFT

(4) Do not unbolt fan blade assembly (Fig. 27)from viscous fan drive at this time.

(5) Remove upper fan shroud attaching hardware (Fig. 28).

(6) Remove upper fan shroud and fan blade/viscous fan drive from vehicle.

(7) After removing fan blade/viscous fan drive assembly, **do not** place viscous fan drive in horizontal position. If stored horizontally, silicone fluid in the viscous fan drive could drain into its bearing assembly and contaminate lubricant.

(8) Remove four bolts securing fan blade assembly to viscous fan drive (Fig. 27).

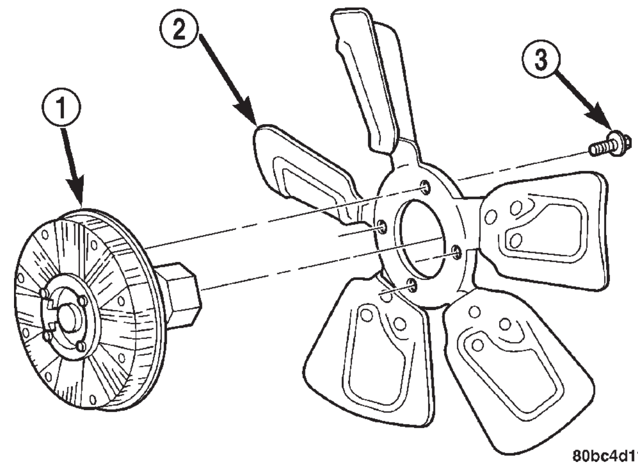


Fig. 27 Viscous Fan Drive and Fan Blade

1 - VISCOUS FAN DRIVE
2 - FAN BLADE
3 - SCREW AND WASHER

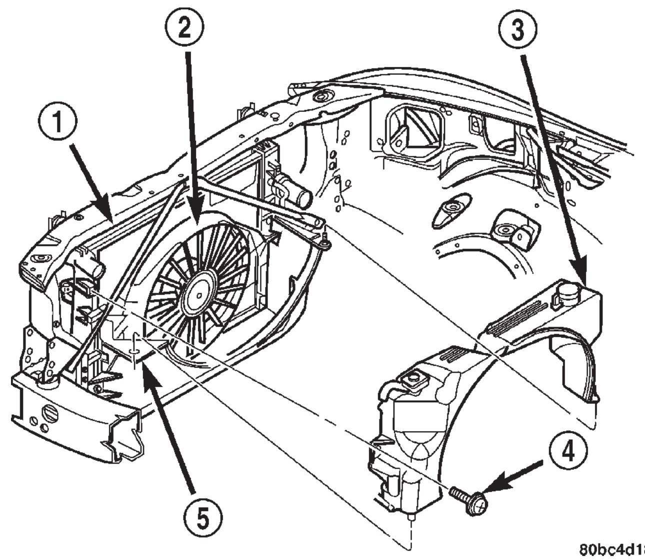


Fig. 28 Upper Fan Shroud Removal/Installation

1 - RADIATOR
2 - ELECTRIC COOLING FAN
3 - UPPER SHROUD AND OVERFLOW BOTTLE
4 - SCREW
5 - LOWER SHROUD

FAN DRIVE VISCOUS CLUTCH - 3.9L/4.7L/5.9L (Continued)

INSTALLATION

(1) Install fan blade assembly to viscous fan drive. Tighten bolts (Fig. 27) to 23 N·m (17 ft. lbs.) torque.

(2) Position fan blade/viscous fan drive assembly and upper shroud into vehicle.

(3) Install fan shroud retaining screws (Fig. 29).

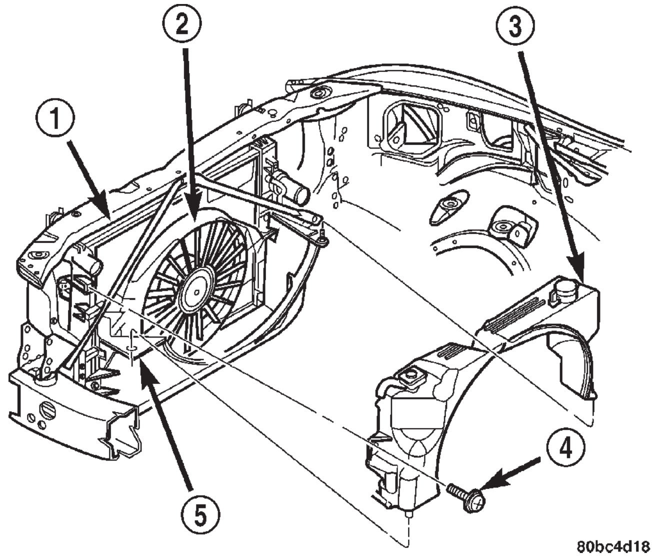


Fig. 29 Upper Fan Shroud Removal/Installation

1 - RADIATOR
2 - ELECTRIC COOLING FAN
3 - UPPER SHROUD AND OVERFLOW BOTTLE
4 - SCREW
5 - LOWER SHROUD

(4) Install fan blade/viscous fan drive assembly to water pump shaft (Fig. 26).

(5) Connect battery negative cable.

RADIATOR

DESCRIPTION

The radiator (Fig. 30) is a aluminum cross-flow design with horizontal tubes through the radiator core and vertical plastic side tanks.

OPERATION

The radiator supplies sufficient heat transfer using the cooling fins interlaced between the horizontal tubes in the radaitor core to cool the engine and automatic transmission oil (if equipped).

DIAGNOSIS AND TESTING—RADIATOR COOLANT FLOW CHECK

Use the following procedure to determine if coolant is flowing through cooling system.

(1) Idle engine until operating temperature is reached. If upper radiator hose is warm to the touch, thermostat is opening and coolant is flowing to radiator.

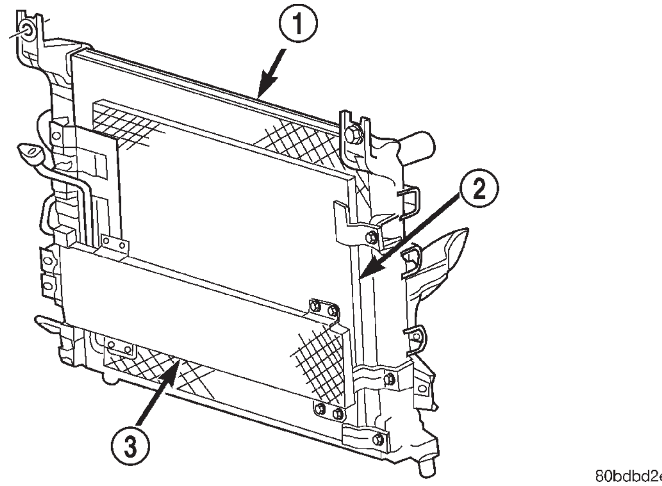


Fig. 30 Radiator—Typical

1 - RADIATOR
2 - A/C CONDENSER (IF EQUIPPED)
3 - TRANSMISSION AUXILIARY OIL COOLER

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. USING A RAG TO COVER RADIATOR PRESSURE CAP, OPEN RADIATOR CAP SLOWLY TO FIRST STOP. ALLOW ANY BUILT-UP PRESSURE TO VENT TO THE RESERVE/OVERFLOW TANK. AFTER PRESSURE BUILD-UP HAS BEEN RELEASED, REMOVE CAP FROM FILLER NECK.

(2) Drain a small amount of coolant from radiator until ends of radiator tubes are visible through filler neck. Idle engine at normal operating temperature. If coolant is flowing past exposed tubes, coolant is circulating.

REMOVAL

WARNING: DO NOT REMOVE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

(1) Disconnect battery negative cable.

RADIATOR (Continued)

(2) Drain cooling system. (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. 31). 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. 32). If replacement is necessary, use only an original equipment clamp with matching number or letter.

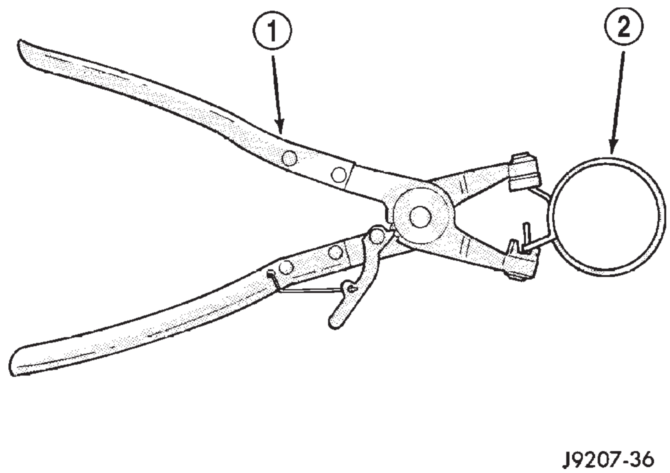


Fig. 31 Hose Clamp Tool—Typical

1 - HOSE CLAMP TOOL 6094
2 - HOSE CLAMP

(3) Remove hose clamps (Fig. 31) and hoses from radiator. Disconnect coolant reserve/overflow tank hose and washer bottle electrical connector and hose.

(4) Remove upper fan shroud mounting screws Lift upper fan shroud assembly up and out of engine compartment (Fig. 33).

(5) Disconnect transmission oil cooler lines, (if equipped) (Fig. 34).

(6) Disconnect electric cooling fan motor connector.

(7) Remove radiator upper mounting screws (Fig. 35). Lift radiator upward and away from vehicle. Do not allow cooling fins of radiator to contact any other vehicle component. Radiator fin damage could result.

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.

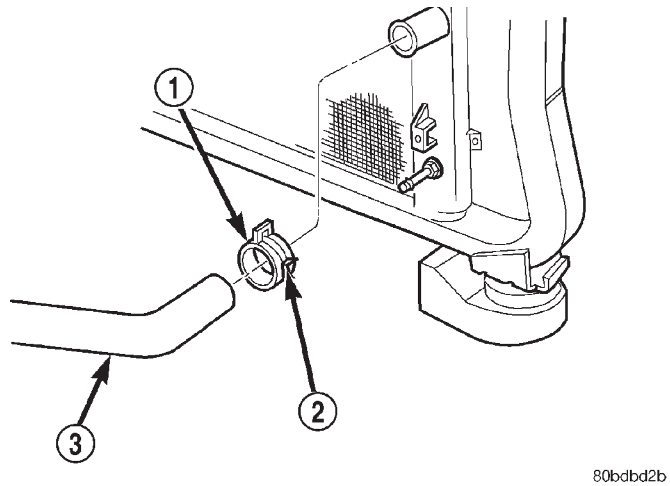


Fig. 32 Clamp Number/Letter Location

1 - CONSTANT TENSION HOSE CLAMP
2 - CLAMP NUMBER/LETTER LOCATION
3 - HOSE

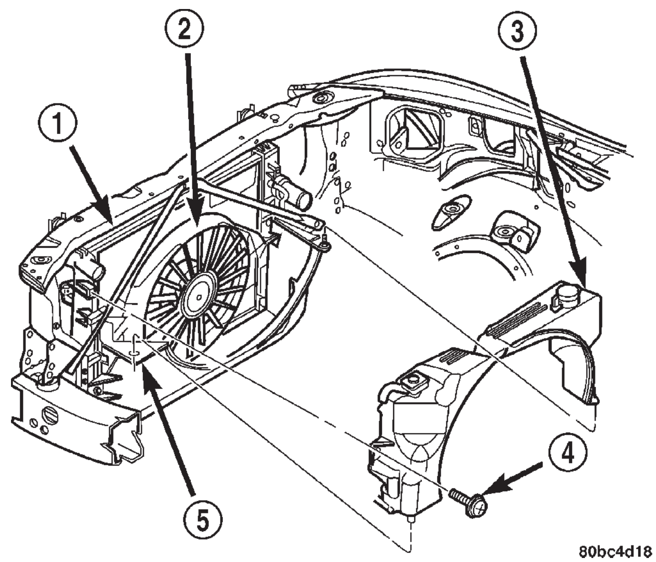


Fig. 33 Radiator Upper Fan Shroud Removal/ Installation—Typical

1 - RADIATOR
2 - ELECTRIC COOLING FAN
3 - UPPER SHROUD AND OVERFLOW BOTTLE
4 - SCREW
5 - LOWER SHROUD

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.

RADIATOR (Continued)

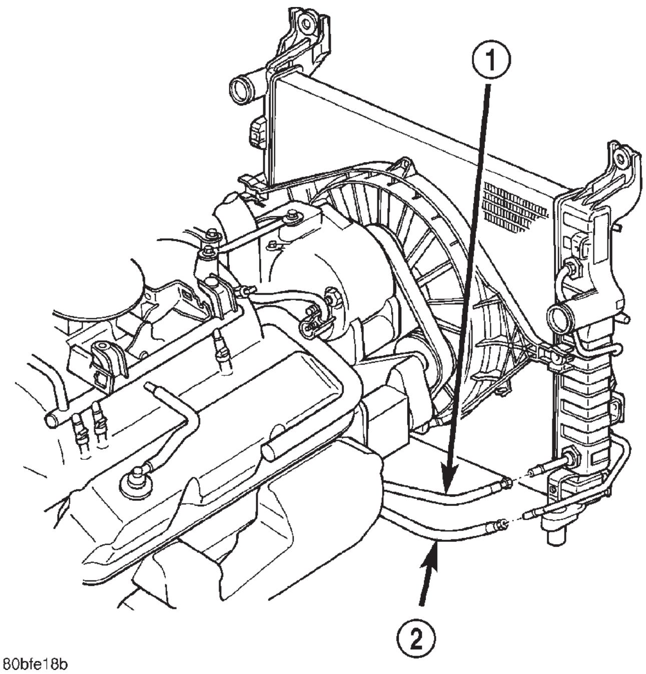


Fig. 34 Transmission Oil Cooler Lines—Automatic Transmission Only

1 - TRANSMISSION COOLER SUPPLY LINE
2 - TRANSMISSION OIL COOLER RETURN LINE

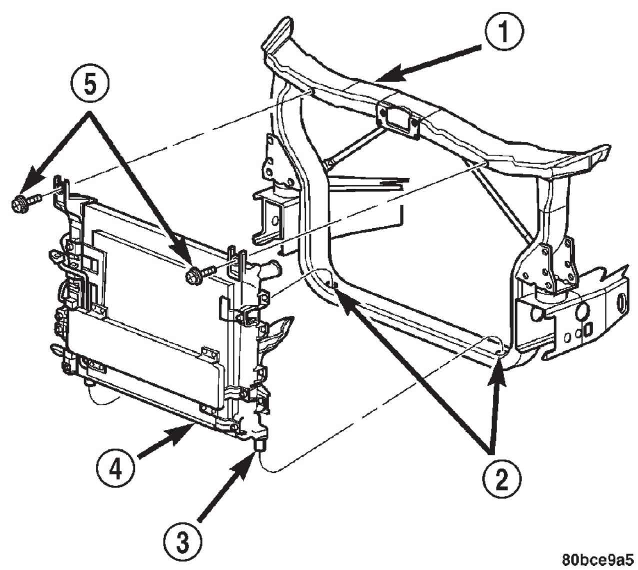


Fig. 35 Radiator Removal/Installation—Typical

1 - CORE SUPPORT
2 - LOWER ISOLATOR MOUNTS
3 - ISOLATOR PINS
4 - RADIATOR ASSEMBLY
5 - SCREWS

INSTALLATION

The radiator has two isolator pins on bottom of both tanks. These fit into alignment holes in radiator lower support (Fig. 35).

(1) Position isolator pins into alignment holes in radiator lower support.

(2) Install and tighten radiator mounting bolts to 23 N·m (200 in. lbs.) (Fig. 35).

(3) Install the transmission oil cooler lines, (if equipped).

(4) Connect fan motor electrical connector to harness connector.

(5) Position upper fan shroud onto lower fan shroud and radiator.

(6) Install retaining screws into shroud.

(7) Install radiator hoses. reconnect coolant reserve/overflow tank hose.

(8) Connect battery negative cable.

(9) Fill cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(10) Start and warm the engine. Check for leaks.

RADIATOR PRESSURE CAP

DESCRIPTION

All cooling systems are equipped with a pressure cap (Fig. 36) in the radiator upper hose. This cap releases pressure at some point within a range of 131-to-158 kPa (19-to-23 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 131-to-158 kPa (19-to-23 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.

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.

RADIATOR PRESSURE CAP (Continued)

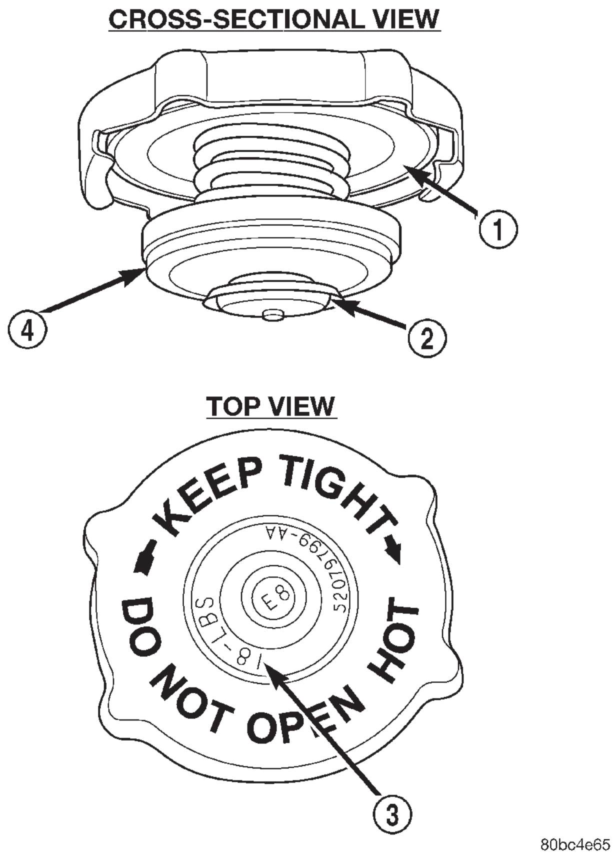


Fig. 36 Radiator Pressure Cap—Typical

1 - FILLER NECK SEAL
2 - VACUUM VENT VALVE
3 - PRESSURE RATING
4 - PRESSURE VALVE

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 131 kPa (21 psi) and hold pressure at a minimum of 130 kPa (18.8 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 COUNTER-CLOCKWISE 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 - PRESSURE TESTING

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. 37).

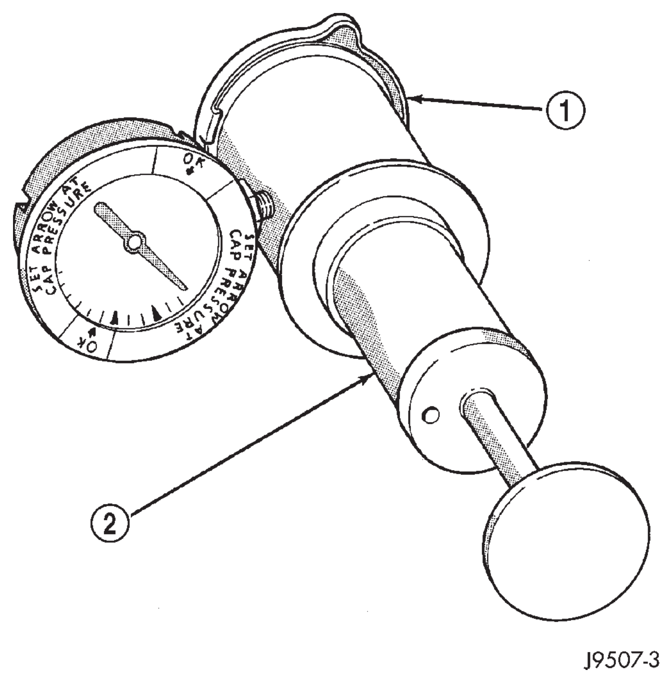


Fig. 37 Pressure Testing Radiator Cap—Typical

1 - PRESSURE CAP
2 - TYPICAL COOLING SYSTEM PRESSURE TESTER

RADIATOR PRESSURE CAP (Continued)

Operate tester pump to bring pressure to 138 kPa (20 psi) on gauge. If pressure cap fails to hold pressure of at least 131 kPa (19 psi) replace cap. Refer to 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 MOTOR

DIAGNOSIS AND TESTING—ELECTRIC COOLING FAN

The powertrain control module (PCM) will set a diagnostic trouble code (DTC) in memory if it detects a problem in the electric cooling fan (Fig. 38), relay or circuit. Refer to On-Board Diagnostics in 25 - EMISSIONS CONTROL for more information on accessing a DTC.

The DTC can also be accessed through the DRB scan tool. Refer to the appropriate Powertrain Diagnostic information for diagnostic information and operation of the DRB scan tool.

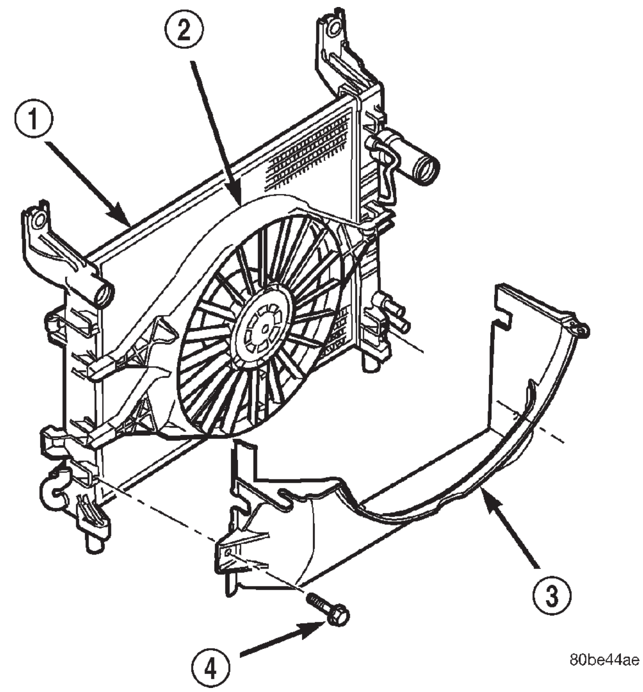


Fig. 38 Electrical Cooling Fan

1 - RADIATOR
2 - ELECTRIC FAN ASSEMBLY
3 - FAN SHROUD (LOWER)
4 - SCREW

RADIATOR FAN MOTOR INOPERATIVE

Equipment Required:

- DRB Scan Tool
- Volt/Ohm meter
- Wiring Diagrams

Test Procedure:

(1) Inspect 10A fuse in junction block and 40A maxi fuse in PDC (Fig. 39).

(2) Remove Cooling Fan Relay from the PDC and make the following checks at the relay connector:

- Apply 12 volts (using a fused 14-gauge wire) to circuit C25 (relay terminal 87). If fan does not come on, check for open in circuit C25 or Z1. If circuits are o.k., replace the cooling fan motor.
- With the ignition key “off” check for battery voltage at circuit C28 (relay terminal 30). If no battery voltage present check for open/shorted circuit C28 between the PDC and relay.
- With the ignition key in the “run” position check for battery voltage at circuit F18 (relay terminal 86). If no battery voltage present, check for open/short in circuit F18 between the junction block and the relay.

RADIATOR FAN MOTOR (Continued)

• If no problems are detected, install the DRB (refer to the appropriate Powertrain Diagnostic Procedures manual for DRB scan tool operating instructions) and start the engine. Clip a 12V test light to the battery positive terminal and probe circuit C27 (relay terminal 85). When the engine temperature reaches 110° C (230° F), or A/C is requested, the test light should light. If not, check circuit C27 for open.
• If no problems are detected at this point, replace the cooling fan relay.

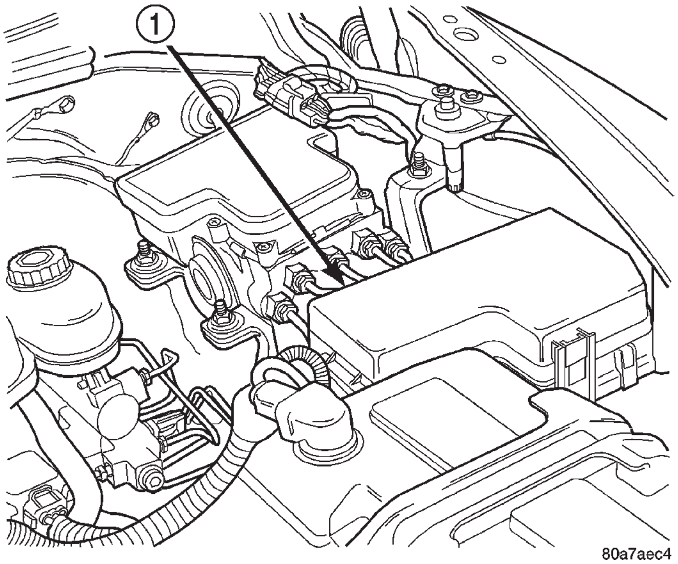


Fig. 39 Power Distribution Center (PDC)

1 - POWER DISTRIBUTION CENTER (PDC)

RADIATOR FAN RELAY

DESCRIPTION

The radiator cooling fan relay is a 5–pin, solenoid type, mini-relay. It is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

OPERATION

The electric radiator cooling fan is controlled by the Powertrain Control Module (PCM) through the radiator cooling fan relay. The PCM will activate the relay after receiving inputs from the engine coolant temperature sensor and/or an air conditioning on/off signal. **Not Equipped With A/C:** The relay is energized when coolant temperature is above approximately 103°C (217°F). It will then de-energize when coolant temperature drops to approximately 98°C (208°F). **Equipped With A/C:** In addition to using coolant temperatures to control cooling fan operation, the cooling fan will also be engaged when the air conditioning system has been activated. Refer to 24 - HEATING & AIR CONDITIONING for additional information.

WATER PUMP - 2.5L

DESCRIPTION

CAUTION: All 2.5L 4-cylinder engines are equipped with a reverse (counterclockwise) rotating water pump. 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. 40) 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.

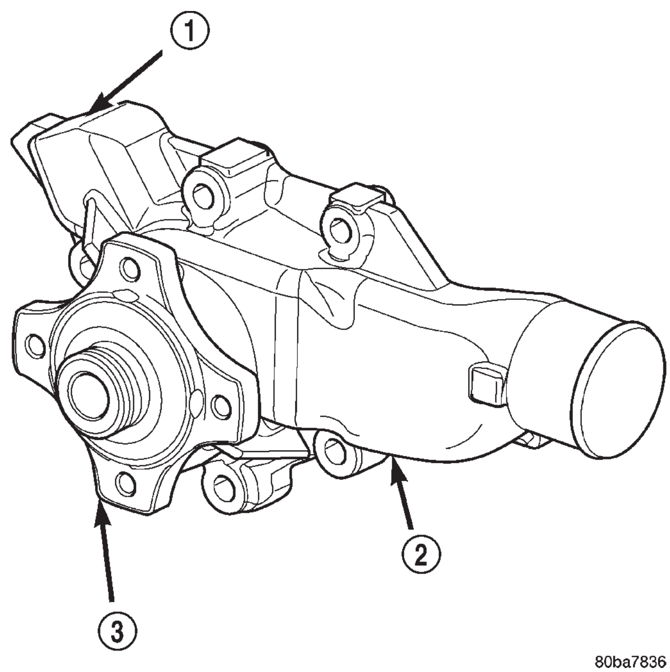


Fig. 40 Water Pump

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. 41) 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.

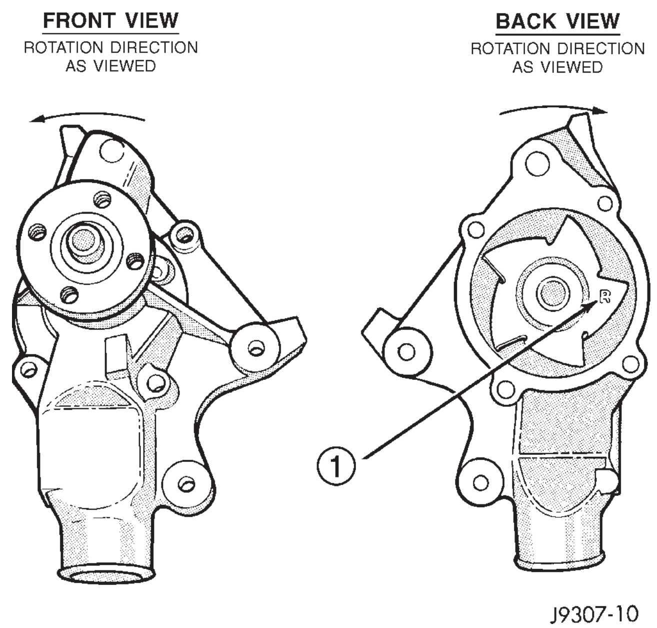


Fig. 41 Reverse Rotating Water Pump

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.

(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. 42) SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

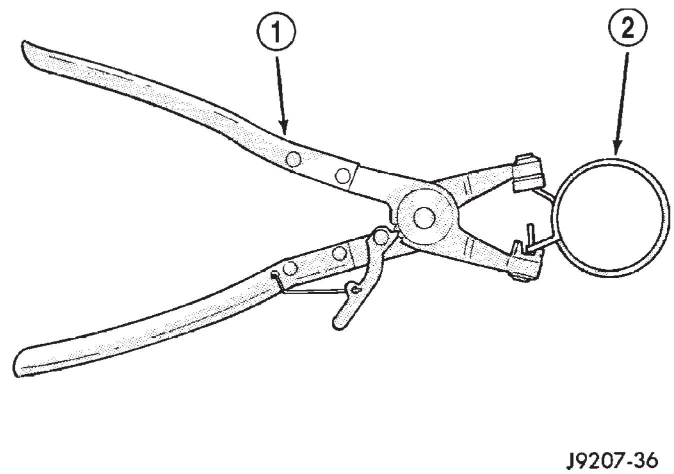


Fig. 42 Hose Clamp Tool – Typical

1 - HOSE CLAMP TOOL 6094
2 - HOSE CLAMP

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 43) . If replacement is necessary, use only an original equipment clamp with matching number or letter.

(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. 44) and remove pump from vehicle. Discard old gasket. Note that one of the four bolts is longer than the other bolts.

WATER PUMP - 2.5L (Continued)

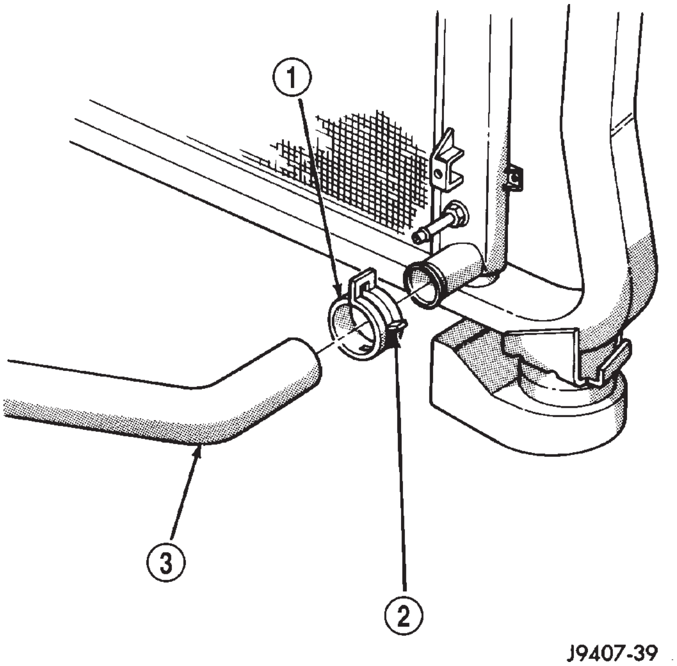


Fig. 43 Clamp Number/Letter Location

1 - TYPICAL CONSTANT TENSION HOSE CLAMP
2 - CLAMP NUMBER/LETTER LOCATION
3 - TYPICAL HOSE

(10) If pump is to be replaced, the heater hose fitting must be removed. Note position of fitting before removal.

INSTALLATION

(1) If pump is being replaced, install the heater hose fitting to the pump. Use a sealant on the fitting such as Mopar® Thread Sealant With Teflon. Refer to the directions on the package.

(2) Clean the gasket mating surfaces. If the original pump is used, remove any deposits or other foreign material. Inspect the cylinder block and water pump mating surfaces for erosion or damage from cavitation.

(3) Install the gasket and water pump. The silicone bead on the gasket should be facing the water pump. Also, the gasket is installed dry. Tighten mounting bolts to 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.

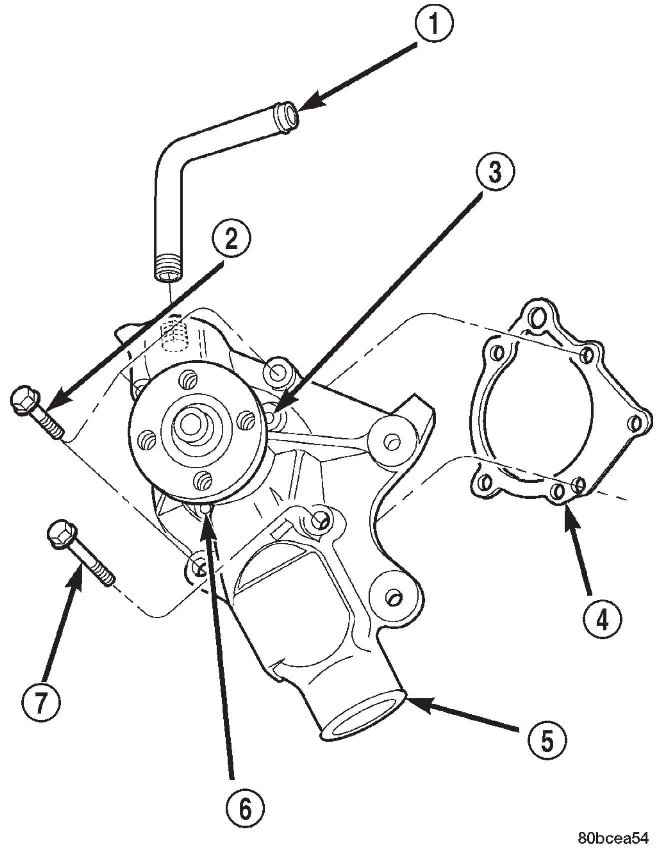


Fig. 44 Water Pump Remove/Install

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

(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 - 3.9L/5.9L

DESCRIPTION

The water pump is located on the engine front cover, and has an integral pulley attached (Fig. 45).

WATER PUMP - 3.9L/5.9L (Continued)

The water pump impeller is pressed onto the rear of a shaft that rotates in a bearing pressed into the water pump body. The body has a small hole for ventilation. The water pump seals are lubricated by antifreeze in the coolant mixture. Additional lubrication is not necessary.

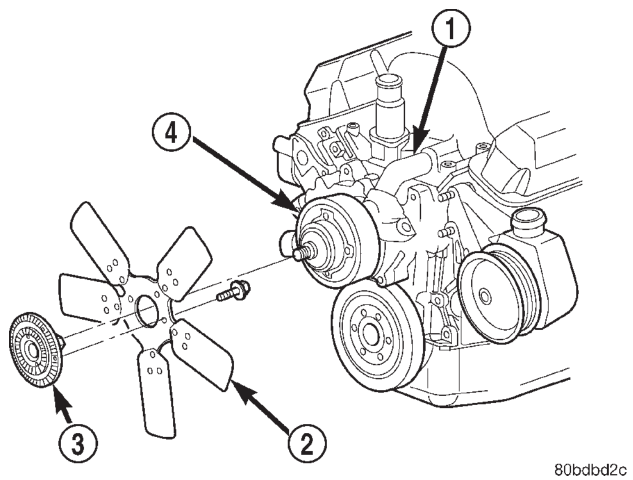


Fig. 45 Water Pump

1 - WATER PUMP BYPASS HOSE
2 - FAN BLADE ASSEMBLY
3 - VISCOUS FAN DRIVE
4 - WATER PUMP AND PULLEY

OPERATION

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core, this coolant absorbs the heat generated when the engine is running. The pump is driven by the engine crankshaft via a drive belt.

REMOVAL

The water pump can be removed and installed without discharging the air conditioning system (if equipped).

(1) Disconnect battery negative cable.

(2) Drain cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). 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. If replacement is necessary, use only an original equipment clamp with matching number or letter.

(4) Remove upper radiator hose clamp and hose at radiator.

(5) The thermal viscous fan drive is attached (threaded) to the water pump hub shaft (Fig. 47). Remove fan/viscous fan drive assembly from water pump by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT HAND.** A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) and Special Tool 6958 Spanner Wrench with Adapter Pins 8346 can be used. Place Special Tool 6958 Spanner Wrench onto the water pump pulley with Adapter Pins 8346 inserted into the holes on the pulley (Fig. 46)to prevent pulley from rotating. Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

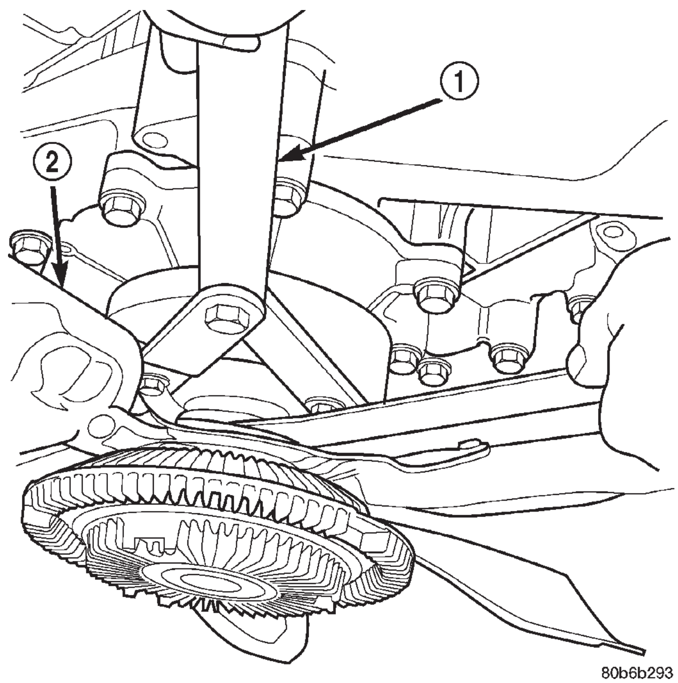


Fig. 46 Viscous Fan Drive Removal / Installation

1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 - FAN

(6) If water pump is being replaced, do not unbolt fan blade assembly (Fig. 47) from thermal viscous fan drive.

(7) Remove fan shroud attaching hardware (two bolts at bottom-two clips at top).

(8) Remove fan shroud and fan blade/viscous fan drive assembly from vehicle as a complete unit.

WATER PUMP - 3.9L/5.9L (Continued)

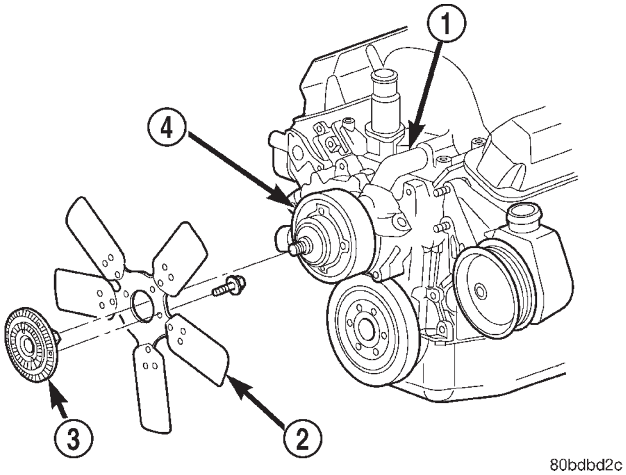


Fig. 47 Fan Blade and Viscous Fan Drive

1 - WATER PUMP BYPASS HOSE
2 - FAN BLADE ASSEMBLY
3 - VISCOUS FAN DRIVE
4 - WATER PUMP AND PULLEY

(9) After removing fan blade/viscous fan drive assembly, **do not** place thermal viscous fan drive in horizontal position. If stored horizontally, silicone fluid in viscous fan drive could drain into its bearing assembly and contaminate lubricant.

(10) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(11) Remove lower radiator hose clamp and remove lower hose at water pump.

(12) Remove heater hose clamp and heater hose from heater hose coolant return tube.

(13) Loosen heater hose coolant return tube mounting bolt (Fig. 48) and remove tube from water pump. Discard the old tube O-ring.

(14) Remove seven water pump mounting bolts.

(15) Loosen clamp at water pump end of bypass hose (Fig. 47). Slip bypass hose from water pump while removing pump from vehicle. Discard old gasket.

CAUTION: Do not pry water pump at timing chain case/cover. The machined surfaces may be damaged resulting in leaks.

CLEANING

Clean the gasket mating surface. Use caution not to damage the gasket sealing surface.

INSPECTION

Inspect the water pump assembly for cracks in the housing, Water leaks from shaft seal, Loose or rough turning bearing or Impeller rubbing either the pump body or timing chain case/cover.

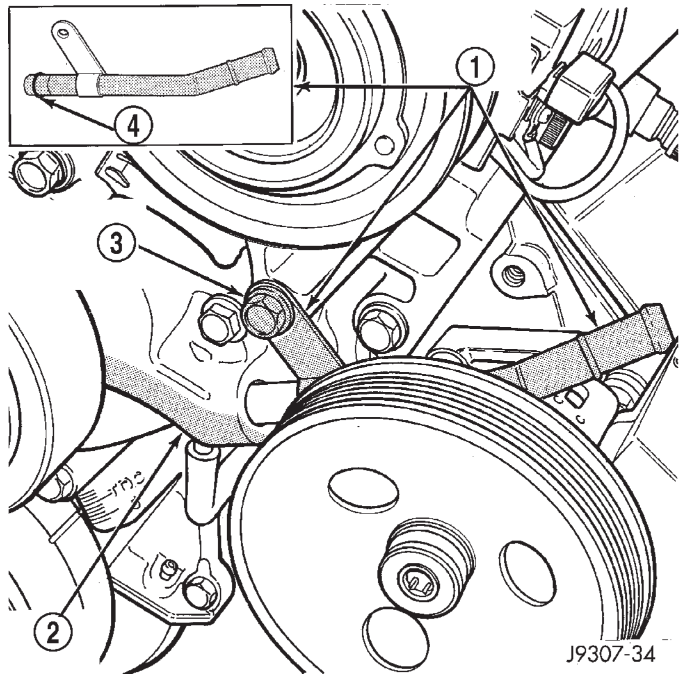


Fig. 48 Coolant Return Tube—Typical

1 - COOLANT RETURN TUBE
2 - WATER PUMP
3 - TUBE MOUNTING BOLT
4 - O-RING

INSTALLATION

(1) Clean gasket mating surfaces.

(2) Using a new gasket, install water pump to engine as follows: Guide water pump nipple into bypass hose as pump is being installed. Install water pump bolts. Tighten water pump mounting bolts to 40 N·m (30 ft. lbs.) torque.

(3) Position bypass hose clamp to bypass hose.

(4) Spin water pump to be sure that pump impeller does not rub against timing chain case/cover.

(5) Install a new O-ring to the heater hose coolant return tube (Fig. 48). Coat the new O-ring with antifreeze before installation.

(6) Install coolant return tube and its mounting bolt to engine (Fig. 48). Be sure the slot in tube bracket is bottomed to mounting bolt. This will properly position return tube.

(7) Connect radiator lower hose to water pump.

(8) Connect heater hose and hose clamp to coolant return tube.

(9) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(10) Position fan shroud and fan blade/viscous fan drive assembly to vehicle as a complete unit.

(11) Install fan shroud.

(12) Install fan blade/viscous fan drive assembly to water pump shaft.

WATER PUMP - 3.9L/5.9L (Continued)

(13) Fill cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(14) Connect battery negative cable.

(15) Start and warm the engine. Check for leaks.

WATER PUMP - 4.7L

DESCRIPTION—WATER PUMP

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core. The pump is driven from the engine crankshaft by a single serpentine drive belt.

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.

Both heater hoses are connected to fittings on the timing chain front cover. The water pump is also mounted directly to the timing chain cover and is equipped with a non serviceable integral pulley (Fig. 49).

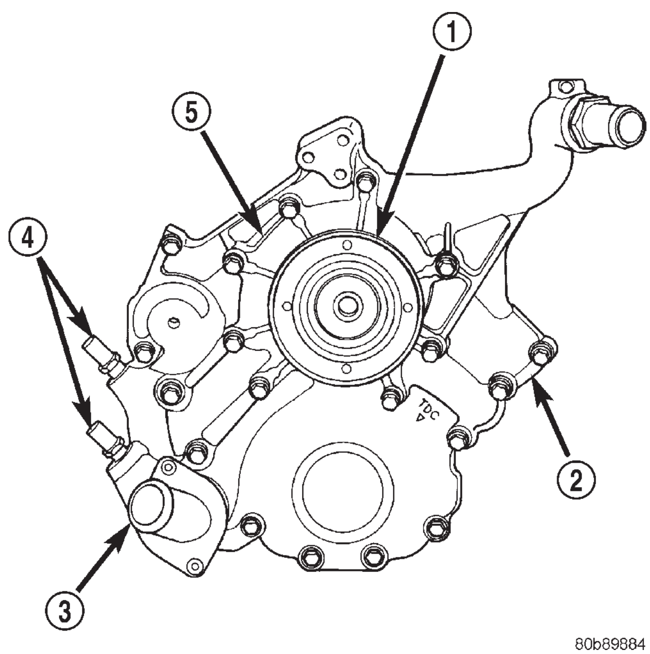


Fig. 49 Water Pump and Timing Chain Cover

1 - INTEGRAL WATER PUMP PULLEY
2 - TIMING CHAIN COVER
3 - THERMOSTAT HOUSING
4 - HEATER HOSE FITTINGS
5 - WATER PUMP

DESCRIPTION—WATER PUMP BYPASS

The 4.7L engine uses an internal water/coolant bypass system. The design uses galleries in the timing chain cover to circulate coolant during engine warm-up preventing the coolant from flowing through the radiator. The thermostat uses a stub shaft located at the rear of the thermostat (Fig. 50) to control flow through the bypass gallery.

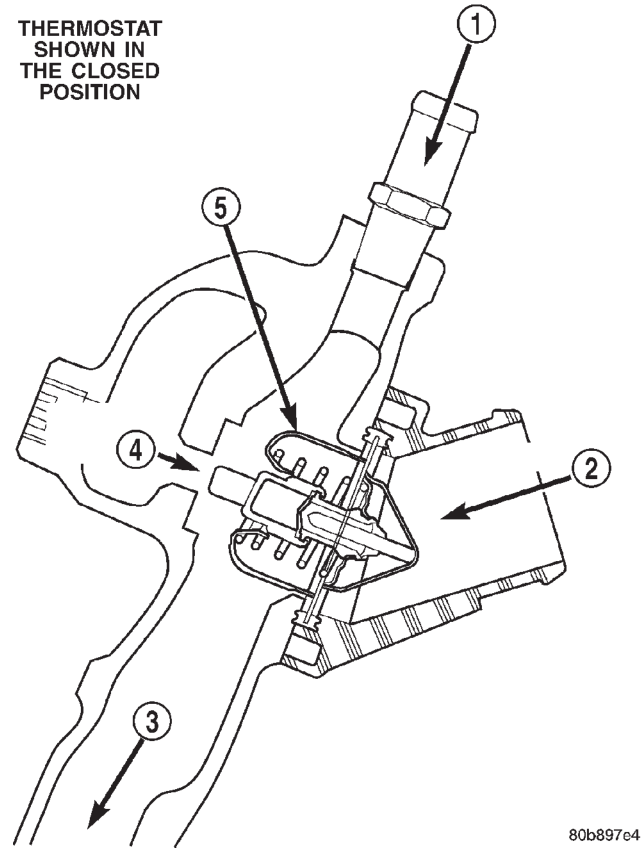


Fig. 50 Water/Coolant Bypass Flow and Thermostat

1 - FROM HEATER
2 - FROM RADIATOR
3 - TO WATER PUMP
4 - ENGINE BYPASS
5 - THERMOSTAT

OPERATION

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core, this coolant absorbs the heat generated when the engine is running. The pump is driven by the engine crankshaft via a drive belt.

WATER PUMP - 4.7L (Continued)

OPERATION—WATER PUMP BYPASS

When the thermostat is in the closed position the bypass gallery is not obstructed allowing 100% flow. When the thermostat is in the open position the stub shaft enters the bypass gallery obstructing bypass coolant flow by 50%. This design allows the coolant to reach operating temperature quickly when cold, while adding extra cooling during normal temperature operation.

REMOVAL

The water pump on 4.7L engines is bolted directly to the engine timing chain case cover.

(1) Disconnect negative battery cable from battery.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove fan/viscous fan drive assembly from water pump (Fig. 51) (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL). Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

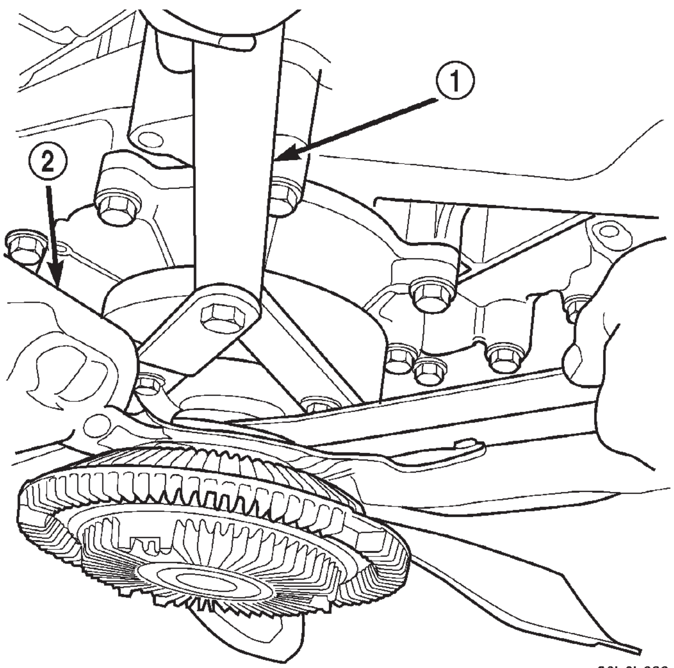


Fig. 51 Viscous Fan and Fan Drive 4.7L

1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 - FAN

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). 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. If replacement is necessary, use only an original equipment clamp with matching number or letter.

(4) If water pump is being replaced, do not unbolt fan blade assembly from thermal viscous fan drive.

(5) Remove two fan shroud-to-radiator screws (Fig. 52). Disconnect the coolant overflow hose, windshield washer fluid hose and washer pump electrical connector.

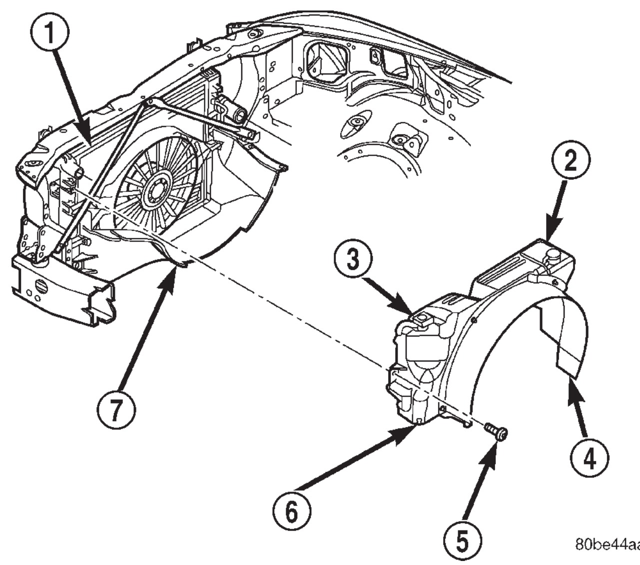


Fig. 52 Upper Fan Shroud, Coolant reservoir and Washer Fluid Reservoir

1 - RADIATOR
2 - WASHER FLUID RESERVOIR
3 - COOLANT OVERFLOW/RESERVOIR
4 - FAN SHROUD (UPPER)
5 - SCREW
6 - INTERLOCKING PINS
7 - FAN SHROUD (LOWER)

WATER PUMP - 4.7L (Continued)

(6) Remove upper fan shroud and fan blade/viscous fan drive assembly from vehicle.

(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 accessory drive belt (Fig. 53) (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

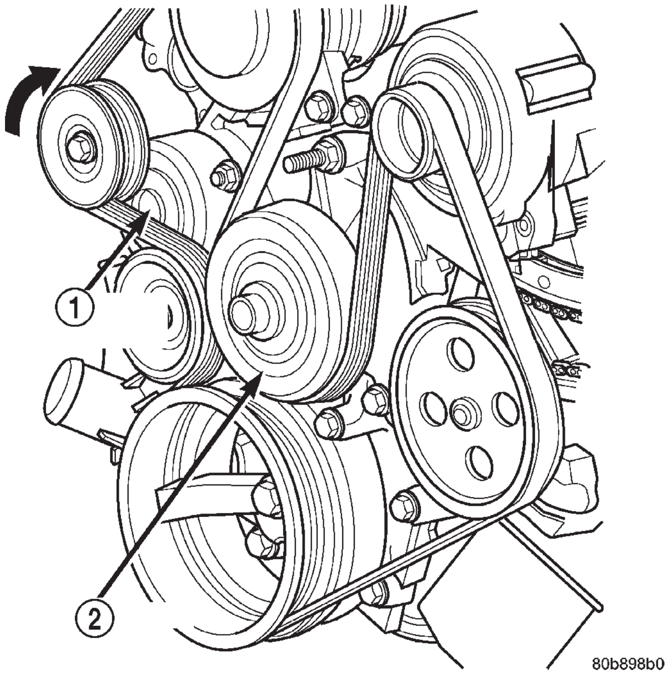


Fig. 53 Automatic Belt Tensioner—4.7L

1 - AUTOMATIC TENSIONER
2 - WATER PUMP PULLEY

(9) Remove lower radiator hose clamp and remove lower hose at water pump.

(10) Remove seven water pump mounting bolts and one stud bolt.

CAUTION: Do not pry water pump at timing chain case/cover. The machined surfaces may be damaged resulting in leaks.

(11) Remove water pump and gasket. Discard gasket.

CLEANING

Clean the gasket mating surface. Use caution not to damage the gasket sealing surface.

INSPECTION

Inspect the water pump assembly for cracks in the housing, Water leaks from shaft seal, Loose or rough turning bearing or Impeller rubbing either the pump body or timing chain case/cover.

INSTALLATION

The water pump on 4.7L engines is bolted directly to the engine timing chain case cover.

(1) Clean gasket mating surfaces.

(2) Using a new gasket, position water pump and install mounting bolts as shown. (Fig. 54). Tighten water pump mounting bolts to 54 N·m (40 ft. lbs.) torque.

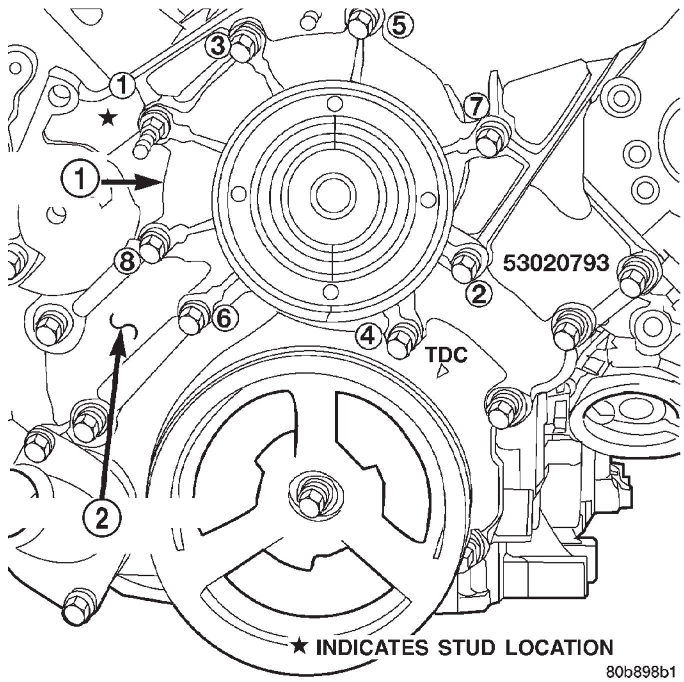


Fig. 54 Water Pump Installation—4.7L

1 - WATER PUMP
2 - TIMING CHAIN COVER

(3) Spin water pump to be sure that pump impeller does not rub against timing chain case/cover.

(4) Connect radiator lower hose to water pump.

(5) Relax tension from belt tensioner (Fig. 53). Install drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

WATER PUMP - 4.7L (Continued)

CAUTION: When installing the serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 55) for correct belt routing. Or, refer to the Belt Routing Label located in the engine compartment. The correct belt with correct length must be used.

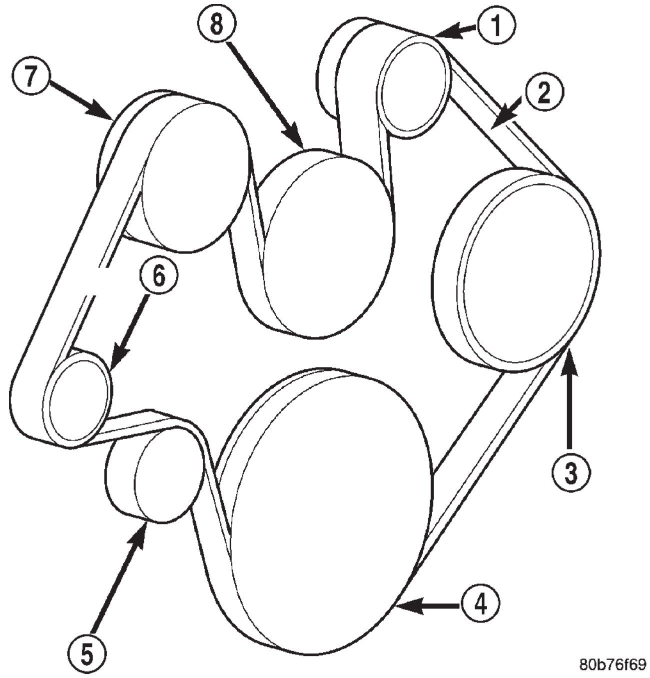


Fig. 55 Belt Routing 4.7L

1 - GENERATOR PULLEY
2 - ACCESSORY DRIVE BELT
3 - POWER STEERING PUMP PULLEY
4 - CRANKSHAFT PULLEY
5 - IDLER PULLEY
6 - TENSIONER
7 - A/C COMPRESSOR PULLEY
8 - WATER PUMP PULLEY

(6) Position upper fan shroud and fan blade/viscous fan drive assembly.

(7) Be sure the upper and lower portions of the fan shroud are firmly connected. All air must flow through the radiator.

(8) Install two fan shroud-to-radiator screws (Fig. 52).

(9) Be sure of at least 25 mm (1.0 inches) between tips of fan blades and fan shroud.

(10) Install fan blade/viscous fan drive assembly to water pump shaft (Refer to 7 - COOLING/ENGINE/ FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(11) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(12) Connect negative battery cable.

(13) Start and warm the engine. Check for leaks.

RADIATOR FAN - ELECTRIC

DESCRIPTION

The fan (Fig. 56) is electrically controlled by the powertrain control module (PCM) through the fan control relay. This relay is located in the power distribution center (PDC) (Fig. 57). For the location of the relay within the PDC, refer to label on PDC cover.

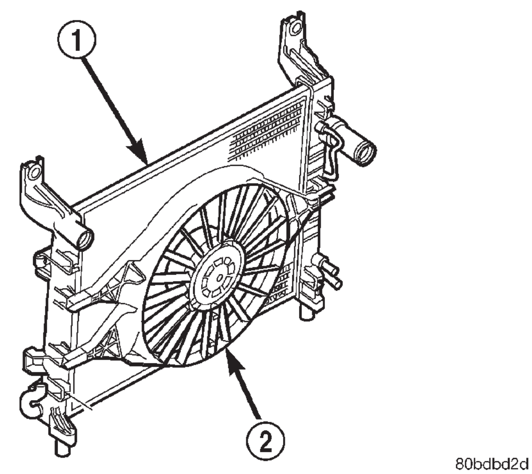


Fig. 56 Electric Fan Assembly—Typical

1 - RADIATOR
2 - ELECTRIC FAN ASSEMBLY

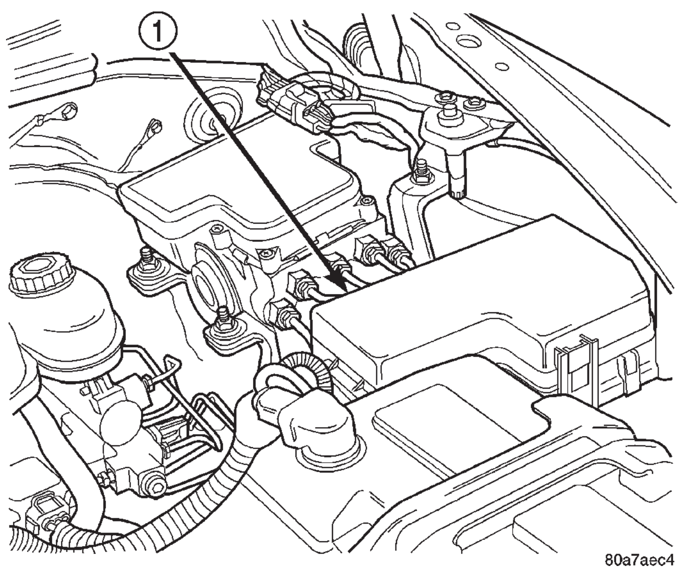


Fig. 57 Power Distribution Center (PDC)

1 - POWER DISTRIBUTION CENTER (PDC)

RADIATOR FAN - ELECTRIC (Continued)

OPERATION

The PCM regulates fan operation based on input from the engine coolant temperature sensor and vehicle speed.

The fan is not energized during engine cranking regardless of the electrical input from the engine coolant temperature sensor. However, if engine operating conditions warrant fan engagement, the fan will run once engine starts.

The fan is energized whenever the engine is running and engine coolant or transmission oil sump temperature is greater than 104° C (220° F) or air conditioning head pressure is greater than 32 kpa (220 psi)..

The fan will turn off when engine coolant or transmission oil sump temperature drops below 102° C (216° F), or air conditioning head pressure drops to 24.6 kpa (170 psi).

REMOVAL

If the fan blade is bent, warped, cracked or damaged in any way, it must be replaced **only** with a replacement fan blade. **Do not attempt to repair a damaged fan blade.**

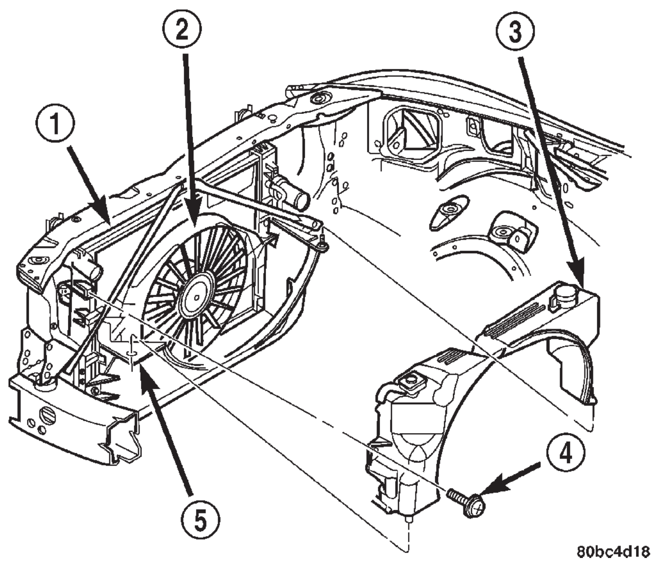


Fig. 58 Fan Shroud—Typical

1 - RADIATOR
2 - ELECTRIC COOLING FAN
3 - UPPER SHROUD AND OVERFLOW BOTTLE
4 - SCREW
5 - LOWER SHROUD

(1) Disconnect battery negative cable.
(2) Disconnect fan motor wire connector.
(3) Remove the two fan shroud mounting clips connecting the upper part of fan shroud to the radiator (Fig. 58) .
(4) Remove fan assembly from radiator.

INSTALLATION

(1) Install fan assembly onto the radiator. Tighten bolts 5 N·m (45 in. lbs.).
(2) Connect fan motor wire connector to harness connector.
(3) Connect battery negative cable.
(4) Start engine and check fan operation.

RADIATOR FAN - VISCOUS

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.

WATER PUMP INLET TUBE

REMOVAL

WITHOUT AIR CONDITIONING

(1) Partially drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WATER PUMP INLET TUBE (Continued)

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. 59). 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. 60). If replacement is necessary, use only an original equipment clamp with matching number or letter.

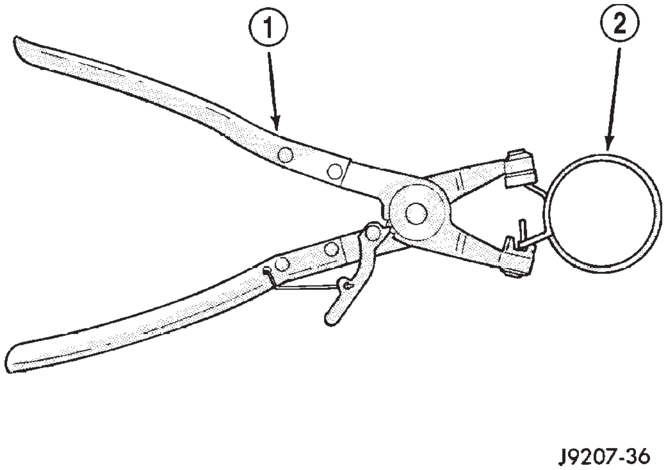


Fig. 59 Hose Clamp Tool—Typical

1 - HOSE CLAMP TOOL 6094
2 - HOSE CLAMP

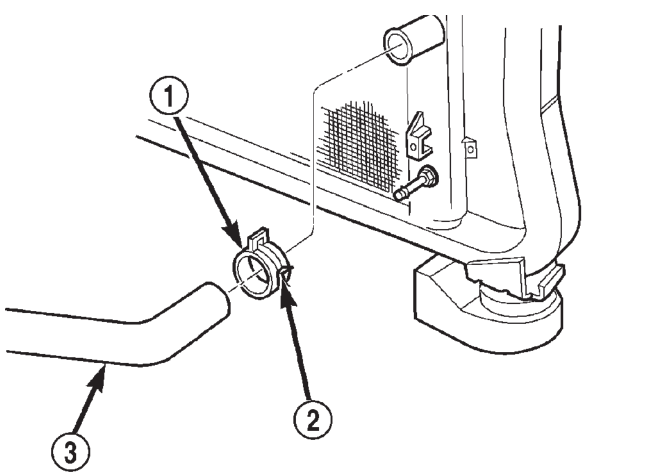


Fig. 60 Clamp Number/Letter Location

1 - CONSTANT TENSION HOSE CLAMP
2 - CLAMP NUMBER/LETTER LOCATION
3 - HOSE

(2) Loosen both bypass hose clamps (Fig. 59) and position to center of hose. Remove hose from vehicle.

WITH AIR CONDITIONING

If equipped with A/C, the generator and A/C compressor along with their common mounting bracket (Fig. 61) must be partially removed. Removing generator or A/C compressor from their mounting bracket is not necessary. Also, discharging A/C system is not necessary. **Do not** remove any refrigerant lines from A/C compressor.

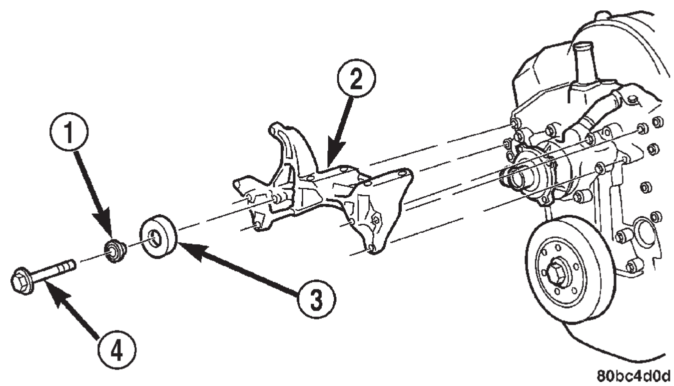


Fig. 61 Generator—A/C Compressor Mounting Bracket

1 - IDLER PULLEY BUSHING
2 - A/C AND/OR GENERATOR MOUNTING BRACKET
3 - IDLER PULLEY
4 - SCREW AND WASHER

WARNING: THE A/C SYSTEM IS UNDER PRESSURE EVEN WITH ENGINE OFF. REFER TO REFRIGERANT WARNINGS IN GROUP 24, HEATING AND AIR CONDITIONING.

(1) Disconnect battery negative cable.

(2) Partially drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(3) Remove upper radiator hose clamp (Fig. 59)and hose at radiator.

(4) Unplug wiring harness from A/C compressor.

(5) Remove air cleaner assembly.

(6) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(7) The drive belt idler pulley must be removed to gain access to one of A/C compressor/generator bracket mounting bolts. Remove idler pulley bolt and remove idler pulley (Fig. 61).

(8) Remove oil dipstick tube mounting bolt at side of A/C-generator mounting bracket.

(9) Disconnect throttle body cables.

WATER PUMP INLET TUBE (Continued)

(10) Remove heater hose clamp and heater hose from heater hose coolant return tube.

(11) Remove heater hose coolant return tube mounting bolt (Fig. 62) and remove tube from engine. Discard the old tube O-ring.

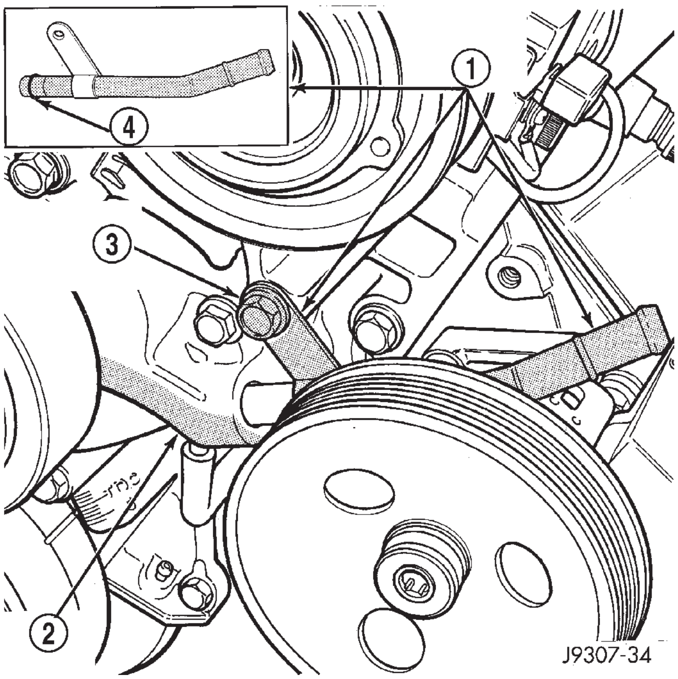


Fig. 62 Coolant Return Tube

1 - COOLANT RETURN TUBE
2 - WATER PUMP
3 - TUBE MOUNTING BOLT
4 - O-RING

(12) Remove bracket-to-intake manifold bolts (Fig. 61).

(13) Remove six bracket bolts (Fig. 61).

(14) Lift and position generator and A/C compressor (along with their common mounting bracket) to gain access to bypass hose. A block of wood may be used to hold assembly in position.

(15) Loosen and position both hose clamps to center of bypass hose. Remove hose from vehicle.

INSTALLATION

WITHOUT AIR CONDITIONING

(1) Position bypass hose clamps (Fig. 59) to center of hose.

(2) Install bypass hose to engine.

(3) Secure both hose clamps (Fig. 59).

(4) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(5) Start and warm the engine. Check for leaks.

WITH AIR CONDITIONING

(1) Position bypass hose clamps to center of hose.

(2) Install bypass hose to engine.

(3) Secure both hose clamps (Fig. 59).

(4) Install generator-A/C mounting bracket assembly to engine. Tighten bolts (number 1 and 2— (Fig. 61) to 54 N·m (40 ft. lbs.) torque. Tighten bolts (number 3— (Fig. 61)to 40 N·m (30 ft. lbs.) torque.

(5) Install a new O-ring to the heater hose coolant return tube (Fig. 62). Coat the new O-ring with antifreeze before installation.

(6) Install coolant return tube and its mounting bolt to engine (Fig. 62).

(7) Connect throttle body control cables.

(8) Install oil dipstick mounting bolt.

(9) Install idler pulley. Tighten bolt to 54 N·m (40 ft. lbs.) torque.

(10) Install drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(11) Install air cleaner assembly.

(12) Install upper radiator hose to radiator.

(13) Connect wiring harness to A/C compressor.

(14) Connect battery negative cable.

(15) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(16) Start and warm the engine. Check for leaks.

TRANSMISSION

TABLE OF CONTENTS

TRANS COOLER

DESCRIPTION

CAUTION: On in-radiator type oil coolers, if transmission oil cooler is leaking, engine coolant may enter cooler, or transmission oil may enter engine cooling system. Both engine cooling system and transmission oil circuit should be drained, flushed, and inspected.

There are two types of transmission oil coolers used. One type of cooler is the in-radiator type or oil to coolant type (Fig. 1). This type oil cooler is not serviceable. The second type used is a remote type auxiliary oil cooler or oil to air cooler (Fig. 2). The oil to air type cooler is located in front of the radiator, and is serviceable.

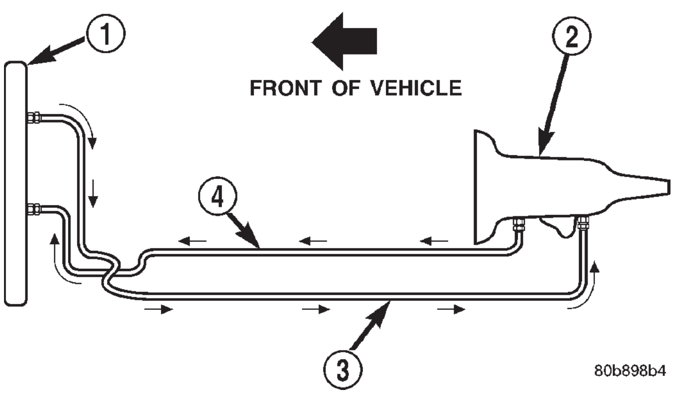


Fig. 1 Oil Flow to Cooler - Top View (Typical)

1 - TRANSMISSION OIL COOLER
2 - AUTOMATIC TRANSMISSION
3 - RETURN LINE
4 - PRESSURE LINE

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.

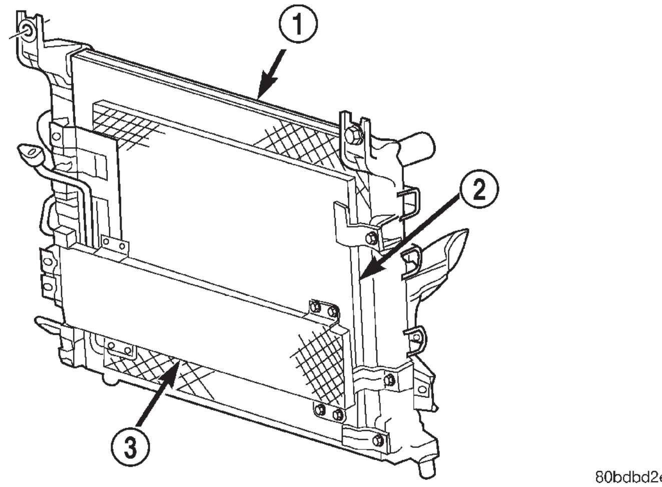


Fig. 2 Auxiliary Transmission Oil Cooler - Typical

1 - RADIATOR
2 - A/C CONDENSER (IF EQUIPPED)
3 - TRANSMISSION AUXILIARY OIL COOLER

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.

TRANS COOLER (Continued)

(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.

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

TABLE OF CONTENTS

AUDIO

DESCRIPTION

An audio system is standard factory-installed equipment on this model, unless the vehicle is ordered with an available radio delete option. The standard equipment audio system includes an AM/FM/cassette (RAS sales code) receiver, and speakers in four locations. Several combinations of radio receivers and speaker systems are offered as optional equipment on this model. The audio system uses an ignition switched source of battery current so that the system will only operate when the ignition switch is in the On or Accessory positions. The audio system includes the following components:

- Antenna
- Clockspring (with remote radio switches only)
- High-line Central Timer Module (CTM) (with remote radio switches)
- Power amplifier (with premium speaker system only)
- Radio noise suppression components
- Radio receiver
- Remote radio switches (optional with RAZ radio receiver only)
- Speakers

(Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - DESCRIPTION). (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL/CENTRAL TIMER MODUL - DESCRIPTION). 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. Following are general descriptions of the remaining major components in the standard and optional factory-installed audio systems.

OPERATION

See the owner's manual in the vehicle glove box for more information on the features, use and operation of each of the available audio systems.

CENTRAL TIMER MODULE

The high-line Central Timer Module (CTM) can also control some features of the audio system when the vehicle is equipped with the optional RAZ radio receiver and remote radio switches. A high-line CTM is used on high-line versions of this vehicle. The CTM combines the functions of a chime/buzzer module, an intermittent wipe module, an illuminated entry module, a remote keyless entry module, and a vehicle theft security system module in a single unit.

The high-line CTM also controls and integrates many of the additional electronic functions and features included on models with this option. The RAZ radio receiver with a remote radio switch option is one of the features that the CTM controls. The CTM is programmed to send switch status messages over the J1850 data bus to control the volume, seek, and pre-set station advance functions of the RAZ radio receiver. The CTM monitors the status of the remote radio switches located on the steering wheel through a hard wired circuit. The CTM then sends the proper switch status messages to the radio receiver. The electronic circuitry within the radio receiver responds to the switch status messages it receives by adjusting the radio settings as requested.

(Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL/CENTRAL TIMER MODUL - DESCRIPTION) for more information on the high-line CTM. (Refer to 8 - ELECTRICAL/AUDIO/REMOTE SWITCHES - DESCRIPTION) for more information on this component. In addition, radio receivers connected to the J1850 data bus have several audio system functions that can be diagnosed using a DRB scan tool. Refer to the proper Diagnostic Procedures manual for more information on DRB testing of the audio systems.

DIAGNOSIS AND TESTING - AUDIO SYSTEM

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 System Diagnosis

CONDITION	POSSIBLE CAUSE	CORRECTION
NO AUDIO	1. Fuse faulty.	1. Check radio fuses in junction block. Replace faulty fuses, if required.
	2. Radio connector faulty.	2. Check for loose or corroded radio connections. 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. Refer to Radio in the Diagnosis and Testing section of this group.
	6. Speakers faulty.	6. Refer to Speaker in the Diagnosis and Testing section of this group.
	7. Amplifier faulty (if equipped).	7. Refer to Speaker in the Diagnosis and Testing section of this group.
NO DISPLAY	1. Fuse faulty.	1. Check radio fuses in junction block. Replace faulty fuses, if required.
	2. Radio connector faulty.	2. Check for loose or corroded radio connections. Repair, if required.

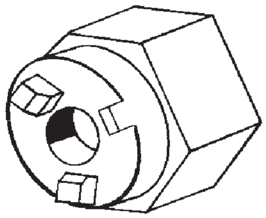
AUDIO (Continued)

Audio System Diagnosis		
CONDITION	POSSIBLE CAUSE	CORRECTION
	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. Refer to Radio in the Diagnosis and Testing section of this group.
CLOCK WILL NOT KEEP SET TIME	1. Fuse faulty.	1. Check ignition-off draw fuse. Replace faulty fuse, if required.
	2. Radio connector faulty.	2. Check for loose or corroded radio connections. 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. Refer to Radio in the Diagnosis and Testing section of this group.
POOR RADIO RECEPTION	1. Antenna faulty.	1. Refer to Antenna in the Diagnosis and Testing section of this group.
	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. Refer to Radio in the Diagnosis and Testing section of this group.
	4. Faulty EMI or RFI noise suppression.	4. Refer to Radio Frequency Interference in the Diagnosis and Testing section of this group.
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.

AUDIO (Continued)

SPECIAL TOOLS

AUDIO SYSTEMS



Antenna Nut Wrench C-4816

AMPLIFIER

DESCRIPTION

Models equipped with the Infinity premium speaker package have a separate power amplifier unit. This power amplifier is rated at 120 watts output. The power amplifier unit is mounted to the right cowl side inner panel under the passenger side end of the instrument panel. The power amplifier unit can be accessed for service by removing the trim from the right cowl side inner panel.

The power amplifier unit should be checked if there is no sound output noted from the speakers. For diagnosis of the power amplifier, (Refer to 8 - ELECTRICAL/AUDIO/SPEAKER - DIAGNOSIS AND TESTING). The power amplifier cannot be repaired or adjusted and, if faulty or damaged, the unit must be replaced.

OPERATION

The power amplifier receives fused battery current from a fuse in the Junction Block (JB) at all times. The internal circuitry of the power amplifier switches the amplifier on based upon a fused 12 volt output signal that is received from the radio receiver whenever the radio is turned on. The power amplifier receives the sound signal inputs for four speaker channels from the radio receiver, then sends the amplified speaker outputs for each of those channels to the six speakers. 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

The power amplifier unit should be checked if there is no sound output noted from the speakers. For diagnosis of the power amplifier, (Refer to 8 - ELECTRICAL/AUDIO/SPEAKER - DIAGNOSIS AND TESTING) 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.

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 trim cover from the right cowl side inner panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - REMOVAL) for the procedures.

(3) Disconnect the two instrument panel wire harness connectors from the connector receptacles on the bottom of the power amplifier.

(4) Remove the three screws that secure the power amplifier to the right cowl side inner panel.

(5) Remove the power amplifier from the right cowl side inner 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) Position the power amplifier to the right cowl side inner panel.

(2) Install the three screws that secure the amplifier to the right cowl side inner panel. Tighten the screws to 2 N·m (17 in. lbs.).

(3) Reconnect the two instrument panel wire harness connectors to the connector receptacles on the bottom of the power amplifier.

(4) Install the trim cover onto the right cowl side inner panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - INSTALLATION) for the procedures.

(5) Reconnect the battery negative cable.

ANTENNA BODY & CABLE

DESCRIPTION

All models use a black painted fixed-length stainless steel rod-type antenna mast, installed on the right front fender of the vehicle. The antenna mast has a spiral groove cut down its length to reduce wind noise. The antenna mast is connected to the center wire of the coaxial antenna cable, and is not grounded to any part of the vehicle. To eliminate static, the antenna base must have a good ground. The coaxial antenna cable shield (the outer wire mesh of the cable) is grounded to the antenna base and the radio receiver chassis.

The antenna coaxial cable has an additional disconnect, located near the outboard side of the glove box opening on the back side of the lower instrument panel reinforcement. This additional disconnect allows the instrument panel assembly to be removed and installed without removing the radio receiver.

The factory-installed Electronically Tuned Radios (ETR) automatically compensate for radio antenna trim. Therefore, no antenna trimmer adjustment is required or possible when replacing the radio 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. 1).

NOTE: This model has a special coating on the antenna mast which is not electrically conductive. Remove the antenna mast from the antenna base before attempting to perform Tests 1 and 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 outboard side of the glove box opening to the antenna base, and then from the coaxial cable connection to the radio chassis connection.

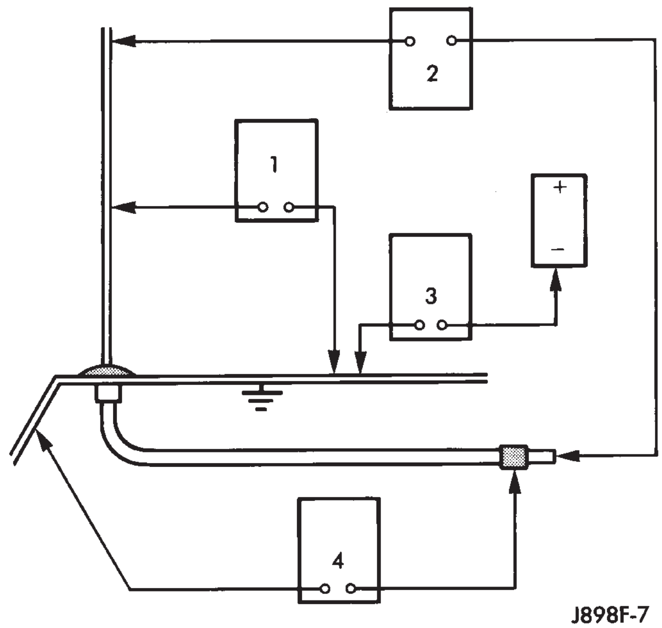


Fig. 1 Antenna Test

TEST 1

Test 1 determines if the antenna mast is insulated from the base. Proceed as follows:

(1) Disconnect the antenna coaxial cable connector from the radio receiver chassis and isolate. Remove the antenna mast from the antenna base.

(2) Insert one ohmmeter test lead into the socket for the antenna mast in the center of the antenna base. Connect the other test lead to the perimeter of the antenna base. Check for continuity.

(3) There should be no continuity. If continuity is found, replace the faulty or damaged antenna base and cable assembly.

TEST 2

Test 2 checks the antenna for an open circuit as follows:

(1) Disconnect the antenna coaxial cable connector from the radio receiver chassis. Remove the antenna mast from the antenna base.

(2) Insert one ohmmeter test lead into the socket for the antenna mast in the center of the antenna base. 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.

ANTENNA BODY & CABLE (Continued)

TEST 3

Test 3 checks the condition of the vehicle body ground connection. This test should be performed with the battery positive cable removed from the battery. Disconnect both battery cables, the negative cable first. Reconnect the battery negative cable and perform the test as follows:

(1) Connect one ohmmeter test lead to the vehicle fender. Connect the other test lead to the battery negative terminal post.

(2) The resistance should be less than one ohm.

(3) If the resistance is more than one ohm, check the braided ground strap(s) connected to the engine and the vehicle body for being loose, corroded, or damaged. Repair the ground strap connections, 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

ANTENNA BODY AND CABLE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the trim cover from the right cowl side inner panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - REMOVAL.

(3) Reach under the instrument panel outboard of the glove box to access and disconnect the antenna coaxial cable connector. Disconnect the connector by pulling it apart while twisting the metal connector halves. Do not pull on the cable.

(4) Disengage the antenna coaxial cable retainers at the right cowl side inner panel and inside the right front fender.

(5) Unscrew the antenna mast from the antenna body (Fig. 2).

(6) Remove the antenna cap nut using an antenna nut wrench (Special Tool C-4816) (Fig. 3).

(7) Remove the antenna adapter from the top of the fender.

(8) Lower the antenna body through the mounting hole in the top of the fender.

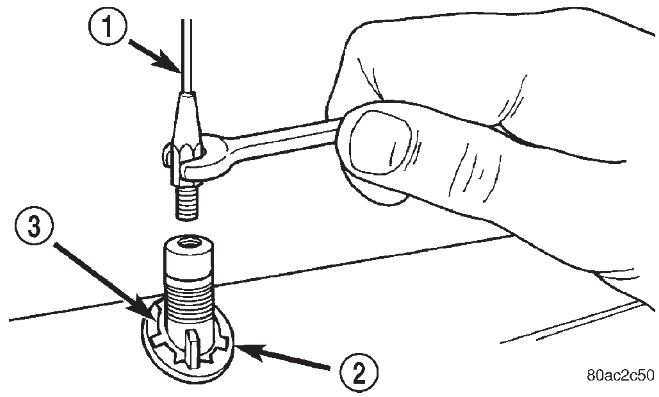


Fig. 2 Antenna Mast

1 - ANTENNA MAST
2 - ADAPTER
3 - CAP NUT

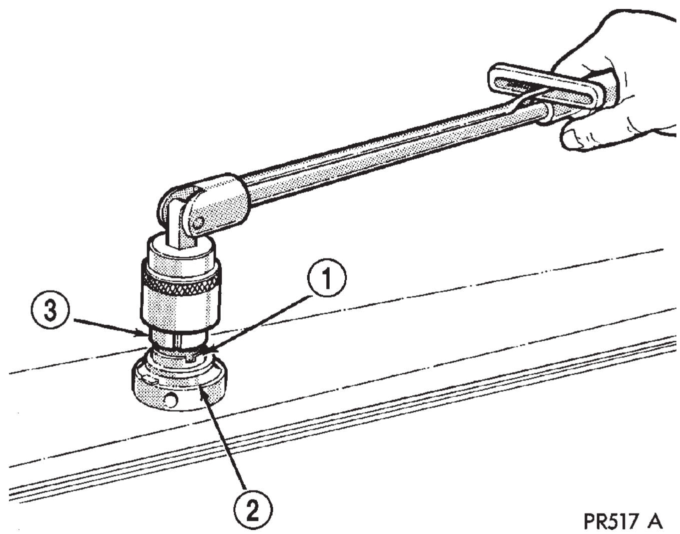


Fig. 3 Antenna Cap Nut

1 - CAP NUT
2 - ANTENNA ADAPTER
3 - TOOL

(9) Pull the antenna body and cable out through the opening between the right cowl side outer panel and the fender through the front door opening (Fig. 4).

(10) Disengage the antenna coaxial cable grommet from the hole in the right cowl side outer panel.

(11) Pull the antenna coaxial cable out of the passenger compartment through the hole in the right cowl side outer panel.

(12) Remove the antenna body and cable from the vehicle.

ANTENNA BODY & CABLE (Continued)

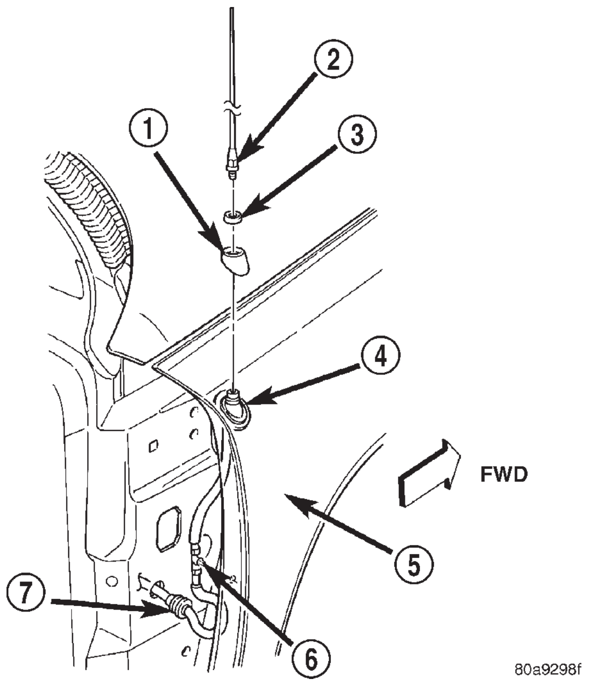


Fig. 4 Antenna Mounting

1 - ADAPTER
2 - MAST
3 - NUT
4 - ANTENNA BODY AND CABLE
5 - RIGHT FRONT FENDER
6 - RETAINER
7 - GROMMET

INSTRUMENT PANEL ANTENNA CABLE

(1) Disconnect and isolate the battery negative cable.

(2) Reach under the instrument panel outboard of the glove box to access and disconnect the antenna coaxial cable connector. Disconnect the connector by pulling it apart while twisting the metal connector halves. Do not pull on the cable.

(3) Securely tie a suitable length of cord or twine to the instrument panel half of the antenna coaxial cable connector. This cord will be used to pull or “fish” the cable back into position during installation.

(4) Disengage the instrument panel antenna cable from the retainer clips on the glove box opening and instrument panel support.

(5) Remove the radio receiver from the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - REMOVAL).

(6) Pull the antenna cable out through the radio receiver opening in the instrument panel.

(7) Untie the cord or twine from the instrument panel antenna cable connector, leaving the cord or twine in place of the cable in the instrument panel.

(8) Remove the antenna cable from the instrument panel.

INSTALLATION

ANTENNA BODY AND CABLE

(1) Position the antenna body and cable in the opening between the right cowl side outer panel and the fender through the front door opening.

(2) Push the antenna coaxial cable into the passenger compartment through the hole in the right cowl side outer panel.

(3) Engage the antenna coaxial cable grommet in the hole in the right cowl side outer panel.

(4) Position the antenna body through the mounting hole in the top of the fender.

(5) Install the adapter over the antenna body from the top of the fender.

(6) Install and tighten the antenna cap nut using an antenna nut wrench (Special Tool C-4816). Tighten the antenna cap nut to 8 N·m (70 in. lbs.).

(7) Install and tighten the antenna mast onto the antenna body. Tighten the mast to 3.3 N·m (30 in. lbs.).

(8) Engage the antenna coaxial cable retainers at the right cowl side inner panel and inside the right front fender.

(9) Engage the antenna coaxial cable in the retainer clips on the lower instrument panel support and the glovebox.

(10) Reach under the instrument panel outboard of the glove box to reconnect the antenna coaxial cable connector.

(11) Install the trim cover onto the right cowl side inner panel.

(12) Reconnect the battery negative cable.

INSTRUMENT PANEL ANTENNA CABLE

(1) Tie the end of the cord or twine that was used during instrument panel antenna cable removal securely to the connector on the end of the antenna coaxial cable being installed into the instrument panel. This cord will be used to pull or “fish” the cable back into position.

(2) Using the cord or twine, pull the antenna cable through the radio receiver opening from under the instrument panel.

(3) Install the radio receiver onto the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - INSTALLATION).

(4) Engage the instrument panel antenna cable to the retainer clip on the lower instrument panel support and on the glove box opening.

(5) Untie the cord or twine from the instrument panel half of the antenna coaxial cable connector.

(6) Reach under the instrument panel outboard of the glove box to access and reconnect the antenna coaxial cable connector.

(7) Reconnect the battery negative cable.

RADIO

DESCRIPTION

Available factory-installed radio receivers for this model include an AM/FM/cassette (RAS sales code), or an AM/FM/CD/cassette/3-band graphic equalizer (RAZ sales code). The factory-installed RAZ sales code radio receivers can also communicate on the J1850 data bus network through a separate two-way wire harness connector. All factory-installed receivers are stereo Electronically Tuned Radios (ETR) and include an electronic digital clock function.

These radio receivers can only be serviced by an authorized radio repair station. See the latest Warranty Policies and Procedures manual for a current listing of authorized radio repair stations.

All vehicles are equipped with an Ignition-Off Draw (IOD) fuse that is removed when the vehicle is shipped from the factory. This fuse feeds various accessories that require battery current when the ignition switch is in the Off position, including the clock. The IOD fuse is removed to prevent battery discharge during vehicle storage.

When removing or installing the IOD fuse, it is important that the ignition switch be in the Off position. Failure to place the ignition switch in the Off position can cause the radio display to become scrambled when the IOD fuse is removed and replaced. Removing and replacing the IOD fuse again, with the ignition switch in the Off position, will correct the scrambled display condition.

The IOD fuse should be checked if the radio or clock displays are inoperative. The IOD fuse is located in the junction block. Refer to the fuse layout label on the back of the instrument panel fuse access panel for IOD fuse identification and location.

OPERATION

The radio receiver operates on fused battery current that is available only when the ignition switch is in the On or Accessory positions. The electronic digital clock function of the radio operates on fused battery current supplied through the IOD fuse, regardless of the ignition switch position.

For more information on the features, setting procedures, and control functions for each of the available factory-installed radio receivers, see the owner's manual in the vehicle glove box. 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 - RADIO

If the vehicle is equipped with the optional remote radio switches located on the steering wheel and the problem being diagnosed is related to one of the symptoms listed below, be certain to check the remote radio switches and circuits. (Refer to 8 - ELECTRICAL/AUDIO/REMOTE SWITCHES - DIAGNOSIS AND TESTING) prior to attempting radio diagnosis or repair.

- Stations changing with no remote radio switch input
- Radio memory presets not working properly
- Volume changes with no remote radio switch input
- Remote radio switch buttons taking on other functions
- CD player skipping tracks
- Remote radio switch inoperative.

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 receiver is a "floating ground" system. Do not allow any speaker lead to short to ground, as damage to the radio receiver may result.

(1) Check the fused B(+) fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit to the Power Distribution Center (PDC) as required.

(3) Check the fused ignition switch output (acc/run) fuse in the junction block. If OK, go to Step 4. If not OK, repair the shorted circuit or component as required and replace the faulty fuse(s).

(4) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (acc/run) fuse in the junction block. If OK, go to Step 5. If not OK, repair the open fused ignition

RADIO (Continued)

switch output (acc/run) circuit to the ignition switch as required.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the radio receiver from the instrument panel, but do not disconnect the wire harness connectors. Check for continuity between the radio receiver chassis and a good ground. There should be continuity. If OK, go to Step 6. If not OK, repair the open ground circuit to ground as required.

(6) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (acc/run) circuit cavity of the left (gray) radio wire harness connector. If OK, go to Step 7. If not OK, repair the open fused ignition switch output (acc/run) circuit to the junction block fuse as required.

(7) 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 receiver. If not OK, repair the open fused B(+) circuit to the junction block 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 cluster bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL) for the procedures.

(3) Remove the four screws that secure the radio receiver to the instrument panel (Fig. 5).

(4) Pull the radio receiver out from the instrument panel far enough to access the instrument panel wire harness connectors and the antenna coaxial cable connector (Fig. 6).

(5) Disconnect the instrument panel wire harness connectors and the antenna coaxial cable connector from the receptacles on the rear of the radio receiver.

(6) Remove the radio receiver from the instrument panel.

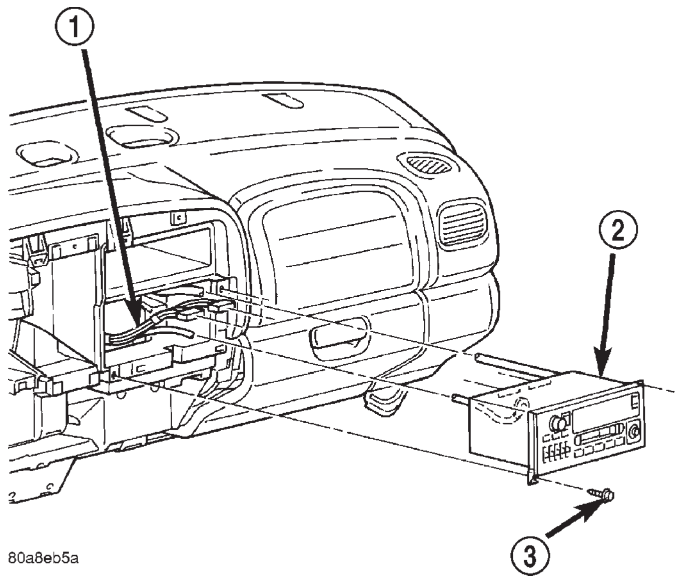


Fig. 5 Radio Receiver Remove/Install

1 - WIRE HARNESS
2 - RADIO
3 - SCREW

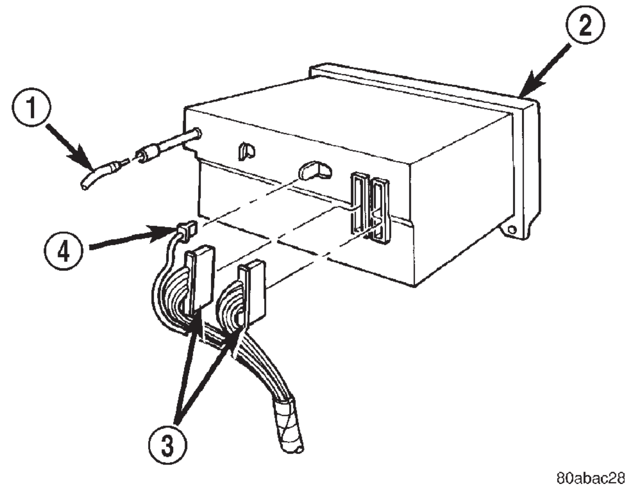


Fig. 6 Radio Receiver Connections - Typical

1 - ANTENNA CABLE
2 - RADIO
3 - INSTRUMENT PANEL WIRING
4 - GROUND WIRE

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.

RADIO (Continued)

(1) Position the radio receiver to the instrument panel.

(2) Reconnect the instrument panel wire harness connectors and the antenna coaxial cable connector to the receptacles on the rear of the radio receiver.

(3) Position the radio receiver into the mounting hole in the instrument panel.

(4) Install and tighten the four screws that secure the radio receiver to the instrument panel. Tighten the screws to 2.25 N·m (20 in. lbs.).

(5) Install the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL - INSTALLATION) for the procedures.

(6) Reconnect 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.

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(s)
- Exhaust system-to-body ground strap (4.7L engines only)
- Resistor-type spark plugs
- Radio suppression-type secondary ignition wiring.

For more information on the spark plugs and secondary ignition components, refer to **ELECTRICAL/ IGNITION CONTROLS.**

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, details of wire harness routing and retention, connector pin-out information 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(s)
- 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 ELECTRICAL/IGNITION CONTROLS. Inspect the following secondary ignition system components:

- Distributor cap and rotor
- Ignition coil
- Spark plugs
- Spark plug wire routing and condition.

Reroute the spark plug wires or replace the faulty components as required.

If the source of the RFI or EMI noise is identified as two-way mobile radio or telephone equipment, check the equipment installation for the following:

- Power connections should be made directly to the battery, and fused as closely to the battery as possible.
- The antenna should be mounted on the roof or toward the rear of the vehicle. Remember that magnetic antenna mounts on the roof panel can adversely affect the operation of an overhead console compass, if the vehicle is so equipped.
- The antenna cable should be fully shielded coaxial cable, should be as short as is practical, and should be routed away from the factory-installed vehicle wire harnesses whenever possible.
- The antenna and cable must be carefully matched to ensure a low Standing Wave Ratio (SWR).

Fleet vehicles are available with an extra-cost RFI-suppressed Powertrain Control Module (PCM). This unit reduces interference generated by the PCM on some radio frequencies used in two-way radio communications. However, this unit will not resolve complaints of RFI in the commercial AM or FM radio frequency ranges.

RADIO NOISE SUPPRESSION GROUND STRAP (Continued)

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIR-BAGS, 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.

EXHAUST SYSTEM-TO-BODY GROUND STRAP

(1) Raise and support the vehicle.

(2) Remove the nut and washer that secures the exhaust system-to-body ground strap eyelet terminal to the exhaust pipe clamp (Fig. 7).

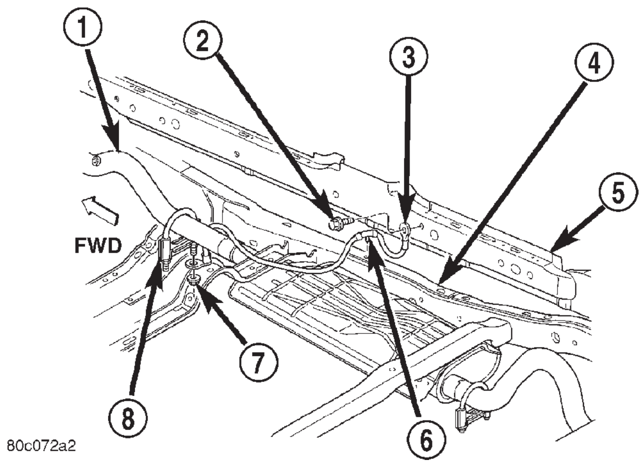


Fig. 7 Exhaust System-To-Body Ground Strap Remove/Install - Typical

1 - EXHAUST PIPE
2 - SCREW
3 - EXHAUST SYSTEM-TO-BODY GROUND STRAP
4 - RIGHT FRAME RAIL
5 - RIGHT BODY SILL PANEL
6 - CLIP
7 - NUT AND WASHER
8 - CLAMP

(3) Remove the screw that secures the exhaust system-to-body ground strap eyelet terminal to the right body sill panel.

(4) Disengage the clip that secures the exhaust system-to-body ground strap from the hole on the top of the right frame rail.

(5) Remove the exhaust system-to-body ground strap from over the top of the right frame rail.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIR-BAGS, 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.

ENGINE-TO-BODY GROUND STRAPS

(1) Remove the nut and washer that secures the left engine-to-body ground strap eyelet terminal to the weld stud on the left side of the lower plenum panel (Fig. 8).

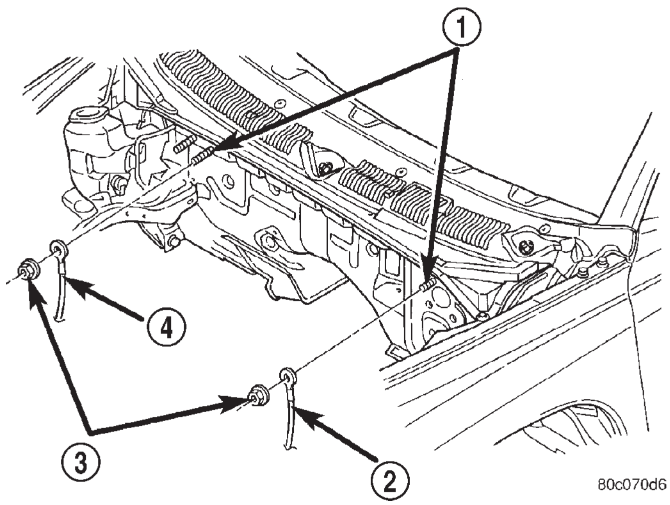


Fig. 8 Engine-To-Body Ground Strap Remove/Install - Typical

1 - WELD STUDS
2 - LEFT GROUND STRAP
3 - NUT AND WASHER (2)
4 - RIGHT GROUND STRAP

(2) On 6 and 8 cylinder engines only, remove the nut and washer that secures the right engine-to-body ground strap eyelet terminal to the inboard weld stud on the right side of the lower plenum panel (Fig. 8).

RADIO NOISE SUPPRESSION GROUND STRAP (Continued)

(3) On 4 cylinder engines only, remove the nut and washer that secures the left engine-to-body ground strap eyelet terminal to the stud on the left rear corner of the engine cylinder head (Fig. 9).

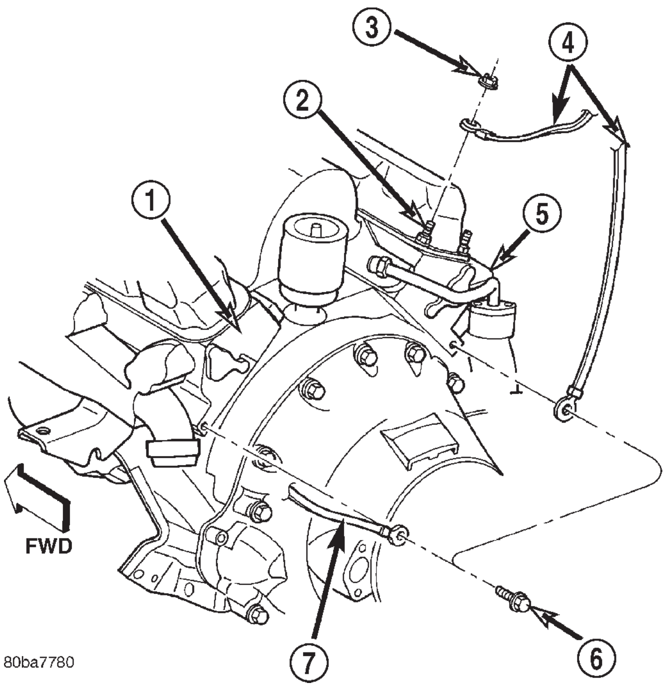


Fig. 9 Engine-To-Body Ground Strap Remove/Install

1 - LEFT CYLINDER HEAD
2 - STUD
3 - NUT
4 - RIGHT GROUND STRAP
5 - RIGHT CYLINDER HEAD
6 - SCREW (2)
7 - LEFT GROUND STRAP

(4) On 6 and 8 cylinder engines only, remove the screw that secures the left engine-to-body ground strap eyelet terminal to the rear of the left cylinder head (Fig. 10) or (Fig. 11).

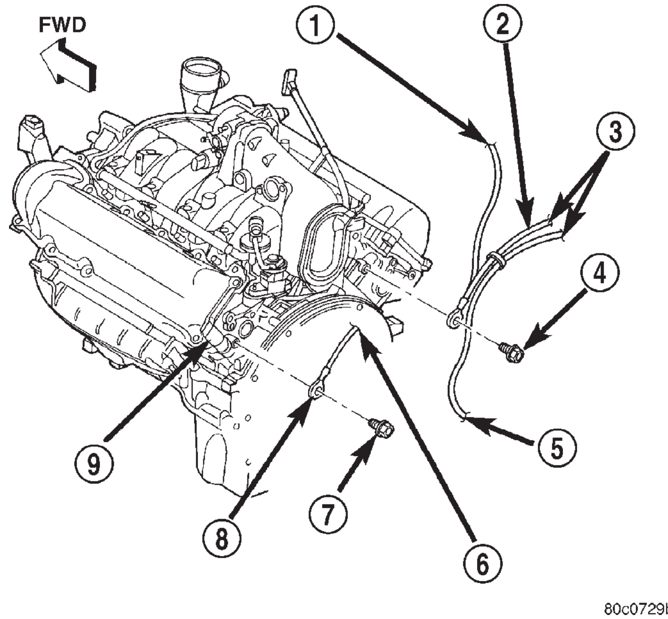


Fig. 10 Engine-To-Body Ground Strap Remove/ Install - 4.7L Engine Only

1 - TO RIGHT COWL STUD
2 - RIGHT GROUND STRAP
3 - TO RIGHT FENDER STUD
4 - SCREW
5 - TO TRANSMISSION
6 - TO LEFT COWL STUD
7 - SCREW
8 - LEFT GROUND STRAP
9 - LEFT CYLINDER HEAD

(5) On 6 and 8 cylinder engines only, remove the screw that secures the right engine-to-body ground strap eyelet terminal to the rear of the right cylinder head (Fig. 10) or (Fig. 11).

RADIO NOISE SUPPRESSION GROUND STRAP (Continued)

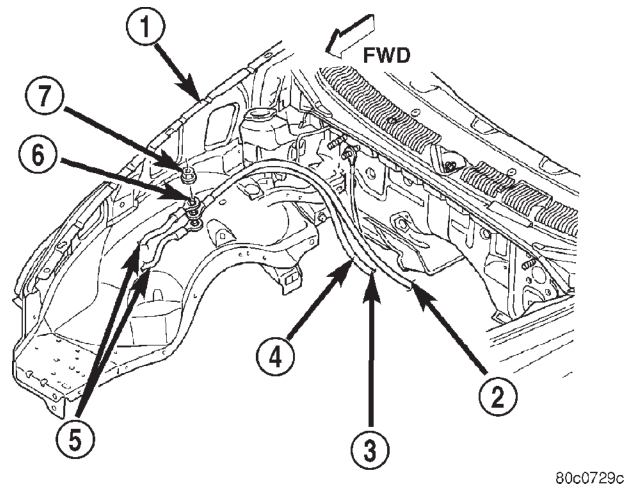


Fig. 11 Engine-To-Body Ground Strap Remove/ Install - 4.7L Engine Only

1 - RIGHT FRONT FENDER
2 - TO RIGHT CYLINDER HEAD
3 - TO TRANSMISSION
4 - RIGHT GROUND STRAP
5 - WIRE HARNESS GROUNDS
6 - WELD STUD
7 - NUT AND WASHER

(6) On 4.7L engines only, remove the nut and washer that secures the right engine-to-body ground strap eyelet terminal and the wire harness grounds to the weld stud on the right front fender wheelhouse inner panel (Fig. 12).

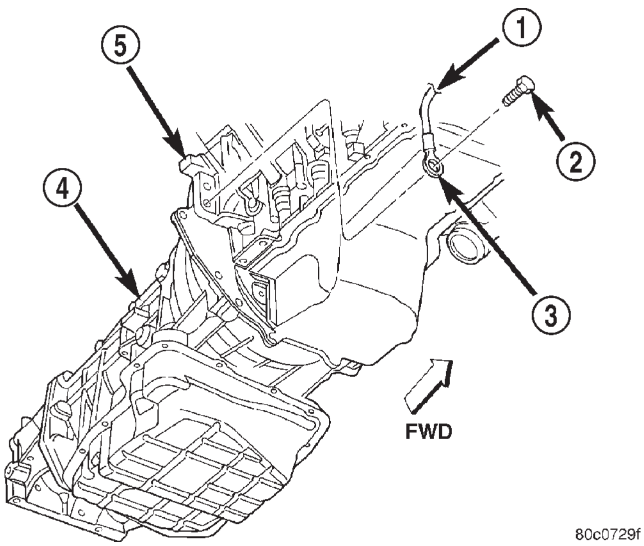


Fig. 12 Engine-To-Body Ground Strap Remove/ Install - 4.7L Engine Only

1 - TO RIGHT FENDER STUD
2 - SCREW AND WASHER
3 - RIGHT GROUND STRAP
4 - TRANSMISSION
5 - ENGINE BLOCK

(7) On 4.7L engines only, remove the screw and washer that secures the right engine-to-body ground strap eyelet terminal to the transmission at the right rear corner of the engine block (Fig. 13).

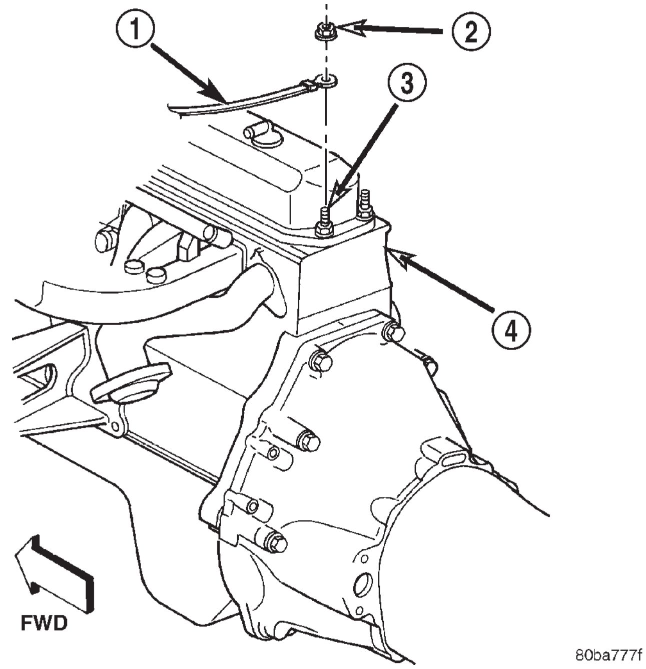


Fig. 13 Left Engine-To-Body Ground Strap Remove/Install - 4 Cylinder Engine Only

1 - LEFT GROUND STRAP
2 - NUT
3 - STUD
4 - ENGINE CYLINDER HEAD

(8) On 3.9L and 5.9L engines only, remove the nut and washer that secures the right engine-to-body ground strap eyelet terminal to the inboard rear valve cover stud of the right cylinder head (Fig. 10).

(9) Remove the engine-to-body ground strap(s) from the engine compartment.

INSTALLATION

EXHAUST SYSTEM-TO-BODY GROUND STRAP

(1) Position the exhaust system-to-body ground strap over the top of the right frame rail.

(2) Engage the clip that secures the exhaust system-to-body ground strap in the hole on the top of the right frame rail.

(3) Install and tighten the screw that secures the exhaust system-to-body ground strap eyelet terminal to the right body sill panel. Tighten the screw to 5.0 N·m (45 in. lbs.).

(4) Position the exhaust system-to-body ground strap eyelet terminal over the exhaust pipe clamp U-bolt.

(5) Install and tighten the nut and washer that secures the exhaust system-to-body ground strap eyelet terminal to the exhaust pipe clamp. Tighten the nut to 27.1 N·m (20 ft. lbs.).

(6) Lower the vehicle.

INSTALLATION

ENGINE TO BODY GROUND STRAPS

(1) Position the engine-to-body ground strap(s) in the engine compartment.

(2) On 3.9L and 5.9L engines only, position the right engine-to-body ground strap eyelet terminal over the inboard rear valve cover stud of the right cylinder head.

(3) On 3.9L and 5.9L engines only, install and tighten the nut and washer that secures the right engine-to-body ground strap eyelet terminal to the inboard rear valve cover stud of the right cylinder head. Tighten the nut to 2.8 N·m (25 in. lbs.).

(4) On 4.7L engines only, install and tighten the screw and washer that secures the right engine-to-body ground strap eyelet terminal to the transmission at the right rear corner of the engine block. Tighten the screw to 67.8 N·m (50 ft. lbs.).

(5) On 4.7L engines only, position the right engine-to-body ground strap eyelet terminal and the wire harness grounds over the weld stud on the right front fender wheelhouse inner panel.

(6) On 4.7L engines only, install and tighten the nut and washer that secures the right engine-to-body ground strap eyelet terminal and the wire harness grounds to the weld stud on the right front fender wheelhouse inner panel. Tighten the nut to 11.8 N·m (105 in. lbs.).

(7) On 6 and 8 cylinder engines only, install and tighten the screw that secures the right engine-to-body ground strap eyelet terminal to the rear of the right cylinder head. On 3.9L and 5.9L engines, tighten the screw to 10.2 N·m (90 in. lbs.). On 4.7L engines, tighten the screw to 10.7 N·m (95 in. lbs.).

(8) On 6 and 8 cylinder engines only, install and tighten the screw that secures the left engine-to-body ground strap eyelet terminal to the rear of the left cylinder head. On 3.9L and 5.9L engines, tighten the screw to 10.2 N·m (90 in. lbs.). On 4.7L engines, tighten the screw to 10.7 N·m (95 in. lbs.).

(9) On 4 cylinder engines only, position the left engine-to-body ground strap eyelet terminal over the stud on the left rear corner of the engine cylinder head.

(10) On 4 cylinder engines only, install and tighten the nut and washer that secures the left engine-to-body ground strap eyelet terminal to the stud on the left rear corner of the engine cylinder head. Tighten the nut to 2.8 N·m (25 in. lbs.).

(11) On 6 and 8 cylinder engines only, position the right engine-to-body ground strap eyelet over the inboard weld stud on the right side of the lower plenum panel.

(12) On 6 and 8 cylinder engines only, install and tighten the nut and washer that secures the right engine-to-body ground strap eyelet to the inboard weld stud on the right side of the lower plenum panel. Tighten the nut to 9 N·m (80 in. lbs.).

(13) Install and tighten the nut and washer that secures the left engine-to-body ground strap eyelet to the weld stud on the left side of the lower plenum panel. Tighten the nut to 9 N·m (80 in. lbs.).

REMOTE SWITCHES

DESCRIPTION

A remote radio switch option is available on models equipped with the AM/FM/CD/cassette/3-band graphic equalizer (RAZ sales code) radio receiver and the high-line Central Timer Module (CTM). (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL/CENTRAL TIMER MODUL - DESCRIPTION) for more information on this component.

Two rocker-type switches (Fig. 14) are mounted in the sides of the rear (instrument panel side) steering wheel trim cover. The switch on the left spoke is the seek switch and has seek up, seek down, and preset station advance functions. The switch on the right spoke is the volume control switch and has volume up, and volume down functions. The switch on the right spoke also includes a “mode” control that allows the driver to sequentially select AM radio, FM radio, cassette player or CD player. The two switches are retained in mounting holes located on each side of the rear steering wheel trim cover by four latches that are integral to the switches.

The remote radio switches share a common steering wheel wire harness with the vehicle speed control switches. The steering wheel wire harness is connected to the instrument panel wire harness through the clockspring. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - DESCRIPTION) for more information on this component.

OPERATION

The remote radio switches are resistor multiplexed units that are hard wired to the high-line CTM through the clockspring. The CTM monitors the status of the remote radio switches and sends the proper switch status messages on the J1850 data bus network to the radio receiver. The electronic circuitry within the radio is programmed to respond to these

REMOTE SWITCHES (Continued)

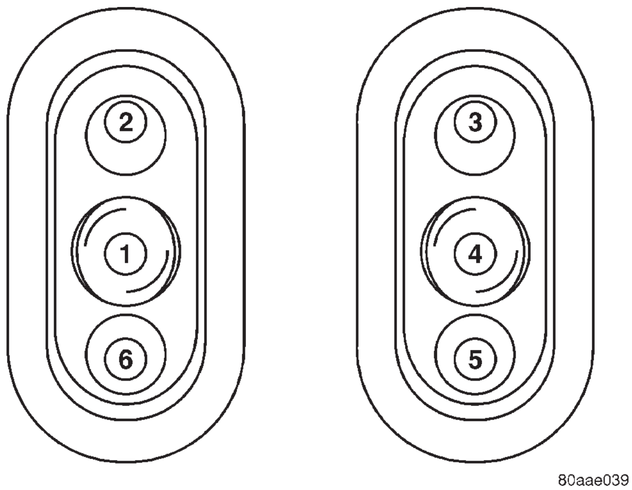


Fig. 14 Remote Radio Switches

1 - PRESET SEEK
2 - SEEK UP
3 - VOLUME UP
4 - MODE
5 - VOLUME DOWN
6 - SEEK DOWN

remote radio switch status messages by adjusting the radio settings as requested.

For diagnosis of the CTM or the J1850 data bus, the use of a DRB scan tool and the proper Diagnostic Procedures manual are recommended. For more information on the features and control functions for each of the remote radio switches, see the owner's manual in the vehicle glove box. 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 - REMOTE SWITCHES

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.

(1) Remove the remote radio switch(es) (Fig. 15) from the steering wheel.

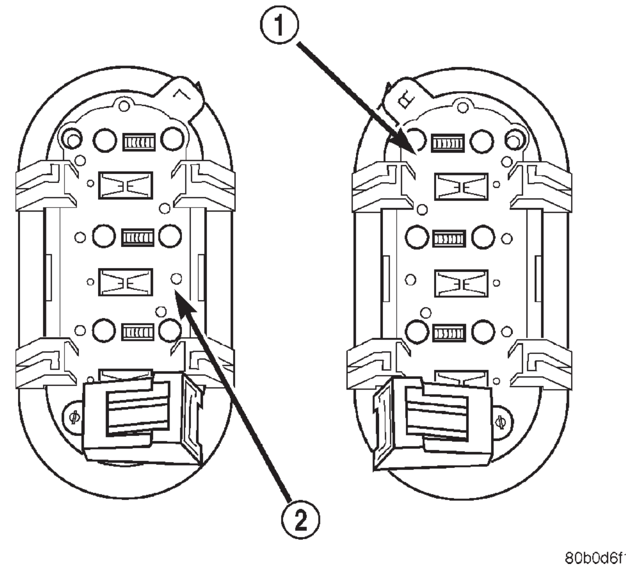


Fig. 15 Remote Radio Switches

1 - WHITE REAR SWITCH
2 - BLACK REAR SWITCH

(2) Use an ohmmeter to check the switch resistances as shown in the Remote Radio Switch Test chart. If the remote radio switch resistances check OK, go to Step 3. If not OK, replace the faulty switch.

REMOTE RADIO SWITCH TEST		
SWITCH	SWITCH POSITION	RESISTANCE
Right (White)	Neutral	24,000 Ohms
Right (White)	Volume Up	5,310 Ohms
Right (White)	Volume Down	9,250 Ohms
Right (White)	Mode	5 Ohms
Left (Black)	Seek Up	1,210 Ohms
Left (Black)	Seek Down	3,350 Ohms
Left (Black)	Pre-Set Station Advance	500 Ohms

(3) Check for continuity between the ground circuit cavity of the remote radio switch wire harness connector and a good ground. There should be conti-

REMOTE SWITCHES (Continued)

nuity. If OK, go to Step 4. If not OK, repair the open ground circuit to ground as required.

(4) Disconnect the 18-way wire harness connector from the Central Timer Module (CTM). Check for continuity between the radio control mux circuit cavity of the remote radio switch wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the shorted radio control mux circuit as required.

(5) Check for continuity between the radio control mux circuit cavities of the remote radio switch wire harness connector and the 18-way CTM wire harness connector. There should be continuity. If OK, refer to the proper Diagnostic Procedures manual to test the CTM and the J1850 data bus. If not OK, repair the open radio control mux circuit 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 driver side airbag module from the steering wheel. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL) for the procedures.

(3) Remove the speed control switch located on the same side of the steering wheel as the remote radio switch that is being serviced. Refer to **ELECTRICAL/SPEED CONTROL** for the procedures.

(4) Disconnect the steering wheel wire harness connector from the connector receptacle of the remote radio switch (Fig. 16).

(5) Disengage the four remote radio switch latches that secure the switch to the inside of the mounting hole in the steering wheel rear trim cover .

(6) From the outside of the steering wheel rear trim cover, remove the remote radio switch from the trim cover mounting hole.

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) Position the remote radio switch to the mounting hole on the outside of the steering wheel rear trim cover. Be certain that the connector receptacle is oriented toward the bottom of the switch and pointed toward the center of the steering wheel.

(2) Press firmly and evenly on the remote radio switch until each of the switch latches is fully engaged in the mounting hole of the steering wheel rear trim cover.

(3) Reconnect the steering wheel wire harness connector to the connector receptacle of the remote radio switch.

(4) Install the speed control switch onto the steering wheel. Refer to **ELECTRICAL/SPEED CONTROL** for the procedures.

(5) Install the driver side airbag module onto the steering wheel. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION) for the procedures.

(6) Reconnect the battery negative cable.

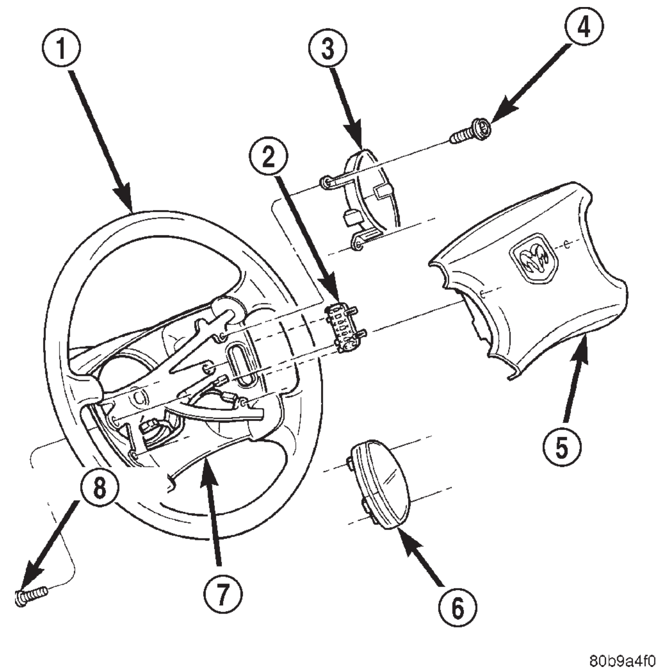


Fig. 16 Remote Radio Switches Remove/Install

1 - STEERING WHEEL
2 - REMOTE RADIO SWITCH
3 - SPEED CONTROL SWITCH
4 - SCREW (2)
5 - DRIVER SIDE AIRBAG MODULE
6 - SPEED CONTROL SWITCH
7 - REAR TRIM COVER
8 - SCREW (2)

SPEAKER

DESCRIPTION

STANDARD

The standard equipment speaker system includes speakers in four locations. One full-range 16.5 centimeter (6.50 inch) diameter speaker is located in each front door. There is also one full-range speaker located in each rear cab side panel, 13.3 centimeter (5.25 inch) diameter units for the standard cab models, and 16.5 centimeter (6.50 inch) diameter units for the club cab models. On quad cab models, the 16.5 centimeter (6.50 inch) diameter full-range speaker units are located in each rear door, instead of in the cab side panel.

PREMIUM

The optional premium speaker system features Infinity model speakers in six locations. Each of the standard speakers in the four speaker stereo system are replaced with Infinity model speakers, and an additional 6.9 centimeter (2.75 inch) diameter Infinity dome tweeter is mounted high in the front door trim panels. The premium speaker system also includes an additional Infinity power amplifier. The total available power of the premium speaker system is about 120 watts.

OPERATION

STANDARD

Each of the four full-range speakers used in the standard speaker system is driven by the amplifier that is integral to the factory-installed radio receiver. 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.

PREMIUM

The six Infinity speakers used in the premium speaker system are all driven by the radio receiver through an Infinity power amplifier. 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 - SPEAKER

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. Go to Step 2.

(2) Turn the radio receiver off. Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the radio receiver from the instrument panel. If the vehicle is equipped with the Infinity speaker package, also disconnect the wire harness connectors at the power amplifier. Check both the speaker feed (+) circuit and return (–) circuit cavities for the inoperative speaker location(s) at the radio receiver wire harness connectors for continuity to ground. In each case, there should be no continuity. If OK, go to Step 3. If not OK, repair the shorted speaker feed (+) and/or return (–) circuit(s) to the speaker as required.

(3) If the vehicle is equipped with the Infinity speaker package, go to Step 6. If the vehicle is equipped with the standard speaker system, check the resistance between the speaker feed (+) circuit and return (–) circuit cavities of the radio receiver wire harness connectors for the inoperative speaker location(s). The meter should read between 2 and 28 ohms (speaker resistance). If OK, go to Step 4. If not OK, go to Step 5.

(4) Install a known good radio receiver. Connect the battery negative cable. Turn the ignition switch to the On position. Turn on the radio receiver and test the speaker operation. If OK, replace the faulty radio receiver. If not OK, turn the radio receiver off, turn the ignition switch to the Off position, discon-

SPEAKER (Continued)

nect and isolate the battery negative cable, remove the test radio receiver, and go to Step 5.

(5) Disconnect the wire harness connector at the inoperative speaker. Check for continuity between the speaker feed (+) circuit cavities of the radio receiver wire harness connector and the speaker wire harness connector. Repeat the check between the speaker return (–) circuit cavities of the radio receiver wire harness connector and the speaker wire harness connector. In each case, there should be continuity. If OK, replace the faulty speaker. If not OK, repair the open speaker feed (+) and/or return (–) circuit(s) as required.

(6) For each inoperative speaker location, check for continuity between the speaker feed (+) circuit cavities of the radio receiver wire harness connectors and the power amplifier wire harness connectors. Repeat the check for each inoperative speaker location between the speaker return (–) circuit cavities of the radio receiver wire harness connectors and the power amplifier wire harness connectors. In each case, there should be continuity. If OK, go to Step 7. If not OK, repair the open speaker feed (+) and/or return (–) circuit(s) as required.

(7) Check for continuity between the two ground circuit cavities of the power amplifier wire harness connector and a good ground. There should be continuity. If OK, go to Step 8. If not OK, repair the open ground circuit(s) to ground as required.

(8) Check the power amplifier fuse in the junction block. If OK, go to Step 9. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(9) Install the radio receiver. Connect the battery negative cable. Check for battery voltage at the power amplifier fuse in the junction block. If OK, go to Step 10. If not OK, repair the open fused B(+) circuit to the PDC as required.

(10) Check for battery voltage at the two fused B(+) circuit cavities of the power amplifier wire harness connector. If OK, go to Step 11. If not OK, repair the open fused B(+) circuit(s) to the fuse in the junction block as required.

(11) Turn the ignition switch to the On position. Turn the radio receiver on. Check for battery voltage at the radio 12 volt output circuit cavity of the power amplifier wire harness connector. If OK, go to Step 12. If not OK, repair the open radio 12 volt output circuit to the radio receiver as required.

(12) Turn the radio receiver off. Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. For each inoperative speaker location, check both the amplified feed (+) circuit and the amplified return (–) circuit cavities of the power amplifier wire harness connectors for continuity to ground. In each case there should be no continuity. If OK, go to Step 13. If not OK, repair the shorted amplified feed (+) and/or amplified return (–) circuit(s) to the speaker as required.

(13) For each inoperative speaker location, check the resistance between the amplified feed (+) circuit and the amplified return (–) circuit cavities of the power amplifier wire harness connectors. The meter should read between 2 and 28 ohms (speaker resistance). If OK, replace the faulty power amplifier. If not OK, go to Step 14.

(14) Disconnect the speaker wire harness connector at the inoperative speaker. Check for continuity between the amplified feed (+) circuit cavities of the speaker wire harness connector and the power amplifier wire harness connector. Repeat the check between the amplified return (–) circuit cavities of the speaker wire harness connector and the power amplifier wire harness connector. In each case there should be continuity. If OK, replace the faulty speaker. If not OK, repair the open amplified feed (+) and/or amplified return (–) circuit(s) as required.

SPEAKER - FRONT DOOR UPPER

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the trim panel from the front door. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL)

(3) Remove the screws that secure the front door upper speaker to the back of the trim panel.

(4) Remove the front door upper speaker from the trim panel.

INSTALLATION

(1) Position the front door upper speaker to the back of the trim panel.

(2) Install and tighten the screws that secure the front door upper speaker to the trim panel. Tighten the screws to 1.3 N·m (12 in. lbs.).

(3) Reconnect the door wire harness connector to the front door upper speaker wire harness connector.

(4) Install the trim panel onto the front door. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION).

(5) Connect the battery negative cable.

SPEAKER - FRONT DOOR LOWER

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the trim panel from the front door. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL).

(3) Remove the screws that secure the speaker to the front door (Fig. 17).

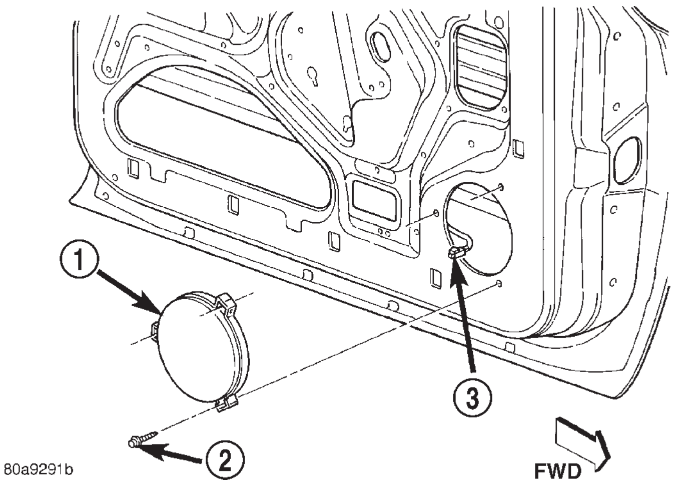


Fig. 17 Front Door Lower Speaker Remove/Install

1 - SPEAKER
2 - SCREW
3 - CONNECTOR

(4) Pull the speaker away from the mounting hole in the front door inner panel far enough to access the wire harness connector.

(5) Disconnect the front door wire harness connector from the speaker.

(6) Remove the speaker from the front door inner panel.

INSTALLATION

(1) Position the speaker to the front door.

(2) Reconnect the front door wire harness connector to the speaker.

(3) Position the speaker into the mounting hole in the front door.

(4) Install and tighten the screws that secure the speaker to the front door. Tighten the screws to 2 N·m (17 in. lbs.).

(5) Install the trim panel onto the front door. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION).

(6) Connect the battery negative cable.

SPEAKER - REAR DOOR

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the trim panel from the rear door. (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - REMOVAL).

(3) Remove the screws that secure the speaker to the rear door (Fig. 18).

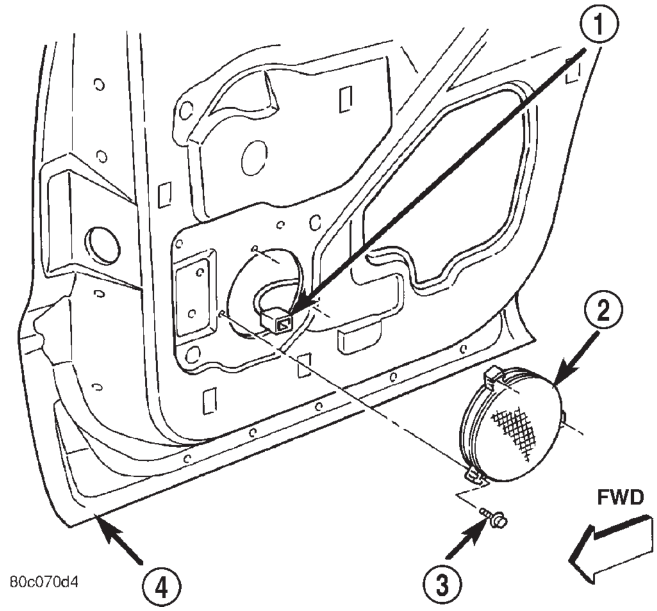


Fig. 18 Rear Door Speaker Remove/Install - Quad Cab

1 - CONNECTOR
2 - SPEAKER
3 - SCREW (3)
4 - REAR DOOR

(4) Pull the speaker away from the mounting hole in the rear door far enough to access the wire harness connector.

(5) Disconnect the rear door wire harness connector from the speaker.

(6) Remove the speaker from the rear door.

INSTALLATION

(1) Connect the rear door wire harness connector to the speaker.

(2) Position the speaker into the mounting hole in the rear door inner panel.

(3) Install and tighten the screws that secure the speaker to the rear door. Tighten the screws to 3.9 N·m (35 in. lbs.).

(4) Install the trim panel onto the rear door. (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - INSTALLATION).

(5) Connect the battery negative cable.

SPEAKER - REAR CAB SIDE - CLUB CAB

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the trim panel from the rear cab side inner panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL).

(3) Remove the three screws that secure the speaker to the rear cab side inner panel (Fig. 19).

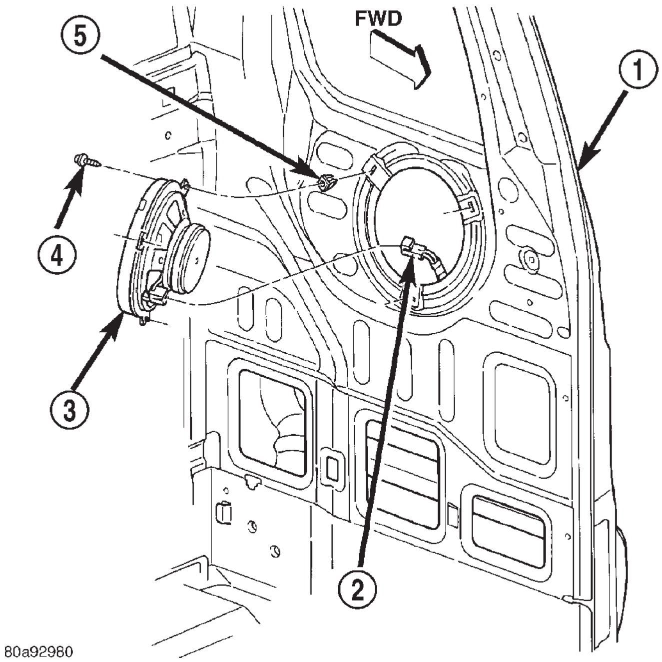


Fig. 19 Rear Cab Side Panel Speaker Remove/Install - Club Cab

1 - REAR CAB SIDE
2 - WIRE HARNESS CONNECTOR
3 - SPEAKER
4 - SCREW
5 - CLIP

(4) Pull the speaker away from the mounting hole in the rear cab side inner panel far enough to access the wire harness connector.

(5) Disconnect the body wire harness connector from the speaker connector receptacle.

(6) Remove the speaker from the rear cab side inner panel.

INSTALLATION

(1) Position the speaker to the rear cab side inner panel.

(2) Reconnect the body wire harness connector to the speaker connector receptacle.

(3) Position the speaker into the mounting hole in the rear cab side inner panel.

(4) Install and tighten the three screws that secure the speaker to the rear cab side inner panel. Tighten the screws to 2 N·m (17 in. lbs.).

(5) Install the trim panel onto the rear cab side inner panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION).

(6) Reconnect the battery negative cable.

SPEAKER - REAR CAB SIDE - REGULAR CAB

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the trim panel from the B-pillar.(Refer to 23 - BODY/INTERIOR/B-PILLAR TRIM - REMOVAL).

(3) Pull the B-pillar trim away from the cab side panel far enough to access the speaker wire harness connector (Fig. 20).

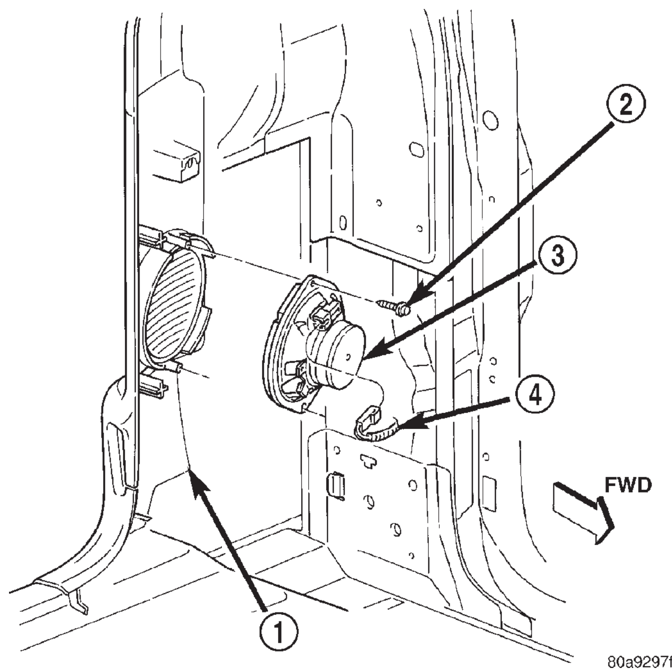


Fig. 20 Rear Cab Side Panel Speaker Remove/Install - Standard Cab

1 - B-PILLAR TRIM PANEL
2 - SCREW
3 - SPEAKER
4 - WIRE HARNESS CONNECTOR

(4) Disconnect the body wire harness connector from the speaker connector receptacle.

SPEAKER - REAR CAB SIDE - REGULAR CAB (Continued)

(5) Remove the two screws that secure the speaker to the back of the B-pillar trim.

(6) Remove the speaker from the back of the B-pillar trim.

INSTALLATION

(1) Position the speaker onto the back of the B-pillar trim.

(2) Install and tighten the two screws that secure the speaker to the back of the B-pillar trim. Tighten the screws to 2 N·m (17 in. lbs.).

(3) Reconnect the body wire harness connector to the speaker connector receptacle.

(4) Install the trim panel onto the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR TRIM - INSTALLATION).

(5) Reconnect 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 Central Timer Module (CTM) 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 manual:

- **Central Timer Module** - The Central Timer Module (CTM) is located on the cowl side inner panel, below the driver side end of the instrument panel. The CTM 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 CTM circuitry monitors hard wired switch inputs as well as electronic messages received from other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus network.
- **Door Ajar Switch** - Door ajar switches are integral to each door latch. These switches provide inputs to the chime warning system indicating whether a door is opened or closed.
- **Headlamp Switch** - The headlamp switch is located on the instrument panel outboard of the steering column. The headlamp switch provides input to the chime warning system indicating whether any interior or exterior lighting is turned On or Off.
- **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.

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 CTM chime warning system circuitry and the integral chime tone generator cannot be adjusted or repaired. If the CTM or the chime tone generator are damaged or faulty, the CTM 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 a fused B(+) fuse in the Junction Block (JB) 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 indication to the vehicle operator under the following conditions:

- **Compass Mini-Trip Computer (CMTC) Reset** - The Central Timer Module (CTM) chime tone generator will generate one chime tone each time a Programmable Communications Interface (PCI) data bus message is received from the optional CMTC indicating that the CMTC data has been reset.
- **Door Ajar Warning** - The CTM chime tone generator will generate repetitive chime tones at a slow rate to announce that a hard wired input from any door ajar switch indicates that a door is open with the ignition switch in the On position. The chimes will continue to sound until the all doors are closed or the ignition switch is turned to the Off position, whichever occurs first.
- **Fasten Seat Belt Warning** - The CTM chime tone generator will generate repetitive chime tones at

CHIME WARNING SYSTEM (Continued)

a slow rate to announce that a hard wired input from the seat belt switch to the Electro-Mechanical Instrument Cluster (EMIC) indicates that the driver side front seat belt is not fastened with the ignition switch in the On position. Unless the driver side front seat belt is fastened the chimes will continue to sound for a duration of about seven seconds each time the ignition switch is turned to the On position, or until the driver side front seat belt is fastened, whichever occurs first. This chime tone is based upon a PCI data bus chime request message input to the CTM from the EMIC, but is not tied to the operation of the EMIC "Seatbelt" indicator.

- **Head/Park/Courtesy Lights-On Warning** - The CTM chime tone generator will generate repetitive chime tones at a fast rate to announce that hard wired inputs from the driver door ajar switch, headlamp switch, and ignition switch indicate that the exterior or courtesy lamps are turned On with the driver side front door opened and the ignition switch in the Off position. The chimes will continue to sound until the exterior or courtesy lamps are turned Off, the driver side front door is closed, or the ignition switch is turned to the On position, whichever occurs first.
- **Key-In-Ignition Warning** - The CTM chime tone generator will generate repetitive chime tones at a fast rate to announce that hard wired inputs from the driver door ajar switch, headlamp switch, and ignition switch indicate that the key is in the ignition lock cylinder with the driver side front 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 side front door is closed, or the ignition switch is turned to the On position, whichever occurs first.
- **Overspeed Warning** - The CTM chime tone generator will generate repetitive chime tones at a slow rate to announce that a PCI data bus vehicle speed message from the Powertrain Control Module (PCM) indicates that the vehicle speed is over a programmed speed value. This feature is only enabled on a CTM that has been programmed with a Middle East Gulf Coast Country (GCC) country code.
- **Warning Chime Support** - The CTM chime tone generator will generate repetitive chime tones at a slow rate to announce that a PCI data bus chime request message input has been received from the EMIC or the Airbag Control Module (ACM). These chime tones provide an audible alert to the vehicle operator that supplements certain visual indications displayed by the EMIC. Supplemented indications include the following:
- The "Airbag" indicator is illuminated. The ACM sends a chime request to the CTM at the same time it sends an airbag lamp-on request to the EMIC. The chimes will continue to sound for a duration of about four seconds each time the indicator is illuminated or until the ignition switch is turned to the Off position, whichever occurs first.
- The "Check Gages" indicator is illuminated. The EMIC sends a chime request to the CTM. The chimes will continue to sound for a duration of about two seconds each time the indicator is illuminated or until the ignition switch is turned to the Off position, whichever occurs first.
- The "Low Coolant" indicator is illuminated (diesel engine only). The EMIC sends a chime request to the CTM. The chimes will continue to sound for a duration of about two seconds each time the indicator is illuminated or until the ignition switch is turned to the Off position, whichever occurs first.
- The "Low Fuel" indicator is illuminated. The EMIC sends a chime request to the CTM. The chimes will continue to sound for a duration of about two seconds each time the indicator is illuminated or until the ignition switch is turned to the Off position, whichever occurs first.
- The "Low Wash" indicator is illuminated. The EMIC sends a chime request to the CTM. The chimes will continue to sound for a duration of about two seconds each time the indicator is illuminated or until the ignition switch is turned to the Off position, whichever occurs first.
- The "Trans Temp" indicator is illuminated (automatic transmission only). The EMIC sends a chime request to the CTM. The chimes will continue to sound for a duration of about two seconds each time the indicator is illuminated or until the ignition switch is turned to the Off position, whichever occurs first.
- A turn signal indicator is illuminated after the vehicle has surpassed a programmed speed and distance. The EMIC sends a chime request to the CTM. The chimes will continue to sound until the turn signal is turned Off, or until the vehicle speed is reduced below the programmed level, whichever occurs first.
- The "Water-In-Fuel" indicator is illuminated (diesel engine only). The EMIC sends a chime request to the CTM. The chimes will continue to sound for a duration of about two seconds each time the indicator is illuminated or until the ignition switch is turned to the Off position, whichever occurs first.

The CTM provides chime service for all available features in the chime warning system. The CTM relies upon its internal programming and hard wired inputs from the door ajar switches, the headlamp switch, and the key-in ignition switch (ignition switch) to provide chime service for the head/park/courtesy lights-on reminder, the key-in ignition

CHIME WARNING SYSTEM (Continued)

reminder, and the door ajar warning. The CTM relies upon electronic message inputs received from other electronic modules over the PCI data bus network to provide chime service for all of the remaining chime warning system features. Upon receiving the proper inputs, the CTM activates the integral chime tone generator to provide the audible chime tone to the vehicle operator. The chime tone generator in the CTM is capable of producing a single short beep and repeated chime tones at two different rates, slow or fast. The slow chime rate is about fifty chime tones per minute, while the fast chime rate is about 180 chime tones per minute. The internal programming of the CTM 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 CTM, as well as other hard wired circuits for this system may be diagnosed and tested using conventional diagnostic tools and procedures. 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 hard wired chime warning system inputs to the Central Timer Module (CTM), as well as other hard wired circuits for this system may be diagnosed and tested using conventional diagnostic tools and procedures.

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.

CHIME WARNING SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
DOOR AJAR WARNING CHIME WITH DOORS CLOSED	1. Driver or passenger door ajar switch sense circuit shorted.	1. Disconnect the door wire harness connector for the driver door ajar switch or the passenger door ajar switch (1 switch - standard/club cab, 3 switches - quad cab) and the body wire harness connector (Connector C2) for the CTM. Check for continuity between the driver or passenger door ajar switch sense circuit cavity and a good ground. There should be no continuity. Repair the shorted driver or passenger door ajar switch sense circuit, if required.
	2. Faulty driver or passenger door ajar switch.	2. Check for continuity between the ground circuit cavity and the driver or passenger door ajar switch sense circuit cavity of the door ajar switch pigtail wire connector. There should be no continuity with the door closed. Replace the faulty door latch, if required.

CHIME WARNING SYSTEM (Continued)

CHIME WARNING SYSTEM DIAGNOSIS		
CONDITION	POSSIBLE CAUSES	CORRECTION
NO DOOR AJAR WARNING CHIME WITH A DOOR OPENED, BUT OTHER CHIME FEATURES OK	1. Driver or passenger door ajar switch ground circuit open.	1. Check for continuity between the ground circuit cavity of the door wire harness connector for the driver or passenger door ajar switch (1 switch - standard/club cab, 3 switches - quad cab) and a good ground. If not OK, repair the open ground circuit to ground as required.
	2. Driver or passenger door ajar switch sense circuit open.	2. Check for continuity between the driver or passenger door ajar switch sense circuit cavities of the door wire harness connector for the driver or passenger door ajar switch and the body wire harness connector (Connector C2) for the CTM. Repair the open driver or passenger door ajar switch sense circuit, if required.
	3. Faulty driver or passenger door ajar switch.	3. Check for continuity between the ground circuit cavity and the driver or passenger door ajar switch sense circuit cavity of the door ajar switch pigtail wire connector. There should be continuity with the door opened. Replace the faulty door latch, if required.
NO KEY-IN IGNITION WARNING CHIME, BUT OTHER CHIME FEATURES OK	1. Ignition switch ground circuit open.	1. Check for continuity between the ground circuit cavity of the instrument panel wire harness connector for the ignition switch and a good ground. Repair the open ground circuit to ground, 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 instrument panel wire harness connector for the ignition switch and the instrument panel wire harness connector (Connector C1) for the CTM. Repair the open key-in ignition switch sense circuit, if required.
	3. Faulty ignition switch.	3. Check for continuity between the key-in ignition switch sense circuit terminal and the ground circuit terminal in the ignition switch connector receptacle. There should be continuity with the key in the ignition lock cylinder. Replace the faulty ignition switch, if required.
KEY-IN IGNITION WARNING CHIME WITH KEY REMOVED FROM IGNITION LOCK CYLINDER	1. Key-in ignition switch sense circuit shorted.	1. Disconnect the instrument panel wire harness connector for the ignition switch and the instrument panel wire harness connector (Connector C1) for the CTM. Check for continuity between the key-in ignition switch sense circuit cavity and a good ground. There should be no continuity. Repair the shorted key-in ignition switch sense circuit, if required.

CHIME WARNING SYSTEM (Continued)

CHIME WARNING SYSTEM DIAGNOSIS		
CONDITION	POSSIBLE CAUSES	CORRECTION
	2. Faulty ignition switch.	2. Check for continuity between the key-in ignition switch sense circuit terminal and the ground circuit terminal in the ignition switch connector receptacle. There should be no continuity with the key removed from the ignition lock cylinder. Replace the faulty ignition switch, if required.
NO CHIMES AND OTHER CTM FEATURES ERRATIC OR DISABLED	1. CTM ground circuit(s) open.	1. Check for continuity between the three ground circuit cavities of the instrument panel wire harness connector (Connector C1) for the CTM and a good ground. Repair the open ground circuit(s), if required.
	2. CTM fused B(+) circuit(s) open.	2. Check for battery voltage at the two fused B(+) circuit cavities of the headlamp and dash wire harness connector (Connector C3) for the CTM. Repair the open fused B(+) circuits, if required.
	3. CTM fused ignition switch output (run-start and/or run-acc) circuit(s) open.	3. With the ignition switch in the On position, check for battery voltage at the fused ignition switch output (run-start and run-acc) circuit cavities of the instrument panel wire harness connector (Connector C1) for the CTM. Repair the open fused ignition switch output circuit(s), if required.
	4. Faulty CTM.	4. Replace the faulty CTM, if required.
NO WARNING CHIME SUPPORT FEATURES FOR EMIC AND/OR CMTC, BUT HARD WIRED CHIMES OK	1. Faulty PCI data bus communication.	1. Use a DRBIII® scan tool to diagnose the PCI data bus and electronic messaging between the CTM, EMIC, and CMTC. Refer to the appropriate diagnostic information. Repair the faulty data bus or replace the faulty electronic modules, if required.
NO CHIMES, BUT ALL OTHER CTM FEATURES OK	1. Faulty CTM.	1. Replace the faulty CTM, 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 secure 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).

ELECTRONIC CONTROL MODULES (Continued)

(6) Press ENTER to transfer the secret key (the SKIM will send the secret key to the PCM).

(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.

CENTRAL TIMER MODULE

DESCRIPTION

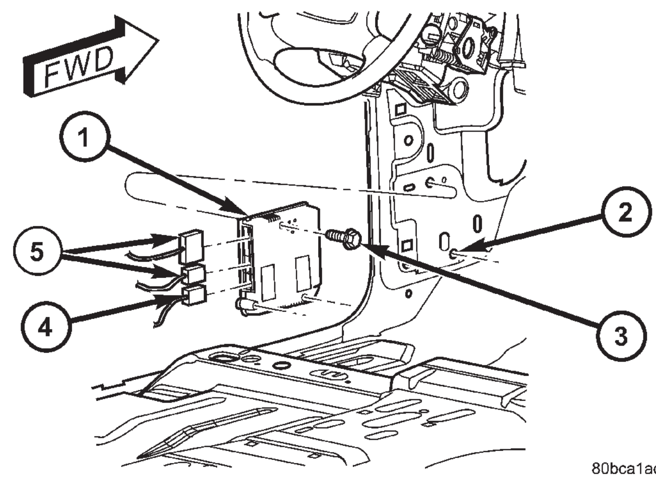

Fig. 1 Central Timer Module

1 - CENTRAL TIMER MODULE
2 - COWL SIDE INNER PANEL
3 - SCREW (3)
4 - BODY WIRE HARNESS CONNECTOR
5 - INSTRUMENT PANEL WIRE HARNESS CONNECTOR (2)

Two versions of the Central Timer Module (CTM) are available on this vehicle, a base version and a high-line version (Fig. 1). Whichever version of the CTM the vehicle is equipped with, it is concealed behind the trim on the left cowl side inner panel below the instrument panel, where it is secured with three screws. The CTM is enclosed in a molded plastic housing with three integral external connector receptacles that connect it to the vehicle electrical system through one take out and connector of the body wire harness, and two take outs and connectors

CENTRAL TIMER MODULE (Continued)

of the instrument panel wire harness. The base version of the CTM is used on base models of this vehicle. These base models are not equipped with the optional power lock system, the Remote Keyless Entry (RKE) system, the Vehicle Theft Security System (VTSS), or the remote radio controls. The high-line version of the CTM is used on high-line vehicles that are equipped with one or more of those options not found on base models.

The CTM utilizes integrated circuitry and information carried on the Programmable Communications Interface (PCI) data bus network along with many hard wired inputs to monitor many sensor and switch inputs throughout the vehicle. In response to those inputs, the internal circuitry and programming of the CTM allow it to supply the vehicle occupants with audible and visual information, and to control and integrate many electronic functions and features of the vehicle through both hard wired outputs and the transmission of electronic message outputs to other electronic modules in the vehicle over the PCI data bus.

The features that the CTM supports or controls include the following:

- **Automatic Door Lock** - The high-line CTM provides an automatic door lock feature (also known as rolling door locks). This is a programmable feature.
- **Battery Protection** - The CTM provides a battery saver feature that performs timed load shedding whenever courtesy, reading, visor vanity, center console, glove box, cargo lamps, or any exterior lamps are left on with the ignition switch in the Off position.
- **Central Locking** - The high-line CTM on vehicles equipped with the optional Vehicle Theft Security System (VTSS) includes a central locking/unlocking feature.
- **Chimes** - All versions of the CTM provide chime service and beep request service through an integral chime tone generator.
- **Door Lock Inhibit** - The high-line CTM provides a power door lock inhibit feature.
- **Enhanced Accident Response** - The high-line CTM provides an optional enhanced accident response feature. This is a programmable feature.
- **Exterior Light Features** - The CTM provides control of park lamps, fog lamps, and headlamps. This includes support for optical horn (also known as flash-to-pass), headlamp time delay, cargo lamps, daytime running lamps (DRL - Canada only), and battery saver features.
- **Interior Light Features** - The CTM provides control of courtesy lamps and dome lamps. This includes support for a timed illuminated entry with fade-to-off, interior lighting delay, courtesy illumination defeat, and battery saver features.
- **Intermittent Wipe Control** - The CTM provides control of the intermittent wipe delay, and wipe-after-wash features for the wiper and washer system.
- **Panic Mode** - The high-line CTM provides support for the optional RKE system panic mode including horn chirp, headlamp flash, and park lamp flash features.
- **Power Lock Control** - The high-line CTM provides the optional power lock system features, including support for the automatic door lock and door lock inhibit modes.
- **Programmable Features** - The CTM provides support for certain programmable features.
- **Remote Keyless Entry** - The high-line CTM provides the optional Remote Keyless Entry (RKE) system features, including support for the RKE Lock (with optional horn chirp and park lamps flash), Unlock (with optional park lamps flash), Panic, and illuminated entry modes, as well as the ability to be programmed to recognize up to four RKE transmitters. The RKE horn chirp, park lamps flash features are programmable. On quad cab models only, a driver-door-only unlock or unlock-all-doors feature is also programmable.
- **Remote Radio Switch Interface** - The high-line CTM monitors and transmits the status of the optional remote radio switches on the steering wheel.
- **Speed Sensitive Intermittent Wipe Control** - The CTM provides a speed sensitive intermittent wipe feature.
- **Vehicle Theft Security System** - The high-line CTM provides control of the optional Vehicle Theft Security System (VTSS) features, including support for the central locking/unlocking mode and control of the Security indicator in the instrument cluster.

Hard wired circuitry connects the CTM 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 CTM 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.

All versions of the CTM for this model are serviced only as a complete unit. Many of the electronic features in the vehicle controlled or supported by the

CENTRAL TIMER MODULE (Continued)

CTM are programmable using the DRBIII® scan tool. In addition, the CTM software is Flash compatible, which means it can be reprogrammed using Flash reprogramming procedures. However, if any of the CTM hardware components are damaged or faulty, the entire CTM unit must be replaced. The hard wired inputs or outputs of all CTM versions can be diagnosed using conventional diagnostic tools and methods; however, for diagnosis of the CTM or the PCI data bus, the use of a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

OPERATION

The microprocessor-based Central Timer Module (CTM) monitors many hard wired switch and sensor inputs as well as those resources it shares with other electronic modules in the vehicle through its communication over the Programmable Communications Interface (PCI) data bus network. The internal programming and all of these inputs allow the CTM microprocessor to determine the tasks it needs to perform and their priorities, as well as both the standard and optional features that it should provide. The CTM programming then performs those tasks and provides those features through both PCI data bus communication with other electronic modules and through hard wired outputs through a number of driver circuits, relays, and actuators. These outputs allow the CTM the ability to control numerous accessory systems in the vehicle.

The CTM operates on battery current received through two fuses in the Junction Block (JB) on two non-switched fused B(+) circuits, a fused ignition switch output (run-start) circuit, and a fused ignition switch output (run-acc) circuit. This arrangement allows the CTM to provide some features regardless of the ignition switch position, while other features will operate only with the ignition switch in the Accessory, On, and/or Start positions. The CTM receives ground through its connector and take out of the instrument panel wire harness on three separate ground circuits. Two of these circuits are grounded through a take out of the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the left inner cowl side panel near the CTM, while the third circuit is grounded through a take out of the instrument panel wire harness with an eyelet terminal connector that is secured by a ground screw to the left side of the floor panel transmission tunnel near the Airbag Control Module (ACM).

The CTM monitors its own internal circuitry as well as many of its input and output circuits, and will store a Diagnostic Trouble Code (DTC) in electronic memory for any failure it detects. These DTCs can be retrieved and diagnosed using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

HARD WIRED INPUTS

The hard wired inputs to the CTM include the following:

- Cargo lamp switch sense
- Courtesy lamp switch sense
- Cylinder lock switch sense - high line with VTSS only
- Driver door ajar switch sense
- Driver door switch mux - high line with power locks only
- Fog lamp switch sense
- Front washer pump/motor control
- Front wiper park switch sense
- Fused B(+) (two circuits)
- Fused ignition switch output (run-acc)
- Fused ignition switch output (run-start)
- Ground (three circuits)
- Headlamp switch off sense
- High beam switch output
- Interior lamp defeat
- Intermittent front wiper mode sense
- Intermittent front wiper switch signal
- Key-in ignition switch sense
- Low beam switch output
- Park brake switch sense
- Park lamp switch sense
- Passenger door ajar switch sense
- Passenger door switch mux - high line with power locks only
- PCI bus circuit
- Radio control mux - high-line with remote radio switches only
- Washer switch sense
- Wiper park switch sense
- Wiper switch mode sense
- Wiper switch mode signal

HARD WIRED OUTPUTS

The hard wired outputs of the CTM include the following:

- Cargo lamp driver
- Courtesy lamp driver
- Door lock relay output - high-line with power locks only
- Door unlock relay output - high-line with power locks only
- Driver door unlock relay output - quad cab high-line with power locks only
- Fog lamp relay control - with fog lamps only
- Front washer pump/motor control
- Front wiper park switch sense
- Front wiper relay control
- Glove box lamp driver

CENTRAL TIMER MODULE (Continued)

- High beam indicator driver
- Horn relay control - high-line with power locks only
- Interior lamp driver
- Left high beam driver
- Left low beam driver
- Park lamp relay control
- Right high beam driver
- Right low beam driver
- VTSS indicator driver - high-line with VTSS only

MESSAGING

The CTM uses the following messages received from other electronic modules over the PCI data bus:

- Airbag Deploy (ACM)
- Beep request (CMTC)
- Charging System Failure (PCM)
- Chime request (EMIC)
- Engine RPM (PCM)
- OK to Arm VTSS (PCM)
- Security indicator request (SKIM)
- System Voltage (PCM)
- Valid/Invalid Key (SKIM)
- Vehicle Distance (PCM)
- Vehicle Speed (PCM)
- Voltage Fault (PCM)

The CTM provides the following messages to other electronic modules over the PCI data bus:

- Door Ajar Status (EMIC)
- Park Brake Status (CAB, EMIC, TCM)
- Radio Mode (Radio)
- Radio Preset Scan (Radio)
- Radio Seek Down (Radio)
- Radio Seek Up (Radio)
- Radio Volume Down (Radio)
- Radio Volume Up (Radio)

DIAGNOSIS AND TESTING - CENTRAL TIMER MODULE

The hard wired inputs to and outputs from the Central Timer Module (CTM) may be diagnosed and tested using conventional diagnostic tools and methods. 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.

However, conventional diagnostic methods may not prove conclusive in the diagnosis of the CTM. In order to obtain conclusive testing of the CTM, the Programmable Communications Interface (PCI) data bus network and all of the electronic modules that provide inputs to or receive outputs from the CTM must also be checked. The most reliable, efficient, and accurate means to diagnose the CTM, the PCI data bus network, and the electronic modules that provide inputs to or receive outputs from the CTM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. The DRBIII® scan tool can provide confirmation that the PCI data bus network is functional, that all of the electronic modules are sending and receiving the proper messages over the PCI data bus, and that the CTM is receiving the proper hard wired inputs and responding with the proper hard wired outputs needed to perform its many functions.

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.

NOTE: The following tests may not prove conclusive in the diagnosis of the Central Timer Module (CTM). The most reliable, efficient, and accurate means to diagnose the CTM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

(1) Check the fused B(+) fuses (Fuse 3 - 20 ampere, and Fuse 12 - 20 ampere) in the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuses (Fuse 3 - 20 ampere, and Fuse 12 - 20 ampere) in the PDC. If OK, go to Step 3. If not OK, repair the open B(+) circuit between the PDC and the battery as required.

(3) Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector (Connector C3) for the CTM from the CTM connector receptacle. Reconnect the battery negative cable. Check for battery voltage at each of the two fused B(+) circuit cavities of the instrument panel wire harness connector (Connector C3) for the CTM. If OK, disconnect and isolate the battery negative cable, reconnect the instrument panel wire harness connector (Connector C3) for the CTM to the CTM connector receptacle, and go to Step 4. If not OK,

CENTRAL TIMER MODULE (Continued)

repair the open fused B(+) circuit(s) between the CTM and the PDC as required.

(4) Check the fused ignition switch output (run-start) fuse (Fuse 11 - 10 ampere) and the fused ignition switch output (run-acc) fuse (Fuse 5 - 20 ampere) in the Junction Block (JB). If OK, go to Step 5. If not OK, repair the shorted circuit or component as required and replace the faulty fuse(s).

(5) 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) fuse (Fuse 11 - 10 ampere) and the fused ignition switch output (run-acc) fuse (Fuse 5 - 20 ampere) in the JB. If OK, go to Step 6. If not OK, repair the open fused ignition switch output (run-start) circuit or fused ignition switch output (run-acc) circuit between the JB and the ignition switch as required.

(6) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector (Connector C1) for the CTM from the CTM 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-start) circuit cavity and the fused ignition switch output (run-acc) cavity of the instrument panel wire harness connector (Connector C1) for the CTM. If OK, go to Step 7. If not OK, repair the open fused ignition switch output (run-start) circuit or fused ignition switch output (run-acc) circuit between the CTM and the JB as required.

(7) Turn the ignition switch to the Off position. Check for continuity between each of the three ground circuits in the instrument panel wire harness connector (Connector C1) for the CTM and a good ground. In each case there should be continuity. If OK, use a DRBIII® scan tool to perform further diagnosis of the CTM. Refer to the appropriate diagnostic information. If not OK, repair the open ground circuit(s) to ground (G207 or G208) as required.

REMOVAL

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.

NOTE: Before replacing a Central Timer Module (CTM), use a DRBIII® scan tool to retrieve the current settings for the CTM programmable features. Refer to the appropriate diagnostic information. These settings should be duplicated in the replacement CTM using the DRBIII® scan tool before returning the vehicle to service.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the trim from the left cowl side inner panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - REMOVAL).

(3) Disconnect the two instrument panel wire harness connectors and one body wire harness connector from the CTM connector receptacles (Fig. 2).

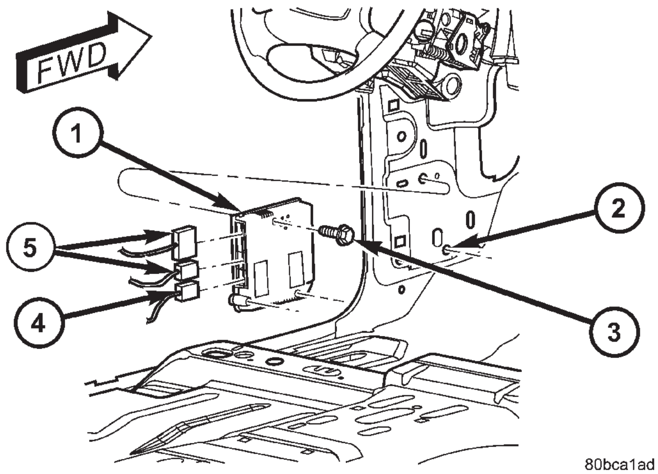

Fig. 2 Central Timer Module

1 - CENTRAL TIMER MODULE
2 - COWL SIDE INNER PANEL
3 - SCREW (3)
4 - BODY WIRE HARNESS CONNECTOR
5 - INSTRUMENT PANEL WIRE HARNESS CONNECTOR (2)

(4) Remove the three screws that secure the CTM to the left cowl side inner panel.

(5) Remove the CTM from the left cowl side inner panel.

CENTRAL TIMER MODULE (Continued)

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.

NOTE: Before replacing a Central Timer Module (CTM), use a DRBIII® scan tool to retrieve the current settings for the CTM programmable features. Refer to the appropriate diagnostic information. These settings should be duplicated in the replacement high-line/premium CTM using the DRBIII® scan tool before returning the vehicle to service.

(1) Position the CTM onto the left cowl side inner panel (Fig. 2).

(2) Install and tighten the three screws that secure the CTM to the left cowl side inner panel. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Reconnect the two instrument panel wire harness connectors and one body wire harness connector to the CTM connector receptacles.

(4) Reinstall the trim onto the left cowl side inner panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - INSTALLATION).

(5) Reconnect the battery negative cable.

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 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 lev-

COMMUNICATION (Continued)

els 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 REAR WHEEL ANTILOCK BRAKE

DESCRIPTION

The Controller Antilock Brakes (CAB) is a microprocessor which handles testing, monitoring and controlling the ABS brake system operation (Fig. 3). The CAB functions are:

• Perform self-test diagnostics.

• Monitor the RWAL brake system for proper operation.

• Control the RWAL valve solenoids.

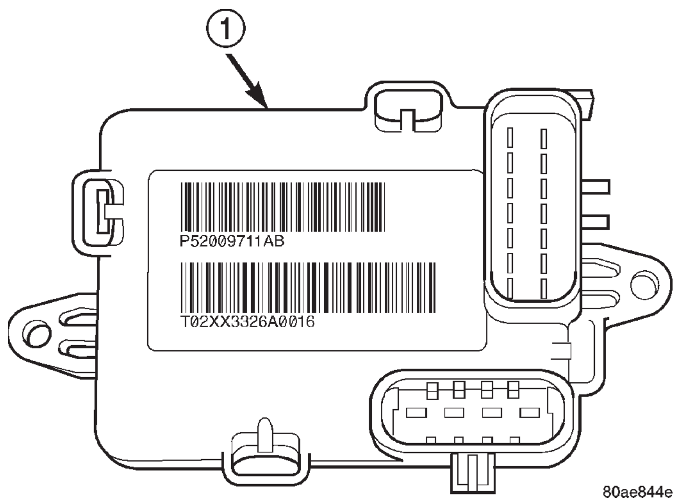

Fig. 3 RWAL CAB

1 - RWAL CAB

CONTROLLER ANTILOCK BRAKE (Continued)

The CAB is mounted on the top of the hydraulic control unit (Fig. 4). The CAB operates the ABS system and is separate from other vehicle electrical circuits. CAB voltage source is through the ignition switch in the RUN position.

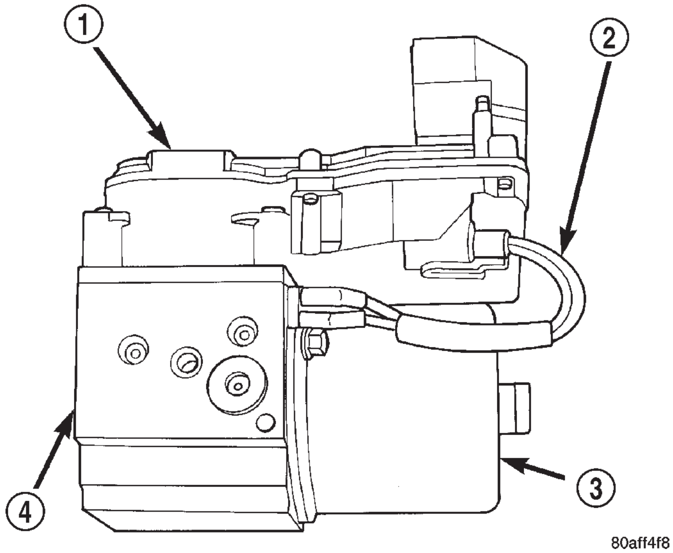

Fig. 4 CAB/HCU

1 - CAB
2 - PUMP WIRING
3 - PUMP MOTOR
4 - HCU

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile, (Refer to 22 - TIRES/WHEELS/TIRES - SPECIFICATIONS). To program the CAB refer to the Chassis Diagnostic Manual.

OPERATION

SYSTEM SELF-TEST

When the ignition switch is turned-on the microprocessor RAM and ROM are tested. If an error occurs during the test, a DTC will be set into the RAM memory. However it is possible the DTC will not be stored in memory if the error has occurred in the RAM module were the DTC's are stored. Also it is possible a DTC may not be stored if the error has occurred in the ROM which signals the RAM to store the DTC.

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.

CAB INPUTS

The CAB continuously monitors the speed of the differential ring gear by monitoring signals generated by the rear wheel speed sensor. The CAB determines a wheel locking tendency when it recognizes the ring gear is decelerating too rapidly. The CAB monitors the following inputs to determine when a wheel locking tendency may exists:

- Rear Wheel Speed Sensor
- Brake Lamp Switch
- Brake Warning Lamp Switch
- Reset Switch
- 4WD Switch (If equipped)

CAB OUTPUTS

The CAB controls the following outputs for antilock braking and brake warning information:

- RWAL Valve
- ABS Warning Lamp
- Brake Warning Lamp

REMOVAL

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile, (Refer to 22 - TIRES/WHEELS/TIRES - SPECIFICATIONS). To program the CAB refer to the Chassis Diagnostic Manual.

(1) Push the CAB harness connector lock to release the lock and remove the connector (Fig. 5) from the controller.

(2) Remove the RWAL valve harness and the pump motor connectors from the controller. (Fig. 6)

(3) Remove the controller mounting screws and remove the controller from the mounting bracket (Fig. 7).

CONTROLLER ANTILOCK BRAKE (Continued)

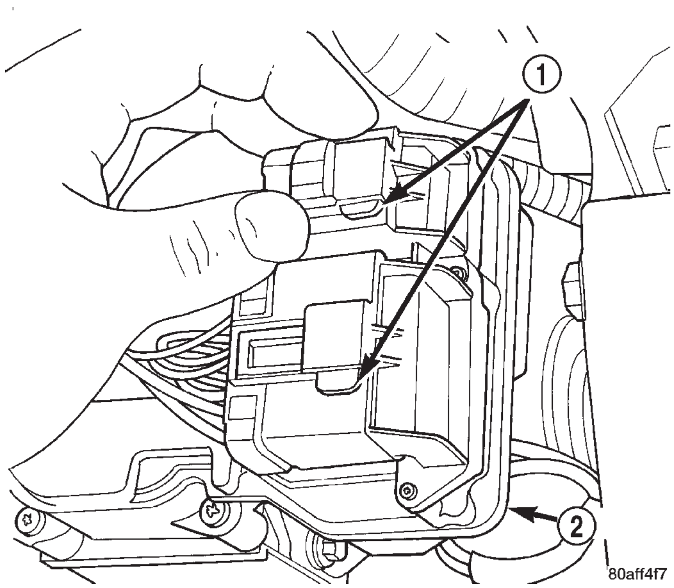

Fig. 5 Harness Connector Locks

1 - CONNECTOR LOCK
2 - CAB

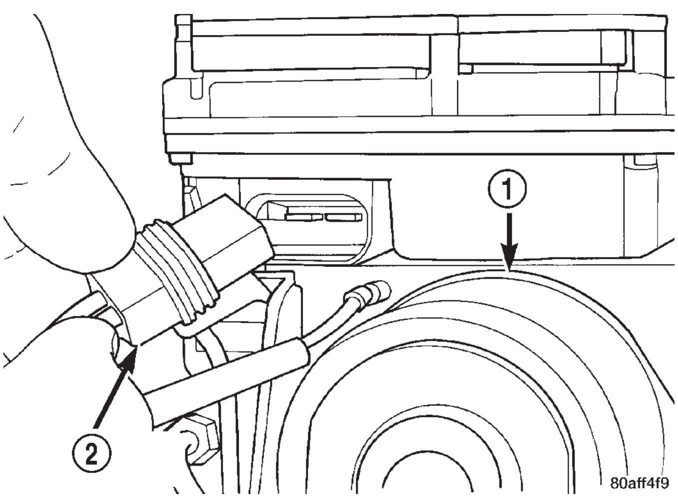

Fig. 6 Pump Motor Connector

1 - PUMP MOTOR
2 - PUMP CONNECTOR

INSTALLATION

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile refer to Group 22 Tire and Wheels. To program the CAB refer to the Chassis Diagnostic Manual.

(1) Position the controller on the bracket.

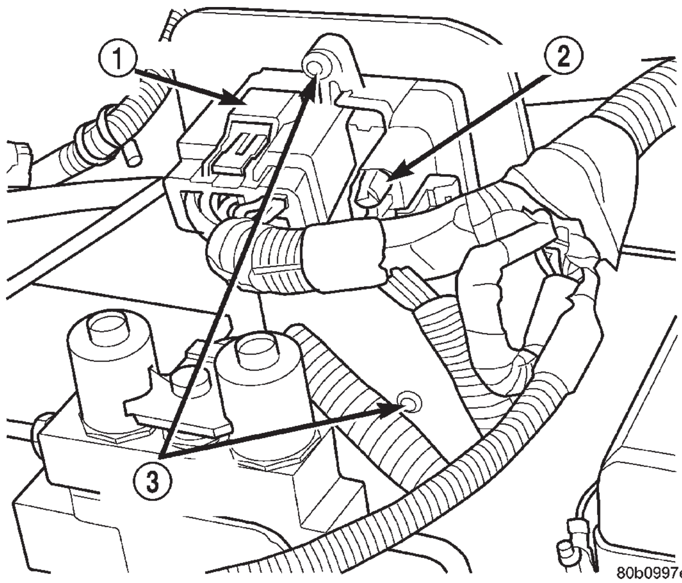

Fig. 7 RWAL Controller

1 - CAB CONNECTOR LOCK
2 - RWAL CONNECTOR
3 - MOUNTING SCREWS

(2) Install the mounting screws and tighten to 6 N·m (53 in. lbs).

(3) Install the RWAL valve harness connector into the controller.

(4) Install the CAB harness connector into the controller and push down on the connector lock.

DATA LINK CONNECTOR

DESCRIPTION

The data link connector is located at the lower edge of the instrument panel near the steering column.

OPERATION

The 16–way data link connector (diagnostic scan tool connector) links the Diagnostic Readout Box (DRB) scan tool or the Mopar Diagnostic System (MDS) with the Powertrain Control Module (PCM).

POWERTRAIN CONTROL MODULE

DESCRIPTION

The Powertrain Control Module (PCM) is located in the engine compartment (Fig. 8). The PCM is referred to as JTEC.

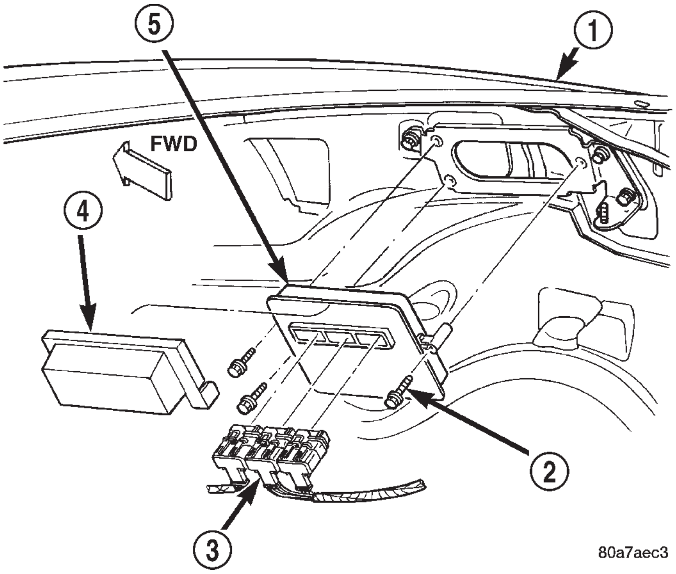

Fig. 8 PCM Location

1 - RIGHT FRONT FENDER
2 - PCM MOUNTING BOLTS (3)
3 - 32–WAY CONNECTORS (3)
4 - COVER
5 - POWERTRAIN CONTROL MODULE (PCM)

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.

ENGINE START-UP MODE

This is an Open Loop mode. The following actions occur when the starter motor is engaged.

The PCM receives inputs from:

- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Starter motor relay
- Camshaft position sensor signal

POWERTRAIN CONTROL MODULE (Continued)

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 clutch relay. This is done if A/C has been selected by the vehicle operator and requested by the A/C thermostat.
- 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

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 clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the PCM receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen (O2S) 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

POWERTRAIN CONTROL MODULE (Continued)

been selected by the vehicle operator and requested by the A/C thermostat.

ACCELERATION MODE

This is an Open Loop mode. The PCM recognizes an abrupt increase in throttle position or MAP 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.

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.

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 - SIGNAL GROUND

Signal ground provides a low noise ground to the data link connector.

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, certain transmission features, speed control, air conditioning

POWERTRAIN CONTROL MODULE (Continued)

compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as Powertrain Control Module (PCM) Outputs. The sensors and switches that provide inputs to the PCM are considered Powertrain Control Module (PCM) Inputs.

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, engine coolant temperature, throttle position, transmission gear selection (automatic transmission), vehicle speed and the brake switch.

The PCM adjusts idle speed based on inputs it receives from sensors that react to: throttle position, vehicle speed, transmission gear selection, engine coolant temperature and from inputs it receives from the air conditioning clutch switch and brake switch.

Based on inputs that it receives, the PCM adjusts ignition coil dwell. The PCM also adjusts the generator charge rate through control of the generator field and provides speed control operation.

NOTE: PCM Inputs:

- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shutdown (ASD) sense
- Battery temperature
- Battery voltage
- Brake switch
- CCD bus (+) circuits
- CCD bus (-) circuits
- Camshaft position sensor signal
- Crankshaft position sensor
- Data link connection for DRB scan tool
- Engine coolant temperature sensor
- Fuel level
- Generator (battery voltage) output
- Ignition circuit sense (ignition switch in on/off/crank/run position)
- Intake manifold air temperature sensor
- Leak detection pump (switch) sense (if equipped)
- Manifold absolute pressure (MAP) sensor
- Oil pressure
- Output shaft speed sensor
- Overdrive/override switch
- Oxygen sensors
- Park/neutral switch (auto. trans. only)
- Power ground
- Sensor return
- Signal ground
- Speed control multiplexed single wire input
- Throttle position sensor
- Transmission governor pressure sensor
- Transmission temperature sensor
- Vehicle speed inputs from ABS or RWAL system

NOTE: PCM Outputs:

- A/C clutch relay
- Auto shutdown (ASD) relay
- CCD bus (+/-) circuits for: speedometer, voltmeter, fuel gauge, oil pressure gauge/lamp, engine temp. gauge and speed control warn. lamp
- Data link connection for DRB scan tool
- EGR valve control solenoid (if equipped)
- EVAP canister purge solenoid
- Five volt sensor supply (primary)
- Five volt sensor supply (secondary)
- Fuel injectors
- Fuel pump relay
- Generator field driver (-)
- Generator field driver (+)
- Generator lamp (if equipped)
- Idle air control (IAC) motor
- Ignition coil
- Leak detection pump (if equipped)
- Malfunction indicator lamp (Check engine lamp). Driven through CCD circuits.
- Overdrive indicator lamp (if equipped)
- Radiator cooling fan (2.5L engine only)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (if equipped). Driven through CCD circuits.
- Transmission convertor clutch circuit
- Transmission 3–4 shift solenoid
- Transmission relay
- Transmission temperature lamp (if equipped)
- Transmission variable force solenoid

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).

POWERTRAIN CONTROL MODULE (Continued)

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.

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. 9).

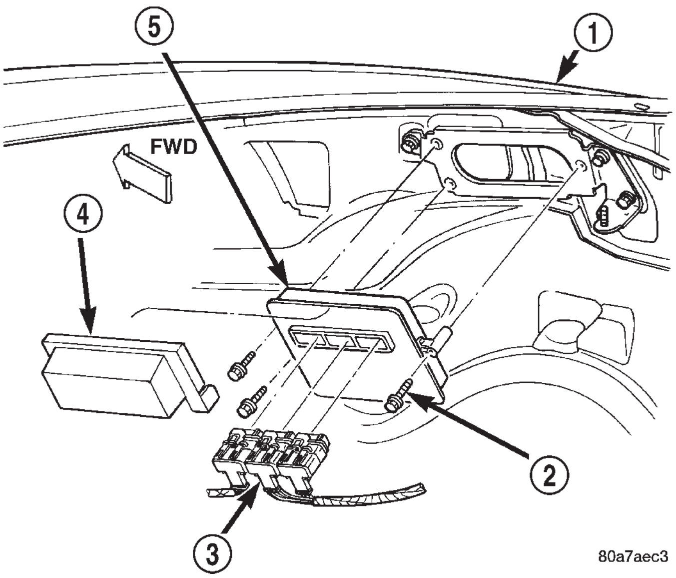

Fig. 9 PCM Location and Mounting

1 - RIGHT FRONT FENDER
2 - PCM MOUNTING BOLTS (3)
3 - 32–WAY CONNECTORS (3)
4 - COVER
5 - POWERTRAIN CONTROL MODULE (PCM)

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 cover over electrical connectors. Cover snaps onto PCM.

(3) Carefully unplug the three 32–way connectors 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 3–5 N·m (30–40 in. lbs.).

(3) Check pin connectors in the PCM and the three 32–way connectors for corrosion or damage. Repair as necessary.

(4) Install three 32–way connectors.

(5) Install cover over electrical connectors. Cover snaps onto PCM.

(6) Install battery cable.

(7) Use the DRB scan tool to reprogram new PCM with vehicles original Identification Number (VIN) and original vehicle mileage. If this step is not done, a Diagnostic Trouble Code (DTC) may be set.

SENTRY KEY IMMOBILIZER MODULE

DESCRIPTION

The Sentry Key Immobilizer Module (SKIM) is the primary component of the Sentry Key Immobilizer System (SKIS) (Fig. 10). The SKIM is located on the right side of the steering column, near 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 side. 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 molded plastic mounting tab that is integral to the SKIM housing has a hole in the center through which a screw passes to secure the unit to the steering column. The

SENTRY KEY IMMOBILIZER MODULE (Continued)

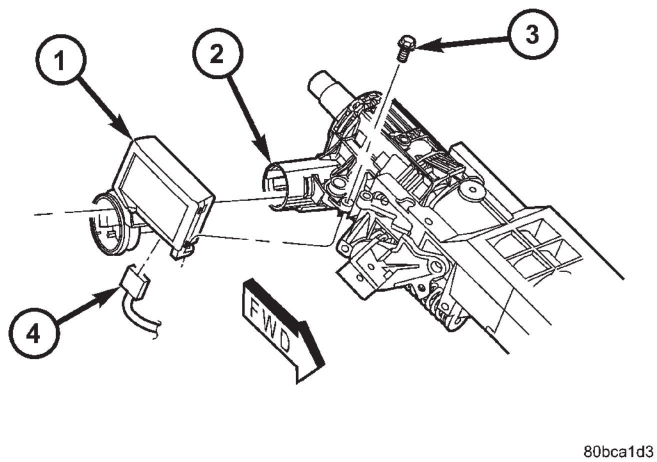

Fig. 10 Sentry Key Immobilizer Module

1 - SENTRY KEY IMMOBILIZER MODULE
2 - IGNITION LOCK CYLINDER HOUSING
3 - SCREW
4 - INSTRUMENT PANEL WIRE HARNESS CONNECTOR

SKIM is connected to the vehicle electrical system through a single take out and connector of the instrument panel wire harness.

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 Central Timer Module (CTM), 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.

The SKIM also sends security indicator status messages to the CTM over the PCI data bus to tell the CTM how to operate the security indicator. The CTM then controls the security indicator in the ElectroMechanical Instrument Cluster (EMIC) through a hard wired security indicator driver circuit. The security indicator status message from the SKIM tells the CTM 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 security indicator status messages to the CTM to turn the indicator off, turn the indicator on, or to flash the indicator on and off. If the security 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 security indicator will stay on solid. If the SKIM detects an invalid key or if a key transponder-related fault exists, the security indicator will flash. If the vehicle is equipped with the Customer Learn transponder programming fea-

SENTRY KEY IMMOBILIZER MODULE (Continued)

ture, the SKIM will also send messages to the CTM to flash the security indicator 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.

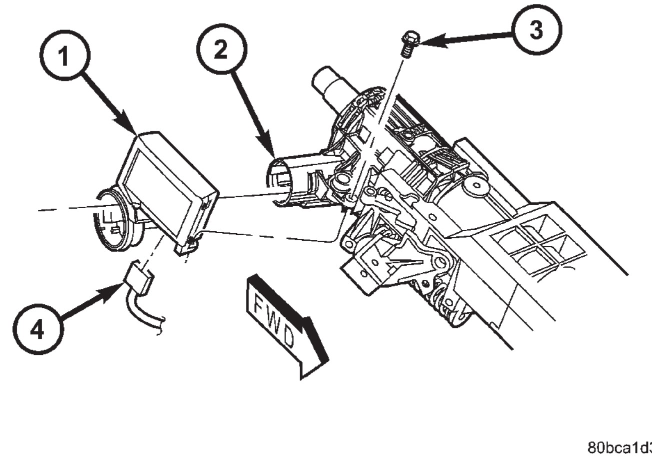

Fig. 11 Sentry Key Immobilizer Module

1 - SENTRY KEY IMMOBILIZER MODULE
2 - IGNITION LOCK CYLINDER HOUSING
3 - SCREW
4 - INSTRUMENT PANEL WIRE HARNESS CONNECTOR

REMOVAL

(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) If the vehicle is so equipped, grasp the tilt steering column knob firmly and pull it straight rearward to remove it from the tilt steering column adjuster mechanism lever located on the left side of the column just below the multi-function switch control stalk.

(4) From below the steering column, remove the two outboard screws that secure the upper shroud to the lower shroud.

(5) Push gently inward on both sides of the upper shroud near the parting line between the upper and lower shrouds to release the snap features that secure it to the lower shroud.

(6) Remove the upper shroud from the lower shroud.

(7) From below the steering column, remove the one center screw that secures the lower shroud to the steering column lock housing.

(8) Remove the lower shroud from the steering column.

(9) Disconnect the instrument panel wire harness connector for the Sentry Key Immobilizer Module (SKIM) from the SKIM connector receptacle (Fig. 11).

(10) Remove the screw that secures the SKIM to the steering column lock housing.

(11) Disengage the SKIM antenna ring from around the ignition lock cylinder housing.

INSTALLATION

(1) Position the Sentry Key Immobilizer Module (SKIM) onto the steering column with the antenna ring oriented around the ignition lock cylinder housing (Fig. 11).

(2) Install and tighten the screw that secures the SKIM to the steering column lock housing. Tighten the screw to 2 N·m (20 in. lbs.).

(3) Reconnect the instrument panel wire harness connector for the SKIM to the SKIM connector receptacle.

(4) Position the lower shroud onto the steering column.

(5) From below the steering column, install and tighten the one center screw that secures the lower shroud to the steering column lock housing. Tighten the screw to 2 N·m (20 in. lbs.).

(6) Position the upper shroud onto the steering column. If the vehicle is equipped with an automatic transmission, be certain to engage the gearshift lever gap hider into the openings in the right side of the upper and lower shrouds.

(7) Align the snap features on the upper shroud with the receptacles on the lower shroud and apply hand pressure to snap them together.

(8) From below the steering column, install and tighten the two screws that secure the upper shroud to the lower shroud. Tighten the screws to 2 N·m (20 in. lbs.).

(9) If the vehicle is so equipped, align the tilt steering column knob with the tilt steering column adjuster mechanism lever located on the left side of the column just below the multi-function switch control stalk and using hand pressure push the knob firmly onto the lever.

(10) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(11) Reconnect the battery negative cable.

TRANSMISSION CONTROL MODULE

DESCRIPTION

The Transmission Control Module (TCM) is located in the engine compartment on the right (passenger) side and is mounted to the radiator core support (Fig. 12).

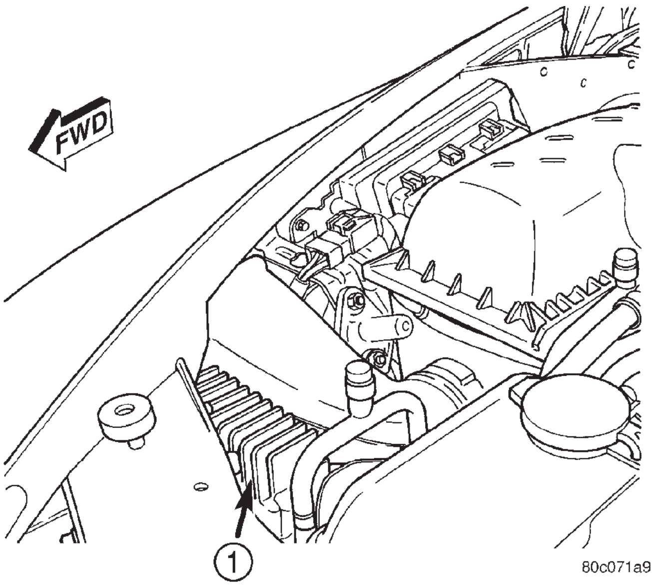

Fig. 12 Transmission Control Module Location

1 - TRANSMISSION CONTROL MODULE

OPERATION

The Transmission Control Module (TCM) is the controlling unit for all electronic operations of the transmission. The TCM receives information regarding vehicle operation from both direct and indirect inputs, and selects the operational mode of the transmission. Direct inputs are hardwired to, and used specifically by the TCM. Indirect inputs originate from other components/modules, and are shared with the TCM via the vehicle communication bus.

Some examples of **direct inputs** to the TCM are:

- Battery (B+) voltage
- Ignition "ON" voltage
- Transmission Control Relay (Switched B+)
- Throttle Position Sensor
- Crankshaft Position Sensor
- Transmission Range Sensor
- Pressure Switches
- Transmission Temperature Sensor
- Input Shaft Speed Sensor
- Output Shaft Speed Sensor
- Line Pressure Sensor

Some examples of **indirect inputs** to the TCM are:

- Engine/Body Identification
- Manifold Pressure
- Target Idle
- Torque Reduction Confirmation
- Engine Coolant Temperature
- Ambient/Battery Temperature
- DRB® Scan Tool Communication

Based on the information received from these various inputs, the TCM determines the appropriate shift schedule and shift points, depending on the present operating conditions and driver demand. This is possible through the control of various direct and indirect outputs.

Some examples of TCM **direct outputs** are:

- Transmission Control Relay
- Solenoids
- Torque Reduction Request

Some examples of TCM **indirect outputs** are:

- Transmission Temperature (to PCM)
- PRNDL Position (to BCM)

In addition to monitoring inputs and controlling outputs, the TCM has other important responsibilities and functions:

- Storing and maintaining Clutch Volume Indexes (CVI)
- Storing and selecting appropriate Shift Schedules
- System self-diagnostics
- Diagnostic capabilities (with DRB® scan tool)

NOTE: If the TCM has been replaced, the "Quick Learn Procedure" must be performed. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)

BATTERY FEED

A fused, direct battery feed to the TCM is used for continuous power. This battery voltage is necessary to retain adaptive learn values in the TCM's RAM (Random Access Memory). When the battery (B+) is disconnected, this memory is lost. When the battery (B+) is restored, this memory loss is detected by the TCM and a Diagnostic Trouble Code (DTC) is set.

CLUTCH VOLUME INDEXES (CVI)

An important function of the TCM is to monitor Clutch Volume Indexes (CVI). CVIs represent the volume of fluid needed to compress a clutch pack.

The TCM monitors gear ratio changes by monitoring the Input and Output Speed Sensors. The Input, or Turbine Speed Sensor sends an electrical signal to the TCM that represents input shaft rpm. The Out-

TRANSMISSION CONTROL MODULE (Continued)

put Speed Sensor provides the TCM with output shaft speed information.

By comparing the two inputs, the TCM can determine transmission gear position. This is important to the CVI calculation because the TCM determines CVIs by monitoring how long it takes for a gear change to occur (Fig. 13).

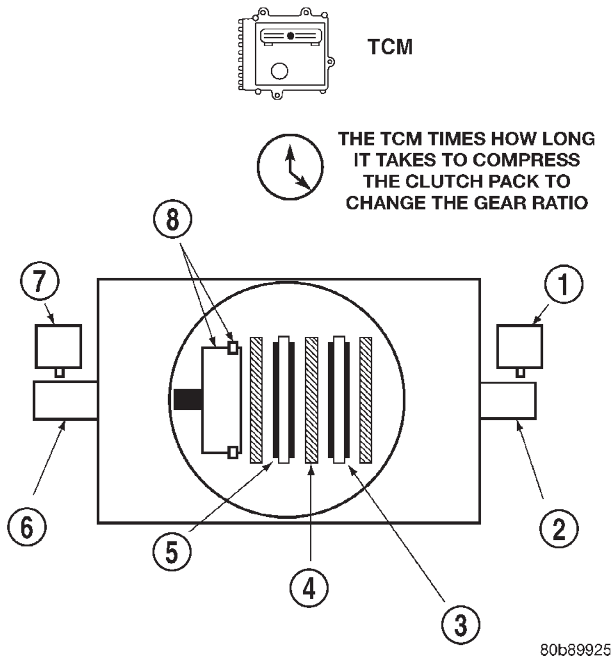

Fig. 13 Example of CVI Calculation

1 - OUTPUT SPEED SENSOR
2 - OUTPUT SHAFT
3 - CLUTCH PACK
4 - SEPARATOR PLATE
5 - FRICTION DISCS
6 - INPUT SHAFT
7 - INPUT SPEED SENSOR
8 - PISTON AND SEAL

Gear ratios can be determined by using the DRB® Scan Tool and reading the Input/Output Speed Sensor values in the "Monitors" display. Gear ratio can be obtained by dividing the Input Speed Sensor value by the Output Speed Sensor value.

For example, if the input shaft is rotating at 1000 rpm and the output shaft is rotating at 500 rpm, then the TCM can determine that the gear ratio is 2:1. In direct drive (3rd gear), the gear ratio changes to 1:1. The gear ratio changes as clutches are applied and released. By monitoring the length of time it takes for the gear ratio to change following a shift request, the TCM can determine the volume of fluid used to apply or release a friction element.

The volume of transmission fluid needed to apply the friction elements are continuously updated for adaptive controls. As friction material wears, the volume of fluid need to apply the element increases.

Certain mechanical problems within the input clutch assembly (broken return springs, out of position snap rings, excessive clutch pack clearance, improper assembly, etc.) can cause inadequate or out-of-range element volumes. Also, defective Input/Output Speed Sensors and wiring can cause these conditions. The following chart identifies the appropriate clutch volumes and when they are monitored/updated:

CLUTCH VOLUMES		
Clutch	**When Updated**	**Proper Clutch Volume**
L/R	2-1 or 3-1 downshift	45 to 134
2C	3-2 kickdown shift	25 to 85
OD	2-3 upshift	30 to 100
4C	3-4 upshift	30 to 85
UD	4-3 kickdown shift	30 to 100

TRANSMISSION CONTROL MODULE (Continued)

SHIFT SCHEDULES

As mentioned earlier, the TCM has programming that allows it to select a variety of shift schedules. Shift schedule selection is dependent on the following:

- Shift lever position
- Throttle position
- Engine load
- Fluid temperature
- Software level

As driving conditions change, the TCM appropriately adjusts the shift schedule. Refer to the following chart to determine the appropriate operation expected, depending on driving conditions.

Schedule	Condition	Expected Operation
Extreme Cold	Oil temperature below -16° F	-Park, Reverse, Neutral and 1st and 3rd gear only in D position, 2nd gear only in Manual 2 or L -No EMCC
Super Cold	Oil temperature between -12° F and 10° F	- Delayed 2-3 upshift - Delayed 3-4 upshift - Early 4-3 coastdown shift - High speed 4-2, 3-2, 2-1 kickdown shifts are prevented -Shifts at high throttle openings willl be early. - No EMCC
Cold	Oil temperature between 10° F and 36° F	-Shift schedule is the same as Super Cold except that the 2-3 upshifts are not delayed.
Warm	Oil temperature between 40° F and 80° F	- Normal operation (upshift, kickdowns, and coastdowns) - No EMCC
Hot	Oil temperature between 80° F and 240° F	- Normal operation (upshift, kickdowns, and coastdowns) - Normal EMCC operation
Overheat	Oil temperature above 240° F or engine coolant temperature above 244° F	- Delayed 2-3 upshift - Delayed 3-4 upshift - 3rd gear FEMCC from 30-48 mph - 3rd gear PEMCC above 35 mph - Above 25 mph the torque converter will not unlock unless the throttle is closed or if a wide open throttle 2nd PEMCC to 1 kickdown is made

TRANSMISSION CONTROL MODULE (Continued)

STANDARD PROCEDURE - TCM QUICK LEARN

The quick learn procedure requires the use of the DRB® scan tool.

This program allows the electronic transmission system to recalibrate itself. This will provide the proper transmission operation. The quick learn procedure should be performed if any of the following procedures are performed:

- Transmission Assembly Replacement
- Transmission Control Module Replacement
- Solenoid Pack Replacement
- Clutch Plate and/or Seal Replacement
- Valve Body Replacement or Recondition

To perform the Quick Learn Procedure, the following conditions must be met:

- The brakes must be applied
- The engine speed must be above 500 rpm
- The throttle angle (TPS) must be less than 3 degrees
- The shift lever position must stay in PARK until prompted to shift to overdrive
- The shift lever position must stay in overdrive after the Shift to Overdrive prompt until the DRB® indicates the procedure is complete
- The calculated oil temperature must be above 60° and below 200°

TRANSFER CASE CONTROL MODULE

DESCRIPTION

The Transfer Case Control Module (TCCM) (Fig. 14) is a microprocessor-based assembly, controlling the 4X4 transfer case shift functions via the actuation of a shift motor and utilizing the feedback of a mode sensor assembly. Communication is via the PCI serial bus. Inputs include user selectable 4X4 modes that include AWD(NV244), 2WD(NV233), 4HI, 4LO, and Neutral. The logic and driver circuitry is contained in a molded plastic housing with an embedded heat-sink and is located behind the center section of the lower instrument panel, to the right of the steering column.

OPERATION

The Transfer Case Control Module (TCCM) utilizes the input from the transfer case mounted mode sensor, the instrument panel mounted selector switch, and the following information from the vehicle's PCI serial bus to determine if a shift is allowed.

- Engine RPM and Vehicle Speed
- Diagnostic Requests
- Manual Transmission and Brake Applied

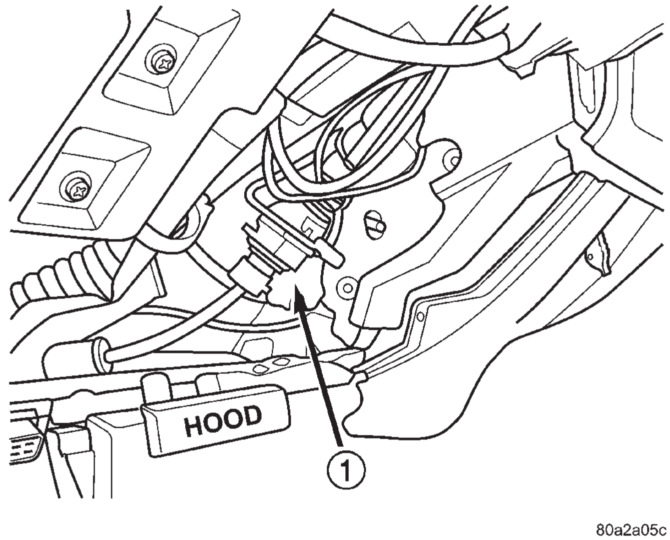

Fig. 14 Transfer Case Control Module (TCCM)

1 - TRANSFER CASE CONTROL MODULE

- PRNDL
- Ignition Status
- VIN

Once the TCCM determines that a requested shift is allowed, it actuates the bi-directional shift motor as necessary to achieve the desired transfer case operating mode. The TCCM also monitors the mode sensor while controlling the shift motor to determine the status of the shift attempt.

Several items can cause the requested shift not to be completed. If the TCCM has recognized a fault (DTC) of some variety, it will begin operation in one of four Functionality Levels. These levels are:

- **Level Zero -** Normal Operation.
- **Level One -** Only Mode Shifts Are Allowed.
- **Level Two -** Only Mode Shifts and Shifts Into LOW Are Allowed (No Neutral Shifts Are Allowed).
- **Level Three -** No Shifts Are Allowed

The TCCM can also be operating in one of three possible power modes. These power modes are:

- **Full Power Mode** is the normal operational mode of the module. This mode is achieved by normal PCI bus traffic being present and the ignition being in the RUN position.
- **Reduced Power Mode** will be entered when the ignition has been powered off. In this state, the module will shut down power supplied to external devices, and to electronic interface inputs and outputs. From this state the module can enter either Sleep Mode or Full Power Mode. To enter this mode, the module must receive an ignition message denoting that the ignition is off, or not receive any messages for 5 ±0.5 seconds. To exit this mode, the module must receive one ignition message that denotes that the ignition is in the RUN position.

TRANSFER CASE CONTROL MODULE (Continued)

• **Sleep Mode** will be entered, from the Reduced Power Mode, when no PCI traffic has been sensed for 20 ±1 seconds. If during Sleep Mode the module detects PCI bus traffic, it will revert to the Reduced Power mode while monitoring for ignition messages. It will remain in this state as long as there is traffic other than run or start messages, and will return to Sleep mode if the bus goes without traffic for 20 ±1 seconds.

SHIFT REQUIREMENTS

If the TCCM is in full power mode and at functionality level zero, it uses the following criteria to determine if a shift is allowed.

Mode shifts will be allowed regardless of transmission gear or vehicle speed, whenever the following conditions are met:

• A change in the Selector switch state indicates that a mode shift has been requested.

• A valid mode sensor signal is being sensed by the TCCM.

• Proper transmit/receive messages are occurring on the PCI bus.

• Ignition key switch is in the RUN position.

Range shifts will be allowed only if all of the following conditions are met:

• A change in the Selector Switch state indicating a range shift has been requested.

• Transmission in NEUTRAL signal must be recognized for at least 1.5 seconds ±100 msec.

• Proper transmit/receive messages are occurring on the PCI bus.

• Clutch signal is recognized for 500 msec ± 50 msec (Clutch pedal depressed if a manual transmission).

• Vehicle speed is less than or equal to 4.8 km/hr (3 miles per hour).

• Ignition key switch is in the RUN position.

• A valid mode sensor signal is being sensed by the TCCM.

A **shift into transfer case Neutral** will be allowed only if all of the following conditions are met:

• The recessed Neutral Selection switch has been depressed continuously for 4.0 seconds ±100 msec while all shift conditions have been continuously met.

• Transmission in NEUTRAL signal recognized from the bus.

• Clutch signal is recognized from the bus (Clutch pedal depressed if a manual transmission).

• Proper message transmissions/receptions are occurring on the PCI bus.

• Vehicle speed is less than or equal to 4.8 km/hr (3 miles per hour).

• Ignition key switch is in the RUN position, engine off.

• Foot Brake is applied.

• A valid mode sensor signal is being sensed by the TCCM.

A **shift out of transfer case Neutral** will be allowed only if all of the following conditions are met:

• The recessed Neutral Selection switch has been depressed continuously for 1.0 seconds ±100 msec while all shift conditions have been continuously met.

• Transmission in NEUTRAL signal recognized from the bus.

• Clutch signal is recognized from the bus (Clutch pedal depressed if a manual transmission).

• Proper message transmissions/receptions are occurring on the PCI bus.

• Vehicle speed is less than or equal to 4.8 km/hr (3 miles per hour).

• Ignition key switch is in the RUN position, engine off.

• Foot Brake is applied.

• A valid mode sensor signal is being sensed by the TCCM.

SHIFT SEQUENCES

Once all the driver controllable conditions for the requested shift have been met, the TCCM begins a shift timer with a maximum duration of 1 second. If the shift timer expires before the TCCM recognizes to correct mode sensor code, the shift is considered to have been blocked. The blocked shift will increment the blocked shift counter by one. The TCCM strategy for handling blocked shifts will be described later. The process the TCCM performs for the various shifts will be described first.

RANGE AND MODE SHIFTS

The process for performing all the range and mode shifts are the same. The following steps describe the process.

• Allow time for Selector Switch debounce; 250 msec ±50 msec.

• Perform diagnostics on the motor that will check for opens/shorts.

• Engage the shift motor for a maximum of 1 second ±100 msec per 'D' channel transition in the destination gear's direction while monitoring the mode sensor channel transitions.

• Transmit a bus message that a transfer case shift is in progress.

• Disengage the shift motor when the correct mode sensor code is recognized.

• Solidly illuminate the current transfer case position's LED while extinguishing the source gear's LED.

• Transmit a bus message that the transfer case shift is complete.

• If the desired mode sensor code is not received after the shift timer expires (ie. a blocked or other

TRANSFER CASE CONTROL MODULE (Continued)

condition exists), stop driving the motor and wait for 1.5 sec ±50 msec. The shift motor is then reversed in the direction back toward the source gear for up to 0.7 seconds ±100msec. The TCCM waits for 1.5 sec ±50 msec. and repeats the attempt to shift to the desired position.

SHIFT OUT OF NEUTRAL

• Perform diagnostics on the motor that will check for opens/shorts.

• Transmit a bus message that a transfer case shift is in progress.

• Engage the shift motor for a maximum of 1 second ±100 msec toward the transfer case 4H mode position while monitoring the mode sensor channel transitions.

• Disengage the shift motor when the correct mode sensor code is recognized.

• Extinguish the Neutral LED.

• Transmit a bus message that the transfer case shift is complete.

• If the desired mode sensor code is not received after the shift timer expires (ie. a blocked or other condition exists), stop driving the motor and wait for 1.5 sec ±50 msec. The shift motor is then reversed in the direction back toward the source gear for up to 0.7 seconds ±100msec. The TCCM waits for 1.5 sec ±50 msec. and repeats the attempt to shift to the desired position.

• When the Neutral button is released, if the 4H position is the desired position, the shift is complete. Illuminate the 4H LED.

• Otherwise when the Neutral button is released, if all of the shift requirements are being met then engage the shift motor towards the desired position for 1 second ±100 msec per ’D’ channel. (if requirements for shifting are not met, illuminate the 4H LED and flash the destination LED as an indication to the driver that all of the driver controllable shift conditions are not being met) If this requires another range or mode shift, begin the range/mode shift process.

• If the desired mode sensor code is not received after the shift timer expires (i.e. a blocked or other condition exists), refer to the section on Blocked Shift Strategy.

BLOCKED SHIFT STRATEGY

When a shift is commanded, the shift motor will be driven towards its destination position, except in the case of shifting out of Neutral if 4L was selected (the transfer case will shift to the 4H position first, before proceeding to 4L). If the shift is blocked on the way to the destination, the TCCM attempts to drive the motor back to the original position. This process will be allowed to occur 5 times before the system stops trying to achieve the desired position. To re-attempt the desired shift, the selector switch will need to be rotated back to the original position until the switch debounce timer expires then a shift will need to be requested again. The TCCM will not prevent shifts on the basis of a block in the destination direction

If the mode sensor position at the end of the 5th blocked attempt is at any other between gear code, drive the shift motor towards the 4H position.

For all blocked shifts in one direction or both directions (destination gear and reversal target), the status of the driver controllable conditions are always rechecked at the end of the reversal unless the mode sensor is still in the Neutral region (actual position or the between gears position on either side). If the mode sensor is in the Neutral region at the expiration of the shift timer, the TCCM will continue to make the shift attempts according to the blocked shift strategy independent of whether or not the driver controlled conditions are met.

For shifts out of Neutral, if all 5 attempts fail to reach the desired position (which by default is 4H) then the motor will be driven to stall in the 4H direction. After the 2 second ±100 msec drive/stall, the TCCM will look at mode sensor position. In the worst case situation after the 2 second drive/stall operation, if the shift motor cannot get to the between gears position on the Neutral side of 4H, the unit will still be considered to be in Neutral. The Neutral LED and ’Service 4WD’ lamp will be illuminated. Otherwise the motor will be on the correct side of the rooster comb and the system will depend on the shift detent poppet to center the sector.

SHIFT REVERSAL TARGETS

If the shift timer expires (1 second per ’D’ channel) and we have not made the desired position, all shifts will attempt to return to their original position with the exceptions of:

• If the intended shift is going to the High rail from Low and can’t make it, but it can make the 2WD/4WD position, we stop at that position. The TCCM will not attempt to cross back over Neutral if it does not have to. This means that there was a block on the first attempt to go to 4H and the transfer case has made it through Neutral to a known good channel, then the motor will go back only to the 2WD/4WD position and execute the remainder of the attempts from there.

• For shifts out of Neutral, any time a shift is commanded out of Neutral the system needs to get out. The same scenario of attempting to get out of Neutral and then returning to it should be followed for all of the shift attempts. The only exception is a shift out of Neutral towards the high side can be considered complete if it can make a between gears reading for the nearest high position. The TCCM should never go to Neutral unless the driver is commanding it and all required conditions are being met

SHIFT ATTEMPT LIMIT

To protect the transfer case system, the TCCM will impose a limit on the number of shifts that can occur over a calibrated time period. The system will monitor the number of 'D' channel segment transitions that occur in any 30 second time period. If the number of segment transitions is 30 or greater, the system will go into a default mode. The default mode of operation for shifting is that the number of allowed 'D' channel transitions permitted to occur will be 3 over each 15 second ±100 msec calibrated window of time. After 5 minutes ±100 msec, the motor can be assumed to have cooled down and the system will revert to normal operation. The following rules also apply to the shift limit:

- The attempt limit will not include shifts coming out of Neutral, they will be allowed regardless of the counter/timer.
- Any shift that is in progress when the counter reaches a maximum count in time will be allowed to complete before the default mode is entered. D-channel transitions during this period will not be counted towards the default mode limit.
- A block, regardless of the direction, whether towards destination or back towards reversal target (shift timer expiring), will count as a value of 2 transitions towards the 30 segment transitions to go into default mode as defined above. Current attempt limit values are 30 transitions in 30 seconds and default mode values are 3 transitions every 15 seconds for 5 minutes.

ENGINE SYSTEMS

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BATTERY SYSTEM

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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 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.

BATTERY SYSTEM (Continued)

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 single complete system. In order for the engine to start and the battery to charge properly, all of the components that are used in these systems must perform within specifications. It is important that the battery, starting, 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.

BATTERY SYSTEM (Continued)

BATTERY SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
THE BATTERY SEEMS WEAK OR DEAD WHEN ATTEMPTING TO START THE ENGINE.	1. The battery has an incorrect size or rating for this vehicle.	1. Refer to Battery Specifications for the proper size and rating. Replace an incorrect battery, as required.
	2. The battery is physically damaged.	2. Inspect the battery for loose terminal posts or a cracked and leaking case. Replace the damaged battery, as required.
	3. The battery terminal connections are loose or corroded.	3. Refer to Battery Cable for the proper cable diagnosis and testing procedures. Clean and tighten the battery terminal connections, as required.
	4. The battery is discharged.	4. Determine the battery state-of-charge. Refer to Standard Procedures for the proper test procedures. Charge the faulty battery, as required.
	5. The electrical system ignition-off draw is excessive.	5. Refer to Standard Procedures for the proper test procedures. Repair the faulty electrical system, as required.
	6. The battery is faulty.	6. Determine the battery cranking capacity. Refer to Standard Procedures for the 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 charging system is faulty.	8. Determine if the charging system is performing to specifications. Refer to Charging System for the proper charging system diagnosis and testing procedures. Repair the faulty charging system, 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 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 generator drive belt is slipping.	3. Refer to Cooling System for the proper accessory drive belt diagnosis and testing procedures. Replace or adjust the faulty generator drive belt, as required.
	4. The electrical system ignition-off draw is excessive.	4. Refer to Standard Procedures for the proper test procedures. Repair the faulty electrical system, as required.
	5. The battery is faulty.	5. Determine the battery cranking capacity. Refer to Standard Procedures for the proper test procedures. Replace the faulty battery, as required.
	6. The starting system is faulty.	6. 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.
	7. The charging system is faulty.	7. Determine if the charging system is performing to specifications. Refer to Charging System for the proper charging system diagnosis and testing procedures. Repair the faulty charging system, as required.
	8. Electrical loads exceed the output of the charging system.	8. Inspect the vehicle for aftermarket electrical equipment which might cause excessive electrical loads.
	9. Slow driving or prolonged idling with high-amperage draw systems in use.	9. Advise the vehicle operator, as required.
THE BATTERY WILL NOT ACCEPT A CHARGE.	1. The battery is faulty.	1. Refer to Standard Procedures for the proper battery charging procedures. Charge or replace the faulty battery, as required.

BATTERY SYSTEM (Continued)

ABNORMAL BATTERY DISCHARGING

Any of the following conditions can result in abnormal battery discharging:

- Corroded or loose battery posts and terminal clamps.
- A loose or worn generator drive belt.
- Electrical loads that exceed the output of the charging system. This can be due to equipment installed after manufacture, or repeated short trip use.
- Slow driving speeds (heavy traffic conditions) or prolonged idling, with high-amperage draw systems in use.
- A faulty circuit or component causing excessive ignition-off draw.
- A faulty or incorrect charging system component. Refer to Charging System for the proper charging system diagnosis and testing procedures.
- A faulty or incorrect starting system component. Refer to Starting System for the proper starting system diagnosis and testing procedures.
- A faulty or incorrect battery. Refer to Standard Procedures for the proper battery diagnosis and testing procedures. Refer to Battery System Specifications for the proper specifications.

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).

(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 Specifications for the factory-installed battery specifications. Confirm that the replacement battery is the correct size and has the correct ratings for the vehicle.

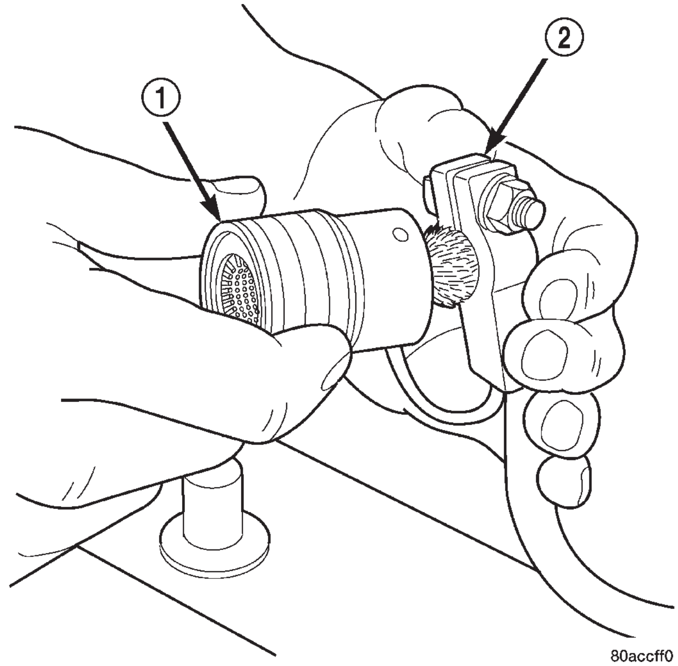

Fig. 1 Clean Battery Cable Terminal Clamp - Typical

1 - TERMINAL BRUSH
2 - BATTERY CABLE

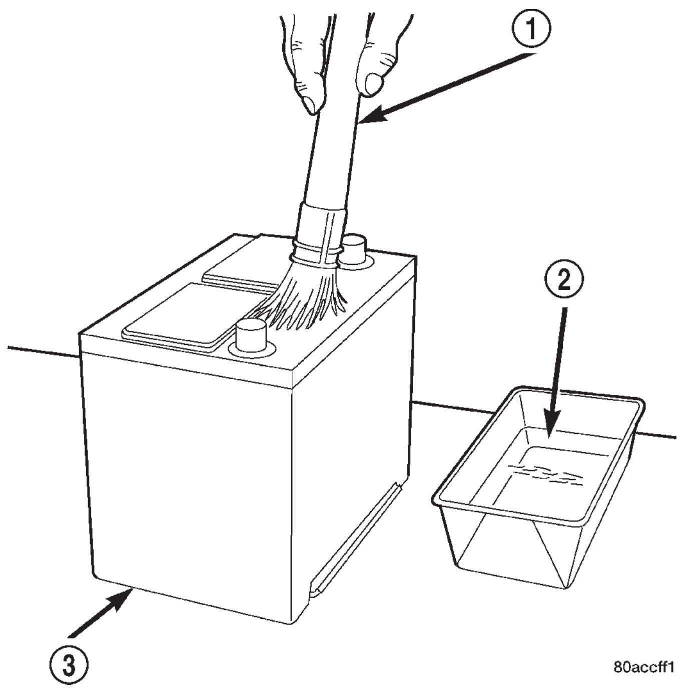

Fig. 2 Clean Battery - Typical

1 - CLEANING BRUSH
2 - WARM WATER AND BAKING SODA SOLUTION
3 - BATTERY

BATTERY SYSTEM (Continued)

(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).

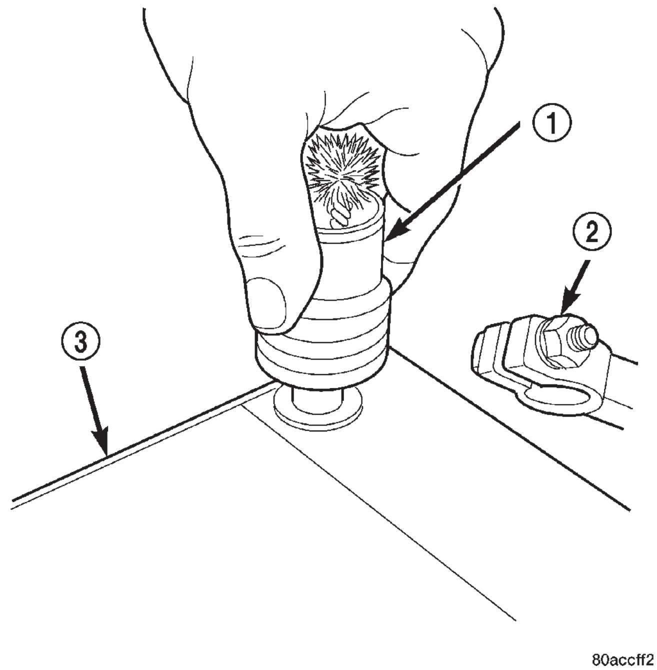

Fig. 3 Clean Battery Terminal Post - Typical

1 - TERMINAL BRUSH
2 - BATTERY CABLE
3 - BATTERY

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, if equipped. Inspect the battery case for cracks or other damage that could result in electrolyte leaks. Also, check the battery terminal posts for looseness. Batteries with damaged cases or loose terminal posts must be replaced.

(4) Inspect the battery 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

BATTERY

Battery Classifications and Ratings					
Part Number	BCI Group Size Classification	Cold Cranking Amperage	Reserve Capacity	Ampere-Hours	Load Test Amperage
56027100	27	600	120 Minutes	66	300
56027302	27	750	150 Minutes	75	375

BATTERY

DESCRIPTION

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 confirma-

BATTERY (Continued)

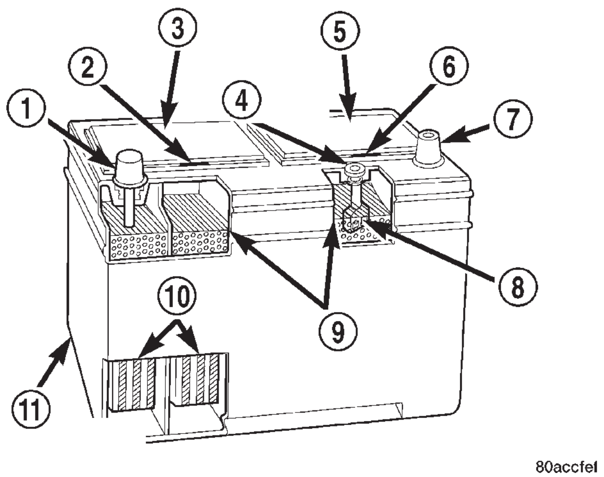

Fig. 4 Low-Maintenance Battery - Typical

1 - POSITIVE POST
2 - VENT
3 - CELL CAP
4 - TEST INDICATOR
5 - CELL CAP
6 - VENT
7 - NEGATIVE POST
8 - GREEN BALL
9 - ELECTROLYTE LEVEL
10 - PLATE GROUPS
11 - LOW-MAINTENANCE BATTERY

tion. Refer to Battery Cables for more information on the battery cables that connect the battery to the vehicle electrical system.

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 non-removable battery cell caps.** Water cannot 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. Rapid loss of electrolyte can be caused by an overcharging condition. Be certain to diagnose the charging system before returning the vehicle to service. Refer to Charging System for the proper charging system diagnosis and testing procedures.

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.

BATTERY (Continued)

DIAGNOSIS AND TESTING - BATTERY

The battery must be completely charged and the top, posts and terminal clamps should be properly cleaned and inspected before diagnostic procedures are performed. Refer to Battery 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.

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.

WARNING: IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS ARE IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.

The condition of a battery is determined by two criteria:

- **State-Of-Charge** - This can be determined by checking the specific gravity of the battery electrolyte (built-in indicator test or hydrometer test), or by checking the battery voltage (open-circuit voltage test).
- **Cranking Capacity** - This can be determined by performing a battery load test, which measures the ability of the battery to supply high-amperage current.

First, determine the battery state-of-charge. This can be done in one of three ways. If the battery has a built-in test indicator, perform the built-in indicator test to determine the state-of-charge. If the battery has no built-in test indicator but does have removable cell caps, perform the hydrometer test to determine the state-of-charge. If the battery cell caps are not removable, or a hydrometer is not available, perform the open-circuit voltage test to determine the state-of-charge. Refer to open-circuit voltage test in the Standard Procedures section of this group.

Second, determine the battery cranking capacity by performing a load test. The battery must be charged before proceeding with a load test if:

- The battery built-in test indicator has a black or dark color visible.
- The temperature corrected specific gravity of the battery electrolyte is less than 1.235.
- The battery open-circuit voltage is less than 12.4 volts.

A battery that will not accept a charge is faulty, and must be replaced. Further testing is not required. A fully-charged battery must be load tested to determine its cranking capacity. A battery that is fully-charged, but does not pass the load test, is faulty and must be replaced.

NOTE: Completely discharged batteries may take several hours to accept a charge. Refer to Standard Procedures for the proper battery charging procedures.

A battery is fully-charged when:

- All battery cells are gassing freely during charging.
- A green color is visible in the sight glass of the battery built-in test indicator.
- Three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in the specific gravity of the battery electrolyte.
- Open-circuit voltage of the battery is 12.4 volts or greater.

STANDARD PROCEDURE - CHECKING BATTERY ELECTROLYTE LEVEL

The following procedure can be used to check the electrolyte level in the battery.

(1) Remove the battery caps (Fig. 5).

(2) Look through the battery cap holes to determine the level of the electrolyte in the battery (Fig. 6). The electrolyte should be approximately 1 centimeter above the battery plates or until the hook inside the battery cap holes is covered.

(3) Add only distilled water until the electrolyte level is approx. one centimeter above the plates.

BATTERY (Continued)

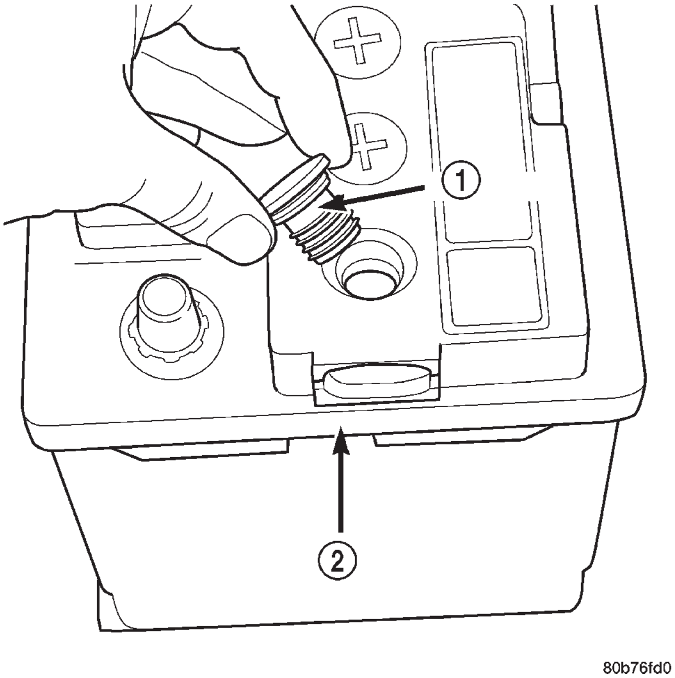

Fig. 5 Battery Caps - Export Battery

1 - BATTERY CAP
2 - BATTERY

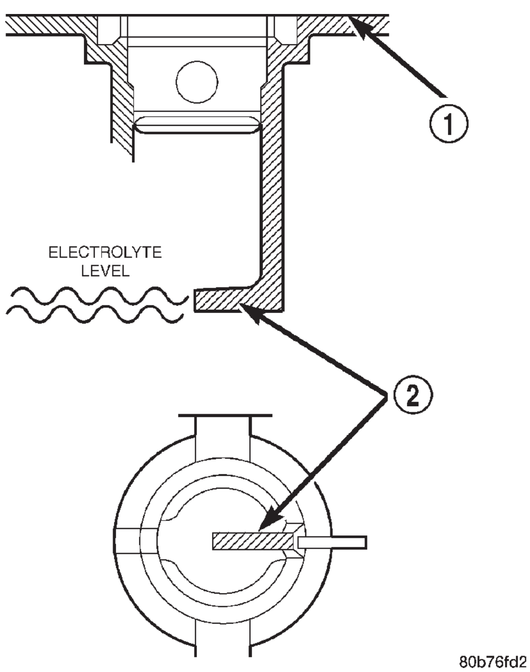

Fig. 6 Hook Inside Battery Cap Holes - Export Battery

1 - BATTERY SURFACE COVER
2 - HOOK

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.
- 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 12.65 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 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.

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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.

BATTERY (Continued)

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.

NOTE: Models equipped with the diesel engine option are equipped with two 12-volt batteries, connected in parallel (positive-to-positive and negative-to-negative). In order to ensure proper charging of each battery, these batteries MUST be disconnected from each other, as well as from the vehicle electrical system, while being charged.

Some battery chargers are equipped with polarity-sensing circuitry. This circuitry protects the battery charger and the battery from being damaged if they are improperly connected. If the battery state-of-charge is too low for the polarity-sensing circuitry to detect, the battery charger will not operate. This makes it appear that the battery will not accept charging current. See the instructions provided by the manufacturer of the battery charger for details on how to bypass the polarity-sensing circuitry.

After the battery has been charged to 12.4 volts or greater, perform a load test to determine the battery cranking capacity. Refer to Standard Procedures for the proper battery load test procedures. If the battery will endure a load test, return the battery to service. If the battery will not endure a load test, it is faulty and must be replaced.

Clean and inspect the battery hold downs, tray, terminals, posts, and top before completing battery service. Refer to Battery System Cleaning for the proper battery system cleaning procedures, and Battery System Inspection for the proper battery system inspection procedures.

CHARGING A COMPLETELY DISCHARGED BATTERY

The following procedure should be used to recharge a completely discharged battery. Unless this procedure is properly followed, a good battery may be needlessly replaced.

(1) Measure the voltage at the battery posts with a voltmeter, accurate to 1/10 (0.10) volt (Fig. 7). 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.

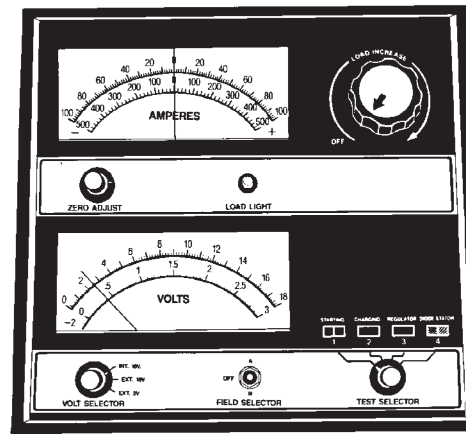

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Fig. 7 Voltmeter - Typical

(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 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.

BATTERY (Continued)

• **Temperature** - A longer time will be needed to charge a battery at -18° C (0° F) than at 27° C (80° F). When a fast battery charger is connected to a cold battery, the current accepted by the battery will be very low at first. As the battery warms, it will accept a higher charging current rate (amperage).

• **Charger Capacity** - A battery charger that supplies only five amperes will require a longer charging time. A battery charger that supplies twenty amperes or more will require a shorter charging time.

• **State-Of-Charge** - A completely discharged battery requires more charging time than a partially discharged battery. Electrolyte is nearly pure water in a completely discharged battery. At first, the charging current (amperage) will be low. As the battery charges, the specific gravity of the electrolyte will gradually rise.

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. 8). 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.

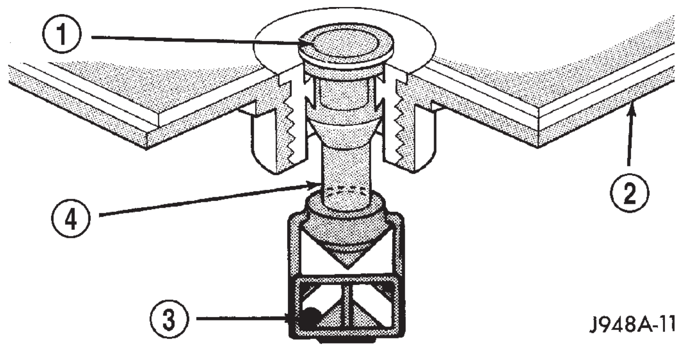

Fig. 8 Built-In Indicator

1 - SIGHT GLASS
2 - BATTERY TOP
3 - GREEN BALL
4 - PLASTIC ROD

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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.

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.**

To read the built-in indicator, look into the sight glass and note the color of the indication (Fig. 9). The battery condition that each color indicates is described in the following list:

BATTERY (Continued)

• **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.

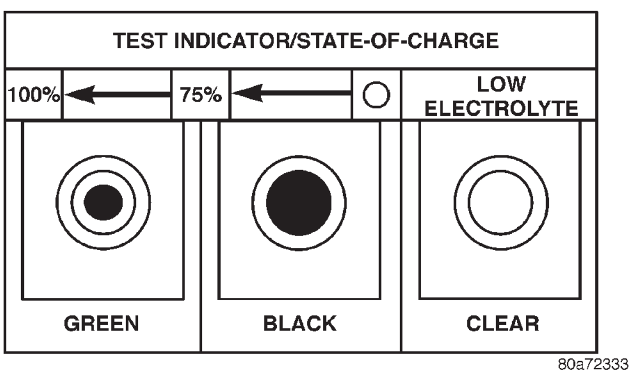

Fig. 9 Built-In Indicator Sight Glass Chart

STANDARD PROCEDURE - HYDROMETER TEST

The hydrometer test reveals the battery state-of-charge by measuring the specific gravity of the electrolyte. **This test cannot be performed on maintenance-free batteries with non-removable cell caps.** If the battery has non-removable cell caps, refer to Diagnosis and Testing for alternate methods of determining the battery state-of-charge.

Specific gravity is a comparison of the density of the battery electrolyte to the density of pure water. Pure water has a specific gravity of 1.000, and sulfuric acid has a specific gravity of 1.835. Sulfuric acid makes up approximately 35% of the battery electrolyte by weight, or 24% by volume. In a fully-charged battery the electrolyte will have a temperature-corrected specific gravity of 1.260 to 1.290. However, a specific gravity of 1.235 or above is satisfactory for the battery to be load tested and/or returned to service.

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.

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Before testing, visually inspect the battery for any damage (a cracked case or cover, loose posts, etc.) that would cause the battery to be faulty. Then remove the battery cell caps and check the electrolyte level. Add distilled water if the electrolyte level is below the top of the battery plates. Refer to Battery System Cleaning for the proper battery inspection procedures.

See the instructions provided by the manufacturer of the hydrometer for recommendations on the correct use of the hydrometer that you are using. Remove only enough electrolyte from the battery cell so that the float is off the bottom of the hydrometer barrel with pressure on the bulb released. To read the hydrometer correctly, hold it with the top surface of the electrolyte at eye level (Fig. 10).

CAUTION: Exercise care when inserting the tip of the hydrometer into a battery cell to avoid damaging the plate separators. Damaged plate separators can cause early battery failure.

BATTERY (Continued)

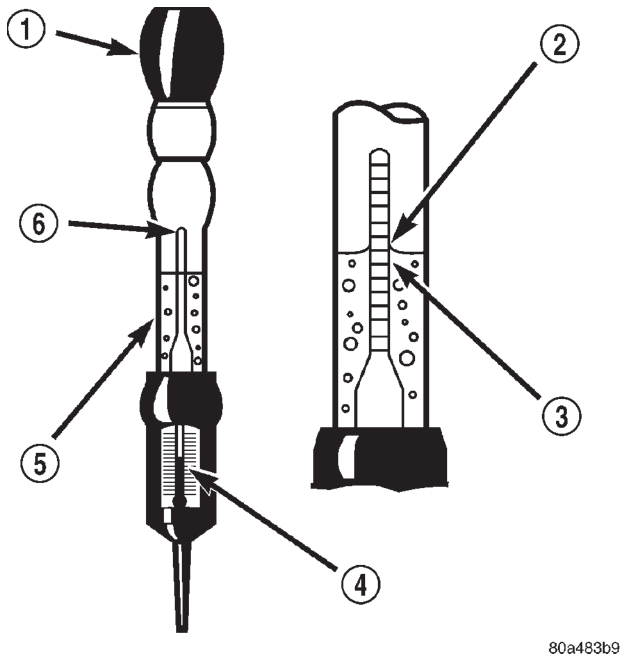

Fig. 10 Hydrometer - Typical

1 - BULB
2 - SURFACE COHESION
3 - SPECIFIC GRAVITY READING
4 - TEMPERATURE READING
5 - HYDROMETER BARREL
6 - FLOAT

Hydrometer floats are generally calibrated to indicate the specific gravity correctly only at 26.7° C (80° F). When testing the specific gravity at any other temperature, a correction factor is required. The correction factor is approximately a specific gravity value of 0.004, which may also be identified as four points of specific gravity. For each 5.5° C above 26.7° C (10° F above 80° F), add four points. For each 5.5° C below 26.7° C (10° F below 80° F), subtract four points. Always correct the specific gravity for temperature variation.

EXAMPLE: A battery is tested at -12.2° C (10° F) and has a specific gravity of 1.240. Determine the actual specific gravity as follows:

(1) Determine the number of degrees above or below 26.7° C (80° F): **26.6° C - -12.2° C = 38.8° C (80° F - 10° F = 70° F)**

(2) Divide the result from Step 1 by 5.5° C (10° F): **38.8° C ÷ 5.5° C = 7 (70° F ÷ 10° F = 7)**

(3) Multiply the result from Step 2 by the temperature correction factor (0.004): **7 X 0.004 = 0.028**

(4) The temperature at testing was below 26.7° C (80° F); therefore, the temperature correction factor is subtracted: **1.240 - 0.028 = 1.212**

(5) The corrected specific gravity of the battery cell in this example is 1.212.

Test the specific gravity of the electrolyte in each battery cell. If the specific gravity of all cells is above 1.235, but the variation between cells is more than fifty points (0.050), the battery should be replaced. If the specific gravity of one or more cells is less than 1.235, charge the battery at a rate of approximately five amperes. Continue charging the battery until three consecutive specific gravity tests, taken at one-hour intervals, are constant. If the cell specific gravity variation is more than fifty points (0.050) at the end of the charge period, replace the battery.

When the specific gravity of all cells is above 1.235, and the cell variation is less than fifty points (0.050), the battery may be load tested to determine its cranking capacity. Refer to Standard Procedures for the proper battery load test procedures.

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.

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BATTERY (Continued)

Before proceeding with this test, completely charge the battery. Refer to Standard Procedures for the proper battery charging procedures.

(1) Before measuring the open-circuit voltage, the surface charge must be removed from the battery. Turn on the 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. 11).

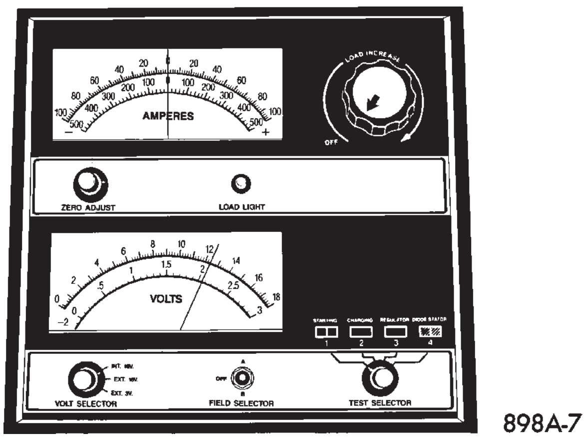

Fig. 11 Testing Open-Circuit Voltage - Typical

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 Standard Procedures for the proper battery load test procedures.

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%

STANDARD PROCEDURE - LOAD TEST

A battery load test will verify the battery cranking capacity. The test is based on the Cold Cranking Amperage (CCA) rating of the battery. To determine the battery CCA rating, see the label affixed to the battery case or refer to Battery Specifications for the proper factory-installed specifications.

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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.

Before proceeding with this test, completely charge the battery. Refer to Standard Procedures for the proper battery charging procedures.

(1) Disconnect and isolate both battery cables, negative cable first. The battery top and posts should be clean. Refer to Battery System Cleaning for the proper cleaning procedures.

(2) Connect a suitable volt-ammeter-load tester (Fig. 12) to the battery posts (Fig. 13). See the instructions provided by the manufacturer of the tester you are using. Check the open-circuit voltage (no load) of the battery. Refer to Standard Procedures for the proper battery open-circuit voltage test procedures. The battery open-circuit voltage must be 12.4 volts or greater.

(3) Rotate the load control knob (carbon pile rheostat) to apply a 300 ampere load to the battery for fifteen seconds, then return the control knob to the Off position (Fig. 14). This will remove the surface charge from the battery.

(4) Allow the battery to stabilize to open-circuit voltage. It may take up to five minutes for the battery voltage to stabilize.

(5) Rotate the load control knob to maintain a load equal to 50% of the CCA rating of the battery (Fig. 15). After fifteen seconds, record the loaded voltage reading, then return the load control knob to the Off position.

BATTERY (Continued)

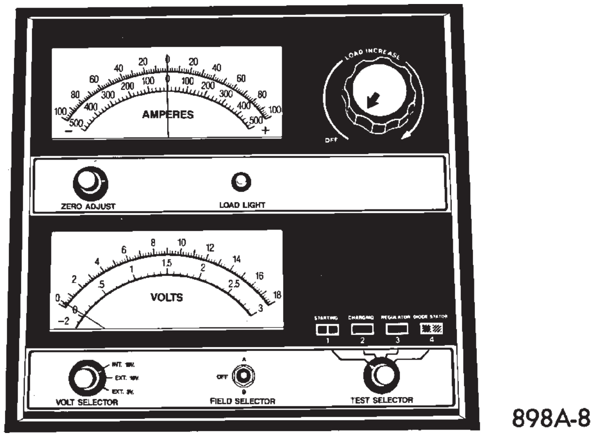

Fig. 12 Volt-Ammeter-Load Tester - Typical

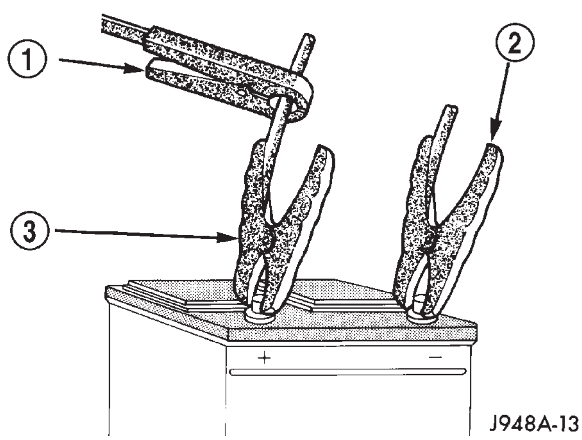

Fig. 13 Volt-Ammeter-Load

1 - INDUCTION AMMETER CLAMP
2 - NEGATIVE CLAMP
3 - POSITIVE CLAMP

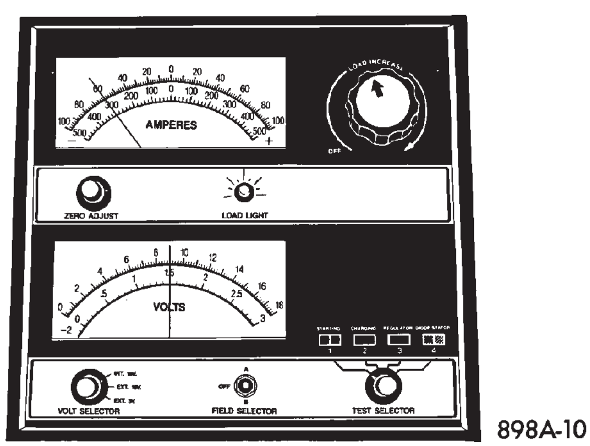

Fig. 14 Remove Surface Charge from Battery

(6) The voltage drop will vary with the battery temperature at the time of the load test. The battery temperature can be estimated by using the ambient temperature during the past several hours. If the battery has been charged, boosted, or loaded a few

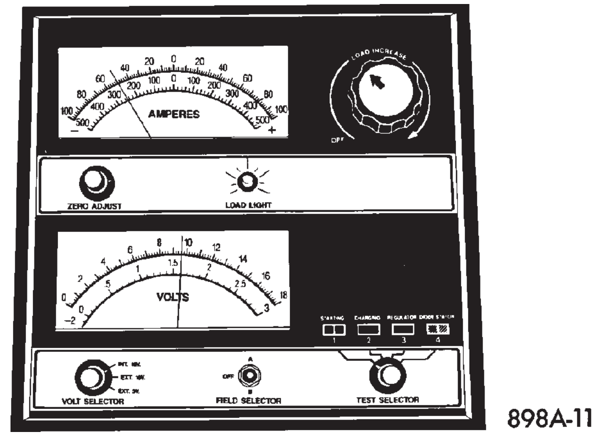

Fig. 15 Load 50% CCA Rating - Note Voltage - Typical

minutes prior to the test, the battery will be somewhat warmer. See the Load Test Temperature Table for the proper loaded voltage reading.

LOAD TEST TEMPERATURE TABLE		
Minimum Voltage	Temperature	
	°F	°C
9.6 volts	70° and above	21° and above
9.5 volts	60°	16°
9.4 volts	50°	10°
9.3 volts	40°	4°
9.1 volts	30°	-1°
8.9 volts	20°	-7°
8.7 volts	10°	-12°
8.5 volts	0°	-18°

(7) If the voltmeter reading falls below 9.6 volts, at a minimum battery temperature of 21° C (70° F), the battery is faulty and must be replaced.

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

BATTERY (Continued)

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. See the Electronic Module Ignition-Off Draw Table for more information.

ELECTRONIC MODULE IGNITION-OFF DRAW (IOD) TABLE			
Module	Time Out? (If Yes, Interval And Wake-Up Input)	IOD	IOD After Time Out
Radio	No	1 to 3 milliamperes	N/A
Audio Power Amplifier	No	up to 1 milliampere	N/A
Central Timer Module (CTM)	No	4.75 milliamperes (max.)	N/A
Powertrain Control Module (PCM)	No	0.95 milliampere	N/A
ElectroMechanical Instrument Cluster (EMIC)	No	0.44 milliampere	N/A
Combination Flasher	No	0.08 milliampere	N/A

(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-re-

BATTERY (Continued)

place 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.

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. 16).

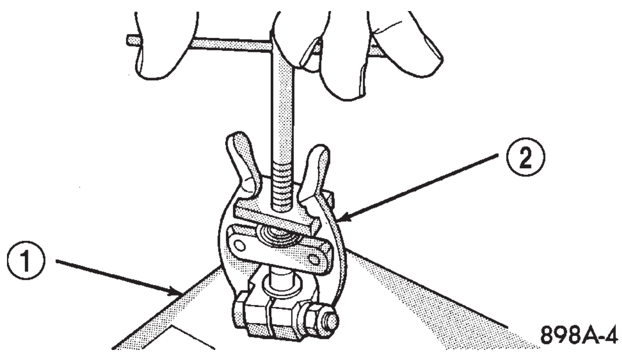

Fig. 16 Remove Battery Cable Terminal Clamp - Typical

1 - BATTERY
2 - BATTERY TERMINAL PULLER

(4) Loosen the battery positive cable terminal clamp pinch-bolt hex nut.

(5) Disconnect the battery positive cable terminal clamp from the battery positive terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post.

(6) Remove the battery hold downs from the battery. Refer to **Battery Hold Downs** in this section for the location of the proper battery hold down removal procedures.

WARNING: WEAR A SUITABLE PAIR OF RUBBER GLOVES (NOT THE HOUSEHOLD TYPE) WHEN REMOVING A BATTERY BY HAND. SAFETY GLASSES SHOULD ALSO BE WORN. IF THE BATTERY IS CRACKED OR LEAKING, THE ELECTROLYTE CAN BURN THE SKIN AND EYES.

(7) Remove the battery from the battery tray.

INSTALLATION

(1) Clean and inspect the battery. Refer to **Battery System** in this section for the location of the proper battery cleaning and inspection procedures.

(2) Position the battery onto the battery tray. 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. 17).

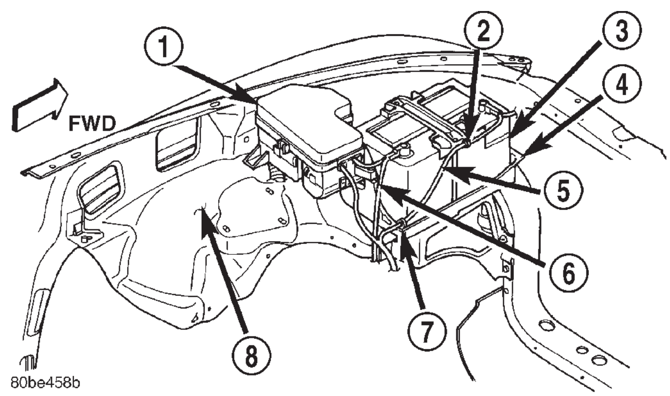

Fig. 17 Battery Cables

1 - POWER DISTRIBUTION CENTER
2 - CLIP
3 - BATTERY
4 - TRAY
5 - NEGATIVE CABLE
6 - POSITIVE CABLE
7 - CLIP
8 - WHEELHOUSE INNER PANEL

(3) Reinstall the battery hold downs onto the battery. Refer to **Battery Hold Downs** in this section for the location of the proper battery hold down installation procedures.

CAUTION: Be certain that the battery cable terminal clamps are connected to the correct battery terminal posts. Reverse battery polarity may damage electrical components of the vehicle.

(4) Clean the battery cable terminal clamps and the battery terminal posts. Refer to **Battery** in this section for the location of the proper battery cleaning and inspection procedures.

(5) Reconnect the battery positive cable terminal clamp to the battery positive terminal post. Tighten

BATTERY (Continued)

the terminal clamp pinch-bolt hex nut to 7.9 N·m (70 in. lbs.).

(6) Reconnect the battery negative cable terminal clamp to the battery negative terminal post. Tighten the terminal clamp pinch-bolt hex nut to 7.9 N·m (70 in. lbs.).

(7) 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

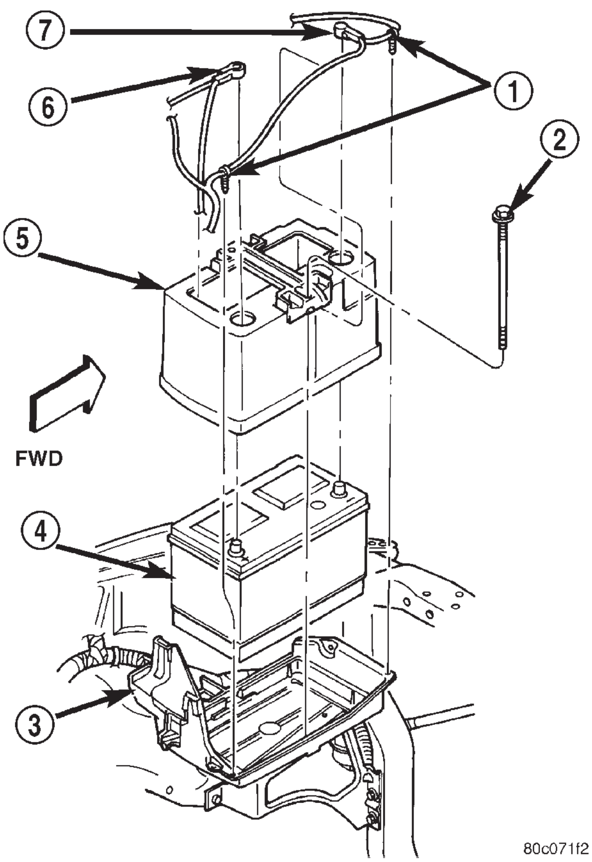

Fig. 18 Battery Hold Downs

1 - CLIPS
2 - BOLT
3 - TRAY
4 - BATTERY
5 - HOLD DOWN STRAP AND THERMAL GUARD
6 - POSITIVE CABLE
7 - NEGATIVE CABLE

The battery hold down hardware (Fig. 18) includes two bolts, two U-nuts and a hold down strap/battery thermoguard unit. The molded plastic battery hold down strap is integral to the battery thermoguard unit, which encloses the sides of the battery case.

When installing a battery into the battery tray, be certain that the hold down hardware is properly installed and that the fasteners are tightened to the proper specifications. Improper hold down fastener tightness, whether too loose or too tight, can result in damage to the battery, the vehicle or both. Refer to **Battery Hold Downs** in this section for the location of the proper battery hold down installation procedures, including 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 removel and lubrication of the battery holddown hardware is recomended to prevent hardware seizure at a later date.

NOTE: Never operate a vehicle without a battery holddown device properly installed. Damage to the vehicle, components and battery could result.

REMOVAL

(1) Turn the ignition switch to the Off position. Be certain that all electrical accessories are turned off.

(2) Loosen the battery negative cable terminal clamp pinch-bolt hex nut.

(3) Disconnect the battery negative cable terminal clamp from the battery negative terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post.

(4) 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.

(5) Remove the two hold down bolts that secure the hold down strap/battery thermal guard unit to the U-nuts in the battery tray (Fig. 19).

(6) Remove the hold down strap/battery thermal guard unit from the top of the battery case.

INSTALLATION

(1) Clean and inspect the battery hold down hardware. Refer to **Battery** in the index of this service manual for the location of the proper battery hold down hardware cleaning and inspection procedures.

(2) Install the hold down strap/battery thermoguard unit over the top of the battery case.

(3) Install and tighten the two hold down bolts that secure the hold down strap/battery thermoguard unit to the U-nuts in the battery tray. Tighten the bolts to 2.1 N·m (19 in. lbs.).

(4) Reconnect the battery positive cable terminal clamp to the battery positive terminal post. Tighten

BATTERY HOLDDOWN (Continued)

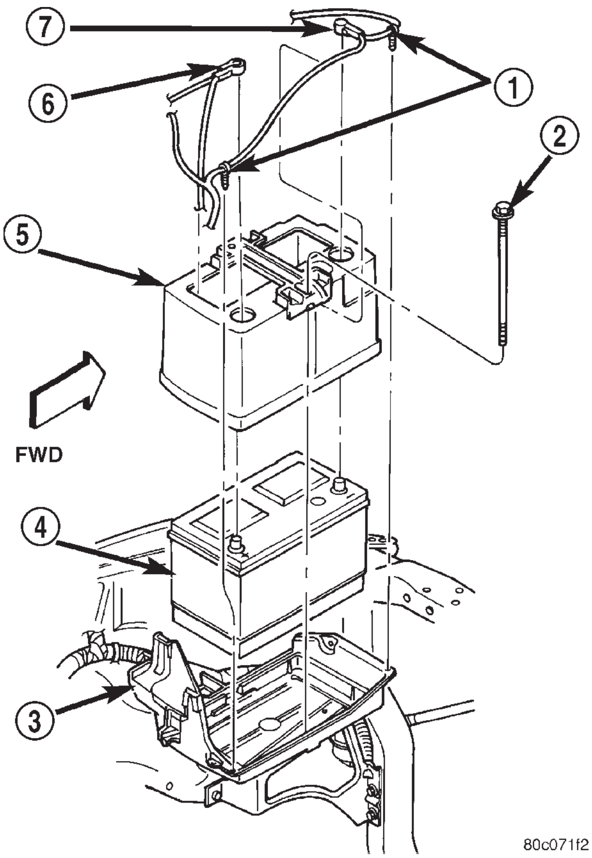

Fig. 19 Battery Hold Downs Remove/Install

1 - CLIPS
2 - BOLT
3 - TRAY
4 - BATTERY
5 - HOLD DOWN STRAP AND THERMAL GUARD
6 - POSITIVE CABLE
7 - NEGATIVE CABLE

the terminal clamp pinch-bolt hex nut to 7.9 N·m (70 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 7.9 N·m (70 in. lbs.).

BATTERY CABLE

DESCRIPTION

The battery cables (Fig. 20) are large gauge, stranded copper wires sheathed within a heavy plastic or synthetic rubber insulating jacket. The wire used in the battery cables combines excellent flexibility and reliability with high electrical current carrying capacity. Refer to **Wiring Diagrams** in the index of this service manual for the location of the proper battery cable wire gauge information.

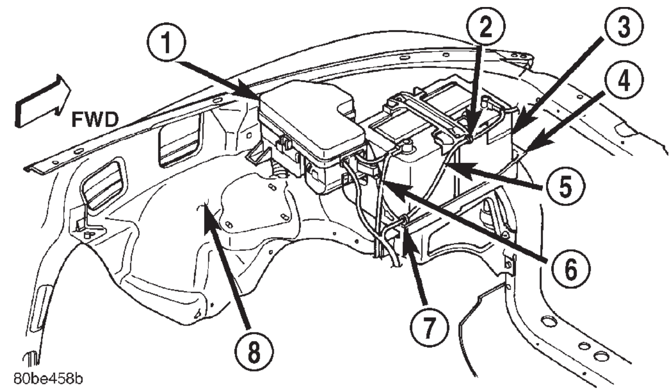

Fig. 20 Battery Cables

1 - POWER DISTRIBUTION CENTER
2 - CLIP
3 - BATTERY
4 - TRAY
5 - NEGATIVE CABLE
6 - POSITIVE CABLE
7 - CLIP
8 - WHEELHOUSE INNER PANEL

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 positive cable wire harness or the battery negative cable wire harness, which may include portions of the wiring circuits for the generator and other components on some models. Refer to **Wiring Diagrams** in the index of this service manual for the location of more information on the various wiring circuits included in the battery cable wire harnesses for the vehicle being serviced.

The battery cables feature a stamped brass clamping type female battery terminal crimped onto one end of the battery cable wire and then solder-dipped. A square headed pinch-bolt and hex nut are installed at the open end of the female battery terminal clamp. The battery positive cable also includes a red molded rubber protective cover for 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.

OPERATION

The battery cables connect the battery terminal posts to the vehicle electrical system. These cables also provide a return path for electrical current gen-

BATTERY CABLE (Continued)

erated by the charging system for restoring the voltage potential of the battery. The female battery terminal clamps on the ends of the battery cable wires provide a strong and reliable connection of the battery cable to the battery terminal posts. The terminal pinch bolts allow the female terminal clamps to be tightened around the male terminal posts on the top of the battery. The eyelet terminals secured to the ends of the battery cable wires opposite the female battery terminal clamps provide secure and reliable connection of the battery to the vehicle electrical system.

DIAGNOSIS & TESTING - BATTERY CABLES

DIAGNOSIS

A voltage drop test will determine if there is excessive resistance in the battery cable terminal connections or the battery cables. If excessive resistance is found in the battery cable connections, the connection point should be disassembled, cleaned of all corrosion or foreign material, then reassembled. Following reassembly, check the voltage drop for the battery cable connection and the battery cable again to confirm repair.

When performing the voltage drop test, it is important to remember that the voltage drop is giving an indication of the resistance between the two points at which the voltmeter probes are attached. **EXAMPLE:** When testing the resistance of the battery positive cable, touch the voltmeter leads to the battery positive cable terminal clamp and to the battery positive cable eyelet terminal at the starter solenoid B(+) terminal stud. If you probe the battery positive terminal post and the battery positive cable eyelet terminal at the starter solenoid B(+) terminal stud, you are reading the combined voltage drop in the battery positive cable terminal clamp-to-terminal post connection and the battery positive cable.

TESTING

VOLTAGE DROP TEST

WARNING:

• IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

• EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

• THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.

• IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS IS IN PLACE AND TIGHT BEFORE THE BATTERY IS RETURNED TO SERVICE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT FROM LOOSE OR MISSING CELL CAPS.

The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing this test, be certain that the following procedures are accomplished:

• The battery is fully-charged and load tested. Refer to **Battery Charging** in the index of this service manual for the location of the proper battery charging procedures. Refer to **Battery** in the index of this service manual for the location of the battery diagnosis and testing procedures, including the proper battery load test procedures.

• Fully engage the parking brake.

• If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position. If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and block the clutch pedal in the fully depressed position.

• Verify that all lamps and accessories are turned off.

• To prevent the engine from starting, remove the Automatic ShutDown (ASD) relay. The ASD relay is located in the Power Distribution Center (PDC), in the engine compartment. See the fuse and relay layout label affixed to the underside of the PDC cover for ASD relay identification and location.

(1) Connect the positive lead of the voltmeter to the battery negative terminal post. Connect the negative lead of the voltmeter to the battery negative cable terminal clamp (Fig. 21). 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.

BATTERY CABLE (Continued)

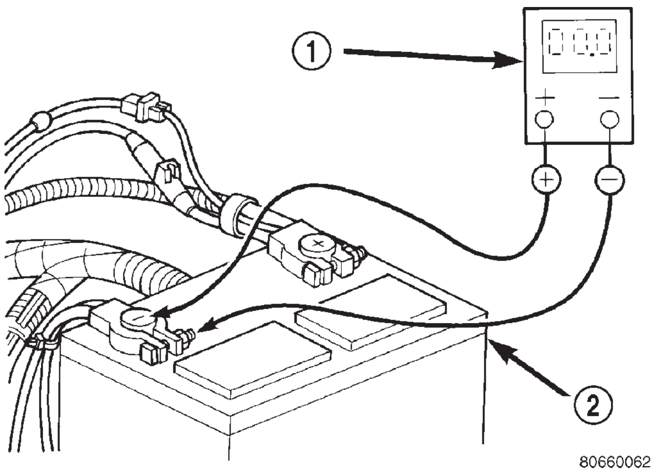

Fig. 21 Test Battery Negative Connection Resistance - Typical

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. 22). 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.

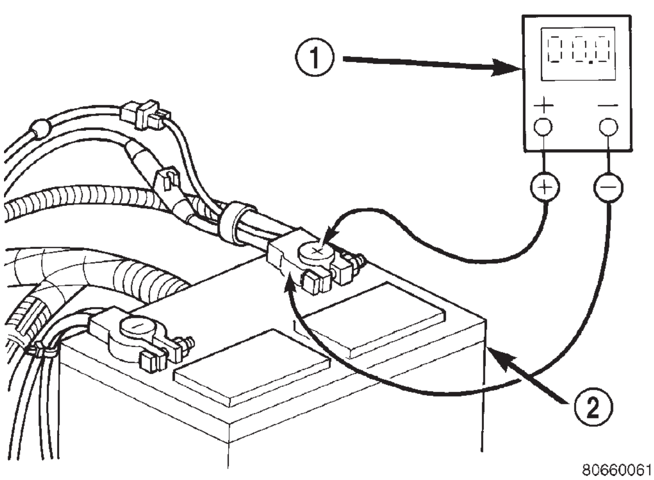

Fig. 22 Test Battery Positive Connection Resistance - Typical

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. 23). 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.

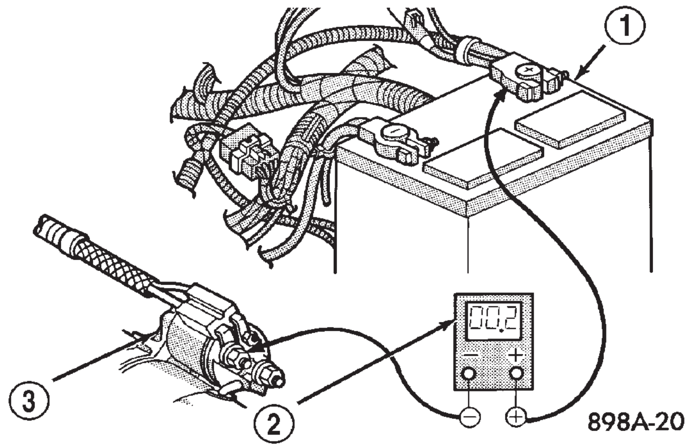

Fig. 23 Test Battery Positive Cable Resistance - Typical

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. 24). 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.

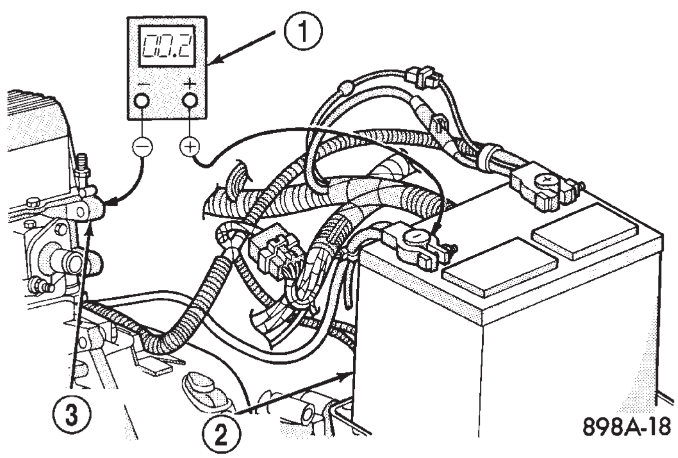

Fig. 24 Test Ground Circuit Resistance - Typical

1 - VOLTMETER
2 - BATTERY
3 - ENGINE GROUND

BATTERY TRAY

DESCRIPTION

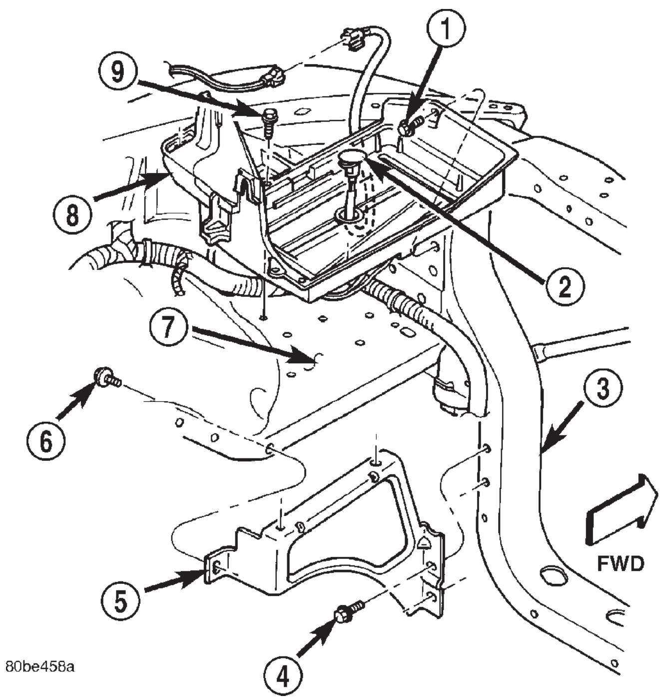

Fig. 25 Battery Tray

1 - SCREW
2 - SENSOR
3 - YOKE
4 - SCREW
5 - SUPPORT
6 - SCREW
7 - WHEELHOUSE INNER PANEL
8 - TRAY
9 - SCREW

The battery is mounted in a molded plastic tray (Fig. 25) located in the left front corner of the engine compartment. The battery tray is secured on the inboard side with screws to a stamped steel battery tray support located on the left side of the radiator, on the outboard side with screws to the front extension of the left front wheelhouse inner panel and at the front to the front closure panel on the left side of the radiator yoke. The battery tray support is secured at the front with screws to the left side of the radiator yoke, and at the rear with a screw to the front extension of the left front wheelhouse inner panel.

A hole in the bottom of the battery tray is fitted with a battery temperature sensor. Refer to **Battery Temperature Sensor** in the index of this service manual for the location of more information on the battery temperature sensor. The battery tray also includes two stanchions that are molded into the rear of the tray, which support the forward end of the Power Distribution Center (PDC). Refer to **Power Distribution Center** in the index of this service manual for the location of more information on the PDC mounting.

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 **Battery** in the index of this service manual for the location of the proper battery removal procedures.

(2) Remove the Power Distribution Center (PDC) from the stanchions on the rear of the battery tray. Refer to **Power Distribution Center** in the index of this service manual for the location of the proper PDC removal procedures.

(3) Remove the two screws that secure the inboard side of the battery tray to the battery tray support (Fig. 26).

(4) Remove the two screws that secure the outboard side of the battery tray to the front extension of the left front wheelhouse inner panel.

(5) Remove the one screw that secures the front of the battery tray to the front closure panel on the left side of the radiator yoke.

(6) Remove the battery temperature sensor from the battery tray. Refer to **Battery Temperature Sensor** in the index of this service manual for the location of the proper battery temperature sensor removal procedures.

(7) Remove the battery tray from the battery tray support and the front extension of the left front wheelhouse inner panel.

(8) Remove the one screw that secures the rear of the battery tray support to the front extension of the left front wheelhouse inner panel.

(9) Remove the two screws that secure the front of the battery tray support to the left side of the radiator yoke.

(10) Remove the battery tray support from the left front wheelhouse inner panel and the left side of the radiator yoke.

BATTERY TRAY (Continued)

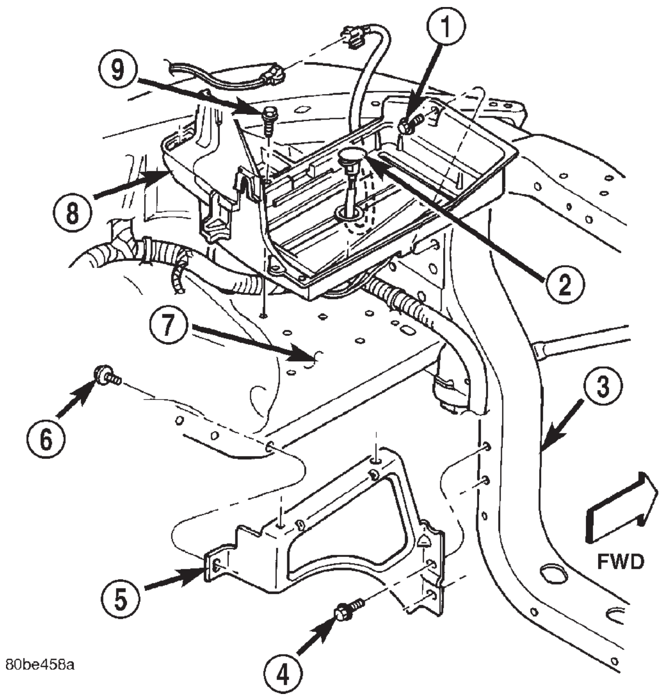

Fig. 26 Battery Tray Remove/Install

1 - SCREW
2 - SENSOR
3 - YOKE
4 - SCREW
5 - SUPPORT
6 - SCREW
7 - WHEELHOUSE INNER PANEL
8 - TRAY
9 - SCREW

INSTALLATION

(1) Clean and inspect the battery tray. Refer to **Battery** in the index of this service manual for the location of the proper battery tray cleaning and inspection procedures.

(2) Position the battery tray support onto the left front wheelhouse inner panel and the left side of the radiator yoke.

(3) Install and tighten the two screws that secure the battery tray support to the left side of the radiator yoke. Tighten the screws to 11.3 N·m (100 in. lbs.).

(4) Install and tighten the one screw that secures the rear of the battery tray support to the front extension of the left front wheelhouse inner panel. Tighten the screw to 11.3 N·m (100 in. lbs.).

(5) Install the battery temperature sensor onto the battery tray. Refer to **Battery Temperature Sensor** in the index of this service manual for the location of the proper battery temperature sensor installation procedures.

(6) Position the battery tray onto the battery tray support and the front extension of the left front wheelhouse inner panel. Be certain that the battery temperature sensor wiring is properly routed.

(7) Install and tighten the two screws (rear screw first) that secure the outboard side of the battery tray to the front extension of the left front wheelhouse inner panel. Tighten the screws to 12.4 N·m (110 in. lbs.).

(8) Install and tighten the two screws that secure the inboard side of the battery tray to the battery tray support. Tighten the screws to 12.4 N·m (110 in. lbs.).

(9) Install and tighten the one screw that secures the front of the battery tray to the front closure panel on the left side of the radiator yoke. Tighten the screw to 12.4 N·m (110 in. lbs.).

(10) Install the Power Distribution Center (PDC) onto the stanchions on the rear of the battery tray. Refer to **Power Distribution Center** in the index of this service manual for the location of the proper PDC installation procedures.

(11) Install the battery onto the battery tray. Refer to **Battery** in the index of this service manual for the location of the proper battery installation procedures.

CHARGING

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CHARGING

DESCRIPTION

The charging system consists of:

- Generator
- Electronic Voltage Regulator (EVR) circuitry within the Powertrain Control Module (PCM)
- Ignition switch (refer to 8, Ignition System for information)
- Battery (refer to 8, Battery for information)
- Battery temperature sensor
- Generator Lamp (if equipped)
- Check Gauges Lamp (if equipped)
- Voltmeter (refer to 8, Instrument Panel and Gauges 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 Panel and Gauges 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

SPECIFICATIONS - GENERATOR RATINGS

TYPE	PART NUMBER	RATED SAE AMPS	ENGINES	MINIMUM TEST AMPS
DENSO	56028686AA	117	2.5L	88
DENSO	56028687AA	136	2.5L	95
DENSO	56029913AA	117	3.9L/5.9L	90
DENSO	56030914AA	136	3.9L/5.9L	100
DENSO	56041693AB	136	4.7L	100
DENSO	56028692AA	117	4.7L	90

SPECIFICATIONS - TORQUE- CHARGING SYSTEM

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Generator Mounting Bolt - 3.9L/5.9L Engines	41	30	
Generator Pivot Bolt -3.9L/5.9L Engines	41	30	
Generator Mounting Bolt –2.5L Engine	55	41	
Generator Pivot Bolt - 2.5L Engine	55	41	
Generator Vertical Mounting Bolt - 4.7L V-8 Engine	55	40	
Generator (long) Horizontal Mounting Bolt - 4.7L V-8 Engine	55	40	
Generator (short) Horizontal Mounting Bolt - 4.7L V-8 Engine	74	55	
Generator B+ Output Cable Terminal Nut	12		108

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

The battery temperature sensor is located under vehicle battery (Fig. 1) and is attached to a mounting hole on battery tray.

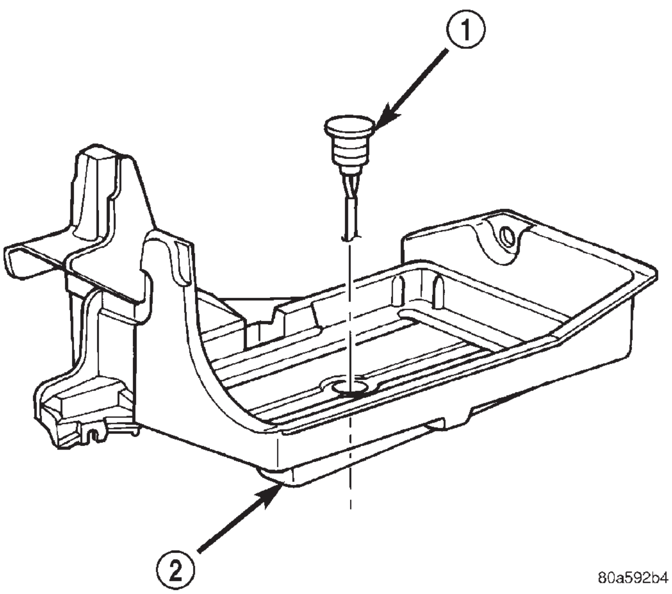

Fig. 1 Battery Temperature Sensor Location

1 - BATTERY TEMPERATURE SENSOR
2 - BATTERY TRAY

(1) Remove battery. Refer to 8, Battery for procedures.

(2) Disconnect sensor pigtail harness from engine wire harness. Sensor pigtail harness is clipped to vehicle near its electrical connector.

(3) Pry sensor straight up from battery tray mounting hole.

INSTALLATION

The battery temperature sensor is located under vehicle battery (Fig. 1) 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.

GENERATOR (Continued)

REMOVAL

WARNING: DISCONNECT NEGATIVE CABLE FROM BATTERY BEFORE REMOVING BATTERY OUTPUT WIRE (B+ WIRE) FROM GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY OR DAMAGE TO ELECTRICAL SYSTEM.

(1) Disconnect negative battery cable at battery.

(2) Remove generator drive belt. Refer to Group 7, Cooling System for procedures.

(3) Unsnap plastic cable protector cover from B+ mounting stud.

(4) 2.5L/3.9L/5.9L Engines: Remove generator pivot and mounting bolts/nut (Fig. 2) or (Fig. 3). Position generator for access to wire connectors.

(5) 4.7L Engine: Remove 3 generator mounting bolts (Fig. 4). Position generator for access to wire connectors.

(6) Remove B+ terminal mounting nut at rear of generator (Fig. 5) or (Fig. 6). Disconnect terminal from generator.

(7) Disconnect field wire connector at rear of generator by pushing on connector tab and pulling connector from generator.

(8) Remove generator from vehicle.

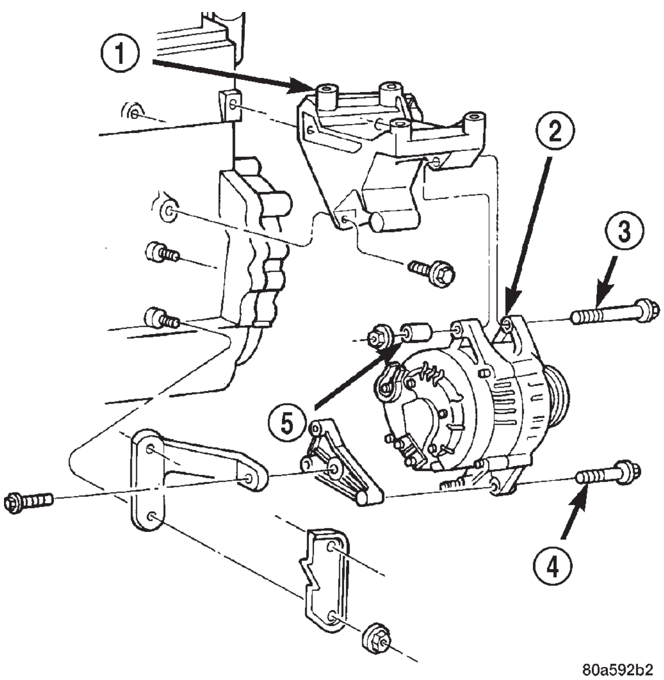

Fig. 2 Remove/Install Generator—2.5L

1 - UPPER MOUNTING BRACKET
2 - GENERATOR
3 - UPPER BOLT
4 - LOWER BOLT
5 - SPACER

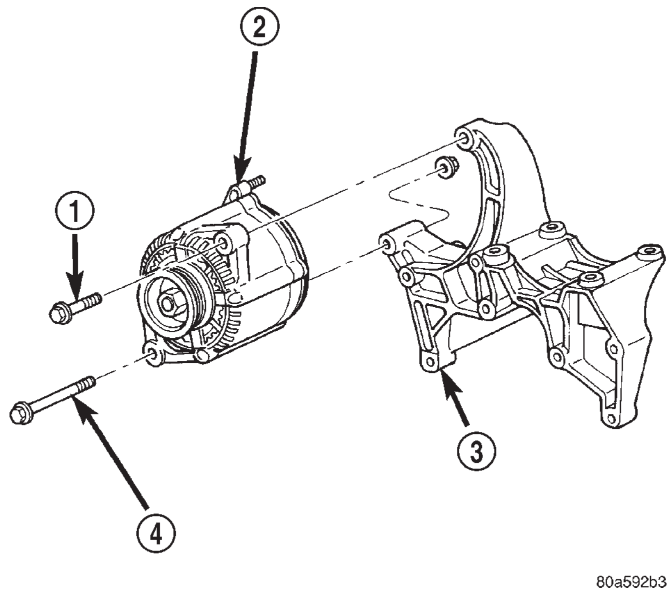

Fig. 3 Remove/Install Generator—3.9L/5.9L Engines

1 - MOUNTING BOLT
2 - GENERATOR
3 - MOUNTING BRACKET
4 - MOUNTING BOLT/NUT

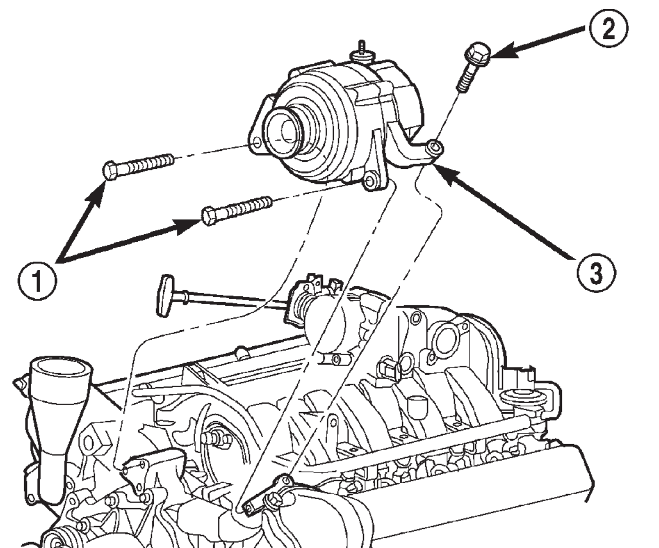

Fig. 4 Remove/Install Generator—4.7L V-8 Engine

1 - LOWER BOLTS
2 - REAR BOLT
3 - GENERATOR

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 12 N·m (108 in. lbs.) torque.

GENERATOR (Continued)

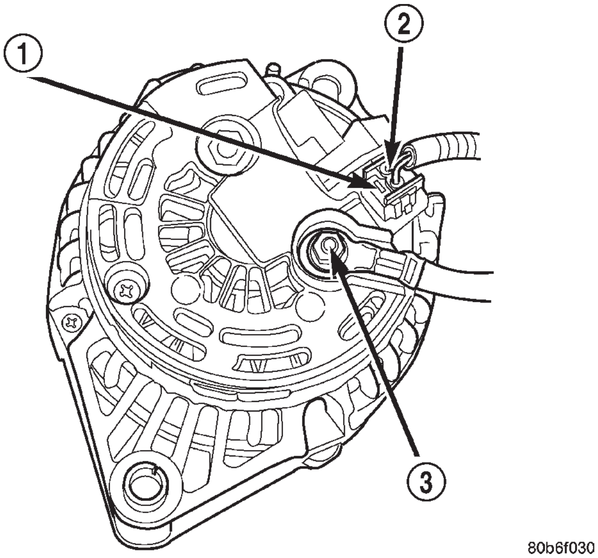

Fig. 5 Generator Connectors—Typical Bosch

1 - FIELD WIRE CONNECTOR
2 - FIELD WIRES
3 - B+ (OUTPUT TERMINAL)

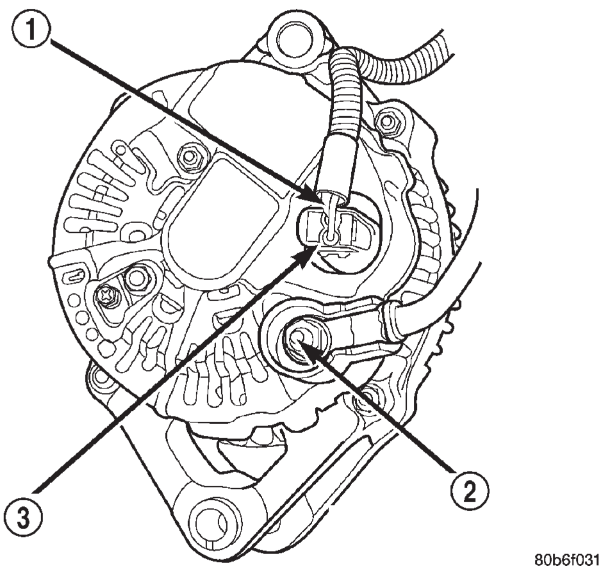

Fig. 6 Generator Connectors—Typical Denso

1 - FIELD WIRES
2 - B+ (OUTPUT TERMINAL)
3 - FIELD WIRE CONNECTOR

(3) Install generator mounting fasteners and tighten as follows:

- Generator mounting bolt 3.9L/5.9L engines—41 N·m (30 ft. lbs.) torque.
- Generator pivot bolt/nut 3.9L/5.9L engines—41 N·m (30 ft. lbs.) torque.
- Generator mounting bolt 2.5L engine—55 N·m (41 ft. lbs.) torque.
- Generator pivot bolt 2.5L engine—55 N·m (41 ft. lbs.) torque.
- Vertical mounting bolt 4.7L engine—55 N·m (40 ft. lbs.)
- Long horizontal mounting bolt 4.7L engine—55 N·m (40 ft. lbs.)
- Short horizontal mounting bolt 4.7L engine—74 N·m (55 ft. lbs.)

CAUTION: Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. The water pump will be rotating in the wrong direction if the belt is installed incorrectly, causing the engine to overheat. Refer to belt routing label in engine compartment, or refer to Belt Schematics in 7, Cooling System.

(4) Install generator drive belt. Refer to 7, Cooling System for procedure.
(5) Snap cable protector cover to B+ mounting stud.
(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

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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 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.

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

STARTING (Continued)

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, and charging systems operate in conjunction with one another, and must be tested as a complete system. For correct starting/charging system operation, all of the components involved in these 3 systems must perform within specifications.

Starting System Diagnosis		
CONDITION	POSSIBLE CAUSE	CORRECTION
STARTER FAILS TO OPERATE.	1. Battery discharged or faulty.	1. Refer to Battery. Charge or replace battery, if required.
	2. Starting circuit wiring faulty.	2. Refer to 8, Wiring Diagrams. Test and repair starter feed and/or control circuits, if required.
	3. Starter relay faulty.	3. Refer to Starter Relay in the Diagnosis and Testing section of this group. Replace starter relay, if required.
	4. Ignition switch faulty.	4. Refer to Ignition Switch and Key Lock Cylinder. Replace ignition switch, if required.
	5. Clutch pedal position switch faulty.	5. Refer to Clutch Pedal Position Switch.
	6. Park/Neutral position switch faulty or misadjusted.	6. Refer to Park/Neutral Position Switch. Replace park/neutral position switch, if required.
	7. Starter solenoid faulty.	7. Refer to Starter Motor. Replace starter motor assembly, if required.
	8. Starter motor faulty.	8. If all other starting system components and circuits test OK, replace starter motor.
STARTER ENGAGES, FAILS TO TURN ENGINE.	1. Battery discharged or faulty.	1. Refer to Battery. Charge or replace battery, if required.
	2. Starting circuit wiring faulty.	2. Refer to 8, Wiring Diagrams. Test and repair starter feed and/or control circuits, if required.
	3. Starter motor faulty.	3. If all other starting system components and circuits test OK, replace starter motor assembly.
	4. Engine seized.	4. Refer to Engine Diagnosis in the Diagnosis and Testing section of 9, Engine.

STARTING (Continued)

Starting System Diagnosis		
CONDITION	POSSIBLE CAUSE	CORRECTION
STARTER ENGAGES, SPINS OUT BEFORE ENGINE STARTS.	1. Starter ring gear faulty.	1. Refer to Starter Motor in Removal and Installation. Remove starter motor to inspect starter ring gear. Replace starter ring gear, if required.
	2. Starter motor faulty.	2. If all other starting system components and circuits test OK, replace the starter motor assembly.
STARTER DOES NOT DISENGAGE.	1. Starter motor improperly installed.	1. Refer to Starter Motor in the Removal and Installation section of this group. Tighten the starter mounting hardware to the correct tightness specifications.
	2. Starter relay faulty.	2. Refer to Starter Relay in the Diagnosis and Testing section of this group. Replace starter relay, if required.
	3. Ignition switch faulty.	3. Refer to Ignition Switch and Key Lock Cylinder. Replace ignition switch, if required.
	4. Starter motor faulty.	4. If all other starting system components and circuits test OK, replace starter motor.

INSPECTION

For complete starter wiring circuit diagrams, refer to 8, Wiring Diagrams. Before removing any unit from starting system for repair or diagnosis, perform the following inspections:

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO 8, PASSIVE RESTRAINT SYSTEMS, BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

- **Battery** - Visually inspect battery for indications of physical damage and loose or corroded cable connections. Determine the state-of-charge and cranking capacity of battery. Charge or replace battery, if required. Refer to **Battery** in 8, Battery. **Note: If equipped with diesel engine, a dual battery system is used, and both batteries must be inspected.**
- **Ignition Switch** - Visually inspect ignition switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Ignition Switch and Key Lock Cylinder.**
- **Clutch Pedal Position Switch** - If equipped with manual transmission, visually inspect clutch pedal position switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Clutch Pedal Position Switch** in 6, Clutch.
- **Park/Neutral Position Switch** - If equipped with automatic transmission, visually inspect park/neutral position switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Park/Neutral Position Switch** in 21, Transmission.
- **Starter Relay** - Visually inspect starter relay for indications of physical damage and loose or corroded wire harness connections.
- **Starter Motor** - Visually inspect starter motor for indications of physical damage and loose or corroded wire harness connections.
- **Starter Solenoid** - Visually inspect starter solenoid for indications of physical damage and loose or corroded wire harness connections.
- **Wiring** - Visually inspect wire harnesses for damage. Repair or replace any faulty wiring, as required. Refer to 8, Wiring Diagrams.

TESTING

COLD CRANKING TEST

For complete starter wiring circuit diagrams, refer to 8, Wiring Diagrams. The battery must be fully-charged and load-tested before proceeding. Refer to **Battery** in 8, Battery.

(1) Connect volt-ampere tester to battery terminals (Fig. 1). See instructions provided by manufacturer of volt-ampere tester being used. **Note: If equipped with dual battery system (diesel), tester should be connected to driver side battery only. Also, tester current reading must be taken from battery positive cable lead that connects to starter motor.**

(2) Fully engage parking brake.

(3) If equipped with manual transmission, place gearshift selector lever in Neutral position and block clutch pedal in fully depressed position. If equipped with automatic transmission, place gearshift selector lever in Park position.

STARTING (Continued)

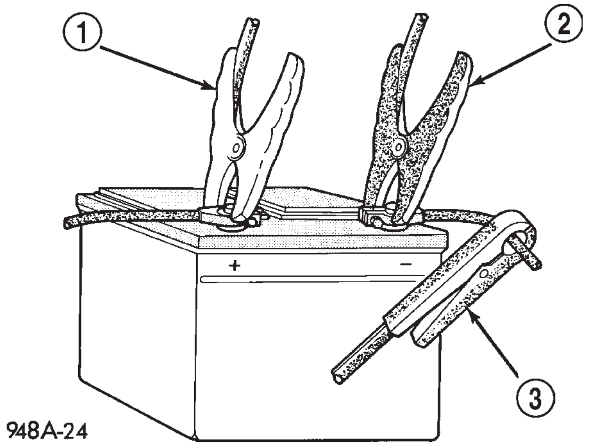

Fig. 1 Volts-Amps Tester Connections - Typical

1 - POSITIVE CLAMP
2 - NEGATIVE CLAMP
3 - INDUCTION AMMETER CLAMP

(4) Verify that all lamps and accessories are turned off.

(5) To prevent a gasoline engine from starting, remove Automatic ShutDown (ASD) relay. To prevent a diesel engine from starting, remove Fuel Pump Relay. These relays are located in Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

WARNING: IF EQUIPPED WITH DIESEL ENGINE, ATTEMPT TO START ENGINE A FEW TIMES BEFORE PROCEEDING WITH FOLLOWING STEP.

(6) Rotate and hold ignition switch in Start position. Note cranking voltage and current (amperage) draw readings shown on volt-ampere tester.

(a) If voltage reads below 9.6 volts, refer to **Starter Motor** in Diagnosis and Testing. If starter motor is OK, refer to **Engine Diagnosis** in 9, Engine for further testing of engine. If starter motor is not OK, replace faulty starter motor.

(b) If voltage reads above 9.6 volts and current (amperage) draw reads below specifications, refer to **Feed Circuit Test** in this section.

(c) If voltage reads 12.5 volts or greater and starter motor does not turn, refer to **Control Circuit Testing** in this section.

(d) If voltage reads 12.5 volts or greater and starter motor turns very slowly, refer to **Feed Circuit Test** in this section.

NOTE: A cold engine will increase starter current (amperage) draw reading, and reduce battery voltage reading.

FEED CIRCUIT TEST

The starter feed circuit test (voltage drop method) will determine if there is excessive resistance in high-amperage feed circuit. For complete starter wiring circuit diagrams, refer 8, Wiring Diagrams.

When performing these tests, it is important to remember that voltage drop is giving an indication of resistance between two points at which voltmeter probes are attached.

Example: When testing resistance of battery positive cable, touch voltmeter leads to battery positive cable clamp and cable connector at starter solenoid. If you probe battery positive terminal post and cable connector at starter solenoid, you are reading combined voltage drop in battery positive cable clamp-to-terminal post connection and battery positive cable.

The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing tests, be certain that following procedures are accomplished:

- Battery is fully-charged and load-tested. Refer to **Battery** in 8, Battery.
- Fully engage parking brake.
- If equipped with manual transmission, place gearshift selector lever in Neutral position and block clutch pedal in fully depressed position. If equipped with automatic transmission, place gearshift selector lever in Park position.
- Verify that all lamps and accessories are turned off.
- To prevent a gasoline engine from starting, remove Automatic ShutDown (ASD) relay. To prevent a diesel engine from starting, remove Fuel Pump Relay. These relays are located in Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

(1) Connect positive lead of voltmeter to battery negative terminal post. Connect negative lead of voltmeter to battery negative cable clamp (Fig. 2). Rotate and hold ignition switch in Start position. Observe voltmeter. If voltage is detected, correct poor contact between cable clamp and terminal post. **Note: If equipped with a dual battery system (diesel), procedure must be performed twice, once for each battery.**

(2) Connect positive lead of voltmeter to battery positive terminal post. Connect negative lead of voltmeter to battery positive cable clamp (Fig. 3). Rotate and hold ignition switch in Start position. Observe voltmeter. If voltage is detected, correct poor contact between cable clamp and terminal post. **Note: If equipped with a dual battery system (diesel), this procedure must be performed twice, once for each battery.**

STARTING (Continued)

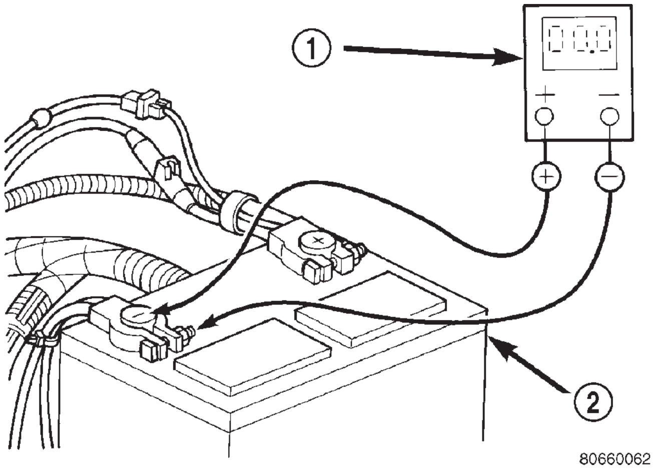

Fig. 2 Test

1 - VOLTMETER
2 - BATTERY

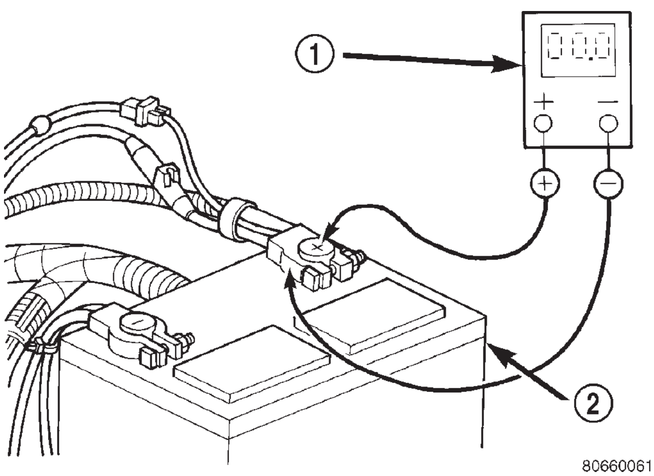

Fig. 3 Test Battery Positive Connection Resistance - Typical

1 - VOLTMETER
2 - BATTERY

(3) Connect voltmeter to measure between battery positive terminal post and starter solenoid battery terminal stud (Fig. 4). Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, clean and tighten battery cable connection at solenoid. Repeat test. If reading is still above 0.2 volt, replace faulty battery positive cable. **Note: If equipped with a dual battery system (diesel), this procedure must be performed on driver side battery only.**

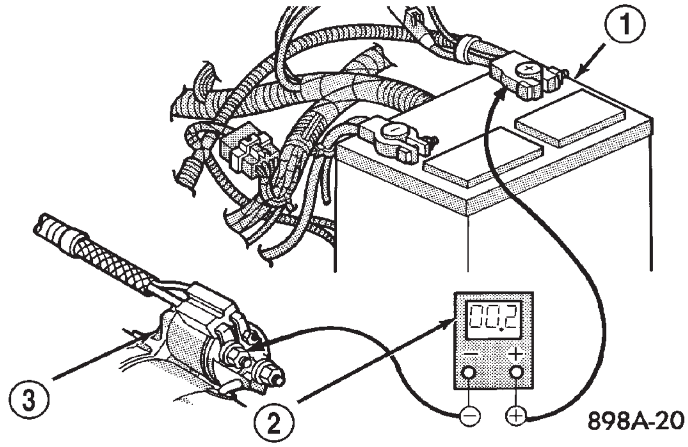

Fig. 4 Test Battery Positive Cable

1 - BATTERY
2 - VOLTMETER
3 - STARTER MOTOR

(4) Connect voltmeter to measure between battery negative terminal post and a good clean ground on engine block (Fig. 5). Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, clean and tighten battery negative cable attachment on engine block. Repeat test. If reading is still above 0.2 volt, replace faulty battery negative cable. **Note: If equipped with dual battery system (diesel), this procedure must be performed twice, once for each battery.**

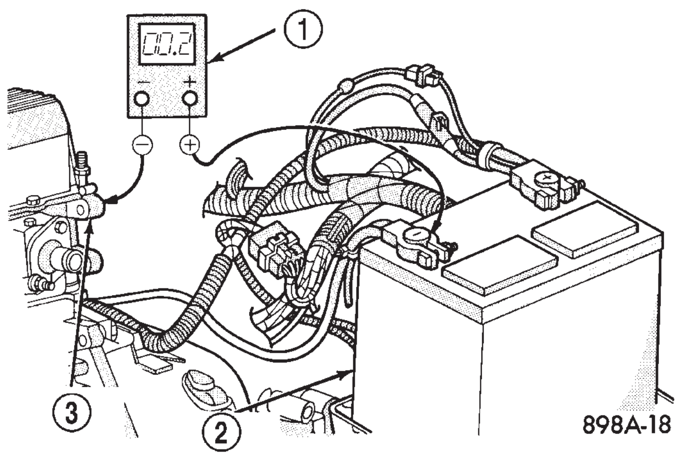

Fig. 5 Test Ground Circuit Resistance - Typical

1 - VOLTMETER
2 - BATTERY
3 - ENGINE GROUND

STARTING (Continued)

(5) Connect positive lead of voltmeter to starter housing. Connect negative lead of voltmeter to battery negative terminal post (Fig. 6). Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, correct poor starter to engine block ground contact. **Note: If equipped with a dual battery system (diesel), this procedure must be performed on driver side battery only.**

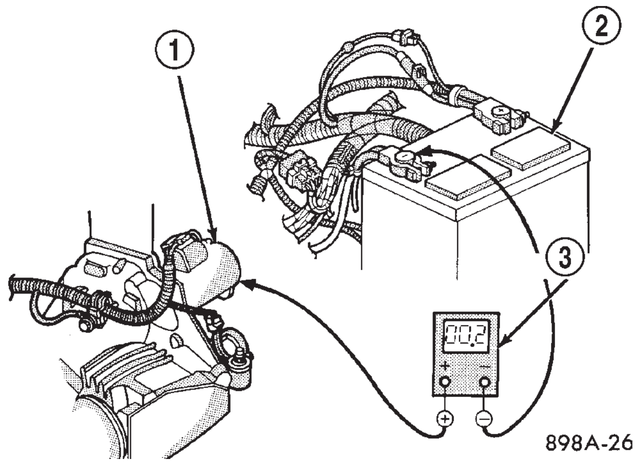

Fig. 6 Test Starter Ground - Typical

1 - STARTER MOTOR
2 - BATTERY
3 - VOLTMETER

(6) If equipped with dual battery system (diesel), connect positive lead of voltmeter to driver side battery positive cable clamp. Connect negative lead of voltmeter to passenger side battery positive terminal post. Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, clean and tighten passenger side battery positive cable eyelet connection at driver side battery positive cable clamp bolt. Repeat test. If reading is still above 0.2 volt, replace faulty passenger side battery positive cable.

If resistance tests detect no feed circuit problems, refer to **Starter Motor** in the Diagnosis and Testing.

CONTROL CIRCUIT TESTING

The starter control circuit components should be tested in the order in which they are listed, as follows:

- **Starter Relay** - Refer to **Starter Relay** Diagnosis and Testing.
- **Starter Solenoid** - Refer to **Starter Motor** Diagnosis and Testing.
- **Ignition Switch** - Refer to **Ignition Switch and Key Lock Cylinder**
- **Clutch Pedal Position Switch** - If equipped with manual transmission, refer to **Clutch Pedal Position Switch** in 6, Clutch.
- **Park/Neutral Position Switch** - If equipped with automatic transmission, refer to **Park/Neutral Position Switch** in 21, Transmission.
- **Wire harnesses and connections** - Refer to 8, Wiring Diagrams.

SPECIFICATIONS

SPECIFICATIONS - STARTING SYSTEM

Starter Motor and Solenoid			
Manufacturer	Mitsubishi	Denso	Denso
Part Number	56041013AC	56027702AC	56028715
Engine Application	2.5L	3.9L, 4.7L (Manual), 5.9L	4.7L (Auto)
Power Rating	1.2 Kilowatt - (1.6 Horsepower)	1.4 Kilowatt - (1.9 Horsepower	1.4 Kilowatt - (1.9 Horsepower
Voltage	12 Volts	12 Volts	12 Volts
Pinion Teeth	9	10	10
Number of Fields	4	4	4
Number of Poles	4	4	4
Number of Brushes	4	4	4
Drive Type	Planetary Gear Reduction	Reduction Gear Train	Reduction Gear Train
Free Running Test Voltage	11.2 Volts	11 Volts	11 Volts

SPECIFICATIONS (Continued)

Starter Motor and Solenoid			
Free Running Test Maximum Amperage Draw	90 Amperes	73 Amperes	73 Amperes
Free Running Test Minimum Speed	2600 rpm	3601 rpm	3601 rpm
Solenoid Closing Maximum Voltage Required	7.8 Volts	7.5 Volts	7.5 Volts
* Cranking Amperage Draw Test	130 Amperes	125 - 250 Amperes	125 - 250 Amperes
* Test at operating temperature. Cold engine, tight (new) engine, or heavy oil will increase starter amperage draw.			

SPECIFICATIONS - TORQUE - STARTING SYSTEM

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Battery Cable Eyelet Nut at Solenoid Stud	14		120
Starter Mounting Bolts – 2.5L Engine	54	40	
Starter Mounting Nuts/Bolts – V-6/V-8 Engines	68	50	

STARTER MOTOR

DESCRIPTION

The 2.5L starter is mounted with two bolts to the clutch housing on the right side of the engine. The 4.7L automatic transmission starter motor is mounted with two bolts to the torque converter housing on the left side of the engine. The starter motors for all of the remaining engine and transmission combinations are mounted with one bolt, a stud and a nut to the clutch or convertor housing, and are located on the left side of the engine.

The electric motors of both starters have four brushes contacting the motor commutator. The 2.5L starter motor uses four permanent magnets for the field poles, while the other starter motors feature four electromagnetic field coils wound around four pole shoes.

The starter motors are serviced only as a unit with 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

The starter motor is equipped with a gear reduction (intermediate transmission) system. The gear reduction system consists of a gear that is integral to the output end of the electric motor armature shaft that is in continual engagement with a larger gear that is splined to the input end of the starter pinion gear shaft. This feature makes it possible to reduce the dimensions of the starter. At the same time, it allows higher armature rotational speed, and delivers increased torque through the starter pinion gear to the starter ring gear.

The starter motor is activated by an integral heavy duty starter solenoid switch mounted to the overrunning clutch housing. This electromechanical switch connects and disconnects the feed of battery voltage to the starter motor, and actuates a shift fork that engages and disengages the starter pinion gear with the starter ring gear.

The starter motor uses an overrunning clutch and starter pinion gear unit to engage and drive the gears on the flywheel (or flywheel ring gear).

DIAGNOSIS AND TESTING - STARTER MOTOR

Correct starter motor operation can be confirmed by performing following free running bench test. This test can only be performed with starter motor removed from vehicle. Refer to Starting Specifications for starter motor specifications.

(1) Remove starter motor from vehicle. Refer to **Starter Motor**Removal and 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.

(3) Connect suitable volt-ampere tester and 12-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 jumper wire from solenoid terminal to solenoid battery terminal. The starter motor should operate. If starter motor fails to operate, replace faulty starter motor assembly.

STARTER MOTOR (Continued)

(5) Adjust carbon pile load of tester to obtain free running test voltage. Refer to Starting Specifications for starter motor free running test voltage specifications.

(6) Note reading on ammeter and compare reading to free running test maximum amperage draw. Refer to Starting Specifications section for starter motor free running test maximum amperage draw specifications.

(7) If ammeter reading exceeds maximum amperage draw specification, replace faulty starter motor assembly.

STARTER MOTOR SOLENOID

This test can only be performed with starter motor removed from vehicle.

(1) Remove starter motor from vehicle. Refer to **Starter Motor** Removal and Installation.

(2) Disconnect wire from solenoid field coil terminal.

(3) Check for continuity between solenoid terminal and solenoid field coil terminal with continuity tester (Fig. 7) or (Fig. 8). There should be continuity. If OK, go to Step 4. If not OK, replace faulty starter motor assembly.

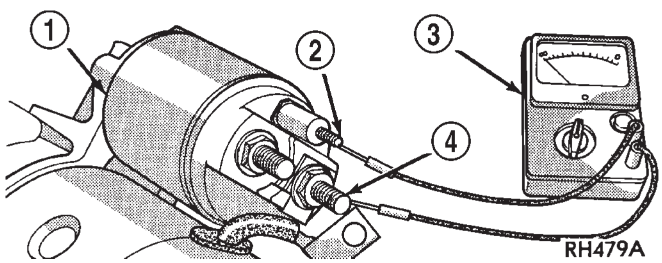

Fig. 7 Continuity Test Between Solenoid Terminal and Field Coil Terminal - 2.5L Engine - Typical

1 - SOLENOID
2 - SOLENOID TERMINAL
3 - OHMMETER
4 - FIELD COIL TERMINAL

(4) Check for continuity between solenoid terminal and solenoid case (Fig. 9) or (Fig. 10). There should be continuity. If not OK, replace faulty starter motor assembly.

REMOVAL

2.5L Engine

(1) Disconnect and isolate negative battery cable.

(2) Raise and support vehicle.

(3) Remove bolt and washer (forward facing) securing starter to clutch housing (Fig. 11).

(4) While supporting starter motor, remove bolt and washer (rearward facing) securing starter motor to transmission housing.

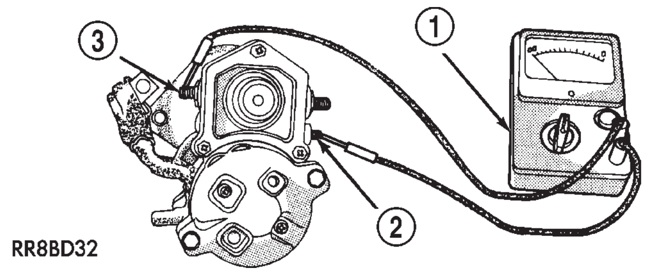

Fig. 8 Continuity Test Between Solenoid Terminal and Field Coil Terminal - 3.9L/4.7L/5.9L Engine - Typical

1 - OHMMETER
2 - SOLENOID TERMINAL
3 - FIELD COIL TERMINAL

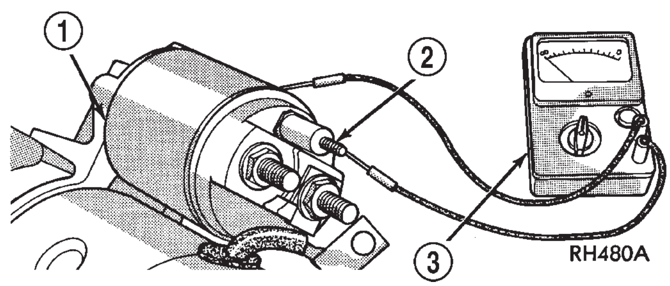

Fig. 9 Continuity Test Between Solenoid Terminal and Solenoid Case - 2.5L Engine - Typical

1 - SOLENOID
2 - SOLENOID TERMINAL
3 - OHMMETER

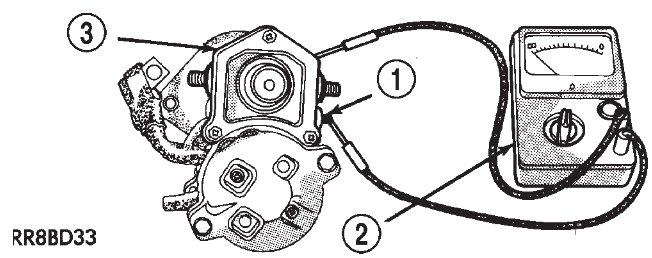

Fig. 10 Continuity Test Between Solenoid Terminal and Solenoid Case - 3.9L/4.7L/5.9L Engine - Typical

1 - SOLENOID TERMINAL
2 - OHMMETER
3 - SOLENOID

(5) Lower starter motor far enough to access and remove battery cable eyelet terminal nut at starter solenoid. Always support starter motor during this process. Do not let starter motor hang from wire harness.

(6) Remove battery cable from stud.

(7) Disconnect solenoid terminal wire harness connector from starter solenoid.

STARTER MOTOR (Continued)

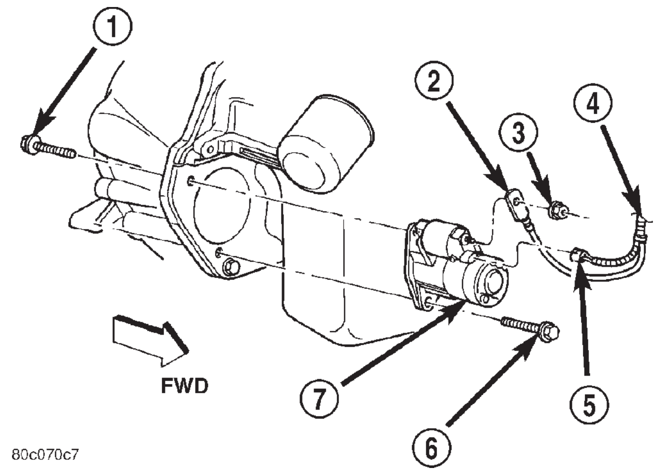

Fig. 11 Starter Motor Remove/Install - 2.5L Engine

1 - SCREW AND WASHER
2 - EYELET TERMINAL
3 - NUT
4 - BATTERY POSITIVE CABLE WIRE HARNESS
5 - WIRE HARNESS CONNECTOR
6 - SCREW AND WASHER
7 - STARTER MOTOR

(8) Remove starter motor from transmission housing.

All 3.9L/5.9L, or 4.7L With Manual Transmission

(1) Disconnect and isolate negative battery cable.
(2) Raise and support vehicle.
(3) Remove nut securing starter motor to stud on transmission housing (Fig. 12).
(4) While supporting starter motor, remove bolt securing starter motor to transmission housing.
(5) If equipped with automatic transmission, slide transmission cooler tube bracket forward on tubes far enough for starter motor to be removed from lower mounting stud.
(6) Lower starter motor from front transmission housing far enough to access and remove nut securing battery cable eyelet to starter solenoid stud. Always support starter motor during this process. Do not let starter motor hang from wire harness.
(7) Remove solenoid wire solenoid terminal stud.
(8) Disconnect battery cable solenoid wire from receptacle on starter solenoid.
(9) Remove starter motor from transmission housing.

4.7L With Automatic Transmission

(1) Disconnect and isolate negative battery cable.
(2) Raise and support vehicle.
(3) Remove bolt and washer (rearward facing) securing starter motor to the transmission housing (Fig. 13).

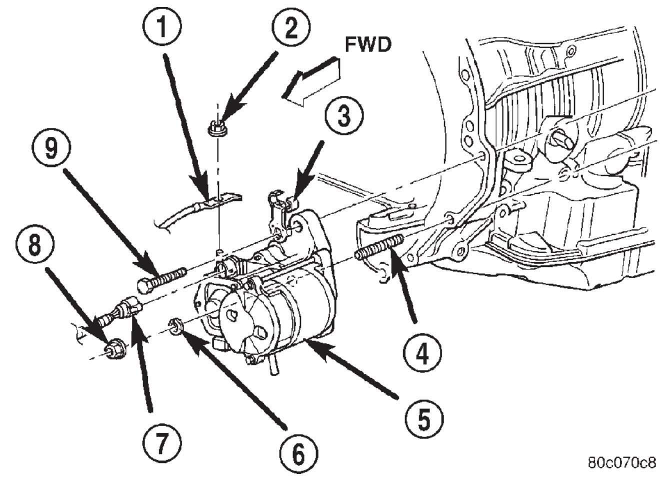

Fig. 12 Starter Motor Remove/Install - All 3.9L/5.9L, or 4.7L Engine with Man. Trans.

1 - EYELET TERMINAL
2 - NUT
3 - BRACKET
4 - STUD
5 - STARTER MOTOR
6 - LOCK WASHER
7 - WIRE HARNESS CONNECTOR
8 - NUT
9 - SCREW AND WASHER

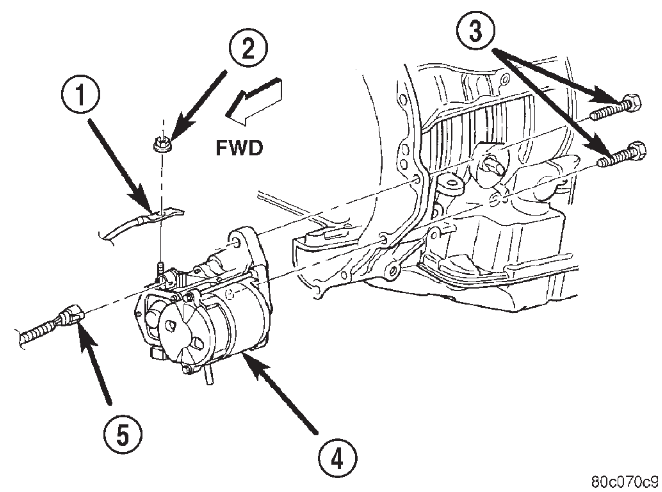

Fig. 13 Starter Motor Remove/Install - 4.7L Engine with Automatic Transmission

1 - EYELET TERMINAL
2 - NUT
3 - SCREW AND WASHER (2)
4 - STARTER MOTOR
5 - WIRE HARNESS CONNECTOR

STARTER MOTOR (Continued)

(4) While supporting starter motor, remove bolt and washer (rearward facing) securing starter motor to the transmission housing.

(5) Lower starter motor from front of transmission housing far enough to access and remove nut securing battery positive cable eyelet terminal to the starter solenoid B(+) terminal stud. Always support starter motor during this process. Do not let starter motor hang from wire harness.

(6) Remove battery cable eyelet terminal from solenoid B(+) terminal stud.

(7) Disconnect battery cable solenoid terminal wire harness connector from receptacle on starter solenoid.

(8) Remove starter motor from transmission housing.

INSTALLATION

2.5L Engine

(1) Position starter motor to transmission housing.

(2) Connect battery cable 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 cable eyelet terminal onto solenoid B(+) terminal stud.

(4) Install and tighten nut securing battery cable eyelet terminal to starter solenoid B(+) terminal stud. Tighten nut to 13.6 N·m (120 in. lbs.).

(5) Position starter motor and install bolts/washers. Tighten bolts to 54.2 N·m (40 ft. lbs.).

(6) Lower vehicle.

(7) Connect negative battery cable.

All 3.9L/5.9L, or 4.7L With Manual Trans.

(1) Position starter motor to transmission housing.

(2) Connect battery cable solenoid terminal wire harness connector to connector receptacle on starter solenoid. Always support the starter motor during this process. Do not let the starter motor hang from the wire harness.

(3) Install battery cable eyelet terminal onto solenoid B(+) terminal stud.

(4) Install and tighten nut securing battery cable eyelet terminal to starter solenoid B(+) terminal stud. Tighten nut to 13.6 N·m (120 in. lbs.).

(5) Position starter motor over stud on transmission housing.

(6) If equipped with automatic transmission, slide automatic transmission cooler tube bracket rearward on tubes and into position over starter motor flange.

(7) Loosely install the washers, bolt, and nut to starter. Tighten bolt and nut to 67.8 N·m (50 ft. lbs.).

(8) Lower vehicle.

(9) Connect negative battery cable.

4.7L With Automatic Trans.

(1) Position starter motor to transmission housing.

(2) Connect battery cable solenoid terminal wire harness connector to connector receptacle on starter solenoid. Always support the starter motor during this process. Do not let the starter motor hang from the wire harness.

(3) Install battery cable eyelet terminal onto solenoid B(+) terminal stud.

(4) Install and tighten nut securing battery cable eyelet terminal to starter solenoid B(+) terminal stud. Tighten nut to 13.6 N·m (120 in. lbs.).

(5) Position starter motor to transmission housing and loosely install two bolts/washers.

(6) Tighten bolts to 67.8 N·m (50 ft. lbs.).

(7) Lower vehicle.

(8) Connect negative battery cable.

STARTER MOTOR RELAY

DESCRIPTION

The starter relay is an electromechanical device that switches battery current to the pull-in coil of the starter solenoid when ignition switch is turned to Start position. The starter relay is located in the Power Distribution Center (PDC) in the engine compartment. See PDC cover for relay identification and location.

The starter relay is a International Standards Organization (ISO) relay. Relays conforming to ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions.

The starter relay cannot be repaired or adjusted and, if faulty or damaged, it must be replaced.

OPERATION

The ISO relay consists of an electromagnetic coil, a resistor or diode, and three (two fixed and one movable) electrical contacts. The movable (common feed) relay contact is held against one of the fixed contacts (normally closed) by spring pressure. When electromagnetic coil is energized, it draws the movable contact away from normally closed fixed contact, and holds it against the other (normally open) fixed contact.

When electromagnetic coil is de-energized, spring pressure returns movable contact to normally closed position. The resistor or diode is connected in parallel with electromagnetic coil within relay, and helps to dissipate voltage spikes produced when coil is de-energized.

STARTER MOTOR RELAY (Continued)

DIAGNOSIS AND TESTING - STARTER RELAY

The starter relay (Fig. 14) is located in Power Distribution Center (PDC). Refer to PDC cover for relay identification and location. For complete starter relay wiring circuit diagrams, refer to 8, Wiring Diagrams.

(1) Remove starter relay from PDC.

(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 12V 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.

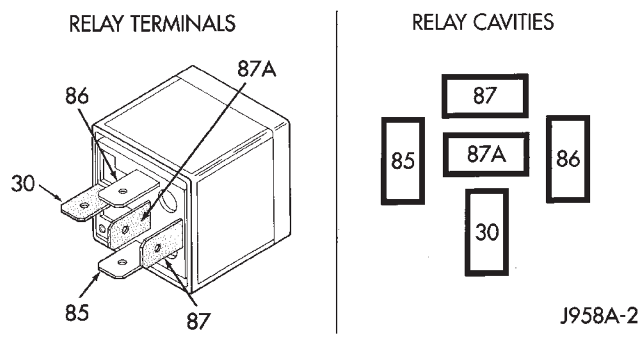

Fig. 14 Starter Relay

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 fuse in 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 common feed terminal (30) in the energized position. This terminal supplies battery voltage to starter solenoid field coils. 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 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 manual transmission, clutch pedal must be fully depressed 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 automatic transmission, check for open or short circuit to ignition switch and repair, if required. If circuit to ignition switch is OK, refer to **Ignition Switch and Key Lock Cylinder** . If not OK with a manual transmission, check circuit between relay and clutch pedal position switch for open or a short. If circuit is OK, refer to **Clutch Pedal Position Switch** in 6 , Clutch.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. On vehicles with manual transmission, it is grounded at all times. On vehicles with 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 manual transmission, repair circuit to ground as required. If not OK with automatic transmission, check for pen or short circuit to park/neutral position switch and repair, if required. If circuit to park/neutral position switch is OK, refer to **Park/Neutral Position Switch** in 21, Transmission.

REMOVAL

(1) Disconnect and isolate negative battery cable.

(2) Remove cover from Power Distribution Center (PDC) (Fig. 15).

(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.

STARTER MOTOR RELAY (Continued)

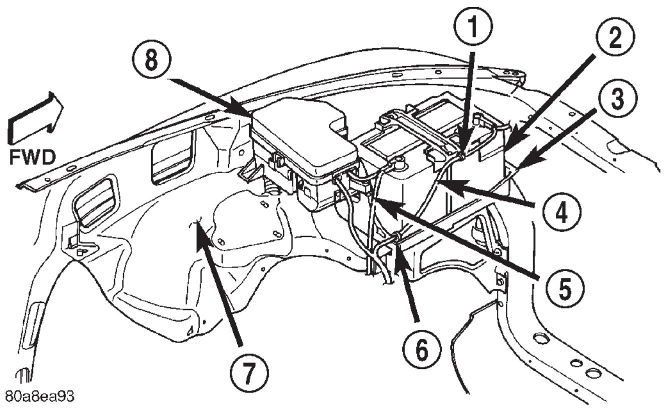

Fig. 15 Power Distribution Center

1 - CLIP
2 - BATTERY
3 - TRAY
4 - NEGATIVE CABLE
5 - POSITIVE CABLE
6 - CLIP
7 - FENDER INNER SHIELD
8 - POWER DISTRIBUTION CENTER

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) Install cover onto PDC.

(6) Reconnect negative battery cable.

HEATED SYSTEMS

TABLE OF CONTENTS

HEATED GLASS

TABLE OF CONTENTS

HEATED GLASS

DESCRIPTION - REAR WINDOW DEFOGGER

The system consists of a rear glass with two vertical bus bars and a series of electrically connected grid lines fired on the inside surface. A control switch and a timing circuit are combined into the HVAC control assembly. A push button on the HVAC control assembly turns the defroster ON or OFF. Circuit protection is provided by a cartridge fuse located in the Power Distribution Center (PDC) for the heated grid circuit, and a fuse in the fuse block for the control circuit.

OPERATION - REAR WINDOW DEFOGGER

The defogger system is controlled by a momentary switch in the HVAC Control assembly, which also includes the switch for the rear wiper and washer system. An amber indicator lamp in the HVAC Control assembly will light to indicate when the defogger system is turned on. The rear window switch also contains the defogger system control circuitry including the timer logic and the defogger relay.

The defogger system will be automatically turned off after a programmed time interval of about ten minutes. After the initial time interval has expired, if the defogger switch is turned on again during the same ignition cycle, the defogger system will automatically turn off after about five minutes.

The defogger system will automatically shut off if the ignition switch is turned to the Off position, or it can be turned off manually by depressing the defogger switch a second time. 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 - REAR WINDOW DEFOGGER SYSTEM

For circuit descriptions and diagrams, refer to Rear Window Defogger in 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.

HEATED GLASS (Continued)

• Turn the ignition switch to the On position. Set the defogger switch in the On position. The rear window defogger operation can be checked by feeling the rear window or outside rear view mirror glass. A distinct difference in temperature between the grid lines and the adjacent clear glass or the mirror glass can be detected within three to four minutes of operation.

• Using a 12-volt DC voltmeter, contact the rear glass heating grid terminal A (right side) with the negative lead, and terminal B (left side) with the positive lead (Fig. 1). The voltmeter should read battery voltage.

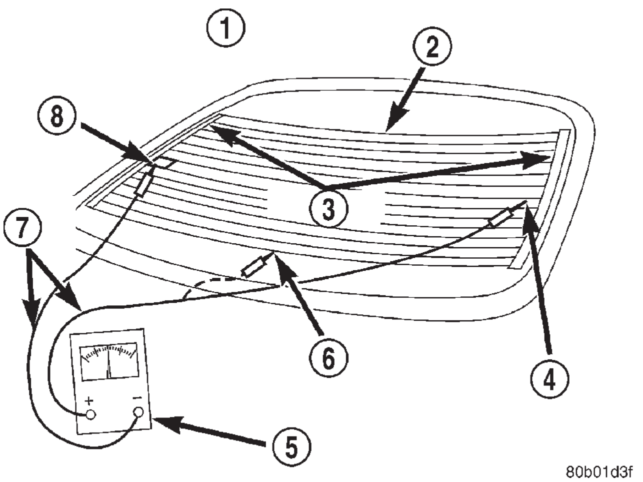

Fig. 1 Grid Line Test

1 - VIEW FROM INSIDE VEHICLE
2 - REAR WINDOW DEFOGGER
3 - BUS BARS
4 - VOLTAGE FEED (A)
5 - VOLTMETER
6 - MID-POINT (C)
7 - PICK-UP LEADS
8 - GROUND (B)

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 rear window defogger logic and timer circuitry, but does not confirm that the electrical current is reaching the rear glass heating grid lines.

If the defogger system does not operate, the problem should be isolated in the following manner:

(1) Confirm that the ignition switch is in the On position.

(2) Ensure that the rear glass heating grid feed and ground wires are connected to the glass. Confirm that the ground wire has continuity to ground.

(3) Check the fuses in the Power Distribution Center (PDC) and in the junction block. The fuses must be tight in their receptacles and all electrical connections must be secure.

When the above steps have been completed and the rear glass heating grid is still inoperative, one or more of the following is faulty:

• Rear window switch (HVAC Control Assembly).

• 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 rear window switch defogger relay output and the rear glass heating grid.

REAR WINDOW DEFOGGER GRID

DESCRIPTION - REAR GLASS HEATING GRID

The heated rear window glass has two electrically conductive vertical bus bars and a series of horizontal grid lines made of a silver-ceramic material, which is baked on and bonded to the inside surface of the glass. The grid lines and bus bars comprise a parallel electrical circuit. A control switch and a timing circuit are combined into the heating-A/C control assembly.

A push-button on the heater-A/C control assembly turns the defroster ON and OFF.

Circuit protection is provided by a cartridge fuse located in the Power Distribution Center (PDC) for the heated grid circuit.

OPERATION - REAR GLASS HEATING GRID

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 heating 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 terminals.

REAR WINDOW DEFOGGER GRID (Continued)

DIAGNOSIS AND TESTING - REAR WINDOW DEFOGGER GRID

For circuit descriptions and diagrams, refer to Rear Window Defogger in 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, (Refer to 8 - ELECTRICAL/HEATED GLASS/REAR WINDOW DEFOGGER SWITCH - DIAGNOSIS AND TESTING).

(2) Using a 12-volt DC voltmeter, contact the vertical bus bar on the right side of the vehicle with the negative lead. With the positive lead, contact the vertical bus bar on the left side of the vehicle. The voltmeter should read battery voltage. If OK, go to Step 3. If not OK, repair the open circuit to the defogger relay as required.

(3) With the negative lead of the voltmeter, contact a good body ground point. The voltage reading should not change. If OK, go to Step 4. If not OK, repair the circuit to ground as required.

(4) Connect the negative lead of the voltmeter to the right side bus bar and touch each grid line at midpoint C with the positive lead. A reading of approximately six volts indicates a line is good. A reading of zero volts indicates a break in the grid line between midpoint C and the left side bus bar. A reading of ten to fourteen volts indicates a break between midpoint C and the right side bus bar. Move the positive lead on the grid line towards the break and the voltage reading will change as soon as the break is crossed.

STANDARD PROCEDURE - REAR WINDOW DEFOGGER GRID REPAIR

Repair of the rear glass heating grid lines, bus bars, terminals or pigtail wires can be accomplished using a Mopar Rear Window Defogger Repair Kit (Part Number 4267922) or equivalent.

WARNING: MATERIALS CONTAINED IN THE REPAIR KIT MAY CAUSE SKIN OR EYE IRRITATION. THE KIT CONTAINS EPOXY RESIN AND AMINE TYPE HARDENER, WHICH ARE HARMFUL IF SWALLOWED. AVOID CONTACT WITH THE SKIN AND EYES. FOR SKIN CONTACT, WASH THE AFFECTED AREAS WITH SOAP AND WATER. FOR CONTACT WITH THE EYES, FLUSH WITH PLENTY OF WATER. DO NOT TAKE INTERNALLY. IF TAKEN INTERNALLY, INDUCE VOMITING AND CALL A PHYSICIAN IMMEDIATELY. USE WITH ADEQUATE VENTILATION. DO NOT USE NEAR FIRE OR FLAME. CONTAINS FLAMMABLE SOLVENTS. KEEP OUT OF THE REACH OF CHILDREN.

(1) Follow the instructions in the repair kit for preparing the damaged area.

(2) Remove the package separator clamp and mix the two conductive epoxy components thoroughly within the packaging. Fold the package in half and cut the center corner to dispense the epoxy.

(3) For grid line repairs, mask the area to be repaired with masking tape or a template (Fig. 2).

(4) Apply the epoxy through the slit in the masking tape or template. Overlap both ends of the break by at least 19 millimeters (0.75 inch).

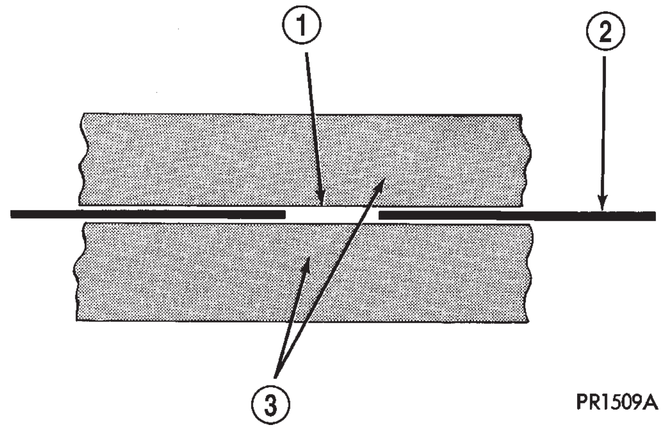

Fig. 2 Grid Line Repair - Typical

1 - BREAK
2 - GRID LINE
3 - MASKING TAPE

(5) For a terminal or pigtail wire replacement, mask the adjacent areas so the epoxy can be extended onto the adjacent grid line as well as the bus bar. Apply a thin layer of epoxy to the area where the terminal or pigtail wire was fastened and onto the adjacent grid line.

(6) Apply a thin layer of conductive epoxy to the terminal or bare wire end of the pigtail and place it in the proper location on the bus bar. To prevent the terminal or pigtail wire from moving while the epoxy is curing, it must be wedged or clamped.

(7) Carefully remove the masking tape or template.

CAUTION: Do not allow the glass surface to exceed 204° C (400° F) or the glass may fracture.

(8) Allow the epoxy to cure 24 hours at room temperature, or use a heat gun with a 260° to 371° C (500° to 700° F) range for fifteen minutes. Hold the heat gun approximately 25.4 centimeters (10 inches) from the repair.

(9) After the conductive epoxy is properly cured, remove the wedge or clamp from the terminal or pigtail wire. Do not attach the wire harness connectors until the curing process is complete.

REAR WINDOW DEFOGGER GRID (Continued)

(10) Check the operation of the rear window defogger glass heating grid.

REAR WINDOW DEFOGGER SWITCH

DESCRIPTION

The rear window defogger switch is integral to the heater—A/C control assembly, which includes the rear wiper and washer switches.

The rear window switch also contains the rear window defogger logic and timer circuitry, an amber defogger indicator lamp, the rear window defogger relay, and two switch illumination lamps. The indicator and illumination lamps in the switch pod use incandescent bulbs, which can be serviced.

The momentary-type rear window defogger switch provides a hard wired ground signal to the rear window defogger logic and timer circuitry, each time it is depressed.

OPERATION

The rear window defogger timer and logic circuitry responds by energizing or de-energizing the rear window defogger relay and the amber defogger indicator lamp, which lights to indicate when the defogger system is turned On. Energizing the rear window defogger relay provides electrical current to the rear window defogger grid.

The rear window switch cannot be repaired. If any function of the switch except lighting is faulty or damaged, the entire heater—A/C control assembly must be replaced.

HEATED MIRRORS

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HEATED MIRRORS

DESCRIPTION

The optional heated mirror system only operates in concert with the rear defogger system, and will be automatically turned off after a programmed time interval of about ten minutes. After the initial time interval has expired, if the defogger switch is turned on again during the same ignition cycle, the heated mirror system will automatically turn off after about five minutes.

The heated mirror 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 defogger switch a second time. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the heated mirror system.

When the rear window defogger switch is in the On position, an electric heater grid located behind the glass of each of the outside rear view mirrors is energized. When energized, each of these heater grids produce heat to help clear the outside rear view mirrors of ice, snow, or fog.

The heated mirror system is controlled by a momentary rear window defogger switch in the HVAC Control panel, which also includes the switch for the rear wiper and washer system. An amber indicator lamp in the switch control will light to indicate when the defogger system is turned on. The HVAC control assembly also contains the defogger system control circuitry including the timer logic and the defogger relay.

OPERATION

The heated mirror system only operates in concert with the rear defogger system, and will be automatically turned off after a programmed time interval of about ten minutes. After the initial time interval has expired, if the defogger switch is turned on again during the same ignition cycle, the heated mirror system will automatically turn off after about five minutes.

The heated mirror 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 defogger switch a second time. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the heated mirror system.

HEATED MIRROR GRID

DESCRIPTION

Vehicles equipped with the optional heated mirror system have an electric heating grid located behind the mirror glass of each outside rear view mirror. The heated mirrors are controlled by the rear window defogger switch. Electrical current is directed to the heating grid inside the mirror only when the rear window defogger switch is in the On position.

If the outside mirror heating grids are both inoperative, see Rear Window Defogger System in the Diagnosis and Testing section of this group. If only one of the outside mirror heating grids is inoperative(Refer to 8 - ELECTRICAL/POWER MIRRORS - DIAGNOSIS AND TESTING).

The heating grid behind each outside mirror glass cannot be repaired and, if faulty or damaged, the entire power mirror unit must be replaced(Refer to 8 - ELECTRICAL/POWER MIRRORS/SIDEVIEW MIRROR - REMOVAL).

HORN

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HORN SYSTEM

DESCRIPTION

A dual-note electric horn system is standard factory-installed equipment on this model. The standard equipment horn system features one low-note horn unit and one high-note horn unit. The horn system uses a non-switched source of battery current so that the system will remain functional, regardless of the ignition switch position. The horn system includes the following components:

- Clockspring
- High-line Central Timer Module (CTM)
- Horns
- Horn relay
- Horn switch

(Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - DESCRIPTION) for more information on this component. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL/CENTRAL TIMER MODUL - DESCRIPTION) for more information on this component. 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. Following are general descriptions of the remaining major components in the horn system.

OPERATION

The horn system is activated by a horn switch concealed beneath the driver side airbag module trim cover in the center of the steering wheel. Depressing the center of the driver side airbag module trim cover closes the horn switch. Closing the horn switch activates the horn relay. The activated horn relay then switches the battery current needed to energize the horns.

Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the horn system.

The high-line Central Timer Module (CTM) can also operate the horn system. A high-line CTM is used on high-line versions of this vehicle. The CTM combines the functions of a chime/buzzer module, an intermittent wipe module, an illuminated entry module, a remote keyless entry module, and a vehicle theft security system module in a single unit.

The high-line CTM also controls and integrates many of the additional electronic functions and features included on models with this option. The horn relay is one of the hard wired outputs of the CTM. The high-line CTM is programmed to energize or de-energize the horn relay in response to certain inputs from the Remote Keyless Entry (RKE) system and/or the Vehicle Theft Security System (VTSS).

(Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL/CENTRAL TIMER MODUL - DESCRIPTION) for more information on the high-line CTM. (Refer to 8 - ELECTRICAL/POWER LOCKS - GENERAL INFORMATION) for more information on the RKE system. Refer to (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - GENERAL INFORMATION) for more information on the VTSS.

HORN

DESCRIPTION

The dual electromagnetic diaphragm-type horns are standard equipment on this model. Both horns are mounted on a single bracket that is secured to the front of the left vertical member of the radiator support, just behind the radiator grille and forward of the radiator. The high-note horn is connected in parallel with the low-note horn. The horns are connected to the vehicle electrical system through the headlamp and dash wire harness. Each horn is grounded through its wire harness connector and a ground circuit to an eyelet terminal secured by a ground screw located on the right front inner fender behind the right headlamp, and receives battery current through the closed contacts of the horn relay.

Both horns and the mounting bracket are serviced as a single unit. The horns cannot be repaired or adjusted and, if faulty or damaged, the entire horn and bracket unit must be 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 electromagnetic coil. The contact points control the current flow through the electromagnet.

When the horn is energized, electrical current flows through the closed contact points to the electromagnet. The resulting electromagnetic field draws the plunger and diaphragm toward it until that movement mechanically opens the contact points. When the contact points open, the electromagnetic field collapses allowing the plunger and diaphragm to return to their relaxed positions and closing the contact points again. This cycle continues repeating at a very rapid rate producing the vibration and movement of air that creates the sound that is directed through the horn outlet.

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, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

(1) Disconnect the wire harness connector(s) from the horn connector receptacle(s). Measure the resistance between the ground circuit cavity of the horn(s) wire harness connector(s) and a good ground. There should be no measurable resistance. If OK, go to Step 2. If not OK, repair the open ground circuit to ground as required.

(2) Check for battery voltage at the horn relay output circuit cavity of the horn(s) wire harness connector(s). There should be zero volts. If OK, go to Step 3. If not OK, repair the shorted horn relay output circuit or replace the faulty horn relay as required.

(3) Depress the horn switch. There should now be battery voltage at the horn relay output circuit cavity of the horn(s) wire harness connector(s). If OK, replace the faulty horn(s). If not OK, repair the open horn relay output circuit to the horn relay as required.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the headlamp and dash wire harness connectors from the horn connector receptacles (Fig. 1) .

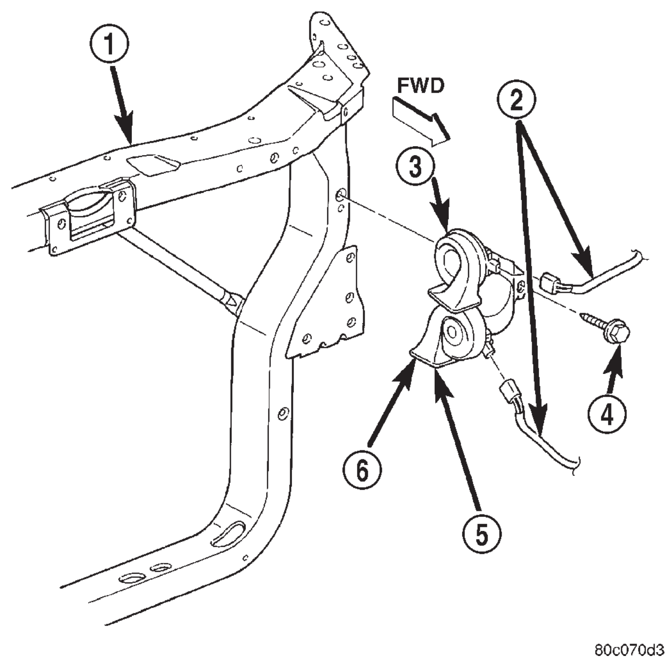

Fig. 1 Horns Remove/Install

1 - RADIATOR SUPPORT
2 - HEADLAMP AND DASH WIRE HARNESS
3 - LOW NOTE
4 - SCREW
5 - HORN AND BRACKET
6 - HIGH NOTE

(3) Remove the screw that secures the horn and mounting bracket unit to the front of the left vertical member of the radiator support.

(4) Remove the horn and mounting bracket unit from the radiator support.

HORN (Continued)

INSTALLATION

(1) Position the horn and mounting bracket unit onto the front of the left vertical member of the radiator support.

(2) Install and tighten the screw that secures the horn and mounting bracket unit to the radiator support. Tighten the screw to 10.7 N·m (95 in. lbs.).

(3) Reconnect the headlamp and dash wire harness connectors to the horn connector receptacles.

(4) Reconnect the battery negative cable.

HORN RELAY

DESCRIPTION

The horn relay is a electromechanical device that switches battery current to the horn when the horn switch grounds the relay coil. The horn relay is located in the Junction Block (JB), on the left end of the instrument panel in the passenger compartment. If a problem is encountered with a continuously sounding horn, it can usually be quickly resolved by removing the horn relay from the JB until further diagnosis is completed. See the fuse and relay layout label affixed to the inside surface of the fuse access panel for horn relay identification and location.

The horn relay is a International Standards Organization (ISO) micro-relay. Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The ISO micro-relay terminal functions are the same as a conventional ISO relay. However, the ISO micro-relay terminal pattern (or footprint) is different, the current capacity is lower, and the physical dimensions are smaller than those of the conventional ISO relay.

The horn relay cannot be repaired or adjusted and, if faulty or damaged, it must be replaced.

OPERATION

The ISO relay consists of an electromagnetic coil, a resistor or diode, and three (two fixed and one movable) electrical contacts. The movable (common feed) relay contact is held against one of the fixed contacts (normally closed) by spring pressure. When the electromagnetic coil is energized, it draws the movable contact away from the normally closed fixed contact, and holds it against the other (normally open) fixed contact.

When the electromagnetic coil is de-energized, spring pressure returns the movable contact to the normally closed position. The resistor or diode is connected in parallel with the electromagnetic coil in the relay, and helps to dissipate voltage spikes that are produced when the coil is de-energized.

DIAGNOSIS AND TESTING - HORN RELAY

The horn relay (Fig. 2) is located in the Junction Block (JB) on the left end of the instrument panel in the passenger compartment of the vehicle. If a problem is encountered with a continuously sounding horn, it can usually be quickly resolved by removing the horn relay from the JB until further diagnosis is completed. See the fuse and relay layout label affixed to the inside surface of the fuse access panel 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, 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.

(1) Remove the horn relay from the JB. (Refer to 8 - ELECTRICAL/HORN/HORN RELAY - REMOVAL) for the procedures.

(2) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, perform the Relay Circuit Test that follows. If not OK, replace the faulty relay.

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the open circuit to the fuse in the PDC as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the horn(s). There should be continuity between the cavity for relay terminal 87 and the horn relay output circuit cavity of each horn wire harness con-

HORN RELAY (Continued)

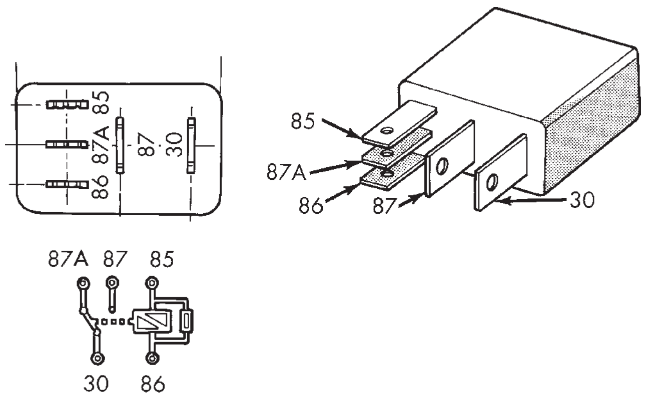

Fig. 2 Horn Relay

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

nector 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. On vehicles equipped with the Remote Keyless Entry (RKE) system, the horn relay coil ground terminal can also be grounded by the Central Timer Module (CTM) in response to certain inputs related to the RKE system or the Vehicle Theft Security System. Check for continuity to ground at the cavity for relay terminal 85. There should be continuity with the horn switch depressed, and no continuity with the horn switch released. If not OK, (Refer to 8 - ELECTRICAL/HORN/HORN SWITCH - DIAGNOSIS AND TESTING).

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 fuse access panel by inserting a finger in the finger recess molded into the panel and then pulling the panel sharply away from the left outboard end of the instrument panel.

(3) See the fuse and relay layout label affixed to the inside of the fuse access panel for horn relay identification and location.

(4) Grasp the horn relay firmly and pull it straight out from the JB.

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) See the fuse and relay layout label affixed to the inside of the fuse access panel for the proper horn relay location.

(2) Position the horn relay in the proper receptacle in the JB.

(3) Align the horn relay terminals with the terminal cavities in the JB receptacle.

(4) Push in firmly on the horn relay until the terminals are fully seated in the terminal cavities in the JB receptacle.

(5) Insert the tabs on the forward edge of the fuse access panel in the notches on the forward edge of the instrument panel fuse access panel opening.

(6) Press the rear edge of the fuse access panel in toward the instrument panel until the panel snaps back into place.

(7) 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. 3) . 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.

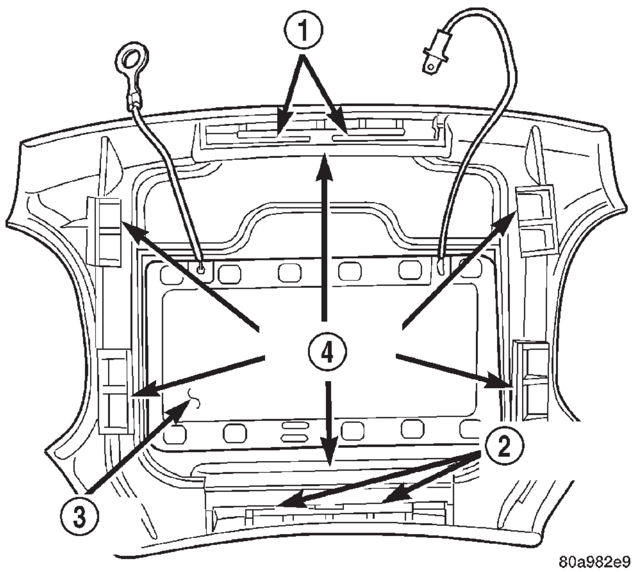

Fig. 3 Driver Side Airbag Module Trim Cover and Horn Switch

1 - RETAINER SLOTS
2 - RETAINER SLOTS
3 - HORN SWITCH
4 - LOCKING BLOCKS

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, 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.

(1) Disconnect and isolate the battery negative cable. Remove the steering column opening cover from the instrument panel.

(2) Check for continuity between the metal steering column jacket and a good ground. There should be continuity. If OK, go to Step 3. If not OK, (Refer to 19 - STEERING/COLUMN - INSTALLATION) for proper installation of the steering column.

(3) Remove the driver side airbag module from the steering wheel. Disconnect the horn switch wire harness connectors from the driver side airbag module.

(4) Remove the horn relay from the Junction Block (JB). Check for continuity between the steering column half of the horn switch feed wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the shorted horn relay control circuit to the horn relay in the JB as required.

(5) Check for continuity between the steering column half of the horn switch feed wire harness connector and the horn relay control circuit cavity for the horn relay in the JB. There should be continuity. If OK, go to Step 6. If not OK, repair the open horn relay control circuit to the horn relay in the JB as required.

HORN SWITCH (Continued)

(6) Check for continuity between the horn switch feed wire and the horn switch ground wire on the driver side airbag module. There should be no continuity. If OK, go to Step 7. If not OK, replace the faulty horn switch.

(7) Depress the center of the driver side airbag module trim cover and check for continuity between the horn switch feed wire and the horn switch ground wire on the driver side airbag module. There should now be continuity. If not OK, replace the faulty horn switch.

IGNITION CONTROL

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IGNITION CONTROL

DESCRIPTION

Two different ignition systems are used. One type of system is for the 2.5L 4–cylinder, the 3.9L V-6 engine and the 5.9L V-8 engine. The other is for the 4.7L V-8 engine.

The ignition systems used on 2.5L 4–cylinder, 3.9L V-6 and 5.9L V-8 engines are basically identical using a conventional distributor and remotely mounted coil. The 4.7L V-8 engine does not use a distributor and has 8 separate coils.

OPERATION

The ignition system is controlled by the Powertrain Control Module (PCM) on all engines.

The ignition system consists of:

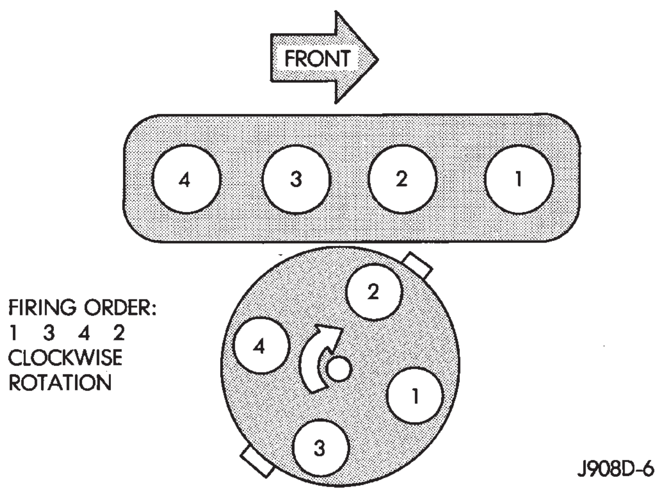
- Spark Plugs
- Ignition Coil(s)
- Secondary Ignition Cables (2.5L/3.9L/5.9L engines)
- Distributor (contains rotor and camshaft position sensor) (2.5L/3.9L/5.9L engines)
- Powertrain Control Module (PCM)
- Crankshaft Position and Camshaft Position Sensors
- The MAP, TPS, IAC and ECT also have an effect on the control of the ignition system.

SPECIFICATIONS

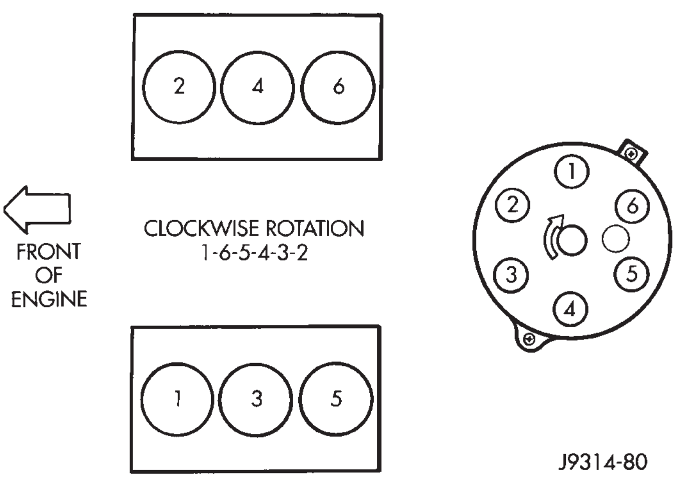
IGNITION TIMING

Ignition timing is not adjustable on any engine.

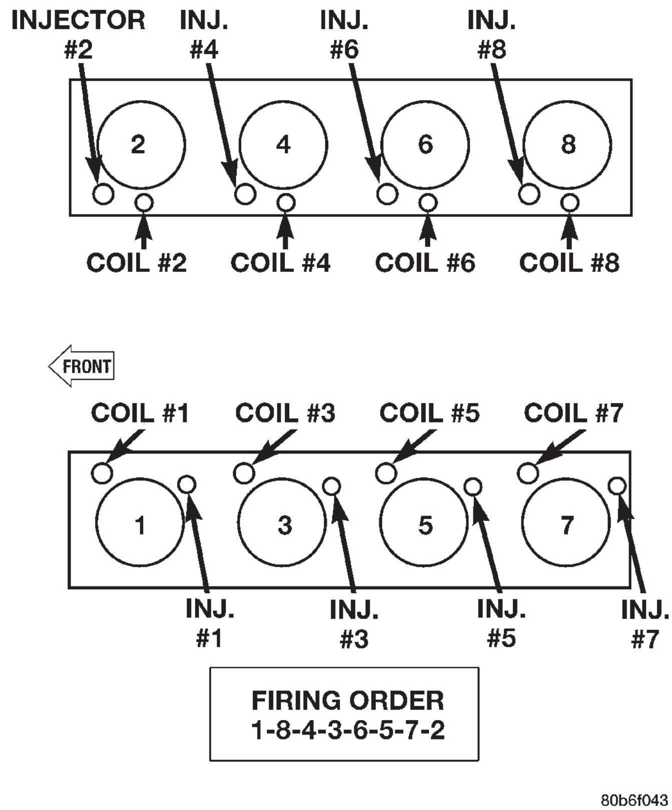
ENGINE FIRING ORDER—2.5L 4-CYLINDER ENGINE



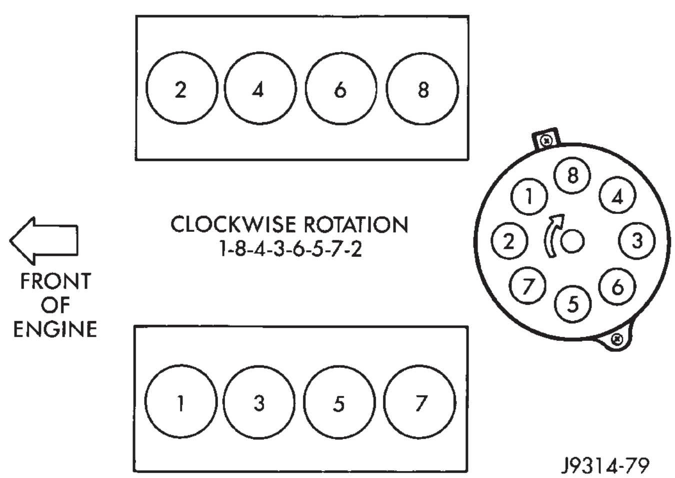
ENGINE FIRING ORDER—3.9L V-6 ENGINE



ENGINE FIRING ORDER—4.7L V-8 ENGINE



ENGINE FIRING ORDER—5.2L/5.9L V-8 ENGINES



SPECIFICATIONS (Continued)

SPECIFICATIONS - TORQUE - IGNITION

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft Position Sensor Bolt—4.7L V-8 Engine	12		106
Crankshaft Position Sensor—2.5L Engine	12	9	
Crankshaft Position Sensor—3.9L/5.2L/5.9L Engines	8		70
Crankshaft Position Sensor Bolt—4.7L V-8 Engine	28	21	
Distributor Hold Down Bolt	23	17	
Ignition Coil Mounting (except 4.7L) (if tapped bolts are used)	5		50
Ignition Coil Mounting (except 4.7L) (if nuts/bolts are used)	11		100
Ignition Coil Mounting Nut—4.7L V-8 Engine	8		70
Spark Plugs—Except 4.7L	35-41	26-30	
Spark Plugs—4.7L V-8 Engine	27	20	

SPECIFICATIONS - IGNITION COIL RESISTANCE - 4.7L V-8 ENGINE

PRIMARY RESISTANCE 21-27°C (70-80°F)	SECONDARY RESISTANCE 21-27°C (70-80°F)
0.6 - 0.9 Ohms	6,000 - 9,000 Ohms

SPECIFICATIONS - IGNITION COIL RESISTANCE—EXCEPT 4.7L

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

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 - SPARK PLUGS

ENGINE	PLUG TYPE	ELECTRODE GAP
2.5L 4-CYL.	RC12ECC	0.89 mm (.035 in.)
3.9L V-6	RC12LC4	1.01 mm (.040 in.)
4.7L V-8	RC12MCC4	1.01 mm (.040 in.)
5.2L V-8	RC12LC4	1.01 mm (.040 in.)
5.9L V-8	RC12LC4	1.01 mm (.040 in.)

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 - 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).

• 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.

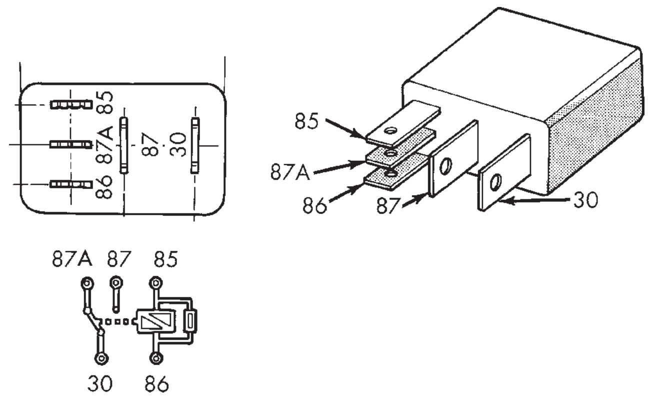


Fig. 1 ASD and Fuel Pump Relay Terminals—Type 1

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

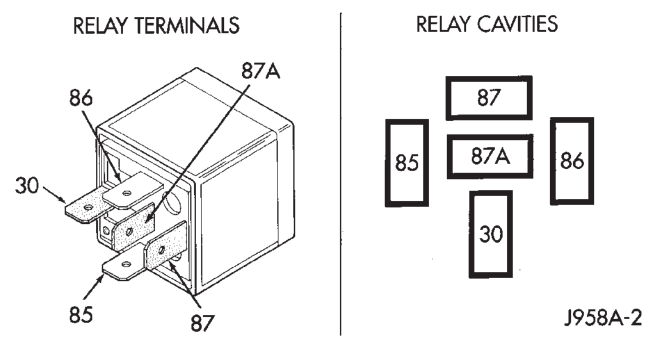


Fig. 2 ASD and Fuel Pump Relay Terminals—Type 2

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

• When the PCM energizes the ASD and fuel pump relays, terminal 87 connects to terminal 30. This is the On position. Terminal 87 supplies voltage to the rest of the circuit.

The following procedure applies to the ASD and fuel pump relays.

(1) Remove relay from connector before testing.

AUTO SHUT DOWN RELAY (Continued)

(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.

(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.

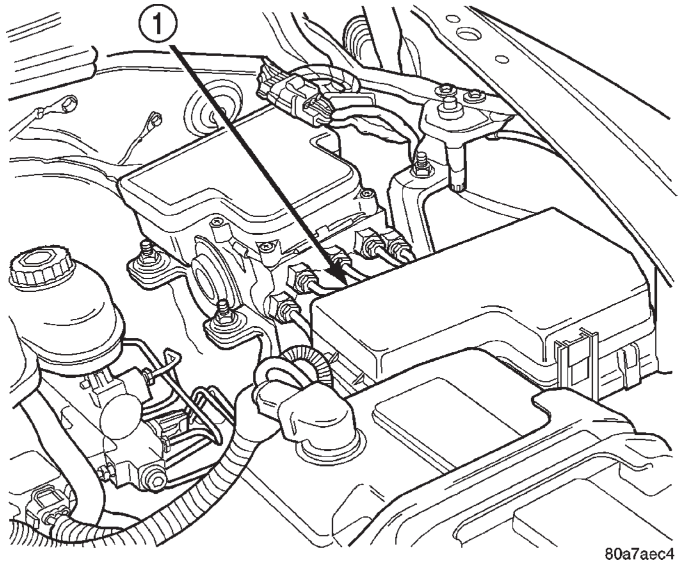


Fig. 3 Power Distribution Center (PDC) Location

1 - POWER DISTRIBUTION CENTER (PDC)

CAMSHAFT POSITION SENSOR

DESCRIPTION - EXCEPT 4.7L

The Camshaft Position (CMP) sensor is located in the distributor.

DESCRIPTION - 4.7L

The Camshaft Position Sensor (CMP) on the 4.7L V–8 engine is bolted to the front/top of the right cylinder head (Fig. 4).

OPERATION - EXCEPT 4.7L

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.

CAMSHAFT POSITION SENSOR (Continued)

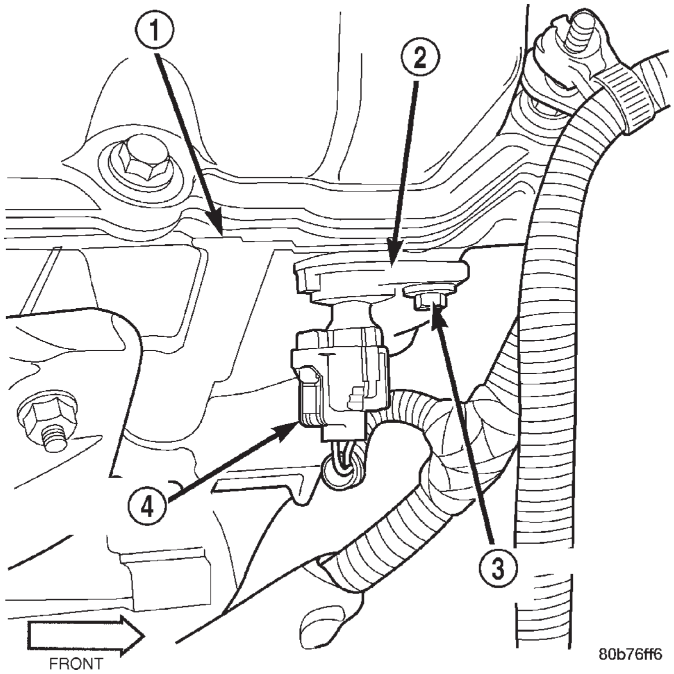


Fig. 4 CMP Location—4.7L Engine

1 - RIGHT CYLINDER HEAD
2 - CAMSHAFT POSITION SENSOR
3 - MOUNTING BOLT
4 - ELEC. CONNECTOR

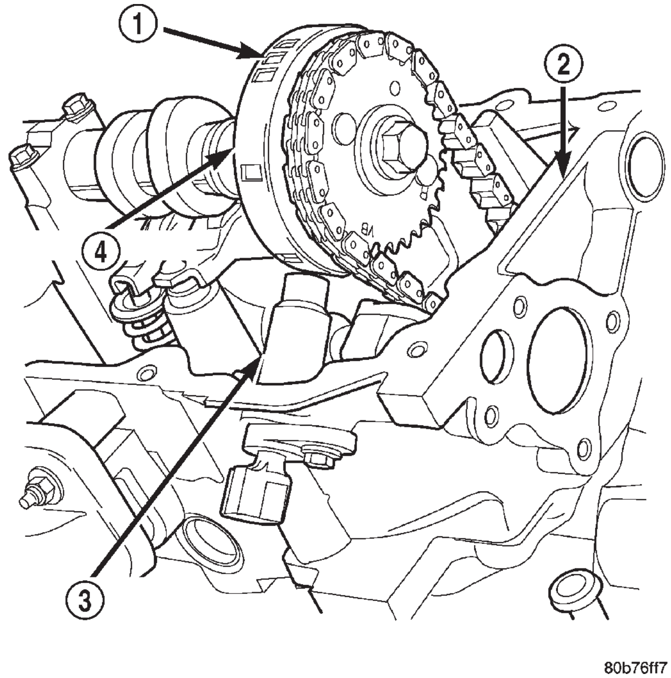


Fig. 5 CMP Sensor and Tonewheel—4.7L Engine

1 - NOTCHES
2 - RIGHT CYLINDER HEAD
3 - CAMSHAFT POSITION SENSOR
4 - TONEWHEEL

OPERATION - 4.7L

The CMP sensor contains a hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects notches located on a tonewheel. The tonewheel is located at the front of the camshaft for the right cylinder head (Fig. 5). As the tonewheel rotates, the notches pass through the sync signal generator. The pattern of the notches (viewed counter-clockwise from front of engine) is: 1 notch, 2 notches, 3 notches, 3 notches, 2 notches 1 notch, 3 notches and 1 notch. The signal from the CMP sensor 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.

REMOVAL - EXCEPT 4.7L

The camshaft position sensor is located in the distributor on all 2.5/3.9/5.2/5.9L engines (Fig. 6).

Distributor removal is not necessary to remove camshaft position sensor.

(1) Remove air cleaner assembly.

(2) Disconnect negative cable from battery.

(3) Remove distributor cap from distributor (two screws).

(4) Disconnect camshaft position sensor wiring harness from main engine wiring harness.

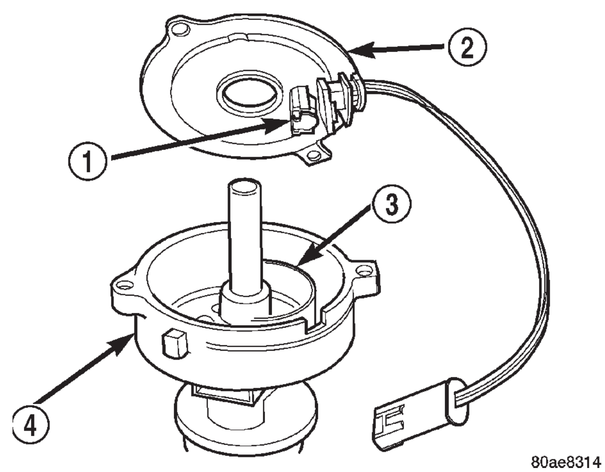


Fig. 6 Camshaft Position Sensor—Typical (3.9/5.2/5.9L Shown)

1 - SYNC SIGNAL GENERATOR
2 - CAMSHAFT POSITION SENSOR
3 - PULSE RING
4 - DISTRIBUTOR ASSEMBLY

(5) Remove distributor rotor from distributor shaft.

(6) Lift the camshaft position sensor assembly from the distributor housing (Fig. 6).

CAMSHAFT POSITION SENSOR (Continued)

REMOVAL - 4.7L

The Camshaft Position Sensor (CMP) on the 4.7L V–8 engine is bolted to the front/top of the right cylinder head (Fig. 7).

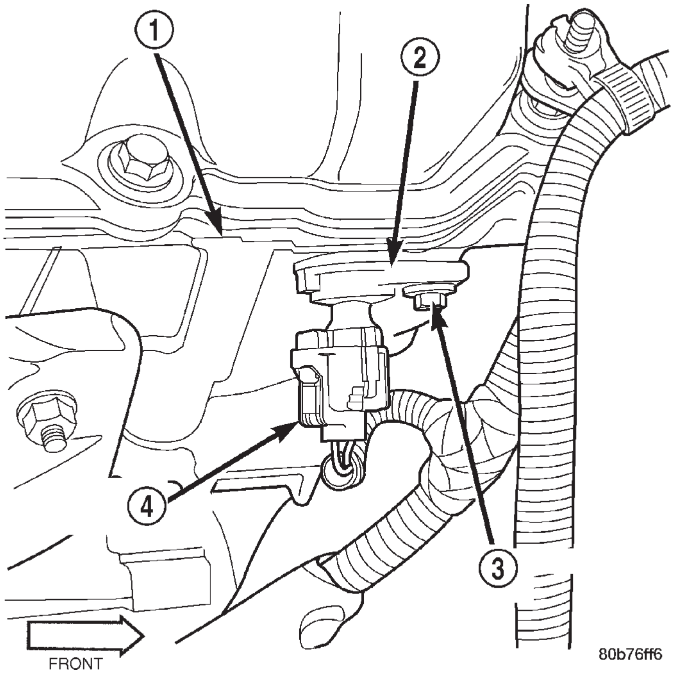


Fig. 7 CMP Location—4.7L Engine

1 - RIGHT CYLINDER HEAD
2 - CAMSHAFT POSITION SENSOR
3 - MOUNTING BOLT
4 - ELEC. CONNECTOR

It is easier to remove/install sensor from under vehicle.

(1) Raise and support vehicle.

(2) Disconnect electrical connector at CMP sensor (Fig. 7).

(3) Remove sensor mounting bolt (Fig. 7).

(4) Carefully pry sensor from cylinder head in a rocking action with two small screwdrivers.

(5) Check condition of sensor o-ring.

INSTALLATION - EXCEPT 4.7L

The camshaft position sensor is located in the distributor on all 2.5/3.9/5.2/5.9L engines (Fig. 6).

(1) Install camshaft position sensor to distributor. Align sensor into notch on distributor housing.

(2) Connect wiring harness.

(3) Install rotor.

(4) Install distributor cap. Tighten mounting screws.

(5) Install air cleaner assembly.

INSTALLATION - 4.7L

The Camshaft Position Sensor (CMP) on the 4.7L V–8 engine is bolted to the front/top of the right cylinder head (Fig. 7).

(1) Clean out machined hole in cylinder head.

(2) Apply a small amount of engine oil to sensor o-ring.

(3) Install sensor into cylinder head with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder head. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten to 12 N·m (106 in. lbs.) torque.

(5) Connect electrical connector to sensor.

(6) Lower vehicle.

DISTRIBUTOR

DESCRIPTION

All 2.5L/3.9L/5.9L engines are equipped with a camshaft driven mechanical distributor (Fig. 8) containing a shaft driven distributor rotor. All distributors are equipped with an internal camshaft position (fuel sync) sensor (Fig. 8).

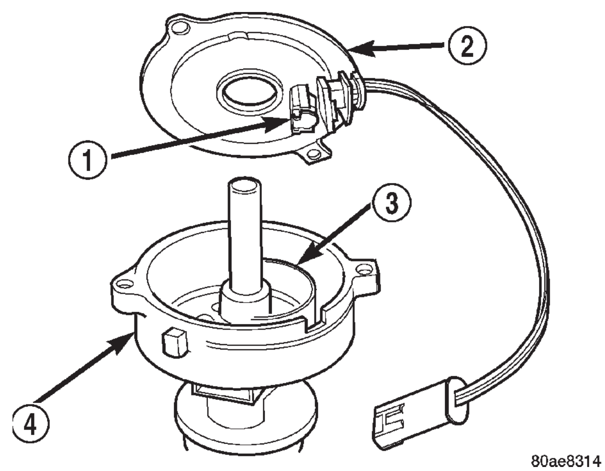


Fig. 8 Distributor and Camshaft Position Sensor-Typical (3.9L/5.9L Shown)

1 - SYNC SIGNAL GENERATOR
2 - CAMSHAFT POSITION SENSOR
3 - PULSE RING
4 - DISTRIBUTOR ASSEMBLY

OPERATION

The camshaft position sensor provides fuel injection synchronization and cylinder identification.

DISTRIBUTOR (Continued)

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 on any of these engines.**

All 2.5L/3.9L/5.9L distributors contain an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

REMOVAL - 2.5 L

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. 9). It is used to temporarily lock the rotor to the cylinder number 1 position during installation. The pin must be removed after installing distributor.

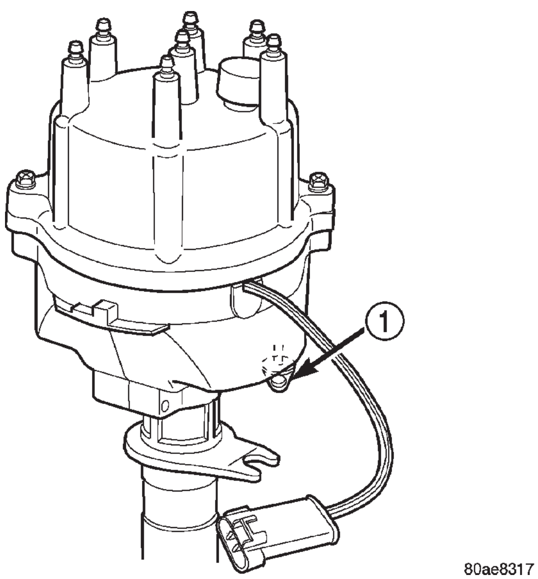


Fig. 9 Plastic Alignment Pin

1 - PLASTIC ALIGNMENT PIN

The camshaft position sensor is located in the distributor on all engines (Fig. 10). For removal/installation procedures, refer to Camshaft Position Sensor. Distributor removal is not necessary for sensor removal.

Refer to (Fig. 10) 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. 10). 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).

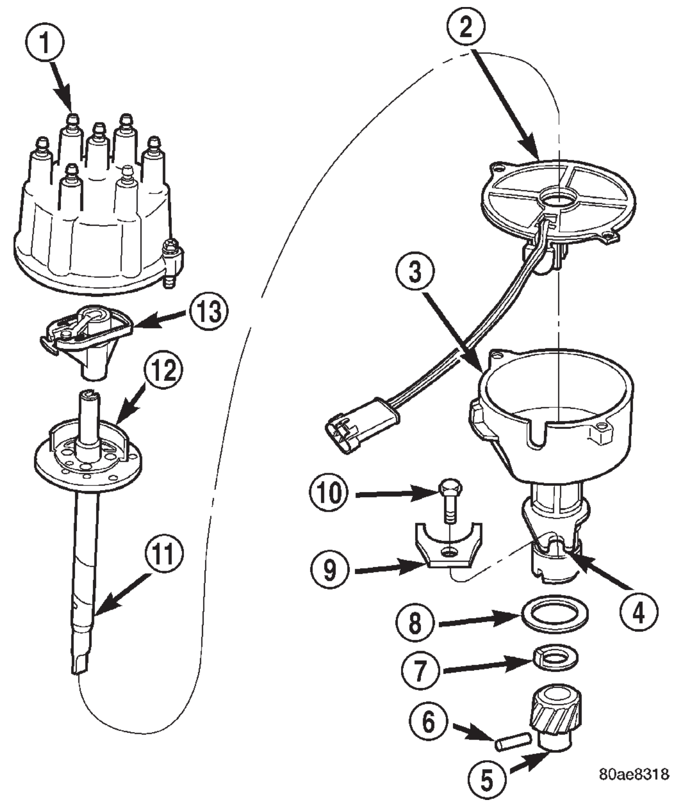


Fig. 10 Distributor—2.5L Engine—Typical

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

The position of the distributor determines fuel synchronization only. It does not determine ignition timing.

NOTE: Do not attempt to modify this fork to attain ignition timing.

(1) Disconnect negative battery cable at battery.

(2) Remove air tube between throttle body and air cleaner housing.

(3) Disconnect coil secondary cable at coil.

(4) Remove distributor cap from distributor (2 screws). Do not remove cables from cap. Do not remove rotor.

DISTRIBUTOR (Continued)

(5) Disconnect distributor wiring harness from main engine harness.

(6) Remove cylinder number 1 spark plug.

(7) Hold a finger over open spark plug hole. Rotate engine at vibration dampener bolt until compression (pressure) is felt.

(8) 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. 11). Always rotate engine in direction of normal rotation. Do not rotate engine backward to align timing marks.

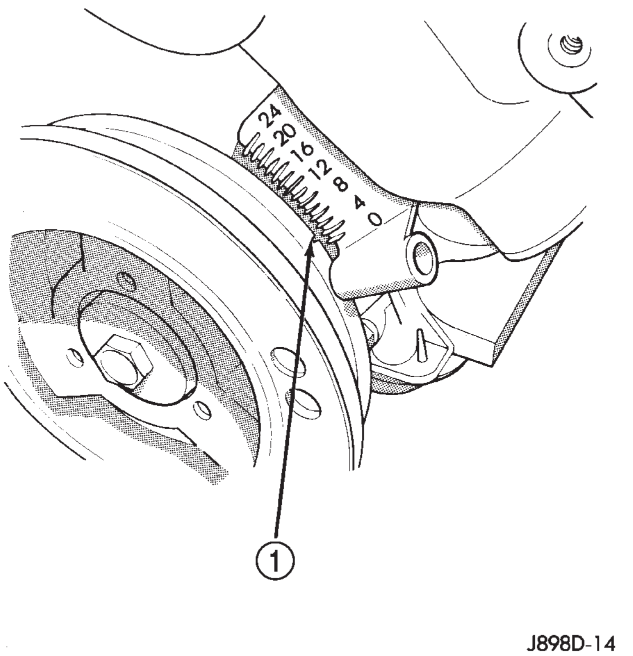


Fig. 11 Align Timing Marks

1 - CRANKSHAFT VIBRATION DAMPER TIMING MARK

(9) Remove distributor holddown bolt and clamp.

(10) Remove distributor from engine by slowly lifting straight up.

(11) 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.

(12) Note removed position of rotor during distributor removal. During installation, this will be referred to as the Pre-position.

(13) Observe slot in oil pump gear through hole on side of engine. It should be slightly before (counterclockwise of) 10 o'clock position (Fig. 12).

(14) Remove and discard the old distributor-to-engine block gasket.

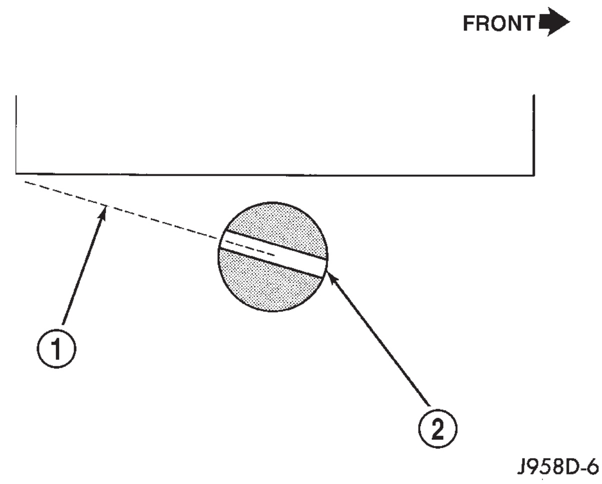


Fig. 12 Slot At 10 O'clock Position—2.5L Engine

1 - 10 0'CLOCK POSITION
2 - OIL PUMP SLOT

REMOVAL - 3.9L/5.2L/5.9L

CAUTION: Base ignition timing is not adjustable on any engine. Distributors do not have built in centrifugal or vacuum assisted advance. Base ignition timing and timing advance are controlled by the Powertrain Control Module (PCM). Because a conventional timing light can not be used to adjust distributor position after installation, note position of distributor before removal.

(1) Remove air cleaner assembly.

(2) Disconnect negative cable from battery.

(3) Remove distributor cap from distributor (two screws).

(4) Mark the position of distributor housing in relationship to engine or dash panel. This is done to aid in installation.

(5) Before distributor is removed, the number one cylinder must be brought to the Top Dead Center (TDC) firing position.

(6) Attach a socket to the Crankshaft Vibration Damper mounting bolt.

(7) Slowly rotate engine clockwise, as viewed from front, until indicating mark on crankshaft vibration damper is aligned to 0 degree (TDC) mark on timing chain cover (Fig. 13).

(8) The distributor rotor should now be aligned to the CYL. NO. 1 alignment mark (stamped) into the camshaft position sensor (Fig. 14). If not, rotate the crankshaft through another complete 360 degree turn. Note the position of the number one cylinder spark plug cable (on the cap) in relation to rotor. Rotor should now be aligned to this position.

(9) Disconnect camshaft position sensor wiring harness from main engine wiring harness.

DISTRIBUTOR (Continued)

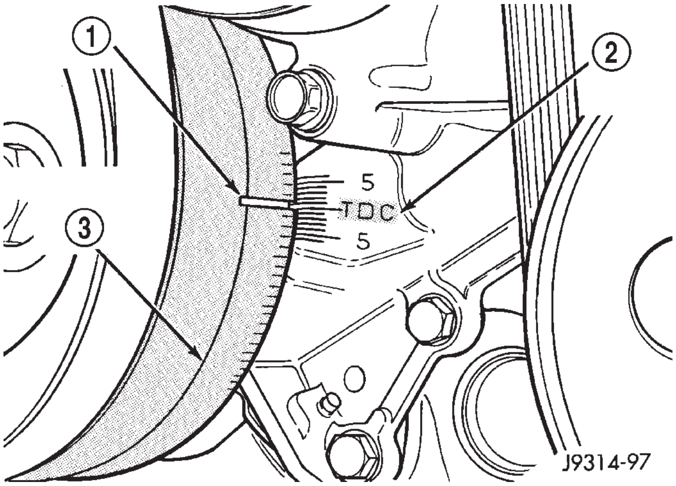


Fig. 13 Damper-To-Cover Alignment Marks—Typical

1 - ALIGNMENT MARK
2 - TIMING CHAIN COVER MARKS
3 - CRANKSHAFT VIBRATION DAMPER

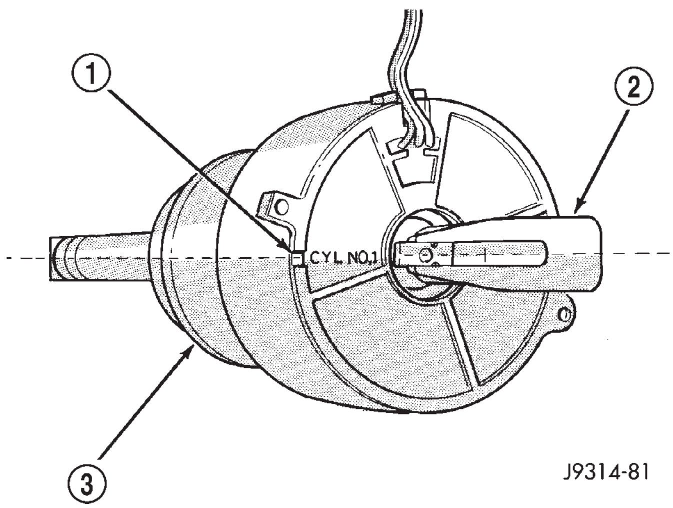


Fig. 14 Rotor Alignment Mark—3.9/5.2/5.9L Engines

1 - CAMSHAFT POSITION SENSOR ALIGNMENT MARK
2 - ROTOR
3 - DISTRIBUTOR

(10) Remove distributor rotor from distributor shaft.

(11) Remove distributor holddown clamp bolt and clamp (Fig. 15). Remove distributor from vehicle.

CAUTION: Do not crank engine with distributor removed. Distributor/crankshaft relationship will be lost.

INSTALLATION - 2.5L

(1) If engine crankshaft has been rotated after distributor removal, cylinder number 1 must be

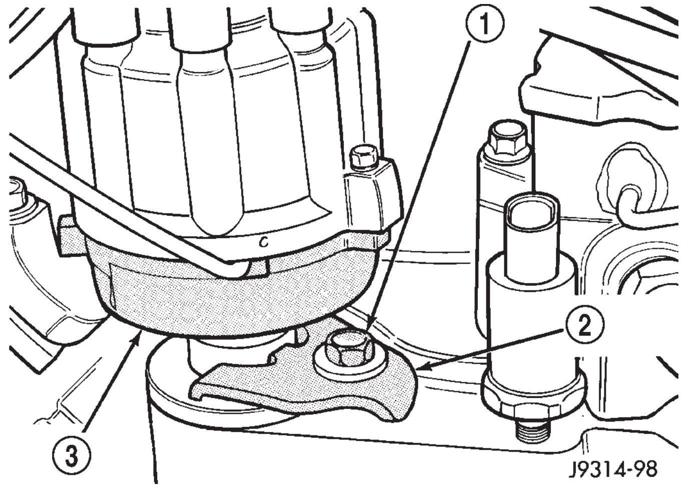


Fig. 15 Distributor Holddown Clamp—3.9/5.2/5.9L Engines

1 - CLAMP BOLT
2 - HOLDDOWN CLAMP
3 - DISTRIBUTOR HOUSING

returned to its proper firing stroke. Refer to previous REMOVAL Step 6 and Step 7. These steps must be done before installing distributor.

(2) Check position of slot on oil pump gear. It should be just slightly before (counterclockwise of) 10 o'clock position (Fig. 12). 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. 9). This pin is used to temporarily hold rotor to cylinder number 1 firing position during distributor installation. If this pin is in place, proceed to Step 8. If not, proceed to next step.

(4) If 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 the plastic ring (Fig. 16). **Note that 2.5L 4–cylinder and 4.0L 6–cylinder engines have different alignment holes (Fig. 16).**

(7) Rotate distributor shaft and install pin punch tool through proper alignment hole in plastic ring (Fig. 16) and into mating access hole in distributor housing. This will prevent distributor shaft and rotor from rotating.

(8) Clean distributor mounting hole area of engine block.

(9) Install new distributor-to-engine block gasket (Fig. 10).

(10) Install rotor to distributor shaft.

DISTRIBUTOR (Continued)

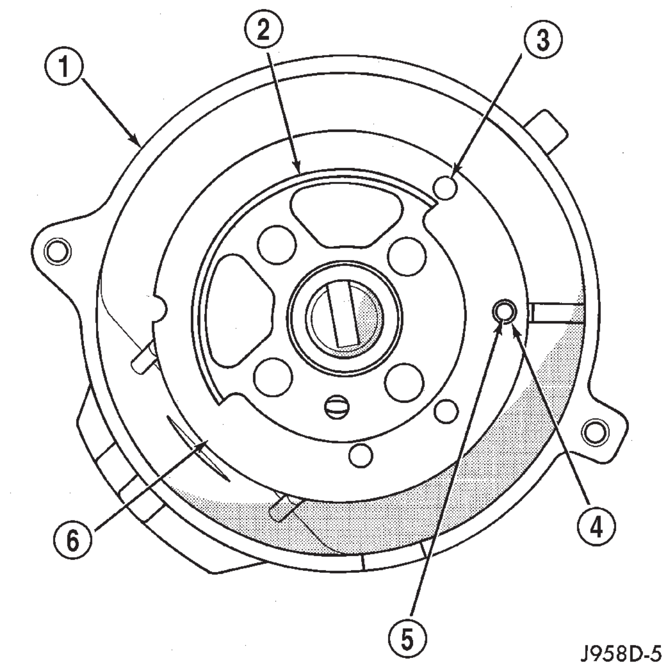


Fig. 16 Pin Alignment Holes

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

(11) Pre-position distributor into engine while holding centerline of base slot in 1 o'clock position (Fig. 17). Continue to engage distributor into engine. The rotor and distributor will rotate clockwise during installation. This is due to 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. 18). The rotor should also be pointed slightly past (clockwise of) 3 o'clock position.

It may be necessary to rotate rotor and distributor shaft (very slightly) to engage distributor shaft with slot in oil pump gear. The same may have to be done to engage distributor gear with camshaft gear.

The distributor is correctly installed when:

- rotor is pointed at the 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, holddown bolt should easily pass through slot and into engine.

No adjustments are necessary. Proceed to next step.

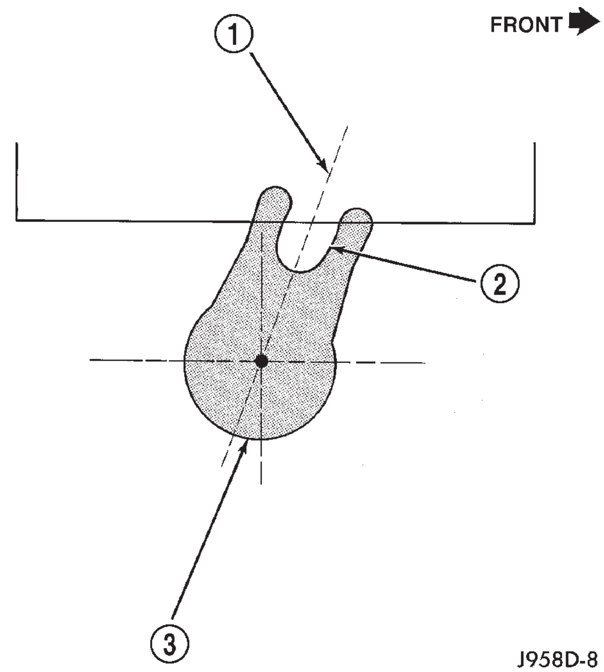


Fig. 17 Distributor Pre-position

1 - 1 O'CLOCK POSITION
2 - BASE SLOT
3 - DISTRIBUTOR BASE

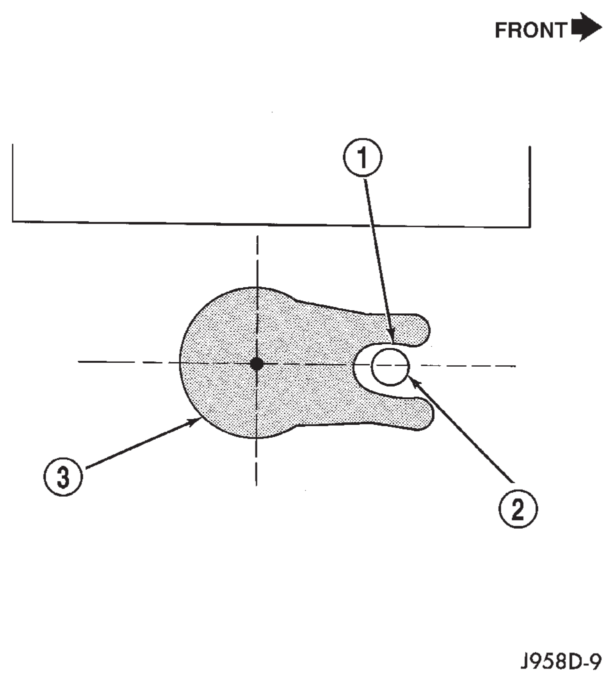


Fig. 18 Distributor Engaged Position—2.5L 4-Cylinder Engine

1 - DISTRIBUTOR BASE SLOT
2 - CLAMP BOLT MOUNTING HOLE (ON ENGINE)
3 - DISTRIBUTOR BASE

DISTRIBUTOR (Continued)

(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, the 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 in Specifications.

(18) Connect distributor wiring harness to main engine harness.

(19) Connect air tube between throttle body and air cleaner housing.

(20) Connect battery cable to battery.

INSTALLATION - 3.9L/5.2L/5.9L

If engine has been cranked while distributor is removed, establish the relationship between distributor shaft and number one piston position as follows:

Rotate crankshaft in a clockwise direction, as viewed from front, until number one cylinder piston is at top of compression stroke (compression should be felt on finger with number one spark plug removed). Then continue to slowly rotate engine clockwise until indicating mark (Fig. 13) is aligned to 0 degree (TDC) mark on timing chain cover.

(1) Clean top of cylinder block for a good seal between distributor base and block.

(2) Lightly oil the rubber o-ring seal on the distributor housing.

(3) Install rotor to distributor shaft.

(4) Position distributor into engine to its original position. Engage tongue of distributor shaft with slot in distributor oil pump drive gear. Position rotor to the number one spark plug cable position.

(5) Install distributor holddown clamp and clamp bolt. Do not tighten bolt at this time.

(6) Rotate the distributor housing until rotor is aligned to CYL. NO. 1 alignment mark on the camshaft position sensor (Fig. 14).

(7) Tighten clamp holddown bolt (Fig. 15) to 22.5 N·m (200 in. lbs.) torque.

(8) Connect camshaft position sensor wiring harness to main engine harness.

(9) Install distributor cap. Tighten mounting screws.

(10) Refer to the following, Checking Distributor Position.

Checking Distributor Position

To verify correct distributor rotational position, 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.

(1) Connect DRB scan tool to data link connector. The data link connector is located in passenger compartment, below and to left of steering column.

(2) Gain access to SET SYNC screen on DRB.

(3) Follow directions on DRB screen and start engine. Bring to operating temperature (engine must be in “closed loop” mode).

(4) With engine running at **idle speed**, the words IN RANGE should appear on screen along with 0°. This indicates correct distributor position.

(5) 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 distributor holddown clamp bolt. Rotate distributor until IN RANGE appears on screen. Continue to rotate distributor until achieving as close to 0° as possible. After adjustment, tighten clamp bolt to 22.5 N·m (200 in. lbs.) torque.

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 distributor will have no effect on ignition timing. All ignition timing values are controlled by Powertrain Control Module (PCM).

After testing, install air cleaner assembly.

DISTRIBUTOR CAP

DIAGNOSIS AND TESTING - DISTRIBUTOR CAP

Remove the distributor cap and wipe it clean with a dry lint free cloth. Visually inspect the cap for cracks, carbon paths, broken towers or damaged rotor button (Fig. 19) or (Fig. 20). 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.

DISTRIBUTOR CAP (Continued)

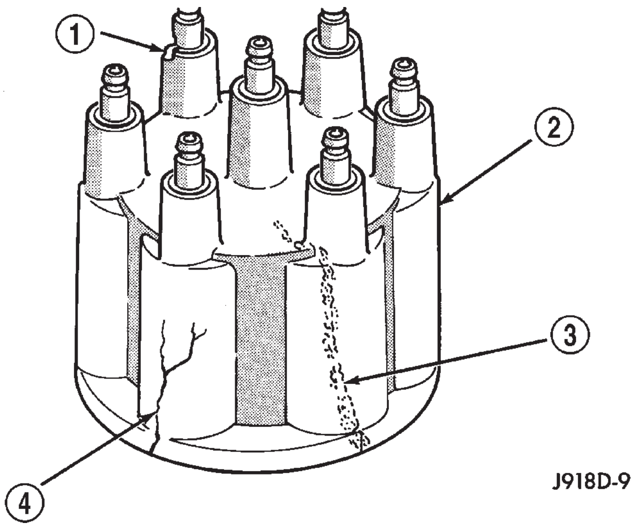


Fig. 19 Cap Inspection—External—Typical

1 - BROKEN TOWER
2 - DISTRIBUTOR CAP
3 - CARBON PATH
4 - CRACK

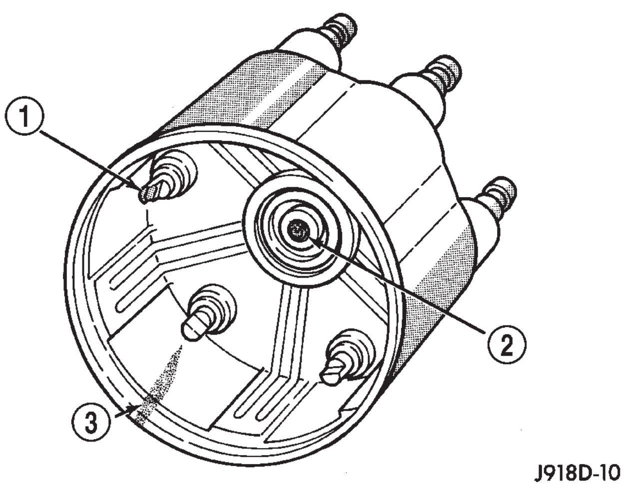


Fig. 20 Cap Inspection—Internal—Typical

1 - CHARRED OR ERODED TERMINALS
2 - WORN OR DAMAGED ROTOR BUTTON
3 - CARBON PATH

DISTRIBUTOR ROTOR

DIAGNOSIS AND TESTING - DISTRIBUTOR ROTOR

Visually inspect the rotor (Fig. 21) 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.

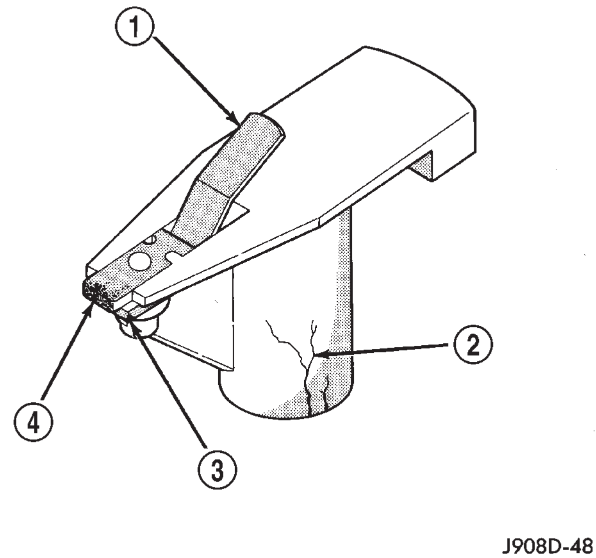


Fig. 21 Rotor Inspection—Typical

1 - INSUFFICIENT SPRING TENSION
2 - CRACKS
3 - EVIDENCE OF PHYSICAL CONTACT WITH CAP
4 - ROTOR TIP CORRODED

IGNITION COIL

DESCRIPTION - EXCEPT 4.7L

A single ignition coil is used. 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.

DESCRIPTION - 4.7L

The 4.7L V–8 engine uses 8 dedicated, and individually fired coil (Fig. 22) for each spark plug. Each coil is mounted directly to the top of each spark plug (Fig. 23).

OPERATION - EXCEPT 4.7L

The Powertrain Control Module (PCM) opens and closes the ignition coil ground circuit for ignition coil operation.

Battery voltage is supplied to the ignition coil positive terminal from the ASD relay. If the PCM does not see a signal from the crankshaft and camshaft sensors (indicating the ignition key is ON but the engine is not running), it will shut down the ASD circuit.

IGNITION COIL (Continued)

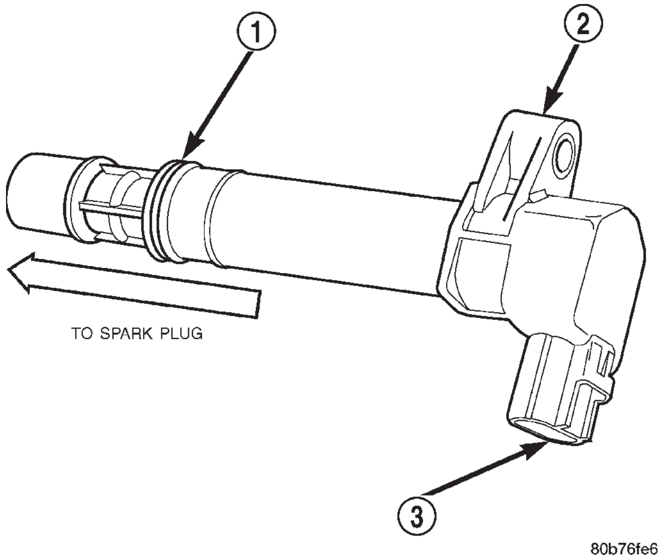


Fig. 22 Ignition Coil—4.7L Engine

1 - O-RING
2 - IGNITION COIL
3 - ELECTRICAL CONNECTOR

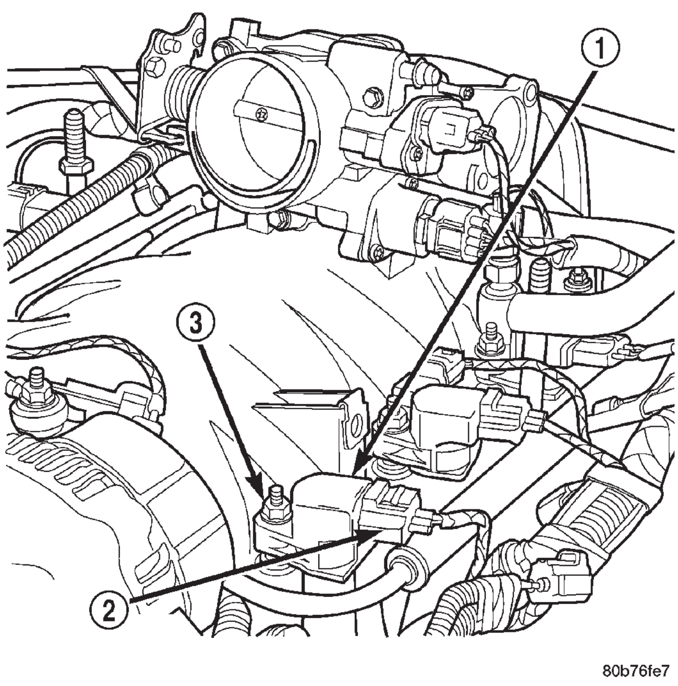


Fig. 23 Ignition Coil Location—4.7L Engine

1 - IGNITION COIL
2 - COIL ELECTRICAL CONNECTOR
3 - COIL MOUNTING STUD/NUT

Base ignition timing is not adjustable on any engine. By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

OPERATION - 4.7L

Battery voltage is supplied to the 8 ignition coils from the ASD relay. The Powertrain Control Module (PCM) opens and closes each ignition coil ground circuit at a determined time 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.

REMOVAL - 2.5L

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

The ignition coil is mounted to a bracket on the side of the engine to the rear of the distributor (Fig. 24).

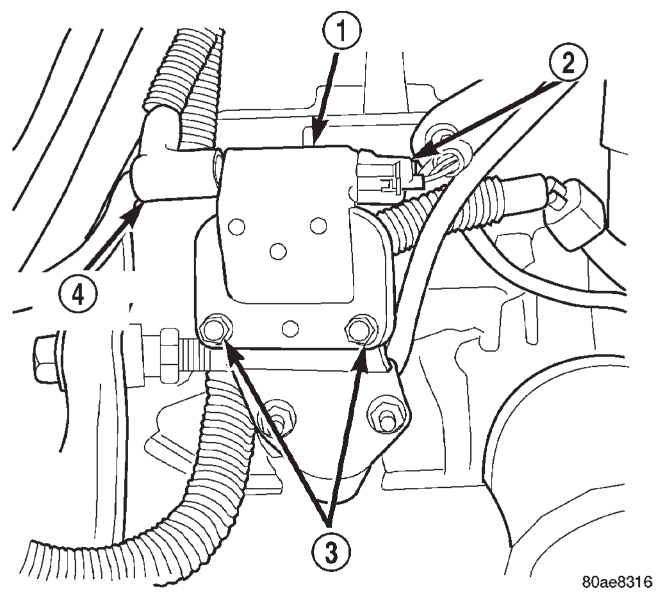


Fig. 24 Ignition Coil—2.5L Engine

1 - IGNITION COIL
2 - ELECTRICAL CONNECTOR
3 - MOUNTING BOLTS (2)
4 - SECONDARY CABLE

(1) Disconnect the ignition coil secondary cable from ignition coil (Fig. 24).

(2) Disconnect engine harness connector from ignition coil.

(3) Remove ignition coil mounting bolts (nuts may also be used on back side of bracket).

(4) Remove coil.

IGNITION COIL (Continued)

REMOVAL - 3.9L/5.2L/5.9L

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

The coil is mounted to a bracket that is bolted to the front of the right engine cylinder head (Fig. 25). This bracket is mounted on top of the automatic belt tensioner bracket using common bolts.

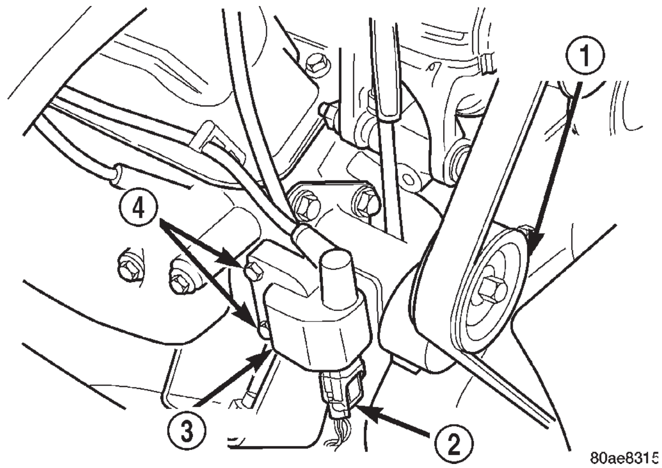


Fig. 25 Ignition Coil—3.9L V-6 or 5.2/5.9L V-8 Engines

1 - ACCESSORY DRIVE BELT TENSIONER
2 - COIL CONNECTOR
3 - IGNITION COIL
4 - COIL MOUNTING BOLTS

(1) Disconnect the primary wiring from the ignition coil.

(2) Disconnect the secondary spark plug cable from the ignition coil.

WARNING: DO NOT REMOVE THE COIL MOUNTING BRACKET-TO-CYLINDER HEAD MOUNTING BOLTS. THE COIL MOUNTING BRACKET IS UNDER ACCESSORY DRIVE BELT TENSION. IF THIS BRACKET IS TO BE REMOVED FOR ANY REASON, ALL BELT TENSION MUST FIRST BE RELIEVED. REFER TO THE BELT SECTION OF 7, COOLING SYSTEM.

(3) Remove ignition coil from coil mounting bracket (two bolts).

REMOVAL - 4.7L

An individual ignition coil is used for each spark plug (Fig. 26). The coil fits into machined holes in the cylinder head. A mounting stud/nut secures each coil to the top of the intake manifold (Fig. 27). The bottom of the coil is equipped with a rubber boot to seal the spark plug 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. An o-ring (Fig. 26) is used to seal the coil at the opening into the cylinder head.

(1) Depending on which coil is being removed, the throttle body air intake tube or intake box may need to be removed to gain access to coil.

(2) Disconnect electrical connector (Fig. 27) from coil by pushing downward on release lock on top of connector and pull connector from coil.

(3) Clean area at base of coil with compressed air before removal.

(4) Remove coil mounting nut from mounting stud (Fig. 27).

(5) Carefully pull up coil from cylinder head opening with a slight twisting action.

(6) Remove coil from vehicle.

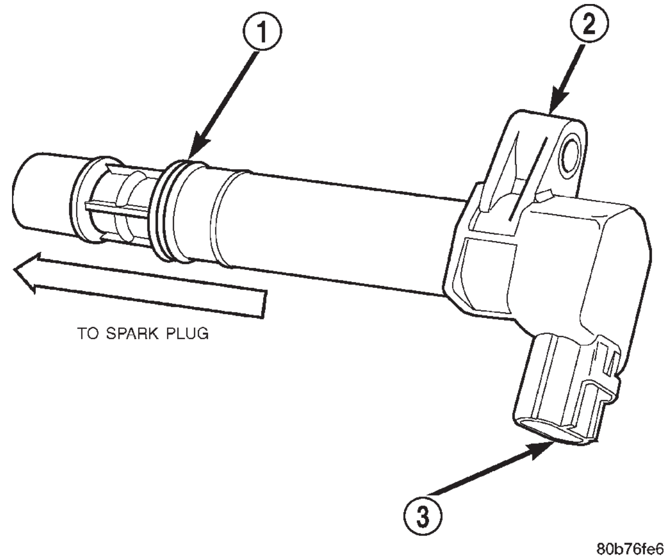


Fig. 26 Ignition Coil—4.7L V–8 Engine

1 - O-RING
2 - IGNITION COIL
3 - ELECTRICAL CONNECTOR

INSTALLATION - 2.5L

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

(1) Install ignition coil to bracket. If nut and bolts are used to secure coil to coil bracket, tighten to 11 N·m (100 in. lbs.) torque. If bolts are used, tighten bolts to 5 N·m (50 in. lbs.) torque.

(2) Connect engine harness connector to coil.

(3) Connect ignition coil cable to ignition coil.

IGNITION COIL (Continued)

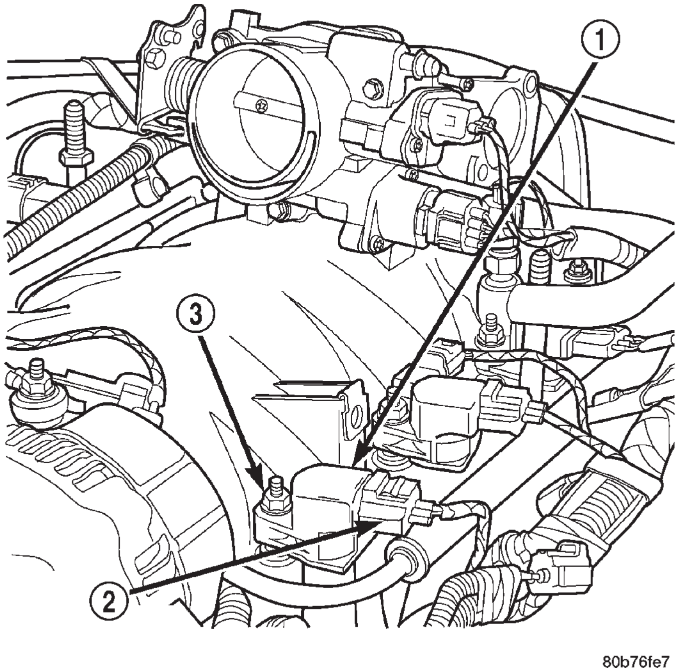


Fig. 27 Ignition Coil Location—4.7L V–8 Engine

1 - IGNITION COIL
2 - COIL ELECTRICAL CONNECTOR
3 - COIL MOUNTING STUD/NUT

INSTALLATION - 3.9L/5.2L/5.9L

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

(1) Install the ignition coil to coil bracket. If nuts and bolts are used to secure coil to coil bracket, tighten to 11 N·m (100 in. lbs.) torque. If the coil mounting bracket has been tapped for coil mounting bolts, tighten bolts to 5 N·m (50 in. lbs.) torque.

(2) Connect all wiring to ignition coil.

INSTALLATION - 4.7L

(1) Using compressed air, blow out any dirt or contaminants from around top of spark plug.

(2) Check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

(3) Position ignition coil into cylinder head opening and push onto spark plug. Do this while guiding coil base over mounting stud.

(4) Install mounting stud nut and tighten to 8 N·m (70 in. lbs.) torque.

(5) Connect electrical connector to coil by snapping into position.

(6) If necessary, install throttle body air tube or box.

SPARK PLUG

DESCRIPTION

All engines use resistor type spark plugs. 4.7L V-8 engines are equipped with “fired in suppressor seal” type spark plugs using a copper core ground electrode.

Because of the use of an aluminum cylinder head on the 4.7L engine, spark plug torque is very critical.

To prevent possible pre-ignition and/or mechanical engine damage, the correct type/heat range/number spark plug must be used.

OPERATION

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 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. On all engines except the 4.7L V-8, gap growth will not average more than approximately 0.025 mm (.001 in) per 3200 km (2000 miles) of operation. On the 4.7L V-8, gap growth will not average more than approximately .0015 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)

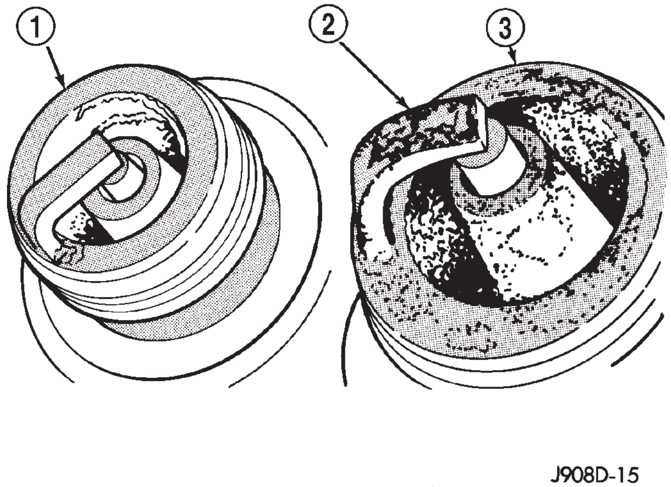


Fig. 28 Normal Operation and Cold (Carbon) Fouling

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.

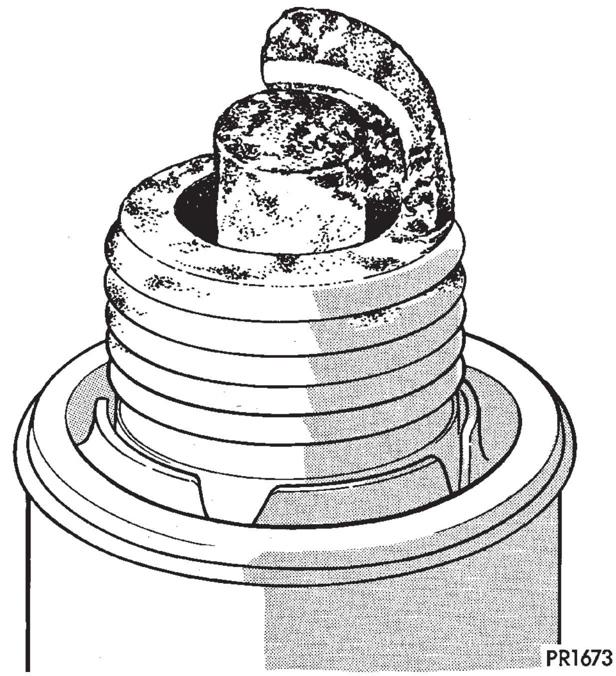


Fig. 29 Oil or Ash Encrusted

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.

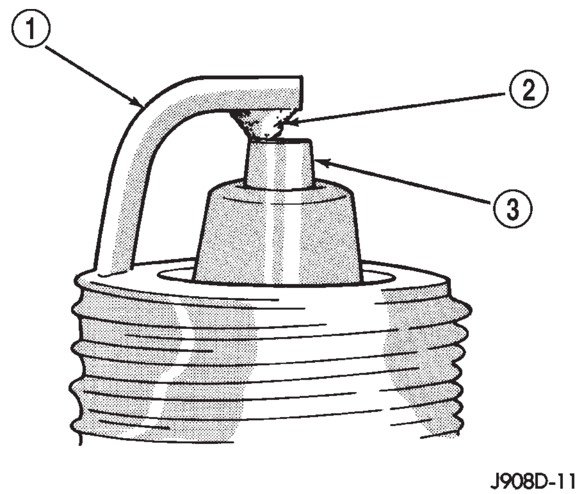


Fig. 30 Electrode Gap Bridging

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.

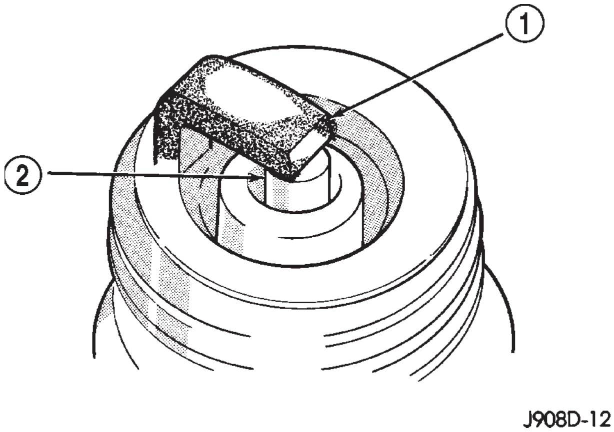


Fig. 31 Scavenger Deposits

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.)

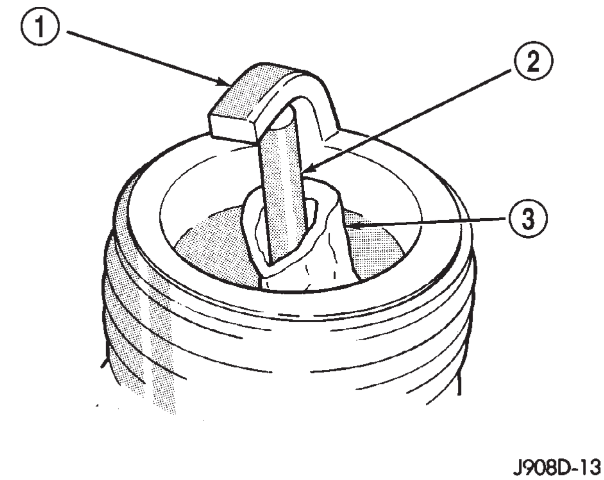


Fig. 32 Chipped Electrode Insulator

1 - GROUND ELECTRODE
2 - CENTER ELECTRODE
3 - CHIPPED INSULATOR

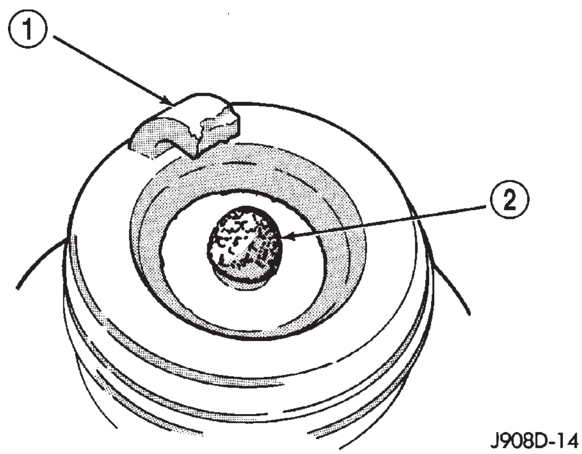


Fig. 33 Preignition Damage

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 3.9L V-6 and 5.2/5.9L V-8 engines, spark plug cable heat shields are pressed into the cylinder head to surround each cable boot and spark plug (Fig. 35).

SPARK PLUG (Continued)

Fig. 34 Spark Plug Overheating

1 - BLISTERED WHITE OR GRAY COLORED INSULATOR

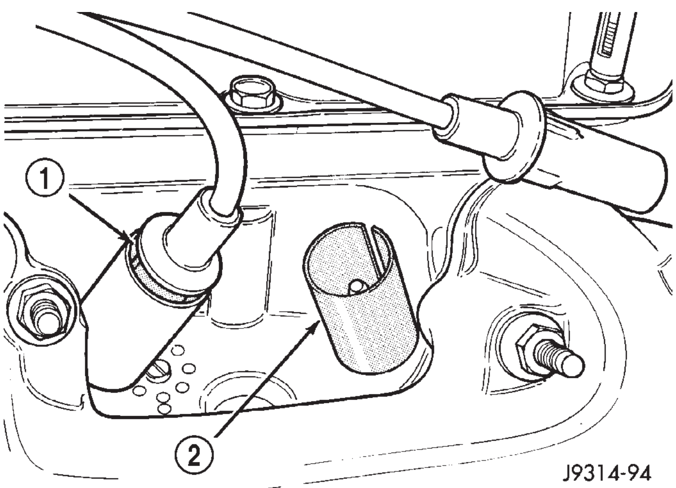


Fig. 35 Heat Shields—3.9/5.2/5.9L Engines

1 - AIR GAP
2 - SPARK PLUG BOOT HEAT SHIELD

If removal of the heat shield(s) is necessary, remove the spark plug cable and compress the sides of shield for removal. Each shield is slotted to allow for compression and removal. To install the shields, align shield to machined opening in cylinder head and tap into place with a block of wood.

4.7L V–8 Engine: Each individual spark plug is located under each ignition coil. Each individual ignition coil must be removed to gain access to each spark plug. Refer to Ignition Coil Removal/Installation.

(1) Except 4.7L Engine: Prior to removing spark plug, spray compressed air around spark plug hole and area around spark plug. This will help prevent foreign material from entering combustion chamber.

(2) 4.7L V–8 Engine: Prior to removing spark plug, spray compressed air around base of ignition coil at cylinder head. This will help prevent foreign material from entering combustion chamber.

(3) Remove spark plug from cylinder head using a quality socket with a rubber or foam insert. If equipped with a 4.7L V-8 engine, also check condition of coil o-ring and replace as necessary.

(4) Except 4.7L: Always remove spark plug or ignition coil cables by grasping at the cable boot (Fig. 37). 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.

(5) Inspect spark plug condition. Refer to Spark Plug Conditions.

CLEANING

The plugs may be cleaned using commercially available spark plug cleaning equipment. After cleaning, file center electrode flat with a small point file or jewelers file before adjusting gap.

CAUTION: Never use a motorized wire wheel brush to clean spark plugs. Metallic deposits will remain on spark plug insulator and will cause plug misfire.

INSTALLATION

CAUTION: The 4.7L V–8 engine is equipped with copper core ground electrode spark plugs. They must be replaced with the same type/number spark plug as the original. If another spark plug is substituted, pre-ignition will result.

Special care should be taken when installing spark plugs into the cylinder head spark plug wells. Be sure the plugs do not drop into the plug wells as electrodes can be damaged.

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap or a cracked porcelain insulator.

Except 4.7L Engine: 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) Except 4.7L Engine: Tighten spark plugs to 35-41 N·m (26-30 ft. lbs.) torque.

(3) Except 4.7L Engine: Install spark plug cables over spark plugs.

(4) 4.7L V–8 Engine: Tighten spark plugs to 27 N·m (20 ft. lbs.) torque.

(5) 4.7L V–8 Engine: Before installing coil(s), check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

(6) 4.7L V–8 Engine: Install ignition coil(s). Refer to Ignition Coil Removal/Installation.

SPARK PLUG CABLE

DESCRIPTION

Spark plug cables 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

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.

On 3.9L V-6 and 5.2/5.9L V-8 engines, spark plug cable heat shields are pressed into the cylinder head to surround each spark plug cable boot and spark plug (Fig. 36). These shields protect the spark plug boots from damage (due to intense engine heat generated by the exhaust manifolds) and should not be removed. After the spark plug cable has been installed, the lip of the cable boot should have a small air gap to the top of the heat shield (Fig. 36).

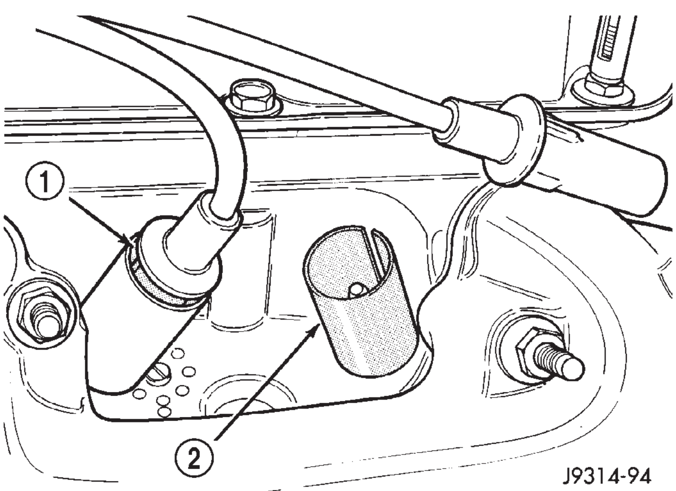


Fig. 36 Heat Shields—3.9/5.2/5.9L Engines

1 - AIR GAP
2 - SPARK PLUG BOOT HEAT SHIELD

TESTING

When testing secondary cables for damage with an oscilloscope, follow the instructions of the equipment manufacturer.

If an oscilloscope is not available, spark plug cables may be tested as follows:

CAUTION: Do not leave any one spark plug cable disconnected for longer than necessary during testing. This may cause possible heat damage to the catalytic converter. Total test time must not exceed ten minutes.

With the engine running, remove spark plug cable from spark plug (one at a time) and hold next to a good engine ground. If the cable and spark plug are in good condition, the engine rpm should drop and the engine will run poorly. If engine rpm does not drop, the cable and/or spark plug may not be operating properly and should be replaced. Also check engine cylinder compression.

With the engine not running, connect one end of a test probe to a good ground. Start the engine and run the other end of the test probe along the entire length of all spark plug cables. If cables are cracked or punctured, there will be a noticeable spark jump from the damaged area to the test probe. The cable running from the ignition coil to the distributor cap can be checked in the same manner. Cracked, damaged or faulty cables should be replaced with resistance type cable. This can be identified by the words ELECTRONIC SUPPRESSION printed on the cable jacket.

Use an ohmmeter to test for open circuits, excessive resistance or loose terminals. If equipped, 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

SPARK PLUG CABLE (Continued)

To test ignition coil-to-distributor cap cable, do not remove the cable from the cap. Connect ohmmeter to rotor button (center contact) of distributor cap and terminal at ignition coil end of cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, remove the cable from the distributor cap. Connect the ohmmeter to the terminal ends of the cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, replace the cable. Inspect the ignition coil tower for cracks, burns or corrosion.

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. 37). Grasp the boot (not the cable) and pull it off with a steady, even force.

Install cables into the proper engine cylinder firing order. Refer to Firing Order in Specifications.

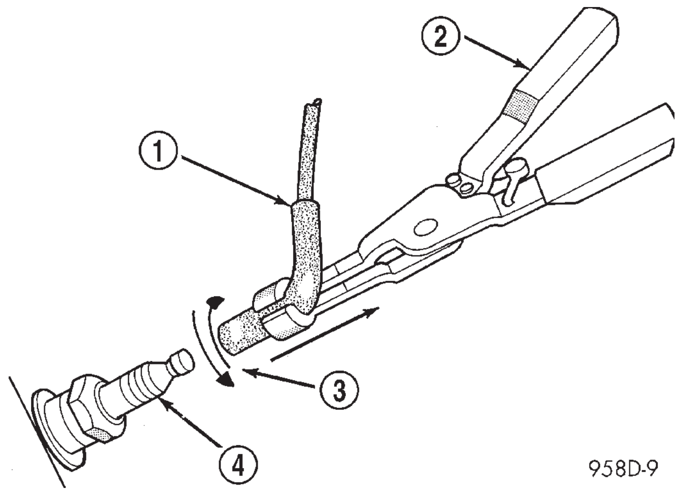


Fig. 37 Cable Removal

1 - SPARK PLUG CABLE AND BOOT
2 - SPARK PLUG BOOT PULLER
3 - TWIST AND PULL
4 - SPARK PLUG

INSTALLATION

Install cables into the proper engine cylinder firing order. Refer to Firing Order in Specifications.

When replacing the spark plug and coil cables, route the cables correctly and secure in the proper retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise. It could also cause cross ignition of the plugs or short circuit the cables to ground.

When installing new cables, make sure a positive connection is made. A snap should be felt when a good connection is made between the plug cable and the distributor cap tower.

INSTRUMENT CLUSTER

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INSTRUMENT CLUSTER

DESCRIPTION

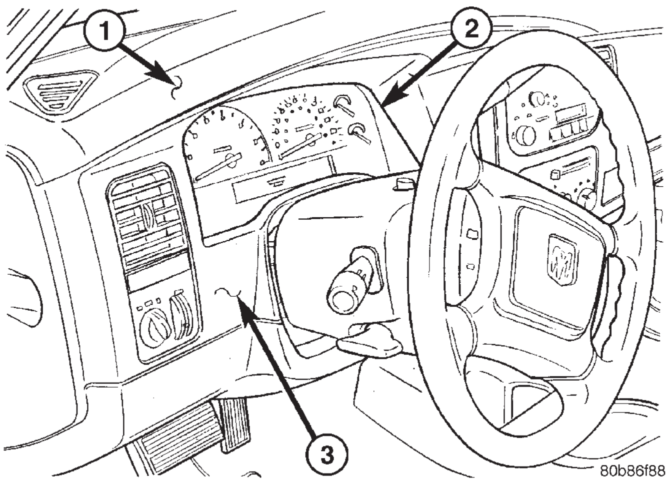

Fig. 1 Instrument Cluster

1 - INSTRUMENT PANEL TOP COVER
2 - INSTRUMENT CLUSTER
3 - CLUSTER BEZEL

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 serves to separate the define the individual gauges and the information center area of the EMIC. Behind the cluster hood and mask is the cluster overlay and gauges. The overlay is a laminated plastic unit. The dark, visible surface of the outer layer 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 overlay only through predetermined cutouts. On the lower edge of the cluster lens just left of center, the odometer/trip odometer switch knob protrudes through dedicated holes in the cluster mask and the cluster lens. 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 each on the upper and lower edges of the housing. The EMIC is secured to the molded plastic instrument panel cluster carrier with four screws. All electrical connections to the EMIC are made at the back of the cluster housing through two take outs of the instrument panel wire harness, each equipped with a self-docking connector.

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 Requests -** The EMIC sends chime tone requests over the PCI data bus network to the Central Timer Module (CTM) when it monitors certain conditions or inputs. The CTM replaces the chime or buzzer module and performs the functions necessary to provide audible alerts that are synchronized with the visual alerts provided by the EMIC. (Refer to 8 - ELECTRICAL/CHIME/BUZZER - DESCRIPTION).
- **Vacuum Fluorescent Display (VFD) Dimming Service -** The EMIC performs the functions necessary to eliminate the need for a separate VFD dimming module by providing control and synchronization of the illumination intensity of all vacuum fluorescent displays in the vehicle, as well as a parade mode.

The EMIC module incorporates a blue-green digital VFD for displaying odometer and trip odometer information, as well as the amber cruise indicator display function. Some variations of the EMIC are necessary to support optional equipment and regulatory requirements. The EMIC includes the following analog gauges:

INSTRUMENT CLUSTER (Continued)

- **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**
- **Coolant Low Indicator (Diesel Engine Only)**
- **Cruise Indicator (Odometer VFD)**
- **Door Ajar Indicator**
- **High Beam Indicator**
- **Low Fuel Indicator**
- **Malfunction Indicator Lamp (MIL)**
- **Overdrive-Off Indicator (Automatic Transmission Only)**
- **Seatbelt Indicator**
- **Security Indicator**
- **Service Four-Wheel Drive Indicator**
- **Transmission Overtemp Indicator**
- **Turn Signal (Right and Left) Indicators**
- **Upshift Indicator**
- **Wait-To-Start Indicator (Diesel Engine Only)**
- **Washer Fluid Indicator**
- **Water-In-Fuel Indicator (Diesel Engine Only)**

Some of these indicators are either programmable or 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. On models equipped with an automatic transmission, the EMIC also incorporates a blue-green digital VFD in the lower right corner of the cluster for displaying the transmission gear that has been selected with the automatic transmission gear selector lever, as well as the amber overdrive-off indicator display function.

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, turn signal indicators, and wait-to-start indicator are also illuminated by dedicated incandescent bulbs. 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 and the hood and mask unit, the rear cluster housing cover, 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 Communications 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 voltage, low oil pressure, or high coolant tempera-

INSTRUMENT CLUSTER (Continued)

ture, the algorithm drives the gauge pointer to an extreme position and the microprocessor turns on a "Check Gauges" indicator to provide a distinct visual indication of a problem to the vehicle operator. The instrument cluster circuitry may also generate an electronic chime tone request message to the Central Timer Module (CTM) over the PCI data bus when it monitors certain conditions or inputs, in order to provide the vehicle operator with an audible alert to supplement a visual indication. One such alert is a turn signal warning chime, which the EMIC provides by monitoring the turn signal indicators and PCI bus messages from the PCM for vehicle speed and distance. If the EMIC determines that a turn signal is left on for a distance greater than about 1.6 kilometers (1 mile) at a vehicle speed greater than about 24 kilometers per hour (15 miles per hour), it will send an electronic message to the CTM requesting a continuous chime to sound until the turn signal is turned off or the vehicle speed is less than 24 kilometers per hour (15 miles per hour).

The EMIC circuitry operates on battery current received through a fused B(+) fuse in the Junction Block (JB) on a non-switched fused B(+) circuit, and on battery current received through a fused ignition switch output (run-start) fuse in the JB on a fused ignition switch output (run-start) circuit. This arrangement allows the EMIC to provide some features 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 through two separate ground circuits located in one of the two instrument cluster connectors and take outs of the instrument panel wire harness. One ground circuit receives ground through a take out with an eyelet terminal connector of the instrument panel wire harness that is secured by a nut to a ground stud located on the left cowl side inner panel below the instrument panel, while the other ground circuit receives ground through a take out with an eyelet terminal connector of the headlamp and dash wire harness that is secured by a nut to a ground stud located on the left front fender inner shield near the battery in the engine compartment.

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 indicators 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 manual.

VACUUM-FLUORESCENT DISPLAY

The Vacuum-Fluorescent Display (VFD) module is soldered to the EMIC circuit board. The display is active with the ignition switch in the On or Start positions, and inactive when the ignition switch is in any other position. The VFD has several display capabilities including odometer, trip odometer, and an amber "CRUISE" indication whenever the optional speed control system is turned On. The cruise indicator function of the VFD is automatically enabled or disabled by the EMIC circuitry based upon whether the vehicle is equipped with the speed control option. 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 button that extends through the lower edge of the cluster lens, just left of center. Actuating this switch momentarily with the ignition switch in the On posi-

INSTRUMENT CLUSTER (Continued)

tion will toggle the VFD between the odometer and trip odometer modes. The word “TRIP” will also appear in blue-green text when the VFD trip odometer mode is active. 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. The EMIC will automatically flash the odometer or trip odometer information on and off if there is a loss of PCI data bus communication. The VFD will also display various information used in several diagnostic procedures. Refer to the appropriate diagnostic information for additional details on this VFD function.

Models equipped with an automatic transmission have a second VFD soldered to the EMIC circuit board, which serves as the electronic transmission gear selector indicator. Like the odometer/trip odometer VFD, this display is active with the ignition switch in the On or Start positions, and inactive when the ignition switch is in any other position. This VFD also has an amber “O/D OFF” indicator that illuminates when the automatic transmission electronic overdrive is turned off by depressing the overdrive-off switch button located in the knob on the end of the gear selector lever on the right side of the steering column. This VFD displays the characters “P,” “R,” “N,” “D,” “2,”and “1,” which represent each of the available gear selector positions. A small rectangular box is illuminated around the character representing the gear position that is currently selected.

Both VFDs 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 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, trip odometer, gear selector indicator, cruise indicator, and overdrive-off indicator functions of these VFDs may be found elsewhere in this service manual.

INDICATORS

Indicators are located in various positions within the EMIC and are all connected to the EMIC circuit board. The high beam indicator, washer fluid indicator, turn signal indicators, and the diesel engine wait-to-start indicator are hard wired. The brake indicator is controlled by PCI data bus messages from the Controller Anti-lock Brake (CAB) and the hard wired park brake switch input to the EMIC. The seatbelt indicator is controlled by the EMIC programming, PCI data bus messages from the Airbag Control Module (ACM), and the hard wired seat belt switch input to the EMIC. The security indicator is controlled by a hard wired Central Timer Module (CTM) input to the EMIC, and by PCI data bus messages from the Sentry Key Immobilizer Module (SKIM) if the vehicle is equipped with the optional Sentry Key Immobilizer System (SKIS). 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 flash the odometer VFD on and off repeatedly until PCI data bus communication is restored. The EMIC uses PCI data bus messages from the CTM, the PCM, the Transfer Case Control Module (TCCM), the ACM, and the CAB to control all of the remaining indicators. Different indicators are controlled by different strategies; some receive fused ignition switch output from the EMIC circuitry cluster 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 programmable or configurable. This feature allows the programmable indicators to be activated or deactivated with a DRBIII® scan tool, while the configurable indicators will be automatically enabled or disabled by the EMIC circuitry for compatibility with certain optional equipment. The only programmable indicator for this model is the upshift indicator. The cruise indicator, service 4WD indicator, gear selector indicator, overdrive-off indicator, and the transmission overtemp indicator are automatically configured, either electronically or mechanically. If the EMIC is disconnected from the fused B(+) circuit for more than about five minutes the EMIC will forget its previous electronic configuration settings, but will learn the proper indicator configuration settings again when it is reinstalled in a vehicle.

The hard wired indicators are diagnosed using conventional diagnostic methods. The EMIC and PCI bus message controlled indicator lamps 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 require 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 manual.

CLUSTER ILLUMINATION

The EMIC has several illumination lamps that are illuminated when the exterior lighting is turned on

INSTRUMENT CLUSTER (Continued)

with the headlamp switch. The illumination brightness of these lamps is adjusted by the panel lamps dimmer rheostat when the headlamp switch thumbwheel is rotated (down to dim, up to brighten). The illumination lamps receive battery current through the panel lamps dimmer rheostat and a fuse in the JB on a fused panel lamps dimmer switch signal circuit. The illumination lamps are grounded at all times.

In addition, an analog/digital (A/D) converter in the EMIC converts the analog panel lamps dimmer rheostat input from the headlamp switch to a digital dimming level signal for controlling the lighting level of the VFD. The EMIC also broadcasts this digital dimming information as a message over the PCI data bus for use by the Compass Mini-Trip Computer (CMTC) in synchronizing the lighting level of its VFD with that of the EMIC. The headlamp switch thumbwheel also has a Parade position to provide a parade mode. The EMIC monitors the request for this mode through a hard wired day brightness sense circuit input from the headlamp switch. In this mode, the EMIC will override the selected panel dimmer switch signal and send a message over the PCI data bus to illuminate all vacuum fluorescent displays at full brightness for easier visibility when driving in daylight with the exterior lighting turned On. The parade mode has no effect on the incandescent bulb illumination intensity.

The hard wired cluster illumination lamps are diagnosed using conventional diagnostic methods. Proper testing of the VFD dimming level and the PCI data bus dimming level message functions requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

CHIME WARNING REQUESTS

The EMIC is programmed to request chime service from the Central Timer Module (CTM) when certain indicator lamps are illuminated. When the programmed conditions are met, the EMIC generates an electronic chime request message and sends it over the PCI data bus to the CTM. Upon receiving the proper chime request message, the CTM activates an integral chime tone generator to provide the audible chime tone to the vehicle operator. (Refer to 8 - ELECTRICAL/CHIME/BUZZER - OPERATION). Proper testing of the EMIC, the CTM and the PCI data bus chime request message functions requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

DIAGNOSIS AND TESTING - INSTRUMENT CLUSTER

If all of the instrument cluster gauges and/or indicator lamps are inoperative, refer to PRELIMINARY DIAGNOSIS. If an individual gauge or Programmable Communications Interface (PCI) data bus message-controlled indicator lamp is inoperative, refer to ACTUATOR TEST. If an individual hard wired indicator lamp is inoperative, refer to the diagnosis and testing information for that specific indicator. If the instrument cluster illumination lighting is inoperative, refer to CLUSTER ILLUMINATION DIAGNOSIS. If the instrument cluster Vacuum-Fluorescent Display (VFD) dimmer service or chime request function is inoperative, use a DRBIII® scan tool to diagnose the problem. Refer to the appropriate diagnostic procedures.

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: Certain indicators in this instrument cluster are programmable or automatically configured. This feature allows those indicators to be activated or deactivated for compatibility with certain optional equipment. If the problem being diagnosed involves improper illumination of the upshift indicator, use a DRBIII® scan tool to be certain that the instrument cluster has been programmed with the proper vehicle equipment option settings. If the problem being diagnosed involves improper illumination of the cruise indicator, the door or gate ajar indicators, the overdrive-off indicator, the service four-wheel drive indicator, the transmission overtemp indicator, or the gear selector indicator, disconnect and isolate the battery negative cable. After about five minutes, reconnect the battery negative cable and turn the ignition switch to the On position. The instrument cluster will automatically relearn the equipment in the vehicle and properly configure the configurable indicators accordingly.

INSTRUMENT CLUSTER (Continued)

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 indicator lamps are inoperative, go to Step 5.

(2) Check the fused B(+) fuse (Fuse 1 - 15 ampere) in the Junction Block (JB). 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 1 - 15 ampere) in the JB. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit between the JB and the Power Distribution Center (PDC) as required.

(4) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the instrument 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 JB as required.

(5) Check the fused ignition switch output (run-start) fuse (Fuse 8 - 10 ampere) in the JB. 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 8 - 10 ampere) in the JB. If OK, go to Step 7. If not OK, repair the open fused ignition switch output (run-start) circuit between the JB 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 thumbwheel on the headlamp switch to the full bright position. The cluster illumination lamps should light. If OK, go to Step 10. If not OK, repair the open ground circuit (Z1) between the instrument panel wire harness connector (Connector C1) for the instrument cluster and ground (G208) as required.

(9) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the instrument cluster. Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run-start) circuit cavity of the instrument 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 JB as required.

(10) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Check for continuity between the ground circuit (Z2) 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 (G113) as required.

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, and the PCI data bus message-controlled indicators are capable of operating as designed. During the actuator test the instrument cluster circuitry will position each of the gauge needles at various calibration points, illuminate each of the segments in the Vacuum-Fluorescent Displays (VFDs), 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. How-

INSTRUMENT CLUSTER (Continued)

ever, there may still be a problem with the PCI data bus, the Powertrain Control Module (PCM), the Engine Control Module (ECM), the Central Timer Module (CTM), the Transmission Control Module (TCM), the Transfer Case Control Module (TCCM), the Airbag Control Module (ACM), the Controller Anti-lock Brake (CAB), 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.

(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) Keep the odometer/trip odometer switch button depressed for about ten seconds, until **CHEC** appears in the odometer display, then release the odometer/trip odometer switch button.

(5) A series of three-digit numeric failure messages may appear in the odometer display, depending upon the failure mode. If a failure message appears, refer to the Instrument Cluster Failure Message chart for the description and proper correction. If no failure message appears, the actuator test will proceed as described in Step 6.

INSTRUMENT CLUSTER FAILURE MESSAGE		
Message	Description	Correction
110	A failure has been identified in the instrument cluster CPU, RAM, or EEPROM.	1. Replace the faulty instrument cluster.
900	The PCI data bus is not operational.	1. Check the PCI data bus connection at the instrument cluster. 2. Check the instrument cluster fuses. 3. Check the PCI data bus functionality using a DRBIII® scan tool. Refer to the appropriate diagnostic information.
920	The instrument cluster is not receiving a vehicle speed message from the PCM.	1. Check the PCM software level and reflash if required. 2. Use a DRBIII® scan tool to verify that the vehicle speed message is being sent by the PCM.
921	The instrument cluster is not receiving a distance pulse message from the PCM.	1. Check the PCM software level and reflash if required. 2. Use a DRBIII® scan tool to verify that the distance pulse message is being sent by the PCM.
940	The instrument cluster is not receiving an airbag lamp-on message from the ACM.	1. Check the PCI data bus connection at the ACM. 2. Check the ACM fuse.
950	The instrument cluster is not receiving an ABS lamp-on message from the CAB.	1. Check the PCI data bus connection at the CAB. 2. Check the CAB fuse.
960	The instrument cluster is not receiving a PRND21 message from the TCM.	1. Check the PCI data bus connection at the TCM. 2. Check the TCM fuse.
999	An error has been discovered.	1. Record the failure message. 2. Depress the odometer/trip odometer switch button to continue the Actuator Test.

INSTRUMENT CLUSTER (Continued)

(6) The instrument cluster will begin the Vacuum Fluorescent Display (VFD) walking segment test. This test will require the operator to visually inspect each VFD segment as it is displayed to determine a pass or fail condition. First, all of the segments will be illuminated at once; then, each individual segment of the VFD will be illuminated in sequence. If any segment in the display fails to illuminate, repeat the test to confirm the failure. If the failure is confirmed, replace the faulty instrument cluster. Following completion of the VFD walking segment test, the actuator test will proceed as described in Step 7.

(7) The instrument cluster will perform a bulb check of each indicator that the instrument cluster circuitry controls. Each of the instrument cluster circuitry controlled indicators except the cruise indicator and the overdrive-off indicator are illuminated by a Light Emitting Diode (LED). If an LED fails to illuminate during this test, the instrument cluster must be replaced. Following the bulb check test, the actuator test will proceed as described in Step 8.

(8) The instrument cluster will perform a gauge actuator test. In this test the instrument cluster circuitry positions each of the gauge needles at three different calibration points, then returns the gauge needles to their relaxed positions. If an individual gauge does not respond properly, or does not respond at all during the gauge actuator test, the instrument cluster should be removed. However, check that the gauge terminal pins are properly inserted through the spring-clip terminal pin receptacles on the instrument cluster electronic circuit board before considering instrument cluster replacement. If the gauge terminal connections are OK, replace the faulty instrument cluster.

(9) 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 on the PCI data bus during the test.

(10) Go back to Step 1 to repeat the test, if 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 headlamp switch, that system needs to be repaired first. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR - 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. If the problem being diagnosed involves a lack of dimming control for the odometer/trip odometer or gear selector indicator Vacuum Fluorescent Displays (VFDs), but all of the other cluster illumination lamps can be dimmed, test and repair the day brightness circuit between the instrument cluster and the headlamp switch as required. 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 instrument panel dimmer fuse (Fuse 9 - 5 ampere) in the Junction Block (JB). 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 exterior lamps On with the headlamp switch. Rotate the headlamp switch panel lamps dimmer thumbwheel upward to just before the interior lamps detent. Check for battery voltage at the instrument panel dimmer fuse (Fuse 9 - 5 ampere) in the JB. Rotate the panel lamps dimmer thumbwheel downward while observing the test voltmeter. The reading should go from battery voltage to zero volts. If OK, go to Step 3. If not OK, repair the open panel lamps dimmer switch signal circuit between the headlamp switch and the JB as required.

(3) Turn the exterior lamps Off. Disconnect and isolate the battery negative cable. Remove the instrument cluster. Remove the instrument panel dimmer fuse (Fuse 9 - 5 ampere) from the JB. Probe the fused panel lamps dimmer switch signal circuit cavity of the instrument panel wire harness connector

INSTRUMENT CLUSTER (Continued)

(Connector C2) for the instrument cluster. Check for continuity to a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the shorted fused panel lamps dimmer switch signal circuit between the instrument cluster and the JB as required.

(4) Reinstall the instrument panel dimmer fuse (Fuse 9 - 5 ampere) in the JB. Reconnect the battery negative cable. Turn the exterior lamps On with the headlamp switch. Rotate the headlamp switch panel lamps dimmer thumbwheel upward to just before the interior lamps detent. Check for battery voltage at the fused panel lamps dimmer switch signal circuit cavity of the instrument panel wire harness connector (Connector C2) for the instrument cluster. If OK, replace the faulty bulb and bulb holder units. If not OK, repair the open fused panel lamps dimmer switch signal circuit between the instrument cluster and the JB as required.

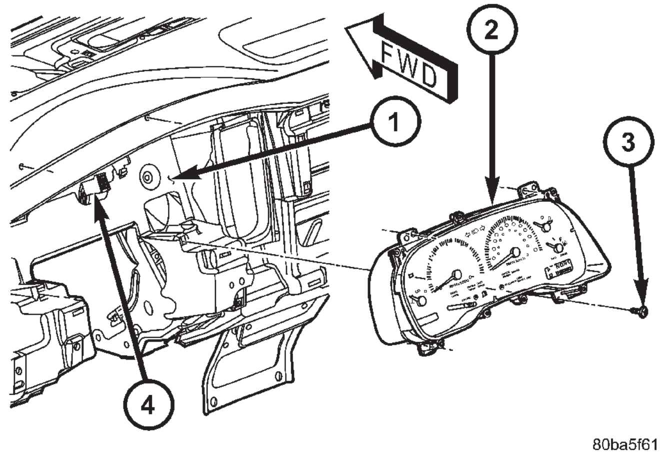

Fig. 2 Instrument Cluster Remove/Install

1 - INSTRUMENT PANEL
2 - INSTRUMENT CLUSTER
3 - SCREW (4)
4 - SELF-DOCKING CONNECTOR (2)

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 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 (Fig. 2).

(4) Pull the instrument cluster rearward far enough to disengage the two self-docking instrument panel wire harness connectors from the cluster connector receptacles.

(5) Roll the bottom of the instrument cluster upward and rearward to remove it from the 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 lamp and illumination lamp bulbs (including the integral bulb holders), the cluster lens and hood unit, and the cluster housing rear cover. The remaining components are serviced only as a part of the cluster housing unit, which includes: the cluster housing, the electronic circuit board unit, the cluster overlay, the gauges, and the odometer/trip odometer reset switch button. Following are the procedures for disassembling the serviced components from the instrument cluster unit.

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.

CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp or indicator lamp bulb and bulb holder units. However, the illumination lamps and the indicator lamps use different bulb and bulb holder unit sizes. They must never be interchanged.

(1) Disconnect and isolate the battery negative cable.

INSTRUMENT CLUSTER (Continued)

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) Turn the bulb holder counterclockwise about sixty degrees on the cluster electronic circuit board (Fig. 3).

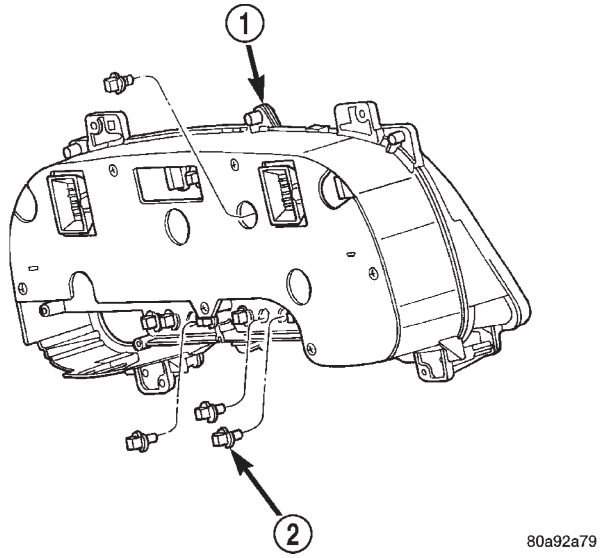

Fig. 3 Cluster Bulb Remove/Install

1 - INSTRUMENT CLUSTER
2 - BULB AND HOLDER

(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 AND HOOD

(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 seven screws that secure the lens and hood unit to the cluster housing (Fig. 4).

(4) Gently pull the lens and hood unit away from the cluster housing.

CAUTION: Do not touch the face of the gauge overlay or the back of the cluster lens with your finger. It will leave a permanent finger print.

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 six screws that secure the rear cover to the back of the cluster housing (Fig. 5).

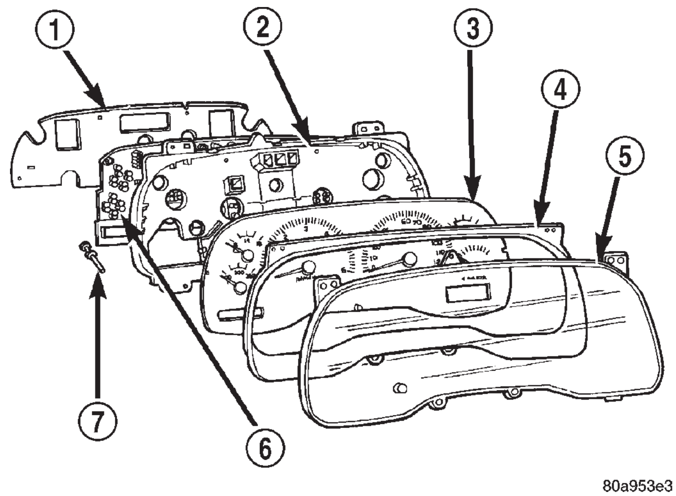

Fig. 4 Instrument Cluster Components

1 - COVER
2 - HOUSING
3 - OVERLAY AND GAUGES
4 - HOOD
5 - LENS
6 - CIRCUIT BOARD
7 - ODOMETER SWITCH BUTTON

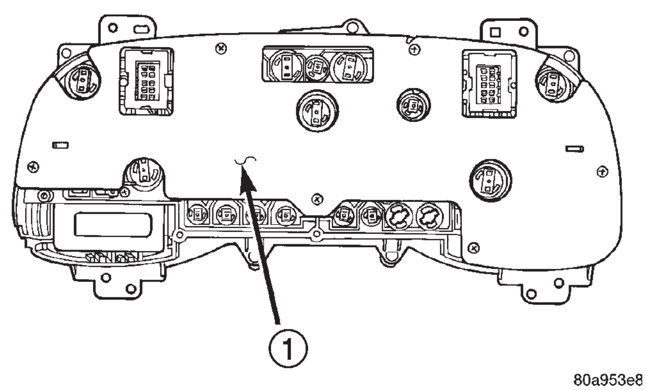

Fig. 5 Cluster Housing Rear Cover Remove/Install

1 - REAR CLUSTER HOUSING COVER

(4) Remove the rear cover from the back of the cluster housing.

CLUSTER HOUSING

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) Remove the lens and hood unit from the cluster housing. Refer to CLUSTER LENS AND HOOD.

(4) Remove the rear cover from the cluster housing. Refer to CLUSTER HOUSING REAR COVER.

INSTRUMENT CLUSTER (Continued)

ASSEMBLY

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.

CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp or indicator lamp bulb and bulb holder units. However, the illumination lamps and the indicator lamps use different bulb and bulb holder unit sizes. They must never be interchanged.

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 AND HOOD

CAUTION: Do not touch the face of the gauge overlay or the back of the cluster lens with your finger. It will leave a permanent finger print.

(1) Align the cluster lens and hood unit with the cluster housing. Be certain that the odometer/trip odometer switch button is installed through the clearance hole in the lens (Fig. 4).

(2) Install and tighten the seven screws that secure the lens and hood unit to the cluster housing. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(4) Reconnect the battery negative cable.

CLUSTER HOUSING REAR COVER

(1) Position the rear cover onto the back of the cluster housing (Fig. 5).

(2) Install and tighten the six screws that secure the rear cover to the back of the cluster housing. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(4) Reconnect the battery negative cable.

CLUSTER HOUSING

(1) Assemble the rear cover onto the cluster housing. Refer to CLUSTER HOUSING REAR COVER.

(2) Assemble the lens and hood unit onto the cluster housing. Refer to CLUSTER LENS AND HOOD.

(3) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(4) Reconnect the battery negative cable.

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 by inserting the top of the instrument cluster between the steering wheel and the top of the instrument panel, then rolling the bottom of the cluster downward and forward.

(2) Align the instrument cluster with the cluster opening in the instrument panel and push the cluster firmly and evenly into place. The instrument panel wire harness has two self-docking connectors that will be automatically aligned with, and connected to the instrument cluster connector receptacles when the cluster is properly installed in the instrument panel.

INSTRUMENT CLUSTER (Continued)

(3) Install and tighten the four screws that secure the instrument cluster to the instrument panel (Fig. 2). Tighten the screws to 2 N·m (17 in. lbs.).

(4) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/ CLUSTER BEZEL - INSTALLATION).

(5) Reconnect the battery negative cable.

NOTE: Some of the indicators in this instrument cluster are either programmable (upshift indicator) or automatically configured (cruise, door and gate ajar, gear selector indicator, service four-wheel drive, overdrive-off, and transmission overtemp indicators) when the cluster is connected to the vehicle electrical system. This feature allows those indicators to be enabled or disabled for compatibility with certain optional equipment. If a new instrument cluster is being installed, use a DRBIII® scan tool to program the instrument cluster with the proper vehicle equipment option setting to enable and/or disable the upshift indicator lamp. Refer to the appropriate diagnostic information.

ABS INDICATOR

DESCRIPTION

An Antilock Brake System (ABS) indicator is standard equipment on all instrument clusters. This indicator serves both the standard equipment Rear Wheel Anti-Lock (RWAL) and optional equipment 4-Wheel Anti-Lock (4WAL) brake systems. The ABS indicator is located in the Information Center area of the instrument cluster, to the left of center. The ABS indicator consists of a stencilled 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 controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Controller Antilock Brake (CAB) over the Programmable Communications Interface (PCI) data bus. 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 instrument cluster transistor. The instrument cluster will turn on the ABS indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the ABS indicator is illuminated by the cluster for about two seconds as a bulb test.
- **ABS Lamp-On Message** - Each time the cluster receives a lamp-on message from the CAB, the ABS indicator will be illuminated. The indicator remains illuminated until the cluster receives a lamp-off message from the CAB, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Communication Error** - If the cluster receives no lamp-on or lamp-off messages from the CAB for six consecutive seconds, the ABS indicator is illuminated. The indicator remains illuminated until the cluster receives a valid message from the CAB, 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 ABS 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.
- **ABS Diagnostic Test** - The ABS indicator is blinked on and off by lamp-on and lamp-off messages from the CAB during the performance of the ABS diagnostic tests.

The CAB continually monitors the ABS circuits and sensors to decide whether the system is in good operating condition. The CAB then sends the proper lamp-on or lamp-off messages to the instrument cluster. If the CAB sends a lamp-on message after the bulb test, it indicates that the CAB has detected a system malfunction and/or that the ABS system has become inoperative. The CAB will store a Diagnostic Trouble Code (DTC) for any malfunction it detects. Each time the ABS indicator fails to light due to an open or short in the cluster ABS indicator circuit, the cluster sends a message notifying the CAB of the condition, and the CAB will store a DTC. For proper diagnosis of the antilock brake system, the CAB, the PCI data bus, or the message inputs to the instrument cluster that control the ABS indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

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 in the Information Center area of the instrument cluster, to the right of center. The airbag indicator consists of a stenciled cutout of the word “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 it is not illuminated. A red lens behind the cutout in the opaque layer of the overlay causes the “AIRBAG” text 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 three consecutive seconds, the airbag indicator is illuminated. The indicator 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. The ACM will store a DTC and the cluster will begin blinking the seat belt indicator. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER/SEATBELT INDICATOR - OPERATION). 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 in the Information Center area of the instrument cluster, to the right of center. The brake indicator consists of a stenciled cutout of the word “BRAKE” and the International Control and Display Symbol icons for “Brake Failure” and “Parking 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 and the two icons 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.

BRAKE/PARK BRAKE INDICATOR (Continued)

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 circuit board based upon cluster programming, and electronic messages received by the cluster from the Central Timer Module (CTM) and the Controller Antilock Brake (CAB) over the Programmable Communications Interface (PCI) data bus. 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 position the brake indicator is illuminated by the instrument cluster for about four seconds as a bulb test.
- **Brake Lamp-On Message** - Each time the cluster receives a lamp-on message from the CTM or the CAB, the brake indicator will be illuminated. If the park brake is applied or not fully released, or if the pressures in the two halves of the split brake hydraulic system are not equal with the ignition switch in the On position, the brake indicator is illuminated solid. The brake indicator will blink on and off repeatedly when the park brake is applied or not fully released and the ignition switch is in the On position if a vehicle with an automatic transmission is not in Park or Neutral, or if the engine is running on vehicles with a manual transmission. The indicator remains illuminated until the cluster receives lamp-off messages from both the CTM and the CAB, 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 bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The park brake switch on the park brake pedal mechanism provides a hard wired ground input to the CTM circuitry through the park brake switch sense circuit whenever the park brake is applied or not fully released. The CTM then sends the proper lamp-on or lamp-off messages to the instrument cluster. The brake pressure switch on the brake combination valve provides a hard wired ground input to the CAB circuitry through the brake pressure switch sense circuit whenever the pressures in the two halves of the split brake hydraulic system are unequal. The CAB then sends the proper lamp-on or lamp-off messages to the instrument cluster. If the CAB sends a lamp-on message after the bulb test, it indicates that the CAB has detected a brake hydraulic system malfunction and/or that the ABS system has become inoperative. The CAB will store a Diagnostic Trouble Code (DTC) for any malfunction it detects. The park brake switch input to the CTM and the brake pressure switch input to the CAB can be diagnosed using conventional diagnostic tools and methods. For proper diagnosis of the antilock brake system, the CTM, the CAB, 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.

CHECK GAUGES INDICATOR

DESCRIPTION

A check gauges indicator is standard equipment on all instrument clusters. The check gauges indicator is located in the Information Center area of the instrument cluster, to the right of center. The check gauges indicator consists of a stenciled cutout of the words “CHECK GAGES” 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 GAGES” 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 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

CHECK GAUGES INDICATOR (Continued)

when it is provided a path to ground 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 of a gasoline engine is about 122° C (253° F) or higher, or a diesel engine is about 112° C (233° 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 temperature of a gasoline engine is about 119° C (246° F) or lower, a diesel engine is about 109° C (226° 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 of a gasoline engine is about 3.45 kPa (0.5 psi) or lower, or a diesel engine is about 51.71 kPa (7.5 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 of a gasoline engine is above 3.45 kPa (0.5 psi), a diesel engine is above 51.71 kPa (7.5 psi), 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 greater than zero.
- **System Voltage Low Message** - Each time the cluster receives a message from the PCM indicating the electrical system voltage is less than 11.5 volts, the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM indicating the electrical system voltage is greater than 12.0 volts (but less than 16.6 volts), or until the ignition switch is turned to the Off position, whichever occurs first.
- **System Voltage High Message** - Each time the cluster receives a message from the PCM indicating the electrical system voltage is greater than 16.6 volts, the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM indicating the electrical system voltage is less than 16.1 volts (but greater than 11.5 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 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 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.

COOLANT LOW INDICATOR

DESCRIPTION

A coolant low indicator is only found in the instrument clusters of vehicles equipped with an optional diesel engine. The coolant low indicator is located in the Information Center area of the instrument cluster, to the left of center. The coolant low indicator consists of a stenciled cutout of the words “LOW COOLANT” 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 “LOW COOLANT” 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 coolant low indicator is serviced as a unit with the instrument cluster.

OPERATION

The coolant low indicator gives an indication to the vehicle operator when the engine coolant level is low. This 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 Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The coolant low 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 coolant low indicator for the following reasons:

COOLANT LOW INDICATOR (Continued)

- **Bulb Test** - Each time the ignition switch is turned to the On position the coolant low indicator is illuminated for about two seconds as a bulb test.
- **Coolant Low Lamp-On Message** - Each time the cluster receives a message from the PCM indicating the engine coolant level is low, the coolant low indicator will be illuminated, and a single chime tone is sounded. The indicator remains illuminated until the cluster receives a message from the PCM indicating that the engine coolant level is not low, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the coolant low indicator is cycled off and then on again by the appropriate lamp-off and lamp-on messages from the PCM.
- **Actuator Test** - Each time the cluster is put through the actuator test, the 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 coolant level through the low coolant level switch, then sends the proper messages to the instrument cluster. For further diagnosis of the coolant low indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the low coolant level switch, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the coolant low 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. However, on vehicles not equipped with the optional speed control system, this indicator is electronically disabled. The cruise indicator consists of the word "CRUISE", which appears in the lower portion of the odometer/trip odometer Vacuum-Fluorescent Display (VFD). The VFD is part of the cluster electronic circuit board, and is visible through a cutout located in the lower left corner of the cluster overlay. The dark lens of the VFD prevents the indicator from being clearly visible when it is not illuminated. The word "CRUISE" appears in an amber color and at the same lighting level as the odometer/trip odometer information when it is illuminated by the instrument cluster electronic circuit board. The cruise indicator is serviced as a unit with the VFD in 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 the instrument cluster 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 cruise indicator 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 indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the cruise indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the cruise indicator is illuminated for about two seconds as a bulb test.
- **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 VFD portion of the test to confirm the functionality of the VFD, and again during the bulb check portion of the test to confirm the functionality of 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.

DOOR AJAR INDICATOR

DESCRIPTION

A door ajar indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with this optional feature, this indicator is electronically disabled. The door ajar indicator is located in the Information Center area of the instrument cluster, to the left of center. The door ajar indicator consists of a stenciled cutout of the words “DOOR AJAR” 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 “DOOR AJAR” 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 door ajar indicator is serviced as a unit with the instrument cluster.

OPERATION

The door ajar indicator gives an indication to the vehicle operator that one or more of the passenger compartment doors may be open or not completely latched. This 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 Central Timer Module (CTM) over the Programmable Communications Interface (PCI) data bus. The door ajar 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 door ajar indicator for the following reasons:

• **Bulb Test** - Each time the ignition switch is turned to the On position the door ajar indicator is illuminated for about two seconds as a bulb test.

• **Door Ajar Lamp-On Message** - Each time the cluster receives a door ajar lamp-on message from the CTM indicating that a door is open or not completely latched, the door ajar indicator will be illuminated. The indicator remains illuminated until the cluster receives an door ajar lamp-off message from the CTM, 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 door ajar indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the cluster control circuitry.

The CTM continually monitors the door ajar switches to determine the status of the doors. The CTM then sends the proper door ajar lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the door ajar indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the door ajar switches and circuits, (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/DOOR AJAR SWITCH - DIAGNOSIS AND TESTING). For proper diagnosis of the CTM, the PCI data bus, or the message inputs to the instrument cluster that control the door ajar 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 left quadrant of the instrument cluster, below the voltage gauge. The engine coolant temperature gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from “C” (or Cold) to “H” (or Hot) for all engines. 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 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 blue-green 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 coolant temperature. This gauge is controlled by the

ENGINE TEMPERATURE GAUGE (Continued)

instrument cluster 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 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 the low end of normal [about 54° C (130° F) for gasoline engines, or 65° C (149° F) for diesel engines] and the high end of normal [about 129° C (264° F) for gasoline engines, or 120° C (248° F) for diesel engines], the gauge needle is moved to the actual temperature position on the gauge scale.
- **Engine Temperature Low Message** - Each time the cluster receives a message from the PCM indicating the engine coolant temperature is below the low end of normal [about 54° C (130° F) for gasoline engines, or 65° C (149° F) for diesel engines], the gauge needle is held at the "C" increment 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 54° C (130° F) for gasoline engines, or 65° C (149° F) for diesel engines, 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 above about 122° C (251° F) for gasoline engines, or 108° C (226° F) for diesel engines, the gauge needle is moved to the appropriate position on the gauge scale, the check gauges indicator is illuminated, and a single chime tone is sounded. The check gauges indicator remains illuminated until the cluster receives a message from the PCM indicating that the engine temperature is below about 119° C (246° F) for gasoline engines, or 104° C (219° F) for diesel engines, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the check gauges indicator is cycled off and then on again by the appropriate engine temperature messages from the PCM.
- **Message Failure** - If the cluster fails to receive an engine temperature message, it will hold the gauge needle at the last indication 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 in order 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 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.

FUEL GAUGE

DESCRIPTION

A fuel gauge is standard equipment on all instrument clusters. The fuel gauge is located in the lower right quadrant of the instrument cluster, below the oil pressure gauge. The fuel gauge consists of a movable gauge needle or pointer controlled by the instrument cluster 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 pointed to 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 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 blue-green and the red graphics appear

FUEL GAUGE (Continued)

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 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 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.
- **Less Than 12.5 Percent Tank Full Message** - Each time the cluster receives messages from the PCM indicating the percent tank full is 12.5 (one-eighth) or less for 10 consecutive seconds and the vehicle speed is zero, or for 60 consecutive seconds and the vehicle speed is greater than zero, 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 indicating that the percent tank full is greater than 12.5 (one-eighth) for 10 consecutive seconds and the vehicle speed is zero, or for 60 consecutive seconds and the vehicle speed is greater than zero, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the low fuel indicator is cycled off and then on again by the appropriate percent tank full messages from the PCM.
- **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 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 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 in order 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.

GEAR SELECTOR INDICATOR

DESCRIPTION

An electronic automatic transmission gear selector indicator is standard factory-installed equipment on this model, when it is also equipped with an optional automatic transmission. The gear selector indicator information is displayed in a Vacuum-Fluorescent Display (VFD), which is visible through a small window cutout located in the lower right quadrant of the cluster overlay. The gear selector indicator displays the following characters from left to right: “P,” “R,” “N,” “D,” “2,” and “1.” Respectively, these characters represent the park, reverse, neutral, drive, second gear, and first gear positions of the transmission gear selector lever on the steering column. The VFD illu-

GEAR SELECTOR INDICATOR (Continued)

minates a rectangular box around the character that represents the currently selected lever position.

During daylight hours (exterior lamps Off) the gear selector indicator VFD is illuminated at full brightness for clear visibility. At night (exterior lamps are On) the VFD lighting level is adjusted with the other cluster illumination lamps using the panel lamps dimmer thumbwheel on the headlamp switch. However, a "Parade" mode position of the panel lamps dimmer thumbwheel allows the VFD to be illuminated at full brightness while the exterior lamps are turned On during daylight hours. The gear selector indicator VFD is serviced as a unit with the instrument cluster.

OPERATION

The electronic gear selector indicator gives an indication to the vehicle operator of the transmission gear that has been selected with the automatic transmission gear selector lever. This gauge is controlled by the instrument cluster circuit board based upon cluster programming. The cluster circuitry automatically configures itself for the proper automatic transmission model based upon the hard wired transmission range sensor mux circuit input to the cluster. Each time the cluster is disconnected from battery current for more than about five minutes, it must configure itself again for the automatic transmission model that is in the vehicle when it is reconnected to battery current. The gear selector indicator information is displayed by a dedicated Vacuum Fluorescent Display (VFD) on the instrument cluster electronic circuit board, and the VFD will not display the gear selector indicator information after the ignition switch is turned to the Off position. The instrument cluster circuitry configures the gear selector indicator VFD based upon the following inputs from the transmission range sensor:

- **Open Circuit -** If the transmission range sensor mux circuit is open, the cluster circuitry controls the gear selector indicator display based upon electronic messages received from the electronic Transmission Control Module (TCM) over the Programmable Communications Interface (PCI) data bus. If the input is open circuit and no electronic messages are received from the TCM within two seconds, the instrument cluster circuitry will cycle the indicated gear selector position from P, to R, to N, to D to 2 repeatedly and continuously until the condition is resolved or until the ignition switch is turned to the Off position, whichever occurs first.
- **Resolved Circuit -** If the transmission range sensor mux circuit is resolved, the cluster circuitry controls the gear selector indicator display based upon the resistance value of the hard wired input from the transmission range sensor. If the cluster has configured itself for the transmission range sensor input and detects a short to ground in the transmission range sensor mux input, the cluster will indicate all positions in the VFD; or, if this input is open circuit, the cluster will blink all positions in the VFD. The VFD display for the short-to-ground and open circuit conditions will continue until the condition is resolved 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 VFD will display all of its characters at once, then step through each character segment individually during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

On models with a TCM, the TCM continually monitors the transmission range sensor, then sends the proper gear selector indicator messages to the instrument cluster. On models without a TCM, the instrument cluster continually monitors the hard wired transmission range sensor multiplexed input. For further diagnosis of the gear selector indicator or the instrument cluster circuitry that controls this function, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). On models without a TCM, for further diagnosis of the transmission range sensor, (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 42RE/TRANSMISSION RANGE SENSOR - DIAGNOSIS AND TESTING) or (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 46RE/TRANSMISSION RANGE SENSOR - DIAGNOSIS AND TESTING). On models with a TCM, for proper diagnosis of the transmission range sensor, the TCM, the PCI data bus, or the message inputs to the instrument cluster that control the gear selector indicator, 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 stenciled 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 when it is illuminated from behind by a replaceable incandescent bulb and

HIGH BEAM INDICATOR (Continued)

bulb 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. This indicator is hard wired on the instrument cluster electronic circuit board, and is controlled by the Central Timer Module (CTM) through the high beam indicator driver circuit input to the cluster based upon a control signal to the CTM from the headlamp beam select switch. The headlamp beam select switch is integral to the multi-function switch on the left side of the steering column. The high beam indicator bulb receives battery current on the instrument cluster electronic circuit board through a fused B(+) circuit at all times; therefore, the indicator remains operational regardless of the ignition switch position. The indicator only illuminates when it is provided with a path to ground by the CTM. The high beam indicator can be diagnosed using conventional diagnostic tools and methods. For proper diagnosis of the CTM and the inputs to the CTM that control the high beam indicator driver circuit, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

DIAGNOSIS AND TESTING - HIGH BEAM INDICATOR

The diagnosis found here addresses an inoperative headlamp high beam indicator condition. If the problem being diagnosed is related to inoperative headlamp high beams, be certain to repair the headlamp system before attempting to diagnose or repair the high beam indicator. If no headlamp system problems are found, the following procedure will help locate a short or 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.

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 HIGH BEAMS SELECTED

(1) Check the fused B(+) fuse (Fuse 1 - 15 ampere) in the Junction Block (JB). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuse (Fuse 1 - 15 ampere) in the JB. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit between the JB and the Power Distribution Center (PDC) as required.

(3) Disconnect and isolate the battery negative cable. Remove the instrument cluster from the instrument panel. 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, go to Step 4. If not OK, repair the open fused B(+) circuit between the instrument cluster and the JB as required.

(4) Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector (Connector C1) for the Central Timer Module (CTM) from the CTM connector receptacle. Check for continuity between the high beam indicator driver circuit cavities of the instrument panel wire harness connector (Connector C1) for the CTM and the instrument panel wire harness connector (Connector C1) for the instrument cluster. There should be continuity. If OK, go to Step 5. If not OK, repair the open high beam indicator driver circuit between the instrument cluster and the CTM as required.

(5) Reinstall the instrument cluster onto the instrument panel. Reconnect the battery negative cable. Install a jumper wire between the high beam indicator driver circuit cavity of the instrument panel wire harness connector (Connector C1) for the CTM and a good ground. The indicator should illuminate. If OK, diagnose the CTM and its inputs using a DRBIII® scan tool. Refer to the appropriate diagnostic procedures. If not OK, replace the faulty high beam indicator bulb and bulb holder unit.

INDICATOR STAYS ILLUMINATED WITH HIGH BEAMS NOT SELECTED

(1) Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector (Connector C1) for the Central Timer Module (CTM) from the CTM connector receptacle. Check for continuity between the high beam indicator driver circuit cavity of the instrument panel wire harness connector (Connector C1) for the CTM and a good

HIGH BEAM INDICATOR (Continued)

ground. There should be no continuity. If OK, diagnose the CTM and its inputs using a DRBIII® scan tool. Refer to the appropriate diagnostic procedures. If not OK, repair the shorted high beam indicator driver circuit between the CTM and the instrument cluster as required.

LOW FUEL INDICATOR

DESCRIPTION

A low fuel indicator is standard equipment on all instrument clusters. The low fuel indicator is located in the Information Center area of the instrument cluster overlay, to the left of center. The low fuel indicator consists of a stenciled 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 the indicator 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 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 indicator is illuminated for about two seconds as a bulb test.
- **Less Than 12.5 Percent Tank Full Message** - Each time the cluster receives messages from the PCM indicating the percent tank full is 12.5 (one-eighth) or less for 10 consecutive seconds and the vehicle speed is zero, or for 60 consecutive seconds and the vehicle speed is greater than zero, 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 indicating that the percent tank full is greater than 12.5 (one-eighth) for 10 consecutive seconds and the vehicle speed is zero, or for 60 consecutive seconds and the vehicle speed is greater than zero, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the low fuel indicator is cycled off and then on again by the appropriate percent tank full messages from the PCM.
- **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 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 instrument cluster. For further diagnosis of the low fuel indicator 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 in the Information Center area of the instrument cluster overlay, to the left of center. The MIL consists of a stencilled cutout of the International Control and Display Symbol icon for “Engine” in the opaque layer of the instrument cluster overlay. The

MALFUNCTION INDICATOR LAMP (MIL) (Continued)

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 the indicator 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. In addition, on models with a diesel engine an Engine Control Module (ECM) supplements the PCM, and can also record an OBDII DTC. The MIL is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the PCM or ECM 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 or ECM, the indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the PCM or ECM message. For some DTC's, if a problem does not recur, the PCM or ECM will send a lamp-off message automatically. Other DTC's may require that a fault be repaired and the PCM or ECM be reset before a lamp-off message will be sent. For more information on the PCM, the ECM, and the DTC set and reset parameters, (Refer to 25 - EMISSIONS CONTROL - OPERATION).
- **Communication Error** - If the cluster receives no lamp-on message from the PCM or ECM for twenty seconds, the MIL is illuminated by the instrument cluster to indicate a loss of bus communication. The indicator remains controlled and illuminated by the cluster until a valid lamp-on message is received from the PCM or ECM.
- **Actuator Test** - Each time the cluster is put through the actuator test, the indicator will be turned on during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM/ECM continually monitors the fuel and emissions system circuits and sensors to decide whether the system is in good operating condition. The PCM or ECM 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 systems may require service. For proper diagnosis of the fuel and emissions systems, the PCM, the ECM, 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 visible through a small window cutout located in the left lower quadrant of the cluster overlay. However, the odometer and trip odometer information are not displayed simultaneously. The trip odometer reset switch on the instrument cluster 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. When the trip odometer information is displayed, the word “TRIP” is also illuminated in a green color and at the same lighting level as the trip odometer information in the lower right corner of the VFD. Both the odometer and the trip odometer information is stored in the instrument cluster memory.

The odometer can display values up to 499,999 kilometers (499,999 miles). The odometer latches at these values, and will not roll over to zero. The trip odometer can display values up to 999.9 kilometers (999.9 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 (kilometers or miles) for

ODOMETER (Continued)

the odometer and trip odometer display is not shown in the VFD. The unit of measure for the instrument cluster odometer/trip odometer is selected at the time that it is manufactured, and cannot be changed. During daylight hours (exterior lamps Off) the VFD is illuminated at full brightness for clear visibility. At night (exterior lamps are On) the VFD lighting level is adjusted with the other cluster illumination lamps using the panel lamps dimmer thumbwheel on the headlamp switch. However, a “Parade” mode position of the panel lamps dimmer thumbwheel 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.

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 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 odometer and trip odometer information is displayed by the instrument cluster Vacuum Fluorescent Display (VFD), and the VFD will not display odometer or trip odometer information after the ignition switch is turned to the Off position. 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 ignition switch in the On position will toggle the VFD between the odometer and trip odometer display. Each time the ignition switch is turned to the On position the VFD will automatically return to the mode (odometer or trip odometer) last displayed when the ignition switch was turned to the Off position.
- **Trip Odometer Reset** - When the trip odometer reset switch is pressed and held for longer than about two seconds, the trip odometer will be reset to 000.0 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 flash the odometer/trip odometer distance information on and off repeatedly until a distance message is received, or until the ignition switch is turned to the Off position, whichever occurs first. 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, the VFD display will be blank.
- **Actuator Test** - Each time the cluster is put through the actuator test, the VFD will display all of its characters at once, then step through each character segment individually during the VFD portion of the test 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 fuel gauge. The oil pressure gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from “L” (or Low) to “H” (or High). 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 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 blue-green 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 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 circuit

OIL PRESSURE GAUGE (Continued)

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 circuitry controls the gauge needle position and provides the following features:

- **Engine Oil Pressure Message** - The instrument cluster circuitry restricts the oil pressure gauge needle operation in order to provide readings that are consistent with customer expectations. Each time the cluster receives a message from the PCM indicating the engine oil pressure is between about 6.9 kPa (1 psi) and 137.9 kPa (20 psi) for gasoline engines, or 76 kPa (11 psi) and 206 kPa (30 psi) for diesel engines, the cluster holds the gauge needle at a point about 11 degrees above the low end of normal increment on the gauge scale. Each time the cluster receives a message from the PCM indicating the engine oil pressure is between about 517.1 kPa (75 psi) and 755 kPa (109.5 psi) for gasoline engines, or 689 kPa (100 psi) and 755 kPa (109.5 psi) for diesel engines, the cluster holds the gauge needle at a point about 7.4 degrees below the high end of normal increment on the gauge scale. When the cluster receives messages from the PCM indicating the engine oil pressure is between about 137.9 kPa (20 psi) and 517.1 kPa (75 psi) for gasoline engines, or 58.6 kPa (8.5 psi) and 551.6 kPa (80 psi) for diesel engines], the gauge needle is moved to the actual pressure position on the gauge scale.
- **Engine Oil Pressure Low Message** - Each time the cluster receives a message from the PCM indicating the engine oil pressure is below about 6.9 kPa (1 psi) for gasoline engines, or 76 kPa (11 psi) for diesel engines, the gauge needle is moved to the L (Low) graduation at the far left 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 above about 6.9 kPa (1 psi) for gasoline engines, or 76 kPa (11 psi) for diesel engines, or until the ignition switch is turned to the Off position, whichever occurs first. The cluster will only turn the check gauges indicator lamp on in response to an engine oil pressure low message if the engine speed message is greater than zero.
- **Engine Oil Pressure High Message** - Each time the cluster receives a message from the PCM indicating the engine oil pressure is above about 755 kPa (109.5 psi) for gasoline or diesel engines, the gauge needle is moved to the H (High) graduation at the far right end of the gauge scale. The gauge needle remains at the high end of the scale until the cluster receives a message from the PCM indicating that the engine oil pressure is below about 755 kPa (109.5 psi) for gasoline or diesel engines, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Message Failure** - If the cluster fails to receive an engine oil pressure message, it will hold the gauge needle at the last indication 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 in order 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.

OVERDRIVE OFF INDICATOR

DESCRIPTION

An overdrive off indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional overdrive automatic transmission, this indicator is electronically disabled. The overdrive off indicator consists of the text “O/D OFF”, which appears in the lower portion of the electronic gear selector indicator Vacuum Fluorescent Display (VFD). The VFD is part of the cluster electronic circuit board, and is visible through a cutout located in the lower right corner of the cluster overlay. The dark lens of the VFD prevents the indicator from being clearly visible when it is not illuminated.

OVERDRIVE OFF INDICATOR (Continued)

The text “O/D OFF” appears in an amber color and at the same lighting level as the gear selector indicator information when it is illuminated by the instrument cluster electronic circuit board. The overdrive off indicator is serviced as a unit with the VFD in the instrument cluster.

OPERATION

The overdrive off indicator gives an indication to the vehicle operator when the Off position of the overdrive off switch has been selected, disabling the electronically controlled overdrive feature of the automatic transmission. This indicator is controlled by the instrument cluster 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 overdrive off indicator 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 indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the overdrive off indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the overdrive off indicator is illuminated for about two seconds as a bulb test.
- **Overdrive Off Lamp-On Message** - Each time the cluster receives an overdrive off lamp-on message from the PCM indicating that the Off position of the overdrive off switch has been selected, the overdrive off indicator will be illuminated. The indicator remains illuminated until the cluster receives an overdrive off 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 overdrive off indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD, and again during the bulb check portion of the test to confirm the functionality of the cluster control circuitry.

The PCM continually monitors the overdrive off switch to determine the proper outputs to the automatic transmission. The PCM then sends the proper overdrive off lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the overdrive off indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the overdrive control system, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the overdrive off indicator, 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 in the Information Center area of the instrument cluster, to the right of center. The seatbelt indicator consists of a stencilled 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 (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 circuit board based upon cluster programming and a hard wired input from the seatbelt switch in the driver side front seatbelt retractor 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 switched 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.

SEATBELT INDICATOR (Continued)

• **Driver Side Front Seatbelt Not Buckled** - Following the seatbelt reminder function, each time the cluster detects an open circuit on the seat belt indicator driver circuit (seatbelt switch open - seatbelt unbuckled) with the ignition switch in the Start or On positions, the indicator will be illuminated. The seatbelt indicator remains illuminated until the seat belt indicator driver input to the cluster is closed to ground (seatbelt switch closed - 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 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 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).

SECURITY INDICATOR

DESCRIPTION

A security indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional Vehicle Theft Security System (VTSS), this indicator is mechanically disabled. The security indicator is located in the Information Center area of the instrument cluster, to the left of center. The security indicator consists of a stenciled cutout of the word “SECURITY” 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 “SECURITY” text 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 security indicator is serviced as a unit with the instrument cluster.

OPERATION

The security indicator gives an indication to the vehicle operator when the Vehicle Theft Security System (VTSS) is arming or is armed. On models equipped with the Sentry Key Immobilizer System (SKIS), the security indicator also gives an indication to the vehicle operator of the status of the SKIS. This indicator is controlled by a hard wired input to the instrument cluster from the Central Timer Module (CTM) on the VTSS indicator driver circuit and, if the vehicle is so equipped, by a transistor on the instrument cluster 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 security indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board at all times through the fused B(+) circuit at all times; therefore, the LED will remain functional regardless of the ignition switch position. The LED only illuminates when it is provided a path to ground by the CTM or by the instrument cluster transistor. The security indicator will be illuminated for the following reasons:

• **Bulb Test** - If the vehicle is equipped with SKIS, each time the ignition switch is turned to the On position the security indicator is illuminated by the instrument cluster for about three seconds based upon an electronic lamp-on message received from the SKIM as a bulb test. There is no bulb test performed for models that are not equipped with the optional SKIS.

• **VTSS Indication** - During the seventeen second VTSS arming function, the CTM will flash the security indicator on and off repeatedly at a steady, fast rate to indicate that the VTSS is in the process of arming. Following successful VTSS arming, the CTM flashes the security indicator on and off continuously at a slower rate to indicate that the VTSS is armed. The security indicator continues flashing at the slower rate until the VTSS is disarmed or triggered. If the VTSS alarm is triggered, the CTM will flash the security indicator at a steady, fast rate for up to eighteen minutes or until the triggering condition is removed, before returning to the slower, armed flash rate.

• **SKIM Lamp-On Message** - Each time the cluster receives a lamp-on message from the SKIM, the security indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the SKIM message. The indicator remains illuminated solid or continues to flash 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. For more information on the SKIS and the security indicator control parameters, (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY/SENTRY KEY IMMOBILIZER SYSTEM - OPERATION).

• **Actuator Test** - Each time the instrument cluster is put through the actuator test, the security 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.

SECURITY INDICATOR (Continued)

The CTM provides a hard wired ground input to the instrument cluster circuitry through the VTSS indicator driver circuit whenever the ignition switch is in the Off position and the VTSS is arming, armed, or triggered. Whenever the ignition switch is in the On or Start positions, the SKIM performs a self-test to decide whether the system is in good operating condition. The SKIM then sends the proper lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the security indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the SKIS turns on the security indicator after the bulb test, either solid or flashing, it indicates that a SKIS malfunction has occurred or that the SKIS is inoperative. The VTSS indicator driver circuit input to the instrument cluster can be diagnosed using conventional diagnostic tools and methods. For proper diagnosis of the VTSS, the CTM, the SKIS, the PCI data bus, or the message inputs to the instrument cluster that control the security indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SERVICE 4WD INDICATOR

DESCRIPTION

A service 4WD indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional four-wheel drive system and electronically shifted transfer case, this indicator is electronically disabled. The service 4WD indicator is located in the Information Center area of the instrument cluster, to the right of center. The service 4WD indicator consists of a stencilled cutout of the words “SERVICE 4WD” 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 “SERVICE 4WD” text to appear in amber 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 service 4WD indicator is serviced as a unit with the instrument cluster.

OPERATION

The service 4WD indicator gives an indication to the vehicle operator when the Transfer Case Control Module (TCCM) has recorded a Diagnostic Trouble Code (DTC) for an electronic transfer case circuit or component malfunction. This 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 TCCM over the Programmable Communications Interface (PCI) data bus. The service 4WD 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 service 4WD indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the service 4WD indicator is illuminated for about two seconds as a bulb test.
- **Service 4WD Lamp-On Message** - Each time the cluster receives a lamp-on message from the TCCM, the indicator will be illuminated. The indicator remains illuminated until the cluster receives a service 4WD lamp-off message from the TCCM, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Communication Error** - If the cluster receives no messages from the TCCM for six seconds, the service 4WD indicator is illuminated by the instrument cluster to indicate a loss of TCCM communication. The indicator remains controlled and illuminated by the cluster until a valid message is received from the TCCM.
- **Actuator Test** - Each time the cluster is put through the actuator test, the service 4WD 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 TCCM continually monitors the electronic transfer case switch and circuits to determine the condition of the system, then sends the proper messages to the instrument cluster. For further diagnosis of the service 4WD indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the TCCM, the PCI data bus, or the message inputs to the instrument cluster that control the service 4WD indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SPEEDOMETER

DESCRIPTION

A speedometer is standard equipment on all instrument clusters. The speedometer is located next to the

SPEEDOMETER (Continued)

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 circuitry and a fixed 210 degree primary scale on the gauge dial face that reads left-to-right either from 0 to 120 mph, or from 0 to 200 km/h, depending upon the market for which the vehicle is manufactured. Each version also has a secondary inner scale on the gauge dial face that provides the equivalent opposite units from the primary scale. Text appearing on the cluster overlay just above the hub of the speedometer needle 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 red (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 blue-green 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 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 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:

- **Message Failure** - If the cluster fails to receive a speedometer message, it will hold the gauge needle at the last indication for about four 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 four 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 to the left of 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 circuitry and a fixed 210 degree scale on the gauge dial face that reads left-to-right from 0 to 7 for gasoline engines, or from 0 to 5 for diesel engines. The text “RPM X 1000” imprinted on the cluster overlay directly above the hub of the tachometer needle identifies that each number on the tachometer scale is to be multiplied by 1000 rpm. The tachometer graphics are white 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 blue-green. 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 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)

TACHOMETER (Continued)

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:

- **Message Failure** - If the cluster fails to receive an engine speed message, it will hold the gauge needle at the last indication for about four 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 four 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 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 TESTING). 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.

TRANSMISSION TEMP INDICATOR

DESCRIPTION

A transmission over-temperature indicator lamp is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional automatic transmission, this indicator is electronically disabled. The transmission over-temperature indicator is located in the Information Center area of the instrument cluster, to the left of center. The transmission over-temperature indicator consists of a stencilled cutout of the words “TRANS TEMP” 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 “TRANS TEMP” 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 transmission over-temperature indicator is serviced as a unit with the instrument cluster.

OPERATION

The transmission over-temperature indicator gives an indication to the vehicle operator when the transmission fluid temperature is excessive, which may lead to accelerated transmission component wear or failure. This 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 Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The transmission over-temperature 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 transmission over-temperature indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the transmission over-temperature indicator is illuminated for about two seconds as a bulb test.
- **Trans Over-Temp Lamp-On Message** - Each time the cluster receives a trans over-temp lamp-on message from the PCM indicating that the transmission fluid temperature is 135° C (275° F) or higher, the indicator will be illuminated and a single chime tone is sounded. The lamp remains illuminated until the cluster receives a trans over-temp lamp-off message from the PCM, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the transmission over-temperature indicator is cycled off and then on again by the appropriate trans over-temp messages from the PCM.
- **Actuator Test** - Each time the cluster is put through the actuator test, the 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 transmission temperature sensor to determine the transmission operating condition, then sends the proper messages to the instrument cluster. If the instrument cluster turns on the transmission over-temperature indicator due to a high transmission oil temperature condition, it may indicate that the transmission and/or the transmission cooling system are being overloaded or that they require service. For further diagnosis of the transmission over-temperature indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the transmission temperature sensor, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the transmission over-temperature indicator, 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 stenciled 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 their lamps are not illuminated. The icons appear in green through the translucent outer layer of the overlay when the indicator is illuminated from behind by a replaceable incandescent bulb and bulb holder unit located on 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 to the instrument cluster electronic circuit board. The turn signal indicator bulbs are grounded on the instrument cluster electronic circuit board at all times. The turn signal indicator bulbs only illuminate when they are provided with battery current by the turn signal and hazard warning circuitry of the combination flasher through separate left and right turn signal circuit inputs to the instrument cluster; therefore, these indicators can be illuminated, regardless of the ignition switch position.

The turn signal indicators are connected in series between ground and the output of the combination flasher circuitry, 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 system. For more information on the turn signal and hazard warning system, (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR - OPERATION - TURN SIGNAL & HAZARD WARNING SYSTEM). The turn signal indicators can be diagnosed using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - TURN SIGNAL INDICATOR

The diagnosis found here addresses an inoperative turn signal indicator condition. If the problem being diagnosed is related to inoperative turn signals or hazard warning lamps, be certain to repair the turn signal and hazard warning system before attempting to diagnose or repair the turn signal indicators. If no turn signal or hazard warning system problems are found, the following procedure will help locate a short or open in the left or right turn signal indicator circuits. 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) Disconnect and isolate the battery negative cable. Remove the instrument cluster.

(2) Connect the battery negative cable. Activate the hazard warning system by moving the hazard warning switch button to the On position. Check for battery voltage at the inoperative (right or left) turn signal circuit cavity of the instrument panel wire harness connector (Connector C2) for the instrument cluster. There should be a switching (on and off) battery voltage signal. If OK, replace the faulty turn signal indicator bulb. If not OK, repair the open (right or left) turn signal circuit between the instrument cluster and the combination flasher as required.

UPSHIFT INDICATOR

DESCRIPTION

An upshift indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with a manual transmission, this indicator is disabled. The upshift indicator is located near the center of the tachometer gauge in the instrument cluster overlay, to the left of center. The upshift indicator consists of an upward pointed arrow icon that is a stenciled cutout 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 the indi-

UPSHIFT INDICATOR (Continued)

cator is illuminated from behind by a Light Emitting Diode (LED) soldered onto the instrument cluster electronic circuit board. 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 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 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 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. On models not equipped with a manual transmission, a unique version of the instrument cluster is used that does not include the upshift indicator. The instrument cluster will turn on the upshift indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the upshift indicator is illuminated for about two seconds as a bulb test.
- **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 indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the indicator 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 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 temperature gauge. The voltage gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from “L” (or Low) to “H” (or High). 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 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 blue-green 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 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:

VOLTAGE GAUGE (Continued)

- **Charge Fail Message** - Each time the cluster receives a message from the PCM indicating a charge fail condition (system voltage is 10.8 volts or lower), the gauge needle is moved to the “L” graduation on the gauge scale and the check gauges indicator is illuminated. The gauge needle remains on the “L” 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 10.9 volts or higher, but lower than 16.7 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 16.7 volts or higher), the gauge needle is moved to the “H” graduation on the gauge scale and the check gauges indicator is illuminated. The gauge needle remains on the “H” 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 16.6 volts or lower, but higher than 10.9 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, it will hold the gauge needle at the last indication 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 in order 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.

WAIT-TO-START INDICATOR

DESCRIPTION

A wait-to-start indicator is only found in the instrument clusters of vehicles equipped with an optional diesel engine. The wait-to-start indicator is located in the Information Center area of the instrument cluster, to the right of center. The wait-to-start indicator consists of a stenciled cutout of the words “WAIT TO START” in the opaque layer of the cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red lens located behind the cutout causes the “WAIT TO START” text to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by a replaceable incandescent bulb and bulb holder unit on the instrument cluster electronic circuit board. The wait-to-start indicator is serviced as a unit with the instrument cluster.

OPERATION

The wait-to-start indicator gives an indication to the vehicle operator when the diesel engine glow plugs are energized in their pre-heat operating mode. This indicator is controlled by a hard wired input to the instrument cluster from the Engine Control Module (ECM). The wait-to-start indicator bulb receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (st-run) circuit whenever the ignition switch is in the On or Start positions; therefore, the lamp will always be off when the ignition switch is in any position except On or Start. The indicator bulb only illuminates when it is switched to ground by the input from the ECM. The ECM will turn on the wait-to-start indicator by pulling the wait-to-start indicator driver circuit to ground each time the ignition switch is turned to the On or Start positions. The indicator then remains illuminated until the ECM determines that the glow plugs have been energized for a sufficient duration to ensure reliable and efficient engine starting, until the ECM detects that the engine is running, or until the ignition switch is turned to the Off position, whichever occurs first.

The ECM continually monitors the coolant temperature sensor and uses this input along with its internal programming to determine how long the glow plugs must be heated in the pre-heat operating mode, then illuminates the wait-to-start indicator for that duration. The wait-to-start indicator driver circuit can be diagnosed using conventional diagnostic tools and methods. For proper diagnosis of the wait-to-start indicator, the ECM, or the inputs the ECM uses to control the wait-to-start indicator operation, a

WAIT-TO-START INDICATOR (Continued)

DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

DIAGNOSIS AND TESTING - WAIT-TO-START INDICATOR

The diagnosis found here addresses an inoperative wait-to-start indicator condition. If the problem being diagnosed is related to indicator accuracy, be certain to confirm that the problem is with the indicator and not with a faulty engine coolant temperature sensor, or an inoperative Engine Control Module (ECM). If no engine coolant temperature sensor or ECM problem is found, the following procedure will help to locate a short or open in the wait-to-start 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.

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 ENGINE COLD

(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 ECM from the ECM connector receptacle. Check for continuity between the wait-to-start indicator driver circuit cavities of the instrument panel wire harness connector (Connector C1) for the instrument cluster and the instrument panel wire harness connector (Connector C1) for the ECM. There should be continuity. If OK, replace the faulty wait-to-start indicator bulb and bulb holder unit. If not OK, repair the open wait-to-start indicator driver circuit between the instrument cluster and the ECM as required.

INDICATOR STAYS ILLUMINATED WITH ENGINE WARM

(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 ECM from the ECM connector receptacle. Check for continuity between the wait-to-start indicator driver circuit cavity of the instrument panel wire harness connector (Connector C1) for the instrument cluster and a good ground. There should be no continuity. If OK, use a DRBIII® scan tool to diagnose the ECM. Refer to the appropriate diagnostic information. If not OK, repair the shorted wait-to-start indicator driver circuit between the instrument cluster and the ECM as required.

WASHER FLUID INDICATOR

DESCRIPTION

A washer fluid indicator is standard equipment on all instrument clusters. The washer fluid indicator is located in the Information Center area of the instrument cluster, to the right of center. The washer fluid indicator consists of a stenciled cutout of the International Control and Display Symbol icon for “Windshield Washer Fluid” 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 washer fluid indicator is serviced as a unit with the instrument cluster.

OPERATION

The washer fluid indicator gives an indication to the vehicle operator when the fluid level in the washer fluid reservoir is low. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming and a hard wired washer fluid level switch input to the cluster. The washer fluid 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 washer fluid indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the indicator is illuminated for about two seconds as a bulb test.

WASHER FLUID INDICATOR (Continued)

- **Washer Fluid Level Switch Input** - Immediately after the bulb test, if the cluster senses ground on the washer fluid switch sense circuit for more than about thirty seconds, it turns on the washer fluid indicator. Any time after the bulb test, the cluster must sense ground on the washer fluid switch sense circuit for more than about sixty seconds before it turns on the indicator. Once illuminated, the indicator will remain illuminated until the ignition switch is cycled and the cluster senses an open circuit on the low washer fluid sense input. This strategy is intended to reduce the effect that fluid sloshing within the washer reservoir can have on reliable indicator operation.
- **Actuator Test** - Each time the cluster is put through the actuator test, the 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 washer fluid level switch is connected in series between ground and the washer fluid switch sense input to the instrument cluster. For more information on the washer fluid level switch,(Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WASHER FLUID LEVEL SWITCH - OPERATION). For further diagnosis of the washer fluid indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). The washer fluid level switch input to the cluster can be diagnosed using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - WASHER FLUID INDICATOR

The diagnosis found here addresses an inoperative washer fluid indicator condition. If the problem being diagnosed is related to indicator accuracy, be certain to confirm that the problem is with the indicator or washer fluid level switch input and not with a damaged or empty washer fluid reservoir, or inoperative instrument cluster indicator control circuitry. Inspect the washer fluid reservoir for proper fluid level and signs of damage or distortion that could affect washer fluid level switch performance and perform the instrument cluster actuator test before you proceed with the following diagnosis. If no washer fluid reservoir or instrument cluster control circuitry problem is found, the following procedure will help to locate a short or open in the washer fluid switch sense 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 WASHER RESERVOIR EMPTY

(1) Disconnect and isolate the battery negative cable. Disconnect the headlamp and dash wire harness connector for the washer fluid level switch from the washer fluid level switch connector receptacle. Check for continuity between the ground circuit cavity of the headlamp and dash wire harness connector for the washer fluid level 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 (G112) as required.

(2) Remove the instrument cluster from the instrument panel. Check for continuity between the washer fluid switch sense circuit cavities of the headlamp and dash wire harness connector for the washer fluid level switch and the instrument panel wire harness connector (Connector C2) for the instrument cluster. If OK, replace the faulty washer fluid level switch. If not OK, repair the open washer fluid switch sense circuit between the washer fluid level switch and the instrument cluster as required.

INDICATOR STAYS ILLUMINATED WITH WASHER RESERVOIR FULL

(1) Disconnect and isolate the battery negative cable. Disconnect the headlamp and dash wire harness connector for the washer fluid level switch from the washer fluid level switch connector receptacle. Check for continuity between the ground circuit terminal and the washer fluid switch sense terminal in the washer fluid level switch connector receptacle. There should be no continuity. If OK, go to Step 2. If not OK, replace the faulty washer fluid level switch.

(2) Remove the instrument cluster from the instrument panel. Check for continuity between the washer fluid switch sense circuit cavity of the headlamp and dash wire harness connector for the washer fluid level switch and a good ground. There should be no continuity. If not OK, repair the shorted washer fluid

WASHER FLUID INDICATOR (Continued)

switch sense circuit between the washer fluid level switch and the instrument cluster as required.

WATER-IN-FUEL INDICATOR

DESCRIPTION

A water-in-fuel indicator is only found in the instrument clusters of vehicles equipped with an optional diesel engine. The water-in-fuel indicator is located in the Information Center area of the instrument cluster, to the left of center. The water-in-fuel indicator consists of a stenciled cutout of the words “WATER IN 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. A red lens behind the cutout in the opaque layer of the overlay causes the “WATER IN FUEL” 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 water-in-fuel indicator is serviced as a unit with the instrument cluster.

OPERATION

The water-in-fuel indicator gives an indication to the vehicle operator when there is excessive water in the fuel system. This 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 Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The water-in-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 water-in-fuel indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the water-in-fuel indicator is illuminated for about two seconds as a bulb test.
- **Water-In-Fuel Lamp-On Message** - Each time the cluster receives a message from the PCM indicating there is excessive water in the fuel system, the water-in-fuel indicator will be illuminated, and a single chime tone is sounded. The indicator remains illuminated until the cluster receives a message from the PCM indicating that the water in the fuel system is not excessive, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the water-in-fuel indicator is cycled off and then on again by the appropriate lamp-off and lamp-on messages from the PCM.
- **Actuator Test** - Each time the cluster is put through the actuator test, the 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 water in the fuel system through the water-in-fuel sensor, then sends the proper messages to the instrument cluster. For further diagnosis of the water-in-fuel indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the water-in-fuel-sensor, the PCM, the PCI data bus, or the message inputs to the instrument cluster that control the water-in-fuel indicator, 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 - EXTERIOR LAMPS

The exterior lighting system consist of the following components:

- **Central Timer Module (CTM)** - located on the left cowl side inner panel below the instrument panel.
- **Headlamp Switch** - located on the left side of the instrument panel.
- **Fog Lamp Relay** - located in the Power Distribution Center (PDC) under the hood near the battery.
- **Park Lamp Relay** - located in the Junction Block in the left end cap of the instrument panel.

Vehicles have incandescent lighting on the exterior for illuminating and indicating purposes. Lighting circuits are protected by fuses. Lighting circuits require an overload protected power source, on/off device, lamps and body ground to operate properly. Replace sockets and bulbs that are corroded.

Wire connectors can make intermittent contact or become corroded. Before coupling wire connectors, inspect the terminals inside the connector. Male terminals should not be bent or disengaged from the insulator. Female terminals should not be sprung open or disengaged from the insulator. Bent and sprung terminals can be repaired using needle nose pliers and pick tool. Corroded terminals appear chalky or green. Corroded terminals should be replaced to avoid recurrence of the problem symptoms.

Begin electrical system failure diagnosis by testing related fuses in the Junction Block (JB) and the Power Distribution Center (PDC). Verify that bulbs are in good condition and test continuity of the circuit ground. 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 - 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 installed in a dedicated connector of the instrument panel wire harness located under the instrument panel outboard of the steering column opening.
- **Hazard Warning Switch** - The hazard warning switch is integral to the 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 steering column shrouds at 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 lower front outboard ends of the headlamp modules, located just outboard of the two sides of the radiator grille opening. The rear turn signal lamps are integral to the taillamp modules that are secured to the quarter panels at each side of the tailgate opening.
- **Turn Signal Switch** - The turn signal switch is integral to the multi-function switch on the left side of the steering column. The multi-function switch control stalk that actuates the turn signal switch protrudes from a dedicated opening in the steering column shrouds on the left side of the column, just below the steering wheel.

The turn signal system in this vehicle includes a turn signal warning chime feature. The EMIC monitors the turn signal indicators and sends an electronic chime request message to the Central Timer Module (CTM) over the Programmable Communications Interface (PCI) data bus network if the indicator remains illuminated 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). (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DESCRIPTION).

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 con-

LAMPS/LIGHTING - EXTERIOR (Continued)

nector 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.

OPERATION - EXTERIOR LAMPS

The headlamps operate through the headlamp switch which provides a ground signal to the headlamp beam selector in the multi-function switch. The multi-function switch sends a low or high beam signal input to the Central Timer Module (CTM), which provides current to the headlamps accordingly.

For park lamps operation the headlamp switch provides a ground signal to the Central Timer Module (CTM), which energizes the park lamp relay. Once the park lamp relay is energized, current is provided to the park lamps through fuse 4 in the junction block.

For fog lamps operation the headlamp switch provides a ground signal to the Central Timer Module (CTM) which energizes the fog lamp relay. Once the fog lamp relay is energized, current is provided to the fog lamps through fuse H in the Power Distribution Center (PDC).

OPERATION - TURN SIGNAL & HAZARD WARNING SYSTEM

The turn signal system operates on battery current received on a fused ignition switch output (run-acc) circuit so that the turn signals will only operate with the ignition switch in the On or Accessory positions. 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 (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, and rear tail/stop/turn signal lamp to flash on and off. With the hazard warning (multi-function) 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, 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 an electronic chime request message to the Central Timer Module (CTM) over the PCI data bus. The CTM then generates an audible chime tone through its integral chime tone generator to provide an audible reminder that a turn signal has been left on. 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.

The hard wired circuits of the turn signal and hazard warning system can be diagnosed using conventional diagnostic tools and methods; however, for proper diagnosis of the turn signal on warning feature, the EMIC, the CTM, and the PCI data bus must be tested using a DRBIII® scan tool. Refer to the appropriate diagnostic information. 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 - SAFETY PRECAUTIONS

WARNING: EYE PROTECTION SHOULD BE USED WHEN SERVICING GLASS COMPONENTS. PERSONAL INJURY CAN RESULT.

CAUTION:
Do not touch the glass of halogen bulbs with fingers or other possibly oily surface, reduced bulb life will result.
Do not use bulbs with higher candle power than indicated in the Bulb Application table at the end of this group. Damage to lamp and/or Daytime Running Lamp Module can result.
Do not use fuses, circuit breakers or relays having greater amperage value than indicated on the fuse panel or in the Owners Manual.

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.

LAMPS/LIGHTING - EXTERIOR (Continued)

DIAGNOSIS AND TESTING - TURN SIGNAL & HAZARD WARNING SYSTEM

When diagnosing the turn signal and 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, be certain to diagnose and repair the charging system as required. If the problem being diagnosed is related to a failure of the turn signals to automatically cancel following completion of a turn, inspect the multi-function switch for a faulty or damaged cancel actuator and inspect the turn signal cancel cam on the clockspring for damaged lobes or improper installation. The hard wired circuits of the turn signal and hazard warning system can be diagnosed using conventional diagnostic tools and methods; however, for diagnosis of the turn signal on warning feature, the use of a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

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, 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) Turn the ignition switch to the On position. Actuate the turn signal switch or the hazard warning switch. Observe the turn signal indicator(s) in the instrument cluster. If the flash rate is very high, check for a turn signal bulb that is not lit or is very dimly lit. Repair the circuits to that lamp or replace the faulty bulb, as required. If the turn signal indicator(s) fail to light, go to Step 2.

(2) Turn the ignition switch to the Off position. Check the fused ignition switch output (run-acc) fuse (Fuse 19 - 10 ampere) in the Junction Block (JB) and the fused B(+) fuse (Fuse 1 - 30 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(s).

(3) Check for battery voltage at the fused B(+) fuse (Fuse 1 - 30 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) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run-acc) fuse (Fuse 19 - 10 ampere) in the JB. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (run-acc) circuit between the JB 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 instrument panel wire harness connector and replace it with a known good unit. Reconnect the battery negative cable. Test the operation of the turn signal and hazard warning systems. If OK, discard the faulty combination flasher. If not OK, remove the test flasher and go to Step 6.

(6) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run-acc) circuit cavity in the instrument panel wire harness connector for the combination flasher. If OK, go to Step 7. If not OK, repair the open fused ignition switch output (run-acc) circuit between the combination flasher and the fused ignition switch output (run-acc) fuse (Fuse 19 - 10 ampere) in the JB as required.

(7) Turn the ignition switch to the Off position. Check for battery voltage at the fused B(+) circuit cavity of the instrument panel wire harness connector for the combination flasher. If OK, go to Step 8. If not OK, repair the open fused B(+) circuit between the combination flasher and the fused B(+) fuse (Fuse 1 - 30 ampere) in the PDC as required.

(8) Disconnect the instrument panel wire harness connector for the multi-function switch from the switch connector receptacle. Check for continuity between the hazard flasher signal circuit cavities in the instrument panel wire harness connector for the combination flasher and the instrument panel wire harness connector for the multi-function switch. There should be continuity. If OK, go to Step 9. If not OK, repair the open hazard flasher signal circuit between the combination flasher and the multi-function switch as required.

(9) Check for continuity between the right turn switch sense circuit cavities in the instrument panel wire harness connector for the combination flasher and the instrument panel wire harness connector for the multi-function switch. Repeat this check between the left turn switch sense circuit cavities if these same connectors. If OK, go to Step 10. If not OK, repair the open right and/or left turn switch sense

LAMPS/LIGHTING - EXTERIOR (Continued)

circuit(s) between the combination flasher and the multi-function switch as required.

(10) Check for continuity between the right and/or left turn signal circuit cavities (there are two of each) in the instrument panel wire harness connector for the combination flasher and the individual turn signal lamps. There should be continuity. If OK, test the multi-function switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DIAGNOSIS AND TESTING). If not OK, repair the open right and/or left turn signal circuit(s) between the combination flasher and the turn signal lamp(s) as required.

DIAGNOSIS AND TESTING - EXTERIOR LAMPS

A good ground is necessary for proper lighting operation. Grounding is provided by the lamp socket when it comes in contact with the metal body, or through a separate ground wire.

Always begin any diagnosis by testing all of the fuses and circuit breakers in the system. 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.

HEADLAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMPS ARE DIM WITH ENGINE IDLING	1. Loose or corroded battery cables.	1. Clean and secure battery cable clamps and posts.
OR IGNITION TURNED OFF	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.
	4. Battery has insufficient charge.	4. Test battery state-of -charge.
	5. Battery is sulfated or shorted.	5. Load test battery.
	6. Poor lighting circuit Z1-ground.	6. Test for voltage drop across Z1-ground locations.
	7. Both headlamp bulbs faulty.	7. Replace both headlamp bulbs.
HEADLAMP BULBS BURN OUT	1. Charging system output too high.	1. Test and repair charging system.
FREQUENTLY	2. Loose or corroded terminals or splices in circuit.	2. Inspect and repair all connectors and splices.
HEADLAMPS ARE DIM WITH ENGINE RUNNING	1. Charging system output too low.	1. Test and repair charging system.
ABOVE IDLE*	2. Poor lighting circuit Z1-ground.	2. Test for voltage drop across Z1-ground locations.
	3. High resistance in headlamp circuit.	3. Test amperage draw of headlamp circuit.
	4. Both headlamp bulbs faulty.	4. Replace both headlamp bulbs.
HEADLAMPS FLASH RANDOMLY	1. Poor lighting circuit Z1-ground.	1. Test for voltage drop across Z1-ground locations.
	2. High resistance in headlamp circuit.	2. Test amperage draw of headlamp circuit. Should not exceed 30 amps.
	3. Faulty headlamps switch circuit breaker.	3. Replace headlamp switch.
	4. Loose or corroded terminals or splices in circuit.	4. Inspect and repair all connectors and splices.

LAMPS/LIGHTING - EXTERIOR (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMPS (HIGH & LOW) DO NOT ILLUMINATE	1. No voltage at either headlamp.	1. Voltage should always be present. Trace short circuit and replace BOTH headlamp fuses. Check wiring circuit from Right headlamp fuse to headlamp. (Repeat for Left side)
	2. No ground for high and low beam circuit.	2. Ground should always be present according to switch position. Check ground at headlamp switch. Check wiring circuit from headlamp switch to Multifunction switch. Check headlamp switch and Multifunction switch continuity. Repair circuit ground.
	3. Headlamp bulb(s) faulty.	3. Replace bulb(s).
	4. Faulty headlamp switch.	4. Replace headlamp switch.
	5. Faulty headlamp dimmer (Multifunction) switch.	5. Replace Multifunction switch.
	6. Broken connector terminal or wire splice in headlamp circuit.	6. Repair connector terminal or wire splice.
	7. Faulty CTM	7. Replace CTM
HEADLAMPS (LOW BEAM) DO NOT ILLUMINATE.	1. No ground for low beam circuit.	1. Ground should be present according to Multifunction switch position. Check wiring circuit from Multifunction switch to headlamp . Trace open circuit in wiring and repair. Check Multifunction Switch for continuity.
	2. Faulty CTM	2. Replace CTM
HEADLAMPS (HIGH BEAM) DO NOT ILLUMINATE.	1. No ground for high beam circuit.	1. Ground should be present according to Multifunction switch position. Check wiring circuit from Multifunction switch to headlamp . Trace open circuit in wiring and repair. Check Multifunction Switch for continuity.
	2. Faulty CTM	2. Replace CTM
HEADLAMPS (LOW BEAM) ALWAYS ILLUMINATE AND CAN NOT BE SHUT OFF.(IF HEADLAMP DELAY IS SELECTED, THE HEADLAMPS WILL REMAIN ON FOR 60 SECONDS)	1. Low beam circuit from bulb to Multifunction switch is shorted to ground.	1. Ground should be present according to Multifunction switch position. Check wiring circuit from Multifunction switch to headlamp . Trace short circuit in wiring and repair.
	2. Faulty CTM	2. Replace CTM

LAMPS/LIGHTING - EXTERIOR (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMPS (HIGH BEAM) ALWAYS ILLUMINATE AND CAN NOT BE SHUT OFF.	1. High beam circuit from bulb to Multifunction switch is shorted to ground.	1. Ground should be present according to Multifunction switch position. Check wiring circuit from Multifunction switch to headlamp . Trace short circuit in wiring and repair.
	2. Faulty CTM	2. Replace CTM
HEADLAMP SWITCH OFF HEADLAMPS AND HIGHBEAM INDICATOR REMAIN ON AND ARE DIM.	1. Headlamp switch feed circuit shorted to ground.	1. Check wiring circuit from right headlamp fuse to headlamp. Repeat for left side. Trace short circuit in wiring and repair.
	2. Faulty CTM	2. Replace CTM
HEADLAMP SWITCH ON (LOW BEAMS ON), ONE LOW BEAM ON AND BOTH HIGH BEAMS DIM.	1. Headlamp feed circuit shorted to ground.	1. Check wiring circuit from right headlamp fuse to headlamp. Repeat for left side. Trace short circuit in wiring and repair.
	2. Faulty CTM	2. Replace CTM
HEADLAMP SWITCH ON (HIGH BEAMS ON), ONE HIGH BEAM ON AND BOTH LOW BEAMS DIM.	1. Headlamp feed circuit shorted to ground.	1. Check wiring circuit from right headlamp fuse to headlamp. Repeat for left side. Trace short circuit in wiring and repair.
	2. Faulty CTM	2. Replace CTM
HEADLAMP SWITCH ON, ONE HEADLAMP FILAMENT WILL BE AT FULL INTENSITY AND ALL OTHER FILAMENTS ARE ON AND DIM.	1. Faulty headlamp fuse.	1. Trace short circuit and replace fuse.
	2. Open circuit from headlamp fuse to headlamp.	2. Repair open headlamp circuit.
	3. Faulty CTM.	3. Replace CTM.
1. HEADLAMPS STAY ON WITH KEY OUT - DRLM EQUIPPED VEHICLES (IF HEADLAMP DELAY IS SELECTED, THE HEADLAMPS WILL REMAIN ON FOR 60 SECONDS).	1. Faulty CTM	1. Replace CTM.
*Canada vehicles must have lamps ON.		

LAMPS/LIGHTING - EXTERIOR (Continued)

FOG LAMPS

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.
	4. Battery has insufficient charge.	4. Test battery state-of -charge.
	5. Battery is sulfated or shorted.	5. Load test battery.
	6. Poor lighting circuit Z1-ground.	6. Test for voltage drop across Z1-ground locations.
	7. Faulty CTM.	7. Replace CTM.
FOG LAMP BULBS BURN OUT FREQUENTLY	1. Charging system output too high.	1. Test and repair charging system.
	2. Loose or corroded terminals or splices in circuit.	2. Inspect and repair all connectors and splices.
	3. Faulty CTM.	3. Replace CTM.
FOG LAMPS ARE DIM WITH ENGINE RUNNING ABOVE IDLE	1. Charging system output too low.	1. Test and repair charging system.
	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.
	4. Faulty CTM.	4. Replace CTM.
FOG LAMPS FLASH RANDOMLY	1. Poor lighting circuit Z1-ground.	1. Test for voltage drop across Z1-ground locations.
	2. High resistance in fog lamp circuit.	2. Test amperage draw of fog lamp circuit.
	3. Faulty fog lamp switch.	3. Replace headlamp switch.
	4. Loose or corroded terminals or splices in circuit.	4. Inspect and repair all connectors and splices.
	5. Faulty CTM.	5. Replace CTM.
FOG LAMPS DO NOT ILLUMINATE	1. Blown fuse for fog lamp.	1. Replace fuse.
	2. No Z1-ground at fog lamps.	2. Repair circuit ground.
	3. Faulty fog lamp switch.	3. Replace headlamp 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.
	6. Faulty CTM.	6. Replace CTM.
FOG LAMPS ARE INOPERATIVE AND FOG LAMP INDICATOR LIGHT ALWAYS STAYS ON.	1. Fog lamp/DRL* feed shorted to ground.	1. Check wiring circuit from fog lamp/DRL* fuse to fog lamp. Trace short circuit in wiring and repair.
FOG LAMPS ARE INOPERATIVE AND FOG LAMP INDICATOR LIGHT IS ILLUMINATED.	1. Fog lamp/DRL* fuse defective.	1. Trace short circuit and replace fuse.
	2. Open circuit from fog lamp fuse to fog lamp.	2. Check wiring circuit from fog lamp/DRL* fuse to fog lamp. Trace open circuit in wiring and repair.

LAMPS/LIGHTING - EXTERIOR (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
PARK LAMPS ARE INOPERATIVE. FOG LAMP INDICATOR IS ON WHEN ALL SWITCHES ARE OFF AND FUNCTIONS OPPOSITE TO FOG LAMPS.	1. Park lamp feed is shorted.	1. Check wiring circuit from park lamp fuse to headlamp switch. Trace short circuit in wiring and repair.
PARK LAMPS ARE INOPERATIVE. FOG LAMP INDICATOR FUNCTIONS OPPOSITE TO FOG LAMPS.	1. Park lamp fuse is faulty.	1. Trace short circuit and replace fuse.
	2. Open circuit from park lamp fuse to headlamp switch.	2. Check wiring circuit from park lamp fuse to headlamp switch. Trace open circuit in wiring and repair.
*Canada vehicles use Daytime Running Lamps (DRL).		

SPECIFICATIONS

EXTERIOR LAMPS

CAUTION: Do not use bulbs other than those 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.

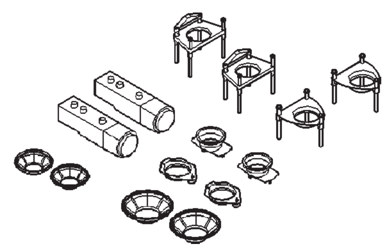
The following Bulb Application Table lists the lamp title on the left side of the column and trade number or part number on the right.

BULB APPLICATION TABLE

LAMP	BULB
BACK-UP	3157
CARGO	921
CENTER HIGH MOUNTED STOP	921
FRONT FOG LAMP	899
FRONT SIDE MARKER	194
HEADLAMP	9007
LICENSE PLATE	168
PARK/TURN SIGNAL	3157
TAIL/BRAKE/TURN SIGNAL	3157
UNDERHOOD	561

SPECIAL TOOLS

SPECIAL TOOLS - HEADLAMP ALIGNMENT



Headlamp Aiming Kit C-4466–A

BRAKE LAMP SWITCH

DESCRIPTION

The plunger type stop lamp switch is mounted on a bracket attached to the brake pedal support.

CAUTION: The switch can only be adjusted during initial installation. If the switch is not adjusted properly a new switch must be installed.

OPERATION

The brake lamp switch is used for the brake lamp, speed control and brake sensor circuits. The brake lamp circuit is open until the plunger is depressed. The speed control and brake sensor circuits is closed until the plunger is depressed.

BRAKE LAMP SWITCH (Continued)

DIAGNOSIS AND TESTING - BRAKE LAMP SWITCH

The brake lamp switch 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 lamp circuit
- Terminals 3 and 4: RWAL/ABS module and Powertrain Control Module (PCM) circuit
- Terminals 5 and 6: speed control circuit

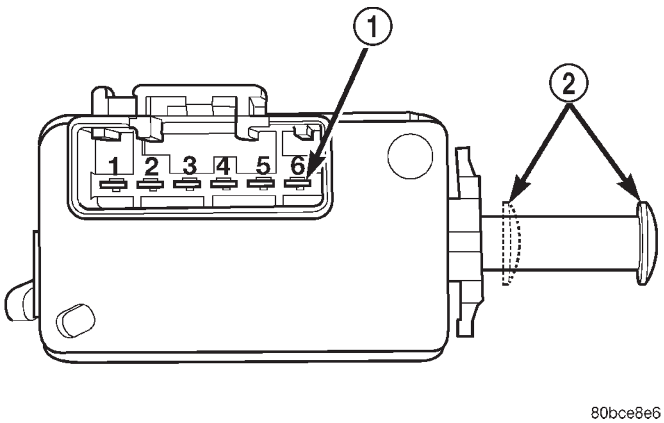


Fig. 1 Brake Lamp Switch Terminal Identification

1 - TERMINAL PINS
2 - PLUNGER TEST POSITIONS

SWITCH CONTINUITY TEST

NOTE: Disconnect switch harness before testing switch continuity.

With switch plunger extended, attach test leads to pins 1 and 2. Replace switch if meter indicates no continuity.

With switch plunger retracted, attach test leads to pins 3 and 4. Replace switch if meter indicates no continuity.

With switch plunger retracted, attach test leads to pins 5 and 6. Replace switch if meter indicates no continuity.

REMOVAL

(1) Disconnect switch harness (Fig. 2).

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

(3) Rotate switch counterclockwise about 30° to align switch lock tab with notch in bracket.

(4) Pull switch rearward out of mounting bracket and release brake pedal.

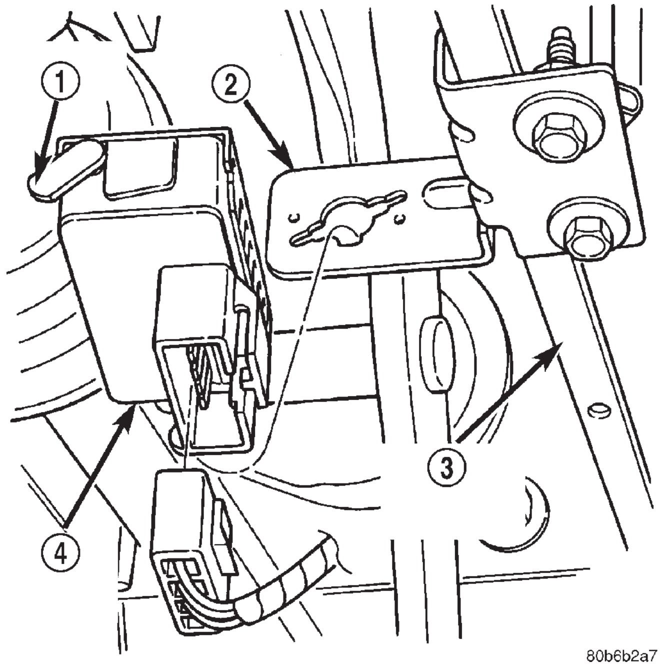


Fig. 2 Brake Lamp Switch & Bracket

1 - RELEASE LEVER
2 - BRACKET
3 - BRAKE PEDAL SUPPORT
4 - BRAKE LAMP SWITCH

INSTALLATION

(1) Press and hold brake pedal down.

(2) Align tab on **new** switch with notch in switch bracket. Then insert switch in bracket and turn it clockwise about 30° to lock it in place.

(3) Connect harness wires to switch.

(4) Release brake pedal.

(5) Move the release lever (Fig. 2) on the switch to engage the switch plunger. The switch is now adjusted and **can not** be adjusted again.

CARGO LAMP BULB

REMOVAL

The cargo lamp bulb is incorporated in the CHMSL assembly, (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/CENTER HIGH MOUNTED STOP LAMP - REMOVAL) for bulb replacement.

CENTER HIGH MOUNTED STOP LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the CHMSL from the roof panel.

(3) Rotate the sockets 1/4 turn clockwise and remove from lamp.

(4) Pull bulb from socket.

INSTALLATION

(1) Push bulb into socket.

(2) Position socket in lamp and rotate socket 1/4 turn counterclockwise.

(3) Install the CHMSL.

(4) Connect battery negative cable.

COMBINATION FLASHER

DESCRIPTION

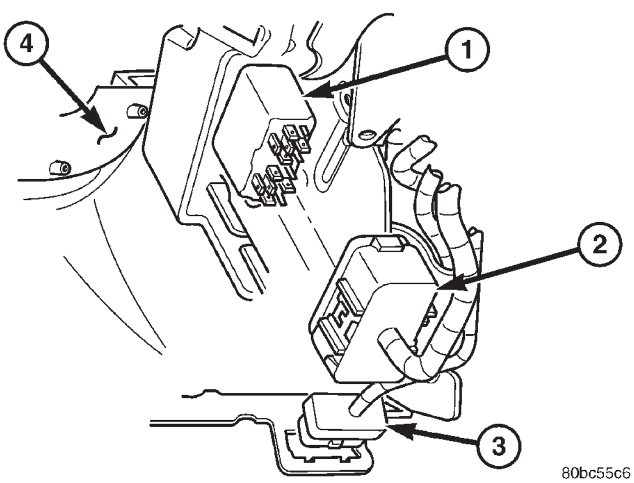


Fig. 3 Combination Flasher

1 - COMBINATION FLASHER
2 - INSTRUMENT PANEL WIRE HARNESS CONNECTOR
3 - 16-WAY DATA LINK CONNECTOR
4 - STEERING COLUMN OPENING COVER

The combination flasher is located in a dedicated connector on a take out of the instrument panel wire harness, located under the instrument panel just outboard of the instrument panel steering column opening (Fig. 3). The combination flasher is a smart relay that functions as both the turn signal system and the hazard warning system flasher. The combination flasher has fourteen blade-type terminals that connect it to the vehicle electrical system through fourteen matching cavities in the instrument panel wire harness connector; however, only ten of the combination flasher terminals are used in this application. 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 fourteen blade-type terminals, but only ten are used in this application. These ten terminals are intended for the following inputs and outputs: fused B(+), fused ignition switch output, right turn signal sense, left turn signal sense, hazard flasher signal, brake lamp switch output, and two outputs each for the right and left turn signal circuits. 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 separate 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 (120 flashes-per-minute or higher). Conventional flashers either continue flashing at their typical rate (heavy-duty type), or discontinue flashing the affected circuit entirely (standard-duty type).

Because of the active electronic elements within the combination flasher, it cannot be tested with conventional automotive electrical test equipment. If the combination flasher is believed to be faulty, test the turn signal 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/TURN SIGNAL & HAZARD WARNING SYSTEM - DIAGNOSIS AND TESTING).

COMBINATION FLASHER (Continued)

REMOVAL

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) Disconnect and isolate the battery negative cable.

(2) Reach under the outboard side of the steering column opening in the instrument panel to access the instrument panel wire harness connector for the combination flasher located on a mounting tab on the back of the instrument panel armature (Fig. 4).

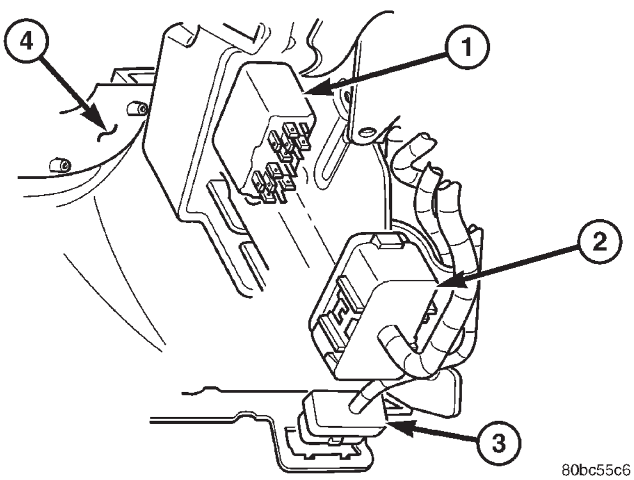


Fig. 4 Combination Flasher

1 - COMBINATION FLASHER
2 - INSTRUMENT PANEL WIRE HARNESS CONNECTOR
3 - 16-WAY DATA LINK CONNECTOR
4 - STEERING COLUMN OPENING COVER

(3) Grasp the combination flasher and connector firmly and pull them toward the dash panel to disengage the connector from the mounting tab on the instrument panel armature.

(4) Remove the combination flasher from the instrument panel wire harness connector.

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) Position the combination flasher to the instrument panel wire harness connector (Fig. 4).

(2) Align the combination flasher terminals with the terminal cavities in the instrument panel wire harness connector.

(3) Using hand pressure, push in firmly on the combination flasher until the terminals are fully seated in the terminal cavities in the instrument panel wire harness connector.

(4) Align the slot in the combination flasher connector with the mounting tab on the instrument panel armature.

(5) Using hand pressure, push the combination flasher connector firmly onto the mounting tab until it is fully engaged in the slot.

(6) Reconnect the battery negative cable.

FOG LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Disengage fog lamp harness connector.
(3) Rotate bulb socket a 1/4 turn counterclockwise and pull from lamp to separate (Fig. 5).
(4) Grasp bulb and pull from lamp.

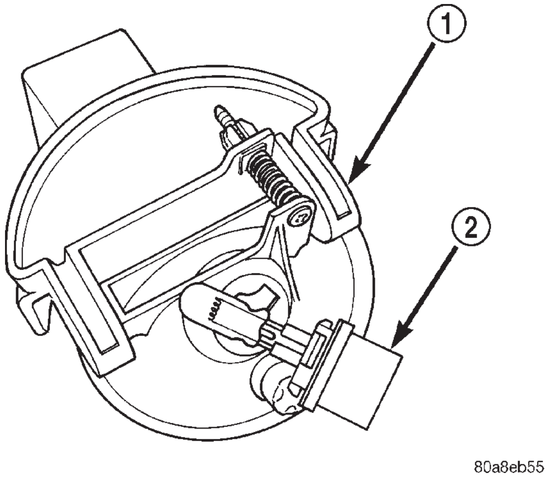


Fig. 5 Fog Lamp Bulb

1 - FOG LAMP
2 - FOG LAMP BULB

INSTALLATION

CAUTION: Do not touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Position bulb in lamp, push to seat and rotate a 1/4 turn clockwise.
(2) Connect fog lamp harness connector.
(3) Connect the battery negative cable.

FOG LAMP UNIT

REMOVAL

NOTE: The fog lamps are serviced from the rearward side of the front bumper.

(1) Disconnect and isolate the battery negative cable.
(2) Disengage fog lamp harness connector.
(3) Remove the bolts attaching the fog lamp to the bumper (Fig. 6).
(4) Separate fog lamp from bumper.

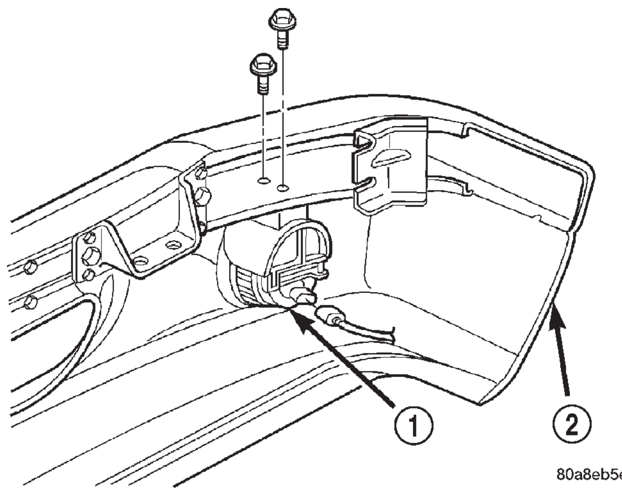


Fig. 6 Fog Lamp

1 - FOG LAMP
2 - FRONT BUMPER

INSTALLATION

(1) Position fog lamp in bumper.
(2) Install the bolts attaching the fog lamp to the bumper.
(3) Connect fog lamp harness connector.
(4) Check for proper operation and beam alignment.
(5) Connect the battery negative cable.

ADJUSTMENTS - FOG LAMP UNIT

Prepare an alignment screen. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - ADJUSTMENTS). 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. 7). Rotate the adjustment screw to adjust beam height (Fig. 8).

FOG LAMP UNIT (Continued)

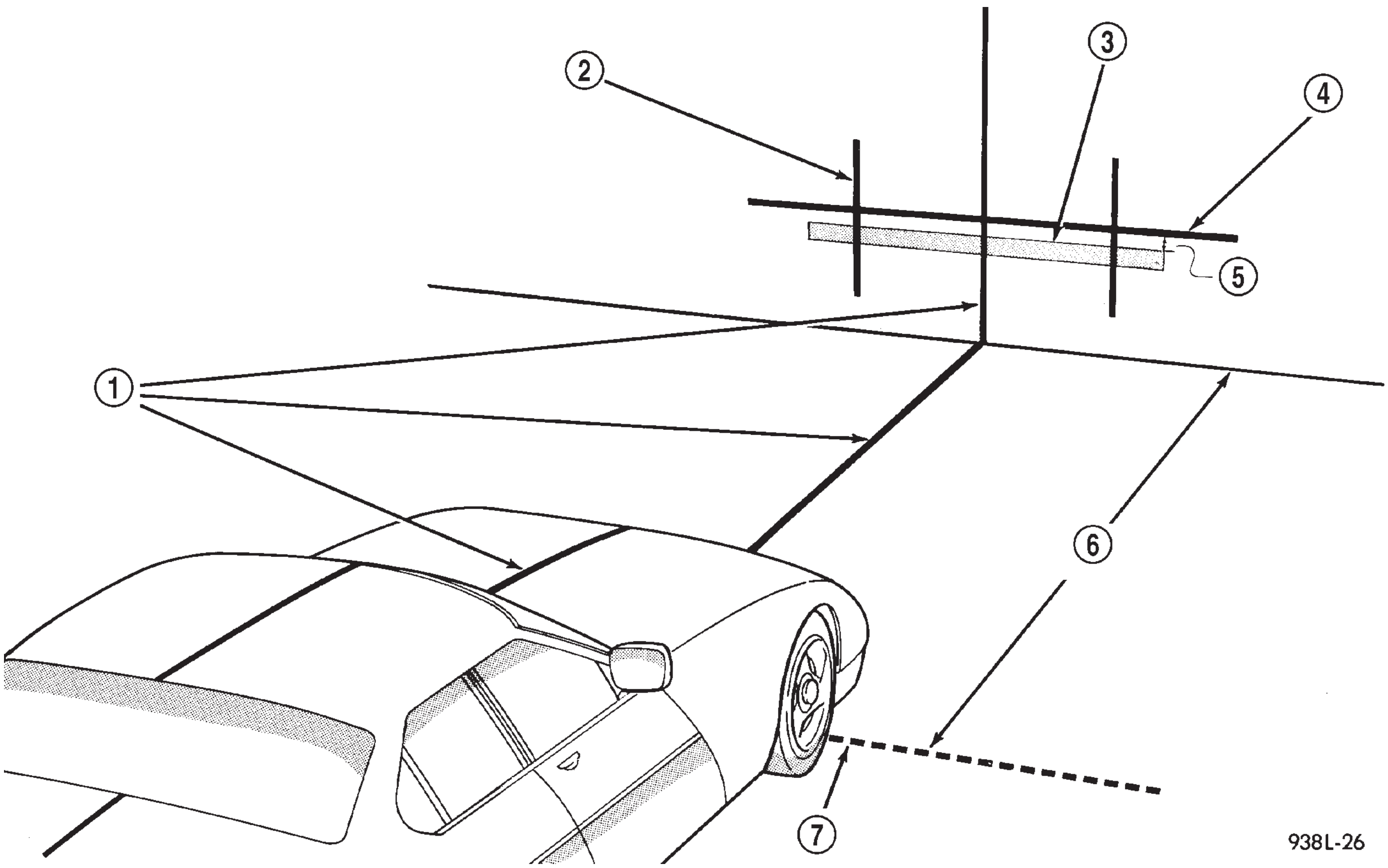


Fig. 7 Fog Lamp Alignment

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

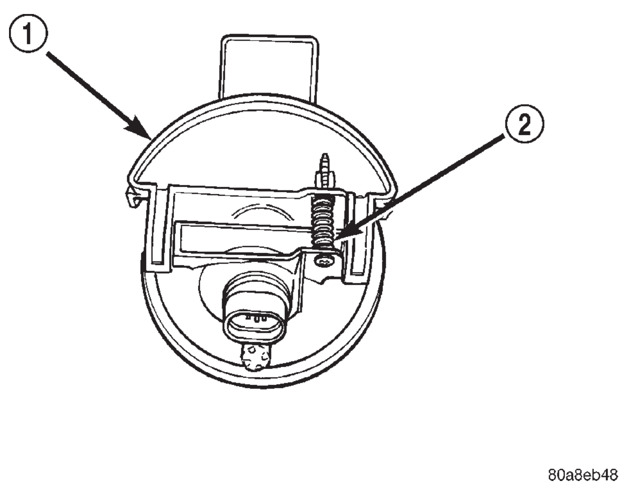


Fig. 8 Fog Lamp Adjustment

1 - FOG LAMP
2 - ADJUSTMENT SCREW

HEADLAMP SWITCH

DESCRIPTION

The headlamp switch is located on the instrument panel. The headlamp switch controls the parking lamps, the headlamps, the interior lamps and the instrument cluster illumination. The headlamp switch also contains a rheostat for controlling the illumination level of the instrument cluster lamps.

OPERATION

The headlamp switch closes a path to ground for the Central Timer Module (CTM) when the park or head lamps are on and the driver door ajar switch is closed (driver door is open). The headlamp switch opens the ground path when the headlamp switch is turned off. The ground path is also opened when the driver door ajar switch is open (driver door is closed).

HEADLAMP SWITCH (Continued)

The headlamp switch cannot be repaired and, if faulty or damaged, it must be replaced. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP SWITCH - REMOVAL) for the service procedures.

DIAGNOSIS AND TESTING - HEADLAMP SWITCH

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) Remove the headlamp switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP SWITCH - REMOVAL).

(2) Using an ohmmeter, test for continuity between the terminals of the switch as shown in the Headlamp Switch Continuity table (Fig. 9).

(3) If test results are not obtained as shown in the Headlamp Switch Continuity table, replace the headlamp switch.

For circuit descriptions and 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.

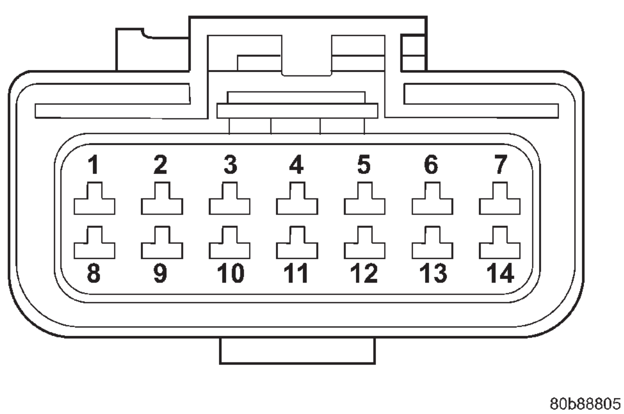


Fig. 9 HEADLAMP SWITCH

HEADLAMP SWITCH CONTINUITY TABLE

SWITCH POSITION	CONTINUITY BETWEEN
OFF	PIN 2 AND 4, PIN 1 AND 14
PARK	PIN 3 AND 4
HEAD	PIN 4 AND 6
FOG LAMP	PIN 5 AND 4
INTERIOR LAMPS DIMMER	PIN 12 AND 9, PIN 1 AND 14, PIN 1 AND 8
PARADE	PIN 1 AND 14, PIN 12 AND 9
DOME	PIN 1 AND 8, PIN 1 AND 14, PIN 10 AND 9
CARGO	PIN 1 AND 14, PIN 1 AND 8, PIN 10 AND 9, PIN 11 AND 9

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 cluster bezel from the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - REMOVAL).

(3) Disconnect the wire harness connector from the headlamp switch.

(4) Remove the headlamp switch from the cluster bezel.

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) Position the headlamp switch to the cluster bezel.

HEADLAMP SWITCH (Continued)

(2) Install and tighten the screws that secure the headlamp switch. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Reconnect the wire harness to the headlamp switch.

(4) Install the cluster bezel onto the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/ CLUSTER BEZEL - INSTALLATION).

(5) Connect the battery negative cable.

HEADLAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove headlamp assembly. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/ HEADLAMP UNIT - REMOVAL).

(3) Remove the retaining ring holding bulb to headlamp.

(4) Pull bulb socket from headlamp (Fig. 10).

(5) Grasp bulb and pull from socket.

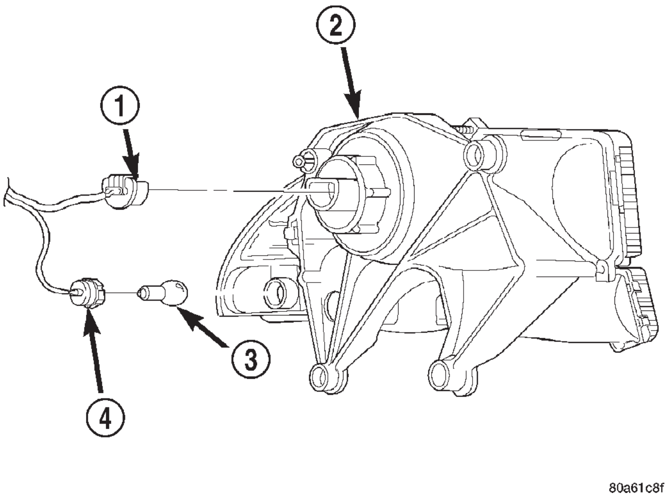


Fig. 10 Headlamp Bulb

1 - HEADLAMP BULB SOCKET
2 - HEADLAMP
3 - BULB
4 - SIDE MARKER LAMP BULB SOCKET

INSTALLATION

CAUTION: Do not touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Position bulb into socket and push into place.

(2) Position bulb socket in headlamp.

(3) Install retaining ring holding bulb to headlamp.

(4) Install headlamp assembly.

(5) Connect the battery negative cable.

HEADLAMP UNIT

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the bolts attaching headlamp to the inner fender panel (Fig. 11).

(3) Grasp the headlamp and firmly pull the headlamp to disengage it from the panel.

(4) Disengage the connector from the headlamp bulb.

(5) Separate bulb from headlamp.

(6) Remove the bulb sockets from the front park/ turn signal/side marker lamps.

(7) Separate headlamp module from vehicle.

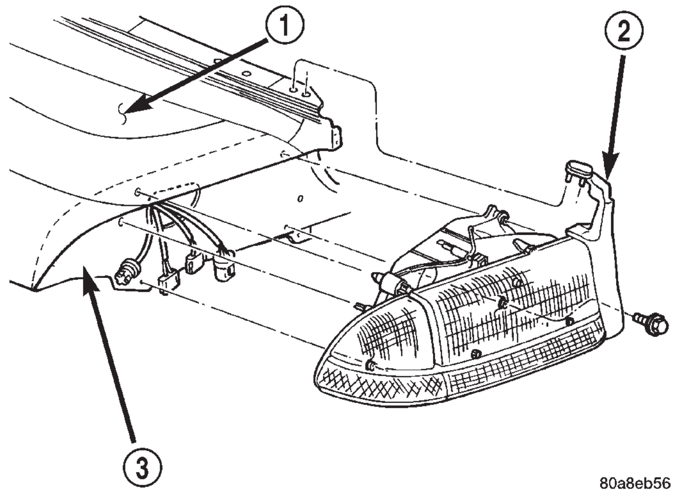


Fig. 11 Headlamp

1 - FENDER
2 - SEAL
3 - INNER FENDER

INSTALLATION

CAUTION: Do not touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Install bulb sockets for the front park/turn signal/side marker lamps.

(2) Engage the connector to the headlamp bulb.

(3) Position headlamp in inner fender panel and firmly push headlamp inward to lock into place.

(4) Install the bolts attaching headlamp to the panel.

(5) Connect the battery negative cable.

HEADLAMP UNIT (Continued)

ADJUSTMENTS

HEADLAMP ALIGNMENT

Headlamps can be aligned using the screen method provided. Alignment Tool C-4466–A or equivalent can also be used. Refer to the instructions provided with the tool for proper procedures.

VEHICLE PREPARATION FOR HEADLAMP ALIGNMENT

(1) Verify headlamp dimmer switch and high beam indicator operation.

(2) Correct defective components that could hinder proper headlamp alignment.

(3) Verify proper tire inflation.

(4) Clean headlamp lenses.

(5) Verify that luggage area is not heavily loaded.

(6) Fuel tank should be FULL. Add 2.94 kg (6.5 lbs.) of weight over the fuel tank for each estimated gallon of missing fuel.

LAMP ALIGNMENT SCREEN PREPARATION

(1) Position vehicle on a level surface perpendicular to a flat wall 7.62 meters (25 ft) away from front of headlamp lens (Fig. 12).

(2) If necessary, tape a line on the floor 7.62 meters (25 ft) away from and parallel to the wall.

(3) Measure from the floor up 1.27 meters (5 ft) and tape a line on the wall at the centerline of the vehicle. Sight along the centerline of the vehicle (from rear of vehicle forward) to verify accuracy of the line placement.

(4) Rock vehicle side-to-side three times to allow suspension to stabilize.

(5) Jounce front suspension three times by pushing downward on front bumper and releasing.

(6) Measure the distance from the center of headlamp lens to the floor. Transfer measurement to the alignment screen (with tape). Use this line for up/down adjustment reference.

(7) Measure distance from the centerline of the vehicle to the center of each headlamp being aligned. Transfer measurements to screen (with tape) to each side of vehicle centerline. Use these lines for left/right adjustment reference.

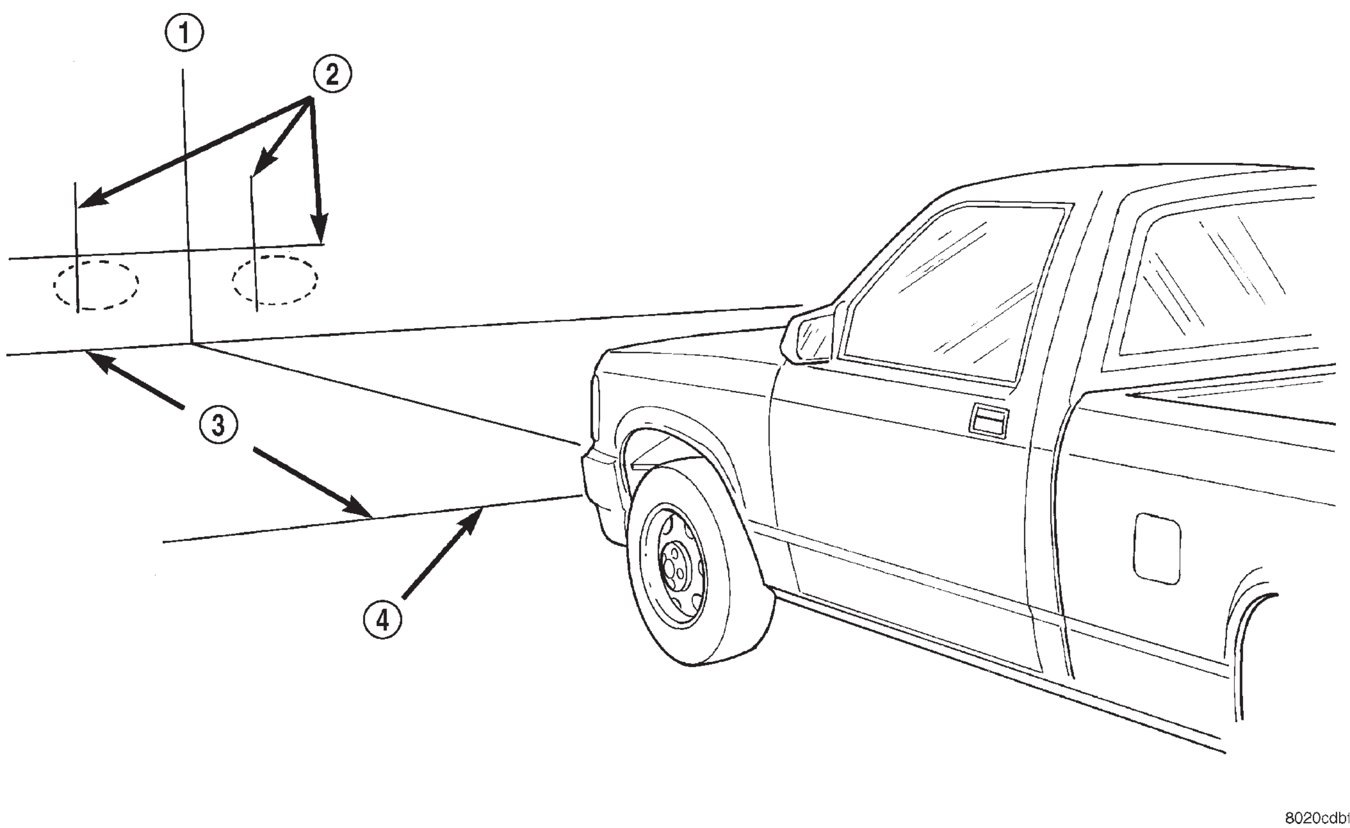


Fig. 12 Headlamp Alignment Screen—Typical

1 - CENTER OF VEHICLE
2 - CENTER OF HEADLAMP
3 - 7.62 METERS (25 FT.)
4 - FRONT OF HEADLAMP

HEADLAMP UNIT (Continued)

HEADLAMP ALIGNMENT

A properly aimed low beam headlamp will project a high intensity light pattern on the screen with the horizontal cut-off line aligned with the tape line 130 mm. (5.12 in.) below the headlamp centerline. The intersection of the horizontal and 15 degree cut-off lines in the projected pattern should align to the intersection of the headlamp centerline vertical tape line and the tape line 130 mm. (5.12 in.) below the headlamp horizontal centerline. The high beam pattern should be correct when the low beams are aligned properly.

To adjust low beam headlamp, rotate alignment screws (Fig. 13) to achieve the specified aim.

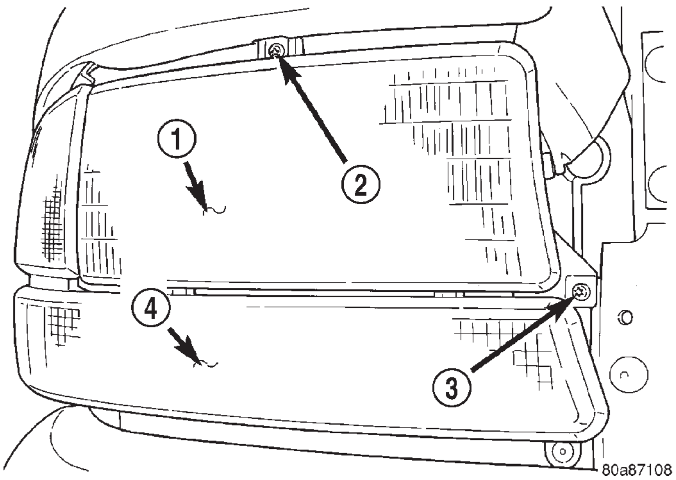


Fig. 13 Headlamp Adjustment Screws

1 - HEADLAMP
2 - UP/DOWN ADJUSTMENT
3 - LEFT/RIGHT ADJUSTMENT
4 - PARK LAMP

LICENSE PLATE LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) From the underside of the bumper, grasp the bulb socket and rotate counter clockwise.
(3) Pull bulb socket from lamp.
(4) Grasp bulb and pull from socket.

INSTALLATION

(1) Position bulb in socket and press into place.
(2) Position bulb socket in lamp and rotate clockwise to lock into place.
(3) Connect the battery negative cable.

LICENSE PLATE LAMP UNIT

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Remove license plate lamp bulb socket.
(3) From the underside of the bumper and using a small flat blade, push in retaining tab to release the lamp from the bumper.
(4) Separate lamp from bumper.

INSTALLATION

(1) Position lamp in bumper and press into place.
(2) Install license plate lamp bulb socket.
(3) Connect the battery negative cable.

MULTI-FUNCTION SWITCH

DESCRIPTION

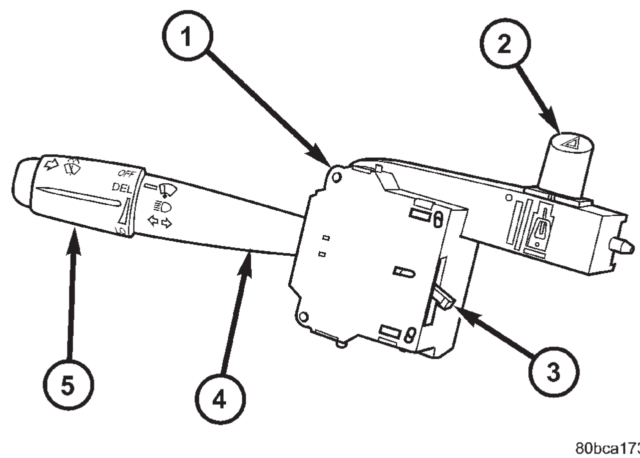


Fig. 14 Multi-Function Switch

1 - MULTI-FUNCTION SWITCH
2 - HAZARD WARNING BUTTON
3 - TURN SIGNAL CANCEL ACTUATOR
4 - CONTROL STALK
5 - CONTROL KNOB

The multi-function switch is secured with two screws to the multi-function switch mounting housing on the left side of the steering column, just below the steering wheel (Fig. 14). The only visible parts of the multi-function switch are the control stalk that extends through a dedicated opening in the left side of the upper steering column shrouds, and the hazard warning switch push button that protrudes through an opening in the upper steering column shroud on the top of the steering column. The remainder of the switch, its mounting provisions, and its electrical connections are all concealed beneath

MULTI-FUNCTION SWITCH (Continued)

the steering column shrouds. The multi-function switch control stalk has both nomenclature and International Control and Display Symbol graphics applied to it, which identify its many functions. An International Control and Display Symbol icon for "Hazard Warning" is applied to the top of the hazard warning switch push button.

The switch housing and its controls are constructed of molded black plastic. A single connector receptacle connects the switch to the vehicle electrical system through a take out and connector of the instrument panel wire harness.

The multi-function switch supports the following functions and features:

- **Continuous Wipe Modes** - The control knob of the multi-function switch provides two continuous wipe switch positions, low speed or high speed.
- **Hazard Warning Control** - The internal circuitry and hardware of the multi-function switch provide detent switching for activation and deactivation of the hazard warning system.
- **Headlamp Beam Selection** - The internal circuitry and hardware of the multi-function switch provide detent switching for selection of the headlamp high or low beams.
- **Headlamp Optical Horn** - The internal circuitry and hardware of the multi-function switch includes momentary switching of the headlamp high beam circuits to provide an optical horn feature (sometimes referred to as flash-to-pass), which allows the vehicle operator to momentarily flash the headlamp high beams as an optical signalling device.
- **Intermittent Wipe Mode** - The control knob of the multi-function switch provides an intermittent wipe mode with multiple delay interval positions.
- **Turn Signal Control** - The internal circuitry and hardware of the multi-function switch provide both momentary non-detent switching and detent switching with automatic cancellation for both the left and right turn signals.
- **Washer Mode** - The control knob of the multi-function switch provides washer system operation when the knob is depressed towards the steering column.

The 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

The multi-function switch uses conventionally switched outputs and a variable resistor to control the many functions and features it provides using hard wired circuitry. The switch is grounded at all times through a single wire take out with an eyelet terminal connector of the instrument panel wire harness that is secured by a nut to a ground stud located on the left cowl side inner panel, near the left instrument panel end bracket. When the ignition switch is in the Accessory or On positions, battery current from a fuse in the Junction Block (JB) is provided through a fused ignition switch output (run-acc) circuit. Following are descriptions of how the multi-function switch operates to control the many functions and features it provides:

- **Continuous Wipe Modes** - When the control knob of the multi-function switch is rotated to the High or Low positions, the circuitry within the switch provides a battery current output directly to the high or low speed brush of the wiper motor. When the control knob is in the Off position, the circuitry within the switch connects the output of the wiper motor park switch to the low speed brush of the wiper motor.
- **Hazard Warning Control** - 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 (hazard warning off), 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 (hazard warning on), the push button will be in a raised position. The multi-function switch hazard warning circuitry provides a signal to the hazard warning sense of the combination flasher to activate or deactivate the flasher output to the hazard warning lamps.
- **Headlamp Beam Selection** - The multi-function switch control stalk is pulled towards the steering wheel past a detent, then released to actuate the headlamp beam selection switch. Each time the control stalk is actuated in this manner, the opposite headlamp mode from what is currently selected will be activated. The internal circuitry of the headlamp beam selection switch directs a ground signal output from the headlamp switch to the appropriate low beam or high beam sense of the Central Timer Module (CTM). The CTM then controls a hard wired output to activate the selected headlamp beams.
- **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 circuitry of the headlamp beam selection switch provides a momentary ground path to the CTM high beam sense.
- **Intermittent Wipe Mode** - When the multi-function switch control knob is rotated to the Delay position, the circuitry within the switch provides a battery current signal to the Central Timer Module

MULTI-FUNCTION SWITCH (Continued)

(CTM). If the Delay mode is selected, the control knob can then be rotated to multiple minor detent positions, which actuates a variable resistor within the switch and provides a hard wired output to the CTM that signals the desired delay interval for the intermittent wiper feature.

- **Turn Signal Control** - The multi-function switch control stalk actuates the turn signal switch. When the control stalk is moved in the upward direction, the right turn signal circuitry is activated; and, when the control stalk is moved in the downward direction, the left turn signal circuitry is activated. The multi-function switch turn signal circuitry provides a signal to the right or left turn signal sense of the combination flasher to activate or deactivate the flasher output to the proper turn signal lamps. The turn signal switch has a detent position in each direction that provides turn signals with automatic cancellation, and an intermediate, momentary position in each direction that provides turn signals only until the multi-function switch control stalk is released. When the 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 mechanism 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. In other words, if the left turn signal detent is selected, the lobes of the cancel cam will ratchet past the cancel actuator when the steering wheel is rotated to the left, but will unlatch the cancel actuator as the steering wheel rotates to the right and returns to center, which will cancel the turn signal event and release the control stalk from the detent so it returns to the neutral Off position.
- **Washer Mode** - Pushing the control knob on the end of the multi-function switch control stalk towards the steering column provides a battery current output through the momentary single pole, single throw washer switch circuitry to provide a washer signal input to the CTM. The CTM then provides a battery current output to operate the washer pump/motor. If the wipers are not operating when the washer switch is actuated, the CTM will operate the wiper motor for as long as the washer switch is depressed plus about three additional wipe cycles. If the wipers are operating in the intermittent mode when the washer switch is actuated, the CTM will operate the wiper motor at a fixed low speed for as long as the washer switch is depressed plus about three additional wipe cycles before the wipers return to the selected intermittent wipe interval.

DIAGNOSIS AND TESTING - 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, 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) Remove the multi-function switch from the switch mounting housing on the steering column. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - REMOVAL).

(2) Using an ohmmeter, perform the continuity and resistance tests at the terminals in the multi-function switch connector receptacle as shown in the Multi-Function Switch Tests chart (Fig. 15).

(3) If the multi-function switch fails any of the continuity or resistance tests, replace the faulty switch unit as required.

REMOVAL

WARNING: 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.

MULTI-FUNCTION SWITCH (Continued)

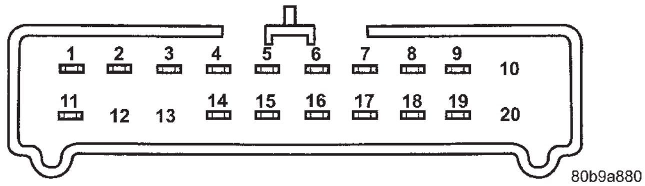


Fig. 15 Multi-Function Switch Tests

TURN & HAZARD SWITCH POSITIONS		CONTINUITY BETWEEN
TURN SIGNAL	HAZARD WARNING	
Left	Off	Pins 5 & 11
Right	Off	Pins 3 & 11
Neutral	On	Pins 1 & 11
WIPER & WASHER SWITCH POSITIONS		CONTINUITY BETWEEN
Off		Pins 14 & 15
*Delay		Pins 4 & 18, Pins 14 & 15
Low		Pins 15 & 17
High		Pins 15 & 16
Wash		Pins 18 & 19
*Resistance for the five intermittent wipe detent positions should also be checked between Pins 2 & 4. The resistance values are as follows, ± 10%.		
INTERMITTENT WIPE DETENT POSITIONS		RESISTANCE
Detent 1 (Longest Delay)		18 kilohms
Detent 2		12 kilohms
Detent 3		6.2 kilohms
Detent 4		3.3 kilohms
Detent 5 (Shortest Delay)		zero ohms
HEADLAMP BEAM SELECT SWITCH POSITIONS		CONTINUITY BETWEEN
Low Beam		Pins 6 & 9
High Beam		Pins 8 & 9
Flash (Optical Horn)		Pins 7 & 8

(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) If the vehicle is so equipped, grasp the tilt steering column knob firmly and pull it straight rearward to remove it from the tilt steering column adjuster mechanism lever located on the left side of the column just below the multi-function switch control stalk.

(4) From below the steering column, remove the two outboard screws that secure the upper shroud to the lower shroud.

(5) Push gently inward on both sides of the upper shroud near the parting line between the upper and lower shrouds to release the snap features that secure it to the lower shroud.

(6) Remove the upper shroud from the lower shroud.

(7) From below the steering column, remove the one center screw that secures the lower shroud to the steering column lock housing.

(8) Remove the lower shroud from the steering column.

(9) Disconnect the instrument panel wire harness connector for the multi-function switch from the switch connector receptacle.

MULTI-FUNCTION SWITCH (Continued)

(10) Remove the two screws that secure the multi-function switch to the multi-function switch mounting housing (Fig. 16).

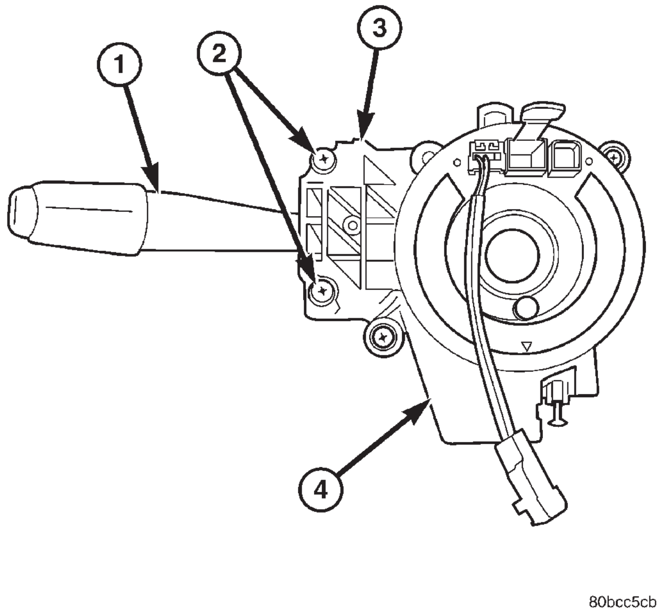


Fig. 16 Multi-Function Switch

1 - MULTI-FUNCTION SWITCH CONTROL STALK
2 - SCREW (2)
3 - MULTI-FUNCTION SWITCH MOUNTING HOUSING
4 - CLOCKSPRING

(11) Grasp the multi-function switch control stalk and pull it straight toward the outboard side of the vehicle to disengage the switch from the multi-function switch mounting housing.

INSTALLATION

(1) Position the multi-function switch onto the multi-function switch mounting housing (Fig. 16).

(2) Install and tighten the two screws that secure the multi-function switch to the multi-function switch mounting housing. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Reconnect the instrument panel wire harness connector for the multi-function switch to the switch connector receptacle.

(4) Position the lower shroud onto the steering column.

(5) From below the steering column, install and tighten the one center screw that secures the lower shroud to the steering column lock housing. Tighten the screw to 2 N·m (20 in. lbs.).

(6) Position the upper shroud onto the steering column. If the vehicle is equipped with an automatic transmission, be certain to engage the gearshift lever gap hider into the openings in the right side of the upper and lower shrouds.

(7) Align the snap features on the upper shroud with the receptacles on the lower shroud and apply hand pressure to snap them together.

(8) From below the steering column, install and tighten the two screws that secure the upper shroud to the lower shroud. Tighten the screws to 2 N·m (20 in. lbs.).

(9) If the vehicle is so equipped, align the tilt steering column knob with the tilt steering column adjuster mechanism lever located on the left side of the column just below the multi-function switch control stalk and using hand pressure push the knob firmly onto the lever.

(10) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(11) Reconnect the battery negative cable.

PARK/TURN SIGNAL LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove park and turn signal lamp.

(3) Rotate bulb socket 1/4 turn counterclockwise and pull turn signal lamp socket from back of lamp (Fig. 17).

(4) Pull park and turn signal lamp bulb from socket.

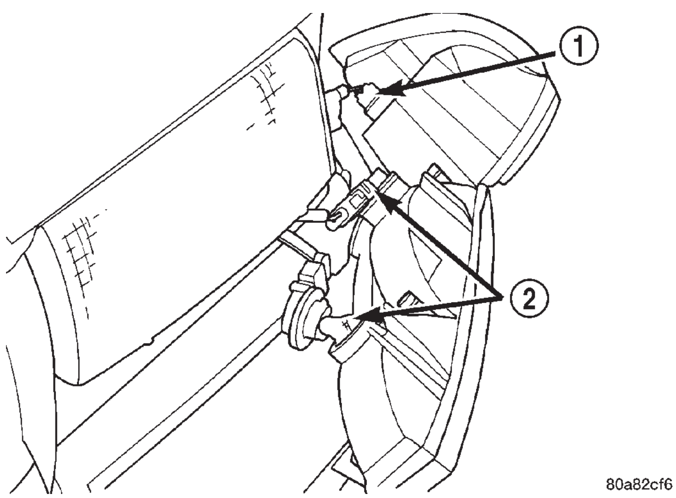


Fig. 17 Park And Turn Signal Lamp bulb

1 - SIDE MARKER LAMP BULB
2 - PARK/TURN SIGNAL LAMP BULB

PARK/TURN SIGNAL LAMP (Continued)

INSTALLATION

(1) Install park and turn signal lamp bulb in socket.

(2) Install park and turn signal lamp socket into back of lamp.

(3) Install park/turn signal lamp.

(4) Connect the battery negative cable.

TAIL LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove screws from tail lamp.

(3) Grasp lamp, firmly pull lamp rearward to disengage retaining studs.

(4) Remove sockets from tail lamp (Fig. 18).

(5) Pull bulb from socket.

(6) Separate tail lamp from cargo box.

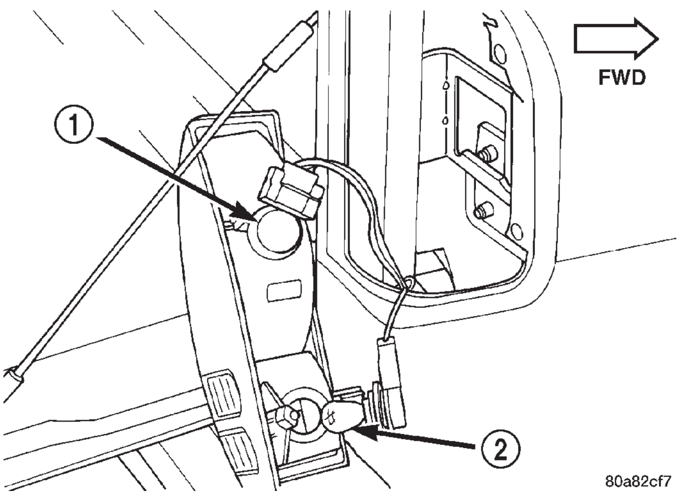


Fig. 18 Tail, Brake, Turn Signal And

1 - TAIL/STOP/TURN SIGNAL LAMP BULB
2 - BACK-UP LAMP BULB

INSTALLATION

(1) Install bulb in socket.

(2) Install socket in tail lamp.

(3) Position tail lamp in cargo box, engage retaining studs and install screws.

(4) Connect the battery negative cable.

TAIL LAMP UNIT

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Release tailgate latch and open tailgate.

(3) Remove screw holding tail lamp to cargo box (Fig. 19).

(4) Grasp lamp, firmly pull lamp rearward to disengage retaining studs.

(5) Remove sockets from tail lamp.

(6) Separate tail lamp from cargo box.

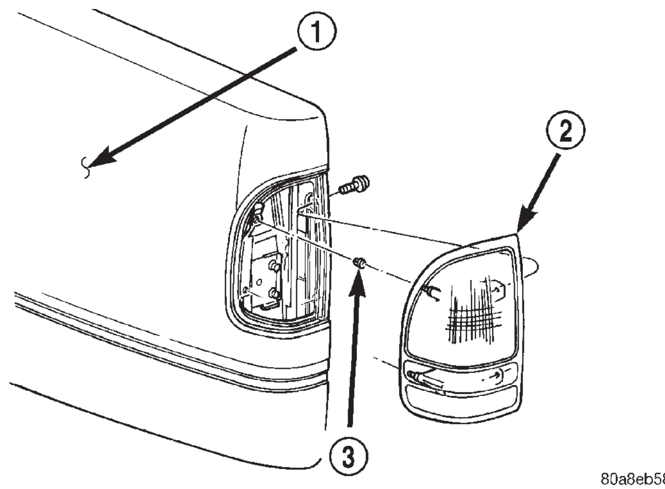


Fig. 19 Tail Lamp

1 - CARGO BOX
2 - TAIL/STOP BACK-UP LAMP
3 - ROUND CLIP

INSTALLATION

(1) Install sockets in tail lamp.

(2) Position tail lamp at cargo box, engage retaining studs (Fig. 20) and install screw.

(3) Close tailgate.

(4) Connect the negative battery cable.

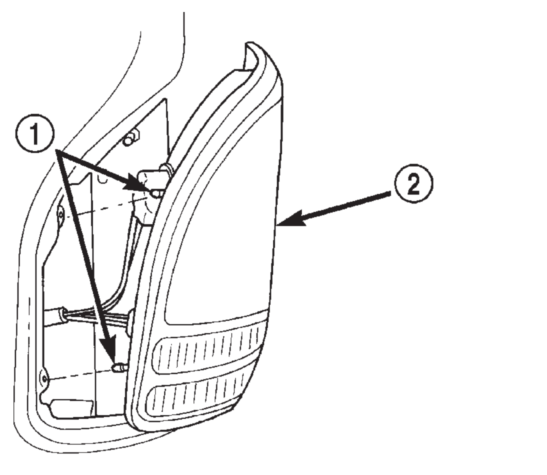


Fig. 20 Retaining Studs

1 - RETAINING STUDS
2 - TAIL LAMP

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 on a molded plastic ring that is snapped into the lower hub of the clockspring rotor. The clockspring mechanism provides turn signal cancellation as well as a constant electrical connection between the horn switch, driver airbag, speed control switches, and remote radio switches on the steering wheel and the instrument panel wire harness on the steering column. The housing of the clockspring is secured to the multi-function switch mounting housing on 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 serviced as a unit with the clockspring and cannot be repaired. If faulty or damaged, the entire clockspring unit must be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

OPERATION

The turn signal cancel cam has two lobes and is secured to the lower hub opening of the clockspring rotor. When the turn signals are activated by moving the multi-function switch control stalk to a detent position, a turn signal cancel actuator is extended from the inside surface of the multi-function switch housing toward the center of the steering column and the turn signal cancel cam. 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. In other words, if the left turn signal detent is selected, the lobes of the cancel cam will ratchet past the cancel actuator when the steering wheel is rotated to the left, but will unlatch the cancel actuator as the steering wheel rotates to the right and returns to center, which will cancel the turn signal event and release the control stalk from the detent so it returns to the neutral Off position.

LAMPS/LIGHTING - INTERIOR

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LAMPS/LIGHTING - INTERIOR

SPECIFICATIONS

INTERIOR LAMPS

CAUTION: Do not use bulbs other than the those 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 Tables lists the lamp title on the left side of the column and trade number or part number on the right.

BULB APPLICATION TABLE

LAMP	BULB TYPE
A/C Heater Control	6233137
Airbag	LED
Anti-lock Brake	PC74
Ash Receiver	161
Brake Warning	LED
Check Engine	PC74
Check Gauges	LED
Cruise	PC74
Dome	579
Engine Oil Pressure	PC74
Four Wheel Drive	PC194
Glove Compartment	194
Headlamp Switch	158
Heater Control	6233137
High Beam	PC74
Ignition Key	53
Instrument Cluster	PC194
Low Fuel	PC74
Low Washer Fluid	PC74
Overdrive Off	PC74
Overhead Console	578
Radio	ASC
RWAL	PC74
Seat Belt	LED
Security	PC74
Stepwell	904
Turn Signal	PC194
Upshift	PC74

DOME LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Using a small flat blade, pry the left side (driver's side) of the dome lamp lens downward from dome lamp.

(3) Allow the lens to hang down (Fig. 1), this will disengage the right side of the lamp (passenger's side) from the headliner.

(4) Pull the right side of the lamp down and slide the lamp to the right (Fig. 2).

(5) Separate the lamp from the headliner.

(6) Disengage dome lamp wire connector from body wire harness.

(7) Separate dome lamp from vehicle.

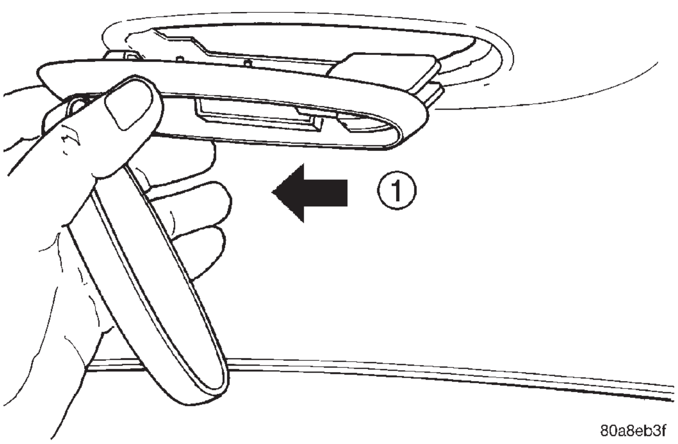


Fig. 1 Dome Lamp

1 - SLIDE LAMP

INSTALLATION

(1) Position dome lamp at headliner.

(2) Connect dome lamp wire connector to body wire harness.

(3) Position the left side of the lamp in the headliner opening and slide lamp to the left.

(4) Push the right side of the lamp in the headliner opening and push the lamp lens up into the lamp to secure.

(5) Connect the battery negative cable.

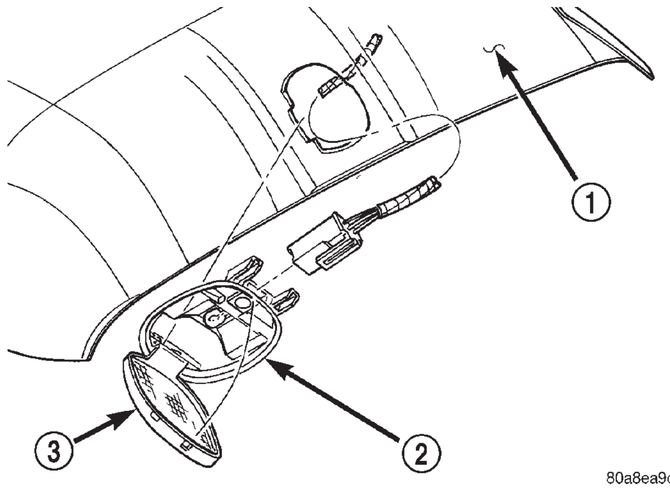


Fig. 2 Dome Lamp Lens

1 - HEAD LINER
2 - DOME LAMP
3 - LENS

DOOR AJAR SWITCH

DESCRIPTION

The door ajar switches are integral to the door latches on each door. The switches close a path to ground for the Central Timer Module (CTM) when a door is opened, and open the ground path when a door is closed.

The door ajar switches cannot be repaired and, if faulty or damaged, the door latch unit must be replaced.

OPERATION

The door ajar switches close a path to ground for the Central Timer Module (CTM) when a door is opened, and opens the ground path when a door is closed. The passenger side front door and both rear door ajar switches are connected in a parallel-series circuit between ground and the CTM, while the driver side front door ajar switch is connected in series between ground and the CTM to provide a unique input. The CTM reads the switch status through an internal pull-up, then sends the proper switch status messages to other electronic modules over the Programmable Communications Interface (PCI) data bus network. The door ajar switches can be diagnosed using conventional diagnostic tools and methods.

DOOR AJAR SWITCH (Continued)

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. Disconnect the door latch pigtail wire connector from the door wire harness connector. Check for continuity between the ground circuit cavity in the door wire harness connector 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 continuity between the ground circuit cavity and the driver or passenger door ajar switch sense circuit cavity in the door latch pigtail wire connector. There should be continuity with the door opened, and no continuity with the door closed. If OK, go to Step 3. If not OK, replace the faulty door latch unit.

(3) Disconnect the body wire harness connector (Connector C2) for the Central Timer Module (CTM) from the CTM connector receptacle. Check for continuity between the driver or passenger door ajar switch sense circuit cavity of the body wire harness connector (Connector C2) 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 latch and the CTM as required.

(4) Check for continuity between the driver or passenger door ajar switch sense circuit cavities of the body wire harness connector (Connector C2) and the door wire harness connector for the door latch. There should be continuity. If OK, use a DRBIII® scan tool to diagnose the CTM. Refer to the appropriate diagnostic procedures. If not OK, repair the open driver or passenger door ajar switch sense circuit between the door latch and the CTM as required.

GLOVE BOX LAMP SWITCH

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) Open the glove box.

(3) Reach through the glove box opening and behind the glove box opening upper reinforcement in the instrument panel to access and depress the retaining latches on the top and bottom of the glove box lamp and switch housing.

(4) While holding the retaining latches depressed, push the glove box lamp and switch out through the mounting hole in the instrument panel glove box opening upper reinforcement (Fig. 3).

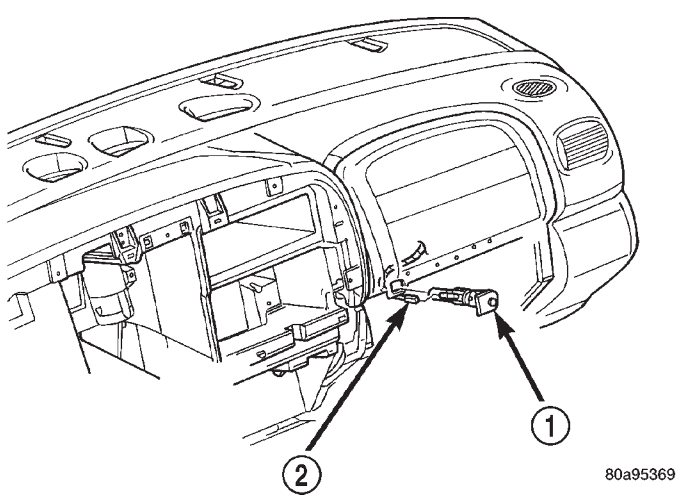


Fig. 3 Glove Box Lamp and Switch

1 - GLOVE BOX LAMP AND SWITCH
2 - CONNECTOR

GLOVE BOX LAMP SWITCH (Continued)

(5) Pull the glove box lamp and switch out from the mounting hole far enough to access the wire harness connector.

(6) Disconnect the instrument panel wire harness connector from the glove box lamp and switch connector receptacle.

(7) Remove the glove box lamp and switch 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) Position the glove box lamp and switch to the instrument panel.

(2) Reconnect the instrument panel wire harness connector to the glove box lamp and switch connector receptacle.

(3) Feed the instrument panel wire harness back into the glove box lamp and switch mounting hole in the glove box opening upper reinforcement.

(4) Align the glove box lamp and switch housing with the mounting hole in the instrument panel glove box opening upper reinforcement.

(5) Push the glove box lamp and switch into the mounting hole in the instrument panel glove box opening upper reinforcement until the retaining latches are fully engaged.

(6) Close the glove box.

(7) Connect the battery negative cable.

READING LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) From the center of the lens outward, pry the lens from the overhead console.

(3) Remove bulb.

INSTALLATION

(1) Install bulb.

(2) Snap lens into position.

(3) Connect the battery negative cable.

MESSAGE SYSTEMS

TABLE OF CONTENTS

OVERHEAD CONSOLE

DESCRIPTION

OVERHEAD CONSOLE

The overhead console for this model includes two front-mounted reading and courtesy lamps, a sunglasses storage bin, universal transmitter and either a standard paperclip or an optional compass mini-trip computer.

The overhead console is secured with two snap clips at the rear and a single screw at the front to the overhead console mounting bracket. The front of the overhead console mounting bracket is secured to the roof header near the windshield with two screws, and the rear of the bracket is secured with double-faced tape to the inside surface of the roof panel. A single electrical connection joins the overhead console wire harness to the roof wire harness.

Following are general descriptions of the major components used in the overhead console. See the owner's manual in the vehicle glove box for more information on the use and operation of the various overhead console features.

SUNGLASS STORAGE BIN

A sunglasses storage bin is included in the overhead console. The storage bin is located near the center of the overhead console and is held in the closed position by a spring-loaded latch mechanism that is integral to the storage bin door. The interior of the bin is lined with a foam rubber padding material to protect the sunglasses from being scratched. A damper spring is snapped onto the pivot shaft of the sunglasses storage bin door. The damper spring engages two flats on the shaft and is anchored in a slot in the rear flange of the overhead console reading and courtesy lamp housing to provide a smooth opening action and an open detent position for the storage bin unit.

The sunglasses storage bin and door unit is available for service replacement. The bin and door unit includes the spring-loaded latch mechanism, the bin liner and the damper spring. If any of these components is damaged or faulty, the sunglasses storage bin and door unit must be replaced.

The sunglasses storage bin is opened by pressing the latch on the rear edge of the door towards the front of the vehicle, then pulling the bin downward to the open detent position. The spring-loaded latch mechanism on the sunglasses bin door will automatically engage when the bin is closed. See the owner's manual in the vehicle glove box for more information on the use and operation of the sunglasses storage bin.

PAPERCLIP

A paperclip is standard equipment on the base version of the overhead console. The paperclip provides a convenient place for storage and easy retrieval of notes, maps, toll tickets or stubs and other paper

OVERHEAD CONSOLE (Continued)

items that may be required or desired while driving. The paperclip is located near the front of the overhead console and is secured in the overhead console housing by four screws.

The paperclip is available for service replacement, but it cannot be adjusted or repaired. If the paperclip is damaged or faulty it must be replaced.

STANDARD PROCEDURE - COMPASS VARIATION ADJUSTMENT

Compass variance, also known as magnetic declination, is the difference in angle between magnetic north and true geographic north. In some geographic locations, the difference between magnetic and geographic north is great enough to cause the compass to give false readings. If this problem occurs, the compass variance must be set.

To set the compass variance:

(1) Using the Variance Settings map, find your geographic location and note the zone number (Fig. 1).

(2) Turn the ignition switch to the On position. If the compass/temperature data is not currently being displayed, momentarily depress and release the Step push button to step through the display options until you have reached the compass/temperature display.

(3) Depress both the U.S./Metric, and the Step push buttons and hold the buttons down until "VAR" appears in the display. This takes about five seconds.

(4) Release both of the push buttons. "VAR" along with the current variance zone will appear in the display.

(5) Momentarily depress and release the U.S./Metric push button to step through the zone numbers, until the zone number for your geographic location appears in the display.

(6) Momentarily depress and release the Step push button to enter the displayed zone number into the compass unit memory.

(7) Confirm that the correct directions are now indicated by the compass.

STANDARD PROCEDURE - COMPASS CALIBRATION

CAUTION: Do not place any external magnets, such as magnetic roof mount antennas, in the vicinity of the compass. Do not use magnetic tools when servicing the overhead console.

The electronic compass unit features a self-calibrating design, which simplifies the calibration procedure. This feature automatically updates the compass calibration while the vehicle is being driven. This allows the compass unit to compensate for small changes in the residual magnetism that the vehicle may acquire during normal use. If the compass readings appear to be erratic or out of calibration, perform the following calibration procedure. Also, new

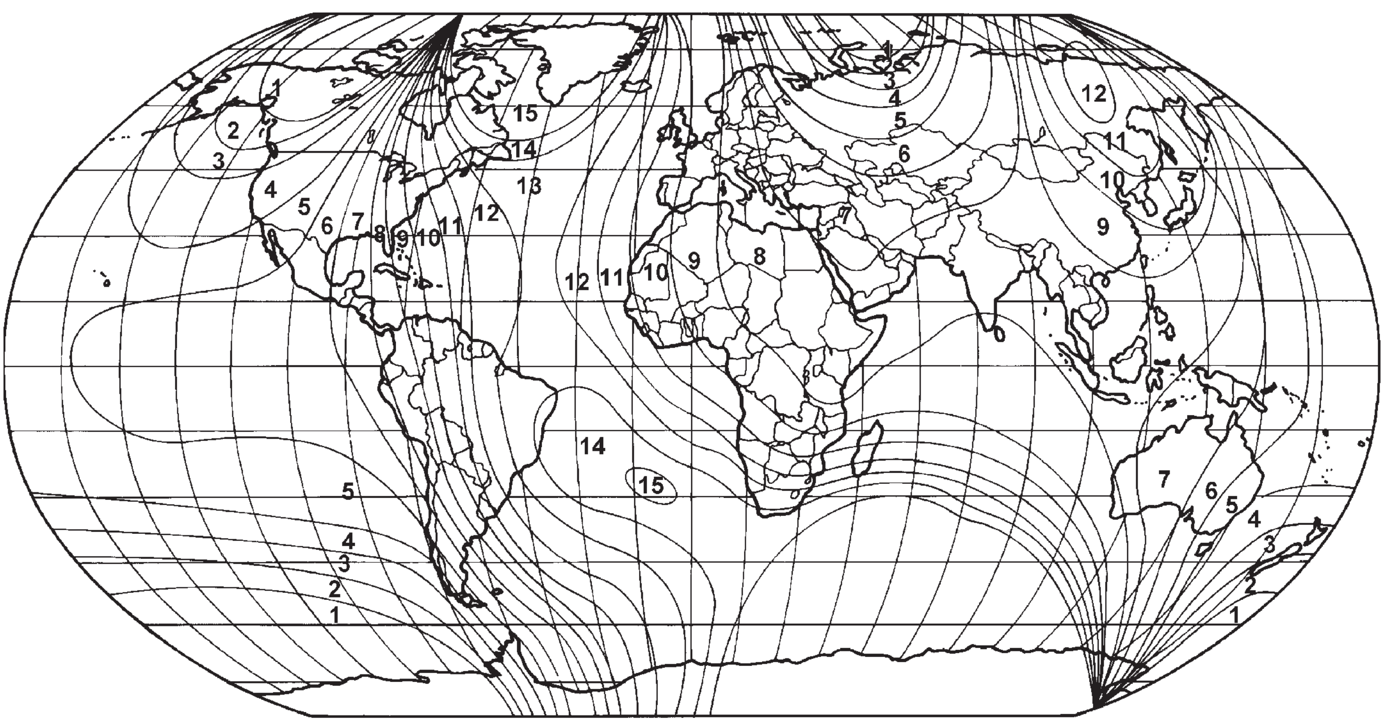


Fig. 1 Variance Settings

OVERHEAD CONSOLE (Continued)

service replacement compass mini-trip computer modules must have their compass calibrated using this procedure. Do not attempt to calibrate the compass near large metal objects such as other vehicles, large buildings, or bridges; or, near overhead or underground power lines.

NOTE: Whenever the compass is calibrated manually, the variation number must also be reset. See Compass Variation Adjustment in the Service Procedures section of this group.

Calibrate the compass manually as follows:

(1) Turn the ignition switch to the On position. If the compass/temperature data is not currently being displayed, momentarily depress and release the Step push button to step through the display options until you have reached the compass/temperature display.

(2) Depress both the U.S./Metric and the Step push buttons. Hold the push buttons down until “CAL” appears in the display. This takes about ten seconds, and appears about five seconds after “VAR” is displayed.

(3) Release both of the push buttons.

(4) Drive the vehicle on a level surface, away from large metal objects and power lines, through three or more complete circles in not less than 48 seconds. The “CAL” message will disappear from the display to indicate that the compass is now calibrated.

NOTE: If the “CAL” message remains in the display, either there is excessive magnetism near the compass, or the unit is faulty. Repeat the calibration procedure at least one more time.

NOTE: If the wrong direction is still indicated in the compass display, the area selected for calibration may be too close to a strong magnetic field. Repeat the calibration procedure in another location.

STANDARD PROCEDURE - COMPASS DEMAGNETIZING

A degaussing tool (Special Tool 6029) is used to demagnetize, or degauss, the overhead console forward mounting screw and the roof panel above the overhead console. Equivalent units must be rated as continuous duty for 110/115 volts and 60 Hz. They must also have a field strength of over 350 gauss at 7 millimeters (0.25 inch) beyond the tip of the probe.

To demagnetize the roof panel and the overhead console forward mounting screw, proceed as follows:

(1) Be certain that the ignition switch is in the Off position, before you begin the demagnetizing procedure.

(2) Connect the degaussing tool to an electrical outlet, while keeping the tool at least 61 centimeters (2 feet) away from the compass unit.

(3) Slowly approach the head of the overhead console forward mounting screw with the degaussing tool connected.

(4) Contact the head of the screw with the plastic coated tip of the degaussing tool for about two seconds.

(5) With the degaussing tool still energized, slowly back it away from the screw. When the tip of the tool is at least 61 centimeters (2 feet) from the screw head, disconnect the tool.

(6) Place a piece of paper approximately 22 by 28 centimeters (8.5 by 11 inches), oriented on the vehicle lengthwise from front to rear, on the center line of the roof at the windshield header (Fig. 2). The purpose of the paper is to protect the roof panel from scratches, and to define the area to be demagnetized.

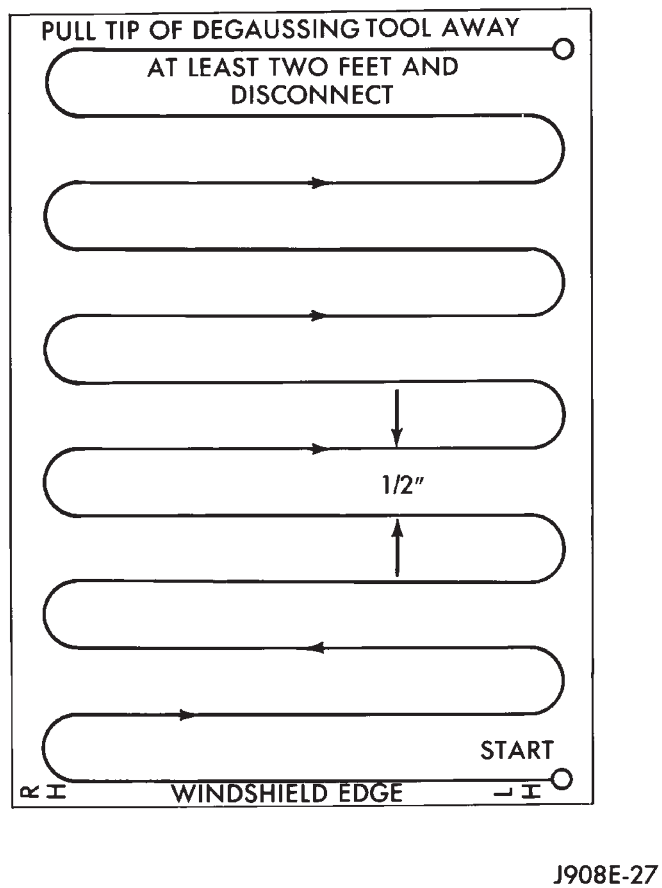


Fig. 2 Roof Demagnetizing Pattern

(7) Connect the degaussing tool to an electrical outlet, while keeping the tool at least 61 centimeters (2 feet) away from the compass unit.

(8) Slowly approach the center line of the roof panel at the windshield header, with the degaussing tool connected.

OVERHEAD CONSOLE (Continued)

(9) Contact the roof panel with the plastic coated tip of the degaussing tool. Be sure that the template is in place to avoid scratching the roof panel. Using a slow, back-and-forth sweeping motion, and allowing 13 millimeters (0.50 inch) between passes, move the tool at least 11 centimeters (4 inches) to each side of the roof center line, and 28 centimeters (11 inches) back from the windshield header.

(10) With the degaussing tool still energized, slowly back it away from the roof panel. When the tip of the tool is at least 61 centimeters (2 feet) from the roof panel, disconnect the tool.

(11) Calibrate the compass and adjust the compass variance. Refer to **Compass Variation Adjustment** and **Compass Calibration** in the Service Procedures section of this group for the procedures.

REMOVAL - OVERHEAD CONSOLE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the screw that secures the front of the overhead console to the front of the overhead console bracket (Fig. 3).

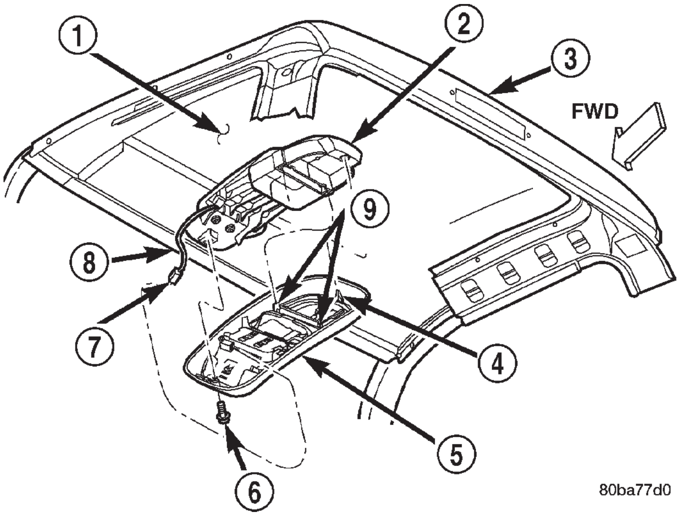


Fig. 3 Overhead Console Remove/Install

1 - HEADLINER
2 - BRACKET
3 - ROOF PANEL
4 - LOCATING PIN
5 - OVERHEAD CONSOLE
6 - SCREW
7 - ROOF WIRE HARNESS CONNECTOR
8 - FRONT HEADER
9 - SNAP CLIP (2)

(3) Insert the fingertips of both hands between the headliner and the sides of the overhead console housing in the area between the garage door opener storage bin and the sunglasses storage bin.

(4) Pull downward on the sides of the overhead console housing firmly and evenly to disengage the two snap clips that secure the rear of the unit from their receptacles in the overhead console bracket.

(5) Lower the overhead console from the headliner far enough to access the wire harness connector.

(6) Disconnect the roof wire harness connector from the overhead console wire harness connector.

(7) Remove the overhead console from the headliner.

REMOVAL - OVERHEAD CONSOLE BRACKET

(1) Disconnect and isolate the battery negative cable.

(2) Remove the overhead console from the overhead console bracket. Refer to **Overhead Console** in the Removal and Installation section of this group for the procedures.

(3) Remove the headliner from the roof panel. Refer to **Headliner** in the Removal and Installation section of Body for the procedures.

(4) Remove the two screws that secure the front of the overhead console bracket to the roof front header (Fig. 4).

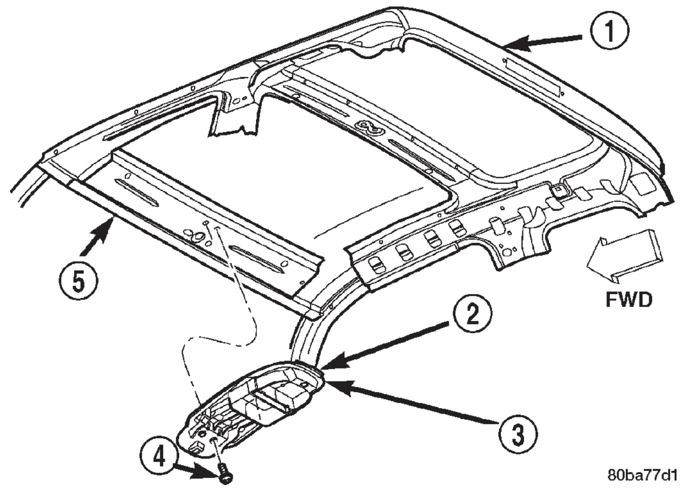


Fig. 4 Overhead Console Bracket Remove/Install

1 - ROOF PANEL
2 - DOUBLE-FACED TAPE
3 - OVERHEAD CONSOLE BRACKET
4 - SCREW (2)
5 - FRONT HEADER

(5) Using a sharp utility knife, cut through the double-faced tape that secures the rear flange of the overhead console bracket to the roof panel.

(6) Remove the overhead console bracket from the roof panel.

OVERHEAD CONSOLE (Continued)

OVERHEAD CONSOLE DISASSEMBLY

SUNGLASS STORAGE BIN

(1) Remove the reading and courtesy lamp housing from the overhead console. Refer to **Overhead Console Reading and Courtesy Lamp Housing** in Lamps for the procedure.

(2) Unlatch and remove the sunglasses storage bin from the overhead console housing.

PAPERCLIP

(1) Remove the overhead console from the headliner. Refer to **Overhead Console** in the Removal and Installation section of this group for the procedures.

(2) Remove the four screws that secure the paperclip to the overhead console housing.

(3) Pull the paperclip away from the overhead console far enough to access the wire harness connectors.

(4) Disengage the overhead console wire harness connector from the mount on the paperclip by pushing the connector firmly toward the left side of the overhead console housing.

(5) Remove the paperclip from the overhead console housing.

OVERHEAD CONSOLE ASSEMBLY

SUNGLASS STORAGE BIN

(1) Position the sunglasses storage bin into the overhead console housing.

(2) Engage the latch of the sunglasses storage bin with the latch striker on the rear of the storage bin opening in the overhead console housing.

(3) Be certain that the sunglasses storage bin pivot shaft is located in the two pivot receptacles just behind the reading and courtesy lamp lenses in the overhead console housing.

(4) Be certain that the sunglasses storage bin damper spring is installed on the pivot shaft with the two end tabs of the spring engaged with the flats on the rear of the shaft, and the center tab engaged over the front of the shaft.

(5) Install the reading and courtesy lamp housing onto the overhead console. Refer to **Overhead Console Reading and Courtesy Lamp Housing** in Lamps for the procedure.

PAPERCLIP

(1) Position the paperclip onto the overhead console housing.

(2) Engage the overhead console wire harness connector onto the mount on the paperclip by aligning the channels on the connector with the tab on the mount and pushing the connector firmly toward the right side of the overhead console housing.

(3) Install and tighten the four screws that secure the paperclip to the overhead console housing. Tighten the screws to 2.2 N·m (20 in. lbs.).

(4) Install the overhead console onto the headliner. Refer to **Overhead Console** in the Removal and Installation section of this group for the procedures.

INSTALLATION - OVERHEAD CONSOLE

(1) Position the overhead console near the mounting location on the headliner.

(2) Reconnect the roof wire harness connector to the overhead console wire harness connector.

(3) Align the locating pin on the rear of the overhead console housing with the receptacle in the rear of the overhead console bracket.

(4) Align the two snap clips on the overhead console housing with their receptacles in the overhead console bracket.

(5) Push upward firmly and evenly on the sides of the overhead console housing over both of the snap clip locations until each of the two snap clips is fully engaged with its receptacle in the overhead console bracket.

(6) Install and tighten the screw that secures the front of the overhead console housing to the overhead console bracket. Tighten the screw to 1.9 N·m (17 in. lbs.).

(7) Reconnect the battery negative cable.

INSTALLATION - OVERHEAD CONSOLE BRACKET

(1) Remove any remnants of the old double-faced tape from the roof panel and the rear flange of the overhead console bracket and clean these areas with a suitable solvent to remove any traces of grease, oil or adhesive residue. When installing the overhead console bracket, always apply a new piece of double-faced tape to the rear flange of the bracket.

(2) Align the two locating pins on the front of the overhead console bracket with the receptacles in the roof front header.

(3) Lower the rear flange of the overhead console bracket from the roof panel far enough to access and remove the release paper from the double-faced tape.

(4) Push upward firmly and evenly on the rear flange of the overhead console bracket over the double-faced tape to ensure complete adhesion to the roof panel.

(5) Install and tighten the two screws that secure the front of the overhead console bracket to the roof front header. Tighten the screws to 1.9 N·m (17 in. lbs.).

OVERHEAD CONSOLE (Continued)

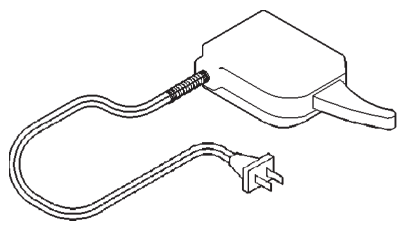
(6) Install the headliner onto the roof panel. Refer to **Headliner** in the Removal and Installation section of Body for the procedures.

(7) Install the overhead console onto the overhead console bracket. Refer to **Overhead Console** in the Removal and Installation section of this group for the procedures.

(8) Reconnect the battery negative cable.

SPECIAL TOOLS

OVERHEAD CONSOLE SYSTEMS



Degaussing Tool 6029

COMPASS/MINI-TRIP COMPUTER

DESCRIPTION

The compass mini-trip computer is located in the overhead console on models equipped with this option. The compass mini-trip computer units include the electronic control module, a Vacuum-Fluorescent Display (VFD), a compass sensor unit and two push button function switches.

The compass mini-trip computer module contains a central processing unit and interfaces with other electronic modules in the vehicle on the Programmable Communication Interface (J1850) data bus network. The J1850 data bus network allows the sharing of sensor information. This helps to reduce wire harness complexity, reduce internal controller hardware, and reduce component sensor current loads. At the same time, this system provides increased reliability, enhanced diagnostics, and allows the addition of many new feature capabilities.

The compass mini-trip computer provides several electronic functions and features. Some of the functions and features that the compass mini-trip computer module supports and/or controls, include the following display options:

- **Compass and temperature** - provides the outside temperature and one of eight compass readings to indicate the direction the vehicle is facing.
- **Trip odometer (TRIP ODO)** - shows the distance travelled since the last trip computer reset.
- **Average fuel economy (AVG ECO)** - shows the average fuel economy since the last trip computer reset.
- **Instant fuel economy (ECO)** - shows the present fuel economy based upon the current vehicle distance and fuel used information.
- **Distance to empty (DTE)** - shows the estimated distance that can be travelled with the fuel remaining in the fuel tank. This estimated distance is computed using the average miles-per-gallon from the last 30 gallons of fuel used.
- **Elapsed time (ET)** - shows the accumulated ignition-on time since the last trip computer reset.
- **Blank screen** - the compass mini-trip VFD is turned off.

The ambient temperature sensor is hard wired to the HVAC control head. Data input for all other compass mini-trip computer functions, including VFD dimming level, is received through J1850 data bus messages. The compass mini-trip computer uses its internal programming and all of these inputs to calculate and display the requested data. If the data displayed is incorrect, perform the self-diagnostic tests as described in this group. If these tests prove inconclusive, the use of a DRB scan tool and the proper Diagnostic Procedures manual are recommended for further testing of the compass mini-trip computer module and the J1850 data bus.

The compass mini-trip computer module cannot be repaired, and is available for service only as a unit. This unit includes the push button switches and the plastic module and display lens. If any of these components is faulty or damaged, the complete compass mini-trip computer module must be replaced.

COMPASS

While in the compass/temperature mode, the compass will display the direction in which the vehicle is pointed using the eight major compass headings (Examples: north is N, northeast is NE). The self-calibrating compass unit requires no adjusting in normal use. The only calibration that may prove necessary is to drive the vehicle in three complete circles, on level ground, in not less than forty-eight seconds. This will reorient the compass unit to its vehicle.

The compass unit also will compensate for magnetism the body of the vehicle may acquire during normal use. However, avoid placing anything magnetic directly on the roof of the vehicle. Magnetic mounts for an antenna, a repair order hat, or a funeral procession flag can exceed the compensating ability of the compass unit if placed on the roof panel. Magnetic bit drivers used on the fasteners that hold the overhead console assembly to the roof header can also affect compass operation. If the vehicle roof

COMPASS/MINI-TRIP COMPUTER (Continued)

should become magnetized, the demagnetizing and calibration procedures found in this group may be required to restore proper compass operation.

THERMOMETER

The thermometer displays the outside ambient temperature in whole degrees. The temperature display can be changed from Fahrenheit to Celsius using the U.S./Metric push button. The displayed temperature is not an instant reading of conditions, but an average temperature. It may take the thermometer display several minutes to respond to a major temperature change, such as driving out of a heated garage into winter temperatures.

When the ignition switch is turned to the Off position, the last displayed temperature reading stays in the thermometer unit memory. When the ignition switch is turned to the On position again, the thermometer will display the memory temperature if the engine coolant temperature is above about 52° C (125° F). If the engine coolant temperature is below about 52° C (125° F), the thermometer will display the actual temperature sensed by the ambient temperature sensor. The thermometer temperature display update interval varies with the vehicle speed.

The thermometer function is supported by an ambient temperature sensor. The sensor is mounted outside the passenger compartment near the front and center of the vehicle, and is hard wired to the HVAC control head which sends temperature on J1850 data bus circuit. The ambient temperature sensor is available as a separate service item.

NOTE: The compass mini-trip computer will display “OC” for temperatures below -40° C and “SC” for temperatures above 55°C.

OPERATION

The compass mini-trip computer only operates with the ignition switch in the On position. When the ignition switch is turned to the On position, all of the segments in the compass mini-trip computer VFD will be turned off for one second, then the display will return to the last function being displayed before the ignition was turned to the Off position. With the ignition switch in the On position, momentarily depressing and releasing the Step push button switch will cause the compass-mini-trip computer to change its mode of operation, and momentarily depressing and releasing the U.S./Metric push button will cause the unit to toggle between U.S. and Metric measurements.

This compass mini-trip computer features several functions that can be reset. If both the Step and U.S./ Metric push buttons are depressed at the same time for more than one second with the ignition switch in the On position, the trip computer information that can be reset is reset. However, the reset will only occur if the function currently displayed is a function that can be reset. The functions that can be reset are: TRIP ODO, AVG ECO, and ET.

For more information on the features and control functions of the compass mini-trip computer, see the owner's manual in the vehicle glove box.

DIAGNOSIS & TESTING - COMPASS MINI-TRIP COMPUTER

If the problem with the compass mini-trip computer module is an “OC” or “SC” in the compass/thermometer display, refer to **Ambient Temperature Sensor** in the Diagnosis and Testing section of this group. If the problem with the compass mini-trip computer module is an inaccurate or scrambled display, refer to **Self-Diagnostic Test** in the Diagnosis and Testing section of this group. If the problem with the compass mini-trip computer module is incorrect Vacuum Fluorescent Display (VFD) dimming levels, use a DRB scan tool and the proper Diagnostic Procedures manual to test for the correct dimming message inputs being received from the instrument cluster over the J1850 data bus. If the problem is a no-display condition, use the following procedures. For complete circuit diagrams, refer to **Overhead Console** in the Contents of Wiring Diagrams.

(1) Check the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open fused ignition switch output (run/start) circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the overhead console. Check for continuity between the ground circuit cavities of the roof wire harness connector for the overhead console and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open ground circuit to ground as required.

(4) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) circuit cavity of the roof wire harness connector for the overhead console. If OK, refer to **Self-Diagnostic Test** in the Diagnosis and Testing section of this group for further diagnosis of the compass mini-trip computer module and the J1850 data bus. If not OK, repair the open fused ignition switch output (run/start) circuit to the junction block fuse as required.

COMPASS/MINI-TRIP COMPUTER (Continued)

SELF-CHECK DIAGNOSTICS

A self-diagnostic test is used to determine that the compass mini-trip computer module is operating properly electrically. Initiate the self-diagnostic test as follows:

(1) With the ignition switch in the Off position, simultaneously depress and hold the Step button and the U.S./Metric button while rotating the ignition switch to the On position..

(2) Continue to hold both buttons depressed until the compass mini-trip computer module enters the display segment test. In this test, all of the Vacuum Fluorescent Display (VFD) segments are lighted while the compass mini-trip computer module performs the following checks:

- Non-Volatile Memory Test (EEPROM)
- Asic Communications Test
- Vref Voltage Test.
- Compass Test
- J1850 Communications Test

(3) Following completion of these tests, the compass mini-trip computer will return to normal operation or display one of two messages: “FAIL” or “BUS.” Respond to these test results as follows:

- If no test result message is displayed, but compass mini-trip computer operation is still improper, the use of a DRB scan tool and the proper Diagnostic Procedures manual are required for further diagnosis.
- If the “FAIL” message is displayed, the compass mini-trip computer module is faulty and must be replaced.
- If the “BUS” message is displayed, one or more of the required J1850 messages are not present (see list below) and the use of a DRB scan tool and the proper Diagnostic Procedures manual are required for further diagnosis.
- If any VFD segment should fail to light during the display segment test, the compass mini-trip computer module is faulty and must be replaced.

(4) If the first five tests pass, the Compass mini-trip computer shall verify that all the required J1850 messages are present on the J1850 bus. If all required J1850 messages are present on the J1850 bus, or if the ignition switch is turned to the Off position, the compass mini-trip computer module will automatically return to normal operation. The required J1850 messages are:

- Dimming message
- Fuel Used message
- Distance Pulses message
- Percentage Fuel Tank Full message
- Fuel Type message
- VIN (Vehicle Identification Number)
- Vehicle Speed message
- Engine gauge data (Coolant temperature data)

NOTE: The Fuel Used J1850 message shall be ignored if the engine type is Diesel or Compressed Natural Gas.

NOTE: Pressing the STEP or US/M switches during any portion of the testing procedure will cause the compass mini-trip computer to exit diagnostics and return to compass/temperature mode.

NOTE: If the compass functions, but accuracy is suspect, it may be necessary to perform a variation adjustment. This procedure allows the compass unit to accommodate variations in the earth’s magnetic field strength, based on geographic location. Refer to Compass Variation Adjustment in the Service Procedures section of this group.

NOTE: If the compass reading has blanked out, and only “CAL” appears in the display, demagnetizing may be necessary to remove excessive residual magnetic fields from the vehicle. Refer to Compass Demagnetizing in the Service Procedures section of this group.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the overhead console from the headliner. Refer to **Overhead Console** in the Removal and Installation section of this group for the procedures.

(3) Remove the four screws that secure the compass mini-trip computer module to the overhead console housing (Fig. 5).

(4) Pull the compass mini-trip computer module away from the overhead console far enough to access the wire harness connectors.

(5) Disengage the overhead console wire harness connector from the mount on the compass mini-trip computer module housing by pushing the connector firmly toward the left side of the overhead console housing.

(6) Disconnect the overhead console wire harness connector from the compass mini-trip computer module connector receptacle.

(7) Remove the compass mini-trip computer module from the overhead console housing.

INSTALLATION

(1) Position the compass mini-trip computer module onto the overhead console housing.

COMPASS/MINI-TRIP COMPUTER (Continued)

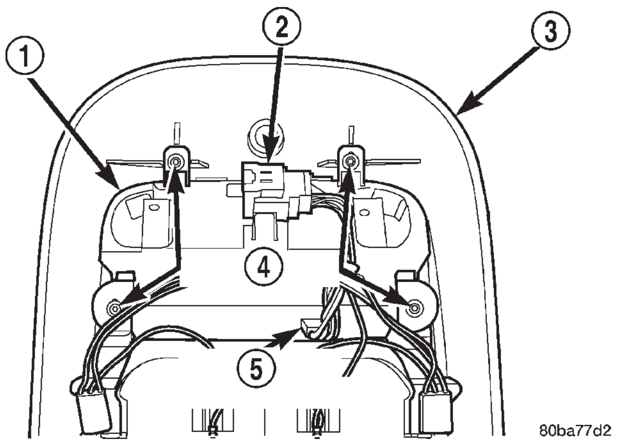


Fig. 5 Compass Mini-Trip Computer

1 - COMPASS MINI-TRIP COMPUTER MODULE
2 - OVERHEAD CONSOLE WIRE HARNESS CONNECTOR
3 - OVERHEAD CONSOLE HOUSING
4 - SCREW (4)
5 - COMPUTER CONNECTOR

(2) Reconnect the overhead console wire harness connector to the compass mini-trip computer module connector receptacle.

(3) Engage the overhead console wire harness connector onto the mount on the compass mini-trip computer module housing by aligning the channels on the connector with the tab on the mount and pushing the connector firmly toward the right side of the overhead console housing.

(4) Install and tighten the four screws that secure the compass mini-trip computer module to the overhead console housing. Tighten the screws to 2.2 N·m (20 in. lbs.).

(5) Install the overhead console onto the headliner. Refer to **Overhead Console** in the Removal and Installation section of this group for the procedures.

(6) Reconnect the battery negative cable.

NOTE: If a new compass mini-trip computer has been installed, the compass will have to be calibrated and the variance set. Refer to Compass Variation Adjustment and Compass Calibration in the Service Procedures section of this group for the procedures.

AMBIENT TEMP SENSOR

DESCRIPTION

Ambient air temperature is monitored by the compass mini-trip computer module through the ambient temperature sensor. The ambient temperature sensor is a variable resistor mounted to a bracket that is secured with a screw to the right side of the radiator yoke, behind the radiator grille and in front of the engine compartment.

For complete circuit diagrams, refer to **Wiring Diagrams**. The ambient temperature sensor cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

OPERATION

The ambient temperature sensor is a variable resistor that operates on a five-volt reference signal sent to it by the HVAC control head unit. The resistance in the sensor changes as temperature changes, changing the temperature sensor signal circuit voltage to the HVAC control head unit. Based upon the resistance in the sensor, the HVAC control head unit senses a specific voltage on the temperature sensor signal circuit, which it is programmed to correspond to a specific temperature.

DIAGNOSIS & TESTING - AMBIENT TEMPERATURE SENSOR

The thermometer function is supported by the ambient temperature sensor, a wiring circuit, and a portion of the HVAC control head unit.. If any portion of the ambient temperature sensor circuit fails, the compass/thermometer display function will self-diagnose the circuit. An "SC" (short circuit) will appear in the display in place of the temperature, when the sensor is exposed to temperatures above 55° C, or if the sensor circuit is shorted. An "OC" (open circuit) will appear in the display in place of the temperature, when the sensor is exposed to temperatures below –40° C, or if the sensor circuit is open.

The ambient temperature sensor circuit can also be diagnosed using the following Sensor Test, and Sensor Circuit Test. If the temperature sensor and circuit are confirmed to be OK, but the temperature display is inoperative or incorrect, refer to **Compass Mini-Trip Computer** in the Diagnosis and Testing section of this group. For complete circuit diagrams, refer to **Overhead Console** in the Contents of Wiring Diagrams.

SENSOR TEST

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the ambient temperature sensor wire harness connector.

(2) Measure the resistance of the ambient temperature sensor. At –40° C (–40° F), the sensor resistance is 336 kilohms. At 55° C (131° F), the sensor resistance is 2.488 kilohms. The sensor resistance should read between these two values. If OK, refer to **Sensor Circuit Test** in the Diagnosis and Testing

AMBIENT TEMP SENSOR (Continued)

section of this group. If not OK, replace the faulty ambient temperature sensor.

SENSOR CIRCUIT TEST

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the ambient temperature sensor wire harness connector and the HVAC control head unit connector.

(2) Connect a jumper wire between the two terminals in the body half of the ambient temperature sensor wire harness connector.

(3) Check for continuity between the sensor return circuit and the ambient temperature sensor signal circuit cavities of the HVAC control head unit connector. There should be continuity. If OK, go to Step 4. If not OK, repair the open sensor return circuit or ambient temperature sensor signal circuit to the ambient temperature sensor as required.

(4) Check for continuity between the ambient temperature sensor signal circuit cavity of the HVAC control head unit connector and a good ground. There should be no continuity. If OK, refer to **Compass Mini-Trip Computer** in the Diagnosis and Testing section of this group. If not OK, repair the shorted ambient temperature sensor signal circuit as required.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Locate the ambient temperature sensor, on the right side of the radiator yoke behind the grille (Fig. 6).

(3) Disconnect the wire harness connector from the ambient temperature sensor connector receptacle.

(4) Remove the one screw that secures the ambient temperature sensor bracket to the radiator yoke.

(5) Remove the ambient temperature sensor from the radiator yoke.

INSTALLATION

(1) Position the ambient temperature sensor onto the radiator yoke.

(2) Install and tighten the one screw that secures the ambient temperature sensor bracket to the radiator yoke. Tighten the screw to 5.6 N·m (50 in. lbs.).

(3) Reconnect the wire harness connector to the ambient temperature sensor connector receptacle.

(4) Reconnect the battery negative cable.

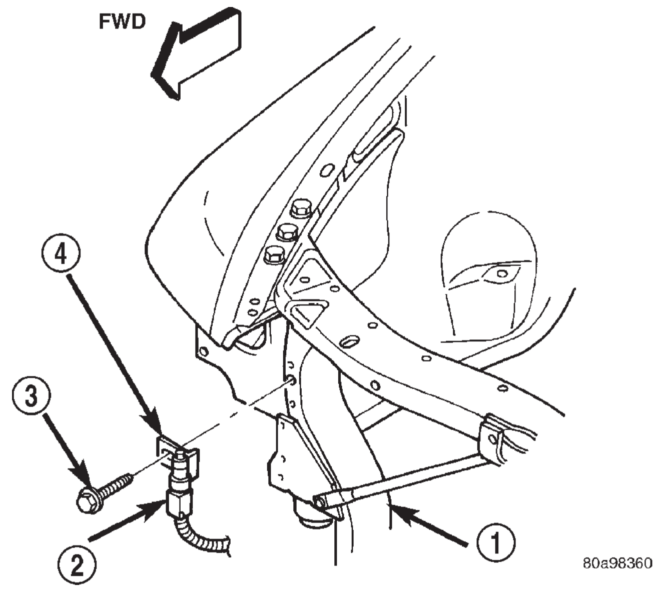


Fig. 6 Ambient Temperature Sensor Remove/Install

1 - YOKE
2 - CONNECTOR
3 - SCREW
4 - SENSOR

UNIVERSAL TRANSMITTER

DESCRIPTION

On some models a Universal Garage Door Opener (UGDO) transceiver is standard factory-installed equipment. The UGDO transceiver is integral to the overhead console. The only visible component of the UGDO are the three transmitter push buttons at the rear of the overhead console. The three UGDO transmitter push buttons are identified with one, two or three raised tactile bumps so that they be easily identified by sight or by feel.

Each of the three UGDO transmitter push buttons controls an independent radio transmitter channel. Each of these three channels can be trained to transmit a different radio frequency signal for the remote operation of garage door openers, motorized gate openers, home or office lighting, security systems or just about any other device that can be equipped with a radio receiver in the 286 to 399 MegaHertz (MHz) frequency range for remote operation. The UGDO is capable of operating systems using either rolling code or non-rolling code technology.

The UGDO cannot be repaired, and is available for service only as a unit. This unit includes the push button switches and the plastic module.

UNIVERSAL TRANSMITTER (Continued)

OPERATION

The UGDO operates on a non-switched source of battery current so the unit will remain functional, regardless of the ignition switch position. For more information on the features, programming procedures and operation of the UGDO, see the owner's manual in the vehicle glove box.

STANDARD PROCEDURE - ERASING TRANSMITTER CODES

To erase the universal transmitter codes, simply hold down the two outside buttons until the red LED begins to flash (Fig. 7).

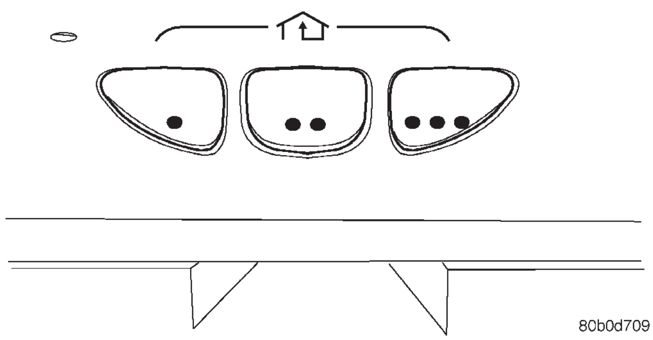


Fig. 7 Universal Transmitter

NOTE: Individual channels cannot be erased. Erasing the transmitter codes will erase ALL programmed codes.

STANDARD PROCEDURE - SETTING TRANSMITTER CODES

(1) Turn off the engine.

(2) Erase the factory test codes by pressing the two outside buttons. Release the buttons when the red light begins to flash (about 20 seconds).

(3) Choose one of the three buttons to train. Place the hand-held transmitter within one inch of the universal transmitter and push the buttons on both transmitters. The red light on the universal transmitter will begin to flash slowly.

(4) When the red light on the universal transmitter begins to flash rapidly (this may take as long as 60 seconds), release both buttons. Your universal transmitter is now "trained". To train the other buttons, repeat Step 3 and Step 4. Be sure to keep your hand-held transmitter in case you need to retrain the universal transmitter.

REMOVAL

(1) Remove the overhead console from the vehicle. Refer to the procedure in this section.

(2) Remove the transmitter retaining screws.

(3) Disconnect harness connector from Universal Transmitter and remove from the overhead console.

INSTALLATION

(1) Connect harness connector on Universal Transmitter and install in the overhead console.

(2) Install the transmitter retaining screws.

(3) Install the overhead console in the vehicle. Refer to the procedure in this section.

POWER SYSTEMS

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POWER LOCKS

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POWER LOCKS

DESCRIPTION - POWER LOCK SYSTEM

A power lock system is optional factory-installed equipment on this model. The power lock system is offered only on models that are also equipped with power windows. On vehicles equipped with power locks, the power lock motors are controlled by a microprocessor-based Central Timer Module (CTM). The CTM is used to provide many electronic features and conveniences that are not possible with a conventional hard wired power lock system. The CTM microprocessor is able to control power lock system operation based upon the CTM programming and electronic message inputs received from other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus network, Radio Frequency (RF) inputs received from the optional Remote Keyless Entry (RKE) system transmitters, as well as many hard wired inputs.

The power lock system includes the following major components, which are described in further detail elsewhere in this service manual:

- **Central Timer Module** - The Central Timer Module (CTM) is located on the left cowl side inner panel under the driver side outboard end of the instrument panel. The CTM contains a microprocessor and software that allow it to provide the many

POWER LOCKS (Continued)

electronic functions and features not available with conventional hard wired power lock systems.

- **Driver Door Module** - A power lock switch is integral to the driver door module unit located near the forward end of the arm rest on the driver side front door trim panel and allows the power lock system to be operated by the driver.
- **Power Lock Motors** - A reversible electric motor integral to the door latch of each door locks or unlocks the latches when provided with the appropriate electrical inputs.
- **Power Lock Switch** - An individual power lock switch is secured to a switch bezel near the forward end of the arm rest on the passenger side front door trim panel and allows the power lock system to be operated by the front seat passenger.

On those models equipped with the optional Vehicle Theft Security System (VTSS), the power lock system also includes the following components, which are described in further detail elsewhere in this service manual:

- **Door Cylinder Lock Switches** - A resistor-multiplexed switch located on the back of each front door lock cylinder allows the power door lock system to be operated using a key inserted in either the driver or passenger front door lock cylinder.

Some of the additional features of the power lock system in this model include:

- **Automatic Door Lock** - The CTM provides an optional automatic door lock feature (also known as rolling door locks). This is a programmable feature.
- **Central Locking** - On models also equipped with the optional VTSS (includes door cylinder lock switches), the CTM provides an optional central locking/unlocking feature.
- **Door Lock Inhibit** - The CTM provides a door lock inhibit feature.
- **Enhanced Accident Response** - The CTM provides an optional enhanced accident response feature. This is a programmable feature.

Hard wired circuitry connects the power lock 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 power lock 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.

Many of the electronic features in the vehicle controlled or supported by the CTM are programmable using the DRBIII® scan tool. In addition, the CTM software is Flash compatible, which means it can be reprogrammed using Flash reprogramming procedures. However, if any of the CTM hardware components are damaged or faulty, the entire CTM unit must be replaced. The power lock system components and the hard wired inputs or outputs of the CTM can be diagnosed using conventional diagnostic tools and methods; however, for diagnosis of the CTM or the PCI data bus, the use of a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

DESCRIPTION - REMOTE KEYLESS ENTRY SYSTEM

A Remote Keyless Entry (RKE) system is an available option on this model when it is equipped with the optional power lock system. The RKE system is a Radio Frequency (RF) system that allows the remote operation of the power lock system and, if the vehicle is so equipped, the Vehicle Theft Security System (VTSS). (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - DESCRIPTION). The RKE system includes the following major components, which are described in further detail elsewhere in this service manual:

- **Central Timer Module** - The Central Timer Module (CTM) is located on the left cowl side inner panel under the driver side outboard end of the instrument panel. The CTM contains a microprocessor, an RF receiver, and the software that allow it to provide the many electronic functions and features of the RKE system.
- **Keyless Entry Transmitter** - The keyless entry transmitter is a small, battery-powered, RF transmitter that is contained within a molded plastic case that is designed to also serve as a convenient key fob.

Some additional features of the RKE system include:

- **Driver Door Unlock Only** - This is a programmable feature on quad cab models only, which allows the option of having a single press of the RKE transmitter Unlock button unlock only the driver door, or all doors. If the driver door only option is selected, a second press of the Unlock button will unlock the remaining doors.
- **Horn Chirp** - This feature provides a short, sharp chirp of the vehicle horn to give an audible confirmation that a valid Lock signal has been received from the RKE transmitter. This feature can be enabled or disabled and, if enabled, one of two optional horn chirp durations (twenty or forty milliseconds) can also be selected.

POWER LOCKS (Continued)

- **Illuminated Entry** - This feature turns on the courtesy lamps in the vehicle for a timed interval (about thirty seconds) each time a valid Unlock signal has been received from the RKE transmitter.
- **Optical Chirp** - This feature provides a flash of the vehicle park lamps to give an optical confirmation that a valid Lock or Unlock signal has been received from the RKE transmitter. The lamps flash once for a Lock signal, and twice for an Unlock signal. This feature can be enabled or disabled.
- **Panic Mode** - This feature allows the vehicle operator to cause the vehicle horn to pulse and headlights to flash for about three minutes, and the courtesy lamps to illuminate for about thirty seconds by depressing a Panic button on the RKE transmitter. Pressing the Panic button a second time will cancel the Panic mode. A vehicle speed of about 24 kilometers-per-hour (15 miles-per-hour) will also cancel the panic mode.

OPERATION - POWER LOCK SYSTEM

The power lock system allows all doors to be locked or unlocked electrically by operating the power lock switch on either front door trim panel. On vehicles that are also equipped with the optional Remote Keyless Entry (RKE) system the power locks can also be operated using the RKE transmitter, and on vehicles that are equipped with the optional Vehicle Theft Security System (VTSS) the power locks can also be operated using a key in either front door or the liftgate lock cylinder. If certain features of the power lock system have been electronically enabled, the power locks may also be operated automatically by the Central Timer Module (CTM) based upon various other inputs. Those features and their inputs are:

- **Automatic Door Lock** - If enabled, the CTM will automatically lock the doors when it receives a message from the Powertrain Control Module (PCM) indicating that the vehicle speed is about 24 kilometers-per-hour (15 miles-per-hour) or greater. The CTM also monitors the door ajar switches, and will not activate the automatic door lock feature until all doors have been closed for at least five seconds. If this feature is enabled and a door is opened after the vehicle is moving at 24 kilometers-per-hour (15 miles-per-hour) or greater, the CTM will lock the doors again five seconds after all doors are again closed.
- **Central Locking** - Vehicles equipped with the optional VTSS also have a resistor-multiplexed door cylinder lock switch mounted to the back of the lock cylinder within each front door. The CTM continually monitors the input from these switches to provide the central locking/unlocking feature. The CTM will automatically lock or unlock all doors when either front door is locked or unlocked using a key.
- **Door Lock Inhibit** - The CTM receives inputs from the key-in ignition switch, the headlamp switch, and the door ajar switches. The logic within the CTM allows it to monitor these inputs to provide a door lock inhibit feature. The door lock inhibit feature prevents the power lock system from being energized with a power lock switch input if the driver door is open with the headlamps on or the key still in the ignition switch. However, the locks can still be operated with the manual door lock button or with a key in the door lock cylinder, and the power locks will still operate using the RKE transmitter while the driver door is open with the headlamps on or a key in the ignition.
- **Enhanced Accident Response** - If enabled, the CTM provides an enhanced accident response feature. This feature uses electronic message inputs received by the CTM from the Airbag Control Module (ACM) to determine when an airbag has been deployed. The CTM also monitors the state of the power lock system and the vehicle speed messages from the PCM in order to provide this feature. If an airbag has been deployed and the vehicle has stopped moving, the CTM will automatically unlock the doors, prevent the doors from being locked, and turn on the courtesy lamps inside the vehicle. Of course, these responses are dependent upon a functional battery and electrical circuitry following the impact.

The power lock system operates on battery current received through a fused B(+) circuit from a fuse in the Junction Block (JB) so that the system remains functional, regardless of the ignition switch position. Also, each power lock switch operates independent of the other and receives ground through a single wire take out of the body wire harness with an eyelet terminal connector that is secured by a ground screw to the lower left B-pillar. The power lock switches direct a resistor multiplexed ground Lock or Unlock request signal to the CTM, and the CTM energizes internal relays to direct the appropriate battery current and ground feeds to the individual power lock motors.

OPERATION - REMOTE KEYLESS ENTRY SYSTEM

On vehicles with the Remote Keyless Entry (RKE) system, the power locks can be operated remotely using the RKE transmitter. If the vehicle is so equipped, the RKE transmitter also arms and disarms the factory-installed Vehicle Theft Security System (VTSS). Three small, recessed buttons on the outside of the transmitter case labelled Lock, Unlock, and Panic allow the user to choose the function that is desired. The RKE transmitter then sends the appropriate Radio Frequency (RF) signal. An RF receiver that is integral to the Central Timer Module (CTM) receives the transmitted signal, which then

POWER LOCKS (Continued)

uses its internal electronic programming to determine whether the received signal is valid and what function has been requested. If the signal is valid, the CTM then provides the programmed features.

Besides operating the power lock system and arming or disarming the VTSS, the RKE system also controls the following features:

- **Driver Door Unlock Only** - On quad cab models only, if this feature is enabled, the CTM unlocks only the driver side front door upon receipt of a first valid Unlock signal through a separate internal relay and control outputs to the driver side front door power lock motor. Then upon receipt of a second valid Unlock signal, the CTM unlocks all of the remaining doors through a separate internal relay and control circuits for those power lock motors.
- **Horn Chirp** - If this feature is enabled, the CTM provides a horn chirp by internally pulling the control coil of the horn relay to ground through a hard wired circuit output.
- **Illuminated Entry** - The CTM provides illuminated entry by internally controlling the current flow to the courtesy lamps in the vehicle through a hard wired output circuit.
- **Optical Chirp** - If this feature is enabled, the CTM provides flashes of the park lamps by internally pulling the control coil of the park lamp relay to ground through a hard wired circuit output.
- **Panic Mode** - The CTM provides the horn pulse by internally pulling the control coil of the horn relay through a hard wired circuit output, then flashes the headlamps and illuminates the courtesy lamps through its internal high side control of these circuits. The CTM also monitors the vehicle speed through electronic messages it receives from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus network.

The RKE system operates on battery current received through a fused B(+) circuit from a fuse in the Junction Block (JB) so that the system remains functional, regardless of the ignition switch position. The RKE system can retain the vehicle access codes of up to four RKE transmitters. The transmitter codes are retained in RKE system memory, even if the battery is disconnected. If a transmitter is faulty or is lost, new transmitter vehicle access codes can be programmed into the system using a DRBIII® scan tool. Refer to the appropriate diagnostic information. Many of the electronic features in the vehicle controlled or supported by the CTM are programmable using the DRBIII® scan tool. In addition, the CTM software is Flash compatible, which means it can be reprogrammed using Flash reprogramming procedures. However, if any of the CTM hardware components are damaged or faulty, the entire CTM unit must be replaced. The hard wired inputs or outputs of the CTM can be diagnosed using conventional diagnostic tools and methods; however, for diagnosis of the CTM or the PCI data bus, the use of a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

DIAGNOSIS AND TESTING - POWER LOCK & REMOTE KEYLESS ENTRY SYSTEM

These tests will help to diagnose the hard wired components and circuits of the power lock system. However, these tests may not prove conclusive in the diagnosis of this system. In order to obtain conclusive testing of the power lock and RKE systems, the Programmable Communication Interface (PCI) data bus network and all of the electronic modules that provide inputs to, or receive outputs from the power lock and RKE system components must be checked.

The most reliable, efficient, and accurate means to diagnose the power lock and RKE systems requires the use of a DRBIII® scan tool. The DRBIII® scan tool can provide confirmation that the PCI data bus is functional, that all of the electronic modules are sending and receiving the proper messages on the PCI data bus, that the Central Timer Module (CTM) is receiving the proper hard wired inputs, and that the power lock motors are being sent the proper hard wired outputs by the CTM.

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.

PRELIMINARY TESTS

To begin this test, note the system operation while you actuate both the Lock and Unlock functions with the power lock switches, the door cylinder lock switches (if equipped with the optional Vehicle Theft Security System (VTSS), and the RKE transmitter. Then, proceed as follows:

- If the entire power lock system fails to function with the power lock switches, the door cylinder lock switches, or the RKE transmitter, check the fused B(+) fuse in the Junction Block (JB). If the fuse is OK, proceed to the diagnosis of the power lock motors. (Refer to 8 - ELECTRICAL/POWER LOCKS/ POWER LOCK MOTOR - DIAGNOSIS AND TESTING).
- If the power lock system functions with both power lock switches, and both the door cylinder lock switches, but not with the RKE transmitter, proceed to the diagnosis of the transmitter. (Refer to 8 - ELECTRICAL/POWER LOCKS/REMOTE KEYLESS

POWER LOCKS (Continued)

ENTRY TRANSMITTER - DIAGNOSIS AND TESTING).

- If the entire power lock system functions with the RKE transmitter, and both door cylinder lock switches, but not with one or both of the power lock switches, proceed to diagnosis of the Driver Door Module (DDM) for the driver side switch or to power lock switch for the passenger side switch. (Refer to 8 - ELECTRICAL/POWER LOCKS/DRIVER DOOR MODULE - DIAGNOSIS AND TESTING) and/or (Refer to 8 - ELECTRICAL/POWER LOCKS/POWER LOCK SWITCH - DIAGNOSIS AND TESTING).
- If the entire power lock system functions with the RKE transmitter, and both power lock switches, but not with one or all of the door cylinder lock switches, proceed to diagnosis of the door cylinder lock switches. (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR CYLINDER LOCK SWITCH - DIAGNOSIS AND TESTING).
- If one power lock motor fails to operate with both of the power lock switches, all of the door cylinder lock switches, and/or the RKE transmitter, proceed to diagnosis of the power lock motor. (Refer to 8 - ELECTRICAL/POWER LOCKS/POWER LOCK MOTOR - DIAGNOSIS AND TESTING).

If the problem being diagnosed is related to one or more of the electronic features (automatic locks, driver door unlock only, door lock inhibit, enhanced accident response, illuminated entry, panic mode, RKE horn chirp, or RKE optical chirp), further diagnosis should be performed using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

DOOR CYLINDER LOCK SWITCH

DESCRIPTION

A door cylinder lock switch is snapped onto the back of the key lock cylinder inside each front door. The door cylinder lock switch is a resistor multiplexed momentary switch that is hard wired in series between a body ground and the Central Timer Module (CTM) through the front door wire harness. The door cylinder lock switches are driven by the key lock cylinders and contain three internal resistors. One resistor is used for the neutral switch position, one for the Lock position, and one for the Unlock position.

The door cylinder lock switches cannot be adjusted or repaired and, if faulty or damaged, they must be replaced.

OPERATION

The door cylinder lock switches are actuated by the key lock cylinder when the key is inserted in the lock cylinder and turned to the lock or unlock positions. The door cylinder lock switch closes a path to ground through one of three internal resistors for the Central Timer Module (CTM) when the front door key lock cylinder is in the Lock, Unlock, or Neutral positions. The CTM reads the switch status through an internal pull-up, then uses this information as an input for both power lock system and Vehicle Theft Security System (VTSS) operation.

The door cylinder lock switches and circuits can be diagnosed using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - DOOR CYLINDER LOCK 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.

(1) Disconnect the door cylinder lock switch pigtail wire connector from the door wire harness connector.

(2) Using an ohmmeter, perform the switch resistance checks between the two cavities of the door cylinder lock switch pigtail wire connector. Actuate the switch by rotating the key in the door lock cylinder to test for the proper resistance values in each of the three switch positions, as shown in the Door Cylinder Lock Switch chart.

DOOR CYLINDER LOCK SWITCH		
Switch Position		Resistance
Driver Side	Passenger Side	
Neutral	Neutral	12 Kilohms
Lock (Clockwise)	Lock (Counter Clockwise)	644 Ohms
Unlock (Counter Clockwise)	Unlock (Clockwise)	1565 Ohms

(3) If a door cylinder lock switch fails any of the resistance tests, replace the faulty switch as required.

DOOR CYLINDER LOCK SWITCH (Continued)

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the door outside latch handle mounting hardware and linkage from the inside of the door. (Refer to 23 - BODY/DOOR - FRONT/EXTERIOR HANDLE - REMOVAL).

(3) From the outside of the door, pull the door outside latch handle out from the door far enough to access the door cylinder lock switch (Fig. 1).

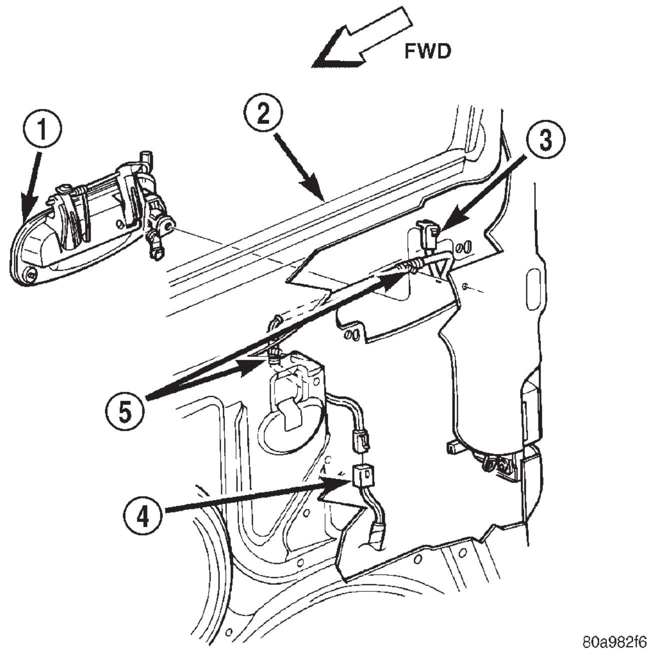

Fig. 1 Door Cylinder Lock Switch - Typical

1 - DOOR OUTSIDE LATCH HANDLE
2 - DOOR
3 - DOOR CYLINDER LOCK SWITCH
4 - CONNECTOR
5 - RETAINERS

(4) Disengage the door cylinder lock switch from the back of the lock cylinder.

(5) Disconnect the door cylinder lock switch pigtail wire connector from the door wire harness connector.

(6) Disengage the retainers that secure the door cylinder lock switch pigtail wire harness to the inner door panel.

(7) Remove the door cylinder lock switch from the door.

INSTALLATION

(1) Position the door cylinder lock switch into the door (Fig. 1).

(2) Engage the retainers that secure the door cylinder lock switch pigtail wire harness to the inner door panel.

(3) Reconnect the door cylinder lock switch pigtail wire connector to the door wire harness connector.

(4) Reinstall the door cylinder lock switch onto the back of the lock cylinder.

(5) Reinstall the door outside latch handle mounting hardware and linkage on the inside of the door. (Refer to 23 - BODY/DOOR - FRONT/EXTERIOR HANDLE - INSTALLATION).

(6) Reconnect the battery negative cable.

DRIVER DOOR MODULE

DESCRIPTION

A Driver Door Module (DDM) is used on all models equipped with power locks, power windows, and power mirrors. The driver door module consists of a molded plastic housing that is secured with three screws to a molded plastic switch bezel. The switch bezel is secured by metal snap clips within an opening near the forward end of the arm rest in the driver side front door trim panel so that the DDM can be serviced without removing the front door trim panel. Two integral connector receptacles on the back of the DDM connect it to the vehicle electrical system through two take outs and connectors of the left front door wire harness. The DDM houses the following switches:

- **Power Lock Switch** - The DDM includes a two-way, momentary, resistor multiplexed switch to control the power lock system.
- **Power Mirror Selector Switch** - A three-position rocker switch in the DDM selects the right or left power mirror for adjustment, or turns the power mirror system Off.
- **Power Mirror Adjustment Switches** - Four momentary, arrowhead shaped, directional switches allow the driver to adjust the selected power mirror in the Up, Down, Right, or Left directions.
- **Power Window Lockout Switch** - A two-way, latching, push-button switch in the DDM allows the vehicle operator to lock out the power window switches on each passenger door so that the passenger door power windows may be operated only from the master switches in the DDM.
- **Power Window Switches** - The DDM houses a two-way, momentary power window switch for the driver side front door. This switch also has a second detent in the Down direction and internal circuitry to provide an Auto-Down feature for the driver side front door power window. In addition to the power window switch for its own door, the DDM houses individual master switches for each passenger door power window.

The DDM also incorporates several green Light-Emitting Diodes (LEDs) that illuminate the power

DRIVER DOOR MODULE (Continued)

lock and power window switch paddles, and the power mirror switch directional buttons to improve switch visibility in dark ambient lighting conditions. The DDM cannot be adjusted or repaired and, if faulty or damaged, the entire DDM unit must be replaced.

OPERATION

The Driver Door Module (DDM) combines a power lock switch, a driver power window switch with an Auto-down feature, master switches for each passenger door power window, a power window lockout switch, a power mirror selector switch, and four power mirror adjustment switches in a single unit. The switches in the DDM can be diagnosed using conventional diagnostic tools and methods.

Power Lock Switch

The DDM power lock switch circuitry is connected in series between ground and the driver door switch mux input of the Central Timer Module (CTM). Each power lock switch position (Lock, Unlock, and Neutral) provides a different resistance value to the CTM input, which allows the CTM to sense the switch position. Based upon the power lock switch input, the CTM controls the battery and ground feed outputs to the individual power lock motors to lock or unlock the door and liftgate latches. The Light-Emitting Diode (LED) in the DDM power lock switch is connected to battery current through the power window circuit breaker in the Junction Block (JB) on a fused ignition switch output (run-acc) circuit so that the switch will be illuminated whenever the ignition switch is in the On or Accessory positions.

Power Window Switches

The DDM power window switch circuitry is connected to battery current through a circuit breaker in the Junction Block (JB) on a fused ignition switch output (run-acc) circuit so that the power windows will operate whenever the ignition switch is in the On or Accessory positions. Each two-way, momentary master passenger power window switch in the DDM provides battery current and ground to the individual power window switches on each passenger door so that the power window switch controls the battery current and ground feeds to its respective power window motor. The DDM switch for the driver side front door power window is labeled with the text “Auto” and includes an auto-down feature. When this switch is depressed to a second momentary detent position and released, the driver door power window is automatically operated through an internal circuit and relay to its fully lowered position. The Auto-down event is cancelled if the switch paddle is depressed a second time in either the Up or Down direction. When the two position window lockout switch in the DDM is depressed and latched in the lockout position, the battery current feed to each of the individual passenger power window switches is interrupted so that the passenger door power windows can only be operated from the master switches in the DDM. The window lockout switch also controls the battery current feed for the LED in each passenger power window switch so that the switch will not be illuminated when it is locked out.

Power Mirror Switches

The DDM power mirror switch circuitry is connected to battery current through a fuse in the JB on a fused B(+) circuit so that the power mirrors remain operational regardless of the ignition switch position. A rocker type selector switch has three positions, one to select the right mirror, one to select the left mirror, and a neutral Off position. After the right or left mirror is selected, one of four directional buttons is depressed to move the selected mirror Up, Down, Right or Left. The DDM power mirror switch circuitry controls the battery current and ground feeds to each of the four (two in each mirror head) power mirror motors. The Light-Emitting Diode (LED) in the DDM power mirror switch is connected to battery current through the power window circuit breaker in the Junction Block (JB) on a fused ignition switch output (run-acc) circuit so that the switch directional buttons will be illuminated whenever the ignition switch is in the On or Accessory positions.

DIAGNOSIS AND TESTING - DRIVER DOOR MODULE

The Light-Emitting Diode (LED) illumination lamps for all of the Driver Door Module (DDM) power window, power lock, and power mirror switches receive battery current through the power window circuit breaker in the Junction Block (JB). If all of the LEDs are inoperative in the DDM, be certain to diagnose the power window system before replacing the switch unit. (Refer to 8 - ELECTRICAL/POWER WINDOWS - DIAGNOSIS AND TESTING). If only one LED in the DDM is inoperative, replace the faulty DDM. If the driver side front door power window operates in a normal manner, but the Auto-Down feature is inoperative, replace the faulty DDM. 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) Disconnect and isolate the battery negative cable. Remove the DDM from the door trim panel.

DRIVER DOOR MODULE (Continued)

Disconnect the door wire harness connectors for the DDM from the DDM connector receptacles.

(2) Test the DDM switch continuity. See the Driver Door Module Switch Tests chart to determine if the continuity is correct for the suspect switches in each switch position (Fig. 2) and/or (Fig. 3). If not OK, replace the faulty DDM as required.

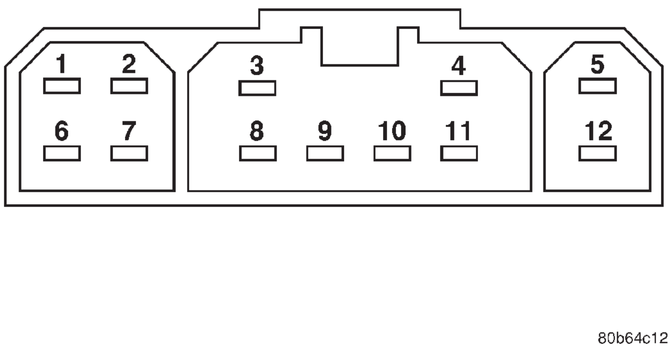

Fig. 2 Driver Door Module Connector C1 Receptacle

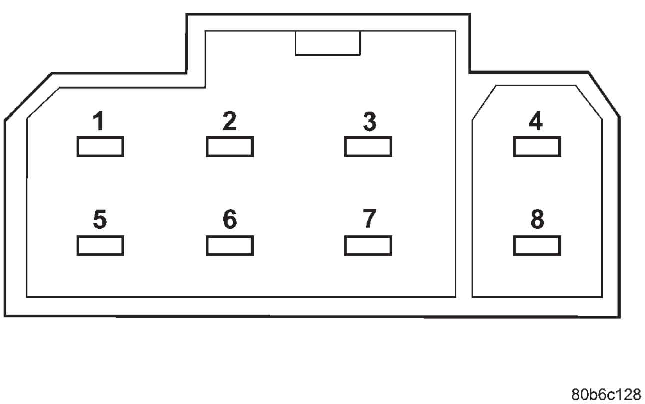

Fig. 3 Driver Door Module Connector C2 Receptacle

DRIVER DOOR MODULE SWITCH TESTS	
POWER LOCK SWITCH	
SWITCH POSITION	RESISTANCE BETWEEN CONNECTOR C-1 PINS 7 & 11
NEUTRAL	10 KILOHMS ± 1%
LOCK	820 OHMS ± 1%
UNLOCK	320 OHMS ± 1%
POWER MIRROR SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN PINS OF CONNECTOR C-2
LEFT MIRROR SELECTED	
UP	PINS 1 & 3
DOWN	PINS 2 & 3
RIGHT	PINS 2 & 3
LEFT	PINS 3 & 6
RIGHT MIRROR SELECTED	
UP	PINS 3 & 7
DOWN	PINS 2 & 3
RIGHT	PINS 2 & 3
LEFT	PINS 3 & 4
POWER WINDOW SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN PINS OF CONNECTOR C-1
NEUTRAL	PINS 1 & 8, PINS 2 & 8, PINS 3 & 8, PINS 4 & 8, PINS 5 & 8, PINS 6 & 8, PINS 8 & 10, PINS 8 & 12
LEFT FRONT UP	PINS 5 & 9
LEFT FRONT DOWN	PINS 9 & 12
RIGHT FRONT UP	PINS 3 & 9
RIGHT FRONT DOWN	PINS 6 & 9
LEFT REAR UP	PINS 4 & 9
LEFT REAR DOWN	PINS 9 & 10
RIGHT REAR UP	PINS 2 & 9
RIGHT REAR DOWN	PINS 1 & 9
POWER WINDOW LOCKOUT SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN
OFF (SWITCH BUTTON RAISED - NOT DEPRESSED)	PIN 9 OF CONNECTOR C-1 & PIN 8 OF CONNECTOR C-2

DRIVER DOOR MODULE (Continued)

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick or another suitable wide flat bladed tool and starting at the rear of the Driver Door Module (DDM) bezel, gently pry the DDM up and out from the driver side front door trim panel (Fig. 4).

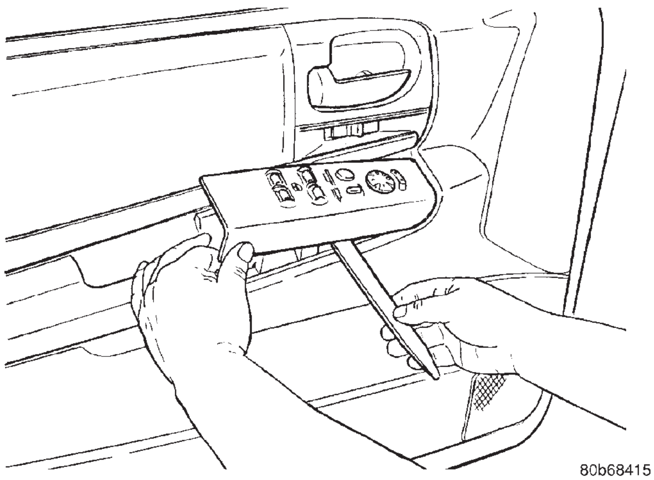

Fig. 4 Driver Door Module

(3) Pull the DDM away from the trim panel opening far enough to access the two connector receptacles on the back of the unit.

(4) Disconnect the two door wire harness connectors for the DDM from the DDM connector receptacles.

(5) Remove the DDM from the door trim panel.

INSTALLATION

(1) Position the Driver Door Module (DDM) to the opening in the driver side front door trim panel.

(2) Reconnect the two door wire harness connectors for the DDM to the DDM connector receptacles.

(3) Insert the front of the DDM bezel into the opening in the driver side front door trim panel (Fig. 4).

(4) Using hand pressure, gently and evenly press down on the rear of the DDM bezel until it snaps into place.

(5) Reconnect the battery negative cable.

POWER LOCK MOTOR

DESCRIPTION

Models equipped with the optional power lock system have a power operated locking mechanism located within each door. The lock mechanisms are actuated by a reversible electric power lock motor. This motor is integral to the door latch unit within each door. A single short pigtail wire with a molded plastic connector insulator connects each lock motor to the vehicle electrical system through a take out and connector of the wire harness within each door.

The power lock motors cannot be adjusted or repaired and, if faulty or damaged, the entire door latch unit must be replaced.

OPERATION

The driver side front door power lock motor is controlled by a unique driver unlock relay output of the Central Timer Module (CTM), while the remaining power lock motors are all connected in parallel and share common CTM lock and unlock relay outputs. The driver side front door power lock motor also shares the common lock relay output from the CTM. This circuit arrangement makes the Remote Keyless Entry (RKE) system driver door unlock only feature option for quad cab models possible. A positive and negative battery connection to the two power lock motor terminals will cause the power lock motor plunger to move in one direction. Reversing the current through these same two connections will cause the power lock motor plunger to move in the opposite direction. The power lock motors and circuits can be tested using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - POWER LOCK MOTOR

Before you proceed with this diagnosis, confirm proper power lock switch, Central Timer Module (CTM), and power lock switch output circuit operation. Remember, the CTM circuitry controls the output to each of the power lock motors. 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 each power lock motor for correct operation while moving the power lock switch to both the Lock and Unlock positions. If all of the power lock motors are inoperative, go to Step 2. If one power lock motor is inoperative, go to Step 3.

(2) If all of the power lock motors are inoperative, the problem may be caused by one shorted motor. Disconnecting a shorted power lock motor from the power lock circuit will allow the good power lock motor to operate. Disconnect the wire harness connector from each power lock motor, one at a time, and recheck both the lock and unlock functions by operating the power lock switch. If all of the power lock motors are still inoperative after the above test, check for a short or open circuit between the power

POWER LOCK MOTOR (Continued)

lock motors and the CTM. If disconnecting one power lock motor causes the other motors to become functional, go to Step 3 to test the disconnected motor.

(3) Once it has been determined which power lock motor is inoperative, that motor can be tested as follows. Disconnect the wire harness connector from the inoperative power lock motor. Apply 12 volts to the lock and unlock driver circuit cavities of the power lock motor pigtail wire connector to check its operation in one direction. Reverse the polarity to check the motor operation in the opposite direction. If OK, repair the shorted or open lock or unlock driver circuits between the power lock motor and the CTM as required. If not OK, replace the faulty power lock motor.

POWER LOCK SWITCH

DESCRIPTION

The power lock system can be controlled by a two-way, momentary, resistor multiplexed, single gang switch on a power lock and window switch bezel located near the forward end of the armrest on the passenger side front door trim panel. The power lock switch on the driver side front door trim panel is integral to the driver door module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DRIVER DOOR MODULE - DESCRIPTION). The power lock switch is secured by integral latch tabs in a molded plastic receptacle on the back side of the power window and lock switch bezel so that only the switch paddle is visible where it protrudes through the bezel. The power window and lock switch bezel is secured by small metal snap clips within an opening near the forward end of the arm rest in the passenger side front door trim panel so that the switches can be serviced without removing the front door trim panel. An integral connector receptacle on the back of the switch connects it to the vehicle electrical system through a take out and connector of the right front door wire harness. The power lock switch has a green Light-Emitting Diode (LED) located in the switch paddle to improve switch visibility in dark ambient lighting conditions. The power lock switch cannot be adjusted or repaired and, if faulty or damaged, the switch unit must be replaced.

OPERATION

The two-way, momentary, power lock switch on the passenger side front door is connected in series between ground and the passenger door switch mux input of the Central Timer Module (CTM). The power lock switch on the driver side front door trim panel is integral to the driver door module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DRIVER DOOR MODULE - OPERATION). Each power lock switch position Lock, Unlock, and Neutral provides a different resistance value to the CTM input which allows the CTM to sense the switch position. Based upon the power lock switch inputs, the CTM controls the battery and ground feed outputs to the power lock motors to lock or unlock the door and liftgate latches. The Light-Emitting Diode (LED) in the paddle of the passenger door power lock switch is connected to battery current through a fuse in the Junction Block (JB) on a fused ignition switch output (run) circuit; therefore, the switch will only be illuminated when the ignition switch is in the On position. The power lock switch can be diagnosed using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - POWER LOCK SWITCH

The Light-Emitting Diode (LED) illumination lamp of the power lock switch receives battery current through a fuse in the Junction Block (JB) on a fused ignition switch output (run) circuit. The power lock switch on the driver side front door trim panel is integral to the driver door module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DRIVER DOOR MODULE - DIAGNOSIS AND TESTING). If the power lock switch operates, but the LED is inoperative, check for battery current at the switch with the ignition switch in the On position. If OK, replace the faulty 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.

(1) Disconnect and isolate the battery negative cable. Remove the power lock switch from the door trim panel. Disconnect the door wire harness connector for the power lock switch from the switch connector receptacle.

(2) Test the power lock switch resistance. See the Power Lock Switch Test chart to determine if the resistance is correct for the switch in each switch position (Fig. 5). If not OK, replace the faulty power lock switch as required.

POWER LOCK SWITCH (Continued)

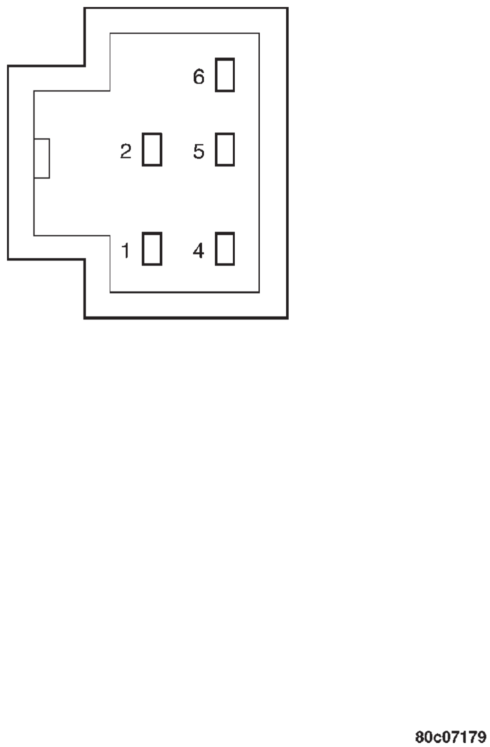

Fig. 5 Power Lock Switch Connector Receptacle

POWER LOCK SWITCH TEST	
SWITCH POSITION	RESISTANCE BETWEEN PINS 1 & 5
NEUTRAL	10 KILOHMS ±1%
LOCK	820 OHMS ±1%
UNLOCK	330 OHMS ±1%

REMOVAL

The power lock switch on the driver side front door trim panel is integral to the driver door module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DRIVER DOOR MODULE - REMOVAL).

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick or another suitable wide flat bladed tool and starting at the rear of the passenger door power window and lock switch bezel, gently pry the bezel up and out from the passenger side front door trim panel.

(3) Pull the power window and lock switch bezel away from the trim panel opening far enough to access the two switch connector receptacles on the back of the unit.

(4) Disconnect the door wire harness connectors for the power lock and power window switches from the switch connector receptacles.

(5) Remove the power window and lock switch bezel from the door trim panel.

(6) Using a small thin-bladed screwdriver, gently pry the snap clips at the sides of the power lock switch receptacle on the back of the power window and lock switch bezel and pull the switch out of the receptacle.

INSTALLATION

The power lock switch on the driver side front door trim panel is integral to the driver door module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DRIVER DOOR MODULE - INSTALLATION).

(1) Align the power lock switch with the receptacle on the back of the power window and lock switch bezel.

(2) Using hand pressure, gently and evenly press down on the power lock switch it snaps into place in the power window and lock switch bezel receptacle.

(3) Position the power window and lock switch bezel to the opening in the passenger side front door trim panel.

(4) Reconnect the two door wire harness connectors for the power window and power lock switches to the switch connector receptacles.

(5) Insert the front of the power window and lock switch bezel into the opening in the passenger side front door trim panel.

(6) Using hand pressure, gently and evenly press down on the rear of the power window and lock switch bezel until it snaps into place.

(7) Reconnect the battery negative cable.

REMOTE KEYLESS ENTRY TRANSMITTER

DESCRIPTION

The Remote Keyless Entry (RKE) system Radio Frequency (RF) transmitter is equipped with three buttons, labeled Lock, Unlock, and Panic. It is also equipped with a key ring and is designed to serve as a key fob. The operating range of the transmitter radio signal is up to 7 meters (23 feet) from the RKE receiver. The RKE receiver is integral to the Central Timer Module (CTM) in this vehicle.

Each RKE transmitter has a different vehicle access code, which must be programmed into the memory of the RKE receiver in the vehicle in order to operate the RKE system. The RKE receiver can retain the access codes for up to four transmitters in its memory. (Refer to 8 - ELECTRICAL/POWER LOCKS/REMOTE KEYLESS ENTRY TRANSMITTER - STANDARD PROCEDURE - RKE TRANSMITTER PROGRAMMING).

The RKE transmitter operates on two Duracell DL2016, Panasonic CR2016 (or equivalent) batteries. Typical battery life is from one to two years. The

REMOTE KEYLESS ENTRY TRANSMITTER (Continued)

RKE transmitter cannot be repaired and, if faulty or damaged, it must be replaced.

OPERATION

See the owner's manual in the vehicle glove box for more information on the features, use and operation of the Remote Keyless Entry (RKE) transmitters.

DIAGNOSIS AND TESTING - REMOTE KEYLESS ENTRY TRANSMITTER

(1) Replace the Remote Keyless Entry (RKE) transmitter batteries. (Refer to 8 - ELECTRICAL/ POWER LOCKS/REMOTE KEYLESS ENTRY TRANSMITTER - STANDARD PROCEDURE - RKE TRANSMITTER BATTERIES). Test each of the RKE transmitter functions. If OK, discard the faulty batteries. If not OK, go to Step 2.

(2) Program the suspect RKE transmitter and another known good transmitter into the RKE receiver. (Refer to 8 - ELECTRICAL/POWER LOCKS/REMOTE KEYLESS ENTRY TRANSMITTER - STANDARD PROCEDURE - RKE TRANSMITTER PROGRAMMING).

(3) Test the RKE system operation with both transmitters. If both transmitters fail to operate the power lock system, a DRBIII® scan tool is required for further diagnosis of the RKE system. Refer to the appropriate diagnostic information. If the known good RKE transmitter operates the power locks and the suspect transmitter does not, replace the faulty RKE transmitter.

NOTE: Be certain to perform the RKE Transmitter Programming procedure again following this test. This procedure will erase the access code of the test transmitter from the RKE receiver.

STANDARD PROCEDURE - RKE TRANSMITTER PROGRAMMING

To program the Remote Keyless Entry (RKE) transmitter access codes into the RKE receiver in the Central Timer Module (CTM) requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

STANDARD PROCEDURE - RKE TRANSMITTER BATTERIES

The Remote Keyless Entry (RKE) transmitter case snaps open and shut for battery access. To replace the RKE transmitter batteries:

(1) Using a trim stick or a thin coin, gently pry at the notch in the center seam of the RKE transmitter case halves located near the key ring until the two halves unsnap.

(2) Lift the back half of the transmitter case off of the RKE transmitter.

(3) Remove the two batteries from the RKE transmitter.

(4) Replace the two batteries with new Duracell DL2016, or their equivalent. Be certain that the batteries are installed with their polarity correctly oriented.

(5) Align the two RKE transmitter case halves with each other, and squeeze them firmly and evenly together using hand pressure until they snap back into place.

POWER MIRRORS

TABLE OF CONTENTS

POWER MIRRORS

DESCRIPTION

AUTOMATIC DAY/NIGHT MIRROR

The automatic day/night mirror system is able to automatically change the reflectance of the inside rear view mirror in order to reduce the glare of headlamps approaching the vehicle from the rear. The automatic day/night rear view mirror receives battery current through a fuse in the junction block only when the ignition switch is in the On position.

OUTSIDE REAR VIEW MIRROR

The power operated or power operated and heated outside rear view mirrors allow the driver to adjust both outside mirrors electrically from the driver side front seat position by operating a switch on the driver side front door trim panel. The power mirrors receive a non-switched battery feed through a fuse in the junction block so that the system will remain operational, regardless of the ignition switch position.

OPERATION

AUTOMATIC DAY/NIGHT MIRROR

A switch located on the bottom of the automatic day/night mirror housing allows the vehicle operator to select whether the automatic dimming feature is operational. When the automatic day/night mirror is turned on, the mirror switch is lighted by an integral Light-Emitting Diode (LED). The mirror will automatically disable its self-dimming feature whenever the vehicle is being driven in reverse.

Following is a general description of the automatic day/night mirror. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the automatic day/night mirror system.

OUTSIDE REAR VIEW MIRROR

The heated mirror option is available only on quad cab models with the rear window defogger option. The heated mirrors include an electric heating grid behind the mirror glass in each outside mirror, which can clear the mirror glass of ice, snow, or fog. (Refer to 8 - ELECTRICAL/HEATED MIRRORS - DESCRIPTION) for more information.

DIAGNOSIS AND TESTING - POWER MIRRORS

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 fuses in the Power Distribution Center (PDC) and the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse(s).

(2) Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the PDC as required.

(3) Disconnect and isolate the battery negative cable. Remove the driver side power window switch and bezel assembly and unplug the wire harness connector from the power mirror switch. Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity in the door wire harness half of the power mirror switch wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit to the junction block as required.

(4) Disconnect and isolate the battery negative cable. Check for continuity between the ground cir-

POWER MIRRORS (Continued)

cuit cavity in the door wire harness half of the power mirror switch wire harness connector and a good ground. There should be continuity. If OK, (Refer to 8 - ELECTRICAL/POWER MIRRORS/SIDEVIEW MIRROR - DIAGNOSIS AND TESTING).

AUTOMATIC DAY / NIGHT MIRROR

DESCRIPTION

The automatic day/night mirror uses a thin layer of electrochromic material between two pieces of conductive glass to make up the face of the mirror. When the mirror switch is in the On position, two photocell sensors are used by the mirror circuitry to monitor external light levels and adjust the reflectance of the mirror.

OPERATION

The ambient photocell sensor is located on the forward-facing (windshield side) of the rear view mirror housing, and detects the ambient light levels outside of the vehicle. The headlamp photocell sensor is located inside the rear view mirror housing behind the mirror glass and faces rearward, to detect the level of the light being received at the rear window side of the mirror. When the circuitry of the automatic day/night mirror detects that the difference between the two light levels is too great (the light level received at the rear of the mirror is much higher than that at the front of the mirror), it begins to darken the mirror.

The automatic day/night mirror circuitry also monitors the transmission using an input from the backup lamp circuit. The mirror circuitry is programmed to automatically disable its self-dimming feature whenever it senses that the transmission backup lamp circuit is energized.

The automatic day/night mirror is a completely self-contained unit and cannot be repaired. If faulty or damaged, the entire mirror assembly must be replaced.

DIAGNOSIS AND TESTING - AUTOMATIC DAY/NIGHT MIRROR

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 fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the junction block. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the wire harness connector from the automatic day/night mirror (Fig. 1). Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) circuit cavity of the automatic day/night mirror wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit to the junction block as required.

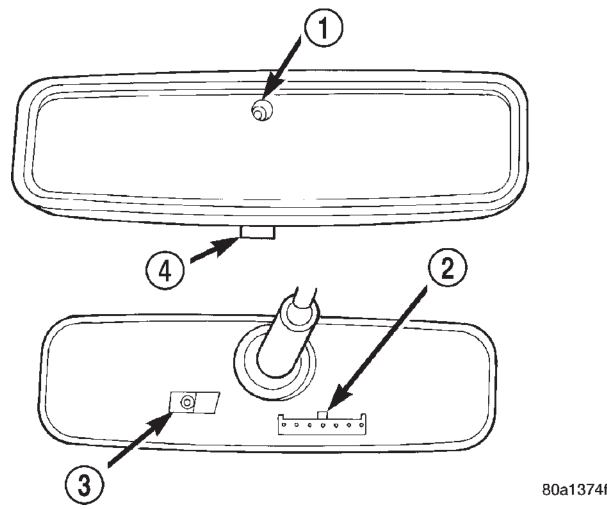

Fig. 1 Automatic Day/Night Mirror

1 - REAR FACING SENSOR
2 - CONNECTOR
3 - FORWARD FACING SENSOR
4 - SWITCH

(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 automatic day/night mirror wire harness connector and a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the circuit to ground as required.

(5) Connect the battery negative cable. Turn the ignition switch to the On position. Set the parking brake. Place the transmission gear selector lever in the Reverse position. Check for battery voltage at the backup lamp switch output circuit cavity of the automatic day/night mirror wire harness connector. If OK, go to Step 6. If not OK, repair the open circuit as required.

(6) Turn the ignition switch to the Off position. Disconnect the battery negative cable. Plug in the automatic day/night mirror wire harness connector. Connect the battery negative cable. Turn the ignition

AUTOMATIC DAY / NIGHT MIRROR (Continued)

switch to the On position. Place the transmission gear selector lever in the Neutral position. Place the mirror switch in the On (the LED in the mirror switch is lighted) position. Cover the forward facing ambient photocell sensor to keep out any ambient light.

NOTE: The ambient photocell sensor must be covered completely, so that no light reaches the sensor. Use a finger pressed tightly against the sensor, or cover the sensor completely with electrical tape.

(7) Shine a light into the rearward facing headlamp photocell sensor. The mirror glass should darken. If OK, go to Step 8. If not OK, replace the faulty automatic day/night mirror unit.

(8) With the mirror glass darkened, place the transmission gear selector lever in the Reverse position. The mirror should return to its normal reflectance. If not OK, replace the faulty automatic day/night mirror unit.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the automatic day/night mirror (Fig. 2).

(3) Remove the set screw that secures the automatic day/night mirror to the windshield support button.

(4) Push the automatic day/night mirror upwards far enough for the mounting bracket to clear the support button and remove the mirror from the windshield support button.

INSTALLATION

(1) Install the mirror to the support button.

(2) Install the set screw. Tighten the set screw to 1.7 N·m (15 in. lbs.).

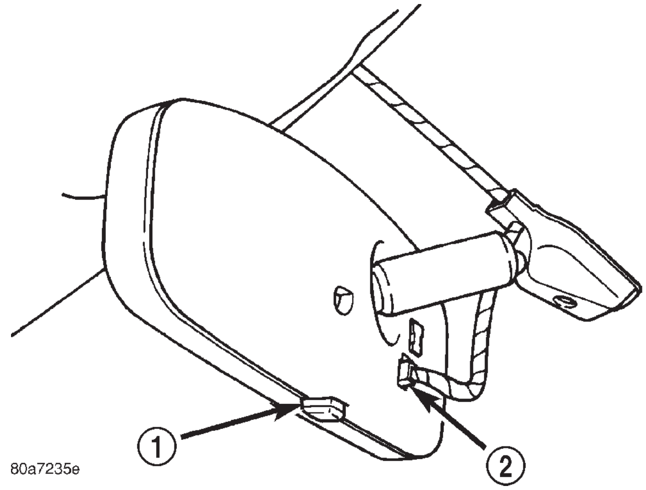

Fig. 2 Automatic Day/Night Mirror Remove/Install

1 - ON/OFF SWITCH
2 - ELECTRICAL CONNECTOR

(3) Reconnect the wire harness to the mirror.

(4) Reconnect the battery negative cable.

POWER MIRROR SWITCH

DIAGNOSIS AND TESTING - POWER MIRROR SWITCH

The power mirror switch is included with the Driver Door Module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - DIAGNOSIS AND TESTING) for service procedures.

REMOVAL

The power mirror switch is included with the Driver Door Module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - REMOVAL) for service procedures.

SIDEVIEW MIRROR

DIAGNOSIS AND TESTING - SIDEVIEW MIRROR

Unplug the wire harness connector at the inoperative power mirror (Fig. 3).

Use two jumper wires, one connected to a 12 - volt battery feed, and the other connected to a good body ground. See the Power Mirror Test chart for the correct jumper wire connections to the power mirror half of the power mirror wire harness connector. If the power mirror(s) do not respond as indicated in the chart, replace the faulty power mirror assembly. If the power mirror(s) do respond as indicated in the chart, repair the circuits between the power mirror and the power mirror switch for a short or open as required.

REMOVAL

For removal procedures, (Refer to 23 - BODY/EXTERIOR/SIDE VIEW MIRROR - REMOVAL).

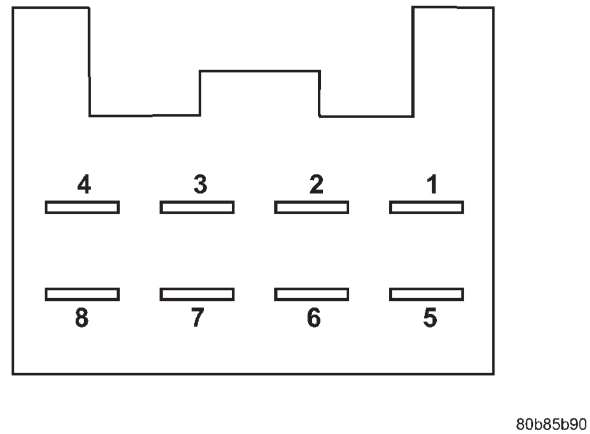

Fig. 3 Power Mirror Test

12 Volts	Ground	Left or Right Mirror MIRROR MOVEMENT
Pin 1	Pin 3	UP
Pin 3	Pin 1	DOWN
Pin 2	Pin 3	LEFT
Pin 3	Pin 2	RIGHT

POWER SEAT SYSTEM

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POWER SEAT SYSTEM

DESCRIPTION

The power seat system option allows the driver to electrically adjust his seating position for optimum control and comfort using the power seat switches located on the outboard seat cushion side shield. The power seat system allows the seating position to be adjusted forward, rearward, front up, front down, rear up, or rear down. The power seat system receives battery current through a fuse in the Power Distribution Center, regardless of the ignition switch position.

The power seat system includes the power seat adjuster and motors unit (seat track) and the power seat switch. Following are general descriptions of the major components in the power seat system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the power seat system.

OPERATION

The power seat system receives battery current through a fuse in the Power Distribution Center (PDC), regardless of the ignition switch position.

DIAGNOSIS AND TESTING - POWER SEAT SYSTEM

Before any testing of the power seat system is attempted, the battery should be fully-charged and all wire harness connections and pins cleaned and tightened to ensure proper continuity and grounds. For circuit descriptions and diagrams, refer to Wiring Diagrams.

With the dome lamp on, apply the power seat switch in the direction of the failure. If the dome lamp dims, the seat may be jamming. Check under and behind the seat for binding or obstructions. If the dome lamp does not dim, proceed with testing of the individual components and circuits.

DRIVER SEAT SWITCH

DESCRIPTION

The power seat can be adjusted in six different ways using the power seat switch. The switch is located on the outboard side of the seat cushion side shield.

The individual switches in the power seat switch unit cannot be repaired. If one switch is damaged or faulty, the entire power seat switch unit must be replaced.

OPERATION

When a power switch control knob or knobs are actuated, a battery feed and a ground path are applied through the switch contacts to the power seat track or recliner adjuster motor. The selected adjuster motor operates to move the seat track or recliner through its drive unit in the selected direction until the switch is released, or until the travel limit of the adjuster is reached. When the switch is moved in the opposite direction, the battery feed and ground path to the motor are reversed through the switch contacts. This causes the adjuster motor to run in the opposite direction.

No power seat switch should be held applied in any direction after the adjuster has reached its travel limit. The power seat adjuster motors each contain a self-resetting circuit breaker to protect them from overload. However, consecutive or frequent resetting of the circuit breaker must not be allowed to continue, or the motor may be damaged.

DRIVER SEAT SWITCH (Continued)

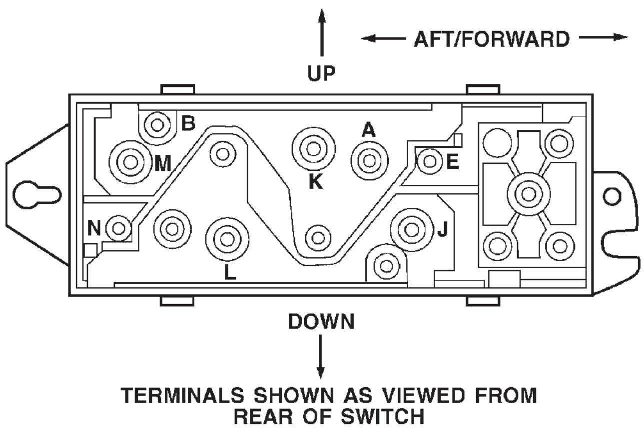
DIAGNOSIS AND TESTING - DRIVER SEAT SWITCH

For circuit descriptions and diagrams, refer to Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the power seat switch from the power seat.

(3) With assistance from another person, use an ohmmeter to test the continuity of the power seat switches in each position. See the Power Seat Switch schematic and Continuity chart (Fig. 1) . If OK, see the Power Seat Track Diagnosis and Testing procedure in this section . If not OK, replace the faulty power seat switch unit.



POWER SEAT SWITCH TEST TABLE	
SWITCH POSITION	CONTINUITY BETWEEN
OFF	B & N, B & J, B & M, B & E, B & L, B & K
VERTICAL UP	A & J, A & N, B & M, B &E
VERTICAL DOWN	A & E, A & M, B & N, B & J
HORIZONTAL FORWARD	A & K, B & L
HORIZONTAL AFT	A & L, B & K
FRONT TILT UP	A & J, B & E
FRONT TILT DOWN	A & E, B & J
REAR TILT UP	A & N, B & M
REAR TILT DOWN	A & M, B & N

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Fig. 1 Power Seat Switch Continuity Test

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the screw that secures the recliner lever to the recliner mechanism release shaft on the outboard side of the driver side front seat.

(3) Pull the recliner lever off of the recliner mechanism release shaft.

(4) Remove the two screws that secure the driver side seat cushion side shield to the outboard seat cushion frame.

(5) Pull the driver side seat cushion side shield away from the seat cushion frame far enough to access the power seat switch module wire harness connector.

(6) Unplug the wire harness connector from the power seat switch module.

(7) Remove the seat cushion side shield and power seat switch module from the seat as a unit.

(8) Remove the two screws that secure the power seat switch to the inside of the seat cushion side shield (Fig. 2).

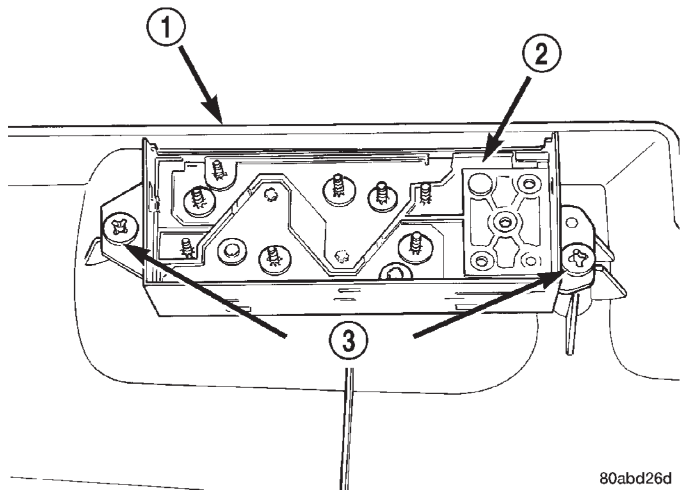

Fig. 2 Power Seat Switch Remove/Install - Typical

1 - Seat Side Shield
2 - Power Seat Switch
3 - Screws

(9) Remove the power seat switch from the seat cushion side shield.

INSTALLATION

(1) Install the two screws that secure the power seat switch to the inside of the seat cushion side shield.

(2) Install the wire harness connector on the power seat switch module.

(3) Install the seat cushion side shield and power seat switch module on the seat as a unit. Refer to Body for the procedure.

DRIVER SEAT SWITCH (Continued)

(4) Install the recliner lever on the recliner mechanism release shaft.

(5) Install the screw that secures the recliner lever to the recliner mechanism release shaft on the outboard side of the driver side front seat.

(6) Connect the battery negative cable.

POWER SEAT TRACK

DESCRIPTION

Vehicles equipped with the power seat option, utilize a power seat track. Three reversible DC motors are incorporated into the power seat track. The motors are connected to worm-drive gearboxes that move the seat track through a combination of screw-type drive units.

The front and rear of the seat are operated by different motors. They can be raised or lowered independently of each other. When the center power seat switch is pushed in the Up or Down direction, both the front and rear motors operate in unison. On standard cab models the entire seat is moved up or down. On extended cab models the seat cushion moves independently of the seat back in the up or down directions.

Each motor contains a self-resetting circuit breaker to protect it from overload. Consecutive or frequent resetting of the circuit breakers must not be allowed to continue, or the motors may be damaged.

The power seat track (adjuster) cannot be repaired, and is serviced only as a complete assembly. If any component in this assembly is faulty or damaged, the entire power seat track must be replaced.

OPERATION

When a power seat switch is actuated, a battery feed and a ground path are applied through the power seat switch contacts to the appropriate motor or motors. The motor and drive unit operate to move the seat in the selected direction until the switch is released, or until the travel limit of the power seat track is reached. When the switch is moved in the opposite direction, the battery feed and ground path to the motor is reversed through the switch contacts. This causes the motor to run in the opposite direction.

DIAGNOSIS AND TESTING - POWER SEAT TRACK

For complete power seat circuit descriptions and diagrams, refer to Wiring Diagrams.

Operate the power seat switch to move all three seat motors in each direction. The seat should move in each of the selected directions. If the power seat track fails to operate in only one direction, move the seat track a short distance in the opposite direction and test again to be certain that the track is not at its travel limit. If the power seat track still fails to operate in only one direction, refer to Diagnosis and Testing of the Power Seat Switch in this section. If the power seat track fails to operate in more than one direction, proceed as follows:

(1) Check the power seat fuse in the power distribution center. If OK, go to Step 2. If not OK, replace the faulty fuse.

(2) Remove the power seat switch from the seat. Check for battery voltage at the fused B(+) circuit cavity of the power seat switch wire harness connector. If OK, go to Step 3. If not OK, repair the open circuit to the power distribution center as required.

(3) Check for continuity between the ground circuit cavity of the power seat switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to ground as required.

(4) Test the power seat switch as described in this group. If the switch tests OK, check the wire harness between the power seat switch and the motor for shorts or opens. If the circuits check OK, replace the faulty power seat track (adjuster) assembly. If the circuits are not OK, repair the wire harness as required.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the driver side seat assembly from the vehicle. Refer to the Body section of the service manual for the procedure.

(3) Disconnect the power seat wire harness connectors.

(4) Disconnect the power seat wire harness retainers from the seat track assembly.

(5) Remove the four bolts that secure the power seat track assembly to the seat cushion frame.

(6) If the vehicle is equipped with a split bench seat, remove the fasteners that secure the center seat cushion section to the brackets on the power seat track assembly.

(7) Remove the power seat track assembly from the seat cushion frame.

CAUTION: Before installing the seat into the vehicle, be certain to adjust the seat fully rearward on its tracks. Then install and tighten the front track mounting screws before installing the rear screws or the tracks may be damaged.

INSTALLATION

(1) Position the power seat track assembly on the seat cushion frame and compare the old and replace-

POWER SEAT TRACK (Continued)

ment seat tracks to be certain the correct part is available.

(2) If the vehicle is equipped with a split bench seat, Install the fasteners that secure the center seat cushion section to the brackets on the power seat track assembly.

(3) Install the four bolts that secure the power seat track assembly to the seat cushion frame. Torque the bolts to 27 N·m (20 ft. lbs.).

(4) Install the power seat wire harness retainers on the seat track assembly.

(5) Connect the power seat wire harness connectors.

(6) Install the driver side seat assembly in the vehicle. Refer to the Body section of the service manual for the procedure.

(7) Connect the battery negative cable.

POWER WINDOWS

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POWER WINDOWS

DESCRIPTION

Power windows are available as factory-installed optional equipment on this model. The Remote Keyless Entry (RKE) system and power lock system are included on vehicles equipped with the power window option. 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.

The power window system allows each of the door windows to be raised and lowered electrically by actuating a switch on the trim panel of each respective door. A master switch on the driver side front door trim panel allows the driver to raise or lower each of the passenger door windows and, on quad cab models, to lock out the individual switches on the passenger doors from operation. The power window system receives battery feed through a circuit breaker in the junction block, only when the ignition switch is in the On position.

The power window system includes the power window switches on each door trim panel, the circuit breaker in the junction block, and the power window motors inside each door. This group covers diagnosis and service of only the electrical components in the power window system. For service of mechanical components, such as the regulator, lift plate, window tracks, or glass refer to Group 23 - Body.

Following are general descriptions of the major components in the power window system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the power window system.

OPERATION

POWER WINDOW SWITCH

On conventional cab and club cab models, the power windows are controlled by two-way switches integral to the power window and lock switch bezel on the passenger side and the Driver Door Module on the driver side of the trim panel of each front door. A second power window switch in the driver side switch and bezel unit allows the driver to control the passenger side window. On quad cab models, the power windows are controlled by four two-way switches and a power window lockout switch that are integral to the Driver Door Module on the driver side front door trim panel. Additionally, each of the passenger doors has a single gang two-way power window switch mounted in a bezel on their respective door trim panels.

On all models, the power window switch for the driver side front door window has an Auto label on it. This switch has a second detent position beyond the normal Down position that provides an automatic one-touch window down feature. This feature is controlled by an electronic circuit and a relay that are integral to the driver side front door power window and lock switch unit.

The power window switches control the battery and ground feeds to the power window motors. All of the passenger door power window switches receive their battery and ground feeds through the circuitry of the driver side master switch unit. On quad cab models, when the power window lockout switch is in the Lock position, the battery feed for the individual passenger door power window switches is interrupted.

A Light-Emitting Diode (LED) in the paddle of each switch is illuminated whenever the ignition switch is in the On position. However, on quad cab models the LEDs for the passenger power window switches are extinguished whenever the driver

POWER WINDOWS (Continued)

selects the Lock position with the power window lockout switch.

POWER WINDOW MOTOR

A permanent magnet reversible motor moves the window regulator through an integral gearbox mechanism. A positive and negative battery connection to the two motor terminals will cause the motor to rotate in one direction. Reversing the current through these same two connections will cause the motor to rotate in the opposite direction.

In addition, each power window motor is equipped with an integral self-resetting circuit breaker to protect the motor from overloads. The power window motor and gearbox assembly cannot be repaired and, if faulty or damaged, the entire power window regulator assembly must be replaced.

CIRCUIT BREAKER

An automatic resetting circuit breaker in the junction block is used to protect the power window system circuit. The circuit breaker can protect the system from a short circuit, or from an overload condition caused by an obstructed or stuck window glass or regulator.

The circuit breaker cannot be repaired and, if faulty, it must be replaced.

DIAGNOSIS AND TESTING - POWER WINDOWS

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.

ALL WINDOWS INOPERATIVE

(1) Check the circuit breaker in the junction block, as described in this group. If OK, go to Step 2. If not OK, replace the faulty circuit breaker.

(2) Disconnect and isolate the battery negative cable. Remove the power window and lock master switch unit from the driver side front door trim panel. Unplug the wire harness connector from the master switch unit.

(3) Check for continuity between the ground circuit cavity of the power window and lock master switch unit wire harness connector and a good ground. If OK, go to Step 4. If not OK, repair the circuit to ground 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 (run) circuit cavity of the power window and lock master switch unit wire harness connector. If OK, (Refer to 8 - ELECTRICAL/POWER WINDOWS/POWER WINDOW SWITCH - DIAGNOSIS AND TESTING). If not OK, repair the circuit to the junction block as required.

ONE WINDOW INOPERATIVE

The window glass must be free to slide up and down for the power window motor to function properly. If the glass is not free to move up and down, the motor will overload and trip the integral circuit breaker. To determine if the glass is free, disconnect the regulator plate from the glass. Then slide the window up and down by hand.

There is an alternate method to check if the glass is free. Position the glass between the up and down stops. Then, shake the glass in the door. Check that the glass can be moved slightly from side to side, front to rear, and up and down. Then check that the glass is not bound tight in the tracks. If the glass is free, proceed with the diagnosis that follows. If the glass is not free, refer to Group 23 - Body for the door window glass and hardware service and adjustment procedures.

If the only inoperative window is in the driver side front door and the preceding checks have not identified a problem, (Refer to 8 - ELECTRICAL/POWER WINDOWS/WINDOW MOTOR - DIAGNOSIS AND TESTING). If the problem being diagnosed involves only the Auto-down feature for the driver side front door window, but all of the power windows are operational, replace the faulty Driver Door Module. If the problem being diagnosed involves only an inoperative power window switch Light-Emitting Diode (LED), but the power window that the switch controls operates satisfactorily from that switch, replace the faulty switch unit. For any other single power window problem proceed with diagnosis as follows:

(1) Disconnect and isolate the battery negative cable. Unplug the wire harness connector from the power window switch unit on the door with the inoperative power window. Check for continuity between the ground circuit cavity of the power window switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 2. If not OK, repair the open circuit to the power window and door lock master switch as required.

(2) 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 in the body half of the power window switch unit wire harness connector. If OK, go to Step 3. If not OK, repair the open circuit to the power window and door lock master switch as required.

(3) Test the power window switch continuity (Refer to 8 - ELECTRICAL/POWER WINDOWS/POWER

POWER WINDOWS (Continued)

WINDOW SWITCH - DIAGNOSIS AND TESTING) . If OK, go to Step 4. If not OK, replace the faulty power window switch unit.

(4) 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. Check the continuity in each circuit between the inoperative power window switch wire harness connector cavities and the corresponding power window motor wire harness connector cavities. If OK, (Refer to 8 - ELECTRICAL/POWER WINDOWS/WINDOW MOTOR - DIAGNOSIS AND TESTING). If not OK, repair the open circuit(s) as required.

NOTE: All passenger door power window switches receive their battery and ground feed for operating the passenger door power window motors through the driver side power window and lock master switch and wire harness connector.

CIRCUIT BREAKER

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) Locate the circuit breaker in the junction block. Pull out the circuit breaker slightly, but be certain that the circuit breaker terminals still contact the terminals in the junction block cavities.

(2) Connect the negative lead of a 12-volt DC voltmeter to a good ground.

(3) With the voltmeter positive lead, check both terminals of the circuit breaker for battery voltage.

If only one terminal has battery voltage, the circuit breaker is faulty and must be replaced. If neither terminal has battery voltage, repair the open circuit from the Power Distribution Center (PDC) as required. If the circuit breaker checks OK, but no power windows operate, refer to ALL WINDOWS INOPERATIVE.

POWER WINDOW SWITCH

DIAGNOSIS AND TESTING - POWER WINDOW SWITCH

CONVENTIONAL CAB AND CLUB CAB

The Light-Emitting Diode (LED) illumination lamps for all of the power window and lock switch and bezel unit switch paddles receive battery current through the power window circuit breaker in the junction block. If all of the LEDs are inoperative in either or both power window and lock switch and bezel units and the power windows are inoperative, perform the diagnosis for Power Window System in this group. If the power windows operate, but any or all of the LEDs are inoperative, the power window and lock switch and must be replaced. 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 circuit breaker in the junction block. If OK, go to Step 2. If not OK, replace the faulty circuit breaker.

(2) Turn the ignition switch to the On position. Check for battery voltage at the circuit breaker in the junction block. If OK, turn the ignition switch to the Off position and go to Step 3. If not OK, repair the circuit to the ignition switch as required.

(3) Disconnect and isolate the battery negative cable. Remove the power window switch unit from the door trim panel (passenger doors only). For diagnosis of the driver side power window switch (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - DIAGNOSIS AND TESTING). Unplug the wire harness connector from the switch unit.

(4) Test the power window switch continuity. See the Power Window Switch Continuity chart to determine if the continuity is correct in the Neutral, Up and Down switch positions (Fig. 1). If OK, (Refer to 8 - ELECTRICAL/POWER WINDOWS/WINDOW MOTOR - DIAGNOSIS AND TESTING). If not OK, replace the faulty switch.

SWITCH POSITION	CONTINUITY BETWEEN
NEUTRAL	PIN 4 AND 1, PIN 2 AND 5
UP	PIN 6 AND 5
DOWN	PIN 6 AND 1

POWER WINDOW SWITCH (Continued)

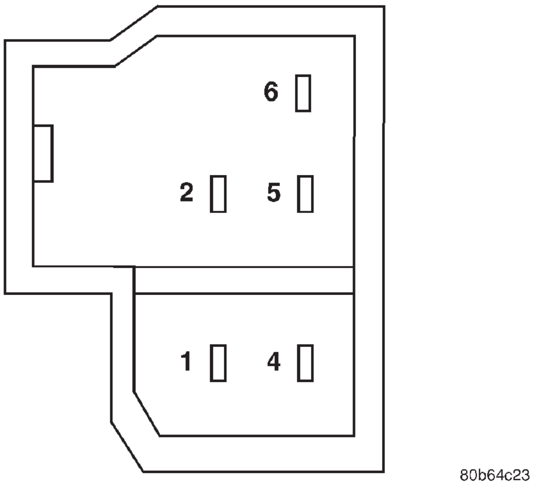

Fig. 1 PASSENGER DOOR SWITCH

QUAD CAB

The Light-Emitting Diode (LED) illumination lamps for all of the power window and lock switch and bezel unit switch paddles receive battery current through the power window circuit breaker in the junction block. If all of the LEDs are inoperative in both the power window and lock switch units and the power windows are inoperative, (Refer to 8 - ELECTRICAL/POWER WINDOWS - DIAGNOSIS AND TESTING). If the power windows operate, but any or all of the LEDs are inoperative, the power window and lock switch units with the inoperative LED(s) is faulty and must be replaced. 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 circuit breaker in the junction block. If OK, go to Step 2. If not OK, replace the faulty circuit breaker.

(2) Turn the ignition switch to the On position. Check for battery voltage at the circuit breaker in the junction block. If OK, turn the ignition switch to the Off position and go to Step 3. If not OK, repair the circuit to the ignition switch as required.

(3) Disconnect and isolate the battery negative cable. Remove the power window switch unit from the door trim panel (passenger doors only). For diagnosis of the driver side power window switch (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - DIAGNOSIS AND TESTING). Unplug the wire harness connector from the switch unit.

(4) Test the power window switch continuity. See the Power Window Switch Continuity chart to determine if the continuity is correct in the Off, Up and Down switch positions (Fig. 2). If OK, (Refer to 8 - ELECTRICAL/POWER WINDOWS/WINDOW MOTOR - DIAGNOSIS AND TESTING). If not OK, replace the faulty switch.

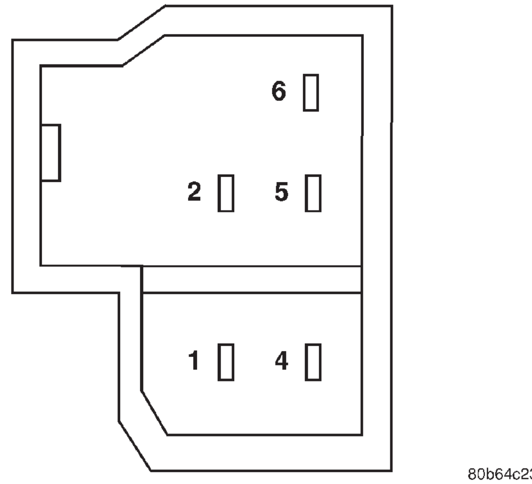

Fig. 2 PASSENGER DOOR SWITCH

SWITCH POSITION	CONTINUITY BETWEEN
NEUTRAL	PIN 2 AND 5, PIN 4 AND 1
UP (FRONT PASSENGER)	PIN 6 AND 5
UP (REAR PASSENGER)	PIN 6 AND 1
DOWN (FRONT PASSENGER)	PIN 6 AND 1
DOWN (REAR PASSENGER)	PIN 6 AND 5

REMOVAL

The driver side power window switch is included with the Drive Door Module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - REMOVAL) for the service procedures.

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick, start at the rear of the switch bezel and pry up from door trim panel .

(3) Disconnect the wire harness connector from switch.

(4) Remove switch from bezel.

INSTALLATION

The driver side power window switch is included with the Drive Door Module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - INSTALLATION) for the service procedures.

(1) Install switch to bezel.

(2) Connect wire harness connector to switch.

(3) Insert the front of the switch into the door trim panel first, then press into position.

(4) Connect the battery negative cable.

WINDOW MOTOR

DIAGNOSIS AND TESTING - WINDOW MOTOR

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) Disconnect and isolate the battery negative cable. Remove the trim panel from the door with the inoperative power window.

(2) Unplug the power window motor wire harness connector. Apply 12 volts across the motor terminals to check its operation in one direction. Reverse the connections across the motor terminals to check the operation in the other direction. Remember, if the window is in the full up or full down position, the motor will not operate in that direction by design. If OK, repair the circuits from the power window motor to the power window switch as required. If not OK, replace the faulty motor.

(3) If the motor operates in both directions, check the operation of the window glass and lift mechanism through its complete up and down travel. There should be no binding or sticking of the window glass or lift mechanism through the entire travel range. If not OK, refer to Group 23 - Body to check the window glass, tracks, and regulator for sticking, binding, or improper adjustment.

REMOVAL

The power window motor and mechanism is integral to the power window regulator unit. If the power window motor or mechanism is faulty or damaged, the entire power window regulator unit must be replaced. (Refer to 23 - BODY/DOOR - FRONT/WINDOW REGULATOR - REMOVAL) or (Refer to 23 - BODY/DOORS - REAR/WINDOW REGULATOR - REMOVAL) for the window regulator service procedures.

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 manual:

• **Airbag Control Module** - The Airbag Control Module (ACM) is located on a mount on the floor

RESTRAINTS (Continued)

8098029e

Fig. 1 SRS Logo

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.
- **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 lower right corner of the instrument panel, to the right of the cigar lighter or power outlet. The passenger airbag on/off switch is not used on quad cab models.
- **Passenger Knee Blocker** - The passenger knee blocker is a structural reinforcement that is integral to and concealed within the glove box door.
- **Seat Belt Tensioners** - Quad cab models are equipped with front seat belt tensioners for both outboard front seating positions. These tensioners are controlled by the ACM and are integral to the front seat belt and retractor assembly.

The ACM and the EMIC each contain a central processing unit and programming that allow them to communicate with each other using the Programmable Communication 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

RESTRAINTS (Continued)

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. Quad cab models are not equipped with a passenger airbag on/off switch, as this model has a full-sized rear seat. 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 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. On quad cab models, the seat belt tensioners are provided with a deployment signal by the ACM in conjunction with 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. The seat belt tensioners on quad cab models remove the slack from the outboard front seat belts to provide further assurance that the driver and front seat passenger are properly positioned and restrained for an airbag deployment.

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, including the seat belt tensioners on quad cab models, 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 Communication 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: WHEN HANDLING A SEAT BELT TENSIONER RETRACTOR, PROPER CARE SHOULD BE EXERCISED TO KEEP FINGERS OUT FROM UNDER THE RETRACTOR COVER AND AWAY FROM THE SEAT BELT WEBBING WHERE IT EXITS FROM THE RETRACTOR COVER.

RESTRAINTS (Continued)

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 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, FRONT 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.

STANDARD PROCEDURE - HANDLING NON-DEPLOYED PASSIVE RESTRAINTS

At no time should any source of electricity be permitted near the inflator on the back of a non-deployed airbag or seat belt tensioner. 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. When handling a non-deployed seat belt tensioner, take proper care to keep fingers out from under the retractor cover and away from the seat belt webbing where it exits from the retractor cover. In addition, the airbag system should be disarmed whenever any steering wheel, steering column, seat belt tensioners, 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 airbags or seat belt tensioners which are replaced on vehicles are to be returned. If an airbag or seat belt tensioner unit is faulty or damaged and non-deployed, follow the instructions in the current Mopar Hazardous Material Awareness Manual or the current DaimlerChrysler Corporation Warranty Policies and Procedures manual for the proper handling and disposal procedures.

PASSIVE RESTRAINT STORAGE

Airbags and seat belt tensioners must be stored in there 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 steering column assembly replaced. On quad cab models, the seat belt tensioners must also be 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.

RESTRAINTS (Continued)

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 nitrogen gas that inflates the airbag. Since sodium hydroxide powder can irritate the skin, eyes, nose, or throat, be sure to wear safety glasses, rubber gloves, and a long-sleeved shirt during cleanup (Fig. 2).

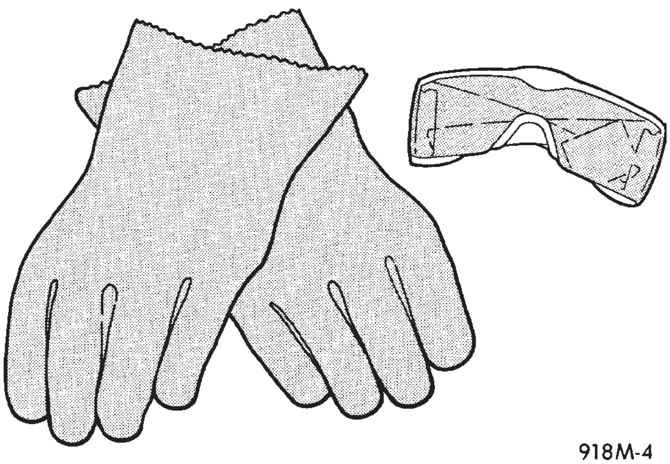


Fig. 2 Wear Safety Glasses and Rubber Gloves - Typical

WARNING: IF YOU EXPERIENCE SKIN IRRITATION DURING CLEANUP, RUN COOL WATER OVER THE AFFECTED AREA. ALSO, IF YOU EXPERIENCE IRRITATION OF THE NOSE OR THROAT, EXIT THE VEHICLE FOR FRESH AIR UNTIL THE IRRITATION CEASES. IF IRRITATION CONTINUES, SEE A PHYSICIAN.

Begin the cleanup by removing both airbags from the vehicle. On quad cab models, also remove both front seat belt tensioners. Refer to the appropriate service manual removal procedures. Place the deployed airbags and seat belt tensioners in your vehicular scrap pile.

Next, use a vacuum cleaner to remove any residual powder from the vehicle interior. Clean from outside the vehicle and work your way inside, so that you avoid kneeling or sitting on a non-cleaned area. Be 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. You may need to vacuum the interior of the vehicle a second time to recover all of the powder.

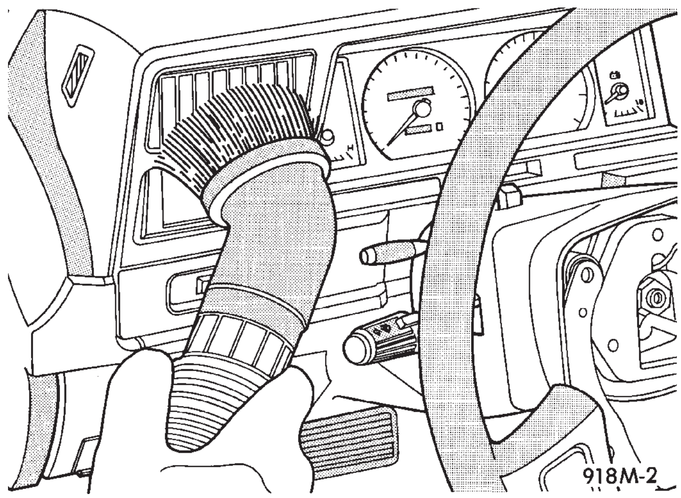


Fig. 3 Vacuum Heater and A/C Outlets - Typical

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, 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.

RESTRAINTS (Continued)

(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).

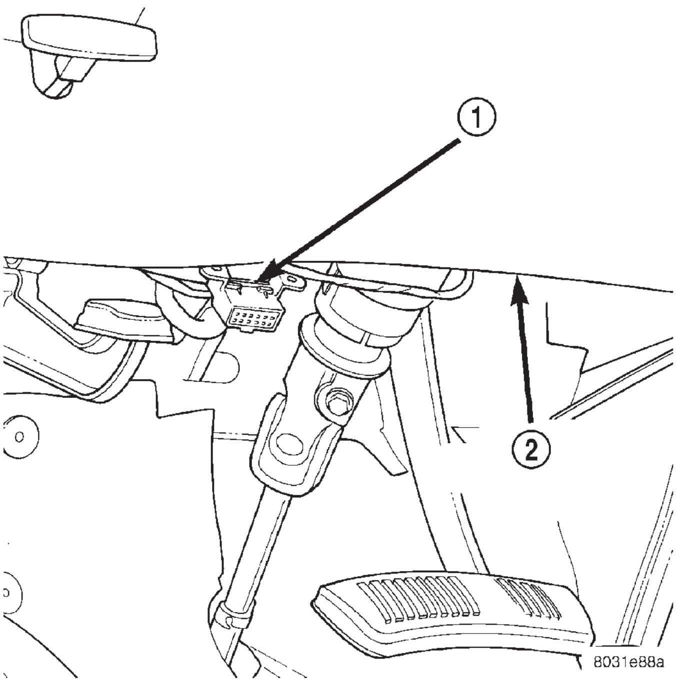


Fig. 4 16-Way Data Link Connector - Typical

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.

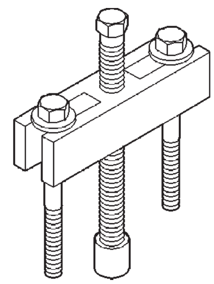
(7) If any DTC is found in Step 5 or Step 6, refer to the appropriate diagnostic information.

(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 position. 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

SPECIAL TOOLS - AIRBAG SYSTEM



Puller C-3428-B

AIRBAG CONTROL MODULE

DESCRIPTION

The Airbag Control Module (ACM) is secured with screws to a mount welded onto the top of the floor panel transmission tunnel behind the instrument panel center support bracket in the passenger compartment of the vehicle. The ACM contains an electronic microprocessor, an electronic impact sensor, an electromechanical safing sensor, and an energy storage capacitor. The ACM is connected to the vehicle electrical system through a take out and connector of the instrument panel 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

AIRBAG CONTROL MODULE (Continued)

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. If the airbag system fault is still present when the ignition switch is turned to the Off position, the DTC is stored in memory by the ACM. However, if a fault does not recur for a number of ignition cycles, the ACM will automatically erase the stored DTC.

For models equipped with the passenger airbag on/off switch (all except quad cab), the ACM receives a resistor multiplexed input from this 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.

The ACM receives battery current through two circuits, on a fused ignition switch output (run) circuit through a fuse in the Junction Block (JB), and on a fused ignition switch output (run-start) circuit through a second fuse in the JB. The ACM is grounded through a ground circuit and take out of the instrument panel wire harness. This take out has a single eyelet terminal connector secured by a ground screw to the left side of the floor panel transmission tunnel near the ACM 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 and, on quad cab models, the seat belt tensioners. The safing sensor is an electromechanical sensor within the ACM that is connected in series between the ACM microprocessor deployment circuit and the airbags/seat belt tensioners. 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/seat belt tensioners 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, SEAT BELT TENSIONERS, 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) From the right side of the floor panel transmission tunnel, remove the screw that secures the floor

AIRBAG CONTROL MODULE (Continued)

duct adapter to the bottom of the heater-air conditioner housing.

(3) Remove the floor duct adapter from the bottom of the heater-air conditioner housing.

(4) 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).

(5) Remove the two screws that secure the ACM to the right side of the mounting bracket that is welded onto the floor panel transmission tunnel (Fig. 5).

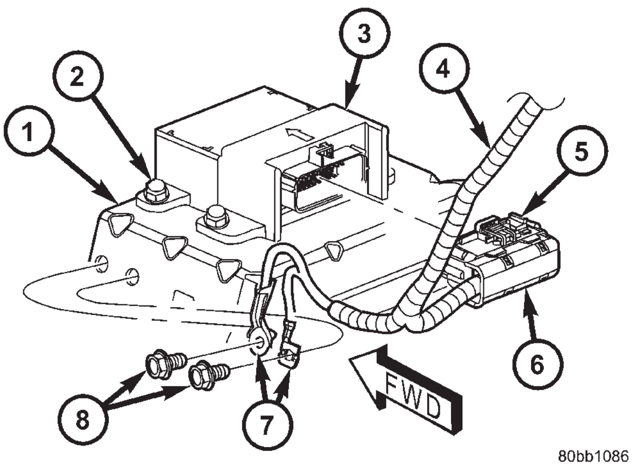


Fig. 5 Airbag Control Module

1 - MOUNTING BRACKET
2 - SCREW (4)
3 - AIRBAG CONTROL MODULE
4 - WIRE HARNESS
5 - CONNECTOR POSITION ASSURANCE LOCK
6 - CONNECTOR
7 - GROUND EYELET TERMINALS (2)
8 - GROUND SCREWS (2)

(6) Remove the two screws that secure the ACM to the left side of the mounting bracket that is welded onto the floor panel transmission tunnel.

(7) 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.

(8) Disconnect the instrument panel wire harness connector for the ACM from the ACM connector receptacle. To disconnect the instrument panel wire harness connector for the ACM:

(a) Slide the red Connector Position Assurance (CPA) lock on the top of the connector toward the right side of the vehicle.

(b) Depress the latch tab on the upper surface of the connector, and pull the connector straight away from the ACM connector receptacle.

(9) Remove the ACM from beneath the instrument panel.

INSTALLATION

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONERS, 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 instrument panel wire harness connector for the ACM to the ACM connector receptacle (Fig. 5). Be certain that the connector latch and the red Connector Position Assurance (CPA) lock are fully engaged.

(3) Carefully position the ACM to the mounting bracket that is welded onto the floor panel transmission tunnel. 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 two screws that secure the ACM to the right side of the mounting bracket that is welded onto the floor panel transmission tunnel. Tighten the screws to 12 N·m (105 in. lbs.).

(5) Install and tighten the two screws that secure the ACM to the left side of the mounting bracket that is welded onto the floor panel transmission tunnel. Tighten the screws to 12 N·m (105 in. lbs.).

AIRBAG CONTROL MODULE (Continued)

(6) Restore the carpet on the right and left sides of the floor panel transmission tunnel to its proper position beneath the instrument panel.

(7) From the right side of the floor panel transmission tunnel, position the floor duct adapter onto the bottom of the heater-air conditioner housing.

(8) Install and tighten the screw that secures the floor duct adapter to the bottom of the heater-air conditioner housing. Tighten the screw to 2 N·m (17 in. lbs.).

(9) 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).

CHILD TETHER

REMOVAL

Standard cab models have two child tether straps secured near the top of the cab back panel. Club cab and quad cab models have three child tether straps secured near the top of the cab back panel.

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) Remove the screw that secures the child tether strap (2 used on standard cab, 3 used on club/quad cab) to the cab back panel (Fig. 6).

(2) Remove the child tether strap from the cab back panel.

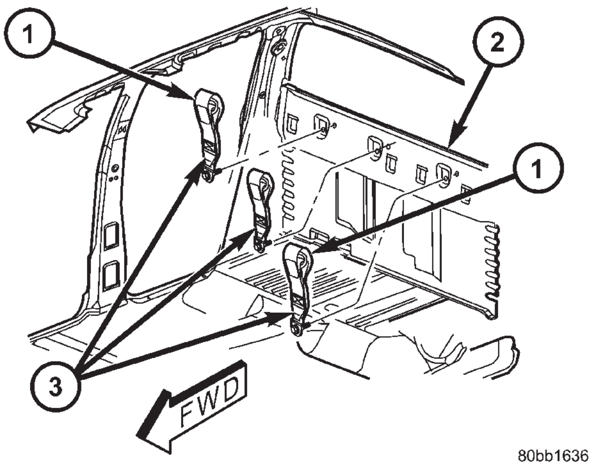


Fig. 6 Child Tether Straps

1 - CHILD TETHER STRAPS - STD. CAB (2)
2 - CAB BACK PANEL
3 - CHILD TETHER STRAPS - CLUB/QUAD CAB (3)

INSTALLATION

Standard cab models have two child tether straps secured near the top of the cab back panel. Club cab and quad cab models have three child tether straps secured near the top of the cab back panel.

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 child tether strap onto the cab back panel (Fig. 6).

(2) Install and tighten the screw that secures the child tether strap onto the cab back panel. Tighten the screw to 13.5 N·m (120 in. lbs.).

CLOCKSPRING

DESCRIPTION

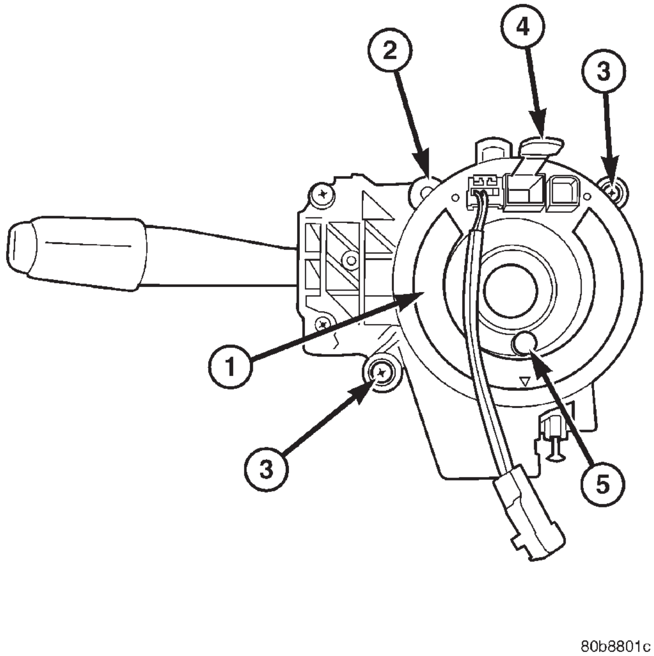


Fig. 7 Clockspring and Multi-Function Switch

1 - CLOCKSPRING
2 - LOCATING PIN
3 - SCREW (2)
4 - LOCKING PIN
5 - ENGAGEMENT DOWEL AND BOOT

The clockspring assembly is secured with two screws onto the multi-function switch mounting housing near the top of the steering column behind the steering wheel (Fig. 7). 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, an engagement dowel with a yellow rubber boot, a short pigtail wire with connector, and two connector receptacles that face toward the steering wheel. The lower surface of the rotor hub has a molded plastic turn signal cancel cam with two lobes that is keyed to the rotor and is secured there with four integral snap features. 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 wire and connector receptacles 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 instrument panel wire harness 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, the speed control switches, and the remote radio switches if the vehicle is so equipped. The clockspring case is positioned and secured to the multi-function switch mounting 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 instrument panel wire harness. The clockspring rotor is movable and is keyed by an engagement dowel that is molded onto the rotor hub between two fins that are cast into the lower surface of the steering wheel armature. A yellow rubber boot is installed over the engagement dowel to eliminate noise. 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 yellow sleeved pigtail wires on the upper surface of the clockspring rotor connect the clockspring to the driver airbag, while a steering wheel wire harness connects the two connector receptacles on the upper surface of the clockspring rotor to the horn switch and, if the vehicle is so equipped, to the optional speed control and remote radio switches on the steering wheel.

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. 8). 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.

WARNING: 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.

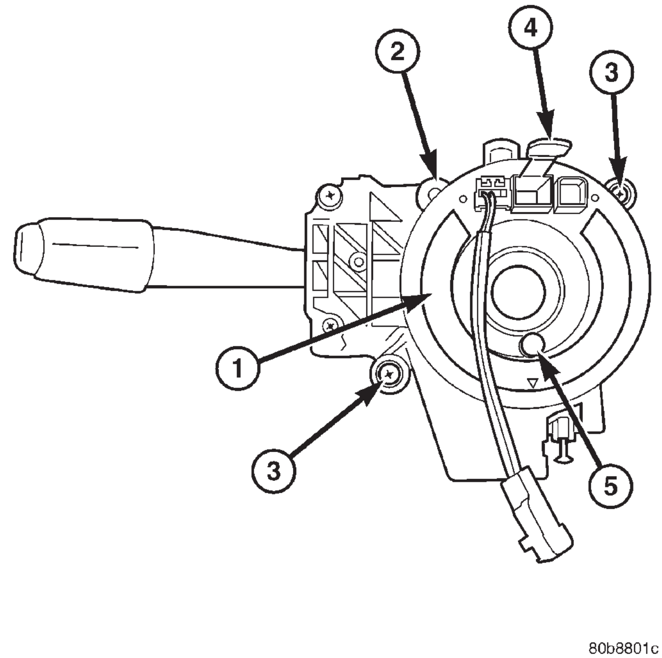


Fig. 8 Clockspring and Multi-Function Switch

1 - CLOCKSPRING
2 - LOCATING PIN
3 - SCREW (2)
4 - LOCKING PIN
5 - ENGAGEMENT DOWEL AND BOOT

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. The engagement dowel and yellow rubber boot should end up at the bottom, and the arrows on the clockspring rotor and case should be in alignment. The clockspring is now centered.

(5) 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).

CLOCKSPRING (Continued)

REMOVAL

The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver airbag has been deployed.

WARNING: 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.

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) Disconnect the steering wheel wire harness connectors from the upper clockspring connector receptacles.

(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) If the vehicle is so equipped, grasp the tilt steering column knob firmly and pull it straight rearward to remove it from the tilt steering column adjuster mechanism lever located on the left side of the column just below the multi-function switch control stalk.

(8) From below the steering column, remove the two outboard screws that secure the upper shroud to the lower shroud.

(9) Push gently inward on both sides of the upper shroud near the parting line between the upper and lower shrouds to release the snap features that secure it to the lower shroud.

(10) Remove the upper shroud from the lower shroud.

(11) From below the steering column, remove the one center screw that secures the lower shroud to the steering column lock housing.

(12) Remove the lower shroud from the steering column.

(13) Disconnect the two instrument panel wire harness connectors for the clockspring from the lower clockspring connector receptacles.

(14) Remove the two screws that secure the clockspring to the multi-function switch mounting housing (Fig. 9).

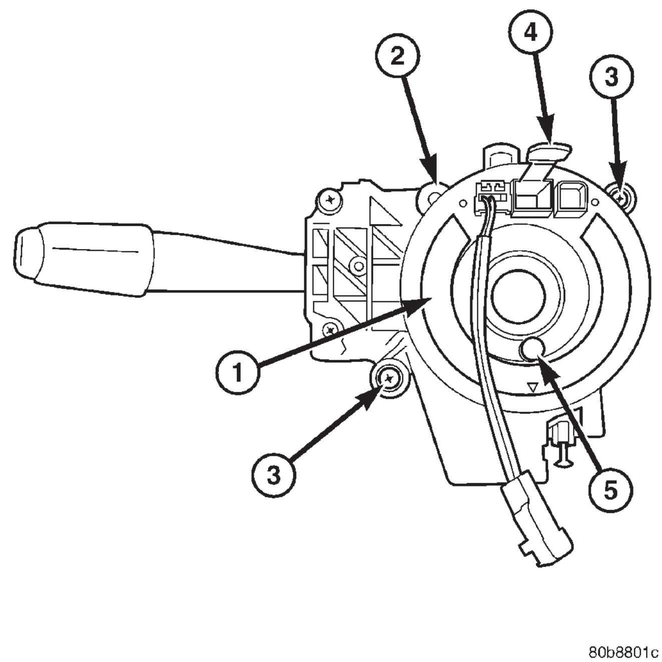


Fig. 9 Clockspring and Multi-Function Switch

1 - CLOCKSPRING
2 - LOCATING PIN
3 - SCREW (2)
4 - LOCKING PIN
5 - ENGAGEMENT DOWEL AND BOOT

(15) Remove the clockspring from the multi-function switch mounting housing. The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver airbag has been deployed.

(16) If the removed clockspring is to be reused, secure the clockspring rotor to the clockspring case to maintain clockspring centering until it is reinstalled

CLOCKSPRING (Continued)

on the steering column. 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.

WARNING: 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.

NOTE: Before starting this procedure, be certain that the front wheels are still in the straight-ahead position.

(1) Carefully slide the centered clockspring down over the steering column upper shaft until the hole in the locating tab at the eleven o'clock position on the clockspring case is engaged over the locating pin on the multi-function switch mounting housing (Fig. 9).

(2) Install and tighten the two screws that secure the clockspring to the multi-function switch mounting housing. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Reconnect the two instrument panel wire harness connectors for the clockspring to the lower clockspring connector receptacles.

(4) Position the lower shroud onto the steering column.

(5) From below the steering column, install and tighten the one center screw that secures the lower shroud to the steering column lock housing. Tighten the screw to 2 N·m (20 in. lbs.).

(6) Position the upper shroud onto the steering column. If the vehicle is equipped with an automatic transmission, be certain to engage the gearshift lever gap hider into the openings in the right side of the upper and lower shrouds.

(7) Align the snap features on the upper shroud with the receptacles on the lower shroud and apply hand pressure to snap them together.

(8) From below the steering column, install and tighten the two screws that secure the upper shroud to the lower shroud. Tighten the screws to 2 N·m (20 in. lbs.).

(9) If the vehicle is so equipped, align the tilt steering column knob with the tilt steering column adjuster mechanism lever located on the left side of the column just below the multi-function switch control stalk and using hand pressure push the knob firmly onto the lever.

(10) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(11) Reinstall the steering wheel onto the steering column upper shaft. Be certain to index the yellow rubber booted engagement dowel on the upper surface of the clockspring rotor between the two fins cast into the lower surface of the steering wheel armature hub. Pull the upper clockspring pigtail wire through the upper hole between the steering wheel back trim cover and the steering wheel armature.

(12) Install and tighten the screw that secures the steering wheel to the steering column upper shaft. Tighten the screw to 61 N·m (45 ft. lbs.). Be certain not to pinch the clockspring pigtail wire or the steering wheel wire harness between the steering wheel and the screw.

(13) Reconnect the steering wheel wire harness connectors to the upper clockspring connector receptacles. Be certain that the steering wire harness is routed between the steering wheel back trim cover and the steering wheel armature.

(14) 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. 10). The airbag used in this model is a Next Generation-type that

DRIVER AIRBAG (Continued)

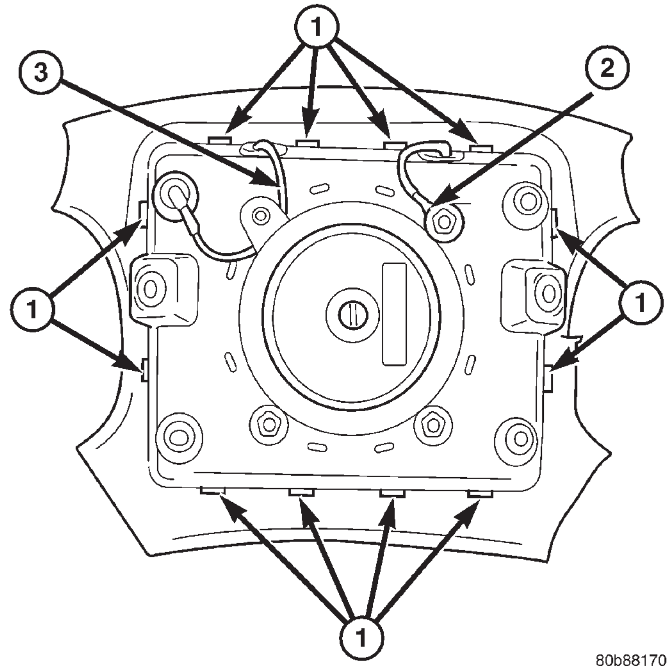


Fig. 10 Driver Airbag

1 - HOUSING HOOKS (12)
2 - HORN SWITCH GROUND PIGTAIL WIRE
3 - HORN SWITCH FEED PIGTAIL WIRE

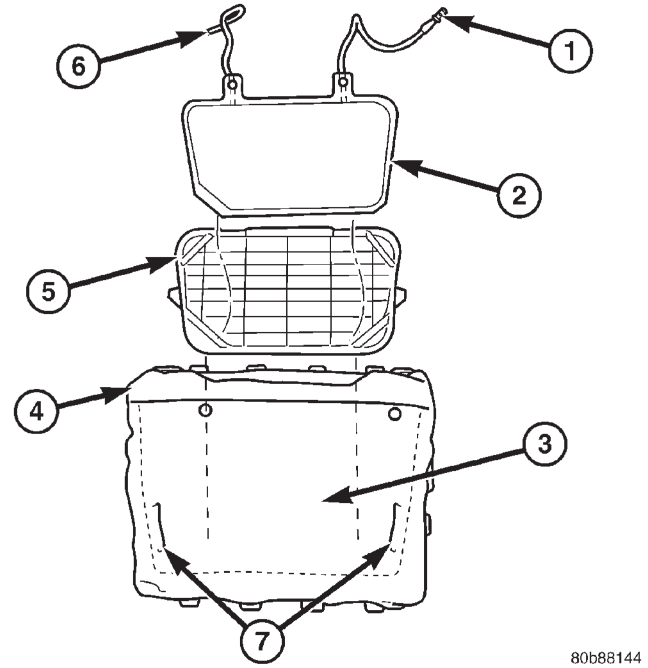


Fig. 11 Horn Switch

1 - HORN SWITCH GROUND PIGTAIL WIRE
2 - HORN SWITCH
3 - POUCH
4 - DRIVER AIRBAG (TRIM COVER REMOVED)
5 - TRAY
6 - HORN SWITCH FEED PIGTAIL WIRE
7 - POUCH SLITS

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 inflator to the airbag housing. The resistive membrane-type horn switch is secured within a plastic tray that is inserted in a pocket or pouch sewn onto the airbag cushion retainer strap, between the trim cover and the folded airbag cushion (Fig. 11). The airbag inflator is a conventional non-azide, pyrotechnic-type unit with four studs and it is secured to the stamped metal airbag housing with four nuts.

The trim cover has an airbag receptacle molded into the back side of it. The four vertical walls of this receptacle have a total of twelve small windows with blocking tabs that are engaged by twelve hook formations around the perimeter of the airbag housing. Each hook is inserted through one of the windows, the integral blocking tab in each window keeps each hook properly engaged with the trim cover, locking the cover securely into place. One horn switch pigtail wire has an eyelet terminal connector that is captured beneath a nut and washer on the upper right inflator mounting stud. The other horn switch pigtail wire is routed between the upper left inflator mounting stud and the inflator, where it is captured by a small plastic retainer that is pushed onto the 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 with tray are available, 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) 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

DRIVER AIRBAG (Continued)

the horn switch and tray unit. 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 may be 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 and the steering column assembly must also be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL) (Refer to 19 - STEERING/COLUMN - REMOVAL).

WARNING: 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.

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. 12).

(3) Pull the driver airbag away from the steering wheel far enough to access the two wire harness connectors at the back of the airbag.

(4) Disconnect the steering wheel wire harness connector for the horn switch from the horn switch feed pigtail wire connector, which is located at the back of the driver airbag.

CAUTION: Do not pull on the clockspring pigtail wire 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 at the back of the driver airbag. Firmly grasp and pull or gently pry on the clockspring driver airbag wire harness connector to disconnect it from the airbag inflator connector receptacle.

(6) Remove the driver airbag from the steering wheel.

(7) If the driver airbag has been deployed, the clockspring and the steering column must be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL). (Refer to 19 - STEERING/COLUMN - REMOVAL).

DISASSEMBLY

The following procedures can be used to replace the driver airbag trim cover or the horn switch and tray unit. If the driver airbag is faulty or deployed, the entire driver airbag, trim cover, and horn switch must be replaced as a unit.

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DRIVER AIRBAG (Continued)

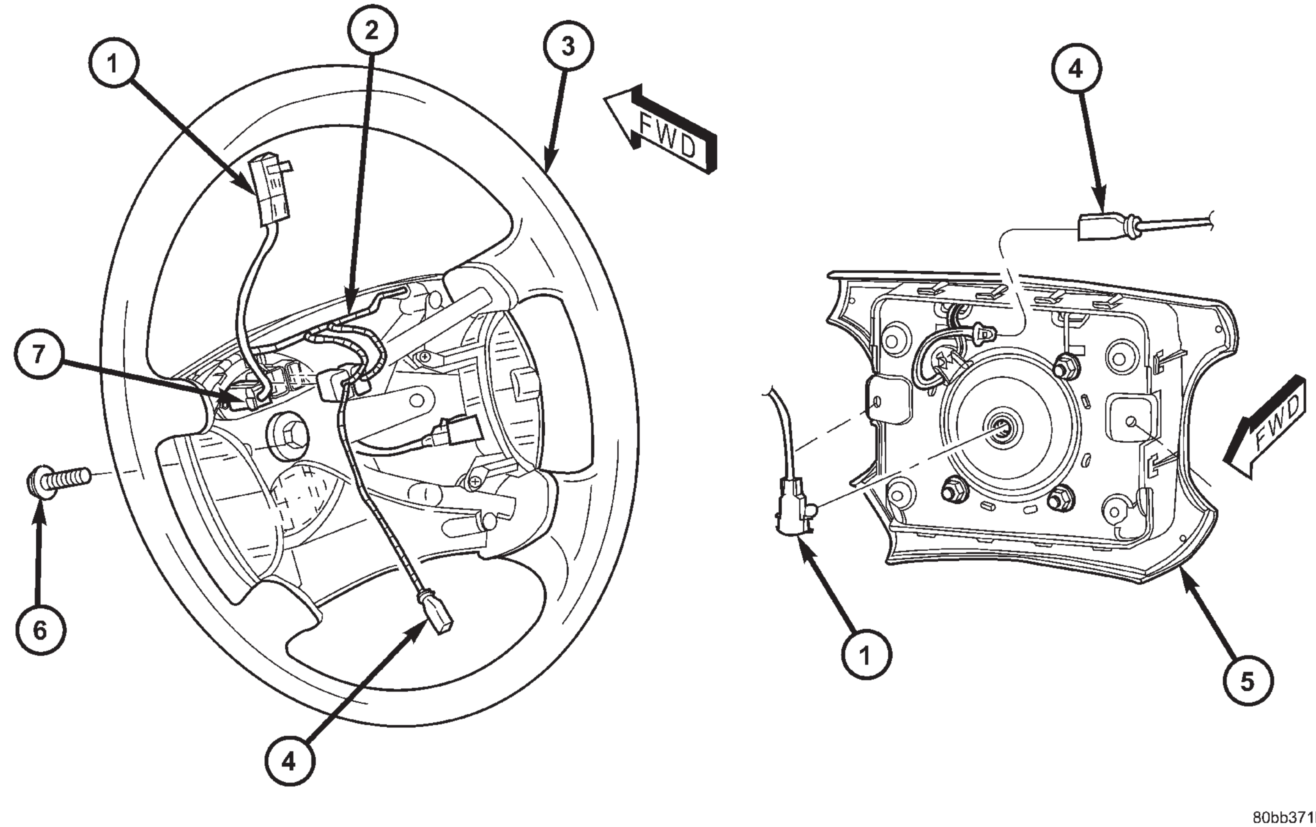

Fig. 12 Driver Airbag Remove/Install

1 - CLOCKSPRING DRIVER AIRBAG PIGTAIL WIRE
2 - STEERING WHEEL WIRE HARNESS
3 - STEERING WHEEL
4 - CONNECTOR FOR HORN SWITCH FEED PIGTAIL WIRE
5 - DRIVER AIRBAG
6 - SCREW (2)
7 - CLOCKSPRING

WARNING: THE HORN SWITCH IS INTEGRAL TO THE DRIVER AIRBAG UNIT. SERVICE OF THIS UNIT SHOULD BE PERFORMED ONLY BY DAIMLER-CHRYSLER-TRAINED AND AUTHORIZED DEALER SERVICE TECHNICIANS. FAILURE TO TAKE THE PROPER PRECAUTIONS OR TO FOLLOW THE PROPER PROCEDURES COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER AIRBAG DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.

(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) Using hand pressure, press the airbag housing down into the receptacle on the back of the driver airbag trim cover.

(4) Carefully pry back the walls of the driver airbag receptacle on the back of the trim cover to release each of the twelve windows of the trim cover receptacle from the twelve hook formations on the perimeter of the airbag housing.

(5) Remove the housing, inflator, cushion, and horn switch as a unit from the driver airbag trim cover receptacle.

(6) Gently pry off the plastic wire retainer that captures the horn switch feed pigtail wire between the upper right inflator stud and the inflator on the back of the driver airbag housing.

(7) Remove the nut and washer that secures the horn switch ground pigtail wire eyelet terminal to the upper left inflator stud on the back of the driver airbag housing.

(8) Remove the horn switch ground pigtail wire eyelet terminal from the upper left inflator stud on the back of the driver airbag housing.

(9) Slide the horn switch and tray unit all the way to one side of the pouch on the driver airbag cushion

DRIVER AIRBAG (Continued)

retainer strap to disengage one of the retaining tabs on the tray from one of the slits located in each side of the pouch.

(10) Remove the horn switch and tray as a unit from the pouch on the driver airbag cushion retainer strap (Fig. 13).

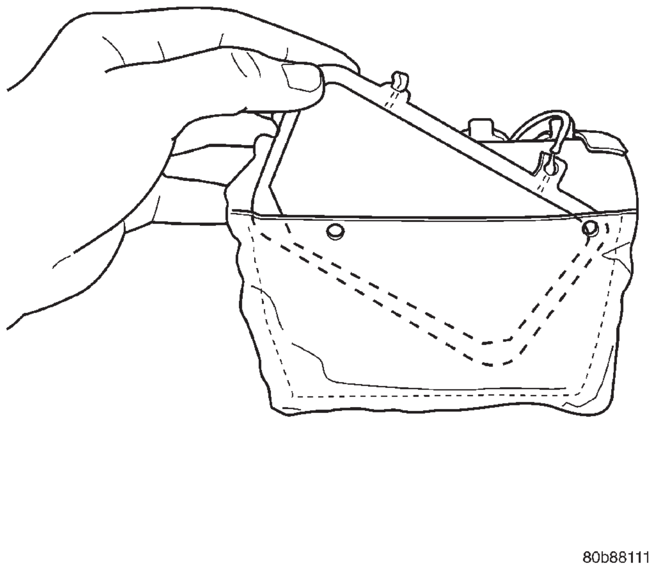

Fig. 13 Horn Switch Remove/Install

ASSEMBLY

The following procedures can be used to replace the driver airbag trim cover or the horn switch and tray unit. If the driver airbag is faulty or deployed, the entire driver airbag, trim cover, and horn switch must be replaced as a unit.

WARNING: 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.

WARNING: THE HORN SWITCH IS INTEGRAL TO THE DRIVER AIRBAG UNIT. SERVICE OF THIS UNIT SHOULD BE PERFORMED ONLY BY DAIMLER-CHRYSLER-TRAINED AND AUTHORIZED DEALER SERVICE TECHNICIANS. FAILURE TO TAKE THE PROPER PRECAUTIONS OR TO FOLLOW THE PROPER PROCEDURES COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER AIRBAG DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.

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) Install the horn switch and tray unit into the pouch on the driver airbag cushion retainer strap. Be certain that the tray is facing the airbag cushion, that the horn switch membrane is facing the airbag trim cover, that the horn switch feed pigtail wire is on the right, that the horn switch ground pigtail wire is on the left, and that the retaining tabs on the tray are each engaged in one of the slits located in each side of the pouch (Fig. 14)

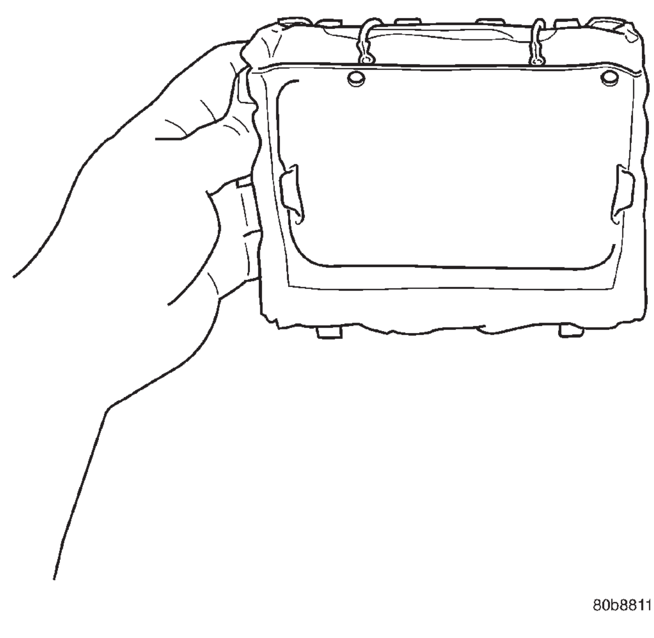

Fig. 14 Horn Switch Installed

DRIVER AIRBAG (Continued)

(2) Route the horn switch ground pigtail wire through the clearance notch between the two upper left hooks on the driver airbag housing. Install the eyelet terminal over the upper left inflator stud and engage the terminal under the anti-rotation tab directly above the stud on the back of the driver airbag housing.

(3) Install and tighten the nut and washer that secure the horn switch ground pigtail wire eyelet terminal to the upper left inflator stud on the back of the driver airbag housing. Tighten the nut to 7 N·m (65 in. lbs.).

(4) Route the horn switch feed pigtail wire through the clearance notch between the two upper right hooks and between the upper right inflator stud and the inflator on the back of the driver airbag housing.

(5) Using hand pressure, press the plastic wire retainer onto the upper right inflator stud to capture the horn switch feed pigtail wire between the stud and the inflator on the back of the driver airbag housing.

(6) Carefully position the driver airbag into the receptacle on the back of the trim cover. Be certain that the horn switch feed and ground pigtail wires remain properly routed through the clearance notches at the top of the airbag housing and are not pinched between the airbag housing and the walls of the trim cover receptacle.

(7) Work around the perimeter of the unit engaging each of the twelve hooks on the driver airbag housing through the windows in the walls of the trim cover receptacle.

(8) After each of the twelve hooks on the driver airbag housing has been engaged in a window of the trim cover receptacle, try pulling the trim cover and the airbag housing away from each other. This action will fully seat the edges of the windows into the cradles of the hooks.

(9) After all of the windows in the walls of the trim cover receptacle have been fully seated in the cradles of the hooks on the airbag housing, push the blocking tabs of the two windows on the right and left side walls of the trim cover receptacle inward so that they are oriented behind the airbag housing hooks, as shown in (Fig. 15).

(10) Inspect the airbag housing hooks in the windows of the upper and lower walls of the trim cover receptacle to be certain they are fully engaged and that the blocking tabs for these windows are oriented over the tops of the hooks, as shown in (Fig. 16).

(11) Reinstall the driver airbag onto the steering wheel (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

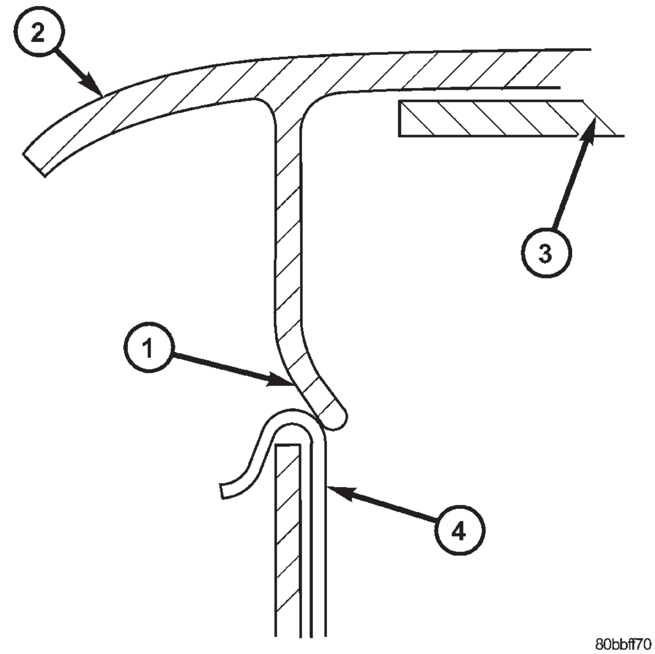

Fig. 15 Driver Airbag Trim Cover Side Blocking Tabs

1 - BLOCKING TAB
2 - DRIVER AIRBAG TRIM COVER
3 - HORN SWITCH
4 - AIRBAG HOUSING HOOK

INSTALLATION

The following procedure is for replacement of a faulty or damaged driver airbag. If the driver airbag has been deployed, the clockspring and the steering column assembly must also be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL) and (Refer to 19 - STEERING/COLUMN - REMOVAL).

WARNING: 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.

DRIVER AIRBAG (Continued)

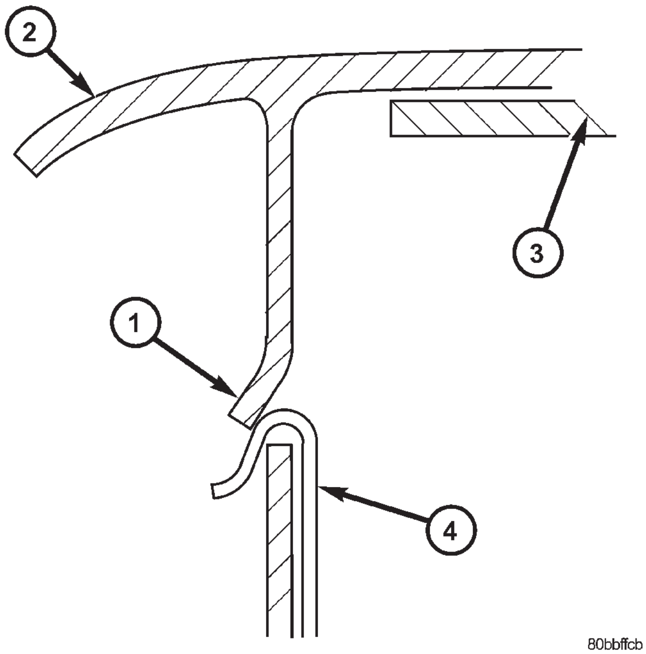

Fig. 16 Driver Airbag Trim Cover Upper & Lower Blocking Tabs

1 - BLOCKING TAB
2 - DRIVER AIRBAG TRIM COVER
3 - HORN SWITCH
4 - AIRBAG HOUSING HOOK

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 inflator connector receptacle by pressing straight in on the connector (Fig. 12). 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 steering wheel wire harness connector for the horn switch to the horn switch feed pigtail wire connector, which is located at the back of the driver airbag.

(4) Carefully position the driver airbag in the steering wheel. Be certain that the clockspring pigtail wire and steering wheel wire harness in the steering wheel hub area are not pinched between the driver airbag and the steering wheel armature.

(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 - QUAD CAB

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.

FRONT SEAT BELT & RETRACTOR (Continued)

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 lower seat belt anchor plate, the retractor, and the B-pillar.

(2) 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.

(3) Lift the cover on the lower seat belt anchor plate far enough to access the screw that secures the anchor plate to the front seat adjuster.

(4) Remove the screw that secures the lower seat belt anchor plate to the seat adjuster (Fig. 17).

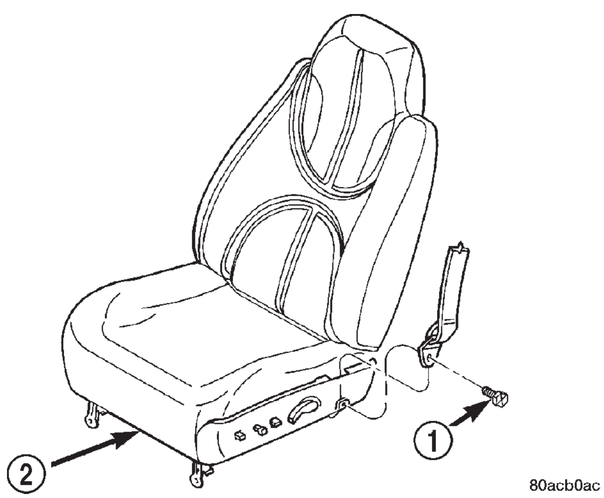

Fig. 17 Front Seat Belt Lower Anchor

1 - SCREW
2 - SEAT

(5) Unsnap and remove the front shoulder belt turning loop cover to access the screw that secures the turning loop to the height adjuster.

(6) Remove the screw that secures the shoulder belt turning loop to the height adjuster (Fig. 18).

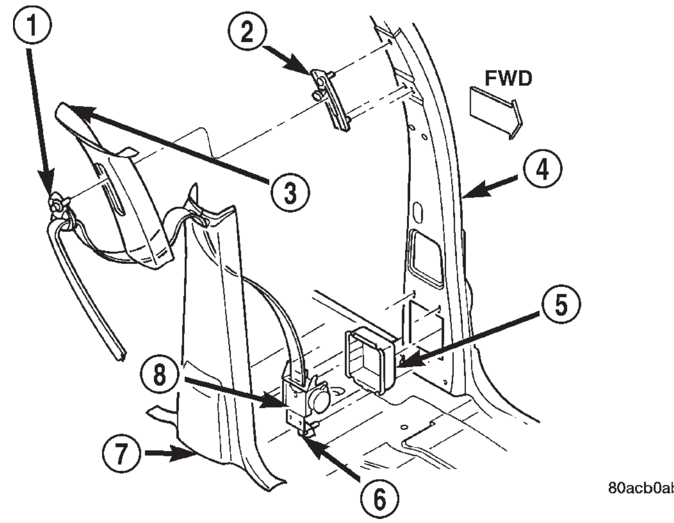

Fig. 18 Front Shoulder Belt & Retractor - Quad Cab

1 - TURNING LOOP
2 - HEIGHT ADJUSTER
3 - UPPER B-PILLAR TRIM
4 - B-PILLAR
5 - SHIELD
6 - SCREW
7 - LOWER B-PILLAR TRIM
8 - RETRACTOR

(7) Remove the shoulder belt turning loop from the height adjuster.

(8) Remove the trim from the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR TRIM - REMOVAL).

(9) Remove the two screws that secure the seat belt web guide to the B-pillar above the retractor.

(10) Disconnect the seat belt tensioner pigtail wire connector from the body wire harness connector.

(11) On the driver side only, disconnect the seat belt switch pigtail wire connector from the body wire harness connector.

(12) Remove the screw that secures the retractor to the B-pillar.

(13) Remove the front shoulder belt and retractor from the B-pillar.

FRONT SEAT BELT & RETRACTOR (Continued)

REMOVAL - STANDARD/CLUB CAB

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 lower seat belt anchor plate, the retractor, and the B-pillar.

(2) Disconnect and isolate the battery negative cable.

(3) Unsnap and remove the front shoulder belt turning loop cover to access the screw that secures the turning loop to the height adjuster.

(4) Remove the screw that secures the shoulder belt turning loop to the height adjuster (Fig. 19).

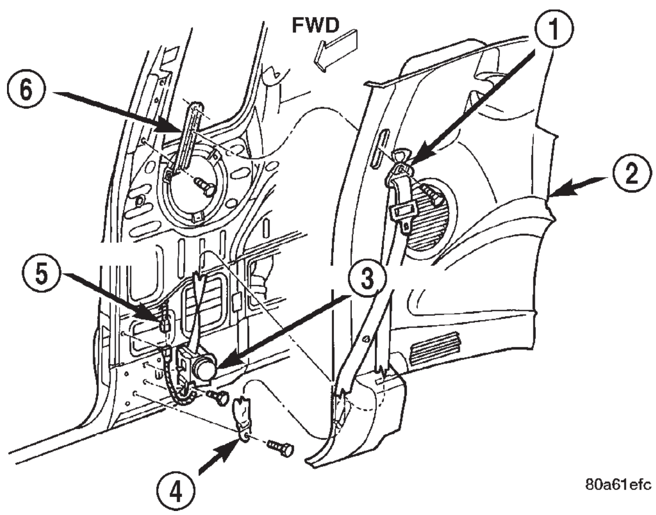

Fig. 19 Front Shoulder Belt & Retractor - Standard/ Club Cab - Typical

1 - TURNING LOOP
2 - QUARTER TRIM
3 - RETRACTOR
4 - LOWER ANCHOR
5 - SEAT BELT SWITCH CONNECTOR (DRIVER SIDE ONLY)
6 - HEIGHT ADJUSTER

(5) Remove the shoulder belt turning loop from the height adjuster.

(6) Remove the trim from the quarter inner panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL).

(7) Remove the screw that secures the lower seat belt anchor plate to the B-pillar.

(8) Remove the lower seat belt anchor plate from the B-pillar.

(9) On the driver side only, disconnect the seat belt switch pigtail wire connector from the body wire harness connector.

(10) Remove the screw that secures the retractor to the B-pillar.

(11) Remove the front shoulder belt and retractor from the B-pillar.

INSTALLATION - QUAD CAB

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.

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) Be certain that the retractor shield is properly installed in the B-pillar and in good condition before installing the retractor (Fig. 18).

(2) Position the retractor into the B-pillar.

FRONT SEAT BELT & RETRACTOR (Continued)

(3) Install and tighten the screw that secures the retractor to the B-pillar. Tighten the screw to 40 N·m (29 ft. lbs.).

(4) Reconnect the seat belt tensioner pigtail wire connector to the body wire harness connector.

(5) On the driver side only, reconnect the seat belt switch pigtail wire connector to the body wire harness connector.

(6) Position the seat belt web guide to the B-pillar above the retractor.

(7) Install and tighten the two screws that secure the seat belt web guide to the B-pillar. Tighten the screws to 2 N·m (17 in. lbs.).

(8) Reinstall the trim onto the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR TRIM - INSTALLATION).

(9) Position the shoulder belt turning loop onto the height adjuster.

(10) Install and tighten the screw that secures the shoulder belt turning loop to the height adjuster. Tighten the screw to 30 N·m (22 ft. lbs.).

(11) Snap the trim cover over the front shoulder belt turning loop anchor plate to conceal the screw that secures the turning loop to the height adjuster.

(12) Position the lower seat belt anchor plate to the seat adjuster (Fig. 17).

(13) Install and tighten the screw that secures the lower seat belt anchor plate to the seat adjuster. Tighten the screw to 30 N·m (22 ft. lbs.).

(14) Reposition the cover over the lower seat belt anchor plate to conceal the screw that secures the anchor plate to the front seat adjuster.

(15) Reconnect the battery negative cable.

INSTALLATION - STANDARD/CLUB CAB

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 retractor into the B-pillar (Fig. 18).

(2) Install and tighten the screw that secures the retractor to the B-pillar. Tighten the screw to 40 N·m (29 ft. lbs.).

(3) On the driver side only, reconnect the seat belt switch pigtail wire connector to the body wire harness connector.

(4) Position the lower seat belt anchor plate to the B-pillar.

(5) Install and tighten the screw that secures the lower seat belt anchor plate to the B-pillar. Tighten the screw to 40 N·m (29 ft. lbs.).

(6) Reinstall the trim onto the quarter inner panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION).

(7) Position the shoulder belt turning loop onto the height adjuster.

(8) Install and tighten the screw that secures the shoulder belt turning loop to the height adjuster. Tighten the screw to 30 N·m (22 ft. lbs.).

(9) Snap the trim cover over the front shoulder belt turning loop anchor plate to conceal the screw that secures the turning loop to the height adjuster.

(10) Reconnect the battery negative cable.

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) If the vehicle is so equipped, remove the console from the floor panel transmission tunnel. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL).

(2) If the vehicle is so equipped, remove the bench seat from the passenger compartment. (Refer to 23 - BODY/SEATS/SEAT - REMOVAL - BENCH).

(3) If the vehicle is so equipped, remove the center seat from the passenger compartment. (Refer to 23 - BODY/SEATS/CENTER SEAT ARMREST/CONSOLE - REMOVAL - CENTER SEAT/CONSOLE).

FRONT SEAT BELT BUCKLE (Continued)

(4) Remove the screw that secures the front seat belt buckle unit to the seat adjuster (Fig. 20).

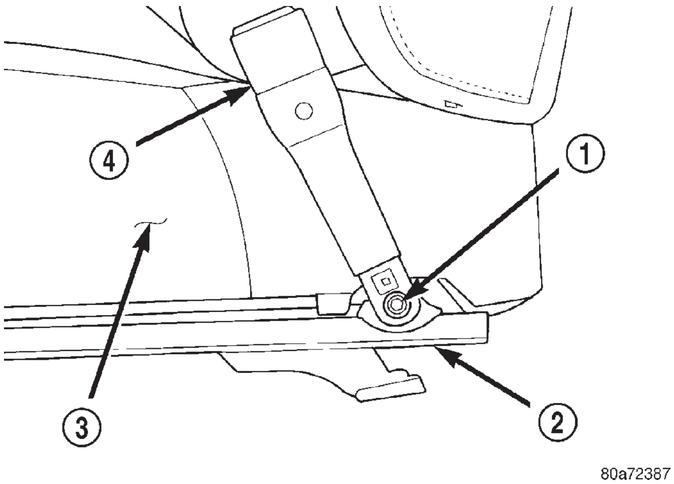

Fig. 20 Front Seat Belt Buckle - Typical

1 - SCREW
2 - SEAT ADJUSTER
3 - SEAT CUSHION
4 - SEAT BELT BUCKLE

(5) Remove the front seat belt buckle from the seat adjuster.

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 belt buckle to the seat adjuster (Fig. 20).

(2) Install and tighten the screw that secures the front seat belt buckle unit to the seat adjuster. Tighten the screw to 23 N·m (17 ft. lbs.). The buckle should be free to pivot slightly fore and aft after the screw is tightened.

(3) If the vehicle is so equipped, reinstall the center seat into the passenger compartment. (Refer to 23 - BODY/SEATS/CENTER SEAT ARMREST/CONSOLE - INSTALLATION - CENTER SEAT/CONSOLE).

(4) If the vehicle is so equipped, reinstall the bench seat into the passenger compartment.(Refer to 23 - BODY/SEATS/SEAT - INSTALLATION - BENCH).

(5) If the vehicle is so equipped, reinstall the console onto the floor panel transmission tunnel. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION).

PASSENGER AIRBAG

DESCRIPTION

The rearward facing surface of the passenger airbag door 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 to the instrument 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 and sealed within the airbag housing along with the folded airbag cushion. The airbag housing is constructed of a long U-shaped aluminum extrusion with two stamped steel end plates. Two tabs that extend from the bottom of the extrusion serve as the rear mounting brackets, while an angled foot on the bottom of each end plate serve as the front mounting brackets. The front brackets are secured with screws to the instrument panel armature above the glove box, while the rear brackets are secured with screws to the upper glove box opening reinforcement. 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 has a predetermined horizontal breakout line near its center which is concealed beneath its decorative outer surface. Return flanges near the top and bottom of the airbag door feature windows that are engaged on hook formations at the top and bottom of the airbag housing. Three tabs extend downward from the lower return flange and are secured with the same screws that secure the glove box module to the upper glove box opening reinforcement. Five molded snap features along the top of the airbag door above the upper return flange snap into receptacles located in the instrument panel base trim just below the instrument panel top cover. Following a passenger airbag

PASSENGER AIRBAG (Continued)

deployment, the passenger airbag and airbag door unit must be replaced. The passenger airbag cannot be repaired, and must be replaced if faulty or in any way damaged. The passenger airbag door is serviced only as a unit with the passenger airbag.

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 the breakout line and the two halves of the door will pivot out of the way. Following an airbag deployment, the airbag cushion quickly deflates by venting the argon gas through vents on the instrument panel side 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

WARNING: 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.

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 glove box module from the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(3) Remove the radio from the instrument panel (Refer to 8 - ELECTRICAL/AUDIO/RADIO - REMOVAL).

(4) Reach through the radio opening in the instrument panel to access and disconnect the instrument panel wire harness connector for the passenger airbag from the passenger airbag pigtail wire connector on the instrument panel armature to the left of the glove box opening (Fig. 21).

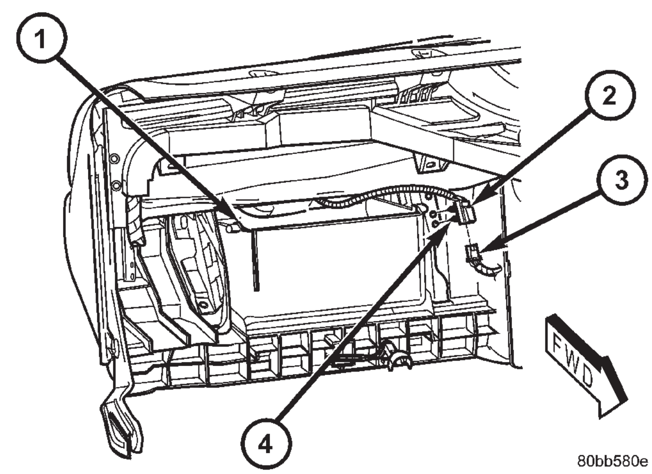

Fig. 21 Passenger Airbag Connector

1 - GLOVE BOX
2 - PASSENGER AIRBAG PIGTAIL WIRE CONNECTOR
3 - INSTRUMENT PANEL WIRE HARNESS CONNECTOR
4 - RETAINER (2)

(5) Disengage the passenger airbag pigtail wire connector retainers from the instrument panel armature.

(6) Working through the glove box opening, remove the two screws that secure the passenger airbag front brackets to the instrument panel armature (Fig. 22).

PASSENGER AIRBAG (Continued)

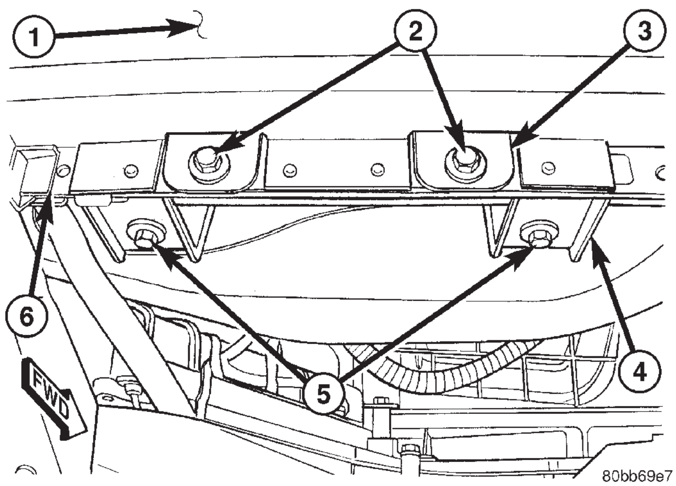

Fig. 22 Passenger Airbag Mounting

1 - PASSENGER AIRBAG DOOR
2 - REAR SCREW (2)
3 - PASSENGER AIRBAG REAR BRACKET
4 - INSTRUMENT PANEL ARMATURE
5 - FRONT SCREW (2)
6 - GLOVE BOX OPENING UPPER REINFORCEMENT

(7) Remove the two screws that secure the passenger airbag rear brackets to the glove box opening upper reinforcement.

(8) Using a trim stick or another suitable wide flat-bladed tool, gently pry the top of the passenger airbag door away from the instrument panel far enough to disengage the five snap features on the airbag door from their receptacles in the instrument panel.

(9) Remove the passenger airbag and airbag door from the instrument panel as a unit.

INSTALLATION

WARNING: 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.

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 PASSENGER 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 into the instrument panel.

(2) Align the five snap features on the upper edge of the passenger airbag door with the receptacles in the instrument panel top cover.

(3) Using hand pressure, press firmly on the passenger airbag door over each of the snap feature locations until each of them is fully engaged in its receptacle.

(4) Install and tighten the two screws that secure the passenger airbag rear brackets to the glove box opening upper reinforcement (Fig. 22). Tighten the screws to 9 N·m (80 in. lbs.).

(5) Working through the glove box opening, install and tighten the two screws that secure the passenger airbag front brackets to the instrument panel armature. Tighten the screws to 9 N·m (80 in. lbs.).

(6) Reach through the radio opening in the instrument panel to access and reconnect the instrument panel wire harness connector for the passenger airbag to the passenger airbag pigtail wire connector (Fig. 21). Be certain that the passenger airbag pigtail wire connector is fully engaged with and latched to the instrument panel wire harness connector.

(7) Engage the passenger airbag pigtail wire connector retainers in the mounting holes provided on the instrument panel armature.

(8) Reinstall the radio into the instrument panel (Refer to 8 - ELECTRICAL/AUDIO/RADIO - INSTALLATION).

(9) Reinstall the glove box module onto the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION).

PASSENGER AIRBAG (Continued)

(10) 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 ON/OFF SWITCH

DESCRIPTION

The passenger airbag on-off switch is standard equipment on all versions of this model except quad cab. 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 in the lower right corner of instrument panel cluster bezel, near the center of instrument panel 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 cluster bezel are the switch face plate and nomenclature, the key cylinder actuator, and a small round lens with the text ″Off″ imprinted on it. The “On” position of the switch is designated by text imprinted upon the face plate of the switch, but is not illuminated. The remainder of the switch is concealed behind the switch face plate and the instrument panel cluster 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 switch face plate with three small screws. The molded plastic face plate also has three integral mounting tabs that are used to secure the switch and face plate unit to the instrument panel cluster bezel with three additional screws. 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 instrument panel 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.

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. The ignition key is the only key or object that should ever be inserted into 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 also store a Diagnostic Trouble Code (DTC) for any fault it detects in the passenger airbag on/off switch or 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.

PASSENGER AIRBAG ON/OFF SWITCH (Continued)

REMOVAL

WARNING: 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) 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 cluster bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - REMOVAL).

(3) Remove the three screws that secure the passenger airbag on/off switch and face plate unit to the back of the cluster bezel (Fig. 23).

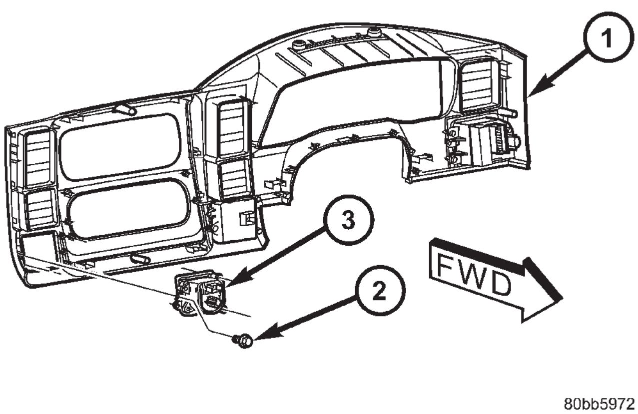

Fig. 23 Passenger Airbag On/Off Switch

1 - CLUSTER BEZEL
2 - SCREW (3)
3 - PASSENGER AIRBAG ON/OFF SWITCH

(4) Remove the passenger airbag on/off switch and face plate from the cluster bezel as a unit.

INSTALLATION

WARNING: 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) Position the passenger airbag on/off switch and face plate unit to the back of the cluster bezel (Fig. 23).

(2) Install and tighten the three screws that secure the passenger airbag on/off switch face plate to the cluster bezel. Tighten the screws to 2 N·m (17 in. lbs.).

(3) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - INSTALLATION).

(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).

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) Unsnap and remove the rear shoulder belt turning loop cover to access the screw that secures the turning loop to the quarter inner panel (club cab) or the C-pillar (quad cab).

(2) Remove the screw that secures the shoulder belt turning loop to the quarter inner panel (club cab) (Fig. 24) or the C-pillar (quad cab) (Fig. 25).

REAR SEAT BELT & RETRACTOR (Continued)

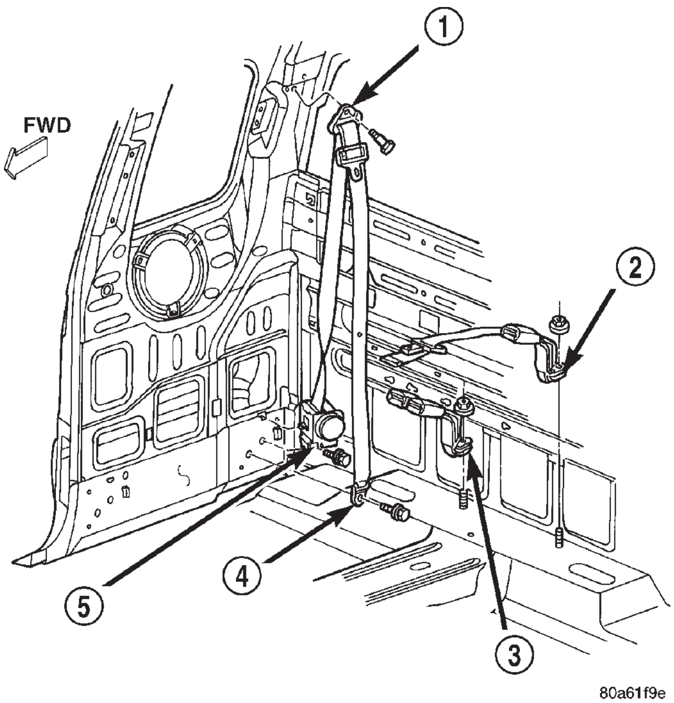

Fig. 24 Rear Seat Belt & Retractor - Club Cab

1 - TURNING LOOP
2 - LAP BELT/BUCKLE ANCHOR
3 - BUCKLE/BUCKLE ANCHOR
4 - LOWER ANCHOR
5 - RETRACTOR

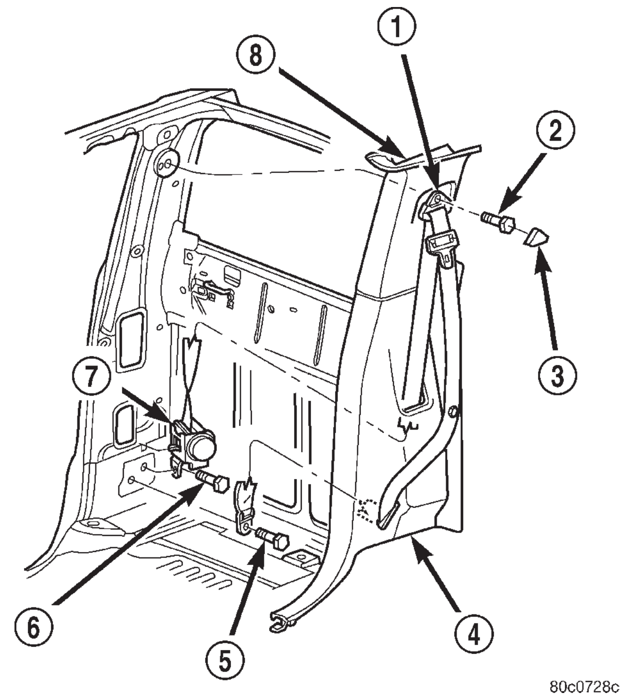

Fig. 25 Rear Seat Belt & Retractor - Quad Cab

1 - TURNING LOOP
2 - SCREW
3 - COVER
4 - LOWER C-PILLAR TRIM
5 - SCREW
6 - SCREW
7 - RETRACTOR
8 - UPPER C-PILLAR TRIM

(3) Remove the shoulder belt turning loop from the quarter inner panel (club cab) or the C-pillar (quad cab).

(4) Remove the trim from the quarter inner panel (club cab) (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL) or the C-pillar (quad cab) (Refer to 23 - BODY/INTERIOR/C-PILLAR TRIM - REMOVAL).

(5) Remove the screw that secures the lower seat belt anchor plate to the quarter inner panel (club cab) or the C-pillar (quad cab).

(6) Remove the lower seat belt anchor plate from the quarter inner panel (club cab) or the C-pillar (quad cab).

(7) Remove the screw that secures the retractor to the quarter inner panel (club cab) or the C-pillar (quad cab).

(8) Remove the rear shoulder belt and retractor from the quarter inner panel (club cab) or the C-pillar (quad cab).

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 retractor onto the quarter inner panel (club cab) (Fig. 24) or the C-pillar (quad cab) (Fig. 25).

(2) Install and tighten the screw that secures the retractor to the quarter inner panel (club cab) or the C-pillar (quad cab). Tighten the screw to 40 N·m (29 ft. lbs.).

(3) Position the lower seat belt anchor plate onto the quarter inner panel (club cab) or the C-pillar (quad cab).

(4) Install and tighten the screw that secures the lower seat belt anchor plate to the quarter inner

REAR SEAT BELT & RETRACTOR (Continued)

panel (club cab) or the C-pillar (quad cab). Tighten the screw to 40 N·m (29 ft. lbs.).

(5) Reinstall the trim onto the quarter inner panel (club cab) (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION) or the C-pillar (quad cab) (Refer to 23 - BODY/INTERIOR/C-PILLAR TRIM - INSTALLATION).

(6) Position the shoulder belt turning loop onto the quarter inner panel (club cab) or the C-pillar (quad cab).

(7) Install and tighten the screw that secures the shoulder belt turning loop to the quarter inner panel (club cab) or the C-pillar (quad cab). Tighten the screw to 30 N·m (22 ft. lbs.).

(8) Snap the trim cover over the rear shoulder belt turning loop anchor plate to conceal the screw that secures the turning loop to the quarter inner panel (club cab) or the C-pillar (quad cab).

REAR SEAT LAP BELT/BUCKLE

REMOVAL

Club cab and quad cab models both have a combined rear seat buckle/buckle unit on the right side of the vehicle that is secured to the rear floor panel beneath the rear seat cushion. Club cab models have a combined rear seat lap belt/buckle unit on the left side of the vehicle that is secured to the rear floor panel beneath the rear seat cushion. The left side of the quad cab models has a rear lap belt unit that is secured to a stud on the left center rear seat riser bracket, and a rear buckle unit that is secured to the rear of the left seat cushion frame.

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.

REAR SEAT BUCKLE/BUCKLE UNIT (CLUB OR QUAD CAB) & LAP BELT/BUCKLE UNIT (CLUB CAB ONLY)

(1) Remove the rear seat from the rear floor panel (club cab) (Refer to 23 - BODY/SEATS/SEAT CUSHION - REMOVAL) or fold up the rear seat cushion (quad cab).

(2) Remove the screw that secures the anchor plate of the rear seat buckle/buckle unit (right side - club cab or quad cab) or lap belt/buckle unit (left side - club cab only) to the rear floor panel (Fig. 26).

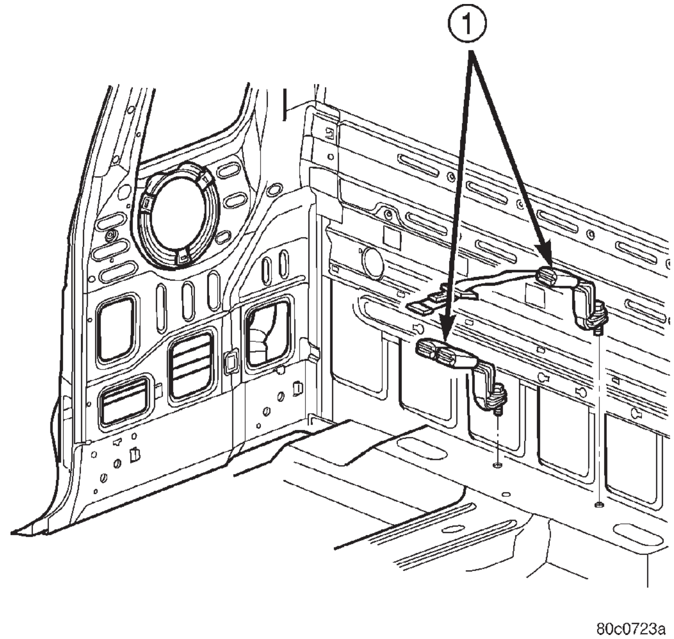

Fig. 26 Rear Seat Belts - Club Cab

1 - REAR SEAT LAP BELT/BUCKLE

(3) Remove the rear seat buckle/buckle unit (right side) or lap belt/buckle unit (left side) from the rear floor panel.

REAR SEAT LAP BELT UNIT - LEFT SIDE - QUAD CAB ONLY

(1) Fold up the rear seat cushions against the rear seat back.

(2) Remove the nut that secures the rear seat lap belt anchor plate to the stud on the inboard side of the left center rear seat riser bracket.

(3) Remove the rear seat lap belt unit from the inboard side of the left center rear seat riser bracket.

REAR SEAT BUCKLE UNIT - LEFT SIDE - QUAD CAB ONLY

(1) Fold up the rear seat cushions against the rear seat back.

(2) Remove the screw that secures the rear seat belt buckle anchor plate to the rear of the left seat cushion frame.

(3) Remove the rear seat belt buckle unit from the rear of the left seat cushion frame.

INSTALLATION

Club cab and quad cab models both have a combined rear seat buckle/buckle unit on the right side of the vehicle that is secured to the rear floor panel

REAR SEAT LAP BELT/BUCKLE (Continued)

beneath the rear seat cushion. Club cab models have a combined rear seat lap belt/buckle unit on the left side of the vehicle that is secured to the rear floor panel beneath the rear seat cushion. The left side of the quad cab models has a rear lap belt unit that is secured to a stud on the left center rear seat riser bracket, and a rear buckle unit that is secured to the rear of the left seat cushion frame.

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.

REAR SEAT BUCKLE/BUCKLE UNIT (CLUB OR QUAD CAB) & LAP BELT/BUCKLE UNIT (CLUB CAB ONLY)

(1) Position the rear seat buckle/buckle unit (right side) or lap belt/buckle unit (left side) onto the rear floor panel (Fig. 26).

(2) Install and tighten the screw that secures the anchor plate of the rear seat buckle/buckle unit (right side - club cab or quad cab) or lap belt/buckle unit (left side - club cab only) to the rear floor panel. Tighten the screw to 40 N·m (29 ft. lbs.).

(3) Reinstall the rear seat onto the rear floor panel (club cab) (Refer to 23 - BODY/SEATS/SEAT CUSHION - INSTALLATION) or fold down the rear seat cushion (quad cab).

REAR SEAT LAP BELT UNIT - LEFT SIDE - QUAD CAB ONLY

(1) Position the rear seat lap belt unit onto the stud on the inboard side of the left center rear seat riser bracket.

(2) Install and tighten the nut that secures the rear seat lap belt anchor plate to the stud on the inboard side of the left center rear seat riser bracket. Tighten the nut to 40 N·m (29 ft. lbs.).

(3) Fold down the rear seat cushions.

REAR SEAT BUCKLE UNIT - LEFT SIDE - QUAD CAB ONLY

(1) Position the rear seat belt buckle unit onto the rear of the left seat cushion frame.

(2) Install and tighten the screw that secures the rear seat belt buckle anchor plate to the rear of the left seat cushion frame. Tighten the screw to 40 N·m (29 ft. lbs.).

(3) Fold down the rear seat cushions.

SEAT BELT SWITCH

DESCRIPTION

The seat belt switch is a small, normally open, single pole, single throw, plunger actuated, momentary switch. Only one seat belt switch is installed in the vehicle, and it is integral to the driver seat belt retractor assembly. The seat belt switch is connected to the vehicle electrical system through a short pigtail wire to a dedicated take out and connector of the body wire harness.

The seat belt switch cannot be adjusted or repaired and, if faulty or damaged, the entire driver seat belt and retractor 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 Electro-Mechanical Instrument Cluster (EMIC). The seat belt switch plunger is actuated by the seat belt webbing wound onto the seat belt retractor spool. When the seat belt tip-half webbing is pulled out of the retractor far enough to engage the seat belt buckle-half, the switch plunger is extended and closes the seat belt switch sense circuit to ground; and, when the seat belt tip-half webbing is wound onto the retractor the switch plunger is depressed, opening the ground path. The EMIC monitors the seat belt switch status, then controls the seatbelt indicator and sends electronic chime request messages over the Programmable Communications Interface (PCI) data bus to the Central Timer Module (CTM) based upon that input.

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 to the left lower B-pillar. The seat belt switch is connected in series between ground and the seat belt switch sense input of the EMIC.

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.

SEAT BELT SWITCH (Continued)

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) Disconnect and isolate the battery negative cable. Disconnect the body wire harness connector for the seat belt switch from the seat belt switch pigtail wire connector from the driver side front seat belt retractor. Check for continuity between the ground circuit cavity of the body wire harness connector for the seat belt 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 (G307) as required.

(2) Check for continuity between the two cavities in the seat belt switch pigtail wire connector. There should be no continuity with the seat belt webbing retracted, and continuity with the seat belt webbing pulled out of the retractor far enough to engage the seat belt buckle. If OK, go to Step 3. If not OK, replace the faulty driver side front seat belt and retractor unit.

(3) Remove the instrument cluster from the instrument panel. Check for continuity between the seat belt switch sense circuit cavity of the body wire harness connector for the seat belt switch and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the shorted seat belt switch sense circuit between the seat belt switch and the instrument cluster as required.

(4) 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 body wire harness connector for the seat belt switch. There should be continuity. If OK, proceed to the diagnosis for the instrument cluster. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If not OK, repair the open seat belt switch sense circuit between the seat belt switch and the instrument cluster as required.

SEAT BELT TENSIONER

DESCRIPTION

Seat belt tensioners supplement the airbag system for all quad cab versions of this model. The seat belt tensioners are integral to the front seat belt retractors, which are secured within each B-pillar in the vehicle where they are concealed behind the B-pillar trim. The seat belt tensioner consists primarily of a sprocket/pinion, a steel tube, a cast metal housing, numerous steel balls, a stamped metal ball trap, a torsion bar, a small pyrotechnically activated gas generator, and a short pigtail wire. All of these components are located on one side of the retractor spool on the outside of the retractor housing except for the torsion bar, which serves as the spindle upon which the retractor spool rides. The seat belt tensioners are controlled by the Airbag Control Module (ACM) and are connected to the vehicle electrical system through a dedicated take out of the body wire harness by a keyed and latching molded plastic connector insulator to ensure a secure connection.

The seat belt tensioners cannot be repaired and, if faulty or damaged, the entire front seat belt, retractor, and tensioner unit must be replaced. The seat belt tensioners are not intended for reuse, and both tensioners must be replaced following any airbag deployment. A growling or grinding sound while attempting to operate the seat belt retractor is a sure indication that the seat belt tensioner has been deployed and requires replacement. For seat belt tensioner service procedures, (Refer to 8 - ELECTRICAL/RESTRAINTS/FRONT SEAT BELT & RETRACTOR - REMOVAL).

OPERATION

The seat belt tensioners are deployed in conjunction with the airbags by a signal generated by the Airbag Control Module (ACM) through the driver or passenger seat belt tensioner line 1 and line 2 (or squib) circuits. When the ACM sends the proper electrical signal to the tensioner, the electrical energy generates enough heat to initiate a small pyrotechnic gas generator. The gas generator is installed in one end of a steel tube that contains numerous steel balls. As the gas expands, it pushes the steel balls through the tube into a cast metal housing, where a ball guide directs the balls into engagement with the teeth of a sprocket that is geared to one end of the retractor spool. As the balls drive past the sprocket, the sprocket turns and drives the seat belt retractor spool causing the slack to be removed from the front seat belts. The ball trap captures the balls as they leave the sprocket and are expelled from the housing. Removing excess slack from the front seat belts not only keeps the occupants properly positioned for an

SEAT BELT TENSIONER (Continued)

airbag deployment following a frontal impact of the vehicle, but also helps to reduce the likelihood of a harmful contact with interior components. Also, the seat belt tensioner torsion bar that the retractor spool rides upon is designed to deform in order to control the loading being applied to the occupants by the seat belts during a frontal impact, further reducing the potential for occupant injuries.

The ACM monitors the condition of the seat belt tensioners through circuit resistance, and will illuminate the airbag indicator in the instrument cluster and store a Diagnostic Trouble Code (DTC) for any fault that is detected. For proper diagnosis of the seat belt tensioners, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

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) Remove the knob from the lever of the seat belt turning loop adjuster. (Refer to 8 - ELECTRICAL/RESTRAINTS/TURNING LOOP HEIGHT ADJUSTER KNOB - REMOVAL).

(2) Remove the screw that secures the shoulder belt turning loop to the height adjuster.

(3) Remove the trim from the upper B-pillar (quad cab) or from the quarter inner panel (standard/club cab). (Refer to 23 - BODY/INTERIOR/B-PILLAR TRIM - REMOVAL) or (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL).

(4) Remove the screw that secures the upper end of the height adjuster to the B-pillar.

(5) Pull the upper end of the height adjuster away from the B-pillar far enough to disengage the hooks on the lower end of the adjuster from the slots in the pillar.

(6) Remove the adjuster from the B-pillar.

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 height adjuster to the B-pillar with the hook formations oriented toward the lower end of the adjuster.

(2) Engage the hooks on the lower end of the adjuster into the slots in the B-pillar.

(3) Tilt the upper end of the height adjuster up into position against the B-pillar.

(4) Install and tighten the screw that secures the upper end of the height adjuster to the B-pillar. Tighten the screw to 40 N·m (29 ft. lbs.).

(5) Reinstall the trim onto the upper B-pillar (quad cab) or onto the quarter inner panel (standard/club cab). (Refer to 23 - BODY/INTERIOR/B-PILLAR TRIM - INSTALLATION) or (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION).

(6) Install and tighten the anchor screw that secures the seat belt turning loop to the adjuster. Tighten the screw to 30 N·m (22 ft. lbs.).

(7) Reinstall the knob onto the lever of the seat belt turning loop adjuster. (Refer to 8 - ELECTRICAL/RESTRAINTS/TURNING LOOP HEIGHT ADJUSTER KNOB - INSTALLATION).

TURNING LOOP HEIGHT ADJUSTER KNOB

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 the seat belt turning loop cover to expose the anchor screw that secures the turning loop to the height adjuster.

(2) Using the head of the turning loop anchor screw as a fulcrum, carefully pry the knob from the height adjuster lever with a suitable trim tool (Fig. 27).

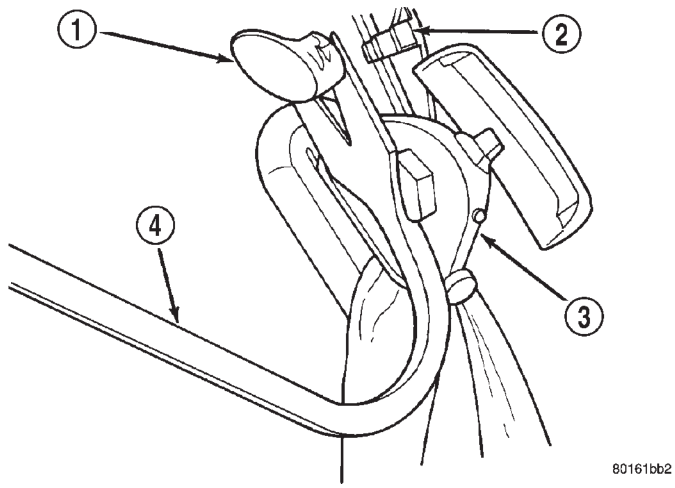

Fig. 27 Turning Loop Height Adjuster Knob Removal - Typical

1 - KNOB
2 - ADJUSTER LEVER
3 - SEAT BELT TURNING LOOP
4 - TRIM TOOL (SNAP-ON A179A)

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) Snap the seat belt turning loop cover back into place over the anchor screw that secures the turning loop to the adjuster.

(2) Position the height adjuster knob to the seat belt turning loop height adjuster lever.

(3) Using hand pressure, push the knob firmly and evenly onto the lever until it is fully engaged.

SPEED CONTROL

TABLE OF CONTENTS

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 8E, Instrument Panel and Gauges for speedometer diagnosis.

If a road test verifies a system problem and the speedometer operates properly, check for:

- A Diagnostic Trouble Code (DTC). If a DTC exists, conduct tests per the Powertrain Diagnostic Procedures service manual.
- A misadjusted brake (stop) lamp switch. This could also cause an intermittent problem.
- Loose, damaged or corroded electrical connections at the servo. Corrosion should be removed from electrical terminals and a light coating of Mopar MultiPurpose Grease, or equivalent, applied.
- Leaking vacuum reservoir.
- Loose or leaking vacuum hoses or connections.
- Defective one-way vacuum check valve.
- Secure attachment of both ends of the speed control servo cable.
- Smooth operation of throttle linkage and throttle body air valve.
- Failed speed control servo. Do the servo vacuum test.

CAUTION: When test probing for voltage or continuity at electrical connectors, care must be taken not to damage connector, terminals or seals. If these components are damaged, intermittent or complete system failure may occur.

SPECIFICATIONS

TORQUE - SPEED CONTROL

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Servo Mounting Bracket-to-Servo Nuts	8.5		75
Servo Mounting Bracket-to-Body Nuts	7-10		63-94
Switch Module Mounting Screws	1.5		14
Vacuum Reservoir Mounting Bolts	2.2		20

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 - EXCEPT 4.7L

(1) Disconnect negative battery cable at battery.

(2) Using finger pressure only, remove speed control cable connector at throttle body bellcrank by pushing connector off the bellcrank pin (Fig. 1) or (Fig. 2). **DO NOT try to pull connector off perpendicular to the bellcrank pin. Connector will be broken.**

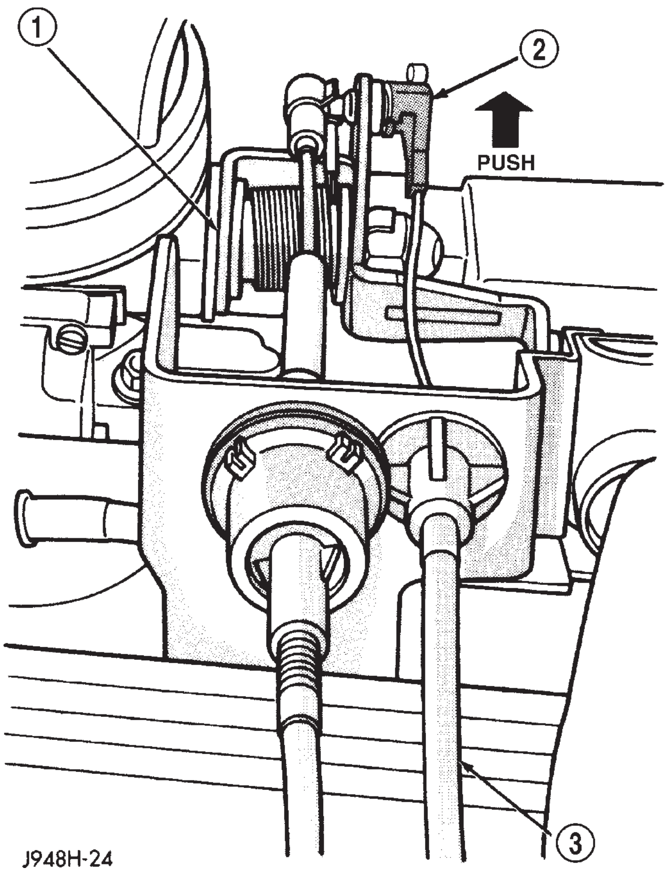

Fig. 1 Cable Connection at Throttle Body—2.5L Engine

1 - BELLCRANK
2 - CABLE CONNECTOR
3 - SPEED CONTROL CABLE

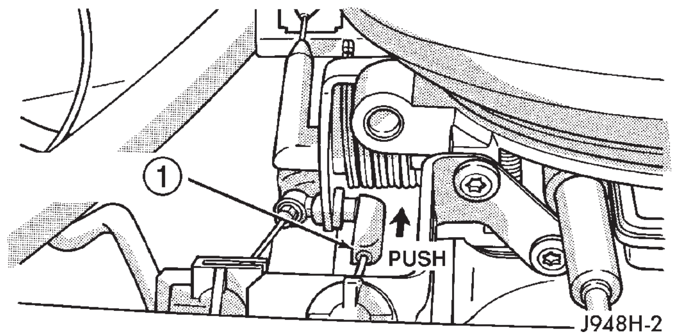

Fig. 2 Cable Connection at Throttle Body—3.9L/5.2L/5.9L Engines

1 - VEHICLE SPEED CONTROL CABLE

(3) 2.5L Engine: Remove cable from cable guide at top of valve cover.

(4) Squeeze 2 tabs on sides of speed control cable at throttle body mounting bracket (locking plate) and push out of bracket.

(5) Remove servo cable from servo. Refer to Speed Control Servo Removal/Installation.

REMOVAL - 4.7L

(1) Disconnect negative battery cable at battery.

(2) Remove air box housing from throttle body.

The accelerator cable must be partially removed to gain access to speed control cable.

(3) Using finger pressure only, disconnect accelerator cable connector at throttle body bellcrank pin by pushing connector off bellcrank pin towards front of vehicle (Fig. 3). **DO NOT try to pull connector off perpendicular to the bellcrank pin. Connector will be broken.**

(4) Lift accelerator cable from top of cable cam (Fig. 3).

(5) Press tab (Fig. 4) to release plastic cable mount from bracket. **Press on tab only enough to release cable from bracket. If tab is pressed too much, it will be broken.** Slide plastic mount (Fig. 4) towards passenger side of vehicle to remove cable from bracket.

(6) Using finger pressure only, disconnect speed control cable connector at throttle body bellcrank pin by pushing connector off bellcrank pin towards front of vehicle (Fig. 3). **DO NOT try to pull connector off perpendicular to the bellcrank pin. Connector will be broken.**

(7) Slide speed control cable plastic mount towards passenger side of vehicle to remove cable from bracket (Fig. 5).

CABLE (Continued)

(8) Remove servo cable from servo. Refer to Speed Control Servo Removal/Installation.

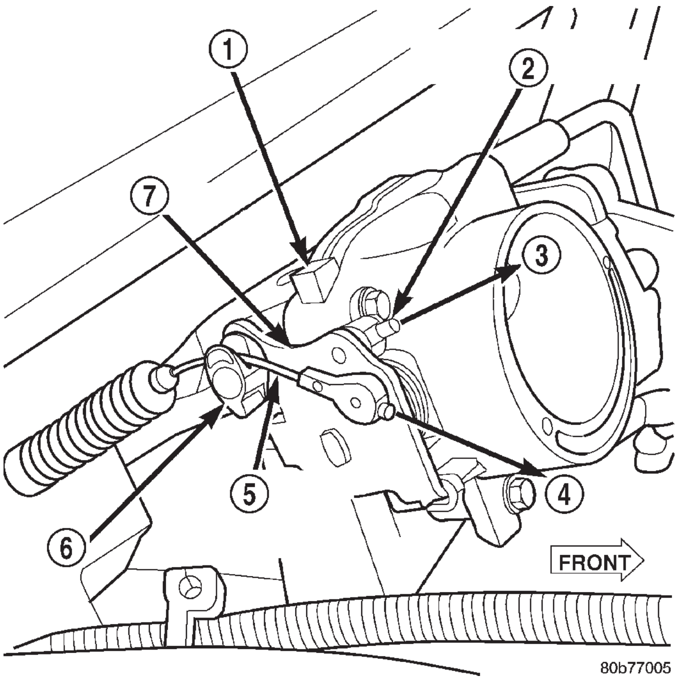

Fig. 3 Cable Connectors at Bell Crank—4.7L V-8 Engine

1 - THROTTLE BODY
2 - SPEED CONTROL CABLE CONNECTOR
3 - OFF
4 - OFF
5 - ACCELERATOR CABLE CONNECTOR
6 - CABLE CAM
7 - BELLCRANK

INSTALLATION - EXCEPT 4.7L

(1) Install end of cable to speed control servo. Refer to Speed Control Servo Removal and Installation.

(2) Install cable into throttle body mounting bracket (snaps in).

(3) Install speed control cable connector at throttle body bellcrank pin (snaps on).

(4) 2.5L Engine: Install cable to cable guide at top of valve cover.

(5) Connect negative battery cable at battery.

(6) Before starting engine, operate accelerator pedal to check for any binding.

INSTALLATION - 4.7L

(1) Install end of cable to speed control servo. Refer to Speed Control Servo Removal/Installation.

(2) Slide speed control cable plastic mount into bracket.

(3) Install speed control cable connector onto throttle body bellcrank pin (snaps on).

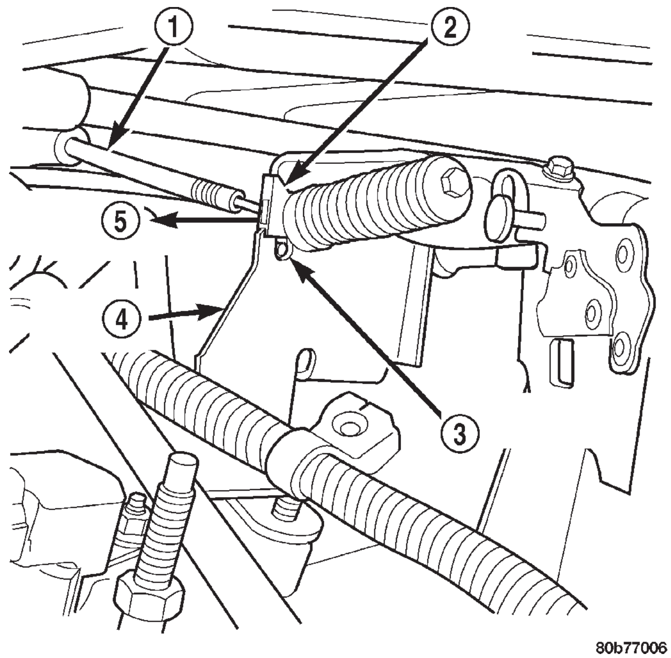

Fig. 4 Accelerator Cable Release Tab—4.7L V-8 Engine

1 - ACCELERATOR CABLE
2 - PLASTIC CABLE MOUNT
3 - PRESS TAB FOR REMOVAL
4 - CABLE BRACKET
5 - SLIDE FOR REMOVAL

(4) Slide accelerator cable plastic mount into bracket. Continue sliding until tab (Fig. 4) is aligned to hole in mounting bracket.

(5) Route accelerator cable over top of cable cam (Fig. 3).

(6) Install accelerator cable connector onto throttle body bellcrank pin (snaps on).

(7) Install air box housing to throttle body.

(8) Connect negative battery cable at battery.

(9) 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.

SERVO (Continued)

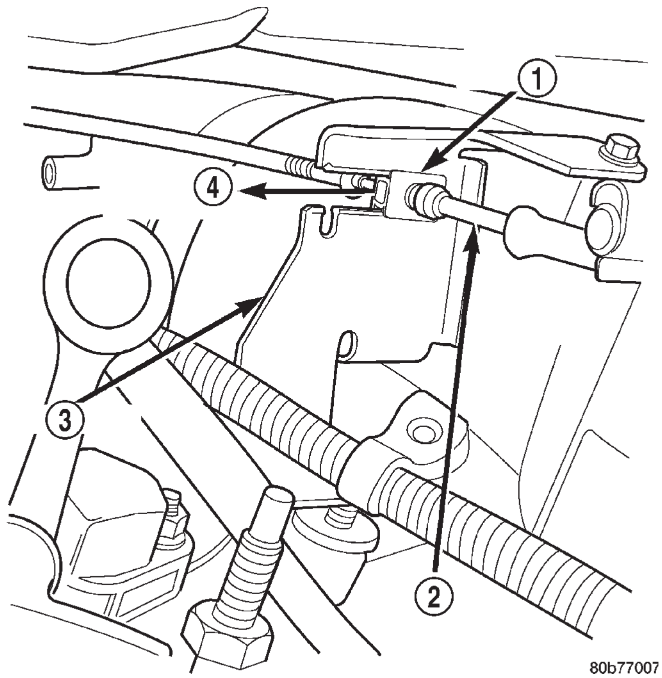

Fig. 5 Speed Control Cable at Bracket—4.7L V-8 Engine

1 - PLASTIC CABLE MOUNT
2 - SPEED CONTROL CABLE
3 - BRACKET
4 - SLIDE FOR REMOVAL

OPERATION

The Powertrain Control Module (PCM) controls the solenoid valve body. The solenoid valve body controls the application and release of vacuum to the diaphragm of the vacuum servo. The servo unit cannot be repaired and is serviced only as a complete assembly.

Power is supplied to the servo's by the PCM through the brake switch. The PCM controls the ground path for the vacuum and vent solenoids.

The dump solenoid is energized anytime it receives power. If power to the dump solenoid is interrupted, the solenoid dumps vacuum in the servo. This provides a safety backup to the vent and vacuum solenoids.

The vacuum and vent solenoids must be grounded at the PCM to operate. When the PCM grounds the vacuum servo solenoid, the solenoid allows vacuum to enter the servo and pull open the throttle plate using the cable. When the PCM breaks the ground, the solenoid closes and no more vacuum is allowed to enter the servo. The PCM also operates the vent solenoid via ground. The vent solenoid opens and closes a passage to bleed or hold vacuum in the servo as required.

The PCM duty cycles the vacuum and vent solenoids to maintain the set speed, or to accelerate and decelerate the vehicle. To increase throttle opening, the PCM grounds the vacuum and vent solenoids. To decrease throttle opening, the PCM removes the grounds from the vacuum and vent solenoids. When the brake is released, if vehicle speed exceeds 30 mph to resume, 35 mph to set, and the RES/ACCEL switch has been depressed, ground for the vent and vacuum circuits is restored.

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Disconnect vacuum hose (line) at servo (Fig. 6).

(3) Disconnect electrical connector at servo.

(4) Disconnect servo cable at throttle body. Refer to Servo Cable Removal/Installation.

(5) Remove 2 mounting nuts holding servo cable sleeve to bracket (Fig. 6) or (Fig. 7).

(6) Pull speed control cable sleeve and servo away from servo mounting bracket to expose cable retaining clip (Fig. 7) and remove clip. Note: The servo mounting bracket displayed in (Fig. 7) is a typical bracket and may/may not be applicable to this model vehicle.

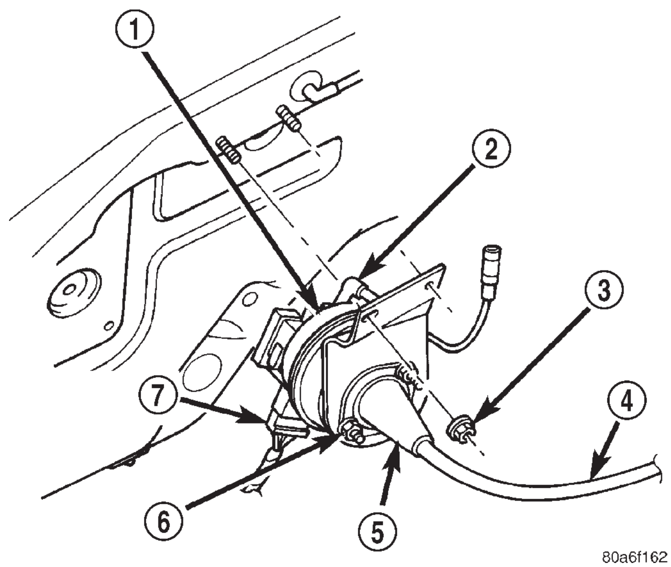

Fig. 6 Speed Control Servo Location

1 - SPEED CONTROL SERVO
2 - VACUUM HOSE
3 - SERVO BRACKET NUTS (2)
4 - SERVO CABLE
5 - CABLE SLEEVE
6 - SERVO MOUNTING NUTS (2)
7 - ELECTRICAL CONNECTOR

(7) Remove servo from mounting bracket. While removing, note orientation of servo to bracket.

SERVO (Continued)

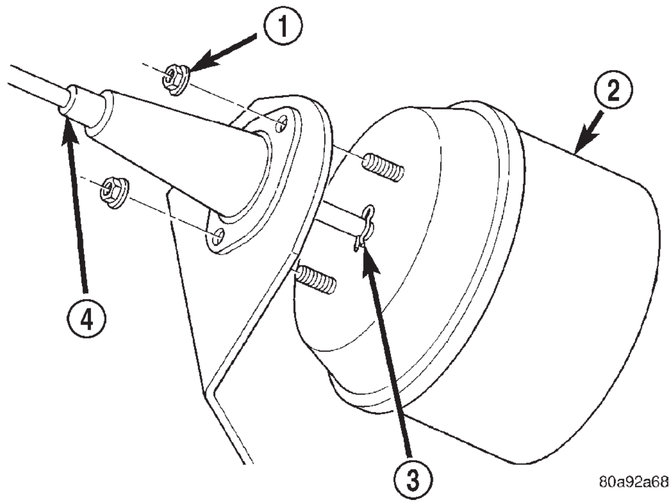

Fig. 7 Servo Cable Clip Remove/Install—Typical

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 Servo 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.

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.

SWITCH (Continued)

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 BEGINNING ANY AIRBAG SYSTEM COMPONENT REMOVAL OR INSTALLATION, REMOVE AND ISOLATE THE NEGATIVE (-) CABLE FROM THE BATTERY. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. THEN WAIT TWO MINUTES FOR SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. FAILURE TO DO THIS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE INJURY.

(1) Disconnect and isolate negative battery cable.
(2) Remove airbag module. Refer to 8, Passive Restraint Systems for procedures.
(3) Remove switch-to-steering wheel mounting screws (Fig. 8).
(4) Remove switch.
(5) Remove electrical connector at switch.

INSTALLATION

(1) Install electrical connector to switch.
(2) Install switch and mounting screws.
(3) Tighten screws to 1.5 N·m (14 in. lbs.) torque.
(4) Install airbag module. Refer to 8, Passive Restraint Systems for procedures.
(5) Connect negative battery cable.

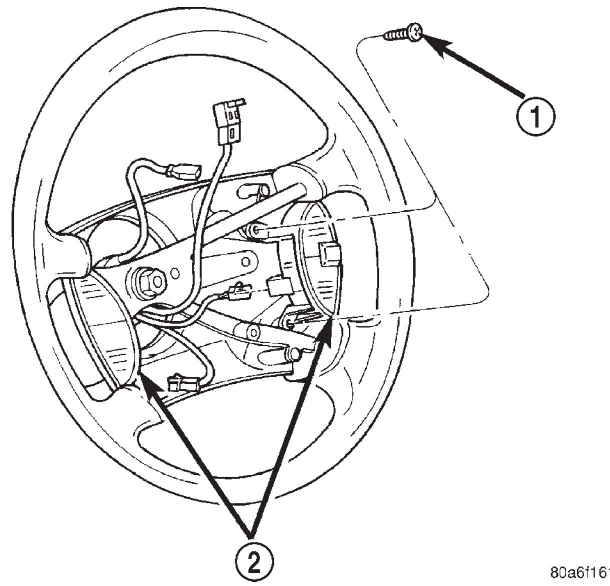

Fig. 8 Speed Control Switches

1 - MOUNTING SCREWS (2)
2 - SPEED CONTROL SWITCHES (2)

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 SUPPLY TEST

(1) Disconnect vacuum hose at speed control servo and install a vacuum gauge into the disconnected hose.
(2) Start engine and observe gauge at idle. Vacuum gauge should read at least ten inches of mercury.

VACUUM RESERVOIR (Continued)

(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 plastic cowl plenum cover at lower base of windshield (Fig. 9) or (Fig. 11).

(1) Disconnect and isolate negative battery at cable.

(2) Remove both windshield wiper arm/blade assemblies. Refer to 8, Wiper and Washer Systems.

(3) Remove rubber weather-strip at front edge of cowl grill (Fig. 10).

(4) Remove four plastic nuts securing cowl plenum cover/grille panel to studs on cowl top panel near base of windshield (Fig. 11).

(5) Remove two plastic rivets securing each side of the cowl plenum cover/grille panel to cowl plenum panel and cowl top panel.

(6) Lift cowl plenum cover/grille panel from vehicle far enough to access windshield washer and vacuum plumbing near right end of cowl plenum.

(7) Disconnect windshield washer supply hose at in-line connector.

(8) Disconnect vacuum supply hose from vacuum supply connector at vacuum reservoir (Fig. 9).

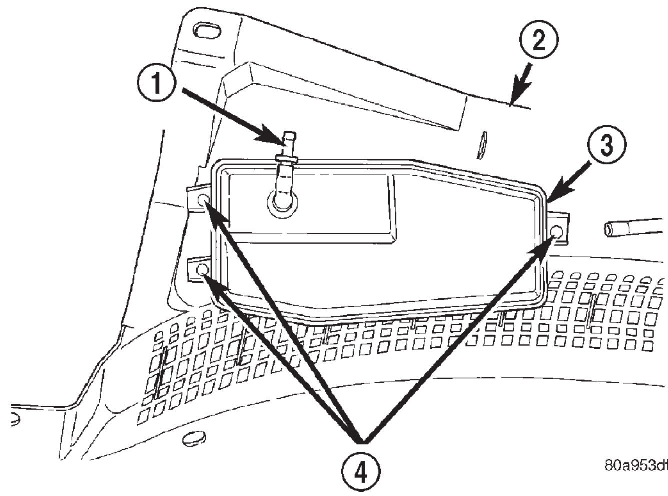

Fig. 9 Vacuum Reservoir Mounting

1 - VACUUM SUPPLY CONNECTOR
2 - COWL PLENUM COVER/GRILLE PANEL
3 - VACUUM RESERVOIR
4 - SCREWS

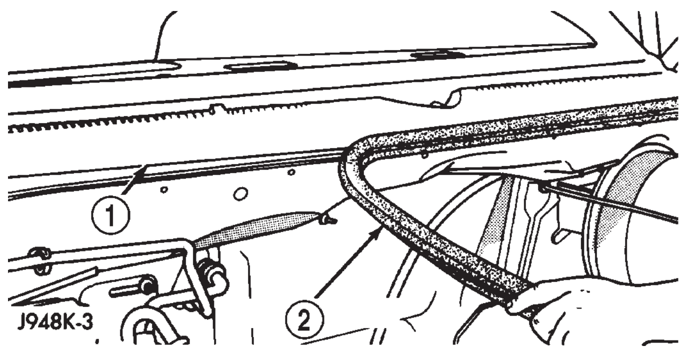

Fig. 10 Cowl Grille Panel Weather-strip

1 - COWL GRILLE
2 - WEATHERSTRIP

(9) Remove cowl plenum cover/grille panel from vehicle.

(10) Remove three reservoir mounting screws (Fig. 9).

(11) Remove vacuum reservoir from vehicle.

INSTALLATION

The vacuum reservoir is located under the plastic cowl plenum cover at lower base of windshield (Fig. 9) or (Fig. 11).

(1) Install vacuum reservoir and three mounting screws to plastic cowl cover. Tighten three screws to 2.2 N·m (20 in. lbs.) torque.

(2) Position cowl plenum cover/grille panel to vehicle.

(3) Connect vacuum supply hose to vacuum reservoir.

VACUUM RESERVOIR (Continued)

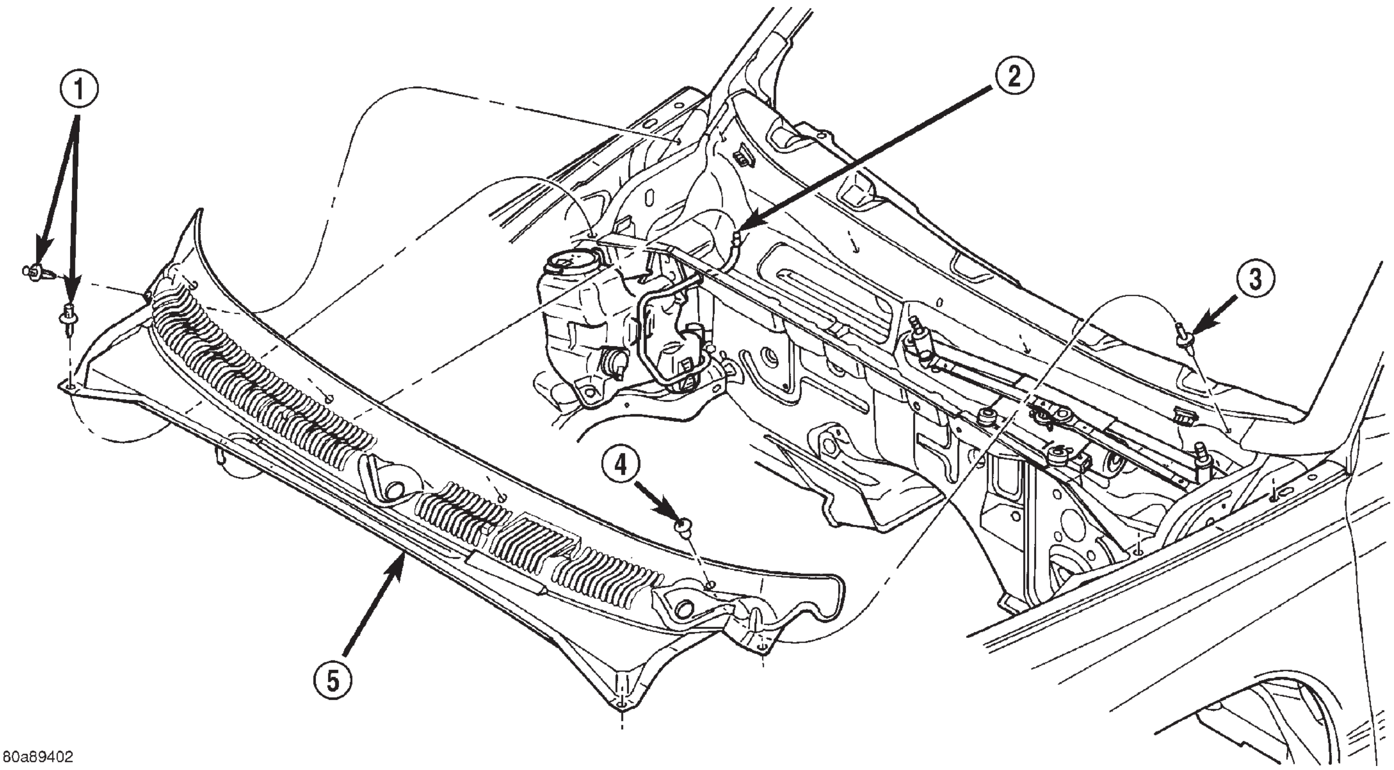

Fig. 11 Cowl Plenum Cover/Grille Panel Remove/Install

1 - PLASTIC RIVET
2 - IN-LINE WASHER SUPPLY HOSE CONNECTOR
3 - STUD
4 - PLASTIC NUT
5 - COWL PLENUM COVER/GRILLE PANEL

(4) Connect windshield washer supply hose at in-line connector.

(5) Install and tighten cowl cover fasteners to vehicle body.

(6) Install rubber weather-strip at front edge of cowl grill.

(7) Install windshield wiper arms. Refer to 8, Wiper and Washer Systems.

(8) Connect negative battery to cable.

VEHICLE THEFT SECURITY

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VEHICLE THEFT SECURITY

DESCRIPTION - VEHICLE THEFT SECURITY SYSTEM

The Vehicle Theft Security System (VTSS) is an available factory-installed option on this model. The VTSS is designed to provide perimeter protection against unauthorized use or tampering by monitoring the vehicle doors and the ignition system. If unauthorized use or tampering is detected, the system responds by pulsing the horn and flashing the headlamp high beams. If the vehicle is also equipped with the optional Sentry Key Immobilizer System (SKIS), which provides passive vehicle protection by preventing the engine from operating unless a valid electronically encoded key is detected in the ignition lock cylinder, the VTSS will also disable the engine from operating until the system is disarmed. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - DESCRIPTION - SENTRY KEY IMMOBILIZER SYSTEM).

The VTSS includes the following major components, which are described in further detail elsewhere in this service information:

- **Central Timer Module** - The Central Timer Module (CTM) is located on the left cowl side inner panel under the driver side outboard end of the instrument panel. The CTM contains a microprocessor and software that allow it to provide the proper VTSS features and outputs based upon the monitored inputs. The CTM 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. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL/CENTRAL TIMER MODULE - DESCRIPTION).
- **Door Ajar Switch** - A door ajar switch is integral to the latch of each door in the vehicle. These switches provide an input to the VTSS indicating whether each door is opened or closed. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/DOOR AJAR SWITCH - DESCRIPTION).
- **Door Cylinder Lock Switch** - A door cylinder lock switch is located on the back of each front door lock cylinder. This switch provides an input to the VTSS indicating whether the system should remain armed or be disarmed. (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR CYLINDER LOCK SWITCH - DESCRIPTION).
- **Horn Relay** - The horn relay is located in the Power Distribution Center (PDC) in the engine compartment near the battery. The horn relay is normally activated by the horn switch to control the sounding of the vehicle horn or horns. However, it can also be activated by an output of the CTM to provide an audible indication that unauthorized vehicle use or tampering has been detected. (Refer to 8 - ELECTRICAL/HORN/HORN RELAY - DESCRIPTION).
- **Security Indicator** - A red Light Emitting Diode (LED) located in the ElectroMechanical Instrument Cluster (EMIC) is illuminated by an output of the CTM to indicate the status of the VTSS or SKIS. This LED is integral to the instrument cluster. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DESCRIPTION).

Hard wired circuitry connects many of the VTSS 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 VTSS 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.

VEHICLE THEFT SECURITY (Continued)

DESCRIPTION - SENTRY KEY IMMOBILIZER SYSTEM

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 a gray molded rubber cap on the head of the ignition key. Models not equipped with 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 information:

- **Powertrain Control Module** - The Powertrain Control Module (PCM) is located on the right front fender inner shield above the right front wheel house in the engine compartment.
- **Sentry Key Immobilizer Module** - The Sentry Key Immobilizer Module (SKIM) is located on the right side of 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.
- **Security Indicator** - The security indicator is located in the Information Center area of the instrument cluster, to the left of center. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER/SECURITY INDICATOR - DESCRIPTION).

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 - VEHICLE THEFT SECURITY SYSTEM

A Central Timer Module (CTM) is used on this model to control and integrate many of the electronic functions and features included in the Vehicle Theft Security System (VTSS). In the VTSS, the CTM receives inputs indicating the status of the door ajar switches, the door cylinder lock switch, and the ignition switch. The programming in the CTM allows it to process the information from all of these inputs and send control outputs to energize or de-energize the horn relay, the headlamp high beams, and the security indicator. If the VTSS alarm is triggered, the CTM pulses the horn for about three minutes and flashes the headlamp high beams and security indicator for about eighteen minutes or until the system is disarmed, whichever occurs first. The control of these inputs and outputs are what constitute all of the features of the VTSS. Following is information on the operation of each of the VTSS features. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the VTSS.

ENABLING

The CTM must have the VTSS function electronically enabled in order for the VTSS to perform as designed. The logic in the CTM keeps its VTSS function dormant until it is enabled using a DRBIII® scan tool. The VTSS function of the CTM is enabled on vehicles equipped with the VTSS option at the factory, but a service replacement CTM must be VTSS-enabled by the dealer using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

ARMING

Passive arming of the VTSS occurs when the vehicle is exited with the key removed from the ignition switch, the headlamps are turned off, and the doors are locked while they are open using the power lock switch, or locked after they are closed by turning either front door lock cylinder to the lock position using the key. The power lock switch will not function if the key is in the ignition switch or the headlamps are turned on with the driver side front door open. The VTSS will not arm if the doors are locked using the mechanical lock button. Active arming of the VTSS occurs when the “Lock” button on the Remote Keyless Entry (RKE) transmitter is depressed to lock the vehicle. For active arming to occur, the doors must be closed and the ignition switch must be in the Off position when the RKE transmitter “Lock” button is depressed. However, once the VTSS arming process has been completed, the ignition switch can be turned to the Accessory position without triggering the alarm.

Pre-arming of the VTSS is initiated when a door is open when the vehicle is locked using a power door lock switch or a key in the door lock cylinder (passive), or when the RKE transmitter “Lock” button is depressed (active). Pre-arming will not occur if the key is in the ignition switch or the headlamps are turned on with the driver side front door open. When the VTSS is pre-armed, the arming sequence is delayed until all of the doors have been closed.

Once the VTSS begins the passive or active arming sequence, the security indicator in the instrument cluster will flash rapidly for about seventeen seconds. This indicates that the VTSS arming is in progress. If the ignition switch is turned to the On position, a door is opened, a door is unlocked by any means, or the RKE "Panic" button is depressed during the seventeen second arming process, the security indicator will stop flashing and the arming process will abort. Once the seventeen second arming sequence is successfully completed, the security indicator will flash at a slower rate, indicating that the VTSS is armed.

DISARMING

Passive disarming of the VTSS occurs when the vehicle is unlocked using the key to unlock either front door or, if the vehicle is equipped with the optional Sentry Key Immobilizer System (SKIS), by turning the ignition switch to the On position using a valid SKIS key. Active disarming of the VTSS occurs when the vehicle is unlocked by depressing the "Unlock" button of the RKE transmitter. Once the alarm has been activated (horn pulsing and headlamps flashing), either disarming method will also deactivate the alarm. Depressing the "Panic" button on the RKE transmitter will **not** disarm the VTSS.

POWER-UP MODE

When the armed VTSS senses that the battery has been disconnected and reconnected, it enters its power-up mode. In the power-up mode the alarm system remains armed following a battery failure or disconnect. If the VTSS was armed prior to a battery disconnect or failure, the technician or vehicle operator will have to actively or passively disarm the alarm system after the battery is reconnected. The power-up mode will also apply if the battery goes dead while the system is armed, and battery jump-starting is attempted. The VTSS will be armed until the technician or vehicle operator has actively or passively disarmed the alarm system. If the VTSS is in the disarmed mode prior to a battery disconnect or failure, it will remain disarmed after the battery is reconnected or replaced, or if jump-starting is attempted.

TAMPER ALERT

The VTSS tamper alert feature will sound the horn three times upon disarming, if the alarm was triggered and has since timed-out (about eighteen minutes). This feature alerts the vehicle operator that the VTSS alarm was activated while the vehicle was unattended.

OPERATION - SENTRY KEY IMMOBILIZER SYSTEM

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).

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 - 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 - VEHICLE THEFT SECURITY SYSTEM

The Vehicle Theft Security System (VTSS)-related hard wired inputs to and outputs from the Central Timer Module (CTM) may be diagnosed and tested using conventional diagnostic tools and procedures. 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

VEHICLE THEFT SECURITY (Continued)

pin-out and location views for the various wire harness connectors, splices and grounds.

However, conventional diagnostic methods may not prove conclusive in the diagnosis of the CTM or the Programmable Communications Interface (PCI) data bus network. In order to obtain conclusive testing of the VTSS, the CTM and the PCI data bus network must also be checked. The most reliable, efficient, and accurate means to diagnose the VTSS requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. The DRBIII® scan tool can provide confirmation that the PCI data bus network is functional, that all of the electronic modules are sending and receiving the proper messages over the PCI data bus, and that these modules are receiving the proper hard wired inputs and responding with the proper hard wired outputs needed to perform their functions. See the “Vehicle Theft Security System” menu item on the DRBIII® scan tool.

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.

DIAGNOSIS AND TESTING - SENTRY KEY IMMOBILIZER SYSTEM

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.

VEHICLE THEFT SECURITY (Continued)

SENTRY KEY IMMOBILIZER SYSTEM DIAGNOSIS		
CONDITION	POSSIBLE CAUSES	CORRECTION
SECURITY INDICATOR FAILS TO LIGHT DURING BULB TEST	1. Light-Emitting Diode (LED) faulty.	1. Perform the instrument cluster actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING - ACTUATOR TEST)..
	2. Fuse faulty.	2. Check the SKIM fused B(+) fuse and the fused ignition switch output (run-start) fuse in the JB. Replace fuses, if required.
	3. Ground path faulty.	3. Check for continuity to ground at the connector for the SKIM. Repair wiring, if required.
	4. Battery feed faulty.	4. Check for battery current at the connector for the SKIM. Repair wiring, if required.
	5. Ignition feed faulty.	5. Check for battery current at the connector for the SKIM with the ignition switch in the On position. Repair wiring, if required.
SECURITY INDICATOR FLASHES FOLLOWING BULB TEST	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 and the appropriate diagnostic information for further diagnosis.
SECURITY INDICATOR LIGHTS SOLID FOLLOWING BULB TEST	1. SKIS system malfunction/ fault detected.	1. Use a DRBIII® scan tool and the appropriate diagnostic information for further diagnosis.
	2. SKIS system inoperative.	2. Use a DRBIII® scan tool and the appropriate diagnostic information for further diagnosis.

SECURITY INDICATOR FAILS TO LIGHT DURING BULB TEST

If the security 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 security 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 fused B(+) fuse (Fuse 1 - 15 ampere) in the Junction Block (JB). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuse (Fuse 1 - 15 ampere) in the JB. If OK, go to Step 3. If not OK, repair the open B(+) circuit between the JB fuse and the Power Distribution Center (PDC) as required.

(3) Check the fused ignition switch output (run-start) fuse (Fuse 10 - 10 ampere) in the JB. 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 10 - 10 ampere) in the JB. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (run-start) circuit between the JB 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 the ground circuit cavity of the instrument panel wire harness connector for the

VEHICLE THEFT SECURITY (Continued)

SKIM and a good ground. There should be continuity. If OK, go to Step 6. If not OK, repair the open ground circuit to ground (G208) 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 JB 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, refer to the appropriate diagnostic information and use a DRBIII® scan tool to complete the diagnosis of the SKIS. If not OK, repair the open fused ignition switch output (run-start) circuit between the SKIM and the JB fuse as required.

SECURITY INDICATOR FLASHES OR LIGHTS SOLID FOLLOWING BULB TEST

A security 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 security 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 Central Timer Module (CTM) that control the security indicator, or the message inputs and outputs between the SKIM and the Powertrain Control Module (PCM) that control engine operation, a DRBIII® scan tool and the appropriate diagnostic information are required. 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.

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

VEHICLE THEFT SECURITY (Continued)

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 security indicator in the instrument cluster will start to flash 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, the security 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 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 (security 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.

TRANSPONDER KEY

DESCRIPTION

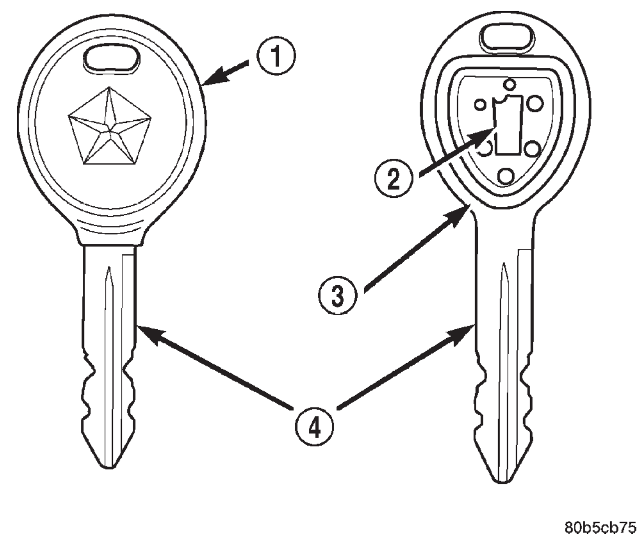

Fig. 1 Sentry Key Immobilizer Transponder

1 - MOLDED CAP
2 - TRANSPONDER CHIP
3 - MOLDED CAP REMOVED
4 - TRANSPONDER KEY

Each ignition key used in the Sentry Key Immobilizer System (SKIS) has an integral transponder chip (Fig. 1). 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

TRANSPONDER KEY (Continued)

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 security 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 - 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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WIPERS/WASHERS

DESCRIPTION

An electrically operated intermittent wiper and washer system is standard factory-installed safety equipment on this model. The wiper and washer system includes the following major components, which are described in further detail elsewhere in this service information:

- **Central Timer Module** - The Central Timer Module (CTM) is located on the left cowl side inner panel under the driver side outboard end of the instrument panel. The CTM contains a microprocessor and software that allow it to provide the many electronic functions and features not available with most conventional hard wired wiper and washer systems. The CTM provides the proper wiper and washer system features based upon the monitored inputs. The CTM 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. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL/CENTRAL TIMER MODULE - DESCRIPTION).
- **Multi-Function Switch** - The multi-function switch is secured to the left side of the steering column, just below the steering wheel. Only the control stalk for the multi-function switch is visible, the remainder of the switch is concealed beneath the steering column shrouds. The multi-function switch contains all of the switches for both the wiper and washer systems.(Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DESCRIPTION)
- **Washer Fluid Level Switch** - The washer fluid level switch is located in a dedicated hole near the

WIPERS/WASHERS (Continued)

front of the windshield washer reservoir on the right outboard end of the upper radiator shroud.

- **Washer Nozzles -** The dual fluidic washer nozzles are secured with integral snap features to dedicated openings in the cowl plenum cover/grille panel located near the base of the windshield. The washer plumbing fittings for the washer nozzles are concealed beneath the cowl plenum cover/grille panel.
- **Washer Pump/Motor -** The washer pump/motor unit is located in a dedicated hole near the bottom of the windshield washer reservoir on the right end of the upper radiator shroud.
- **Washer Reservoir -** The washer reservoir is integral to and located on the right end of the upper radiator shroud. The washer reservoir filler is accessed from the right front corner of the engine compartment.
- **Wiper Arms -** The two 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.
- **Wiper Blades -** The two wiper blades are secured to the two wiper arms, and are parked on the glass near the bottom of the windshield when the wiper system is not in operation.
- **Wiper Module -** The wiper pivots are the only visible components of the wiper module. The remainder of the module is concealed within the cowl plenum beneath the cowl plenum cover/grille panel. The wiper module includes the module bracket, the single wiper motor, the wiper linkage, and the two wiper pivots.
- **Wiper Relay -** The wiper relay is located in the Power Distribution Center (PDC) in the engine compartment near the battery.

Features of the wiper and washer system include the following:

- **Continuous Wipe Modes -** The two-speed wiper motor and the internal circuitry of the multi-function switch work in concert to provide two continuous wipe cycles, low speed or high speed.
- **Intermittent Wipe Mode -** The internal circuitry of the multi-function switch, the CTM, and the wiper relay work in concert to provide an intermittent wipe mode with multiple delay interval selections. The CTM also automatically adjusts each manually selected delay interval to compensate for vehicle speed.
- **Washer Mode -** When the washer system is activated with the multi-function switch while the wiper system is operating, washer fluid will be dispensed onto the windshield glass through the washer nozzles for as long as the washer pump/motor is energized.
- **Wipe-After-Wash Mode -** The internal circuitry of the CTM provides a wipe-after-wash feature which, if the wipers are turned Off, will operate the washer pump/motor and the wipers for as long as the washer system is activated, then provide several additional wipe cycles after the washer system is deactivated before parking the wiper blades near the base of the windshield.

Hard wired circuitry connects the 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 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 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 wiper and washer system functions with the multi-function switch control stalk that extends from the left side of the steering column, just below the steering wheel. Rotating the knob on the end of the multi-function switch control stalk selects the desired wiper system operating mode. The wiper system allows the vehicle operator to select from two continuous wiper speeds, Hi or Lo, or one of several intermittent wipe Delay mode intervals. Pushing the knob on the end of the control stalk towards the steering column activates the washer pump/motor, which dispenses washer fluid onto the windshield glass through the washer nozzles.

WIPERS/WASHERS (Continued)

When the ignition switch is in the Accessory or On positions, battery current from a fuse in the Junction Block (JB) is provided through a fused ignition switch output (run-acc) circuit to the wiper motor park switch, the wiper relay, and the multi-function switch. The internal circuitry of the multi-function switch provides a direct hard wired battery current output to the low speed or high speed brushes of the wiper motor when the Lo or Hi switch setting is selected, which causes the wipers to cycle at the selected speed. The intermittent wipe, and wipe-after-wash features of the wiper and washer system are provided by the electronic intermittent wipe logic circuit within the Central Timer Module (CTM). In order to provide the intermittent wipe feature, the CTM monitors the wiper switch state and the wiper motor park switch state. In order to provide the wipe-after-wash feature, the CTM monitors both the washer switch state and the wiper motor park switch state. When a Delay position is selected with the multi-function switch control knob, the CTM logic circuit responds by calculating the correct delay interval. The CTM then energizes the wiper relay by pulling the relay control coil to ground. The energized wiper relay directs battery current through the normally open contact of the relay back through the internal Delay position circuitry of the multi-function switch to the low speed brush of the wiper motor. The CTM monitors the wiper motor operation through the wiper park switch sense circuit, which allows the CTM to determine the proper timing to begin the next wiper blade sweep. The normal delay intervals are driver adjustable from about one-half second to about eighteen seconds.

The CTM also provides a speed sensitive intermittent wipe feature. By monitoring vehicle speed messages received from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus network, the CTM is able to adjust the delay intervals to compensate for vehicle speed. Above about sixteen kilometers-per-hour (ten miles-per-hour) the delay is driver adjustable from about one-half second to about eighteen seconds. Below about sixteen kilometers-per-hour (ten miles-per-hour) the delay times are doubled by the CTM, from about one second to about thirty-six seconds.

When the Off position of the multi-function switch wiper control knob 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 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 a fused ignition switch output (run-acc) circuit. The park switch sense circuit directs this battery current to the low speed brush of the wiper motor through the normally closed contact of the wiper relay and the internal Off position circuitry of the multi-function 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 multi-function switch is selected, the Wash position circuitry within the switch directs a battery current signal input to the CTM. The CTM monitors the washer switch state through this input to control a battery current output to the washer pump/motor unit. When the washer switch is closed with the wiper system turned Off, the CTM operates the wiper motor through the wiper relay in the same manner as it does to provide the Delay mode operation. After the state of the washer switch changes to open, the CTM monitors the wiper motor through the wiper park switch sense circuit, which allows the CTM to monitor the number of wiper blade sweeps. After the appropriate number of wiper sweeps, the CTM de-energizes the wiper relay and the wipers return to their park position.

Proper testing of the CTM, the PCM, or the PCI data bus vehicle speed messages requires a DRBIII® scan tool. Refer to the appropriate diagnostic information. Refer to the owner's manual in the vehicle glove box for more information on the features and operation of the wiper and washer system.

DIAGNOSIS AND TESTING - WIPER & WASHER SYSTEM

WIPER SYSTEM

The diagnosis found here addresses an electrically inoperative wiper system. If the wiper motor operates, but the wipers do not move on the windshield, replace the faulty 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/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.

The following tests will help to diagnose the hard wired components and circuits of the wiper system. However, these tests may not prove conclusive in the

WIPERS/WASHERS (Continued)

diagnosis of the Central Timer Module (CTM). In order to obtain conclusive testing of the CTM, the Programmable Communications Interface (PCI) data bus network and all of the electronic modules that provide inputs to or receive outputs from the wiper system components must be checked. The most reliable, efficient, and accurate means to diagnose the CTM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. The DRBIII® scan tool can provide confirmation that the PCI data bus is functional, that all of the electronic modules are sending and receiving the proper messages on the PCI data bus, and that the wiper relay is being sent the proper hard wired outputs by the CTM for it to perform its wiper system functions.

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) Check the fused ignition switch output (run-acc) fuse (Fuse 5 - 20 ampere) in the Junction Block (JB). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run-acc) fuse (Fuse 5 - 20 ampere) in the JB. If OK, go to Step 3. If not OK, repair the open fused ignition switch output (run-acc) circuit between the JB 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 multi-function 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-acc) circuit cavity of the instrument panel wire harness connector for the multi-function switch. If OK, go to Step 4. If not OK, repair the open fused ignition switch output (run-acc) circuit between the multi-function switch and the JB as required.

(4) If the problem being diagnosed involves only the intermittent wipe feature, go to Step 5. If the problem being diagnosed involves all wiper modes, or only the Low and/or High speed modes, go to Step 7.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector (Connector C1) for the CTM from the CTM connector receptacle. Check for continuity between the intermittent front wiper mode sense circuit cavities of the instrument panel wire harness connector for the multi-function switch and the instrument panel wire harness connector (Connector C1) for the CTM. There should be continuity. If OK, go to Step 6. If not OK, repair the open intermittent front wiper mode sense circuit between the multi-function switch and the CTM as required.

(6) Check for continuity between the intermittent front wiper switch signal circuit cavities of the instrument panel wire harness connector for the multi-function switch and the instrument panel wire harness connector (Connector C1) for the CTM. There should be continuity. If OK, proceed to the diagnosis for the wiper relay. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER RELAY - DIAGNOSIS AND TESTING). If not OK, repair the open intermittent front wiper switch signal circuit between the multi-function switch and the CTM as required.

(7) Check for continuity between the two front wiper low speed circuit cavities of the instrument panel wire harness connector for the multi-function switch. There should be continuity. If OK, go to Step 8. If not OK, repair the open front wiper low speed circuit between the two cavities of the instrument panel wire harness connector for the multi-function switch as required.

(8) Test the multi-function switch continuity. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DIAGNOSIS AND TESTING). If the multi-function switch tests OK, reconnect the instrument panel wire harness connector for the multi-function switch to the switch connector receptacle and go to Step 9. If not OK, replace the faulty multi-function switch and test the wiper system operation again. If still not OK, go to Step 9.

(9) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Measure the resistance between the headlamp and dash wire harness ground wire for the wiper motor and a good ground. The meter should read zero ohms. If OK, go to Step 10. If not OK, repair the open ground circuit to ground (G113) as required.

(10) Disconnect the headlamp and dash wire harness connector for the wiper module from the wiper motor pigtail wire connector. Reconnect the battery negative cable. Turn the ignition switch to the On position. Place the multi-function switch in the posi-

WIPERS/WASHERS (Continued)

tions indicated in the tests below, and check for battery voltage at the appropriate cavity of the headlamp and dash wire harness connector for the wiper motor.

(a) Check for battery voltage at the fused ignition switch output (run-acc) circuit cavity of the headlamp and dash wire harness connector for the wiper module with the multi-function switch in any position. If OK, go to Step b. If not OK, repair the open fused ignition switch output (run-acc) circuit between the wiper module and the JB as required.

(b) Check for battery voltage at the front wiper low speed circuit cavity of the headlamp and dash wire harness connector for the wiper module with the multi-function switch in the Lo position. If OK, go to Step c. If not OK, repair the open front wiper low speed circuit between the wiper module and the multi-function switch as required.

(c) Check for battery voltage at the front wiper high speed circuit cavity of the headlamp and dash wire harness connector for the wiper module with the multi-function switch in the Hi position. If OK, go to Step d. If not OK, repair the open front wiper high speed circuit between the wiper module and the multi-function switch as required.

(d) Check for battery voltage at the front wiper park switch sense circuit cavity of the headlamp and dash wire harness connector for the wiper module with the multi-function switch in the Lo or Hi position, then move the switch to the Off position. The meter should switch between battery voltage and zero volts while the wipers are cycling. The meter should read battery voltage when the switch is first moved to the Off position until the wipers park, and then read a steady zero volts. If not OK, replace the faulty wiper module.

WASHER SYSTEM

The diagnosis found here addresses an electrically inoperative washer system. However, these tests may not prove conclusive in the diagnosis of the Central Timer Module (CTM). In order to obtain conclusive testing of the CTM, the Programmable Communications Interface (PCI) data bus network and all of the electronic modules that provide inputs to or receive outputs from the washer system components must be checked. The most reliable, efficient, and accurate means to diagnose the CTM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. 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/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, 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) Turn the ignition switch to the On position. Turn the multi-function switch wiper control knob to the Lo or Hi speed position. Check whether the wipers operate. If OK, go to Step 2. If not OK, repair the wiper system as required before proceeding with the following tests. Refer to WIPER SYSTEM .

(2) Turn the multi-function switch wiper control knob to the Off position. Depress the control knob to the Wash position. The washer pump should operate and the wipers should operate for as long as the control knob is depressed. The wipers should continue to operate for about three sweep cycles after the control knob is released before they park. If the wipers are OK, but the washers are not, go to Step 3. If the washers are OK, but the wipers are not, go to Step 5.

(3) 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 washer pump/motor from the motor connector receptacle. Measure the resistance between the ground circuit cavity of the headlamp and dash wire harness connector for the washer pump/motor and a good ground. The meter should read zero ohms. If OK, go to Step 4. If not OK, repair the open ground circuit to ground (G112) as required.

(4) Reconnect the battery negative cable. Turn the ignition switch to the On position. With the control knob of the multi-function switch depressed to the Wash position, check for battery voltage at the front washer pump/motor control circuit cavity of the headlamp and dash wire harness connector for the washer pump/motor. If OK, replace the faulty washer pump/motor. If not OK, repair the open front washer pump/motor control circuit between the washer pump/motor and the CTM as required.

WIPERS/WASHERS (Continued)

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector (Connector C1) for the CTM from the CTM connector receptacle. Reconnect the battery negative cable. Turn the ignition switch to the On position. With the control knob of the multi-function switch depressed to the Wash position, check for battery voltage at the front washer pump/motor control circuit cavity of the instrument panel wire harness connector (Connector C1) for the CTM. If OK, proceed to the diagnosis for the wiper relay. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER RELAY - DIAGNOSIS AND TESTING). If not OK, repair the open front washer pump/motor control circuit between the CTM and the multi-function switch as required.

CLEANING - 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 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. Never use sharp instruments to clear a plugged washer nozzle or damage to the nozzle orifice and improper nozzle spray patterns will result.

INSPECTION - WIPER & WASHER SYSTEM

WIPER SYSTEM

The 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/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 side-to-side looseness evident. If there is any binding evident in the wiper arm hinge, or there is evident side-to-side 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/WIPERS/WASHERS - CLEANING). After

WIPERS/WASHERS (Continued)

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.

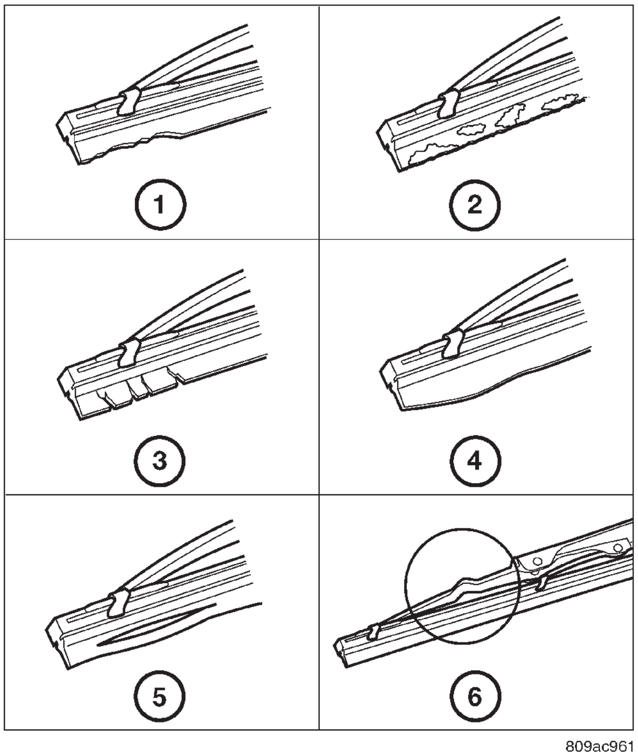


Fig. 1 Wiper Blade Inspection

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/WIPERS/WASHERS - CLEANING).

(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.

CHECK VALVE

DESCRIPTION

A washer system check valve is standard equipment on this model. The check valve is integral to the washer nozzle plumbing wye fitting located in the cowl plenum beneath the cowl plenum cover/grille panel near the base of the windshield. The check valve consists of a molded plastic body with a round center section. Three barbed hose nipples are formed in a wye configuration on the outside circumference of the center section of the valve body. Within the check valve body, a small check valve operated by a small coiled spring restricts flow through the unit until the valve is unseated by a predetermined inlet fluid pressure. The check valve cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

OPERATION

The check valve provides more than one function in this application. It serves as a wye connector fitting between the cowl grille panel and washer nozzle sections of the washer supply hose. It also prevents washer fluid from draining out of the washer supply hoses back to the washer reservoir. This drain-back would result in a lengthy delay from when the washer switch is actuated until washer fluid was dispensed through the washer nozzles, because the washer pump would have to refill the washer plumbing from the reservoir to the nozzles. Finally, the check valve prevents washer fluid from siphoning through the washer nozzles after the washer system is turned Off. When the washer pump pressurizes and pumps washer fluid from the reservoir through the washer plumbing, the fluid pressure overrides the spring pressure applied to the check valve and unseats the valve, allowing washer fluid to flow toward the washer nozzles. When the washer pump stops operating, spring pressure seats the check valve and fluid flow in either direction within the washer plumbing is prevented.

REMOVAL

(1) Remove the wiper arms from the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - REMOVAL).

CHECK VALVE (Continued)

(2) Open the hood and pull the hood to plenum seal off of the forward flanges of the cowl grille cover and the plenum panel.

(3) Remove the cowl plenum cover/grille panel from the top of the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL).

(4) From the underside of the cowl plenum cover/ grille panel, disconnect the washer hoses from the three barbed nipples of the wye fitting/check valve unit.

(5) Remove the wye fitting/check valve unit from the underside of the cowl plenum cover/grille panel.

INSTALLATION

(1) Position the wye fitting/check valve unit to the underside of the cowl plenum cover/grille panel.

(2) From the underside of the cowl plenum cover/ grille panel, reconnect the three washer hoses to the barbed nipples of the wye fitting/check valve unit.

(3) Reinstall the washer hoses for the washer nozzles into their locating clips on the underside of the cowl plenum cover/grille panel.

(4) Reinstall the cowl plenum cover/grille panel onto the top of the cowl plenum panel. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION).

(5) Reinstall the wiper arms onto the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/ WIPER ARMS - INSTALLATION).

WASHER FLUID LEVEL SWITCH

DESCRIPTION

The washer fluid level switch is a single pole, single throw reed-type switch mounted on the outboard side of the washer reservoir forward of the washer pump/motor, in the right front corner of the engine compartment. Only the molded plastic switch mounting flange and connector receptacle are visible when the switch is installed in the reservoir. A short nipple formation extends from the inner surface of the switch mounting flange, and a barb on the nipple near the switch mounting flange is press-fit into a rubber grommet seal installed in the mounting hole of the reservoir. A small plastic float pivots on the end of a bracket that extends from the switch nipple formation. Within the float is a small magnet, which actuates the reed switch. The washer fluid level switch cannot be adjusted or repaired. If faulty or damaged, the switch must be replaced.

OPERATION

The washer fluid level switch uses a pivoting, oblong float to monitor the level of the washer fluid in the washer reservoir. The float contains a small magnet. When the float pivots, the changing proximity of its magnetic field will cause the contacts of the small, stationary reed switch to open or close. When the fluid level in the washer reservoir is at or above the float level, the float moves to a vertical position and the switch contacts open. When the fluid level in the washer reservoir falls below the pivoting float, the float moves to a horizontal position and the switch contacts close. The switch contacts are connected in series between ground and the washer fluid switch sense input of the instrument cluster. The switch is connected to the vehicle electrical system through a dedicated take out and connector of the headlamp and dash wire harness. The switch receives ground through another take out of the headlamp and dash wire harness with a single eyelet terminal connector that is secured under a nut to a ground stud located on the right front fender inner shield in the engine compartment. The washer fluid level switch can be diagnosed using conventional diagnostic tools and methods. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER/WASHER FLUID INDICATOR - DIAGNOSIS AND TESTING).

REMOVAL

The washer fluid level switch can be removed from the washer reservoir without removing the reservoir from the vehicle.

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the washer hose from the barbed outlet nipple of the washer pump/motor unit and allow the washer fluid to drain into a clean container for reuse.

(3) Disconnect the headlamp and dash wire harness connector for the washer fluid level switch from the switch connector receptacle (Fig. 2).

NOTE: The pivoting float of the washer fluid level switch must be in a horizontal position within the reservoir in order to be removed. With the reservoir empty and in an upright position, the pivoting float will orient itself to the horizontal position when the switch connector receptacle is pointed straight downwards.

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the barbed nipple of the washer fluid level switch out of the rubber grommet seal on the outboard side of the reservoir. Care must be taken not to damage the reservoir.

(5) Remove the washer fluid level switch and float from the washer reservoir.

(6) Remove the rubber grommet seal from the washer fluid level switch mounting hole in the washer reservoir and discard.

WASHER FLUID LEVEL SWITCH (Continued)

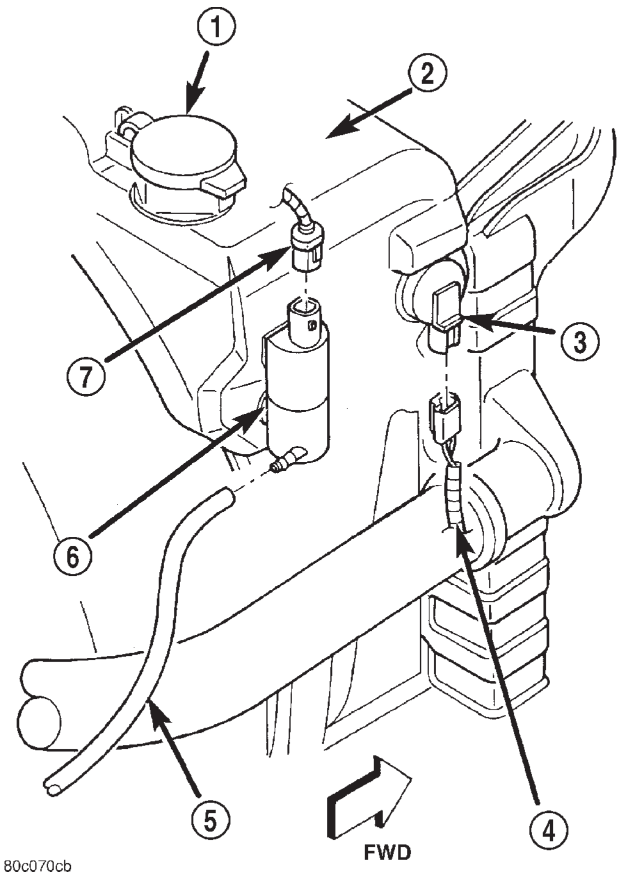


Fig. 2 Washer Fluid Level Switch

1 - WASHER RESERVOIR FILLER CAP
2 - UPPER RADIATOR SHROUD
3 - WASHER FLUID LEVEL SWITCH
4 - WIRE HARNESS CONNECTOR
5 - WASHER SUPPLY HOSE
6 - WASHER PUMP/MOTOR
7 - WIRE HARNESS CONNECTOR

INSTALLATION

(1) Install a new rubber grommet seal into the washer fluid level switch mounting hole in the outboard side of the washer reservoir. Always use a new rubber grommet seal on the reservoir.

(2) Position the float of the washer fluid level switch through the rubber grommet seal in the washer reservoir (Fig. 2). The connector receptacle of the washer fluid level switch should be pointed downward.

(3) Press firmly and evenly on the washer fluid level switch using hand pressure until the barbed nipple is fully seated in the rubber grommet seal in the washer reservoir mounting hole.

(4) Reconnect the headlamp and dash wire harness connector for the washer fluid level switch to the switch connector receptacle.

(5) Reconnect the washer hose to the barbed outlet nipple of the 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.

WASHER HOSES/TUBES

DESCRIPTION

The washer plumbing consists of a small diameter rubber hose that is routed from the barbed outlet nipple of the washer pump/motor on the washer reservoir through the engine compartment along the headlamp and dash wire harness near the right inner fender shield to the dash panel. The washer hose passes from the engine compartment into the cowl plenum area through a dedicated hole with a rubber grommet near the right end of the cowl plenum panel. Beneath the cowl plenum cover/grille panel, a molded plastic in-line fitting with barbed nipples joins the engine compartment hose to a cowl plenum cover/grille panel hose. The cowl plenum cover/grille panel hose is routed through locating clips molded to the underside of the cowl plenum cover/grille panel to a molded plastic wye fitting with barbed nipples and an integral check valve near the passenger side washer nozzle. Two hoses are then routed from the wye fitting through additional locating clips on the underside of the cowl plenum cover/grille panel to the two washer nozzles.

Washer hose is available for service only as roll stock, which must then be cut to length. 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 washer pump/motor through the washer system plumbing and fittings to the two 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.

WASHER NOZZLE

DESCRIPTION

The two washer nozzles have integral snap features that secure them in dedicated holes in the cowl plenum cover/grille panel located near the base of the windshield. The domed upper surface of the washer nozzle is visible on the top of the plenum cover/grille panel, and the nozzle orifice is oriented towards the

WASHER NOZZLE (Continued)

windshield glass. The washer plumbing fittings for the washer nozzles are concealed beneath the cowl plenum cover/grille panel. These fluidic washer nozzles are constructed of molded plastic. The cowl plenum cover/grille panel must be removed from the vehicle to access the nozzles for service. The washer nozzles cannot be adjusted or repaired and, if faulty or damaged, they must be replaced.

OPERATION

The two 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 washer pump/motor through rubber hoses, which are attached to a barbed nipple on each washer nozzle below the cowl plenum cover/grille panel. The washer nozzles incorporate a fluidic design, which causes the nozzle to emit the pressurized washer fluid as an oscillating stream to more effectively cover a larger area of the glass area to be cleaned.

REMOVAL

(1) Remove the wiper arms from the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/ WIPER ARMS - REMOVAL).

(2) Remove the cowl plenum cover/grille panel from the top of the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL).

(3) From the underside of the cowl plenum cover/ grille panel, disconnect the washer hose from the nozzle fitting.

(4) From the underside of the cowl plenum cover/ grille panel, compress the snap features of the washer nozzle and push the nozzle out through the top of the panel.

INSTALLATION

(1) Align the washer nozzle with the opening on the top of cowl plenum cover/grille panel.

(2) Using hand pressure, push the washer nozzle into the opening from the top of the cowl plenum cover/grille panel until the snap features of the nozzle are fully engaged.

(3) From the underside of the cowl plenum cover/ grille panel, reconnect the washer hose to the nozzle fitting.

(4) Reinstall the cowl plenum cover/grille panel onto the top of the cowl plenum. (Refer to 23 - BODY/ EXTERIOR/COWL GRILLE - INSTALLATION).

(5) Reinstall the wiper arms onto the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/ WIPER ARMS - INSTALLATION).

WASHER PUMP/MOTOR

DESCRIPTION

The washer pump/motor unit is located on the outboard side of the washer reservoir, near the bottom in the right front corner of the engine compartment. A small permanently lubricated and sealed electric motor is coupled to the rotor-type washer pump. A seal flange with a large barbed inlet nipple on the pump housing passes through a rubber grommet seal installed in the dedicated mounting hole near the bottom of the washer reservoir. A smaller barbed outlet nipple on the pump housing connects the unit to the washer hose. The washer pump/motor unit is retained on the reservoir by the interference fit between the barbed pump inlet nipple and the grommet seal, which is a light press fit. An integral electrical connector receptacle is located on the motor housing. The washer pump/motor unit cannot be repaired. If faulty or damaged, the entire washer pump/motor unit must be replaced.

OPERATION

The 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 by a nut to a ground stud located on the right front fender inner shield in the engine compartment. The washer pump/motor receives battery current on a front washer pump/motor control circuit through an output of the Central Timer Module (CTM) whenever the CTM receives an input through the closed contacts of the momentary washer switch within the multi-function switch. 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 washer plumbing, and the washer nozzles onto the windshield glass.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the headlamp and dash wire harness connector for the washer pump/motor from the motor connector receptacle (Fig. 3).

(3) Disconnect the washer supply hose from the barbed outlet nipple of the washer pump/motor and allow the washer fluid to drain into a clean container for reuse.

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the barbed inlet nipple of

WASHER PUMP/MOTOR (Continued)

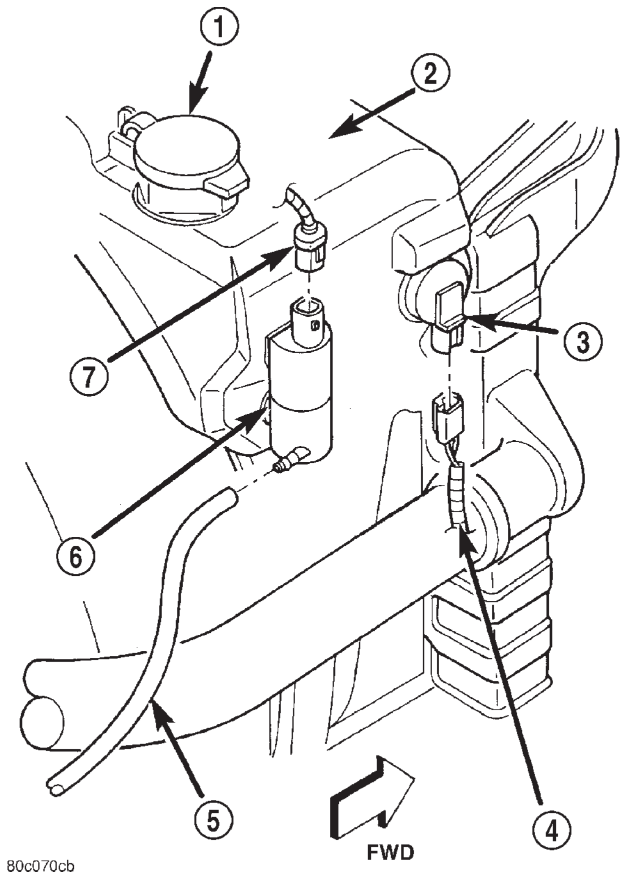


Fig. 3 Washer Pump/Motor Remove/Install

1 - WASHER RESERVOIR FILLER CAP
2 - UPPER RADIATOR SHROUD
3 - WASHER FLUID LEVEL SWITCH
4 - WIRE HARNESS CONNECTOR
5 - WASHER SUPPLY HOSE
6 - WASHER PUMP/MOTOR
7 - WIRE HARNESS CONNECTOR

the washer pump out of the rubber grommet seal in the reservoir. Care must be taken not to damage the reservoir.

(5) Remove the rubber grommet seal from the washer pump mounting hole in the washer reservoir and discard.

INSTALLATION

(1) Install a new rubber grommet seal into the washer pump mounting hole in the washer reservoir. Always use a new rubber grommet seal on the reservoir.

(2) Position the barbed inlet nipple of the washer pump to the rubber grommet seal in the reservoir.

(3) Using hand pressure, press firmly and evenly on the washer pump until the barbed inlet nipple is fully seated in the rubber grommet seal in the washer reservoir mounting hole.

(4) Reconnect the washer hose to the barbed outlet nipple of the washer pump.

(5) Reconnect the headlamp and dash wire harness connector for the washer pump/motor to the motor connector receptacle (Fig. 3).

(6) Refill the washer reservoir with the washer fluid drained from the reservoir during the removal procedure.

(7) Reconnect the battery negative cable.

WASHER RESERVOIR

DESCRIPTION

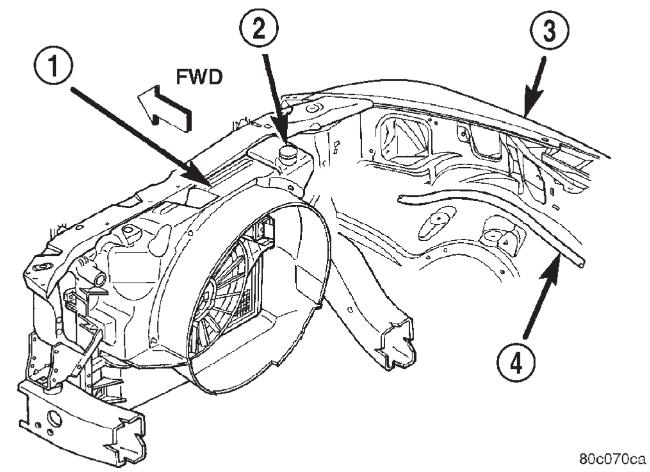


Fig. 4 Washer Reservoir

1 - UPPER RADIATOR SHROUD
2 - WASHER RESERVOIR FILLER CAP
3 - RIGHT FRONT FENDER
4 - WASHER SUPPLY HOSE

The molded plastic washer fluid reservoir is integral to, and located on the right end of the upper radiator shroud in the right front corner of the engine compartment (Fig. 4). A bright yellow plastic filler cap with a rubber seal and an International Control and Display Symbol icon for “Windshield Washer” and the text “Washer Fluid Only” molded into it snaps over the open end of the filler neck. The cap hinges on and is secured to a molded-in hook formation on the top of the reservoir just inboard of the filler neck when it is removed for inspecting or adjusting the fluid level in the reservoir. There are separate, dedicated holes on the outboard side of the reservoir provided for the mounting of the washer/pump motor unit and the washer fluid level switch.

The washer reservoir is serviced only as a unit with the upper radiator shroud. The washer reservoir cannot be repaired and, if faulty or damaged, the upper fan shroud unit must be replaced. The grommet seals for the washer pump/motor unit and the

WASHER RESERVOIR (Continued)

washer fluid level switch, and the filler cap are each available for service replacement.

OPERATION

The washer fluid reservoir provides a secure, on-vehicle storage location for a large reserve of washer fluid for operation of the washer system. The washer reservoir filler neck provides a clearly marked and readily accessible point from which to add washer fluid to the reservoir. The washer/pump motor unit is located in a sump area near the bottom of the reservoir to be certain that washer fluid will be available to the pump as the fluid level in the reservoir becomes depleted. The washer fluid level switch is mounted just above the sump area of the reservoir so that there will be adequate warning to the vehicle operator that the washer fluid level is low, before the washer system will no longer operate.

REMOVAL

NOTE: The washer reservoir is integral to the right end of the upper radiator shroud, and the engine coolant reserve/overflow tank is integral to the left end of the upper radiator shroud (Fig. 5).

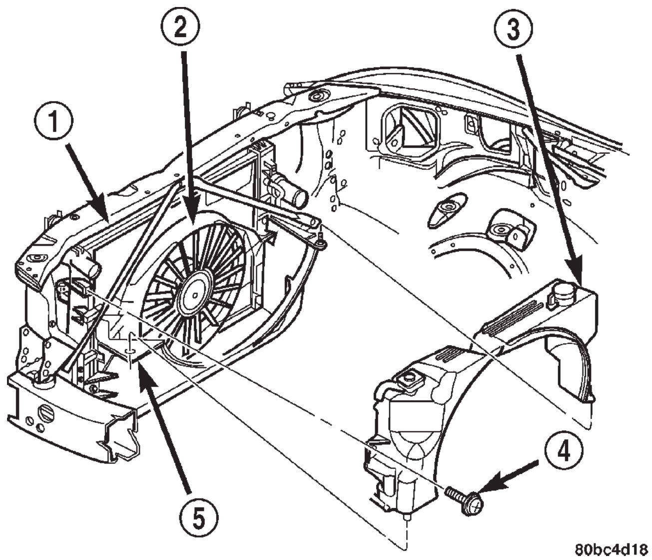


Fig. 5 Upper Fan Shroud Remove/Install

1 - RADIATOR
2 - ELECTRIC COOLING FAN
3 - UPPER SHROUD & WASHER RESERVOIR UNIT
4 - SCREW
5 - LOWER SHROUD

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the headlamp and dash wire harness connector for the washer fluid level switch from the switch connector receptacle (Fig. 6).

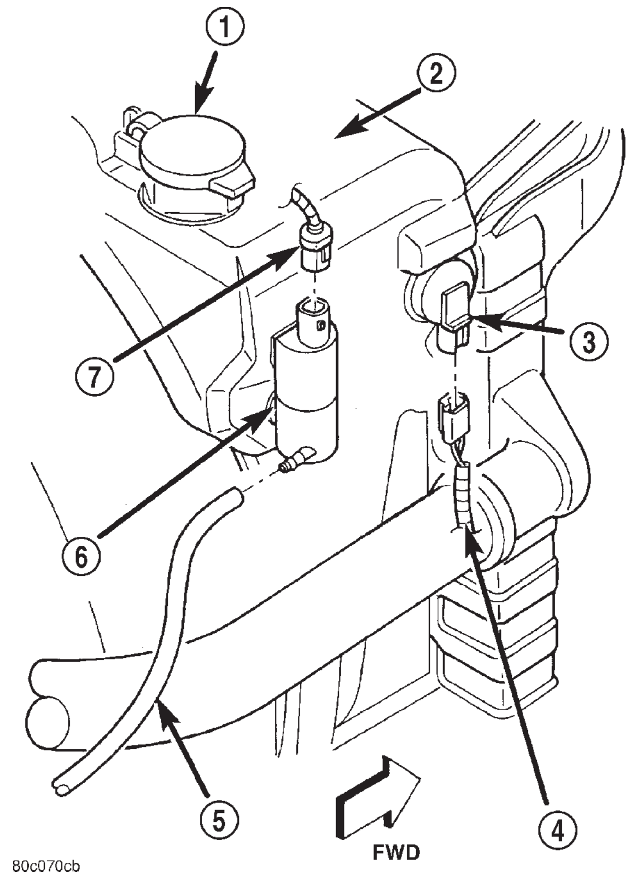


Fig. 6 Washer Pump/Motor Remove/Install

1 - WASHER RESERVOIR FILLER CAP
2 - UPPER RADIATOR SHROUD
3 - WASHER FLUID LEVEL SWITCH
4 - WIRE HARNESS CONNECTOR
5 - WASHER SUPPLY HOSE
6 - WASHER PUMP/MOTOR
7 - WIRE HARNESS CONNECTOR

(3) Disconnect the headlamp and dash wire harness connector for the washer pump/motor unit from the motor connector receptacle.

(4) Disconnect the washer hose from the barbed outlet nipple of the washer pump/motor and allow the washer fluid to drain into a clean container for reuse.

(5) Disconnect the engine coolant reserve/overflow hose from the nipple of the radiator filler spout in the upper radiator hose.

(6) Remove the six screws that secure the upper radiator shroud to the radiator.

(7) Disengage the locator dowels on the bottom of the upper radiator shroud from the locator holes in the upper flanges of the lower shroud.

(8) Remove the upper radiator shroud from the radiator.

WASHER RESERVOIR (Continued)

INSTALLATION

NOTE: The washer reservoir is integral to the right end of the upper radiator shroud, and the engine coolant reserve/overflow tank is integral to the left end of the upper radiator shroud (Fig. 5).

(1) Position the upper radiator shroud onto the radiator.

(2) Engage the locator dowels on the bottom of the upper radiator shroud into the locator holes in the upper flanges of the lower shroud.

(3) Install and tighten the six screws that secure the upper radiator shroud to the radiator. Tighten the screws to 6 N·m (50 in. lbs.).

(4) Reconnect the engine coolant reserve/overflow hose to the nipple of the radiator filler spout in the upper radiator hose.

(5) Reconnect the washer hose to the barbed outlet nipple of the washer pump/motor (Fig. 6).

(6) Reconnect the headlamp and dash wire harness connector for the washer pump/motor unit to the motor connector receptacle.

(7) Reconnect the headlamp and dash wire harness connector for the washer fluid level switch to the switch connector receptacle.

(8) Refill the washer reservoir with the washer fluid drained from the reservoir during the removal procedure.

(9) Reconnect the battery negative cable.

WIPER ARM

DESCRIPTION

The 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. These wiper arms feature an over-center hinge that allows easy access to the windshield glass for cleaning. The wiper arm has a die cast metal pivot end with a large mounting hole with internal serrations at one end. A molded black plastic cap fits over the wiper arm retaining nut to conceal the nut and this mounting hole following wiper arm installation. The wide end of a tapered, stamped steel channel hinges on and is secured with a hinge pin to the blade end of the wiper arm pivot end. 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 engaged with a wire hook on the underside of 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 mounting hole 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 mounting nut locks the wiper arm to the threaded stud on the wiper pivot. 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 wiper arm to its over-center position to hold the wiper blade off of the glass and relieve the spring tension on the wiper arm to wiper pivot connection.

(2) Open the hood of the vehicle.

(3) Carefully pry the plastic nut cap off of the pivot end of the wiper arm (Fig. 7).

(4) Remove the nut that secures the wiper arm to the wiper pivot shaft.

(5) Use a suitable battery terminal puller to disengage the wiper arm from the wiper pivot shaft splines (Fig. 8).

(6) Remove the 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 multi-function switch control knob 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 wiper arms must be indexed to the wiper pivots with the wiper motor in the park position to

WIPER ARM (Continued)

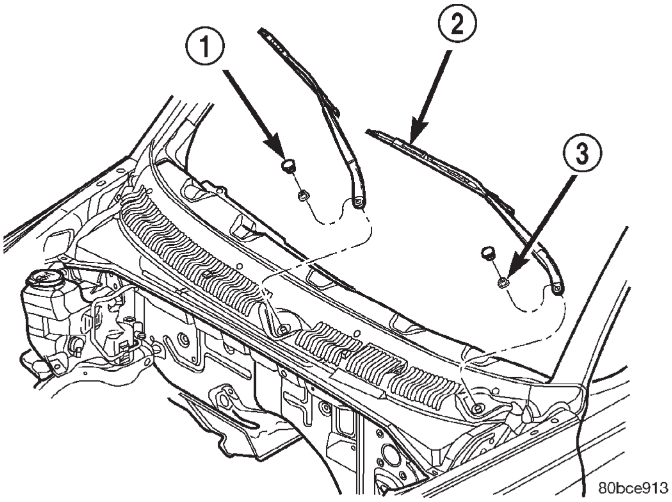


Fig. 7 Wiper Arm Remove/Install

1 - NUT CAP
2 - WIPER ARM AND BLADE
3 - NUT

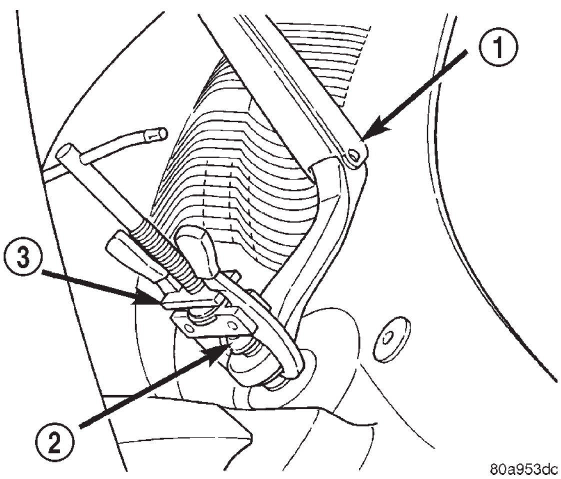


Fig. 8 Wiper Arm Puller - Typical

1 - WIPER ARM
2 - WIPER PIVOT
3 - BATTERY TERMINAL PULLER

be properly installed. Position the wiper arm pivot ends onto the wiper pivots so that the lower edge of the blade is aligned with the wiper alignment lines concealed in the upper margin of the lower windshield blackout area, ± 15 mm (± 0.59 in.) (Fig. 9).

(2) Once the wiper blade is aligned, lift the wiper arm away from the windshield slightly to relieve the spring tension on the pivot end and push the pivot hole on the end of the wiper arm down over the wiper pivot shaft.

(3) Install and tighten the nut that secures the wiper arm to the wiper pivot shaft. Tighten the nut to 23.7 N·m (210 in. lbs.).

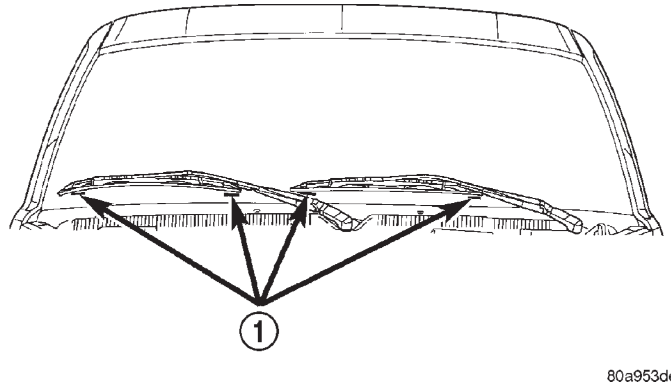


Fig. 9 Wiper Arm Installation

1 - WIPER ALIGNMENT LINES ± 15 mm (± 0.59 in.)

(4) Wet the windshield glass, then operate the wipers. Turn the wiper switch to the Off position, then check for the correct wiper arm position and readjust as required.

(5) Reinstall the plastic nut cap onto the wiper arm pivot nut.

WIPER BLADE

DESCRIPTION

Each wiper blade is secured by an integral latching pivot block to the hook formation on the tip of the wiper arms, and rests on the glass near the base of the windshield when the wipers are not in operation. The wiper blade consists of the following components:

- **Superstructure** - The superstructure includes several stamped steel bridges and links with claw formations that grip the wiper blade element. The driver side and passenger side wiper blades are not interchangeable. The superstructure of the driver side blade features an additional bridge, which provides an additional set of claws to retain the wiper squeegees. Their are eight sets of claws on the driver side, and six sets of claws used on the passenger side. 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 Dakota truck models have two 50 centimeter (19.69 inch) wiper blades with non-replaceable rubber elements (squeegees). These wiper blades also

WIPER BLADE (Continued)

include an anti-lift feature. 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.

REMOVAL

NOTE: The driver side and passenger side wiper blades are not interchangeable. The driver side wiper blade has an extra bridge and eight pairs of claws securing the wiper element. The passenger side wiper blade has six pairs of claws securing the wiper element. The notched retainer end of both wiper elements should always be oriented towards the end of the wiper blade that is nearest to the wiper pivot.

(1) Turn the wiper control knob on the end of the multi-function switch control stalk to the On position. Cycle the wiper blades to a convenient working location on the windshield by turning the ignition switch to the On and Off positions.

(2) Lift the wiper arm to raise the wiper blade and element off of the glass.

(3) 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. 10).

(4) 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.

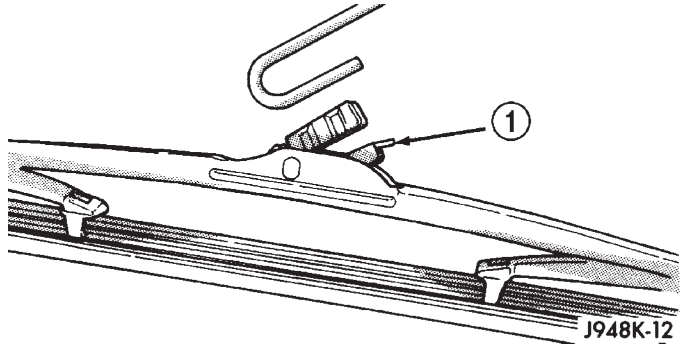


Fig. 10 Wiper Blade Remove/Install - Typical

1 - RELEASE TAB

(5) Gently lower the wiper arm tip onto the glass.

INSTALLATION

NOTE: The driver side and passenger side wiper blades are not interchangeable. The driver side wiper blade has an extra bridge and eight pairs of claws securing the wiper element. The passenger side wiper blade has six pairs of claws securing the wiper element. The notched retainer end of both wiper elements should always be oriented towards the end of the wiper blade that is nearest to the wiper pivot.

(1) Lift the wiper arm off of the windshield glass.

(2) Position the 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. 10).

(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.

WIPER MODULE

DESCRIPTION

The wiper module is secured with screws through four rubber grommet-type insulators to the cowl plenum panel and concealed within the cowl plenum area beneath the cowl plenum cover/grille panel. 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 wiper module. The

WIPER MODULE (Continued)

wiper module consists of the following major components:

• **Bracket** - The 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.

• **Crank Arm** - The wiper motor crank arm is a stamped steel unit that has a slotted hole on the 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 wiper linkage members are each constructed of stamped steel. A driver side drive link with a plastic socket-type bushing in the left end, and a plastic sleeve-type bushing in the right end. Socket bushing is snap-fit over the pivot ball stud on the left pivot, while the sleeve bushing is fit over the longer wiper motor crank arm pivot stud. The passenger side drive link has a plastic socket-type bushing on each end. One end of this drive link is snap-fit over the pivot ball stud on the right pivot, while the other end is snap-fit over the exposed end of the longer ball stud on the wiper motor crank arm.

• **Motor** - The wiper motor is secured with three screws to the motor mounting plate near the center of the wiper module bracket. 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 Positive Temperature Coefficient (PTC) circuit breaker.

• **Pivots** - The two wiper pivots are secured to the ends of the wiper module bracket. The crank arms that extend from the bottom of the pivot shafts each have a ball stud on their end. The upper end of each pivot shaft where the wiper arms will be fastened each has an externally serrated drum secured to it.

The wiper module cannot be adjusted or repaired. If any component of the module is faulty or damaged, the entire wiper module unit must be replaced.

OPERATION

The wiper module operation is controlled by the vehicle operator through battery current inputs received by the wiper motor from the multi-function switch on the steering column. 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 wiper arms from the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - REMOVAL).

(3) Remove the cowl plenum cover/grille panel from the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL).

(4) Remove the four screws that secure the wiper module bracket to the cowl plenum panel and the dash panel (Fig. 11).

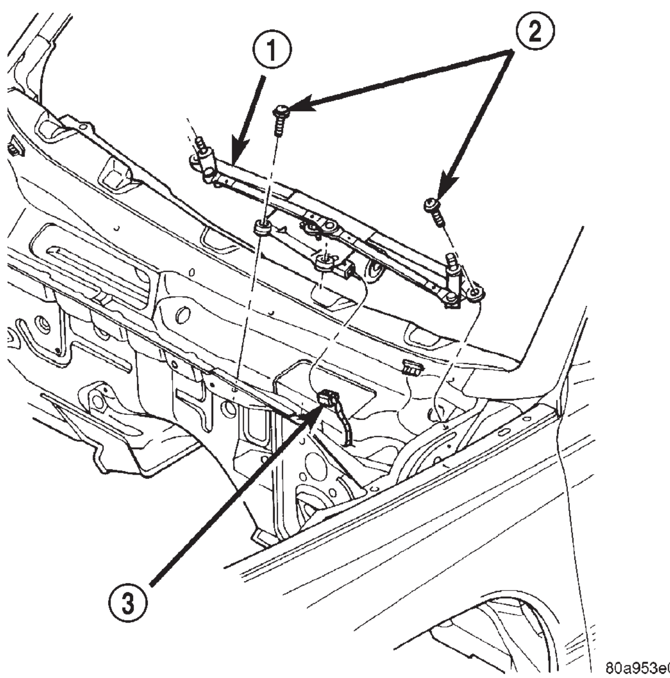


Fig. 11 Wiper Module Remove/Install

1 - WIPER MODULE
2 - SCREW (4)
3 - WIRE HARNESS CONNECTOR

(5) Reach into the cowl plenum to move the wiper module far enough to access the wiper module electrical connections.

WIPER MODULE (Continued)

(6) Disconnect the headlamp and dash wire harness connector for the wiper motor from the wiper motor pigtail wire connector.

(7) Disconnect the headlamp and dash wire harness ground connector from the wiper motor ground terminal.

(8) Remove the wiper module from the cowl plenum as a unit.

INSTALLATION

(1) Position the wiper module into the cowl plenum as a unit.

(2) Reconnect the headlamp and dash wire harness ground connector to the wiper motor ground terminal (Fig. 11).

(3) Reconnect the headlamp and dash wire harness connector for the wiper motor to the wiper motor pigtail wire connector.

(4) Reach into the cowl plenum to align the wiper module mounting bracket with the locations for the mounting screws.

(5) Install and tighten the four screws that secure the wiper module bracket to the cowl plenum panel and the dash panel. Tighten the screws to 8 N·m (72 in. lbs.).

(6) Reinstall the cowl plenum cover/grille panel over the top of the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION).

(7) Reinstall the wiper arms onto the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - INSTALLATION).

(8) Reconnect the battery negative cable.

WIPER RELAY

DESCRIPTION

The wiper relay (or intermittent wipe relay) is located in the Power Distribution Center (PDC) near the battery in the engine compartment. See the fuse and relay layout label affixed to the inside surface of the PDC cover for wiper relay identification and location. The wiper relay is a conventional International Standards Organization (ISO) micro relay. 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. The relay is connected to all of the required inputs and outputs through its PDC receptacle by five male spade-type terminals that extend from the bottom of the relay base. The ISO designation for each terminal is molded into the base adjacent to the terminal. The ISO terminal designations are as follows:

- **30 (Common Feed)** - This terminal is connected to the movable contact point of the relay.
- **85 (Coil Ground)** - This terminal is connected to the ground feed side of the relay control coil.
- **86 (Coil Battery)** - This terminal is connected to the battery feed side of the relay control coil.
- **87 (Normally Open)** - This terminal is connected to the normally open fixed contact point of the relay.
- **87A (Normally Closed)** - This terminal is connected to the normally closed fixed contact point of the relay.

The wiper relay cannot be adjusted or repaired. If the relay is damaged or faulty, it must be replaced.

OPERATION

The wiper relay (or intermittent wipe relay) is an electromechanical switch that uses a low current input from the Central Timer Module (CTM) to control a high current output to the low speed brush of the wiper motor. The movable common feed contact point is held against the fixed 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 or diode 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.

The wiper relay terminals are connected to the vehicle electrical system through a connector receptacle in the Power Distribution Center (PDC). The inputs and outputs of the wiper relay include:

- The common feed terminal (30) is connected to the wiper motor low speed brush through the wiper control circuitry of the multi-function switch on the steering column. When the wiper relay is de-energized, the common feed terminal is connected to the wiper park switch output through the CTM on the front wiper park switch sense circuit. The wiper park switch output may be battery current (wipers are not parked), or ground (wipers are parked). When the wiper relay is energized, the common feed terminal of the relay is connected to battery current from a fuse in the Junction Block (JB) through a fused ignition switch output (run-acc) circuit.
- The coil ground terminal (85) is connected to the relay control output of the CTM through the wiper relay control circuit. The CTM controls the ground path for this circuit internally to energize or de-energize the wiper relay based upon its programming, inputs from the wiper and washer control circuitry of

WIPER RELAY (Continued)

the multi-function switch, and inputs from the wiper motor park switch.

- The coil battery terminal (86) is connected to battery current from a fuse in the Junction Block (JB) through a fused ignition switch output (run-acc) circuit whenever the ignition switch is in the On or Accessory positions.
- The normally open terminal (87) is connected to battery current from a fuse in the Junction Block (JB) through a fused ignition switch output (run-acc) circuit whenever the wiper relay control coil is energized by the CTM. This circuit provides fused ignition switch output (run-acc) current to the wiper motor low speed brush only when the wiper relay control coil is energized.
- The normally closed terminal (87A) is connected to the output of the wiper motor park switch through the CTM on the front wiper park switch sense circuit. This circuit provides battery current (wipers are not parked) or ground (wipers are parked) to the wiper motor low speed brush whenever the wiper relay control coil is de-energized and the Off position of the wiper control circuitry within the multi-function switch is selected.

The wiper relay can be diagnosed using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - WIPER RELAY

The wiper relay (or intermittent wipe relay) (Fig. 12) 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 wiper relay identification and location. 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) Remove the wiper relay from the PDC. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER 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, test the relay input and output circuits. Refer to RELAY CIRCUIT TEST . If not OK, replace the faulty relay.

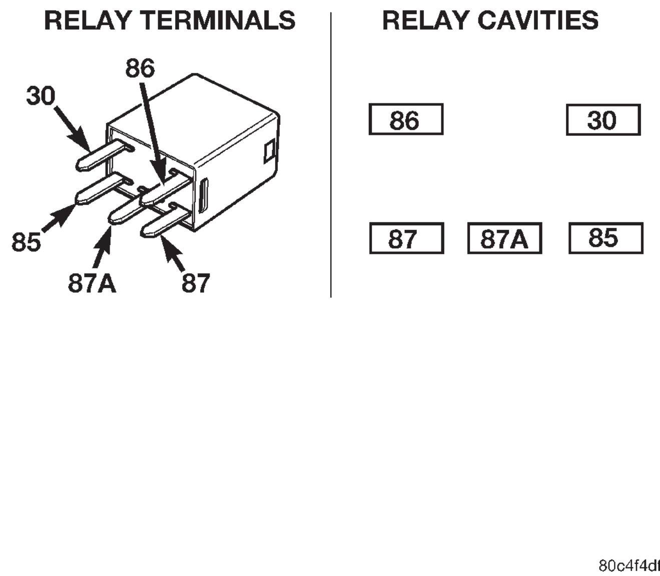


Fig. 12 Wiper Relay

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 the multi-function switch. There should be continuity between the receptacle for terminal 30 of the wiper relay in the PDC and the intermittent front wiper low speed circuit cavity of the instrument panel wire harness connector for the multi-function switch at all times. If OK, go to Step 2. If not OK, repair the open intermittent front wiper low speed circuit between the PDC and the multi-function switch as required.

(2) The relay normally closed terminal (87A) is connected to the wiper motor park switch through the CTM on the front wiper park switch sense circuit. There should be continuity between the receptacle for terminal 87A of the wiper relay in the PDC and the front wiper park switch sense circuit cavity of the headlamp and dash wire harness connector for the wiper motor at all times. If OK, go to Step 3. If not OK, repair the open front wiper park switch sense circuit between the PDC and the wiper motor as required.

(3) The relay normally open terminal (87) is connected to a fused ignition switch output (run-acc) fuse in the Junction Block (JB) through a fused ignition switch output (run-acc) circuit. There should be battery voltage at the receptacle for terminal 87 of the wiper relay in the PDC whenever the ignition switch is in the On or Accessory positions. If OK, go to Step 4. If not OK, repair the open fused ignition

WIPER RELAY (Continued)

switch output (run-acc) circuit between the PDC and the JB as required.

(4) The coil battery terminal (86) is connected to a fused ignition switch output (run-acc) fuse in the JB through a fused ignition switch output (run-acc) circuit. There should be battery voltage at the receptacle for terminal 86 of the wiper relay in the PDC whenever the ignition switch is in the On or Accessory positions. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (run-acc) circuit between the PDC and the JB as required.

(5) The coil ground terminal (85) is connected to the output of the Central Timer Module (CTM) through the wiper relay control circuit. There should be continuity between the receptacle for terminal 85 of the wiper relay in the PDC and the wiper relay control circuit cavity of the instrument panel wire harness connector (Connector C3) for the CTM at all times. If not OK, repair the open wiper relay control circuit between the PDC and the CTM as required.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 13).

(3) See the fuse and relay layout label affixed to the underside of the PDC cover for wiper relay identification and location.

(4) Remove the wiper relay by grasping it firmly and pulling it straight out from the receptacle in the PDC.

INSTALLATION

(1) See the fuse and relay layout label affixed to the underside of the PDC cover for the proper wiper relay location (Fig. 13).

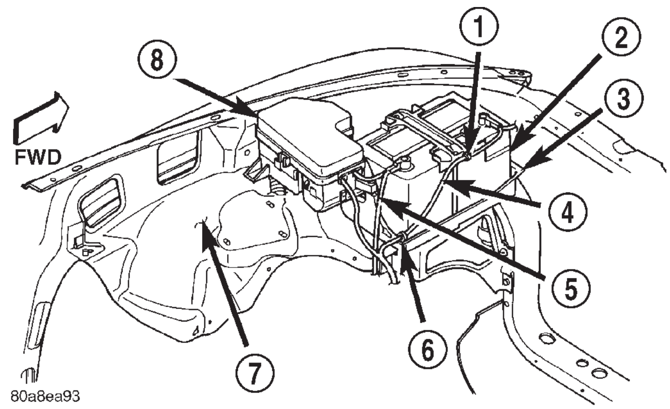


Fig. 13 Power Distribution Center - Typical

1 - CLIP
2 - BATTERY
3 - TRAY
4 - NEGATIVE CABLE
5 - POSITIVE CABLE
6 - CLIP
7 - FENDER INNER SHIELD
8 - POWER DISTRIBUTION CENTER

(2) Position the wiper relay in the proper receptacle in the PDC.

(3) Align the wiper relay terminals with the terminal cavities in the PDC receptacle.

(4) Push firmly and evenly on the top of the wiper relay until the terminals are fully seated in the terminal cavities in the PDC receptacle.

(5) Reinstall the cover onto the PDC.

WIRING

TABLE OF CONTENTS

8W-01 WIRING DIAGRAM INFORMATION

TABLE OF CONTENTS

WIRING DIAGRAM INFORMATION

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)

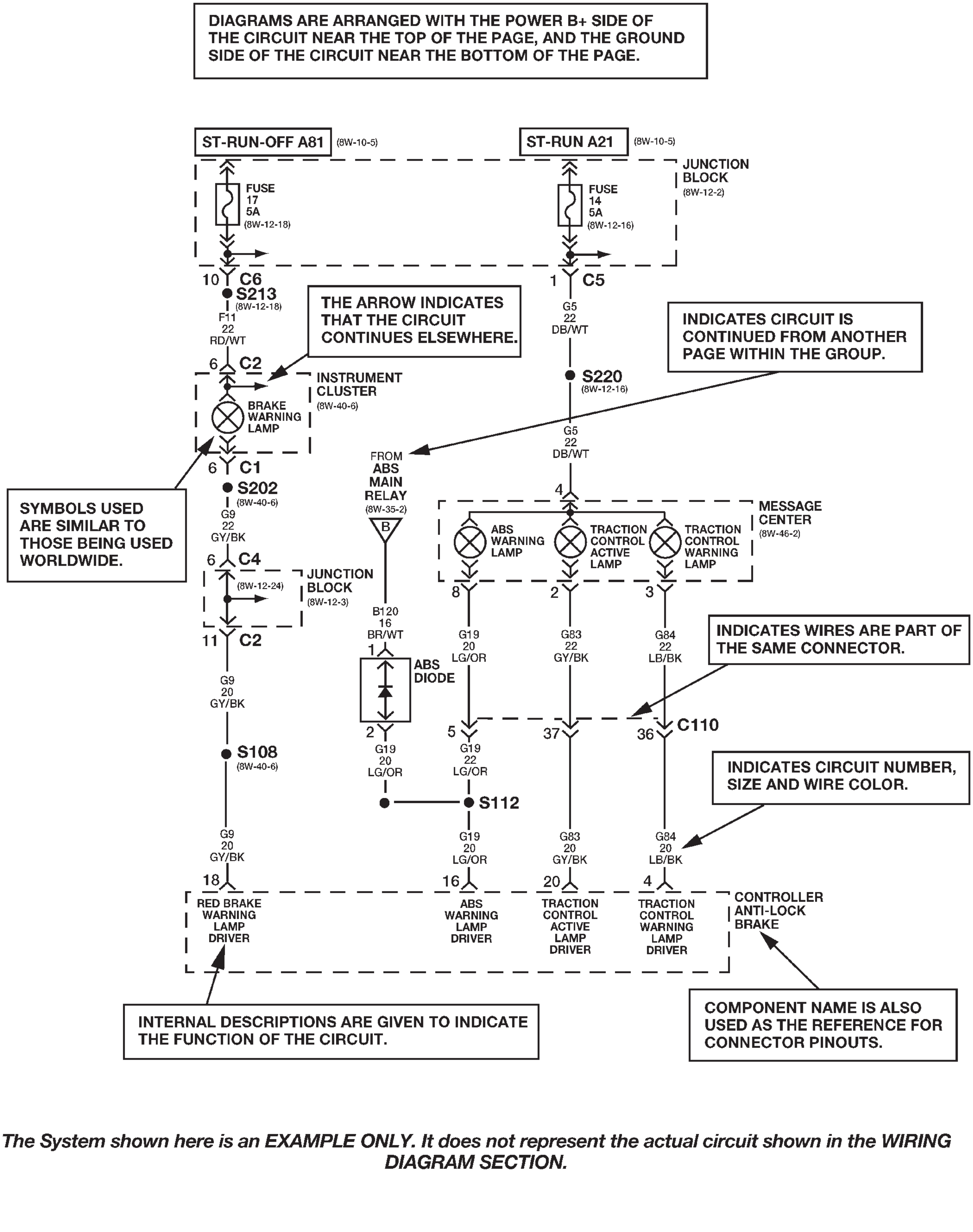
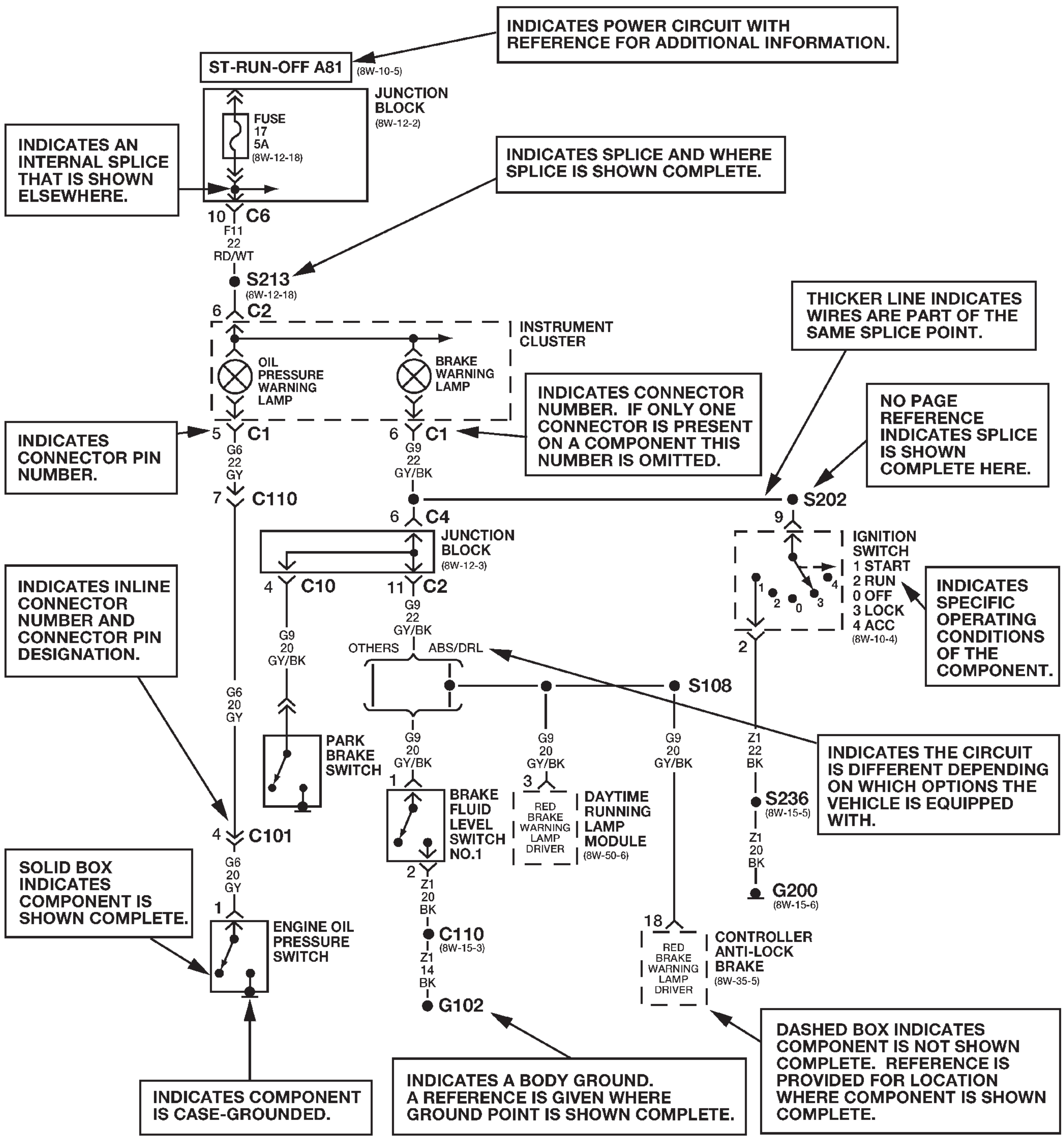


Fig. 1 WIRING DIAGRAM EXAMPLE 1

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)

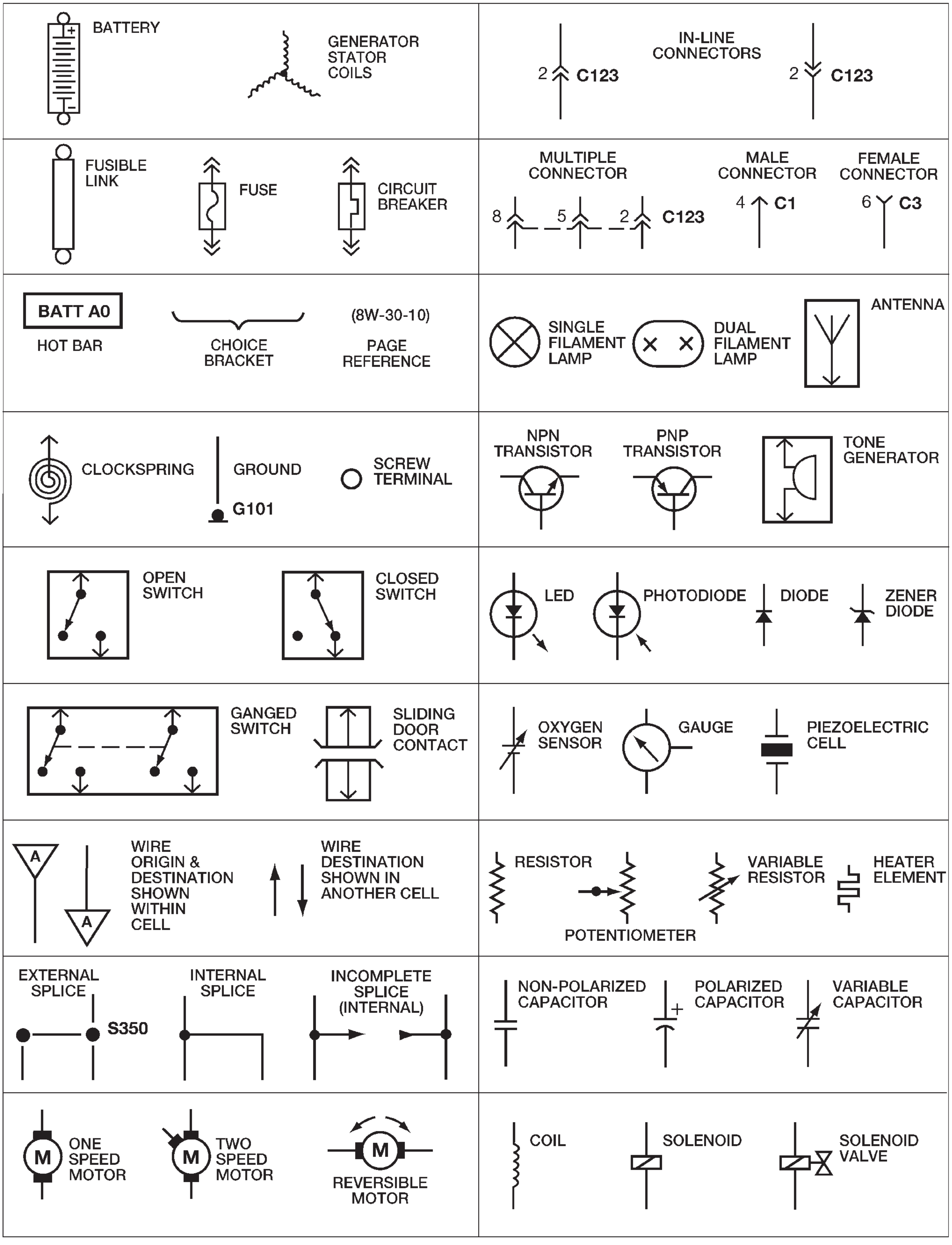


Fig. 3 WIRING DIAGRAM SYMBOLS

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

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 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.

- 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. 4)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.

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

WIRING DIAGRAM INFORMATION (Continued)

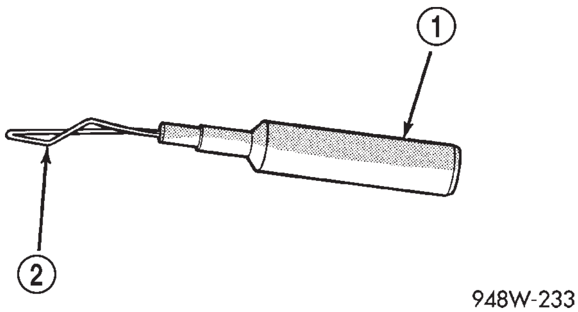


Fig. 4 PROBING TOOL

1 - SPECIAL TOOL 6801
2 - PROBING END

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 - TESTING FOR VOLTAGE POTENTIAL

(1) Connect the ground lead of a voltmeter to a known good ground (Fig. 5).

(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.

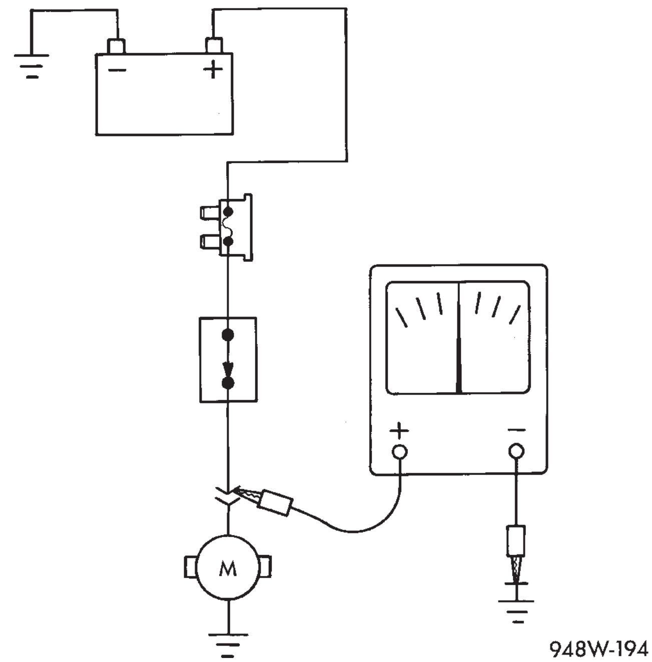


Fig. 5 TESTING FOR VOLTAGE POTENTIAL

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. 6)

(3) Connect the other lead to the other end of the circuit being tested. Low or no resistance means good continuity.

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.

WIRING DIAGRAM INFORMATION (Continued)

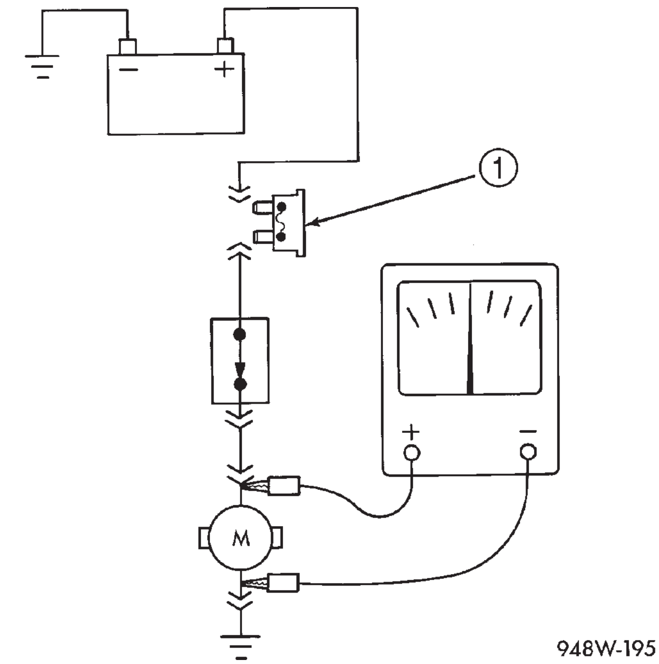


Fig. 6 TESTING FOR CONTINUITY

1 - FUSE REMOVED FROM CIRCUIT

STANDARD PROCEDURE - TESTING FOR SHORT TO GROUND ON FUSES POWERING SEVERAL LOADS

(1) Refer to the wiring diagrams and disconnect or isolate all items on the suspected fused circuits.

(2) Replace the blown fuse.

(3) Supply power to the fuse by turning ON the ignition switch or re-connecting the battery.

(4) Start connecting the items in the fuse circuit one at a time. When the fuse blows the circuit with the short to ground has been isolated.

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. 7).

(2) Connect the other lead of the voltmeter to the other side of the switch or component.

(3) Operate the item.

(4) The voltmeter will show the difference in voltage between the two points.

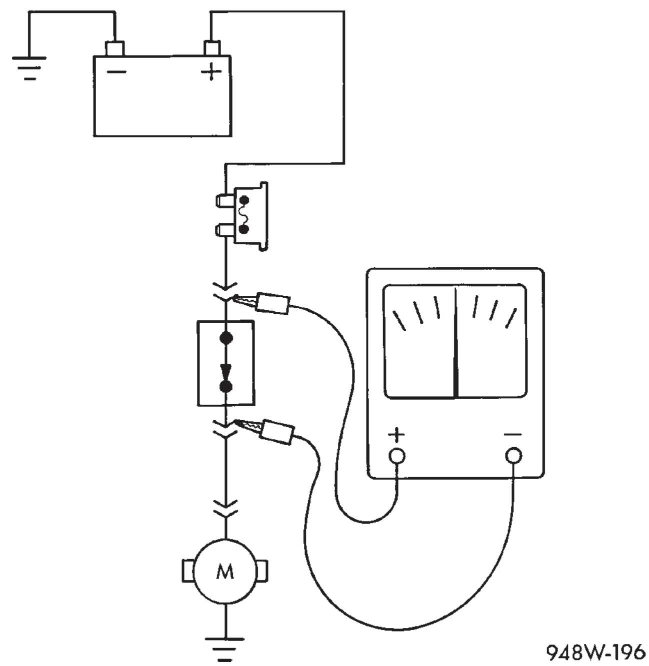
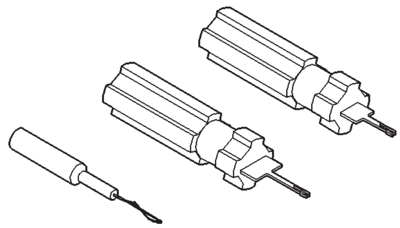


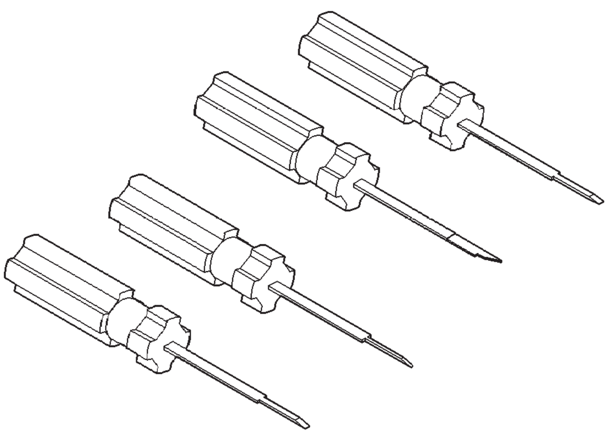
Fig. 7 TESTING FOR VOLTAGE DROP

SPECIAL TOOLS

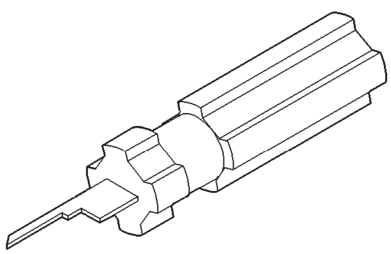
SPECIAL TOOLS - WIRING/TERMINAL



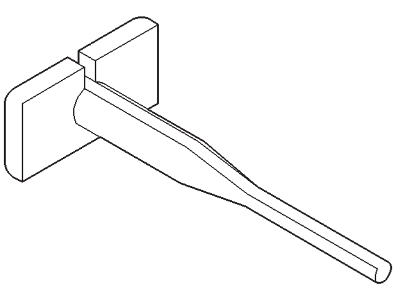
PROBING TOOL PACKAGE 6807



TERMINAL PICK 6680



TERMINAL REMOVING TOOL 6932



TERMINAL REMOVING TOOL 6934

CONNECTOR - AUGAT

REMOVAL

(1) Disconnect battery.

(2) Disconnect the connector from its mating half/component.

(3) Push down on the yellow connector locking tab to release the terminals (Fig. 8).

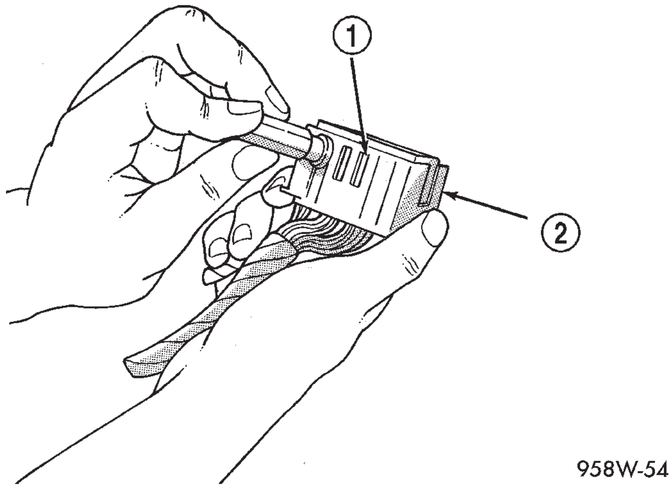


Fig. 8 AUGAT CONNECTOR REPAIR

1 - LOCKING TAB
2 - CONNECTOR

(4) Using special tool 6932, push the terminal to remove it from the connector (Fig. 9).

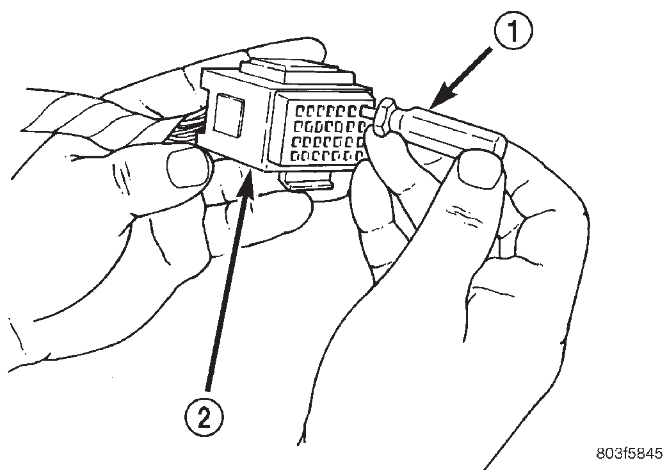


Fig. 9 USING

1 - SPECIAL TOOL 6932
2 - CONNECTOR

(5) Repair or replace the terminal as necessary.

INSTALLATION

(1) Reset the terminal locking tang.

CONNECTOR - AUGAT (Continued)

(2) Insert the removed wire in the same cavity on the repair connector.

(3) Repeat steps for each wire in the connector, being sure that all wires are inserted into the proper cavities. For additional connector pin-out identification, refer to the wiring diagrams.

(4) When the connector is re-assembled, the locking tab must be placed in the locked position to prevent terminal push out.

(5) Connect connector to its mating half/component.

(6) Connect battery and test all affected systems.

CONNECTOR - MOLEX

REMOVAL

(1) Disconnect battery.

(2) Disconnect the connector from its mating half/component.

(3) Insert special tool 6742 into the terminal end of the connector (Fig. 10).

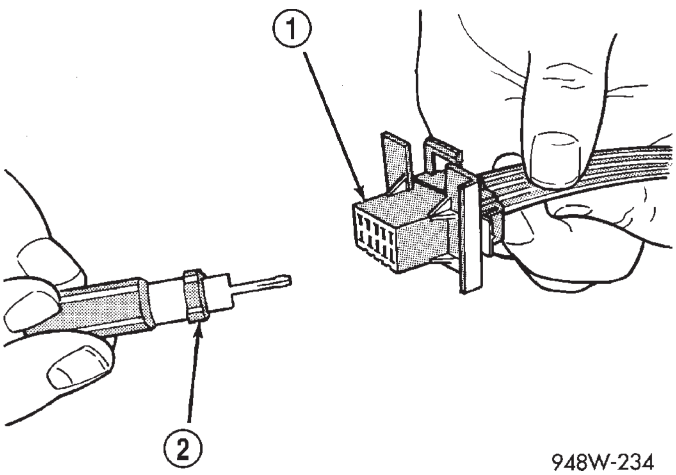


Fig. 10 MOLEX CONNECTOR REPAIR

1 - CONNECTOR
2 - SPECIAL TOOL 6742

(4) Using special tool 6742, release the locking fingers on the terminal (Fig. 11).

(5) Pull on the wire to remove it from the connector.

(6) Repair or replace the terminal as necessary.

INSTALLATION

(1) Reset the terminal locking tang.

(2) Insert the removed wire in the same cavity on the repair connector.

(3) Repeat steps for each wire in the connector, being sure that all wires are inserted into the proper cavities. For additional connector pin-out identification, refer to the wiring diagrams.

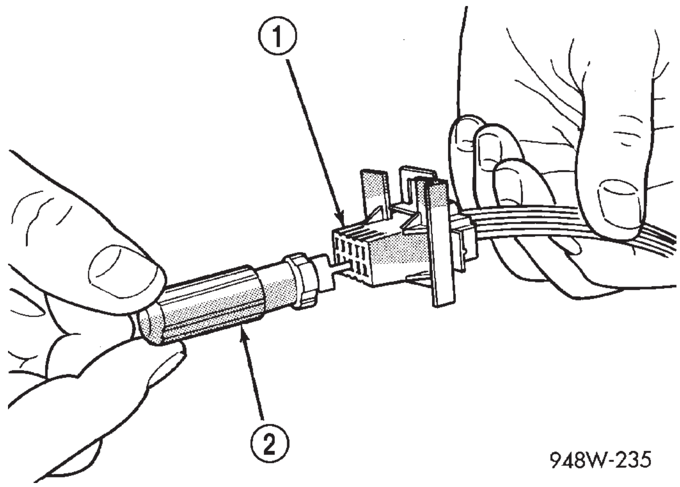


Fig. 11 USING SPECIAL TOOL 6742

1 - CONNECTOR
2 - SPECIAL TOOL 6742

(4) Connect connector to its mating half/component.

(5) Connect battery and test all affected systems.

CONNECTOR - THOMAS AND BETTS

REMOVAL

(1) Disconnect battery.

(2) Disconnect the connector from its mating half/component.

(3) Push in the two lock tabs on the side of the connector (Fig. 12).

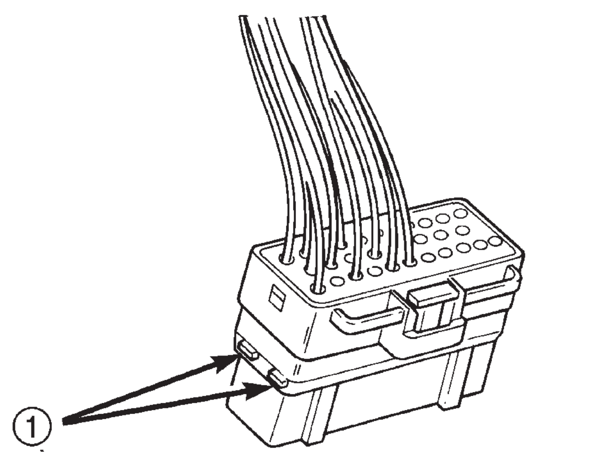


Fig. 12 THOMAS AND BETTS CONNECTOR LOCK RELEASE TABS

1 - LOCK TABS

CONNECTOR - THOMAS AND BETTS (Continued)

(4) Insert the probe end of special tool 6934 into the back of the connector cavity (Fig. 13).

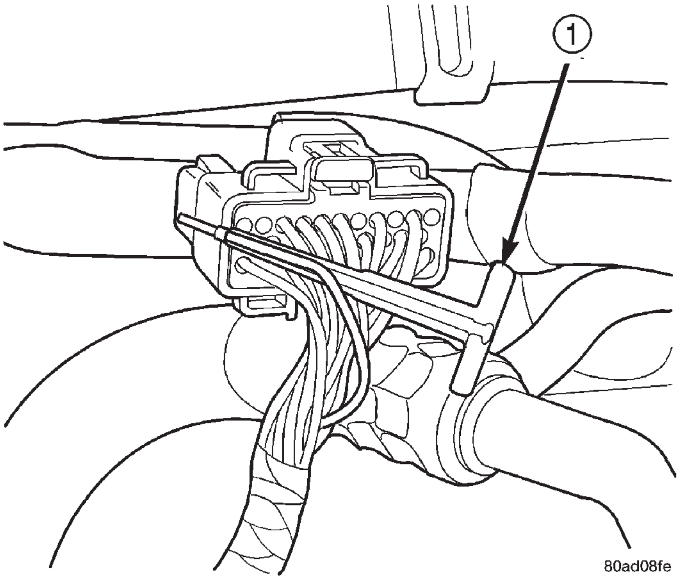


Fig. 13 REMOVING WIRE TERMINAL

1 - SPECIAL TOOL 6934

(5) Grasp the wire and tool 6934, then slowly remove the wire and terminal from the connector.

(6) Repair or replace the terminal as necessary.

INSTALLATION

(1) Reset the terminal locking tang.

(2) Insert the removed wire in the same cavity on the repair connector.

(3) Repeat steps for each wire in the connector, being sure that all wires are fully seated into the proper cavities. For additional connector pin-out identification, refer to the wiring diagrams.

(4) Push in the single lock tab on the side of the connector (Fig. 14).

(5) Connect connector to its mating half/component.

(6) Connect battery and test all affected systems.

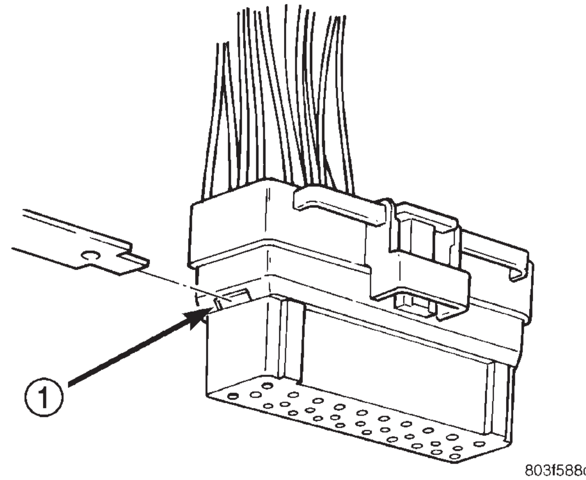


Fig. 14 SINGLE LOCK TAB

1 - SINGLE LOCK TAB

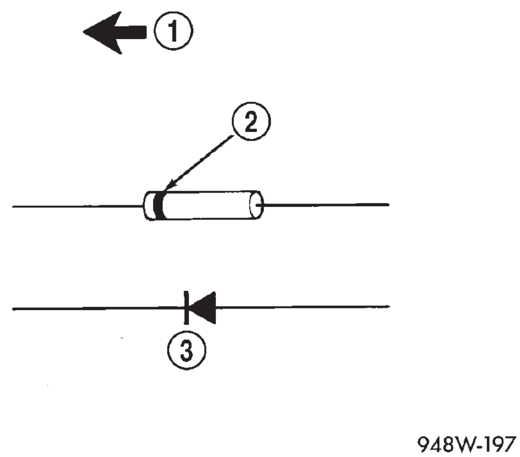


Fig. 15 DIODE IDENTIFICATION

1 - CURRENT FLOW

2 - BAND AROUND DIODE INDICATES CURRENT FLOW

3 - DIODE AS SHOWN IN THE DIAGRAMS

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. 15).

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. 15).

(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) Disconnect battery.

(2) Disconnect the connector being repaired from its mating half/component.

(3) Remove the connector locking wedge, if required (Fig. 16).

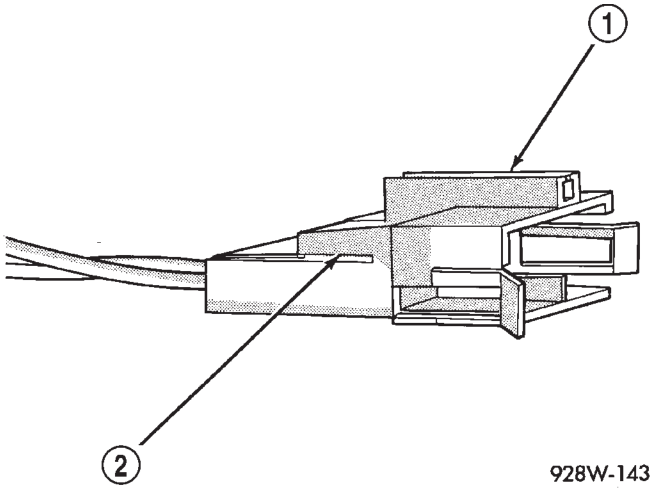


Fig. 16 CONNECTOR LOCKING WEDGE TAB (TYPICAL)

1 - CONNECTOR
2 - CONNECTOR LOCKING WEDGE TAB

(4) Position the connector locking finger away from the terminal using the proper pick from special tool kit 6680. Pull on the wire to remove the terminal from the connector (Fig. 17) (Fig. 18).

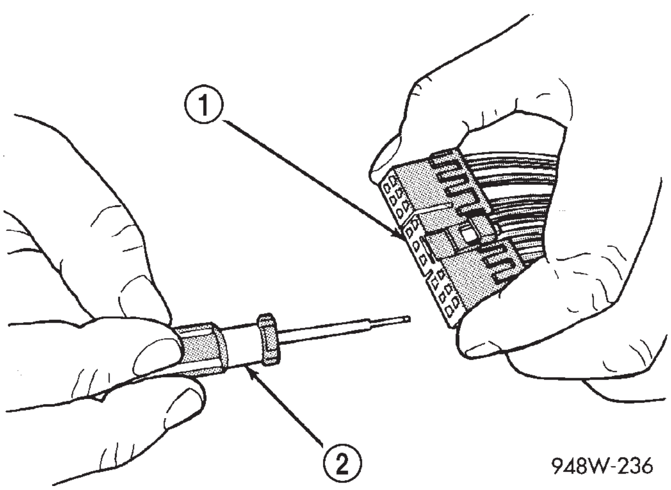


Fig. 17 TERMINAL REMOVAL

1 - CONNECTOR
2 - FROM SPECIAL TOOL KIT 6680

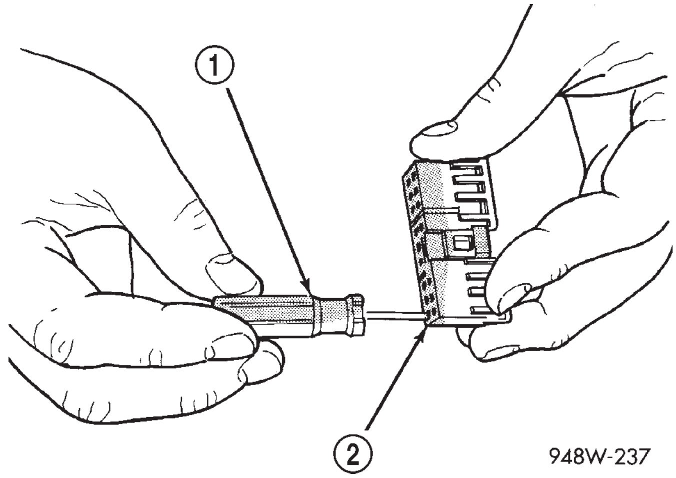


Fig. 18 TERMINAL REMOVAL USING SPECIAL TOOL

1 - FROM SPECIAL TOOL KIT 6680
2 - CONNECTOR

(5) Cut the wire 6 inches from the back of the connector.

INSTALLATION

(1) Select a wire from the terminal repair assembly that best matches the color 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 .

(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. 19).

(4) Using crimping tool, Miller p/n 8272, crimp the splice clip and wires together (Fig. 20)

(5) Solder the connection together using rosin core type solder only (Fig. 21).

WIRE (Continued)

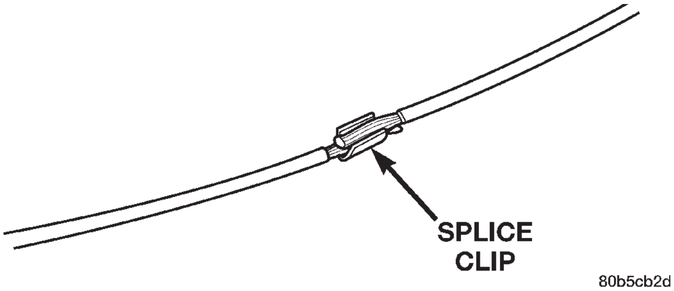


Fig. 19 SPLICE CLIP

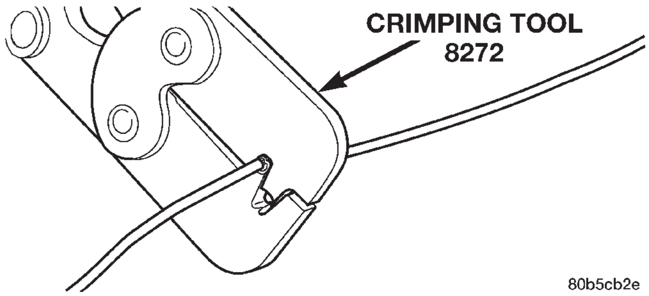


Fig. 20 CRIMPING TOOL

CAUTION: DO NOT USE ACID CORE SOLDER.

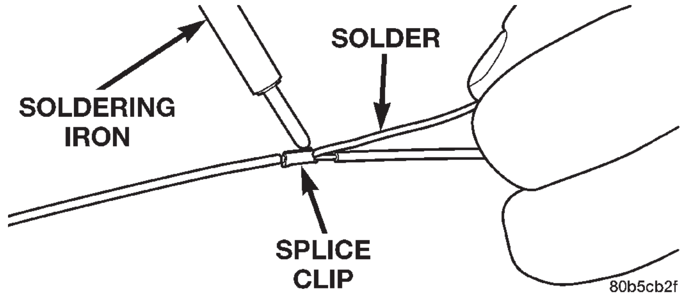


Fig. 21 SOLDER

(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. 22).

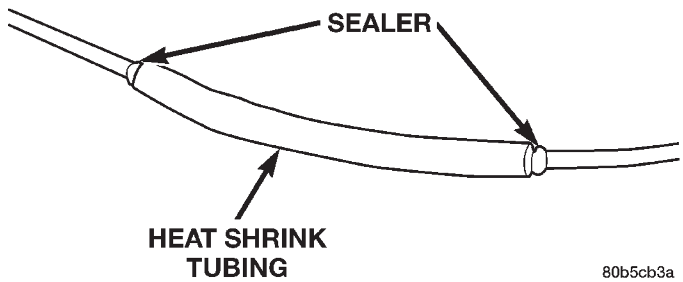
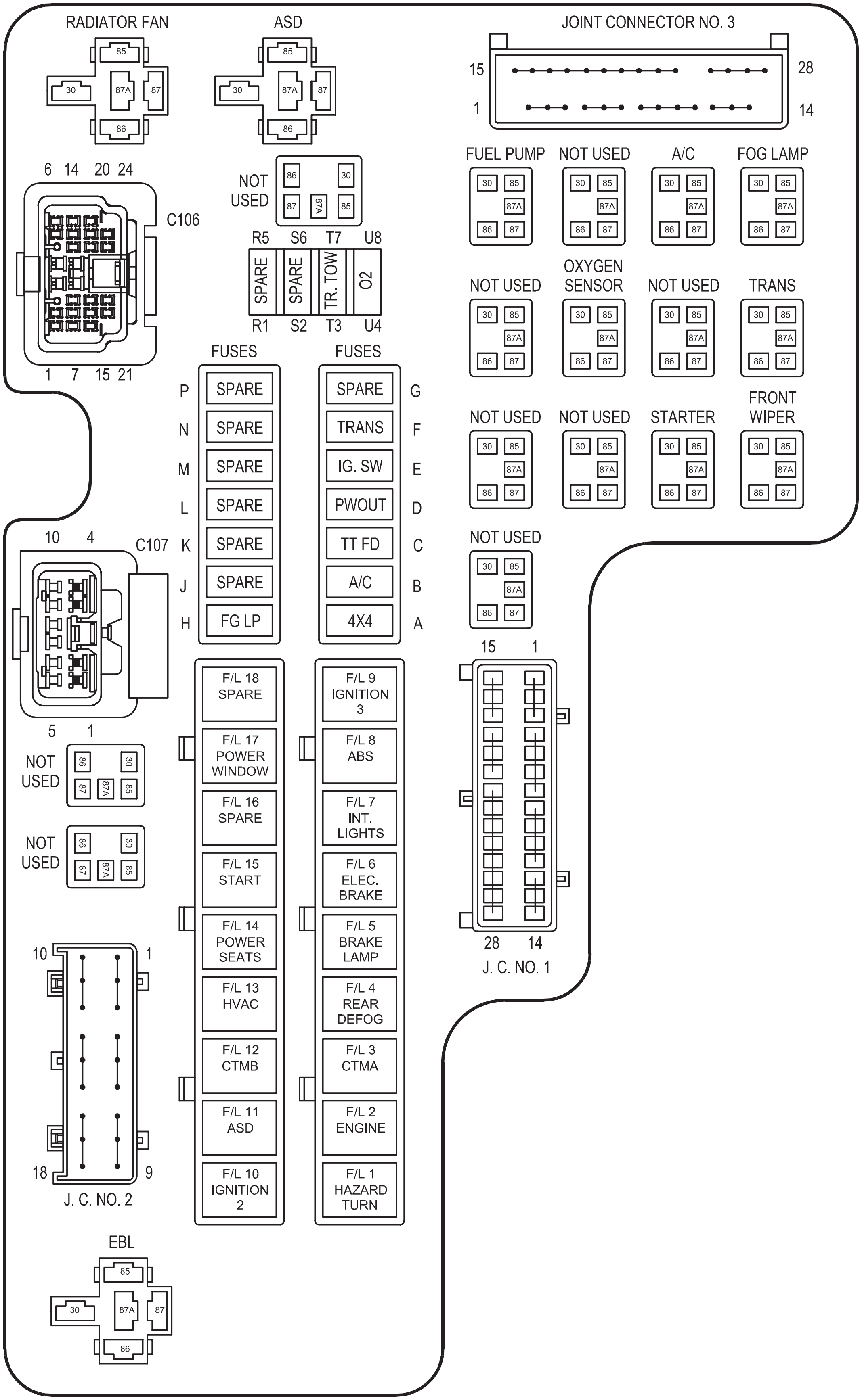


Fig. 22 HEAT SHRINK TUBING

8W-02 COMPONENT INDEX

8W-10 POWER DISTRIBUTION

POWER DISTRIBUTION CENTER



FUSES

FUSE	AMPS	FUSED CIRCUIT	FUNCTION
A	20A	A34 16LB/RD	FUSED B(+)
B	10A	F31 18VT	FUSED B(+)
C	20A	Y203 16RD/WT ▲	FUSED B(+)
D	20A	A12 12RD/TN	FUSED B(+)
E	20A	A19 16RD/YL	FUSED B(+)
F	20A	F84 16YL/WT	FUSED B(+)
G	-	-	-
H	20A	A114 18GY/RD	FUSED B(+)
J	-	-	-
K	-	-	-
L	-	-	-
M	-	-	-
N	-	-	-
P	-	-	-
R	-	-	-
S	-	-	-
T	10A	L207 18YL/BK	FUSED PARK LAMP RELAY OUTPUT
U	20A	F142 16OR/DG	FUSED AUTOMATIC SHUTDOWN RELAY OUTPUT
1	30A	L9 14BK/WT	FUSED B(+)
2	20A	A14 16RD/WT	FUSED B(+)
3	20A	A301 16RD/LG	FUSED B(+)
4	40A	A4 10BK/PK	FUSED B(+)
5	20A	F32 14PK/DB	FUSED B(+)
6	30A	Y202 12RD/TN ▲	FUSED B(+)
7	40A	A7 12RD/BK	FUSED B(+)
8	40A	A10 12RD/DG	FUSED B(+)
9	50A	A2 12PK/BK	FUSED B(+)
10	40A	A1 12RD	FUSED B(+)

CONTINUED ON NEXT PAGE

▲ TRAILER TOW

FUSES

CONTINUED FROM PREVIOUS PAGE

FUSE	AMPS	FUSED CIRCUIT	FUNCTION
11	30A	A16 14GY	FUSED B(+)
12	20A	A302 16RD/TN	FUSED B(+)
13	40A	A111 10RD/LB	FUSED B(+)
14	50A	F91 12GY/RD	FUSED B(+)
15	50A	C28 10DB/OR	FUSED B(+)
16	50A	A149 12RD/TN	FUSED B(+)
17	50A	A18 12RD/BK	FUSED B(+)
18	-	-	-

A/C COMPRESSOR CLUTCH RELAY

CAVITY	CIRCUIT	FUNCTION
30	F31 18VT	FUSED B(+)
85	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
86	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
87	C3 18DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
87A	-	-

AUTOMATIC SHUT DOWN RELAY

CAVITY	CIRCUIT	FUNCTION
30	A16 14GY	FUSED B(+)
85	K51 18DB/YL	AUTOMATIC SHUT DOWN RELAY CONTROL
86	A14 16RD/WT	FUSED B(+)
87	A142 14DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
87A	-	-

ENGINE STARTER MOTOR RELAY

CAVITY	CIRCUIT	FUNCTION
30	A149 12RD/TN	FUSED B(+)
85	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE
86	A169 18RD/YL	FUSED IGNITION SWITCH OUTPUT (START)
87	T40 12BR	STARTER RELAY OUTPUT
87A	-	-

FOG LAMP RELAY

CAVITY	CIRCUIT	FUNCTION
30	A114 18GY/RD	FUSED B(+)
85	L26 20WT/VT	FOG LAMP RELAY CONTROL
86	A114 18GY/RD	FUSED B(+)
87	L39 18LB	FUSED B(+)
87A	-	-

FRONT WIPER RELAY

CAVITY	CIRCUIT	FUNCTION
30	V49 18RD/BK	INTERMITTENT FRONT WIPER LOW SPEED
85	V18 18YL/DG	FRONT WIPER RELAY CONTROL
86	V6 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
87	V6 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
87A	V5 18DG/YL	FRONT WIPER PARK SWITCH SENSE

FUEL PUMP RELAY

CAVITY	CIRCUIT	FUNCTION
30	A14 16RD/WT	FUSED B(+)
85	K31 18BR	FUEL PUMP RELAY CONTROL
86	F18 20LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
87	A61 16DG/BK	FUEL PUMP RELAY OUTPUT
87A	-	-

OXYGEN SENSOR DOWNSTREAM HEATER RELAY

CAVITY	CIRCUIT	FUNCTION
30	F142 16OR/DG	FUSED B(+)
85	K512 18DG/BK	OXYGEN SENSOR DOWNSTREAM HEATER RELAY CONTROL
86	F142 16OR/DG	FUSED B(+)
87	F242 18DG/PK ▲▲	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
87	F242 16DG/PK ▲	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
87A	-	-

RADIATOR FAN RELAY

CAVITY	CIRCUIT	FUNCTION
30	C28 10DB/OR	FUSED B(+)
85	C24 18DB/PK	RADIATOR FAN RELAY CONTROL
86	F18 20LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
87	C25 10LG	HIGH SPEED FAN RELAY OUTPUT
87A	-	-

▲ 3.9L/5.9L
▲▲ 4.7L

REAR WINDOW DEFOGGER RELAY

CAVITY	CIRCUIT	FUNCTION
30	A4 10BK/PK	FUSED B(+)
85	C80 18DB/WT	REAR WINDOW DEFOGGER RELAY CONTROL
86	F20 20WT	FUSED IGNITION SWITCH OUTPUT (RUN)
87	C15 10BK/WT	REAR WINDOW DEFOGGER RELAY OUTPUT
87A	-	-

TRANSMISSION CONTROL RELAY

CAVITY	CIRCUIT	FUNCTION
30	F84 16YL/WT	FUSED B(+)
85	K30 18PK ●●	TRANSMISSION CONTROL RELAY CONTROL
	Z1 20BK ●	GROUND
86	T15 18LG ●	TRANSMISSION CONTROL RELAY CONTROL
	K125 18WT/DB ●●	GENERATOR SOURCE
87	T16 16RD	TRANSMISSION CONTROL RELAY OUTPUT
87A	-	-

● 4.7L
●● 3.9L/5.9L

C106 (ENGINE)			C106 (PDC)	
CAVITY	CIRCUIT	FUNCTION	CAVITY	CIRCUIT
1	F142 18OR/DG ■	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT	1	F142 16OR/DG
1	F142 16OR/DG ■■	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT		
2	Y112 16DG/VT ●●	MODE SENSOR D	2	Y112 18YL/BR
3	Y124 16DG/VT ●●	SHIFT MOTOR CONTROL A	3	Y124 16DG/VT
4	Y125 16DG/WT ●●	SHIFT MOTOR CONTROL B	4	Y125 16DG/WT
5	Y115 18YL/WT ●●	MODE SENSOR C	5	Y115 18YL/WT
6	Y117 18YL/DB ●●	5 VOLT MODE SENSOR SUPPLY	6	Y117 18YL/DB
7	Y119 18YL/TN ●●	MODE SENSOR GROUND	7	Y119 18YL/TN
8	Y114 18YL/VT ●●	MODE SENSOR B	8	Y114 18YL/VT
9	L1 18VT/BK	BACK-UP LAMP FEED	9	L1 18VT/BK
10	A142 14DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT	10	A142 14DG/OR
11	F242 18DG/PK ■	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUPTUT	11	F242 16DG/OR ■
11	A169 18RD/YL ▲	FUSED IGNITION SWITCH OUTPUT (START)	11	A169 18RD/WT ▲
12	A14 16RD/WT	FUSED B(+)	12	A14 16RD/WT
13	L10 18BR/LG	BACK-UP LAMP FEED	13	L10 18BR/LG
14	G7 20DB ■	VEHICLE SPEED SENSOR SIGNAL	14	G7 18WT/OR
14	G7 18WT/OR ■■	VEHICLE SPEED SENSOR SIGNAL		
15	Y113 18YL/OR ●●	MODE SENSOR A	15	Y113 18YL/OR
16	K200 18VT/OR	OXYGEN SENSOR DOWNSTREAM RELAY OUTPUT	16	K200 18VT/OR
17	K100 18VT/WT	OXYGEN SENSOR UPSTREAM RELAY OUTPUT	17	K100 18VT/WT
18	F18 18LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)	18	F18 20LG/BK
19	K125 18WT/DB	GENERATOR SOURCE	19	K125 18WT/DB
20	D25 18VT/YL ▲	PCI BUS	20	D25 18VT/YL ▲
20	C24 18DB/PK ▲▲	5 VOLT MODE SENSOR SUPPLY	20	C24 18DB/PK ▲▲
21	K4 18BK/LB ●●	SENSOR GROUND	21	K4 18BK/LB ●●
22	T41 18BK/WT ●●	PARK/NEUTRAL POSITION SWITCH	22	T41 18BK/WT ●●
23	C3 18DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT	23	C3 20DB/BK
24	-	-	24	-

●● EXCEPT 2.5L
▲ 4.7L
▲▲ EXCEPT 4.7L
■ 3.9L/5.9L
■■ EXCEPT 3.9L/5.9L

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C107 (4.7L ENGINE) / **C107 (4.7L PDC)**

CAVITY	CIRCUIT	FUNCTION	CAVITY	CIRCUIT
1	-	-	1	-
2	D22 20PK/BK	SCI RECEIVE	2	D22 20PK/BK
3	D21 18PK	SCI TRANSMIT	3	D21 18PK
4	F11 18RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)	4	F11 18RD/WT
5	T15 18LG	TRANSMISSION CONTROL RELAY CONTROL	5	T15 18LG
6	F242 18DG/PK	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT	6	F242 18DG/PK
7	T6 18OR/WT	OVERDRIVE OFF SWITCH SENSE	7	T6 18OR/WT
8	T10 18YL/DG	TORQUE MANAGEMENT REQUEST SENSE	8	T10 18YL/DG
9	-	-	9	-
10	C24 18DB/PK	RADIATOR FAN RELAY CONTROL	10	C24 18DB/PK

JOINT CONNECTOR NO. 1 (IN PDC)

CAVITY	CIRCUIT	FUNCTION
1	L1 18VT/BK	BACK-UP LAMP FEED
2	L1 18VT/BK	BACK-UP LAMP FEED
3	L1 18VT/BK	BACK-UP LAMP FEED
4	F142 16OR/DG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
5	F142 16OR/DG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
6	F142 16OR/DG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
7	F142 16OR/DG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
8	L39 18LB	FUSED B (+)
9	L39 18LB	FUSED B (+)
10	L39 18LB	FUSED B (+)
11	L39 18LB	FUSED B (+)
12	K125 18WT/DB ◇◇	GENERATOR SOURCE
12	F84 16YL/WT ◇	FUSED B (+)
13	K125 18WT/DB ◇◇	GENERATOR SOURCE
13	F84 16YL/WT ◇	FUSED B (+)
14	K125 18WT/DB ◇◇	GENERATOR SOURCE
14	F84 16YL/WT ◇	FUSED B (+)
15	D21 18PK	SCI TRANSMIT
16	D21 18PK	SCI TRANSMIT
17	D21 18PK	SCI TRANSMIT
18	L50 14WT/TN ▲	BRAKE LAMP SWITCH OUTPUT
19	L50 14WT/TN ▲	BRAKE LAMP SWITCH OUTPUT
20	L50 14WT/TN ▲	BRAKE LAMP SWITCH OUTPUT
21	A14 16RD/WT	FUSED B (+)
22	A14 16RD/WT	FUSED B (+)
23	A14 16RD/WT	FUSED B (+)
24	A14 16RD/WT	FUSED B (+)
25	-	-
26	-	-
27	-	-
28	-	-

NOTE: ALL CIRCUITS ON SAME BUSBAR OF JOINT CONNECTOR ARE INTERCHANGABLE.

▲ TRAILER TOW
◇ 4.7L
◇◇ 3.9L/5.9L

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JOINT CONNECTOR NO. 2 (IN PDC)

CAVITY	CIRCUIT	FUNCTION
1	L61 16LG	LEFT TURN SIGNAL
2	L61 16LG	LEFT TURN SIGNAL
3	L61 16LG	LEFT TURN SIGNAL
4	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
5	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
6	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
7	L60 16TN	RIGHT TURN SIGNAL
8	L60 16TN	RIGHT TURN SIGNAL
9	L60 16TN	RIGHT TURN SIGNAL
10	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
11	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
12	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
13	A142 14DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
14	A142 14DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
15	A142 14DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
16	V40 20WT/PK	BRAKE LAMP SWITCH SENSE
17	V40 18WT/PK	BRAKE LAMP SWITCH SENSE
18	V40 18WT/PK	BRAKE LAMP SWITCH SENSE

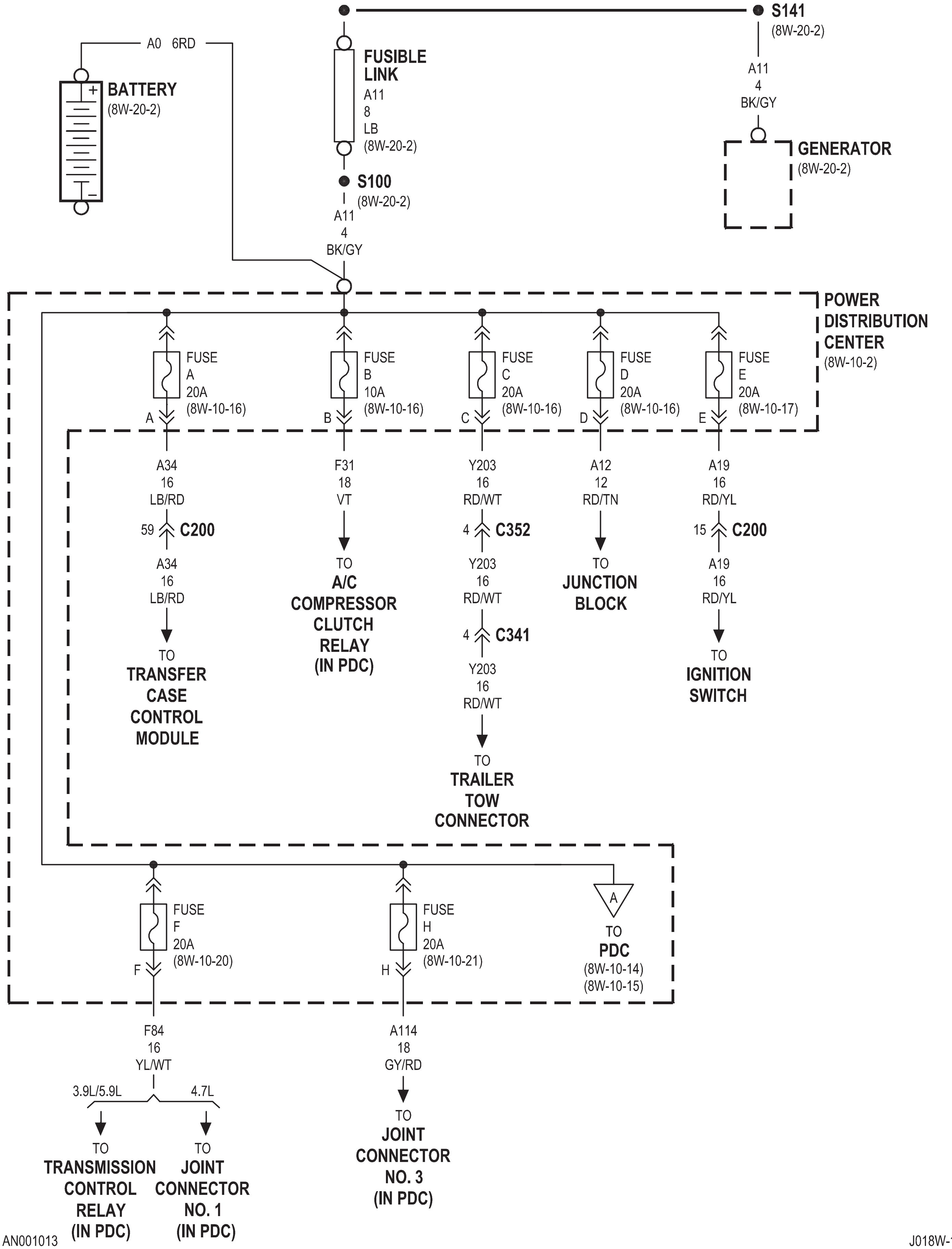
NOTE: ALL CIRCUITS ON SAME BUSBAR OF JOINT CONNECTOR ARE INTERCHANGABLE.

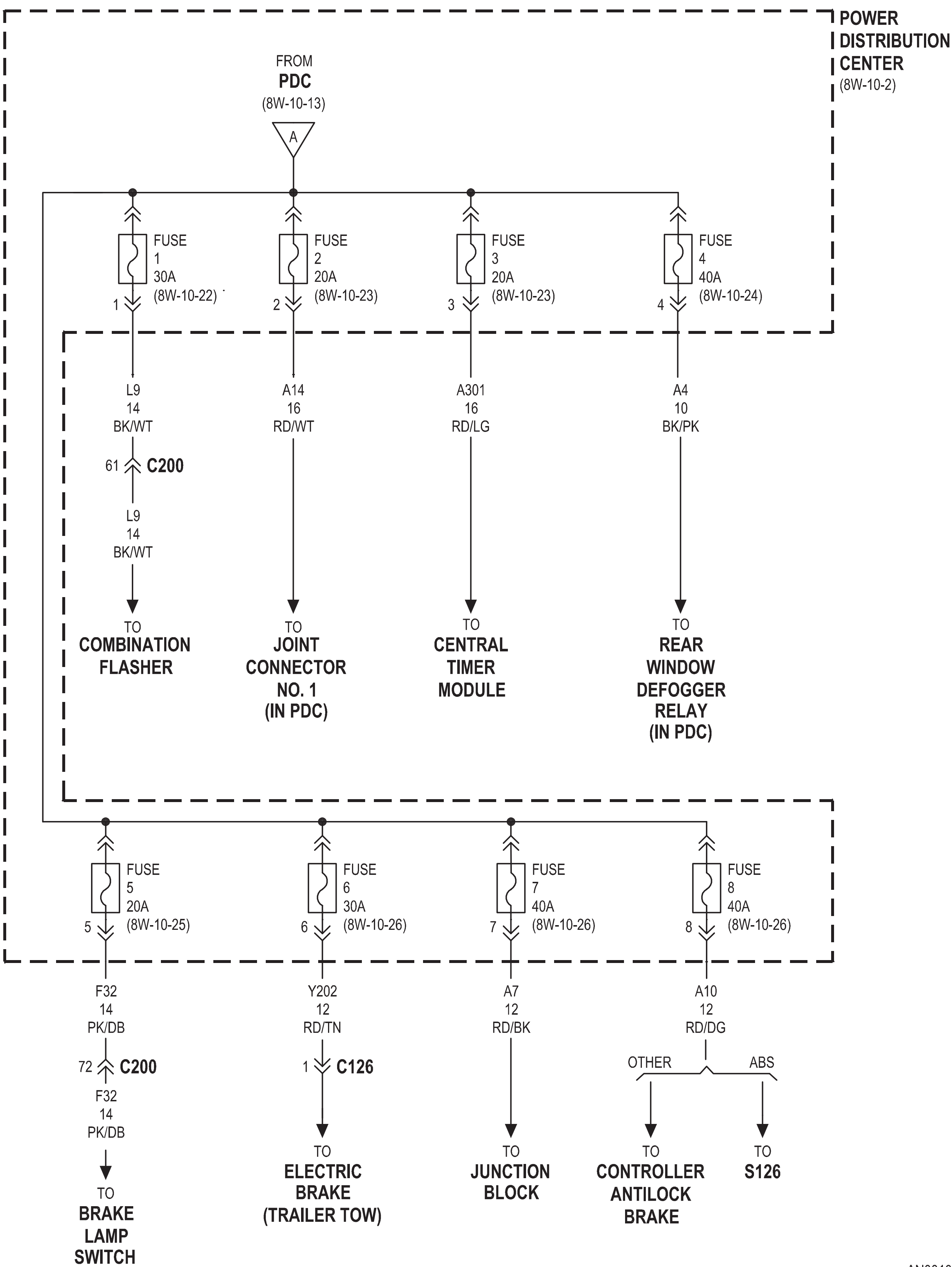
JOINT CONNECTOR NO. 3

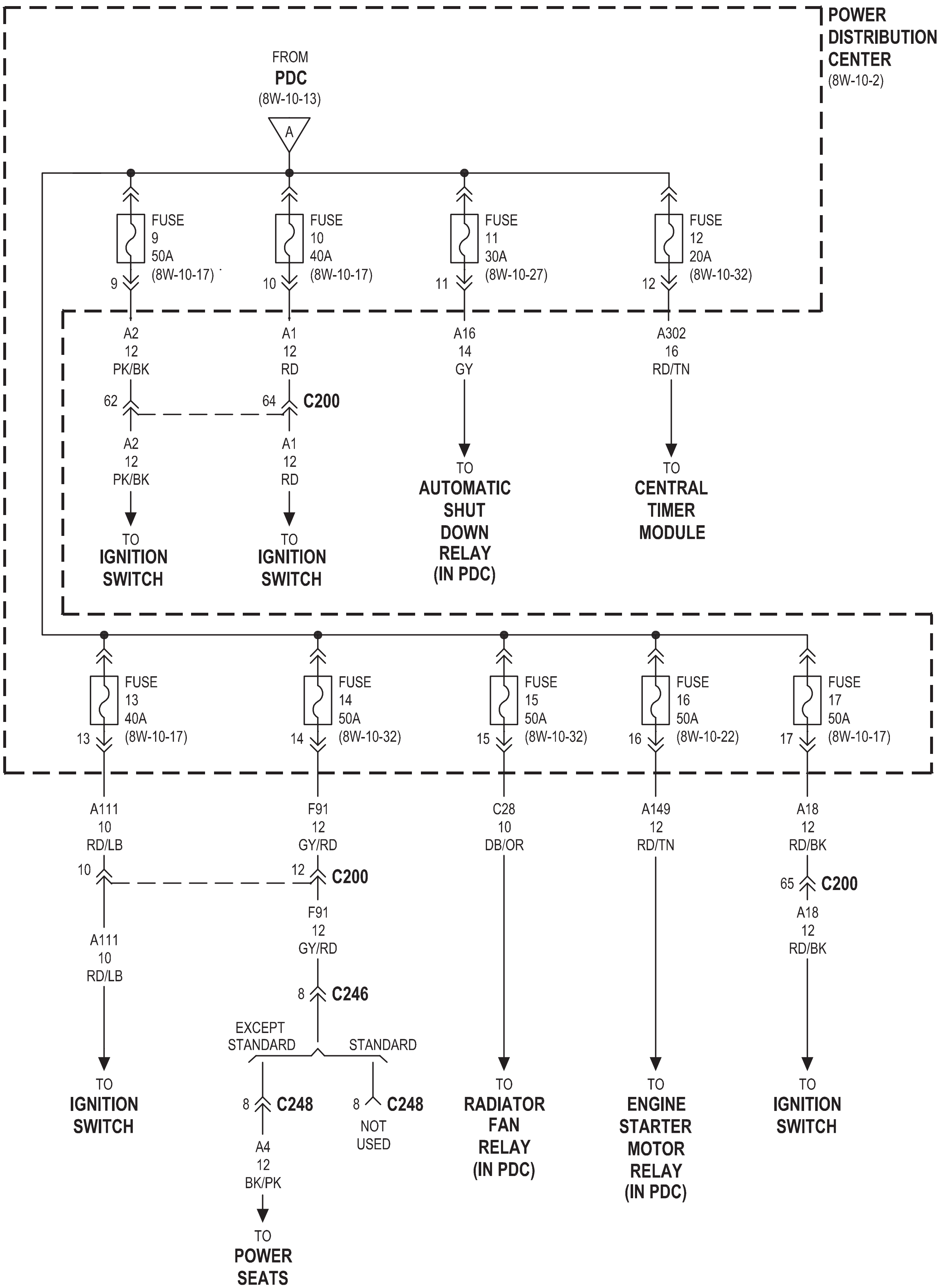
CAVITY	CIRCUIT	FUNCTION
1	A114 18GY/RD	FUSED B(+)
2	A114 18GY/RD	FUSED B(+)
3	A114 18GY/RD	FUSED B(+)
4	-	-
5	-	-
6	-	-
7	K4 18BK/LB	SENSOR GROUND
8	K4 18BK/LB	SENSOR GROUND
9	K4 18BK/LB	SENSOR GROUND
10	K4 18BK/LB	SENSOR GROUND
11	K4 18BK/LB	SENSOR GROUND
12	A169 18RD/YL ◇	FUSED IGNITION SWITCH OUTPUT (START)
13	A169 18RD/YL ◇	FUSED IGNITION SWITCH OUTPUT (START)
14	A169 18RD/YL ◇	FUSED IGNITION SWITCH OUTPUT (START)
15	L7 18BK/YL	PARK LAMP RELAY OUTPUT
16	L7 20BK/YL	PARK LAMP RELAY OUTPUT
17	L7 20BK/YL	PARK LAMP RELAY OUTPUT
18	L7 20BK/YL	PARK LAMP RELAY OUTPUT
19	L7 20BK/YL	PARK LAMP RELAY OUTPUT
20	L7 20BK/YL	PARK LAMP RELAY OUTPUT
21	L7 20BK/YL	PARK LAMP RELAY OUTPUT
22	L7 20BK/YL	PARK LAMP RELAY OUTPUT
23	L7 20BK/YL ▲	PARK LAMP RELAY OUTPUT
24	-	-
25	F20 20WT	FUSED IGNITION SWITCH OUTPUT (RUN)
26	F20 20WT	FUSED IGNITION SWITCH OUTPUT (RUN)
27	-	-
28	F20 20WT	FUSED IGNITION SWITCH OUTPUT (RUN)

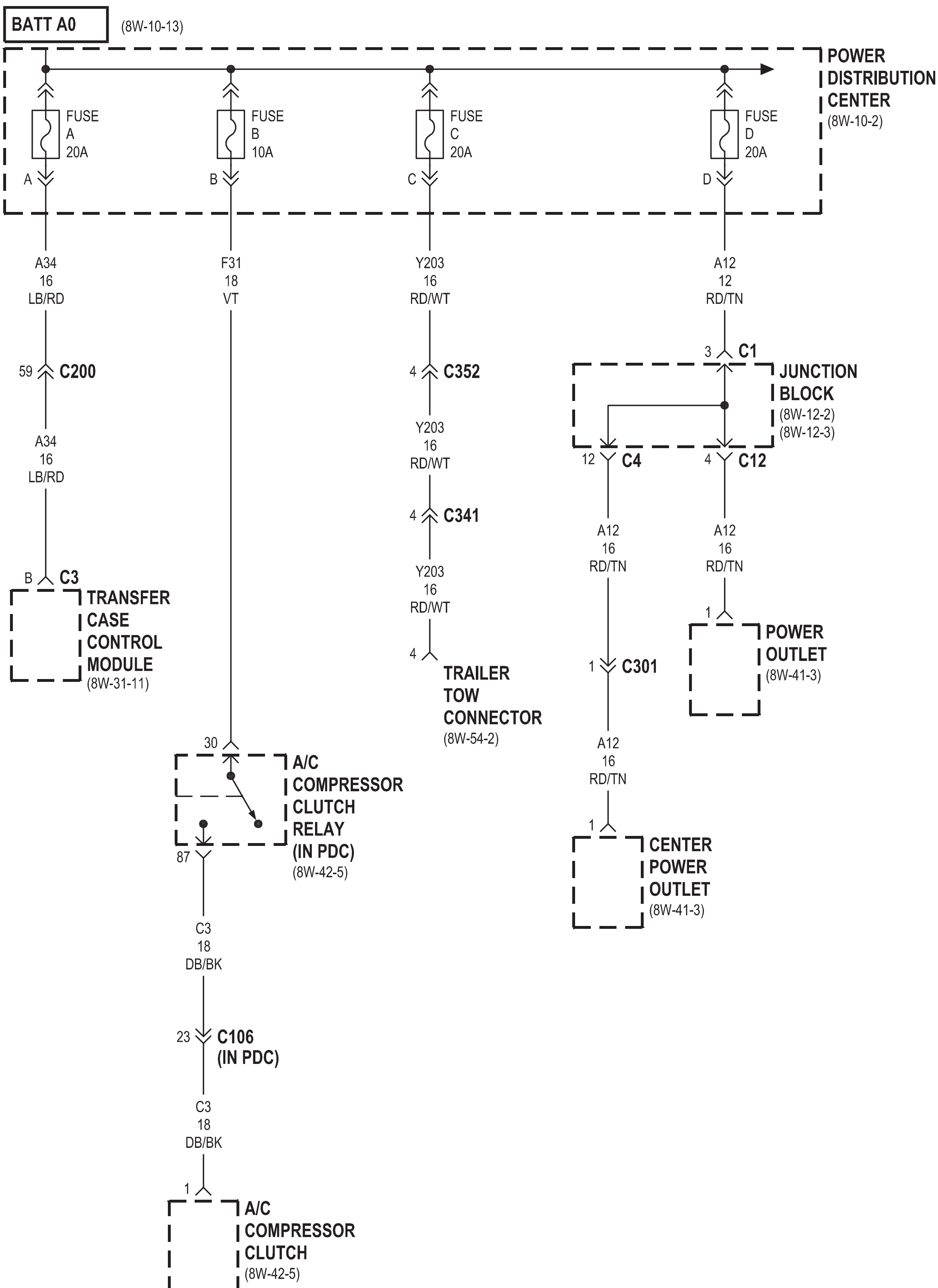
NOTE: ALL CIRCUITS ON SAME BUSBAR OF JOINT CONNECTOR ARE INTERCHANGABLE.

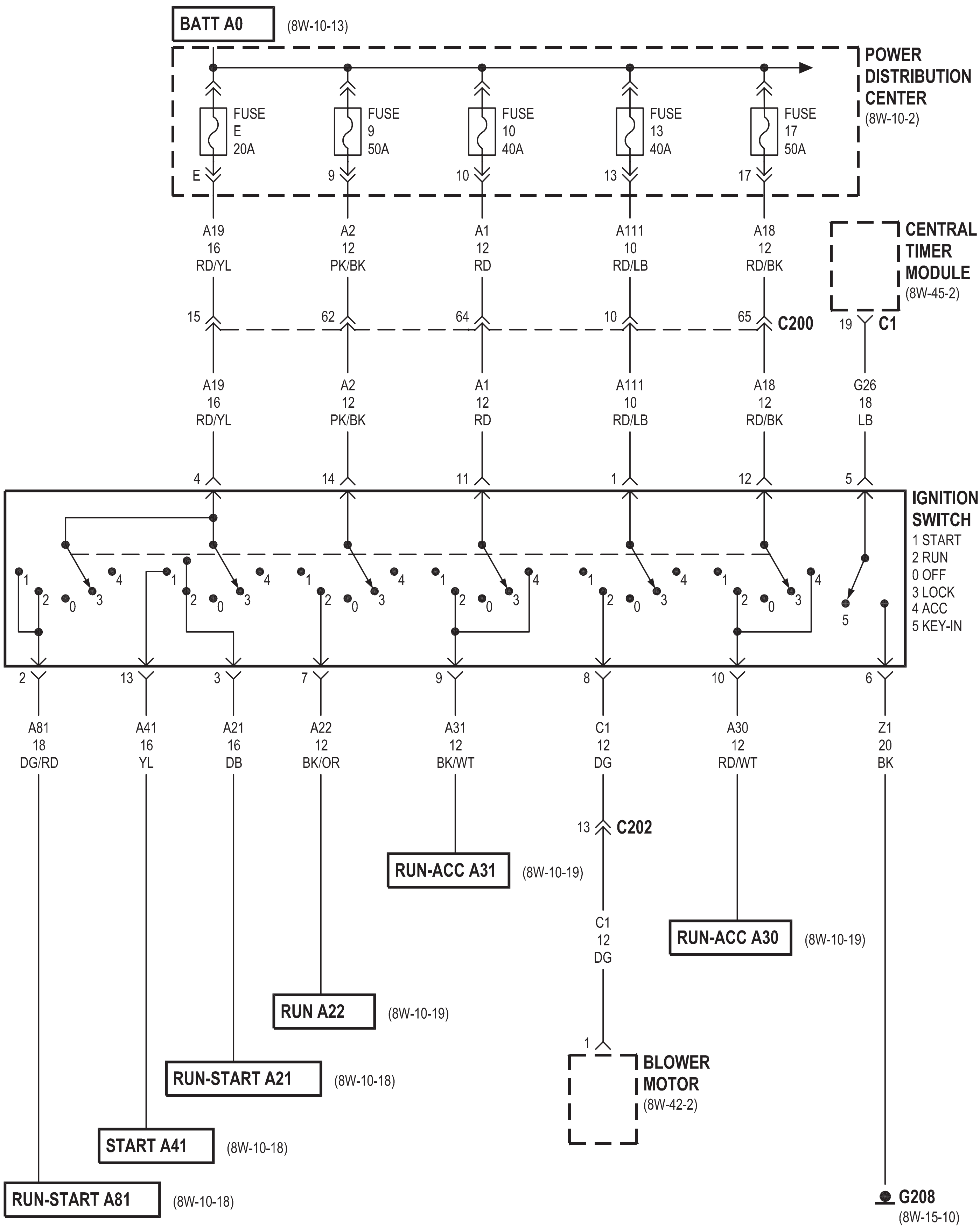
▲ TRAILER TOW
◇ 4.7L

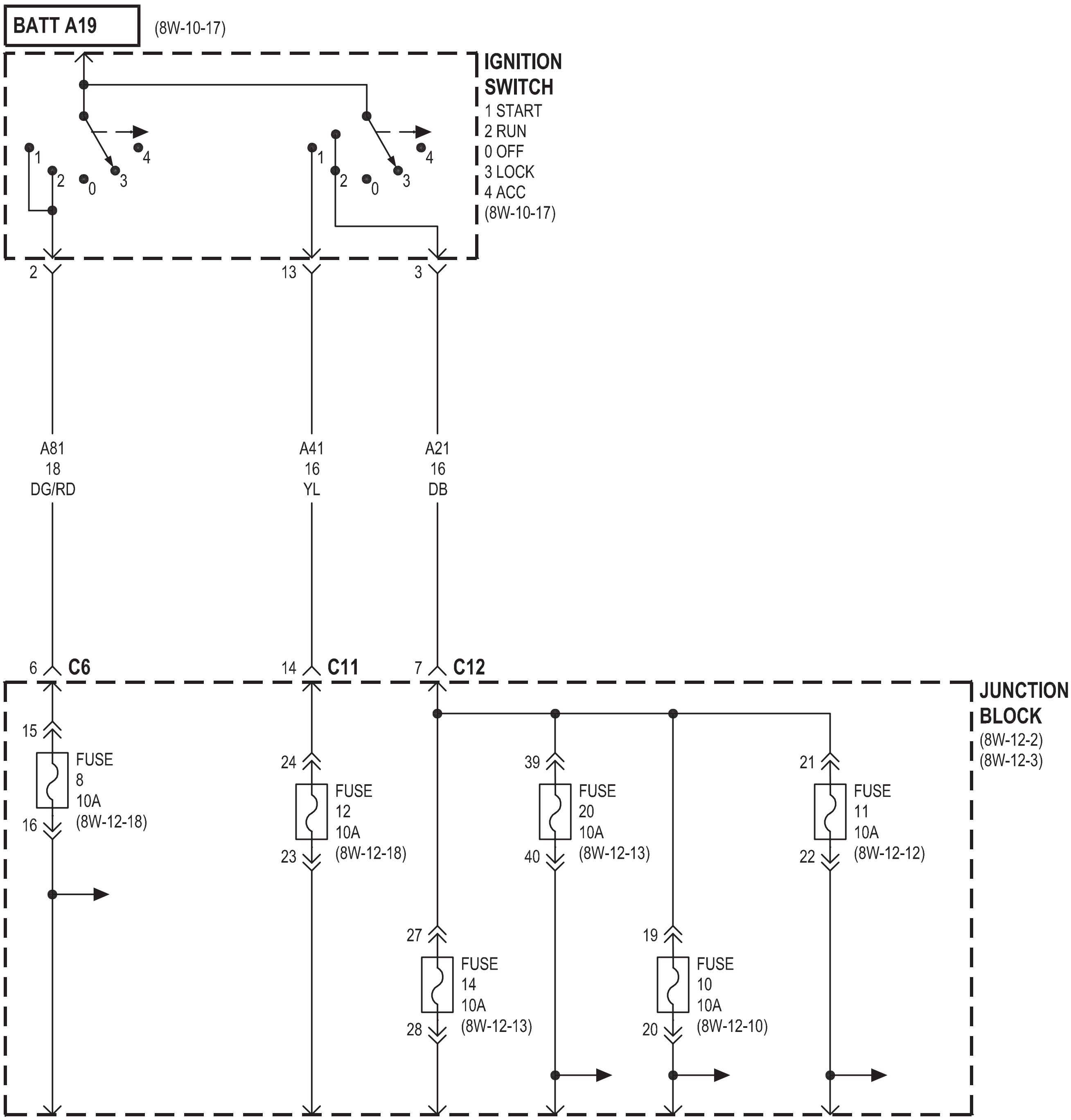

S141
(8W-20-2)
A0 6RD
FUSIBLE LINK
A11
8
LB
(8W-20-2)
BATTERY
(8W-20-2)
A11
4
BK/GY
GENERATOR
(8W-20-2)
S100
(8W-20-2)
A11
4
BK/GY
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE A 20A (8W-10-16)
FUSE B 10A (8W-10-16)
FUSE C 20A (8W-10-16)
FUSE D 20A (8W-10-16)
FUSE E 20A (8W-10-17)
A34 16 LB/RD
59 C200
A34 16 LB/RD
TO TRANSFER CASE CONTROL MODULE
F31 18 VT
TO A/C COMPRESSOR CLUTCH RELAY (IN PDC)
Y203 16 RD/WT
4 C352
Y203 16 RD/WT
4 C341
Y203 16 RD/WT
TO TRAILER TOW CONNECTOR
A12 12 RD/TN
TO JUNCTION BLOCK
A19 16 RD/YL
15 C200
A19 16 RD/YL
TO IGNITION SWITCH
FUSE F 20A (8W-10-20)
FUSE H 20A (8W-10-21)
A
TO PDC
(8W-10-14)
(8W-10-15)
F84 16 YL/WT
3.9L/5.9L
4.7L
TO TRANSMISSION CONTROL RELAY (IN PDC)
TO JOINT CONNECTOR NO. 1 (IN PDC)
A114 18 GY/RD
TO JOINT CONNECTOR NO. 3 (IN PDC)


POWER DISTRIBUTION CENTER (8W-10-2)
FROM PDC (8W-10-13)
A
FUSE 1 30A (8W-10-22)
FUSE 2 20A (8W-10-23)
FUSE 3 20A (8W-10-23)
FUSE 4 40A (8W-10-24)
1
2
3
4
L9 14 BK/WT
A14 16 RD/WT
A301 16 RD/LG
A4 10 BK/PK
61 C200
L9 14 BK/WT
TO COMBINATION FLASHER
TO JOINT CONNECTOR NO. 1 (IN PDC)
TO CENTRAL TIMER MODULE
TO REAR WINDOW DEFOGGER RELAY (IN PDC)
FUSE 5 20A (8W-10-25)
FUSE 6 30A (8W-10-26)
FUSE 7 40A (8W-10-26)
FUSE 8 40A (8W-10-26)
5
6
7
8
F32 14 PK/DB
Y202 12 RD/TN
A7 12 RD/BK
A10 12 RD/DG
72 C200
1 C126
OTHER
ABS
F32 14 PK/DB
TO BRAKE LAMP SWITCH
TO ELECTRIC BRAKE (TRAILER TOW)
TO JUNCTION BLOCK
TO CONTROLLER ANTILOCK BRAKE
TO S126

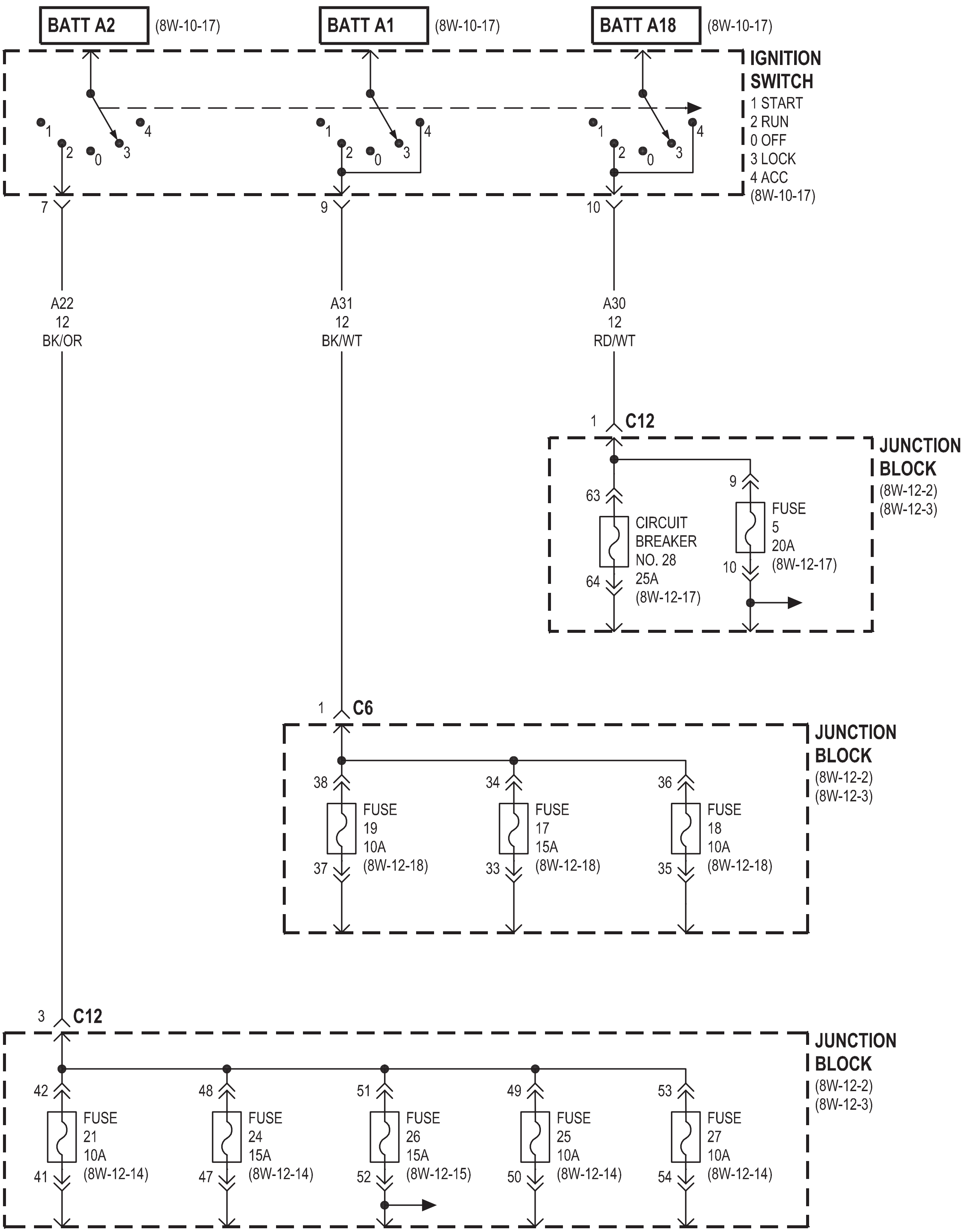

POWER DISTRIBUTION CENTER
(8W-10-2)
FROM
PDC
(8W-10-13)
A
FUSE 9 50A (8W-10-17)
FUSE 10 40A (8W-10-17)
FUSE 11 30A (8W-10-27)
FUSE 12 20A (8W-10-32)
9
10
11
12
A2 12 PK/BK
A1 12 RD
A16 14 GY
A302 16 RD/TN
62
64
C200
A2 12 PK/BK
A1 12 RD
TO AUTOMATIC SHUT DOWN RELAY (IN PDC)
TO CENTRAL TIMER MODULE
TO IGNITION SWITCH
TO IGNITION SWITCH
FUSE 13 40A (8W-10-17)
FUSE 14 50A (8W-10-32)
FUSE 15 50A (8W-10-32)
FUSE 16 50A (8W-10-22)
FUSE 17 50A (8W-10-17)
13
14
15
16
17
A111 10 RD/LB
F91 12 GY/RD
C28 10 DB/OR
A149 12 RD/TN
A18 12 RD/BK
10
12
C200
65
C200
A18 12 RD/BK
A111 10 RD/LB
F91 12 GY/RD
8
C246
EXCEPT STANDARD
STANDARD
8
C248
8
C248
NOT USED
A4 12 BK/PK
TO POWER SEATS
TO IGNITION SWITCH
TO RADIATOR FAN RELAY (IN PDC)
TO ENGINE STARTER MOTOR RELAY (IN PDC)
TO IGNITION SWITCH


BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE A 20A
FUSE B 10A
FUSE C 20A
FUSE D 20A
A
B
C
D
A34 16 LB/RD
F31 18 VT
Y203 16 RD/WT
A12 12 RD/TN
59 C200
A34 16 LB/RD
B C3
TRANSFER CASE CONTROL MODULE
(8W-31-11)
4 C352
Y203 16 RD/WT
4 C341
Y203 16 RD/WT
4
TRAILER TOW CONNECTOR
(8W-54-2)
3 C1
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
12 C4
4 C12
A12 16 RD/TN
A12 16 RD/TN
1
POWER OUTLET
(8W-41-3)
1 C301
A12 16 RD/TN
1
CENTER POWER OUTLET
(8W-41-3)
30
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
(8W-42-5)
87
C3 18 DB/BK
23 C106 (IN PDC)
C3 18 DB/BK
1
A/C COMPRESSOR CLUTCH
(8W-42-5)

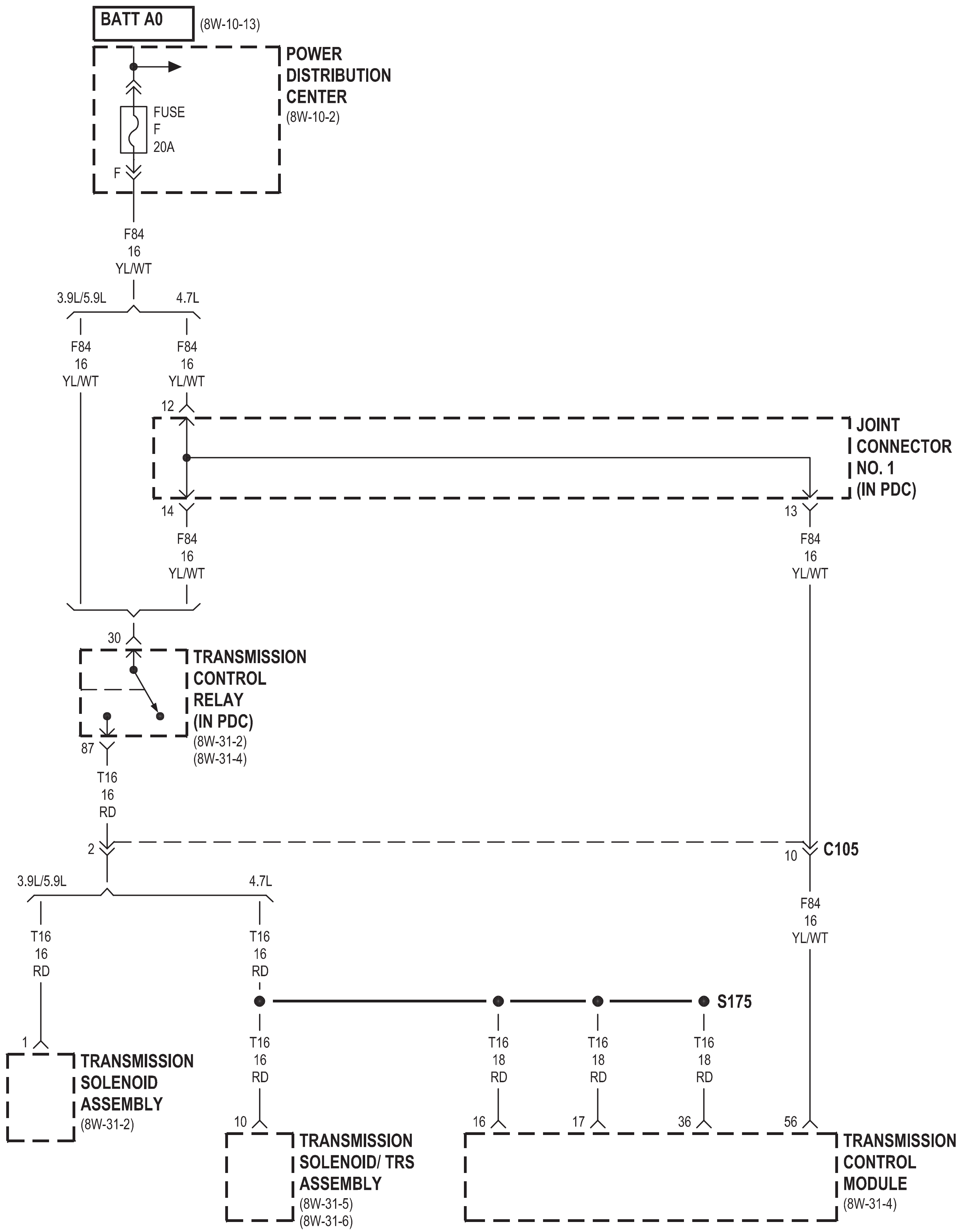

BATT A0
(8W-10-13)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
E
20A
FUSE
9
50A
FUSE
10
40A
FUSE
13
40A
FUSE
17
50A
E
9
10
13
17
A19
16
RD/YL
A2
12
PK/BK
A1
12
RD
A111
10
RD/LB
A18
12
RD/BK
CENTRAL
TIMER
MODULE
(8W-45-2)
15
62
64
10
65
C200
19
C1
A19
16
RD/YL
A2
12
PK/BK
A1
12
RD
A111
10
RD/LB
A18
12
RD/BK
G26
18
LB
4
14
11
1
12
5
IGNITION
SWITCH
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
5 KEY-IN
2
13
3
7
9
8
10
6
A81
18
DG/RD
A41
16
YL
A21
16
DB
A22
12
BK/OR
A31
12
BK/WT
C1
12
DG
A30
12
RD/WT
Z1
20
BK
13
C202
RUN-ACC A31
(8W-10-19)
C1
12
DG
RUN-ACC A30
(8W-10-19)
RUN A22
(8W-10-19)
1
BLOWER
MOTOR
(8W-42-2)
RUN-START A21
(8W-10-18)
START A41
(8W-10-18)
RUN-START A81
(8W-10-18)
G208
(8W-15-10)

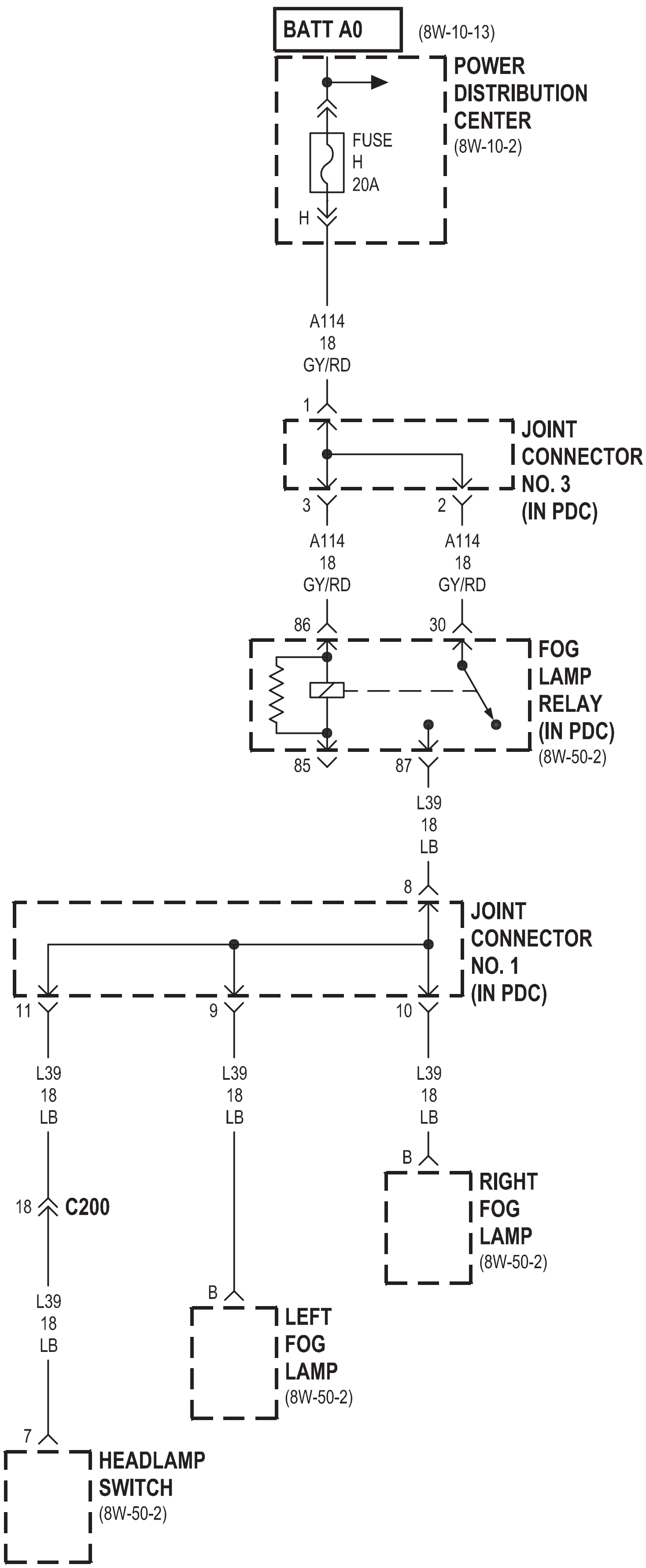


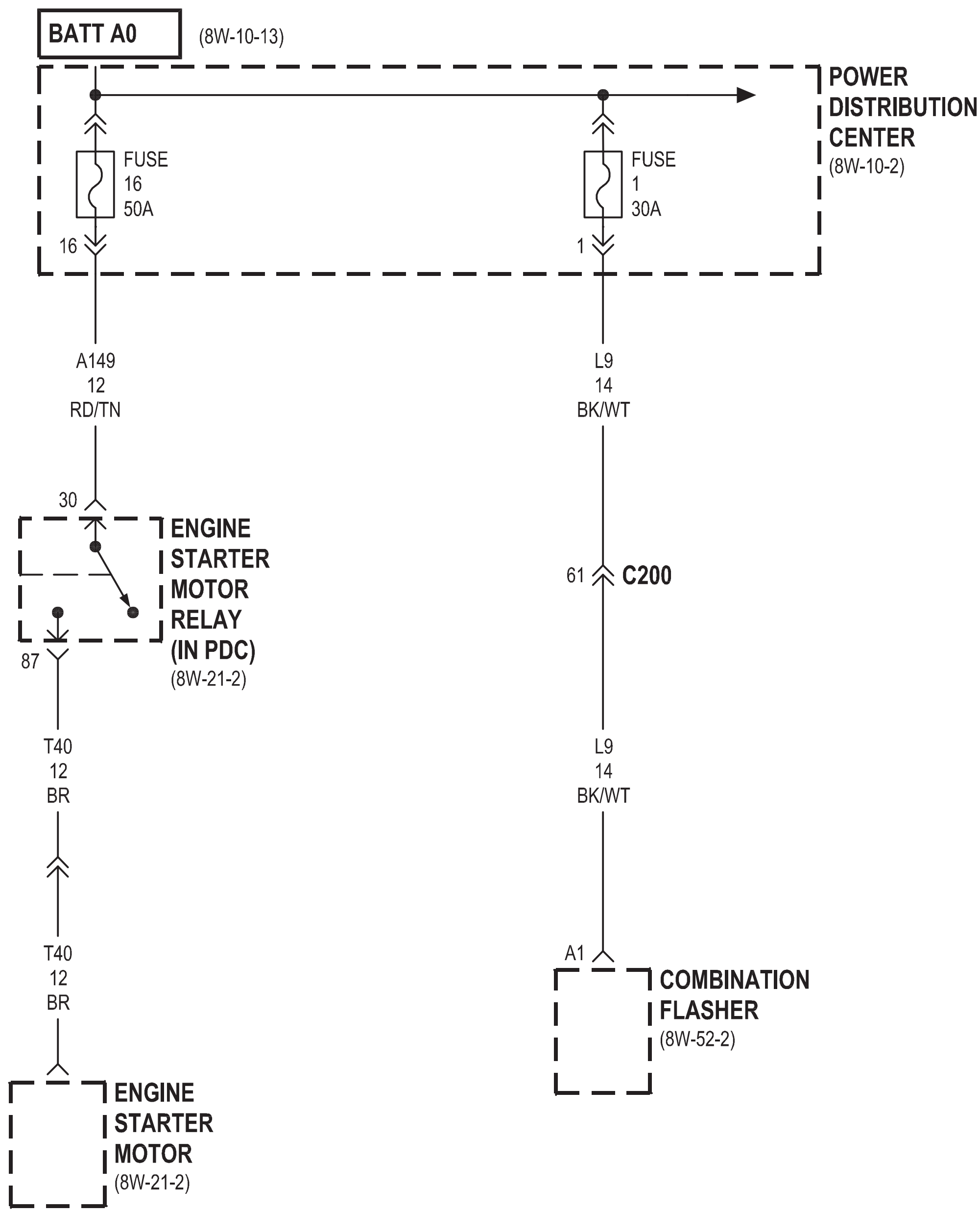
BATT A19
(8W-10-17)
IGNITION SWITCH
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
(8W-10-17)
1
2
0
3
4
2
13
3
A81
18
DG/RD
A41
16
YL
A21
16
DB
6
C6
14
C11
7
C12
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
15
FUSE
8
10A
(8W-12-18)
16
24
FUSE
12
10A
(8W-12-18)
23
39
FUSE
20
10A
(8W-12-13)
40
21
FUSE
11
10A
(8W-12-12)
22
27
FUSE
14
10A
(8W-12-13)
28
19
FUSE
10
10A
(8W-12-10)
20



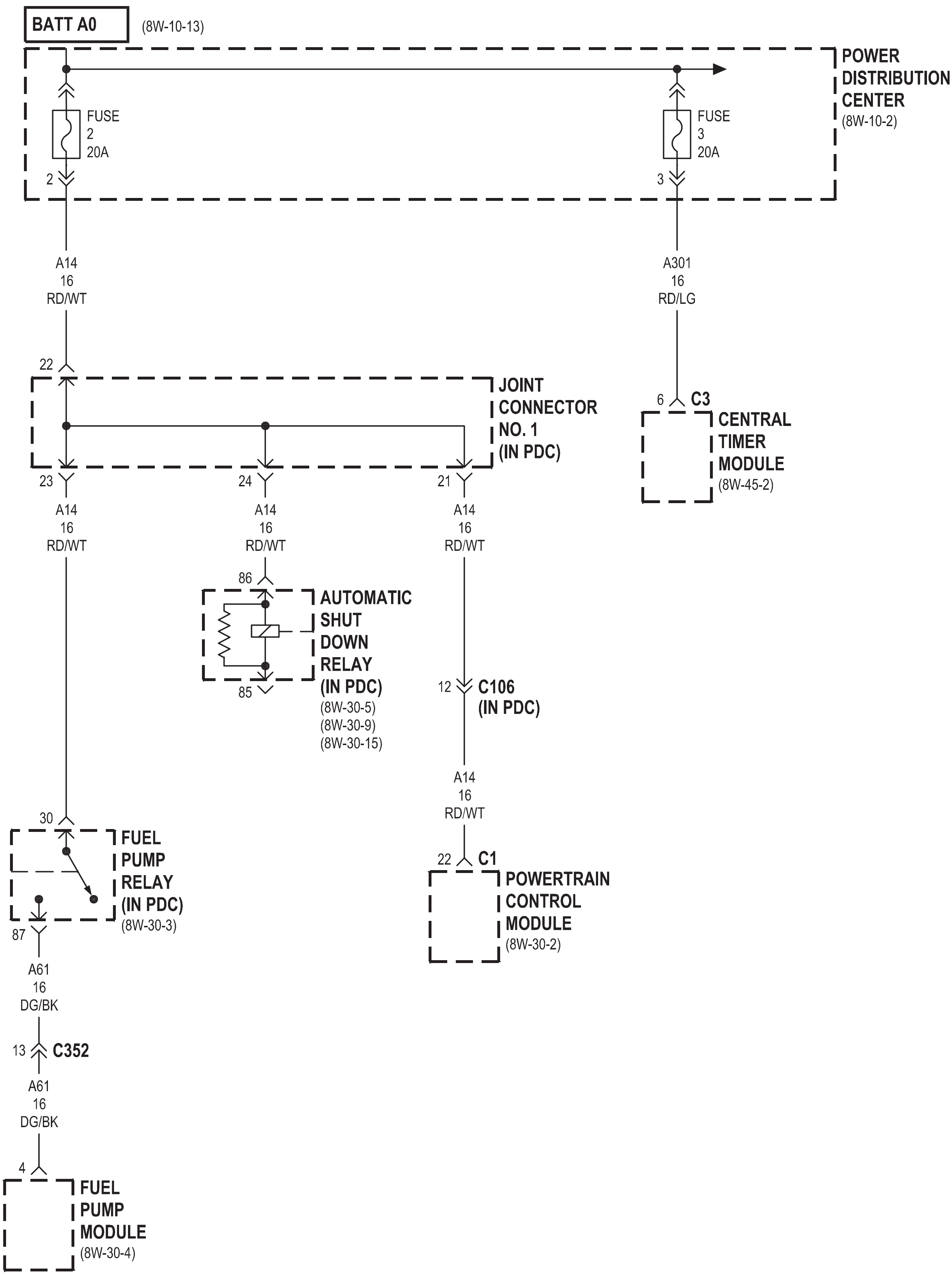
BATT A2
(8W-10-17)
BATT A1
(8W-10-17)
BATT A18
(8W-10-17)
IGNITION SWITCH
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
(8W-10-17)
1
2
0
3
4
7
9
10
A22
12
BK/OR
A31
12
BK/WT
A30
12
RD/WT
1
C12
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
63
CIRCUIT BREAKER NO. 28
25A
(8W-12-17)
64
9
FUSE
5
20A
(8W-12-17)
10
1
C6
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
38
FUSE
19
10A
(8W-12-18)
37
34
FUSE
17
15A
(8W-12-18)
33
36
FUSE
18
10A
(8W-12-18)
35
3
C12
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
42
FUSE
21
10A
(8W-12-14)
41
48
FUSE
24
15A
(8W-12-14)
47
51
FUSE
26
15A
(8W-12-15)
52
49
FUSE
25
10A
(8W-12-14)
50
53
FUSE
27
10A
(8W-12-14)
54

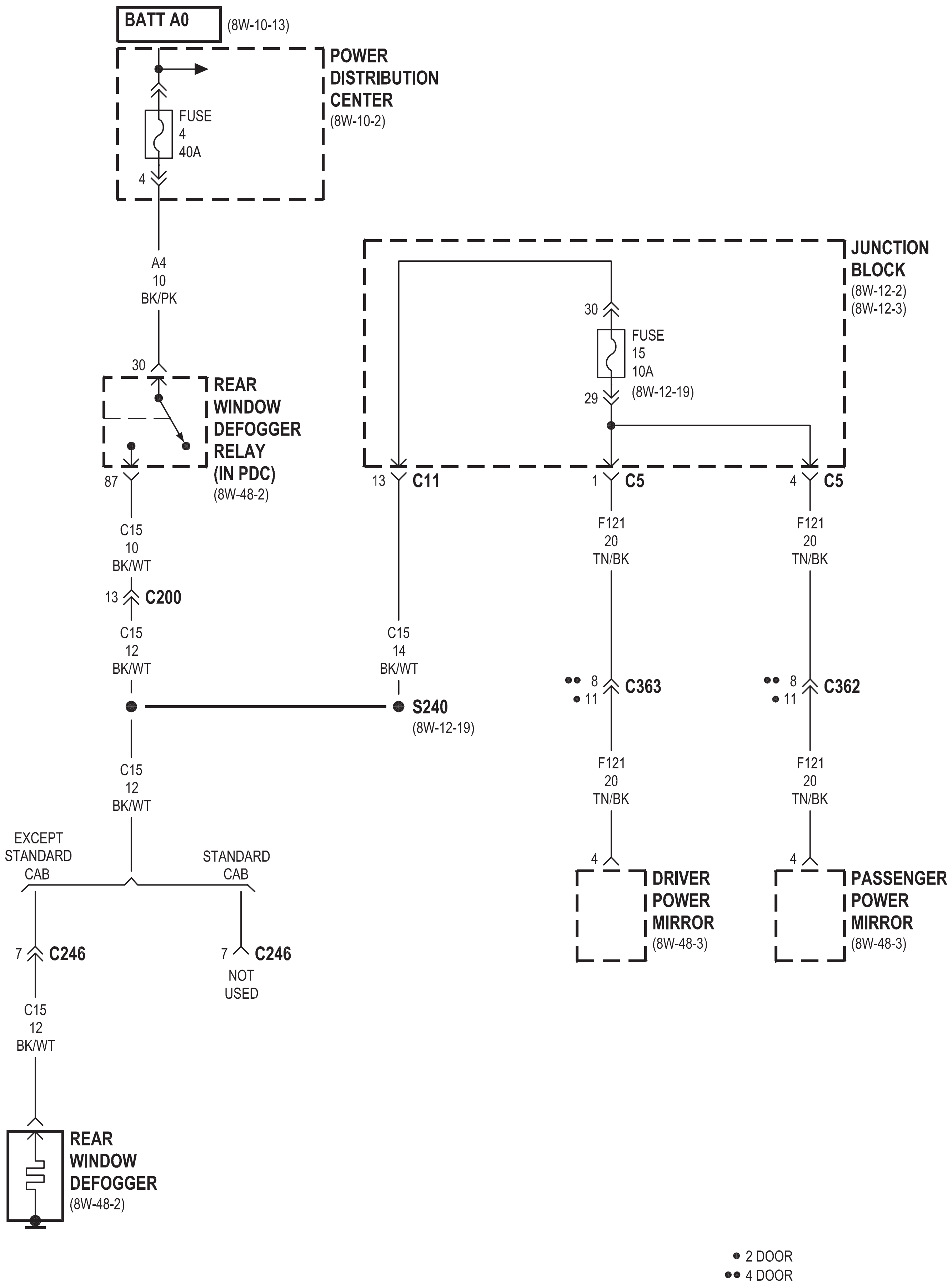

BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
F
20A
F
F84
16
YL/WT
3.9L/5.9L
4.7L
F84
16
YL/WT
F84
16
YL/WT
12
JOINT CONNECTOR NO. 1 (IN PDC)
14
13
F84
16
YL/WT
F84
16
YL/WT
30
TRANSMISSION CONTROL RELAY (IN PDC)
(8W-31-2)
(8W-31-4)
87
T16
16
RD
2
C105
10
3.9L/5.9L
4.7L
F84
16
YL/WT
T16
16
RD
T16
16
RD
S175
T16
16
RD
T16
18
RD
T16
18
RD
T16
18
RD
1
TRANSMISSION SOLENOID ASSEMBLY
(8W-31-2)
10
TRANSMISSION SOLENOID/ TRS ASSEMBLY
(8W-31-5)
(8W-31-6)
16
17
36
56
TRANSMISSION CONTROL MODULE
(8W-31-4)


BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
H
20A
H
A114
18
GY/RD
1
JOINT CONNECTOR NO. 3 (IN PDC)
3
2
A114
18
GY/RD
A114
18
GY/RD
86
30
FOG LAMP RELAY (IN PDC)
(8W-50-2)
85
87
L39
18
LB
8
JOINT CONNECTOR NO. 1 (IN PDC)
11
9
10
L39
18
LB
L39
18
LB
L39
18
LB
B
RIGHT FOG LAMP
(8W-50-2)
18
C200
L39
18
LB
B
LEFT FOG LAMP
(8W-50-2)
7
HEADLAMP SWITCH
(8W-50-2)

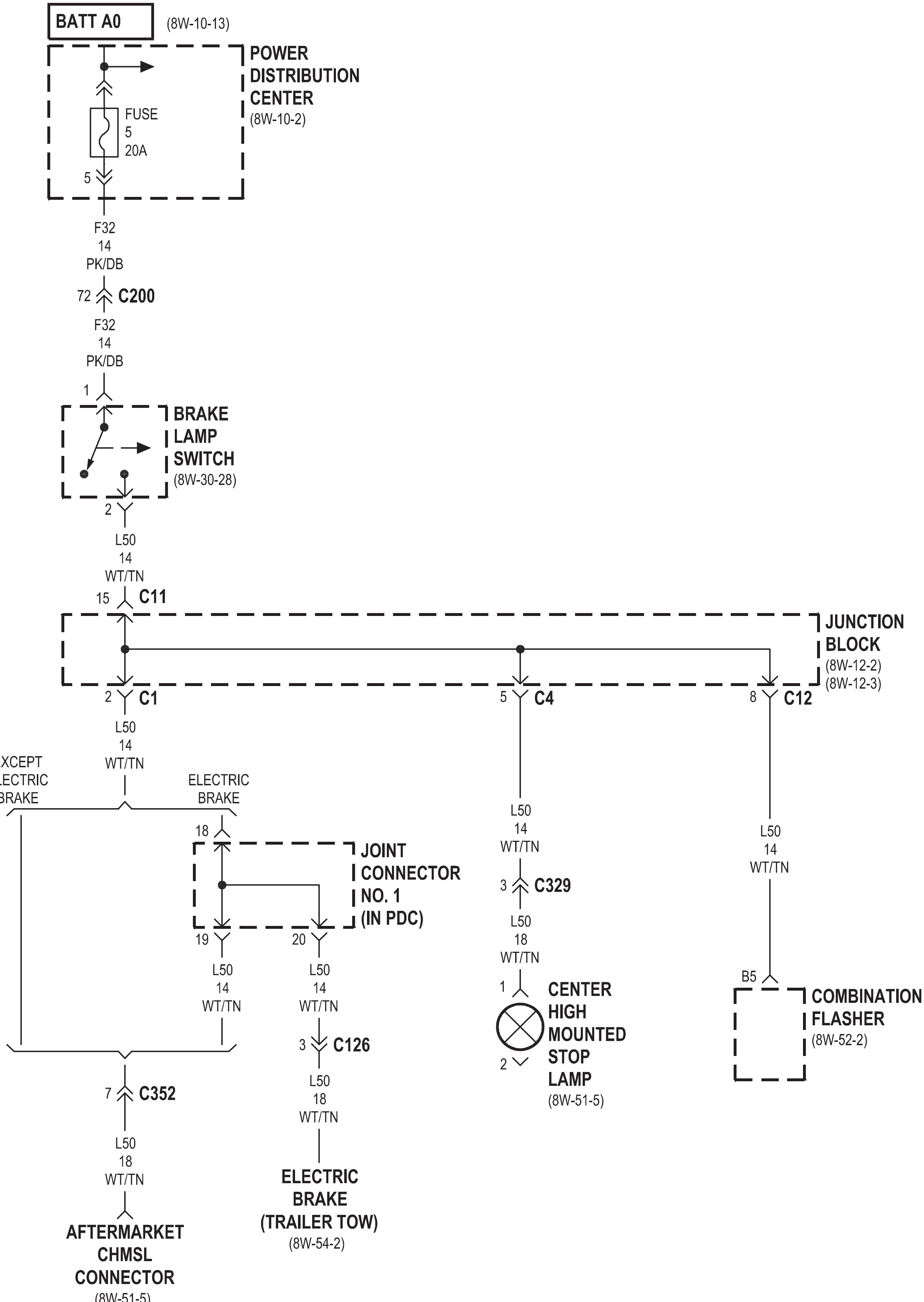


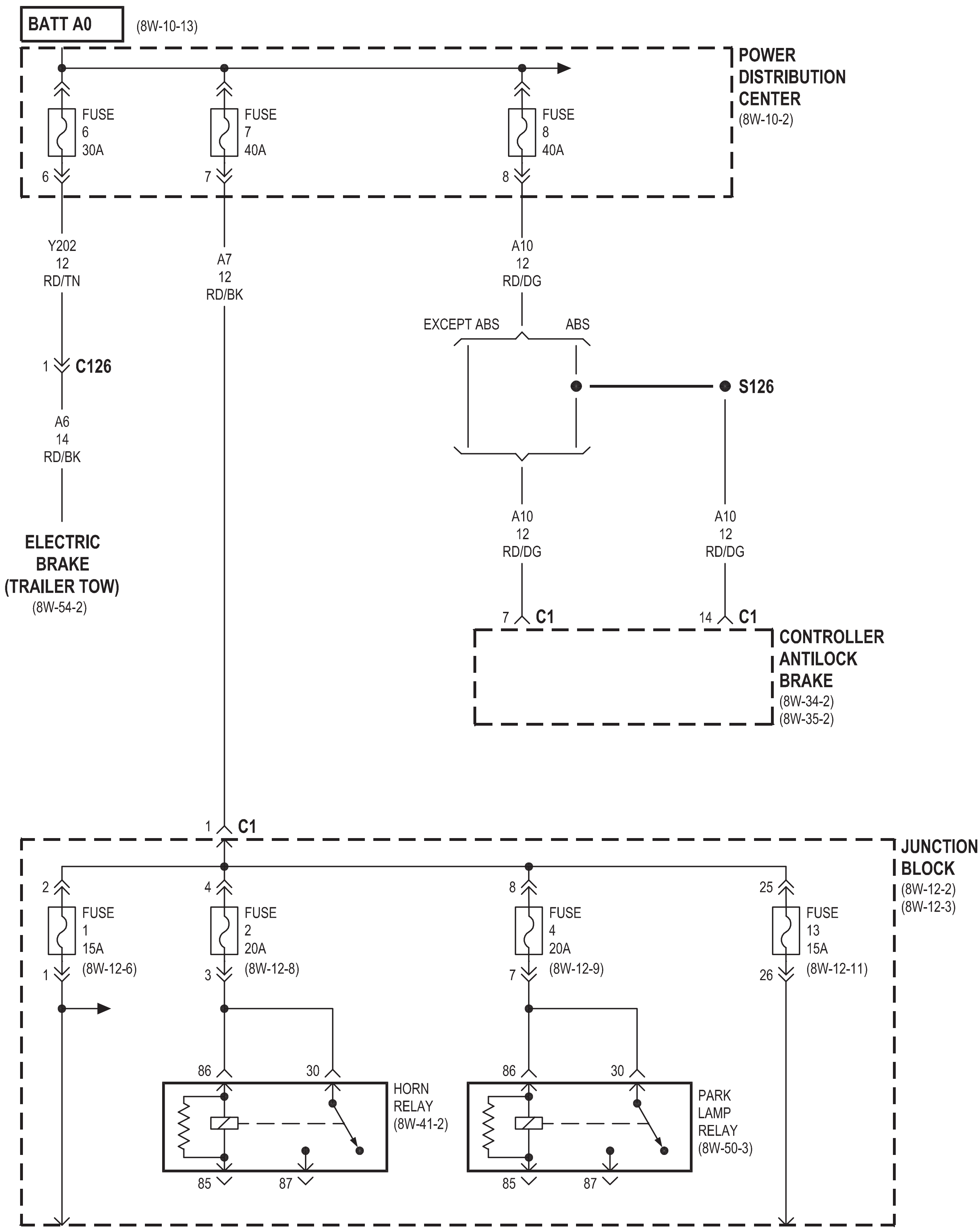
BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 16 50A
16
FUSE 1 30A
1
A149 12 RD/TN
L9 14 BK/WT
30
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-2)
87
61
C200
T40 12 BR
L9 14 BK/WT
T40 12 BR
A1
COMBINATION FLASHER
(8W-52-2)
ENGINE STARTER MOTOR
(8W-21-2)

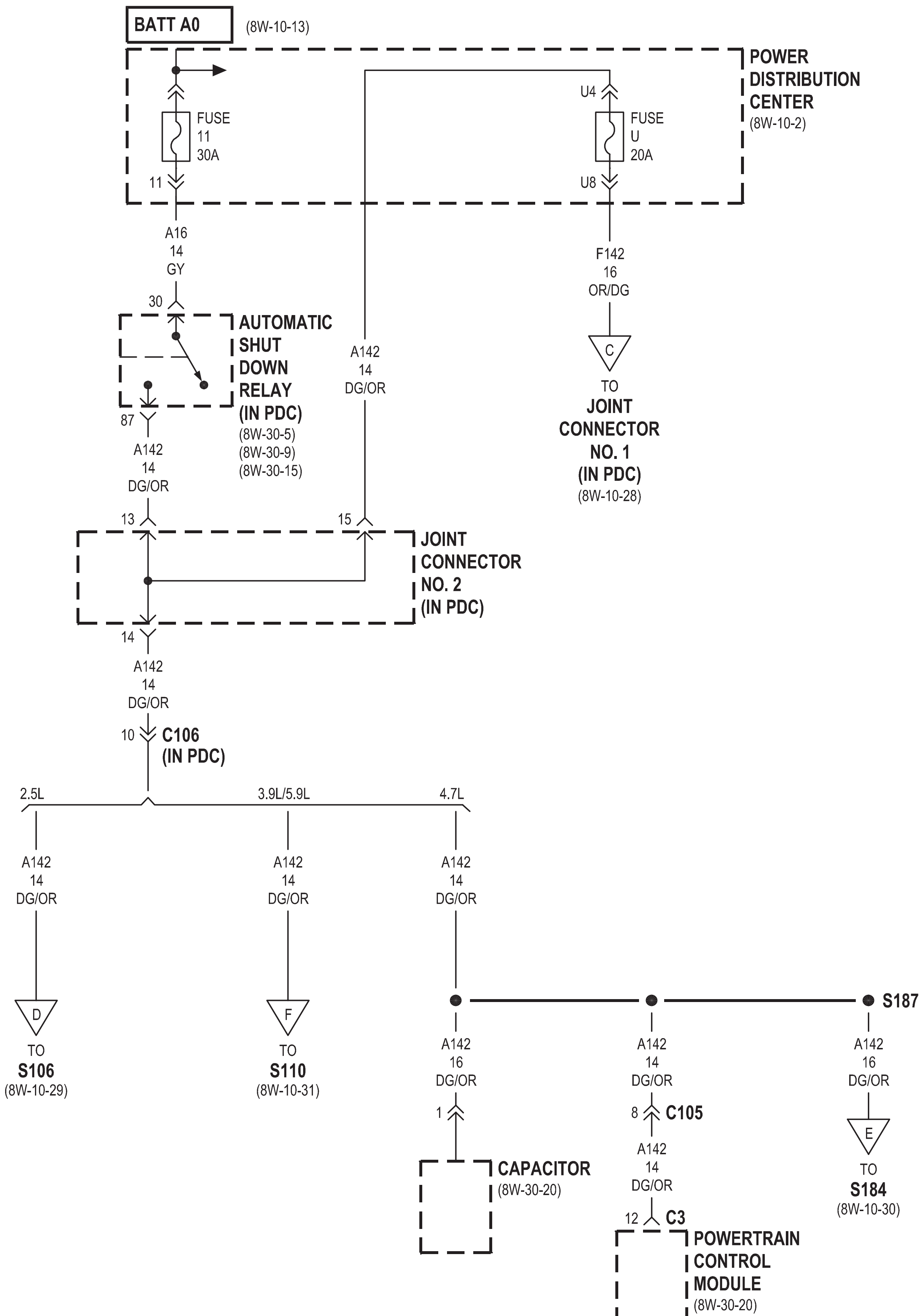

BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 2 20A
2
FUSE 3 20A
3
A14 16 RD/WT
A301 16 RD/LG
22
JOINT CONNECTOR NO. 1 (IN PDC)
6 C3
CENTRAL TIMER MODULE
(8W-45-2)
23 24 21
A14 16 RD/WT
A14 16 RD/WT
A14 16 RD/WT
86
AUTOMATIC SHUT DOWN RELAY (IN PDC)
85
(8W-30-5)
(8W-30-9)
(8W-30-15)
12 C106 (IN PDC)
A14 16 RD/WT
30
FUEL PUMP RELAY (IN PDC)
(8W-30-3)
87
22 C1
POWERTRAIN CONTROL MODULE
(8W-30-2)
A61 16 DG/BK
13 C352
A61 16 DG/BK
4
FUEL PUMP MODULE
(8W-30-4)

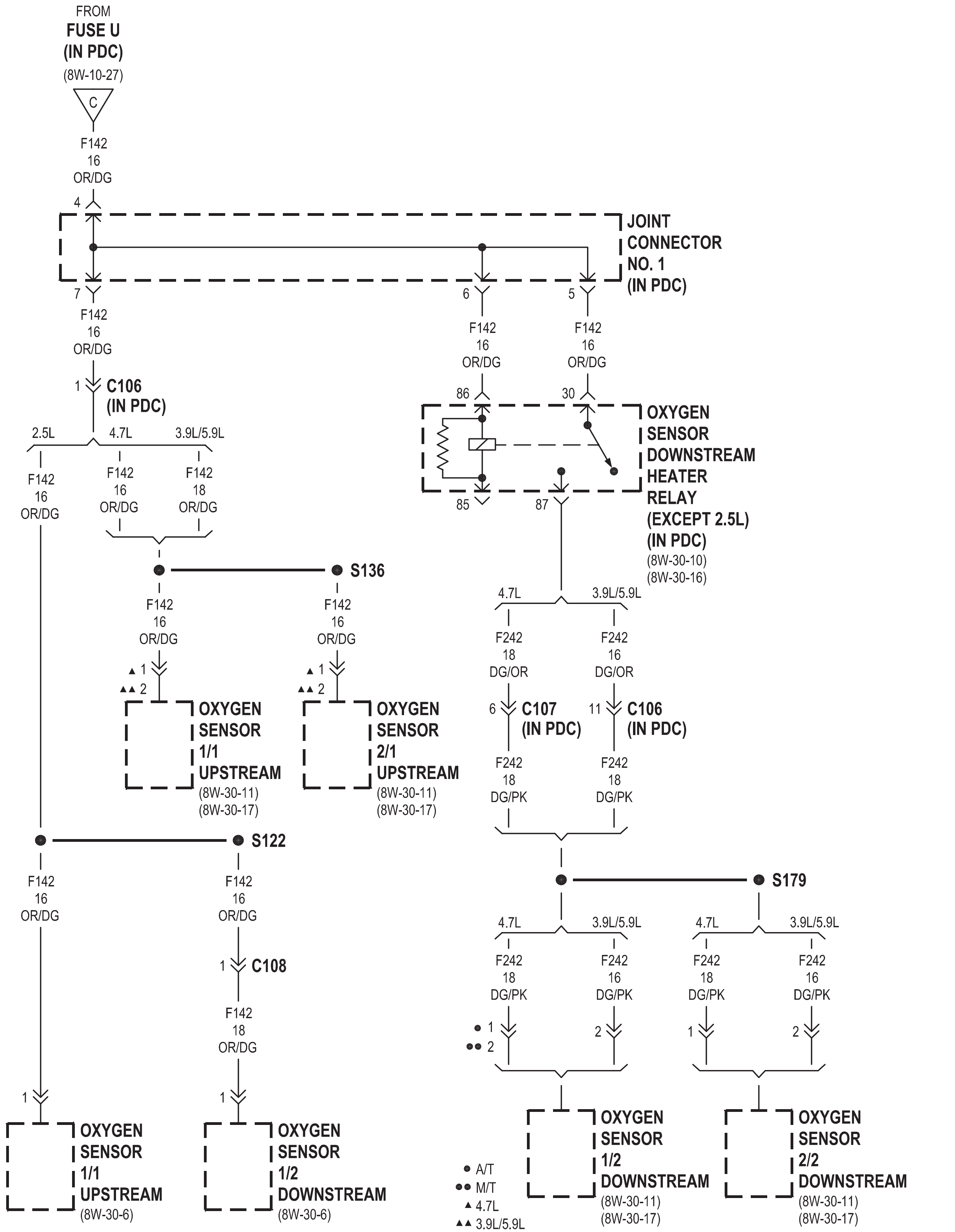


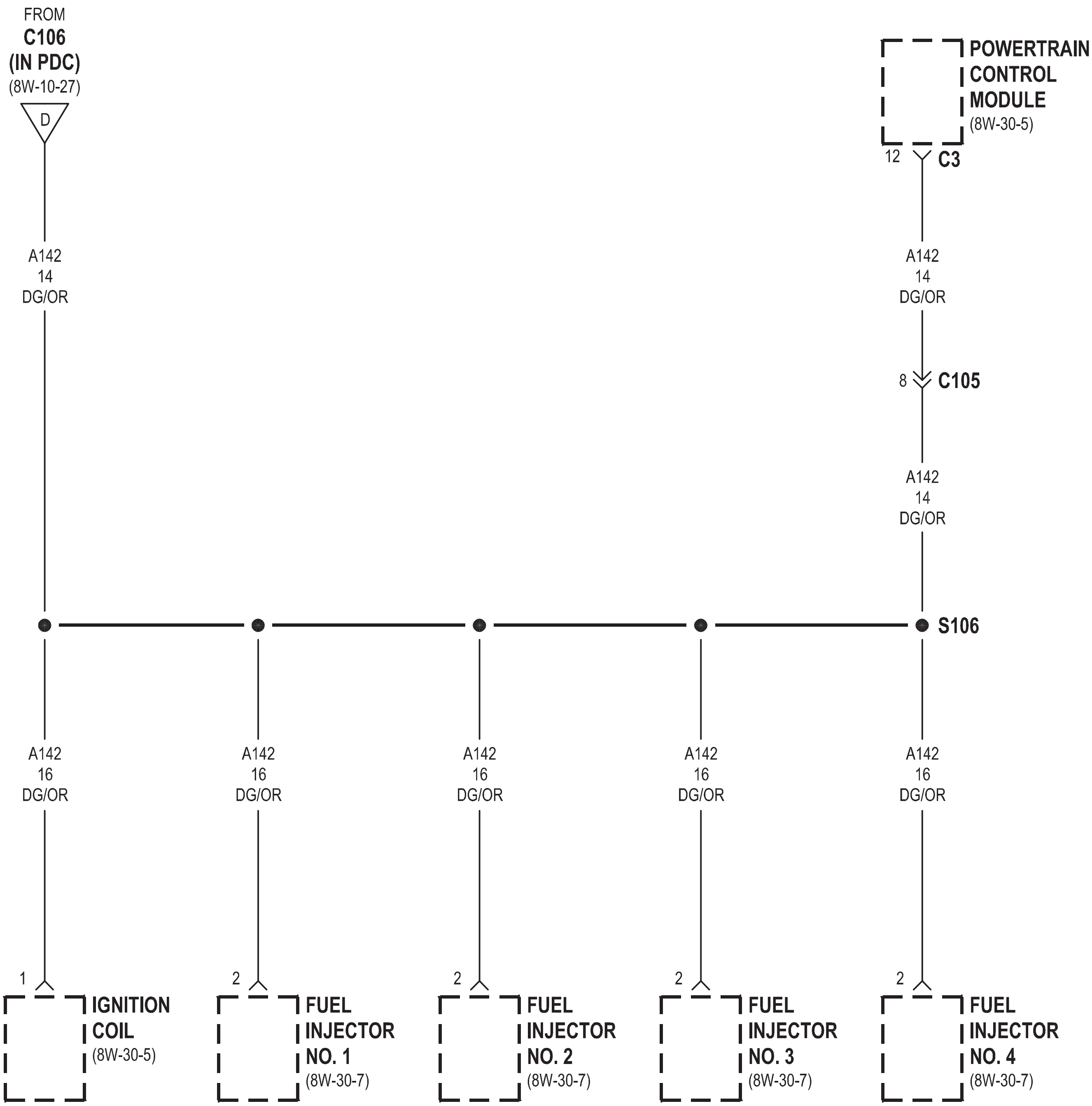
BATT A0
(8W-10-13)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
4
40A
4
A4
10
BK/PK
30
REAR
WINDOW
DEFOGGER
RELAY
(IN PDC)
(8W-48-2)
87
C15
10
BK/WT
13
C200
C15
12
BK/WT
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
30
FUSE
15
10A
29
(8W-12-19)
13
C11
1
C5
4
C5
F121
20
TN/BK
C15
14
BK/WT
S240
(8W-12-19)
8
11
C363
C362
C15
12
BK/WT
EXCEPT
STANDARD
CAB
STANDARD
CAB
7
C246
NOT
USED
4
DRIVER
POWER
MIRROR
(8W-48-3)
PASSENGER
POWER
MIRROR
(8W-48-3)
C15
12
BK/WT
REAR
WINDOW
DEFOGGER
(8W-48-2)
2 DOOR
4 DOOR


BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 5 20A
5
F32 14 PK/DB
72 C200
F32 14 PK/DB
1
BRAKE LAMP SWITCH
(8W-30-28)
2
L50 14 WT/TN
15 C11
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
2 C1
5 C4
8 C12
L50 14 WT/TN
EXCEPT ELECTRIC BRAKE
ELECTRIC BRAKE
18
JOINT CONNECTOR NO. 1 (IN PDC)
19
20
L50 14 WT/TN
L50 14 WT/TN
3 C126
L50 18 WT/TN
ELECTRIC BRAKE (TRAILER TOW)
(8W-54-2)
7 C352
L50 18 WT/TN
AFTERMARKET CHMSL CONNECTOR
(8W-51-5)
L50 14 WT/TN
3 C329
L50 18 WT/TN
1
CENTER HIGH MOUNTED STOP LAMP
2
(8W-51-5)
L50 14 WT/TN
B5
COMBINATION FLASHER
(8W-52-2)

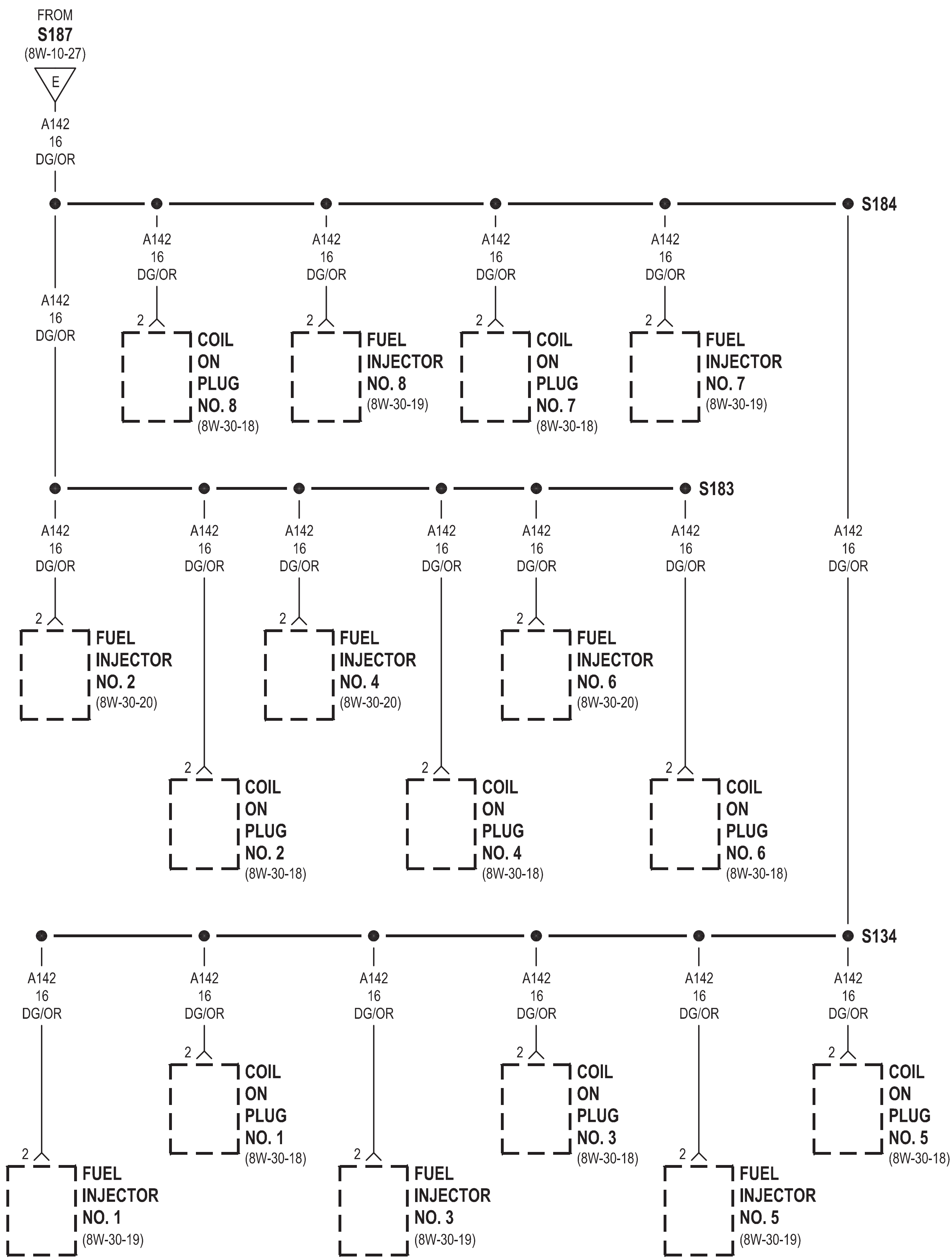

BATT A0
(8W-10-13)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
6
30A
FUSE
7
40A
FUSE
8
40A
6
7
8
Y202
12
RD/TN
A7
12
RD/BK
A10
12
RD/DG
EXCEPT ABS
ABS
S126
1
C126
A6
14
RD/BK
ELECTRIC
BRAKE
(TRAILER TOW)
(8W-54-2)
A10
12
RD/DG
A10
12
RD/DG
7
C1
14
C1
CONTROLLER
ANTILOCK
BRAKE
(8W-34-2)
(8W-35-2)
1
C1
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
2
FUSE
1
15A
(8W-12-6)
1
4
FUSE
2
20A
(8W-12-8)
3
8
FUSE
4
20A
(8W-12-9)
7
25
FUSE
13
15A
(8W-12-11)
26
86
30
HORN
RELAY
(8W-41-2)
85
87
86
30
PARK
LAMP
RELAY
(8W-50-3)
85
87

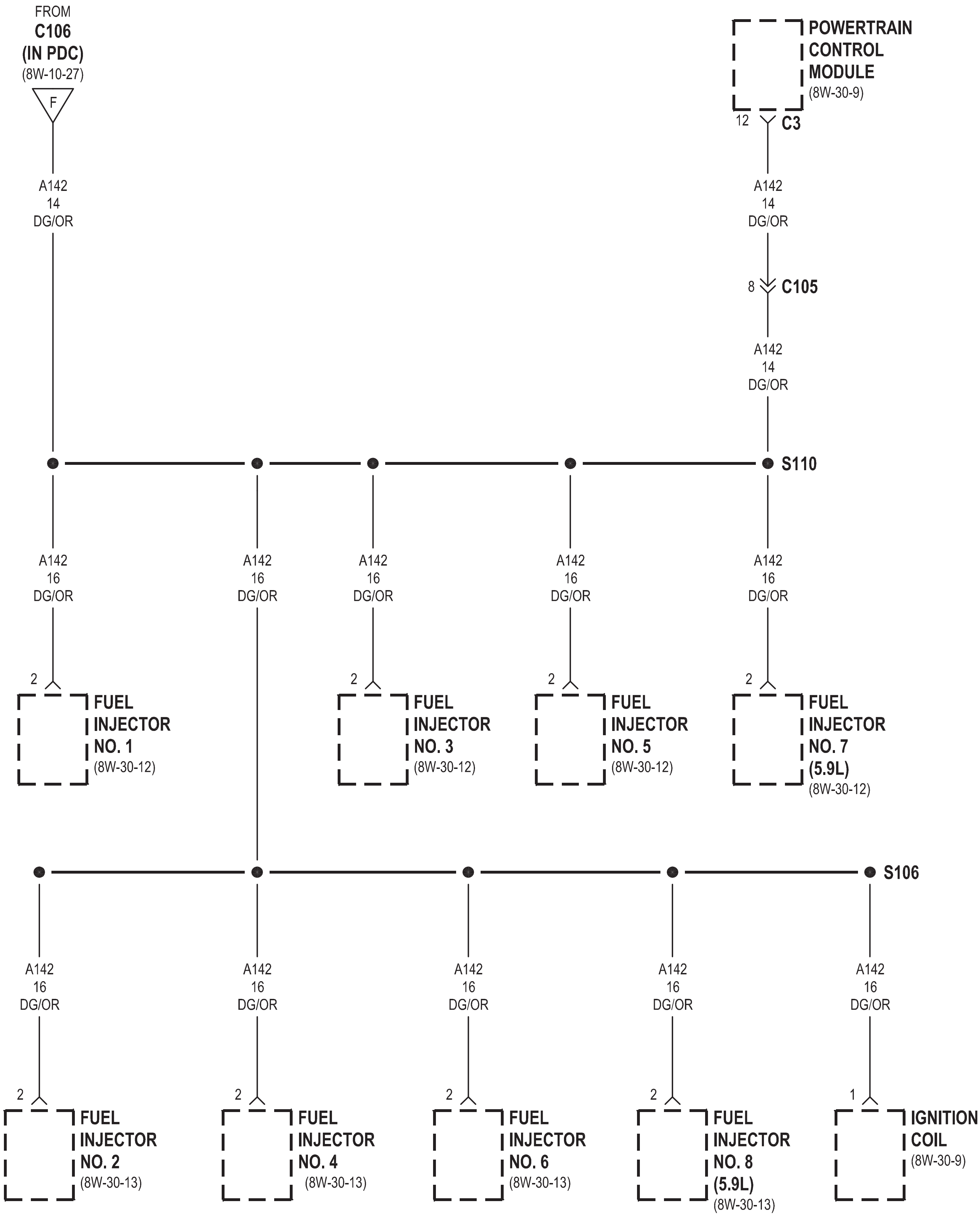

BATT A0
(8W-10-13)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
11
30A
11
U4
FUSE
U
20A
U8
A16
14
GY
F142
16
OR/DG
30
AUTOMATIC
SHUT
DOWN
RELAY
(IN PDC)
(8W-30-5)
(8W-30-9)
(8W-30-15)
87
A142
14
DG/OR
C
TO
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-10-28)
13
15
JOINT
CONNECTOR
NO. 2
(IN PDC)
14
10
C106
(IN PDC)
2.5L
3.9L/5.9L
4.7L
D
TO
S106
(8W-10-29)
F
TO
S110
(8W-10-31)
S187
A142
16
DG/OR
1
CAPACITOR
(8W-30-20)
8
C105
12
C3
POWERTRAIN
CONTROL
MODULE
(8W-30-20)
E
TO
S184
(8W-10-30)

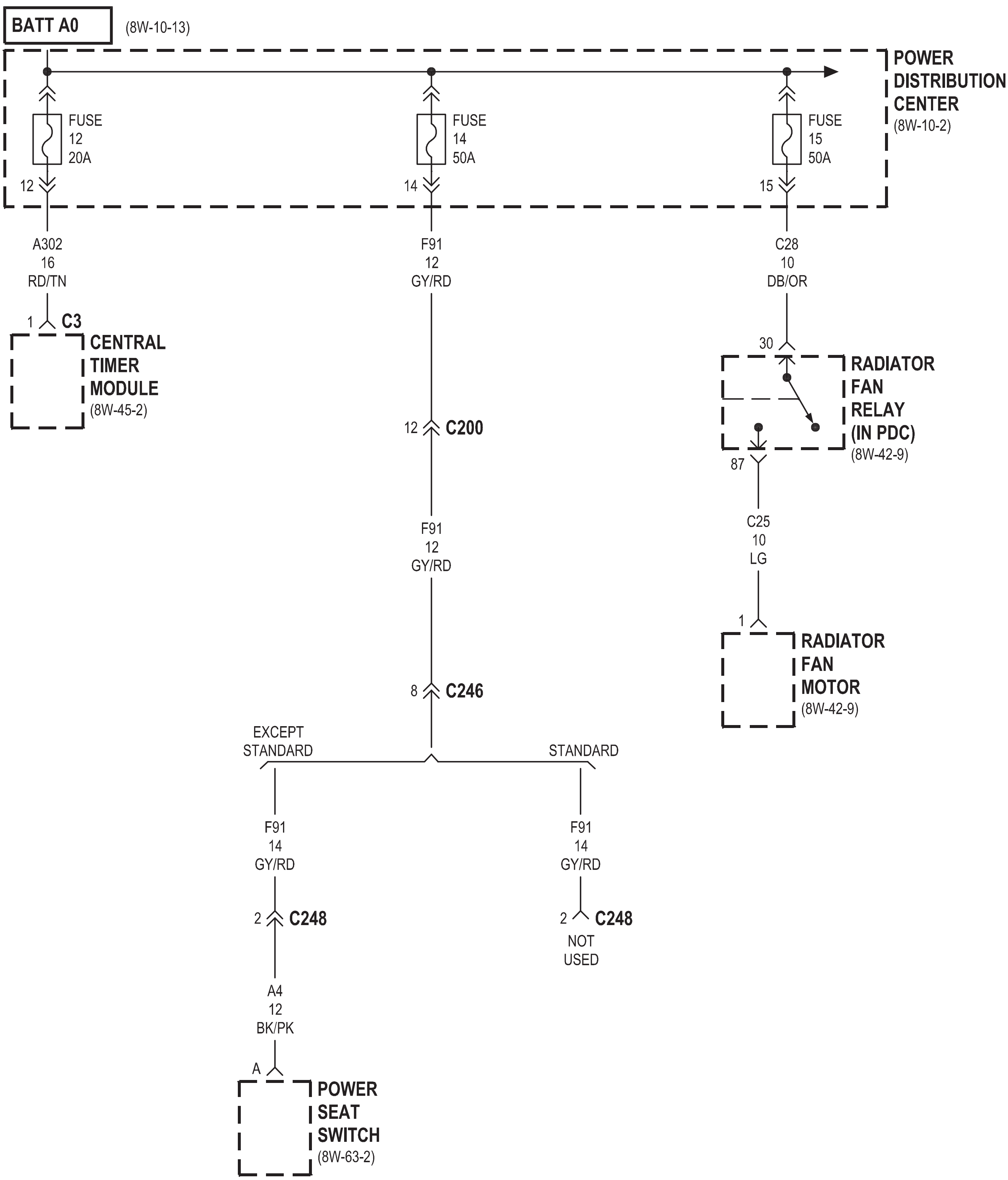

FROM
FUSE U
(IN PDC)
(8W-10-27)
C
F142
16
OR/DG
4
JOINT
CONNECTOR
NO. 1
(IN PDC)
7
6
5
F142
16
OR/DG
1
C106
(IN PDC)
2.5L
4.7L
3.9L/5.9L
86
30
OXYGEN
SENSOR
DOWNSTREAM
HEATER
RELAY
(EXCEPT 2.5L)
(IN PDC)
(8W-30-10)
(8W-30-16)
85
87
F142
18
OR/DG
S136
OXYGEN
SENSOR
1/1
UPSTREAM
(8W-30-11)
(8W-30-17)
OXYGEN
SENSOR
2/1
UPSTREAM
(8W-30-11)
(8W-30-17)
F242
18
DG/OR
F242
16
DG/OR
6
C107
(IN PDC)
11
C106
(IN PDC)
F242
18
DG/PK
S122
C108
S179
OXYGEN
SENSOR
1/1
UPSTREAM
(8W-30-6)
OXYGEN
SENSOR
1/2
DOWNSTREAM
(8W-30-6)
OXYGEN
SENSOR
1/2
DOWNSTREAM
(8W-30-11)
(8W-30-17)
OXYGEN
SENSOR
2/2
DOWNSTREAM
(8W-30-11)
(8W-30-17)
● A/T
●● M/T
▲ 4.7L
▲▲ 3.9L/5.9L

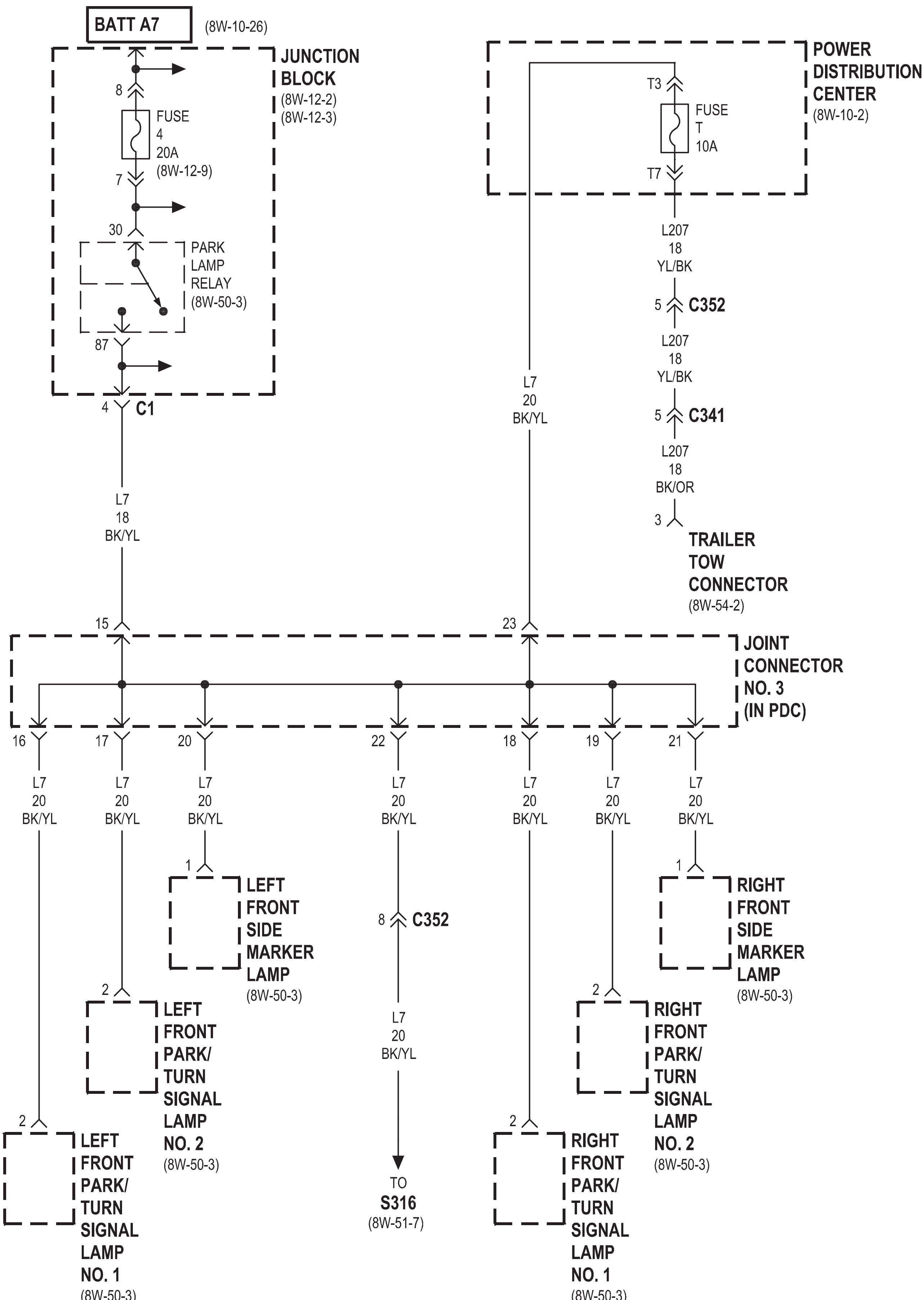

FROM
C106
(IN PDC)
(8W-10-27)
D
POWERTRAIN
CONTROL
MODULE
(8W-30-5)
12
C3
A142
14
DG/OR
8
C105
S106
A142
16
DG/OR
1
IGNITION
COIL
(8W-30-5)
2
FUEL
INJECTOR
NO. 1
(8W-30-7)
FUEL
INJECTOR
NO. 2
(8W-30-7)
FUEL
INJECTOR
NO. 3
(8W-30-7)
FUEL
INJECTOR
NO. 4
(8W-30-7)

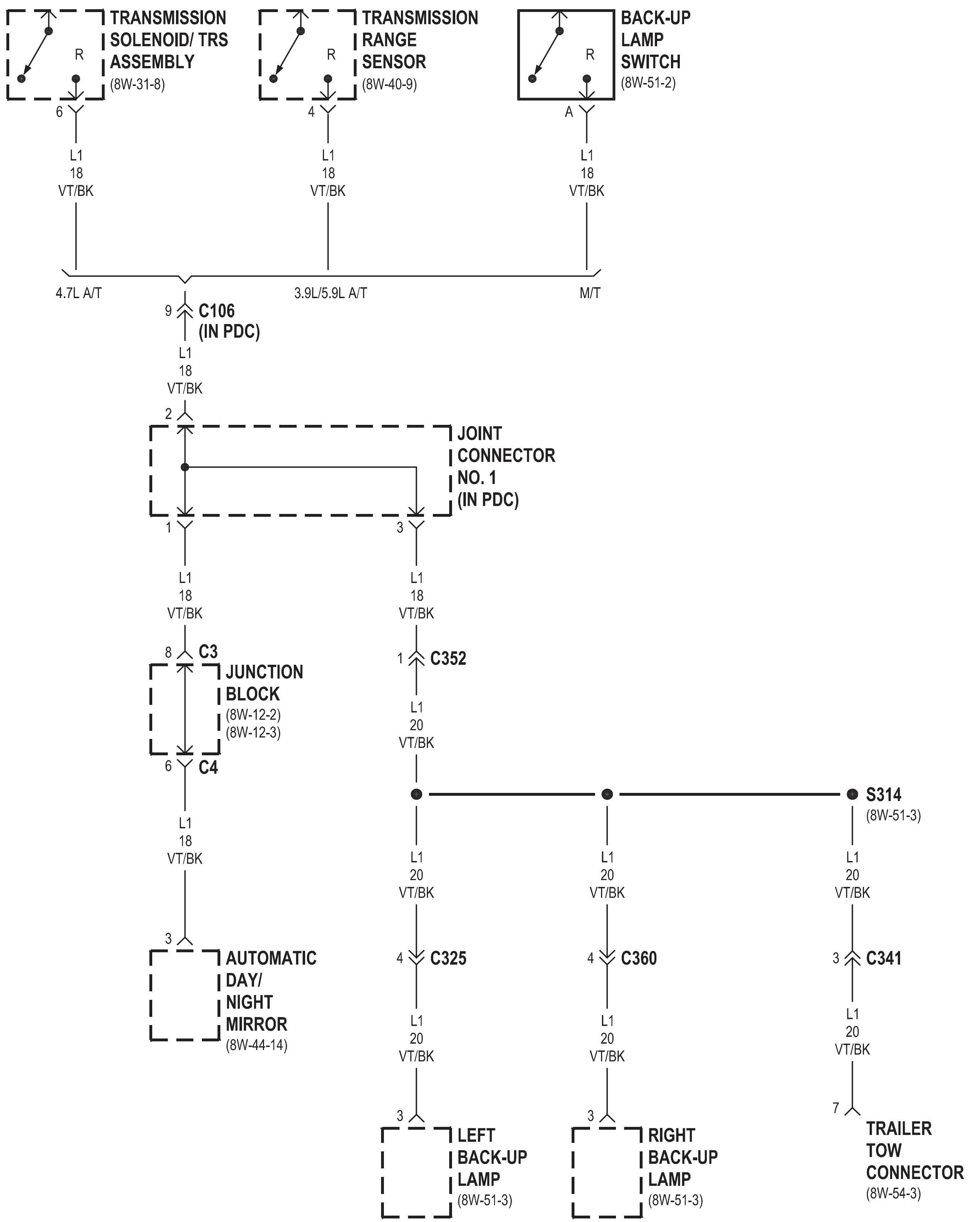
4.7L


FROM
S187
(8W-10-27)
E
A142
16
DG/OR
S184
COIL ON PLUG NO. 8
(8W-30-18)
FUEL INJECTOR NO. 8
(8W-30-19)
COIL ON PLUG NO. 7
(8W-30-18)
FUEL INJECTOR NO. 7
(8W-30-19)
S183
FUEL INJECTOR NO. 2
(8W-30-20)
FUEL INJECTOR NO. 4
(8W-30-20)
FUEL INJECTOR NO. 6
(8W-30-20)
COIL ON PLUG NO. 2
(8W-30-18)
COIL ON PLUG NO. 4
(8W-30-18)
COIL ON PLUG NO. 6
(8W-30-18)
S134
COIL ON PLUG NO. 1
(8W-30-18)
COIL ON PLUG NO. 3
(8W-30-18)
COIL ON PLUG NO. 5
(8W-30-18)
FUEL INJECTOR NO. 1
(8W-30-19)
FUEL INJECTOR NO. 3
(8W-30-19)
FUEL INJECTOR NO. 5
(8W-30-19)

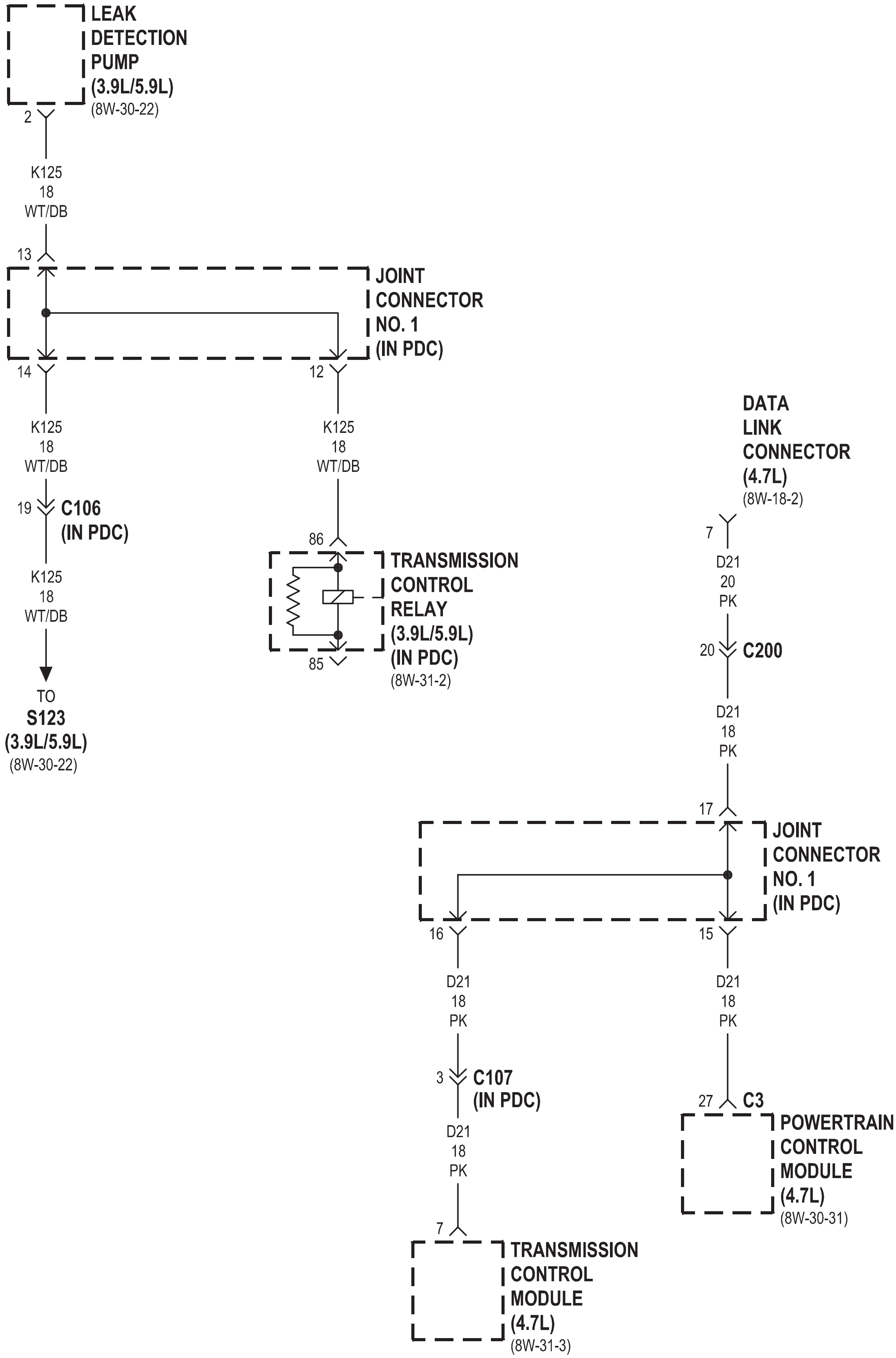

FROM
C106
(IN PDC)
(8W-10-27)
F
A142
14
DG/OR
POWERTRAIN
CONTROL
MODULE
(8W-30-9)
12
C3
A142
14
DG/OR
8
C105
A142
14
DG/OR
S110
A142
16
DG/OR
2
FUEL
INJECTOR
NO. 1
(8W-30-12)
FUEL
INJECTOR
NO. 3
(8W-30-12)
FUEL
INJECTOR
NO. 5
(8W-30-12)
FUEL
INJECTOR
NO. 7
(5.9L)
(8W-30-12)
S106
FUEL
INJECTOR
NO. 2
(8W-30-13)
FUEL
INJECTOR
NO. 4
(8W-30-13)
FUEL
INJECTOR
NO. 6
(8W-30-13)
FUEL
INJECTOR
NO. 8
(5.9L)
(8W-30-13)
1
IGNITION
COIL
(8W-30-9)

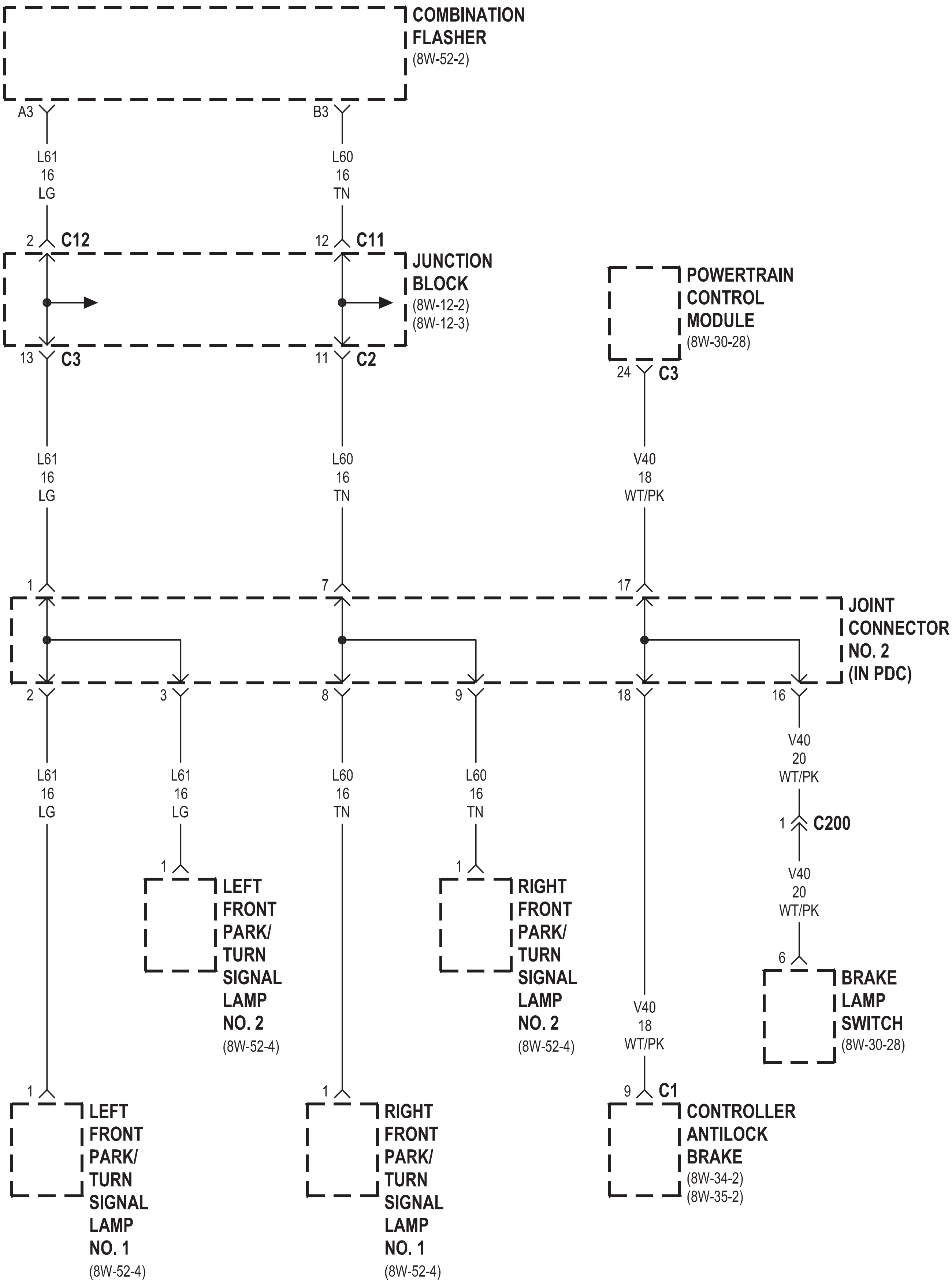

BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 12 20A
FUSE 14 50A
FUSE 15 50A
12
14
15
A302 16 RD/TN
F91 12 GY/RD
C28 10 DB/OR
1 C3
CENTRAL TIMER MODULE
(8W-45-2)
12 C200
30
RADIATOR FAN RELAY (IN PDC)
(8W-42-9)
87
C25 10 LG
1
RADIATOR FAN MOTOR
(8W-42-9)
8 C246
EXCEPT STANDARD
STANDARD
F91 14 GY/RD
F91 14 GY/RD
2 C248
2 C248
NOT USED
A4 12 BK/PK
A
POWER SEAT SWITCH
(8W-63-2)


BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
8
FUSE 4 20A (8W-12-9)
7
30
PARK LAMP RELAY (8W-50-3)
87
4 C1
L7 18 BK/YL
POWER DISTRIBUTION CENTER
(8W-10-2)
T3
FUSE T 10A
T7
L207 18 YL/BK
5 C352
L207 18 YL/BK
5 C341
L207 18 BK/OR
3
TRAILER TOW CONNECTOR
(8W-54-2)
L7 20 BK/YL
15
23
JOINT CONNECTOR NO. 3 (IN PDC)
16
17
20
22
18
19
21
L7 20 BK/YL
L7 20 BK/YL
L7 20 BK/YL
L7 20 BK/YL
L7 20 BK/YL
L7 20 BK/YL
L7 20 BK/YL
1
LEFT FRONT SIDE MARKER LAMP
(8W-50-3)
8 C352
L7 20 BK/YL
TO S316
(8W-51-7)
1
RIGHT FRONT SIDE MARKER LAMP
(8W-50-3)
2
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 2
(8W-50-3)
2
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 2
(8W-50-3)
2
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 1
(8W-50-3)
2
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 1
(8W-50-3)

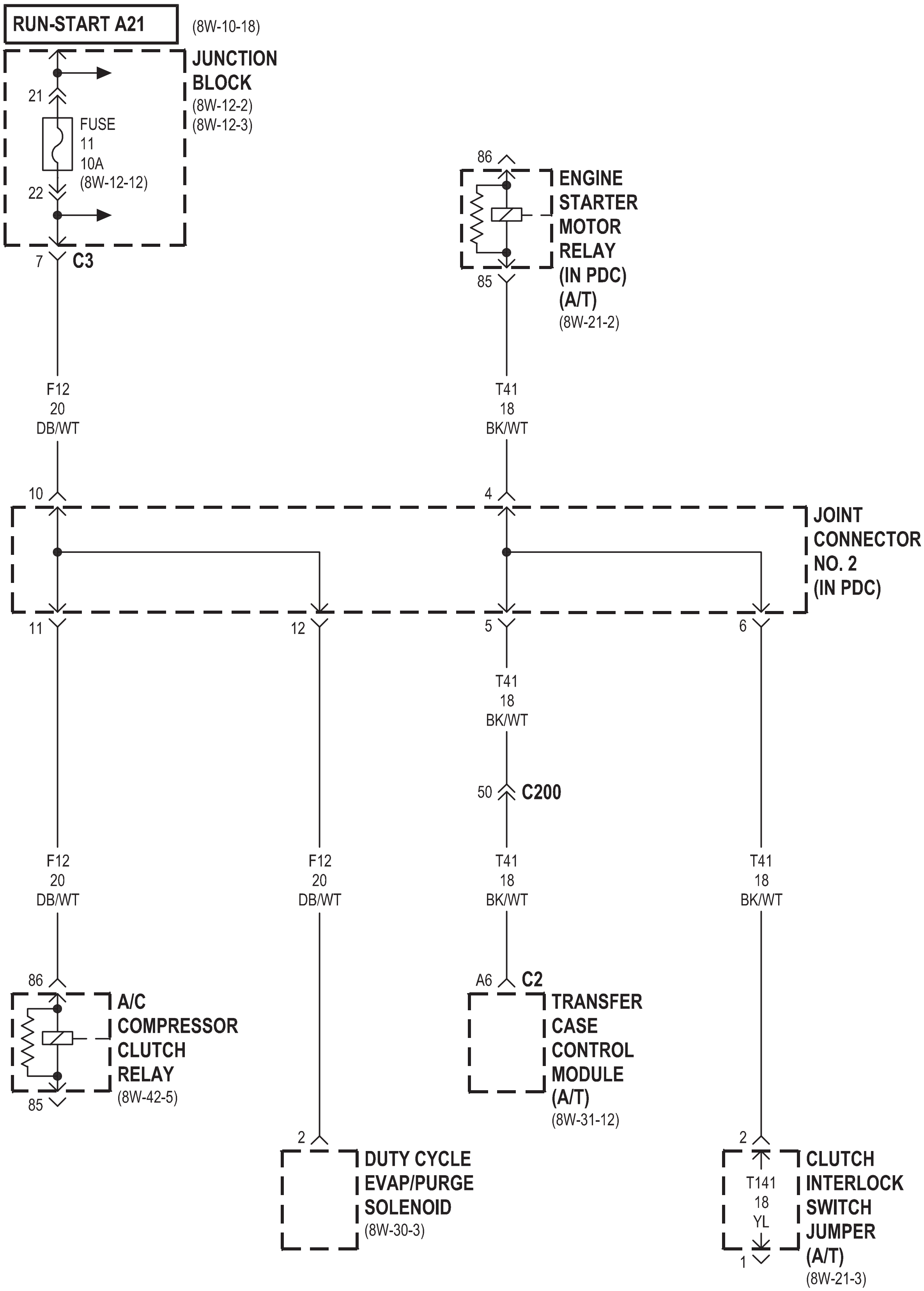


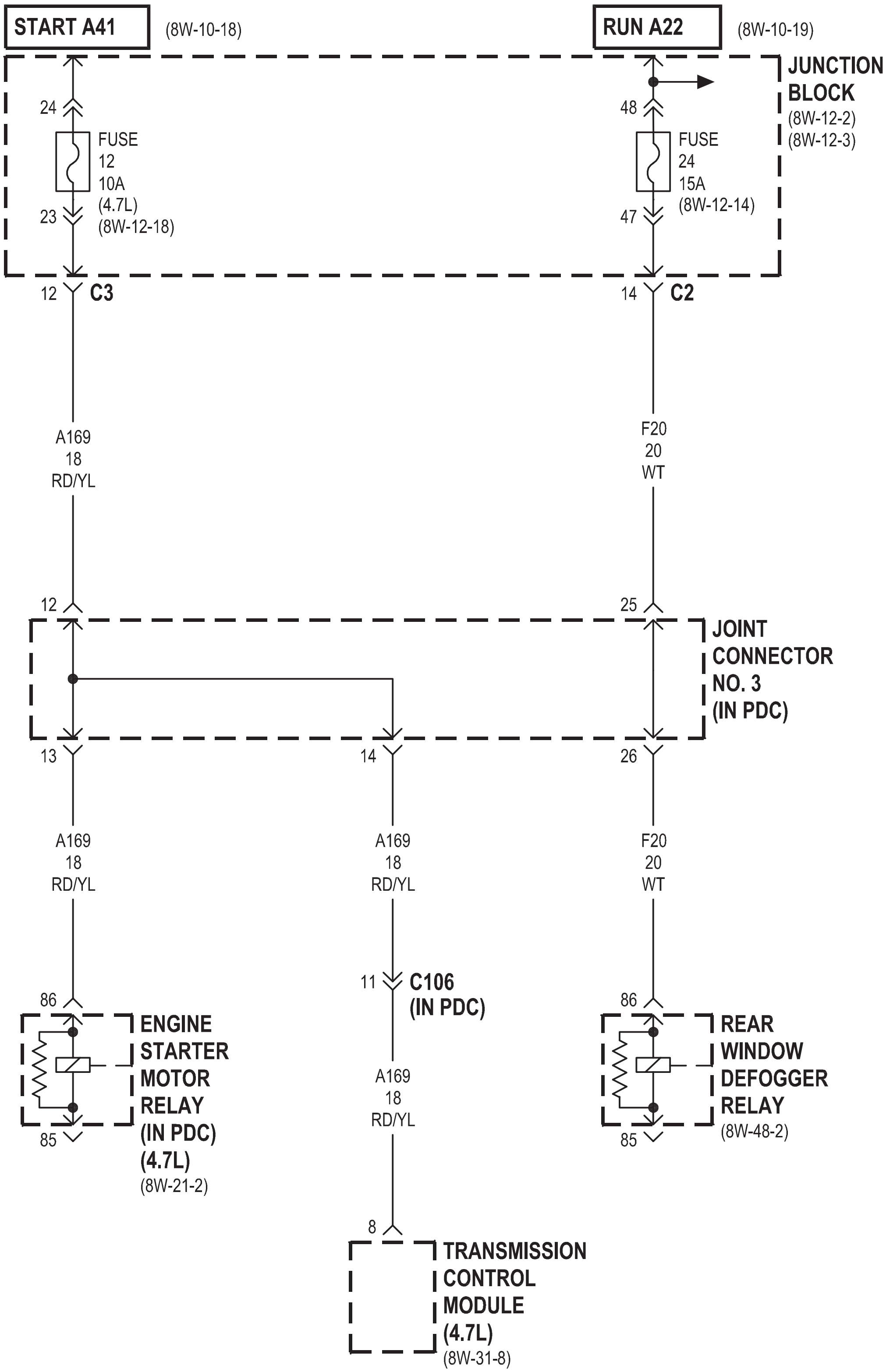
TRANSMISSION SOLENOID/ TRS ASSEMBLY
(8W-31-8)
TRANSMISSION RANGE SENSOR
(8W-40-9)
BACK-UP LAMP SWITCH
(8W-51-2)
R
6
4
A
L1
18
VT/BK
4.7L A/T
3.9L/5.9L A/T
M/T
9
C106
(IN PDC)
2
JOINT CONNECTOR NO. 1
(IN PDC)
1
3
8
C3
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
6
C4
1
C352
L1
20
VT/BK
S314
(8W-51-3)
3
AUTOMATIC DAY/ NIGHT MIRROR
(8W-44-14)
4
C325
4
C360
3
C341
3
LEFT BACK-UP LAMP
(8W-51-3)
3
RIGHT BACK-UP LAMP
(8W-51-3)
7
TRAILER TOW CONNECTOR
(8W-54-3)

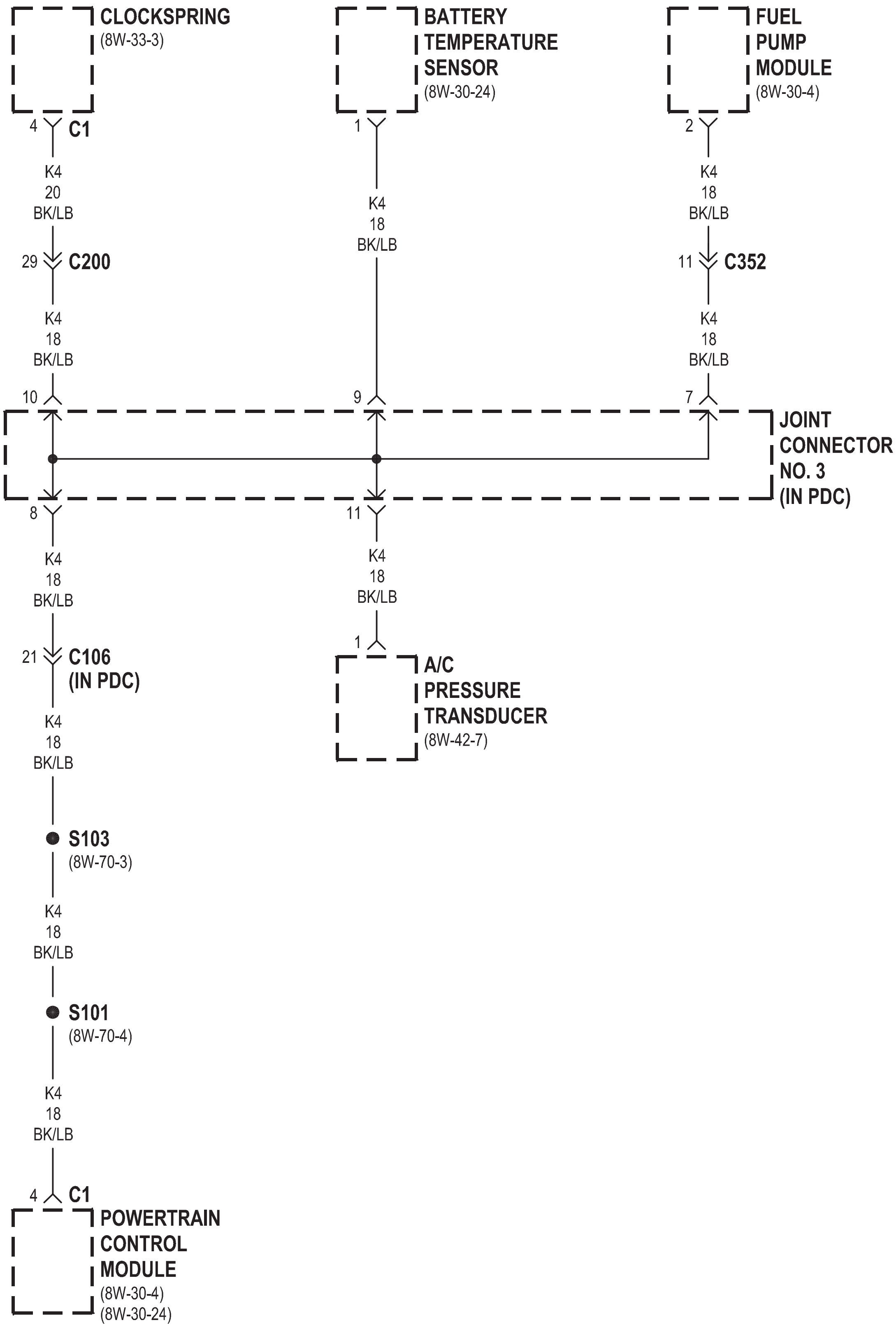

LEAK
DETECTION
PUMP
(3.9L/5.9L)
(8W-30-22)
2
K125
18
WT/DB
13
JOINT
CONNECTOR
NO. 1
(IN PDC)
14
12
K125
18
WT/DB
K125
18
WT/DB
19
C106
(IN PDC)
K125
18
WT/DB
TO
S123
(3.9L/5.9L)
(8W-30-22)
86
TRANSMISSION
CONTROL
RELAY
(3.9L/5.9L)
(IN PDC)
(8W-31-2)
85
DATA
LINK
CONNECTOR
(4.7L)
(8W-18-2)
7
D21
20
PK
20
C200
D21
18
PK
17
JOINT
CONNECTOR
NO. 1
(IN PDC)
16
15
D21
18
PK
D21
18
PK
3
C107
(IN PDC)
D21
18
PK
7
TRANSMISSION
CONTROL
MODULE
(4.7L)
(8W-31-3)
27
C3
POWERTRAIN
CONTROL
MODULE
(4.7L)
(8W-30-31)



COMBINATION FLASHER (8W-52-2)
A3
B3
L61 16 LG
L60 16 TN
2 C12
12 C11
JUNCTION BLOCK (8W-12-2) (8W-12-3)
13 C3
11 C2
POWERTRAIN CONTROL MODULE (8W-30-28)
24 C3
L61 16 LG
L60 16 TN
V40 18 WT/PK
1
7
17
JOINT CONNECTOR NO. 2 (IN PDC)
2
3
8
9
18
16
L61 16 LG
L61 16 LG
L60 16 TN
L60 16 TN
V40 20 WT/PK
1 C200
V40 20 WT/PK
1
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 2 (8W-52-4)
1
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 2 (8W-52-4)
6
BRAKE LAMP SWITCH (8W-30-28)
V40 18 WT/PK
1
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 1 (8W-52-4)
1
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 1 (8W-52-4)
9 C1
CONTROLLER ANTILOCK BRAKE (8W-34-2) (8W-35-2)

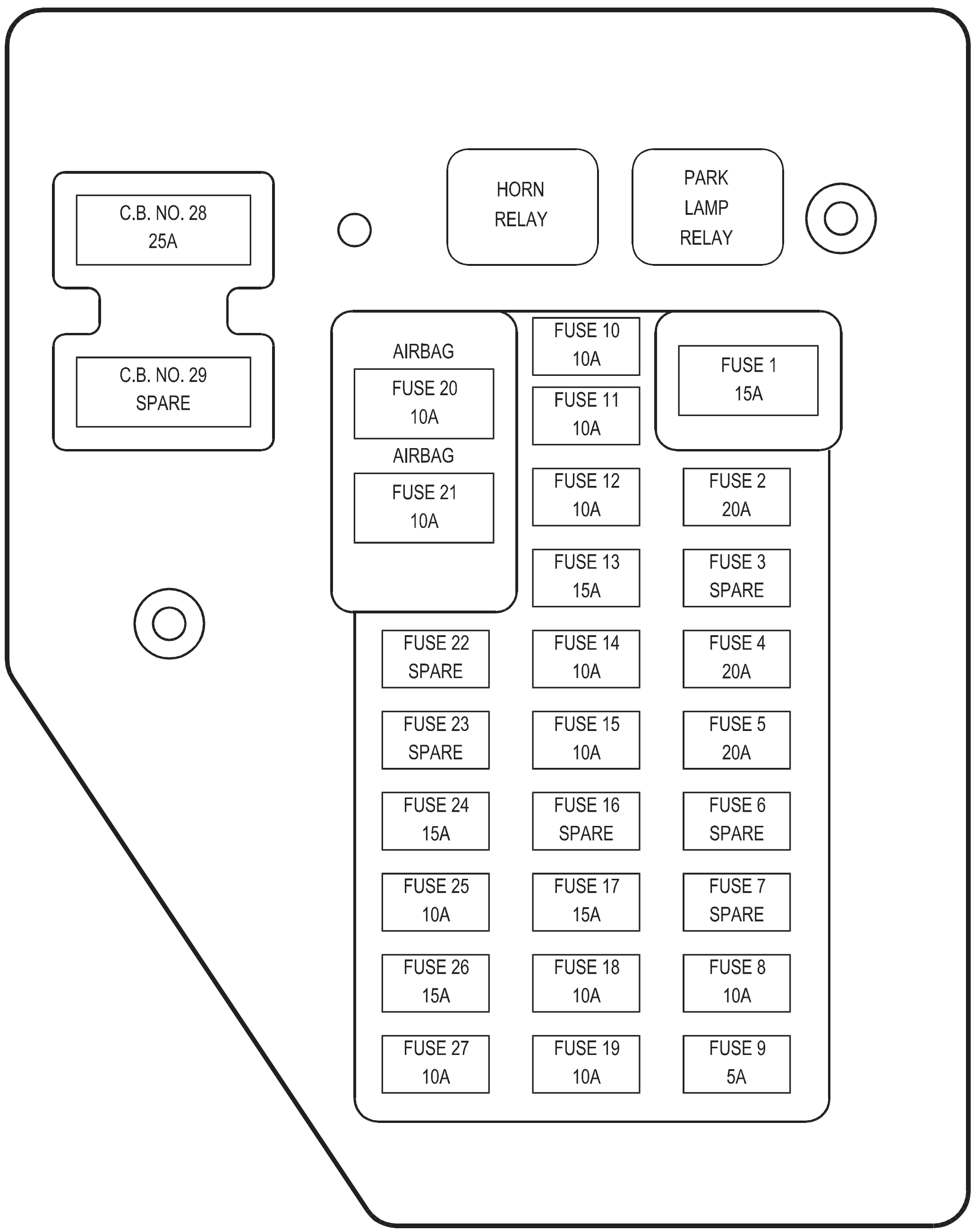

RUN-START A21
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
21
FUSE
11
10A
(8W-12-12)
22
7
C3
F12
20
DB/WT
86
ENGINE STARTER MOTOR RELAY (IN PDC) (A/T)
(8W-21-2)
85
T41
18
BK/WT
10
4
JOINT CONNECTOR NO. 2 (IN PDC)
11
12
5
6
T41
18
BK/WT
50
C200
F12
20
DB/WT
F12
20
DB/WT
T41
18
BK/WT
T41
18
BK/WT
86
A/C COMPRESSOR CLUTCH RELAY
(8W-42-5)
85
A6
C2
TRANSFER CASE CONTROL MODULE (A/T)
(8W-31-12)
2
DUTY CYCLE EVAP/PURGE SOLENOID
(8W-30-3)
2
CLUTCH INTERLOCK SWITCH JUMPER (A/T)
(8W-21-3)
T141
18
YL
1


START A41
(8W-10-18)
RUN A22
(8W-10-19)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
24
FUSE
12
10A
(4.7L)
(8W-12-18)
23
48
FUSE
24
15A
(8W-12-14)
47
12
C3
14
C2
A169
18
RD/YL
F20
20
WT
12
25
JOINT
CONNECTOR
NO. 3
(IN PDC)
13
14
26
A169
18
RD/YL
A169
18
RD/YL
F20
20
WT
11
C106
(IN PDC)
86
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
(4.7L)
(8W-21-2)
85
A169
18
RD/YL
86
REAR
WINDOW
DEFOGGER
RELAY
(8W-48-2)
85
8
TRANSMISSION
CONTROL
MODULE
(4.7L)
(8W-31-8)

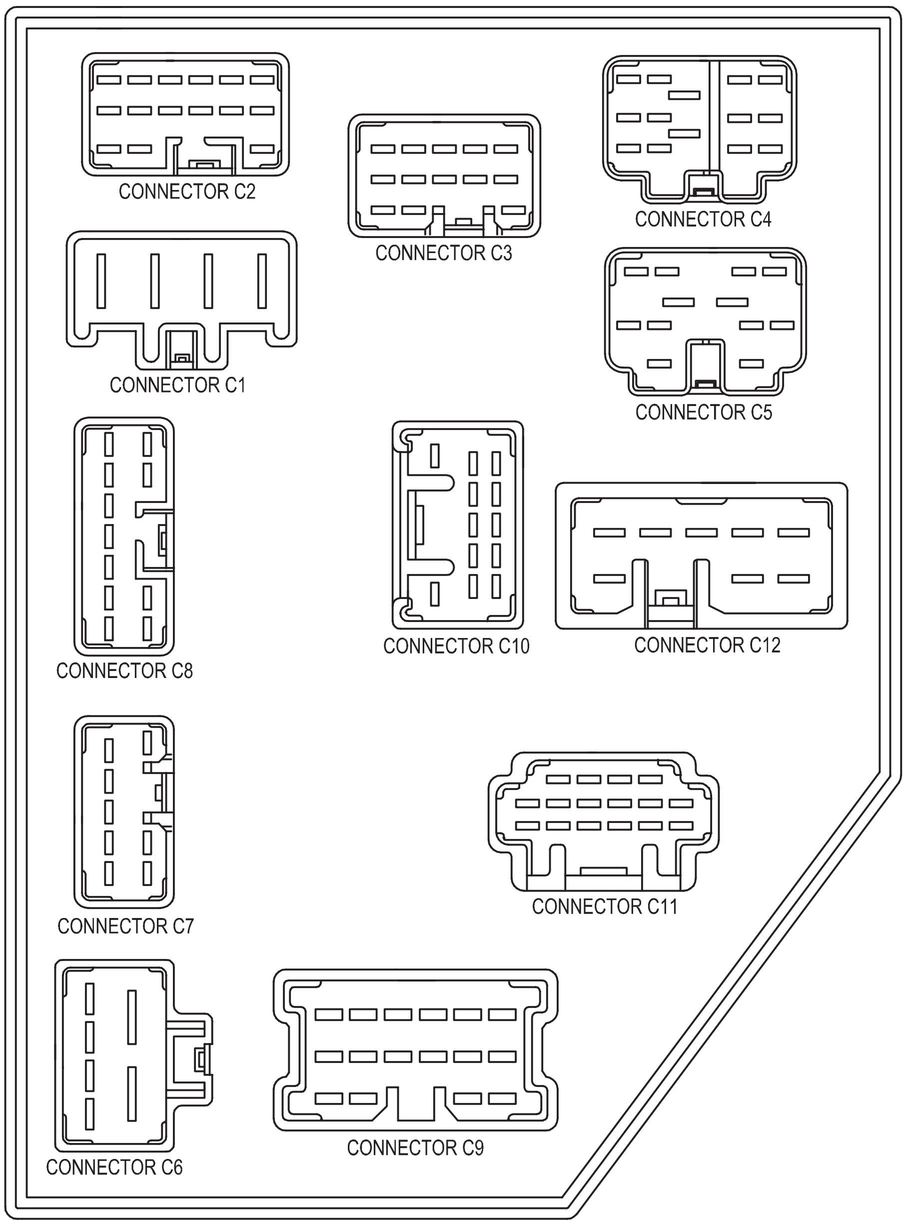

CLOCKSPRING
(8W-33-3)
4 C1
K4
20
BK/LB
29 C200
K4
18
BK/LB
10
BATTERY
TEMPERATURE
SENSOR
(8W-30-24)
1
K4
18
BK/LB
9
FUEL
PUMP
MODULE
(8W-30-4)
2
K4
18
BK/LB
11 C352
K4
18
BK/LB
7
JOINT
CONNECTOR
NO. 3
(IN PDC)
8
K4
18
BK/LB
21 C106
(IN PDC)
K4
18
BK/LB
S103
(8W-70-3)
K4
18
BK/LB
S101
(8W-70-4)
K4
18
BK/LB
4 C1
POWERTRAIN
CONTROL
MODULE
(8W-30-4)
(8W-30-24)
11
K4
18
BK/LB
1
A/C
PRESSURE
TRANSDUCER
(8W-42-7)

8W-12 JUNCTION BLOCK

JUNCTION BLOCK
(FRONT VIEW)



JUNCTION BLOCK
(REAR VIEW)



FUSES

FUSE	AMPS	FUSED CIRCUIT	FUNCTION
1	15A	INTERNAL	FUSED B(+)
2	20A	INTERNAL	FUSED B(+)
3	-	-	-
4	20A	INTERNAL	FUSED B(+)
5	20A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
6	-	-	-
7	-	-	-
8	10A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
9	5A	INTERNAL	FUSED HEADLAMP SWITCH OUTPUT
10	10A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
11	10A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
12	10A	A169 18RD/YL	FUSED IGNITION SWITCH OUTPUT (START)
13	15A	F75 18VT	FUSED B(+)
14	10A	F15 18DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
15	10A	INTERNAL	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
16	-	-	-
17	15A	F38 16RD/TN	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
18	10A	X12 16RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
19	10A	L5 18BK	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
20	10A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
21	10A	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
22	-	-	-
23	-	-	-
24	15A	F20 20WT	FUSED IGNITION SWITCH OUTPUT (RUN)
25	10A	F24 20RD/DG	FUSED IGNITION SWITCH OUTPUT (RUN)
26	15A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN)
27	10A	A20 20RD/DB	FUSED IGNITION SWITCH OUTPUT (RUN)

CIRCUIT BREAKER

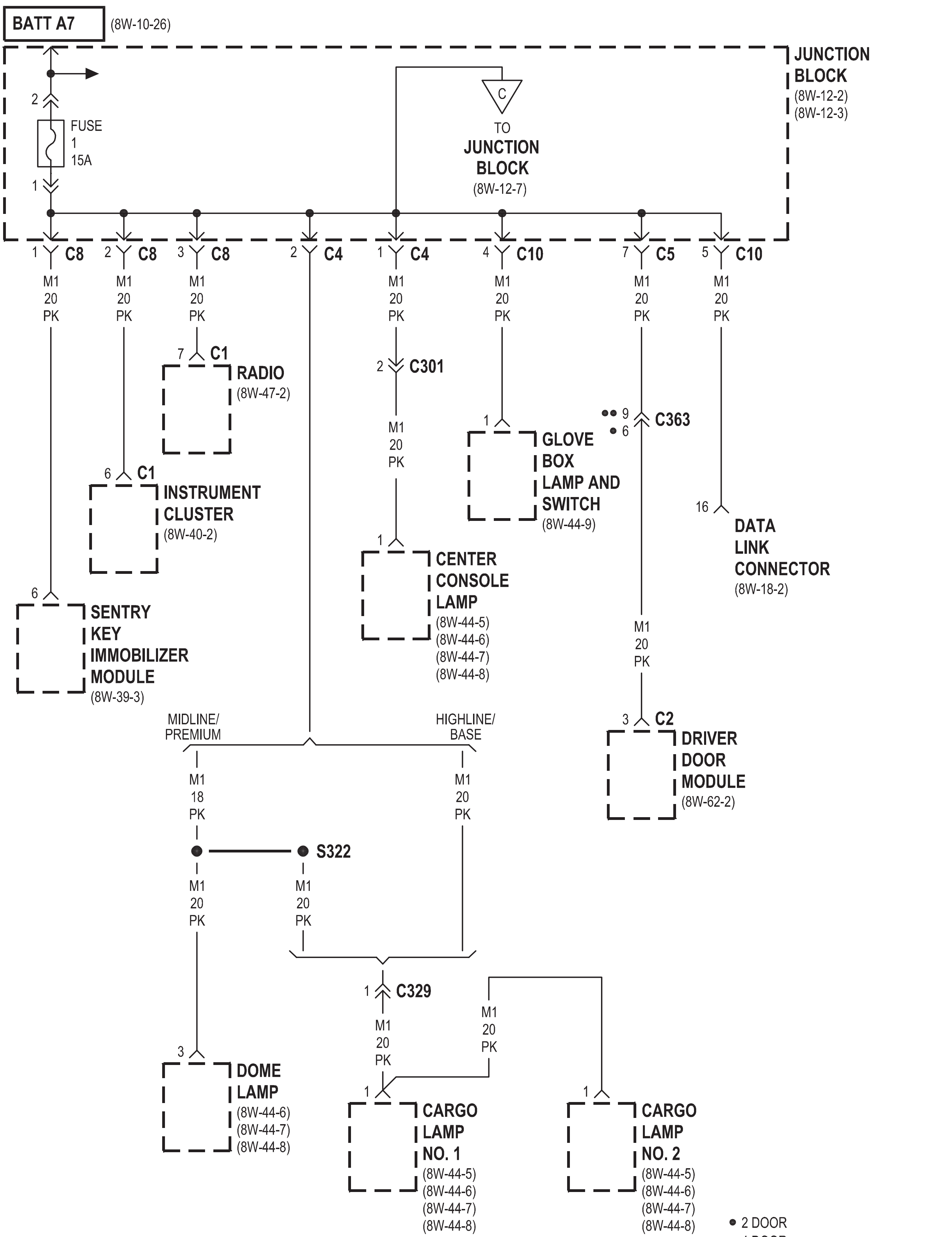
CB NO.	AMPS	FUSED CIRCUIT	FUNCTION
28	25A	F21 12TN	FUSED IGNITION SWITCH OUTPUT (RUN)
29	-	-	-

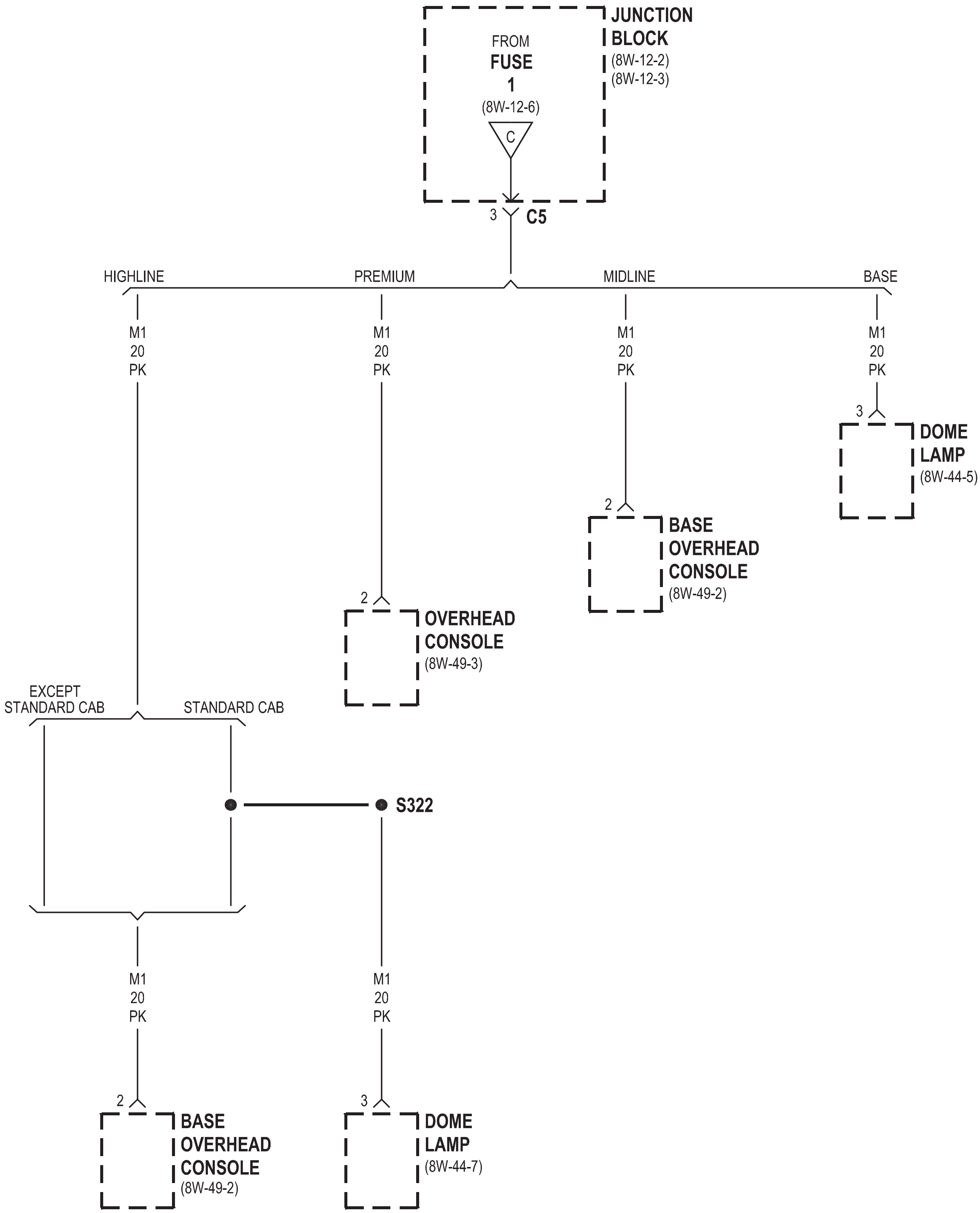
HORN RELAY

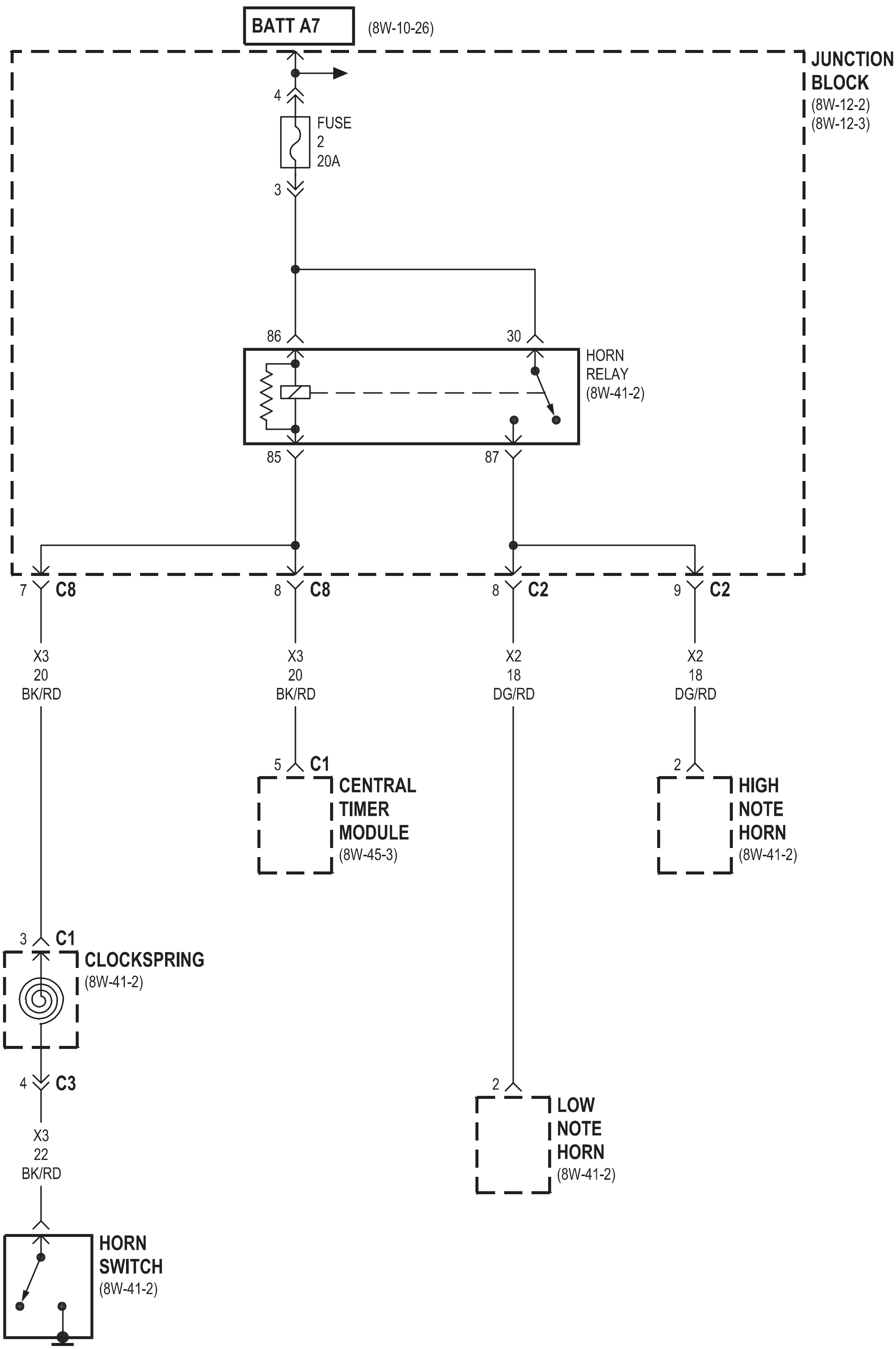
CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	HORN RELAY CONTROL
86	INTERNAL	FUSED B(+)
87	INTERNAL	HORN RELAY OUTPUT
87A	-	-

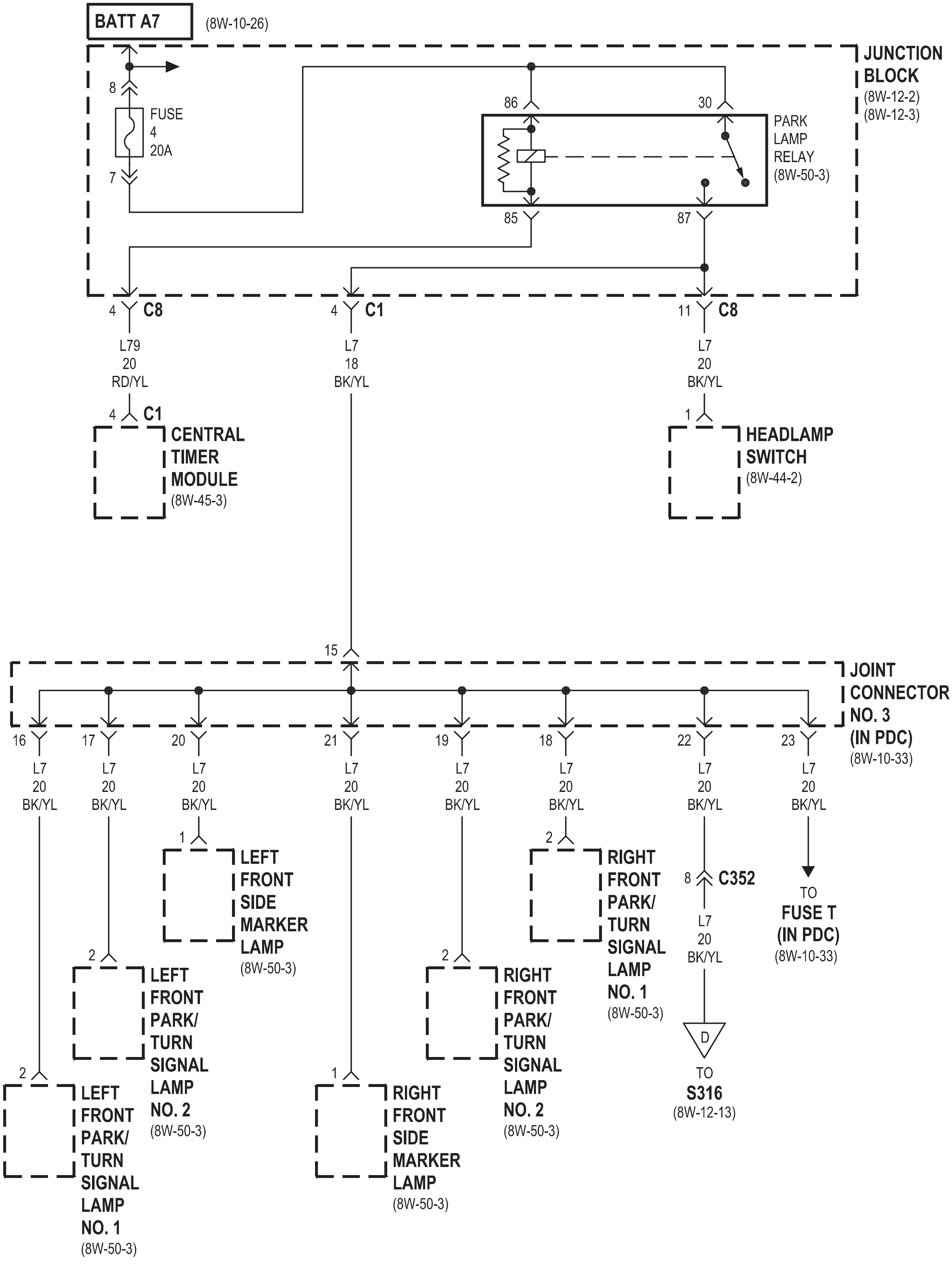
PARK LAMP RELAY

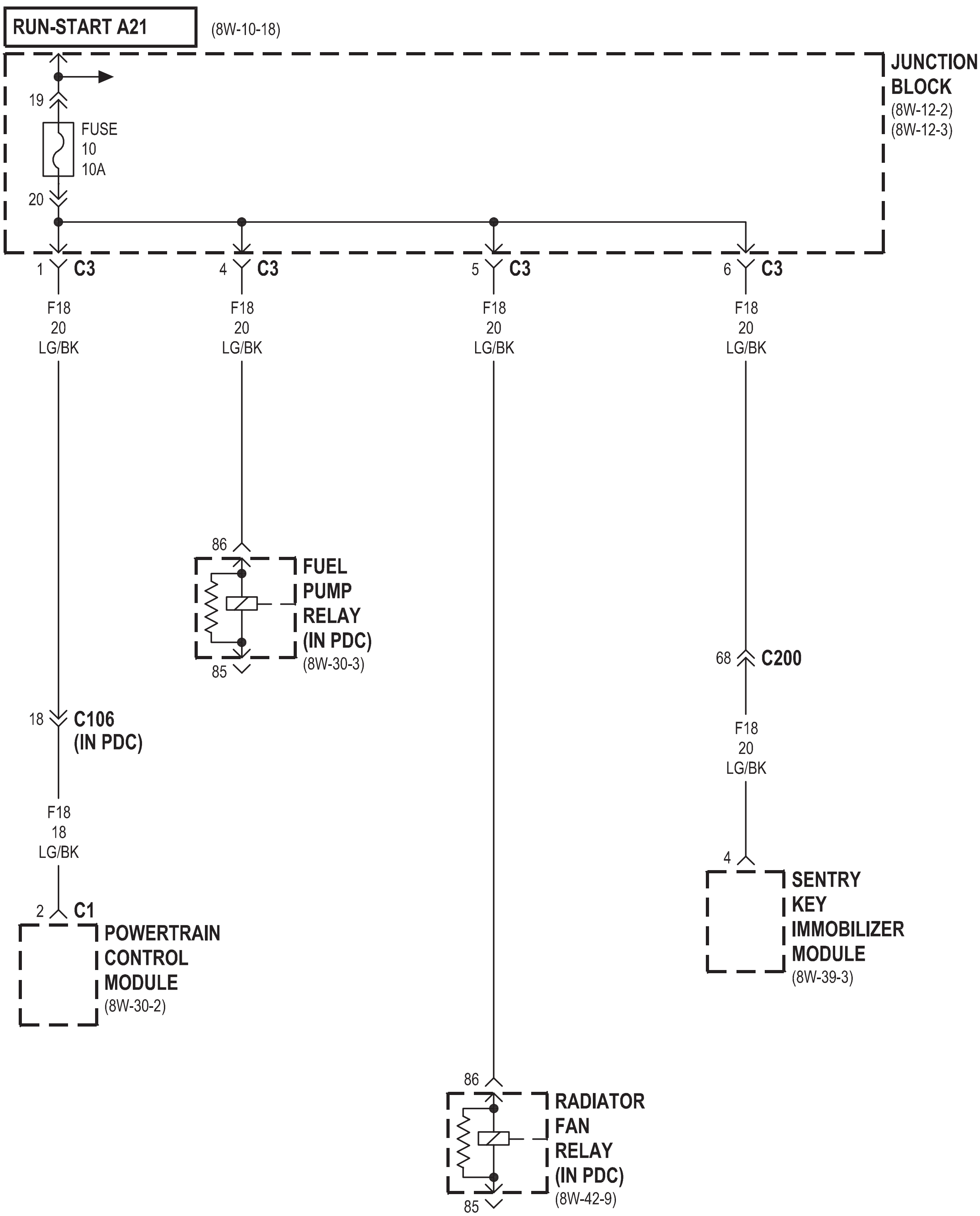
CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	L79 20RD/YL	PARK LAMP RELAY CONTROL
86	INTERNAL	FUSED B(+)
87	INTERNAL	PARK LAMP RELAY OUTPUT
87A	-	-

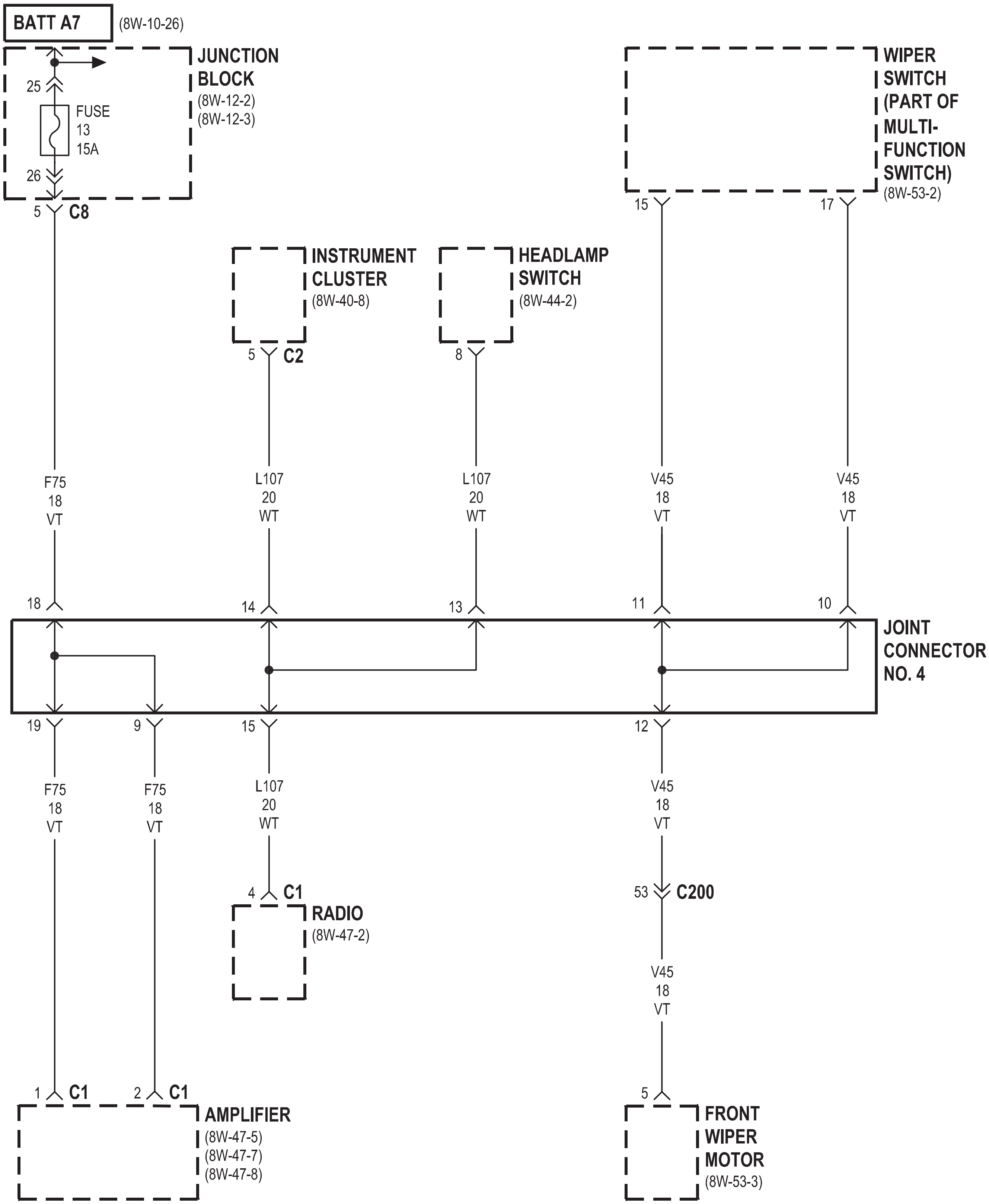

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FUSE 1 15A
C
TO JUNCTION BLOCK
(8W-12-7)
C8
C4
C10
C5
M1 20 PK
C1
RADIO
(8W-47-2)
C301
INSTRUMENT CLUSTER
(8W-40-2)
GLOVE BOX LAMP AND SWITCH
(8W-44-9)
C363
DATA LINK CONNECTOR
(8W-18-2)
CENTER CONSOLE LAMP
(8W-44-5)
(8W-44-6)
(8W-44-7)
(8W-44-8)
SENTRY KEY IMMOBILIZER MODULE
(8W-39-3)
MIDLINE/ PREMIUM
HIGHLINE/ BASE
C2
DRIVER DOOR MODULE
(8W-62-2)
M1 18 PK
S322
C329
DOME LAMP
(8W-44-6)
(8W-44-7)
(8W-44-8)
CARGO LAMP NO. 1
(8W-44-5)
(8W-44-6)
(8W-44-7)
(8W-44-8)
CARGO LAMP NO. 2
(8W-44-5)
(8W-44-6)
(8W-44-7)
(8W-44-8)
• 2 DOOR
•• 4 DOOR

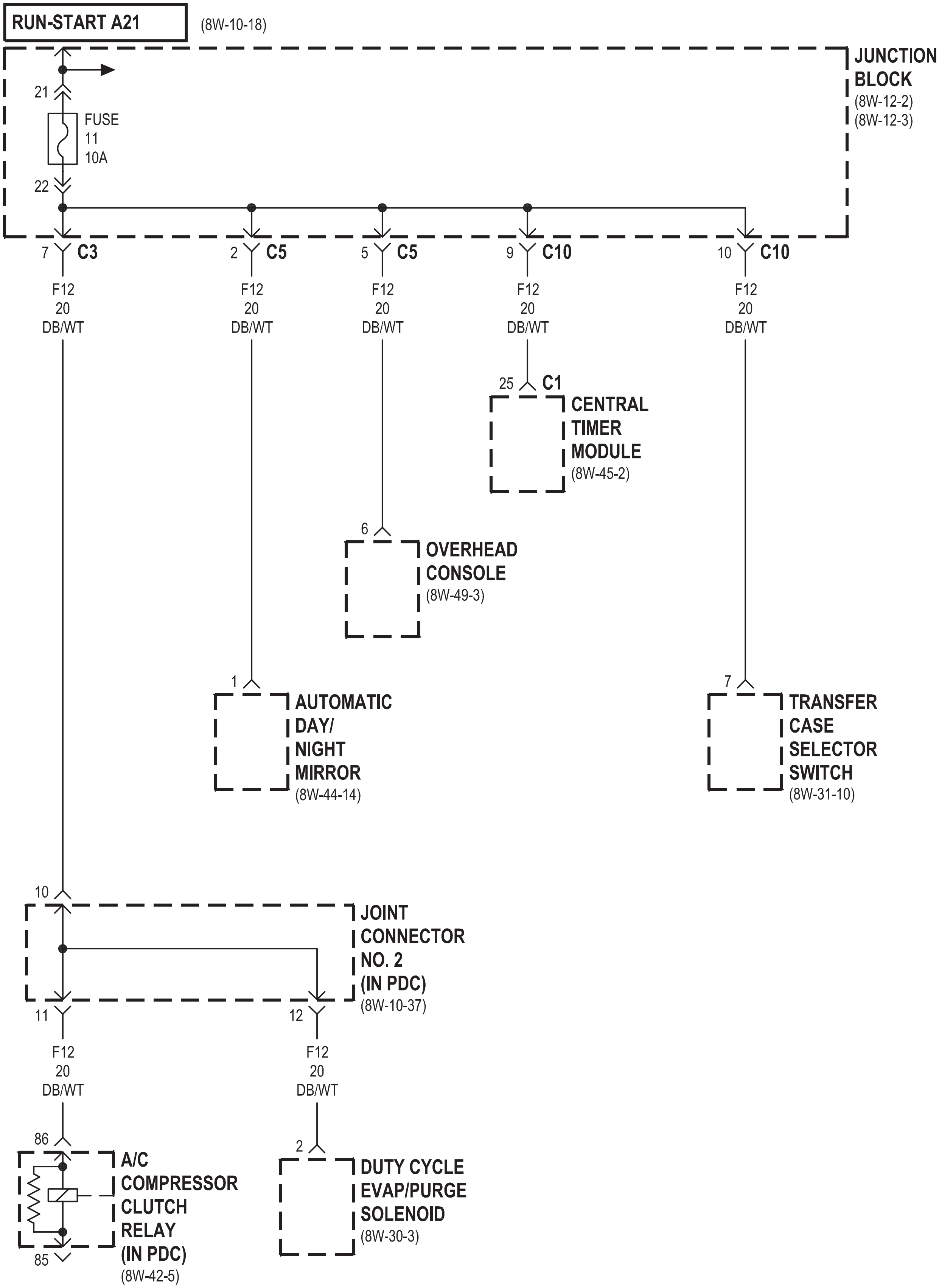

JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
FROM
FUSE
1
(8W-12-6)
C
3
C5
HIGHLINE
PREMIUM
MIDLINE
BASE
M1
20
PK
M1
20
PK
M1
20
PK
M1
20
PK
3
DOME
LAMP
(8W-44-5)
2
BASE
OVERHEAD
CONSOLE
(8W-49-2)
2
OVERHEAD
CONSOLE
(8W-49-3)
EXCEPT
STANDARD CAB
STANDARD CAB
S322
M1
20
PK
M1
20
PK
2
BASE
OVERHEAD
CONSOLE
(8W-49-2)
3
DOME
LAMP
(8W-44-7)

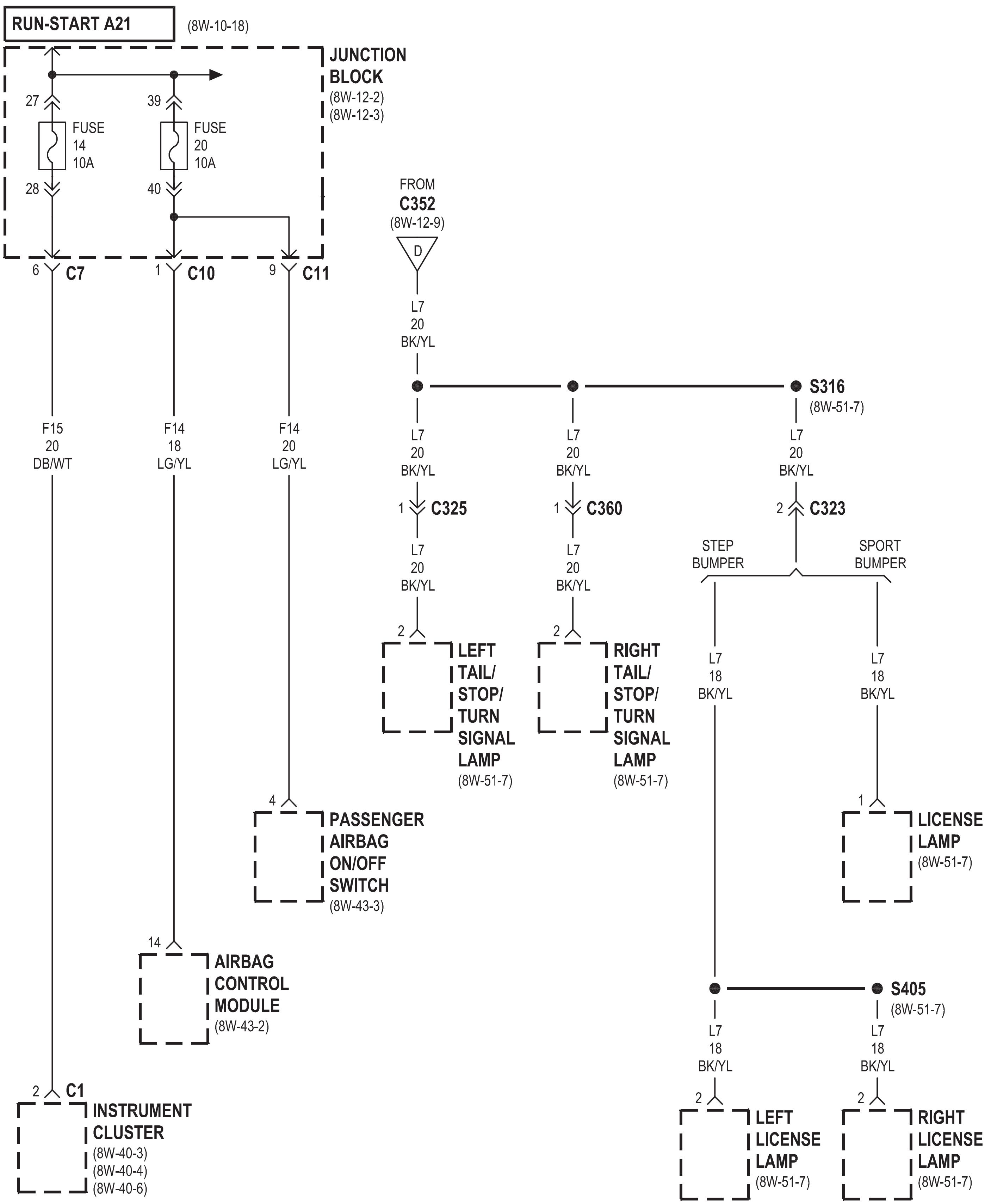

BATT A7
(8W-10-26)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
4
FUSE
2
20A
3
86
30
HORN
RELAY
(8W-41-2)
85
87
7
C8
8
C8
8
C2
9
C2
X3
20
BK/RD
X3
20
BK/RD
X2
18
DG/RD
X2
18
DG/RD
5
C1
CENTRAL
TIMER
MODULE
(8W-45-3)
2
HIGH
NOTE
HORN
(8W-41-2)
3
C1
CLOCKSPRING
(8W-41-2)
4
C3
X3
22
BK/RD
2
LOW
NOTE
HORN
(8W-41-2)
HORN
SWITCH
(8W-41-2)

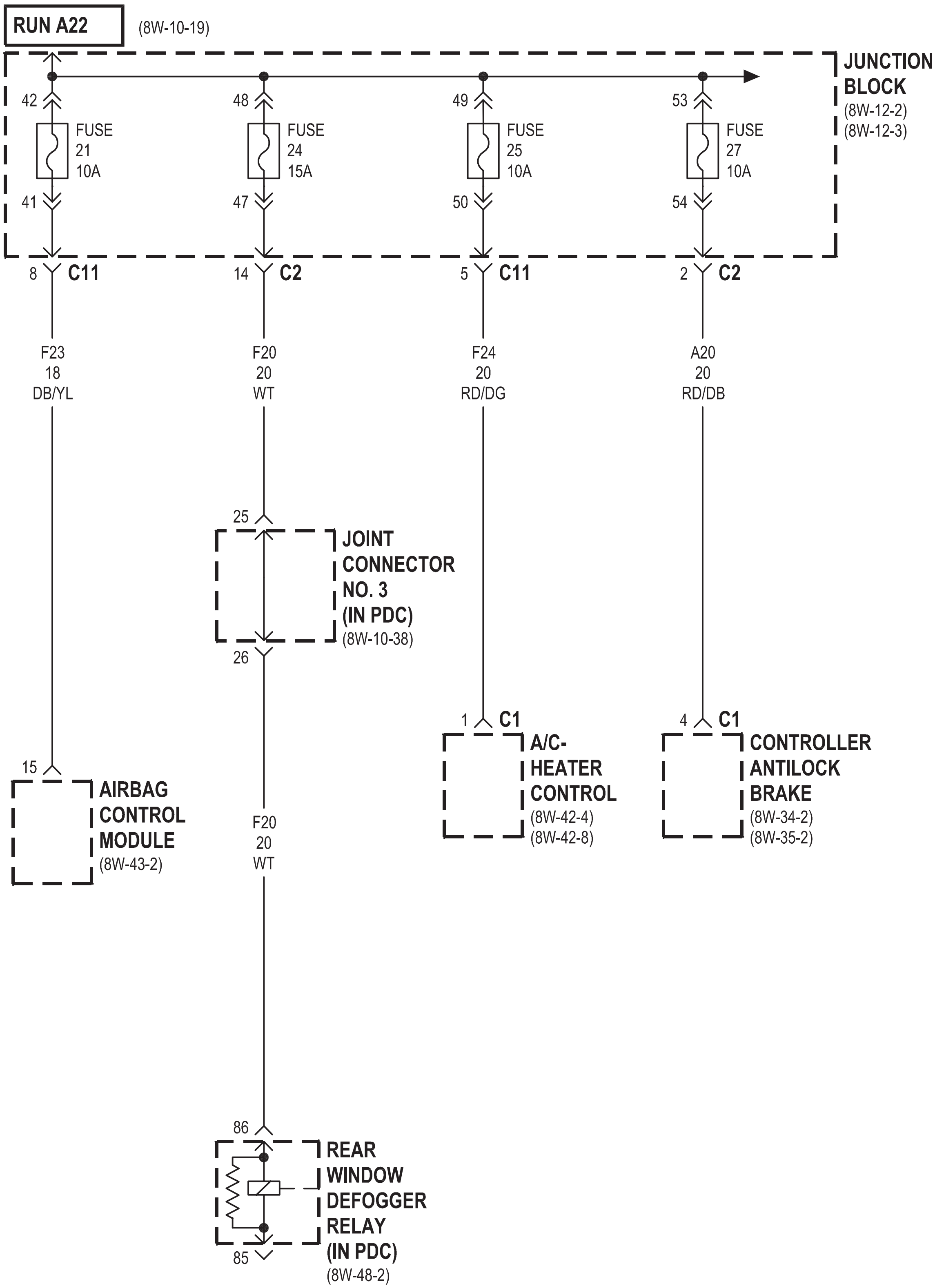

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
8
FUSE 4 20A
7
86
30
PARK LAMP RELAY
(8W-50-3)
85
87
4 C8
4 C1
11 C8
L79 20 RD/YL
L7 18 BK/YL
L7 20 BK/YL
4 C1
CENTRAL TIMER MODULE
(8W-45-3)
1
HEADLAMP SWITCH
(8W-44-2)
15
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-33)
16
17
20
21
19
18
22
23
L7 20 BK/YL
1
LEFT FRONT SIDE MARKER LAMP
(8W-50-3)
2
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 1
(8W-50-3)
8 C352
TO FUSE T (IN PDC)
(8W-10-33)
2
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 2
(8W-50-3)
2
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 2
(8W-50-3)
D
TO S316
(8W-12-13)
2
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 1
(8W-50-3)
1
RIGHT FRONT SIDE MARKER LAMP
(8W-50-3)

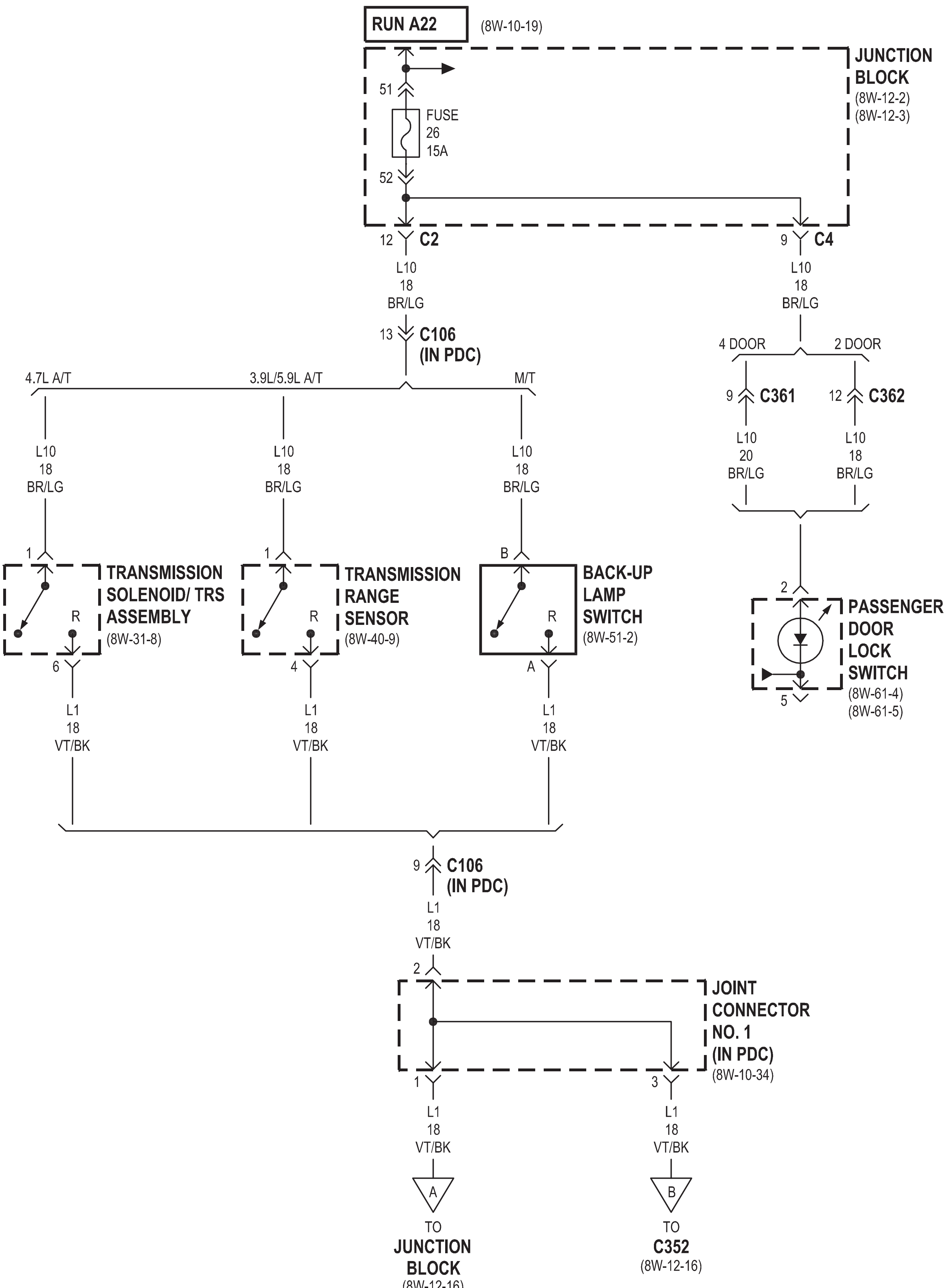

RUN-START A21
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
19
FUSE
10
10A
20
1 C3
4 C3
5 C3
6 C3
F18
20
LG/BK
86
FUEL PUMP RELAY (IN PDC)
(8W-30-3)
85
68 C200
18 C106 (IN PDC)
F18
18
LG/BK
2 C1
POWERTRAIN CONTROL MODULE
(8W-30-2)
4
SENTRY KEY IMMOBILIZER MODULE
(8W-39-3)
86
RADIATOR FAN RELAY (IN PDC)
(8W-42-9)
85

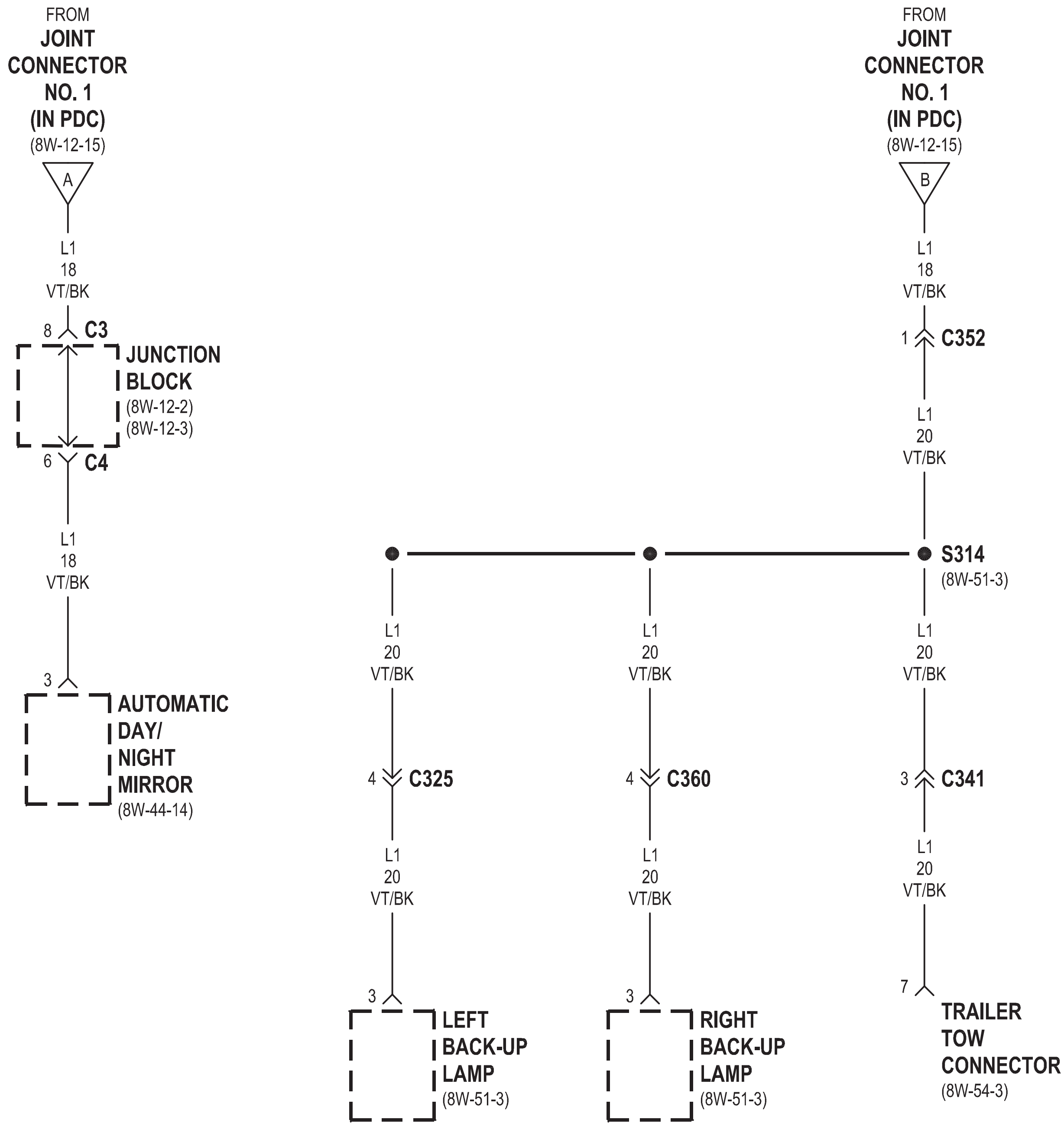

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
25
FUSE 13 15A
26
5 C8
F75 18 VT
INSTRUMENT CLUSTER
(8W-40-8)
5 C2
L107 20 WT
HEADLAMP SWITCH
(8W-44-2)
8
L107 20 WT
WIPER SWITCH (PART OF MULTI-FUNCTION SWITCH)
(8W-53-2)
15
17
V45 18 VT
V45 18 VT
18
14
13
11
10
JOINT CONNECTOR NO. 4
19
9
15
12
F75 18 VT
F75 18 VT
L107 20 WT
V45 18 VT
4 C1
RADIO
(8W-47-2)
53 C200
V45 18 VT
1 C1
2 C1
AMPLIFIER
(8W-47-5)
(8W-47-7)
(8W-47-8)
5
FRONT WIPER MOTOR
(8W-53-3)

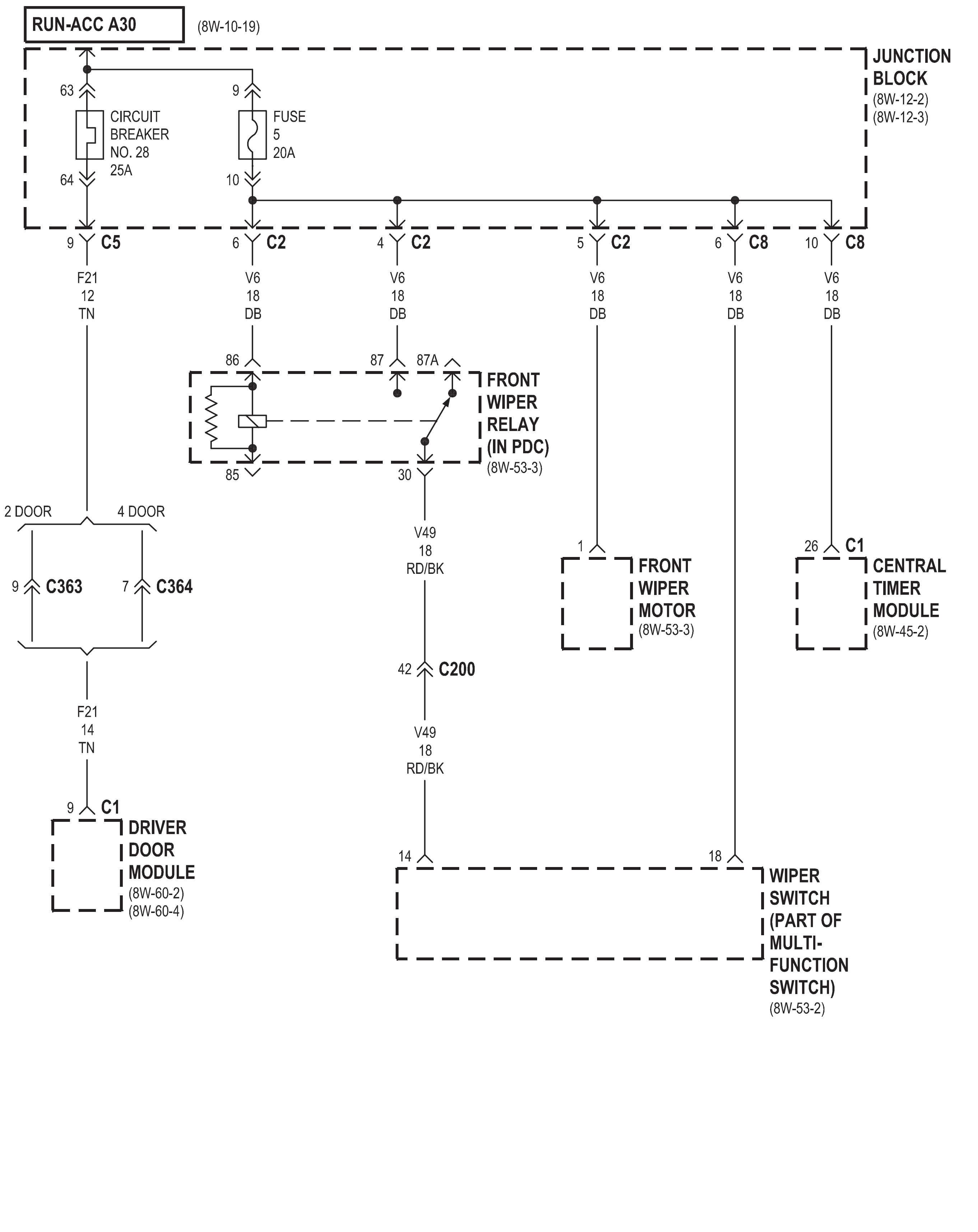

RUN-START A21
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
21
FUSE
11
10A
22
7 C3
2 C5
5 C5
9 C10
10 C10
F12
20
DB/WT
25 C1
CENTRAL TIMER MODULE
(8W-45-2)
6
OVERHEAD CONSOLE
(8W-49-3)
1
AUTOMATIC DAY/ NIGHT MIRROR
(8W-44-14)
7
TRANSFER CASE SELECTOR SWITCH
(8W-31-10)
10
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-37)
11
12
86
A/C COMPRESSOR CLUTCH RELAY (IN PDC)
85
(8W-42-5)
2
DUTY CYCLE EVAP/PURGE SOLENOID
(8W-30-3)

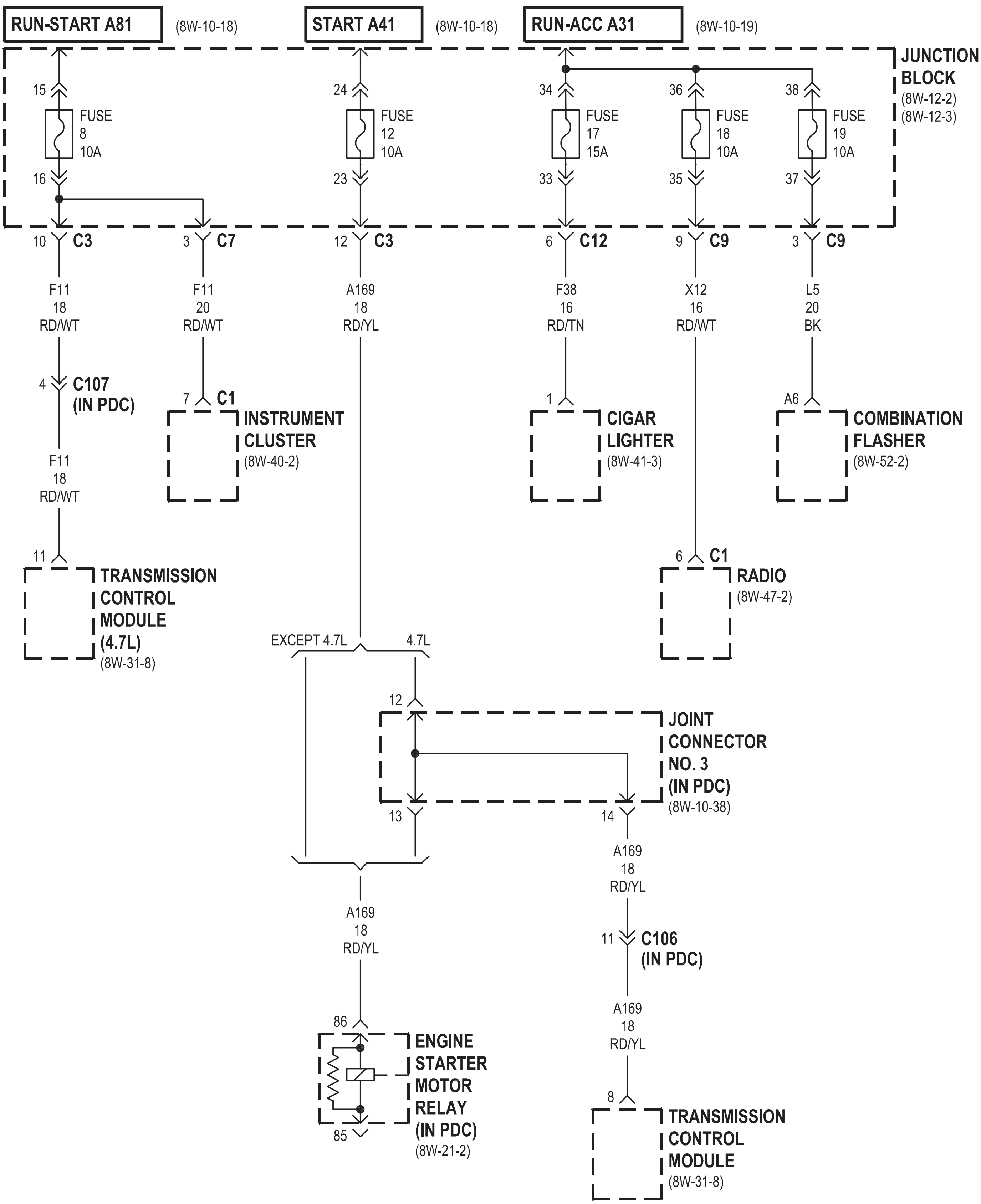

RUN-START A21
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
27
39
FUSE 14 10A
FUSE 20 10A
28
40
6 C7
1 C10
9 C11
F15 20 DB/WT
F14 18 LG/YL
F14 20 LG/YL
FROM C352
(8W-12-9)
D
L7 20 BK/YL
S316
(8W-51-7)
1 C325
1 C360
2 C323
STEP BUMPER
SPORT BUMPER
L7 18 BK/YL
2
LEFT TAIL/ STOP/ TURN SIGNAL LAMP
(8W-51-7)
RIGHT TAIL/ STOP/ TURN SIGNAL LAMP
(8W-51-7)
4
PASSENGER AIRBAG ON/OFF SWITCH
(8W-43-3)
1
LICENSE LAMP
(8W-51-7)
14
AIRBAG CONTROL MODULE
(8W-43-2)
S405
(8W-51-7)
2 C1
INSTRUMENT CLUSTER
(8W-40-3)
(8W-40-4)
(8W-40-6)
LEFT LICENSE LAMP
(8W-51-7)
RIGHT LICENSE LAMP
(8W-51-7)

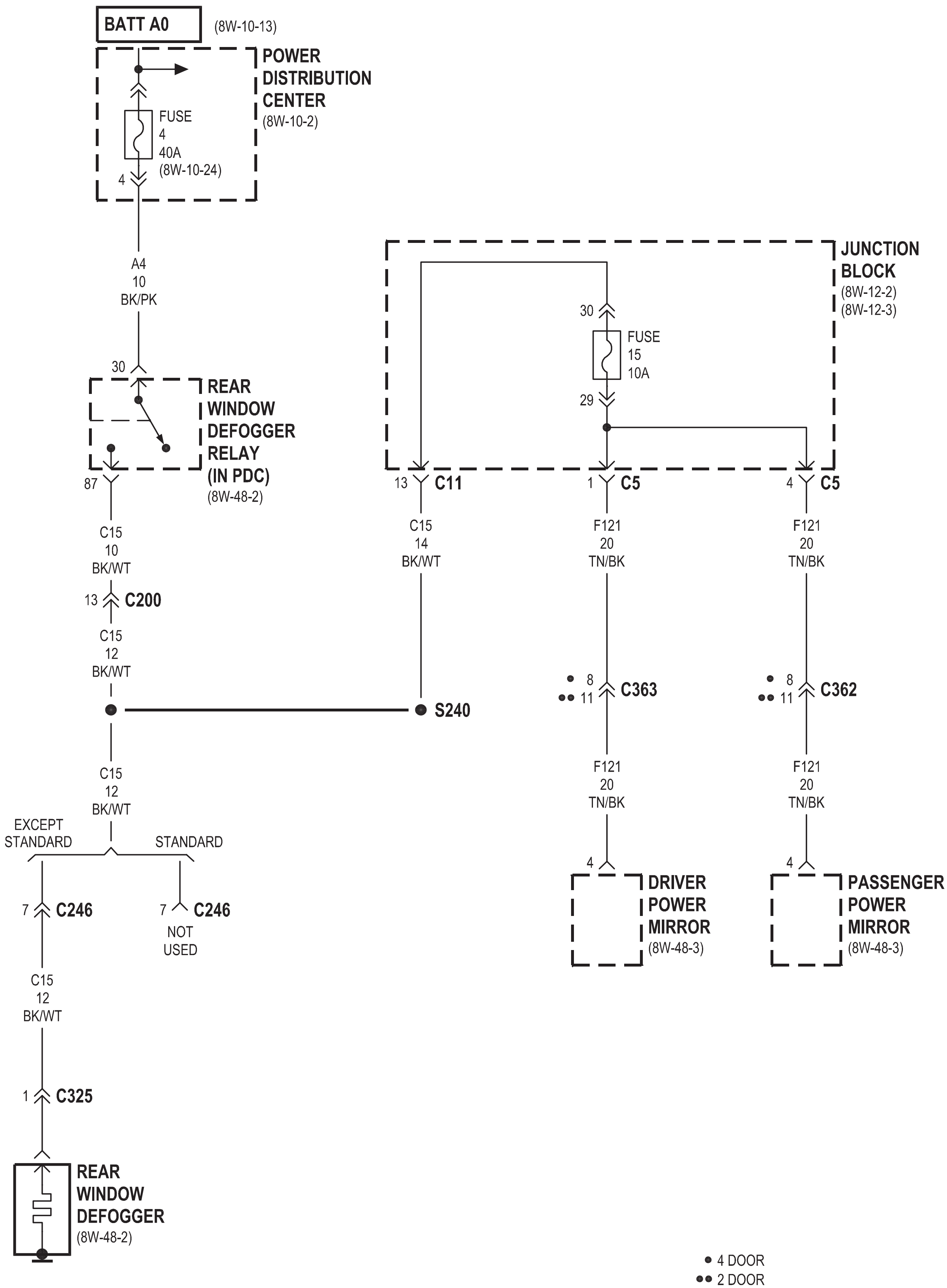

RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
42
FUSE 21 10A
41
48
FUSE 24 15A
47
49
FUSE 25 10A
50
53
FUSE 27 10A
54
8 C11
14 C2
5 C11
2 C2
F23 18 DB/YL
F20 20 WT
F24 20 RD/DG
A20 20 RD/DB
25
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-38)
26
1 C1
A/C-HEATER CONTROL
(8W-42-4)
(8W-42-8)
4 C1
CONTROLLER ANTILOCK BRAKE
(8W-34-2)
(8W-35-2)
15
AIRBAG CONTROL MODULE
(8W-43-2)
F20 20 WT
86
REAR WINDOW DEFOGGER RELAY (IN PDC)
(8W-48-2)
85

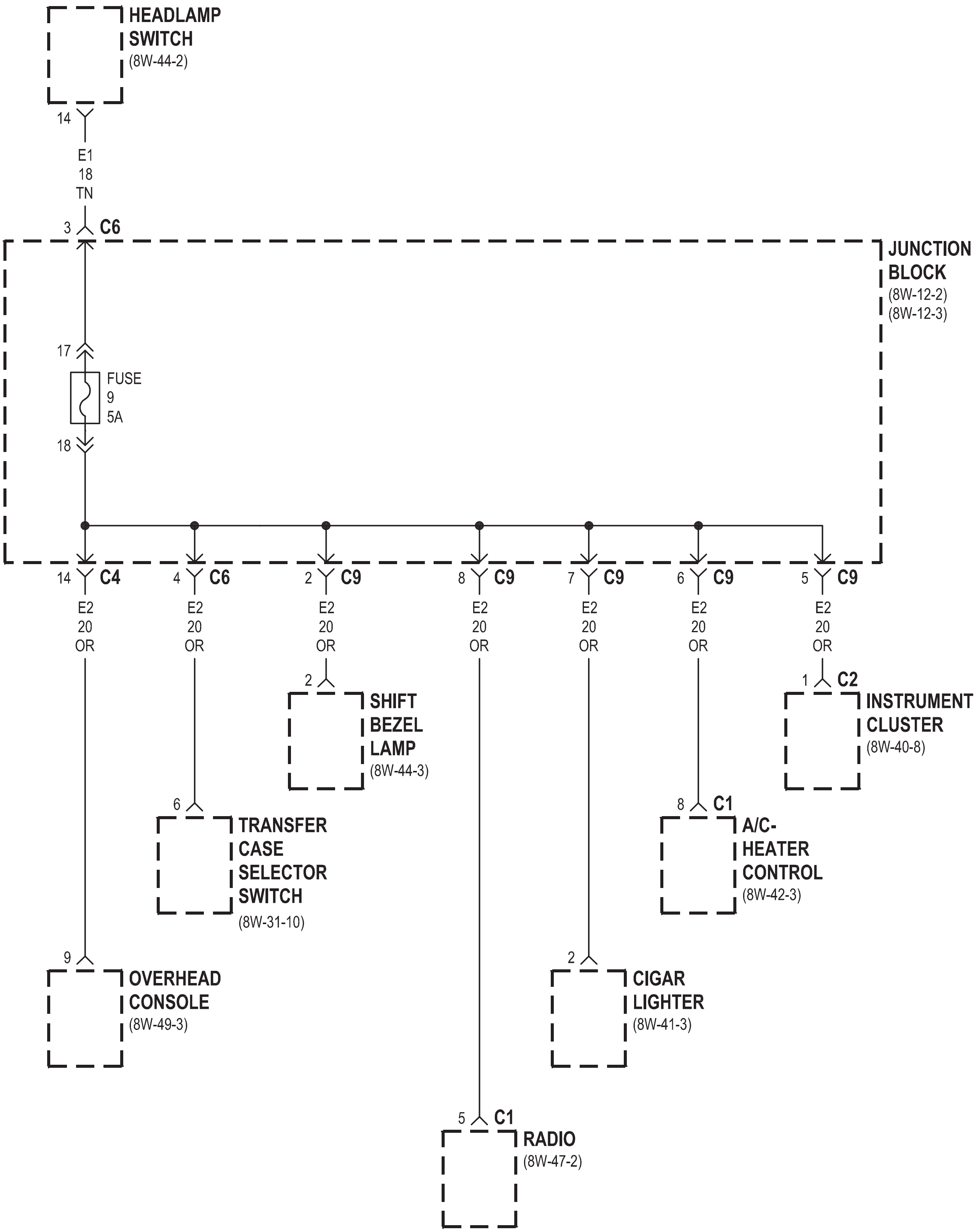

RUN A22
(8W-10-19)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
51
FUSE
26
15A
52
12
C2
9
C4
L10
18
BR/LG
L10
18
BR/LG
13
C106
(IN PDC)
4 DOOR
2 DOOR
4.7L A/T
3.9L/5.9L A/T
M/T
9
C361
12
C362
L10
20
BR/LG
L10
18
BR/LG
L10
18
BR/LG
L10
18
BR/LG
L10
18
BR/LG
1
TRANSMISSION
SOLENOID/ TRS
ASSEMBLY
(8W-31-8)
R
6
1
TRANSMISSION
RANGE
SENSOR
(8W-40-9)
R
4
B
BACK-UP
LAMP
SWITCH
(8W-51-2)
R
A
2
PASSENGER
DOOR
LOCK
SWITCH
(8W-61-4)
(8W-61-5)
5
L1
18
VT/BK
L1
18
VT/BK
L1
18
VT/BK
9
C106
(IN PDC)
L1
18
VT/BK
2
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-10-34)
1
3
L1
18
VT/BK
L1
18
VT/BK
A
TO
JUNCTION
BLOCK
(8W-12-16)
B
TO
C352
(8W-12-16)

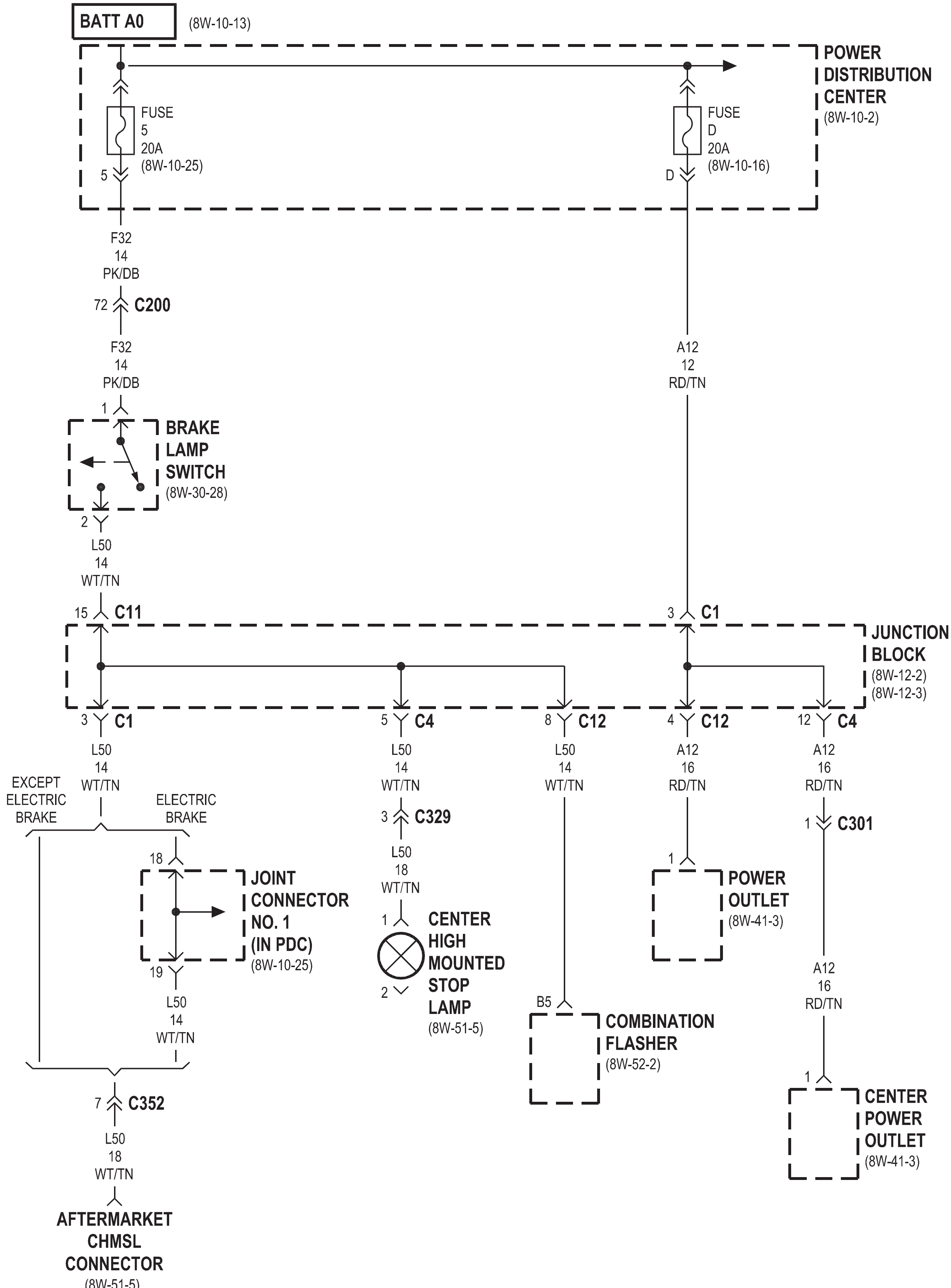

FROM
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-12-15)
A
L1
18
VT/BK
8
C3
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
6
C4
L1
18
VT/BK
3
AUTOMATIC DAY/ NIGHT MIRROR
(8W-44-14)
FROM
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-12-15)
B
L1
18
VT/BK
1
C352
L1
20
VT/BK
S314
(8W-51-3)
L1
20
VT/BK
4
C325
L1
20
VT/BK
3
LEFT BACK-UP LAMP
(8W-51-3)
L1
20
VT/BK
4
C360
L1
20
VT/BK
3
RIGHT BACK-UP LAMP
(8W-51-3)
L1
20
VT/BK
3
C341
L1
20
VT/BK
7
TRAILER TOW CONNECTOR
(8W-54-3)

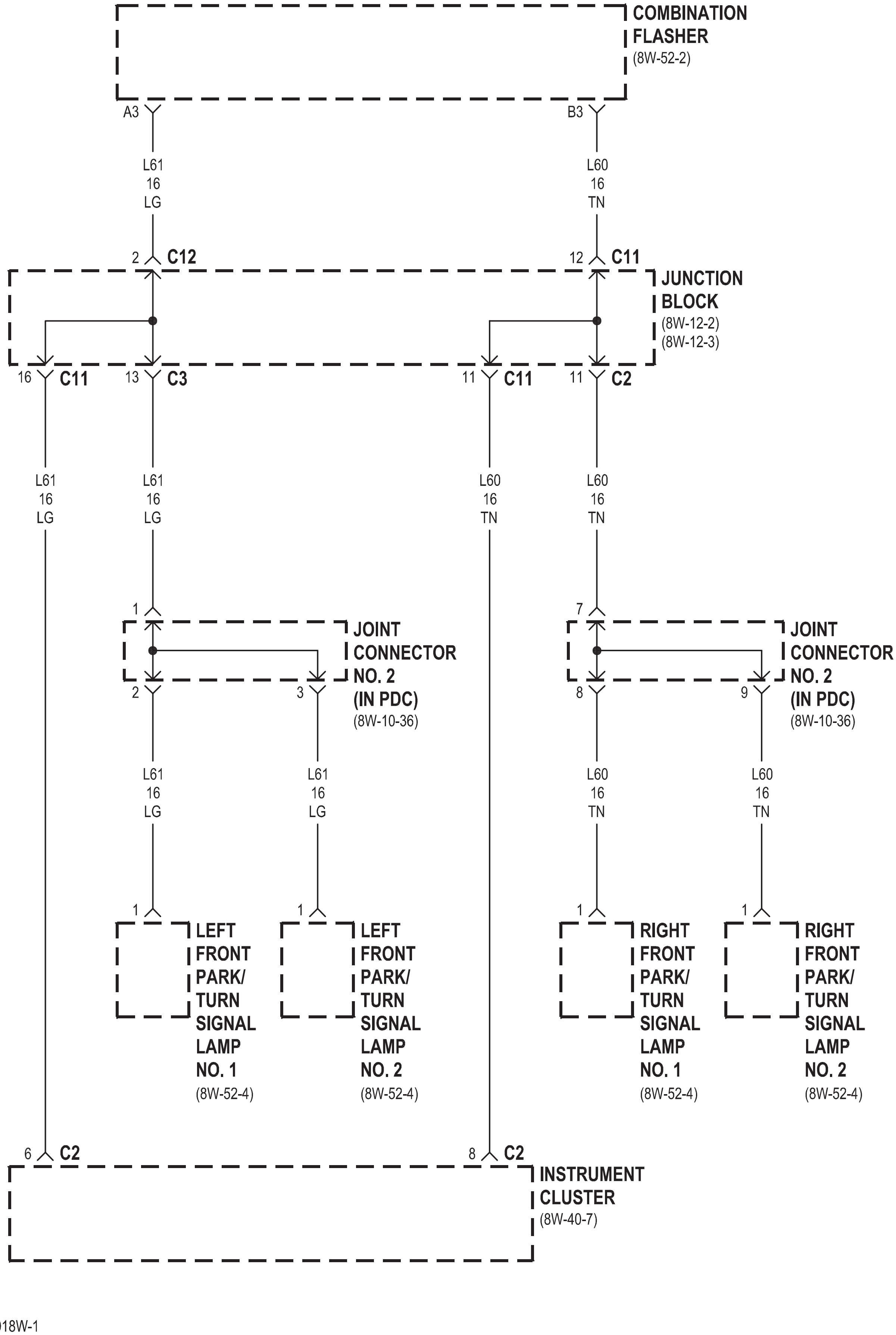

RUN-ACC A30
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
63
CIRCUIT BREAKER NO. 28 25A
64
9
FUSE 5 20A
10
9 C5
6 C2
4 C2
5 C2
6 C8
10 C8
F21 12 TN
V6 18 DB
V6 18 DB
V6 18 DB
V6 18 DB
V6 18 DB
86
87
87A
FRONT WIPER RELAY (IN PDC)
(8W-53-3)
85
30
2 DOOR
4 DOOR
9 C363
7 C364
V49 18 RD/BK
1
FRONT WIPER MOTOR
(8W-53-3)
26 C1
CENTRAL TIMER MODULE
(8W-45-2)
42 C200
F21 14 TN
V49 18 RD/BK
9 C1
DRIVER DOOR MODULE
(8W-60-2)
(8W-60-4)
14
18
WIPER SWITCH (PART OF MULTI-FUNCTION SWITCH)
(8W-53-2)


RUN-START A81
(8W-10-18)
START A41
(8W-10-18)
RUN-ACC A31
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FUSE 8 10A
FUSE 12 10A
FUSE 17 15A
FUSE 18 10A
FUSE 19 10A
15
16
24
23
34
33
36
35
38
37
10 C3
3 C7
12 C3
6 C12
9 C9
3 C9
F11 18 RD/WT
F11 20 RD/WT
A169 18 RD/YL
F38 16 RD/TN
X12 16 RD/WT
L5 20 BK
4 C107 (IN PDC)
7 C1
INSTRUMENT CLUSTER
(8W-40-2)
1
CIGAR LIGHTER
(8W-41-3)
A6
COMBINATION FLASHER
(8W-52-2)
F11 18 RD/WT
11
TRANSMISSION CONTROL MODULE (4.7L)
(8W-31-8)
6 C1
RADIO
(8W-47-2)
EXCEPT 4.7L
4.7L
12
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-38)
13
14
A169 18 RD/YL
A169 18 RD/YL
11 C106 (IN PDC)
A169 18 RD/YL
86
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-2)
85
8
TRANSMISSION CONTROL MODULE
(8W-31-8)

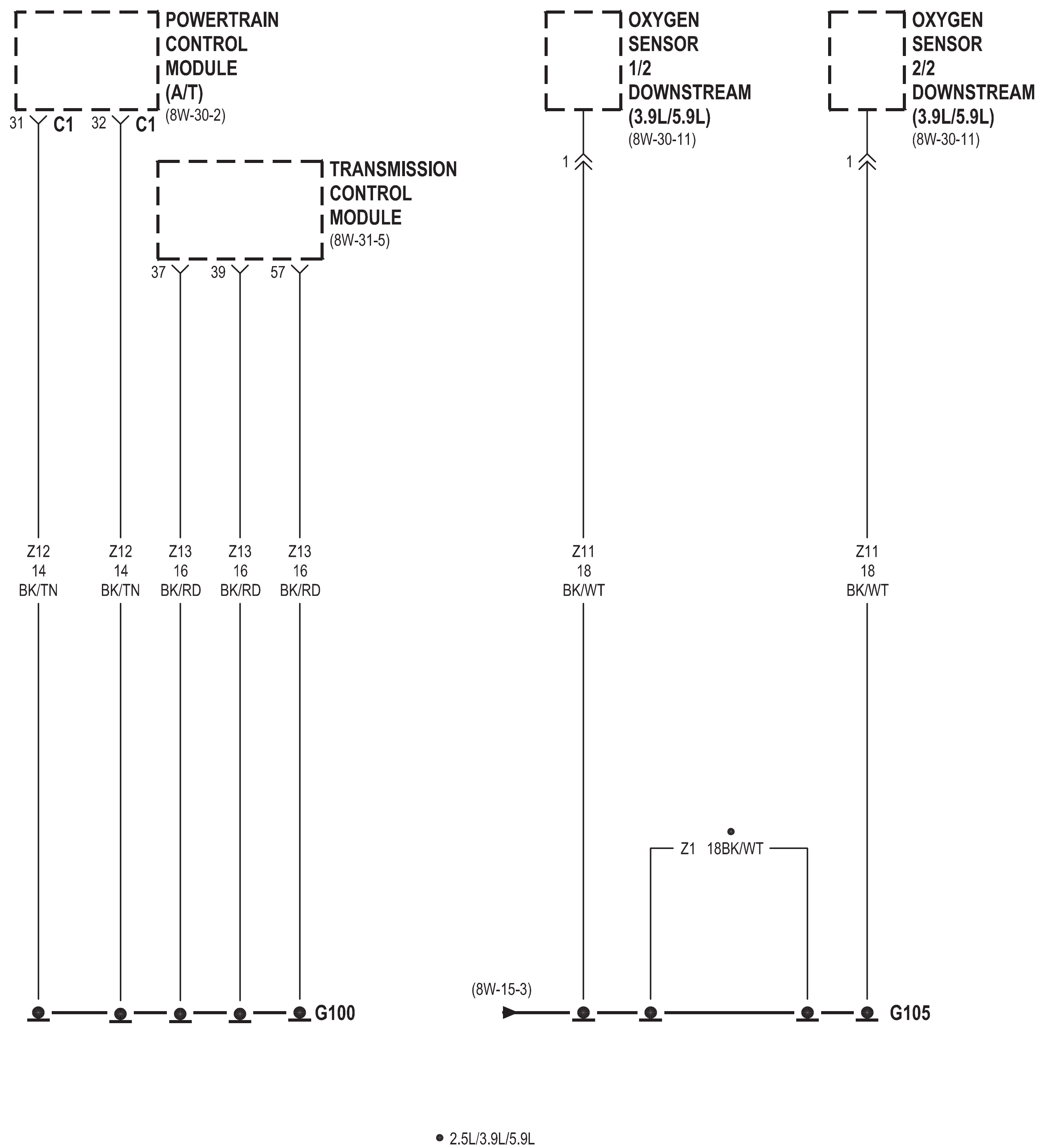

BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
4
40A
(8W-10-24)
4
A4
10
BK/PK
30
REAR WINDOW DEFOGGER RELAY (IN PDC)
(8W-48-2)
87
C15
10
BK/WT
13
C200
C15
12
BK/WT
S240
C15
12
BK/WT
EXCEPT STANDARD
STANDARD
7
C246
7
C246
NOT USED
C15
12
BK/WT
1
C325
REAR WINDOW DEFOGGER
(8W-48-2)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
30
FUSE
15
10A
29
13
C11
1
C5
4
C5
C15
14
BK/WT
F121
20
TN/BK
F121
20
TN/BK
8
11
C363
8
11
C362
F121
20
TN/BK
F121
20
TN/BK
4
DRIVER POWER MIRROR
(8W-48-3)
4
PASSENGER POWER MIRROR
(8W-48-3)
• 4 DOOR
•• 2 DOOR

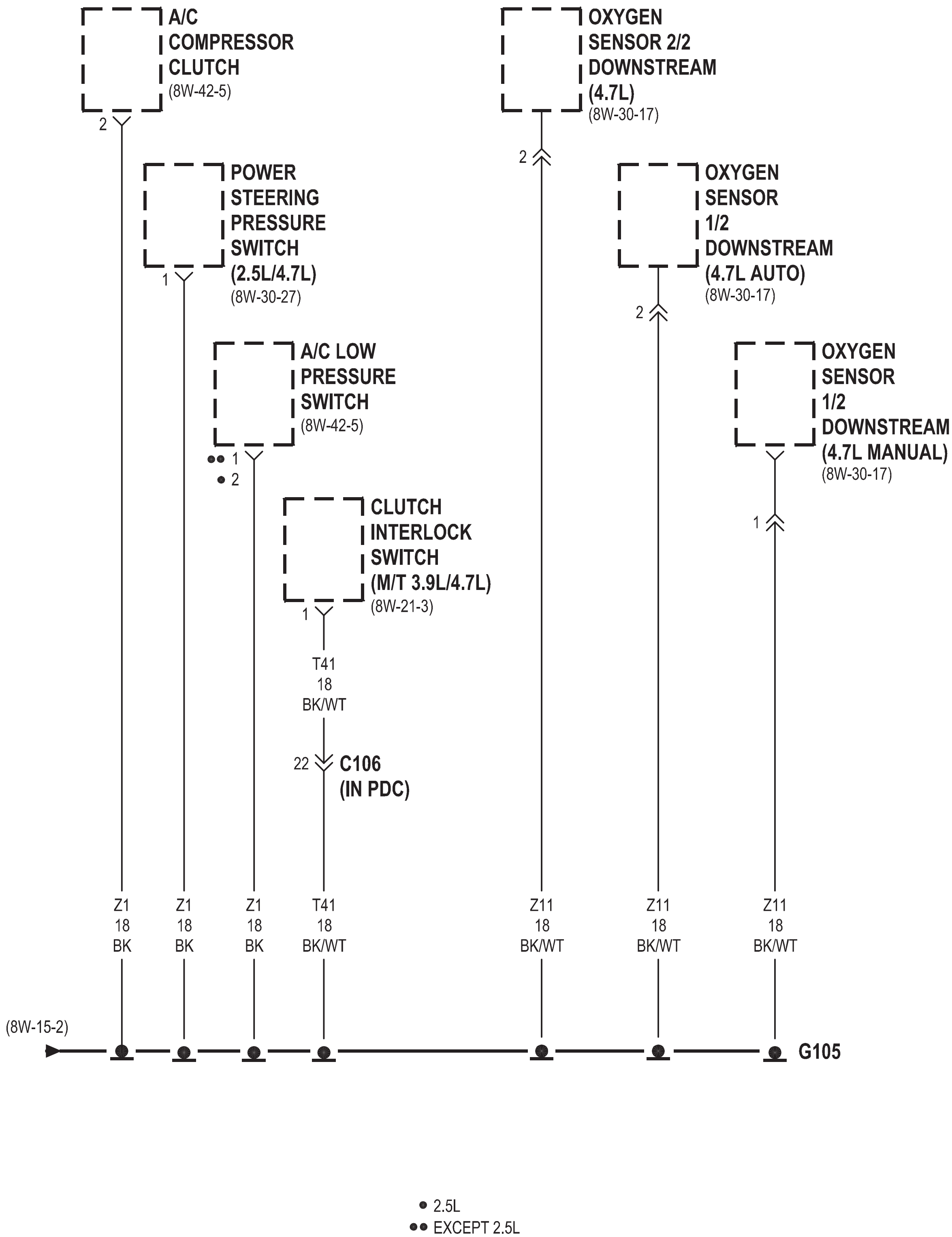

HEADLAMP SWITCH
(8W-44-2)
14
E1
18
TN
3
C6
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
17
FUSE
9
5A
18
14 C4
4 C6
2 C9
8 C9
7 C9
6 C9
5 C9
E2
20
OR
2
SHIFT BEZEL LAMP
(8W-44-3)
1 C2
INSTRUMENT CLUSTER
(8W-40-8)
6
TRANSFER CASE SELECTOR SWITCH
(8W-31-10)
8 C1
A/C-HEATER CONTROL
(8W-42-3)
9
OVERHEAD CONSOLE
(8W-49-3)
2
CIGAR LIGHTER
(8W-41-3)
5 C1
RADIO
(8W-47-2)

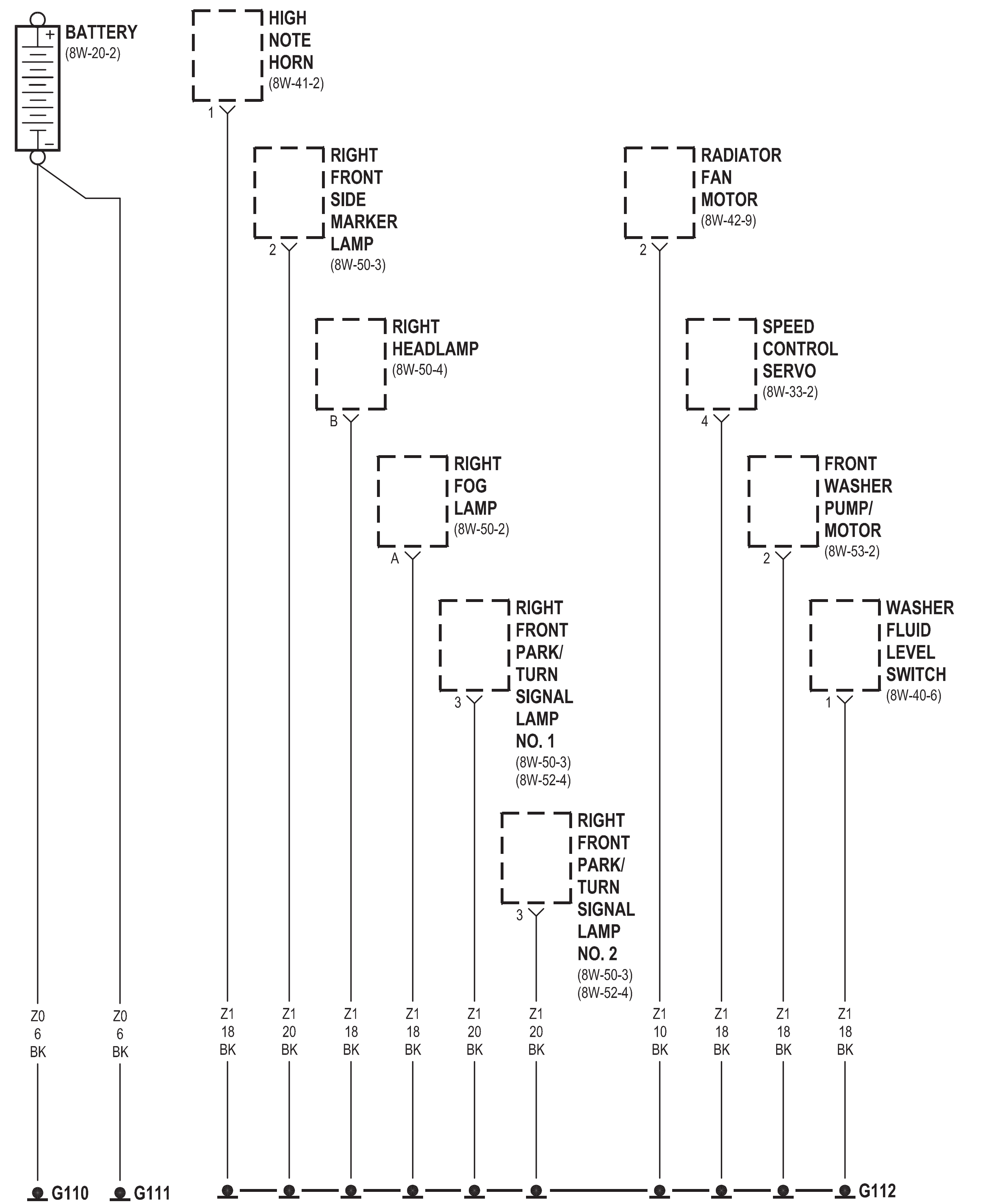

BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
5
20A
(8W-10-25)
FUSE
D
20A
(8W-10-16)
5
D
F32
14
PK/DB
72
C200
F32
14
PK/DB
A12
12
RD/TN
1
BRAKE LAMP SWITCH
(8W-30-28)
2
L50
14
WT/TN
15
C11
3
C1
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
3
C1
5
C4
8
C12
4
C12
12
C4
L50
14
WT/TN
L50
14
WT/TN
L50
14
WT/TN
A12
16
RD/TN
A12
16
RD/TN
EXCEPT ELECTRIC BRAKE
ELECTRIC BRAKE
3
C329
1
C301
18
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-25)
19
L50
18
WT/TN
1
CENTER HIGH MOUNTED STOP LAMP
(8W-51-5)
2
1
POWER OUTLET
(8W-41-3)
A12
16
RD/TN
L50
14
WT/TN
B5
COMBINATION FLASHER
(8W-52-2)
1
CENTER POWER OUTLET
(8W-41-3)
7
C352
L50
18
WT/TN
AFTERMARKET CHMSL CONNECTOR
(8W-51-5)

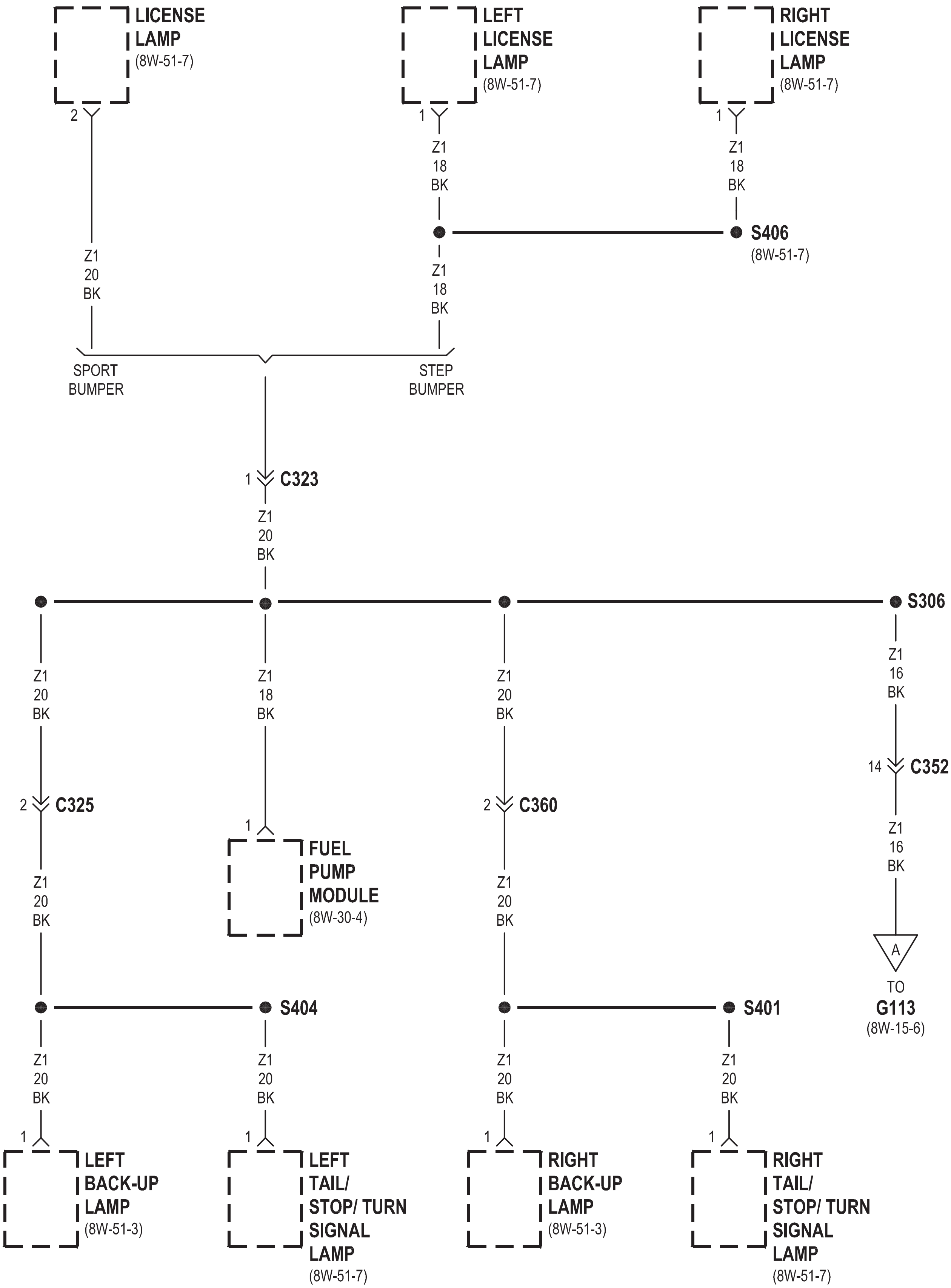

COMBINATION
FLASHER
(8W-52-2)
A3
B3
L61
16
LG
L60
16
TN
2 C12
12 C11
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
16 C11
13 C3
11 C11
11 C2
L61
16
LG
L61
16
LG
L60
16
TN
L60
16
TN
1
7
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-36)
2
3
8
9
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-36)
L61
16
LG
L61
16
LG
L60
16
TN
L60
16
TN
1
1
1
1
LEFT
FRONT
PARK/
TURN
SIGNAL
LAMP
NO. 1
(8W-52-4)
LEFT
FRONT
PARK/
TURN
SIGNAL
LAMP
NO. 2
(8W-52-4)
RIGHT
FRONT
PARK/
TURN
SIGNAL
LAMP
NO. 1
(8W-52-4)
RIGHT
FRONT
PARK/
TURN
SIGNAL
LAMP
NO. 2
(8W-52-4)
6 C2
8 C2
INSTRUMENT
CLUSTER
(8W-40-7)

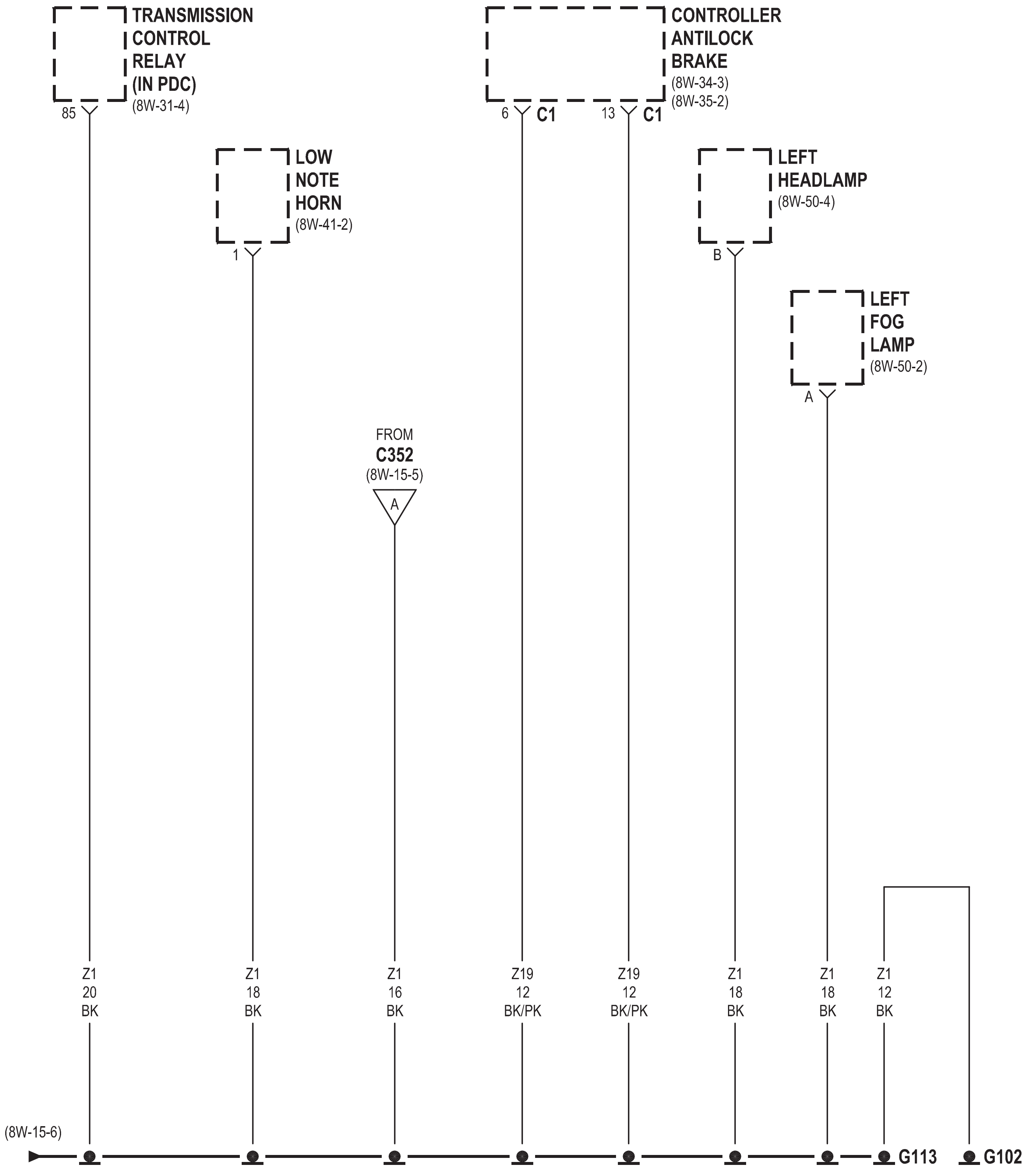
8W-15 GROUND DISTRIBUTION

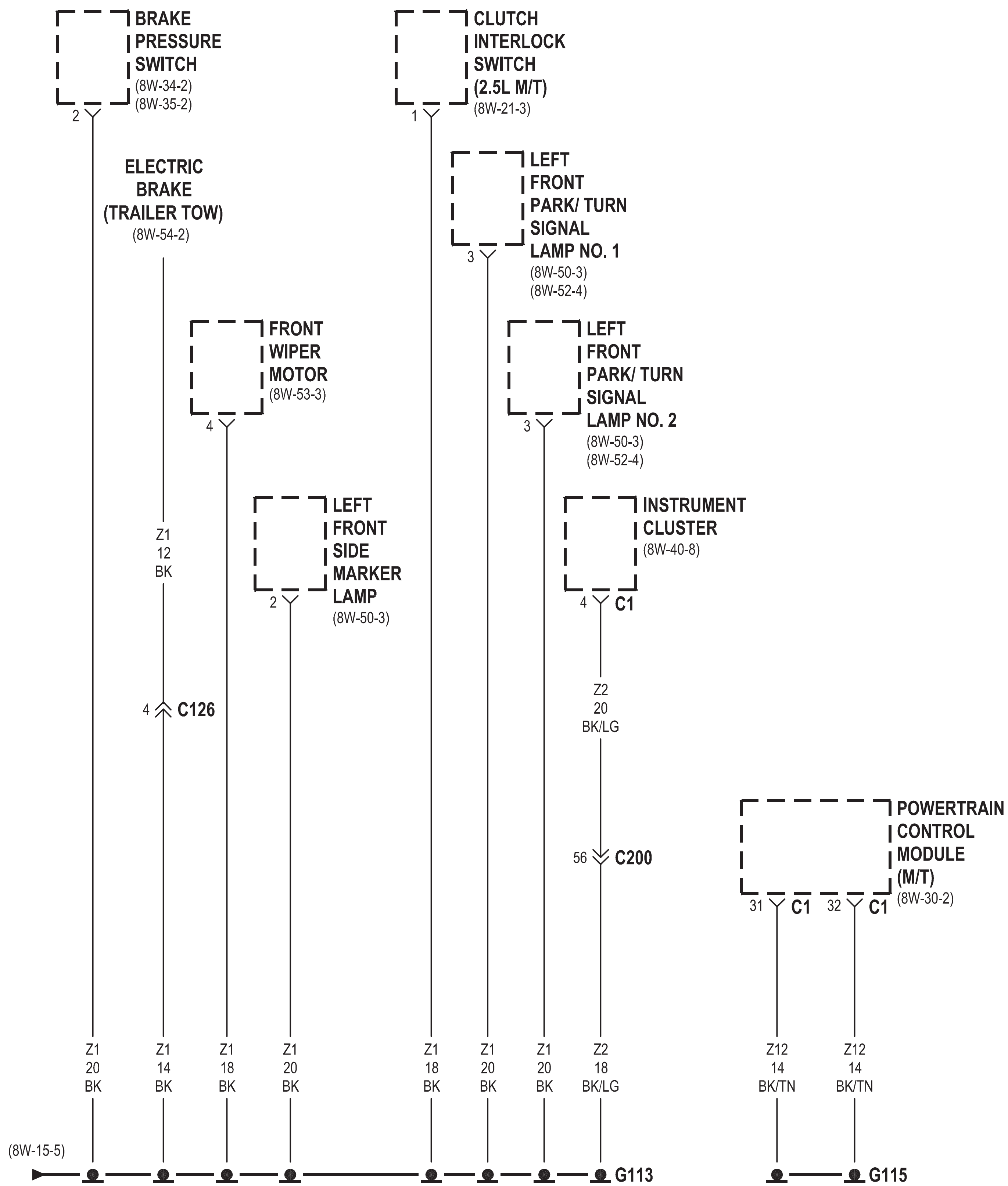

POWERTRAIN CONTROL MODULE (A/T)
(8W-30-2)
31 C1
32 C1
TRANSMISSION CONTROL MODULE
(8W-31-5)
37
39
57
OXYGEN SENSOR 1/2 DOWNSTREAM (3.9L/5.9L)
(8W-30-11)
1
OXYGEN SENSOR 2/2 DOWNSTREAM (3.9L/5.9L)
(8W-30-11)
1
Z12 14 BK/TN
Z12 14 BK/TN
Z13 16 BK/RD
Z13 16 BK/RD
Z13 16 BK/RD
Z11 18 BK/WT
Z11 18 BK/WT
Z1 18BK/WT
(8W-15-3)
G100
G105
2.5L/3.9L/5.9L

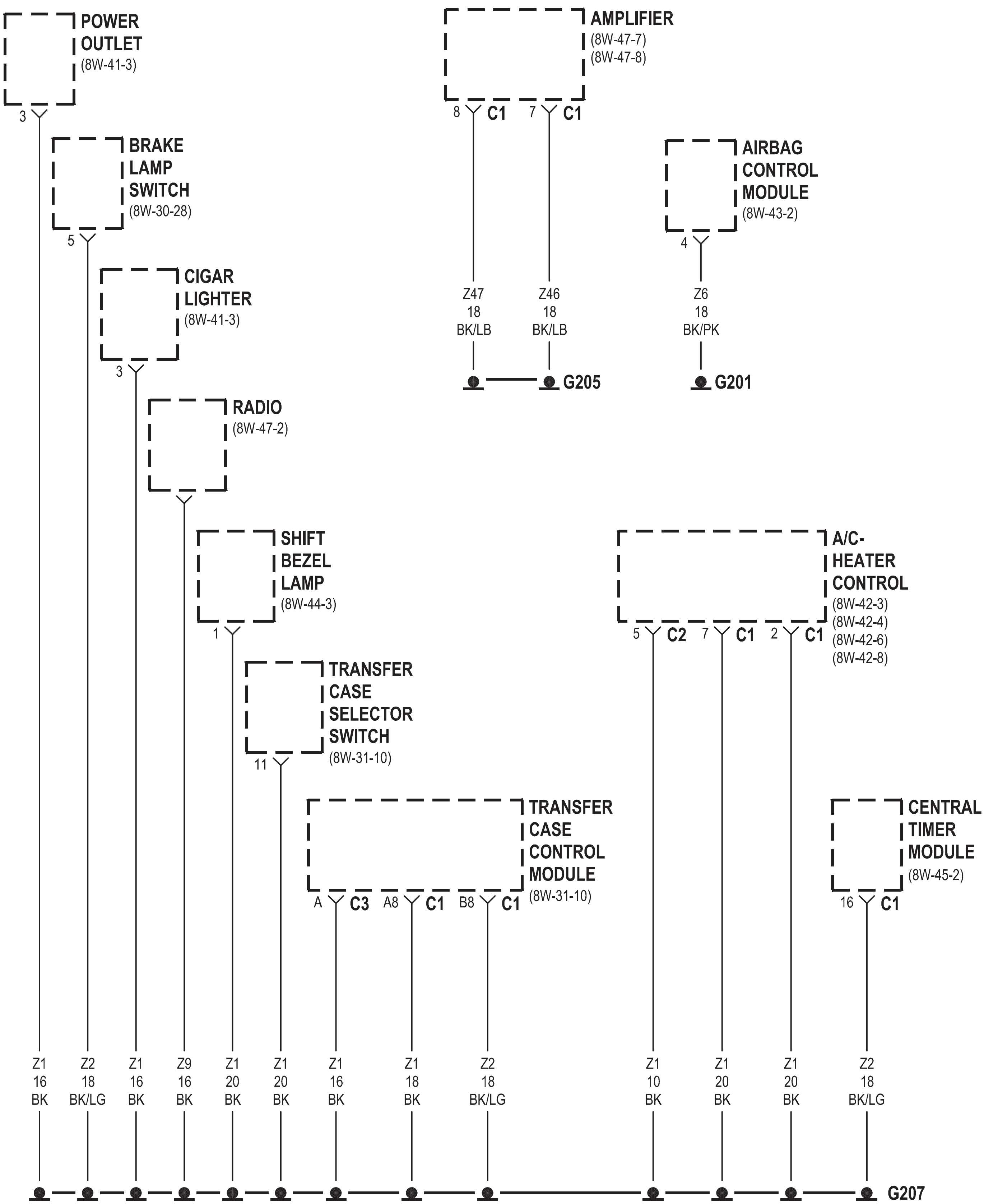

A/C
COMPRESSOR
CLUTCH
(8W-42-5)
POWER
STEERING
PRESSURE
SWITCH
(2.5L/4.7L)
(8W-30-27)
A/C LOW
PRESSURE
SWITCH
(8W-42-5)
CLUTCH
INTERLOCK
SWITCH
(M/T 3.9L/4.7L)
(8W-21-3)
T41
18
BK/WT
C106
(IN PDC)
OXYGEN
SENSOR 2/2
DOWNSTREAM
(4.7L)
(8W-30-17)
OXYGEN
SENSOR
1/2
DOWNSTREAM
(4.7L AUTO)
(8W-30-17)
OXYGEN
SENSOR
1/2
DOWNSTREAM
(4.7L MANUAL)
(8W-30-17)
Z1
18
BK
Z1
18
BK
Z1
18
BK
T41
18
BK/WT
Z11
18
BK/WT
Z11
18
BK/WT
Z11
18
BK/WT
(8W-15-2)
G105
● 2.5L
●● EXCEPT 2.5L

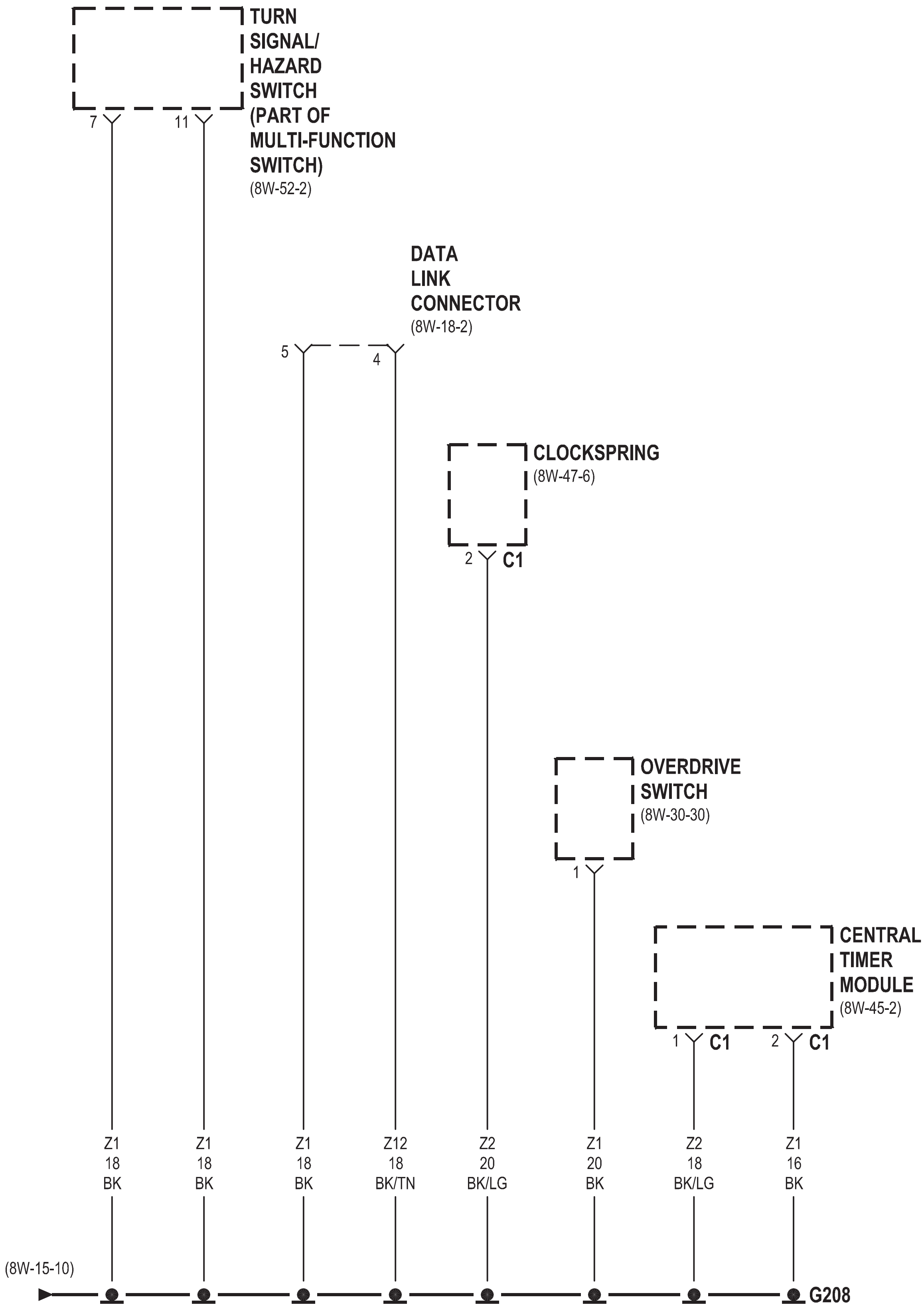

BATTERY
(8W-20-2)
HIGH NOTE HORN
(8W-41-2)
RIGHT FRONT SIDE MARKER LAMP
(8W-50-3)
RIGHT HEADLAMP
(8W-50-4)
RIGHT FOG LAMP
(8W-50-2)
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 1
(8W-50-3)
(8W-52-4)
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 2
(8W-50-3)
(8W-52-4)
RADIATOR FAN MOTOR
(8W-42-9)
SPEED CONTROL SERVO
(8W-33-2)
FRONT WASHER PUMP/ MOTOR
(8W-53-2)
WASHER FLUID LEVEL SWITCH
(8W-40-6)
1
2
B
A
3
3
2
4
2
1
Z0 6 BK
Z0 6 BK
Z1 18 BK
Z1 20 BK
Z1 18 BK
Z1 18 BK
Z1 20 BK
Z1 20 BK
Z1 10 BK
Z1 18 BK
Z1 18 BK
Z1 18 BK
G110
G111
G112

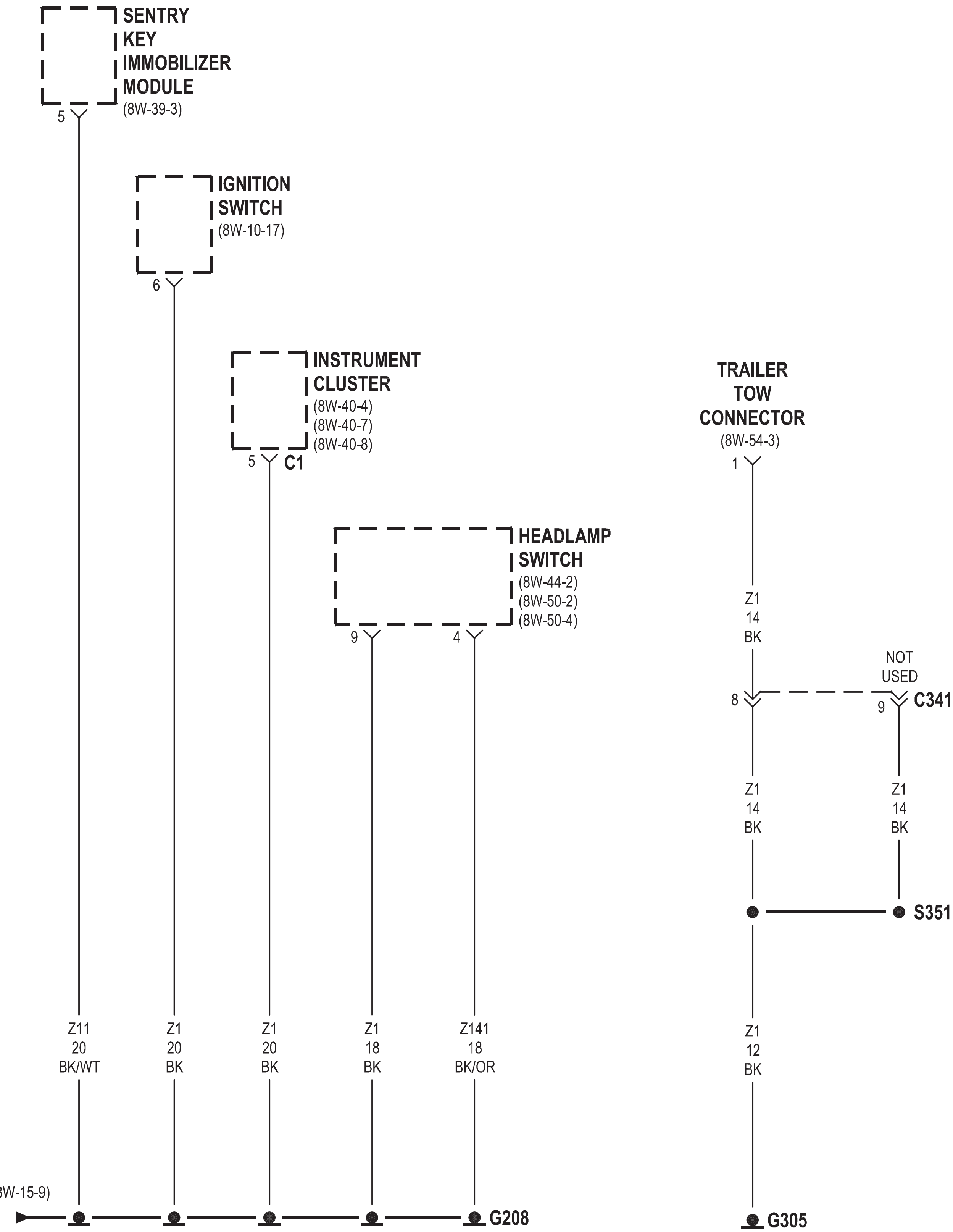

LICENSE
LAMP
(8W-51-7)
2
Z1
20
BK
LEFT
LICENSE
LAMP
(8W-51-7)
1
Z1
18
BK
RIGHT
LICENSE
LAMP
(8W-51-7)
1
Z1
18
BK
S406
(8W-51-7)
Z1
18
BK
SPORT
BUMPER
STEP
BUMPER
1
C323
Z1
20
BK
S306
Z1
20
BK
2
C325
Z1
20
BK
Z1
18
BK
1
FUEL
PUMP
MODULE
(8W-30-4)
Z1
20
BK
2
C360
Z1
20
BK
Z1
16
BK
14
C352
Z1
16
BK
A
TO
G113
(8W-15-6)
S404
S401
Z1
20
BK
1
LEFT
BACK-UP
LAMP
(8W-51-3)
Z1
20
BK
1
LEFT
TAIL/
STOP/ TURN
SIGNAL
LAMP
(8W-51-7)
Z1
20
BK
1
RIGHT
BACK-UP
LAMP
(8W-51-3)
Z1
20
BK
1
RIGHT
TAIL/
STOP/ TURN
SIGNAL
LAMP
(8W-51-7)

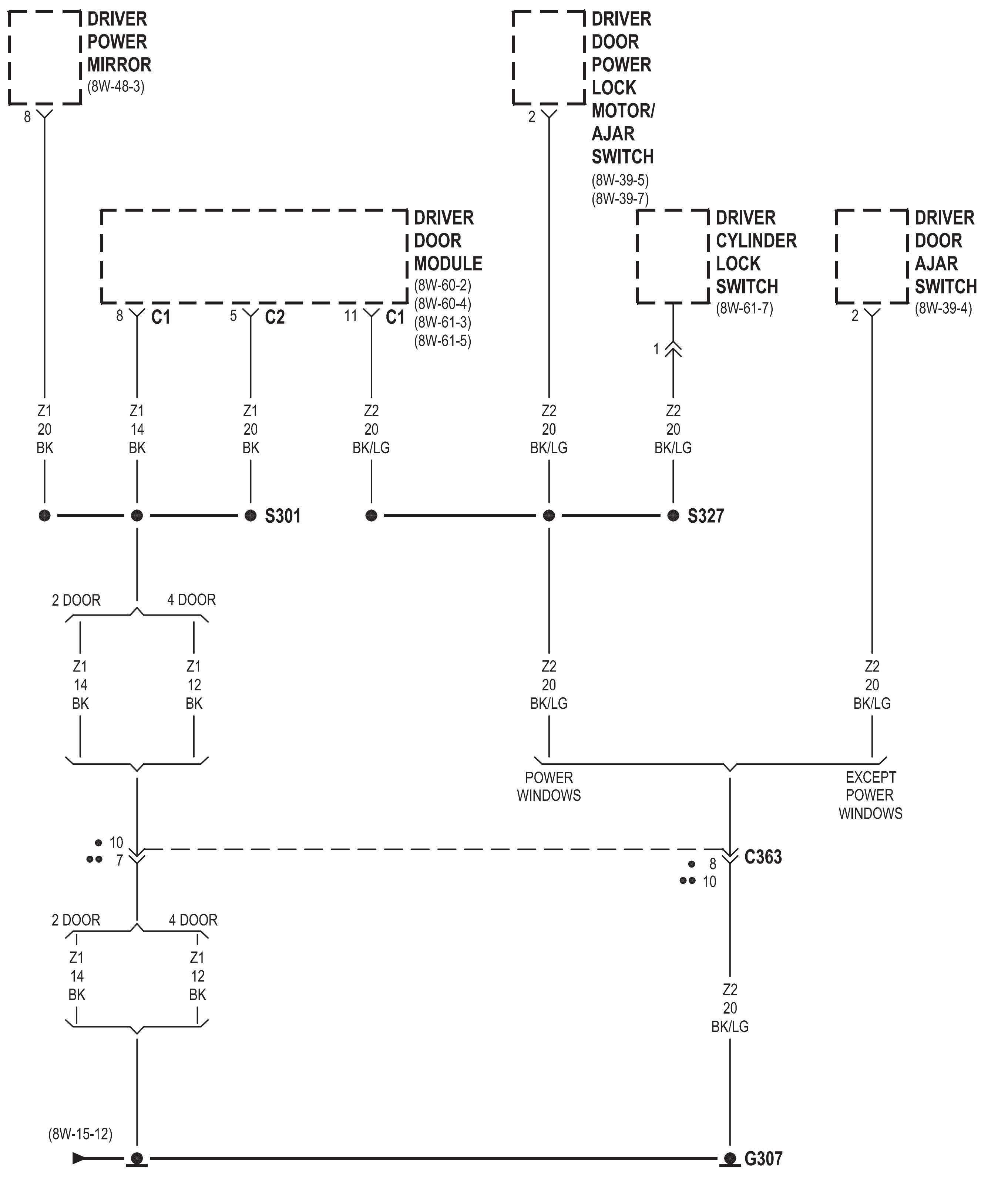

TRANSMISSION CONTROL RELAY (IN PDC)
(8W-31-4)
85
CONTROLLER ANTILOCK BRAKE
(8W-34-3)
(8W-35-2)
6 C1
13 C1
LOW NOTE HORN
(8W-41-2)
1
LEFT HEADLAMP
(8W-50-4)
B
LEFT FOG LAMP
(8W-50-2)
A
FROM
C352
(8W-15-5)
A
Z1 20 BK
Z1 18 BK
Z1 16 BK
Z19 12 BK/PK
Z19 12 BK/PK
Z1 18 BK
Z1 18 BK
Z1 12 BK
(8W-15-6)
G113
G102

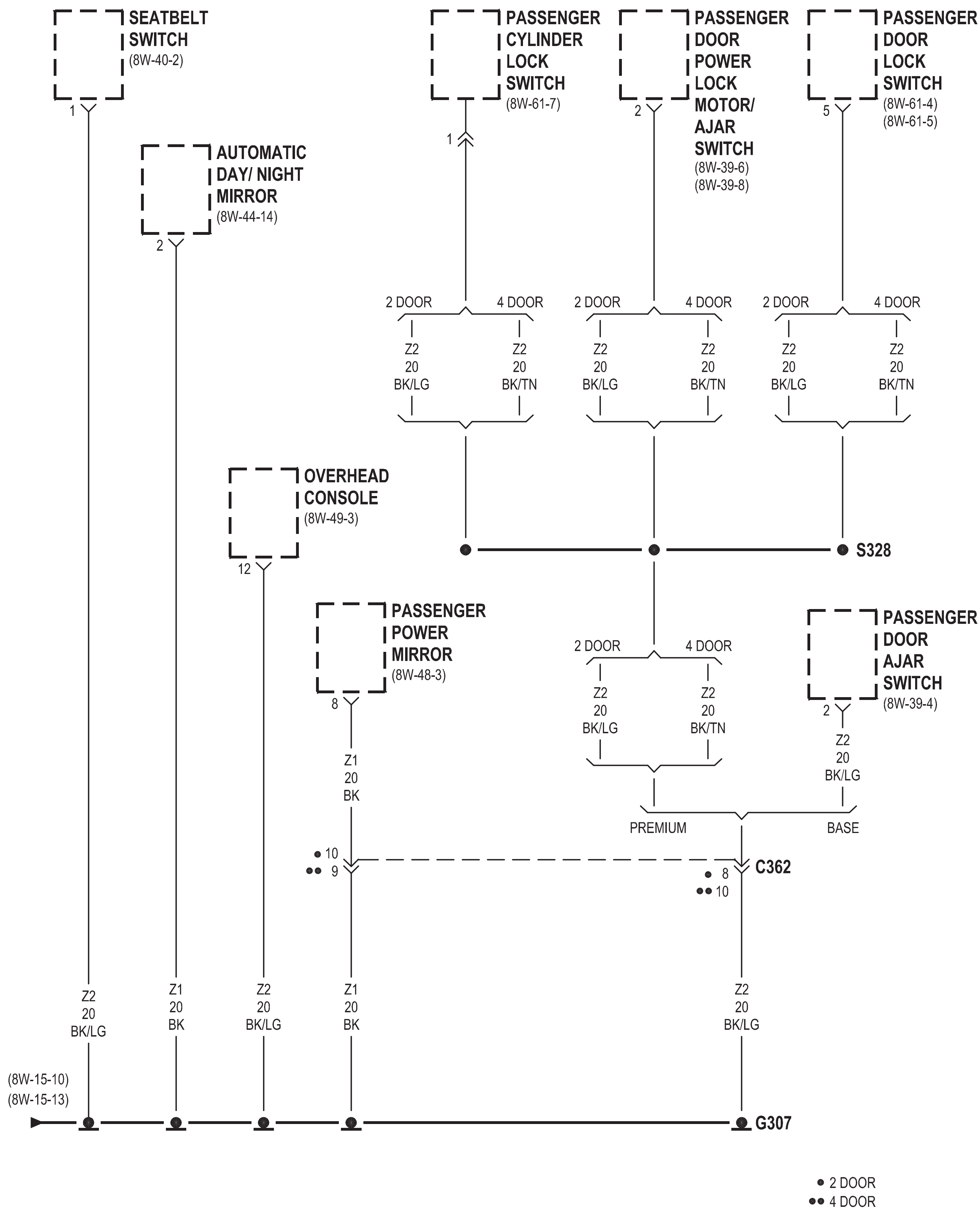

BRAKE PRESSURE SWITCH
(8W-34-2)
(8W-35-2)
2
CLUTCH INTERLOCK SWITCH (2.5L M/T)
(8W-21-3)
1
ELECTRIC BRAKE (TRAILER TOW)
(8W-54-2)
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 1
(8W-50-3)
(8W-52-4)
3
FRONT WIPER MOTOR
(8W-53-3)
4
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 2
(8W-50-3)
(8W-52-4)
3
LEFT FRONT SIDE MARKER LAMP
(8W-50-3)
2
INSTRUMENT CLUSTER
(8W-40-8)
4 C1
Z1 12 BK
4 C126
Z2 20 BK/LG
56 C200
POWERTRAIN CONTROL MODULE (M/T)
(8W-30-2)
31 C1
32 C1
Z1 20 BK
Z1 14 BK
Z1 18 BK
Z1 20 BK
Z1 18 BK
Z1 20 BK
Z1 20 BK
Z2 18 BK/LG
Z12 14 BK/TN
Z12 14 BK/TN
(8W-15-5)
G113
G115

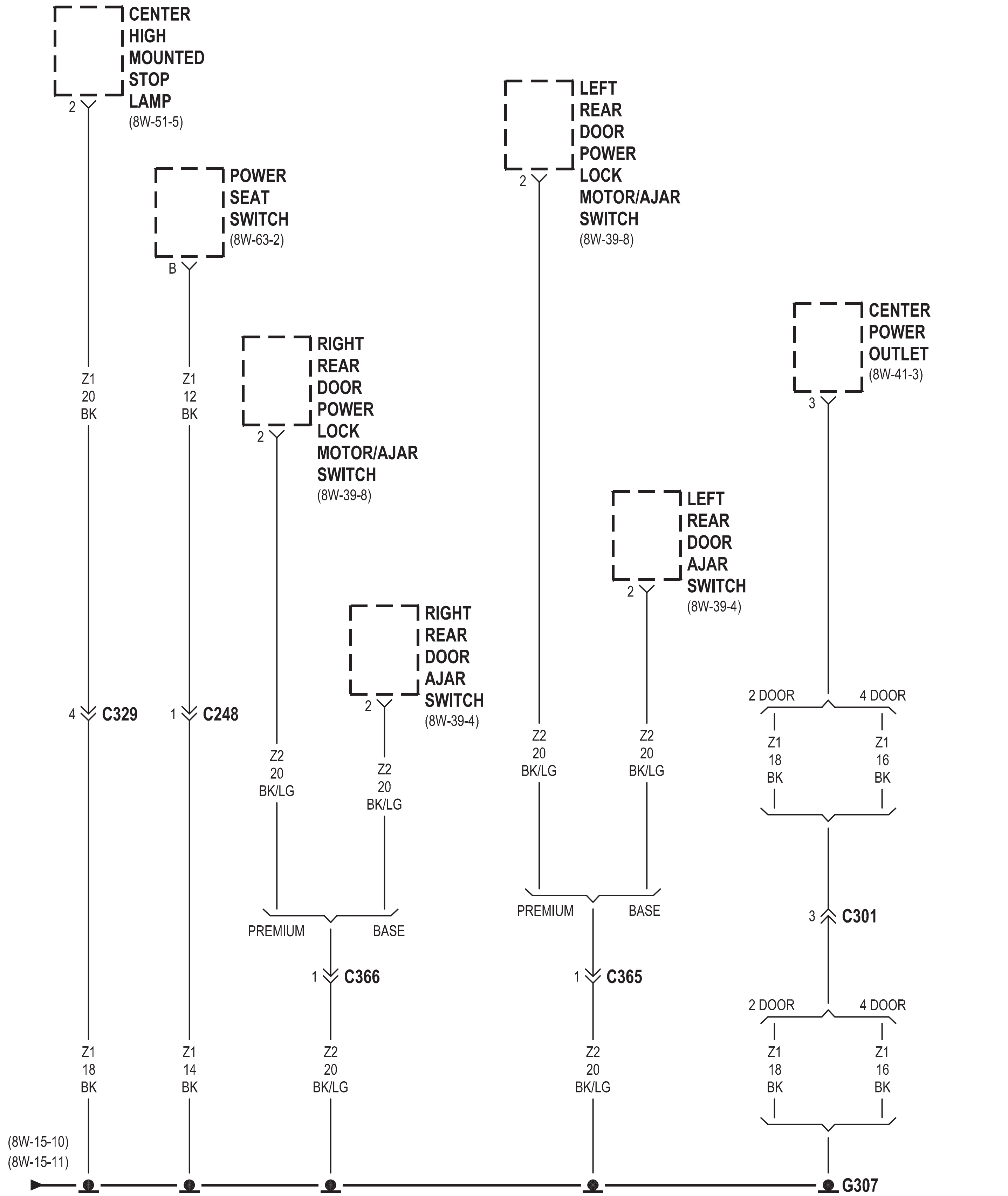

POWER OUTLET
(8W-41-3)
3
BRAKE LAMP SWITCH
(8W-30-28)
5
CIGAR LIGHTER
(8W-41-3)
3
RADIO
(8W-47-2)
SHIFT BEZEL LAMP
(8W-44-3)
1
TRANSFER CASE SELECTOR SWITCH
(8W-31-10)
11
TRANSFER CASE CONTROL MODULE
(8W-31-10)
A C3
A8 C1
B8 C1
AMPLIFIER
(8W-47-7)
(8W-47-8)
8 C1
7 C1
Z47 18 BK/LB
Z46 18 BK/LB
G205
AIRBAG CONTROL MODULE
(8W-43-2)
4
Z6 18 BK/PK
G201
A/C-HEATER CONTROL
(8W-42-3)
(8W-42-4)
(8W-42-6)
(8W-42-8)
5 C2
7 C1
2 C1
CENTRAL TIMER MODULE
(8W-45-2)
16 C1
Z1 16 BK
Z2 18 BK/LG
Z1 16 BK
Z9 16 BK
Z1 20 BK
Z1 20 BK
Z1 16 BK
Z1 18 BK
Z2 18 BK/LG
Z1 10 BK
Z1 20 BK
Z1 20 BK
Z2 18 BK/LG
G207


TURN SIGNAL/ HAZARD SWITCH (PART OF MULTI-FUNCTION SWITCH)
(8W-52-2)
7
11
DATA LINK CONNECTOR
(8W-18-2)
5
4
CLOCKSPRING
(8W-47-6)
2
C1
OVERDRIVE SWITCH
(8W-30-30)
1
CENTRAL TIMER MODULE
(8W-45-2)
1
C1
2
C1
Z1 18 BK
Z1 18 BK
Z1 18 BK
Z12 18 BK/TN
Z2 20 BK/LG
Z1 20 BK
Z2 18 BK/LG
Z1 16 BK
(8W-15-10)
G208

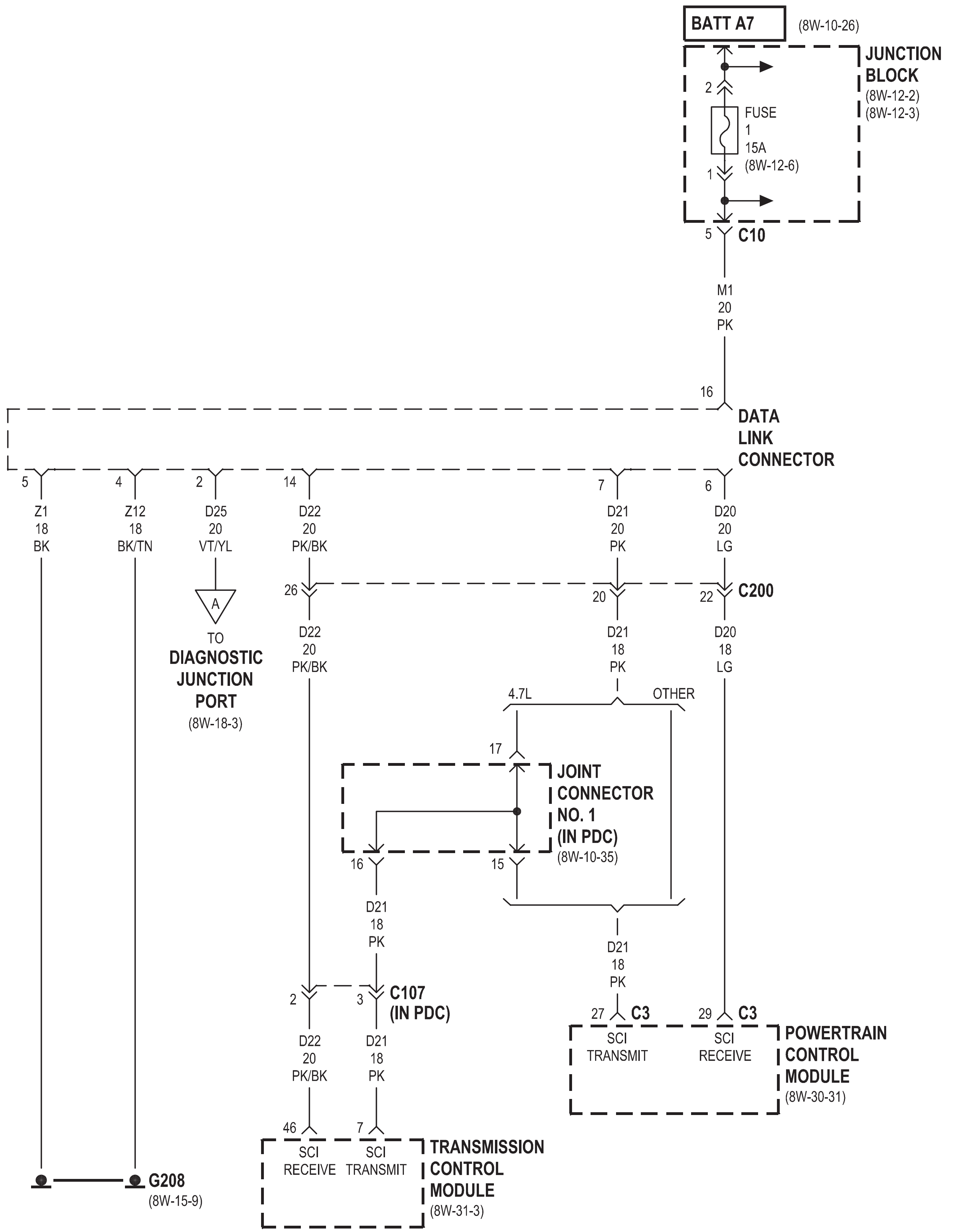

SENTRY KEY IMMOBILIZER MODULE
(8W-39-3)
5
IGNITION SWITCH
(8W-10-17)
6
INSTRUMENT CLUSTER
(8W-40-4)
(8W-40-7)
(8W-40-8)
5
C1
HEADLAMP SWITCH
(8W-44-2)
(8W-50-2)
(8W-50-4)
9
4
TRAILER TOW CONNECTOR
(8W-54-3)
1
Z1 14 BK
NOT USED
8
9
C341
Z1 14 BK
Z1 14 BK
S351
Z11 20 BK/WT
Z1 20 BK
Z1 20 BK
Z1 18 BK
Z141 18 BK/OR
Z1 12 BK
(8W-15-9)
G208
G305

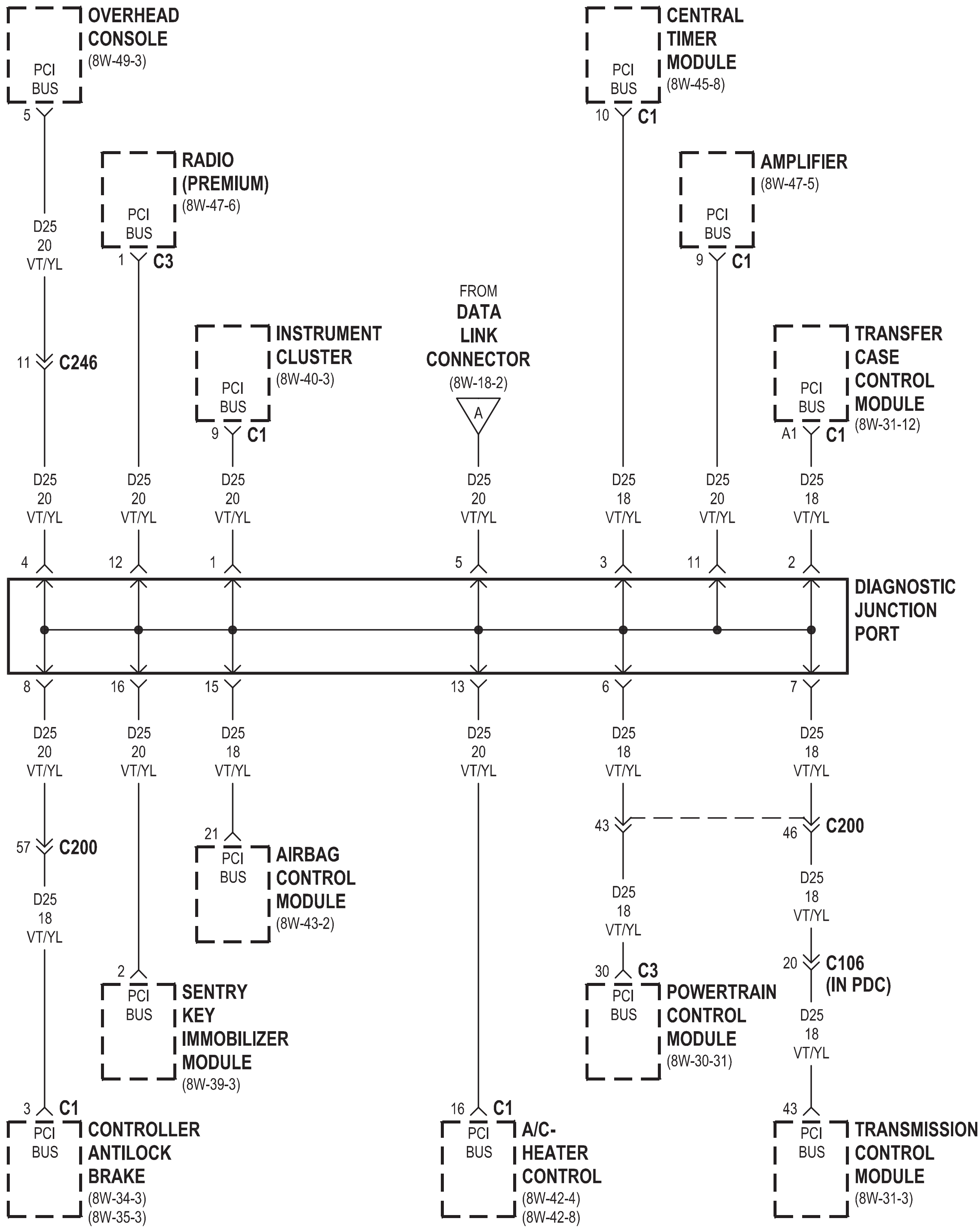

DRIVER POWER MIRROR
(8W-48-3)
8
DRIVER DOOR POWER LOCK MOTOR/ AJAR SWITCH
(8W-39-5)
(8W-39-7)
2
DRIVER DOOR MODULE
(8W-60-2)
(8W-60-4)
(8W-61-3)
(8W-61-5)
8 C1
5 C2
11 C1
DRIVER CYLINDER LOCK SWITCH
(8W-61-7)
1
DRIVER DOOR AJAR SWITCH
(8W-39-4)
2
Z1 20 BK
Z1 14 BK
Z1 20 BK
Z2 20 BK/LG
Z2 20 BK/LG
Z2 20 BK/LG
S301
S327
2 DOOR
4 DOOR
Z1 14 BK
Z1 12 BK
Z2 20 BK/LG
Z2 20 BK/LG
POWER WINDOWS
EXCEPT POWER WINDOWS
10
7
C363
8
10
2 DOOR
4 DOOR
Z1 14 BK
Z1 12 BK
Z2 20 BK/LG
(8W-15-12)
G307
2 DOOR
4 DOOR


SEATBELT SWITCH
(8W-40-2)
1
AUTOMATIC DAY/ NIGHT MIRROR
(8W-44-14)
2
PASSENGER CYLINDER LOCK SWITCH
(8W-61-7)
1
PASSENGER DOOR POWER LOCK MOTOR/ AJAR SWITCH
(8W-39-6)
(8W-39-8)
2
PASSENGER DOOR LOCK SWITCH
(8W-61-4)
(8W-61-5)
5
2 DOOR
4 DOOR
Z2
20
BK/LG
Z2
20
BK/TN
OVERHEAD CONSOLE
(8W-49-3)
12
S328
PASSENGER POWER MIRROR
(8W-48-3)
8
Z1
20
BK
PASSENGER DOOR AJAR SWITCH
(8W-39-4)
2
PREMIUM
BASE
10
9
C362
8
10
(8W-15-10)
(8W-15-13)
G307
2 DOOR
4 DOOR

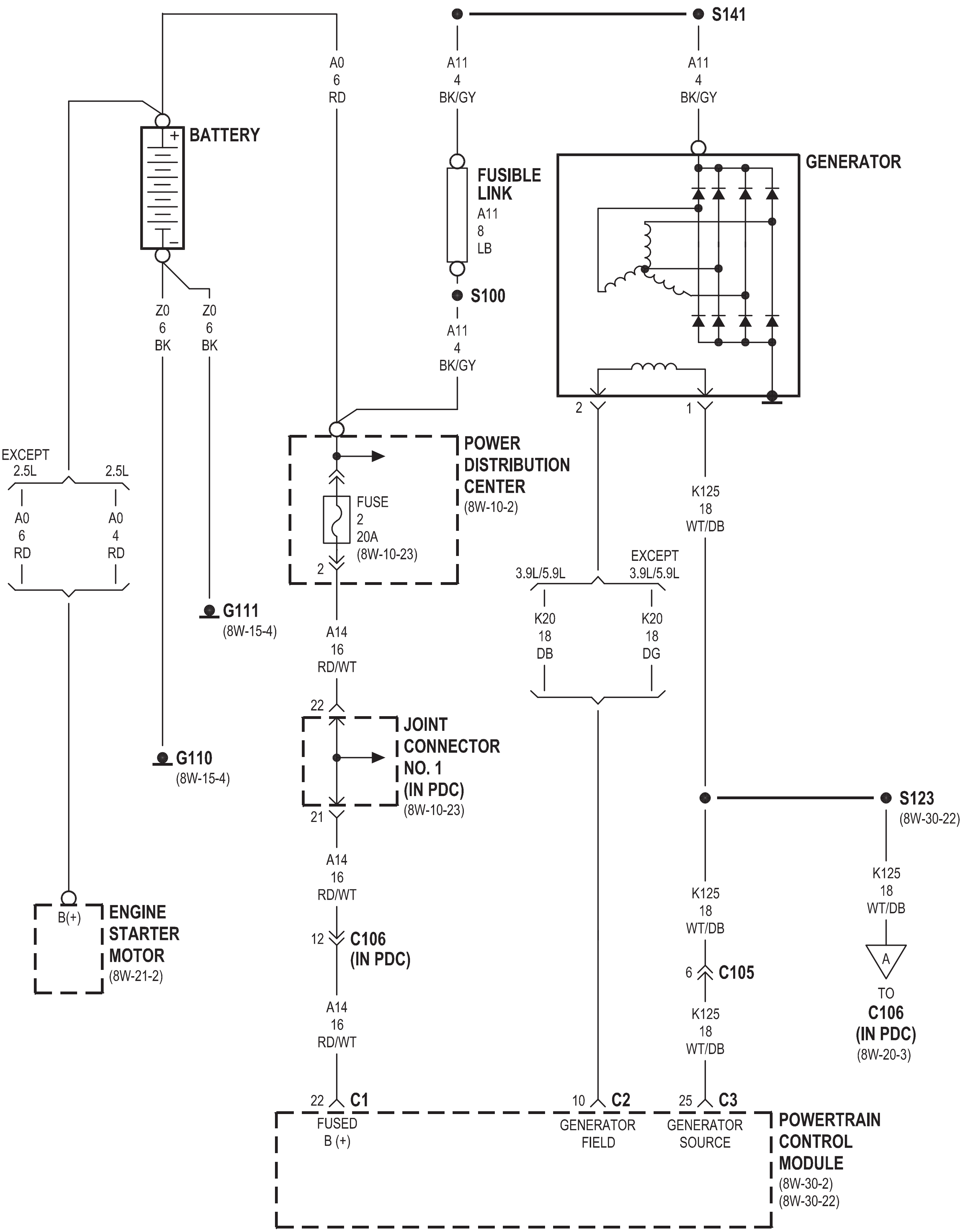

CENTER HIGH MOUNTED STOP LAMP
(8W-51-5)
2
POWER SEAT SWITCH
(8W-63-2)
B
LEFT REAR DOOR POWER LOCK MOTOR/AJAR SWITCH
(8W-39-8)
2
RIGHT REAR DOOR POWER LOCK MOTOR/AJAR SWITCH
(8W-39-8)
2
CENTER POWER OUTLET
(8W-41-3)
3
LEFT REAR DOOR AJAR SWITCH
(8W-39-4)
2
RIGHT REAR DOOR AJAR SWITCH
(8W-39-4)
2
Z1 20 BK
Z1 12 BK
4 C329
1 C248
Z2 20 BK/LG
Z2 20 BK/LG
Z2 20 BK/LG
Z2 20 BK/LG
2 DOOR
4 DOOR
Z1 18 BK
Z1 16 BK
PREMIUM
BASE
PREMIUM
BASE
3 C301
1 C366
1 C365
2 DOOR
4 DOOR
Z1 18 BK
Z1 14 BK
Z2 20 BK/LG
Z2 20 BK/LG
Z1 18 BK
Z1 16 BK
(8W-15-10)
(8W-15-11)
G307

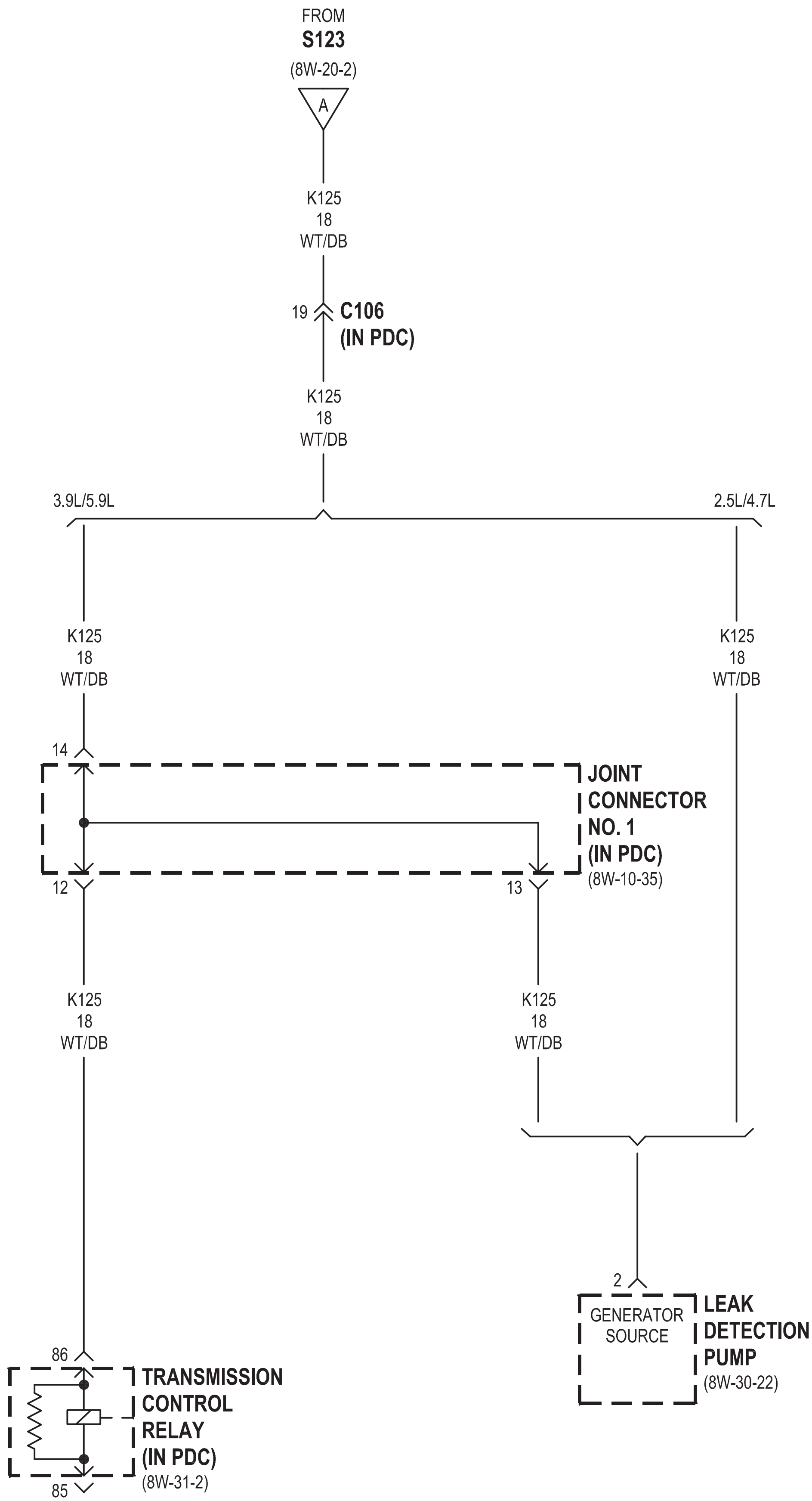
8W-18 BUS COMMUNICATIONS

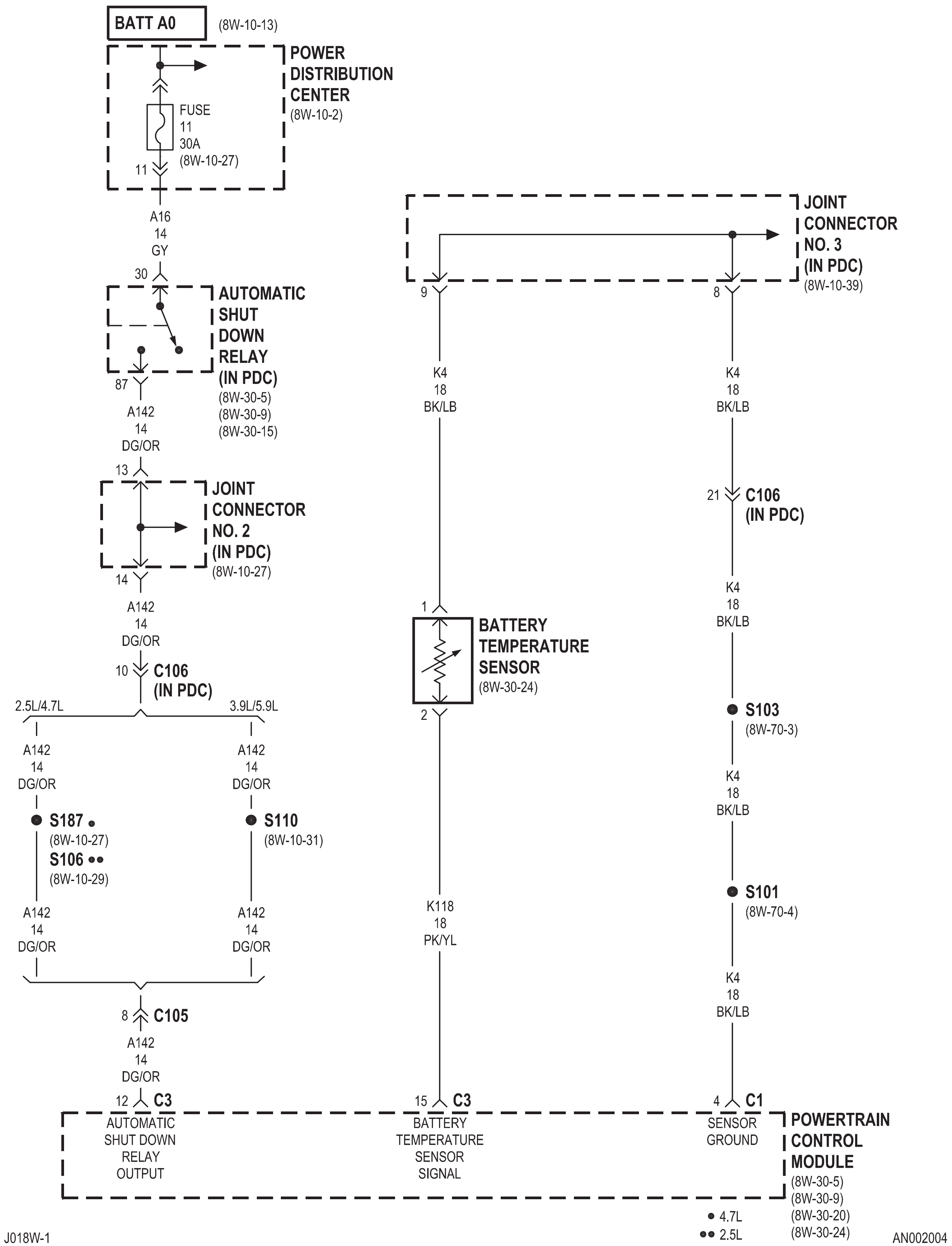

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
2
FUSE
1
15A
(8W-12-6)
1
5
C10
M1
20
PK
16
DATA LINK CONNECTOR
5
Z1
18
BK
4
Z12
18
BK/TN
2
D25
20
VT/YL
A
TO
DIAGNOSTIC JUNCTION PORT
(8W-18-3)
14
D22
20
PK/BK
7
D21
20
PK
6
D20
20
LG
26
20
22
C200
D22
20
PK/BK
D21
18
PK
D20
18
LG
4.7L
OTHER
17
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-35)
16
15
D21
18
PK
D21
18
PK
2
3
C107 (IN PDC)
D22
20
PK/BK
D21
18
PK
27
C3
29
C3
SCI TRANSMIT
SCI RECEIVE
POWERTRAIN CONTROL MODULE
(8W-30-31)
46
7
SCI RECEIVE
SCI TRANSMIT
TRANSMISSION CONTROL MODULE
(8W-31-3)
G208
(8W-15-9)


OVERHEAD CONSOLE
(8W-49-3)
PCI BUS
CENTRAL TIMER MODULE
(8W-45-8)
RADIO (PREMIUM)
(8W-47-6)
AMPLIFIER
(8W-47-5)
INSTRUMENT CLUSTER
(8W-40-3)
FROM DATA LINK CONNECTOR
(8W-18-2)
A
TRANSFER CASE CONTROL MODULE
(8W-31-12)
C246
C1
C3
D25 20 VT/YL
D25 18 VT/YL
DIAGNOSTIC JUNCTION PORT
C200
AIRBAG CONTROL MODULE
(8W-43-2)
SENTRY KEY IMMOBILIZER MODULE
(8W-39-3)
POWERTRAIN CONTROL MODULE
(8W-30-31)
C106 (IN PDC)
CONTROLLER ANTILOCK BRAKE
(8W-34-3)
(8W-35-3)
A/C-HEATER CONTROL
(8W-42-4)
(8W-42-8)
TRANSMISSION CONTROL MODULE
(8W-31-3)

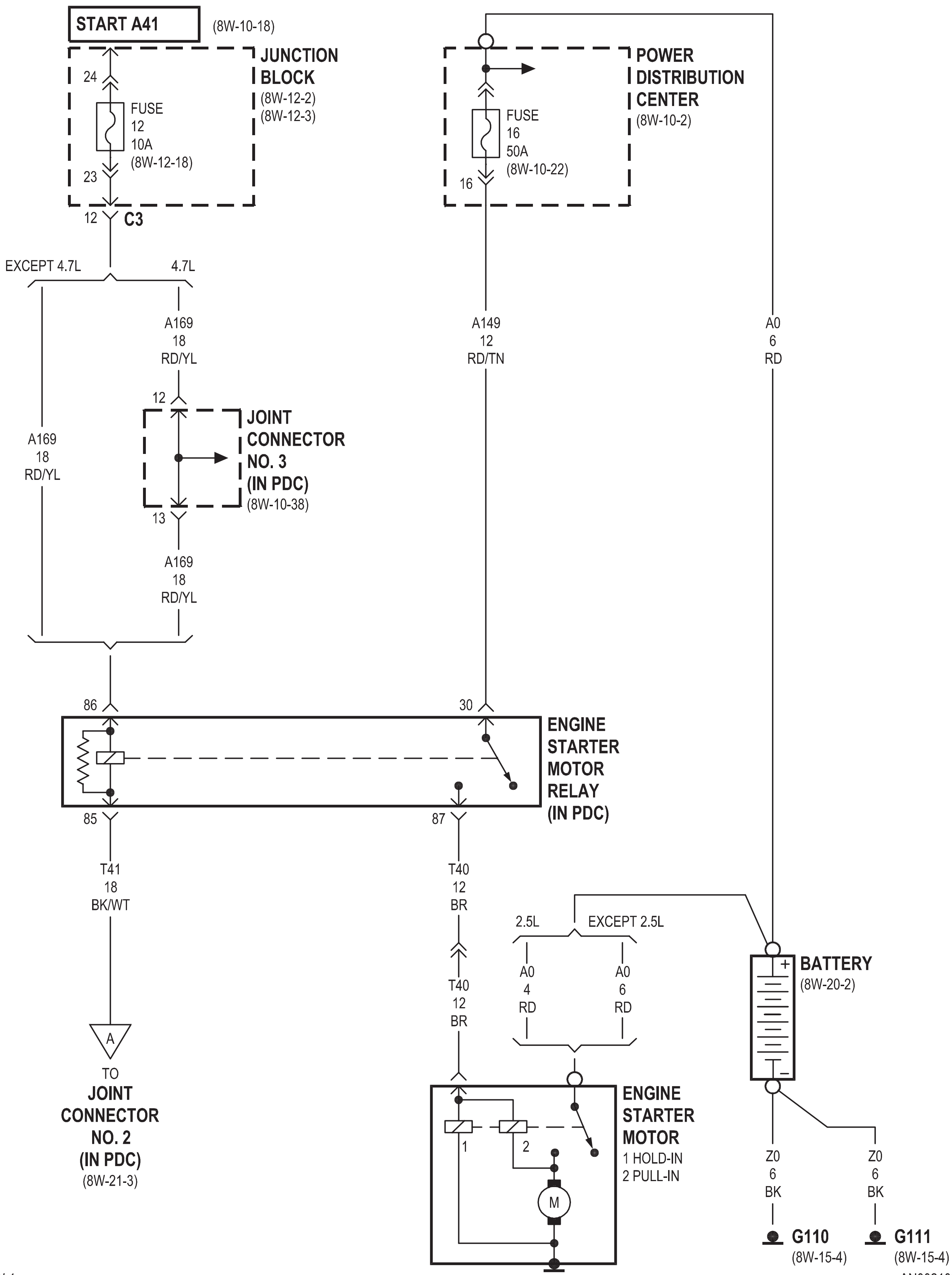
8W-20 CHARGING SYSTEM

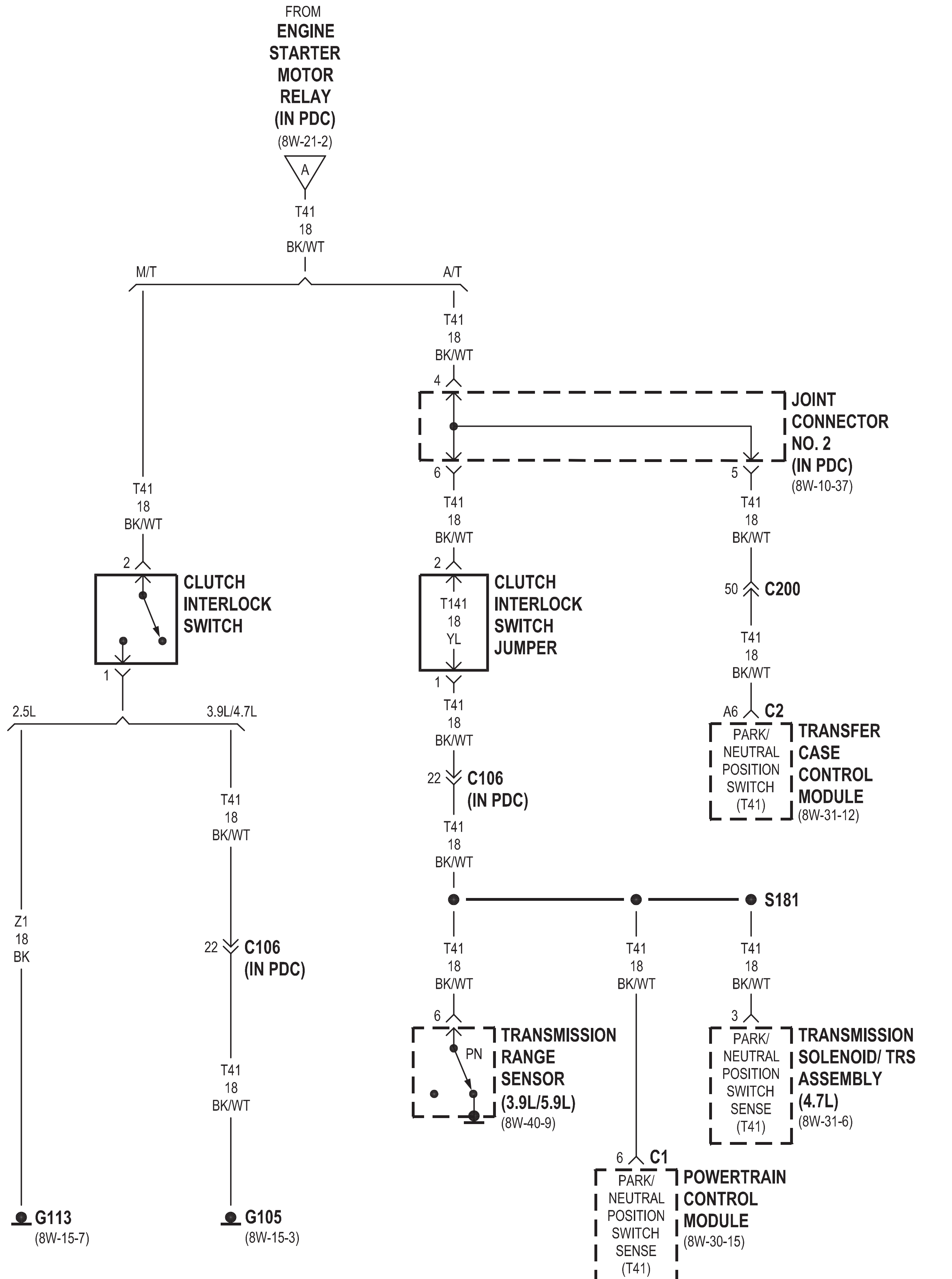

S141
A0
6
RD
A11
4
BK/GY
A11
4
BK/GY
BATTERY
FUSIBLE
LINK
A11
8
LB
GENERATOR
S100
A11
4
BK/GY
Z0
6
BK
Z0
6
BK
2
1
EXCEPT
2.5L
2.5L
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
2
20A
(8W-10-23)
2
A0
6
RD
A0
4
RD
K125
18
WT/DB
EXCEPT
3.9L/5.9L
3.9L/5.9L
K20
18
DB
K20
18
DG
G111
(8W-15-4)
A14
16
RD/WT
22
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-10-23)
21
G110
(8W-15-4)
S123
(8W-30-22)
A14
16
RD/WT
K125
18
WT/DB
K125
18
WT/DB
B(+)
ENGINE
STARTER
MOTOR
(8W-21-2)
12
C106
(IN PDC)
6
C105
A
TO
C106
(IN PDC)
(8W-20-3)
A14
16
RD/WT
K125
18
WT/DB
22
C1
10
C2
25
C3
FUSED
B (+)
GENERATOR
FIELD
GENERATOR
SOURCE
POWERTRAIN
CONTROL
MODULE
(8W-30-2)
(8W-30-22)


FROM
S123
(8W-20-2)
A
K125
18
WT/DB
19
C106
(IN PDC)
K125
18
WT/DB
3.9L/5.9L
2.5L/4.7L
K125
18
WT/DB
K125
18
WT/DB
14
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-10-35)
12
13
K125
18
WT/DB
K125
18
WT/DB
2
GENERATOR
SOURCE
LEAK
DETECTION
PUMP
(8W-30-22)
86
TRANSMISSION
CONTROL
RELAY
(IN PDC)
(8W-31-2)
85

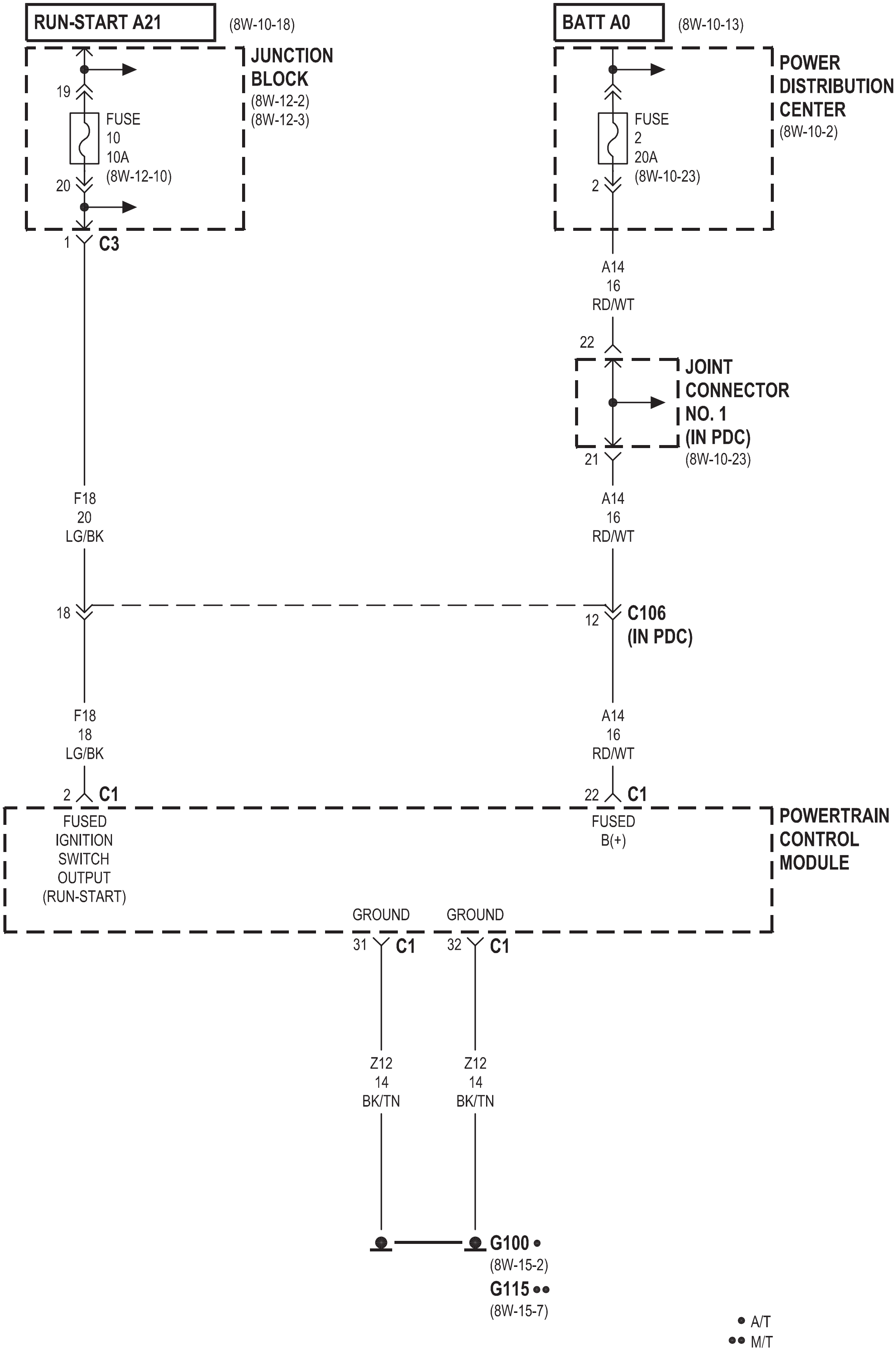

BATT A0
(8W-10-13)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
11
30A
(8W-10-27)
11
A16
14
GY
30
AUTOMATIC
SHUT
DOWN
RELAY
(IN PDC)
(8W-30-5)
(8W-30-9)
(8W-30-15)
87
A142
14
DG/OR
13
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-27)
14
A142
14
DG/OR
10
C106
(IN PDC)
2.5L/4.7L
3.9L/5.9L
A142
14
DG/OR
S187 •
(8W-10-27)
S106 ••
(8W-10-29)
S110
(8W-10-31)
A142
14
DG/OR
8
C105
A142
14
DG/OR
12
C3
JOINT
CONNECTOR
NO. 3
(IN PDC)
(8W-10-39)
9
8
K4
18
BK/LB
21
C106
(IN PDC)
1
BATTERY
TEMPERATURE
SENSOR
(8W-30-24)
2
S103
(8W-70-3)
S101
(8W-70-4)
K118
18
PK/YL
15
C3
4
C1
AUTOMATIC
SHUT DOWN
RELAY
OUTPUT
BATTERY
TEMPERATURE
SENSOR
SIGNAL
SENSOR
GROUND
POWERTRAIN
CONTROL
MODULE
(8W-30-5)
(8W-30-9)
(8W-30-20)
(8W-30-24)
• 4.7L
•• 2.5L
J018W-1
AN002004

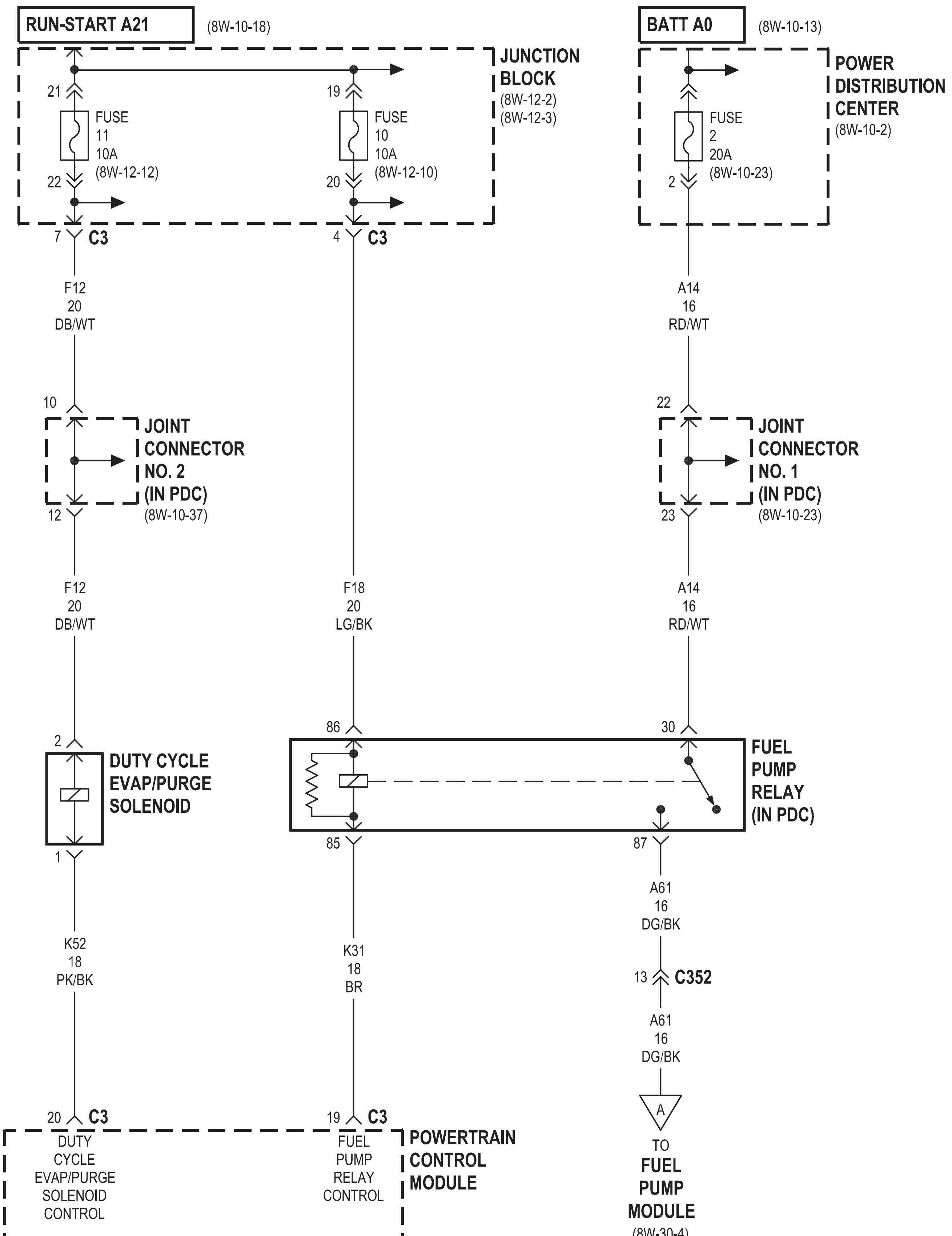
8W-21 STARTING SYSTEM

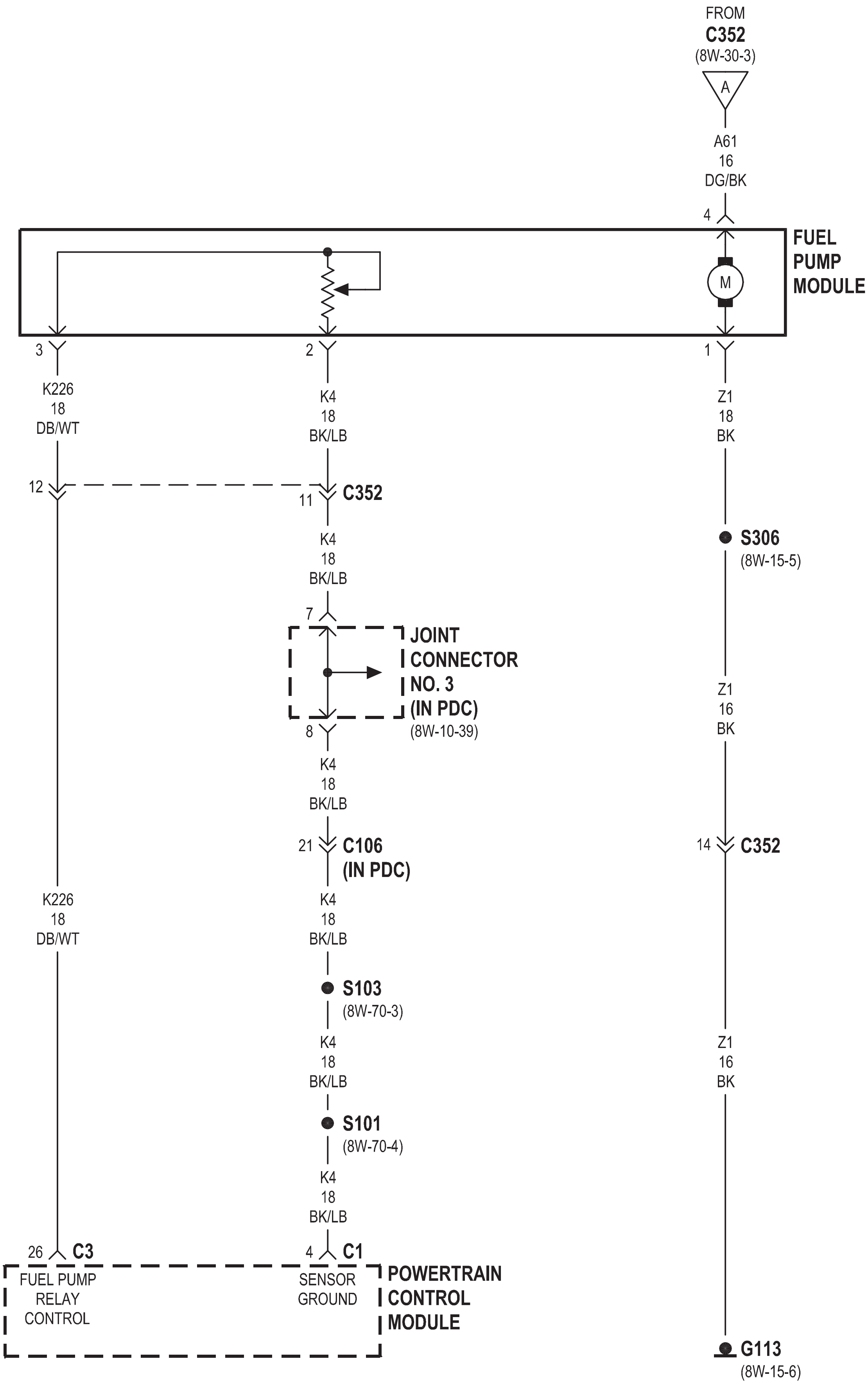

START A41
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
24
FUSE
12
10A
(8W-12-18)
23
12
C3
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
16
50A
(8W-10-22)
16
EXCEPT 4.7L
4.7L
A169
18
RD/YL
A149
12
RD/TN
A0
6
RD
12
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-38)
13
A169
18
RD/YL
86
30
ENGINE STARTER MOTOR RELAY (IN PDC)
85
87
T41
18
BK/WT
T40
12
BR
2.5L
EXCEPT 2.5L
A0
4
RD
A0
6
RD
BATTERY
(8W-20-2)
A
TO
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-21-3)
ENGINE STARTER MOTOR
1 HOLD-IN
2 PULL-IN
M
1
2
Z0
6
BK
Z0
6
BK
G110
(8W-15-4)
G111
(8W-15-4)


FROM
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-2)
A
T41 18 BK/WT
M/T
A/T
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-37)
4
6
5
CLUTCH INTERLOCK SWITCH
CLUTCH INTERLOCK SWITCH JUMPER
T141 18 YL
50 C200
A6 C2
PARK/ NEUTRAL POSITION SWITCH (T41)
TRANSFER CASE CONTROL MODULE
(8W-31-12)
2.5L
3.9L/4.7L
22 C106 (IN PDC)
Z1 18 BK
S181
TRANSMISSION RANGE SENSOR (3.9L/5.9L)
PN
(8W-40-9)
TRANSMISSION SOLENOID/ TRS ASSEMBLY (4.7L)
PARK/ NEUTRAL POSITION SWITCH SENSE (T41)
(8W-31-6)
6 C1
POWERTRAIN CONTROL MODULE
(8W-30-15)
G113
(8W-15-7)
G105
(8W-15-3)

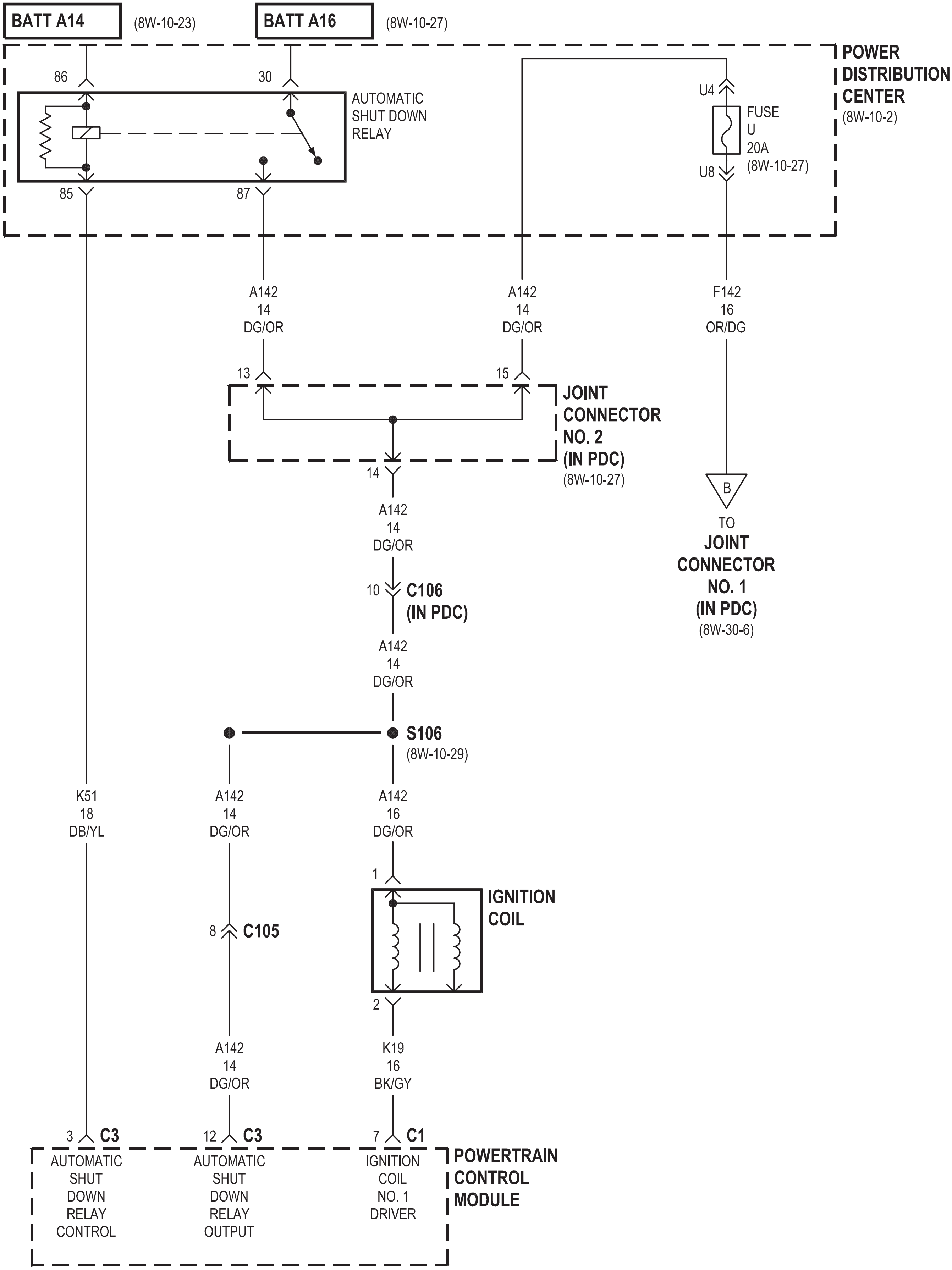
8W-30 FUEL/IGNITION SYSTEM


RUN-START A21
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
19
FUSE
10
10A
(8W-12-10)
20
1
C3
BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
2
20A
(8W-10-23)
2
A14
16
RD/WT
22
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-23)
21
A14
16
RD/WT
F18
20
LG/BK
18
12
C106 (IN PDC)
F18
18
LG/BK
A14
16
RD/WT
2
C1
22
C1
FUSED IGNITION SWITCH OUTPUT (RUN-START)
FUSED B(+)
POWERTRAIN CONTROL MODULE
GROUND
GROUND
31
C1
32
C1
Z12
14
BK/TN
Z12
14
BK/TN
G100 •
(8W-15-2)
G115 ••
(8W-15-7)
• A/T
•• M/T

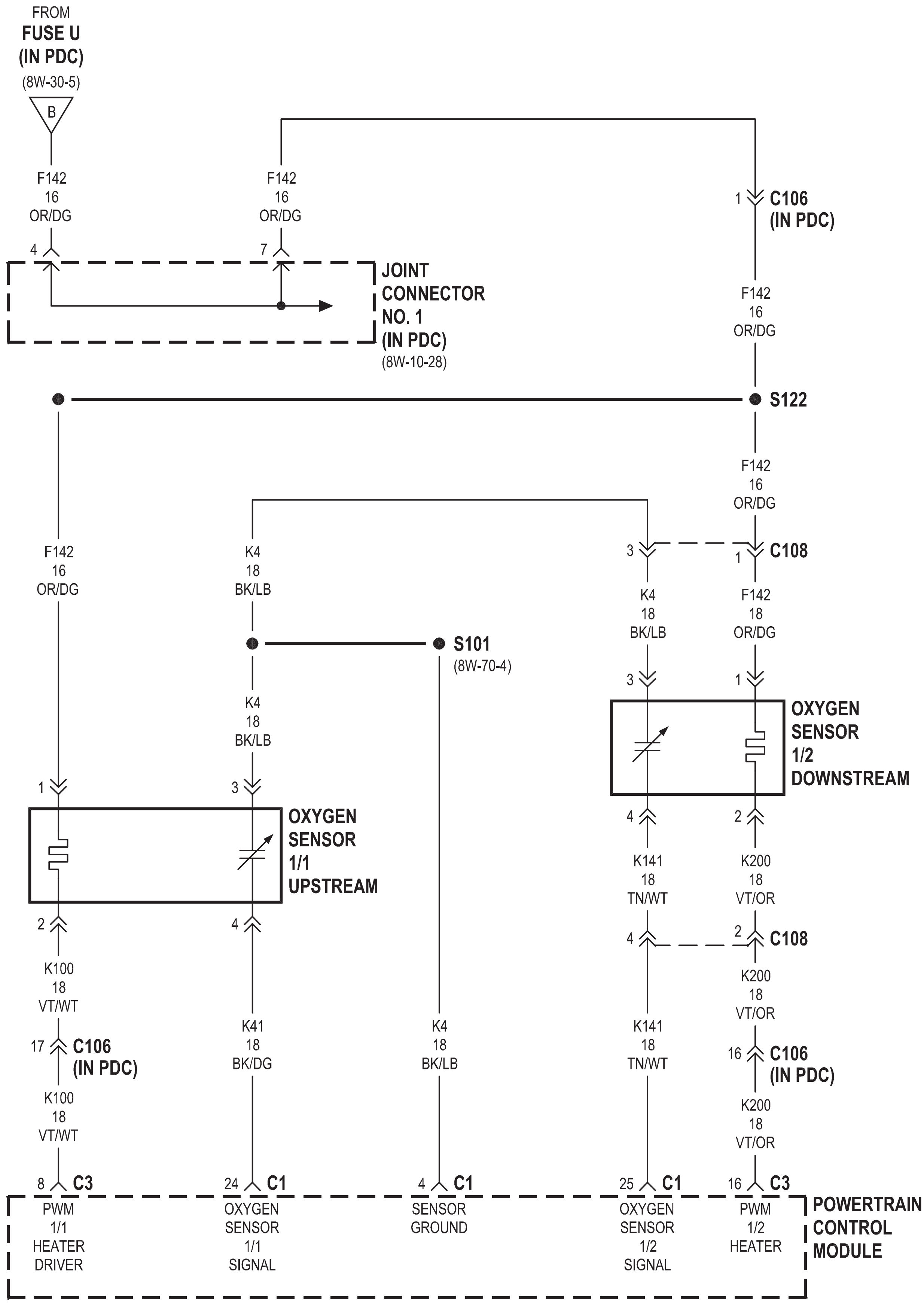

RUN-START A21
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
21
22
FUSE 11 10A (8W-12-12)
19
20
FUSE 10 10A (8W-12-10)
7 C3
4 C3
F12 20 DB/WT
10
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-37)
12
F12 20 DB/WT
2
DUTY CYCLE EVAP/PURGE SOLENOID
1
K52 18 PK/BK
20 C3
F18 20 LG/BK
86
85
K31 18 BR
19 C3
POWERTRAIN CONTROL MODULE
DUTY CYCLE EVAP/PURGE SOLENOID CONTROL
FUEL PUMP RELAY CONTROL
BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 2 20A (8W-10-23)
2
A14 16 RD/WT
22
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-23)
23
A14 16 RD/WT
30
FUEL PUMP RELAY (IN PDC)
87
A61 16 DG/BK
13 C352
A61 16 DG/BK
A
TO FUEL PUMP MODULE
(8W-30-4)


FROM
C352
(8W-30-3)
A
A61
16
DG/BK
4
FUEL
PUMP
MODULE
M
3
2
1
K226
18
DB/WT
K4
18
BK/LB
Z1
18
BK
12
11
C352
S306
(8W-15-5)
K4
18
BK/LB
7
JOINT
CONNECTOR
NO. 3
(IN PDC)
(8W-10-39)
8
Z1
16
BK
K4
18
BK/LB
21
C106
(IN PDC)
14
C352
K226
18
DB/WT
K4
18
BK/LB
S103
(8W-70-3)
K4
18
BK/LB
Z1
16
BK
S101
(8W-70-4)
K4
18
BK/LB
26
C3
4
C1
FUEL PUMP
RELAY
CONTROL
SENSOR
GROUND
POWERTRAIN
CONTROL
MODULE
G113
(8W-15-6)

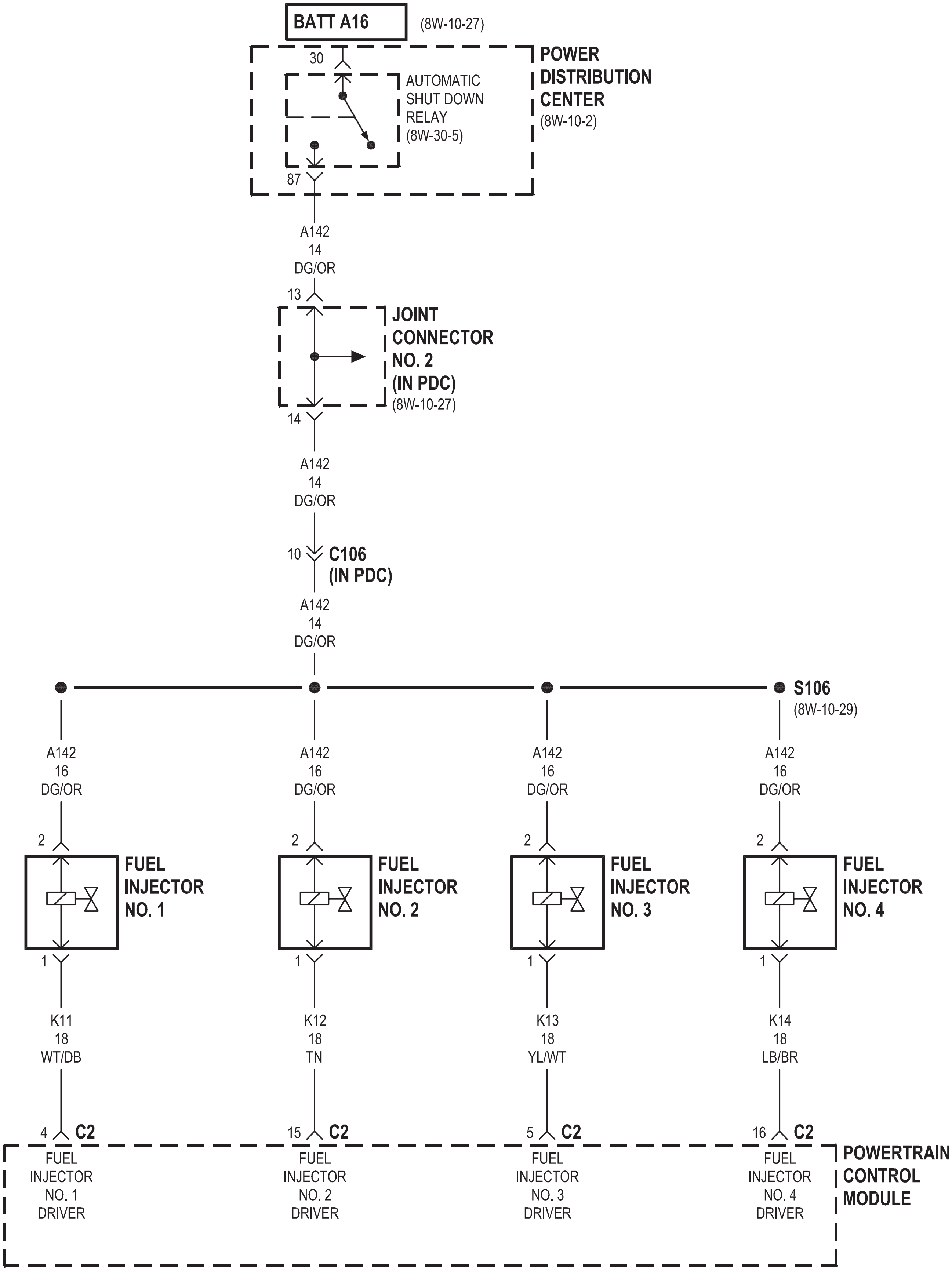
2.5L

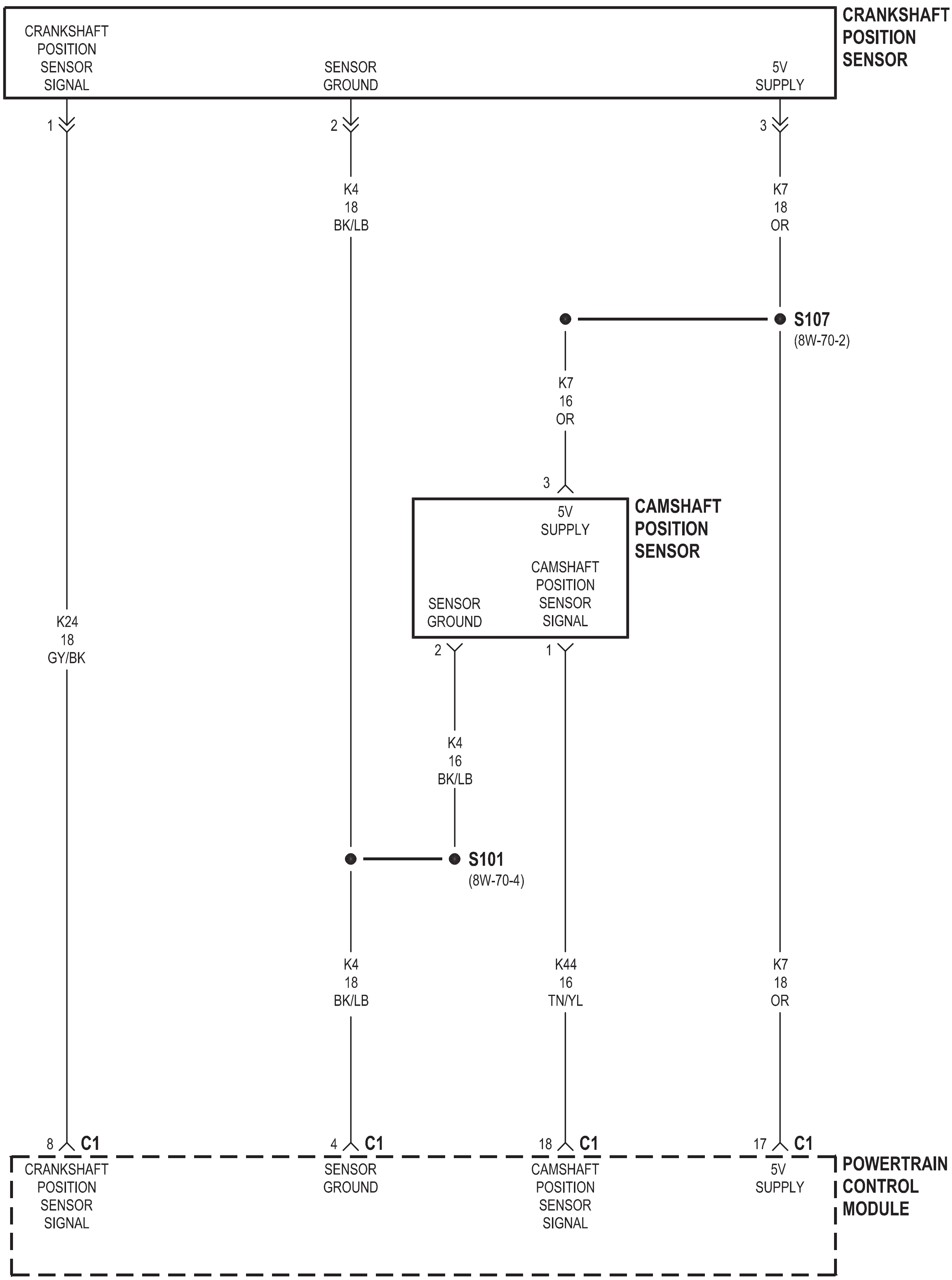

BATT A14
(8W-10-23)
BATT A16
(8W-10-27)
POWER DISTRIBUTION CENTER
(8W-10-2)
86
30
85
87
AUTOMATIC SHUT DOWN RELAY
U4
FUSE U 20A
(8W-10-27)
U8
A142 14 DG/OR
A142 14 DG/OR
F142 16 OR/DG
13
15
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-27)
14
B
TO JOINT CONNECTOR NO. 1 (IN PDC)
(8W-30-6)
A142 14 DG/OR
10
C106 (IN PDC)
A142 14 DG/OR
S106
(8W-10-29)
K51 18 DB/YL
A142 14 DG/OR
A142 16 DG/OR
1
IGNITION COIL
2
8
C105
A142 14 DG/OR
K19 16 BK/GY
3 C3
12 C3
7 C1
AUTOMATIC SHUT DOWN RELAY CONTROL
AUTOMATIC SHUT DOWN RELAY OUTPUT
IGNITION COIL NO. 1 DRIVER
POWERTRAIN CONTROL MODULE

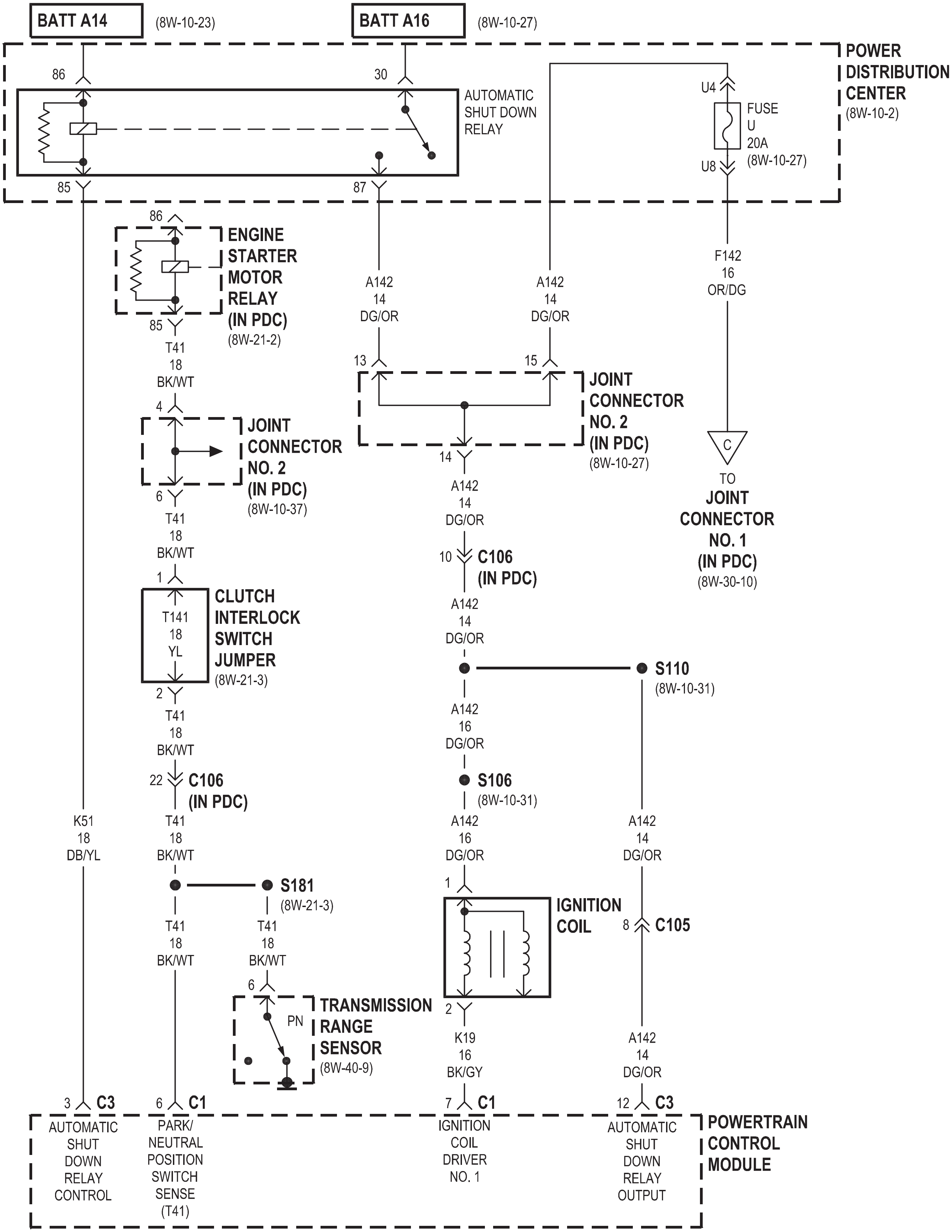
2.5L

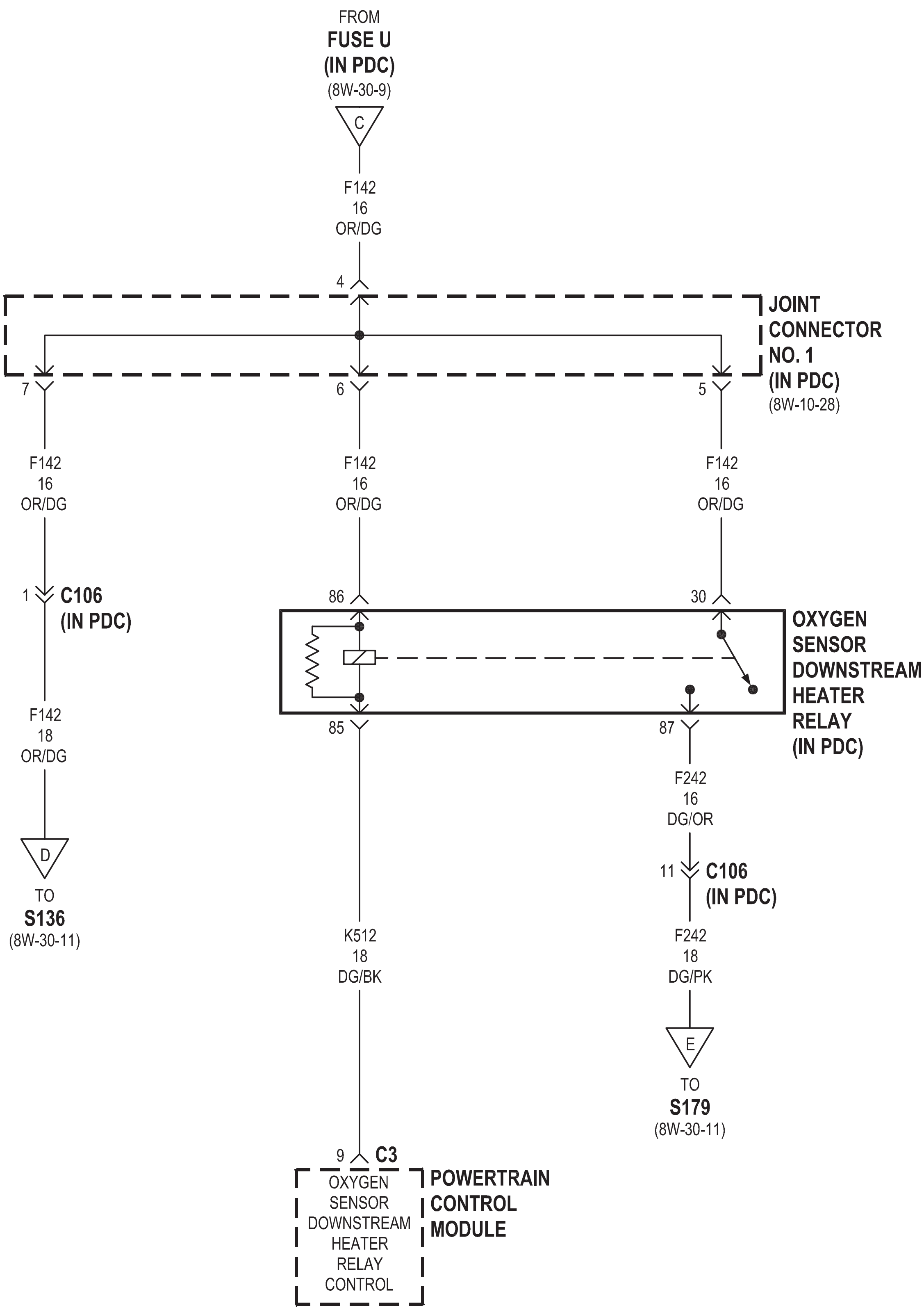

FROM
FUSE U
(IN PDC)
(8W-30-5)
B
F142
16
OR/DG
4
7
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-10-28)
1
C106
(IN PDC)
S122
C108
3
K4
18
BK/LB
S101
(8W-70-4)
K41
BK/DG
OXYGEN
SENSOR
1/1
UPSTREAM
OXYGEN
SENSOR
1/2
DOWNSTREAM
K100
VT/WT
K141
TN/WT
K200
VT/OR
17
C106
(IN PDC)
16
8 C3
24 C1
4 C1
25 C1
16 C3
PWM
1/1
HEATER
DRIVER
OXYGEN
SENSOR
1/1
SIGNAL
SENSOR
GROUND
OXYGEN
SENSOR
1/2
SIGNAL
PWM
1/2
HEATER
POWERTRAIN
CONTROL
MODULE

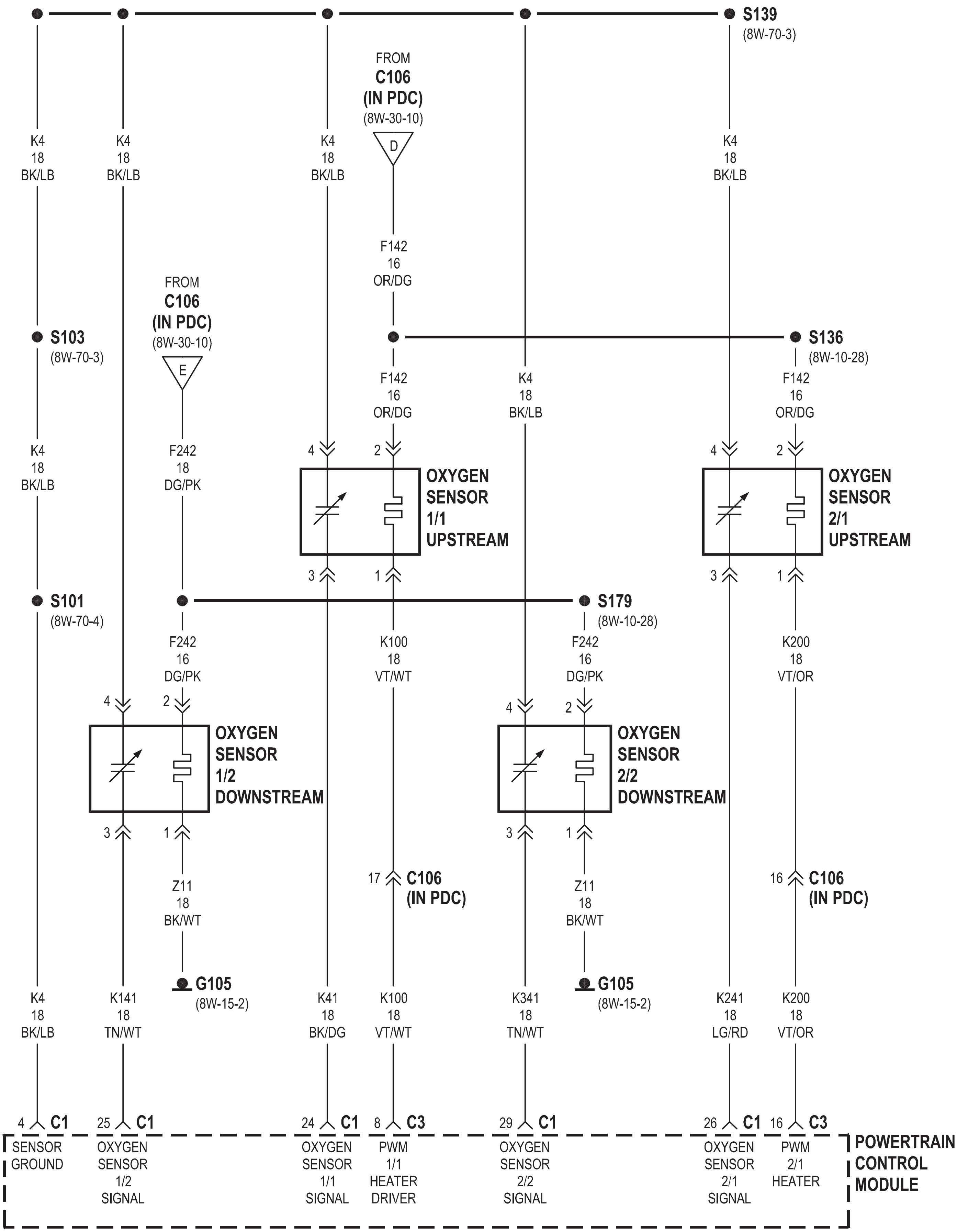
2.5L

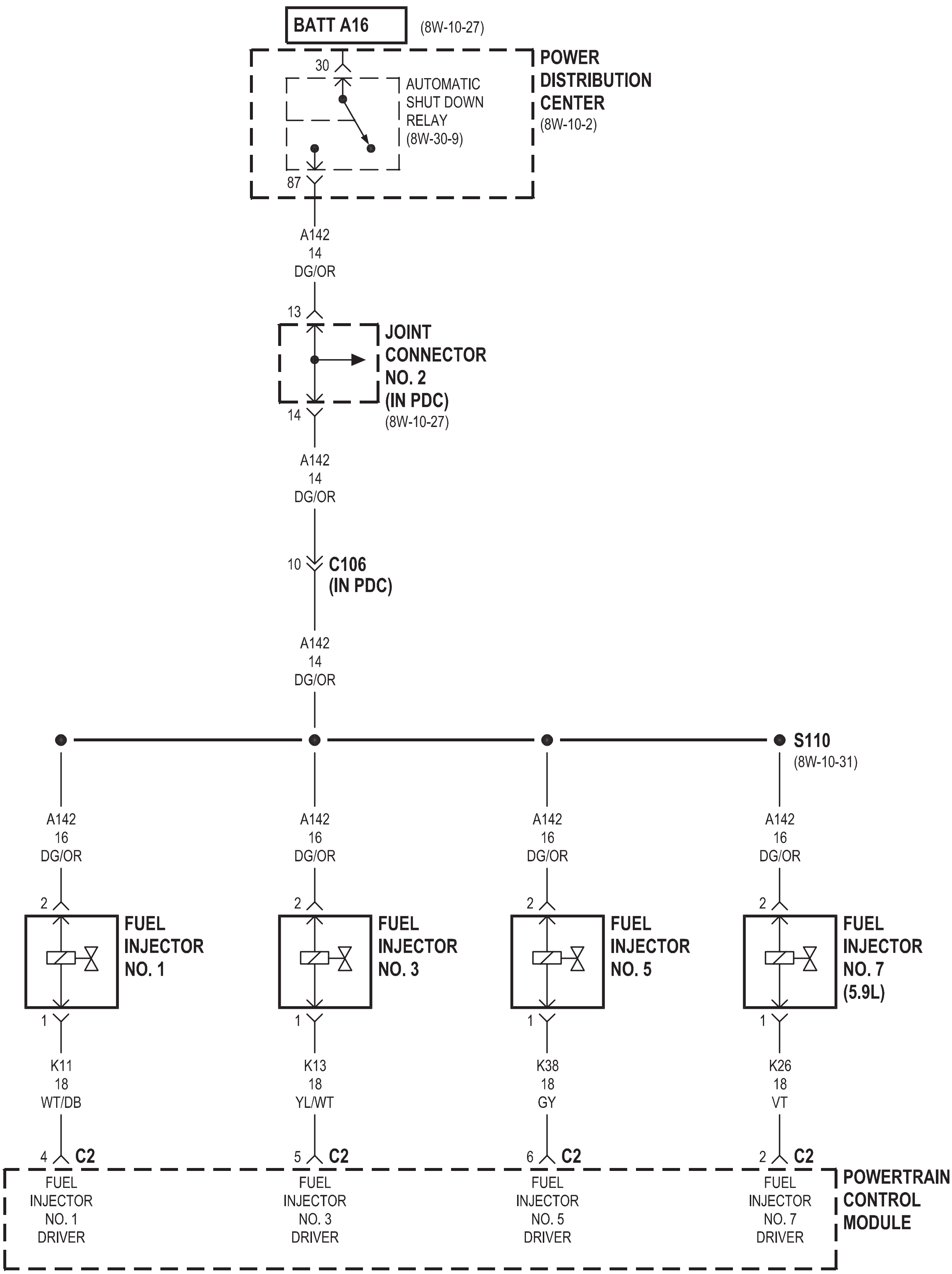

BATT A16
(8W-10-27)
30
AUTOMATIC
SHUT DOWN
RELAY
(8W-30-5)
87
POWER
DISTRIBUTION
CENTER
(8W-10-2)
A142
14
DG/OR
13
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-27)
14
A142
14
DG/OR
10
C106
(IN PDC)
A142
14
DG/OR
S106
(8W-10-29)
A142
16
DG/OR
2
FUEL
INJECTOR
NO. 1
1
K11
18
WT/DB
4
C2
FUEL
INJECTOR
NO. 2
K12
18
TN
15
FUEL
INJECTOR
NO. 3
K13
18
YL/WT
5
FUEL
INJECTOR
NO. 4
K14
18
LB/BR
16
FUEL
INJECTOR
NO. 1
DRIVER
FUEL
INJECTOR
NO. 2
DRIVER
FUEL
INJECTOR
NO. 3
DRIVER
FUEL
INJECTOR
NO. 4
DRIVER
POWERTRAIN
CONTROL
MODULE

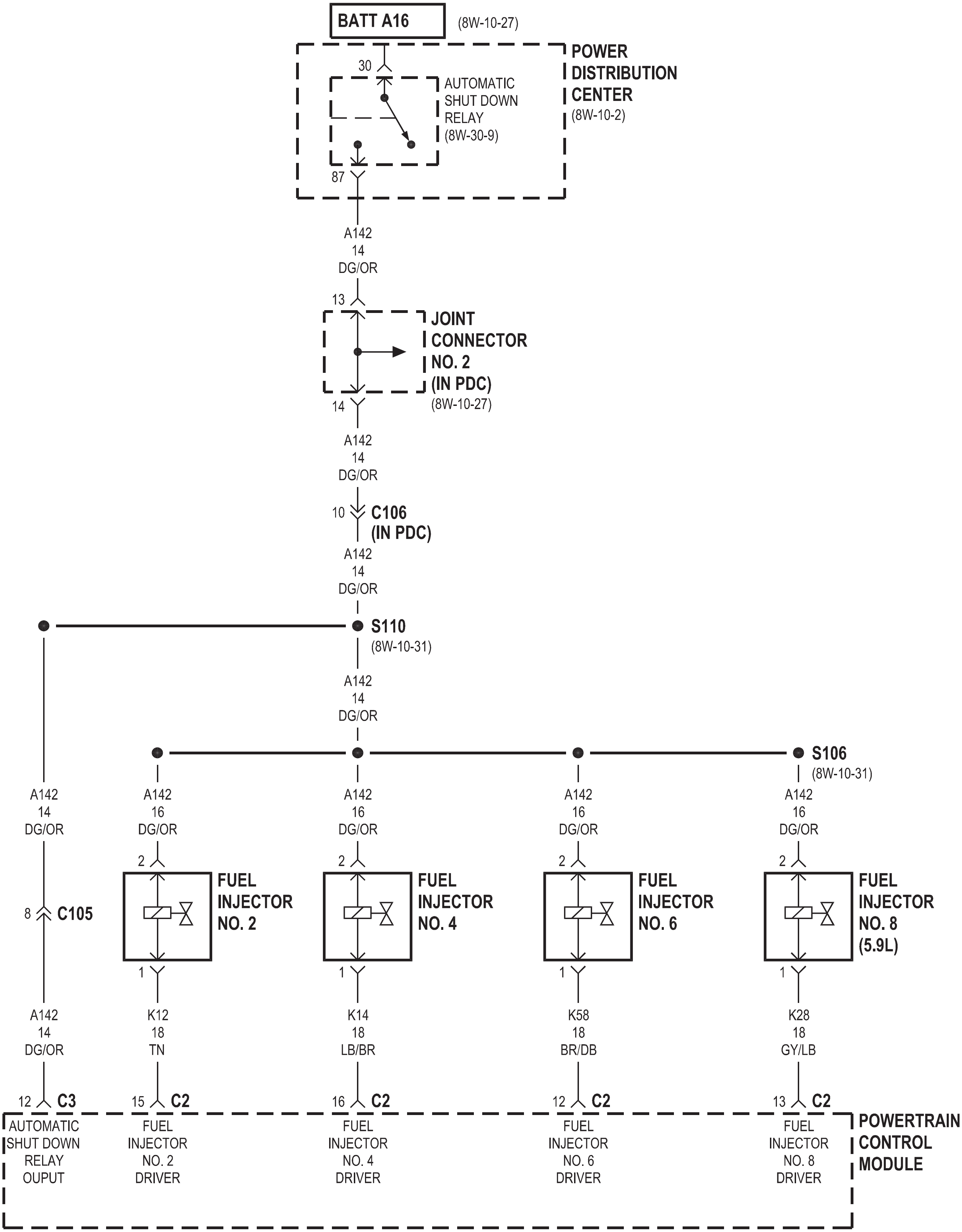

CRANKSHAFT POSITION SENSOR
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
5V SUPPLY
1
2
3
K4 18 BK/LB
K7 18 OR
S107
(8W-70-2)
K7 16 OR
3
CAMSHAFT POSITION SENSOR
5V SUPPLY
CAMSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
2
1
K24 18 GY/BK
K4 16 BK/LB
S101
(8W-70-4)
K4 18 BK/LB
K44 16 TN/YL
K7 18 OR
8 C1
4 C1
18 C1
17 C1
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
CAMSHAFT POSITION SENSOR SIGNAL
5V SUPPLY
POWERTRAIN CONTROL MODULE

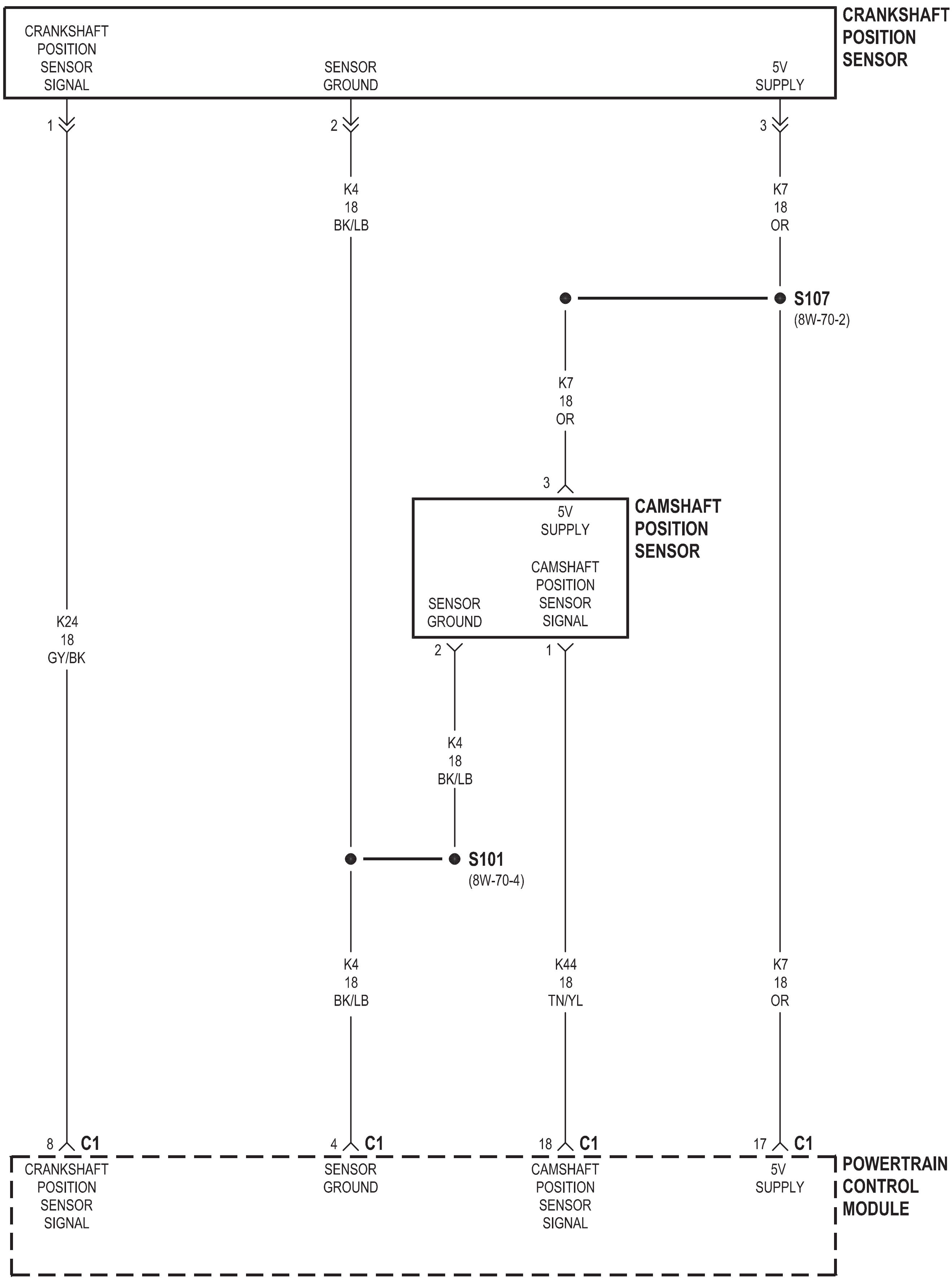

BATT A14
(8W-10-23)
BATT A16
(8W-10-27)
POWER DISTRIBUTION CENTER
(8W-10-2)
86
30
AUTOMATIC SHUT DOWN RELAY
U4
FUSE U 20A
(8W-10-27)
U8
85
87
86
ENGINE STARTER MOTOR RELAY (IN PDC)
(8W-21-2)
85
T41 18 BK/WT
A142 14 DG/OR
A142 14 DG/OR
F142 16 OR/DG
13
15
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-27)
14
4
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-37)
6
C
TO JOINT CONNECTOR NO. 1 (IN PDC)
(8W-30-10)
A142 14 DG/OR
T41 18 BK/WT
10
C106 (IN PDC)
1
CLUTCH INTERLOCK SWITCH JUMPER
(8W-21-3)
T141 18 YL
2
A142 14 DG/OR
S110
(8W-10-31)
T41 18 BK/WT
A142 16 DG/OR
22
C106 (IN PDC)
S106
(8W-10-31)
K51 18 DB/YL
T41 18 BK/WT
A142 16 DG/OR
A142 14 DG/OR
S181
(8W-21-3)
1
IGNITION COIL
T41 18 BK/WT
T41 18 BK/WT
8
C105
6
PN
TRANSMISSION RANGE SENSOR
(8W-40-9)
2
K19 16 BK/GY
A142 14 DG/OR
3 C3
6 C1
7 C1
12 C3
AUTOMATIC SHUT DOWN RELAY CONTROL
PARK/ NEUTRAL POSITION SWITCH SENSE (T41)
IGNITION COIL DRIVER NO. 1
AUTOMATIC SHUT DOWN RELAY OUTPUT
POWERTRAIN CONTROL MODULE

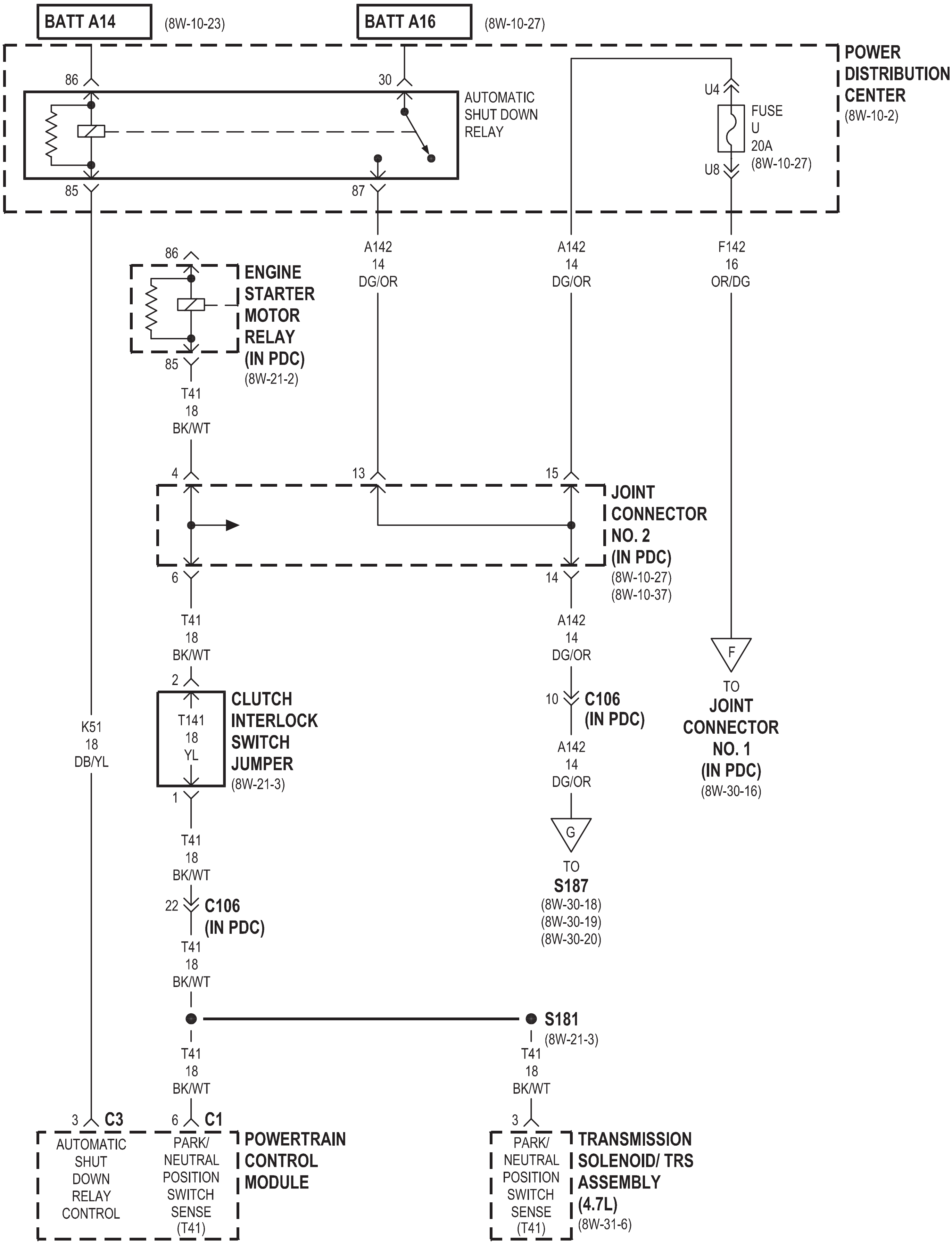

FROM
FUSE U
(IN PDC)
(8W-30-9)
C
F142
16
OR/DG
4
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-10-28)
7
6
5
F142
16
OR/DG
F142
16
OR/DG
F142
16
OR/DG
1
C106
(IN PDC)
86
30
OXYGEN
SENSOR
DOWNSTREAM
HEATER
RELAY
(IN PDC)
85
87
F142
18
OR/DG
F242
16
DG/OR
D
TO
S136
(8W-30-11)
11
C106
(IN PDC)
K512
18
DG/BK
F242
18
DG/PK
E
TO
S179
(8W-30-11)
9
C3
OXYGEN
SENSOR
DOWNSTREAM
HEATER
RELAY
CONTROL
POWERTRAIN
CONTROL
MODULE

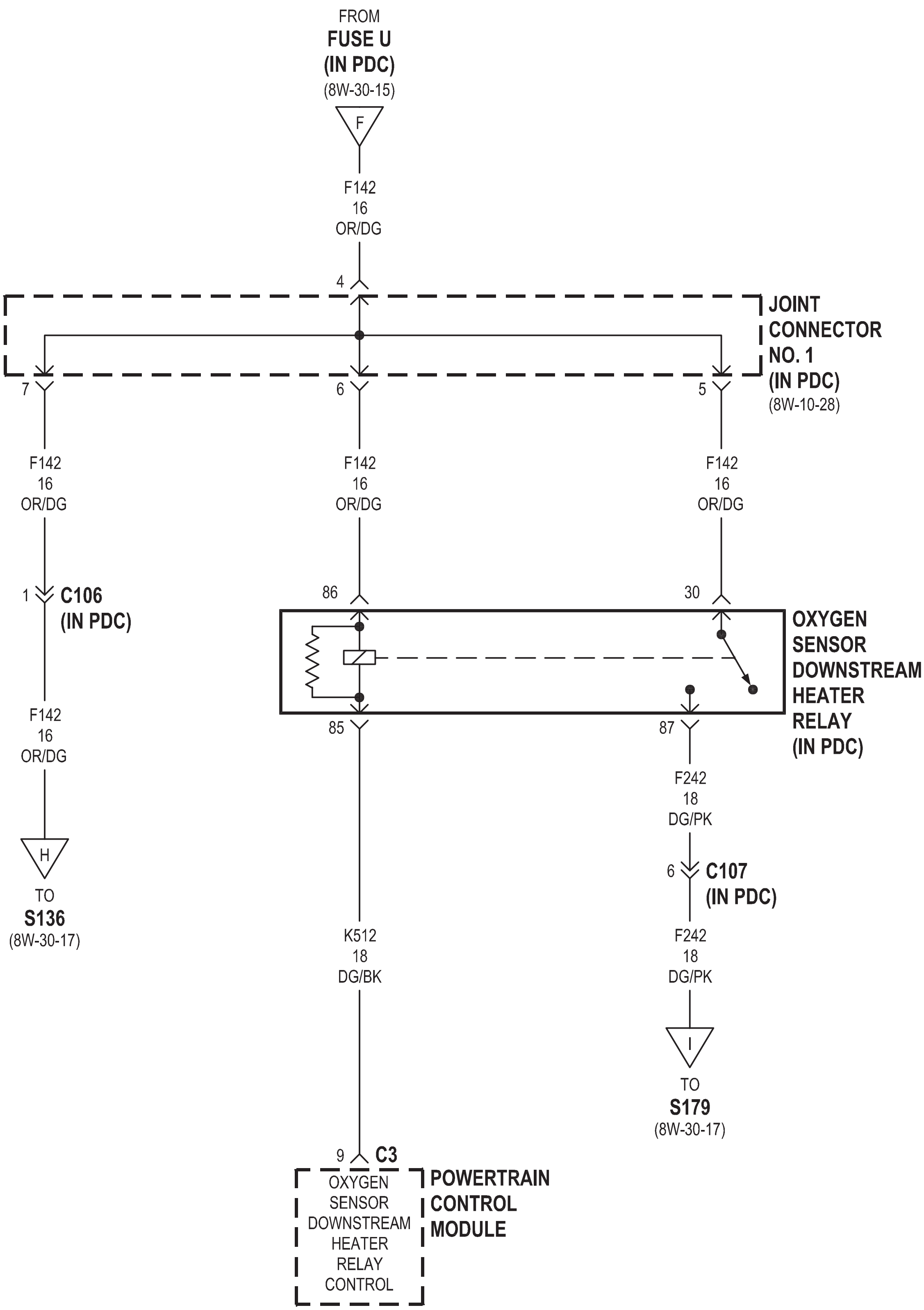

S139
(8W-70-3)
FROM
C106
(IN PDC)
(8W-30-10)
D
K4
18
BK/LB
F142
16
OR/DG
S103
(8W-70-3)
FROM
C106
(IN PDC)
(8W-30-10)
E
S136
(8W-10-28)
F242
18
DG/PK
OXYGEN
SENSOR
1/1
UPSTREAM
OXYGEN
SENSOR
2/1
UPSTREAM
S101
(8W-70-4)
S179
(8W-10-28)
F242
16
DG/PK
K100
18
VT/WT
K200
18
VT/OR
OXYGEN
SENSOR
1/2
DOWNSTREAM
OXYGEN
SENSOR
2/2
DOWNSTREAM
C106
(IN PDC)
Z11
18
BK/WT
G105
(8W-15-2)
K141
18
TN/WT
K41
18
BK/DG
K341
18
TN/WT
K241
18
LG/RD
C1
C3
SENSOR
GROUND
OXYGEN
SENSOR
1/2
SIGNAL
OXYGEN
SENSOR
1/1
SIGNAL
PWM
1/1
HEATER
DRIVER
OXYGEN
SENSOR
2/2
SIGNAL
OXYGEN
SENSOR
2/1
SIGNAL
PWM
2/1
HEATER
POWERTRAIN
CONTROL
MODULE

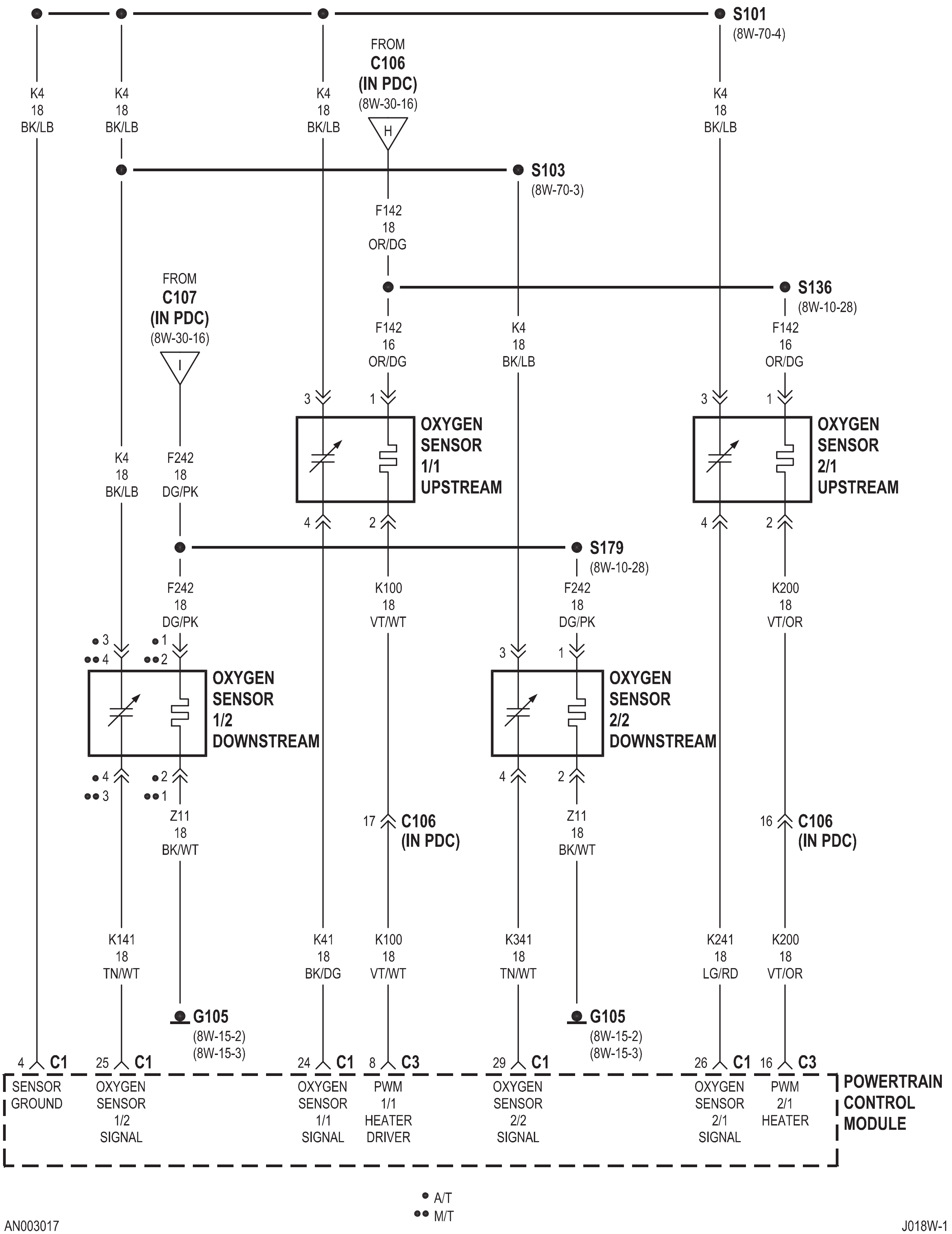

BATT A16
(8W-10-27)
30
AUTOMATIC
SHUT DOWN
RELAY
(8W-30-9)
87
POWER
DISTRIBUTION
CENTER
(8W-10-2)
A142
14
DG/OR
13
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-27)
14
A142
14
DG/OR
10
C106
(IN PDC)
A142
14
DG/OR
S110
(8W-10-31)
A142
16
DG/OR
2
FUEL
INJECTOR
NO. 1
1
K11
18
WT/DB
4
C2
FUEL
INJECTOR
NO. 3
K13
18
YL/WT
5
FUEL
INJECTOR
NO. 5
K38
18
GY
6
FUEL
INJECTOR
NO. 7
(5.9L)
K26
18
VT
FUEL
INJECTOR
NO. 1
DRIVER
FUEL
INJECTOR
NO. 3
DRIVER
FUEL
INJECTOR
NO. 5
DRIVER
FUEL
INJECTOR
NO. 7
DRIVER
POWERTRAIN
CONTROL
MODULE


BATT A16
(8W-10-27)
POWER DISTRIBUTION CENTER
(8W-10-2)
30
AUTOMATIC SHUT DOWN RELAY
(8W-30-9)
87
A142
14
DG/OR
13
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-27)
14
A142
14
DG/OR
10
C106 (IN PDC)
A142
14
DG/OR
S110
(8W-10-31)
A142
14
DG/OR
S106
(8W-10-31)
A142
14
DG/OR
8
C105
A142
14
DG/OR
A142
16
DG/OR
2
FUEL INJECTOR NO. 2
1
K12
18
TN
A142
16
DG/OR
2
FUEL INJECTOR NO. 4
1
K14
18
LB/BR
A142
16
DG/OR
2
FUEL INJECTOR NO. 6
1
K58
18
BR/DB
A142
16
DG/OR
2
FUEL INJECTOR NO. 8 (5.9L)
1
K28
18
GY/LB
12 C3
15 C2
16 C2
12 C2
13 C2
AUTOMATIC SHUT DOWN RELAY OUPUT
FUEL INJECTOR NO. 2 DRIVER
FUEL INJECTOR NO. 4 DRIVER
FUEL INJECTOR NO. 6 DRIVER
FUEL INJECTOR NO. 8 DRIVER
POWERTRAIN CONTROL MODULE

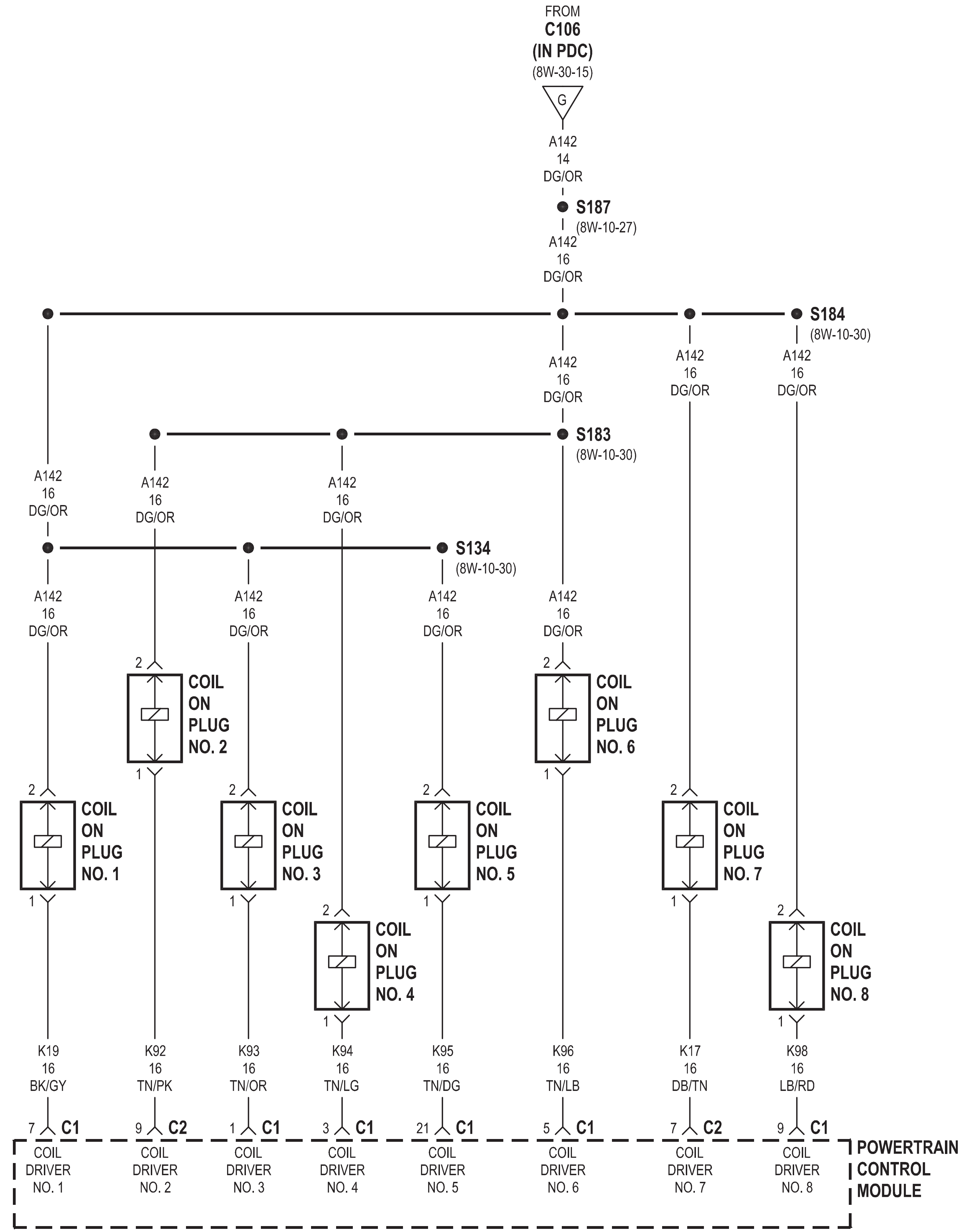

CRANKSHAFT POSITION SENSOR
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
5V SUPPLY
1
2
3
K4 18 BK/LB
K7 18 OR
S107
(8W-70-2)
K7 18 OR
3
CAMSHAFT POSITION SENSOR
5V SUPPLY
CAMSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
2
1
K24 18 GY/BK
K4 18 BK/LB
S101
(8W-70-4)
K4 18 BK/LB
K44 18 TN/YL
K7 18 OR
8 C1
4 C1
18 C1
17 C1
POWERTRAIN CONTROL MODULE
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
CAMSHAFT POSITION SENSOR SIGNAL
5V SUPPLY


BATT A14
(8W-10-23)
BATT A16
(8W-10-27)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
86
30
AUTOMATIC
SHUT DOWN
RELAY
U4
FUSE
U
20A
(8W-10-27)
U8
85
87
A142
14
DG/OR
A142
14
DG/OR
F142
16
OR/DG
86
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
(8W-21-2)
85
T41
18
BK/WT
4
13
15
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-27)
(8W-10-37)
6
14
T41
18
BK/WT
A142
14
DG/OR
F
TO
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-30-16)
2
T141
18
YL
CLUTCH
INTERLOCK
SWITCH
JUMPER
(8W-21-3)
1
10
C106
(IN PDC)
A142
14
DG/OR
K51
18
DB/YL
G
TO
S187
(8W-30-18)
(8W-30-19)
(8W-30-20)
T41
18
BK/WT
22
C106
(IN PDC)
T41
18
BK/WT
S181
(8W-21-3)
T41
18
BK/WT
T41
18
BK/WT
3
C3
6
C1
AUTOMATIC
SHUT
DOWN
RELAY
CONTROL
PARK/
NEUTRAL
POSITION
SWITCH
SENSE
(T41)
POWERTRAIN
CONTROL
MODULE
3
PARK/
NEUTRAL
POSITION
SWITCH
SENSE
(T41)
TRANSMISSION
SOLENOID/ TRS
ASSEMBLY
(4.7L)
(8W-31-6)

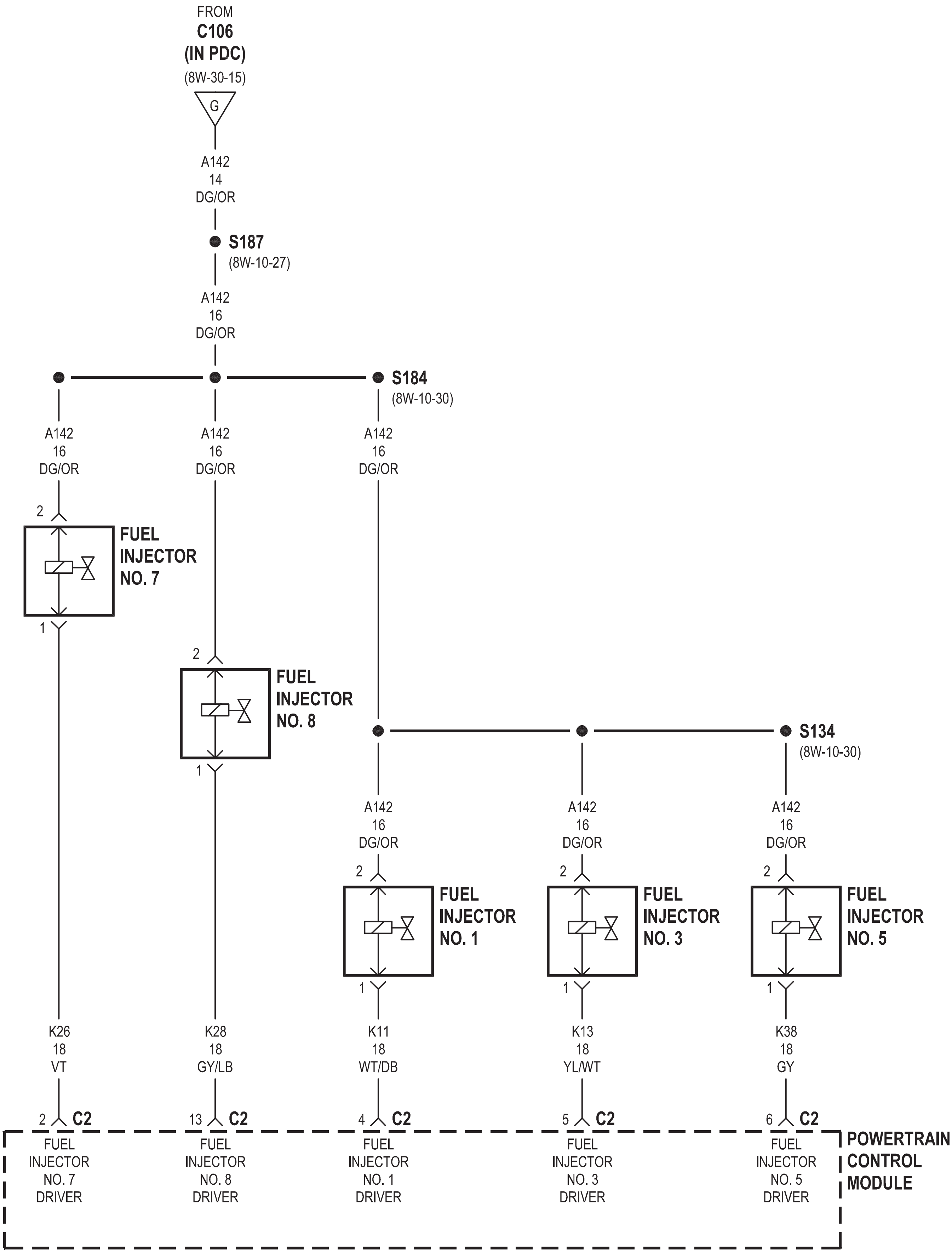

FROM
FUSE U
(IN PDC)
(8W-30-15)
F
F142
16
OR/DG
4
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-10-28)
7
6
5
F142
16
OR/DG
F142
16
OR/DG
F142
16
OR/DG
1
C106
(IN PDC)
F142
16
OR/DG
H
TO
S136
(8W-30-17)
86
30
OXYGEN
SENSOR
DOWNSTREAM
HEATER
RELAY
(IN PDC)
85
87
F242
18
DG/PK
6
C107
(IN PDC)
F242
18
DG/PK
I
TO
S179
(8W-30-17)
K512
18
DG/BK
9
C3
OXYGEN
SENSOR
DOWNSTREAM
HEATER
RELAY
CONTROL
POWERTRAIN
CONTROL
MODULE

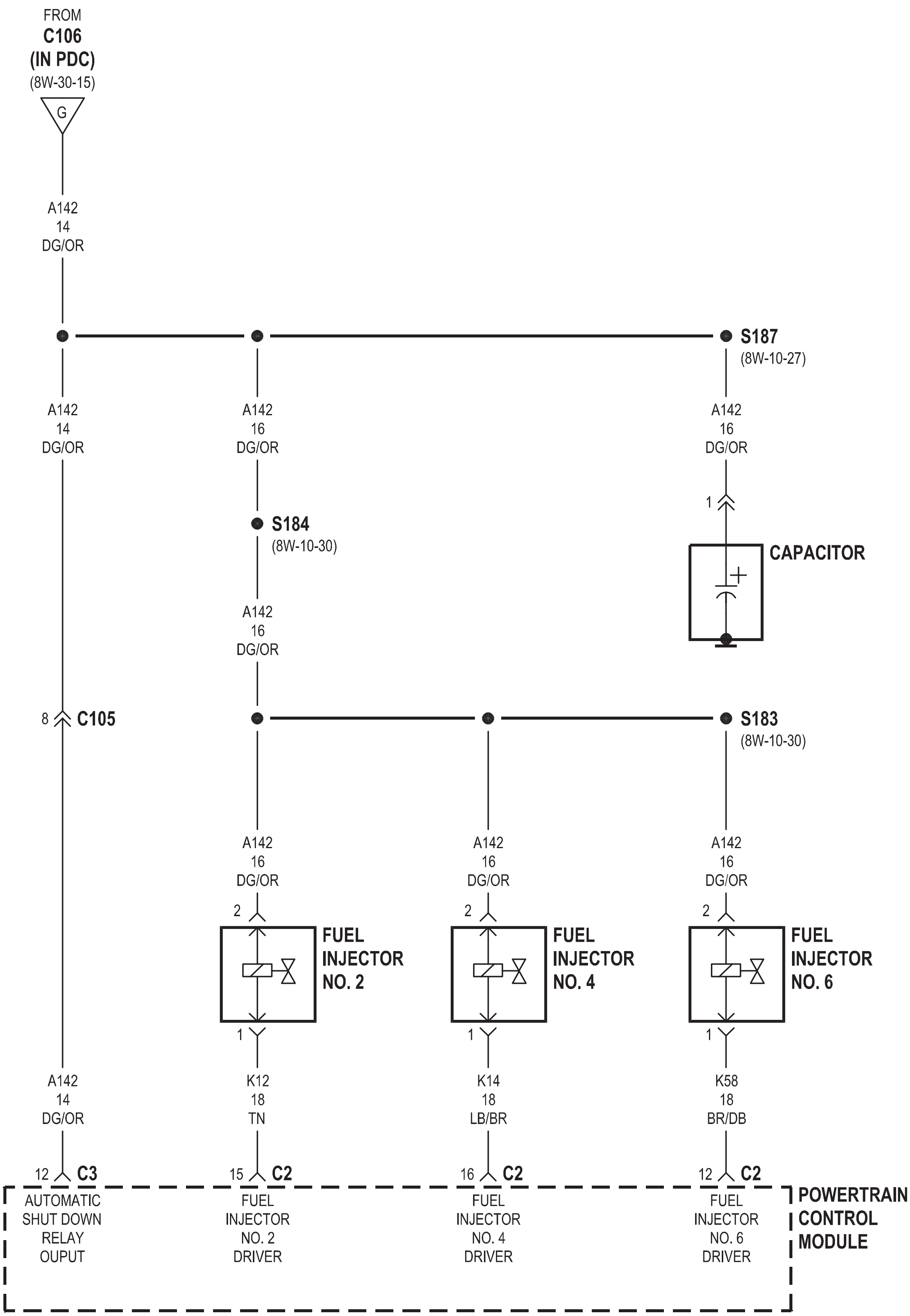

S101
(8W-70-4)
K4
18
BK/LB
FROM
C106
(IN PDC)
(8W-30-16)
H
S103
(8W-70-3)
F142
18
OR/DG
S136
(8W-10-28)
F142
16
OR/DG
FROM
C107
(IN PDC)
(8W-30-16)
I
F242
18
DG/PK
OXYGEN SENSOR 1/1 UPSTREAM
OXYGEN SENSOR 2/1 UPSTREAM
S179
(8W-10-28)
K100
18
VT/WT
K200
18
VT/OR
OXYGEN SENSOR 1/2 DOWNSTREAM
OXYGEN SENSOR 2/2 DOWNSTREAM
C106
(IN PDC)
Z11
18
BK/WT
K141
18
TN/WT
K41
18
BK/DG
K341
18
TN/WT
K241
18
LG/RD
G105
(8W-15-2)
(8W-15-3)
C1
C3
SENSOR GROUND
OXYGEN SENSOR 1/2 SIGNAL
OXYGEN SENSOR 1/1 SIGNAL
PWM 1/1 HEATER DRIVER
OXYGEN SENSOR 2/2 SIGNAL
OXYGEN SENSOR 2/1 SIGNAL
PWM 2/1 HEATER
POWERTRAIN CONTROL MODULE
● A/T
●● M/T

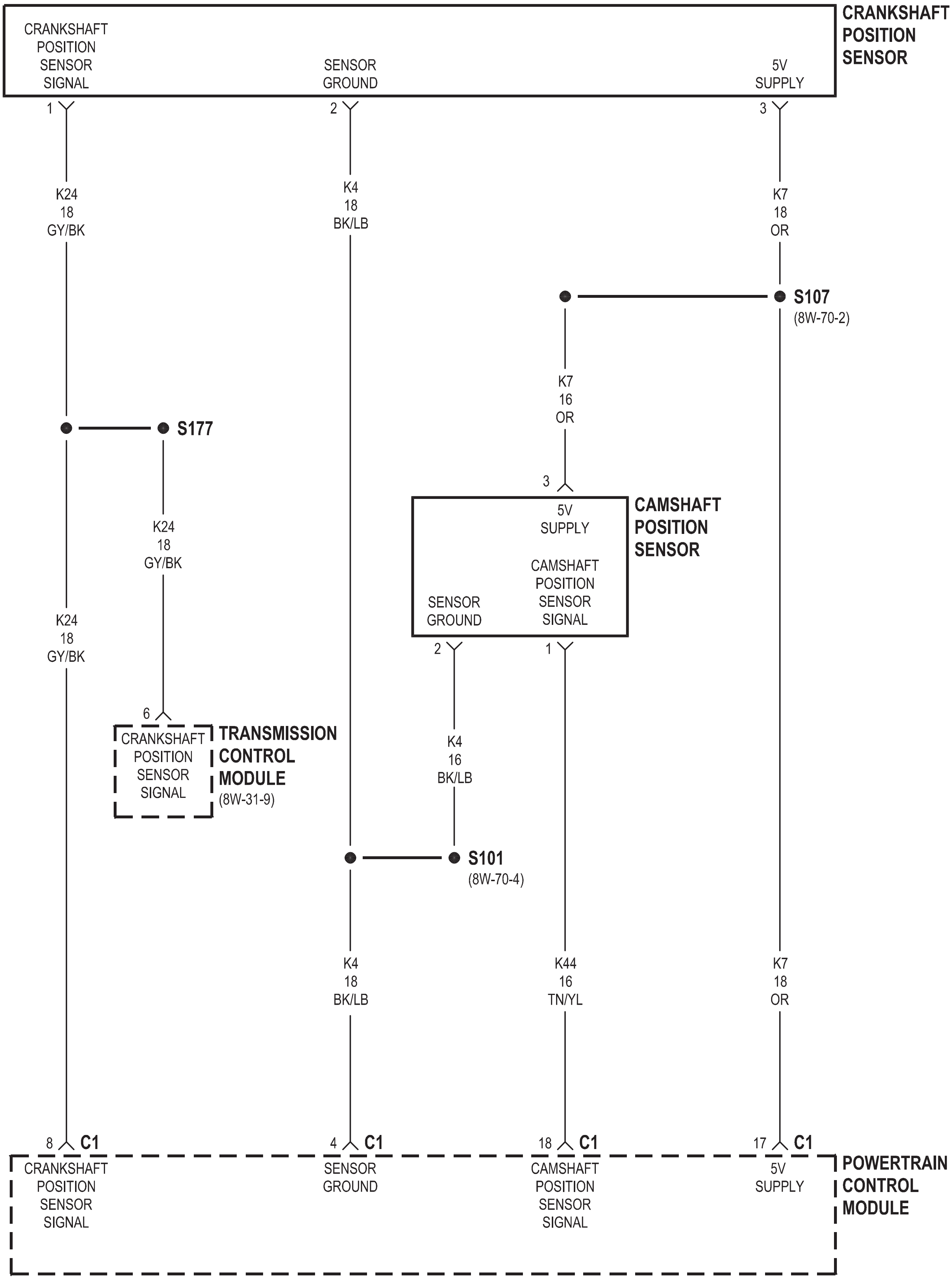
4.7L

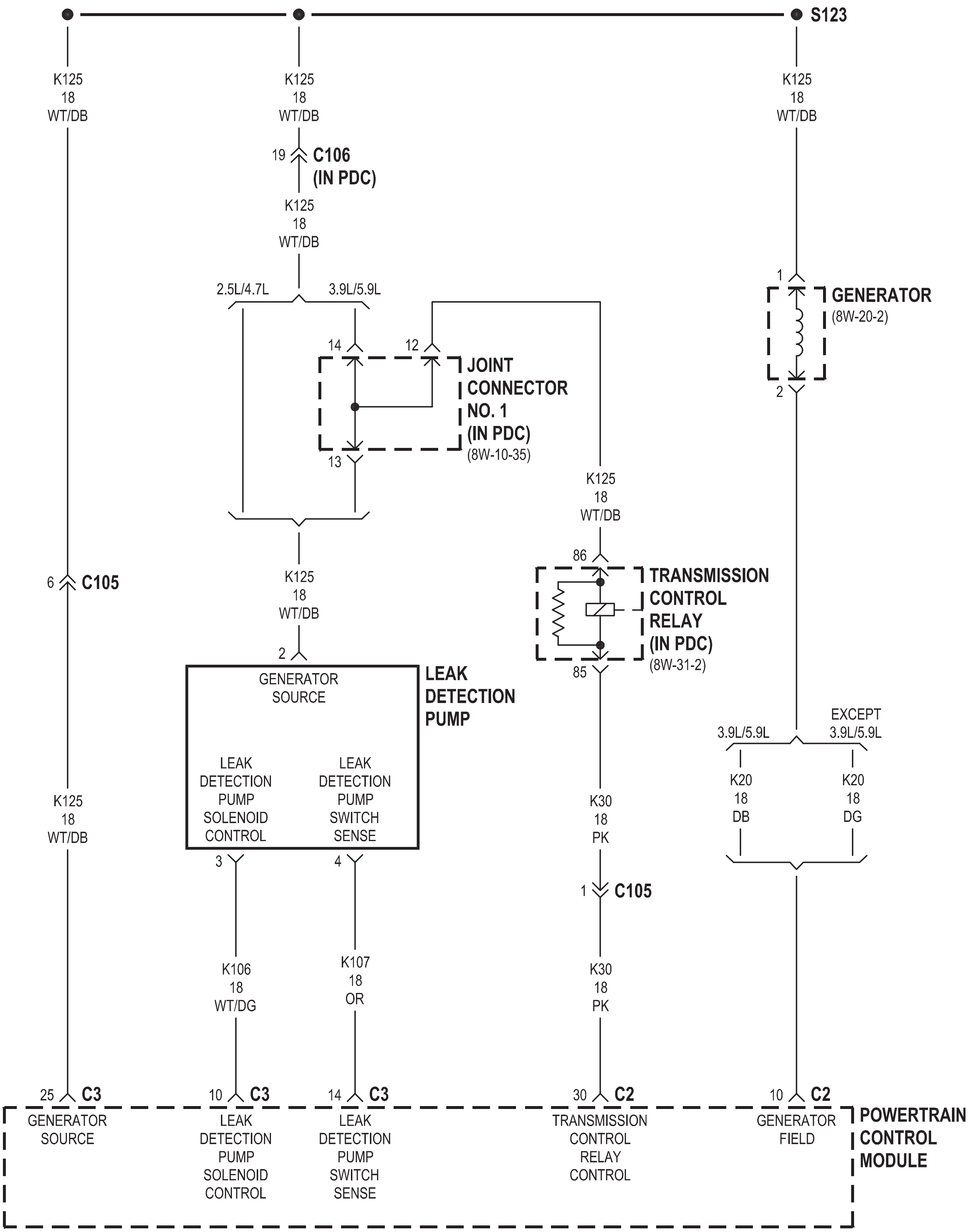


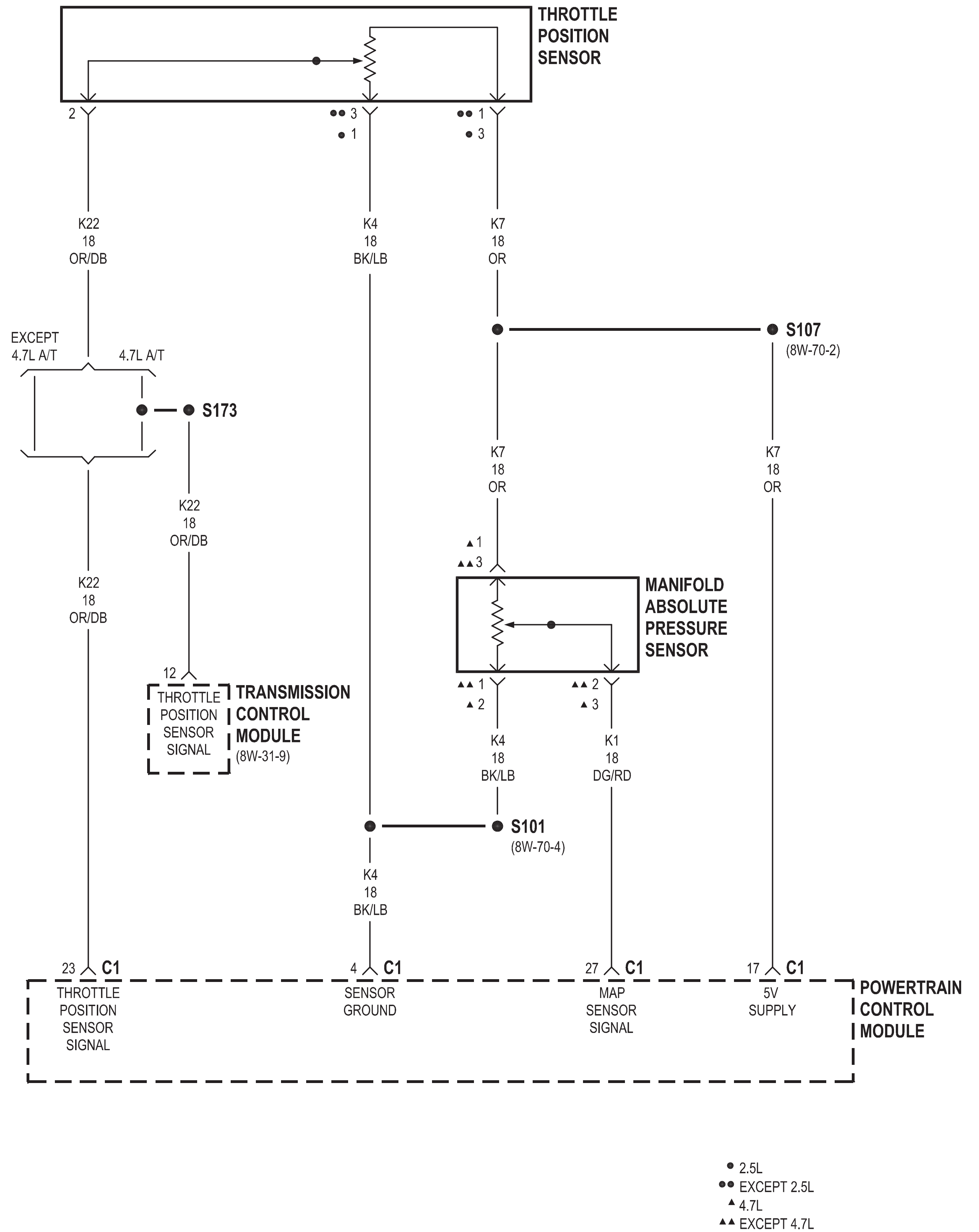
FROM
C106
(IN PDC)
(8W-30-15)
G
A142
14
DG/OR
S187
(8W-10-27)
A142
16
DG/OR
S184
(8W-10-30)
S183
(8W-10-30)
S134
(8W-10-30)
A142
16
DG/OR
COIL
ON
PLUG
NO. 1
COIL
ON
PLUG
NO. 2
COIL
ON
PLUG
NO. 3
COIL
ON
PLUG
NO. 4
COIL
ON
PLUG
NO. 5
COIL
ON
PLUG
NO. 6
COIL
ON
PLUG
NO. 7
COIL
ON
PLUG
NO. 8
K19
16
BK/GY
K92
16
TN/PK
K93
16
TN/OR
K94
16
TN/LG
K95
16
TN/DG
K96
16
TN/LB
K17
16
DB/TN
K98
16
LB/RD
7 C1
9 C2
1 C1
3 C1
21 C1
5 C1
7 C2
9 C1
COIL
DRIVER
NO. 1
COIL
DRIVER
NO. 2
COIL
DRIVER
NO. 3
COIL
DRIVER
NO. 4
COIL
DRIVER
NO. 5
COIL
DRIVER
NO. 6
COIL
DRIVER
NO. 7
COIL
DRIVER
NO. 8
POWERTRAIN
CONTROL
MODULE

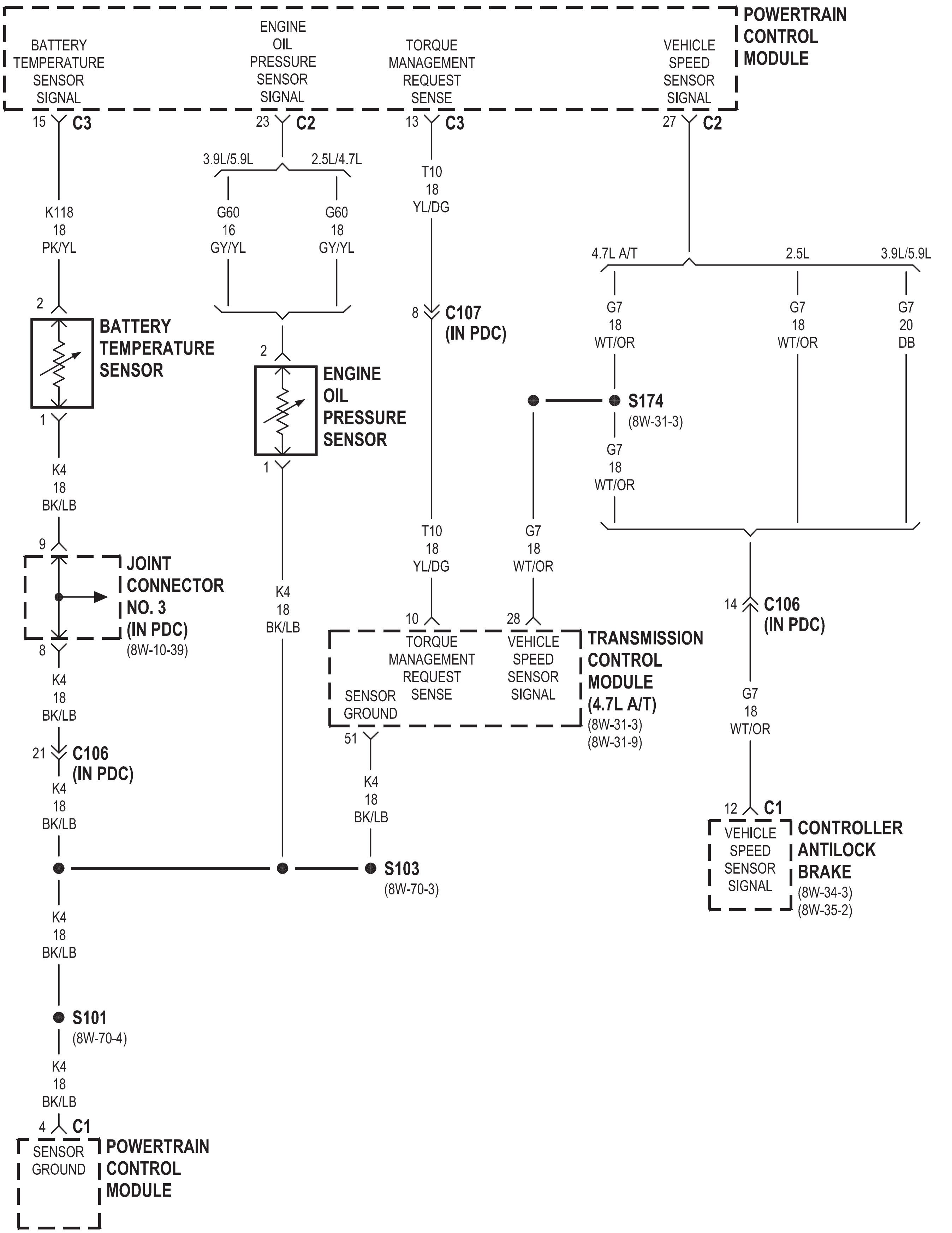

FROM
C106
(IN PDC)
(8W-30-15)
G
A142
14
DG/OR
S187
(8W-10-27)
A142
16
DG/OR
S184
(8W-10-30)
A142
16
DG/OR
A142
16
DG/OR
A142
16
DG/OR
2
FUEL
INJECTOR
NO. 7
1
2
FUEL
INJECTOR
NO. 8
1
S134
(8W-10-30)
A142
16
DG/OR
A142
16
DG/OR
A142
16
DG/OR
2
FUEL
INJECTOR
NO. 1
1
2
FUEL
INJECTOR
NO. 3
1
2
FUEL
INJECTOR
NO. 5
1
K26
18
VT
K28
18
GY/LB
K11
18
WT/DB
K13
18
YL/WT
K38
18
GY
2 C2
13 C2
4 C2
5 C2
6 C2
FUEL
INJECTOR
NO. 7
DRIVER
FUEL
INJECTOR
NO. 8
DRIVER
FUEL
INJECTOR
NO. 1
DRIVER
FUEL
INJECTOR
NO. 3
DRIVER
FUEL
INJECTOR
NO. 5
DRIVER
POWERTRAIN
CONTROL
MODULE

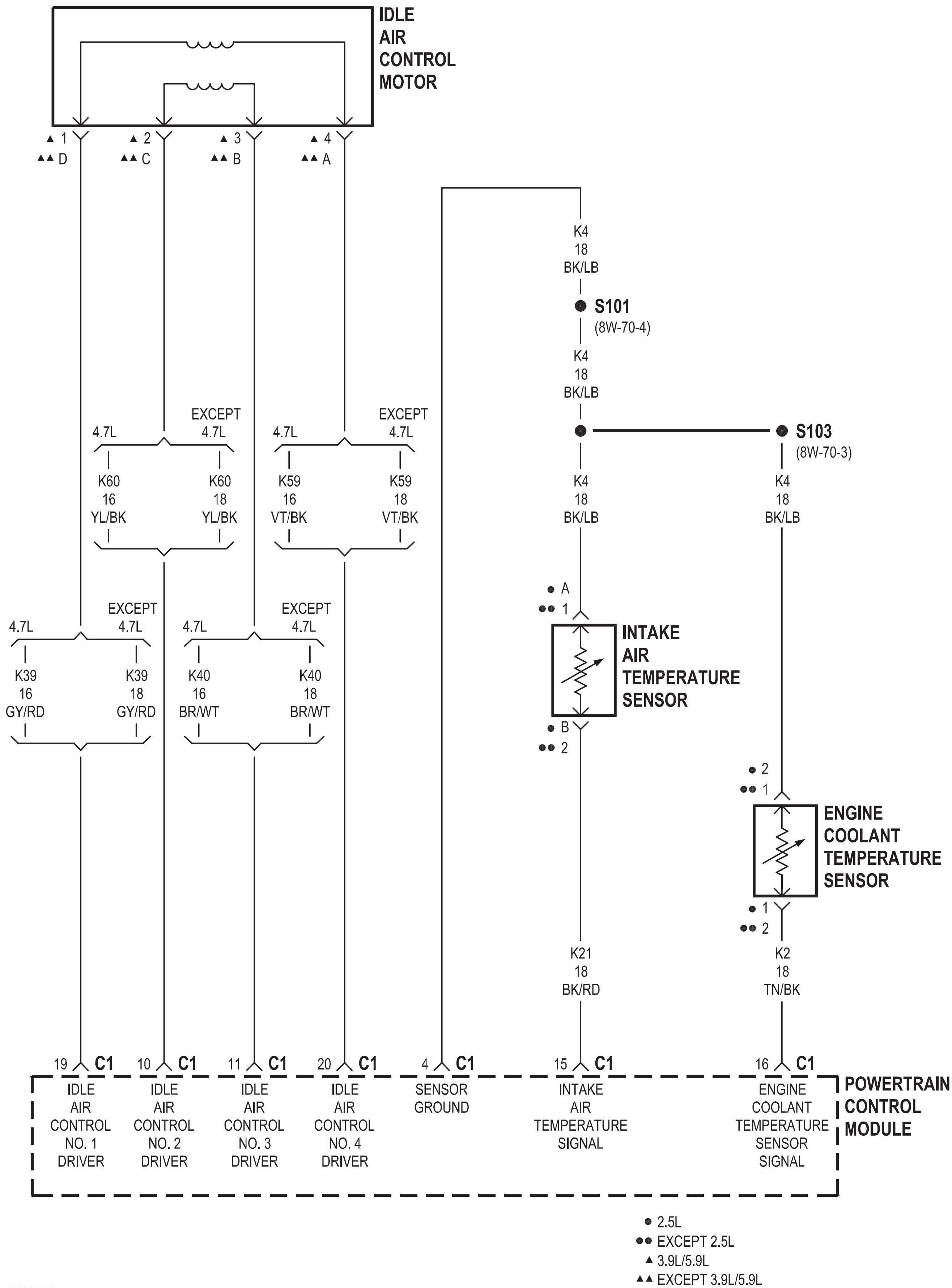

FROM
C106
(IN PDC)
(8W-30-15)
G
A142
14
DG/OR
S187
(8W-10-27)
A142
16
DG/OR
1
CAPACITOR
S184
(8W-10-30)
8
C105
S183
(8W-10-30)
2
FUEL
INJECTOR
NO. 2
FUEL
INJECTOR
NO. 4
FUEL
INJECTOR
NO. 6
K12
18
TN
K14
18
LB/BR
K58
18
BR/DB
12
C3
15
C2
16
C2
12
C2
AUTOMATIC
SHUT DOWN
RELAY
OUPUT
FUEL
INJECTOR
NO. 2
DRIVER
FUEL
INJECTOR
NO. 4
DRIVER
FUEL
INJECTOR
NO. 6
DRIVER
POWERTRAIN
CONTROL
MODULE

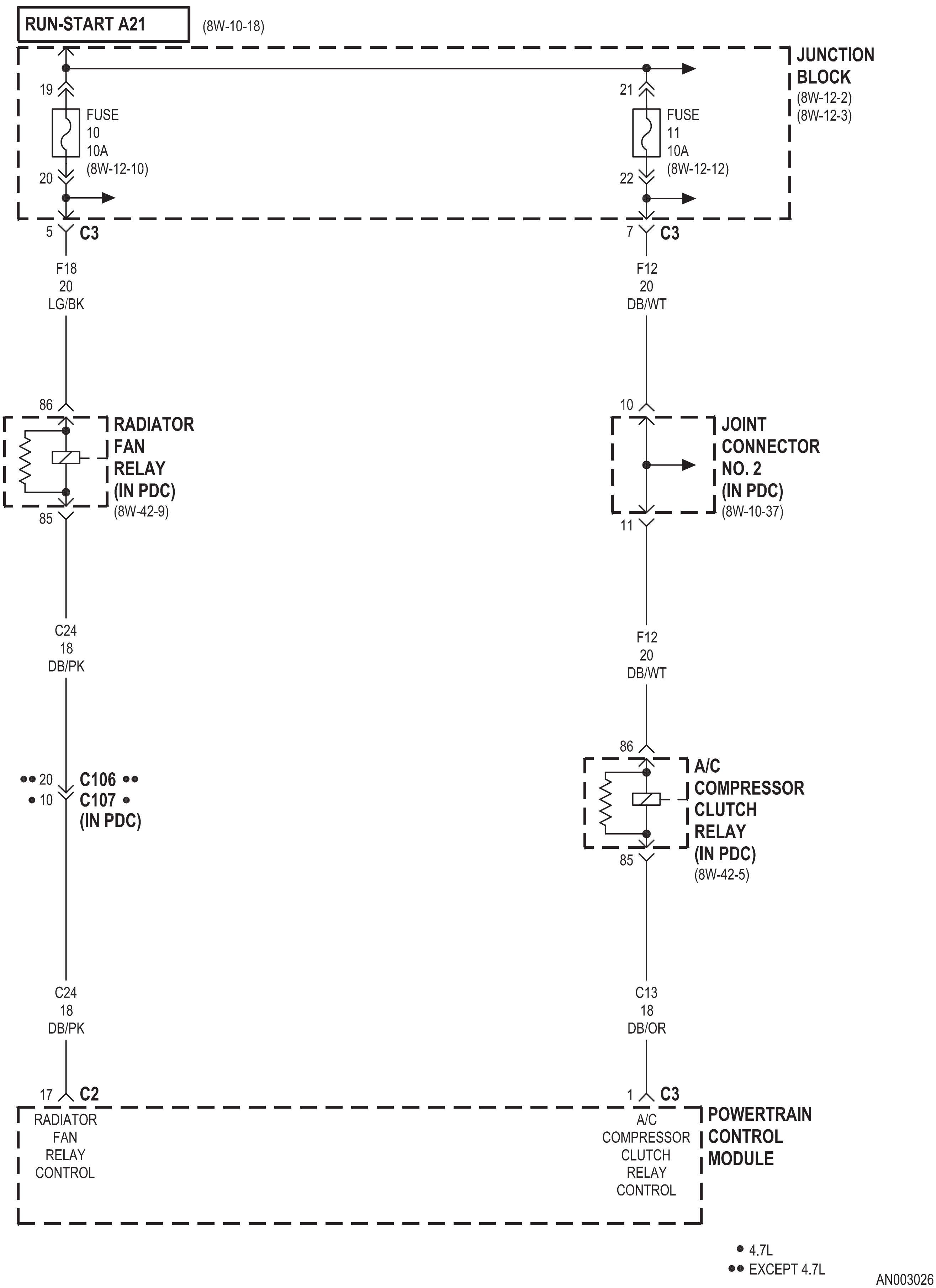

CRANKSHAFT POSITION SENSOR
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
5V SUPPLY
1
2
3
K24 18 GY/BK
K4 18 BK/LB
K7 18 OR
S107
(8W-70-2)
K7 16 OR
S177
K24 18 GY/BK
K24 18 GY/BK
3
CAMSHAFT POSITION SENSOR
5V SUPPLY
CAMSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
2
1
6
TRANSMISSION CONTROL MODULE
CRANKSHAFT POSITION SENSOR SIGNAL
(8W-31-9)
K4 16 BK/LB
S101
(8W-70-4)
K4 18 BK/LB
K44 16 TN/YL
K7 18 OR
8 C1
4 C1
18 C1
17 C1
POWERTRAIN CONTROL MODULE
CRANKSHAFT POSITION SENSOR SIGNAL
SENSOR GROUND
CAMSHAFT POSITION SENSOR SIGNAL
5V SUPPLY

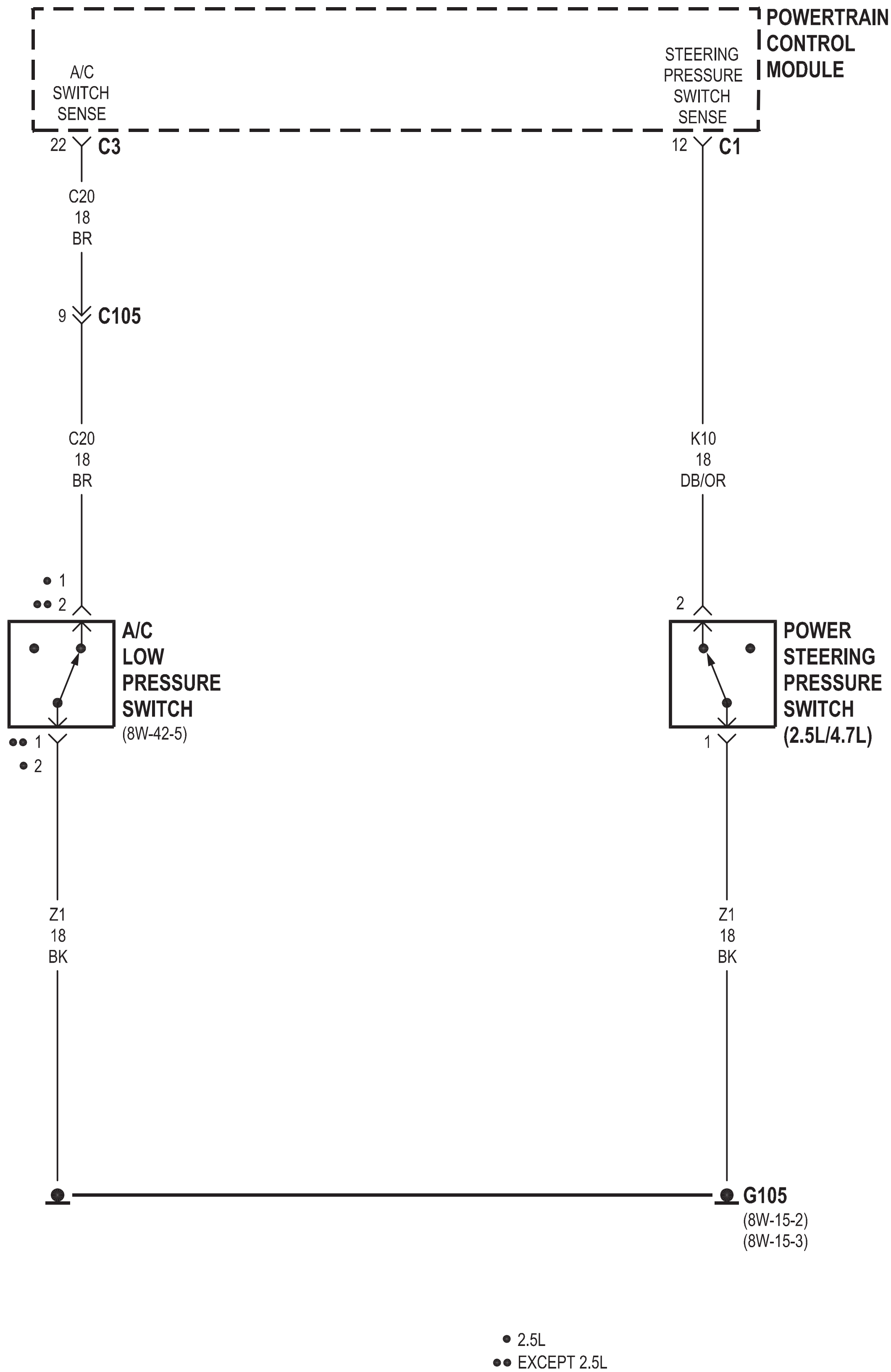

S123
K125
18
WT/DB
19
C106
(IN PDC)
2.5L/4.7L
3.9L/5.9L
14
12
13
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-10-35)
1
2
GENERATOR
(8W-20-2)
86
85
TRANSMISSION
CONTROL
RELAY
(IN PDC)
(8W-31-2)
6
C105
LEAK
DETECTION
PUMP
GENERATOR
SOURCE
LEAK
DETECTION
PUMP
SOLENOID
CONTROL
LEAK
DETECTION
PUMP
SWITCH
SENSE
3
4
K106
18
WT/DG
K107
18
OR
K30
18
PK
1
C105
EXCEPT
3.9L/5.9L
K20
18
DB
K20
18
DG
25 C3
10 C3
14 C3
30 C2
10 C2
GENERATOR
SOURCE
TRANSMISSION
CONTROL
RELAY
CONTROL
GENERATOR
FIELD
POWERTRAIN
CONTROL
MODULE

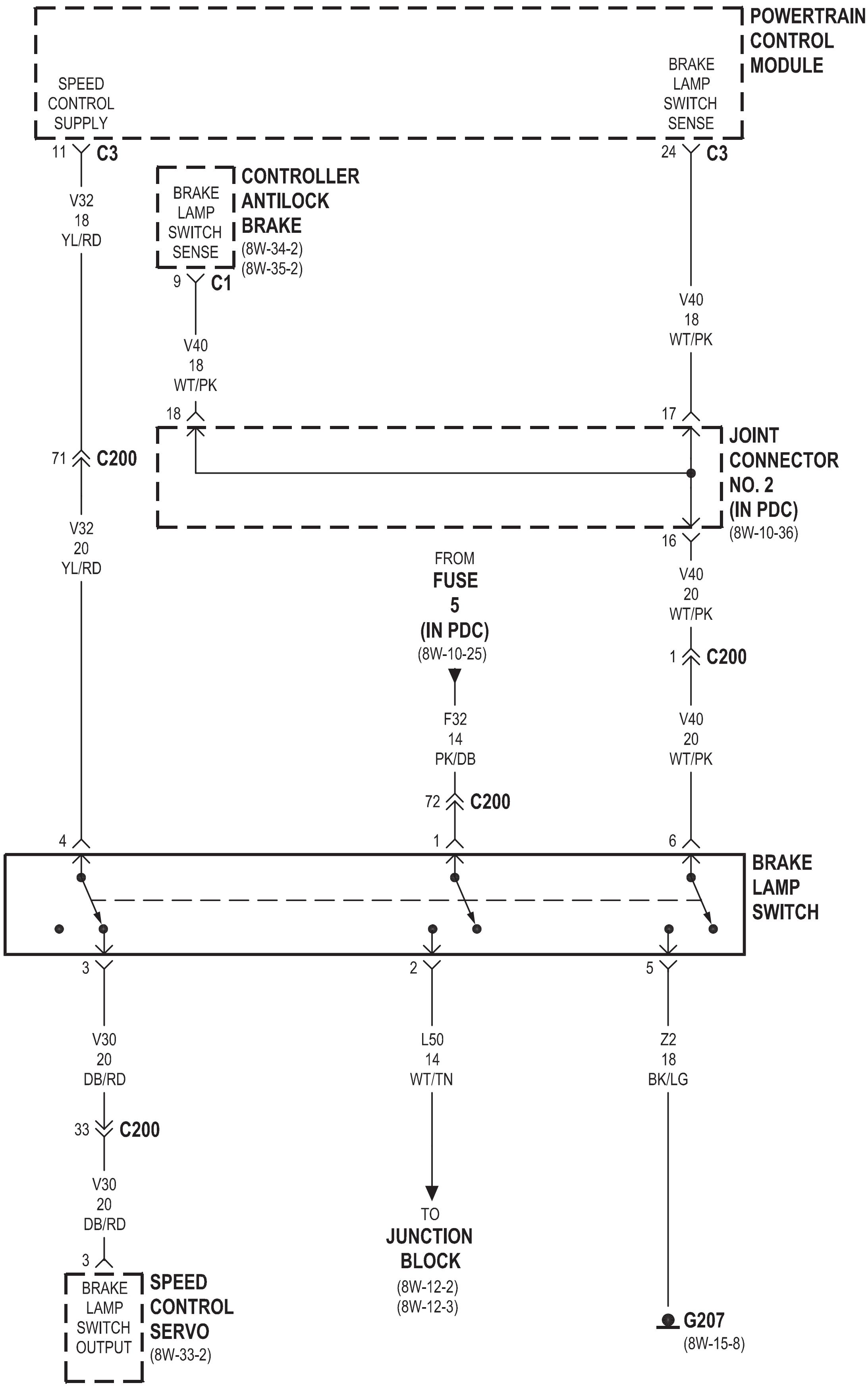

THROTTLE POSITION SENSOR
2
3
1
1
3
K22 18 OR/DB
K4 18 BK/LB
K7 18 OR
S107 (8W-70-2)
EXCEPT 4.7L A/T
4.7L A/T
S173
K7 18 OR
K7 18 OR
K22 18 OR/DB
K22 18 OR/DB
1
3
MANIFOLD ABSOLUTE PRESSURE SENSOR
12
THROTTLE POSITION SENSOR SIGNAL
TRANSMISSION CONTROL MODULE (8W-31-9)
1
2
2
3
K4 18 BK/LB
K1 18 DG/RD
S101 (8W-70-4)
K4 18 BK/LB
23 C1
4 C1
27 C1
17 C1
THROTTLE POSITION SENSOR SIGNAL
SENSOR GROUND
MAP SENSOR SIGNAL
5V SUPPLY
POWERTRAIN CONTROL MODULE
● 2.5L
●● EXCEPT 2.5L
▲ 4.7L
▲▲ EXCEPT 4.7L

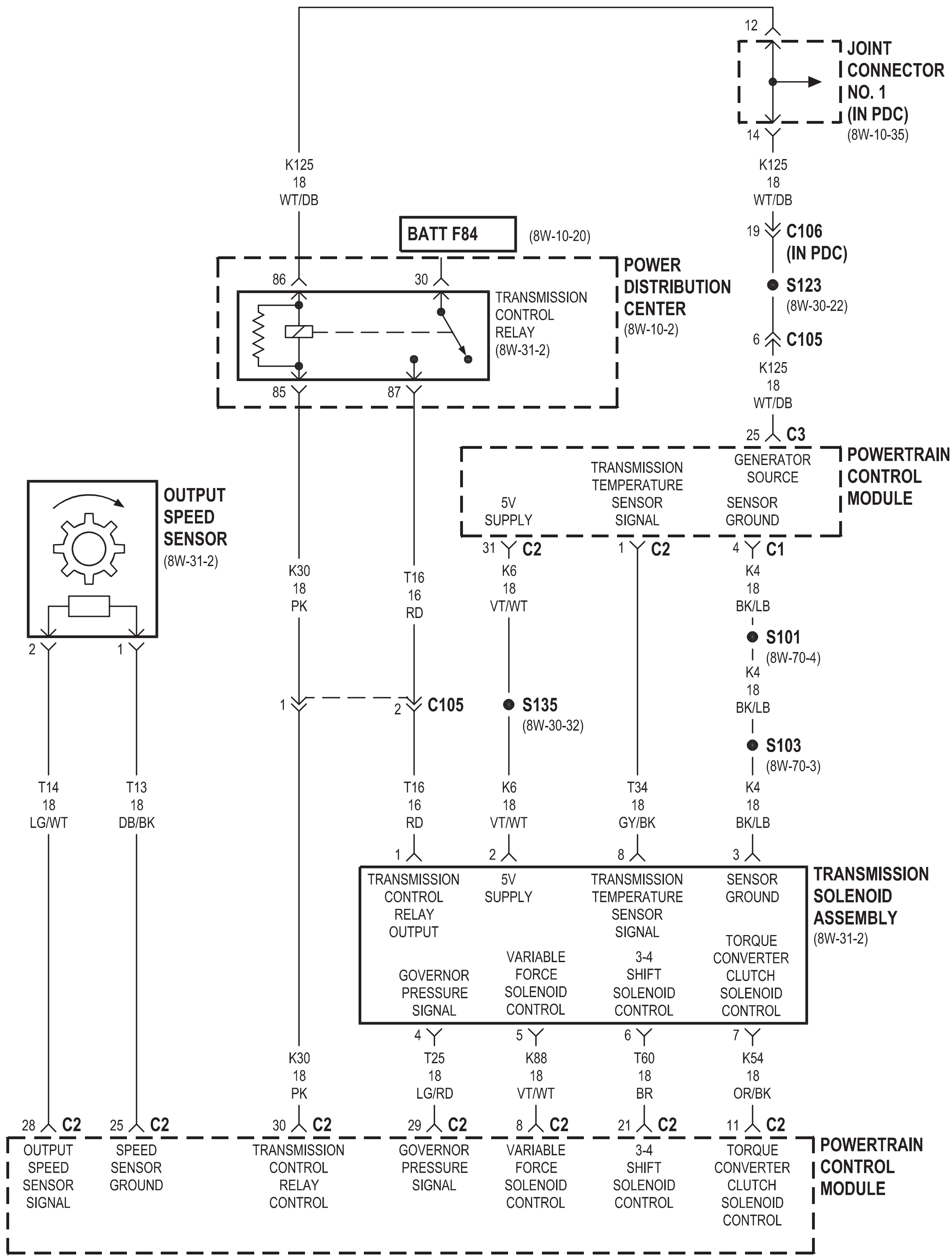

POWERTRAIN CONTROL MODULE
BATTERY TEMPERATURE SENSOR SIGNAL
ENGINE OIL PRESSURE SENSOR SIGNAL
TORQUE MANAGEMENT REQUEST SENSE
VEHICLE SPEED SENSOR SIGNAL
15 C3
23 C2
13 C3
27 C2
3.9L/5.9L
2.5L/4.7L
K118 18 PK/YL
G60 16 GY/YL
G60 18 GY/YL
T10 18 YL/DG
4.7L A/T
2.5L
3.9L/5.9L
G7 18 WT/OR
G7 18 WT/OR
G7 20 DB
2
BATTERY TEMPERATURE SENSOR
1
8 C107 (IN PDC)
2
ENGINE OIL PRESSURE SENSOR
1
S174 (8W-31-3)
G7 18 WT/OR
K4 18 BK/LB
9
JOINT CONNECTOR NO. 3 (IN PDC) (8W-10-39)
8
K4 18 BK/LB
T10 18 YL/DG
G7 18 WT/OR
14 C106 (IN PDC)
10
28
TRANSMISSION CONTROL MODULE (4.7L A/T) (8W-31-3) (8W-31-9)
TORQUE MANAGEMENT REQUEST SENSE
VEHICLE SPEED SENSOR SIGNAL
SENSOR GROUND
51
K4 18 BK/LB
21 C106 (IN PDC)
K4 18 BK/LB
G7 18 WT/OR
K4 18 BK/LB
12 C1
CONTROLLER ANTILOCK BRAKE (8W-34-3) (8W-35-2)
VEHICLE SPEED SENSOR SIGNAL
S103 (8W-70-3)
K4 18 BK/LB
S101 (8W-70-4)
K4 18 BK/LB
4 C1
SENSOR GROUND
POWERTRAIN CONTROL MODULE

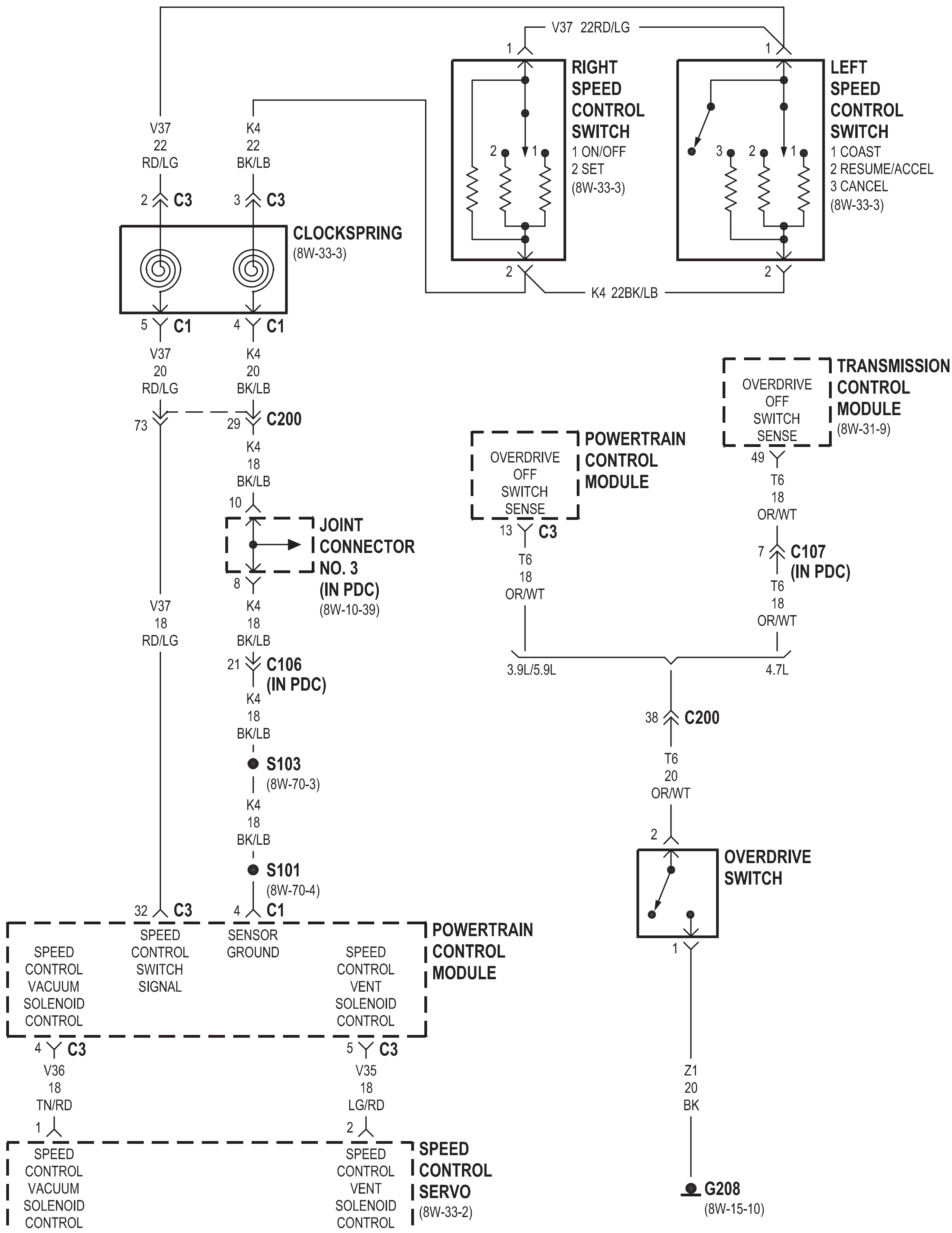

IDLE AIR CONTROL MOTOR
▲ 1 ▲▲ D
▲ 2 ▲▲ C
▲ 3 ▲▲ B
▲ 4 ▲▲ A
4.7L
EXCEPT 4.7L
K60 16 YL/BK
K60 18 YL/BK
K59 16 VT/BK
K59 18 VT/BK
K39 16 GY/RD
K39 18 GY/RD
K40 16 BR/WT
K40 18 BR/WT
K4 18 BK/LB
S101 (8W-70-4)
S103 (8W-70-3)
● A ●● 1
INTAKE AIR TEMPERATURE SENSOR
● B ●● 2
● 2 ●● 1
ENGINE COOLANT TEMPERATURE SENSOR
● 1 ●● 2
K21 18 BK/RD
K2 18 TN/BK
19 C1
10 C1
11 C1
20 C1
4 C1
15 C1
16 C1
IDLE AIR CONTROL NO. 1 DRIVER
IDLE AIR CONTROL NO. 2 DRIVER
IDLE AIR CONTROL NO. 3 DRIVER
IDLE AIR CONTROL NO. 4 DRIVER
SENSOR GROUND
INTAKE AIR TEMPERATURE SIGNAL
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
POWERTRAIN CONTROL MODULE
● 2.5L
●● EXCEPT 2.5L
▲ 3.9L/5.9L
▲▲ EXCEPT 3.9L/5.9L


RUN-START A21
(8W-10-18)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
19
FUSE
10
10A
(8W-12-10)
20
21
FUSE
11
10A
(8W-12-12)
22
5
C3
7
C3
F18
20
LG/BK
F12
20
DB/WT
86
RADIATOR
FAN
RELAY
(IN PDC)
(8W-42-9)
85
10
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-37)
11
C24
18
DB/PK
F12
20
DB/WT
86
A/C
COMPRESSOR
CLUTCH
RELAY
(IN PDC)
(8W-42-5)
85
●● 20
● 10
C106 ●●
C107 ●
(IN PDC)
C24
18
DB/PK
C13
18
DB/OR
17
C2
1
C3
RADIATOR
FAN
RELAY
CONTROL
A/C
COMPRESSOR
CLUTCH
RELAY
CONTROL
POWERTRAIN
CONTROL
MODULE
● 4.7L
●● EXCEPT 4.7L


POWERTRAIN
CONTROL
MODULE
A/C
SWITCH
SENSE
STEERING
PRESSURE
SWITCH
SENSE
22
C3
12
C1
C20
18
BR
9
C105
C20
18
BR
K10
18
DB/OR
1
2
2
A/C
LOW
PRESSURE
SWITCH
(8W-42-5)
POWER
STEERING
PRESSURE
SWITCH
(2.5L/4.7L)
1
2
1
Z1
18
BK
Z1
18
BK
G105
(8W-15-2)
(8W-15-3)
● 2.5L
●● EXCEPT 2.5L


POWERTRAIN
CONTROL
MODULE
SPEED
CONTROL
SUPPLY
BRAKE
LAMP
SWITCH
SENSE
11 C3
24 C3
V32
18
YL/RD
BRAKE
LAMP
SWITCH
SENSE
CONTROLLER
ANTILOCK
BRAKE
(8W-34-2)
(8W-35-2)
9 C1
V40
18
WT/PK
V40
18
WT/PK
18
17
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-36)
71 C200
V32
20
YL/RD
16
V40
20
WT/PK
FROM
FUSE
5
(IN PDC)
(8W-10-25)
1 C200
F32
14
PK/DB
V40
20
WT/PK
72 C200
4
1
6
BRAKE
LAMP
SWITCH
3
2
5
V30
20
DB/RD
L50
14
WT/TN
Z2
18
BK/LG
33 C200
V30
20
DB/RD
3
BRAKE
LAMP
SWITCH
OUTPUT
SPEED
CONTROL
SERVO
(8W-33-2)
TO
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
G207
(8W-15-8)


12
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-35)
14
K125
18
WT/DB
K125
18
WT/DB
BATT F84
(8W-10-20)
19
C106 (IN PDC)
86
30
TRANSMISSION CONTROL RELAY
(8W-31-2)
POWER DISTRIBUTION CENTER
(8W-10-2)
S123
(8W-30-22)
6
C105
K125
18
WT/DB
85
87
25
C3
POWERTRAIN CONTROL MODULE
5V SUPPLY
TRANSMISSION TEMPERATURE SENSOR SIGNAL
GENERATOR SOURCE
SENSOR GROUND
OUTPUT SPEED SENSOR
(8W-31-2)
31 C2
1 C2
4 C1
K30
18
PK
T16
16
RD
K6
18
VT/WT
K4
18
BK/LB
S101
(8W-70-4)
K4
18
BK/LB
2
1
1
2
C105
S135
(8W-30-32)
S103
(8W-70-3)
T14
18
LG/WT
T13
18
DB/BK
T16
16
RD
K6
18
VT/WT
T34
18
GY/BK
K4
18
BK/LB
1
2
8
3
TRANSMISSION CONTROL RELAY OUTPUT
5V SUPPLY
TRANSMISSION TEMPERATURE SENSOR SIGNAL
SENSOR GROUND
GOVERNOR PRESSURE SIGNAL
VARIABLE FORCE SOLENOID CONTROL
3-4 SHIFT SOLENOID CONTROL
TORQUE CONVERTER CLUTCH SOLENOID CONTROL
TRANSMISSION SOLENOID ASSEMBLY
(8W-31-2)
4
5
6
7
K30
18
PK
T25
18
LG/RD
K88
18
VT/WT
T60
18
BR
K54
18
OR/BK
28 C2
25 C2
30 C2
29 C2
8 C2
21 C2
11 C2
OUTPUT SPEED SENSOR SIGNAL
SPEED SENSOR GROUND
TRANSMISSION CONTROL RELAY CONTROL
GOVERNOR PRESSURE SIGNAL
VARIABLE FORCE SOLENOID CONTROL
3-4 SHIFT SOLENOID CONTROL
TORQUE CONVERTER CLUTCH SOLENOID CONTROL
POWERTRAIN CONTROL MODULE



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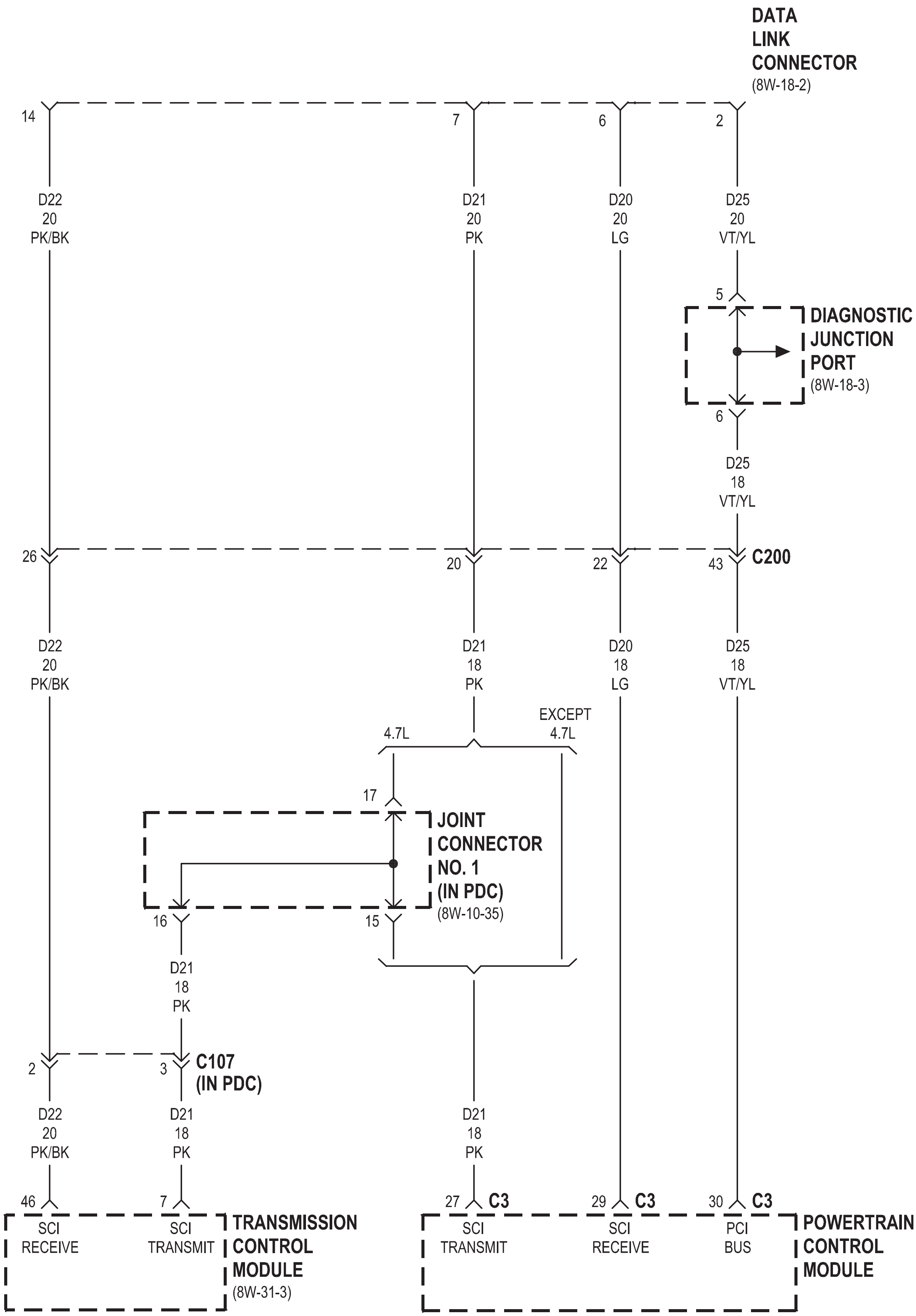
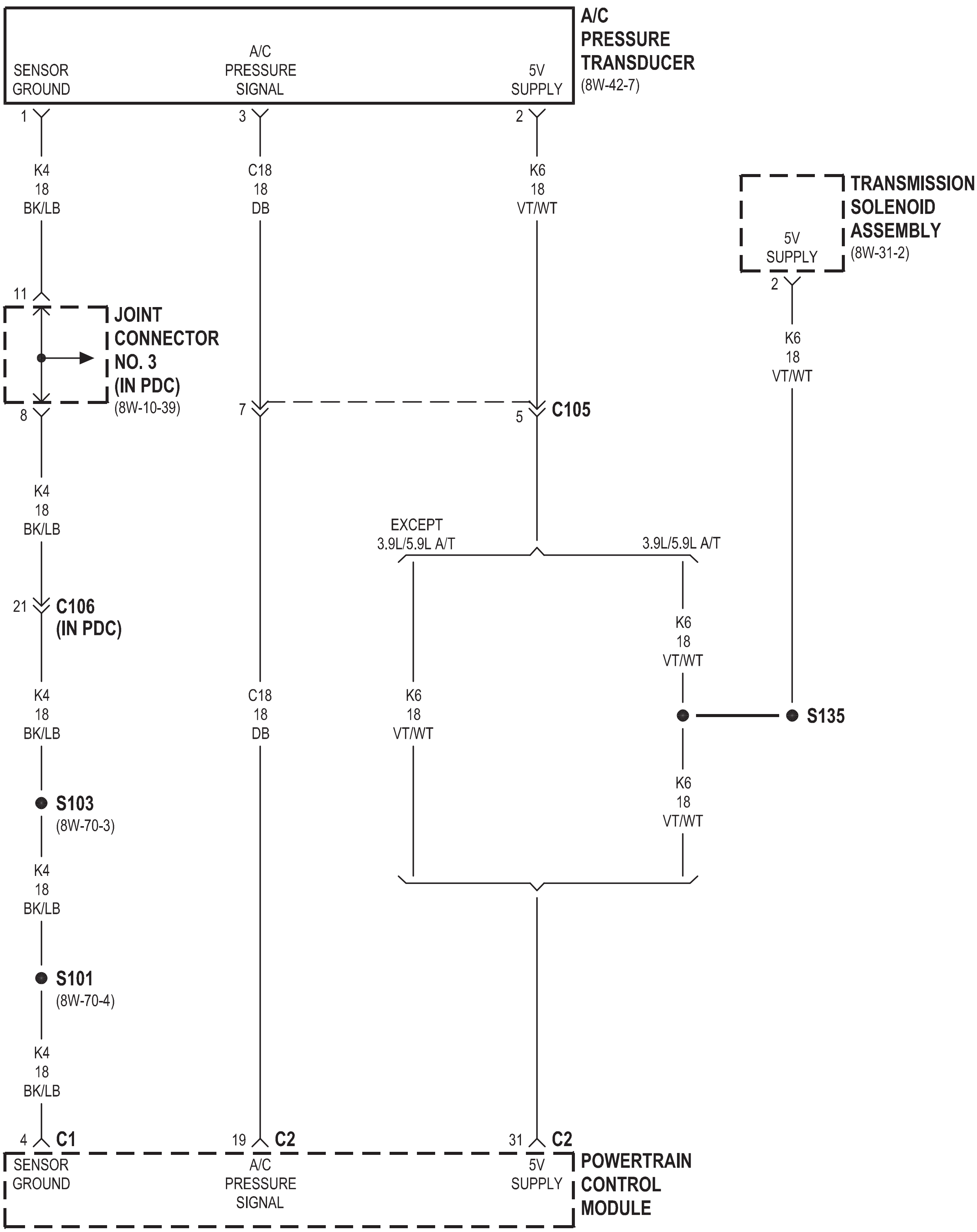
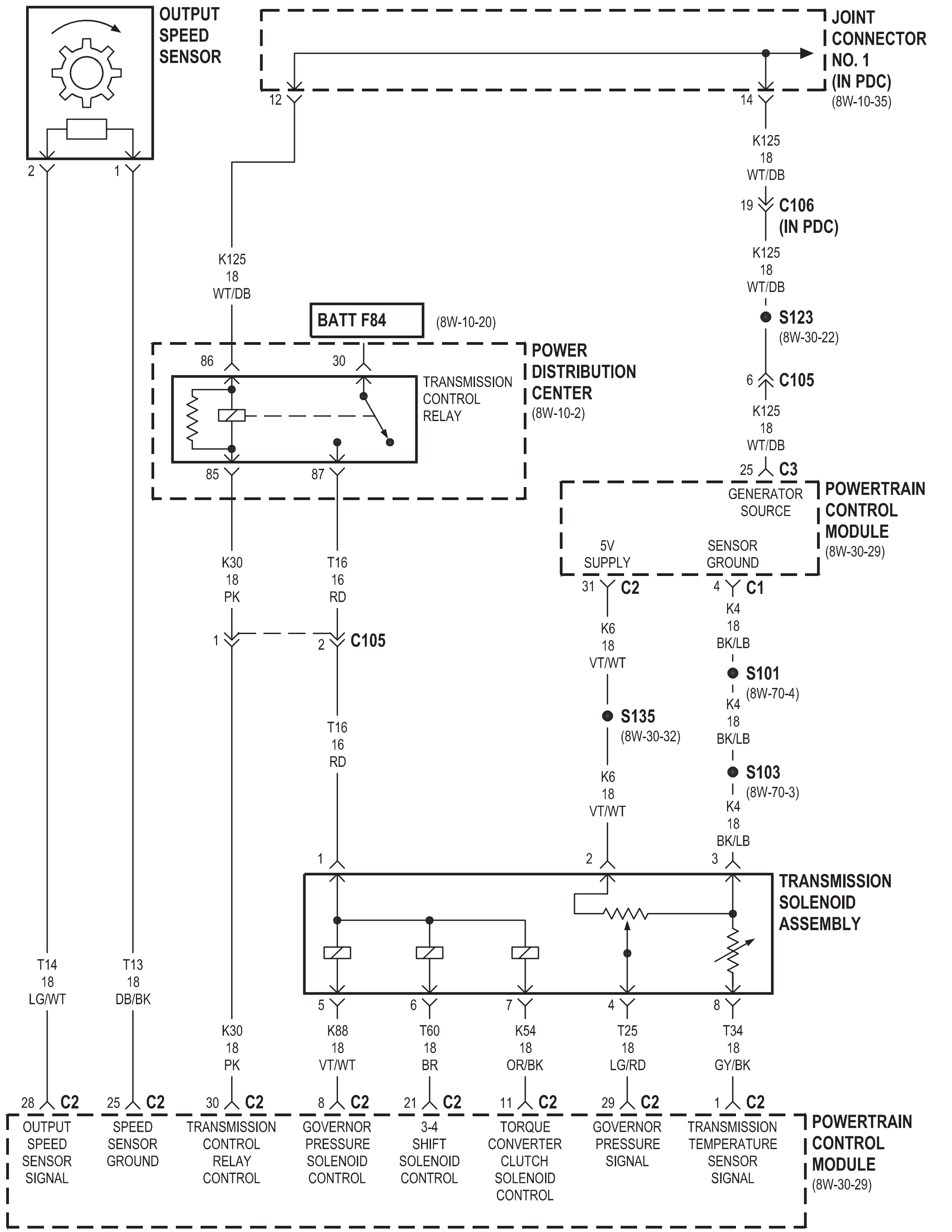

DATA
LINK
CONNECTOR
(8W-18-2)
14
7
6
2
D22
20
PK/BK
D21
20
PK
D20
20
LG
D25
20
VT/YL
5
DIAGNOSTIC
JUNCTION
PORT
(8W-18-3)
6
D25
18
VT/YL
26
20
22
43
C200
D22
20
PK/BK
D21
18
PK
D20
18
LG
D25
18
VT/YL
4.7L
EXCEPT
4.7L
17
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-10-35)
16
15
D21
18
PK
2
3
C107
(IN PDC)
D22
20
PK/BK
D21
18
PK
D21
18
PK
46
7
27 C3
29 C3
30 C3
SCI
RECEIVE
SCI
TRANSMIT
TRANSMISSION
CONTROL
MODULE
(8W-31-3)
SCI
TRANSMIT
SCI
RECEIVE
PCI
BUS
POWERTRAIN
CONTROL
MODULE


A/C PRESSURE TRANSDUCER
(8W-42-7)
SENSOR GROUND
A/C PRESSURE SIGNAL
5V SUPPLY
1
3
2
K4 18 BK/LB
C18 18 DB
K6 18 VT/WT
TRANSMISSION SOLENOID ASSEMBLY
(8W-31-2)
5V SUPPLY
2
K6 18 VT/WT
11
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-39)
8
7
5
C105
K4 18 BK/LB
EXCEPT 3.9L/5.9L A/T
3.9L/5.9L A/T
K6 18 VT/WT
21
C106 (IN PDC)
K4 18 BK/LB
C18 18 DB
K6 18 VT/WT
S135
K6 18 VT/WT
S103
(8W-70-3)
K4 18 BK/LB
S101
(8W-70-4)
K4 18 BK/LB
4 C1
19 C2
31 C2
SENSOR GROUND
A/C PRESSURE SIGNAL
5V SUPPLY
POWERTRAIN CONTROL MODULE

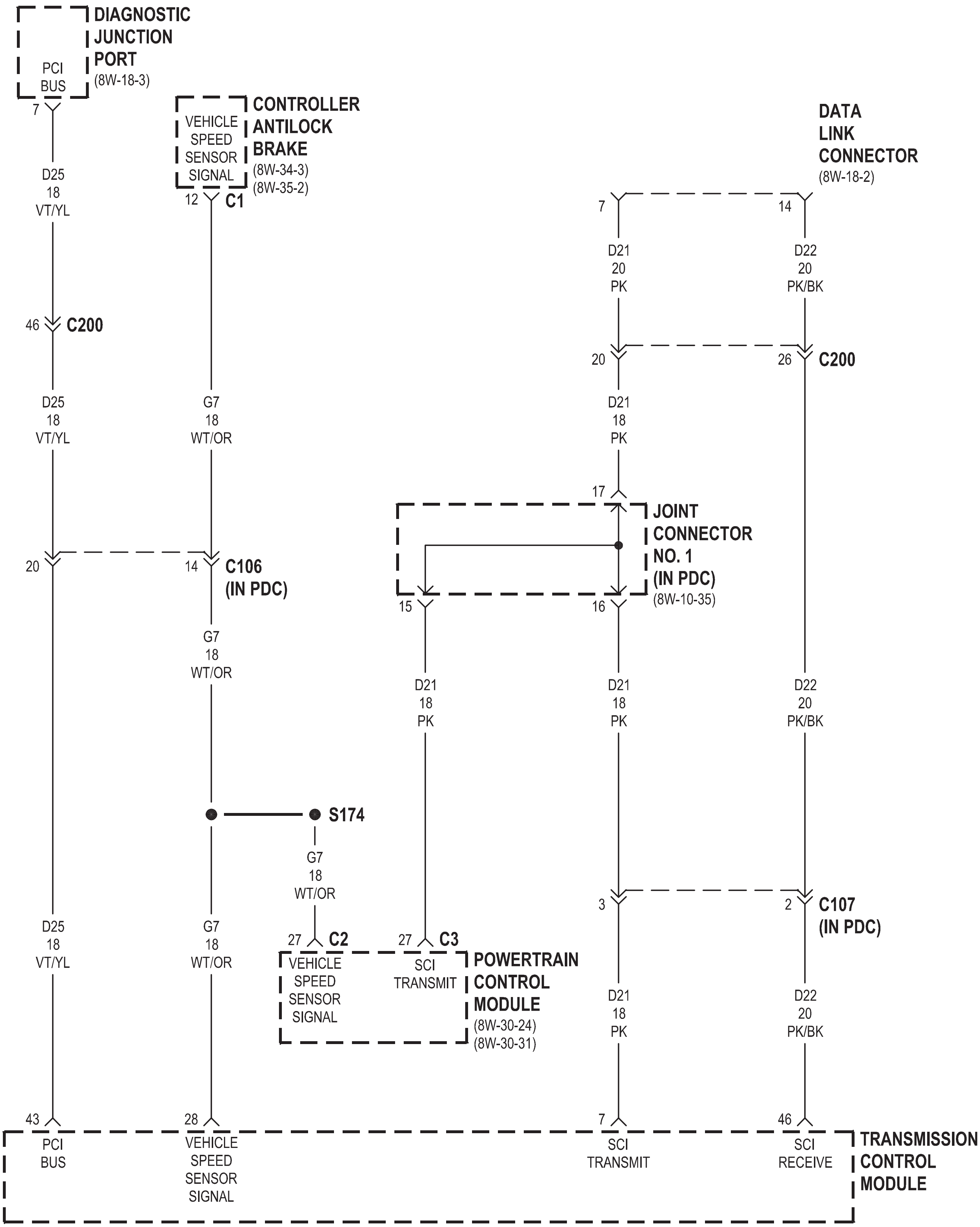
8W-31 TRANSMISSION CONTROL SYSTEM

3.9L/5.9L

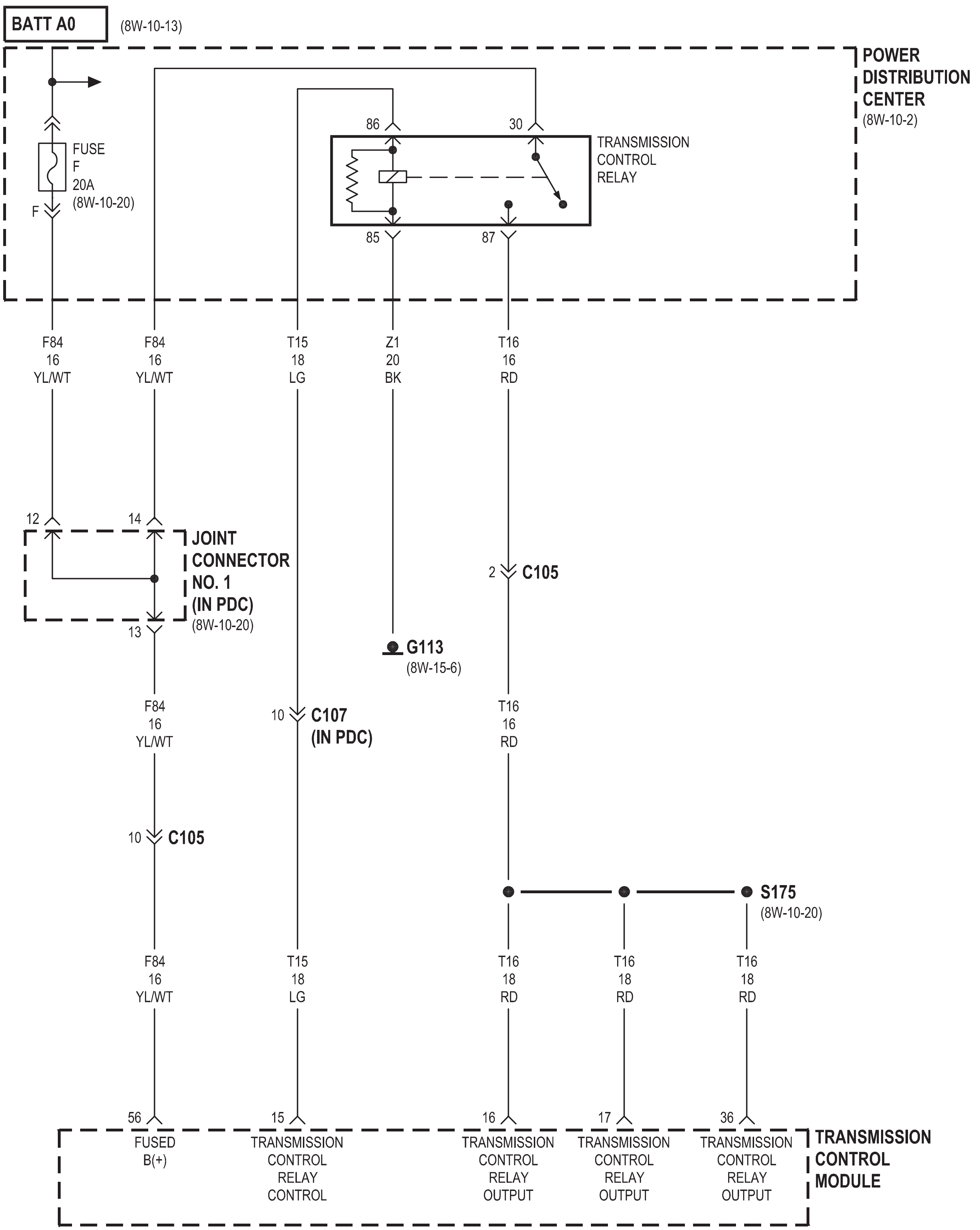


J018W-1 AN003102

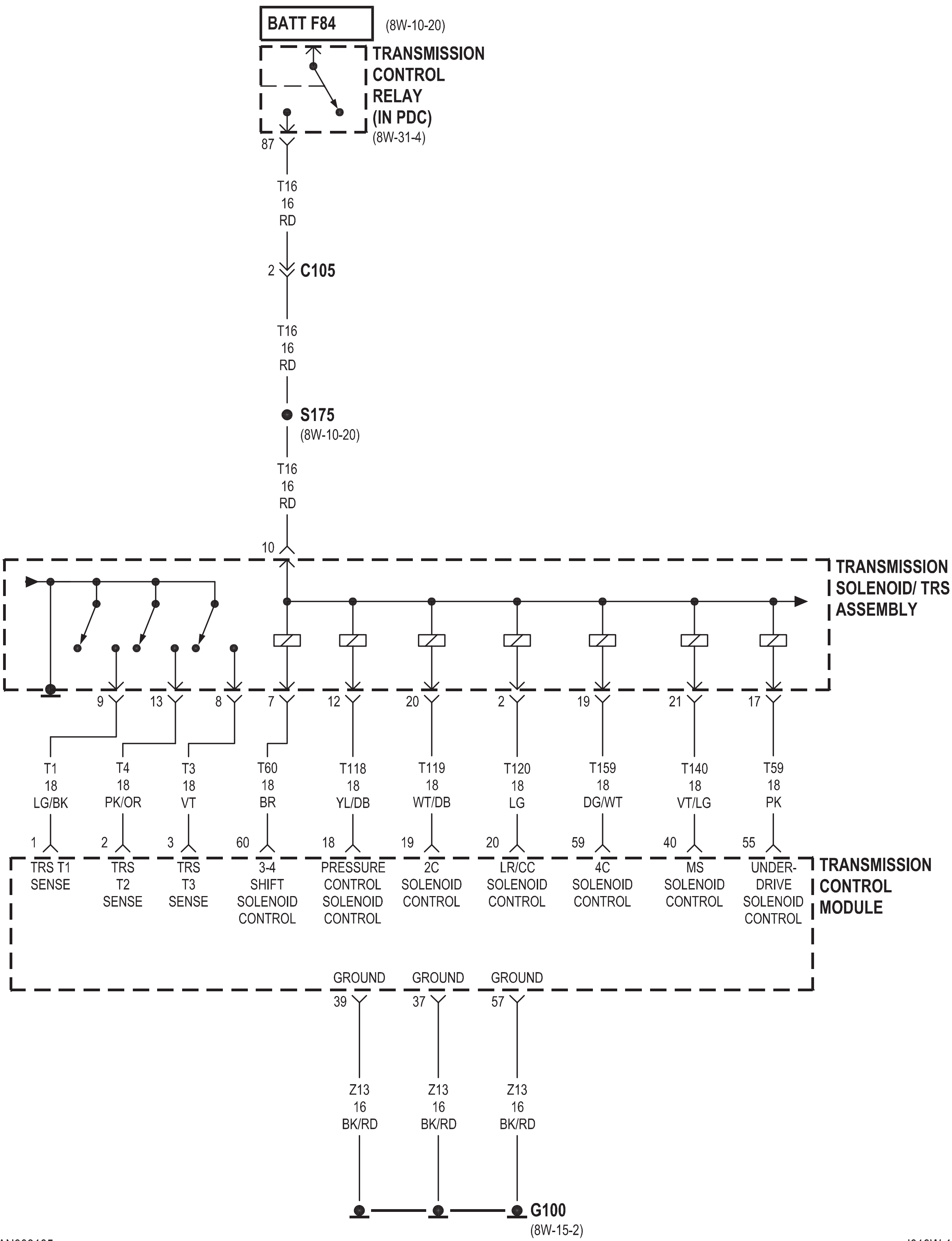
4.7L

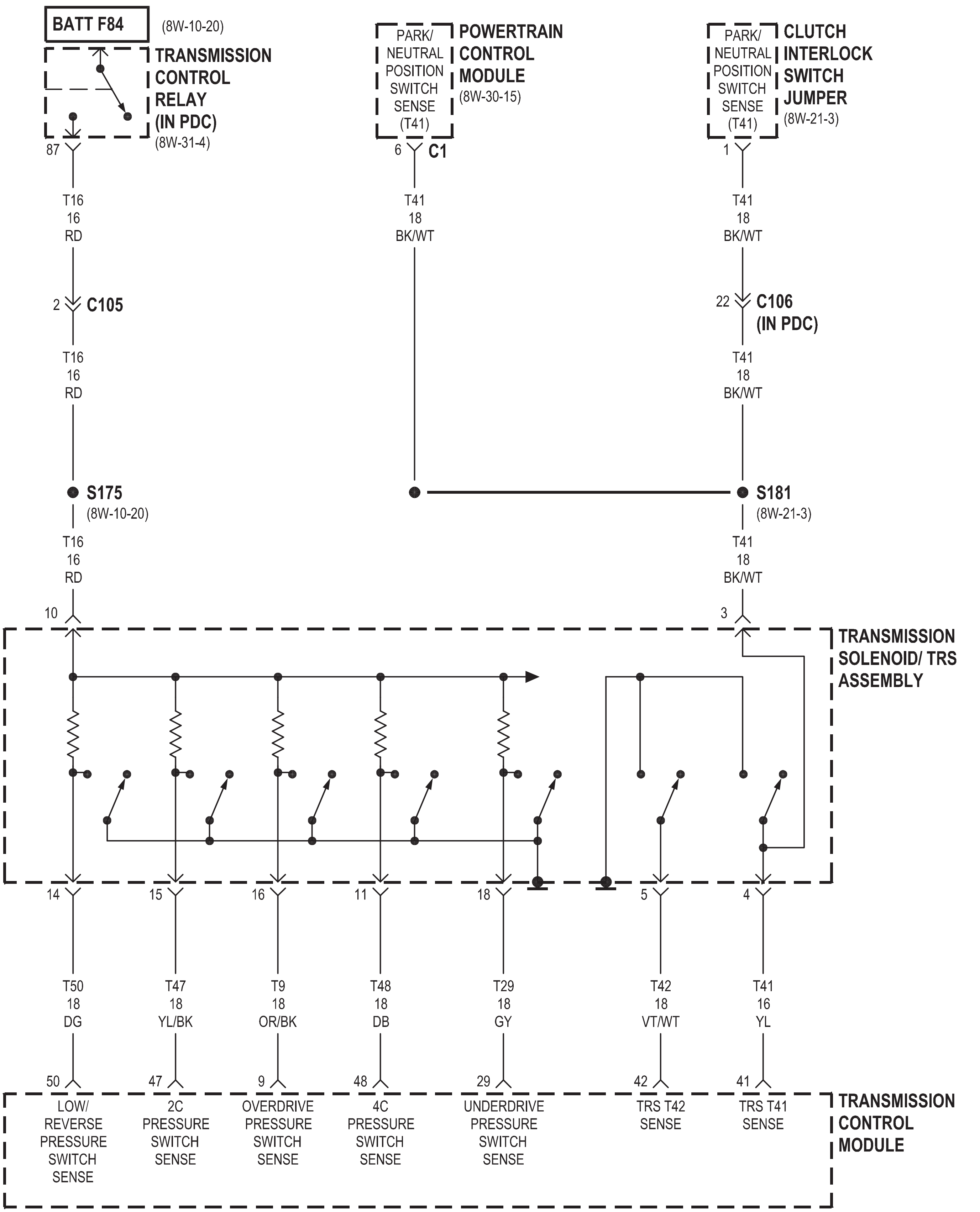

DIAGNOSTIC JUNCTION PORT
(8W-18-3)
PCI BUS
7
D25 18 VT/YL
46 C200
D25 18 VT/YL
20
C106 (IN PDC)
D25 18 VT/YL
CONTROLLER ANTILOCK BRAKE
(8W-34-3)
(8W-35-2)
VEHICLE SPEED SENSOR SIGNAL
12 C1
G7 18 WT/OR
14
G7 18 WT/OR
S174
G7 18 WT/OR
G7 18 WT/OR
27 C2
27 C3
POWERTRAIN CONTROL MODULE
(8W-30-24)
(8W-30-31)
VEHICLE SPEED SENSOR SIGNAL
SCI TRANSMIT
DATA LINK CONNECTOR
(8W-18-2)
7
14
D21 20 PK
D22 20 PK/BK
20
26 C200
D21 18 PK
17
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-35)
15
16
D21 18 PK
D21 18 PK
D22 20 PK/BK
3
2 C107 (IN PDC)
D21 18 PK
D22 20 PK/BK
43
28
7
46
PCI BUS
VEHICLE SPEED SENSOR SIGNAL
SCI TRANSMIT
SCI RECEIVE
TRANSMISSION CONTROL MODULE

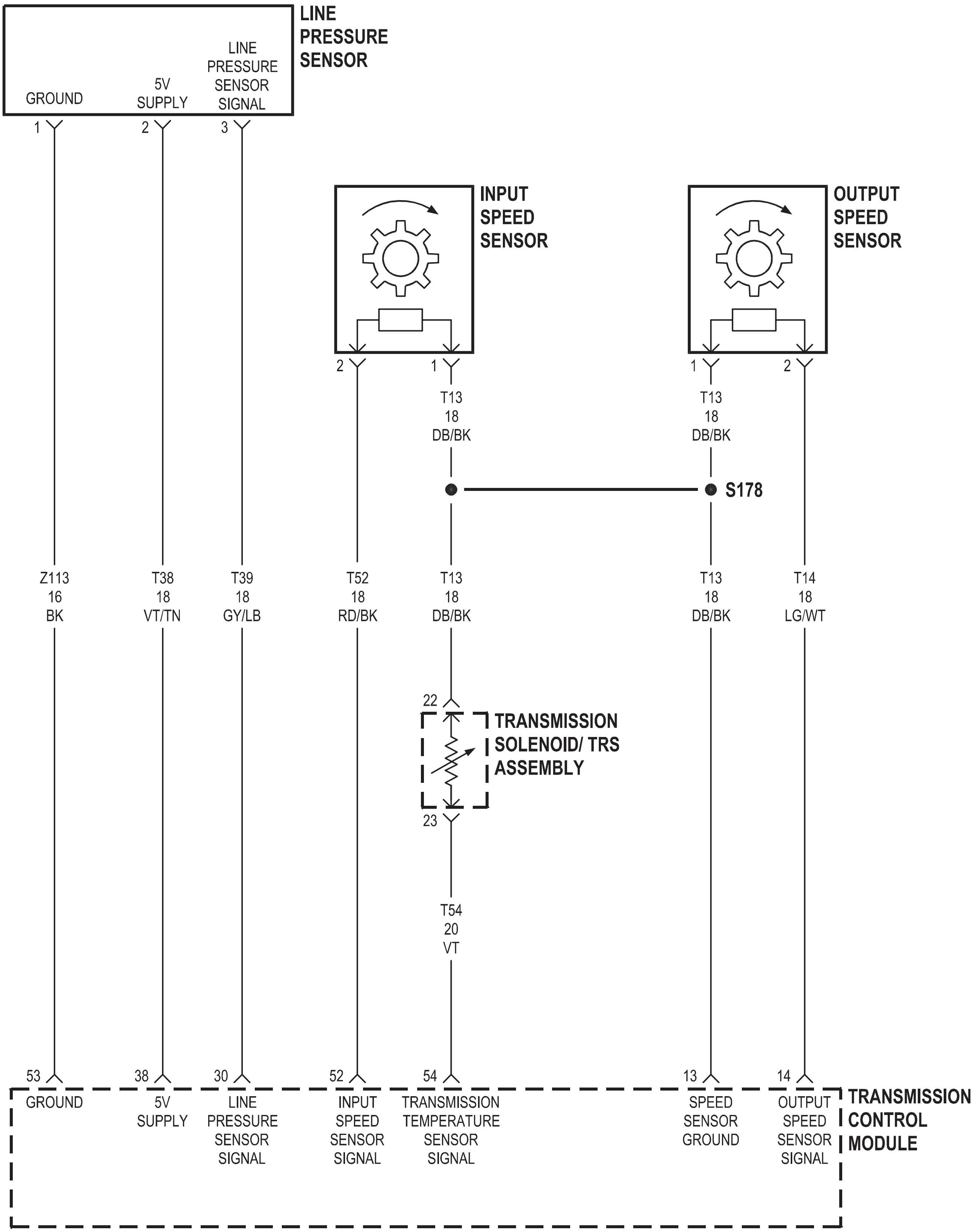
4.7L


BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
F
20A
(8W-10-20)
F
86
30
TRANSMISSION CONTROL RELAY
85
87
F84 16 YL/WT
F84 16 YL/WT
T15 18 LG
Z1 20 BK
T16 16 RD
12
14
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-20)
13
2 C105
G113
(8W-15-6)
F84 16 YL/WT
10 C107 (IN PDC)
T16 16 RD
10 C105
S175
(8W-10-20)
F84 16 YL/WT
T15 18 LG
T16 18 RD
T16 18 RD
T16 18 RD
56
15
16
17
36
FUSED B(+)
TRANSMISSION CONTROL RELAY CONTROL
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION CONTROL MODULE

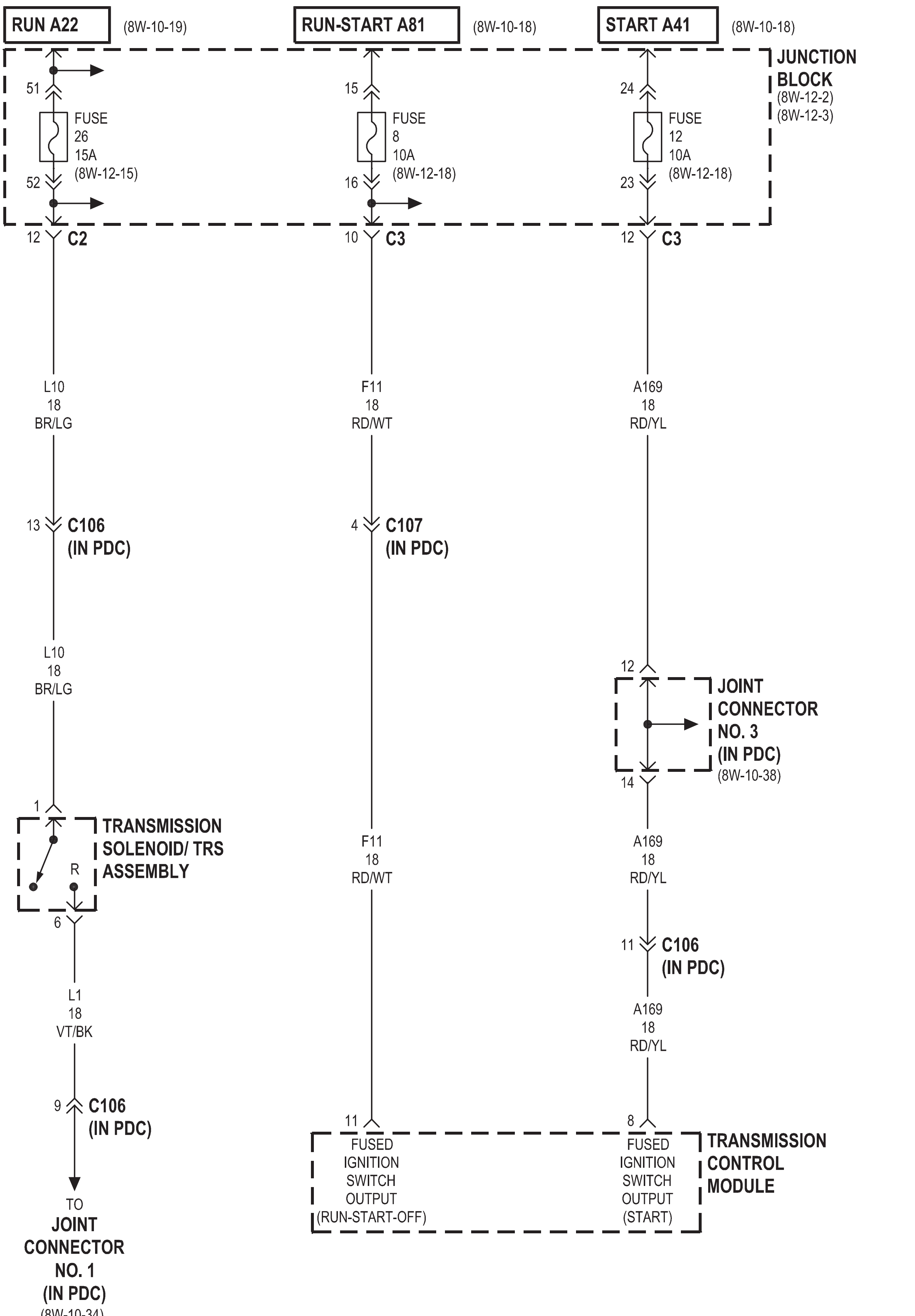
4.7L

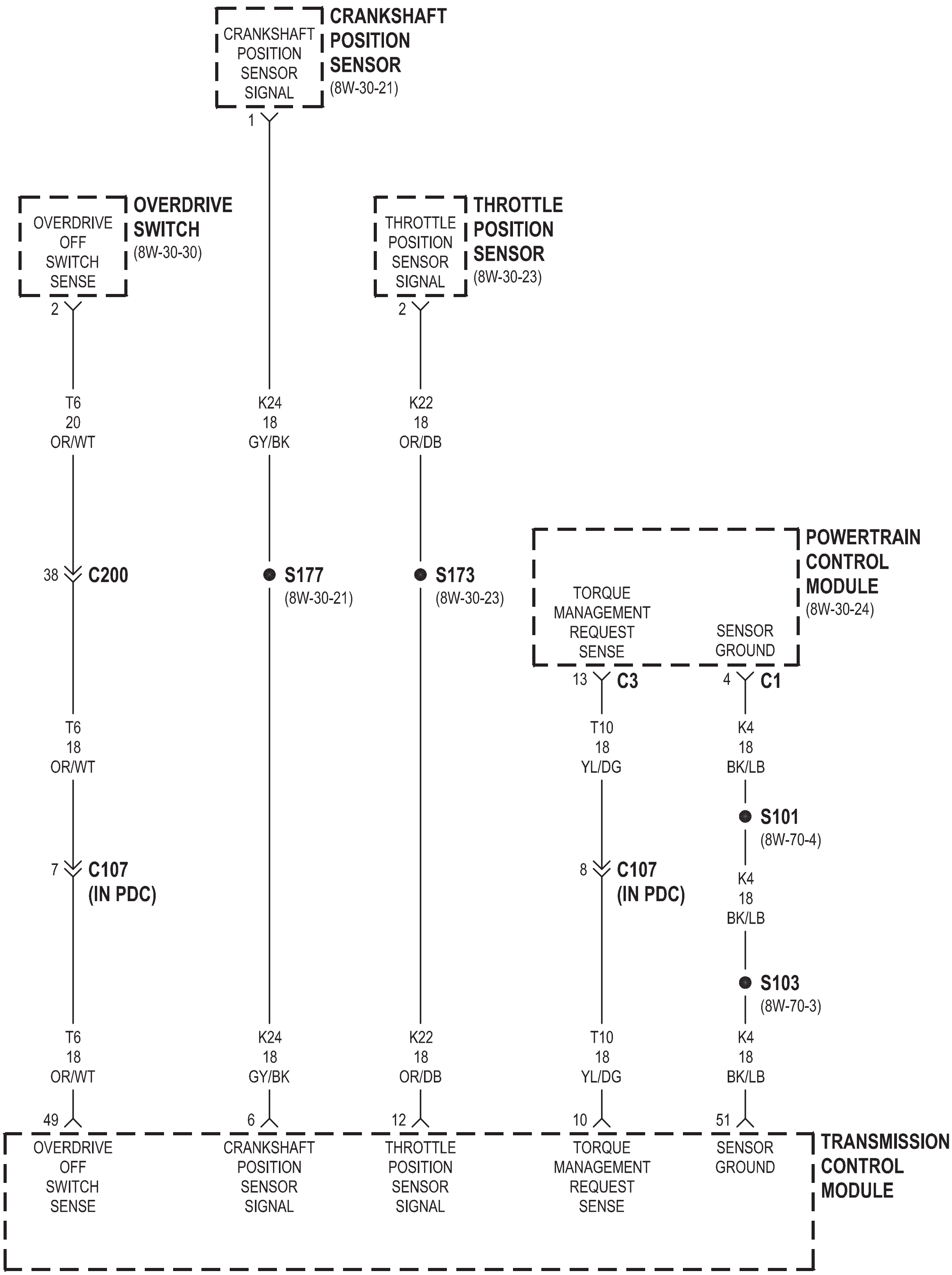

BATT F84
(8W-10-20)
TRANSMISSION CONTROL RELAY (IN PDC)
(8W-31-4)
87
T16 16 RD
2 C105
T16 16 RD
S175
(8W-10-20)
T16 16 RD
10
TRANSMISSION SOLENOID/ TRS ASSEMBLY
9 13 8 7 12 20 2 19 21 17
T1 18 LG/BK
T4 18 PK/OR
T3 18 VT
T60 18 BR
T118 18 YL/DB
T119 18 WT/DB
T120 18 LG
T159 18 DG/WT
T140 18 VT/LG
T59 18 PK
1 2 3 60 18 19 20 59 40 55
TRS T1 SENSE
TRS T2 SENSE
TRS T3 SENSE
3-4 SHIFT SOLENOID CONTROL
PRESSURE CONTROL SOLENOID CONTROL
2C SOLENOID CONTROL
LR/CC SOLENOID CONTROL
4C SOLENOID CONTROL
MS SOLENOID CONTROL
UNDER-DRIVE SOLENOID CONTROL
TRANSMISSION CONTROL MODULE
GROUND GROUND GROUND
39 37 57
Z13 16 BK/RD
Z13 16 BK/RD
Z13 16 BK/RD
G100
(8W-15-2)

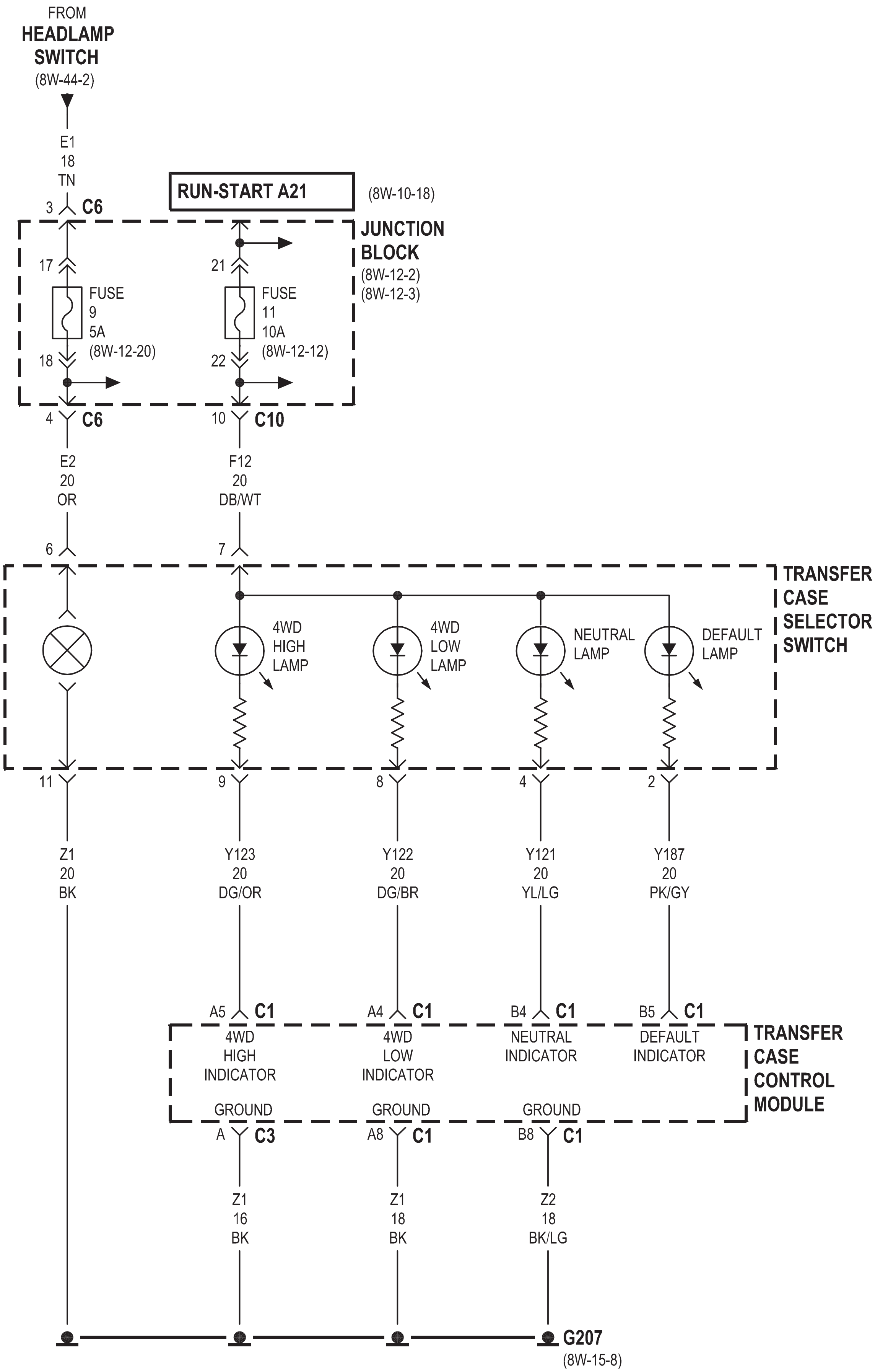

BATT F84
(8W-10-20)
TRANSMISSION CONTROL RELAY (IN PDC)
(8W-31-4)
87
T16 16 RD
2 C105
T16 16 RD
S175
(8W-10-20)
T16 16 RD
10
PARK/ NEUTRAL POSITION SWITCH SENSE (T41)
POWERTRAIN CONTROL MODULE
(8W-30-15)
6 C1
T41 18 BK/WT
PARK/ NEUTRAL POSITION SWITCH SENSE (T41)
CLUTCH INTERLOCK SWITCH JUMPER
(8W-21-3)
1
T41 18 BK/WT
22 C106 (IN PDC)
T41 18 BK/WT
S181
(8W-21-3)
T41 18 BK/WT
3
TRANSMISSION SOLENOID/ TRS ASSEMBLY
14 15 16 11 18 5 4
T50 18 DG
T47 18 YL/BK
T9 18 OR/BK
T48 18 DB
T29 18 GY
T42 18 VT/WT
T41 16 YL
50 47 9 48 29 42 41
LOW/ REVERSE PRESSURE SWITCH SENSE
2C PRESSURE SWITCH SENSE
OVERDRIVE PRESSURE SWITCH SENSE
4C PRESSURE SWITCH SENSE
UNDERDRIVE PRESSURE SWITCH SENSE
TRS T42 SENSE
TRS T41 SENSE
TRANSMISSION CONTROL MODULE

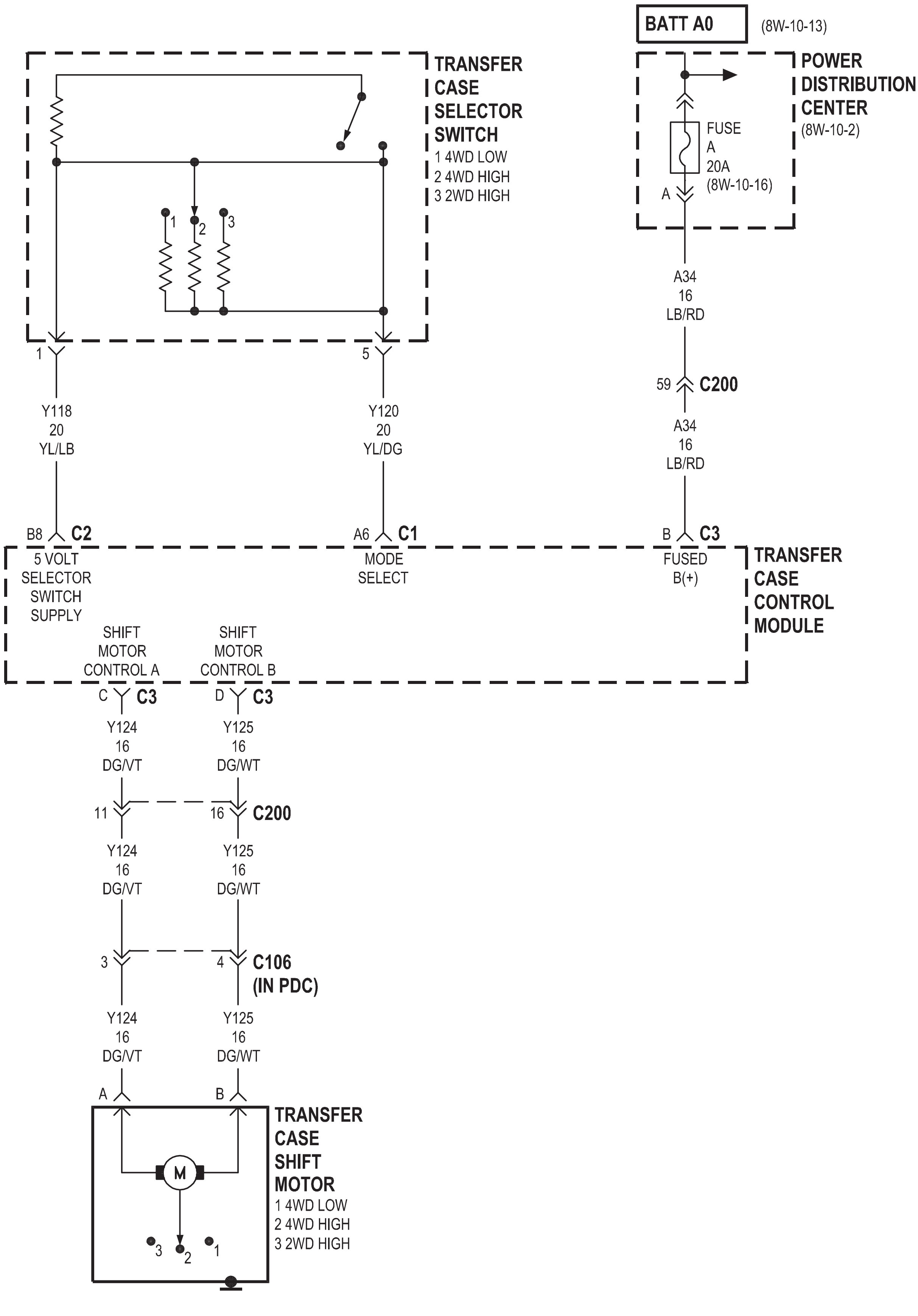

LINE PRESSURE SENSOR
GROUND
5V SUPPLY
LINE PRESSURE SENSOR SIGNAL
1
2
3
INPUT SPEED SENSOR
OUTPUT SPEED SENSOR
2
1
1
2
T13 18 DB/BK
T13 18 DB/BK
S178
Z113 16 BK
T38 18 VT/TN
T39 18 GY/LB
T52 18 RD/BK
T13 18 DB/BK
T13 18 DB/BK
T14 18 LG/WT
22
TRANSMISSION SOLENOID/ TRS ASSEMBLY
23
T54 20 VT
53
38
30
52
54
13
14
GROUND
5V SUPPLY
LINE PRESSURE SENSOR SIGNAL
INPUT SPEED SENSOR SIGNAL
TRANSMISSION TEMPERATURE SENSOR SIGNAL
SPEED SENSOR GROUND
OUTPUT SPEED SENSOR SIGNAL
TRANSMISSION CONTROL MODULE

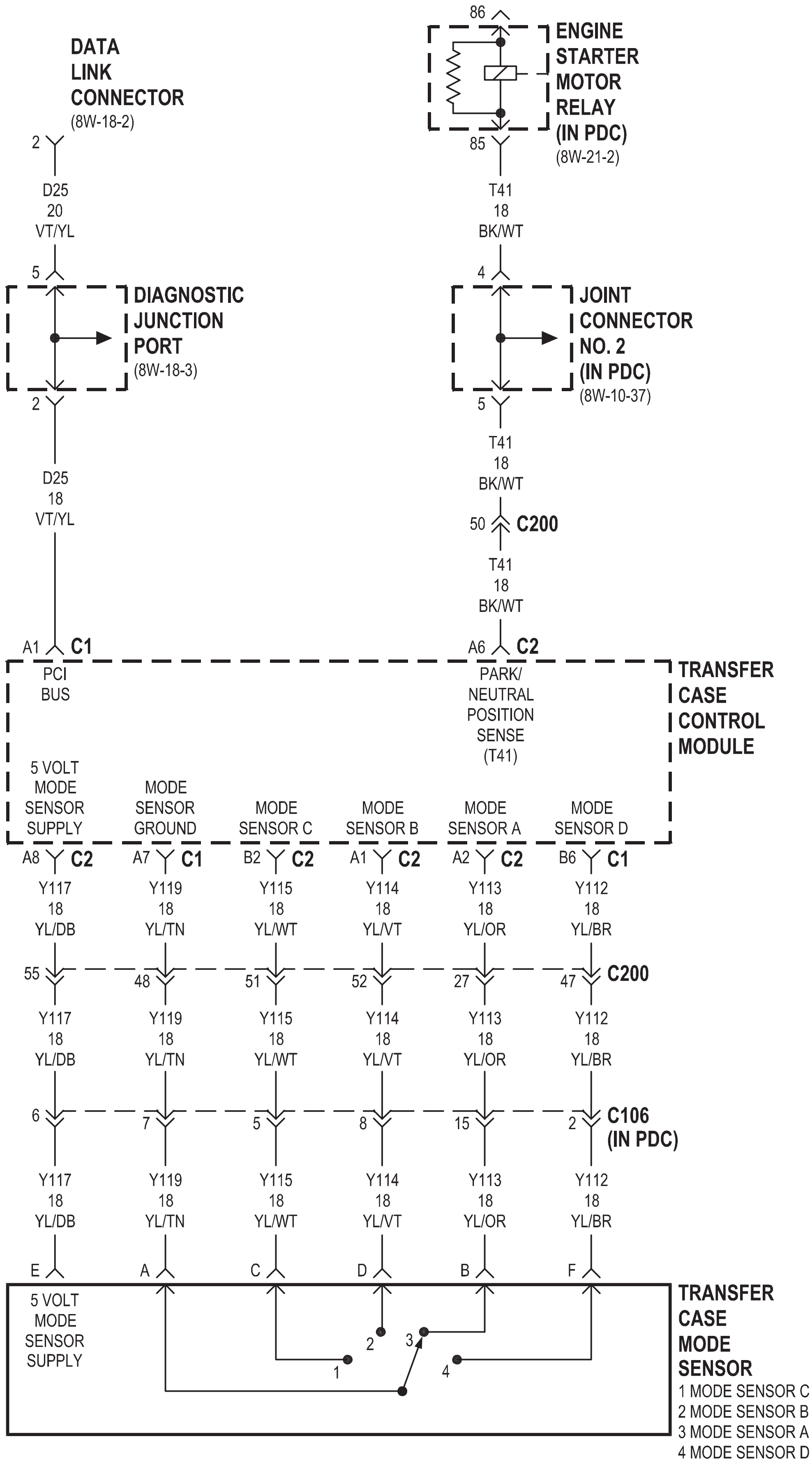
4.7L


RUN A22
(8W-10-19)
RUN-START A81
(8W-10-18)
START A41
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
51
FUSE 26 15A (8W-12-15)
52
15
FUSE 8 10A (8W-12-18)
16
24
FUSE 12 10A (8W-12-18)
23
12 C2
10 C3
12 C3
L10 18 BR/LG
F11 18 RD/WT
A169 18 RD/YL
13 C106 (IN PDC)
4 C107 (IN PDC)
L10 18 BR/LG
12
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-38)
14
1
TRANSMISSION SOLENOID/ TRS ASSEMBLY
R
6
F11 18 RD/WT
A169 18 RD/YL
11 C106 (IN PDC)
L1 18 VT/BK
A169 18 RD/YL
9 C106 (IN PDC)
11
8
FUSED IGNITION SWITCH OUTPUT (RUN-START-OFF)
FUSED IGNITION SWITCH OUTPUT (START)
TRANSMISSION CONTROL MODULE
TO JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-34)

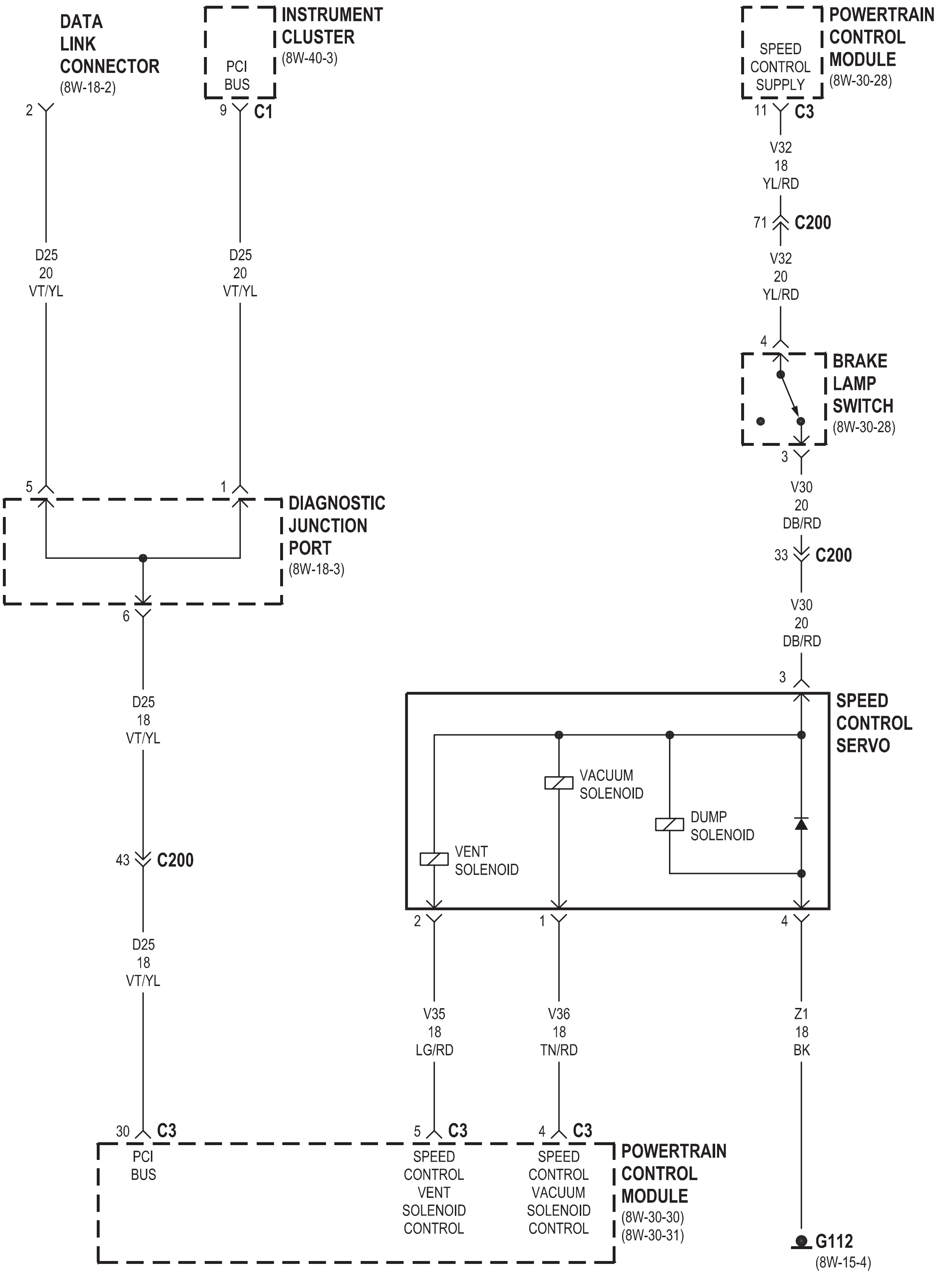

CRANKSHAFT POSITION SENSOR SIGNAL
CRANKSHAFT POSITION SENSOR
(8W-30-21)
1
OVERDRIVE OFF SWITCH SENSE
OVERDRIVE SWITCH
(8W-30-30)
2
THROTTLE POSITION SENSOR SIGNAL
THROTTLE POSITION SENSOR
(8W-30-23)
2
T6
20
OR/WT
K24
18
GY/BK
K22
18
OR/DB
38
C200
S177
(8W-30-21)
S173
(8W-30-23)
TORQUE MANAGEMENT REQUEST SENSE
SENSOR GROUND
POWERTRAIN CONTROL MODULE
(8W-30-24)
13
C3
4
C1
T6
18
OR/WT
T10
18
YL/DG
K4
18
BK/LB
S101
(8W-70-4)
7
C107
(IN PDC)
8
C107
(IN PDC)
K4
18
BK/LB
S103
(8W-70-3)
T6
18
OR/WT
K24
18
GY/BK
K22
18
OR/DB
T10
18
YL/DG
K4
18
BK/LB
49
6
12
10
51
OVERDRIVE OFF SWITCH SENSE
CRANKSHAFT POSITION SENSOR SIGNAL
THROTTLE POSITION SENSOR SIGNAL
TORQUE MANAGEMENT REQUEST SENSE
SENSOR GROUND
TRANSMISSION CONTROL MODULE

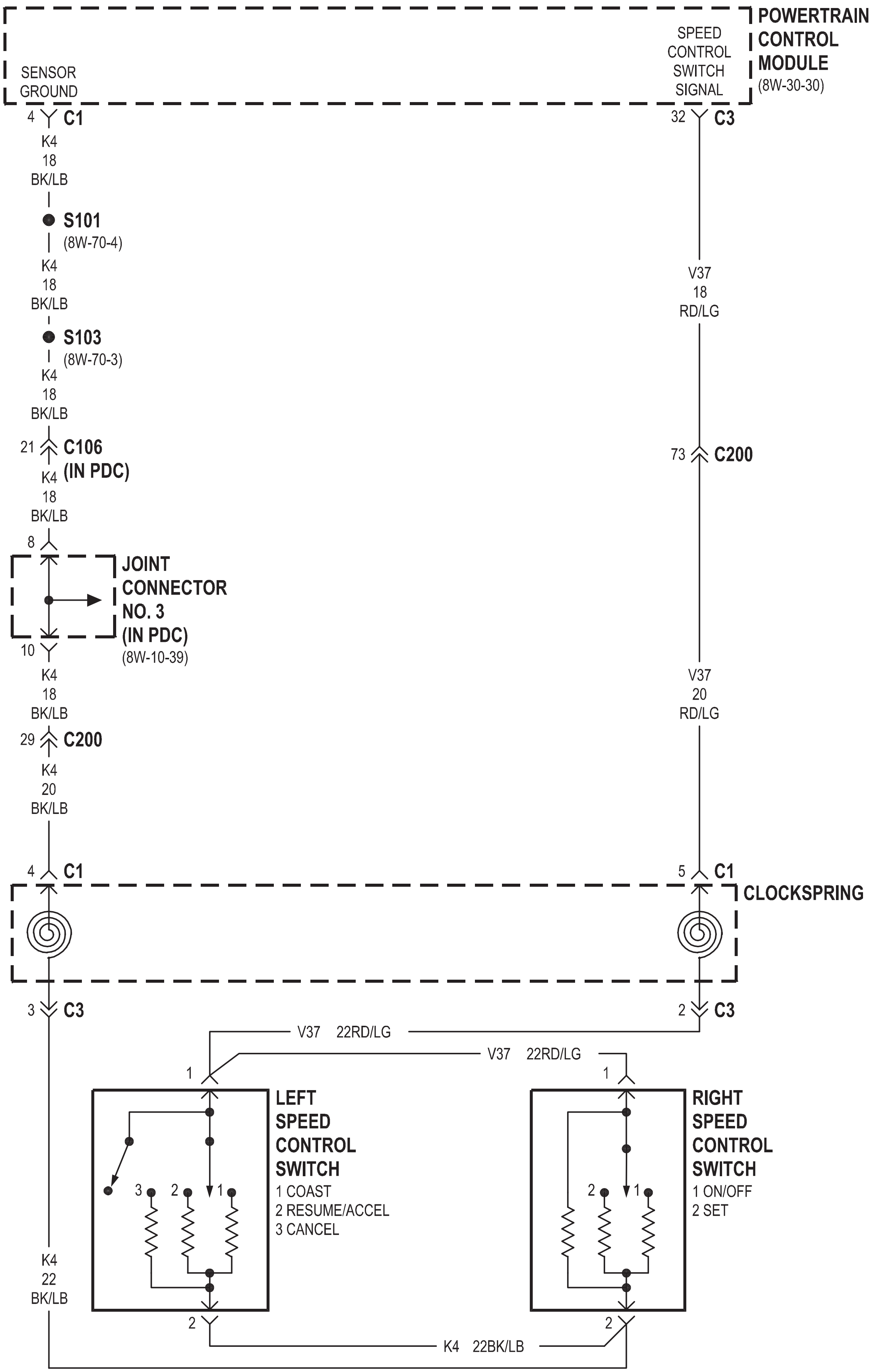

FROM
HEADLAMP
SWITCH
(8W-44-2)
E1
18
TN
3
C6
RUN-START A21
(8W-10-18)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
17
FUSE
9
5A
(8W-12-20)
18
21
FUSE
11
10A
(8W-12-12)
22
4
C6
10
C10
E2
20
OR
F12
20
DB/WT
6
7
TRANSFER
CASE
SELECTOR
SWITCH
4WD
HIGH
LAMP
4WD
LOW
LAMP
NEUTRAL
LAMP
DEFAULT
LAMP
11
9
8
4
2
Z1
20
BK
Y123
20
DG/OR
Y122
20
DG/BR
Y121
20
YL/LG
Y187
20
PK/GY
A5
C1
A4
C1
B4
C1
B5
C1
TRANSFER
CASE
CONTROL
MODULE
4WD
HIGH
INDICATOR
4WD
LOW
INDICATOR
NEUTRAL
INDICATOR
DEFAULT
INDICATOR
GROUND
GROUND
GROUND
A
C3
A8
C1
B8
C1
Z1
16
BK
Z1
18
BK
Z2
18
BK/LG
G207
(8W-15-8)


BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
A
20A
(8W-10-16)
A
A34
16
LB/RD
59
C200
A34
16
LB/RD
B
C3
FUSED B(+)
TRANSFER CASE SELECTOR SWITCH
1 4WD LOW
2 4WD HIGH
3 2WD HIGH
1
2
3
1
5
Y118
20
YL/LB
Y120
20
YL/DG
B8
C2
A6
C1
5 VOLT SELECTOR SWITCH SUPPLY
MODE SELECT
TRANSFER CASE CONTROL MODULE
SHIFT MOTOR CONTROL A
SHIFT MOTOR CONTROL B
C
C3
D
C3
Y124
16
DG/VT
Y125
16
DG/WT
11
16
C200
Y124
16
DG/VT
Y125
16
DG/WT
3
4
C106
(IN PDC)
Y124
16
DG/VT
Y125
16
DG/WT
A
B
M
3
2
1
TRANSFER CASE SHIFT MOTOR
1 4WD LOW
2 4WD HIGH
3 2WD HIGH

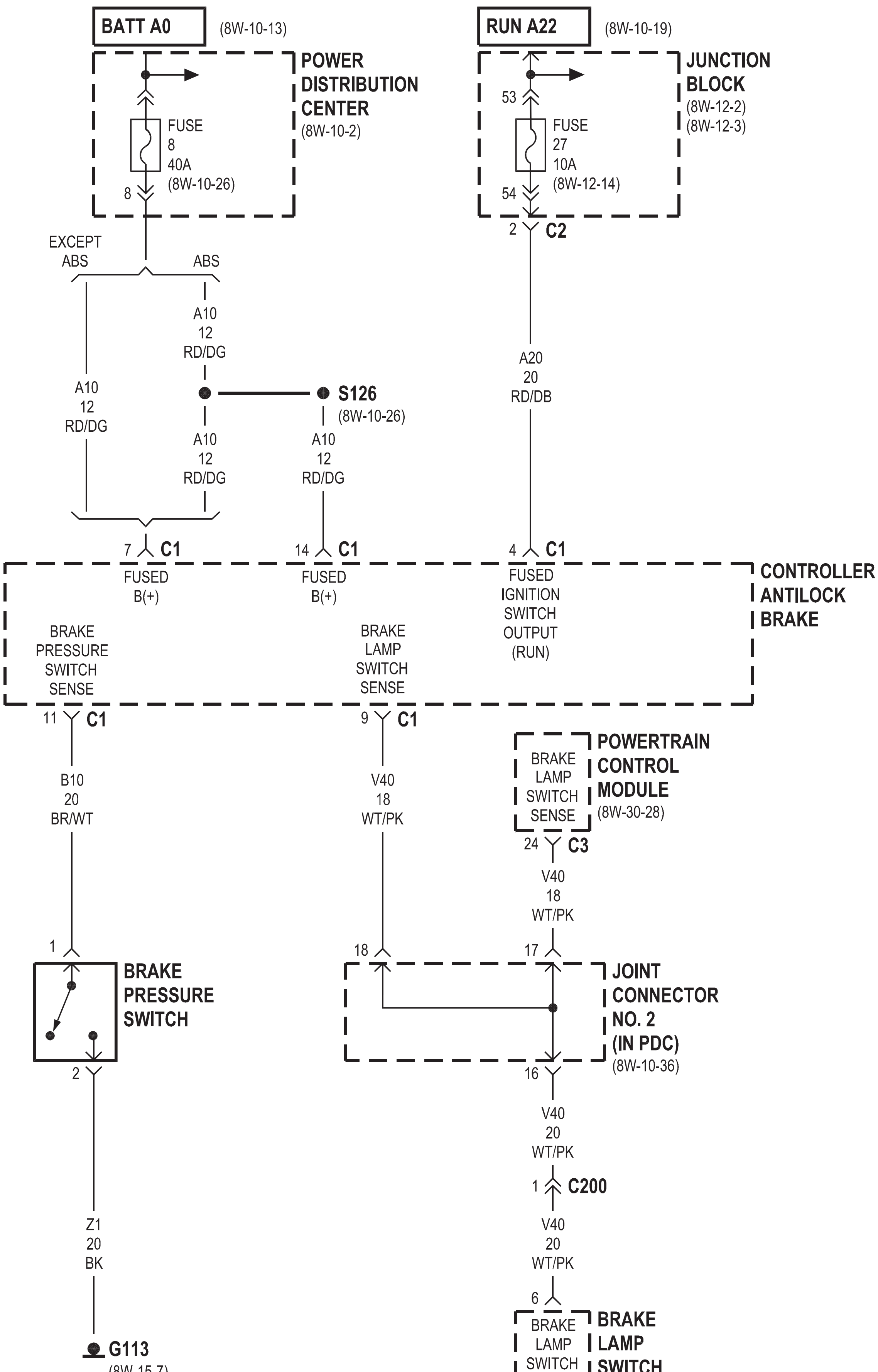

DATA
LINK
CONNECTOR
(8W-18-2)
2
D25
20
VT/YL
5
DIAGNOSTIC
JUNCTION
PORT
(8W-18-3)
2
D25
18
VT/YL
A1 C1
PCI
BUS
86
ENGINE
STARTER
MOTOR
RELAY
(IN PDC)
(8W-21-2)
85
T41
18
BK/WT
4
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-37)
5
T41
18
BK/WT
50 C200
T41
18
BK/WT
A6 C2
PARK/
NEUTRAL
POSITION
SENSE
(T41)
TRANSFER
CASE
CONTROL
MODULE
5 VOLT
MODE
SENSOR
SUPPLY
MODE
SENSOR
GROUND
MODE
SENSOR C
MODE
SENSOR B
MODE
SENSOR A
MODE
SENSOR D
A8 C2
A7 C1
B2 C2
A1 C2
A2 C2
B6 C1
Y117
18
YL/DB
Y119
18
YL/TN
Y115
18
YL/WT
Y114
18
YL/VT
Y113
18
YL/OR
Y112
18
YL/BR
55
48
51
52
27
47
C200
6
7
5
8
15
2
C106
(IN PDC)
E
A
C
D
B
F
5 VOLT
MODE
SENSOR
SUPPLY
1
2
3
4
TRANSFER
CASE
MODE
SENSOR
1 MODE SENSOR C
2 MODE SENSOR B
3 MODE SENSOR A
4 MODE SENSOR D

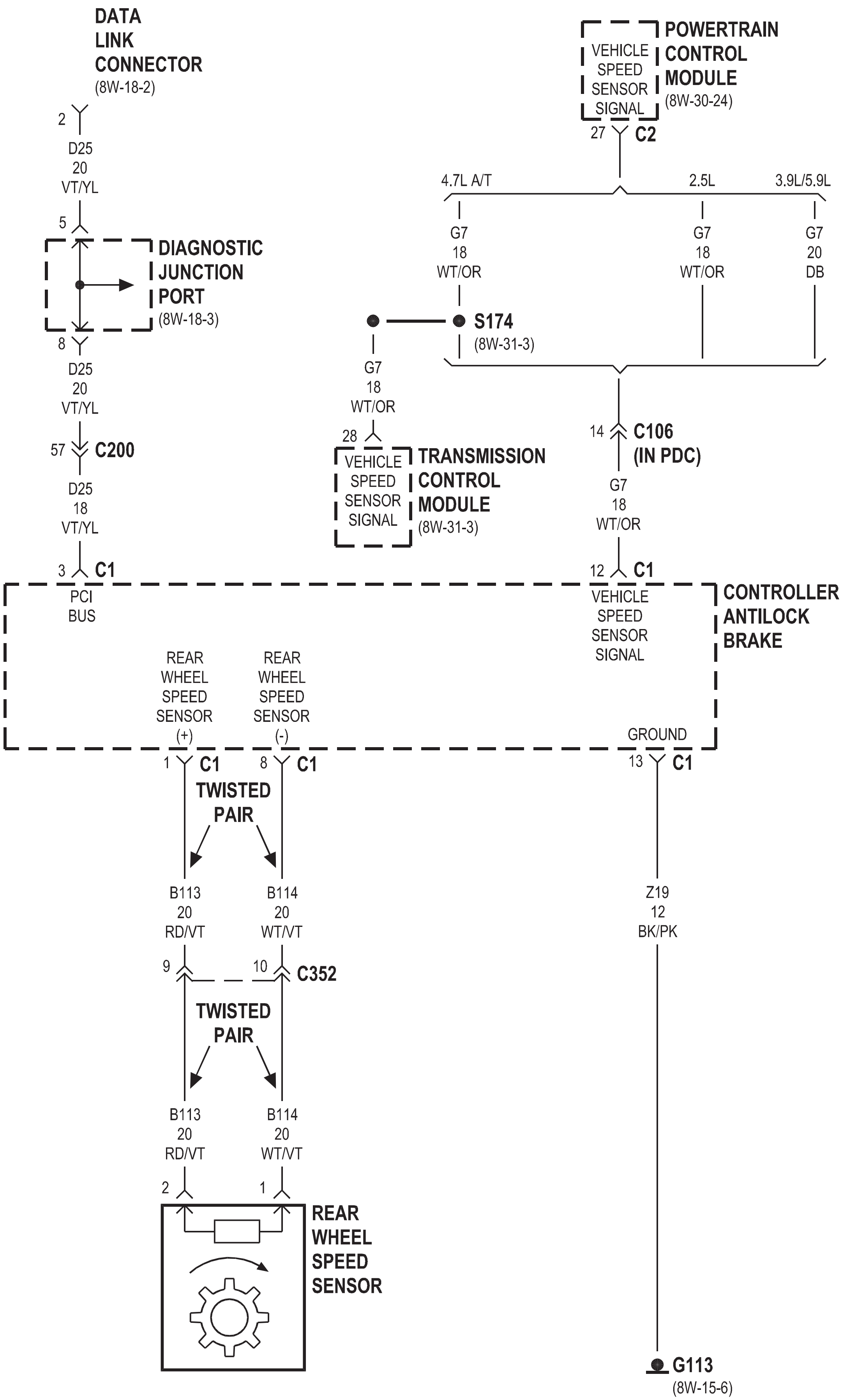
8W-33 VEHICLE SPEED CONTROL


DATA LINK CONNECTOR
(8W-18-2)
2
INSTRUMENT CLUSTER
(8W-40-3)
PCI BUS
9 C1
POWERTRAIN CONTROL MODULE
(8W-30-28)
SPEED CONTROL SUPPLY
11 C3
V32
18
YL/RD
71 C200
V32
20
YL/RD
4
BRAKE LAMP SWITCH
(8W-30-28)
3
V30
20
DB/RD
33 C200
V30
20
DB/RD
D25
20
VT/YL
D25
20
VT/YL
5
1
DIAGNOSTIC JUNCTION PORT
(8W-18-3)
6
D25
18
VT/YL
43 C200
D25
18
VT/YL
3
SPEED CONTROL SERVO
VACUUM SOLENOID
DUMP SOLENOID
VENT SOLENOID
2
1
4
V35
18
LG/RD
V36
18
TN/RD
Z1
18
BK
30 C3
5 C3
4 C3
PCI BUS
SPEED CONTROL VENT SOLENOID CONTROL
SPEED CONTROL VACUUM SOLENOID CONTROL
POWERTRAIN CONTROL MODULE
(8W-30-30)
(8W-30-31)
G112
(8W-15-4)

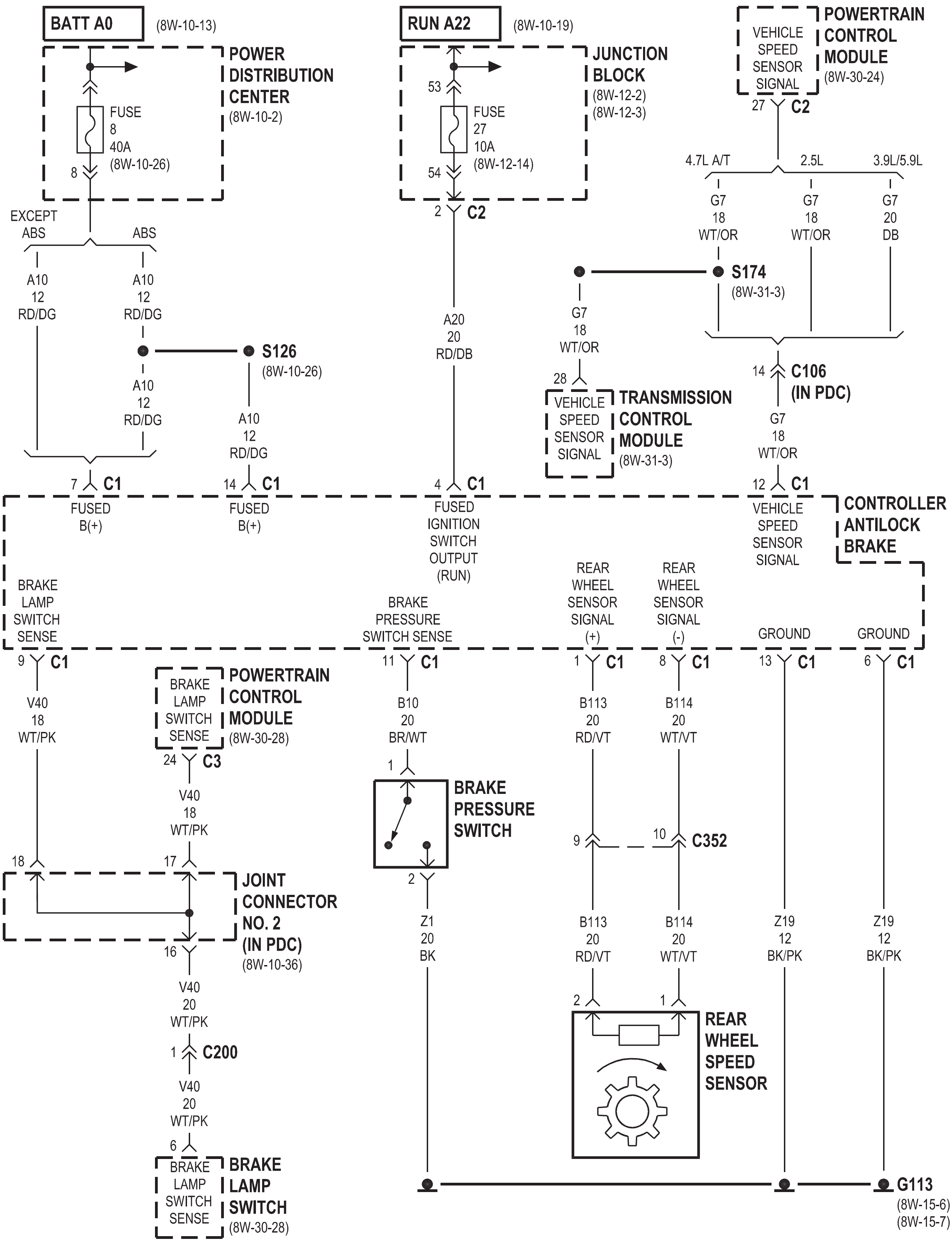

POWERTRAIN
CONTROL
MODULE
(8W-30-30)
SENSOR
GROUND
SPEED
CONTROL
SWITCH
SIGNAL
4 C1
32 C3
K4
18
BK/LB
S101
(8W-70-4)
S103
(8W-70-3)
V37
18
RD/LG
21 C106
(IN PDC)
73 C200
8
JOINT
CONNECTOR
NO. 3
(IN PDC)
(8W-10-39)
10
V37
20
RD/LG
29 C200
K4
20
BK/LB
4 C1
5 C1
CLOCKSPRING
3 C3
2 C3
V37 22RD/LG
LEFT
SPEED
CONTROL
SWITCH
1 COAST
2 RESUME/ACCEL
3 CANCEL
RIGHT
SPEED
CONTROL
SWITCH
1 ON/OFF
2 SET
K4
22
BK/LB
K4 22BK/LB

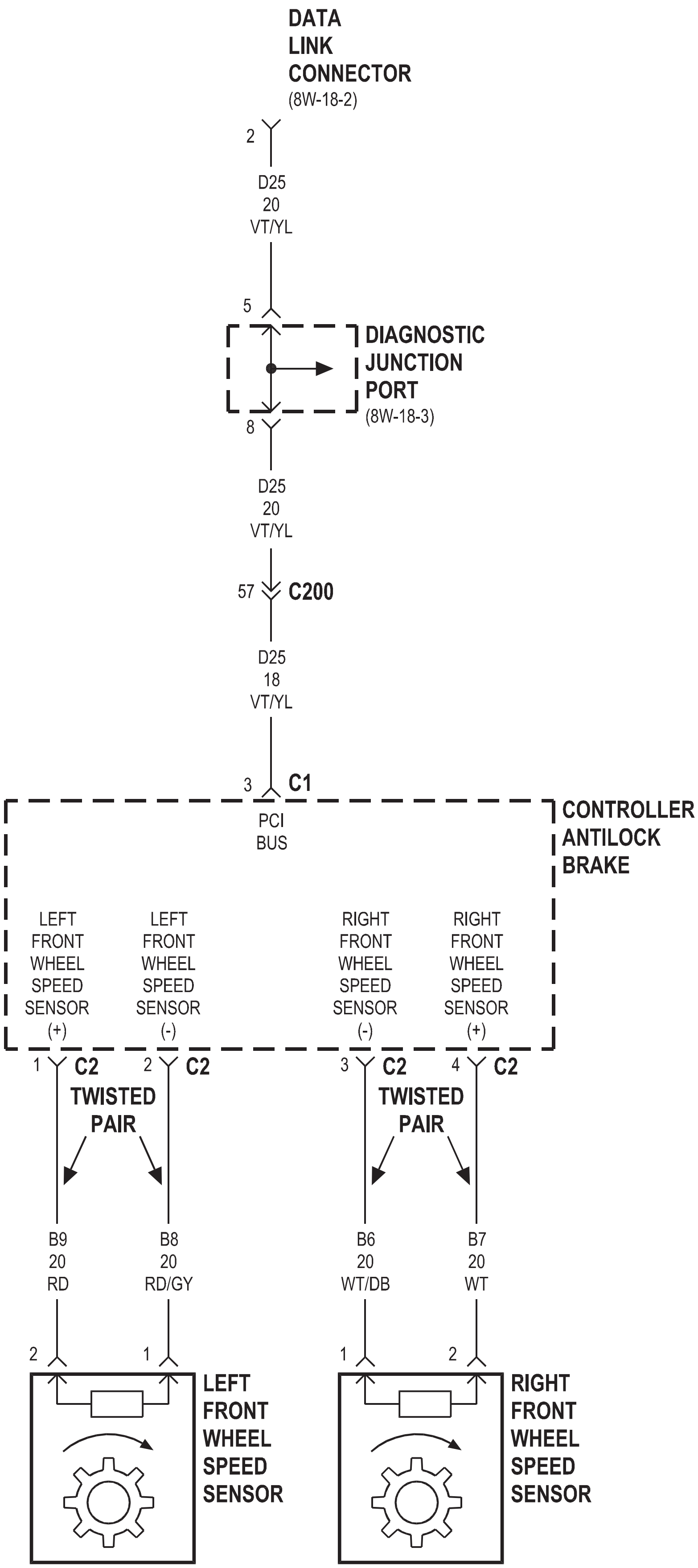
8W-34 REAR WHEEL ANTILOCK BRAKES


BATT A0
(8W-10-13)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
8
40A
(8W-10-26)
8
RUN A22
(8W-10-19)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
53
FUSE
27
10A
(8W-12-14)
54
2 C2
EXCEPT
ABS
ABS
A10
12
RD/DG
S126
(8W-10-26)
A20
20
RD/DB
7 C1
14 C1
4 C1
FUSED
B(+)
FUSED
IGNITION
SWITCH
OUTPUT
(RUN)
CONTROLLER
ANTILOCK
BRAKE
BRAKE
PRESSURE
SWITCH
SENSE
BRAKE
LAMP
SWITCH
SENSE
11 C1
9 C1
B10
20
BR/WT
V40
18
WT/PK
POWERTRAIN
CONTROL
MODULE
(8W-30-28)
24 C3
1
BRAKE
PRESSURE
SWITCH
2
18
17
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-36)
16
V40
20
WT/PK
1 C200
Z1
20
BK
6
BRAKE
LAMP
SWITCH
(8W-30-28)
G113
(8W-15-7)

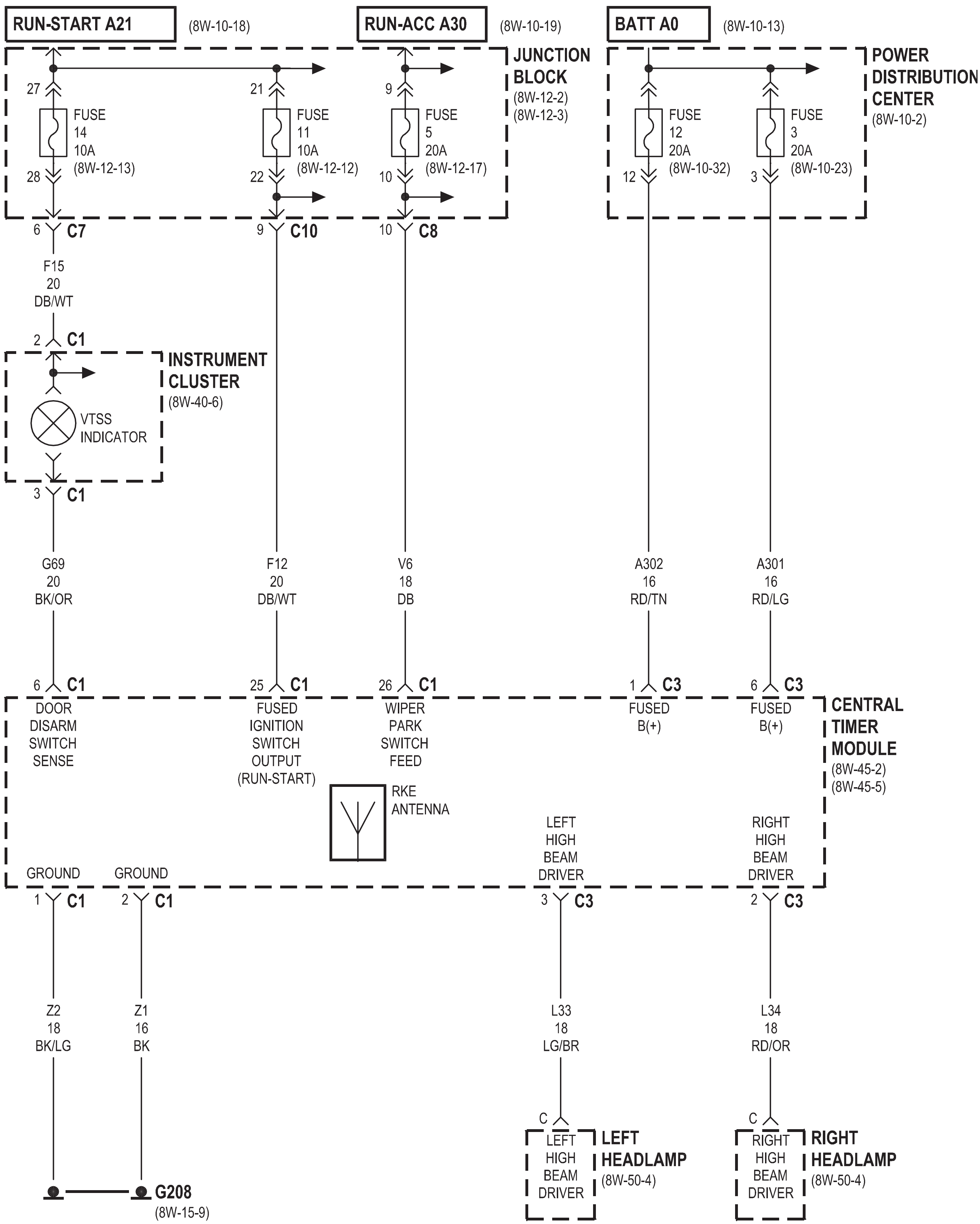

DATA
LINK
CONNECTOR
(8W-18-2)
2
D25
20
VT/YL
5
DIAGNOSTIC
JUNCTION
PORT
(8W-18-3)
8
D25
20
VT/YL
57
C200
D25
18
VT/YL
3
C1
PCI
BUS
VEHICLE
SPEED
SENSOR
SIGNAL
POWERTRAIN
CONTROL
MODULE
(8W-30-24)
27
C2
4.7L A/T
2.5L
3.9L/5.9L
G7
18
WT/OR
G7
18
WT/OR
G7
20
DB
S174
(8W-31-3)
G7
18
WT/OR
28
VEHICLE
SPEED
SENSOR
SIGNAL
TRANSMISSION
CONTROL
MODULE
(8W-31-3)
14
C106
(IN PDC)
G7
18
WT/OR
12
C1
VEHICLE
SPEED
SENSOR
SIGNAL
CONTROLLER
ANTILOCK
BRAKE
REAR
WHEEL
SPEED
SENSOR
(+)
REAR
WHEEL
SPEED
SENSOR
(-)
GROUND
1
C1
8
C1
13
C1
TWISTED
PAIR
B113
20
RD/VT
B114
20
WT/VT
Z19
12
BK/PK
9
10
C352
TWISTED
PAIR
B113
20
RD/VT
B114
20
WT/VT
2
1
REAR
WHEEL
SPEED
SENSOR
G113
(8W-15-6)

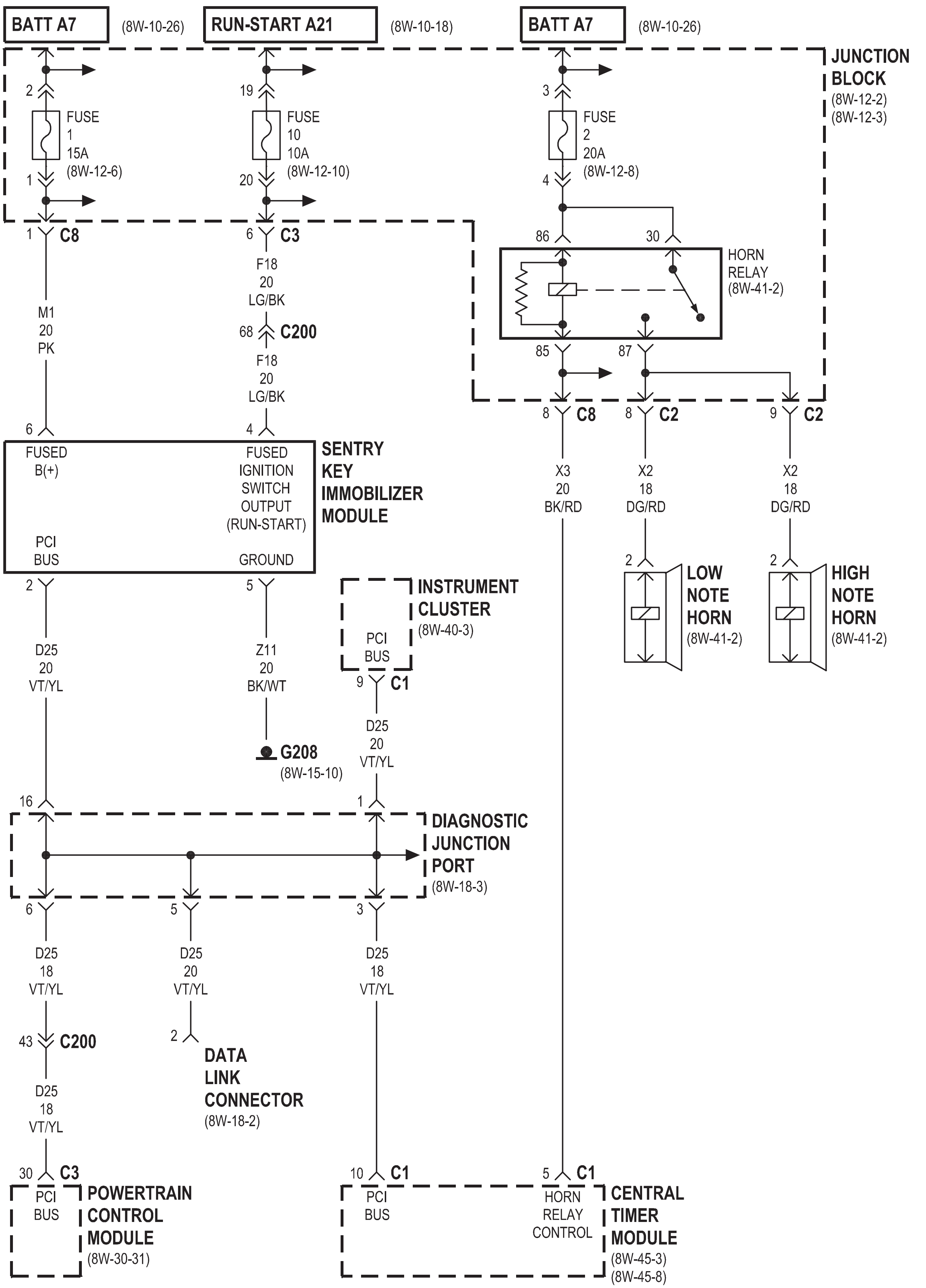
8W-35 ALL WHEEL ANTILOCK BRAKES


BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 8 40A (8W-10-26)
8
EXCEPT ABS
ABS
A10 12 RD/DG
A10 12 RD/DG
S126
(8W-10-26)
A10 12 RD/DG
A10 12 RD/DG
RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
53
FUSE 27 10A (8W-12-14)
54
2 C2
A20 20 RD/DB
POWERTRAIN CONTROL MODULE
(8W-30-24)
VEHICLE SPEED SENSOR SIGNAL
27 C2
4.7L A/T
2.5L
3.9L/5.9L
G7 18 WT/OR
G7 18 WT/OR
G7 20 DB
S174
(8W-31-3)
G7 18 WT/OR
28
VEHICLE SPEED SENSOR SIGNAL
TRANSMISSION CONTROL MODULE
(8W-31-3)
14 C106 (IN PDC)
G7 18 WT/OR
7 C1
14 C1
4 C1
12 C1
FUSED B(+)
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (RUN)
VEHICLE SPEED SENSOR SIGNAL
CONTROLLER ANTILOCK BRAKE
BRAKE LAMP SWITCH SENSE
BRAKE PRESSURE SWITCH SENSE
REAR WHEEL SENSOR SIGNAL (+)
REAR WHEEL SENSOR SIGNAL (-)
GROUND
GROUND
9 C1
11 C1
1 C1
8 C1
13 C1
6 C1
V40 18 WT/PK
BRAKE LAMP SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-28)
24 C3
V40 18 WT/PK
18
17
JOINT CONNECTOR NO. 2 (IN PDC)
(8W-10-36)
16
V40 20 WT/PK
1 C200
V40 20 WT/PK
6
BRAKE LAMP SWITCH SENSE
BRAKE LAMP SWITCH
(8W-30-28)
B10 20 BR/WT
1
BRAKE PRESSURE SWITCH
2
Z1 20 BK
B113 20 RD/VT
B114 20 WT/VT
9
10 C352
B113 20 RD/VT
B114 20 WT/VT
2
1
REAR WHEEL SPEED SENSOR
Z19 12 BK/PK
Z19 12 BK/PK
G113
(8W-15-6)
(8W-15-7)


DATA
LINK
CONNECTOR
(8W-18-2)
2
D25
20
VT/YL
5
DIAGNOSTIC
JUNCTION
PORT
(8W-18-3)
8
D25
20
VT/YL
57
C200
D25
18
VT/YL
3
C1
PCI
BUS
CONTROLLER
ANTILOCK
BRAKE
LEFT FRONT WHEEL SPEED SENSOR (+)
LEFT FRONT WHEEL SPEED SENSOR (-)
RIGHT FRONT WHEEL SPEED SENSOR (-)
RIGHT FRONT WHEEL SPEED SENSOR (+)
1 C2
2 C2
3 C2
4 C2
TWISTED PAIR
TWISTED PAIR
B9 20 RD
B8 20 RD/GY
B6 20 WT/DB
B7 20 WT
2
1
1
2
LEFT
FRONT
WHEEL
SPEED
SENSOR
RIGHT
FRONT
WHEEL
SPEED
SENSOR

8W-39 VEHICLE THEFT SECURITY SYSTEM


RUN-START A21
(8W-10-18)
RUN-ACC A30
(8W-10-19)
BATT A0
(8W-10-13)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 14 10A (8W-12-13)
FUSE 11 10A (8W-12-12)
FUSE 5 20A (8W-12-17)
FUSE 12 20A (8W-10-32)
FUSE 3 20A (8W-10-23)
6 C7
9 C10
10 C8
F15 20 DB/WT
2 C1
INSTRUMENT CLUSTER
(8W-40-6)
VTSS INDICATOR
3 C1
G69 20 BK/OR
F12 20 DB/WT
V6 18 DB
A302 16 RD/TN
A301 16 RD/LG
6 C1
25 C1
26 C1
1 C3
6 C3
DOOR DISARM SWITCH SENSE
FUSED IGNITION SWITCH OUTPUT (RUN-START)
WIPER PARK SWITCH FEED
FUSED B(+)
FUSED B(+)
CENTRAL TIMER MODULE
(8W-45-2)
(8W-45-5)
RKE ANTENNA
LEFT HIGH BEAM DRIVER
RIGHT HIGH BEAM DRIVER
GROUND
GROUND
1 C1
2 C1
3 C3
2 C3
Z2 18 BK/LG
Z1 16 BK
L33 18 LG/BR
L34 18 RD/OR
C
LEFT HIGH BEAM DRIVER
LEFT HEADLAMP
(8W-50-4)
C
RIGHT HIGH BEAM DRIVER
RIGHT HEADLAMP
(8W-50-4)
G208
(8W-15-9)



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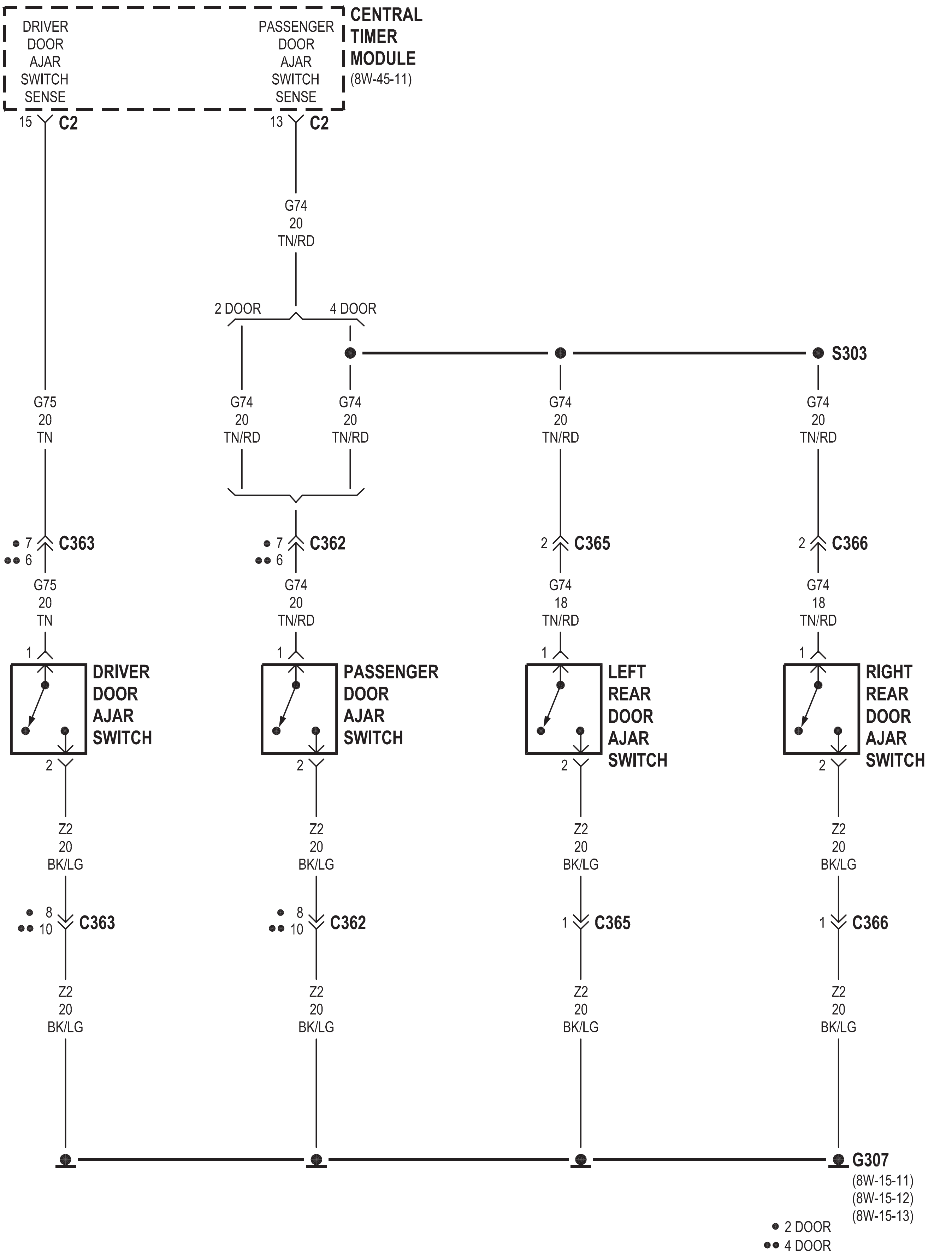
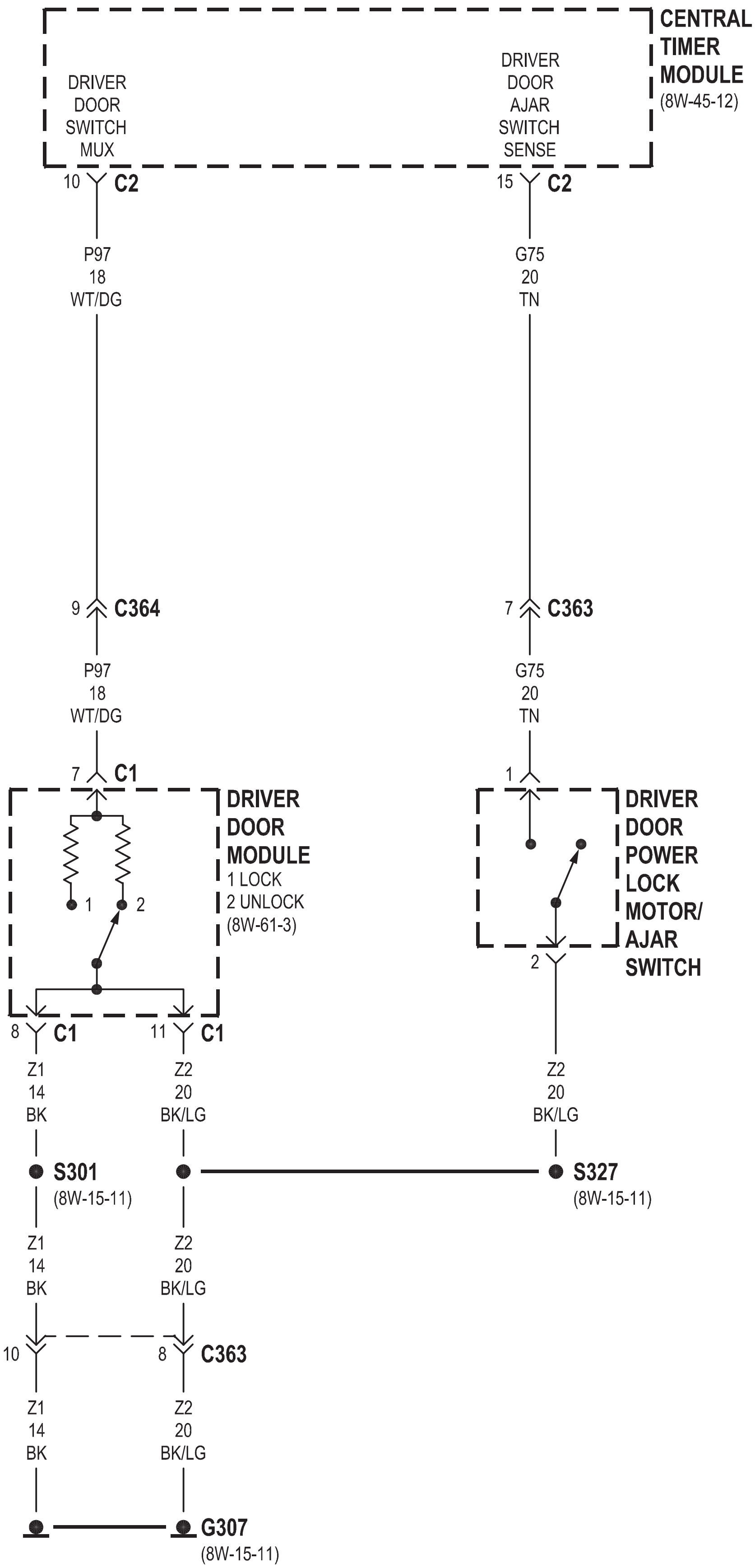
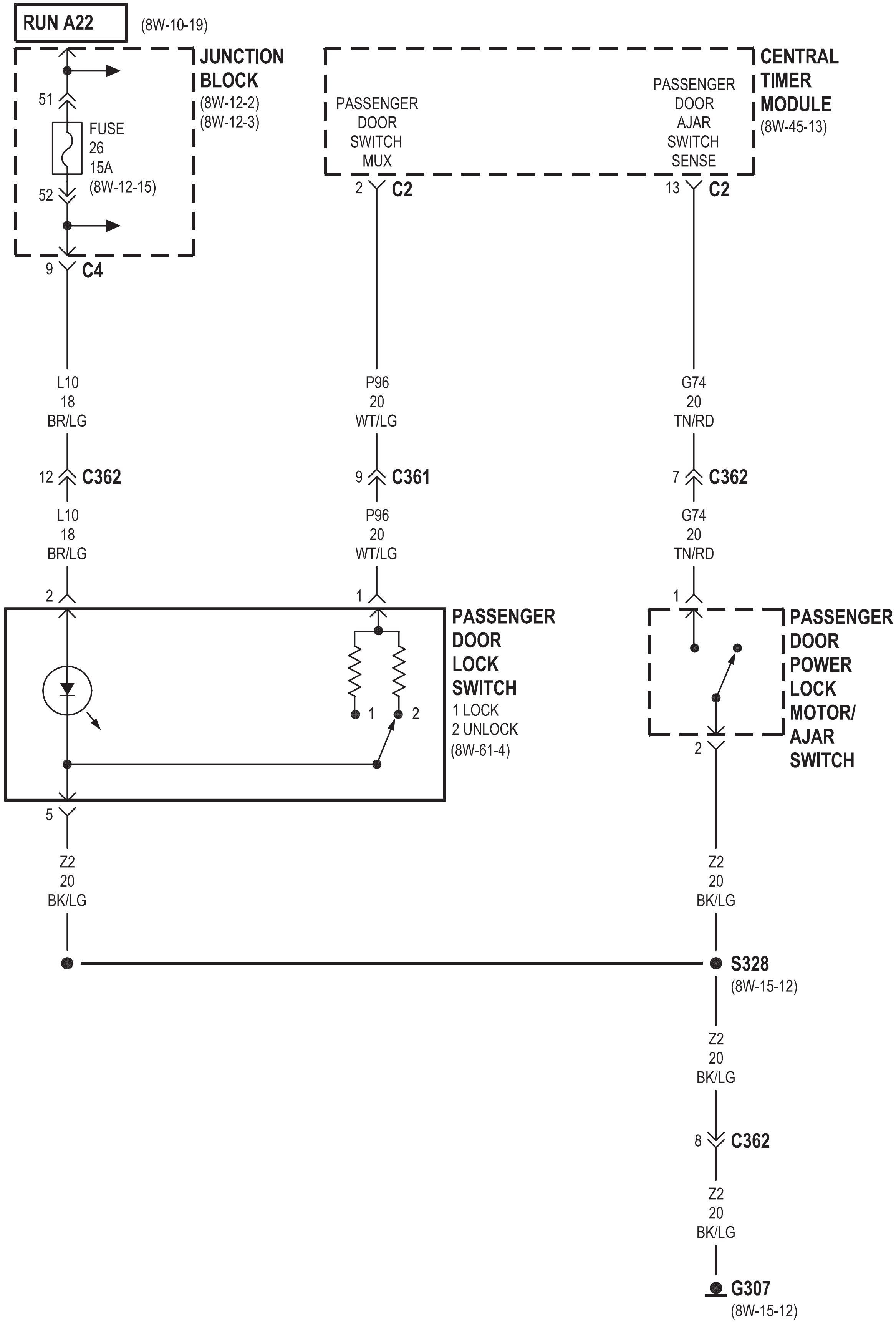
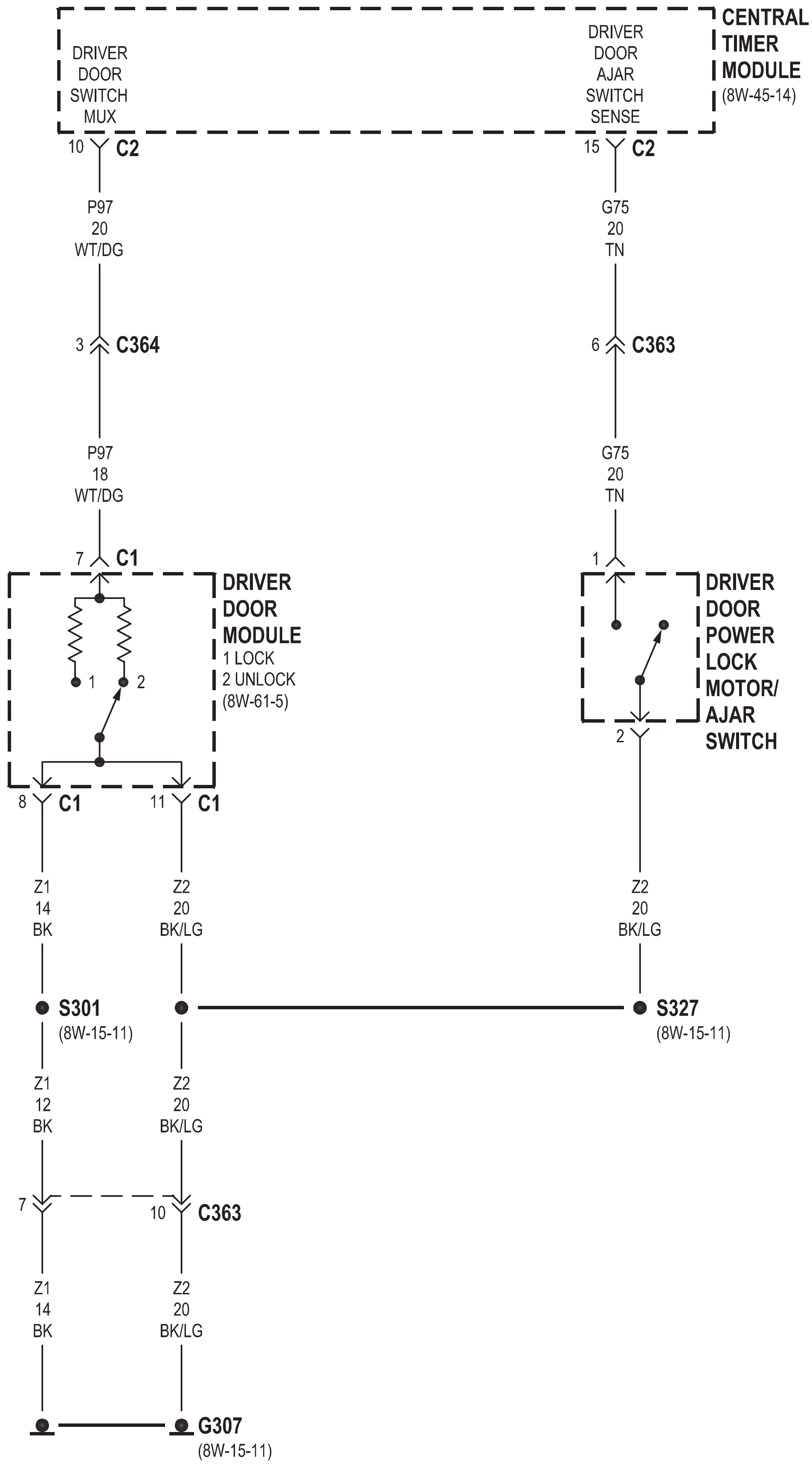
BASE


CENTRAL
TIMER
MODULE
(8W-45-11)
DRIVER
DOOR
AJAR
SWITCH
SENSE
PASSENGER
DOOR
AJAR
SWITCH
SENSE
15 C2
13 C2
G74
20
TN/RD
2 DOOR
4 DOOR
S303
G75
20
TN
G74
20
TN/RD
G74
20
TN/RD
G74
20
TN/RD
G74
20
TN/RD
7 C363
6
7 C362
6
2 C365
2 C366
G75
20
TN
G74
20
TN/RD
G74
18
TN/RD
G74
18
TN/RD
1
DRIVER
DOOR
AJAR
SWITCH
PASSENGER
DOOR
AJAR
SWITCH
LEFT
REAR
DOOR
AJAR
SWITCH
RIGHT
REAR
DOOR
AJAR
SWITCH
2
Z2
20
BK/LG
8
10 C363
8
10 C362
1 C365
1 C366
Z2
20
BK/LG
G307
(8W-15-11)
(8W-15-12)
(8W-15-13)
● 2 DOOR
●● 4 DOOR

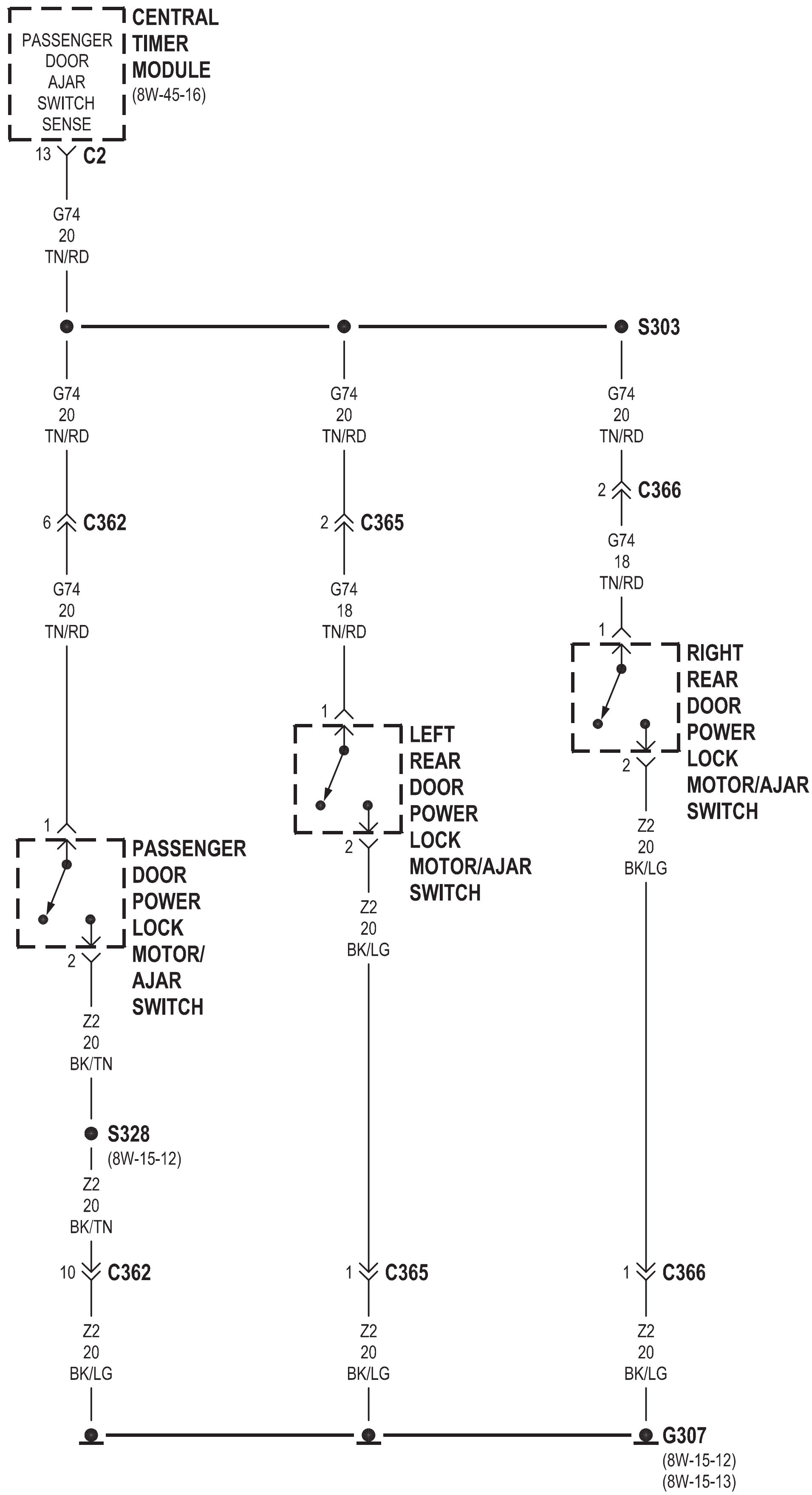

CENTRAL TIMER MODULE
(8W-45-12)
DRIVER DOOR SWITCH MUX
DRIVER DOOR AJAR SWITCH SENSE
10 C2
15 C2
P97 18 WT/DG
G75 20 TN
9 C364
7 C363
P97 18 WT/DG
G75 20 TN
7 C1
1
DRIVER DOOR MODULE
1 LOCK
2 UNLOCK
(8W-61-3)
1
2
DRIVER DOOR POWER LOCK MOTOR/ AJAR SWITCH
2
8 C1
11 C1
Z1 14 BK
Z2 20 BK/LG
Z2 20 BK/LG
S301
(8W-15-11)
S327
(8W-15-11)
Z1 14 BK
Z2 20 BK/LG
10
8 C363
Z1 14 BK
Z2 20 BK/LG
G307
(8W-15-11)

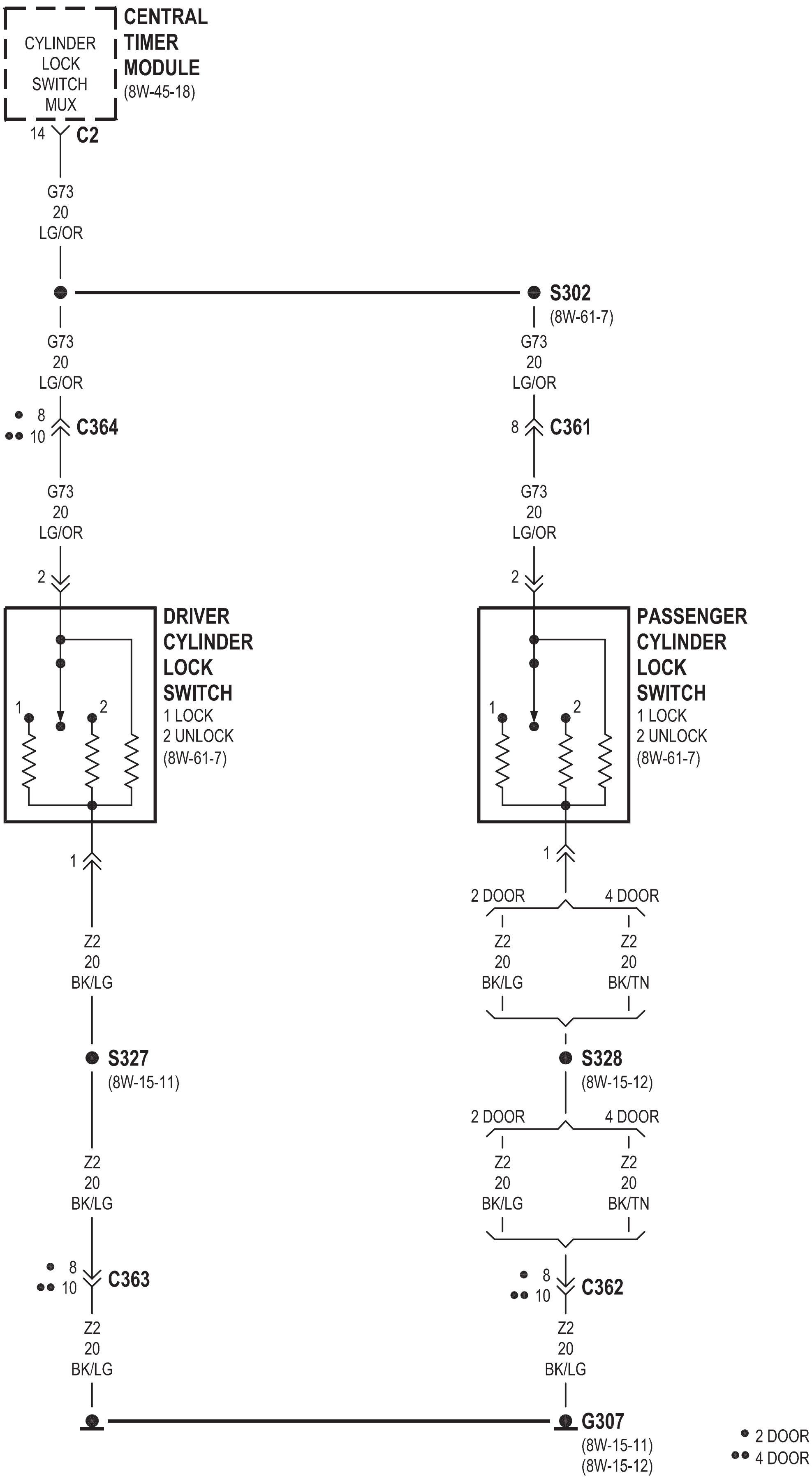


RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
51
FUSE
26
15A
(8W-12-15)
52
9 C4
PASSENGER DOOR SWITCH MUX
PASSENGER DOOR AJAR SWITCH SENSE
CENTRAL TIMER MODULE
(8W-45-13)
2 C2
13 C2
L10
18
BR/LG
P96
20
WT/LG
G74
20
TN/RD
12 C362
9 C361
7 C362
L10
18
BR/LG
P96
20
WT/LG
G74
20
TN/RD
2
1
1
PASSENGER DOOR LOCK SWITCH
1 LOCK
2 UNLOCK
(8W-61-4)
PASSENGER DOOR POWER LOCK MOTOR/ AJAR SWITCH
2
5
Z2
20
BK/LG
Z2
20
BK/LG
S328
(8W-15-12)
Z2
20
BK/LG
8 C362
Z2
20
BK/LG
G307
(8W-15-12)

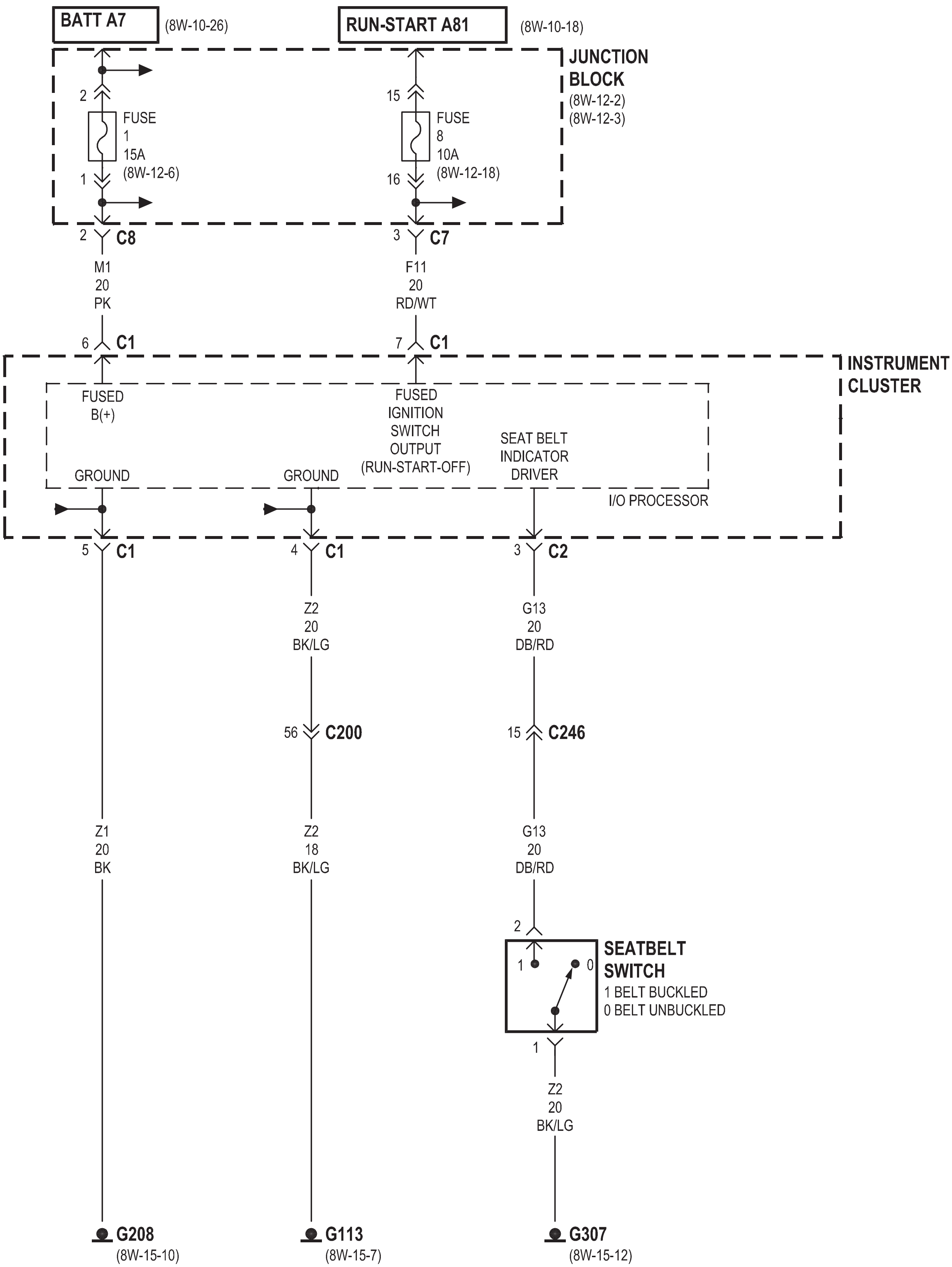

CENTRAL TIMER MODULE
(8W-45-14)
DRIVER DOOR SWITCH MUX
DRIVER DOOR AJAR SWITCH SENSE
10
C2
15
C2
P97
20
WT/DG
G75
20
TN
3
C364
6
C363
P97
18
WT/DG
G75
20
TN
7
C1
1
DRIVER DOOR MODULE
1 LOCK
2 UNLOCK
(8W-61-5)
1
2
DRIVER DOOR POWER LOCK MOTOR/ AJAR SWITCH
2
8
C1
11
C1
Z1
14
BK
Z2
20
BK/LG
Z2
20
BK/LG
S301
(8W-15-11)
S327
(8W-15-11)
Z1
12
BK
Z2
20
BK/LG
7
10
C363
Z1
14
BK
Z2
20
BK/LG
G307
(8W-15-11)

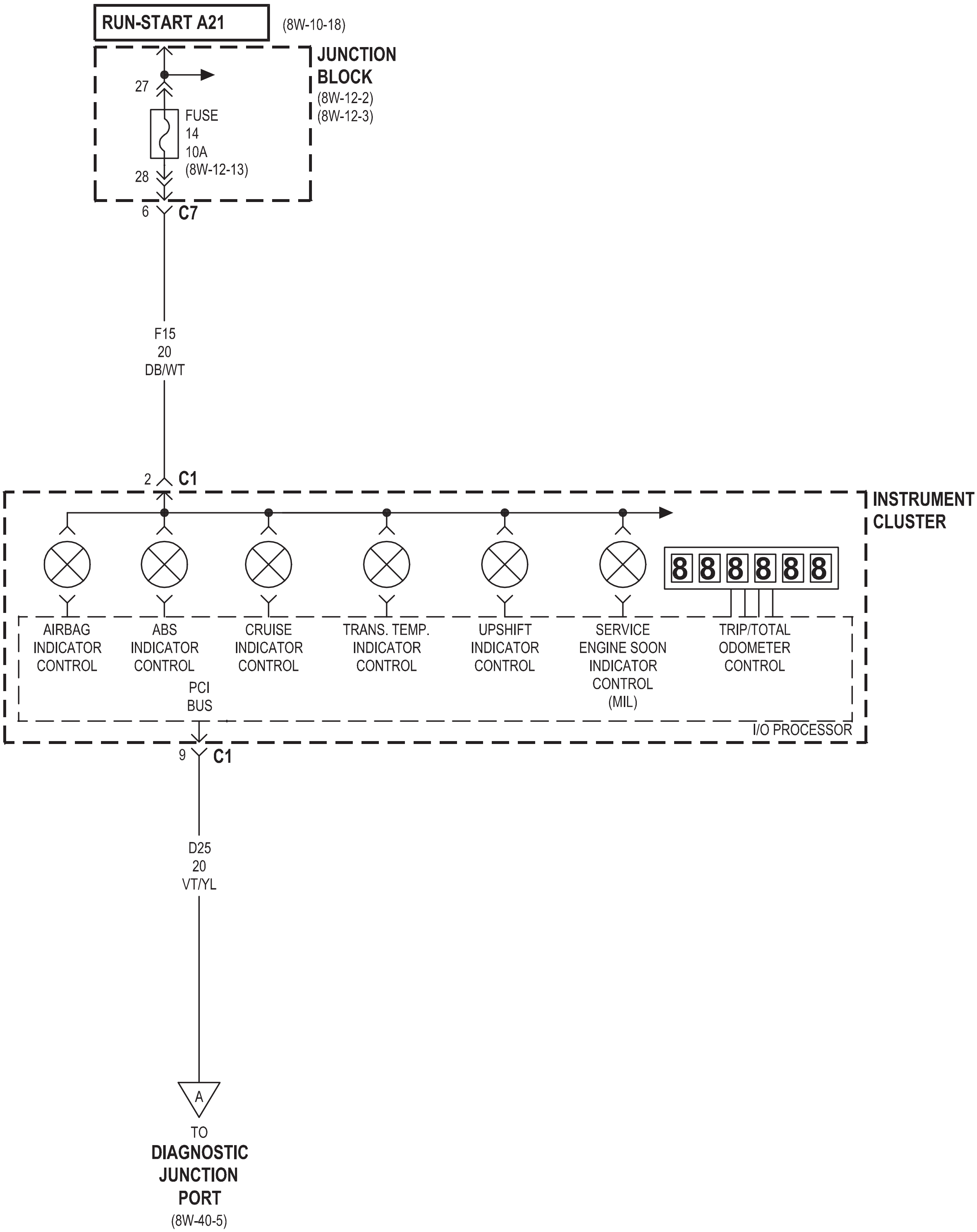
PREMIUM 4 DOOR

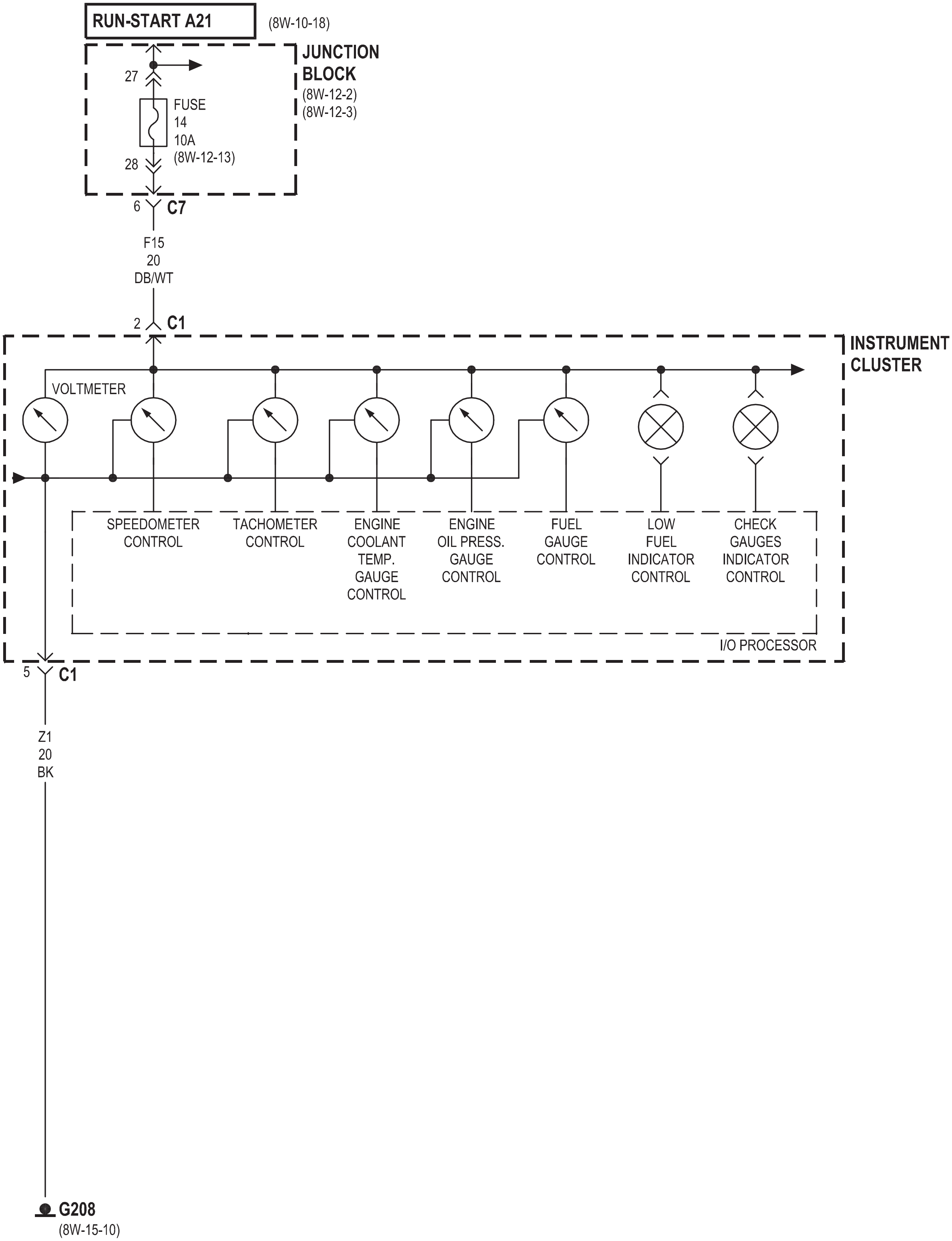


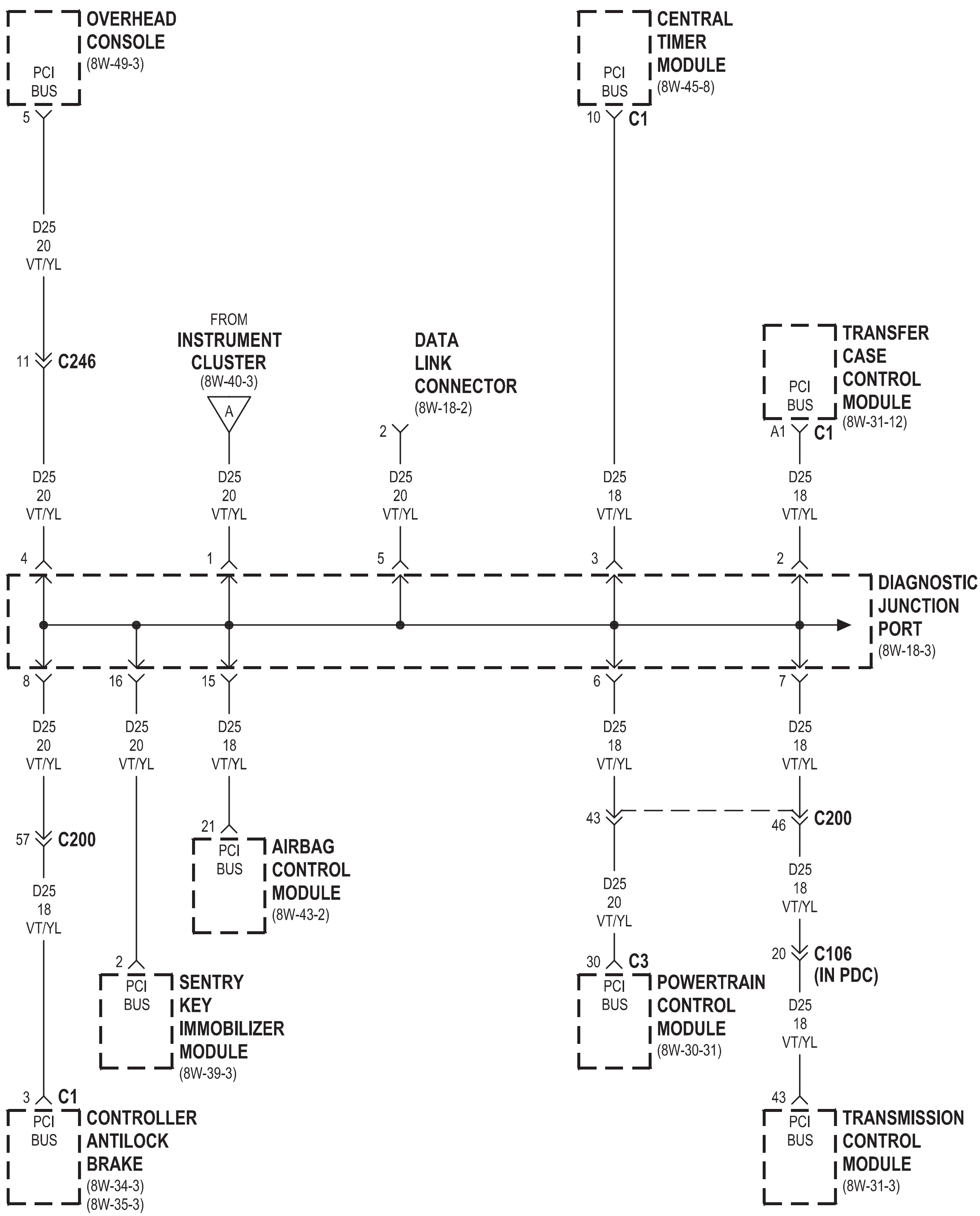

CENTRAL
TIMER
MODULE
(8W-45-18)
CYLINDER
LOCK
SWITCH
MUX
14
C2
G73
20
LG/OR
S302
(8W-61-7)
C364
8
10
C361
2
DRIVER
CYLINDER
LOCK
SWITCH
1 LOCK
2 UNLOCK
(8W-61-7)
PASSENGER
CYLINDER
LOCK
SWITCH
1 LOCK
2 UNLOCK
(8W-61-7)
1
2 DOOR
4 DOOR
Z2
20
BK/LG
BK/TN
S327
(8W-15-11)
S328
(8W-15-12)
C363
C362
G307
(8W-15-11)
(8W-15-12)
• 2 DOOR
•• 4 DOOR

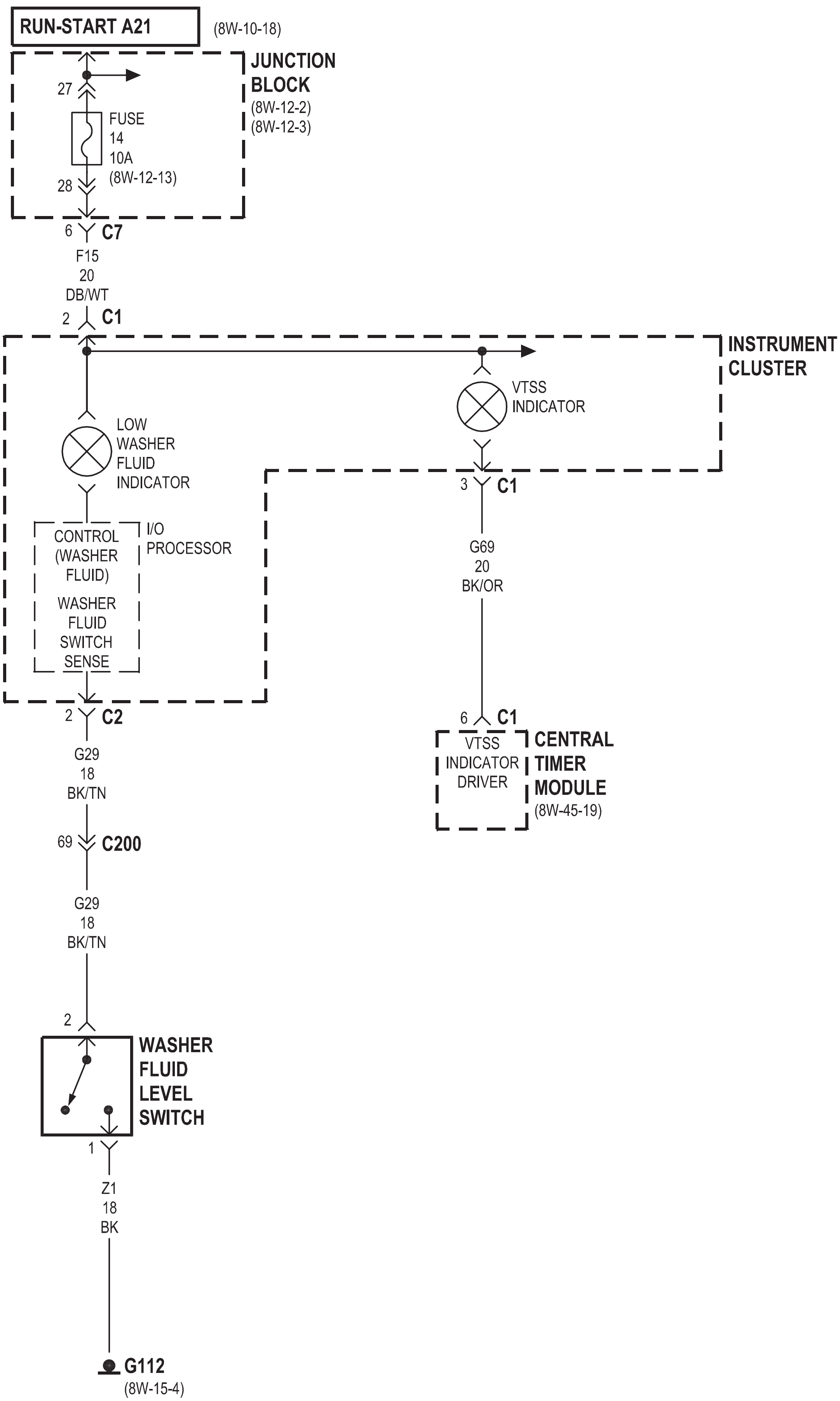
8W-40 INSTRUMENT CLUSTER

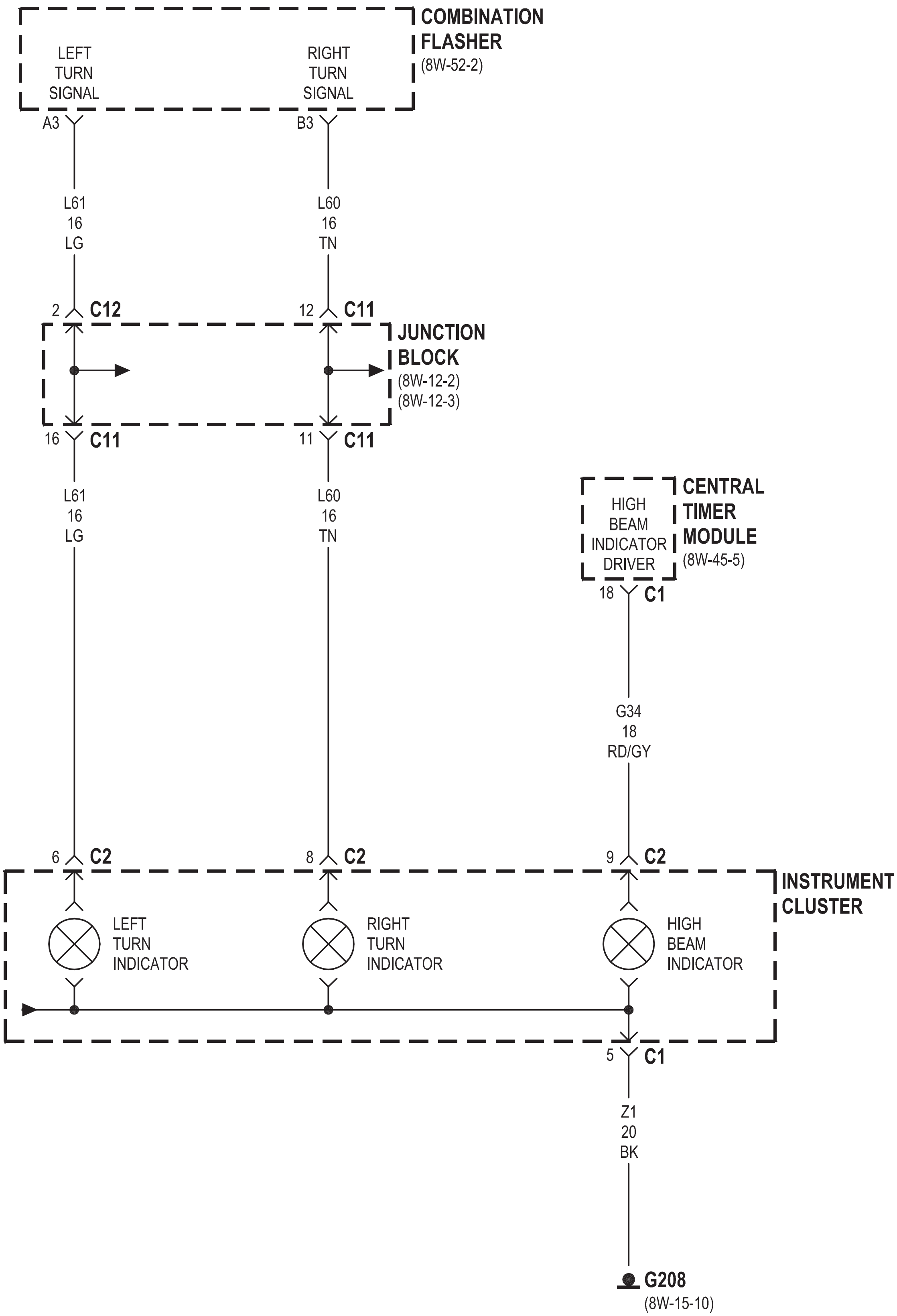

BATT A7
(8W-10-26)
RUN-START A81
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
2
FUSE
1
15A
(8W-12-6)
1
15
FUSE
8
10A
(8W-12-18)
16
2 C8
3 C7
M1
20
PK
F11
20
RD/WT
6 C1
7 C1
INSTRUMENT CLUSTER
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (RUN-START-OFF)
SEAT BELT INDICATOR DRIVER
GROUND
GROUND
I/O PROCESSOR
5 C1
4 C1
3 C2
Z2
20
BK/LG
G13
20
DB/RD
56 C200
15 C246
Z1
20
BK
Z2
18
BK/LG
G13
20
DB/RD
2
SEATBELT SWITCH
1 BELT BUCKLED
0 BELT UNBUCKLED
1
0
1
Z2
20
BK/LG
G208
(8W-15-10)
G113
(8W-15-7)
G307
(8W-15-12)


RUN-START A21
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
27
FUSE
14
10A
(8W-12-13)
28
6
C7
F15
20
DB/WT
2
C1
INSTRUMENT CLUSTER
AIRBAG INDICATOR CONTROL
ABS INDICATOR CONTROL
CRUISE INDICATOR CONTROL
TRANS. TEMP. INDICATOR CONTROL
UPSHIFT INDICATOR CONTROL
SERVICE ENGINE SOON INDICATOR CONTROL (MIL)
TRIP/TOTAL ODOMETER CONTROL
PCI BUS
I/O PROCESSOR
9
C1
D25
20
VT/YL
A
TO
DIAGNOSTIC JUNCTION PORT
(8W-40-5)

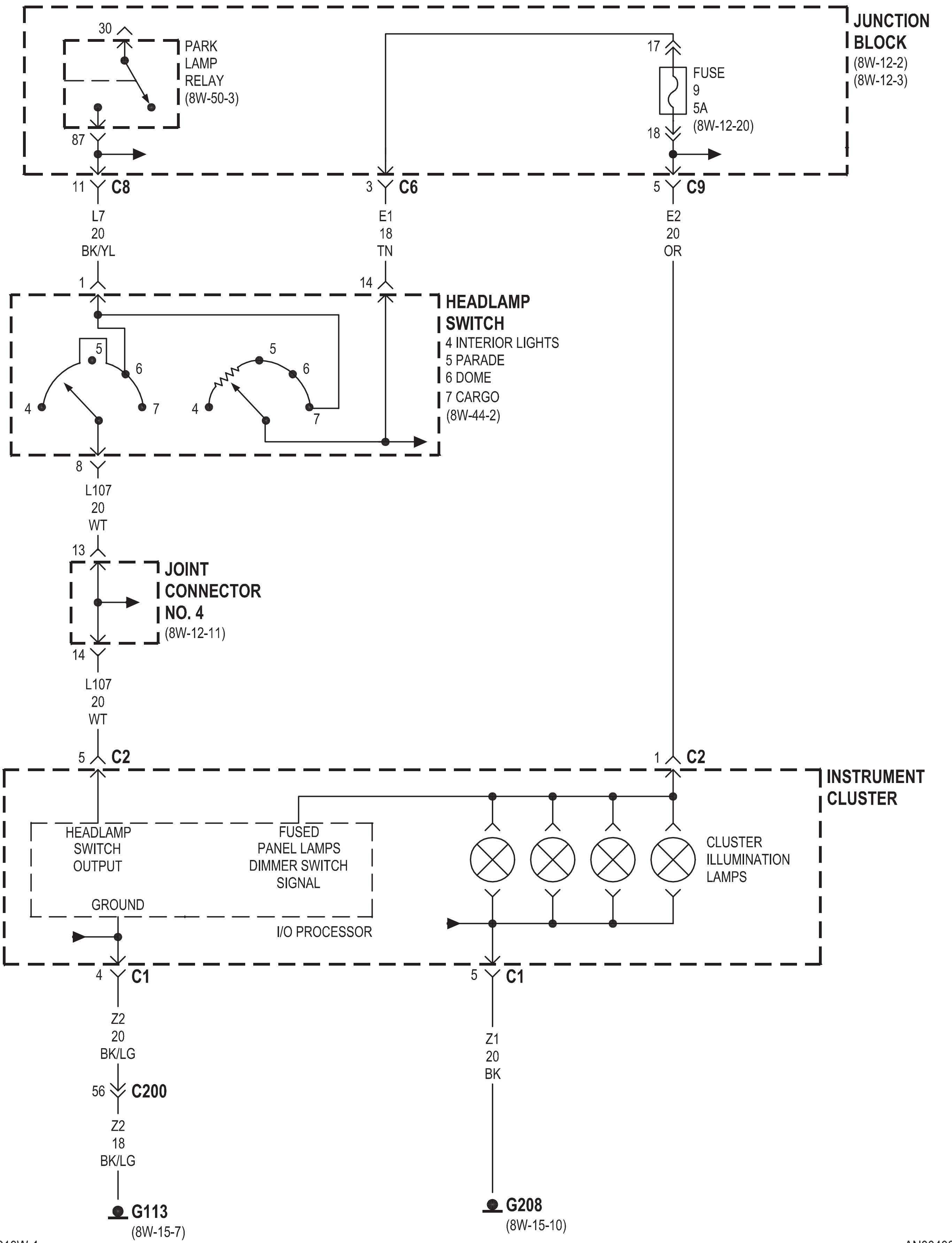

RUN-START A21
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
27
FUSE
14
10A
(8W-12-13)
28
6
C7
F15
20
DB/WT
2
C1
INSTRUMENT CLUSTER
VOLTMETER
SPEEDOMETER CONTROL
TACHOMETER CONTROL
ENGINE COOLANT TEMP. GAUGE CONTROL
ENGINE OIL PRESS. GAUGE CONTROL
FUEL GAUGE CONTROL
LOW FUEL INDICATOR CONTROL
CHECK GAUGES INDICATOR CONTROL
I/O PROCESSOR
5
C1
Z1
20
BK
G208
(8W-15-10)


OVERHEAD
CONSOLE
(8W-49-3)
PCI
BUS
5
D25
20
VT/YL
11
C246
CENTRAL
TIMER
MODULE
(8W-45-8)
PCI
BUS
10
C1
FROM
INSTRUMENT
CLUSTER
(8W-40-3)
A
DATA
LINK
CONNECTOR
(8W-18-2)
2
TRANSFER
CASE
CONTROL
MODULE
(8W-31-12)
PCI
BUS
A1
C1
D25
20
VT/YL
D25
18
VT/YL
4
1
5
3
2
DIAGNOSTIC
JUNCTION
PORT
(8W-18-3)
8
16
15
6
7
57
C200
43
46
C200
D25
18
VT/YL
21
PCI
BUS
AIRBAG
CONTROL
MODULE
(8W-43-2)
20
C106
(IN PDC)
2
PCI
BUS
SENTRY
KEY
IMMOBILIZER
MODULE
(8W-39-3)
30
C3
PCI
BUS
POWERTRAIN
CONTROL
MODULE
(8W-30-31)
3
C1
PCI
BUS
CONTROLLER
ANTILOCK
BRAKE
(8W-34-3)
(8W-35-3)
43
PCI
BUS
TRANSMISSION
CONTROL
MODULE
(8W-31-3)


RUN-START A21
(8W-10-18)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
27
FUSE
14
10A
(8W-12-13)
28
6
C7
F15
20
DB/WT
2
C1
INSTRUMENT
CLUSTER
VTSS
INDICATOR
LOW
WASHER
FLUID
INDICATOR
3
C1
CONTROL
(WASHER
FLUID)
WASHER
FLUID
SWITCH
SENSE
I/O
PROCESSOR
G69
20
BK/OR
2
C2
6
C1
VTSS
INDICATOR
DRIVER
CENTRAL
TIMER
MODULE
(8W-45-19)
G29
18
BK/TN
69
C200
G29
18
BK/TN
2
WASHER
FLUID
LEVEL
SWITCH
1
Z1
18
BK
G112
(8W-15-4)

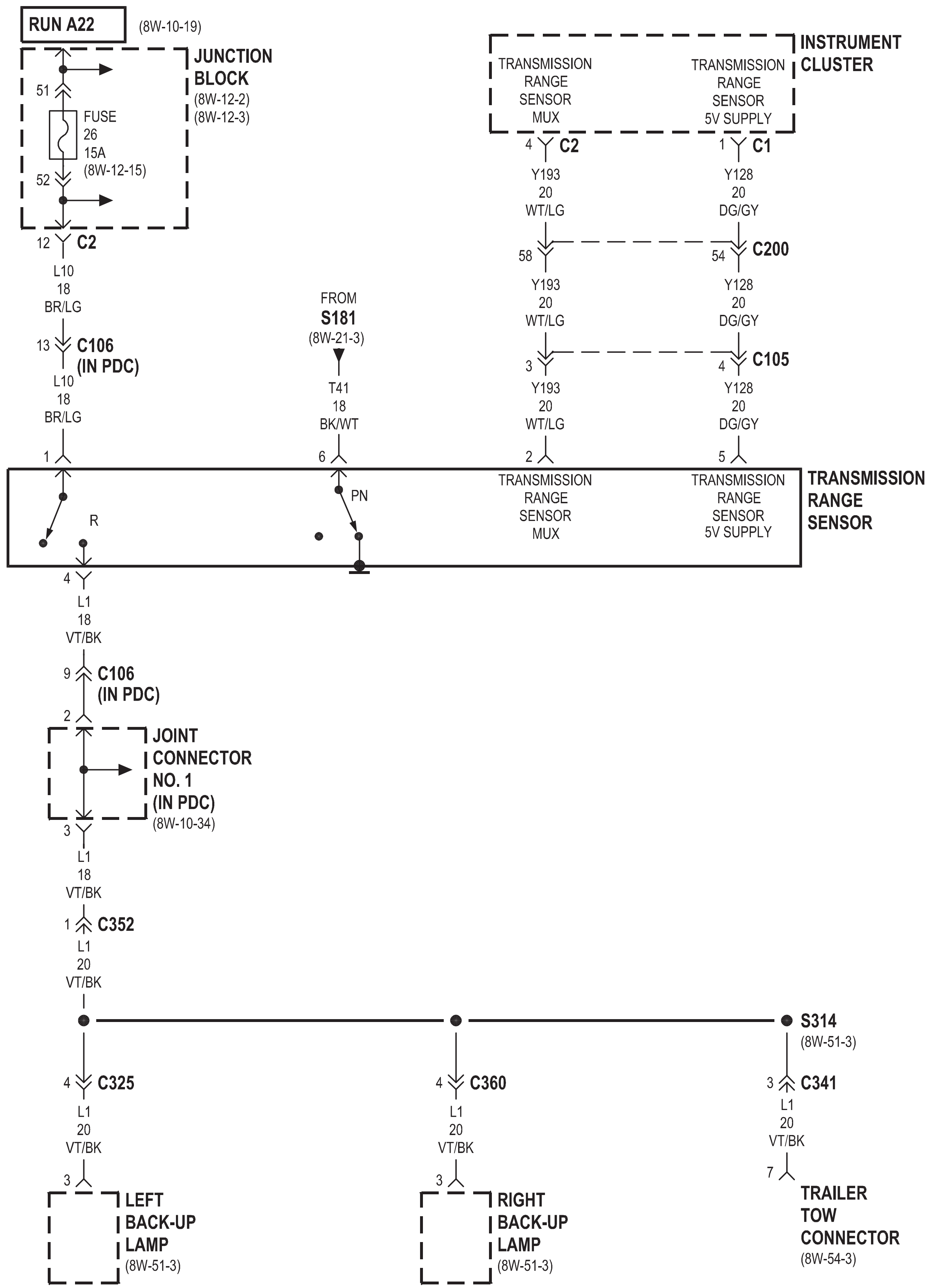


COMBINATION FLASHER
(8W-52-2)
LEFT TURN SIGNAL
RIGHT TURN SIGNAL
A3
B3
L61
16
LG
L60
16
TN
2
C12
12
C11
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
16
C11
11
C11
L61
16
LG
L60
16
TN
CENTRAL TIMER MODULE
(8W-45-5)
HIGH BEAM INDICATOR DRIVER
18
C1
G34
18
RD/GY
6
C2
8
C2
9
C2
INSTRUMENT CLUSTER
LEFT TURN INDICATOR
RIGHT TURN INDICATOR
HIGH BEAM INDICATOR
5
C1
Z1
20
BK
G208
(8W-15-10)

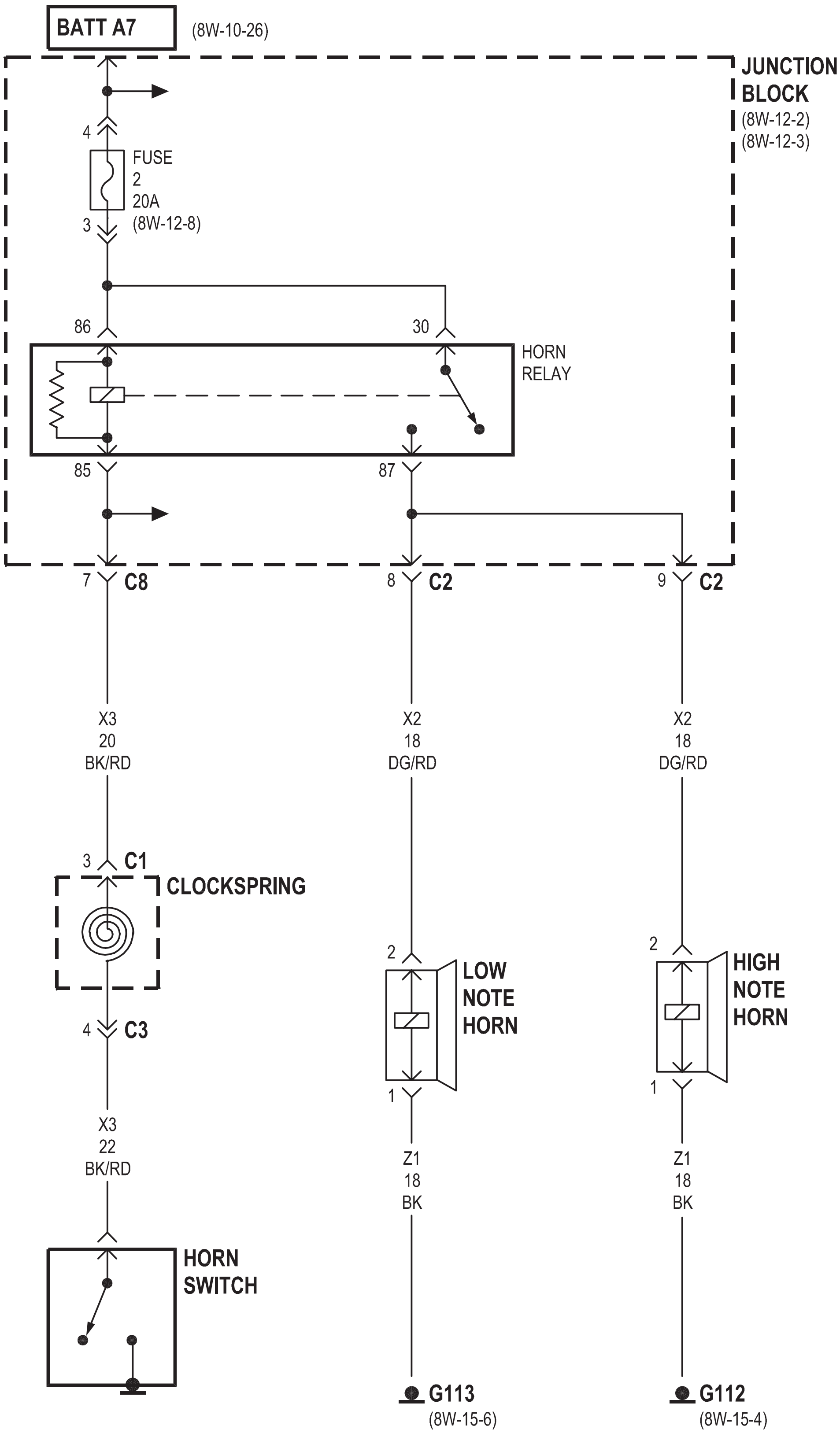


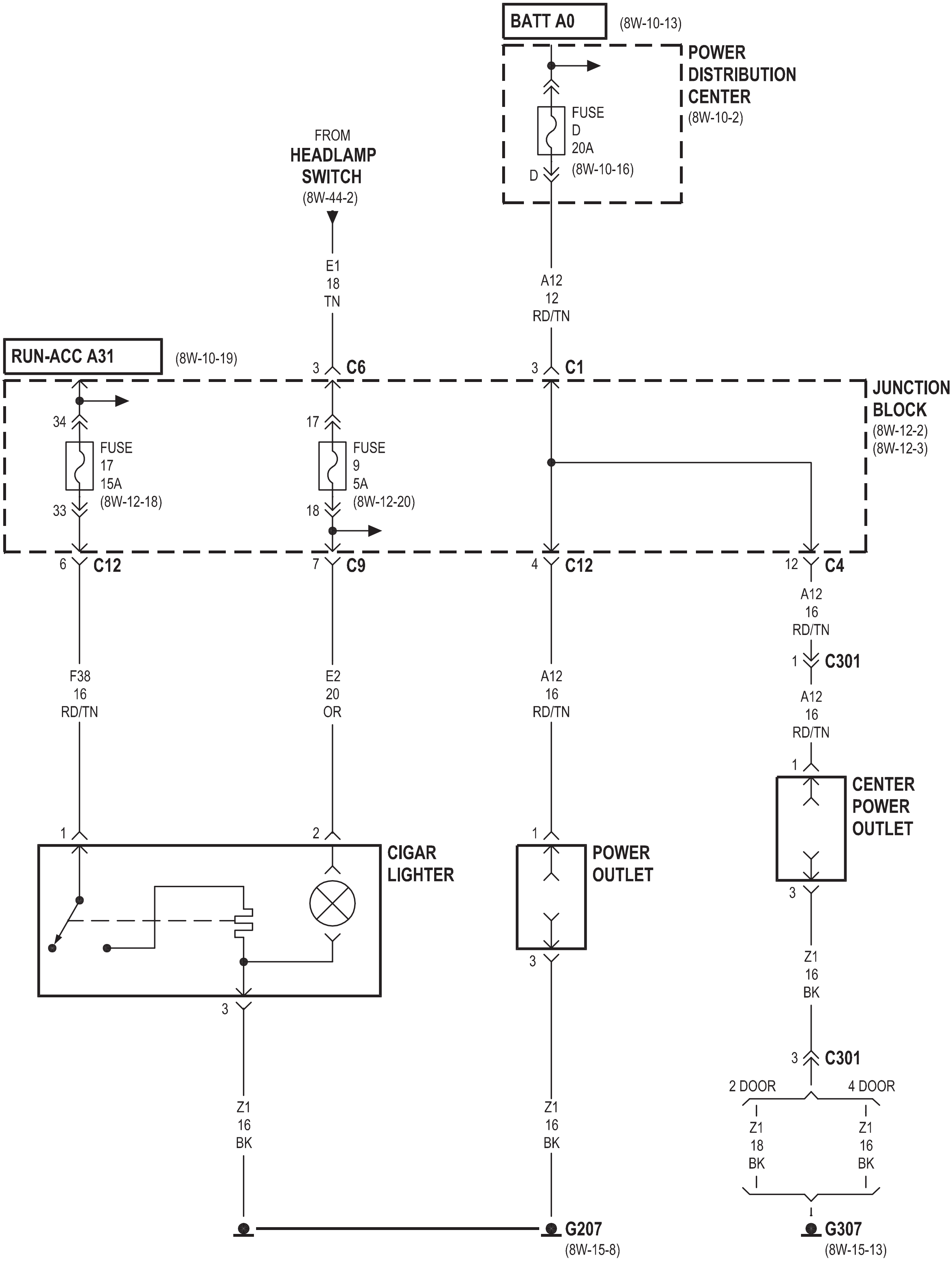
30
PARK
LAMP
RELAY
(8W-50-3)
87
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
17
FUSE
9
5A
(8W-12-20)
18
11 C8
3 C6
5 C9
L7
20
BK/YL
E1
18
TN
E2
20
OR
1
14
HEADLAMP
SWITCH
4 INTERIOR LIGHTS
5 PARADE
6 DOME
7 CARGO
(8W-44-2)
5
6
4
7
5
6
4
7
8
L107
20
WT
13
JOINT
CONNECTOR
NO. 4
(8W-12-11)
14
L107
20
WT
5 C2
1 C2
INSTRUMENT
CLUSTER
HEADLAMP
SWITCH
OUTPUT
FUSED
PANEL LAMPS
DIMMER SWITCH
SIGNAL
GROUND
I/O PROCESSOR
CLUSTER
ILLUMINATION
LAMPS
4 C1
5 C1
Z2
20
BK/LG
56 C200
Z2
18
BK/LG
G113
(8W-15-7)
Z1
20
BK
G208
(8W-15-10)

3.9L/5.9L A/T

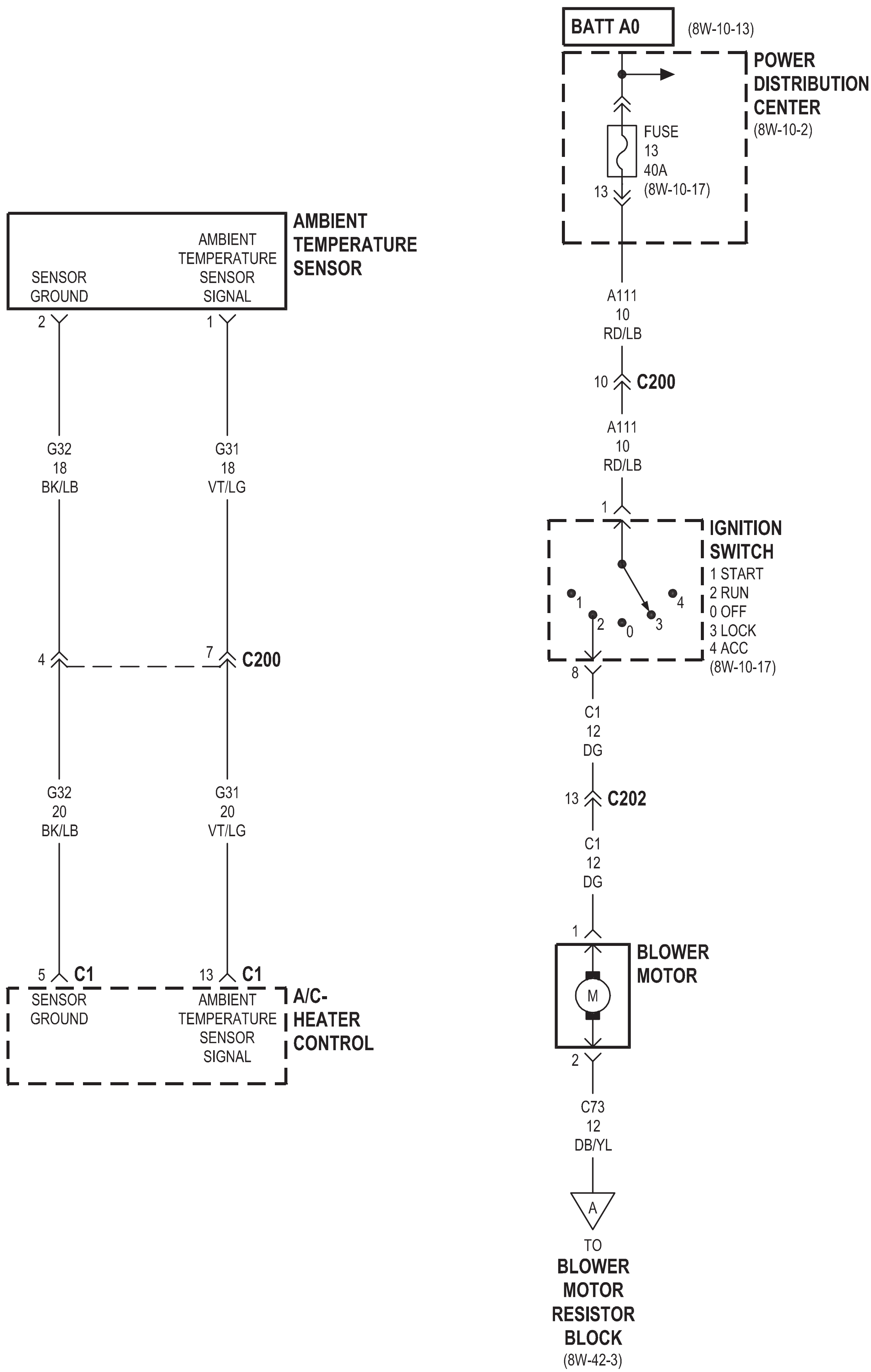

RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
51
FUSE
26
15A
(8W-12-15)
52
12 C2
L10
18
BR/LG
13 C106 (IN PDC)
L10
18
BR/LG
FROM S181
(8W-21-3)
T41
18
BK/WT
INSTRUMENT CLUSTER
TRANSMISSION RANGE SENSOR MUX
TRANSMISSION RANGE SENSOR 5V SUPPLY
4 C2
1 C1
Y193
20
WT/LG
Y128
20
DG/GY
58
54 C200
3
4 C105
1
6
2
5
R
PN
TRANSMISSION RANGE SENSOR
4
L1
18
VT/BK
9 C106 (IN PDC)
2
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-34)
3
1 C352
L1
20
VT/BK
S314
(8W-51-3)
4 C325
4 C360
3 C341
7
LEFT BACK-UP LAMP
(8W-51-3)
RIGHT BACK-UP LAMP
(8W-51-3)
TRAILER TOW CONNECTOR
(8W-54-3)

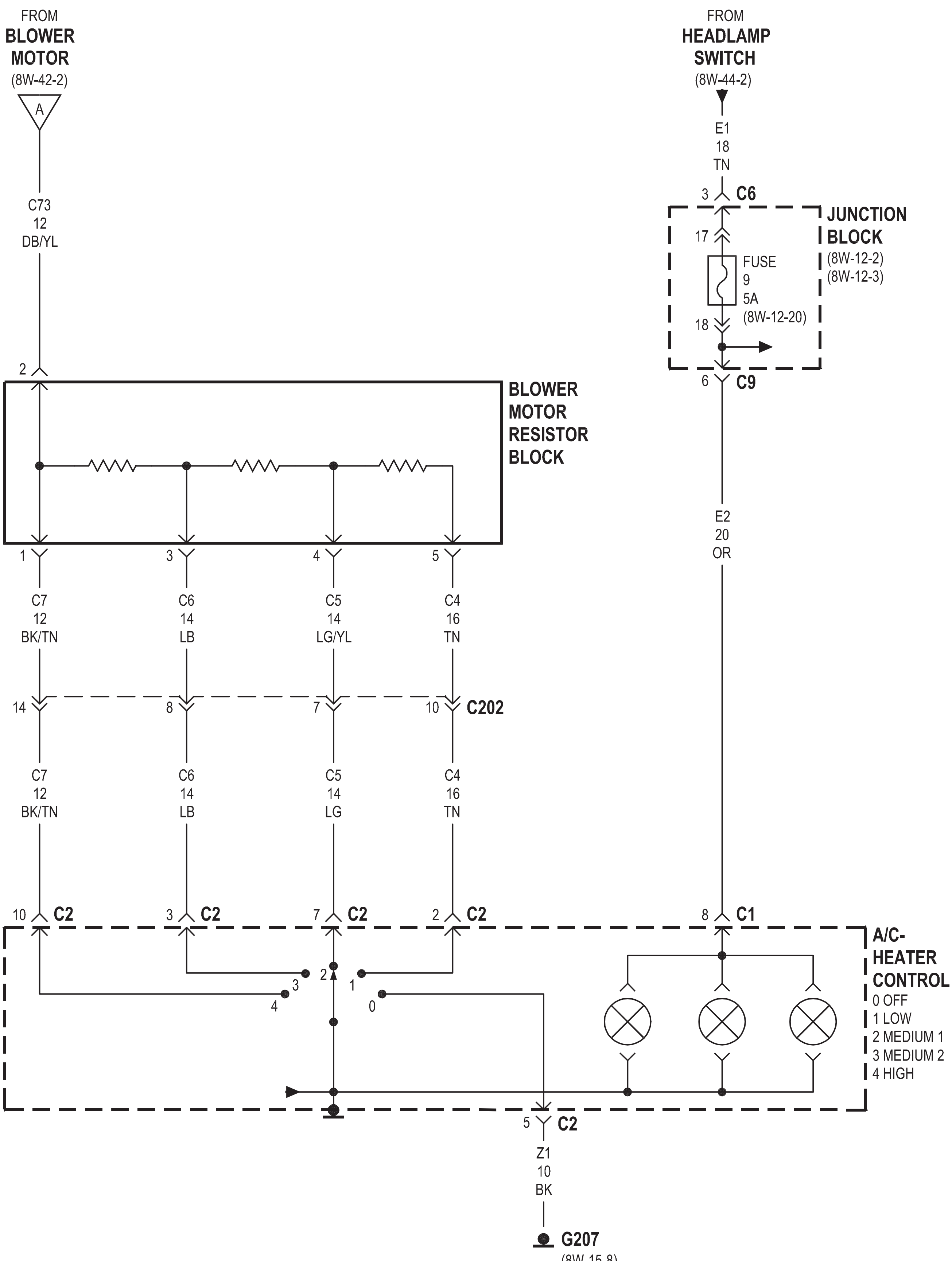
8W-41 HORN/CIGAR LIGHTER/POWER OUTLET

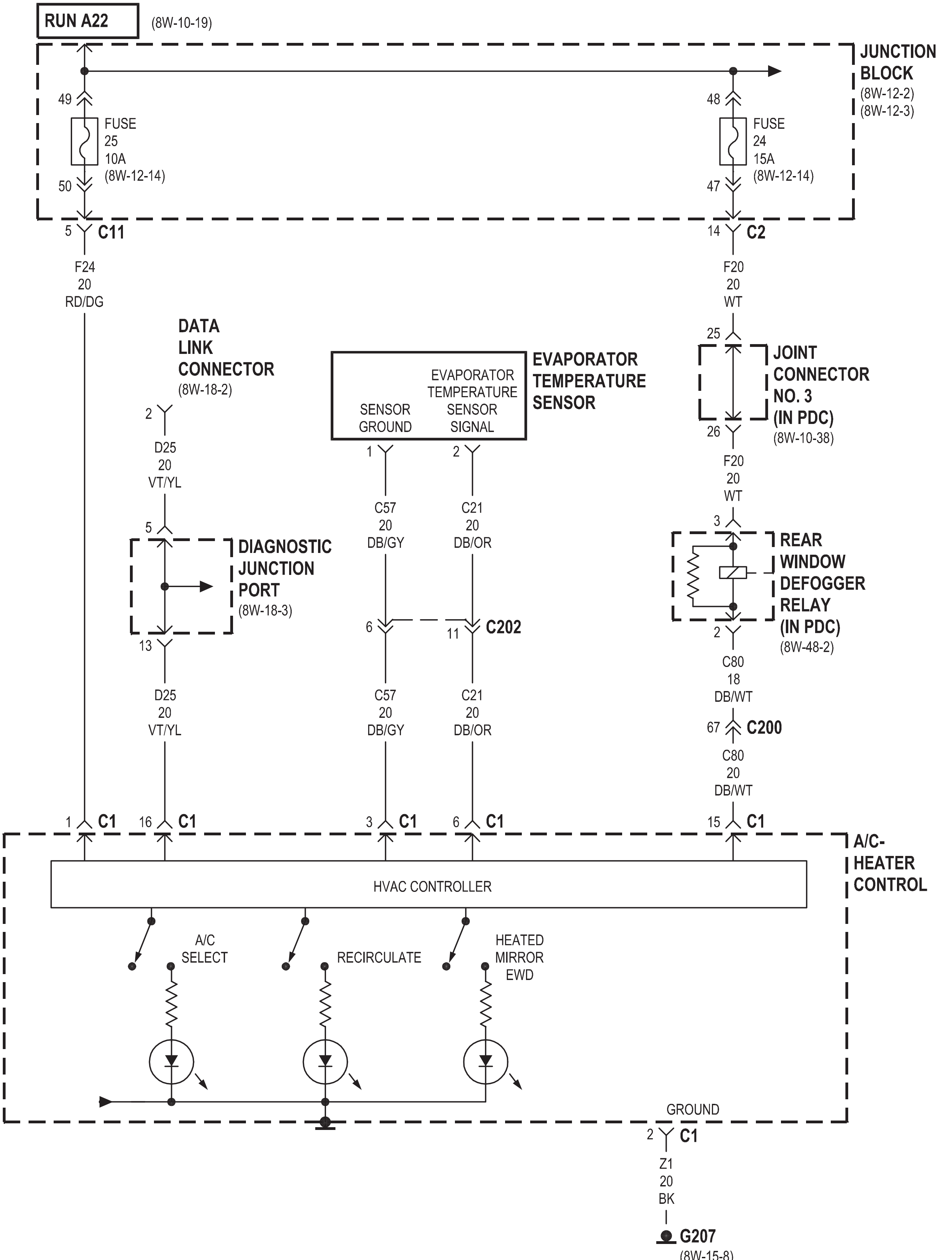

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
4
FUSE
2
20A
(8W-12-8)
3
86
30
HORN RELAY
85
87
7 C8
8 C2
9 C2
X3
20
BK/RD
X2
18
DG/RD
X2
18
DG/RD
3 C1
CLOCKSPRING
4 C3
X3
22
BK/RD
2
LOW NOTE HORN
1
2
HIGH NOTE HORN
1
Z1
18
BK
Z1
18
BK
HORN SWITCH
G113
(8W-15-6)
G112
(8W-15-4)

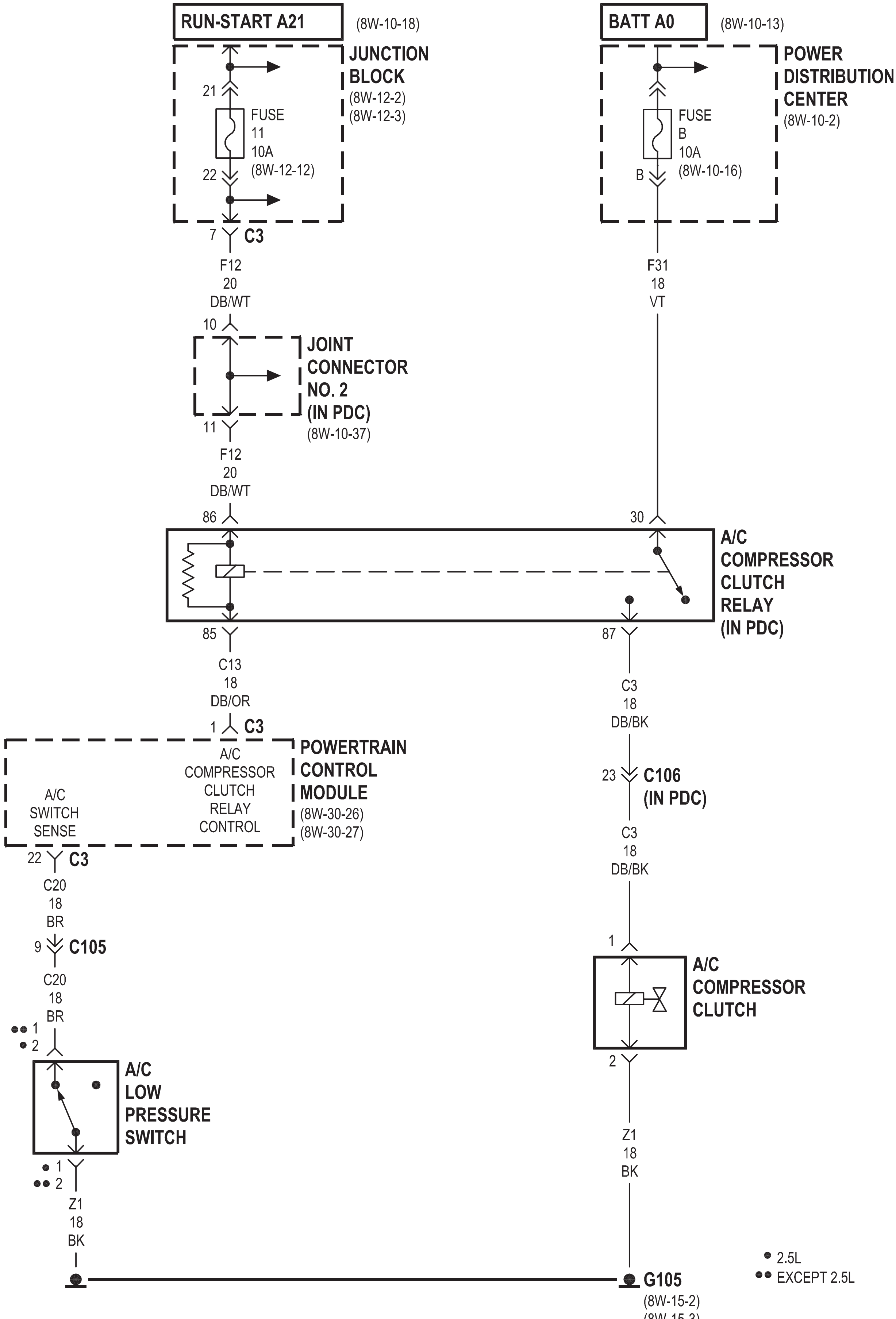

BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE D 20A
(8W-10-16)
D
FROM HEADLAMP SWITCH
(8W-44-2)
E1 18 TN
A12 12 RD/TN
RUN-ACC A31
(8W-10-19)
3 C6
3 C1
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
34
FUSE 17 15A
(8W-12-18)
33
17
FUSE 9 5A
(8W-12-20)
18
6 C12
7 C9
4 C12
12 C4
A12 16 RD/TN
1 C301
A12 16 RD/TN
F38 16 RD/TN
E2 20 OR
A12 16 RD/TN
1
CENTER POWER OUTLET
3
1
2
CIGAR LIGHTER
1
POWER OUTLET
3
3
Z1 16 BK
3 C301
2 DOOR
4 DOOR
Z1 18 BK
Z1 16 BK
Z1 16 BK
Z1 16 BK
G207
(8W-15-8)
G307
(8W-15-13)

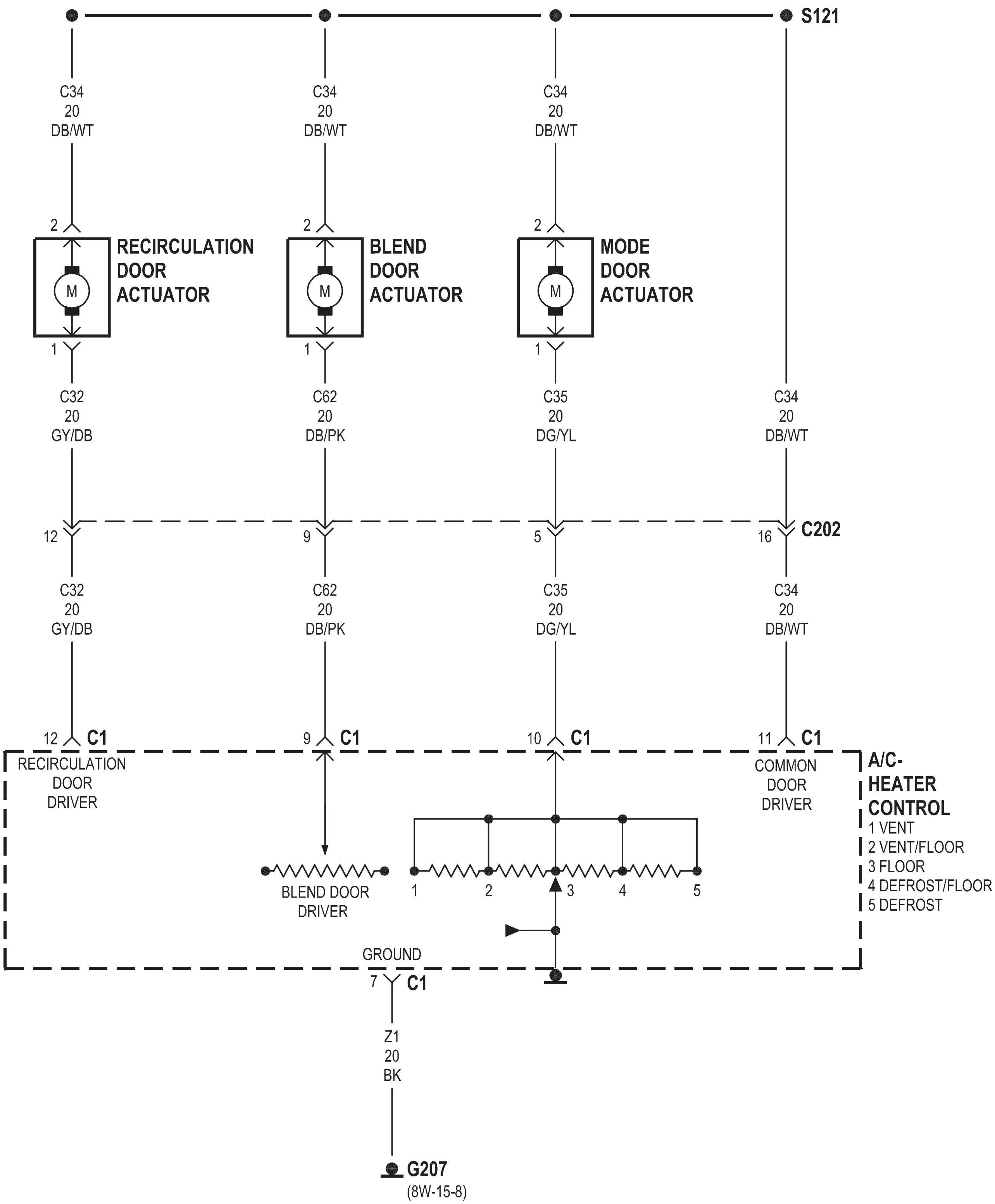
8W-42 AIR CONDITIONING-HEATER

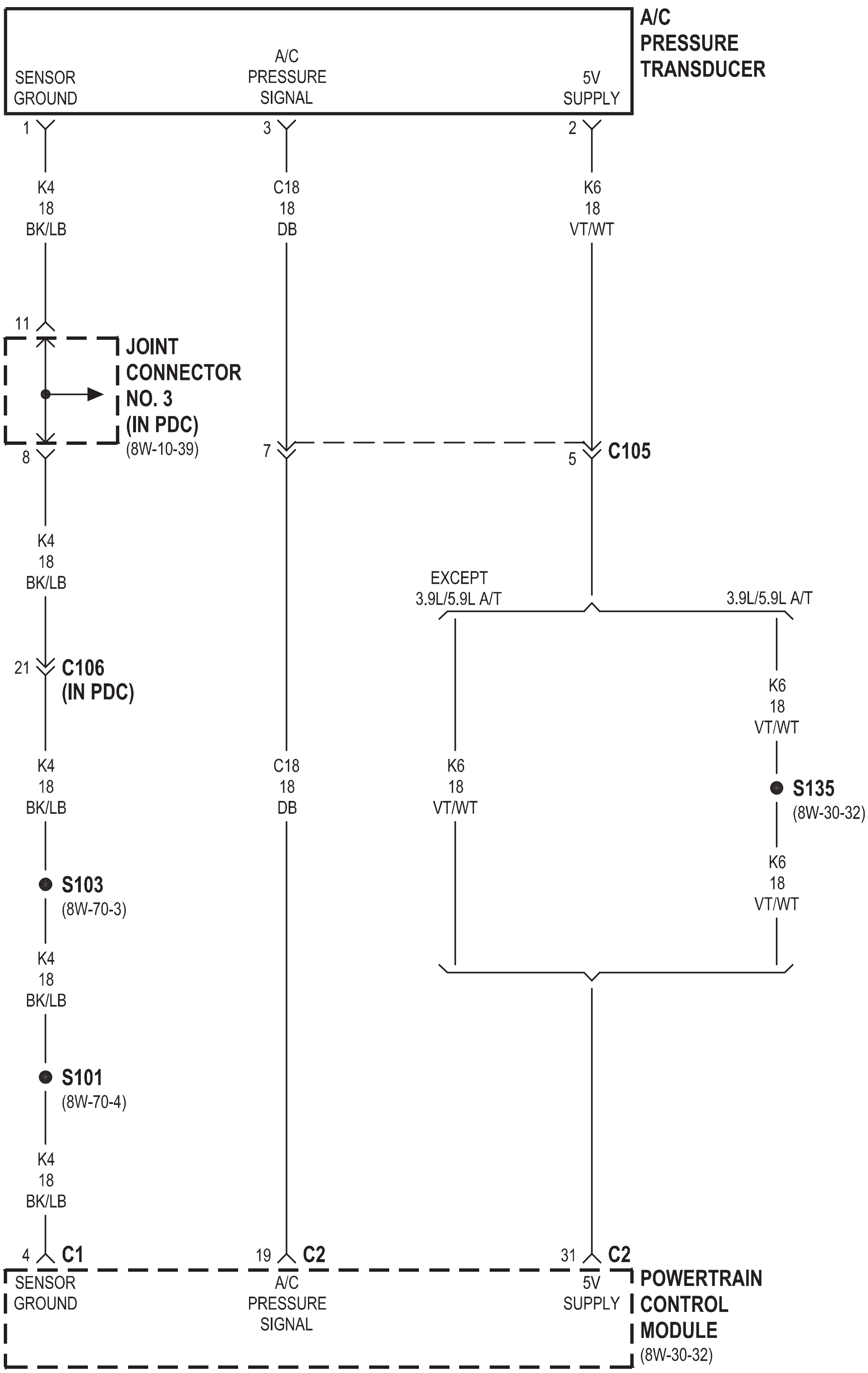

BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
13
40A
(8W-10-17)
13
A111
10
RD/LB
10
C200
A111
10
RD/LB
1
IGNITION SWITCH
1 START
2 RUN
0 OFF
3 LOCK
4 ACC
(8W-10-17)
1
2
0
3
4
8
C1
12
DG
13
C202
C1
12
DG
1
BLOWER MOTOR
M
2
C73
12
DB/YL
A
TO
BLOWER MOTOR RESISTOR BLOCK
(8W-42-3)
AMBIENT TEMPERATURE SENSOR
SENSOR GROUND
AMBIENT TEMPERATURE SENSOR SIGNAL
2
1
G32
18
BK/LB
G31
18
VT/LG
4
7
C200
G32
20
BK/LB
G31
20
VT/LG
5
C1
13
C1
A/C-HEATER CONTROL
SENSOR GROUND
AMBIENT TEMPERATURE SENSOR SIGNAL


FROM
BLOWER
MOTOR
(8W-42-2)
A
C73
12
DB/YL
FROM
HEADLAMP
SWITCH
(8W-44-2)
E1
18
TN
3 C6
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
17
FUSE
9
5A
(8W-12-20)
18
6 C9
2
BLOWER
MOTOR
RESISTOR
BLOCK
1
3
4
5
C7
12
BK/TN
C6
14
LB
C5
14
LG/YL
C4
16
TN
E2
20
OR
14
8
7
10
C202
C7
12
BK/TN
C6
14
LB
C5
14
LG
C4
16
TN
10 C2
3 C2
7 C2
2 C2
8 C1
A/C-
HEATER
CONTROL
0 OFF
1 LOW
2 MEDIUM 1
3 MEDIUM 2
4 HIGH
2
3
4
1
0
5 C2
Z1
10
BK
G207
(8W-15-8)

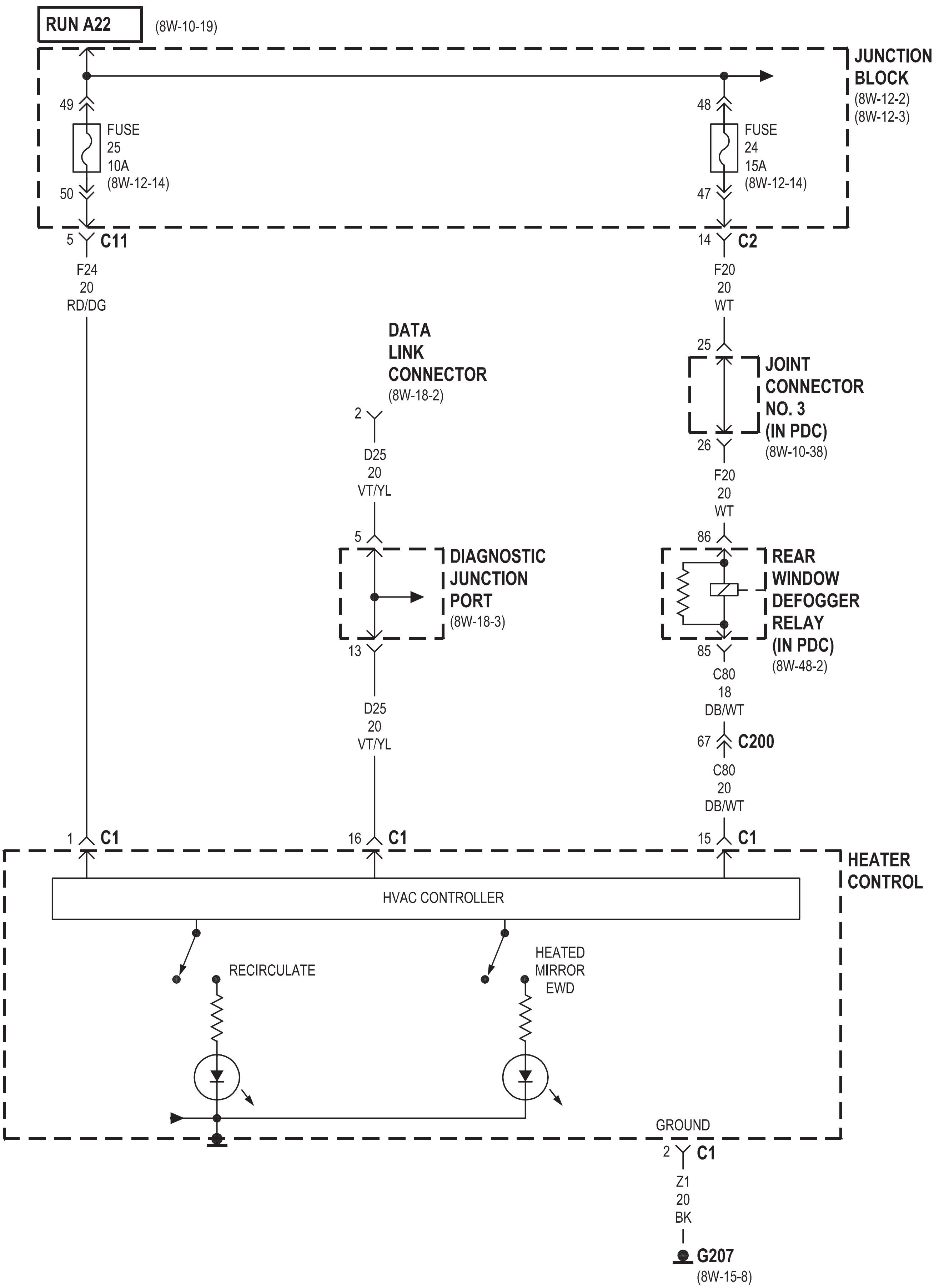

RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
49
FUSE
25
10A
(8W-12-14)
50
48
FUSE
24
15A
(8W-12-14)
47
5 C11
14 C2
F24
20
RD/DG
F20
20
WT
DATA LINK CONNECTOR
(8W-18-2)
2
D25
20
VT/YL
5
DIAGNOSTIC JUNCTION PORT
(8W-18-3)
13
D25
20
VT/YL
EVAPORATOR TEMPERATURE SENSOR
SENSOR GROUND
EVAPORATOR TEMPERATURE SENSOR SIGNAL
1
2
C57
20
DB/GY
C21
20
DB/OR
6
11
C202
C57
20
DB/GY
C21
20
DB/OR
25
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-38)
26
F20
20
WT
3
REAR WINDOW DEFOGGER RELAY (IN PDC)
(8W-48-2)
2
C80
18
DB/WT
67 C200
C80
20
DB/WT
1 C1
16 C1
3 C1
6 C1
15 C1
A/C-HEATER CONTROL
HVAC CONTROLLER
A/C SELECT
RECIRCULATE
HEATED MIRROR EWD
GROUND
2 C1
Z1
20
BK
G207
(8W-15-8)

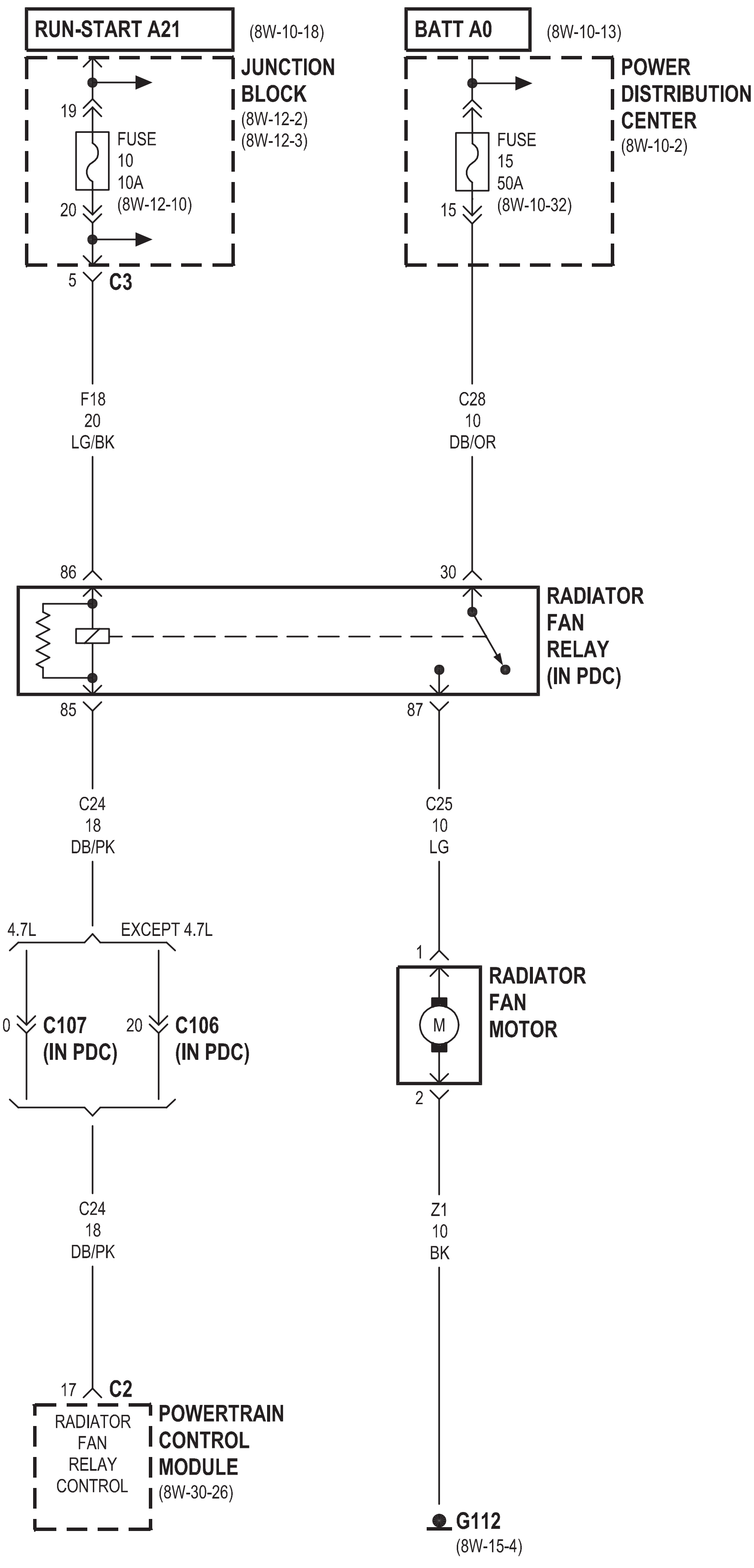

RUN-START A21
(8W-10-18)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
21
FUSE
11
10A
(8W-12-12)
22
7
C3
F12
20
DB/WT
10
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-37)
11
F12
20
DB/WT
86
BATT A0
(8W-10-13)
POWER
DISTRIBUTION
CENTER
(8W-10-2)
FUSE
B
10A
(8W-10-16)
B
F31
18
VT
30
A/C
COMPRESSOR
CLUTCH
RELAY
(IN PDC)
85
87
C13
18
DB/OR
1
C3
POWERTRAIN
CONTROL
MODULE
(8W-30-26)
(8W-30-27)
A/C
COMPRESSOR
CLUTCH
RELAY
CONTROL
A/C
SWITCH
SENSE
22
C3
C20
18
BR
9
C105
C20
18
BR
•• 1
• 2
A/C
LOW
PRESSURE
SWITCH
• 1
•• 2
Z1
18
BK
C3
18
DB/BK
23
C106
(IN PDC)
C3
18
DB/BK
1
A/C
COMPRESSOR
CLUTCH
2
Z1
18
BK
G105
(8W-15-2)
(8W-15-3)
• 2.5L
•• EXCEPT 2.5L


S121
C34
20
DB/WT
RECIRCULATION DOOR ACTUATOR
BLEND DOOR ACTUATOR
MODE DOOR ACTUATOR
M
C32
20
GY/DB
C62
20
DB/PK
C35
20
DG/YL
C202
12
9
5
16
C1
10
11
RECIRCULATION DOOR DRIVER
COMMON DOOR DRIVER
A/C-HEATER CONTROL
1 VENT
2 VENT/FLOOR
3 FLOOR
4 DEFROST/FLOOR
5 DEFROST
BLEND DOOR DRIVER
GROUND
7
Z1
20
BK
G207
(8W-15-8)

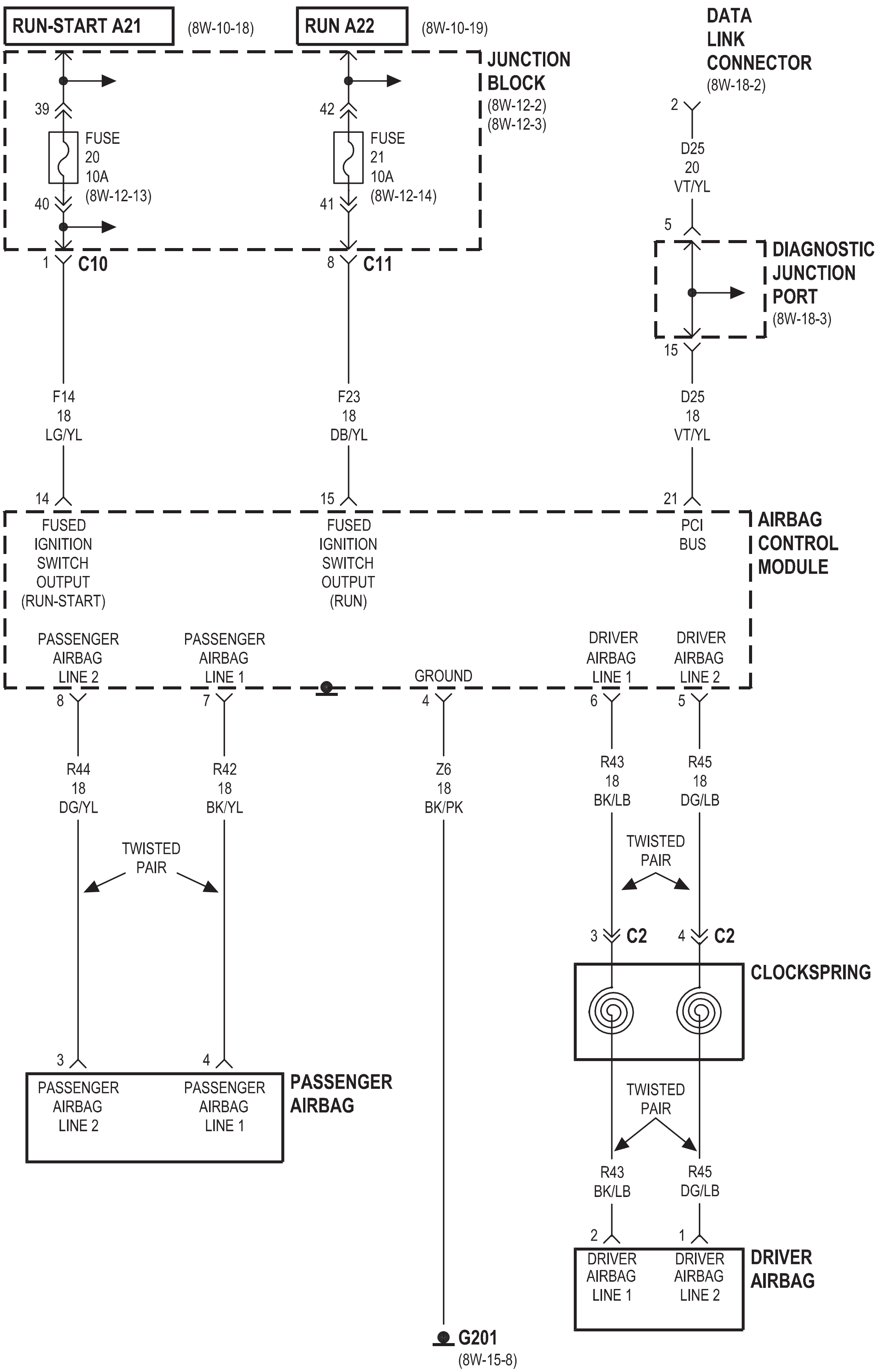

A/C PRESSURE TRANSDUCER
SENSOR GROUND
A/C PRESSURE SIGNAL
5V SUPPLY
1
3
2
K4 18 BK/LB
C18 18 DB
K6 18 VT/WT
11
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-39)
8
7
5
C105
K4 18 BK/LB
EXCEPT 3.9L/5.9L A/T
3.9L/5.9L A/T
21
C106 (IN PDC)
K4 18 BK/LB
C18 18 DB
K6 18 VT/WT
K6 18 VT/WT
S135
(8W-30-32)
K6 18 VT/WT
S103
(8W-70-3)
K4 18 BK/LB
S101
(8W-70-4)
K4 18 BK/LB
4
C1
19
C2
31
C2
SENSOR GROUND
A/C PRESSURE SIGNAL
5V SUPPLY
POWERTRAIN CONTROL MODULE
(8W-30-32)

HEATER ONLY

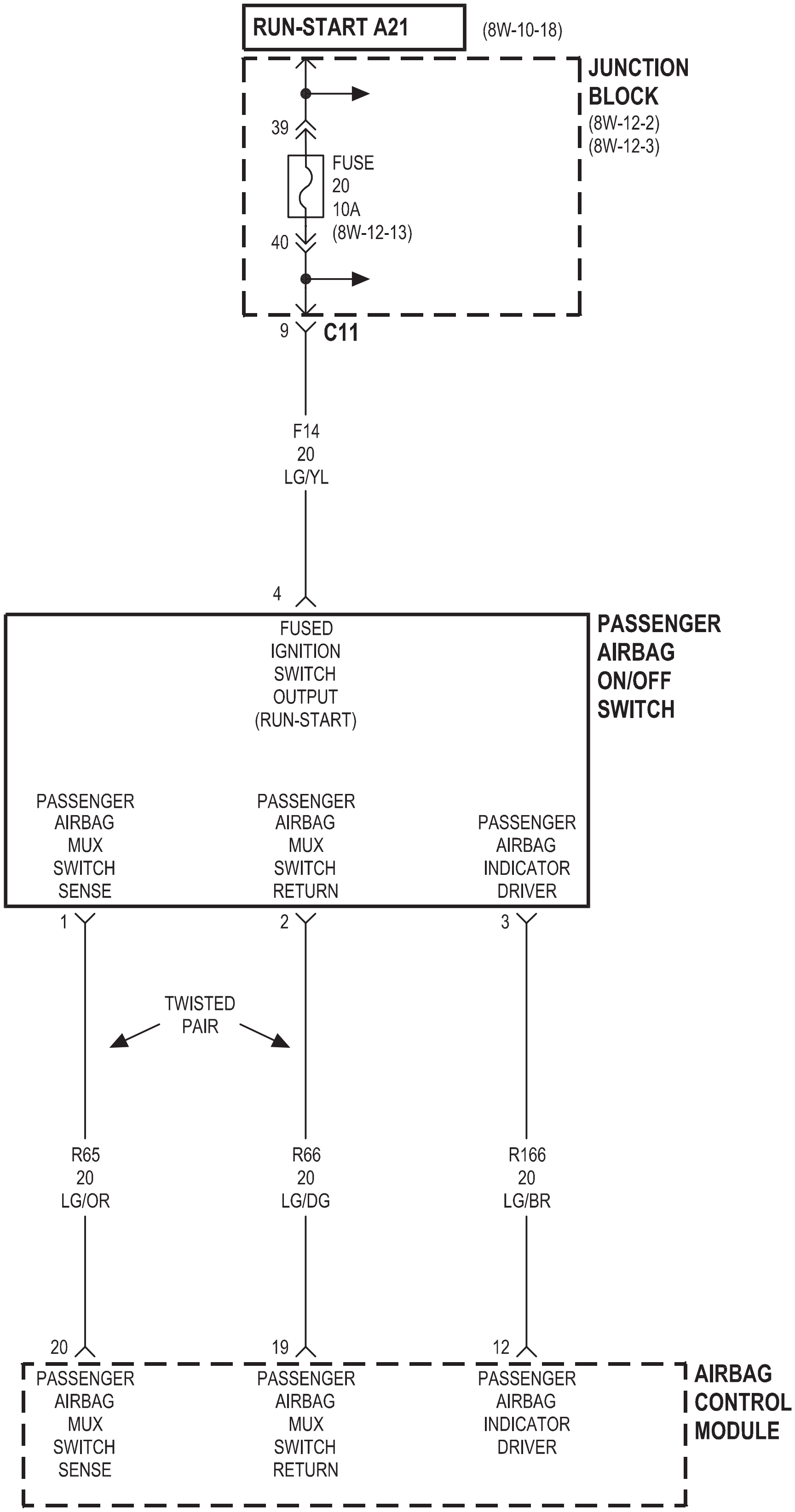

RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
49
FUSE 25 10A (8W-12-14)
50
48
FUSE 24 15A (8W-12-14)
47
5 C11
14 C2
F24 20 RD/DG
F20 20 WT
DATA LINK CONNECTOR
(8W-18-2)
2
D25 20 VT/YL
25
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-38)
26
F20 20 WT
5
DIAGNOSTIC JUNCTION PORT
(8W-18-3)
13
86
REAR WINDOW DEFOGGER RELAY (IN PDC)
(8W-48-2)
85
C80 18 DB/WT
D25 20 VT/YL
67 C200
C80 20 DB/WT
1 C1
16 C1
15 C1
HEATER CONTROL
HVAC CONTROLLER
RECIRCULATE
HEATED MIRROR EWD
GROUND
2 C1
Z1 20 BK
G207
(8W-15-8)

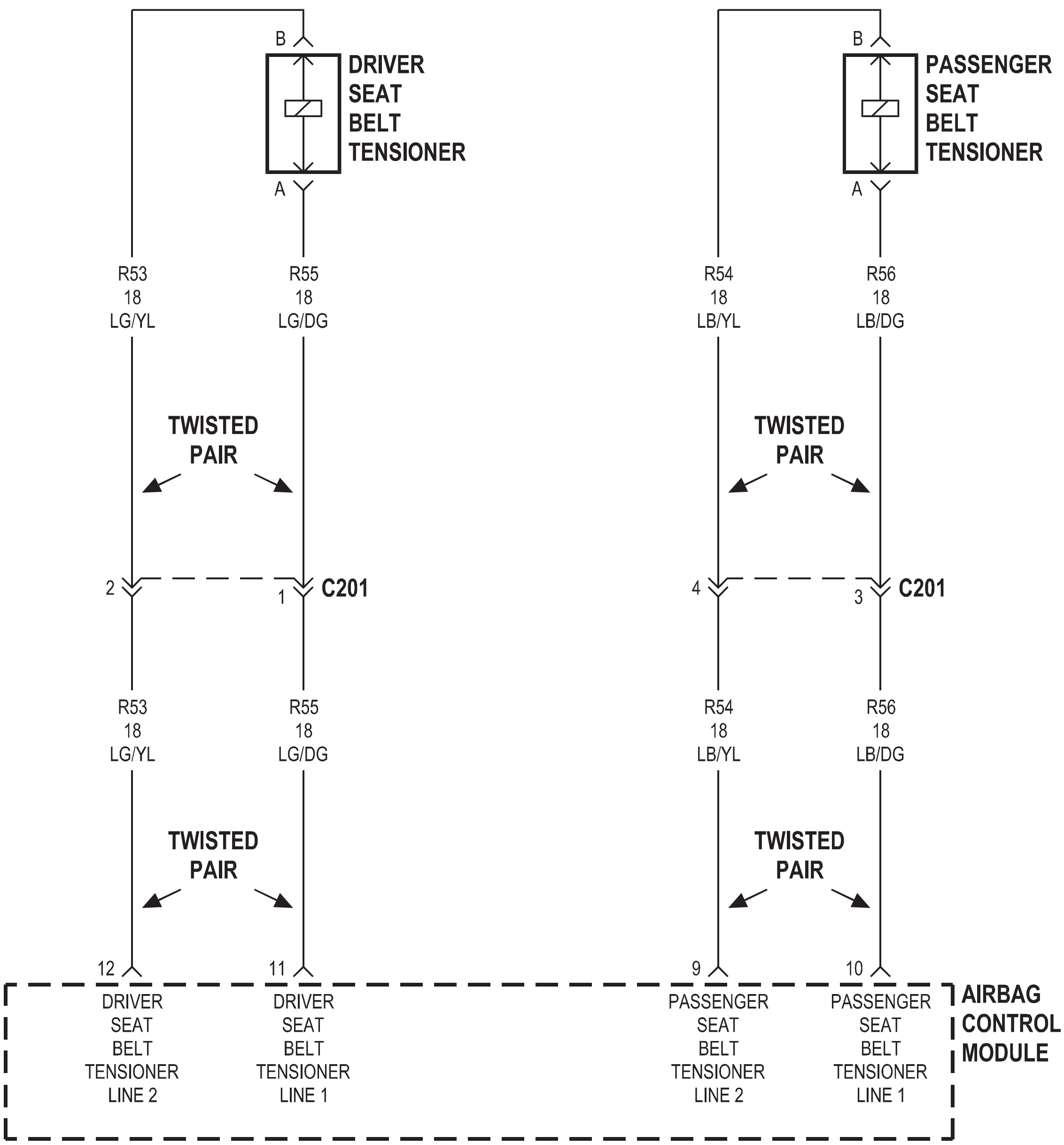

RUN-START A21
(8W-10-18)
BATT A0
(8W-10-13)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
19
FUSE
10
10A
(8W-12-10)
20
5
C3
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
15
50A
(8W-10-32)
15
F18
20
LG/BK
C28
10
DB/OR
86
30
RADIATOR FAN RELAY (IN PDC)
85
87
C24
18
DB/PK
C25
10
LG
4.7L
EXCEPT 4.7L
10
C107 (IN PDC)
20
C106 (IN PDC)
1
RADIATOR FAN MOTOR
M
2
C24
18
DB/PK
Z1
10
BK
17
C2
RADIATOR FAN RELAY CONTROL
POWERTRAIN CONTROL MODULE
(8W-30-26)
G112
(8W-15-4)

8W-43 AIRBAG SYSTEM

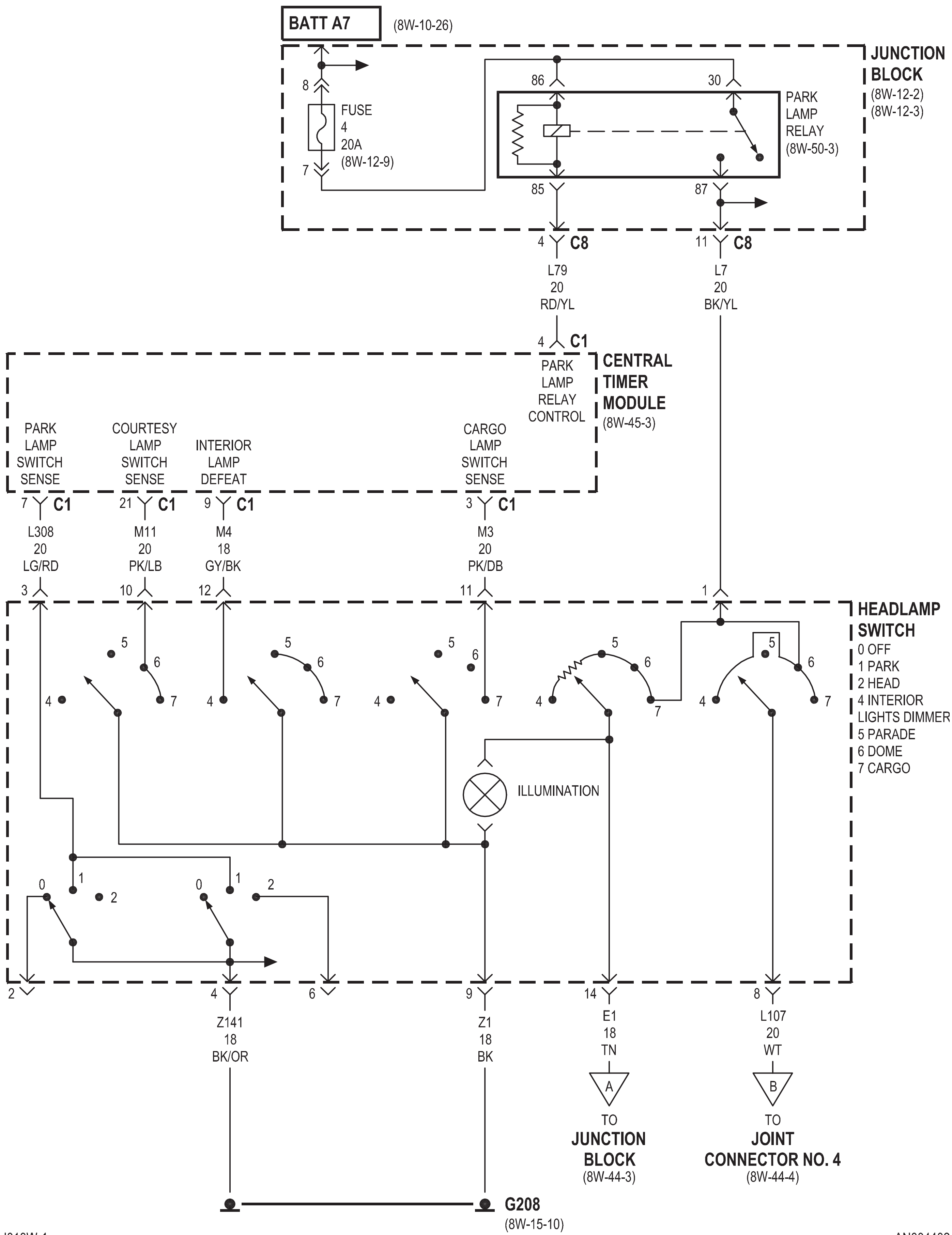

RUN-START A21
(8W-10-18)
RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
39
FUSE
20
10A
(8W-12-13)
40
42
FUSE
21
10A
(8W-12-14)
41
1 C10
8 C11
DATA LINK CONNECTOR
(8W-18-2)
2
D25
20
VT/YL
5
DIAGNOSTIC JUNCTION PORT
(8W-18-3)
15
F14
18
LG/YL
F23
18
DB/YL
D25
18
VT/YL
14
15
21
FUSED IGNITION SWITCH OUTPUT (RUN-START)
FUSED IGNITION SWITCH OUTPUT (RUN)
PCI BUS
AIRBAG CONTROL MODULE
PASSENGER AIRBAG LINE 2
PASSENGER AIRBAG LINE 1
GROUND
DRIVER AIRBAG LINE 1
DRIVER AIRBAG LINE 2
8
7
4
6
5
R44
18
DG/YL
R42
18
BK/YL
Z6
18
BK/PK
R43
18
BK/LB
R45
18
DG/LB
TWISTED PAIR
TWISTED PAIR
3 C2
4 C2
CLOCKSPRING
TWISTED PAIR
R43
BK/LB
R45
DG/LB
3
4
PASSENGER AIRBAG LINE 2
PASSENGER AIRBAG LINE 1
PASSENGER AIRBAG
2
1
DRIVER AIRBAG LINE 1
DRIVER AIRBAG LINE 2
DRIVER AIRBAG
G201
(8W-15-8)

2 DOOR

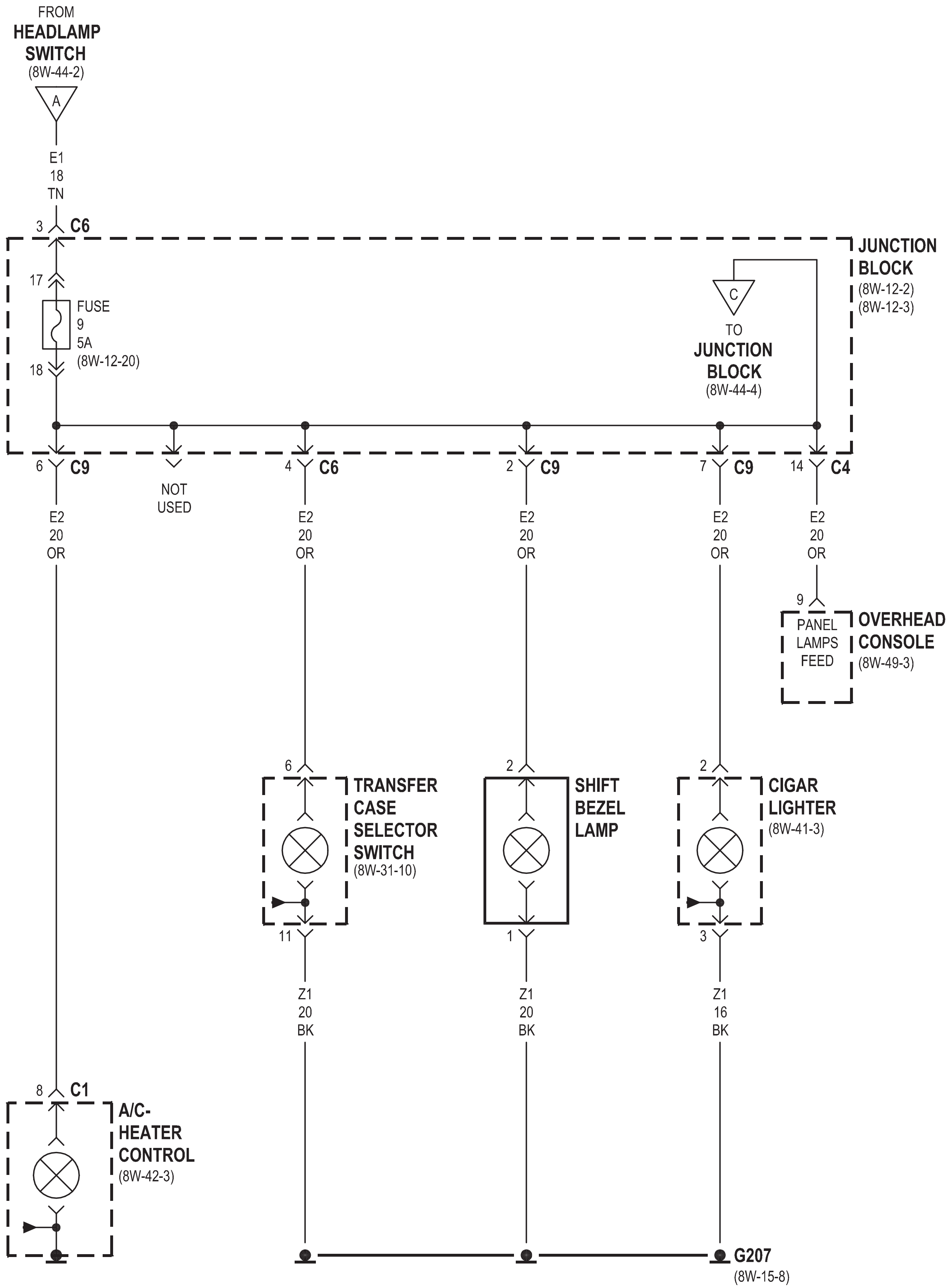

RUN-START A21
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
39
FUSE
20
10A
(8W-12-13)
40
9
C11
F14
20
LG/YL
4
FUSED IGNITION SWITCH OUTPUT (RUN-START)
PASSENGER AIRBAG ON/OFF SWITCH
PASSENGER AIRBAG MUX SWITCH SENSE
PASSENGER AIRBAG MUX SWITCH RETURN
PASSENGER AIRBAG INDICATOR DRIVER
1
2
3
TWISTED PAIR
R65
20
LG/OR
R66
20
LG/DG
R166
20
LG/BR
20
19
12
PASSENGER AIRBAG MUX SWITCH SENSE
PASSENGER AIRBAG MUX SWITCH RETURN
PASSENGER AIRBAG INDICATOR DRIVER
AIRBAG CONTROL MODULE

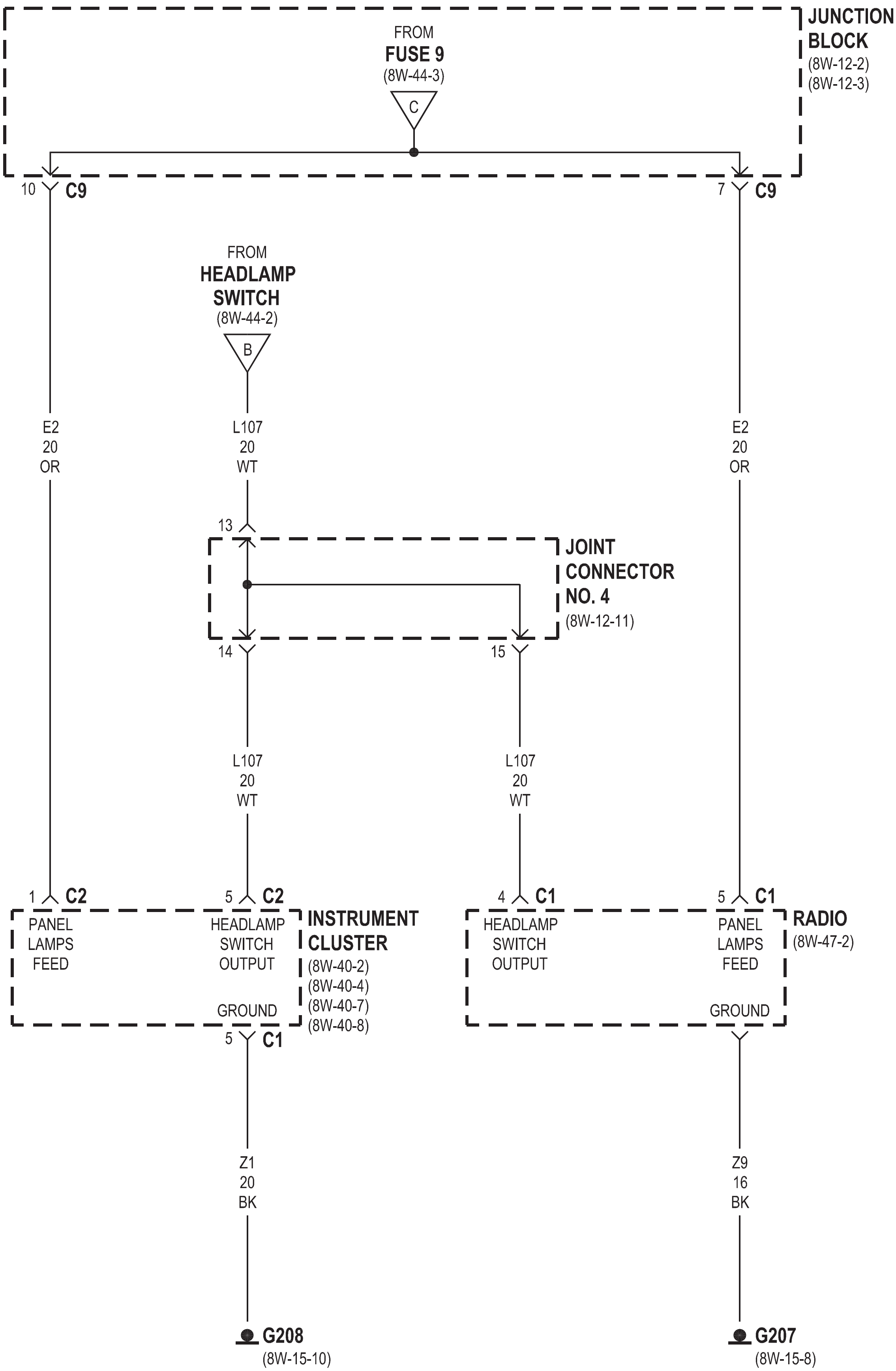

B
DRIVER
SEAT
BELT
TENSIONER
A
R53
18
LG/YL
R55
18
LG/DG
TWISTED
PAIR
2
1
C201
R53
18
LG/YL
R55
18
LG/DG
TWISTED
PAIR
12
11
DRIVER
SEAT
BELT
TENSIONER
LINE 2
DRIVER
SEAT
BELT
TENSIONER
LINE 1
B
PASSENGER
SEAT
BELT
TENSIONER
A
R54
18
LB/YL
R56
18
LB/DG
TWISTED
PAIR
4
3
C201
R54
18
LB/YL
R56
18
LB/DG
TWISTED
PAIR
9
10
PASSENGER
SEAT
BELT
TENSIONER
LINE 2
PASSENGER
SEAT
BELT
TENSIONER
LINE 1
AIRBAG
CONTROL
MODULE

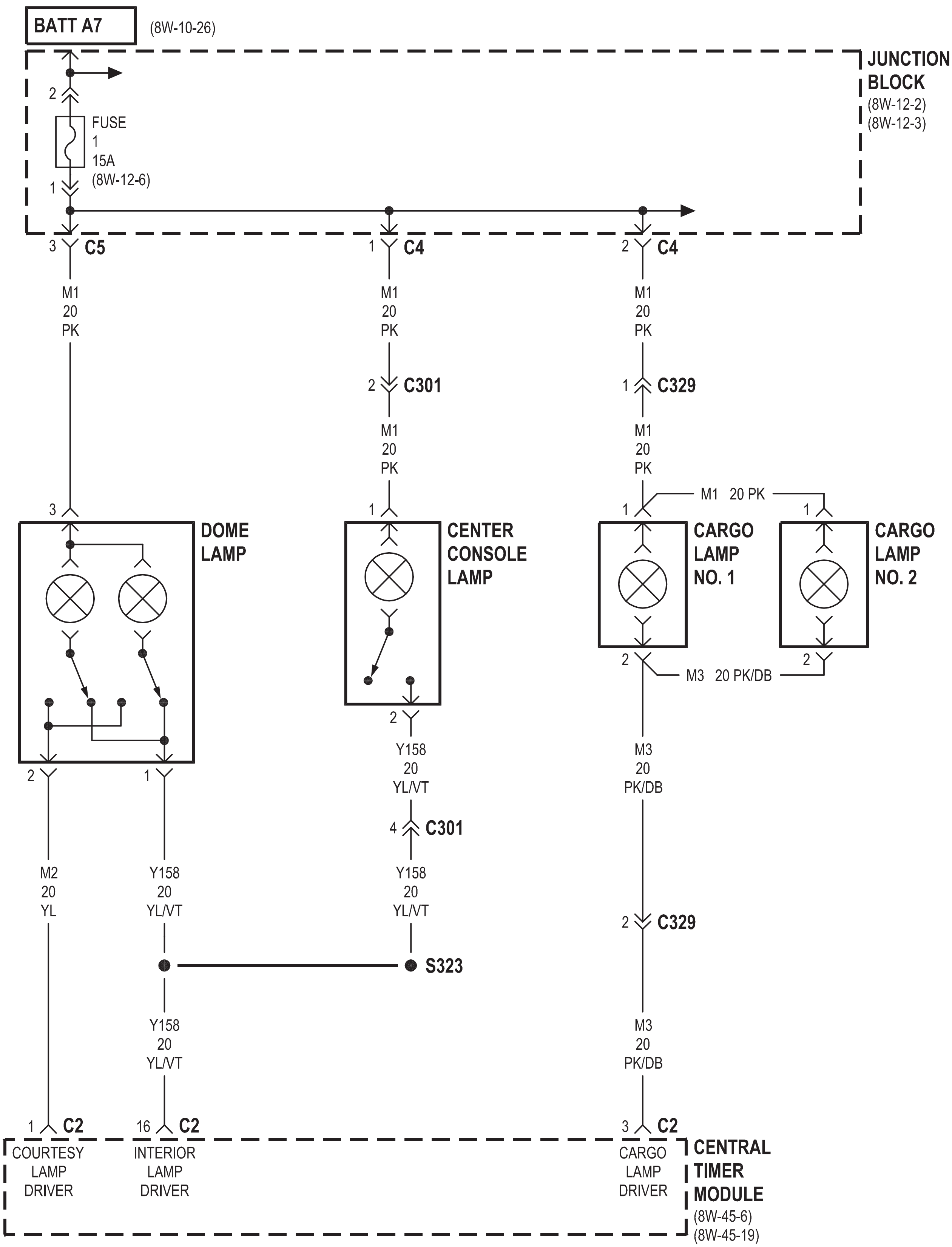
8W-44 INTERIOR LIGHTING



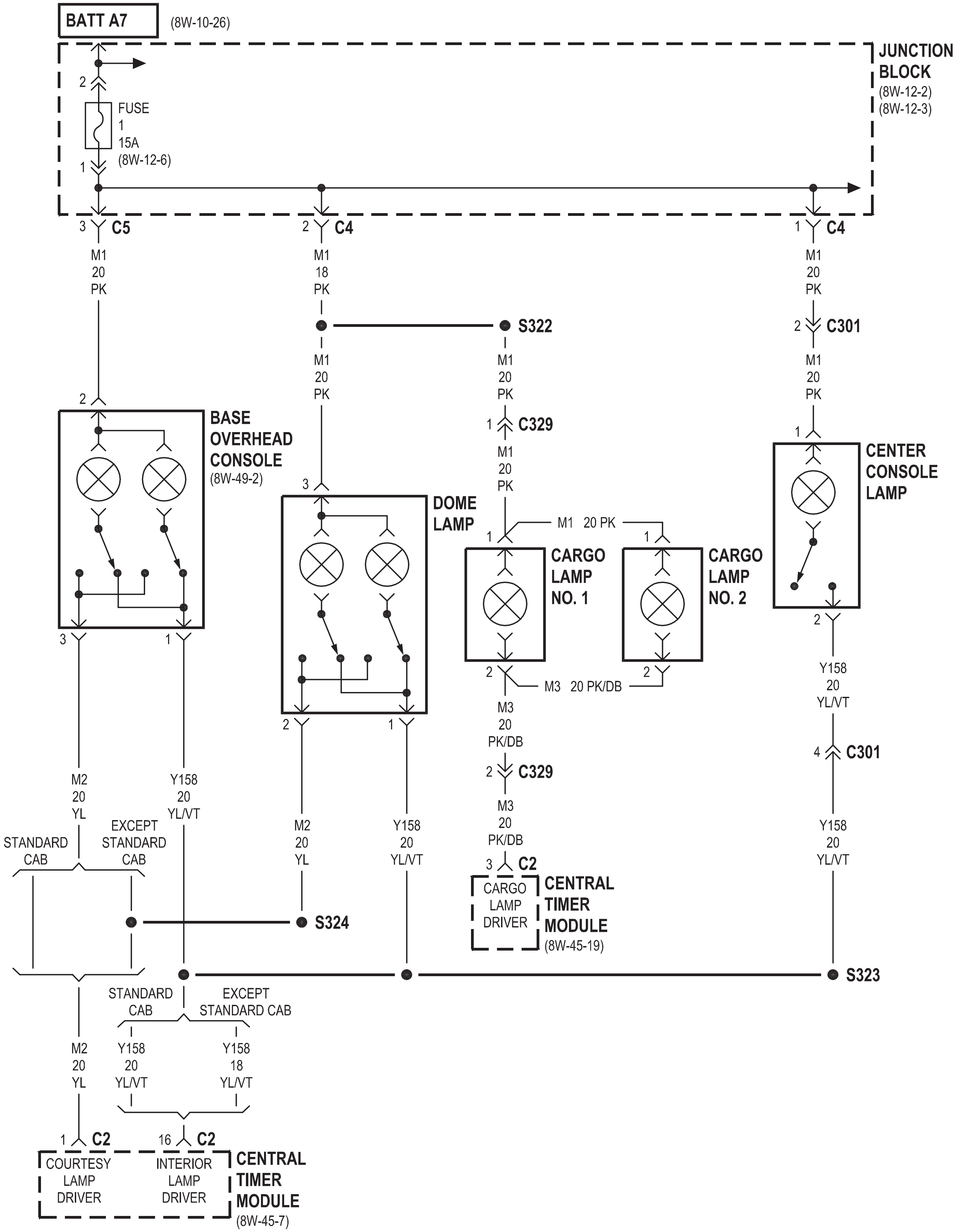
J018W-1 AN004402

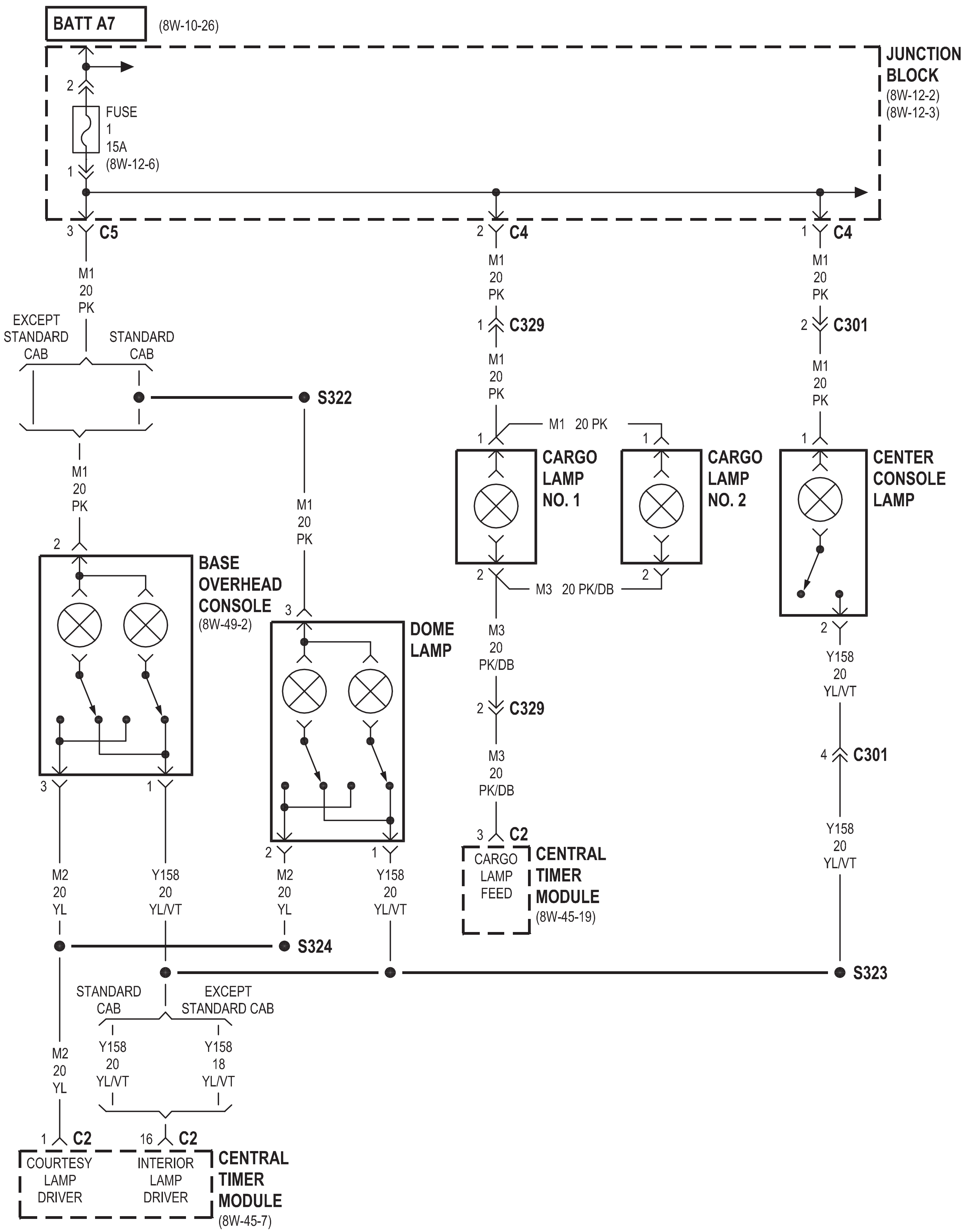

FROM
HEADLAMP
SWITCH
(8W-44-2)
A
E1
18
TN
3
C6
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
17
FUSE
9
5A
(8W-12-20)
18
C
TO
JUNCTION
BLOCK
(8W-44-4)
6
C9
NOT
USED
4
C6
2
C9
7
C9
14
C4
E2
20
OR
9
PANEL
LAMPS
FEED
OVERHEAD
CONSOLE
(8W-49-3)
6
TRANSFER
CASE
SELECTOR
SWITCH
(8W-31-10)
11
2
SHIFT
BEZEL
LAMP
1
2
CIGAR
LIGHTER
(8W-41-3)
3
Z1
20
BK
Z1
16
BK
8
C1
A/C-
HEATER
CONTROL
(8W-42-3)
G207
(8W-15-8)

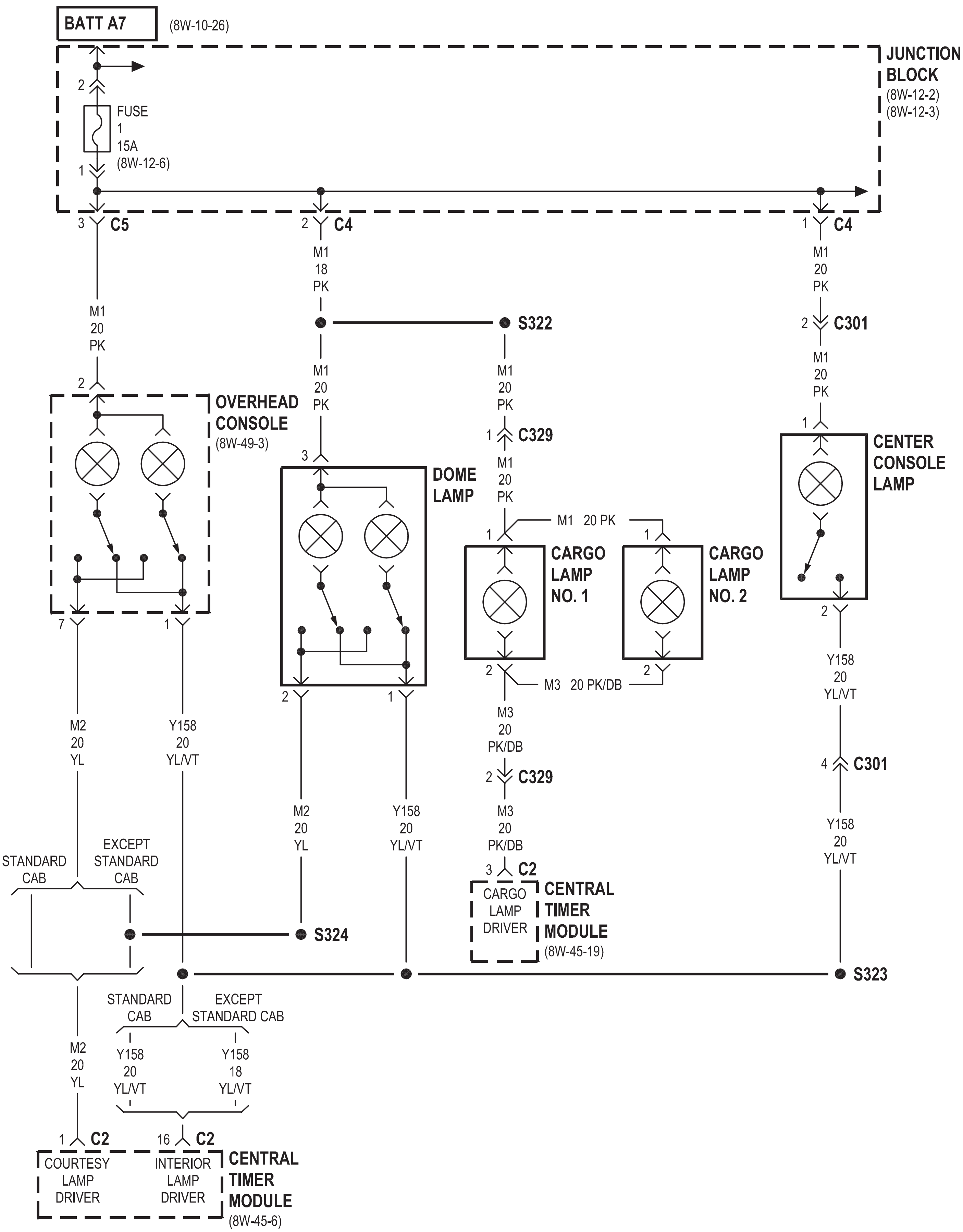

JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FROM
FUSE 9
(8W-44-3)
C
10
C9
7
C9
FROM
HEADLAMP SWITCH
(8W-44-2)
B
E2
20
OR
L107
20
WT
E2
20
OR
13
JOINT CONNECTOR NO. 4
(8W-12-11)
14
15
L107
20
WT
L107
20
WT
1
C2
5
C2
4
C1
5
C1
PANEL LAMPS FEED
HEADLAMP SWITCH OUTPUT
GROUND
INSTRUMENT CLUSTER
(8W-40-2)
(8W-40-4)
(8W-40-7)
(8W-40-8)
HEADLAMP SWITCH OUTPUT
PANEL LAMPS FEED
GROUND
RADIO
(8W-47-2)
5
C1
Z1
20
BK
Z9
16
BK
G208
(8W-15-10)
G207
(8W-15-8)

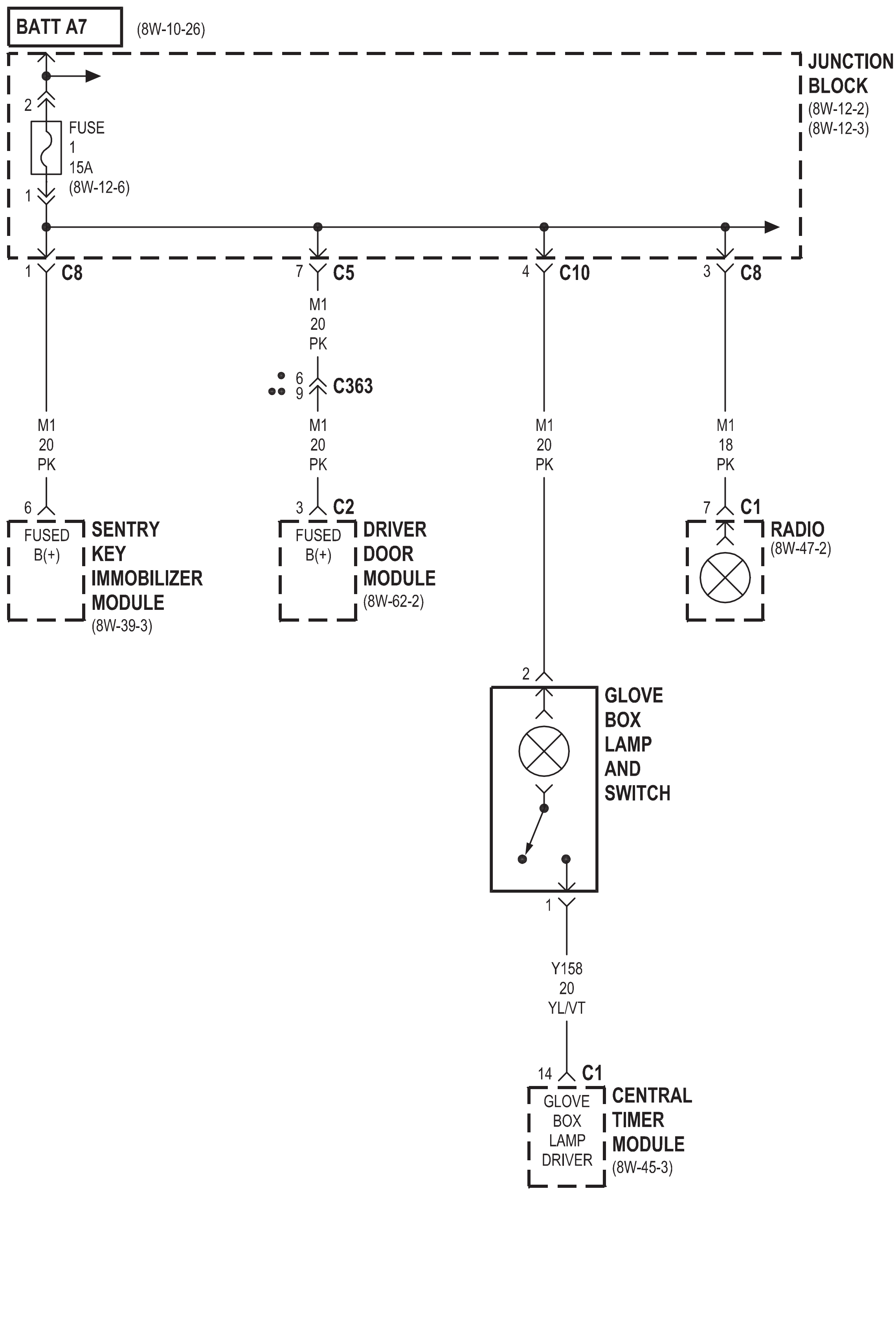

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FUSE
1
15A
(8W-12-6)
C5
C4
C4
M1
20
PK
C301
C329
DOME LAMP
CENTER CONSOLE LAMP
CARGO LAMP NO. 1
CARGO LAMP NO. 2
M1 20 PK
M3 20 PK/DB
Y158
20
YL/VT
M3
20
PK/DB
C301
C329
M2
20
YL
S323
C2
COURTESY LAMP DRIVER
INTERIOR LAMP DRIVER
CARGO LAMP DRIVER
CENTRAL TIMER MODULE
(8W-45-6)
(8W-45-19)

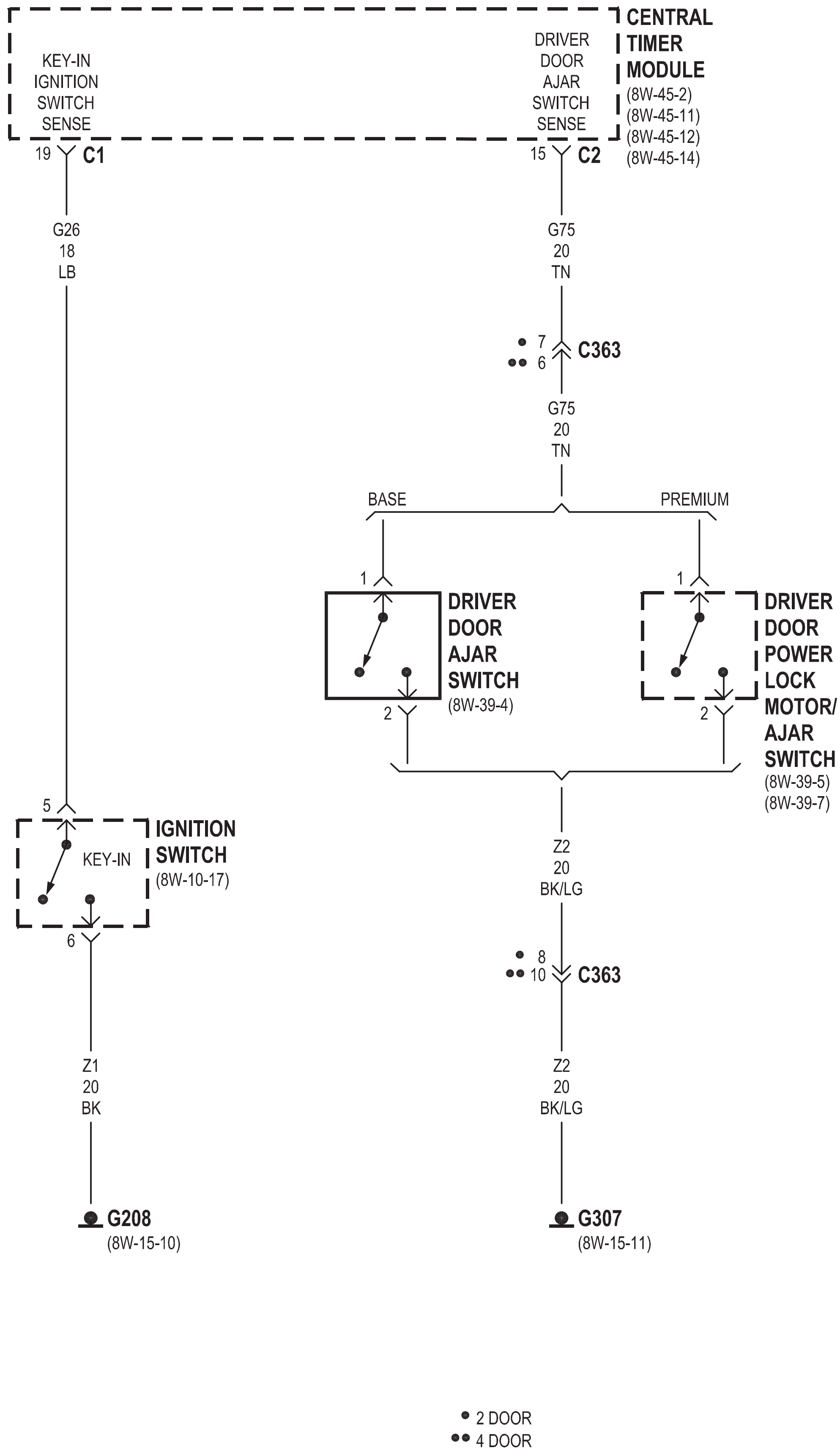
MIDLINE

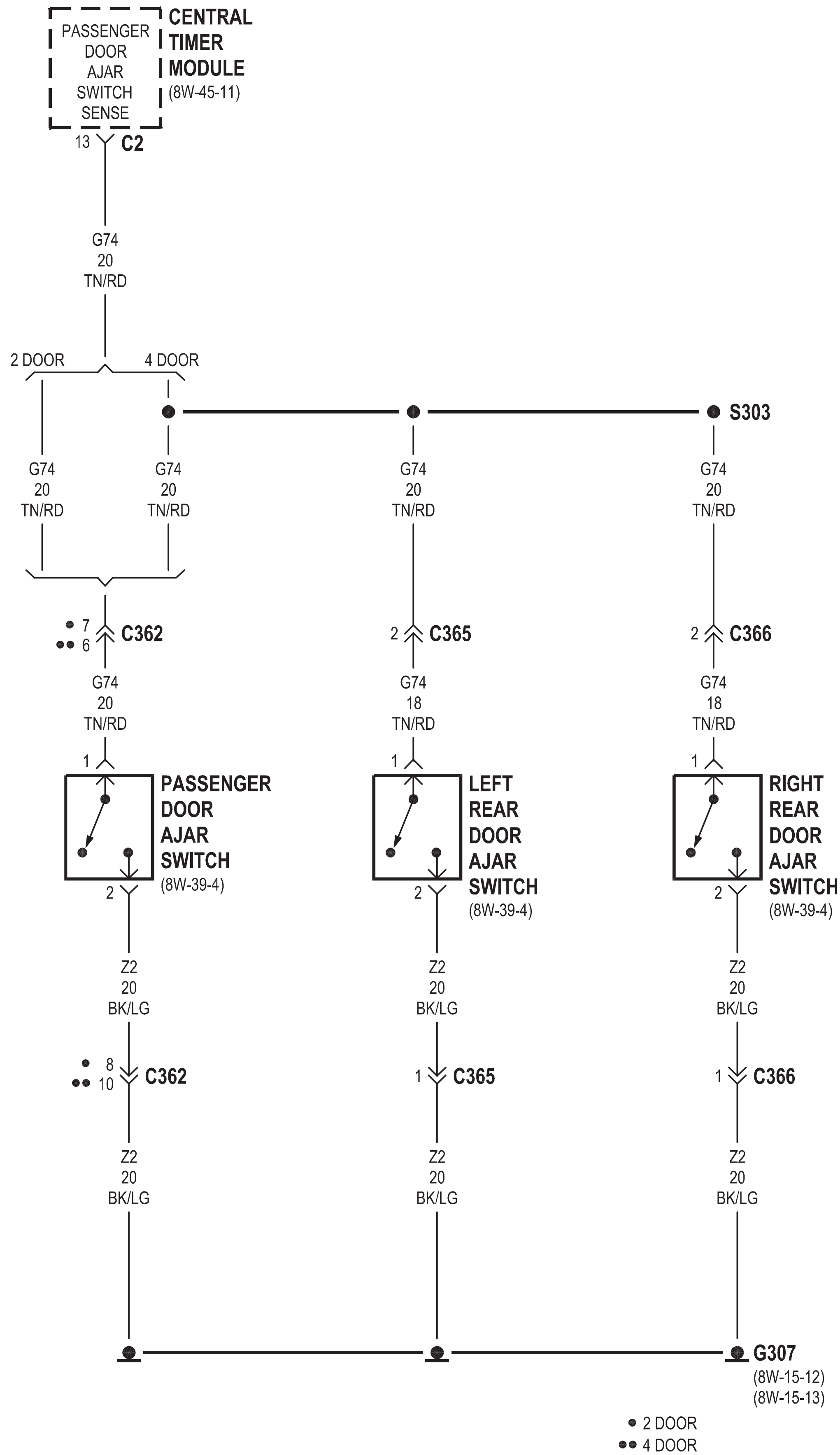

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FUSE
1
15A
(8W-12-6)
C5
C4
C4
M1 20 PK
M1 18 PK
M1 20 PK
S322
C301
M1 20 PK
C329
BASE OVERHEAD CONSOLE
(8W-49-2)
DOME LAMP
CENTER CONSOLE LAMP
M1 20 PK
CARGO LAMP NO. 1
CARGO LAMP NO. 2
M3 20 PK/DB
M3 20 PK/DB
Y158 20 YL/VT
C301
C329
M2 20 YL
Y158 20 YL/VT
STANDARD CAB
EXCEPT STANDARD CAB
C2
CENTRAL TIMER MODULE
CARGO LAMP DRIVER
(8W-45-19)
S324
S323
Y158 18 YL/VT
COURTESY LAMP DRIVER
INTERIOR LAMP DRIVER
(8W-45-7)

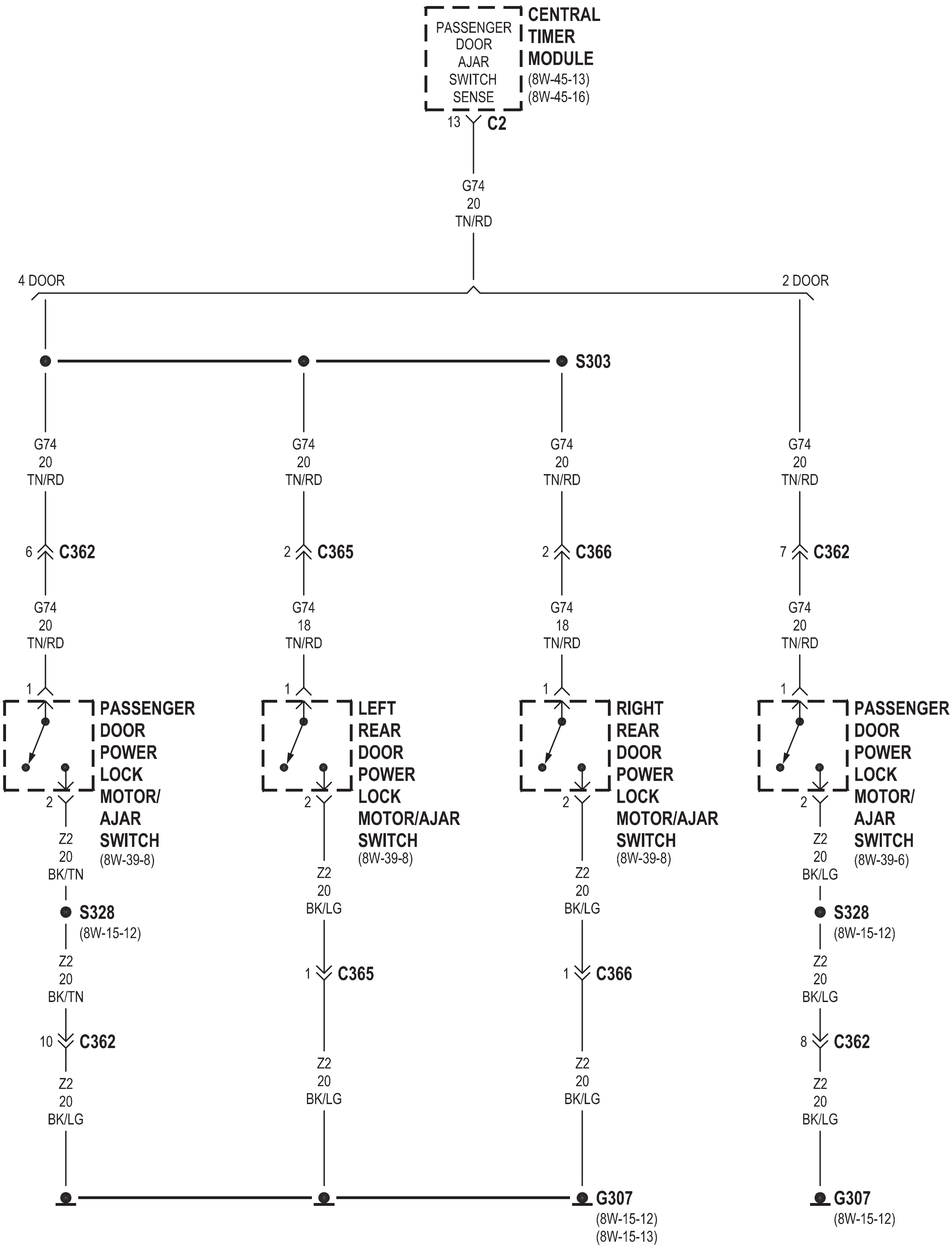

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FUSE
1
15A
(8W-12-6)
C5
C4
M1 20 PK
C329
C301
EXCEPT STANDARD CAB
STANDARD CAB
S322
M1 20 PK
CARGO LAMP NO. 1
CARGO LAMP NO. 2
CENTER CONSOLE LAMP
M3 20 PK/DB
BASE OVERHEAD CONSOLE
(8W-49-2)
DOME LAMP
Y158 20 YL/VT
M2 20 YL
C2
CARGO LAMP FEED
CENTRAL TIMER MODULE
(8W-45-19)
S324
S323
STANDARD CAB
EXCEPT STANDARD CAB
Y158 18 YL/VT
COURTESY LAMP DRIVER
INTERIOR LAMP DRIVER
CENTRAL TIMER MODULE
(8W-45-7)

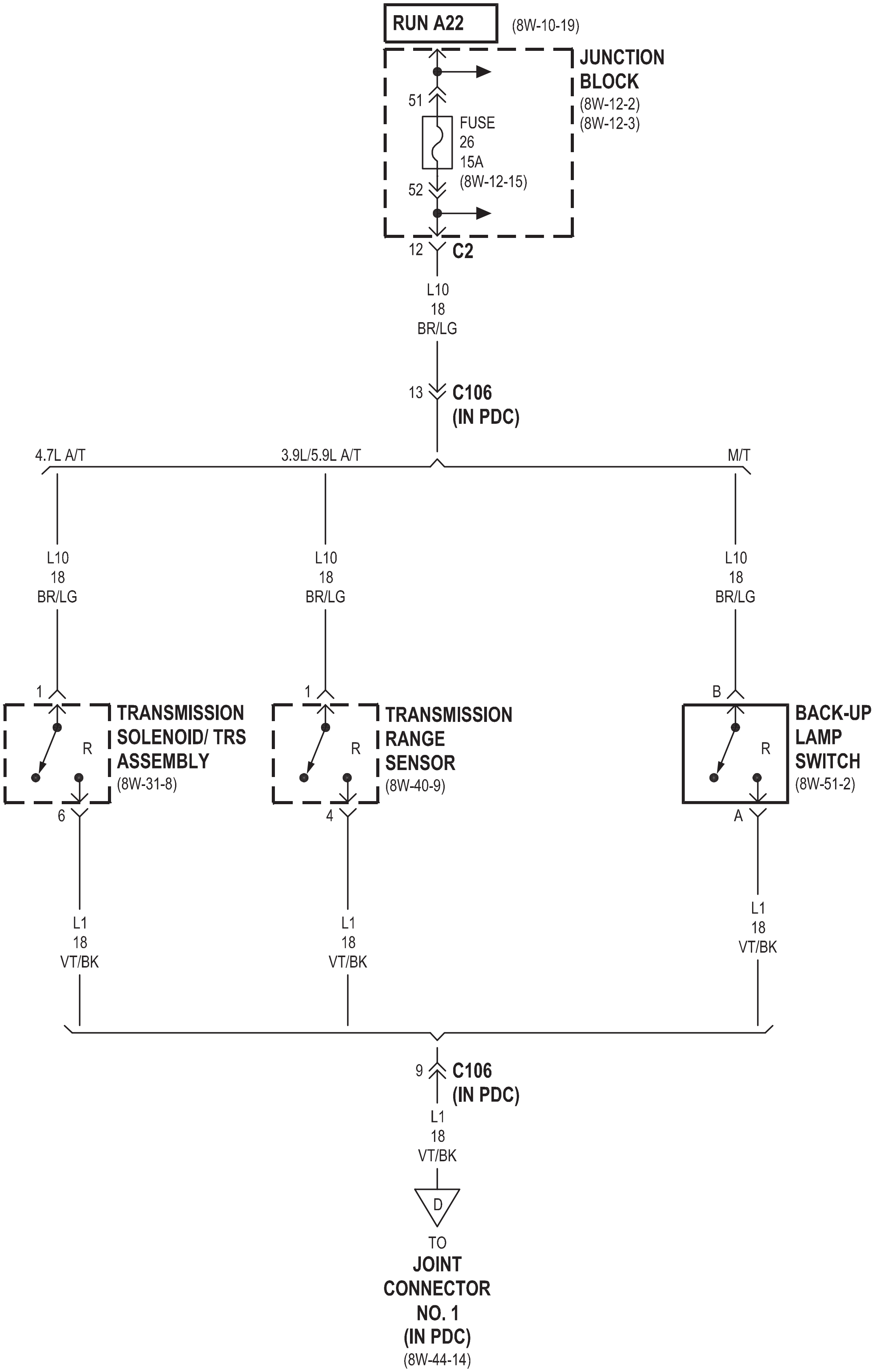

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FUSE
1
15A
(8W-12-6)
C5
C4
C4
M1 20 PK
M1 18 PK
S322
C301
OVERHEAD CONSOLE
(8W-49-3)
DOME LAMP
C329
CENTER CONSOLE LAMP
M1 20 PK
CARGO LAMP NO. 1
CARGO LAMP NO. 2
M3 20 PK/DB
M2 20 YL
Y158 20 YL/VT
Y158 18 YL/VT
STANDARD CAB
EXCEPT STANDARD CAB
S324
S323
C2
CARGO LAMP DRIVER
CENTRAL TIMER MODULE
(8W-45-19)
COURTESY LAMP DRIVER
INTERIOR LAMP DRIVER
(8W-45-6)

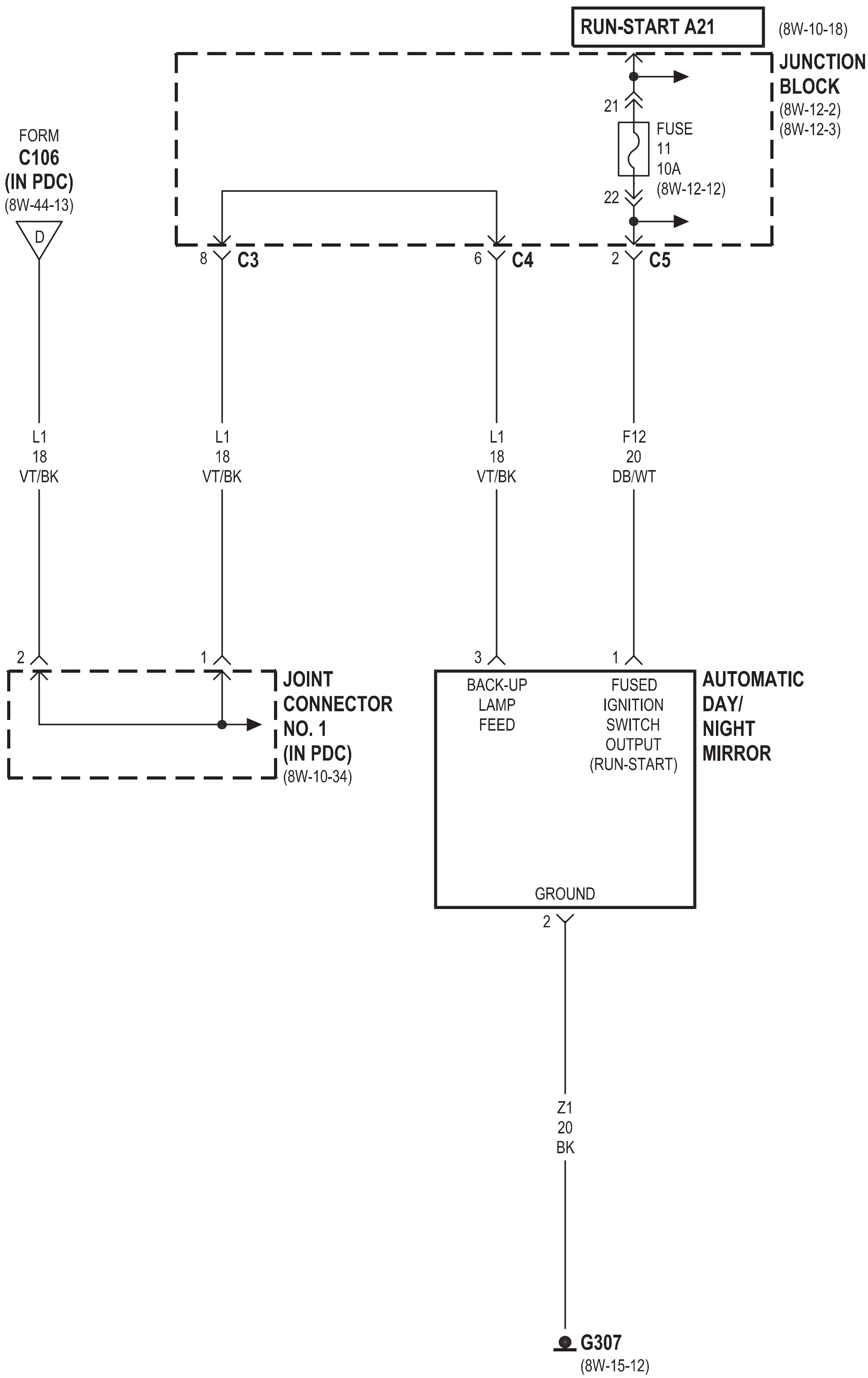

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
2
FUSE
1
15A
(8W-12-6)
1
1 C8
7 C5
4 C10
3 C8
M1
20
PK
6
9
C363
M1
20
PK
M1
20
PK
M1
20
PK
M1
18
PK
6
FUSED
B(+)
SENTRY KEY IMMOBILIZER MODULE
(8W-39-3)
3 C2
FUSED
B(+)
DRIVER DOOR MODULE
(8W-62-2)
7 C1
RADIO
(8W-47-2)
2
GLOVE BOX LAMP AND SWITCH
1
Y158
20
YL/VT
14 C1
GLOVE
BOX
LAMP
DRIVER
CENTRAL TIMER MODULE
(8W-45-3)
• 2 DOOR
•• 4 DOOR


CENTRAL TIMER MODULE
(8W-45-2)
(8W-45-11)
(8W-45-12)
(8W-45-14)
KEY-IN IGNITION SWITCH SENSE
DRIVER DOOR AJAR SWITCH SENSE
19 C1
15 C2
G26 18 LB
G75 20 TN
7
6
C363
G75 20 TN
BASE
PREMIUM
1
2
DRIVER DOOR AJAR SWITCH
(8W-39-4)
1
2
DRIVER DOOR POWER LOCK MOTOR/ AJAR SWITCH
(8W-39-5)
(8W-39-7)
5
KEY-IN
IGNITION SWITCH
(8W-10-17)
6
Z2 20 BK/LG
8
10
C363
Z1 20 BK
Z2 20 BK/LG
G208
(8W-15-10)
G307
(8W-15-11)
2 DOOR
4 DOOR

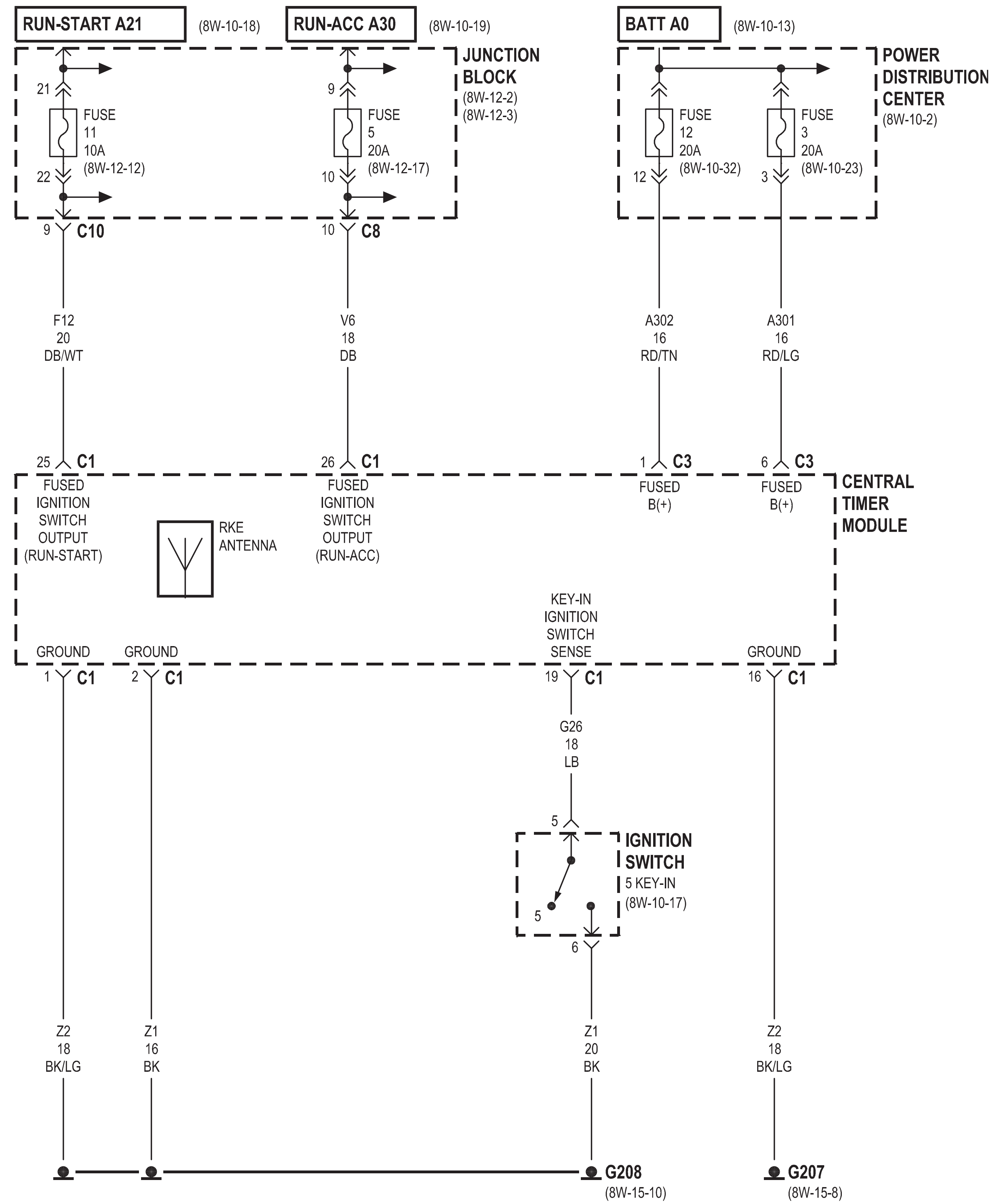

PASSENGER DOOR AJAR SWITCH SENSE
CENTRAL TIMER MODULE
(8W-45-11)
13
C2
G74
20
TN/RD
2 DOOR
4 DOOR
S303
G74
20
TN/RD
7
6
C362
2
C365
2
C366
G74
18
TN/RD
1
PASSENGER DOOR AJAR SWITCH
(8W-39-4)
LEFT REAR DOOR AJAR SWITCH
(8W-39-4)
RIGHT REAR DOOR AJAR SWITCH
(8W-39-4)
2
Z2
20
BK/LG
8
10
C362
1
C365
1
C366
G307
(8W-15-12)
(8W-15-13)
• 2 DOOR
•• 4 DOOR

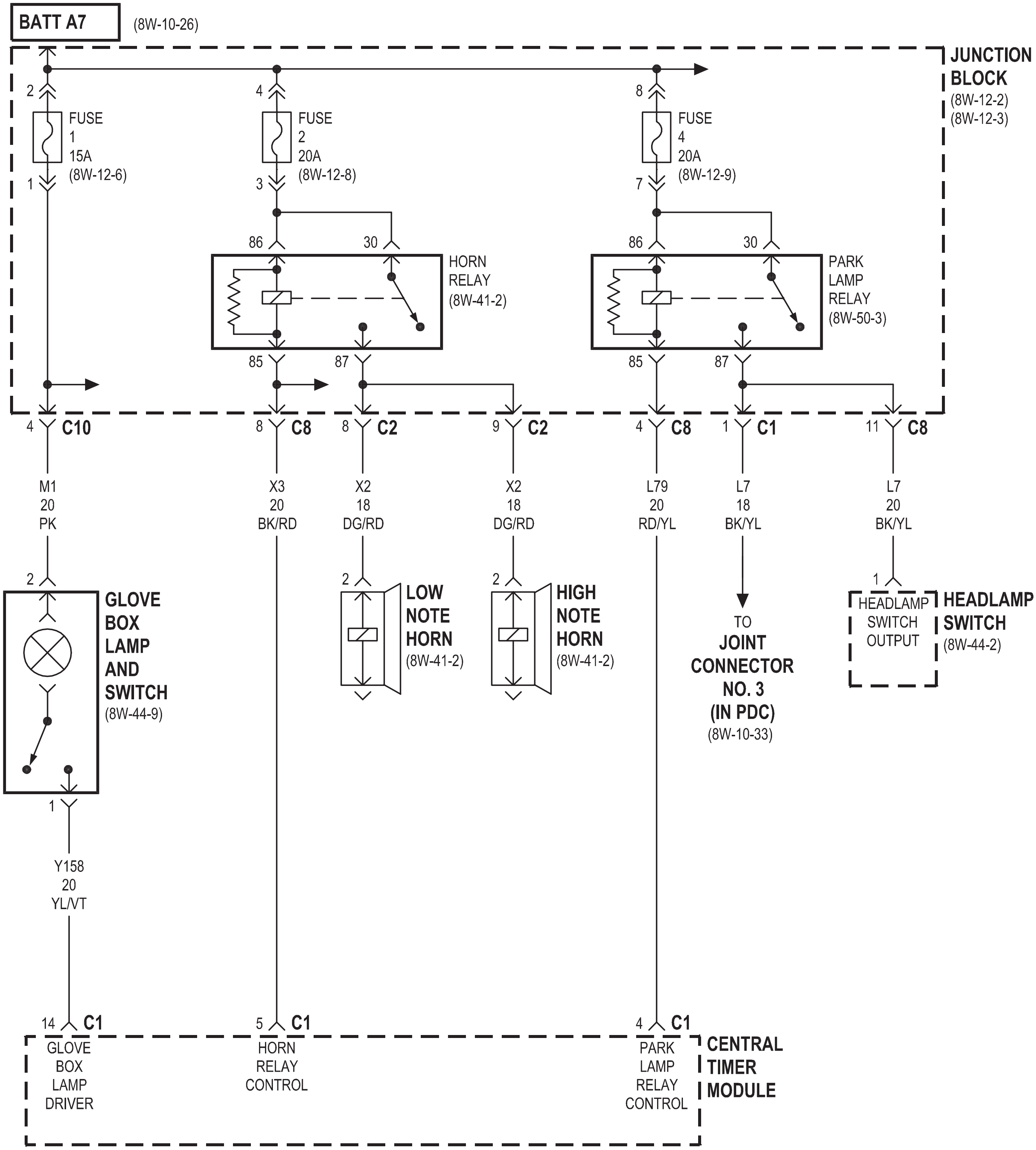

PASSENGER DOOR AJAR SWITCH SENSE
CENTRAL TIMER MODULE
(8W-45-13)
(8W-45-16)
13
C2
G74 20 TN/RD
4 DOOR
2 DOOR
S303
G74 20 TN/RD
6 C362
2 C365
2 C366
7 C362
G74 20 TN/RD
G74 18 TN/RD
1
2
PASSENGER DOOR POWER LOCK MOTOR/ AJAR SWITCH
(8W-39-8)
LEFT REAR DOOR POWER LOCK MOTOR/AJAR SWITCH
(8W-39-8)
RIGHT REAR DOOR POWER LOCK MOTOR/AJAR SWITCH
(8W-39-8)
PASSENGER DOOR POWER LOCK MOTOR/ AJAR SWITCH
(8W-39-6)
Z2 20 BK/TN
Z2 20 BK/LG
S328
(8W-15-12)
1 C365
1 C366
10 C362
8 C362
G307
(8W-15-12)
(8W-15-13)
G307
(8W-15-12)

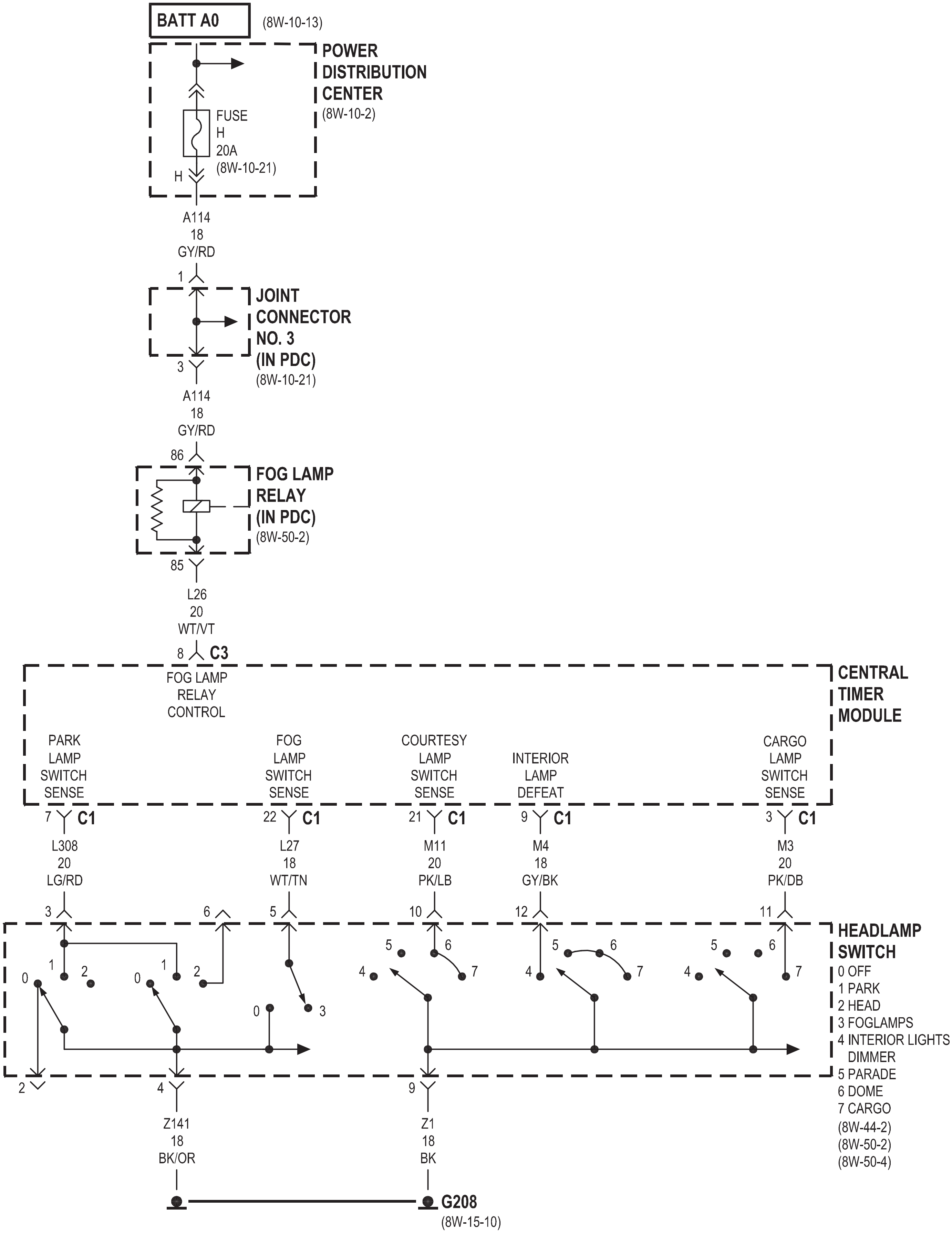

RUN A22
(8W-10-19)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
51
FUSE
26
15A
(8W-12-15)
52
12
C2
L10
18
BR/LG
13
C106
(IN PDC)
4.7L A/T
3.9L/5.9L A/T
M/T
L10
18
BR/LG
L10
18
BR/LG
L10
18
BR/LG
1
TRANSMISSION
SOLENOID/ TRS
ASSEMBLY
(8W-31-8)
R
6
1
TRANSMISSION
RANGE
SENSOR
(8W-40-9)
R
4
B
BACK-UP
LAMP
SWITCH
(8W-51-2)
R
A
L1
18
VT/BK
L1
18
VT/BK
L1
18
VT/BK
9
C106
(IN PDC)
L1
18
VT/BK
D
TO
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-44-14)

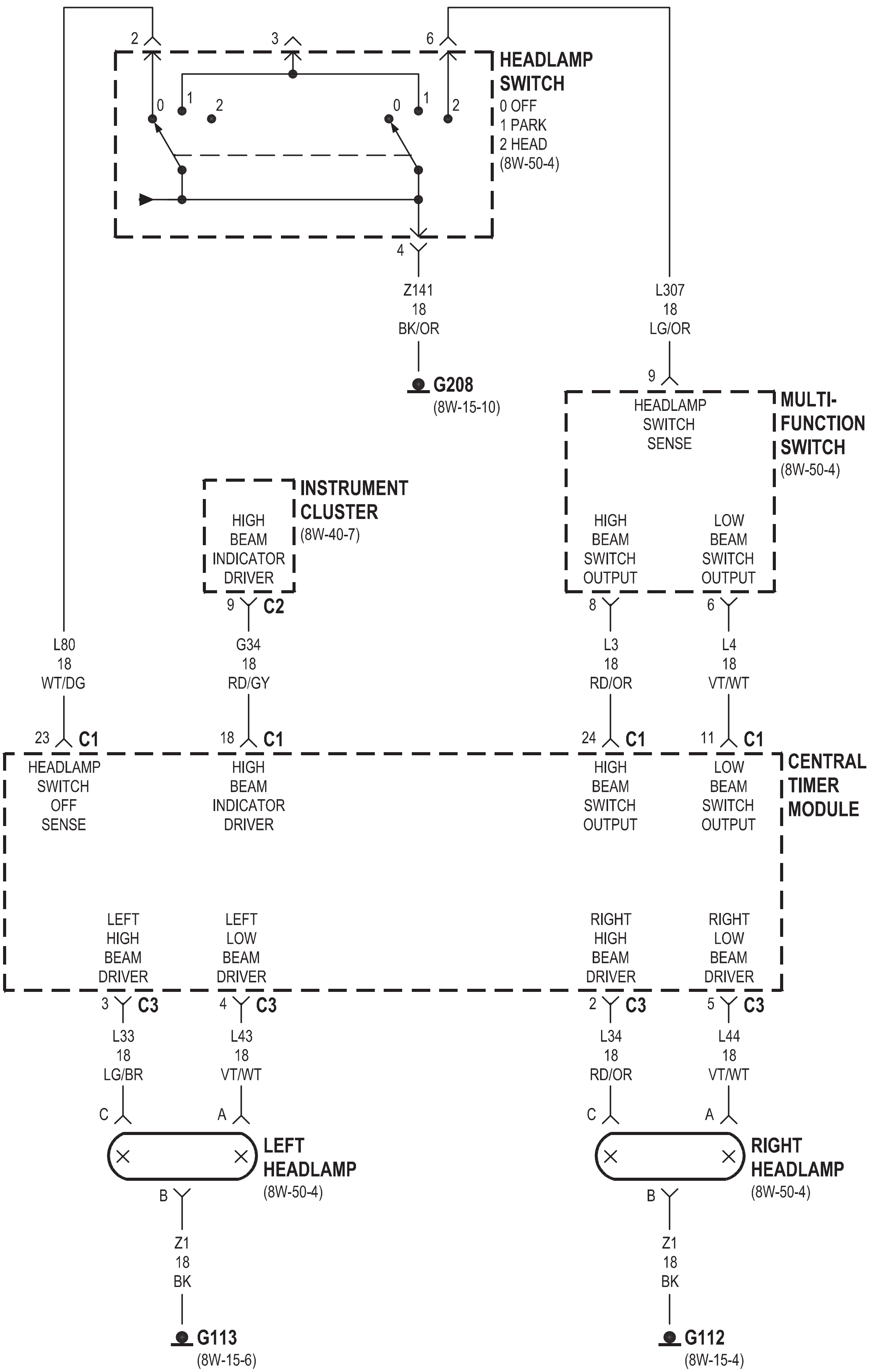

RUN-START A21
(8W-10-18)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
21
FUSE
11
10A
(8W-12-12)
22
FORM
C106
(IN PDC)
(8W-44-13)
D
8 C3
6 C4
2 C5
L1
18
VT/BK
L1
18
VT/BK
L1
18
VT/BK
F12
20
DB/WT
2
1
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-10-34)
3
1
BACK-UP
LAMP
FEED
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-START)
AUTOMATIC
DAY/
NIGHT
MIRROR
GROUND
2
Z1
20
BK
G307
(8W-15-12)

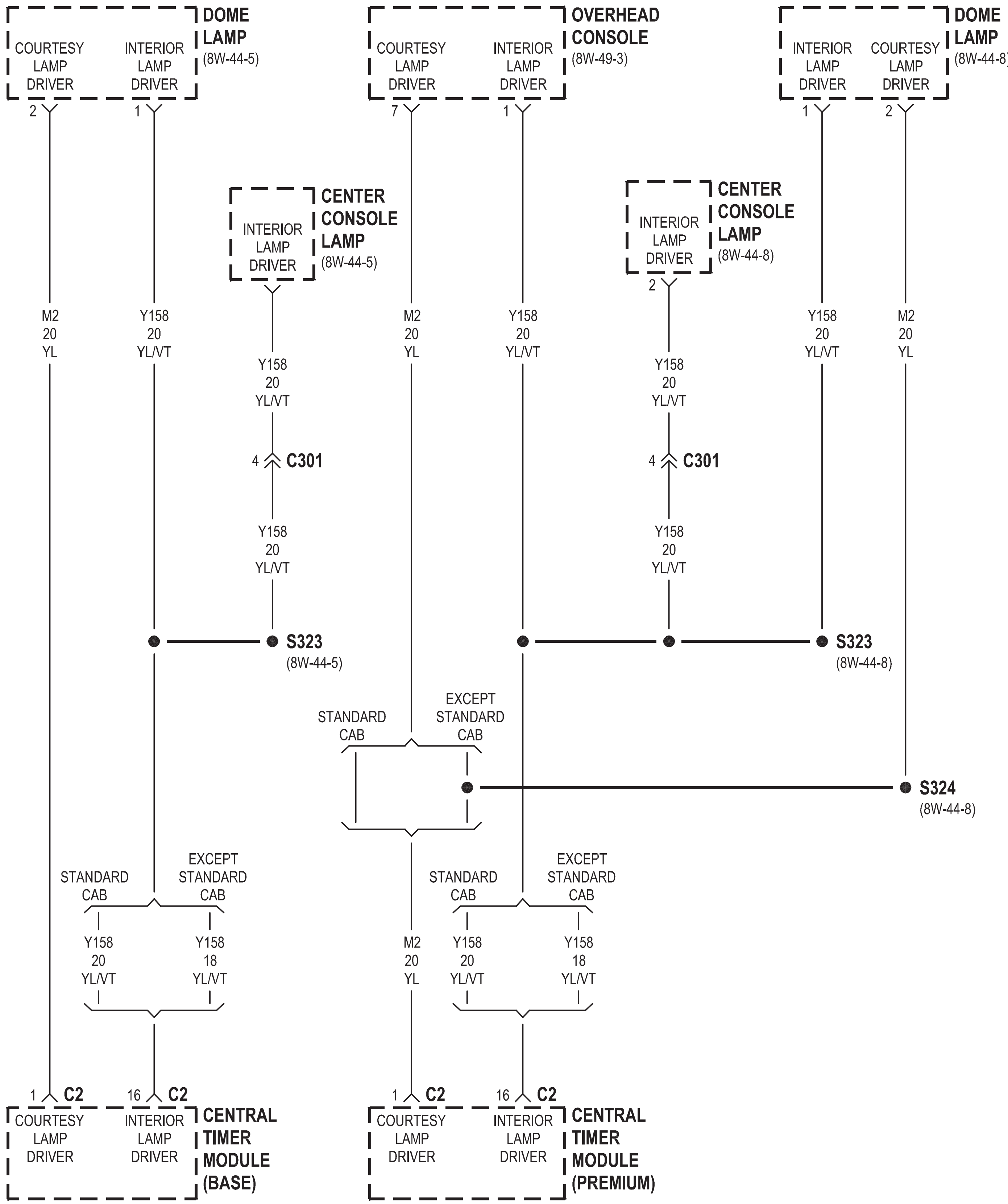
8W-45 CENTRAL TIMER MODULE

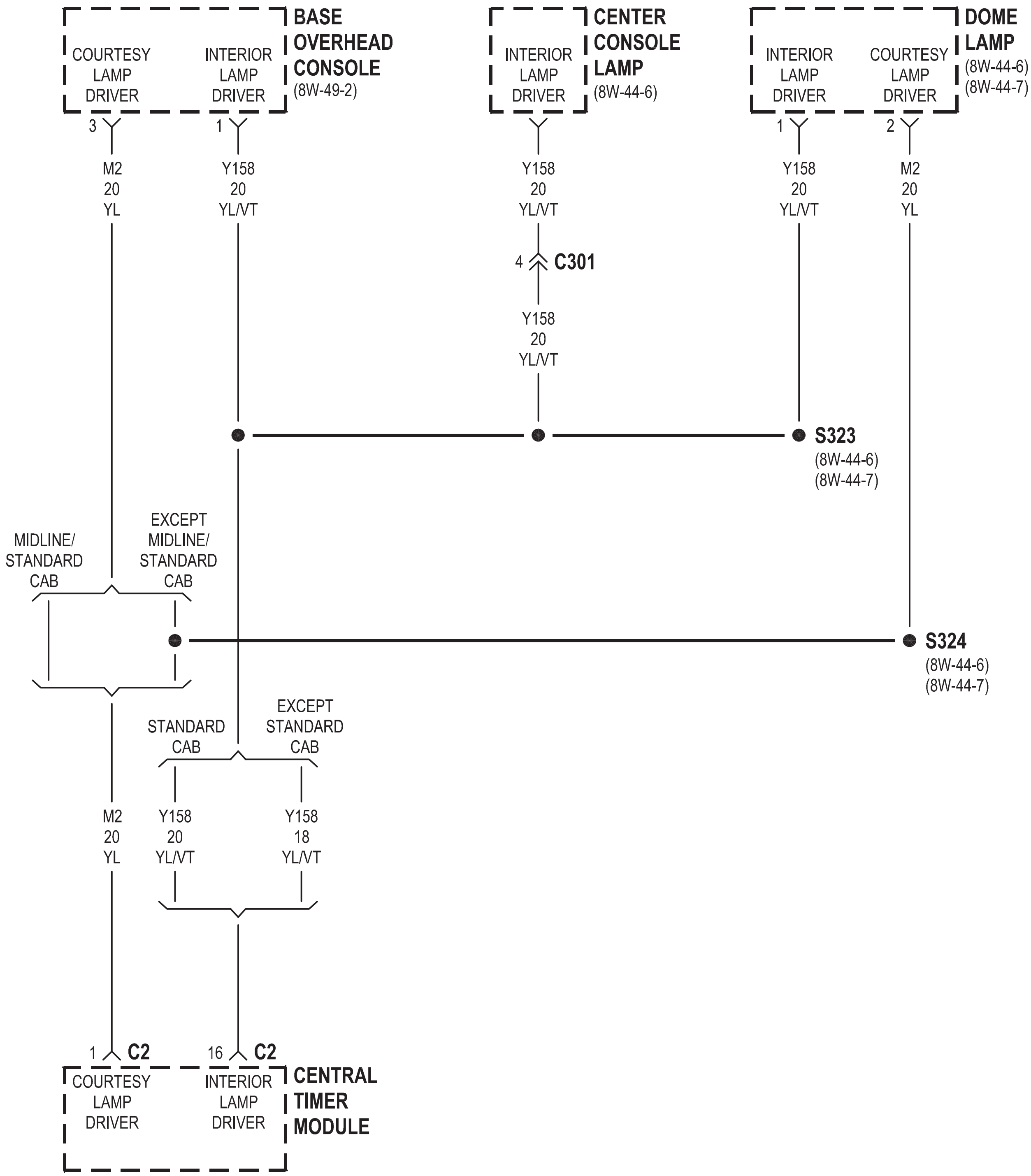

RUN-START A21
(8W-10-18)
RUN-ACC A30
(8W-10-19)
BATT A0
(8W-10-13)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FUSE 11 10A (8W-12-12)
FUSE 5 20A (8W-12-17)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 12 20A (8W-10-32)
FUSE 3 20A (8W-10-23)
C10
C8
F12 20 DB/WT
V6 18 DB
A302 16 RD/TN
A301 16 RD/LG
C1
C3
CENTRAL TIMER MODULE
FUSED IGNITION SWITCH OUTPUT (RUN-START)
RKE ANTENNA
FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
FUSED B(+)
FUSED B(+)
KEY-IN IGNITION SWITCH SENSE
GROUND
GROUND
GROUND
G26 18 LB
IGNITION SWITCH
5 KEY-IN
(8W-10-17)
Z2 18 BK/LG
Z1 16 BK
Z1 20 BK
Z2 18 BK/LG
G208
(8W-15-10)
G207
(8W-15-8)

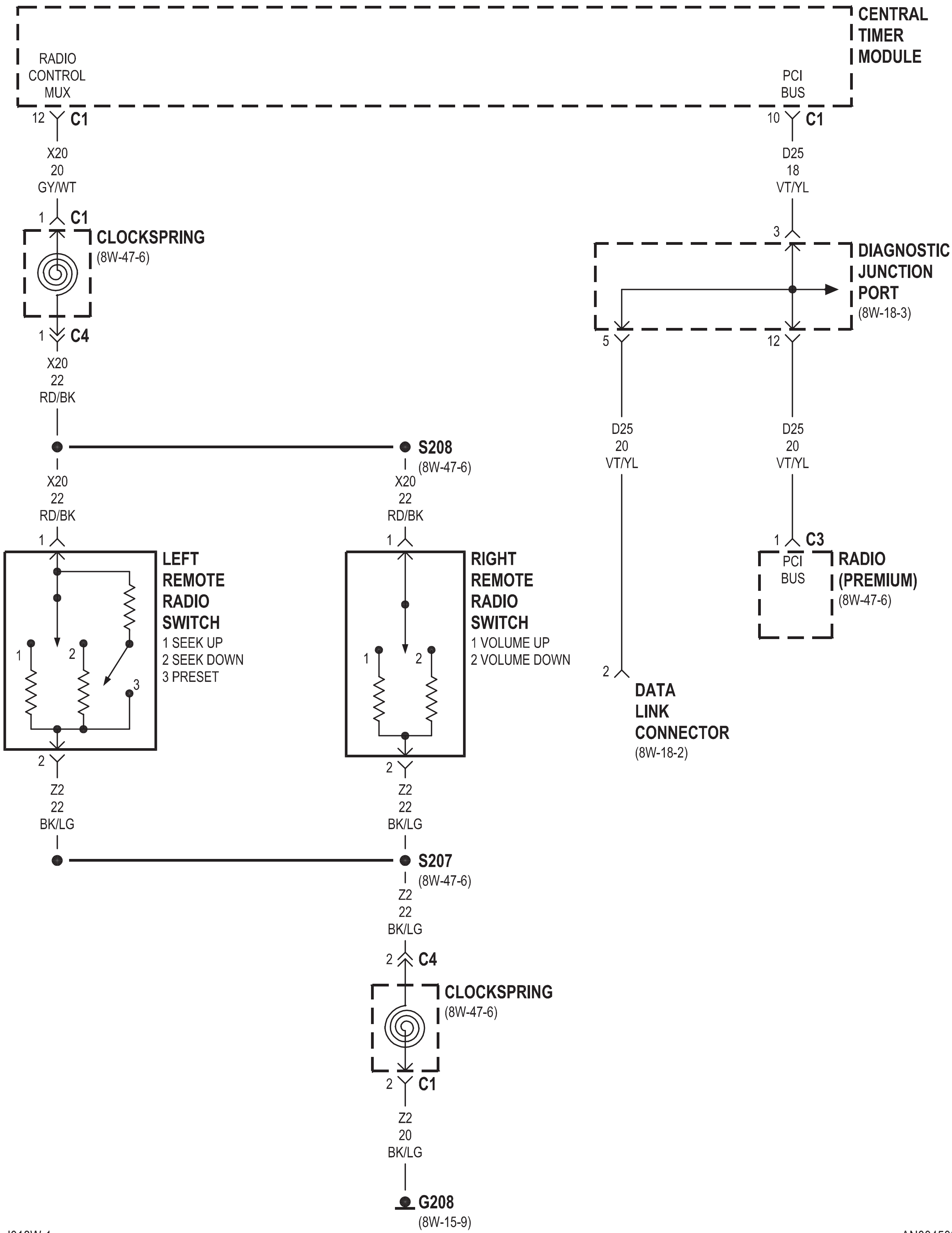

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FUSE 1 15A (8W-12-6)
FUSE 2 20A (8W-12-8)
FUSE 4 20A (8W-12-9)
HORN RELAY (8W-41-2)
PARK LAMP RELAY (8W-50-3)
86 30 85 87
C10 C8 C2 C2 C8 C1 C8
M1 20 PK
X3 20 BK/RD
X2 18 DG/RD
X2 18 DG/RD
L79 20 RD/YL
L7 18 BK/YL
L7 20 BK/YL
GLOVE BOX LAMP AND SWITCH
(8W-44-9)
LOW NOTE HORN
(8W-41-2)
HIGH NOTE HORN
(8W-41-2)
TO JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-33)
HEADLAMP SWITCH OUTPUT
HEADLAMP SWITCH
(8W-44-2)
Y158 20 YL/VT
C1 C1 C1
GLOVE BOX LAMP DRIVER
HORN RELAY CONTROL
PARK LAMP RELAY CONTROL
CENTRAL TIMER MODULE

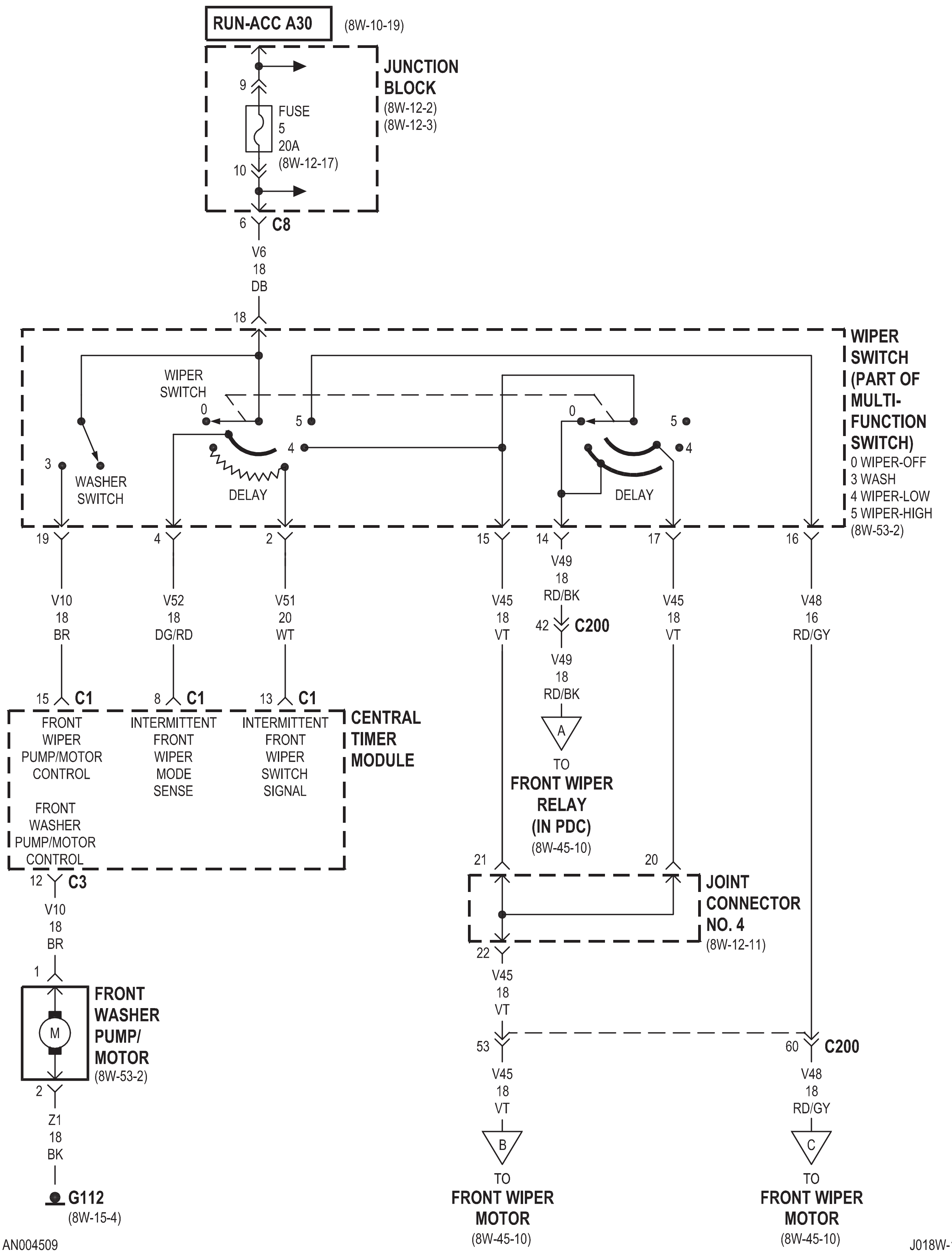

BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
H
20A
(8W-10-21)
H
A114
18
GY/RD
1
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-21)
3
A114
18
GY/RD
86
FOG LAMP RELAY (IN PDC)
(8W-50-2)
85
L26
20
WT/VT
8 C3
FOG LAMP RELAY CONTROL
CENTRAL TIMER MODULE
PARK LAMP SWITCH SENSE
FOG LAMP SWITCH SENSE
COURTESY LAMP SWITCH SENSE
INTERIOR LAMP DEFEAT
CARGO LAMP SWITCH SENSE
7 C1
22 C1
21 C1
9 C1
3 C1
L308
20
LG/RD
L27
18
WT/TN
M11
20
PK/LB
M4
18
GY/BK
M3
20
PK/DB
3
6
5
10
12
11
HEADLAMP SWITCH
0 OFF
1 PARK
2 HEAD
3 FOGLAMPS
4 INTERIOR LIGHTS DIMMER
5 PARADE
6 DOME
7 CARGO
(8W-44-2)
(8W-50-2)
(8W-50-4)
2
4
9
Z141
18
BK/OR
Z1
18
BK
G208
(8W-15-10)

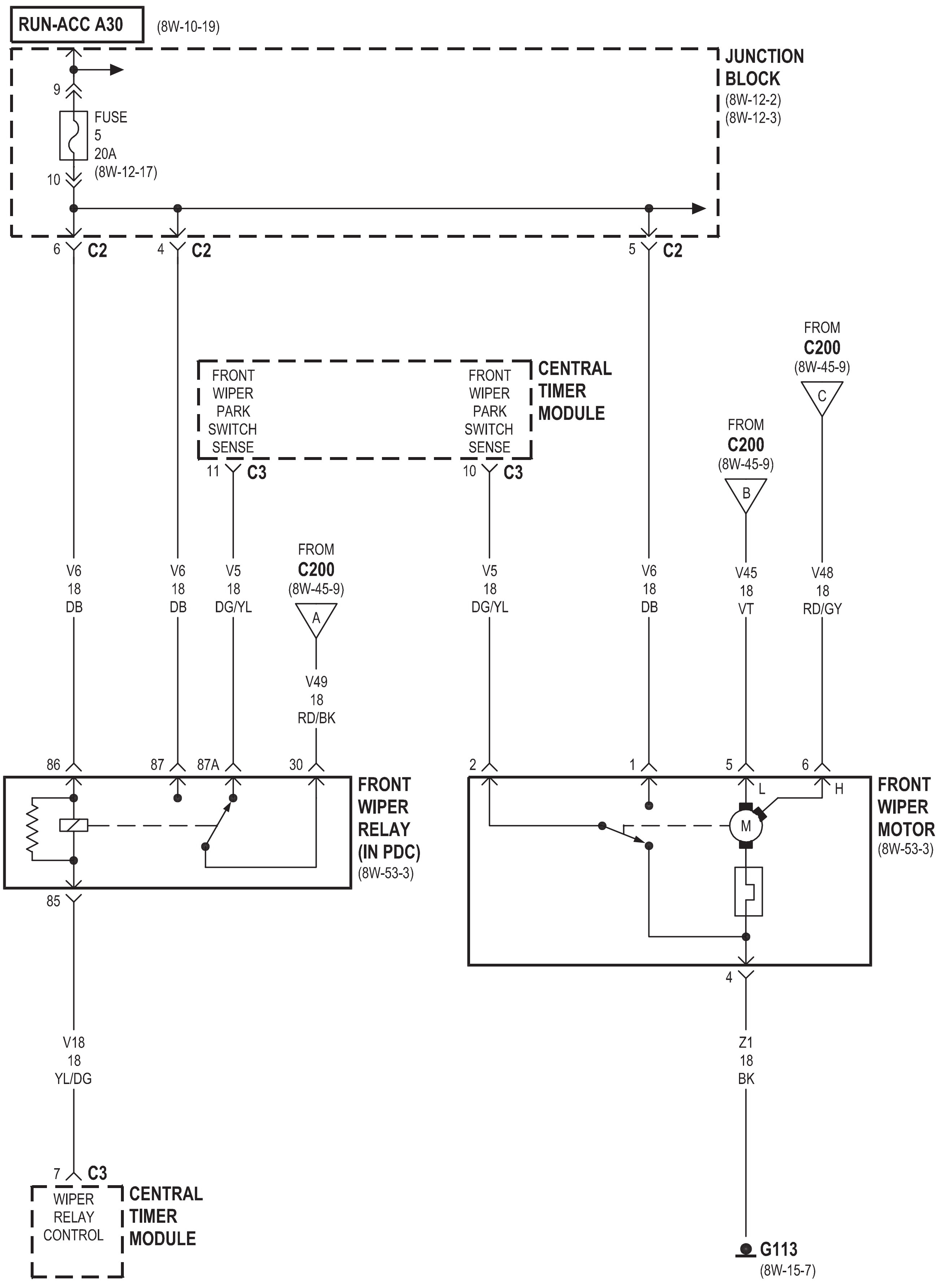

HEADLAMP
SWITCH
0 OFF
1 PARK
2 HEAD
(8W-50-4)
2
3
6
0
1
2
0
1
2
4
Z141
18
BK/OR
G208
(8W-15-10)
L307
18
LG/OR
9
HEADLAMP
SWITCH
SENSE
MULTI-
FUNCTION
SWITCH
(8W-50-4)
HIGH
BEAM
SWITCH
OUTPUT
LOW
BEAM
SWITCH
OUTPUT
8
6
INSTRUMENT
CLUSTER
(8W-40-7)
HIGH
BEAM
INDICATOR
DRIVER
9 C2
L80
18
WT/DG
G34
18
RD/GY
L3
18
RD/OR
L4
18
VT/WT
23 C1
18 C1
24 C1
11 C1
CENTRAL
TIMER
MODULE
HEADLAMP
SWITCH
OFF
SENSE
HIGH
BEAM
INDICATOR
DRIVER
HIGH
BEAM
SWITCH
OUTPUT
LOW
BEAM
SWITCH
OUTPUT
LEFT
HIGH
BEAM
DRIVER
LEFT
LOW
BEAM
DRIVER
RIGHT
HIGH
BEAM
DRIVER
RIGHT
LOW
BEAM
DRIVER
3 C3
4 C3
2 C3
5 C3
L33
18
LG/BR
L43
18
VT/WT
L34
18
RD/OR
L44
18
VT/WT
C
A
C
A
LEFT
HEADLAMP
(8W-50-4)
RIGHT
HEADLAMP
(8W-50-4)
B
B
Z1
18
BK
Z1
18
BK
G113
(8W-15-6)
G112
(8W-15-4)

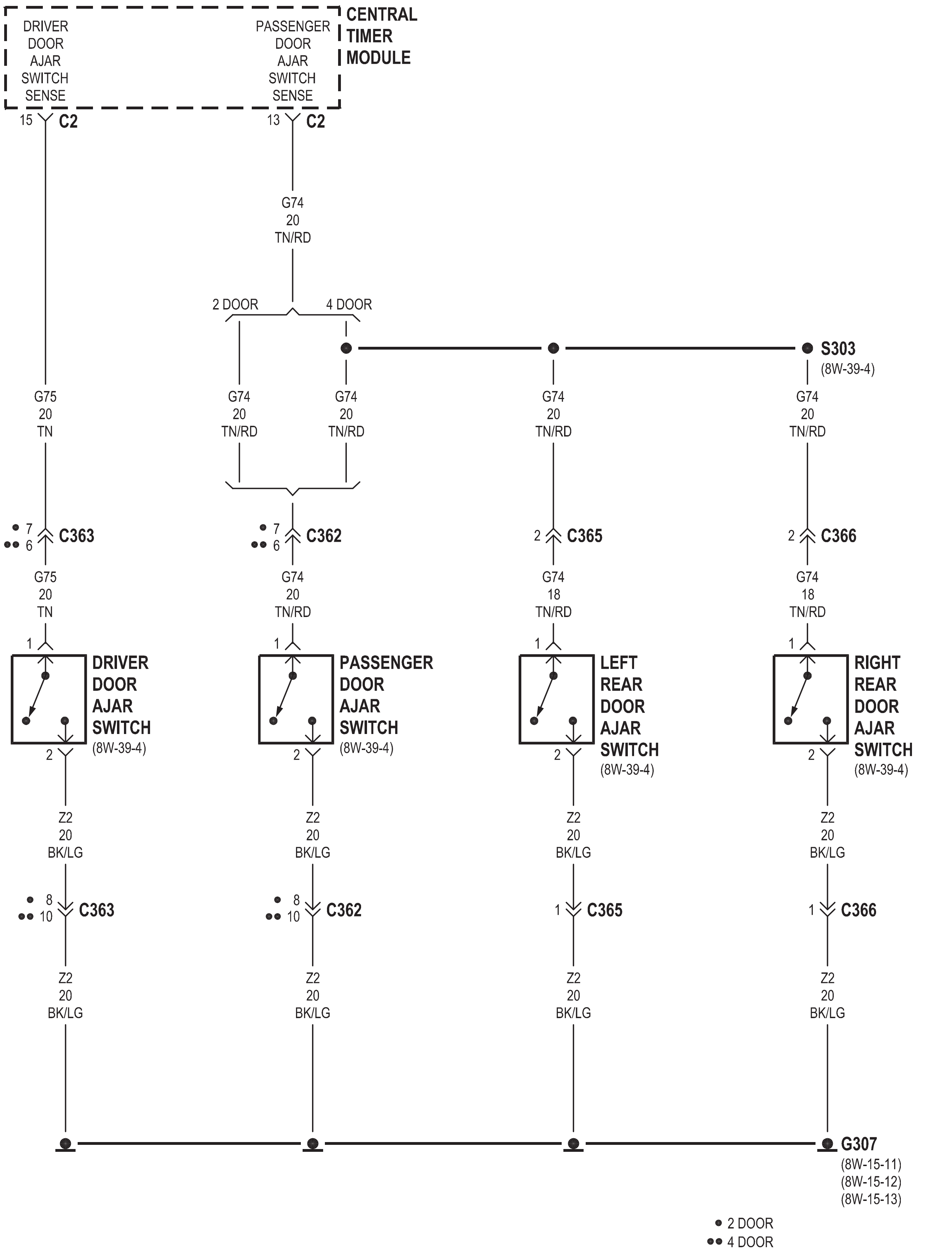

DOME LAMP
(8W-44-5)
COURTESY LAMP DRIVER
INTERIOR LAMP DRIVER
OVERHEAD CONSOLE
(8W-49-3)
DOME LAMP
(8W-44-8)
CENTER CONSOLE LAMP
(8W-44-5)
(8W-44-8)
M2
20
YL
Y158
20
YL/VT
Y158
18
YL/VT
C301
S323
S324
STANDARD CAB
EXCEPT STANDARD CAB
C2
CENTRAL TIMER MODULE (BASE)
CENTRAL TIMER MODULE (PREMIUM)

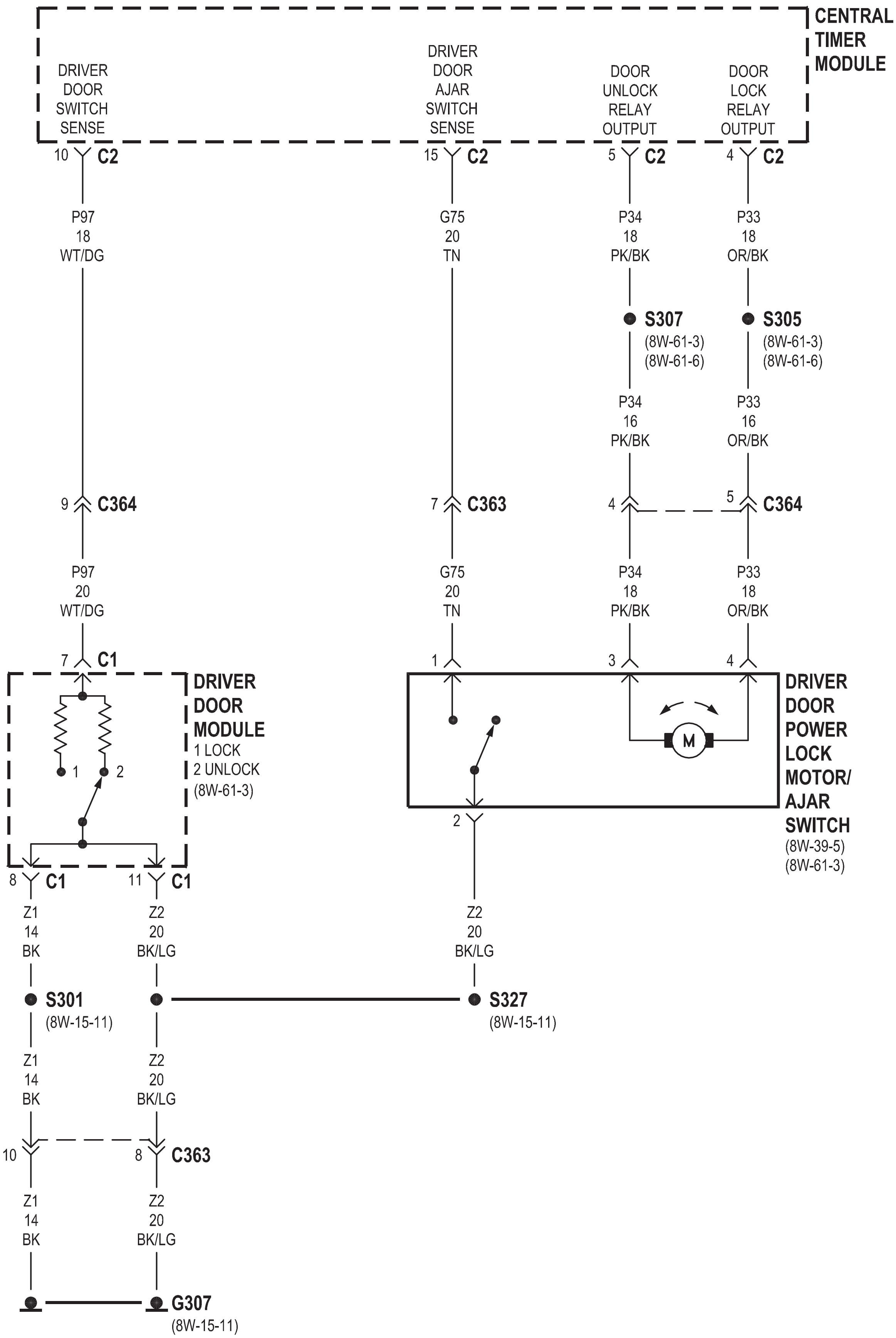

BASE OVERHEAD CONSOLE
(8W-49-2)
COURTESY LAMP DRIVER
INTERIOR LAMP DRIVER
CENTER CONSOLE LAMP
(8W-44-6)
INTERIOR LAMP DRIVER
DOME LAMP
(8W-44-6)
(8W-44-7)
INTERIOR LAMP DRIVER
COURTESY LAMP DRIVER
3
1
1
2
M2 20 YL
Y158 20 YL/VT
Y158 20 YL/VT
Y158 20 YL/VT
M2 20 YL
4
C301
Y158 20 YL/VT
S323
(8W-44-6)
(8W-44-7)
MIDLINE/ STANDARD CAB
EXCEPT MIDLINE/ STANDARD CAB
S324
(8W-44-6)
(8W-44-7)
STANDARD CAB
EXCEPT STANDARD CAB
M2 20 YL
Y158 20 YL/VT
Y158 18 YL/VT
1
C2
16
C2
COURTESY LAMP DRIVER
INTERIOR LAMP DRIVER
CENTRAL TIMER MODULE

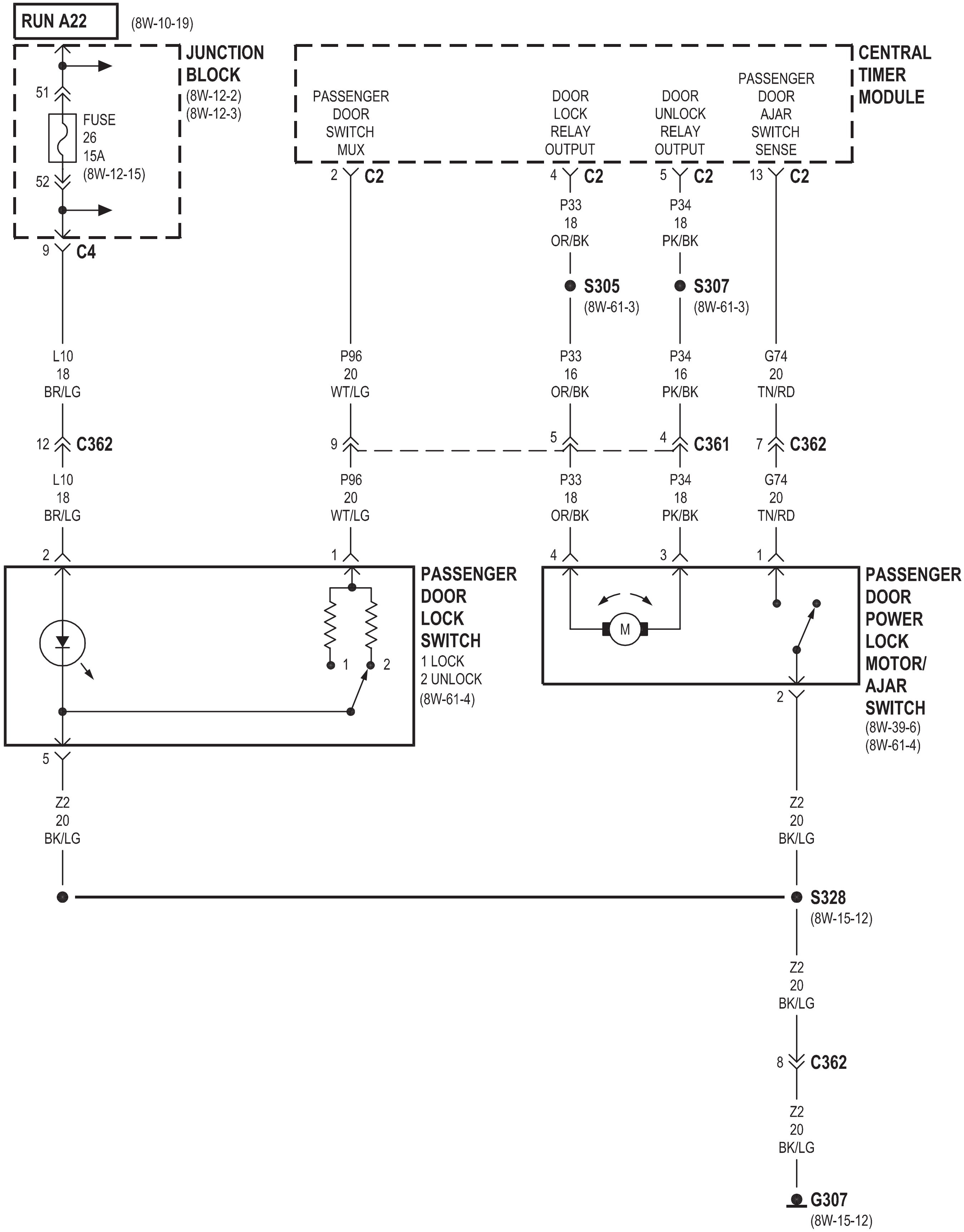

CENTRAL TIMER MODULE
RADIO CONTROL MUX
PCI BUS
12 C1
10 C1
X20 20 GY/WT
D25 18 VT/YL
1 C1
CLOCKSPRING (8W-47-6)
3
DIAGNOSTIC JUNCTION PORT (8W-18-3)
1 C4
5
12
X20 22 RD/BK
D25 20 VT/YL
D25 20 VT/YL
S208 (8W-47-6)
X20 22 RD/BK
X20 22 RD/BK
1
1
1 C3
LEFT REMOTE RADIO SWITCH
1 SEEK UP
2 SEEK DOWN
3 PRESET
RIGHT REMOTE RADIO SWITCH
1 VOLUME UP
2 VOLUME DOWN
PCI BUS
RADIO (PREMIUM) (8W-47-6)
2
DATA LINK CONNECTOR (8W-18-2)
2
2
Z2 22 BK/LG
Z2 22 BK/LG
S207 (8W-47-6)
Z2 22 BK/LG
2 C4
CLOCKSPRING (8W-47-6)
2 C1
Z2 20 BK/LG
G208 (8W-15-9)

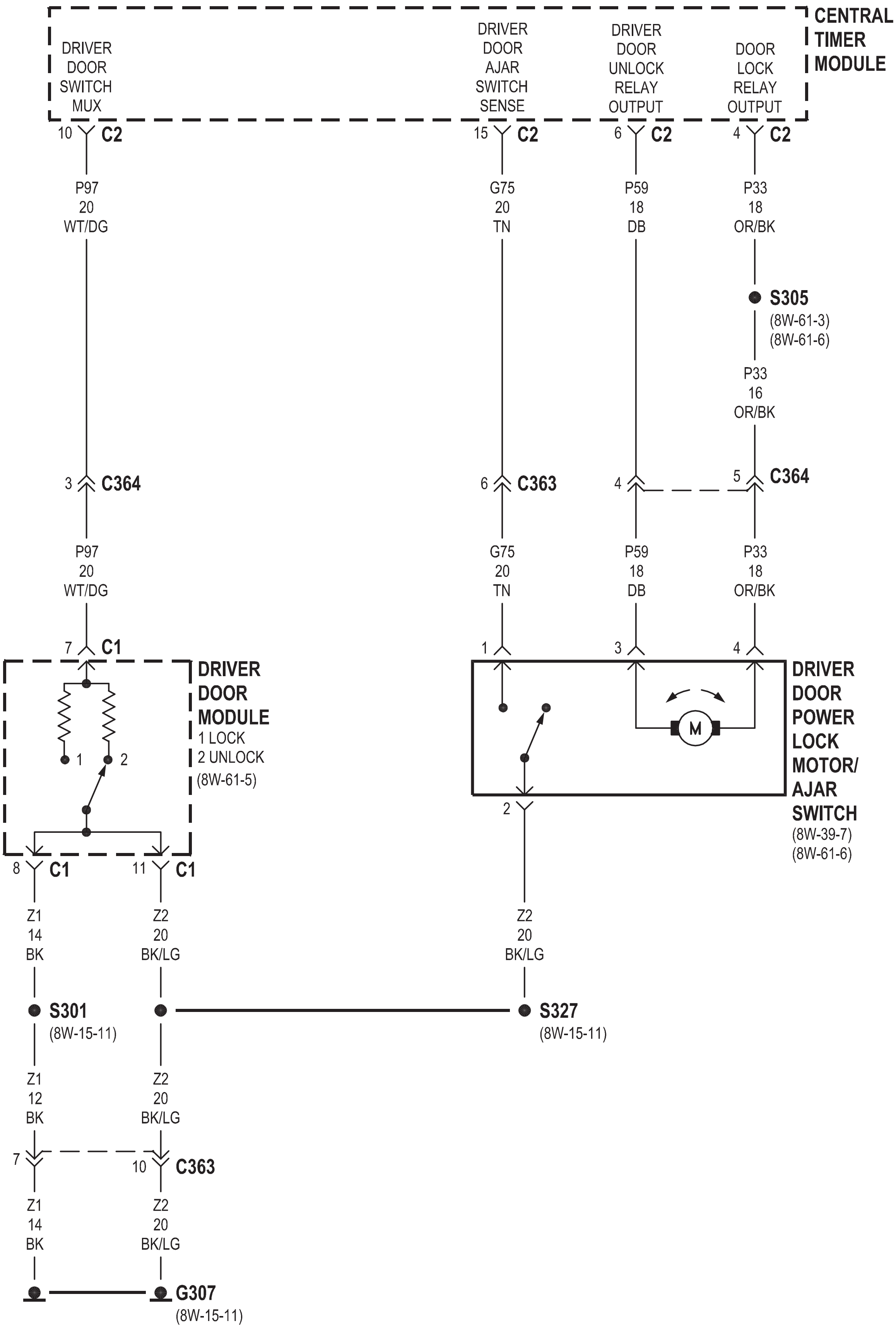

RUN-ACC A30
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FUSE 5 20A (8W-12-17)
9
10
6 C8
V6 18 DB
18
WIPER SWITCH (PART OF MULTI-FUNCTION SWITCH)
0 WIPER-OFF
3 WASH
4 WIPER-LOW
5 WIPER-HIGH
(8W-53-2)
WIPER SWITCH
WASHER SWITCH
DELAY
DELAY
0
5
4
3
0
5
4
19
4
2
15
14
17
16
V10 18 BR
V52 18 DG/RD
V51 20 WT
V45 18 VT
V49 18 RD/BK
42 C200
V49 18 RD/BK
V45 18 VT
V48 16 RD/GY
15 C1
8 C1
13 C1
CENTRAL TIMER MODULE
FRONT WIPER PUMP/MOTOR CONTROL
INTERMITTENT FRONT WIPER MODE SENSE
INTERMITTENT FRONT WIPER SWITCH SIGNAL
FRONT WASHER PUMP/MOTOR CONTROL
A
TO FRONT WIPER RELAY (IN PDC)
(8W-45-10)
12 C3
V10 18 BR
1
M
FRONT WASHER PUMP/ MOTOR
(8W-53-2)
2
Z1 18 BK
G112
(8W-15-4)
21
20
JOINT CONNECTOR NO. 4
(8W-12-11)
22
V45 18 VT
53
60 C200
V45 18 VT
V48 18 RD/GY
B
C
TO FRONT WIPER MOTOR
(8W-45-10)
TO FRONT WIPER MOTOR
(8W-45-10)

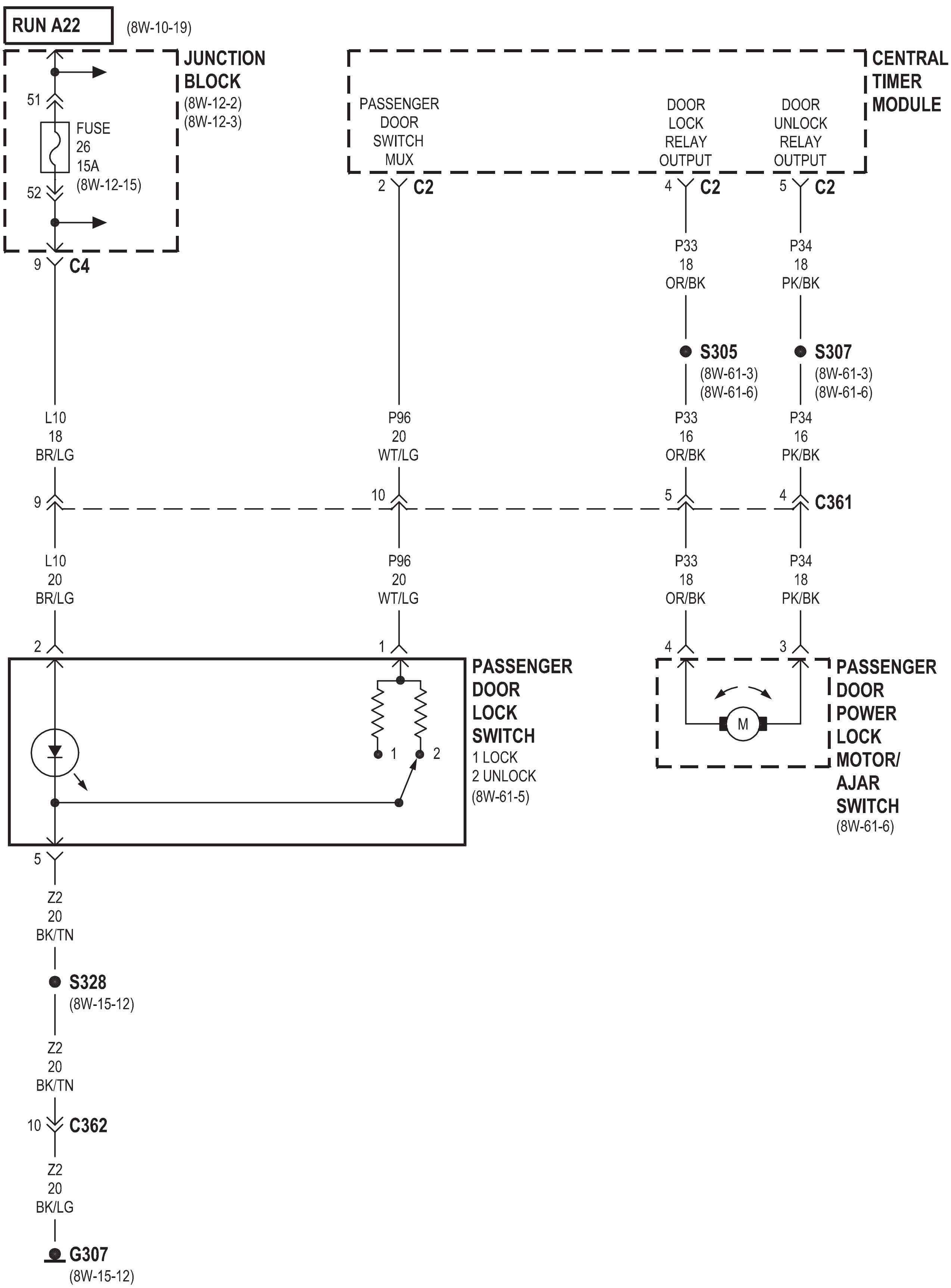

RUN-ACC A30
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
9
FUSE
5
20A
(8W-12-17)
10
6 C2
4 C2
5 C2
FRONT WIPER PARK SWITCH SENSE
FRONT WIPER PARK SWITCH SENSE
CENTRAL TIMER MODULE
11 C3
10 C3
FROM C200 (8W-45-9)
A
B
C
V6 18 DB
V6 18 DB
V5 18 DG/YL
V49 18 RD/BK
V5 18 DG/YL
V6 18 DB
V45 18 VT
V48 18 RD/GY
86
87
87A
30
FRONT WIPER RELAY (IN PDC)
(8W-53-3)
85
2
1
5
6
L
H
M
FRONT WIPER MOTOR
(8W-53-3)
4
V18 18 YL/DG
Z1 18 BK
7 C3
WIPER RELAY CONTROL
CENTRAL TIMER MODULE
G113
(8W-15-7)

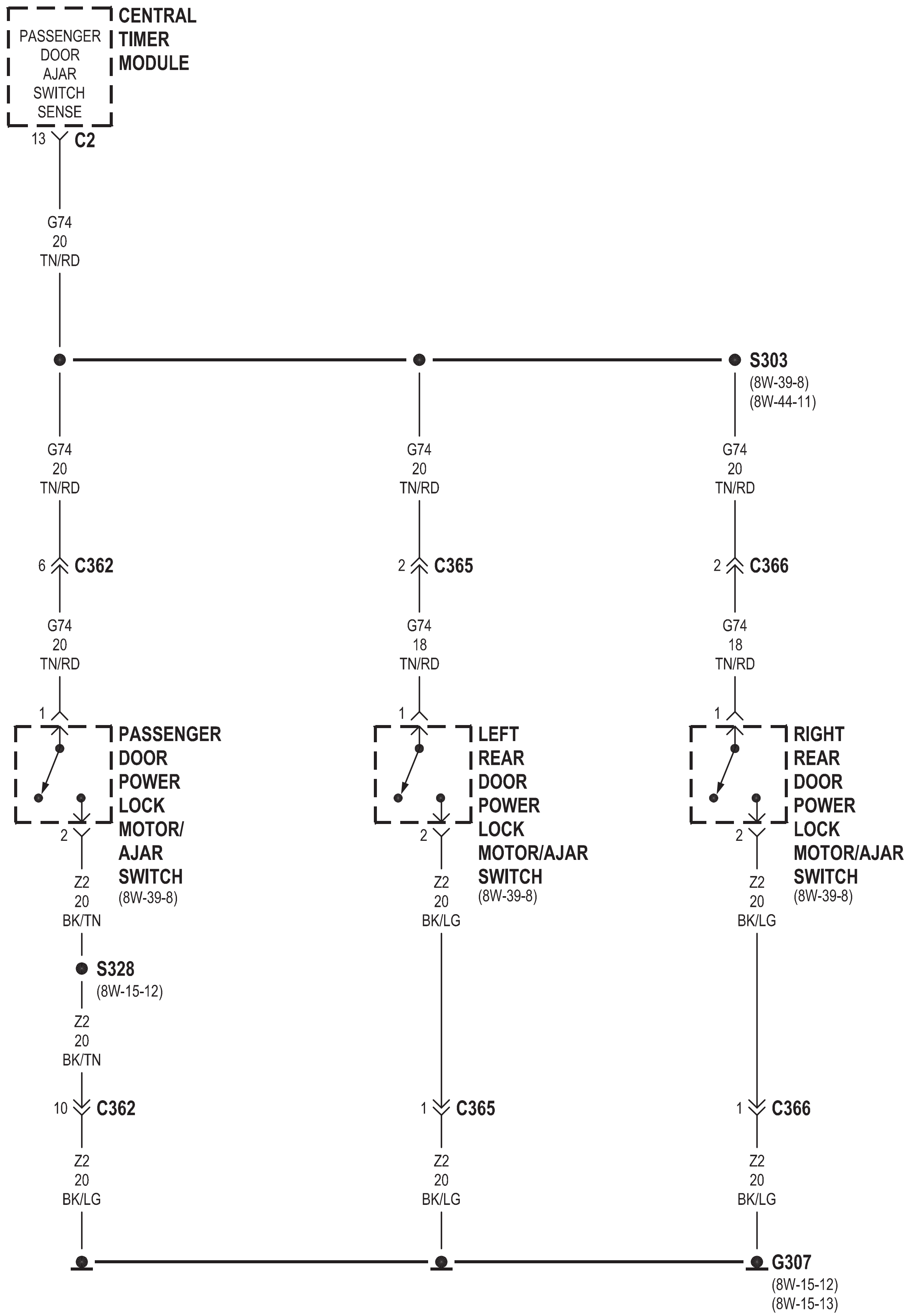

CENTRAL
TIMER
MODULE
DRIVER
DOOR
AJAR
SWITCH
SENSE
PASSENGER
DOOR
AJAR
SWITCH
SENSE
15
C2
13
C2
G74
20
TN/RD
2 DOOR
4 DOOR
S303
(8W-39-4)
G75
20
TN
G74
20
TN/RD
7
6
C363
C362
2
C365
C366
G74
18
TN/RD
1
2
DRIVER
DOOR
AJAR
SWITCH
(8W-39-4)
PASSENGER
DOOR
AJAR
SWITCH
(8W-39-4)
LEFT
REAR
DOOR
AJAR
SWITCH
(8W-39-4)
RIGHT
REAR
DOOR
AJAR
SWITCH
(8W-39-4)
Z2
20
BK/LG
8
10
G307
(8W-15-11)
(8W-15-12)
(8W-15-13)
● 2 DOOR
●● 4 DOOR


CENTRAL TIMER MODULE
DRIVER DOOR SWITCH SENSE
DRIVER DOOR AJAR SWITCH SENSE
DOOR UNLOCK RELAY OUTPUT
DOOR LOCK RELAY OUTPUT
10 C2
15 C2
5 C2
4 C2
P97 18 WT/DG
G75 20 TN
P34 18 PK/BK
P33 18 OR/BK
S307 (8W-61-3) (8W-61-6)
S305 (8W-61-3) (8W-61-6)
P34 16 PK/BK
P33 16 OR/BK
9 C364
7 C363
4
5 C364
P97 20 WT/DG
G75 20 TN
P34 18 PK/BK
P33 18 OR/BK
7 C1
1
3
4
DRIVER DOOR MODULE
1 LOCK
2 UNLOCK
(8W-61-3)
M
DRIVER DOOR POWER LOCK MOTOR/ AJAR SWITCH
(8W-39-5) (8W-61-3)
2
8 C1
11 C1
Z1 14 BK
Z2 20 BK/LG
Z2 20 BK/LG
S301 (8W-15-11)
S327 (8W-15-11)
Z1 14 BK
Z2 20 BK/LG
10
8 C363
Z1 14 BK
Z2 20 BK/LG
G307 (8W-15-11)

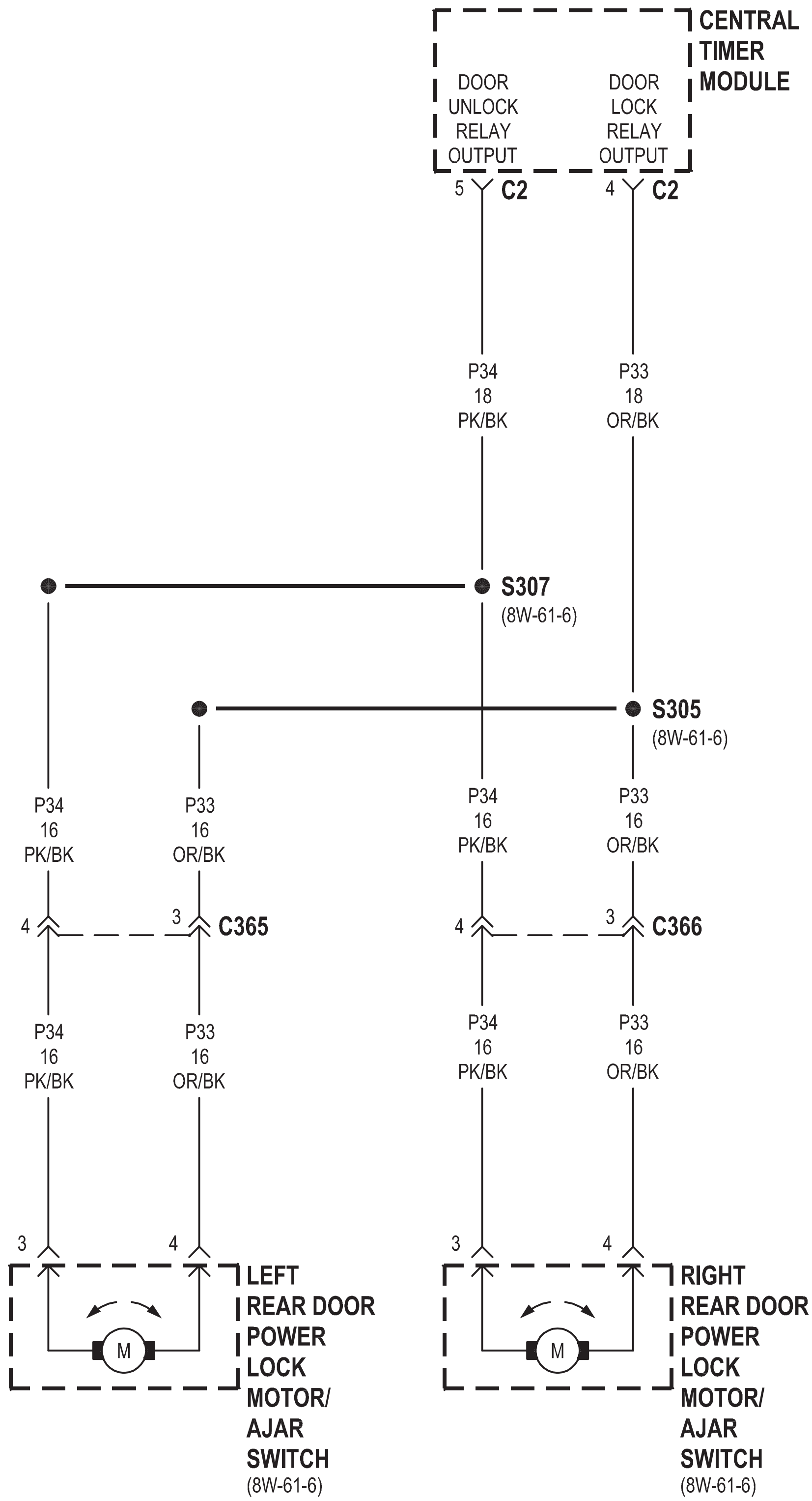

RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
51
FUSE
26
15A
(8W-12-15)
52
9 C4
CENTRAL TIMER MODULE
PASSENGER DOOR SWITCH MUX
DOOR LOCK RELAY OUTPUT
DOOR UNLOCK RELAY OUTPUT
PASSENGER DOOR AJAR SWITCH SENSE
2 C2
4 C2
5 C2
13 C2
P33 18 OR/BK
P34 18 PK/BK
S305
(8W-61-3)
S307
(8W-61-3)
L10 18 BR/LG
P96 20 WT/LG
P33 16 OR/BK
P34 16 PK/BK
G74 20 TN/RD
12 C362
9
5
4 C361
7 C362
L10 18 BR/LG
P96 20 WT/LG
P33 18 OR/BK
P34 18 PK/BK
G74 20 TN/RD
2
1
4
3
1
PASSENGER DOOR LOCK SWITCH
1 LOCK
2 UNLOCK
(8W-61-4)
1
2
M
PASSENGER DOOR POWER LOCK MOTOR/ AJAR SWITCH
(8W-39-6)
(8W-61-4)
2
5
Z2 20 BK/LG
Z2 20 BK/LG
S328
(8W-15-12)
Z2 20 BK/LG
8 C362
Z2 20 BK/LG
G307
(8W-15-12)

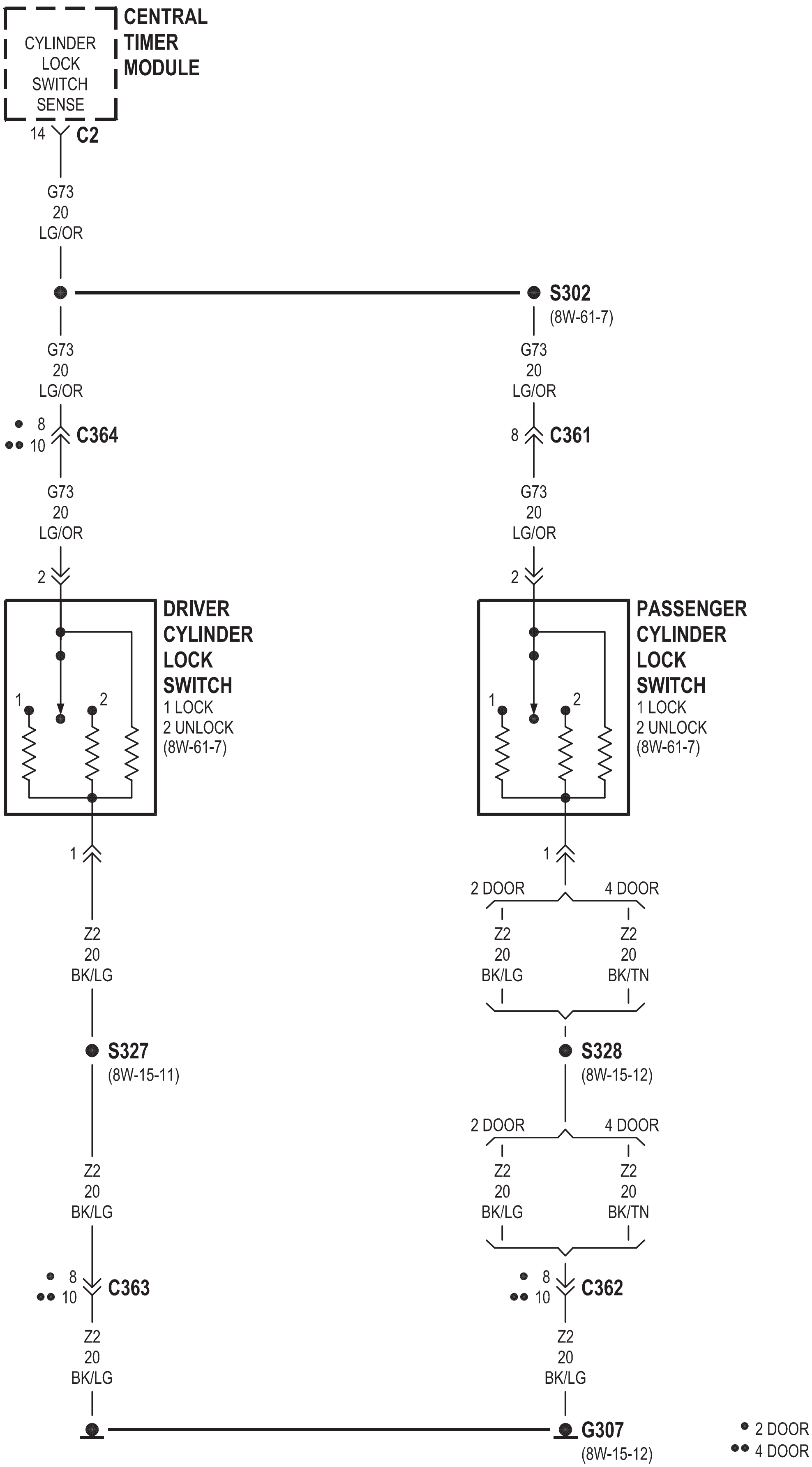

CENTRAL TIMER MODULE
DRIVER DOOR SWITCH MUX
DRIVER DOOR AJAR SWITCH SENSE
DRIVER DOOR UNLOCK RELAY OUTPUT
DOOR LOCK RELAY OUTPUT
10 C2
15 C2
6 C2
4 C2
P97 20 WT/DG
G75 20 TN
P59 18 DB
P33 18 OR/BK
S305 (8W-61-3) (8W-61-6)
P33 16 OR/BK
3 C364
6 C363
4
5 C364
P97 20 WT/DG
G75 20 TN
P59 18 DB
P33 18 OR/BK
7 C1
1
3
4
DRIVER DOOR MODULE
1 LOCK
2 UNLOCK
(8W-61-5)
1
2
M
DRIVER DOOR POWER LOCK MOTOR/ AJAR SWITCH (8W-39-7) (8W-61-6)
2
8 C1
11 C1
Z1 14 BK
Z2 20 BK/LG
Z2 20 BK/LG
S301 (8W-15-11)
S327 (8W-15-11)
Z1 12 BK
Z2 20 BK/LG
7
10 C363
Z1 14 BK
Z2 20 BK/LG
G307 (8W-15-11)

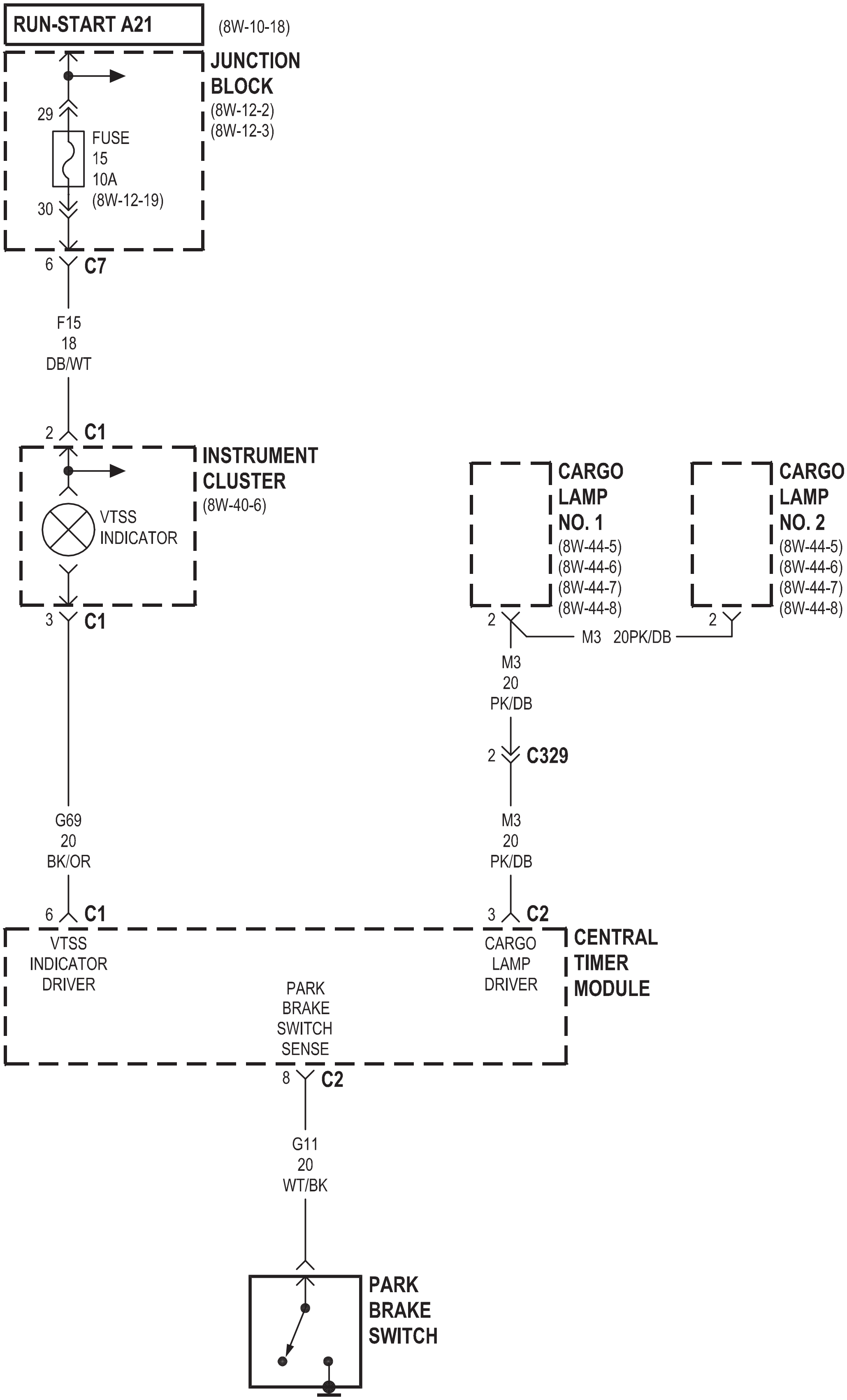

RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
51
FUSE
26
15A
(8W-12-15)
52
9 C4
CENTRAL TIMER MODULE
PASSENGER DOOR SWITCH MUX
DOOR LOCK RELAY OUTPUT
DOOR UNLOCK RELAY OUTPUT
2 C2
4 C2
5 C2
P33
18
OR/BK
P34
18
PK/BK
S305
(8W-61-3)
(8W-61-6)
S307
(8W-61-3)
(8W-61-6)
L10
18
BR/LG
P96
20
WT/LG
P33
16
OR/BK
P34
16
PK/BK
9
10
5
4 C361
L10
20
BR/LG
P96
20
WT/LG
P33
18
OR/BK
P34
18
PK/BK
2
1
4
3
PASSENGER DOOR LOCK SWITCH
1 LOCK
2 UNLOCK
(8W-61-5)
1
2
M
PASSENGER DOOR POWER LOCK MOTOR/ AJAR SWITCH
(8W-61-6)
5
Z2
20
BK/TN
S328
(8W-15-12)
Z2
20
BK/TN
10 C362
Z2
20
BK/LG
G307
(8W-15-12)


CENTRAL TIMER MODULE
PASSENGER DOOR AJAR SWITCH SENSE
13 C2
G74 20 TN/RD
S303
(8W-39-8)
(8W-44-11)
G74 20 TN/RD
6 C362
2 C365
2 C366
G74 20 TN/RD
G74 18 TN/RD
1
PASSENGER DOOR POWER LOCK MOTOR/ AJAR SWITCH
(8W-39-8)
LEFT REAR DOOR POWER LOCK MOTOR/AJAR SWITCH
(8W-39-8)
RIGHT REAR DOOR POWER LOCK MOTOR/AJAR SWITCH
(8W-39-8)
2
Z2 20 BK/TN
Z2 20 BK/LG
S328
(8W-15-12)
10 C362
1 C365
1 C366
G307
(8W-15-12)
(8W-15-13)

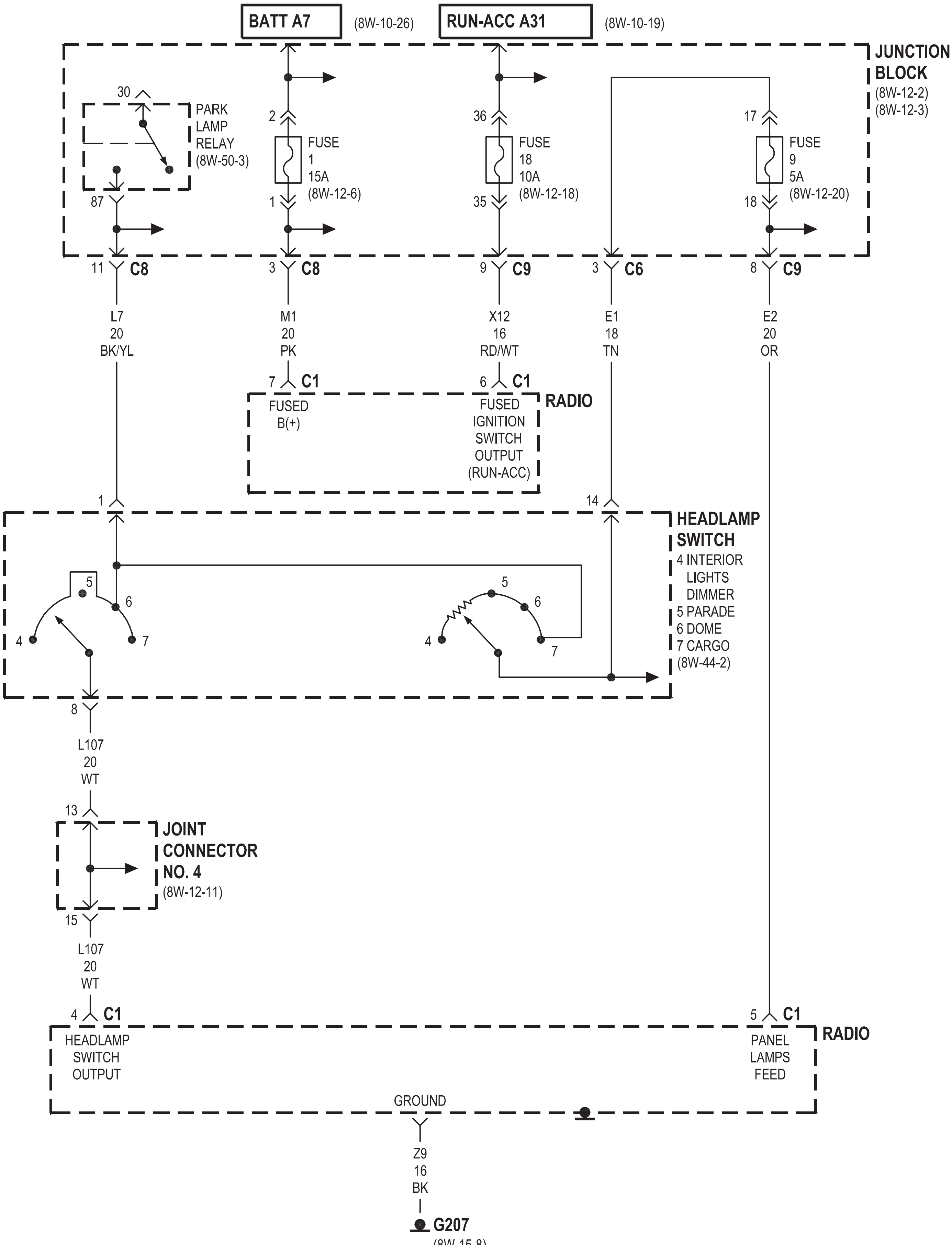
PREMIUM 4 DOOR

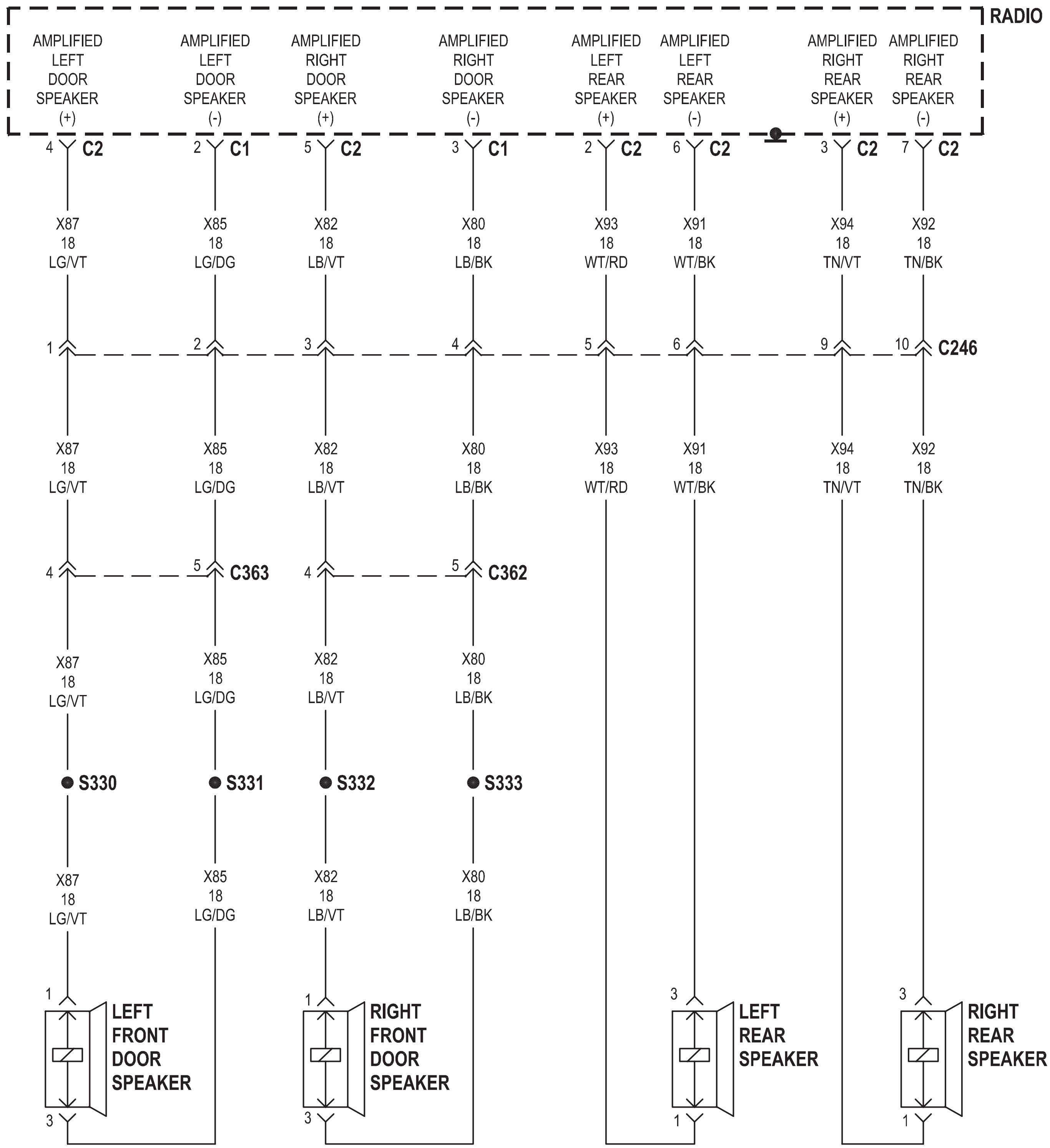



CENTRAL TIMER MODULE
CYLINDER LOCK SWITCH SENSE
14
C2
G73 20 LG/OR
S302
(8W-61-7)
G73 20 LG/OR
8
10
C364
8
C361
2
DRIVER CYLINDER LOCK SWITCH
1 LOCK
2 UNLOCK
(8W-61-7)
PASSENGER CYLINDER LOCK SWITCH
1 LOCK
2 UNLOCK
(8W-61-7)
1
2
2 DOOR
4 DOOR
Z2 20 BK/LG
Z2 20 BK/TN
S327
(8W-15-11)
S328
(8W-15-12)
C363
C362
G307
(8W-15-12)
• 2 DOOR
•• 4 DOOR

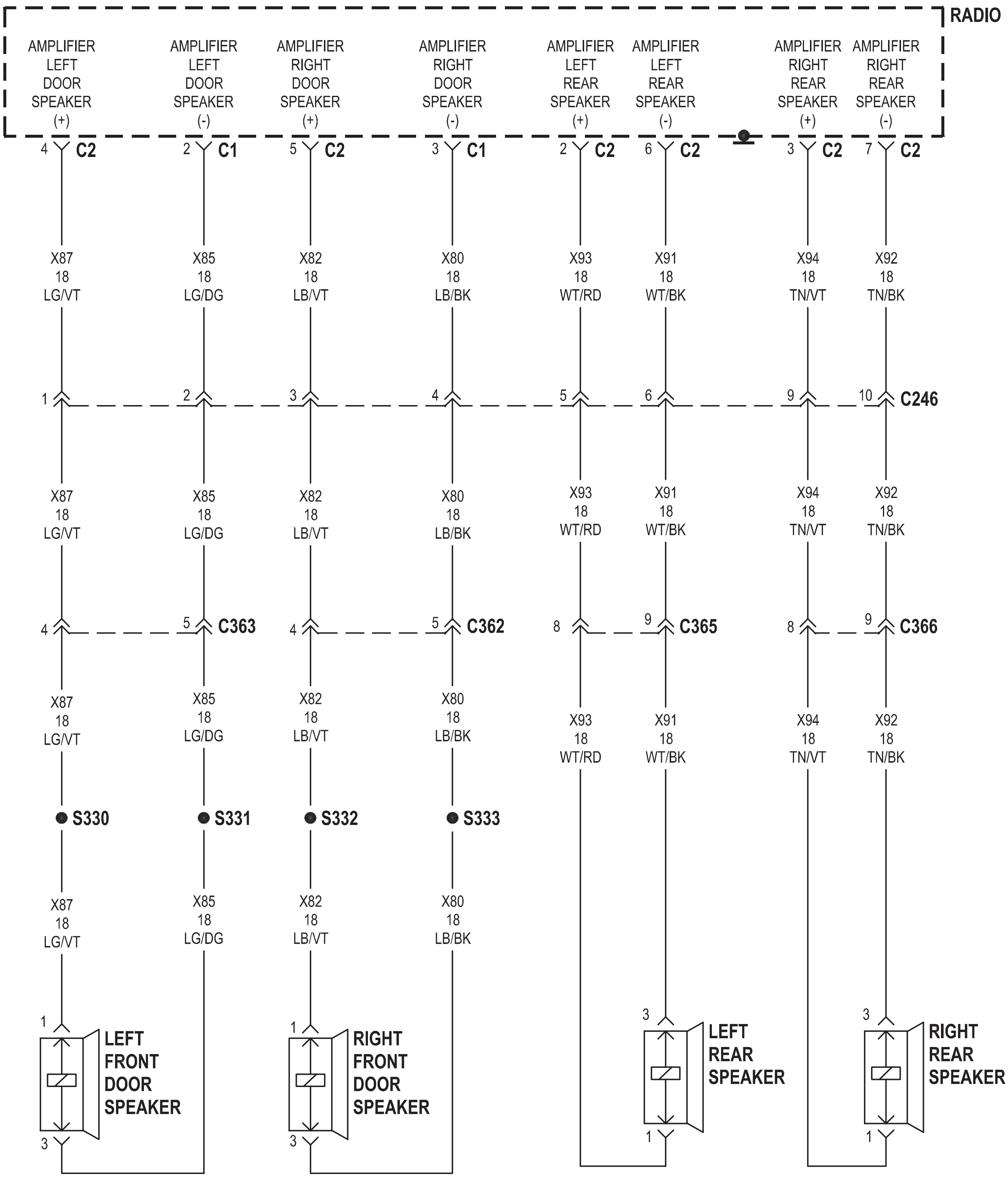

RUN-START A21
(8W-10-18)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
29
FUSE
15
10A
(8W-12-19)
30
6 C7
F15
18
DB/WT
2 C1
INSTRUMENT CLUSTER
(8W-40-6)
VTSS INDICATOR
3 C1
G69
20
BK/OR
CARGO LAMP NO. 1
(8W-44-5)
(8W-44-6)
(8W-44-7)
(8W-44-8)
CARGO LAMP NO. 2
(8W-44-5)
(8W-44-6)
(8W-44-7)
(8W-44-8)
2
M3 20PK/DB
2
M3
20
PK/DB
2 C329
M3
20
PK/DB
6 C1
3 C2
CENTRAL TIMER MODULE
VTSS INDICATOR DRIVER
CARGO LAMP DRIVER
PARK BRAKE SWITCH SENSE
8 C2
G11
20
WT/BK
PARK BRAKE SWITCH

8W-47 AUDIO SYSTEM

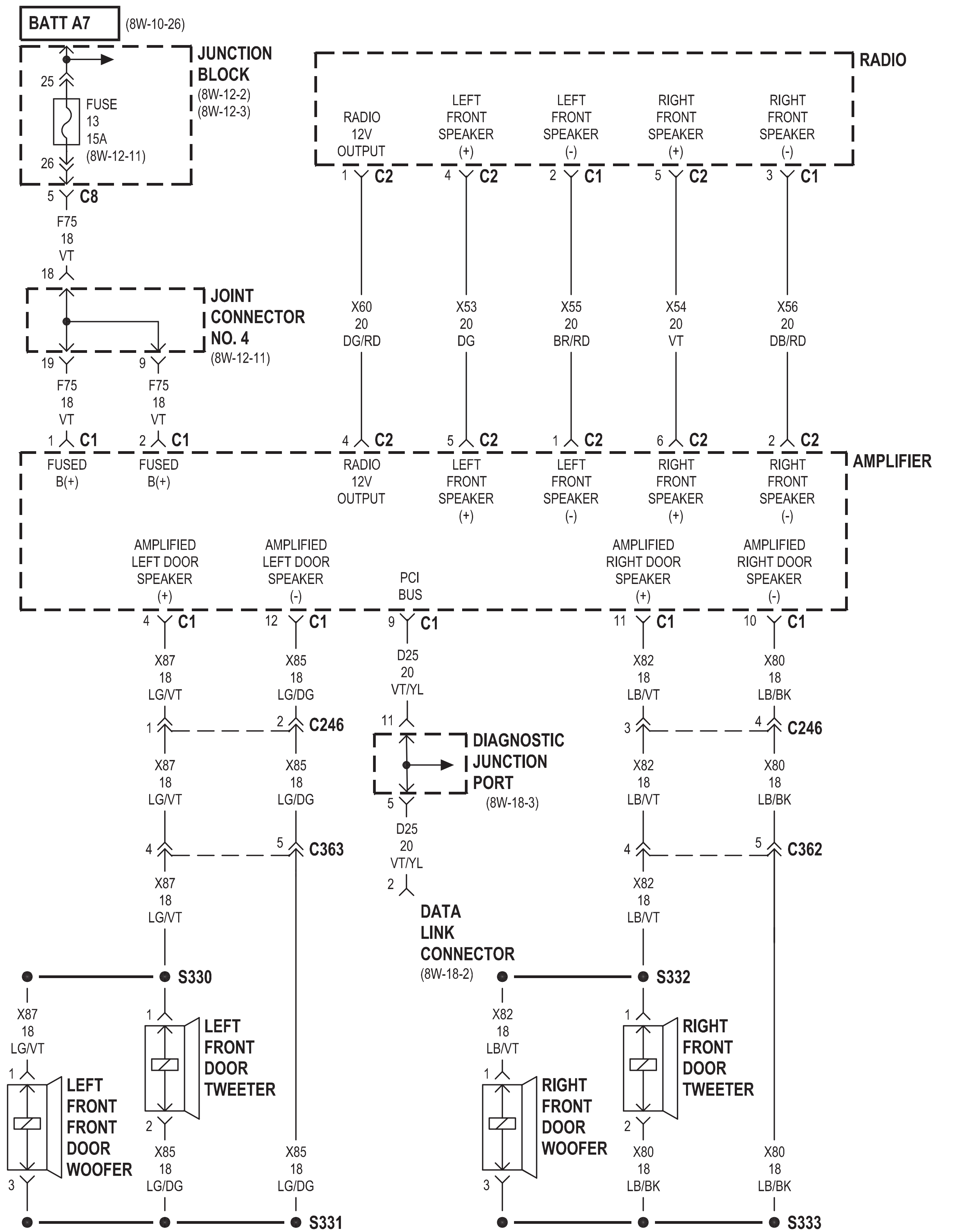

BATT A7
(8W-10-26)
RUN-ACC A31
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
PARK LAMP RELAY
(8W-50-3)
30
87
FUSE 1 15A (8W-12-6)
2
1
FUSE 18 10A (8W-12-18)
36
35
FUSE 9 5A (8W-12-20)
17
18
11 C8
3 C8
9 C9
3 C6
8 C9
L7 20 BK/YL
M1 20 PK
X12 16 RD/WT
E1 18 TN
E2 20 OR
7 C1
6 C1
RADIO
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
1
14
HEADLAMP SWITCH
4 INTERIOR LIGHTS DIMMER
5 PARADE
6 DOME
7 CARGO
(8W-44-2)
4
5
6
7
8
L107 20 WT
13
JOINT CONNECTOR NO. 4
(8W-12-11)
15
L107 20 WT
4 C1
5 C1
RADIO
HEADLAMP SWITCH OUTPUT
PANEL LAMPS FEED
GROUND
Z9 16 BK
G207
(8W-15-8)

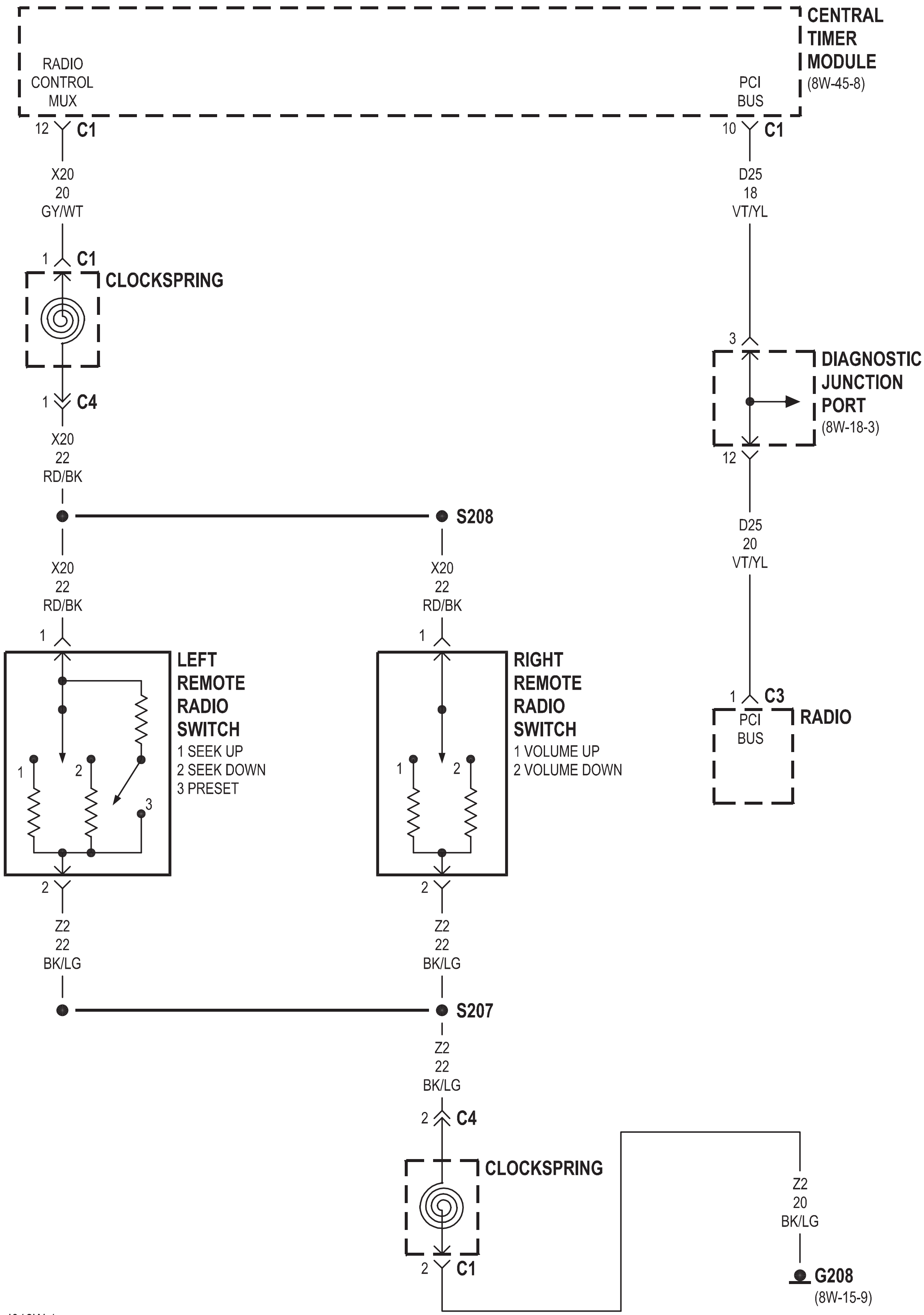

RADIO
AMPLIFIED LEFT DOOR SPEAKER (+)
AMPLIFIED LEFT DOOR SPEAKER (-)
AMPLIFIED RIGHT DOOR SPEAKER (+)
AMPLIFIED RIGHT DOOR SPEAKER (-)
AMPLIFIED LEFT REAR SPEAKER (+)
AMPLIFIED LEFT REAR SPEAKER (-)
AMPLIFIED RIGHT REAR SPEAKER (+)
AMPLIFIED RIGHT REAR SPEAKER (-)
4 C2
2 C1
5 C2
3 C1
2 C2
6 C2
3 C2
7 C2
X87 18 LG/VT
X85 18 LG/DG
X82 18 LB/VT
X80 18 LB/BK
X93 18 WT/RD
X91 18 WT/BK
X94 18 TN/VT
X92 18 TN/BK
C246
1 2 3 4 5 6 9 10
4 5 C363
4 5 C362
S330
S331
S332
S333
LEFT FRONT DOOR SPEAKER
RIGHT FRONT DOOR SPEAKER
LEFT REAR SPEAKER
RIGHT REAR SPEAKER

BASE 4 DOOR

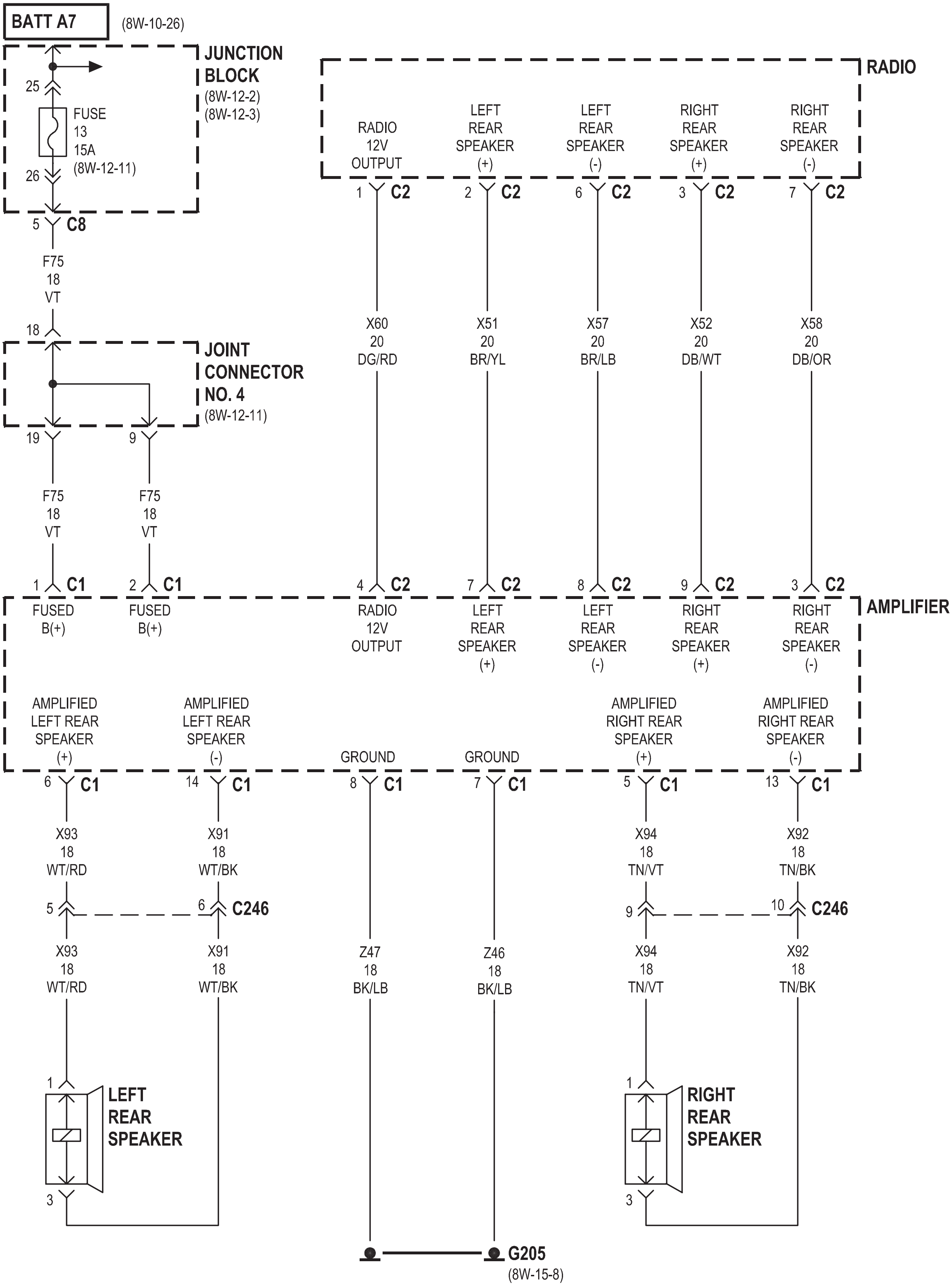

RADIO
AMPLIFIER LEFT DOOR SPEAKER (+)
AMPLIFIER LEFT DOOR SPEAKER (-)
AMPLIFIER RIGHT DOOR SPEAKER (+)
AMPLIFIER RIGHT DOOR SPEAKER (-)
AMPLIFIER LEFT REAR SPEAKER (+)
AMPLIFIER LEFT REAR SPEAKER (-)
AMPLIFIER RIGHT REAR SPEAKER (+)
AMPLIFIER RIGHT REAR SPEAKER (-)
4 C2
2 C1
5 C2
3 C1
2 C2
6 C2
3 C2
7 C2
X87 18 LG/VT
X85 18 LG/DG
X82 18 LB/VT
X80 18 LB/BK
X93 18 WT/RD
X91 18 WT/BK
X94 18 TN/VT
X92 18 TN/BK
1 2 3 4 5 6 9 10 C246
4 5 C363
4 5 C362
8 9 C365
8 9 C366
S330
S331
S332
S333
1
3
LEFT FRONT DOOR SPEAKER
1
3
RIGHT FRONT DOOR SPEAKER
3
1
LEFT REAR SPEAKER
3
1
RIGHT REAR SPEAKER

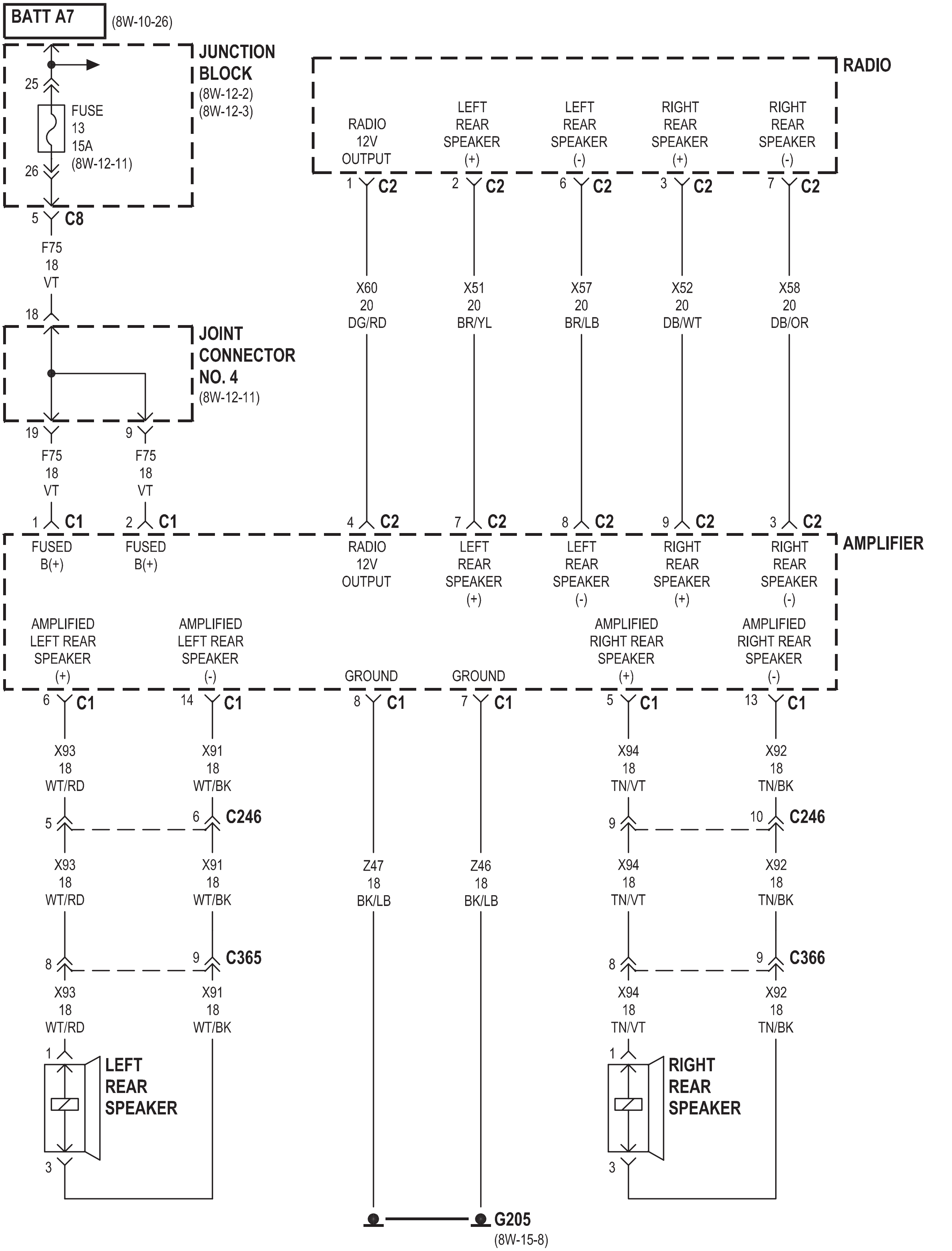
MID-LEVEL/PREMIUM



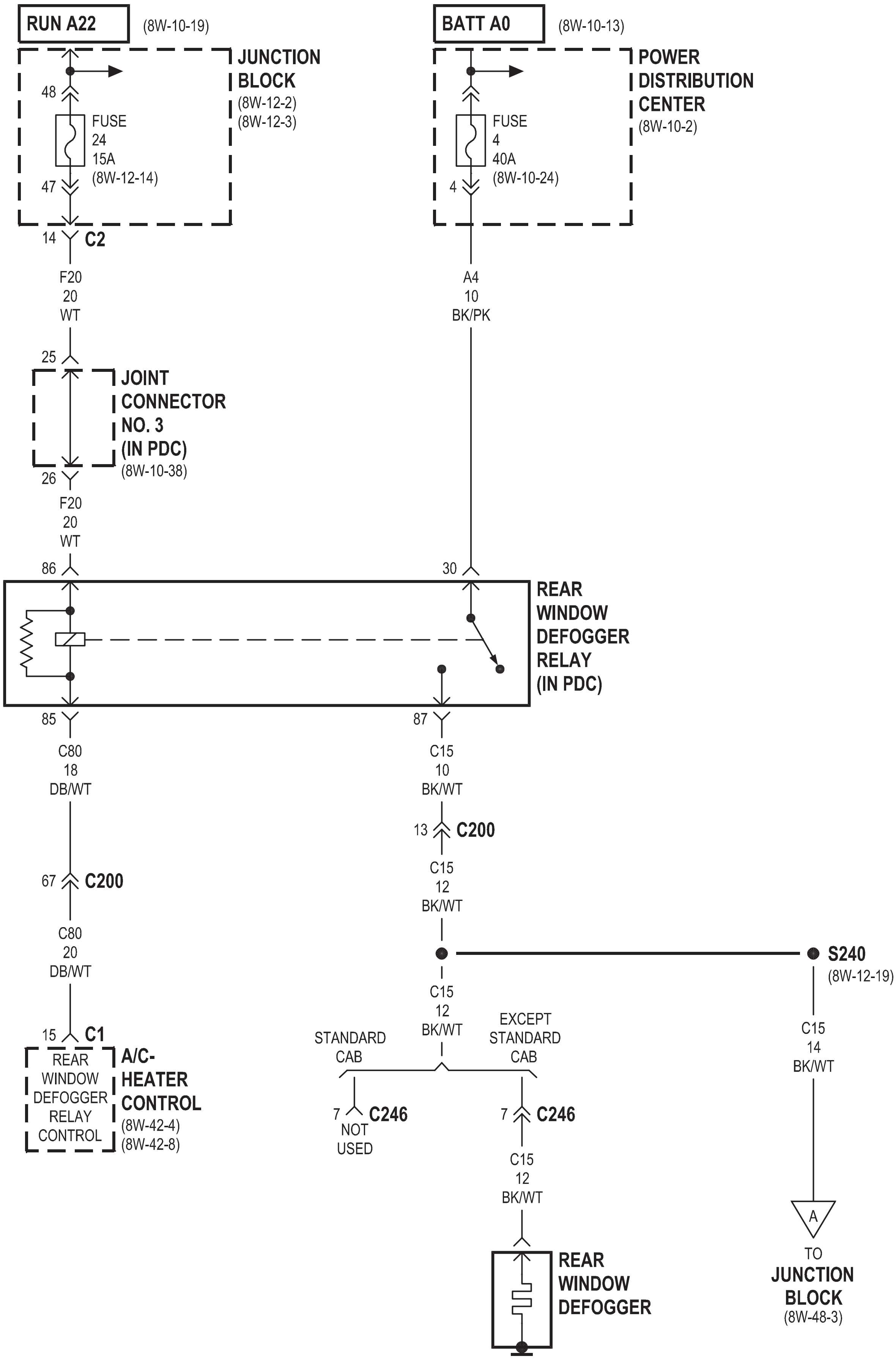

CENTRAL
TIMER
MODULE
(8W-45-8)
RADIO
CONTROL
MUX
PCI
BUS
12 C1
10 C1
X20
20
GY/WT
D25
18
VT/YL
1 C1
CLOCKSPRING
1 C4
X20
22
RD/BK
3
DIAGNOSTIC
JUNCTION
PORT
(8W-18-3)
12
D25
20
VT/YL
S208
X20
22
RD/BK
X20
22
RD/BK
1
1
LEFT
REMOTE
RADIO
SWITCH
1 SEEK UP
2 SEEK DOWN
3 PRESET
RIGHT
REMOTE
RADIO
SWITCH
1 VOLUME UP
2 VOLUME DOWN
1 C3
PCI
BUS
RADIO
2
2
Z2
22
BK/LG
Z2
22
BK/LG
S207
Z2
22
BK/LG
2 C4
CLOCKSPRING
2 C1
Z2
20
BK/LG
G208
(8W-15-9)

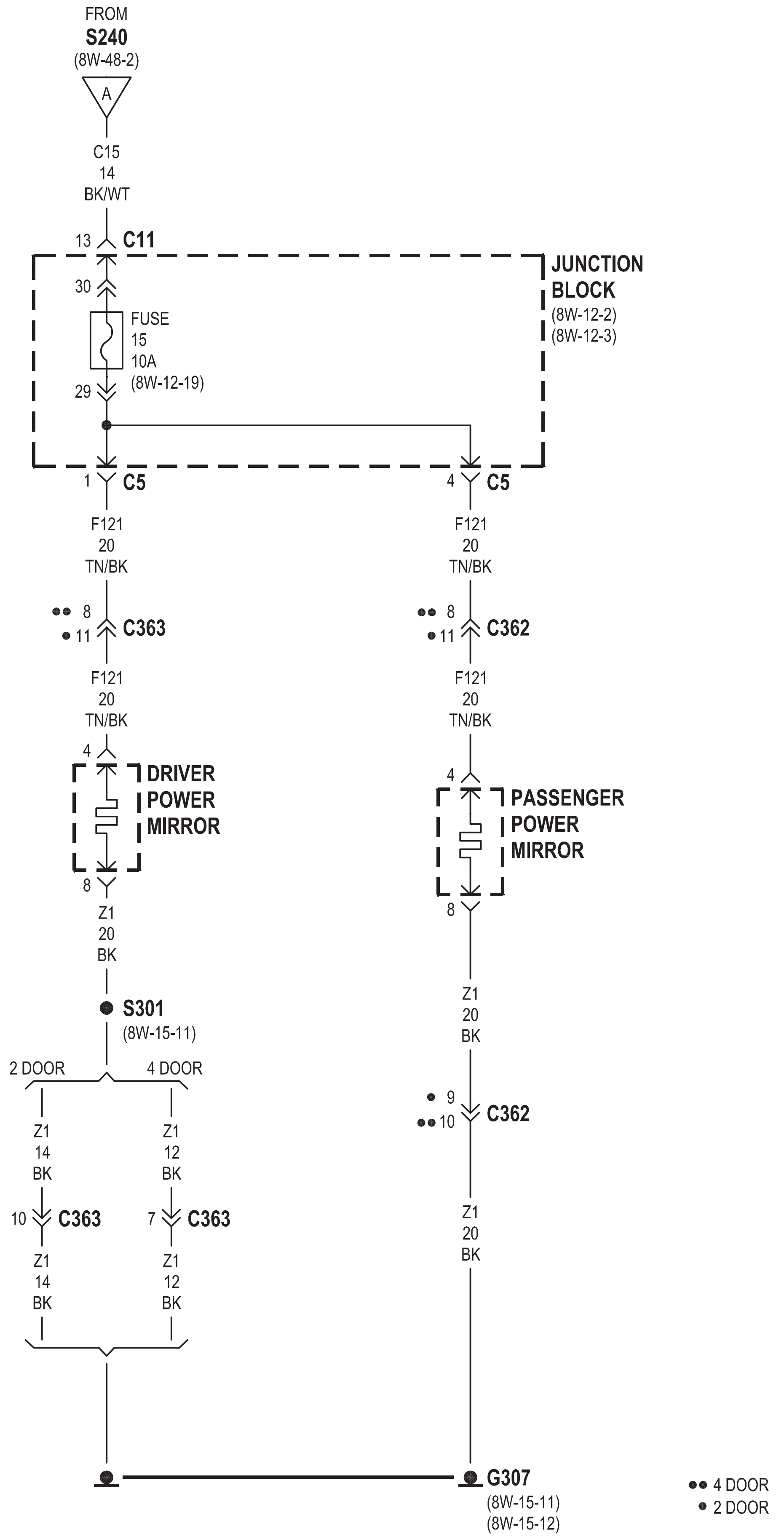
MID-LEVEL/PREMIUM 2 DOOR



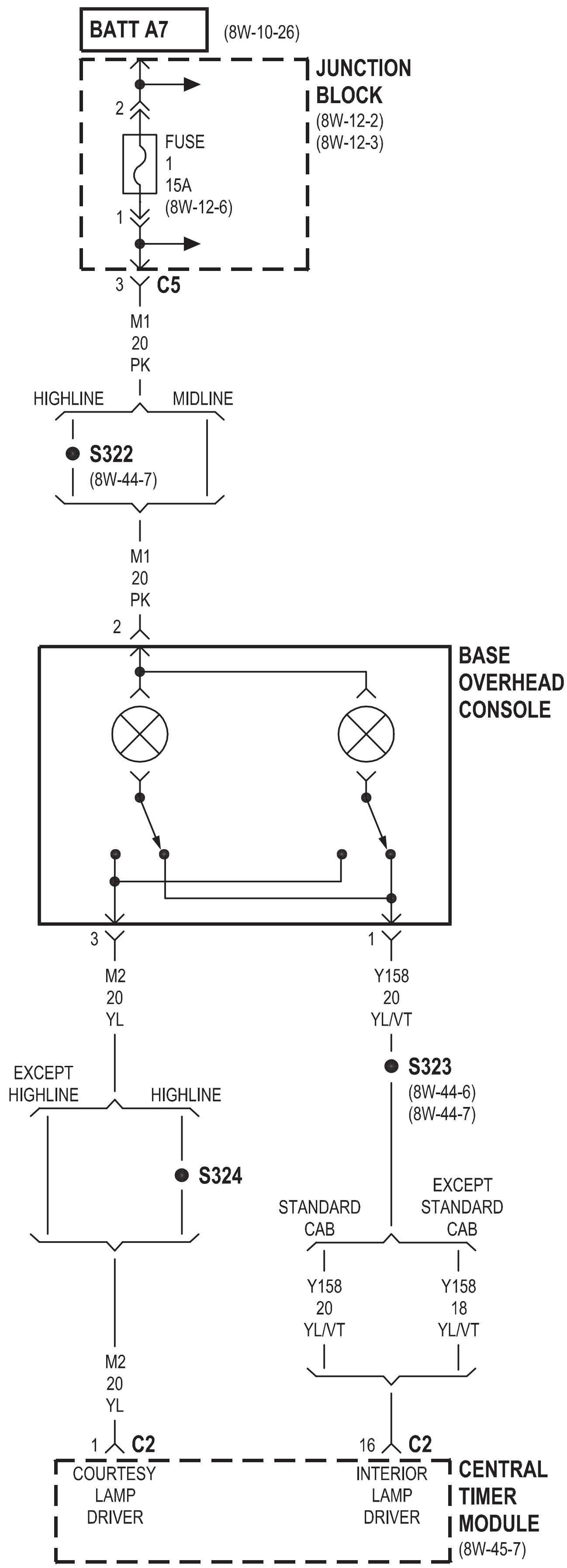

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
25
FUSE 13 15A (8W-12-11)
26
5 C8
F75 18 VT
18
JOINT CONNECTOR NO. 4
(8W-12-11)
19
9
F75 18 VT
F75 18 VT
1 C1
2 C1
FUSED B(+)
FUSED B(+)
RADIO
RADIO 12V OUTPUT
LEFT REAR SPEAKER (+)
LEFT REAR SPEAKER (-)
RIGHT REAR SPEAKER (+)
RIGHT REAR SPEAKER (-)
1 C2
2 C2
6 C2
3 C2
7 C2
X60 20 DG/RD
X51 20 BR/YL
X57 20 BR/LB
X52 20 DB/WT
X58 20 DB/OR
4 C2
7 C2
8 C2
9 C2
3 C2
AMPLIFIER
RADIO 12V OUTPUT
LEFT REAR SPEAKER (+)
LEFT REAR SPEAKER (-)
RIGHT REAR SPEAKER (+)
RIGHT REAR SPEAKER (-)
AMPLIFIED LEFT REAR SPEAKER (+)
AMPLIFIED LEFT REAR SPEAKER (-)
GROUND
GROUND
AMPLIFIED RIGHT REAR SPEAKER (+)
AMPLIFIED RIGHT REAR SPEAKER (-)
6 C1
14 C1
8 C1
7 C1
5 C1
13 C1
X93 18 WT/RD
X91 18 WT/BK
X94 18 TN/VT
X92 18 TN/BK
5
6 C246
9
10 C246
X93 18 WT/RD
X91 18 WT/BK
Z47 18 BK/LB
Z46 18 BK/LB
X94 18 TN/VT
X92 18 TN/BK
8
9 C365
8
9 C366
X93 18 WT/RD
X91 18 WT/BK
X94 18 TN/VT
X92 18 TN/BK
1
LEFT REAR SPEAKER
3
1
RIGHT REAR SPEAKER
3
G205
(8W-15-8)

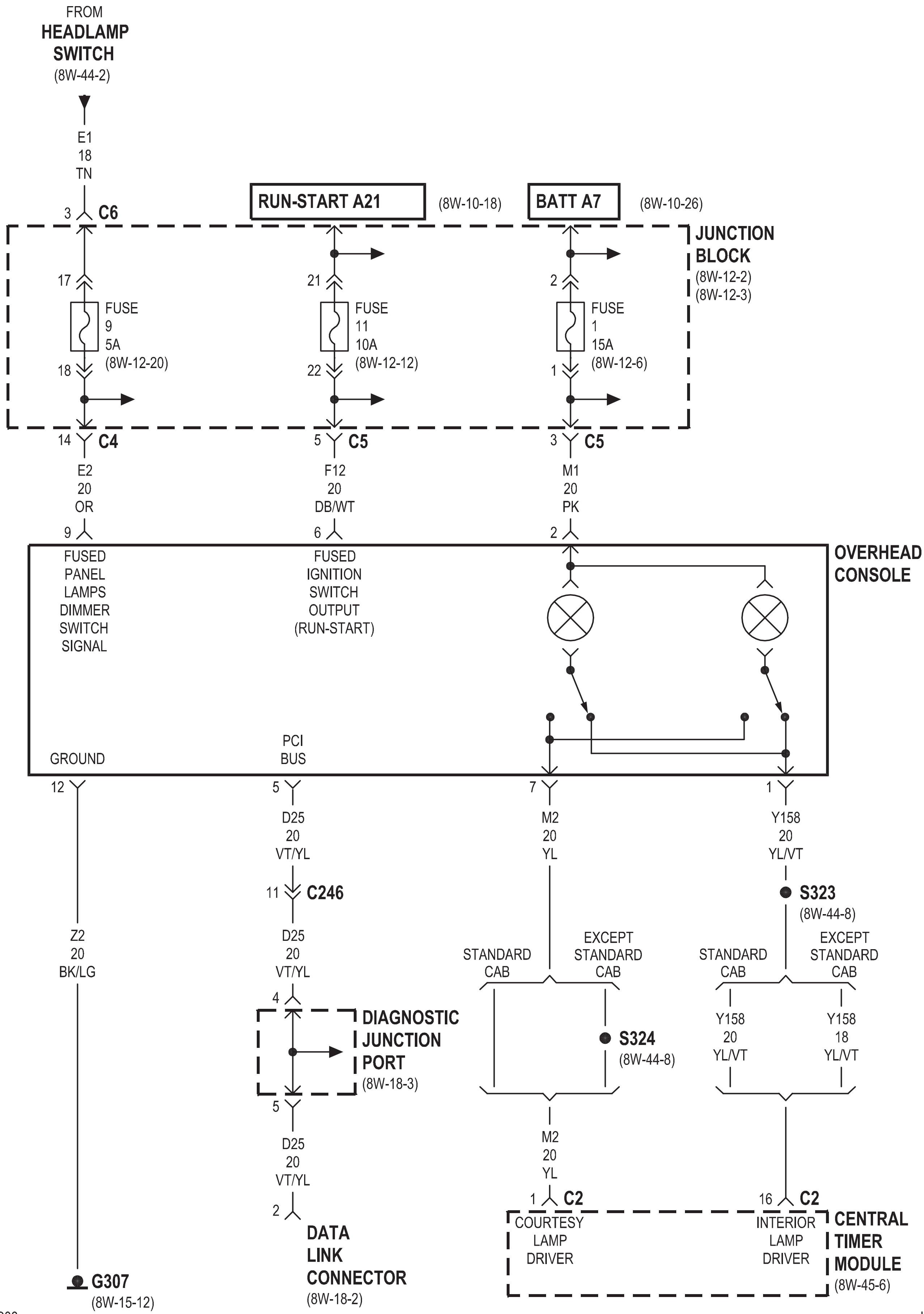
8W-48 REAR WINDOW DEFOGGER


RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
48
FUSE 24 15A (8W-12-14)
47
14 C2
F20 20 WT
25
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-38)
26
F20 20 WT
86
BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 4 40A (8W-10-24)
4
A4 10 BK/PK
30
REAR WINDOW DEFOGGER RELAY (IN PDC)
85
87
C80 18 DB/WT
67 C200
C80 20 DB/WT
15 C1
REAR WINDOW DEFOGGER RELAY CONTROL
A/C-HEATER CONTROL
(8W-42-4)
(8W-42-8)
C15 10 BK/WT
13 C200
C15 12 BK/WT
S240
(8W-12-19)
C15 12 BK/WT
STANDARD CAB
EXCEPT STANDARD CAB
7 C246
NOT USED
7 C246
C15 12 BK/WT
REAR WINDOW DEFOGGER
C15 14 BK/WT
A
TO JUNCTION BLOCK
(8W-48-3)

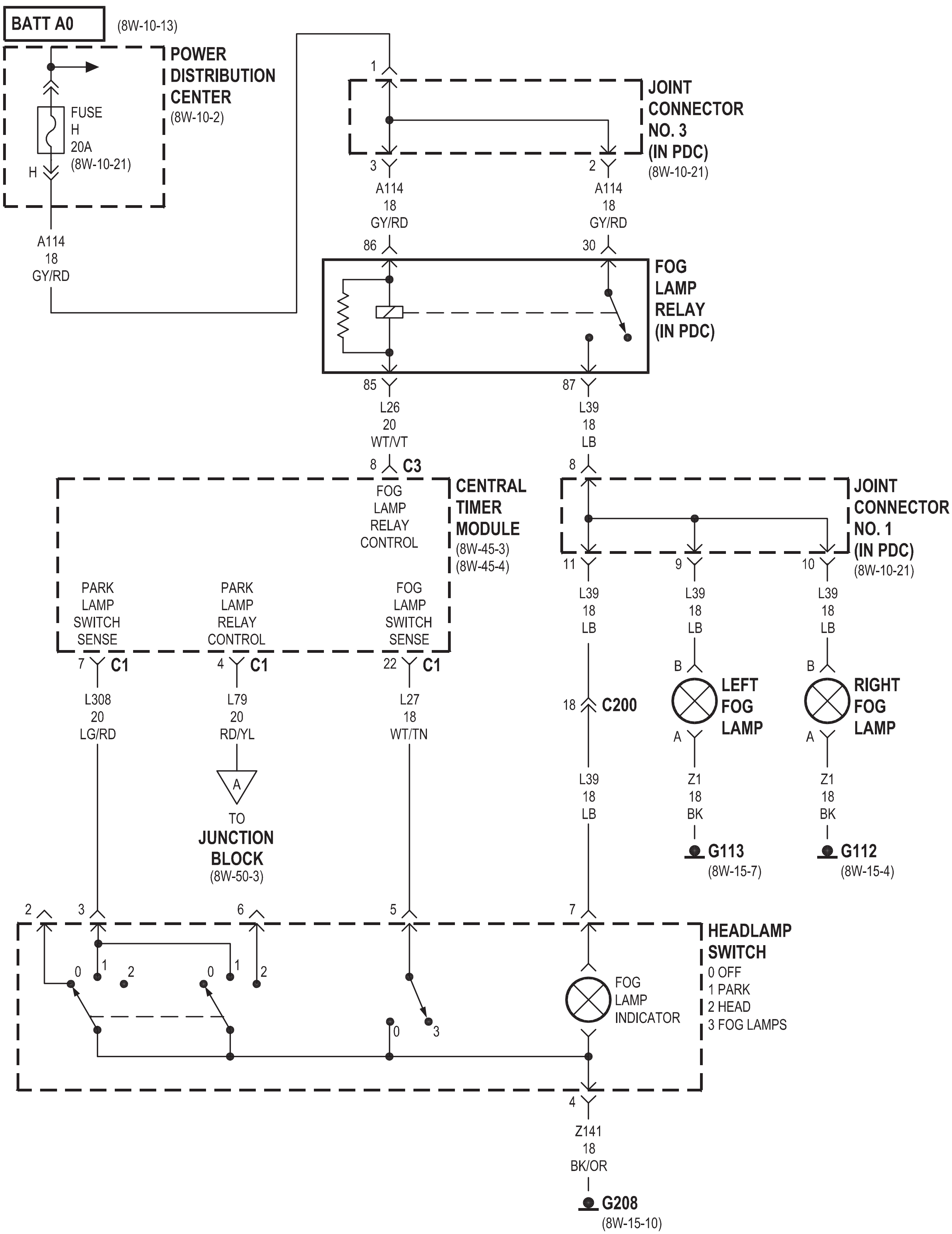

FROM
S240
(8W-48-2)
A
C15
14
BK/WT
13 C11
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
30
FUSE
15
10A
(8W-12-19)
29
1 C5
4 C5
F121
20
TN/BK
F121
20
TN/BK
●● 8
● 11 C363
●● 8
● 11 C362
F121
20
TN/BK
F121
20
TN/BK
4
DRIVER
POWER
MIRROR
8
4
PASSENGER
POWER
MIRROR
8
Z1
20
BK
S301
(8W-15-11)
Z1
20
BK
2 DOOR
4 DOOR
● 9
●● 10 C362
Z1
14
BK
Z1
12
BK
10 C363
7 C363
Z1
20
BK
Z1
14
BK
Z1
12
BK
G307
(8W-15-11)
(8W-15-12)
●● 4 DOOR
● 2 DOOR

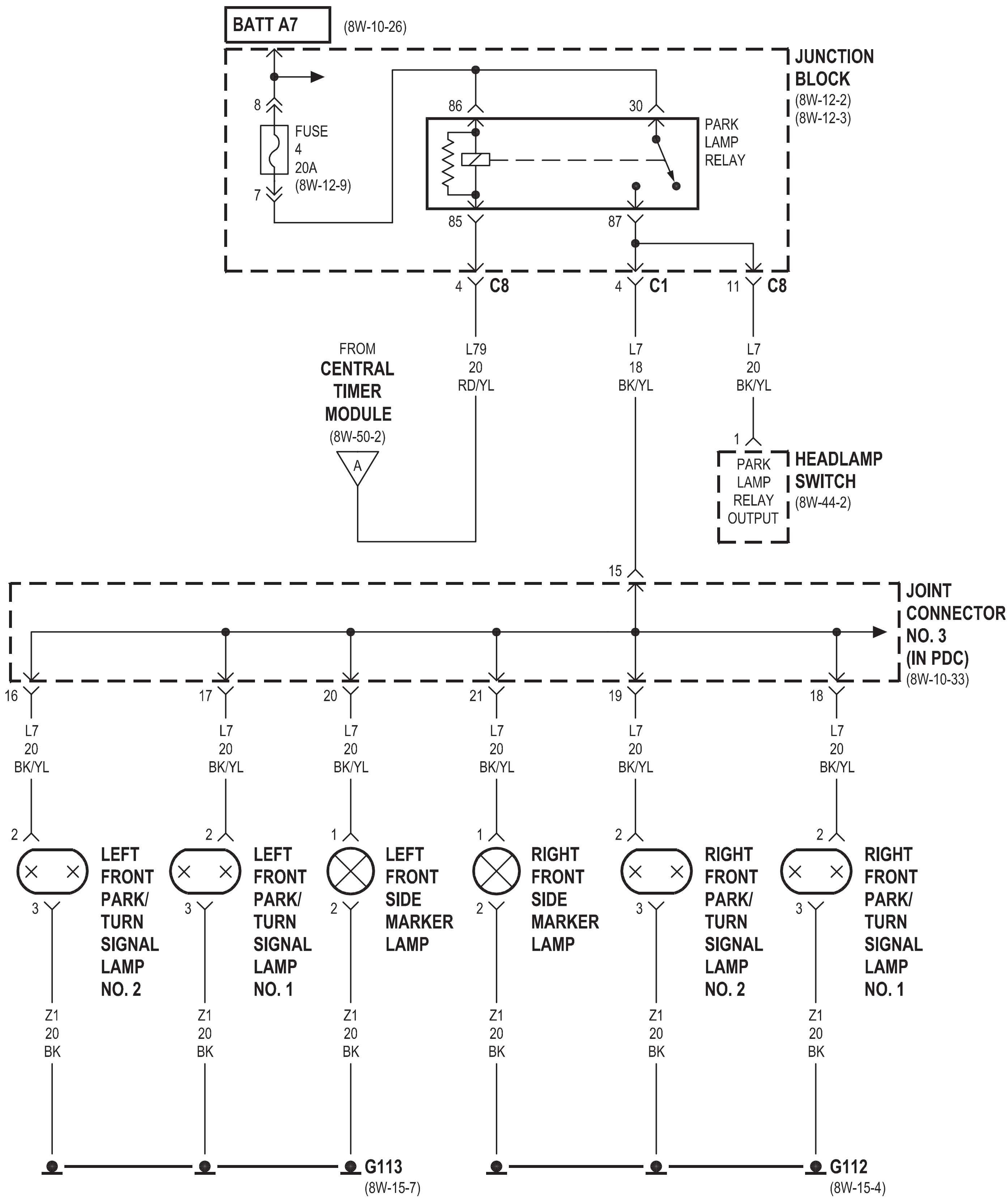
8W-49 OVERHEAD CONSOLE

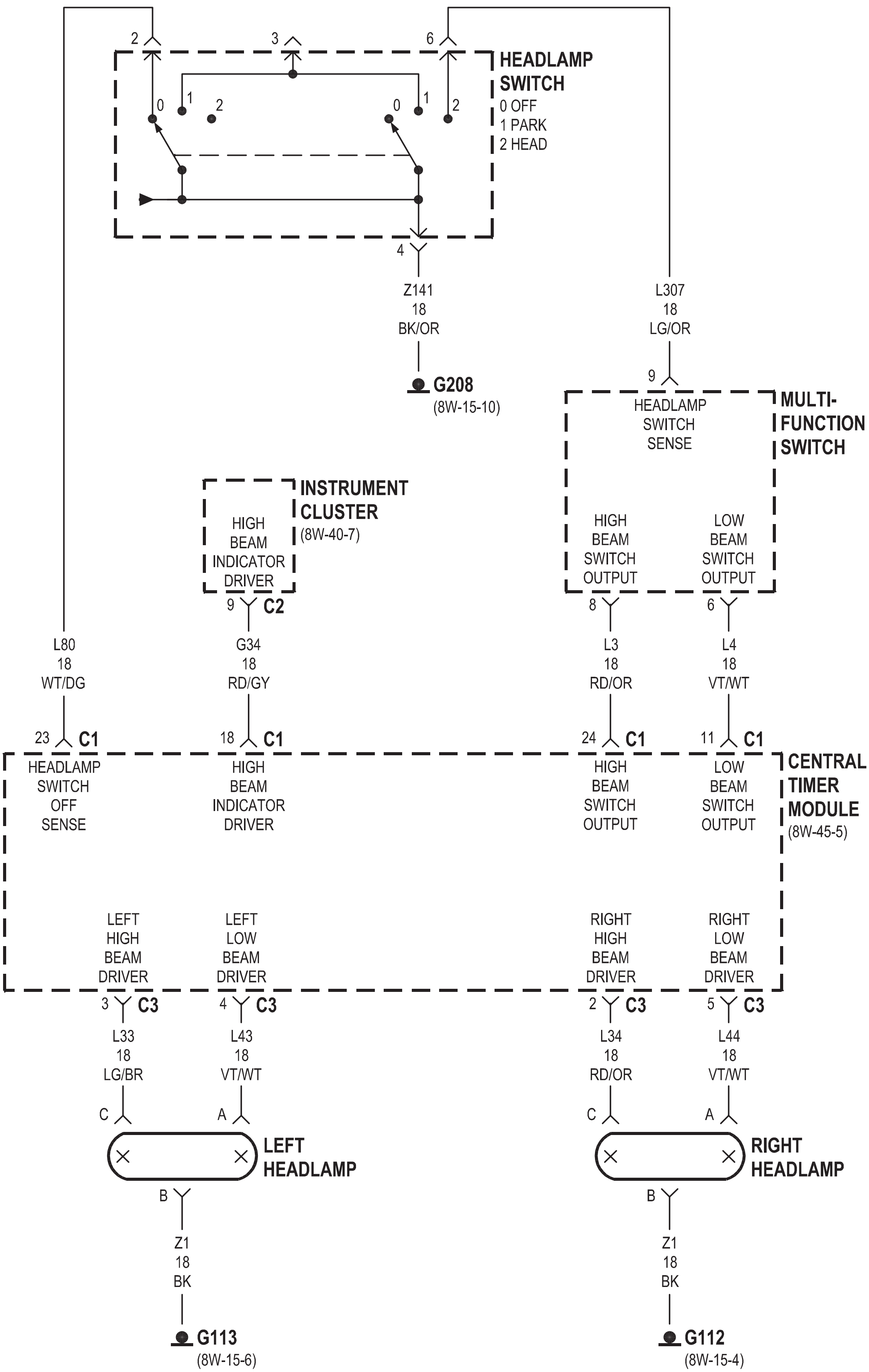

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
2
FUSE
1
15A
(8W-12-6)
1
3
C5
M1
20
PK
HIGHLINE
MIDLINE
S322
(8W-44-7)
M1
20
PK
2
BASE OVERHEAD CONSOLE
3
1
M2
20
YL
Y158
20
YL/VT
S323
(8W-44-6)
(8W-44-7)
EXCEPT HIGHLINE
HIGHLINE
S324
STANDARD CAB
EXCEPT STANDARD CAB
Y158
20
YL/VT
Y158
18
YL/VT
M2
20
YL
1
C2
16
C2
COURTESY LAMP DRIVER
INTERIOR LAMP DRIVER
CENTRAL TIMER MODULE
(8W-45-7)


FROM
HEADLAMP SWITCH
(8W-44-2)
E1
18
TN
3
C6
RUN-START A21
(8W-10-18)
BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
17
FUSE
9
5A
(8W-12-20)
18
21
FUSE
11
10A
(8W-12-12)
22
2
FUSE
1
15A
(8W-12-6)
1
14
C4
5
C5
3
C5
E2
20
OR
F12
20
DB/WT
M1
20
PK
9
6
2
OVERHEAD CONSOLE
FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
FUSED IGNITION SWITCH OUTPUT (RUN-START)
GROUND
PCI BUS
12
5
7
1
D25
20
VT/YL
M2
20
YL
Y158
20
YL/VT
11
C246
S323
(8W-44-8)
Z2
20
BK/LG
STANDARD CAB
EXCEPT STANDARD CAB
S324
(8W-44-8)
Y158
20
YL/VT
Y158
18
YL/VT
4
DIAGNOSTIC JUNCTION PORT
(8W-18-3)
5
2
DATA LINK CONNECTOR
(8W-18-2)
G307
(8W-15-12)
1
C2
16
C2
COURTESY LAMP DRIVER
INTERIOR LAMP DRIVER
CENTRAL TIMER MODULE
(8W-45-6)

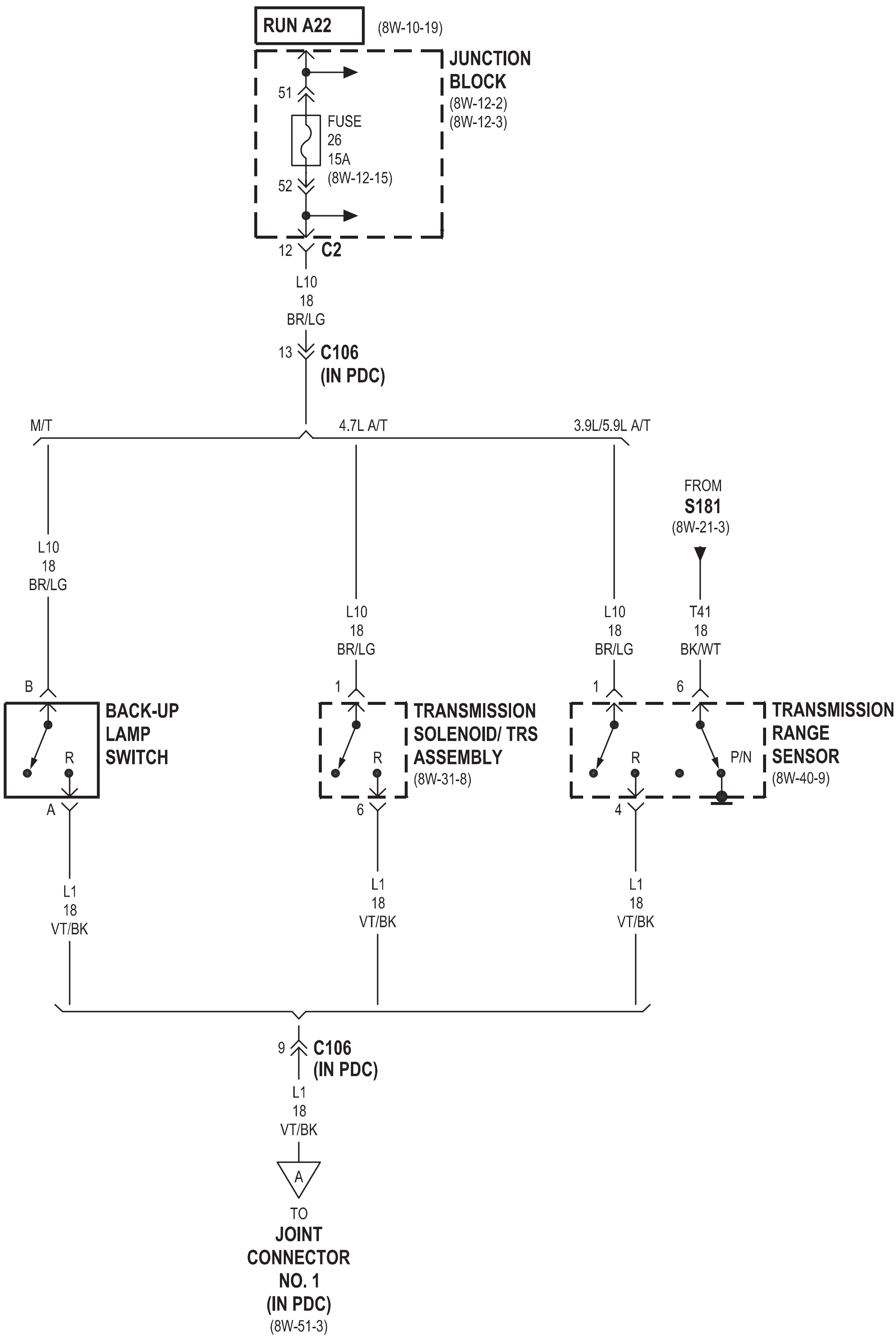
8W-50 FRONT LIGHTING

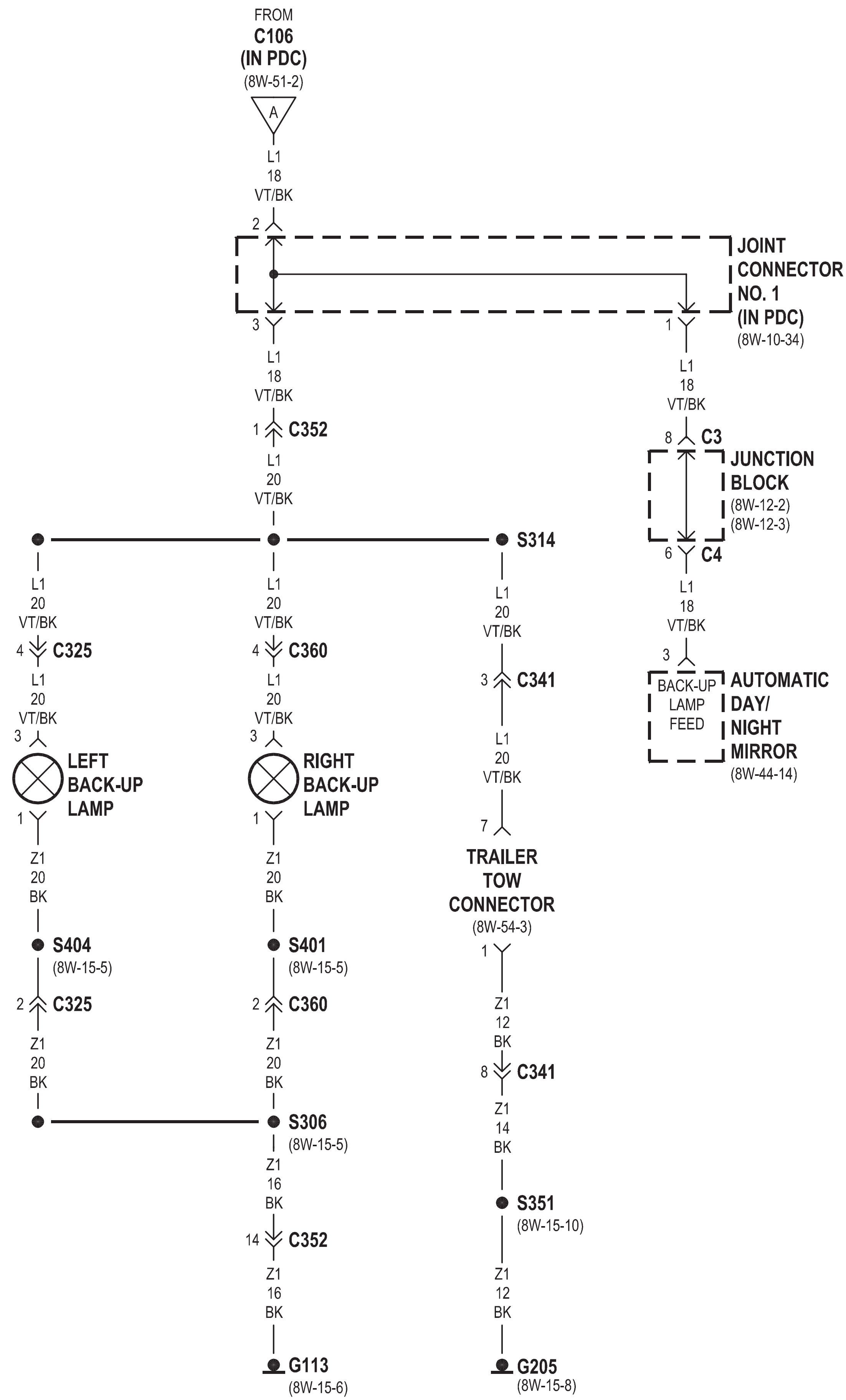

BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
H
20A
(8W-10-21)
H
A114
18
GY/RD
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-21)
1
3
2
A114
18
GY/RD
A114
18
GY/RD
86
30
FOG LAMP RELAY (IN PDC)
85
87
L26
20
WT/VT
L39
18
LB
8 C3
8
CENTRAL TIMER MODULE
(8W-45-3)
(8W-45-4)
FOG LAMP RELAY CONTROL
PARK LAMP SWITCH SENSE
PARK LAMP RELAY CONTROL
FOG LAMP SWITCH SENSE
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-21)
11
9
10
L39
18
LB
L39
18
LB
L39
18
LB
7 C1
4 C1
22 C1
L308
20
LG/RD
L79
20
RD/YL
L27
18
WT/TN
A
TO JUNCTION BLOCK
(8W-50-3)
18 C200
L39
18
LB
B
A
LEFT FOG LAMP
B
A
RIGHT FOG LAMP
Z1
18
BK
Z1
18
BK
G113
(8W-15-7)
G112
(8W-15-4)
2
3
6
5
7
HEADLAMP SWITCH
0 OFF
1 PARK
2 HEAD
3 FOG LAMPS
0
1
2
0
1
2
0
3
FOG LAMP INDICATOR
4
Z141
18
BK/OR
G208
(8W-15-10)

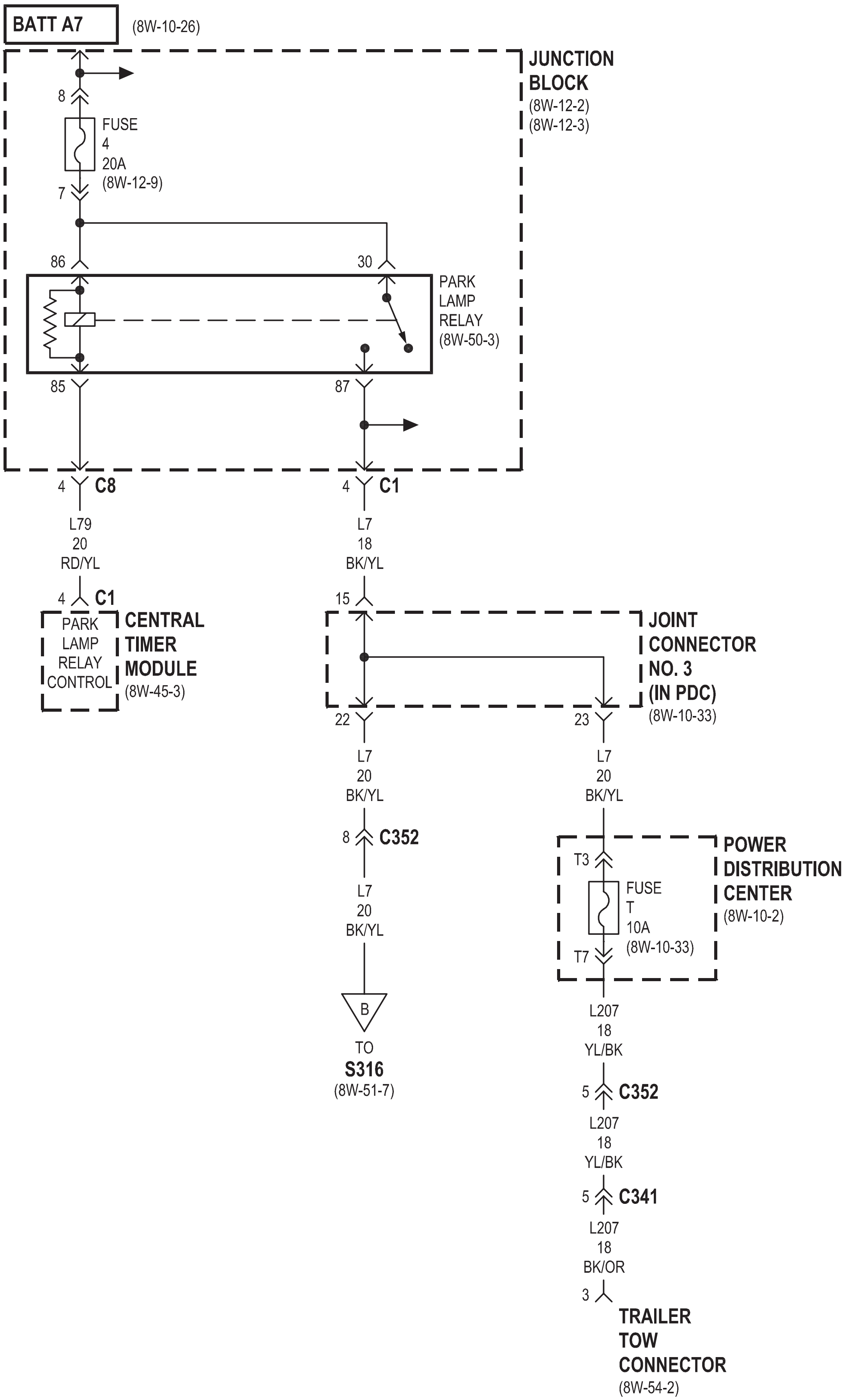

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
8
FUSE
4
20A
(8W-12-9)
7
86
30
PARK LAMP RELAY
85
87
4 C8
4 C1
11 C8
FROM CENTRAL TIMER MODULE
(8W-50-2)
A
L79
20
RD/YL
L7
18
BK/YL
L7
20
BK/YL
1
PARK LAMP RELAY OUTPUT
HEADLAMP SWITCH
(8W-44-2)
15
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-33)
16
17
20
21
19
18
L7
20
BK/YL
2
1
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 2
LEFT FRONT PARK/ TURN SIGNAL LAMP NO. 1
LEFT FRONT SIDE MARKER LAMP
RIGHT FRONT SIDE MARKER LAMP
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 2
RIGHT FRONT PARK/ TURN SIGNAL LAMP NO. 1
3
Z1
20
BK
G113
(8W-15-7)
G112
(8W-15-4)

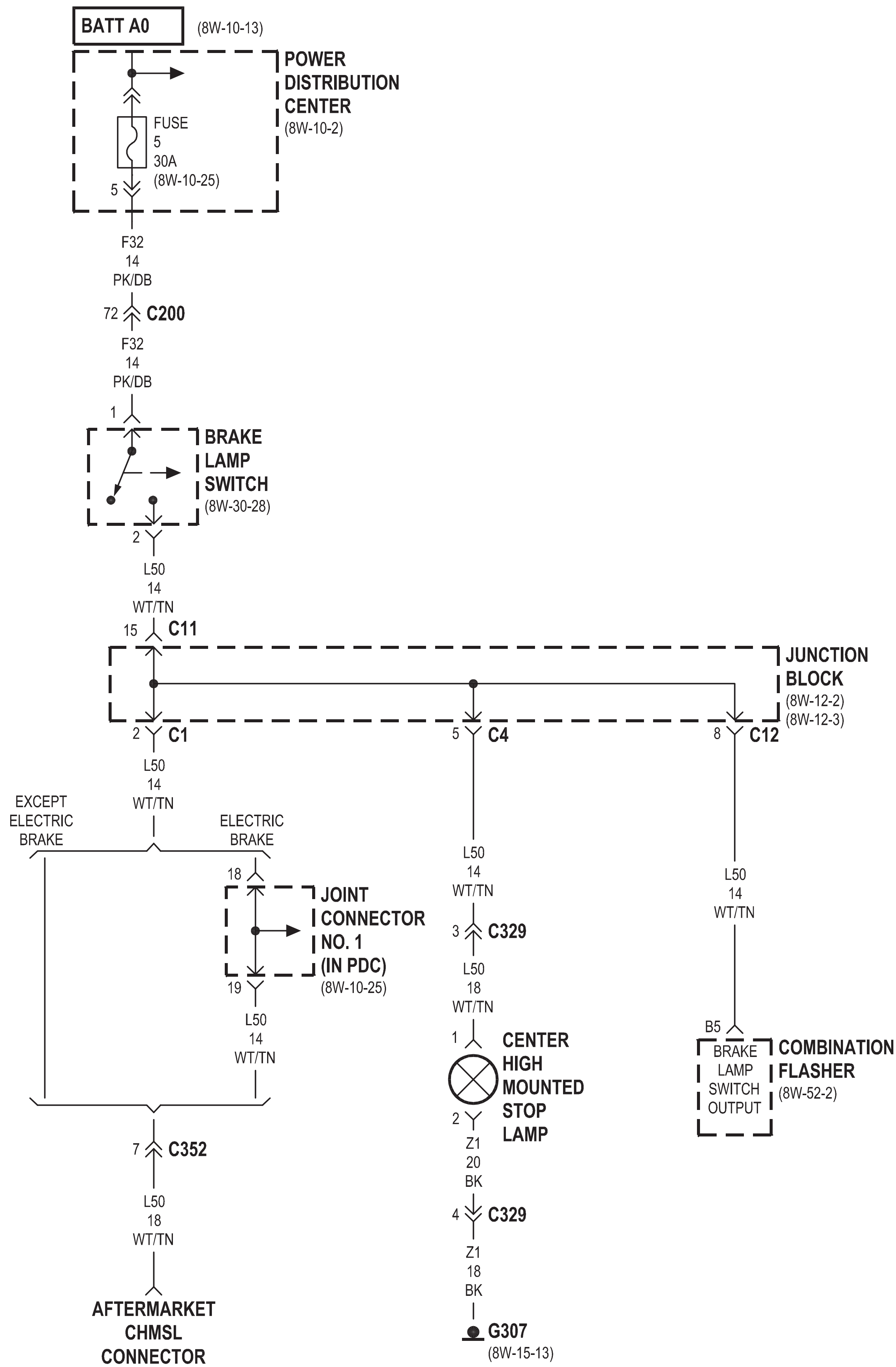

HEADLAMP SWITCH
0 OFF
1 PARK
2 HEAD
Z141
18
BK/OR
G208
(8W-15-10)
L307
18
LG/OR
HEADLAMP SWITCH SENSE
MULTI-FUNCTION SWITCH
HIGH BEAM SWITCH OUTPUT
LOW BEAM SWITCH OUTPUT
INSTRUMENT CLUSTER
(8W-40-7)
HIGH BEAM INDICATOR DRIVER
C2
L80
18
WT/DG
G34
18
RD/GY
L3
18
RD/OR
L4
18
VT/WT
C1
HEADLAMP SWITCH OFF SENSE
HIGH BEAM INDICATOR DRIVER
HIGH BEAM SWITCH OUTPUT
LOW BEAM SWITCH OUTPUT
CENTRAL TIMER MODULE
(8W-45-5)
LEFT HIGH BEAM DRIVER
LEFT LOW BEAM DRIVER
RIGHT HIGH BEAM DRIVER
RIGHT LOW BEAM DRIVER
C3
L33
18
LG/BR
L43
18
VT/WT
L34
18
RD/OR
L44
18
VT/WT
LEFT HEADLAMP
RIGHT HEADLAMP
Z1
18
BK
G113
(8W-15-6)
G112
(8W-15-4)

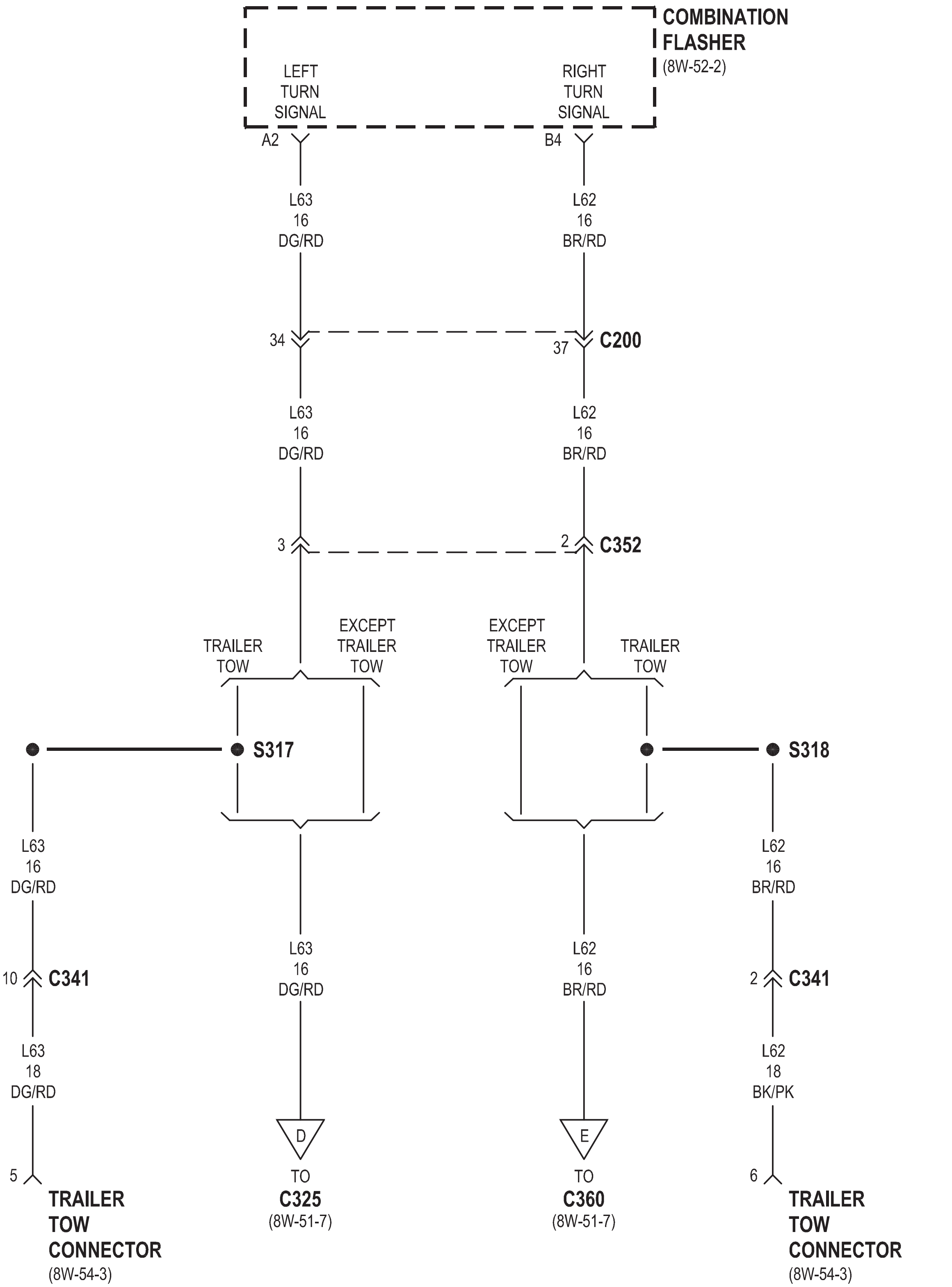
8W-51 REAR LIGHTING

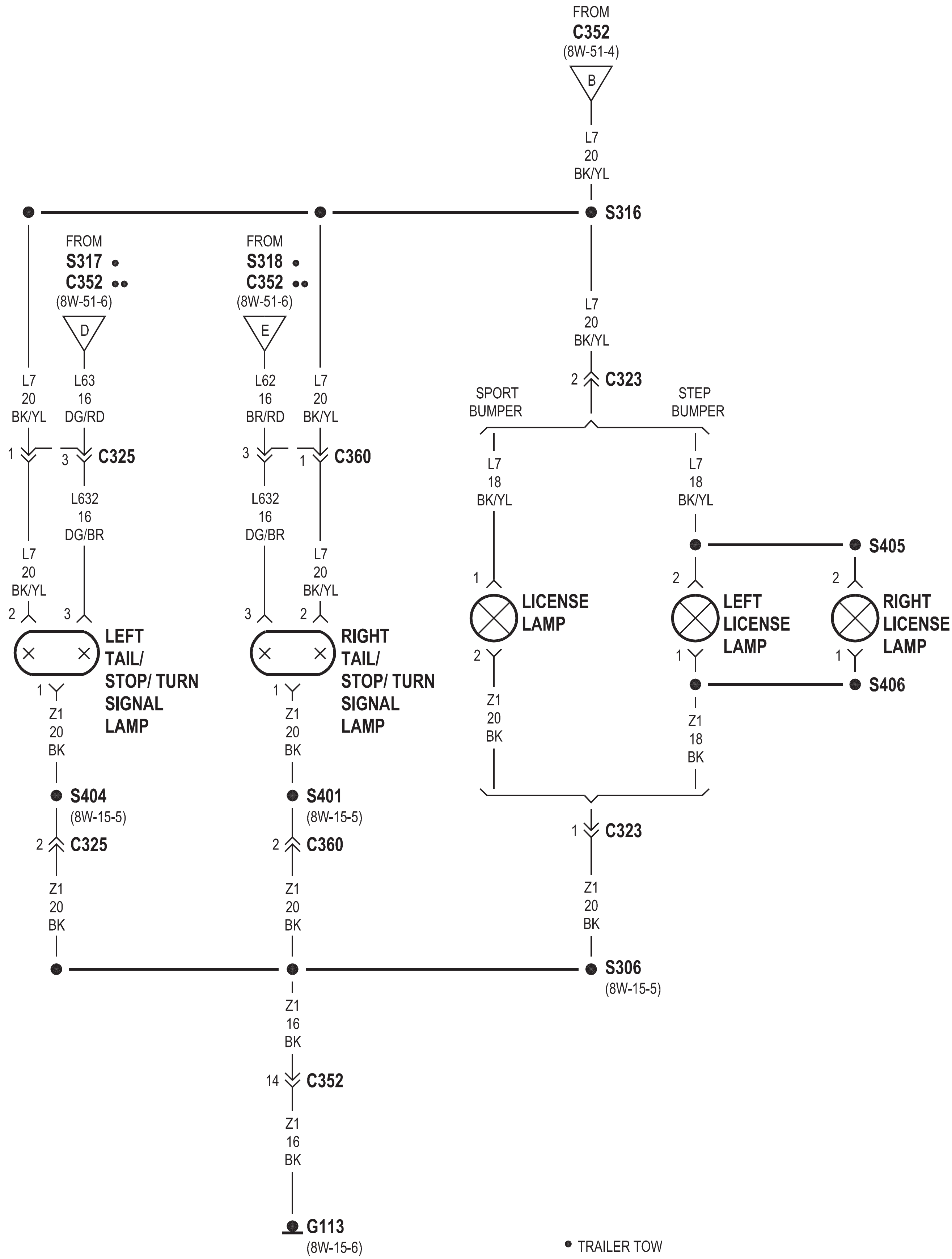

RUN A22
(8W-10-19)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
51
FUSE
26
15A
(8W-12-15)
52
12
C2
L10
18
BR/LG
13
C106
(IN PDC)
M/T
4.7L A/T
3.9L/5.9L A/T
FROM
S181
(8W-21-3)
L10
18
BR/LG
L10
18
BR/LG
L10
18
BR/LG
T41
18
BK/WT
B
1
1
6
BACK-UP
LAMP
SWITCH
R
TRANSMISSION
SOLENOID/ TRS
ASSEMBLY
(8W-31-8)
R
R
P/N
TRANSMISSION
RANGE
SENSOR
(8W-40-9)
A
6
4
L1
18
VT/BK
L1
18
VT/BK
L1
18
VT/BK
9
C106
(IN PDC)
L1
18
VT/BK
A
TO
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-51-3)


FROM
C106
(IN PDC)
(8W-51-2)
A
L1
18
VT/BK
JOINT
CONNECTOR
NO. 1
(IN PDC)
(8W-10-34)
C352
C3
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
C4
S314
C325
C360
C341
BACK-UP
LAMP
FEED
AUTOMATIC
DAY/
NIGHT
MIRROR
(8W-44-14)
LEFT
BACK-UP
LAMP
RIGHT
BACK-UP
LAMP
TRAILER
TOW
CONNECTOR
(8W-54-3)
Z1
20
BK
S404
(8W-15-5)
S401
(8W-15-5)
S306
(8W-15-5)
S351
(8W-15-10)
G113
(8W-15-6)
G205
(8W-15-8)


BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
8
FUSE
4
20A
(8W-12-9)
7
86
30
PARK LAMP RELAY
(8W-50-3)
85
87
4 C8
4 C1
L79
20
RD/YL
L7
18
BK/YL
4 C1
PARK LAMP RELAY CONTROL
CENTRAL TIMER MODULE
(8W-45-3)
15
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-33)
22
23
L7
20
BK/YL
L7
20
BK/YL
8 C352
L7
20
BK/YL
B
TO
S316
(8W-51-7)
POWER DISTRIBUTION CENTER
(8W-10-2)
T3
FUSE
T
10A
(8W-10-33)
T7
L207
18
YL/BK
5 C352
L207
18
YL/BK
5 C341
L207
18
BK/OR
3
TRAILER TOW CONNECTOR
(8W-54-2)

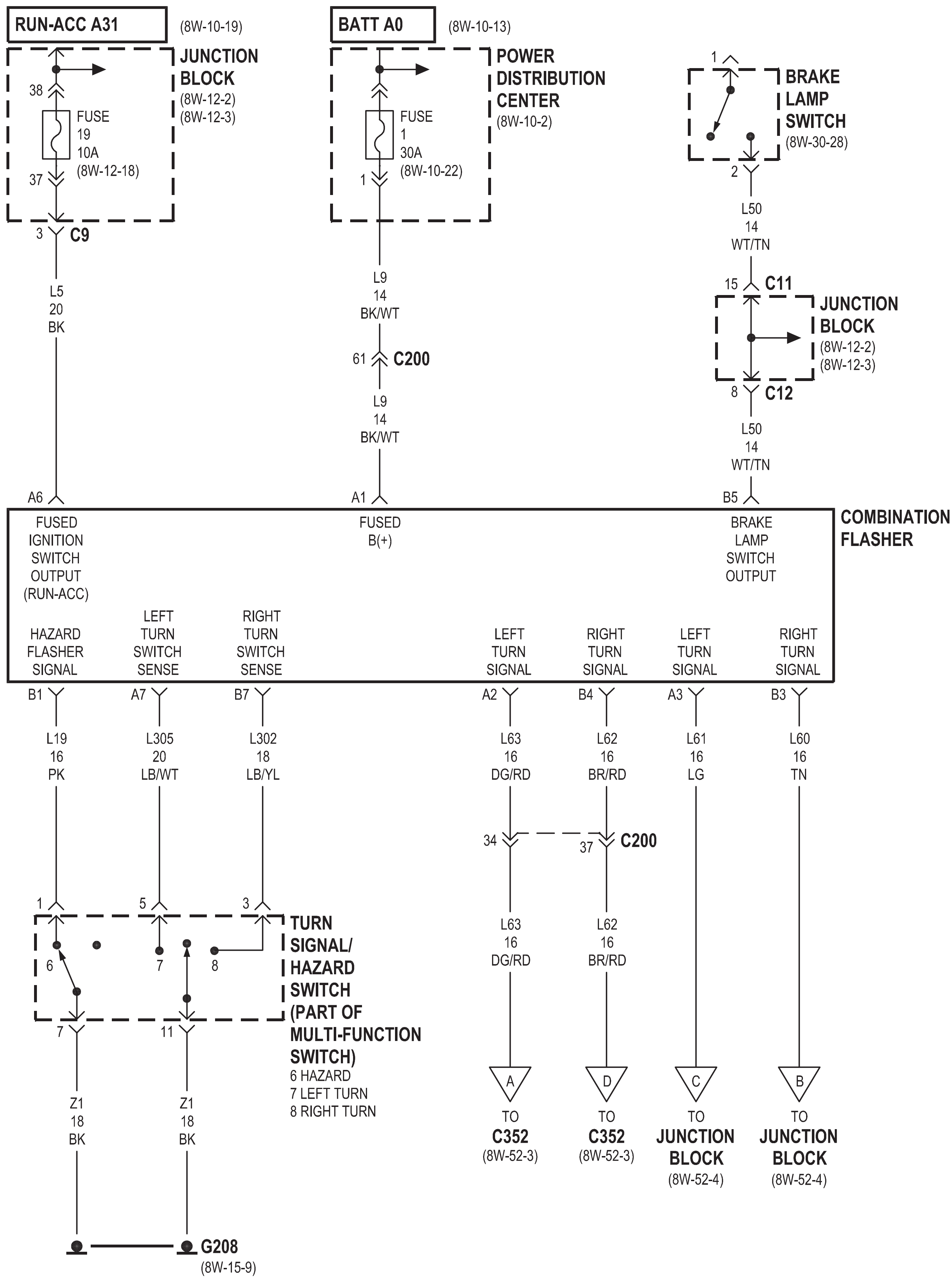

BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
5
30A
(8W-10-25)
5
F32
14
PK/DB
72
C200
F32
14
PK/DB
1
BRAKE LAMP SWITCH
(8W-30-28)
2
L50
14
WT/TN
15
C11
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
2
C1
5
C4
8
C12
L50
14
WT/TN
EXCEPT ELECTRIC BRAKE
ELECTRIC BRAKE
18
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-25)
19
L50
14
WT/TN
7
C352
L50
18
WT/TN
AFTERMARKET CHMSL CONNECTOR
L50
14
WT/TN
3
C329
L50
18
WT/TN
1
CENTER HIGH MOUNTED STOP LAMP
2
Z1
20
BK
4
C329
Z1
18
BK
G307
(8W-15-13)
L50
14
WT/TN
B5
BRAKE LAMP SWITCH OUTPUT
COMBINATION FLASHER
(8W-52-2)

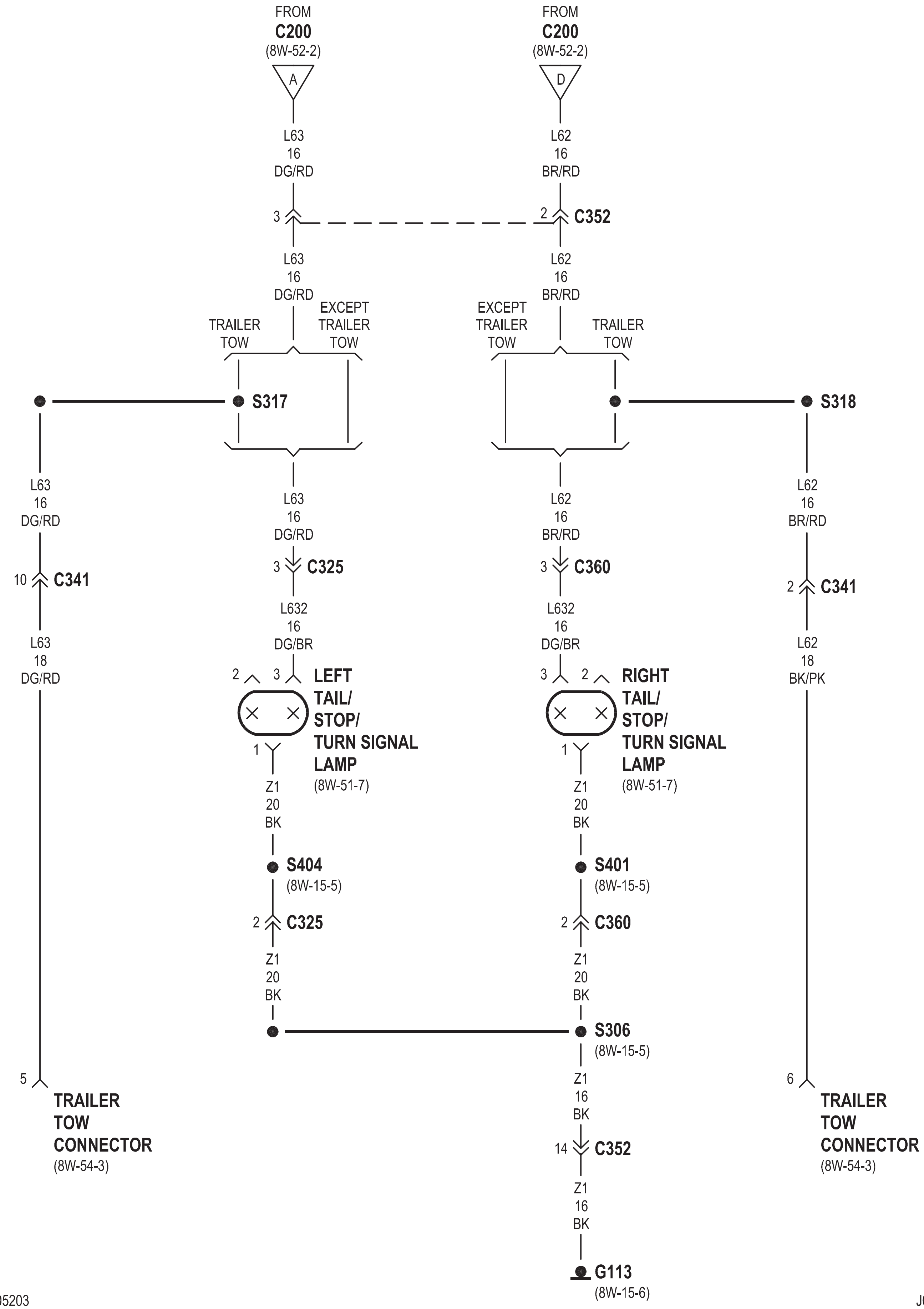

COMBINATION
FLASHER
(8W-52-2)
LEFT
TURN
SIGNAL
RIGHT
TURN
SIGNAL
A2
B4
L63
16
DG/RD
L62
16
BR/RD
34
37
C200
L63
16
DG/RD
L62
16
BR/RD
3
2
C352
TRAILER
TOW
EXCEPT
TRAILER
TOW
EXCEPT
TRAILER
TOW
TRAILER
TOW
S317
S318
L63
16
DG/RD
10
C341
L63
18
DG/RD
5
TRAILER
TOW
CONNECTOR
(8W-54-3)
L63
16
DG/RD
D
TO
C325
(8W-51-7)
L62
16
BR/RD
E
TO
C360
(8W-51-7)
L62
16
BR/RD
2
C341
L62
18
BK/PK
6
TRAILER
TOW
CONNECTOR
(8W-54-3)

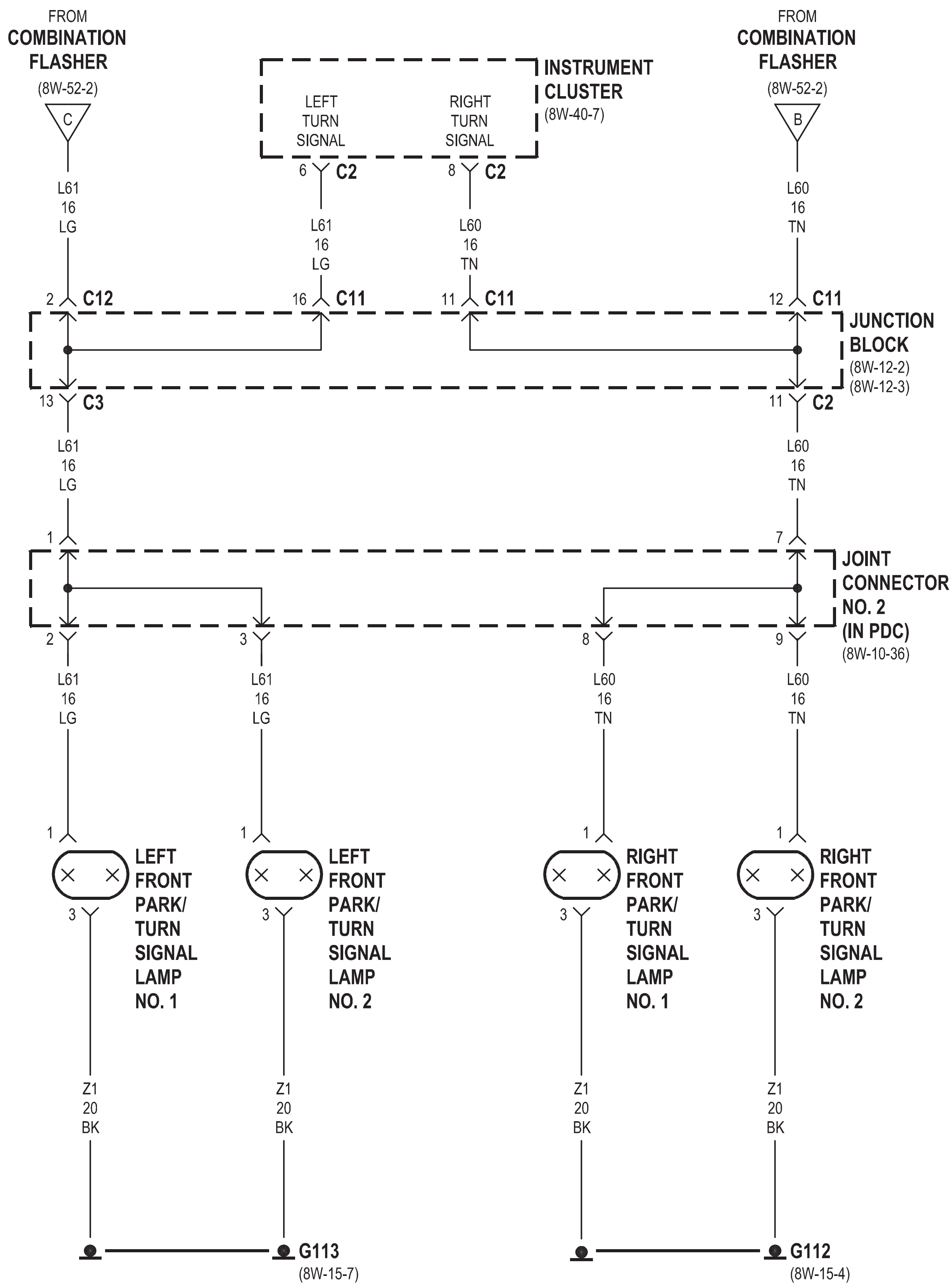


FROM
C352
(8W-51-4)
B
L7
20
BK/YL
S316
FROM
S317 •
C352 ••
(8W-51-6)
D
FROM
S318 •
C352 ••
(8W-51-6)
E
L7
20
BK/YL
L63
16
DG/RD
L62
16
BR/RD
L7
20
BK/YL
2 C323
SPORT
BUMPER
STEP
BUMPER
1
3 C325
3
1 C360
L632
16
DG/BR
L632
16
DG/BR
L7
18
BK/YL
L7
18
BK/YL
S405
L7
20
BK/YL
L7
20
BK/YL
2
3
3
2
1
LICENSE
LAMP
2
LEFT
LICENSE
LAMP
2
RIGHT
LICENSE
LAMP
LEFT
TAIL/
STOP/ TURN
SIGNAL
LAMP
RIGHT
TAIL/
STOP/ TURN
SIGNAL
LAMP
2
1
1
S406
1
1
Z1
20
BK
Z1
20
BK
Z1
20
BK
Z1
18
BK
S404
(8W-15-5)
S401
(8W-15-5)
2 C325
2 C360
1 C323
Z1
20
BK
Z1
20
BK
Z1
20
BK
S306
(8W-15-5)
Z1
16
BK
14 C352
Z1
16
BK
G113
(8W-15-6)
• TRAILER TOW
•• EXCEPT TRAILER TOW

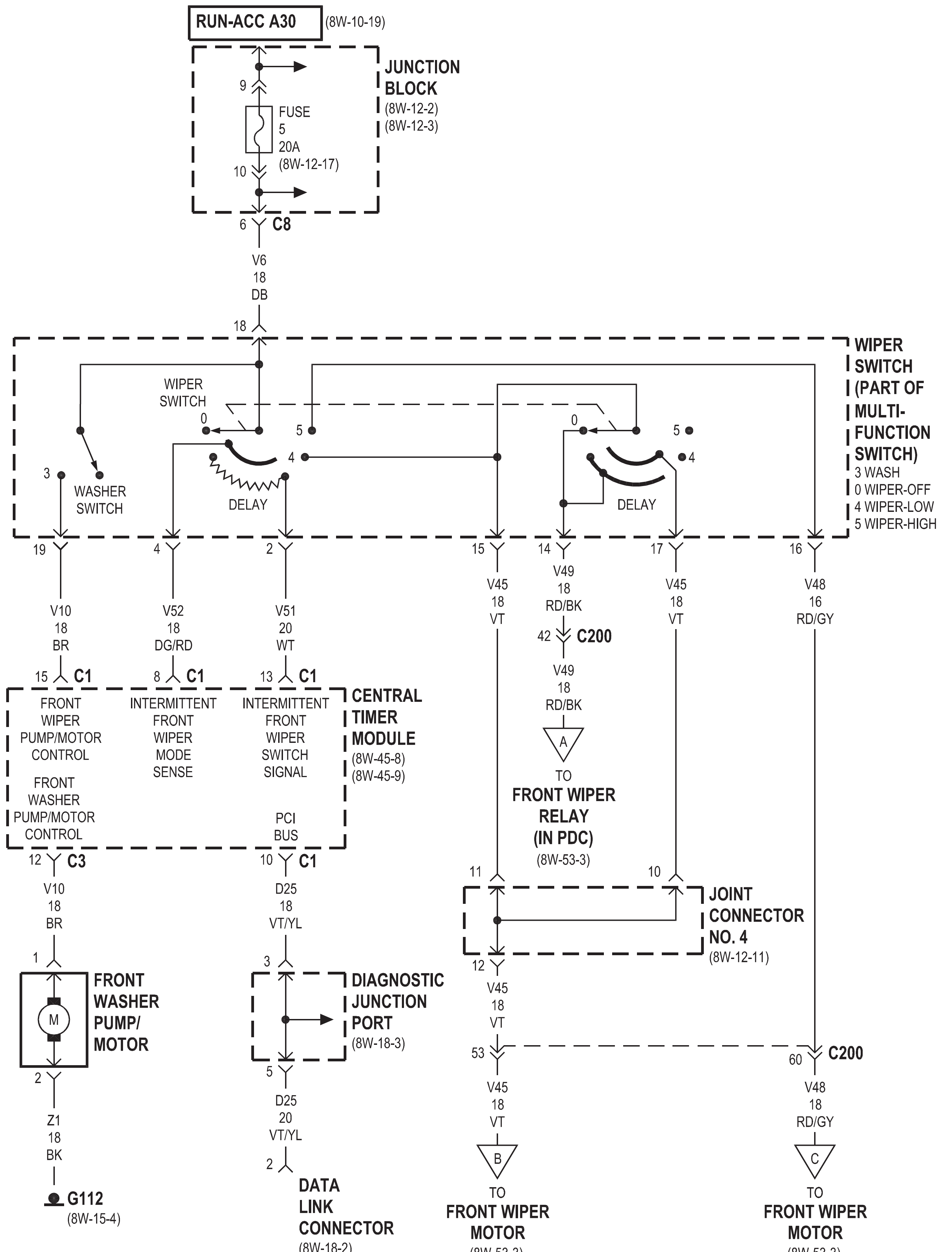
8W-52 TURN SIGNALS

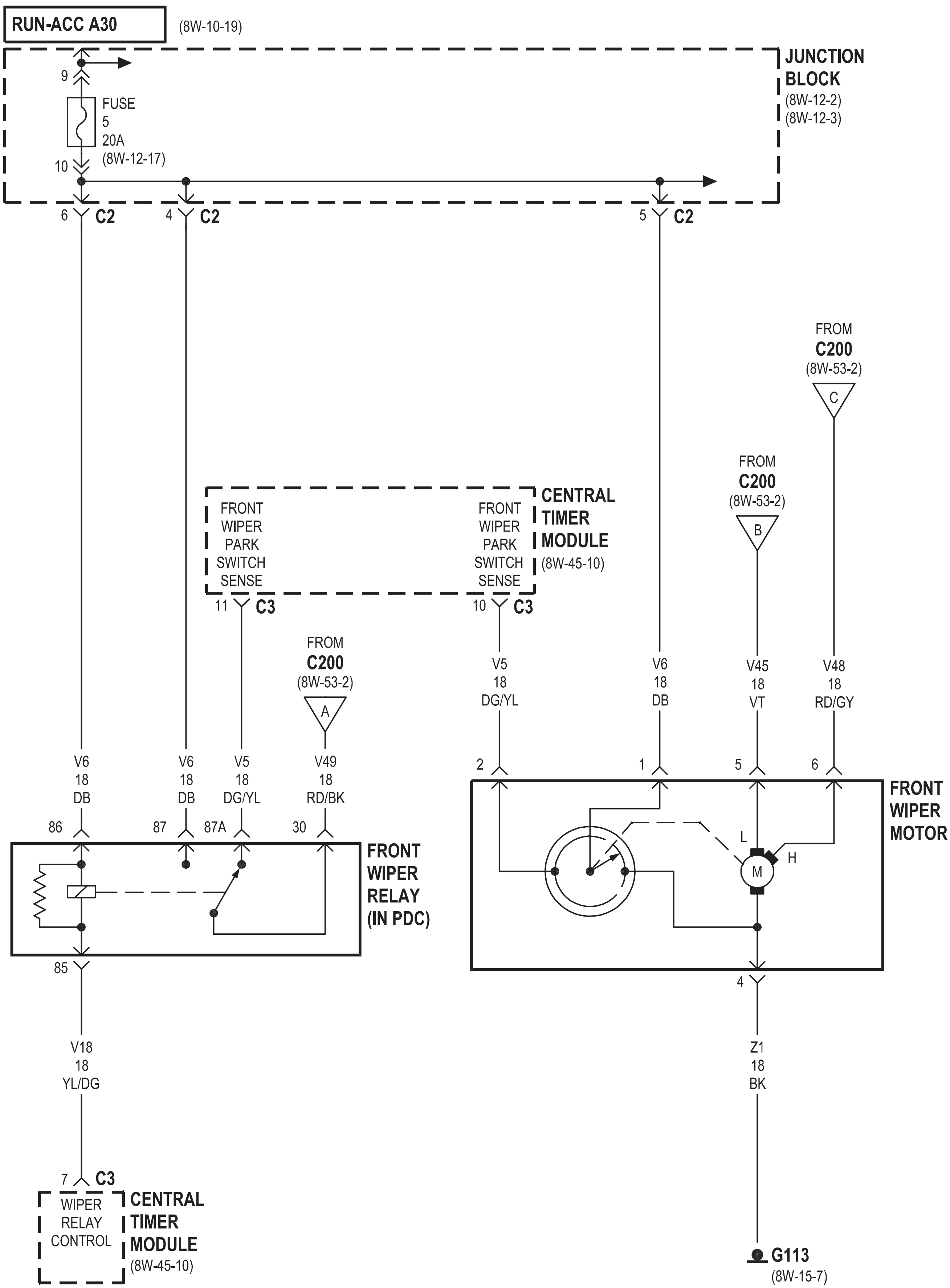

RUN-ACC A31
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
38
FUSE 19 10A (8W-12-18)
37
3 C9
L5 20 BK
BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE 1 30A (8W-10-22)
1
L9 14 BK/WT
61 C200
L9 14 BK/WT
1
BRAKE LAMP SWITCH
(8W-30-28)
2
L50 14 WT/TN
15 C11
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
8 C12
L50 14 WT/TN
A6
A1
B5
FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
FUSED B(+)
BRAKE LAMP SWITCH OUTPUT
COMBINATION FLASHER
HAZARD FLASHER SIGNAL
LEFT TURN SWITCH SENSE
RIGHT TURN SWITCH SENSE
LEFT TURN SIGNAL
RIGHT TURN SIGNAL
LEFT TURN SIGNAL
RIGHT TURN SIGNAL
B1
A7
B7
A2
B4
A3
B3
L19 16 PK
L305 20 LB/WT
L302 18 LB/YL
L63 16 DG/RD
L62 16 BR/RD
L61 16 LG
L60 16 TN
34
37 C200
L63 16 DG/RD
L62 16 BR/RD
1
5
3
6
7
8
TURN SIGNAL/ HAZARD SWITCH (PART OF MULTI-FUNCTION SWITCH)
6 HAZARD
7 LEFT TURN
8 RIGHT TURN
7
11
Z1 18 BK
Z1 18 BK
G208
(8W-15-9)
A
D
C
B
TO C352 (8W-52-3)
TO C352 (8W-52-3)
TO JUNCTION BLOCK (8W-52-4)
TO JUNCTION BLOCK (8W-52-4)


FROM
C200
(8W-52-2)
A
L63
16
DG/RD
3
FROM
C200
(8W-52-2)
D
L62
16
BR/RD
2
C352
L63
16
DG/RD
TRAILER
TOW
EXCEPT
TRAILER
TOW
L62
16
BR/RD
EXCEPT
TRAILER
TOW
TRAILER
TOW
S317
S318
L63
16
DG/RD
10
C341
L63
18
DG/RD
5
TRAILER
TOW
CONNECTOR
(8W-54-3)
L63
16
DG/RD
3
C325
L632
16
DG/BR
2
3
LEFT
TAIL/
STOP/
TURN SIGNAL
LAMP
(8W-51-7)
1
Z1
20
BK
S404
(8W-15-5)
2
C325
Z1
20
BK
L62
16
BR/RD
3
C360
L632
16
DG/BR
3
2
RIGHT
TAIL/
STOP/
TURN SIGNAL
LAMP
(8W-51-7)
1
Z1
20
BK
S401
(8W-15-5)
2
C360
Z1
20
BK
S306
(8W-15-5)
Z1
16
BK
14
C352
Z1
16
BK
G113
(8W-15-6)
L62
16
BR/RD
2
C341
L62
18
BK/PK
6
TRAILER
TOW
CONNECTOR
(8W-54-3)

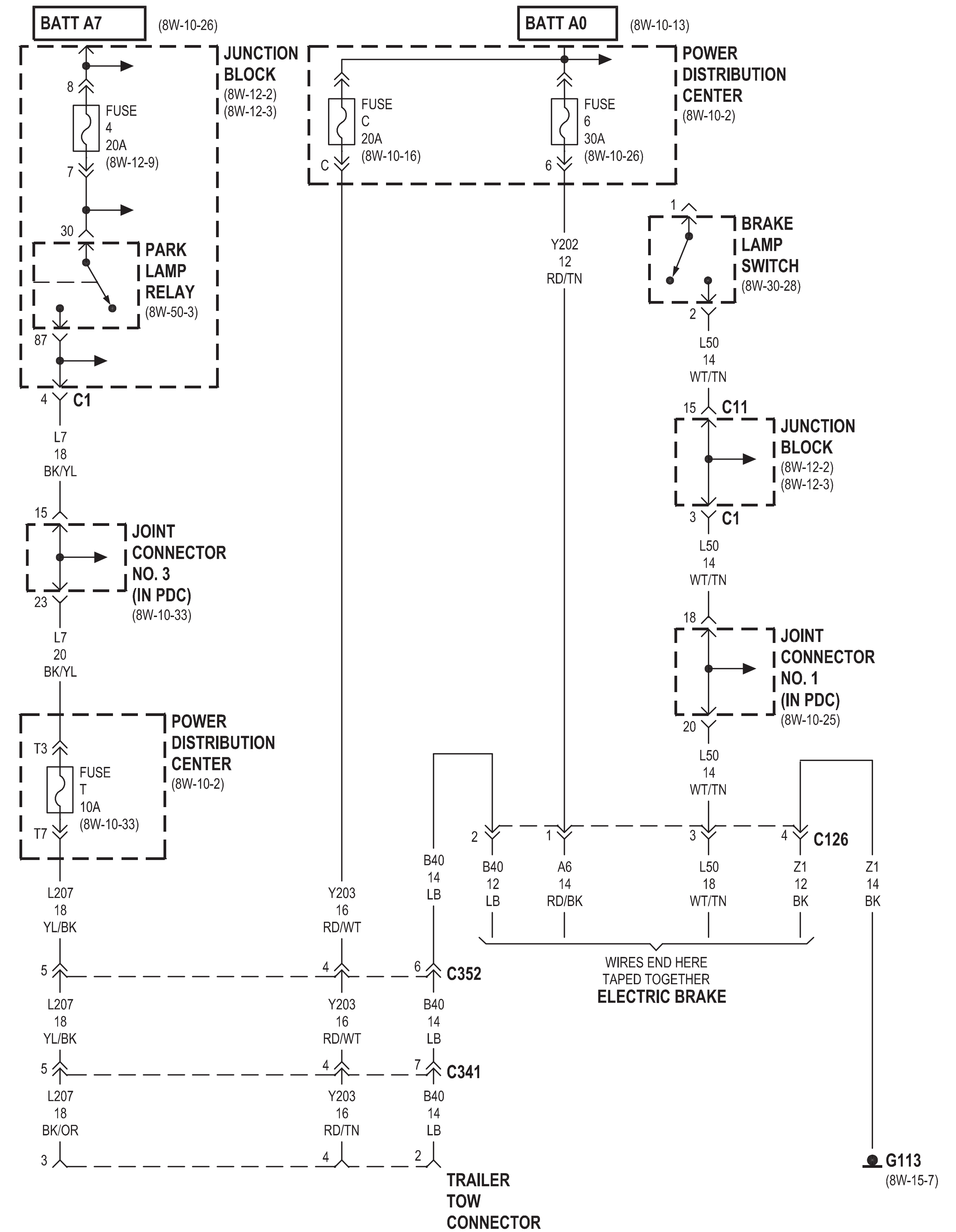

FROM
COMBINATION
FLASHER
(8W-52-2)
C
INSTRUMENT
CLUSTER
(8W-40-7)
LEFT
TURN
SIGNAL
RIGHT
TURN
SIGNAL
FROM
COMBINATION
FLASHER
(8W-52-2)
B
6 C2
8 C2
L61
16
LG
L60
16
TN
2 C12
16 C11
11 C11
12 C11
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
13 C3
11 C2
JOINT
CONNECTOR
NO. 2
(IN PDC)
(8W-10-36)
LEFT
FRONT
PARK/
TURN
SIGNAL
LAMP
NO. 1
LEFT
FRONT
PARK/
TURN
SIGNAL
LAMP
NO. 2
RIGHT
FRONT
PARK/
TURN
SIGNAL
LAMP
NO. 1
RIGHT
FRONT
PARK/
TURN
SIGNAL
LAMP
NO. 2
Z1
20
BK
G113
(8W-15-7)
G112
(8W-15-4)

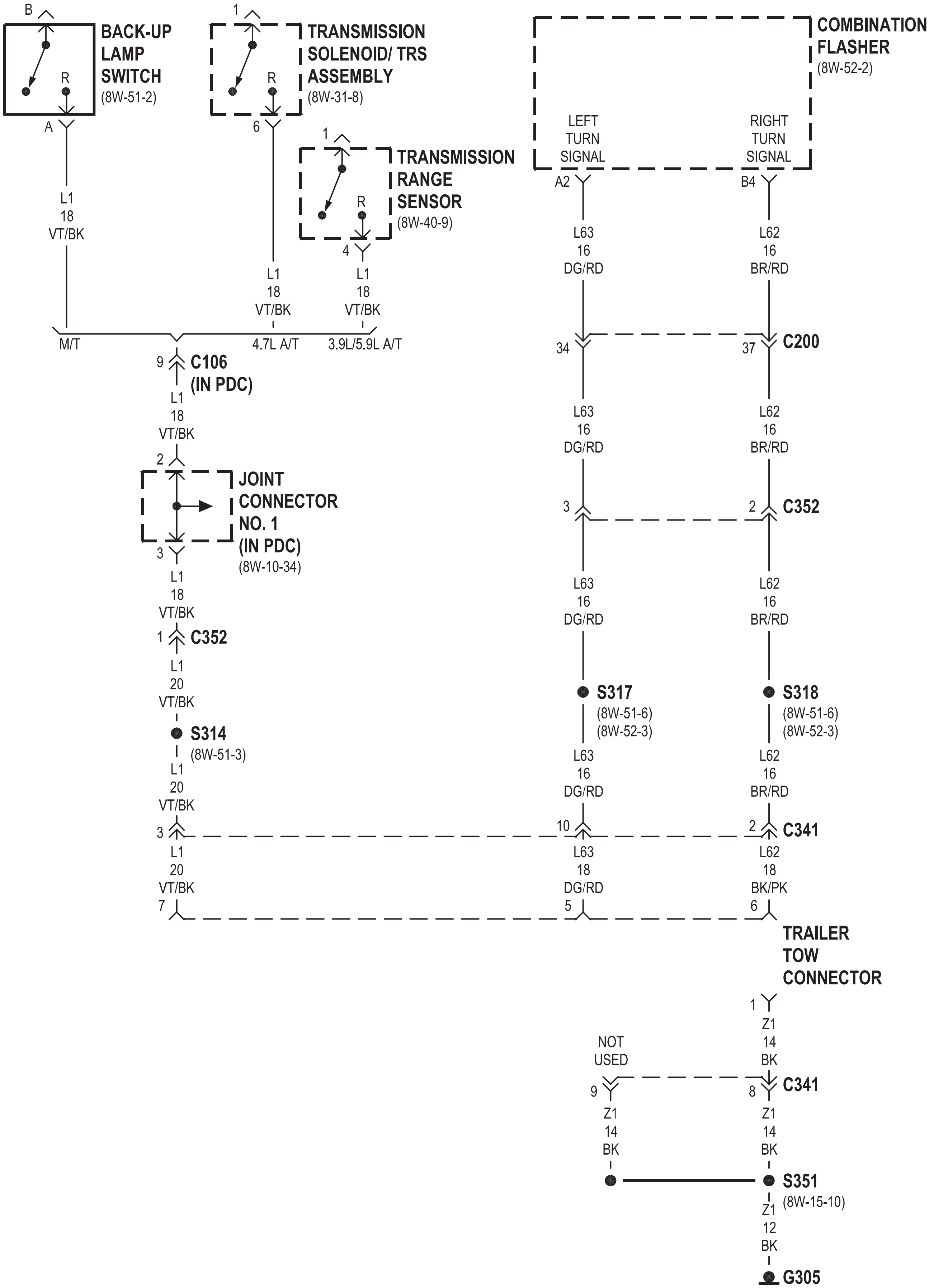
8W-53 WIPERS


RUN-ACC A30
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
9
FUSE
5
20A
(8W-12-17)
10
6
C8
V6
18
DB
18
WIPER SWITCH (PART OF MULTI-FUNCTION SWITCH)
3 WASH
0 WIPER-OFF
4 WIPER-LOW
5 WIPER-HIGH
WIPER SWITCH
0
5
4
3
WASHER SWITCH
DELAY
0
5
4
DELAY
19
4
2
15
14
17
16
V10
18
BR
V52
18
DG/RD
V51
20
WT
V45
18
VT
V49
18
RD/BK
42
C200
V49
18
RD/BK
A
TO
FRONT WIPER RELAY (IN PDC)
(8W-53-3)
V45
18
VT
V48
16
RD/GY
15 C1
8 C1
13 C1
CENTRAL TIMER MODULE
(8W-45-8)
(8W-45-9)
FRONT WIPER PUMP/MOTOR CONTROL
INTERMITTENT FRONT WIPER MODE SENSE
INTERMITTENT FRONT WIPER SWITCH SIGNAL
FRONT WASHER PUMP/MOTOR CONTROL
PCI BUS
12 C3
10 C1
V10
18
BR
D25
18
VT/YL
11
10
JOINT CONNECTOR NO. 4
(8W-12-11)
12
V45
18
VT
53
60
C200
1
FRONT WASHER PUMP/ MOTOR
M
2
3
DIAGNOSTIC JUNCTION PORT
(8W-18-3)
5
D25
20
VT/YL
2
DATA LINK CONNECTOR
(8W-18-2)
Z1
18
BK
G112
(8W-15-4)
V45
18
VT
B
TO
FRONT WIPER MOTOR
(8W-53-3)
V48
18
RD/GY
C
TO
FRONT WIPER MOTOR
(8W-53-3)

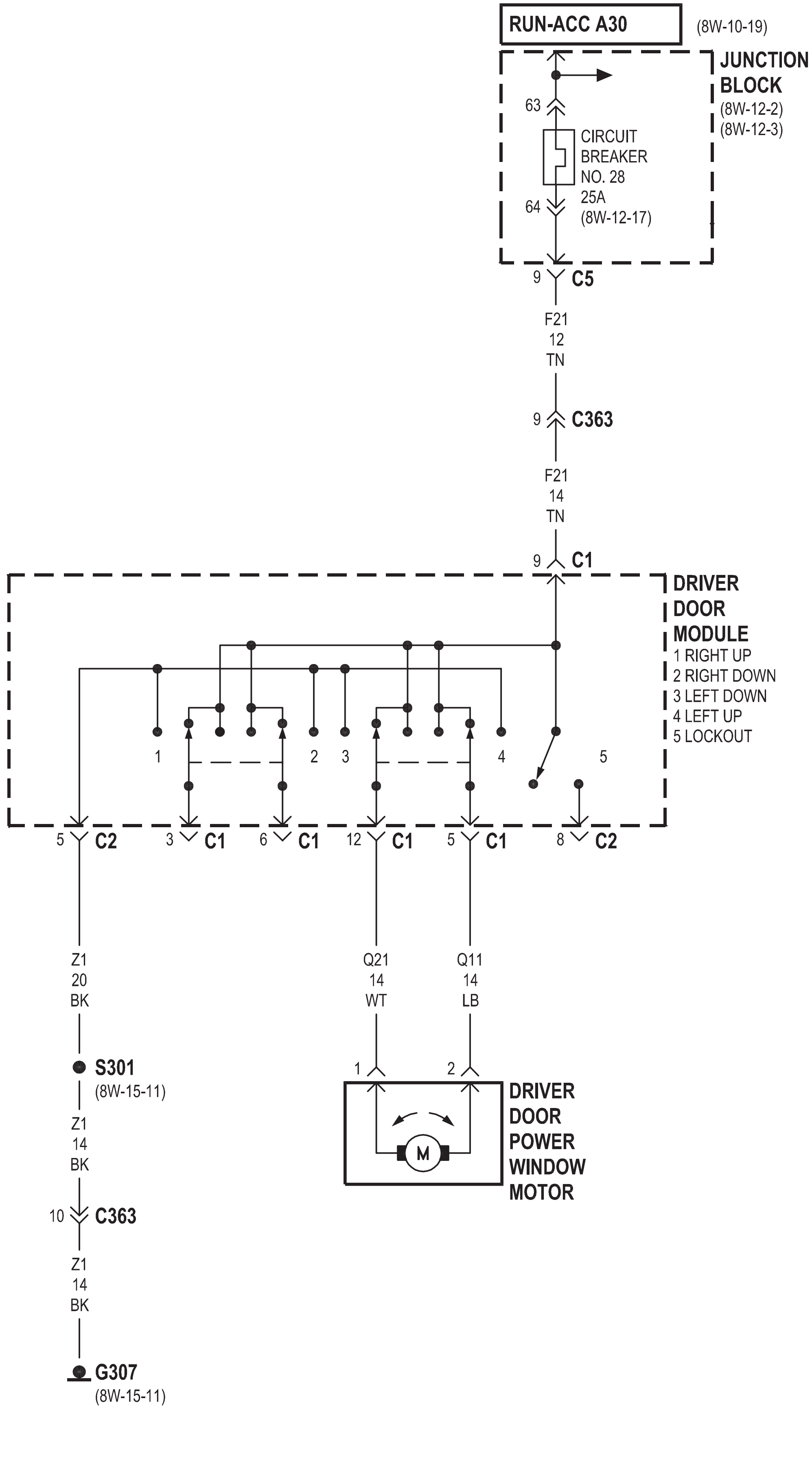

RUN-ACC A30
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FUSE
5
20A
(8W-12-17)
C2
CENTRAL TIMER MODULE
(8W-45-10)
FRONT WIPER PARK SWITCH SENSE
FRONT WIPER PARK SWITCH SENSE
C3
FROM C200 (8W-53-2)
A
B
C
V5 18 DG/YL
V6 18 DB
V45 18 VT
V48 18 RD/GY
V6 18 DB
V6 18 DB
V5 18 DG/YL
V49 18 RD/BK
86
87
87A
30
85
FRONT WIPER RELAY (IN PDC)
FRONT WIPER MOTOR
L
H
M
V18 18 YL/DG
Z1 18 BK
WIPER RELAY CONTROL
CENTRAL TIMER MODULE
(8W-45-10)
G113
(8W-15-7)

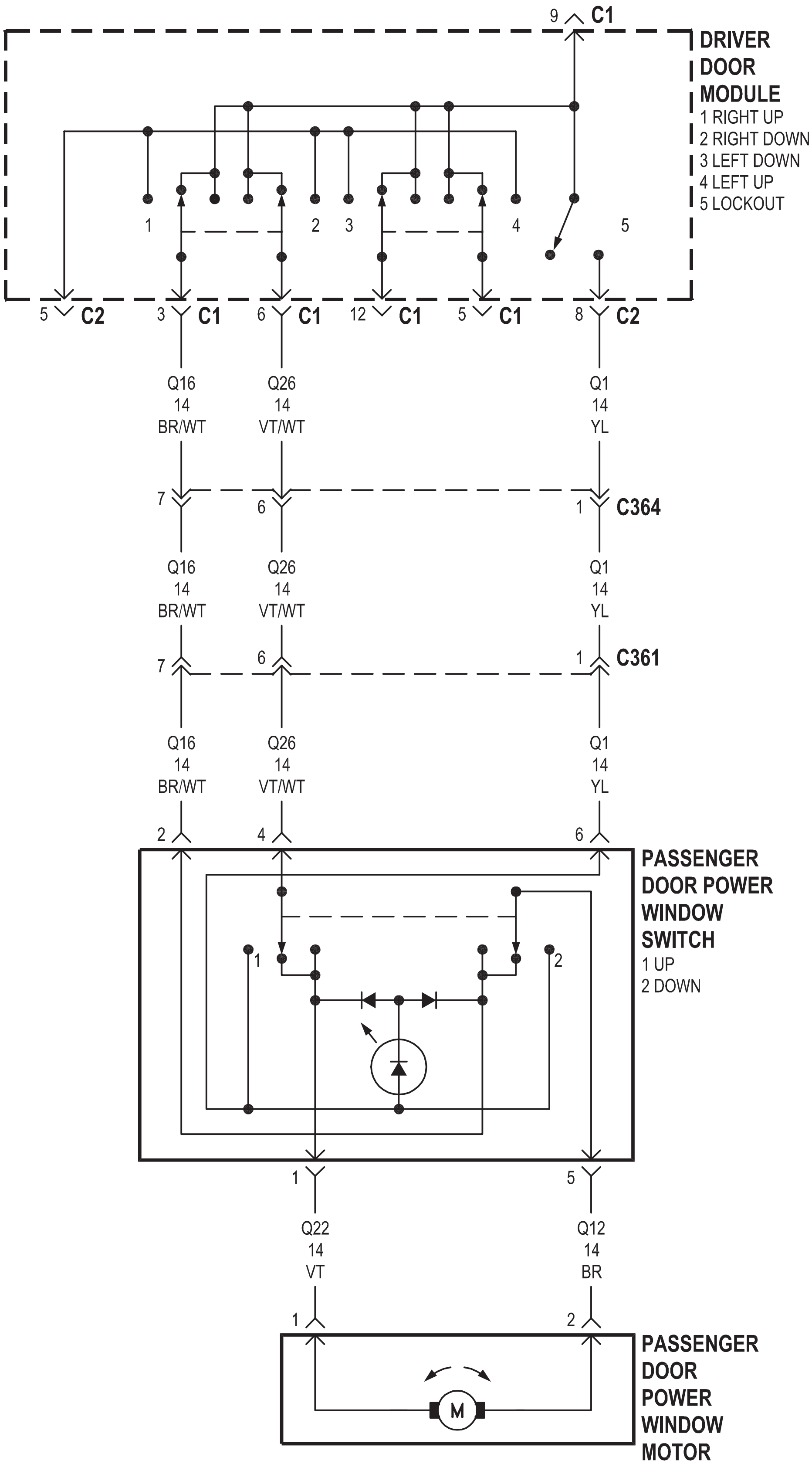
8W-54 TRAILER TOW

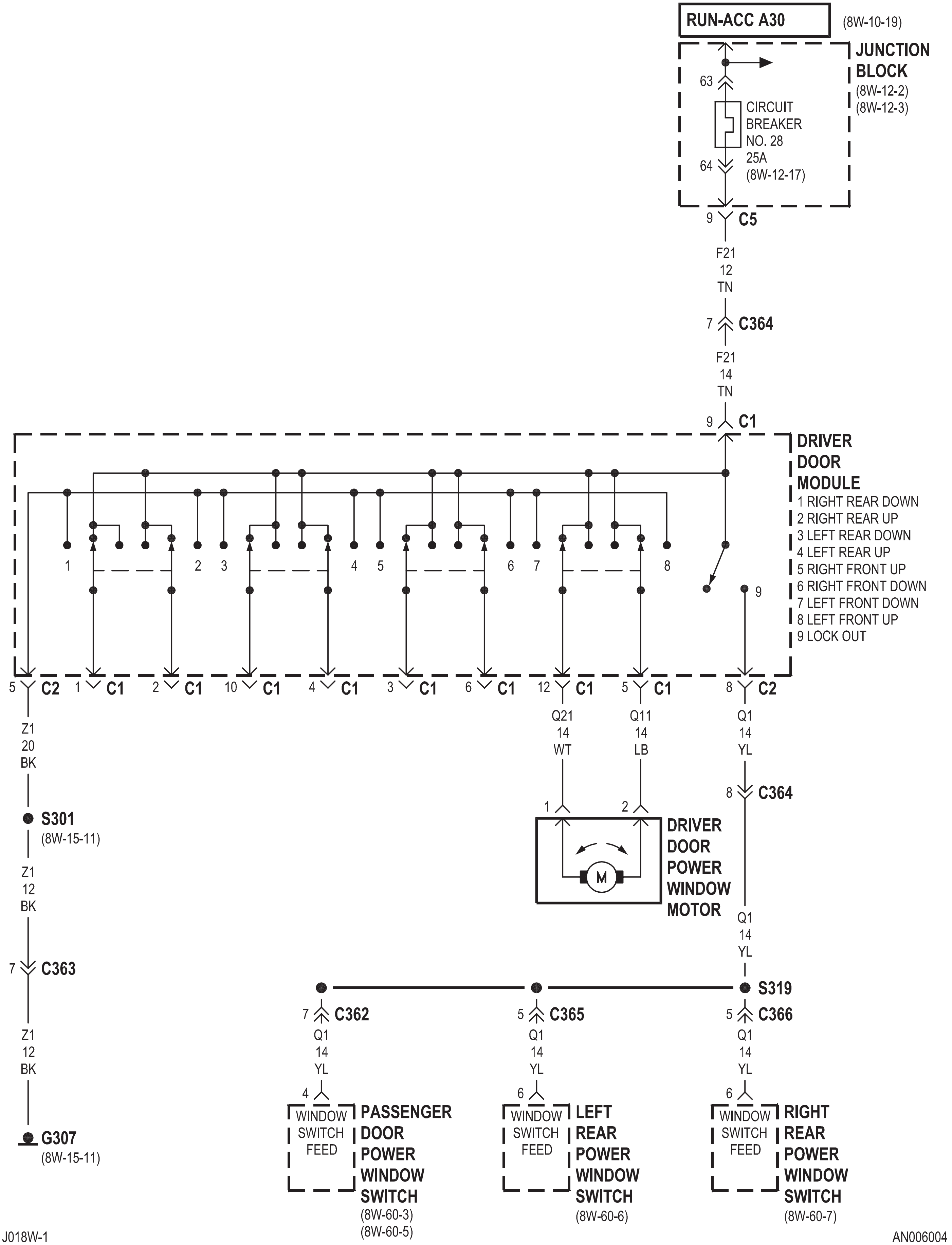

BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
8
FUSE
4
20A
(8W-12-9)
7
30
PARK LAMP RELAY
(8W-50-3)
87
4
C1
L7
18
BK/YL
15
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-10-33)
23
L7
20
BK/YL
POWER DISTRIBUTION CENTER
(8W-10-2)
T3
FUSE
T
10A
(8W-10-33)
T7
L207
18
YL/BK
BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
C
20A
(8W-10-16)
C
FUSE
6
30A
(8W-10-26)
6
Y202
12
RD/TN
BRAKE LAMP SWITCH
(8W-30-28)
1
2
L50
14
WT/TN
15
C11
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
3
C1
L50
14
WT/TN
18
JOINT CONNECTOR NO. 1 (IN PDC)
(8W-10-25)
20
L50
14
WT/TN
2
1
3
4
C126
B40
14
LB
B40
12
LB
A6
14
RD/BK
L50
18
WT/TN
Z1
12
BK
Z1
14
BK
WIRES END HERE
TAPED TOGETHER
ELECTRIC BRAKE
Y203
16
RD/WT
5
4
6
C352
L207
18
YL/BK
Y203
16
RD/WT
B40
14
LB
5
4
7
C341
L207
18
BK/OR
Y203
16
RD/TN
B40
14
LB
3
4
2
TRAILER TOW CONNECTOR
G113
(8W-15-7)

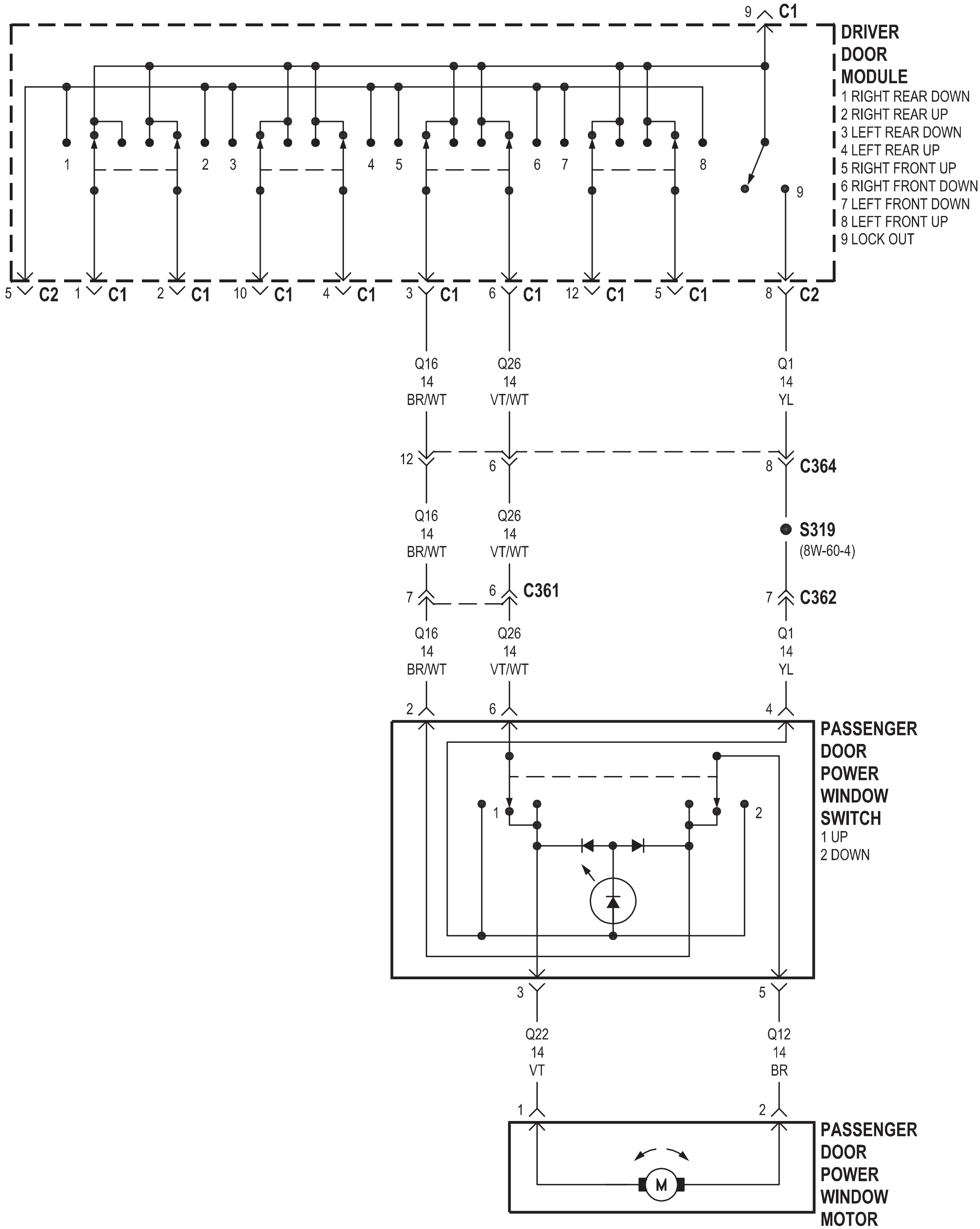

B
BACK-UP LAMP SWITCH
(8W-51-2)
R
A
L1
18
VT/BK
1
TRANSMISSION SOLENOID/ TRS ASSEMBLY
(8W-31-8)
R
6
1
TRANSMISSION RANGE SENSOR
(8W-40-9)
R
4
L1
18
VT/BK
L1
18
VT/BK
M/T
4.7L A/T
3.9L/5.9L A/T
9
C106
(IN PDC)
L1
18
VT/BK
2
JOINT CONNECTOR NO. 1
(IN PDC)
(8W-10-34)
3
L1
18
VT/BK
1
C352
L1
20
VT/BK
S314
(8W-51-3)
L1
20
VT/BK
3
L1
20
VT/BK
7
COMBINATION FLASHER
(8W-52-2)
LEFT TURN SIGNAL
RIGHT TURN SIGNAL
A2
B4
L63
16
DG/RD
L62
16
BR/RD
34
37
C200
L63
16
DG/RD
L62
16
BR/RD
3
2
C352
L63
16
DG/RD
L62
16
BR/RD
S317
(8W-51-6)
(8W-52-3)
S318
(8W-51-6)
(8W-52-3)
L63
16
DG/RD
L62
16
BR/RD
10
2
C341
L63
18
DG/RD
L62
18
BK/PK
5
6
TRAILER TOW CONNECTOR
1
Z1
14
BK
NOT USED
9
8
C341
Z1
14
BK
Z1
14
BK
S351
(8W-15-10)
Z1
12
BK
G305
(8W-15-10)

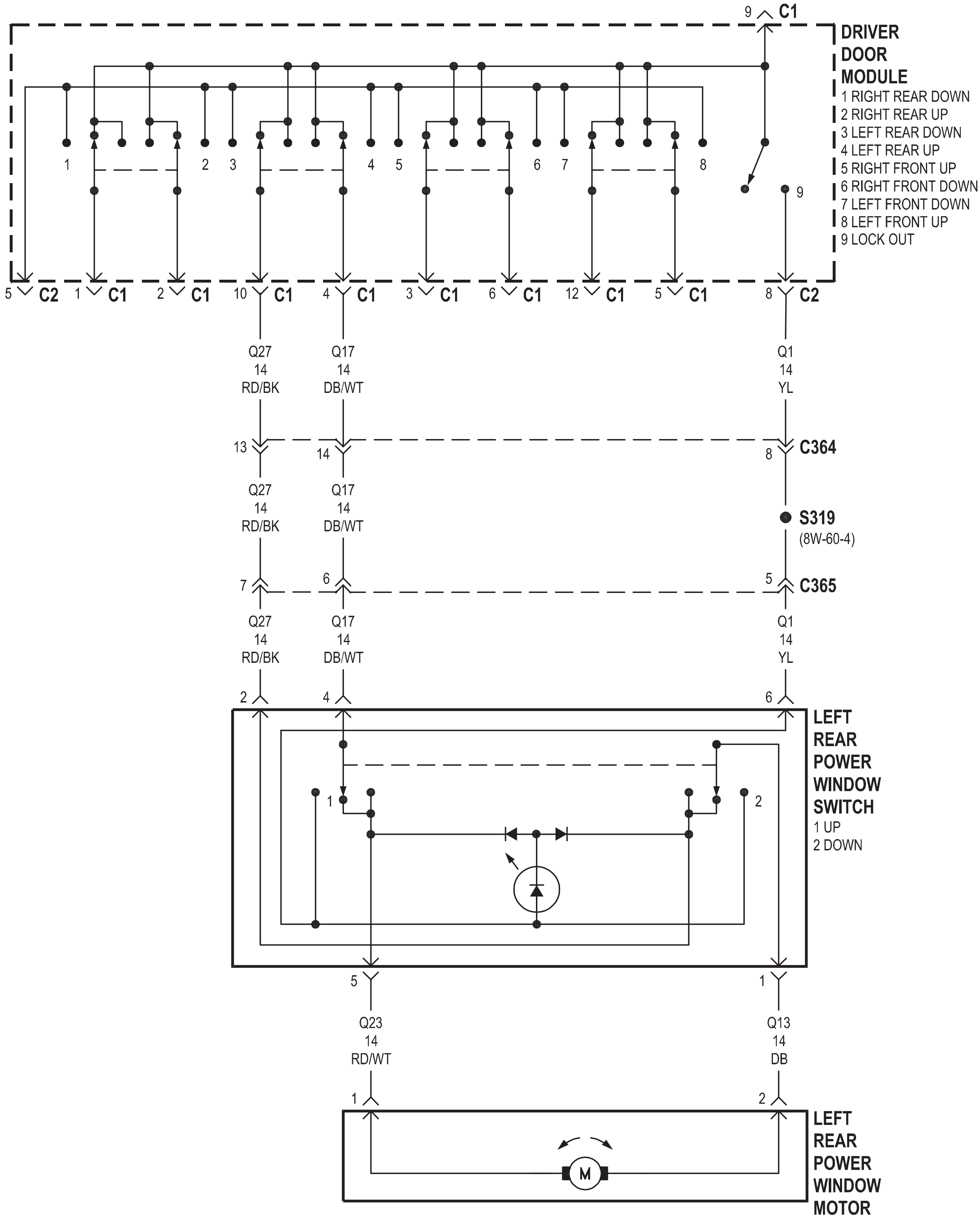
8W-60 POWER WINDOWS

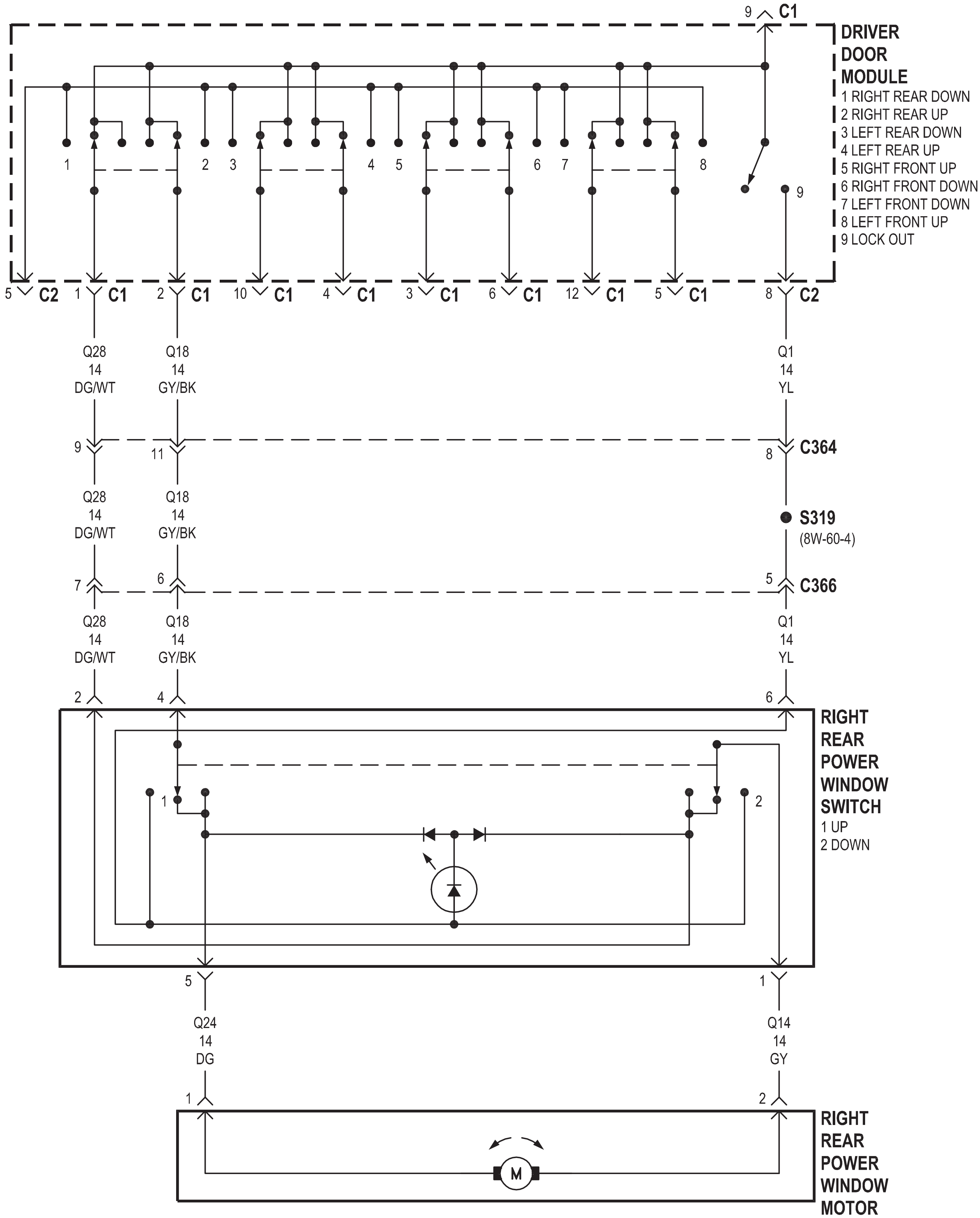

RUN-ACC A30
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
63
CIRCUIT BREAKER NO. 28 25A
(8W-12-17)
64
9 C5
F21 12 TN
9 C363
F21 14 TN
9 C1
DRIVER DOOR MODULE
1 RIGHT UP
2 RIGHT DOWN
3 LEFT DOWN
4 LEFT UP
5 LOCKOUT
1
2
3
4
5
5 C2
3 C1
6 C1
12 C1
5 C1
8 C2
Z1 20 BK
Q21 14 WT
Q11 14 LB
S301
(8W-15-11)
1
2
DRIVER DOOR POWER WINDOW MOTOR
M
Z1 14 BK
10 C363
Z1 14 BK
G307
(8W-15-11)


9 C1
DRIVER DOOR MODULE
1 RIGHT UP
2 RIGHT DOWN
3 LEFT DOWN
4 LEFT UP
5 LOCKOUT
1
2
3
4
5
5 C2
3 C1
6 C1
12 C1
5 C1
8 C2
Q16 14 BR/WT
Q26 14 VT/WT
Q1 14 YL
7
6
1
C364
Q16 14 BR/WT
Q26 14 VT/WT
Q1 14 YL
7
6
1
C361
Q16 14 BR/WT
Q26 14 VT/WT
Q1 14 YL
2
4
6
PASSENGER DOOR POWER WINDOW SWITCH
1 UP
2 DOWN
1
2
1
5
Q22 14 VT
Q12 14 BR
1
2
PASSENGER DOOR POWER WINDOW MOTOR
M


RUN-ACC A30
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
63
CIRCUIT BREAKER NO. 28 25A
(8W-12-17)
64
9 C5
F21 12 TN
7 C364
F21 14 TN
9 C1
DRIVER DOOR MODULE
1 RIGHT REAR DOWN
2 RIGHT REAR UP
3 LEFT REAR DOWN
4 LEFT REAR UP
5 RIGHT FRONT UP
6 RIGHT FRONT DOWN
7 LEFT FRONT DOWN
8 LEFT FRONT UP
9 LOCK OUT
1 2 3 4 5 6 7 8 9
5 C2
1 C1
2 C1
10 C1
4 C1
3 C1
6 C1
12 C1
5 C1
8 C2
Z1 20 BK
S301
(8W-15-11)
Z1 12 BK
7 C363
Z1 12 BK
G307
(8W-15-11)
Q21 14 WT
Q11 14 LB
Q1 14 YL
8 C364
1 2
M
DRIVER DOOR POWER WINDOW MOTOR
Q1 14 YL
S319
7 C362
5 C365
5 C366
Q1 14 YL
Q1 14 YL
Q1 14 YL
4
6
6
WINDOW SWITCH FEED
PASSENGER DOOR POWER WINDOW SWITCH
(8W-60-3)
(8W-60-5)
WINDOW SWITCH FEED
LEFT REAR POWER WINDOW SWITCH
(8W-60-6)
WINDOW SWITCH FEED
RIGHT REAR POWER WINDOW SWITCH
(8W-60-7)

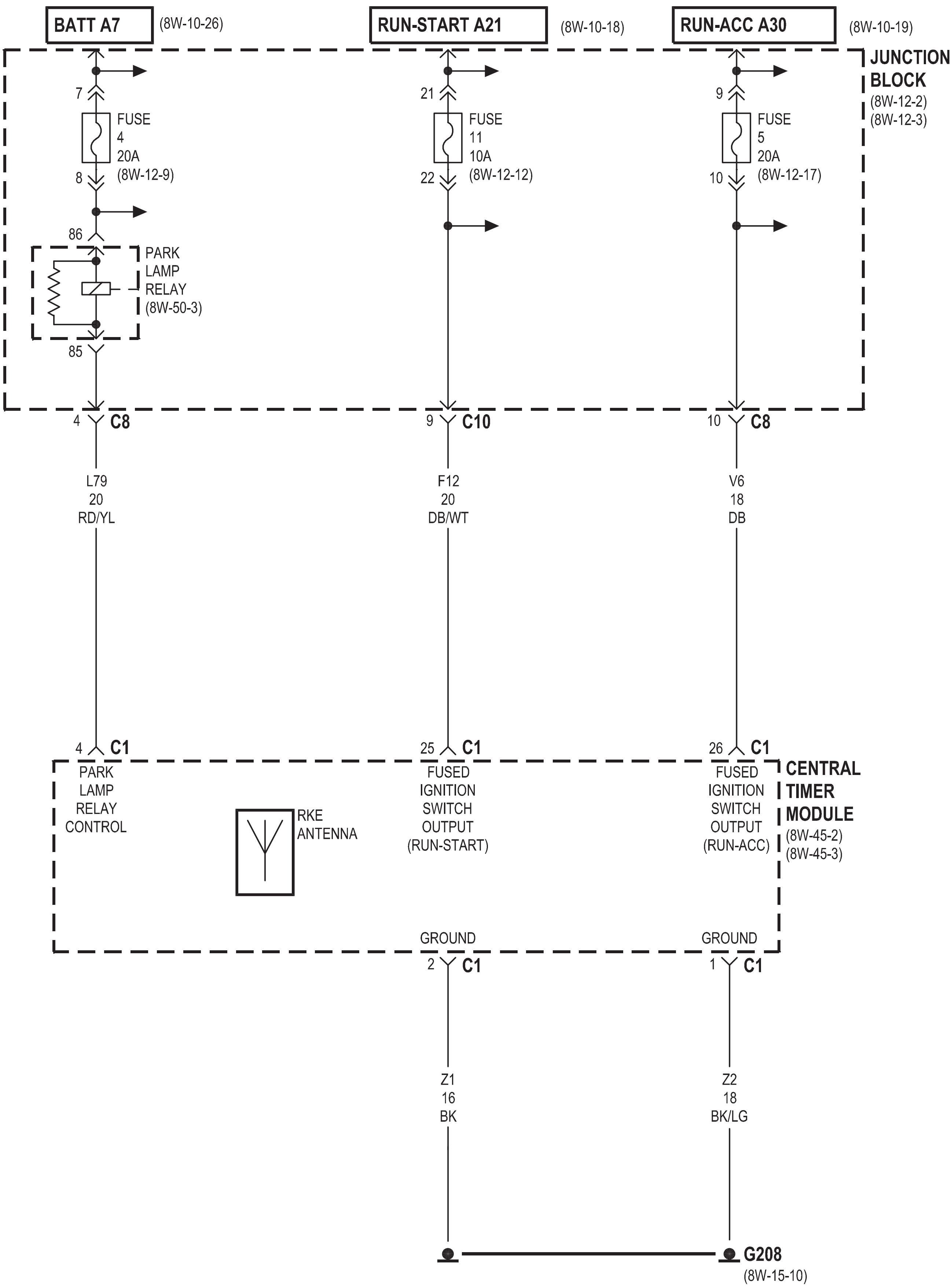

C1
DRIVER
DOOR
MODULE
1 RIGHT REAR DOWN
2 RIGHT REAR UP
3 LEFT REAR DOWN
4 LEFT REAR UP
5 RIGHT FRONT UP
6 RIGHT FRONT DOWN
7 LEFT FRONT DOWN
8 LEFT FRONT UP
9 LOCK OUT
C2
C1
Q16
14
BR/WT
Q26
14
VT/WT
Q1
14
YL
C364
S319
(8W-60-4)
C361
C362
PASSENGER
DOOR
POWER
WINDOW
SWITCH
1 UP
2 DOWN
Q22
14
VT
Q12
14
BR
M
PASSENGER
DOOR
POWER
WINDOW
MOTOR

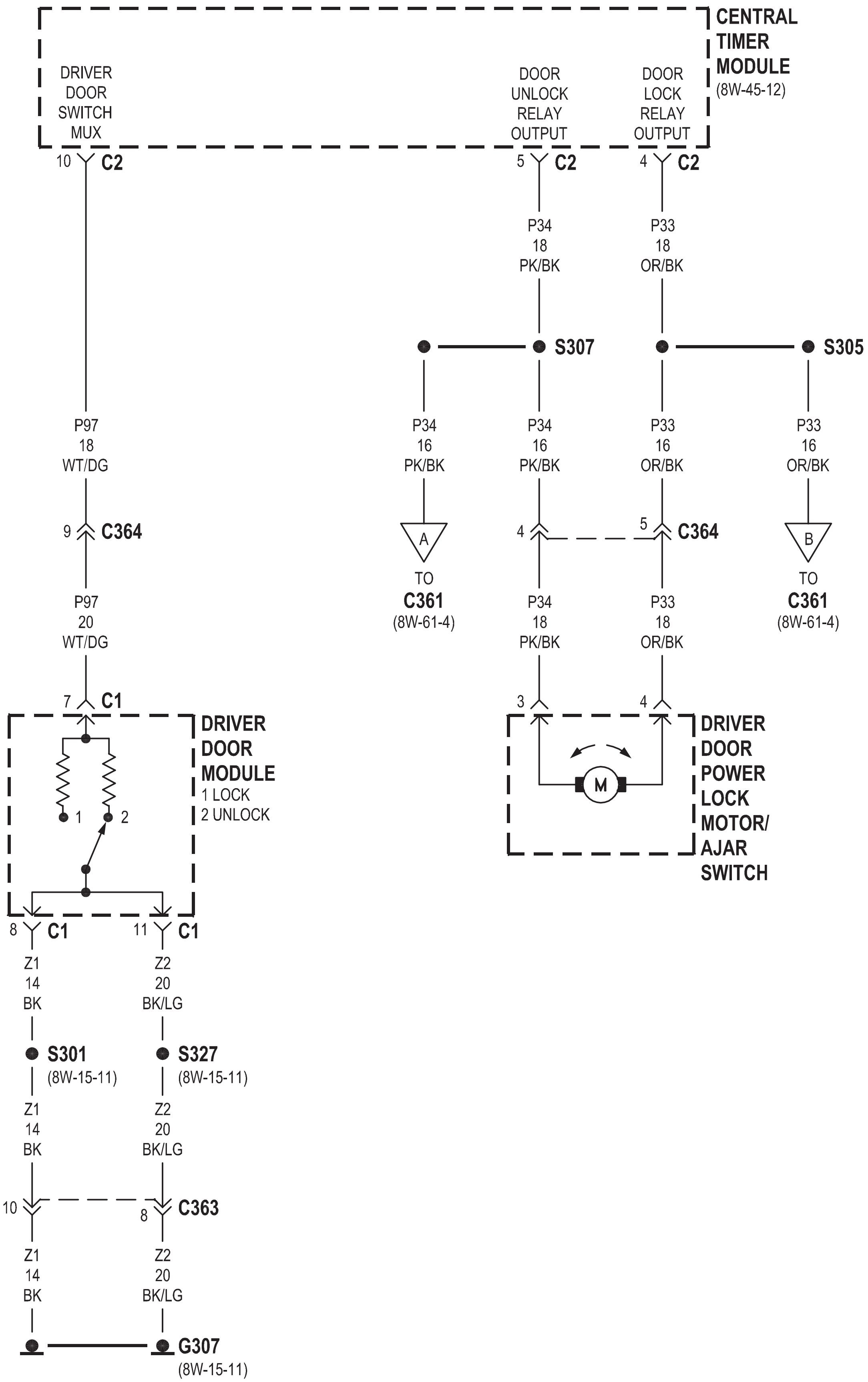

9 C1
DRIVER
DOOR
MODULE
1 RIGHT REAR DOWN
2 RIGHT REAR UP
3 LEFT REAR DOWN
4 LEFT REAR UP
5 RIGHT FRONT UP
6 RIGHT FRONT DOWN
7 LEFT FRONT DOWN
8 LEFT FRONT UP
9 LOCK OUT
5 C2
1 C1
2 C1
10 C1
4 C1
3 C1
6 C1
12 C1
5 C1
8 C2
Q27 14 RD/BK
Q17 14 DB/WT
Q1 14 YL
C364
S319
(8W-60-4)
C365
LEFT
REAR
POWER
WINDOW
SWITCH
1 UP
2 DOWN
Q23 14 RD/WT
Q13 14 DB
LEFT
REAR
POWER
WINDOW
MOTOR
M

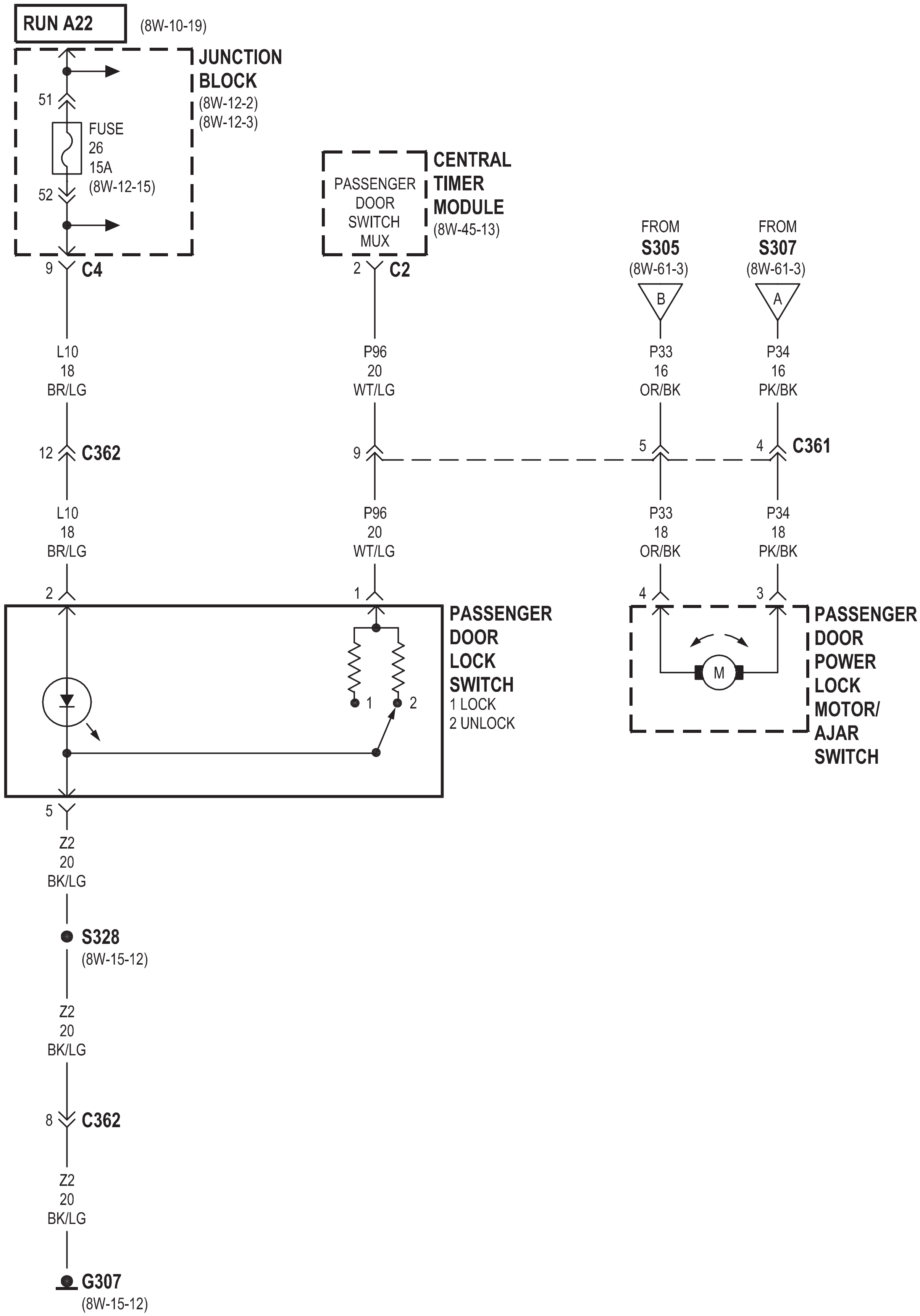


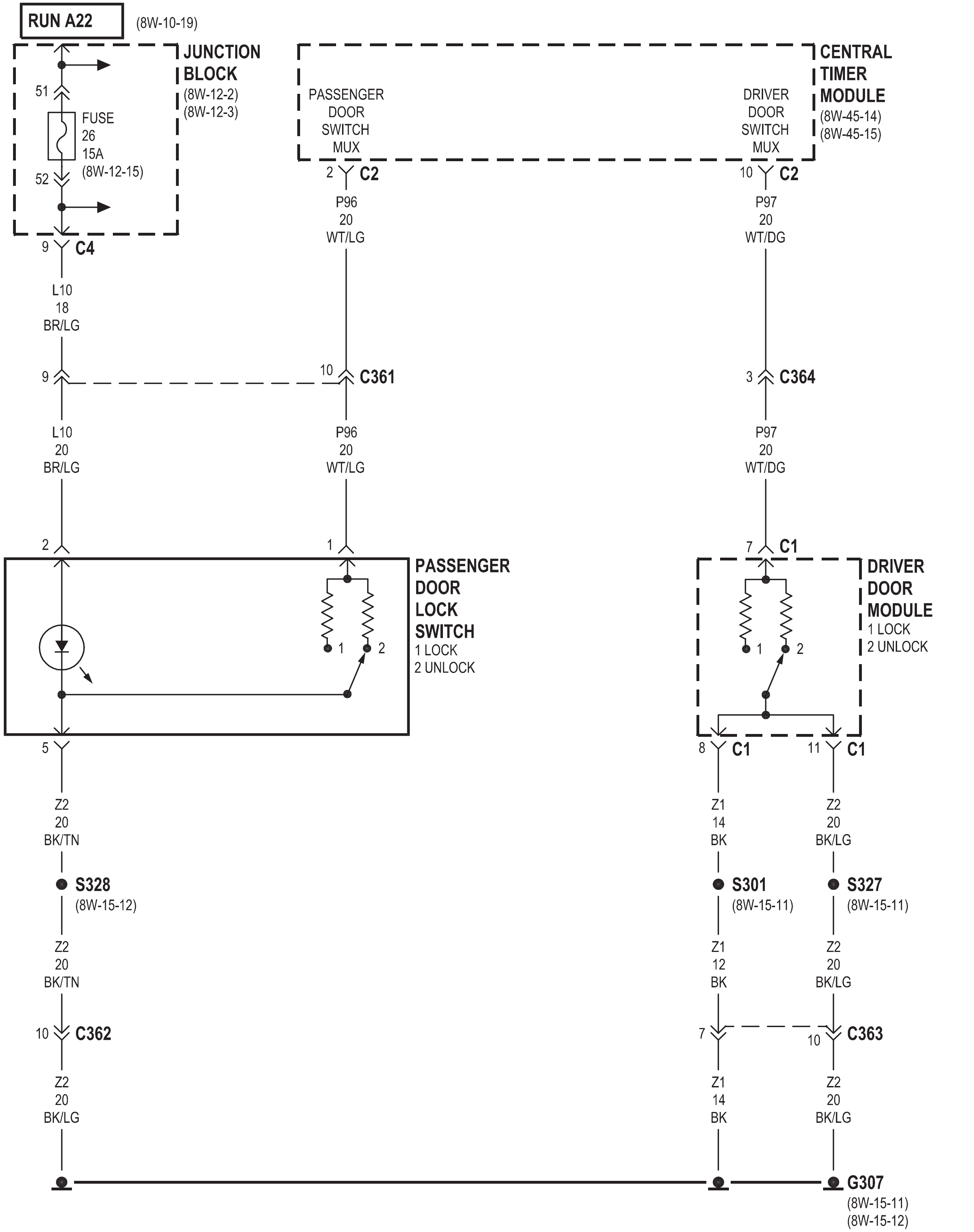
9 C1
DRIVER DOOR MODULE
1 RIGHT REAR DOWN
2 RIGHT REAR UP
3 LEFT REAR DOWN
4 LEFT REAR UP
5 RIGHT FRONT UP
6 RIGHT FRONT DOWN
7 LEFT FRONT DOWN
8 LEFT FRONT UP
9 LOCK OUT
5 C2 1 C1 2 C1 10 C1 4 C1 3 C1 6 C1 12 C1 5 C1 8 C2
Q28 14 DG/WT
Q18 14 GY/BK
Q1 14 YL
9 11 8 C364
S319 (8W-60-4)
7 6 5 C366
Q28 14 DG/WT
Q18 14 GY/BK
Q1 14 YL
2 4 6
RIGHT REAR POWER WINDOW SWITCH
1 UP
2 DOWN
5 1
Q24 14 DG
Q14 14 GY
1 2
M
RIGHT REAR POWER WINDOW MOTOR

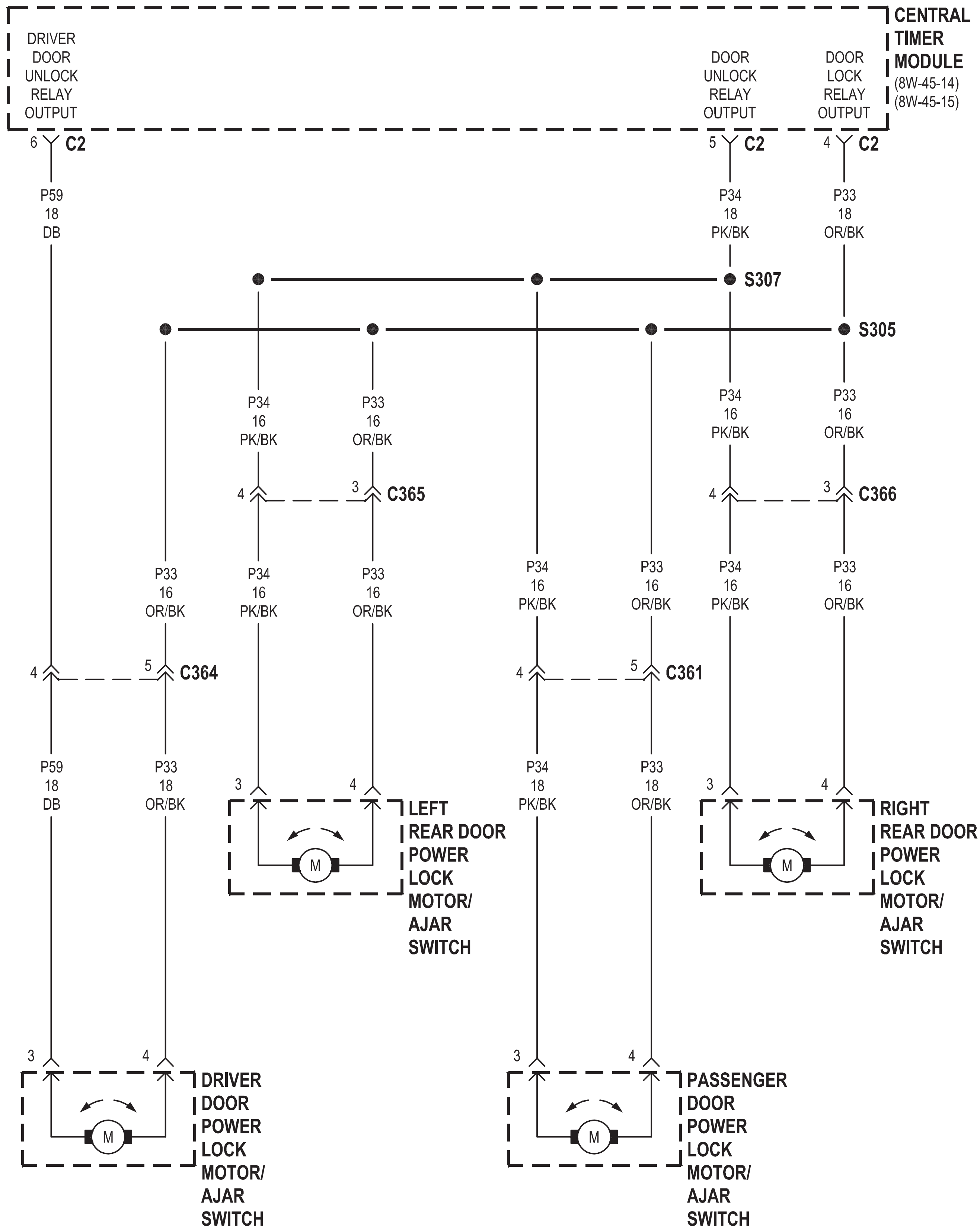
8W-61 POWER DOOR LOCKS

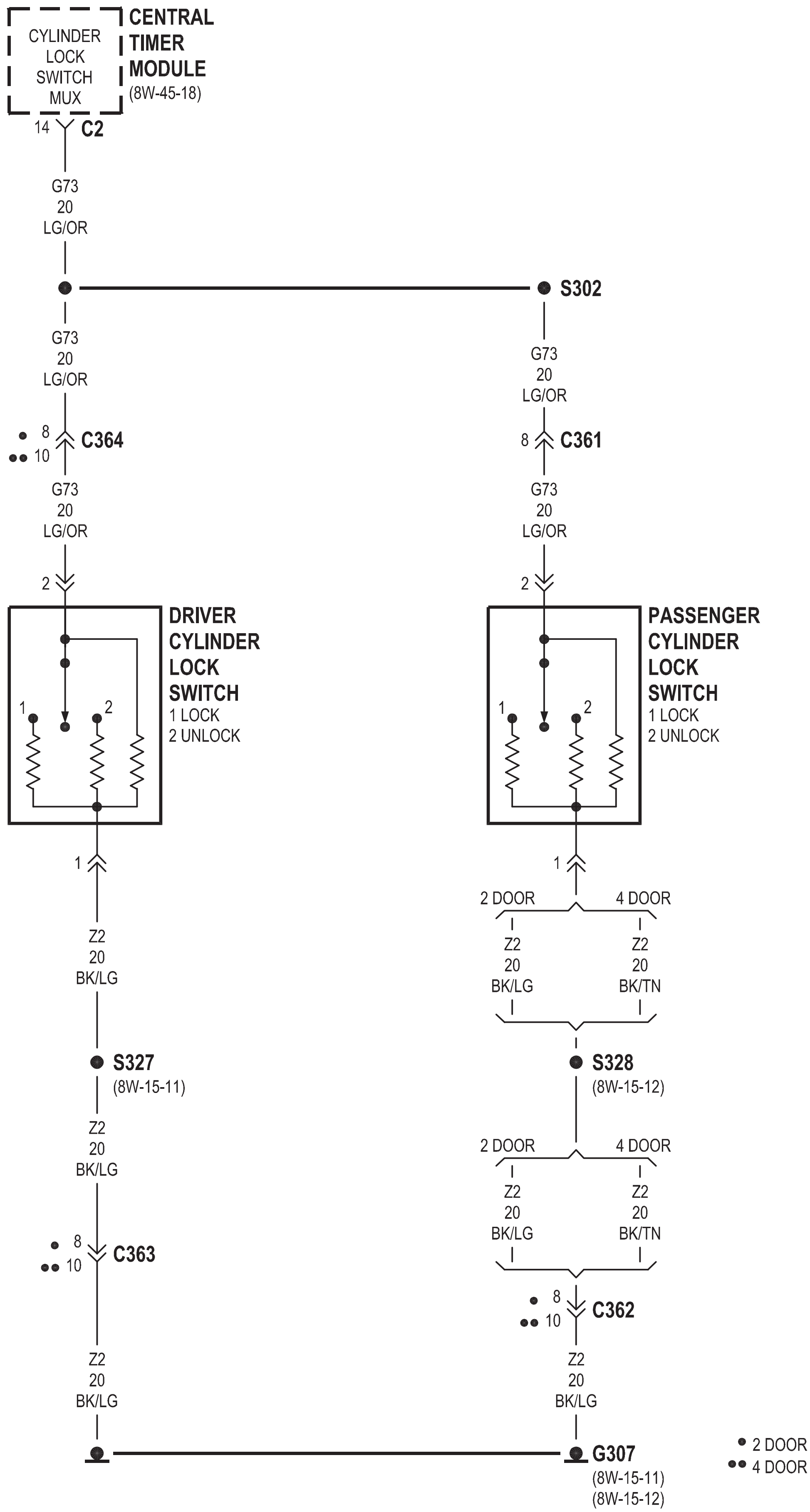

BATT A7
(8W-10-26)
RUN-START A21
(8W-10-18)
RUN-ACC A30
(8W-10-19)
JUNCTION
BLOCK
(8W-12-2)
(8W-12-3)
7
FUSE
4
20A
(8W-12-9)
8
21
FUSE
11
10A
(8W-12-12)
22
9
FUSE
5
20A
(8W-12-17)
10
86
PARK
LAMP
RELAY
(8W-50-3)
85
4 C8
9 C10
10 C8
L79
20
RD/YL
F12
20
DB/WT
V6
18
DB
4 C1
25 C1
26 C1
PARK
LAMP
RELAY
CONTROL
RKE
ANTENNA
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-START)
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-ACC)
CENTRAL
TIMER
MODULE
(8W-45-2)
(8W-45-3)
GROUND
GROUND
2 C1
1 C1
Z1
16
BK
Z2
18
BK/LG
G208
(8W-15-10)


CENTRAL
TIMER
MODULE
(8W-45-12)
DRIVER
DOOR
SWITCH
MUX
DOOR
UNLOCK
RELAY
OUTPUT
DOOR
LOCK
RELAY
OUTPUT
10 C2
5 C2
4 C2
P34
18
PK/BK
P33
18
OR/BK
S307
S305
P97
18
WT/DG
P34
16
PK/BK
P34
16
PK/BK
P33
16
OR/BK
P33
16
OR/BK
9 C364
A
TO
C361
(8W-61-4)
4
5 C364
B
TO
C361
(8W-61-4)
P97
20
WT/DG
P34
18
PK/BK
P33
18
OR/BK
7 C1
3
4
DRIVER
DOOR
MODULE
1 LOCK
2 UNLOCK
1
2
M
DRIVER
DOOR
POWER
LOCK
MOTOR/
AJAR
SWITCH
8 C1
11 C1
Z1
14
BK
Z2
20
BK/LG
S301
(8W-15-11)
S327
(8W-15-11)
Z1
14
BK
Z2
20
BK/LG
10
8 C363
Z1
14
BK
Z2
20
BK/LG
G307
(8W-15-11)

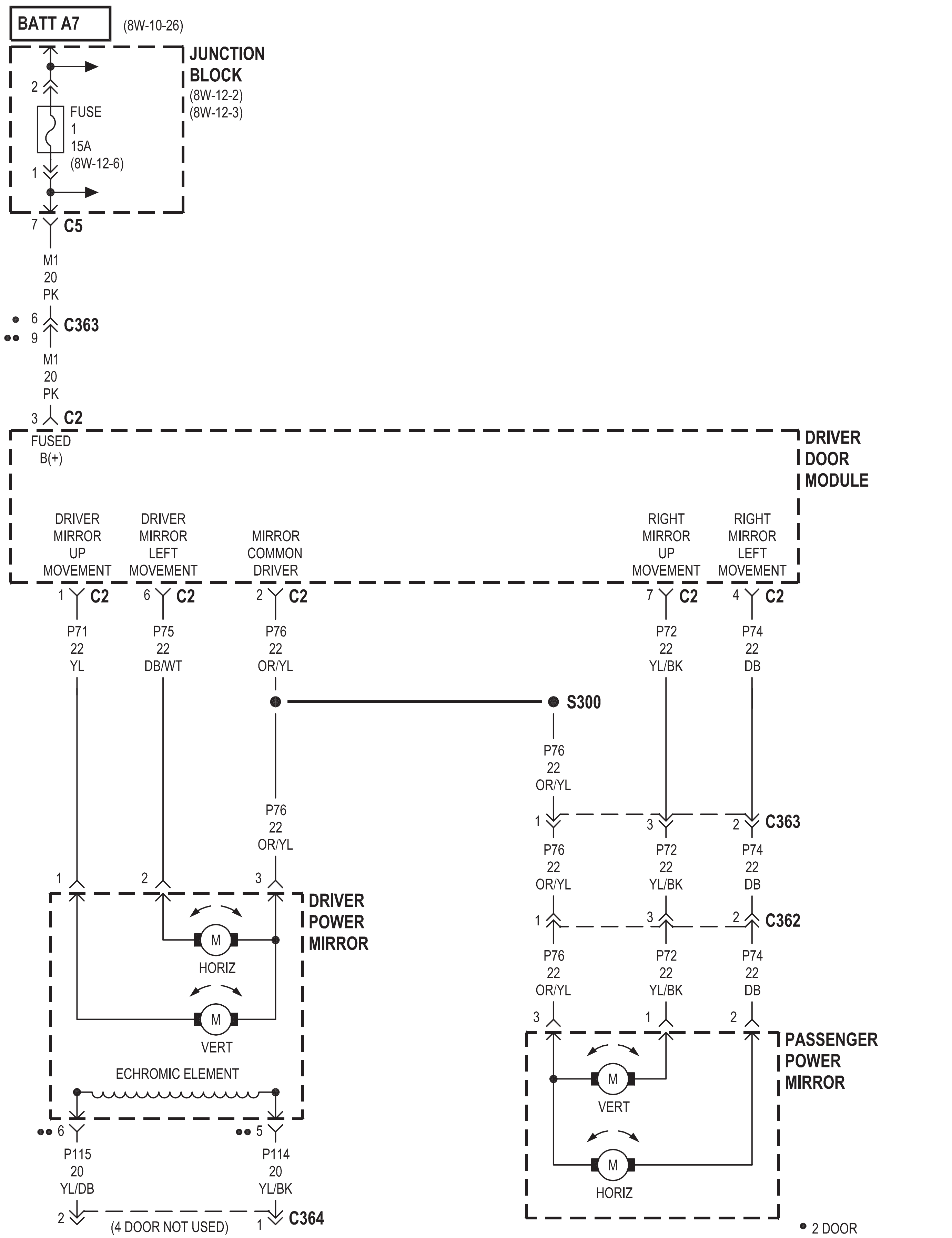

RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
51
FUSE
26
15A
(8W-12-15)
52
9
C4
L10
18
BR/LG
12
C362
L10
18
BR/LG
2
CENTRAL TIMER MODULE
(8W-45-13)
PASSENGER DOOR SWITCH MUX
2
C2
P96
20
WT/LG
9
P96
20
WT/LG
1
PASSENGER DOOR LOCK SWITCH
1 LOCK
2 UNLOCK
1
2
5
Z2
20
BK/LG
S328
(8W-15-12)
Z2
20
BK/LG
8
C362
Z2
20
BK/LG
G307
(8W-15-12)
FROM
S305
(8W-61-3)
B
P33
16
OR/BK
5
P33
18
OR/BK
4
FROM
S307
(8W-61-3)
A
P34
16
PK/BK
4
C361
P34
18
PK/BK
3
M
PASSENGER DOOR POWER LOCK MOTOR/ AJAR SWITCH


RUN A22
(8W-10-19)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
51
FUSE
26
15A
(8W-12-15)
52
9 C4
L10
18
BR/LG
9
L10
20
BR/LG
2
CENTRAL TIMER MODULE
(8W-45-14)
(8W-45-15)
PASSENGER DOOR SWITCH MUX
DRIVER DOOR SWITCH MUX
2 C2
P96
20
WT/LG
10 C361
P96
20
WT/LG
1
10 C2
P97
20
WT/DG
3 C364
P97
20
WT/DG
7 C1
PASSENGER DOOR LOCK SWITCH
1 LOCK
2 UNLOCK
1
2
DRIVER DOOR MODULE
1 LOCK
2 UNLOCK
1
2
5
Z2
20
BK/TN
S328
(8W-15-12)
Z2
20
BK/TN
10 C362
Z2
20
BK/LG
8 C1
Z1
14
BK
S301
(8W-15-11)
Z1
12
BK
7
Z1
14
BK
11 C1
Z2
20
BK/LG
S327
(8W-15-11)
Z2
20
BK/LG
10 C363
Z2
20
BK/LG
G307
(8W-15-11)
(8W-15-12)

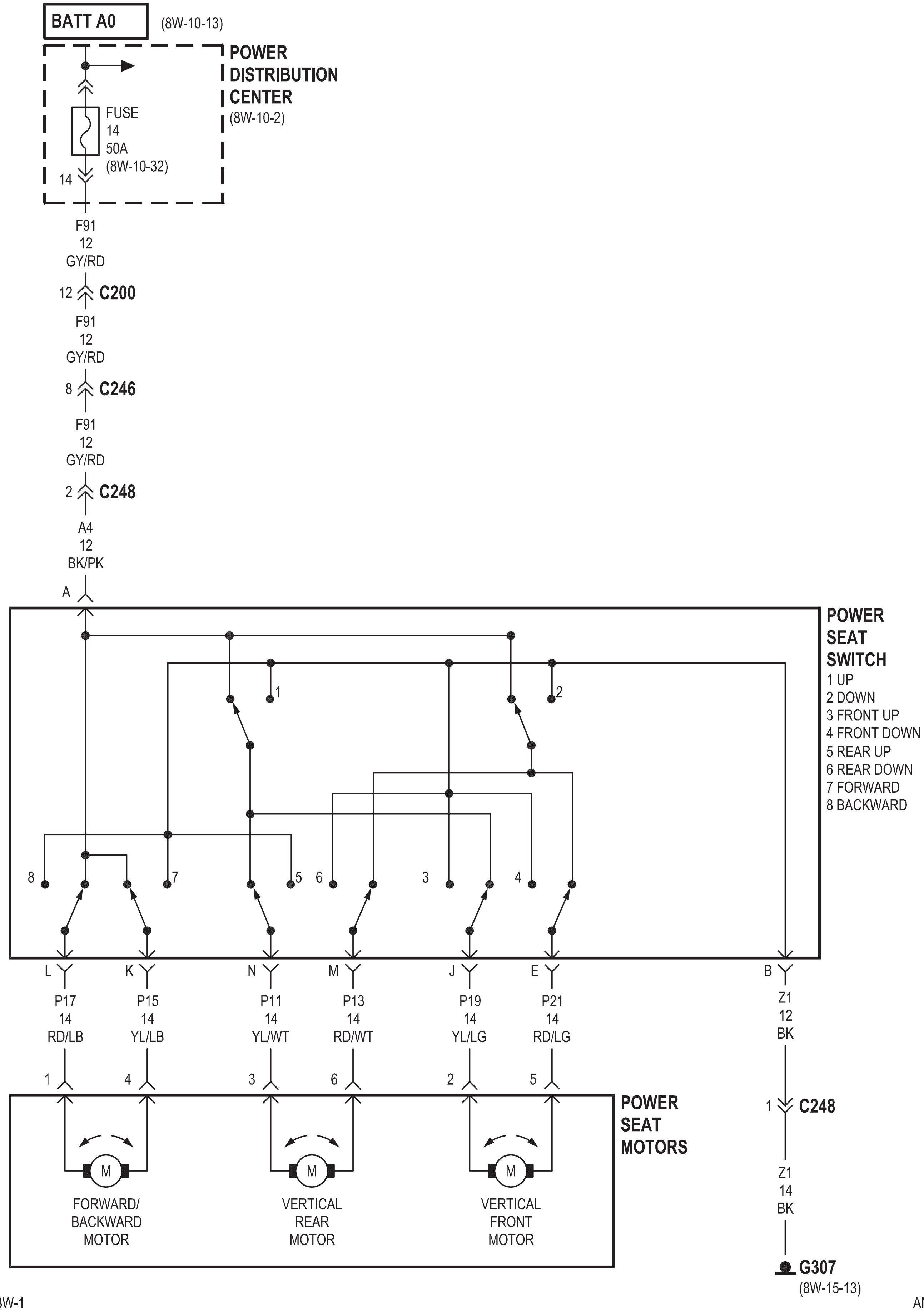

CENTRAL TIMER MODULE
(8W-45-14)
(8W-45-15)
DRIVER DOOR UNLOCK RELAY OUTPUT
DOOR UNLOCK RELAY OUTPUT
DOOR LOCK RELAY OUTPUT
6 C2
5 C2
4 C2
P59 18 DB
P34 18 PK/BK
P33 18 OR/BK
S307
S305
P34 16 PK/BK
P33 16 OR/BK
C365
C366
C364
C361
P59 18 DB
P33 18 OR/BK
P34 18 PK/BK
M
LEFT REAR DOOR POWER LOCK MOTOR/ AJAR SWITCH
RIGHT REAR DOOR POWER LOCK MOTOR/ AJAR SWITCH
DRIVER DOOR POWER LOCK MOTOR/ AJAR SWITCH
PASSENGER DOOR POWER LOCK MOTOR/ AJAR SWITCH


CYLINDER
LOCK
SWITCH
MUX
CENTRAL
TIMER
MODULE
(8W-45-18)
14
C2
G73
20
LG/OR
S302
C364
8
10
C361
2
DRIVER
CYLINDER
LOCK
SWITCH
1 LOCK
2 UNLOCK
PASSENGER
CYLINDER
LOCK
SWITCH
1 LOCK
2 UNLOCK
1
Z2
20
BK/LG
2 DOOR
4 DOOR
BK/TN
S327
(8W-15-11)
S328
(8W-15-12)
C363
C362
G307
(8W-15-11)
(8W-15-12)
2 DOOR
4 DOOR

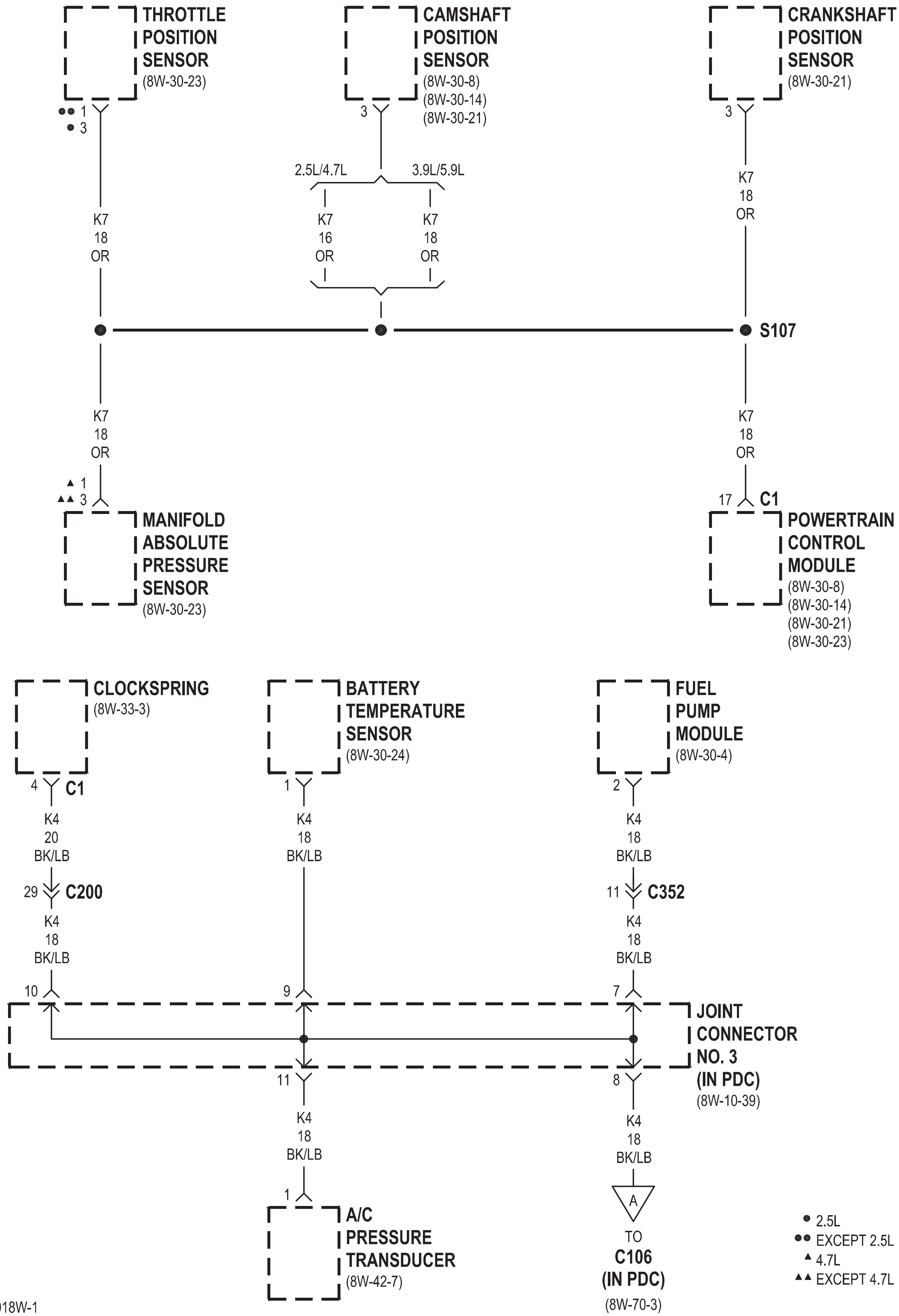
8W-62 POWER MIRRORS


BATT A7
(8W-10-26)
JUNCTION BLOCK
(8W-12-2)
(8W-12-3)
FUSE 1 15A (8W-12-6)
C5
M1 20 PK
C363
M1 20 PK
C2
FUSED B(+)
DRIVER DOOR MODULE
DRIVER MIRROR UP MOVEMENT
DRIVER MIRROR LEFT MOVEMENT
MIRROR COMMON DRIVER
RIGHT MIRROR UP MOVEMENT
RIGHT MIRROR LEFT MOVEMENT
P71 22 YL
P75 22 DB/WT
P76 22 OR/YL
P72 22 YL/BK
P74 22 DB
S300
C363
C362
DRIVER POWER MIRROR
HORIZ
VERT
ECHROMIC ELEMENT
P115 20 YL/DB
P114 20 YL/BK
(4 DOOR NOT USED)
C364
PASSENGER POWER MIRROR
2 DOOR
4 DOOR

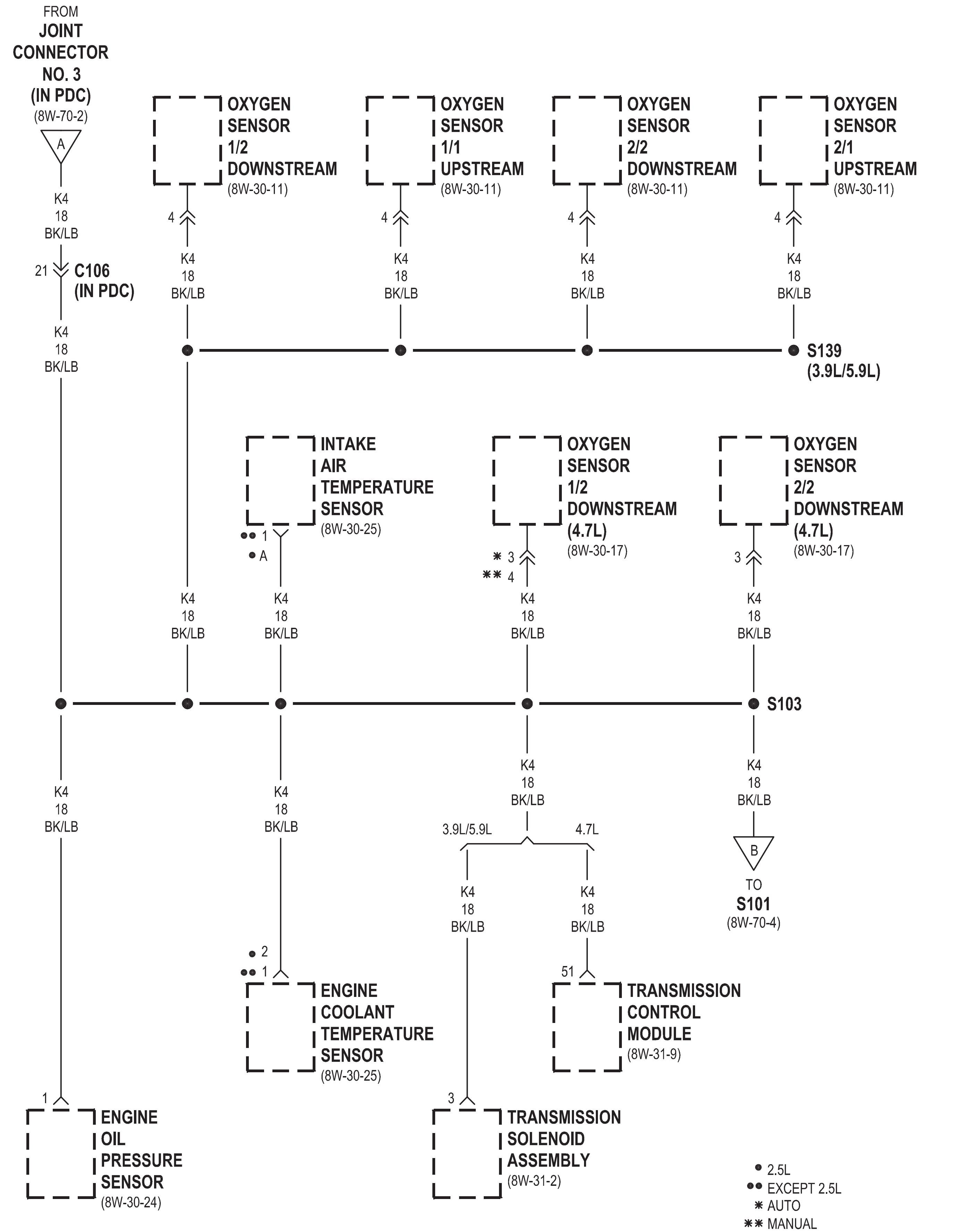
8W-63 POWER SEAT

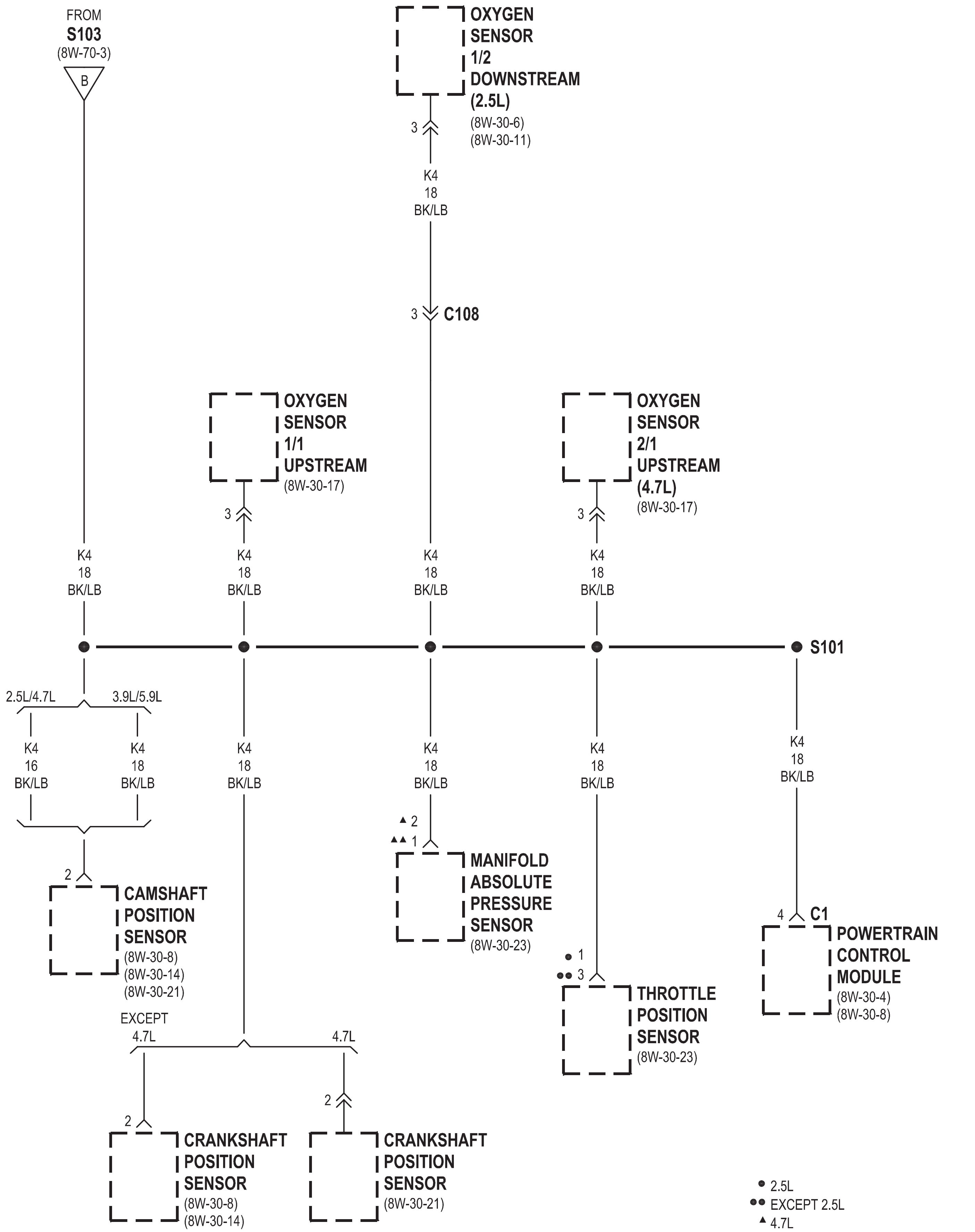

BATT A0
(8W-10-13)
POWER DISTRIBUTION CENTER
(8W-10-2)
FUSE
14
50A
(8W-10-32)
14
F91
12
GY/RD
12
C200
F91
12
GY/RD
8
C246
F91
12
GY/RD
2
C248
A4
12
BK/PK
A
POWER SEAT SWITCH
1 UP
2 DOWN
3 FRONT UP
4 FRONT DOWN
5 REAR UP
6 REAR DOWN
7 FORWARD
8 BACKWARD
1
2
8
7
5
6
3
4
L
K
N
M
J
E
B
P17
14
RD/LB
P15
14
YL/LB
P11
14
YL/WT
P13
14
RD/WT
P19
14
YL/LG
P21
14
RD/LG
Z1
12
BK
1
4
3
6
2
5
1
C248
Z1
14
BK
POWER SEAT MOTORS
M
FORWARD/
BACKWARD
MOTOR
M
VERTICAL
REAR
MOTOR
M
VERTICAL
FRONT
MOTOR
G307
(8W-15-13)

8W-70 SPLICE INFORMATION

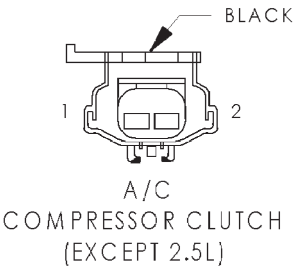


J018W-1 AN007002


FROM
JOINT CONNECTOR NO. 3 (IN PDC)
(8W-70-2)
A
K4 18 BK/LB
21
C106 (IN PDC)
K4 18 BK/LB
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-11)
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-11)
OXYGEN SENSOR 2/2 DOWNSTREAM
(8W-30-11)
OXYGEN SENSOR 2/1 UPSTREAM
(8W-30-11)
4
K4 18 BK/LB
S139 (3.9L/5.9L)
INTAKE AIR TEMPERATURE SENSOR
(8W-30-25)
●● 1
● A
OXYGEN SENSOR 1/2 DOWNSTREAM (4.7L)
(8W-30-17)
✱ 3
✱✱ 4
OXYGEN SENSOR 2/2 DOWNSTREAM (4.7L)
(8W-30-17)
3
S103
3.9L/5.9L
4.7L
B
TO
S101
(8W-70-4)
● 2
●● 1
ENGINE COOLANT TEMPERATURE SENSOR
(8W-30-25)
51
TRANSMISSION CONTROL MODULE
(8W-31-9)
1
ENGINE OIL PRESSURE SENSOR
(8W-30-24)
3
TRANSMISSION SOLENOID ASSEMBLY
(8W-31-2)
● 2.5L
●● EXCEPT 2.5L
✱ AUTO
✱✱ MANUAL

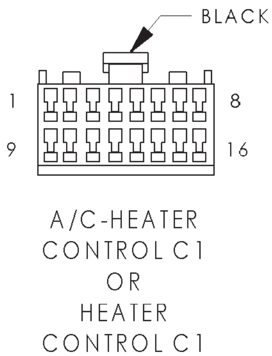

FROM
S103
(8W-70-3)
B
OXYGEN SENSOR 1/2 DOWNSTREAM (2.5L)
(8W-30-6)
(8W-30-11)
3
K4 18 BK/LB
3 C108
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-17)
OXYGEN SENSOR 2/1 UPSTREAM (4.7L)
(8W-30-17)
K4 18 BK/LB
S101
2.5L/4.7L
3.9L/5.9L
K4 16 BK/LB
K4 18 BK/LB
CAMSHAFT POSITION SENSOR
(8W-30-8)
(8W-30-14)
(8W-30-21)
MANIFOLD ABSOLUTE PRESSURE SENSOR
(8W-30-23)
THROTTLE POSITION SENSOR
(8W-30-23)
4 C1
POWERTRAIN CONTROL MODULE
(8W-30-4)
(8W-30-8)
EXCEPT 4.7L
4.7L
CRANKSHAFT POSITION SENSOR
(8W-30-8)
(8W-30-14)
CRANKSHAFT POSITION SENSOR
(8W-30-21)
● 2.5L
●● EXCEPT 2.5L
▲ 4.7L
▲▲ EXCEPT 4.7L

8W-80 CONNECTOR PINOUTS



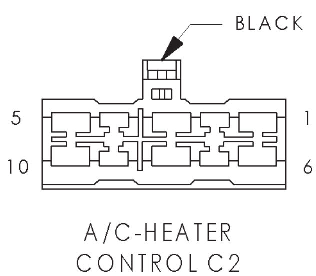
A/C COMPRESSOR CLUTCH (EXCEPT 2.5L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	C3 18DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
2	Z1 18BK	GROUND



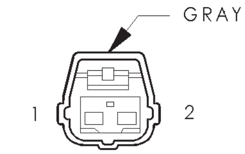
A/C-HEATER CONTROL C1 OR HEATER CONTROL C1 - BLACK 16 WAY

CAV	CIRCUIT	FUNCTION
1	F24 20RD/DG	FUSED IGNITION SWITCH OUTPUT (RUN)
2	Z1 20BK	GROUND
3	C57 20DB/GY	SENSOR GROUND
4	-	-
5	G32 20BK/LB	SENSOR GROUND
6	C21 20DB/OR	A/C SWITCH SENSE
7	Z1 20BK	GROUND
8	E2 20OR	PANEL LAMPS FEED
9	C62 20DB/PK	DUAL ZONE A/C ACTUATOR (+/-)
10	C35 20DG/YL	MODE DOOR DRIVER
11	C34 20DB/WT	COMMON DOOR DRIVER
12	C32 20GY/DB	RECIRCULATION DOOR DRIVER
13	G31 20VT/LG	AMBIENT TEMPERATURE SENSOR SIGNAL
14	-	-
15	C80 20DB/WT	REAR WINDOW DEFOGGER RELAY CONTROL
16	D25 20VT/YL	PCI BUS



A/C-HEATER CONTROL C2 - BLACK 10 WAY

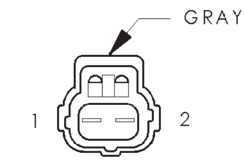
CAV	CIRCUIT	FUNCTION
1	-	-
2	C4 16TN	LOW SPEED BLOWER MOTOR DRIVER
3	C6 14LB	M2 SPEED BLOWER MOTOR DRIVER
4	-	-
5	Z1 10BK	GROUND
6	-	-
7	C5 14LG	M1 SPEED BLOWER MOTOR DRIVER
8	-	-
9	-	-
10	C7 12BK/TN	HIGH SPEED BLOWER MOTOR DRIVER



A/C LOW PRESSURE SWITCH (2.5L/3.9L/5.9L)

A/C LOW PRESSURE SWITCH (2.5L/3.9L/5.9L) - GRAY 2 WAY

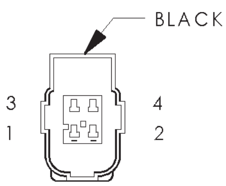
CAV	CIRCUIT	FUNCTION
1	Z1 18BK (3.9L/5.9L)	GROUND
1	C20 18BR (2.5L)	A/C SWITCH SENSE
2	C20 18BR (3.9L/5.9L)	A/C SWITCH SENSE
2	Z1 18BK (2.5L)	GROUND



A/C LOW PRESSURE SWITCH (4.7L)

A/C LOW PRESSURE SWITCH (4.7L) - GRAY 2 WAY

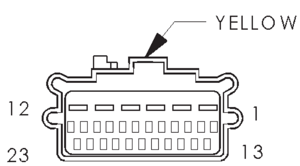
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	C20 18BR	A/C SWITCH SENSE



A/C PRESSURE TRANSDUCER

A/C PRESSURE TRANSDUCER - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K6 18VT/WT	5V SUPPLY
3	C18 18DB	A/C PRESSURE SIGNAL
4	-	-



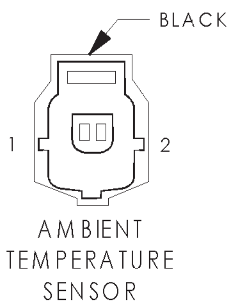
AIRBAG CONTROL MODULE

AIRBAG CONTROL MODULE - YELLOW 23 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	-	-
4	Z6 18BK/PK	GROUND
5	R45 18DG/LB	AIRBAG LINE 2
6	R43 18BK/LB	AIRBAG LINE 1
7	R42 18BK/YL	PASSENGER AIRBAG LINE 1
8	R44 18DG/YL	PASSENGER AIRBAG LINE 2
9	R54 18LB/YL	PASSENGER SEATBELT TENSIONER LINE 2
10	R56 18LB/DG	PASSENGER SEATBELT TENSIONER LINE 1
11	R55 18LG/DG	DRIVER SEATBELT TENSIONER (-) LINE 1
12	R166 20LG/BR	PASSENGER AIRBAG INDICATOR DRIVER
12	R53 18LG/YL	DRIVER SEATBELT TENSIONER (+) LINE 2
13	-	-
14	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
15	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
16	-	-
17	-	-
18	-	-
19	R66 20LG/DG	PASSENGER AIRBAG MUX SWITCH RETURN
20	R65 20LG/OR	PASSENGER AIRBAG MUX SWITCH SENSE

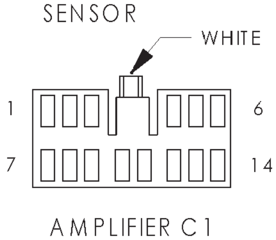
AIRBAG CONTROL MODULE - YELLOW 23 WAY

CAV	CIRCUIT	FUNCTION
21	D25 18VT/YL	PCI BUS
22	-	-
23	-	-



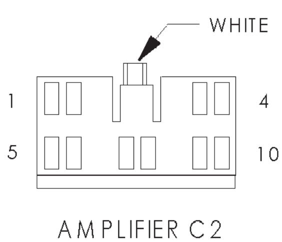
AMBIENT TEMPERATURE SENSOR - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	G31 18VT/LG	AMBIENT TEMPERATURE SENSOR SIGNAL
2	G32 18BK/LB	SENSOR GROUND



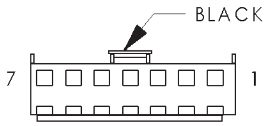
AMPLIFIER C1 - WHITE 14 WAY

CAV	CIRCUIT	FUNCTION
1	F75 18VT	FUSED B(+)
2	F75 18VT	FUSED B(+)
3	-	-
4	X87 18LG/VT	AMPLIFIED LEFT DOOR SPEAKER (+)
5	X94 18TN/VT	AMPLIFIED RIGHT REAR SPEAKER (+)
6	X93 18WT/RD	AMPLIFIED LEFT REAR SPEAKER (+)
7	Z46 18BK/LB	GROUND
8	Z47 18BK/LB	GROUND
9	D25 20VT/YL	PCI BUS
10	X80 18LB/BK	AMPLIFIED RIGHT DOOR SPEAKER (-)
11	X82 18LB/VT	AMPLIFIED RIGHT DOOR SPEAKER (+)
12	X85 18LG/DG	AMPLIFIED LEFT DOOR SPEAKER (-)
13	X92 18TN/BK	AMPLIFIED RIGHT REAR SPEAKER (-)
14	X91 18WT/BK	AMPLIFIED LEFT REAR SPEAKER (-)



AMPLIFIER C2 - WHITE 10 WAY

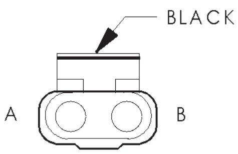
CAV	CIRCUIT	FUNCTION
1	X55 20BR/RD	LEFT FRONT SPEAKER (-)
2	X56 20DB/RD	RIGHT FRONT SPEAKER (-)
3	X58 20DB/OR	RIGHT REAR SPEAKER (-)
4	X60 20DG/RD	RADIO 12V OUTPUT
5	X53 20DG	LEFT FRONT SPEAKER (+)
6	X54 20VT	RIGHT FRONT SPEAKER (+)
7	X51 20BR/YL	LEFT REAR SPEAKER (+)
8	X57 20BR/LB	LEFT REAR SPEAKER (-)
9	X52 20DB/WT	RIGHT REAR SPEAKER (+)
10	-	-



AUTOMATIC DAY/NIGHT MIRROR

AUTOMATIC DAY/NIGHT MIRROR - BLACK 7 WAY

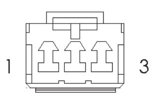
CAV	CIRCUIT	FUNCTION
1	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
2	Z1 20BK	GROUND
3	L1 18VT/BK	BACK-UP LAMP FEED
4	-	-
5	-	-
6	-	-
7	-	-



BACK-UP LAMP SWITCH

BACK-UP LAMP SWITCH - BLACK 2 WAY

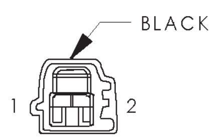
CAV	CIRCUIT	FUNCTION
A	L1 18VT/BK (3.9L/5.9L)	BACK-UP LAMP FEED
A	L1 18VT/BK (EXCEPT 3.9L/5.9L)	BACK-UP LAMP FEED
B	L10 18BR/LG (3.9L/5.9L)	TRS REVERSE SENSE
B	L10 18BR/LG (EXCEPT 3.9L/5.9L)	FUSED IGNITION SWITCH OUTPUT (RUN)



BASE OVERHEAD CONSOLE

BASE OVERHEAD CONSOLE - 3 WAY

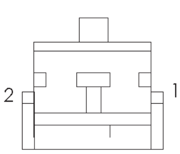
CAV	CIRCUIT	FUNCTION
1	Y158 20YL/VT	INTERIOR LAMP DRIVER
2	M1 20PK	FUSED B(+)
3	M2 20YL	COURTESY LAMP DRIVER



BATTERY TEMPERATURE SENSOR

BATTERY TEMPERATURE SENSOR - BLACK 2 WAY

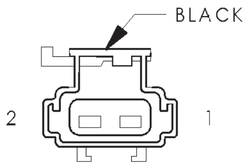
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL



BLEND DOOR ACTUATOR

BLEND DOOR ACTUATOR - 2 WAY

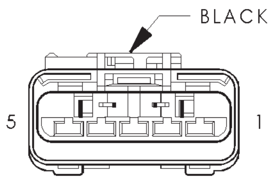
CAV	CIRCUIT	FUNCTION
1	C62 20DB/PK	BLEND DOOR DRIVER
2	C34 20DB/WT	COMMON DOOR DRIVER



BLOWER MOTOR

BLOWER MOTOR - BLACK 2 WAY

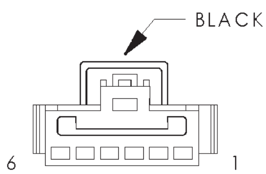
CAV	CIRCUIT	FUNCTION
1	C1 12DG	BLOWER MOTOR FEED
2	C73 12DB/YL	BLOWER MOTOR COMMON DRIVER



BLOWER MOTOR RESISTOR BLOCK

BLOWER MOTOR RESISTOR BLOCK - BLACK 5 WAY

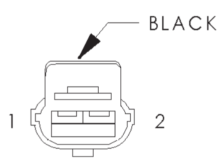
CAV	CIRCUIT	FUNCTION
1	C7 12BK/TN	HIGH SPEED BLOWER MOTOR DRIVER
2	C73 12DB/YL	COMMON DRIVER
3	C6 14LB	M2 SPEED BLOWER MOTOR DRIVER
4	C5 14LG/YL	M1 SPEED BLOWER MOTOR DRIVER
5	C4 16TN	LOW SPEED BLOWER MOTOR DRIVER



BRAKE LAMP SWITCH

BRAKE LAMP SWITCH - BLACK 6 WAY

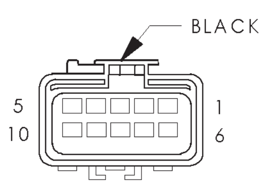
CAV	CIRCUIT	FUNCTION
1	F32 14PK/DB	FUSED B(+)
2	L50 14WT/TN	BRAKE LAMP SWITCH OUTPUT
3	V30 20DB/RD	BRAKE LAMP SWITCH OUTPUT
4	V32 20YL/RD	SPEED CONTROL SUPPLY
5	Z2 18BK/LG	GROUND
6	V40 20WT/PK	BRAKE LAMP SWITCH SENSE



BRAKE PRESSURE SWITCH

BRAKE PRESSURE SWITCH - BLACK 2 WAY

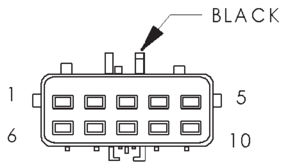
CAV	CIRCUIT	FUNCTION
1	B10 20BR/WT	BRAKE PRESSURE SWITCH SENSE
2	Z1 20BK	GROUND



C105

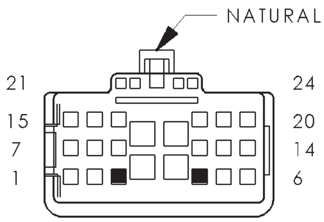
C105 - BLACK (ENGINE SIDE)

CAV	CIRCUIT
1	K30 18PK (3.9L/5.9L)
2	T16 16RD (EXCEPT 2.5L)
3	Y193 20WT/LG (4.7L)
4	Y128 20DG/GY (EXCEPT 2.5L)
5	K6 18VT/WT
6	K125 18WT/DB
7	C18 18DB
8	A142 14DG/OR
9	C20 18BR
10	F84 16YL/WT (4.7L)



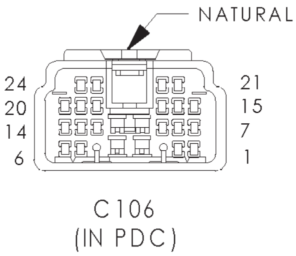
C105 - BLACK (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	K30 18PK (3.9L/5.9L)
2	T16 16RD (EXCEPT 2.5L)
3	Y193 20WT/LG
4	Y128 20DG/GY
5	K6 18VT/WT
6	K125 18WT/DB
7	C18 18DB
8	A142 14DG/OR
9	C20 18BR
10	F84 16YL/WT (4.7L)



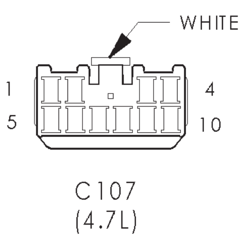
C106 - NATURAL (ENGINE SIDE)

CAV	CIRCUIT
1	F142 18OR/DG (3.9L/5.9L)
1	F142 16OR/DG (EXCEPT 3.9L/5.9L)
2	Y112 18YL/BR (EXCEPT 2.5L)
3	Y124 16DG/VT (EXCEPT 2.5L)
4	Y125 16DG/WT (EXCEPT 2.5L)
5	Y115 18YL/WT (EXCEPT 2.5L)
6	Y117 18YL/DB (EXCEPT 2.5L)
7	Y119 18YL/TN (EXCEPT 2.5L)
8	Y114 18YL/VT (EXCEPT 2.5L)
9	L1 18VT/BK
10	A142 14DG/OR
11	F242 18DG/PK (3.9L/5.9L)
12	A14 16RD/WT
13	L10 18BR/LG
14	G7 20DB (3.9L/5.9L)
15	Y113 18YL/OR (EXCEPT 2.5L)
16	K200 18VT/OR
17	K100 18VT/WT
18	F18 18LG/BK
19	K125 18WT/DB
20	D25 18VT/YL (4.7L)
21	K4 18BK/LB (EXCEPT 2.5L)
22	T41 18BK/WT (EXCEPT 2.5L)
23	C3 18DB/BK
24	-



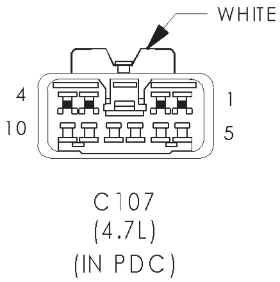
C106 - NATURAL (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	F142 16OR/DG
2	Y112 18YL/BR
3	Y124 16DG/VT
4	Y125 16DG/WT
5	Y115 18YL/WT
6	Y117 18YL/DB
7	Y119 18YL/TN
8	Y114 18YL/VT
9	L1 18VT/BK
10	A142 14DG/OR
11	A169 18RD/YL (4.7L)
11	F242 16DG/OR (3.9L/5.9L)
12	A14 16RD/WT
13	L10 18BR/LG
14	G7 18WT/OR
15	Y113 18YL/OR
16	K200 18VT/OR
17	K100 18VT/WT
18	F18 20LG/BK
19	K125 18WT/DB
20	D25 18VT/YL (4.7L)
20	C24 18DB/PK (EXCEPT 4.7L)
21	K4 18BK/LB (EXCEPT 2.5L)
22	T41 18BK/WT (EXCEPT 2.5L)
23	C3 18DB/BK
24	-



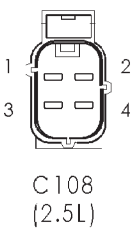
C107 (4.7L) - WHITE (ENGINE SIDE)

CAV	CIRCUIT
1	-
2	D22 20PK/BK
3	D21 18PK
4	F11 18RD/WT
5	T15 18LG
6	F242 18DG/OR
7	T6 18OR/WT
8	T10 18YL/DG
9	-
10	C24 18DB/PK



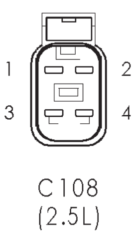
C107 (4.7L) (IN PDC) - WHITE (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	-
2	D22 20PK/BK
3	D21 18PK
4	F11 18RD/WT
5	T15 18LG
6	F242 18DG/PK
7	T6 18OR/WT
8	T10 18YL/DG
9	-
10	F242 18DG/OR



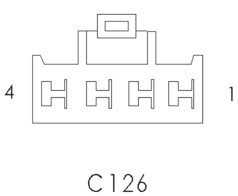
C108 (2.5L) - (ENGINE SIDE)

CAV	CIRCUIT
1	F142 18OR/DG
2	K200 18VT/OR
3	K4 18BK/LB
4	K141 18TN/WT



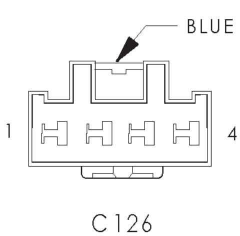
C108 (2.5L) - (OXYGEN SENSOR JUMPER)

CAV	CIRCUIT
1	F142 18OR/DG
2	K200 18VT/OR
3	K4 18BK/LB
4	K141 18TN/WT



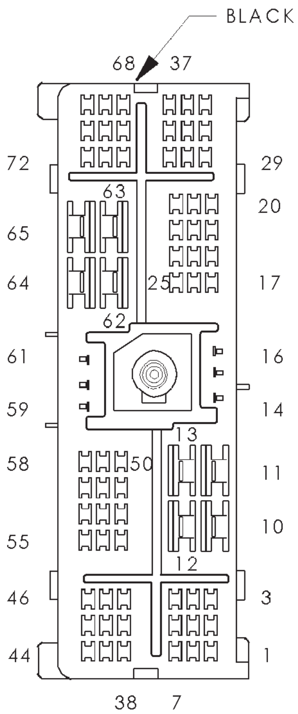
C126 - (ELECTRIC BRAKE SIDE)

CAV	CIRCUIT
1	A6 12RD/BK
2	B40 12LB
3	L50 18WT/TN
4	Z1 12BK



C126 - BLUE (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	Y202 12RD/TN
2	B40 14LB
3	L50 14WT/TN
4	Z1 14BK



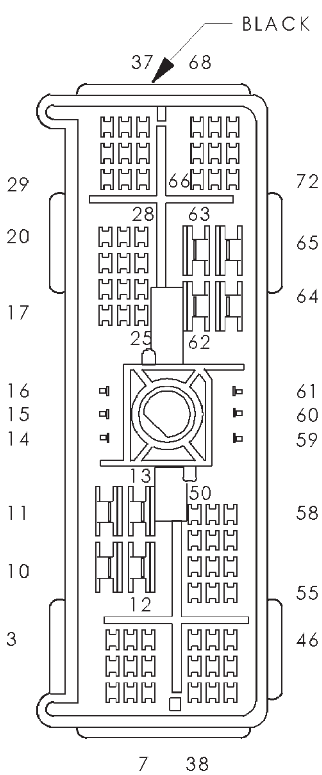
C200

C200 - BLACK (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	V40 20WT/OR
2	-
3	-
4	G32 18BK/LB
5	-
6	-
7	G31 18VT/LG
8	-
9	-
10	A111 10RD/LB
11	Y124 16DG/VT
12	F91 12GY/RD
13	C15 10BK/WT
14	-
15	A19 16RD/YL
16	Y125 16DG/WT
17	-
18	L39 12LB
19	-
20	D21 18PK
21	-
22	D20 18LG
23	-
24	-
25	V23 16BR/PK
26	D22 20PK/BK (4.7L)
27	Y113 18YL/OR
28	-
29	K4 18BK/LB (EXCEPT 2.5L)
30	-
31	-
32	-
33	V30 20DB/RD (SPEED CONTROL)
34	L63 16DG/RD
35	-
36	-
37	L62 16BR/RD
38	T6 18OR/WT (EXCEPT 2.5L)
39	-
40	-
41	-
42	V49 18RD/BK
43	D25 18VT/YL
44	-
45	-
46	D25 18VT/YL
47	Y112 18YL/BR
48	Y119 18YL/TN
49	-
50	T41 18BK/WT
51	Y115 18YL/WT
52	Y114 18YL/VT

C200 - BLACK (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
53	V45 18VT
54	Y128 20DG/GY
55	Y117 18YL/DB
56	Z2 18BK/LG
57	D25 18VT/YL
58	Y193 20WT/LG
59	A34 16LB/RD
60	V48 18RD/GY
61	L9 14BK/WT
62	A2 12BR/WT
63	C40 12BR/WT
64	A1 12RD
65	A18 12RD/BK
66	-
67	C80 18DB/WT
68	F18 20LG/BK
69	G29 18BK/TN
70	C43 18OR/LB
71	V32 18YL/RD (EXCEPT 2.5L)
72	F32 14PK/DB
73	V37 18RD/LG (EXCEPT 2.5L)
74	V20 18BK/WT

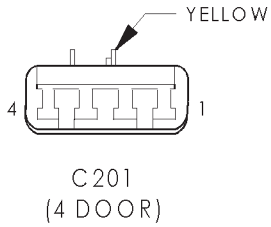


C200 - BLACK (INSTRUMENT PANEL SIDE)

CAV	CIRCUIT
1	V40 20WT/PK
2	-
3	-
4	G32 20BK/LB
5	-
6	-
7	G31 20VT/LG
8	-
9	-
10	A111 10RD/LB
11	Y124 16DG/VT
12	F91 12GY/RD
13	C15 12BK/WT
14	-
15	A19 16RD/YL
16	Y125 16DG/WT
17	-
18	L39 18LB
19	-
20	D21 20PK
21	-
22	D20 20LG
23	-
24	-
25	V23 16BR/PK
26	D22 20PK/BK

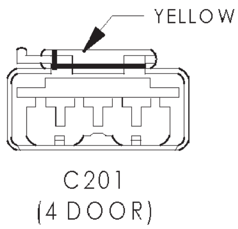
C200 - BLACK (INSTRUMENT PANEL SIDE)

CAV	CIRCUIT
27	Y113 18YL/OR
28	-
29	K4 20BK/LB (EXCEPT 2.5L)
30	-
31	-
32	-
33	V30 20DB/RD
34	L63 16DG/RD
35	-
36	-
37	L62 16BR/RD
38	T6 20OR/WT (EXCEPT 2.5L)
39	-
40	-
41	-
42	V49 18RD/BK
43	D25 18VT/YL
44	-
45	-
46	D25 18VT/YL
47	Y112 18YL/BR
48	Y119 18YL/TN
49	-
50	T41 18BK/WT
51	Y115 18YL/WT
52	Y114 18YL/VT
53	V45 18VT
54	Y128 20DG/GY
55	Y117 18YL/DB
56	Z2 20BK/LG
57	D25 20VT/YL
58	Y193 20ST/LG
59	A34 16LB/RD
60	V48 16RD/GY
61	L9 14BK/WT
62	A2 12PK/BK
63	-
64	A1 12RD
65	A18 12RD/BK
66	-
67	C80 20DB/WT
68	F18 20LG/BK
69	G29 18BK/TN
70	C43 20OR/LB
71	V32 20YL/RD
72	F32 14PK/DB
73	V37 20RD/LG (EXCEPT 2.5L)
74	V20 20BK/WT



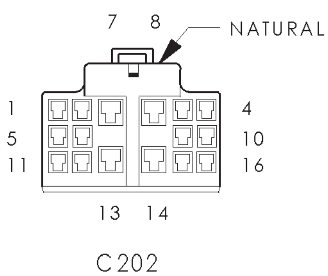
C201 (4 DOOR) - YELLOW (BODY SIDE)

CAV	CIRCUIT
1	Z2 20BK/LG
2	G73 20LG/OR



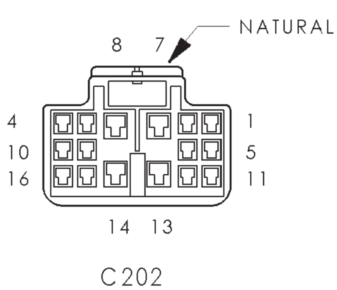
C201 (4 DOOR) - YELLOW (INSTRUMENT PANEL SIDE)

CAV	CIRCUIT
1	M1 20PK
1	M1 20PK
2	M3 20PK/DB
2	M3 20PK/DB



C202 - NATURAL (INSTRUMENT PANEL SIDE)

CAV	CIRCUIT
1	-
2	-
3	-
4	-
5	C35 20DG/YL
6	C57 20DB/GY
7	C5 14LG
8	C6 14LB
9	C62 20DB/GY
10	C4 16TN
11	C21 20DB/OR
12	C32 20GY/DB
13	C1 12DG
14	C7 12BK/TN
15	-
16	C34 20DB/WT

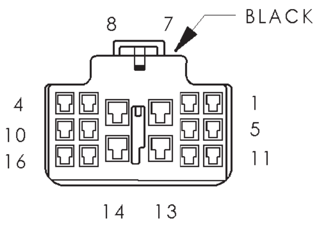


C202 - NATURAL (FRONT HVAC JUMPER SIDE)

CAV	CIRCUIT
1	-
2	-
3	-
4	-
5	C35 20DG/YL
6	C57 20DB/GY
7	C5 14LG/YL
8	C6 14LB
9	C62 20DB/PK

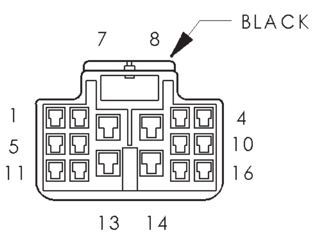
C202 - NATURAL (FRONT HVAC JUMPER SIDE)

CAV	CIRCUIT
10	C4 16TN
11	C21 20DB/OR
12	C32 20GYDB
13	C1 12DG
14	C7 12BK/TN
15	-
16	C34 20DB/WT



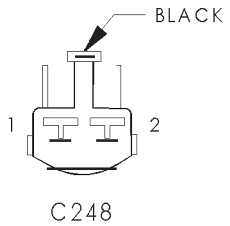
C246 - BLACK (INSTRUMENT PANEL SIDE)

CAV	CIRCUIT
1	X87 18LG/VT
2	X85 18LG/DG
3	X82 18LB/VT
4	X80 18LB/BK
5	X93 18WT/RD
6	X91 18WT/BK
7	C15 12BK/WT
8	F91 12GY/RD
9	X94 18TN/VT
10	X92 18TN/BK
11	D25 20VT/YL
12	C63 20LB
13	-
14	C70 12DG
15	G13 20BR/RD
16	-



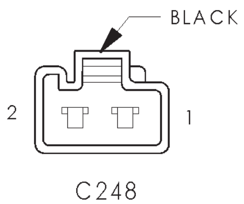
C246 - BLACK (BODY SIDE)

CAV	CIRCUIT
1	X87 18LG/VT
2	X85 18LG/DG
3	X82 18LB/VT
4	X80 18LB/BK
5	X93 18WT/RD
6	X91 18WT/BK
7	C15 12BK/WT (REAR WINDOW DEFOG-GER)
8	F91 12GY/RD (EXCEPT STANDARD)
9	X94 18TN/VT
10	X92 18TN/BK
11	D25 20VT/YL
12	-
13	-
14	-
15	G13 20DB/RD
16	-



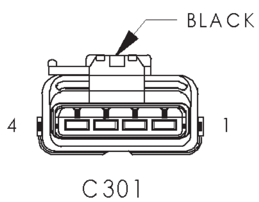
C248 - BLACK (BODY SIDE)

CAV	CIRCUIT
1	Z1 14BK
2	F91 12GY/RD



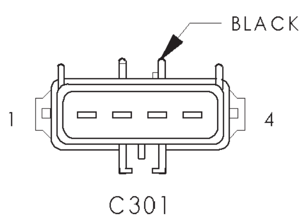
C248 - BLACK (DRIVER SEAT SIDE)

CAV	CIRCUIT
1	Z1 12BK
2	A4 12BK/PK



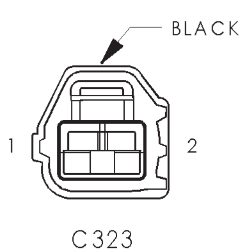
C301 - BLACK (BASE CONSOLE SIDE)

CAV	CIRCUIT
1	A12 16RD/TN
2	M1 20PK
3	Z1 16BK
4	Y158 20YL/VT



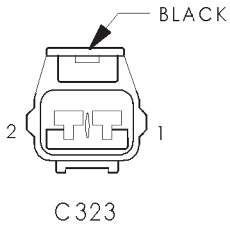
C301 - BLACK (BODY SIDE)

CAV	CIRCUIT
1	A12 16RD/TN
2	M1 20PK
3	Z1 16BK (4 DOOR)
3	Z1 18BK (2 DOOR)
4	Y158 20YL/VT



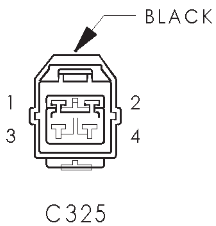
C323 - BLACK (BODY SIDE)

CAV	CIRCUIT
1	Z1 20BK
2	L7 20BK/YL



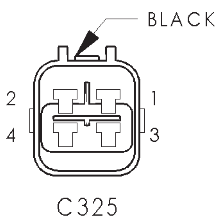
C323 - BLACK (CHASSIS SIDE)

CAV	CIRCUIT
1	Z1 18BK (STEP BUMPER)
1	Z1 20BK (SPORT BUMPER)
2	L7 18BK/YL



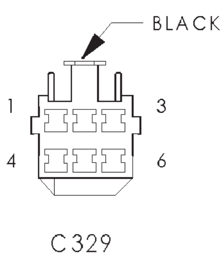
C325 - BLACK (TAIL LAMPS SIDE)

CAV	CIRCUIT
1	L7 20BK/YL
2	Z1 20BK
3	L632 16DG/RD
4	L1 20VT/BK



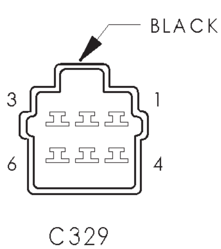
C325 - BLACK (CHASSIS SIDE)

CAV	CIRCUIT
1	L7 20BK/YL
2	Z1 20BK
3	L63 16DG/RD
4	L1 20VT/BK



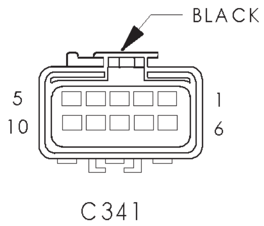
C329 - BLACK (BODY SIDE)

CAV	CIRCUIT
1	M1 20PK
2	M3 20PK/DB
3	L50 14WT/TN
4	Z1 18BK
5	-
6	-



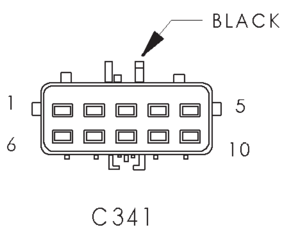
C329 - BLACK (CARGO LAMPS SIDE)

CAV	CIRCUIT
1	M1 20PK (CARGO LAMPS)
2	M3 20PK/DB (CARGO LAMPS)
3	L50 18WT/TN
4	Z1 20BK
5	-
6	-



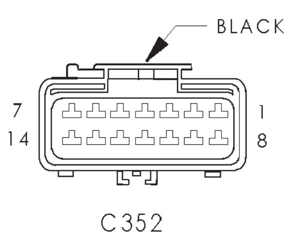
CAV	CIRCUIT
1	-
2	L62 16BR/RD
3	L1 20VT/BK
4	Y203 16RD/WT
5	L207 18YL/BK
6	-
7	B40 14LB
8	Z1 14BK
9	Z1 14BK
10	L63 16DG/RD

C341 - BLACK (CHASSIS SIDE)



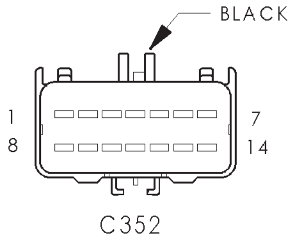
C341 - BLACK (TRAILER TOW)

CAV	CIRCUIT
1	-
2	L62 18BK/PK
3	L1 20VT/BK
4	Y203 16RD/WT
5	L207 18BK/OR
6	-
7	B40 14LB
8	Z1 14BK
9	Z1 14BK
10	L63 18DG/RD



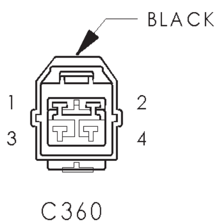
C352 - BLACK (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	L1 18VT/BK
2	L62 16BR/RD
3	L63 16DG/RD
4	Y203 16RD/WT
5	L207 18YL/BK
6	B40 14LB
7	L50 14WT/TN
8	L7 20BK/YL
9	B113 20RD/VT
10	B114 20WT/VT
11	K4 18BK/LB
12	K226 18DB/WT
13	A61 16DG/BK
14	Z1 16BK



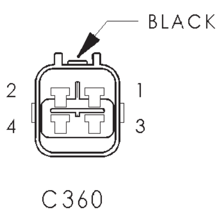
C352 - BLACK (CHASSIS SIDE)

CAV	CIRCUIT
1	L1 20VT/BK
2	L62 16BR/RD
2	L62 16BR/RD
3	L63 16DG/RD
3	L63 16DG/RD
4	Y203 16RD/WT
5	L207 18YL/BK
6	B40 14LB
7	L50 18WT/TN
8	L7 20BK/YL
9	B113 20RD/VT
10	B114 20WT/VT
11	K4 18BK/LB
12	K226 18DB/WT
13	A61 16DG/BK
14	Z1 16BK



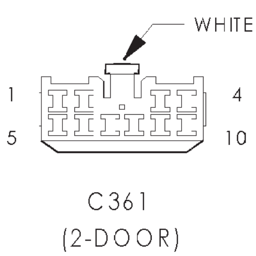
C360 - BLACK (TAIL LAMPS SIDE)

CAV	CIRCUIT
1	L7 20BK/YL
2	Z1 20BK
3	L632 16DG/BR
4	L1 20VT/BK



C360 - BLACK (CHASSIS SIDE)

CAV	CIRCUIT
1	L7 20BK/YL
2	Z1 20BK
3	L62 16BR/RD
3	L62 16BR/RD
4	L1 20VT/BK

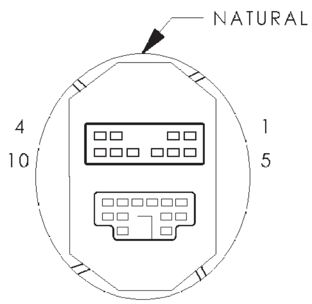


C361 (2 DOOR) - WHITE (BODY SIDE)

CAV	CIRCUIT
1	Q1 14YL
2	-
3	-
4	P34 16PK/BK
5	P33 16OR/BK
6	Q26 14VT/WT

C361 (2 DOOR) - WHITE (BODY SIDE)

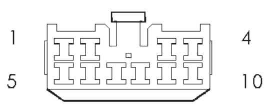
CAV	CIRCUIT
7	Q16 14BR/WT
8	G73 20LG/OR
9	P96 20WT/LG
10	-



C361
(2-DOOR)

C361 (2 DOOR) - NATURAL (RIGHT FRONT DOOR SIDE)

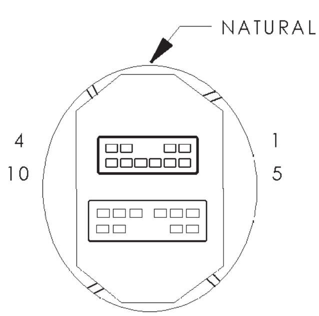
CAV	CIRCUIT
1	Q1 14YL
2	-
3	-
4	P34 18PK/BK
5	P33 18OR/BK
6	Q26 14VT/WT
7	Q16 14BR/WT
8	G73 20LG/OR (VTSS)
9	P96 20WT/LG
10	-



C361
(4-DOOR)

C361 (4 DOOR) - WHITE (BODY SIDE)

CAV	CIRCUIT
1	-
2	-
3	-
4	P34 16PK/BK
5	P33 16OR/BK
6	Q26 14VT/WT
7	Q16 14BR/WT
8	G73 20LG/OR (VTSS)
9	L10 18BR/LG
10	P96 20WT/LG



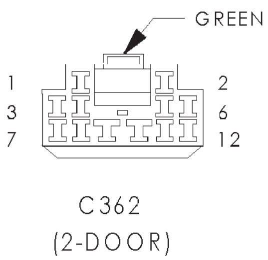
C361
(4-DOOR)

C361 (4 DOOR) - NATURAL (RIGHT FRONT DOOR SIDE)

CAV	CIRCUIT
1	-
2	-
3	-
4	P34 18PK/BK
5	P33 18OR/BK
6	Q26 14VT/WT
7	Q16 14BR/WT
8	G73 20LG/OR (VTSS)

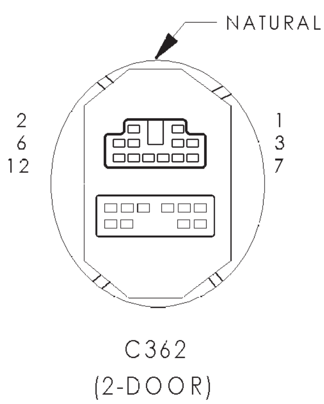
C361 (4 DOOR) - NATURAL (RIGHT FRONT DOOR SIDE)

CAV	CIRCUIT
9	L10 20BR/LG
10	P96 20WT/LG



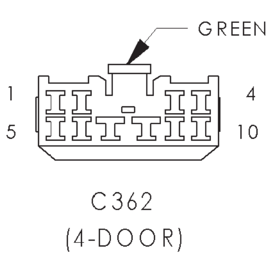
C362 (2 DOOR) - GREEN (BODY SIDE)

CAV	CIRCUIT
1	P76 22OR/YL
2	P74 22DB
3	P72 22YL/BK
4	X82 18LB/VT
5	X80 18LB/BK
6	-
7	G74 20TN/RD
8	Z2 20BK/LG
9	-
10	Z1 20BK
11	F121 20TN/BK
12	L10 18BR/LG



C362 (2 DOOR) - NATURAL (RIGHT FRONT DOOR SIDE)

CAV	CIRCUIT
1	P76 22OR/YL
2	P74 22DB
3	P72 22YL/BK
4	X82 18LB/VT
5	X80 18LB/BK
6	-
7	G74 20TN/RD
8	Z2 20BK/LG
9	-
10	Z1 20BK
11	F121 20TN/BK
12	L10 18BR/LG

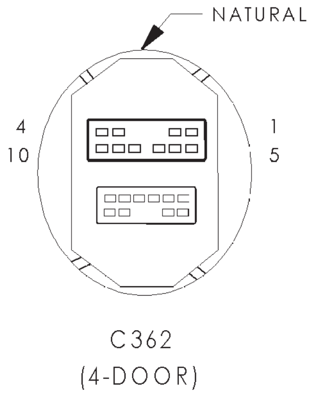


C362 (4 DOOR) - GREEN (BODY SIDE)

CAV	CIRCUIT
1	P76 22OR/YL
2	P74 22DB
3	P72 22YL/BK
4	X82 18LB/VT
5	X80 18LB/BK
6	G74 20TN/RD
7	Q1 14YL (POWER WINDOWS/LOCKS)
8	F121 20TN/BK (HEATED MIRRORS)
9	Z1 20BK

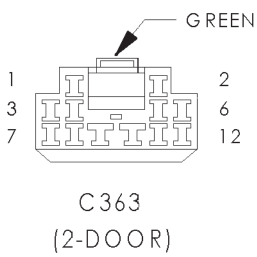
C362 (4 DOOR) - GREEN (BODY SIDE)

CAV	CIRCUIT
10	Z2 20BK/LG



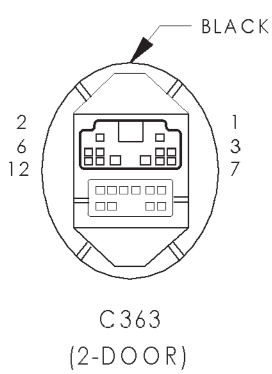
C362 (4 DOOR) - NATURAL (RIGHT FRONT DOOR SIDE)

CAV	CIRCUIT
1	P76 22OR/YL
2	P74 22DB
3	P72 22YL/BK
4	X82 18LB/VT
5	X80 18LB/BK
6	G74 20TN/RD (POWER WINDOWS/ LOCKS)
7	Q1 14YL (POWER WINDOWS/LOCKS)
8	F121 20TN/BK (HEATED MIRRORS)
9	Z1 20BK
10	Z2 20BK/TN



C363 (2 DOOR) - GREEN (BODY SIDE (PREMIUM))

CAV	CIRCUIT
1	P76 22OR/YL
2	P74 22DB
3	P72 22YL/BK
4	X87 18LG/VT
5	X85 18LG/DG
6	M1 20PK
7	G75 20TN
8	Z2 20BK/LG
9	F21 12TN (POWER WINDOWS/LOCKS)
10	Z1 14BK (POWER WINDOWS/LOCKS)
11	F121 20TN/BK
12	-

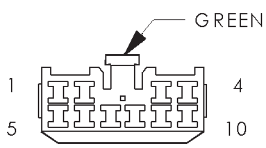


C363 (2 DOOR) - BLACK (LEFT FRONT DOOR SIDE (PREMIUM))

CAV	CIRCUIT
1	P76 22OR/YL
2	P74 22DB (HEATED MIRRORS)
3	P72 22YL/BK (HEATED MIRRORS)
4	X87 18LG/VT
5	X85 18LG/DG
6	M1 20PK (POWER MIRRORS)
7	G75 20TN
8	Z2 20BK/LG
9	F21 14TN (POWER WINDOWS/LOCKS)
10	Z1 14BK
11	F121 20TN/BK

C363 (2 DOOR) - BLACK (LEFT FRONT DOOR SIDE (PREMIUM))

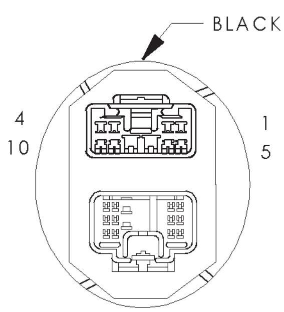
CAV	CIRCUIT
12	-



C363
(4-DOOR)

C363 (4 DOOR) - GREEN (BODY SIDE (PREMIUM))

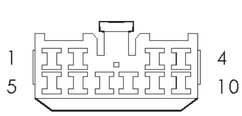
CAV	CIRCUIT
1	P76 22OR/YL
2	P74 22DB
3	P72 22YL/BK
4	X87 18LG/VT
5	X85 18LG/DG
6	G75 20TN
7	Z1 12BK (POWER WINDOWS/LOCKS)
8	F121 20TN/BK (HEATED MIRRORS)
9	M1 20PK
10	Z2 20BK/LG



C363
(4-DOOR)

C363 (4 DOOR) - BLACK (LEFT FRONT DOOR SIDE (PREMIUM))

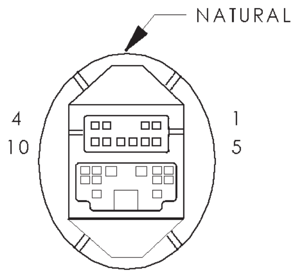
CAV	CIRCUIT
1	P76 22OR/YL
2	P74 22DB (POWER MIRRORS)
3	P72 22YL/BK (POWER MIRRORS)
4	X87 18LG/VT
5	X85 18LG/DG
6	G75 20TN
7	Z1 12BK
8	F121 20TN/BK (HEATED MIRRORS)
9	M1 20PK (POWER MIRRORS)
10	Z2 20BK/LG



C364
(2-DOOR)

C364 (2 DOOR) - (BODY SIDE)

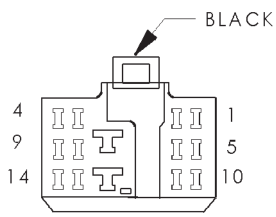
CAV	CIRCUIT
1	Q1 14YL
2	-
3	-
4	P34 16PK/BK
5	P33 16OR/BK
6	Q26 14VT/WT
7	Q16 14BR/WT
8	G73 20LG/OR
9	P97 18WT/DG
10	-



C364
(2-DOOR)

C364 (2 DOOR) - NATURAL (LEFT FRONT DOOR SIDE)

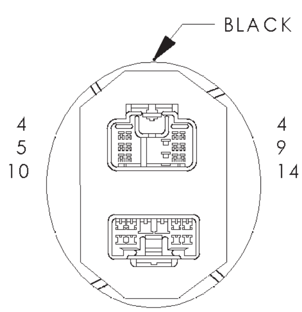
CAV	CIRCUIT
1	Q1 14YL
2	-
3	-
4	P34 18PK/BK
5	P33 16OR/BK
6	Q26 14VT/WT
7	Q16 14BR/WT
8	G73 20LG/OR
9	P97 20WT/DG
10	-



C364
(4-DOOR)

C364 (4 DOOR) - BLACK (BODY SIDE)

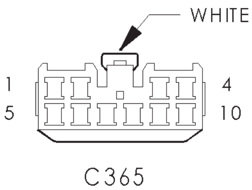
CAV	CIRCUIT
1	-
2	-
3	P97 18WT/DG
4	P59 18DB
5	P33 16OR/BK
6	Q26 14VT/WT
7	Q1 14YL
8	F21 12TN
9	Q28 14DG/WT
10	G73 20LG/OR
11	Q18 14GY/BK
12	Q16 14BR/WT
13	Q27 14RD/BK
14	Q17 14DB/WT



C364
(4-DOOR)

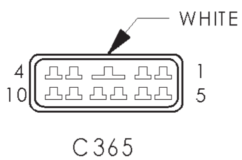
C364 (4 DOOR) - BLACK (LEFT FRONT DOOR SIDE)

CAV	CIRCUIT
1	P114 20YL/BK
2	P115 20YL/DB
3	P97 20WT/DG
4	P59 18DB
5	P33 18OR/BK
6	Q26 14VT/WT
7	Q1 14YL
8	F21 14TN
9	Q28 14DG/WT
10	G73 20LG/OR (VTSS)
11	Q18 14GY/BK
12	Q16 14BR/WT
13	Q27 14RD/BK
14	Q17 14DB/WT



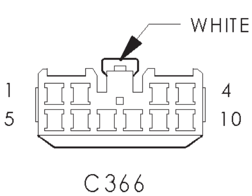
C365 - WHITE (BODY SIDE)

CAV	CIRCUIT
1	Z2 20BK/LG
2	G74 20TN/RD
3	P33 16OR/BK
4	P34 16PK/BK
5	Q1 14YL (POWER WINDOWS/LOCKS)
6	Q17 14DB/WT (POWER WINDOWS/ LOCKS)
7	Q27 14RD/BK (POWER WINDOWS/ LOCKS)
8	X93 18WT/RD
9	X91 18WT/BK
10	-



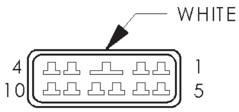
C365 - WHITE (REAR DOOR SIDE) (LEFT)

CAV	CIRCUIT
1	Z2 20BK/LG
2	G74 18TN/RD
3	P33 16OR/BK (POWER WINDOWS/ LOCKS)
4	P34 16PK/BK (POWER WINDOWS/ LOCKS)
5	Q1 14YL
6	Q17 14DB/WT
7	Q27 14RD/BK
8	X93 18WT/RD
9	X91 18WT/BK
10	-



C366 - WHITE (BODY SIDE)

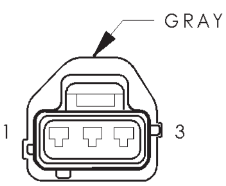
CAV	CIRCUIT
1	Z2 20BK/LG
2	G74 20TN/RD
3	P33 16OR/BK
4	P34 16PK/BK
5	Q1 14YL (POWER WINDOWS/LOCKS)
6	Q18 14GY/BK (POWER WINDOWS/ LOCKS)
7	Q28 14DG/WT
8	X94 18TN/VT
9	X92 18TN/BK
10	-



C366

C366 - WHITE (REAR DOOR) (RIGHT)

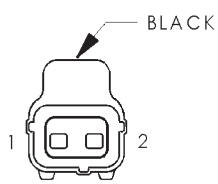
CAV	CIRCUIT
1	Z2 20BK/LG
2	G74 18TN/RD
3	P33 16OR/BK (POWER WINDOWS/ LOCKS)
4	P34 16PK/BK (POWER WINDOWS/ LOCKS)
5	Q1 14YL
6	Q18 14GY/BK
7	Q28 14DG/WT
8	X94 18TN/VT
9	X92 18TN/BK
10	-



CAMSHAFT POSITION SENSOR

CAMSHAFT POSITION SENSOR - GRAY 3 WAY

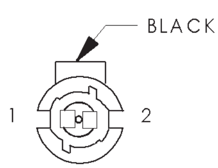
CAV	CIRCUIT	FUNCTION
1	K44 18TN/YL (3.9L/5.9L)	CAMSHAFT POSITION SENSOR SIGNAL
1	K44 16TN/YL (2.5L)	CAMSHAFT POSITION SENSOR SIGNAL
2	K4 18BK/LB (3.9L/5.9L)	SENSOR GROUND
2	K4 16BK/LB (2.5L)	SENSOR GROUND
3	K7 16OR (3.9L/5.9L)	5V SUPPLY
3	K7 18OR (2.5L)	5V SUPPLY



CAPACITOR

CAPACITOR - BLACK 2 WAY

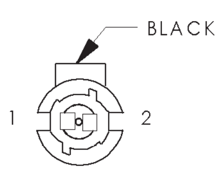
CAV	CIRCUIT	FUNCTION
1	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	-	-



CARGO LAMP NO. 1

CARGO LAMP NO. 1 - BLACK 2 WAY

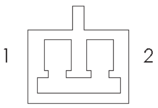
CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
1	M1 20PK	FUSED B(+)
2	M3 20PK/DB	CARGO LAMP DRIVER
2	M3 20PK/DB	CARGO LAMP DRIVER



CARGO LAMP NO. 2

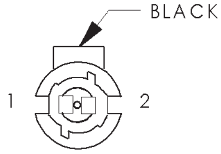
CARGO LAMP NO. 2 - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	M3 20PK/DB	CARGO LAMP DRIVER



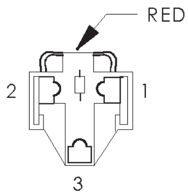
CENTER CONSOLE LAMP - 2 WAY

CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	Y158 20YL/VT	INTERIOR LAMP DRIVER



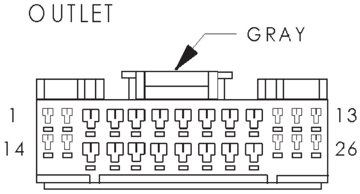
CENTER HIGH MOUNTED STOP LAMP - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
2	Z1 20BK	GROUND



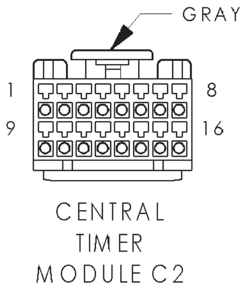
CENTER POWER OUTLET - RED 3 WAY

CAV	CIRCUIT	FUNCTION
1	A12 16RD/TN	FUSED B(+)
2	-	-
3	Z1 16BK	GROUND



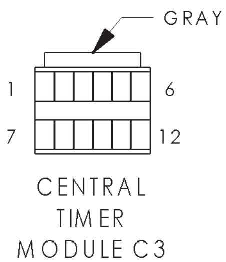
CENTRAL TIMER MODULE C1 - GRAY 26 WAY

CAV	CIRCUIT	FUNCTION
1	Z2 18BK/LG	GROUND
2	Z1 16BK	GROUND
3	M3 20PK/DB	CARGO LAMP SWITCH SENSE
4	L79 20RD/YL	PARK LAMP RELAY CONTROL
5	X3 20BK/RD	HORN RELAY CONTROL
6	G69 20BK/OR	VTSS INDICATOR DRIVER
7	L308 20LG/RD	PARK LAMP SWITCH SENSE
8	V52 18DG/RD	INTERMITTENT FRONT WIPER MODE SENSE
9	M4 18GY/BK	INTERIOR LAMP DEFEAT
10	D25 18VT/YL	PCI BUS
11	L4 18VT/WT	LOW BEAM SWITCH OUTPUT
12	X20 20GY/WT	RADIO CONTROL MUX
13	V51 20WT	INTERMITTENT FRONT WIPER SWITCH SIGNAL
14	Y158 20YL/VT	GLOVE BOX LAMP DRIVER
15	V10 18BR	FRONT WIPER PUMP/MOTOR CONTROL
16	Z2 18BK/LG	GROUND
17	-	-
18	G34 18RD/GY	HIGH BEAM INDICATOR DRIVER
19	G26 18LB	KEY-IN IGNITION SWITCH SENSE
20	-	-
21	M11 20PK/LB	COURTESY LAMP SWITCH SENSE
22	L27 18WT/TN	FOG LAMP SWITCH SENSE
23	L80 18WT/DG	HEADLAMP SWITCH OFF SENSE
24	L3 18RD/OR	HIGH BEAM RELAY OUTPUT
25	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
26	V6 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)



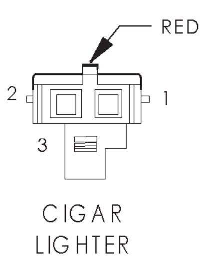
CENTRAL TIMER MODULE C2 - GRAY 16 WAY

CAV	CIRCUIT	FUNCTION
1	M2 20YL	COURTESY LAMP DRIVER
2	P96 20WT/LG	PASSENGER DOOR SWITCH MUX
3	M3 20PK/DB	CARGO LAMP DRIVER
4	P33 18OR/BK	DOOR LOCK RELAY OUTPUT
5	P34 18PK/BK	DOOR UNLOCK RELAY OUTPUT
6	P59 18DB	DRIVER DOOR UNLOCK RELAY OUTPUT
7	-	-
8	G11 20WT/BK	PARK BRAKE SWITCH SENSE
9	-	-
10	P97 20WT/DG (4 DOOR)	DRIVER DOOR SWITCH MUX
10	P97 18WT/DG (2 DOOR)	DRIVER DOOR SWITCH MUX
11	-	-
12	-	-
13	G74 20TN/RD	PASSENGER DOOR AJAR SWITCH SENSE
14	G73 20LG/OR	CYLINDER LOCK SWITCH SENSE
15	G75 20TN	DRIVER DOOR AJAR SWITCH SENSE
16	Y158 20YL/VT (STANDARD)	INTERIOR LAMP DRIVER
16	Y158 18YL/VT (EXCEPT STANDARD)	INTERIOR LIGHTS CONTROL



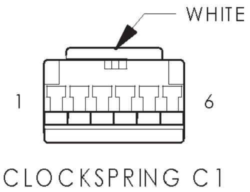
CENTRAL TIMER MODULE C3 - GRAY 12 WAY

CAV	CIRCUIT	FUNCTION
1	A302 16RD/TN	FUSED B(+)
2	L34 18RD/OR	RIGHT HIGH BEAM DRIVER
3	L33 18LG/BR	LEFT HIGH BEAM DRIVER
4	L43 18VT/WT	LEFT LOW BEAM DRIVER
5	L44 18VT/WT	RIGHT LOW BEAM DRIVER
6	A301 16RD/LG	FUSED B(+)
7	V18 18YL/DG	FRONT WIPER RELAY CONTROL
8	L26 20WT/VT	FOG LAMP RELAY CONTROL
9	-	-
10	V5 18DG/YL	FRONT WIPER PARK SWITCH SENSE
11	V5 18DG/YL	FRONT WIPER PARK SWITCH SENSE
12	V10 18BR	FRONT WASHER PUMP/MOTOR CONTROL



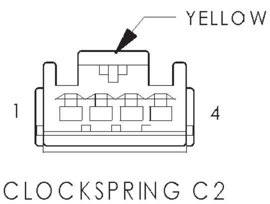
CIGAR LIGHTER - RED 3 WAY

CAV	CIRCUIT	FUNCTION
1	F38 16RD/TN	FUSED B(+)
2	E2 20OR	PANEL LAMP FEED
3	Z1 16BK	GROUND



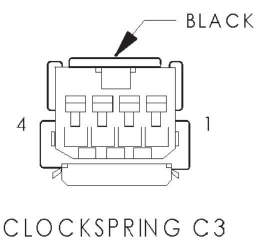
CLOCKSPRING C1 - WHITE 6 WAY

CAV	CIRCUIT	FUNCTION
1	X20 20GY/WT	RADIO CONTROL MUX
2	Z2 20BK/LG	GROUND
3	X3 20BK/RD	HORN RELAY CONTROL
4	K4 20BK/LB	SENSOR GROUND
5	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL
6	-	-



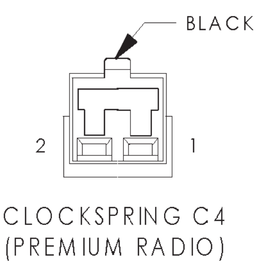
CLOCKSPRING C2 - YELLOW 4 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	R43 18BK/LB	AIRBAG LINE 1
4	R45 18DG/LB	AIRBAG LINE 2



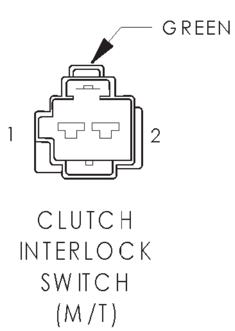
CLOCKSPRING C3 - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	V37 22RD/LG (SPEED CONTROL)	SPEED CONTROL SWITCH SIGNAL
3	K4 22BK/LB (SPEED CONTROL)	SENSOR GROUND
4	X3 22BK/RD	HORN RELAY CONTROL



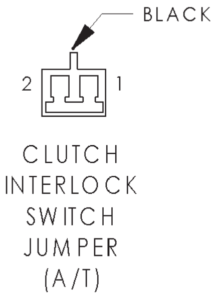
CLOCKSPRING C4 (PREMIUM RADIO) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	X20 22RD/BK	RADIO CONTROL MUX
2	Z2 22BK/LG	GROUND



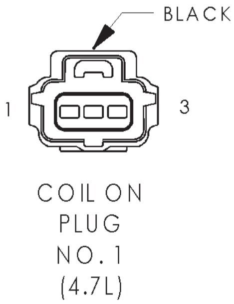
CLUTCH INTERLOCK SWITCH (M/T) - GREEN 2 WAY

CAV	CIRCUIT	FUNCTION
1	Z1 18BK (2.5L)	GROUND
1	T41 18BK/WT (EXCEPT 2.5L)	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
2	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SNESE (T41)



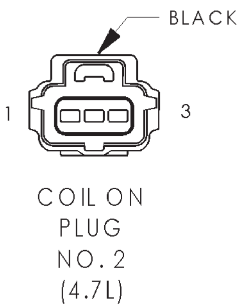
CLUTCH INTERLOCK SWITCH JUMPER (A/T) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	T141 18YL	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
2	T141 18YL	PARK/NEUTRAL POSITION SWITCH SENSE (T41)



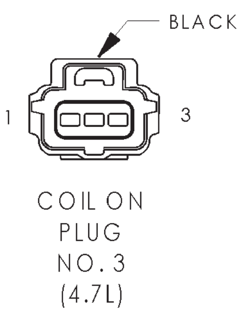
COIL ON PLUG NO. 1 (4.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K19 16BK/GY	COIL DRIVER NO. 1
2	A142 16DG/OR	AUTMATIC SHUT DOWN RELAY OUTPUT
3	-	-



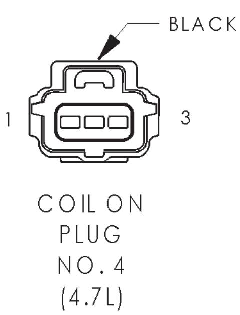
COIL ON PLUG NO. 2 (4.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K92 16TN/PK	COIL DRIVER NO. 2
2	A142 16DG/OR	AUTMATIC SHUT DOWN RELAY OUTPUT
3	-	-



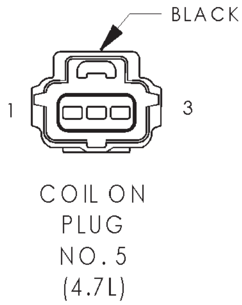
COIL ON PLUG NO. 3 (4.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K93 16TN/OR	COIL DRIVER NO. 3
2	A142 16DG/OR	AUTMATIC SHUT DOWN RELAY OUTPUT
3	-	-



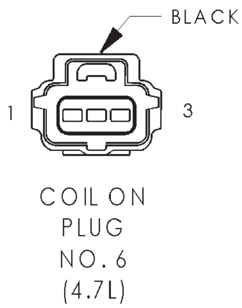
COIL ON PLUG NO. 4 (4.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K94 16TN/LG	COIL DRIVER NO. 4
2	A142 16DG/OR	AUTMATIC SHUT DOWN RELAY OUTPUT
3	-	-



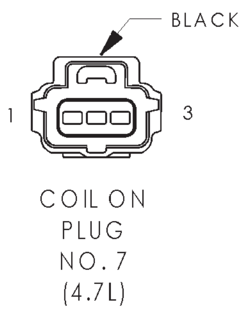
COIL ON PLUG NO. 5 (4.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K95 16TN/DG	COIL DRIVER NO. 5
2	A142 16DG/OR	AUTMATIC SHUT DOWN RELAY OUTPUT
3	-	-



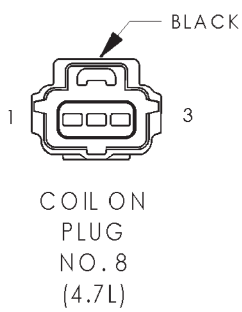
COIL ON PLUG NO. 6 (4.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K96 16TN/LB	COIL DRIVER NO. 6
2	A142 16DG/OR	AUTMATIC SHUT DOWN RELAY OUTPUT
3	-	-



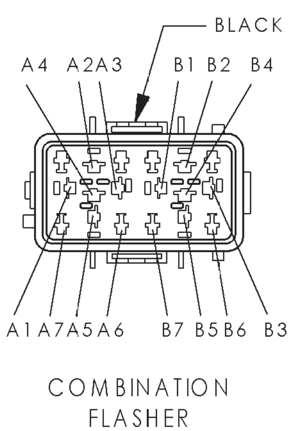
COIL ON PLUG NO. 7 (4.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K17 16DB/TN	COIL DRIVER NO. 7
2	A142 16DG/OR	AUTMATIC SHUT DOWN RELAY OUTPUT
3	-	-



COIL ON PLUG NO. 8 (4.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K98 16LB/RD	COIL DRIVER NO. 8
2	A142 16DG/OR	AUTMATIC SHUT DOWN RELAY OUTPUT
3	-	-

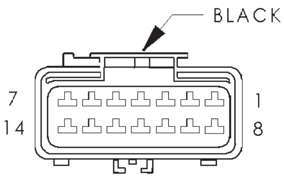


COMBINATION FLASHER - BLACK 14 WAY

CAV	CIRCUIT	FUNCTION
A1	L9 14BK/WT	FUSED B(+)
A2	L63 16DG/RD	LEFT TURN SIGNAL
A3	L61 16LG	LEFT TURN SIGNAL
A4	-	-
A5	Z1 18BK	GROUND
A6	L5 18BK	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
A7	L305 18LB/WT	LEFT TURN SWITCH SENSE
A8	-	-
B1	L19 16PK	HAZARD FLASHER SIGNAL
B2	-	-
B3	L60 16TN	RIGHT TURN SIGNAL
B4	L62 16BR/RD	RIGHT TURN SIGNAL
B5	L50 14WT/TN	BRAKE LAMP SWITCH OUTPUT

COMBINATION FLASHER - BLACK 14 WAY

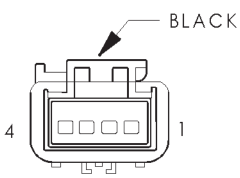
CAV	CIRCUIT	FUNCTION
B6	-	-
B7	L302 18LB/YL	RIGHT TURN SWITCH SENSE
B8	-	-



CONTROLLER ANTILOCK BRAKE C1

CONTROLLER ANTILOCK BRAKE C1 - BLACK 14 WAY

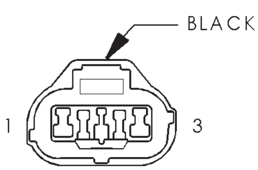
CAV	CIRCUIT	FUNCTION
1	B113 20RD/VT	REAR WHEEL SPEED SENSOR (+)
2	-	-
3	D25 18VT/YL	PCI BUS
4	A20 20RD/DB	FUSED IGNITION SWITCH OUTPUT (RUN)
5	-	-
6	Z19 12BK/PK	GROUND
7	A10 12RD/DG	FUSED B(+)
8	B114 20WT/VT	REAR WHEEL SPEED SENSOR (-)
9	V40 18WT/PK	BRAKE LAMP SWITCH SENSE
10	-	-
11	B10 20BR/WT	BRAKE PRESSURE SWITCH SENSE
12	G7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL
13	Z19 12BK/PK	GROUND
14	A10 12RD/DG	FUSED B(+)



CONTROLLER ANTILOCK BRAKE C2

CONTROLLER ANTILOCK BRAKE C2 - BLACK 4 WAY

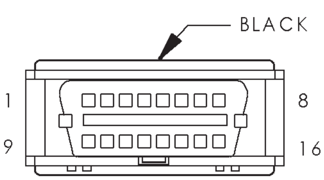
CAV	CIRCUIT	FUNCTION
1	B9 20RD	LEFT FRONT WHEEL SPEED SENSOR (+)
2	B8 20RD/GY	LEFT FRONT WHEEL SPEED SENSOR (-)
3	B6 20WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
4	B7 20WT	RIGHT FRONT WHEEL SPEED SENSOR (+)



CRANKSHAFT POSITION SENSOR

CRANKSHAFT POSITION SENSOR - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
2	K4 18BK/LB	SENSOR GROUND
3	K7 18OR	5V SUPPLY



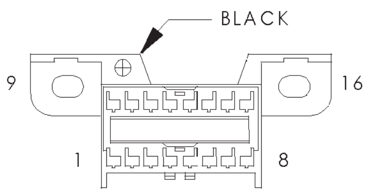
DATA LINK CONNECTOR

DATA LINK CONNECTOR - BLACK 16 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	D25 20VT/YL	PCI BUS
3	-	-
4	Z12 18BK/TN	GROUND
5	Z1 18BK	GROUND
6	D20 20LG	SCI RECEIVE

DATA LINK CONNECTOR - BLACK 16 WAY

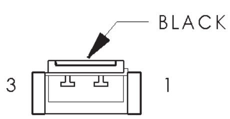
CAV	CIRCUIT	FUNCTION
7	D21 20PK	SCI TRANSMIT
8	-	-
9	-	-
10	-	-
11	-	-
12	-	-
13	-	-
14	D22 20PK/BK	SCI RECEIVE
15	-	-
16	M1 20PK	FUSED B(+)



DIAGNOSTIC JUNCTION PORT

DIAGNOSTIC JUNCTION PORT - BLACK 16 WAY

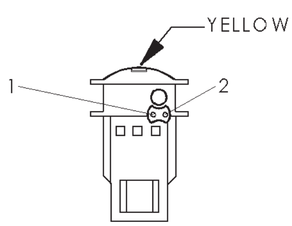
CAV	CIRCUIT	FUNCTION
1	D25 20VT/YL	PCI BUS (MIC)
2	D25 18VT/YL	PCI BUS (TCCM)
3	D25 18VT/YL	PCI BUS (CTM)
4	D25 20VT/YL	PCI BUS (OVERHEAD)
5	D25 20VT/YL	PCI BUS (DLC)
6	D25 18VT/YL	PCI BUS (PCM)
7	D25 18VT/YL	PCI BUS (TCM)
8	D25 20VT/YL	PCI BUS (CAB)
9	-	-
10	-	-
11	D25 20VT/YL	PCI BUS (AMP)
12	D25 20VT/YL	PCI BUS (RADIO)
13	D25 20VT/YL	PCI BUS (HVAC)
14	-	-
15	D25 18VT/YL	PCI BUS (ACM)
16	D25 20VT/YL	PCI BUS (SKIM)



DOME LAMP

DOME LAMP - BLACK 3 WAY

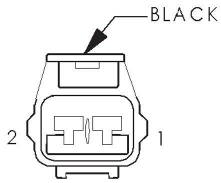
CAV	CIRCUIT	FUNCTION
1	Y158 20YL/VT	INTERIOR LAMP DRIVER
2	M2 20YL	COURTESY LAMP DRIVER
3	M1 20PK	FUSED B(+)



DRIVER AIRBAG

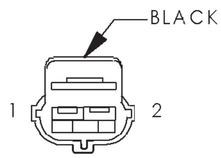
DRIVER AIRBAG - YELLOW 2 WAY

CAV	CIRCUIT	FUNCTION
1	R45 DG/LB	DRIVER AIRBAG LINE 2
2	R43 BK/LB	DRIVER AIRBAG LINE 1



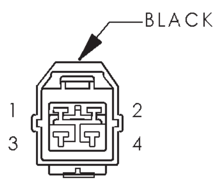
DRIVER CYLINDER LOCK SWITCH - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Z2 20BK/LG	GROUND
2	G73 20LG/OR	CYLINDER LOCK SWITCH MUX



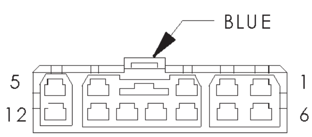
DRIVER DOOR AJAR SWITCH (BASE) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	G75 20TN	DRIVER DOOR AJAR SWITCH SENSE
2	Z2 20BK/LG	GROUND



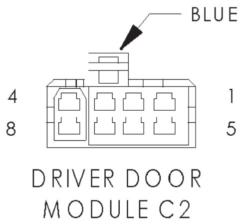
DRIVER DOOR POWER LOCK/MOTOR AJAR SWITCH (PREMIUM) - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	G75 20TN	DRIVER DOOR AJAR SWITCH SENSE
2	Z2 20BK/LG	GROUND
3	P59 18DB (4 DOOR)	DRIVER DOOR UNLOCK RELAY OUTPUT
3	P34 18PK/BK (2 DOOR)	DOOR UNLOCK RELAY OUTPUT
4	P33 18OR/BK (2 DOOR)	DOOR LOCK RELAY OUTPUT
4	P33 16OR/BK (4 DOOR)	DOOR LOCK RELAY OUTPUT



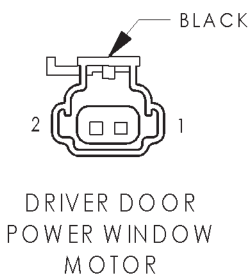
DRIVER DOOR MODULE C1 - BLUE 12 WAY

CAV	CIRCUIT	FUNCTION
1	Q28 14DG/WT	MASTER WINDOW SWITCH RIGHT REAR (DOWN)
2	Q18 14GY/BK	MASTER WINDOW SWITCH RIGHT REAR (UP)
3	Q16 14BR/WT	MASTER WINDOW SWITCH RIGHT FRONT (UP)
4	Q17 14DB/WT	LEFT REAR WINDOW DRIVER (UP)
5	Q11 14LB	LEFT FRONT WINDOW DRIVER (UP)
6	Q26 14VT/WT	MASTER WINDOW SWITCH RIGHT FRONT (DOWN)
7	P97 20WT/DG	DRIVER DOOR SWITCH MUX
8	Z1 14BK	GROUND
9	F21 14TN	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
10	Q27 14RD/BK	LEFT REAR WINDOW DRIVER (DOWN)
11	Z2 20BK/LG	GROUND
12	Q21 14WT	LEFT FRONT WINDOW DRIVER (DOWN)



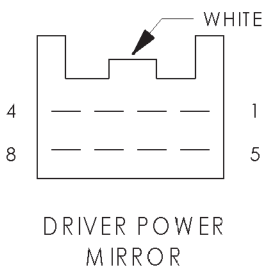
DRIVER DOOR MODULE C2 - BLUE 8 WAY

CAV	CIRCUIT	FUNCTION
1	P71 22YL	DRIVER MIRROR UP MOVEMENT
2	P76 22OR/YL	MIRROR COMMON DRIVER
3	M1 20PK	FUSED B(+)
4	P74 22DB	RIGHT MIRROR LEFT MOVEMENT
5	Z1 20BK	GROUND
6	P75 22DB/WT	DRIVER MIRROR LEFT MOVEMENT
7	P72 22YL/BK	RIGHT MIRROR UP MOVEMENT
8	Q1 14YL	WINDOW SWITCH FEED



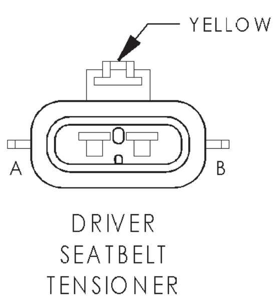
DRIVER DOOR POWER WINDOW MOTOR - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Q21 14WT	LEFT FRONT WINDOW DRIVER (DOWN)
2	Q11 14LB	LEFT FRONT WINDOW DRIVER (UP)



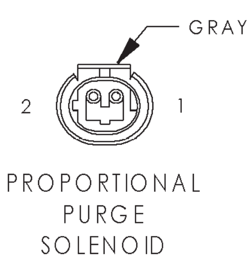
DRIVER POWER MIRROR - WHITE 8 WAY

CAV	CIRCUIT	FUNCTION
1	P71 22YL	DRIVER MIRROR UP MOVEMENT
2	P75 22DB/WT	DRIVER MIRROR LEFT MOVEMENT
3	P76 22OR/YL	MIRROR COMMON DRIVER
4	F121 20TN/BK	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
5	P114 20YL/BK (4 DOOR)	AUTO DAY/NIGHT MIRROR (-)
6	P115 20YL/DG (4 DOOR)	AUTO DAY/NIGHT MIRROR (+)
7	-	-
8	Z1 20BK	GROUND



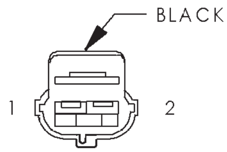
DRIVER SEATBELT TENSIONER - YELLOW 2 WAY

CAV	CIRCUIT	FUNCTION
A	R55 18LG/DB	DRIVER SEATBELT TENSIONER (-) LINE 1
B	R53 18LG/YL	DRIVER SEATBELT TENSIONER (+) LINE 2



DUTY CYCLE EVAP/PURGE SOLENOID - GRAY 2 WAY

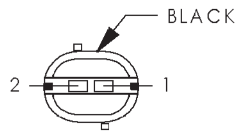
CAV	CIRCUIT	FUNCTION
1	K52 18PK/BK	DUTY CYCLE EVAP/PURGE SOLENOID CONTROL
2	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)



ENGINE COOLANT TEMPERATURE SENSOR (2.5L)

ENGINE COOLANT TEMPERATURE SENSOR (2.5L) - BLACK 2 WAY

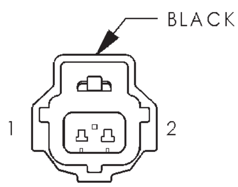
CAV	CIRCUIT	FUNCTION
1	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
2	K4 18BK/LB	SENSOR GROUND



ENGINE COOLANT TEMPERATURE SENSOR (3.9L/5.9L)

ENGINE COOLANT TEMPERATURE SENSOR (3.9L/5.9L) - BLACK 2 WAY

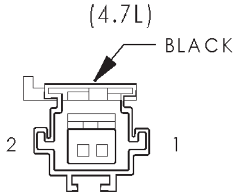
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL



ENGINE COOLANT TEMPERATURE SENSOR (4.7L)

ENGINE COOLANT TEMPERATURE SENSOR (4.7L) - BLACK 2 WAY

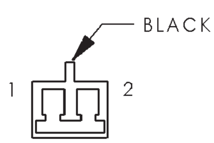
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL



ENGINE OIL PRESSURE SENSOR

ENGINE OIL PRESSURE SENSOR - BLACK 2 WAY

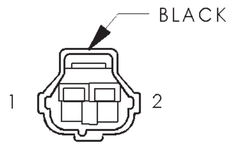
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	G60 18GY/YL (2.5L/4.7L)	ENGINE OIL PRESSURE SENSOR SIGNAL
2	G60 16GY/YL (3.9L/5.9L)	ENGINE OIL PRESSURE SENSOR SIGNAL



EVAPORATOR TEMPERATURE SENSOR

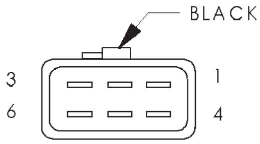
EVAPORATOR TEMPERATURE SENSOR - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	C57 20DB/GY	SENSOR GROUND
2	C21 20DB/OR	A/C SWITCH SENSE



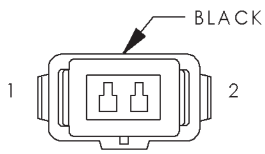
FRONT WASHER PUMP/MOTOR - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	V10 18BR	FRONT WASHER PUMP/MOTOR CONTROL
2	Z1 18BK	GROUND



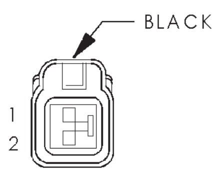
FRONT WIPER MOTOR - BLACK 6 WAY

CAV	CIRCUIT	FUNCTION
1	V6 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	V5 18DG/YL	FRONT WIPER PARK SWITCH SENSE
3	-	-
4	Z1 18BK	GROUND
5	V45 18VT	FRONT WIPER LOW SPEED
6	V48 18RD/GY	FRONT WIPER HIGH SPEED



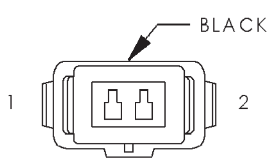
FUEL INJECTOR NO. 1 (2.5L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT



FUEL INJECTOR NO. 1 (3.9L/4.7L/5.9L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K11 18ST/DB	FUEL INJECTOR NO. 1 DRIVER
2	A142 18DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT

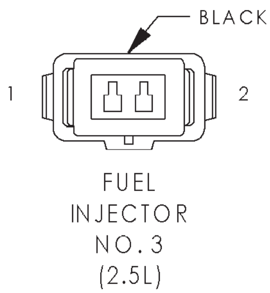


FUEL INJECTOR NO. 2 (2.5L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K12 18TN	FUEL INJECTOR NO. 2 DRIVER
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT

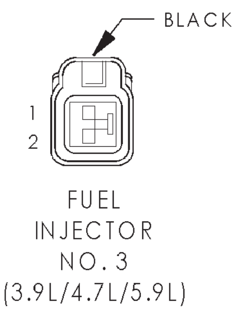
FUEL INJECTOR NO. 2 (3.9L/4.7L/5.9L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K12 18TN	FUEL INJECTOR NO. 2 DRIVER
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT



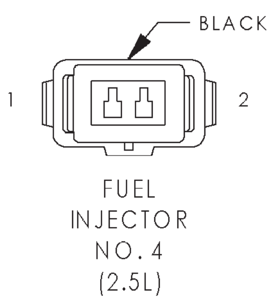
FUEL INJECTOR NO. 3 (2.5L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT



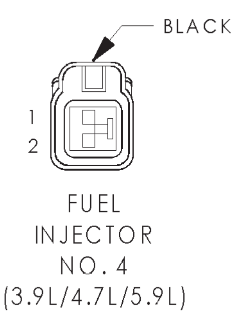
FUEL INJECTOR NO. 3 (3.9L/4.7L/5.9L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT



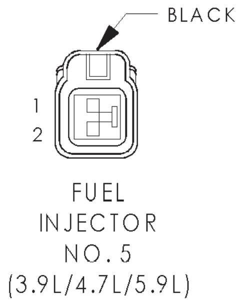
FUEL INJECTOR NO. 4 (2.5L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT



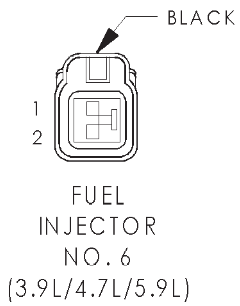
FUEL INJECTOR NO. 4 (3.9L/4.7L/5.9L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT



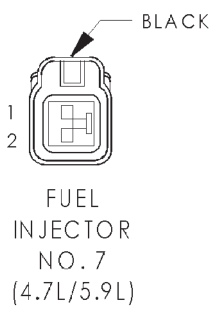
FUEL INJECTOR NO. 5 (3.9L/4.7L/5.9L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K38 18GY	FUEL INJECTOR NO. 5 DRIVER
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT



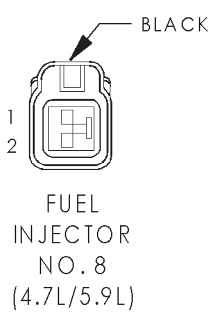
FUEL INJECTOR NO. 6 (3.9L/4.7L/5.9L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K38 18GY	FUEL INJECTOR NO. 6 DRIVER
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT



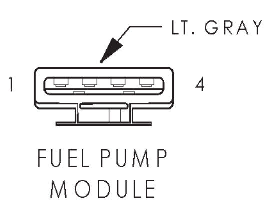
FUEL INJECTOR NO. 7 (4.7L/5.9L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K26 18VT	FUEL INJECTOR NO. 7 DRIVER
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT



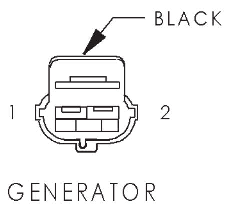
FUEL INJECTOR NO. 8 (4.7L/5.9L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K28 18GY/LB	FUEL INJECTOR NO. 8 DRIVER
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT



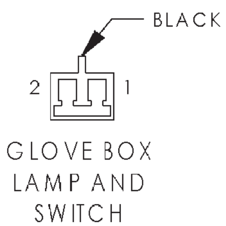
FUEL PUMP MODULE - LT. GRAY 4 WAY

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	K4 18BK/LB	SENSOR GROUND
3	K226 18DB/WT	FUEL PUMP RELAY CONTROL
4	A61 16DG/BK	FUEL PUMP RELAY OUTPUT



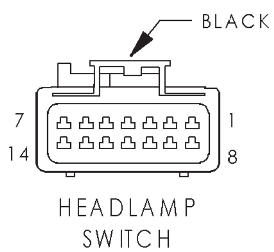
GENERATOR - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K125 18WT/DB	GENERATOR SOURCE
2	K20 18DG	GENERATOR FIELD



GLOVE BOX LAMP AND SWITCH - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Y158 20YL/VT	GLOVE BOX DRIVER
2	M1 20PK	FUSED B(+)

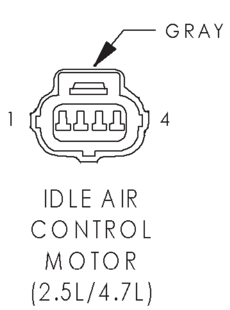


HEADLAMP SWITCH - BLACK 14 WAY

CAV	CIRCUIT	FUNCTION
1	L7 20BK/YL	PARK LAMP RELAY OUTPUT
2	L80 18WT/DG	HEADLAMP SWITCH OFF SENSE
3	L308 20LG/RD	PARK LAMP SWITCH SENSE
4	Z141 18BK/OR	GROUND
5	L27 18WT/TN	FOG LAMP SWITCH SENSE
6	L307 18LG/OR	HEADLAMP SWITCH SENSE
7	L39 18LB	FOG LAMP RELAY OUTPUT
8	L107 20WT	HEADLAMP SWITCH OUTPUT
9	Z1 18BK	GROUND
10	M11 20PK/LB	COURTESY LAMP SWITCH SENSE
11	M3 20PK/DB	CARGO LAMP SWITCH SENSE
12	M4 18GY/BK	INTERIOR LAMP DEFEAT
13	-	-
14	E1 18TN	PANEL LAMPS DIMMER SWITCH SIGNAL

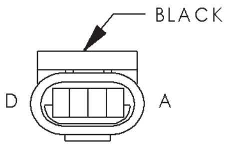
HIGH NOTE HORN - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	X2 18DG/RD	HORN RELAY OUTPUT



IDLE AIR CONTROL MOTOR (2.5L/4.7L) - GRAY 4 WAY

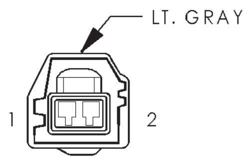
CAV	CIRCUIT	FUNCTION
1	K39 18GY/RD (2.5L)	IDLE AIR CONTROL NO. 1 DRIVER
1	K39 16GY/RD (4.7L)	IDLE AIR CONTROL NO. 1 DRIVER
2	K60 18YL/BK (2.5L)	IDLE AIR CONTROL NO. 2 DRIVER
2	K60 16YL/BK (4.7L)	IDLE AIR CONTROL NO. 2 DRIVER
3	K40 18BR/WT (2.5L)	IDLE AIR CONTROL NO. 3 DRIVER
3	K40 16BR/WT (4.7L)	IDLE AIR CONTROL NO. 3 DRIVER
4	K59 18VT/BK (2.5L)	IDLE AIR CONTROL NO. 4 DRIVER
4	K59 16VT/BK (4.7L)	IDLE AIR CONTROL NO. 4 DRIVER



IDLE AIR CONTROL MOTOR (3.9L/5.9L)

IDLE AIR CONTROL MOTOR (3.9L/5.9L) - BLACK 4 WAY

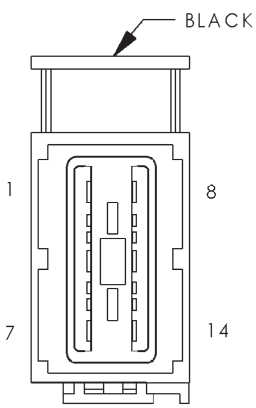
CAV	CIRCUIT	FUNCTION
A	K59 18VT/BK	IDLE AIR CONTROL NO. 4 DRIVER
B	K40 18BR/WT	IDLE AIR CONTROL NO. 3 DRIVER
C	K60 18YL/BK	IDLE AIR CONTROL NO. 2 DRIVER
D	K39 18GY/RD	IDLE AIR CONTROL NO. 1 DRIVER



IGNITION COIL (EXCEPT 4.7L)

IGNITION COIL (EXCEPT 4.7L) - LT. GRAY 2 WAY

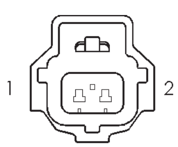
CAV	CIRCUIT	FUNCTION
1	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K19 16BK/GY	IGNITION COIL NO. 1 DRIVER



IGNITION SWITCH

IGNITION SWITCH - BLACK 14 WAY

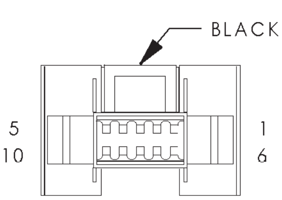
CAV	CIRCUIT	FUNCTION
1	A111 10RD/LB	FUSED B(+)
2	A81 18DG/RD	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	A21 16DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
4	A19 16RD/YL	FUSED B(+)
5	G26 18LB	KEY-IN IGNITION SWITCH SENSE
6	Z1 20BK	GROUND
7	A22 12BK/OR	FUSED IGNITION SWITCH OUTPUT (RUN)
8	C1 12DG	BLOWER MOTOR FEED
9	A31 12BK/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
10	A30 12RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
11	A1 12RD	FUSED B(+)
12	A18 12RD/BK	FUSED B(+)
13	A41 16YL	FUSED IGNITION SWITCH OUTPUT (START)
14	A2 12PK/BK	FUSED B(+)



INPUT SPEED SENSOR (4.7L A/T)

INPUT SPEED SENSOR (4.7L A/T) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	T13 18DB/BK	SPEED SENSOR GROUND
2	T52 18RD/BK	INPUT SPEED SENSOR SIGNAL



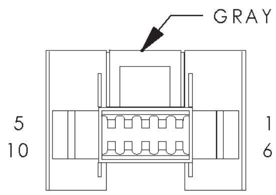
INSTRUMENT CLUSTER C1

INSTRUMENT CLUSTER C1 - BLACK 10 WAY

CAV	CIRCUIT	FUNCTION
1	Y128 20DG/GY	TRANS RANGE SENSOR 5V SUPPLY
2	F15 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
3	G69 20BK/OR	DOOR DISARM SWITCH SENSE
4	Z2 20BK/LG	GROUND
5	Z1 20BK	GROUND
6	M1 20PK	FUSED B(+)

INSTRUMENT CLUSTER C1 - BLACK 10 WAY

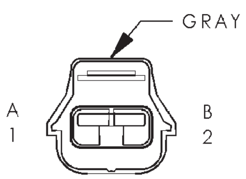
CAV	CIRCUIT	FUNCTION
7	F11 20RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
8	-	-
9	D25 20VT/YL	PCI BUS
10	-	-



INSTRUMENT CLUSTER C2

INSTRUMENT CLUSTER C2 - GRAY 10 WAY

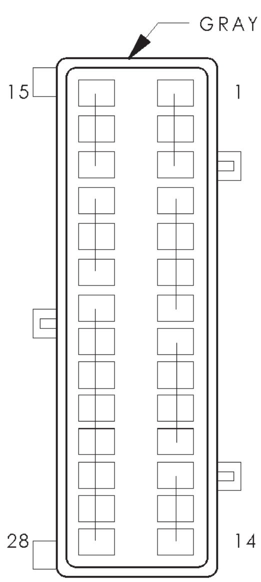
CAV	CIRCUIT	FUNCTION
1	E2 20OR	PANEL LAMPS FEED
2	G29 18BK/TN	WASHER FLUID SWITCH SENSE
3	G13 20DB/RD	SEAT BELT INDICATOR DRIVER
4	Y193 20WT/LG	TRANS RANGE SENSOR MUX
5	L107 20WT	HEADLAMP SWITCH OUTPUT
6	L61 16LG	LEFT TURN SIGNAL
7	-	-
8	L60 16TN	RIGHT TURN SIGNAL
9	G34 18RD/GY	HIGH BEAM INDICATOR DRIVER
10	-	-



INTAKE AIR TEMPERATURE SENSOR

INTAKE AIR TEMPERATURE SENSOR - GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB (EXCEPT 2.5L)	SENSOR GROUND
2	K21 18BK/RD (EXCEPT 2.5L)	INTAKE AIR TEMPERATURE SIGNAL
A	K4 18BK/LB (2.5L)	SENSOR GROUND
B	K21 18BK/RD (2.5L)	INTAKE AIR TEMPERATURE SIGNAL



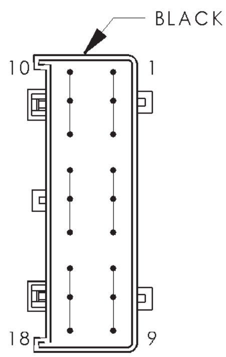
JOINT CONNECTOR NO. 1 (IN PDC)

JOINT CONNECTOR NO. 1 (IN PDC) - GRAY 28 WAY

CAV	CIRCUIT	FUNCTION
1	L1 18VT/BK	BACK-UP LAMP FEED
2	L1 18VT/BK	BACK-UP LAMP FEED
3	L1 18VT/BK	BACK-UP LAMP FEED
4	F142 16OR/DG	FUSED AUTOMATIC SHUT-DOWN RELAY OUTPUT
5	F142 16OR/DG	FUSED AUTOMATIC SHUT-DOWN RELAY OUTPUT
6	F142 16OR/DG	FUSED AUTOMATIC SHUT-DOWN RELAY OUTPUT
7	F142 16OR/DG	FUSED AUTOMATIC SHUT-DOWN RELAY OUTPUT
8	L39 18LB	FUSED B(+)
9	L39 18LB	FUSED B(+)
10	L39 18LB	FUSED B(+)
11	L39 18LB	FUSED B(+)
12	F84 16YL/WT (4.7L)	FUSED B(+)
12	K125 18WT/DB (3.9L/5.9L	GENERATOR SOURCE
13	K125 18WT/DB (3.9L/5.9L)	GENERATOR SOURCE
13	F84 16YL/WT (4.7L)	FUSED B(+)
14	F84 16YL/WT (4.7L)	FUSED B(+)
14	K125 18WT/DB (3.9L/5.9L)	GENERATOR SOURCE
15	D21 18PK (4.7L)	SCI TRANSMIT
16	D21 18PK (4.7L)	SCI TRANSMIT
17	D21 18PK (4.7L)	SCI TRANSMIT
18	L50 14WT/TN	BRAKE LAMP SWITCH OUTPUT
19	L50 14WT/TN	BRAKE LAMP SWITCH OUTPUT

JOINT CONNECTOR NO. 1 (IN PDC) - GRAY 28 WAY

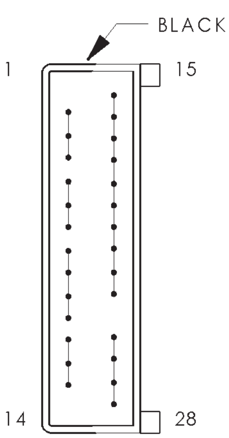
CAV	CIRCUIT	FUNCTION
20	L50 14WT/TN	BRAKE LAMP SWITCH OUTPUT
21	A14 16RD/WT	FUSED B(+)
22	A14 16RD/WT	FUSED B(+)
23	A14 16RD/WT	FUSED B(+)
24	A14 16RD/WT	FUSED B(+)
25	-	-
26	-	-
27	-	-
28	-	-



JOINT CONNECTOR NO. 2 (IN PDC)

JOINT CONNECTOR NO. 2 (IN PDC) - BLACK 18 WAY

CAV	CIRCUIT	FUNCTION
1	L61 16LG	LEFT TURN SIGNAL
2	L61 16LG	LEFT TURN SIGNAL
3	L61 16LG	LEFT TURN SIGNAL
4	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
5	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
6	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
7	L60 16TN	RIGHT TURN SIGNAL
8	L60 16TN	RIGHT TURN SIGNAL
9	L60 16TN	RIGHT TURN SIGNAL
10	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
11	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
12	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
13	A142 14DG/OR	AUTOMATIC SHUT-DOWN RELAY OUTPUT
14	A142 14DG/OR	AUTOMATIC SHUT-DOWN RELAY OUTPUT
15	A142 14DG/OR	AUTOMATIC SHUT-DOWN RELAY OUTPUT
16	V40 20WT/PK	BRAKE LAMP SWITCH SENSE
17	V40 18WT/PK	BRAKE LAMP SWITCH SENSE
18	V40 18WT/PK	BRAKE LAMP SWITCH SENSE



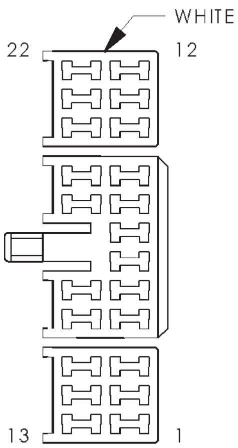
JOINT CONNECTOR NO. 3 (IN PDC)

JOINT CONNECTOR NO. 3 (IN PDC) - BLACK 28 WAY

CAV	CIRCUIT	FUNCTION
1	A114 18GY/RD	FUSED B(+)
2	A114 18GY/RD	FUSED B(+)
3	A114 18GY/RD	FUSED B(+)
4	-	-
5	-	-
6	-	-
7	K4 18BK/LB	SENSOR GROUND
8	K4 18BK/LB	SENSOR GROUND
9	K4 18BK/LB	SENSOR GROUND
10	K4 18BK/LB	SENSOR GROUND
11	K4 18BK/LB	SENSOR GROUND
12	A169 18RD/YL	FUSED IGNITION SWITCH OUTPUT (START)
13	A169 18RD/YL	FUSED IGNITION SWITCH OUTPUT (START)
14	A169 18RD/YL	FUSED IGNITION SWITCH OUTPUT (START)
15	L7 18BK/YL	PARK LAMP RELAY OUTPUT
16	L7 20BK/YL	PARK LAMP RELAY OUTPUT
17	L7 20BK/YL	PARK LAMP RELAY OUTPUT
18	L7 20BK/YL	PARK LAMP RELAY OUTPUT
19	L7 20BK/YL	PARK LAMP RELAY OUTPUT
20	L7 20BK/YL	PARK LAMP RELAY OUTPUT
21	L7 20BK/YL	PARK LAMP RELAY OUTPUT

JOINT CONNECTOR NO. 3 (IN PDC) - BLACK 28 WAY

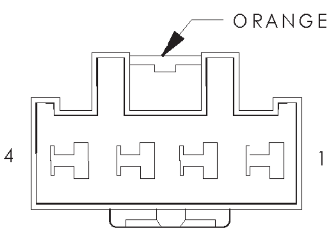
CAV	CIRCUIT	FUNCTION
22	L7 20BK/YL	PARK LAMP RELAY OUTPUT
23	L7 20BK/YL	PARK LAMP RELAY OUTPUT
24	-	-
25	F20 20WT	FUSED IGNITION SWITCH OUTPUT (RUN)
26	F20 20WT	FUSED IGNITION SWITCH OUTPUT (RUN)
27	-	-
28	-	-



JOINT CONNECTOR NO. 4

JOINT CONNECTOR NO. 4 - WHITE 22 WAY

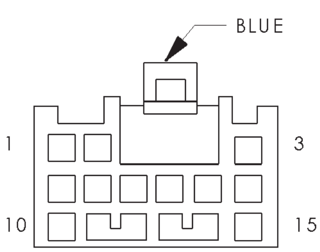
CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-
7	-	-
8	-	-
9	F75 18VT (PREMIUM RADIO)	FUSED B(+)
10	V45 18VT	FRONT WIPER LOW SPEED
11	V45 18VT	FRONT WIPER LOW SPEED
12	V45 18VT	FRONT WIPER LOW SPEED
13	L107 20WT	HEADLAMP SWITCH OUTPUT
14	L107 20WT	HEADLAMP SWITCH OUTPUT
15	L107 20WT	HEADLAMP SWITCH OUTPUT
16	-	-
17	-	-
18	F75 18VT	FUSED B(+)
19	F75 18VT (PREMIUM RADIO)	FUSED B(+)
20	-	-
21	-	-
22	-	-



JUNCTION BLOCK C1

JUNCTION BLOCK C1 - ORANGE 4 WAY

CAV	CIRCUIT	FUNCTION
1	A7 12RD/BK	FUSED B(+)
2	L50 14WT/TN	BRAKE LAMP SWITCH OUTPUT
3	A12 12RD/TN	FUSED B(+)
4	L7 18BK/YL	HEADLAMP SWITCH OUTPUT



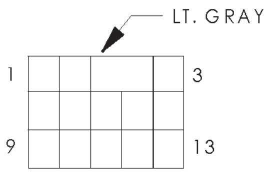
JUNCTION BLOCK C2

JUNCTION BLOCK C2 - BLUE 15 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	A20 20RD/DB	MODULE IDENTIFICATION
3	-	-
4	V6 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
5	V6 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
6	V6 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
7	-	-
8	X2 18DG/RD	HORN RELAY OUTPUT
9	X2 18DG/RD	HORN RELAY OUTPUT
10	-	-
11	L60 16TN	RIGHT TURN SIGNAL

JUNCTION BLOCK C2 - BLUE 15 WAY

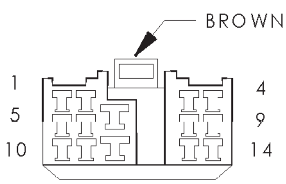
CAV	CIRCUIT	FUNCTION
12	L10 18BR/LG	FUSED IGNITION SWITCH OUTPUT (RUN)
13	-	-
14	F20 20WT	FUSED IGNITION SWITCH OUTPUT (RUN)
15	-	-



JUNCTION BLOCK C3

JUNCTION BLOCK C3 - LT. GRAY 13 WAY

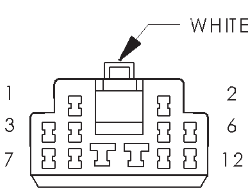
CAV	CIRCUIT	FUNCTION
1	F18 20LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
2	-	-
3	-	-
4	F18 20LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
5	F18 20LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
6	F18 20LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
7	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
8	L1 18VT/BK	BACK-UP LAMP FEED
9	-	-
10	F11 18RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
11	-	-
12	A169 18RD/YL	FUSED IGNITION SWITCH OUTPUT (START)
13	L61 16LG	LEFT TURN SIGNAL



JUNCTION BLOCK C4

JUNCTION BLOCK C4 - BROWN 14 WAY

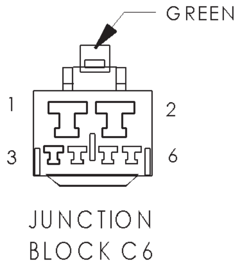
CAV	CIRCUIT	FUNCTION
1	M120PK	FUSED B(+)
2	M1 20PK (HIGHLINE/BASE)	FUSED B(+)
2	M1 18PK (MIDLINE/PREMIUM)	FUSED B(+)
3	-	-
4	-	-
5	L50 14WT/TN	BRAKE LAMP SWITCH OUTPUT
6	L1 18VT/BK	BACK-UP LAMP FEED
7	-	-
8	-	-
9	L10 18BR/LG	FUSED IGNITION SWITCH OUTPUT (RUN)
10	-	-
11	-	-
12	A12 16RD/TN	FUSED B(+)
13	-	-
14	E2 20OR	PANEL LAMPS FEED



JUNCTION BLOCK C5

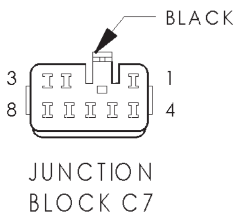
JUNCTION BLOCK C5 - WHITE 12 WAY

CAV	CIRCUIT	FUNCTION
1	F121 20TN/BK	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
2	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	M1 20PK	FUSED B(+)
4	F121 20TN/BK	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
5	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
6	-	-
7	M1 20PK	FUSED B(+)
8	-	-
9	F21 12TN	FUSED IGNITION SWITCH OUTPUT (RUN)
10	-	-
11	-	-
12	-	-



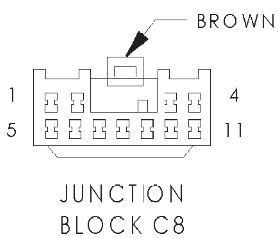
JUNCTION BLOCK C6 - GREEN 6 WAY

CAV	CIRCUIT	FUNCTION
1	A31 12BK/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	-	-
3	E1 18TN	PANEL LAMPS DIMMER SWITCH SIGNAL
4	E2 20OR	PANEL LAMPS FEED
5	-	-
6	A81 18DG/RD	FUSED IGNITION SWITCH OUTPUT (RUN-START)



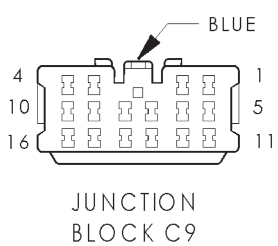
JUNCTION BLOCK C7 - BLACK 8 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	F11 20RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
4	-	-
5	-	-
6	F15 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
7	-	-
8	-	-



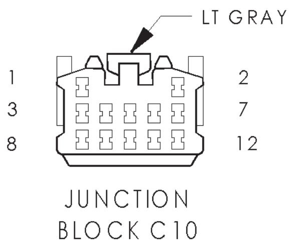
JUNCTION BLOCK C8 - BROWN 11 WAY

CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	M1 20PK	FUSED B(+)
3	M1 20PK	FUSED B(+)
4	L79 20RD/YL	PARK LAMP RELAY CONTROL
5	F75 18VT	FUSED B(+)
6	V6 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
7	X3 20BK/RD	HORN RELAY CONTROL
8	X3 20BK/RD	HORN RELAY CONTROL
9	-	-
10	V6 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
11	L7 20BK/YL	HEADLAMP SWITCH OUTPUT



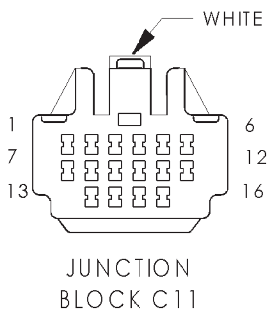
JUNCTION BLOCK C9 - BLUE 16 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	E20 20OR	PANEL LAMPS FEED
3	L5 20BK	FUSED IGNITION SWITCH OUTPUT (RUN)
4	-	-
5	E2 20OR	PANEL LAMPS FEED
6	E2 20OR	PANEL LAMPS FEED
7	E2 20OR	PANEL LAMPS FEED
8	E2 20OR	PANEL LAMPS FEED
9	X12 16RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
10	-	-
11	-	-
12	-	-
13	-	-
14	-	-
15	-	-
16	-	-



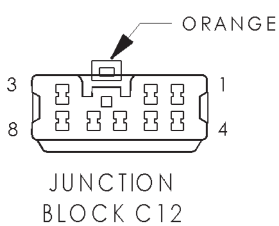
JUNCTION BLOCK C10 - LT. GRAY 12 WAY

CAV	CIRCUIT	FUNCTION
1	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
2	-	-
3	-	-
4	M1 20PK	FUSED B(+)
5	M1 20PK	FUSED B(+)
6	-	-
7	-	-
8	-	-
9	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
10	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
11	-	-
12	-	-



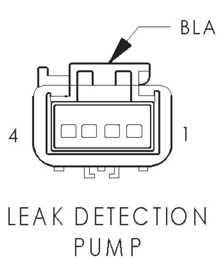
JUNCTION BLOCK C11 - WHITE 16 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	-	-
4	-	-
5	F24 20RD/DG	FUSED IGNITION SWITCH OUTPUT (RUN)
6	-	-
7	-	-
8	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
9	F14 20LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
10	-	-
11	L60 16TN	RIGHT TURN SIGNAL
12	L60 16TN	RIGHT TURN SIGNAL
13	C15 14BK/WT	REAR WINDOW DEFOGGER RELAY OUTPUT
14	A41 16YL	FUSED IGNITION SWITCH OUTPUT (START)
15	L50 14WT/TN	BRAKE LAMP SWITCH OUTPUT
16	L61 16LG	LEFT TURN SIGNAL



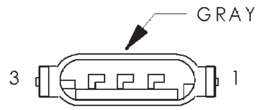
JUNCTION BLOCK C12 - ORANGE 8 WAY

CAV	CIRCUIT	FUNCTION
1	A30 12RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	L61 16LG	LEFT TURN SIGNAL
3	A22 12BK/OR	FUSED IGNITION SWITCH OUTPUT (RUN)
4	A12 16RD/TN	FUSED B(+)
5	-	-
6	F38 16RD/TN	FUSED B(+)
7	A21 16DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
8	L50 14WT/TN	BRAKE LAMP SWITCH OUTPUT



LEAK DETECTION PUMP - BLACK 4 WAY

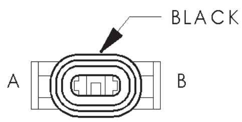
CAV	CIRCUIT	FUNCTION
1	-	-
2	K125 18WT/DB	GENERATOR SOURCE
3	K106 18WT/DG	LEAK DETECTION PUMP SOLENOID CONTROL
4	K107 18OR	LEAK DETECTION PUMP SWITCH SENSE



LEFT BACK-UP LAMP

LEFT BACK-UP LAMP - GRAY 3 WAY

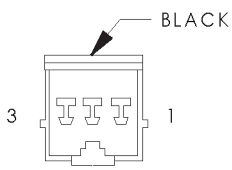
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	-	-
3	L1 20VT/BK	BACK-UP LAMP FEED



LEFT FOG LAMP

LEFT FOG LAMP - BLACK 2 WAY

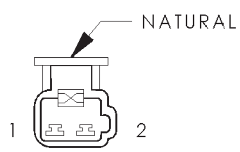
CAV	CIRCUIT	FUNCTION
A	Z1 18BK	GROUND
B	L39 18LB	FOG LAMP RELAY OUTPUT



LEFT FRONT DOOR SPEAKER (BASE)

LEFT FRONT DOOR SPEAKER (BASE) - BLACK 3 WAY

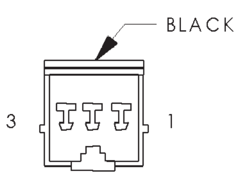
CAV	CIRCUIT	FUNCTION
1	X87 18LG/VT	AMPLIFIED LEFT DOOR SPEAKER (+)
2	-	-
3	X85 18LG/DG	AMPLIFIED LEFT DOOR SPEAKER (-)



LEFT FRONT DOOR TWEETER (MIDLEVEL/ PREMIUM)

LEFT FRONT DOOR TWEETER (MIDLEVEL/PREMIUM) - NATURAL 2 WAY

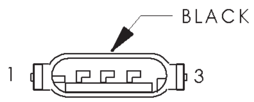
CAV	CIRCUIT	FUNCTION
1	X87 18LG/VT	AMPLIFIED LEFT DOOR SPEAKER (+)
2	X85 18LG/DG	AMPLIFIED LEFT DOOR SPEAKER (-)



LEFT FRONT DOOR WOOFER (MIDLEVEL/ PREMIUM)

LEFT FRONT DOOR WOOFER (MIDLEVEL/PREMIUM) - BLACK 3 WAY

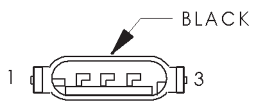
CAV	CIRCUIT	FUNCTION
1	X87 18LG/VT	AMPLIFIED LEFT DOOR SPEAKER (+)
2	-	-
3	X85 18LG/DG	AMPLIFIED LEFT DOOR SPEAKER (-)



LEFT FRONT PARK/TURN SIGNAL LAMP NO. 1

LEFT FRONT PARK/TURN SIGNAL LAMP NO. 1 - BLACK 3 WAY

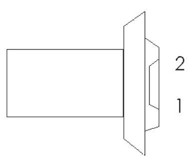
CAV	CIRCUIT	FUNCTION
1	L61 16LG	LEFT TURN SIGNAL
2	L7 20BK/YL	PARK LAMP RELAY OUTPUT
3	Z1 20BK	GROUND



LEFT FRONT PARK/TURN SIGNAL LAMP NO. 2

LEFT FRONT PARK/TURN SIGNAL LAMP NO. 2 - BLACK 3 WAY

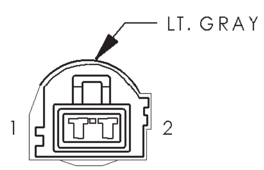
CAV	CIRCUIT	FUNCTION
1	L61 16LG	LEFT TURN SIGNAL
2	L7 20BK/YL	PARK LAMP RELAY OUTPUT
3	Z1 20BK	GROUND



LEFT FRONT SIDE MARKER LAMP

LEFT FRONT SIDE MARKER LAMP - 2 WAY

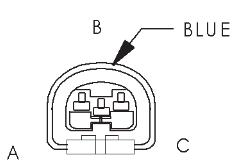
CAV	CIRCUIT	FUNCTION
1	L7 20BK/YL	PARK LAMP RELAY OUTPUT
2	Z1 20BK	GROUND



LEFT FRONT WHEEL SPEED SENSOR

LEFT FRONT WHEEL SPEED SENSOR - LT. GRAY 2 WAY

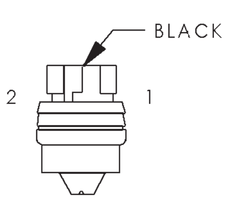
CAV	CIRCUIT	FUNCTION
1	B8 20RD/GY	LEFT FRONT WHEEL SPEED SENSOR (-)
2	B9 20RD	LEFT FRONT WHEEL SPEED SENSOR (+)



LEFT HEADLAMP

LEFT HEADLAMP - BLUE 3 WAY

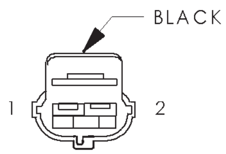
CAV	CIRCUIT	FUNCTION
A	L43 18VT/WT	LEFT LOW BEAM DRIVER
B	Z1 18BK	GROUND
C	L33 18LG/BR	LEFT HIGH BEAM DRIVER



LEFT LICENSE LAMP

LEFT LICENSE LAMP - BLACK 2 WAY

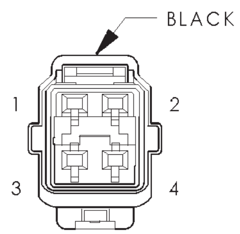
CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L7 18BK/YL	PARK LAMP RELAY OUTPUT



LEFT REAR DOOR AJAR SWITCH (BASE)

LEFT REAR DOOR AJAR SWITCH (BASE) - BLACK 2 WAY

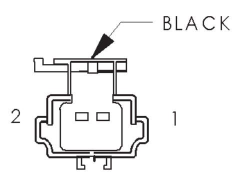
CAV	CIRCUIT	FUNCTION
1	G74 18TN/RD	PASSENGER DOOR AJAR SWITCH SENSE
2	Z2 20BK/LG	GROUND



LEFT REAR DOOR POWER LOCK MOTOR/ AJAR SWITCH (PREMIUM)

LEFT REAR DOOR POWER LOCK MOTOR/AJAR SWITCH (PREMIUM) - BLACK 4 WAY

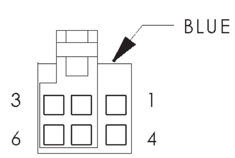
CAV	CIRCUIT	FUNCTION
1	G74 18TN/RD	PASSENGER DOOR AJAR SWITCH SENSE
2	Z2 20BK/LG	GROUND
3	P34 16PK/BK	DOOR UNLOCK RELAY OUTPUT
4	P33 16OR/BK	DOOR LOCK RELAY OUTPUT



LEFT REAR DOOR POWER WINDOW MOTOR

LEFT REAR DOOR POWER WINDOW MOTOR - BLACK 2 WAY

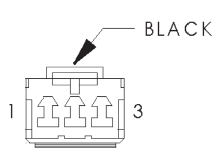
CAV	CIRCUIT	FUNCTION
1	Q23 14RD/WT	LEFT REAR WINDOW DRIVER (DOWN)
2	Q13 14DB	LEFT REAR WINDOW DRIVER (UP)



LEFT REAR DOOR POWER WINDOW SWITCH

LEFT REAR DOOR POWER WINDOW SWITCH - BLUE 6 WAY

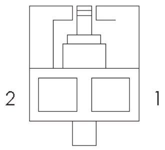
CAV	CIRCUIT	FUNCTION
1	Q13 14DB	LEFT REAR WINDOW DRIVER (UP)
2	Q27 14RD/BK	LEFT REAR WINDOW DRIVER (DOWN)
3	-	-
4	Q17 14DB/WT	LEFT REAR WINDOW DRIVER (UP)
5	Q23 14RD/WT	LEFT REAR WINDOW DRIVER (DOWN)
6	Q1 14YL	WINDOW SWITCH FEED



LEFT REAR SPEAKER

LEFT REAR SPEAKER - BLACK 3 WAY

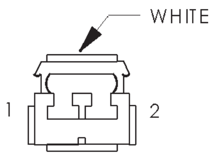
CAV	CIRCUIT	FUNCTION
1	X93 18WT/RD	AMPLIFIED LEFT REAR SPEAKER (+)
2	-	-
3	X91 18WT/BK	AMPLIFIED LEFT REAR SPEAKER (-)



LEFT REMOTE RADIO SWITCH (PREMIUM)

LEFT REMOTE RADIO SWITCH (PREMIUM) - 2 WAY

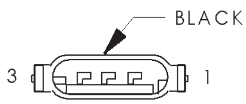
CAV	CIRCUIT	FUNCTION
1	X20 22RD/BK	RADIO CONTROL MUX
2	Z2 22BK/LG	GROUND



LEFT SPEED CONTROL SWITCH

LEFT SPEED CONTROL SWITCH - WHITE 2 WAY

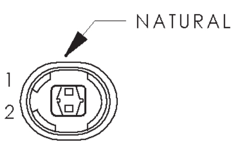
CAV	CIRCUIT	FUNCTION
1	V37 22RD/LG	SPEED CONTROL SWITCH SIGNAL
1	V37 22RD/LG	SPEED CONTROL SWITCH SIGNAL
2	K4 22BK/LB	SENSOR GROUND



LEFT TAIL/ STOP/TURN SIGNAL LAMP

LEFT TAIL/STOP/TURN SIGNAL LAMP - BLACK 3 WAY

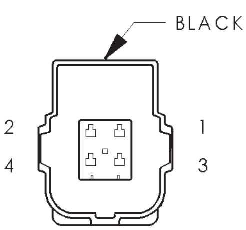
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	L7 20BK/YL	HEADLAMP SWITCH OUTPUT
3	L632 16DG/BR	LEFT REAR TURN SIGNAL



LICENSE LAMP

LICENSE LAMP - NATURAL 2 WAY

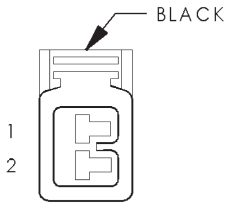
CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	PARK LAMP RELAY OUTPUT
2	Z1 20BK	GROUND



LINE PRESSURE SENSOR (4.7)

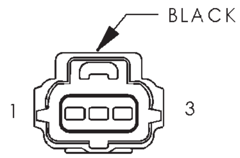
LINE PRESSURE SENSOR (4.7L) - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	Z113 16BK	GROUND
2	T38 18VT/TN	5V SUPPLY
3	T39 18GY/LB	LINE PRESSURE SENSOR SIGNAL
4	-	-



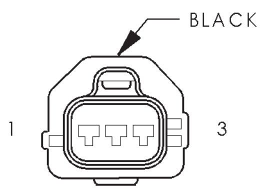
LOW NOTE HORN - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	X2 18DG/RD	HORN RELAY OUTPUT



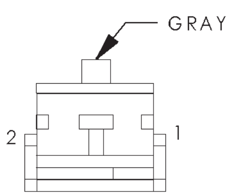
MANIFOLD ABSOLUTE PRESSURE SENSOR (4.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K7 18OR	5V SUPPLY
2	K4 18BK/LB	SENSOR GROUND
3	K1 18DG/RD	MAP SENSOR SIGNAL



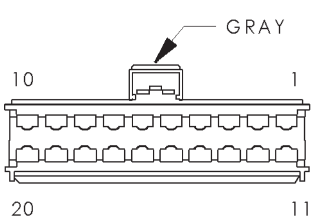
MANIFOLD ABSOLUTE PRESSURE SENSOR (EXCEPT 4.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K1 18DG/RD	MAP SENSOR SIGNAL
3	K7 18OR	5V SUPPLY



MODE DOOR ACTUATOR - GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	C35 20DG/YL	MODE DOOR DRIVER
2	C34 20DB/WT	COMMON DOOR DRIVER

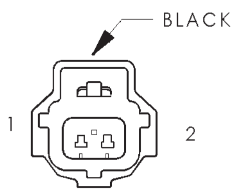


MULTI-FUNCTION SWITCH - GRAY 20 WAY

CAV	CIRCUIT	FUNCTION
1	L19 16PK	HAZARD FLASHER SIGNAL
2	V51 20WT	FRONT WIPER SWITCH SENSE
3	L302 18LB/YL	RIGHT TURN SWITCH SENSE
4	V52 18DG/RD	INTERMITTENT WIPER MODE SENSE
5	L305 20LB/WT	LEFT TURN SWITCH SENSE
6	L4 18VT/WT	LOW BEAM SWITCH OUTPUT
7	Z1 18BK	GROUND
8	L3 18RD/OR	HIGH BEAM SWITCH OUTPUT

MULTI-FUNCTION SWITCH - GRAY 20 WAY

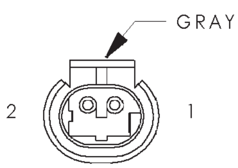
CAV	CIRCUIT	FUNCTION
9	L307 18LG/OR	HEADLAMP SWITCH SENSE
10	-	-
11	Z1 18BK	GROUND
12	-	-
13	-	-
14	V49 18RD/BK	INTERMITTENT FRONT WIPER LOW SPEED
15	V45 18VT	FRONT WIPER LOW SPEED
16	V48 16RD/GY	FRONT WIPER HIGH SPEED
17	V45 18VT	FRONT WIPER LOW SPEED
18	V6 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
19	V10 18BR	FRONT WIPER PUMP/MOTOR CONTROL
20	-	-



OUTPUT SPEED SENSOR (4.7L)

OUTPUT SPEED SENSOR (4.7L) - BLACK 2 WAY

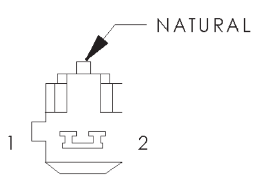
CAV	CIRCUIT	FUNCTION
1	T13 18DB/BK	SPEED SENSOR GROUND
2	T14 18LG/WT	OUTPUT SPEED SENSOR SIGNAL



OUTPUT SPEED SENSOR (3.9L/5.9L)

OUTPUT SPEED SENSOR (3.9L/5.9L) - GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	T13 18DB/BK	SPEED SENSOR GROUND
2	T14 18LG/WT	OUTPUT SPEED SENSOR SIGNAL



OVERDRIVE SWITCH

OVERDRIVE SWITCH - NATURAL 2 WAY

CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	T6 20OR/WT	OVERDRIVE OFF SWITCH SENSE

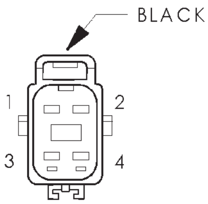
OVERHEAD CONSOLE

OVERHEAD CONSOLE - 12 WAY

CAV	CIRCUIT	FUNCTION
1	Y158 20YL/VT	INTERIOR LAMP DRIVER
2	M1 20PK	FUSED B(+)
3	-	-
4	-	-

OVERHEAD CONSOLE - 12 WAY

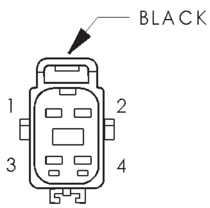
CAV	CIRCUIT	FUNCTION
5	D25 20VT/YL	PCI BUS
6	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
7	M2 20YL	COURTESY LAMP DRIVER
8	-	-
9	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
10	-	-
11	-	-
12	Z2 20BK/LG	GROUND



OXYGEN SENSOR 1/1 UPSTREAM (3.9L/5.9L)

OXYGEN SENSOR 1/1 UPSTREAM (3.9L/5.9L) - BLACK 4 WAY

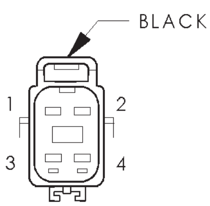
CAV	CIRCUIT	FUNCTION
1	K100 18VT/WT	PWM 1/1 HEATER DRIVER
2	F142 16OR/DG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
3	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL
4	K4 18BK/LB	SENSOR GROUND



OXYGEN SENSOR 1/1 UPSTREAM (EXCEPT 3.9L/5.9L)

OXYGEN SENSOR 1/1 UPSTREAM (EXCEPT 3.9L/5.9L) - BLACK 4 WAY

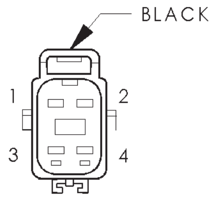
CAV	CIRCUIT	FUNCTION
1	F142 16OR/DG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K100 18VT/WT	PWM 1/1 HEATER DRIVER
3	K4 18BK/LB	SENSOR GROUND
4	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL



OXYGEN SENSOR 1/2 DOWNSTREAM (2.5L)

OXYGEN SENSOR 1/2 DOWNSTREAM (2.5L) - BLACK 4 WAY

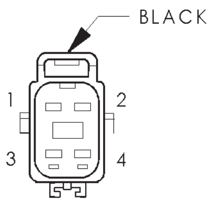
CAV	CIRCUIT	FUNCTION
1	F142 18OR/DG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K200 18VT/OR	OXYGEN SENSOR RELAY DRIVER
3	K4 18BK/LB	SENSOR GROUND
4	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL



OXYGEN SENSOR 1/2 DOWNSTREAM (3.9L/5.9L)

OXYGEN SENSOR 1/2 DOWNSTREAM (3.9L/5.9L) - BLACK 4 WAY

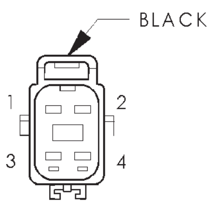
CAV	CIRCUIT	FUNCTION
1	Z11 18BK/WT	GROUND
2	F242 16DG/PK	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
3	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL
4	K4 18BK/LB	SENSOR GROUND



OXYGEN SENSOR 1/2 DOWNSTREAM (4.7L)

OXYGEN SENSOR 1/2 DOWNSTREAM (4.7L) - BLACK 4 WAY

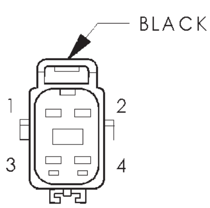
CAV	CIRCUIT	FUNCTION
1	F242 18DG/PK (4.7L A/T)	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
1	Z11 18BK/WT (4.7L M/T)	GROUND
2	F242 18DG/PK (4.7L M/T)	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
2	Z11 18BK/WT (4.7L A/T)	GROUND
3	K141 18TN/WT (4.7L M/T)	OXYGEN SENSOR 1/2 SIGNAL
3	K4 18BK/LB (4.7L A/T)	SENSOR GROUND
4	K141 18TN/WT (4.7L M/T)	OXYGEN SENSOR 1/2 SIGNAL
4	K4 18BK/LB (4.7L A/T)	SENSOR GROUND



OXYGEN SENSOR 2/1 UPSTREAM (3.9L/5.9L)

OXYGEN SENSOR 2/1 UPSTREAM (3.9L/5.9L) - BLACK 4 WAY

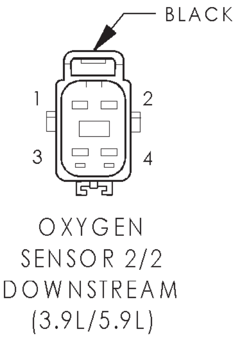
CAV	CIRCUIT	FUNCTION
1	K200 18VT/OR	PWM 2/1 HEATER
2	F142 16OR/DG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
3	K241 18LG/RD	OXYGEN SENSOR 2/1 SIGNAL
4	K4 18BK/LB	SENSOR GROUND



OXYGEN SENSOR 2/1 UPSTREAM (4.7L)

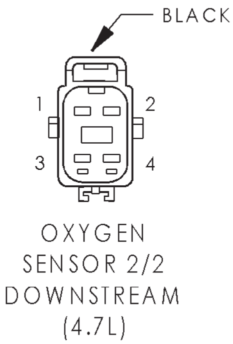
OXYGEN SENSOR 2/1 UPSTREAM (4.7L) - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	F142 16OR/DG	FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K200 18BR/WT	PWM 2/1 HEATER
3	K4 18BK/LB	SENSOR GROUND
4	K241 18LG/RD	OXYGEN SENSOR 2/1 SIGNAL



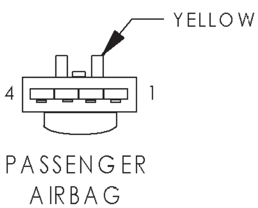
OXYGEN SENSOR 2/2 DOWNSTREAM (3.9L/5.9L) - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	Z11 18BK/WT	GROUND
2	F242 16DG/PK	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
3	K341 18TN/WT	OXYGEN SENSOR 2/2 SIGNAL
4	K4 18BK/LB	SENSOR GROUND



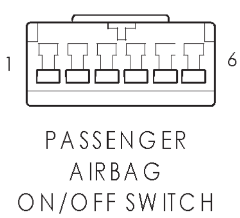
OXYGEN SENSOR 2/2 DOWNSTREAM (4.7L) - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	F242 18DG/PK	OXYGEN SENSOR DOWNSTREAM HEATER RELAY OUTPUT
2	Z11 18BK/WT	GROUND
3	K4 18BK/LB	SENSOR GROUND
4	K341 18TN/WT	OXYGEN SENSOR 2/2 SIGNAL



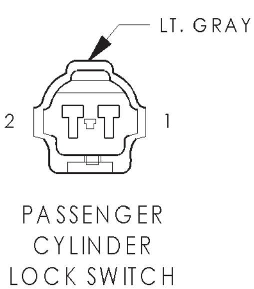
PASSENGER AIRBAG - YELLOW 4 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	R44 18DG/YL	PASSENGER AIRBAG LINE 2
4	R42 18BK/YL	PASSENGER AIRBAG LINE 1



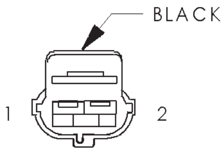
PASSENGER AIRBAG ON/OFF SWITCH - 6 WAY

CAV	CIRCUIT	FUNCTION
1	R65 20LG/OR	PASSENGER AIRBAG MUX SWITCH SENSE
2	R66 20LG/DG	PASSENGER AIRBAG MUX SWITCH SENSE
3	R166 20LG/BR	PASSENGER AIRBAG MUX SWITCH SENSE
4	F14 20LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
5	-	-
6	-	-



PASSENGER CYLINDER LOCK SWITCH - LT. GRAY 2 WAY

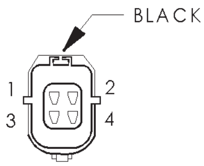
CAV	CIRCUIT	FUNCTION
1	Z2 20BK/TN (4 DOOR)	GROUND
1	Z2 20BK/LG (2 DOOR)	GROUND
2	G73 20LG/OR	CYLINDER LOCK SWITCH MUX



PASSENGER DOOR AJAR SWITCH (BASE)

PASSENGER DOOR AJAR SWITCH (BASE) - BLACK 2 WAY

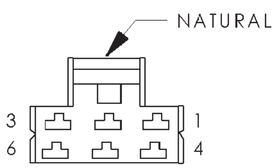
CAV	CIRCUIT	FUNCTION
1	G74 20TN/RD	PASSENGER DOOR AJAR SWITCH SENSE
2	Z2 20BK/LG	GROUND



PASSENGER DOOR POWER LOCK MOTOR/ AJAR SWITCH (PREMIUM)

PASSENGER DOOR POWER LOCK MOTOR/AJAR SWITCH (PREMIUM) - BLACK 4 WAY

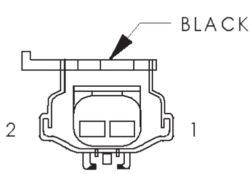
CAV	CIRCUIT	FUNCTION
1	G74 20TN/RD	PASSENGER DOOR AJAR SWITCH SENSE
2	Z2 20BK/TN (4 DOOR)	GROUND
2	Z2 20BK/LG (2 DOOR)	GROUND
3	P34 18PK/BK	DOOR UNLOCK RELAY OUTPUT
4	P33 18OR/BK	DOOR LOCK RELAY OUTPUT



PASSENGER DOOR POWER LOCK SWITCH

PASSENGER DOOR POWER LOCK SWITCH - NATURAL 6 WAY

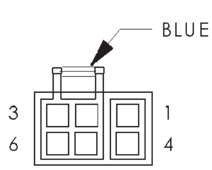
CAV	CIRCUIT	FUNCTION
1	P96 20WT/LG	PASSENGER DOOR SWITCH MUX
2	L10 20BR/LG (4 DOOR)	FUSED IGNITION SWITCH OUTPUT (RUN)
2	L10 18BR/LG (2 DOOR)	FUSED IGNITION SWITCH OUTPUT (RUN)
3	-	-
4	-	-
5	Z2 20BK/TN (4 DOOR)	GROUND
5	Z2 20BK/LG (2 DOOR)	GROUND
6	-	-



PASSENGER DOOR POWER WINDOW MOTOR

PASSENGER DOOR POWER WINDOW MOTOR - BLACK 2 WAY

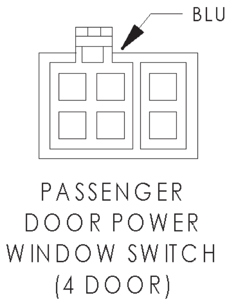
CAV	CIRCUIT	FUNCTION
1	Q22 14VT	PASSENGER WINDOW DRIVER (DOWN)
2	Q12 14BR	PASSENGER WINDOW DRIVER (UP)



PASSENGER DOOR POWER WINDOW SWITCH (2 DOOR)

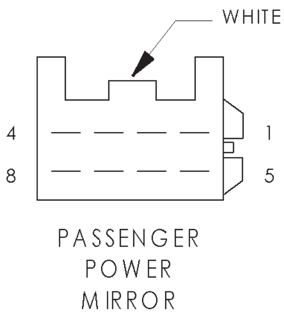
PASSENGER DOOR POWER WINDOW SWITCH (2 DOOR) - BLUE 6 WAY

CAV	CIRCUIT	FUNCTION
1	Q22 14VT	PASSENGER WINDOW DRIVER (DOWN)
2	Q16 14BR/WT	MASTER WINDOW SWITCH RIGHT FRONT (UP)
3	-	-
4	Q26 14VT/WT	MASTER WINDOW SWITCH RIGHT FRONT (DOWN)
5	Q12 14BR	PASSENGER WINDOW DRIVER (UP)
6	Q1 14YL	WINDOW SWITCH FEED



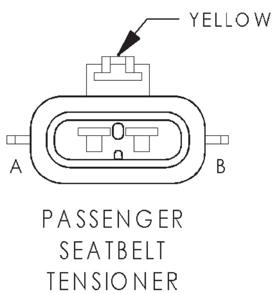
PASSENGER DOOR POWER WINDOW SWITCH (4 DOOR) - BLUE 6 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	Q16 14BR/WT	MASTER WINDOW SWITCH RIGHT FRONT (UP)
3	Q22 14VT	PASSENGER WINDOW DRIVER (DOWN)
4	Q1 14YL	WINDOW SWITCH FEED
5	Q12 14BR	PASSENGER WINDOW DRIVER (UP)
6	Q26 14VT/WT	MASTER WINDOW SWITCH RIGHT FRONT (DOWN)



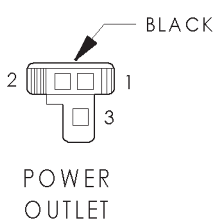
PASSENGER POWER MIRROR - WHITE 8 WAY

CAV	CIRCUIT	FUNCTION
1	P72 22YL/BK	RIGHT MIRROR UP MOVEMENT
2	P74 22DB	RIGHT MIRROR LEFT MOVEMENT
3	P76 22OR/YL	MIRROR COMMON DRIVER
4	F121 20TN/BK	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT
5	-	-
6	-	-
7	-	-
8	Z1 20BK	GROUND



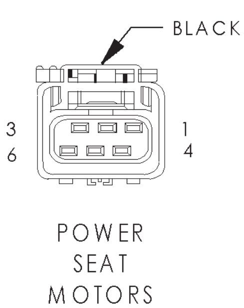
PASSENGER SEATBELT TENSIONER - YELLOW 2 WAY

CAV	CIRCUIT	FUNCTION
A	R56 18LB/DG	PASSENGER SEATBELT TENSIONER LINE 1
B	R54 18LB/YL	PASSENGER SEATBELT TENSIONER LINE 2



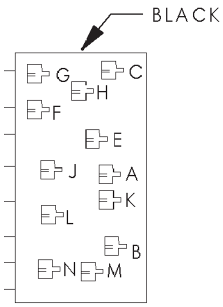
POWER OUTLET - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	A12 16RD/TN	FUSED B(+)
2	-	-
3	Z1 16BK	GROUND



POWER SEAT MOTORS - BLACK 6 WAY

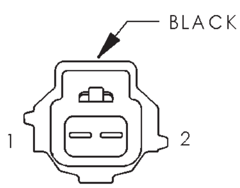
CAV	CIRCUIT	FUNCTION
1	P17 14RD/LB	SEAT HORIZONTAL REARWARD SWITCH SENSE
2	P19 14YL/LG	SEAT FRONT UP SWITCH SENSE
3	P11 14YL/WT	SEAT REAR UP SWITCH SENSE
4	P15 14YL/LB	SEAT HORIZONTAL FORWARD SWITCH SENSE
5	P21 14RD/LG	SEAT FRONT DOWN SWITCH SENSE
6	P13 14RD/WT	SEAT REAR DOWN SWITCH SENSE



POWER SEAT SWITCH

POWER SEAT SWITCH - BLACK 14 WAY

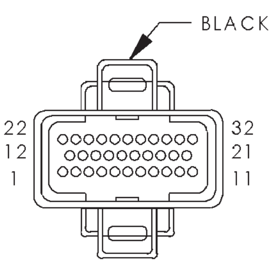
CAV	CIRCUIT	FUNCTION
A	A4 12BK/PK	FUSED B(+)
B	Z1 12BK	GROUND
C	-	-
D	-	-
E	P21 14RD/LG	SEAT FRONT DOWN SWITCH SENSE
F	-	-
G	-	-
H	-	-
I	-	-
J	P19 14YL/LG	SEAT FRONT UP SWITCH SENSE
K	P15 14YL/LB	SEAT HORIZONTAL FORWARD SWITCH SENSE
L	P17 14RD/LB	SEAT HORIZONTAL REARWARD SWITCH SENSE
M	P13 14RD/WT	SEAT REAR DOWN SWITCH SENSE
N	P11 14YL/WT	SEAT REAR UP SWITCH SENSE



POWER STEERING PRESSURE SWITCH (2.5L/4.7L)

POWER STEERING PRESSURE SWITCH (2.5L/4.7L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	K10 18DB/OR	STEERING PRESSURE SWITCH SENSE



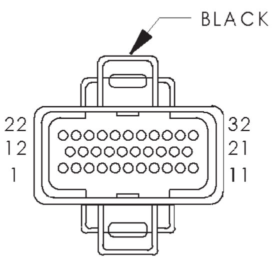
POWERTRAIN CONTROL MODULE C1 (2.5L)

POWERTRAIN CONTROL MODULE C1 (2.5L) - BLACK 32 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	F18 18LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	-	-
4	K4 18BK/LB	SENSOR GROUND
5	-	-
6	-	-
7	K19 16BK/GY	IGNITION COIL NO. 1 DRIVER
8	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
9	-	-
10	K60 18YL/BK	IDLE AIR CONTROL NO. 2 DRIVER
11	K40 18BR/WT	IDLE AIR CONTROL NO. 3 DRIVER
12	K10 18DB/OR	STEERING PRESSURE SWITCH SENSE
13	-	-
14	-	-
15	K21 18BK/RD	INTAKE AIR TEMPERATURE SIGNAL
16	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
17	K7 18OR	5V SUPPLY
18	K44 16TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
19	K39 18GY/RD	IDLE AIR CONTROL NO. 1 DRIVER
20	K59 18VT/BK	IDLE AIR CONTROL NO. 4 DRIVER
21	-	-

POWERTRAIN CONTROL MODULE C1 (2.5L) - BLACK 32 WAY

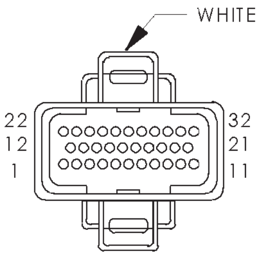
CAV	CIRCUIT	FUNCTION
22	A14 16RD/WT	FUSED B(+)
23	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
24	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL
25	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL
26	-	-
27	K1 18DG/RD	MAP SENSOR SIGNAL
28	-	-
29	-	-
30	-	-
31	Z12 14BK/TN	GROUND
32	Z12 14BK/TN	GROUND



POWERTRAIN CONTROL MODULE C1 (3.9L/4.7L/5.9L)

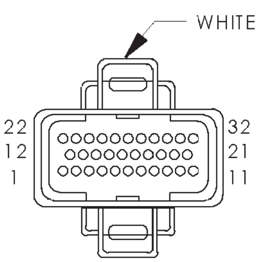
POWERTRAIN CONTROL MODULE C1 (3.9L/4.7L/5.9L) - BLACK 32 WAY

CAV	CIRCUIT	FUNCTION
1	K93 16TN/OR (4.7L)	COIL DRIVER NO. 3
2	F18 18LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	K94 16TN/LG (4.7L)	COIL DRIVER NO. 4
4	K4 18BK/LB	SENSOR GROUND
5	K96 16TN/LB (4.7L)	COIL DRIVER NO. 6
6	T41 18BK/WT (A/T)	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
7	K19 16BK/GY	COIL DRIVER NO. 1
8	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
9	K98 16LB/RD (4.7L)	COIL DRIVER NO. 8
10	K60 16YL/BK (4.7L)	IDLE AIR CONTROL NO. 2 DRIVER
10	K60 18YL/BK (3.9L/5.9L)	IDLE AIR CONTROL NO. 2 DRIVER
11	K40 16BR/WT (4.7L)	IDLE AIR CONTROL NO. 3 DRIVER
11	K40 18BR/WT (3.9L/5.9L)	IDLE AIR CONTROL NO. 3 DRIVER
12	K10 18DB/OR (4.7L)	STEERING PRESSURE SWITCH SENSE
13	-	-
14	-	-
15	K21 18BK/RD	INTAKE AIR TEMPERATURE SIGNAL
16	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
17	K7 18OR	5V SUPPLY
18	K44 18TN/YL (3.9L/5.9L)	CAMSHAFT POSITION SENSOR SIGNAL
18	K44 16TN/YL (4.7L)	CAMSHAFT POSITION SENSOR SIGNAL
19	K39 18GY/RD (3.9L/5.9L)	IDLE AIR CONTROL NO. 1 DRIVER
19	K39 16GY/RD (4.7L)	IDLE AIR CONTROL NO. 1 DRIVER
20	K59 18VT/BK (3.9L/5.9L)	IDLE AIR CONTROL NO. 4 DRIVER
20	K59 16VT/BK (4.7L)	IDLE AIR CONTROL NO. 4 DRIVER
21	K95 16TN/DG (4.7L)	COIL DRIVER NO. 5
22	A14 16RD/WT	FUSED B(+)
23	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
24	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL
25	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL
26	K241 18LG/RD	OXYGEN SENSOR 2/1 SIGNAL
27	K1 18DG/RD	MAP SENSOR SIGNAL
28	-	-
29	K341 18TN/WT	OXYGEN SENSOR 2/2 SIGNAL
30	-	-
31	Z12 14BK/TN	GROUND
32	Z12 14BK/TN	GROUND



POWERTRAIN CONTROL MODULE C2 (2.5L) - WHITE 32 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	-	-
4	K11 18WT/DB	FUEL INJECTOR NO .1 DRIVER
5	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER
6	-	-
7	-	-
8	-	-
9	-	-
10	K20 18DG	GENERATOR FIELD
11	-	-
12	-	-
13	-	-
14	-	-
15	K12 18TN	FUEL INJECTOR NO. 2 DRIVER
16	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER
17	C24 18DB/PK	RADIATOR FAN RELAY CONTROL
18	-	-
19	C18 18DB	A/C PRESSURE SIGNAL
20	-	-
21	-	-
22	-	-
23	G60 18GY/YL	ENGINE OIL PRESSURE SENSOR SIGNAL
24	-	-
25	-	-
26	-	-
27	G7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL
28	-	-
29	-	-
30	-	-
31	K6 18VT/WT	5V SUPPLY
32	-	-

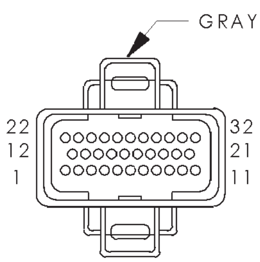


POWERTRAIN CONTROL MODULE C2 (3.9L/4.7L/5.9L) - WHITE 32 WAY

CAV	CIRCUIT	FUNCTION
1	T34 18GY/BK (3.9L/5.9L)	TRANSMISSION TEMPERATURE SENSOR SIGNAL
2	K26 18VT (4.7L/5.9L)	FUEL INJECTOR NO. 7 DRIVER
3	-	-
4	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER
5	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER
6	K38 18GY	FUEL INJECTOR NO. 5 DRIVER
7	K17 16DB/TN (4.7L)	COIL DRIVER NO. 7
8	K88 18VT/WT (A/T 3.9L/5.9L)	VARIABLE FORCE SOLENOID CONTROL
9	K92 16TN/PK (4.7L)	COIL DRIVER NO. 2
10	K20 18DB (3.9L/5.9L)	GENERATOR FIELD
10	K20 18DG (4.7L)	GENERATOR FIELD
11	K54 18OR/BK (A/T 3.9L/5.9L)	TORQUE CONVERTER CLUTCH SOLENOID CONTROL
12	K58 18BR/DB	FUEL INJECTOR NO. 6 DRIVER
13	K28 18GY/LB (4.7L/5.9L)	FUEL INJECTOR NO. 8 DRIVER
14	-	-
15	K12 18TN	FUEL INJECTOR NO. 2 DRIVER
16	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER
17	C24 18DB/PK	RADIATOR FAN RELAY CONTROL
18	-	-

POWERTRAIN CONTROL MODULE C2 (3.9L/4.7L/5.9L) - WHITE 32 WAY

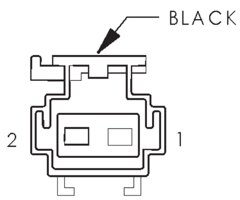
CAV	CIRCUIT	FUNCTION
19	C18 18DB	A/C PRESSURE SIGNAL
20	-	-
21	T60 18BR (A/T 3.9L/5.9L)	3-4 SHIFT SOLENOID CONTROL
22	-	-
23	G60 16GY/YL (3.9L/5.9L)	ENGINE OIL PRESSURE SENSOR SIGNAL
23	G60 18GY/YL (4.7L)	ENGINE OIL PRESSURE SENSOR SIGNAL
24	-	-
25	T13 18DB/BK (A/T 3.9L/5.9L)	SPEED SENSOR GROUND
26	-	-
27	G7 20DB (3.9L/5.9L)	VEHICLE SPEED SENSOR SIGNAL
27	G7 18WT/OR (4.7L)	VEHICLE SPEED SENSOR SIGNAL
28	T14 18LG/WT (A/T 3.9L/5.9L)	OUTPUT SPEED SENSOR SIGNAL
29	T25 18LG/RD (A/T 3.9L/5.9L)	GOVERNOR PRESSURE SIGNAL
30	K30 18PK (3.9L/5.9L)	TRANSMISSION CONTROL RELAY CONTROL
31	K6 18VT/WT	5V SUPPLY
32	-	-



POWERTRAIN CONTROL MODULE C3

POWERTRAIN CONTROL MODULE C3 - GRAY 32 WAY

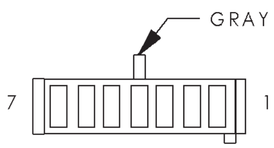
CAV	CIRCUIT	FUNCTION
1	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
2	-	-
3	K51 18DB/YL	AUTOMATIC SHUT DOWN RELAY CONTROL
4	V36 18TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
5	V35 18LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
6	-	-
7	-	-
8	K100 18VT/WT	OXYGEN SENSOR 1/1 HEATER CONTROL
9	K512 18DG/BK	OXYGEN SENSOR DOWNSTREAM HEATER RELAY CONTROL
10	K106 18WT/DG	LEAK DETECTION PUMP SOLENOID CONTROL
11	V32 18YL/RD	SPEED CONTROL SUPPLY
12	A142 14DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
13	T10 18YL/DG (2.5L/4.7L)	TORQUE MANAGEMENT REQUEST SENSE
13	T6 18OR/WT (3.9L/5.9L)	OVERDRIVE OFF SWITCH SENSE
14	K107 18OR	LEAK DETECTION PUMP SWITCH SENSE
15	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
16	K200 18VT/OR	OXYGEN SENSOR RELAY DRIVER
17	-	-
18	-	-
19	K31 18BR	FUEL PUMP RELAY CONTROL
20	K52 18PK/BK	DUTY CYCLE EVAP/PURGE SOLENOID CONTROL
21	-	-
22	C20 18BR	A/C SWITCH SENSE
23	-	-
24	V40 18WT/PK	BRAKE LAMP SWITCH SENSE
25	K125 18WT/DB	GENERATOR SOURCE
26	K226 18DB/WT	FUEL PUMP RELAY CONTROL
27	D21 18PK	SCI TRANSMIT
28	-	-
29	D20 18LG	SCI RECEIVE
30	D25 18VT/YL	PCI BUS
31	-	-
32	V37 18RD/LG	SPEED CONTROL SWITCH SIGNAL



RADIATOR FAN MOTOR

RADIATOR FAN MOTOR - BLACK 2 WAY

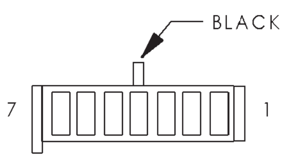
CAV	CIRCUIT	FUNCTION
1	C25 10LG	HIGH SPEED FAN RELAY OUTPUT
2	Z1 10BK	GROUND



RADIO C1

RADIO C1 - GRAY 7 WAY

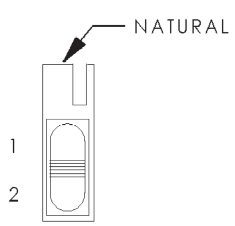
CAV	CIRCUIT	FUNCTION
1	-	-
2	X85 18LG/DG (BASE RADIO)	AMPLIFIED LEFT DOOR SPEAKER (-)
2	X55 20BR/RD (PREMIUM RADIO)	LEFT FRONT SPEAKER (-)
3	X80 18LB/BK (BASE RADIO)	AMPLIFIED RIGHT DOOR SPEAKER (-)
3	X56 20DB/RD (PREMIUM RADIO)	RIGHT FRONT SPEAKER (-)
4	L107 20WT	HEADLAMP SWITCH OUTPUT
5	E2 20OR	PANEL LAMPS FEED
6	X12 16RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
7	M1 20PK	FUSED B(+)



RADIO C2

RADIO C2 - BLACK 7 WAY

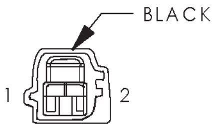
CAV	CIRCUIT	FUNCTION
1	X60 20DG/RD	RADIO 12V OUTPUT
2	X93 18WT/RD (BASE RADIO)	AMPLIFIED LEFT REAR SPEAKER (+)
2	X51 20BR/YL (PREMIUM RADIO)	LEFT REAR SPEAKER (+)
3	X94 18TN/VT (BASE RADIO)	AMPLIFIED RIGHT REAR SPEAKER (+)
3	X52 20DB/WT (PREMIUM RADIO)	RIGHT REAR SPEAKER (+)
4	X87 18LG/VT (BASE RADIO)	AMPLIFIED LEFT DOOR SPEAKER (+)
4	X53 20DG (PREMIUM RADIO)	LEFT FRONT SPEAKER (+)
5	X82 18LB/VT (BASE RADIO)	AMPLIFIED RIGHT DOOR SPEAKER (+)
5	X54 20VT (PREMIUM RADIO)	RIGHT FRONT SPEAKER (+)
6	X91 18WT/BK (BASE RADIO)	AMPLIFIED LEFT REAR SPEAKER (-)
6	X57 20BR/LB (PREMIUM RADIO)	LEFT REAR SPEAKER (-)
7	X92 18TN/BK (BASE RADIO)	AMPLIFIED RIGHT REAR SPEAKER (-)
7	X58 20DB/OR (PREMIUM RADIO)	RIGHT REAR SPEAKER (-)



RADIO C3

RADIO C3 - NATURAL 2 WAY

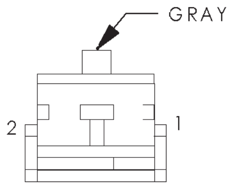
CAV	CIRCUIT	FUNCTION
1	D25 20VT/YL	PCI BUS
2	-	-



REAR WHEEL SPEED SENSOR

REAR WHEEL SPEED SENSOR - BLACK 2 WAY

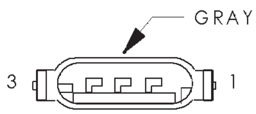
CAV	CIRCUIT	FUNCTION
1	B114 20WT/VT	REAR WHEEL SPEED SENSOR (-)
2	B113 20RD/VT	REAR WHEEL SPEED SENSOR (+)



RECIRCULATION DOOR ACTUATOR

RECIRCULATION DOOR ACTUATOR - GRAY 2 WAY

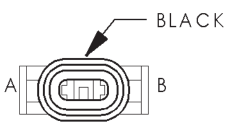
CAV	CIRCUIT	FUNCTION
1	C32 20GY/DB	RECIRCULATION DOOR DRIVER
2	C34 20DB/WT	COMMON DOOR DRIVER



RIGHT BACK-UP LAMP

RIGHT BACK-UP LAMP - GRAY 3 WAY

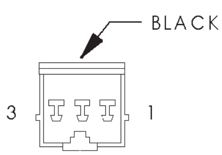
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	-	-
3	L1 20VT/BK	BACK-UP LAMP FEED



RIGHT FOG LAMP

RIGHT FOG LAMP - BLACK 2 WAY

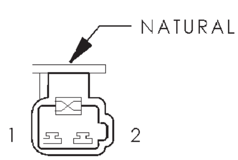
A	Z1 18BK	GROUND
CAV	CIRCUIT	FUNCTION
B	L39 18LB	FOG LAMP RELAY OUTPUT



RIGHT FRONT DOOR SPEAKER (BASE)

RIGHT FRONT DOOR SPEAKER (BASE) - BLACK 3 WAY

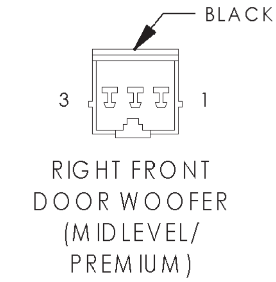
CAV	CIRCUIT	FUNCTION
1	X82 18LB/VT	AMPLIFIED RIGHT DOOR SPEAKER (+)
2	-	-
3	X80 18LB/BK	AMPLIFIED RIGHT DOOR SPEAKER (-)



RIGHT FRONT DOOR TWEETER (MIDLEVEL/ PREMIUM)

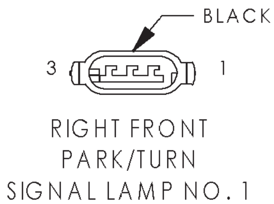
RIGHT FRONT DOOR TWEETER (MIDLEVEL/PREMIUM) - NATURAL 2 WAY

CAV	CIRCUIT	FUNCTION
1	X82 18LB/VT	AMPLIFIED RIGHT DOOR SPEAKER (+)
2	X80 18LB/BK	AMPLIFIED RIGHT DOOR SPEAKER (-)



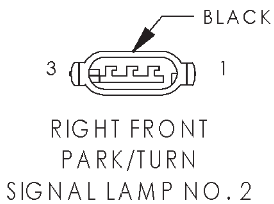
RIGHT FRONT DOOR WOOFER (MIDLEVEL/PREMIUM) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	X82 18LB/VT	AMPLIFIED RIGHT DOOR SPEAKER (+)
2	-	-
3	X80 18LB/BK	AMPLIFIED RIGHT DOOR SPEAKER (-)



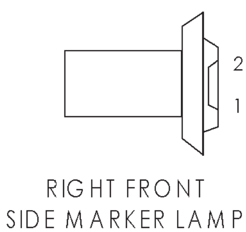
RIGHT FRONT PARK/TURN SIGNAL LAMP NO. 1 - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	L60 16TN	RIGHT TURN SIGNAL
2	L7 20BK/YL	PARK LAMP RELAY OUTPUT
3	Z1 20BK	GROUND



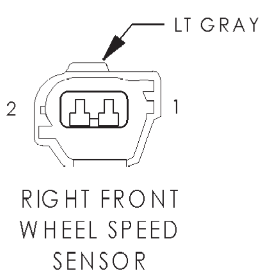
RIGHT FRONT PARK/TURN SIGNAL LAMP NO. 2 - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	L60 16TN	RIGHT TURN SIGNAL
2	L7 20BK/YL	PARK LAMP RELAY OUTPUT
3	Z1 20BK	GROUND



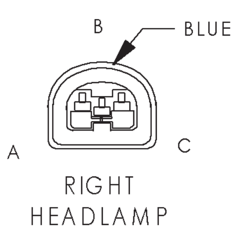
RIGHT FRONT SIDE MARKER LAMP - 2 WAY

CAV	CIRCUIT	FUNCTION
1	L7 20BK/YL	PARK LAMP RELAY OUTPUT
2	Z1 20BK	GROUND



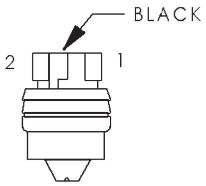
RIGHT FRONT WHEEL SPEED SENSOR - LT. GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	B6 20WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
2	B7 20WT	RIGHT FRONT WHEEL SPEED SENSOR (+)



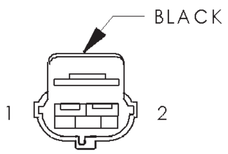
RIGHT HEADLAMP - BLUE 3 WAY

CAV	CIRCUIT	FUNCTION
A	L44 18VT/WT	FUSED RIGHT LOW BEAM OUTPUT
B	Z1 18BK	GROUND
C	L34 18RD/OR	FUSED RIGHT HIGH BEAM OUTPUT



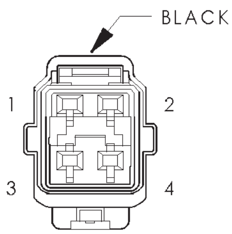
RIGHT LICENSE LAMP - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	L7 18BK/YL	HEADLAMP SWITCH OUTPUT



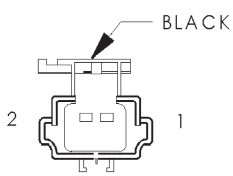
RIGHT REAR DOOR AJAR SWITCH (BASE) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	G74 18TN/RD	PASSENGER DOOR AJAR SWITCH SENSE
2	Z2 20BK/LG	GROUND



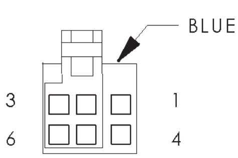
RIGHT REAR DOOR POWER LOCK MOTOR/AJAR SWITCH (PREMIUM) - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	G74 18TN/RD	PASSENGER DOOR AJAR SWITCH SENSE
2	Z2 20BK/LG	GROUND
3	P34 16PK/BK	DOOR UNLOCK RELAY OUTPUT
4	P33 16OR/BK	DOOR LOCK RELAY OUTPUT



RIGHT REAR POWER WINDOW MOTOR - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Q24 14DG	RIGHT REAR WINDOW DRIVER (DOWN)
2	Q14 14GY	RIGHT REAR WINDOW DRIVER (UP)

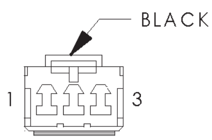


RIGHT REAR POWER WINDOW SWITCH - BLUE 6 WAY

CAV	CIRCUIT	FUNCTION
1	Q14 14GY	RIGHT REAR WINDOW DRIVER (UP)
2	Q28 14DG/WT	MASTER WINDOW SWITCH RIGHT REAR (DOWN)
3	-	-

RIGHT REAR POWER WINDOW SWITCH - BLUE 6 WAY

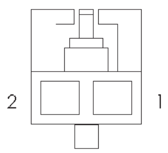
CAV	CIRCUIT	FUNCTION
4	Q18 14GY/BK	MASTER WINDOW SWITCH RIGHT REAR (UP)
5	Q24 14DG	RIGHT REAR WINDOW DRIVER (DOWN)
6	Q1 14YL	WINDOW SWITCH FEED



RIGHT REAR SPEAKER

RIGHT REAR SPEAKER - BLACK 3 WAY

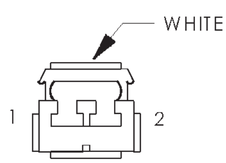
CAV	CIRCUIT	FUNCTION
1	X94 18TN/VT	AMPLIFIED RIGHT REAR SPEAKER (+)
2	-	-
3	X92 18TN/BK	AMPLIFIED RIGHT REAR SPEAKER (-)



RIGHT REMOTE RADIO SWITCH (PREMIUM)

RIGHT REMOTE RADIO SWITCH (PREMIUM) - 2 WAY

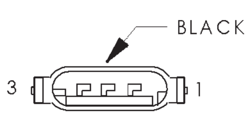
CAV	CIRCUIT	FUNCTION
1	X20 22RD/BK	RADIO CONTROL MUX
2	Z2 22BK/LG	GROUND



RIGHT SPEED CONTROL SWITCH

RIGHT SPEED CONTROL SWITCH - WHITE 2 WAY

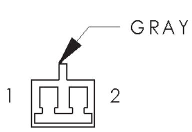
CAV	CIRCUIT	FUNCTION
1	V37 22RD/LG	SPEED CONTROL SWITCH SIGNAL
2	K4 22BK/LB	SENSOR GROUND
2	K4 22BK/LB	SENSOR GROUND



RIGHT TAIL/ STOP/TURN SIGNAL LAMP

RIGHT TAIL/STOP/TURN SIGNAL LAMP - BLACK 3 WAY

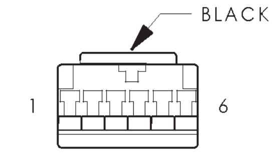
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	L7 20BK/YL	HEADLAMP SWITCH OUTPUT
3	L632 16DG/BR	RIGHT REAR TURN SIGNAL



SEAT BELT SWITCH

SEAT BELT SWITCH - GRAY 2 WAY

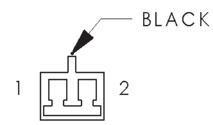
CAV	CIRCUIT	FUNCTION
1	Z2 20BK/LG	GROUND
2	G13 20DB/RD	SEAT BELT INDICATOR DRIVER



SENTRY KEY IMMOBILIZER MODULE

SENTRY KEY IMMOBILIZER MODULE - BLACK 6 WAY

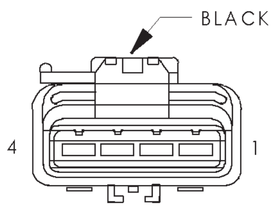
CAV	CIRCUIT	FUNCTION
1	-	-
2	D25 20VT/YL	PCI BUS
3	-	-
4	F18 20LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
5	Z11 20BK/WT	GROUND
6	M1 20PK	FUSED B(+)



SHIFT BEZEL LAMP

SHIFT BEZEL LAMP - BLACK 2 WAY

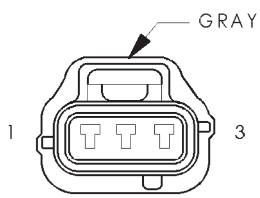
CAV	CIRCUIT	FUNCTION
1	Z1 20BK	GROUND
2	E2 20OR	PANEL LAMPS FEED



SPEED CONTROL SERVO (EXCEPT 2.5L)

SPEED CONTROL SERVO (EXCEPT 2.5L) - BLACK 4 WAY

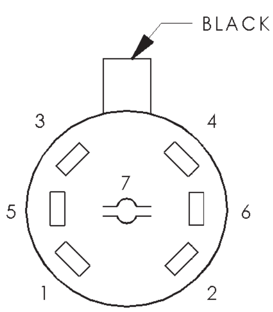
CAV	CIRCUIT	FUNCTION
1	V36 18TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
2	V35 18LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
3	V30 20DB/RD	BRAKE LAMP SWITCH OUTPUT
4	Z1 18BK	GROUND



THROTTLE POSITION SENSOR

THROTTLE POSITION SENSOR - GRAY 3 WAY

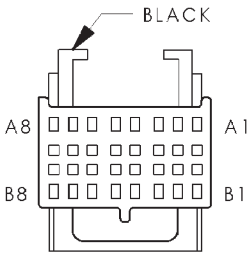
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB (2.5L)	SENSOR GROUND
1	K7 18OR (3.9L/4.7L/5.9L)	5V SUPPLY
2	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
3	K4 18BK/LB (3.9L/4.7L/5.9L)	5V SUPPLY
3	K7 18OR (2.5L)	SENSOR GROUND



TRAILER TOW CONNECTOR

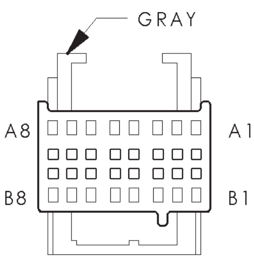
TRAILER TOW CONNECTOR - BLACK 7 WAY

CAV	CIRCUIT	FUNCTION
1	Z1 14BK	GROUND
2	B40 14LB	TRAILER TOW BRAKE B(+)
3	L207 18BK/OR	TRAILER TOW RELAY OUTPUT
4	Y203 16RD/TN	FUSED B(+)
5	L63 18DG/RD	LEFT TURN SIGNAL
6	L62 18BK/PK	RIGHT TURN SIGNAL
7	L1 20VT/BK	BACK-UP LAMP FEED



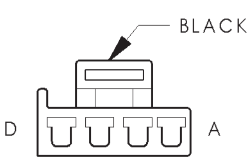
TRANSFER CASE CONTROL MODULE C1 - BLACK 16 WAY

CAV	CIRCUIT	FUNCTION
A1	D25 18VT/YL	PCI BUS
A2	-	-
A3	-	-
A4	Y122 20DG/BR	4WD LOW INDICATOR
A5	Y123 20DG/OR	4WD HIGH INDICATOR
A6	Y120 20YL/DG	MODE SELECT
A7	Y119 18YL/TN	MODE SENSOR GROUND
A8	Z1 18BK	GROUND
B1	-	-
B2	-	-
B3	-	-
B4	Y121 20YL/LG	NEUTRAL INDICATOR
B5	Y187 20PK/GY	DEFAULT INDICATOR
B6	Y112 18YL/BR	MODE SENSOR D
B7	-	-
B8	Z2 18BK/LG	GROUND



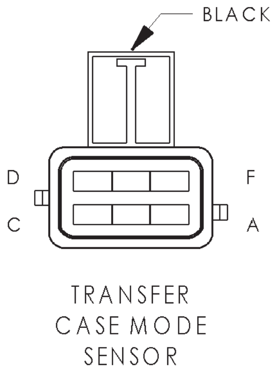
TRANSFER CASE CONTROL MODULE C2 - GRAY 16 WAY

CAV	CIRCUIT	FUNCTION
A1	Y114 18YL/VT	5 VOLT SELECTOR SWITCH SUPPLY
A2	Y113 18YL/OR	MODE SENSOR A
A3	-	-
A4	-	-
A5	-	-
A6	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
A7	-	-
A8	Y117 18YL/DB	5 VOLT MODE SENSOR SUPPLY
B1	-	-
B2	Y115 18YL/WT	MODE SENSOR C
B3	-	-
B4	-	-
B5	-	-
B6	-	-
B7	-	-
B8	Y118 20YL/LB	5 VOLT SELECTOR SWITCH SUPPLY



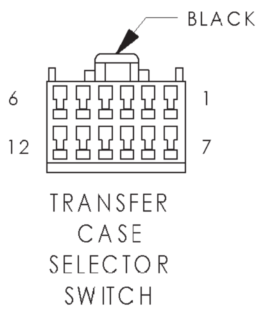
TRANSFER CASE CONTROL MODULE C3 - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
A	Z1 16BK	GROUND
B	A34 16LB/RD	FUSED B(+)
C	Y124 16DG/VT	SHIFT MOTOR CONTROL A
D	Y125 16DG/WT	SHIFT MOTOR CONTROL B



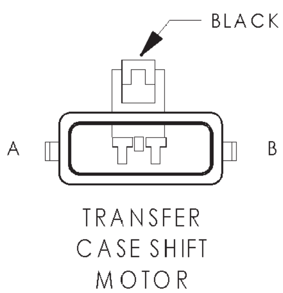
TRANSFER CASE MODE SENSOR - BLACK 6 WAY

CAV	CIRCUIT	FUNCTION
A	Y119 18YL/TN	MODE SENSOR GROUND
B	Y113 18YL/OR	MODE SENSOR A
C	Y115 18YL/WT	MODE SENSOR C
D	Y114 18YL/VT	MODE SENSOR B
E	Y117 18YL/DB	5 VOLT MODE SENSOR SUPPLY
F	Y112 18YL/BR	MODE SENSOR D



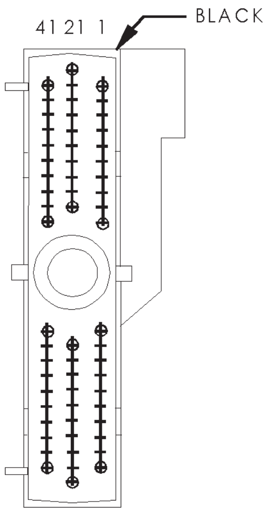
TRANSFER CASE SELECTOR SWITCH - BLACK 12 WAY

CAV	CIRCUIT	FUNCTION
1	Y118 20YL/LB	5 VOLT SELECTOR SWITCH SUPPLY
2	Y187 20PK/GY	DEFAULT INDICATOR
3	-	-
4	Y121 20YL/LG	NEUTRAL INDICATOR
5	Y120 20YL/DG	MODE SELECT
6	E2 20OR	PANEL LAMPS FEED
7	F12 20DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
8	Y122 20DG/BR	4WD LOW INDICATOR
9	Y123 20DG/OR	4WD HIGH INDICATOR
10	-	-
11	Z1 20BK	GROUND
12	-	-



TRANSFER CASE SHIFT MOTOR - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
A	Y124 16DG/VT	SHIFT MOTOR CONTROL A
B	Y125 16DG/WT	SHIFT MOTOR CONTROL B



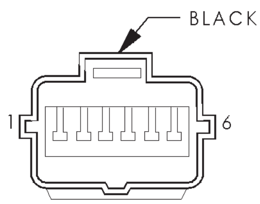
TRANSMISSION
CONTROL
MODULE
(4.7L)

TRANSMISSION CONTROL MODULE (4.7L) - BLACK 60 WAY

CAV	CIRCUIT	FUNCTION
1	T1 18LG/BK	TRS T1 SENSE
2	T4 18PK/OR	TRS T2 SENSE
3	T3 18VT	TRS T3 SENSE
4	-	-
5	-	-
6	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
7	D21 18PK	SCI TRANSMIT
8	A169 18RD/YL	FUSED IGNITION SWITCH OUTPUT (START)
9	T9 18OR/BK	OVERDRIVE PRESSURE SWITCH SENSE
10	T10 18YL/DG	TORQUE MANAGEMENT REQUEST SENSE
11	F11 18RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
12	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
13	T13 18DB/BK	SPEED SENSOR GROUND
14	T14 18LG/WT	OUTPUT SPEED SENSOR SIGNAL
15	T15 18LG	TRANSMISSION RELAY CONTROL
16	T16 18RD	TRANSMISSION CONTROL RELAY OUTPUT
17	T16 18RD	TRANSMISSION CONTROL RELAY OUTPUT
18	T118 18YL/DB	PRESSURE CONTROL SOLENOID CONTROL
19	T119 18WT/DB	2C SOLENOID CONTROL
20	T120 18LG	LR/CC SOLENOID CONTROL
21	-	-
22	-	-
23	-	-
24	-	-
25	-	-
26	-	-
27	-	-
28	G7 18WT/OR	VEHICLE SPEED SENSOR SIGNAL
29	T29 18GY	UNDERDRIVE PRESSURE SWITCH SENSE
30	T39 18GY/LB	LINE PRESSURE SENSOR SIGNAL
31	-	-
32	-	-
33	-	-
34	-	-
35	-	-
36	T16 18RD	TRANSMISSION CONTROL RELAY OUTPUT
37	Z13 16BK/RD	GROUND
38	T38 18VT/TN	5V SUPPLY
39	Z13 16BK/RD	GROUND
40	T140 18VT/LG	MS SOLENOID CONTROL
41	T41 16YL	TRS T41 SENSE
42	T42 18VT/WT	TRS T42 SENSE
43	D25 18VT/YL	PCI BUS
44	-	-
45	-	-
46	D22 20PK/BK	SCI RECEIVE
47	T47 18YL/BK	2C PRESSURE SWITCH SENSE
48	T48 18DB	4C PRESSURE SWITCH SENSE
49	T6 18OR/WT	OVERDRIVE OFF SWITCH SENSE
50	T50 18DG	LOW/REVERSE PRESSURE SWITCH SENSE
51	K4 18BK/LB	SENSOR GROUND
52	T52 18RD/BK	INPUT SPEED SENSOR SIGNAL
53	Z113 16BK	GROUND
54	T54 20VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL

TRANSMISSION CONTROL MODULE (4.7L) - BLACK 60 WAY

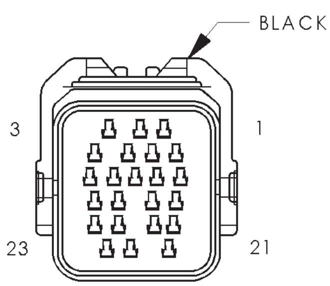
CAV	CIRCUIT	FUNCTION
55	T59 18PK	UNDERDRIVE SOLENOID CONTROL
56	F84 16YL/WT	FUSED B(+)
57	Z13 16BK/RD	GROUND
58	-	-
59	T159 18DG/WT	4C SOLENOID CONTROL
60	T60 18BR	3-4 SHIFT SOLENOID CONTROL



TRANSMISSION RANGE SENSOR (3.9L/5.9L A/T)

TRANSMISSION RANGE SENSOR (3.9L/5.9L A/T) - BLACK 6 WAY

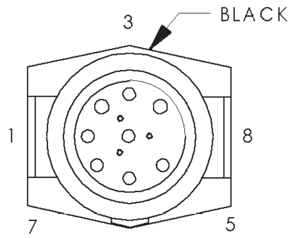
CAV	CIRCUIT	FUNCTION
1	L10 18BR/LG	FUSED IGNITION SWITCH OUTPUT (RUN)
2	Y193 20WT/LG	TRANS RANGE SENSOR MUX
3	-	-
4	L1 18VT/BK	BACK-UP LAMP FEED
5	Y128 20DG/GY	TRANS RANGE SENSOR 5V SUPPLY
6	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE (T41)



TRANSMISSION SOLENOID/TRS ASSEMBLY (4.7L)

TRANSMISSION SOLENOID/TRS ASSEMBLY (4.7L) - BLACK 23 WAY

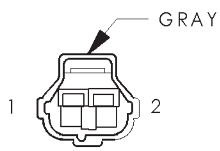
CAV	CIRCUIT	FUNCTION
1	L10 18BR/LG	FUSED IGNITION SWITCH OUTPUT (RUN)
2	T120 18LG	LR/CC SOLENOID CONTROL
3	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
4	T41 16YL	TRS T41 SENSE
5	T42 18VT/WT	TRS T42 SENSE
6	L1 18VT/BK	BACK-UP LAMP FEED
7	T60 18BR	3-4 SHIFT SOLENOID CONTROL
8	T3 18VT	TRS T3 SENSE
9	T1 18LG/BK	TRS T1 SENSE
10	T16 16RD	TRANSMISSION CONTROL RELAY OUTPUT
11	T48 18DB	4C PRESSURE SWITCH SENSE
12	T118 18YL/DB	PRESSURE CONTROL SOLENOID CONTROL
13	T4 18PK/OR	TRS T4 SENSE
14	T50 18DG	LOW/REVERSE PRESSURE SWITCH SENSE
15	T47 18YL/BK	2C PRESSURE SWITCH SENSE
16	T9 18OR/BK	OVERDRIVE PRESSURE SWITCH SENSE
17	T59 18PK	UNDERDRIVE SOLENOID CONTROL
18	T29 18GY	UNDERDRIVE PRESSURE SWITCH SENSE
19	T159 18DG/WT	4C SOLENOID CONTROL
20	T119 18WT/DB	2C SOLENOID CONTROL
21	T140 18VT/LG	MS SOLENOID CONTROL
22	T13 18DB/BK	SPEED SENSOR GROUND
23	T54 20VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL



TRANSMISSION SOLENOID ASSEMBLY (3.9L/5.9L)

TRANSMISSION SOLENOID ASSEMBLY (3.9L/5.9L) - BLACK 8 WAY

CAV	CIRCUIT	FUNCTION
1	T16 16RD	TRANSMISSION CONTROL RELAY OUTPUT
2	K6 18VT/WT	5V SUPPLY
3	K4 18BK/LB	SENSOR GROUND
4	T25 18LG/RD	GOVERNOR PRESSURE SIGNAL
5	K88 18VT/WT	GOVERNOR PRESSURE SOLENOID CONTROL
6	T60 18BR	OVERDRIVE SOLENOID CONTROL
7	K54 18OR/BK	TORQUE CONVERTER CLUTCH SOLENOID CONTROL
8	T34 18GY/BK	TRANSMISSION TEMPERATURE SENSOR SIGNAL



WASHER FLUID LEVEL SWITCH

WASHER FLUID LEVEL SWITCH - GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	Z1 18BK	GROUND
2	G29 18BK/TN	WASHER FLUID SWITCH SENSE

8W-90 CONNECTOR/GROUND LOCATIONS

TABLE OF CONTENTS

page

CONNECTOR/GROUND LOCATIONS

DESCRIPTION

This section provides illustrations identifying component and connector locations in the vehicle. A connector index is provided. Use the wiring diagrams in each section for connector 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.

Connector Name/Number	Color	Location	Fig.
A/C Compressor Clutch	BK	Side of A/C Compressor, Rear of A/C Compressor	10, 11, 14, 17
A/C Heater Control - C1	BK	At HVAC Control	30
A/C Heater Control - C2	BK	At HVAC Control	30
A/C Low Pressure Switch	GN	Right Rear of Engine Compartment	7, 19
A/C Pressure Transducer	BK	Right Fender Side Shield	1
Airbag Control Module	YL	Lower Center of Instrument Panel	31, 32, 33
Ambient Temperature Sensor	BK	Radiator Top Support	1
Amplifier-C1	WT	Right Side of Instrument Panel	30, 32
Amplifier-C2	WT	Right Side of Instrument Panel	30, 32
Automatic Day/Night Mirror	BK	Top of Windshield	38
Back-Up Lamp Switch	BK	Side of Transmission	20, 21, 22, 23
Base Overhead Console		Headliner	N/S
Battery Temperature Sensor	BK	At Battery	2
Blend Door Actuator		Right Center of Instrument Panel	N/S
Blower Motor	BK	Upper Center of Instrument Panel	N/S
Blower Motor Resistor Block	BK	Upper Center of Instrument Panel	N/S
Brake Lamp Switch	BK	Lower Left of Instrument Panel	31
Brake Pressure Switch	BK	At Anti-Lock Brake Controller	8
C105	BK	Right Fender Side Shield	1, 7, 19
C106	NAT	Left Fender Side Shield	N/S
C107 (4.7L)		Left Fender Side Shield	N/S
C108 (2.5L)		Side of Transmission	20
C126	BL	Lower Left of Instrument Panel	5
C200	BK	Lower Left of Instrument Panel	5, 6, 31, 32
C201		Right Side of Instrument Panel	N/S
C202		Upper Center of Instrument Cluster	30, 32

CONNECTOR/GROUND LOCATIONS (Continued)

Connector Name/Number	Color	Location	Fig.
C246		Lower Left of Instrument Panel	31, 38
C248	BK	Under Driver Seat	40
C301	BK	Between Front Seats	40
C323	BK	Rear of Frame	41
C325	BK	At Tail Lamp	41, 42
C329	BK	Near Cargo Lamps	N/S
C341	BK	Trailer Tow Wiring	41
C352	BK	Frame Ground Left Fender	4, 41
C360	BK	Left Inner Fender	41
C361	NAT	Near Right Front Door Hinge	36, 40
C362	BK	Near Right Front Door Hinge	36, 40
C363	BK	Near Left Front Door Hinge	36, 40
C364 (2 Door)	NAT	Near Left Front Door Hinge	36, 40
C364 (4 Door)	BK	Near Left Front Door Hinge	N/S
C365	BK	Near Left Rear Door Hinge	37, 40
C366	BK	Near Right Rear Door Hinge	40
Camshaft Position Sensor	GY	At Distributor, Right Front of Engine	10, 13, 18
Capacitor	BK	Left Side of Engine	19
Cargo Lamp No. 1	BK	At Lamp	N/S
Cargo Lamp No. 2	BK	At Lamp	N/S
Center Console Lamp		In Center of Console	N/S
Center High Mounted Stop Lamp	BK	Headliner	N/S
Center Power Outlet		In Center of Console	N/S
Central Timer Module-C1		Right Side of Instrument Panel	32
Central Timer Module-C2		Right Side of Instrument Panel	40
Central Timer Module-C3	GY	Right Side of Instrument Panel	N/S
Cigar Lighter	NAT	Upper Center of Instrument Panel	30
Clockspring-C1		Steering Column	31, 34
Clockspring-C2		Steering Column	31, 34
Clockspring-C3	BK	Steering Column	N/S
Clockspring-C4		Steering Column	N/S
Clutch Interlock Switch (M/T)	GN	Left Side of Instrument Panel	6
Clutch Interlock Switch Jumper (A/T)	BK	Left Side of Instrument Panel	6
Coil On Plug No.1	BK	Left Side of Engine	16
Coil On Plug No.2	BK	Right Side of Engine	17
Coil On Plug No.3	BK	Left Side of Engine	16
Coil On Plug No.4	BK	Right Side of Engine	17
Coil On Plug No.5	BK	Left Side of Engine	16
Coil On Plug No.6	BK	Right Side of Engine	17
Coil On Plug No.7	BK	Left Side of Engine	16

CONNECTOR/GROUND LOCATIONS (Continued)

Connector Name/Number	Color	Location	Fig.
Coil On Plug No.8	BK	Right Side of Engine	17
Combination Flasher	BK	Lower Left Side of Instrument Panel	31, 32
Controller Antilock Brake-C1	BK	At Antilock Brake Controller	8
Controller Antilock Brake-C2	BK	At Antilock Brake Controller	8
Crankshaft Position Sensor (2.5L)	BK	Rear of Engine	9
Crankshaft Position Sensor (4.7L)	BK	Rear of Engine	17
Crankshaft Position Sensor (A/T 3.9L/5.9L)	BK	Rear of Engine	13
Crankshaft Position Sensor (M/T 3.9L/5.9L)	NAT	Rear of Engine	13
Data Link Connector	BK	Lower Left of Instrument Panel	31, 32
Diagnostic Junction Port	BK	Lower Left of Instrument Panel	31, 32
Dome Lamp	BK	Headliner	N/S
Driver Airbag	YL	Steering Column	N/S
Driver Cylinder Lock Switch	BK	Driver Door	36
Driver Door Ajar Switch	BK	Driver Door Jamb	N/S
Driver Door Module-C1	BL	Driver Door	36
Driver Door Module-C2	BL	Driver Door	36
Driver Door Power Lock Motor/Ajar Switch (Premium)	BK	Driver Door	36
Driver Door Power Window Motor	BK	Driver Door	36
Driver Power Mirror		Driver Door	36
Driver Seatbelt Tensioner		Pillar Between Driver Doors	N/S
Duty Cycle Evap/Purge Solenoid	GY	Rear of Engine Compartment	2, 7, 19
Engine Coolant Temperature Sensor (2.5L/3.9L/5.9L)	BK	At Thermostat Housing	9, 13
Engine Coolant Temperature Sensor (4.7L)	BK	At Thermostat Housing	18
Engine Oil Pressure Sensor	BK	Right Front of Engine	10, 13, 16
Evaporator Temperature Sensor	BK	Upper Center of Instrument Cluster	N/S
Front Washer Pump Motor	BK	At Washer Fluid Reservoir	1
Front Wiper Motor	BK	At Motor	4
Fuel Injector No. 1	BK	At Injector	9, 11, 14, 16
Fuel Injector No. 2	BK	At Injector	9, 12, 15, 17
Fuel Injector No. 3	BK	At Injector	9, 11, 14, 16
Fuel Injector No. 4	BK	At Injector	9, 12, 15, 17
Fuel Injector No. 5	BK	At Injector	11, 14, 16
Fuel Injector No. 6	BK	At Injector	12, 15, 17
Fuel Injector No. 7	BK	At Injector	14, 16

CONNECTOR/GROUND LOCATIONS (Continued)

Connector Name/Number	Color	Location	Fig.
Fuel Injector No. 8	BK	At Injector	15, 17
Fuel Pump Module	LTGY	At Fuel Tank	41
G100		Right Front of Engine Compartment	N/S
G102		Left Inner Fender	4
G105		Top Rear of Valve Cover, Right Front of Engine	9, 18
G110		Left Front Inner Fender	N/S
G111		Engine Ground	11, 14, 16
G112		Right Fender Side Shield	1
G113		Near Battery	2
G115		Right Fender Side Shield	7, 19
G201		Lower Center of Instrument Panel	31, 32, 33
G205		Right Side Instrument Panel	30, 32
G207		Lower Center of Instrument Panel	31, 32, 33
G208		Right Side Instrument Panel	32
G305		Frame Ground Left Fender	4, 41
G307		Near T/O to Seatbelt Switch	40
Generator	BK	At Generator	10, 12, 15, 16
Glove Box Lamp and Switch	BK	Upper Center of Instrument Panel	30, 32
Headlamp Switch	BK	Left Side of Instrument Panel	31
Heater Control	BK	At HVAC Control	N/S
High Note Horn	BK	Left Front Inner Fender	1
Idle Air Control Motor (3.9L/5.9L)	BK	At Throttle Body	11, 14
Idle Air Control Motor (2.5L/4.7L)	GY	At Throttle Body	9, 16
Ignition Coil	LT GY	Near Distributor, Right Front of Engine	10, 12, 15
Ignition Switch	BK	Steering Column	31, 34
Input Speed Sensor		Left Side of Transmission	27, 28
Instrument Cluster-C1	GY	At Instrument Cluster	31
Instrument Cluster-C2	BK	At Instrument Cluster	31
Intake Air Temperature Sensor	GY	At Throttle Body, Right Top of Intake Manifold	9, 12, 15, 16
Joint Connector No. 1		Power Distribution Center	N/S
Joint Connector No. 2		Power Distribution Center	N/S
Joint Connector No. 3		Left Side Instrument Panel	N/S
Joint Connector No. 4		Near Steering Column	30, 32
Junction Block-C1		At Junction Block	5
Junction Block-C2		At Junction Block	5
Junction Block-C3		At Junction Block	N/S
Junction Block-C4		At Junction Block	38
Junction Block-C5		At Junction Block	38

CONNECTOR/GROUND LOCATIONS (Continued)

Connector Name/Number	Color	Location	Fig.
Junction Block-C6	GN	At Junction Block	35
Junction Block-C7	BK	At Junction Block	35
Junction Block-C8	BR	At Junction Block	35
Junction Block-C9	BL	At Junction Block	35
Junction Block-C10	LTGY	At Junction Block	35
Junction Block-C11		At Junction Block	35
Junction Block-C12	OR	At Junction Block	35
Key-in Switch	GY	Steering Column	N/S
Leak Detection Pump	BK	Near Battery	2, 8
Left Back-Up Lamp	BK	At Lamp	42
Left Front Door Speaker		Left Door	N/S
Left Front Door Tweeter	NAT	Left Door	36
Left Front Door Woofer		Left Door	36
Left Fog Lamp	WT	At Lamp	1
Left Front Park/Turn Signal Lamp No.1	BK	At Lamp	N/S
Left Front Park/Turn Signal Lamp No.2	BK	At Lamp	N/S
Left Front Side Marker Lamp		At Lamp	N/S
Left Front Wheel Speed Sensor	LT GY	Near Brake Controller	2, 8
Left Headlamp	BL	At Lamp	N/S
Left License Lamp	BK	At Lamp	N/S
Left Rear Door Ajar Switch (Base)	BK	Rear Door	N/S
Left Rear Door Power Lock Motor/Ajar Switch (Premium)	BK	Rear Door	37
Left Rear Speaker		Left Door	37, 39
Left Rear Door Power Window Motor	BK	Left Door	37
Left Rear Door Power Window Switch	BL	Left Door	37
Left Remote Radio Switch		Steering Column	N/S
Left Speed Control Switch	WT	Steering Column	N/S
Left Tail/Stop/Turn Signal Lamp	BK	At Lamp	42
License Lamp		At Lamp	N/S
Line Pressure Sensor		Right Side of Transmission	27, 29
Low Note Horn	BK	At Horn	1
Manifold Absolute Pressure Sensor	BK	On Throttle Body	9, 11, 14, 18
Mode Door Actuator		Right Center of Instrument Panel	N/S
Multi-Function Switch	GY	At Steering Column	31, 34

CONNECTOR/GROUND LOCATIONS (Continued)

Connector Name/Number	Color	Location	Fig.
Output Speed Sensor	BK	Under Transmission, Left Side of Transmission	25, 26, 27, 28
Overdrive Switch	NAT	At Steering Column	31, 34
Overhead Console		Headliner	38
Oxygen Sensor 1/1 Upstream	BK	At Oxygen Sensor	20, 21, 22, 23, 25, 26, 27, 28
Oxygen Sensor 1/2 Downstream	BK	At Oxygen Sensor	20, 21, 22, 23, 25, 26, 27, 28
Oxygen Sensor 2/1 Upstream	BK	At Oxygen Sensor	21, 22, 24, 25, 26, 27, 29
Oxygen Sensor 2/2 Downstream	BK	At Oxygen Sensor	21, 22, 24, 25, 26, 27, 29
Park Brake Switch		Left Side of Instrument Panel	38
Passenger Airbag	YL	Right Center of Instrument Panel	30
Passenger Airbag On/Off Switch		Instrument Panel	30
Passenger Door Ajar Switch (Base)	BK	Passenger Door	N/S
Passenger Lock Cylinder Switch	LTGY	Passenger Door	N/S
Passenger Door Power Lock Motor/Ajar Switch (Premium)	BK	Passenger Door	N/S
Passenger Door Power Lock Switch	NAT	Passenger Door	N/S
Passenger Door Power Window Motor	BK	Passenger Door	N/S
Passenger Door Power Window Switch	BL	Passenger Door	N/S
Passenger Power Mirror		Passenger Door	N/S
Passenger Seatbelt Tensioner		Pillar Between Passenger Doors	N/S
Power Mirror Switch		Driver Door	36
Power Outlet	BK	Upper Center of Instrument Panel	30, 32
Power Seat Motors	BK	Under Seat	N/S
Power Seat Switch		At Switch	N/S
Power Steering Pressure Switch	BK	Near Power Steering Pump	9, 16
Powertrain Control Module-C1	BK	At Powertrain Control Module	7
Powertrain Control Module-C2	WT	At Powertrain Control Module	7
Powertrain Control Module-C3	GY	At Powertrain Control Module	1, 7
Radiator Fan Motor	BK	Below Radiator	1
Radio-C1	GY	Upper Center of Instrument Panel	30
Radio-C2	BK	Upper Center of Instrument Panel	30

CONNECTOR/GROUND LOCATIONS (Continued)

Connector Name/Number	Color	Location	Fig.
Radio-C3	NAT	Upper Center of Instrument Panel	30
Radio Case Ground		Upper Center of Instrument Panel	30
Rear Wheel Speed Sensor	BK	At Rear Axle	41
Rear Window Defogger Switch	BK	Upper Center of Instrument Panel	N/S
Recirculation Door Actuator		Right Center of Instrument Panel	N/S
Right Back-Up Lamp	BK	At Lamp	N/S
Right Front Door Speaker		Right Door	N/S
Right Front Door Tweeter	NAT	Right Door	N/S
Right Front Door Woofer		Right Door	N/S
Right Fog Lamp	WT	At Lamp	1
Right Front Park/Turn Signal Lamp No.1	BK	At Lamp	3
Right Front Park/Turn Signal Lamp No.2	BK	At Lamp	3
Right Front Side Marker Lamp		At Lamp	3
Right Front Wheel Speed Sensor	LTGY	Right Fender Side Shield	1
Right Headlamp	BL	At Lamp	3
Right License Lamp	BK	At Lamp	N/S
Right Rear Door Ajar Switch (Base)	BK	Right Rear Door	N/S
Right Rear Door Power Lock Motor/Ajar Switch (Premium)	BK	Right Rear Door	N/S
Right Rear Speaker	BK	Right Door	N/S
Right Rear Power Window Motor	BK	Right Rear Door	N/S
Right Rear Power Window Switch	BL	Right Rear Door	N/S
Right Remote Radio Switch		Steering Column	N/S
Right Speed Control Switch	WT	Steering Column	N/S
Right Tail Stop/Turn Signal Lamp	BK	At Lamp	N/S
Seatbelt Switch	NAT	Near Left Rear Speaker, at Seatbelt Switch	39, 40
Sentry Key Immobilizer Module	BK	On Steering Column	31
Shift Bezel Lamp		Lower Center of Instrument Panel	30, 32
Speed Control Servo	BK	Right Fender Side Shield	1
Throttle Position Sensor (3.9L/5.9L)	GY	On Throttle Body	11, 14
Throttle Position Sensor (2.5L)	NAT	On Throttle Body	9

CONNECTOR/GROUND LOCATIONS (Continued)

Connector Name/Number	Color	Location	Fig.
Throttle Position Sensor (4.7L)	GY	On Throttle Body	16
Trailer Tow Connector	BK	Rear of Frame	N/S
Transfer Case Control Module-C1		Right Side of Steering Column	N/S
Transfer Case Control Module-C2		Right Side of Steering Column	N/S
Transfer Case Control Module-C3		Right Side of Steering Column	N/S
Transfer Case Mode Sensor	BK	Side of Transmission	23, 26, 28
Transfer Case Selector Switch	BK	Center of Instrument Panel at Switch	30
Transfer Case Shift Motor	BK	Side of Transmission	23, 26, 28
Transmission Control Module	BK	Right Front of Engine Compartment	N/S
Transmission Range Sensor	BK	On Transmission	25, 26
Transmission Solenoid Assembly	BK	Left Side of Transmission	25, 26
Transmission Solenoid/TRS Assembly	BK	Left Side of Transmission	27, 28
Washer Fluid Level Switch	GY	At Washer Fluid Reservoir	1

CONNECTOR/GROUND LOCATIONS (Continued)

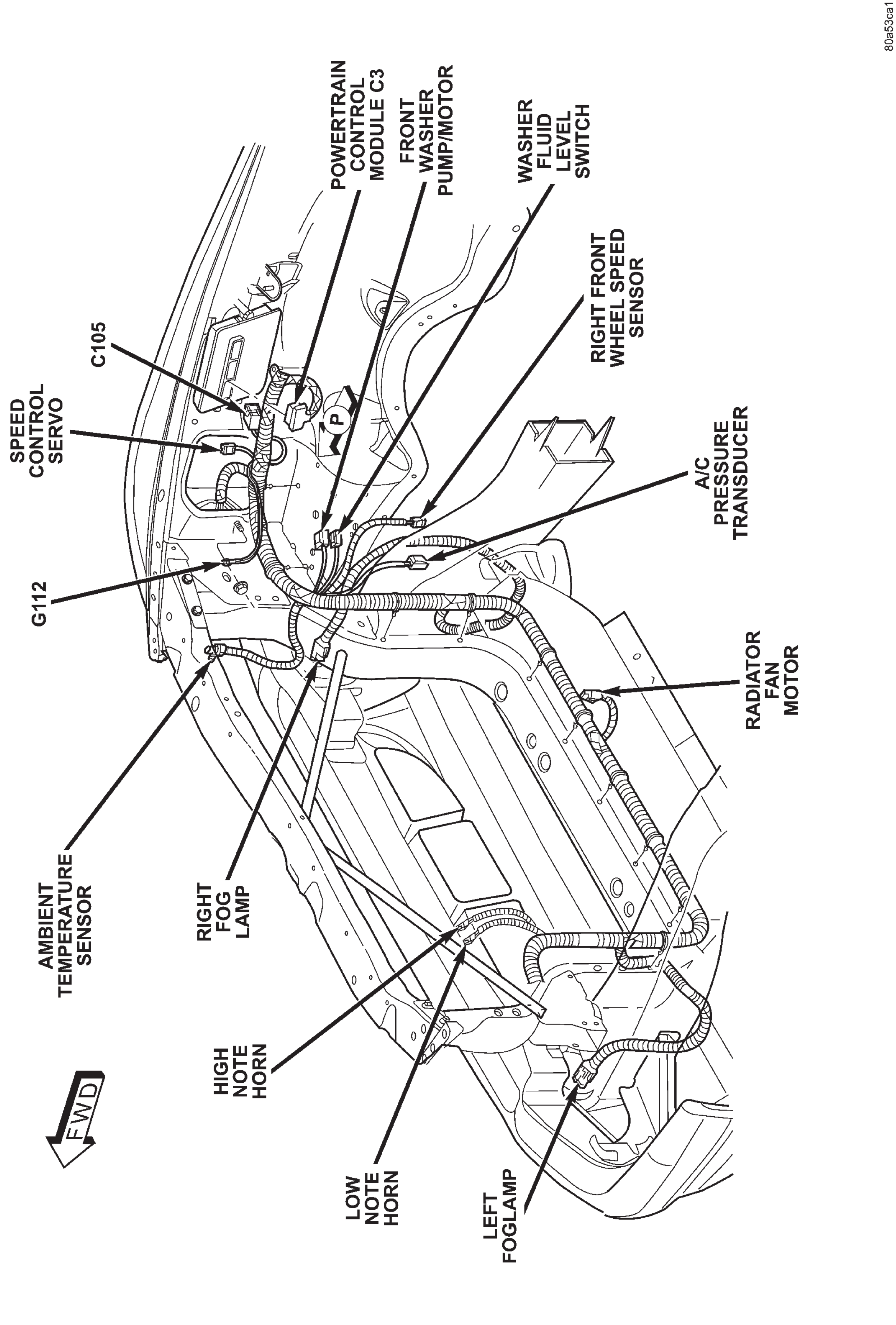


Fig. 1 RIGHT FRONT ENGINE COMPARTMENT

CONNECTOR/GROUND LOCATIONS (Continued)

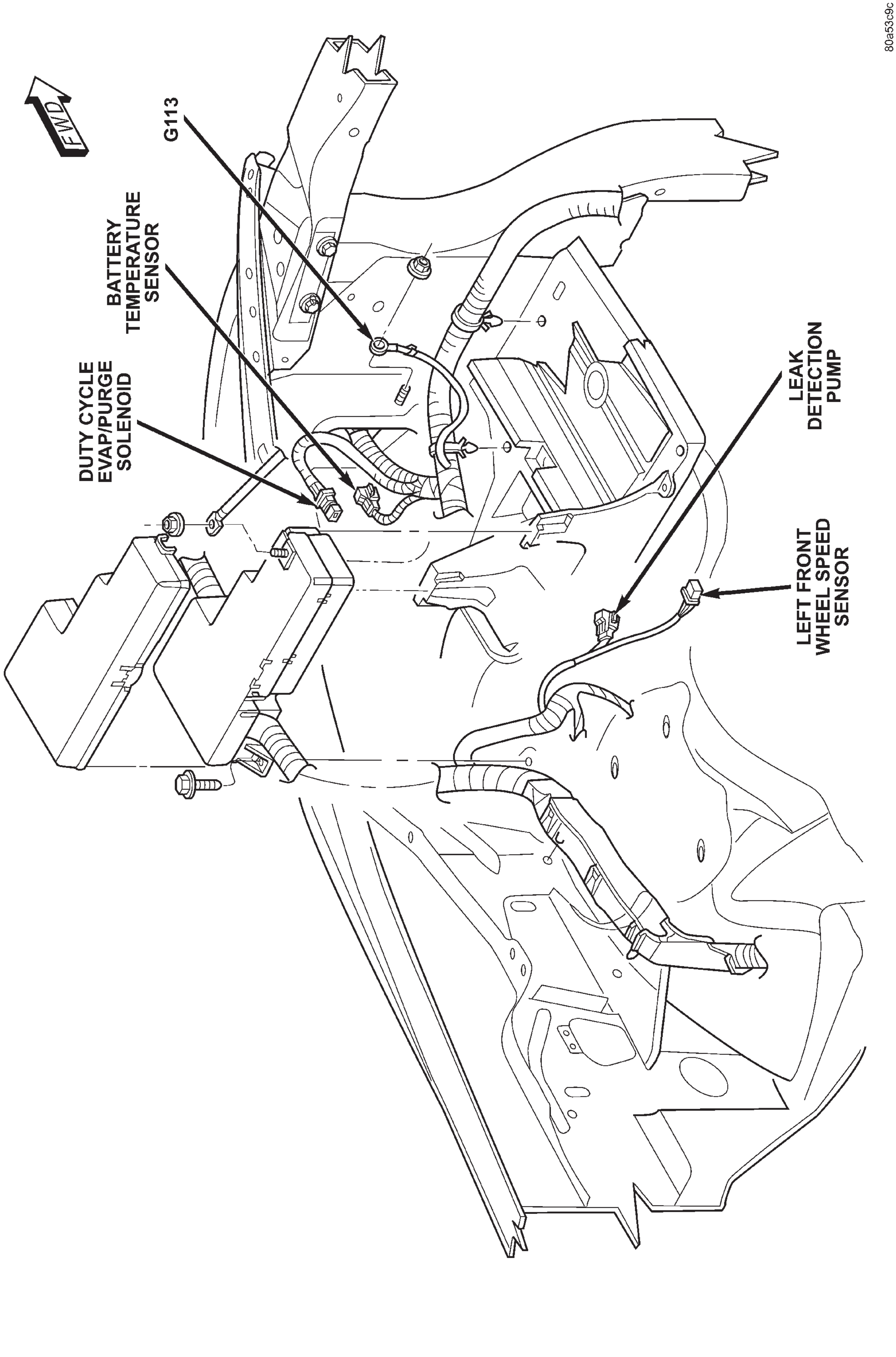


Fig. 2 LEFT FRONT ENGINE COMPARTMENT

CONNECTOR/GROUND LOCATIONS (Continued)

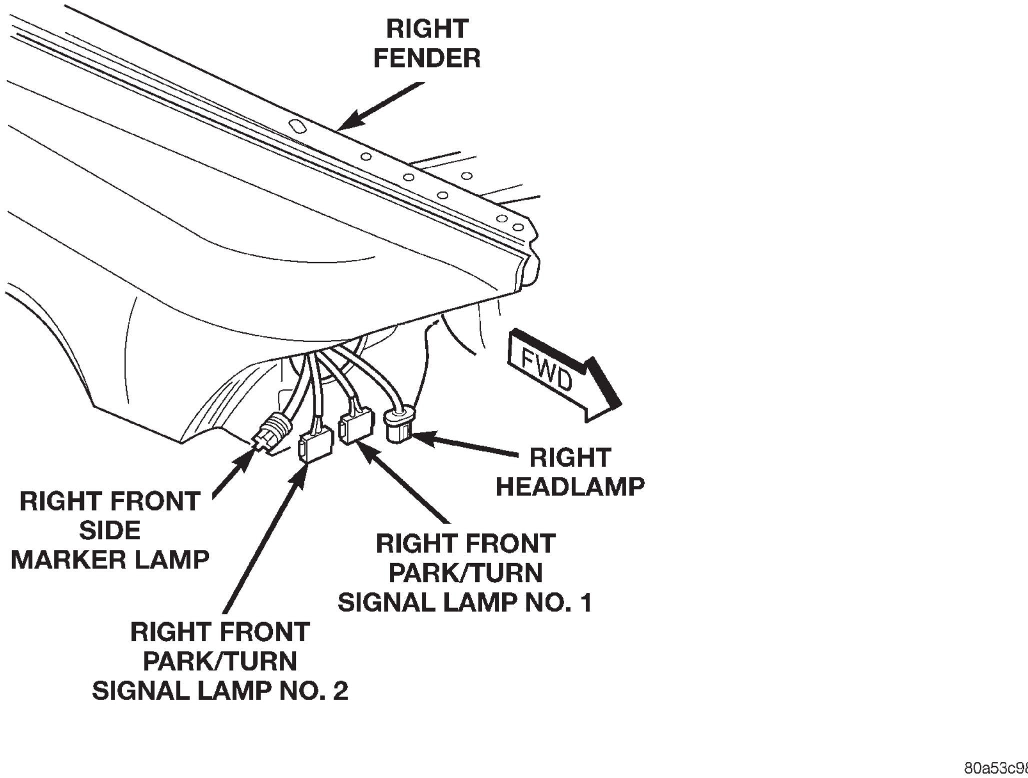


Fig. 3 RIGHT FENDER AREA

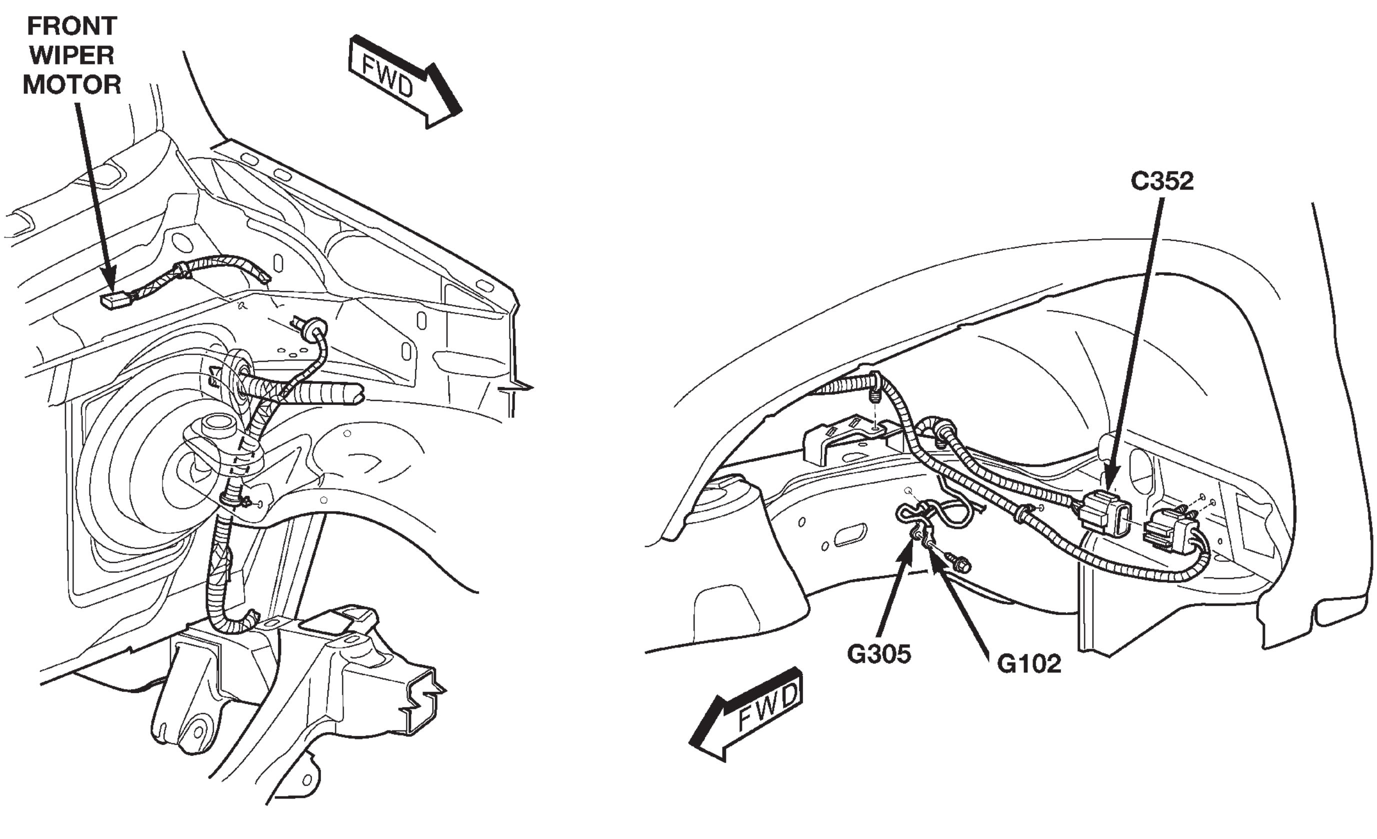


Fig. 4 LEFT FENDER AREA

CONNECTOR/GROUND LOCATIONS (Continued)

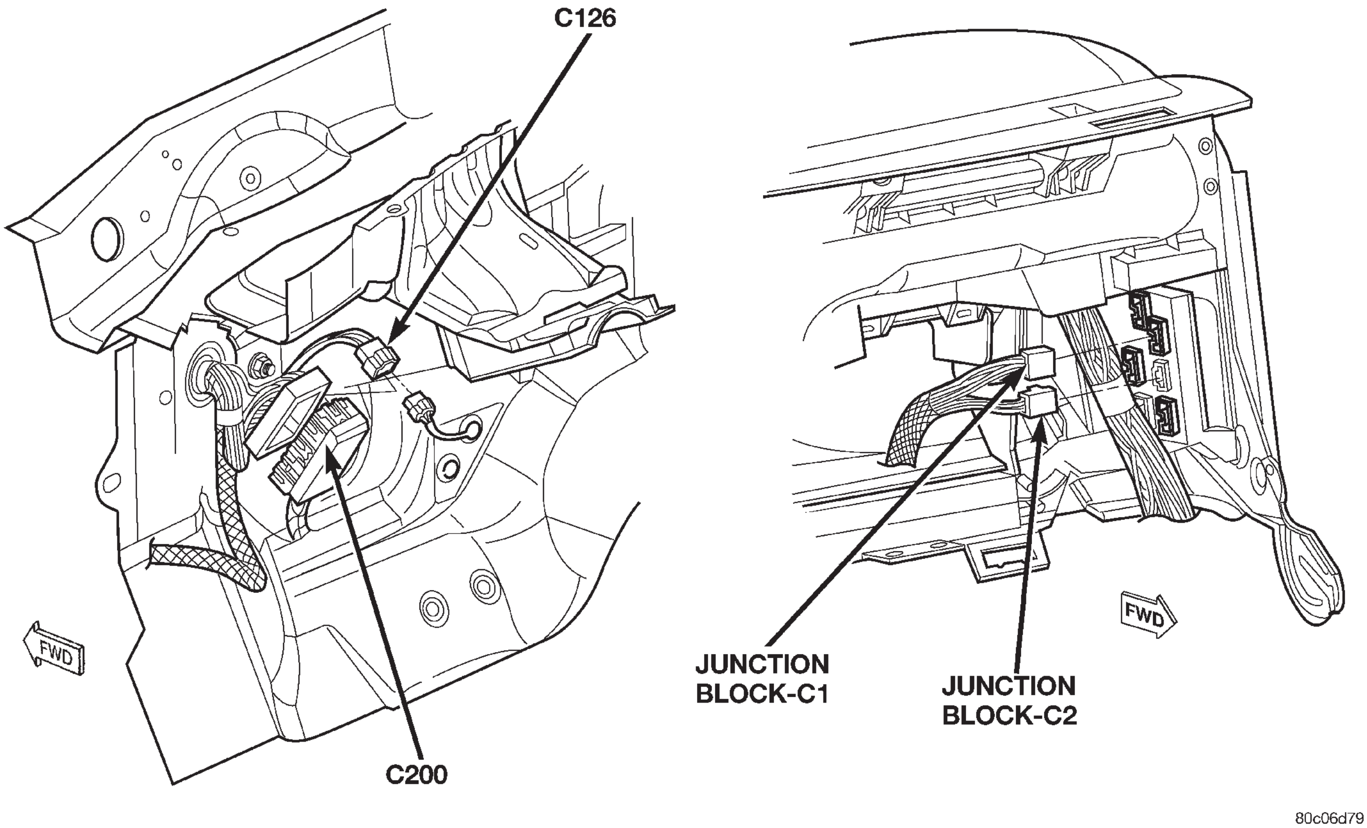


Fig. 5 KICK PANEL AREAS

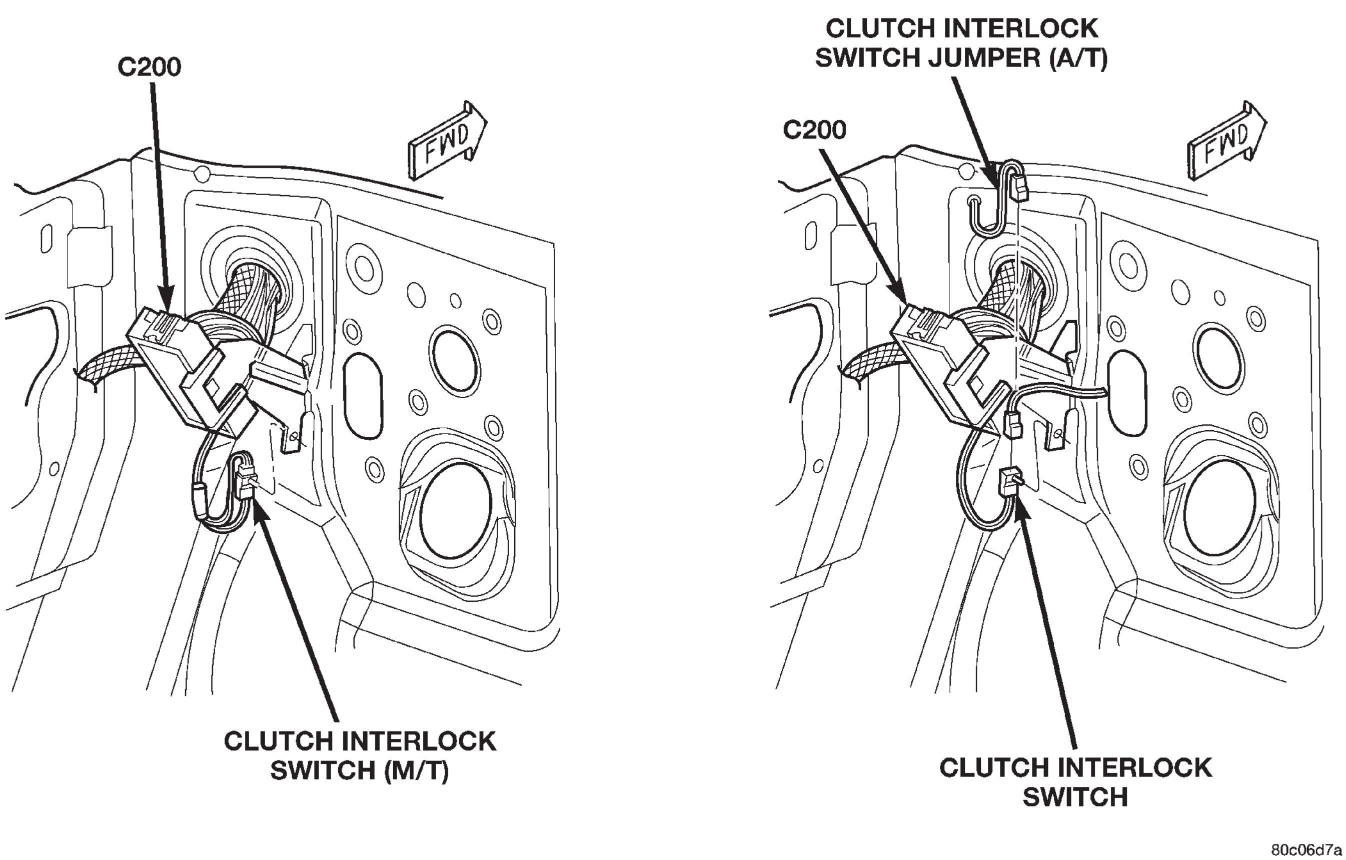


Fig. 6 ENGINE COMPARTMENT TO DASH

CONNECTOR/GROUND LOCATIONS (Continued)

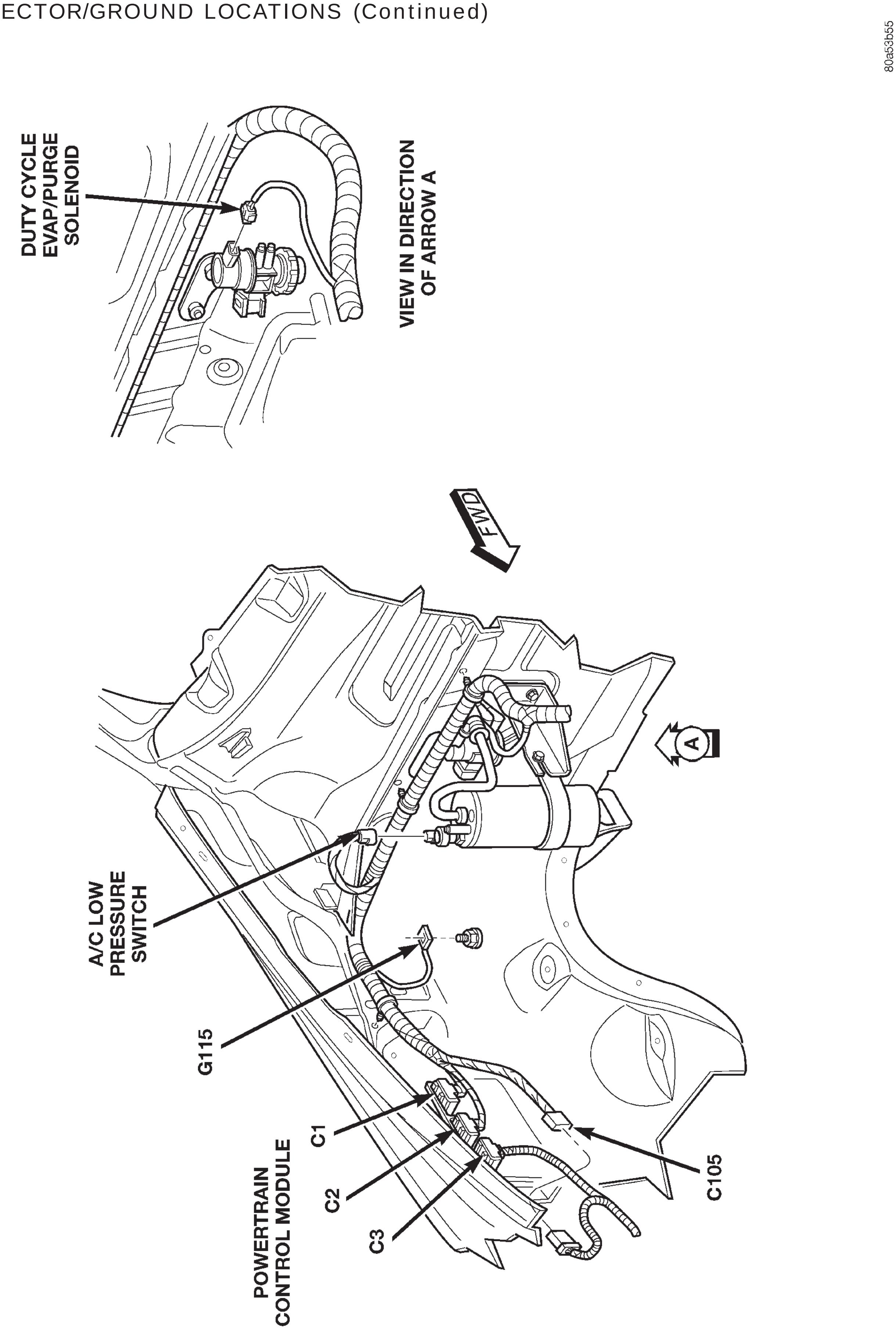


Fig. 7 RIGHT REAR ENGINE COMPARTMENT

CONNECTOR/GROUND LOCATIONS (Continued)

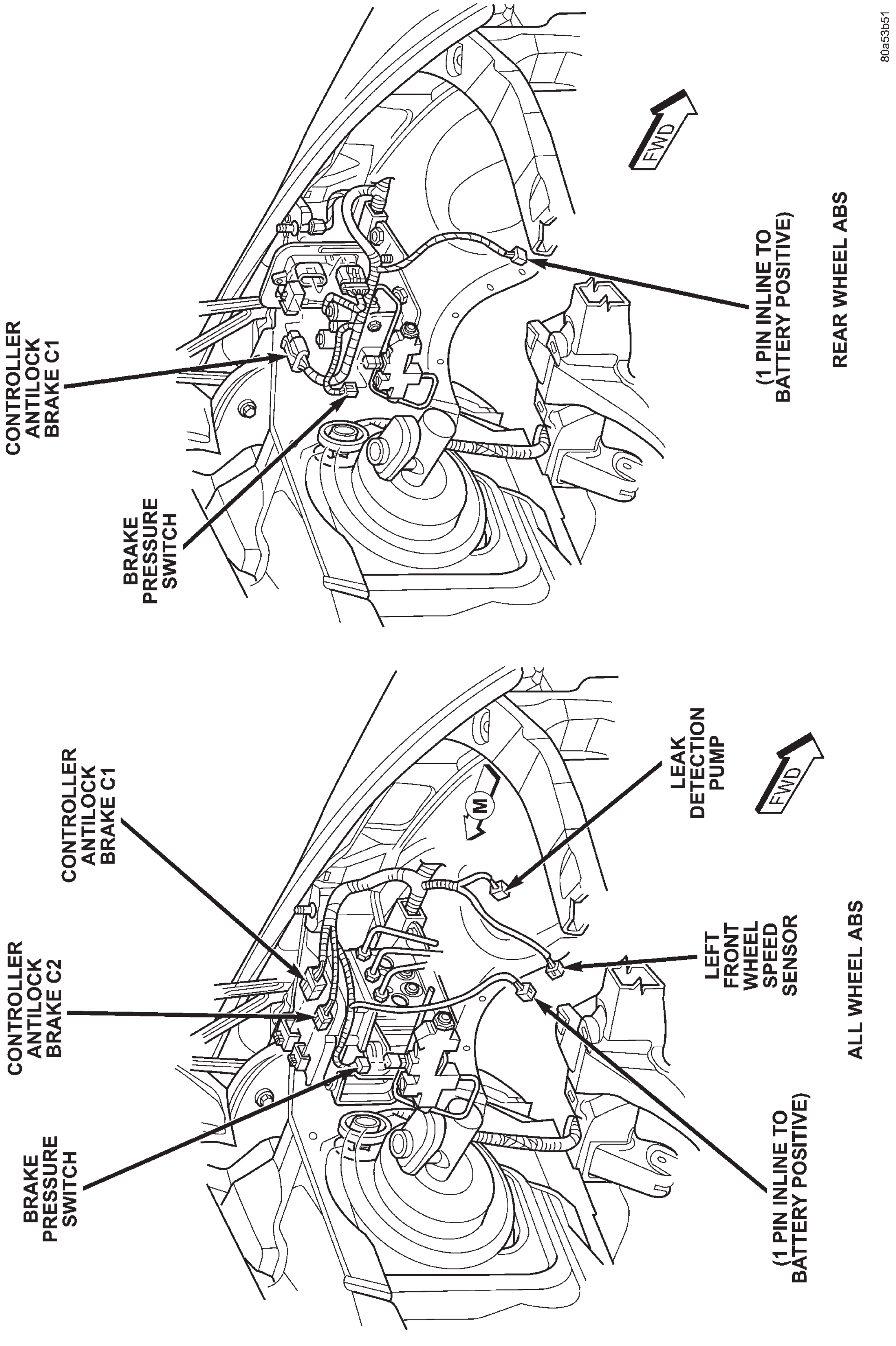


Fig. 8 RIGHT FENDER AREA

CONNECTOR/GROUND LOCATIONS (Continued)

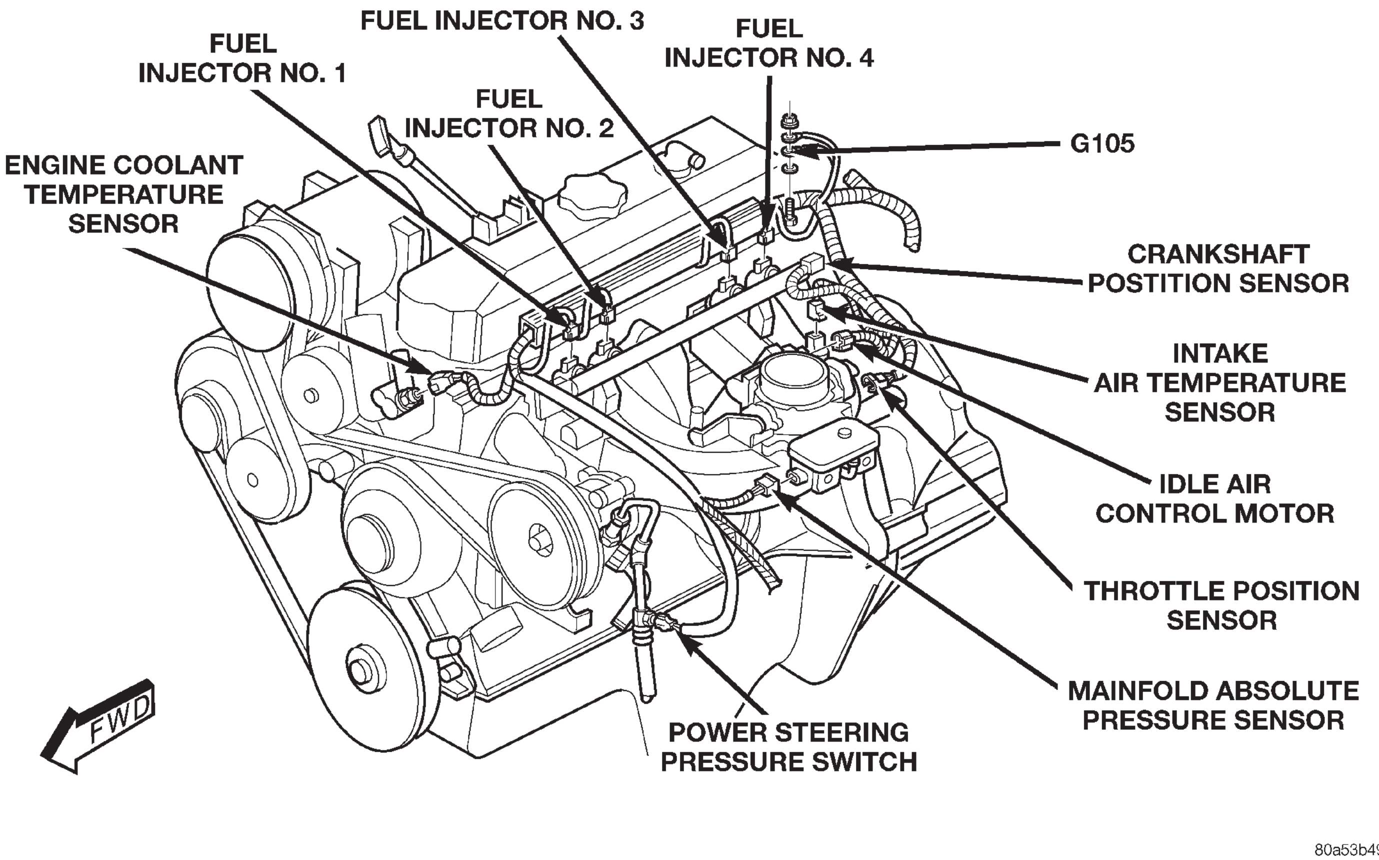


Fig. 9 ENGINE LEFT SIDE 2.5L

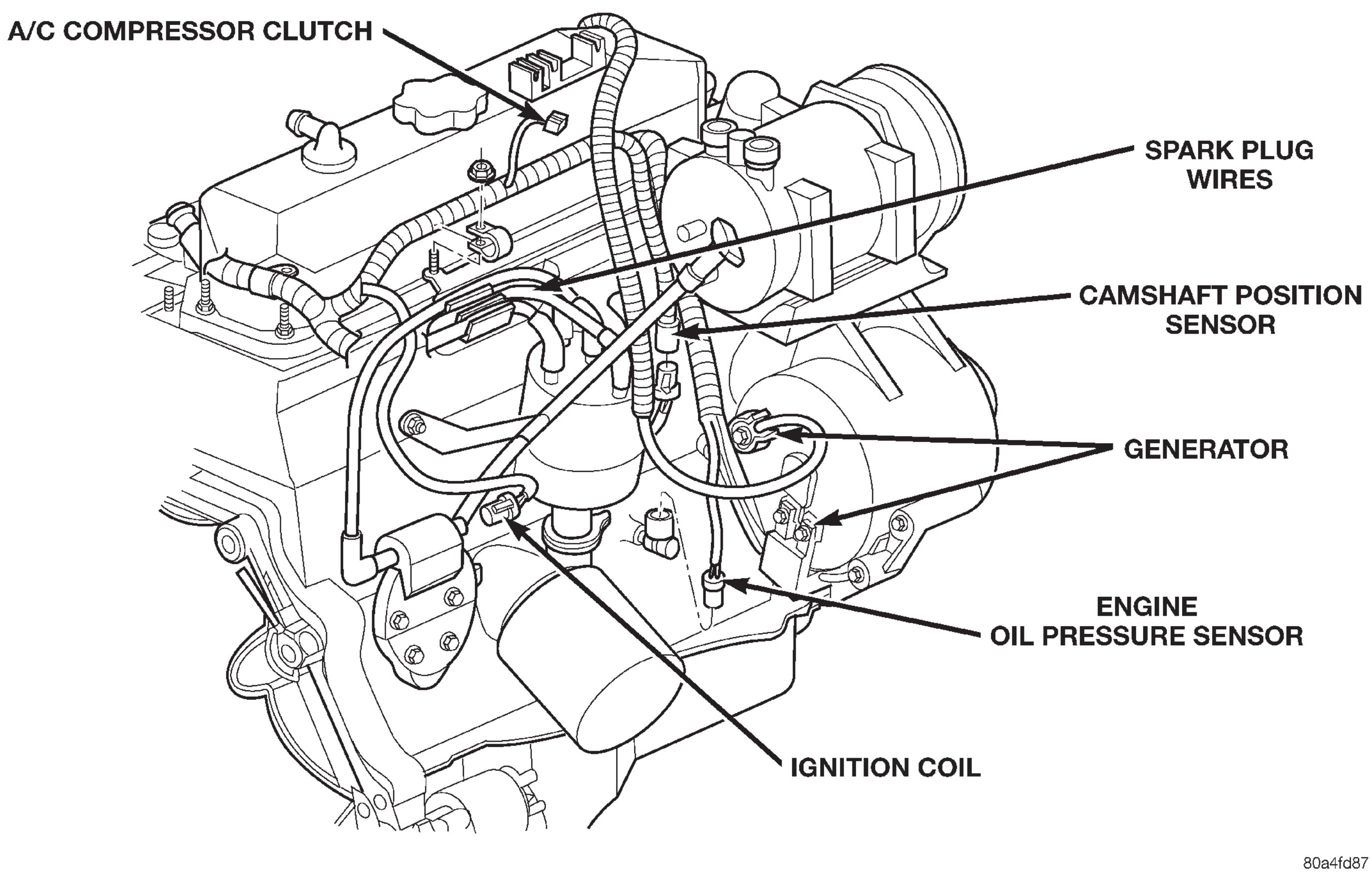


Fig. 10 ENGINE RIGHT SIDE 2.5L

CONNECTOR/GROUND LOCATIONS (Continued)

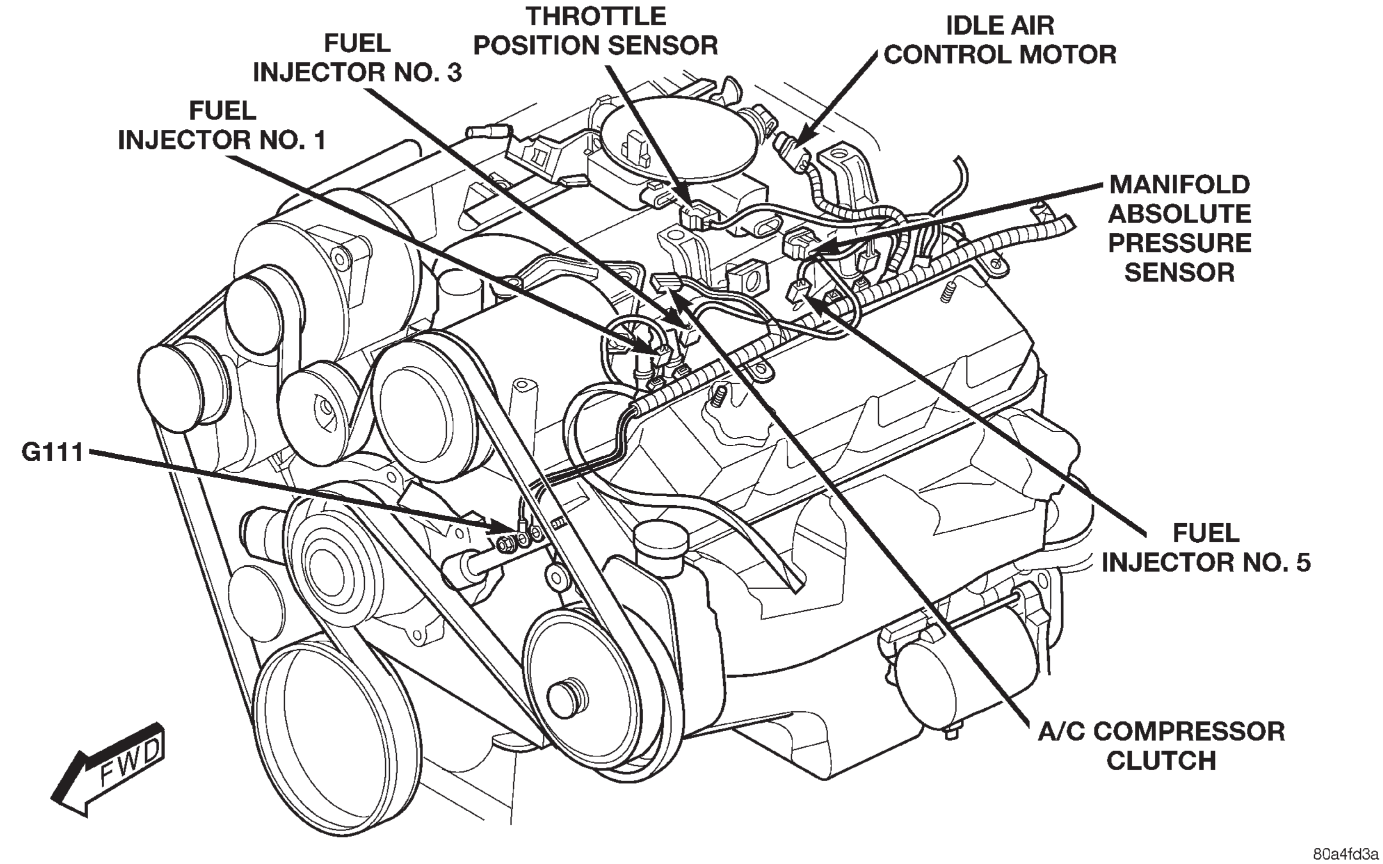


Fig. 11 ENGINE LEFT SIDE 3.9L

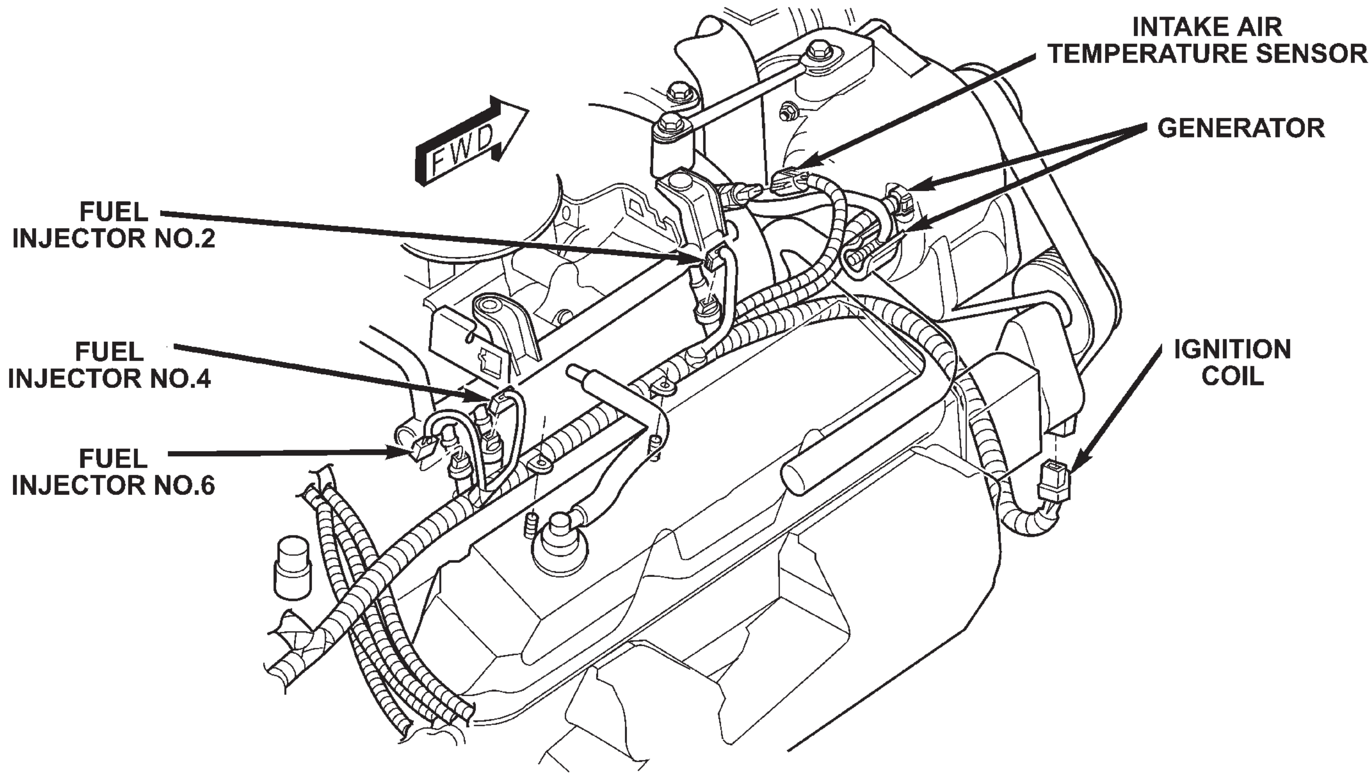


Fig. 12 ENGINE RIGHT SIDE 3.9L

CONNECTOR/GROUND LOCATIONS (Continued)

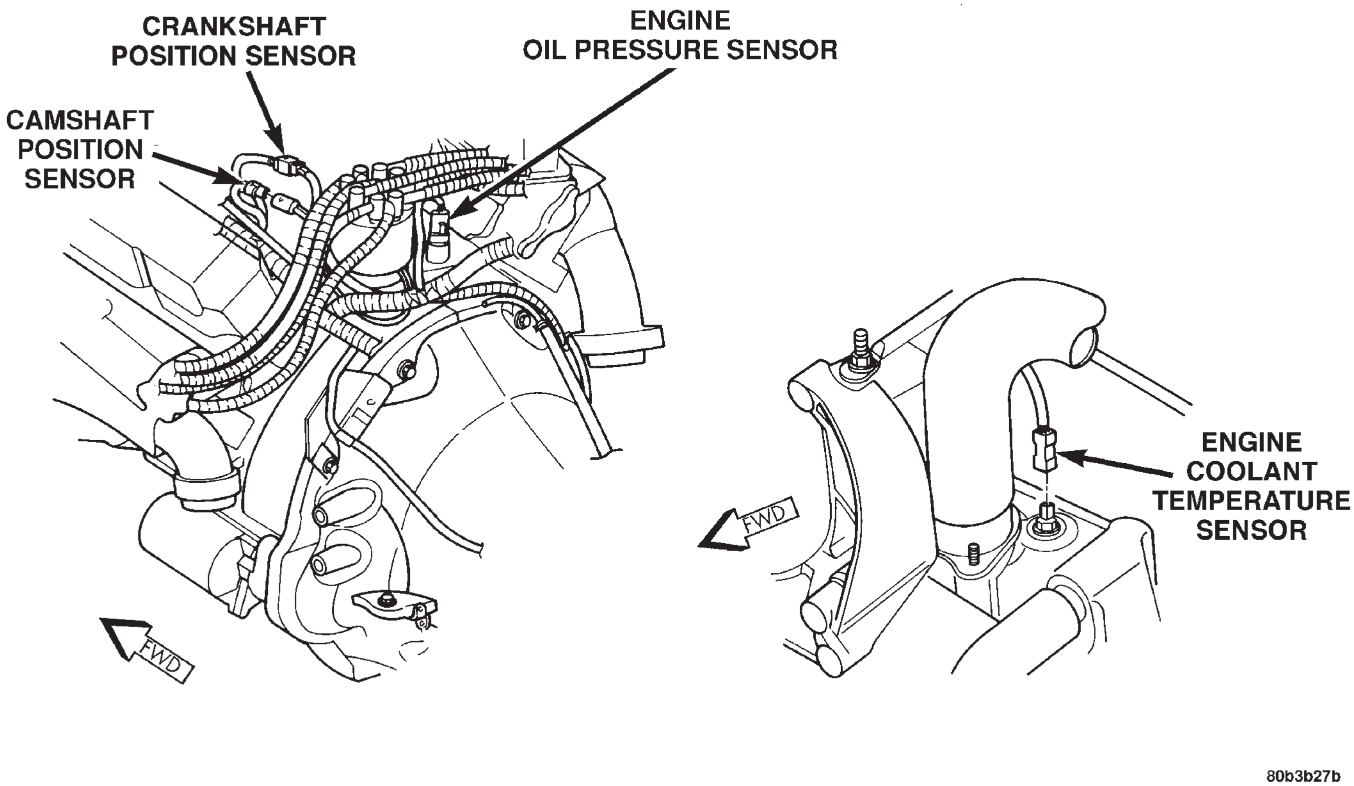


Fig. 13 ENGINE REAR 3.9L

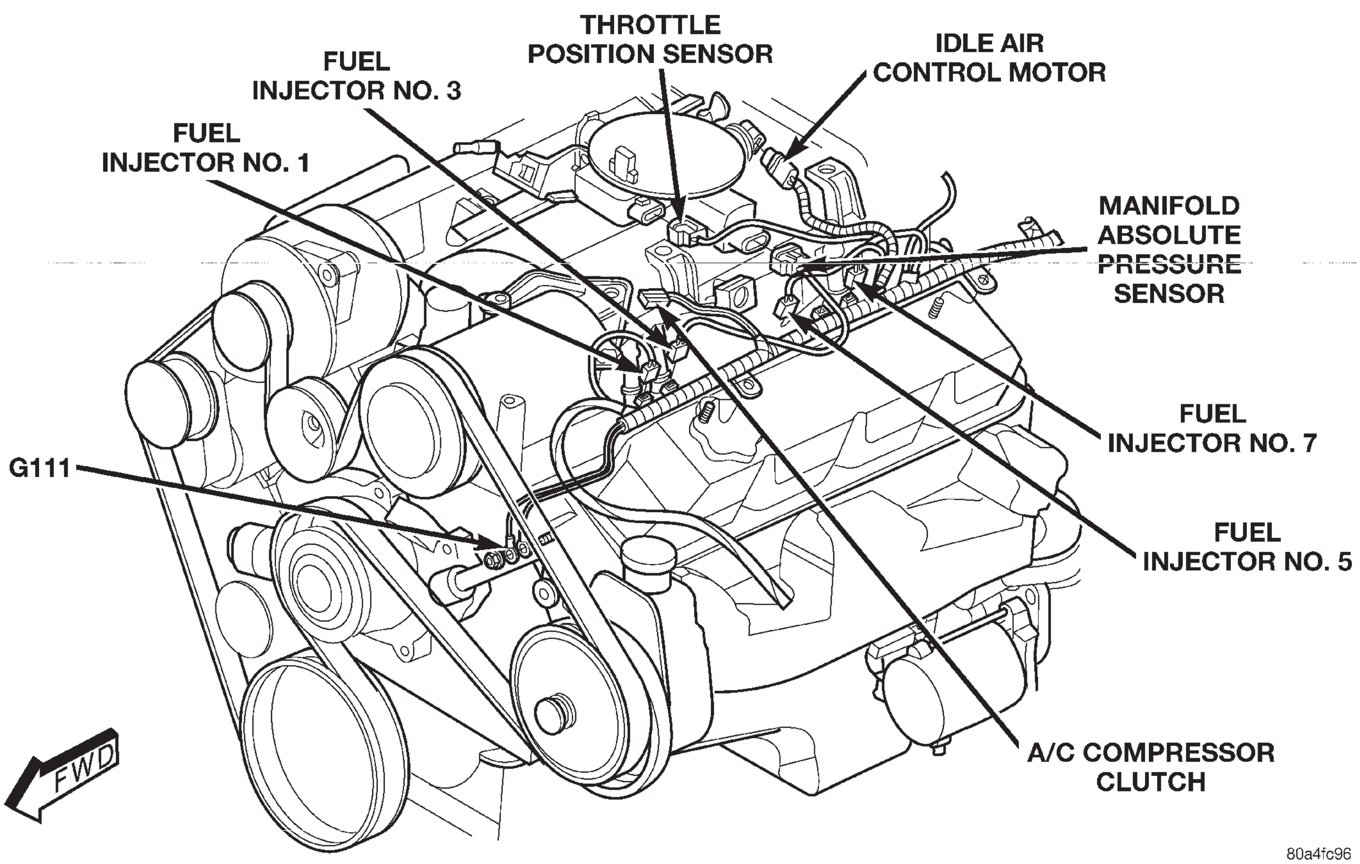


Fig. 14 ENGINE LEFT SIDE 5.9L

CONNECTOR/GROUND LOCATIONS (Continued)

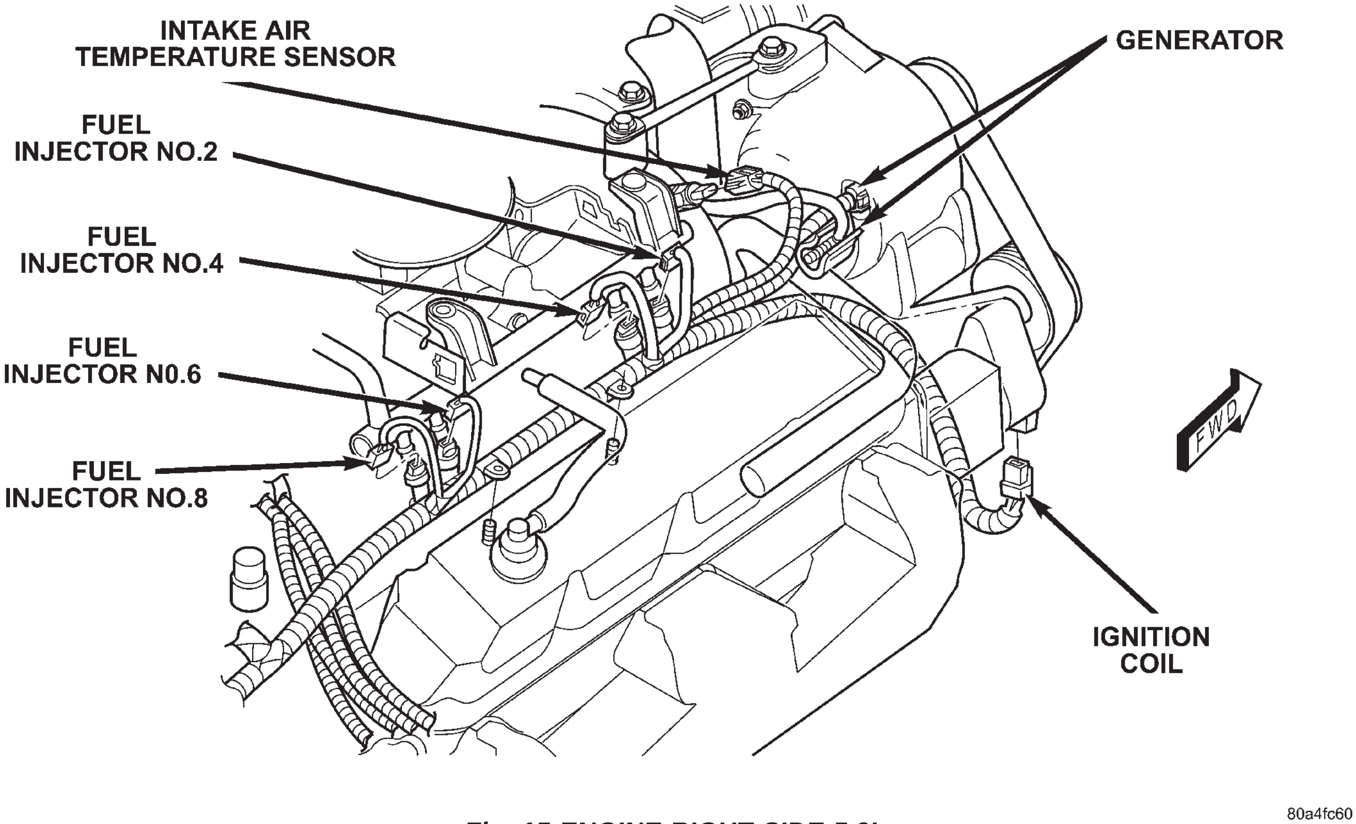


Fig. 15 ENGINE RIGHT SIDE 5.9L

CONNECTOR/GROUND LOCATIONS (Continued)

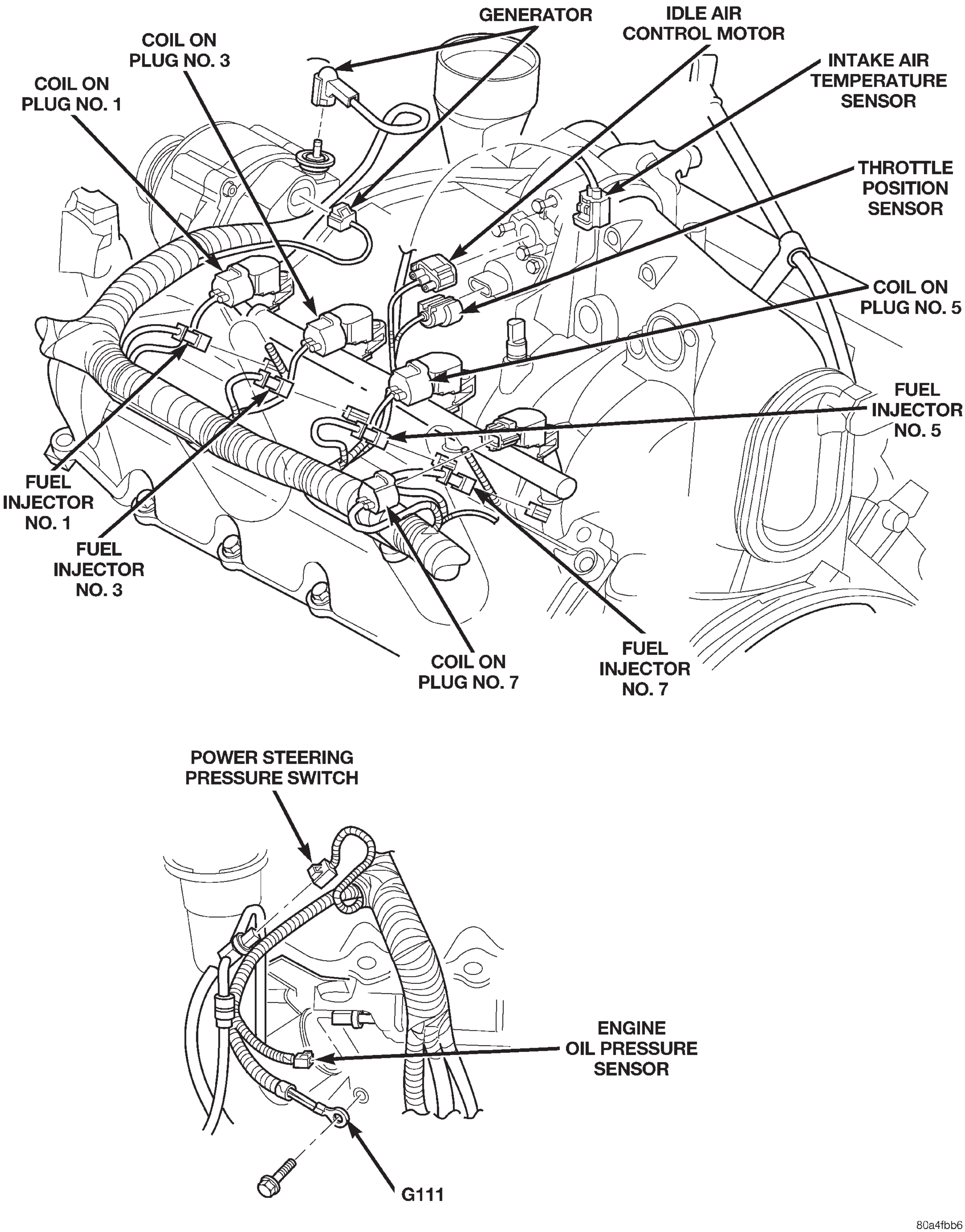
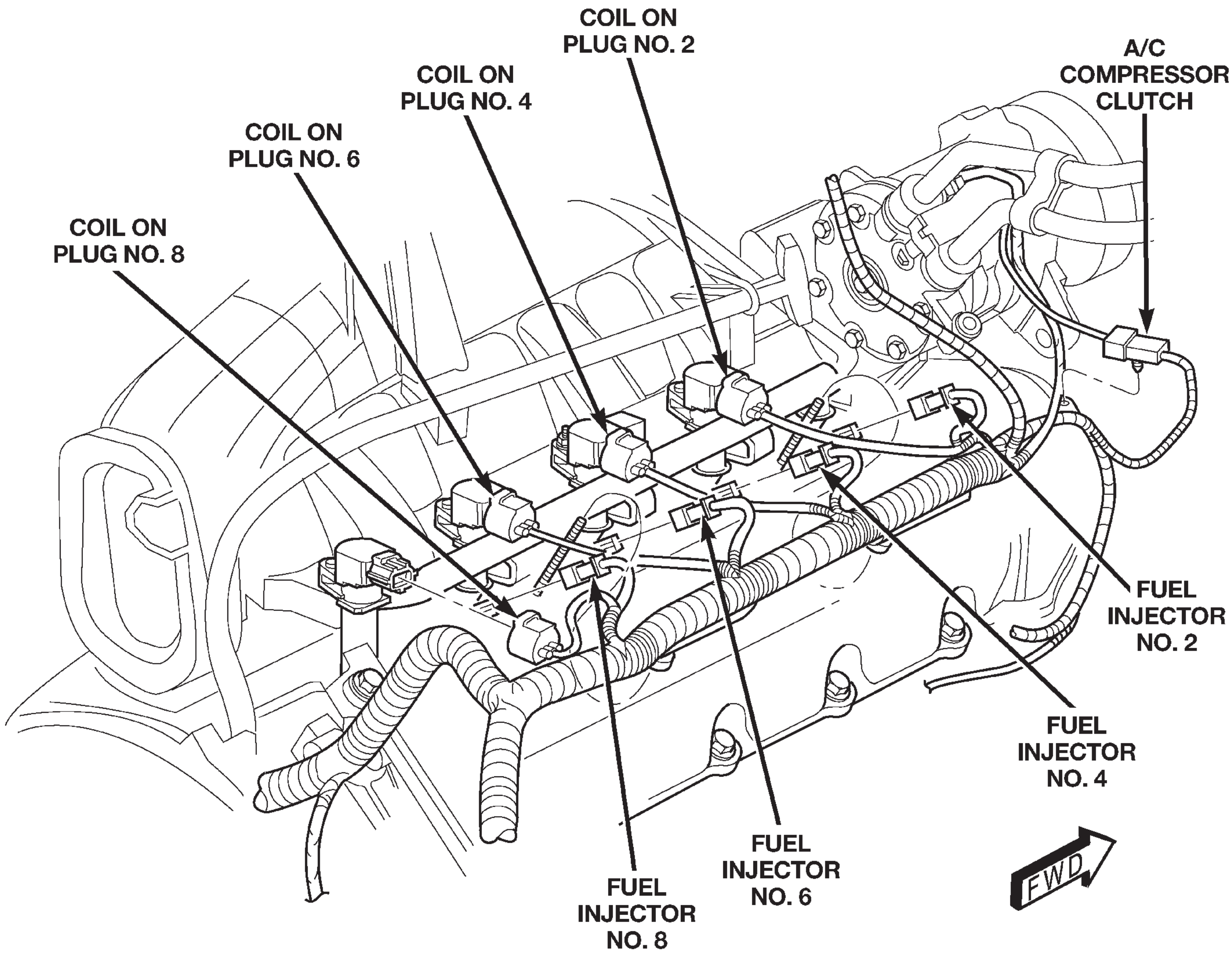


Fig. 16 ENGINE LEFT SIDE 4.7L

CONNECTOR/GROUND LOCATIONS (Continued)



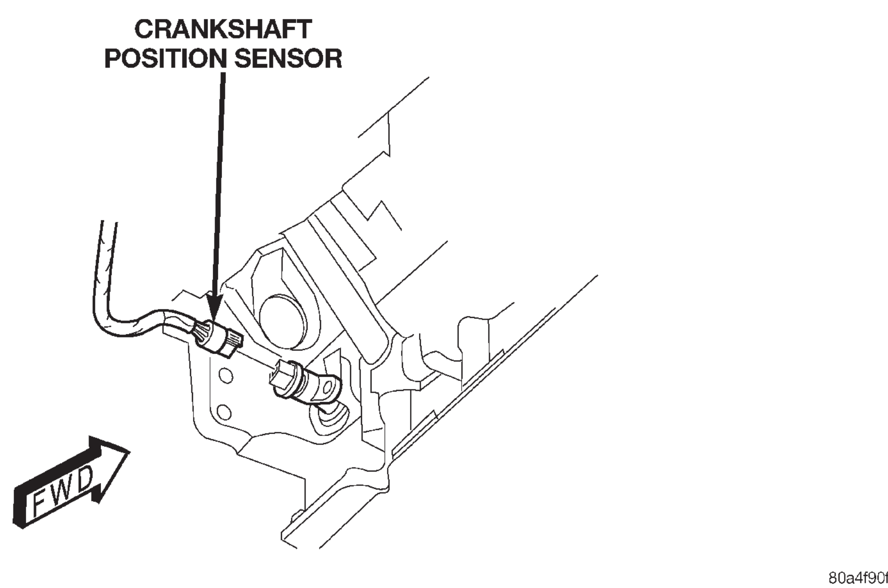


Fig. 17 ENGINE RIGHT SIDE 4.7L

CONNECTOR/GROUND LOCATIONS (Continued)

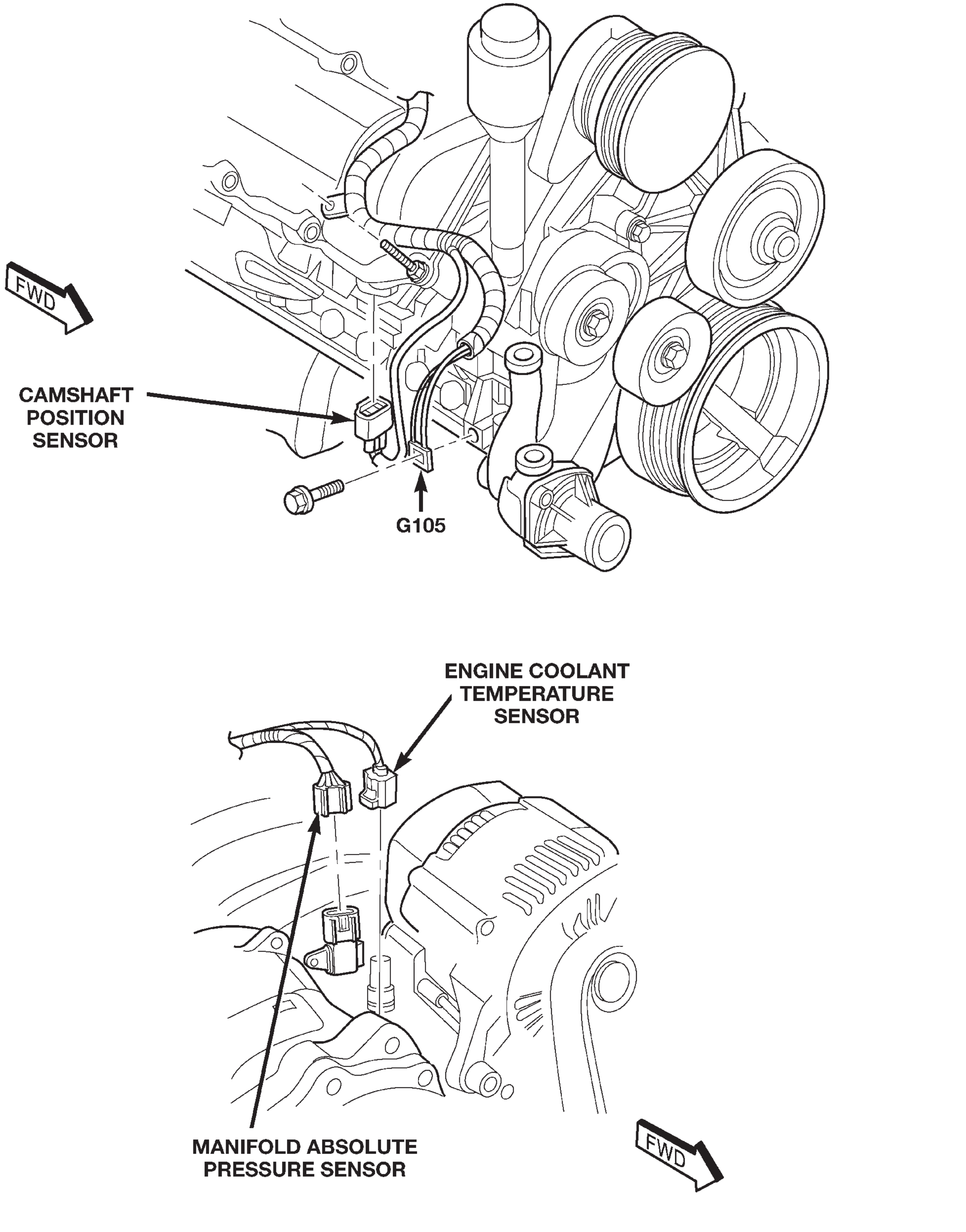


Fig. 18 ENGINE CONNECTORS FRONT 4.7L

CONNECTOR/GROUND LOCATIONS (Continued)

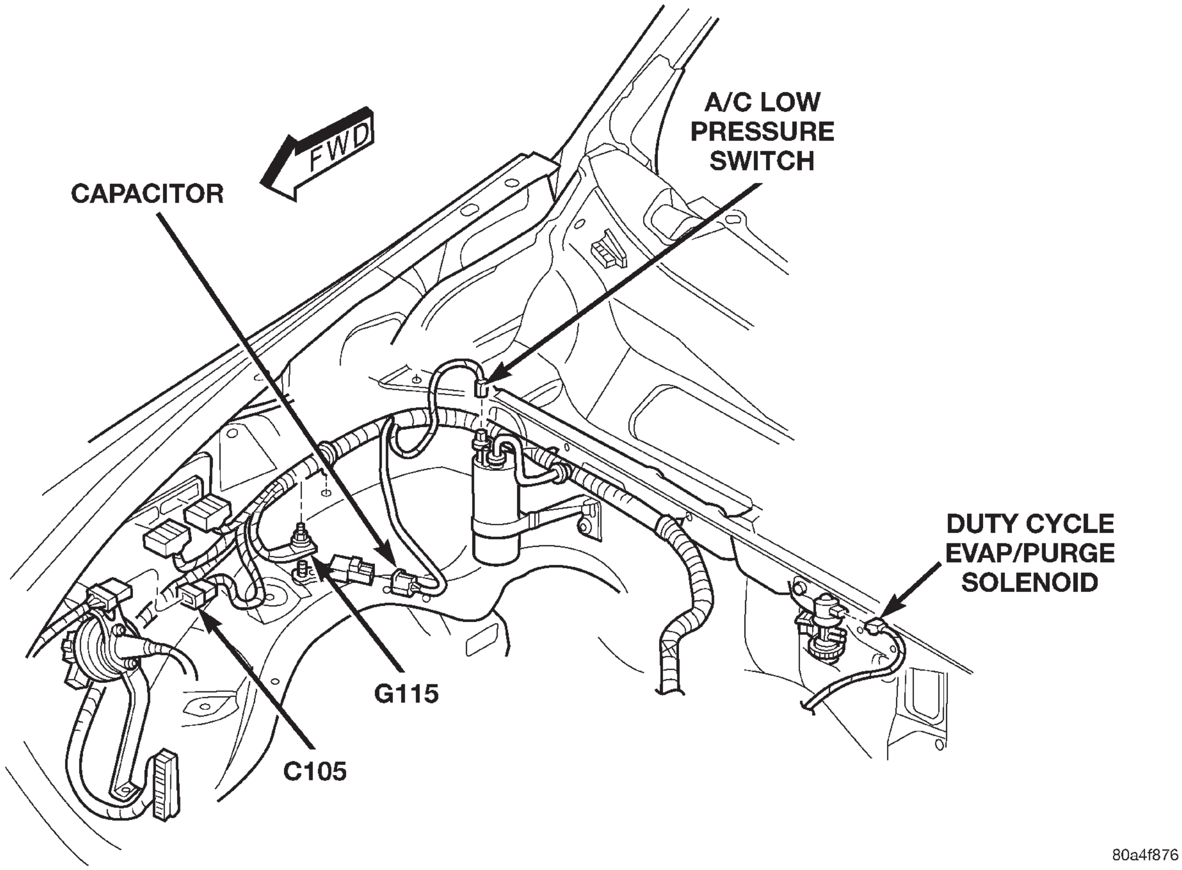


Fig. 19 RIGHT REAR ENGINE COMPARTMENT CONNECTORS

CONNECTOR/GROUND LOCATIONS (Continued)

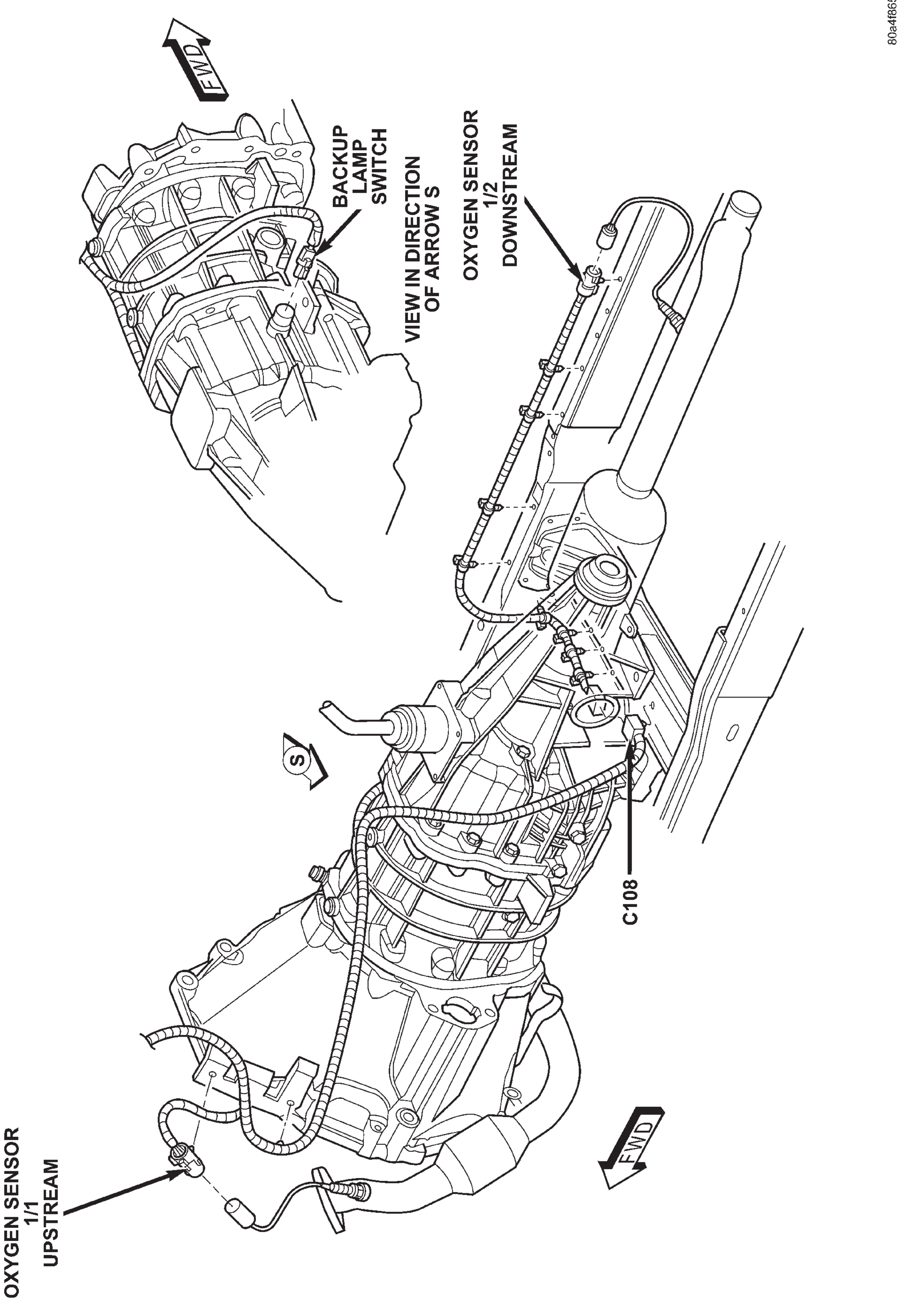


Fig. 20 MANUAL TRANSMISSION CONNECTORS 2.5L

CONNECTOR/GROUND LOCATIONS (Continued)

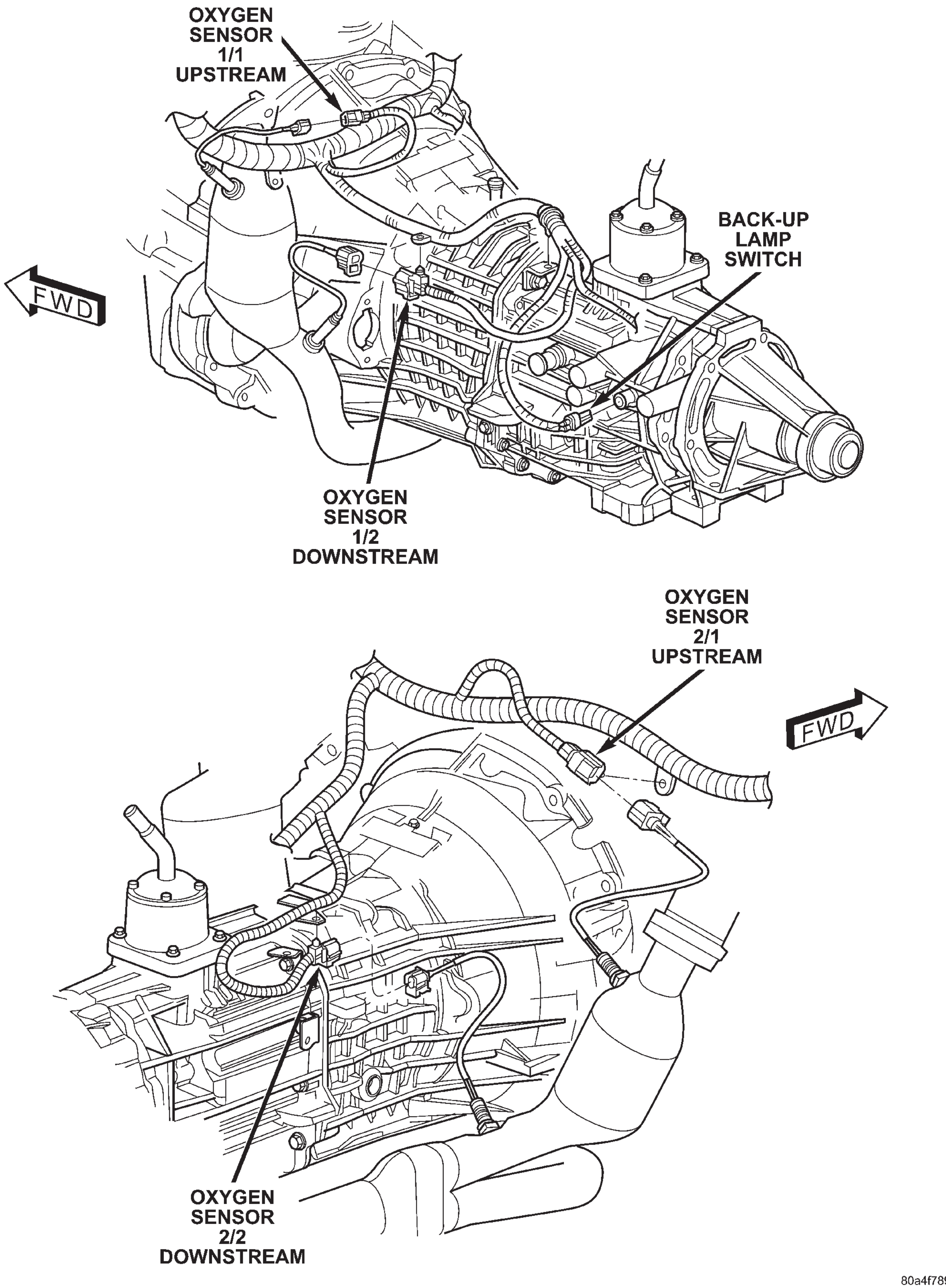


Fig. 21 MANUAL TRANSMISSION CONNECTORS 3.9L

CONNECTOR/GROUND LOCATIONS (Continued)

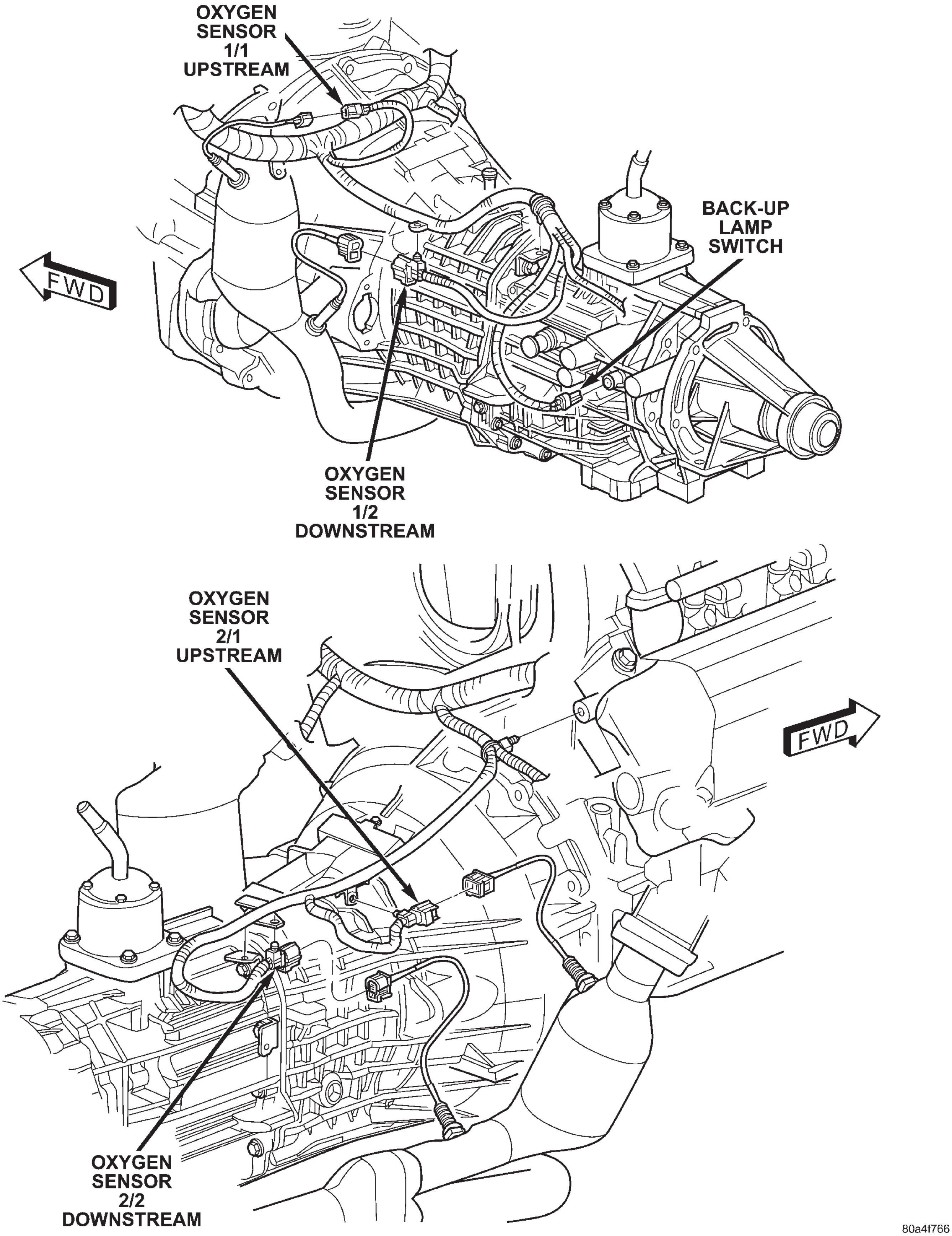


Fig. 22 MANUAL TRANSMISSION 4.7L (4X2)

CONNECTOR/GROUND LOCATIONS (Continued)

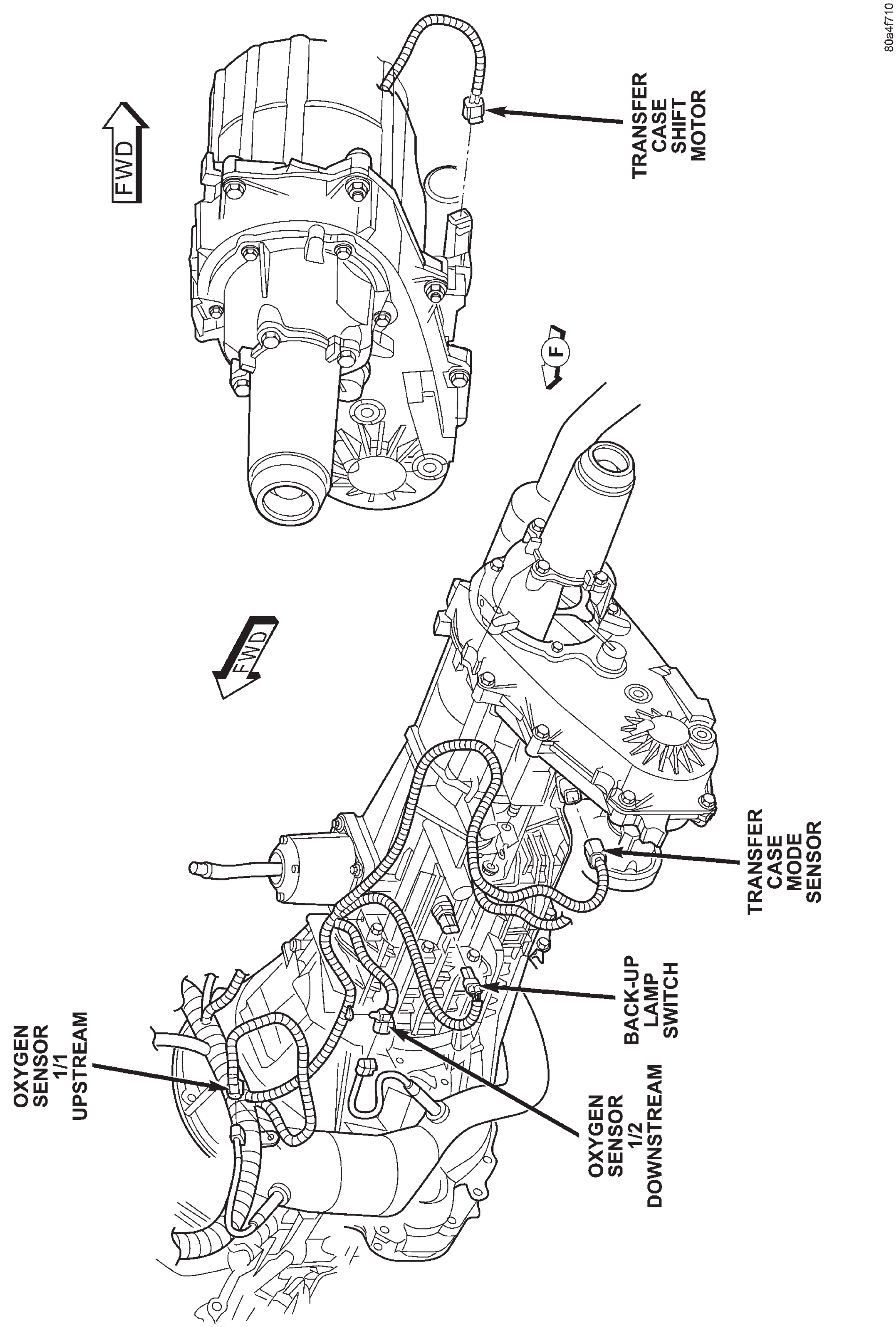


Fig. 23 MANUAL TRANSMISSION 4.7L (4X4)

CONNECTOR/GROUND LOCATIONS (Continued)

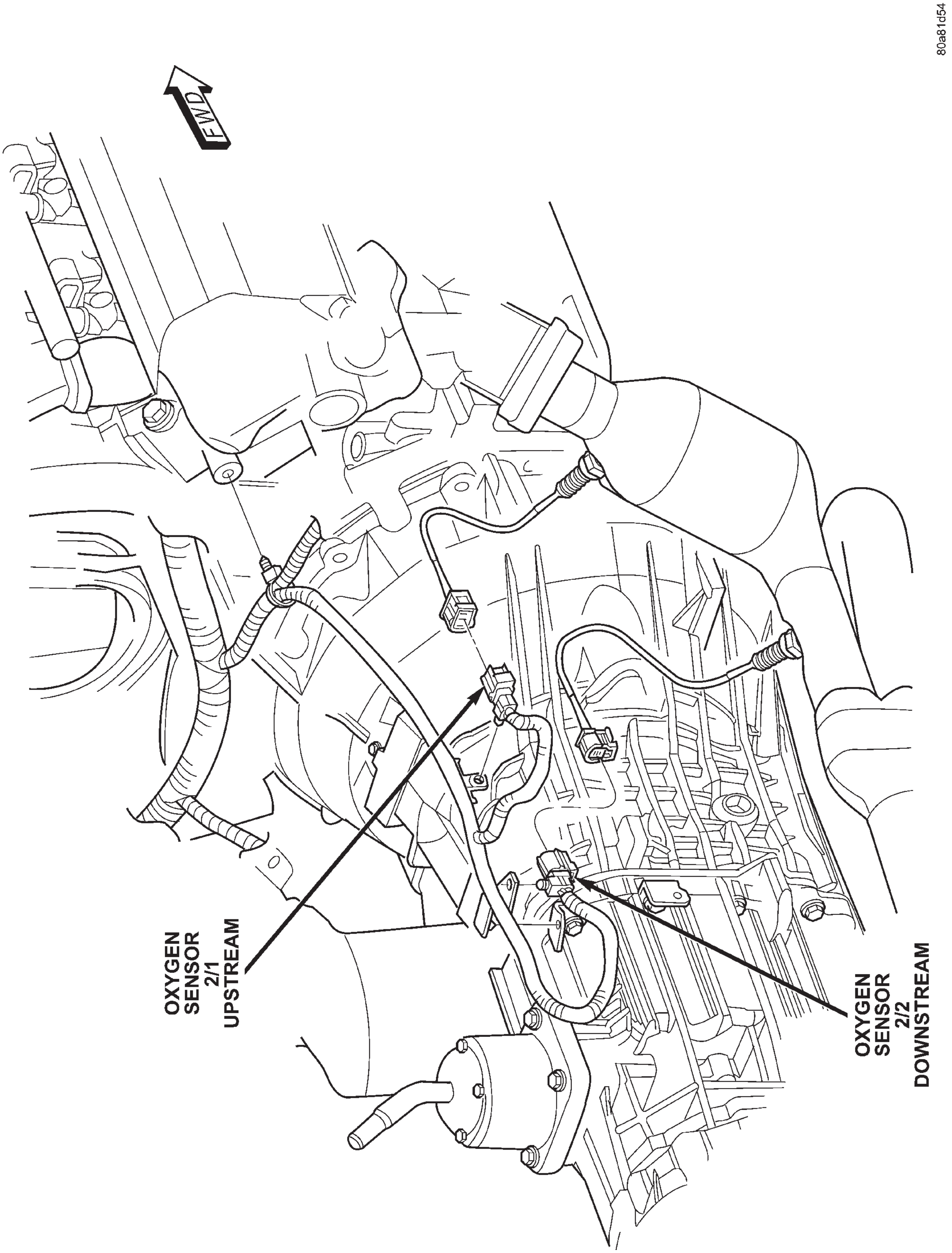


Fig. 24 MANUAL TRANSMISSION 4.7 (4X4)

CONNECTOR/GROUND LOCATIONS (Continued)

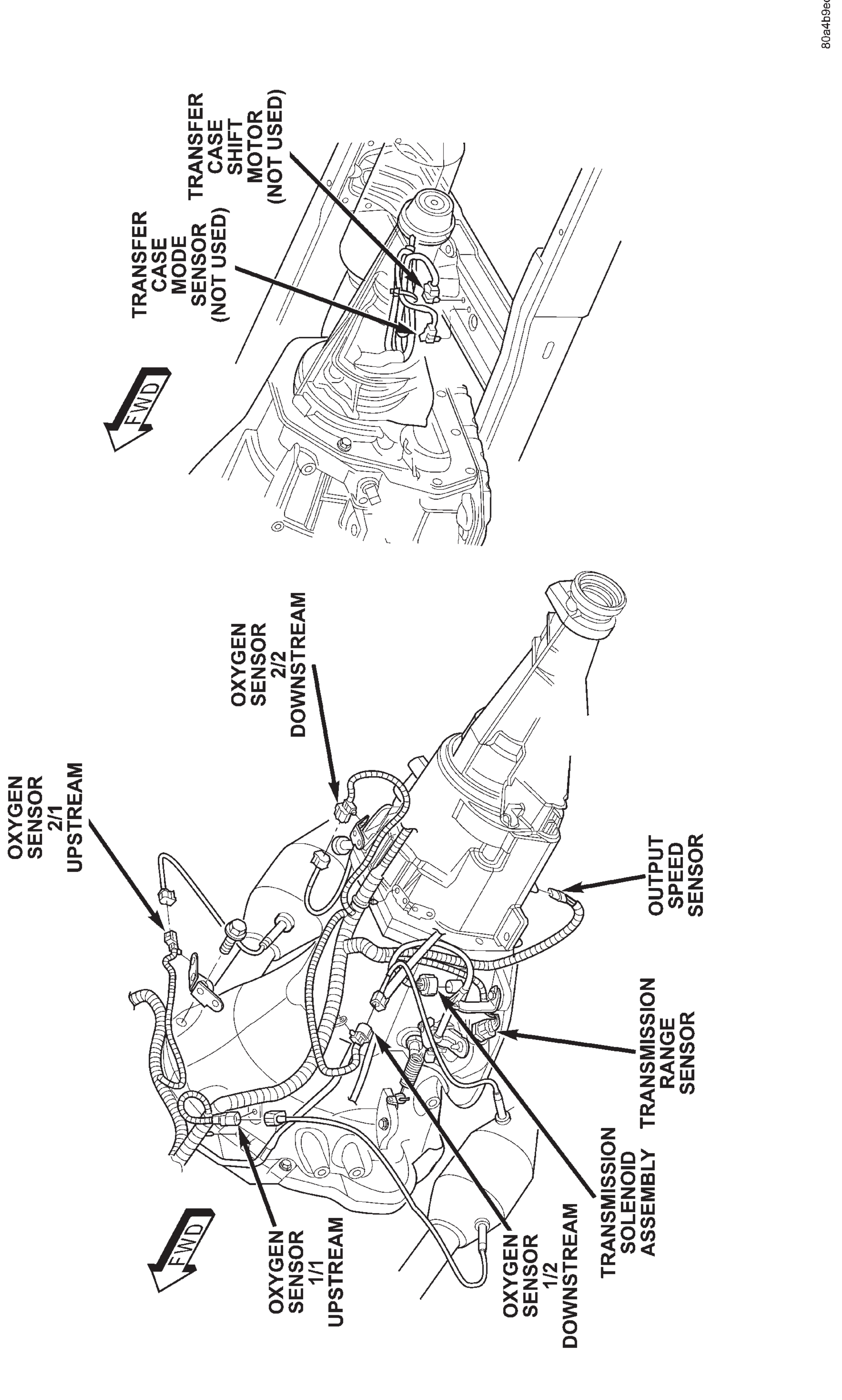


Fig. 25 AUTOMATIC TRANSMISSION CONNECTORS 3.9/5.9L (4X2)

CONNECTOR/GROUND LOCATIONS (Continued)

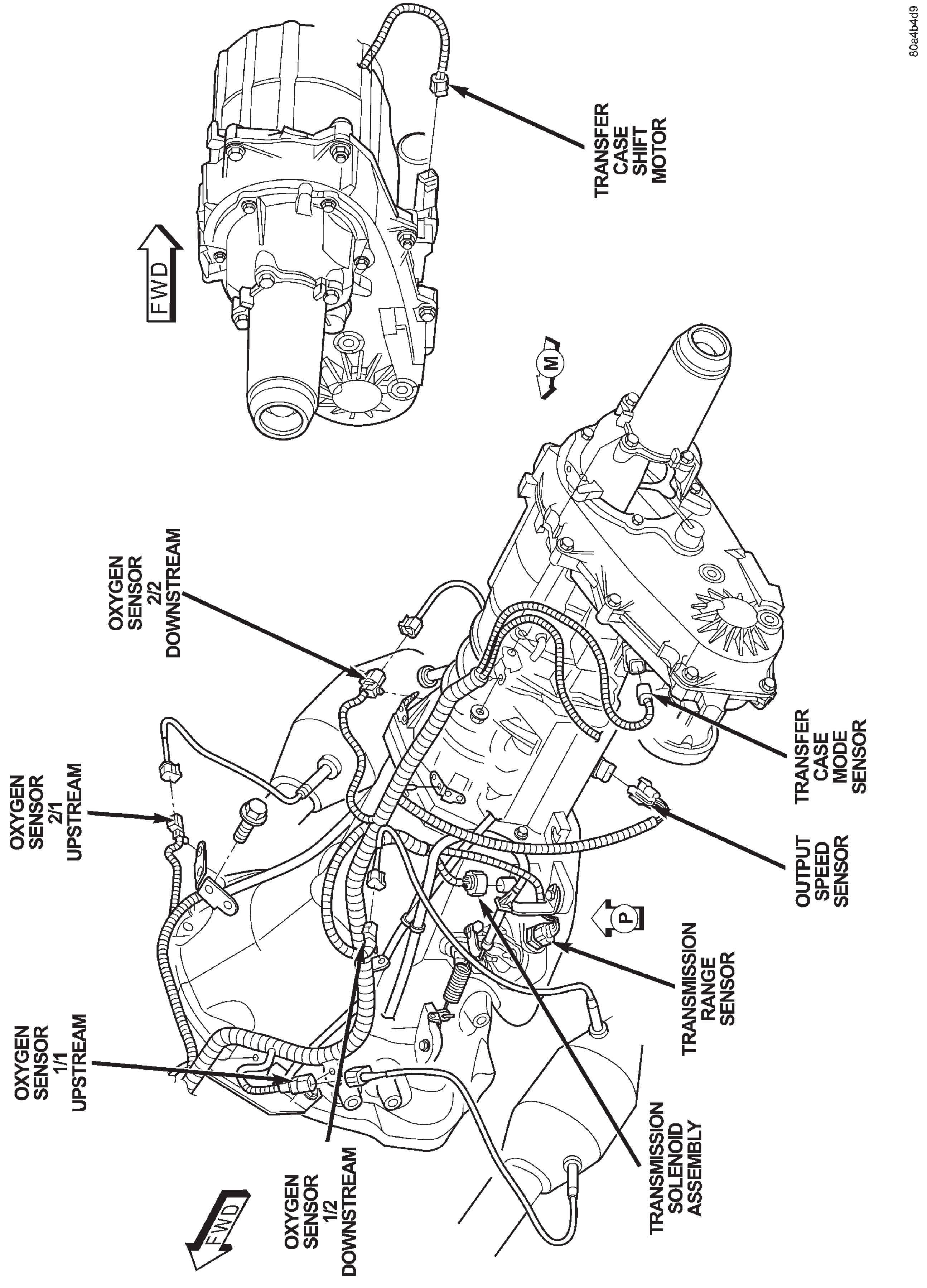


Fig. 26 AUTOMATIC TRANSMISSION CONNECTORS 3.9L/5.9L (4X4)

CONNECTOR/GROUND LOCATIONS (Continued)

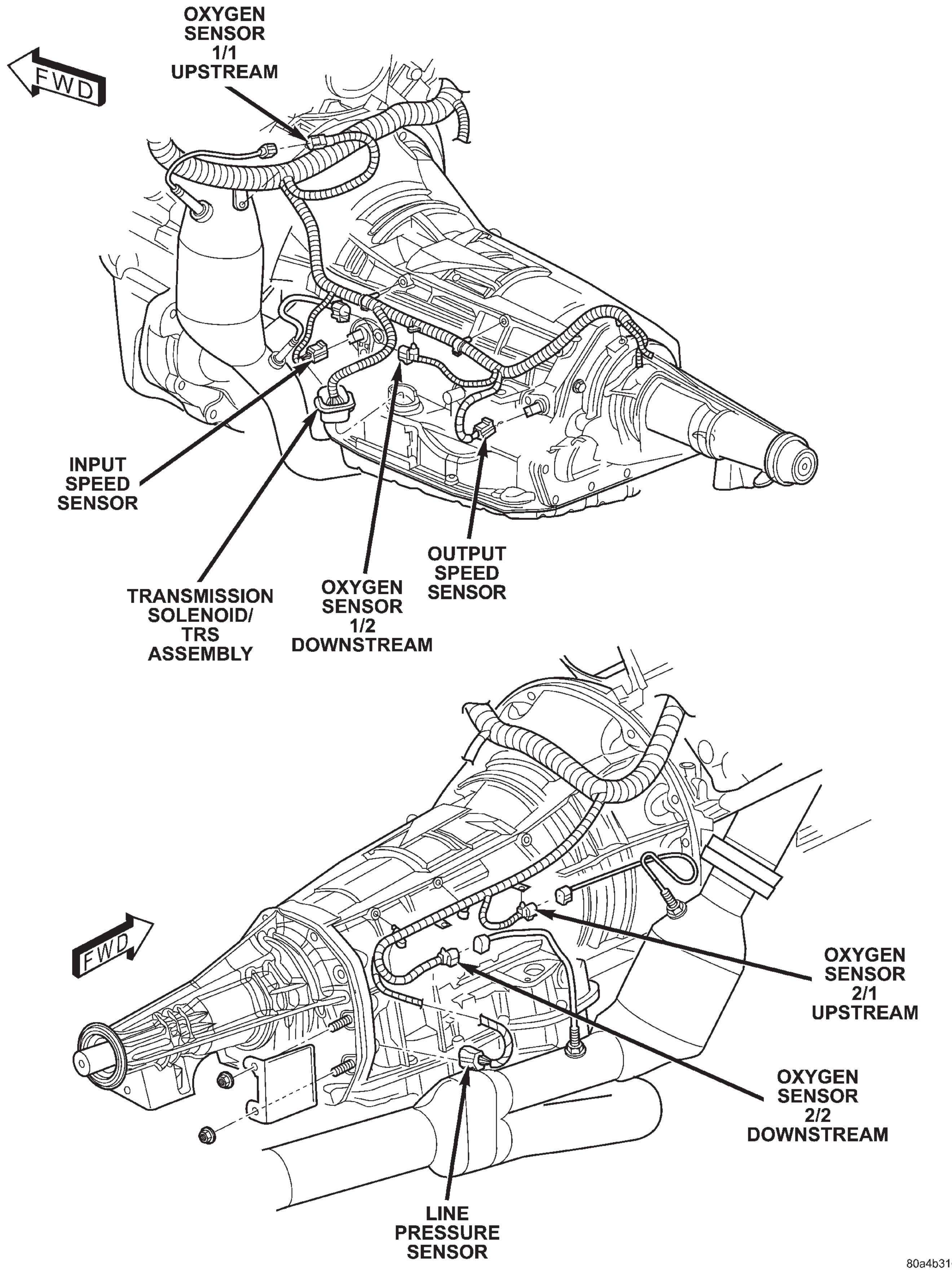


Fig. 27 AUTOMATIC TRANSMISSION 4.7L (4X2)

CONNECTOR/GROUND LOCATIONS (Continued)

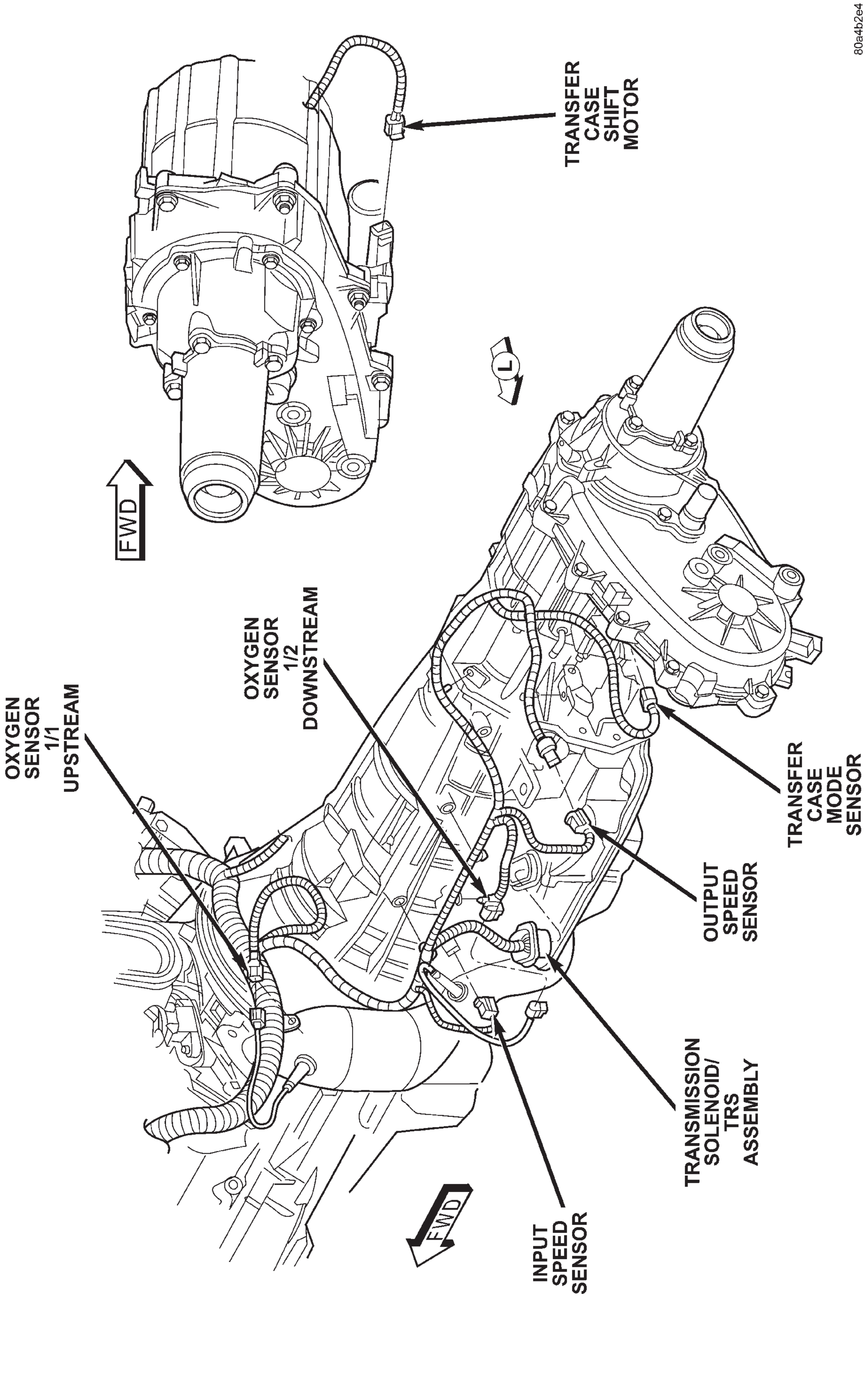


Fig. 28 AUTOMATIC TRANSMISSION 4.7L (4X4)

CONNECTOR/GROUND LOCATIONS (Continued)

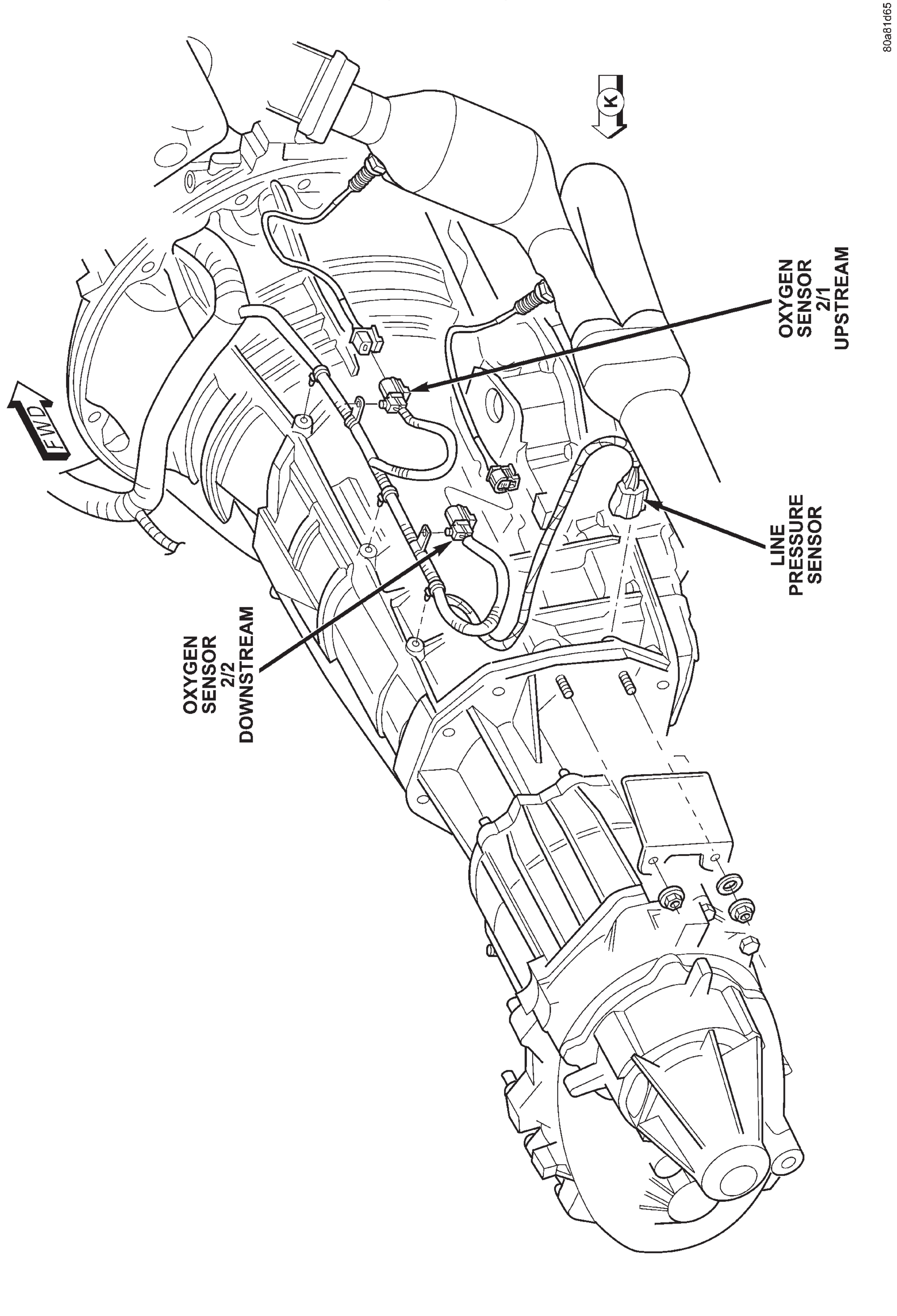


Fig. 29 AUTOMATIC TRANSMISSION 4.7 (4X4)

CONNECTOR/GROUND LOCATIONS (Continued)

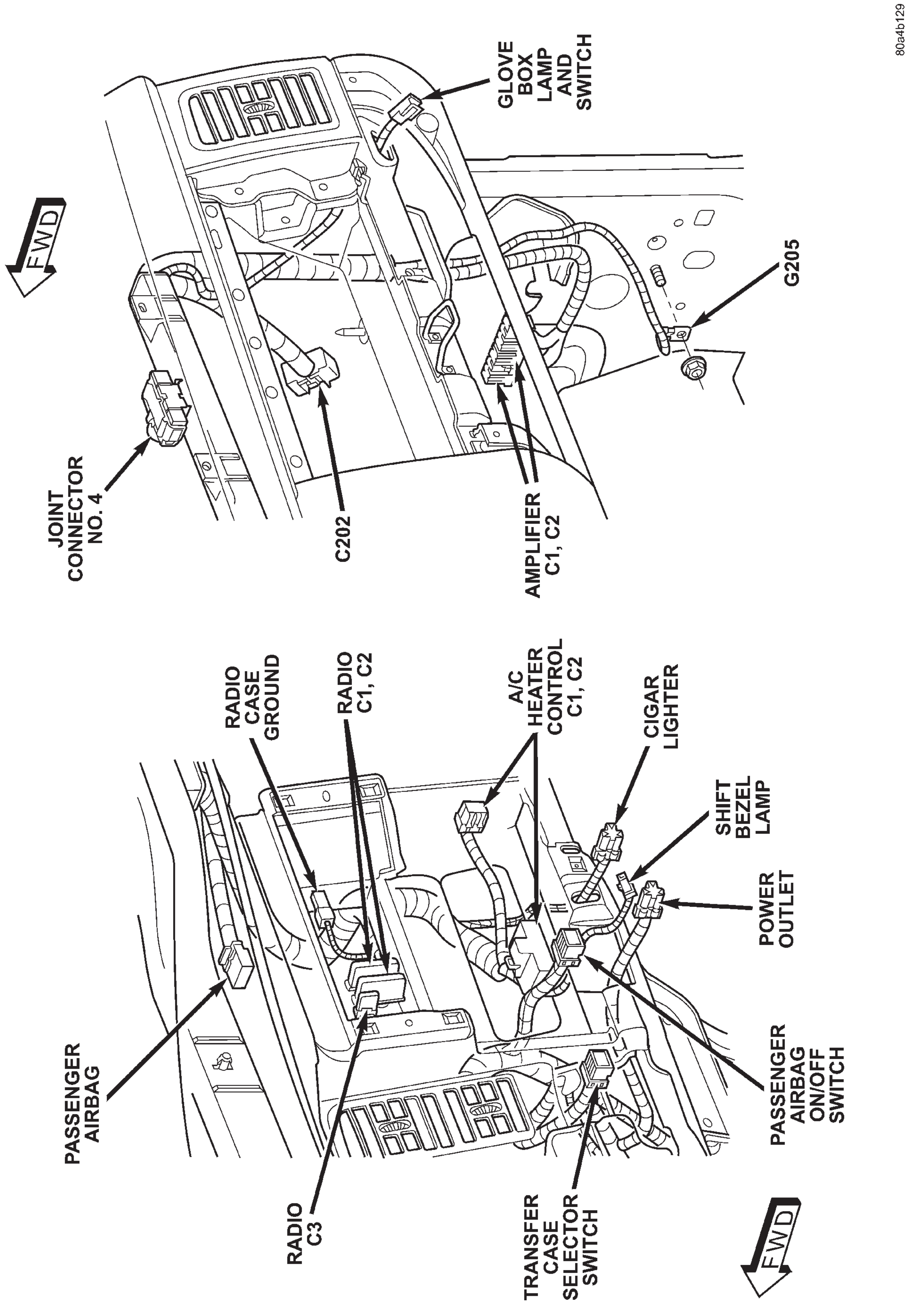


Fig. 30 RIGHT SIDE/CENTER INSTRUMENT PANEL CONNECTORS

CONNECTOR/GROUND LOCATIONS (Continued)

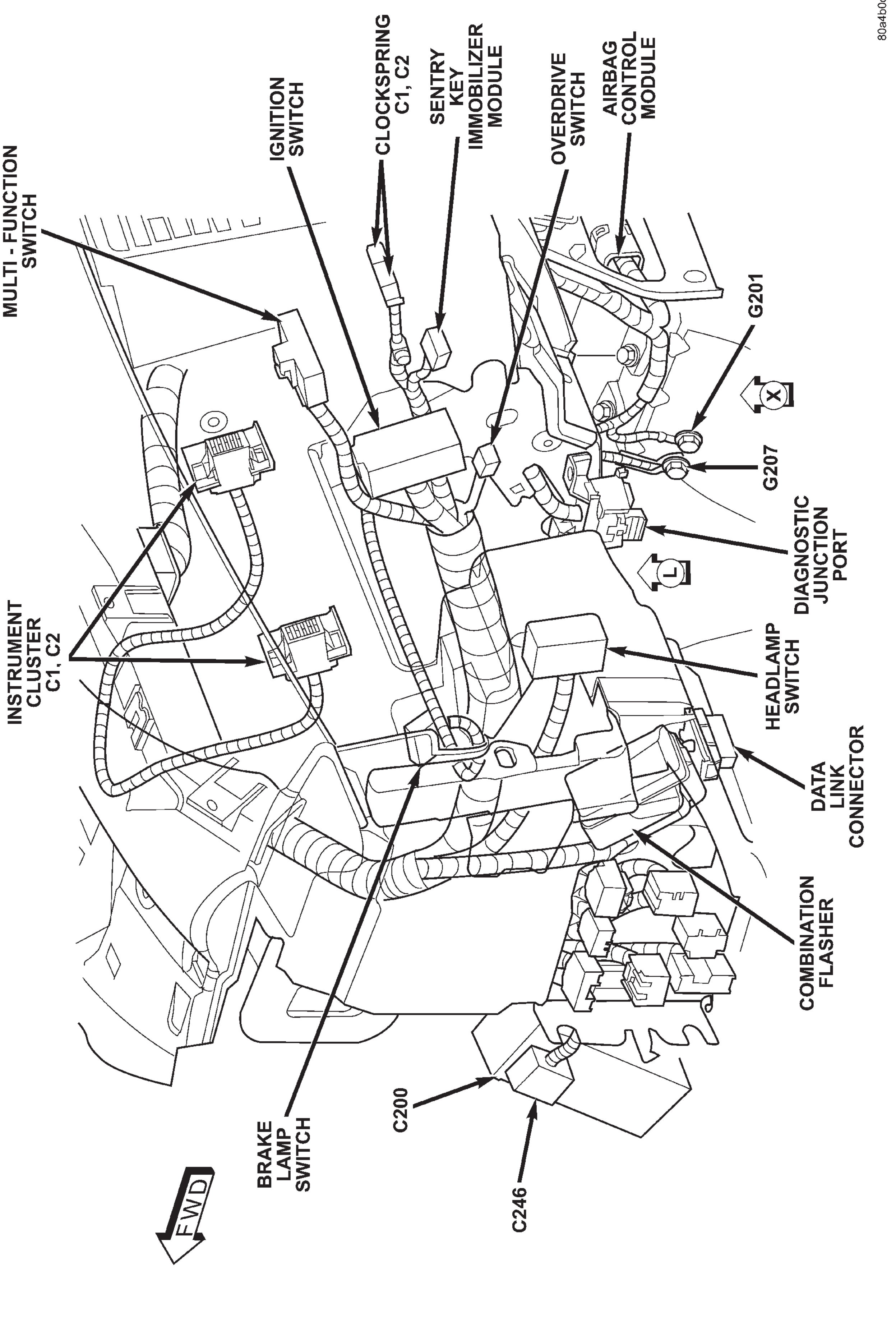


Fig. 31 LEFT SIDE INSTRUMENT PANEL CONNECTORS

CONNECTOR/GROUND LOCATIONS (Continued)

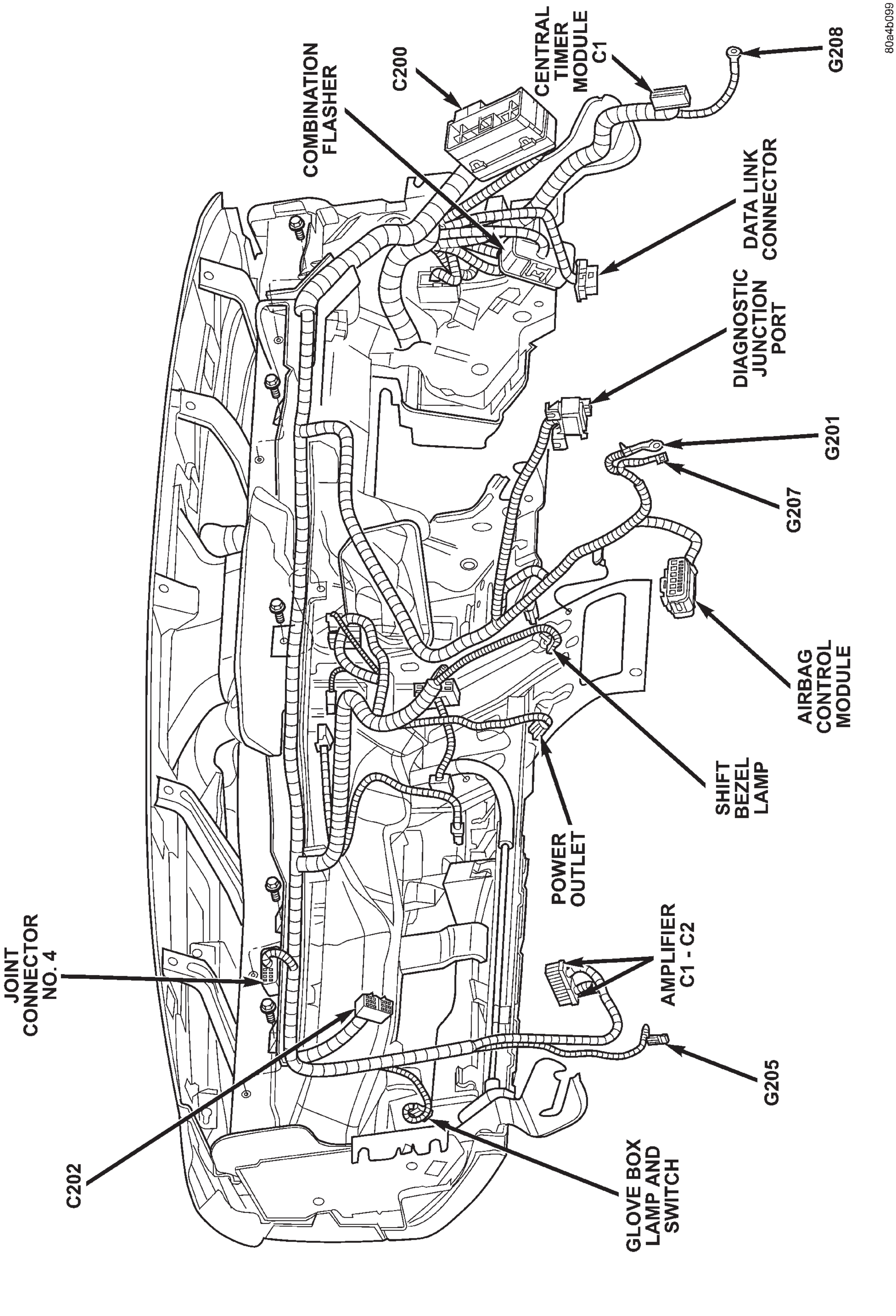


Fig. 32 INSTRUMENT PANEL CONNECTORS

CONNECTOR/GROUND LOCATIONS (Continued)

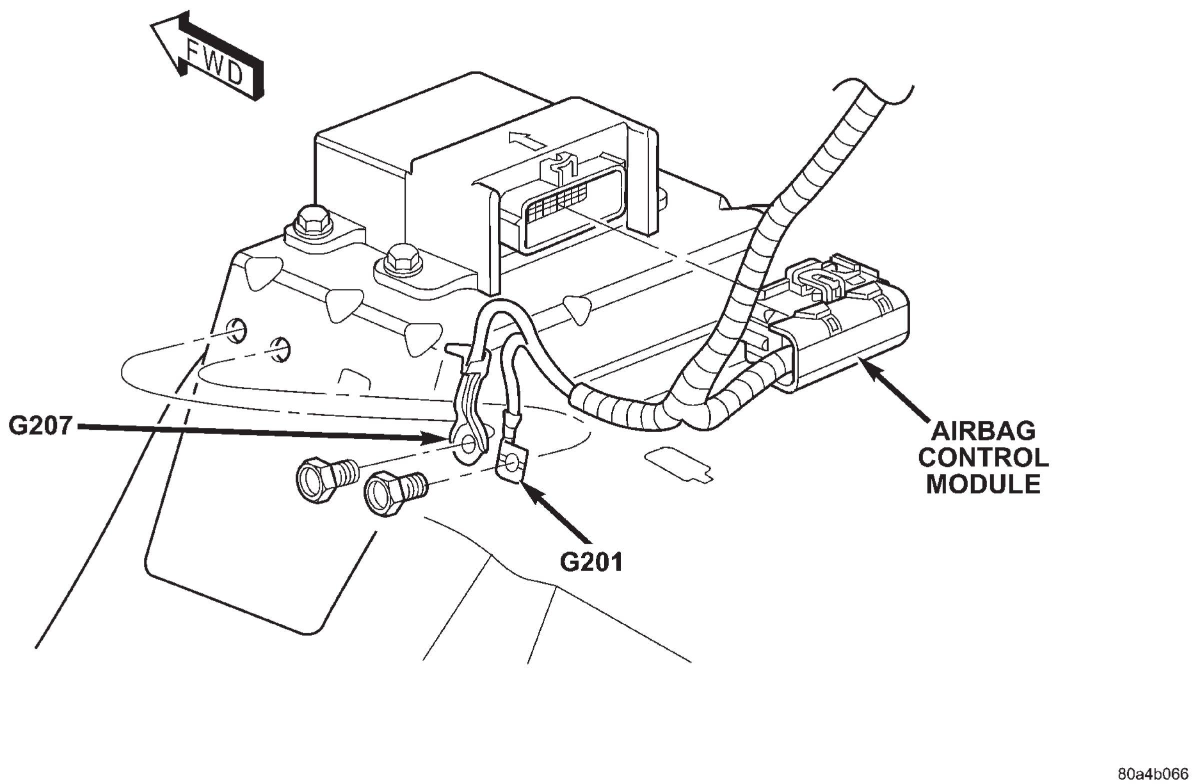


Fig. 33 AIRBAG CONTROL MODULE

CONNECTOR/GROUND LOCATIONS (Continued)

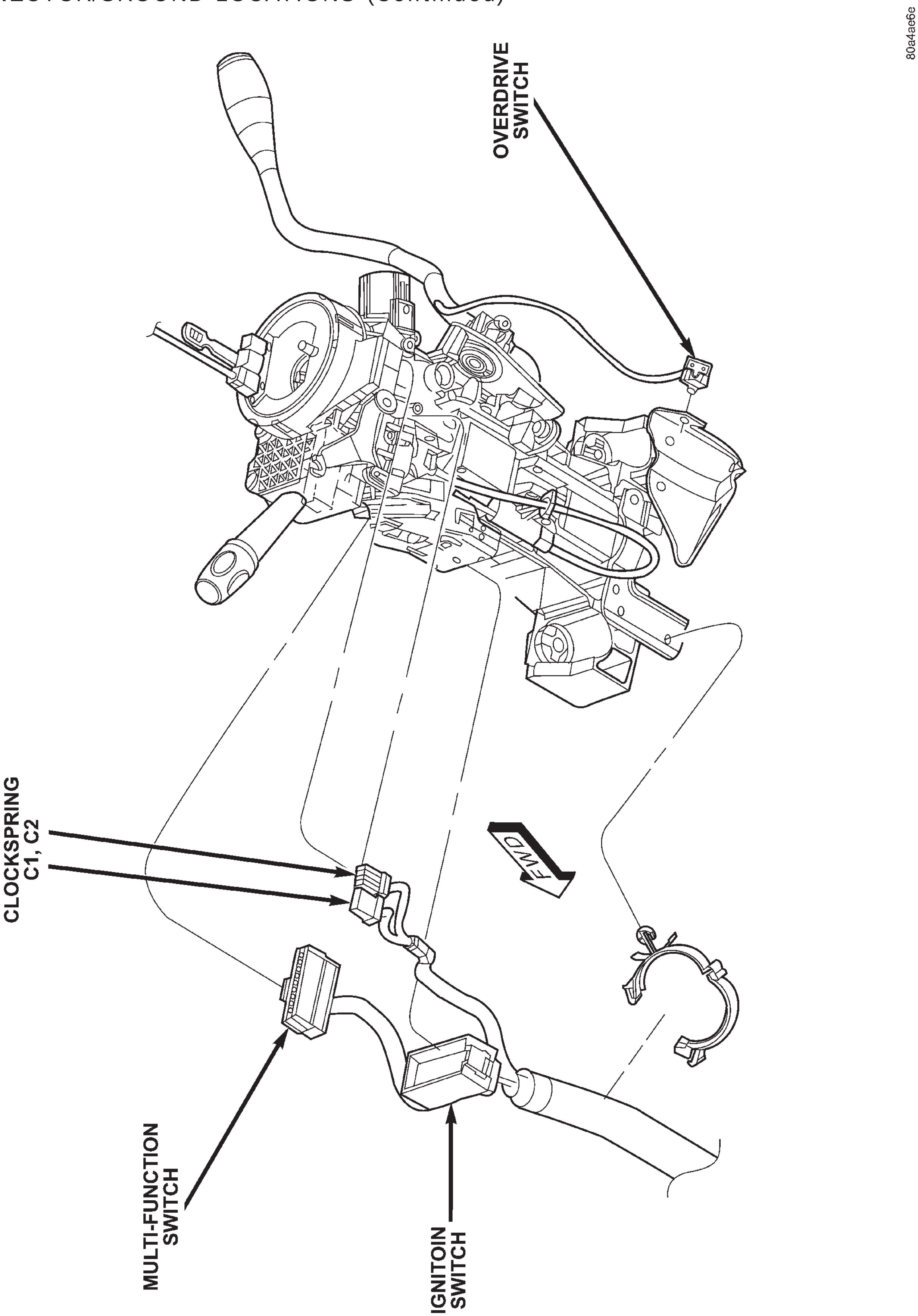


Fig. 34 MULTI-FUNCTION SWITCH CONNECTORS

CONNECTOR/GROUND LOCATIONS (Continued)

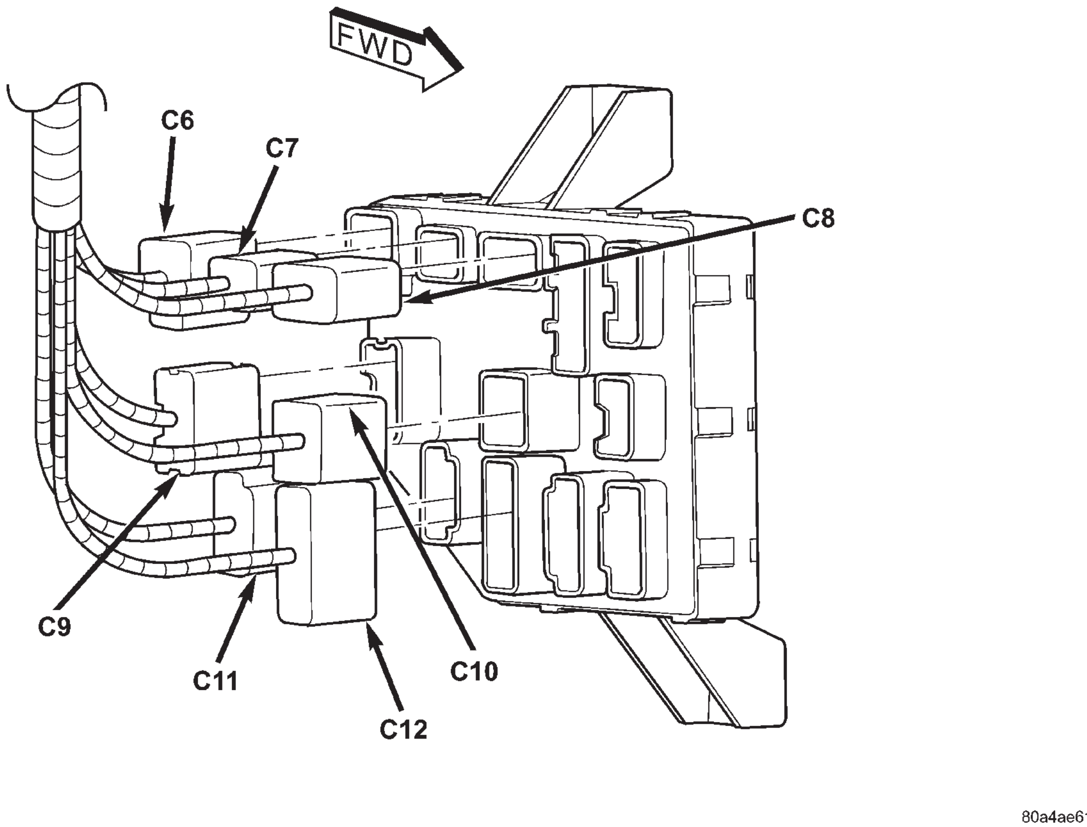


Fig. 35 JUNCTION BLOCK CONNECTORS

CONNECTOR/GROUND LOCATIONS (Continued)

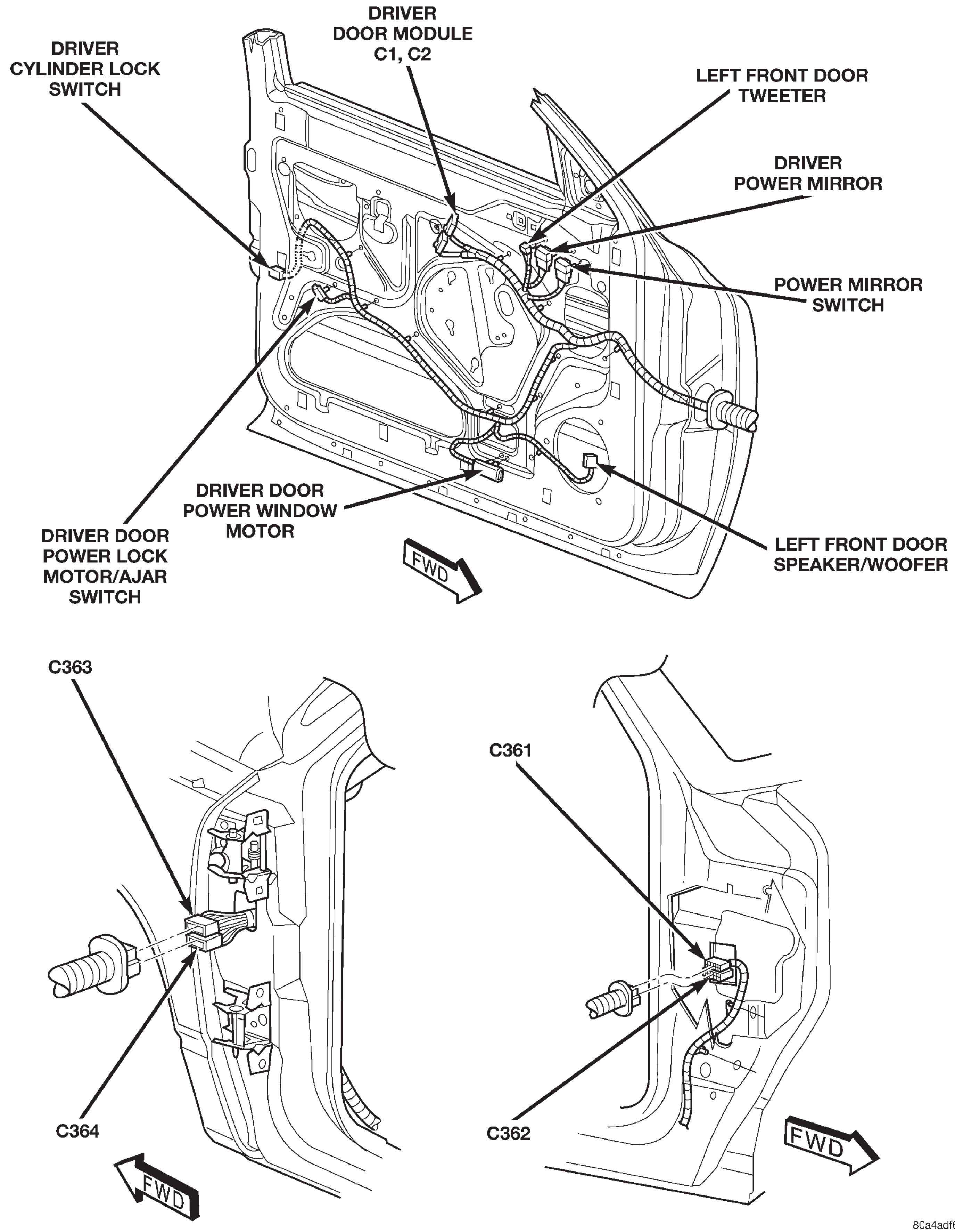


Fig. 36 FRONT DOOR CONNECTORS

CONNECTOR/GROUND LOCATIONS (Continued)

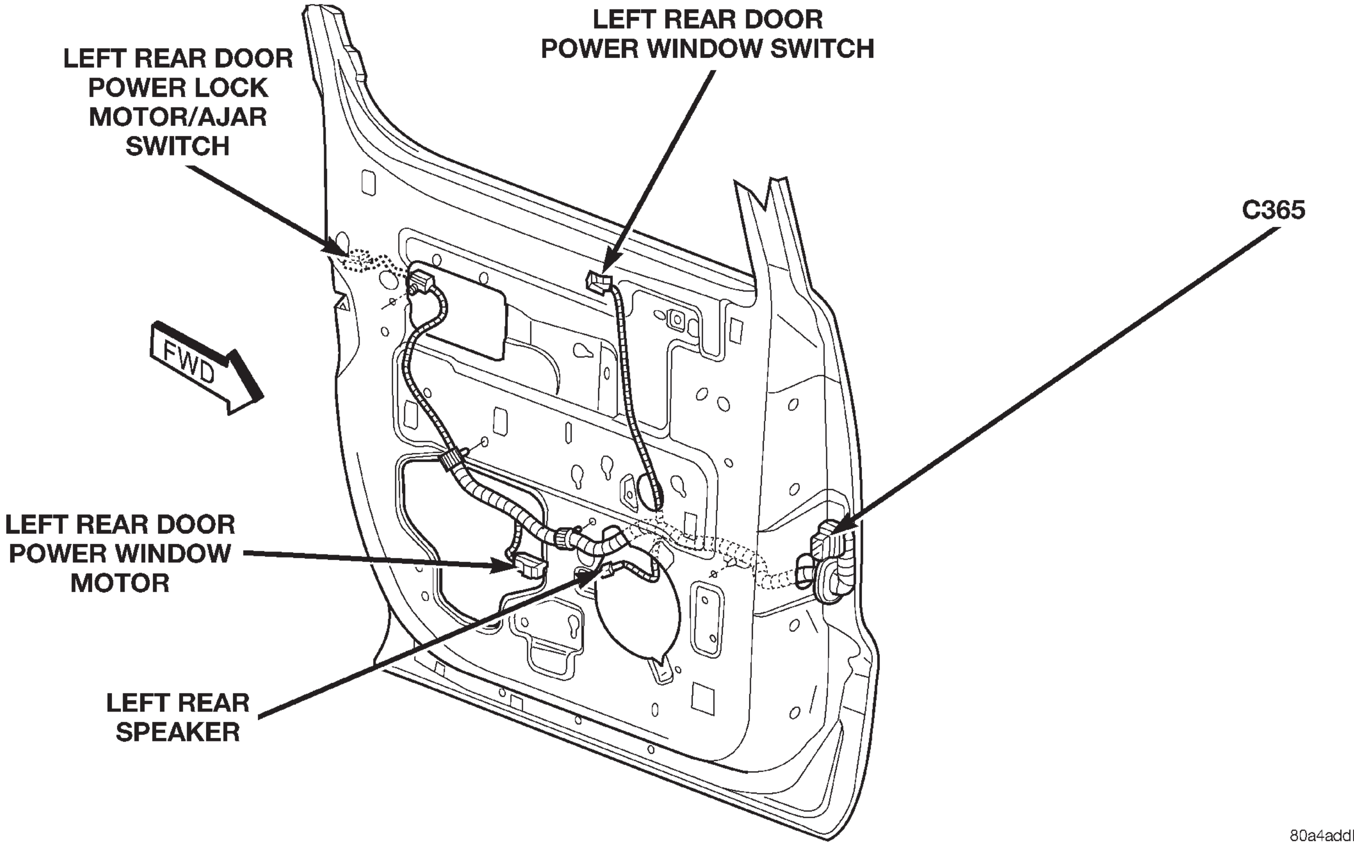


Fig. 37 REAR DOOR CONNECTORS

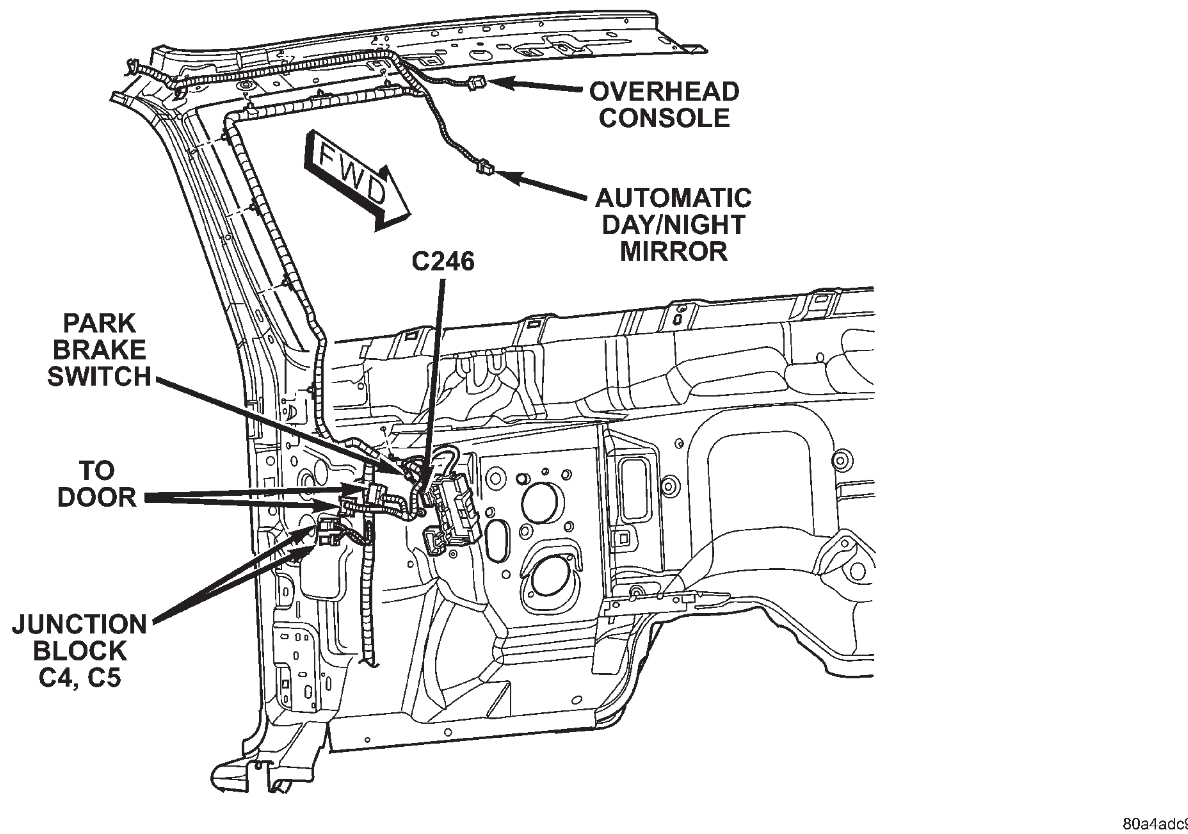


Fig. 38 LEFT FRONT BODY WIRING

CONNECTOR/GROUND LOCATIONS (Continued)

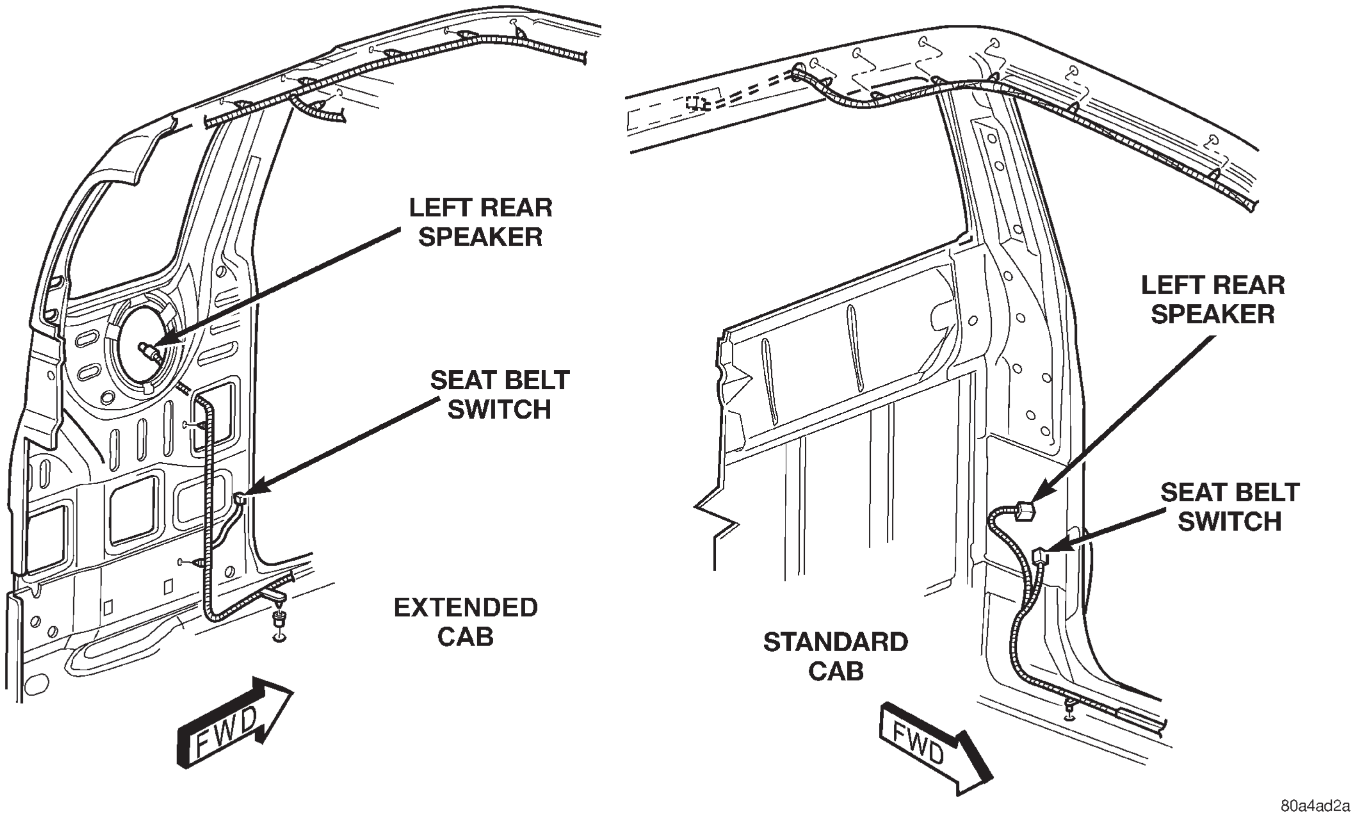


Fig. 39 CAB WIRING

CONNECTOR/GROUND LOCATIONS (Continued)

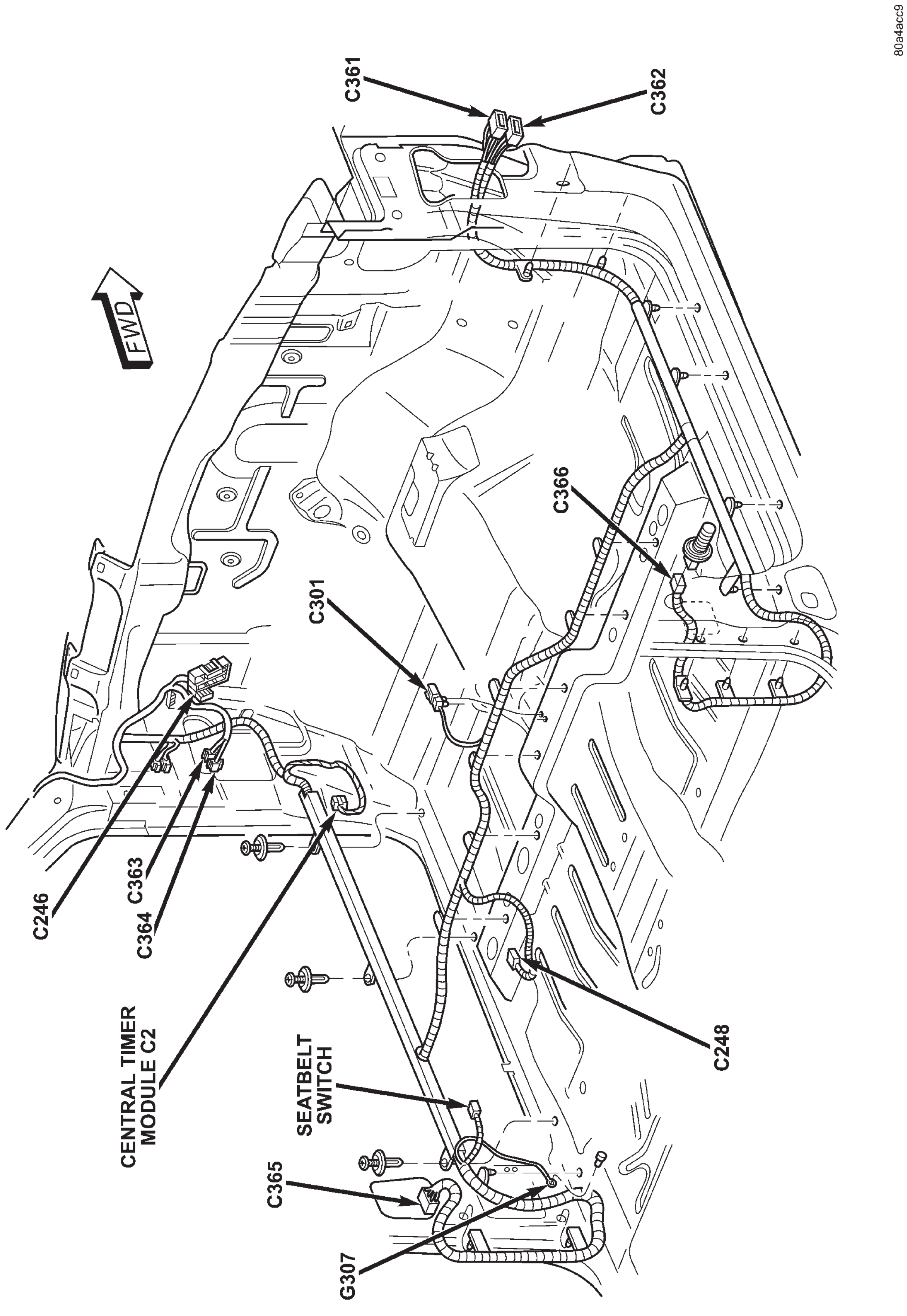


Fig. 40 BODY WIRING

CONNECTOR/GROUND LOCATIONS (Continued)

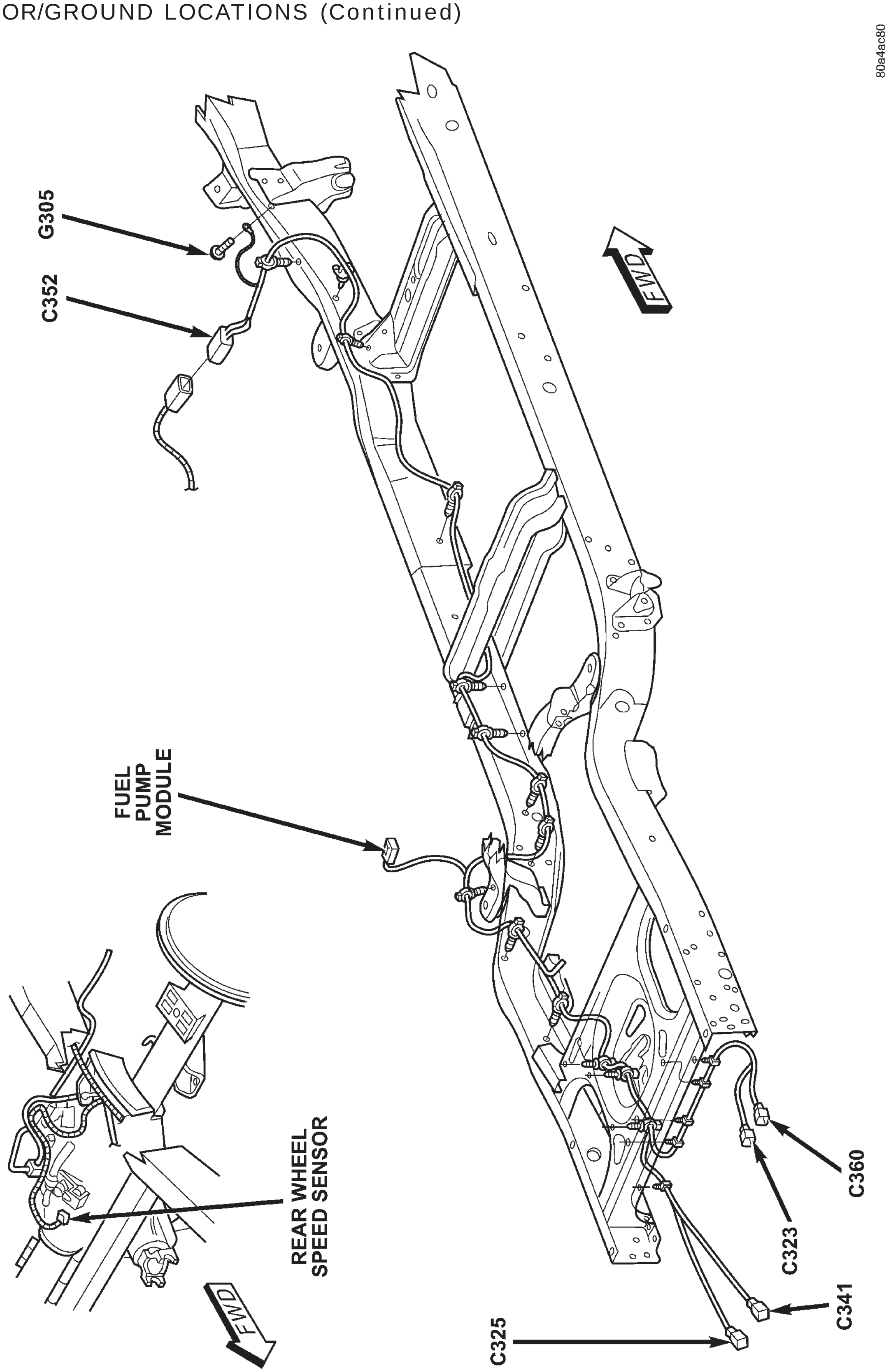


Fig. 41 CHASSIS WIRING

CONNECTOR/GROUND LOCATIONS (Continued)

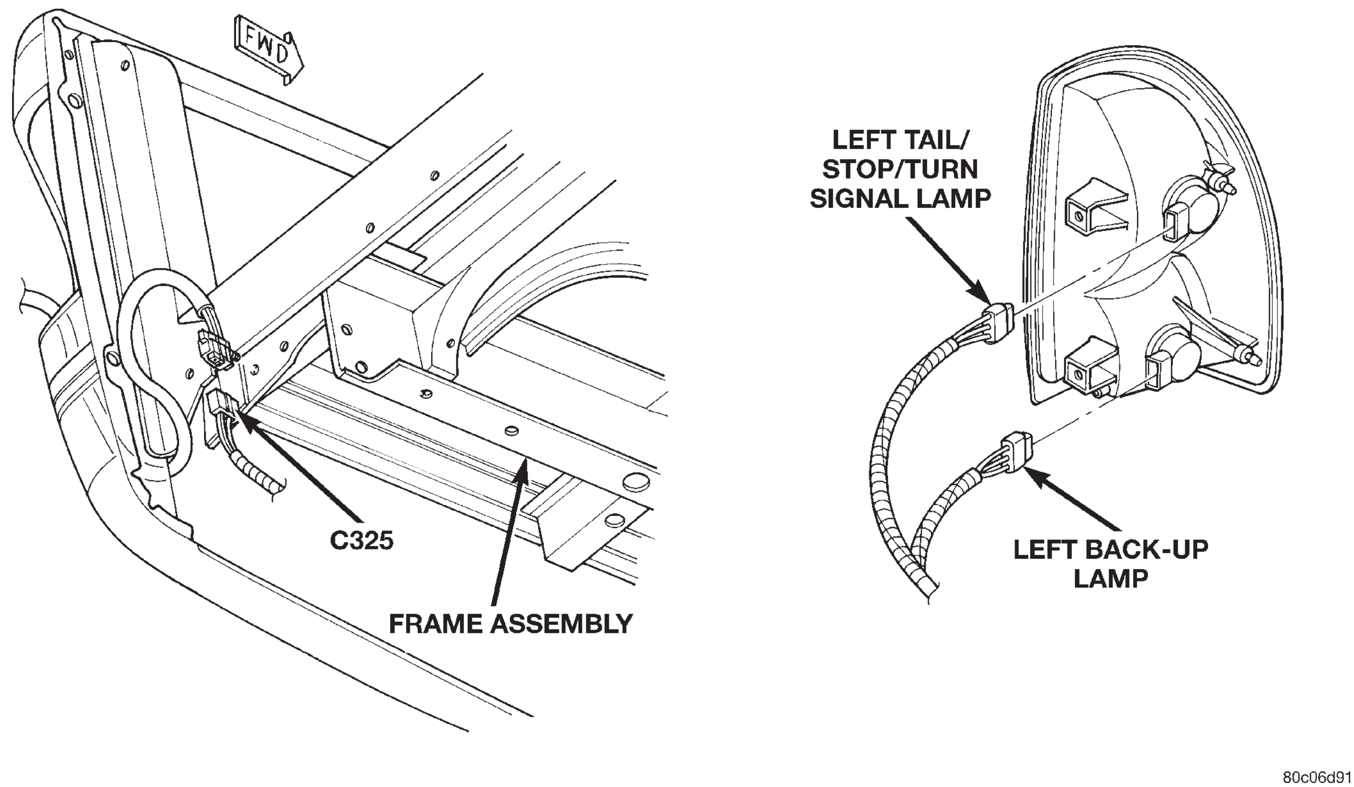


Fig. 42 TAIL LAMPS

8W-95 SPLICE LOCATIONS

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SPLICE LOCATIONS

DESCRIPTION

This section provides illustrations identifying the general location of the splices in this vehicle. A splice index is provided. Use the wiring diagrams in each section for splice number identification. Refer to the index for proper splice number. For splices that are not shown in the figures N/S appears in the Fig. column.

Splice No.	Location	Fig.
S100	Near Power Distribution Center	N/S
S101 (2.5L)	Near T/O for Injector 3	1
S101 (3.9L, 5.9L)	Rear of Engine	N/S
S101 (4.7L)	Near T/O for Injector 7	N/S
S103 (2.5L)	Rear of Engine	1
S103 (3.9L, 4.7L, 5.9L)	Rear of Engine	3, 6
S106 (2.5L)	Rear of Engine	2
S106 (3.9L, 5.9L)	Near Inj #4	4
S107 (2.5L)	Rear of Engine	N/S
S107 (3.9L, 5.2L)	Rear of Engine	N/S
S107 (4.7L)	Right Rear of Engine	N/S
S110	Near Inj #5 T/O	3, 5
S121	Near Mode Door Motor	N/S
S122	Rear of Engine	N/S
S123	Right Rear of Engine	2, 6
S126	In T/O for Controller Anti-Lock Brakes	12
S134	Right Rear of Engine	6
S135	Near Powertrain Control Module	N/S
S136	Rear of Engine	N/S
S139	Rear of Engine	N/S
S141	Near Battery	N/S
S173	Near Powertrain Control Module	N/S
S174	Near Powertrain Control Module	N/S
S175	Near Powertrain Control Module	N/S
S177	Right Rear of Engine	N/S
S178	Near Transmission Control Module	N/S
S179	Right Rear of Engine	6
S181	Near Injector 3 T/O	7
S183	Near Injector 6 T/O	7

SPLICE LOCATIONS (Continued)

Splice No.	Location	Fig.
S184	In Wiring Trough	7
S187	Near Power Distribution Center	N/S
S207	In Steering Wheel Jumper	N/S
S208	In Steering Wheel Jumper	N/S
S240	Between Instrument Cluster T/O's	8
S300	Near T/O for Tweeter	13
S301	Front of Left Door	N/S
S302	Near T/O for CTM	10
S303	Near T/O for CTM	10
S305	Near T/O for CTM	10
S306	Near Fuel Tank T/O	11
S307	Near T/O for CTM	10
S314	Near T/O for Tail Lamps	11
S316	Left Rear Frame Rail	11
S317	Near T/O for Tail Lamps	11
S318	Left Rear Frame Rail	11
S319	Near T/O for CTM	10
S322	Left A Post	9
S323	Left A-Pillar	9
S324	Left A Post	9
S327	Near T/O for Speaker	13
S328	Near T/O for Speaker	N/S
S330	Near T/O for Speaker	13
S331	Near T/O for Speaker	13
S332	Near T/O for Speaker	N/S
S333	Near T/O for Speaker	N/S
S351	Near T/O for Tail Lamps	11
S401	In Tail Lamp Harness	N/S
S404	In Tail Lamp Harness	N/S
S405	Near RT License Lamp	N/S
S406	Near RT License Lamp	N/S

SPLICE LOCATIONS (Continued)

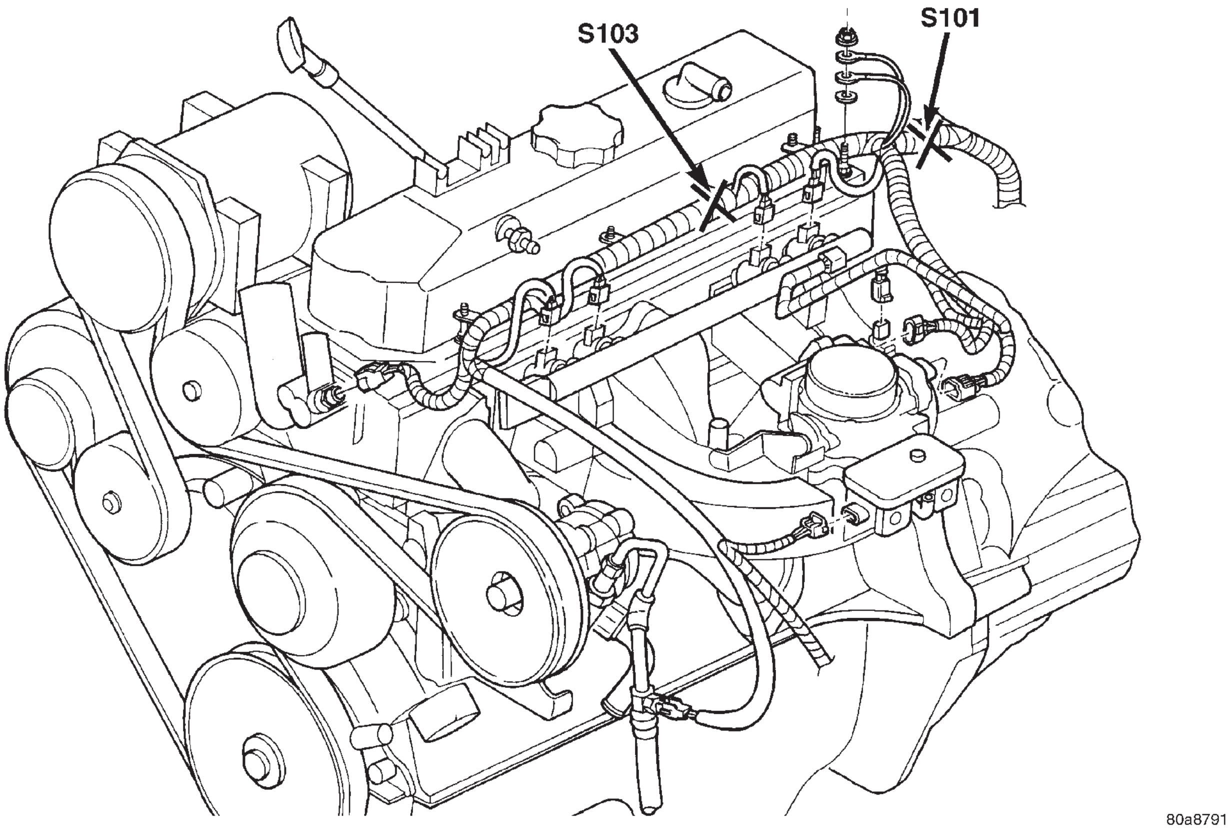

Fig. 1 LEFT SIDE ENGINE HARNESS SPLICES 2.5L

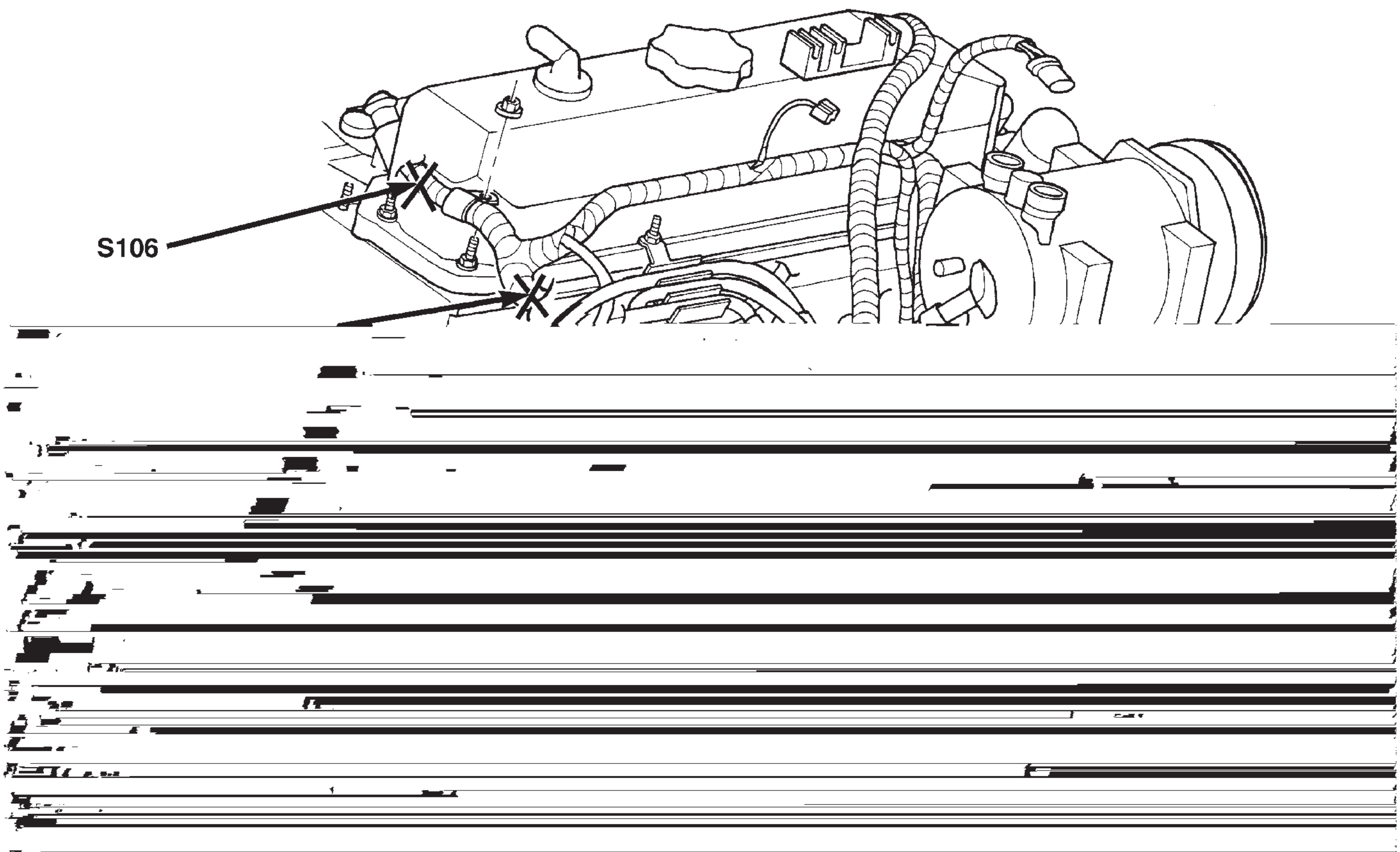

Fig. 2 RIGHT SIDE ENGINE HARNESS SPLICES 2.5L

SPLICE LOCATIONS (Continued)

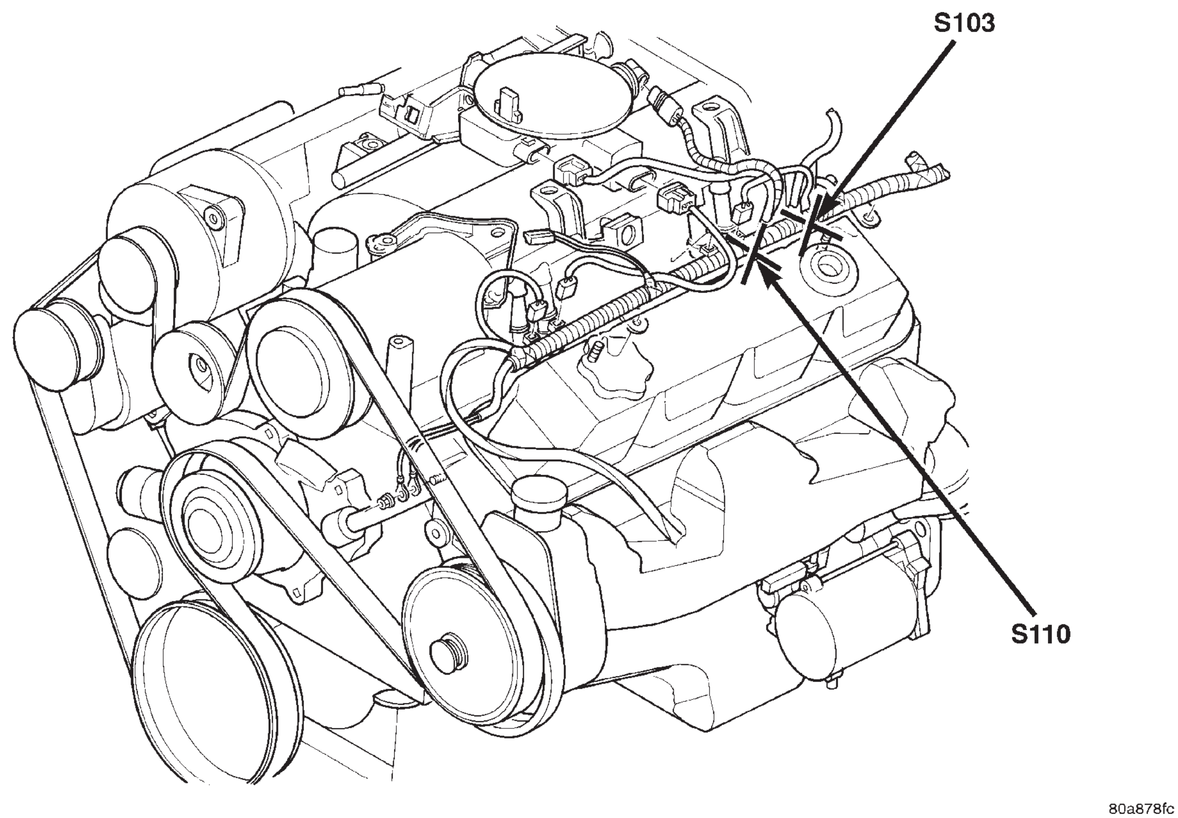

Fig. 3 LEFT SIDE ENGINE HARNESS SPLICES 3.9L

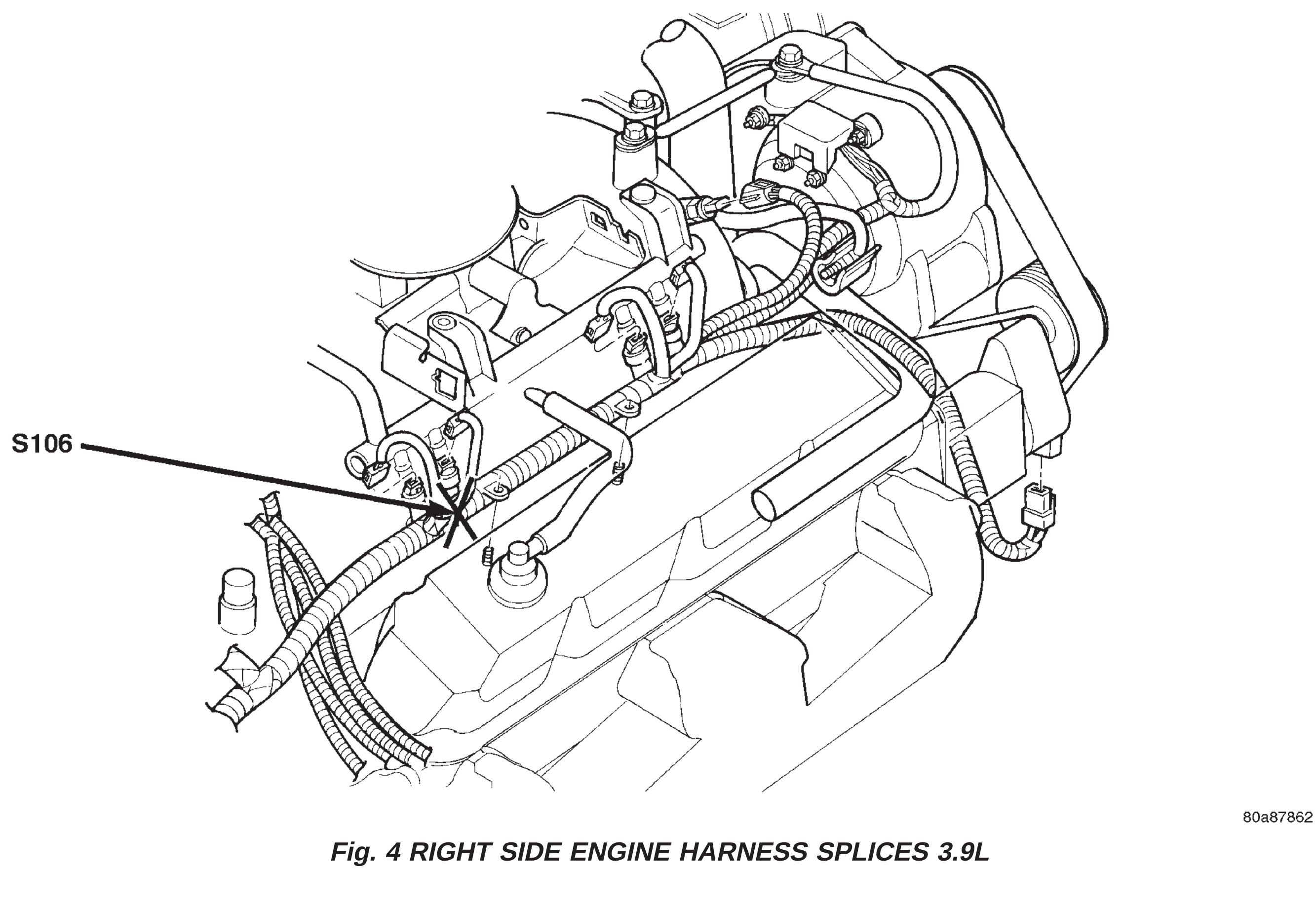

Fig. 4 RIGHT SIDE ENGINE HARNESS SPLICES 3.9L

SPLICE LOCATIONS (Continued)

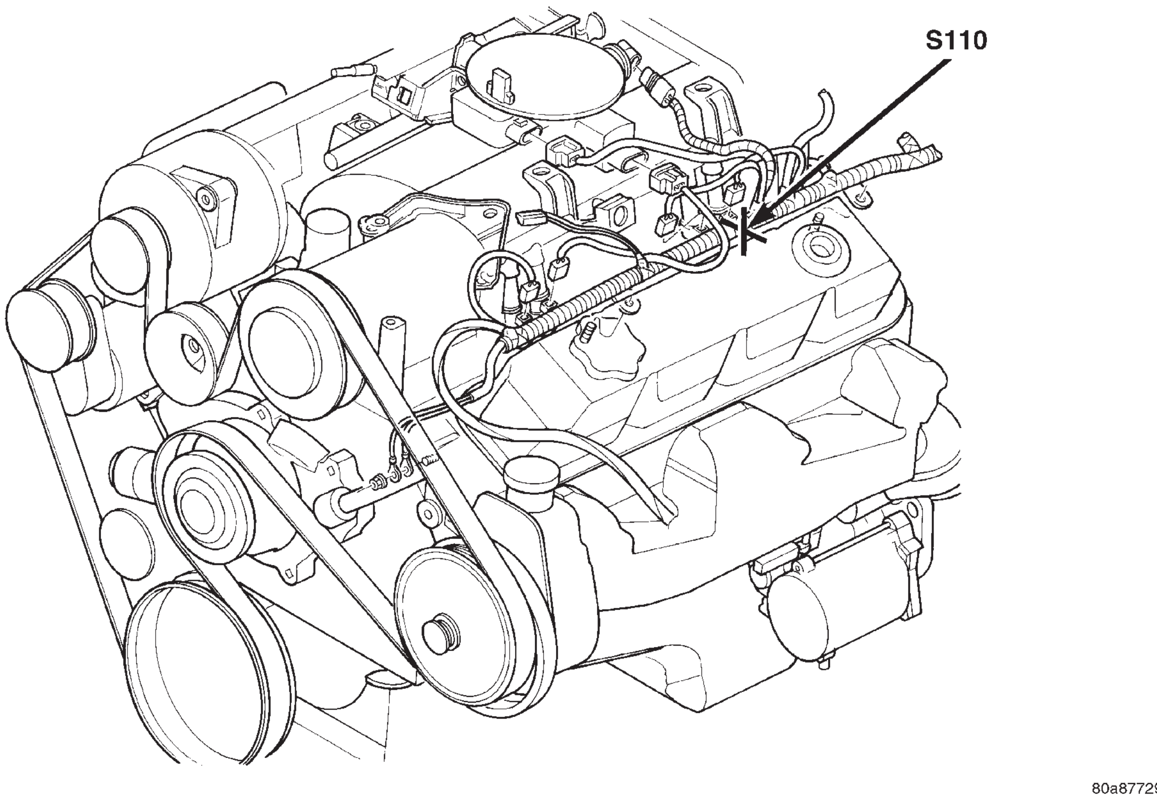

Fig. 5 LEFT SIDE ENGINE HARNESS SPLICES 5.9L

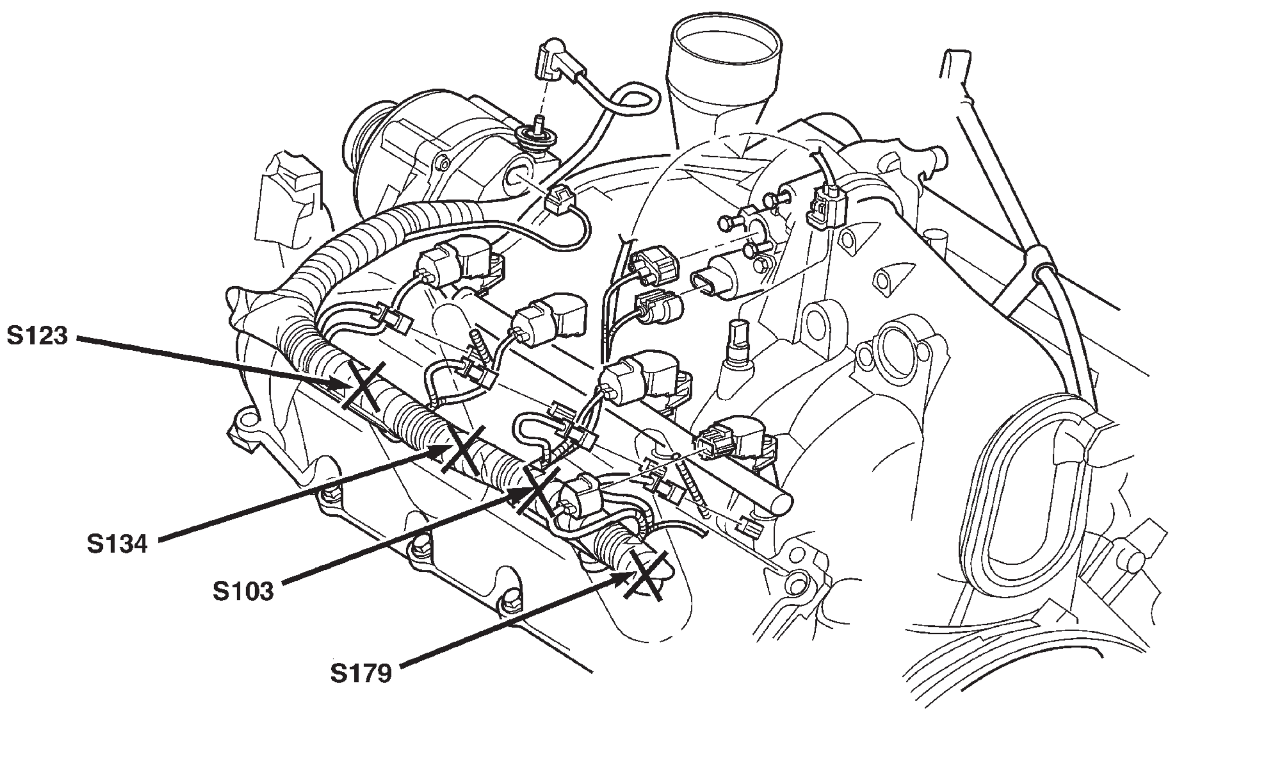

Fig. 6 LEFT SIDE ENGINE HARNESS SPLICES 4.7L

SPLICE LOCATIONS (Continued)

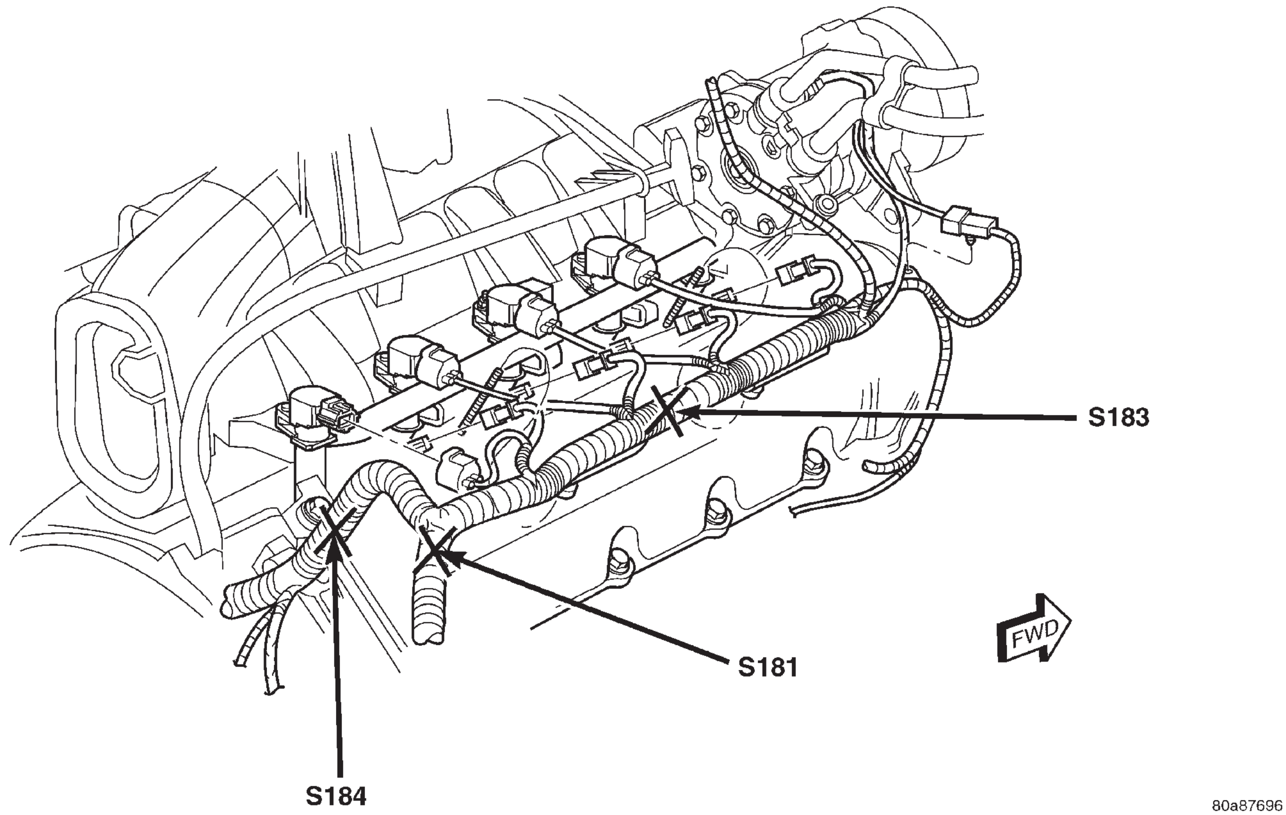

Fig. 7 RIGHT SIDE ENGINE HARNESS SPLICES 4.7L

SPLICE LOCATIONS (Continued)

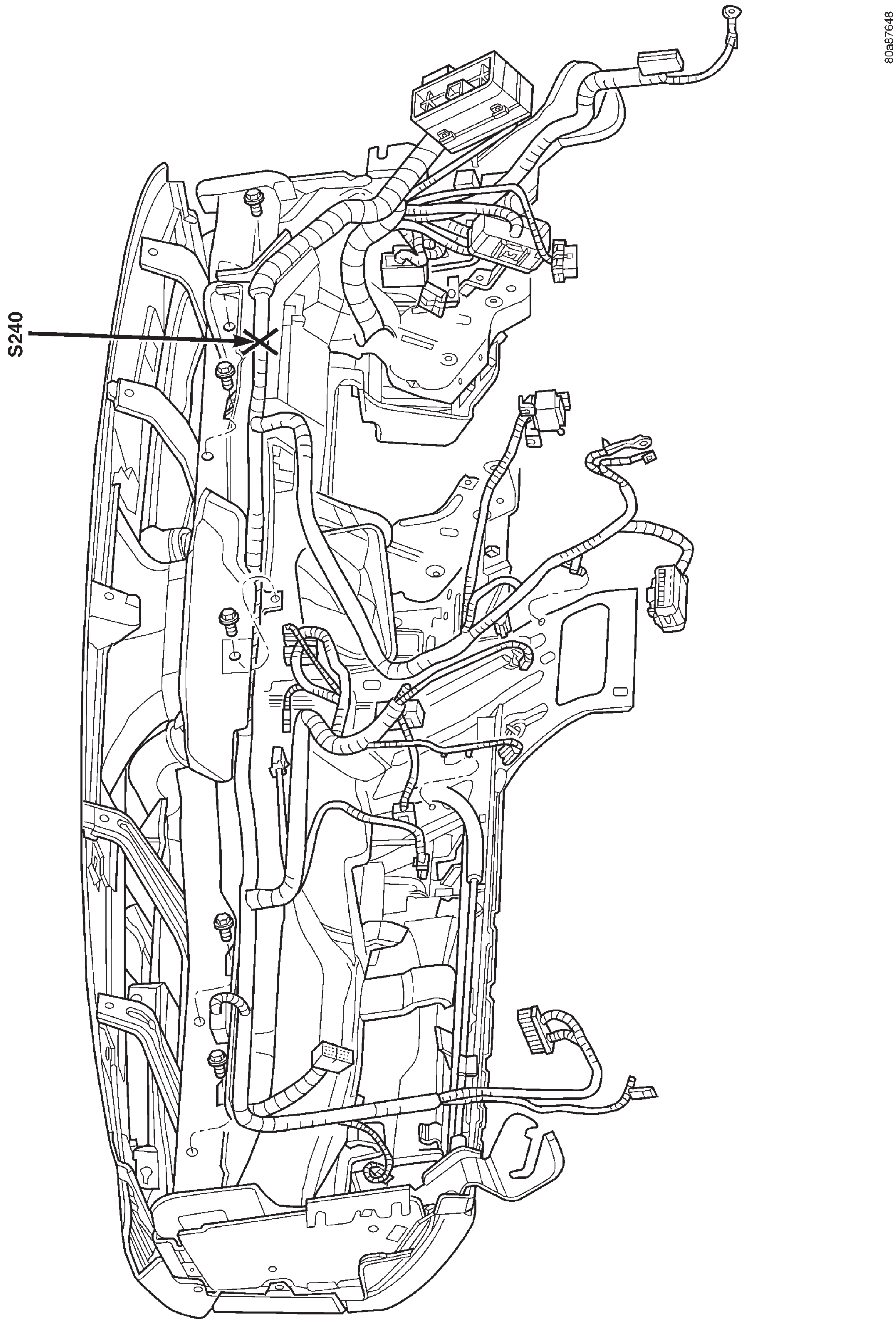

Fig. 8 INSTRUMENT PANEL

SPLICE LOCATIONS (Continued)

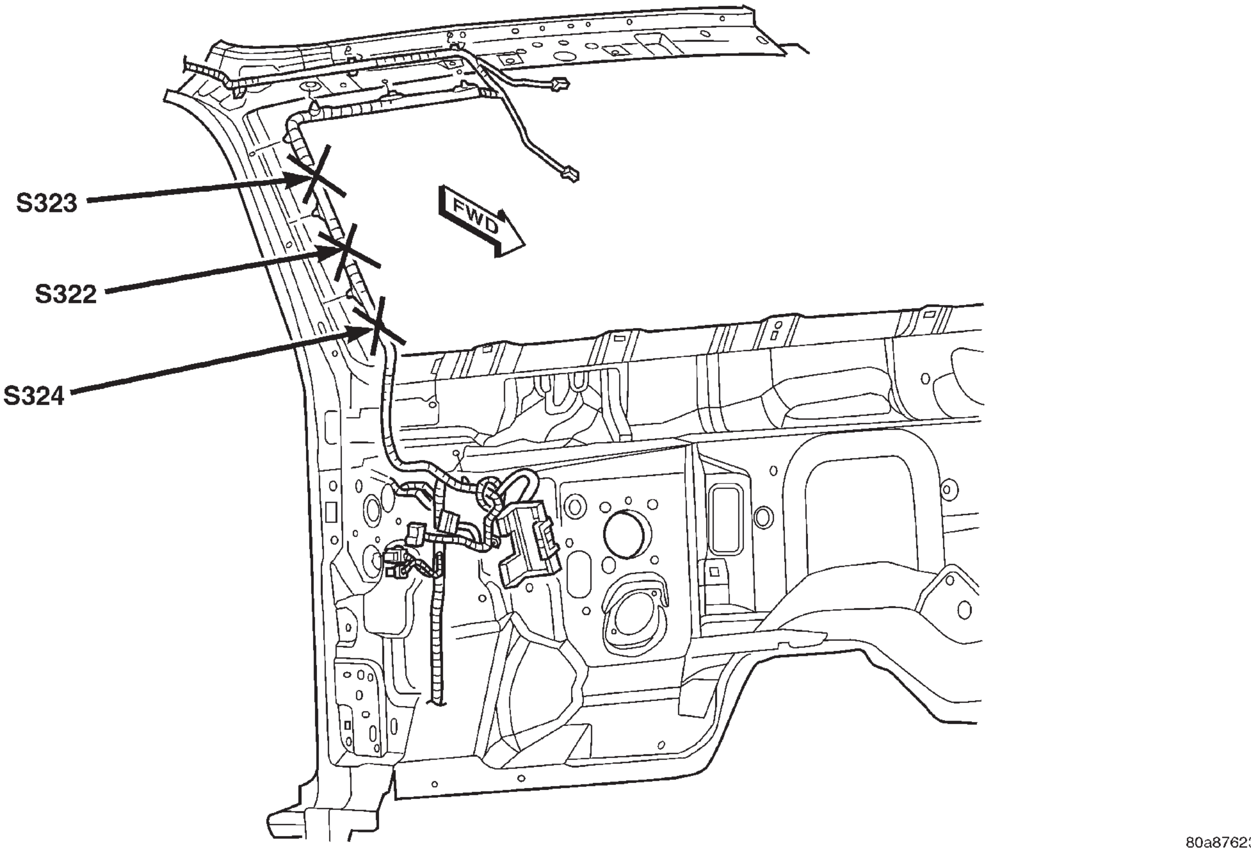

Fig. 9 A-PILLAR SPLICES

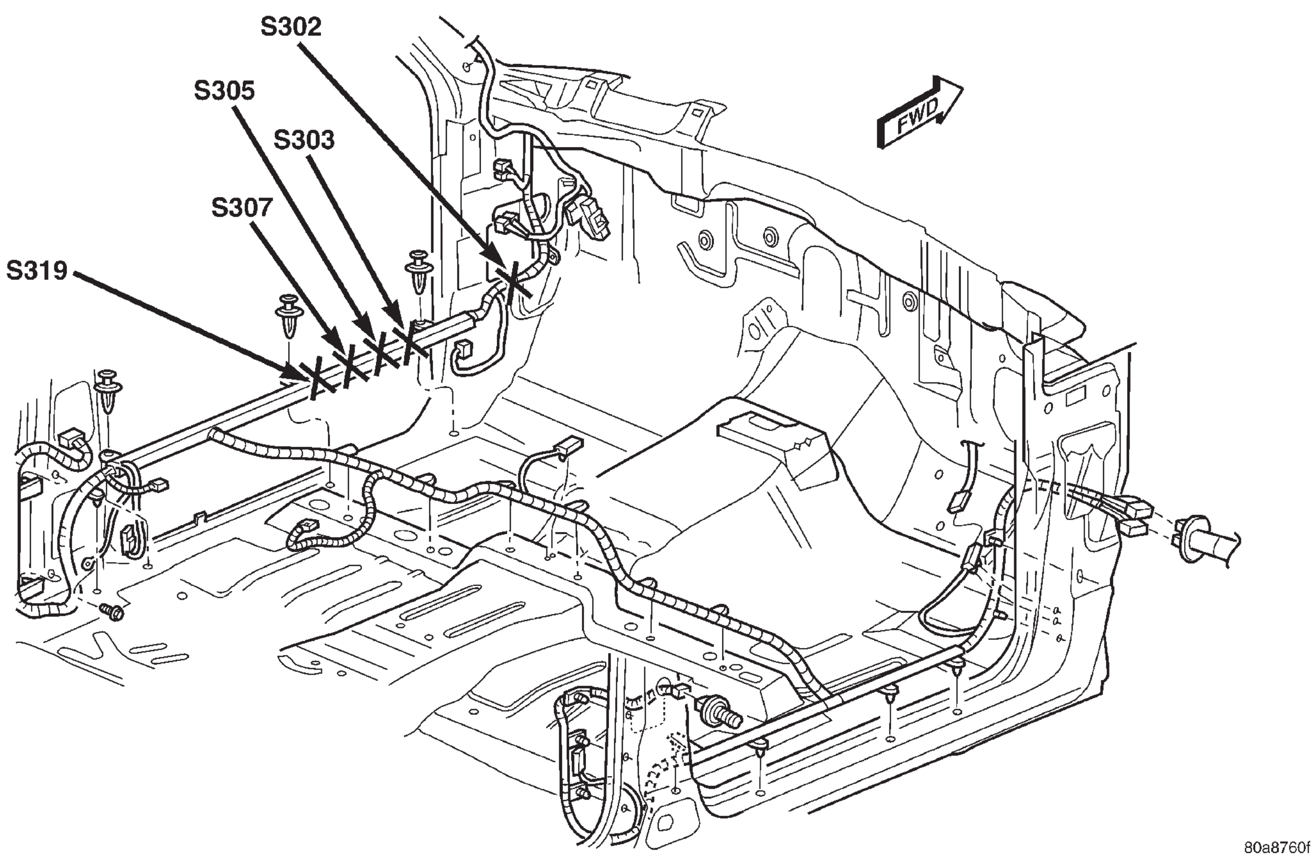

Fig. 10 CAB SPLICES

SPLICE LOCATIONS (Continued)

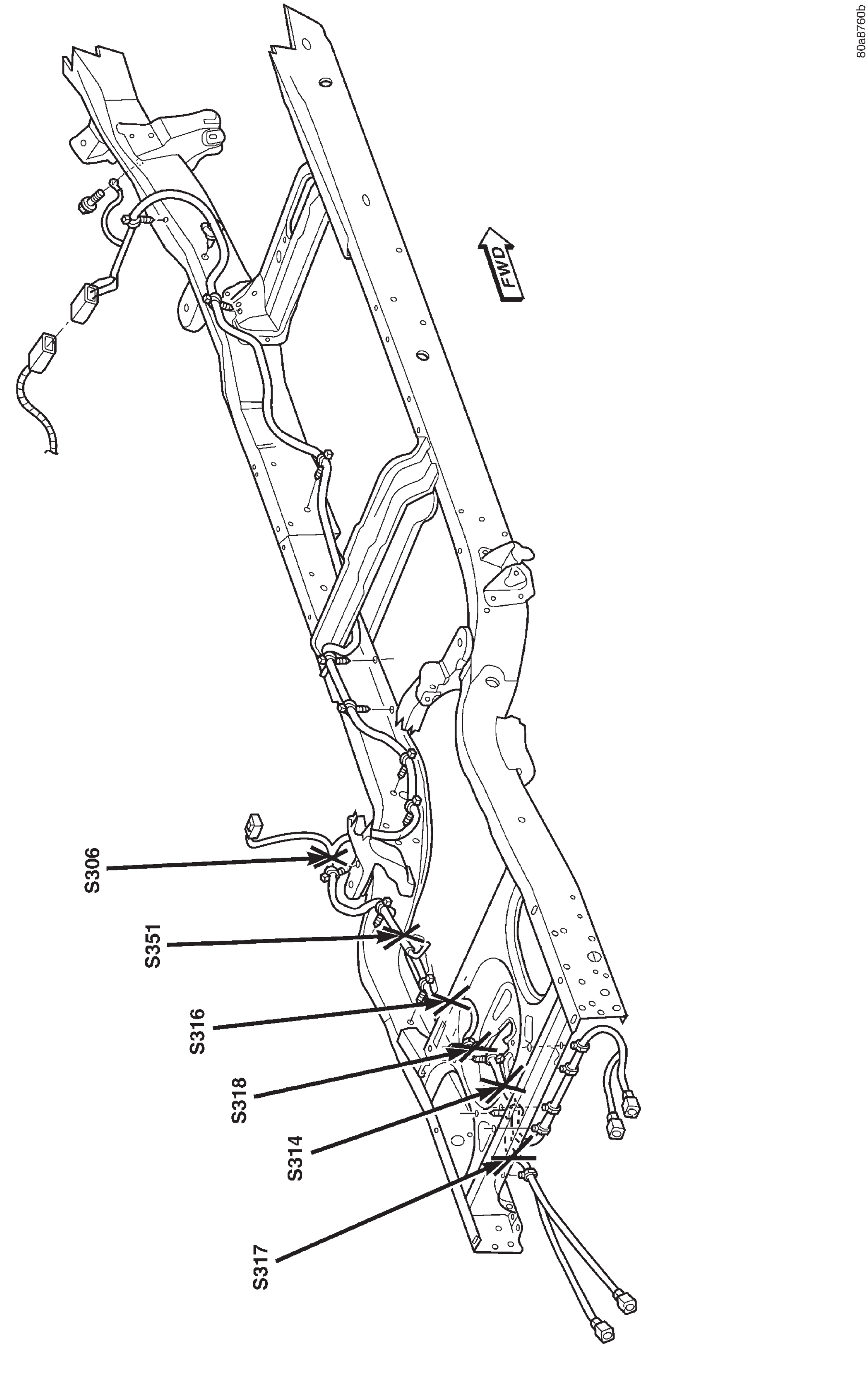

Fig. 11 CHASSIS SPLICES

SPLICE LOCATIONS (Continued)

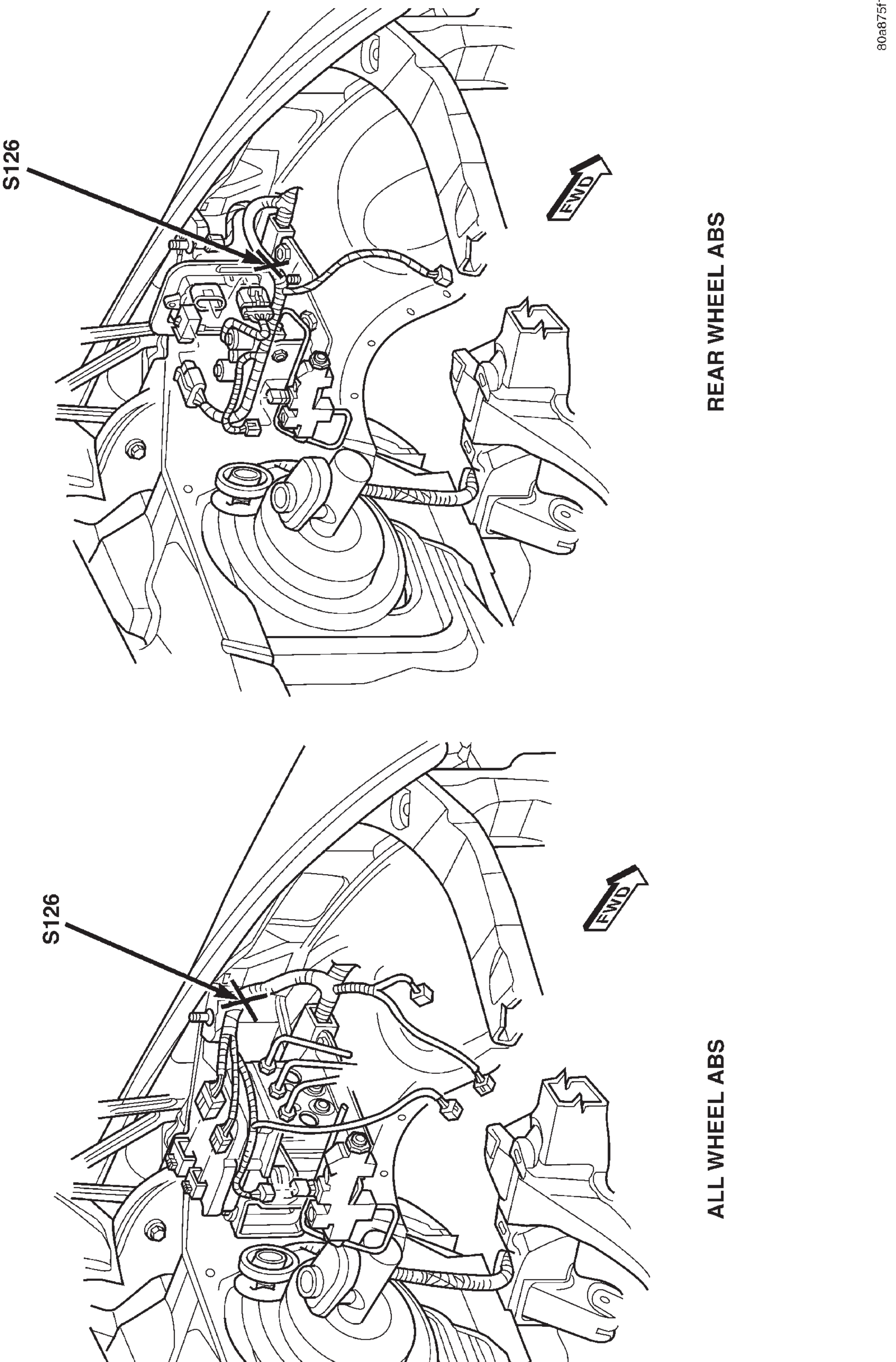

Fig. 12 RIGHT FENDER AREA

SPLICE LOCATIONS (Continued)

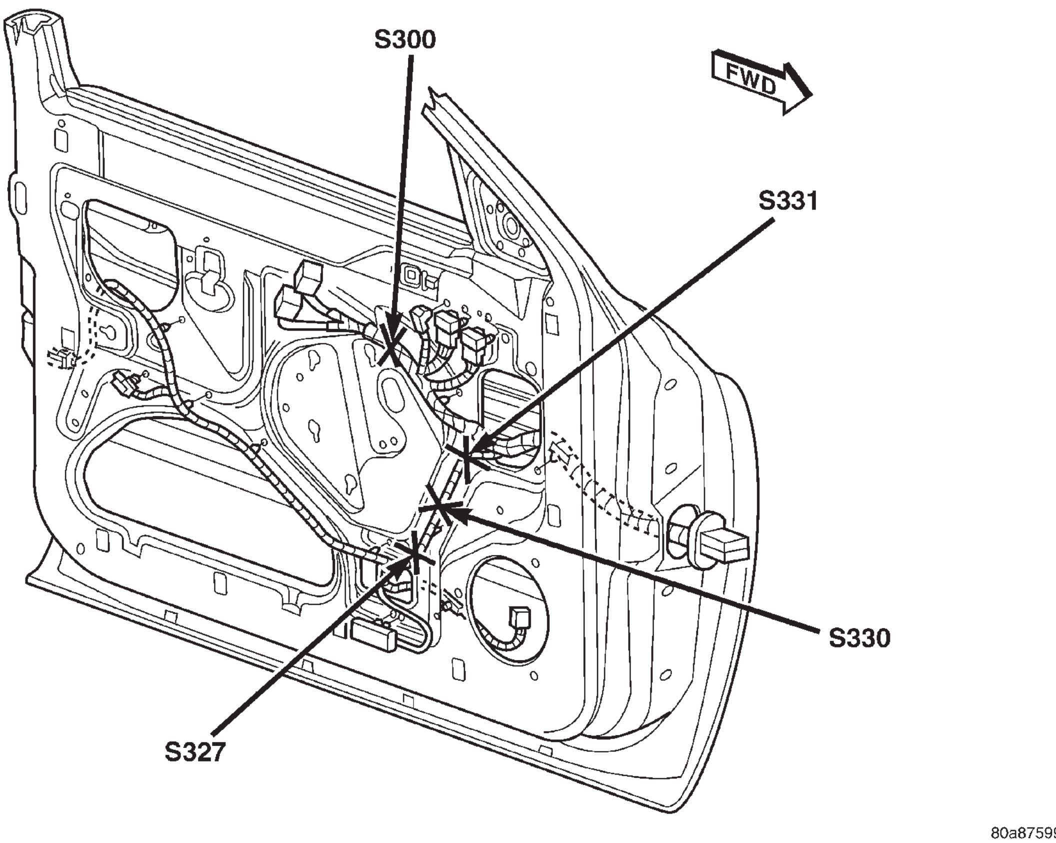

Fig. 13 FRONT DOOR SPLICES

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)
- Junction Block (JB)
- Relay and Fuse Block.

The power distribution system also incorporates various types of circuit control and protection features, including:

- Automatic resetting circuit breakers
- Blade-type fuses
- Cartridge fuses
- Circuit splice blocks
- Flashers
- 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.

CIGAR LIGHTER OUTLET

DESCRIPTION

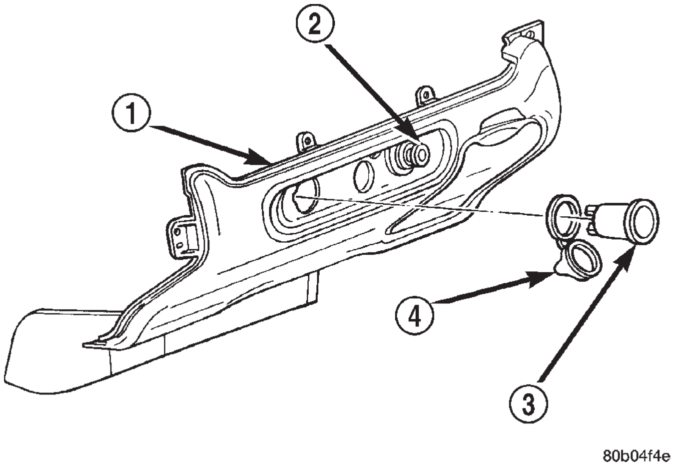

Fig. 1 Cigar Lighter and Power Outlet

1 - INSTRUMENT PANEL LOWER BEZEL
2 - CIGAR LIGHTER KNOB AND ELEMENT
3 - POWER OUTLET BASE AND MOUNT
4 - POWER OUTLET CAP

A cigar lighter is standard equipment on this model. The cigar lighter is installed in the instrument panel lower bezel, which is located near the center of the instrument panel, below the radio (Fig. 1). The cigar lighter base is secured by a snap fit within the instrument panel lower bezel.

The cigar lighter knob and heating element unit, and the cigar lighter receptacle unit are available for service. These components cannot be repaired and, if faulty or damaged, they must be replaced.

OPERATION

The cigar lighter consists of two major components: a knob and heating element unit, and the cigar lighter base or receptacle shell. The receptacle shell is connected to ground, and an insulated contact in the bottom of the shell is connected to battery current. The cigar lighter receives battery voltage from a fuse in the junction block only when the ignition switch is in the Accessory or On positions.

The knob and heating element are encased within a spring-loaded housing, which also features a sliding protective heat shield. When the knob and heating element are inserted in the receptacle shell, the heating element resistor coil is grounded through its housing to the receptacle shell. If the cigar lighter knob is pushed inward, the heat shield slides up toward the knob exposing the heating element, and the heating element extends from the housing toward the insulated contact in the bottom of the receptacle shell.

Two small spring-clip retainers are located on either side of the insulated contact inside the bottom of the receptacle shell. These clips engage and hold the heating element against the insulated contact long enough for the resistor coil to heat up. When the heating element is engaged with the contact, battery current can flow through the resistor coil to ground, causing the resistor coil to heat.

When the resistor coil becomes sufficiently heated, excess heat radiates from the heating element causing the spring-clips to expand. Once the spring-clips expand far enough to release the heating element, the spring-loaded housing forces the knob and heating element to pop back outward to their relaxed position. When the cigar lighter knob and element are pulled out of the receptacle shell, the protective heat shield slides downward on the housing so that the heating element is recessed and shielded around its circumference for safety.

CIGAR LIGHTER

For complete circuit diagrams, refer to **Cigar Lighter** in the Component Index of Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fused ignition switch output (run/accessory) fuse in the junction block. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/accessory) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open fused ignition switch output (run/accessory) circuit to the ignition switch as required.

(3) Turn the ignition switch to the Off position. Remove the cigar lighter knob and element from the cigar lighter receptacle. Check for continuity between the inside circumference of the cigar lighter receptacle and a good ground. There should be continuity. If OK, go to Step 4. If not OK, go to Step 5.

(4) 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. If OK, replace the faulty cigar lighter knob and element. If not OK, go to Step 5.

CIGAR LIGHTER OUTLET (Continued)

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the instrument panel lower bezel. Check for continuity between the ground circuit cavity of the cigar lighter wire harness connector and a good ground. There should be continuity. If OK, go to Step 6. If not OK, repair the open ground circuit to ground as required.

(6) Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/accessory) circuit cavity of the cigar lighter wire harness connector. If OK, replace the faulty cigar lighter receptacle. If not OK, repair the open fused ignition switch output (run/accessory) circuit to the junction block fuse as required.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the lower bezel from the instrument panel. Refer to **Instrument Panel Lower Bezel** in Body for the procedure.

(3) Pull the cigar lighter knob and element out of the cigar lighter receptacle base, or unsnap the protective cap from the power outlet receptacle base (Fig. 2).

(4) Look inside the cigar lighter or power outlet receptacle base and note the position of the rectangular retaining bosses of the mount that secures the receptacle base to the instrument panel lower bezel (Fig. 3).

(5) Insert a pair of external snap ring pliers into the cigar lighter or power outlet receptacle base and engage the tips of the pliers with the retaining bosses of the mount.

(6) Squeeze the pliers to disengage the mount retaining bosses from the receptacle base and, using a gentle rocking motion, pull the pliers and the receptacle base out of the mount.

(7) Remove the cigar lighter or power outlet mount from the instrument panel lower bezel.

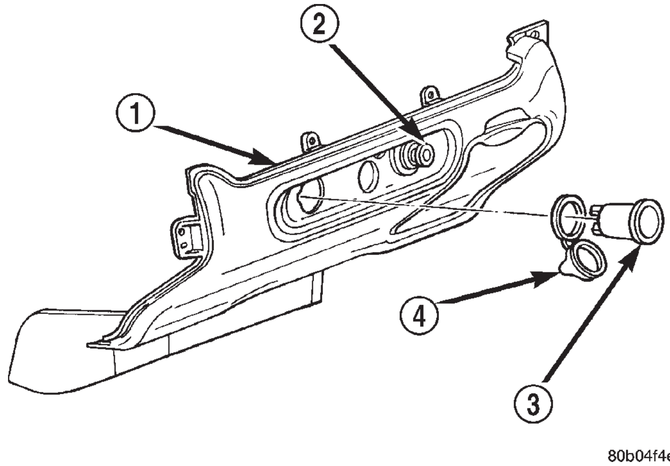

Fig. 2 Cigar Lighter and Power Outlet

1 - INSTRUMENT PANEL LOWER BEZEL
2 - CIGAR LIGHTER KNOB AND ELEMENT
3 - POWER OUTLET BASE AND MOUNT
4 - POWER OUTLET CAP

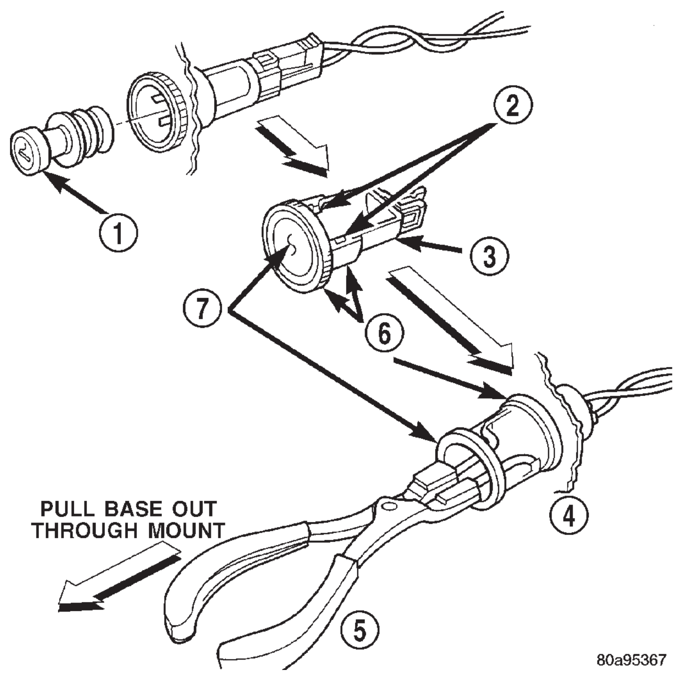

Fig. 3 Cigar Lighter and Power Outlet Remove/ Install - Typical

1 - KNOB AND ELEMENT
2 - RETAINING BOSSES-ENGAGE PLIERS HERE
3 - BASE
4 - PARTIALLY REMOVED
5 - EXTERNAL SNAP-RING PLIERS
6 - MOUNT
7 - BASE

CIGAR LIGHTER OUTLET (Continued)

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Install the cigar lighter or power outlet mount into the instrument panel lower bezel.

(2) Align the splines on the outside of the cigar lighter or power outlet receptacle base connector receptacle with the grooves on the inside of the mount.

(3) Press firmly on the cigar lighter or power outlet receptacle base until the retaining bosses of the mount are fully engaged in their receptacles.

(4) Install the cigar lighter knob and element into the cigar lighter receptacle base, or the protective cap into the power outlet receptacle base.

(5) Install the lower bezel onto the instrument panel. Refer to **Instrument Panel Lower Bezel** in the Removal and Installation section of this group for the procedures.

(6) Reconnect the battery negative cable.

CIRCUIT BREAKER

DESCRIPTION

An automatic resetting circuit breaker in the junction block is used to protect the power seat system circuit. The circuit breaker can protect the system from a short circuit, or from an overload condition caused by an obstructed or stuck seat adjuster.

The circuit breaker cannot be repaired and, if faulty or damaged, it must be replaced.

DESCRIPTION

An automatic resetting circuit breaker in the junction block is used to protect the power window system circuit. The circuit breaker can protect the system from a short circuit, or from an overload condition caused by an obstructed or stuck window glass or regulator.

The circuit breaker cannot be repaired and, if faulty, it must be replaced.

CIRCUIT BREAKER

For circuit descriptions and diagrams, refer to 8W-63 - Power Seat in Group 8W - Wiring Diagrams.

(1) Locate the correct circuit breaker in the junction block. Pull out the circuit breaker slightly, but be certain that the circuit breaker terminals still contact the terminals in the junction block cavities.

(2) Connect the negative lead of a 12-volt DC voltmeter to a good ground.

(3) With the voltmeter positive lead, check both terminals of the circuit breaker for battery voltage.

If only one terminal has battery voltage, the circuit breaker is faulty and must be replaced. If neither terminal has battery voltage, repair the open circuit from the Power Distribution Center (PDC) as required.

CIRCUIT BREAKER

For circuit descriptions and diagrams, refer to 8W-60 - Power Windows in Group 8W - Wiring Diagrams.

(1) Locate the circuit breaker in the junction block. Pull out the circuit breaker slightly, but be certain that the circuit breaker terminals still contact the terminals in the junction block cavities.

(2) Connect the negative lead of a 12-volt DC voltmeter to a good ground.

(3) With the voltmeter positive lead, check both terminals of the circuit breaker for battery voltage.

If only one terminal has battery voltage, the circuit breaker is faulty and must be replaced. If neither terminal has battery voltage, repair the open circuit from the Power Distribution Center (PDC) as required. If the circuit breaker checks OK, but no power windows operate, see Power Window System in the Diagnosis and Testing section of this group.

GENERATOR CARTRIDGE FUSE

DESCRIPTION

A 140 ampere generator cartridge fuse is used on this model. The generator cartridge fuse is similar to other cartridge fuses found in the Power Distribution Center (PDC). This fuse has a color-coded plastic housing and a clear plastic fuse conductor inspection cover like other cartridge fuses, but has a higher current rating and is connected and secured with screws instead of being pushed onto male spade-type terminals. The generator cartridge fuse cannot be repaired and, if faulty or damaged, it must be replaced.

OPERATION

The generator cartridge fuse is secured between the two B(+) terminal stud connection bus bars within the Power Distribution Center (PDC). This fuse protects the vehicle electrical system from damage that could be caused by excessive charging sys-

GENERATOR CARTRIDGE FUSE (Continued)

tem output and/or excessive electrical system current levels resulting from a faulty generator or faulty charging system control circuits. If the current rating of the fuse is exceeded, the fuse conductor melts to open the generator output circuit connection to the PDC. If a generator cartridge fuse fails, be certain to completely inspect and test the vehicle charging system before replacing the fuse and returning the vehicle to service. Refer to **Charging System** in the index of this service manual for the charging system diagnostic procedures. Refer to **Power Distribution** in the index of this service manual for the location of complete PDC circuit diagrams.

REMOVAL

If a generator cartridge fuse fails, be certain to inspect and test the vehicle charging system before replacing the cartridge fuse and returning the vehicle to service. Refer to **Charging System** in the index of this service manual for the charging system diagnostic procedures.

(1) Disconnect and isolate the battery negative cable.

(2) Unlatch and remove the cover from the Power Distribution Center (PDC).

(3) Remove the two screws that secure the generator cartridge fuse to the two B(+) terminal stud bus bars within the PDC.

(4) Remove the generator cartridge fuse from the PDC.

INSTALLATION

If a generator cartridge fuse fails, be certain to inspect and test the vehicle charging system before replacing the cartridge fuse and returning the vehicle to service. Refer to **Charging System** in the index of this service manual for the charging system diagnostic procedures.

(1) Position the generator cartridge fuse onto the two B(+) terminal stud bus bars within the PDC.

(2) Install and tighten the two screws that secure the generator cartridge fuse to the two B(+) terminal stud bus bars within the PDC. Tighten the screws to 3.4 N·m (30 in. lbs.). **Be certain that both screws are tightened to the proper torque value.**

(3) Install and latch the cover onto the PDC.

(4) Reconnect the battery negative cable.

IOD FUSE

DESCRIPTION

All vehicles are equipped with an Ignition-Off Draw (IOD) fuse (Fig. 4) that is disconnected within the Junction Block (JB) when the vehicle is shipped from the factory. Dealer personnel are to reconnect the IOD fuse in the JB as part of the preparation procedures performed just prior to new vehicle delivery.

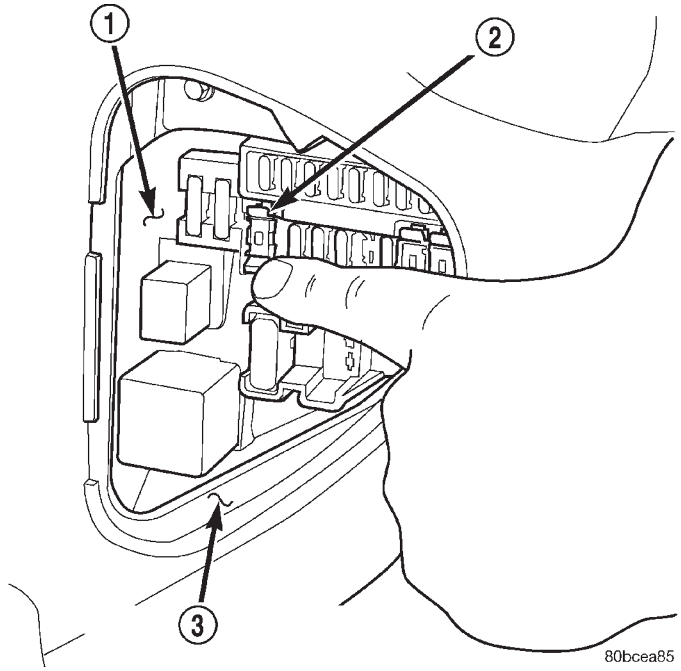

Fig. 4 Ignition-Off Draw Fuse - Typical

1 - JUNCTION BLOCK
2 - IGNITION-OFF DRAW FUSE AND HOLDER
3 - LEFT INSTRUMENT PANEL END BRACKET

The left end of the instrument panel cover has a snap-fit fuse access panel that can be removed to provide service access to the fuses in the JB. A finger recess is molded into the access panel for easy removal. An adhesive-backed fuse layout map is secured to the instrument panel side of the access panel to ensure proper fuse identification. The IOD fuse is a 15 ampere mini blade-type fuse. The fuse is secured within a black molded plastic fuse holder and puller unit that serves both as a tool for disconnecting and reconnecting the fuse in its JB cavity, and as a fuse holder that conveniently stores the fuse in the same JB cavity after it has been disconnected.

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 some 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 disconnected is to reduce the normal IOD of the vehicle electrical system during new vehicle transportation and pre-delivery storage to reduce battery

IOD FUSE (Continued)

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 disconnected from JB fuse cavity 12 when the vehicle is shipped from the assembly plant. Dealer personnel must reconnect 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 disconnecting the IOD fuse will not eliminate IOD, but only reduce this normal condition. If a vehicle will be stored for more than about thirty days, the battery negative cable should be disconnected to eliminate normal IOD; and, the battery should be tested and recharged at regular intervals during the vehicle storage period to prevent the battery from becoming discharged or damaged. Refer to **Battery** in the index of this service manual for the location of additional service information covering the battery.

REMOVAL

The Ignition-Off Draw (IOD) fuse is disconnected from Junction Block (JB) fuse cavity 12 (Fig. 5) when the vehicle is shipped from the assembly plant. Dealer personnel must reconnect the IOD fuse when the vehicle is being prepared for delivery in order to restore full electrical system operation.

NOTE: When removing or installing the IOD fuse, it is important that the ignition switch be in the Off position. Failure to place the ignition switch in the Off position can cause the radio display to become scrambled when the IOD fuse is installed. Removing and installing the IOD fuse again with the ignition switch in the Off position will usually correct the scrambled radio display condition.

REMOVAL

(1) Turn the ignition switch to the Off position.

(2) Remove the fuse access panel by unsnapping it from the left outboard end of the instrument panel.

(3) Grasp the upper and lower tabs of the IOD fuse holder unit in fuse cavity 12 of the JB between the thumb and forefinger and pull the unit firmly outward.

(4) Install the fuse access panel by snapping it onto the left outboard end of the instrument panel.

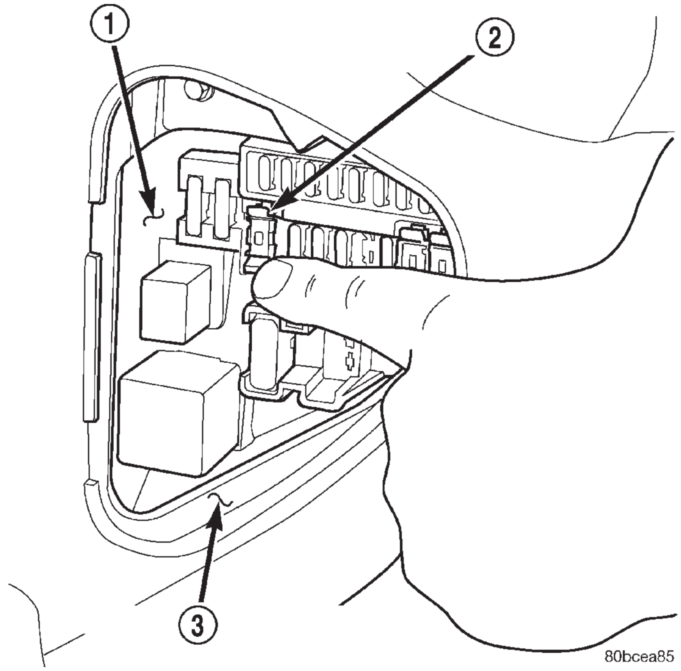

Fig. 5 Ignition-Off Draw Fuse - Typical

1 - JUNCTION BLOCK
2 - IGNITION-OFF DRAW FUSE AND HOLDER
3 - LEFT INSTRUMENT PANEL END BRACKET

INSTALLATION

The Ignition-Off Draw (IOD) fuse is disconnected from Junction Block (JB) fuse cavity 12 (Fig. 5) when the vehicle is shipped from the assembly plant. Dealer personnel must reconnect 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) Remove the fuse access panel by unsnapping it from the left outboard end of the instrument panel.

(3) To install the IOD fuse, use a thumb to press the IOD fuse holder unit in fuse cavity 12 firmly into the JB.

(4) Install the fuse access panel by snapping it onto the left outboard end of the instrument panel.

JUNCTION BLOCK

DESCRIPTION

An electrical Junction Block (JB) is concealed behind the left outboard end of the instrument panel cover (Fig. 6). The JB serves to simplify and centralize numerous electrical components, and to distribute

JUNCTION BLOCK (Continued)

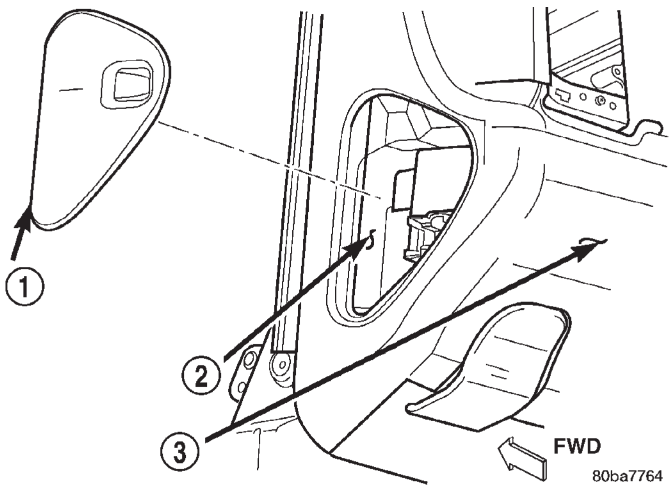

Fig. 6 Junction Block Location

1 - FUSE ACCESS PANEL
2 - JUNCTION BLOCK
3 - INSTRUMENT PANEL

electrical current to many of the accessory systems in the vehicle. It also eliminates the need for numerous splice connections and serves in place of a bulkhead connector between many of the engine compartment, instrument panel, and body wire harnesses. The JB houses up to nineteen blade-type fuses (two standard-type and seventeen mini-type), up to two blade-type automatic resetting circuit breakers, and two International Standards Organization (ISO) relays (one standard-type and one micro-type).

The molded plastic JB housing has integral mounting brackets that are secured with two screws to the left instrument panel end bracket. The left end of the instrument panel cover has a snap-fit fuse access panel that can be removed for service of the JB. A fuse puller and spare fuse holders are located on the back of the fuse access cover, as well as an adhesive-backed fuse layout map to ensure proper fuse identification.

The JB unit cannot be repaired and is only serviced as an assembly. If any internal circuit or the JB housing is faulty or damaged, the entire JB unit must be replaced.

OPERATION

All of the circuits entering and leaving the JB do so through up to nine wire harness connectors, which are connected to the JB through integral connector receptacles molded into the JB housing. Internal connection of all of the JB circuits is accomplished by an intricate combination of hard wiring and bus bars. Refer to **Junction Block** in the index of this service manual for the location of complete JB circuit diagrams.

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 fuse access panel by unsnapping it from the left outboard end of the instrument panel (Fig. 7).

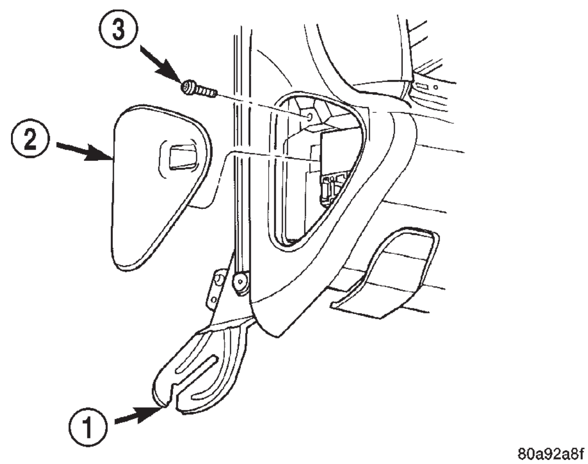

Fig. 7 Fuse Access Panel Remove/Install

1 - INSTRUMENT PANEL
2 - FUSE ACCESS PANEL
3 - SCREW

(3) Reach through the instrument panel fuse access panel opening to access and remove the one screw that secures the Junction Block (JB) to the left instrument panel end bracket.

(4) Remove the steering column opening cover from the instrument panel. Refer to **Steering Column Opening Cover** in the index of this service manual for the location of the steering column opening cover removal procedures.

(5) Reach through the outboard side of the instrument panel steering column opening to access and disconnect all of the wire harness connectors from the JB connector receptacles (Fig. 8).

JUNCTION BLOCK (Continued)

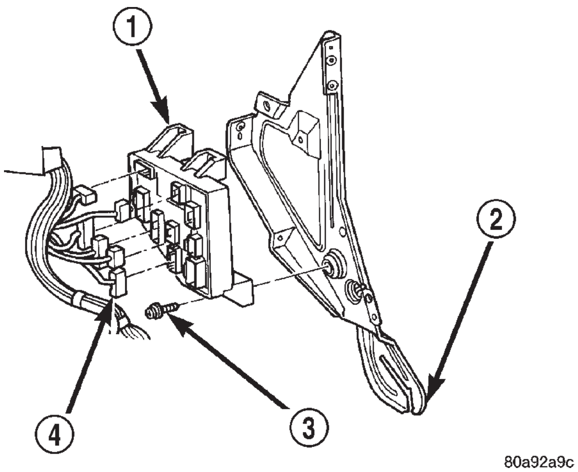

Fig. 8 Junction Block Remove/Install

1 - JUNCTION BLOCK
2 - INSTRUMENT PANEL
3 - SCREW
4 - CONNECTORS

(6) Reach through the outboard side of the instrument panel steering column opening to access and remove the relay and fuse block from the JB. Push the relay and fuse block towards the left end of the instrument panel to disengage its mounting slots from the tabs on the JB.

(7) Reach through the outboard side of the instrument panel steering column opening to access and remove the one screw that secures the JB to the left instrument panel end bracket.

(8) Reach through the outboard side of the instrument panel steering column opening to remove the JB from the left instrument panel end bracket.

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.

NOTE: If the Junction Block (JB) is being replaced with a new unit, be certain to transfer each of the fuses, circuit breakers and relays from the faulty JB to the proper cavities of the replacement JB. Refer to Junction Block in the index of this service manual for the location of complete circuit diagrams and cavity assignments for the JB.

(1) Reach through the outboard side of the instrument panel steering column opening to position the JB onto the left instrument panel end bracket.

(2) Reach through the outboard side of the instrument panel steering column opening to install and tighten the one screw that secures the JB to the left instrument panel end bracket. Tighten the screw to 2.2 N·m (20 in. lbs.).

(3) Reach through the outboard side of the instrument panel steering column opening to access and install the relay and fuse block onto the JB by engaging the relay and fuse block mounting slots with the tabs on the JB.

(4) Reach through the outboard side of the instrument panel steering column opening to access and reconnect all of the wire harness connectors to the JB connector receptacles.

(5) Install the steering column opening cover onto the instrument panel. Refer to **Steering Column Opening Cover** in the index of this service manual for the location of the steering column opening cover installation procedures.

(6) Reach through the instrument panel fuse access panel opening to install and tighten the one screw that secures the junction block to the left instrument panel end bracket. Tighten the screw to 2.2 N·m (20 in. lbs.).

(7) Install the fuse access panel by snapping it onto the left outboard end of the instrument panel.

(8) Reconnect the battery negative cable.

POWER DISTRIBUTION CENTER

DESCRIPTION

All of the electrical current distributed throughout this vehicle is directed through the standard equipment Power Distribution Center (PDC) (Fig. 9). The molded plastic PDC housing is located in the left front corner of the engine compartment, just behind the battery. The PDC houses the generator cartridge fuse and up to ten maxi-type cartridge fuses, which replace all in-line fusible links. The PDC also houses up to seven blade-type mini fuses, up to thirteen International Standards Organization (ISO) relays (one standard-type and twelve micro-type), two joint connectors (one sixteen-way and one twenty-six-way) and a sixteen-way engine wire harness in-line connector.

POWER DISTRIBUTION CENTER (Continued)

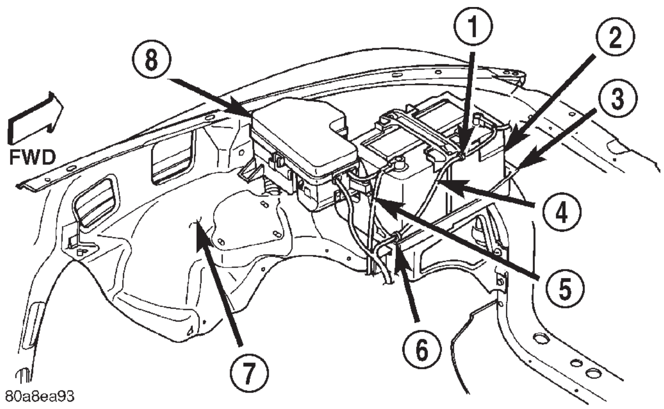

Fig. 9 Power Distribution Center Location - Typical

1 - CLIP
2 - BATTERY
3 - TRAY
4 - NEGATIVE CABLE
5 - POSITIVE CABLE
6 - CLIP
7 - FENDER INNER SHIELD
8 - POWER DISTRIBUTION CENTER

The PDC housing is secured in the engine compartment at three points. Integral mounts on the front and inboard sides of the PDC housing engage and latch to stanchions that are integral to the molded plastic battery tray. An integral bracket on the rear of the PDC housing is secured with a screw to the top of the left front inner wheel house. The PDC housing has a molded plastic cover that includes two integral latches, one on each side. The PDC cover is easily opened and 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 unit cannot be repaired and is only serviced as a unit with the headlamp and dash wire harness. If the internal circuits or the PDC housing are faulty or damaged, the headlamp and dash wire harness unit must be replaced.

OPERATION

All of the current from the battery and the generator output enters the PDC through one cable with eyelets that are secured with a nut to the one B(+) terminal stud located just inside the inboard side of the PDC housing. The PDC cover is unlatched and removed to access the battery and generator output connection B(+) terminal studs, the fuses, the relays, the joint connectors and the engine wire harness in-line connector. Internal connection of all of the PDC circuits is accomplished by an intricate combination of hard wiring and bus bars. Refer to **Power Distribution** in the index of this service manual for the location of complete PDC circuit diagrams.

REMOVAL

The Power Distribution Center (PDC) is serviced as a unit with the headlamp and dash wire harness. If any internal circuit of the PDC or the PDC housing is faulty or damaged, the entire PDC and headlamp and dash wire harness unit must be replaced.

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect each of the headlamp and dash wire harness connectors. Refer to **Connector Locations** in the Wiring Section of this service manual for the location of more information on the headlamp and dash wire harness connector locations.

(3) Remove all of the fasteners that secure each of the headlamp and dash wire harness ground eyelets to the vehicle body and chassis components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the ground eyelet locations.

(4) Disengage each of the retainers that secure the headlamp and 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 headlamp and dash wire harness retainer locations.

(5) Unlatch and remove the cover from the PDC.

(6) Disconnect the engine wire harness in-line connector from the PDC connector receptacle.

(7) Slide the engine wire harness retainer clip upward and disengage the harness from the trough on the rear of the PDC housing.

(8) Remove the nut that secures the eyelet of the battery negative cable generator output take out to the rearward B(+) terminal stud in the PDC and remove the eyelet from the stud.

(9) Remove the nut that secures the eyelet of the battery positive cable PDC take out to the B(+) terminal stud in the PDC and remove the eyelet from the stud.

(10) Remove the screw that secures the PDC housing to the left front fender wheel housing.

(11) Disengage the latches for the two PDC mounts and lift the unit off of the battery tray stanchions.

(12) Remove the PDC and the headlamp and dash wire harness from the engine compartment as a unit.

INSTALLATION

The Power Distribution Center (PDC) is serviced as a unit with the headlamp and dash wire harness. If any internal circuit of the PDC or the PDC housing is faulty or damaged, the entire PDC and headlamp and dash wire harness unit must be replaced.

POWER DISTRIBUTION CENTER (Continued)

NOTE: If the PDC is being replaced with a new unit, be certain to transfer each of the blade-type fuses, cartridge fuses and relays from the faulty PDC to the proper cavities of the replacement PDC. Refer to Power Distribution in the index of this service manual for the location of complete PDC circuit diagrams and cavity assignments.

(1) Position the PDC and the headlamp and dash wire harness unit in the engine compartment.

(2) Install the two PDC mounts onto the two stanchions of the battery tray.

(3) Install and tighten the screw that secures the PDC housing to the left front fender wheel housing. Tighten the screw to 7.9 N·m (70 in. lbs.).

(4) Install the eyelet of the battery positive cable PDC take out onto the forward B(+) terminal stud in the PDC.

(5) Install and tighten the nut that secures the eyelet of the battery positive cable PDC take out to the forward B(+) terminal stud in the PDC. Tighten the nut to 9 N·m (80 in. lbs.).

(6) Install the eyelet of the battery negative cable generator output take out onto the rearward B(+) terminal stud in the PDC.

(7) Install and tighten the nut that secures the eyelet of the battery negative cable generator output take out to the rearward B(+) terminal stud in the PDC. Tighten the nut to 9 N·m (80 in. lbs.).

(8) Engage the engine wire harness in the trough on the back of the PDC housing and secure it with the retainer clip.

(9) Reconnect the engine wire harness in-line connector to the PDC in-line connector receptacle.

(10) Install and latch the cover onto the PDC.

(11) Engage each of the retainers that secure the headlamp and dash wire harness to the vehicle body and chassis components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the headlamp and dash wire harness retainer locations.

(12) Install all of the fasteners that secure each of the headlamp and dash wire harness ground eyelets to the vehicle body and chassis components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the ground eyelet locations.

(13) Reconnect each of the headlamp and dash wire harness connectors. Refer to **Connector Locations** in the index of this service manual for the location of more information on the headlamp and dash wire harness connector locations.

(14) Reconnect the battery negative cable.

POWER OUTLET

DESCRIPTION

An accessory power outlet is optional equipment on this model. The power outlet is installed in the instrument panel lower bezel, which is located near the center of the instrument panel, below the radio. The power outlet base is secured by a snap fit within the instrument panel lower bezel. A plastic protective cap snaps into the power outlet base when the power outlet is not being used, and hangs from the power outlet base mount by an integral bail strap while the power outlet is in use.

The power outlet receptacle unit and the accessory power outlet protective cap are available for service. The power outlet receptacle cannot be repaired and, if faulty or damaged, it must be replaced.

OPERATION

The power outlet base or receptacle shell is connected to ground, and an insulated contact in the bottom of the shell is connected to battery current. The power outlet receives battery voltage from a fuse in the Power Distribution Center (PDC) at all times.

While the power outlet is very similar to a cigar lighter base unit, it does not include the two small spring-clip retainers inside the bottom of the receptacle shell that are used to secure the cigar lighter heating element to the insulated contact.

POWER OUTLET

For complete circuit diagrams, refer to **Power Outlet** in the Component Index of Group 8W - Wiring Diagrams.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fused B(+) fuse in the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuse in the PDC. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit to the battery as required.

(3) Remove the plastic protective cap from the power outlet receptacle. Check for continuity between the inside circumference of the power outlet recepta-

POWER OUTLET (Continued)

cle and a good ground. There should be continuity. If OK, go to Step 4. If not OK, go to Step 5.

(4) Check for battery voltage at the insulated contact located at the back of the power outlet receptacle. If not OK, go to Step 5.

(5) Disconnect and isolate the battery negative cable. Remove the instrument panel lower bezel. Check for continuity between the ground circuit cavity of the power outlet wire harness connector and a good ground. There should be continuity. If OK, go to Step 6. If not OK, repair the open ground circuit to ground as required.

(6) Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the power outlet wire harness connector. If OK, replace the faulty power outlet receptacle. If not OK, repair the open fused B(+) circuit to the PDC fuse as required.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the lower bezel from the instrument panel. Refer to **Instrument Panel Lower Bezel** in Body for the procedure.

(3) Pull the cigar lighter knob and element out of the cigar lighter receptacle base, or unsnap the protective cap from the power outlet receptacle base (Fig. 10).

(4) Look inside the cigar lighter or power outlet receptacle base and note the position of the rectangular retaining bosses of the mount that secures the receptacle base to the instrument panel lower bezel (Fig. 11).

(5) Insert a pair of external snap ring pliers into the cigar lighter or power outlet receptacle base and engage the tips of the pliers with the retaining bosses of the mount.

(6) Squeeze the pliers to disengage the mount retaining bosses from the receptacle base and, using a gentle rocking motion, pull the pliers and the receptacle base out of the mount.

(7) Remove the cigar lighter or power outlet mount from the instrument panel lower bezel.

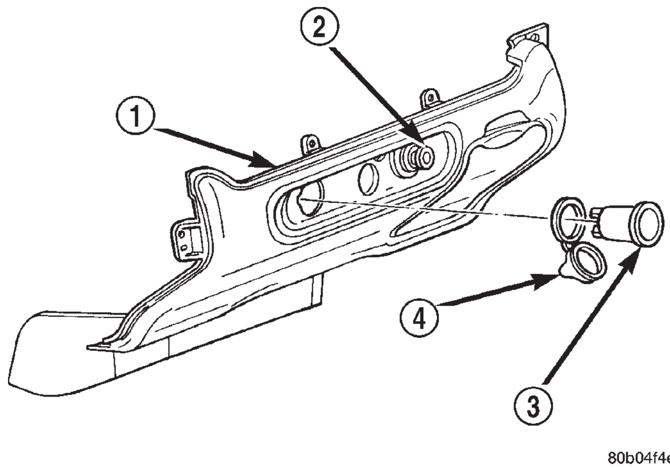

Fig. 10 Cigar Lighter and Power Outlet

1 - INSTRUMENT PANEL LOWER BEZEL
2 - CIGAR LIGHTER KNOB AND ELEMENT
3 - POWER OUTLET BASE AND MOUNT
4 - POWER OUTLET CAP

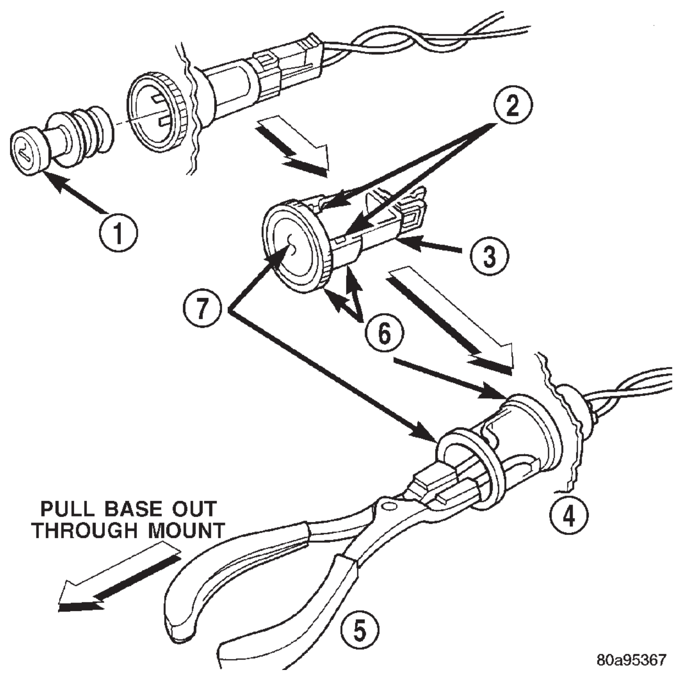

Fig. 11 Cigar Lighter and Power Outlet Remove/ Install - Typical

1 - KNOB AND ELEMENT
2 - RETAINING BOSSES-ENGAGE PLIERS HERE
3 - BASE
4 - PARTIALLY REMOVED
5 - EXTERNAL SNAP-RING PLIERS
6 - MOUNT
7 - BASE

POWER OUTLET (Continued)

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Install the cigar lighter or power outlet mount into the instrument panel lower bezel.

(2) Align the splines on the outside of the cigar lighter or power outlet receptacle base connector receptacle with the grooves on the inside of the mount.

(3) Press firmly on the cigar lighter or power outlet receptacle base until the retaining bosses of the mount are fully engaged in their receptacles.

(4) Install the cigar lighter knob and element into the cigar lighter receptacle base, or the protective cap into the power outlet receptacle base.

(5) Install the lower bezel onto the instrument panel. Refer to **Instrument Panel Lower Bezel** in the Removal and Installation section of this group for the procedures.

(6) Reconnect the battery negative cable.

RELAY CENTER

DESCRIPTION

The relay and fuse block is snap fit onto mounting tabs located on the end of the Junction Block (JB) nearest to the dash panel, under the left outboard end of the instrument panel (Fig. 12). The relay and fuse block provides additional capacity for distribution and control of electrical current for some of the accessory systems that are unique to this vehicle, and which could not be accommodated by the JB or the Power Distribution Center (PDC). The relay and fuse block has cavities for up to four additional blade-type mini fuses, the electronic combination flasher, and three additional International Standards Organization relays (one standard-type and two micro-type).

The relay and fuse block components are accessed for service by removing the steering column opening cover from the instrument panel. The relay and fuse block is then disengaged from the JB mounting tabs and pulled out from under the instrument panel. Service replacement of the relay and fuse block unit requires instrument panel assembly removal.

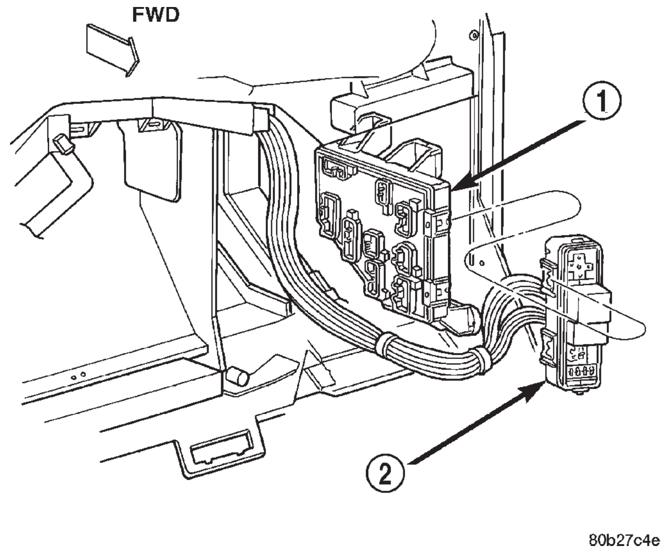

Fig. 12 Relay and Fuse Block Location

1 - JUNCTION BLOCK
2 - RELAY AND FUSE BLOCK

The relay and fuse block unit cannot be repaired and is only serviced as a unit with the instrument panel wire harness assembly. If the relay and fuse block housing or its internal circuits are faulty or damaged, the entire instrument panel wire harness unit must be replaced.

OPERATION

The relay and fuse block is integral to the instrument panel wire harness, and all circuits entering or leaving this module do so through the instrument panel wire harness. Internal connection of all of the relay and fuse block circuits is accomplished by hard wiring. Refer to **Fuse/Fuse Block** in the index of this service manual for the location of complete circuit diagrams and cavity assignments for the relay and fuse block.

REMOVAL

The relay and fuse block is serviced as a unit with the instrument panel wire harness. If any internal circuit of the relay and fuse block or the relay and fuse block housing is faulty or damaged, the entire instrument panel wire harness unit must be replaced.

RELAY CENTER (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 instrument panel assembly from the dash panel. Refer to **Instrument Panel Assembly** in the index of this service manual for the instrument panel assembly removal procedures.

(3) Disconnect each of the instrument panel wire harness connectors. Refer to **Connector Locations** in the index of this service manual for the location of more information on the instrument panel wire harness connector locations.

(4) Remove all of the fasteners that secure each of the instrument panel wire harness ground eyelets to the instrument panel components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the ground eyelet locations.

(5) Disengage each of the retainers that secure the instrument panel wire harness to the instrument panel components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the instrument panel wire harness retainer locations.

(6) Push the relay and fuse block towards the left end of the instrument panel to disengage its mounting slots from the tabs on the Junction Block (JB) (Fig. 13) .

(7) Remove the relay and fuse block and the instrument panel wire harness from the instrument panel as a unit.

INSTALLATION

The relay and fuse block is serviced as a unit with the instrument panel wire harness. If any internal circuit of the relay and fuse block or the relay and fuse block housing is faulty or damaged, the entire instrument panel wire harness unit must be replaced.

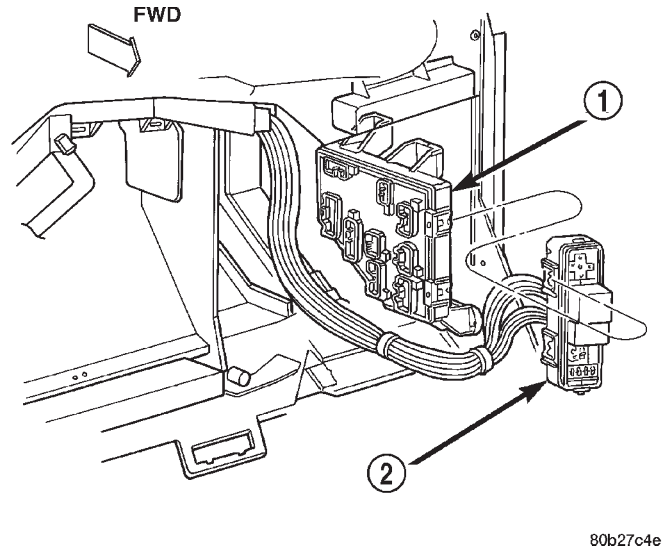

Fig. 13 Relay and Fuse Block Remove/Install

1 - JUNCTION BLOCK
2 - RELAY AND FUSE BLOCK

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: If the relay and fuse block is being replaced with a new unit, be certain to transfer each of the fuses, the flasher and the relays from the faulty relay and fuse block to the proper cavities of the replacement relay and fuse block. Refer to Fuse/Fuse Block in the index of this service manual for the location of complete relay and fuse block circuit diagrams and cavity assignments.

(1) Position the relay and fuse block and the instrument panel wire harness onto the instrument panel.

(2) Install the relay and fuse block by engaging its mounting slots onto the tabs on the Junction Block (JB).

(3) Engage each of the retainers that secure the instrument panel wire harness to the instrument panel components. Refer to **Connector Locations** in the index of this service manual for the location of

RELAY CENTER (Continued)

more information on the instrument panel wire harness retainer locations.

(4) Install all of the fasteners that secure each of the instrument panel wire harness ground eyelets to the instrument panel components. Refer to **Connector Locations** in the index of this service manual for the location of more information on the ground eyelet locations.

(5) Reconnect each of the instrument panel wire harness connectors. Refer to **Connector Locations** in the index of this service manual for the location of more information on the instrument panel wire harness connector locations.

(6) Install the instrument panel assembly onto the dash panel. Refer to **Instrument Panel Assembly** in the index of this service manual for the location of the instrument panel assembly installation procedures.

(7) Reconnect the battery negative cable.

REAR POWER OUTLET

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the lower bezel from the instrument panel. Refer to **Instrument Panel Lower Bezel** in Body for the procedure.

(3) Pull the cigar lighter knob and element out of the cigar lighter receptacle base, or unsnap the protective cap from the power outlet receptacle base (Fig. 10).

(4) Look inside the cigar lighter or power outlet receptacle base and note the position of the rectangular retaining bosses of the mount that secures the receptacle base to the instrument panel lower bezel (Fig. 11).

(5) Insert a pair of external snap ring pliers into the cigar lighter or power outlet receptacle base and engage the tips of the pliers with the retaining bosses of the mount.

(6) Squeeze the pliers to disengage the mount retaining bosses from the receptacle base and, using a gentle rocking motion, pull the pliers and the receptacle base out of the mount.

(7) Remove the cigar lighter or power outlet mount from the instrument panel lower bezel.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO GROUP 8M - PASSIVE RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Install the cigar lighter or power outlet mount into the instrument panel lower bezel.

(2) Align the splines on the outside of the cigar lighter or power outlet receptacle base connector receptacle with the grooves on the inside of the mount.

(3) Press firmly on the cigar lighter or power outlet receptacle base until the retaining bosses of the mount are fully engaged in their receptacles.

(4) Install the cigar lighter knob and element into the cigar lighter receptacle base, or the protective cap into the power outlet receptacle base.

(5) Install the lower bezel onto the instrument panel. Refer to **Instrument Panel Lower Bezel** in the Removal and Installation section of this group for the procedures.

(6) Reconnect the battery negative cable.

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).

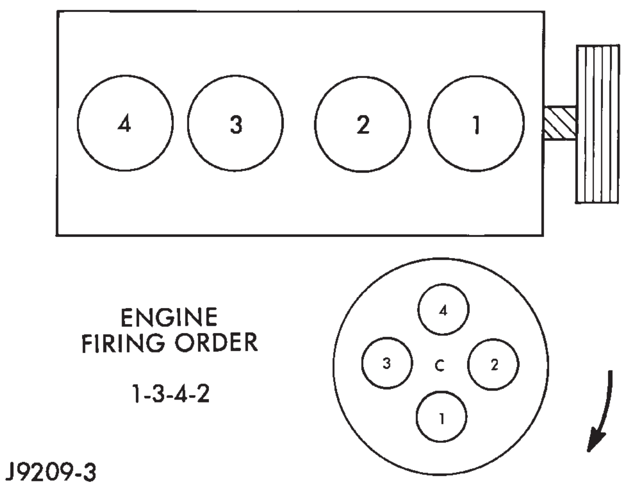


Fig. 1 Engine Firing Order

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.

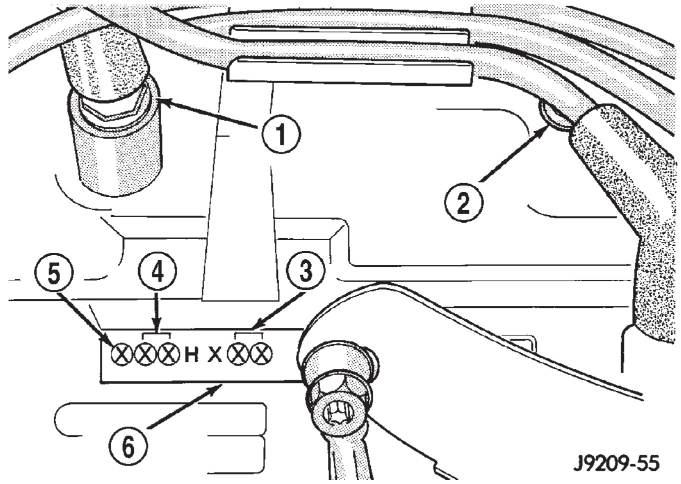


Fig. 2 Build Date Code Location

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 mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Preformance) or (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Mechanical). Refer to 14 - FUEL SYSTEM for fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that cannot be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following:

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- 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)
- Lash Adjuster (Tappet) Noise Diagnosis (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - DIAGNOSIS AND TESTING)
- Engine Oil Leak Inspection (Refer to 9 - ENGINE/LUBRICATION - 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—ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings.	1.
	(a) Misaligned or damaged.	(a) Replace as necessary.
	(b) Loose fasteners, broken or porous metal parts.	(b) Tighten fasteners, Repair or replace metal parts.
	2. Crankshaft rear seal	2. Replace as necessary.
	3. Crankshaft seal flange. Scratched, nicked or grooved.	3. Polish or replace crankshaft.
	4. Oil pan flange cracked.	4. Replace oil pan.
	5. Timing chain cover seal, damaged or misaligned.	5. Replace seal.
	6. Scratched or damaged vibration damper hub.	6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sending unit.	2. Replace sending unit.
	3. Low oil pressure.	3. Check pump and bearing clearance.
	4. Clogged oil filter.	4. Replace oil filter.
	5. Worn oil pump.	5. Replace as necessary.
	6. Thin or diluted oil.	6. Change oil and filter.
	7. Excessive bearing clearance.	7. Replace as necessary.
	8. Oil pump relief valve stuck.	8. Clean or replace relief valve.
	9. Oil pump suction tube loose or damaged.	9. Replace as necessary.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in oil ring slots.	2. Replace rings.
	3. Incorrect ring size installed.	3. Replace rings.
	4. Worn valve guides.	4. Ream guides and replace valves.
	5. Leaking intake gasket.	5. Replace intake gaskets.
	6. Leaking valve guide seals.	6. Replace valve guide seals.

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.

ENGINE 2.5L (Continued)

(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.

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART below

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 - 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

ENGINE 2.5L (Continued)

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.

(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.

ENGINE 2.5L (Continued)

(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 50° to 60° for proper seating of rings (Fig. 3).

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

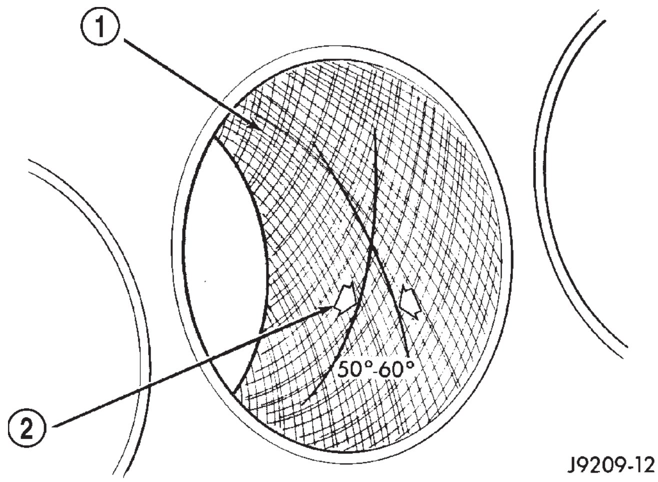


Fig. 3 Cylinder Bore Crosshatch Pattern

1 - CROSSHATCH PATTERN
2 - INTERSECT ANGLE

STANDARD PROCEDURE - ENGINE CORE AND OIL GALLERY PLUGS

Using a blunt tool such as a drift and a hammer, strike the bottom edge of the cup plug. With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 4).

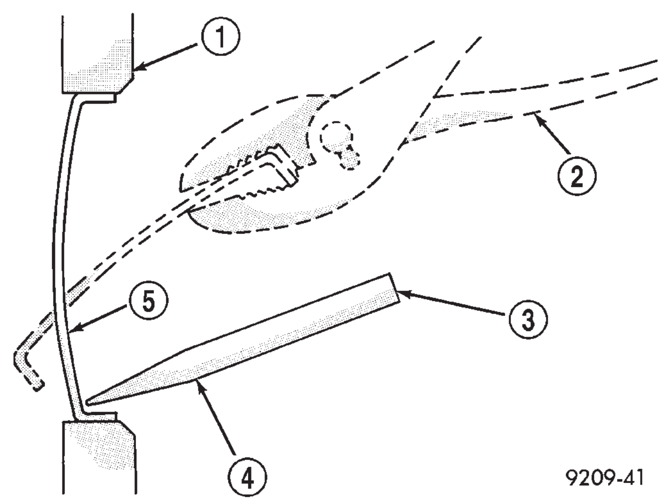


Fig. 4 Core Hole Plug Removal

1 - CYLINDER BLOCK
2 - REMOVE PLUG WITH PLIERS
3 - STRIKE HERE WITH HAMMER
4 - DRIFT PUNCH
5 - CUP PLUG

CAUTION: Do not drive cup plug into the casting as restricted cooling can result and cause serious engine problems.

ENGINE 2.5L (Continued)

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer. Lightly coat inside of cup plug hole with Mopar® Stud and Bearing Mount. Make certain the new plug is cleaned of all oil or grease. Using proper drive plug, drive plug into hole so that the sharp edge of the plug is at least 0.5 mm (0.020 in.) inside the lead-in chamfer.

It is not necessary to wait for curing of the sealant. The cooling system can be refilled and the vehicle placed in service immediately.

STANDARD PROCEDURE - ENGINE GASKET SURFACE PREPARATION

To ensure engine gasket sealing, proper surface preparation must be performed.

Never use the following to clean gasket surfaces:

- Metal scraper
- Abrasive pad or paper to clean cylinder block and head
- High speed power tool with an abrasive pad or a wire brush (Fig. 5)

Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover
- Plastic or wood scraper (Fig. 5)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (Fig. 5)

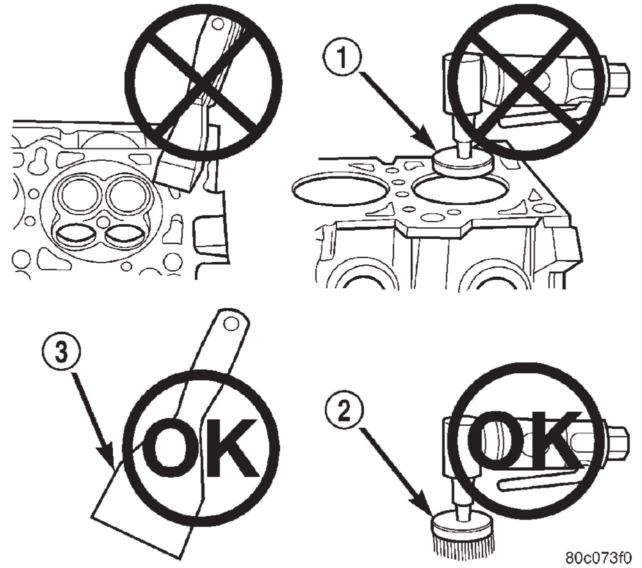


Fig. 5 PROPER TOOL USAGE FOR SURFACE PREPARATION

1 - ABRASIVE PAD
2 - 3M ROLOC™ BRISTLE DISC
3 - PLASTIC/WOOD SCRAPER

CAUTION: Excessive pressure or high RPM (beyond the recommended speed), can damage the sealing surfaces. The mild (white, 120 grit) bristle disc is recommended. If necessary, the medium (yellow, 80 grit) bristle disc may be used on cast iron surfaces with care.

REMOVAL

(1) Disconnect the battery cables. Remove the battery.

(2) Mark the hinge locations on the hood panel for alignment reference during installation. Remove the engine compartment lamp. Remove the hood.

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. USE CARE TO PREVENT SCALDING BY HOT COOLANT. CAREFULLY RELEASE THE PRESSURE BEFORE REMOVING THE RADIATOR DRAIN COCK AND CAP.

(3) Drain the coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Remove the air cleaner assembly, air in-let hose and resonator assembly (Fig. 6).

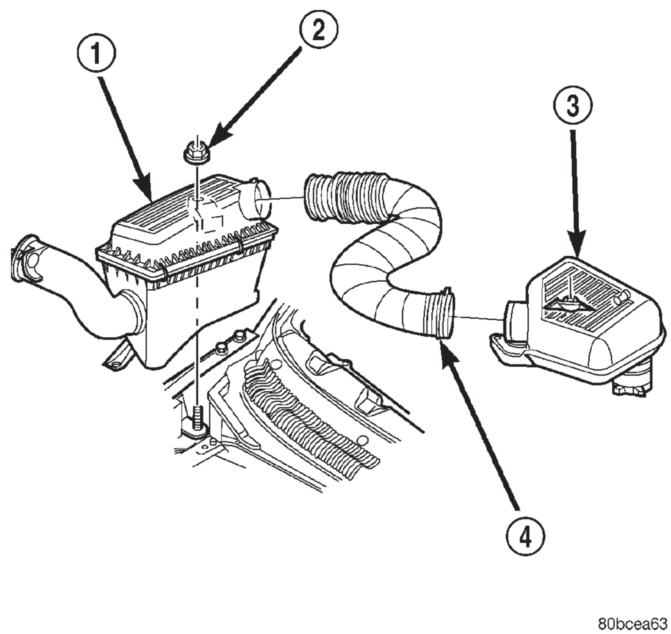


Fig. 6 Air Cleaner and Resonator Removal and Installation

1 - AIR CLEANER ASSEMBLY
2 - NUT AND WASHER
3 - RESONATOR ASSEMBLY
4 - AIR INLET HOSE

(5) Recover refrigerant (if equipped with A/C).(Refer to 24 - HEATING & AIR CONDITIONING/ PLUMBING - 24 - HEATING & AIR CONDITIONING).

(6) Remove the radiator lower hose.

ENGINE 2.5L (Continued)

(7) Remove the radiator upper hose and coolant recovery hose (Fig. 7).

(8) Remove the fan shroud (Fig. 7).

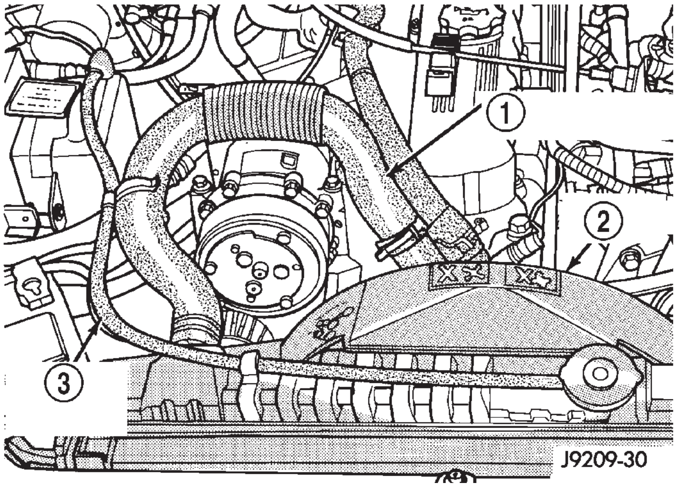


Fig. 7 Upper Radiator Hose, Coolant Recovery Hose & Fan Shroud

1 - UPPER RADIATOR HOSE
2 - FAN SHROUD
3 - COOLANT RECOVERY HOSE

(9) 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 air conditioning).

(10) Remove fan assembly and install a 5/16 x 1/2-inch SAE capscrew through fan pulley into water pump flange. This will maintain the pulley and water pump in alignment when crankshaft is rotated.

(11) Disconnect the heater hoses.

(12) Disconnect the throttle cable, speed control cable (if equipped) and transmission cable (if equipped).

(13) Disconnect the body ground at the firewall.

(14) Disconnect the wires from the starter motor solenoid.

(15) Disconnect all fuel injection harness connections.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE TURNED OFF). BEFORE DISCONNECTING FUEL LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

(16) Perform fuel pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(17) Disconnect the quick-connect fuel line at the fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(18) Disconnect suction/discharge hose from A/C compressor and cap off ports to prevent intrusion of foreign material or refrigerant oil loss.

(19) Remove the power brake vacuum check valve from the booster, if equipped.

(20) If equipped with power steering:

(a) Disconnect the power steering hoses from the fittings at the steering gear.

(b) Drain the pump reservoir.

(c) Cap the fittings on the hoses and steering gear to prevent foreign material from entering the system.

(21) Identify, tag and disconnect all necessary wire connectors and vacuum hoses.

(22) Raise the vehicle.

(23) Remove the oil filter.

(24) Remove the starter motor(Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(25) Disconnect the exhaust pipe from the exhaust manifold.

(26) Remove the flywheel housing access cover.

(27) Remove the upper flywheel and converter housing bolts and loosen the bottom bolts.

(28) Remove the engine support cushion-to-engine compartment bracket bolts.

(29) Remove the engine shock damper bracket from the sill.

(30) Lower the vehicle.

(31) Attach a lifting device to the engine.

(32) Raise the engine slightly off the front supports.

(33) Place a support stand under the converter or flywheel housing.

(34) Lift the engine out of the engine compartment and install on an engine stand.

(35) Install the oil filter to keep foreign material out of the engine.

INSTALLATION

(1) Remove the oil filter.

(2) Lift the engine off the stand and lower it into the engine compartment. For easier installation, it may be useful to remove the engine support cushions from the engine support brackets as an aide for alignment of the engine-to-transmission.

(3) Insert the transmission shaft into the clutch spline. (M/T models)

(4) Align the flywheel housing with the engine.

(5) Install and tighten the flywheel housing lower bolts.

(6) Install the engine support cushions (if removed).

ENGINE 2.5L (Continued)

(7) Lower the engine and engine support cushions onto the engine compartment brackets.
(8) Remove the engine lifting device.
(9) Raise the vehicle.
(10) Install the converter-housing access cover.
(11) Install the exhaust pipe support.
(12) Install the starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).
(13) Tighten the engine support cushion through-bolt nuts.
(14) Connect the exhaust pipe to the manifold.
(15) Install the oil filter.
(16) Lower the vehicle.
(17) Connect the coolant hoses and tighten the clamps.
(18) If equipped with power steering:
(a) Remove the protective caps
(b) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.
(c) Fill the pump reservoir with fluid.
(19) Remove the pulley-to-water pump flange alignment capscrew and install the fan assembly.
(20) Install the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION),condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION) (if equipped with air conditioning) and fan shroud.
(21) Connect the radiator hoses.
(22) Connect the oxygen sensor wire connector.
(23) Connect the throttle cable and install the rod. Connect the transmission and speed control cables (if equipped)
(24) Connect the fuel supply line to the injector rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).
(25) Connect all the vacuum hoses and wire connectors.
(26) Connect suction/discharge hose to compressor (if equipped).
(27) Fill the power steering reservoir.
(28) Recharge air conditioning (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).
(29) Connect the battery cables.
(30) Install the resonator assembly, air in-let hose and air cleaner (Fig. 6).
(31) Install the hood.
(32) Add engine oil and coolant.
(33) Start the engine and inspect for leaks.
(34) Stop the engine and check the fluid levels. Add fluid, as required.

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

ENGINE 2.5L (Continued)

DESCRIPTION	SPECIFICATION
	(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	
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	

ENGINE 2.5L (Continued)

DESCRIPTION	SPECIFICATION
(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.)
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

DESCRIPTION	SPECIFICATION
	(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.)
Valve Seat Angle	
Intake	44.5°
Exhaust	44.5°
Valve Seat Width	1.01 to 1.52 mm (0.040 to 0.060 in.)
Valve Seat Runout	0.064 mm (0.0025 in.)
Flatness	0.03 mm per 25 mm (0.001 in. per 1 in.) 0.05 mm per 152 mm (0.002 in. per 6 in.)
Flatness (Max)	0.20 mm for total length (0.008 in. for total length)

ENGINE 2.5L (Continued)

DESCRIPTION	SPECIFICATION
ROCKER ARMS, PUSH RODS & TAPPETS	
Rocker Arm Ratio	1.6:1
Push Rod Length (Blue)	241.300 to 241.808 mm (9.500 to 9.520 in.)
Push Rod Diameter	7.92 to 8.00 mm (0.312 to 0.315 in.)
Hydraulic Tappet Diameter	22.962 to 22.974 mm (0.904 to 0.9045 in.)
Tappet to Bore Clearance	0.025 to 0.063 mm (0.001 to 0.0025 in.)
PISTON	
Weight (Less Pin)	417 to 429 grams (14.7 to 15.1 oz.)
Compression Height	40.61 to 40.72 mm (1.599 to 1.603 in.)
Piston to Bore Clearance	0.018 to 0.038 mm (0.0008 to 0.0015 in.)
Piston Ring Groove Height	
Compression Rings	1.530 to 1.555 mm (0.0602 to 0.0612 in.)
Oil Control Ring	4.035 to 4.060 mm (0.1589 to 0.1598 in.)
Piston Ring Groove Diameter	
Compression Ring #1	88.39 to 88.65 mm (3.48 to 3.49 in.)
Compression Ring #2	87.63 to 87.88 mm (89.66 to 89.92 in.)
Oil Control Ring	89.66 to 89.92 mm (3.53 to 3.54 in.)
Piston Pin Bore Diameter	23.650 to 23.658 mm (0.9312 to 0.9315 in.)
Piston Pin Diameter	23.637 to 23.640 mm (0.9306 to 0.9307 in.)
Piston to Pin Clearance	0.0102 to 0.0208 mm (0.0005 to 0.0009 in.)

DESCRIPTION	SPECIFICATION
PISTON RINGS	
Ring Gap Clearance	
Top Compression Ring	0.229 to 0.610 mm (0.0090 to 0.0240 in.)
2nd Compression Ring	0.483 to 0.965 mm (0.0190 to 0.0380 in.)
Oil Control Steel Rails	0.254 to 1.500 mm (0.010 to 0.060 in.)
Ring Side Clearance	
Compression Rings	0.042 to 0.084 mm (0.0017 to 0.0033 in.)
Oil Control Rings	0.06 to 0.21 mm (0.0024 to 0.0083 in.)
OIL PUMP AND OIL PRESSURE	
Gear to Body Clearance	
(Radial)	0.051 to 0.102 mm (0.002 to 0.004 in.)
(Radial Preferred)	0.051 mm (0.002 in.)
Gear End Clearance—	
Plastigage	0.051 to 0.152 mm (0.002 to 0.006 in.)
Plastigage Preferred	0.051 mm (0.002 in.)
Feeler Gauge	0.1016 to 0.2032 mm (0.004 to 0.008 in.)
Feeler Gauge Preferred	0.1778 mm (0.007 in.)
Min. Pressure (600 rpm)	89.6 kPa (13 psi)
Min. Pressure at Idle (800 rpm)	172 to 241 kPa (25 to 35 psi)
Min. Pressure at 1600 rpm and Higher	255 to 517 kPa (37 to 75 psi)
Oil Pressure Relief	517 kPa (75 psi)

ENGINE 2.5L (Continued)

TORQUE

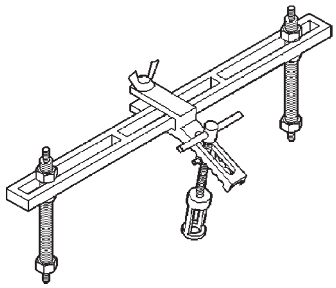
2.5L ENGINE

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	—
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	—

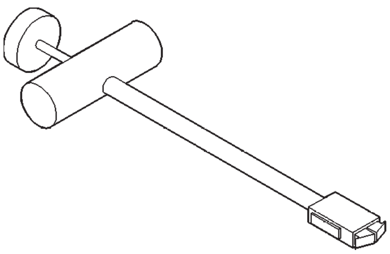
ENGINE 2.5L (Continued)

SPECIAL TOOLS

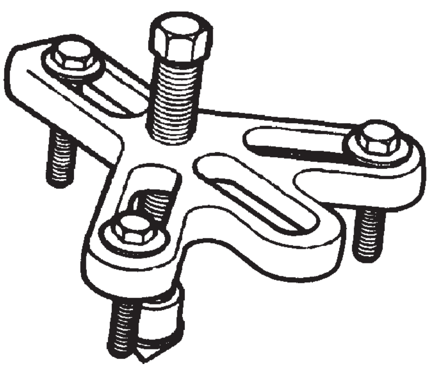
2.5L ENGINE



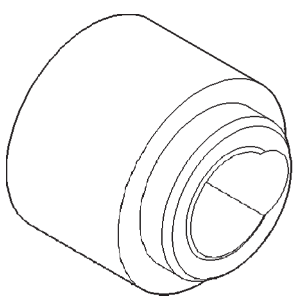
Valve Spring Compressor Tool MD-998772A



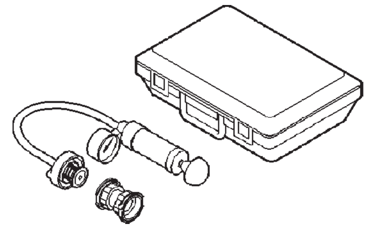
Hydraulic Valve Tappet Removal Tool C–4129–A



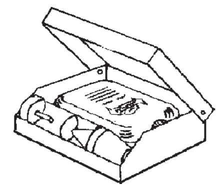
Vibration Damper Removal Tool 7697



Timing Case Cover Alignment and Seal Tool 6139



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A

AIR CLEANER ELEMENT

REMOVAL

Housing removal is not necessary for element (filter) replacement.

(1) Pry up spring clips from housing cover (spring clips retain cover to housing).

(2) Release housing cover from locating tabs on housing (Fig. 8) and remove cover.

(3) Remove air cleaner element (filter) from housing.

(4) Clean inside of housing before replacing element.

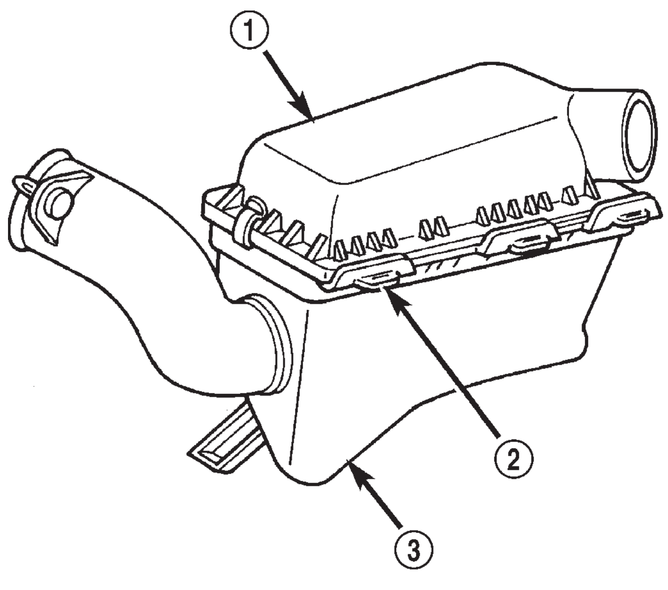


Fig. 8 Air Cleaner Housing Assembly

1 - AIR CLEANER ELEMENT COVER
2 - TABS
3 - HOUSING

AIR CLEANER ELEMENT (Continued)

INSTALLATION

(1) Install element into housing.

(2) Position housing cover into housing locating tabs.

(3) Pry up spring clips and lock cover to housing.

CYLINDER HEAD

DESCRIPTION

The cast iron cylinder head (Fig. 9) is mounted to the cylinder block using ten bolts. The spark plugs are located in the peak of the wedge between the valves.

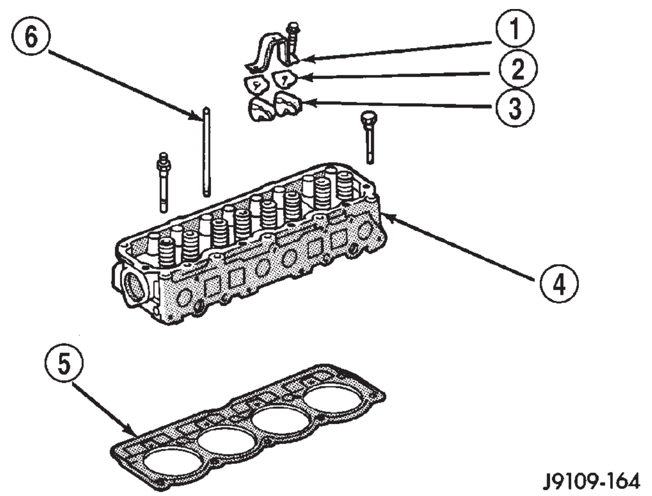


Fig. 9 Cylinder Head—2.5L Engine

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

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 (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING). 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 158 kPa (23 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.

CYLINDER HEAD (Continued)

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. 10). The special sleeve places the valve at the correct height for checking with a dial indicator.

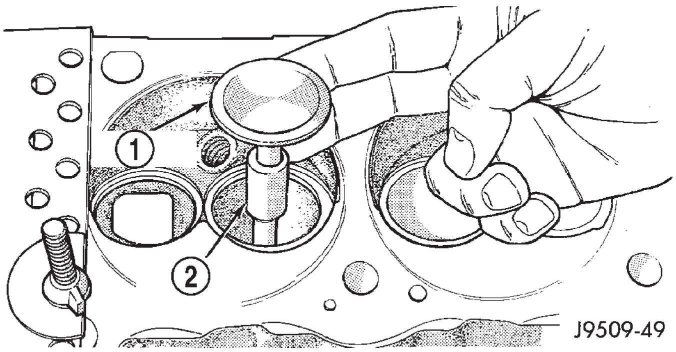


Fig. 10 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 11).

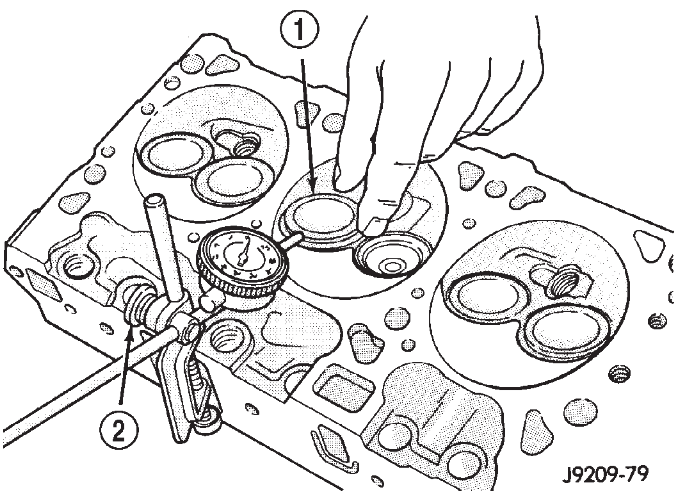


Fig. 11 Measuring Valve Guide Wear

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

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. 12).

(6) Remove the push rods (Fig. 12). **Retain the push rods, bridges, pivots and rocker arms in the same order as removed.**

(7) Loosen the accessory drive belt at the power steering pump bracket, if equipped or at the idler pulley bracket (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

CYLINDER HEAD (Continued)

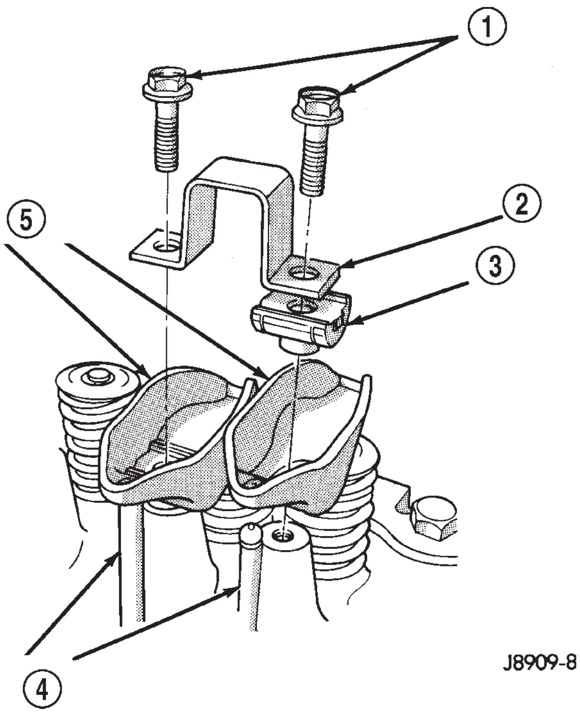


Fig. 12 Rocker Arm Assembly

1 - CAPSCREWS
2 - BRIDGE
3 - PIVOT ASSEMBLY
4 - PUSH RODS
5 - ROCKER ARMS

(8) If equipped with air conditioning, perform the following:

(a) Remove the bolts from the A/C compressor mounting bracket and set the compressor aside.

(b) Remove the air conditioner compressor bracket bolts from the engine cylinder head.

(c) Loosen the through bolt at the bottom of the bracket.

(9) If equipped, disconnect the power steering pump bracket. Set the pump and bracket aside. DO NOT disconnect the hoses.

(10) Perform fuel pressure release procedure (Refer to 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. 13).

(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.

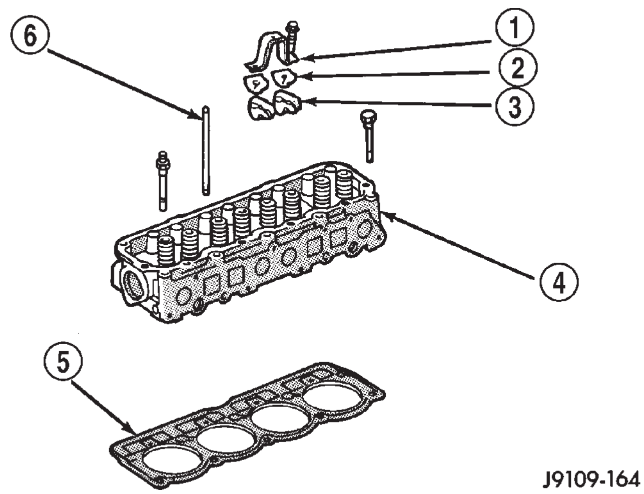


Fig. 13 Engine Cylinder Head Assembly

1 - BRIDGE
2 - PIVOT ASM.
3 - ROCKER ARM
4 - CYLINDER HEAD
5 - HEAD GASKET
6 - PUSH ROD

CLEANING

Thoroughly clean the engine cylinder head and cylinder block mating surfaces. Clean the intake and exhaust manifold and engine cylinder head mating surfaces. Remove all gasket material and carbon.

Check to ensure that no coolant or foreign material has fallen into the tappet bore area.

Remove the carbon deposits from the combustion chambers and top of the pistons.

INSPECTION

Use a straightedge and feeler gauge to check the flatness of the engine cylinder head and block mating surfaces.

CYLINDER HEAD (Continued)

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 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. 14). 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.

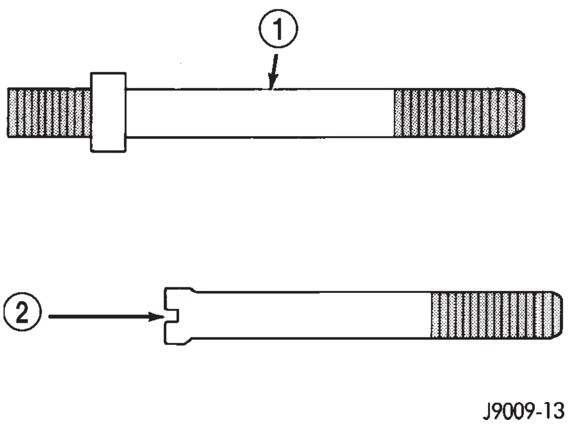


Fig. 14 Fabricate Alignment Dowels

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. 15).

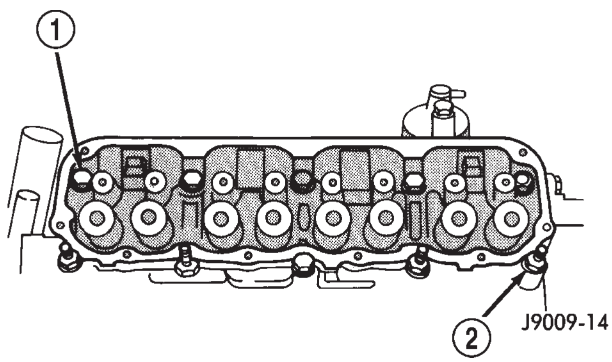


Fig. 15 Alignment Dowel Locations

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. 16):

(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.

(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.

(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).

CYLINDER HEAD (Continued)

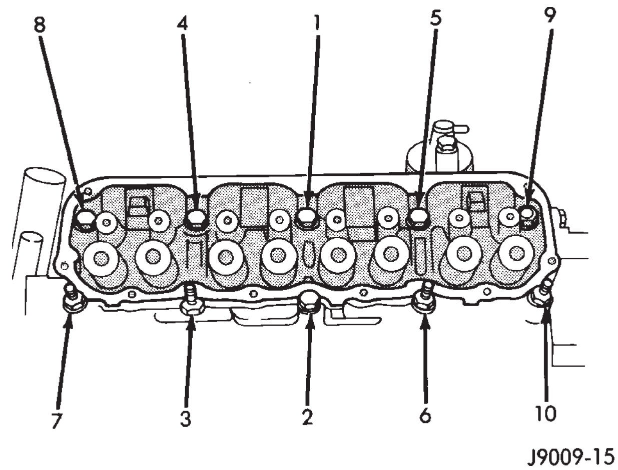


Fig. 16 Engine cylinder head Bolt Tightening Sequence

(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. 17).

(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. 17).

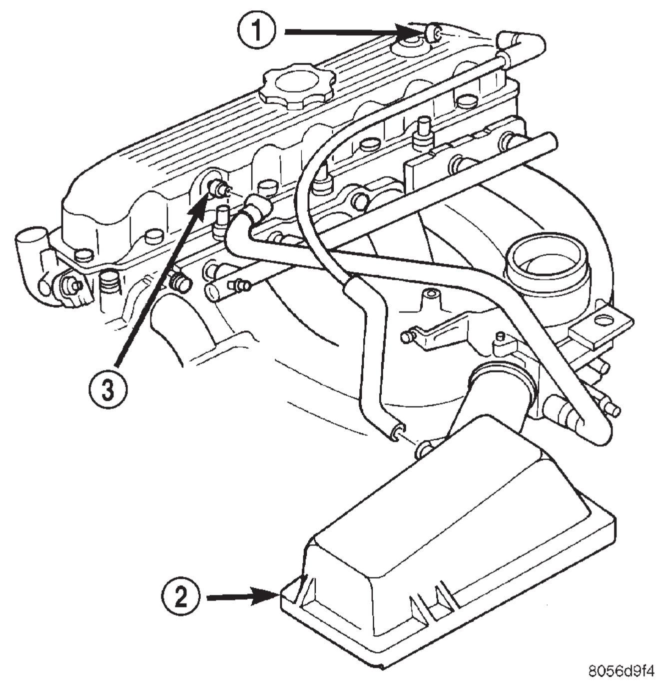


Fig. 17 Engine Cylinder Head Cover

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.

CYLINDER HEAD COVER(S) (Continued)

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.

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. 17).

(5) Connect negative cable to battery.

(6) Install the air inlet hose and resonator.

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. 18). 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. 18). 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.

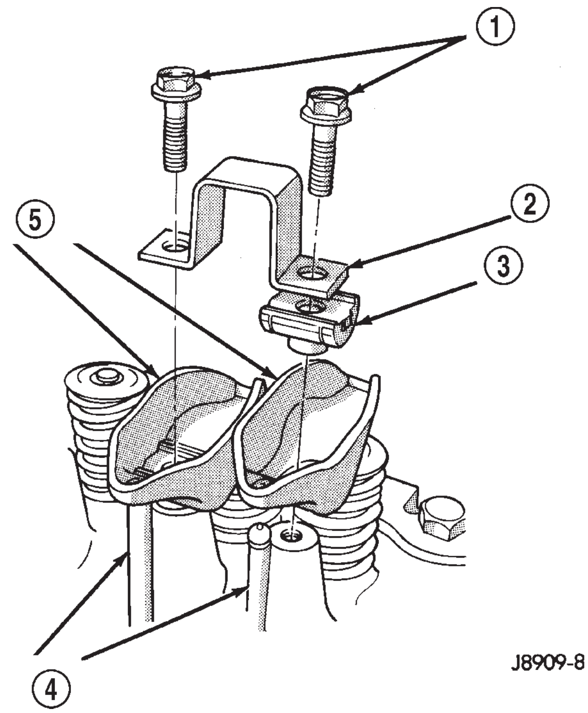


Fig. 18 Rocker Arm Assembly

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.

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

ROCKER ARMS (Continued)

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).

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—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. 19).

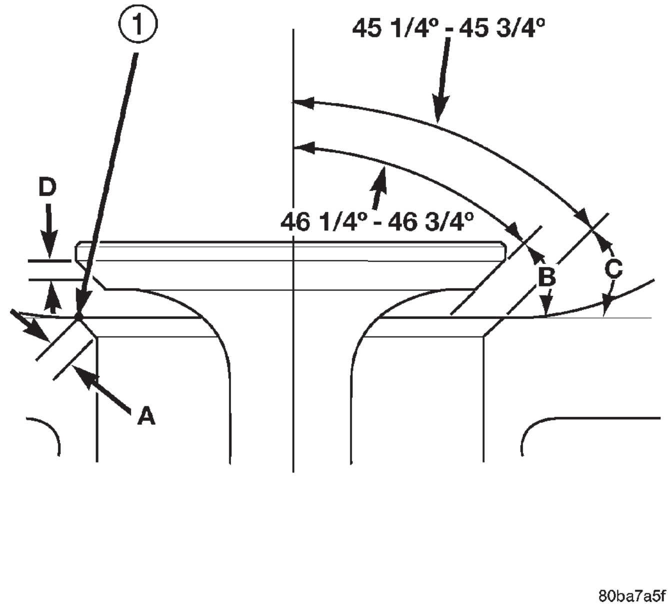


Fig. 19 Valve Face and

1 - CONTACT POINT

A,B,C and D Refer to VALVE FACE AND VALVE SEAT ANGLE CHART

VALVE FACE AND VALVE SEAT ANGLE CHART

ITEM	DESCRIPTION	SPECIFICATION
A	SEAT WIDTH	
	INTAKE	1.016 - 1.524 mm (0.040 - 0.060 in.)
	EXHAUST	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	—

Inspect the remaining margin after the valves are refaced (Fig. 20). Valves with less than 1.190 mm (0.047 in.) margin should be discarded.

INTAKE/EXHAUST VALVES & SEATS (Continued)

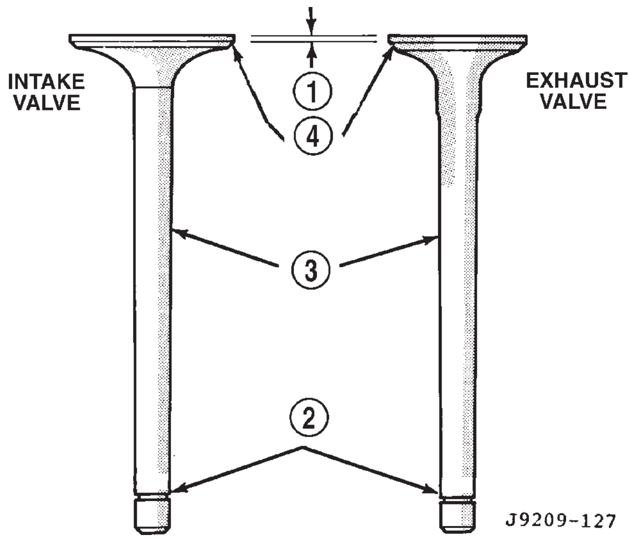


Fig. 20 Intake and Exhaust Valves

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. 21).

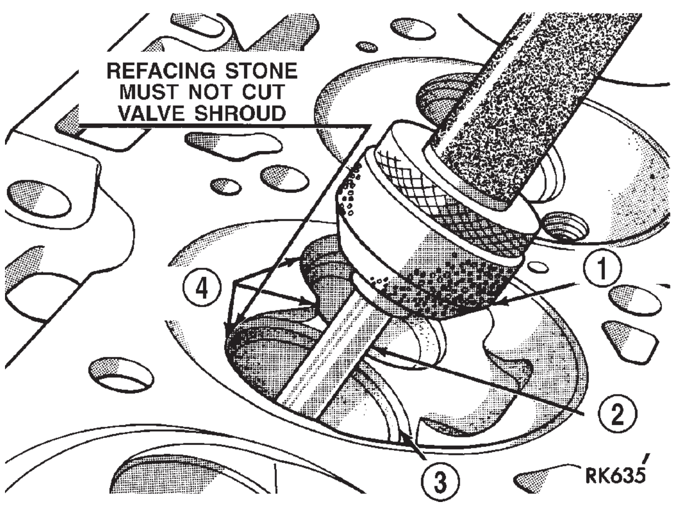


Fig. 21 Refacing Valve Seats

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.).

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.

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—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. 22). Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. (Refer to 9 - ENGINE - SPECIFICATIONS) to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

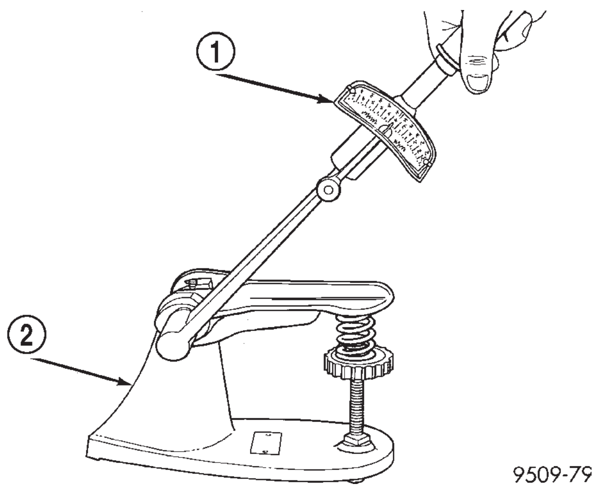


Fig. 22 Testing Valve Spring for Compressed Length

1 - TORQUE WRENCH
2 - VALVE SPRING TESTER

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. 23).

(9) Remove valve spring and retainer (Fig. 23).

(10) Remove valve stem oil seals (Fig. 23). Note the valve seals are different for intake and exhaust valves. The top of each seal is marked either INT (intake/black in color) or EXH (exhaust/brown in color). DO NOT mix the seals.

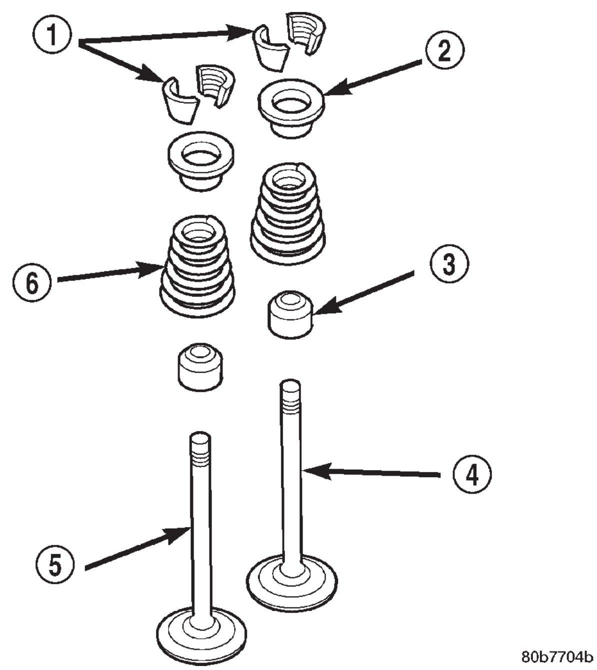


Fig. 23 Valve and Valve Components

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

VALVE SPRINGS (Continued)

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).

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. 24).

• The front and rear oil galley holes (Fig. 25) (Fig. 26).

• The feed holes for the crankshaft main bearings.

Once the block has been completely cleaned, apply Mopar® Thread Sealant with Teflon to the threads of the front and rear oil galley plugs. Tighten the plugs to 41 N·m (30 ft. lbs.) torque.

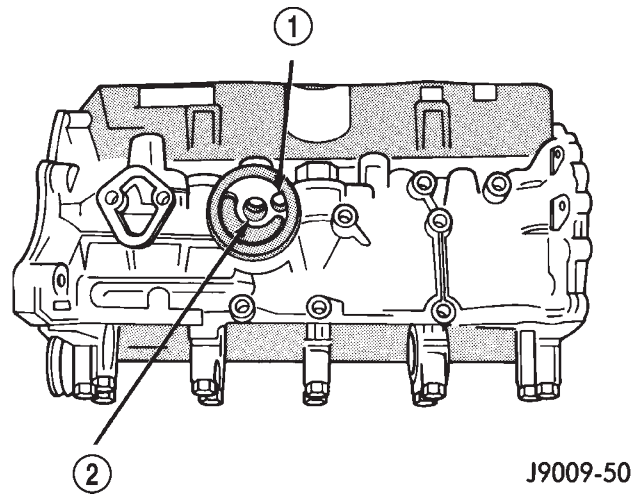


Fig. 24 Oil Filter Adaptor Hole

1 - FILTER BYPASS HOLE
2 - OIL FILTER ADAPTOR HOLE

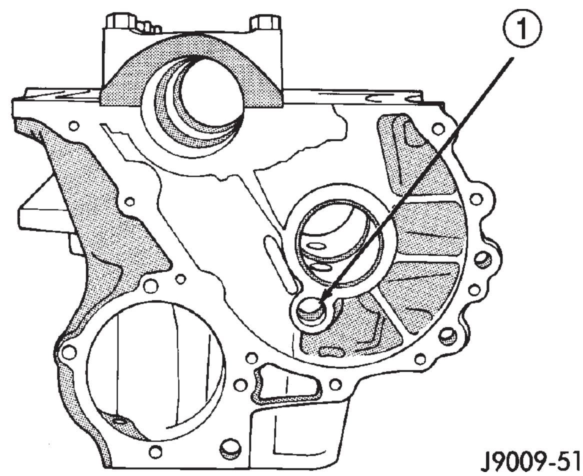


Fig. 25 Front Oil Galley Hole

1 - FRONT OIL GALLEY HOLE

INSPECTION

Inspect the cylinder bores for signs of scorring, pitting or cracks. If the cylinder bores are scorred or pitted the cylinder bores will require boreing or honing to clean them up. Refer to Honing Cylinder Bores in this Section. If the cylinder bore(s) are cracked the cylinder block must be replaced.

Inspect the cylinder block to cylinder head mating surface for flatness and/or pitting.

ENGINE BLOCK (Continued)

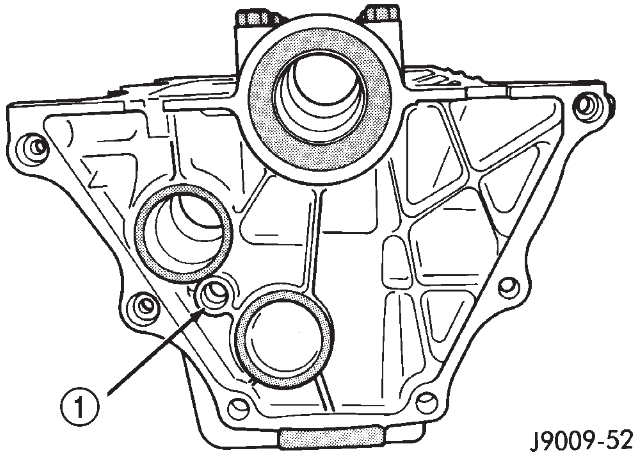


Fig. 26 Rear Oil Galley Hole

1 - REAR OIL GALLEY HOLE

CAMSHAFT & BEARINGS (IN BLOCK)

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. 27).

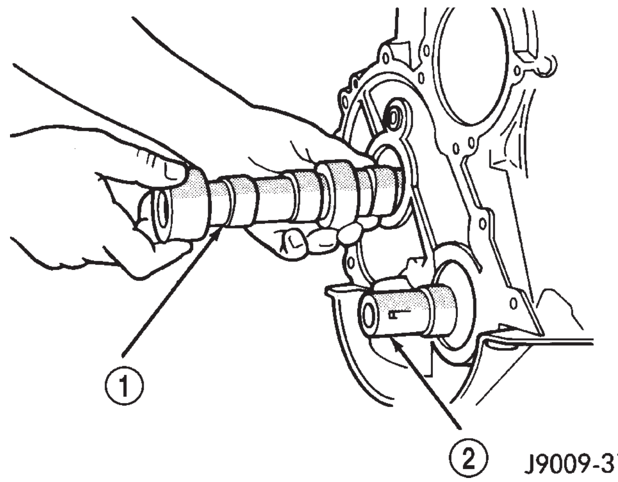


Fig. 27 Camshaft

1 - CAMSHAFT
2 - CRANKSHAFT

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.

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

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.

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. 27).

(8) Turn the tensioner lever to the unlocked (down) position (Fig. 28).

(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. 28).

(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. 28).

(12) Install the timing case cover with a replacement oil seal (Fig. 29) (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).

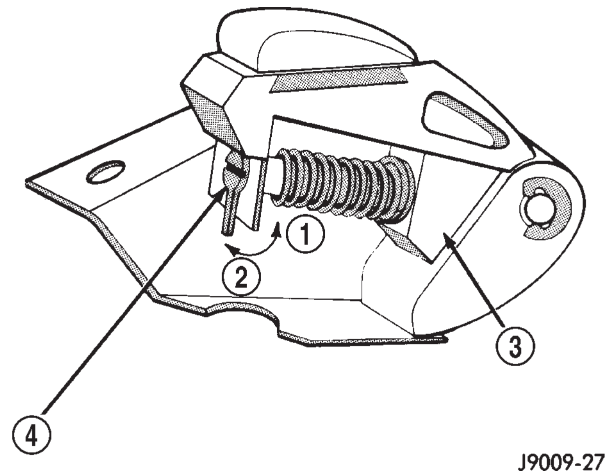


Fig. 28 Loading Timing Chain Tensioner

1 - LOCK
2 - UNLOCK
3 - TENSIONER BLOCK
4 - TENSIONER LEVER

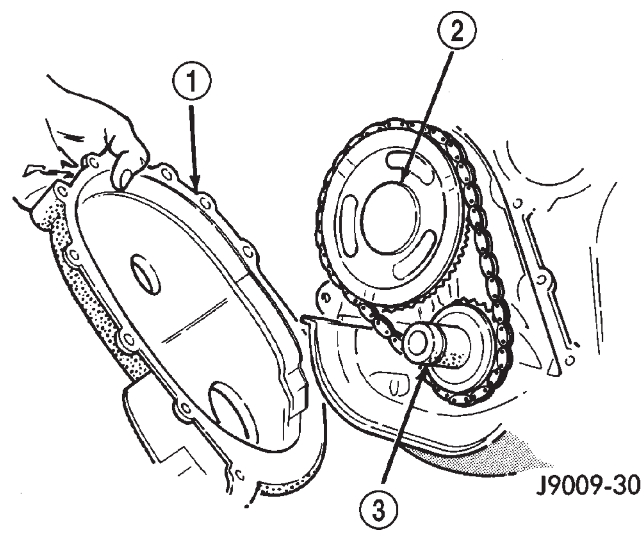


Fig. 29 Timing Case Cover

1 - TIMING CASE COVER
2 - CAMSHAFT
3 - CRANKSHAFT

(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).

(19) Install the resonator assembly and air in-let hose. Tighten clamps to 4 N·m (35 in. lbs.).

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(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 CONNECTING ROD BEARING - FITTING

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 30) (Fig. 31). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 32) . Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

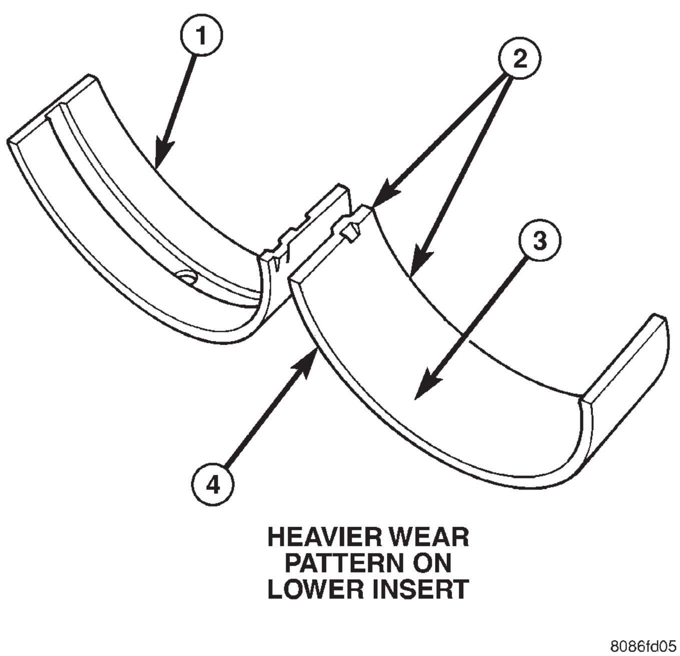


Fig. 30 Connecting Rod Bearing Inspection

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.

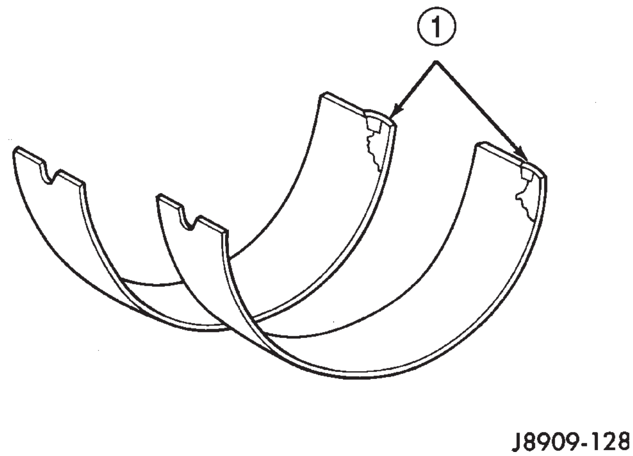


Fig. 31 Locking Tab Inspection

1 - ABNORMAL CONTACT AREA CAUSED BY LOCKING TABS NOT FULLY SEATED OR BEING BENT

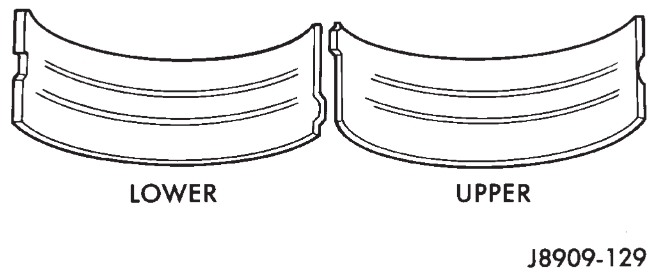


Fig. 32 Scoring Caused by Insufficient Lubrication

(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. 33). Verify that the oil squirt holes in the rods face the camshaft and that the arrows on the pistons face the front of the engine.

(5) Install the lower bearing insert in the bearing cap. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.

(6) Install bearing cap and connecting rod on the journal and tighten nuts to 45 N·m (33 ft. lbs.) torque. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(7) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 34). (Refer to 9 - ENGINE - SPECIFICATIONS) for the proper clearance. **Plastigage should indicate the same clear-**

CONNECTING ROD BEARINGS (Continued)

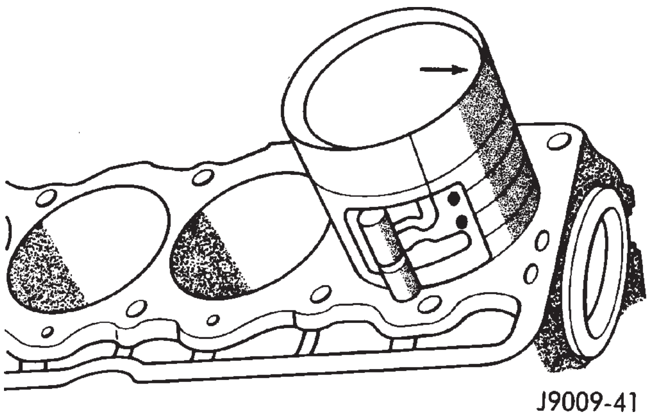


Fig. 33 Rod and Piston Assembly Installation

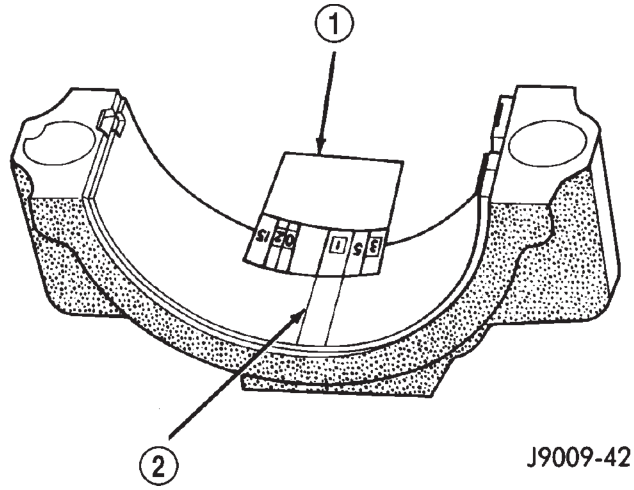


Fig. 34 Measuring Bearing Clearance

1 - PLASTIGAGE SCALE
2 - COMPRESSED PLASTIGAGE

ance 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.

(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. 35). (Refer to 9 - ENGINE - SPECIFICATIONS) for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

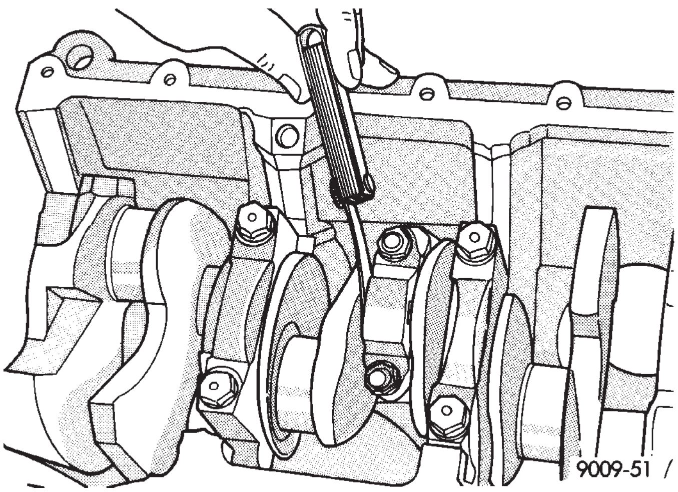


Fig. 35 Checking Connecting Rod Side Clearance - Typical

CRANKSHAFT

DESCRIPTION

The crankshaft (Fig. 36) 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.

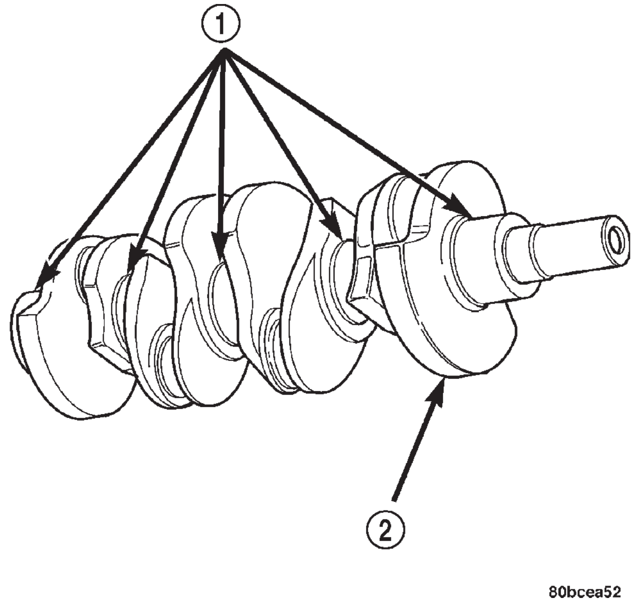


Fig. 36 Crankshaft 3.9L Engine

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. 37). 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)

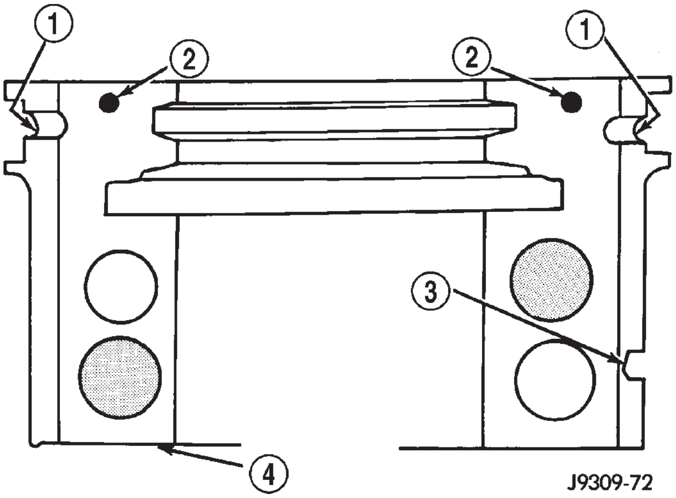


Fig. 37 Sealant Application to Bearing Cap

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT SLOTS
2 - MOPAR® GASKET MAKER (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. 38). 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).

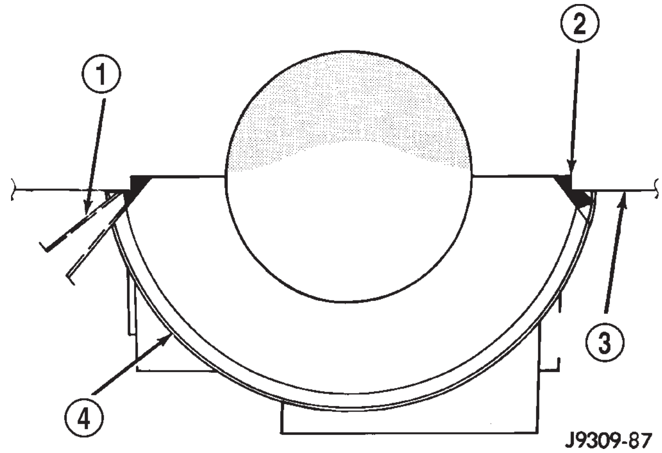


Fig. 38 Apply Sealant to Bearing Cap to Block

1 - MOPAR ® GEN II SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 - SEALANT APPLIED
3 - CYLINDER BLOCK
4 - REAR MAIN BEARING CAP

CRANKSHAFT MAIN BEARINGS

DESCRIPTION

Main bearings (Fig. 39) 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.

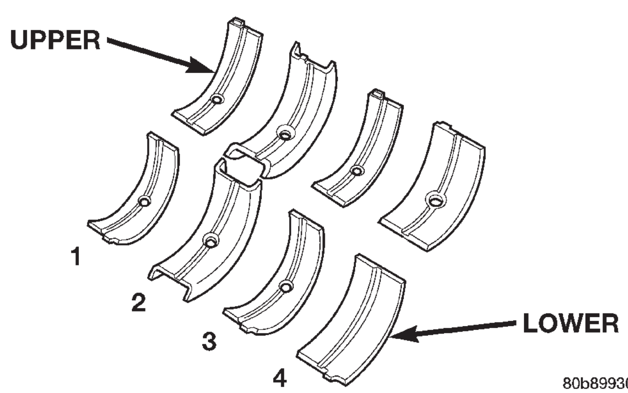


Fig. 39 Main Bearing Orientation

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.

CRANKSHAFT MAIN BEARINGS (Continued)

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).

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.)	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)

CRANKSHAFT MAIN BEARINGS (Continued)

Crankshaft Journals #1 - #4			
	0.0381 mm (0.0015 in.) Undersize		
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.)	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)

Crankshaft Journals #1 - #4			
	0.0254 mm (0.001 in.) Undersize		
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.)

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

CRANKSHAFT MAIN BEARINGS (Continued)

(Fig. 40). Refer to Engine Specifications for the proper clearance.

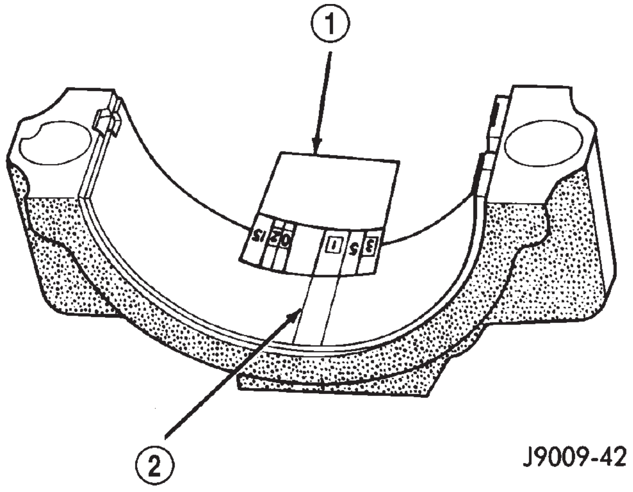


Fig. 40 Measuring Bearing Clearance with Plastigage

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. 41).

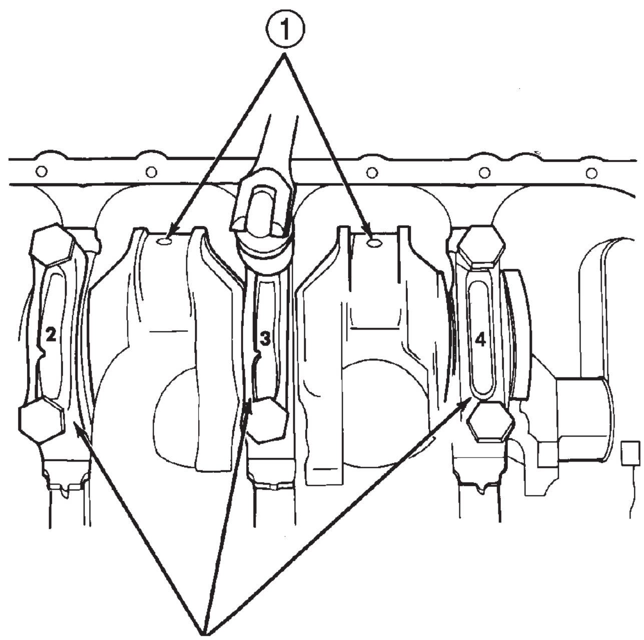


Fig. 41 Removing Main Bearing Caps and Lower Inserts

1 - CONNECTING ROD JOURNAL
2 - MAIN BEARING CAPS

CRANKSHAFT MAIN BEARINGS (Continued)

(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. 42). 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. 42). After moving the insert approximately 25 mm (1 inch), it can be removed by applying pressure under the tab.

(8) Using the same procedure described above, remove the remaining bearing inserts one at a time for inspection.

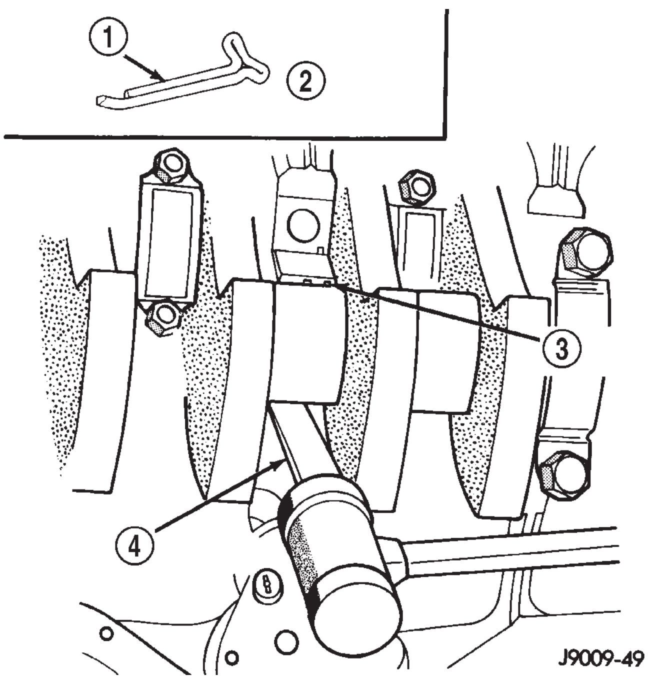


Fig. 42 Removing Upper Inserts

1 - COTTER PIN
2 - FABRICATED TOOL
3 - BEARING INSERT
4 - TONGUE DEPRESSOR

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. 43).

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.

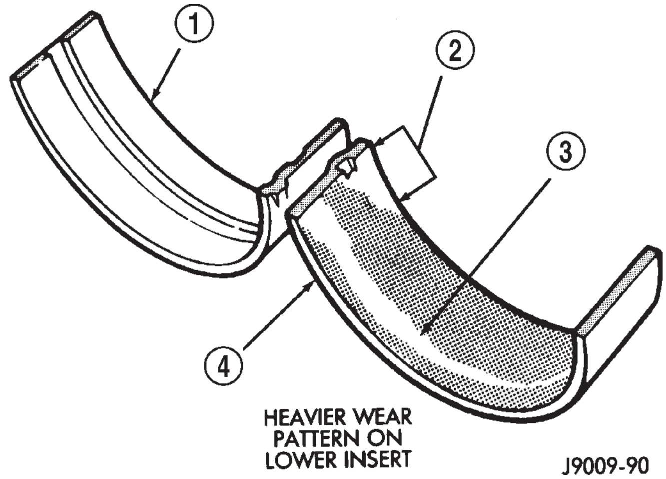


Fig. 43 Main Bearing Wear Patterns

1 - UPPER INSERT
2 - NO WEAR IN THIS AREA
3 - LOW AREA IN BEARING LINING
4 - LOWER INSERT

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) Install the main bearing cap(s) and lower insert(s).

(5) Clean the rear main bearing cap (No.5) mating surfaces.

(6) Apply Mopar® Gasket Maker, or equivalent on the rear bearing cap (Fig. 44). The bead should be 3 mm (0.125 in) thick. DO NOT apply Mopar® Gasket Maker, or equivalent to the lip of the seal.

(7) Install the rear main bearing cap. DO NOT strike the cap more than twice for proper engagement.

(8) Tighten the bolts of caps 1, 3, 4 and 5 to 54 N·m (40 ft. lbs.) torque. Now tighten these bolts to 95 N·m (70 ft. lbs.) torque. Finally, tighten these bolts to 108 N·m (80 ft. lbs.) torque.

(9) Push the crankshaft forward and backward. Load the crankshaft front or rear and tighten cap bolt No.2 to 54 N·m (40 ft. lbs.) torque. Then tighten to 95 N·m (70 ft. lbs.) torque and finally tighten to 108 N·m (80 ft. lbs.) torque.

(10) Rotate the crankshaft after tightening each main bearing cap to ensure the crankshaft rotates freely.

(11) Check crankshaft end play. Crankshaft end play is controlled by the thrust bearing which is flange and installed at the No.2 main bearing position.

CRANKSHAFT MAIN BEARINGS (Continued)

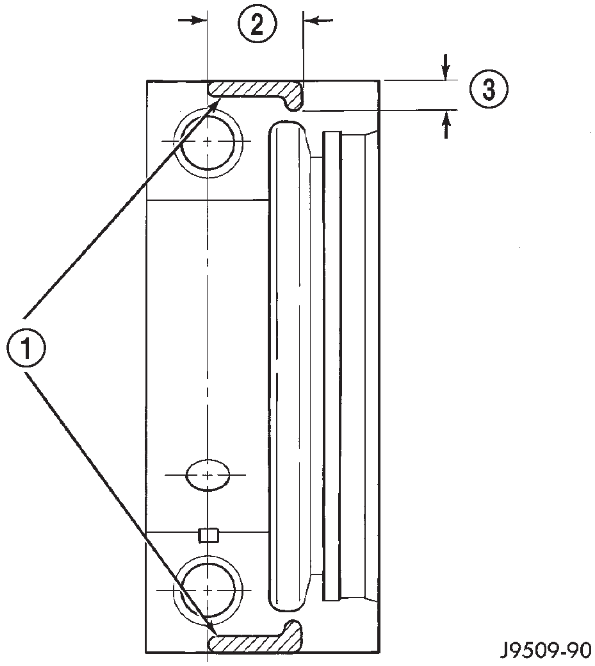


Fig. 44 Location of Mopar® Gasket Maker

1 - MOPAR® GASKET MAKER (OR EQUIVALENT)
2 - 19 mm (.75 IN)
3 - 6 mm (0.025 IN)

(a) Attach a magnetic base dial indicator to the cylinder block at either the front or rear of the engine.

(b) Position the dial indicator rod so that it is parallel to the center line of the crankshaft.

(c) Pry the crankshaft forward, position the dial indicator to zero.

(d) Pry the crankshaft forward and backward. Note the dial indicator readings. End play is the difference between the high and low measurements (Fig. 45). Correct end play is 0.038-0.165 mm (0.0015-0.0065 inch). The desired specifications are 0.051-0.064 mm (0.002-0.0025 inch).

(e) If end play is not within specification, inspect crankshaft thrust faces for wear. If no wear is apparent, replace the thrust bearing and measure end play. If end play is still not within specification, replace the crankshaft.

(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).

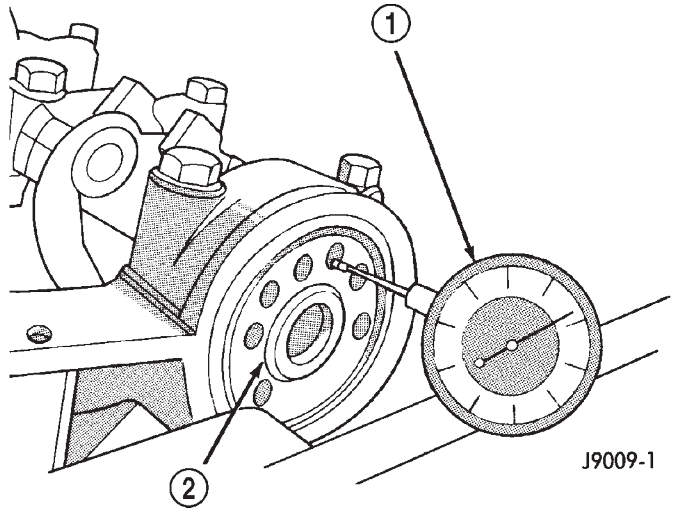


Fig. 45 Crankshaft End Play Measurement

1 - DIAL INDICATOR
2 - CRANKSHAFT

(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).

CRANKSHAFT OIL SEAL - FRONT (Continued)

(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. 46).

(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.

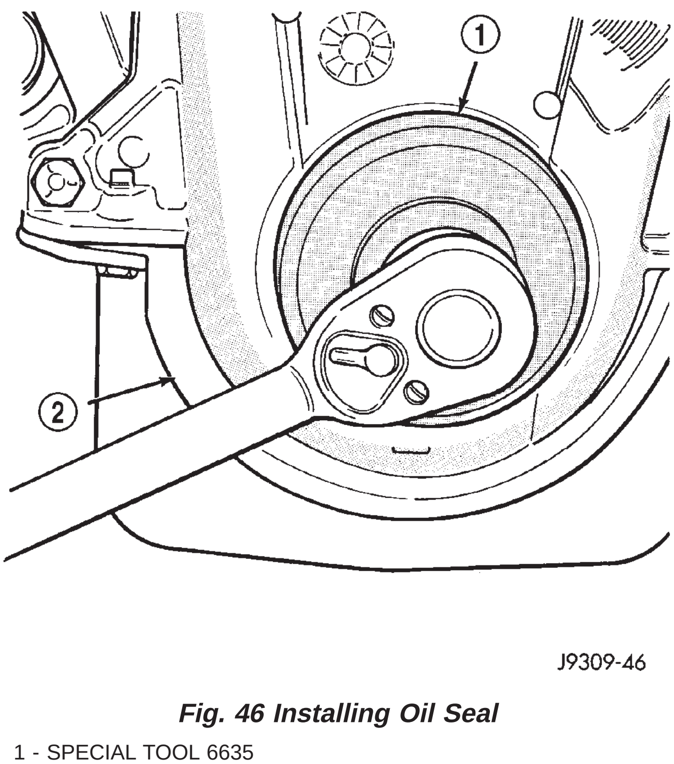


Fig. 46 Installing Oil Seal

1 - SPECIAL TOOL 6635
2 - TIMING CHAIN COVER

CRANKSHAFT OIL SEAL - REAR

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. 47).

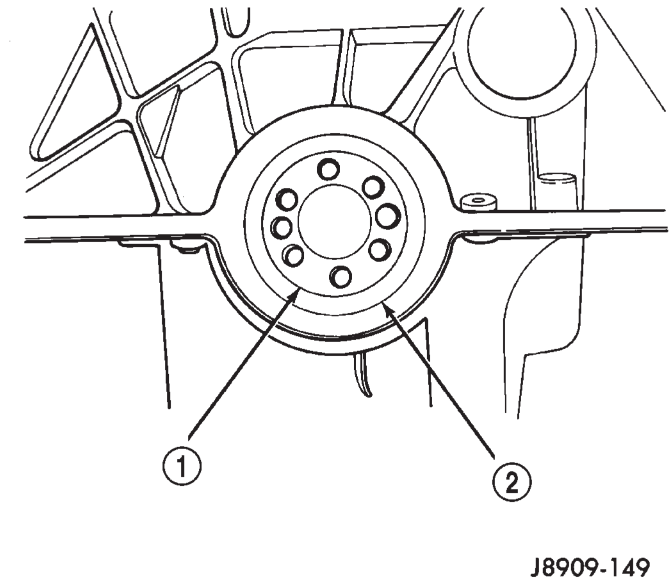


Fig. 47 Replacement of Rear Crankshaft Oil Seal

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 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. 48).

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

HYDRAULIC LIFTERS (CAM IN BLOCK) (Continued)

20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

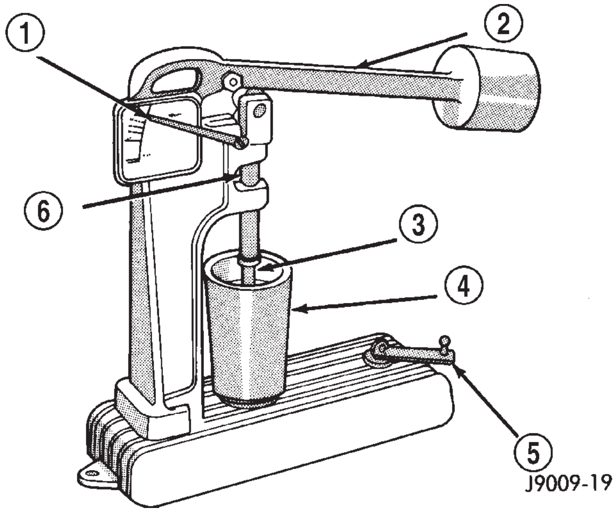


Fig. 48 Leak-Down Tester

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.

(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. 49).

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.

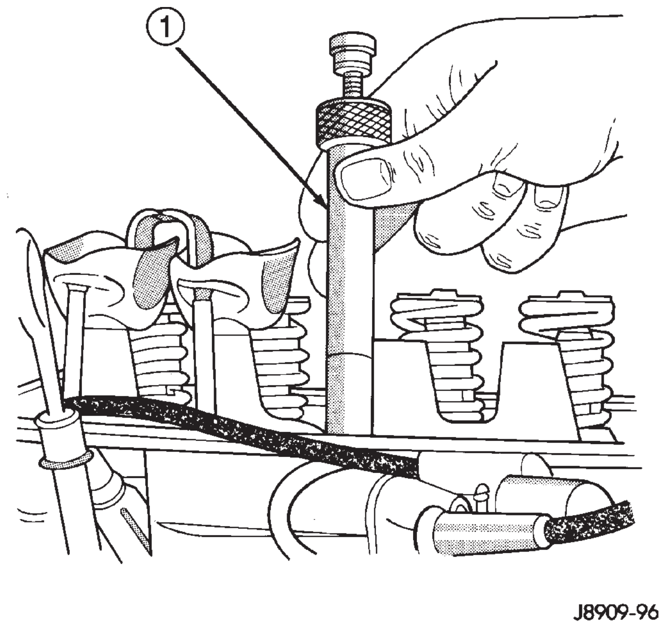


Fig. 49 Hydraulic Valve Tappet Removal/Installation Tool

1 - HYDRAULIC VALVE TAPPET REMOVAL/INSTALLATION TOOL

INSTALLATION

It is not necessary to charge the tappets with engine oil. They will charge themselves within a very short period of engine operation.

(1) Dip each tappet in Mopar® Engine Oil Supplement, or equivalent.

(2) Use Hydraulic Valve Tappet Removal/Installation Tool to install each tappet in the same bore from where it was originally removed.

(3) Install the push rods in their original locations.

(4) Install the rocker arms and bridge and pivot assemblies at their original locations. Loosely install the capscrews at each bridge.

(5) Tighten the capscrews alternately, one turn at a time, to avoid damaging the bridges. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(6) Install the engine cylinder head cover (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.

PISTON & CONNECTING ROD (Continued)

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. 51).

(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. 50). 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.

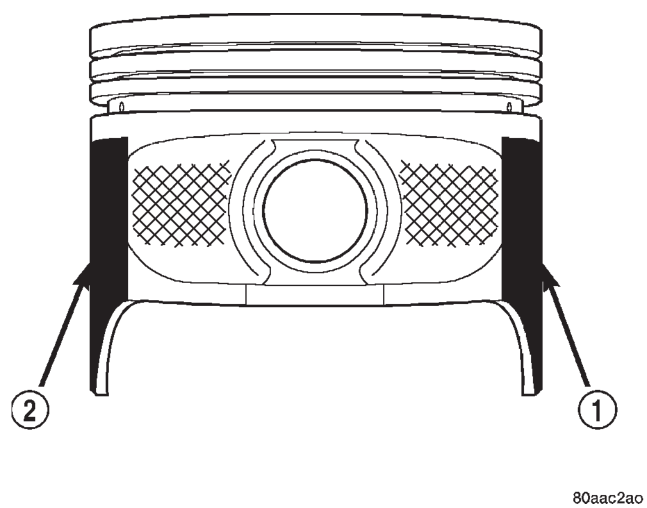


Fig. 50 Moly Coated Piston

1 - MOLY COATED
2 - MOLY COATED

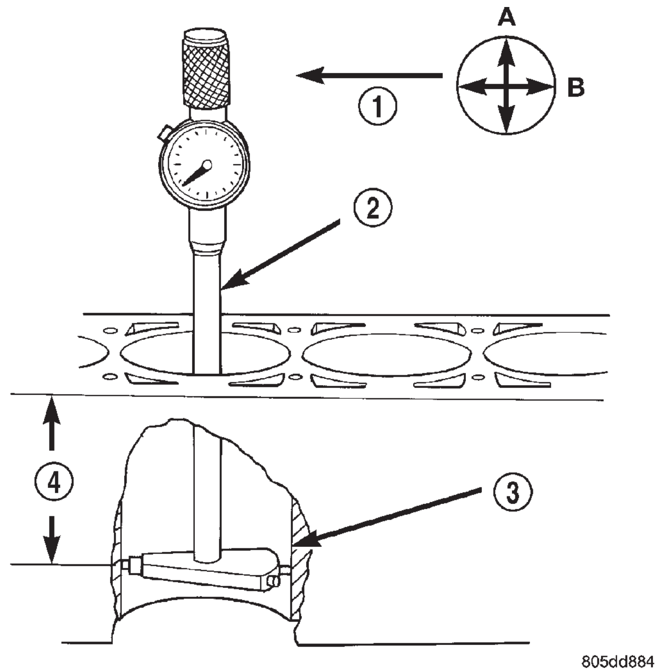


Fig. 51 Bore Gauge

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 38 MM (1.5 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).

PISTON & CONNECTING ROD (Continued)

(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. 52).

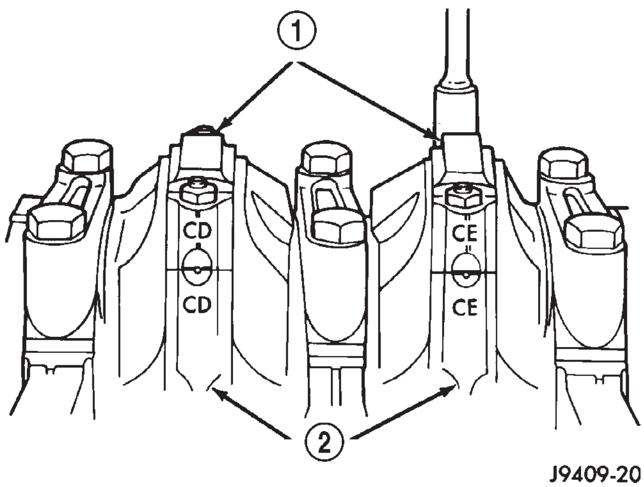


Fig. 52 Stamped Connecting Rods and Caps

1 - CONNECTING ROD CAP
2 - CONNECTING ROD

(10) Lower the vehicle until it is about 2 feet from the floor.

CAUTION: Ensure that the connecting rod bolts DO NOT scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose, slipped over the rod bolts will provide protection during removal.

(11) Have an assistant push the piston and connecting rod assemblies up and through the top of the cylinder bores (Fig. 53).

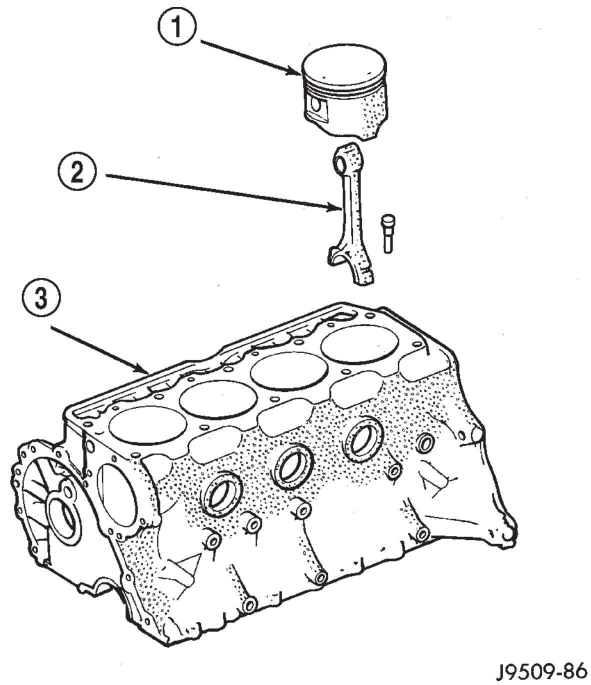


Fig. 53 Removal of Connecting Rod and Piston Assembly

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.

PISTON & CONNECTING ROD (Continued)

(4) Use a piston ring compressor to install the connecting rod and piston assemblies through the top of the cylinder bores (Fig. 54).

(5) Ensure the arrow on the piston top points to the front of the engine (Fig. 54).

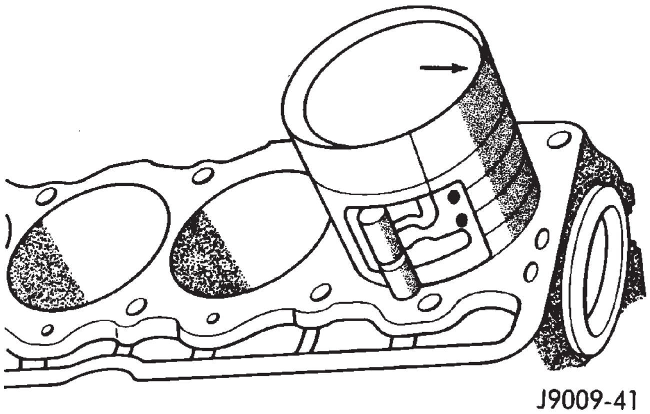


Fig. 54 Rod and Piston Assembly Installation

(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 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 (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. 55) (Fig. 56). Rotate the ring in the groove. It must move freely around circumference of the groove.

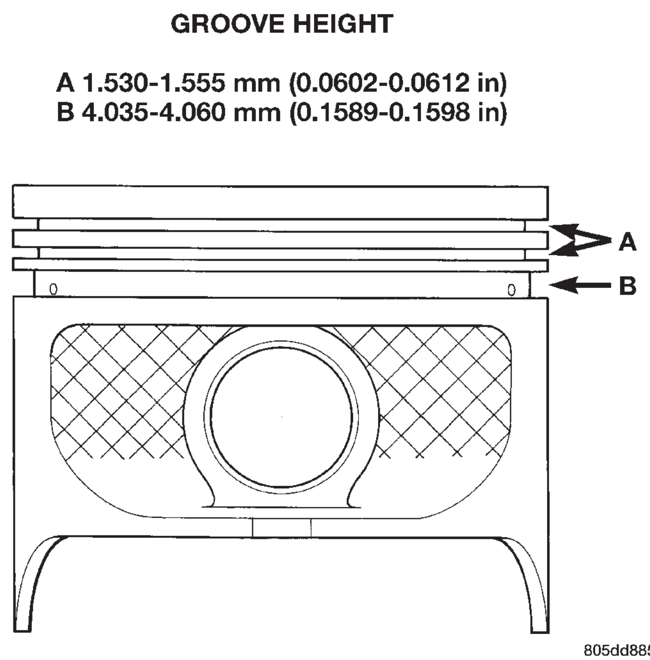


Fig. 55 Piston Dimensions

PISTON RINGS (Continued)

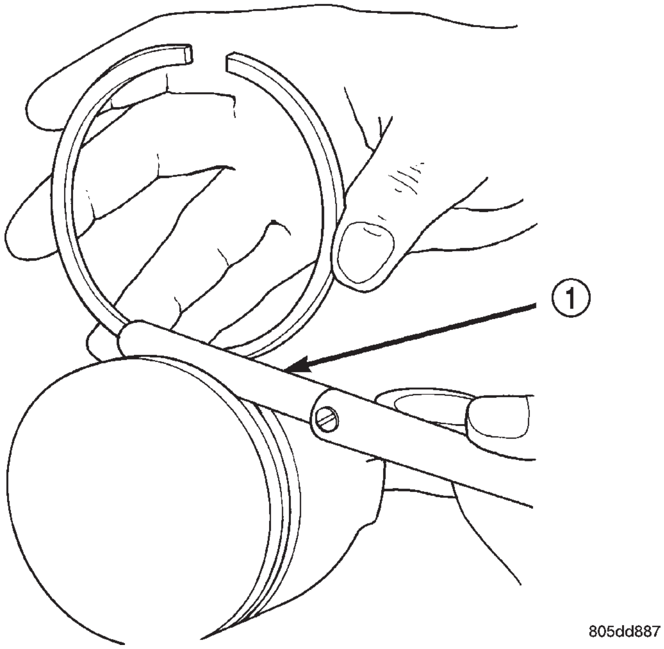


Fig. 56 Ring Side Clearance Measurement

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.)

(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. 57).

RING GAP MEASUREMENT CHART

ITEM	SPECIFICATION
Top Compression Ring	0.229 - 0.610 mm (0.0090 - 0.0240 in.)
Second Compression Ring	0.483 - 0.965 mm (0.0190 - 0.080 in.)
Oil Control Ring	0.254 - 1.500 mm (0.010 - 0.060 in.)

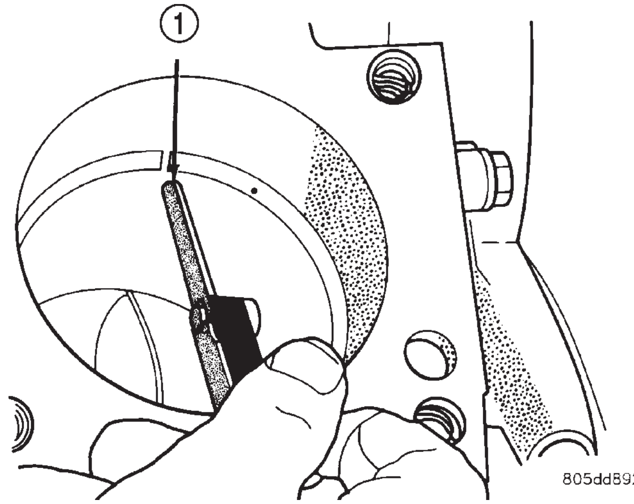


Fig. 57 Gap Measurement

1 - FEELER GAUGE

(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. 58).

(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. 60).

(8) Using a ring installer, install the second compression ring with the dot facing up (Fig. 59) (Fig. 61).

(9) Using a ring installer, install the top compression ring (either side up).

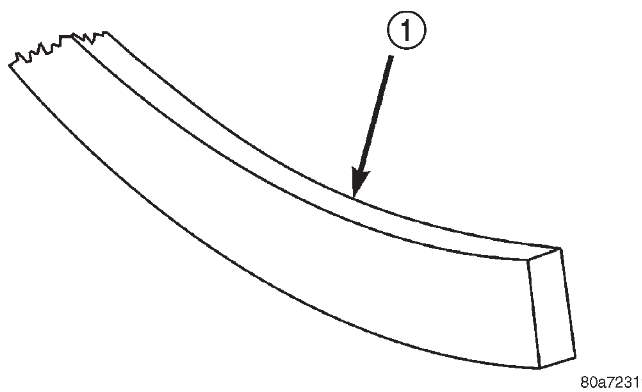


Fig. 58 Top Compression ring

1 - TOP COMPRESSION RING

PISTON RINGS (Continued)

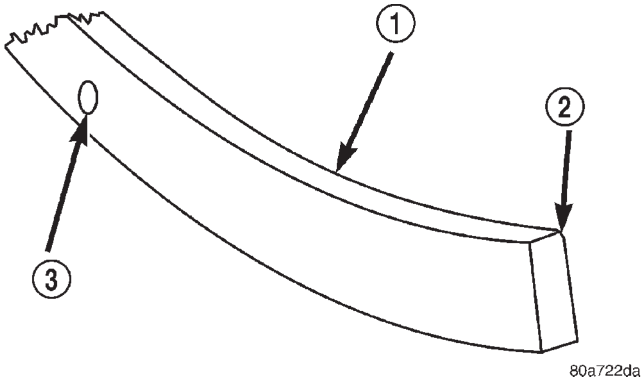


Fig. 59 Second Compression Ring Identification

1 - SECOND COMPRESSION RING
2 - CHAMFER
3 - ONE DOT

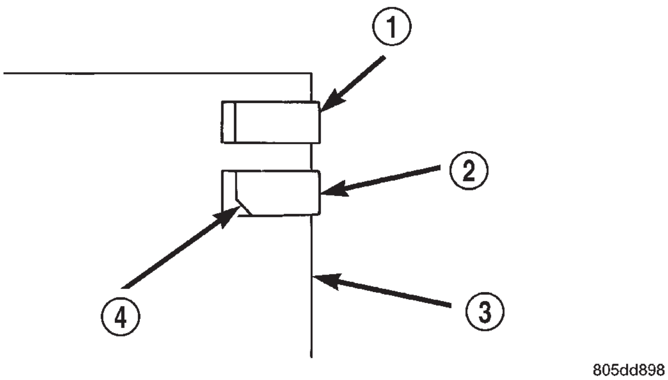


Fig. 60 Compression Ring Chamfer Location

1 - TOP COMPRESSION RING
2 - SECOND COMPRESSION RING
3 - PISTON
4 - CHAMFER

Ring Gap Orientation

- Position the gaps on the piston as shown (Fig. 62).
- 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.

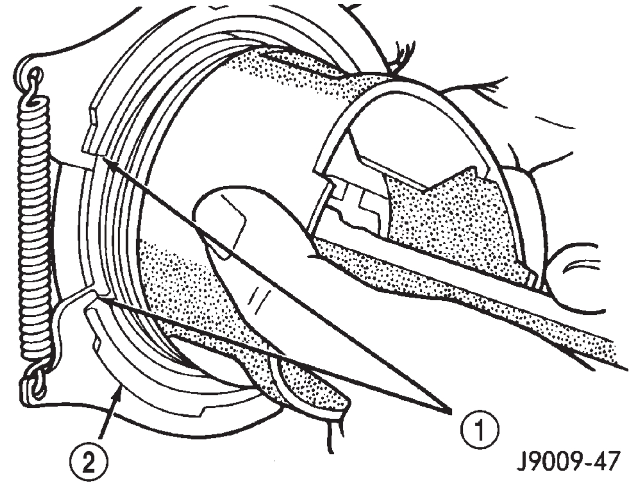


Fig. 61 Compression Ring

1 - COMPRESSION RING
2 - RING EXPANDER RECOMMENDED

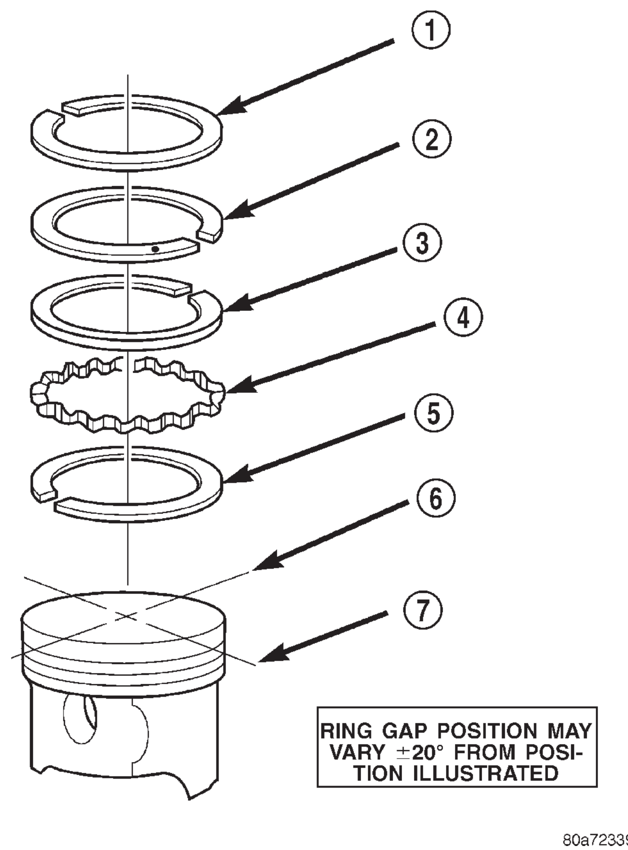


Fig. 62 Ring Gap Orientation

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. 63).

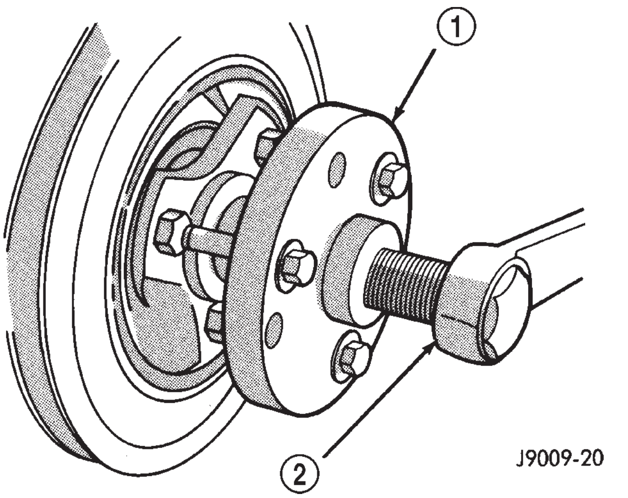


Fig. 63 Vibration Damper Removal Tool 7697

1 - VIBRATION DAMPER REMOVAL TOOL
2 - WRENCH

INSTALLATION

(1) Apply Mopar® Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key in position, align the keyway on the vibration damper hub with the crankshaft key and tap the damper onto the crankshaft.
(2) Install the vibration damper retaining bolt and washer.
(3) Tighten the damper retaining bolt to 108 N·m (80 ft. lbs.) torque.
(4) Install the serpentine drive belt (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

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 through bolt and nut.
(5) Raise engine to allow clearance when removing insulator.
(6) Remove the retaining bolts attaching insulator assembly to engine block.
(7) Remove the insulator assembly (Fig. 64) (Fig. 65).

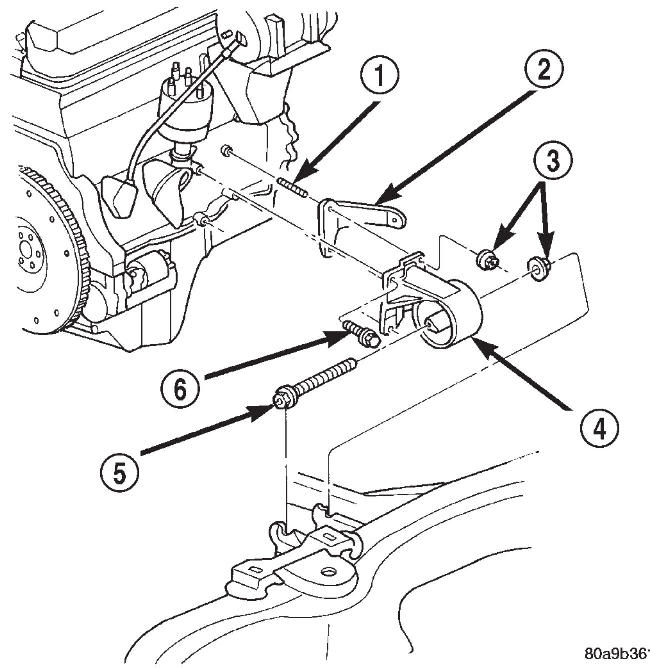


Fig. 64 Right Front Engine Mount Assembly

1 - STUD
2 - GENERATOR BRACKET
3 - NUT
4 - INSULATOR
5 - THROUGH BOLT
6 - BOLT

INSTALLATION

The front mounts support the engine at each side. These supports are made of resilient rubber.

(1) Position insulator assembly on cylinder block and install the nuts and bolts. Tighten the bolts to 81 N·m (60 ft. lbs.) torque. Tighten the nuts to 47 N·m (35 ft. lbs.)
(2) Install the through bolt and retaining nut but DO NOT TIGHTEN.
(3) Lower engine until through bolt and nut are resting in frame bracket and weight of engine is off of supporting device.
(4) Tighten the through bolt nut to 68 N·m (60 ft. lbs.) torque.
(5) Remove the engine support.
(6) Lower the vehicle.

FRONT MOUNT (Continued)

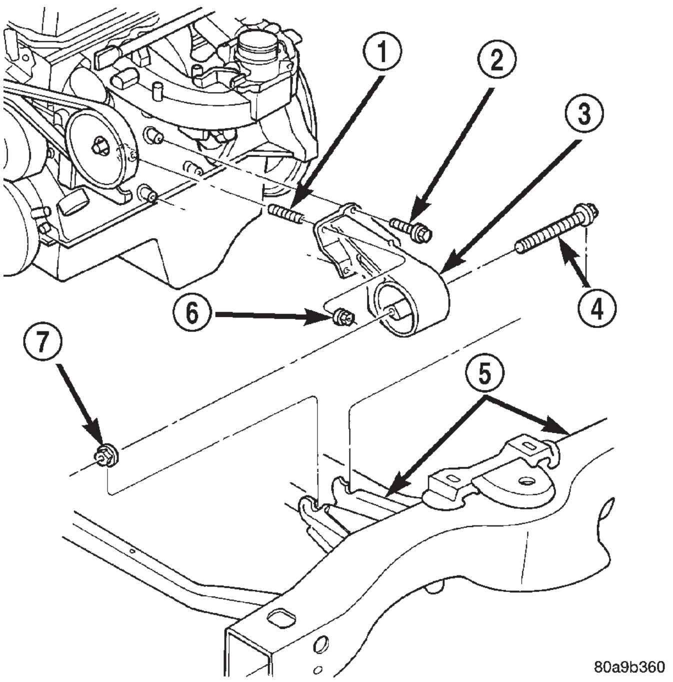


Fig. 65 Left Front Engine Mount Assembly

1 - STUD
2 - BOLT
3 - INSULATOR
4 - THROUGH BOLT
5 - FRAME
6 - NUT
7 - NUT

(7) Connect negative cable to battery.

REAR MOUNT

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise vehicle on hoist.

(3) Remove the through bolt and nut.

(4) Support the transmission with a jack. Raise transmission slightly.

(5) Remove nuts securing insulator to crossmember (Fig. 66).

(6) Remove insulator.

INSTALLATION

(1) If the rear engine support bracket was removed, position the bracket to the transmission. Tighten the stud nuts to 41 N·m (30 ft. lbs.) torque.

(2) Install the insulator onto the transmission mounting crossmember. Tighten the stud nuts to 41 N·m (30 ft. lbs.) torque.

(3) Lower the transmission and engine while aligning the rear engine support bracket to the insulator.

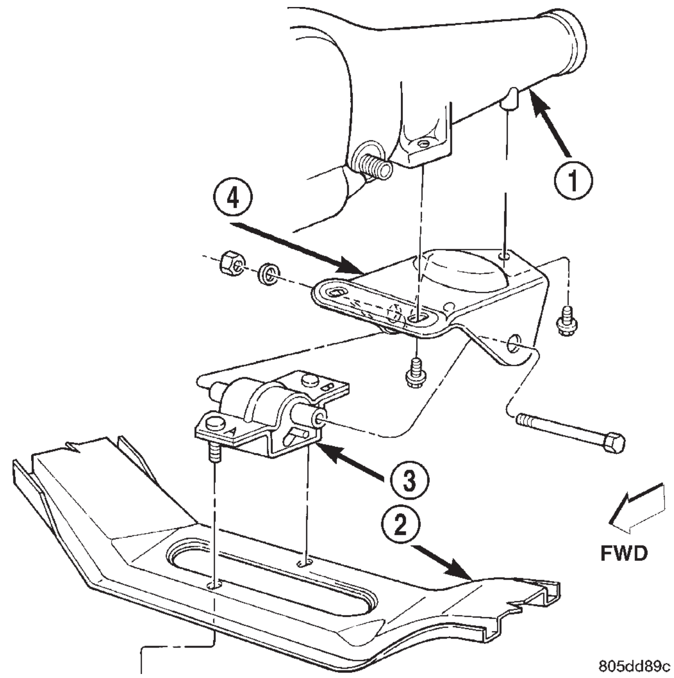


Fig. 66 Rear Engine Support

1 - TRANSMISSION
2 - CROSSMEMBER
3 - INSULATOR
4 - SUPPORT BRACKET

(a) Install through-bolt in bracket and insulator. Tighten through-bolt nut to 68 Nm (50 ft. lbs.) torque.

(4) Remove transmission jack.

(5) Lower the vehicle.

(6) Connect the negative cable to the 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

LUBRICATION (Continued)

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).

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)

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.

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.

LUBRICATION (Continued)

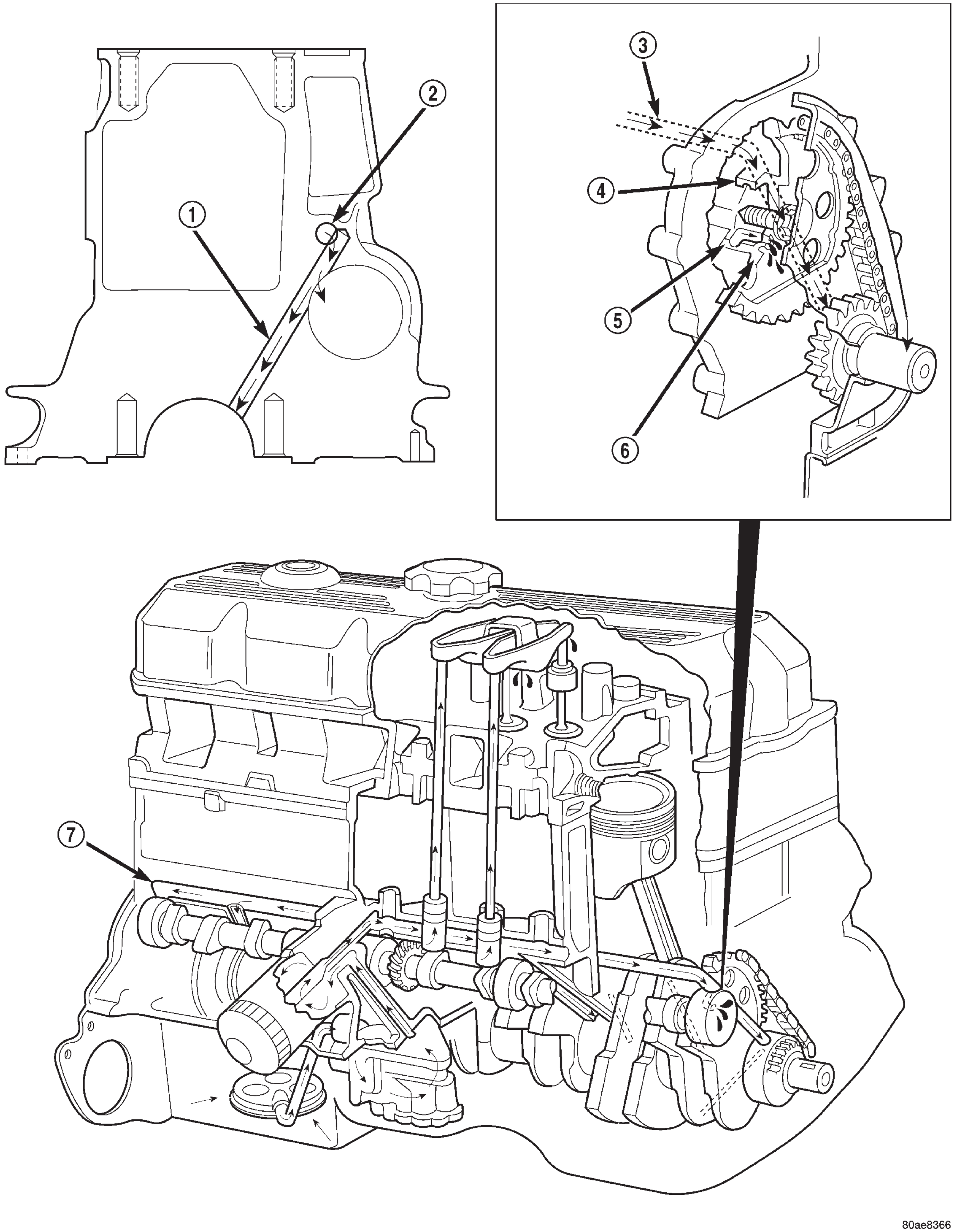


Fig. 67 Oil Lubrication System—2.5L Engine

LUBRICATION (Continued)

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

(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

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right front of the engine, left of the generator (Fig. 68).

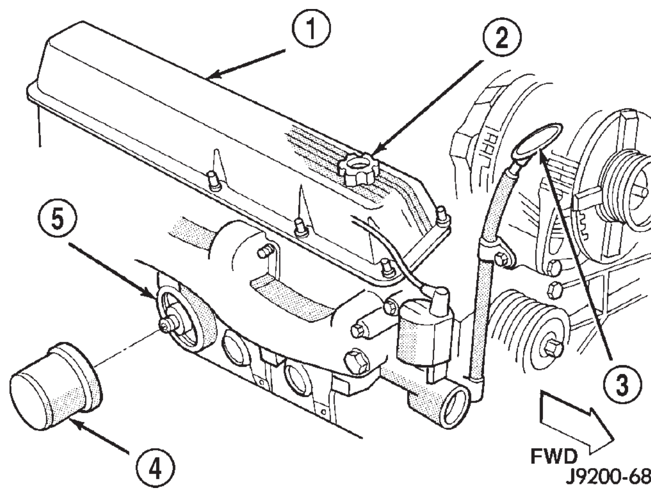


Fig. 68 Oil Level Indicator Location

1 - CYLINDER HEAD COVER
2 - ENGINE OIL FILL CAP
3 - DIPSTICK
4 - ENGINE OIL FILTER
5 - FILTER BOSS

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, oil foaming and oil pressure loss can result.

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.

(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.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in the Maintenance Schedule. This information can be found in the owner's manual.

TO CHANGE ENGINE OIL

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist vehicle.

(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 and gasket if damaged.

(6) Install drain plug in crankcase.

(7) Change oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).

OIL (Continued)

(8) Lower vehicle and fill crankcase with specified type (Refer to LUBRICATION & MAINTENANCE/ FLUID TYPES - DESCRIPTION) and amount of engine oil (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(9) Install oil fill cap.

(10) Start engine and inspect for leaks.

(11) Stop engine and inspect oil level.

OIL FILTER

REMOVAL

All engines are equipped with a high quality full-flow, disposable 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 (Fig. 69).

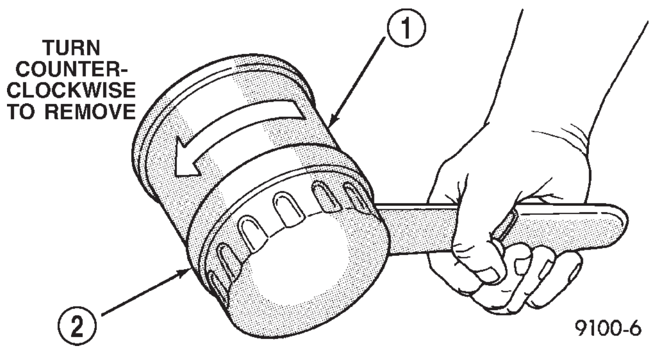


Fig. 69 Oil Filter Removal—Typical

1 - ENGINE OIL FILTER
2 - OIL FILTER WRENCH

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) With a wiping cloth, clean the gasket sealing surface (Fig. 70) of oil and grime.

(6) Install new filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).

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. 70) hand tighten filter one full turn, do not over tighten.

(3) Add oil (Refer to 9 - ENGINE/LUBRICATION/ OIL - STANDARD PROCEDURE).

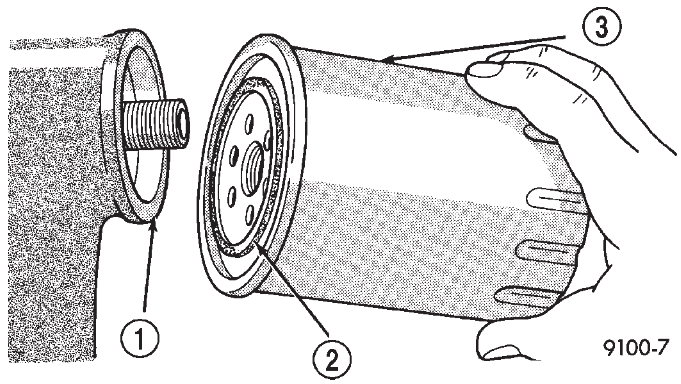


Fig. 70 Oil Filter Sealing Surface—Typical

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.**

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.

OIL PAN (Continued)

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. 71).

(3) Install two dowels in the timing case cover.

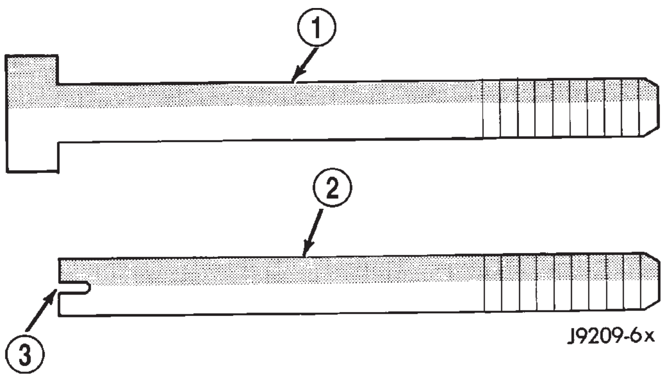


Fig. 71 Fabrication of Alignment Dowels

1 - 1/4" × 1 1/2" BOLT
2 - DOWEL
3 - SLOT

Install the other two dowels in the cylinder block (Fig. 72).

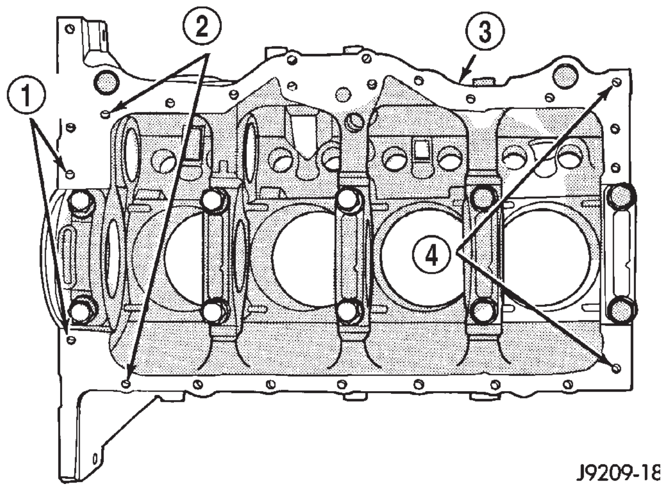


Fig. 72 Position of Dowels in Cylinder Block

1 - 5/16" HOLES
2 - DOWEL HOLES
3 - CYLINDER BLOCK
4 - 5/16" HOLES

(4) Apply Mopar® Silicone Adhesive Sealant onto the cylinder block in four location as shown (Fig. 73)

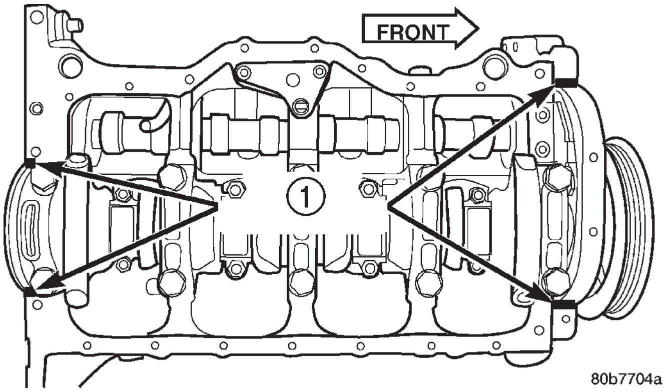


Fig. 73 Location of Mopar® Silicone Adhesive Sealant on

1 - SEALER LOCATIONS

(5) Slide the one-piece gasket over the dowels and onto the block and timing case cover.

(6) Position the oil pan over the dowels and onto the gasket.

(7) Install the 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque. Install the 5/16 inch oil pan bolts (Fig. 74). Tighten these bolts to 15 N·m (132 in. lbs.) torque.

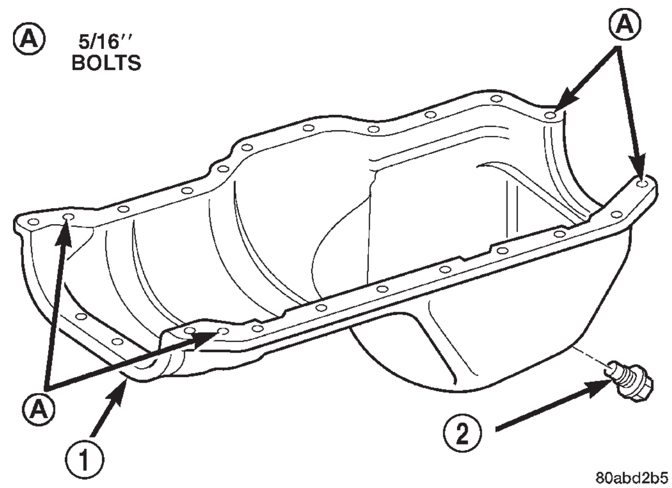


Fig. 74 Position of 5/16 inch Oil Pan Bolts

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.

OIL PAN (Continued)

(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. 74). 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.

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 PRESSURE SENSOR/ SWITCH

DESCRIPTION

The 2–wire, electrical/mechanical engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

OPERATION

The oil pressure sensor uses two circuits. They are:
- A signal to the PCM relating to engine oil pressure
- A sensor ground through the PCM's sensor return

The oil pressure 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 a CCD bus circuit 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

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. 75).

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.

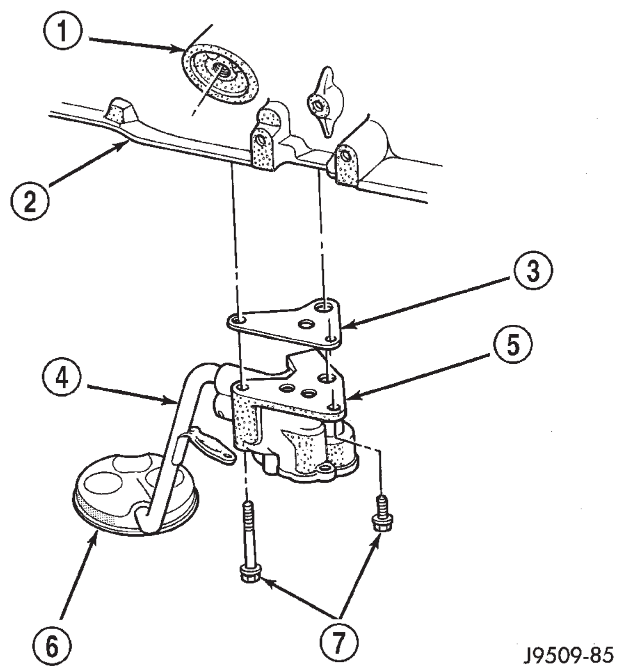


Fig. 75 Oil Pump Assembly

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.

OIL PUMP (Continued)

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.

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 (Fig. 76).

(4) Loosen the accessory drive belt tension and remove the belt from the power steering pump (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

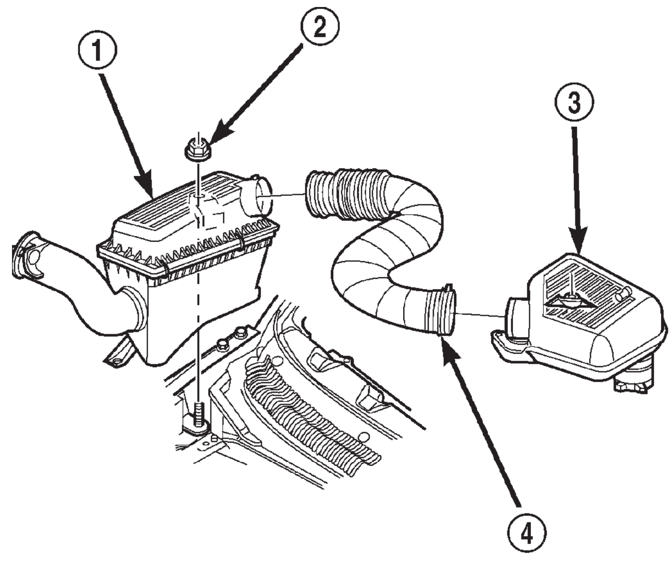


Fig. 76 Air Cleaner, Resonator and Air Inlet Hose Removal and Installation

1 - AIR CLEANER ASSEMBLY
2 - NUT AND WASHER
3 - RESONATOR ASSEMBLY
4 - AIR INLET HOSE

(5) Remove the power steering pump and brackets from the water pump and intake manifold. Secure power steering pump and bracket out of the way.

(6) Perform fuel system 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, the cruise control cable (if equipped), and the transmission line pressure cable (if equipped) from the throttle body and remove them from the cable bracket.

CAUTION: When disconnecting the cruise control connector at the throttle body, DO NOT pry the connector off with pliers or screwdriver. Use finger pressure only. Prying the connector off could break it.

(9) Disconnect the electrical connectors. Pull the harnesses away from the manifold and secure them so they do not interfere with the manifold removal and installation process.

- The throttle position sensor.
- The idle air control motor.
- The coolant temperature sensor at the thermostat.

INTAKE MANIFOLD (Continued)

• The manifold air temperature sensor at the intake manifold.
• The fuel injectors.
• The oxygen sensor.

(10) Disconnect the crankcase ventilation (CCV) vacuum hose and manifold absolute pressure (MAP) sensor vacuum hose connector at the intake manifold.

(11) Disconnect vacuum hose from vacuum port on the intake manifold.

(12) Disconnect CCV hose at the cylinder head cover (Fig. 77).

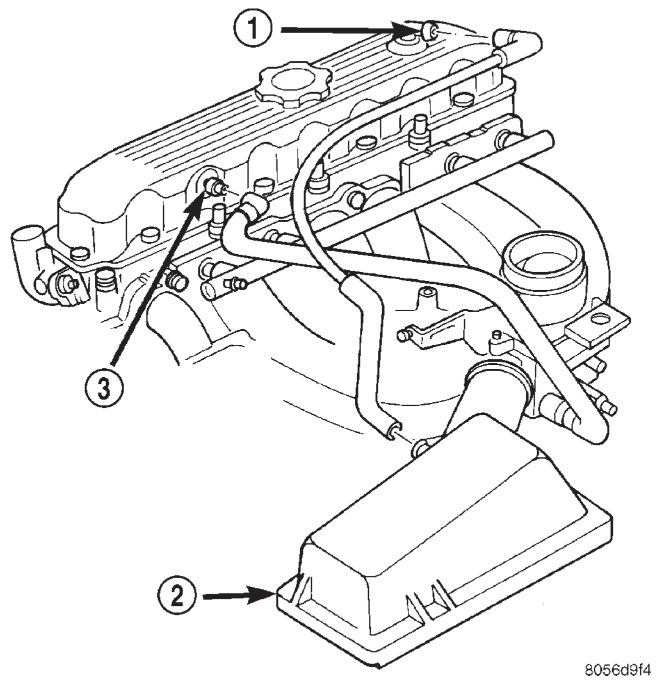


Fig. 77 Crankcase Ventilation (CCV) Hose—2.5L

1 - AIR INLET FITTING
2 - AIR FILTER COVER
3 - FIXED ORIFICE FITTING

(13) Remove the molded vacuum harness.

(14) Disconnect the vacuum brake booster hose at the intake manifold.

(15) Remove bolts 2 through 5 securing the intake manifold to the cylinder head (Fig. 78). Slightly loosen bolt No.1 and nuts 6 and 7.

(16) 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. 78).

• 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) Connect fuel supply tube to the fuel rail inlet (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(6) Pull out on the fuel supply tube to ensure that it is locked in place.

(7) Connect the molded vacuum hoses to the vacuum port on the intake manifold and the cylinder head cover.

(8) Connect the electrical connectors.

• The throttle position sensor.
• The idle air control motor.
• The coolant temperature sensor at the thermostat housing.
• The fuel injectors.
• The air manifold temperature sensor.
• The oxygen sensor.

(9) Connect the CCV vacuum hose and MAP sensor vacuum hose connectors to the throttle body.

(10) Install the power steering pump and bracket assembly to the water pump and intake manifold. Hand start the three (3) tensioner bracket to p/s pump to intake manifold bolts and the two (2) tensioner bracket to water pump bolts.

(11) Tighten the power steering pump bolts to 28 N·m (21 ft. lbs.) Tighten the tensioner bracket to water pump bolts to 28 N·m (21 ft. lbs.).

(12) Connect the accelerator cable, cruise control cable (if equipped), and the transmission line pressure cable (if equipped) to the hold-down bracket and the throttle lever.

(13) Install and tension the accessory drive belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

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.

(14) Connect the air inlet hose and resonator to the throttle body and the air cleaner. Tighten clamps to 4 N·m (35 in. lbs.).

(15) Connect the battery negative cable.

(16) 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. 78).

(8) Remove fasteners 1, 6 and 7 and remove the engine exhaust manifold (Fig. 78).

CLEANING

Clean mating surfaces on cylinder head and manifold, wash with solvent and blow dry with compressed air.

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.

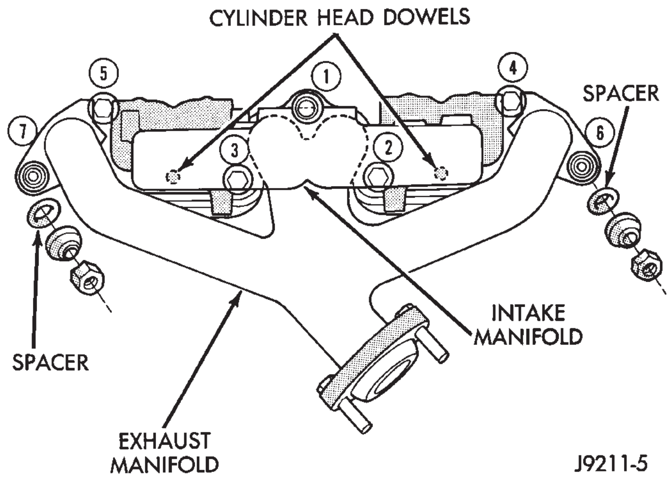


Fig. 78 Intake/Exhaust Manifold Removal/Installation

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. 78).**

(4) Tighten bolt No.1 to 41 N·m (30 ft. lbs.) torque (Fig. 78).

(5) Install the intake manifold on the cylinder head dowels (Fig. 78).

(6) Install bolts 2 through 5 (Fig. 78). 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. 78).

(8) Tighten nuts 6 and 7 to 23 N·m (17 ft. lbs.) torque (Fig. 78).

(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. 79) .

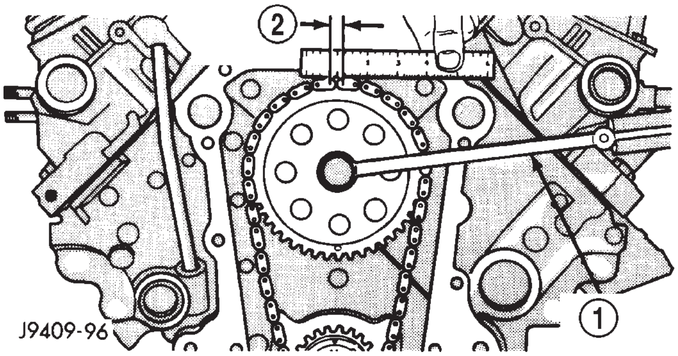


Fig. 79 Measuring Timing Chain Wear and Stretch

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. 80).

(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. 80).

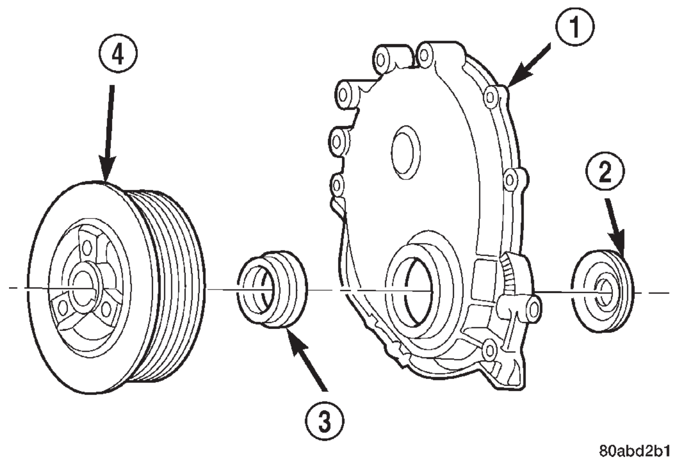


Fig. 80 Timing Case Cover Components

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 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. 81).

(6) Install the timing case cover-to-cylinder block and the oil pan-to-timing case cover bolts.

TIMING BELT / CHAIN COVER(S) (Continued)

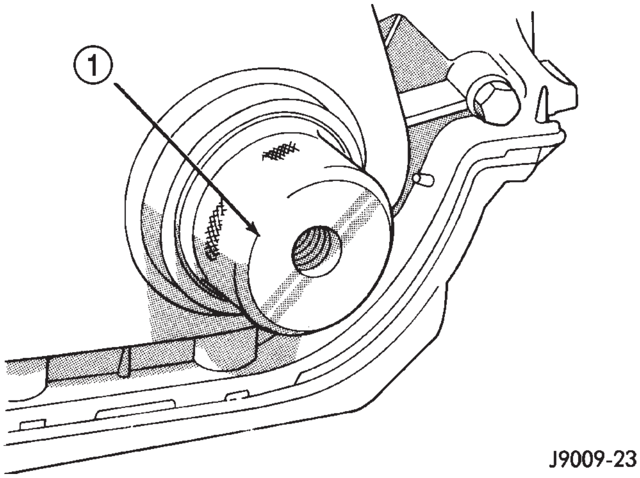


Fig. 81 Timing Case Cover Alignment and Seal Installation Tool 6139

1 - TIMING CASE COVER ALIGNMENT AND SEAL INSTALLATION TOOL

(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. 82).

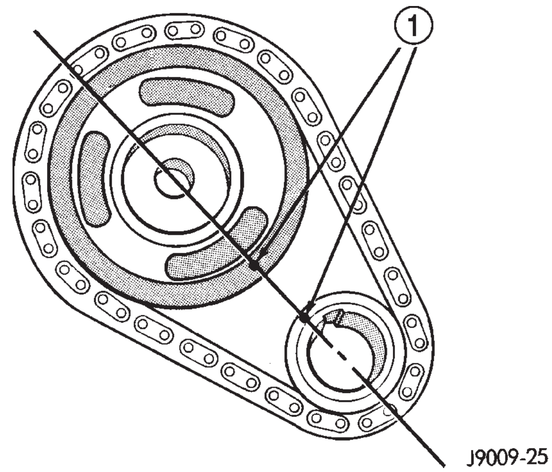


Fig. 82 Crankshaft—Camshaft Alignment

1 - TIMING MARKS

(7) Remove the oil slinger from the crankshaft.

(8) Remove the camshaft retaining bolt and remove the sprockets and chain as an assembly (Fig. 83).

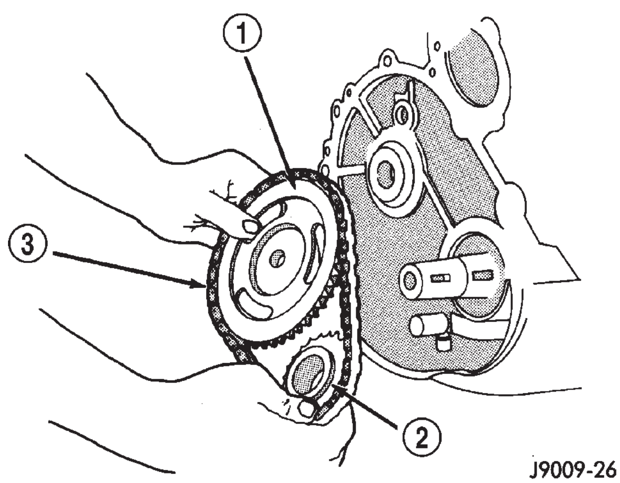


Fig. 83 Camshaft and Crankshaft Sprockets and Chain

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. 84).

(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. 84).

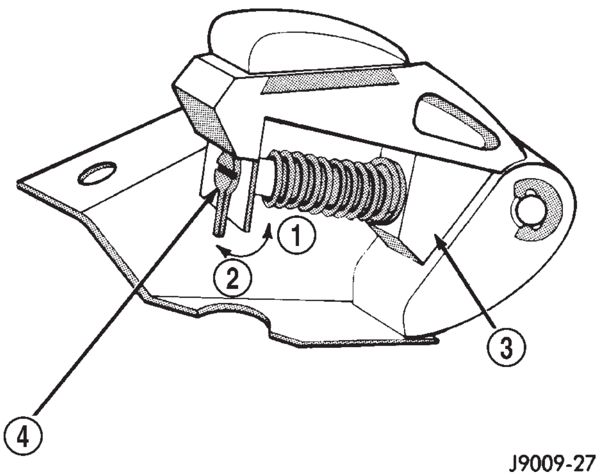


Fig. 84 Loading Timing Chain Tensioner

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. 82).

(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. 85). Count the number of chain pins between the timing marks of both sprockets. There must be 20 pins.

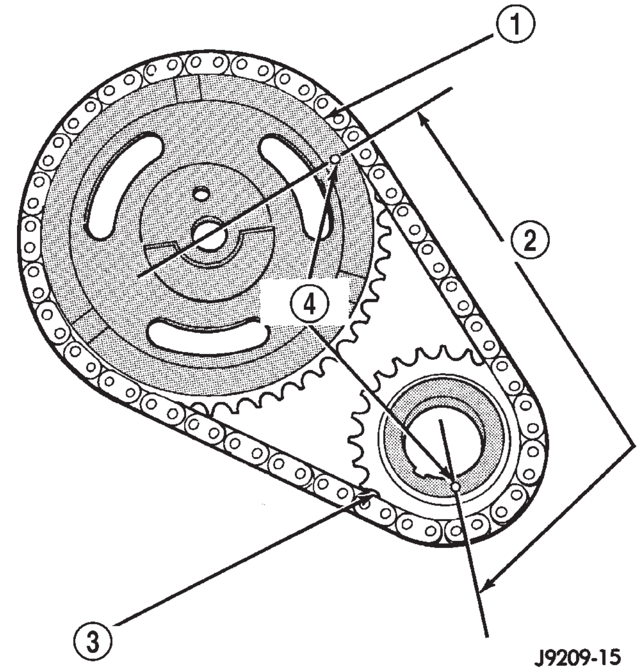


Fig. 85 Verify Sprocket—Chain Installation

1 - CAMSHAFT SPROCKET
2 - 20 PINS
3 - CRANKSHAFT SPROCKET
4 - TIMING MARKS

(6) Turn the chain tensioner lever to the unlocked (down) position (Fig. 84).

(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 3.9L

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ENGINE 3.9L

DESCRIPTION

The 3.9 Liter (238 CID) six-cylinder engine is a V-Type, lightweight, single cam, overhead valve engine with hydraulic roller tappets. This engine is designed to use unleaded fuel.

The engine lubrication system consists of a rotor type oil pump and a full-flow oil filter.

The cylinders are numbered from front to rear; 1, 3, 5 on the left bank and 2, 4, 6 on the right bank. The firing order is 1-6-5-4-3-2 (Fig. 1).

The engine serial number is stamped into a machined pad located on the left front corner of the cylinder block. When component part replacement is necessary, use the engine type and serial number for reference (Fig. 2).

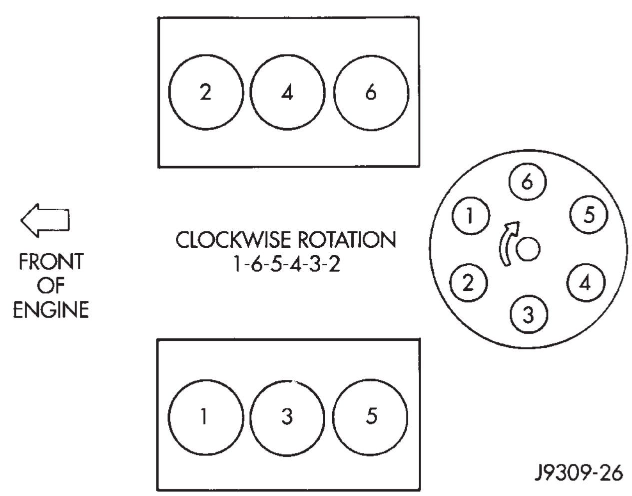


Fig. 1 Firing Order

ENGINE 3.9L (Continued)

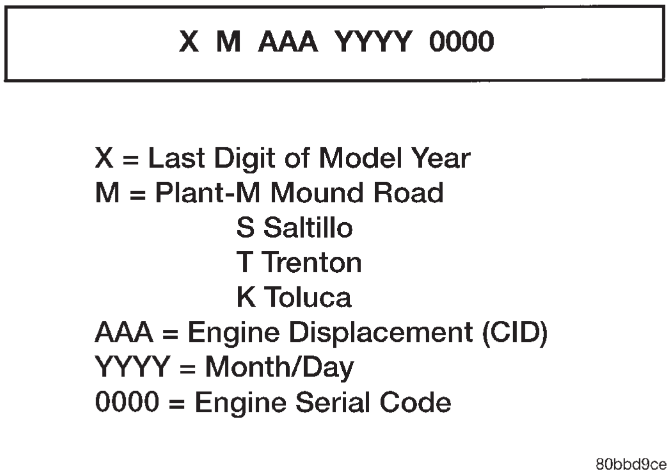


Fig. 2 Engine Identification (Serial) Number

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 mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Preformance) or (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Mechanical). Refer to 14 - FUEL SYSTEM for fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that cannot be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following:

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- 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)
- Lash Adjuster (Tappet) Noise Diagnosis (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - DIAGNOSIS AND TESTING)
- Engine Oil Leak Inspection (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)

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 3.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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
	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)

ENGINE 3.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	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 3.9L (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 3.9L (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 3.9L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings.	1.
	(a) Misaligned or damaged.	(a) Replace as necessary.
	(b) Loose fasteners, broken or porous metal parts.	(b) Tighten fasteners, Repair or replace metal parts.
	2. Crankshaft rear seal	2. Replace as necessary.
	3. Crankshaft seal flange. Scratched, nicked or grooved.	3. Polish or replace crankshaft.
	4. Oil pan flange cracked.	4. Replace oil pan.
	5. Timing chain cover seal, damaged or misaligned.	5. Replace seal.
	6. Scratched or damaged vibration damper hub.	6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sending unit.	2. Replace sending unit.
	3. Low oil pressure.	3. Check pump and bearing clearance.
	4. Clogged oil filter.	4. Replace oil filter.
	5. Worn oil pump.	5. Replace as necessary.
	6. Thin or diluted oil.	6. Change oil and filter.
	7. Excessive bearing clearance.	7. Replace as necessary.
	8. Oil pump relief valve stuck.	8. Clean or replace relief valve.
	9. Oil pump suction tube loose or damaged.	9. Replace as necessary.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in oil ring slots.	2. Replace rings.
	3. Incorrect ring size installed.	3. Replace rings.
	4. Worn valve guides.	4. Ream guides and replace valves.
	5. Leaking intake gasket.	5. Replace intake gaskets.
	6. Leaking valve guide seals.	6. Replace valve guide seals.

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.

ENGINE 3.9L (Continued)

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.

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART below

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—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.

ENGINE 3.9L (Continued)

CAUTION: DO NOT use engine or transmission oil, mineral spirits, or kerosene.

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 3).

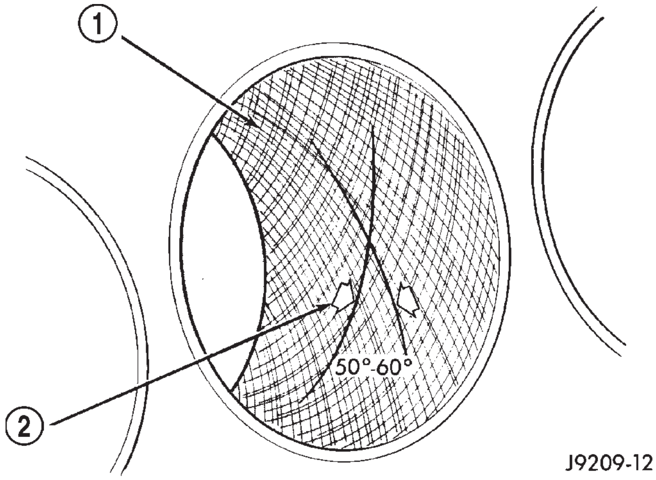


Fig. 3 Cylinder Bore Crosshatch Pattern

1 - CROSSHATCH PATTERN
2 - INTERSECT ANGLE

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper cross-hatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the cross-hatch 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.

STANDARD PROCEDURE - ENGINE GASKET SURFACE PREPARATION

To ensure engine gasket sealing, proper surface preparation must be performed.

Never use the following to clean gasket surfaces:

- Metal scraper
- Abrasive pad or paper to clean cylinder block and head
- High speed power tool with an abrasive pad or a wire brush (Fig. 4)

Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover
- Plastic or wood scraper (Fig. 4)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (Fig. 4)

CAUTION: Excessive pressure or high RPM (beyond the recommended speed), can damage the sealing surfaces. The mild (white, 120 grit) bristle disc is recommended. If necessary, the medium (yellow, 80 grit) bristle disc may be used on cast iron surfaces with care.

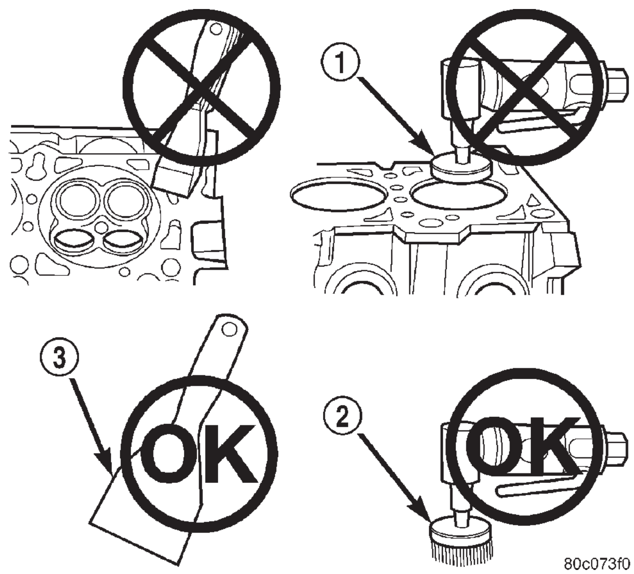


Fig. 4 PROPER TOOL USAGE FOR SURFACE PREPARATION

1 - ABRASIVE PAD
2 - 3M ROLOC™ BRISTLE DISC
3 - PLASTIC/WOOD SCRAPER

STANDARD PROCEDURE - ENGINE CORE AND OIL GALLERY PLUGS

Using a blunt tool such as a drift and a hammer, strike the bottom edge of the cup plug. With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 5).

CAUTION: Do not drive cup plug into the casting as restricted cooling can result and cause serious engine problems.

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer. Lightly coat inside of cup plug hole with Mopar® Stud and Bearing Mount. Make certain the new plug is cleaned of all oil or grease. Using proper drive plug, drive plug into hole so that the sharp edge of the plug is at least 0.5 mm (0.020 in.) inside the lead-in chamfer.

It is not necessary to wait for curing of the sealant. The cooling system can be refilled and the vehicle placed in service immediately.

ENGINE 3.9L (Continued)

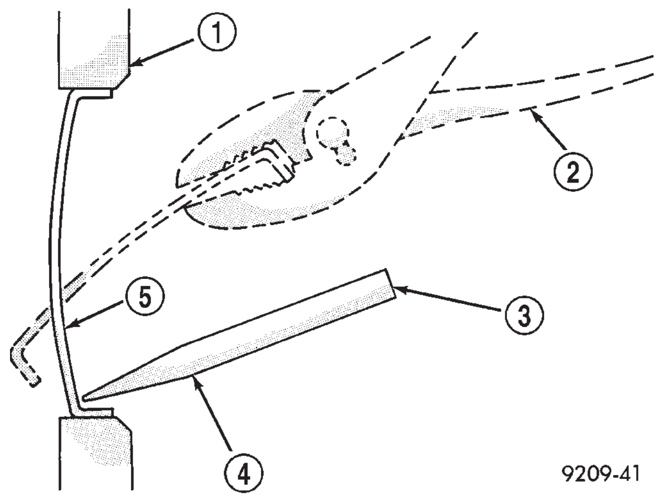


Fig. 5 Core Hole Plug Removal

1 - CYLINDER BLOCK
2 - REMOVE PLUG WITH PLIERS
3 - STRIKE HERE WITH HAMMER
4 - DRIFT PUNCH
5 - CUP PLUG

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.

(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 - 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 - 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.

ENGINE 3.9L (Continued)

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.

REMOVAL

(1) Scribe hood hinge outlines on hood. Remove the hood.

(2) Remove the battery.

(3) Drain cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Remove the air cleaner, air in-let hose and resonator assembly.

(5) Disconnect the radiator and heater hoses. Remove radiator. (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(6) Disconnect the vacuum lines from the intake manifold.

(7) Remove the distributor cap and wiring.

(8) Disconnect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL).

(9) Remove throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).

(10) Perform the Fuel System Pressure Release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(11) Disconnect the starter wires.

(12) Disconnect the oil pressure wire.

(13) Discharge the air conditioning system, if equipped. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(14) Disconnect the air conditioning hoses.

(15) Disconnect the power steering hoses, if equipped.

(16) Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(17) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(18) Raise and support the vehicle on a hoist.

(19) Disconnect exhaust pipe at manifolds.

(20) RemoveTransmission. Refer to 21 - TRANSMISSION AND TRANSFER CASE.

CAUTION: DO NOT lift the engine by the intake manifold.

(21) Install an engine lifting fixture.

(22) **2WD VEHICLES**—Remove engine front mount bolts.

(23) **4WD VEHICLES**—The engine and front driving axle (engine/axle/transmission) are connected through insulators and support brackets. Separate the engine as follows:

- **LEFT SIDE**—Remove 2 bolts attaching (engine/pinion nose/transmission) bracket to transmission bell housing. Remove 2 bracket to pinion nose adap-

ENGINE 3.9L (Continued)

tor bolts. Separate engine from insulator by removing upper nut washer assembly and bolt from engine support bracket.

- **RIGHT SIDE**—Remove 2 bracket to axle (disconnect housing) bolts and 1 bracket to bell housing bolt. Separate engine from insulator by removing upper nut washer assembly and bolt from engine support bracket.

(24) Lower the vehicle.

(25) On automatic transmission vehicles, disconnect the engine from the torque converter drive plate. On manual transmission vehicles, move engine forward until drive pinion shaft clears the clutch disc. Remove engine from engine compartment.

(26) Install engine assembly on engine repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment.

(2) Install an engine support fixture.

(3) Raise and support the vehicle on a hoist.

(4) Install transmission.

(5) Install the front engine mounts (Refer to 9 - ENGINE/ENGINE MOUNTING/FRONT MOUNT - INSTALLATION).

(6) Install exhaust pipe to manifold.

(7) Lower the vehicle.

(8) Remove engine lifting fixture.

(9) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

(10) Install starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(11) Connect power steering hoses, if equipped.

(12) Connect air conditioning hoses.

(13) Evacuate and charge the air conditioning system, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(14) Using a new gasket, install throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - INSTALLATION).

(15) Connect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - INSTALLATION).

(16) Connect the starter wires.

(17) Connect the oil pressure sensor wire.

(18) Install the distributor cap and wiring.

(19) Connect the vacuum lines.

(20) Connect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(21) Install the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION). Connect the radiator hoses and heater hoses.

(22) Install fan shroud in position.

(23) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(24) Install the air cleaner, resonator assembly and air in-let hose. Tighten clamps to 4 N·m (35 in. lbs.).

(25) Install the battery.

(26) Warm engine and adjust.

(27) Install hood and line up with the scribe marks.

(28) Road test vehicle.

SPECIFICATIONS

TORQUE

TORQUE CHART 3.9L ENGINE

DESCRIPTION	N·m	In. Lbs.	Ft. Lbs.
Camshaft Sprocket—Bolt	68	—	50
Camshaft Thrust Plate—Bolts	24	210	—
Timing Chain Case Cover— Bolts	41	—	30
Connecting Rod Cap—Bolts	61	—	45
Main Bearing Cap—Bolts	115	—	85
Crankshaft Pulley—Bolts	24	210	—
Cylinder Head—Bolts			
Step 1	68	—	50
Step 2	143	—	105
Cylinder Head Cover—Bolts	11	95	—
Engine Support Bracket to Block (4wd)—Bolts	41	—	30
Exhaust Manifold to Cylinder Head—bolts/nuts	34	—	25
Flywheel—Bolts	75	—	55
Front Insulator—through Bolts	95	—	70
Front Insulator to Support Bracket (4wd)			
—Stud Nut	41	—	30
—Through Bolt/Nut	102	—	75
Front Insulator to Block—	95	—	70

ENGINE 3.9L (Continued)

DESCRIPTION	N·m	In.	Ft.
Bolts (2wd)			
Generator—Mounting Bolt	41	—	30
Intake Manifold—Bolts	Refer to Procedure		
Oil Pan—Bolts	24	215	—
Oil Pan—Drain Plug	34	—	25
Oil Pump—Mounting Bolts	41	—	30
Oil Pump Cover—Bolts	11	95	—
Rear Insulator to Bracket— Through-Bolt (2WD)	68	—	50
Rear Insulator to Crossmember Support Bracket—Nut (2WD)	41	—	30
Rear Insulator to Crossmember—Nuts (4WD)	68	—	50
Rear Insulator to Transmission — Bolts (4WD)	68	—	50
Rear Insulator Bracket—Bolts (4WD Automatic)	68	—	50
Rear Support Bracket to Crossmember Flange—Nuts	41	—	30
Rear Support Plate to Transfer Case—Bolts	41	—	30
Rocker Arm—Bolts	28	—	21
Spark Plugs	41	—	30
Starter Motor—Mounting Bolts	68	—	50
Thermostat Housing—Bolts	25	225	—
Throttle Body—Bolts	23	200	—
Torque Converter Drive Plate— Bolts	31	270	—
Transfer Case to Insulator Mounting Plate—Nuts	204	—	150
Transmission Support Bracket —Bolts (2WD)	68	—	50
Vibration Damper—Bolt	183	—	135
Water Pump to Timing Chain Case Cover— Bolts	41	—	30

3.9L ENGINE

GENERAL DESCRIPTION

DESCRIPTION	SPECIFICATION
Engine Type	90° V-6 OHV
Bore and Stroke	99.3 x 84.0 mm (3.91 x 3.31 in.)
Displacement	3.9L (238 c.i.)
Compression Ratio	9.1:1
Firing Order	1–6–5–4–3–2
Cylinder Compression Pressure (Min.)	689.5 kPa (100 psi)
CAMSHAFT	
Bearing Diameter (Inside)	
No. 1	50.800 - 50.825 mm (2.000 - 2.001 in.)
No. 2	50.394 - 50.825 mm (1.984 - 1.985 in.)
No. 3	49.606 - 49.632 mm (1.953 - 1.954 in.)
No. 4	39.688 - 39.713 mm (1.5265 - 1.5653 in.)
Journal Diameter	
No. 1	50.749 - 50.775 mm (1.998 - 1.999 in.)
No. 2	50.343 - 50.368 mm (1.982 - 1.983 in.)
No. 3	49.555 - 49.581 mm (1.951 - 1.952 in.)
No. 4	39.637 - 39.662 mm (1.5605 - 1.5615 in.)

ENGINE 3.9L (Continued)

DESCRIPTION	SPECIFICATION
Bearing to Journal Clearance	
Standard	0.0254 - 0.0762 mm (0.001 - 0.003 in.)
Max Allowable	0.127 mm (0.005 in.)
End Play	0.051 - 0.254 mm (0.002 - 0.010 in.)
CONNECTING RODS	
Piston Pin Bore Diameter	24.940 - 24.978 mm (0.9819 - 0.9834 in.)
Side Clearance (Two Rods)	0.152 - 0.356 mm (0.006 - 0.014 in.)
Total Weight	762 grams (25.61 oz.)
CRANKSHAFT	
Rod Journal Diameter	53.950 - 53.975 mm (2.124 - 2.125 in.)
Rod Journal Out of Round (Max)	0.0254 mm (0.001 in.)
Rod Journal Taper (Max)	0.0254 mm (0.001 in.)
Rod Journal Bearing Clearance	0.013 - 0.056 mm (0.0005 - 0.0022 in.)
Rod Journal Service Limit	0.08 mm (0.003 in.)
Main Journal Diameter	63.487 - 63.513 mm (2.4995 - 2.5005 in.)
Main Journal Out of Round (Max)	0.0254 mm (0.001 in.)

DESCRIPTION	SPECIFICATION
Main Journal Taper (Max)	0.0254 mm (0.001 in.)
Main Journal Beraing Clearance	
No. 1	0.013 - 0.038 mm (0.0005 - 0.0015 in.)
No. 2 - 4	0.013 - 0.051 mm (0.0005 - 0.0020 in.)
Service Limit	0.064 mm (0.0025 in.)
End Play	0.051 - 0.178 mm (0.002 - 0.007 in.)
End Play Service Limit	0.254 mm (0.010 in.)
CYLINDER BLOCK	
Cylinder Bore Diameter	99.308 - 99.371 mm (3.9098 - 3.9122 in.)
Cylinder Bore Out of Round and taper (Max)	0.025 mm (0.001 in.)
Lifter Bore Diameter	22.99 - 23.01 mm (0.9501 - 0.9059 in.)
Distributor Drive Bushing to Bore Interference (Press Fit)	0.0127 - 0.3556 mm (0.0005 - 0.0140 in.)
Distributor Shaft to Bushing Clearance	0.0178 - 0.0686 mm (0.0007 - 0.0027 in.)
CYLINDER HEAD and VALVES	
Valve Seat Angle	44.25° - 44.75°
Valve Seat Runout (Max)	0.0762 mm (0.003 in.)

ENGINE 3.9L (Continued)

DESCRIPTION	SPECIFICATION
Valve Seat Width (Finish)	
Intake	1.016 - 1.542 mm (0.040 - 0.060 in.)
Exhaust	1.524 - 2.032 mm (0.040 - 0.060 in.)
Valve Face Angle	43.25° - 43.75°
Valve Head Diameter	
Intake	48.666 mm (1.916 in.)
Exhaust	41.250 mm (1.624 in.)
Valve Length (Overall)	
Intake	124.28 - 125.92 mm (4.893 - 4.918 in.)
Exhaust	124.64 - 125.27 mm (4.907 - 4.932 in.)
Valve Lift (@ Zero Lash)	10.973 mm (0.432 in.)
Valve Stem Diameter	7.899 - 7.925 mm (0.311 - 0.312 in.)
Valve Guide Bore Diameter	7.950 - 7.976 mm (0.313 - 0.314 in.)
Valve Stem to Guide Clearance	0.0254 - 0.0762 mm (0.001 - 0.003 in.)
Valve Stem to Guide Clearance Service Limit (Rocking Method)	0.4318 mm (0.017 in.)
VALVE SPRINGS	
Free Length	49.962 mm (1.967 in.)
Spring Tension	
Valve Closed	378 N @ 41.66 mm (85 lbs. @ 1.64 in.)
Valve Open	890 N @ 30.89 mm (200 lbs. @ 1.212 in.)

DESCRIPTION	SPECIFICATION
Number of Coils	6.8
Installed Height	41.66 mm (1.64 in.)
Wire Diameter	4.50 mm (0.177 in.)
HYDRAULIC TAPPETS	
Body Diameter	22.949 - 22.962 mm (0.9035 - 0.9040 in.)
Clearance in Block	0.0279 - 0.0610 mm (0.0011 - 0.210 in.)
Dry Lash	1.524 - 5.334 mm (0.060 - 0.210 in.)
Push Rod Length	175.64 - 176.15 mm (6.915 - 6.935 in.)
OIL PRESSURE	
@ Curb Idle (Min.)*	41.4 kPa (6 psi)
@ 3000 rpm	207 - 552 kPa (30 - 80 psi)
Bypass Valve Setting	62 - 103 kPa (9 - 15 psi)
Switch Actuating Pressure	34.5 - 48.3 kPa (5 - 7 psi)
*** If oil pressure is zero at curb idle, DO NOT RUN ENGINE.**	
OIL PUMP	
Clearance Over Rotors	
(Max)	0.1016 mm (0.004 in.)
Cover Out of Flat	
(Max)	0.0381 mm (0.0015 in.)
Inner Rotor Thickness	
(Min)	20.955 mm (0.825 in.)

ENGINE 3.9L (Continued)

DESCRIPTION	SPECIFICATION
Outer Rotor Clearance (Max)	0.3556 mm (0.014 in.)
Outer Rotor Diameter (Min)	62.7126 mm (2.469 in.)
Outer Rotor Thickness (Min)	20.955 mm (0.825 in.)
Tip Clearance Between Rotors (Max)	0.2032 mm (0.008 in.)
PISTONS	
Clearance at Top of Skirt	0.0127 - 0.0381 mm (0.0005 - 0.0015 in.)
Land Clearance (Diameter)	0.635 - 1.016 mm (0.025 - 0.040 in.)
Piston Length	86.360 mm (3.40 in.)
Ring Groove Depth #1 & 2 #3	 4.572 - 4.826 mm (0.180 - 0.190 in.) 3.810 - 4.064 mm (0.150 - 0.160 in.)
Weight	592.6 - 596.6 grams (20.90 - 21.04 oz.)
PISTON PINS	
Clearance in Piston	0.0064 - 0.0191 mm (0.00025 - 0.00075 in.)
Clearance in Rod (Interference)	0.0178 - 0.0356 mm (0.0007 - 0.0014 in.)

DESCRIPTION	SPECIFICATION
Diameter	24.996 - 25.001 mm (0.9841 - 0.9843 in.)
End Play Length	None 75.946 - 76.454 mm (2.990 - 3.010 in.)
PISTON RINGS	
Ring Gap Compression Rings Oil Control (Steel Rails)	 0.254 - 0.508 mm (0.010 - 0.020 in.) 0.254 - 1.270 mm (0.010 - 0.050 in.)
Ring Side Clearance Compression Rings Oil Control (Steel Rails)	 0.038 - 0.076 mm (0.0015 - 0.0030 in.) 0.06 - 0.21 mm (0.002 - 0.008 in.)
Ring Width Compression Rings Oil Control (Steel Rails)	 1.971 - 1.989 mm (0.0776 - 0.0783 in.) 3.848 - 3.975 mm (0.1515 - 0.1565 in.)
VALVE TIMING	
Exhaust Valve Closes Opens Duration	 16° (ATDC) 52° (BBDC) 248°
Intake Valve Closes Opens Duration	 50° (ABDC) 10° (BTDC) 240°
Valve Overlap	26°

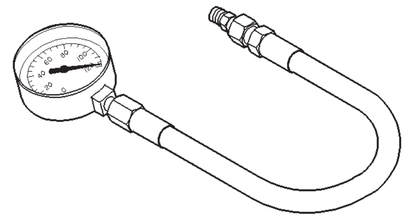
ENGINE 3.9L (Continued)

OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS CHART

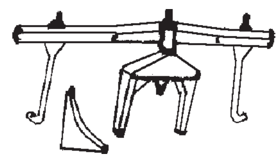
OS-US	Item	Identification	Location of Identification
U/S .0254 MM (.001 IN.)	Crankshaft	R or M M-2-3 ect. (indicating No. 2 & 3 main bearing journal) and/or R-1-4 ect. (indicating No. 1 & 4 connecting rod journal)	Milled flat on No. eight crankshaft counterweight.
O/S .2032 mm (.008 in.)	Tappets	◊	3/8″ diamound -shaped stamp Top pad — Front of engine and flat ground on outside surface of each O/S tappet bore.
O/S .127 mm (0.005 in.)	Valve Stems	X	Milled pad adjacent to two 3/8″ tapped holes on each end of cylinder head.

SPECIAL TOOLS

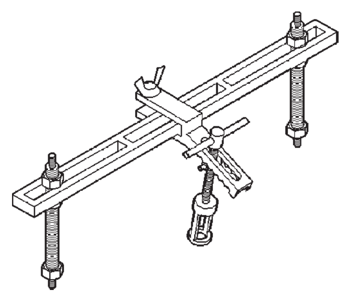
ENGINE—3.9L



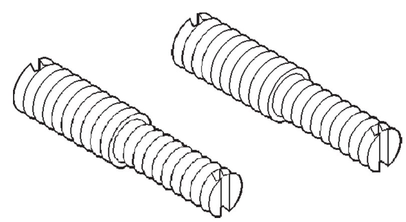
Oil Pressure Gauge C-3292



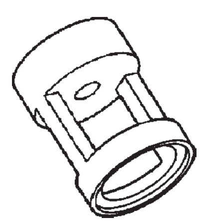
Engine Support Fixture C-3487–A



Valve Spring Compressor MD-998772–A

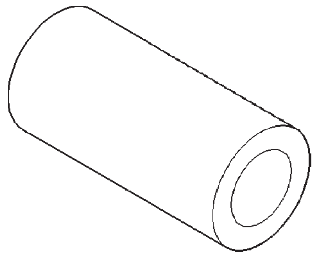


Adapter 6633

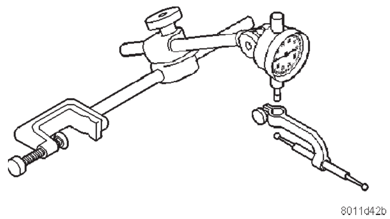


Adapter 6716A

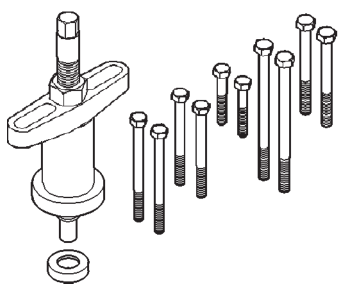
ENGINE 3.9L (Continued)



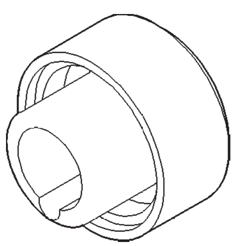
Valve Guide Sleeve C-3973



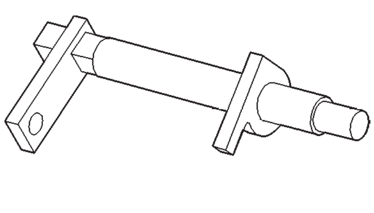
Dial Indicator C-3339



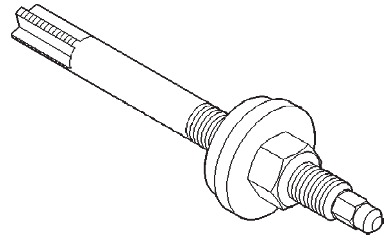
Puller C-3688



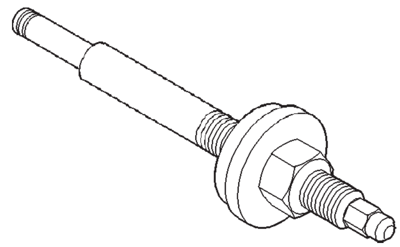
Front Oil Seal Installer 6635



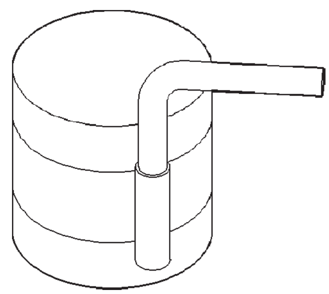
Camshaft Holder C-3509



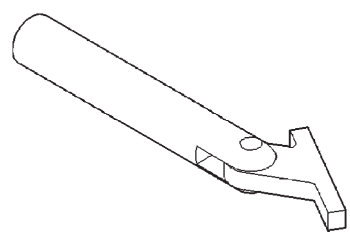
Distributor Bushing Puller C-3052



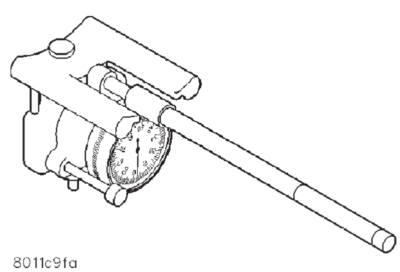
Distributor Bushing Driver/Burnisher C-3053



Piston Ring Compressor C-385

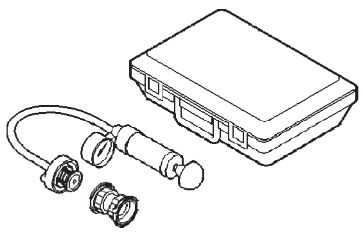


Crankshaft Main Bearing Remover C-3059

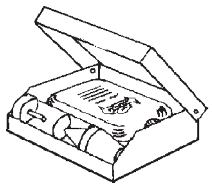


Cylinder Bore Gauge C-119

ENGINE 3.9L (Continued)



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A

AIR CLEANER ELEMENT

REMOVAL

Housing removal is not necessary for element (filter) replacement.

(1) Pry up spring clips from housing cover (spring clips retain cover to housing).

(2) Release housing cover from locating tabs on housing (Fig. 6) and remove cover.

(3) Remove air cleaner element (filter) from housing.

(4) Clean inside of housing before replacing element.

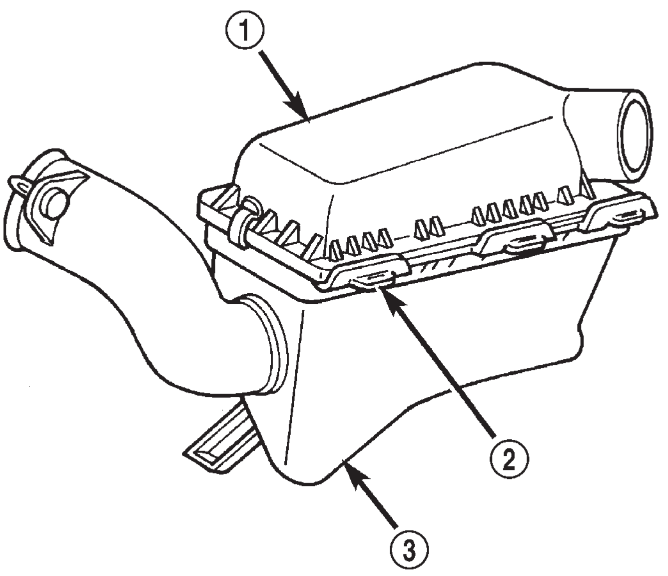


Fig. 6 Air Cleaner Housing Assembly

1 - AIR CLEANER ELEMENT COVER
2 - TABS
3 - HOUSING

INSTALLATION

(1) Install element into housing.

(2) Position housing cover into housing locating tabs.

(3) Pry up spring clips and lock cover to housing.

CYLINDER HEAD

DESCRIPTION

The cast iron cylinder heads (Fig. 7) are mounted to the cylinder block using eight bolts. The spark plugs are located in the peak of the wedge between the valves.

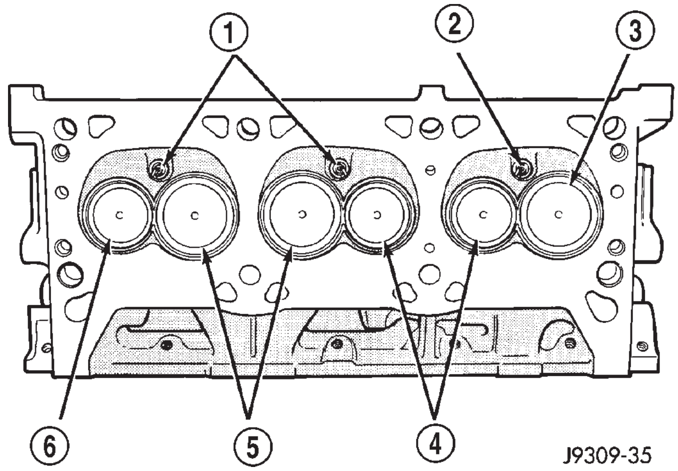


Fig. 7 Cylinder Head Assembly—3.9L Engine

1 - SPARK PLUGS
2 - SPARK PLUG
3 - INTAKE VALVE
4 - EXHAUST VALVES
5 - INTAKE VALVES
6 - EXHAUST VALVE

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

CYLINDER HEAD (Continued)

- 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 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 158 kPa (23 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

The alloy cast iron cylinder heads (Fig. 8) are held in place by eight bolts. The spark plugs are located at the peak of the wedge between the valves.

(1) Disconnect the battery negative cable from the battery.

(2) Drain cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the intake manifold-to-generator bracket support rod. Remove the generator.

(4) Remove closed crankcase ventilation system.

(5) Disconnect the evaporation control system.

(6) Remove the air cleaner, air in-let hose and resonator.

(7) Perform fuel system pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(8) Disconnect the fuel supply line from the fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(9) Disconnect accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(10) Remove distributor cap and wires.

(11) Disconnect the coil wires.

(12) Disconnect coolant temperature sending unit wire.

(13) Disconnect heater hoses and bypass hose.

(14) Disconnect the vacuum supply hoses from the intake manifold.

(15) Disconnect the fuel injector harness and secure out of the way.

(16) Remove cylinder head covers and gaskets (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(17) Remove intake manifold and throttle body as an assembly. Discard the flange side gaskets and the front and rear cross-over gaskets.

(18) Remove exhaust manifolds (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - REMOVAL).

(19) Remove rocker arm assemblies and push rods. Identify to ensure installation in original locations.

(20) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.

(21) Remove spark plugs.

CLEANING

Clean all surfaces of cylinder block and cylinder heads.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

CYLINDER HEAD (Continued)

INSPECTION

Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out-of-flatness exceeds 0.00075mm/mm (0.0001in./in.) times the span length in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE:—A 305 mm (12 in.) span is 0.102 mm (0.004 in.) out-of-flat. The allowable out-of-flat is 305 x 0.00075 (12 x 0.00075) equals 0.23 mm (0.009 in.). This amount of out-of-flat is acceptable.

The cylinder head surface finish should be 1.78-3.00 microns (70-125 microinches).

Inspect push rods. Replace worn or bent rods.

INSTALLATION

The alloy cast iron cylinder heads (Fig. 8) are held in place by eight bolts. The spark plugs are located at the peak of the wedge between the valves.

(1) Position the new cylinder head gaskets onto the cylinder block.

(2) Position the cylinder heads onto head gaskets and cylinder block.

(3) Starting at top center, tighten all cylinder head bolts, in sequence, to 68 N·m (50 ft. lbs.) torque (Fig. 8). Repeat procedure, tighten all cylinder head bolts to 143 N·m (105 ft. lbs.) torque. Repeat procedure to confirm that all bolts are at 143 N·m (105 ft. lbs.) torque.

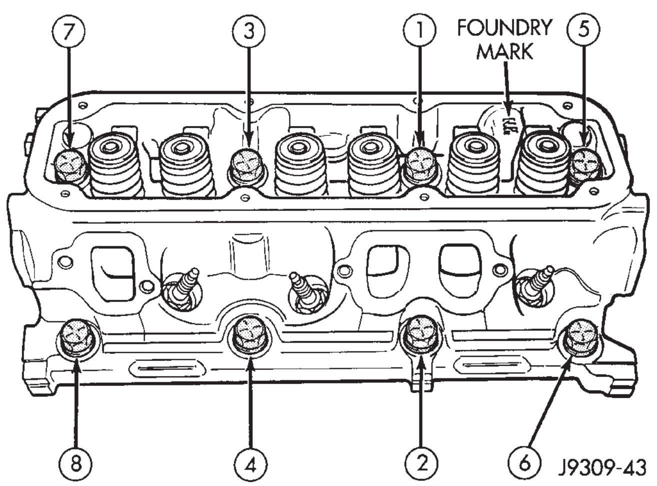


Fig. 8 Cylinder Head Bolt -Tightening Sequence

CAUTION: When tightening the rocker arm bolts, be sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

(4) Install push rods and rocker arm assemblies in their original positions. Tighten the bolts to 28 N·m (21 ft. lbs.) torque.

(5) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION) and throttle body assembly.

(6) Install exhaust manifolds (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - INSTALLATION).

(7) Adjust spark plugs to specifications. Install the plugs and tighten to 41 N·m (30 ft. lbs.) torque.

(8) Install coil wires.

(9) Connect coolant temperature sending unit wire.

(10) Connect the fuel injector harness.

(11) Connect the vacuum supply hoses to the intake manifold.

(12) Connect the heater hoses and bypass hose.

(13) Install distributor cap and wires.

(14) Connect the accelerator linkage and, if so equipped, the speed control and transmission kick-down cables.

(15) Install the fuel supply line.

(16) Install the generator and accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION). Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque.

(17) Install the intake manifold-to-generator bracket support rod. Tighten the bolts.

(18) Install cylinder head covers. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(19) Install closed crankcase ventilation system.

(20) Connect the evaporation control system.

(21) Install the resonator assembly, air in-let hose and air cleaner.

(22) Install the heat shields. Tighten the bolts to 41 N·m (30 ft. lbs.) torque.

(23) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(24) Connect the battery negative cable.

CYLINDER HEAD COVER(S)

DESCRIPTION—CYLINDER HEAD COVER GASKET

The cylinder head cover gasket (Fig. 9) is a steel-backed silicone gasket, designed for long life usage.

REMOVAL

A steel-backed silicone gasket is used with the cylinder head cover (Fig. 10). This gasket can be used again.

(1) Disconnect the negative cable from the battery.

(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover.

(3) Remove cylinder head cover bolts, cover and gasket. The gasket may be used again.

CLEANING

Clean cylinder head cover gasket surface.

Clean head rail, if necessary.

CYLINDER HEAD COVER(S) (Continued)

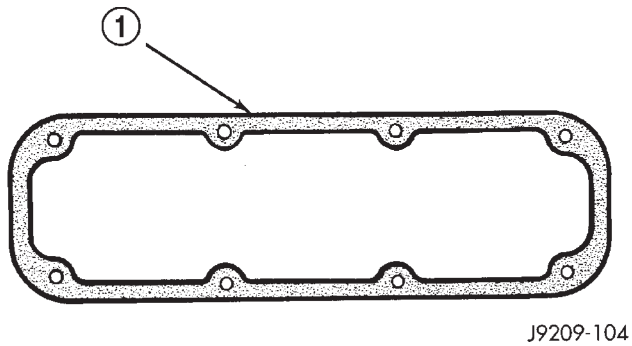


Fig. 9 Cylinder Head Cover Gasket

1 - CYLINDER HEAD COVER GASKET

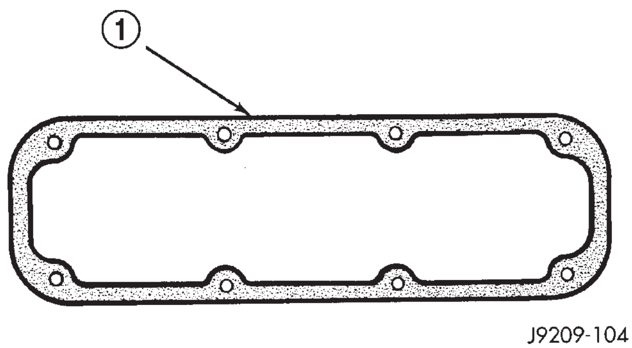


Fig. 10 Cylinder Head Cover Gasket

1 - CYLINDER HEAD COVER GASKET

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 steel-backed silicone gasket is used with the cylinder head cover (Fig. 10) . This gasket can be used again.

(1) Position the cylinder head cover gasket onto the head rail.

(2) Position the cylinder head cover onto the gasket and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(3) Install closed crankcase ventilation system and evaporation control system.

(4) Connect the negative cable to the battery.

(5) Start engine and check for leaks.

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—VALVES, GUIDES AND SPRINGS

VALVE 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.

VALVE GUIDES

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. 11). The special sleeve places the valve at the correct height for checking with a dial indicator.

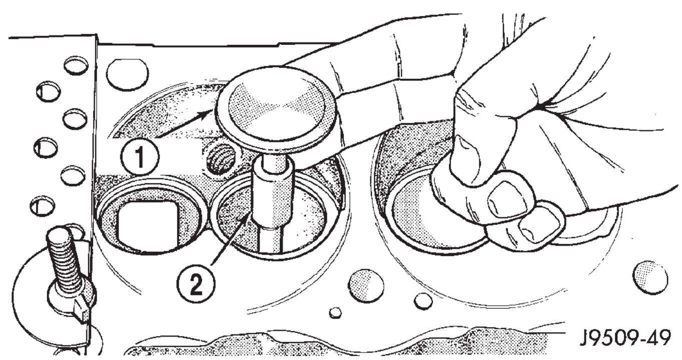


Fig. 11 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 12).

(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.

INTAKE/EXHAUST VALVES & SEATS (Continued)

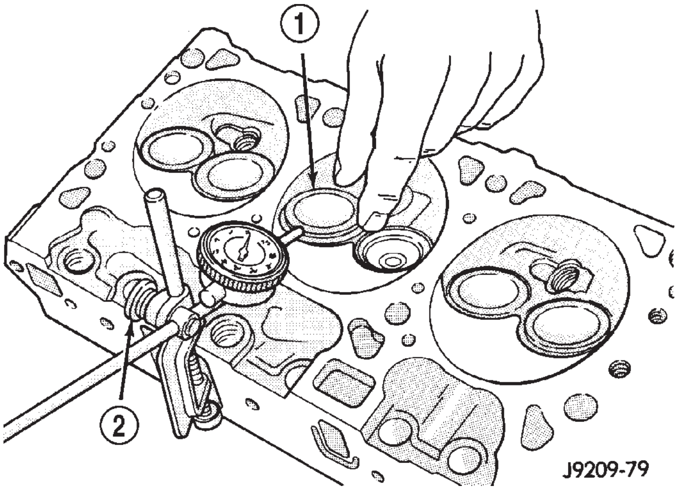


Fig. 12 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

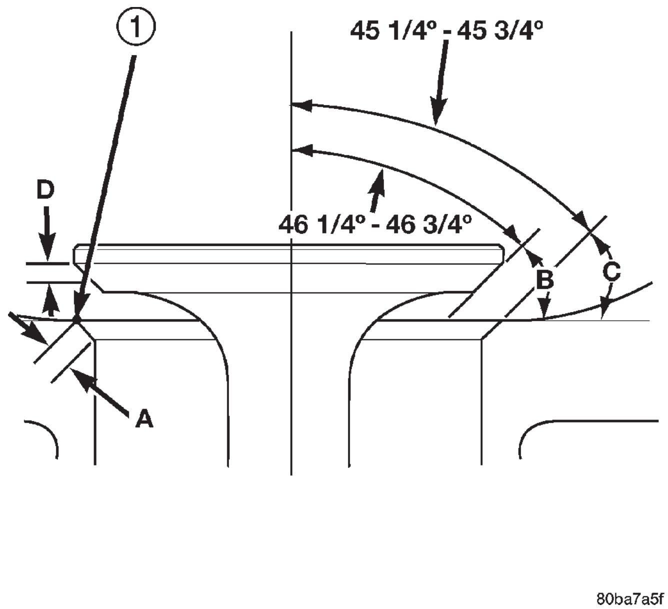


Fig. 13 Valve Face and Seat Angles

1 - CONTACT POINT
A,B,C and D Refer to VALVE FACE AND VALVE SEAT ANGLE CHART

VALVE GUIDES

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).

REFACING VALVES AND VALVE SEATS

The intake and exhaust valves have a 43-1/4° to 43-3/4° face angle and a 44-1/4° to 44-3/4° seat angle (Fig. 13).

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)

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 14). Valves with less than 1.190 mm (0.047 in.) margin should be discarded.

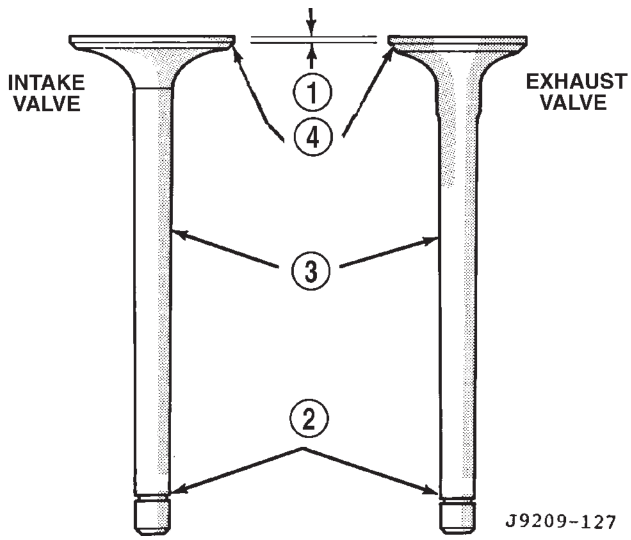


Fig. 14 Intake and Exhaust Valves

1 - MARGIN
2 - VALVE SPRING RETAINER LOCK GROOVE
3 - STEM
4 - FACE

VALVE SEATS

CAUTION: DO NOT un-shroud valves during valve seat refacing (Fig. 15).

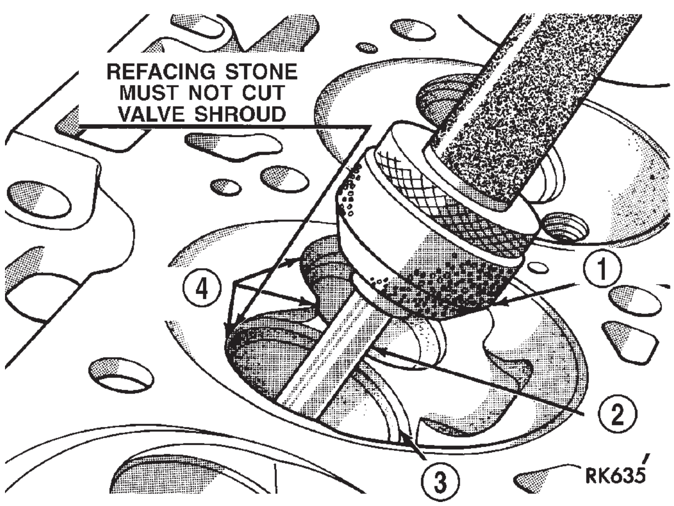


Fig. 15 Refacing Valve Seats

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.).

VALVE SPRINGS

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. 16). Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

REMOVAL

(1) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(2) Compress valve springs using Valve Spring Compressor Tool MD- 998772A and adapter 6716A.

(3) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.

(4) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

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.

INTAKE/EXHAUST VALVES & SEATS (Continued)

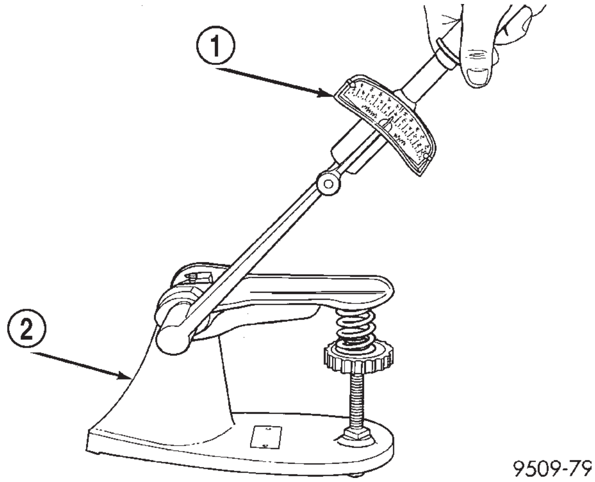


Fig. 16 Testing Valve Spring for Compressed Length

1 - TORQUE WRENCH
2 - VALVE SPRING TESTER

INSPECTION

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. 17). The special sleeve places the valve at the correct height for checking with a dial indicator.

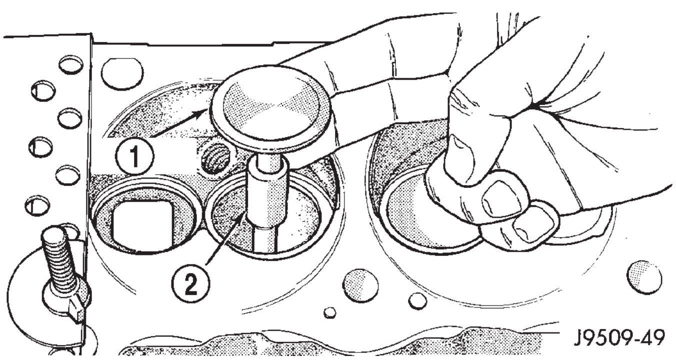


Fig. 17 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 18).

(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.

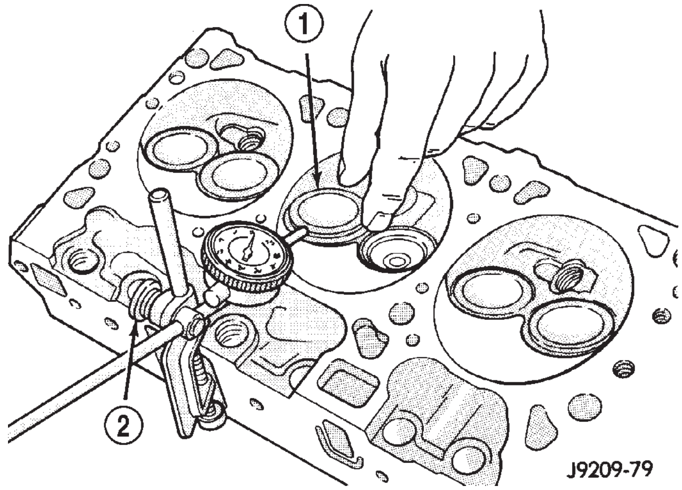


Fig. 18 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

INSTALLATION

(1) Clean valves thoroughly. Discard burned, warped and cracked valves.

(2) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

(3) Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

(4) Coat valve stems with lubrication oil and insert them in cylinder head.

(5) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.

(6) Install new seals on all valve guides. Install valve springs and valve retainers.

(7) 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. Make sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 inch) spacer in head counterbore. This should bring spring height back to normal 41.27 to 42.86 mm (1-5/8 to 1-11/16 inch).

(8) Install cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

ENGINE BLOCK

CLEANING

Clean cylinder block thoroughly and check all core hole plugs for evidence of leakage.

INSPECTION

Examine block for cracks or fractures.

The cylinder walls should be checked for out-of-round and taper. Refer to Honing Cylinder Bores in the Service Procedures portion of this Section.

Inspect the oil line plug, the oil line plug is located in the vertical passage at the rear of the block between the oil-to-filter and oil-from-filter passages (Fig. 19) . Improper installation or missing plug could cause erratic, low, or no oil pressure.

The oil plug must come out the bottom. Use flat dowel, down the oil pressure sending unit hole from the top, to remove oil plug.

(1) Remove oil pressure sending unit from back of block.

(2) Insert a 3.175 mm (1/8 in.) finish wire, or equivalent, into passage.

(3) Plug should be 190.0 to 195.2 mm (7-1/2 to 7-11/16 in.) from machined surface of block (Fig. 19) . If plug is too high, use a suitable flat dowel to position properly.

(4) If plug is too low, remove oil pan and No. 4 main bearing cap. Use suitable flat dowel to position properly . Coat outside diameter of plug with Mopar® Stud and Bearing Mount Adhesive. Plug should be 54.0 to 57.7 mm (2-1/8 to 2-5/16 in.) from bottom of the block.

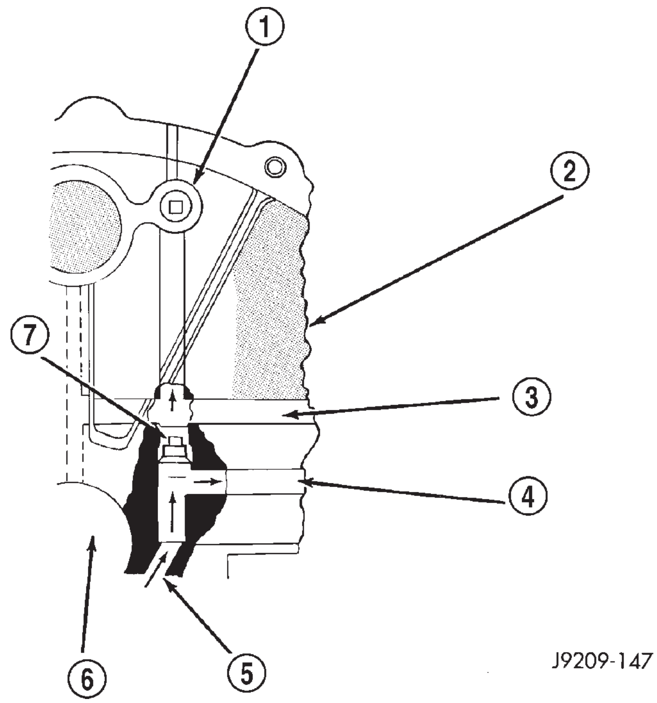


Fig. 19 Oil Line Plug

1 - RIGHT OIL GALLERY
2 - CYLINDER BLOCK
3 - OIL FROM FILTER TO SYSTEM
4 - OIL TO FILTER
5 - FROM OIL PUMP
6 - CRANKSHAFT
7 - PLUG

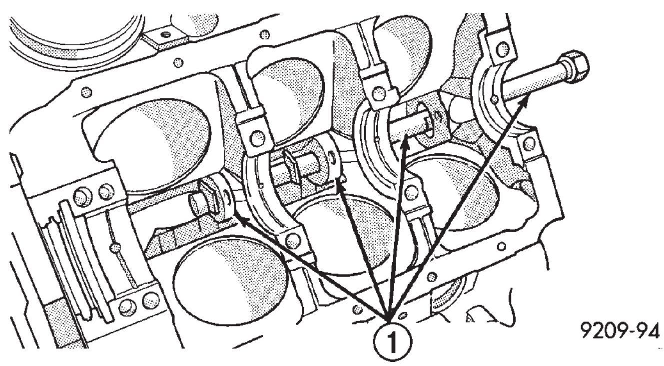


Fig. 20 Camshaft Bearings Removal and Installation with Tool C-3132-A

1 - SPECIAL TOOL C-3132A

CAMSHAFT & BEARINGS (IN BLOCK)

REMOVAL—CAMSHAFT BEARINGS

(1) With engine completely disassembled, drive out rear cam bearing core hole plug.

(2) Install proper size adapters and horseshoe washers (part of Camshaft Bearing Remover/Installer Tool C-3132-A) at back of each bearing shell. Drive out bearing shells (Fig. 20).

REMOVAL—CAMSHAFT

(1) Disconnect battery negative cable.

(2) Remove radiator. (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(3) Remove intake manifold. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(4) Remove distributor assembly (Refer to 8 - ELECTRICAL/IGNITION CONTROL/DISTRIBUTOR - REMOVAL).

(5) Remove cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(6) Remove rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL).

(7) Remove push rods and tappets (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - REMOVAL). Identify each part so it can be installed in the original locations.

(8) Remove timing chain cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(9) Align timing marks (Fig. 21) and remove timing chain and sprockets.

(10) Remove the three tensioner to block mounting bolts and remove tensioner.

(11) Install a long bolt into front of camshaft to aid in removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

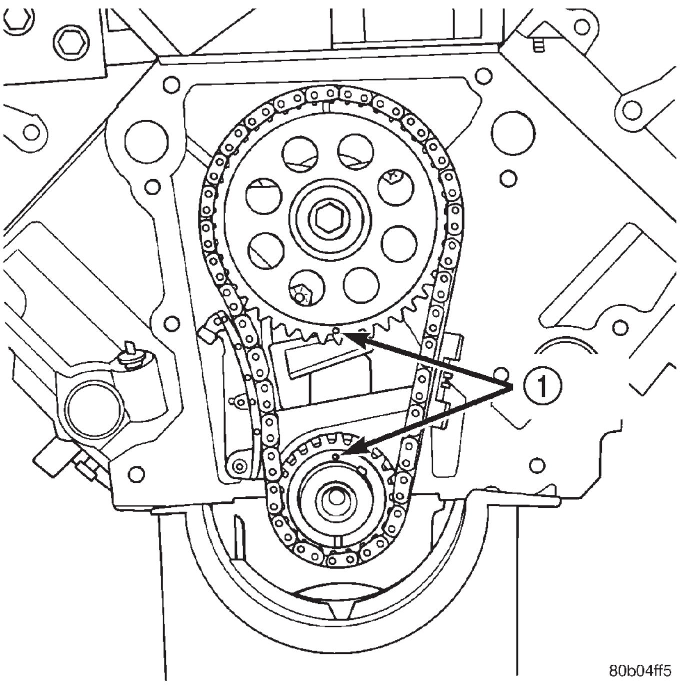


Fig. 21 Alignment of Timing Marks

1 - TIMING MARKS

INSTALLATION—CAMSHAFT BEARINGS

(1) Install new camshaft bearings with Camshaft Bearing Remover/Installer Tool C-3132-A by sliding the new camshaft bearing shell over proper adapter.

(2) Position rear bearing in the tool. Install horseshoe lock and, by reversing removal procedure, carefully drive bearing shell into place.

(3) Install remaining bearings in the same manner. Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

INSTALLATION—CAMSHAFT

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft to within 51 mm (2 inches) of its final position in cylinder block.

(2) Install Camshaft Holding Tool C-3509 with tongue back of distributor drive gear (Fig. 22) .

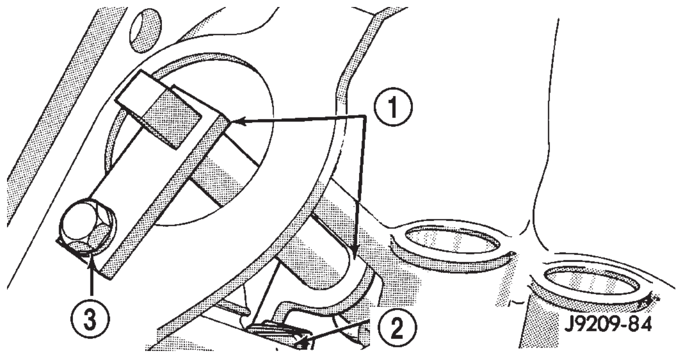


Fig. 22 Camshaft Holding Tool C-3509 (Installed Position)

1 - SPECIAL TOOL C-3509
2 - DRIVE GEAR
3 - DISTRIBUTOR LOCK BOLT

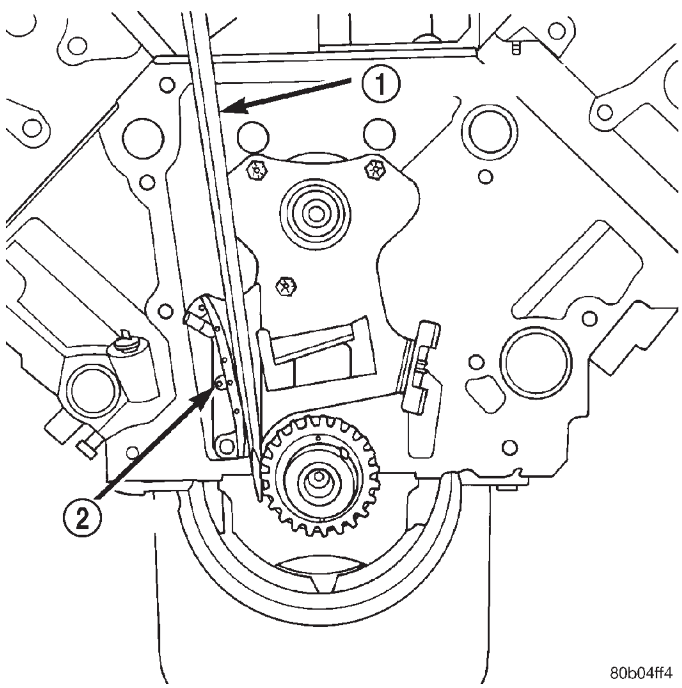


Fig. 23 Compressing Tensioner Shoe For Timing Chain Installation

1 - SCREWDRIVER
2 - INSERT PIN HERE

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

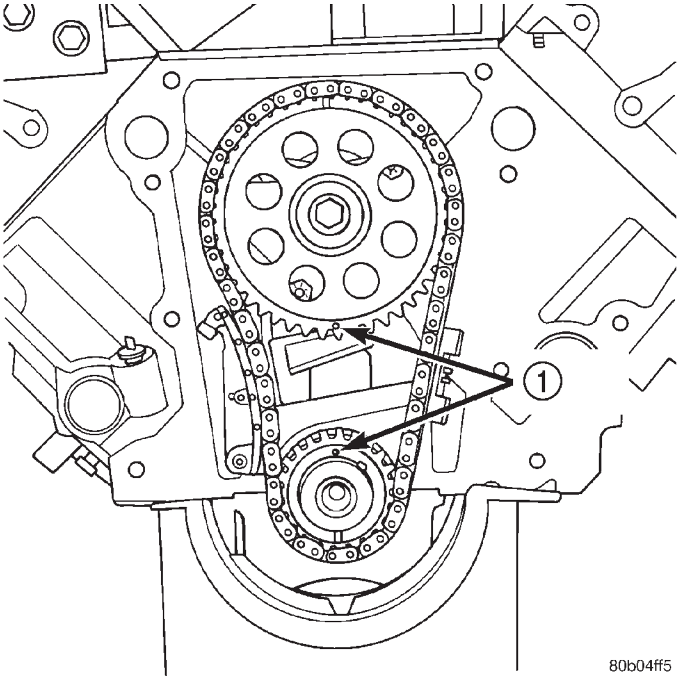


Fig. 24 Alignment of Timing Marks

1 - TIMING MARKS

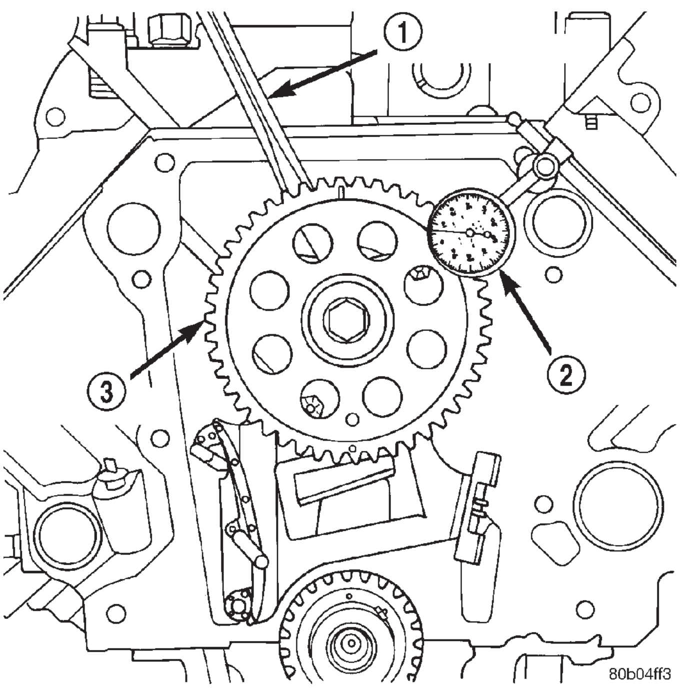


Fig. 25 Checking Camshaft End Play

1 - SCREWDRIVER
2 - DIAL INDICATOR
3 - CAM SPROCKET

(3) Hold tool in position with a distributor lock-plate bolt. This tool will restrict camshaft from being pushed in too far and prevent knocking out the welch plug in rear of cylinder block. **Tool should remain installed until the camshaft and crankshaft sprockets and timing chain have been installed.**

(4) Install timing chain tensioner. Torque bolts to 24 N·m (210 in. lbs.) torque.

(5) Compress tensioner shoe (Fig. 23) and install a suitable sized pin to retain shoe for chain installation.

(6) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on an exact imaginary center line through both camshaft and crankshaft bores.

(7) Place timing chain around both sprockets.

(8) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(9) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(10) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 24) .

(11) Install the camshaft bolt/cup washer. Tighten bolt to 68 N·m (50 ft. lbs.) torque.

(12) Measure camshaft end play (Fig. 25). (Refer to 9 - ENGINE - SPECIFICATIONS) for proper clearance. If not within limits, install a new timing chain tensioner.

(13) Each tappet reused must be installed in the same position at which it was removed. **When camshaft is replaced, all of the tappets must be replaced.**Install hydraulic tappets (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - INSTALLATION).

(14) Install timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(15) Install intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(16) Install distributor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/DISTRIBUTOR - INSTALLATION).

(17) Install cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(18) Install radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).

(19) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(20) Connect battery negative cable.

(21) Start engine and check for leaks.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE—CONNECTING ROD BEARING FITTING

Fit all rods on a bank until completed. DO NOT alternate from one bank to another, because connecting rods and pistons are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly.

Each bearing cap has a small V-groove across the parting face. When installing the lower bearing shell, be certain that the V-groove in the shell is in line with the V-groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

The bearing shells must be installed so that the tangs are in the machined grooves in the rods and caps.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 in.). Bearings are available in 0.025 mm (0.001 in.), 0.051 mm (0.002 in.), 0.076 mm (0.003 in.), 0.254 mm (0.010 in.) and 0.305 mm (0.012 in.) undersize. **Install the bearings in pairs. DO NOT use a new bearing half with an old bearing half. DO NOT file the rods or bearing caps.**

CRANKSHAFT

DESCRIPTION

The crankshaft (Fig. 26) is of a forged steel splayed type design, with four main bearing journals.The crankshaft is located at the bottom of the engine block and is held in place with four main bearing caps.

Undersize Journal	Identification Stamp
ROD – 0.025mm (0.001 in.)	R1-R2-R3-Etc.
MAIN – 0.025mm (0.001 in.)	M1-M2-M3 or M4

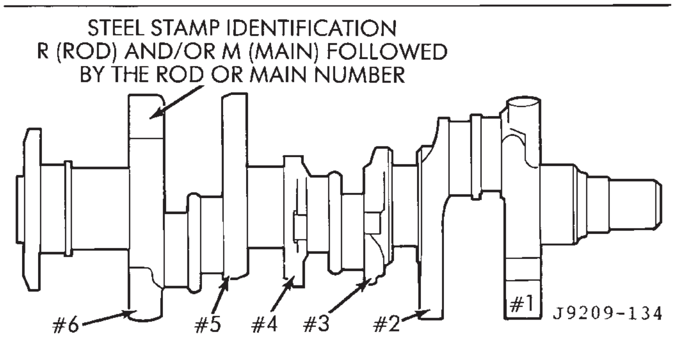


Fig. 26 Crankshaft—3.9L Engine

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 (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(3) Identify bearing caps before removal. Remove bearing caps and bearings one at a time.

(4) Lift the crankshaft out of the block.

(5) Remove and discard the crankshaft rear oil seals.

(6) Remove and discard the front crankshaft oil seal.

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 Loctite 518, or equivalent, on each side of the rear main bearing cap (Fig. 27). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(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 two 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) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap-to-block and oil pan sealing (Fig. 28). Apply enough sealant so that a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(11) Install new front crankshaft oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION).

(12) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

CRANKSHAFT (Continued)

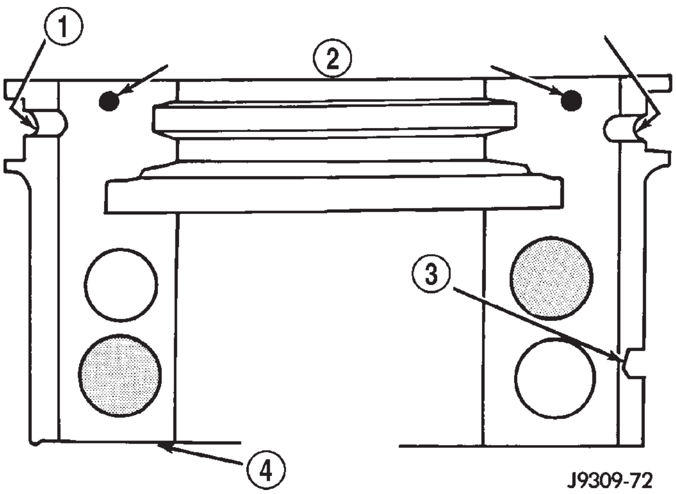


Fig. 27 Sealant Application to Bearing Cap

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT SLOTS
2 - LOCTITE 515 (OR EQUIVALENT)
3 - CAP ALIGNMENT SLOT
4 - REAR MAIN BEARING CAP

(13) Install new rear oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - INSTALLATION).

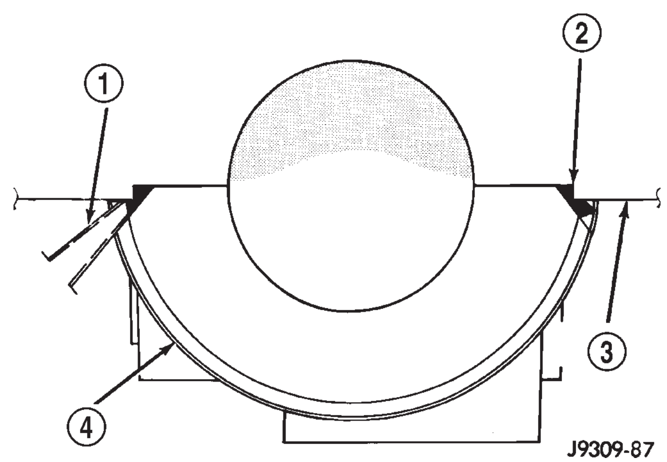


Fig. 28 Apply Sealant to Bearing Cap-to-Block Joint

1 - MOPAR ® GEN II SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 - SEALANT APPLIED
3 - CYLINDER BLOCK
4 - REAR MAIN BEARING CAP

CRANKSHAFT MAIN BEARINGS

DESCRIPTION

Main bearings (Fig. 29) 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 four main bearings. Number two main bearing is flanged, this flange controls crankshaft thrust.

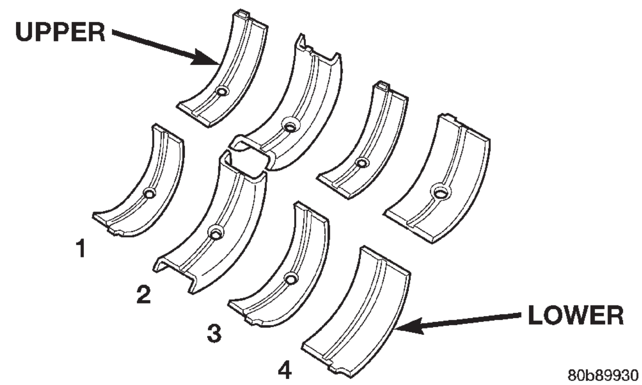


Fig. 29 Main Bearing Orientation

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 BEARING FITTING

Bearing caps are NOT interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of No. 1 and 3 are interchangeable.

Upper and lower No. 2 bearing halves are flanged to carry the crankshaft thrust loads. They are NOT interchangeable with any other bearing halves in the engine (Fig. 30). Bearing shells are available in standard and the following undersizes: 0.25 mm (0.001 in.), 0.051 mm (0.002 in.), 0.076 mm (0.003 in.), 0.254 mm (0.010 in.) and 0.305 mm (0.012 in.). Never install an undersize bearing that will reduce clearance below specifications.

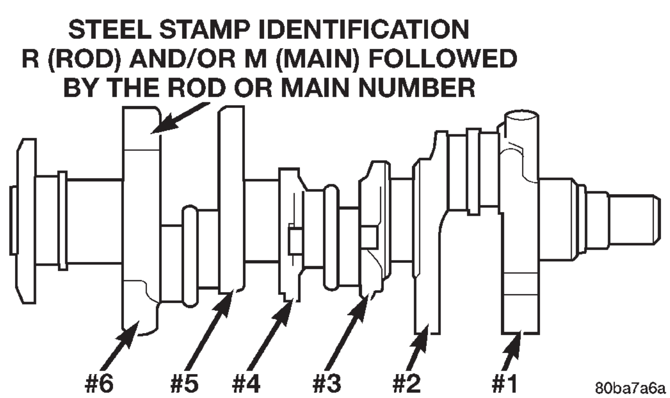


Fig. 30 Main Bearing Identification

CRANKSHAFT MAIN BEARINGS (Continued)

CRANKSHAFT IDENTIFICATION LOCATION CHART

ITEM	MEASUREMENT	IDENTIFICATION
ROD U/S	0.025 mm (0.001 in.)	R1-R2-R3 ect. indicates rod journal No. 1, 2 and 3.
MAIN U/S	0.025 mm (0.001 in.)	M1-M2-M3 or M4 indicates main journal No. 1, 2, 3, and 4.

REMOVAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(3) Identify bearing caps before removal. Remove bearing caps one at a time.

(4) Remove upper half of bearing by inserting Crankshaft Main Bearing Remover/Installer Tool C-3059 into the oil hole of crankshaft (Fig. 31).

(5) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

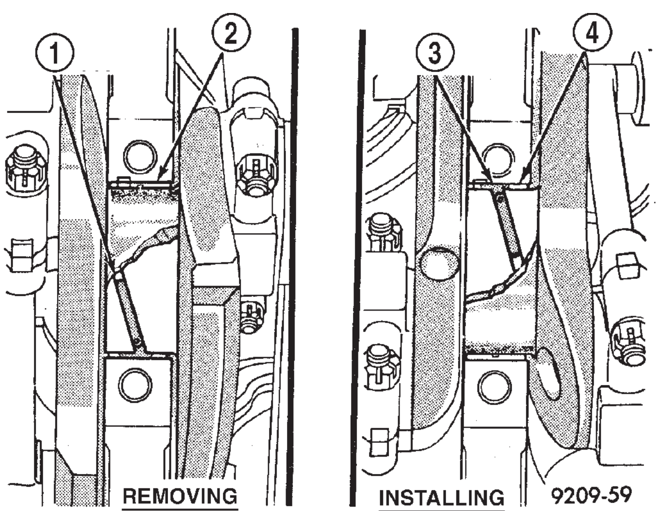


Fig. 31 Upper Main Bearing Removal and Installation with Tool C-3059

1 - SPECIAL TOOL C-3059
2 - BEARING
3 - SPECIAL TOOL C-3059
4 - BEARING

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened. All bearing capbolts removed during service procedures are to be cleaned and oiled before installation. DO NOT use a new bearing half with an old bearing half.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Crankshaft Main Bearing Remover/Installer Tool C-3059 into oil hole of crankshaft (Fig. 31).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

(3) Install the bearing caps. Clean and oil the bolts. Tighten the capbolts to 115 N·m (85 ft. lbs.) torque.

(4) Install the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(5) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

CRANKSHAFT OIL SEAL - FRONT

DESCRIPTION

The crankshaft front seal is a one piece viton seal with a steel housing. The front seal is located in the engine front cover.

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 (Fig. 32) . Seat the oil seal in the groove of the tool.

(2) Position the seal and tool onto the crankshaft (Fig. 33).

CRANKSHAFT OIL SEAL - FRONT (Continued)

(3) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 34).

(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.

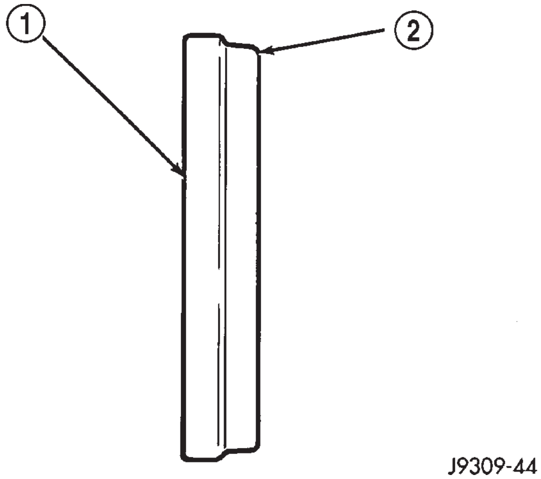


Fig. 32 Placing Oil Seal on Installation Tool 6635

1 - CRANKSHAFT FRONT OIL SEAL
2 - INSTALL THIS END INTO SPECIAL TOOL 6635

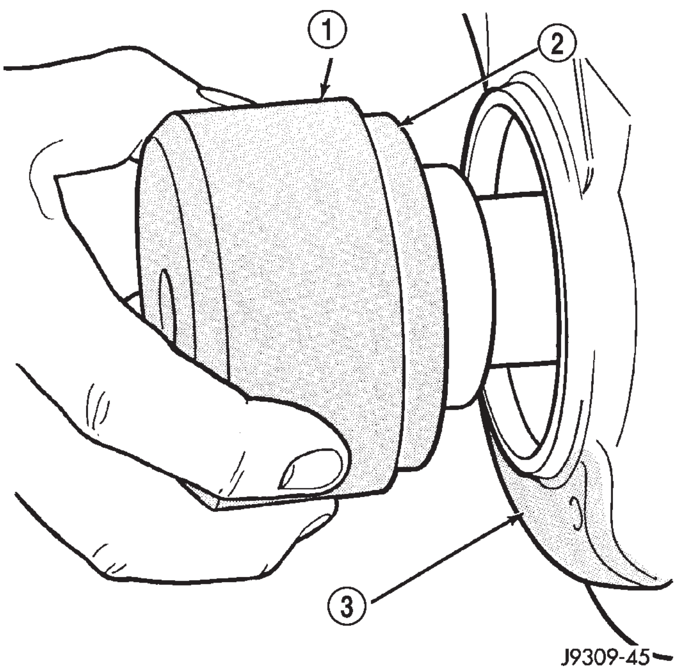


Fig. 33 Position Tool and Seal onto Crankshaft

1 - SPECIAL TOOL 6635
2 - OIL SEAL
3 - TIMING CHAIN COVER

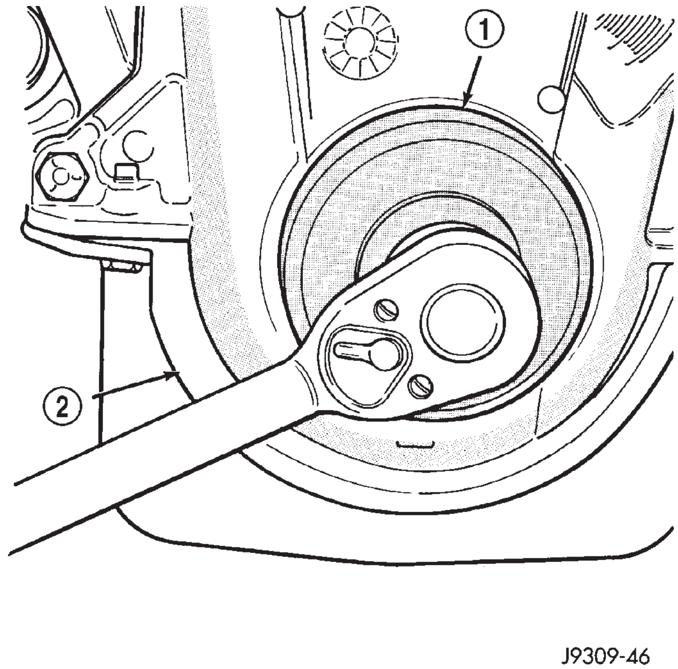


Fig. 34 Installing Oil Seal

1 - SPECIAL TOOL 6635
2 - TIMING CHAIN COVER

CRANKSHAFT OIL SEAL - REAR

DESCRIPTION

The crankshaft rear seal is a two piece viton seal. One part of the two piece rear seal is located in a slot in the number four (4) crankshaft main bore, the second part of the two piece seal is located in the number four (4) main bearing cap.

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.

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:

CRANKSHAFT OIL SEAL - REAR (Continued)

(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)

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

The service seal is a two piece, Viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal. The lower seal half can be installed only with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

(1) Remove the crankshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - REMOVAL). Discard the old upper seal.

UPPER SEAL—CRANKSHAFT INSTALLED

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(3) Remove the rear main bearing cap. Remove and discard the old lower oil seal.

(4) Carefully remove and discard the old upper oil seal.

LOWER SEAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(3) Remove the rear main bearing cap and discard the old lower seal.

INSTALLATION

The service seal is a two piece, Viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal. The lower seal half can be installed only with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

(1) Clean the cylinder block rear cap mating surface. Be sure the seal groove is free of debris. Check for burrs at the oil hole on the cylinder block mating surface to rear cap.

(2) Lightly oil the new upper seal lips with engine oil.

(3) Install the new upper rear bearing oil seal with the white paint facing toward the rear of the engine.

(4) Position the crankshaft into the cylinder block.

(5) Lightly oil the new lower seal lips with engine oil.

(6) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(7) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 35). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(8) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(9) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(10) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(11) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap to block and oil pan sealing (Fig. 36) . Apply enough sealant so that a small amount is

CRANKSHAFT OIL SEAL - REAR (Continued)

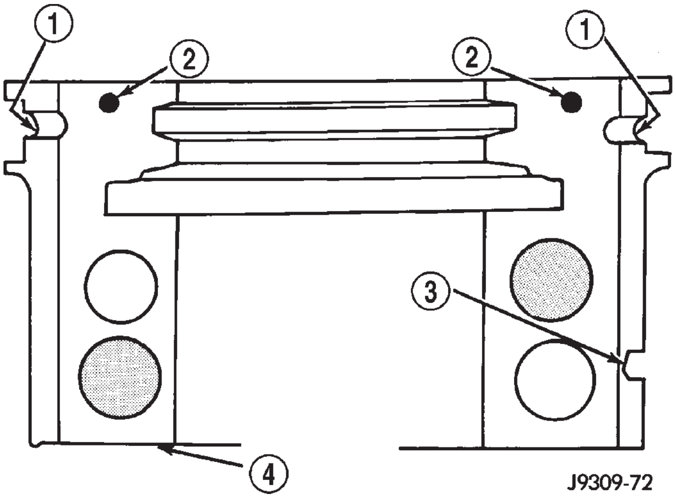


Fig. 35 Sealant Application to Bearing Cap

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT SLOTS
2 - MOPAR® GASKET MAKER (OR EQUIVALENT)
3 - CAP ALIGNMENT SLOT
4 - REAR MAIN BEARING CAP

squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(12) Install new front crankshaft oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION).

(13) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

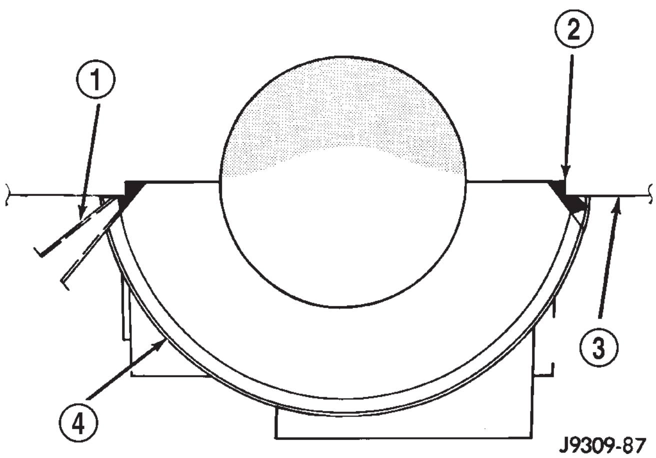


Fig. 36 Apply Sealant to Bearing Cap-to-Block Joint

1 - MOPAR ® GEN II SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 - SEALANT APPLIED
3 - CYLINDER BLOCK
4 - REAR MAIN BEARING CAP

UPPER SEAL—CRANKSHAFT INSTALLED

(1) Clean the cylinder block mating surfaces before oil seal installation. Check for burrs at the oil hole on the cylinder block mating surface to rear cap.

(2) Lightly oil the new upper seal lips with engine oil. To allow ease of installation of the seal, loosen at least the two main bearing caps forward of the rear bearing cap.

(3) Rotate the new upper seal into the cylinder block, being careful not to shave or cut the outer surface of the seal. To ensure proper installation, use the installation tool provided with the kit. Install the new seal with the white paint facing toward the rear of the engine.

(4) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing toward the rear of the engine.

(5) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 35). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application. Be sure the white paint faces toward the rear of the engine.

(6) 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 two times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten ALL cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(9) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap-to-block and oil pan sealing (Fig. 36). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

LOWER SEAL

(1) Clean the rear main cap mating surfaces including the oil pan gasket groove.

(2) Carefully install a new upper seal. Refer to UPPER SEAL—CRANKSHAFT INSTALLED .

(3) Lightly oil the new lower seal lips with engine oil.

(4) Install a new lower seal in bearing cap with the white paint facing the rear of engine.

(5) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 35). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assem-

ble bearing cap to cylinder block immediately after sealant application.

(6) 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 two times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten the cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(9) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap to block and oil pan sealing. Apply enough sealant so that a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

DISTRIBUTOR BUSHING

REMOVAL

(1) Remove distributor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/DISTRIBUTOR - REMOVAL).

(2) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(3) Insert Distributor Drive Shaft Bushing Puller Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 37) .

(4) Hold puller screw and tighten puller nut until bushing is removed.

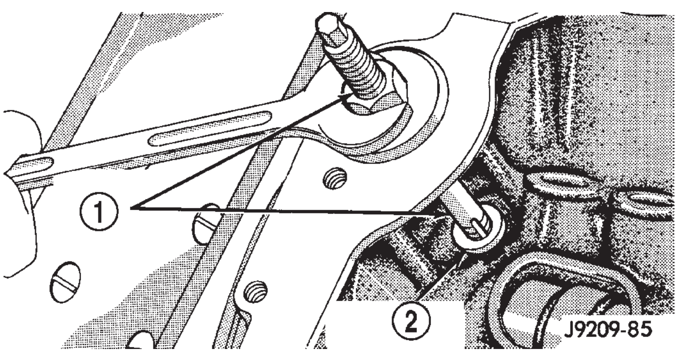


Fig. 37 Distributor Driveshaft Bushing Removal

1 - SPECIAL TOOL C-3052
2 - BUSHING

INSTALLATION

(1) Slide new bushing over burnishing end of Distributor Drive Shaft Bushing Driver/Burnisher Tool C-3053. Insert the tool and bushing into the bore.

(2) Drive bushing and tool into position, using a hammer (Fig. 38) .

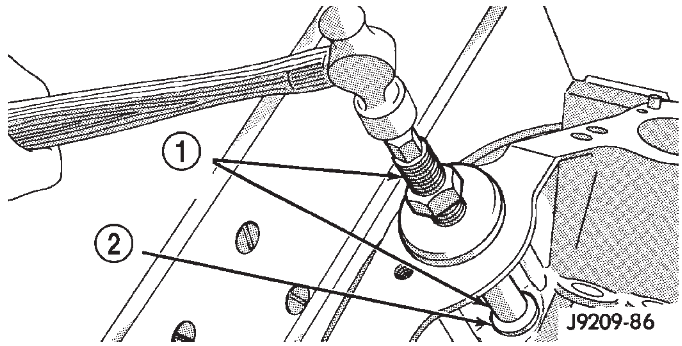


Fig. 38 Distributor Driveshaft Bushing Installation

1 - SPECIAL TOOL C-3053
2 - BUSHING

(3) As the burnisher is pulled through the bushing, the bushing is expanded tight in the block and burnished to correct size (Fig. 39). **DO NOT ream this bushing.**

CAUTION: This procedure MUST be followed when installing a new bushing or seizure to shaft may occur.

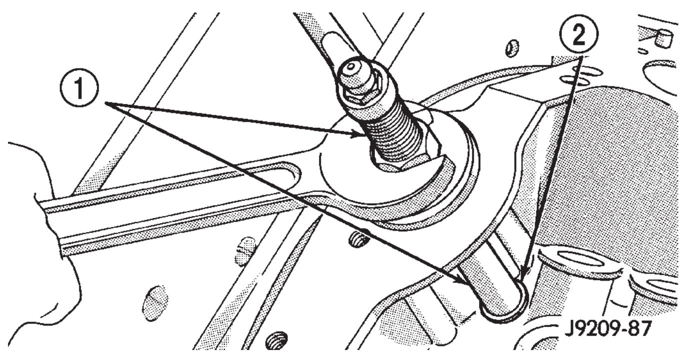


Fig. 39 Burnishing Distributor Bushing

1 - SPECIAL TOOL C-3053
2 - BUSHING

(4) Install the intake manifold. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(5) Install the distributor.

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 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. 40).

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.

HYDRAULIC LIFTERS (CAM IN BLOCK) (Continued)

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

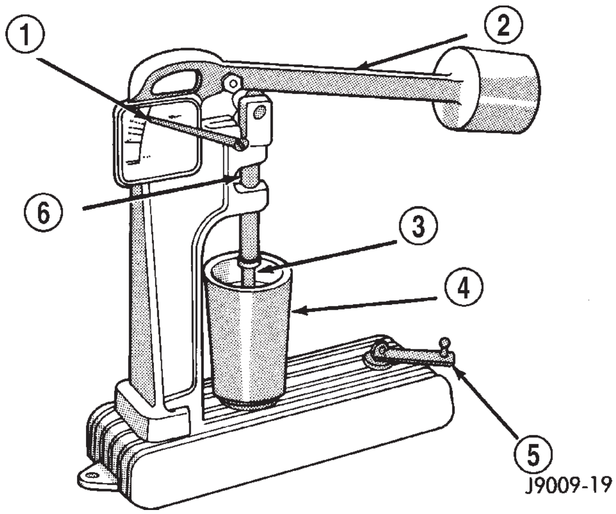


Fig. 40 Leak-Down Tester

1 - POINTER
2 - WEIGHTED ARM
3 - RAM
4 - CUP
5 - HANDLE
6 - PUSH ROD

REMOVAL

(1) Remove the air cleaner assembly and air in-let hose.

(2) Remove cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(3) Remove rocker assembly and push rods (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). Identify push rods to ensure installation in original locations.

(4) Remove intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(5) Remove yoke retainer and aligning yokes.

(6) Slide Hydraulic Tappet Remover/Installer Tool C-4129-A through opening in cylinder head and seat tool firmly in the head of tappet.

(7) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

(8) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize. Replace with oversize tappet.

CLEANING

Clean tappet with a suitable solvent. Rinse in hot water and blow dry with a clean shop rag or compressed air.

INSTALLATION

(1) Lubricate tappets with Mopar® Engine Oil Supplement or equivalent.

(2) Install tappets and push rods in their original positions . Ensure that the oil feed hole in the side of the tappet body faces up (away from the crankshaft).

(3) Install aligning yokes with ARROW toward camshaft.

(4) Install yoke retainer. Tighten the bolts to 23 N·m (200 in. lbs.) torque. Install intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(5) Install rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(6) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(7) Install air cleaner assembly and air in-let hose.

(8) Start and operate engine. Warm up to normal operating temperature.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

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

Check the cylinder block bore for out-of-round, taper, scoring, or scuffing.

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 41).

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.013-0.038 mm (0.0005-0.0015 in.) at 21°C (70°F).

Piston diameter should be measured at the top of skirt, 90° to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).

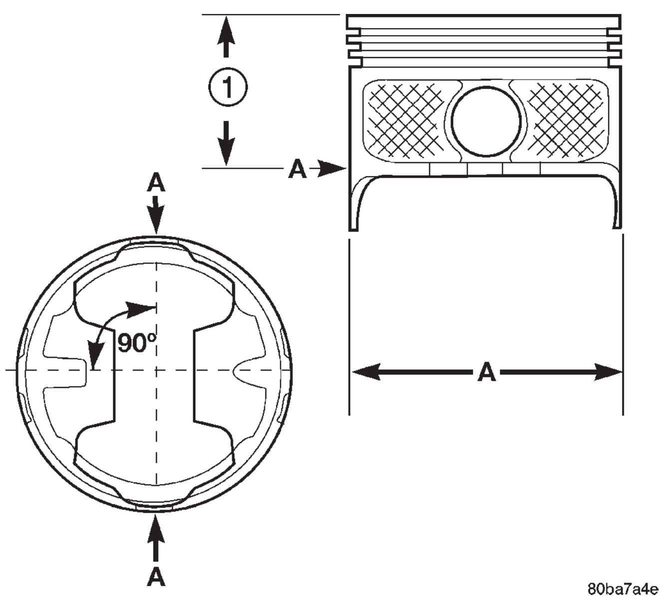


Fig. 41 Piston Measurements

1 - 62.230 mm
(2.45 IN.)

PISTON MEASUREMENTS CHART

PISTON SIZE	A DIA = PISTON DIAMETER		BORE DIAMETER	
	MIN. mm (in.)	MAX. mm (in.)	MIN. mm (in.)	MAX. mm (in.)
A	99.280 (3.9087)	99.294 (3.9092)	99.308 (3.9098)	99.320 (3.9103)
B	99.294 (3.9092)	99.306 (3.9097)	99.320 (3.9103)	99.333 (3.9108)
C	99.306 (3.9097)	99.319 (3.9102)	99.333 (3.9108)	99.345 (3.9113)
D	99.319 (3.9102)	99.332 (3.9107)	99.346 (3.9113)	99.358 (3.9118)
E	99.332 (3.9107)	99.344 (3.9112)	99.358 (3.9118)	99.371 (3.9123)

DESCRIPTION	SPECIFICATION
PISTON PIN BORE	25.007 - 25.014 mm (.9845 - .9848 in.)
RING GROOVE HEIGHT (OIL RAIL)	4.0309 - 4.0538 mm (.1587 - .1596 in.)
RING GROOVE HEIGHT (COMPRESSION RAIL)	2.0294 - 2.0548 mm (.0799 - .0809 in.)
TOTAL FINISHED WEIGHT	594.6 ± 2 grams (20.974 ± .0706 ounces)

REMOVAL

(1) Remove the engine from the vehicle (Refer to 9 - ENGINE - REMOVAL).

(2) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. Be sure to keep tops of pistons covered during this operation.

(5) Be sure each connecting rod and connecting rod cap is identified with the cylinder number. Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts.

(6) Pistons and connecting rods must be removed from top of cylinder block. When removing the assemblies from the engine, rotate crankshaft so that

PISTON & CONNECTING ROD (Continued)

the connecting rod is centered in cylinder bore and at BDC. **Be careful not to nick crankshaft journals.**

(7) After removal, install bearing cap on the mating rod.

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 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

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 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

INSTALLATION

(1) Be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.

(2) Before installing the ring compressor, be sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 42) .

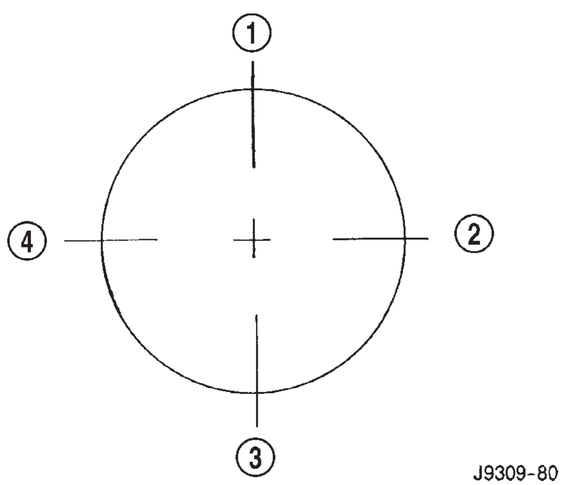


Fig. 42 Proper Ring Installation

1 - OIL RING SPACER GAP
2 - SECOND COMPRESSION RING GAP OIL RING RAIL GAP (TOP)
3 - OIL RING RAIL GAP (BOTTOM)
4 - TOP COMPRESSION RING GAP

(3) Immerse the piston head and rings in clean engine oil. Slide Piston Ring Compressor Tool C-385 over the piston and tighten with the special wrench (part of Tool C-385). **Be sure position of rings does not change during this operation.**

(4) Install connecting rod bolt protectors on rod bolts. The long protector should be installed on the numbered side of the connecting rod.

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Be sure connecting rod and cylinder bore number are the same. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

(6) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on crankshaft journal.

(7) The notch, or groove, on top of piston must be pointing toward front of engine. The larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(8) Install rod caps. Be sure connecting rod, connecting rod cap, and cylinder bore number are the same. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N·m (45 ft. lbs.) torque.

(9) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(10) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(11) Install the engine into the vehicle (Refer to 9 - ENGINE - INSTALLATION).

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

(1) Measurement of end gaps:

(a) Measure piston ring gap 2 in. from bottom of cylinder bore. An inverted piston can be used to push the rings down to ensure positioning rings squarely in the cylinder bore before measuring.

(b) Insert feeler gauge in the gap. The top compression ring gap should be between 0.254-0.508 mm (0.010-0.020 in.). The second compression ring gap should be between 0.508-0.762 mm (0.020-0.030 in.). The oil ring gap should be 0.254-1.270 mm (0.010-0.050 in.).

(c) Rings with insufficient end gap may be properly filed to the correct dimension. Rings with excess gaps should not be used.

(2) Install rings, and confirm ring side clearance:

(a) Install oil rings being careful not to nick or scratch the piston. Install the oil control rings according to instructions in the package. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(b) Install the second compression rings using Installation Tool C-4184. The compression rings

PISTON RINGS (Continued)

must be installed with the identification mark face up (toward top of piston) and chamfer facing down. An identification mark on the ring is a drill point, a stamped letter “O”, an oval depression, or the word “TOP” (Fig. 43) (Fig. 45).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 44) (Fig. 45). An identification mark on the ring is a drill point, a stamped letter “O”, an oval depression or the word “TOP” facing up.

(d) Measure side clearance between piston ring and ring land. Clearance should be 0.074-0.097 mm (0.0029-0.0038 in.) for the compression rings. The steel rail oil ring should be free in groove, but should not exceed 0.246 mm (0.0097 in.) side clearance.

(e) Pistons with insufficient, or excessive, side clearance should be replaced.

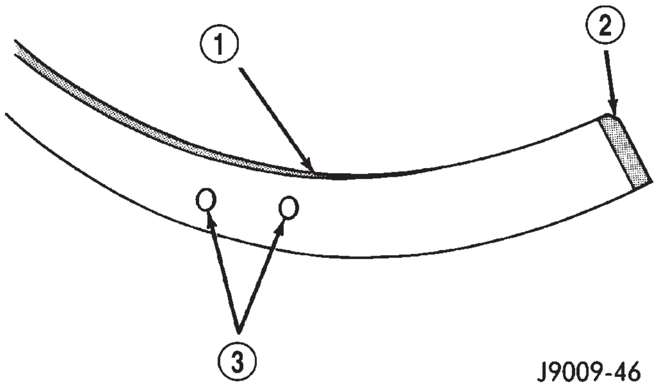


Fig. 43 Second Compression Ring Identification (Typical)

1 - SECOND COMPRESSION RING (BLACK CAST IRON)
2 - CHAMFER
3 - TWO DOTS

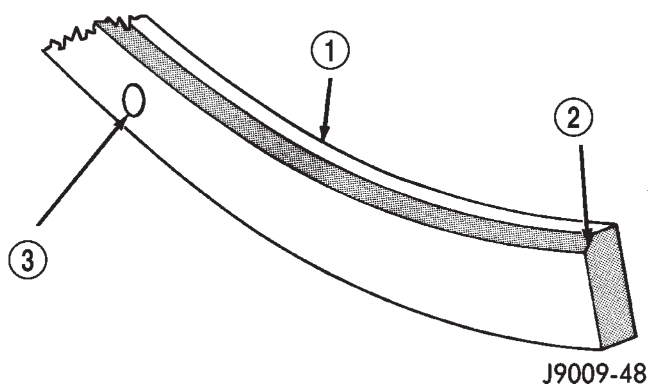


Fig. 44 Top Compression Ring Identification (Typical)

1 - TOP COMPRESSION RING (GRAY IN COLOR)
2 - CHAMFER
3 - ONE DOT

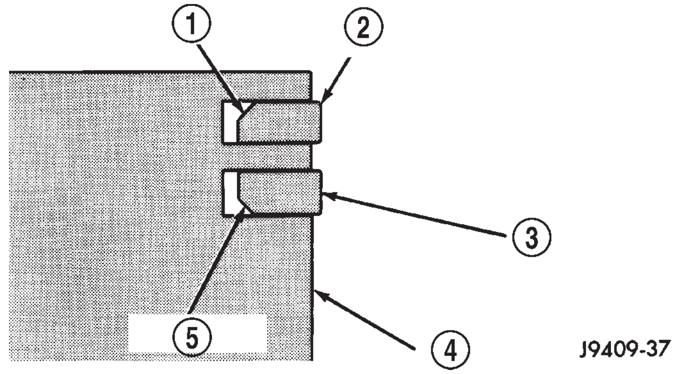


Fig. 45 Compression Ring Chamfer Location (Typical)

1 - CHAMFER
2 - TOP COMPRESSION RING
3 - SECOND COMPRESSION RING
4 - PISTON
5 - CHAMFER

(3) Orient the rings:

(a) Arrange top compression ring 90° counterclockwise from the oil ring rail gap (Fig. 46) .

(b) Arrange second compression ring 90° clockwise from the oil ring rail gap (Fig. 46) .

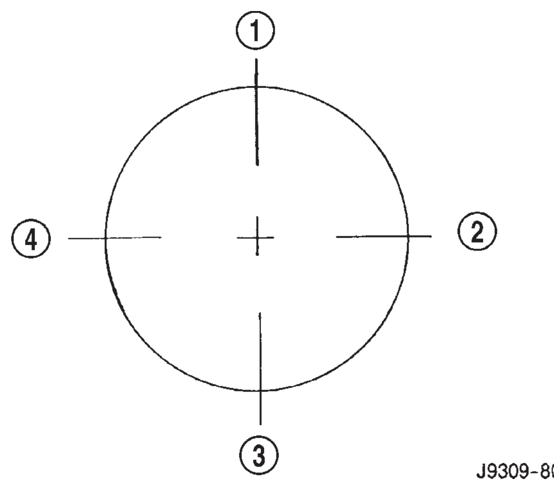


Fig. 46 Proper Ring Installation

1 - OIL RING SPACER GAP
2 - SECOND COMPRESSION RING GAP OIL RING RAIL GAP (TOP)
3 - OIL RING RAIL GAP (BOTTOM)
4 - TOP COMPRESSION RING GAP

VIBRATION DAMPER

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove fan, and fan drive (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(3) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove the vibration damper pulley.

(5) Remove vibration damper bolt and washer from end of crankshaft.

(6) Install bar and screw from Puller Tool Set C-3688. Install two bolts with washers through the puller tool and into the vibration damper (Fig. 47).

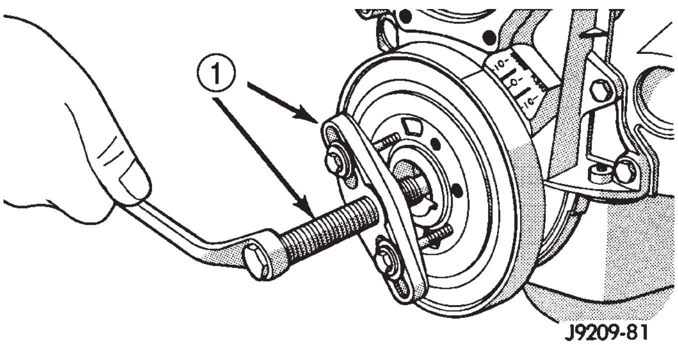


Fig. 47 Vibration Damper Assembly

1 - SPECIAL TOOL C-3688

(7) Pull vibration damper off of the crankshaft.

INSTALLATION

(1) Position the vibration damper onto the crankshaft.

(2) Place installing tool, part of Puller Tool Set C-3688, in position and press the vibration damper onto the crankshaft (Fig. 48).

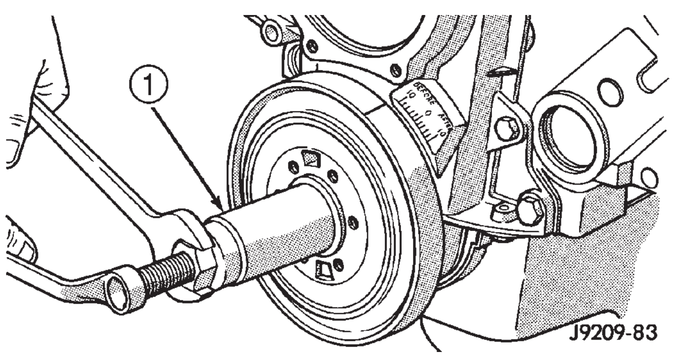


Fig. 48 Installing Vibration Damper

1 - SPECIAL TOOL C-3688

(3) Install the crankshaft bolt and washer. Tighten the bolt to 244 N·m (180 ft. lbs.) torque.

(4) Install the crankshaft pulley. Tighten the pulley bolts to 23 N·m (200 in. lbs.) torque.

(5) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(6) Install viscous fan drive and fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(7) Install the fan shroud.

(8) Connect the negative cable to the battery.

FRONT MOUNT

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.

(2) Raise hood and position fan to assure clearance for radiator top tank and hose.

CAUTION: DO NOT lift the engine by the intake manifold.

(3) Install engine lifting fixture.

(4) Raise vehicle on hoist.

(5) Remove the insulator through bolt (Fig. 49) (Fig. 50) (Fig. 51).

(6) Raise engine with lifting fixture SLIGHTLY. Remove insulator retaining bolts and remove the insulator assembly.

(7) Remove insulator heat shield and transfer to new insulator.

4WD

On 4-WD vehicles the engine front support brackets attach directly to engine block and the axle housing. The brackets provide a solid interconnection for these units (Fig. 52) (Fig. 53). Engine and front axle must be supported during any service procedures involving the front support assemblies.

(1) Disconnect the negative cable from the battery.

(2) Raise vehicle on hoist.

(3) Install engine lifting (support) fixture.

(4) Remove front axle.(Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - C205F - REMOVAL).

FRONT MOUNT (Continued)

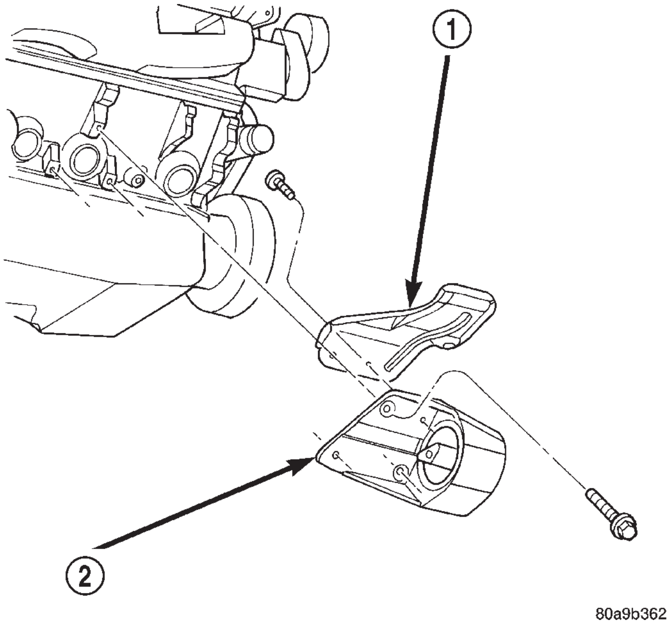


Fig. 49 Engine Right Front Insulator Mount—2WD Vehicles

1 - HEAT SHIELD
2 - INSULATOR

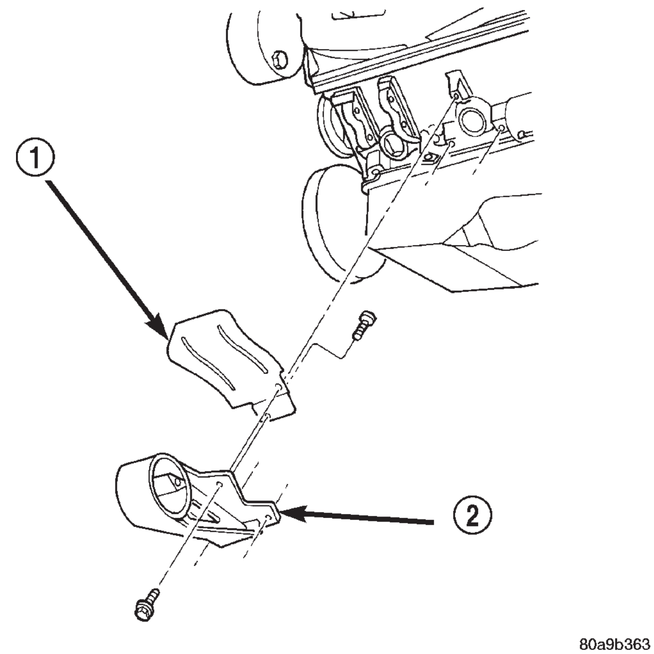


Fig. 50 Engine Left Front Insulator Mount—2WD Vehicles

1 - HEAT SHIELD
2 - INSULATOR

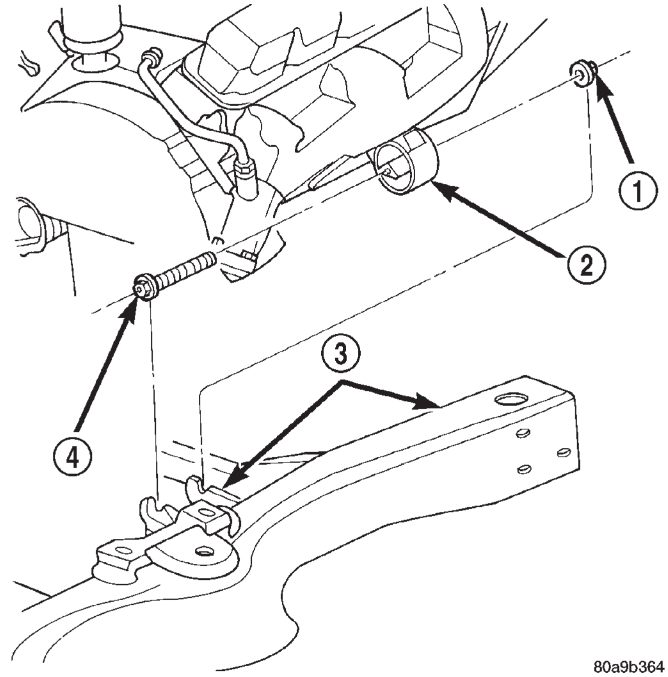


Fig. 51 Engine Mount Insulator at Frame

1 - NUT
2 - INSULATOR
3 - FRAME
4 - THROUGH BOLT

(5) **Left mount insulator only.** Remove starter wires and starter motor assembly.

(6) Remove insulator to frame throught bolt (Fig. 54).

(7) Raise engine slightly.

(8) Remove upper insulator to support bracket stud nut and insulator to support through bolt.

(9) Remove engine mount insulator. (Fig. 52) (Fig. 53).

(10) If engine support bracket is to be removed/replaced, remove support bracket to transmission bell housing bolt(s) and three (3) support bracket to engine block bolts. Remove support bracket (Fig. 52) (Fig. 53).

FRONT MOUNT (Continued)

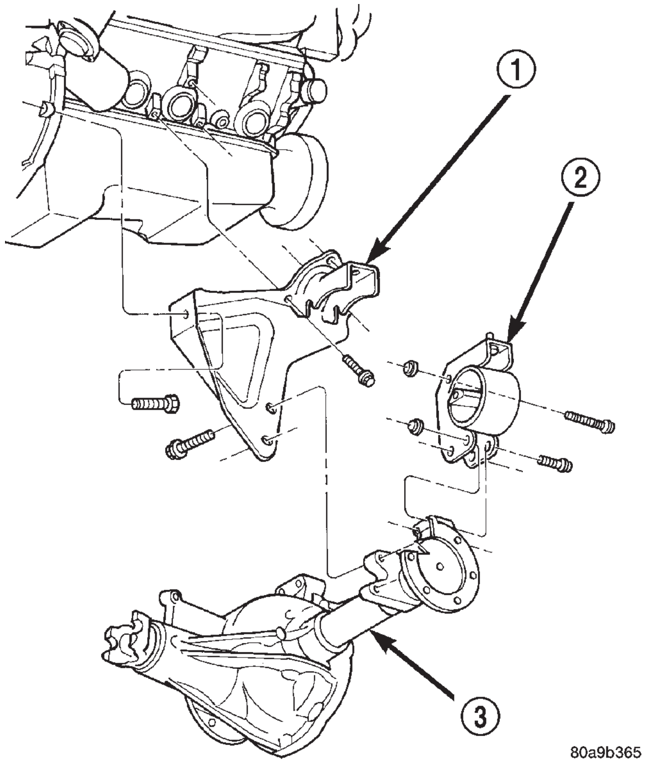


Fig. 52 Right Engine Mount Insulator and Support Bracket—4WD Vehicles

1 - ENGINE SUPPORT BRACKET
2 - INSULATOR
3 - FRONT AXLE

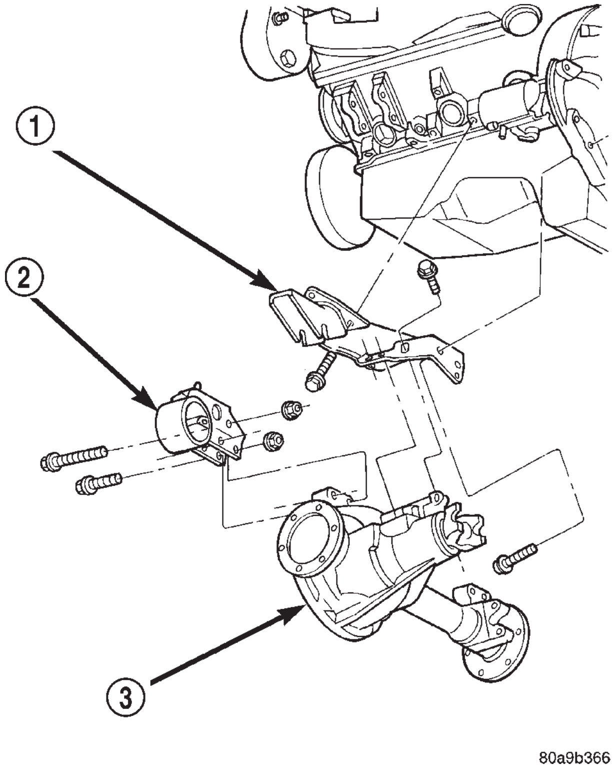


Fig. 53 Left Engine Mount Insulator and Support Bracket—4WD Vehicles

1 - ENGINE SUPPORT BRACKET
2 - INSULATOR
3 - FRONT AXLE

INSTALLATION

2WD

(1) With the engine raised SLIGHTLY, position insulator assembly onto the engine block and install bolts (Fig. 46) (Fig. 47). Tighten the bolts to 41 N·m (30 ft. lbs.) torque.

(2) Lower engine with lifting fixture while guiding insulator assembly into the engine insulator bracket (Fig. 48).

(3) Install insulator to bracket thru-bolt. Tighten the thru-bolt nut to 68 N·m (50 ft. lbs.) torque.

(4) Remove lifting fixture.

(5) Connect the negative cable to the battery.

4WD

(1) If engine support brackets were removed, intall them and their fasteners (Fig. 52) (Fig. 53). Tighten support bracket to block bolts to 41 N·m (30 ft. lbs.). Tighten support bracket to transmission bellhousing bolt(s) to 88 N·m (65 ft. lbs.)

(2) Install Engine mount insulator and tighten insulator to support bracket nut to 41 N·m (30 ft. lbs.). Tighten insulator to support bracket through bolt nut to 102 N·m (75 ft. lbs.)

(3) Lower engine and install insulator to frame through bolt and nut (Fig. 54). Tighten nut to 95 N·m (70 ft. lbs.)

(4) Install starter motor and mounting bolts. Tighten bolts to 68 N·m (50 ft. lbs.)

(5) Connect starter wires.

(6) Remove engine lifting (support) fixture.

(7) Install front axle assembly (Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - C205F - INSTALLATION).

(8) Lower the vehicle.

(9) Connect the negative cable to the battery.

REAR MOUNT (Continued)

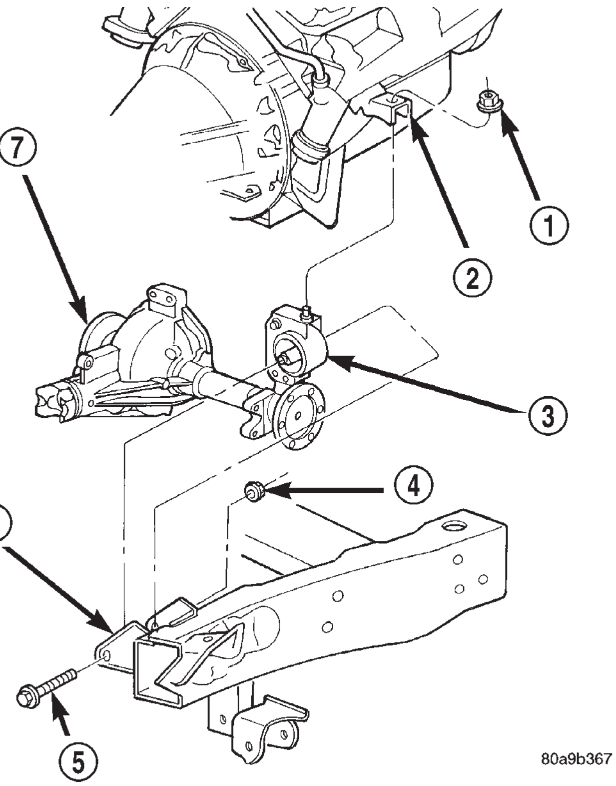


Fig. 54 Engine Mount

1 - NUT
2 - ENGINE SUPPORT BRACKET
3 - INSULATOR
4 - NUT
5 - THROUGH BOLT
6 - FRAME
7 - FRONT AXLE

REAR MOUNT

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle on a hoist.
(3) Support the transmission with a jack.

NOTE: AUTOMATIC TRANSMISSION

• Remove engine support bracket—insulator thru-bolt (Fig. 55).
• Raise the transmission and engine slightly.
• Remove stud nuts attaching insulator to cross-member (Fig. 55). Remove insulator.

NOTE: MANUAL TRANSMISSION

• Remove the stud nuts attaching the insulator to the transmission extension (Fig. 56).
• Raise the transmission and engine slightly.
• Remove stud nuts attaching insulator to cross-member (Fig. 56). Remove insulator.

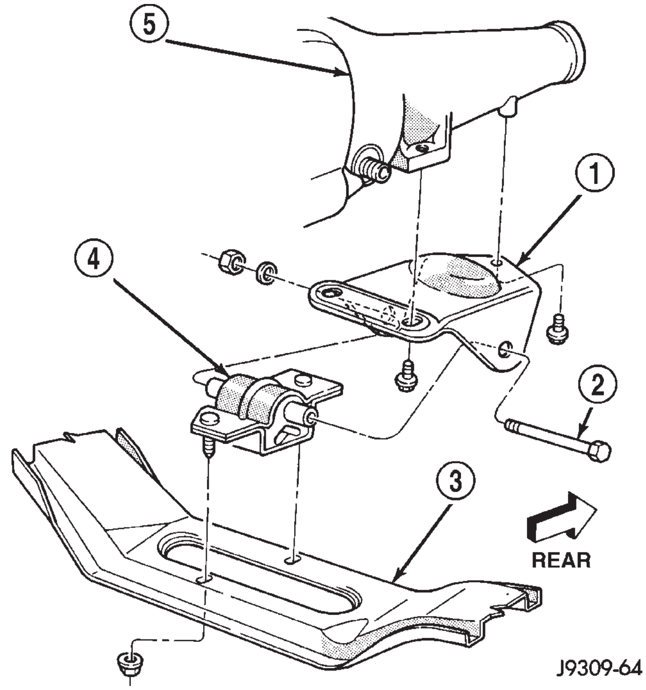


Fig. 55 Rear Insulator Automatic Transmission—2WD

1 - ENGINE SUPPORT BRACKET
2 - THROUGH BOLT
3 - CROSSMEMBER
4 - INSULATOR
5 - TRANSMISSION EXTENSION

4WD

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle on a hoist.
(3) Support the transmission with a transmission jack.

NOTE: AUTOMATIC TRANSMISSION

• Remove stud nuts holding the insulator to the crossmember (Fig. 57).
• Raise rear of transmission SLIGHTLY.
• Remove bolts holding the insulator to the insulator bracket (Fig. 57). Remove the insulator.

NOTE: MANUAL TRANSMISSION

• Remove stud nuts holding the insulator to the crossmember (Fig. 58).
• Raise rear of transmission SLIGHTLY.
• Remove bolts holding the insulator to the transmission (Fig. 58). Remove the insulator.

REAR MOUNT (Continued)

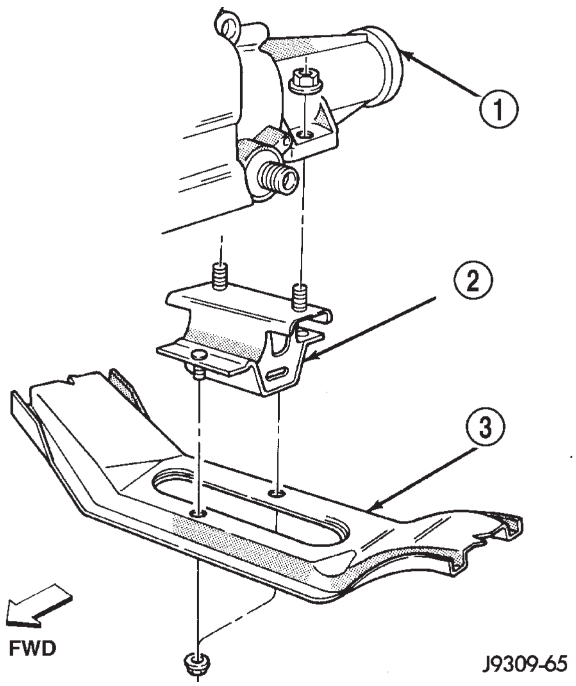


Fig. 56 Rear Insulator Manual Transmission—2WD

1 - TRANSMISSION EXTENSION
2 - INSULATOR
3 - CROSSMEMBER

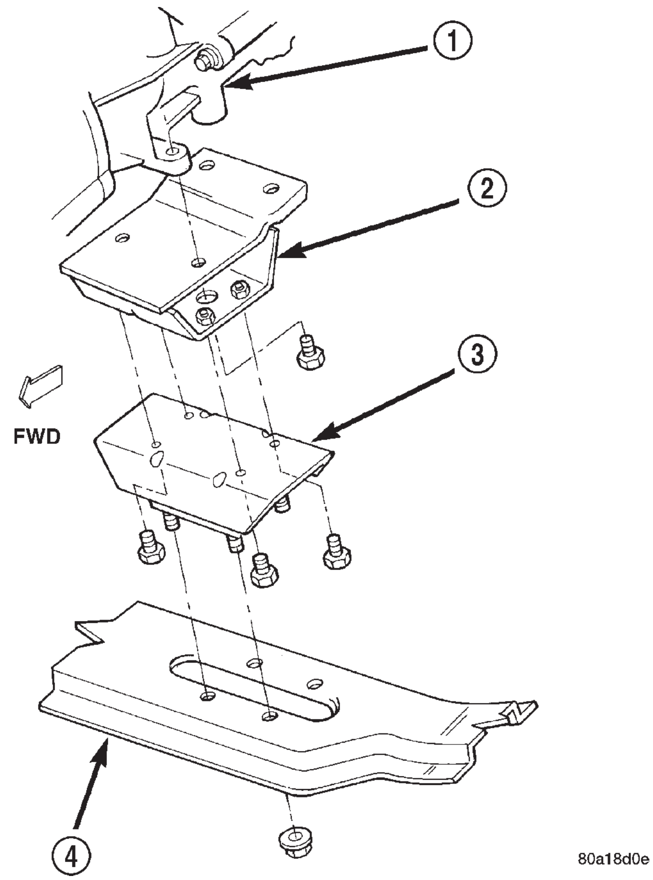


Fig. 57 Rear Insulator Automatic Transmission—4WD

1 - AUTOMATIC TRANSMISSION
2 - INSULATOR BRACKET
3 - INSULATOR
4 - CROSSMEMBER

INSTALLATION

2WD

(1) If the engine support bracket (Automatic Transmissions) was removed, position the bracket to the transmission extension (Fig. 55). Tighten the bolts to 68 N·m (50 ft. lbs.) torque.

NOTE: AUTOMATIC TRANSMISSION

- Install the insulator onto crossmember. Tighten the stud nuts to 41 N·m (30 ft. lbs) torque.
- Lower the transmission and engine while aligning the engine support bracket to the insulator.
- Install thru-bolt in bracket and insulator. Tighten thru-bolt nut to 68 N·m (50 ft. lbs.) torque.

NOTE: MANUAL TRANSMISSION

- Install the insulator onto crossmember. Tighten the stud nuts to 41 N·m (30 ft. lbs) torque.
- Lower the transmission and engine while aligning the insulator studs into the transmission extension.
- Install the stud nuts. Tighten the stud nuts to 41 N·m (30 ft. lbs) torque.

(2) Remove transmission jack.
(3) Lower the vehicle.
(4) Connect the negative cable to the battery.

4WD

NOTE: AUTOMATIC TRANSMISSION

- If the insulator bracket was removed, install the bracket to the transmission (Fig. 57). Tighten the bolts to 68 N·m (50 ft. lbs.) torque.
- Install the bolts holding insulator to insulator bracket. Tighten the bolts to 68 N·m (50 ft. lbs.) torque.
- Lower rear of transmission while aligning the insulator studs into the mounting support bracket. Install stud nuts and tighten to 68 N·m (50 ft. lbs.) torque.

NOTE: MANUAL TRANSMISSION

- Install the bolts holding insulator to insulator bracket. Tighten the bolts to 68 N·m (50 ft. lbs.) torque.

REAR MOUNT (Continued)

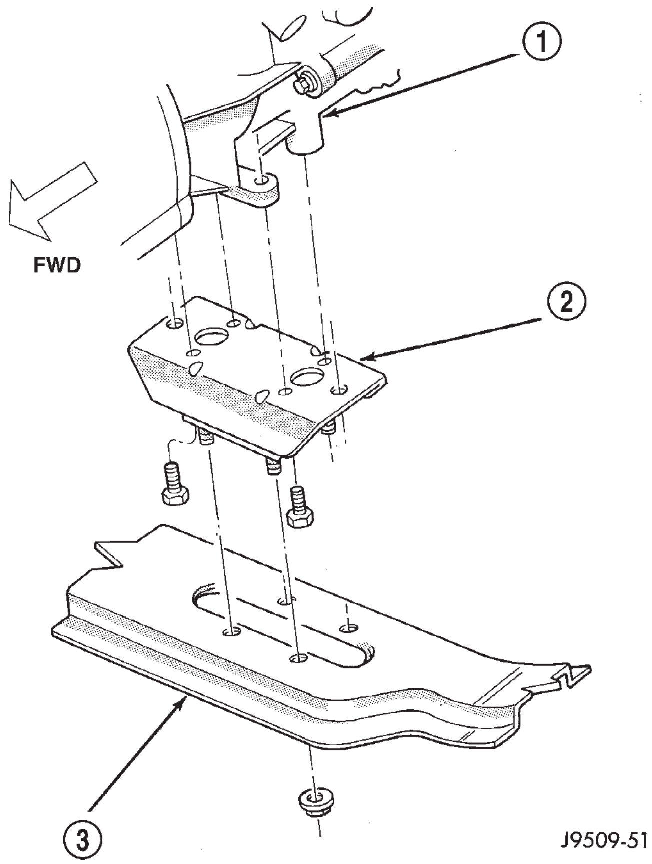


Fig. 58 Rear Insulator Manual Transmission—4WD

1 - MANUAL TRANSMISSION
2 - INSULATOR
3 - CROSSMEMBER

• Lower rear of transmission while aligning the insulator studs into the mounting support bracket. Install stud nuts and tighten to 68 N·m (50 ft. lbs.) torque.

(1) Remove the transmission jack.
(2) Lower the vehicle.
(3) Connect the negative cable to the battery.

LUBRICATION

DESCRIPTION

A gear-type positive displacement pump (Fig. 59) is mounted at the underside of the rear main bearing cap. The pump uses a pick-up tube and screen assembly to gather engine oil from the oil pan.

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

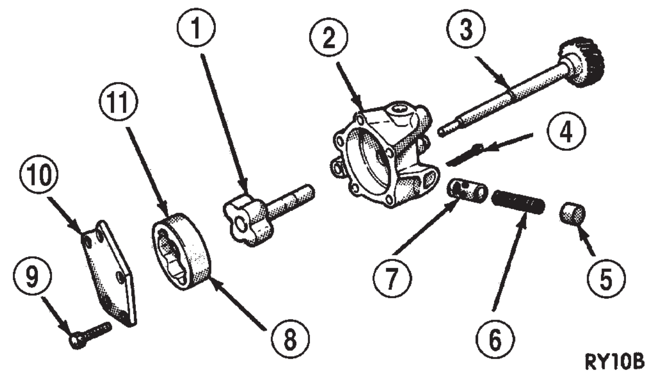


Fig. 59 Positive Displacement Oil Pump—Typical

1 - INNER ROTOR AND SHAFT
2 - BODY
3 - DISTRIBUTOR DRIVESHAFT (REFERENCE)
4 - COTTER PIN
5 - RETAINER CAP
6 - SPRING
7 - RELIEF VALVE
8 - LARGE CHAMFERED EDGE
9 - BOLT
10 - COVER
11 - OUTER ROTOR

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 on the right side of the block. The oil then goes down to the No. 1 main bearing, back up to the left side of the block, and into the oil gallery on the left side of the engine.

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 to the connecting rod journals. Each connecting rod bearing has half a hole in it, oil passes through the hole when the rods rotate and the hole lines up, oil is then 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. The camshaft bearings receive oil from the main bearing 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 No. 1 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. The oil then passes down through the push rod guide holes and the oil drain-back passages in the cylinder head, past the valve tappet area, and then returns to the oil pan (Fig. 60).

LUBRICATION (Continued)

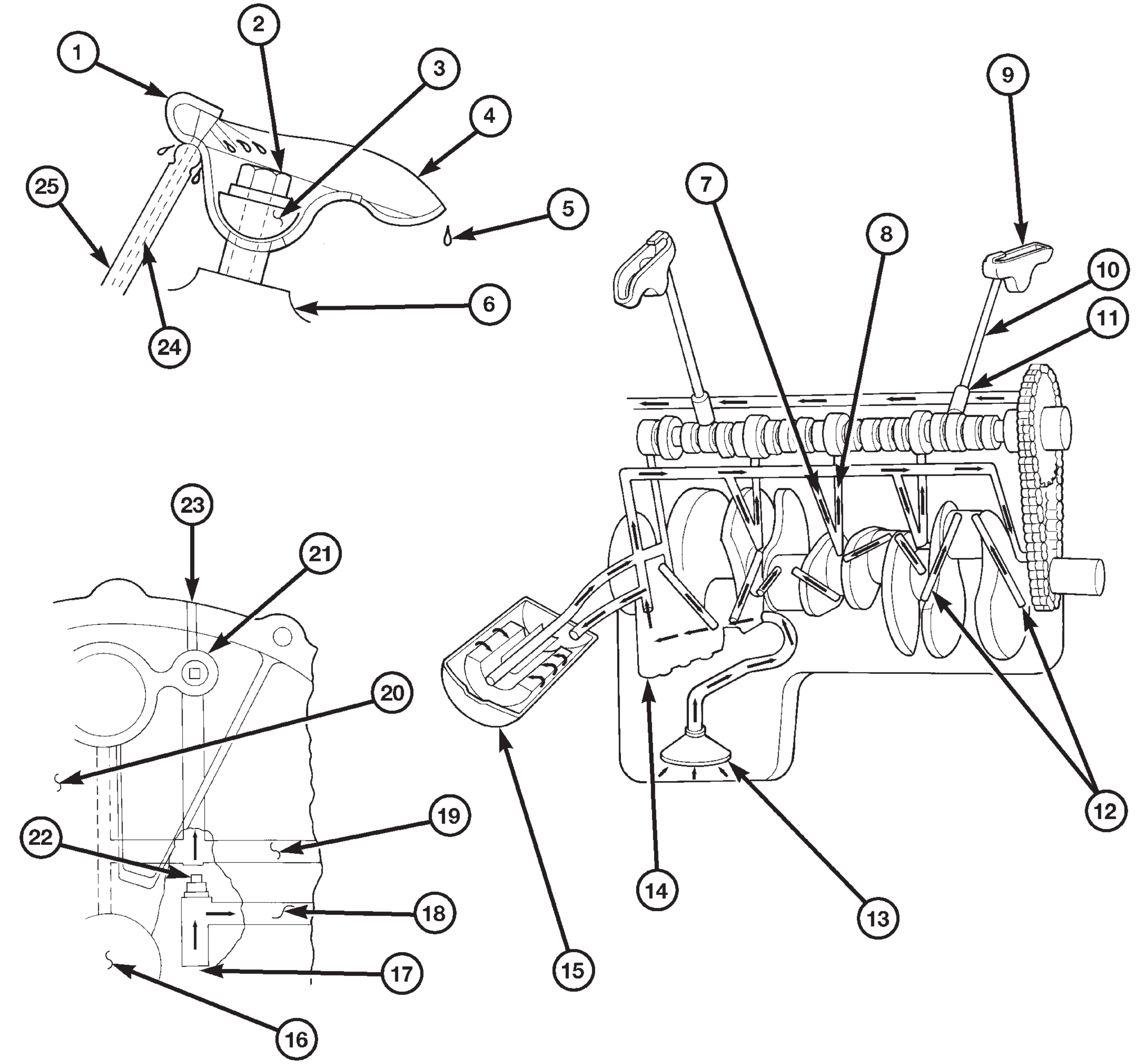


Fig. 60 Oil Lubrication System

1 - OIL DEFLECTOR TAB
2 - BOLT
3 - ROCKER ARM PIVOT
4 - ROCKER ARM
5 - DRIP OILING FOR VALVE TIP
6 - CYLINDER HEAD BOSS
7 - TO MAIN BEARINGS
8 - TO CAMSHAFT BEARINGS
9 - ROCKER ARM
10 - HOLLOW PUSH ROD
11 - TAPPET
12 - TO CONNECTING ROD BEARINGS
13 - OIL INTAKE
14 - OIL PUMP
15 - OIL FILTER
16 - CRANKSHAFT
17 - FROM OIL PUMP
18 - OIL TO FILTER
19 - OIL FROM FILTER TO SYSTEM
20 - PASSAGE TO CAMSHAFT REAR BEARING
21 - RIGHT OIL GALLERY
22 - PLUG
23 - OIL PASSAGE FOR OIL PRESSURE INDICATOR LIGHT
24 - OIL SUPPLY VIA HOLLOW PUSH ROD SUPPLY IS FROM OIL GALLERY METERED THROUGH HYDRAULIC TAPPET
25 - OIL SUPPLY FROM HOLLOW PUSH ROD

LUBRICATION (Continued)

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).

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.

OIL

STANDARD PROCEDURE - ENGINE OIL

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right front of the engine, left of the generator (Fig. 61).

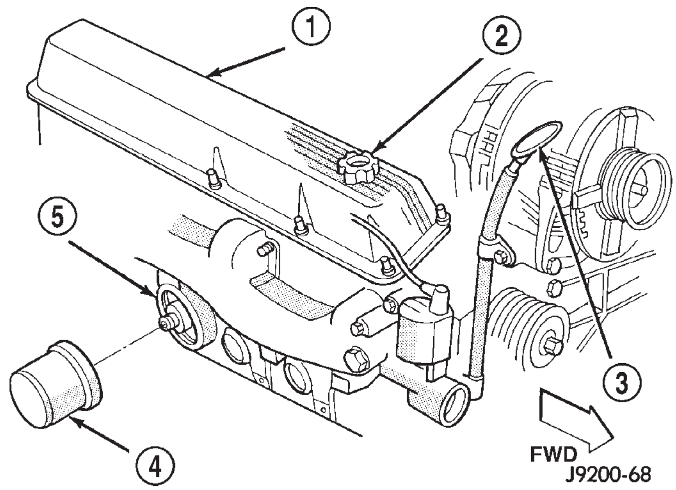


Fig. 61 Oil Level Indicator Location

1 - CYLINDER HEAD COVER
2 - ENGINE OIL FILL CAP
3 - DIPSTICK
4 - ENGINE OIL FILTER
5 - FILTER BOSS

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, oil foaming and oil pressure loss can result.

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.

(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.

(6) Add oil only if level is below the ADD mark on dipstick.

OIL (Continued)

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in the Maintenance Schedule. This information can be found in the owner's manual.

TO CHANGE ENGINE OIL

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist vehicle.

(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 and gasket if damaged.

(6) Install drain plug in crankcase.

(7) Change oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).

(8) Lower vehicle and fill crankcase with specified type (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION) and amount of engine oil (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(9) Install oil fill cap.

(10) Start engine and inspect for leaks.

(11) Stop engine and inspect oil level.

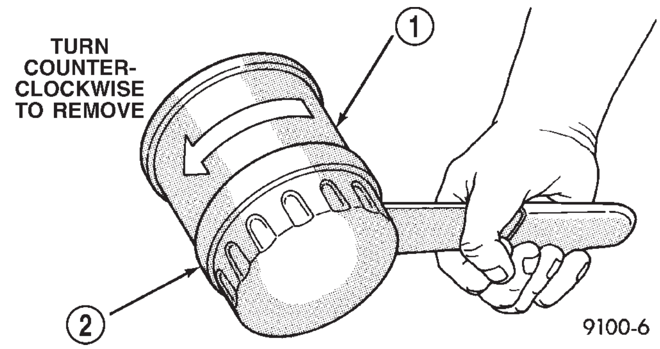


Fig. 62 Oil Filter Removal—Typical

1 - ENGINE OIL FILTER
2 - OIL FILTER WRENCH

OIL FILTER

REMOVAL

All engines are equipped with a high quality full-flow, disposable 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 (Fig. 62).

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) With a wiping cloth, clean the gasket sealing surface (Fig. 70) of oil and grime.

(6) Install new filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).

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. 63) hand tighten filter one full turn, do not over tighten.

(3) Add oil (Refer to 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE).

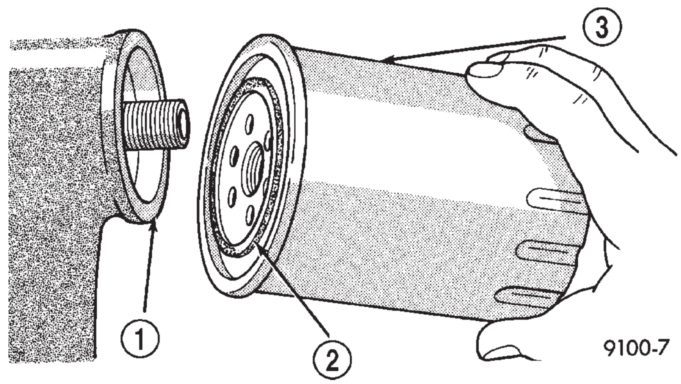


Fig. 63 Oil Filter Sealing Surface—Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

OIL PAN

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove engine oil dipstick.

(3) Raise vehicle.

(4) Drain engine oil.

(5) Remove exhaust pipe.

(6) Remove left engine to transmission strut.

(7) Loosen the right side engine support bracket cushion through-bolt nut and raise the engine slightly. Remove oil pan by sliding backward and out.

(8) Remove the one-piece 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 four alignment dowels from 5/16 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. 64) .

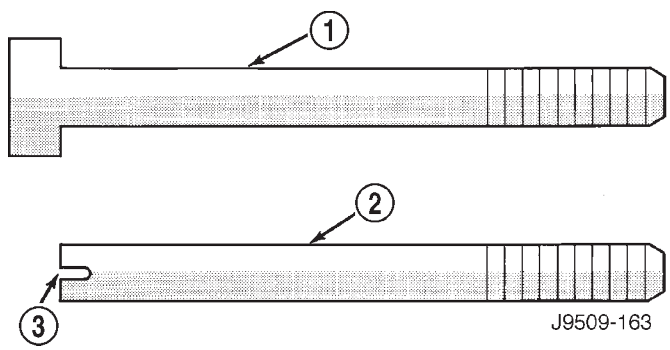


Fig. 64 Fabrication of Alignment Dowels

1 - 5/16" X 1½" BOLT
2 - DOWEL
3 - SLOT

(3) Install the dowels in the cylinder block (Fig. 65) .

(4) Apply small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent, in the corner of the cap and the cylinder block.

(5) Slide the one-piece gasket over the dowels and onto the block.

(6) Position the oil pan over the dowels and onto the gasket.

(7) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.

(8) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.

(9) Lower the engine into the support cushion brackets and tighten the through-bolt nut to the proper torque.

(10) Install the drain plug. Tighten drain plug to 34 N·m (27 ft. lbs.) torque.

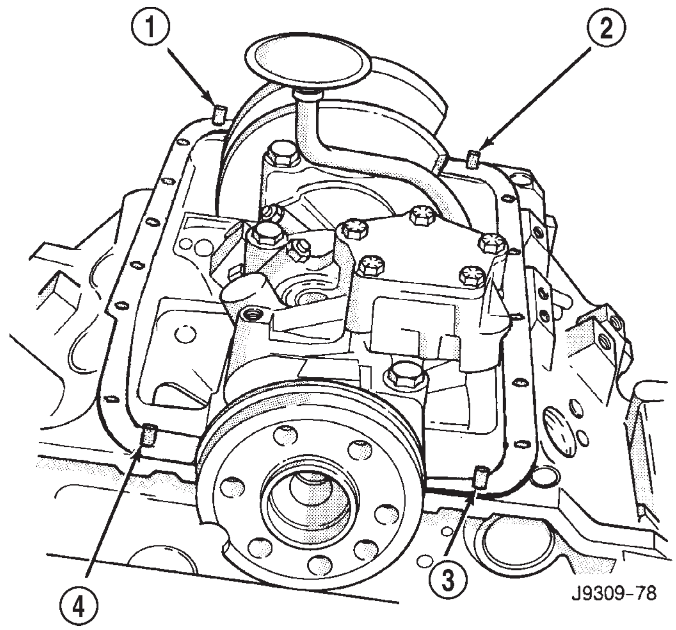


Fig. 65 Position of Dowels in Cylinder Block

1 - DOWEL
2 - DOWEL
3 - DOWEL
4 - DOWEL

(11) Install the engine to transmission strut.

(12) Install exhaust pipe.

(13) Lower vehicle.

(14) Install dipstick.

(15) Connect the negative cable to the battery.

(16) Fill crankcase with oil to proper level.

OIL PUMP

REMOVAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump from rear main bearing cap.

DISASSEMBLY

(1) Remove the relief valve as follows:

(a) Remove cotter pin. Drill a 3.175 mm (1/8 in.) hole into the relief valve retainer cap and insert a self-threading sheet metal screw into cap.

(b) Clamp screw into a vise and while supporting oil pump, remove cap by tapping pump body using a soft hammer. Discard retainer cap and remove spring and relief valve (Fig. 66) .

(2) Remove oil pump cover (Fig. 67) .

(3) Remove pump outer rotor and inner rotor with shaft (Fig. 67) .

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

OIL PUMP (Continued)

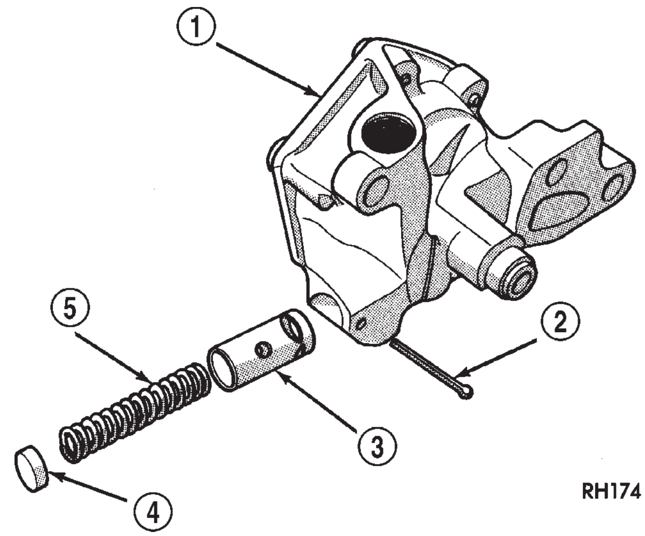


Fig. 66 Oil Pressure Relief Valve

1 - OIL PUMP ASSEMBLY
2 - COTTER PIN
3 - RELIEF VALVE
4 - RETAINER CAP
5 - SPRING

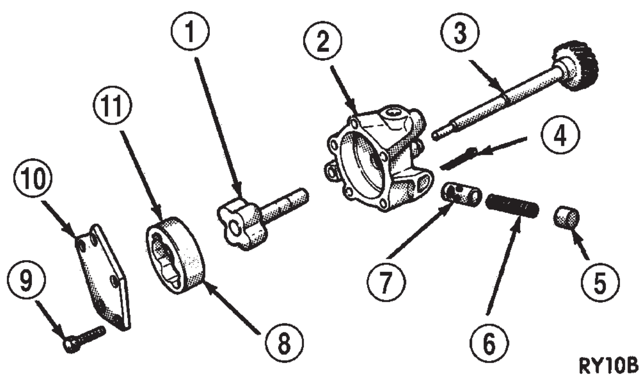


Fig. 67 Oil Pump

1 - INNER ROTOR AND SHAFT
2 - BODY
3 - DISTRIBUTOR DRIVESHAFT (REFERENCE)
4 - COTTER PIN
5 - RETAINER CAP
6 - SPRING
7 - RELIEF VALVE
8 - LARGE CHAMFERED EDGE
9 - BOLT
10 - COVER
11 - OUTER ROTOR

CLEANING

Use only mild solvents to clean the oil pump. Do not use any abrasive material to clean the oil pump housing or rotors.

INSPECTION

Mating surface of the oil pump cover should be smooth. Replace pump assembly if cover is scratched or grooved.

Lay a straightedge across the pump cover surface (Fig. 68) . If a 0.038 mm (0.0015 in.) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

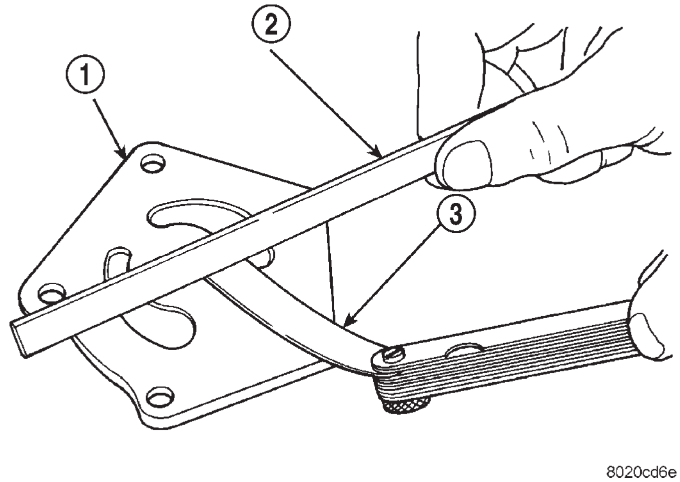


Fig. 68 Checking Oil Pump Cover Flatness

1 - COVER
2 - STRAIGHT EDGE
3 - FEELER GAUGE

Measure thickness and diameter of outer rotor. If outer rotor thickness measures 20.9 mm (0.825 in.) or less, or if the diameter is 62.7 mm (2.469 in.) or less, replace outer rotor (Fig. 69) .

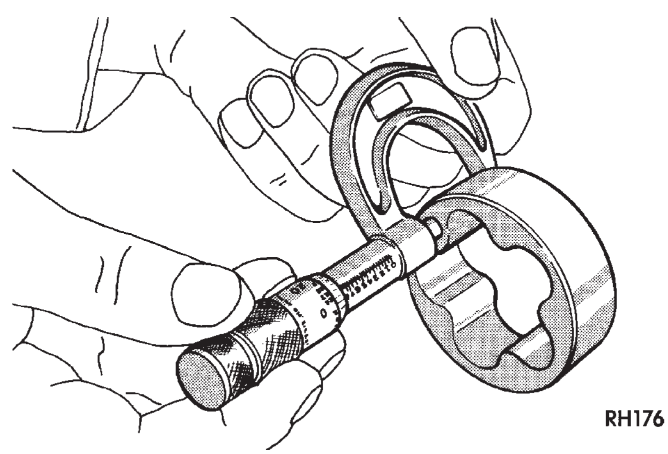


Fig. 69 Measuring Outer Rotor Thickness

OIL PUMP (Continued)

If inner rotor measures 20.9 mm (0.825 in.) or less, replace inner rotor and shaft assembly (Fig. 70) .

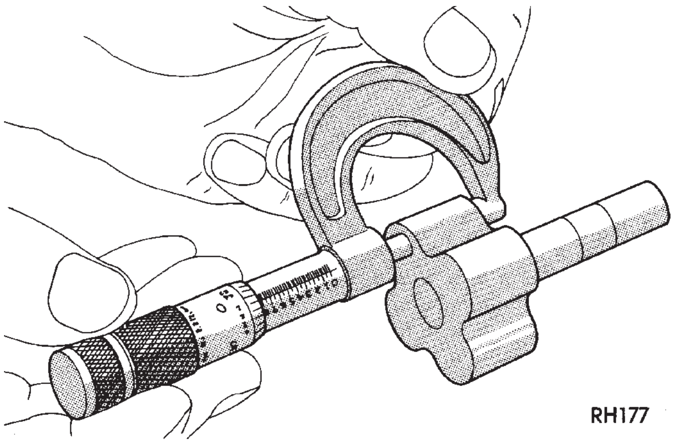


Fig. 70 Measuring Inner Rotor Thickness

Slide outer rotor into pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 71) . If clearance is 0.356 mm (0.014 in.) or more, replace oil pump assembly.

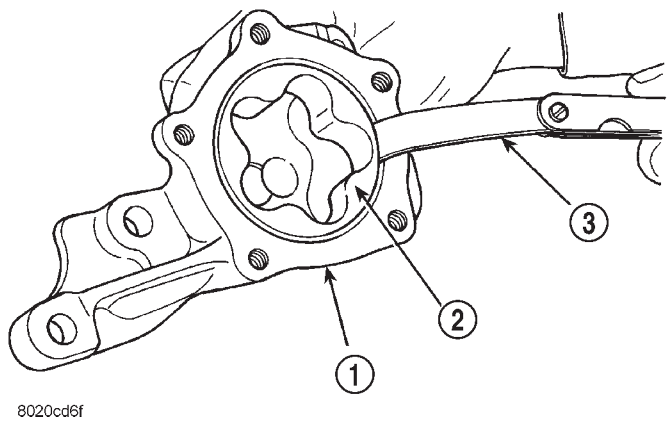


Fig. 71 Measuring Outer Rotor Clearance in Housing

1 - PUMP BODY
2 - OUTER ROTOR
3 - FEELER GAUGE

Install inner rotor and shaft into pump body. If clearance between inner and outer rotors is 0.203 mm (0.008 in.) or more, replace shaft and both rotors (Fig. 72) .

Place a straightedge across the face of the pump, between bolt holes. If a feeler gauge of 0.102 mm (0.004 in.) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 73) .

Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

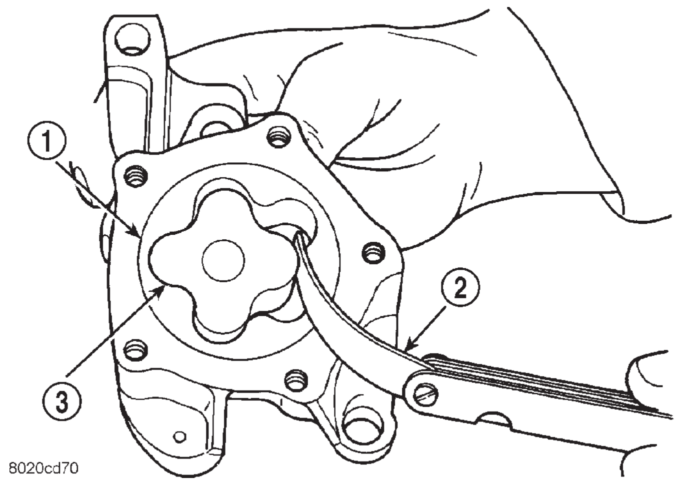


Fig. 72 Measuring Clearance Between Rotors

1 - OUTER ROTOR
2 - FEELER GAUGE
3 - INNER ROTOR

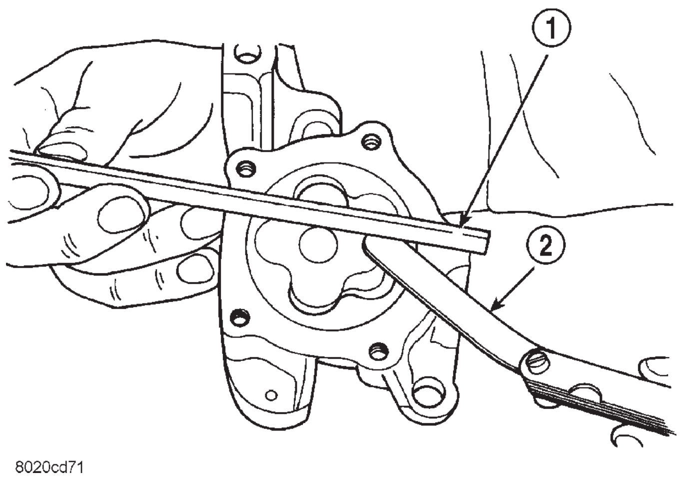


Fig. 73 Measuring Clearance Over Rotors

1 - STRAIGHT EDGE
2 - FEELER GAUGE

The relief valve spring has a free length of approximately 49.5 mm (1.95 in.). The spring should test between 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 in.). Replace spring that fails to meet these specifications (Fig. 74) .

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

ASSEMBLY

(1) Install pump rotors and shaft, using new parts as required.

(2) Position the oil pump cover onto the pump body. Tighten cover bolts to 11 N·m (95 in. lbs.) torque.

OIL PUMP (Continued)

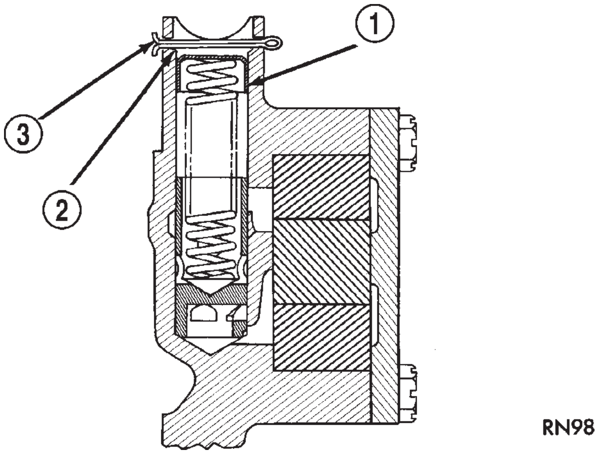


Fig. 74 Proper Installation of Retainer Cap

1 - RETAINER CAP
2 - CHAMFER
3 - COTTER KEY

(3) Install the relief valve and spring. Insert the cotter pin.

(4) Tap on a new retainer cap.

(5) Prime oil pump before installation by filling rotor cavity with engine oil.

INSTALLATION

(1) Install oil pump. During installation, slowly rotate pump body to ensure driveshaft-to-pump rotor shaft engagement.

(2) Hold the oil pump base flush against mating surface on No. 4 main bearing cap. Finger-tighten pump attaching bolts. Tighten attaching bolts to 41 N·m (30 ft. lbs.) torque.

(3) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

INTAKE MANIFOLD

DESCRIPTION

The aluminum intake manifold (Fig. 75) is a single plane design with equal length runners. This manifold uses a separate plenum pan and gasket, therefore the plenum gasket is servicable. It also uses separate flange gaskets and front and rear cross-over gaskets. Extreme care must be used when sealing the gaskets to ensure that excess sealant does not enter the intake runners causing a restriction.

OPERATION

The intake manifold, meters and delivers air to the combustion chambers allowing the fuel delivered by the fuel injectors to ignite, thus producing power.

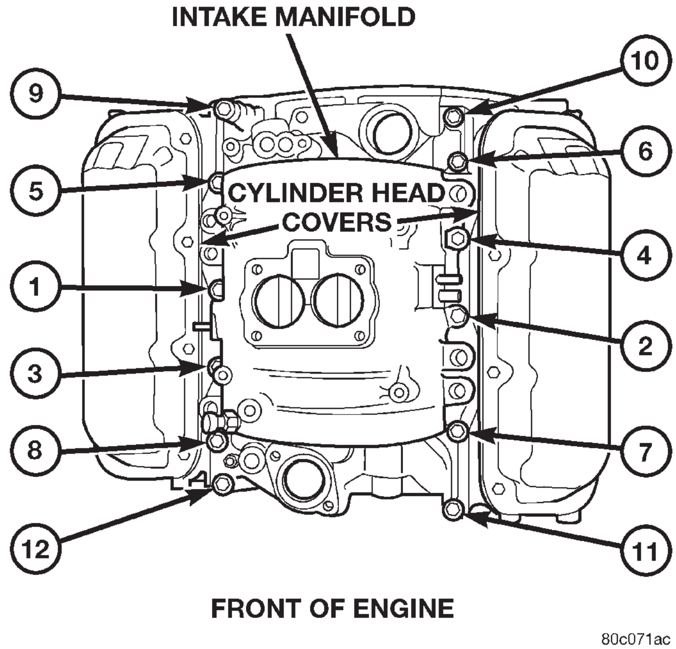


Fig. 75 Intake Manifold with Tightening Sequence—3.9L Engine

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 RPMs occurs, the area of the suspected leak has been found.

(4) Repair as required.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

(4) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(5) Remove the accessory drive bracket.

(6) Remove the air cleaner.

(7) Perform the Fuel System Pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIV-

INTAKE MANIFOLD (Continued)

ERY - STANDARD PROCEDURE). Disconnect the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(8) Disconnect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL) and if so equipped, the speed control and transmission kickdown cables.

(9) Remove the return spring.

(10) Remove the distributor cap and wires.

(11) Disconnect the coil wires.

(12) Disconnect the heat indicator sending unit wire.

(13) Disconnect the heater hoses and bypass hose.

(14) Remove the closed crankcase ventilation and evaporation control systems.

(15) Remove intake manifold bolts.

(16) Lift the intake manifold and throttle body out of the engine compartment as an assembly.

(17) Remove and discard the flange side gaskets and the front and rear cross-over gaskets.

(18) Remove the throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).

(19) If required, remove the plenum pan and gasket. Discard gasket.

CLEANING

Clean manifold in solvent and blow dry with compressed air.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

The plenum pan rail must be clean and dry (free of all foreign material).

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straightedge.

INSTALLATION

(1) If the plenum pan was removed, position a new gasket and install the plenum pan (Fig. 76). Tighten bolts in the following sequence:

- Step 1. Tighten bolts to 5.4 N·m (48 in. lbs.)
- Step 2. Tighten bolts to 9.5 N·m (84 in. lbs.)
- Step 3. Check bolts to 9.5 N·m (84 in. lbs.)

(2) Install the flange gaskets. Ensure that the vertical port alignment tab is resting on the deck face of the block. Also the horizontal alignment tabs must be in position with the mating cylinder head gasket tabs (Fig. 78). The words MANIFOLD SIDE should be visible on the center of each flange gasket.

(3) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, to the four corner joints. An excessive amount of sealant is not required to

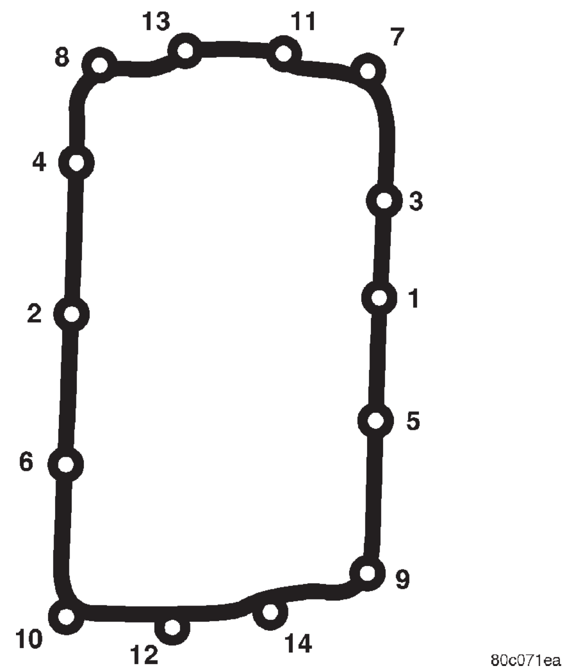


Fig. 76 Plenum Pan Bolt Tightening Sequence

ensure a leak proof seal. However, an excessive amount of sealant may reduce the effectiveness of the flange gasket. The sealant should be approximately 5 mm (0.2 in) in diameter.

(4) Install the front and rear cross-over gaskets (Fig. 77).

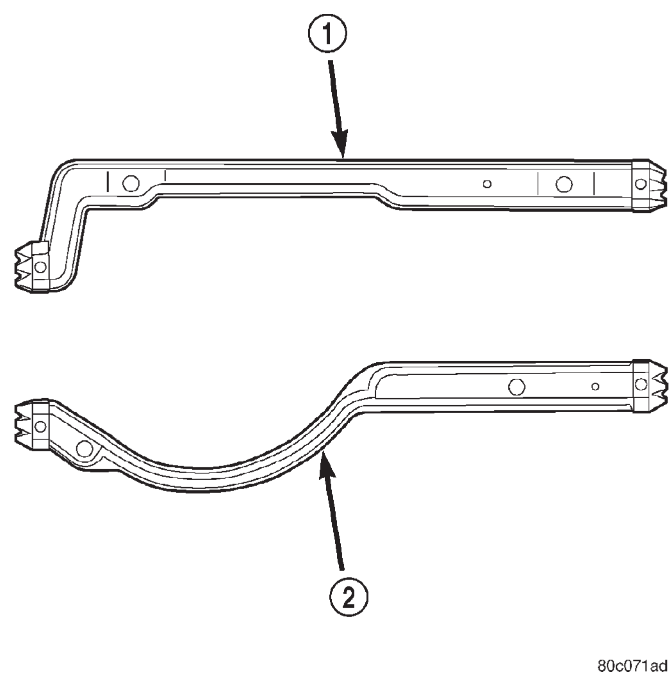


Fig. 77 Cross-Over Gaskets

1 - FRONT CROSS-OVER GASKET
2 - REAR CROSS-OVER GASKET

INTAKE MANIFOLD (Continued)

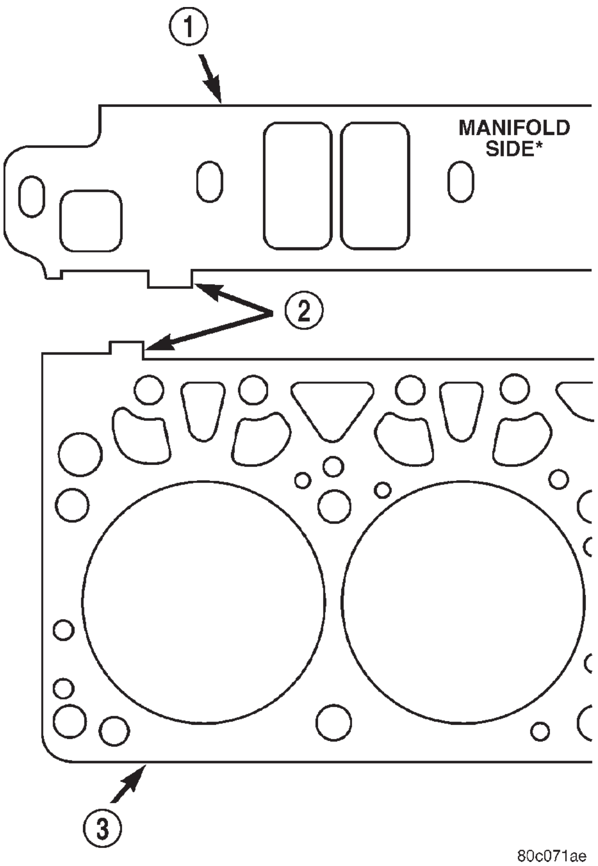


Fig. 78 Intake Manifold Flange Gasket Alignment

1 - FLANGE GASKET
2 - ALIGNMENT TABS
3 - CYLINDER HEAD GASKET

(5) Using a new gasket, install the throttle body onto the intake manifold (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - INSTALLATION).

(6) Carefully lower intake manifold into position on the cylinder block and cylinder heads. After intake manifold is in place, inspect to make sure seals are in place.

(7) Install the intake manifold bolts and tighten as follows (Fig. 79):

- Step 1. Tighten bolts 1 and 2 to 8 N·m (72 in. lbs.) Tighten in alternating steps 1.4 N·m (12 in. lbs.) at a time
- Step 2. Tighten bolts 3 through 12 to 8 N·m (72 in. lbs.)
- Step 3. Check all bolts are torqued to 8 N·m (72 in. lbs.)
- Step 4. Tighten all bolts in sequence to 16 N·m (12 ft. lbs.)
- Step 5. Check all bolts are torqued to 16 N·m (12 ft. lbs.)

(8) Install closed crankcase ventilation and evaporation control systems.

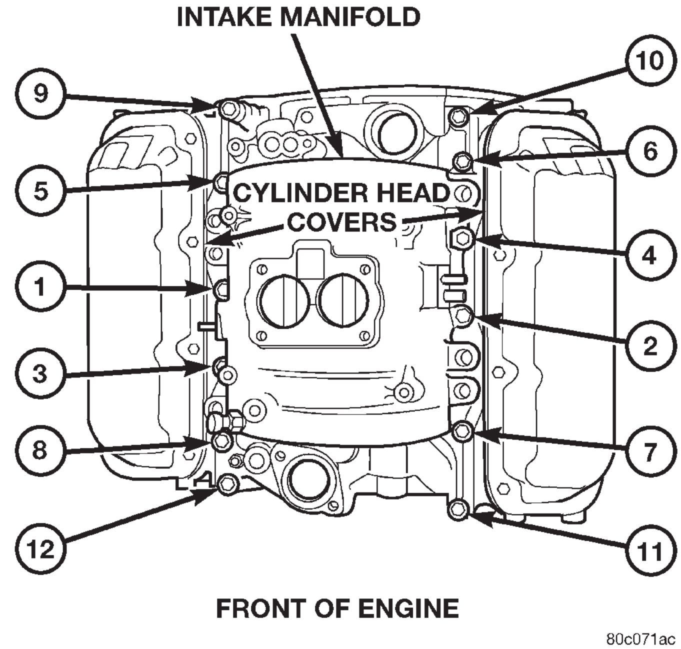


Fig. 79 Intake Manifold Bolt Tightening Sequence

(9) Connect the coil wires.

(10) Connect the heat indicator sending unit wire.

(11) Connect the heater hoses and bypass hose.

(12) Install distributor cap and wires.

(13) Hook up the return spring.

(14) Connect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - INSTALLATION) and if so equipped, the speed control and transmission kickdown cables.

(15) Install the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(16) Install the accessory drive bracket and A/C Compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(17) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION) and drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(18) Install the air cleaner.

(19) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(20) Connect the negative cable to the battery.

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds (Fig. 80) are constructed of cast iron and are LOG type with balanced flow. One exhaust manifold is attached to each cylinder head.

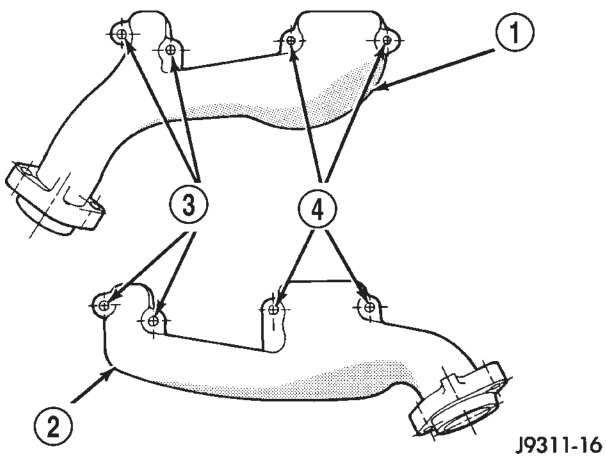


Fig. 80 Exhaust Manifolds—3.9L Engine

1 - EXHAUST MANIFOLD (RIGHT)
2 - EXHAUST MANIFOLD (LEFT)
3 - BOLTS & WASHERS
4 - NUTS & WASHERS

OPERATION

The exhaust manifolds collect the engine exhaust exiting the combustion chambers, then channels the exhaust gases to the exhaust pipes attached to the manifolds.

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise and support the vehicle.
(3) Disconnect the exhaust pipe from the exhaust manifold (Refer to 11 - EXHAUST SYSTEM/EXHAUST PIPE - REMOVAL).
(4) Lower the vehicle.
(5) Remove the exhaust heat shields.
(6) Remove bolts, nuts and washers attaching manifold to cylinder head.
(7) Remove manifold from the cylinder head.

CLEANING

Clean mating surfaces on cylinder head and manifold. Wash with solvent and blow dry with compressed air.

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straight edge. Gasket surfaces must be flat within 0.2 mm per 300 mm (0.008 inch per foot).

INSTALLATION

CAUTION: If the studs came out with the nuts when removing the engine exhaust manifold, install new studs. Apply sealer on the coarse thread ends. Water leaks may develop at the studs if this precaution is not taken.

(1) Position the engine exhaust manifolds on the two studs located on the cylinder head. Install conical washers and nuts on these studs (Fig. 81) .
(2) Install two bolts and conical washers at the inner ends of the engine exhaust manifold outboard arms. Install two bolts WITHOUT washers on the center arm of engine exhaust manifold (Fig. 81) . Starting at the center arm and working outward, tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.
(3) Install the exhaust heat shields.
(4) Raise and support the vehicle.
(5) Assemble exhaust pipe to manifold and secure with bolts, nuts and retainers. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.
(6) Lower the vehicle.
(7) Connect the negative cable to the battery.

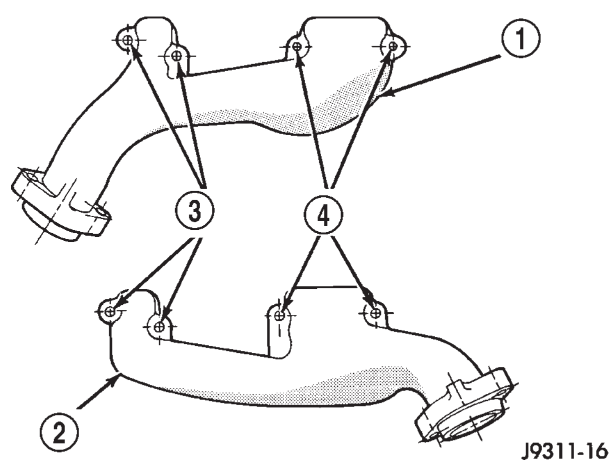


Fig. 81 Engine Exhaust Manifold Installation—3.9L Engine

1 - EXHAUST MANIFOLD (RIGHT)
2 - EXHAUST MANIFOLD (LEFT)
3 - BOLTS & WASHERS
4 - NUTS & WASHERS

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove water pump (Refer to 7 - COOLING/ENGINE/WATER PUMP - REMOVAL).

(5) Remove power steering pump (Refer to 19 - STEERING/PUMP - REMOVAL).

(6) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(7) Loosen oil pan bolts and remove the front bolt at each side.

(8) Remove the cover bolts.

(9) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

(10) From the inside of the cover tap the front crankshaft oil seal outward. Be careful not to damage the timing cover sealing surface.

INSTALLATION

(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.

(2) Using a new cover gasket, carefully install chain case cover to avoid damaging oil pan gasket. Use a small amount of Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at the joint between timing chain cover gasket and the oil pan gasket. Finger tighten the timing chain cover bolts at this time.

CAUTION: If chain cover is replaced for any reason, be sure the oil hole (passenger side of cover) is plugged.

NOTE: Special Tool 6635 must be used to align cover and seal with crankshaft.

(3) Position the special tool 6635 onto the crankshaft (Fig. 82).

(4) Tighten chain case cover bolts to 41 N·m (30 ft. lbs.) torque. Tighten oil pan bolts to 24 N·m (215 in. lbs.) torque.

(5) Remove special tool 6635.

(6) Inspect the seal flange on the vibration damper.

(7) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

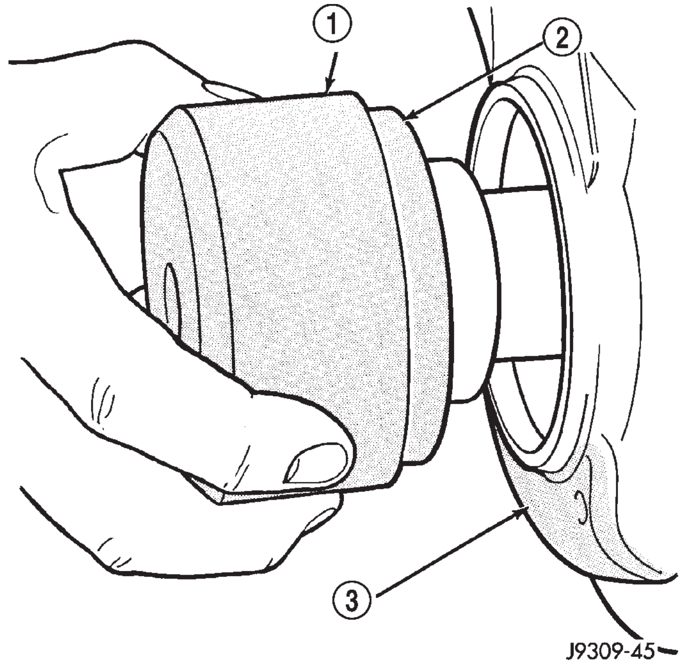


Fig. 82 Position Special Tool 6635 onto Crankshaft

1 - SPECIAL TOOL 6635
2 - OIL SEAL
3 - TIMING CHAIN COVER

(8) Install water pump (Refer to 7 - COOLING/ENGINE/WATER PUMP - INSTALLATION).

(9) Install power steering pump (Refer to 19 - STEERING/PUMP - INSTALLATION).

(10) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(11) Install the cooling system fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(12) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(13) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(14) Connect the negative cable to the battery.

TIMING BELT/CHAIN TENSIONER AND PULLEY

DESCRIPTION

The timing chain tensioner is a stamped steel constant tension mechanical design. It is mounted to the front of the engine, behind the timing chain drive.

OPERATION

The timing chain tension is maintained by routing the timing chain through the tensioner assembly. A nylon covered spring steel arm presses on the timing chain maintaining the correct chain tension.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect battery negative cable.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(4) Rotate crankshaft to align timing marks (Fig. 84) to #1 TDC.

(5) Remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

(6) Slip crankshaft sprocket onto crankshaft and compress tensioner shoe by placing a large screwdriver between crankshaft sprocket and tensioner shoe (Fig. 83). Compress shoe until hole in shoe lines up with hole in bracket. Slide a suitable pin into the holes (Fig. 83) and remove screwdriver.

(7) If tensioner assembly is to be replaced, remove the three tensioner to block bolts and remove tensioner assembly.

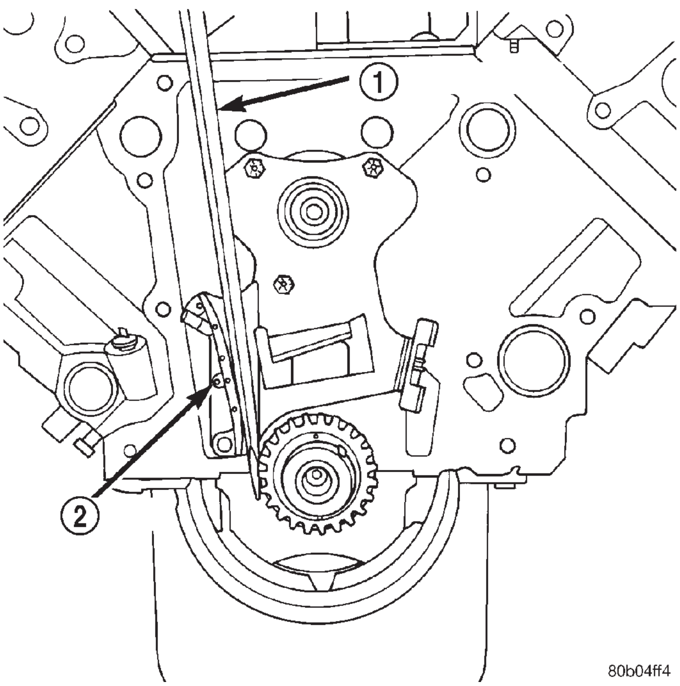


Fig. 83 Compressing Tensioner For Chain Installation

1 - SCREWDRIVER
2 - INSERT PIN HERE

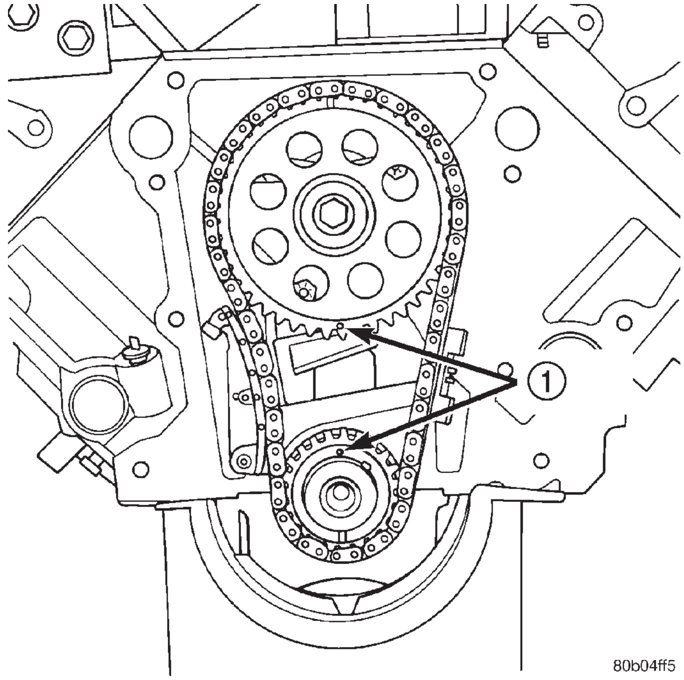


Fig. 84 Alignment of Timing Marks

1 - TIMING MARKS

INSPECTION—MEASURING TIMING CHAIN STRETCH

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. 85) .

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

TIMING BELT/CHAIN AND SPROCKETS (Continued)

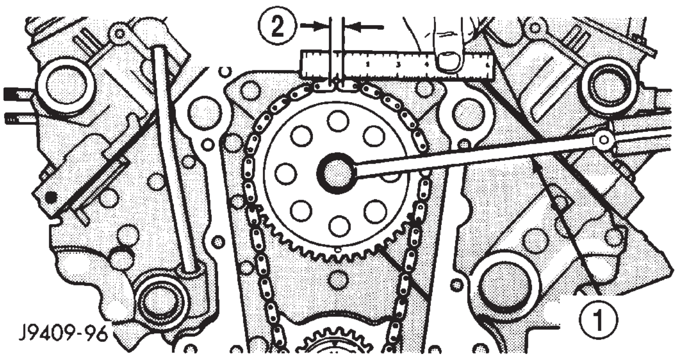


Fig. 85 Measuring Timing Chain Wear and Stretch

1 - TORQUE WRENCH
2 - 3.175 MM (0.125 IN.)

INSTALLATION

(1) If tensioner assembly is being replaced, install tensioner and mounting bolts. Torque bolts to 24 N·m (210 in. lbs.).

(2) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on an exact imaginary center line through both camshaft and crankshaft bores.

(3) Place timing chain around both sprockets.

(4) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(5) Slide both sprockets evenly over their respective shafts and verify alignment of timing marks (Fig. 86) with a straight-edge if necessary.

(6) Install the camshaft bolt. Tighten the bolt to 68 N·m (50 ft. lbs.) torque.

(7) **Remove tensioner pin.** Again, verify alignment of timing marks.

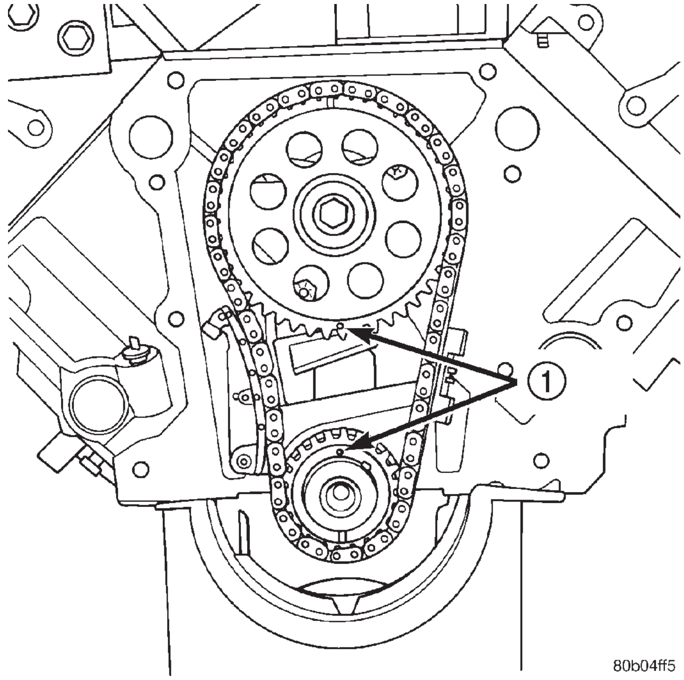


Fig. 86 Alignment of Timing Marks

1 - TIMING MARKS

(8) Install timing cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(9) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(10) Connect battery negative cable.

(11) Start engine and check for oil and coolant leaks.

ENGINE 4.7L

TABLE OF CONTENTS

ENGINE 4.7L

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 and (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)—MECHANICAL for possible causes and corrections of malfunctions. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DIAGNOSIS AND TESTING) and (Refer to 14 - FUEL SYSTEM/FUEL INJECTION - DIAGNOSIS AND TESTING) 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 4.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery	1. Charge or replace as necessary.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals.
	3. Faulty starter.	3. (Refer to 8 - ELECTRICAL/ STARTING - DIAGNOSIS AND TESTING).
	4. Faulty coil or control unit.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	5. Incorrect spark plug gap.	5. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	6. Dirt or water in fuel system.	6. Clean system and replace fuel filter.
	7. Faulty fuel pump, relay or wiring.	7. Repair or replace as necessary.
ENGINE STALLS OR ROUGH IDLE	1. Idle speed set to low.	1. (Refer to 14 - FUEL SYSTEM/ FUEL INJECTION/IDLE AIR CONTROL MOTOR - REMOVAL).
	2. Idle mixture to lean or to rich.	2. Refer to Powertrain Diagnosis Information.
	3. Vacuum leak.	3. Inspect intake manifold and vacuum hoses, repair or replace as necessary.
	4. Faulty coil.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	5. Incorrect engine timing.	5. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE).
1. ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped spark plugs.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Dirt or water in fuel system.	2. Clean system and replace fuel filter.
	3. Faulty fuel pump.	3. (Refer to 14 - FUEL SYSTEM/ FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING).
	4. Blown cylinder head gasket.	4. Replace cylinder head gasket.
	5. Low compression.	5. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING), repair as necessary.
	6. Burned, warped or pitted valves.	6. Replace as necessary.

ENGINE 4.7L (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
	7. Plugged or restricted exhaust system.	7. Inspect and replace as necessary.
	8. Faulty coil.	8. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
1. ENGINE MISSES ON ACCELERATION	1. Spark plugs dirty or incorrectly gapped.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Dirt in fuel system.	2. Clean fuel system.
	3. Burned, warped or pitted valves.	3. Replcae as necessary.
	4. Faulty coil.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
1. ENGINE MISSES AT HIGH SPEED	1. Spark plugs dirty or incorrectly gapped.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Faulty coil.	2. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	3. Dirt or water in fuel system.	3. Clean system and replace fuel filter.

ENGINE 4.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTIONS
NOISY VALVES	1. High or low oil level in crankcase.	1. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS).
	2. Thin or diluted oil.	2. Change oil and filter.
	3. Low oil pressure.	3. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	4. Dirt in lash adjusters.	4. Replace as necessary.
	5. Worn rocker arms.	5. Replace as necessary.
	6. Worn lash adjusters	6. Replace as necessary.
	7. Worn valve guides.	7. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).
	8. Excessive runout of valve seats on valve faces.	8. Service valves and valve seats. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).
CONNECTING ROD NOISE	1. Insufficient oil supply.	1. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS).
	2. Low oil pressure.	2. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Replace as necessary.
	5. Connecting rod journal out-of-round.	5. Service or replace crankshaft.
	6. Misaligned connecting rods.	6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply.	1. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS).
	2. Low oil pressure.	2. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Replace as necessary.
	5. Excessive end play.	5. Check thrust washers for wear.
	6. Crankshaft journal out-of round.	6. Service or replace crankshaft.
	7. Loose flywheel or torque converter.	7. Tighten to correct torque

ENGINE 4.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings.	1.
	(a) Misaligned or damaged.	(a) Replace as necessary.
	(b) Loose fasteners, broken or porous metal parts.	(b) Tighten fasteners, Repair or replace metal parts.
	2. Crankshaft rear seal	2. Replace as necessary (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT OIL SEAL - REAR - REMOVAL).
	3. Crankshaft seal flange. Scratched, nicked or grooved.	3. Polish or replace crankshaft.
	4. Oil pan flange cracked.	4. Replace oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
	5. Timing chain cover seal, damaged or misaligned.	5. Replace seal (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT OIL SEAL - FRONT - REMOVAL).
	6. Scratched or damaged vibration damper hub.	6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sending unit.	2. Replace sending unit (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE SENSOR/SWITCH - REMOVAL).
	3. Low oil pressure.	3. Check oil pump and bearing clearance.
	4. Clogged oil filter.	4. Replace oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).
	5. Worn oil pump.	5. Replace oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).
	6. Thin or diluted oil.	6. Change oil and filter.
	7. Excessive bearing clearance.	7. Replace as necessary.
	8. Oil pump relief valve stuck.	8. Replace oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).
	9. Oil pump suction tube loose, damaged or clogged.	9. Replace as necessary.

ENGINE 4.7L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in oil ring slots.	2. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE).
	3. Incorrect ring size installed.	3. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE).
	4. Worn valve guides.	4. Ream guides and replace valves (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).
	5. Leaking valve guide seals.	5. Replace valve guide seals.

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.

(3) Secure the throttle in the wide-open position.

(4) Disable the fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DESCRIPTION).

(5) Remove the ASD relay (Refer to 8 - ELECTRICAL/IGNITION CONTROL/AUTO SHUT DOWN RELAY - REMOVAL).

(6) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(7) Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.

(8) (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.

(4) Remove the oil filler cap.

(5) Remove the air cleaner.

(6) Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

(7) Perform the test procedures on each cylinder according to the tester manufacturer's instructions. Set piston of cylinder to be tested at TDC compression,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 .

ENGINE 4.7L (Continued)

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. Inspect valve springs. 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. Inspect valve springs. 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 - 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 - 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 mate-

ENGINE 4.7L (Continued)

rial 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.

REMOVAL

NOTE: This procedure applies to both the 4X2 and 4X4 vehicles, steps that apply to the 4X4 vehicle only, are identified.

(1) Disconnect the battery negative and positive cables.

(2) Remove the battery and the battery tray.

(3) Raise vehicle on hoist.

(4) Remove exhaust crossover pipe from exhaust manifolds.

(5) **4X4 vehicles**Disconnect axle vent tube from left side engine mount.

(6) Remove the through bolt retaining nut and bolt from both the left and right side engine mounts (Fig. 1) (Fig. 2).

(7) **4X4 vehicles**Remove locknut from left and right side engine mount brackets (Fig. 2).

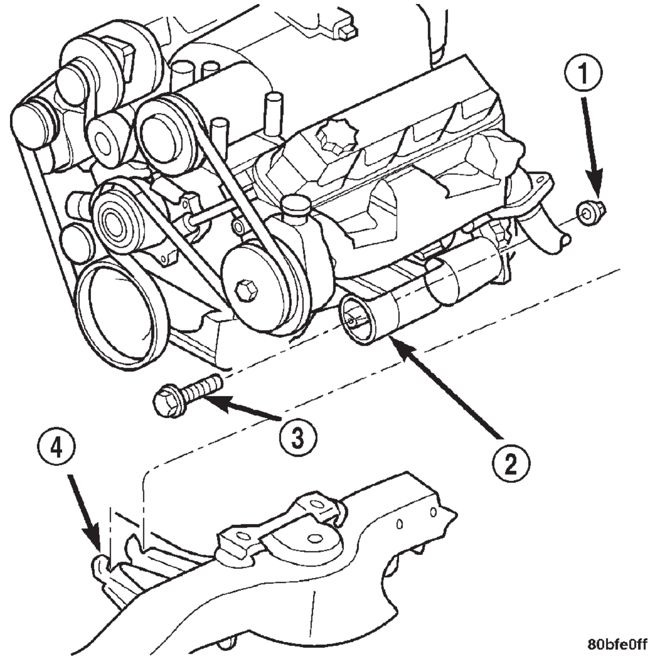


Fig. 1 Engine Mount Through Bolt and Nut Removal / Installation—4X2

1 - LOCKNUT AND WASHER
2 - ENGINE MOUNT/INSULATOR
3 - THROUGH BOLT
4 - FRAME

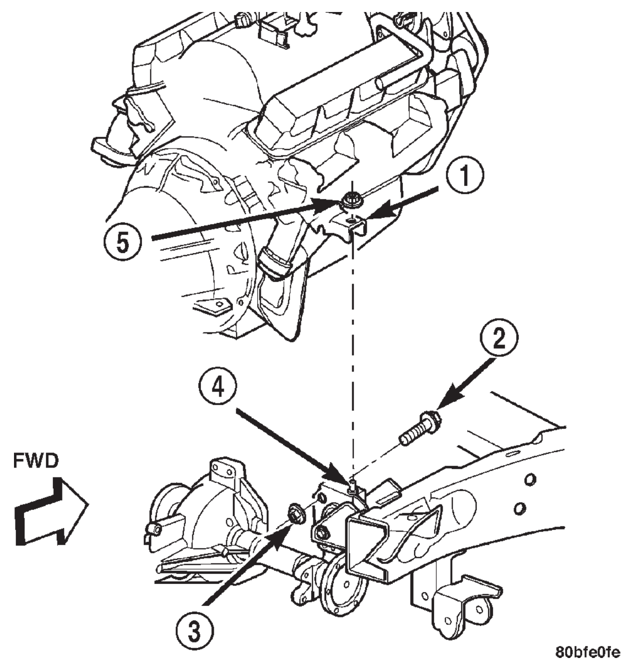


Fig. 2 Engine Mount Through Bolt and Nut Removal / Installation—4X4

1 - ENGINE MOUNT BRACKET (2)
2 - THROUGH BOLT (2)
3 - LOCKNUT AND WASHER (2)
4 - ENGINE ISOLATOR TO ENGINE MOUNT BRACKET STUD (2)
5 - LOCKNUT (2)

ENGINE 4.7L (Continued)

(8) Disconnect two ground straps from the lower left hand side and one ground strap from the lower right hand side of the engine.

(9) Disconnect crankshaft position sensor. (Fig. 4)

NOTE: The following step applies to 4X4 vehicles equipped with automatic transmission only.

(10) **4X4 vehicles**Remove the axle isolator bracket from the engine, transmission and the axle (Fig. 3).

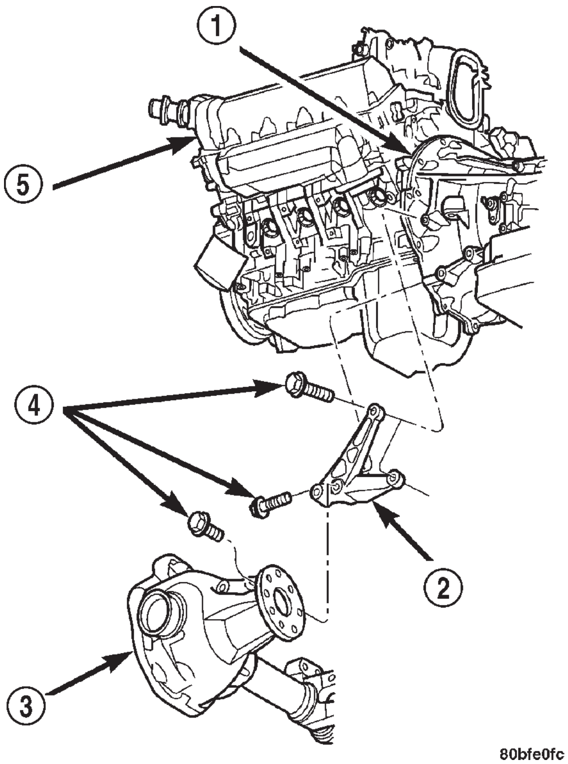


Fig. 3 Axle Isolator Bracket Removal / Installation—4X4 Vehicles With

1 - TRANSMISSION
2 - AXLE ISOLATOR BRACKET
3 - FRONT AXLE 4X4 VEHICLES
4 - BOLTS
5 - ENGINE

(11) Remove structural cover (Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - REMOVAL).

(12) Remove starter (Refer to 8 - ELECTRICAL/ STARTING/STARTER MOTOR - REMOVAL).

(13) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(14) Remove torque converter bolts (Automatic Transmission Only).

(15) Remove transmission to engine mounting bolts.

(16) Disconnect the engine block heater power cable from the block heater, if equipped.

(17) Lower vehicle.

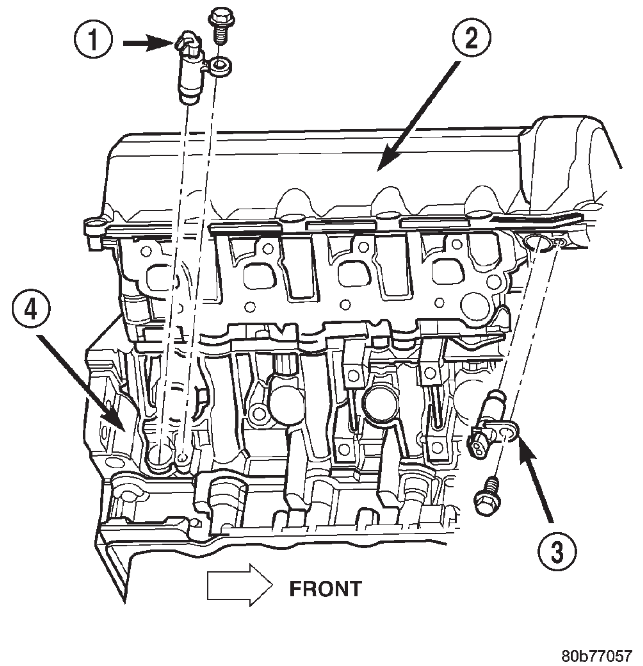


Fig. 4 Crankshaft Position Sensor

1 - CRANKSHAFT POSITION SENSOR
2 - CYLINDER HEAD COVER
3 - CAMSHAFT POSITION SENSOR
4 - RIGHT SIDE CYLINDER BLOCK

(18) Remove throttle body resonator assembly and air inlet hose.

(19) Disconnect throttle and speed control cables.

(20) Disconnect tube from both the left and right side crankcase breathers (Fig. 5). Remove breathers

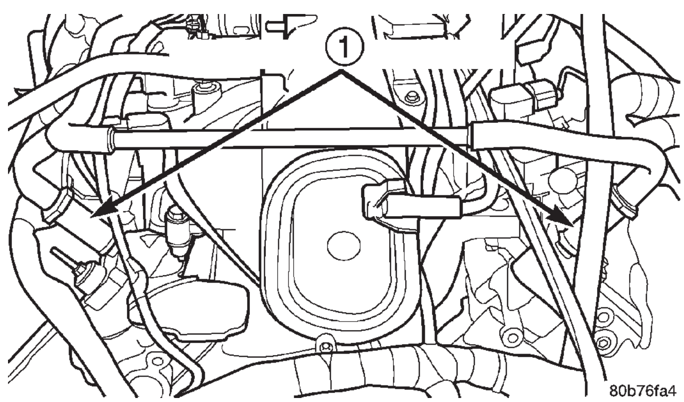


Fig. 5 Crankcase Breather Connection Points

1 - CRANKCASE BREATHERS

(21) Discharge A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(22) Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

ENGINE 4.7L (Continued)

(23) Remove shroud, fan assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL) and accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(24) Disconnect transmission oil cooler lines at the radiator.

(25) Disconnect radiator upper and lower hoses.

(26) Remove radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL), A/C condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL) and transmission oil cooler.

(27) Remove generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(28) Disconnect the two heater hoses from the timing chain cover and heater core.

(29) Unclip and remove heater hoses and tubes from the intake manifold (Fig. 6).

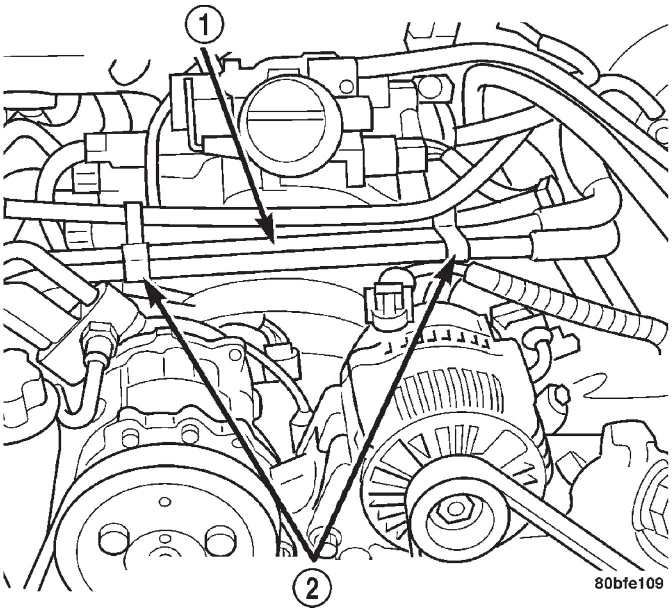


Fig. 6 Heater Hoses and Tubes Removal / Installation

1 - HEATER HOSES AND TUBES
2 - ROUTING/RETAINING CLIPS

(30) Disconnect engine harness at the following points :

- Intake air temperature (IAT) sensor (Fig. 7)
- Fuel Injectors
- Throttle Position (TPS) Switch
- Idle Air Control (IAC) Motor
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold absolute pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs

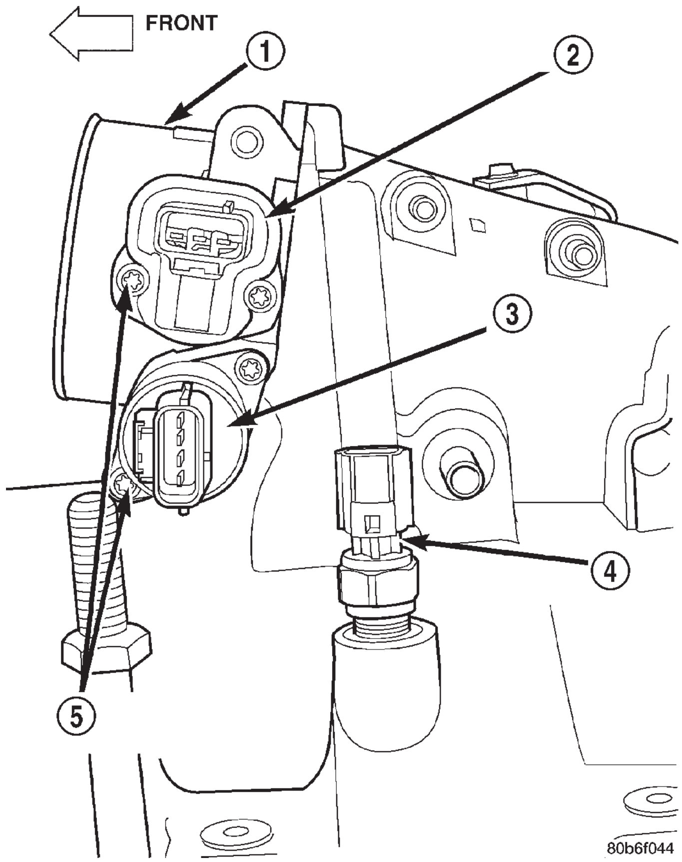


Fig. 7 Throttle Body Connection Points

1 - THROTTLE BODY
2 - TPS
3 - IAC MOTOR
4 - IAT SENSOR
5 - MOUNTING SCREWS

(31) Disconnect the vacuum lines at the throttle body and intake manifold.

(32) Release fuel rail pressure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE) then disconnect the fuel supply quick connect fitting at the fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(33) Remove power steering pump and position out of the way.

(34) Install Special Tools 8400 Lifting Studs, into the cylinder heads.

(35) Install Engine Lifting Fixture Special Tool 8347 (Fig. 8) following these steps.

- Holding the lifting fixture at a slight angle, slide the large bore in the front plate over the hex portion of the lifting stud.
- Position the two remaining fixture arms onto the two Special Tools 8400 Lifting Studs, in the cylinder heads.

ENGINE 4.7L (Continued)

• Pull foward and upward on the lifting fixture so that the lifting stud rest in the slotted area below the large bore.

• Secure the lifting fixture to the three studs using three 7/16 – 14 N/C locknuts.

• Make sure the lifting loop in the lifting fixture is in the last hole (closest to the throttle body) to minimize the angle of engine during removal.

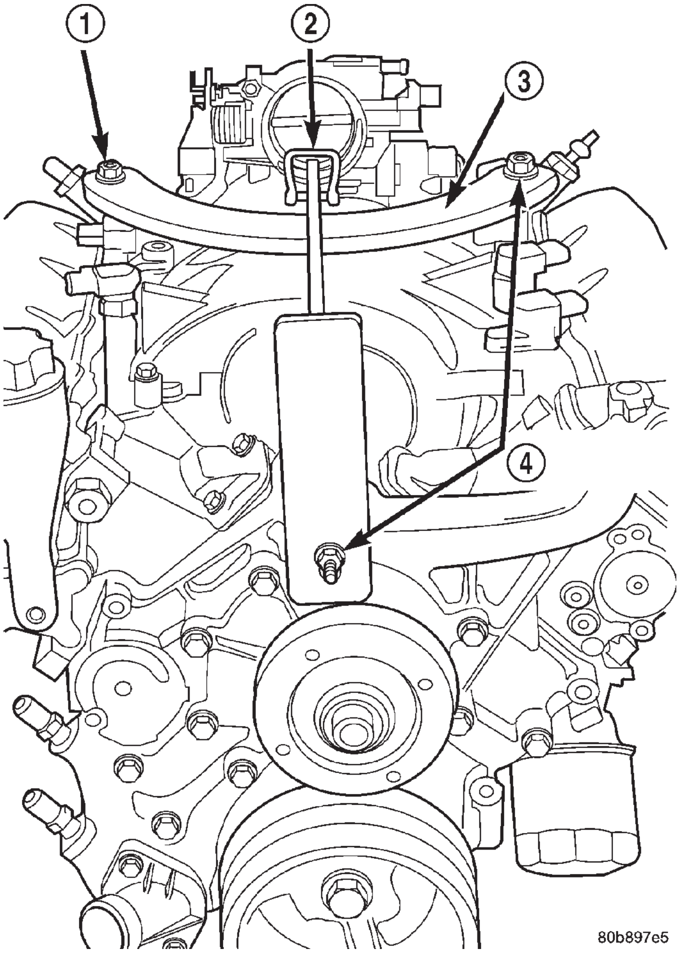


Fig. 8 Engine Lifting Fixture Attachment Locations

1 - ATTACHING LOCATION
2 - ADJUSTABLE HOOK
3 - SPECIAL TOOL 8347 ENGINE LIFT FIXTURE
4 - ATTACHING LOCATIONS

(36) Disconnect body ground strap at the right side cowl (Fig. 9).

(37) Disconnect body ground strap at the left side cowl (Fig. 10).

NOTE: It will be necessary to support the transmission in order to remove the engine.

(38) Position a suitable jack under the transmission.

(39) Remove engine from the vehicle.

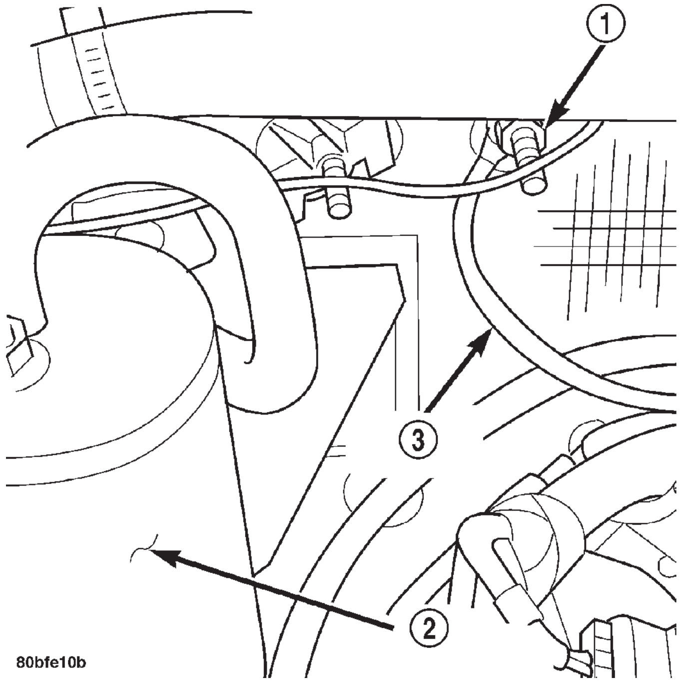


Fig. 9 Body Ground Strap—Right Side Removal / Installation

1 - NUT
2 - A/C ACCUMULATOR
3 - GROUND STRAP

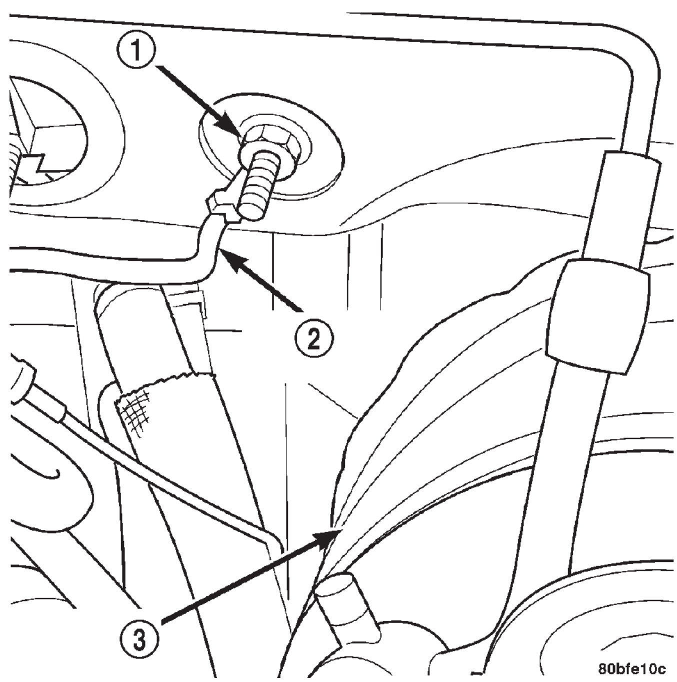


Fig. 10 Body Ground Strap—Left Side Removal / Installation

1 - NUT
2 - GROUND STRAP
3 - BRAKE BOOSTER

ENGINE 4.7L (Continued)

INSTALLATION

(1) Position engine in the vehicle.

Position both the left and right side engine mount brackets and install the through bolts and nuts. Tighten nuts to **4X2 vehicles** 95 N·m (70 ft. lbs.). **4X4 vehicles** 102 N·m (75 ft. lbs.).

(2) **4X4 vehicles** Install locknuts onto the engine mount brackets. Tighten locknuts to 41 N·m (30 ft. lbs.).

(3) Remove jack from under the transmission.

(4) Remove Engine Lifting Fixture Special Tool 8347 (Fig. 8).

(5) Remove Special Tools 8400 Lifting Studs.

(6) Position generator wiring behind the oil dipstick tube, then install the oil dipstick tube upper mounting bolt.

(7) Connect both left and right side body ground straps.

(8) Install power steering pump.

(9) Connect fuel supply line quick connect fitting (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(10) Connect the vacuum lines at the throttle body and intake manifold.

(11) Connect engine harness at the following points (Fig. 7):

- Intake Air Temperature (IAT) Sensor
- Idle Air Control (IAC) Motor
- Fuel Injectors
- Throttle Position (TPS) Switch
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs

(12) Position and install heater hoses and tubes onto intake manifold.

(13) Install the heater hoses onto the heater core and the engine front cover.

(14) Install generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

(15) Install A/C condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION), radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION) and transmission oil cooler.

(16) Connect radiator upper and lower hoses.

(17) Connect the transmission oil cooler lines to the radiator.

(18) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION), fan assembly and shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(19) Install A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(20) Install both breathers. Connect tube to both crankcase breathers (Fig. 5).

(21) Connect throttle and speed control cables.

(22) Install throttle body resonator assembly and air inlet hose. Tighten clamps 4 N·m (35 in. lbs.).

(23) Raise vehicle.

(24) Install transmission to engine mounting bolts. Tighten the bolts to 41 N·m (30 ft. lbs.).

(25) Install torque converter bolts (Automatic Transmission Only).

(26) Connect crankshaft position sensor (Fig. 4).

(27) **4X4 vehicles** Position and install the axle isolator bracket onto the axle, transmission and engine block. Tighten bolts to specification (Refer to 9 - ENGINE - SPECIFICATIONS).

(28) Install starter (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

CAUTION: The structural cover requires a specific torque sequence. Failure to follow this sequence may cause severe damage to the cover.

(29) Install structural cover (Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - INSTALLATION).

(30) Install exhaust crossover pipe.

(31) Install engine block heater power cable, If equipped.

(32) **4X4 vehicles** Connect axle vent tube to left side engine mount.

(33) Lower vehicle.

(34) Check and fill engine oil.

(35) Recharge the A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(36) Refill the engine cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(37) Install the battery tray and battery.

(38) Connect the battery positive and negative cables.

(39) Start the engine and check for leaks.

ENGINE 4.7L (Continued)

SPECIFICATIONS

4.7L ENGINE

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90° SOHC V-8 16-Valve
Displacement	4.7 Liters / 4701cc (287 Cubic Inches)
Bore	93.0 mm (3.66 in.)
Stroke	86.5 mm (3.40 in.)
Compression Ratio	9.0:1
Horsepower	235 BHP @ 4800 RPM
Torque	295 LB-FT @ 3200 RPM
Lead Cylinder	#1 Left Bank
Firing Order	1-8-4-3-6-5-7-2
CYLINDER BLOCK	
Cylinder Block	Cast Iron
Bore Diameter	93.010 ± .0075 mm (3.6619 ± 0.0003 in.)
Out of Round (MAX)	0.076 mm (0.003 in.)
Taper (MAX)	0.051 mm (0.002 in.)
PISTONS	
Material	Aluminum Alloy
Diameter	92.975 mm (3.6605 in.)
Weight	367.5 grams (12.96 oz)
Ring Groove Diameter	
No. 1	83.73 - 83.97 mm (3.296 - 3.269 in.)
No. 2	82.833 - 83.033 mm (3.261 - 3.310 in.)
No. 3	83.88 - 84.08 mm (3.302 - 3.310 in.)
PISTON PINS	
Type	Pressed Fit
Clearance In Piston	0.010 - 0.019 mm (0.0004 - 0.0008 in.)
Diameter	24.013 - 24.016 mm (0.9454 - 0.9456 in.)
PISTON RINGS	
Ring Gap	
Top Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Second Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Oil Control (Steel Rails)	0.25 - 0.76 mm (0.0099 - 0.30 in.)
Side Clearance	
Top Compression Ring	.051 - .094 mm (0.0020 - 0.0037 in.)
Second Compression Ring	0.040 - 0.080 mm (0.0016 - 0.0031 in.)
Oil Ring (Steel Ring)	.019 - .229 mm (.0007 - .0091 in.)
Ring Width	
Top Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Second Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Oil Ring (Steel Rails)	0.445 - 0.470 mm (0.017 - 0.018 in.)
CONNECTING RODS	
Bearing Clearance	0.010 - 0.048 mm (0.0004 - 0.0019 in.)
Side Clearance	0.10 - 0.35 mm (0.004 - 0.0138 in.)
Piston Pin Bore Diameter (Interference Fit)	.022 - .045 mm (0.0009 - 0.0018 in.)
Bearing Bore Out of Round (MAX)	0.004 mm (0.0002 in.)
Total Weight (Less Bearing)	555 grams (19.5771 ounces)
CRANKSHAFT	
Main BearingJournal	
Diameter	63.488 - 63.512 mm (2.4996 - 2.5005 in.)
Bearing Clearance	0.018 - 0.052 mm (0.0008 - 0.0021 in.)
Out of Round (MAX)	0.005 mm (0.0002 in.)

ENGINE 4.7L (Continued)

DESCRIPTION	SPECIFICATION
Taper (MAX)	0.008 mm (0.0004 in.)
End Play	0.052 - 0.282 mm (0.0021 - 0.0112 in.)
End Play (MAX)	0.282 mm (0.0112 in)
Connecting Rod Journal	
Diameter	50.992 - 51.008 mm (2.0076 - 2.0082 in.)
Bearing Clearance	0.015 - 0.055 mm (0.0006 -0.0022 in.)
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.008 mm (0.0004 in.)
CAMSHAFT	
Bore Diameter	26.02 - 26.04 mm
	(1.0245 - 1.0252 in.)
Bearing Journal Diameter	25.975 - 25.995 mm (1.0227 - 1.0235 in.)
Bearing Clearance	0.025 - 0.065 mm (0.001 - 0.0026 in.)
Bearing Clearance (MAX)	0.065 mm (0.0026 in.)
End Play	.075 - .200 mm (0.003 - 0.0079 in.)
End Play (MAX)	.200 mm (0.0079 in.)
VALVE TIMING	
Intake	
Opens (ATDC)	3.6°
Closes (ATDC)	247.1°
Duration	243.5°
Exhaust	
Opens (BTDC)	232.5°
Closes (ATDC)	21.2°
Duration	253.70°
Valve Overlap	17.6°
VALVES	
Face Angle	45° - 45.5°
Head Diameter	
Intake	48.52 - 48.78 mm (1.9103 - 1.9205 in.)
Exhaust	36.87 - 37.13 mm 1.4516 - 1.4618 in.)

DESCRIPTION	SPECIFICATION
Length (Overall)	
Intake	113.45 - 114.21 mm (4.4666 - 4.4965)
Exhaust	114.92 - 115.68 mm (4.5244 - 4.5543 in.)
Stem Diameter	
Intake	6.931 - 6.957 mm (0.2729 - 0.2739 in.)
Exhaust	6.902 - 6.928 mm (0.2717 - 0.2728 in.)
Stem - to - Guide Clearance	
Intake	.018 - .069 mm (0.0008 - 0.0028 in.)
Exhaust	.047 - .098 mm (0.0019 - 0.0039 in.)
Max. Allowable Stem - to - Guide Clearance (Rocking Method)	
Intake	0.069 mm (0.0028 in.)
Exhaust	0.098 mm (0.0039 in.)
Valve Lift (Zero Lash)	
Intake	11.25 mm (0.443 in.)
Exhaust	10.90 mm (0.4292 in.)
VALVE SPRING	
Free Length (Approx)	
Intake and Exhaust	48.6 mm (1.9134 in.)
Spring Force (Valve Closed)	
Intake and Exhaust	315.5 - 352.5 N @ 40.89 mm (70.92722 - 79.24515 lbs. @ 1.6099 in.)
Spring Force (Valve Open)	
Intake and Exhaust	786.0 - 860.0 N @ 29.64 mm 176.6998 - 193.3357 lbs. @ 1.167 in.)

ENGINE 4.7L (Continued)

DESCRIPTION	SPECIFICATION
Number of Coils	
Intake and Exhaust	6.69
Wire Diameter	
Intake and Exhaust	4.2799 - 4.3561 mm (0.1685 - 0.1715 in.)
Installed Height (Spring Seat to Bottom of Retainer)	
Nominal	
Intake	40.97 mm (1.613 in.)
Exhaust	40.81 mm (1.606 in.)
CYLINDER HEAD	
Gasket Thickness (Compressed)	.7 mm (0.0276 in.)
Valve Seat Angle	44.5° - 45.0°
Valve Seat Runout (MAX)	0.051 mm (0.002 in.)
Valve Seat Width	
Intake	1.75 - 2.36 mm (0.0698 - 0.0928 in.)
Exhaust	1.71 - 2.32 mm (0.0673 - 0.0911 in.)
Guide Bore Diameter (Std.)	6.975 - 7.00 mm (0.2747 - 0.2756 in.)
Cylinder Head Warpage (Flatness)	0.0508 mm (0.002 in.)
OIL PUMP	
Clearance Over Rotors / End Face (MAX)	.035 - .095 mm (0.0014 - 0.0038 in.)
Cover Out - of -Flat (MAX)	.025 mm (0.001 in.)
Inner and Outer Rotor Thickness	12.02 mm (0.4731 in.)
Outer Rotor Clearance (MAX)	.235 mm (.0093 in.)
Outer Rotor Diameter (MIN)	85.925 mm (0.400 in.)
Tip Clearance Between Rotors (MAX)	.150 mm (0.006 in.)

DESCRIPTION	SPECIFICATION
OIL PRESSURE	
At Curb Idle Speed (MIN)*	25 kPa (4 psi)
@ 3000 rpm	170 - 758 kPa (25 - 110 psi)
*** CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 rpm.**	

TORQUE

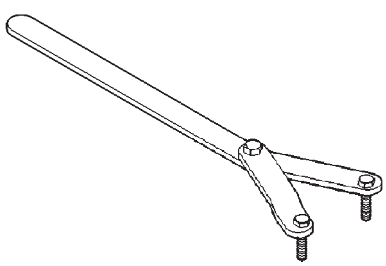
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft			
Non - Oiled Sprocket Bolt	122	90	—
Bearing Cap Bolts	11	—	100
Timing Chain Cover—Bolts	54	40	—
Connecting Rod Cap—Bolts	27	20	—
	PLUS 90° TURN		
Bed Plate—Bolts	Refer to Procedure		
Crankshaft Damper—Bolt	175	130	—
Cylinder Head—Bolts			
M11 Bolts	81	60	—
M8 Bolts	26	19	—
Cylinder Head Cover—Bolts	12	—	105
Exhaust Manifold—Bolts	25	18	—
Exhaust Manifold Heat Shield—Nuts	8	—	72
	Then loosen 45°		
Flexplate—Bolts	60	45	—
Engine Mount Bracket to Block—Bolts	61	45	—
Rear Mount to Transmission—Bolts	46	34	—
Generator Mounting—Bolts			
M10 Bolts	54	40	—
M8 Bolts	28	—	250
Intake Manifold—Bolts	12	—	105
	Refer to Procedure for Tightening Sequence		
Oil Pan—Bolts	15	—	130

ENGINE 4.7L (Continued)

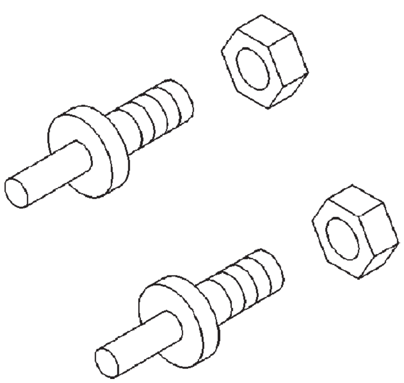
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Oil Pan—Drain Plug	34	25	—
Oil Pump—Bolts	28	—	250
Oil Pump Cover—Bolts	12	—	105
Oil Pickup Tube—Bolt and Nut	28	—	250
Oil Dipstick Tube to Engine Block—Bolt	15	—	130
Oil Fill Tube—Bolts	12	—	105
Timing Chain Guide—Bolts	28	—	250
Timing Chain Tensioner Arm—Special Pin Bolt	17	—	150
Hydraulic Tensioner—Bolts	28	—	250
Timing Chain Primary Tensioner—Bolts	28	—	250
Timing Drive Idler Sprocket—Bolt	34	25	—
Thermostat Housing—Bolts	13	—	115
Water Pump—Bolts	54	40	—

SPECIAL TOOLS

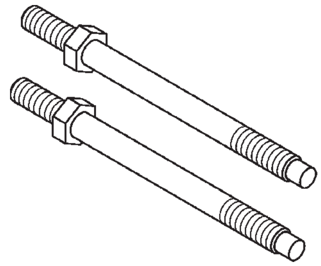
4.7L ENGINE



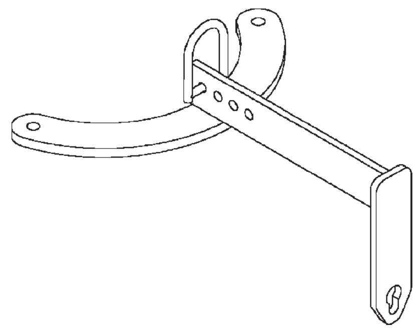
Spanner Wrench 6958



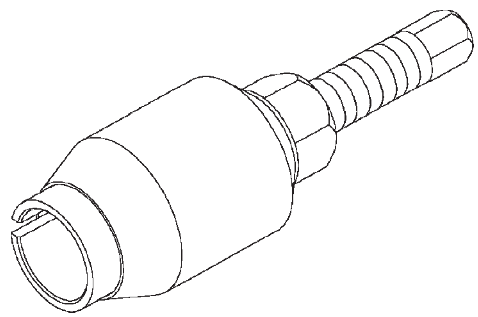
Adapter Pins 8346



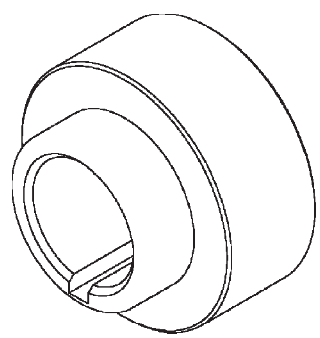
Engine Lifting Studs 8400



Engine Lift Fixture 8347

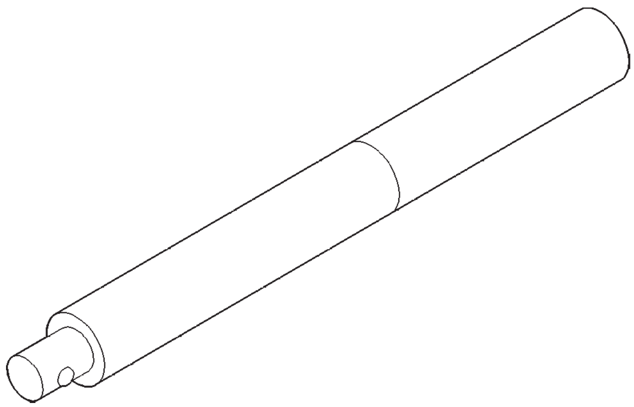


Front Crankshaft Seal Remover 8511

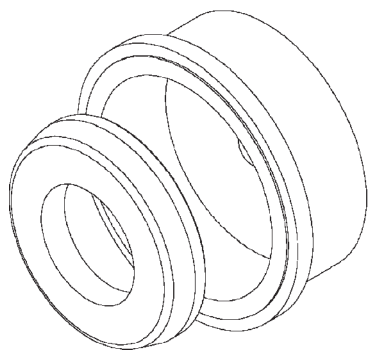


Front Crankshaft Seal Installer 8348

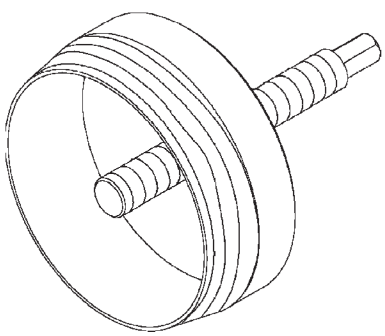
ENGINE 4.7L (Continued)



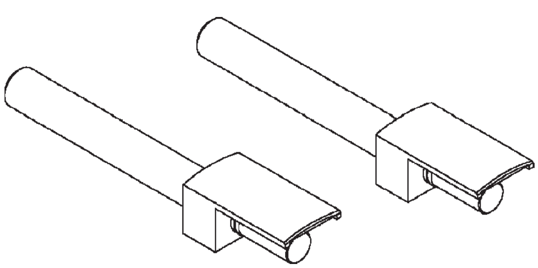
Handle C-4171



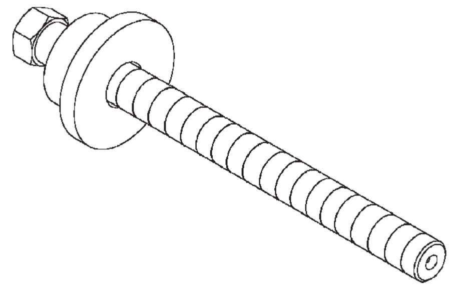
Rear Crankshaft Seal Installer 8349



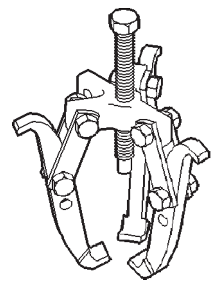
Rear Crankshaft Seal Remover 8506



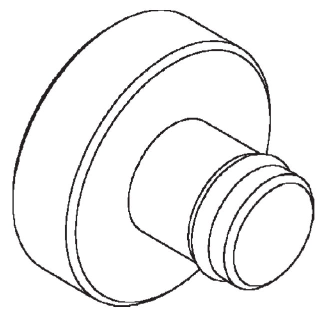
Connecting Rod Guides 8507



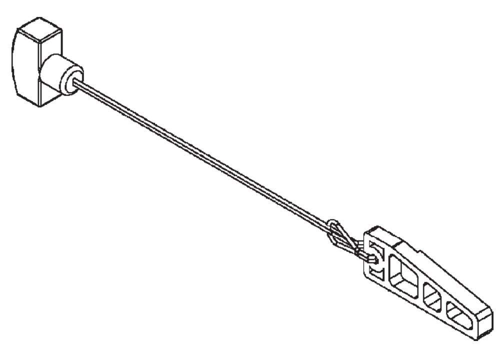
Crankshaft Damper Installer 8512



Puller 1026

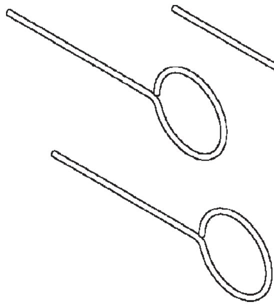


Crankshaft Damper Removal Insert 8513

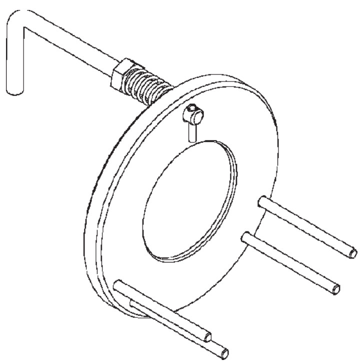


Chain Tensioner Wedge 8350

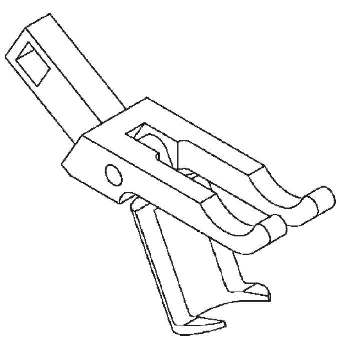
ENGINE 4.7L (Continued)



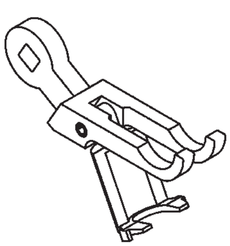
Chain Tensioner Pins 8514



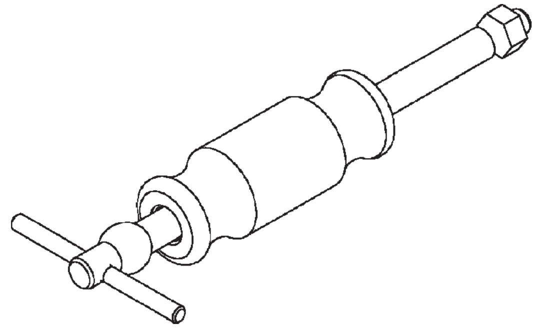
Secondary Chain Holder 8515



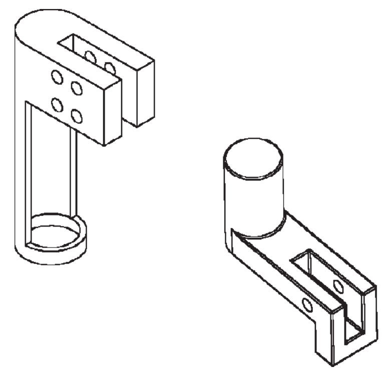
Remover, Rocker Arm 8516



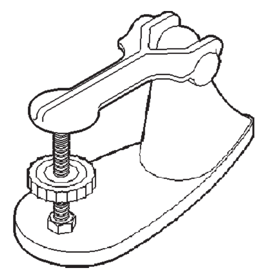
Valve Spring Compressor 8387



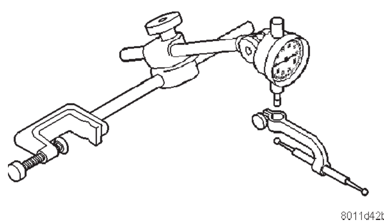
Idler Shaft Remover 8517



Valve Spring Compressor Adapters 8519

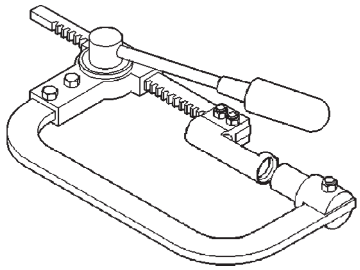


Valve Spring Tester C-647

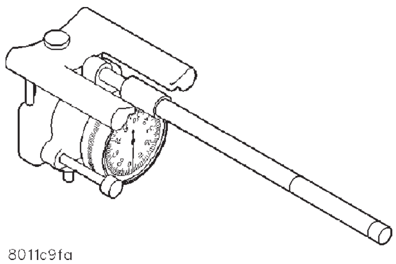


Dial Indicator C-3339

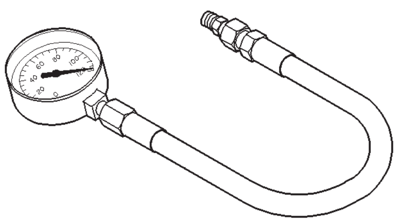
ENGINE 4.7L (Continued)



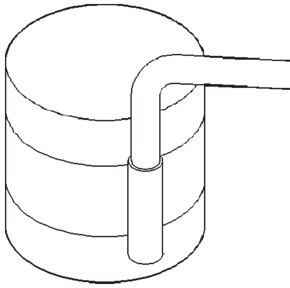
Valve Spring Compressor C-3422-B



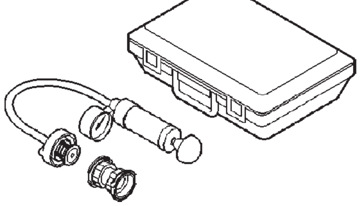
Bore Size Indicator C-119



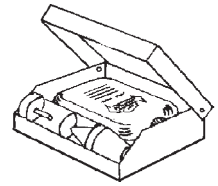
Oil Pressure Gauge C-3292



Piston Ring Compressor C-385



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A

AIR CLEANER ELEMENT

REMOVAL

Housing removal is not necessary for element (filter) replacement.

(1) Pry up spring clips from housing cover (spring clips retain cover to housing).

(2) Release housing cover from locating tabs on housing (Fig. 11) and remove cover.

(3) Remove air cleaner element (filter) from housing.

(4) Clean inside of housing before replacing element.

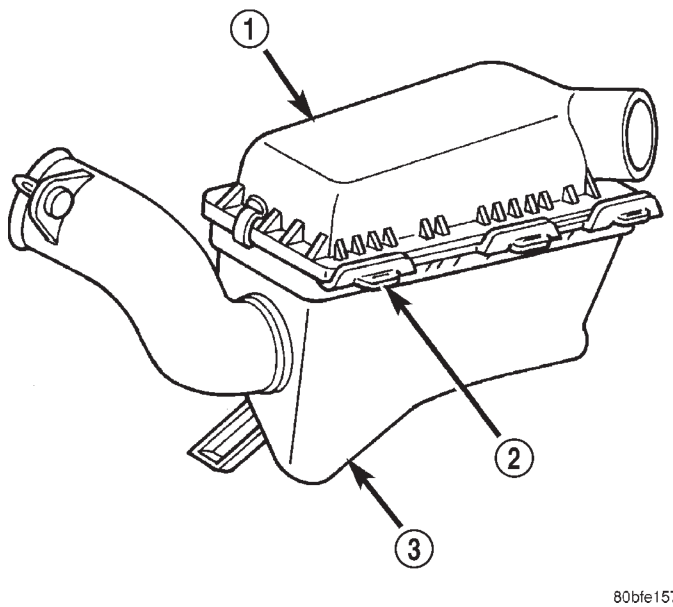


Fig. 11 Air Cleaner Housing Assembly

1 - AIR CLEANER ELEMENT COVER
2 - TABS
3 - HOUSING

INSTALLATION

(1) Install element into housing.

(2) Position housing cover into housing locating tabs.

(3) Pry up spring clips and lock cover to housing.

CYLINDER HEAD

DESCRIPTION - CYLINDER HEAD

The cylinder heads are made of an aluminum alloy. The cylinder head features two valves per cylinder with pressed in powdered metal valve guides. The cylinder heads also provide enclosures for the timing chain drain, necessitating unique left and right cylinder heads.

DESCRIPTION - VALVE GUIDES

The valve guides are made of powered metal and are pressed into the cylinder head. The guides are not replaceable or serviceable, and valve guide reaming is not recommended. If the guides are worn beyond acceptable limits, replace the cylinder heads.

REMOVAL - LEFT CYLINDER HEAD

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle on a hoist.
(3) Disconnect the exhaust pipe at the left side exhaust manifold.
(4) Drain the engine coolant. Refer to COOLING SYSTEM.
(5) Lower the vehicle.
(6) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).
(7) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
(8) Remove the fan shroud and fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(9) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(10) Remove the power steering pump and set aside.
(11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 12).
(12) Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 14). Rotate the crankshaft one turn if necessary.
(13) Remove the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
(14) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(15) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 13).

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

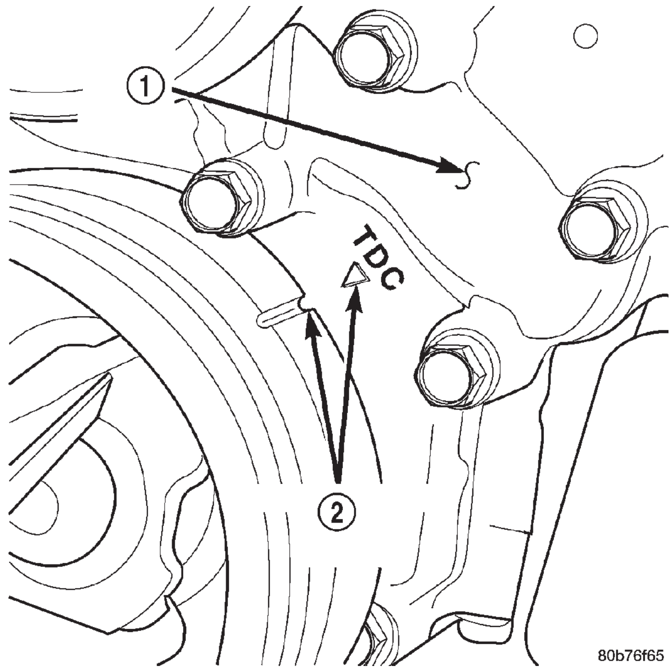


Fig. 12 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

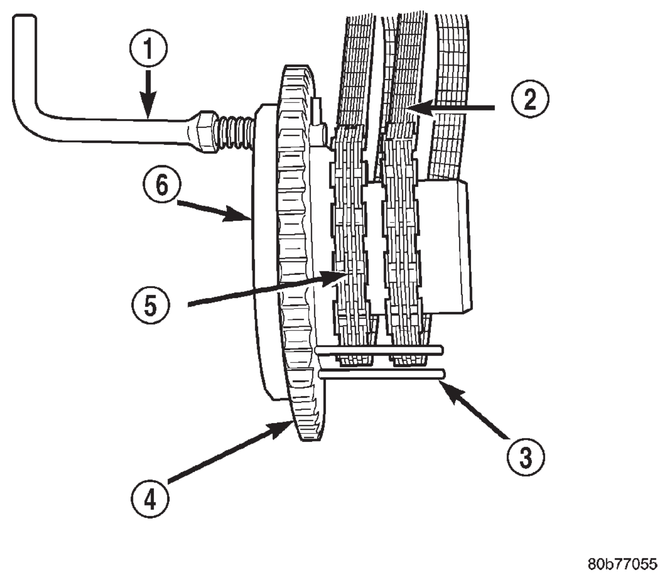


Fig. 13 Using Special Tool 8515 to Hold Chains to Idler Sprocket.

1 - LOCK ARM
2 - RIGHT CAMSHAFT CHAIN
3 - SECONDARY CHAINS RETAINING PINS (4)
4 - IDLER SPROCKET
5 - LEFT CAMSHAFT CHAIN
6 - SPECIAL TOOL 8515

(16) Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear (Fig. 14).

CYLINDER HEAD (Continued)

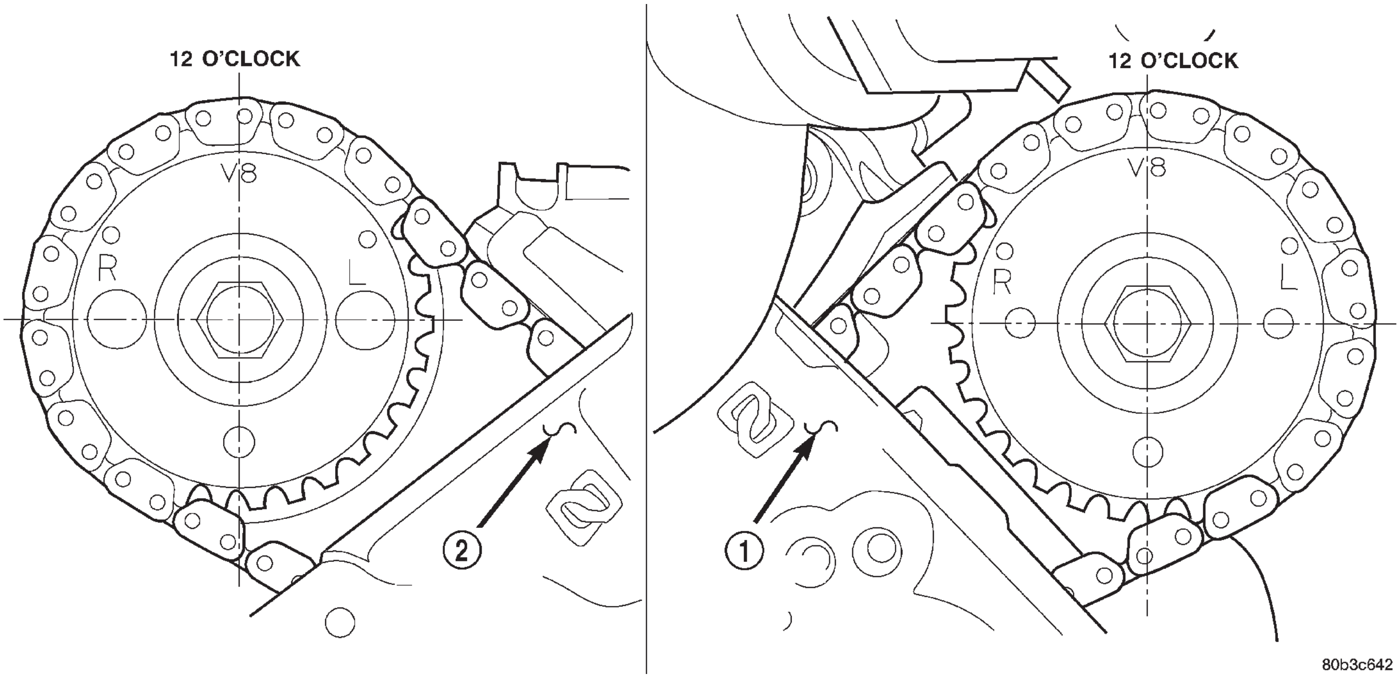


Fig. 14 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

(17) Remove the left side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(18) Remove the cylinder head access plug (Fig. 15).

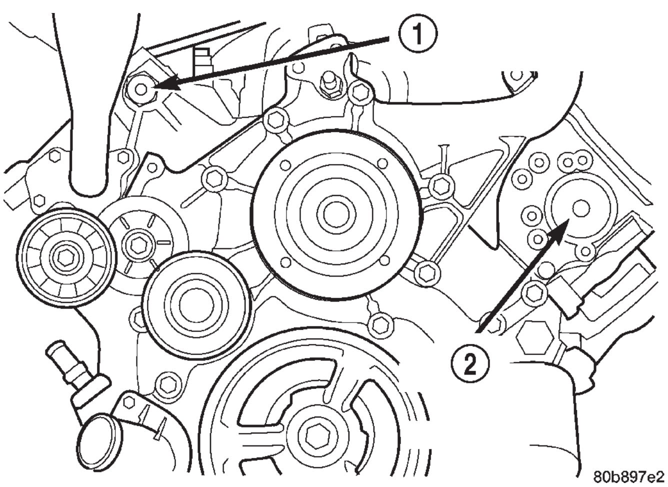


Fig. 15 Cylinder Head Access Plugs

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

(19) Remove the left side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(20) Remove the retaining bolt and the camshaft drive gear.

CAUTION: Do not allow the engine to rotate. Severe damage to the valve train can occur.

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

NOTE: The cylinder head is attached to the cylinder block with fourteen bolts.

(21) Remove the cylinder head retaining bolts.

(22) Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on its gasket sealing surface, due to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

REMOVAL - RIGHT CYLINDER HEAD

(1) Disconnect battery negitive cable.

(2) Raise the vehicle on a hoist.

CYLINDER HEAD (Continued)

(3) Disconnect the exhaust pipe at the right side exhaust manifold.

(4) Drain the engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(5) Lower the vehicle.

(6) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(7) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(8) Remove the fan shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(9) Remove oil fill housing from cylinder head.

(10) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 16).

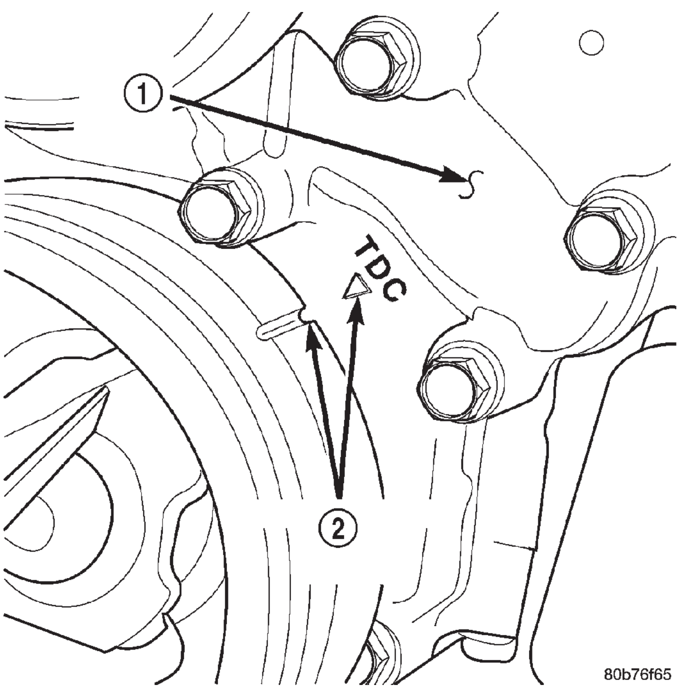


Fig. 16 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER

2 - CRANKSHAFT TIMING MARKS

(12) Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 17). Rotate the crankshaft one turn if necessary.

(13) Remove the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(14) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(15) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 18).

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

(16) Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear (Fig. 17).

(17) Remove the right side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(18) Remove the cylinder head access plug (Fig. 19).

(19) Remove the right side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(20) Remove the retaining bolt and the camshaft drive gear.

CAUTION: Do not allow the engine to rotate. severe damage to the valve train can occur.

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason. A damaged target wheel can result in a vehicle no start condition.

NOTE: The cylinder head is attached to the cylinder block with fourteen bolts.

(21) Remove the cylinder head retaining bolts.

(22) Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on its gasket sealing surface, do to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

CLEANING

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components. (Refer to 9 - ENGINE - STANDARD PROCEDURE)

CYLINDER HEAD (Continued)

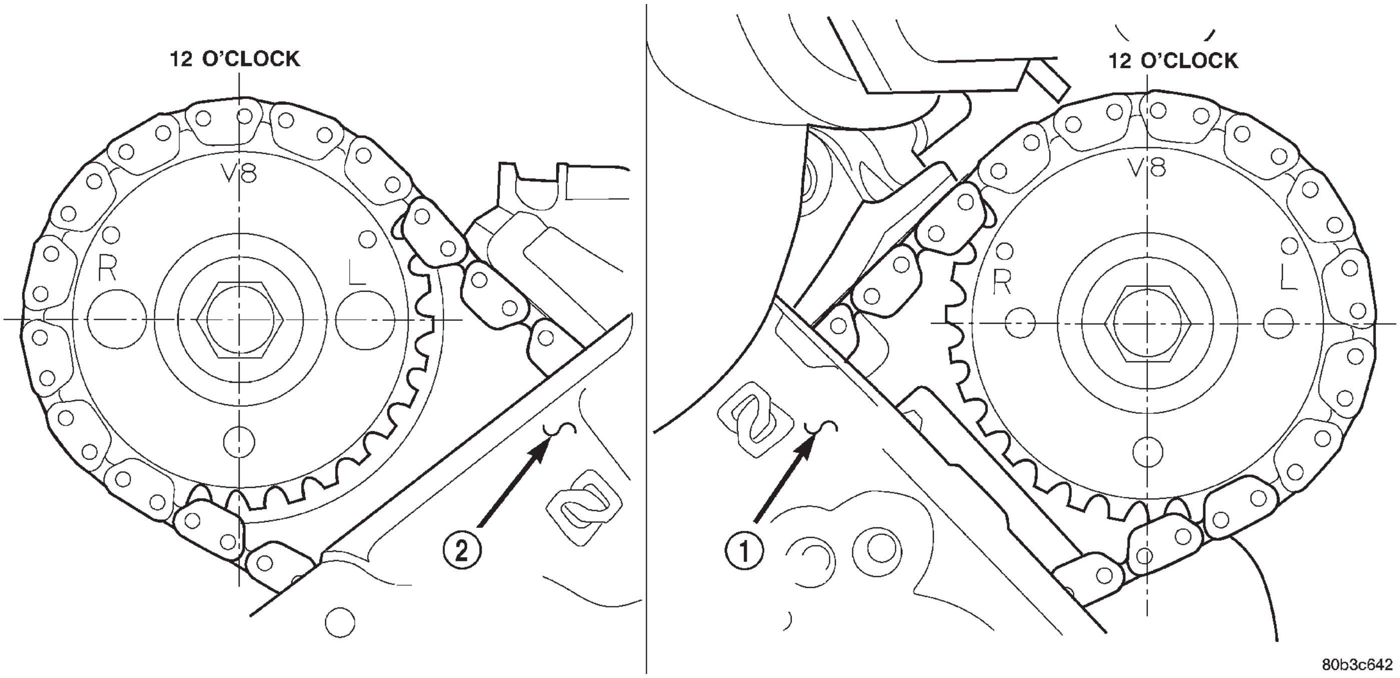


Fig. 17 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

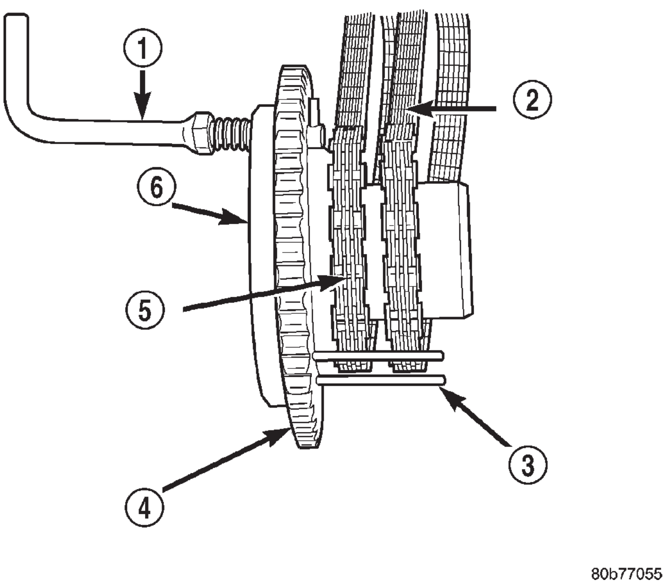


Fig. 18 Using Special Tool 8515 to Hold Chains to Idler Sprocket.

1 - LOCK ARM
2 - RIGHT CAMSHAFT CHAIN
3 - SECONDARY CHAINS RETAINING PINS (4)
4 - IDLER SPROCKET
5 - LEFT CAMSHAFT CHAIN
6 - SPECIAL TOOL 8515

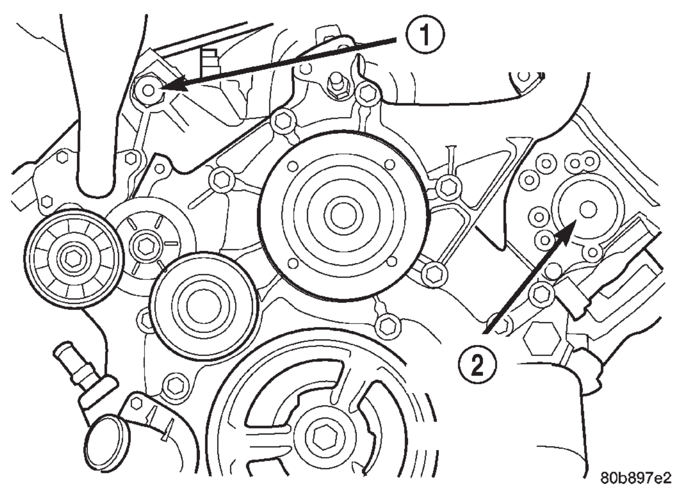


Fig. 19 Cylinder Head Access Plugs

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

INSPECTION

(1) Inspect the cylinder head for out-of-flatness, using a straightedge and a feeler gauge. If tolerances exceed 0.0508 mm (0.002 in.) replace the cylinder head.

(2) Inspect the valve seats for damage. Service the valve seats as necessary.

CYLINDER HEAD (Continued)

(3) Inspect the valve guides for wear, cracks or looseness. If either condition exist, replace the cylinder head.

INSTALLATION - LEFT CYLINDER HEAD

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced (Fig. 20).

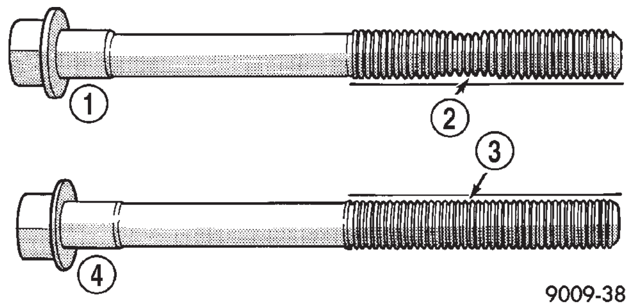


Fig. 20 Checking Cylinder Head Bolts for Stretching (Necking)

1 - STRETCHED BOLT
2 - THREADS ARE NOT STRAIGHT ON LINE
3 - THREADS ARE STRAIGHT ON LINE
4 - UNSTRETCHED BOLT

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

(1) Clean the cylinder head and cylinder block mating surfaces (Fig. 21).

(2) Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

(3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the ten M11 bolts.

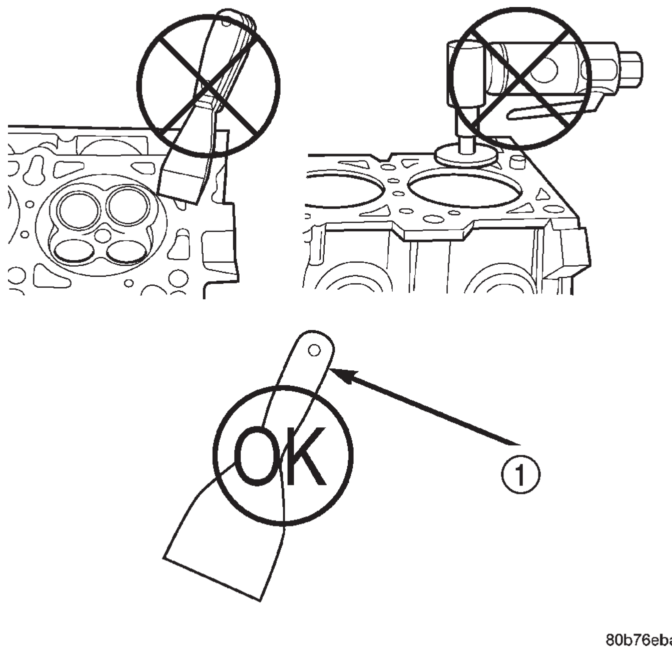


Fig. 21 Proper Tool Usage for

1 - PLASTIC/WOOD SCRAPER

(5) Coat the four M8 cylinder head bolts with **Mopar® Lock and Seal Adhesive** then install the bolts.

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

(6) Tighten the bolts in sequence (Fig. 22) using the following steps and torque values:

- Step 1: Tighten bolts 1–10, 20 N·m (15 ft. lbs.).
- Step 2: Tighten bolts 1–10, 47 N·m (35 ft. lbs.). Tighten bolts 11–14, 25 N·m (18 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees. Tighten bolts 11–14, 30 N·m (22 ft. lbs.).

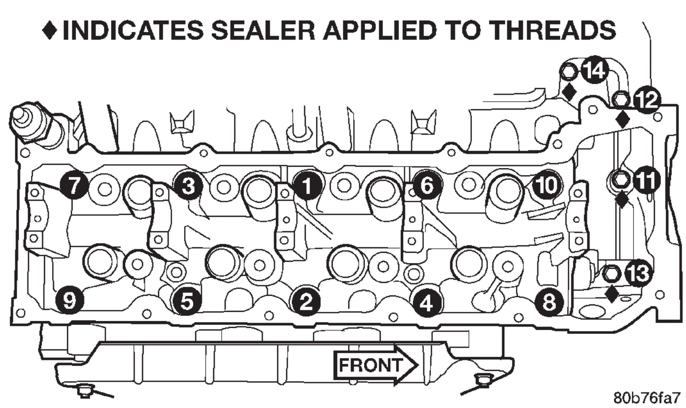


Fig. 22 Cylinder Head Tightening Sequence

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on

CYLINDER HEAD (Continued)

either side of the V8 mark on the gear and position the gear onto the camshaft.

(8) Install the camshaft drive gear retaining bolt.

(9) Install the left side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(10) Install the cylinder head access plug (Fig. 23).

(11) Re-set and Install the left side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(12) Remove Special Tool 8515.

(13) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(14) Install the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(15) Install the power steering pump.

(16) Install the fan blade assembly and fan shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(17) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(18) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(19) Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(20) Raise the vehicle.

(21) Install the exhaust pipe onto the left exhaust manifold.

(22) Lower the vehicle.

(23) Connect the negative cable to the battery.

(24) Start the engine and check for leaks.

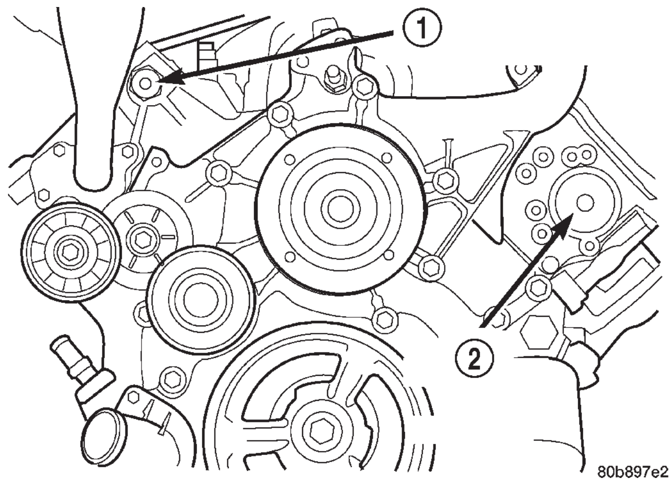


Fig. 23 Cylinder Head Access Plugs

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

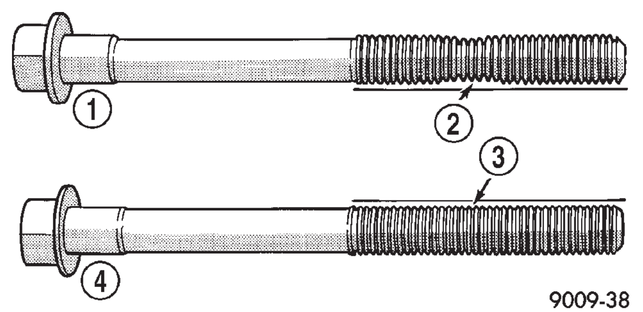


Fig. 24 Checking Cylinder Head Bolts for Stretching (Necking)

1 - STRETCHED BOLT
2 - THREADS ARE NOT STRAIGHT ON LINE
3 - THREADS ARE STRAIGHT ON LINE
4 - UNSTRETCHED BOLT

INSTALLATION - RIGHT CYLINDER HEAD

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced (Fig. 24).

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

(1) Clean the cylinder head and cylinder block mating surfaces (Fig. 25).

(2) Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

(3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the ten M10 bolts.

(5) Coat the four M8 cylinder head bolts with **Mopar® Lock and Seal Adhesive** then install the bolts.

CYLINDER HEAD (Continued)

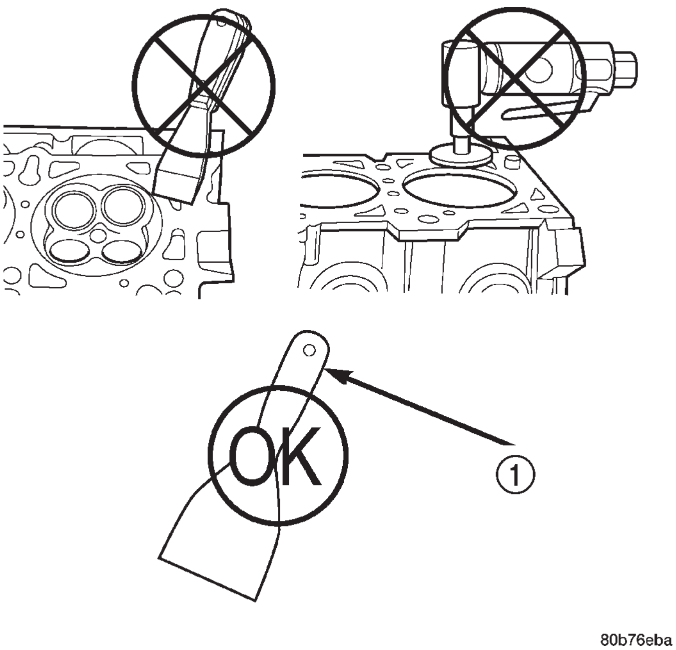


Fig. 25 Proper Tool Usage for

1 - PLASTIC/WOOD SCRAPER

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

(6) Tighten the bolts in sequence (Fig. 26) using the following steps and torque values:

- Step 1: Tighten bolts 1–10, 20 N·m (15 ft. lbs.).
- Step 2: Tighten bolts 1–10, 47 N·m (35 ft. lbs.). Tighten bolts 11–14, 25 N·m (18 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees. Tighten bolts 11–14, 30 N·m (22 ft. lbs.).

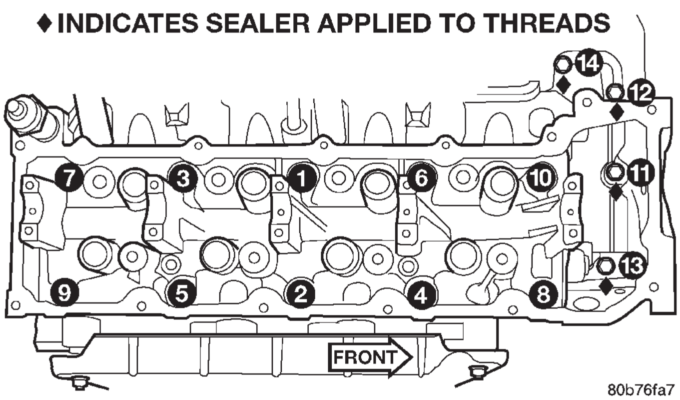


Fig. 26 Cylinder Head Tightening Sequence

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V8 mark on the gear and position the gear onto the camshaft.

(8) Install the camshaft drive gear retaining bolt.

(9) Install the right side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(10) Install the right side cylinder head access plug (Fig. 27).

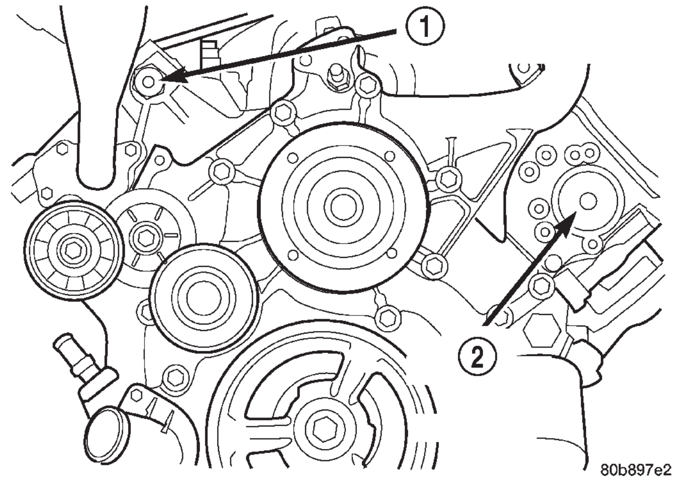


Fig. 27 Cylinder Head Access Plugs

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

(11) Re-set and install the right side secondary chain tensioner.

(12) Remove Special Tool 8515.

(13) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(14) Install the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(15) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(16) Install the fan shroud.

(17) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(18) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(19) Install oil fill housing onto cylinder head.

(20) Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(21) Raise the vehicle.

(22) Install the exhaust pipe onto the right exhaust manifold.

(23) Lower the vehicle.

(24) Reconnect battery negitive cable.

(25) Start the engine and check for leaks.

CAMSHAFT(S) - LEFT

DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. A steel post or nose piece is friction-welded to the steel camshaft tube. Five bearing journals are machined into the camshaft, four on the steel tube and one on the steel nose piece. Camshaft end play is controlled by two thrust walls that border the nose piece journal. Engine oil enters the hollow camshafts at the third journal and lubricates every intake lobe rocker through a drilled passage in the intake lobe.

REMOVAL

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use Special Tool 8350 will result in hydraulic tensioner ratchet over extension, requiring timing chain cover removal to reset the tensioner ratchet.

(1) Remove cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL) .

(2) Set engine to TDC cylinder #1, camshaft sprocket V8 marks at the 12 o'clock position.

(3) Mark one link on the secondary timing chain on both sides of the V8 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel (Located on the right side camshaft sprocket) for any reason, Severe damage will occur to the target wheel resulting in a vehicle no start condition.

(4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave the bolt snug against the sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

(5) Position Special Tool 8350 timing chain wedge between the timing chain strands, tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 28).

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

(6) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 29).

(7) Using the pliers, gently allow the camshaft to rotate 15° clockwise until the camshaft is in the neutral position (no valve load).

(8) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

(9) Remove the camshaft bearing caps and the camshaft.

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

NOTE: Position the left side camshaft so that the camshaft sprocket dowel is near the 1 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

CAMSHAFT(S) - LEFT (Continued)

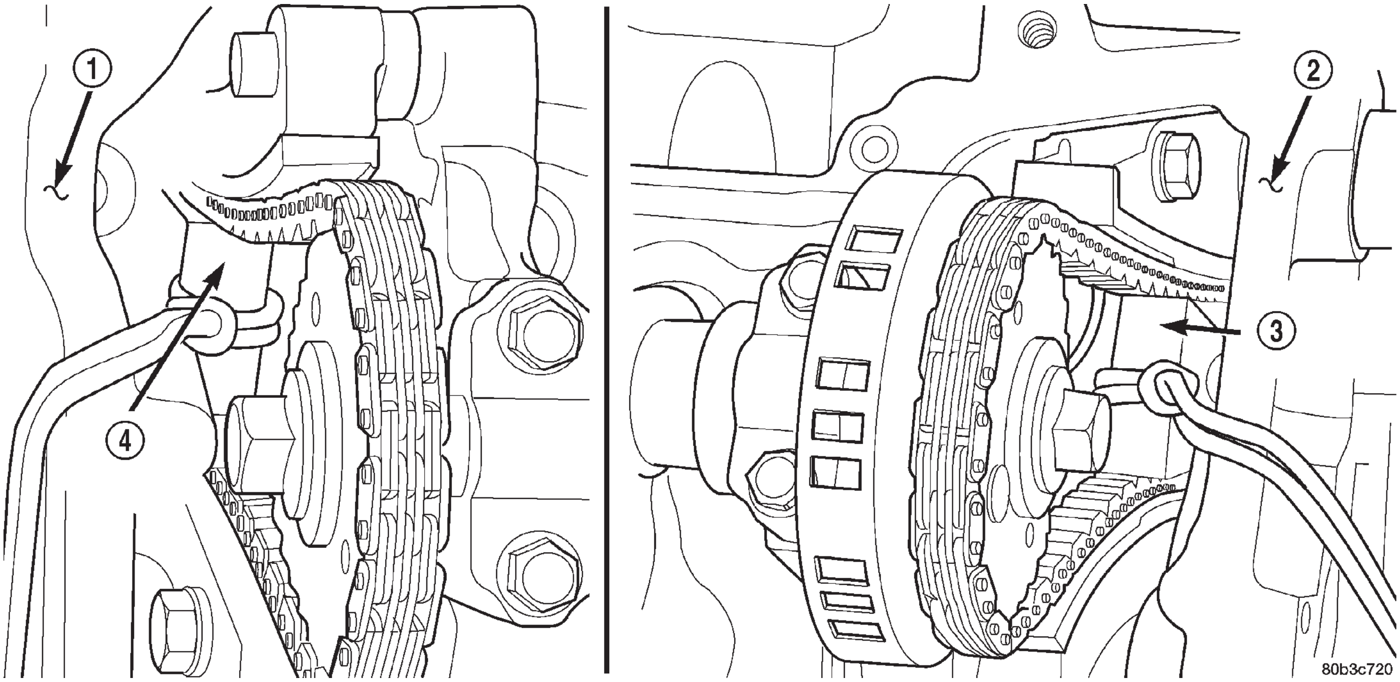


Fig. 28 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

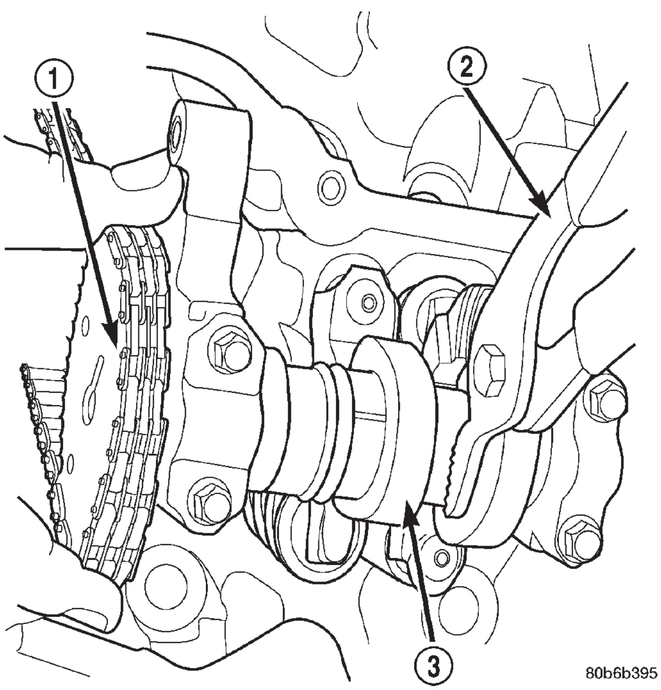


Fig. 29 Camshaft Sprocket and Chain

1 - CAMSHAFT SPROCKET AND CHAIN
2 - ADJUSTABLE PLIERS
3 - CAMSHAFT

(2) Position the camshaft into the cylinder head.

(3) Install the camshaft bearing caps, hand tighten the retaining bolts.

(4) Working in ½ turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 30).

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(6) Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (Fig. 31).

CAMSHAFT(S) - LEFT (Continued)

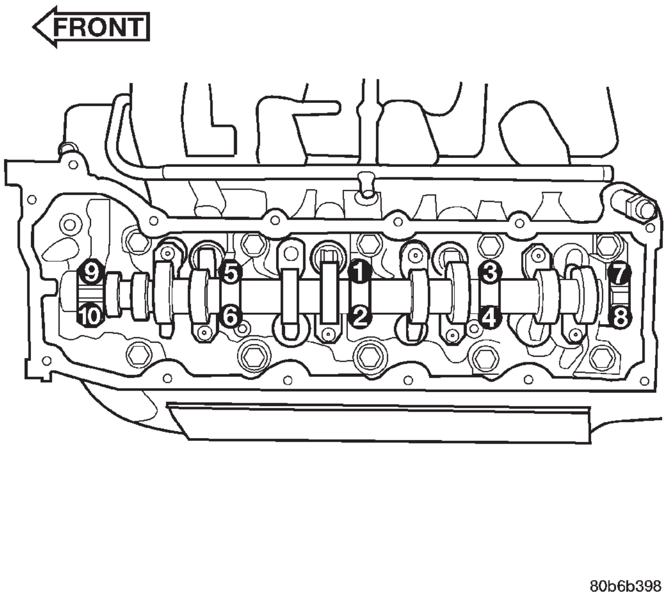


Fig. 30 Camshaft Bearing Caps Tightening Sequence

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

(7) Using the adjustable pliers, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft (Fig. 32).

CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt overtorque resulting in bolt failure.

(8) Remove excess oil from bolt, then install the camshaft sprocket retaining bolt and hand tighten.

(9) Remove Special Tool 8350 timing chain wedge (Fig. 33).

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 34), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the cylinder head cover.

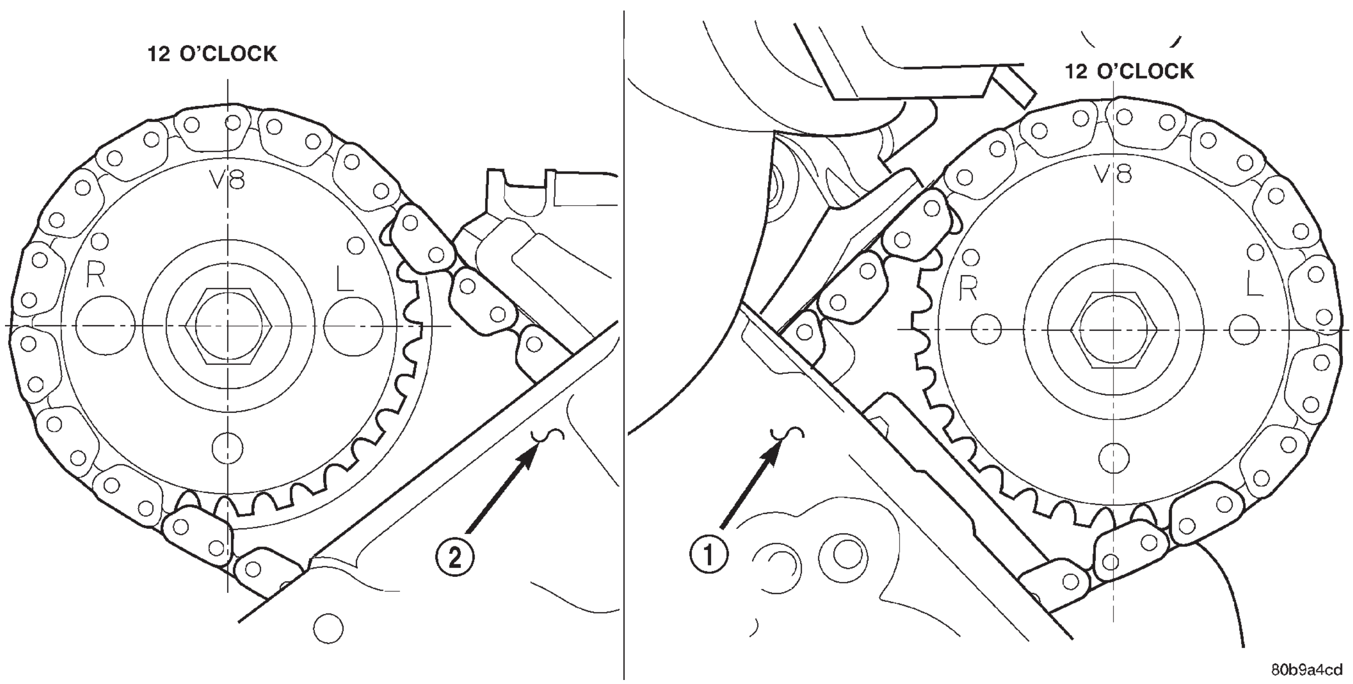


Fig. 31 Timing Chain to Sprocket Alignment

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

CAMSHAFT(S) - LEFT (Continued)

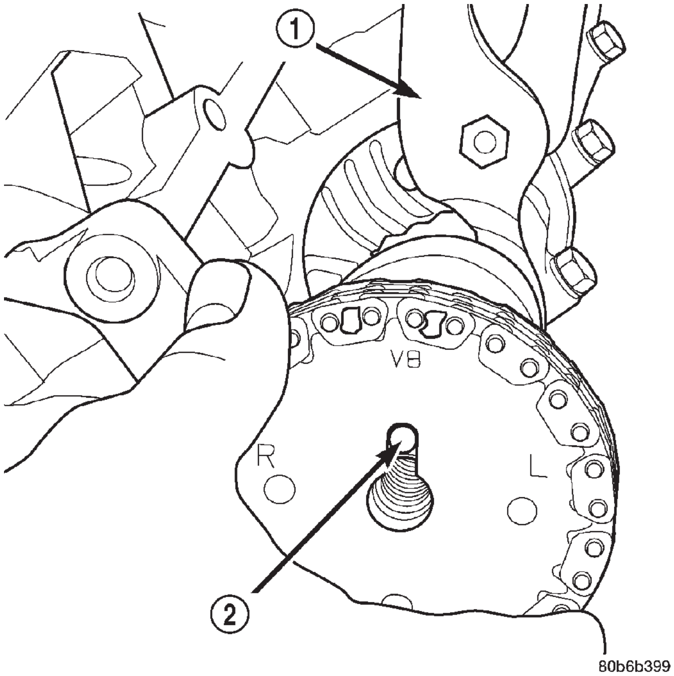


Fig. 32 Camshaft Sprocket Installation

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

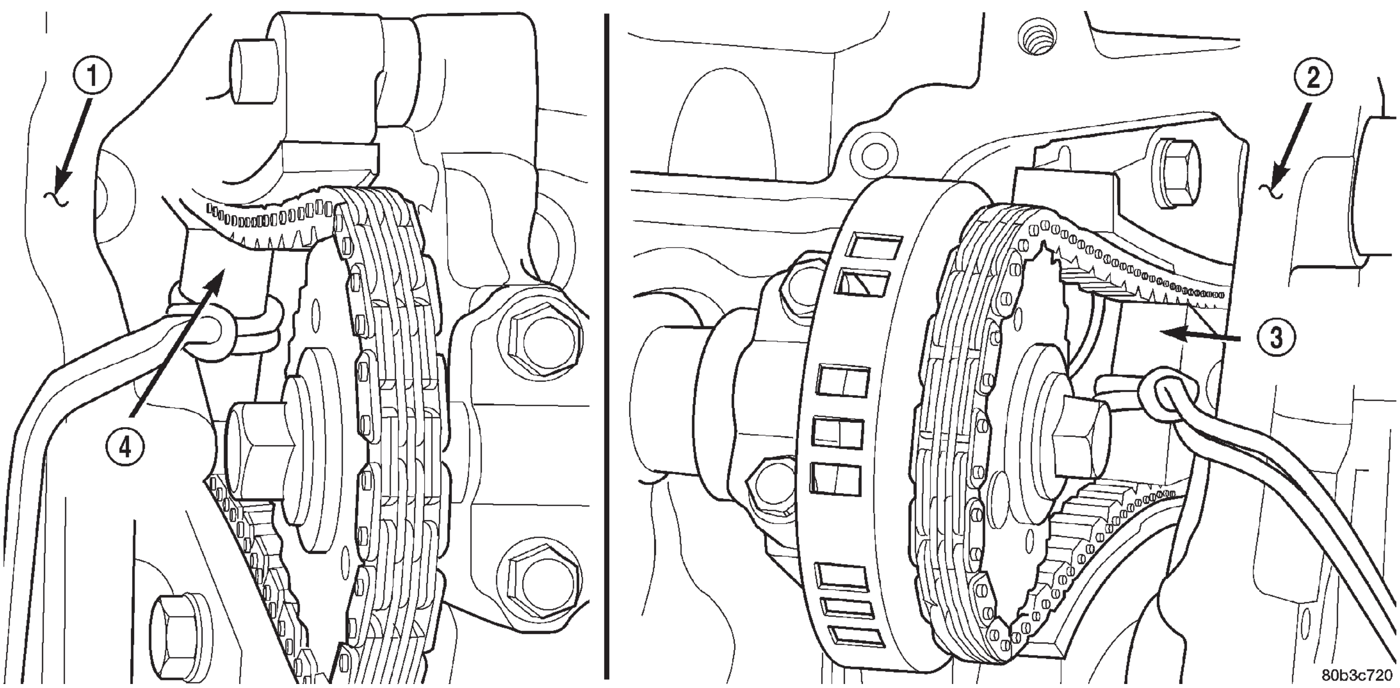


Fig. 33 SPECIAL TOOL 8350

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

CAMSHAFT(S) - LEFT (Continued)

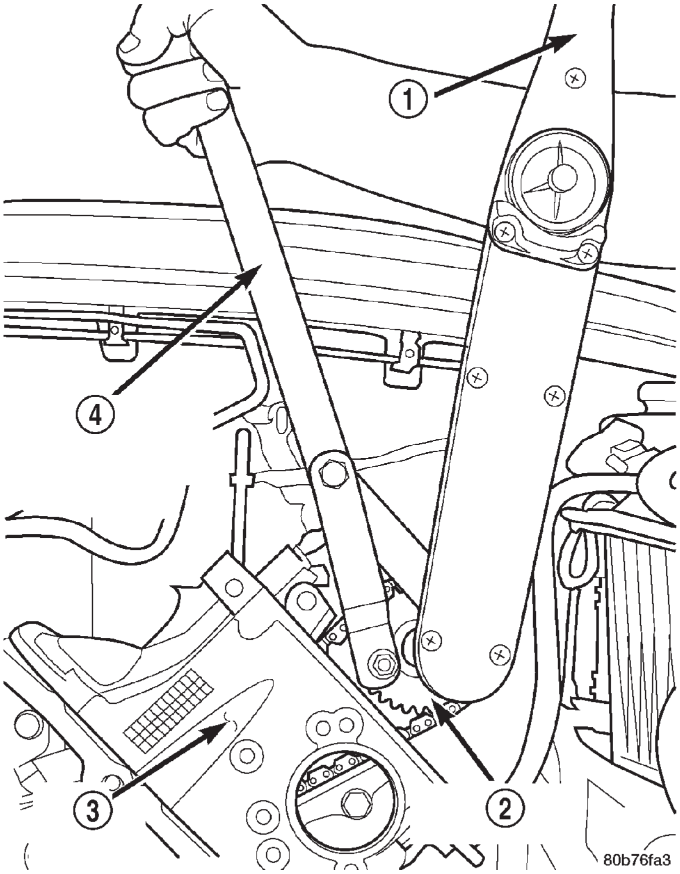


Fig. 34 Tightening Left Side Cam Sprocket Retaining Bolt

1 - TORQUE WRENCH
2 - CAMSHAFT SPROCKET
3 - LEFT CYLINDER HEAD
4 - SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

CAMSHAFT(S) - RIGHT

DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. A steel post or nose piece is friction-welded to the steel camshaft tube. Five bearing journals are machined into the camshaft, four on the steel tube and one on the steel nose piece. Camshaft end play is controlled by two thrust walls that border the nose piece journal. Engine oil enters the hollow camshafts at the third journal and lubricates every intake lobe rocker through a drilled passage in the intake lobe.

REMOVAL

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use special tool 8350 will result in hydraulic tensioner ratchet over extension, Requiring timing chain cover removal to re-set the tensioner ratchet.

(1) Remove the cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Set engine to TDC cylinder #1, camshaft sprocket V8 marks at the 12 o'clock position.

(3) Mark one link on the secondary timing chain on both sides of the V8 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason, Severe damage will occur to the target wheel. A damaged target wheel could cause a vehicle no start condition.

(4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave bolt snug against sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

(5) Position Special Tool 8350 timing chain wedge between the timing chain strands. Tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 35).

(6) Remove the camshaft position sensor (Fig. 36).

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

(7) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 37).

(8) Using the pliers, gently allow the camshaft to rotate 45° counter-clockwise until the camshaft is in the neutral position (no valve load).

(9) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAMSHAFT(S) - RIGHT (Continued)

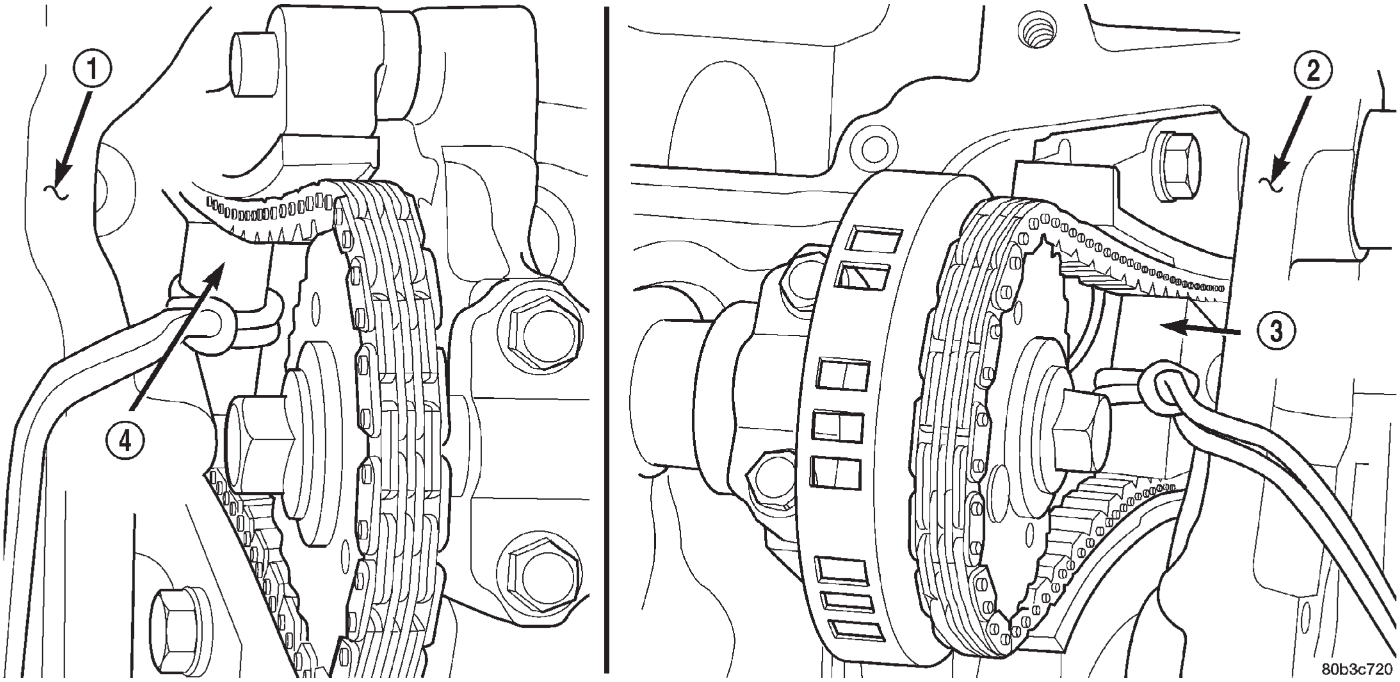


Fig. 35 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

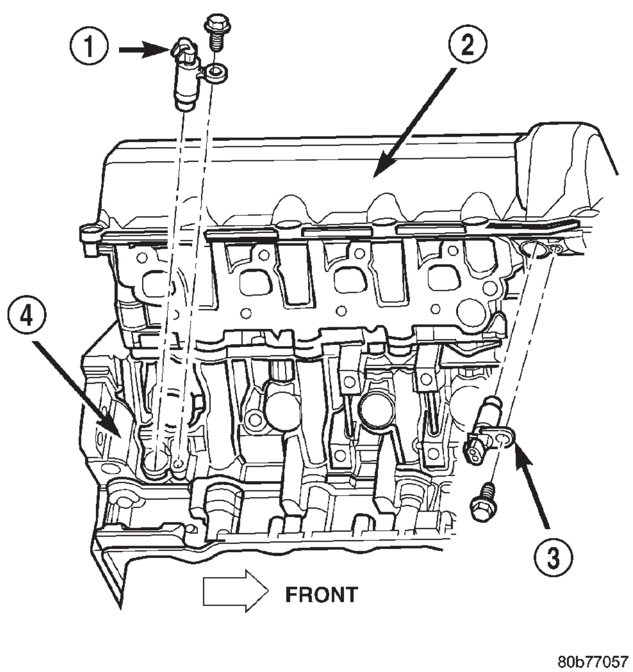


Fig. 36 Camshaft Position Sensor

1 - CRANKSHAFT POSITION SENSOR
2 - CYLINDER HEAD COVER
3 - CAMSHAFT POSITION SENSOR
4 - RIGHT SIDE CYLINDER BLOCK

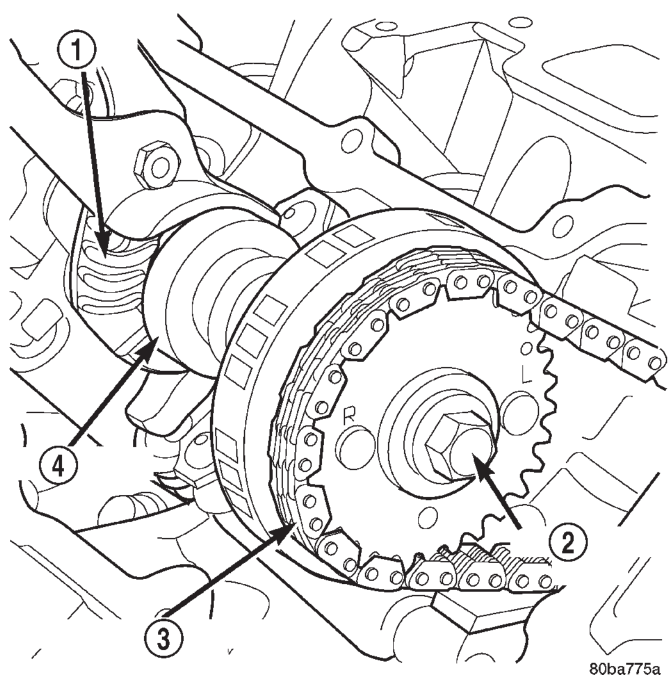


Fig. 37 Camshaft Sprocket and Chain

1 - ADJUSTABLE PLIERS
2 - SPROCKET BOLT
3 - CAMSHAFT SPROCKET AND CHAIN
4 - CAMSHAFT

CAMSHAFT(S) - RIGHT (Continued)

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

(10) Remove the camshaft bearing caps and the camshaft.

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

NOTE: Position the right side camshaft so that the camshaft sprocket dowel is near the 10 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

(2) Position the camshaft into the cylinder head.

(3) Install the camshaft bearing caps, hand tighten the retaining bolts.

(4) Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 38).

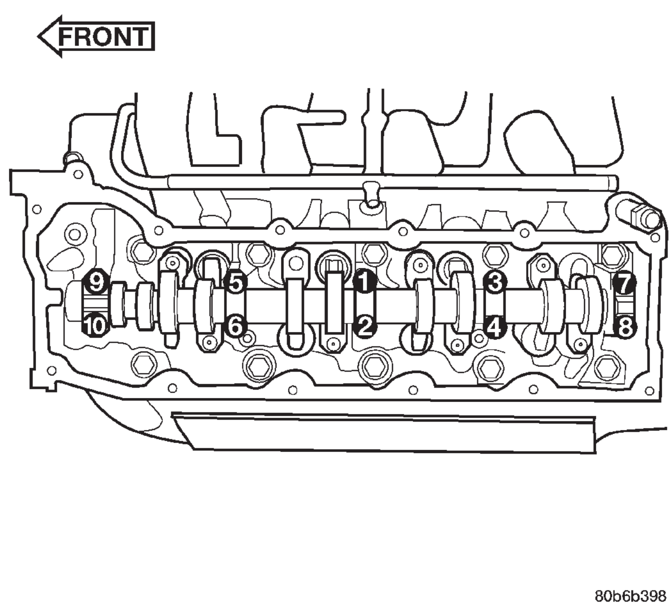


Fig. 38 Camshaft Bearing Caps Tightening Sequence

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(6) Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (Fig. 39).

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

(7) Using the adjustable pliers, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket . Install the sprocket onto the camshaft (Fig. 40).

CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt over-torque resulting in bolt failure.

(8) Remove excess oil from camshaft sprocket bolt, then install the camshaft sprocket retaining bolt and hand tighten.

(9) Remove timing chain wedge special tool 8350 (Fig. 35).

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 41), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the camshaft position sensor (Fig. 36).

(12) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

CAMSHAFT(S) - RIGHT (Continued)

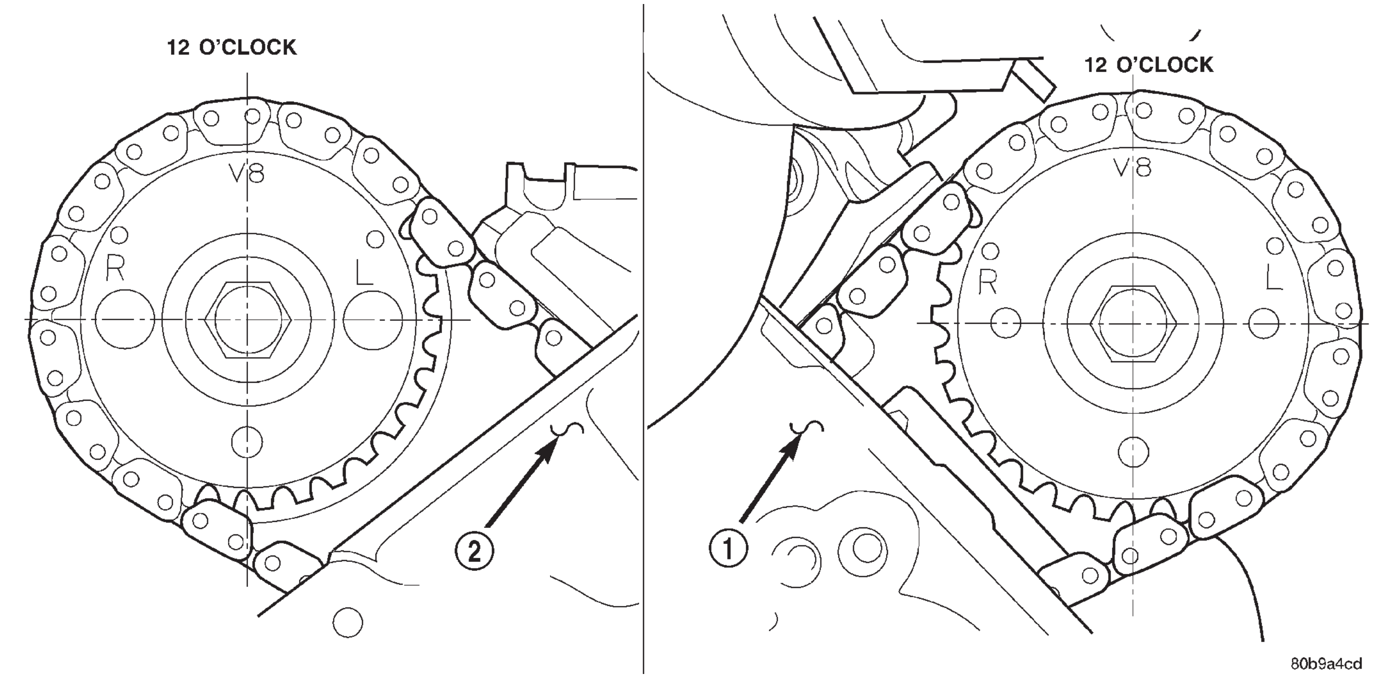


Fig. 39 Timing Chain to Sprocket Alignment

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

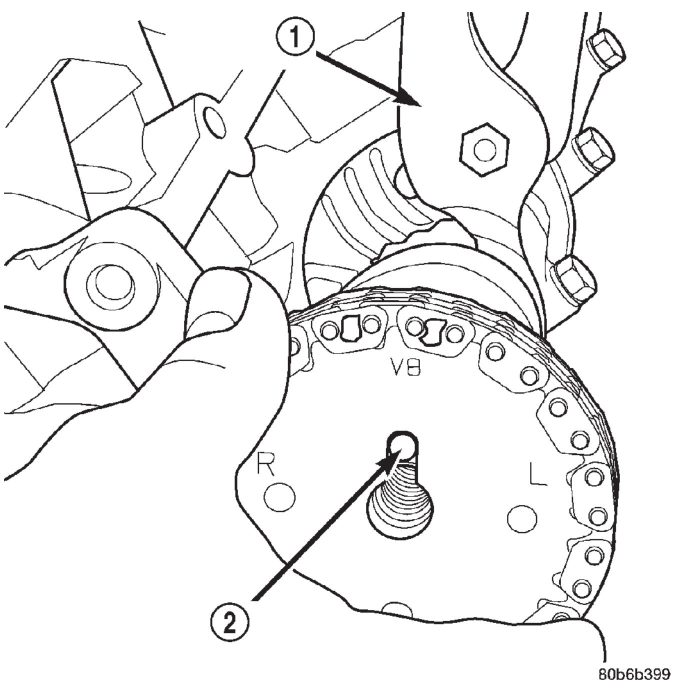


Fig. 40 Camshaft Sprocket Installation

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

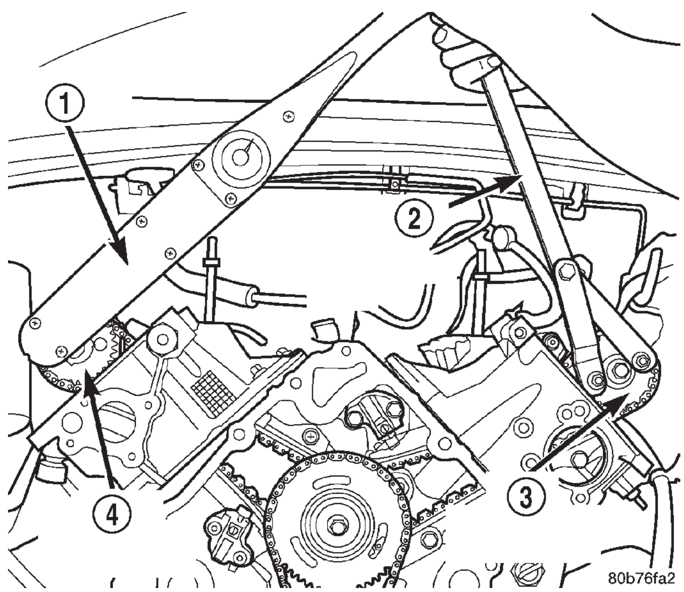


Fig. 41 Tightening Right Side Cam Sprocket Retaining Bolt

1 - TORQUE WRENCH
2 - SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
3 - LEFT CAMSHAFT SPROCKET
4 - RIGHT CAMSHAFT SPROCKET

CYLINDER HEAD COVER(S)

DESCRIPTION

The cylinder head covers are made of die cast magnesium, and are not interchangeable from side-to-side. It is imperative that nothing rest on the cylinder head covers. Prolonged contact with other items may wear a hole in the cylinder head cover.

REMOVAL - RIGHT SIDE

(1) Disconnect battery negative cable.
(2) Remove air cleaner assembly, resonator assembly and air inlet hose.
(3) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(4) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(5) Remove air conditioning compressor retaining bolts and move compressor to the left.
(6) Remove heater hoses.
(7) Disconnect injector and ignition coil connectors.
(8) Disconnect and remove positive crankcase ventilation (PCV) hose.
(9) Remove oil fill tube.
(10) Un-clip injector and ignition coil harness and move away from cylinder head cover.
(11) Remove right rear breather tube and filter assembly.
(12) Remove cylinder head cover retaining bolts.
(13) Remove cylinder head cover.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

REMOVAL - LEFT SIDE

(1) Disconnect negative cable from battery.
(2) Remove the resonator assemble and air inlet hose.
(3) Disconnect injector connectors and un-clip the injector harness.
(4) Route injector harness in front of cylinder head cover.
(5) Disconnect the left side breather tube and remove the breather tube.
(6) Remove the cylinder head cover mounting bolts.
(7) Remove cylinder head cover and gasket.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

CLEANING

Clean cylinder head cover gasket surface.
Clean head rail, if necessary.

INSTALLATION - RIGHT SIDE

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

CAUTION: DO NOT allow other components including the wire harness to rest on or against the engine cylinder head cover. Prolonged contact with other objects may wear a hole in the cylinder head cover.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
(2) Install cylinder head cover and hand start all fasteners. Verify that all double ended studs are in the correct location shown in (Fig. 42).

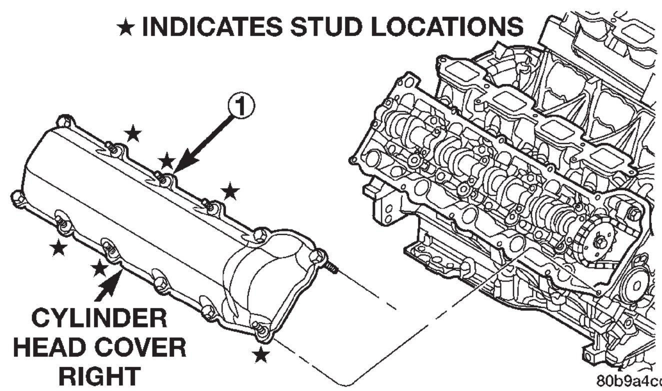


Fig. 42 Cylinder Head Cover—Right

ITEM	DESCRIPTION	TORQUE
1	Cover Fasteners	12 N·m (105 in. lbs.)

(3) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs).
(4) Install right rear breather tube and filter assembly.
(5) Connect injector, ignition coil electrical connectors and harness retaining clips.
(6) Install the oil fill tube.
(7) Install PCV hose.
(8) Install heater hoses.
(9) Install air conditioning compressor retaining bolts.
(10) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(11) Fill Cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

CYLINDER HEAD COVER(S) (Continued)

(12) Install air cleaner assembly, resonator assembly and air inlet hose.

(13) Connect battery negative cable.

INSTALLATION—LEFT SIDE

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

CAUTION: DO NOT allow other components including the wire harness to rest on or against the cylinder head cover. Prolonged contact with other objects may wear a hole in the engine cylinder head cover.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.

(2) Install cylinder head cover and hand start all fasteners. Verify that all studs are in the correct location shown in (Fig. 43).

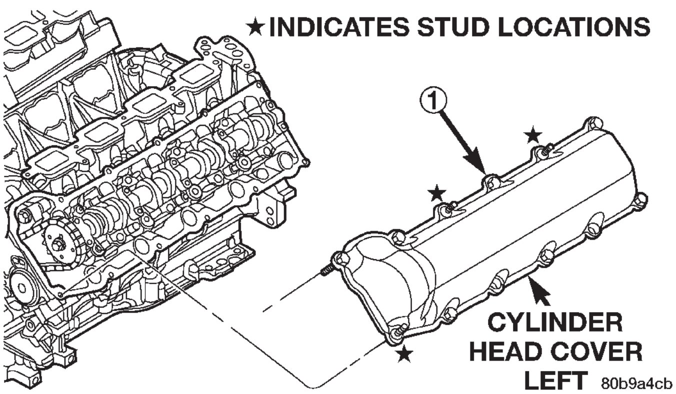


Fig. 43 Cylinder Head Cover—Left

ITEM	DESCRIPTION	TORQUE
1	Cover Fasteners	12 N·m (105 in. lbs.)

(3) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs.).

(4) Install left side breather and connect breather tube.

(5) Connect injector electrical connectors and injector harness retaining clips.

(6) Install the resonator and air inlet hose.

(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. Each valve is actuated by a roller rocker arm which pivots on a stationary lash adjuster. All valves use three bead lock keepers to retain the springs and promote valve rotation.

STANDARD PROCEDURE—REFACING

NOTE: Valve seats that are worn or burned can be reworked, provided that correct angle and seat width are maintained. Otherwise the cylinder head must be replaced.

NOTE: When refacing valves and 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.

(1) Using a suitable dial indicator measure the center of the valve seat Total run out must not exceed 0.051 mm (0.002 in).

(2) Apply a small amount of Prussian blue to the valve seat, insert the valve into the cylinder head, while applying light pressure on the valve rotate the valve. Remove the valve and examine the valve face. If the blue is transferred below the top edge of the valve face, lower the valve seat using a 15 degree stone. If the blue is transferred to the bottom edge of the valve face, raise the valve seat using a 65 degree stone.

(3) When the seat is properly positioned the width of the intake seat must be 1.75 – 2.36 mm (0.0689 – 0.0928 in.) and the exhaust seat must be 1.71 – 2.32 mm (0.0673 – 0.0911 in.).

(4) Check the valve spring installed height after refacing the valve and seat. The installed height for both intake and exhaust valve springs must not exceed 41.44 mm (1.6315 in.) .

(5) The valve seat and valve face must maintain a face angle of 44.5 – 45 degrees angle (Fig. 44).

INTAKE/EXHAUST VALVES & SEATS (Continued)

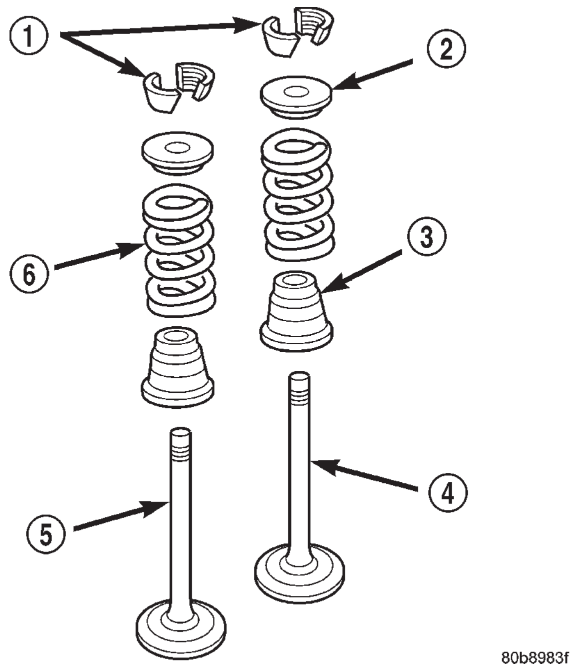


Fig. 44 Valve Assembly Configuration

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 steel stampings with an integral roller bearing. The rocker arms incorporate a 2.8 mm (0.11 inch) oil hole in the lash adjuster socket for roller and camshaft lubrication.

DIAGNOSIS AND TESTING - HYDRAULIC LASH ADJUSTER

A tappet-like noise may be produced from several items. Check the following items.

(1) Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.

(2) Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.

(3) Turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.

(4) Low oil pressure.

(5) The oil restrictor in cylinder head gasket or the oil passage to the cylinder head is plugged with debris.

(6) Air ingested into oil due to broken or cracked oil pump pick up.

(7) Worn valve guides.

(8) Rocker arm ears contacting valve spring retainer.

(9) Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.

(10) Oil leak or excessive cam bore wear in cylinder head.

(11) Faulty lash adjuster.

- Check lash adjusters for sponginess while installed in cylinder head and cam on camshaft at base circle. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be bottomed out easily.
- Remove suspected lash adjusters, and replace.
- Before installation, make sure adjusters are at least partially full of oil. This can be verified by little or no plunger travel when lash adjuster is depressed.

REMOVAL

NOTE: Disconnect the battery negative cable to prevent accidental starter engagement.

(1) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) For rocker arm removal on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(3) For rocker arm removal on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

(4) For rocker arm removal on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.

(5) For rocker arm removal on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.

(6) Using special tool 8516 Rocker Arm Remover, press downward on the valve spring, remove rocker arm (Fig. 45).

INSTALLATION

CAUTION: Make sure the rocker arms are installed with the concave pocket over the lash adjusters. Failure to do so may cause severe damage to the rocker arms and/or lash adjusters.

NOTE: Coat the rocker arms with clean engine oil prior to installation.

ROCKER ARM / ADJUSTER ASSEMBLY (Continued)

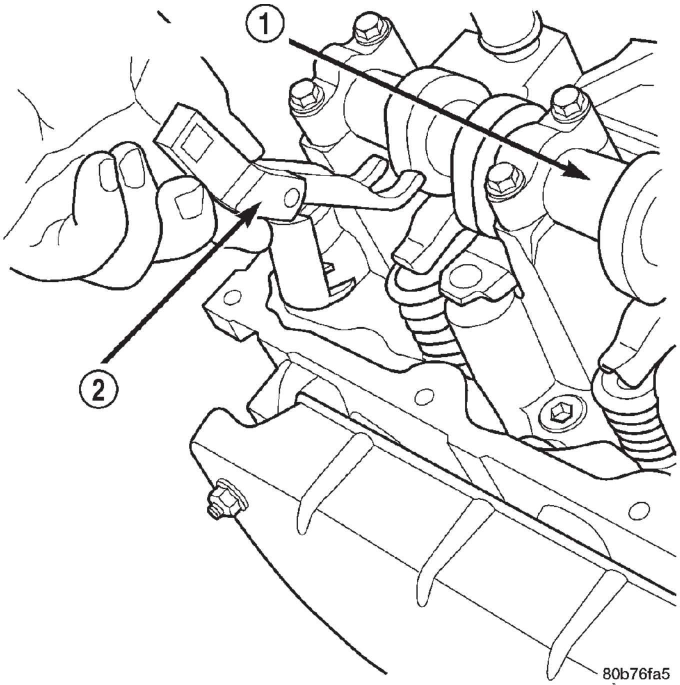


Fig. 45 Rocker Arm—Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

(1) For rocker arm installation on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(2) For rocker arm installation on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

(3) For rocker arm installation on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.

(4) For rocker arm installation on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.

(5) Using special tool 8516 press downward on the valve spring, install rocker arm (Fig. 45).

(6) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

VALVE SPRINGS

DESCRIPTION

The valve springs are made from high strength chrome silicon steel. The springs are common for intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which is a positive type seal to control lubrication.

REMOVAL

(1) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Using Special Tool 8516 Rocker Arm Remover, remove the rocker arms and the hydraulic lash adjusters (Fig. 46).

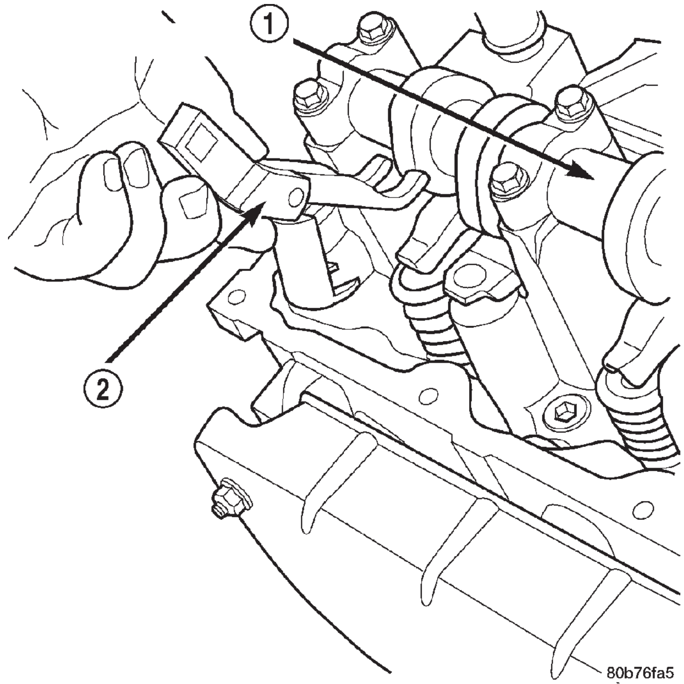


Fig. 46 Rocker Arm—Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

(3) Remove the spark plug for the cylinder the valve spring and seal are to be removed from.

(4) Apply shop air to the cylinder to hold the valves in place when the spring is removed

(5) Remove the camshaft (Refer to 9 - ENGINE/CYLINDER HEAD/CAMSHAFT(S) - REMOVAL).

NOTE: All eight valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.

(6) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

(7) Remove the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

VALVE SPRINGS (Continued)

(8) Remove the valve spring compressor.
(9) Remove the spring retainer, and the spring.
(10) Remove the valve stem seal.

NOTE: The valve stem seals are common between intake and exhaust.

INSTALLATION

(1) coat the valve stem with clean engine oil and install the valve stem seal. Make sure the seal is fully seated and that the garter spring at the top of the seal is intact.

(2) Install the spring and the spring retainer (Fig. 47).

(3) Using Special Tool 8387 Valve Spring Compressor, compress the spring and install the two valve spring retainer halves.

(4) Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated.

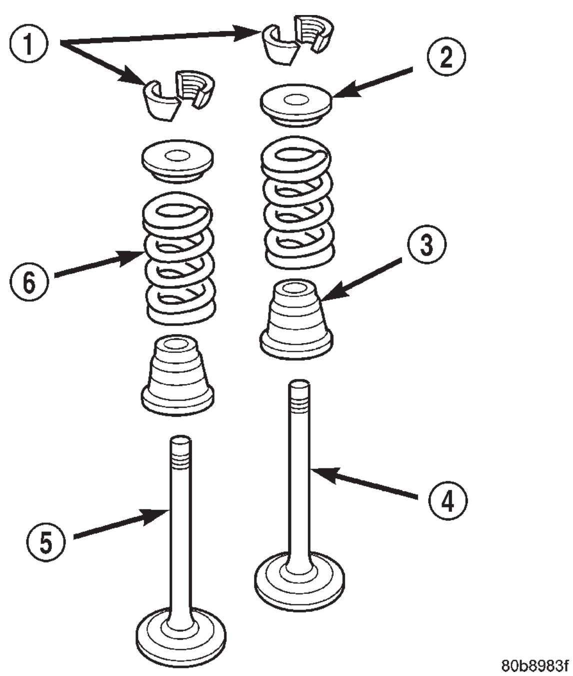


Fig. 47 Valve Assembly Configuration

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

(5) Install the camshaft (Refer to 9 - ENGINE/CYLINDER HEAD/CAMSHAFT(S) - INSTALLATION).

(6) Position the hydraulic lash adjusters and rocker arms (Fig. 46).

(7) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

VALVE STEM SEALS

DESCRIPTION

The valve stem seals are made of rubber and incorporate an integral steel valve spring seat. The integral garter spring maintains consistent lubrication control to the valve stems.

ENGINE BLOCK

DESCRIPTION

The cylinder block is made of cast iron. The block is a closed deck design with the left bank forward. To provide high rigidity and improved NVH an enhanced compacted graphite bedplate is bolted to the block. The block design allows coolant flow between the cylinders bores, and an internal coolant bypass to a single poppet inlet thermostat is included in the cast aluminum front cover.

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.

ENGINE BLOCK (Continued)

The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 48).

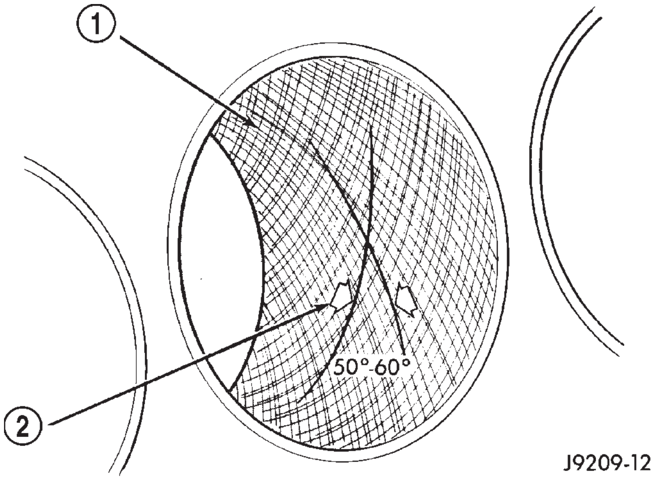


Fig. 48 Cylinder Bore Crosshatch Pattern

1 - CROSSHATCH PATTERN
2 - INTERSECT ANGLE

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper cross-hatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the cross-hatch 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.

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

- The galley at the oil filter adaptor hole.
- The front and rear oil galley holes.
- The feed holes for the crankshaft main bearings.

Once the block has been completely cleaned, apply Loctite PST pipe sealant with Teflon 592 to the threads of the front and rear oil galley plugs. Tighten the plugs to 34 N·m (25 ft. lbs.) torque.

INSPECTION

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter. 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. 49).

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

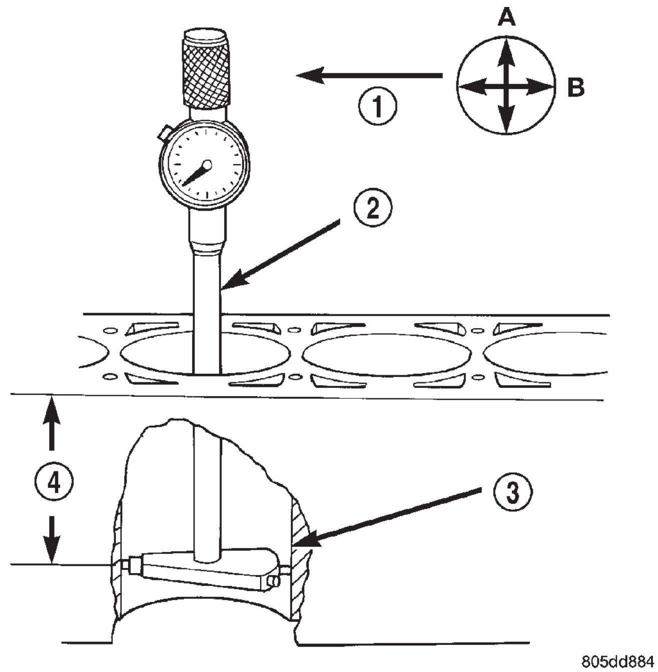


Fig. 49 Bore Gauge—Typical

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 38 MM
(1.5 in)

(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 block must be replaced. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE—CONNECTING ROD BEARING FITTING

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 50) (Fig. 51). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 52). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

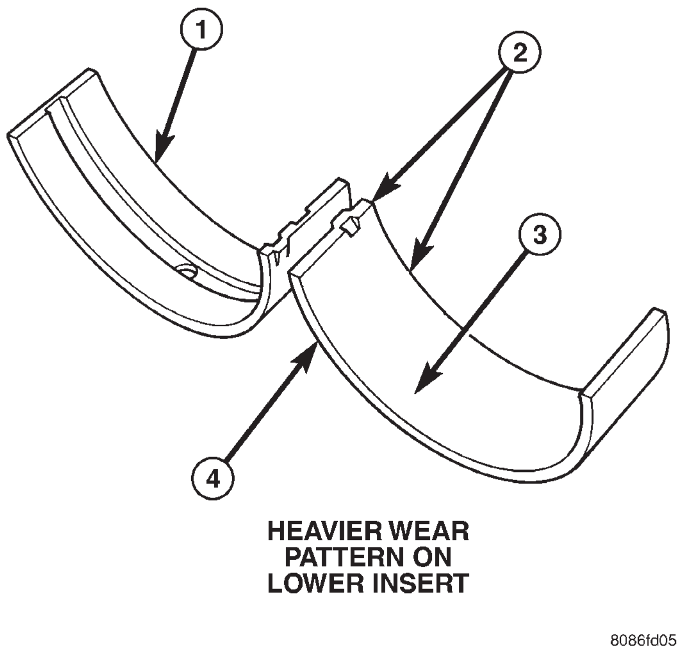


Fig. 50 Connecting Rod Bearing Inspection

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) Lubricate the upper bearing insert and install in connecting rod.

(3) Use piston ring compressor and Guide Pins Special Tool 8507 (Fig. 53) to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The “F”’s near the piston wrist pin bore should point to the front of the engine.

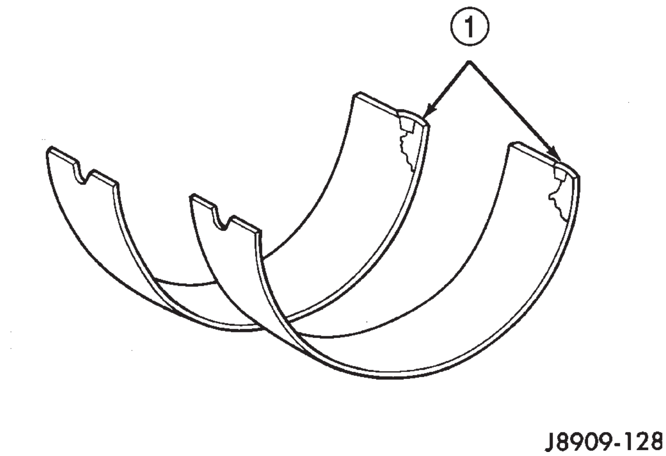


Fig. 51 Locking Tab Inspection

1 - ABNORMAL CONTACT AREA CAUSED BY LOCKING TABS NOT FULLY SEATED OR BEING BENT

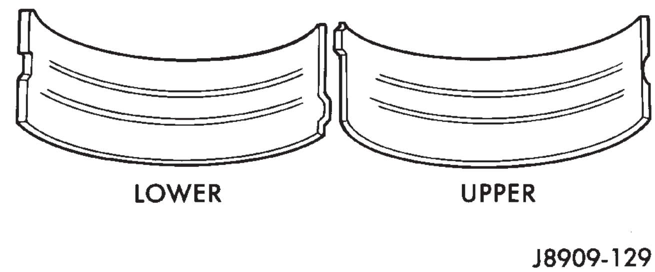


Fig. 52 Scoring Caused by Insufficient Lubrication or Damaged Crankshaft Journal

(4) 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.

(5) Install bearing cap and connecting rod on the journal and tighten bolts to 27 N·m (20 ft. lbs.) plus a 90° turn. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(6) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 54). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

(7) 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.

CONNECTING ROD BEARINGS (Continued)

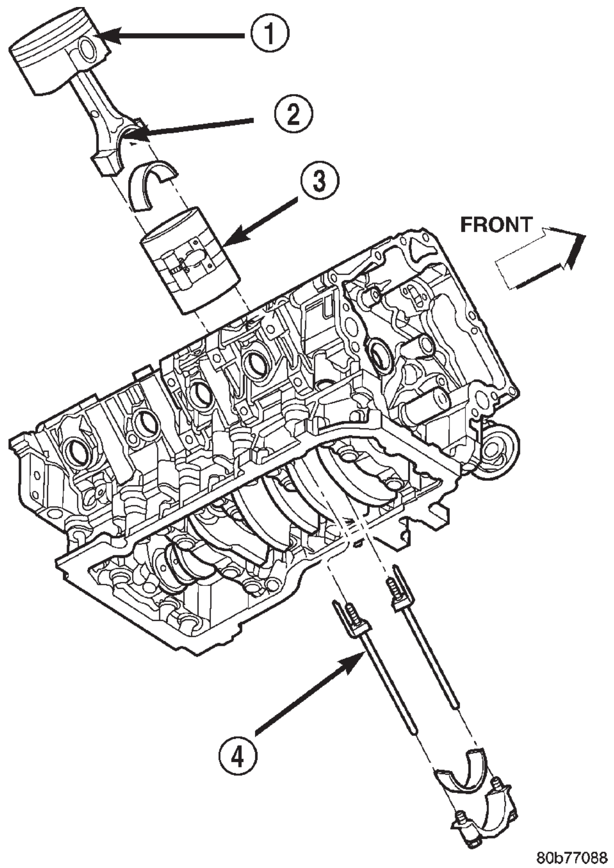


Fig. 53 Piston and Connecting Rod—Installation

1 - "F" TOWARD FRONT OF ENGINE
2 - OIL SLINGER SLOT
3 - RING COMPRESSOR
4 - SPECIAL TOOL 8507

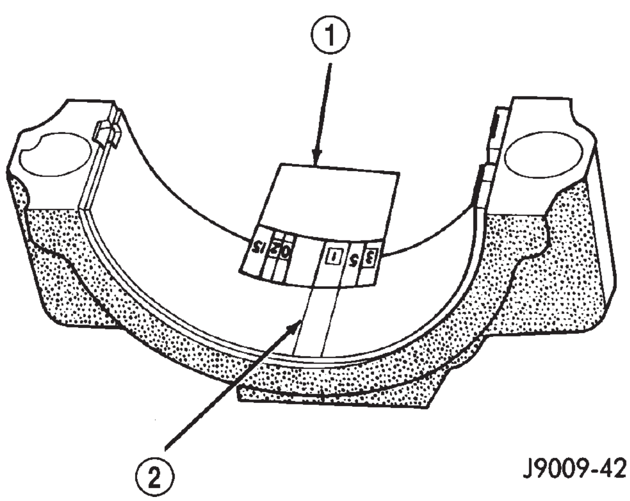


Fig. 54 Measuring Bearing Clearance with Plastigage

1 - PLASTIGAGE SCALE
2 - COMPRESSED PLASTIGAGE

(8) If bearing-to-journal clearance exceeds the specification, determin which services bearing set to use the bearing sizes are as follows:

Bearing Mark	SIZE	USED WITH JOURNAL SIZE
.025 US	.025 mm (.001 in.)	50.983-50.967 mm (2.0073-2.0066 in.)
Std.	STANDARD	50.992-51.008 mm (2.0076-2.0082 in.)
.250 US	.250 mm (.010 in.)	50.758-50.742 mm (1.9984-1.9978 in.)

(9) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(10) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 27 N·m (20 ft. lbs.) plus a 90° turn.

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 55). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

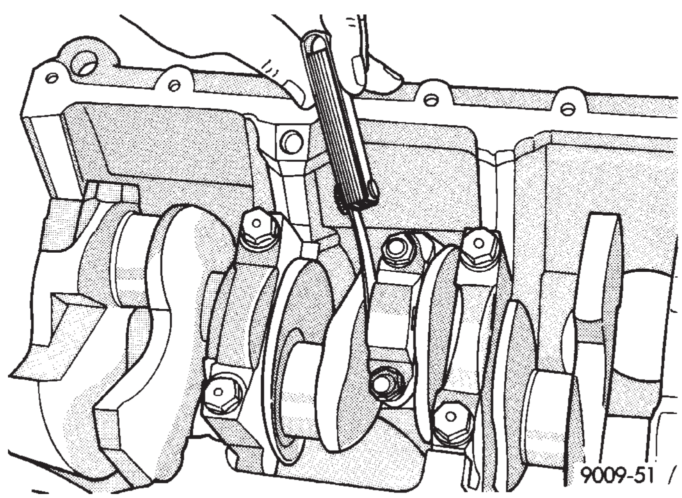


Fig. 55 Checking Connecting Rod Side Clearance—Typical

CORE PLUGS

REMOVAL

(1) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(2) Using a blunt tool such as a drift or a screw driver and a hammer, strike the bottom edge of the cup plug (Fig. 56)

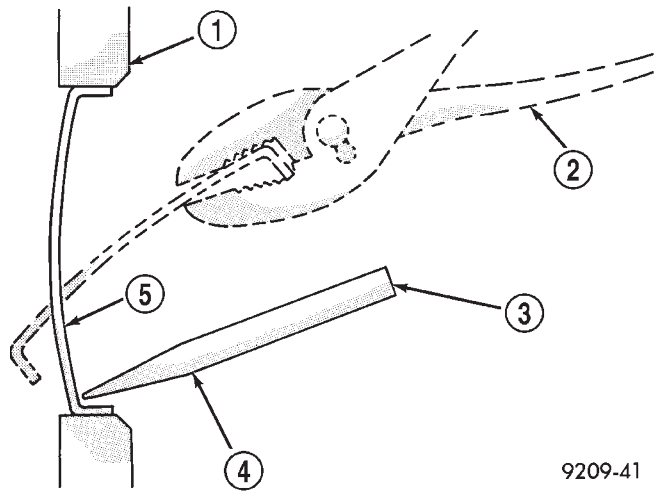


Fig. 56 Engine Core Plug Removal

1 - CYLINDER BLOCK
2 - REMOVE PLUG WITH PLIERS
3 - STRIKE HERE WITH HAMMER
4 - DRIFT PUNCH
5 - CUP PLUG

(3) Using a suitable pair of pliers, grasp the core plug and remove.

INSTALLATION

NOTE: Thoroughly clean core plug bore, remove all of the old sealer.

(1) Coat the edges of the engine core plug and the core plug bore with Mopar Gasket Maker, or equivalent.

NOTE: It is not necessary to wait for the sealant to cure on the core plugs. The cooling system can be filled and the vehicle returned to service immediately.

(2) Using proper plug driver, drive core plug into the core plug bore. The sharp edge of the core plug should be at least 0.50 mm (0.020 in.) inside the lead in chamfer.

(3) Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

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 five select fit 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 number eight counterweight has provisions for crankshaft position sensor target wheel mounting. The select fit main bearing markings are located on the rear side of the target wheel. The crankshaft oil seals are one piece design. The front oil seal is retained in the timing chain cover, and the rear seal is pressed in to a bore formed by the cylinder block and the bedplate assembly.

REMOVAL

NOTE: To remove the crankshaft from the engine, the engine must be removed from the vehicle.

(1) Remove the engine. (Refer to 9 - ENGINE - REMOVAL).

(2) Remove the engine oil pump.(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

CAUTION: DO NOT pry on the oil pan gasket when removing the oil pan, The oil pan gasket is mounted to the cylinder block in three locations and will remain attached to block when removing oil pan. Gasket can not be removed with oil pan.

(3) Remove oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) Remove the oil pump pickup tube and oil pan gasket /windage tray.

(5) Remove the bedplate mounting bolts. Note the location of the three stud bolts for installation.

(6) Remove the connecting rods from the crankshaft.

CAUTION: The bedplate to cylinder block mating surface is a critical sealing surface. Do not pry on or damage this surface in anyway.

NOTE: The bedplate contains the lower main bearing halves. Use care when handling bedplate as not to drop or damage bearing halves. Installing main bearing halves in the wrong position will cause sever damage to the crankshaft.

CRANKSHAFT (Continued)

NOTE: The bedplate has pry points cast into it. Use these points only. The pry points are on both the left and right sides, only the left side is shown.

(7) Carefully pry on the pry points (Fig. 57) to loosen the bedplate then remove the bedplate.

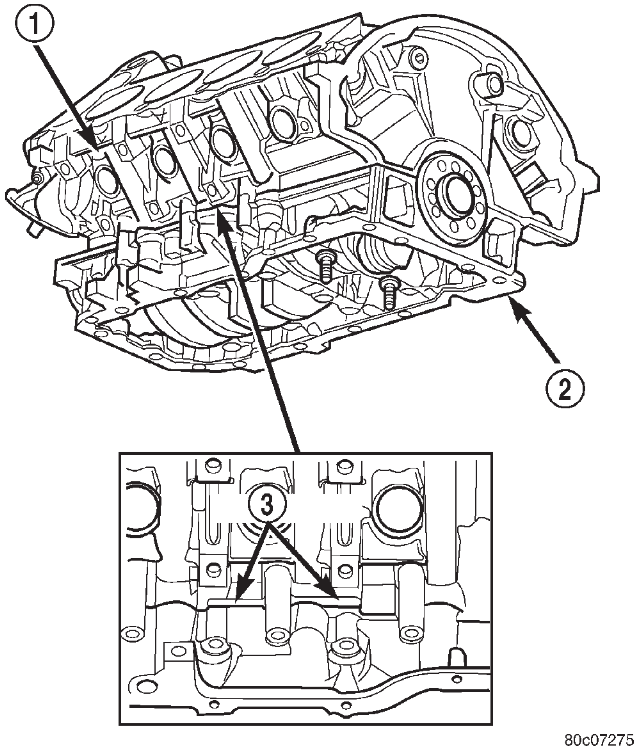


Fig. 57 Bedplate Pry Point Location

1 - CYLINDER BLOCK
2 - BEDPLATE
3 - PRY POINT

CAUTION: When removing the crankshaft, use care not to damage bearing surfaces on the crankshaft.

(8) Remove the crankshaft.
(9) Remove the crankshaft target wheel.

INSPECTION

NOTE: Thoroughly inspect the connecting rod bearing bores and main bearing bores for scoring, blueing or severe scratches. Further disassembly may be required.

If connecting rod bearing bores show damage, the cylinder heads must be removed to service the piston and rod assemblies. If the bedplate or the cylinder block main bearing bores show damage the engine must be replaced.

(1) If required, remove the main bearing halves from the cylinder block and bedplate.

(2) Thoroughly clean the bedplate to cylinder block sealing surfaces and main bearing bores. Remove all oil and sealant residue.

(3) Inspect the bedplate main bearing bores for cracks, scoring or severe blueing. If either condition exists the engine must be replaced.

(4) Inspect the crankshaft thrust washer for scoring, scratches or blueing. If either condition exist replace the thrust washer.

(5) Inspect the oil pan gasket/windage tray for splits, tears or cracks in the gasket sealing surfaces. Replace gasket as necessary.

INSTALLATION

CAUTION: Main bearings are select fit. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE) for proper bearing selections.

(1) Lubricate upper main bearing halves with clean engine oil.

CAUTION: When installing crankshaft, use care not to damage bearing surfaces on the crankshaft.

NOTE: Apply sealant to the target wheel retaining screws prior to installation.

(2) Install the crankshaft target wheel. Torque the mounting screws to 22 N·m (21 ft. lbs.).
(3) Position crankshaft in cylinder block.
(4) Install the thrust washers (Fig. 58).

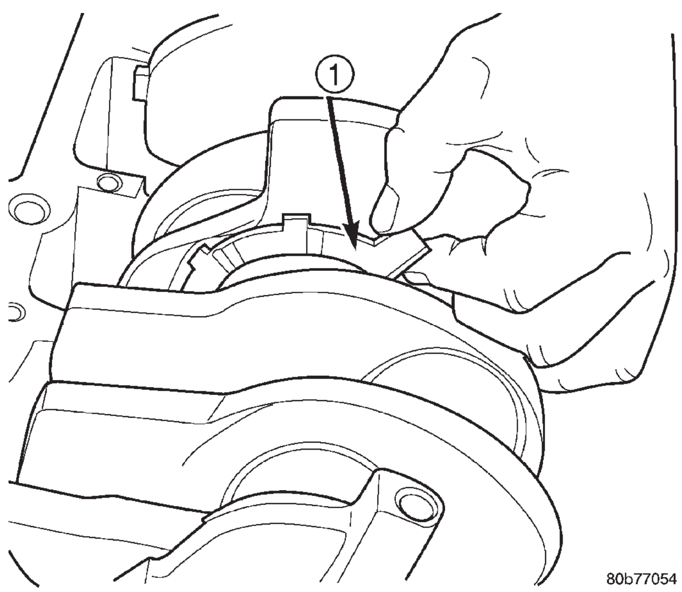


Fig. 58 Crankshaft Thrust Washer Installation

1 - CRANKSHAFT THRUST WASHER

CRANKSHAFT (Continued)

CAUTION: The bedplate to cylinder block mateing surface must be coated with sealant prior to installation. Failure to do so will cause severe oil leaks.

NOTE: The installation time to install the bedplate after the sealant has been applied is critical.

NOTE: Make sure that the bedplate and cylinder block sealing surfaces are clean and free of oil or other contaminants. Contaminants on the sealing surfaces may cause main bearing distortion and/or oil leaks.

(5) Apply a 2.5mm (0.100 inch) (Fig. 59) bead of Mopar® Gen II Silicone Rubber Adhesive sealant to the cylinder block-to-bedplate mating surface as shown (Fig. 60).

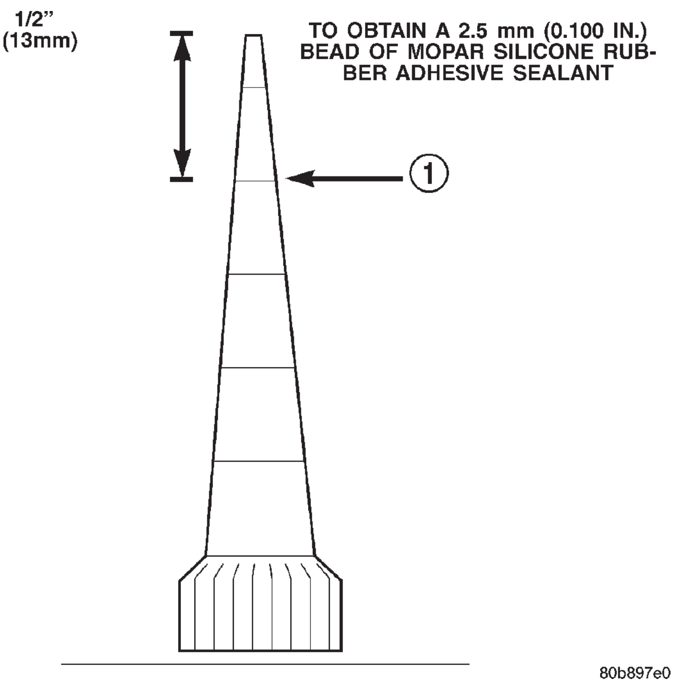


Fig. 59 Cutting Aplicator to Achieve 2.5mm (0.100 in.) Bead

1 - CUT HERE

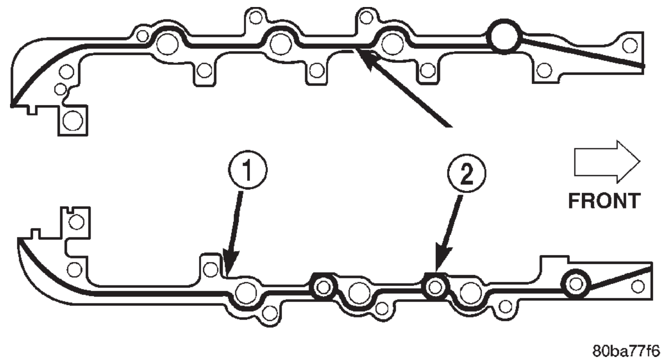


Fig. 60 Cylinder Block-to-Bedplate Sealent Bead Location

1 - CYLINDER BLOCK
2 - SEALANT BEAD LOCATION

(6) Coat the crankshaft main bearing journals with clean engine oil and position the bedplate onto the cylinder block.

NOTE: Lubricate the bedplate retaining bolts with clean engine oil prior to installation.

(7) Install the bedplate retaining bolts, making sure to place the stud bolts in the correct location, Torque the bolts in the sequence shown (Fig. 61).

- Tighten bolts **A – L** to 54 N·m (40 ft. lbs.)
- Tighten bolts **1–10** to 2.8 N·m (25 in. lbs.)
- Turn bolts **1–10** an additional 90°.
- Tighten bolts **A1– A6** to 27 N·m (20 ft. lbs.)

(8) Measure crankshaft end play. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - STANDARD PROCEDURE).

(9) Install the connecting rods and measure side clearance. (Refer to 9 - ENGINE/ENGINE BLOCK/ CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

(10) Position the oil pan gasket/windage tray, using a new o-ring, install the oil pickup tube. Torque the bolt to 28N·n (20 ft. lbs.) torque the nuts to 28N·m (20 ft. lbs.).

(11) Install the oil pan. Torque the retaining bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 62).

(12) Install the engine (Refer to 9 - ENGINE - INSTALLATION).

CRANKSHAFT (Continued)

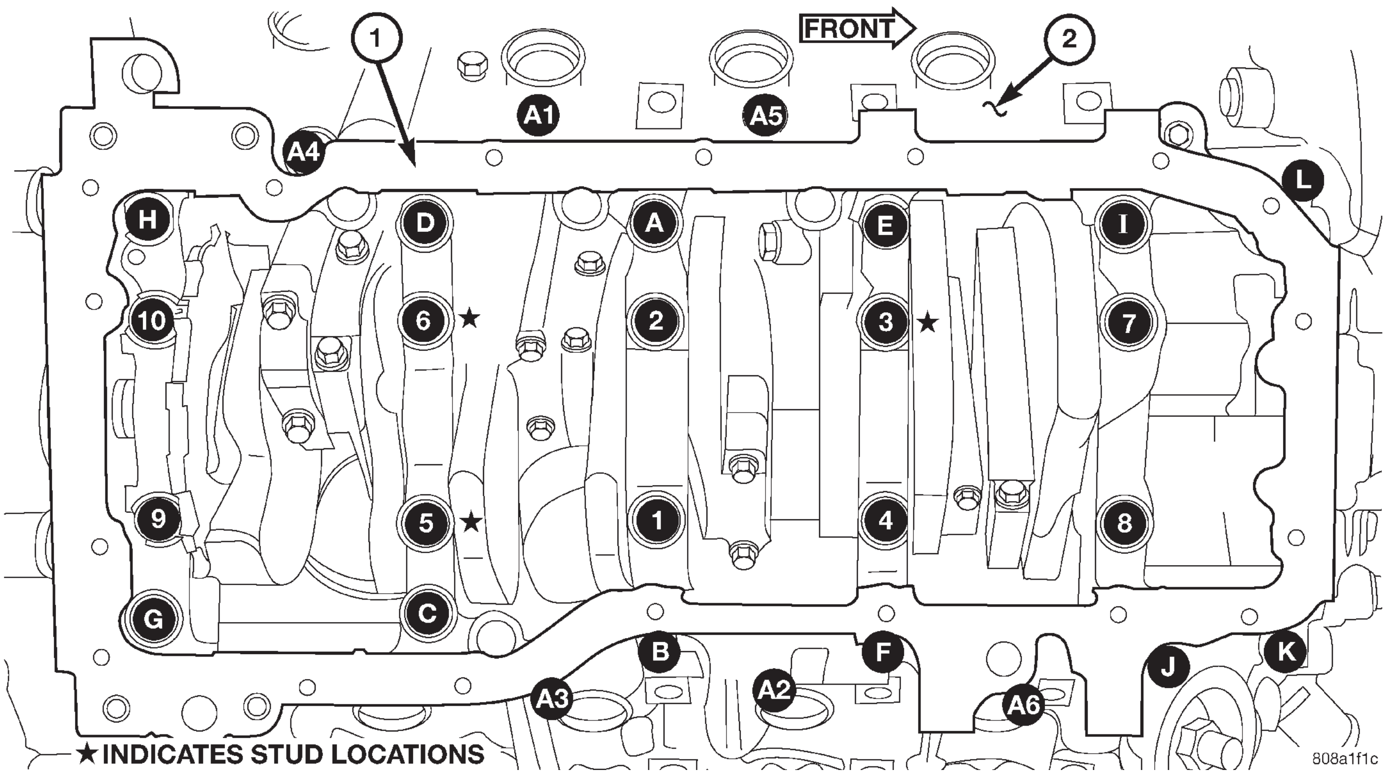


Fig. 61 Bedplate Tightening Sequence

1 - BEDPLATE
2 - CYLINDER BLOCK

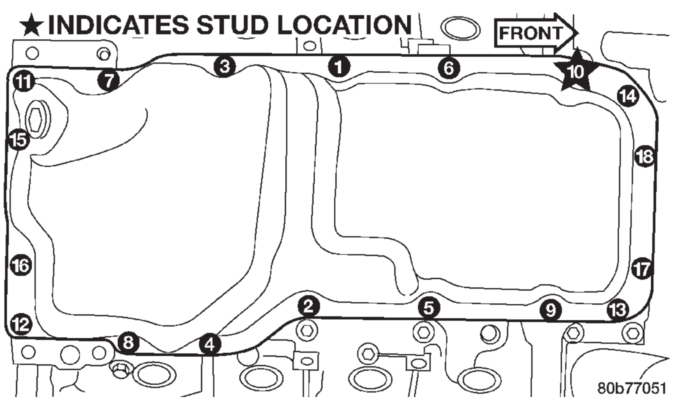


Fig. 62 Oil Pan Tightening Sequence

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE—CRANKSHAFT MAIN BEARING - FITTING

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Crankshaft removed 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 is 0.008mm (0.0004 inch.) and maximum out of round is 0.005mm (0.002 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.

CRANKSHAFT MAIN BEARING SELECTION

The main bearings are “select fit” to achieve proper oil clearances. For main bearing selection, the crankshaft position sensor target wheel has grade identification marks stamped into it (Fig. 63). These marks are read from left to right, corresponding with journal number 1, 2, 3, 4 and 5. The crankshaft position sensor target wheel is mounted to the number 8 counter weight on the crankshaft.

NOTE: Service main bearings are coded. These codes identify what size (grade) the bearing is.

CRANKSHAFT MAIN BEARINGS (Continued)

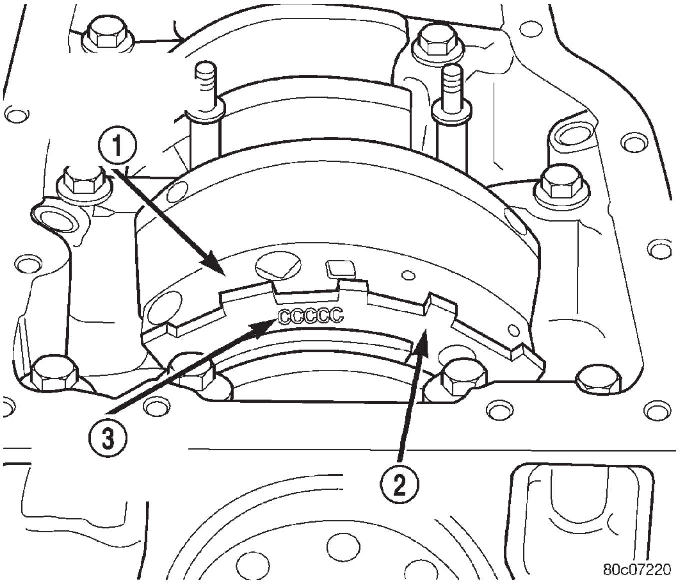


Fig. 63 Main Bearing Markings on Target Wheel

1 - REARMOST CRANKSHAFT COUNTER WEIGHT
2 - TARGET WHEEL
3 - MAIN BEARING SELECT FIT MARKINGS

MAIN BEARING SELECTION CHART—4.7L

GRADE MARKING	SIZE mm (in.)	FOR USE WITH JOURNAL SIZE
A	0.008 mm U/S (0.0004 in.) U/S	63.488–63.496 mm (2.4996–2.4999 in.)
B	NOMINAL	63.496–63.504 mm (2.4999–2.5002 in.)
C	0.008 mm O/S (0.0004 in.) O/S	63.504–63.512 mm (2.5002–2.5005 in.)

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. 64).

NOTE: If any of the crankshaft journals are scored, the crankshaft must be repaired or replaced.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

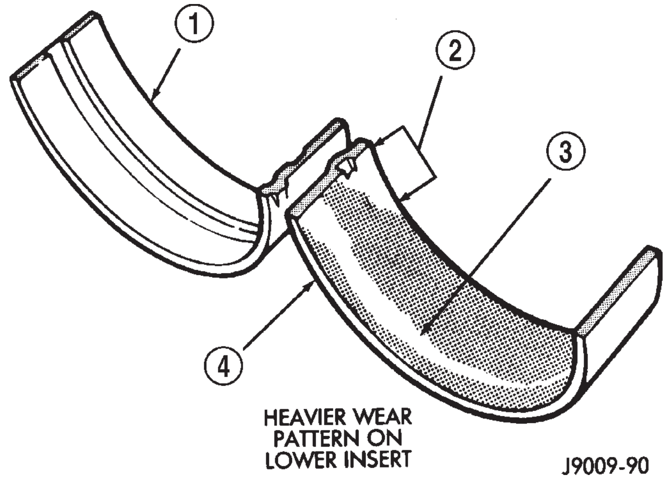


Fig. 64 Main Bearing Wear Patterns

1 - UPPER INSERT
2 - NO WEAR IN THIS AREA
3 - LOW AREA IN BEARING LINING
4 - LOWER INSERT

Replace all damaged or worn bearing inserts.

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(3) Remove A/C compressor mouning fasteners and set aside.

(4) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(5) Remove upper radiator hose.

(6) Disconnect electrical connector for fan mounted inside radiator shroud.

(7) Remove radiator shroud attaching fasteners.

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

(8) Remove radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(9) Remove crankshaft damper bolt.

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 65).

(11) Using Special Tool 8511, remove crankshaft front seal (Fig. 66).

CRANKSHAFT OIL SEAL - FRONT (Continued)

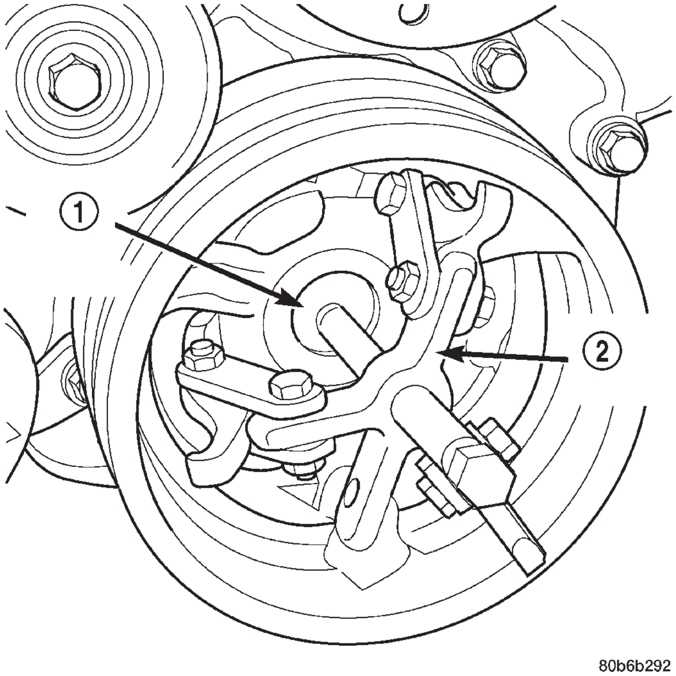


Fig. 65 Crankshaft Damper—Removal

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

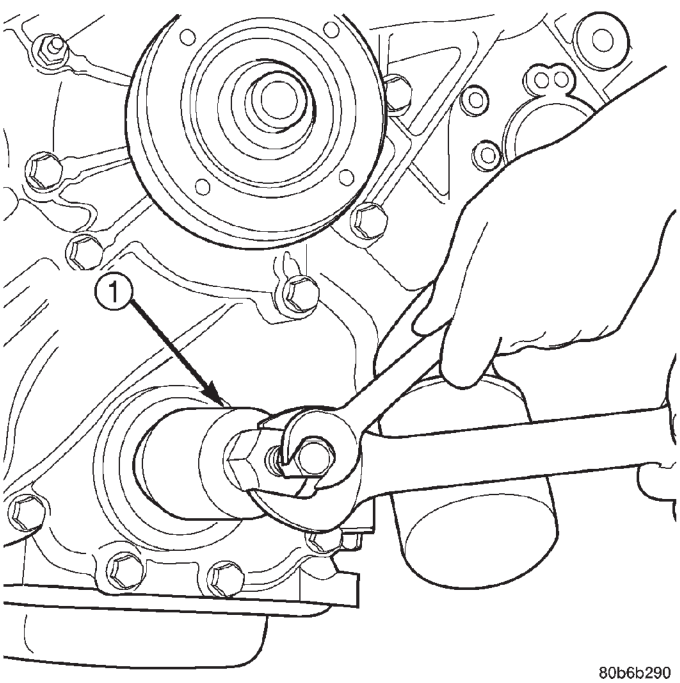


Fig. 66 Crankshaft Front Seal—Removal

1 - SPECIAL TOOL 8511

INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(1) Using Special Tool 8348 and 8512, install crankshaft front seal (Fig. 67).

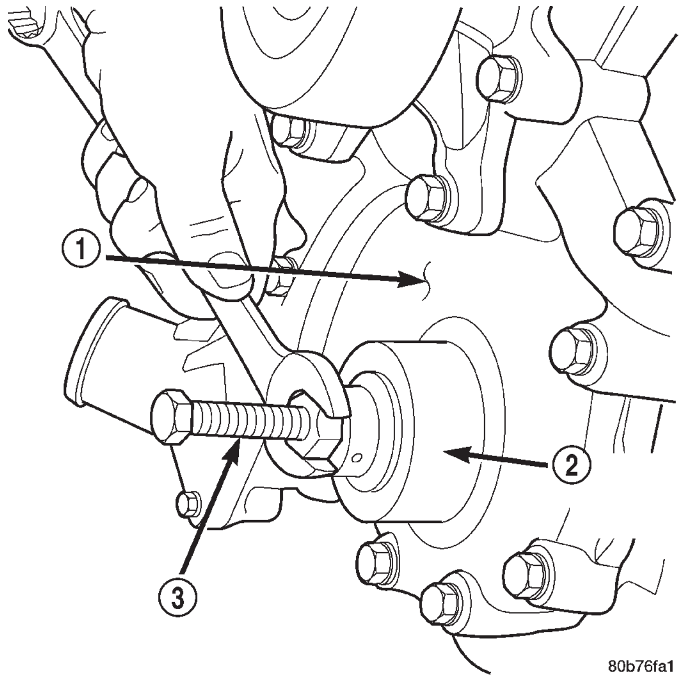


Fig. 67 Crankshaft Front Seal—Installation

1 - TIMING CHAIN COVER
2 - SPECIAL TOOL 8348
3 - SPECIAL TOOL 8512

(2) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(3) Install radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(4) Install upper radiator hose.

(5) Install A/C compressor and tighten fasteners to 54 N·m (40 ft. lbs.).

(6) Install accessory drive belt refer (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(7) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(8) Connect negative cable to battery.

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. See Engine, for proper repair procedures of these items.

(4) If no leaks are detected, pressurized the crankcase as outlined in the section, 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 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 9 - ENGINE - DIAGNOSIS AND TESTING), 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).

REMOVAL

NOTE: This procedure can be preformed in vehicle.

(1) If being preformed in vehicle, remove the transmission.

(2) Remove the flexplate (Refer to 9 - ENGINE/ENGINE BLOCK/FLEX PLATE - REMOVAL).

NOTE: The crankshaft oil seal CAN NOT be reused after removal.

NOTE: The crankshaft rear oil seal remover Special Tool 8506 must be installed deeply into the seal. Continue to tighten the removal tool into the seal until the tool can not be turned farther. Failure to install tool correctly the first time will cause tool to pull free of seal without removing seal from engine.

(3) Using Special Tool 8506 (Fig. 68), remove the crankshaft rear oil seal.

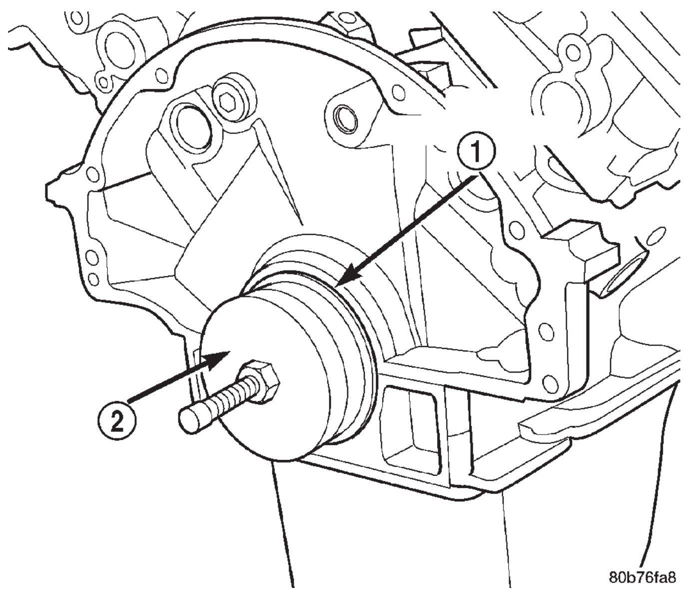


Fig. 68 Crankshaft Rear Oil Seal Removal

1 - REAR CRANKSHAFT SEAL
2 - SPECIAL TOOL 8506

INSTALLATION

(1) Position the magnetic seal guide Special Tool 8349–2 (Fig. 69) onto the crankshaft rear face. Then position the crankshaft rear oil seal onto the guide.

(2) Using Special Tools 8349 Crankshaft Rear Oil Seal Installer and C-4171 Driver Handle (Fig. 70), with a hammer, tap the seal into place. Continue to tap on the driver handle until the seal installer seats against the cylinder block crankshaft bore.

(3) Install the flexplate.

(4) If removed, install the transmission.

CRANKSHAFT OIL SEAL - REAR (Continued)

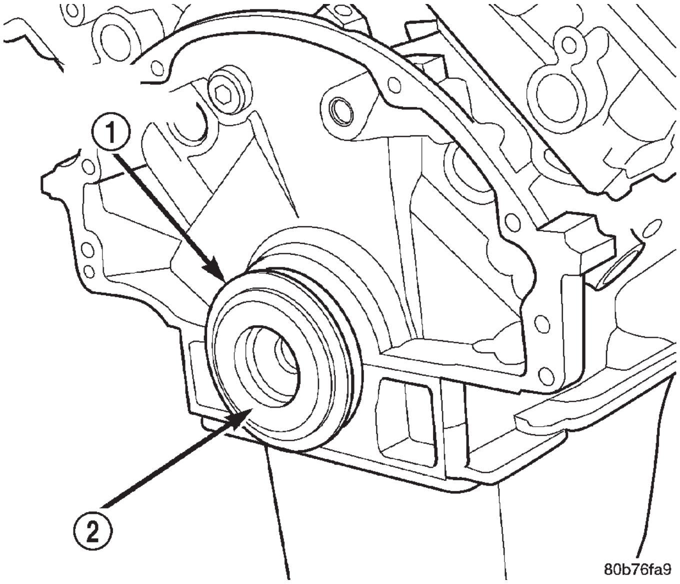


Fig. 69 Crankshaft Rear Oil Seal Guide Special Tool 8349–2 and Oil

1 - REAR CRANKSHAFT SEAL
2 - SPECIAL TOOL 8349–2 GUIDE

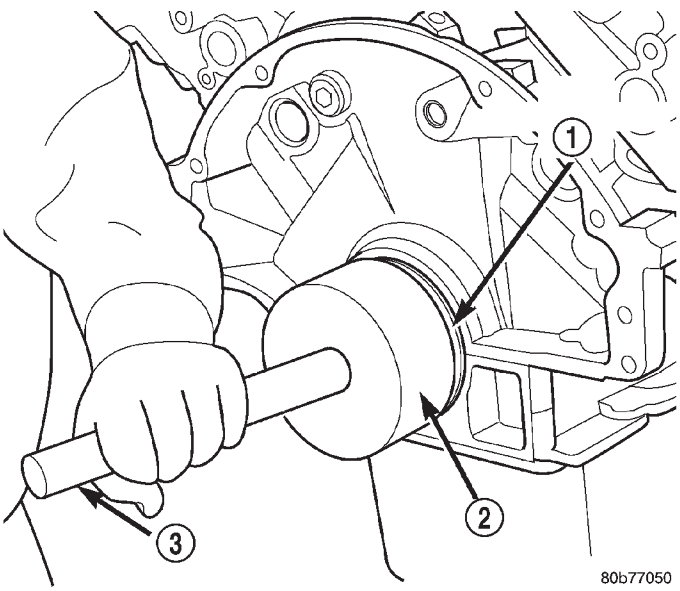


Fig. 70 Crankshaft Rear Oil Seal Installation

1 - REAR CRANKSHAFT SEAL
2 - SPECIAL TOOL 8349–1 INSTALLER
3 - SPECIAL TOOL C-4171 HANDLE

FLEX PLATE

REMOVAL

(1) Remove the transmission.
(2) Remove the bolts and flexplate.

INSTALLATION

(1) Position the flexplate onto the crankshaft and install the bolts hand tight.
(2) Tighten the flexplate retaining bolts to 60 N·m (45 ft. lbs.) in the sequence shown (Fig. 71).
(3) Install the transmission.

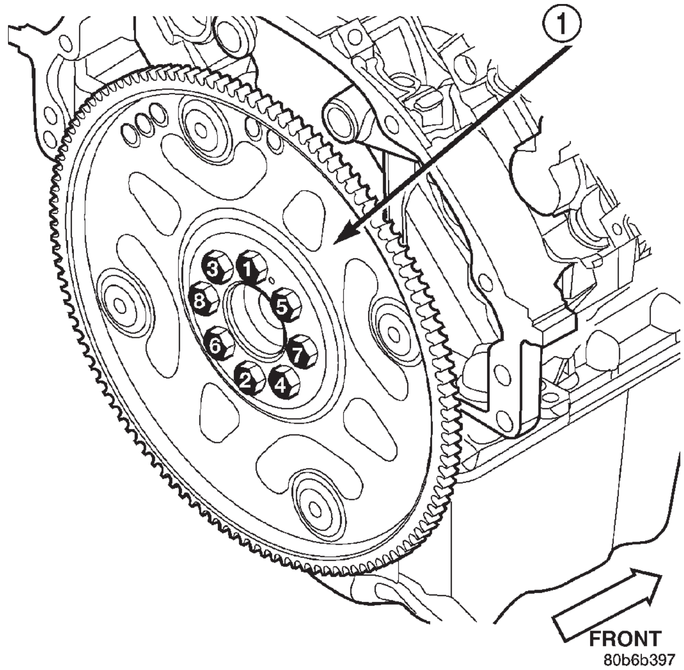


Fig. 71 Flexplate Tightening Sequence

1 - FLEXPLATE

PISTON & CONNECTING ROD

DESCRIPTION

CAUTION: Do not use a metal stamp to mark connecting rods as damage may result, instead use ink or a scratch awl.

The pistons are made of a high strength aluminum alloy. The anodized top ring groove and crown has been replaced with a coated top ring that is blue in color. Piston skirts are coated with a solid lubricant (Molykote) to reduce friction and provide scuff resistance. The connecting rods are made of forged powdered metal, with a “fractured cap” design. A pressed fit piston pin is used to attach the piston and connecting rod.

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.

PISTON & CONNECTING ROD (Continued)

(2) Measure the inside diameter of the cylinder bore at a point 38.0 mm (1.5 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. 73).

(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled.

(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. 72). 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.

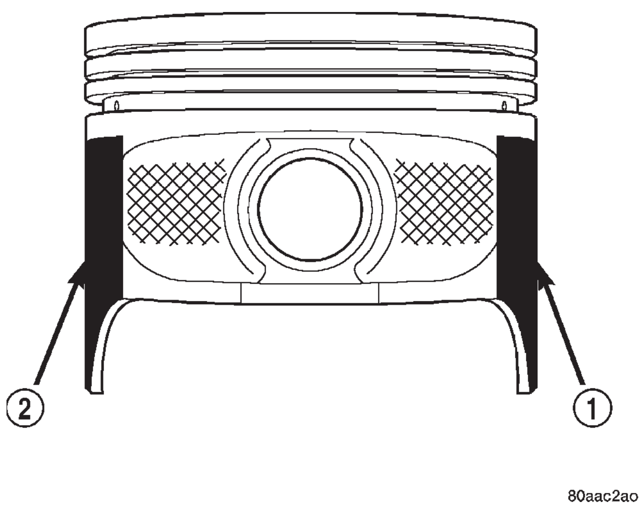


Fig. 72 Moly Coated Piston—Typical

1 - MOLY COATED
2 - MOLY COATED

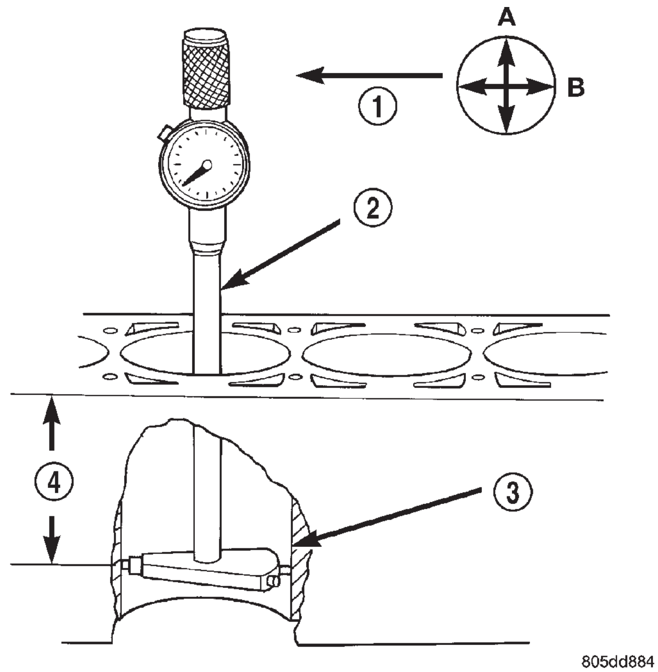


Fig. 73 Bore Gauge—Typical

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 38 MM
(1.5 in)

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the following components:

• Oil pan and gasket/windage tray (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

• Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

• Timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

• Cylinder head(s) (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) If necessary, remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

CAUTION: DO NOT use a number stamp or a punch to mark connecting rods or caps, as damage to connecting rods could occur

NOTE: Connecting rods and bearing caps are not interchangeable and should be marked before removing to ensure correct reassembly.

(4) Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool (Fig. 74).

CAUTION: Care must be taken not to damage the fractured rod and cap joint face surfaces, as engine damage may occur.

PISTON & CONNECTING ROD (Continued)

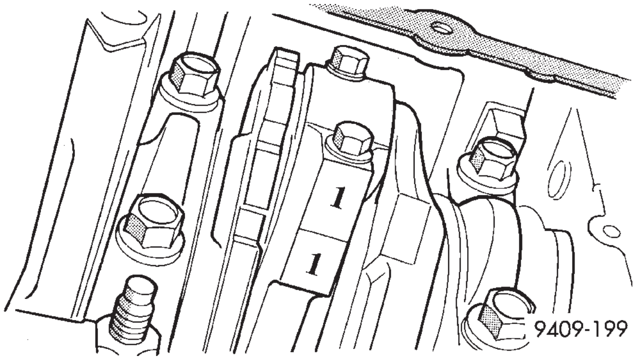


Fig. 74 Identify Connecting Rod to Cylinder Position—Typical

(5) Remove connecting rod cap. Install Special Tool 8507 Connecting Rod Guides into the connecting rod being removed. Remove piston from cylinder bore. Repeat this procedure for each piston being removed.

CAUTION: Care must be taken not to nick crankshaft journals, as engine damage may occur

(6) Immediately after piston and connecting rod removal, install bearing cap on the mating connecting rod to prevent damage to the fractured cap and rod surfaces.

(7) Carefully remove piston rings from piston(s), starting from the top ring down.

CLEANING

CAUTION: DO NOT use a wire wheel or other abrasive cleaning devise to clean the pistons or connecting rods. The pistons have a Moly coating, this coating must not be damaged.

(1) Using a suitable cleaning solvent clean the pistons in warm water and towel dry.

(2) Use a wood or plastic scraper to clean the ring land grooves.

CAUTION: DO NOT remove the piston pin from the piston and connecting rod assembly.

INSPECTION

Check the connecting rod journal for excessive wear, taper and scoring (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

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 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

INSTALLATION

(1) Before installing piston and connecting rod assemblies into the bore, install the piston rings.

(2) Immerse the piston head and rings in clean engine oil. Position a ring compressor over the piston and rings. Tighten ring compressor. **Ensure position of rings do not change during this operation.**

(3) Position bearing onto connecting rod. Ensure that hole in bearing shell aligns with hole in connecting rod. Lubricate bearing surface with clean engine oil.

(4) Install Special Tool 8507 Connecting Rod Guides into connecting rod bolt threads (Fig. 75).

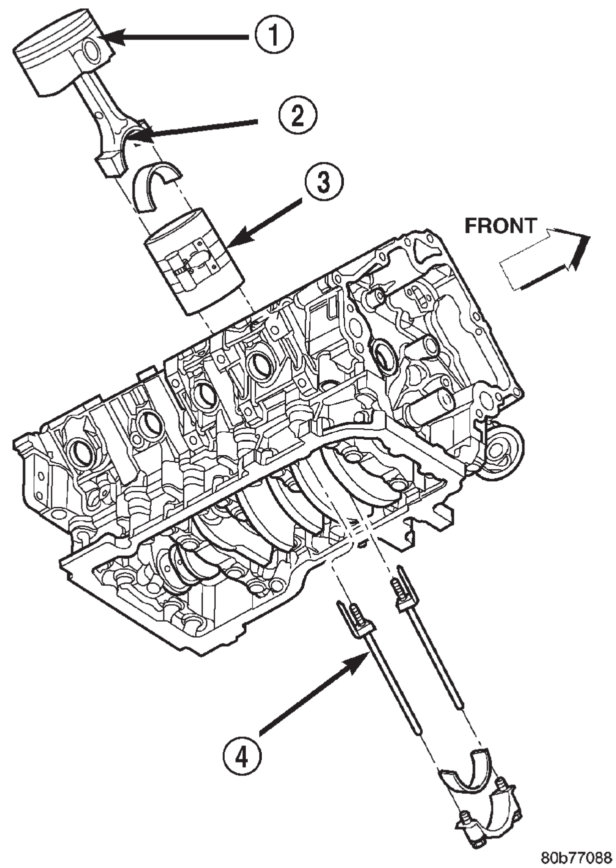


Fig. 75 Piston and Connecting Rod—Installation

1 - “F” TOWARD FRONT OF ENGINE
2 - OIL SLINGER SLOT
3 - RING COMPRESSOR
4 - SPECIAL TOOL 8507

(5) The pistons are marked on the piston pin bore surface with an raised “F” indicating installation position. This mark must be pointing toward the front of engine on both cylinder banks. The connect-

PISTON & CONNECTING ROD (Continued)

ing rod oil slinger slot faces the front of the engine (Fig. 76).

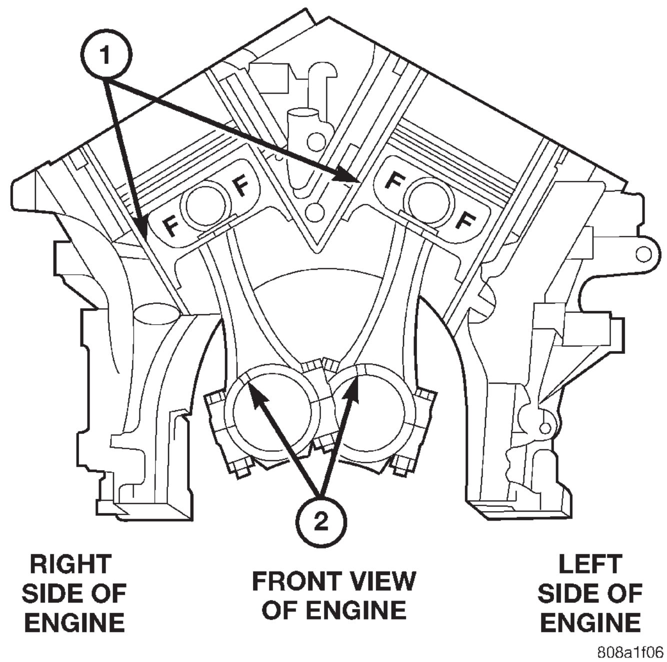


Fig. 76 Piston and Connecting Rod Orientation

1 - MAJOR THRUST SIDE OF PISTON
2 - OIL SLINGER SLOT

(6) Wipe cylinder bore clean and lubricate with engine oil.

(7) Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and piston into cylinder bore and carefully position connecting rod guides over crankshaft journal.

(8) Tap piston down in cylinder bore using a hammer handle. While at the same time, guide connecting rod into position on rod journal.

CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.

(9) Lubricate rod bolts and bearing surfaces with engine oil. Install connecting rod cap and bearing. Tighten bolts to 27 N·m (20 ft. lbs.) plus 90°.

(10) Install the following components:

- Cylinder head(s). (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).
- Timing chain and cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
- Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
- Oil pan and gasket/windage tray. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(11) Fill crankcase with proper engine oil to correct level.

(12) Connect negative cable to battery.

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

Before reinstalling used rings or installing new rings, the ring clearances must be checked.

(1) Wipe the cylinder bore clean.

(2) Insert the ring in the cylinder bore.

NOTE: The ring gap measurement must be made with the ring positioned at least 12mm (0.50 inch.) from bottom of cylinder bore.

(3) Using a piston, to ensure that the ring is squared in the cylinder bore, slide the ring downward into the cylinder.

(4) Using a feeler gauge check the ring end gap (Fig. 77). Replace any rings not within specification.

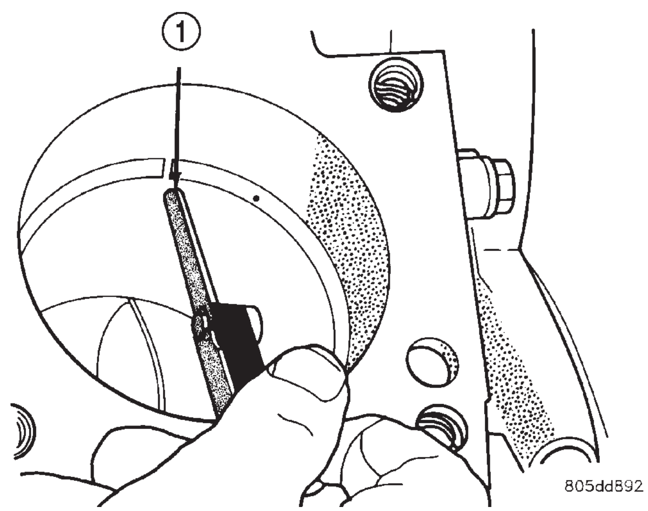


Fig. 77 Ring End Gap Measurement - Typical

1 - FEELER GAUGE

PISTON RING SIDE CLEARANCE

NOTE: Make sure the piston ring grooves are clean and free of nicks and burrs.

(5) Measure the ring side clearance as shown (Fig. 78)make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.

PISTON RINGS (Continued)

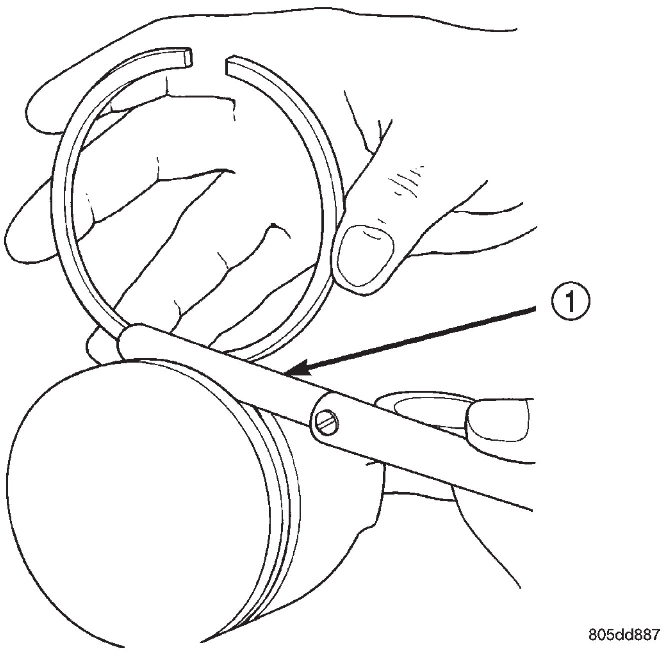


Fig. 78 Measuring Piston Ring Side Clearance

1 - FEELER GAUGE

(6) Rotate the ring around the piston, the ring must rotate in the groove with out binding.

PISTON RING SPECIFICATION CHART

Ring Position	Groove Clearance	Maximum Clearance
Upper Ring	.051-.094mm (0.0020- .0037 in.)	0.11mm (0.004 in.)
Intermediate Ring	0.04-0.08mm (0.0016-0.0031 in.)	0.10mm (0.004 in.)
Oil Control Ring (Steel Rails)	.019-.229mm (.0007-.0090 in.)	.25mm (0.010 in.)
Ring Position	**Ring Gap**	**Wear Limit**
Upper Ring	0.23-0.39mm (0.009-0.015 in.)	0.43mm (0.0017 in.)
Intermediate Ring	0.40-0.66mm (0.015-0.026 in.)	0.74mm (0.029 in.)
Oil Control Ring (Steel Rail)	0.028-0.79mm (0.011- 0.031 in.)	1.55mm (0.061 in.)

(7) The No. 1 and No. 2 piston rings have a different cross section. Ensure No. 2 ring is installed with manufacturers I.D. mark (Dot) facing up, towards top of the piston.

NOTE: Piston rings are installed in the following order:

- Oil ring expander.
- Upper oil ring side rail.
- Lower oil ring side rail.
- No. 2 Intermediate piston ring.
- No. 1 Upper piston ring.

(8) Install the oil ring expander.

(9) Install upper side rail (Fig. 79) by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.

(10) Install No. 2 intermediate piston ring using a piston ring installer (Fig. 80).

(11) Install No. 1 upper piston ring using a piston ring installer (Fig. 80).

(12) Position piston ring end gaps as shown in (Fig. 81). It is important that expander ring gap is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.

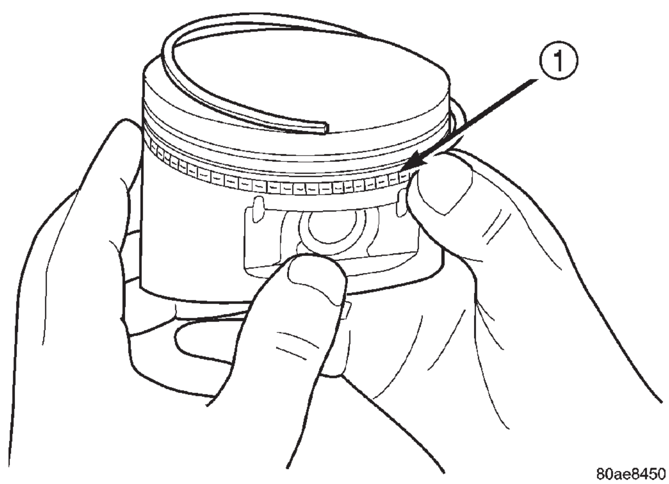


Fig. 79 Side Rail—Installation

1 - SIDE RAIL END

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(3) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

VIBRATION DAMPER (Continued)

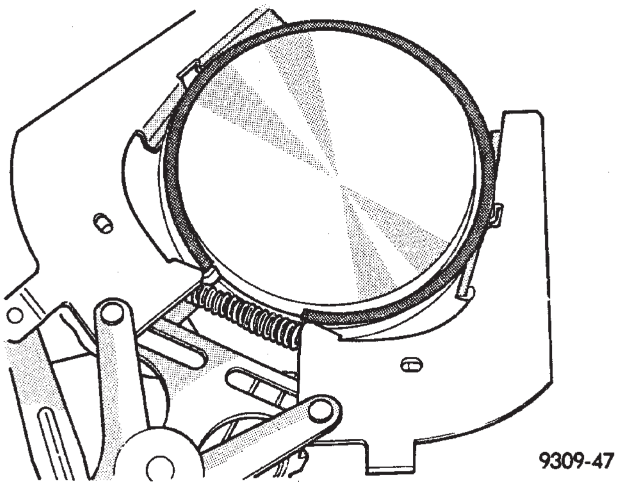


Fig. 80 Upper and Intermediate Rings—Installation

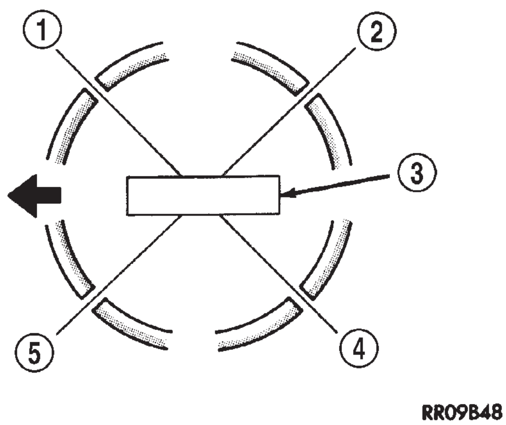


Fig. 81 Piston Ring End Gap Position

1 - SIDE RAIL UPPER
2 - NO. 1 RING GAP
3 - PISTON PIN
4 - SIDE RAIL LOWER
5 - NO. 2 RING GAP AND SPACER EXPANDER GAP

(4) Remove radiator upper hose.

(5) Remove upper fan shroud.

(6) Using Special Tools 6958 Spanner with Adapter Pins 8346, loosen fan and viscous assembly from water pump (Fig. 82).

(7) Remove fan and viscous assembly.

(8) Disconnect electrical connector for fan mounted inside radiator shroud.

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

(9) Remove crankshaft damper bolt.

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 83).

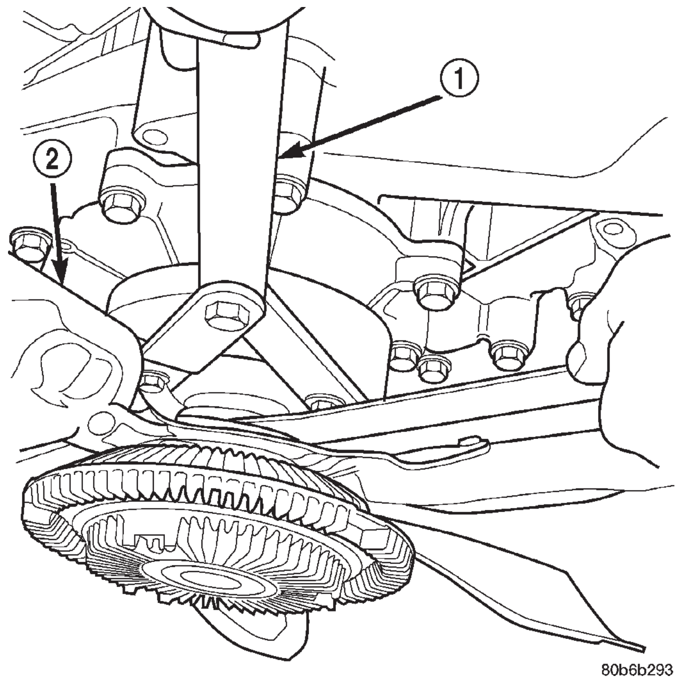


Fig. 82 Fan Assembly—Removal/Installation

1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 - FAN

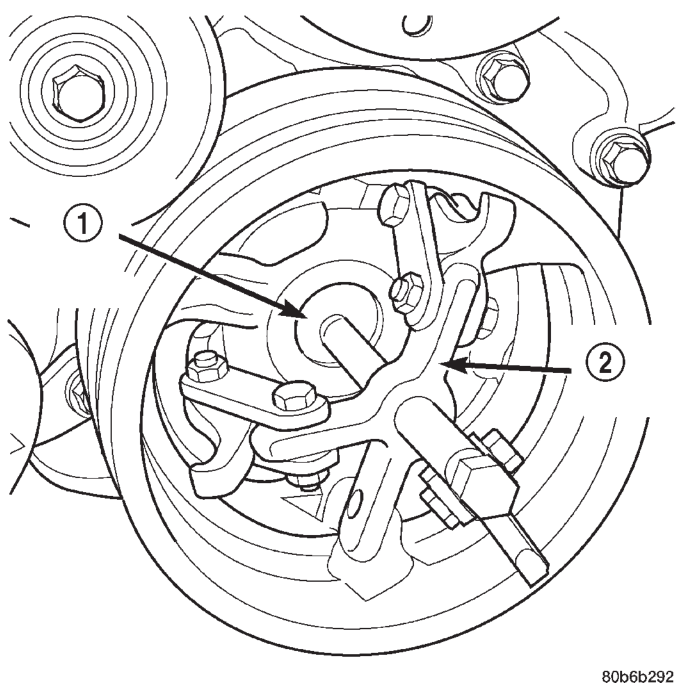


Fig. 83 Crankshaft Damper—Removal

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

VIBRATION DAMPER (Continued)

INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512–A, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(1) Align crankshaft damper slot with key in crankshaft. Slide damper onto crankshaft slightly.

CAUTION: Special Tool 8512–A, is assembled in a specific sequence. Failure to assemble this tool in this sequence can result in tool failure and severe damage to either the tool or the crankshaft.

(2) Assemble Special Tool 8512–A as follows, The nut is threaded onto the shaft first. Then the roller bearing is placed onto the threaded rod (The hardened bearing surface of the bearing **MUST**face the nut). Then the hardened washer slides onto the threaded rod (Fig. 84). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

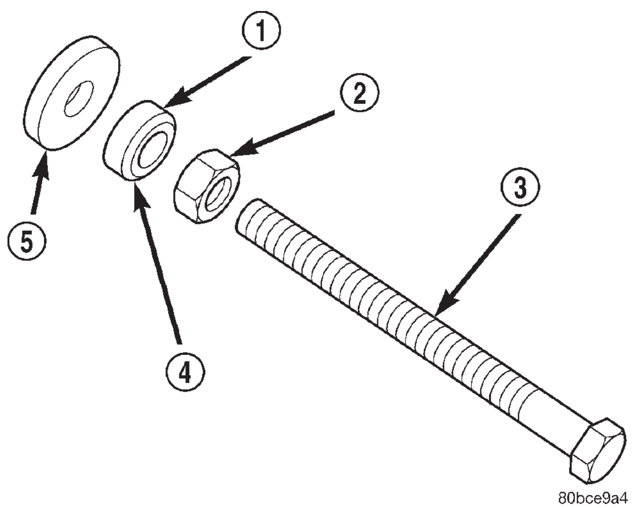


Fig. 84 Proper Assembly Method for Special Tool 8512–A

1 - BEARING
2 - NUT
3 - THREADED ROD
4 - BEARING HARDENED SURFACE (FACING NUT)
5 - HARDENED WASHER

(3) Using Special Tool 8512–A, press damper onto crankshaft (Fig. 85).

(4) Install then tighten crankshaft damper bolt to 175 N·m (130 ft. lbs.).

(5) Install fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(6) Install radiator upper shroud and tighten fasteners to 11 N·m (95 in. lbs.).

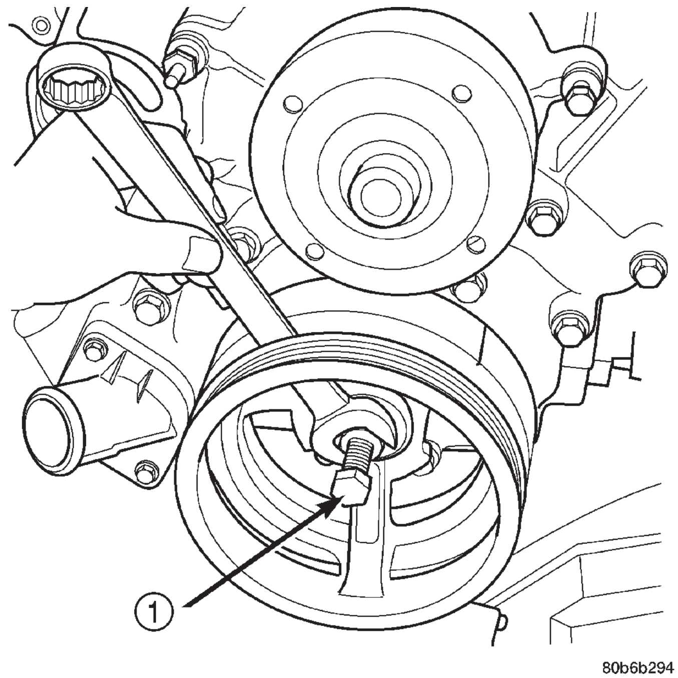


Fig. 85 Crankshaft Damper Installation

1 - SPECIAL TOOL 8512

(7) Connect electrical connector for shroud fan.

(8) Install radiator upper hose.

(9) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(10) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(11) Connect negative cable to battery.

STRUCTURAL COVER

DESCRIPTION

The structural dust cover is made of die cast aluminum and joins the lower half of the transmission bell housing to the engine bedplate.

OPERATION

The structural cover provides additional powertrain stiffness and reduces noise and vibration.

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove the left hand exhaust pipe from exhaust manifold.

(3) Loosen the right hand exhaust manifold-to-exhaust pipe retaining bolts.

(4) Remove the eight bolts retaining structural cover (Fig. 86) in the sequence shown.

(5) Pivot the exhaust pipe downward and remove the structural cover.

STRUCTURAL COVER (Continued)

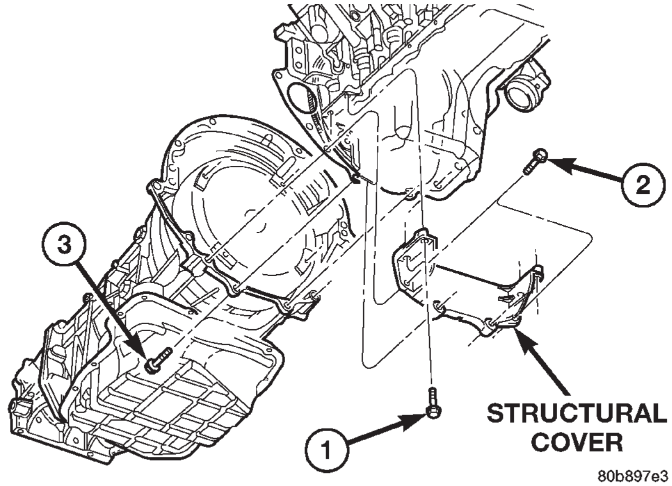


Fig. 86 Structural Cover

INSTALLATION

CAUTION: The structural cover must be installed as described in the following steps. Failure to do so will cause severe damage to the cover.

(1) Position the structural cover in the vehicle.

(2) Install all four bolts retaining the cover-to-engine. DO NOT tighten the bolts at this time.

(3) Install the four cover-to-transmission bolts. Do NOT tighten at this time.

CAUTION: The structural cover must be held tightly against both the engine and the transmission bell housing during tightening sequence. Failure to do so may cause damage to the cover.

(4) Starting with the two rear cover-to-engine bolts, tighten bolts (1) (Fig. 87) to 54 N·m (40 ft. lbs.), then tighten bolts (2) (Fig. 87) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.

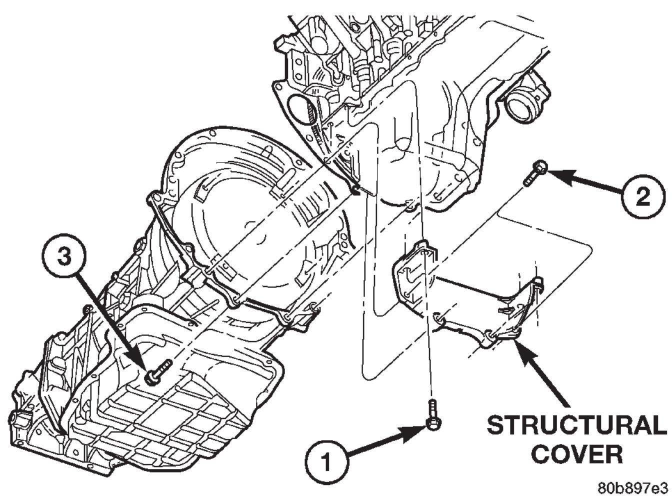


Fig. 87 Structural Cover

(5) Install the exhaust pipe on left hand exhaust manifold.

(6) Tighten exhaust manifold-to-exhaust pipe retaining bolts to 20–26 N·m (15–20 ft. lbs.).

FRONT MOUNT

REMOVAL

(1) Disconnect the negative cable from the battery.

CAUTION: Remove the fan blade, fan clutch and fan shroud before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.

(2) Remove the fan blade, fan clutch and fan shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(3) Remove the engine oil filter.

(4) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.

(5) Remove the four (4) cylinder block-to-insulator mount bolts and the nut from the engine insulator mount through bolt (4x2 Vehicles only) (Fig. 88) (Fig. 89).

(6) Remove the three (3) cylinder block-to-insulator mount bolts and loosen the nut from the engine insulator mount through bolt (4x4 Vehicles only) (Fig. 90) (Fig. 91).

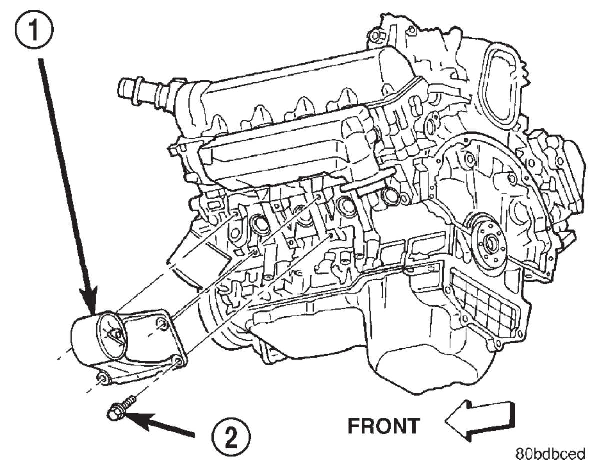


Fig. 88 Engine Insulator Mount 4x2 Vehicle—Left Side

1 - ENGINE INSULATOR MOUNT-LEFT SIDE
2 - MOUNTING BOLT

FRONT MOUNT (Continued)

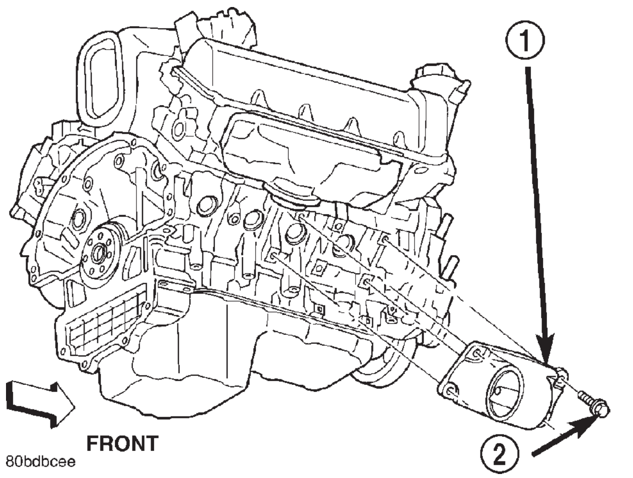


Fig. 89 Engine Insulator Mount 4x2 Vehicle—Right Side

1 - ENGINE INSULATOR MOUNT-RIGHT SIDE
2 - MOUNTING BOLT

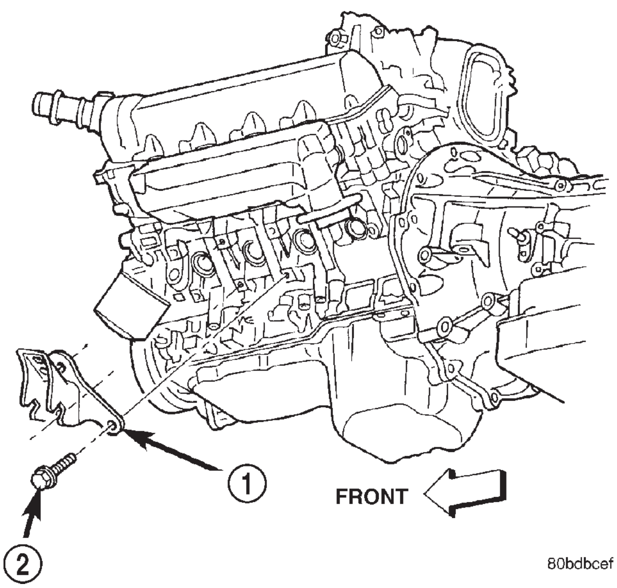


Fig. 90 Engine Insulator Mount 4x4 Vehicle—Left Side

1 - ENGINE INSULATOR MOUNT-LEFT SIDE
2 - MOUNTING BOLT

(7) Using the jack, raise the engine high enough to remove the engine insulator mount through bolt and the insulator mount.

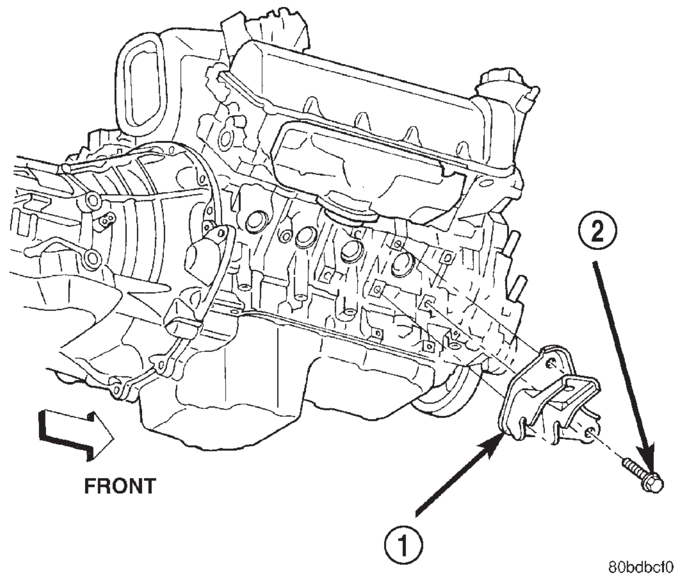


Fig. 91 Engine Insulator Mount 4x4 Vehicle—Right Side

1 - ENGINE INSULATOR MOUNT-RIGHT SIDE
2 - MOUNTING BOLT

INSTALLATION

(1) Position the insulator mount and install the insulator mount through bolt.

(2) Lower the engine until the four cylinder block-to-insulator mount bolts can be installed.

(3) Remove the jack and block of wood.

(4) Torque the cylinder block-to-insulator mount bolts to 61N·m (45 ft. lbs.).

(5) Install and torque the through bolt retaining nut to 61N·m (45 ft. lbs.).

(6) Install the fan blade, fan clutch and fan shroud.

REAR MOUNT

REMOVAL

(1) Raise vehicle on hoist.

(2) Using a suitable jack, support transmission.

(3) Remove the nut from the insulator mount through bolt (Manual transmission and 4x2 automatic transmission only) (Fig. 92) (Fig. 93).

(4) Remove the four bolts and washers retaining the mount to the transmission (4x4 automatic transmission only) (Fig. 94).

(5) Raise the transmission enough to remove the through bolt (Manual transmission and 4x2 automatic transmission only) (Fig. 92) (Fig. 93).

(6) Raise the transmission and remove the bolts retaining the mount to the crossmember (4x4 automatic transmission only) (Fig. 94).

REAR MOUNT (Continued)

(7) Remove the two nuts retaining the isolator to the crossmember (Manual transmission and 4x2 automatic transmission only) (Fig. 92) (Fig. 93).

(8) Remove the bolts (two bolts manual transmission)(three bolts 4x2 automatic transmission) retaining the insulator bracket to the transmission.

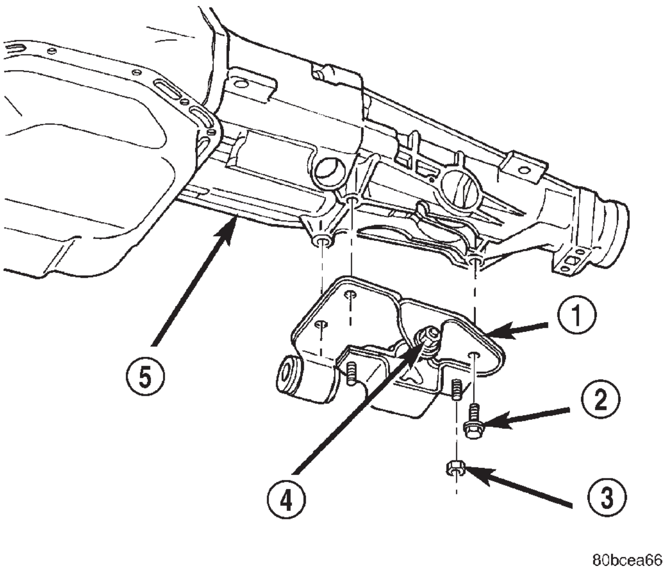


Fig. 92 Engine Rear Mount—4X2 Automatic Transmission

1 - ENGINE REAR MOUNT
2 - BOLT
3 - NUT
4 - THROUGH BOLT NUT
5 - TRANSMISSION

INSTALLATION

(1) Follow the removal procedure in the reverse order.

(2) Tighten the through bolt retaining nut to 101 N·m (75 ft. lbs.).

(3) Tighten the isolator bracket to transmission retaining bolts (Manual transmission and 4x2 automatic transmission only) to 68 N·m (50 ft. lbs.).

(4) Tighten the mount bracket to transmission retaining bolts (4x4 automatic transmission only) to 68 N·m (50 ft. lbs.).

(5) Tighten the isolator mount to crossmember retaining nuts (Manual transmission and 4x2 automatic transmission only) to 41 N·m (30 ft. lbs.).

(6) Tighten the mount bracket to crossmember retaining bolts (4x4 automatic transmission only) to 28 N·m (250 in. lbs.).

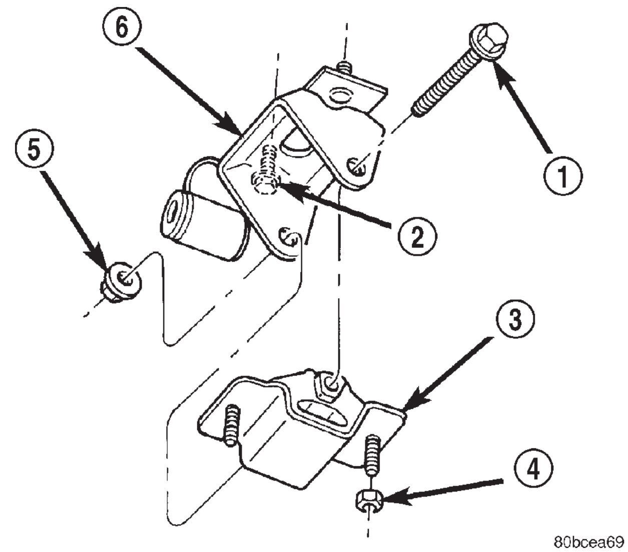


Fig. 93 Engine Rear Mount—4X2 and 4X4 Manual Transmission

1 - THROUGH BOLT
2 - BOLT
3 - INSULATOR SUPPORT
4 - NUT
5 - NUT AND WASHER
6 - INSULATOR BRACKET TO TRANSMISSION

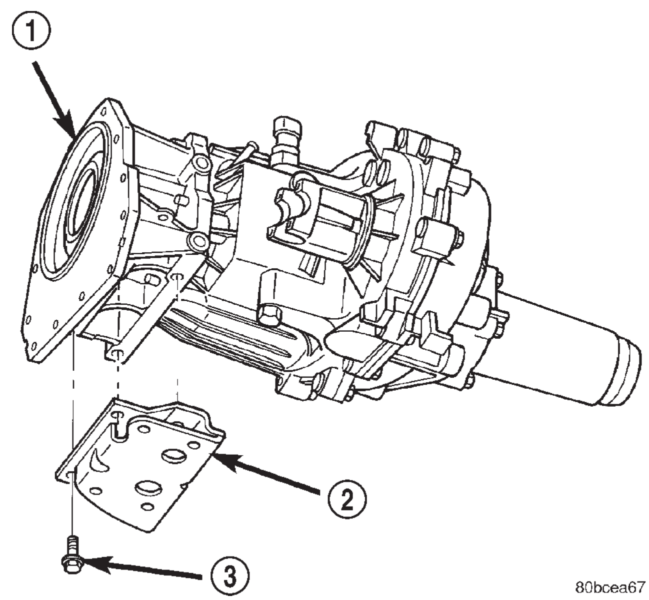


Fig. 94 Engine Rear Mount—4X4 Automatic Transmission

1 - TRANSMISSION
2 - ENGINE REAR MOUNT
3 - BOLT

LUBRICATION

DESCRIPTION

The lubrication system (Fig. 95) is a full flow filtration pressure feed type.

OPERATION

Oil from the oil pan is pumped by a gerotor type oil pump directly mounted to the crankshaft nose. Oil pressure is controlled by a relief valve mounted inside the oil pump housing. For lubrication flow refer to (Fig. 95).

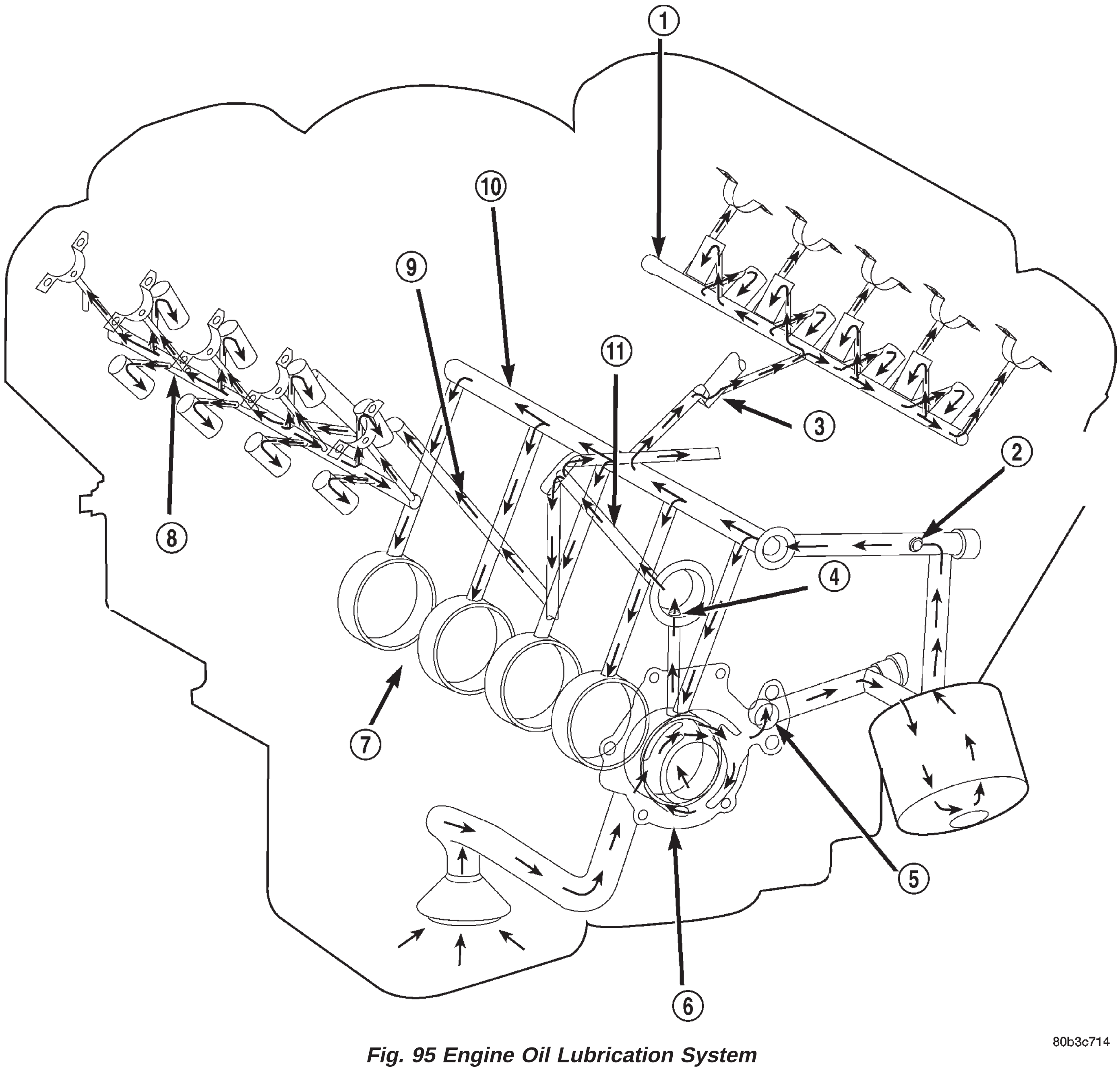


Fig. 95 Engine Oil Lubrication System

1 - LEFT CYLINDER HEAD OIL GALLERY
2 - OIL PRESSURE SENSOR LOCATION
3 - TO LEFT CYLINDER HEAD
4 - OIL FEED TO IDLER SHAFT
5 - OIL PUMP OUTLET TO BLOCK
6 - OIL PUMP
7 - TO CRANKSHAFT MAIN JOURNALS
8 - RIGHT CYLINDER HEAD OIL GALLERY
9 - TO RIGHT CYLINDER HEAD
10 - CYLINDER BLOCK MAIN GALLERY
11 - OIL FEED TO BOTH SECONDARY TENSIONERS

LUBRICATION (Continued)

The camshaft exhaust valve lobes and rocker arms are lubricated through a small hole in the rocker arm; oil flows through the lash adjuster then through the rocker arm and onto the camshaft lobe. Due to the orentation of the rocker arm, the camshaft intake lobes are not lubed in the same manner as the exhaust lobes. The intake lobes are lubed through internal passages in the camshaft. Oil flows through a bore in the number 3 camshaft bearing bore, and as the camshaft turns, a hole in the camshaft aligns with the hole in the camshaft bore allowing engine oil to enter the camshaft tube. The oil then exits through 1.6mm (0.063 in.) holes drilled into the intake lobes, lubricating the lobes and the rocker arms.

ENGINE LUBRICATION FLOW CHART—BLOCK: TABLE 1

FROM	TO
Oil Pickup Tube	Oil Pump
Oil Pump	Oil Filter
Oil Filter	Block Main Oil Gallery
Block Main Oil Gallery	1. Crankshaft Main Journal 2. Left Cylinder Head* 3. Right Cylinder Head*
Crankshaft Main Journals	Crankshaft Rod Journals
Crankshaft Number One Main Journal	1.Front Timing Chain Idler Shaft 2.Both Secondary Chain Tensioners
Left Cylinder Head	See Table 2
Right Cylinder Head	See Table 2
* The cylinder head gaskets have an oil restricter to control oil flow to the cylinder heads.	

ENGINE LUBRICATION FLOW CHART—CYLINDER HEADS: TABLE 2

FROM	TO
Cylinder Head Oil Port (in bolt hole)	Diagonal Cross Drilling to Main Oil Gallery
Main Oil Gallery (drilled through head from rear to front)	1. Base of Camshaft Towers 2. Lash Adjuster Towers
Base of Camshaft Towers	Vertical Drilling Through Tower to Camshaft Bearings**
Lash Adjuster Towers	Diagonal Drillings to Hydraulic Lash Adjuster Pockets
** The number three camshaft bearing journal feeds oil into the hollow camshaft tubes. Oil is routed to the intake lobes, which have oil passages drilled into them to lubricate the rocker arms.	

DIAGNOSIS AND TESTING—ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit (Fig. 96)and install gauge assembly C-3292.

(2) Run engine until thermostat opens.

(3) Oil Pressure:

- Curb Idle—25 Kpa (4 psi) minimum
- 3000 rpm—170 - 550 KPa (25 - 80 psi)

(4) If oil pressure is 0 at idle, shut off engine. Check for a clogged oil pick-up screen or a pressure relief valve stuck open.

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.

LUBRICATION (Continued)

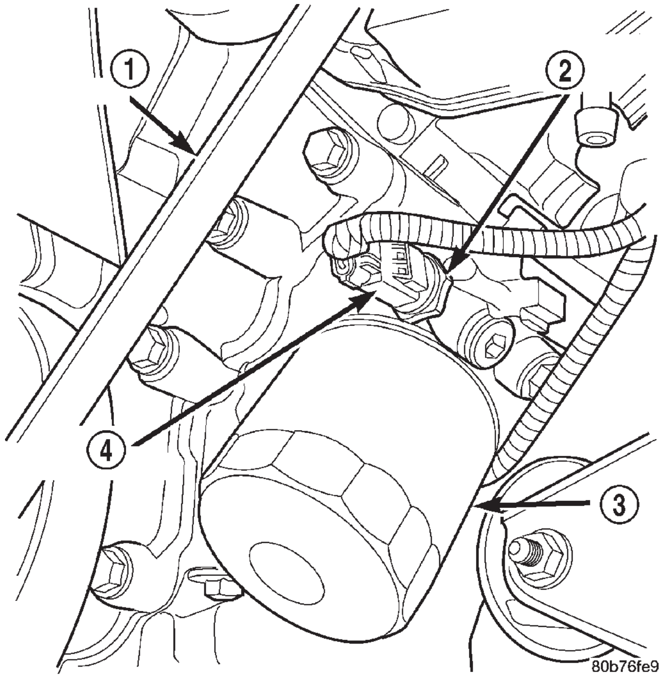


Fig. 96 Oil Pressure Sending Unit

1 - BELT
2 - OIL PRESSURE SENSOR
3 - OIL FILTER
4 - ELEC. CONNECTOR

(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 PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(3) Attach an air hose with pressure gauge and regulator to the dipstick tube.

CAUTION: Do not subject the engine assembly to more than 20.6 kpa (3 PSI) of test pressure.

(4) Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

(5) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(6) If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve and breather cap hose.

(7) Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

INSPECTION FOR REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

(a) Circular spray pattern generally indicates seal leakage or crankshaft damage.

(b) Where leakage tends to run straight down, possible causes are a porous block, distributor seal, camshaft bore cup plugs oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces.

(4) If no leaks are detected, pressurize the crankcase as outlined in the, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

(5) If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks and scratches. The crankshaft seal flange is especially machined to complement the function of the rear oil seal.

(6) For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled.

OIL

STANDARD PROCEDURE—ENGINE OIL SERVICE

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

ENGINE OIL SPECIFICATION

CAUTION: Do not use non-detergent or straight mineral oil when adding or changing crankcase lubricant. Engine failure can result.

API SERVICE GRADE CERTIFIED

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 in the 4.7L engines. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 97).

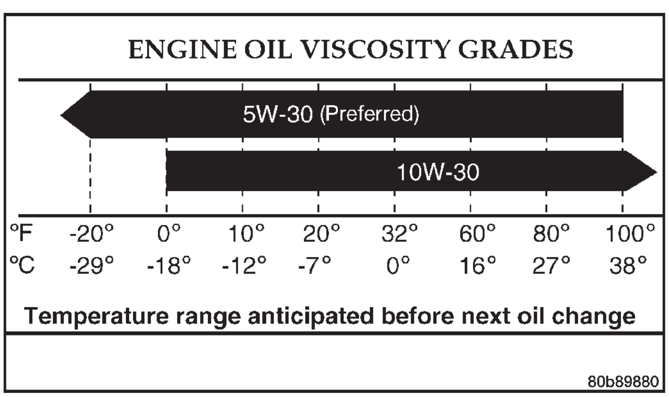


Fig. 97 Temperature/Engine Oil Viscosity—4.7L Engine

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. 98).

Fig. 98 Engine Oil Container Standard Notations

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right rear of the engine on the 4.7L engines. (Fig. 99).

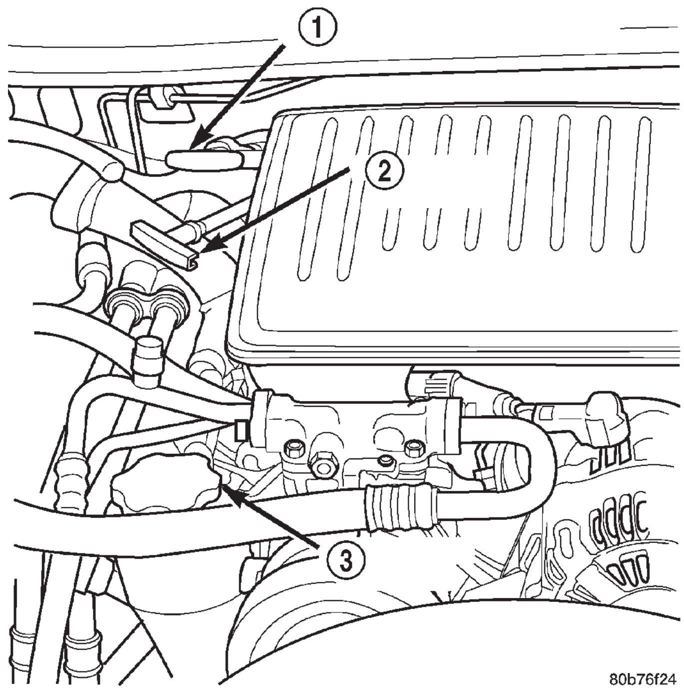


Fig. 99 Engine Oil Dipstick 4.7L Engine

1 - TRANSMISSION DIPSTICK
2 - ENGINE OIL DIPSTICK
3 - ENGINE OIL FILL CAP

OIL (Continued)

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, pressure loss or oil foaming can result.

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.

(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.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules.

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.

(6) Install drain plug in crankcase.

(7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(8) Install oil fill cap.

(9) Start engine and inspect for leaks.

(10) Stop engine and inspect oil level.

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING at beginning of this section.

OIL FILTER

REMOVAL

All engines are equipped with a high quality full-flow, disposable 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 (Fig. 100)to remove it from the cylinder block oil filter boss.

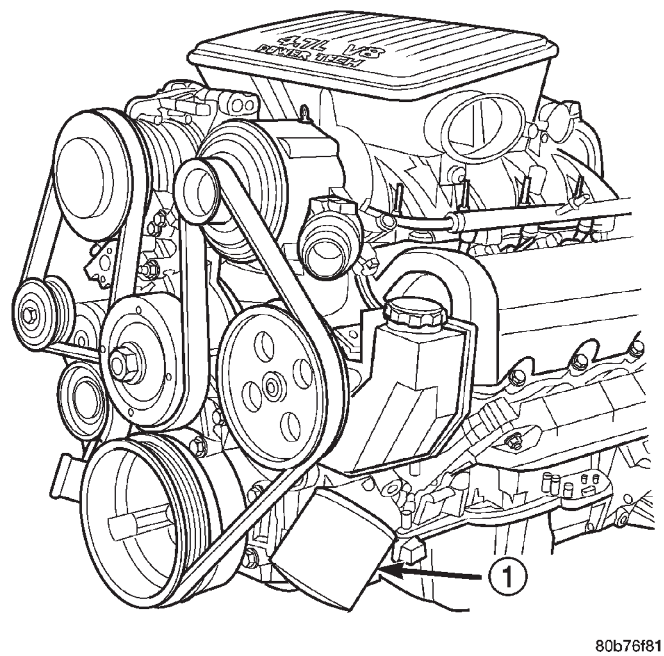


Fig. 100 Oil Filter - 4.7L Engine

1 - ENGINE OIL FILTER

(4) When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

NOTE: Make sure filter gasket was removed with filter.

(5) With a wiping cloth, clean the gasket sealing surface of oil and grime.

INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil.

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 101)hand tighten filter one full turn, do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

OIL FILTER (Continued)

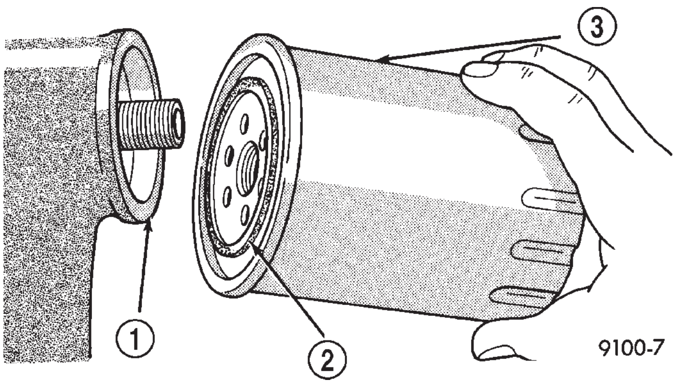


Fig. 101 Oil Filter Sealing Surface—Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

OIL PAN

REMOVAL—4X2

(1) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(2) Remove the upper fan shroud.

(3) Remove the throttle body resonator and air inlet hose.

(4) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(5) Raise vehicle on hoist.

(6) Disconnect exhaust pipe at exhaust manifolds.

(7) Remove the structural dust cover (Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - REMOVAL) (Fig. 102) using sequence shown.

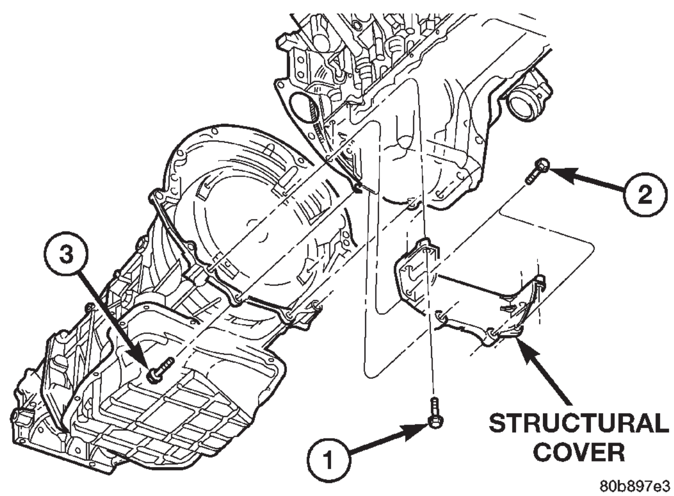


Fig. 102 Structural Dust Cover Removal / Installation

(8) Drain engine oil and remove oil filter.

(9) Position suitable jack under engine.

(10) Remove both left and right side engine mount through bolts (Fig. 103).

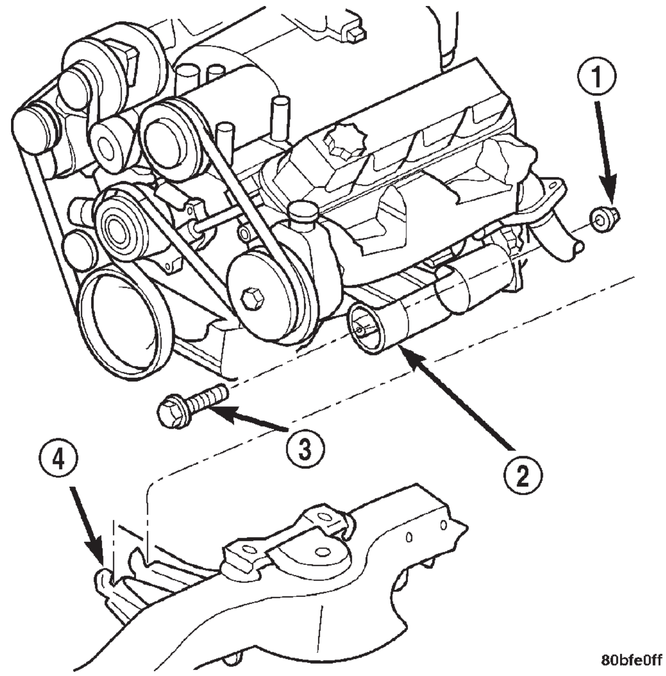


Fig. 103 Engine Mount Through Bolt and Nut Removal / Installation

1 - LOCKNUT AND WASHER
2 - ENGINE MOUNT/INSULATOR
3 - THROUGH BOLT
4 - FRAME

(11) Raise engine to provide clearance to remove oil pan.

(12) Place blocks of wood between engine brackets and lower mounts to provide stability to engine.

NOTE: Do not pry on oil pan or oil pan gasket. Gasket is mounted to engine and does not come out with oil pan.

(13) Remove the oil pan mounting bolts and oil pan (Fig. 104).

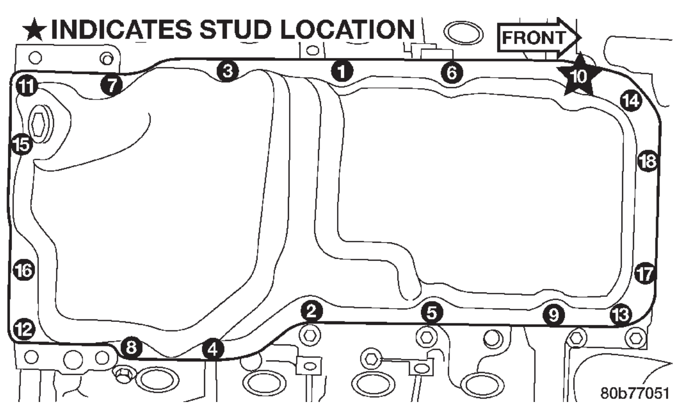


Fig. 104 Oil Pan Mounting Bolts and Oil Pan

OIL PAN (Continued)

(14) Unbolt oil pump pickup tube and remove tube and oil pan gasket from engine.

REMOVAL—4X4

NOTE: 4X4 vehicles equipped with a 4.7L engine must have the front axle removed before the oil pan can be removed.

(1) Remove the front axle from vehicle. Refer to DIFFERENTIAL AND DRIVELINE.

(2) Remove the structural dust cover (Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - REMOVAL) (Fig. 105) using sequence shown.

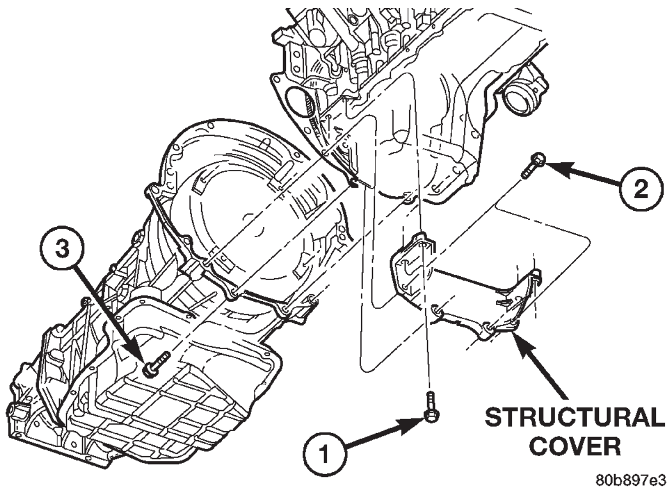


Fig. 105 Structural Dust Cover Removal

(3) Drain the engine oil and remove oil filter.

NOTE: Do not pry on oil pan or oil pan gasket. Gasket is mounted to engine and does not come out with oil pan.

(4) Remove the oil pan mounting bolts and oil pan (Fig. 106).

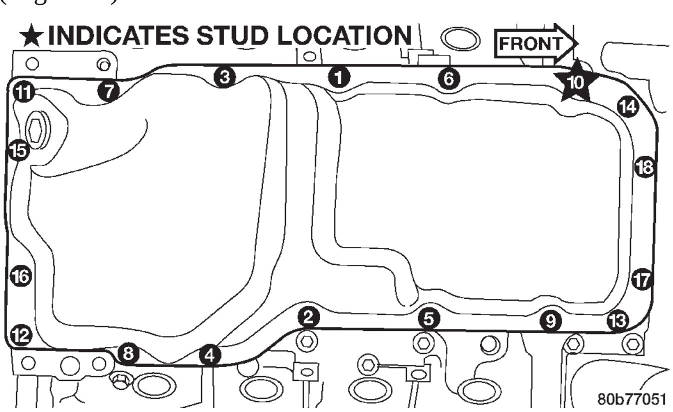


Fig. 106 Oil Pan Mounting Bolts and Oil Pan

(5) Unbolt oil pump pickup tube and remove tube and oil pan gasket from engine.

INSTALLATION—4X2

(1) Clean the oil pan gasket mating surface of the bedplate and oil pan.

(2) Position the oil pan gasket and pickup tube with new o-ring. Install the mounting bolt and nuts. Tighten bolt and nuts to 28 N·m (20 ft. lbs.).

(3) Position the oil pan and install the mounting bolts. Tighten the mounting bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 104).

(4) Raise the engine and remove the blocks of wood.

(5) Lower engine and install both the left and right side engine mount through bolts (Fig. 103). Tighten the nuts to 68 N·m (50 ft. lbs.).

(6) Remove jack and install oil filter.

(7) Install structural dust cover (Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - INSTALLATION).

(8) Install exhaust pipe onto exhaust manifolds.

(9) Lower vehicle.

(10) Install intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(11) Install throttle body resonator and air inlet hose.

(12) Install upper fan shroud.

(13) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(14) Fill engine oil.

(15) Start engine and check for leaks.

INSTALLATION—4X4

(1) Clean the oil pan gasket mating surface of the bedplate and oil pan.

(2) Position the oil pan gasket and pickup tube with new o-ring. Install the mounting bolt and nuts. Tighten bolt and nuts to 28 N·m (20 ft. lbs.).

(3) Position the oil pan and install the mounting bolts. Tighten the mounting bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 106).

(4) Install structural dust cover (Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - INSTALLATION).

(5) Install oil filter.

(6) Install front axle. Refer to DIFFERENTIAL AND DRIVELINE.

(7) Lower vehicle.

(8) Fill engine oil.

(9) Start engine check for leaks.

OIL PRESSURE SENSOR/ SWITCH

DESCRIPTION

The 2–wire, electrical/mechanical engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

OPERATION

The oil pressure sensor uses two circuits. They are:

- A signal to the PCM relating to engine oil pressure
- A sensor ground through the PCM's sensor return

The oil pressure 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 a CCD bus circuit 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.

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise vehicle on hoist.
(3) Remove front splash shield.
(4) Disconnect oil pressure sender wire (Fig. 107).
(5) Remove the pressure sender (Fig. 107).

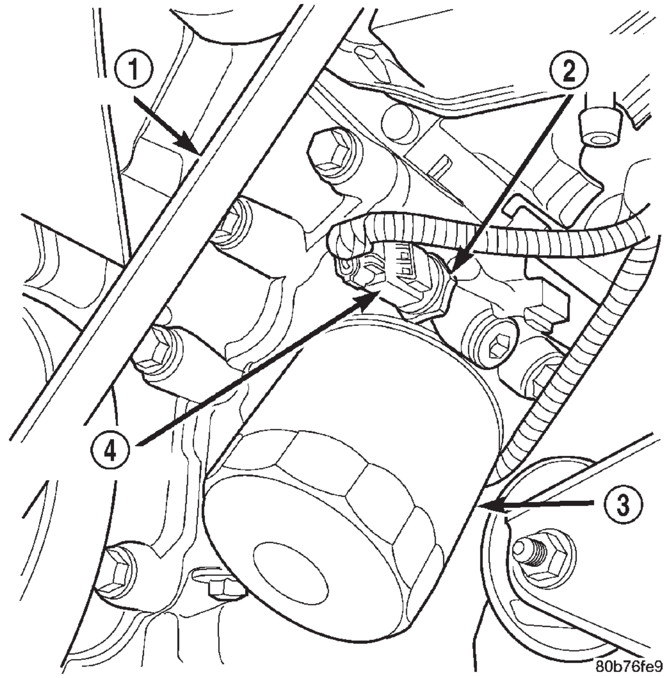


Fig. 107 Oil Pressure Sending Unit

1 - BELT
2 - OIL PRESSURE SENSOR
3 - OIL FILTER
4 - ELEC. CONNECTOR

INSTALLATION

(1) Install oil pressure sender.
(2) Connect oil pressure sender wire.
(3) Install front splash shield.
(4) Lower vehicle.
(5) Connect the negative battery cable.

OIL PUMP

REMOVAL

(1) Remove the oil pan and pick-up tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
(2) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(3) Remove the timing chains and tensioners (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
(4) Remove the four bolts, primary timing chain tensioner and the oil pump.

DISASSEMBLY

(1) Remove oil pump cover screws and lift off cover plate.
(2) Remove pump inner and outer rotors.

NOTE: Once the oil pressure relief valve, cup plug, and pin are removed, the pump assembly must be replaced.

(3) If it is necessary to remove the pressure relief valve, drive the roll pin from pump housing and remove cup plug, spring and valve.

CLEANING

(1) Wash all parts in a suitable solvent.

INSPECTION

CAUTION: Oil pump pressure relief valve and spring should not be removed from the oil pump. If the these components are disassembled andør removed from the pump the entire oil pump assembly must be replaced.

(1) Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. If the pump cover is scratched or grooved the oil pump assembly should be replaced.
(2) Lay a straight edge across the pump cover surface (Fig. 108). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between the cover and the straight edge the oil pump assembly should be replaced.
(3) Measure the thickness of the outer rotor (Fig. 109). If the outer rotor thickness measures at 12.005

OIL PUMP (Continued)

mm (0.4727 in.) or less the oil pump assembly must be replaced.

(4) Measure the diameter of the outer rotor. If the outer rotor diameter measures at 85.925 mm (3.3829 in.) or less the oil pump assembly must be replaced.

(5) Measure the thickness of the inner rotor (Fig. 110). If the inner rotor thickness measures at 12.005 mm (0.4727 in.) or less then the oil pump assembly must be replaced.

(6) Slide outer rotor into the body of the oil pump. Press the outer rotor to one side of the oil pump body and measure clearance between the outer rotor and the body (Fig. 111). If the measurement is 0.235mm (0.009 in.) or more the oil pump assembly must be replaced.

(7) Install the inner rotor in the into the oil pump body. Measure the clearance between the inner and outer rotors (Fig. 112). If the clearance between the rotors is .150 mm (0.006 in.) or more the oil pump assembly must be replaced.

(8) Place a straight edge across the body of the oil pump (between the bolt holes), if a feeler gauge of .095 mm (0.0038 in.) or greater can be inserted between the straightedge and the rotors, the pump must be replaced (Fig. 113).

NOTE: 4.7 Oil pump is released as an assembly. There are no DaimlerChrysler part numbers for Sub-Assembly components. In the event the oil pump is not functioning or out of specification it must be replaced as an assembly.

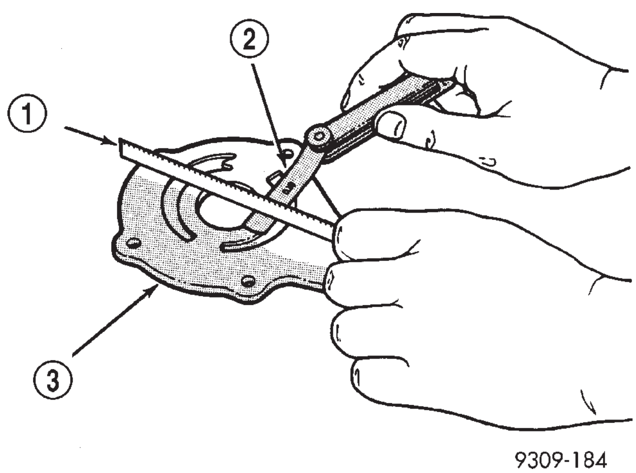


Fig. 108 Checking Oil Pump Cover Flatness

1 - STRAIGHT EDGE
2 - FEELER GAUGE
3 - OIL PUMP COVER

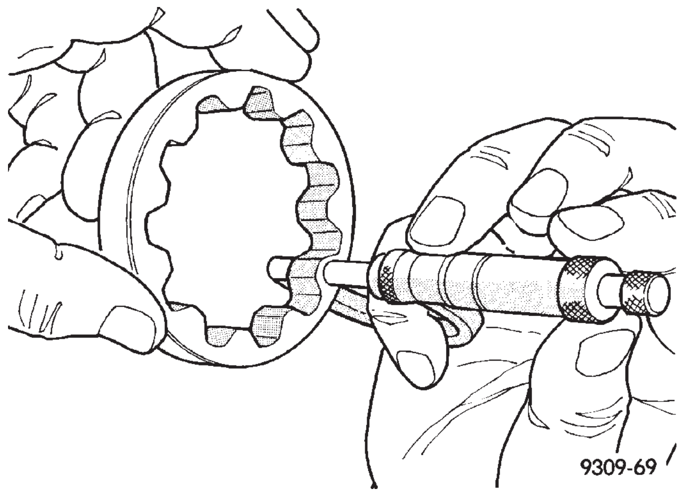


Fig. 109 Measuring Outer Rotor Thickness

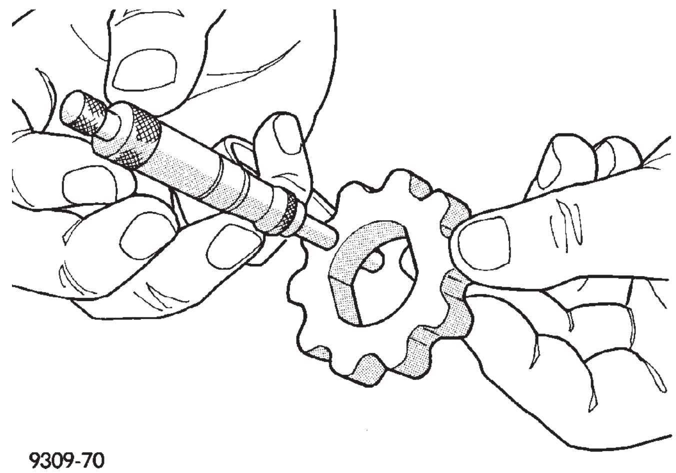


Fig. 110 Measuring Inner Rotor Thickness

ASSEMBLY

(1) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

(2) Install inner and outer rotors

(3) Install oil pump cover plate and install cover bolts and tighten them to 12 N·m (105 in. lbs.).

(4) Prime oil pump before installation by filling rotor cavity with engine oil.

(5) If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other causes for oil pressure loss.

OIL PUMP (Continued)

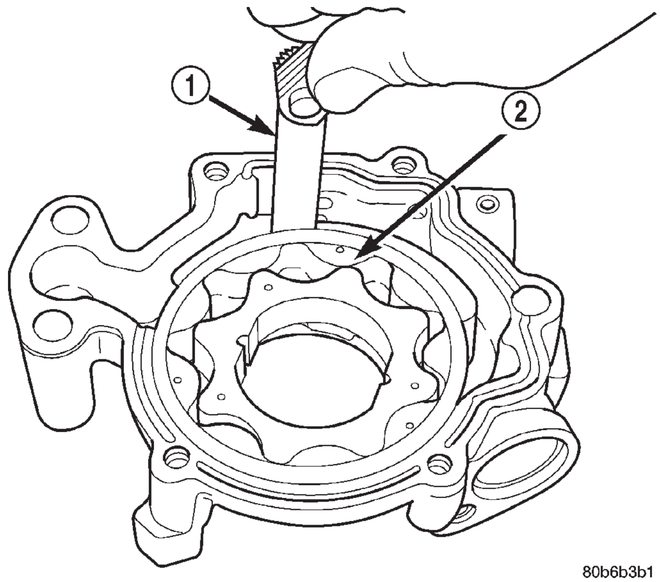


Fig. 111 Measuring Outer Rotor Clearance in

1 - FEELER GAUGE
2 - OUTER ROTOR

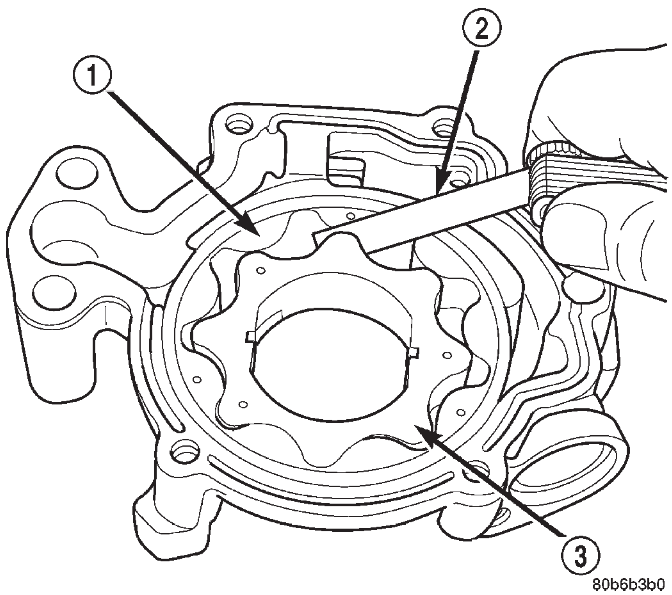


Fig. 112 Measuring Clearance Between Rotors

1 - OUTER ROTOR
2 - FEELER GAUGE
3 - INNER ROTOR

INSTALLATION

(1) Position the oil pump onto the crankshaft and install two oil pump retaining bolts.

(2) Position the primary timing chain tensioner and install the two retaining bolts.

(3) Tighten the oil pump and primary timing chain tensioner retaining bolts to 28 N·m (250 in. lbs.) in the sequence shown (Fig. 114).

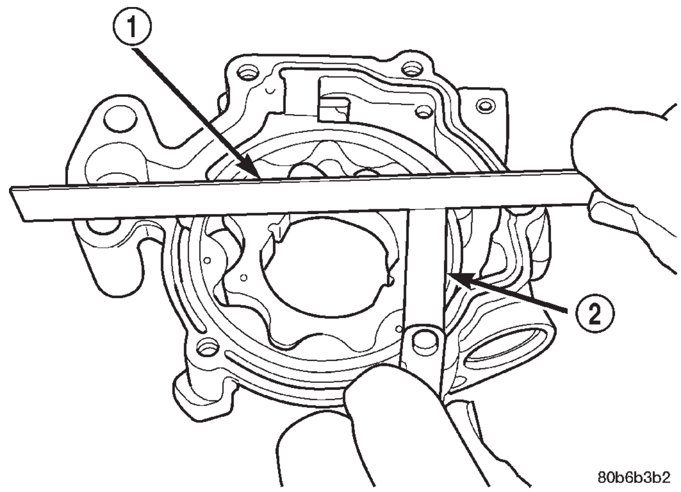


Fig. 113 Measuring Clearance Over Rotors

1 - STRAIGHT EDGE
2 - FEELER GAUGE

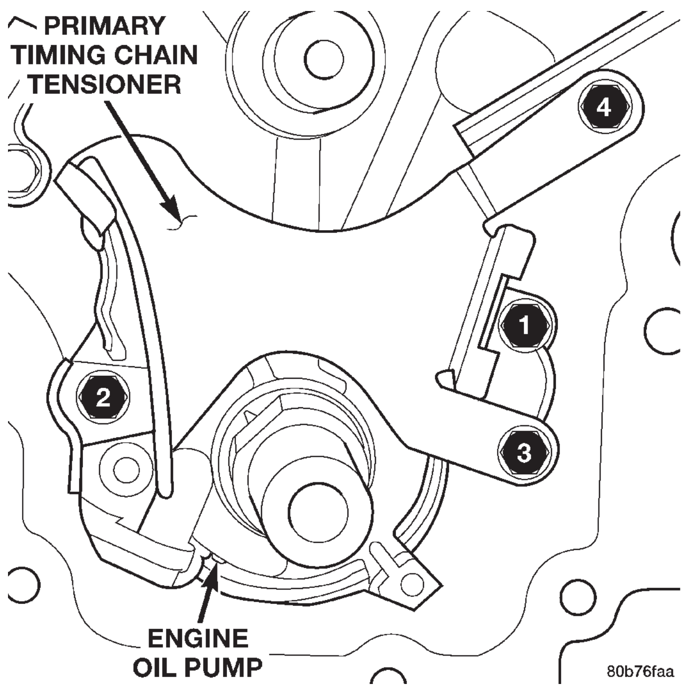


Fig. 114 Oil Pump and Primary Timing Chain Tightening Sequence

(4) Install the secondary timing chain tensioners and timing chains (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(5) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(6) Install the pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

INTAKE MANIFOLD

DESCRIPTION

The intake manifold is made of a composite material and features long runners which maximizes low end torque. The intake manifold uses single plane sealing which consist of eight individual press in place port gaskets to prevent leaks. Eight studs and two bolts are used to fasten the intake to the head.

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

(1) Disconnect negative cable from battery.
(2) Remove resonator assembly and air inlet hose.
(3) Disconnect throttle and speed control cables.
(4) Disconnect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor

(5) Disconnect brake booster hose and positive crankcase ventilation (PCV) hose.
(6) Disconnect generator electrical connections.
(7) Disconnect air conditioning compressor electrical connections.
(8) Disconnect left and right radio suppressor straps.
(9) Disconnect and remove ignition coil towers (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL).
(10) Remove top oil dipstick tube retaining bolt and ground strap.
(11) Bleed fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).
(12) Remove fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL RAIL - REMOVAL).
(13) Remove throttle body assembly and mounting bracket.
(14) Drain cooling system below coolant temperature level (Refer to 7 - COOLING - STANDARD PROCEDURE).
(15) Remove the heater hoses from the engine front cover and the heater core.
(16) Unclip and remove heater hoses and tubes from intake manifold (Fig. 115).

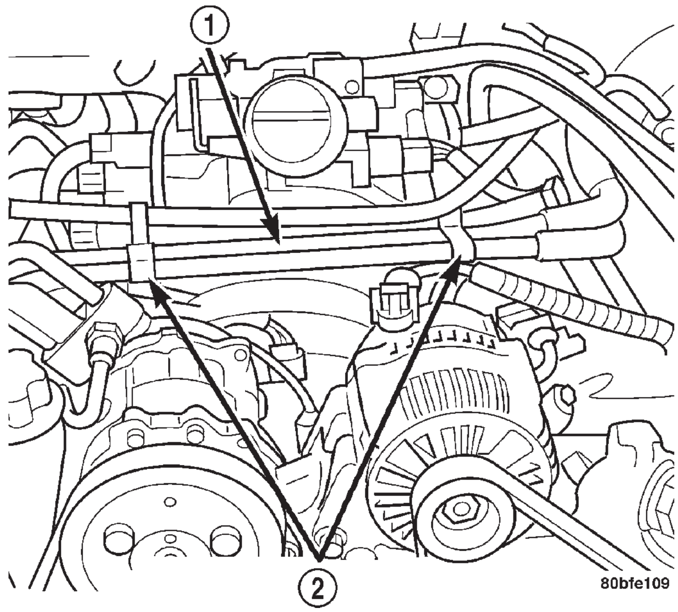


Fig. 115 Heater Hoses and Tubes Removal / Installation

1 - HEATER HOSES AND TUBES
2 - ROUTING/RETAINING CLIPS

(17) Remove coolant temperature sensor (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT TEMPERATURE SENSO - REMOVAL).
(18) Remove intake manifold retaining fasteners in reverse order of tightening sequence (Fig. 116).
(19) Remove intake manifold.

CLEANING

NOTE: There is NO approved repair procedure for the intake manifold. If severe damage is found during inspection, the intake manifold must be replaced.

Before installing the intake manifold thoroughly clean the mating surfaces. Use a suitable cleaning solvent, then air dry.

INTAKE MANIFOLD (Continued)

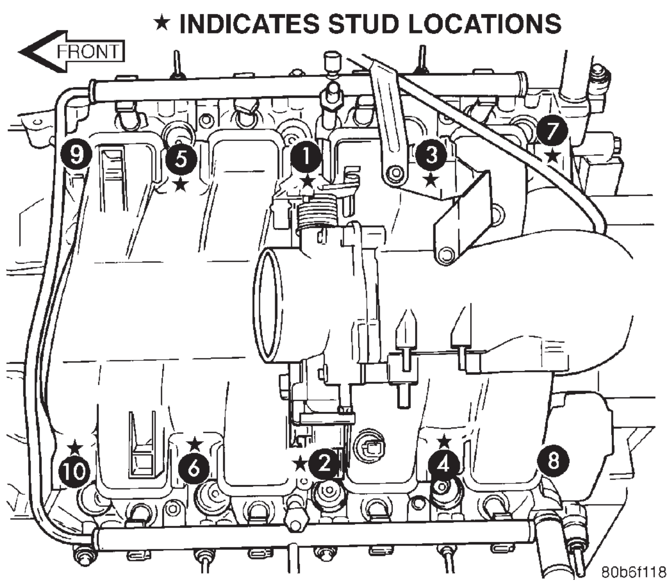


Fig. 116 Intake Manifold Tightening Sequence

INSPECTION

(1) Inspect the intake sealing surface for cracks, nicks and distortion.

(2) Inspect the intake manifold vacuum hose fittings for looseness or blockage.

(3) Inspect the manifold to throttle body mating surface for cracks, nicks and distortion.

INSTALLATION

(1) Install intake manifold gaskets.

(2) Position intake manifold.

(3) Install intake manifold retaining bolts and tighten in sequence shown in (Fig. 117) to 12 N·m (105 in. lbs.).

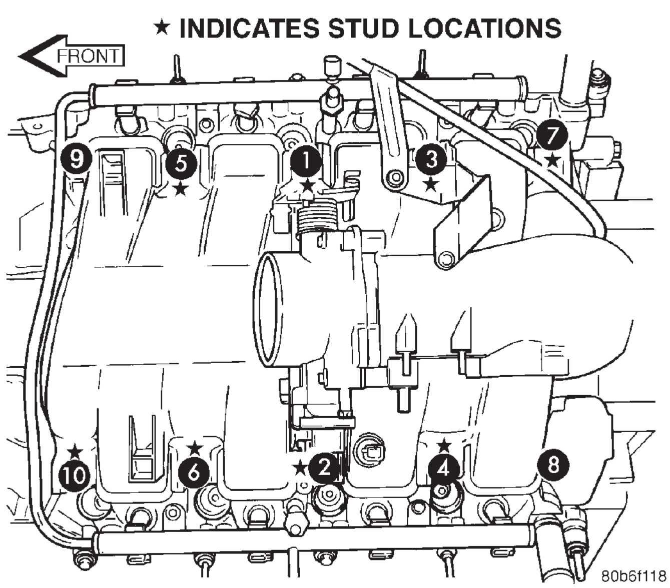


Fig. 117 Intake Manifold Tightening Sequence

(4) Install left and right radio suppressor straps.

(5) Install throttle body assembly.

(6) Install throttle cable bracket.

(7) Connect throttle cable and speed control cable to throttle body.

(8) Install fuel rail (Refer to 14 - FUEL SYSTEM/ FUEL DELIVERY/FUEL RAIL - INSTALLATION).

(9) Install ignition coil towers (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - INSTALLATION).

(10) Position and install heater hoses and tubes onto intake manifold.

(11) Install the heater hoses to the heater core and engine front cover.

(12) Connect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor
- Ignition coil towers
- Fuel injectors

(13) Install top oil dipstick tube retaining bolt and ground strap.

(14) Connect generator electrical connections.

(15) Connect Brake booster hose and Positive crankcase ventilation (PCV) hose.

(16) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(17) Install resonator assembly and air inlet hose.

(18) Connect negative cable to battery.

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds are log style with a patented flow enhancing design to maximize performance. The exhaust manifolds are made of high silicon molybdenum cast iron. A perforated core graphite exhaust manifold gasket is used to improve sealing to the cylinder head. The exhaust manifolds are covered by a three layer laminated heat shield for thermal protection and noise reduction. The heat shields are fastened with a torque prevailing nut that is backed off slightly to allow for the thermal expansion of the exhaust manifold.

REMOVAL

RIGHT EXHAUST MANIFOLD

(1) Disconnect negative cable for battery.

(2) Remove air cleaner assembly, resonator assembly and air inlet hose.

EXHAUST MANIFOLD (Continued)

(3) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

(5) Remove A/C accumulator support bracket fastener.

(6) Drain coolant below heater hose level (Refer to 7 - COOLING - STANDARD PROCEDURE).

(7) Remove heater hoses at engine.

(8) Remove fasteners attaching exhaust manifold heat shield.

(9) Remove heat shield.

(10) Remove upper exhaust manifold attaching fasteners.

(11) Raise vehicle on hoist.

(12) Disconnect exhaust pipe from manifold.

(13) Remove fasteners attaching starter. Move starter aside.

(14) Remove lower exhaust manifold attaching fasteners.

(15) Remove exhaust manifold and gasket (Fig. 118). Manifold is removed from below the engine compartment.

LEFT EXHAUST MANIFOLD

(1) Disconnect negative cable for battery.

(2) Hoist vehicle.

(3) Disconnect exhaust pipe at manifold.

(4) Lower vehicle.

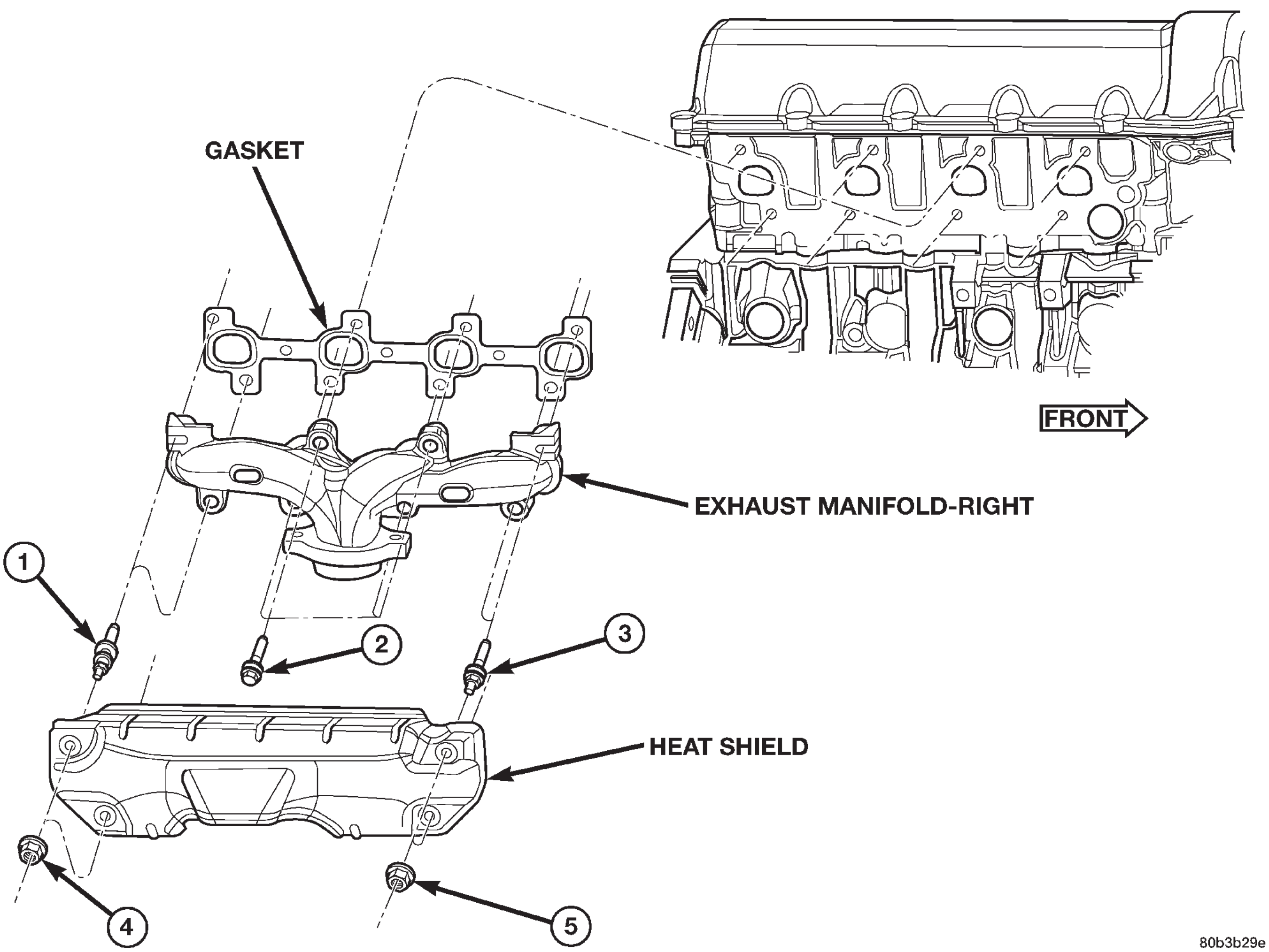


Fig. 118 Exhaust Manifold—Right

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

EXHAUST MANIFOLD (Continued)

(5) Remove the front two exhaust heat shield retaining fasteners. Raise vehicle and remove the fasteners at rear of heat shield.

(6) Remove heat shield (Fig. 119).

(7) Lower vehicle and remove the upper exhaust manifold retaining bolts (Fig. 119).

(8) Raise vehicle and remove the lower exhaust manifold retaining bolts (Fig. 119).

(9) Remove exhaust manifold and gasket (Fig. 119). Manifold is removed from below the engine compartment.

CLEANING

(1) Clean the exhaust manifold using a suitable cleaning solvent, then allow to air dry.

(2) Clean all gasket residue from the manifold mating surface.

INSPECTION

(1) Inspect the exhaust manifold for cracks in the mating surface and at every mounting bolt hole.

(2) Using a straight edge and a feeler gauge, check the mating surface for warp and twist.

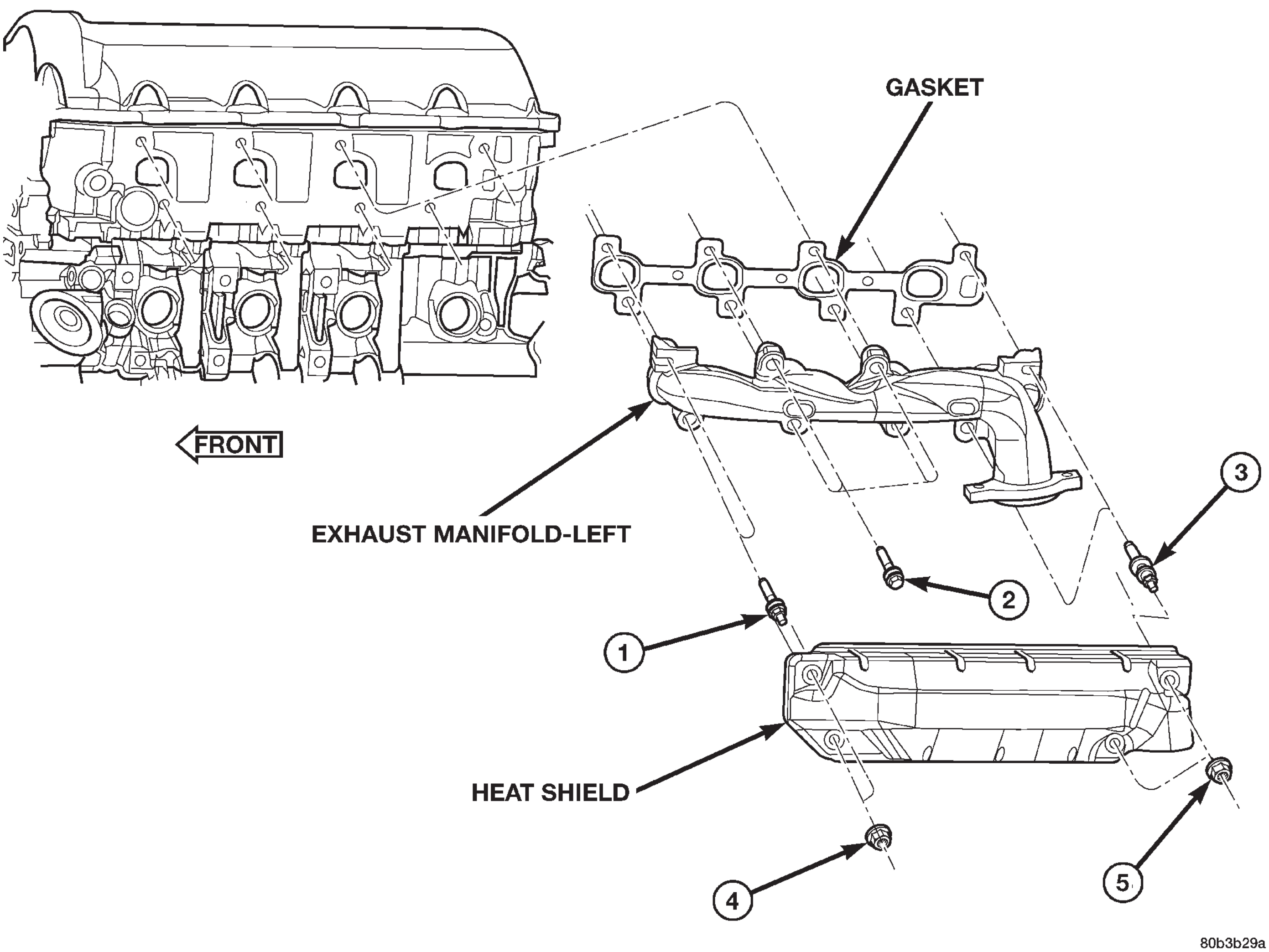


Fig. 119 Exhaust Manifold—Left

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

EXHAUST MANIFOLD (Continued)

(3) Inspect the manifold to exhaust pipe mating surface for cracks, gouges, or other damage that would prevent sealing.

INSTALLATION

RIGHT EXHAUST MANIFOLD

(1) Install exhaust manifold and gasket (Fig. 120) from below engine compartment.

(2) Install lower exhaust manifold fasteners. DO NOT tighten until all fasteners are in place.

(3) Lower vehicle and install upper exhaust manifold fasteners. Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

(4) Install exhaust manifold heat shield. Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.

(5) Install starter and fasteners.

(6) Connect exhaust pipe to manifold.

(7) Connect heater hoses at engine.

(8) Install fastener attaching A/C accumulator.

(9) Install A/C compressor and fasteners.

(10) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(11) Install air cleaner assembly, resonator assembly and air inlet hose.

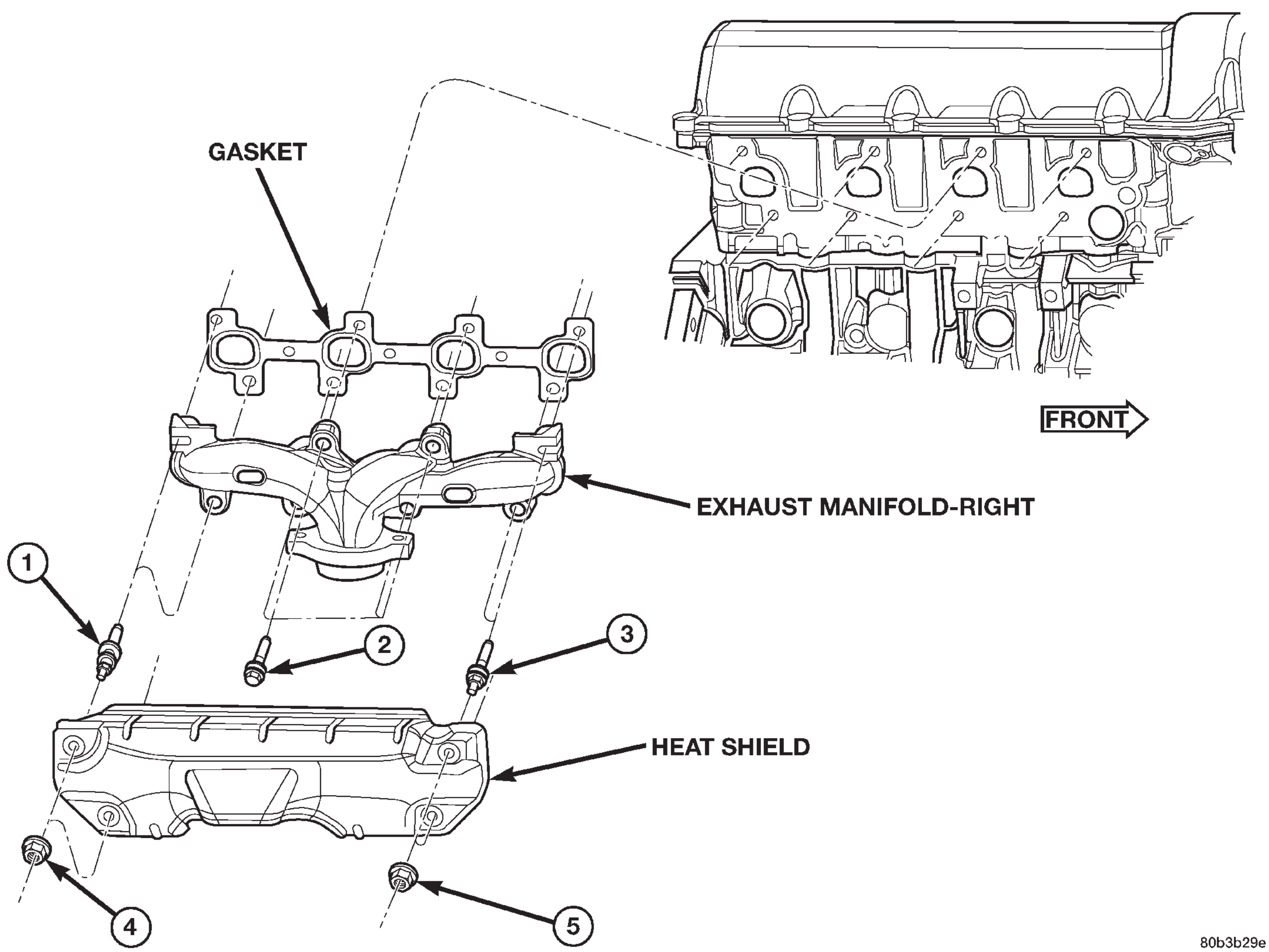


Fig. 120 Exhaust Manifold—Right

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

EXHAUST MANIFOLD (Continued)

(12) Install battery and connect cables.

(13) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

LEFT EXHAUST MANIFOLD

(1) Install exhaust manifold and gasket from below engine compartment.

(2) Install lower exhaust manifold fasteners (Fig. 121). DO NOT tighten until all fasteners are in place.

(3) Lower vehicle and install upper exhaust manifold fasteners (Fig. 121). Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

(4) Install exhaust manifold heat shield (Fig. 121). Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.

(5) Connect exhaust pipe to manifold.

(6) Connect negative cable to battery.

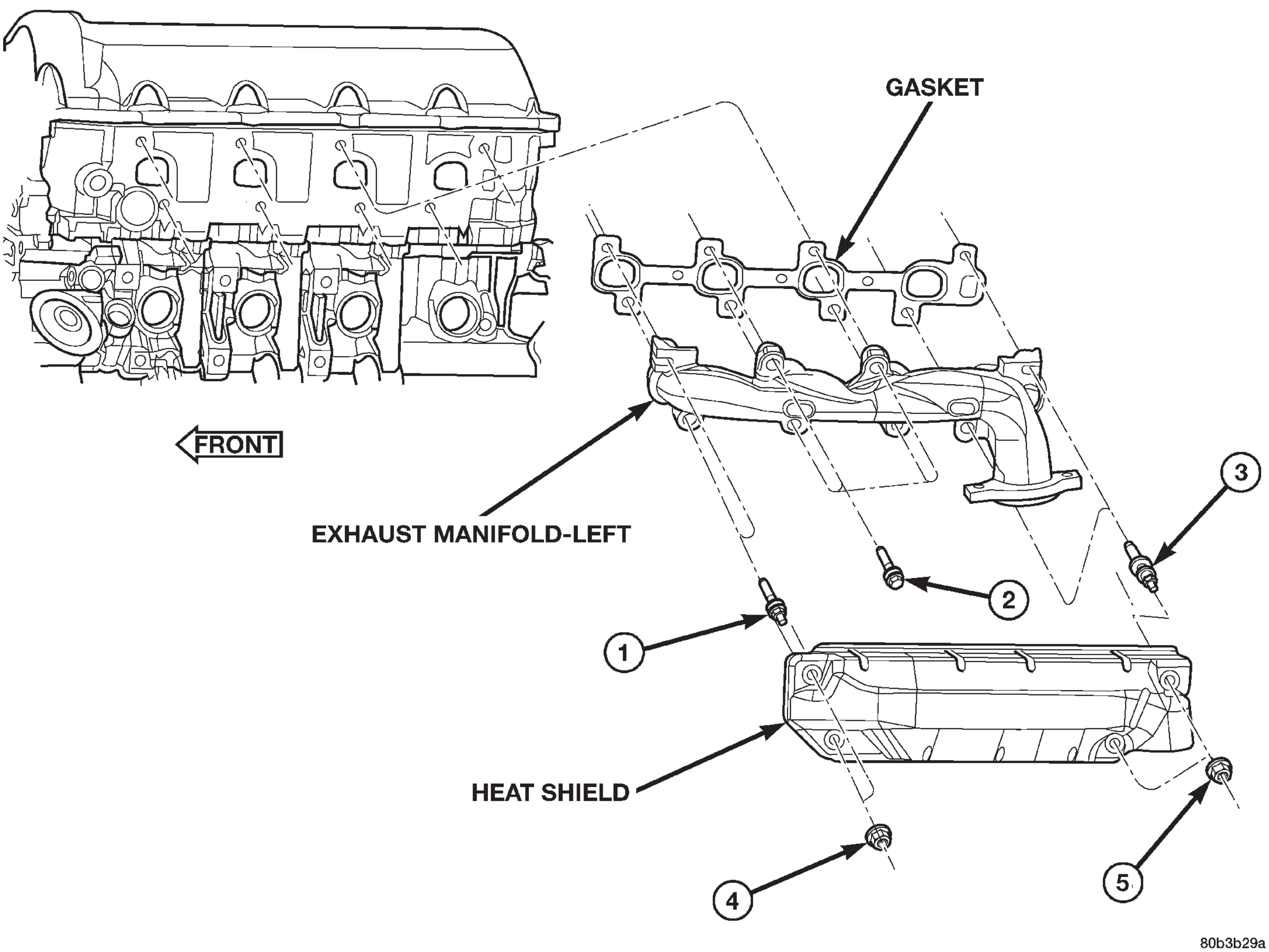


Fig. 121 Exhaust Manifold—Left

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

VALVE TIMING

DESCRIPTION—TIMING DRIVE SYSTEM

The timing drive system (Fig. 122) has been designed to provide quiet performance and reliability to support a **non-free wheeling** engine. Specifically the intake valves are non-free wheeling and can be easily damaged with forceful engine rotation if camshaft-to-crankshaft timing is incorrect. The timing drive system consists of a primary chain and two secondary timing chain drives.

OPERATION—TIMING DRIVE SYSTEM

The primary timing chain is a single inverted tooth type. The primary chain drives the large fifty tooth idler sprocket directly from a 25 tooth crankshaft sprocket. Primary chain motion is controlled by a pivoting leaf spring tensioner arm and a fixed guide. The arm and the guide both use nylon plastic wear faces for low friction and long wear. The primary chain receives oil splash lubrication from the secondary chain drive and oil pump leakage. The idler sprocket assembly connects the primary and secondary chain drives. The idler sprocket assembly consists of two integral thirty tooth sprockets and a fifty tooth sprocket that is splined to the assembly. The spline joint is a non – serviceable press fit anti rattle type. A spiral ring is installed on the outboard side of the fifty tooth sprocket to prevent spline disengagement. The idler sprocket assembly spins on a stationary idler shaft. The idler shaft is press-fit into the cylinder block. A large washer on the idler shaft bolt and the rear flange of the idler shaft are used to control sprocket thrust movement. Pressurized oil is routed through the center of the idler shaft to provide lubrication for the two bushings used in the idler sprocket assembly.

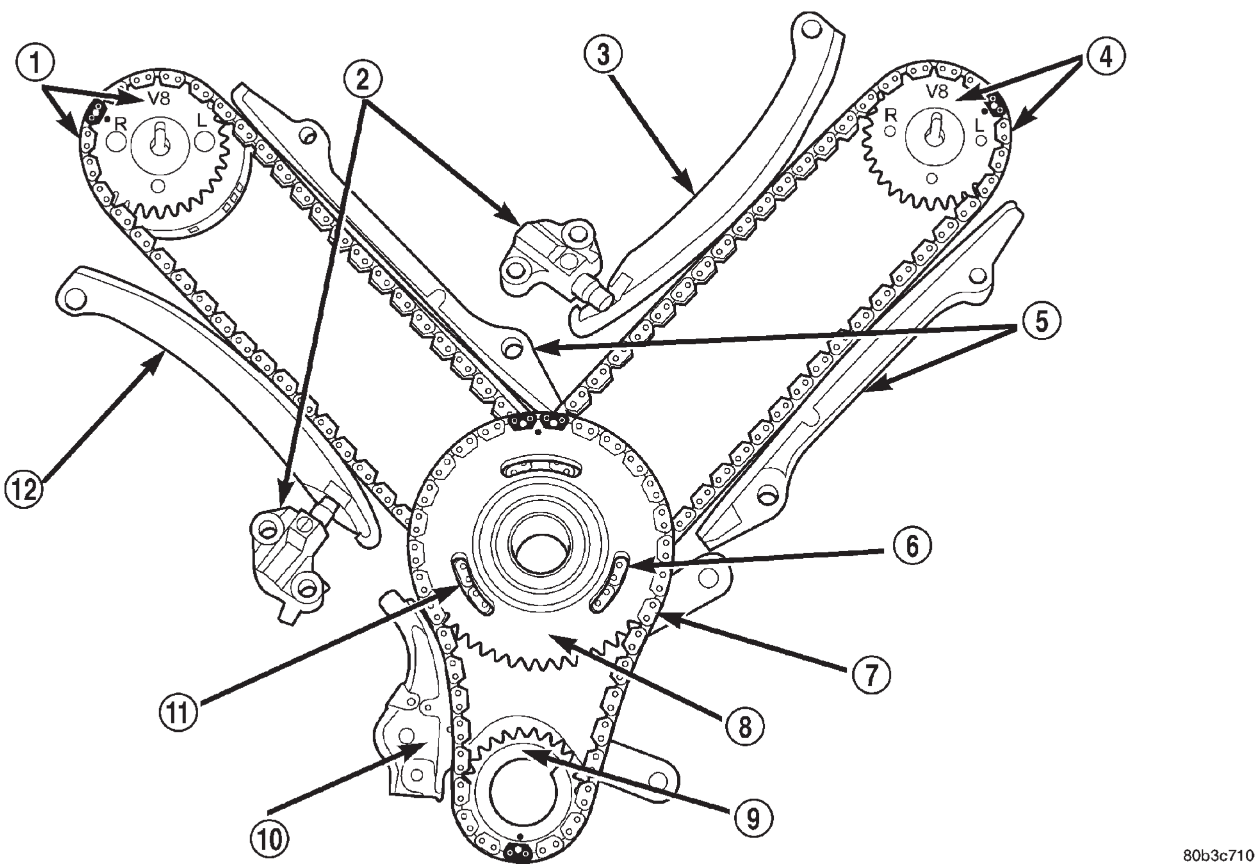


Fig. 122 Timing Drive System

1 - RIGHT CAMSHAFT SPROCKET AND SECONDARY CHAIN
2 - SECONDARY TIMING CHAIN TENSIONER (LEFT AND RIGHT SIDE NOT COMMON)
3 - SECONDARY TENSIONER ARM
4 - LEFT CAMSHAFT SPROCKET AND SECONDARY CHAIN
5 - CHAIN GUIDE
6 - TWO PLATED LINKS ON RIGHT CAMSHAFT CHAIN
7 - PRIMARY CHAIN
8 - IDLER SPROCKET
9 - CRANKSHAFT SPROCKET
10 - PRIMARY CHAIN TENSIONER
11 - TWO PLATED LINKS ON LEFT CAMSHAFT CHAIN
12 - SECONDARY TENSIONER ARM

VALVE TIMING (Continued)

There are two secondary drive chains, both are inverted tooth type, one to drive the camshaft in each SOHC cylinder head. There are no shaft speed changes in the secondary chain drive system. Each secondary chain drives a thirty tooth cam sprocket directly from the thirty tooth sprocket on the idler sprocket assembly. A fixed chain guide and a hydraulic oil damped tensioner are used to maintain tension in each secondary chain system. The hydraulic tensioners for the secondary chain systems are fed pressurized oil from oil reservoir pockets in the block. Each tensioner also has a mechanical ratchet system that limits chain slack if the tensioner piston bleeds down after engine shut down. The tensioner arms and guides also utilize nylon wear faces for low friction and long wear. The secondary timing chains receive lubrication from a small orifice in the tensioners. This orifice is protected from clogging by a fine mesh screen which is located on the back of the hydraulic tensioners (Fig. 122).

STANDARD PROCEDURE—MEASURING TIMING CHAIN WEAR

NOTE: This procedure must be performed with the timing chain cover removed.

(1) Remove the timing chain cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(2) To determine if the secondary timing chains are worn, rotate the engine clockwise until maximum tensioner piston extension is obtained. Measure the distance between the secondary timing chain tensioner housing and the step ledge on the piston (Fig. 123). The measurement at point (A) must be less than 15mm (0.5906 inches).

(3) If the measurement exceeds the specification the secondary timing chains are worn and require replacement. (Refer to 9 - ENGINE/VALVE TIMING/ TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

NOTE: If the secondary chains are to be replaced the primary chain must also be replaced.

STANDARD PROCEDURE - ENGINE TIMING - VERIFICATION

CAUTION: The 4.7L is a non free-wheeling design engine. Therefore, correct engine timing is critical.

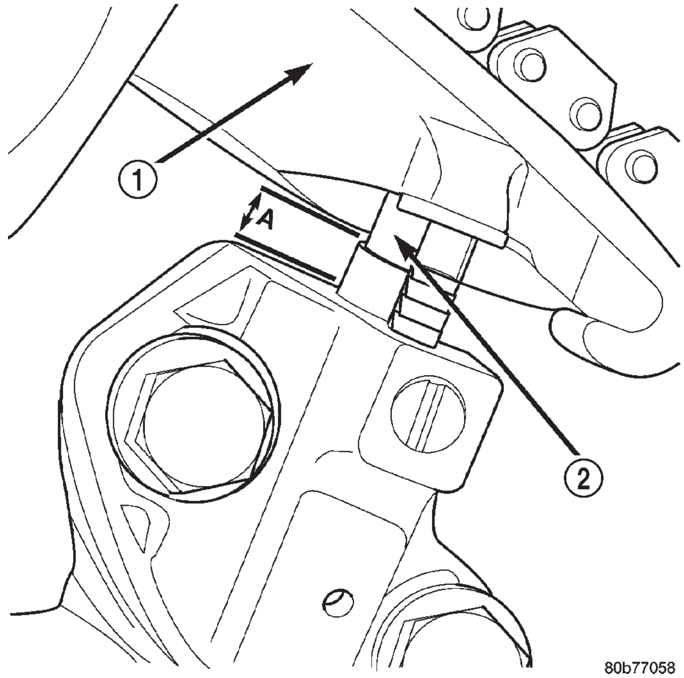


Fig. 123 Measuring Secondary Timing Chains For Wear

1 - SECONDARY TENSIONER ARM
2 - SECONDARY CHAIN TENSIONER PISTON

NOTE: Components referred to as left hand or right hand are as viewed from the drivers position inside the vehicle.

NOTE: The blue link plates on the chains and the dots on the camshaft drive sprockets may not line up during the timing verification procedure. The blue link plates are lined up with the sprocket dots only when re-timing the complete timing drive. Once the timing drive is rotated blue link-to-dot alignment is no longer valid.

Engine base timing can be verified by the following procedure:

(1) Remove the cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Using a mirror, locate the TDC arrow on the front cover (Fig. 124). Rotate the crankshaft until the mark on the crankshaft damper is aligned with the TDC arrow on the front cover. The engine is now at TDC.

(3) Note the location of the V8 mark stamped into the camshaft drive gears (Fig. 125). If the V8 mark on each camshaft drive gear is at the twelve o'clock position, the engine is at TDC (cylinder #1) on the exhaust stroke. If the V8 mark on each gear is at the six o'clock position, the engine is at TDC (cylinder #1) on the compression stroke.

VALVE TIMING (Continued)

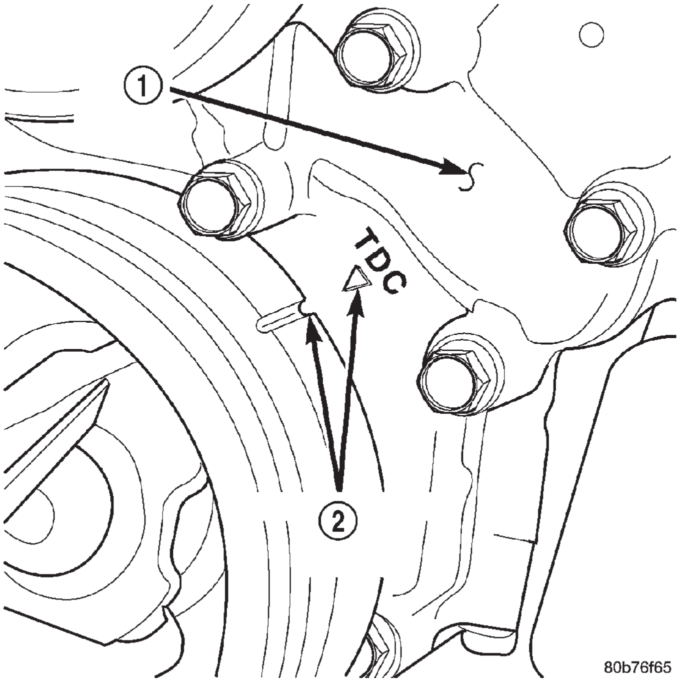


Fig. 124 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

(4) If both of the camshaft drive gears are off in the same or opposite directions, the primary chain or both secondary chains are at fault. Refer to Timing Chain and Sprockets procedure in this section.

(5) If only one of the camshaft drive gears is off and the other is correct, the problem is confined to one secondary chain. Refer to Single camshaft timing, in this procedure.

(6) If both camshaft drive gear V8 marks are at the twelve o'clock or the six o' clock position the engine base timing is correct. Reinstall the cylinder head covers.

SINGLE CAMSHAFT TIMING

NOTE: to adjust the timing on one camshaft, preform the following procedure.

(1) Using Chain Tensioner Wedge, special tool 8350, stabilize the secondary chain drive (Fig. 126). For reference purposes, mark the chain-to-sprocket position (Fig. 126).

(2) Remove the camshaft drive gear retaining bolt.

(3) Carefully remove the camshaft drive gear from the camshaft.

(4) Re-index the camshaft drive gear in the chain until the V8 mark is at the same position as the V8 mark on the opposite camshaft drive gear.

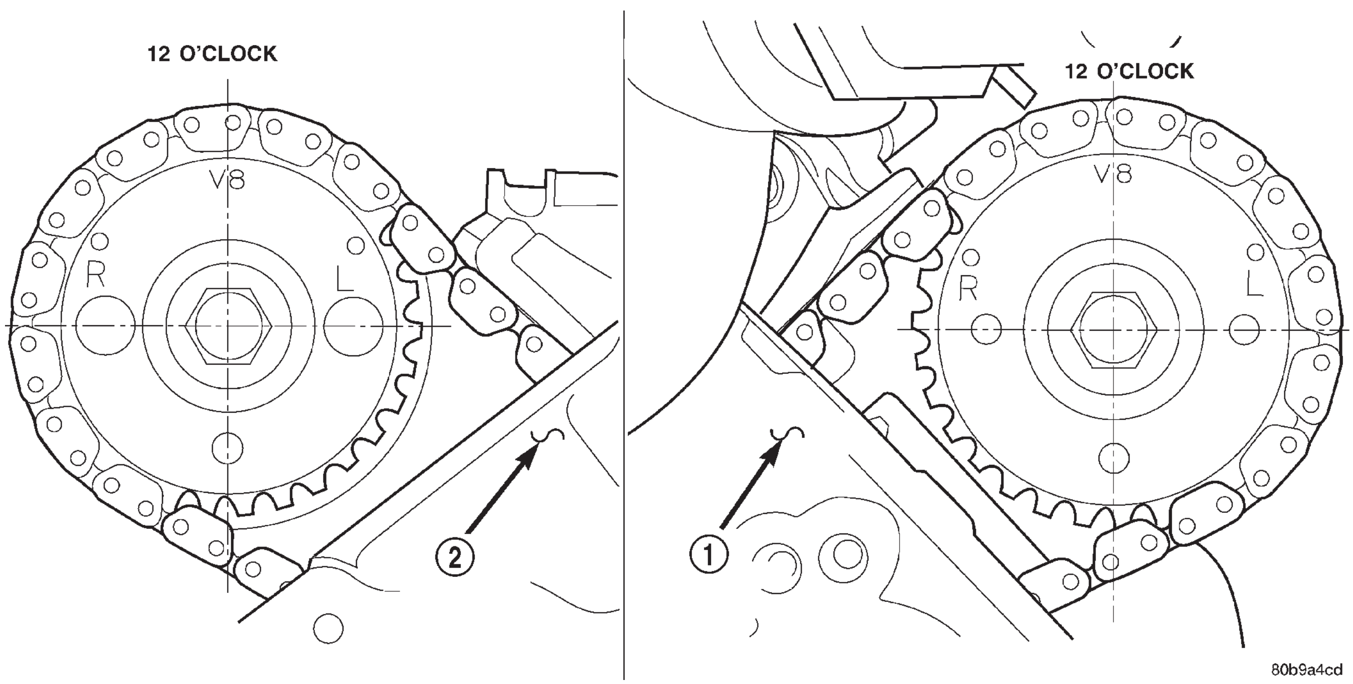


Fig. 125 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

VALVE TIMING (Continued)

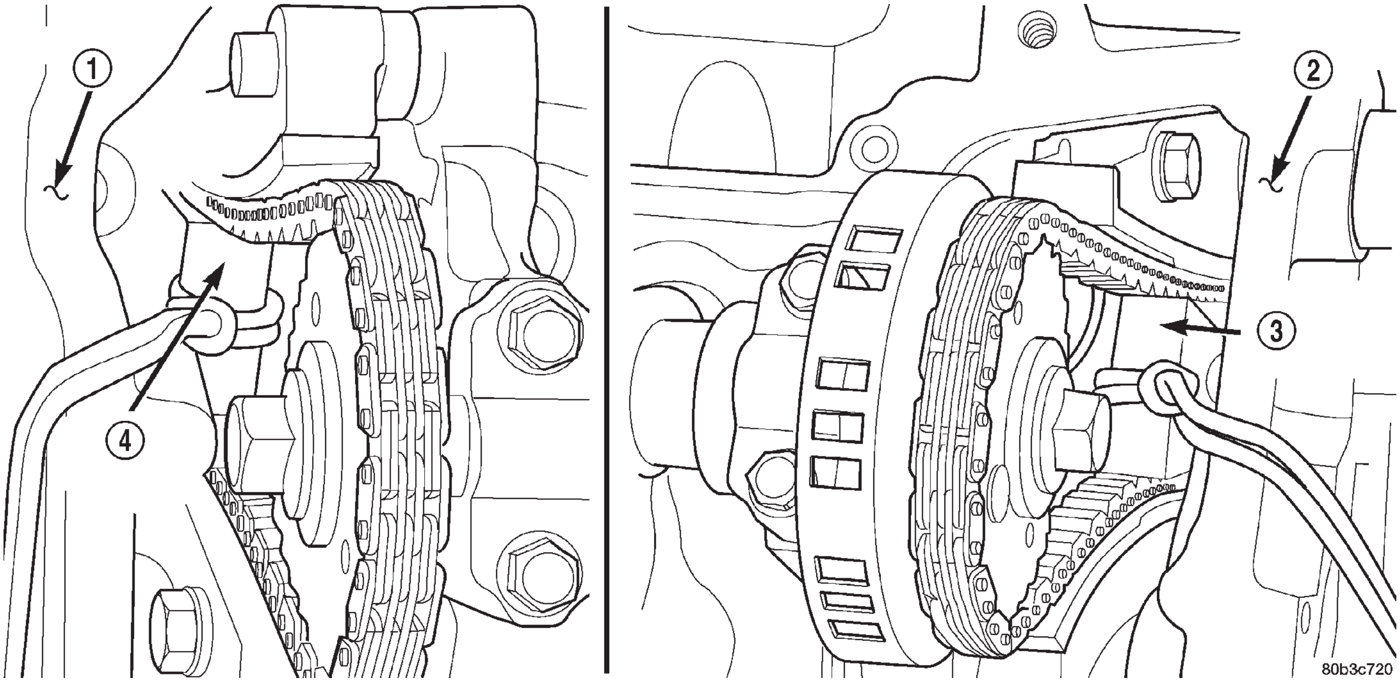


Fig. 126 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

(5) Using a suitable pair of adjustable pliers, rotate the camshaft until the alignment dowel on the camshaft is aligned with the slot in the camshaft drive gear (Fig. 127).

CAUTION: Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torqueing of bolt resulting in bolt failure.

(6) Position the camshaft drive gear onto the camshaft, remove oil from bolt then install the retaining bolt. Using Special Tools, Spanner Wrench 6958 with Adapter Pins 8346 and a suitable torque wrench, Tighten retaining bolt to 122N·m (90 ft. Lbs.) (Fig. 128) (Fig. 129).

(7) Remove special tool 8350.

(8) Rotate the crankshaft two full revolutions, then reverify that the camshaft drive gear V8 marks are in fact aligned.

(9) Install the cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

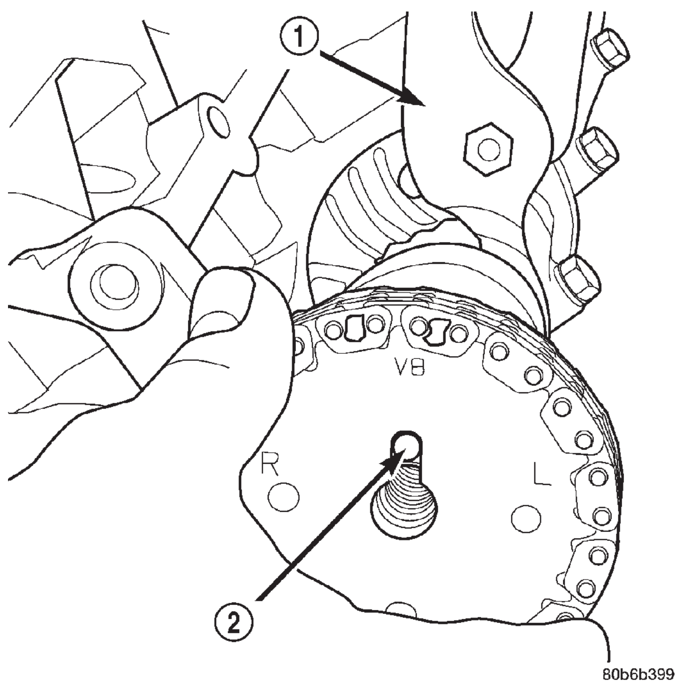


Fig. 127 Camshaft Dowel To

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

VALVE TIMING (Continued)

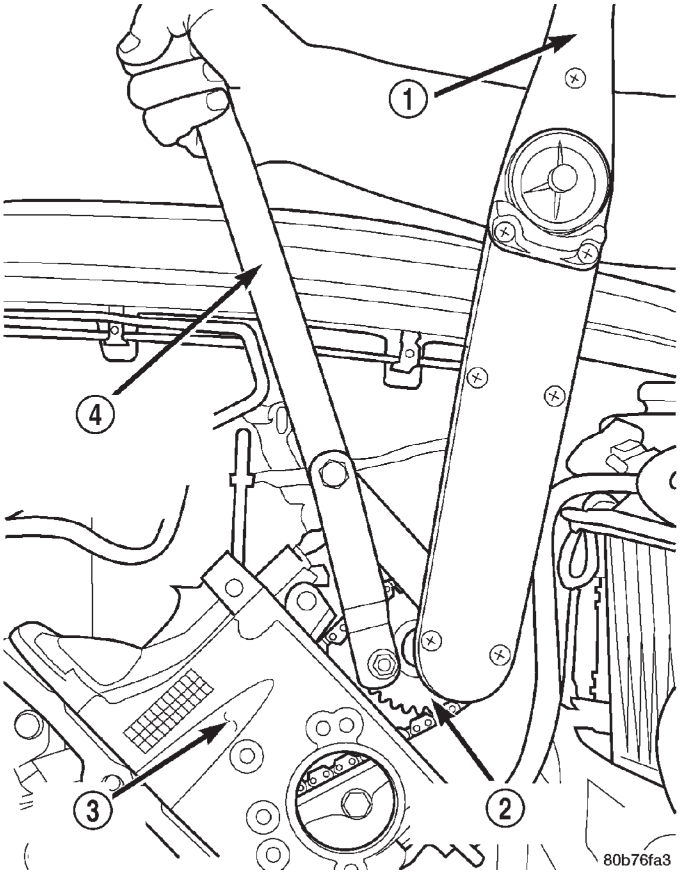


Fig. 128 Camshaft Sprocket Left Cylinder Head

1 - TORQUE WRENCH
2 - CAMSHAFT SPROCKET
3 - LEFT CYLINDER HEAD
4 - SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

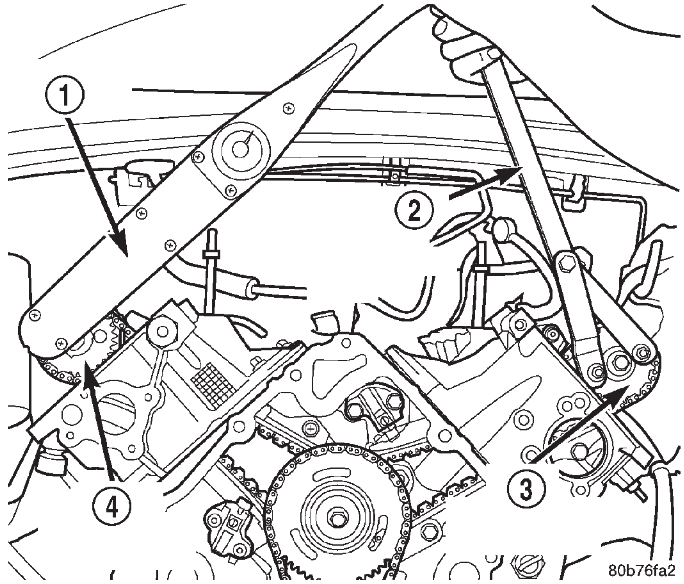


Fig. 129 Camshaft Sprocket Installation—Right Cylinder Head

1 - TORQUE WRENCH
2 - SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
3 - LEFT CAMSHAFT SPROCKET
4 - RIGHT CAMSHAFT SPROCKET

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove fan and fan drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(4) Disconnect both heater hoses at timing cover.

(5) Disconnect lower radiator hose at engine.

(6) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(7) Remove accessory drive belt tensioner assembly (Fig. 130).

(8) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

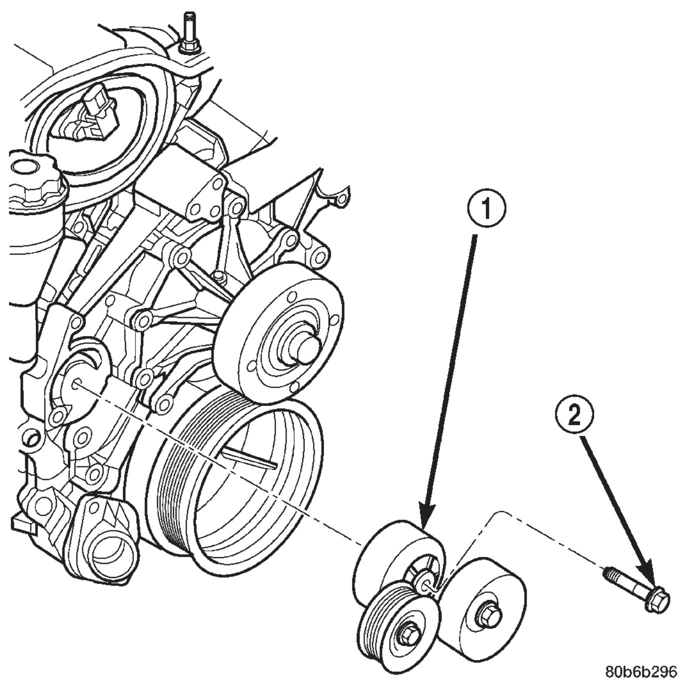


Fig. 130 Accessory Drive Belt Tensioner

1 - TENSIONER ASSEMBLY
2 - FASTENER TENSIONER TO FRONT COVER

(9) Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

(10) Remove cover and gasket (Fig. 131).

TIMING BELT / CHAIN COVER(S) (Continued)

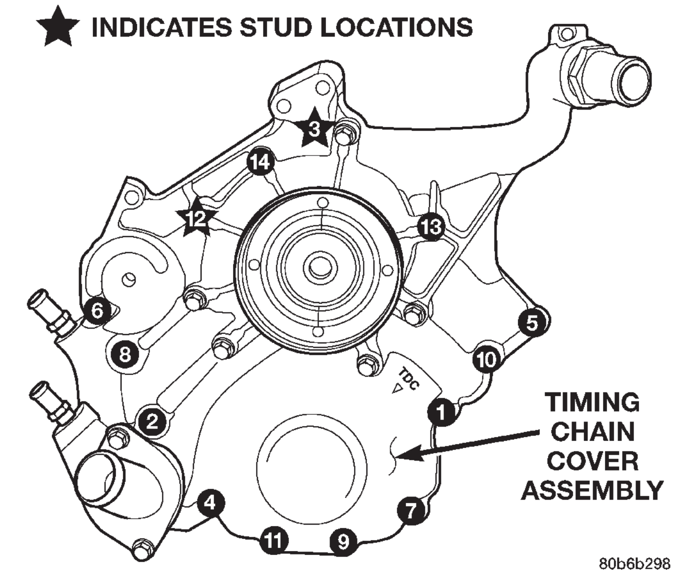


Fig. 131 Timing Chain Cover Fasteners

INSTALLATION

(1) Clean timing chain cover and block surface. Inspect cover gasket and replace as necessary.

(2) Install cover and gasket. Tighten fasteners in sequence as shown in (Fig. 132) to 54 N·m (40 ft. lbs.) .

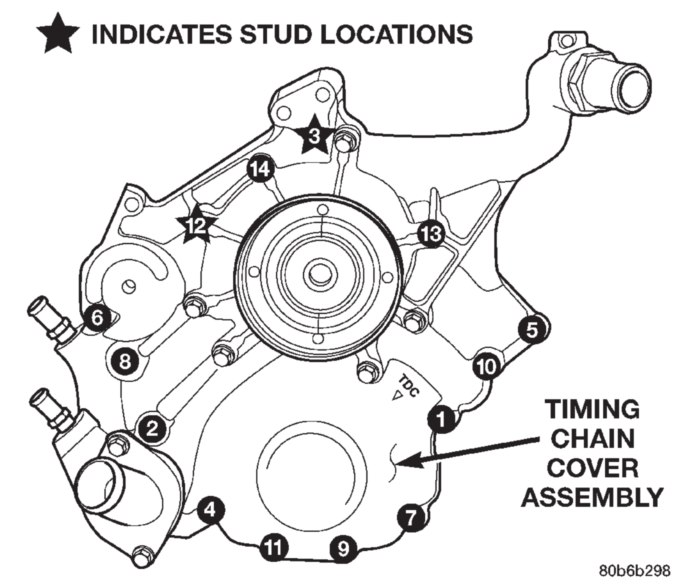


Fig. 132 Timing Chain Cover Fasteners

(3) Install the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(4) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

(5) Install crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(6) Install accessory drive belt tensioner assembly (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - INSTALLATION).

(7) Install radiator lower hose.

(8) Install both heater hoses.

(9) Install radiator shroud and viscous fan drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(10) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(11) Connect the battery negative cable.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove right and left cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(4) Remove radiator fan shroud.

(5) Rotate engine until timing mark on crankshaft damper aligns with TDC mark on timing chain cover (Fig. 133) (#1 cylinder exhaust stroke) and the camshaft sprocket “V8” marks are at the 12 o'clock position (Fig. 134).

(6) Remove power steering pump (Refer to 19 - STEERING/PUMP - REMOVAL).

(7) Remove access plugs (2) from left and right cylinder heads for access to chain guide fasteners (Fig. 135).

(8) Remove the oil fill housing to gain access to the right side tensioner arm fastener.

(9) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) and timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(10) Collapse and pin primary chain tensioner (Fig. 136).

CAUTION: Plate behind left secondary chain tensioner could fall into oil pan. Therefore, cover pan opening.

(11) Remove secondary chain tensioners.

(12) Remove camshaft position sensor from right cylinder head (Fig. 137).

TIMING BELT/CHAIN AND SPROCKETS (Continued)

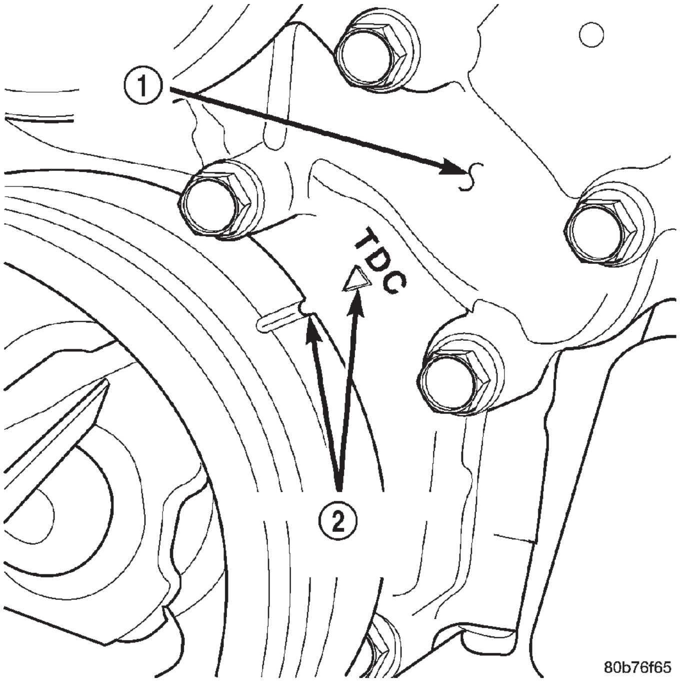


Fig. 133 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

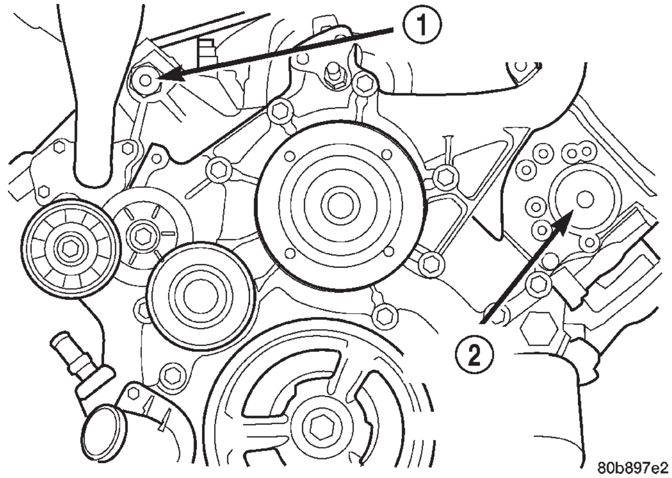


Fig. 135 Cylinder Head Access Plug Location

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

CAUTION: Care should be taken not to damage camshaft target wheel. Do not hold target wheel while loosening or tightening camshaft sprocket. Do not place the target wheel near a magnetic source of any kind. A damaged or magnetized target wheel could cause a vehicle no start condition.

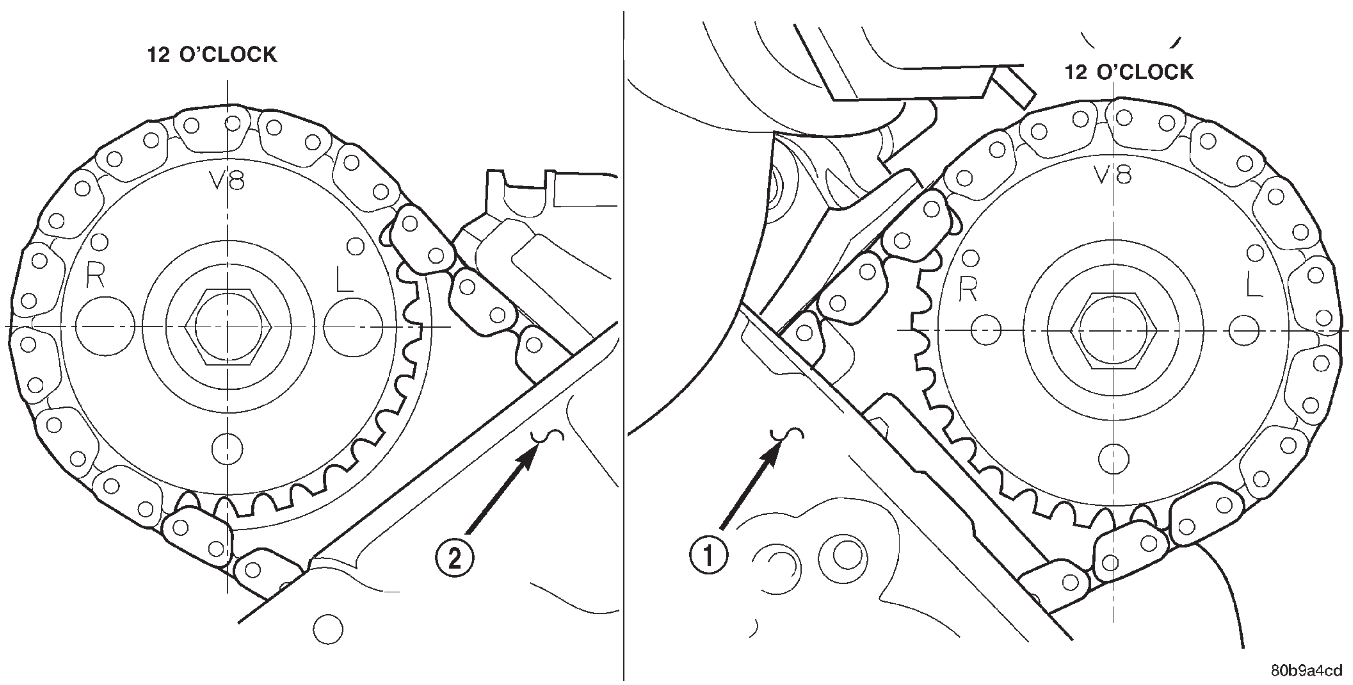


Fig. 134 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

TIMING BELT/CHAIN AND SPROCKETS (Continued)

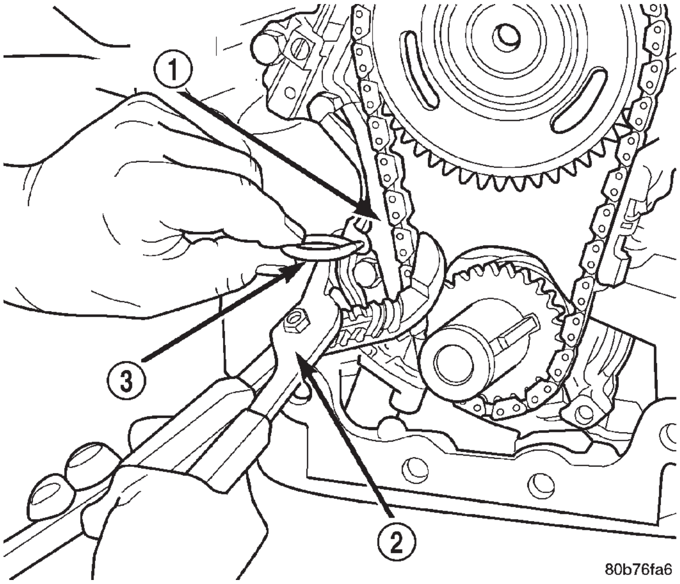


Fig. 136 Collapsing And Pinning Primary Chain Tensioner

1 - PRIMARY CHAIN TENSIONER
2 - ADJUSTABLE PLIERS
3 - SPECIAL TOOL 8514

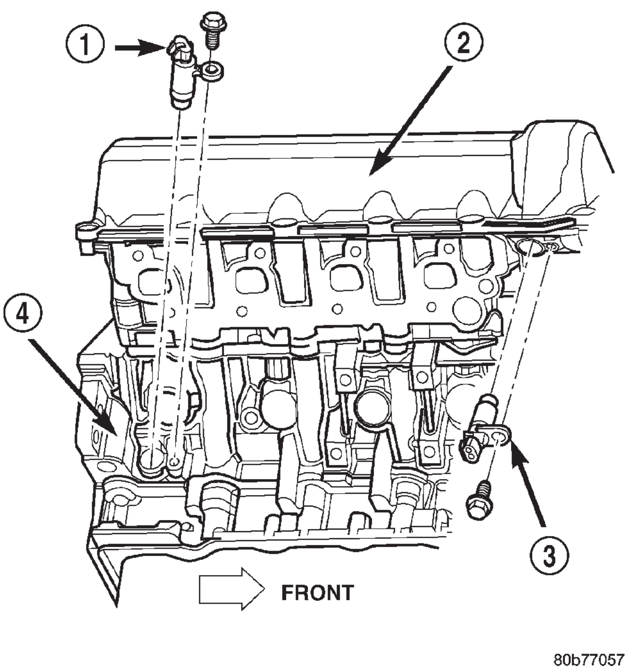


Fig. 137 Camshaft Position Sensor—Removal

1 - CRANKSHAFT POSITION SENSOR
2 - CYLINDER HEAD COVER
3 - CAMSHAFT POSITION SENSOR
4 - RIGHT SIDE CYLINDER BLOCK

CAUTION: Do not forcefully rotate the camshafts or crankshaft independently of each other. Damaging intake valve to piston contact will occur. Ensure negative battery cable is disconnected to guard against accidental starter engagement.

(13) Remove left and right camshaft sprocket bolts.

(14) While holding the left camshaft steel tube with adjustable pliers, (Fig. 138) remove the left camshaft sprocket. Slowly rotate the camshaft approximately 15 degrees clockwise to a neutral position.

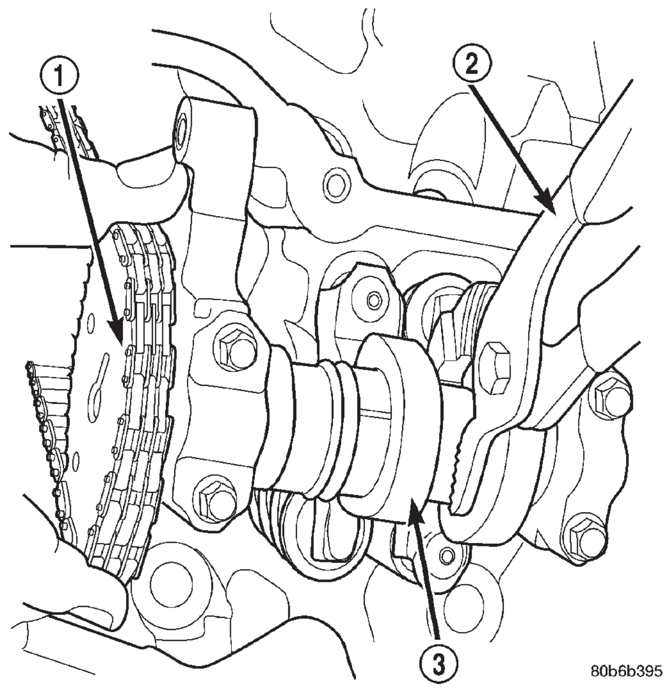


Fig. 138 Camshaft Rotation—Left Side

1 - CAMSHAFT SPROCKET AND CHAIN
2 - ADJUSTABLE PLIERS
3 - CAMSHAFT

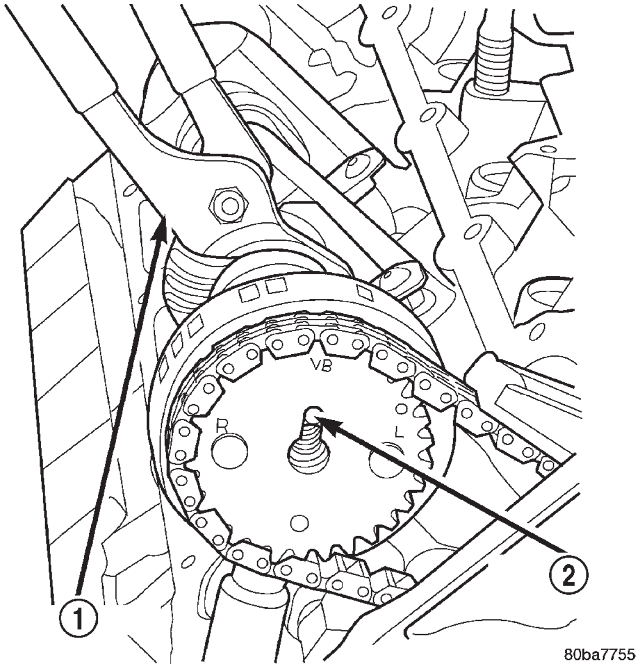


Fig. 139 Camshaft Rotation—Right Side

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

(15) While holding the right camshaft steel tube with adjustable pliers, (Fig. 139) remove the right camshaft sprocket. Slowly rotate the camshaft approximately 45 degrees counterclockwise to a neutral position.

(16) Remove idler sprocket assembly bolt.

(17) Slide the idler sprocket assembly and crank sprocket forward simultaneously to remove the primary and secondary chains.

(18) Remove both pivoting tensioner arms and chain guides.

(19) Remove chain tensioner.

INSPECTION

Inspect the following components:

- Sprockets for excessive tooth wear. Some tooth markings are normal and not a cause for sprocket replacement.
- Idler sprocket assembly bushing and shaft for excessive wear.
- Idler sprocket assembly spline joint. The joint should be tight with no backlash or axial movement.
- Chain guides and tensioner arms. Replace these parts if grooving in plastic face is more than 1 mm (0.039 in.) deep. If plastic face is severely grooved or melted, the tensioner lube jet may be clogged. The tensioner should be replaced.
- secondary chain tensioner piston and ratcheting device. Inspect for evidence of heavy contact between tensioner piston and tensioner arm. If this condition exist the tensioner and tensioner arm should be replaced.
- Primary chain tensioner plastic faces. Replace as required (Fig. 140).

INSTALLATION

(1) Using a vise, lightly compress the secondary chain tensioner piston until the piston step is flush with the tensioner body. Using a pin or suitable tool, release ratchet pawl by pulling pawl back against spring force through access hole on side of tensioner. While continuing to hold pawl back, Push ratchet device to approximately 2 mm from the tensioner body. Install Special Tool 8514 lock pin into hole on front of tensioner. Slowly open vise to transfer piston spring force to lock pin (Fig. 141).

(2) Position primary chain tensioner over oil pump and insert bolts into lower two holes on tensioner bracket. Tighten bolts to 28 N·m (250 in. lbs.).

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

TIMING BELT/CHAIN AND SPROCKETS (Continued)

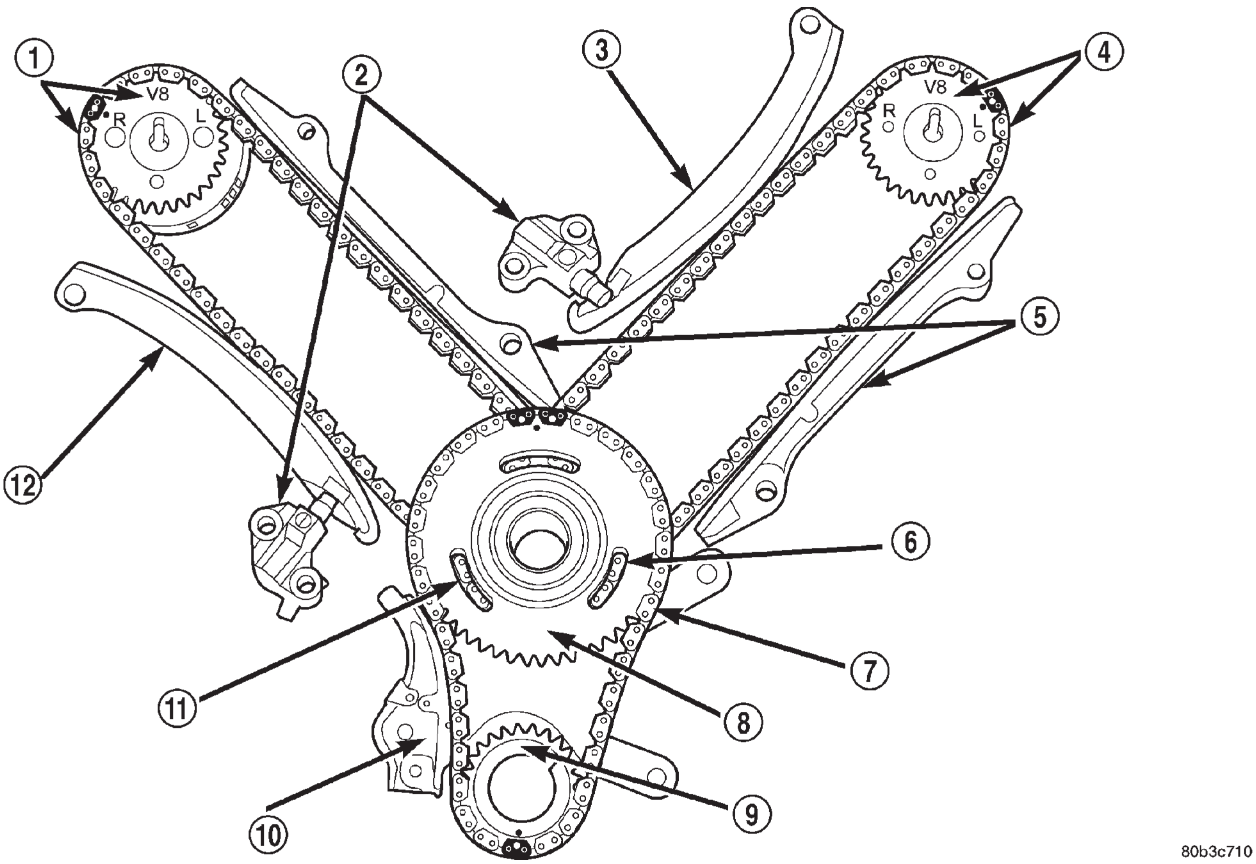


Fig. 140 Timing Chain System

1 - RIGHT CAMSHAFT SPROCKET AND SECONDARY CHAIN
2 - SECONDARY TIMING CHAIN TENSIONER (LEFT AND RIGHT SIDE NOT COMMON)
3 - SECONDARY TENSIONER ARM
4 - LEFT CAMSHAFT SPROCKET AND SECONDARY CHAIN
5 - CHAIN GUIDE
6 - TWO PLATED LINKS ON RIGHT CAMSHAFT CHAIN
7 - PRIMARY CHAIN
8 - IDLER SPROCKET
9 - CRANKSHAFT SPROCKET
10 - PRIMARY CHAIN TENSIONER
11 - TWO PLATED LINKS ON LEFT CAMSHAFT CHAIN
12 - SECONDARY TENSIONER ARM

(3) Install right side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).

NOTE: The silver bolts retain the guides to the cylinder heads and the black bolts retain the guides to the engine block.

(4) Install the left side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

(5) Install left side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).

(6) Install the right side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

(7) Install both secondary chains onto the idler sprocket. Align two plated links on the secondary chains to be visible through the two lower openings on the idler sprocket (4 o'clock and 8 o'clock). Once the secondary timing chains are installed, position special tool 8515 to hold chains in place for installation (Fig. 142).

(8) Align primary chain double plated links with the timing mark at 12 o'clock on the idler sprocket. Align the primary chain single plated link with the timing mark at 6 o'clock on the crankshaft sprocket (Fig. 140).

TIMING BELT/CHAIN AND SPROCKETS (Continued)

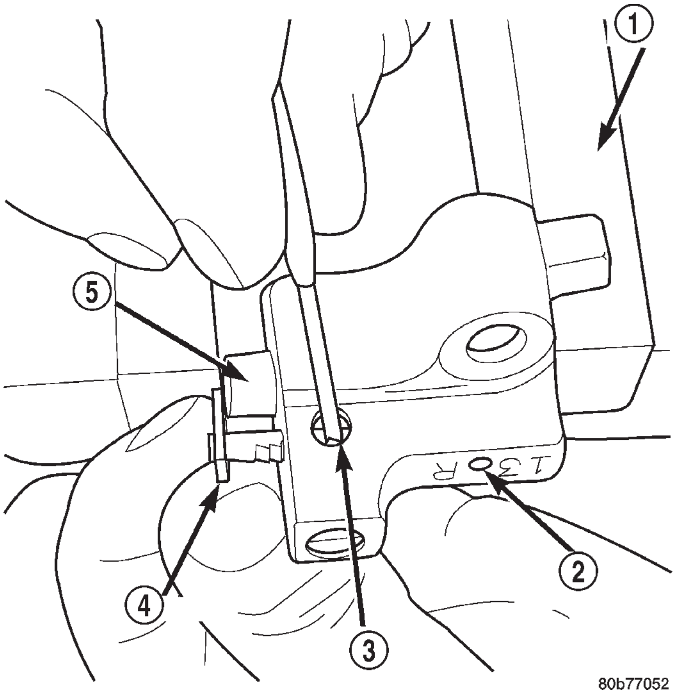


Fig. 141 Resetting Secondary Chain Tensioners

1 - VISE
2 - INSERT LOCK PIN
3 - RATCHET PAWL
4 - RATCHET
5 - PISTON

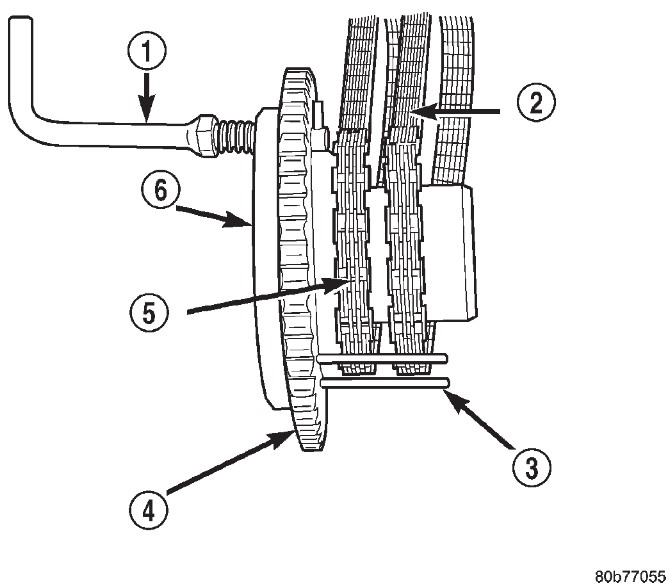


Fig. 142 Installing Secondary Timing Chains on Idler Sprocket

1 - LOCK ARM
2 - RIGHT CAMSHAFT CHAIN
3 - SECONDARY CHAINS RETAINING PINS (4)
4 - IDLER SPROCKET
5 - LEFT CAMSHAFT CHAIN
6 - SPECIAL TOOL 8515

(9) Lubricate idler shaft and bushings with clean engine oil.

(10) Install all chains, crankshaft sprocket, and idler sprocket as an assembly (Fig. 143). After guiding both secondary chains through the block and cylinder head openings, affix chains with a elastic strap or the equivalent, This will maintain tension on chains to aid in installation.

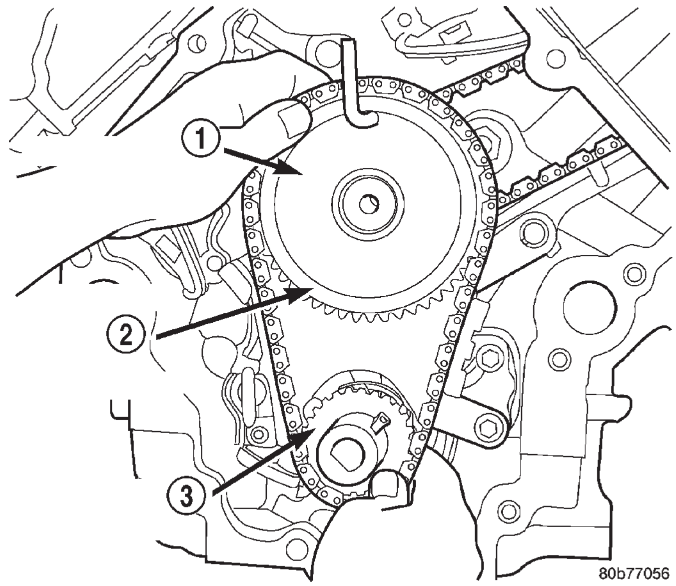


Fig. 143 Installing Idler Gear, Primary and Secondary Timing Chains

1 - SPECIAL TOOL 8515
2 - PRIMARY CHAIN IDLER SPROCKET
3 - CRANKSHAFT SPROCKET

NOTE: It will be necessary to slightly rotate camshafts for sprocket installation.

(11) Align left camshaft sprocket “L” dot to plated link on chain.

(12) Align right camshaft sprocket “R” dot to plated link on chain.

CAUTION: Remove excess oil from the camshaft sprocket bolt. Failure to do so can result in overtorque of bolt resulting in bolt failure.

(13) Remove Special Tool 8515, then attach both sprockets to camshafts. Remove excess oil from bolts, then Install sprocket bolts, but do not tighten at this time.

(14) Verify that all plated links are aligned with the marks on all sprockets and the “V8” marks on camshaft sprockets are at the 12 o’clock position (Fig. 140).

TIMING BELT/CHAIN AND SPROCKETS (Continued)

CAUTION: Ensure the plate between the left secondary chain tensioner and block is correctly installed.

(15) Install both secondary chain tensioners. Tighten bolts to 28 N·m (250 in. lbs.).

NOTE: Left and right secondary chain tensioners are not common.

(16) Before installing idler sprocket bolt, lubricate washer with oil, and tighten idler sprocket assembly retaining bolt to 34 N·m (25 ft. lbs.).

(17) Remove all locking pins (3) from tensioners.

CAUTION: After pulling locking pins out of each tensioner, DO NOT manually extend the tensioner(s) ratchet. Doing so will over tension the chains, resulting in noise and/or high timing chain loads.

(18) Using Special Tool 6958, Spanner with Adaptor Pins 8346, tighten left (Fig. 144) and right (Fig. 145) camshaft sprocket bolts to 122 N·m (90 ft. lbs.).

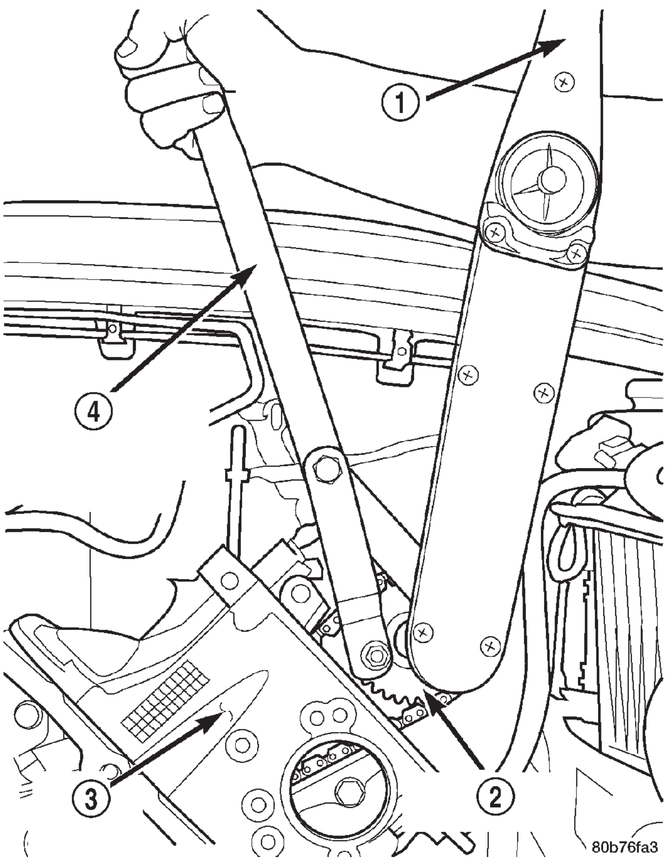


Fig. 144 Tightening Left Side Camshaft Sprocket Bolt

1 - TORQUE WRENCH
2 - CAMSHAFT SPROCKET
3 - LEFT CYLINDER HEAD
4 - SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

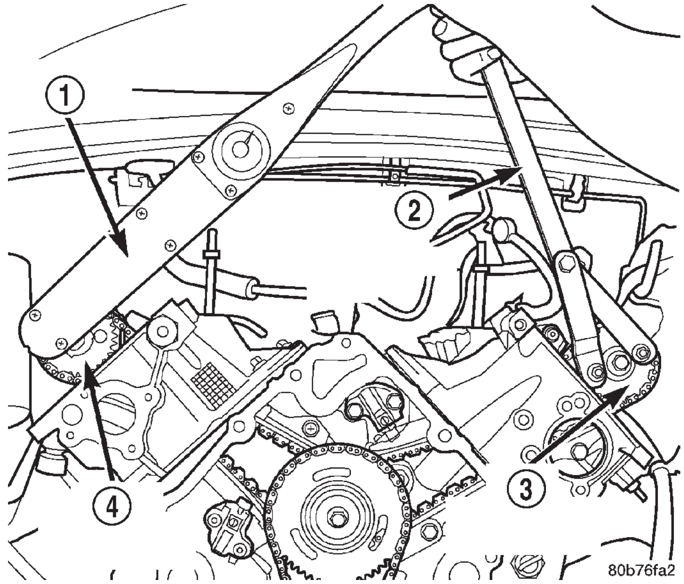


Fig. 145 Tightening Right Side Camshaft Sprocket Bolt

1 - TORQUE WRENCH
2 - SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
3 - LEFT CAMSHAFT SPROCKET
4 - RIGHT CAMSHAFT SPROCKET

(19) Rotate engine two full revolutions. Verify timing marks are at the follow locations:

- primary chain idler sprocket dot is at 12 o'clock (Fig. 140)
- primary chain crankshaft sprocket dot is at 6 o'clock (Fig. 140)
- secondary chain camshaft sprockets “V8” marks are at 12 o'clock (Fig. 140)

(20) Lubricate all three chains with engine oil.

TIMING BELT/CHAIN AND SPROCKETS (Continued)

(21) After installing all chains, it is recommended that the idler gear end play be checked (Fig. 146). The end play must be within 0.10–0.25 mm (0.004–0.010 in.). If not within specification, the idler gear must be replaced.

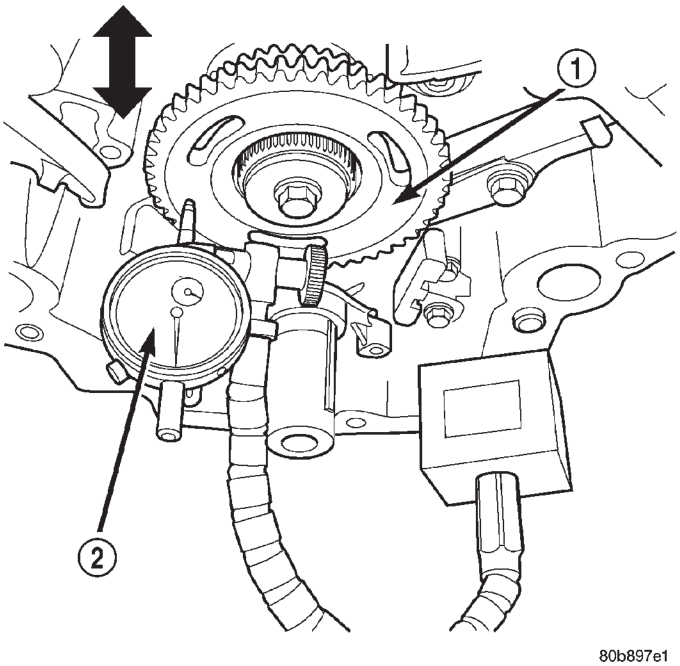


Fig. 146 Measuring Idler Gear End Play

1 - IDLER SPROCKET ASSEMBLY
2 - DIAL INDICATOR

(22) Install timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION) and crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(23) Install cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

NOTE: Before installing threaded plug in right cylinder head, the plug must be coated with sealant to prevent leaks.

(24) Coat the large threaded access plug with **Mopar® Thread Sealant with Teflon**, then install into the right cylinder head and tighten to 81 N·m (60 ft. lbs.) (Fig. 135).

(25) Install the oil fill housing.

(26) Install access plug in left cylinder head (Fig. 135).

(27) Install power steering pump (Refer to 19 - STEERING/PUMP - INSTALLATION).

(28) Install radiator fan shroud.

(29) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(30) Connect negative cable to battery.

ENGINE 5.9L

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ENGINE 5.9L

DESCRIPTION

The 5.9 Liter (360 CID) eight-cylinder engine is a V-Type lightweight, single cam, overhead valve engine with hydraulic roller tappets. This engine is designed for unleaded fuel.

The engine lubrication system consists of a rotor type oil pump and a full flow oil filter.

The cylinders are numbered from front to rear; 1, 3, 5, 7 on the left bank and 2, 4, 6, 8 on the right bank. The firing order is 1-8-4-3-6-5-7-2 (Fig. 1).

The engine serial number is stamped into a machined pad located on the left, front corner of the cylinder block. When component part replacement is necessary, use the engine type and serial number for reference (Fig. 2).

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 mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

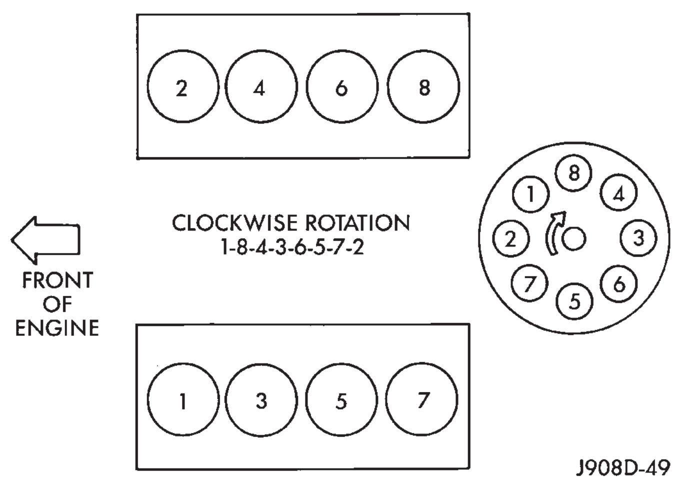


Fig. 1 Firing Order

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Preformance) or (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Mechanical). Refer to 14 - FUEL SYSTEM for fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that cannot be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following:

ENGINE 5.9L (Continued)

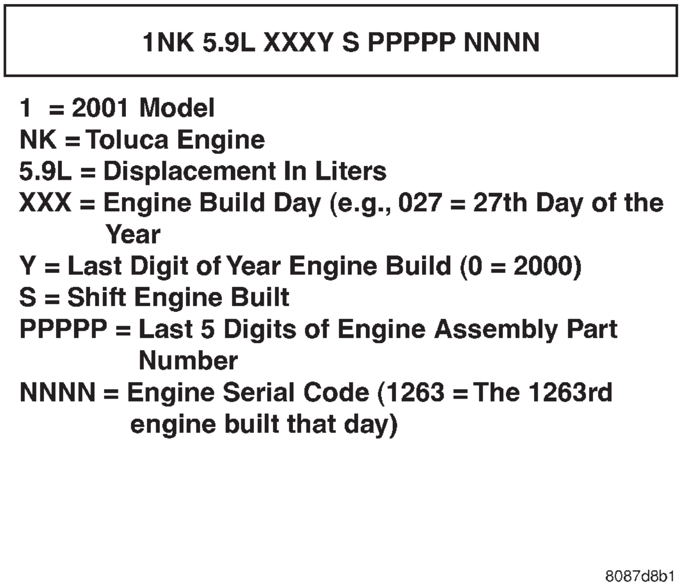


Fig. 2 Engine Identification Number

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- 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)
- Lash Adjuster (Tappet) Noise Diagnosis (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - DIAGNOSIS AND TESTING)
- Engine Oil Leak Inspection (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)

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 5.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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
	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)

ENGINE 5.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	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)

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)

ENGINE 5.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	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.
	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

ENGINE 5.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	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 5.9L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings.	1.
	(a) Misaligned or damaged.	(a) Replace as necessary.
	(b) Loose fasteners, broken or porous metal parts.	(b) Tighten fasteners, Repair or replace metal parts.
	2. Crankshaft rear seal	2. Replace as necessary.
	3. Crankshaft seal flange. Scratched, nicked or grooved.	3. Polish or replace crankshaft.
	4. Oil pan flange cracked.	4. Replace oil pan.
	5. Timing chain cover seal, damaged or misaligned.	5. Replace seal.
	6. Scratched or damaged vibration damper hub.	6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sending unit.	2. Replace sending unit.
	3. Low oil pressure.	3. Check pump and bearing clearance.
	4. Clogged oil filter.	4. Replace oil filter.
	5. Worn oil pump.	5. Replace as necessary.
	6. Thin or diluted oil.	6. Change oil and filter.
	7. Excessive bearing clearance.	7. Replace as necessary.
	8. Oil pump relief valve stuck.	8. Clean or replace relief valve.
	9. Oil pump suction tube loose or damaged.	9. Replace as necessary.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in oil ring slots.	2. Replace rings.
	3. Incorrect ring size installed.	3. Replace rings.
	4. Worn valve guides.	4. Ream guides and replace valves.
	5. Leaking intake gasket.	5. Replace intake gaskets.
	6. Leaking valve guide seals.	6. Replace valve guide seals.

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.

ENGINE 5.9L (Continued)

(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.

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART below

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 5.9L (Continued)

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 5.9L (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).

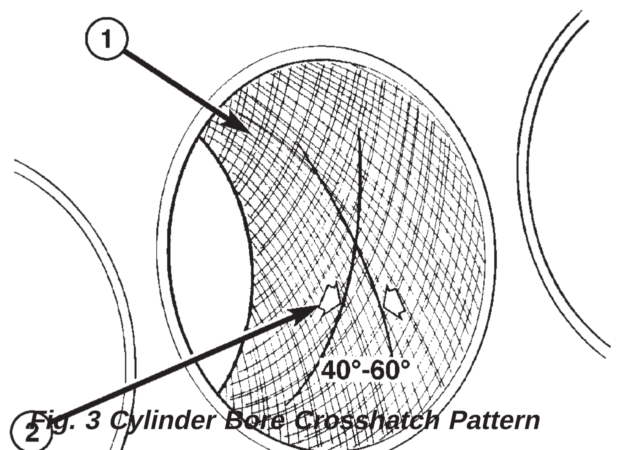


Fig. 3 Cylinder Bore Crosshatch Pattern

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) Scribe hood hinge outlines on hood. Remove the hood.

(2) Remove the battery.

(3) Drain cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Remove the air cleaner, air in-let hose and resonator assembly.

(5) Disconnect the radiator and heater hoses. Remove radiator. (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

ENGINE 5.9L (Continued)

(6) Disconnect the vacuum lines from the intake manifold.
(7) Remove the distributor cap and wiring.
(8) Disconnect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL).
(9) Remove throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).
(10) Perform the Fuel System Pressure Release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).
(11) Disconnect the starter wires.
(12) Disconnect the oil pressure wire.
(13) Discharge the air conditioning system, if equipped. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).
(14) Disconnect the air conditioning hoses.
(15) Disconnect the power steering hoses, if equipped.
(16) Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).
(17) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).
(18) Raise and support the vehicle on a hoist.
(19) Disconnect exhaust pipe at manifolds.
(20) RemoveTransmission. Refer to 21 - TRANSMISSION AND TRANSFER CASE.

CAUTION: DO NOT lift the engine by the intake manifold.

(21) Install an engine lifting fixture.
(22) **2WD VEHICLES**—Remove engine front mount bolts.
(23) **4WD VEHICLES**—The engine and front driving axle (engine/axle/transmission) are connected through insulators and support brackets. Separate the engine as follows:

- **LEFT SIDE**—Remove 2 bolts attaching (engine/pinion nose/transmission) bracket to transmission bell housing. Remove 2 bracket to pinion nose adaptor bolts. Separate engine from insulator by removing upper nut washer assembly and bolt from engine support bracket.
- **RIGHT SIDE**—Remove 2 bracket to axle (disconnect housing) bolts and 1 bracket to bell housing bolt. Separate engine from insulator by removing upper nut washer assembly and bolt from engine support bracket.

(24) Lower the vehicle.
(25) On automatic transmission vehicles, disconnect the engine from the torque converter drive plate. On manual transmission vehicles, move engine forward until drive pinion shaft clears the clutch disc. Remove engine from engine compartment.
(26) Install engine assembly on engine repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment.
(2) Install an engine support fixture.
(3) Raise and support the vehicle on a hoist.
(4) Install transmission.
(5) Install the front engine mounts (Refer to 9 - ENGINE/ENGINE MOUNTING/FRONT MOUNT - INSTALLATION).
(6) Install exhaust pipe to manifold.
(7) Lower the vehicle.
(8) Remove engine lifting fixture.
(9) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).
(10) Install starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).
(11) Connect power steering hoses, if equipped.
(12) Connect air conditioning hoses.
(13) Evacuate and charge the air conditioning system, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).
(14) Using a new gasket, install throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - INSTALLATION).
(15) Connect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - INSTALLATION).
(16) Connect the starter wires.
(17) Connect the oil pressure sensor wire.
(18) Install the distributor cap and wiring.
(19) Connect the vacuum lines.
(20) Connect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).
(21) Install the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION). Connect the radiator hoses and heater hoses.
(22) Install fan shroud in position.
(23) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(24) Install the air cleaner, resonator assembly and air in-let hose. Tighten clamps to 4 N·m (35 in. lbs.).
(25) Install the battery.
(26) Warm engine and adjust.
(27) Install hood and line up with the scribe marks.
(28) Road test vehicle.

ENGINE 5.9L (Continued)

SPECIFICATIONS

5.9L ENGINE

ENGINE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90° V-8 OHV
Bore and Stroke	101.6 x 90.9 mm (4.00 x 3.58 in.)
Displacement	5.9L (360 c.i.)
Compression Ratio	9.1:1
Firing Order	1–8–4–3–6–5–7–2
Lubrication	Pressure Feed – Full Flow Filtration
Cooling System	Liquid Cooled – Forced Circulation
Cylinder Block	Cast Iron
Cylinder Head	Cast Iron
Crankshaft	Nodular Iron
Camshaft	Nodular Cast Iron
Pistons	Aluminum Alloy w/strut
Connecting Rods	Forged Steel
Compression Pressure	689.5 kPa (100 psi) (Min.)
CAMSHAFT	
Bearing Diameter	
No. 1	50.800 – 50.825 mm (2.000 – 2.001 in.)
No. 2	50.394 – 50.419 mm (1.984 – 1.985 in.)
No. 3	50.013 – 50.038 mm (1.969 – 1.970 in.)
No. 4	49.606 – 49.632 mm (1.953 – 1.954 in.)
No. 5	39.688 – 39.713 mm (1.5625 – 1.5635 in.)
Bearing Journal Diameter	
No. 1	50.723 – 50.775 mm (1.997 – 1.999 in.)
No. 2	50.317 – 50.368 mm (1.981 – 1.983 in.)
No. 3	49.936 – 49.987 mm (1.966 – 1.968 in.)
No. 4	49.53 – 49.581 mm (1.950 – 1.952 in.)
No. 5	39.611 – 39.662 mm (1.5595 – 1.5615 in.)
Bearing to Journal Clearance	
Standard	0.0254 – 0.0762 mm (0.001 – 0.003 in.)
Service Limit	0.127 mm (0.005 in.)
Camshaft End Play	0.051 – 0.254 mm (0.002 – 0.010 in.)
CONNECTING RODS	
Piston Pin bore Diameter	24.966 – 24.978 mm (0.9829 – 0.9834 in.)
Side Clearance	0.152 – 0.356 mm (0.006 – 0.014 in.)
CRANKSHAFT	
Rod Journal	
Diameter	53.950 – 53.975 mm (2.124 – 2.125 in.)
Out of Round (Max.)	0.0254 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	0.013 – 0.056 mm (0.0005 – 0.0022 in.)
Main Bearing Journal	
Diameter	71.361 – 71.387 mm
	(2.8095 – 2.8105 in.)
Out of Round (Max.)	0.127 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	

ENGINE 5.9L (Continued)

DESCRIPTION	SPECIFICATION
Journal #1	0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Journals # 2 - 5	0.013 – 0.051 mm (0.0005 – 0.002 in.)
Service Limit	
Journal #1	0.0381 mm (0.0015 in.)
Journals #2-5	0.064 mm (0.0025 in.)
Crankshaft End Play	0.051 – 0.178 mm (0.002 – 0.007 in.)
Service Limit	0.254 mm (0.010 in.)
CYLINDER BLOCK	
Cylinder Bore	
Diameter	101.60 – 101.65 mm (4.000 – 4.002 in.)
Out of Round (Max.)	.0254 mm (0.001 in.)
Taper (Max.)	.0254 mm (0.001 in.)
Lifter Bore	
Diameter	22.99 – 23.01 mm (0.9051 – 0.9059 in.)
Distributor Drive Bushing Press Fit	
Bushing to Bore Interference	0.0127 – 0.3556 mm (0.0005 – 0.0140 in.)
Shaft to Bushing Clearance	0.0178 – 0.0686 mm (0.0007 – 0.0027 in.)
CYLINDER HEAD AND VALVES	
Valve Seat	
Angle	44.25° – 44.75°
Runout (Max.)	0.0762 mm (0.003 in.)
Width (Finish)	
Intake	1.016 – 1.524 mm (0.040 – 0.060 in.)
Exhaust	1.524 – 2.032 mm (0.060 – 0.080 in.)
Valves	
Face Angle	43.25° – 43.75°

DESCRIPTION	SPECIFICATION
Head Diameter	
Intake	47.752 mm (1.88 in.)
Exhaust	41.072 (1.617 in.)
Length (Overall)	
Intake	126.21 – 126.85 mm (4.969 – 4.994 in.)
Exhaust	126.44 – 127.30 mm (4.978 – 5.012 in.)
Lift (@ zero lash)	
Intake	10.414 mm (0.410 in.)
Exhaust	10.592 mm (0.417 in.)
Stem Diameter	
Intake	9.449 – 9.474 mm (0.372 – 0.373 in.)
Exhaust	9.423 – 9.449 mm (0.371 – 0.372 in.)
Guide Bore	9.500 – 9.525 mm (0.374 – 0.375 on.)
Stem to Guide Clearance	
Intake	0.0254 – 0.0762 mm (0.001 – 0..003 in.)
Exhaust	0.0508 – 0.1016 mm (0.002 – 0.004 in.)
Service Limit	0.4318 (0.017 in.)
Valve Springs	
Free Length	49.962 mm (1.967 in.)
Spring Tension	
Valve closed	378 N @ 41.66 mm (85 lbs. @ 1.64 in.)
Valve open	890 N @ 30.89 mm (200 lbs. @ 1.212 in.)
Number of Coils	6.8
Installed Height	41.66 mm (1.64 in.)
Wire Diameter	4.50 mm (0.177 in.)

ENGINE 5.9L (Continued)

DESCRIPTION	SPECIFICATION
HYDRAULIC TAPPETS	
Body Diameter	22.949 – 22.962 mm (0.9035 – 0.9040 in.)
Clearance (to bore)	0.0279 – 0.0610 mm (0.0011 – 0.0024 in.)
Dry Lash	1.524 – 5.334 mm (0.060 – 0.210 in.)
Push Rod Length	175.64 – 176.15 mm (6.915 – 6.935 in.)
OIL PRESSURE	
Curb Idle (Min.*)	41.4 kPa (6 psi)
@ 3000 rpm	207 – 552 kPa (30 – 80 psi)
Oil Pressure Bypass Valve Setting	62 – 103 kPa (9 – 15 psi)
Switch Actuating Pressure	34.5 – 48.3 kPa (5 – 7 psi)
*** If oil pressure is zero at curb idle, DO NOT RUN ENGINE.**	
OIL PUMP	
Clearance over Rotors (Max.)	0.1016 mm (0.004 in.)
Cover Out of Flat (Max.)	0.0381 mm (0.0015 in.)
Inner Rotor Thickness (Min.)	20.955 mm (0.825 in.)
Outer Rotor	
Clearance (Max.)	0.3556 mm (0.014 in.)
Diameter (Min.)	62.7126 mm (2.469 in.)
Thickness (Min.)	20.955 mm (0.825 in.)
Tip Clearance between Rotors (Max.)	0.2032 mm (0.008 in.)
PISTONS	
Clearance at Top of Skirt	0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Land Clearance (Diam.)	0.508 – 0.660 mm (0.020 – 0.026 in.)
Piston Length	81.03 mm (3.19 in.)
Piston Ring Groove Depth	
Groove #1&2	4.761 – 4.912 mm (0.187 – 0.193 in.)
Groove #3	3.996 – 4.177 mm (0.157 – 0.164 in.)
Weight	582 – 586 grams (20.53 – 20.67 oz.)
PISTON PINS	
Clearance in Piston	0.006 – 0.019 mm (0.00023 – 0.00074 in.)
Diameter	25.007 – 25.015 mm (0.9845 – 0.9848 in.)
End Play	NONE
Length	67.8 – 68.3 mm (2.67 – 2.69 in.)
PISTON RINGS	
Ring Gap	
Compression Ring (Top)	0.30 – 0.55 mm (0.012 – 0.022 in.)
Compression Ring (2nd)	0.55 – 0.80 mm (0.022 – 0.031 in.)
Oil Control (Steel Rails)	0.381 – 1.397 mm (0.015 – 0.055 in.)
Ring Side Clearance	
Compression Rings	0.040 – 0.085 mm (0.0016 – 0.0033 in.)
Oil Ring (Steel Rails)	0.05 – 0.21 mm (0.002 – 0.008 in.)
Ring Width	
Compression rings	1.530 – 1.555 mm (0.060 – 0.061 in.)
Oil Ring (Steel Rails) – Max.	0.447 –0.473 mm (0.018 – 0.019 in.)

ENGINE 5.9L (Continued)

DESCRIPTION	SPECIFICATION
VALVE TIMING	
Exhaust Valve	
Closes (ATDC)	33°
Opens (BBDC)	56°
Duration	269°
Intake Valve	
Closes (ATDC)	62°
Opens (BBDC)	7°
Duration	249°
Valve Overlap	41°

OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS CHART

OS-US	Item	Identification	Location of Identification
U/S .025 MM (.001 in.)	Crankshaft	R or M M-2-3 ect. (indicating No. 2 & 3 main bearing journal) and/or R-1-4 ect. (indicating No. 1 & 4 connecting rod journal)	Milled flat on No. three crankshaft counterweight.
O/S .508 mm (.020 in.)	Cylinder Bores	A	Following engine serial number.
O/S .203 mm (.008 in.)	Tappets	◊	3/8″ diamound -shaped stamp Top pad — Front of engine and flat ground on outside surface of each O/S tappet bore.
O/S .127 mm (.005 in.)	Valve Stems	X	Milled pad adjacent to two 3/8″ tapped holes on each end of cylinder head.

TORQUE

TORQUE CHART 5.9L ENGINE

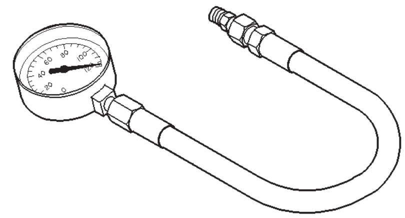
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft Sprocket—Bolt	68	50	—
Camshaft Thrust Plate—Bolts	24	—	210
Timing Chain Case Cover—Bolts	41	30	—
Connecting Rod Cap—Bolts	61	45	—
Main Bearing Cap—Bolts	115	85	—
Crankshaft Pulley—Bolts	24	—	210
Cylinder Head—Bolts			
Step 1	68	50	—
Step 2	143	105	—
Cylinder Head Cover—Bolts	11	—	95
Engine Support Bracket to Block—Bolts (4WD)	41	30	—
Exhaust Manifold to Cylinder Head—Bolts/Nuts	34	25	—
Flywheel—Bolts	75	55	—
Front Insulator—Through bolt/nut	95	70	—
Front Insulator to Support Bracket			
—Stud Nut (4WD)	41	30	—
—Through Bolt/Nut (4WD)	102	75	—

ENGINE 5.9L (Continued)

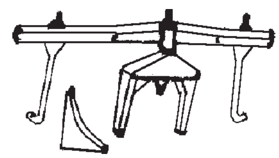
DESCRIPTION	N·m	Ft.	In.
Front Insulator to Block—Bolts (2WD)	95	70	—
Generator—Mounting Bolt	41	30	—
Intake Manifold—Bolts	Refer to Procedure		
Oil Pan—Bolts	24	—	215
Oil Pan—Drain Plug	34	25	—
Oil Pump—Attaching Bolts	41	30	—
Oil Pump Cover—Bolts	11	—	95
Rear Insulator to Bracket—Through-Bolt (2WD)	68	50	—
Rear Insulator to Crossmember Support Bracket—Nut (2WD)	41	30	—
Rear Insulator to Crossmember—Nuts (4WD)	68	50	—
Rear Insulator to Transmission—Bolts (4WD)	68	50	—
Rear Insulator Bracket—Bolts (4WD Automatic)	68	50	—
Rear Support Bracket to Crossmember Flange—Nuts	41	30	—
Rear Support Plate to Transfer Case—Bolts	41	30	—
Rocker Arm—Bolts	28	21	—
Spark Plugs	41	30	—
Starter Motor—Mounting Bolts	68	50	—
Thermostat Housing—Bolts	25	—	225
Throttle Body—Bolts	23	—	200
Torque Converter Drive Plate—Bolts	31	—	270
Transfer Case to Insulator Mounting Plate—Nuts	204	105	—
Transmission Support Bracket—Bolts (2WD)	68	50	—
Vibration Damper—Bolt	244	180	—
Water Pump to Timing Chain Case Cover—Bolts	41	30	—

SPECIAL TOOLS

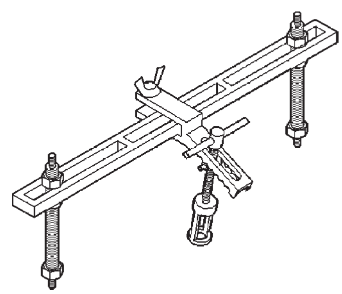
5.9L ENGINE



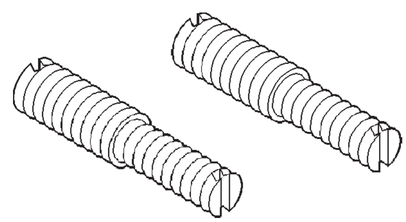
Oil Pressure Gauge C-3292



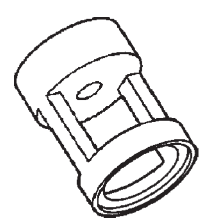
Engine Support Fixture C-3487–A



Valve Spring Compressor MD-998772–A

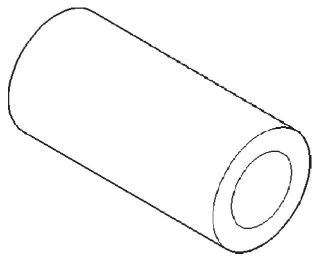


Adaptor 6633

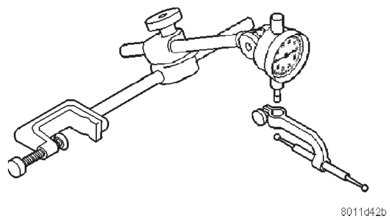


Adaptor 6716A

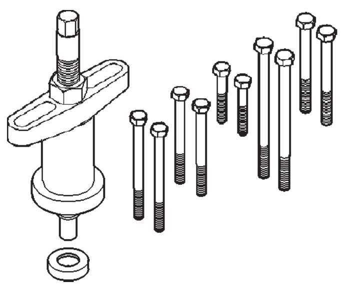
ENGINE 5.9L (Continued)



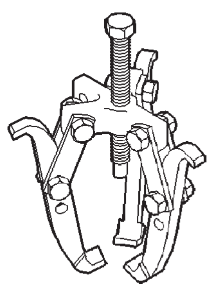
Valve Guide Sleeve C-3973



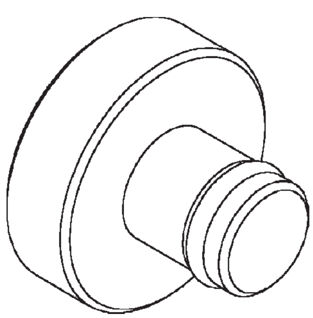
Dial Indicator C-3339



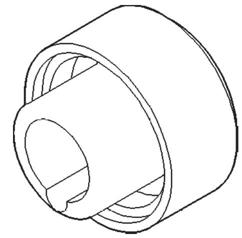
Puller C-3688



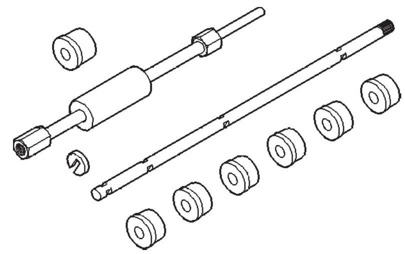
Puller 1026



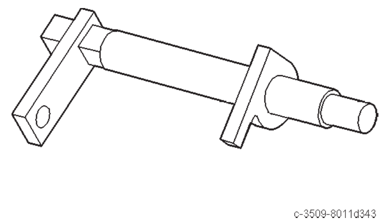
Crankshaft Damper Removal Insert 8513



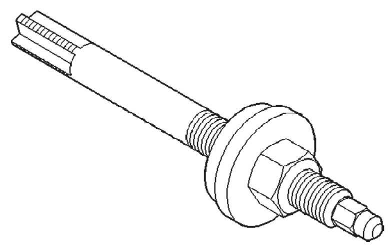
Front Oil Seal Installer 6635



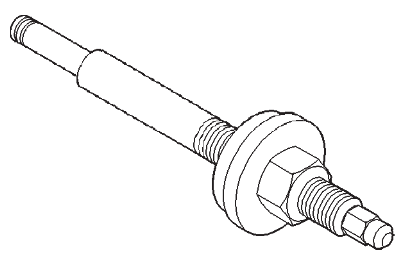
Cam Bearing Remover/Installer C3132–A



Camshaft Holder C-3509

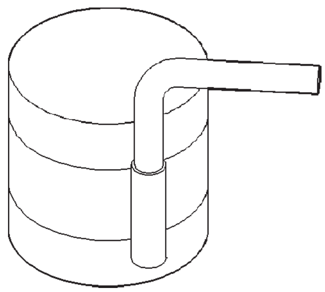


Distributor Bushing Puller C-3052

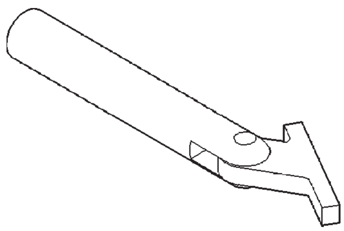


Distributor Bushing Driver/Burnisher C-3053

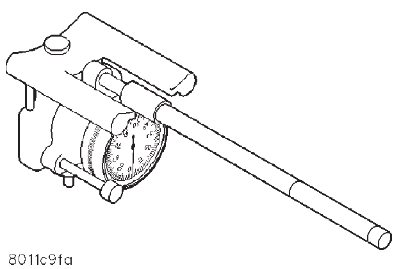
ENGINE 5.9L (Continued)



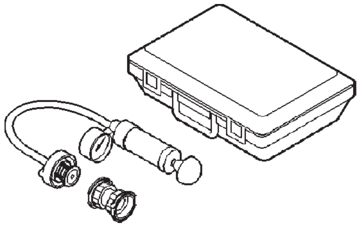
Piston Ring Compressor C-385



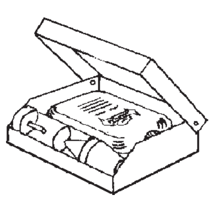
Crankshaft Main Bearing Remover C-3059



Cylinder Bore Gauge C-119



Pressure Tester Kit 7700



Bloc–Check–Kit C-3685–A

AIR CLEANER ELEMENT

REMOVAL

Housing removal is not necessary for element (filter) replacement.

(1) Pry up spring clips from housing cover (spring clips retain cover to housing).

(2) Release housing cover from locating tabs on housing (Fig. 4) and remove cover.

(3) Remove air cleaner element (filter) from housing.

(4) Clean inside of housing before replacing element.

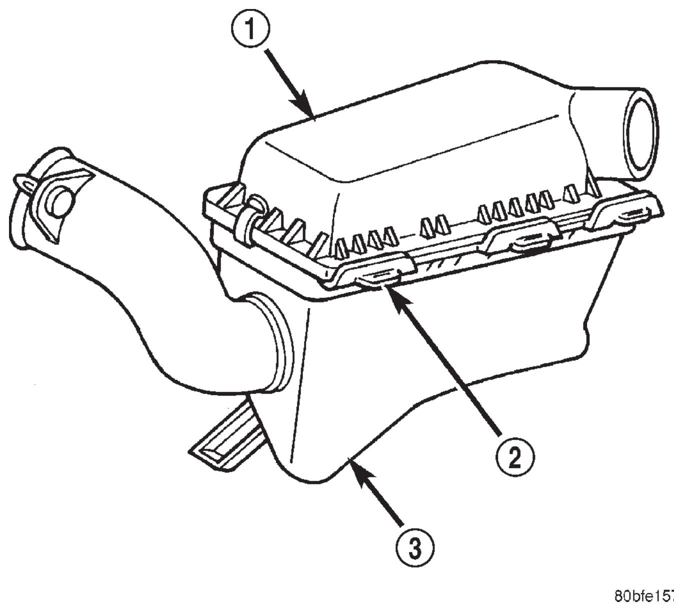


Fig. 4 Air Cleaner Housing Assembly

1 - AIR CLEANER ELEMENT COVER
2 - TABS
3 - HOUSING

INSTALLATION

(1) Install element into housing.

(2) Position housing cover into housing locating tabs.

(3) Pry up spring clips and lock cover to housing.

CYLINDER HEAD

DESCRIPTION

The cast iron cylinder heads (Fig. 5) are mounted to the cylinder block using ten bolts. The spark plugs are located in the peak of the wedge between the valves.

CYLINDER HEAD (Continued)

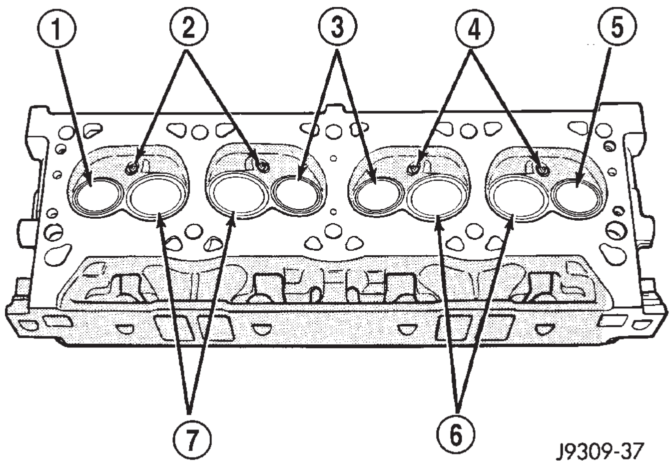


Fig. 5 Cylinder Head Assembly—V-8 Gas Engines

1 - EXHAUST VALVE
2 - SPARK PLUGS
3 - EXHAUST VALVES
4 - SPARK PLUGS
5 - EXHAUST VALVE
6 - INTAKE VALVES
7 - INTAKE VALVES

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 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 158 kPa (23 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

(1) Disconnect the battery negative cable.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the air cleaner resonator and duct work.

(4) Remove the intake manifold-to-generator bracket support rod. Remove the generator.

(5) Remove closed crankcase ventilation system.

(6) Disconnect the evaporation control system.

(7) Perform the Fuel System Pressure Release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

CYLINDER HEAD (Continued)

(8) Disconnect accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(9) Remove distributor cap and wires.

(10) Disconnect the coil wires.

(11) Disconnect heat indicator sending unit wire.

(12) Disconnect heater hoses and bypass hose.

(13) Remove cylinder head covers and gaskets (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(14) Remove intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL) and throttle body as an assembly. Discard the flange side gaskets and the front and rear cross-over gaskets.

(15) Remove exhaust manifolds (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - REMOVAL).

(16) Remove rocker arm assemblies and push rods. Identify to ensure installation in original locations.

(17) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.

(18) Remove spark plugs.

CLEANING

Clean all surfaces of cylinder block and cylinder heads.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

INSPECTION

Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out-of-flatness exceeds 0.00075mm/mm (0.0001in./in.) times the span length in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE:—A 305 mm (12 in.) span is 0.102 mm (0.004 in.) out-of-flat. The allowable out-of-flat is 305 x 0.00075 (12 x 0.00075) equals 0.23 mm (0.009 in.). This amount of out-of-flat is acceptable.

The cylinder head surface finish should be 1.78-3.00 microns (70-125 microinches).

Inspect push rods. Replace worn or bent rods.

INSTALLATION

(1) Clean all surfaces of cylinder block and cylinder heads.

(2) Clean cylinder block front and rear gasket surfaces using a suitable solvent.

(3) Position new cylinder head gaskets onto the cylinder block.

(4) Position cylinder heads onto head gaskets and cylinder block.

(5) Starting at top center, tighten all cylinder head bolts, in sequence (Fig. 6).

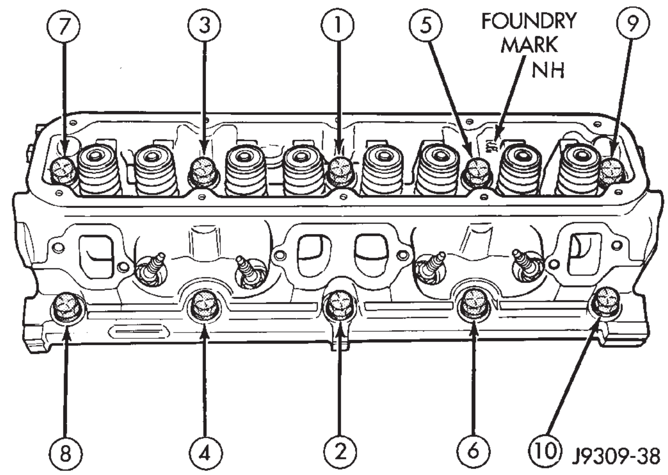


Fig. 6 Cylinder Head Bolt Tightening Sequence

CAUTION: When tightening the rocker arm bolts, make sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

(6) Install push rods and rocker arm assemblies in their original position. Tighten the bolts to 28 N·m (21 ft. lbs.) torque.

(7) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION) and throttle body assembly.

(8) Install exhaust manifolds (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - INSTALLATION).

(9) If required, adjust spark plugs to specifications. Install the plugs and tighten to 41 N·m (30 ft. lbs.) torque.

(10) Install coil wire.

(11) Connect heat indicator sending unit wire.

(12) Connect the heater hoses and bypass hose.

(13) Install distributor cap and wires.

(14) Connect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(15) Install the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(16) Install the generator and drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION). Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque. Tighten the adjusting strap bolt to 23 N·m (200 in. lbs.) torque.

(17) Install the intake manifold-to-generator bracket support rod. Tighten the bolts.

(18) Place the cylinder head cover gaskets in position and install cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(19) Install closed crankcase ventilation system.

CYLINDER HEAD (Continued)

(20) Connect the evaporation control system.
(21) Install the air cleaner.
(22) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(23) Connect the negative cable to the battery.
(24) Start engine check for leaks.

CYLINDER HEAD COVER(S)

DESCRIPTION - CYLINDER HEAD COVER GASKET

The cylinder head cover gasket (Fig. 7) is a steel-backed silicone gasket, designed for long life usage.

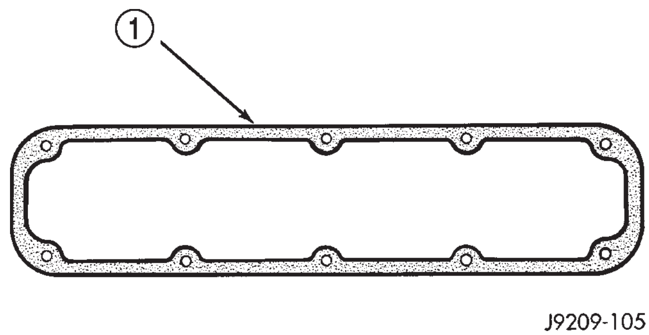


Fig. 7 Cylinder Head Cover Gasket V-8 Gas Engines

1 - CYLINDER HEAD COVER GASKET

OPERATION - CYLINDER HEAD COVER GASKET

The steel-backed silicone gasket is designed to seal the cylinder head cover for long periods of time through extensive heat and cold, without failure. The gasket is designed to be reusable.

REMOVAL

NOTE: A steel backed silicon gasket is used with the cylinder head cover (Fig. 8). This gasket can be used again.

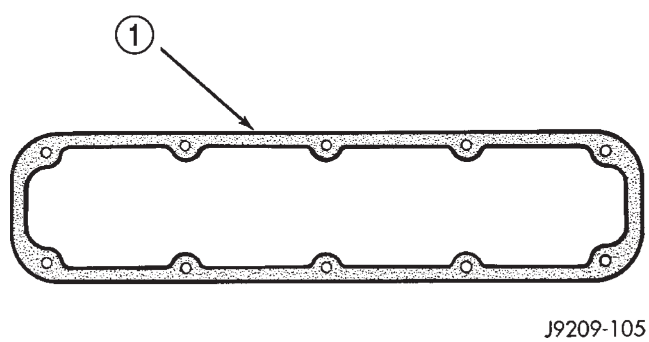


Fig. 8 Cylinder Head Cover Gasket

1 - CYLINDER HEAD COVER GASKET

(1) Disconnect the negative cable from the battery.
(2) Disconnect the spark plug wires form the spark plugs and set aside.
(3) Disconnect closed ventilation system and evaporation control system from cylinder head cover.
(4) Remove cylinder head cover and gasket.

CLEANING

Clean cylinder head cover gasket surface.
Clean head rail, if necessary.

INSPECTION

Inspect cover for distortion and straighten, if necessary.

Check the gasket for use in head cover installation. If damaged, use a new gasket.

INSTALLATION

(1) The cylinder head cover gasket can be used again. Install the gasket onto the head rail.
(2) Position the cylinder head cover onto the gasket. Tighten the bolts to 11 N·m (95 in. lbs.) torque.
(3) Install closed crankcase ventilation system and evaporation control system.
(4) Connect the spark plug wires to the spark plugs.
(5) Connect the negative cable to the battery.

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—VALVES, GUIDES AND SPRINGS

VALVE 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.

VALVE GUIDES

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. 9). The special

INTAKE/EXHAUST VALVES & SEATS (Continued)

sleeve places the valve at the correct height for checking with a dial indicator.

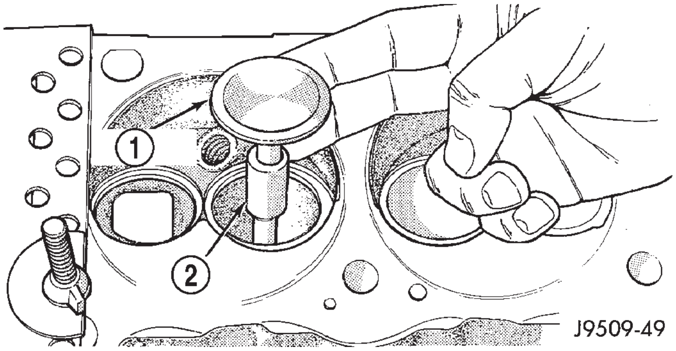


Fig. 9 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 10).

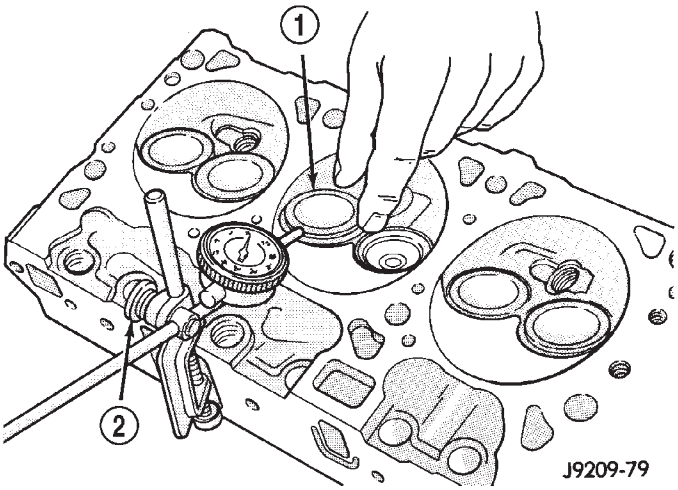


Fig. 10 Measuring Valve Guide Wear

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.

VALVE GUIDES

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).

REFACING VALVES AND VALVE SEATS

The intake and exhaust valves have a 43-1/4° to 43-3/4° face angle and a 44-1/4° to 44-3/4° seat angle (Fig. 11).

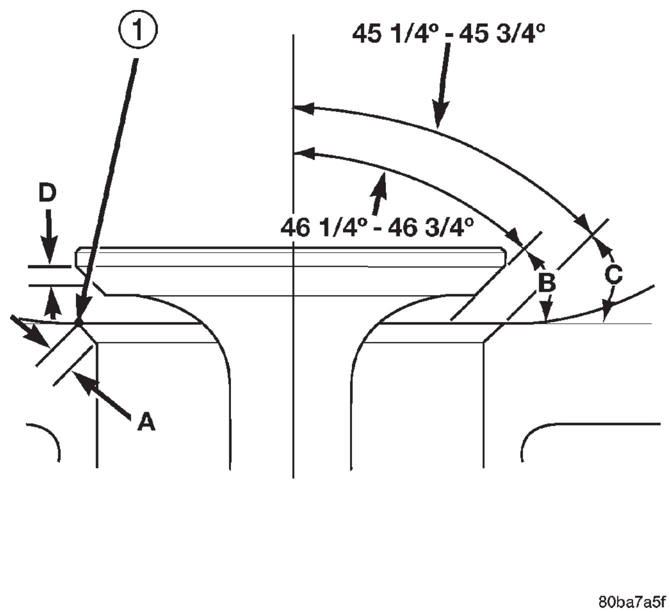


Fig. 11 Valve Face and Seat Angles

1 - CONTACT POINT
A,B,C and D Refer to VALVE FACE AND VALVE SEAT ANGLE CHART

INTAKE/EXHAUST VALVES & SEATS (Continued)

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	—

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 12). Valves with less than 1.190 mm (0.047 in.) margin should be discarded.

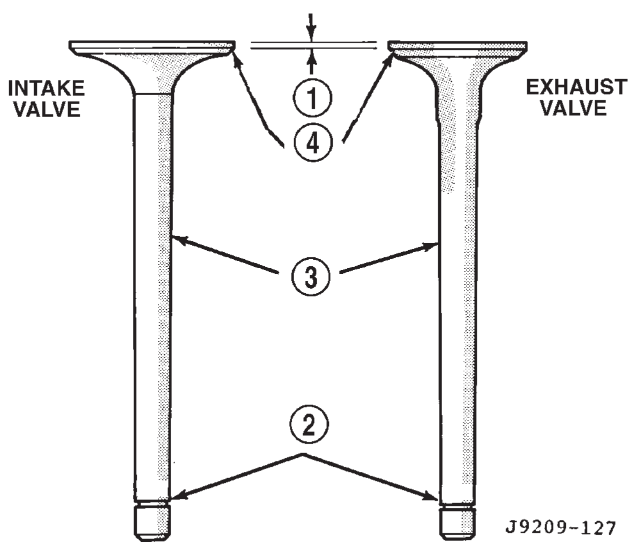


Fig. 12 Intake and Exhaust Valves

1 - MARGIN
2 - VALVE SPRING RETAINER LOCK GROOVE
3 - STEM
4 - FACE

VALVE SEATS

CAUTION: DO NOT un-shroud valves during valve seat refacing (Fig. 13).

(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.

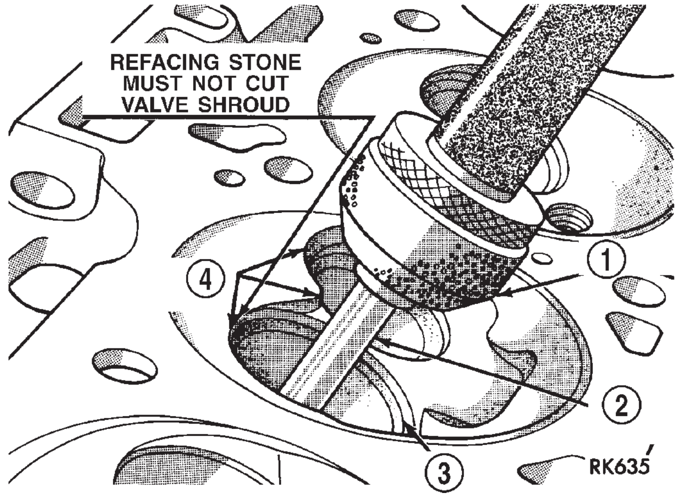


Fig. 13 Refacing Valve Seats

1 - STONE
2 - PILOT
3 - VALVE SEAT
4 - SHROUD

(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.).

VALVE SPRINGS

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. 14). Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

INTAKE/EXHAUST VALVES & SEATS (Continued)

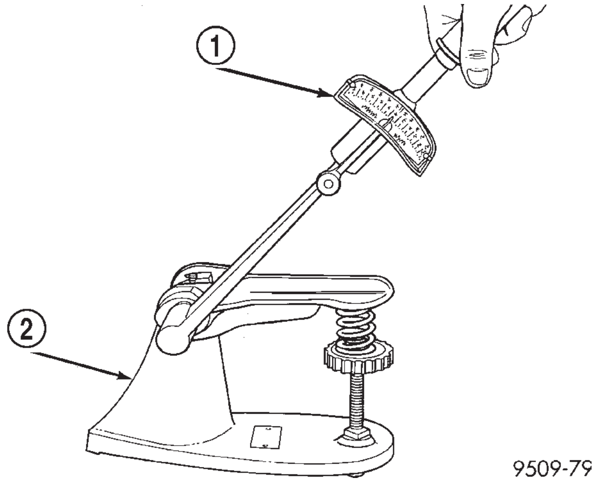


Fig. 14 Testing Valve Spring for Compressed Length

1 - TORQUE WRENCH
2 - VALVE SPRING TESTER

REMOVAL

(1) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(2) Compress valve springs using Valve Spring Compressor Tool MD- 998772A and adapter 6716A.

(3) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.

(4) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

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.

INSPECTION

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. 15). The special sleeve places the valve at the correct height for checking with a dial indicator.

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 16).

(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.

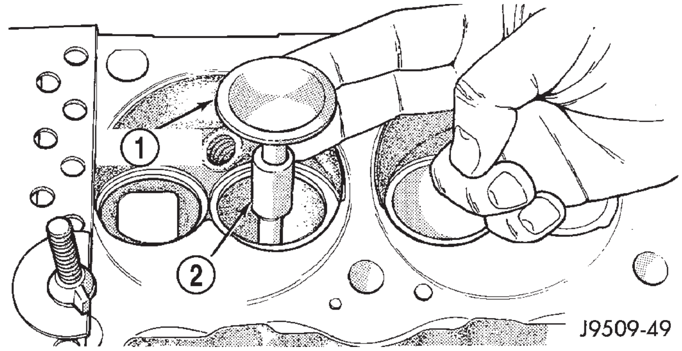


Fig. 15 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

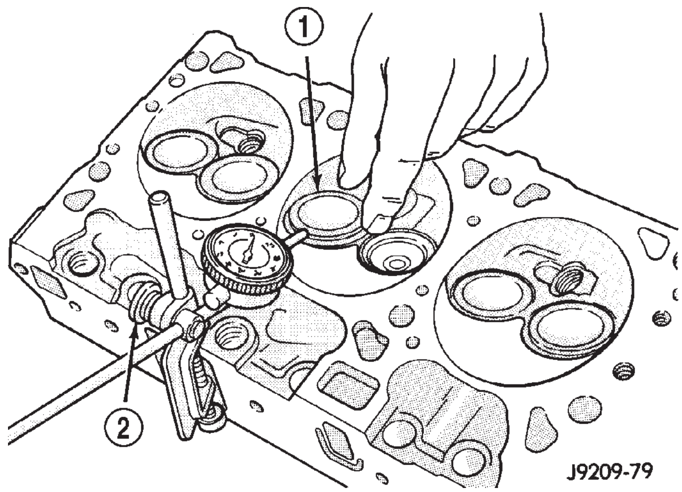


Fig. 16 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

INSTALLATION

(1) Clean valves thoroughly. Discard burned, warped and cracked valves.

(2) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

(3) Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

(4) Coat valve stems with lubrication oil and insert them in cylinder head.

(5) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.

(6) Install new seals on all valve guides. Install valve springs and valve retainers.

(7) 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. Make sure the measurement is taken from bottom of

INTAKE/EXHAUST VALVES & SEATS (Continued)

spring seat in cylinder head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 inch) spacer in head counterbore. This should bring spring height back to normal 41.27 to 42.86 mm (1-5/8 to 1-11/16 inch).

(8) Install cylinder head (Refer to 9 - ENGINE/ CYLINDER HEAD - INSTALLATION).

ROCKER ARM / ADJUSTER ASSEMBLY

REMOVAL

(1) Remove cylinder head cover and gasket (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Remove the rocker arm bolts and pivots (Fig. 17). Place them on a bench in the same order as removed.

(3) Remove the push rods and place them on a bench in the same order as removed.

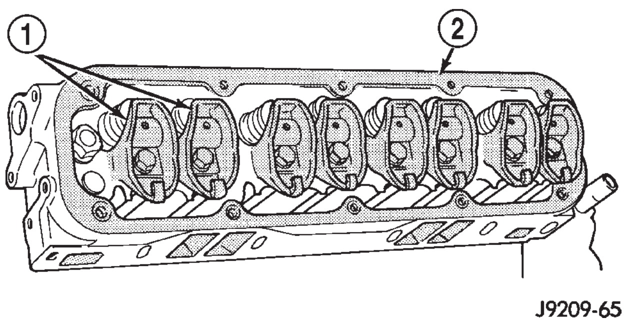


Fig. 17 Rocker Arms

1 - ROCKER ARMS
2 - CYLINDER HEAD

INSTALLATION

(1) Rotate the crankshaft until the "V8" mark lines up with the TDC mark on the timing chain case cover. This mark is located 147° ATDC from the No.1 firing position.

(2) Install the push rods in the same order as removed.

(3) Install rocker arm and pivot assemblies in the same order as removed. Tighten the rocker arm bolts to 28 N·m (21 ft. lbs.) torque.

CAUTION: DO NOT rotate or crank the engine during or immediately after rocker arm installation. Allow the hydraulic roller tappets adequate time to bleed down (about 5 minutes).

(4) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

ENGINE BLOCK

CLEANING

Clean cylinder block thoroughly and check all core hole plugs for evidence of leakage.

INSPECTION

Examine block for cracks or fractures.

The cylinder walls should be checked for out-of-round and taper. Refer to Honing Cylinder Bores in the Service Procedures portion of this Section.

Inspect the oil line plug, the oil line plug is located in the vertical passage at the rear of the block between the oil-to-filter and oil-from-filter passages (Fig. 18) . Improper installation or missing plug could cause erratic, low, or no oil pressure.

The oil plug must come out the bottom. Use flat dowel, down the oil pressure sending unit hole from the top, to remove oil plug.

(1) Remove oil pressure sending unit from back of block.

(2) Insert a 3.175 mm (1/8 in.) finish wire, or equivalent, into passage.

(3) Plug should be 190.0 to 195.2 mm (7-1/2 to 7-11/16 in.) from machined surface of block (Fig. 18) . If plug is too high, use a suitable flat dowel to position properly.

(4) If plug is too low, remove oil pan and No. 4 main bearing cap. Use suitable flat dowel to position properly . Coat outside diameter of plug with Mopar® Stud and Bearing Mount Adhesive. Plug should be 54.0 to 57.7 mm (2-1/8 to 2-5/16 in.) from bottom of the block.

CAMSHAFT & BEARINGS (IN BLOCK)

REMOVAL—CAMSHAFT BEARINGS

NOTE: This procedure requires that the engine is removed from the vehicle.

(1) With engine completely disassembled, drive out rear cam bearing core plug.

(2) Install proper size adapters and horseshoe washers (part of Camshaft Bearing Remover/Installer Tool C-3132-A) at back of each bearing shell. Drive out bearing shells (Fig. 19).

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

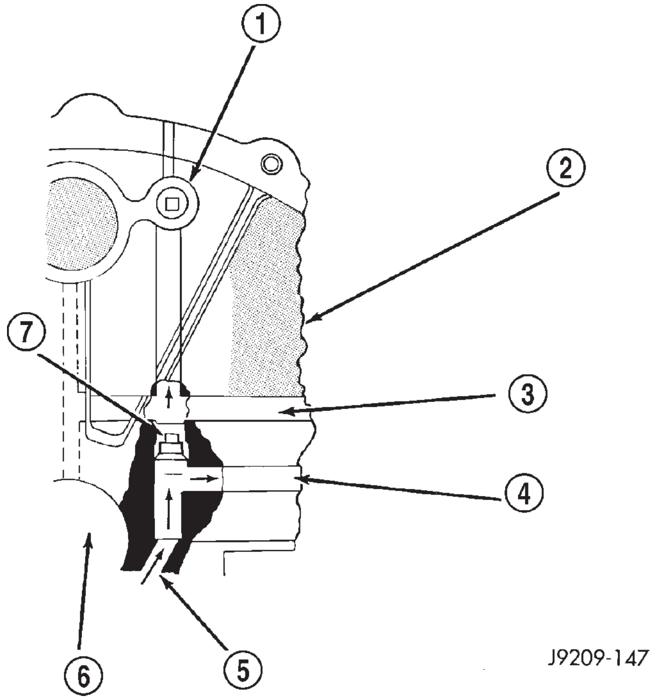


Fig. 18 Oil Line Plug

1 - RIGHT OIL GALLERY
2 - CYLINDER BLOCK
3 - OIL FROM FILTER TO SYSTEM
4 - OIL TO FILTER
5 - FROM OIL PUMP
6 - CRANKSHAFT
7 - PLUG

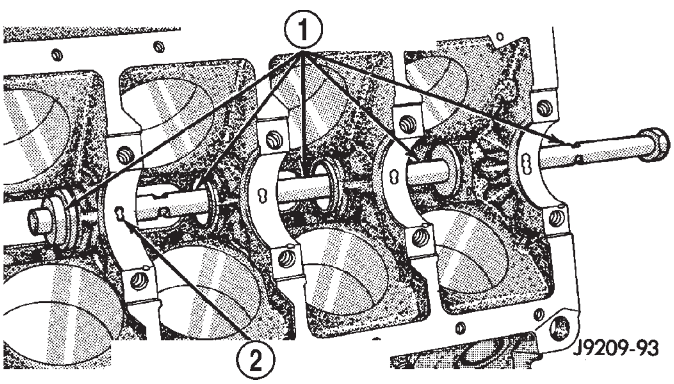


Fig. 19 Camshaft Bearings

1 - SPECIAL TOOL C-3132–A
2 - MAIN BEARING OIL HOLE

REMOVAL—CAMSHAFT

NOTE: The camshaft has an integral oil pump and distributor drive gear (Fig. 20) .

(1) Remove the radiator (Refer to 7 - COOLING/ ENGINE/RADIATOR - REMOVAL).

(2) Remove the A/C Condenser (if equipped)

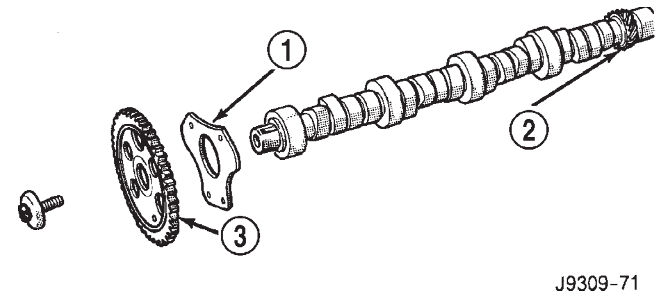


Fig. 20 Camshaft and Sprocket Assembly

1 - THRUST PLATE
2 - OIL PUMP AND DISTRIBUTOR DRIVE GEAR INTEGRAL WITH CAMSHAFT
3 - CAMSHAFT SPROCKET

(3) Remove the engine cover.

(4) Remove intake manifold (Refer to 9 - ENGINE/ MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(5) Remove cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(6) Remove timing case cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL) and timing chain (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(7) Remove rocker arms.

(8) Remove push rods and tappets. Identify each part so it can be installed in its original location.

(9) Remove distributor and lift out the oil pump and distributor drive shaft.

(10) Remove camshaft thrust plate, note location of oil tab (Fig. 21).

(11) Install a long bolt into front of camshaft to aid in removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSTALLATION—CAMSHAFT BEARINGS

(1) Install new camshaft bearings with Camshaft Bearing Remover/Installer Tool C-3132-A by sliding the new camshaft bearing shell over proper adapter.

(2) Position rear bearing in the tool. Install horseshoe lock and by reversing removal procedure, carefully drive bearing shell into place.

(3) Install remaining bearings in the same manner. Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

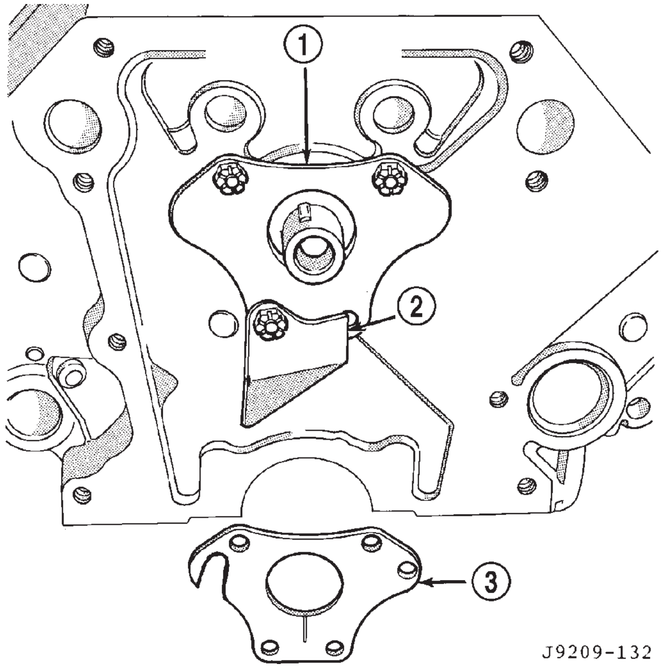


Fig. 21 Timing Chain Oil

1 - THRUST PLATE FRONT SIDE
2 - CHAIN OIL TAB
3 - THRUST PLATE REAR SIDE

INSTALLATION—CAMSHAFT

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft to within 51 mm (2 inches) of its final position in cylinder block.

(2) Install Camshaft Holder Tool C-3509 with tongue back of distributor drive gear (Fig. 22).

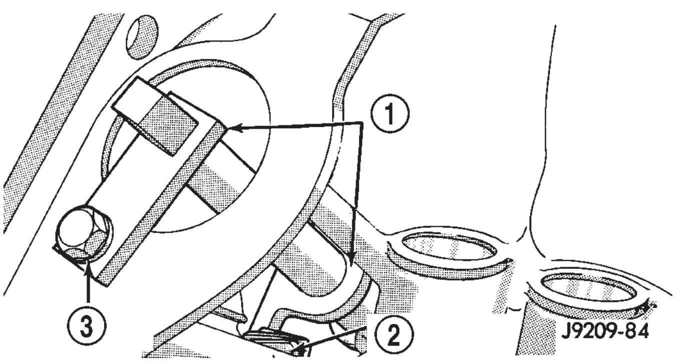


Fig. 22 Camshaft Holding Tool C-3509 (Installed Position)

1 - SPECIAL TOOL C-3509
2 - DRIVE GEAR
3 - DISTRIBUTOR LOCK BOLT

(3) Hold tool in position with a distributor lock-plate bolt. This tool will restrict camshaft from being pushed in too far and prevent knocking out the welch plug in rear of cylinder block. **Tool should remain installed until the camshaft and crankshaft sprockets and timing chain have been installed.**

(4) Install camshaft thrust plate and chain oil tab. **Make sure tang enters lower right hole in thrust plate.** Tighten bolts to 24 N·m (210 in. lbs.) torque. Top edge of tab should be flat against thrust plate in order to catch oil for chain lubrication.

(5) Install timing chain and gears (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(6) Measure camshaft end play (Refer to 9 - ENGINE - SPECIFICATIONS). If not within limits install a new thrust plate.

(7) Each tappet reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the tappets must be replaced.**

(8) Install distributor and distributor drive shaft.

(9) Install push rods and tappets.

(10) Install rocker arms.

(11) Install timing case cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(12) Install cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(13) Install intake manifold (Refer to 9 - ENGINE/ MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(14) Install the engine cover.

(15) Install the A/C Condenser (if equipped)

(16) Install the radiator (Refer to 7 - COOLING/ ENGINE/RADIATOR - INSTALLATION).

(17) Start engine check for leaks.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE—CONNECTING ROD BEARING FITTING

Fit all rods on a bank until completed. DO NOT alternate from one bank to another, because connecting rods and pistons are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly.

Each bearing cap has a small V-groove across the parting face. When installing the lower bearing shell, be certain that the V-groove in the shell is in line with the V-groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

The bearing shells must be installed so that the tangs are in the machined grooves in the rods and caps.

CONNECTING ROD BEARINGS (Continued)

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 in.). Bearings are available in 0.025 mm (0.001 in.), 0.051 mm (0.002 in.), 0.076 mm (0.003 in.), 0.254 mm (0.010 in.) and 0.305 mm (0.012 in.) undersize. **Install the bearings in pairs. DO NOT use a new bearing half with an old bearing half. DO NOT file the rods or bearing caps.**

CRANKSHAFT

DESCRIPTION

The crankshaft (Fig. 23) is of a cast nodular steel splayed type design, with five main bearing journals.The crankshaft is located at the bottom of the engine block and is held in place with five main bearing caps. The number 3 counterweight is the location for journal size identification.

Undersize Journal	Identification Stamp
0.025 mm (0.001 inch) (Rod)	R1-R2-R3 or R4
0.025 mm (0.001 inch) (Main)	M1-M2-M3-M4 or M5

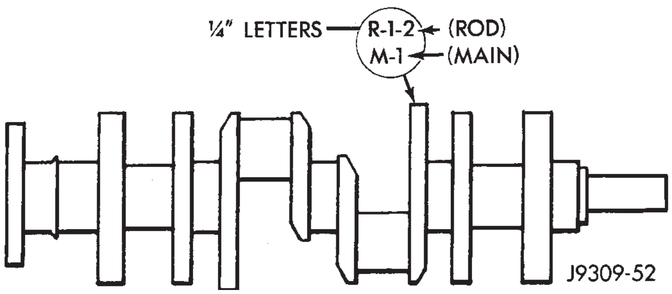


Fig. 23 Crankshaft with Journal Size Identification

OPERATION

The crankshaft transfers force generated by combustion within the cylinder bores to the flywheel or flexplate.

REMOVAL

NOTE: This procedure can be done in vehicle. However the transmission must be removed first.

(1) If crankshaft is to be removed while engine is in vehicle remove the transmission. Refer to 21 - TRANSMISSION/TRANSAXLE.

(2) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(3) Remove the oil pump from the rear main bearing cap (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(4) Remove the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(5) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(6) Identify rod bearing caps before removal. Remove rod bearing caps with bearings.

CAUTION: Support crankshaft before removing main bearing caps. failure to do so will allow the crankshaft to fall damaging the crankshaft.

(7) Using a suitable jack, support the crankshaft.

(8) Identify main bearing caps before removal. Remove main bearing caps and bearings one at a time.

(9) Lower the crankshaft out of the block.

(10) Remove and discard the crankshaft rear oil seals.

(11) Remove and discard the front crankshaft oil seal.

INSTALLATION

(1) Clean Gasket Maker residue and sealant from the cylinder block and rear cap mating surface. Do this before applying the Mopar® Gasket Maker and the installation of rear cap.

(2) Lightly oil the new upper seal lips with engine oil.

(3) Install the new upper rear bearing oil seal with the white paint facing towards the rear of the engine.

(4) Position the crankshaft into the cylinder block.

(5) Lightly oil the new lower seal lips with engine oil.

(6) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(7) Apply 5 mm (0.20 in) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 24). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(8) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(9) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(10) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(11) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

CRANKSHAFT (Continued)

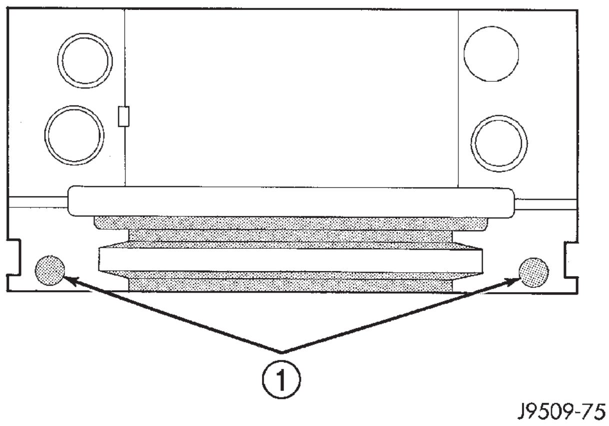


Fig. 24 Sealant Application to Bearing Cap

1 - .25 DROP OF LOCTITE 515 ON BOTH SIDES OF REAR MAIN CAP

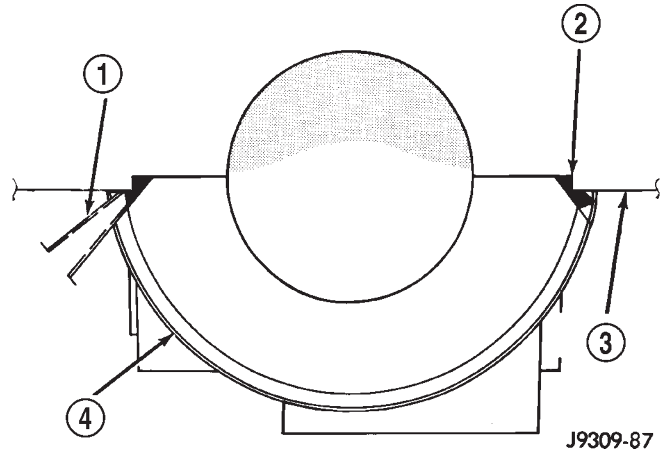


Fig. 25 Apply Sealant to Bearing Cap to Block Joint

1 - MOPAR ® GEN II SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 - SEALANT APPLIED
3 - CYLINDER BLOCK
4 - REAR MAIN BEARING CAP

(12) Install the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(13) Position the connecting rods onto the crankshaft and install the rod bearing caps. Tighten the nuts to 61 N·m (45 ft. lbs.).

(14) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 25). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(15) Install new front crankshaft oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION).

(16) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(17) If the transmission was removed, install the transmission. Refer to 21 - TRANSMISSION/TRANSAXLE.

CRANKSHAFT MAIN BEARINGS

DESCRIPTION

Main bearings (Fig. 26) 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 three main bearing is flanged, this flange controls crankshaft thrust.

OPERATION

The main bearings encircle the crankshaft main bearing journals, this aligns the crankshaft to the

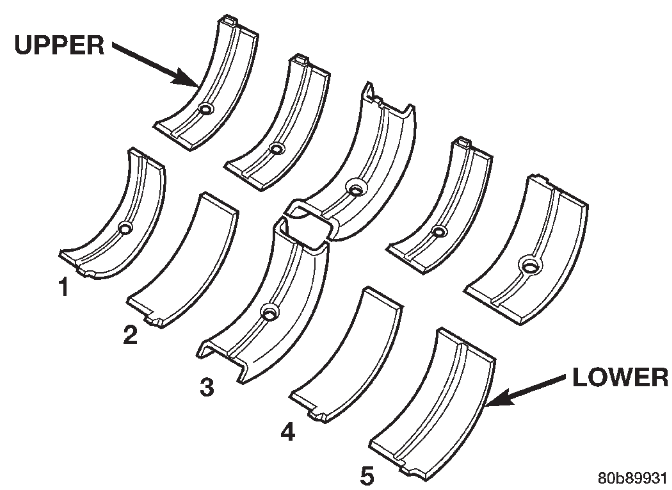


Fig. 26 Main Bearing Orientation

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 BEARING FITTING

Bearing caps are not interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of No.2 and 4 are interchangeable.

Upper and lower No.3 bearing halves are flanged to carry the crankshaft thrust loads. They are NOT interchangeable with any other bearing halves in the engine (Fig. 27). Bearing shells are available in standard and the following undersizes: Never install an

CRANKSHAFT MAIN BEARINGS (Continued)

undersize bearing that will reduce clearance below specifications.

Main Bearing Undersize Availability List

- 0.25 mm (0.001 inch)
- 0.051 mm (0.002 inch)
- 0.076 mm (0.003 inch)
- 0.254 mm (0.010 inch)
- 0.305 mm (0.012 inch)

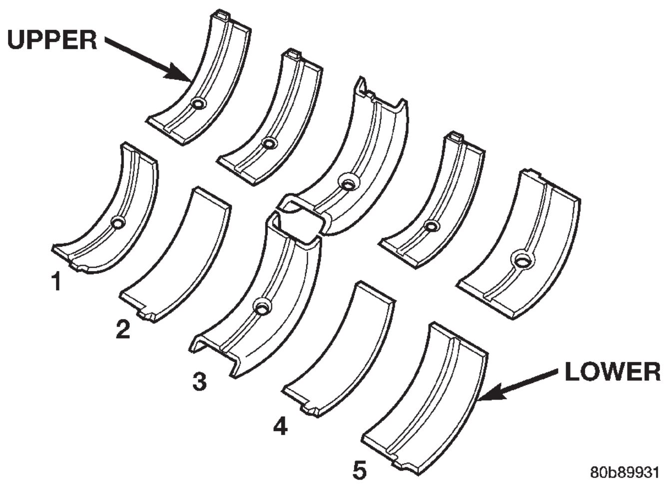


Fig. 27 Main Bearing

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 (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(3) Identify bearing caps before removal. Remove bearing caps one at a time.

(4) Remove upper half of bearing by inserting Crankshaft Main Bearing Remover/Installer Tool C-3059 into the oil hole of crankshaft (Fig. 28).

(5) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened. All bearing capbolts removed during service procedures are to be cleaned and oiled before installation.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Crankshaft Main Bearing Remover/Installer Tool C-3059 into oil hole of crankshaft (Fig. 28).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

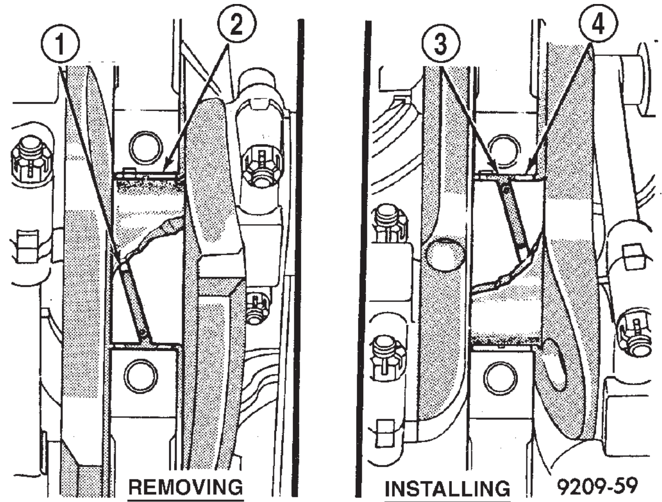


Fig. 28 Upper Main Bearing Removal and Installation with Tool C-3059

1 - SPECIAL TOOL C-3059
2 - BEARING
3 - SPECIAL TOOL C-3059
4 - BEARING

(3) Install the bearing caps. Clean and oil the bolts. Tighten the capbolts to 115 N·m (85 ft. lbs.) torque.

(4) Install the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(5) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(6) Start engine check for leaks.

CRANKSHAFT OIL SEAL - FRONT

DESCRIPTION

The crankshaft front seal is a one piece viton seal with a steel housing. The front seal is located in the engine front cover.

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).

CRANKSHAFT OIL SEAL - FRONT (Continued)

(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 (Fig. 29) . Seat the oil seal in the groove of the tool.

(2) Position the seal and tool onto the crankshaft (Fig. 30).

(3) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 31).

(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.

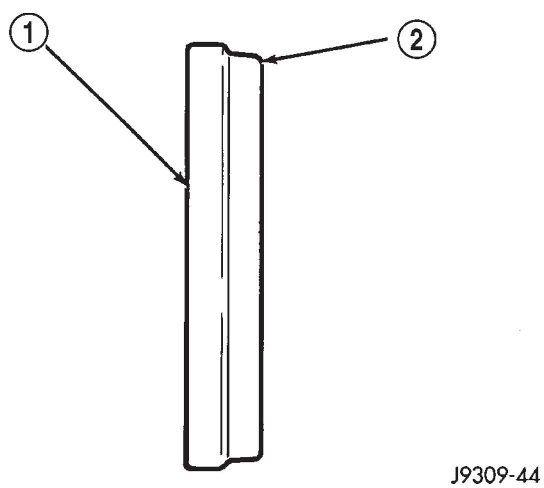


Fig. 29 Placing Oil Seal on Installation Tool 6635

1 - CRANKSHAFT FRONT OIL SEAL
2 - INSTALL THIS END INTO SPECIAL TOOL 6635

CRANKSHAFT OIL SEAL - REAR

DESCRIPTION

The crankshaft rear seal is a two piece viton seal. One part of the two piece rear seal is located in a slot in the cylinder block oppsite the crankshaft main bearing cap, the second part of the two piece seal is located in the main bearing cap itself.

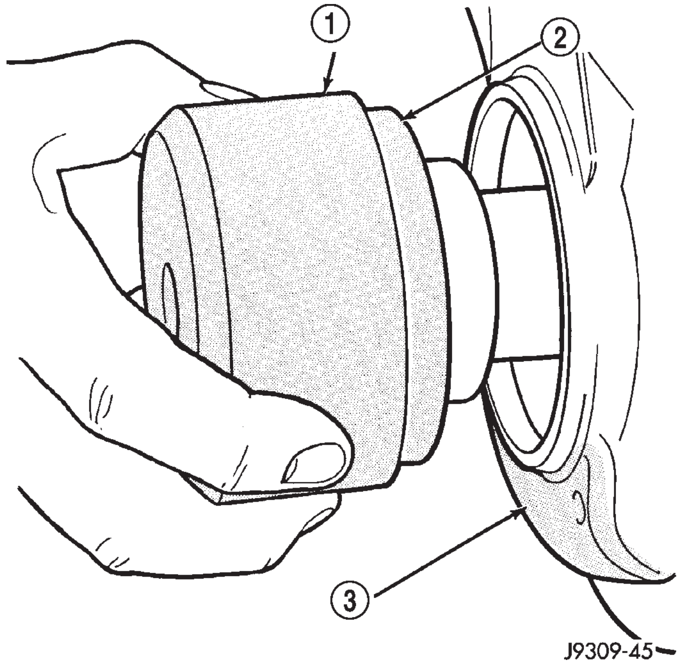


Fig. 30 Position Tool and Seal onto Crankshaft

1 - SPECIAL TOOL 6635
2 - OIL SEAL
3 - TIMING CHAIN COVER

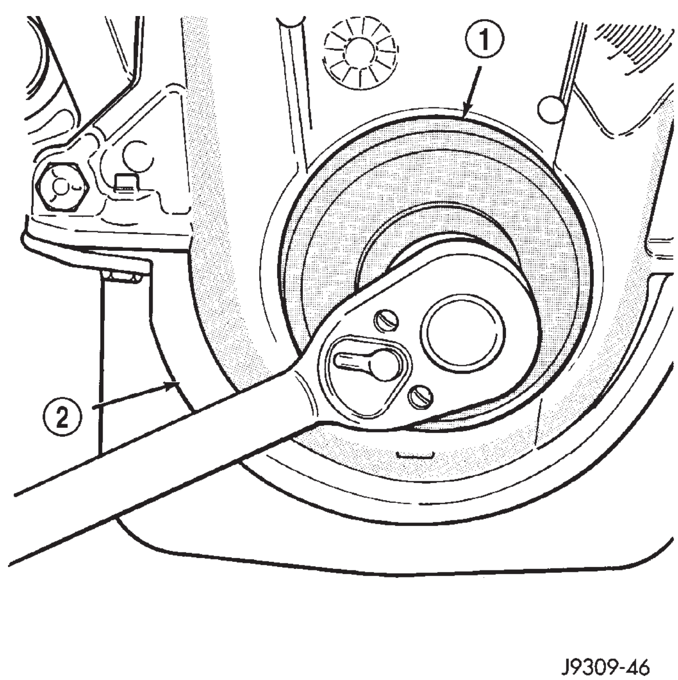


Fig. 31 Installing Oil Seal

1 - SPECIAL TOOL 6635
2 - TIMING CHAIN COVER

CRANKSHAFT OIL SEAL - REAR (Continued)

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.

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)

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

The service seal is a two piece, Viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal. The lower seal half can be installed only with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

(1) Remove the crankshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - REMOVAL). Discard the old upper seal.

UPPER SEAL—CRANKSHAFT INSTALLED

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(3) Remove the rear main bearing cap. Remove and discard the old lower oil seal.

(4) Carefully remove and discard the old upper oil seal.

LOWER SEAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(3) Remove the rear main bearing cap and discard the old lower seal.

INSTALLATION

The service seal is a two piece, Viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal. The lower seal half can be installed only with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

(1) Clean the cylinder block rear cap mating surface. Be sure the seal groove is free of debris. Check for burrs at the oil hole on the cylinder block mating surface to rear cap.

(2) Lightly oil the new upper seal lips with engine oil.

(3) Install the new upper rear bearing oil seal with the white paint facing toward the rear of the engine.

(4) Position the crankshaft into the cylinder block.

(5) Lightly oil the new lower seal lips with engine oil.

(6) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(7) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main

CRANKSHAFT OIL SEAL - REAR (Continued)

bearing cap (Fig. 32). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

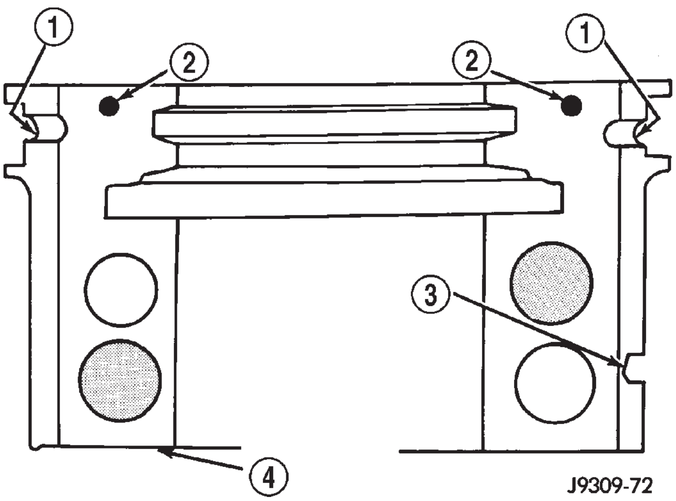


Fig. 32 Sealant Application to Bearing Cap

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT SLOTS
2 - MOPAR® GASKET MAKER (OR EQUIVALENT)
3 - CAP ALIGNMENT SLOT
4 - REAR MAIN BEARING CAP

(8) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(9) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(10) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(11) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap to block and oil pan sealing (Fig. 33) . Apply enough sealant so that a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(12) Install new front crankshaft oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION).

(13) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

UPPER SEAL—CRANKSHAFT INSTALLED

(1) Clean the cylinder block mating surfaces before oil seal installation. Check for burrs at the oil hole on the cylinder block mating surface to rear cap.

(2) Lightly oil the new upper seal lips with engine oil. To allow ease of installation of the seal, loosen at least the two main bearing caps forward of the rear bearing cap.

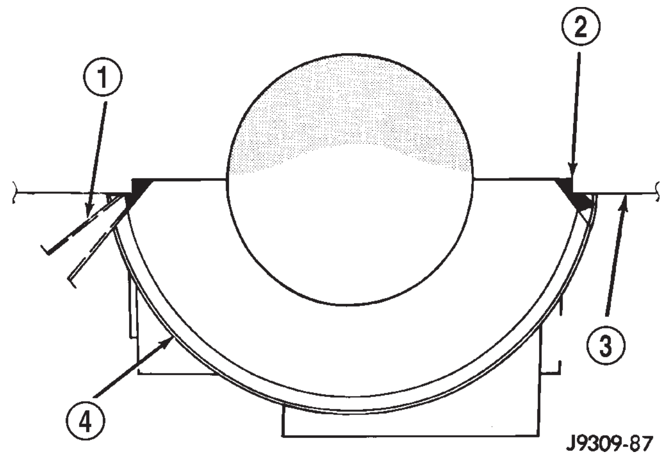


Fig. 33 Apply Sealant to Bearing Cap-to-Block Joint

1 - MOPAR ® GEN II SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 - SEALANT APPLIED
3 - CYLINDER BLOCK
4 - REAR MAIN BEARING CAP

(3) Rotate the new upper seal into the cylinder block, being careful not to shave or cut the outer surface of the seal. To ensure proper installation, use the installation tool provided with the kit. Install the new seal with the white paint facing toward the rear of the engine.

(4) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing toward the rear of the engine.

(5) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 32). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application. Be sure the white paint faces toward the rear of the engine.

(6) 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 two times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten ALL cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(9) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap-to-block and oil pan sealing (Fig. 33). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

CRANKSHAFT OIL SEAL - REAR (Continued)

(10) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

LOWER SEAL

(1) Clean the rear main cap mating surfaces including the oil pan gasket groove.

(2) Carefully install a new upper seal. Refer to UPPER SEAL—CRANKSHAFT INSTALLED .

(3) Lightly oil the new lower seal lips with engine oil.

(4) Install a new lower seal in bearing cap with the white paint facing the rear of engine.

(5) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 32). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(6) 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 two times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten the cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(9) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap to block and oil pan sealing. Apply enough sealant so that a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

DISTRIBUTOR BUSHING

REMOVAL

(1) Remove distributor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/DISTRIBUTOR - REMOVAL).

(2) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(3) Insert Distributor Drive Shaft Bushing Puller Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 34).

(4) Hold puller screw and tighten puller nut until bushing is removed.

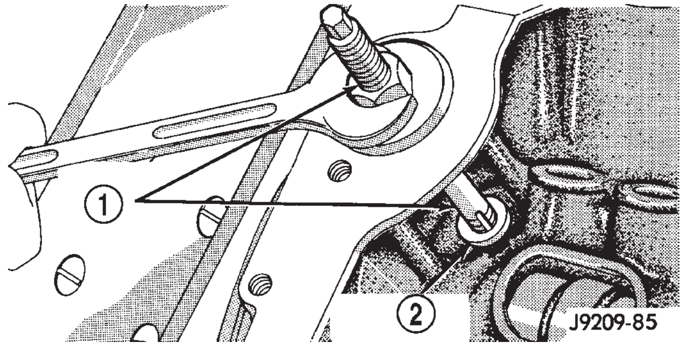


Fig. 34 Distributor Driveshaft Bushing Removal

1 - SPECIAL TOOL C-3052
2 - BUSHING

INSTALLATION

(1) Slide new bushing over burnishing end of Distributor Drive Shaft Bushing Driver/Burnisher Tool C-3053. Insert the tool and bushing into the bore.

(2) Drive bushing and tool into position, using a hammer (Fig. 35).

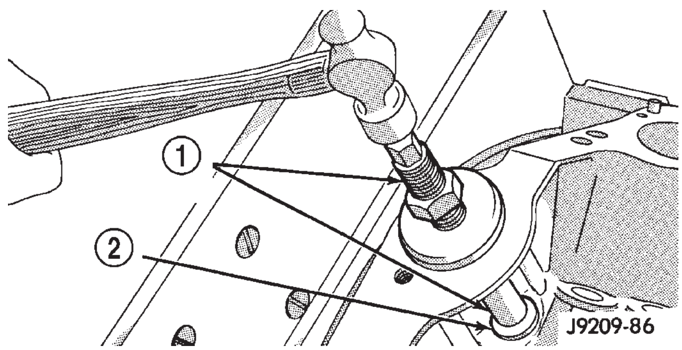


Fig. 35 Distributor Driveshaft Bushing Installation

1 - SPECIAL TOOL C-3053
2 - BUSHING

(3) As the burnisher is pulled through the bushing, the bushing is expanded tight in the block and burnished to correct size (Fig. 36). **DO NOT ream this bushing.**

CAUTION: This procedure MUST be followed when installing a new bushing or seizure to shaft may occur.

(4) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(5) Install the distributor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/DISTRIBUTOR - INSTALLATION).

DISTRIBUTOR BUSHING (Continued)

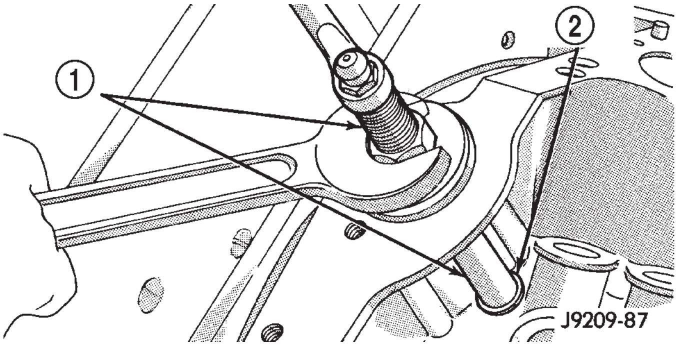


Fig. 36 Burnishing Distributor Driveshaft Bushing

1 - SPECIAL TOOL C-3053
2 - BUSHING

HYDRAULIC LIFTERS

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 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. 37).

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.

HYDRAULIC LIFTERS (Continued)

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.

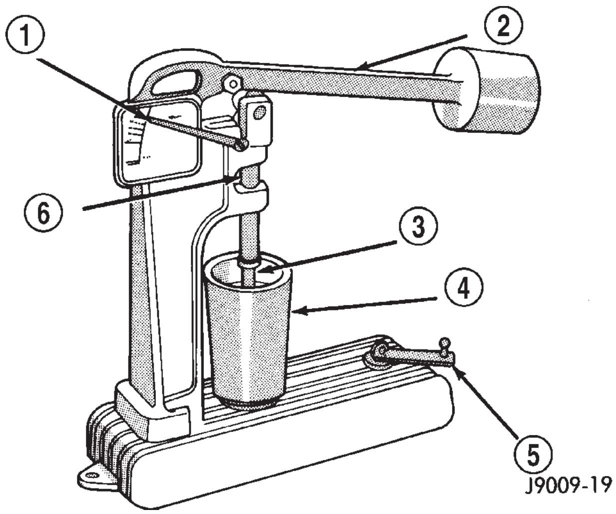


Fig. 37 Leak-Down Tester

1 - POINTER
2 - WEIGHTED ARM
3 - RAM
4 - CUP
5 - HANDLE
6 - PUSH ROD

REMOVAL

(1) Remove the air cleaner assembly and air in-let hose.

(2) Remove cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(3) Remove rocker assembly and push rods (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). Identify push rods to ensure installation in original locations.

(4) Remove intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(5) Remove yoke retainer and aligning yokes.

(6) Slide Hydraulic Tappet Remover/Installer Tool C-4129-A through opening in cylinder head and seat tool firmly in the head of tappet.

(7) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

(8) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize. Replace with oversize tappet.

CLEANING

Clean tappet with a suitable solvent. Rinse in hot water and blow dry with a clean shop rag or compressed air.

INSTALLATION

(1) Lubricate tappets with Mopar® Engine Oil Supplement or equivalent.

(2) Install tappets and push rods in their original positions . Ensure that the oil feed hole in the side of the tappet body faces up (away from the crankshaft).

(3) Install aligning yokes with ARROW toward camshaft.

(4) Install yoke retainer. Tighten the bolts to 23 N·m (200 in. lbs.) torque. Install intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(5) Install rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(6) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(7) Install air cleaner assembly and air in-let hose.

(8) Start and operate engine. Warm up to normal operating temperature.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

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.

PISTON & CONNECTING ROD (Continued)

STANDARD PROCEDURE - PISTON FITTING

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.013-0.038 mm (0.0005-0.0015 inch) at 21°C (70°F).

Piston diameter should be measured at the top of skirt, 90° to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 38).

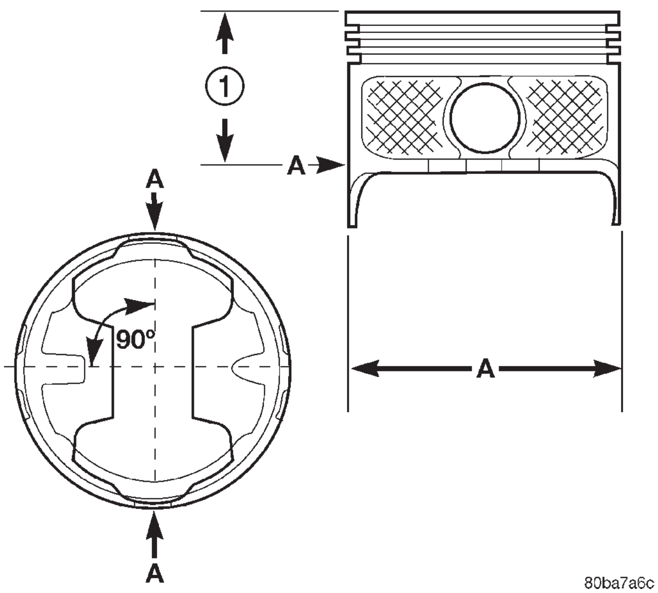


Fig. 38 Piston Measurements

1 - 49.53 mm
(1.95 IN.)

PISTON MEASUREMENT CHART

PISTON SIZE	A DIA = PISTON DIAMETER		BORE DIAMETER	
	MIN. mm (in.)	MAX. mm (in.)	MIN. mm (in.)	MAX. mm (in.)
A	—	—	—	—
B	101.580 (3.9992)	101.592 (3.9997)	101.605 (4.0002)	101.618 (4.0007)
C	101.592 (3.9997)	101.605 (4.0002)	101.618 (4.0007)	101.630 (4.0012)
D	101.605 (4.0002)	101.618 (4.0007)	101.630 (4.0012)	101.643 (4.0017)
E	—	—	—	—

DESCRIPTION	SPECIFICATION
PISTON PIN BORE	25.007 - 25.015 mm (.9845 - .9848 in.)
RING GROOVE HEIGHT	
OIL RAIL	4.033 - 4.058 mm (.1588 - .1598 in.)
COMPRESSION RAIL	1.529 - 1.554 mm (.0602 - .0612 in.)
TOTAL FINISHED WEIGHT	470.8 ± 2 grams (16.607 ± .0706 ounces)

REMOVAL

(1) Remove the engine from the vehicle (Refer to 9 - ENGINE - REMOVAL).

(2) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. Be sure to keep tops of pistons covered during this operation.

(5) Be sure each connecting rod and connecting rod cap is identified with the cylinder number. Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts.

(6) Pistons and connecting rods must be removed from top of cylinder block. When removing the assemblies from the engine, rotate crankshaft so that the connecting rod is centered in cylinder bore and at BDC. **Be careful not to nick crankshaft journals.**

(7) After removal, install bearing cap on the mating rod.

CLEANING

Clean the piston and connecting rod assembly using a suitable solvent.

PISTON & CONNECTING ROD (Continued)

INSPECTION

Check the connecting rod journal for excessive wear, taper and scoring (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

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 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

INSTALLATION

(1) Be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.

(2) Before installing the ring compressor, be sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 39) .

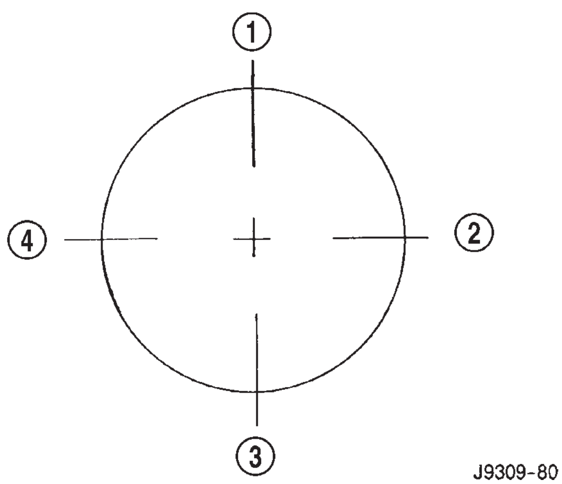


Fig. 39 Proper Ring Installation

1 - OIL RING SPACER GAP
2 - SECOND COMPRESSION RING GAP OIL RING RAIL GAP (TOP)
3 - OIL RING RAIL GAP (BOTTOM)
4 - TOP COMPRESSION RING GAP

(3) Immerse the piston head and rings in clean engine oil. Slide Piston Ring Compressor Tool C-385 over the piston and tighten with the special wrench (part of Tool C-385). **Be sure position of rings does not change during this operation.**

(4) Install connecting rod bolt protectors on rod bolts. The long protector should be installed on the numbered side of the connecting rod.

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Be sure connecting rod and cylinder bore number are the same. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

(6) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on crankshaft journal.

(7) The notch, or groove, on top of piston must be pointing toward front of engine. The larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(8) Install rod caps. Be sure connecting rod, connecting rod cap, and cylinder bore number are the same. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N·m (45 ft. lbs.) torque.

(9) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(10) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(11) Install the engine into the vehicle (Refer to 9 - ENGINE - INSTALLATION).

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

(1) Measurement of end gaps:

(a) Measure piston ring gap 2 in. from bottom of cylinder bore. An inverted piston can be used to push the rings down to ensure positioning rings squarely in the cylinder bore before measuring.

(b) Insert feeler gauge in the gap. The top compression ring gap should be between 0.254-0.508 mm (0.010-0.020 in.). The second compression ring gap should be between 0.508-0.762 mm (0.020-0.030 in.). The oil ring gap should be 0.254-1.270 mm (0.010-0.050 in.).

(c) Rings with insufficient end gap may be properly filed to the correct dimension. Rings with excess gaps should not be used.

(2) Install rings, and confirm ring side clearance:

(a) Install oil rings being careful not to nick or scratch the piston. Install the oil control rings according to instructions in the package. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(b) Install the second compression rings using Installation Tool C-4184. The compression rings must be installed with the identification mark face up (toward top of piston) and chamfer facing down. An identification mark on the ring is a drill point, a stamped letter “O”, an oval depression, or the word “TOP” (Fig. 40) (Fig. 42).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 41) (Fig. 42). An identification mark on the ring is a drill point, a stamped letter “O”, an oval depression or the word “TOP” facing up.

PISTON RINGS (Continued)

(d) Measure side clearance between piston ring and ring land. Clearance should be 0.074-0.097 mm (0.0029-0.0038 in.) for the compression rings. The steel rail oil ring should be free in groove, but should not exceed 0.246 mm (0.0097 in.) side clearance.

(e) Pistons with insufficient, or excessive, side clearance should be replaced.

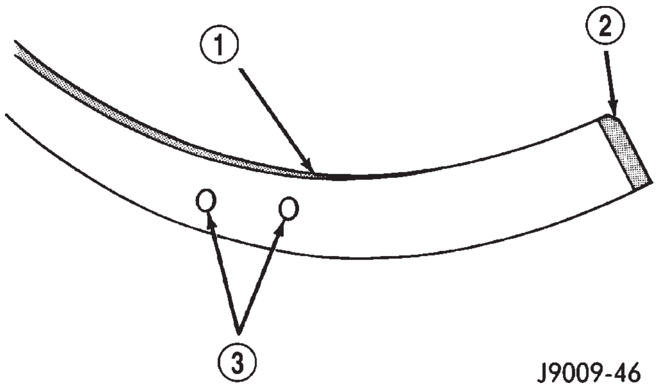


Fig. 40 Second Compression Ring Identification (Typical)

1 - SECOND COMPRESSION RING (BLACK CAST IRON)
2 - CHAMFER
3 - TWO DOTS

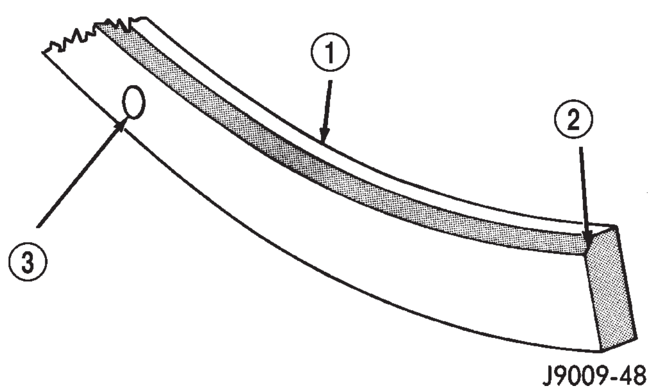


Fig. 41 Top Compression Ring Identification (Typical)

1 - TOP COMPRESSION RING (GRAY IN COLOR)
2 - CHAMFER
3 - ONE DOT

(3) Orient the rings:

(a) Arrange top compression ring 90° counterclockwise from the oil ring rail gap (Fig. 43).

(b) Arrange second compression ring 90° clockwise from the oil ring rail gap (Fig. 43).

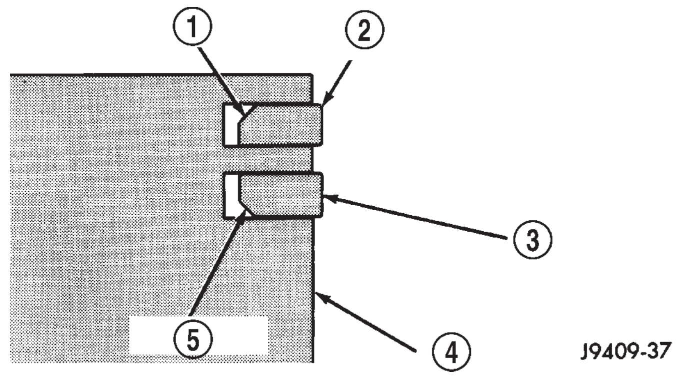


Fig. 42 Compression Ring Chamfer Location (Typical)

1 - CHAMFER
2 - TOP COMPRESSION RING
3 - SECOND COMPRESSION RING
4 - PISTON
5 - CHAMFER

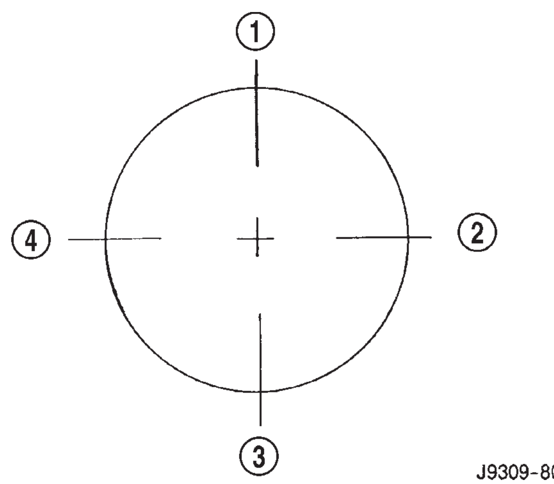


Fig. 43 Proper Ring Installation

1 - OIL RING SPACER GAP
2 - SECOND COMPRESSION RING GAP OIL RING RAIL GAP (TOP)
3 - OIL RING RAIL GAP (BOTTOM)
4 - TOP COMPRESSION RING GAP

VIBRATION DAMPER

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove the cooling system fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(3) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove vibration damper bolt and washer from end of crankshaft.

VIBRATION DAMPER (Continued)

(5) Position Special Tool 8513 Insert into the crankshaft nose.

(6) Install Special Tool 1026 Three Jaw Puller onto the vibration damper (Fig. 44).

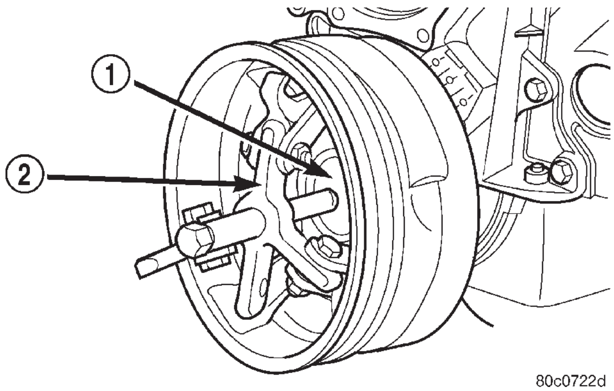


Fig. 44 Vibration Damper Removal

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

(7) Pull vibration damper off of the crankshaft.

INSTALLATION

CAUTION: Thoroughly remove any contaminants from the crankshaft nose and the vibration damper bore. Failure to do so can cause sever damage to the crankshaft.

(1) Position the vibration damper onto the crankshaft.

(2) Place installing tool, part of Puller Tool Set C-3688 in position and press the vibration damper onto the crankshaft (Fig. 45).

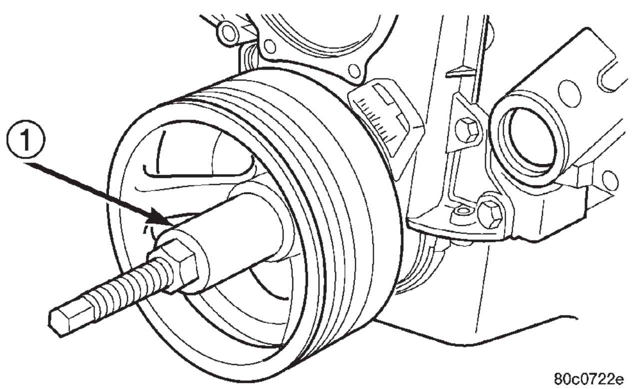


Fig. 45 Vibration Damper Installation

1 - SPECIAL TOOL C-3688

(3) Install the crankshaft bolt and washer. Tighten the bolt to 244 N·m (180 ft. lbs.) torque.

(4) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(5) Position the fan shroud and install the bolts. Tighten the retainer bolts to 11 N·m (95 in. lbs.) torque.

(6) Install the cooling fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(7) Connect the battery negative cable.

FRONT MOUNT

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.

(2) Raise hood and position fan to assure clearance for radiator top tank and hose.

CAUTION: DO NOT lift the engine by the intake manifold.

(3) Install engine lifting fixture.

(4) Raise vehicle on hoist.

(5) Remove the insulator through bolt (Fig. 46) (Fig. 47).

(6) Raise engine with lifting fixture SLIGHTLY. Remove insulator retaining bolts and remove the insulator assembly.

(7) Remove insulator heat shield and transfer to new insulator.

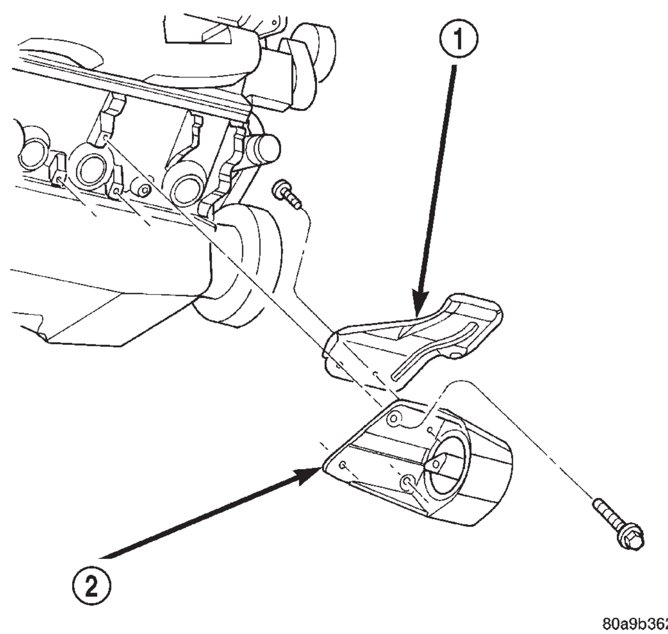


Fig. 46 Engine Right Front Insulator Mount—2WD Vehicles

1 - HEAT SHIELD
2 - INSULATOR

FRONT MOUNT (Continued)

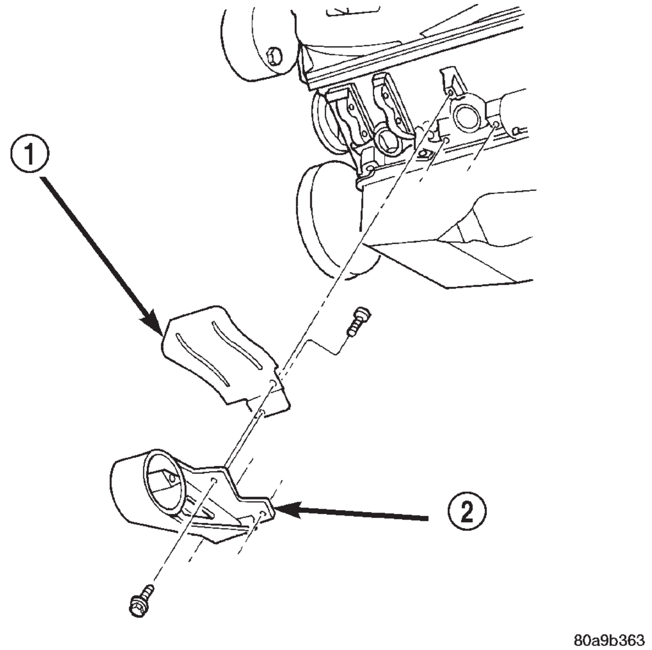


Fig. 47 Engine Left Front Insulator

1 - HEAT SHIELD
2 - INSULATOR

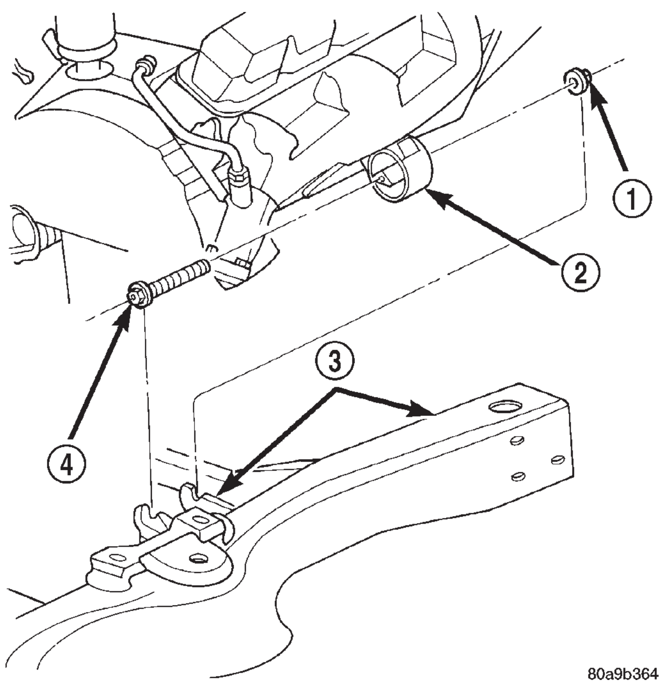


Fig. 48 Engine Mount Insulator at Frame

1 - NUT
2 - INSULATOR
3 - FRAME
4 - THROUGH BOLT

4WD

On 4WD vehicles the engine front support brackets attach directly to engine block and the axle housing. The brackets provide a solid interconnection for these units (Fig. 49) (Fig. 50). Engine must be supported during any service procedures involving the front support assemblies.

(1) Disconnect the negative cable from the battery.

(2) Raise vehicle on hoist.

(3) Install engine lifting (support) fixture.

(4) Remove front axle (Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - C205F - REMOVAL).

(5) **Left mount insulator only.** Remove starter wires and starter motor assembly (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(6) Remove insulator to frame through bolt (Fig. 51).

(7) Raise engine slightly.

(8) Remove upper insulator to support bracket stud nut and insulator to support through bolt.

(9) Remove engine mount insulator (Fig. 49) (Fig. 50).

(10) If engine support bracket is to be removed/replaced, remove support bracket to transmission bell housing bolt(s) and three (3) support bracket to engine block bolts. Remove support bracket (Fig. 49) (Fig. 50).

INSTALLATION

2WD

(1) With the engine raised SLIGHTLY, position insulator assembly onto the engine block and install bolts (Fig. 46) (Fig. 47). Tighten the bolts to 41 N·m (30 ft. lbs.) torque.

(2) Lower engine with lifting fixture while guiding insulator assembly into the engine insulator bracket (Fig. 48).

(3) Install insulator to bracket thru-bolt. Tighten the thru-bolt nut to 68 N·m (50 ft. lbs.) torque.

(4) Remove lifting fixture.

(5) Connect the negative cable to the battery.

4WD

(1) If engine support brackets were removed, install them and their fasteners (Fig. 49) (Fig. 50) . Tighten support bracket to block bolts to 41 N·m (30 ft. lbs.). Tighten support bracket to transmission bell-housing bolt(s) to 88 N·m (65 ft. lbs.).

(2) Install Engine mount insulator and tighten insulator to support bracket nut to 41 N·m (30 ft. lbs.). Tighten insulator to support bracket through bolt nut to 102 N·m (75 ft. lbs.).

FRONT MOUNT (Continued)

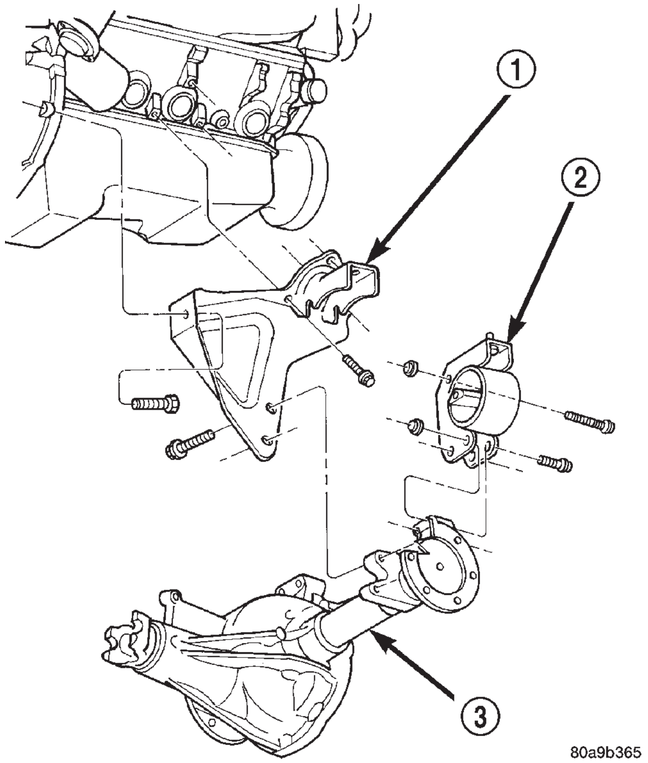


Fig. 49 Right Engine Mount Insulator and Support Bracket—4WD Vehicles

1 - ENGINE SUPPORT BRACKET
2 - INSULATOR
3 - FRONT AXLE

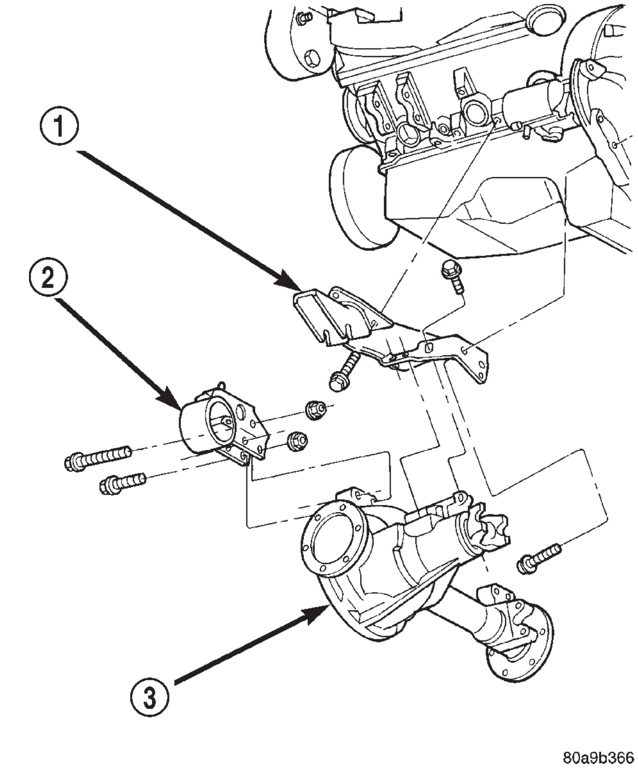


Fig. 50 Left Engine Mount Insulator and Support Bracket—4WD Vehicles

1 - ENGINE SUPPORT BRACKET
2 - INSULATOR
3 - FRONT AXLE

(3) Lower engine and install insulator to frame through bolt and nut (Fig. 51). Tighten nut to 95 N·m (70 ft. lbs.).

(4) Install starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(5) Connect starter wires.

(6) Remove engine lifting (support) fixture.

(7) Install front axle assembly (Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - C205F - INSTALLATION).

(8) Lower the vehicle.

(9) Connect the negative cable to the battery.

REAR MOUNT

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.

(2) Raise the vehicle on a hoist.

(3) Support the transmission with a jack.

(4) Remove engine support bracket and insulator thru-bolt (Fig. 52).

(5) Raise the transmission and engine slightly.

(6) Remove stud nuts attaching insulator to crossmember (Fig. 52). Remove insulator.

4WD

(1) Disconnect the negative cable from the battery.

(2) Raise the vehicle on a hoist.

(3) Support the transmission with a transmission jack.

(4) Remove stud nuts holding the insulator to the crossmember (Fig. 53).

(5) Raise rear of transmission SLIGHTLY.

(6) Remove bolts holding the insulator to the insulator bracket (Fig. 53). Remove the insulator.

INSTALLATION

2WD

(1) If the engine support bracket was removed, position the bracket to the transmission extension (Fig. 52). Tighten the bolts to 68 N·m (50 ft. lbs.) torque.

(2) Install the insulator onto crossmember. Tighten the stud nuts to 41 N·m (30 ft. lbs.) torque.

REAR MOUNT (Continued)

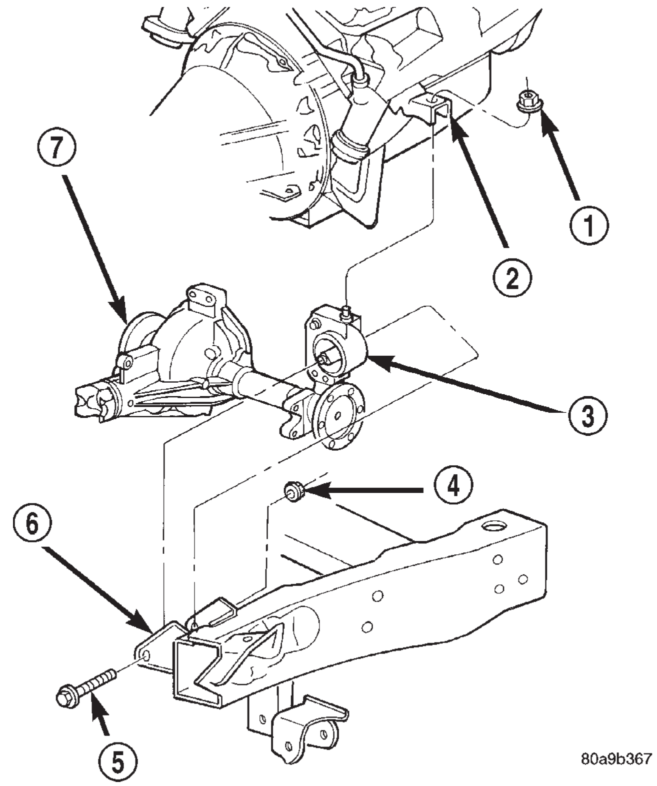


Fig. 51 Engine Mount Insulator at Frame—4WD Vehicles

1 - NUT
2 - ENGINE SUPPORT BRACKET
3 - INSULATOR
4 - NUT
5 - THROUGH BOLT
6 - FRAME
7 - FRONT AXLE

(3) Lower the transmission and engine while aligning the engine support bracket to the insulator.

(4) Install thru-bolt in bracket and insulator. Tighten thru-bolt nut to 68 N·m (50 ft. lbs.) torque.

(5) Remove transmission jack.

(6) Lower the vehicle.

(7) Connect the negative cable to the battery.

4WD

(1) If the insulator bracket was removed, install the bracket to the transmission (Fig. 53). Tighten the bolts to 28 N·m (250 in. lbs.) torque.

(2) Install the bolts holding insulator to insulator bracket. Tighten the bolts to 28 N·m (250 in. lbs.) torque.

(3) Lower rear of transmission while aligning the insulator studs into the mounting support bracket. Install stud nuts and tighten to 28 N·m (250 in. lbs.) torque.

(4) Remove the transmission jack.

(5) Lower the vehicle.

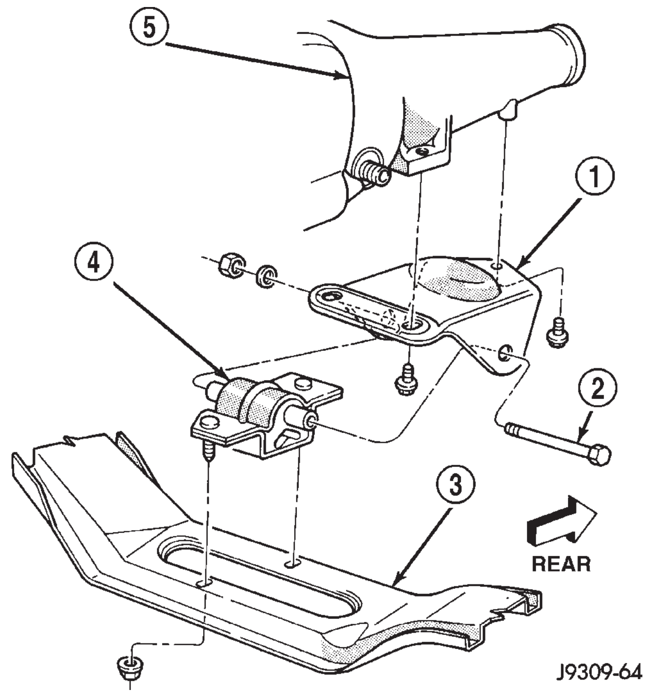


Fig. 52 Rear Insulator—2WD Vehicles

1 - ENGINE SUPPORT BRACKET
2 - THROUGH BOLT
3 - CROSSMEMBER
4 - INSULATOR
5 - TRANSMISSION EXTENSION

(6) Connect the negative cable to the battery.

LUBRICATION

DESCRIPTION

A gear-type positive displacement pump (Fig. 54) is mounted at the underside of the rear main bearing cap. The pump uses a pick-up tube and screen assembly to gather engine oil from the oil pan.

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 on the right side of the block. The oil then goes down to the No. 1 main bearing, back up to the left side of the block, and into the oil gallery on the left side of the engine.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The

LUBRICATION (Continued)

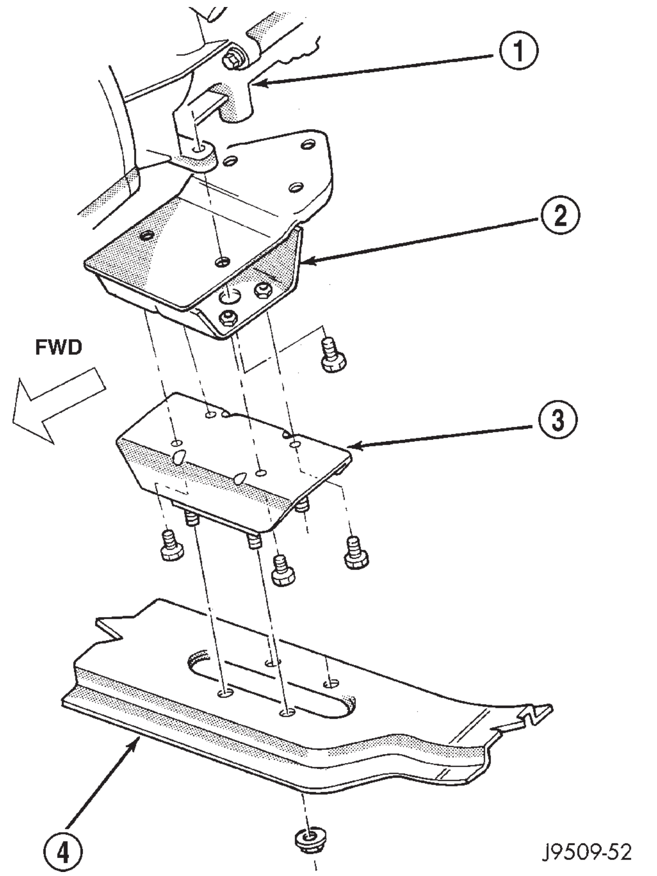


Fig. 53 Rear Insulator—4WD Vehicles

1 - AUTOMATIC TRANSMISSION
2 - INSULATOR BRACKET
3 - INSULATOR
4 - CROSSMEMBER

crankshaft is drilled internally to pass oil from the main bearing journals to the connecting rod journals. Each connecting rod bearing has half a hole in it, oil passes through the hole when the rods rotate and the hole lines up, oil is then 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. The camshaft bearings receive oil from the main bearing 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 No. 1 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. The oil then passes down through the push rod guide holes and the oil drain-back passages in the cylinder

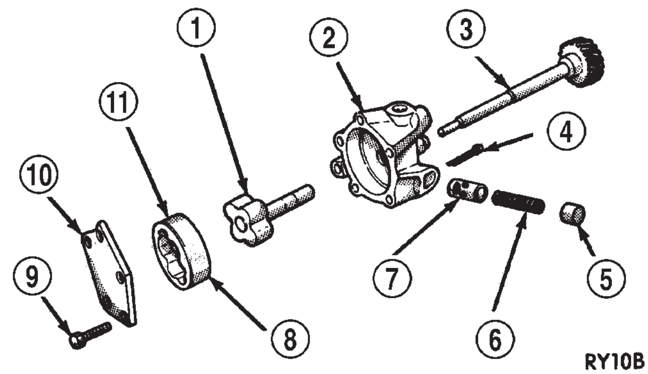


Fig. 54 Positive Displacement Oil Pump—Typical

1 - INNER ROTOR AND SHAFT
2 - BODY
3 - DISTRIBUTOR DRIVESHAFT (REFERENCE)
4 - COTTER PIN
5 - RETAINER CAP
6 - SPRING
7 - RELIEF VALVE
8 - LARGE CHAMFERED EDGE
9 - BOLT
10 - COVER
11 - OUTER ROTOR

head, past the valve tappet area, and then returns to the oil pan (Fig. 55).

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.

LUBRICATION (Continued)

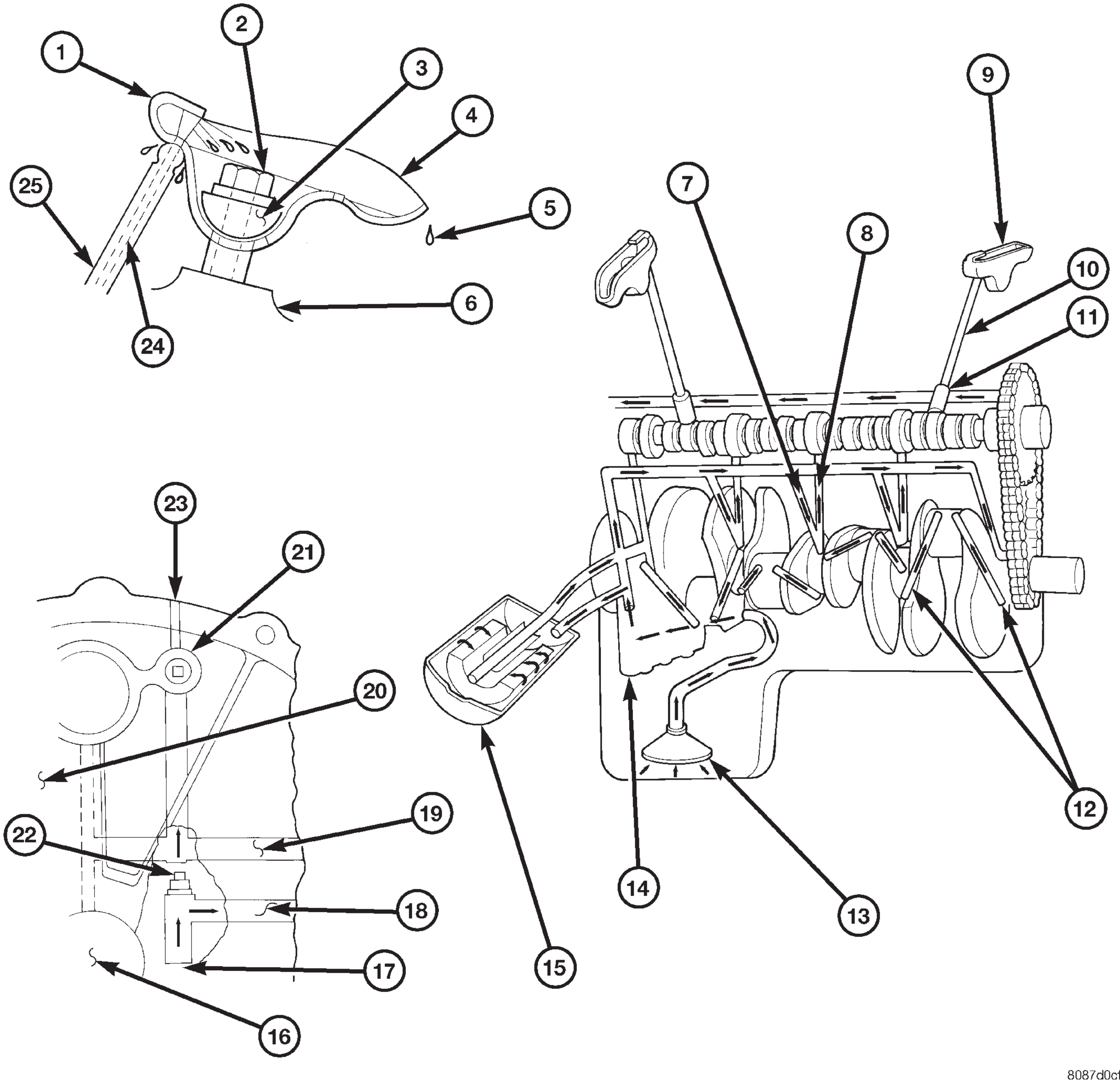


Fig. 55 Oil Lubrication System

1 - OIL DEFLECTOR TAB
2 - BOLT
3 - ROCKER ARM PIVOT
4 - ROCKER ARM
5 - DRIP OILING FOR VALVE TIP
6 - CYLINDER HEAD BOSS
7 - TO MAIN BEARINGS
8 - TO CAMSHAFT BEARINGS
9 - ROCKER ARM
10 - HOLLOW PUSH ROD
11 - TAPPET
12 - TO CONNECTING ROD BEARINGS
13 - OIL INTAKE
14 - OIL PUMP
15 - OIL FILTER
16 - CRANKSHAFT
17 - FROM OIL PUMP
18 - OIL TO FILTER
19 - OIL FROM FILTER TO SYSTEM
20 - PASSAGE TO CAMSHAFT REAR BEARING
21 - RIGHT OIL GALLERY
22 - PLUG
23 - OIL PASSAGE FOR OIL PRESSURE INDICATOR LIGHT
24 - OIL SUPPLY VIA HOLLOW PUSH ROD SUPPLY IS FROM OIL GALLERY METERED THROUGH HYDRAULIC TAPPET
25 - OIL SUPPLY FROM HOLLOW PUSH ROD

LUBRICATION (Continued)

(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

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right front of the engine, left of the generator (Fig. 56).

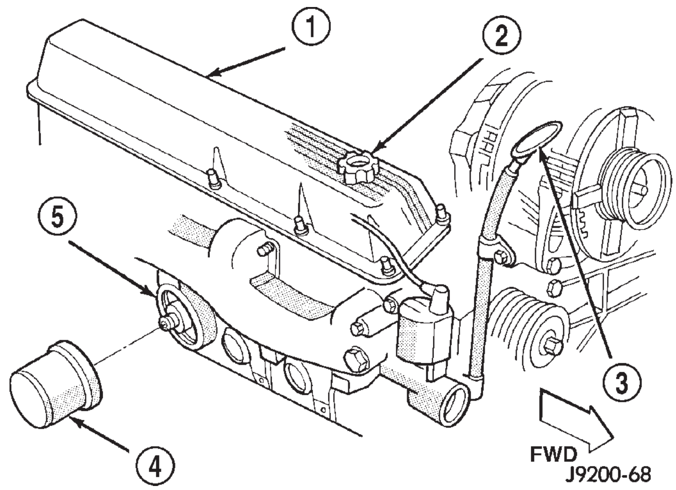


Fig. 56 Oil Level Indicator Location

1 - CYLINDER HEAD COVER
2 - ENGINE OIL FILL CAP
3 - DIPSTICK
4 - ENGINE OIL FILTER
5 - FILTER BOSS

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, oil foaming and oil pressure loss can result.

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.

(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.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in the Maintenance Schedule. This information can be found in the owner's manual.

TO CHANGE ENGINE OIL

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist vehicle.

(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 and gasket if damaged.

(6) Install drain plug in crankcase.

(7) Change oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).

(8) Lower vehicle and fill crankcase with specified type (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION) and amount of engine oil (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

OIL (Continued)

(9) Install oil fill cap.
(10) Start engine and inspect for leaks.
(11) Stop engine and inspect oil level.

OIL FILTER

REMOVAL

All engines are equipped with a high quality full-flow, disposable 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 (Fig. 57).

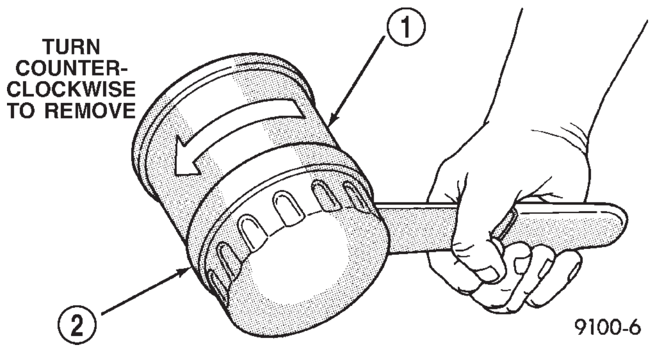


Fig. 57 Oil Filter Removal—Typical

1 - ENGINE OIL FILTER
2 - OIL FILTER WRENCH

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.
(5) With a wiping cloth, clean the gasket sealing surface (Fig. 70) of oil and grime.
(6) Install new filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).

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. 58) hand tighten filter one full turn, do not over tighten.
(3) Add oil (Refer to 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE).

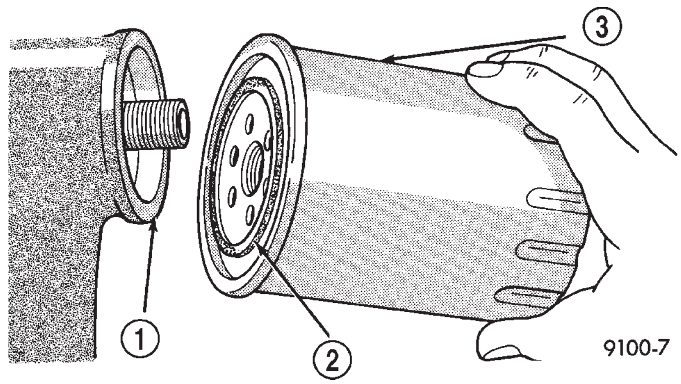


Fig. 58 Oil Filter Sealing Surface—Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

OIL PAN

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.
(2) Remove engine oil dipstick.
(3) Disconnect distributor cap and position away from cowl.
(4) Raise vehicle.
(5) Drain engine oil.
(6) Remove engine mount insulator through bolts.
(7) Raise engine by way of oil pan using a block of wood between the jack and oil pan.
(8) When engine is high enough, place mount through bolts in the engine mount attaching points on the frame brackets.
(9) Lower engine so bottom of engine mounts rest on the replacement bolts placed in the engine mount frame brackets.
(10) Remove oil pan and one-piece gasket.

4WD

(1) Disconnect the negative cable from the battery.
(2) Remove engine oil dipstick.
(3) Raise vehicle.
(4) Drain engine oil.
(5) Remove front driving axle (Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - C205F - REMOVAL).
(6) Remove both engine mount support brackets (Refer to 9 - ENGINE/ENGINE MOUNTING/FRONT MOUNT - REMOVAL).
(7) Remove transmission inspection cover.
(8) Remove oil pan and one-piece gasket.

OIL PAN (Continued)

CLEANING

Clean the block and pan gasket surfaces.

Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**

If present, trim excess sealant from inside the engine.

Clean oil pan in solvent and wipe dry with a clean cloth.

Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSPECTION

Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

INSTALLATION

2WD

(1) Fabricate 4 alignment dowels from 5/16 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. 59).

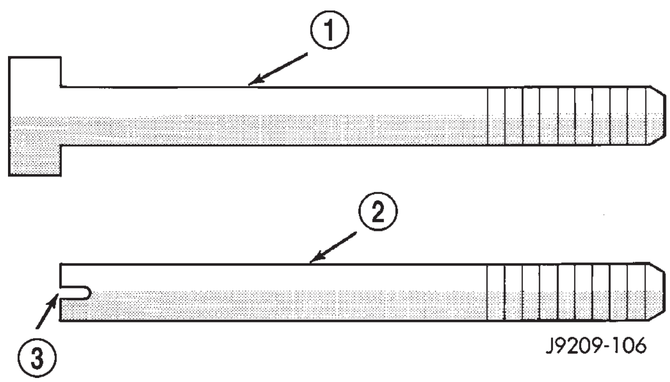


Fig. 59 Fabrication of Alignment Dowels

1 - 1 1/2” x 5/16” BOLT
2 - DOWEL
3 - SLOT

(2) Install the dowels in the cylinder block (Fig. 60).

(3) Apply small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent in the corner of the cap and the cylinder block.

(4) Slide the one-piece gasket over the dowels and onto the block.

(5) Position the oil pan over the dowels and onto the gasket.

(6) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.

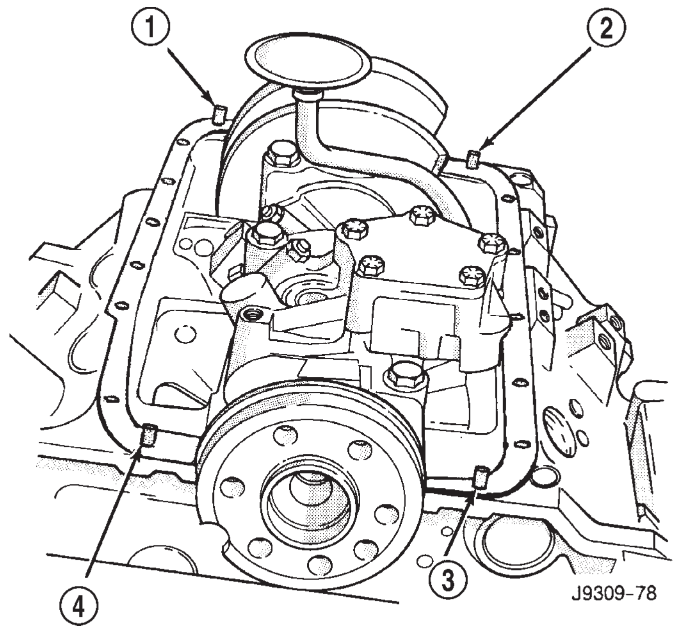


Fig. 60 Position of Dowels in Cylinder Block

1 - DOWEL
2 - DOWEL
3 - DOWEL
4 - DOWEL

(7) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.

(8) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.

(9) Raise engine by way of oil pan with a wood block placed between jack and oil pan.

(10) Remove temporary bolts from frame brackets and lower engine. Install mount insulator through bolts and tighten to 95 N·m (70 ft. lbs.).

(11) Lower vehicle.

(12) Connect the distributor cap.

(13) Install dipstick.

(14) Connect the negative cable to the battery.

(15) Fill crankcase with oil to proper level.

4WD

(1) Fabricate 4 alignment dowels from 1 1/2 x 5/16 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 59).

(2) Install the dowels in the cylinder block (Fig. 60).

(3) Apply small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent in the corner of the cap and the cylinder block.

(4) Slide the one-piece gasket over the dowels and onto the block.

(5) Position the oil pan over the dowels and onto the gasket.

OIL PAN (Continued)

(6) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.

(7) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.

(8) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.

(9) Install transmission inspection cover.

(10) Install engine mount support brackets and insulators (Refer to 9 - ENGINE/ENGINE MOUNTING/FRONT MOUNT - INSTALLATION).

(11) Install front driving axle (Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - C205F - INSTALLATION).

(12) Lower vehicle

(13) Connect the distributor cap.

(14) Install dipstick.

(15) Connect the negative cable to the battery.

(16) Fill crankcase with oil to proper level.

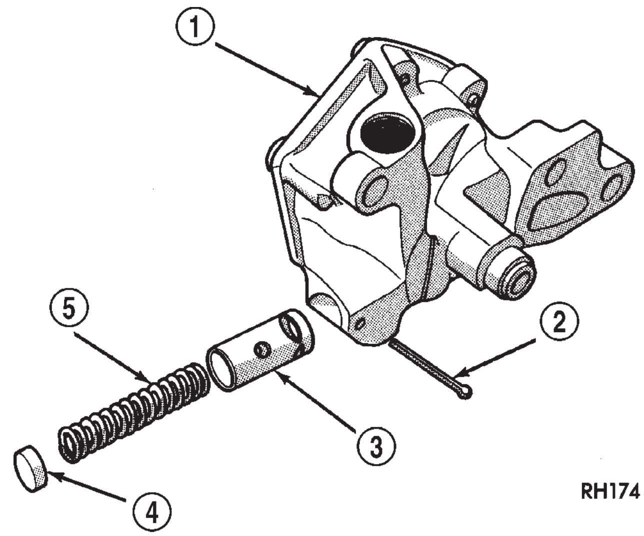


Fig. 61 Oil Pressure Relief Valve

1 - OIL PUMP ASSEMBLY
2 - COTTER PIN
3 - RELIEF VALVE
4 - RETAINER CAP
5 - SPRING

OIL PUMP

REMOVAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump from rear main bearing cap.

DISASSEMBLY

(1) Remove the relief valve as follows:

(a) Remove cotter pin. Drill a 3.175 mm (1/8 inch) hole into the relief valve retainer cap and insert a self-threading sheet metal screw.

(b) Clamp screw into a vise and while supporting oil pump, remove cap by tapping pump body using a soft hammer. Discard retainer cap and remove spring and relief valve (Fig. 61).

(2) Remove oil pump cover (Fig. 62).

(3) Remove pump outer rotor and inner rotor with shaft (Fig. 62).

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

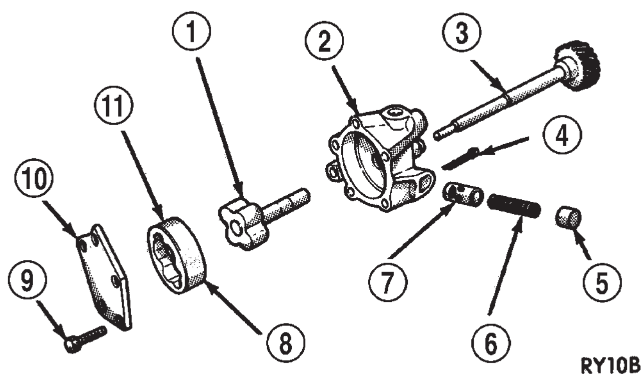


Fig. 62 Oil Pump

1 - INNER ROTOR AND SHAFT
2 - BODY
3 - DISTRIBUTOR DRIVESHAFT (REFERENCE)
4 - COTTER PIN
5 - RETAINER CAP
6 - SPRING
7 - RELIEF VALVE
8 - LARGE CHAMFERED EDGE
9 - BOLT
10 - COVER
11 - OUTER ROTOR

INSPECTION

Mating surface of the oil pump cover should be smooth. Replace pump assembly if cover is scratched or grooved.

Lay a straightedge across the pump cover surface (Fig. 63). If a 0.038 mm (0.0015 inch) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

Measure thickness and diameter of OUTER rotor. If outer rotor thickness measures 20.9 mm (0.825 inch) or less or if the diameter is 62.7 mm (2.469 inches) or less, replace outer rotor (Fig. 64).

If inner rotor measures 20.9 mm (0.825 inch) or less, replace inner rotor and shaft assembly (Fig. 65).

Slide outer rotor into pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 66). If clearance is 0.356 mm (0.014 inch) or more, replace oil pump assembly.

OIL PUMP (Continued)

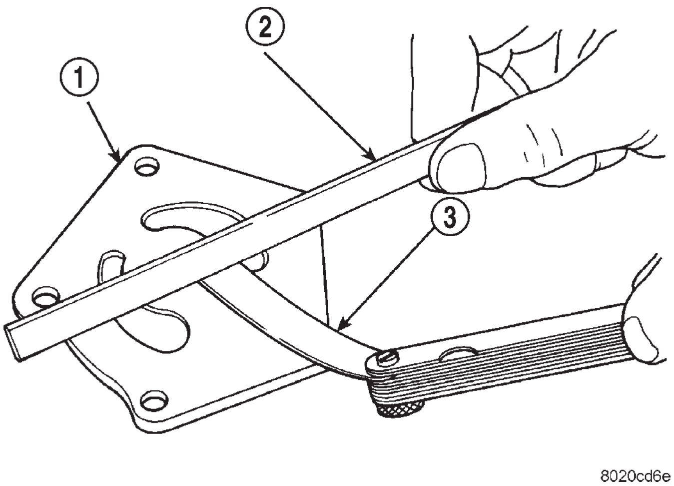


Fig. 63 Checking Oil Pump Cover Flatness

1 - COVER
2 - STRAIGHT EDGE
3 - FEELER GAUGE

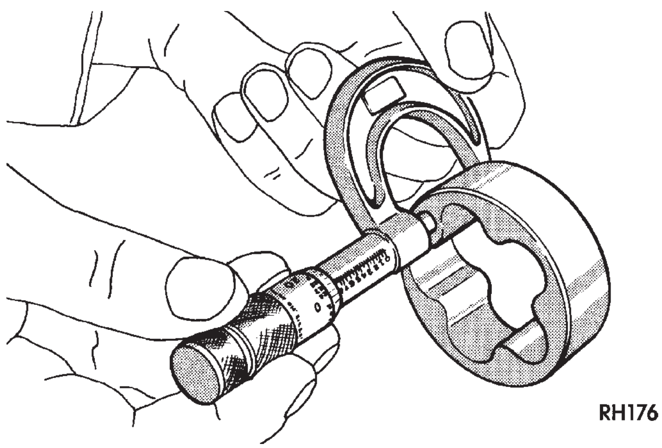


Fig. 64 Measuring Outer Rotor Thickness

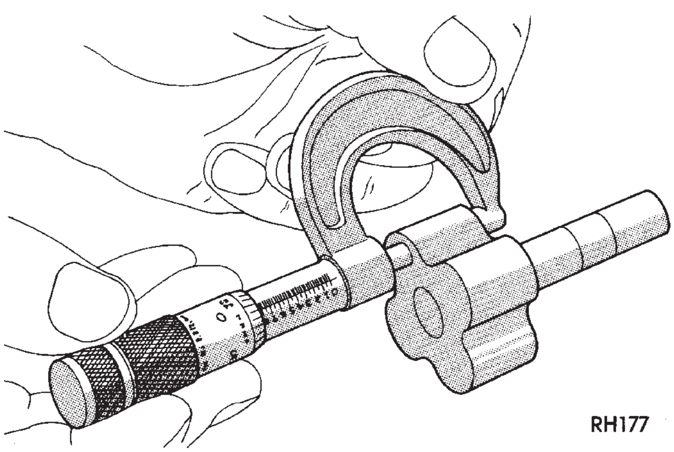


Fig. 65 Measuring Inner Rotor Thickness

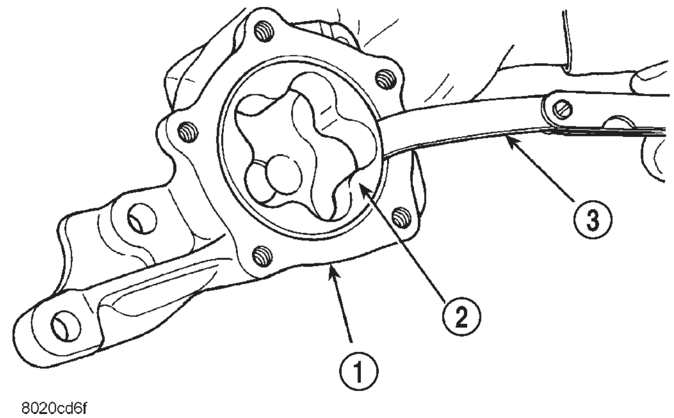


Fig. 66 Measuring Outer Rotor Clearance in Housing

1 - PUMP BODY
2 - OUTER ROTOR
3 - FEELER GAUGE

Install inner rotor and shaft into pump body. If clearance between inner and outer rotors is 0.203 mm (0.008 inch) or more, replace shaft and both rotors (Fig. 67).

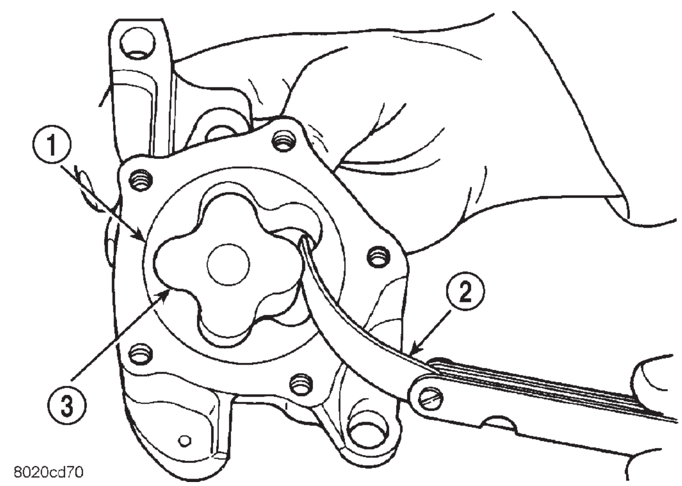


Fig. 67 Measuring Clearance Between Rotors

1 - OUTER ROTOR
2 - FEELER GAUGE
3 - INNER ROTOR

OIL PUMP (Continued)

Place a straightedge across the face of the pump, between bolt holes. If a feeler gauge of 0.102 mm (0.004 inch) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 68).

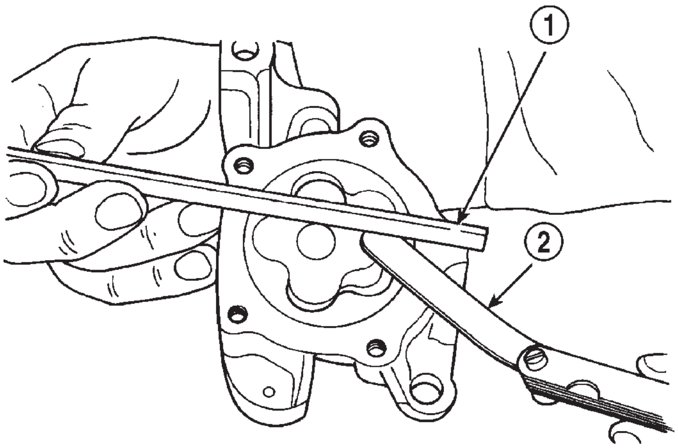


Fig. 68 Measuring Clearance Over Rotors

1 - STRAIGHT EDGE
2 - FEELER GAUGE

Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

The relief valve spring has a free length of approximately 49.5 mm (1.95 inches). The spring should test between 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet these specifications (Fig. 69).

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

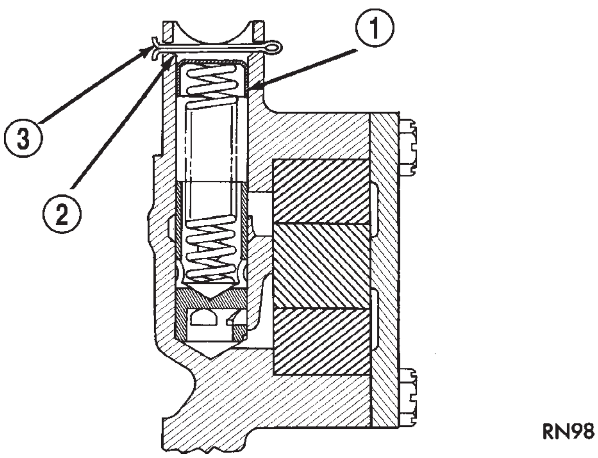


Fig. 69 Proper Installation of Retainer Cap

1 - RETAINER CAP
2 - CHAMFER
3 - COTTER KEY

ASSEMBLY

(1) Install pump rotors and shaft, using new parts as required.

(2) Position the oil pump cover onto the pump body. Tighten cover bolts to 11 N·m (95 in. lbs.) torque.

(3) Install the relief valve and spring. Insert the cotter pin.

(4) Tap on a new retainer cap.

(5) Prime oil pump before installation by filling rotor cavity with engine oil.

INSTALLATION

(1) Install oil pump. During installation slowly rotate pump body to ensure driveshaft-to-pump rotor shaft engagement.

(2) Hold the oil pump base flush against mating surface on No.5 main bearing cap. Finger tighten pump attaching bolts. Tighten attaching bolts to 41 N·m (30 ft. lbs.) torque.

(3) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds (Fig. 70) are constructed of cast iron and are LOG type with balanced flow. One exhaust manifold is attached to each cylinder head.

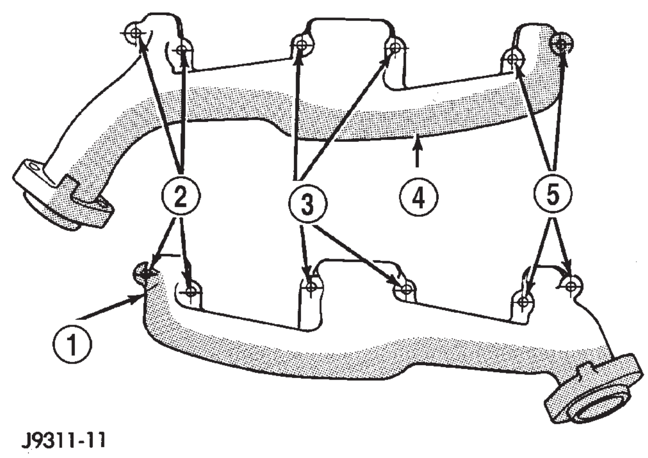


Fig. 70 Exhaust Manifolds—V-8 Gas Engines Typical

1 - EXHAUST MANIFOLD (LEFT)
2 - BOLTS & WASHERS
3 - NUTS & WASHERS
4 - EXHAUST MANIFOLD (RIGHT)
5 - BOLTS & WASHERS

OPERATION

The exhaust manifolds collect the engine exhaust exiting the combustion chambers, then channels the

EXHAUST MANIFOLD (Continued)

exhaust gases to the exhaust pipes attached to the manifolds.

REMOVAL

(1) Disconnect the battery negative cable.
(2) Raise the vehicle.
(3) Remove the exhaust pipe to manifold nuts.
(4) Lower the vehicle.
(5) Remove three nuts, heat shield and washers from the right side exhaust manifold, if necessary (Fig. 71).
(6) Remove two nuts, heat shield and washers from the left side exhaust manifold, if necessary (Fig. 72).
(7) Remove bolts, nuts and washers attaching manifold to cylinder head.
(8) Remove manifold from the cylinder head.

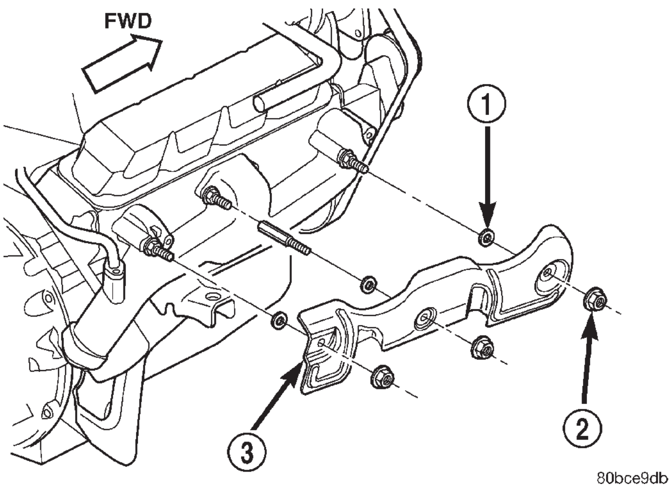


Fig. 71 Exhaust Manifold Heat Shield—Right Side

1 - WASHER
2 - NUT AND WASHER
3 - EXHAUST MANIFOLD HEAT SHIELD

CLEANING

Clean mating surfaces on cylinder head and manifold. Wash with solvent and blow dry with compressed air.

INSPECTION

Inspect manifold for cracks.
Inspect mating surfaces of manifold for flatness with a straight edge. Gasket surfaces must be flat within 0.2 mm per 300 mm (0.008 inch per foot).

INSTALLATION

CAUTION: If the studs came out with the nuts when removing the exhaust manifold, install new studs.

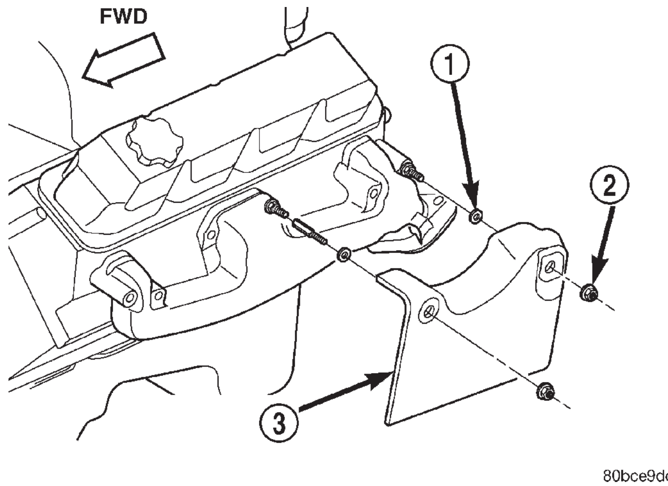


Fig. 72 Exhaust Manifold Heat Shield—Left Side

1 - WASHER
2 - NUT AND WASHER
3 - EXHAUST MANIFOLD HEAT SHIELD

(1) Position the exhaust manifolds on the two studs located on the cylinder head. Install conical washers and nuts on these studs (Fig. 73).
(2) Install new bolt and washer assemblies in the remaining holes (Fig. 73). Start at the center arm and work outward. Tighten the bolts and nuts to 24 N·m (18 ft. lbs.) torque.

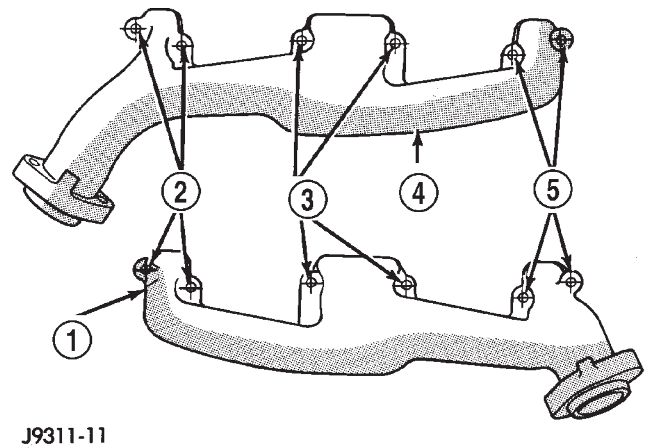


Fig. 73 Exhaust Manifold Installation—5.9L Engine

1 - EXHAUST MANIFOLD (LEFT)
2 - BOLTS & WASHERS
3 - NUTS & WASHERS
4 - EXHAUST MANIFOLD (RIGHT)
5 - BOLTS & WASHERS

(3) Position three washers, heat shield and nuts on the right side exhaust manifold. Tighten nuts to 24 N·m (18 ft. lbs.).
(4) Position two washers, heat shield and nuts on the left side exhaust manifold. Tighten nuts to 24 N·m (18 ft. lbs.).

EXHAUST MANIFOLD (Continued)

(5) Raise the vehicle.

(6) Assemble the exhaust pipe to the exhaust manifold and secure with bolts, nuts and washers. Tighten these nuts to 27 N·m (20 ft. lbs.) torque.

(7) Lower the vehicle.

(8) Connect the battery negative cable.

INTAKE MANIFOLD

DESCRIPTION

The aluminum intake manifold (Fig. 74) is a single plane design with equal length runners and uses a separate plenum, therefore the manifold does have a plenum gasket. It also uses separate flange gaskets and front and rear cross-over gaskets. Extreme care must be used when sealing the gaskets to ensure that excess sealant does not enter the intake runners causing a restriction. Whenever the intake manifold is removed inspect the plenum pan for evidence of excess oil buildup, this condition indicates that the plenum pan gasket is leaking.

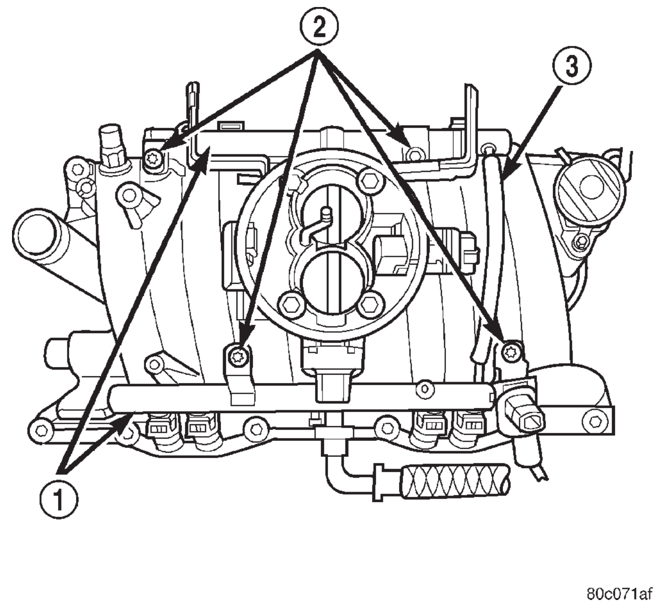


Fig. 74 Intake Manifold and Throttle Body—V-8 Gas Engines Typical

1 - FUEL RAIL ASSEMBLY
2 - FUEL RAIL MOUNTING BOLTS
3 - FUEL RAIL CONNECTING HOSES

OPERATION

The intake manifold, meters and delivers air to the combustion chambers allowing the fuel delivered by the fuel injectors to ignite, thus producing power.

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 RPMs occurs, the area of the suspected leak has been found.

(4) Repair as required.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

(4) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(5) Remove the accessory drive bracket.

(6) Remove the air cleaner.

(7) Perform the Fuel System Pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(8) Disconnect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL) and if so equipped, the speed control and transmission kickdown cables.

(9) Remove the return spring.

(10) Remove the distributor cap and wires.

(11) Disconnect the coil wires.

(12) Disconnect the heat indicator sending unit wire.

(13) Disconnect the heater hoses and bypass hose.

(14) Remove the closed crankcase ventilation and evaporation control systems.

(15) Remove intake manifold bolts.

(16) Lift the intake manifold and throttle body out of the engine compartment as an assembly.

(17) Remove and discard the flange side gaskets and the front and rear end seals.

(18) Remove the throttle body bolts and lift the throttle body off the intake manifold (Fig. 75). Discard the gasket.

INTAKE MANIFOLD (Continued)

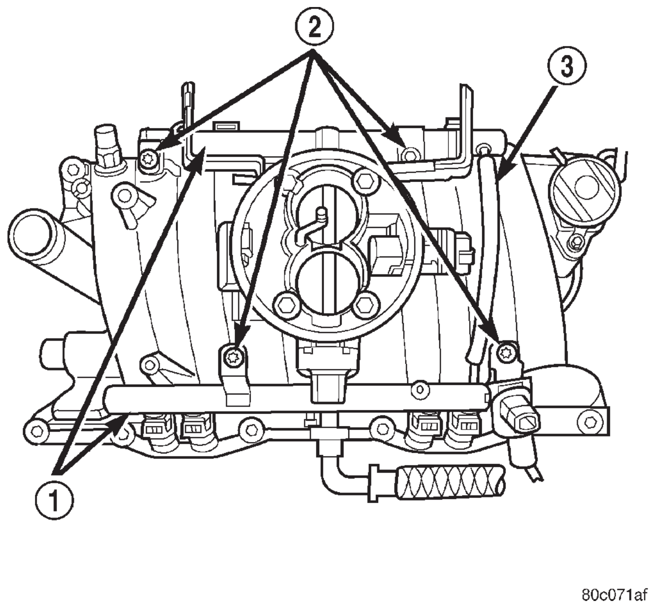


Fig. 75 Throttle Body Assembly

1 - FUEL RAIL ASSEMBLY
2 - FUEL RAIL MOUNTING BOLTS
3 - FUEL RAIL CONNECTING HOSES

(19) If required, remove the plenum pan and gasket. Discard gasket.

CLEANING

Clean manifold in solvent and blow dry with compressed air.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

The plenum pan rail must be clean and dry (free of all foreign material).

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straightedge.

INSTALLATION

(1) If removed, position new plenum gasket and install plenum pan (Fig. 76).

(2) Tighten plenum pan mounting bolts as follows:

- Step 1. Tighten bolts to 5.4 N·m (48 in. lbs.)
- Step 2. Tighten bolts to 9.5 N·m (84 in. lbs.)
- Step 3. Check all bolts are at 9.5 N·m (84 in. lbs.)

(3) Install the flange gaskets. Ensure that the vertical port alignment tab is resting on the deck face of the block. Also the horizontal alignment tabs must be in position with the mating cylinder head gasket tabs (Fig. 78). The words MANIFOLD SIDE should be visible on the center of each flange gasket.

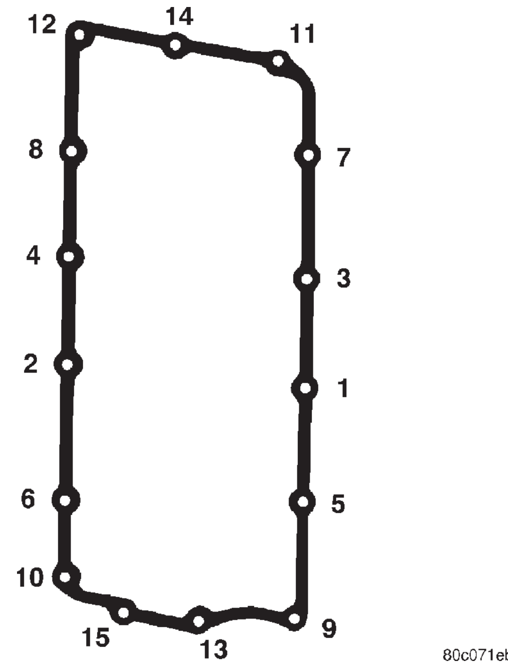


Fig. 76 Plenum Pan Bolt Tightening Sequence

(4) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, to the four corner joints. An excessive amount of sealant is not required to ensure a leak proof seal. However, an excessive amount of sealant may reduce the effectiveness of the flange gasket. The sealant should be approximately 5 mm (0.2 in) in diameter and 15mm (0.6in) long.

(5) Install the front and rear end seals (Fig. 77). Make sure the molded dowel pins on the end seals fully enter the corresponding holes in the cylinder block.

(6) Carefully lower intake manifold into position on the cylinder block and cylinder heads. After intake manifold is in place, inspect to make sure seals are in place.

(7) Using a new gasket, install the throttle body onto the intake manifold. Tighten the bolts to 23 N·m (200 in. lbs.) torque.

(8) Install the intake manifold bolts and tighten as follows (Fig. 79):

- Step 1. Tighten bolts 1 through 4 to 8 N·m (72 in. lbs.) Tighten in alternating steps 1.4 N·m (12 in. lbs.) at a time
- Step 2. Tighten bolts 5 through 12 to 8 N·m (72 in. lbs.)
- Step 3. Check all bolts are torqued to 8 N·m (72 in. lbs.)
- Step 4. Tighten all bolts in sequence to 16 N·m (12 ft. lbs.)
- Step 5. Check all bolts are torqued to 16 N·m (12 ft. lbs.)

(9) Install closed crankcase ventilation and evaporation control systems.

INTAKE MANIFOLD (Continued)

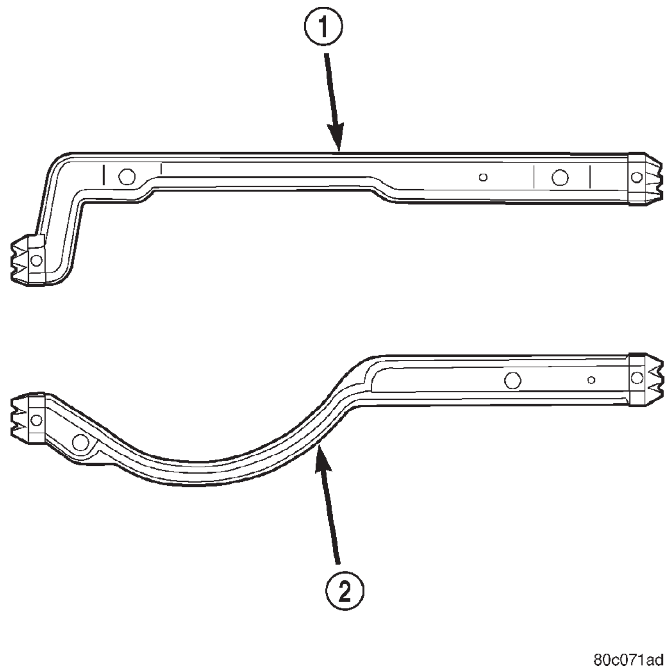


Fig. 77 Front and End Rear Seals

1 - FRONT END SEAL
2 - REAR END SEAL

(10) Connect the coil wires.
(11) Connect the heat indicator sending unit wire.
(12) Connect the heater hoses and bypass hose.
(13) Install distributor cap and wires.
(14) Hook up the return spring.
(15) Connect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - INSTALLATION) and if so equipped, the speed control and transmission kick-down cables.
(16) Install the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).
(17) Install the accessory drive bracket and A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).
(18) Install the generator and drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION). Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque.
(19) Install the air cleaner.
(20) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(21) Connect the negative cable to the battery.

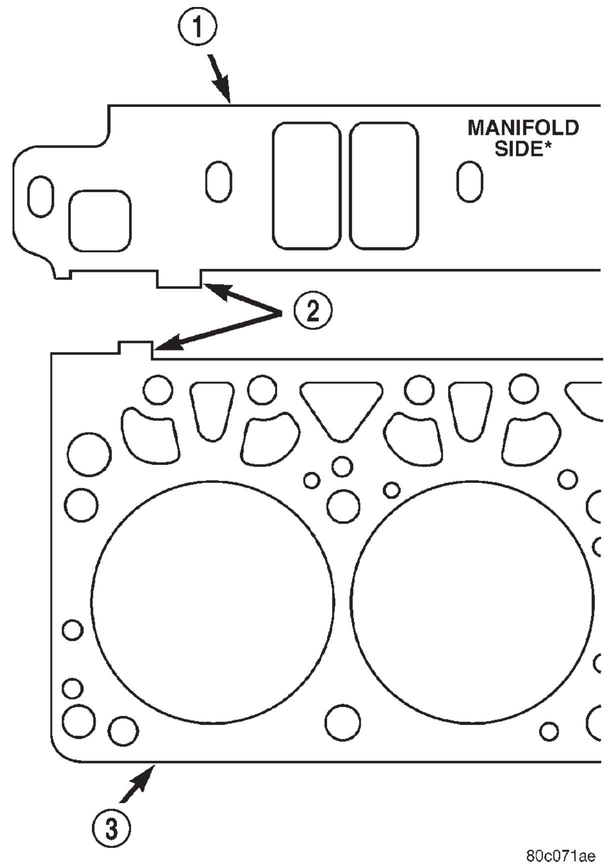


Fig. 78 Intake Manifold Flange Gasket Alignment

1 - FLANGE GASKET
2 - ALIGNMENT TABS
3 - CYLINDER HEAD GASKET

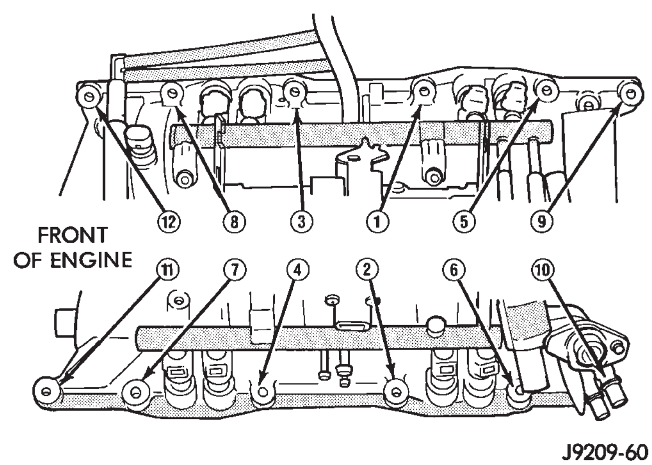


Fig. 79 Intake Manifold Bolt Tightening Sequence

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(3) Remove the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(4) Remove water pump (Refer to 7 - COOLING/ENGINE/WATER PUMP - REMOVAL).
(5) Remove power steering pump (refer to Steering).
(6) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
(7) Remove fuel lines (refer to Fuel System).
(8) Loosen oil pan bolts and remove the front bolt at each side.
(9) Remove the cover bolts.
(10) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.
(11) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal surface of cover (Fig. 80).

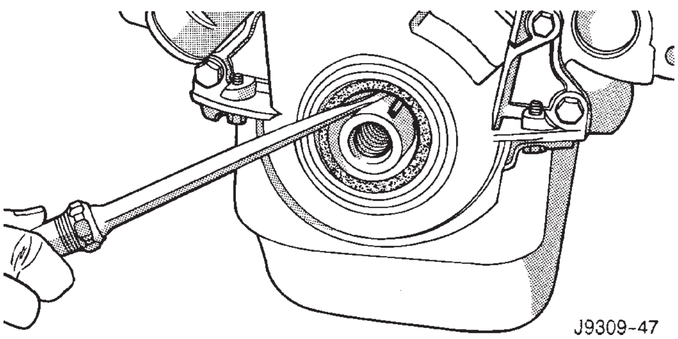


Fig. 80 Removal of Front Crankshaft Oil Seal

INSTALLATION

(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.
(2) The water pump mounting surface must be cleaned.
(3) Using a new cover gasket, carefully install chain case cover to avoid damaging oil pan gasket. Use a small amount of Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at the joint between timing chain cover gasket and the oil pan gasket. Finger tighten the timing chain cover bolts at this time.
(4) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 81). Seat the oil seal in the groove of the tool.

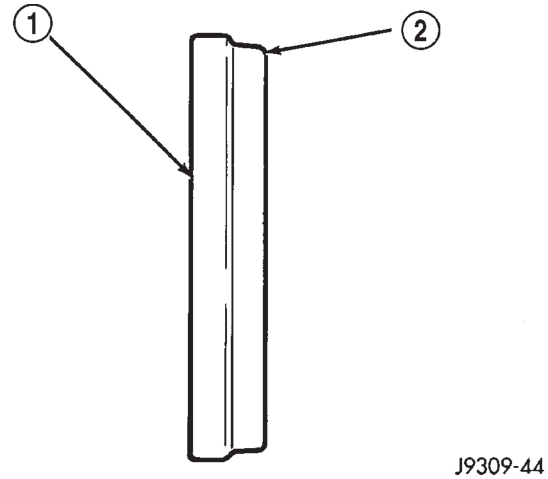


Fig. 81 Placing Oil Seal on Installation Tool 6635

1 - CRANKSHAFT FRONT OIL SEAL
2 - INSTALL THIS END INTO SPECIAL TOOL 6635

(5) Position the seal and tool onto the crankshaft (Fig. 82).
(6) Tighten the 4 lower chain case cover bolts to 13N·m (10 ft.lbs.) to prevent the cover from tipping during seal installation.

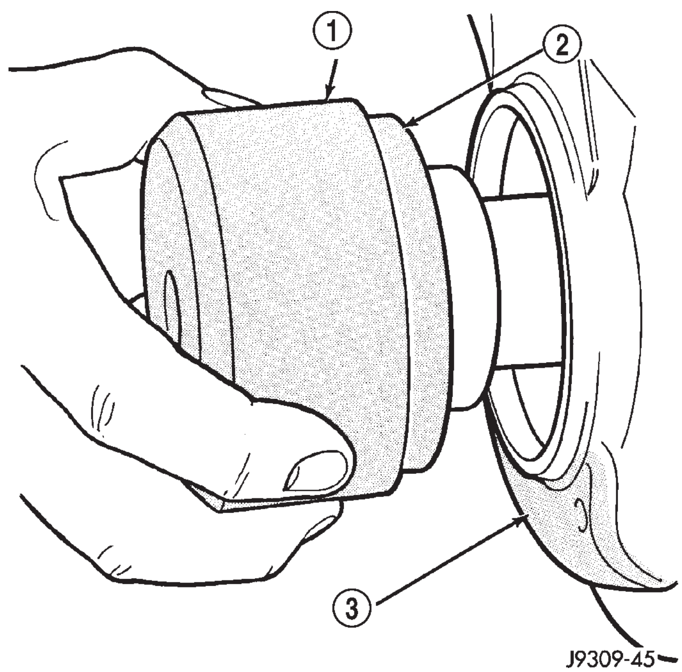


Fig. 82 Position Tool and Seal onto Crankshaft

1 - SPECIAL TOOL 6635
2 - OIL SEAL
3 - TIMING CHAIN COVER

(7) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 83).

TIMING BELT / CHAIN COVER(S) (Continued)

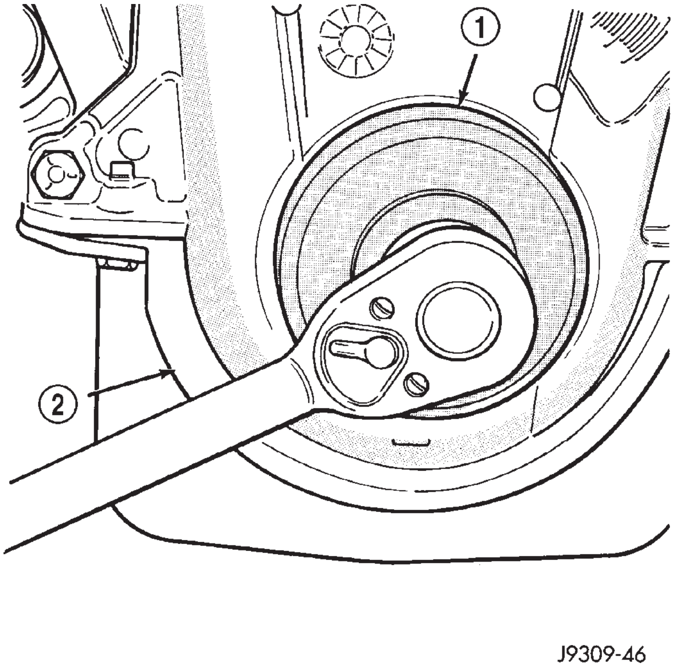


Fig. 83 Installing Oil Seal

1 - SPECIAL TOOL 6635
2 - TIMING CHAIN COVER

(8) Loosen the 4 bolts tightened in step 4 to allow realignment of front cover assembly.

(9) Tighten chain case cover bolts to 41 N·m (30 ft. lbs.) torque. Tighten oil pan bolts to 24 N·m (215 in. lbs.) torque.

(10) Remove the vibration damper bolt and seal installation tool.

(11) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(12) Install water pump (Refer to 7 - COOLING/ ENGINE/WATER PUMP - INSTALLATION).

(13) Install power steering pump (refer to Steering).

(14) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(15) Install the cooling system fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(16) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(17) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(18) Connect the negative cable to the battery.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove Timing Chain Cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(3) Re-install the vibration damper bolt finger tight. Using a suitable socket and breaker bar, rotate the crankshaft to align timing marks as shown in (Fig. 84).

(4) Remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

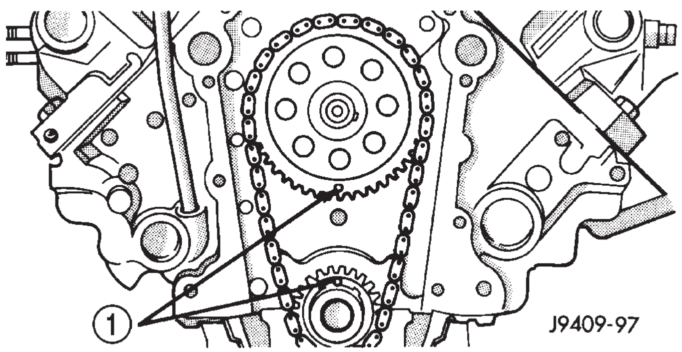


Fig. 84 Alignment of Timing Marks

1 - TIMING MARKS

TIMING BELT/CHAIN AND SPROCKETS (Continued)

INSTALLATION

(1) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(2) Place timing chain around both sprockets.

(3) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(4) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(5) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 85).

(6) Install the camshaft bolt. Tighten the bolt to 68 N·m (50 ft. lbs.) torque.

(7) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

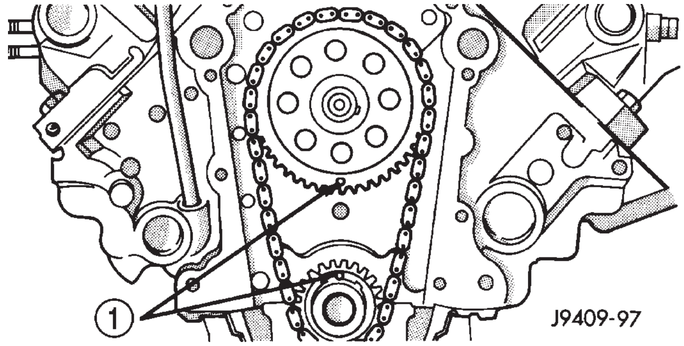


Fig. 85 Alignment of Timing Marks

1 - TIMING MARKS

(8) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

EXHAUST SYSTEM

TABLE OF CONTENTS

EXHAUST SYSTEM

DESCRIPTION—EXHAUST SYSTEM 2.5L ENGINE

CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan exhaust heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.

The gasoline engine exhaust system consists of engine exhaust manifolds, exhaust pipes, catalytic converter(s), extension pipe (if needed), exhaust heat shields, muffler and exhaust tailpipe.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. Minimum clearance between any exhaust component and the body or frame is 25.4 mm (1.0 in.). If the system contacts any body panel, it may amplify objectionable noises from the engine or body (Fig. 1).

DESCRIPTION—EXHAUST SYSTEM 3.9L/4.7L AND 5.9L ENGINES

CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan exhaust heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.

EXHAUST SYSTEM (Continued)

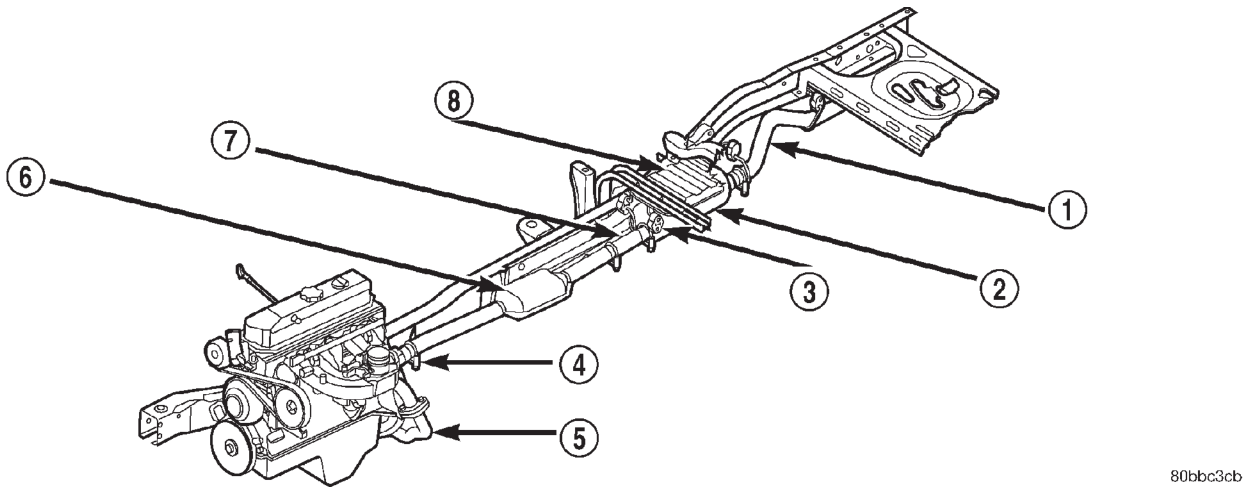


Fig. 1 Exhaust System 2.5L Engines—Typical

1 - TAILPIPE
2 - MUFFLER
3 - MUFFLER HANGER BRACKET AND ISOLATOR
4 - CLAMP
5 - EXHAUST PIPE
6 - CATALYTIC CONVERTER
7 - EXTENSION PIPE
8 - MUFFLER HEAT SHIELD

The gasoline engine exhaust system consists of engine exhaust manifolds, exhaust pipes, catalytic converter(s), extension pipe (if needed), exhaust heat shields, muffler and exhaust tailpipe.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. Minimum clearance between any exhaust component and the body or frame is 25.4 mm (1.0 in.). If the system contacts any body panel, it may amplify objectionable noises from the engine or body (Fig 2).

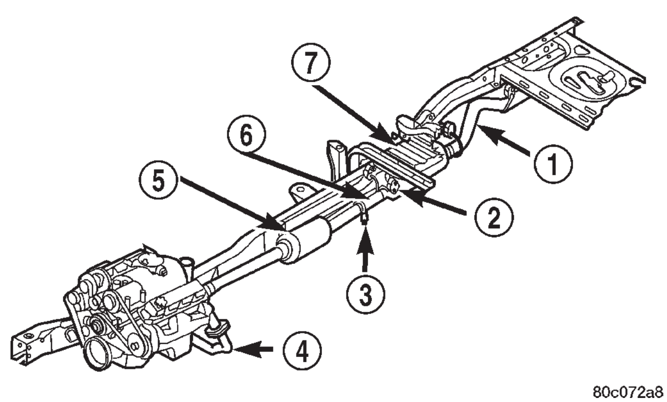


Fig. 2 Exhaust System 3.9L, 4.7L and 5.9L Engines—Typical

1 - TAILPIPE
2 - MUFFLER HANGER BRACKET AND ISOLATOR
3 - CLAMP
4 - EXHAUST PIPE
5 - CATALYTIC CONVERTER
6 - EXTENSION PIPE
7 - MUFFLER HEAT SHIELD

DIAGNOSIS AND TESTING—EXHAUST SYSTEM

EXHAUST SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE	1. Leaks at pipe joints.	1. Tighten clamps to specified torque at leaking joints (Refer to 11 - EXHAUST SYSTEM - SPECIFICATIONS).
	2. Burned or blown out muffler.	2. Replace muffler assembly (Refer to 11 - EXHAUST SYSTEM/MUFFLER - REMOVAL). Check exhaust system.
	3. Burned or rusted-out exhaust pipe.	3. Replace exhaust pipe (Refer to 11 - EXHAUST SYSTEM/EXHAUST PIPE - REMOVAL).
	4. Exhaust pipe leaking at manifold flange.	4. Tighten connection attaching nuts (Refer to 11 - EXHAUST SYSTEM - SPECIFICATIONS).
	5. Exhaust manifold cracked or broken.	5. Replace exhaust manifold (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - REMOVAL).
	6. Leak between exhaust manifold and cylinder head.	6. Tighten exhaust manifold to cylinder head stud nuts or bolts (Refer to 9 - ENGINE - SPECIFICATIONS).
	7. Restriction in muffler or tailpipe.	7. Remove restriction, if possible. Replace muffler or tailpipe, as necessary.
	8. Exhaust system contacting body or chassis.	8. Re-align exhaust system to clear surrounding components.
LEAKING EXHAUST GASES	1. Leaks at pipe joints.	1. Tighten/replace clamps at leaking joints (Refer to 11 - EXHAUST SYSTEM - SPECIFICATIONS).

SPECIFICATIONS

TORQUE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
EGR Tube—Bolts	23	17	—
Exhaust Clamps—Nuts	41	30	—
Exhaust Pipe to Manifold—Nuts	26	19	—
Heat Shield—Nuts			
Floor Pan/Dash Panel	6	—	55
Floor Pan (All Except 4 Door Cab)	7	—	60
Floor Pan (4 Door Cab)	5	—	45
Electrical Connector (45RFE Trans.)	20	—	175
Heat Shield—Screws			
Floor Pan	22	16	—
Muffler	22	16	—
Tail Pipe	22	16	—
Center Bearing	22	16	—
Muffler Hanger—Screws	22	16	—
Tail Pipe Hanger—Screws	22	16	—

CATALYTIC CONVERTER - 2.5L

DESCRIPTION

California emissions vehicles incorporate mini catalytic converters into the exhaust system. These catalytic converters are made of stainless steel designed to operate at extremely high temperatures.

OPERATION

The catalytic converter captures and burns any unburned fuel mixture exiting the combustion chambers during the exhaust stroke of the engine. This process aids in reducing emissions output.

REMOVAL

CAUTION: When servicing or 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.

(1) Raise and support the vehicle.

(2) Saturate the bolts and nuts with Mopar® Rust Penetrant. Allow 5 minutes for penetration.

(3) Remove the clamp holding the catalytic converter flange to the exhaust pipe(s) (Fig. 3).

(4) Remove the clamp holding the catalytic converter flange to the muffler or extension pipe .

(5) Remove the rear engine mount.(Refer to 9 - ENGINE/ENGINE MOUNTING/REAR MOUNT - REMOVAL)

(6) Remove the crossmember.

(7) Remove the catalytic converter. You may have to loosen up other sections of the exhaust system.

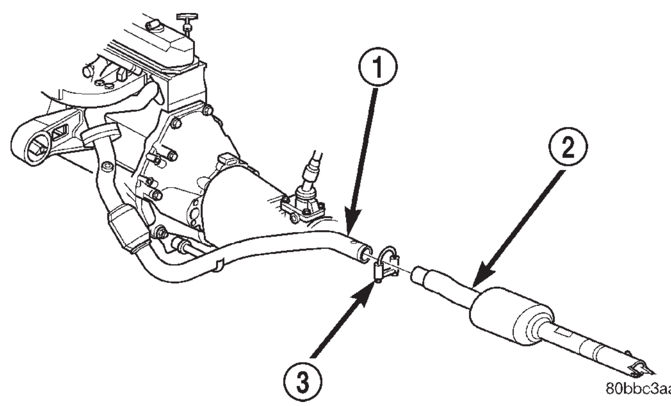


Fig. 3 Catalytic Converter—2.5L Engine

1 - EXHAUST PIPE
2 - CATALYTIC CONVERTER AND PIPE
3 - CLAMP

INSPECTION

Look at the stainless steel body of the converter, inspect for bulging or other distortion that could be a result of overheating. If the converter has a heat shield attached make sure it is not bent or loose.

If you suspect internal damage to the catalyst, tapping the bottom of the catalyst with a rubber mallet may indicate a damaged core.

CATALYTIC CONVERTER - 2.5L (Continued)

INSTALLATION

CAUTION: When servicing or 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.

(1) Align and connect the catalytic converter flange to the exhaust pipe (Fig. 9).

(2) Install the catalytic converter flange into the muffler or extension pipe (Fig. 4).

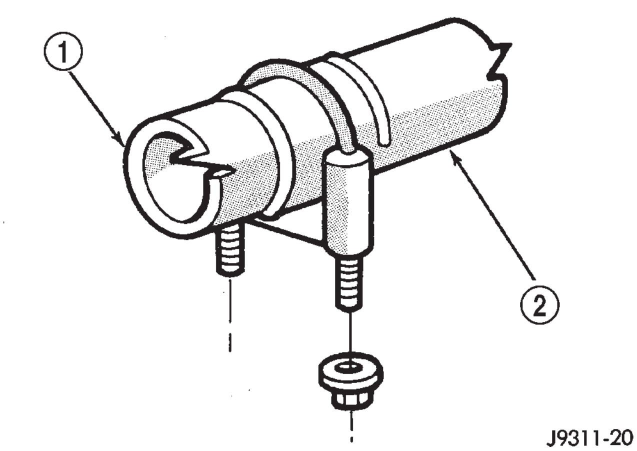


Fig. 4 Extension Pipe/Muffler to Catalytic Converter Flange

1 - CATALYTIC CONVERTER FLANGE
2 - EXTENSION PIPE

(3) If other sections of the exhaust system where loosened in removal, refer to that information for the tightening procedures.

(4) At the catalytic converter flange connections, install the clamp and nuts. Tighten the clamp nuts to 41 N·m (30 ft. lbs.) torque.

(5) Install the crossmember.

(6) Install the rear engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/REAR MOUNT - INSTALLATION).

(7) Lower the vehicle.

(8) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

CATALYTIC CONVERTER - 3.9L/5.9L

DESCRIPTION

California emissions vehicles incorporate mini catalytic converters into the exhaust system. These catalytic converters are made of stainless steel designed to operate at extremely high temperatures.

OPERATION

The catalytic converter captures and burns any unburned fuel mixture exiting the combustion chambers during the exhaust stroke of the engine. This process aids in reducing emissions output.

REMOVAL

CAUTION: When servicing or 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.

(1) Raise and support the vehicle.

(2) Saturate the bolts and nuts with Mopar® Rust Penetrant. Allow 5 minutes for penetration.

(3) Remove the clamp holding the catalytic converter flange to the exhaust pipe(s) (Fig. 3) (Fig. 5).

(4) Remove the clamp holding the catalytic converter flange to the muffler or extension pipe .

(5) Remove the engine rear mount (Refer to 9 - ENGINE/ENGINE MOUNTING/REAR MOUNT - REMOVAL).

(6) Remove the crossmember.

(7) Remove the catalytic converter. You may have to loosen up other sections of the exhaust system.

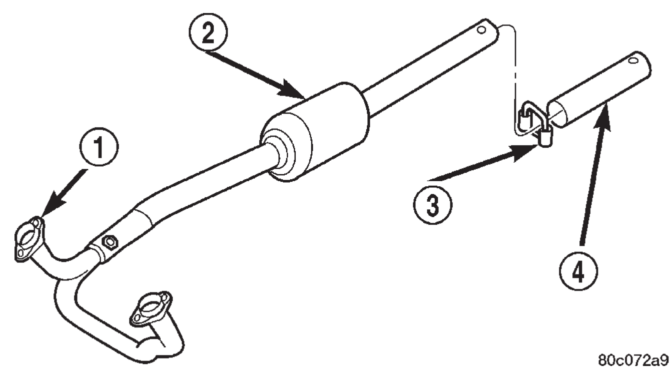


Fig. 5 Catalytic Converter—3.9L/5.9L Engine

1 - EXHAUST PIPE
2 - CATALYTIC CONVERTER
3 - CLAMP
4 - EXTENSION PIPE TO MUFFLER

CATALYTIC CONVERTER - 3.9L/5.9L (Continued)

INSPECTION

Look at the stainless steel body of the converter, inspect for bulging or other distortion that could be a result of overheating. If the converter has a heat shield attached make sure it is not bent or loose.

If you suspect internal damage to the catalyst, tapping the bottom of the catalyst with a rubber mallet may indicate a damaged core.

INSTALLATION

CAUTION: When servicing or 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.

(1) Align and connect the catalytic converter flange to the exhaust pipe (Fig. 9).

(2) Install the catalytic converter flange into the muffler or extension pipe (Fig. 6).

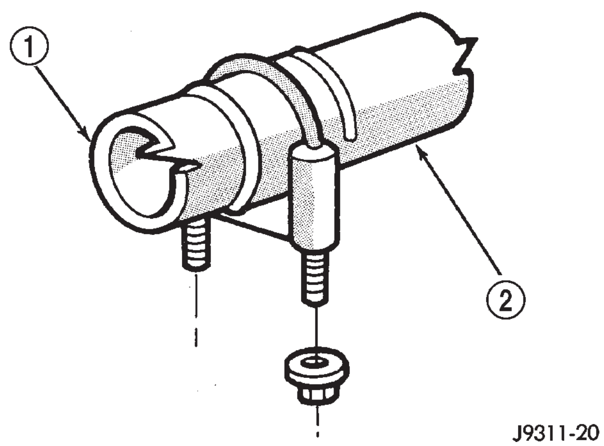


Fig. 6 Extension Pipe/Muffler to Catalytic Converter Flange

1 - CATALYTIC CONVERTER FLANGE
2 - EXTENSION PIPE

(3) If other sections of the exhaust system where loosened in removal, refer to that information for the tightening procedures.

(4) At the catalytic converter flange connections, install the clamp and nuts. Tighten the clamp nuts to 41 N·m (30 ft. lbs.) torque.

(5) Install the crossmember.

(6) Install the rear engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/REAR MOUNT - INSTALLATION).

(7) Lower the vehicle.

(8) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

CATALYTIC CONVERTER - 4.7L

DESCRIPTION

California emissions vehicles incorporate mini catalytic converters into the exhaust system. These catalytic converters are made of stainless steel designed to operate at extremely high temperatures.

OPERATION

The catalytic converter captures and burns any unburned fuel mixture exiting the combustion chambers during the exhaust stroke of the engine. This process aids in reducing emissions output.

REMOVAL

The mini catalytic converters used on the 4.7L engine is an integeral part of the exhaust pipe. To replace the mini catalytic converters, the entire exhaust pipe assembly must be replaced. (Refer to 11 - EXHAUST SYSTEM/EXHAUST PIPE - REMOVAL).

CAUTION: When servicing or 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.

(1) Raise and support the vehicle.

(2) Saturate the bolts and nuts with Mopar® Rust Penetrant. Allow 5 minutes for penetration.

(3) Remove the clamp holding the catalytic converter flange to the exhaust pipe(s).

(4) Remove the clamp holding the catalytic converter flange to the muffler or extension pipe .

(5) Remove the engine rear mount (Refer to 9 - ENGINE/ENGINE MOUNTING/REAR MOUNT - REMOVAL).

(6) Remove the crossmember.

(7) Remove the catalytic converter. You may have to loosen up other sections of the exhaust system.

INSPECTION

Look at the stainless steel body of the converter, inspect for bulging or other distortion that could be a result of overheating. If the converter has a heat shield attached make sure it is not bent or loose.

If you suspect internal damage to the catalyst, tapping the bottom of the catalyst with a rubber mallet may indicate a damaged core.

CATALYTIC CONVERTER - 4.7L (Continued)

INSTALLATION

CAUTION: When servicing or 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.

(1) Align and connect the catalytic converter flange to the exhaust pipe (Fig. 9).

(2) Install the catalytic converter flange into the muffler or extension pipe (Fig. 7).

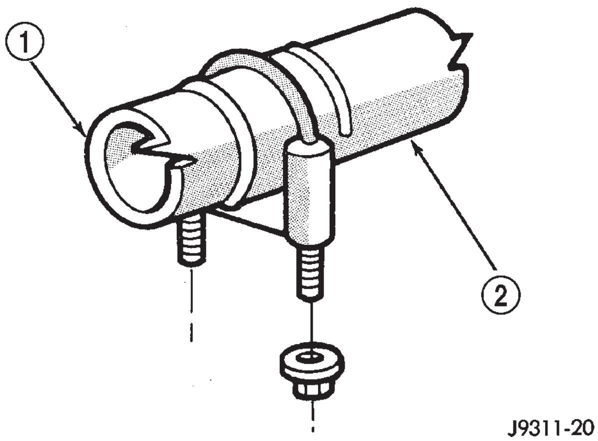


Fig. 7 Extension Pipe/Muffler to Catalytic Converter Flange

1 - CATALYTIC CONVERTER FLANGE
2 - EXTENSION PIPE

(3) If other sections of the exhaust system where loosened in removal, refer to that information for the tightening procedures.

(4) At the catalytic converter flange connections, install the clamp and nuts. Tighten the clamp nuts to 41 N·m (30 ft. lbs.) torque.

(5) Install the crossmember.

(6) Install the rear engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/REAR MOUNT - INSTALLATION).

(7) Lower the vehicle.

(8) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

EXHAUST PIPE - 2.5L

REMOVAL

CAUTION: When servicing or 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.

(1) Raise and support the vehicle.

(2) Saturate the bolts and nuts with Mopar® Rust Penetrant. Allow 5 minutes for penetration.

(3) Disconnect the oxygen sensor(s).

(4) Remove the exhaust manifold-to-exhaust pipe nuts (Fig. 8).

(5) Remove exhaust pipe to converter exhaust clamp.

(6) Disconnect the exhaust pipe from the catalytic converter front flange.

(7) Remove the exhaust pipe.

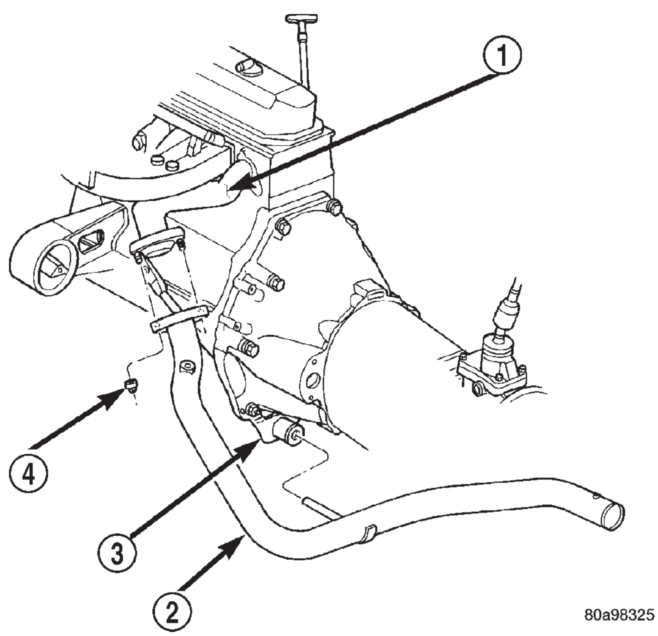


Fig. 8 Exhaust Pipe to Manifold Connection—(2.5L)

1 - EXHAUST MANIFOLD
2 - EXHAUST PIPE
3 - SUPPORT BRACKET
4 - NUT

EXHAUST PIPE - 2.5L (Continued)

INSPECTION

Discard rusted clamps, broken or worn supports and attaching parts. Replace a component with original equipment parts, or equivalent. This will assure proper alignment with other parts in the system and provide acceptable exhaust noise levels.

INSTALLATION

(1) Connect the exhaust pipe(s) to the exhaust manifold. Tighten the nuts to 26 N·m (19 ft. lbs.) torque.

(2) Align and connect the exhaust pipe to the catalytic converter flange (Fig. 9). Install exhaust clamp and tighten clamp nuts to 41 N·m (33 ft. lbs.) torque.

(3) Connect oxygen sensor connector(s).

(4) Lower the vehicle.

(5) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

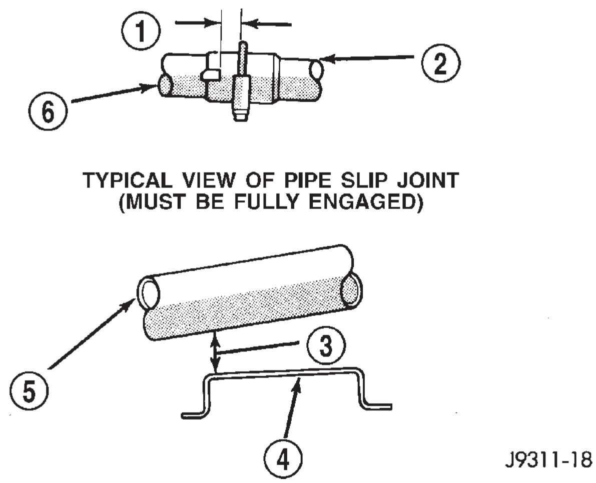


Fig. 9 Exhaust Pipe-to-Catalytic Converter Flange Alignment—Typical

1 - 7.874–17.526 mm (0.31–0.69 in.)
2 - CATALYTIC CONVERTER FLANGE
3 - 20 mm (0.79″) MIN.
4 - CROSSMEMBER
5 - EXHAUST PIPE
6 - EXHAUST PIPE

EXHAUST PIPE - 3.9L AND 5.9L

REMOVAL

CAUTION: When servicing or 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.

(1) Raise and support the vehicle.

(2) Saturate the bolts and nuts with Mopar® Rust Penetrant. Allow 5 minutes for penetration.

(3) Disconnect the oxygen sensor(s).

(4) Remove the exhaust manifold-to-exhaust pipe nuts (Fig. 10).

(5) Remove exhaust pipe to converter exhaust clamp.

(6) Disconnect the exhaust pipe from the catalytic converter front flange.

(7) Remove the exhaust pipe.

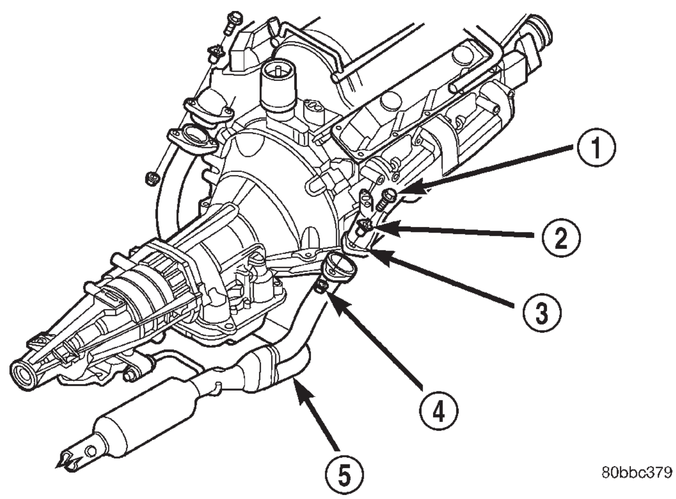


Fig. 10 Exhaust Pipe to Manifold Connection—(3.9L/5.9L)

1 - BOLT
2 - RETAINER
3 - EXHAUST MANIFOLD
4 - NUT
5 - EXHAUST PIPE

EXHAUST PIPE - 3.9L AND 5.9L (Continued)

INSPECTION

Discard rusted clamps, broken or worn supports and attaching parts. Replace a component with original equipment parts, or equivalent. This will assure proper alignment with other parts in the system and provide acceptable exhaust noise levels.

INSTALLATION

(1) Connect the exhaust pipe(s) to the exhaust manifold. Tighten the nuts to 26 N·m (19 ft. lbs.) torque.

(2) Align and connect the exhaust pipe to the catalytic converter flange (Fig. 11). Install exhaust clamp and tighten clamp nuts to 41 N·m (33 ft. lbs.) torque.

(3) Connect oxygen sensor connector(s).

(4) Lower the vehicle.

(5) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

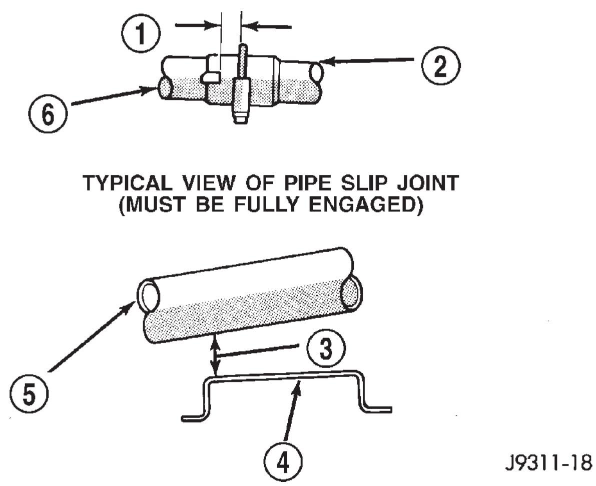


Fig. 11 Exhaust Pipe-to-Catalytic Converter Flange Alignment—Typical

1 - 7.874–17.526 mm (0.31–0.69 in.)
2 - CATALYTIC CONVERTER FLANGE
3 - 20 mm (0.79″) MIN.
4 - CROSSMEMBER
5 - EXHAUST PIPE
6 - EXHAUST PIPE

EXHAUST PIPE - 4.7L

REMOVAL

CAUTION: When servicing or 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.

(1) Raise and support the vehicle.

(2) Saturate the bolts and nuts with Mopar® Rust Penetrant. Allow 5 minutes for penetration.

(3) Disconnect the oxygen sensor(s).

(4) Remove the exhaust manifold-to-exhaust pipe nuts (Fig. 12).

(5) Remove exhaust pipe to converter exhaust clamp.

(6) Disconnect the exhaust pipe from the catalytic converter front flange.

(7) Remove the exhaust pipe.

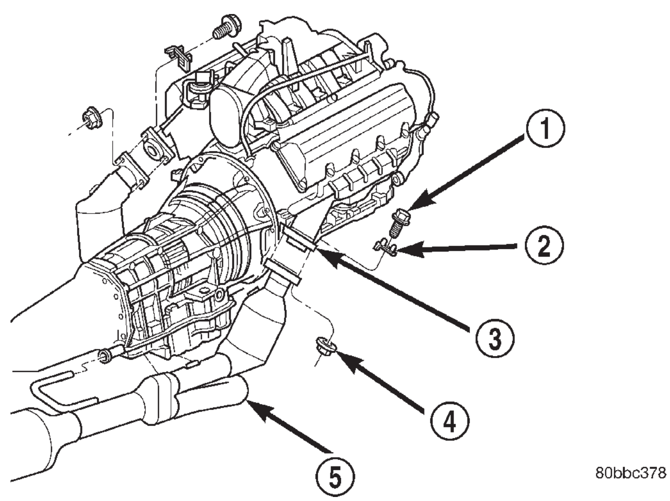


Fig. 12 Exhaust Pipe(s) to Manifold Connection - (50 State Models)

1 - BOLT
2 - RETAINER
3 - EXHAUST MANIFOLD
4 - NUT
5 - EXHAUST PIPE

EXHAUST PIPE - 4.7L (Continued)

INSPECTION

Discard rusted clamps, broken or worn supports and attaching parts. Replace a component with original equipment parts, or equivalent. This will assure proper alignment with other parts in the system and provide acceptable exhaust noise levels.

INSTALLATION

(1) Connect the exhaust pipe(s) to the exhaust manifold. Tighten the nuts to 26 N·m (19 ft. lbs.) torque.

(2) Align and connect the exhaust pipe to the catalytic converter flange (Fig. 13). Install exhaust clamp and tighten clamp nuts to 41 N·m (33 ft. lbs.) torque.

(3) Connect oxygen sensor connector(s).

(4) Lower the vehicle.

(5) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

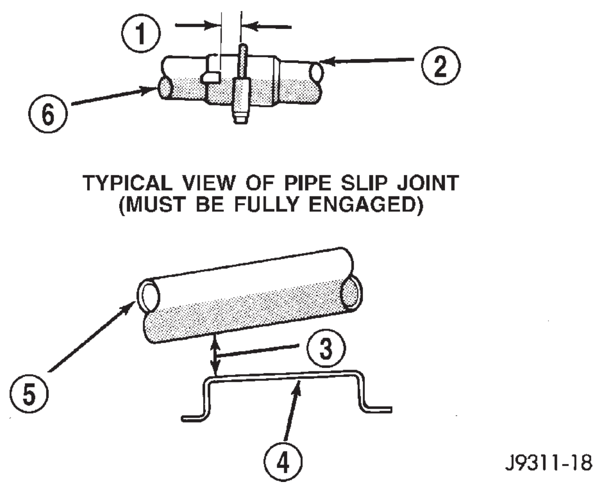


Fig. 13 Exhaust Pipe-to-Catalytic Converter Flange Alignment—Typical

1 - 7.874–17.526 mm (0.31–0.69 in.)
2 - CATALYTIC CONVERTER FLANGE
3 - 20 mm (0.79″) MIN.
4 - CROSSMEMBER
5 - EXHAUST PIPE
6 - EXHAUST PIPE

HEAT SHIELDS

DESCRIPTION

There are two types of heat shields used. One is stamped steel the other is molded foil sheets. The shields attach to the vehicle around the exhaust system to prevent heat from the exhaust system from entering the passenger area and other areas where the heat can cause damage to other components (Fig. 14, 15, 16, 17, 18, 19, 20, 21, 22).

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.

(3) When removing muffler heat shield, the muffler front support bracket must be removed first.

(4) Slide the shields out around the exhaust system.

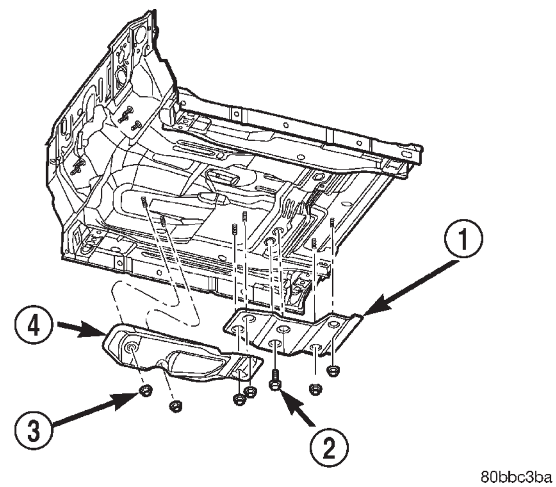


Fig. 14 Floor Pan Heat Shields—Standard Cab

1 - FLOOR PAN HEAT SHIELD
2 - SCREW AND WASHER SELF TAPPING
3 - NUT AND WASHER
4 - FLOOR PAN HEAT SHIELD

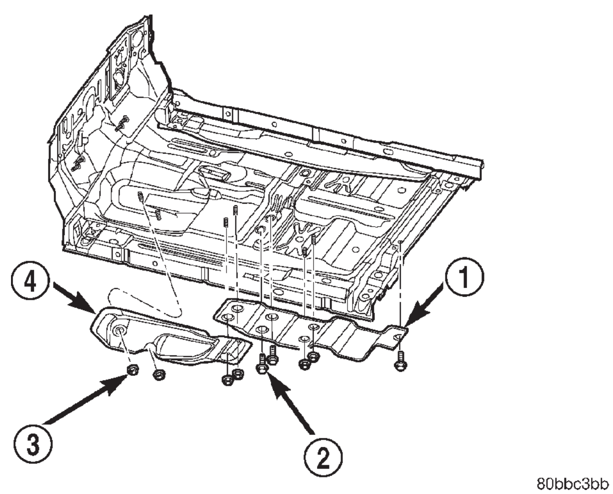


Fig. 15 Floor Pan Heat Shields—Extended Cab

1 - FLOOR PAN AND CATALYTIC CONVERTER HEAT SHIELD
2 - SCREW AND WASHER SELF TAPPING
3 - NUT AND WASHER
4 - FLOOR PAN HEAT SHIELD

HEAT SHIELDS (Continued)

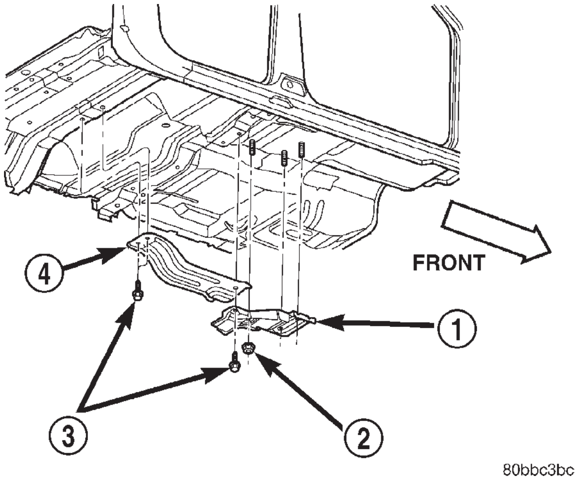


Fig. 16 Floor Pan Heat Shields, Front and Middle Shields—4 Door Cab

1 - FLOOR PAN (FRONT) HEAT SHIELD
2 - NUT AND WASHER
3 - SELF TAPPING SCREW
4 - FLOOR PAN (MIDDLE) HEAT SHIELD

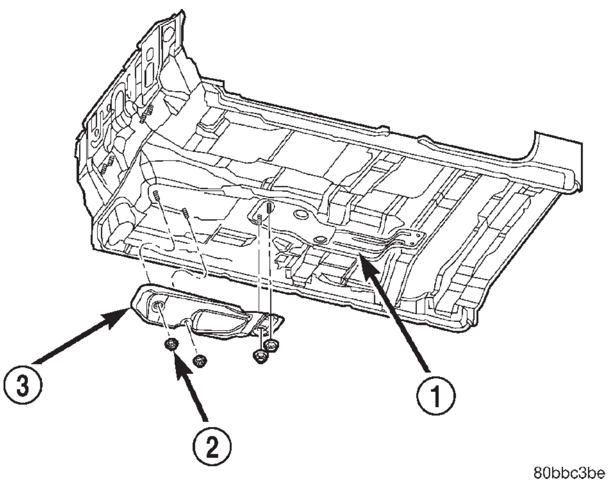


Fig. 17 Floor Pan Heat Shields Front Floor Pan Shield—4 Door Cab

1 - FLOOR PAN (MIDDLE) HEAT SHIELD
2 - NUT AND WASHER
3 - FLOOR PAN (FRONT) HEAT SHIELD

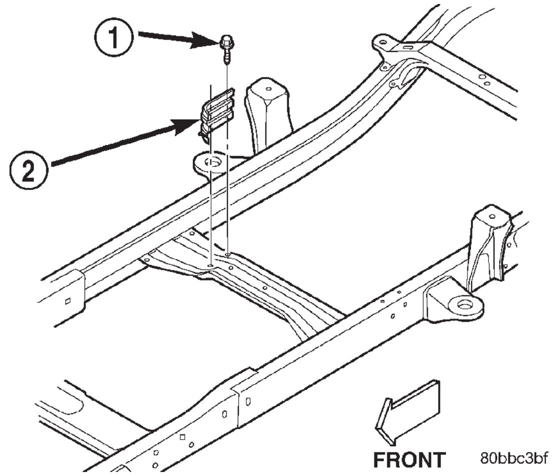


Fig. 18 Center Bearing Heat Shield—Standard Cab and Extended Cab

1 - SCREW AND WASHER SELF TAPPING
2 - CENTER BEARING HEAT SHIELD

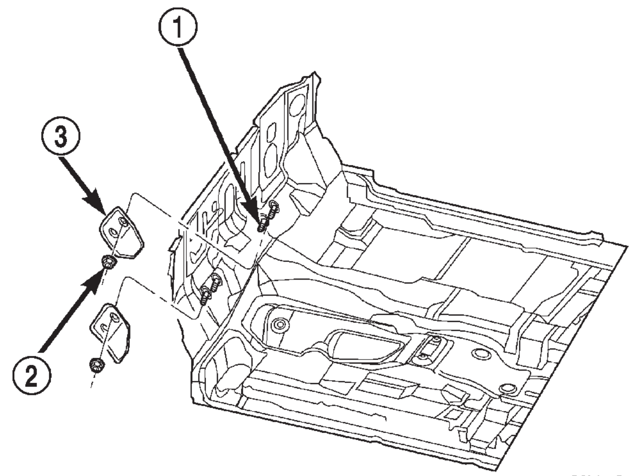


Fig. 19 Dash/Floor Pan Heat Shields

1 - SCREWS
2 - NUT AND WASHER
3 - FRONT FLOOR/DASH HEAT SHIELD

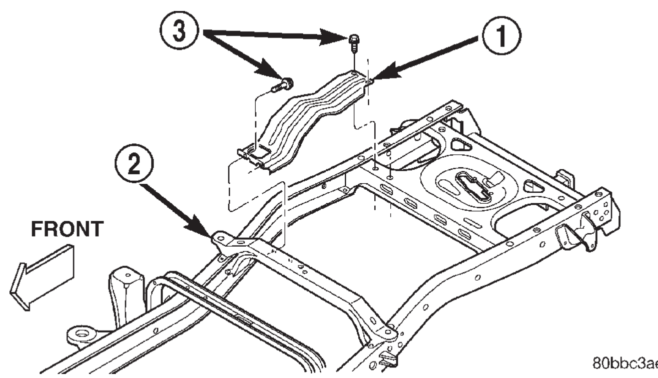


Fig. 20 Tail Pipe Heat Shield

1 - TAILPIPE HEAT SHIELD
2 - FUEL TANK CROSSMEMBER
3 - SCREW AND WASHER

HEAT SHIELDS (Continued)

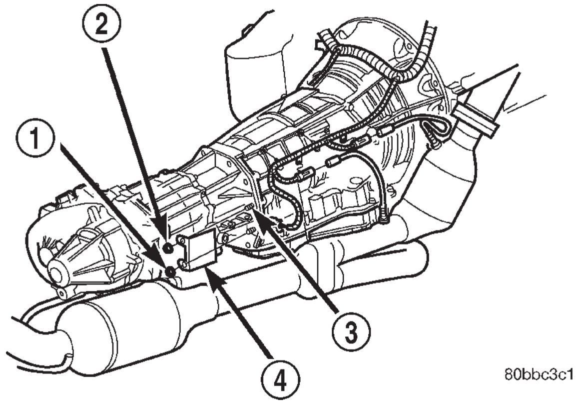


Fig. 21 Electrical Connector Heat Shield—45RFE Transmission

1 - BOLT RETAINER
2 - LOCKNUT
3 - STUDS
4 - HEAT SHIELD

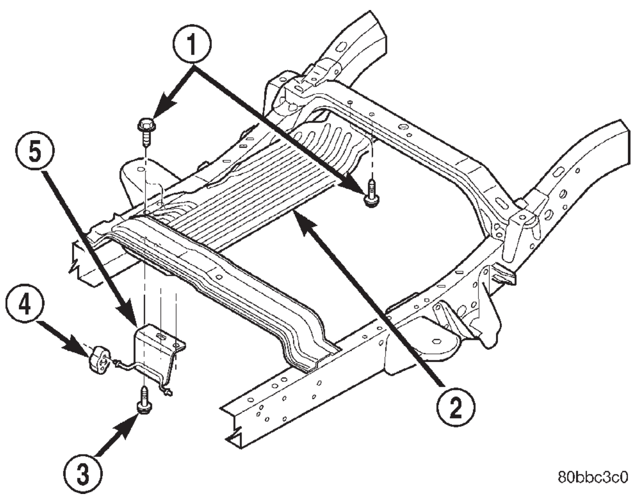


Fig. 22 Muffler Heat Shield—4 Door Cab

1 - SCREW SELF TAPPING
2 - MUFFLER HEAT SHIELD
3 - SCREW SELF TAPPING
4 - ISOLATOR
5 - HANGER BRACKET

INSTALLATION

(1) Position the heat shields to the floor pan or the frame and install the screws and/or nuts.

(2) Tighten the nuts and/or screws to specification. Refer to Specifications in this section for correct torque values.

(3) Lower the vehicle.

INTERMEDIATE PIPE

REMOVAL

(1) Raise and support the vehicle.

(2) Saturate the clamp nuts with Mopar® Rust Penetrant. Allow 5 minutes for penetration.

(3) Remove the front and rear clamp nuts.

(4) It may be necessary to loosen other sections of the exhaust system to remove the extension pipe.

INSTALLATION

(1) Position the extension pipe in the muffler and the catalytic converter flange.

(2) If other sections of the exhaust system where loosened in removal, refer to the section for tightening procedures.

(3) Install the clamps and nuts (Fig. 4). Tighten the nuts to 47 N·m (35 ft. lbs.) torque.

(4) Lower the vehicle.

(5) Start the engine, inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

MUFFLER

DESCRIPTION

All engines use a stainless steel muffler to control exhaust noise levels and exhaust back pressure.

REMOVAL

CAUTION: When servicing or 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.

(1) Raise and support the vehicle.

(2) Saturate the clamp nuts with Mopar® Rust Penetrant. Allow 5 minutes for penetration.

(3) Remove the muffler clamp nuts from the front hanger and the rear muffler to tailpipe connection (Fig. 23).

(4) Disconnect the muffler from the tailpipe. The tailpipe should be supported when the muffler is disconnected.

(5) Remove the muffler from the extension pipe or catalytic converter flange.

MUFFLER (Continued)

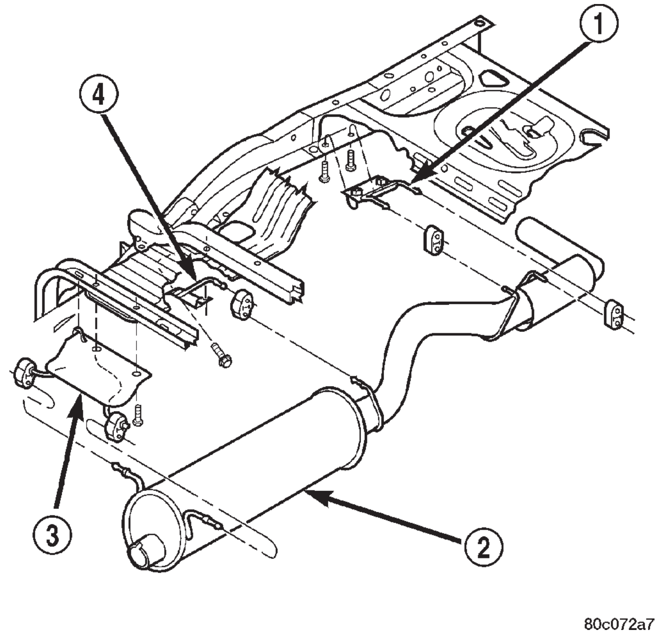


Fig. 23 Muffler and Tailpipe Assembly

1 - TAILPIPE HANGER
2 - MUFFLER AND TAILPIPE
3 - FRONT MUFFLER HANGER
4 - REAR MUFFLER HANGER

INSTALLATION

CAUTION: When servicing or 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.

(1) If the upper front muffler support was removed (Fig. 23), install the bolts into the frame. Tighten the bolts to 23 N·m (200 in. lbs.) torque. The insulators slip over the ends of the upper and lower muffler hangers.

(2) Install the muffler into the extension pipe or catalytic converter flange. Install the clamp and tighten the nuts finger tight.

(3) Install the tailpipe into the rear of the muffler.

(4) Tighten the clamp nuts on the front and rear muffler hangers to 41 N·m (30 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Start the engine, inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

TAILPIPE - 2.5L/3.9L/4.7L

DESCRIPTION

The tailpipe is made of stainless steel and attaches to the muffler.

REMOVAL

CAUTION: When servicing or 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.

(1) Raise and support the vehicle.

(2) Saturate the clamp nuts with Mopar® Rust Penetrant. Allow 5 minutes for penetration.

(3) Remove muffler to tailpipe exhaust clamp.

(4) Remove the tailpipe from the front and rear insulators (Fig. 24).

(5) Remove the tailpipe.

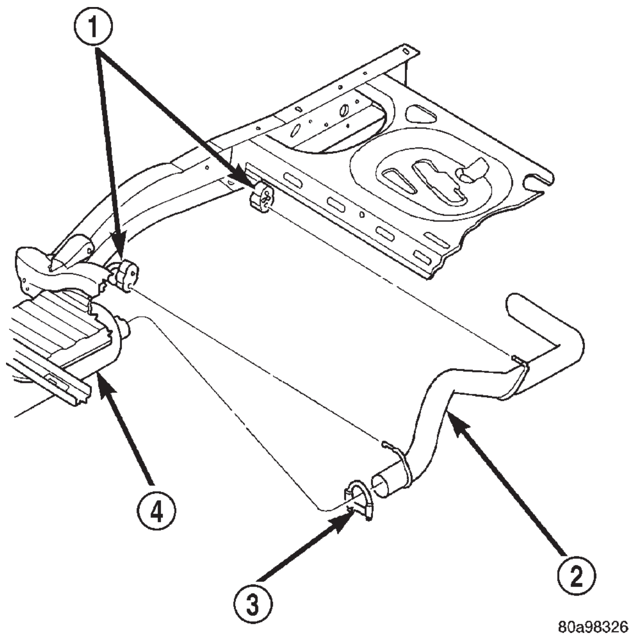


Fig. 24 Tailpipe and Hangers—2.5L/3.9L/4.7L

1 - INSULATORS
2 - TAILPIPE
3 - CLAMP
4 - MUFFLER

TAILPIPE - 2.5L/3.9L/4.7L (Continued)

INSTALLATION

CAUTION: When servicing or 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.

(1) Position the tailpipe into the muffler. Install the nuts onto the clamp bolt finger tight.
(2) Install the tailpipe into the insulators.
(3) Position tailpipe and tighten the muffler rear clamp nuts to 47 N·m (35 ft. lbs.) torque.
(4) Lower the vehicle.
(5) Start the engine, inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

TAILPIPE - 5.9L

DESCRIPTION

The tailpipe is made of stainless steel and attaches to the muffler.

REMOVAL

CAUTION: When servicing or 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.

(1) Raise and support the vehicle.
(2) Saturate the clamp nuts with Mopar® Rust Penetrant. Allow 5 minutes for penetration.
(3) Remove muffler to tailpipe exhaust clamp.
(4) Remove the tailpipe from the front and rear insulators (Fig. 25).
(5) Remove the tailpipe.

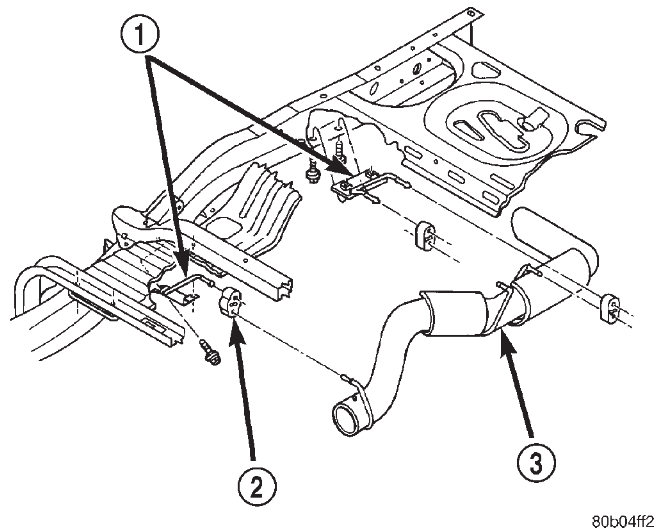


Fig. 25 Tailpipe and Hangers—5.9L R/T

1 - HANGER BRACKETS
2 - ISOLATOR
3 - TAILPIPE

INSTALLATION

CAUTION: When servicing or 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.

(1) Position the tailpipe into the muffler. Install the nuts onto the clamp bolt finger tight.
(2) Install the tailpipe into the insulators.
(3) Position tailpipe and tighten the muffler rear clamp nuts to 47 N·m (35 ft. lbs.) torque.
(4) Lower the vehicle.
(5) Start the engine, inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

FRAME & BUMPERS

TABLE OF CONTENTS

BUMPERS

DESCRIPTION

Bumpers are used at the front and rear of the vehicle. Bumpers are incorporated into the design of the front and rear fascias. They are mounted to the frame with brackets and may contain some lamp elements.

OPERATION

Bumpers are designed to protect the exterior sheetmetal in low impact situations. The bumpers are attached to the frame and provide mounting points for some optional accessories such as fog lights and tow hooks.

FRONT BUMPER

REMOVAL

(1) Open hood.

(2) Support front bumper on a suitable lifting device.

(3) Disengage wire connectors from fog lamps, if equipped.

(4) Disengage push-in fasteners attaching air deflector to bottom of bumper fascia.

(5) Pull the front wheelhouse liner back at the bumper and remove bolts attaching outer bumper brackets to frame rail (Fig. 1).

(6) Remove the bolts attaching the bumper to the inner bumper bracket.

(7) Separate front bumper with outer bracket attached from vehicle.

FRONT BUMPER (Continued)

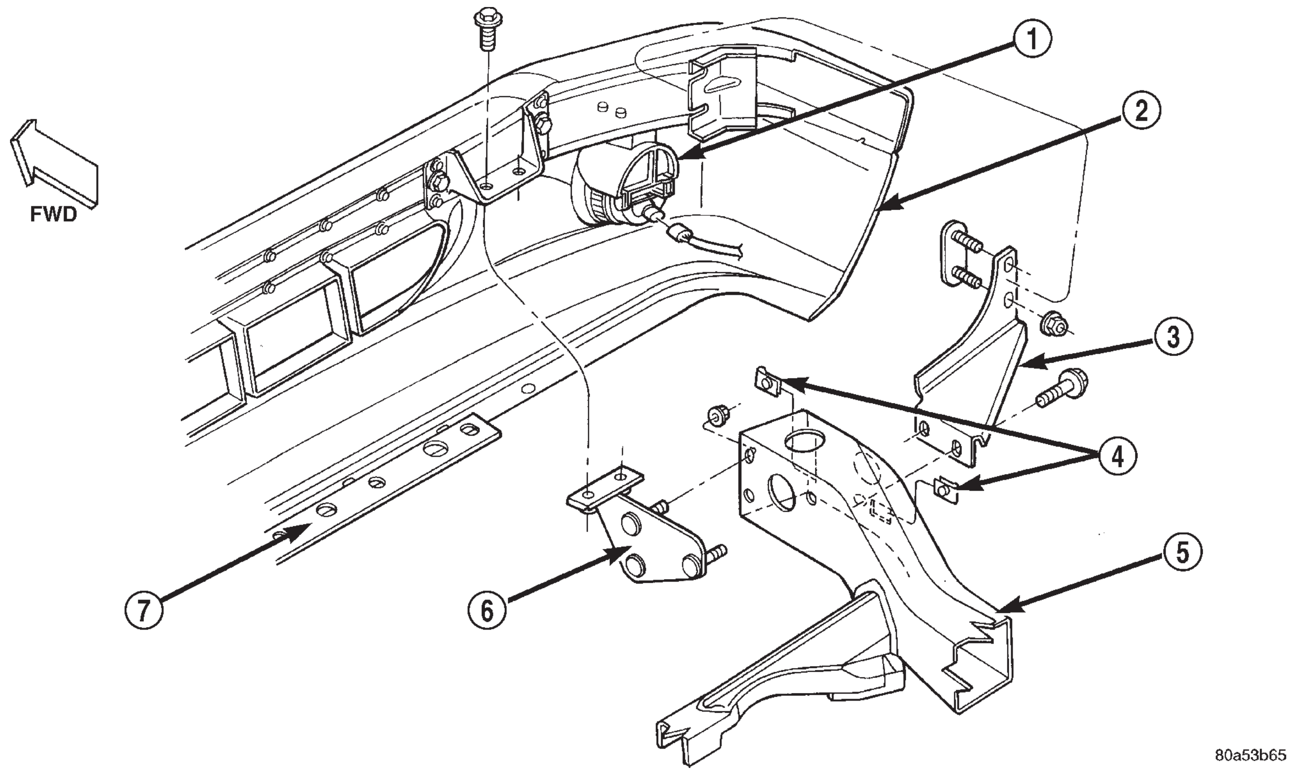


Fig. 1 Front Bumper

1 - FOG LAMP
2 - FRONT BUMPER
3 - OUTER BUMPER BRACKET
4 - U-NUT
5 - FRAME
6 - INNER BUMPER BRACKET
7 - FASCIA BRACKET

INSTALLATION

When the front bumper is installed, there should be a 19 mm gap between the bumper and front fender.

(1) Place the bumper on a suitable lifting device and position the bumper at the vehicle.

(2) Install the bolts attaching front bumper to inner bumper bracket. Tighten to 94 N·m (70 ft. lbs.) torque.

(3) Install the bolts attaching outer bumper brackets to the frame rail. Tighten to 94 N·m (70 ft. lbs.) torque. Ensure front wheelhouse liners are positioned correctly behind bumper.

(4) Engage wire connectors to fog lamps, if equipped.

(5) Install push-in fasteners attaching air deflector to front bumper fascia.

(6) Remove lifting device.

(7) Close hood.

FRONT FASCIA

REMOVAL

(1) Remove the front bumper.

(2) Remove the bolts attaching the fascia to the bumper.

(3) Separate fascia from bumper.

INSTALLATION

(1) Position fascia on bumper.

(2) Install the bolts attaching the fascia to the bumper.

(3) Install the front bumper.

REAR BUMPER

REMOVAL

(1) Support rear bumper on a suitable lifting device.

(2) Remove bolts attaching inner bumper brackets to frame rails (Fig. 2).

REAR BUMPER (Continued)

(3) Disengage license plate lamp wire connector from body wire harness, if equipped.

(4) Separate rear bumper from vehicle.

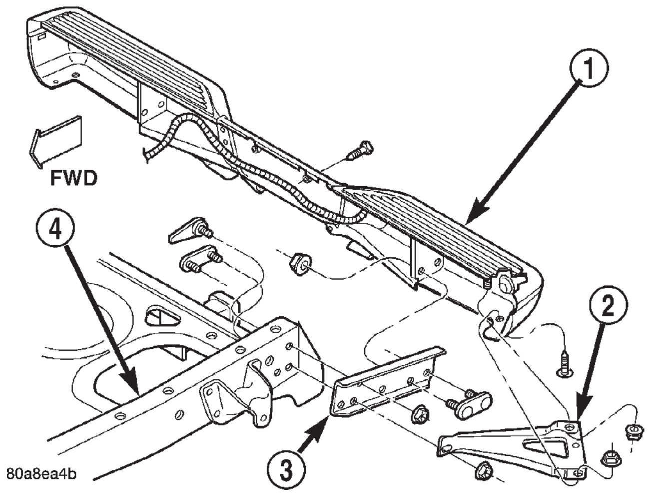


Fig. 2 Rear Bumper

1 - REAR BUMPER
2 - OUTER BRACKET
3 - INNER BRACKET
4 - FRAME

INSTALLATION

(1) Place bumper on a suitable lifting device and raise into position.

(2) Engage license plate lamp wire connector from body wire harness, if equipped.

(3) Install bolts attaching inner bumper brackets to frame rails. Tighten to 94 N·m (70 ft. lbs.) torque.

(4) Remove lifting device.

FRAME

DESCRIPTION

Dakota trucks have a ladder-type frame with Box-section front rails, dropped center section and open-channel side rails in the rear (Fig. 3) and (Fig. 4).

Cross members attached to the frame side rails with rivets, welds or bolts form a ladder-type construction. Additionally, the Dakota Quad Cab uses a mass dampener located between the frame rails, immediately forward of the rear bumper. This damper is used to address NVH issues. The cab is isolated from the frame with rubber load cushions (Fig. 5) and (Fig. 6) with through-bolts. The cargo box or bed is attached to the frame with bolts (Fig. 7) (Refer to 23 - BODY/EXTERIOR/CARGO BOX - REMOVAL).

OPERATION

The frame is designed to absorb and dissipate flexing and twisting due to acceleration, braking, cornering and road surface variances without bending when subjected to normal driving conditions. The frame is the mounting platform for the following systems and components:

- Front and rear suspension systems.
- Engine, transmission, and transfer case.
- Steering gear and linkage.
- Exhaust system and heat shields.
- Fuel cell and fuel line tubing.
- Front end sheet metal and radiator closure panel.
- Skid plate.
- Passenger cab.
- Cargo box or bed.
- Spare tire winch.
- Front and rear bumper systems.

FRAME (Continued)

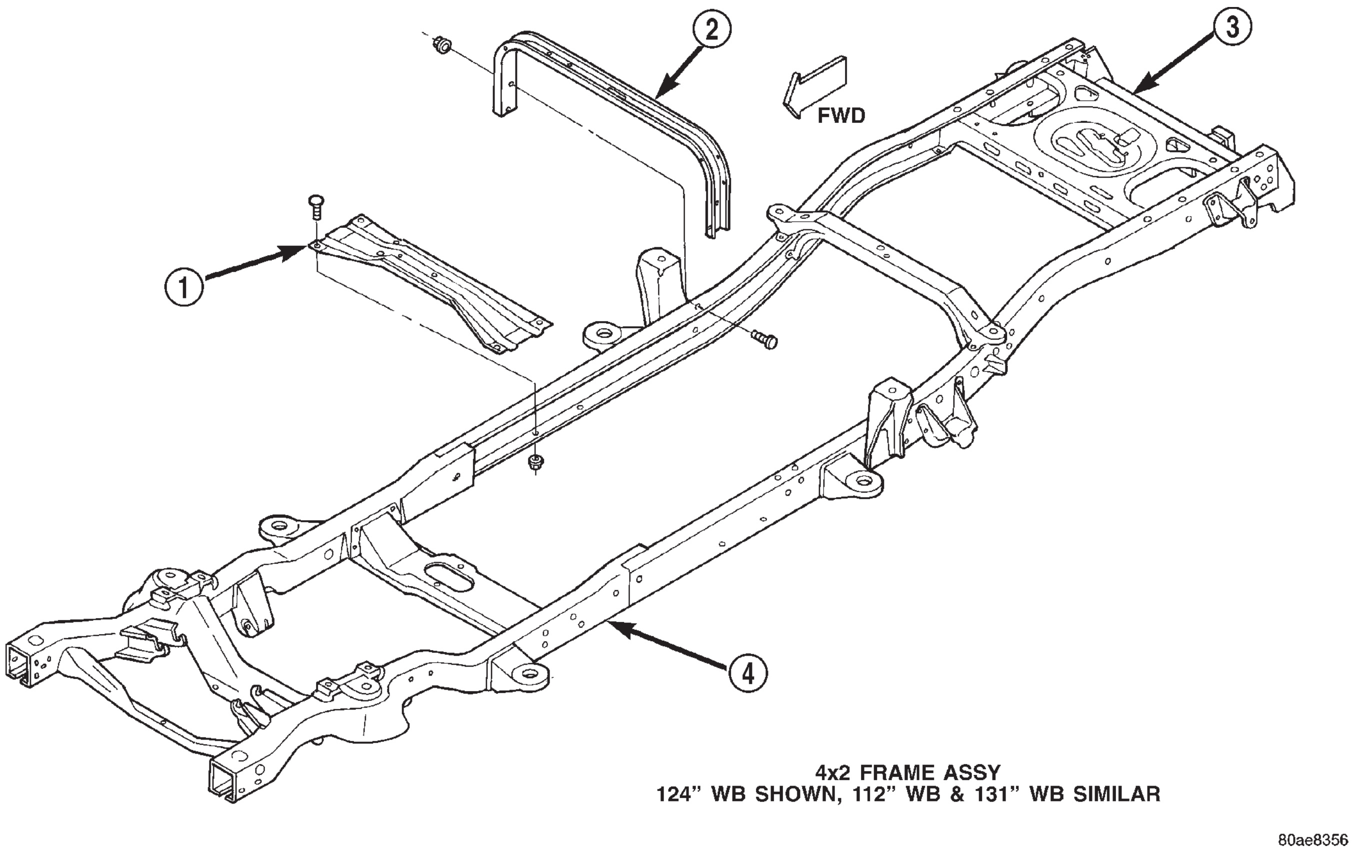


Fig. 3 4X2 Frame

1 - CENTER BEARING CROSSMEMBER
2 - FUEL TANK CROSSMEMBER
3 - TRAILER HITCH
4 - 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 5 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)

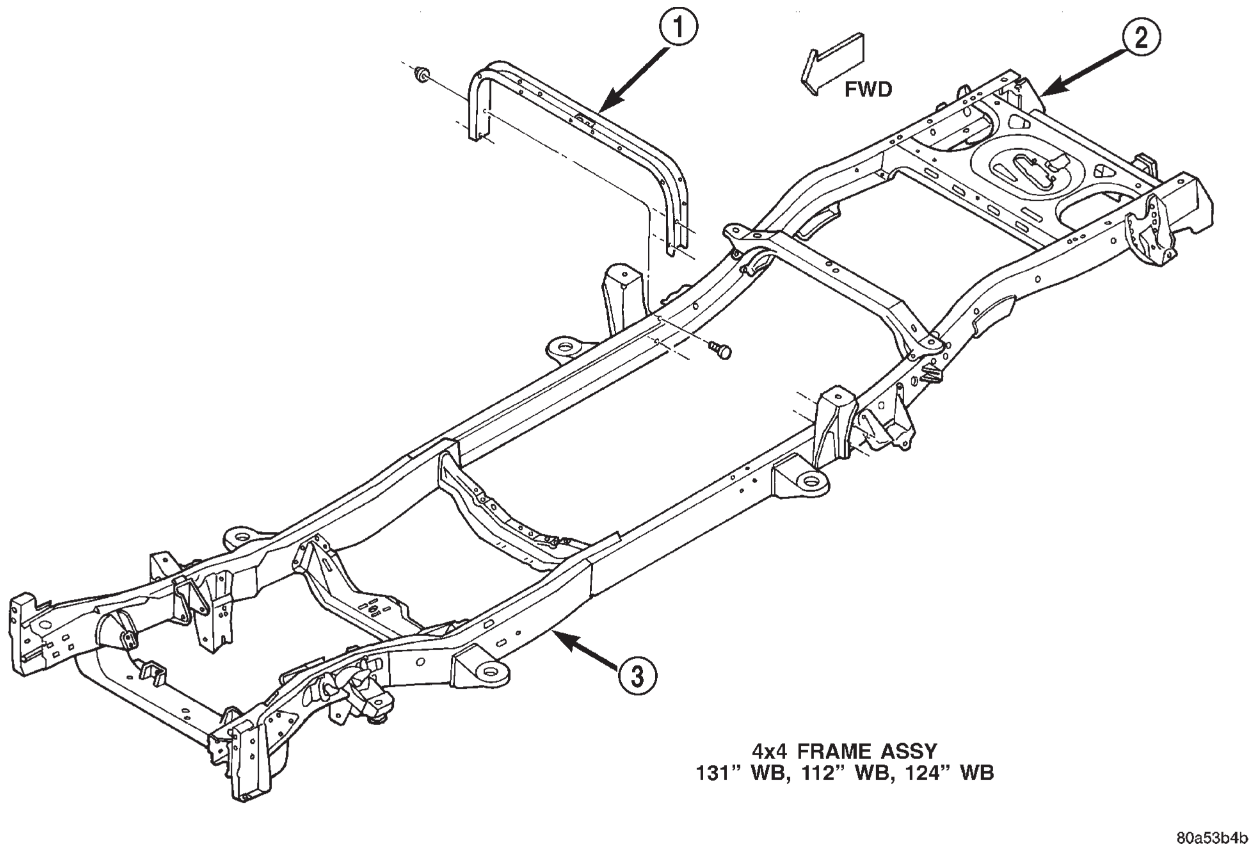


Fig. 4 4X4 Frame

1 - FUEL TANK CROSSMEMBER
2 - TRAILER HITCH
3 - FRAME

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 frame side rail top and bottom flanges, 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. 8) over the repaired area.

FRAME (Continued)

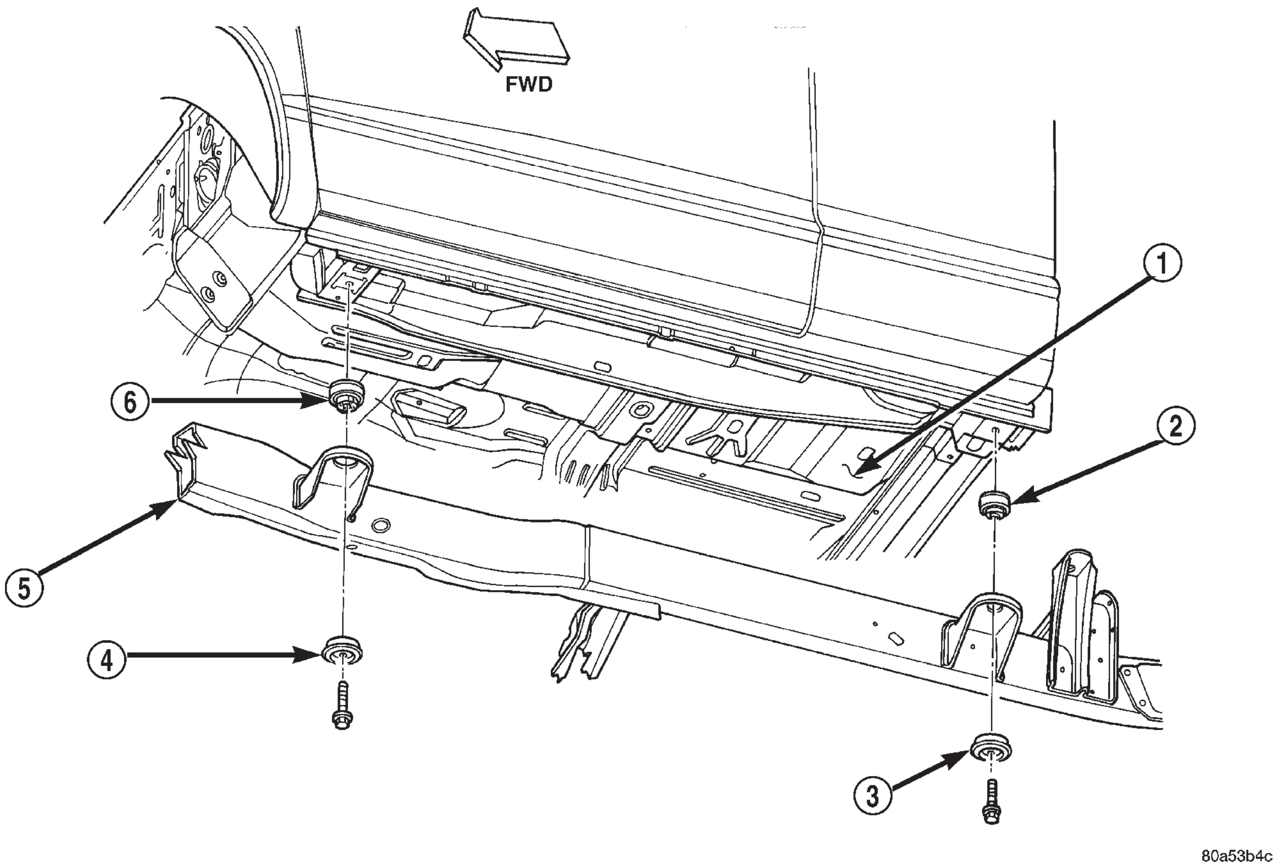


Fig. 5 Cab Mounts

1 - FLOOR PAN
2 - REAR CAB ISOLATOR
3 - UNDER CAB ISOLATOR
4 - UNDER CAB ISOLATOR
5 - FRAME
6 - FRONT CAB ISOLATOR

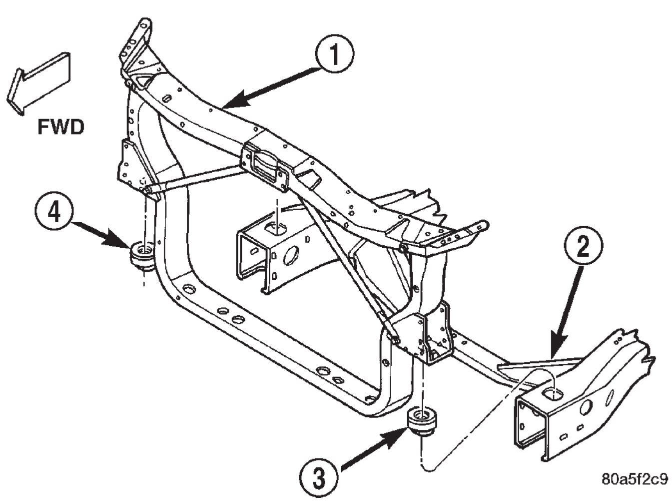


Fig. 6 Radiator Closure Panel

1 - RADIATOR CLOSURE PANEL
2 - FRAME
3 - ISOLATOR
4 - ISOLATOR

NOTE: If a reinforcement channel is required, the top and bottom flanges should be 0.250 inches narrower than the side rail flanges. Weld only in the areas indicated (Fig. 8).

FRAME FASTENERS

Bolts, nuts and rivets can be used to repair frames or to install a reinforcement section on the frame. Bolts can be used in place of rivets. When replacing rivets with bolts, install the next larger size diameter bolt to assure proper fit. If necessary, ream the hole out just enough to sufficiently receive the bolt.

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.

FRAME (Continued)

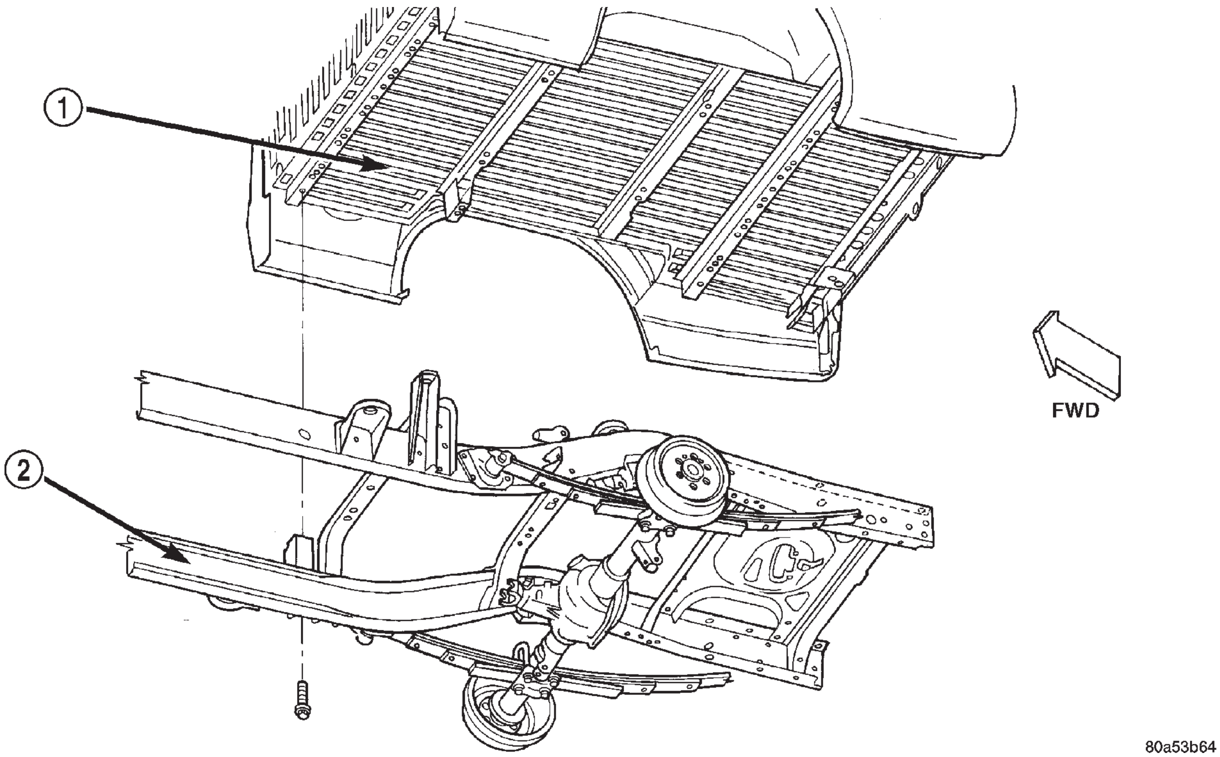


Fig. 7 Cargo Box

1 - CARGO BOX
2 - FRAME RAIL

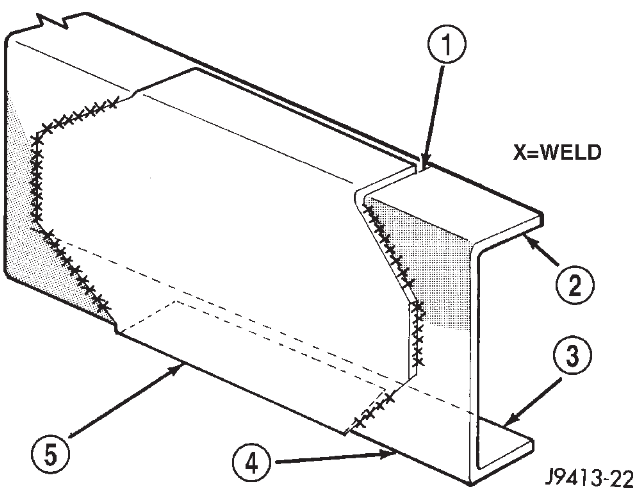


Fig. 8 Frame Reinforcement

1 - .250 IN FROM EDGE
2 - TOP FLANGE
3 - BOTTOM FLANGE
4 - FRAME RAIL
5 - FRAME REPAIR REINFORCEMENT

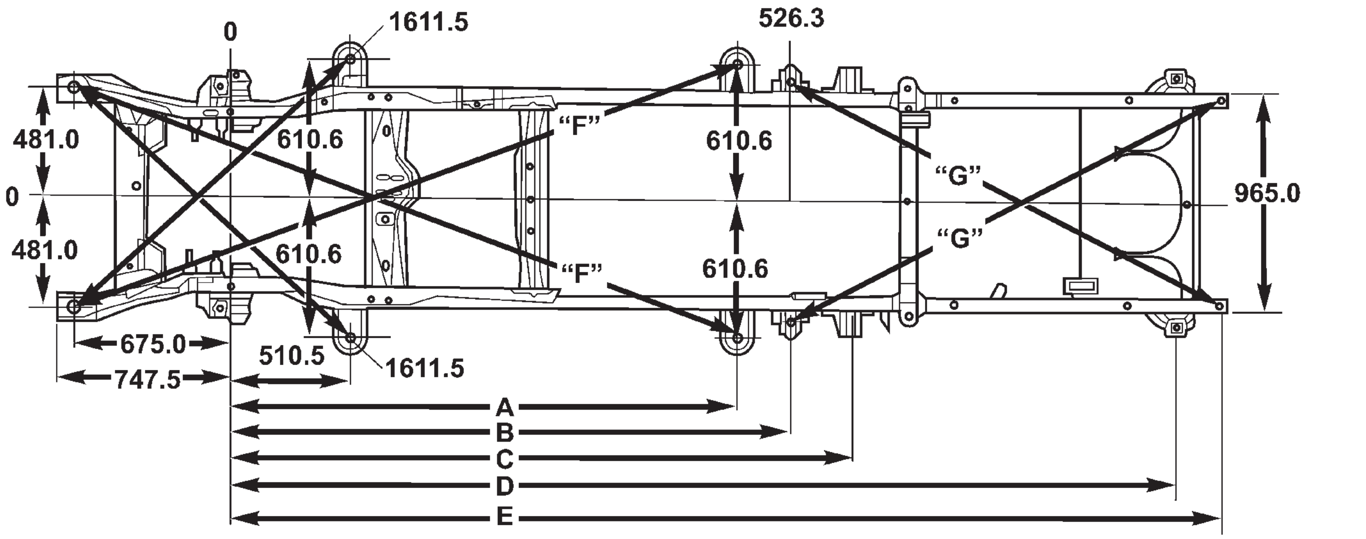
FRAME (Continued)

SPECIFICATIONS

FRAME DIMENSIONS

All dimensions are listed in millimeters.

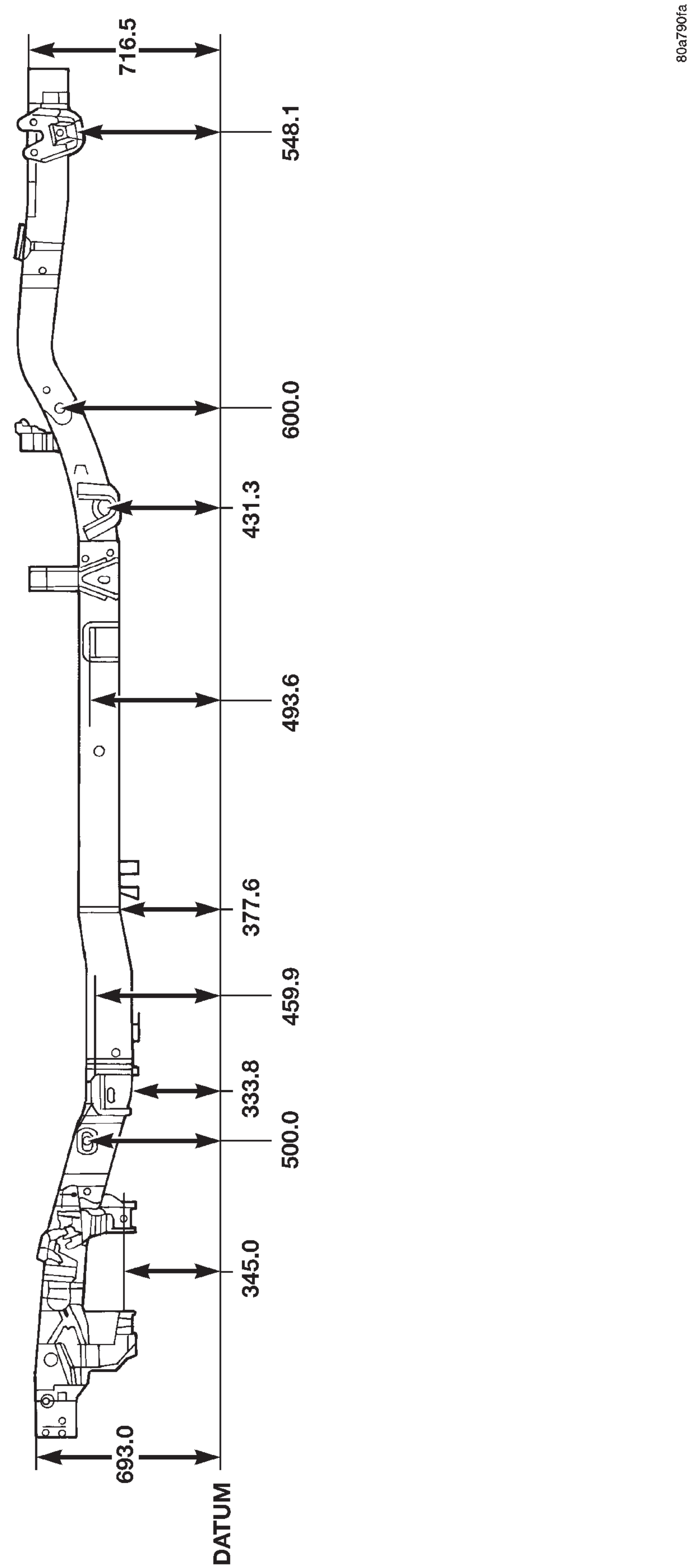
4X4 FRAME TOP VIEW



WHEELBASE	4X2 4X4	DIMN A	DIMN B	DIMN C	DIMN D	DIMN E	DIMN F	DIMN G
112	4X4	1674.8	1901.0	2159.3	3539.4	3738.5	2591.0	2081.7
124	4X4	1674.8	1901.0	2464.0	3844.2	4208.5	2591.0	2506.1
131	4X4	2156.7	2383.0	2641.9	4022.0	4220.5	3034.9	2081.7

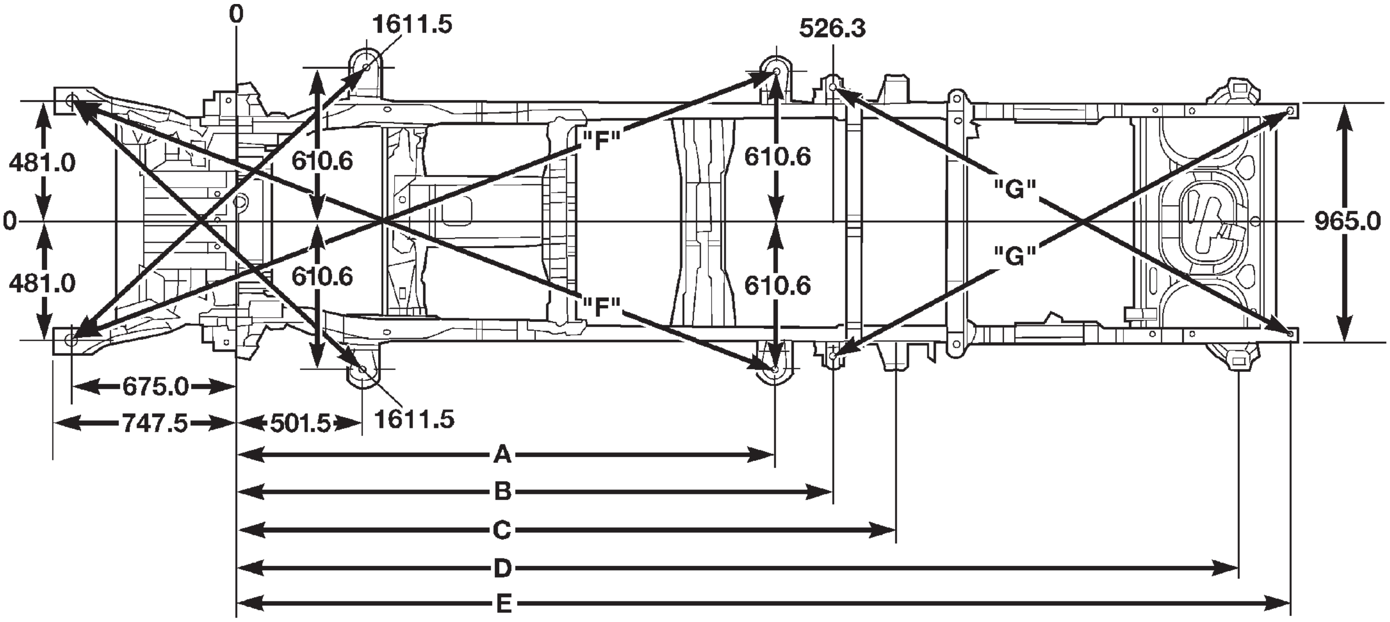
FRAME (Continued)

4X4 FRAME SIDE VIEW



FRAME (Continued)

4X2 FRAME TOP VIEW



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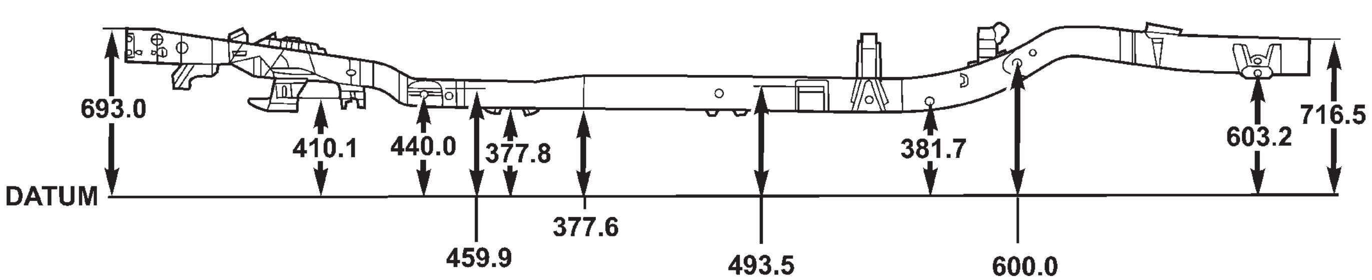
WHEELBASE	4X2 4X4	DIMN A	DIMN B	DIMN C	DIMN D	DIMN E	DIMN F	DIMN G
112	4X2	1674.8	1901.0	2176.9	3539.5	3738.5	2591.0	2081.7
124	4X2	1674.8	1901.0	2481.6	3844.2	4208.5	2591.0	2506.1
131	4X2	2156.7	2383.0	2659.5	4022.1	4220	3034.9	2081.7

4X2 FRAME SIDE VIEW



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FRAME (Continued)

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Cab bolts	81 N·m (60 ft. lbs.)
Front axle skid plate-to-front x-member bolt	23 N·m (17 ft. lbs.)
Front axle skid plate-to-trans x-member bolt	23 N·m (17 ft. lbs.)
Front bumper brkt-to-frame nut	94 N·m (70 ft. lbs.)
Front bumper outer brace bolt	94 N·m (70 ft. lbs.)
Fuel tank skid plate to x-member nut	41 N·m (30 ft. lbs.)
Fuel tank skid plate to side rail screws	23 N·m (200 in. lbs.)
Rear bumper-to-brace nut	94 N·m (70 ft. lbs.)
Rear bumper brace-to-brkt nut	94 N·m (70 ft. lbs.)
Rear bumper brkt-to-frame nut	94 N·m (70 ft. lbs.)
Transfer case skid plate-to-x-member bolt	23 N·m (17 ft. lbs.)
Trailer hitch nut	108 N·m (80 ft. lbs.)

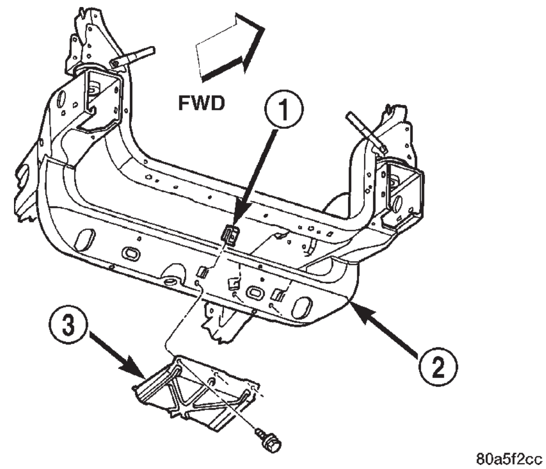

Fig. 9 Front Axle Skid Plate

1 - U-NUT
2 - FRAME
3 - SKID PLATE

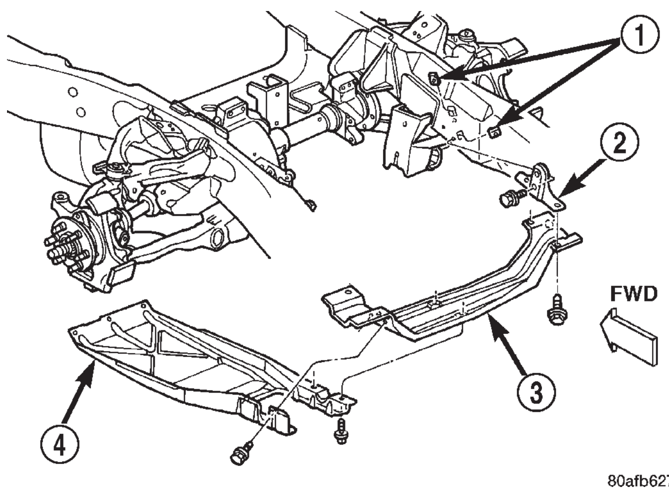

Fig. 10 Front Axle Skid Plate

1 - U-NUT
2 - BRACKET
3 - SKID PLATE CROSSMEMBER
4 - SKID PLATE

FRONT SKID PLATE

REMOVAL

(1) Position a support under the skid plate.

(2) Remove the bolts that attach the skid plate to the front crossmember (Fig. 9).

(3) Remove the bolts that attach the skid plate to the skid plate crossmember (Fig. 10).

(4) Separate the crossmember from the vehicle.

INSTALLATION

(1) Position and support the skid plate at the front crossmember.

(2) Install the bolts that attach the skid plate to the transmission crossmember. Tighten to 23 N·m (17 ft. lbs.) torque.

(3) Install the bolts that attach the skid plate to the front crossmember. Tighten to 23 N·m (17 ft. lbs.) torque.

(4) Remove the support from under the skid plate.

FUEL TANK SKID PLATE

REMOVAL

(1) Position a support under the skid plate.

(2) Remove the nuts that attach the skid plate to the fuel tank crossmember and the frame crossmember (Fig. 11).

(3) Remove the screws that attach the skid plate to the support bracket and the frame side rail.

(4) Remove the support and the skid plate from the vehicle.

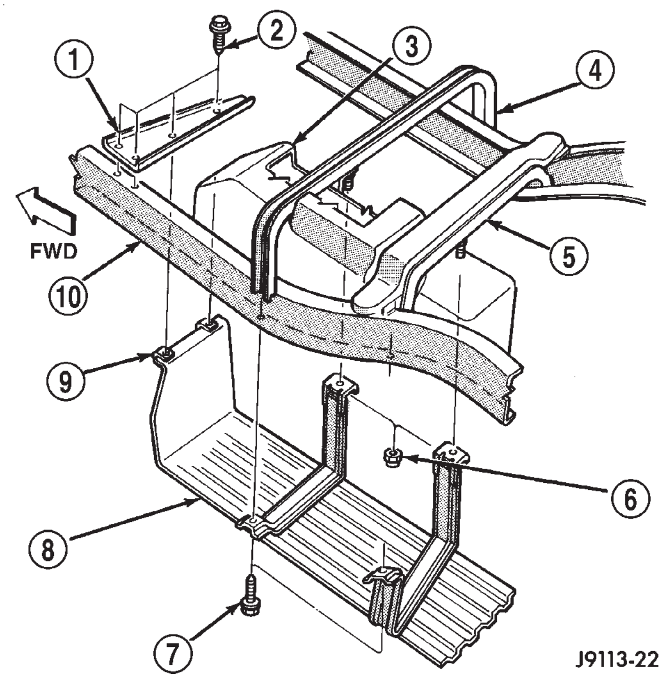

Fig. 11 Fuel Tank Skid Plate—4WD

1 - SKID PLATE SUPPORT BRACKET
2 - SCREW
3 - FUEL TANK
4 - FUEL TANK CROSSMEMBER
5 - FRAME CROSSMEMBER
6 - LOCK NUT
7 - SCREW
8 - SKID PLATE
9 - U-NUT
10 - FRAME RAIL

INSTALLATION

(1) Position and support the skid plate under the fuel tank.

(2) Install the nuts to attach the skid plate to the fuel tank crossmember and the frame crossmember. Tighten the nuts with 41 N·m (30 ft. lbs.) torque.

(3) Install the screws to attach the skid plate to the frame side rail and the support bracket. Tighten the screws with 23 N·m (200 in. lbs.) torque.

(4) Remove the support from under the skid plate.

TRAILER HITCH

REMOVAL

(1) Support trailer hitch on a suitable lifting device.

(2) Remove fasteners attaching trailer wiring connector to trailer hitch, if equipped.

(3) Remove bolts attaching trailer hitch to frame rails (Fig. 12).

(4) Separate trailer hitch from vehicle.

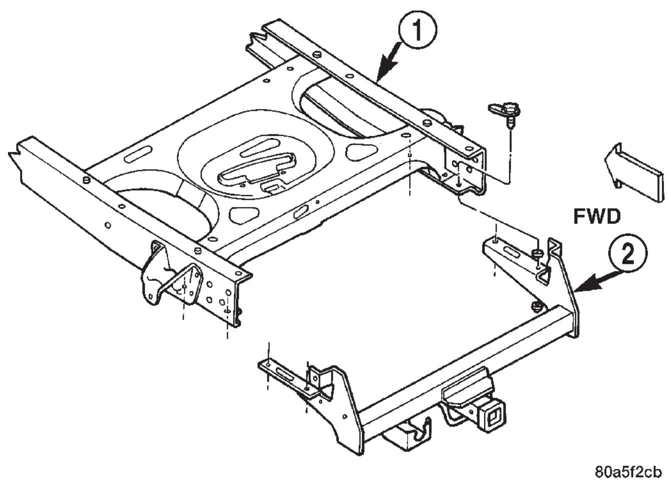

Fig. 12 Trailer Hitch

1 - FRAME
2 - TRAILER HITCH

INSTALLATION

(1) Position trailer hitch on vehicle.

(2) Install the bolts attaching trailer hitch to frame rails and remove lifting device. Tighten to 108 N·m (80 ft. lbs.) torque.

(3) Install fasteners attaching trailer wiring connector to trailer hitch, if equipped.

VALANCE PANEL

REMOVAL

(1) Remove nuts attaching valance panel to bracket (Fig. 13).

(2) Disengage license plate lamp harness connector.

(3) Separate valance panel from cargo box.

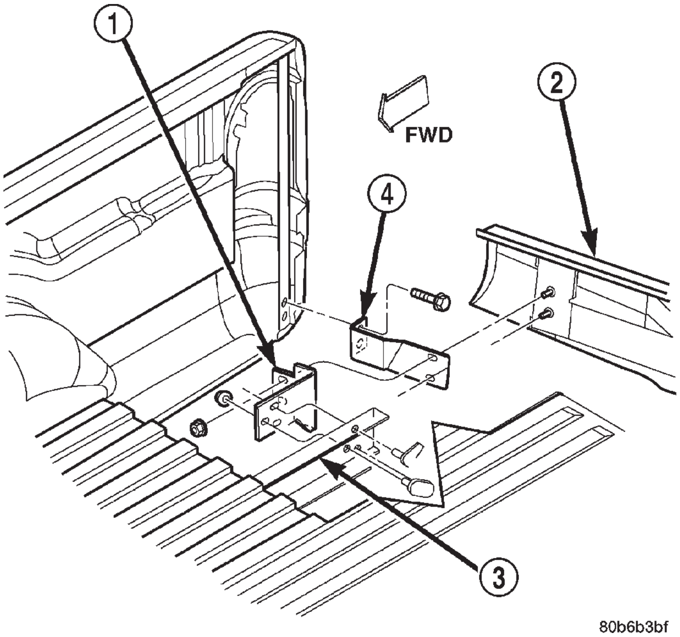

Fig. 13 Valance Panel

1 - BRACKET
2 - VALANCE PANEL
3 - FRAME
4 - BRACKET

INSTALLATION

(1) Position valance panel on cargo box.

(2) Engage license plate lamp harness connector.

(3) Install nuts attaching valance panel to bracket .

TRANSFER CASE SKID PLATE

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove bolts attaching skid plate to crossmembers (Fig. 14).

(3) Separate skid plate from vehicle.

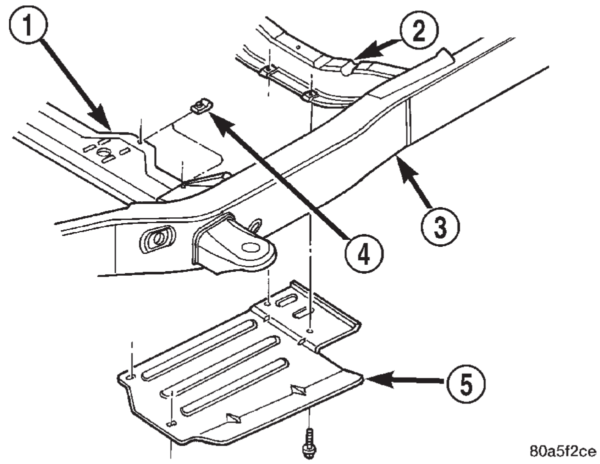

Fig. 14 Transfer Case Skid Plate

1 - TRANSMISSION CROSSMEMBER
2 - TORSION BAR CROSSMEMBER
3 - FRAME
4 - U-NUT
5 - TRANSFER CASE SKID PLATE

INSTALLATION

(1) Position skid plate on vehicle.

(2) Install bolts attaching skid plate to crossmembers. (Fig. 14) Tighten to 23 N·m (17 ft. lbs.) torque.

(3) Remove safety stands and lower vehicle.

FUEL SYSTEM

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FUEL DELIVERY

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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 DELIVERY (Continued)

- fuel tank filler tube cap
- 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 rollover valve (refer to rollover valve for information).

A fuel filler/vent tube assembly using a pressure/ vacuum, 1/4 turn fuel filler cap is used. The fuel filler tube contains a flap door located below the fuel fill cap.

Also to be considered part of the fuel system is the evaporation control system. This is designed to reduce the emission of fuel vapors into the atmosphere. The description and function of the Evaporative Control System is found in 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).

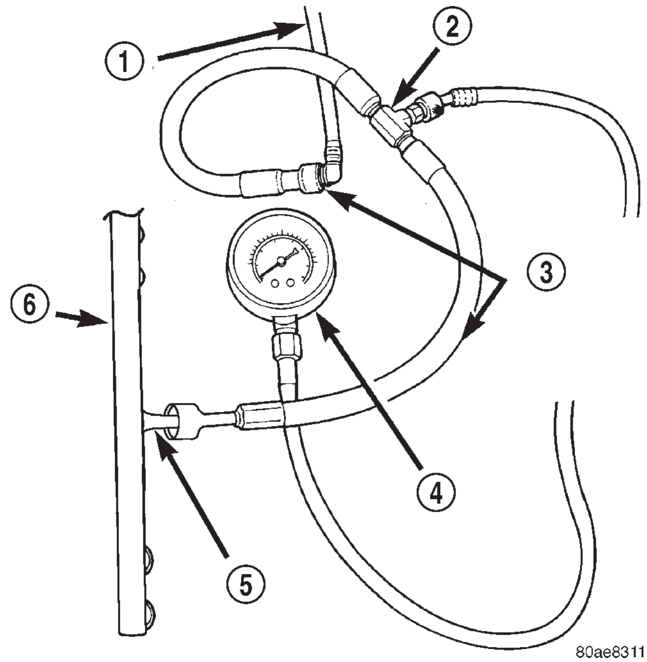


Fig. 1 Connecting Adapter Tool—Typical

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

(4) Connect the 0-414 kPa (0-60 psi) fuel pressure test gauge (from Gauge Set 5069) to the test port on the appropriate Adaptor Tool. **The DRB® III Scan Tool along with the PEP module, the 500 psi pressure transducer, and the transducer-to-test port adapter may also be used in place of the fuel pressure gauge.**

The fittings on both tools must be in good condition and free from any small leaks before performing the proceeding test.

(5) Start engine and bring to normal operating temperature.

(6) Observe test gauge. Normal operating pressure should be 339 kPa +/–34 kPa (49.2 psi +/–5 psi).

(7) Shut engine off.

(8) Pressure should not fall below **30 psi for five minutes.**

FUEL DELIVERY (Continued)

(9) If pressure falls below 30 psi, it must be determined if a fuel injector, the check valve within the fuel pump module, or a fuel tube/line is leaking.

(10) Again, start engine and bring to normal operating temperature.

(11) Shut engine off.

(12) **Testing for fuel injector or fuel rail leakage:** Clamp off the rubber hose portion of Adaptor Tool between the fuel rail and the test port “T” on Adapter Tool. If pressure now holds at or above 30 psi, a fuel injector or the fuel rail is leaking.

(13) **Testing for fuel pump check valve, filter/regulator check valve or fuel tube/line leakage:** Clamp off the rubber hose portion of Adaptor Tool between the vehicle fuel line and test port “T” on Adapter Tool. If pressure now holds at or above 30 psi, a leak may be found at a fuel tube/line. If no leaks are found at fuel tubes or lines, one of the check valves in either the electric fuel pump or filter/regulator may be leaking.

Note: A quick loss of pressure usually indicates a defective check valve in the filter/regulator. A slow loss of pressure usually indicates a defective check valve in the electric fuel pump.

The electric fuel pump is not serviced separately. Replace the fuel pump module assembly. The filter/regulator may be replaced separately on certain applications. Refer to Fuel Filter/Fuel Pressure Regulator Removal/Installation for additional information.

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).

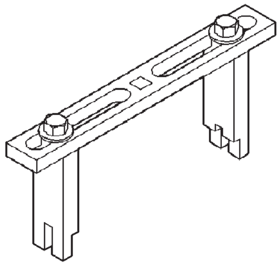
TORQUE - FUEL DELIVERY

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Accelerator Pedal Bracket Mounting Nuts	7	_	65
Fuel Pump Module Locknut	54	_	40
Fuel Rail Mounting Bolts - 3.9L/5.2L/5.9L	23	_	200
Fuel Rail Mounting Bolts - 4.7L	27	20	_
Fuel Rail Mounting Bolts - 2.5L	11	_	100
Fuel Tank Mounting Nuts	27-54	20-40	_
Fuel Hose Clamps	3	_	25

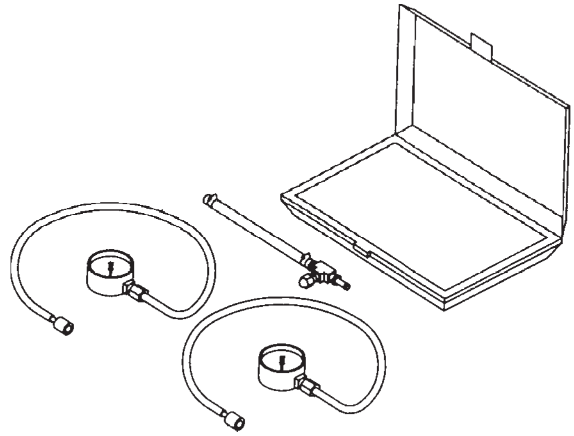
FUEL DELIVERY (Continued)

SPECIAL TOOLS

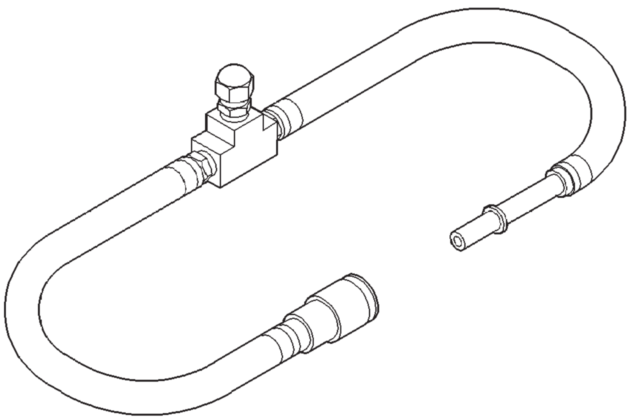
FUEL SYSTEM



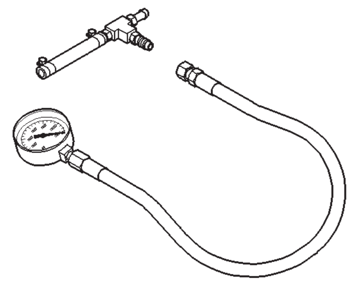
Spanner Wrench—6856



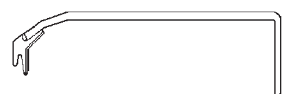
Test Kit, Fuel



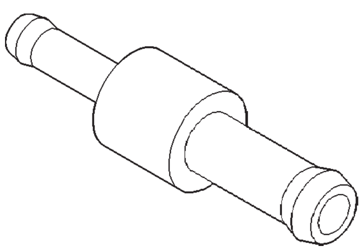
Adapters, Fuel Pressure Test—6539 and/or 6631



Test Kit, Fuel Pressure—C-4799-B



Fuel Line Removal Tool—6782



Fitting, Air Metering—6714

O2S (Oxygen Sensor) Remover/Installer—C-4907

FUEL FILTER/PRESSURE REGULATOR

DESCRIPTION

A combination fuel filter and fuel pressure regulator (Fig. 2) is used on all engines. It is located on the top of the fuel pump module. A separate frame mounted fuel filter is not used with any engine.

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.

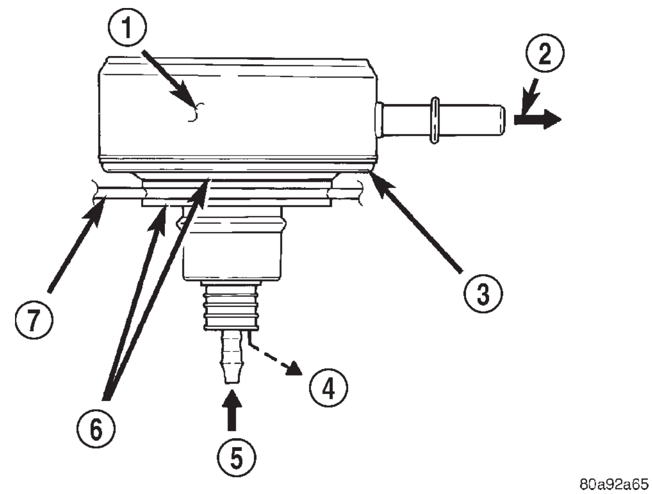


Fig. 2 Side View—Filter/Regulator

1 - INTERNAL FUEL FILTER
2 - FUEL FLOW TO FUEL INJECTORS
3 - FUEL FILTER/FUEL PRESSURE REGULATOR
4 - EXCESS FUEL BACK TO TANK
5 - FUEL INLET
6 - RUBBER GROMMET
7 - TOP OF PUMP MODULE

OPERATION

Fuel Pressure Regulator Operation: The pressure regulator is a mechanical device that is not controlled by engine vacuum or the powertrain control module (PCM).

The regulator is calibrated to maintain fuel system operating pressure of approximately 339 kPa ± 34 kPa (49.2 psi ± 5 psi) at the fuel injectors. It contains a diaphragm, calibrated springs and a fuel return valve. The internal fuel filter (Fig. 2) 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. 2).

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 49.2 psi, an internal diaphragm opens and excess fuel pressure is routed back into the tank through the bottom of pressure regulator.

Both fuel filters (at bottom of fuel pump module and within fuel pressure regulator) are designed for extended service. They do not require normal scheduled maintenance. Filters should only be replaced if a diagnostic procedure indicates to do so.

FUEL 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

FUEL LEVEL SENDING UNIT / SENSOR (Continued)

a message across the multi-plex bus circuits to the instrument panel cluster. Here it is translated into the appropriate fuel gauge level reading. Refer to Instrument Panel for additional information.

For OBD II Emission Monitor Requirements: The PCM will monitor the voltage output sent from the resistor track on the sending unit to indicate fuel level. The purpose of this feature is to prevent the OBD II system from recording/setting false misfire and fuel system monitor diagnostic trouble codes. The feature is activated if the fuel level in the tank is less than approximately 15 percent of its rated capacity. If equipped with a Leak Detection Pump (EVAP system monitor), this feature will also be activated if the fuel level in the tank is more than approximately 85 percent of its rated capacity.

DIAGNOSIS AND TESTING - FUEL GAUGE SENDING UNIT

The fuel gauge sending unit contains a variable resistor (track). As the float moves up or down, electrical resistance will change. Refer to 8, 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 ±6 ohms. With float in down position, resistance should be 220 ohms ±6 ohms.

REMOVAL

The fuel gauge sending unit (fuel level sensor) and float assembly is located on the side of fuel pump module (Fig. 3) or (Fig. 4). The fuel pump module is located inside 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) **2 Door Models:**

(a) Unplug 4–way electrical connector (Fig. 3).

(b) Disconnect 2 sending unit wires at 4–way connector. The locking collar of connector must be removed before wires can be released from connector. Note location of wires within 4–way connector.

(c) The sending unit is retained to pump module with a small lock tab and notch (Fig. 5). Carefully push lock tab to the side and away from notch while sliding sending unit downward on tracks for removal. Note wire routing while removing unit from module.

(4) **4 Door Models:**

(a) Remove electrical connector at sending unit terminals.

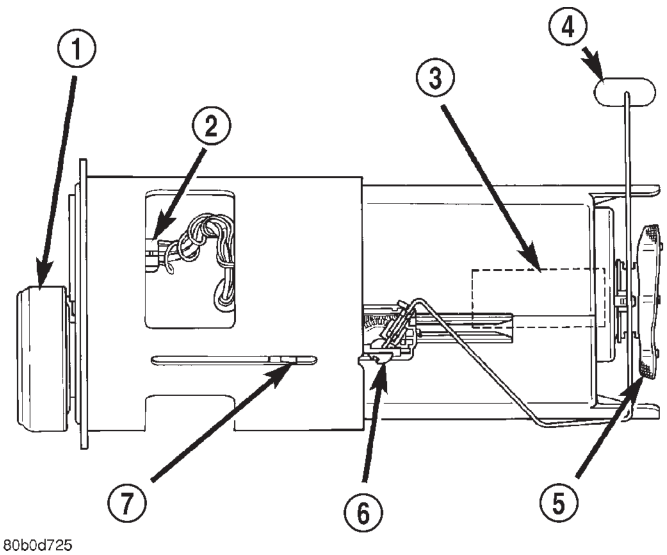


Fig. 3 Fuel Gauge Sending Unit - 2 Door Models

1 - FUEL FILTER/PRESSURE REGULATOR
2 - ELECTRICAL CONNECTOR
3 - ELECTRIC FUEL PUMP
4 - FUEL GAUGE FLOAT
5 - FUEL PUMP INLET FILTER
6 - FUEL GAUGE SENDING UNIT
7 - MODULE LOCK TABS (3)

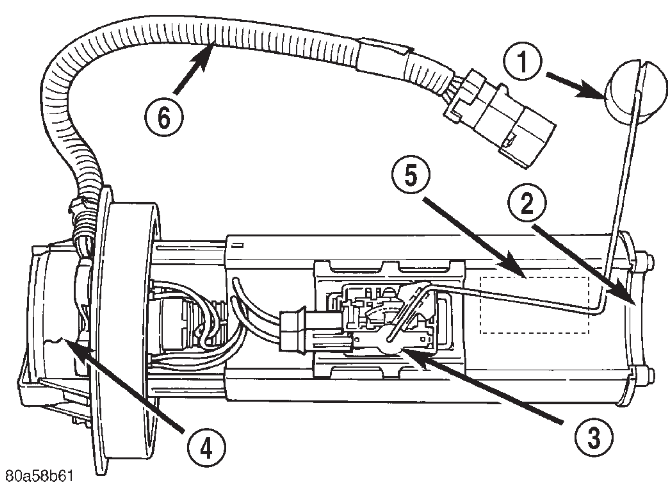


Fig. 4 Fuel Gauge Sending Unit Location – 4 Door Models

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

(b) Press on release tab (Fig. 6) to remove sending unit from pump module.

FUEL LEVEL SENDING UNIT / SENSOR (Continued)

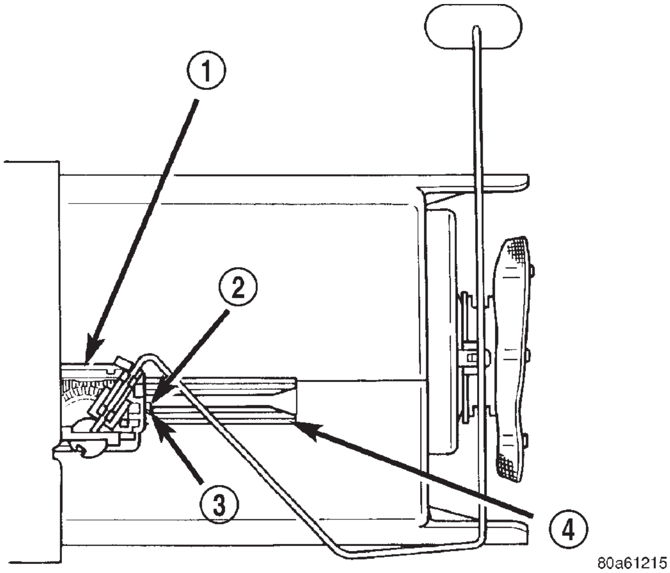


Fig. 5 Fuel Gauge Sending Unit Lock Tab/Tracks - 2 Door Models

1 - FUEL GAUGE SENDING UNIT
2 - LOCK TAB
3 - NOTCH
4 - TRACKS

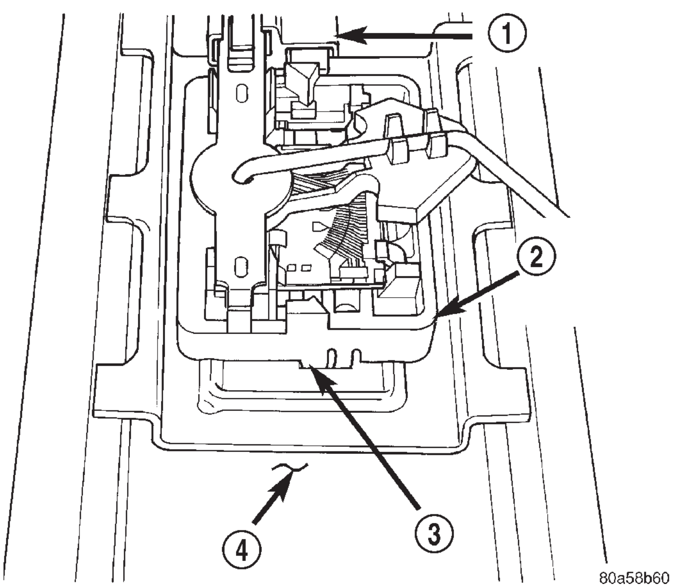


Fig. 6 Fuel Gauge Sending Unit Release Tab - 4 Door Models

1 - ELECTRICAL CONNECTOR
2 - FUEL GAUGE SENDING UNIT
3 - RELEASE TAB
4 - FUEL PUMP MODULE

INSTALLATION

The fuel gauge sending unit (fuel level sensor) and float assembly is located on the side of fuel pump module (Fig. 3) or (Fig. 4). The fuel pump module is located inside of fuel tank.

(1) **2 Door Models:**

(a) Position sending unit into tracks. Note wire routing.

(b) Push unit on tracks until lock tab snaps into notch.

(c) Connect 2 sending unit wires into 4–way connector and install locking collar.

(d) Connect 4–way electrical connector to module.

(2) **4 Door Models:**

(a) Position sending unit to pump module and snap into place.

(b) 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 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 fuel pump is located inside of the fuel pump module. A 12 volt, permanent magnet, electric motor powers the fuel pump.

FUEL PUMP (Continued)

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.

DIAGNOSIS AND TESTING - FUEL PUMP PRESSURE TEST

Use this test in conjunction with the Fuel Pump Capacity Test, Fuel Pressure Leak Down Test and Fuel Pump Amperage Test found elsewhere in this group.

Check Valve Operation: The electric fuel pump outlet contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** When the electric fuel pump is activated, fuel pressure should **immediately** (1–2 seconds) rise to specification.

All fuel systems are equipped with a fuel tank module mounted, combination fuel filter/fuel pressure regulator. The fuel pressure regulator is not controlled by engine vacuum.

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. BEFORE DISCONNECTING FUEL LINE AT FUEL RAIL, THIS PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

(1) Remove protective cap at fuel rail test port. Connect the 0–414 kPa (0-60 psi) fuel pressure gauge (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.**

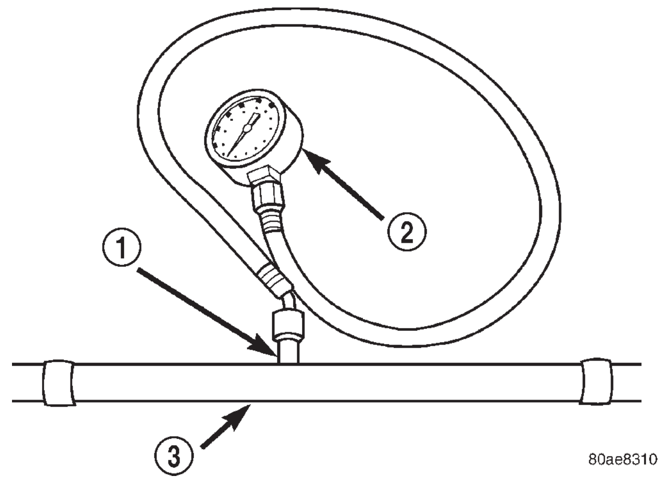


Fig. 7 Fuel Pressure Test Gauge (Typical Gauge Installation at Test Port)

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 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.

FUEL PUMP (Continued)

(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 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.

(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.

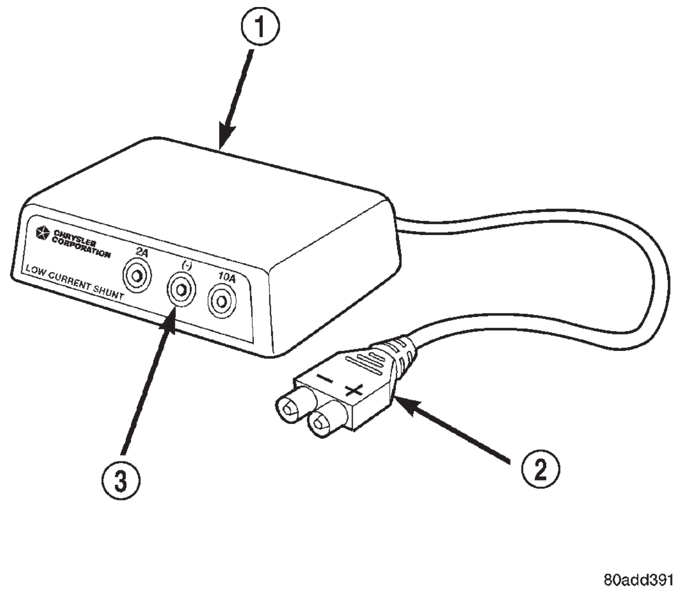


Fig. 8 Low Current Shunt

1 - LOW CURRENT SHUNT ADAPTER
2 - PLUG TO DRB
3 - TEST LEAD RECEPTACLES

(8) Using left/right arrow keys, highlight CHANNEL 1 function on DRB screen.

(9) Press ENTER three times.

(10) Using up/down arrow keys, highlight RANGE on DRB screen (screen will default to 2 amp scale).

(11) Press ENTER to change 2 amp scale to 10 amp scale. **This step must be done to prevent damage to DRB scan tool or LCS adapter (blown fuse).**

(12) Remove cover from Power Distribution Center (PDC).

(13) Remove fuel pump relay from PDC. Refer to label on PDC cover for relay location.

WARNING: BEFORE PROCEEDING TO NEXT STEP, NOTE THE FUEL PUMP WILL BE ACTIVATED AND SYSTEM PRESSURE WILL BE PRESENT. THIS WILL OCCUR AFTER CONNECTING TEST LEADS FROM LCS ADAPTER INTO FUEL PUMP RELAY CAVITIES. THE FUEL PUMP WILL OPERATE EVEN WITH IGNITION KEY IN OFF POSITION. BEFORE ATTACHING TEST LEADS, BE SURE ALL FUEL LINES AND FUEL SYSTEM COMPONENTS ARE CONNECTED.

CAUTION: To prevent possible damage to the vehicle electrical system and LCS adapter, the test leads must be connected into relay cavities exactly as shown in following steps.

Depending upon vehicle model, year or engine configuration, three different types of relays may be used: Type-1, type-2 and type–3.

FUEL PUMP (Continued)

(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).

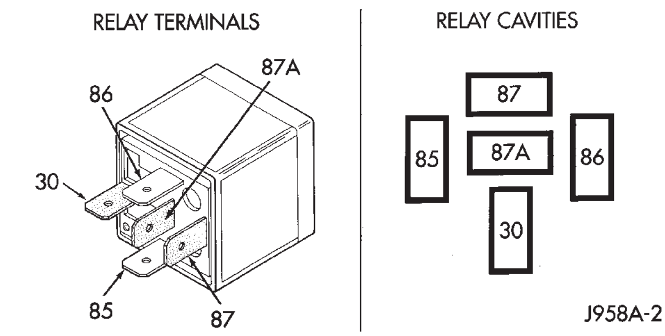


Fig. 9 FUEL PUMP RELAY - TYPE 1

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

(17) When LCS adapter test leads are attached into relay cavities, fuel pump **will be activated.** Determine fuel pump amperage on DRB screen. Amperage should be below 10.0 amps. If amperage is below 10.0 amps, and specifications for the Fuel Pump Pressure, Fuel Pump Capacity and Fuel Pressure Leak Down tests were met, the fuel pump module is OK.

(18) If amperage is more than 10.0 amps, replace fuel pump module assembly. The electric fuel pump is not serviced separately.

(19) Disconnect test leads from relay cavities immediately after testing.

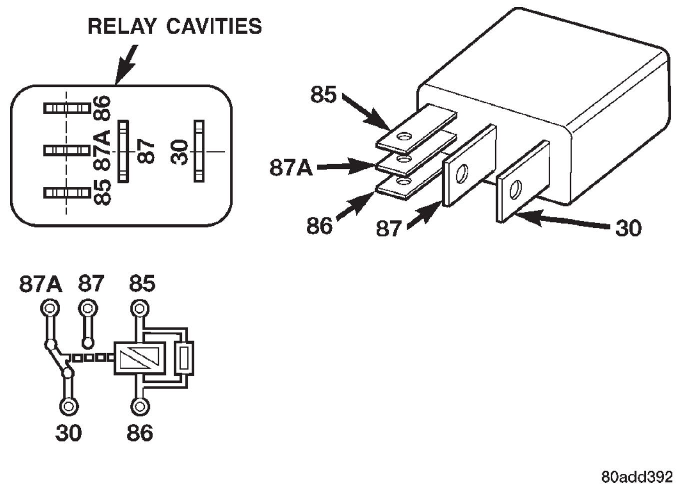


Fig. 10 FUEL PUMP RELAY - TYPE 2

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

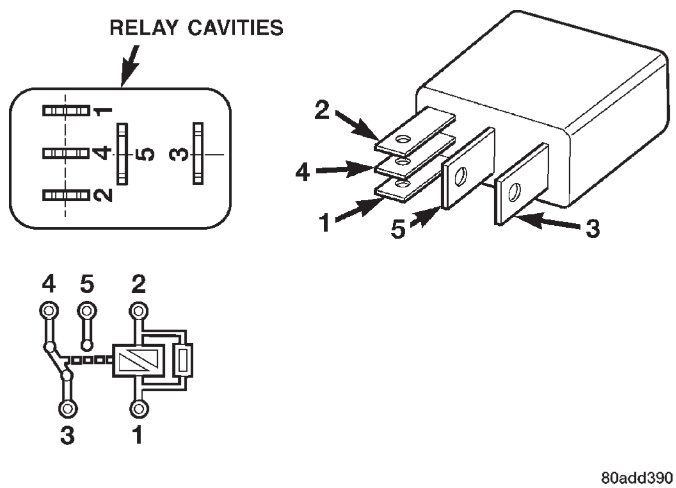


Fig. 11 FUEL PUMP RELAY - TYPE 3

TERMINAL LEGEND

NUMBER	IDENTIFICATION
1	COIL BATTERY
2	COIL GROUND
3	COMMON FEED
4	NORMALLY CLOSED
5	NORMALLY OPEN

FUEL PUMP MODULE

DESCRIPTION

The fuel pump module on all models/all engines is installed in the top of the fuel tank (Fig. 12) or (Fig. 13). The fuel pump module contains the following components :

- A combination fuel filter/fuel pressure regulator
- Electric fuel pump
- Fuel pump reservoir
- A separate in-tank fuel filter (at bottom of module)
- Fuel gauge sending unit (fuel level sensor)
- Fuel supply line connection at filter/regulator
- A threaded locknut to retain pump module to fuel tank
- A rubber gasket between tank flange and pump module

The fuel gauge sending unit (fuel level sensor), and pick-up filter (at bottom of module) may be serviced separately. If the electrical fuel pump requires service, the entire fuel pump module must be replaced.

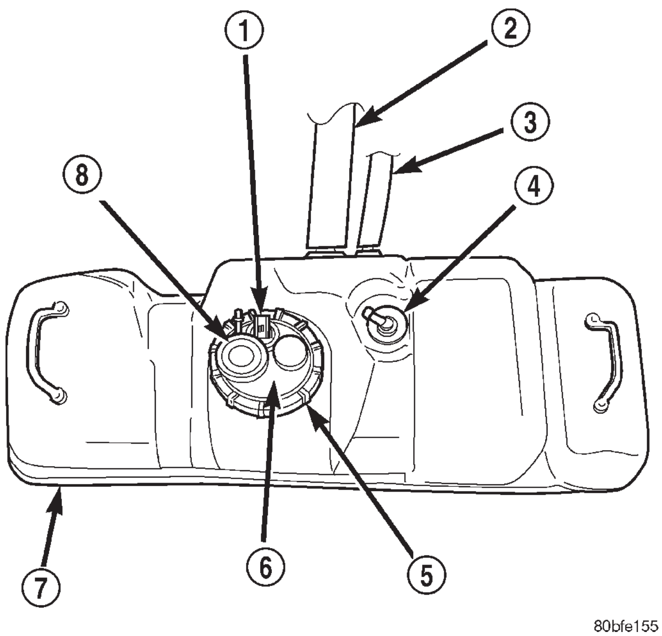


Fig. 12 Fuel Tank/Fuel Pump Module—2 Door Models

1 - FILL HOSE
2 - VENT HOSE
3 - ROLLOVER VALVE
4 - LOCKNUT
5 - FUEL PUMP MODULE
6 - FUEL TANK
7 - FUEL FILTER/FUEL PRESSURE REGULATOR

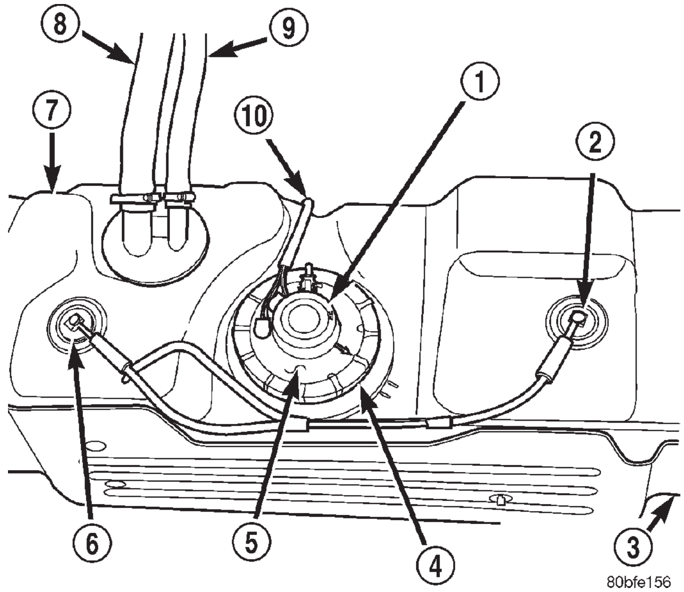


Fig. 13 Fuel Tank/Fuel Pump Module—4 Door Models

1 - FUEL FILTER/FUEL PRESSURE REGULATOR
2 - ROLLOVER VALVE
3 - FUEL TANK SHIELD
4 - LOCKNUT
5 - FUEL PUMP MODULE
6 - ROLLOVER VALVE
7 - FUEL TANK
8 - FILL HOSE
9 - VENT HOSE
10 - PIGTAIL HARNESS

OPERATION

Refer to Fuel Pump, Fuel Filter/Fuel Pressure Regulator and Fuel Gauge Sending Unit.

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH ENGINE OFF). BEFORE SERVICING FUEL PUMP MODULE, FUEL SYSTEM PRESSURE MUST BE RELEASED.

(1) Drain fuel tank and remove tank. Refer to Fuel Tank Removal.

(2) Thoroughly wash and clean area around pump module to prevent contaminants from entering tank.

(3) The fuel pump module locknut is threaded onto fuel tank (Fig. 14) or (Fig. 15). Install Special Tool 6856 to fuel pump module locknut and remove locknut (Fig. 16).

(4) Remove module from fuel tank.

FUEL PUMP MODULE (Continued)

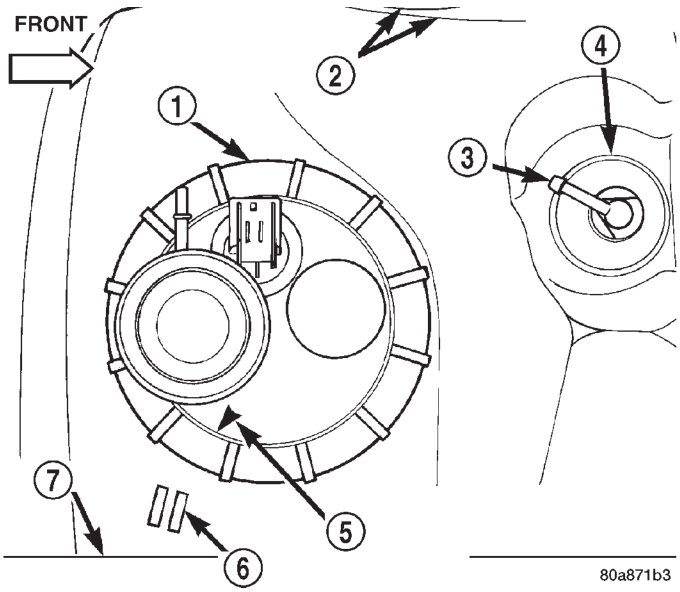


Fig. 14 Top View of Fuel Pump Module—2 Door Models

1 - LOCKNUT
2 - TANK FITTINGS
3 - EVAP FITTING
4 - ROLLOVER VALVE
5 - MODULE ALIGNMENT ARROW (7 O'CLOCK)
6 - TANK MARKINGS
7 - FUEL TANK

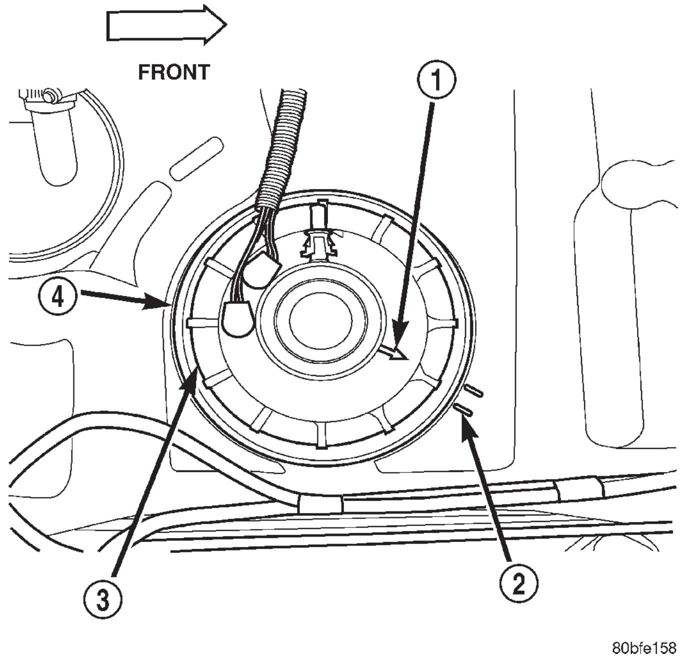


Fig. 15 Top View of Fuel Pump Module—4 Door Models

1 - MODULE ALIGNMENT ARROW (4 O'CLOCK)
2 - TANK MARKINGS
3 - LOCKNUT
4 - FUEL TANK

INSTALLATION

CAUTION: Whenever fuel pump module is serviced, the module gasket must be replaced.

(1) Using a new gasket, position fuel pump module into opening in fuel tank. Be sure rubber gasket remains in place. **2 Door Models:** Rotate module assembly until module alignment arrow is at 7 o'clock position (Fig. 14). The front of fuel tank is to the right in (Fig. 14). Arrow should be pointed to fuel tank markings (Fig. 14). **4 Door Models:** Rotate module assembly until module alignment arrow is at 4 o'clock position (Fig. 15). The front of fuel tank is to the right in (Fig. 15). Arrow should be pointed to fuel tank markings (Fig. 15). This step must be followed to prevent float/float rod from contacting sides of fuel tank.

(2) Position locknut over top of fuel pump module. Tighten finger tight.

(3) Carefully rotate fuel filter/fuel pressure regulator until fuel fitting is pointed towards drivers side of vehicle (Fig. 14) or (Fig. 15). The front of fuel tank is to the right in (Fig. 14) or (Fig. 15).

(4) Install Special Tool 6856 to locknut.

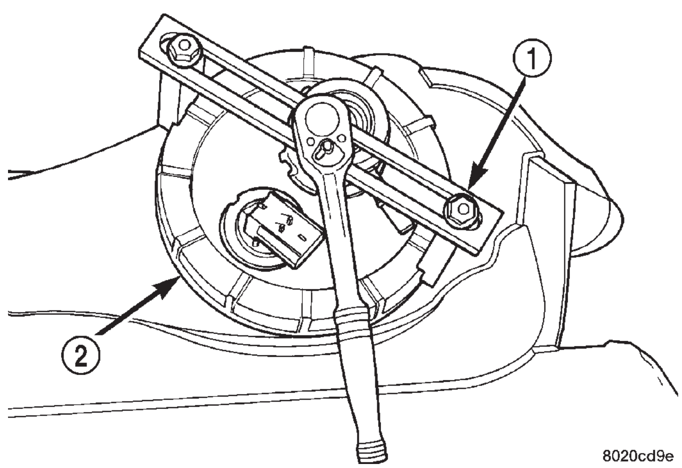


Fig. 16 Locknut Removal/Installation—Typical

1 - SPECIAL TOOL 6856
2 - LOCKNUT

(5) Tighten locknut to 54 N·m (40 ft. lbs.) torque. While tightening locknut, be sure module has not rotated.

(6) Install fuel tank. Refer to Fuel Tank Installation.

FUEL RAIL

DESCRIPTION - 3.9L/5.2L/5.9L

The fuel injector rail is used to attach the fuel injectors to the engine. It is mounted to the engine (Fig. 17).

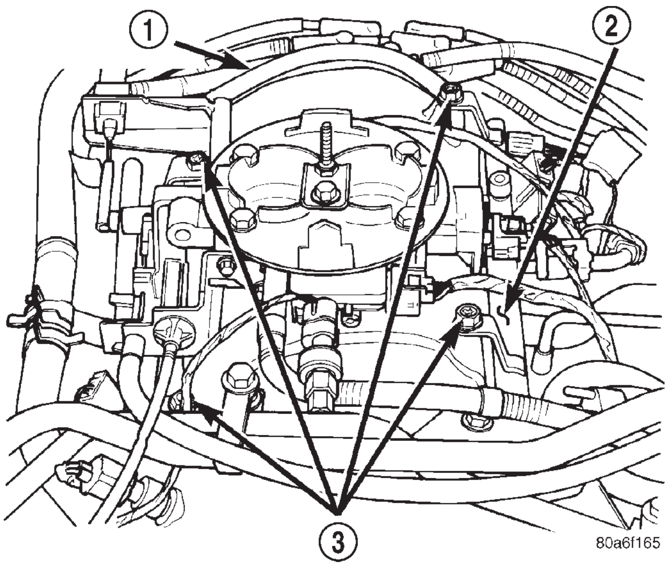


Fig. 17 Fuel Rail—3.9/5.2/5.9L Engine—Typical

1 - FUEL RAIL CONNECTING HOSE
2 - FUEL RAIL
3 - MOUNTING BOLTS (4)

DESCRIPTION - 4.7L

The fuel injector rail is used to mount the fuel injectors to the engine. It is mounted to the intake manifold (Fig. 18).

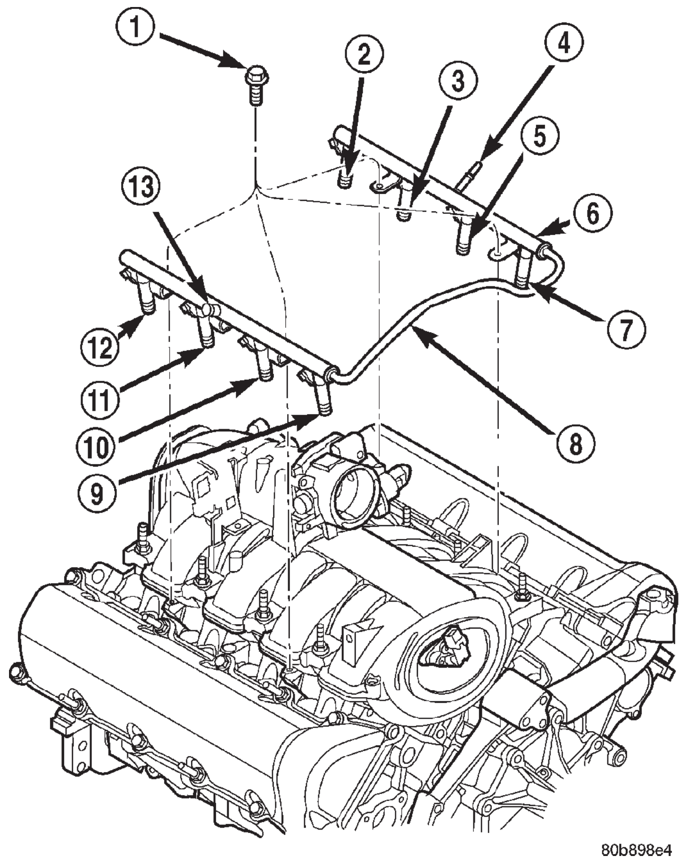


Fig. 18 Fuel Injector Rail—4.7L V-8 Engine

1 - MOUNTING BOLTS (4)
2 - INJ.#7
3 - INJ.#5
4 - QUICK-CONNECT FITTING
5 - INJ.#3
6 - FUEL INJECTOR RAIL
7 - INJ.#1
8 - CONNECTOR TUBE
9 - INJ.#2
10 - INJ.#4
11 - INJ.#6
12 - INJ.#8
13 - PRESSURE TEST PORT CAP

DESCRIPTION - 2.5L

The fuel injector rail is used to mount the fuel injectors to the engine (Fig. 19). On the 2.5L 4–cylinder engine, a **fuel damper** is located at the front of the fuel rail (Fig. 19).

OPERATION - 3.9L/5.2L/5.9L

High pressure from the fuel pump is routed to the fuel rail. The fuel rail then supplies the necessary fuel to each individual fuel injector.

A fuel pressure test port is located on the fuel rail. A quick-connect fitting with a safety latch clip is used to attach the fuel line to the fuel rail.

The fuel rail is not repairable.

CAUTION: The left and right sections of the fuel rail are connected with a flexible connecting hose. Do not attempt to separate the rail halves at this connecting hose. Due to the design of this connecting hose, it does not use any clamps. Never attempt to install a clamping device of any kind to the hose. When removing the fuel rail assembly for any reason, be careful not to bend or kink the connecting hose.

OPERATION - 4.7L

High pressure fuel from the fuel pump is routed to the fuel rail. The fuel rail then supplies the necessary fuel to each individual fuel injector.

A fuel pressure test port is located on the fuel rail (Fig. 18). A quick-connect fitting with a safety latch is used to attach the fuel line to the fuel rail.

The fuel rail is not repairable.

FUEL RAIL (Continued)

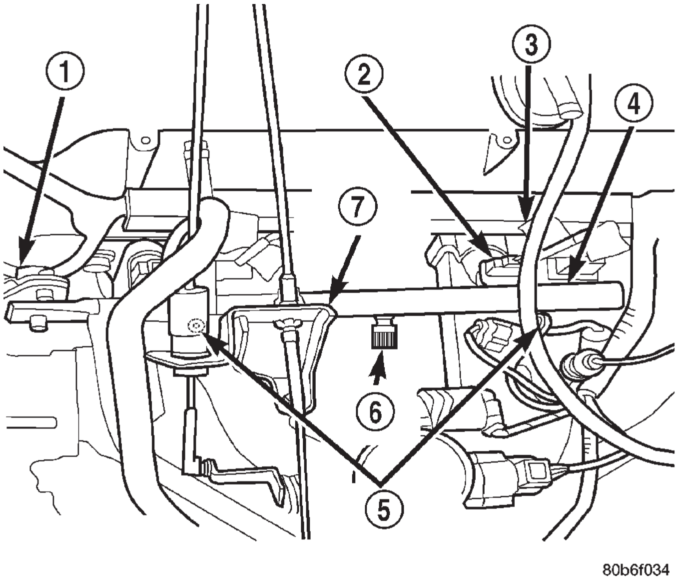


Fig. 19 Fuel Injector Rail/Fuel Damper—2.5L Engine

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 - 2.5L

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 - 2.5L

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. 20). If not, identify each connector before removal.

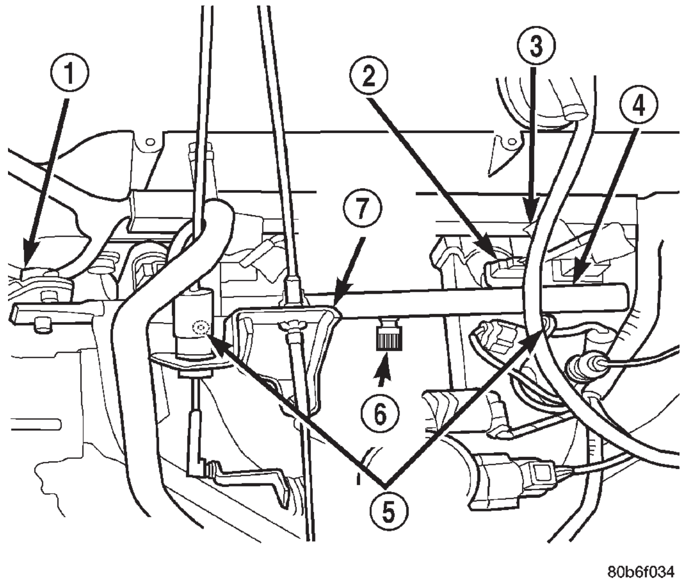


Fig. 20 Fuel Rail Mounting—2.5L Engine

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. 20) at intake manifold.

(11) Remove nut securing crankshaft position sensor pigtail harness to fuel rail mounting stud. Remove clamp and harness from fuel rail mounting stud.

(12) Clean dirt/debris from each fuel injector at intake manifold.

(13) Remove fuel rail mounting nuts/bolts (Fig. 20).

(14) Remove fuel rail by gently rocking until all the fuel injectors are out of intake manifold.

FUEL RAIL (Continued)

REMOVAL - 3.9L/5.2L/5.9L

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH ENGINE TURNED OFF). BEFORE SERVICING FUEL RAIL ASSEMBLY, FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to Fuel System Pressure Release Procedure in this group.

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate rail halves at connecting hose (Fig. 21). Due to the design of this connecting hose, it does not use any clamps. Never attempt to install a clamping device of any kind to hose. When removing fuel rail assembly for any reason, be careful not to bend or kink connecting hose.

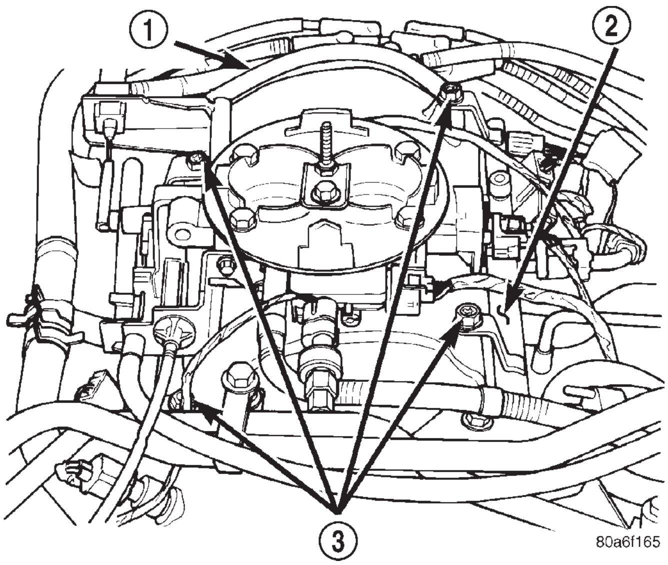


Fig. 21 Fuel Rail Assembly—3.9/5.2/5.9L Engine—Typical

1 - FUEL RAIL CONNECTING HOSE
2 - FUEL RAIL
3 - MOUNTING BOLTS (4)

(1) Remove negative battery cable at battery.
(2) Remove air cleaner.
(3) Perform fuel pressure release procedure.
(4) Remove throttle body from intake manifold. Refer to Throttle Body removal in this group.
(5) If equipped with air conditioning, remove A-shaped A/C compressor-to-intake manifold support bracket (three bolts) (Fig. 22).
(6) Disconnect electrical connectors at all 8 fuel injectors. To remove connector refer to (Fig. 23). 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.
(7) 3.9L (V-6) engine only: Disconnect electrical connector at intake manifold air temperature sensor. Do not remove sensor.
(8) Disconnect fuel tube (line) at side of fuel rail. Refer to Quick-Connect Fittings for procedures,
(9) Remove remaining fuel rail mounting bolts.
(10) Clean dirt/debris from each fuel injector at intake manifold.

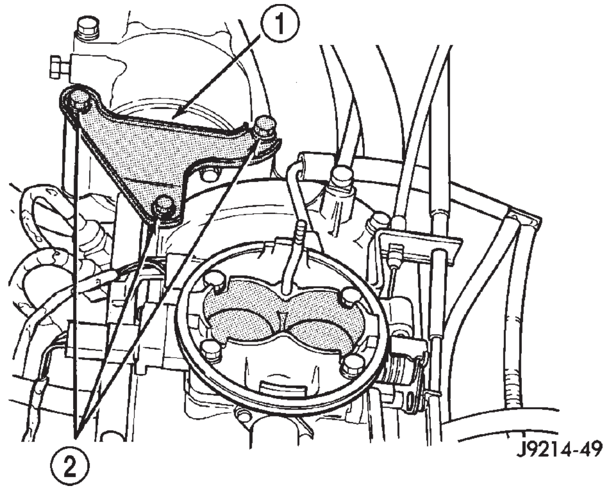


Fig. 22 A/C Compressor Support

1 - AIR CONDITIONING COMPRESSOR SUPPORT BRACKET
2 - MOUNTING BOLTS

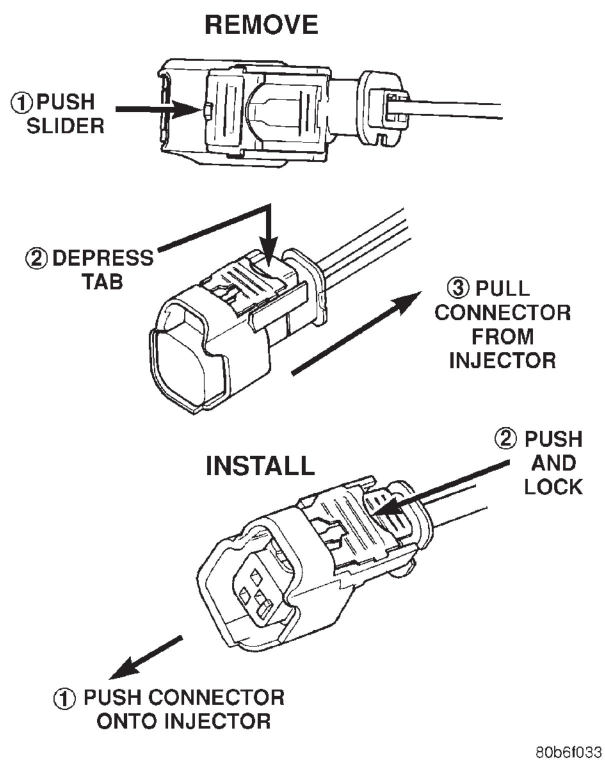


Fig. 23 Remove/Install Injector Connector

FUEL RAIL (Continued)

(11) Gently rock and pull **left** fuel rail until fuel injectors just start to clear intake manifold. Gently rock and pull **right** fuel rail until fuel injectors just start to clear intake manifold. Repeat this procedure (left/right) until all fuel injectors have cleared intake manifold.

(12) Remove fuel rail (with injectors attached) from engine.

(13) Remove clip(s) retaining injector(s) to fuel rail (Fig. 24) or (Fig. 25).

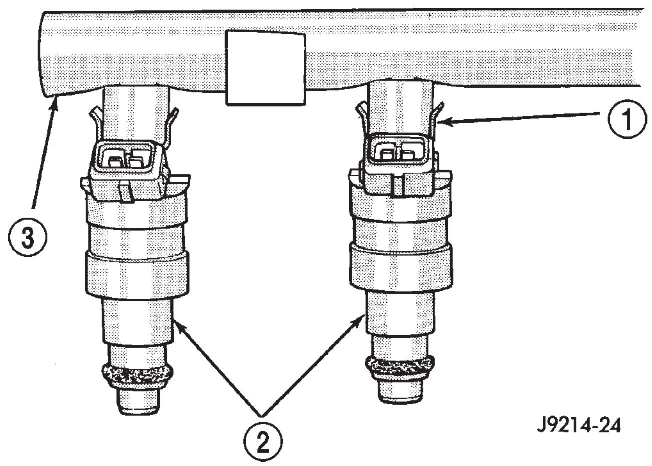


Fig. 24 Fuel Injector

1 - CLIP
2 - INJECTOR
3 - FUEL RAIL

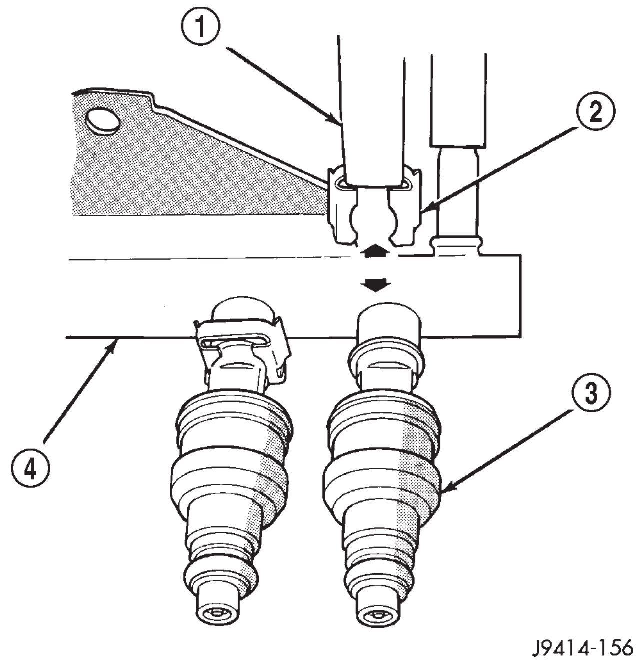


Fig. 25 Injector Retaining

1 - PLIERS
2 - INJECTOR CLIP
3 - FUEL INJECTOR
4 - FUEL RAIL

REMOVAL - 4.7L

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT PRESSURE EVEN WITH ENGINE OFF. BEFORE SERVICING FUEL RAIL, FUEL SYSTEM PRESSURE MUST BE RELEASED.

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate rail halves at connector tube (Fig. 26). Due to design of tube, it does not use any clamps. Never attempt to install a clamping device of any kind to tube. When removing fuel rail assembly for any reason, be careful not to bend or kink tube.

(1) Remove fuel tank filler tube cap.

(2) Perform Fuel System Pressure Release Procedure.

(3) Remove negative battery cable at battery.

(4) Remove air duct at throttle body air box.

(5) Remove air box at throttle body.

(6) Remove wiring at rear of generator.

(7) Disconnect fuel line latch clip and fuel line at fuel rail. A special tool will be necessary for fuel line disconnection. Refer to Quick-Connect Fittings.

(8) Remove vacuum lines at throttle body.

(9) Disconnect electrical connectors at all 8 fuel injectors. To remove connector refer to (Fig. 27). 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.

(10) Disconnect electrical connectors at throttle body.

(11) Disconnect electrical connectors at MAP and IAT sensors.

(12) Remove first three ignition coils on each bank (cylinders #1, 3, 5, 2, 4 and 6). Refer to Ignition Coil Removal/Installation.

(13) Remove 4 fuel rail mounting bolts (Fig. 26).

(14) Gently rock and pull **left** side of fuel rail until fuel injectors just start to clear machined holes in cylinder head. Gently rock and pull **right** side of rail until injectors just start to clear cylinder head holes. Repeat this procedure (left/right) until all injectors have cleared cylinder head holes.

(15) Remove fuel rail (with injectors attached) from engine.

(16) If fuel injectors are to be removed, refer to Fuel Injector Removal/Installation.

FUEL RAIL (Continued)

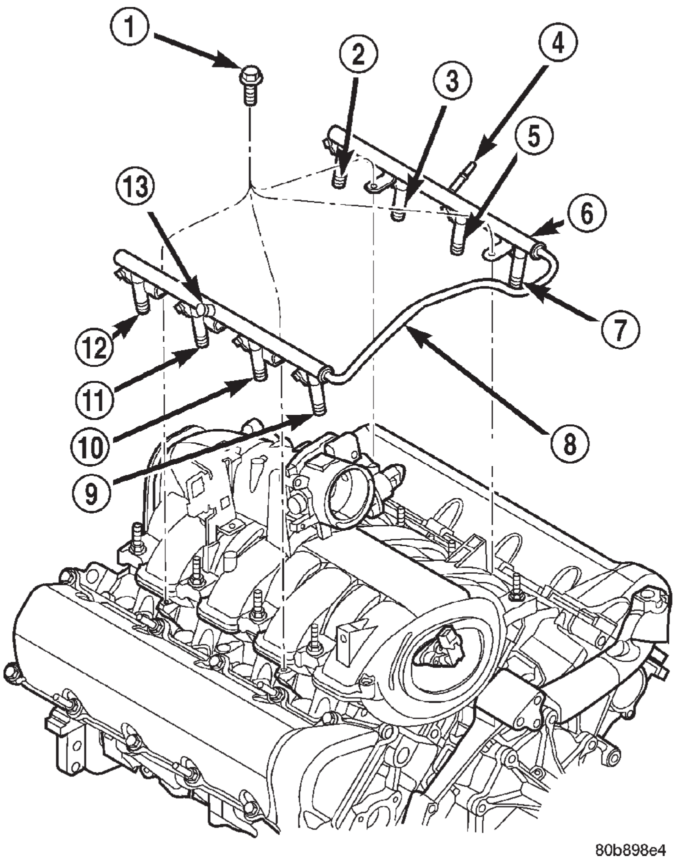


Fig. 26 Fuel Rail Mounting—4.7L V-8 Engine

1 - MOUNTING BOLTS (4)
2 - INJ.#7
3 - INJ.#5
4 - QUICK-CONNECT FITTING
5 - INJ.#3
6 - FUEL INJECTOR RAIL
7 - INJ.#1
8 - CONNECTOR TUBE
9 - INJ.#2
10 - INJ.#4
11 - INJ.#6
12 - INJ.#8
13 - PRESSURE TEST PORT CAP

INSTALLATION - 2.5L

(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.

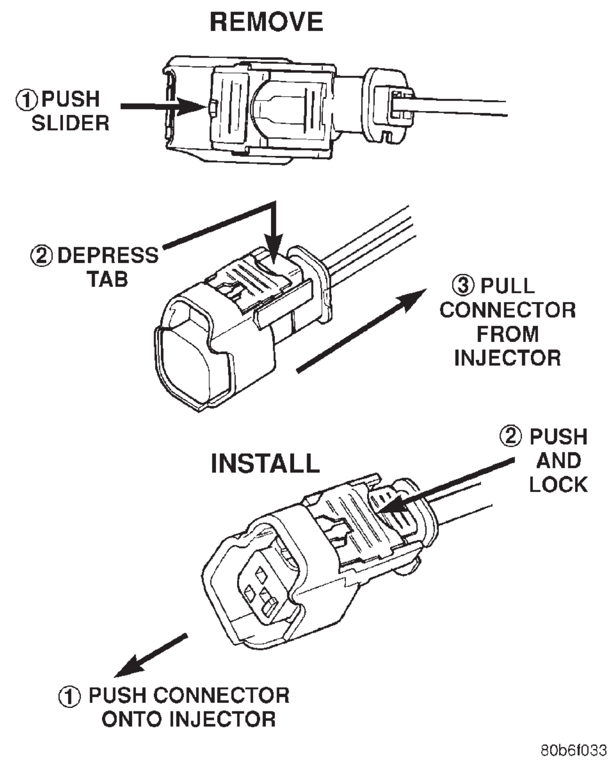


Fig. 27 Remove/Install Injector Connector—4.7L V-8 Engine

(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.

INSTALLATION - 3.9L/5.2L/5.9L

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH ENGINE TURNED OFF). BEFORE SERVICING FUEL RAIL ASSEMBLY, FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to Fuel System Pressure Release Procedure in this group.

FUEL RAIL (Continued)

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate rail halves at connecting hose (Fig. 21). Due to the design of this connecting hose, it does not use any clamps. Never attempt to install a clamping device of any kind to hose. When removing fuel rail assembly for any reason, be careful not to bend or kink connecting hose.

(1) Apply a small amount of clean engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(2) Install injector(s) and injector clip(s) to fuel rail.

(3) Position fuel rail/fuel injector assembly to injector openings on intake manifold.

(4) Guide each injector into intake manifold. Be careful not to tear injector o-ring.

(5) Push **right** fuel rail down until fuel injectors have bottomed on injector shoulder. Push **left** fuel rail down until fuel injectors have bottomed on injector shoulder.

(6) Install fuel rail mounting bolts.

(7) Connect electrical connector to intake manifold air temperature sensor.

(8) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 23). 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.

(9) Install A/C support bracket (if equipped).

(10) Install throttle body to intake manifold. Refer to Throttle Body installation in this group.

(11) Install fuel tube (line) at side of fuel rail. Refer to Quick-Connect Fittings for procedures.

(12) Install air cleaner.

(13) Connect battery cable to battery.

(14) Start engine and check for leaks.

INSTALLATION - 4.7L

(1) If fuel injectors are to be installed, refer to Fuel Injector Removal/Installation.

(2) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(3) Position fuel rail/fuel injector assembly to machined injector openings in cylinder head.

(4) Guide each injector into cylinder head. Be careful not to tear injector o-rings.

(5) Push **right** side of fuel rail down until fuel injectors have bottomed on cylinder head shoulder. Push **left** fuel rail down until injectors have bottomed on cylinder head shoulder.

(6) Install 4 fuel rail mounting bolts and tighten to 27 N·m (20 ft. lbs.).

(7) Install ignition coils. Refer to Ignition Coil Removal/Installation.

(8) Connect electrical connectors to throttle body.

(9) Connect electrical connectors to MAP and IAT sensors.

(10) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 27). 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.

(11) Connect vacuum lines to throttle body.

(12) Connect fuel line latch clip and fuel line to fuel rail. Refer to Quick-Connect Fittings.

(13) Connect wiring to rear of generator.

(14) Install air box to throttle body.

(15) Install air duct to air box.

(16) Connect battery cable to battery.

(17) Start engine and check for 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 rollover valve(s) is mounted into the top of the fuel tank (or pump module). Refer to Rollover Valve information.

An evaporation control system is connected to the rollover valve(s) to reduce emissions of fuel vapors into the atmosphere. When fuel evaporates from the fuel tank, vapors pass through vent hoses or tubes to a charcoal canister where they are temporarily held. When the engine is running, the vapors are drawn into the intake manifold. Certain models are also equipped with a self-diagnosing system using a Leak Detection Pump (LDP). Refer to Emission Control System for additional information.

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH ENGINE OFF). BEFORE DRAINING FUEL TANK, FUEL SYSTEM PRESSURE MUST BE RELEASED.

The fuel tank **cannot** be drained through the fill or vent fittings at the top of the fuel tank. Two different procedures may be used to drain fuel tank (using an approved gasoline draining station, or using the DRB scan tool along with an approved gasoline draining station). Draining is done from the disconnected fuel line, at the fuel rail, with either procedure.

FUEL TANK (Continued)

(1) Remove fuel tank filler tube cap.

(2) Perform Fuel System Pressure Release procedure.

(3) Disconnect negative battery cable at battery.

(4) Disconnect quick-connect fuel line at fuel rail. Refer to Quick-Connect Fittings for procedures.

(5) The hose from the gasoline draining station must be adapted into the 5/16” quick-connect fitting on disconnected fuel line. One way to accomplish this is to obtain a 5/16” test fitting such as from Snap-On ® Fuel Injection Adapter Set # FIDA44. Snap the fitting into the disconnected fuel line and attach hose from gasoline draining station.

(6) Operate the gasoline draining station to drain fuel tank. As an alternative procedure, the electric fuel pump may be activated. Refer to DRB scan tool for fuel pump activation procedures. Activate electric fuel pump, or gasoline draining station, and drain tank until empty. If electric fuel pump is not operating, the gasoline draining station must be used.

(7) Raise vehicle and remove splash shield in front of left/rear wheelhouse.

(8) Remove hose clamps and disconnect rubber fill and vent hoses (Fig. 29) at fill and vent tubes (Fig. 28). Do not disconnect hoses at fuel tank.

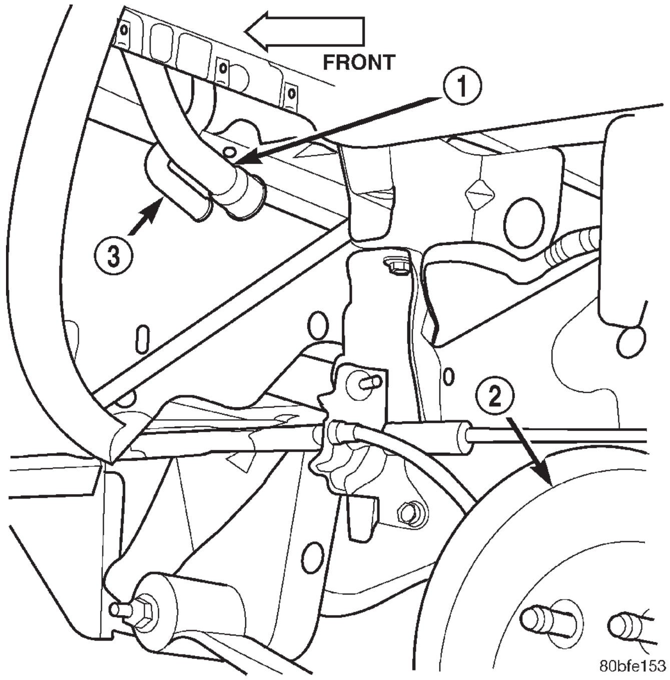


Fig. 28 Fuel Fill and Vent Tubes

1 - FUEL FILL TUBE
2 - L.R. BRAKE DRUM
3 - FUEL VENT TUBE

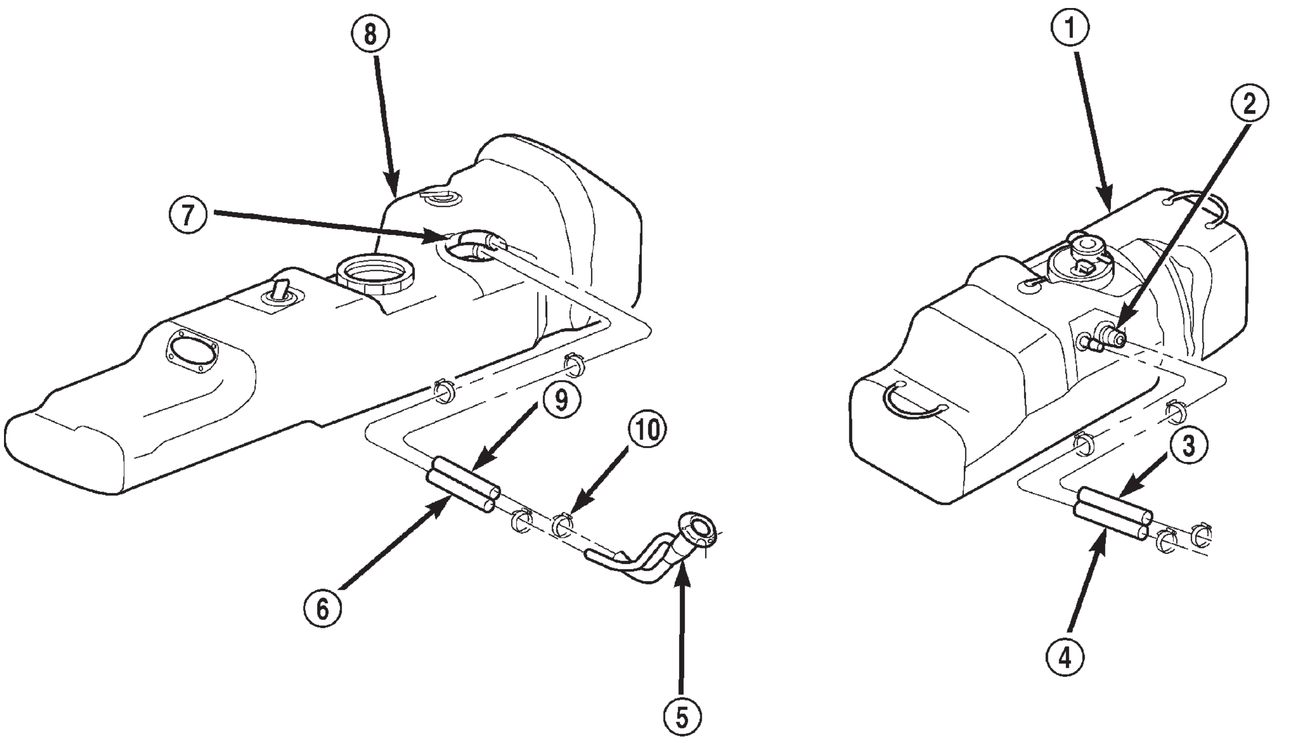


Fig. 29 Fuel Tank and Hoses

1 - FUEL TANK (4—DOOR)
2 - TANK FITTINGS
3 - FILL HOSE
4 - VENT HOSE
5 - FUEL TUBE ASSEMBLY
6 - VENT HOSE
7 - TANK FITTINGS
8 - FUEL TANK (4—DOOR)
9 - FILL HOSE
10 - CLAMPS

FUEL TANK (Continued)

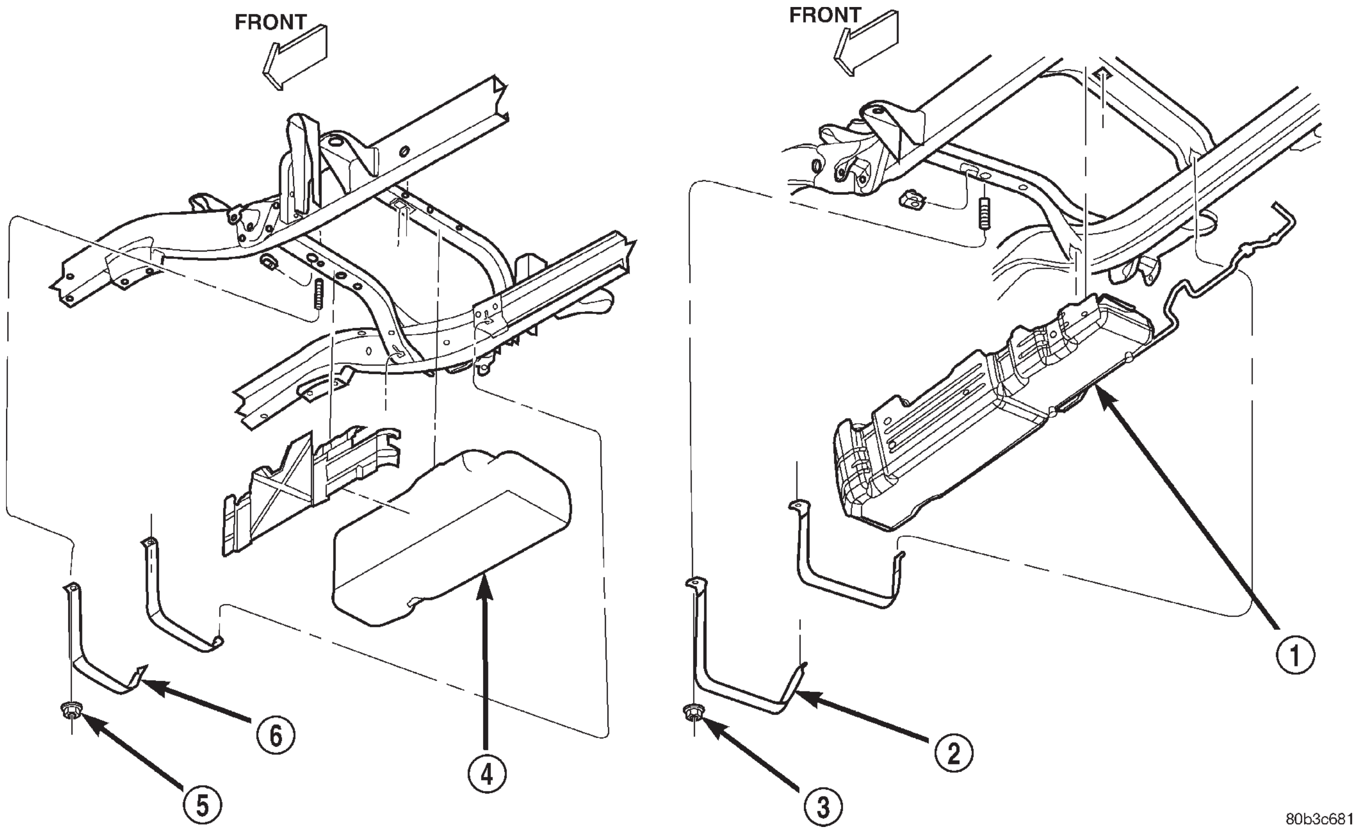


Fig. 30 Fuel Tank Mounting

1 - FUEL TANK (2—DOOR)
2 - STRAPS (2)
3 - NUTS (2)
4 - FUEL TANK (2—DOOR)
5 - NUTS (2)
6 - STRAPS (2)

(9) If equipped with a 2–piece driveshaft, the crossmember located below the fuel tank must be removed.

(a) Remove bolts/nuts securing driveshaft center bearing carrier bracket to crossmember.

(b) Raise and support driveshaft and carrier bracket assembly using a length of rope.

(c) Center punch all rivets.

(d) Drill out rivets with a 3/8” drill bit. Do not use a larger bit, as holes in crossmember and vehicle frame may become too large.

(e) Remove crossmember from vehicle.

(f) Remove remaining rivet material from crossmember and vehicle frame.

(10) If equipped, remove fuel tank skid plate. Refer to 23, Body

(11) Place and secure a transmission jack under center of fuel tank and apply slight pressure.

(12) Remove two tank mounting nuts from mounting straps (Fig. 30). Position tank mounting straps to side of vehicle and lower tank just enough to allow access to connections at top of tank.

(13) Clean quick-connect fittings of any dirt/contaminants before removal.

(14) Disconnect fuel supply line from fuel filter/fuel pressure regulator fitting at top of tank. Refer to Quick-Connect Fittings for procedures.

(15) Disconnect fuel vapor line(s) from rollover valve(s) at top of tank.

(16) Disconnect electrical connector at pump module at top of tank.

(17) Lower tank from vehicle. On certain models, the tank must first be moved rearward, and then down, for removal.

(18) Remove tank from hydraulic jack.

(19) If fuel pump module requires service, refer to Fuel Pump Module Removal/Installation.

(20) If fill and vent hoses are to be removed from tank, note their position on fuel tank fittings before removal.

FUEL TANK (Continued)

INSTALLATION

(1) If fuel pump module is being installed, refer to Fuel Pump Module Removal/Installation.

(2) Install fill and vent hoses to tank fittings.

(3) Place and secure fuel tank to transmission jack.

(4) Raise tank up enough to connect fuel line, electrical connector and vapor hoses to top of fuel tank. Refer to Quick-Connect Fittings for fuel line procedures.

(5) Continue raising tank into position and install mounting straps and nuts. Tighten nuts to 27–54 N·m (20–40 ft. lbs.) torque. **Do not over tighten mounting strap nuts.**

(6) Remove transmission jack.

(7) If equipped, install fuel tank skid plate. Refer to 23, Body.

(8) If equipped with a 2–piece driveshaft:

(a) Obtain new bolts and nuts to secure crossmember to frame. Use the same OEM bolts/nuts that are used to secure the upper fuel tank crossmember to the vehicle frame.

(b) Position crossmember to vehicle frame. Install bolts and tighten to 54 N·m (40 ft. lbs.) torque.

(c) Position driveshaft and carrier bracket assembly to crossmember.

(d) Install bolts and tighten to 54 N·m (40 ft. lbs.) torque.

(9) Install fill and vent hoses to fill and vent tubes.

(10) Install splash shield in front of left/rear wheelhouse.

(11) Connect negative cable to battery.

(12) Refill fuel tank and install fill cap.

(13) Inspect all hoses and lines for leaks.

INLET FILTER

REMOVAL

The fuel pump inlet filter (strainer) is located on the bottom of the fuel pump module (Fig. 31) or (Fig. 32). The fuel pump module is located inside 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) 2 Door Models: Remove filter by carefully prying 2 lock tabs at bottom of module with 2 screwdrivers. Filter is snapped to module.

(4) 4 Door Models: Remove filter by carefully prying it from bottom of pump module with 2 screwdrivers. Filter is snapped to module.

(5) Clean bottom of pump module.

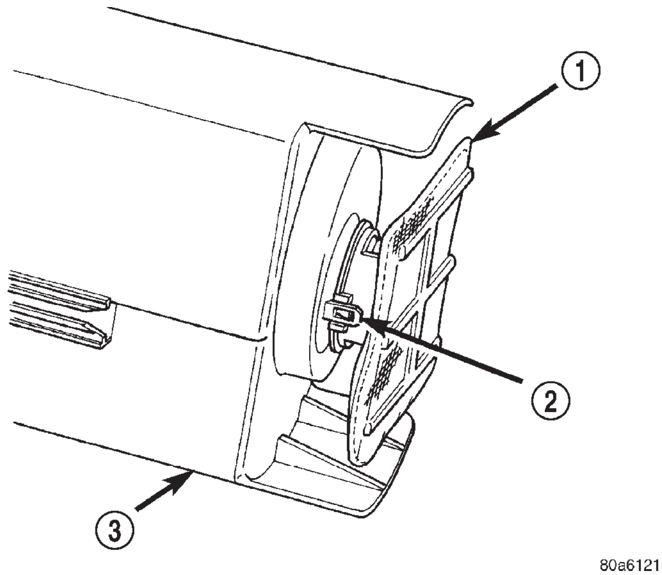


Fig. 31 Fuel Pump Inlet Filter—2 Door Models

1 - FUEL PUMP INLET FILTER
2 - LOCK TABS (2)
3 - FUEL PUMP MODULE (BOTTOM)

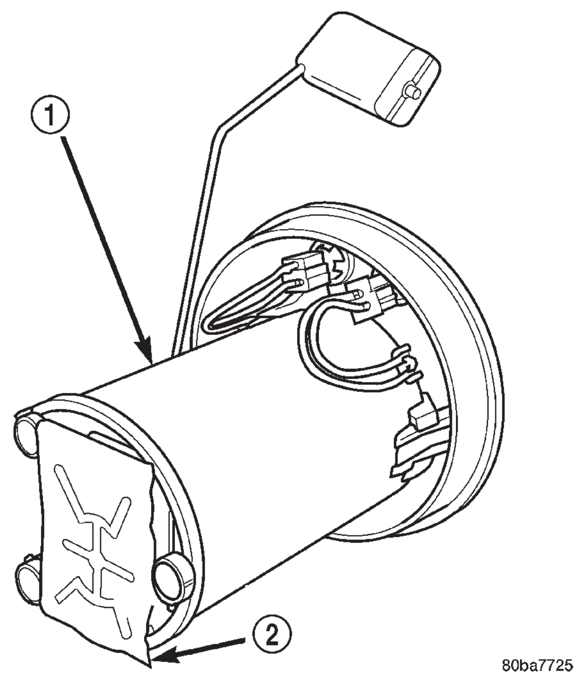


Fig. 32 Fuel Pump Inlet Filter—4 Door Models

1 - FUEL PUMP MODULE
2 - FUEL PUMP INLET FILTER

INSTALLATION

The fuel pump inlet filter (strainer) is located on the bottom of the fuel pump module (Fig. 31) or (Fig. 32). The fuel pump module is located inside of fuel tank.

INLET FILTER (Continued)

(1) Snap new filter to bottom of module. Be sure o-ring is in correct position.

(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.

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) **Single-Tab Type Fitting:** This type of fitting is equipped with a single pull tab (Fig. 33). 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. 34). **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. 34).

(c) Raise pull tab until it separates from quick-connect fitting (Fig. 35).

(5) **Two-Tab Type Fitting:** This type of fitting is equipped with tabs located on both sides of fitting (Fig. 36). The tabs are supplied for disconnecting quick-connect fitting from component being serviced.

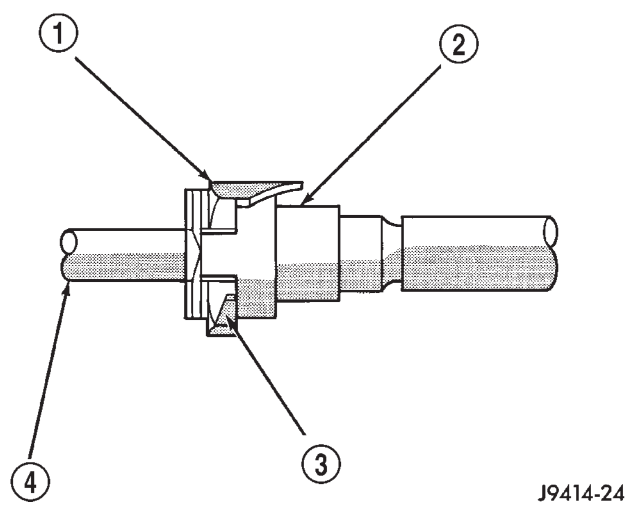


Fig. 33 Single-Tab Type Fitting

1 - PULL TAB
2 - QUICK-CONNECT FITTING
3 - PRESS HERE TO REMOVE PULL TAB
4 - INSERTED TUBE END

(a) To disconnect quick-connect fitting, squeeze plastic retainer tabs (Fig. 36) against sides of quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic retainer.

(b) Pull fitting from fuel system component being serviced.

(c) The plastic retainer will remain on component being serviced after fitting is disconnected. The o-rings and spacer will remain in quick-connect fitting connector body.

QUICK CONNECT FITTING (Continued)

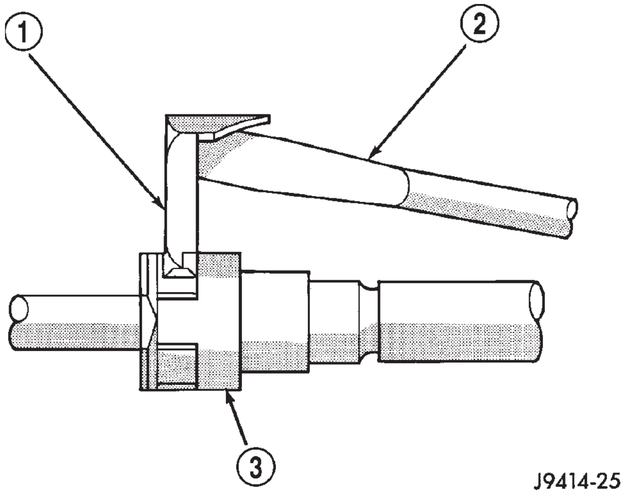


Fig. 34 Disconnecting Single-Tab Type Fitting

1 - PULL TAB
2 - SCREWDRIVER
3 - QUICK-CONNECT FITTING

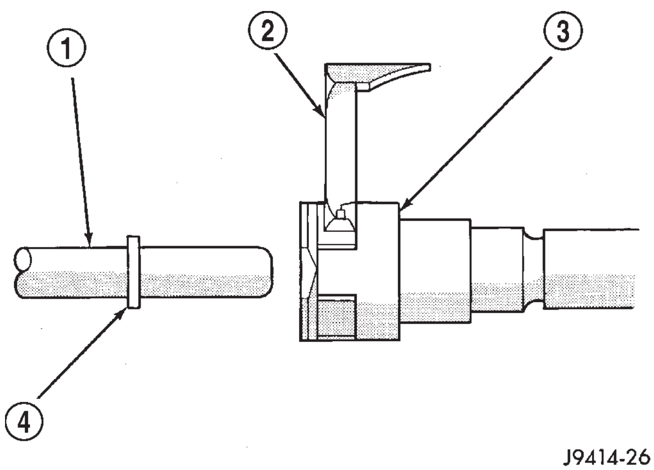


Fig. 35 Removing Pull Tab

1 - FUEL TUBE OR FUEL SYSTEM COMPONENT
2 - PULL TAB
3 - QUICK-CONNECT FITTING
4 - FUEL TUBE STOP

(6) **Plastic Retainer Ring Type Fitting:** This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 37) 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. 37). 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.

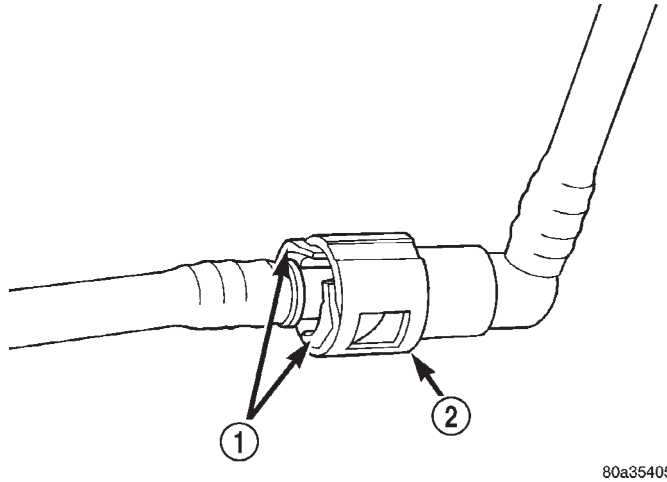


Fig. 36 Typical Two-Tab Type Quick-Connect Fitting

1 - TAB(S)
2 - QUICK-CONNECT FITTING

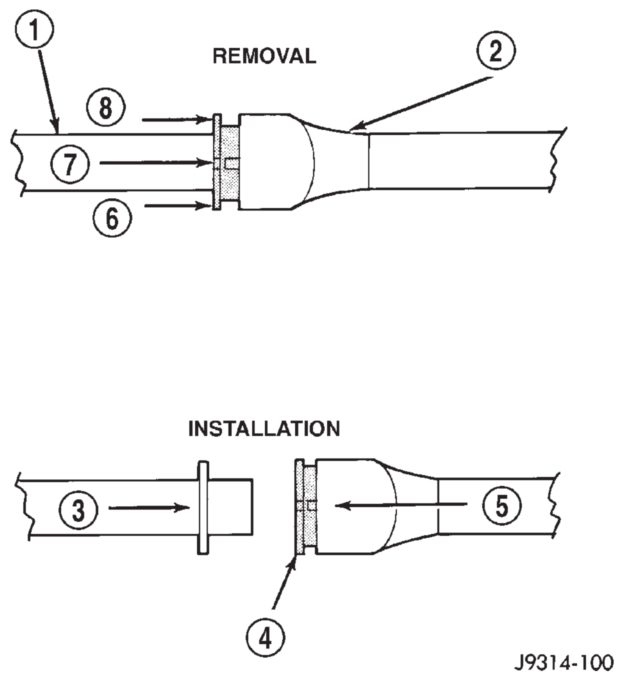


Fig. 37 Plastic Retainer Ring Type Fitting

1 - FUEL TUBE
2 - QUICK CONNECT FITTING
3 - PUSH
4 - PLASTIC RETAINER
5 - PUSH
6 - PUSH
7 - PUSH
8 - PUSH

QUICK CONNECT FITTING (Continued)

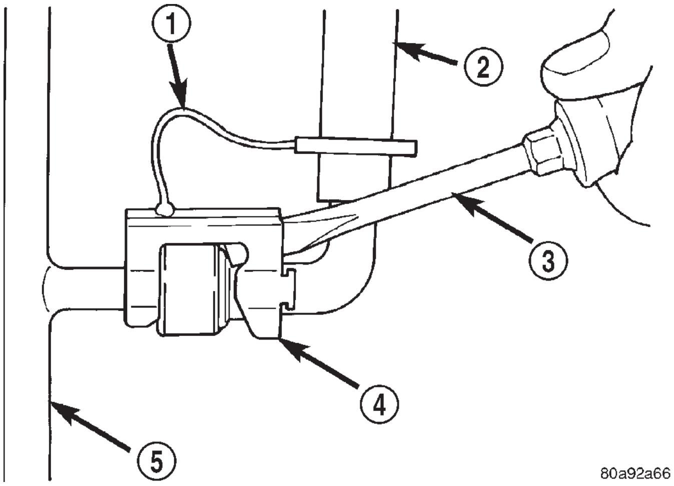


Fig. 38 Latch Clip—Type 1

1 - TETHER STRAP
2 - FUEL LINE
3 - SCREWDRIVER
4 - LATCH CLIP
5 - FUEL RAIL

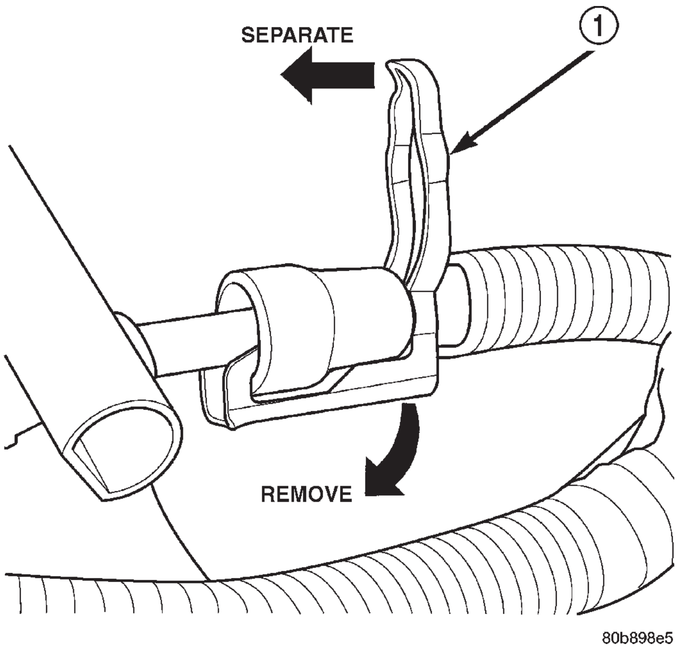


Fig. 39 Latch Clip—Type 2

1 - LATCH CLIP

(c) Inspect fitting connector body, plastic retainer ring and fuel system component for damage. Replace as necessary.

(7) **Latch Clips:** Depending on vehicle model and engine, 2 different types of safety latch clips are used (Fig. 38) or (Fig. 39). 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. 38).

(b) Type 2: Separate and unlatch 2 small arms on end of clip (Fig. 39) 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. 40). Use tool to release locking fingers in end of line.

(e) With special tool still inserted, pull fuel line from fuel rail.

(f) After disconnection, locking fingers will remain within quick-connect fitting at end of fuel line.

(8) Disconnect quick-connect fitting from fuel system component being serviced.

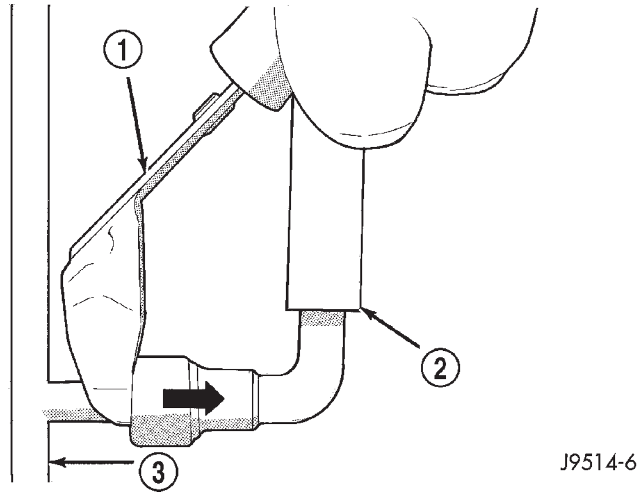


Fig. 40 Fuel Line Disconnection Using Special Tool

1 - SPECIAL FUEL LINE TOOL
2 - FUEL LINE
3 - FUEL RAIL

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.

QUICK CONNECT FITTING (Continued)

(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.

ROLLOVER VALVE

DESCRIPTION

The fuel tank on 2-door models is equipped with 1 rollover valve. This valve is located on the top of the fuel tank (Fig. 41). The fuel tank on 4-door models is equipped with 2 rollover valves. These valves are also located on the top of the fuel tank (Fig. 42).

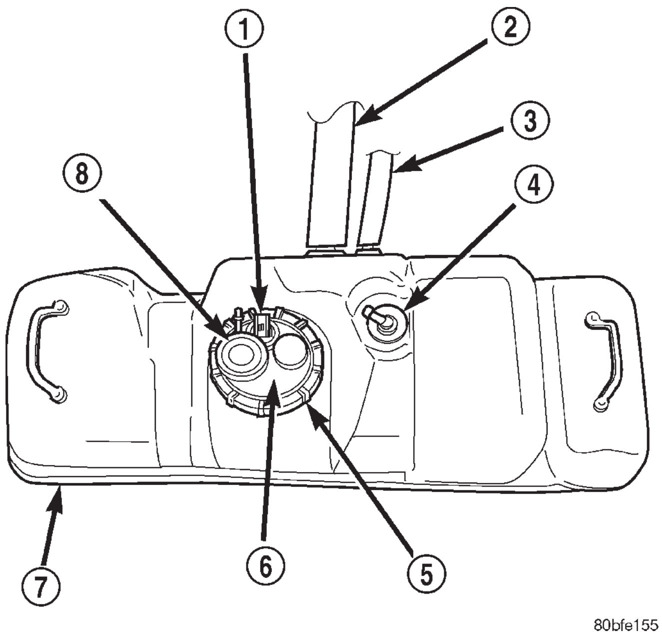


Fig. 41 Rollover Valve Location (2–Door Models)

1 - FILL HOSE
2 - VENT HOSE
3 - ROLLOVER VALVE
4 - LOCKNUT
5 - FUEL PUMP MODULE
6 - FUEL TANK
7 - FUEL FILTER/FUEL PRESSURE REGULATOR

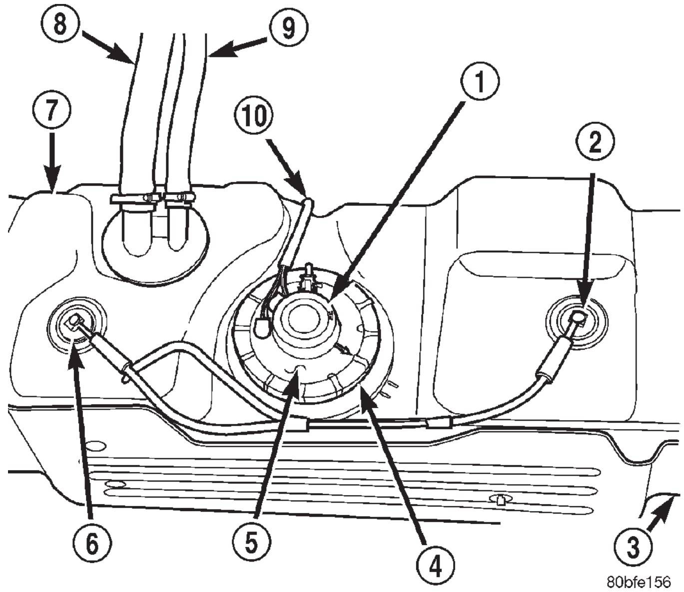


Fig. 42 Rollover Valve Locations (4–Door Models)

1 - FUEL FILTER/FUEL PRESSURE REGULATOR
2 - ROLLOVER VALVE
3 - FUEL TANK SHIELD
4 - LOCKNUT
5 - FUEL PUMP MODULE
6 - ROLLOVER VALVE
7 - FUEL TANK
8 - FILL HOSE
9 - VENT HOSE
10 - PIGTAIL HARNESS

OPERATION

The rollover valve(s) will prevent fuel flow through the fuel tank vent (EVAP) hoses in the event of an accidental vehicle rollover. The EVAP canister draws fuel vapors from the fuel tank through this valve(s).

The valve(s) cannot be serviced separately. If replacement is necessary, the fuel tank must be replaced. Refer to Fuel Tank Removal/Installation.

REMOVAL

The rollover valves(s) are/is molded into the fuel tank and are not serviced separately. If replacement is necessary, the fuel tank must be replaced. Refer to Fuel Tank Removal/Installation.

INSTALLATION

The rollover valves(s) are/is molded into the fuel tank and are not serviced separately. If replacement is necessary, the fuel tank must be replaced. Refer to Fuel Tank Removal/Installation.

FUEL INJECTION

TABLE OF CONTENTS

FUEL INJECTION

DIAGNOSIS AND TESTING - VISUAL INSPECTION—3.9L/5.2L/5.9L ENGINES

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 three 32–way electrical connectors are fully inserted into connector of powertrain control module (PCM) (Fig. 1).

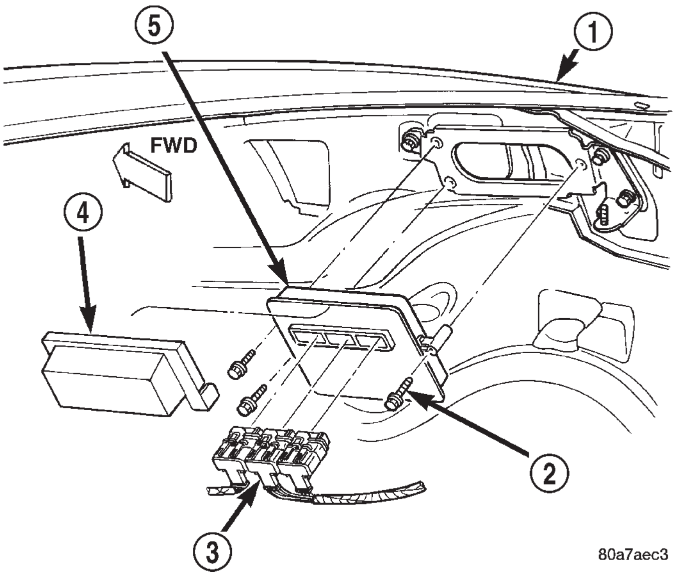


Fig. 1 Powertrain Control Module (PCM)

1 - RIGHT FRONT FENDER
2 - PCM MOUNTING BOLTS (3)
3 - 32–WAY CONNECTORS (3)
4 - COVER
5 - POWERTRAIN CONTROL MODULE (PCM)

(2) Inspect battery cable connections. Be sure they are clean and tight.

(3) Inspect fuel pump relay and air conditioning compressor clutch relay (if equipped). Inspect ASD relay connections. Inspect starter motor relay connections. Inspect relays for signs of physical damage and corrosion. The relays are located in Power Distribution Center (PDC) (Fig. 2). Refer to label on PDC cover for relay location.

(4) Inspect ignition coil connections. Verify coil secondary cable is firmly connected to coil (Fig. 3).

(5) Verify distributor cap is correctly attached to distributor. Be sure spark plug cables are firmly connected to the distributor cap and the spark plugs are in their correct firing order. Be sure coil cable is

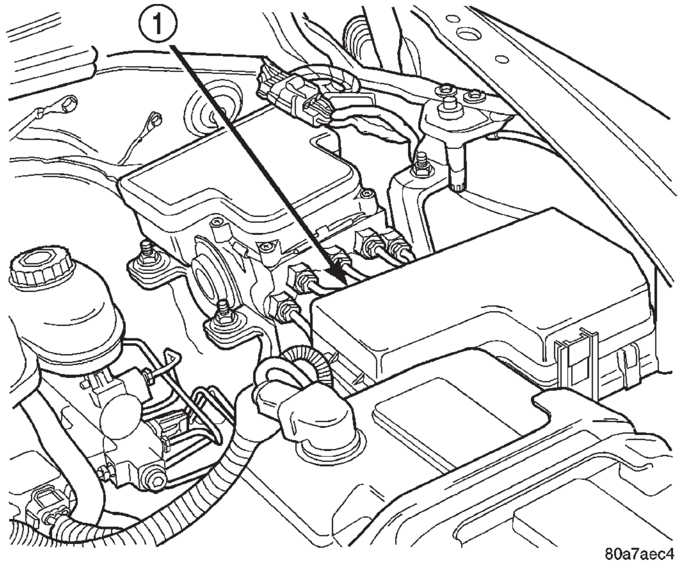


Fig. 2 Power Distribution Center (PDC)

1 - POWER DISTRIBUTION CENTER (PDC)

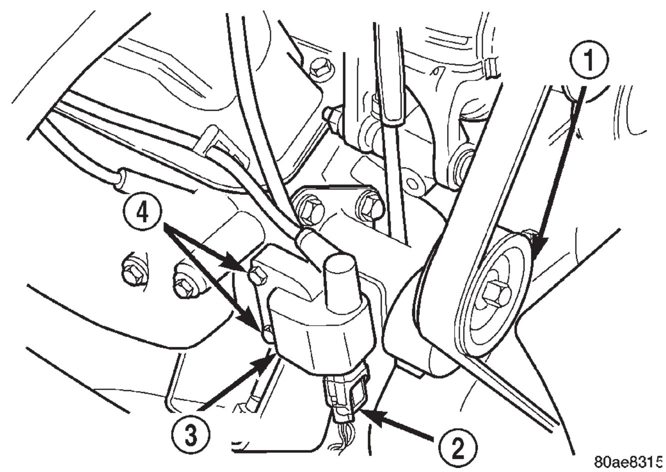


Fig. 3 Ignition Coil—3.9/5.2/5.9L Engines—Typical

1 - ACCESSORY DRIVE BELT TENSIONER
2 - COIL CONNECTOR
3 - IGNITION COIL
4 - COIL MOUNTING BOLTS

firmly connected to distributor cap and coil. Be sure camshaft position sensor wire connector (at the distributor) is firmly connected to harness connector. Inspect spark plug condition. Refer to 8, Ignition. Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables.

(6) Verify generator output wire, generator connector and ground wire are firmly connected to generator.

(7) Inspect system body grounds for loose or dirty connections. Refer to 8, Wiring for ground locations.

FUEL INJECTION (Continued)

(8) Verify positive crankcase ventilation (PCV) valve operation. Refer to 25, Emission Control System for additional information. Verify PCV valve hose is firmly connected to PCV valve and manifold (Fig. 4).

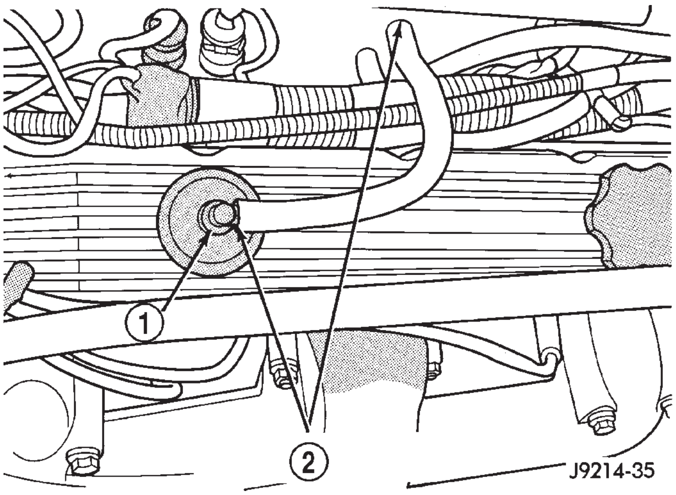


Fig. 4 PCV Valve Hose Connections—3.9/5.2/5.9L Engines—Typical

1 - PCV VALVE
2 - PCV VALVE HOSE CONNECTIONS

(9) Inspect fuel tube quick-connect fitting-to-fuel rail connections.

(10) Verify hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

(11) Inspect accelerator cable, transmission throttle cable (if equipped) and cruise control cable connections (if equipped). Check their connections to throttle arm of throttle body for any binding or restrictions.

(12) If equipped with vacuum brake booster, verify vacuum booster hose is firmly connected to fitting on intake manifold. Also check connection to brake vacuum booster.

(13) Inspect air cleaner inlet and air cleaner element for dirt or restrictions.

(14) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

(15) Verify intake manifold air temperature sensor wire connector is firmly connected to harness connector (Fig. 5).

(16) 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).

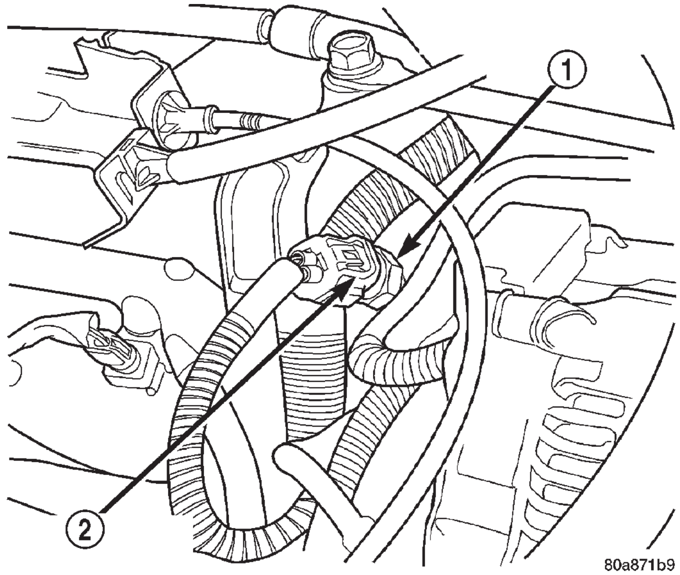


Fig. 5 Intake Manifold Air Temperature Sensor—Typical

1 - INTAKE MANIFOLD AIR TEMPERATURE SENSOR
2 - ELECTRICAL CONNECTOR

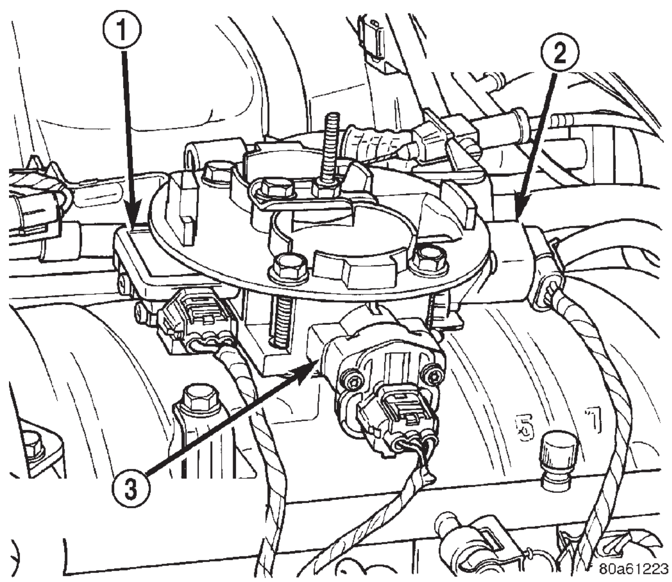


Fig. 6 Sensor and IAC Motor Location—Typical (V-8 Shown)

1 - MAP SENSOR
2 - IDLE AIR CONTROL MOTOR
3 - THROTTLE POSITION SENSOR

FUEL INJECTION (Continued)

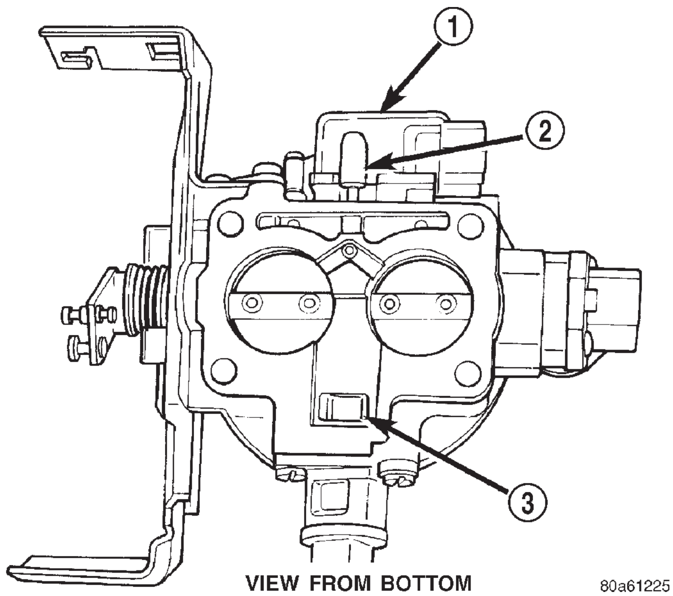


Fig. 7 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

1 - MAP SENSOR
2 - RUBBER FITTING
3 - IDLE AIR PASSAGE

(17) Verify fuel injector wire harness connectors are firmly connected to injectors in correct order. Each harness connector is numerically tagged with injector number (INJ 1, INJ 2 etc.) of its corresponding fuel injector and cylinder number.

(18) Verify harness connectors are firmly connected to idle air control (IAC) motor, throttle position sensor (TPS) and manifold absolute pressure (MAP) sensor (Fig. 6).

(19) Verify wire harness connector is firmly connected to engine coolant temperature sensor (Fig. 8).

(20) Raise and support vehicle.

(21) **All 3.9L V-6 and 5.2L V-8. All 5.9L V-8 With Four Wheel Drive (4WD) :** Verify both upstream and downstream oxygen sensor wire connectors are firmly connected to sensors. Inspect sensors and connectors for damage (Fig. 9) or (Fig. 10).

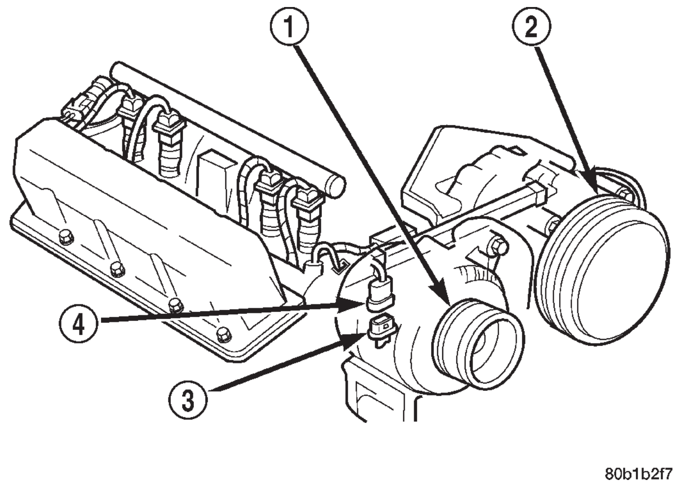


Fig. 8 Engine Coolant Temperature Sensor—3.9/5.2L

1 - GENERATOR
2 - A/C COMPRESSOR
3 - ENGINE COOLANT TEMPERATURE SENSOR
4 - ELEC. CONN.

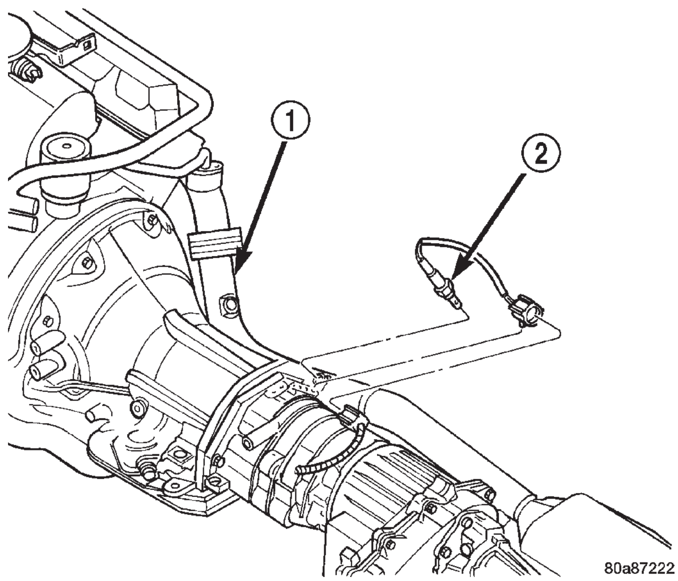


Fig. 9 Upstream Oxygen Sensor—All 3.9/5.2L Engines or 5.9L

1 - EXHAUST PIPE
2 - UPSTREAM OXYGEN SENSOR

FUEL INJECTION (Continued)

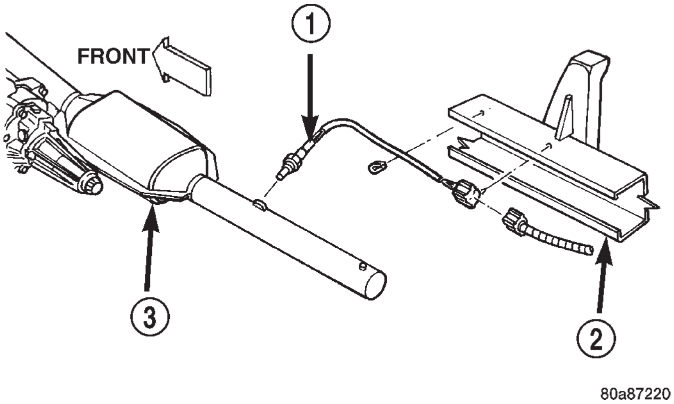


Fig. 10 Downstream Oxygen Sensor—3.9/5.2L Engines or 5.9L Engine With 4WD

1 - DOWNSTREAM OXYGEN SENSOR
2 - FRAME RAIL
3 - CATALYTIC CONVERTER

(22) **5.9L V-8 Engine With Two Wheel Drive (2WD):**

(a) This engine/transmission is equipped with 4 oxygen sensors. Verify both pre-catalyst and post-catalyst oxygen sensor wire connectors (before and after catalytic convertor) are firmly connected to sensors (Fig. 11). Inspect sensors and connectors for damage.

(b) Verify left and right oxygen sensor wire connectors (at exhaust downpipes) are firmly connected to sensors (Fig. 12). Inspect sensors and connectors for damage.

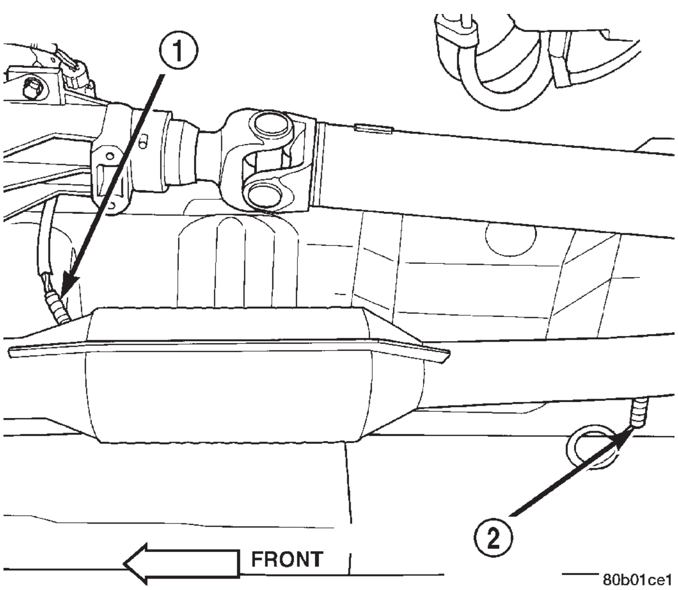


Fig. 11 Pre-Catalyst/Post-Catalyst Oxygen Sensors—5.9L Engine With 2WD

1 - PRE-CATALYST OXYGEN SENSOR
2 - POST-CATALYST OXYGEN SENSOR

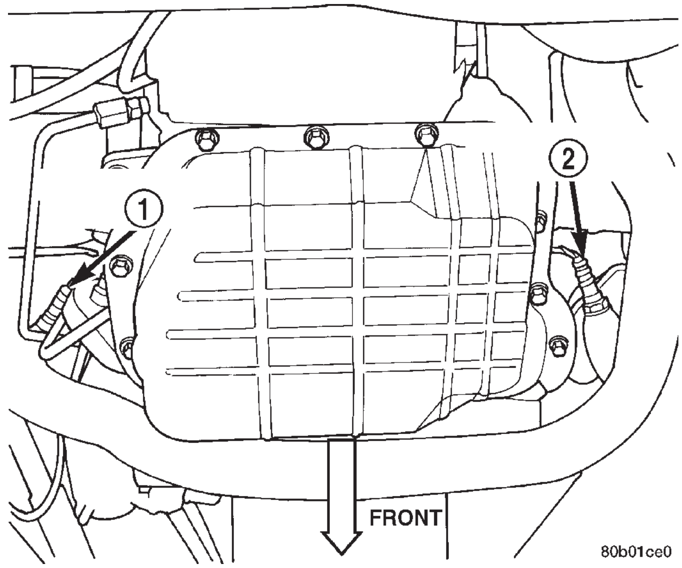


Fig. 12 Left/Right Oxygen Sensors—5.9L Engine With 2WD

1 - LEFT OXYGEN SENSOR
2 - RIGHT OXYGEN SENSOR

(23) Inspect for pinched or leaking fuel tubes. Inspect for pinched, cracked or leaking fuel hoses.

(24) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(25) If equipped with automatic transmission, verify electrical harness is firmly connected to park/neutral switch. Refer to Automatic Transmission.

(26) Verify electrical harness is firmly connected to rear wheel speed sensor. Verify rear wheel speed sensor is firmly attached to rear axle with proper air gap. Refer to 5, Brakes for information.

(27) If equipped with 4–wheel antilock brake system, verify electrical harness is firmly connected to each front wheel speed sensor. Verify both front wheel speed sensors are firmly attached. Refer to 5, Brakes for information.

(28) Verify 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.

(30) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

(31) Verify battery cable and solenoid feed wire connections to starter solenoid are tight and clean. Inspect for chaffed wires or wires rubbing against other components.

FUEL INJECTION (Continued)

DIAGNOSIS AND TESTING - VISUAL INSPECTION—2.5L ENGINE

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 three 32–way electrical connectors are fully inserted into connector of powertrain control module (PCM) (Fig. 13).

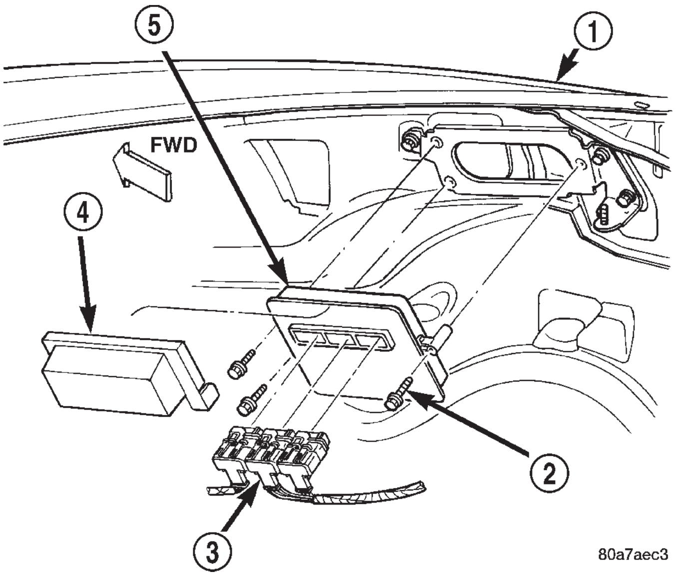


Fig. 13 Powertrain Control Module (PCM)

1 - RIGHT FRONT FENDER
2 - PCM MOUNTING BOLTS (3)
3 - 32–WAY CONNECTORS (3)
4 - COVER
5 - POWERTRAIN CONTROL MODULE (PCM)

(2) Inspect battery cable connections. Be sure they are clean and tight.

(3) Inspect fuel pump relay connections. Inspect ASD relay connections. Inspect starter motor relay connections. Inspect relays for signs of physical damage and corrosion. The relays are located in Power Distribution Center (PDC) (Fig. 14). Refer to label on PDC cover for relay location.

(4) Inspect ignition coil connections. Verify coil secondary cable is firmly connected to coil (Fig. 15).

(5) Verify distributor cap is correctly attached to distributor. Be sure spark plug cables are firmly connected to distributor cap and the spark plugs are in their correct firing order. Be sure coil cable is firmly connected to distributor cap and coil. Be sure camshaft position sensor wire connector (at the distributor) is firmly connected to harness connector. Inspect spark plug condition. Refer to 8, Ignition. Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables.

(6) Verify generator output wire, generator connector and ground wire are firmly connected to the generator.

(7) Inspect system body grounds for loose or dirty connections. Refer to 8, Wiring for ground locations.

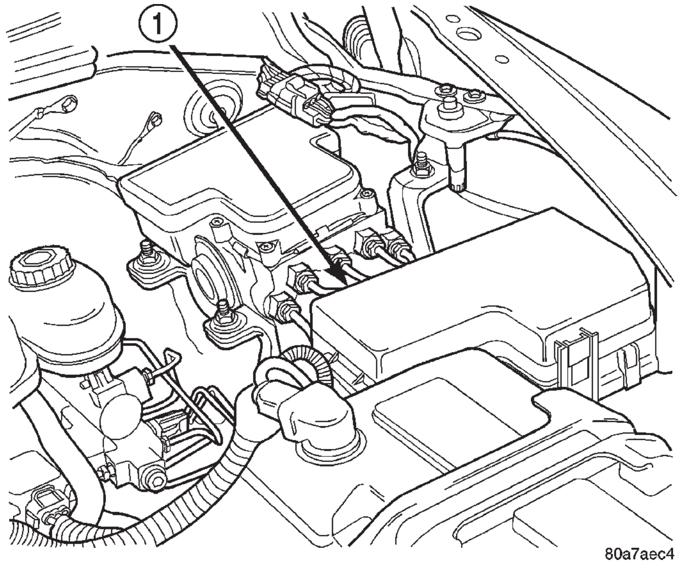


Fig. 14 Power Distribution Center (PDC)

1 - POWER DISTRIBUTION CENTER (PDC)

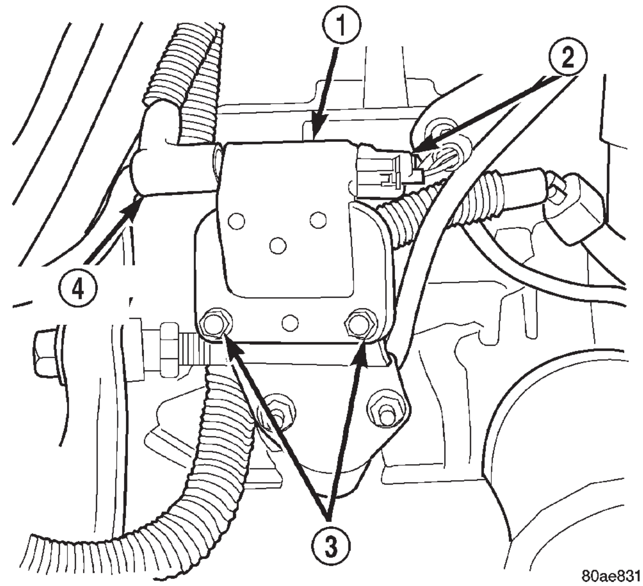


Fig. 15 Ignition Coil—2.5L Engine

1 - IGNITION COIL
2 - ELECTRICAL CONNECTOR
3 - MOUNTING BOLTS (2)
4 - SECONDARY CABLE

FUEL INJECTION (Continued)

(8) Verify Crankcase Ventilation (CCV) system operation. Verify CCV system hoses and fixed orifice fitting are firmly connected (Fig. 16). Refer to 25, Emission Control System for additional information.

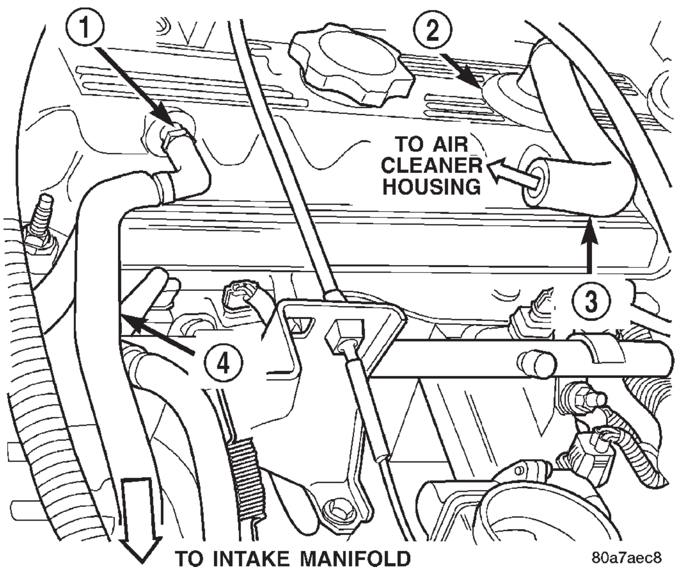


Fig. 16 CCV System—2.5L Engine

1 - FIXED ORIFICE FITTING
2 - AIR INLET FITTING
3 - CCV TUBE
4 - CCV TUBE

(9) Inspect fuel tube quick-connect fitting-to-fuel rail connections.

(10) Verify hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

(11) Inspect accelerator cable and throttle cable. Check their connections to throttle arm of throttle body for any binding or restrictions.

(12) If equipped with vacuum brake booster, verify vacuum booster hose is firmly connected to fitting on intake manifold. Also check connection to brake vacuum booster.

(13) Inspect air cleaner inlet and air cleaner element for dirt or restrictions.

(14) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

(15) Verify intake manifold air temperature sensor wire connector is firmly connected to harness connector (Fig. 17).

(16) Verify MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 18). Also verify rubber L-shaped fitting from MAP sensor to throttle body is firmly connected.

(17) Verify 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.

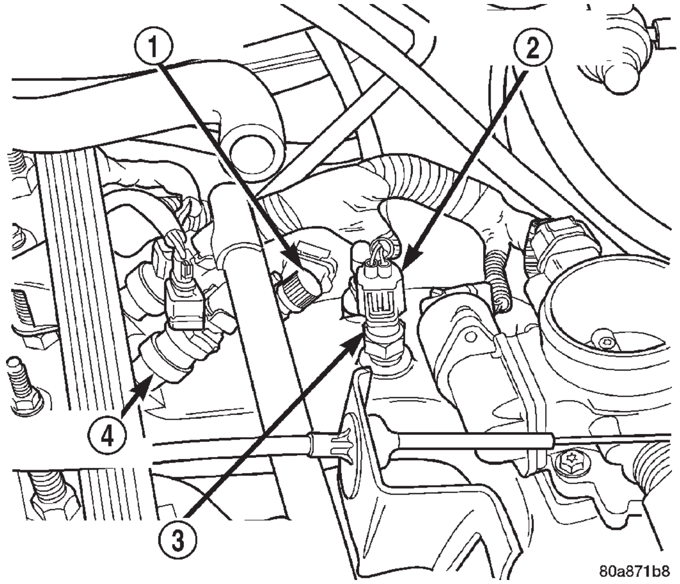


Fig. 17 Intake Manifold Air Temperature Sensor—2.5L Engine

1 - FUEL PRESSURE TEST PORT
2 - ELECTRICAL CONNECTOR
3 - INTAKE MANIFOLD AIR TEMPERATURE SENSOR
4 - FUEL INJECTOR

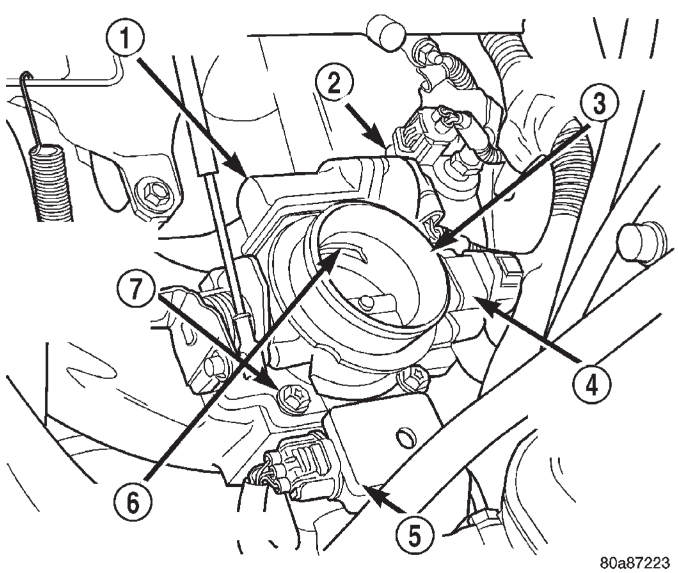


Fig. 18 Sensor Location—2.5L Engine

1 - IDLE AIR CONTROL MOTOR
2 - IAT SENSOR
3 - THROTTLE BODY
4 - THROTTLE POSITION SENSOR
5 - MAP SENSOR
6 - IDLE AIR CONTROL PASSAGE INLET
7 - THROTTLE BODY MOUNTING BOLTS (4)

(18) Verify harness connectors are firmly connected to idle air control (IAC) motor, throttle posi-

FUEL INJECTION (Continued)

tion sensor (TPS) and manifold absolute pressure (MAP) sensor (Fig. 18).

(19) Verify wire harness connector is firmly connected to engine coolant temperature sensor (Fig. 19).

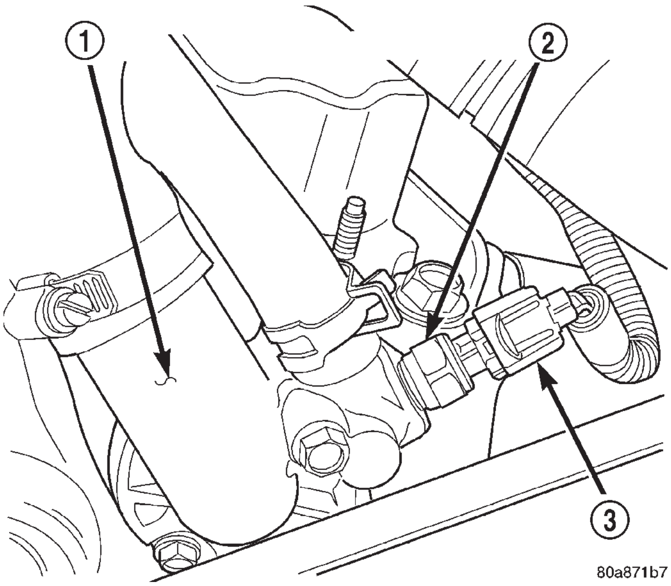


Fig. 19 Engine Coolant Temperature Sensor—2.5L Engine

1 - THERMOSTAT HOUSING
2 - ENGINE COOLANT TEMPERATURE SENSOR
3 - ELECTRICAL CONNECTOR

(20) Raise and support the vehicle.

(21) Verify both upstream and downstream oxygen sensor wire connectors are firmly connected to sensors. Inspect sensors and connectors for damage (Fig. 20) or (Fig. 21).

(22) Inspect for pinched or leaking fuel tubes. Inspect for pinched, cracked or leaking fuel hoses.

(23) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(24) Verify electrical harness is firmly connected to rear wheel speed sensor. Verify rear wheel speed sensor is firmly attached to rear axle with proper air gap. Refer to 5, Brakes for information.

(25) If equipped with 4–wheel antilock brake system, verify electrical harness is firmly connected to each front wheel speed sensor. Verify both front wheel speed sensors are firmly attached. Refer to 5, Brakes for information.

(26) Verify fuel pump/gauge sender unit wire connector is firmly connected to harness connector.

(27) Inspect fuel hoses at fuel pump/gauge sender unit for cracks or leaks.

(28) Inspect clutch housing for damage to timing ring on drive plate/flywheel.

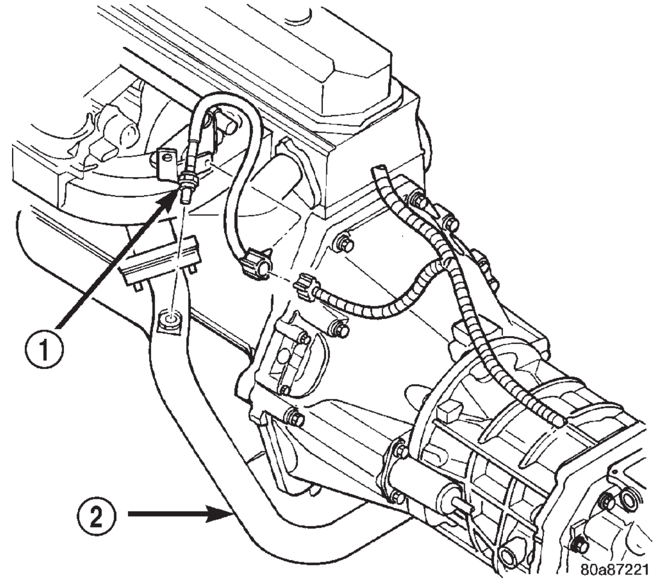


Fig. 20 Upstream Oxygen Sensor—2.5L Engine

1 - UPSTREAM OXYGEN SENSOR
2 - EXHAUST PIPE

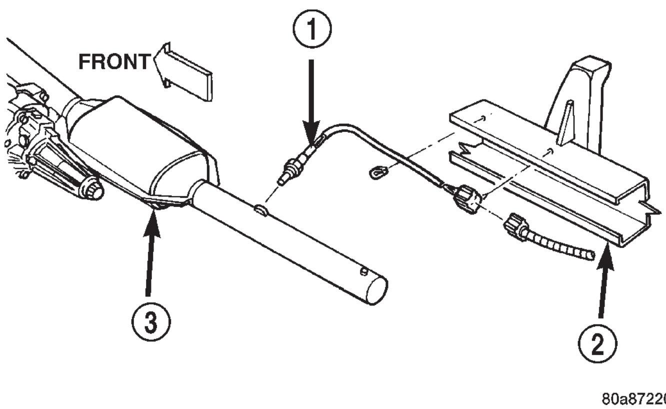


Fig. 21 Downstream Oxygen

1 - DOWNSTREAM OXYGEN SENSOR
2 - FRAME RAIL
3 - CATALYTIC CONVERTER

(29) Verify battery cable and solenoid feed wire connections to the starter solenoid are tight and clean. Inspect for chaffed wires or wires rubbing against other components.

FUEL INJECTION (Continued)

SPECIFICATIONS

SPECIFICATIONS - TORQUE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Engine Coolant Temperature Sensor—All Engines	11		96
IAC Motor-To-Throttle Body Bolts	7		60
Intake Manifold Air Temp. Sensor—All Engines	28	20	
MAP Sensor Mounting Screws—All Engines	3		25
Oxygen Sensor—All Engines	30	22	
Power Steering Pressure Switch	14-22		124-195
Powertrain Control Module Mounting Screws	3-5		30-40
Throttle Body Mounting Bolts—2.5L Engine	11		100
Throttle Body Mounting Bolts—3.9L/5.2L Engines	23		200
Throttle Position Sensor Mounting Screws—All Engines	7		60

ACCELERATOR PEDAL

REMOVAL

All engines are equipped with torsion return springs located on the throttle body shaft. 3.9L V-6 and 5.2/5.9L V-8 engines equipped with a manual transmission have an additional pedal return spring on the throttle body linkage.

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing accelerator pedal or cables.

(1) From inside the vehicle, hold up accelerator pedal. Remove plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 22). Plastic cable retainer snaps into pedal arm.

(2) Remove two accelerator pedal/bracket nuts (Fig. 22)and remove pedal/bracket assembly from vehicle.

INSTALLATION

All engines are equipped with torsion return springs located on the throttle body shaft. 3.9L V-6 and 5.2/5.9L V-8 engines equipped with a manual transmission have an additional pedal return spring on the throttle body linkage.

(1) Position pedal/bracket assembly over the two dash panel mounting studs and install retaining nuts.

(2) Tighten nuts to 7 N·m (65 in. lbs.) torque.

(3) From inside the vehicle, hold up the accelerator pedal. Install the throttle cable core wire and plastic cable retainer into the upper end of the pedal arm. The plastic retainer is snapped into the pedal arm.

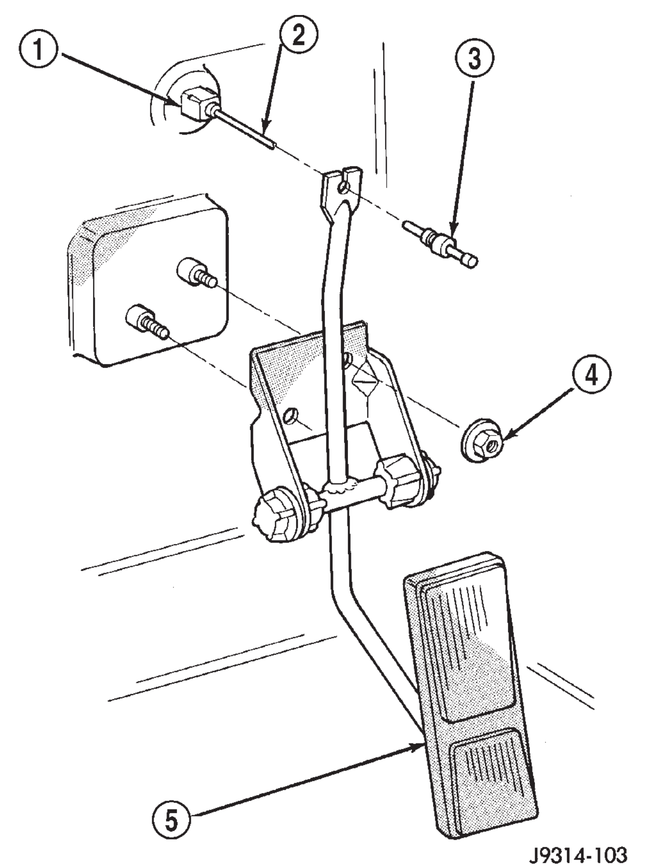


Fig. 22 Accelerator Pedal—Removal or Installation

1 - PINCH SIDES
2 - CABLE
3 - CABLE RETAINER
4 - NUTS (2)
5 - ACCELERATOR PEDAL

ACCELERATOR PEDAL (Continued)

When installing the plastic retainer to the accelerator pedal arm, note the index tab on the pedal arm (Fig. 23). Align the index slot (Fig. 23) on the plastic cable retainer to this index tab.

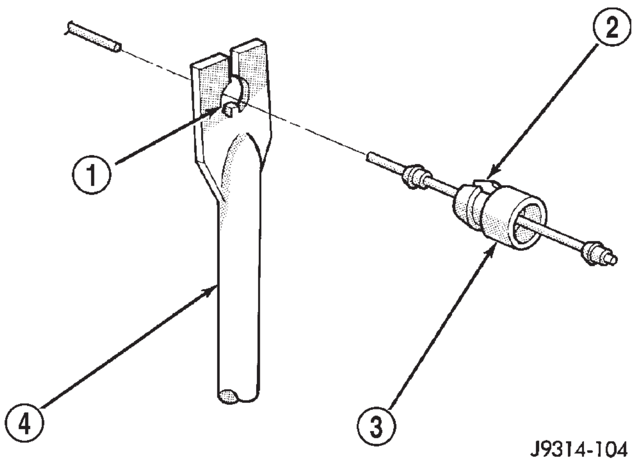


Fig. 23 Index Tab and Slot

1 - INDEX TAB
2 - INDEX SLOT
3 - CABLE RETAINER
4 - PEDAL ARM

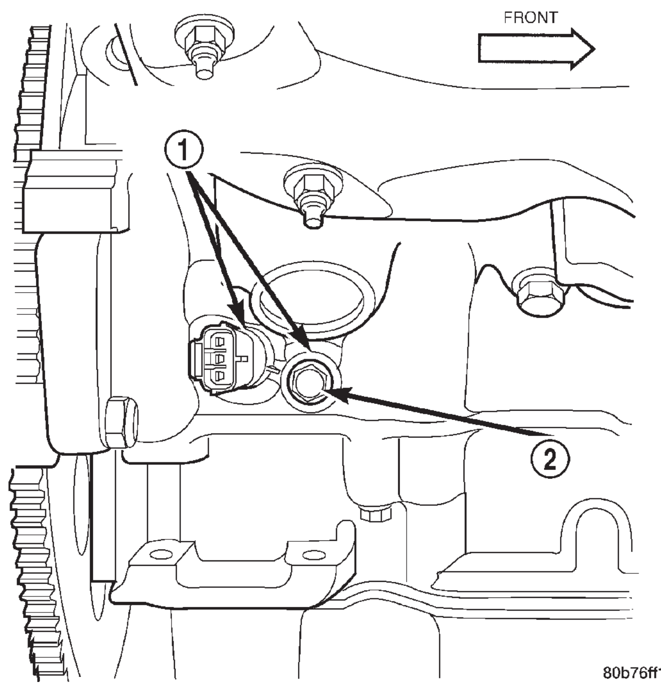


Fig. 24 CKP Sensor Location—4.7L V–8 Engine

1 - CRANKSHAFT POSITION SENSOR
2 - MOUNTING BOLT

CRANKSHAFT POSITION SENSOR

DESCRIPTION - 2.5L

The Crankshaft Position (CKP) sensor is located near the outer edge of the flywheel (or starter ringear).

DESCRIPTION - 3.9L

The Crankshaft Position (CKP) sensor is located near the outer edge of the flywheel (starter ringear).

DESCRIPTION - 5.2L/5.9L

The Crankshaft Position (CKP) sensor is located near the outer edge of the flywheel (starter ringear).

DESCRIPTION - 4.7L

The Crankshaft Position Sensor (CKP) is mounted into the right-rear side of the engine block (Fig. 24).

OPERATION - 2.5L

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. 25).

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.

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.

OPERATION - 3.9L

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 notches at its outer edge. On 3.9L V-6 engines, there are three

CRANKSHAFT POSITION SENSOR (Continued)

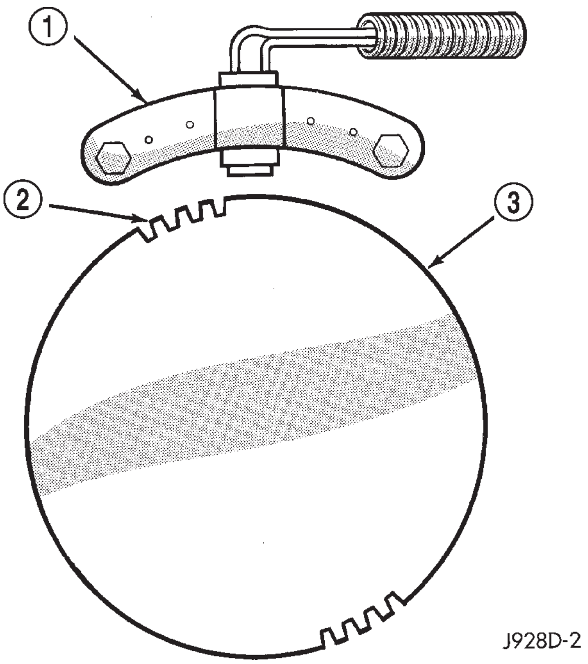


Fig. 25 CKP Sensor Operation—2.5L 4-Cyl. Engine

1 - CRANKSHAFT POSITION SENSOR
2 - NOTCHES
3 - FLYWHEEL

sets of double notches and three sets of single notches (Fig. 26).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM.

The engine will not operate if the PCM does not receive a CKP sensor input.

OPERATION - 5.2L/5.9L

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.

On 5.2/5.9L V-8 engines, the flywheel/drive plate has 8 single notches, spaced every 45 degrees, at its outer edge (Fig. 27).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM. For each engine revolution, there are 8 pulses generated on V-8 engines.

The engine will not operate if the PCM does not receive a CKP sensor input.

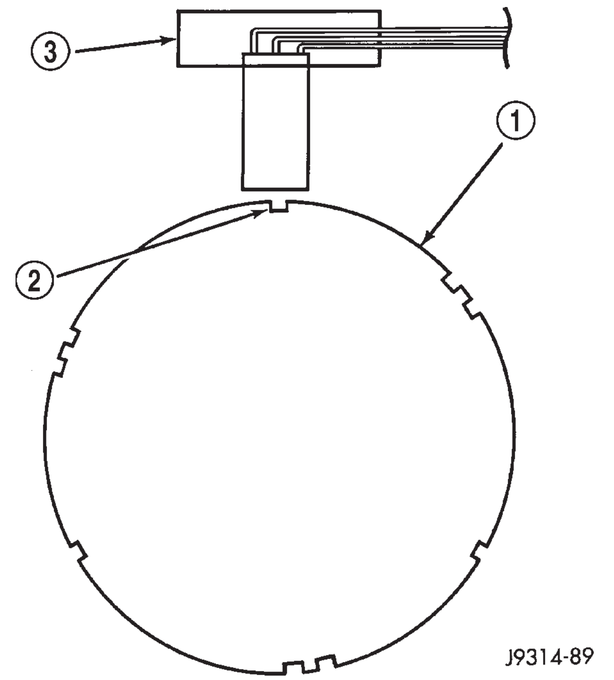


Fig. 26 CKP Sensor Operation—3.9L Engine

1 - FLYWHEEL
2 - NOTCHES
3 - CRANKSHAFT POSITION SENSOR

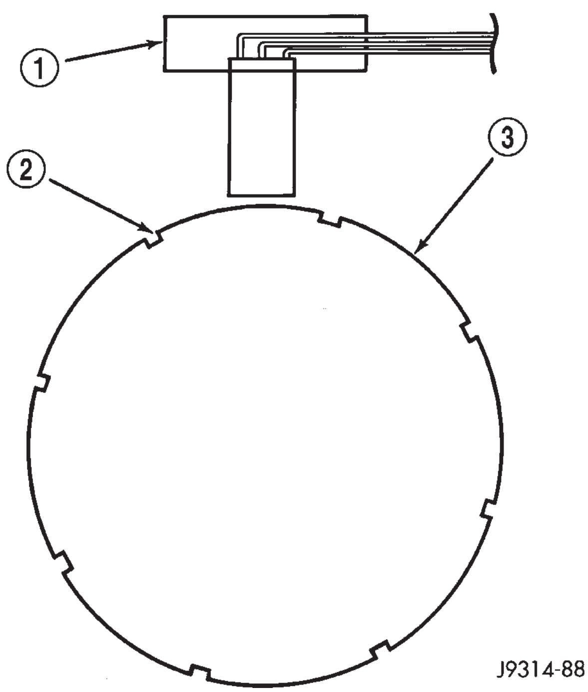


Fig. 27 CKP Sensor Operation—5.2L/5.9L Engine

1 - CRANKSHAFT POSITION SENSOR
2 - NOTCHES
3 - FLYWHEEL

CRANKSHAFT POSITION SENSOR (Continued)

OPERATION - 4.7L

Engine speed and crankshaft position are provided through the crankshaft position sensor. The sensor generates pulses that are the input sent to the powertrain control module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

On the 4.7L V–8 engine, a tonewheel is bolted to the engine crankshaft (Fig. 28). This tonewheel has sets of notches at its outer edge (Fig. 28).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM.

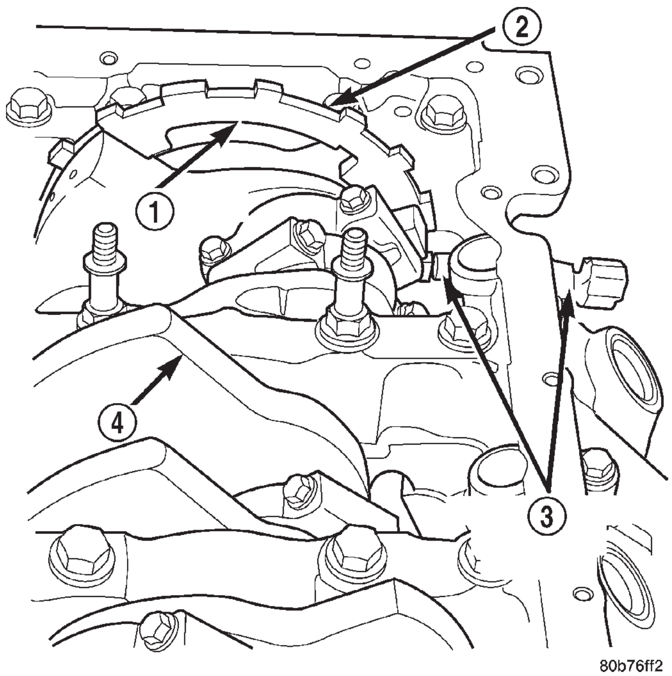


Fig. 28 CKP Sensor Operation and Tonewheel—4.7L V–8 Engine

1 - TONEWHEEL
2 - NOTCHES
3 - CRANKSHAFT POSITION SENSOR
4 - CRANKSHAFT

REMOVAL - 2.5L

The crankshaft position sensor is mounted in the transmission bellhousing at left/rear side of engine block (Fig. 29).

(1) Remove air tube between throttle body and air cleaner housing.

(2) Near rear of intake manifold, disconnect pigtail harness (on the sensor) from main electrical harness.

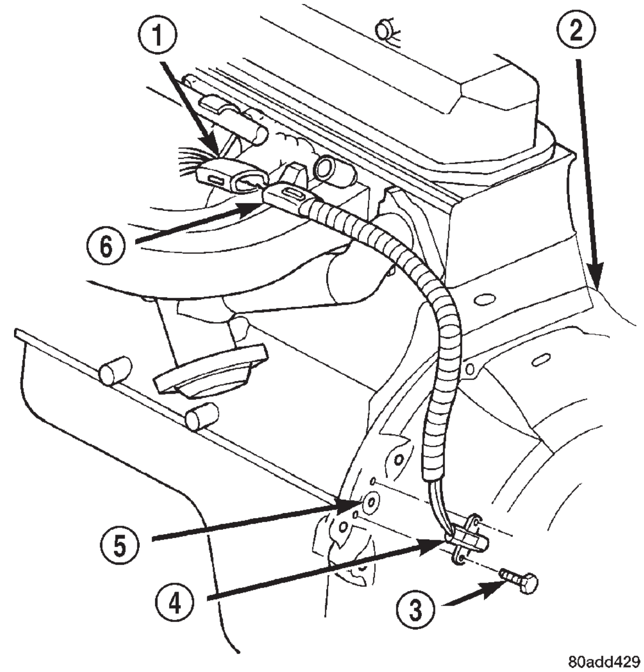


Fig. 29 Crankshaft Position Sensor—2.5L 4-Cylinder Engine

1 - ELECTRICAL CONNECTOR
2 - TRANSMISSION BELLHOUSING
3 - MOUNTING BOLTS (2)
4 - CRANKSHAFT POSITION SENSOR
5 - RUBBER GROMMET
6 - PIGTAIL HARNESS

(3) Remove 2 sensor mounting bolts.
(4) Remove sensor.
(5) Remove clip from sensor wire harness.

REMOVAL - 3.9/5.2/5.9L

The sensor is bolted to the top of the cylinder block near the rear of right cylinder head (Fig. 30). The sensor is accessed by removing the right front fender liner.

(1) Remove right front tire and right front wheelhouse liner. Refer to Front Wheelhouse Liner in Group 23, Body.

(2) Disconnect crankshaft position sensor pigtail harness from main wiring harness.

(3) Remove two sensor (recessed hex head) mounting bolts (Fig. 30).

(4) Remove sensor from engine.

CRANKSHAFT POSITION SENSOR (Continued)

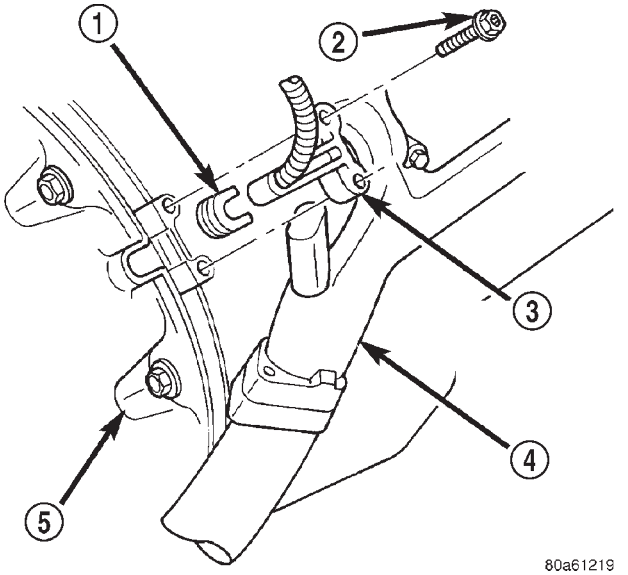


Fig. 30 Crankshaft Position Sensor—3.9/5.2/5.9L Engines

1 - GROMMET
2 - MOUNTING BOLTS (2)
3 - CRANKSHAFT POSITION SENSOR
4 - RIGHT EXHAUST MANIFOLD
5 - TRANSMISSION BELL HOUSING

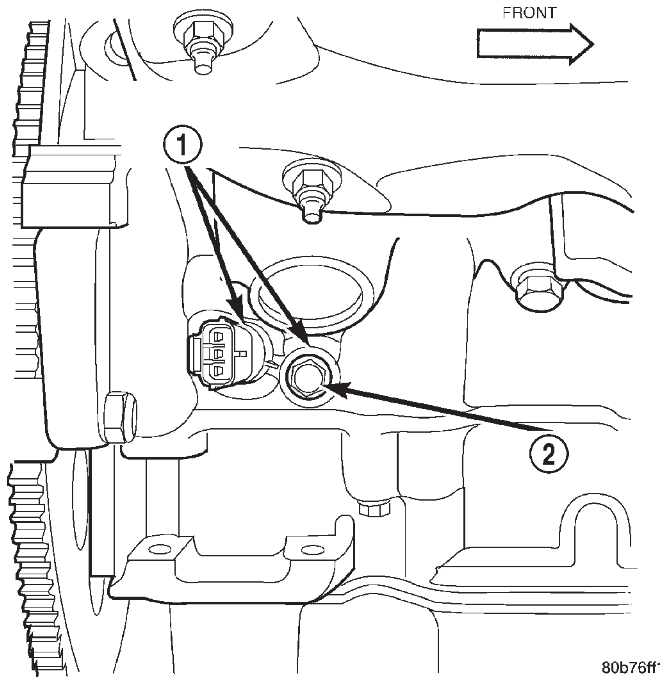


Fig. 31 CKP Sensor Location/Removal/Installation—4.7L V–8 Engine

1 - CRANKSHAFT POSITION SENSOR
2 - MOUNTING BOLT

REMOVAL - 4.7L

The Crankshaft Position (CKP) sensor is located at the right-rear side of the engine cylinder block (Fig. 31). It is positioned and bolted into a machined hole in the engine block.

(1) Disconnect CKP electrical connector at sensor.
(2) Remove CKP mounting bolt (Fig. 31).
(3) Carefully pry sensor from cylinder block in a rocking action with two small screwdrivers.
(4) Remove sensor from vehicle.
(5) Check condition of sensor o-ring.

INSTALLATION - 2.5L

The crankshaft position sensor is mounted in the transmission bellhousing at left/rear side of engine block (Fig. 29).

(1) Install sensor flush against opening in transmission housing.
(2) Install and tighten two sensor mounting bolts to 12 N·m (9 ft. lbs.) torque.

CAUTION: Two bolts are used to secure the sensor to transmission. These bolts are specially machined to correctly space the unit to flywheel. Do not attempt to install any other bolts.

(3) Connect electrical connector to sensor.
(4) Install clip on sensor wire harness.
(5) Install air tube between throttle body and air cleaner housing.

INSTALLATION - 3.9/5.2/5.9L

(1) Position crankshaft position sensor to engine.
(2) Install mounting bolts and tighten to 8 N·m (70 in. lbs.) torque.
(3) Connect main harness electrical connector to sensor.
(4) Install right front tire and right front wheelhouse liner. Refer to Front Wheelhouse Liner in Group 23, Body.

INSTALLATION - 4.7L

(1) Clean out machined hole in engine block.
(2) Apply a small amount of engine oil to sensor o-ring.
(3) Install sensor into engine block with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder block. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten to 28 N·m (21 ft. lbs.) torque.
(5) Connect electrical connector to sensor.

FUEL INJECTOR

DESCRIPTION

An individual fuel injector (Fig. 32) is used for each individual cylinder.

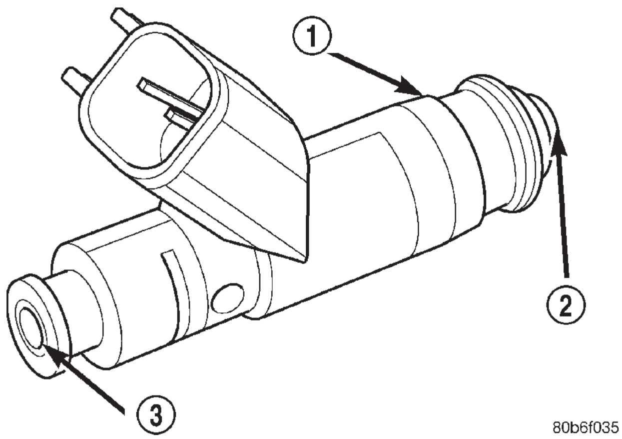


Fig. 32 Fuel Injector—Typical

1 - FUEL INJECTOR
2 - NOZZLE
3 - TOP (FUEL ENTRY)

OPERATION

The top (fuel entry) end of the injector (Fig. 32) 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.

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.

DIAGNOSIS AND TESTING - FUEL INJECTOR TEST

To perform a complete test of the fuel injectors and their circuitry, use the DRB scan tool and refer to the appropriate Powertrain Diagnostics Procedures manual. To test the injector only, refer to the following:

Disconnect the fuel injector wire harness connector from the injector. The injector is equipped with 2 electrical terminals (pins). Place an ohmmeter across the terminals. Resistance reading should be approximately 12 ohms ±1.2 ohms at 20°C (68°F).

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE EVEN WITH ENGINE TURNED OFF. BEFORE SERVICING FUEL INJECTOR(S), FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to Fuel System Pressure Release Procedure.

To remove one or more fuel injectors, fuel rail assembly must be removed from engine.

(1) Remove air cleaner assembly.

(2) Remove fuel injector rail assembly. Refer to Fuel Injector Rail Removal/Installation in this group.

(3) Remove clip(s) retaining the injector(s) to fuel rail (Fig. 24) or (Fig. 25).

(4) Remove injector(s) from fuel rail.

FUEL INJECTOR (Continued)

INSTALLATION

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE EVEN WITH ENGINE TURNED OFF. BEFORE SERVICING FUEL INJECTOR(S), FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to Fuel System Pressure Release Procedure.

To remove one or more fuel injectors, fuel rail assembly must be removed from engine.

(1) Apply a small amount of clean engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(2) Install injector(s) and injector clip(s) to fuel rail.

(3) Install fuel rail assembly. Refer to Fuel Injector Rail Removal/Installation.

(4) Install air cleaner.

(5) Start engine and check for 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. 33) . 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.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

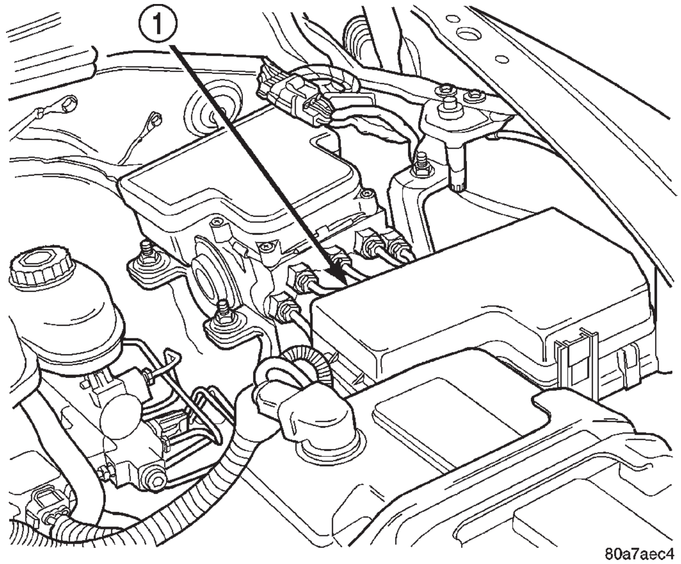


Fig. 33 Power Distribution Center (PDC)

1 - POWER DISTRIBUTION CENTER (PDC)

INSTALLATION

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 33) . 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.

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).

IDLE AIR CONTROL MOTOR (Continued)

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 - 3.9L/5.2L/5.9L

The IAC motor is located on the back of the throttle body (Fig. 34).

(1) Remove air duct at throttle body.

(2) Disconnect electrical connector from IAC motor.

(3) Remove two mounting bolts (screws) (Fig. 34).

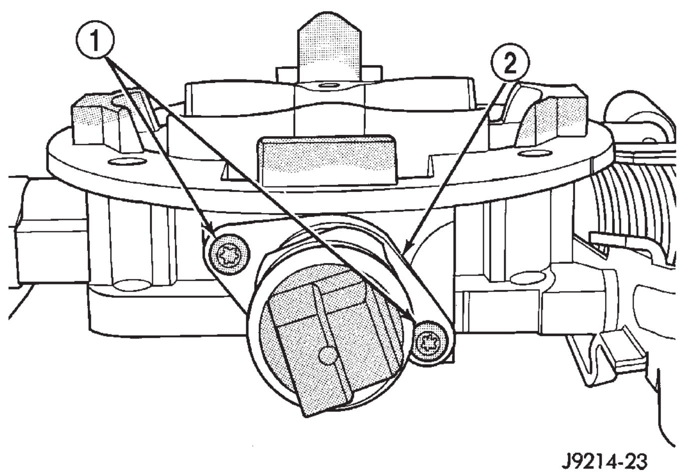


Fig. 34 Mounting Bolts (Screws)—IAC Motor—3.9/5.2/5.9L Engines

1 - MOUNTING SCREWS
2 - IDLE SPEED MOTOR

(4) Remove IAC motor from throttle body.

REMOVAL - 4.7L

The IAC motor is located on the throttle body.

(1) Remove air duct and air resonator box at throttle body.

(2) Disconnect electrical connector from IAC motor (Fig. 54).

(3) Remove two mounting bolts (screws) (Fig. 60).

(4) Remove IAC motor from throttle body.

REMOVAL - 2.5L

The IAC motor is located on the side of the throttle body (Fig. 35).

(1) Remove air duct at throttle body.

(2) Disconnect electrical connector from IAC motor.

IDLE AIR CONTROL MOTOR (Continued)

(3) Remove two mounting bolts (screws) (Fig. 35).
(4) Remove IAC motor from throttle body.

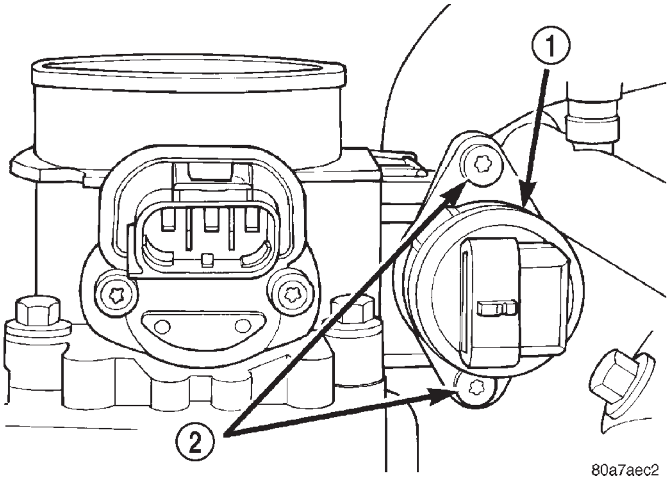


Fig. 35 Mounting Bolts (Screws)—IAC Motor—2.5L Engine

1 - IDLE AIR CONTROL MOTOR
2 - MOUNTING SCREWS

INSTALLATION - 3.9L/5.2L/5.9L

The IAC motor is located on the back of the throttle body (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 duct at throttle body.

INSTALLATION - 4.7L

(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 duct/air box to throttle body.

INSTALLATION - 2.5L

The IAC motor is located on the side of the throttle body (Fig. 35).

(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 duct at 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 - 3.9L/5.2L/5.9L

The intake manifold air temperature sensor is located in the front/side of the intake manifold (Fig. 36).

(1) Remove air duct at throttle body.
(2) Disconnect electrical connector at sensor (Fig. 36).
(3) Remove sensor from intake manifold.

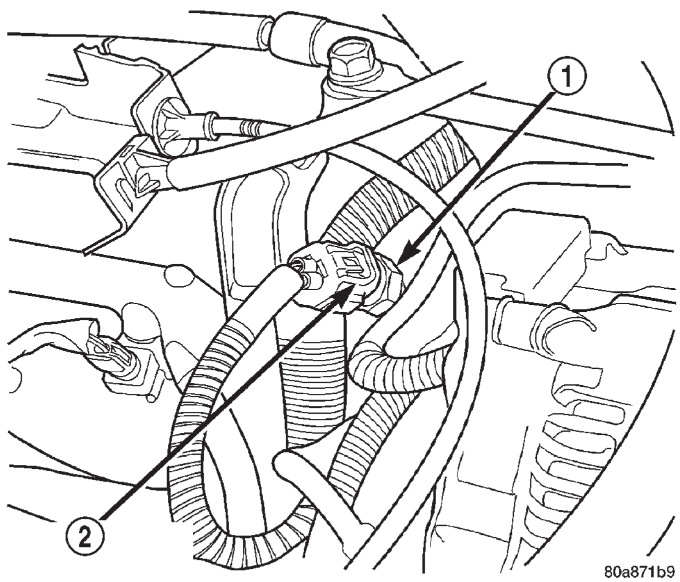


Fig. 36 Intake Manifold Air Temperature Sensor—3.9/5.2/5.9L Engines—Typical

1 - INTAKE MANIFOLD AIR TEMPERATURE SENSOR
2 - ELECTRICAL CONNECTOR

INTAKE AIR TEMPERATURE SENSOR (Continued)

REMOVAL - 4.7L

The Intake Manifold Air Temperature (IAT) sensor is installed into the intake manifold plenum near the left side of the throttle body (Fig. 37).

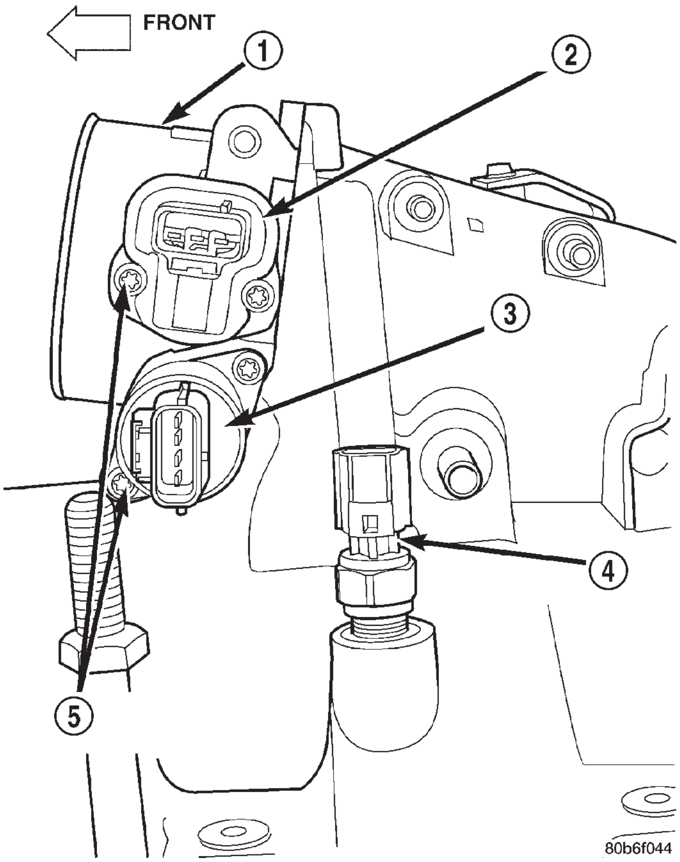


Fig. 37 Intake Manifold Air Sensor Location—4.7L V-8 Engine

1 - THROTTLE BODY
2 - TPS
3 - IAC MOTOR
4 - IAT SENSOR
5 - MOUNTING SCREWS

(1) Disconnect electrical connector from sensor.
(2) Remove sensor from intake manifold.

REMOVAL - 2.5L

The intake manifold air temperature sensor is located in the intake manifold (Fig. 38).

(1) Remove air duct at throttle body.
(2) Disconnect electrical connector at sensor (Fig. 38).
(3) Remove sensor from intake manifold.

INSTALLATION - 3.9L/5.2L/5.9L

The intake manifold air temperature sensor is located in the front/side of the intake manifold (Fig. 36).

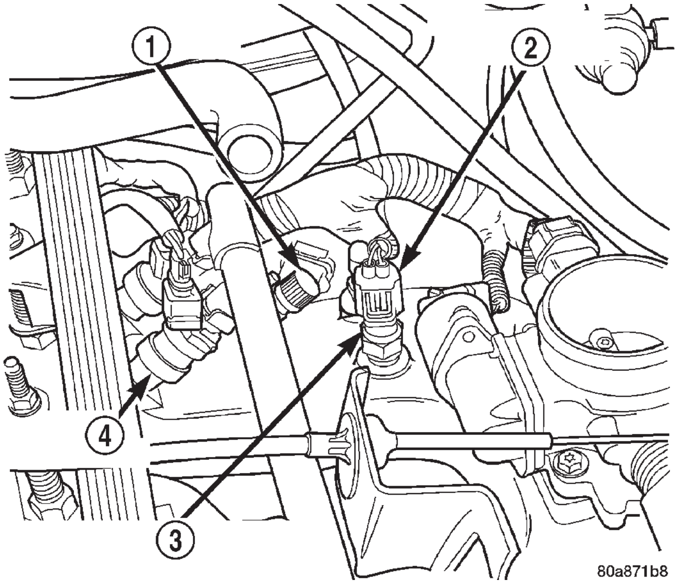


Fig. 38 Intake Manifold Air Temperature Sensor—2.5L Engine

1 - FUEL PRESSURE TEST PORT
2 - ELECTRICAL CONNECTOR
3 - INTAKE MANIFOLD AIR TEMPERATURE SENSOR
4 - FUEL INJECTOR

(1) Install sensor to intake manifold. Tighten to 28 N·m (20 ft. lbs.) torque.
(2) Install electrical connector.
(3) Install air duct at throttle body.

INSTALLATION - 4.7L

(1) Install sensor into intake manifold. Tighten sensor to 28 N·m (20 ft. lbs.) torque.
(2) Connect electrical connector to sensor.

INSTALLATION - 2.5L

The intake manifold air temperature sensor is located in the intake manifold (Fig. 38).

(1) Install sensor to intake manifold. Tighten to 28 N·m (20 ft. lbs.) torque.
(2) Install electrical connector.
(3) Install air duct at throttle body.

MAP SENSOR

DESCRIPTION - EXCEPT 4.7L

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.

MAP SENSOR (Continued)

DESCRIPTION - 4.7L

The MAP sensor is located on the front of the intake manifold. An o-ring seals the sensor to the intake manifold.

OPERATION

The MAP sensor is used as an input to the Powertrain Control Module (PCM). It contains a silicon based sensing unit to provide data on the manifold vacuum that draws the air/fuel mixture into the combustion chamber. The PCM requires this information to determine injector pulse width and spark advance. When manifold absolute pressure (MAP) equals Barometric pressure, the pulse width will be at maximum.

A 5 volt reference is supplied from the PCM and returns a voltage signal to the PCM that reflects manifold pressure. The zero pressure reading is 0.5V and full scale is 4.5V. For a pressure swing of 0–15 psi, the voltage changes 4.0V. To operate the sensor, it is supplied a regulated 4.8 to 5.1 volts. Ground is provided through the low-noise, sensor return circuit at the PCM.

The MAP sensor input is the number one contributor to fuel injector pulse width. The most important function of the MAP sensor is to determine barometric pressure. The PCM needs to know if the vehicle is at sea level or at a higher altitude, because the air density changes with altitude. It will also help to correct for varying barometric pressure. Barometric pressure and altitude have a direct inverse correlation; as altitude goes up, barometric goes down. At key-on, the PCM powers up and looks at MAP voltage, and based upon the voltage it sees, it knows the current barometric pressure (relative to altitude). Once the engine starts, the PCM looks at the voltage again, continuously every 12 milliseconds, and compares the current voltage to what it was at key-on. The difference between current voltage and what it was at key-on, is manifold vacuum.

During key-on (engine not running) the sensor reads (updates) barometric pressure. A normal range can be obtained by monitoring a known good sensor.

As the altitude increases, the air becomes thinner (less oxygen). If a vehicle is started and driven to a very different altitude than where it was at key-on, the barometric pressure needs to be updated. Any time the PCM sees Wide Open Throttle (WOT), based upon Throttle Position Sensor (TPS) angle and RPM, it will update barometric pressure in the MAP memory cell. With periodic updates, the PCM can make its calculations more effectively.

The PCM uses the MAP sensor input to aid in calculating the following:

- Manifold pressure
- Barometric pressure
- Engine load
- Injector pulse-width
- Spark-advance programs
- Shift-point strategies (certain automatic transmissions only)
- Idle speed
- Decel fuel shutoff

The MAP sensor signal is provided from a single piezoresistive element located in the center of a diaphragm. The element and diaphragm are both made of silicone. As manifold pressure changes, the diaphragm moves causing the element to deflect, which stresses the silicone. When silicone is exposed to stress, its resistance changes. As manifold vacuum increases, the MAP sensor input voltage decreases proportionally. The sensor also contains electronics that condition the signal and provide temperature compensation.

The PCM recognizes a decrease in manifold pressure by monitoring a decrease in voltage from the reading stored in the barometric pressure memory cell. The MAP sensor is a linear sensor; meaning as pressure changes, voltage changes proportionately. The range of voltage output from the sensor is usually between 4.6 volts at sea level to as low as 0.3 volts at 26 in. of Hg. Barometric pressure is the pressure exerted by the atmosphere upon an object. At sea level on a standard day, no storm, barometric pressure is approximately 29.92 in Hg. For every 100 feet of altitude, barometric pressure drops .10 in. Hg. If a storm goes through it can change barometric pressure from what should be present for that altitude. You should know what the average pressure and corresponding barometric pressure is for your area.

MAP SENSOR (Continued)

REMOVAL - 3.9L/5.2L/5.9L

The MAP sensor is located on the front of the throttle body (Fig. 39). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 40).

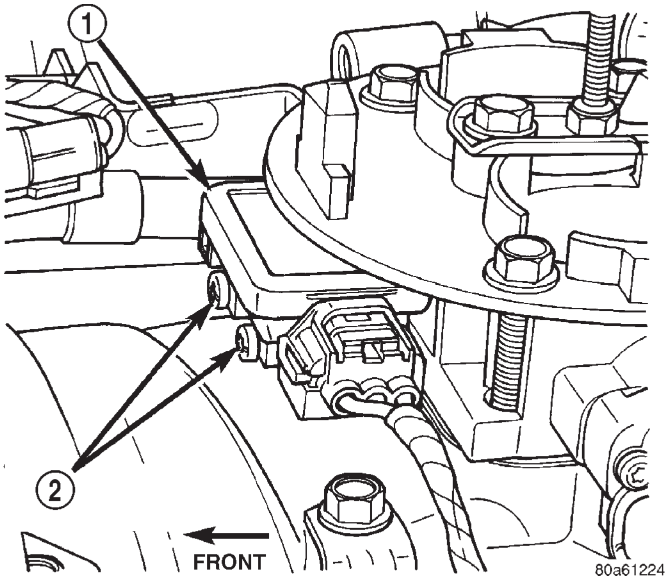


Fig. 39 MAP Sensor Location—3.9/5.2/5.9L Engines

1 - MAP SENSOR
2 - MOUNTING SCREWS (2)

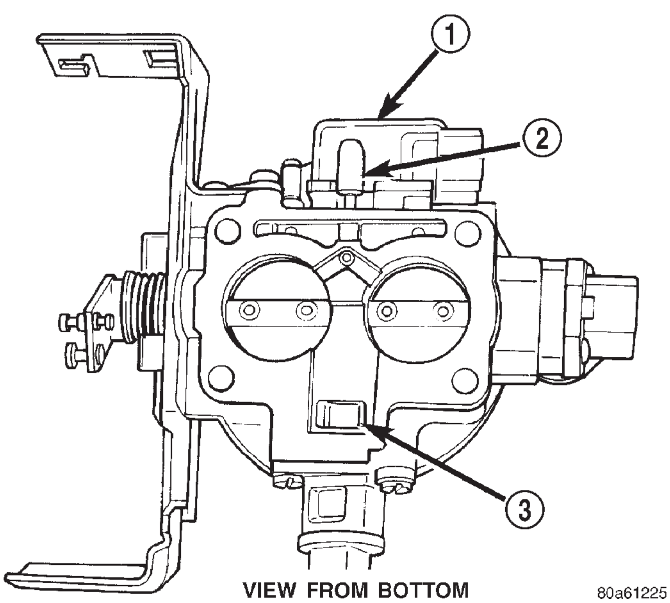


Fig. 40 MAP Sensor L-Shaped Rubber Fitting—3.9/5.2/5.9L Engines

1 - MAP SENSOR
2 - RUBBER FITTING
3 - IDLE AIR PASSAGE

(1) Remove air duct at throttle body.

(2) Remove two MAP sensor mounting bolts (screws) (Fig. 39).

(3) While removing MAP sensor, slide the vacuum rubber L-shaped fitting (Fig. 40) from the throttle body.

(4) Remove rubber L-shaped fitting from MAP sensor.

REMOVAL - 4.7L

The MAP sensor is located on the front of the intake manifold (Fig. 41). An o-ring seals the sensor to the intake manifold.

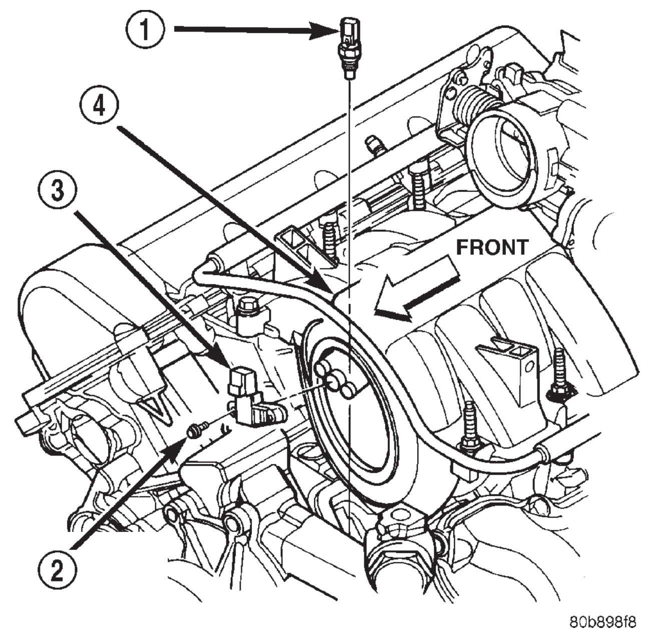


Fig. 41 MAP and ECT Sensor Locations—4.7L V–8 Engine

1 - ECT SENSOR
2 - MOUNTING BOLTS (2)
3 - MAP SENSOR
4 - INTAKE MANIFOLD

(1) Disconnect electrical connector at sensor.

(2) Clean area around MAP sensor.

(3) Remove 2 sensor mounting bolts (Fig. 41).

(4) Remove MAP sensor from intake manifold.

MAP SENSOR (Continued)

REMOVAL - 2.5L

The MAP sensor is mounted to the side of the throttle body (Fig. 42). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 43).

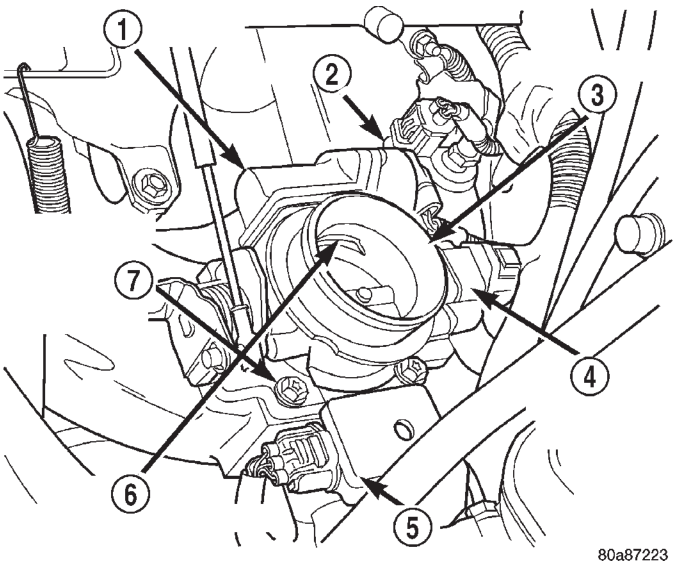


Fig. 42 MAP Sensor Location—2.5L Engine

1 - IDLE AIR CONTROL MOTOR
2 - IAT SENSOR
3 - THROTTLE BODY
4 - THROTTLE POSITION SENSOR
5 - MAP SENSOR
6 - IDLE AIR CONTROL PASSAGE INLET
7 - THROTTLE BODY MOUNTING BOLTS (4)

(1) Remove air duct at throttle body.
(2) Remove electrical connector at sensor.
(3) Remove two MAP sensor mounting bolts (screws) (Fig. 43).
(4) While removing MAP sensor, slide the rubber L-shaped fitting (Fig. 43) from the throttle body.
(5) Remove rubber L-shaped fitting from MAP sensor.

INSTALLATION - 3.9L/5.2L/5.9L

The MAP sensor is located on the front of the throttle body (Fig. 39). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 40).

(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 duct at throttle body.

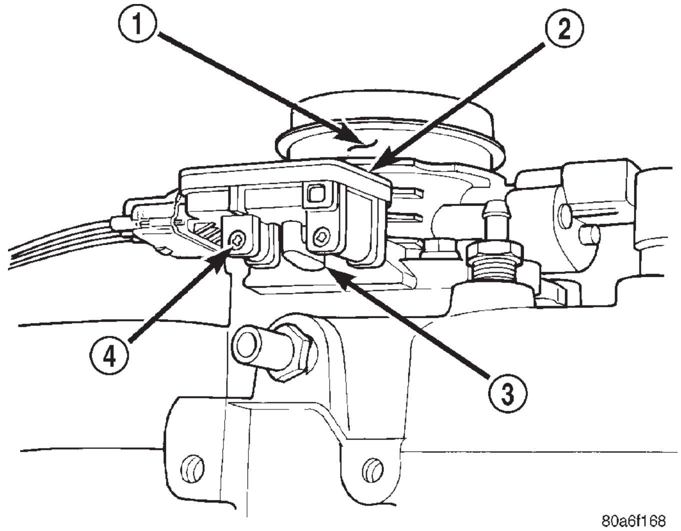


Fig. 43 MAP Sensor Mounting and Rubber Fitting—2.5L Engine

1 - THROTTLE BODY
2 - MAP SENSOR
3 - RUBBER FITTING
4 - MOUNTING SCREWS (2)

INSTALLATION - 4.7L

The MAP sensor is located on the front of the intake manifold (Fig. 41). An o-ring seals the sensor to the intake manifold.

(1) Clean MAP sensor mounting hole at intake manifold.
(2) Check MAP sensor o-ring seal for cuts or tears.
(3) Position sensor into manifold.
(4) Install MAP sensor mounting bolts (screws). Tighten screws to 3 N·m (25 in. lbs.) torque.
(5) Connect electrical connector.

INSTALLATION - 2.5L

The MAP sensor is mounted to the side of the throttle body (Fig. 42). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 43).

(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 electrical connector at sensor.
(5) Install air duct at throttle body.

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) (Fig. 33). 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.

(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) (Fig. 33). 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. Depending on the emission package, the vehicle may use a total of either 2 or 4 sensors.

NAA Emissions Package: Two sensors are used: upstream (referred to as 1/1) and downstream (referred to as 1/2). With this emission package, the upstream sensor (1/1) is located just before the main catalytic convertor. The downstream sensor (1/2) is located just after the main catalytic convertor.

NAS or NAE Emissions Package: On this emissions package, 4 sensors are used: 2 upstream (referred to as 1/1 and 2/1) and 2 downstream (referred to as 1/2 and 2/2). With this emission package, the right upstream sensor (2/1) is located in the right exhaust downpipe just before the mini-catalytic convertor. The left upstream sensor (1/1) is located in the left exhaust downpipe just before the mini-catalytic convertor. The right downstream sensor (2/2) is located in the right exhaust downpipe just after the mini-catalytic convertor, and before the main catalytic convertor. The left downstream sensor (1/2) is located in the left exhaust downpipe just after the mini-catalytic convertor, and before the main catalytic convertor.

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 wire harness. This is why it is important to never solder an O2 sensor connector, or pack the connector with grease.

Four wires (circuits) are used on each O2 sensor: a 12–volt feed circuit for the sensor heating element; a ground circuit for the heater element; a low-noise sensor return circuit to the PCM, and an input circuit from the sensor back to the PCM to detect sensor operation.

Oxygen Sensor 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 on 2.5/3.9/5.2 and 5.9L engines. It is approximately 13.5 ohms on the 4.7L engine. 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

O2 SENSOR (Continued)

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 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.

O2 SENSOR (Continued)

REMOVAL - EXCEPT 2.5L

Never apply any type of grease to the oxygen sensor electrical connector, or attempt any soldering of the sensor wiring harness. For sensor operation, it must have a comparison source of oxygen from outside the exhaust system. This fresh air is supplied to the sensor through its pigtail wiring harness.

For sensor locations, refer to (Fig. 44), (Fig. 45), (Fig. 46) (Fig. 47) or (Fig. 48).

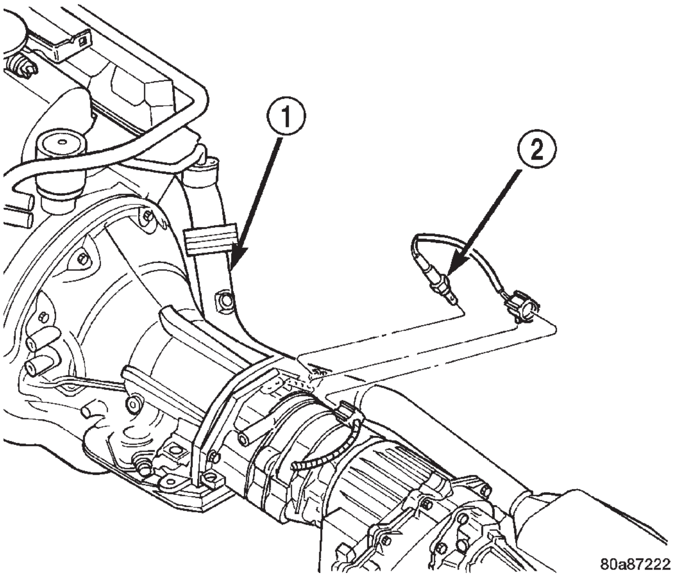


Fig. 44 Upstream Oxygen Sensor Locations—Except 4.7L V-8 Engine

1 - EXHAUST PIPE
2 - UPSTREAM OXYGEN SENSOR

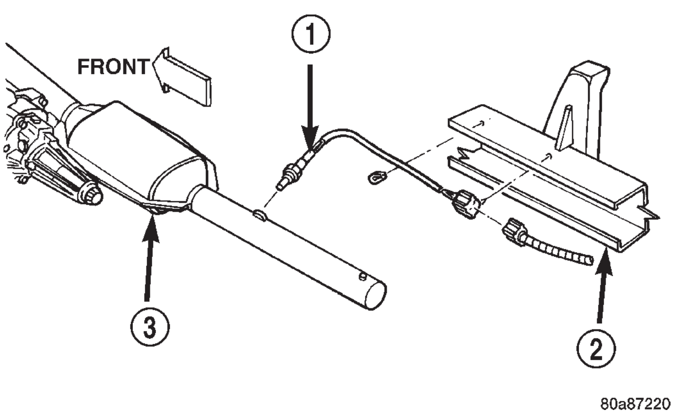


Fig. 45 Downstream Oxygen Sensor Location—Except 4.7L V-8 Engine

1 - DOWNSTREAM OXYGEN SENSOR
2 - FRAME RAIL
3 - CATALYTIC CONVERTER

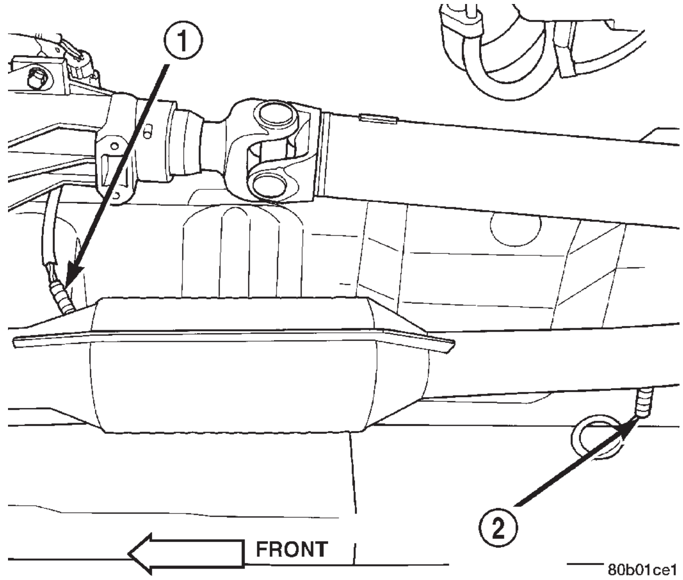


Fig. 46 Pre-Catalyst/Post-Catalyst Oxygen Sensor Locations—Except 4.7L V-8 Engine

1 - PRE-CATALYST OXYGEN SENSOR
2 - POST-CATALYST OXYGEN SENSOR

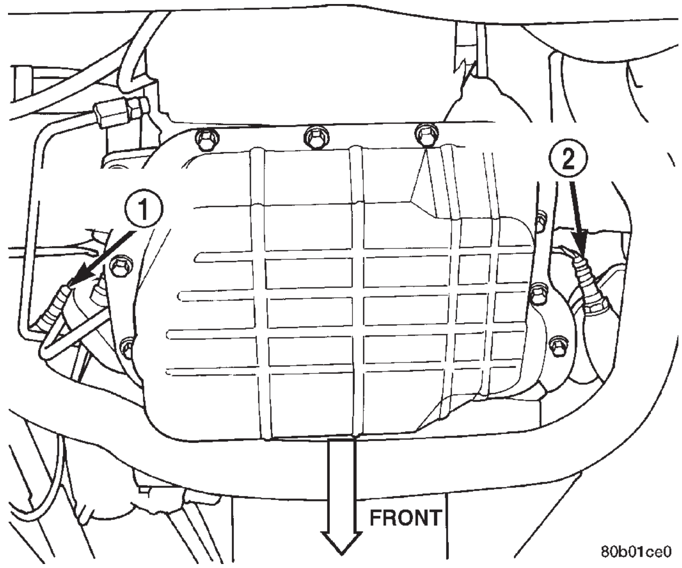


Fig. 47 Left/Right Oxygen Sensor Locations—Except 4.7L V-8 Engine

1 - LEFT OXYGEN SENSOR
2 - RIGHT OXYGEN SENSOR

WARNING: THE EXHAUST MANIFOLD, EXHAUST PIPES AND CATALYTIC CONVERTER BECOME VERY HOT DURING ENGINE OPERATION. ALLOW ENGINE TO COOL BEFORE REMOVING OXYGEN SENSOR.

O2 SENSOR (Continued)

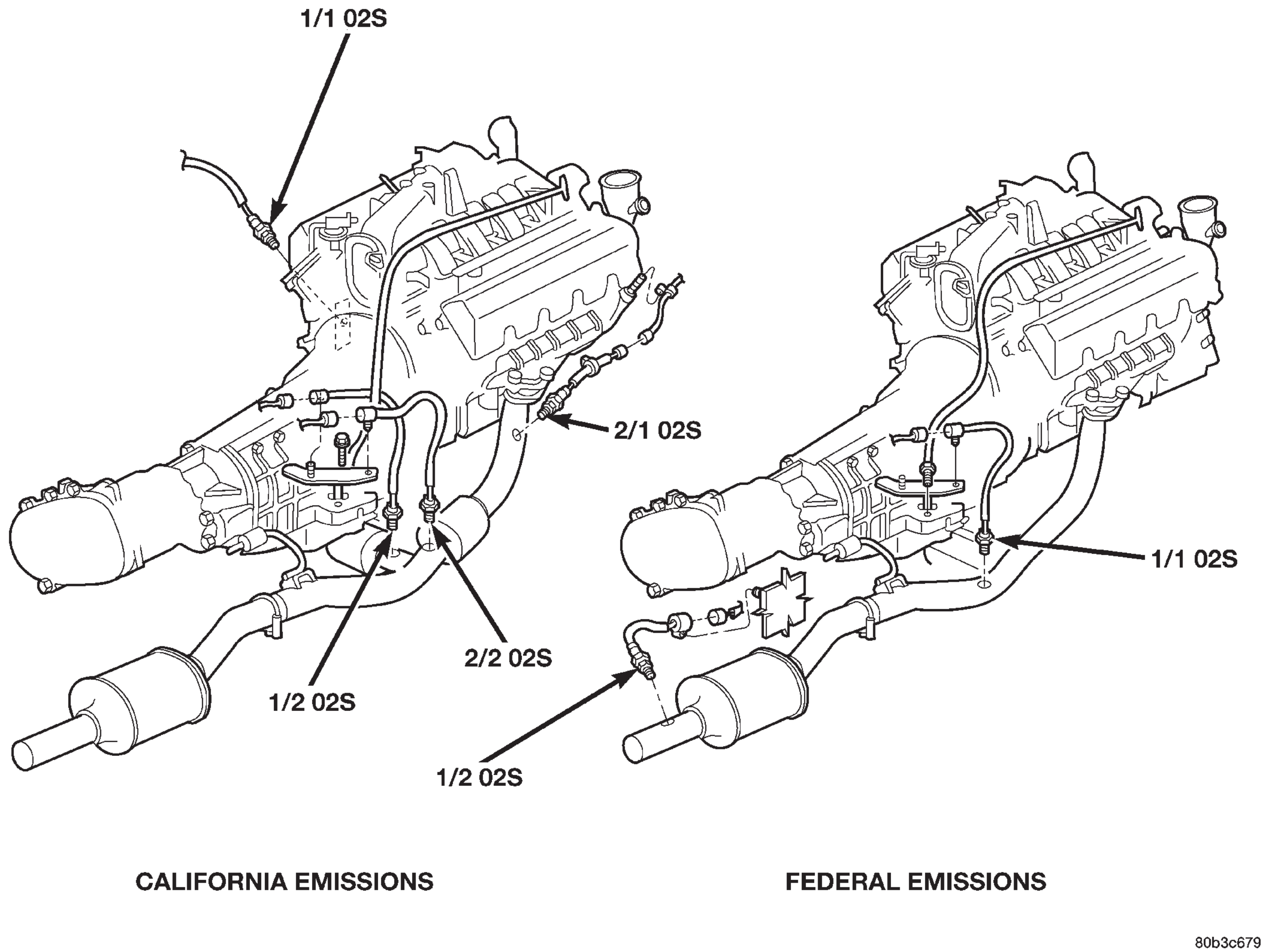


Fig. 48 Oxygen Sensor Locations—4.7L V-8 Engine

(1) Raise and support the vehicle.

(2) Disconnect the wire connector from the O2S sensor.

CAUTION: When disconnecting the sensor electrical connector, do not pull directly on wire going into sensor.

(3) Remove the O2S sensor with an oxygen sensor removal and installation tool.

O2 SENSOR (Continued)

REMOVAL - 2.5L

Never apply any type of grease to the oxygen sensor electrical connector, or attempt any soldering of the sensor wiring harness. For sensor operation, it must have a comparison source of oxygen from outside the exhaust system. This fresh air is supplied to the sensor through its pigtail wiring harness.

The upstream O2S sensor is located in the exhaust downpipe. The downstream sensor is located near outlet end of catalytic converter. Refer to (Fig. 49) or (Fig. 50).

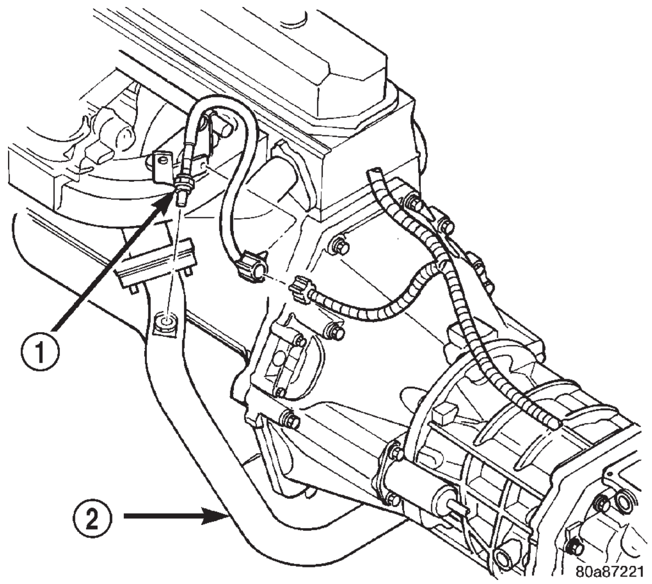


Fig. 49 Upstream Oxygen Sensor Location—2.5L Engine

1 - UPSTREAM OXYGEN SENSOR
2 - EXHAUST PIPE

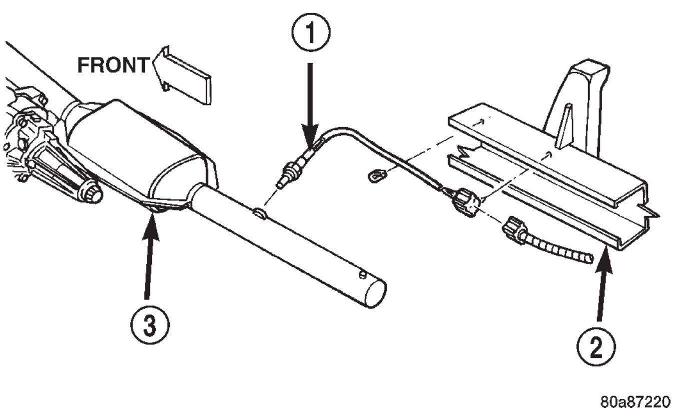


Fig. 50 Downtream Oxygen Sensor Location—2.5L Engine

1 - DOWNSTREAM OXYGEN SENSOR
2 - FRAME RAIL
3 - CATALYTIC CONVERTER

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 the vehicle.
(2) Disconnect the wire connector from the O2S sensor.

CAUTION: When disconnecting the sensor electrical connector, do not pull directly on wire going into sensor.

(3) Remove the O2S sensor with an oxygen sensor removal and installation tool.

INSTALLATION - EXCEPT 2.5L

Threads of new oxygen sensors are factory coated with anti-seize compound to aid in removal. **DO NOT add any additional anti-seize compound to the threads of a new oxygen sensor.**

(1) Install the O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.
(2) Connect the O2S sensor wire connector.
(3) Lower the vehicle.

INSTALLATION - 2.5L

Threads of new oxygen sensors are factory coated with anti-seize compound to aid in removal. **DO NOT add any additional anti-seize compound to the threads of a new oxygen sensor.**

(1) Install the O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.
(2) Connect the O2S sensor wire connector.
(3) Lower the 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.

THROTTLE BODY (Continued)

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 - 3.9L/5.2L/5.9L

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 the air duct at throttle body.

(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 51).

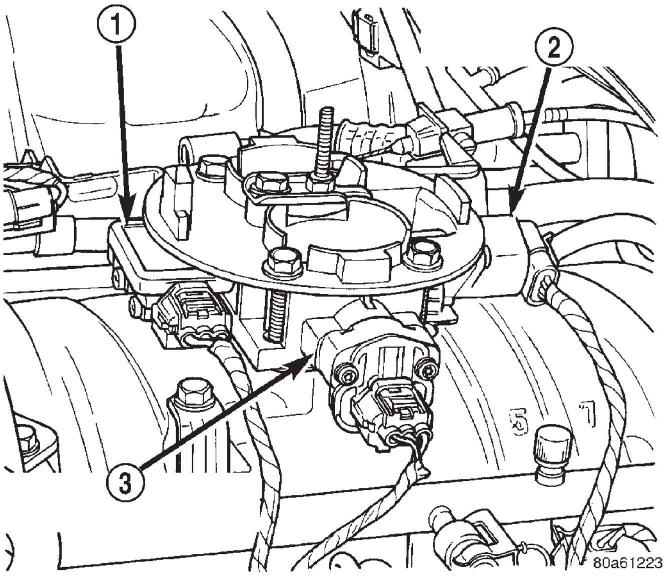


Fig. 51 Sensor Electrical Connectors—3.9/5.2/5.9L Engines—Typical

1 - MAP SENSOR
2 - IDLE AIR CONTROL MOTOR
3 - THROTTLE POSITION SENSOR

(3) Remove vacuum line at throttle body.

(4) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section of this group for additional information.

(5) Remove four throttle body mounting bolts (Fig. 52).

(6) Remove throttle body from intake manifold.

(7) Discard old throttle body-to-intake manifold gasket.

REMOVAL - 2.5L

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).

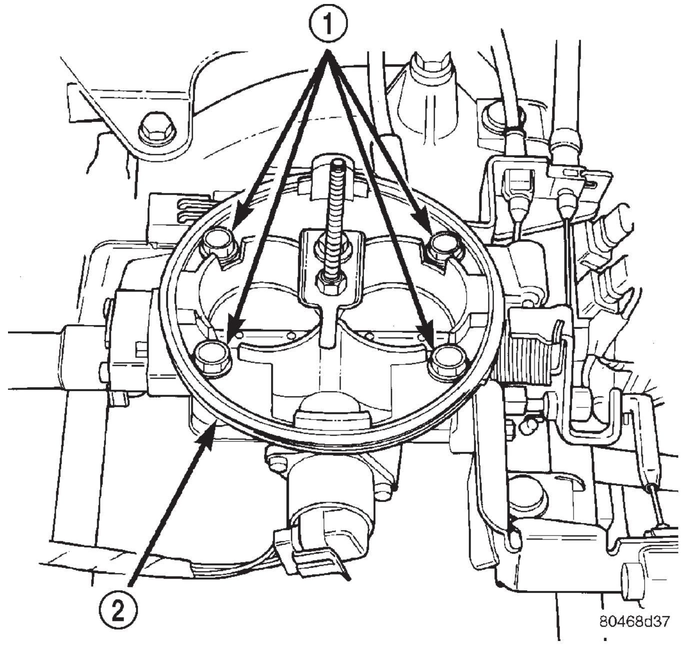


Fig. 52 Throttle

1 - THROTTLE BODY MOUNTING BOLTS (4)
2 - THROTTLE BODY

(1) Remove air duct at throttle body.

(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 53).

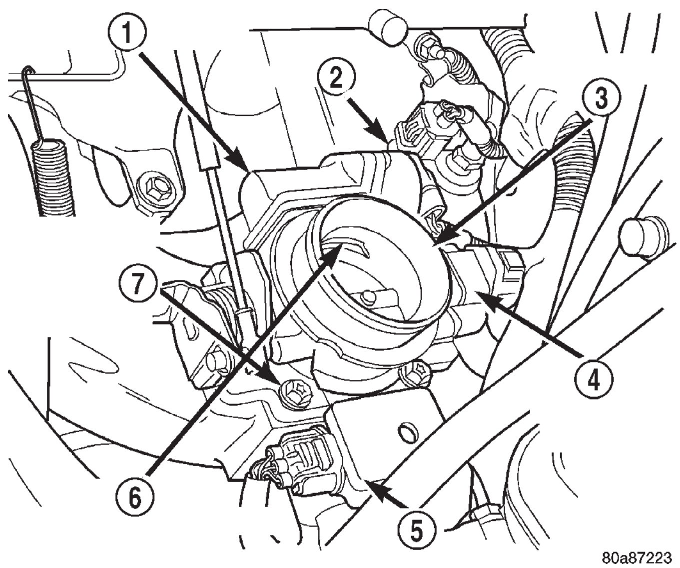


Fig. 53 Throttle Body—2.5L Engine

1 - IDLE AIR CONTROL MOTOR
2 - IAT SENSOR
3 - THROTTLE BODY
4 - THROTTLE POSITION SENSOR
5 - MAP SENSOR
6 - IDLE AIR CONTROL PASSAGE INLET
7 - THROTTLE BODY MOUNTING BOLTS (4)

THROTTLE BODY (Continued)

(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 throttle body from intake manifold.

(5) Discard old throttle body-to-intake manifold gasket.

REMOVAL - 4.7L

(1) Remove the air duct and air resonator box at throttle body.

(2) Disconnect throttle body electrical connectors at IAC motor and TPS (Fig. 54).

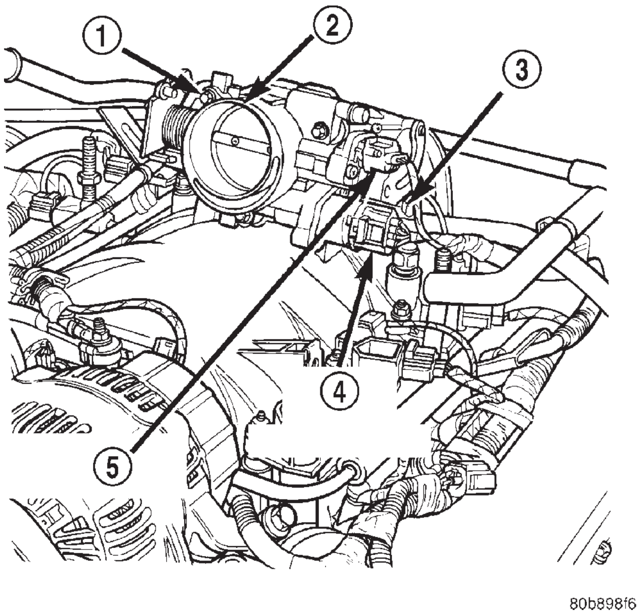


Fig. 54 Throttle Body, Sensors and Electrical Connectors—4.7L V-8 Engine

1 - MOUNTING BOLTS (3)
2 - THROTTLE BODY
3 - IAT SENSOR CONNECTOR
4 - IAC MOTOR CONNECTOR
5 - TPS CONNECTOR

(3) Remove vacuum line at throttle body.

(4) Remove all control cables from throttle body (lever) arm. Refer to Accelerator Pedal and Throttle Cable.

(5) Remove three throttle body mounting bolts (Fig. 54).

(6) Remove throttle body from intake manifold.

INSTALLATION - 3.9L/5.2L/5.9L

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) Clean the mating surfaces of the throttle body and the intake manifold.

(2) Install new throttle body-to-intake manifold gasket.

(3) Install throttle body to intake manifold.

(4) Install four mounting bolts. Tighten bolts to 23 N·m (200 in. lbs.) torque.

(5) Install control cables.

(6) Install vacuum line to throttle body.

(7) Install electrical connectors.

(8) Install air duct at throttle body.

INSTALLATION - 2.5L

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) Clean the mating surfaces of the throttle body and the intake manifold.

(2) Install new throttle body-to-intake manifold gasket.

(3) Install throttle body to intake manifold.

(4) Install four mounting bolts. Tighten bolts to 11 N·m (100 in. lbs.) torque.

(5) Install control cables.

(6) Install electrical connectors.

(7) Install air duct at throttle body.

INSTALLATION - 4.7L

(1) Clean throttle body-to-intake manifold o-ring.

(2) Clean mating surfaces of throttle body and intake manifold.

(3) Install throttle body to intake manifold by positioning throttle body to manifold alignment pins.

(4) Install three mounting bolts. Tighten bolts to 12 N·m (105 in. lbs.) torque.

(5) Install control cables.

(6) Install vacuum line to throttle body.

(7) Install electrical connectors.

(8) Install air duct/air box at throttle body.

THROTTLE CONTROL CABLE

REMOVAL - EXCEPT 4.7L

CAUTION: Be careful not to damage or kink cable core wire (within cable sheathing) while servicing accelerator pedal or cables.

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 22). Plastic cable retainer snaps into pedal arm.

(2) Remove cable core wire at pedal arm.

(3) From inside vehicle, pinch both sides of cable housing retainer at dash panel (Fig. 22). Remove cable housing from dash panel and pull into engine compartment.

(4) Remove air tube at top of throttle body.

(5) **3.9/5.2/5.9L Engines:**

(a) Operate throttle body lever (by hand) to full open throttle position. Slip cable end rearward from pin on throttle lever (Fig. 55).

(b) Remove cable housing at throttle body mounting bracket by pressing forward on release tab with a small screwdriver (Fig. 56). **To prevent cable housing breakage, press on tab only enough to release cable from bracket.** Lift cable housing straight up from bracket while pressing on release tab. Remove cable housing.

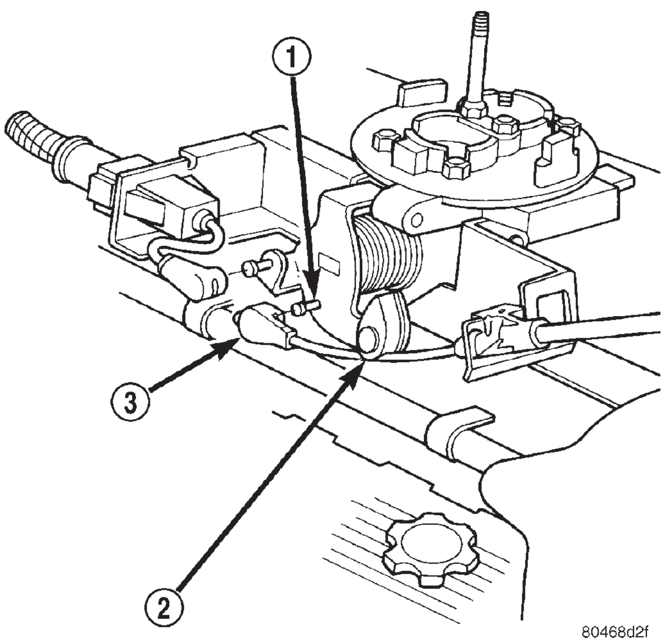


Fig. 55 Throttle Cable at Throttle

1 - THROTTLE LEVER PIN
2 - CAM (V-8 ENGINE ONLY)
3 - THROTTLE CABLE END

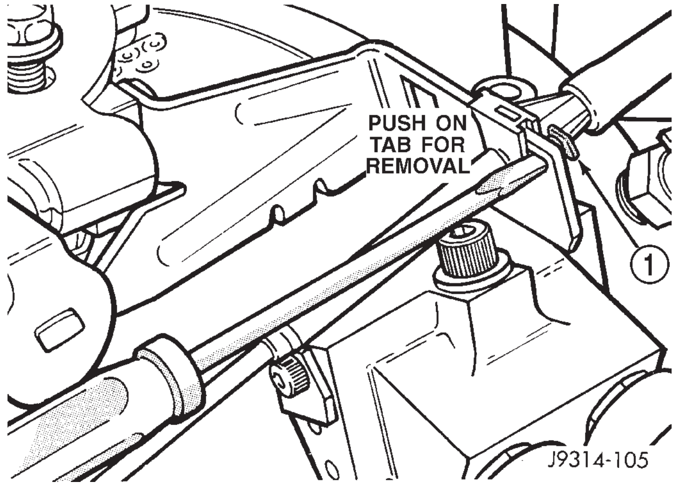


Fig. 56 Cable Release Tab—Typical V-6/V8 Engine

1 - TAB

(6) **2.5L Engine:**

(a) Remove cable ball socket at throttle body linkage (snaps off toward rear of vehicle).

(b) Pinch sides of cable housing clips at cable mounting bracket (Fig. 57) to release housing from bracket.

(c) Unsnap cable housing at valve cover retainer.

(d) Remove cable from vehicle.

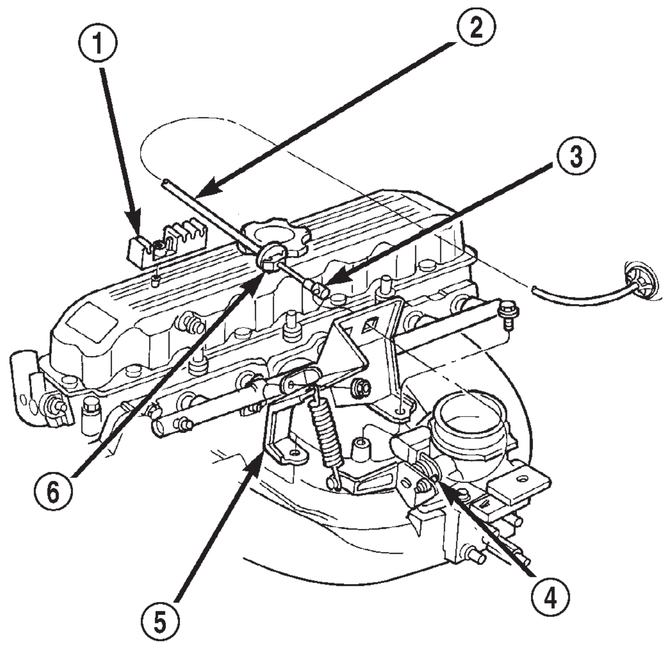


Fig. 57 Throttle Cable—2.5L Engine

1 - VALVE COVER RETAINER
2 - CABLE AND HOUSING
3 - BALL SOCKET
4 - THROTTLE LINKAGE BAIL
5 - MOUNTING BRACKET
6 - CABLE HOUSING CLIPS

THROTTLE CONTROL CABLE (Continued)

(7) Remove cable from vehicle.

REMOVAL - 4.7L

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing 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 pedal arm (Fig. 22). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove cable core wire at pedal arm.

(3) From inside vehicle, remove clip holding cable to dashpanel (Fig. 22).

(4) Remove air box at throttle body.

(5) Unsnap cable from dashpanel routing clip.

(6) Remove cable housing from dash panel and pull into engine compartment.

(7) Using finger pressure only, disconnect accelerator cable connector at throttle body bellcrank pin by pushing connector off bellcrank pin towards front of vehicle (Fig. 58). **DO NOT try to pull connector off perpendicular to the bellcrank pin. Connector will be broken.**

(8) Lift accelerator cable from top of cable cam (Fig. 58).

(9) Press tab (Fig. 59) to release plastic cable mount from bracket. **Press on tab only enough to release cable from bracket. If tab is pressed too much, it will be broken.** Slide plastic mount (Fig. 59) towards passenger side of vehicle to remove cable from bracket.

(10) Remove throttle cable from vehicle.

INSTALLATION - EXCEPT 4.7L

CAUTION: Be careful not to damage or kink cable core wire (within cable sheathing) while servicing accelerator pedal or cables.

(1) **3.9/5.2/5.9L Engines:**

(a) Snap cable end onto lever pin (Fig. 55). On models with V-8 engines, be sure cable is routed **under** plastic cam (Fig. 55).

(b) Connect cable to throttle body mounting bracket (push down and lock).

(2) **2.5L Engine:**

(a) Slip cable housing through hole in mounting bracket and snap cable into bracket.

(b) Attach ball socket at throttle body linkage (snaps on).

(c) Attach cable housing at valve cover retainer (snaps on).

(3) Install remaining cable housing end into dash panel opening (snaps into position).

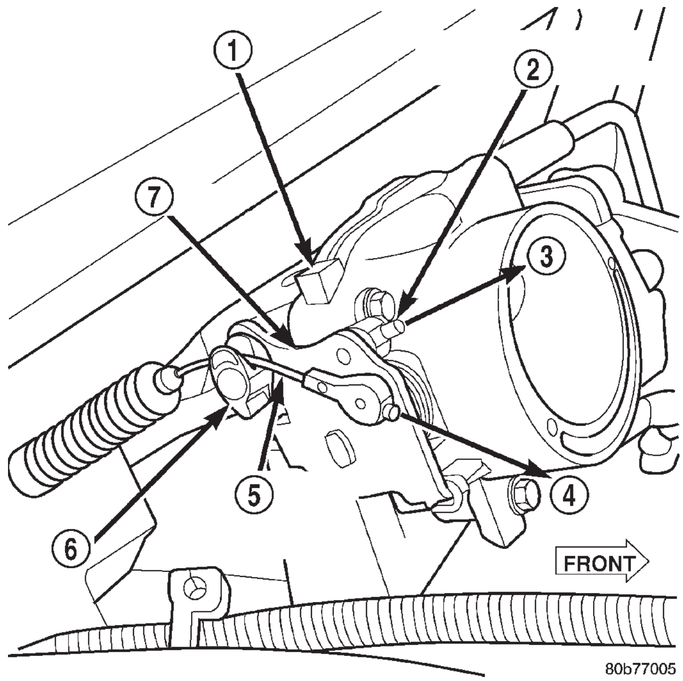


Fig. 58 Accelerator Cable at Bell Crank—4.7L V-8 Engine

1 - THROTTLE BODY
2 - SPEED CONTROL CABLE CONNECTOR
3 - OFF
4 - OFF
5 - ACCELERATOR CABLE CONNECTOR
6 - CABLE CAM
7 - BELLCRANK

(4) Install ball end of cable wire through hole in pedal arm. Install plastic cable retainer. The plastic retainer is snapped into pedal arm. When installing retainer to accelerator pedal arm, note index tab on pedal arm (Fig. 23). Align index slot (Fig. 57) on plastic retainer to this index tab.

(5) Operate and test throttle before starting engine.

(6) Install air tube to throttle body.

INSTALLATION - 4.7L

(1) Slide accelerator cable plastic mount into bracket. Continue sliding until tab (Fig. 59) is aligned to hole in mounting bracket.

(2) Route accelerator cable over top of cable cam.

(3) Connect cable end to throttle body bellcrank pin (snaps on rearward).

(4) Slide rubber grommet away from plastic cable housing.

(5) Install rubber grommet into dash panel until seated.

(6) Push cable housing into rubber grommet and through opening in dash panel.

THROTTLE CONTROL CABLE (Continued)

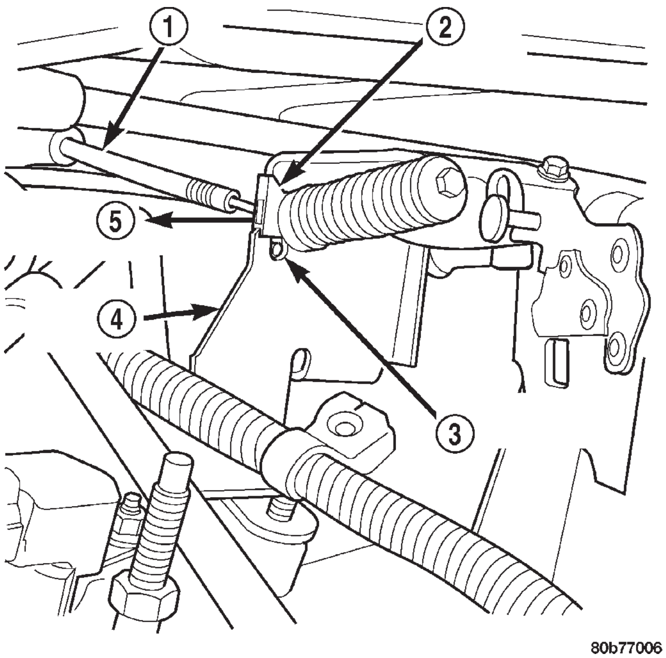


Fig. 59 Accelerator Cable Release Tab—4.7L V-8 Engine

1 - ACCELERATOR CABLE
2 - PLASTIC CABLE MOUNT
3 - PRESS TAB FOR REMOVAL
4 - CABLE BRACKET
5 - SLIDE FOR REMOVAL

(7) From inside vehicle, install clip holding cable to dashpanel (Fig. 22).

(8) From inside vehicle, slide throttle cable core wire into opening in top of pedal arm.

(9) Push cable retainer (clip) into pedal arm opening until it snaps in place.

(10) Snap cable into dashpanel routing clip.

(11) Install air box to throttle body.

(12) 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 - 3.9L/5.2L/5.9L

The TPS is located on side of throttle body.

(1) Remove air duct at throttle body.

(2) Disconnect TPS electrical connector.

(3) Remove two TPS mounting bolts (Fig. 60).

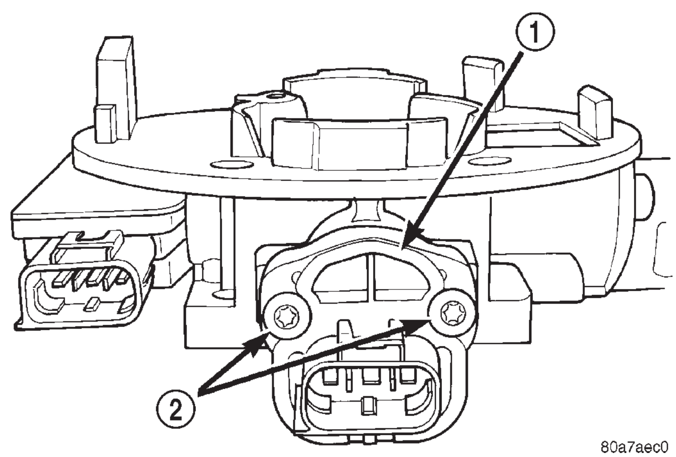


Fig. 60 TPS Mounting Bolts—3.9/5.2/5.9L Engines

1 - THROTTLE POSITION SENSOR
2 - MOUNTING SCREWS

(4) Remove TPS from throttle body.

REMOVAL - 4.7

The TPS is located on the throttle body.

THROTTLE POSITION SENSOR (Continued)

(1) Remove air duct and air resonator box at throttle body.
(2) Disconnect TPS electrical connector (Fig. 54).
(3) Remove two TPS mounting bolts (screws) (Fig. 61).

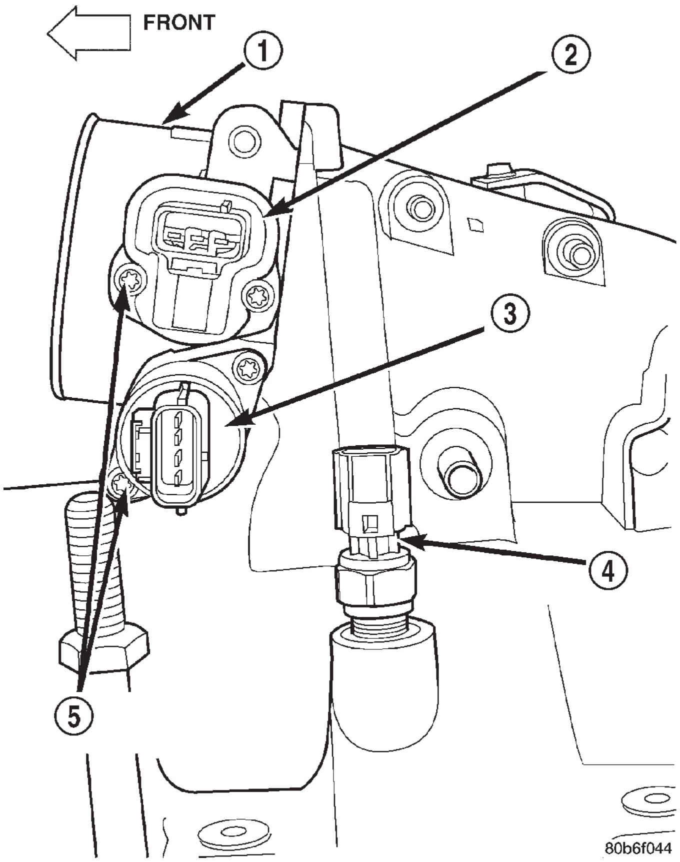


Fig. 61 TPS Mounting Bolts—4.7L V–8

1 - THROTTLE BODY
2 - TPS
3 - IAC MOTOR
4 - IAT SENSOR
5 - MOUNTING SCREWS

(4) Remove TPS from throttle body.

REMOVAL - 2.5L

The TPS is mounted to the throttle body (Fig. 53).
(1) Remove air duct at throttle body.
(2) Disconnect TPS electrical connector.
(3) Remove TPS mounting screws (Fig. 62).
(4) Remove TPS.

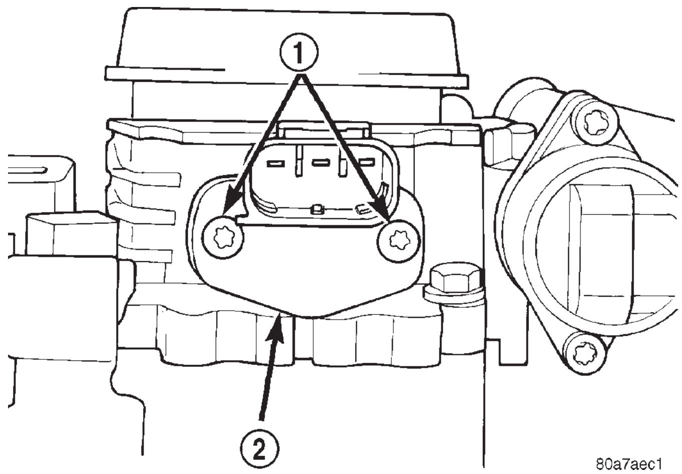


Fig. 62 TPS Mounting Screws—2.5L Engine

1 - MOUNTING SCREWS
2 - TPS

INSTALLATION - 3.9L/5.2L/5.9L

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 63). The TPS must be installed so that it can be rotated a few degrees. If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs. The TPS will be under slight tension when rotated.

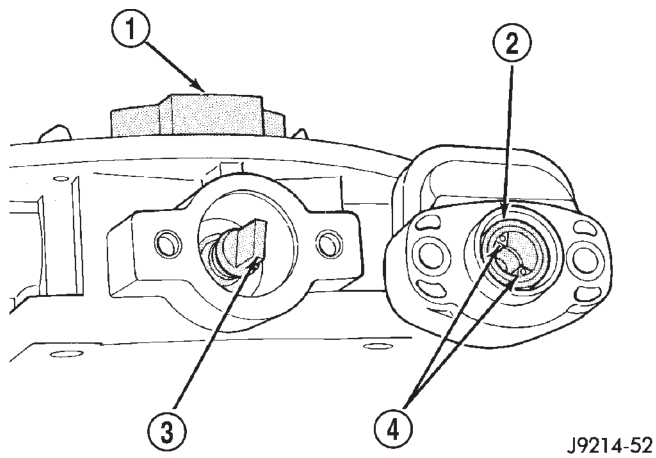


Fig. 63 Installation—3.9/5.2/5.9L Engines—Typical

1 - THROTTLE BODY
2 - THROTTLE POSITION SENSOR
3 - THROTTLE SHAFT
4 - SOCKET LOCATING TANGS

(1) Install the TPS and two retaining bolts.
(2) Tighten bolts to 7 N·m (60 in. lbs.) torque.
(3) Manually operate the throttle control lever by hand to check for any binding of the TPS.
(4) Connect TPS electrical connector to TPS.
(5) Install air duct at throttle body.

THROTTLE POSITION SENSOR (Continued)

INSTALLATION - 4.7L

The throttle shaft end of throttle body slides into a socket in TPS (Fig. 64). The TPS must be installed so that it can be rotated a few degrees. If sensor will not rotate, install sensor with throttle shaft on other side of socket tangs. The TPS will be under slight tension when rotated.

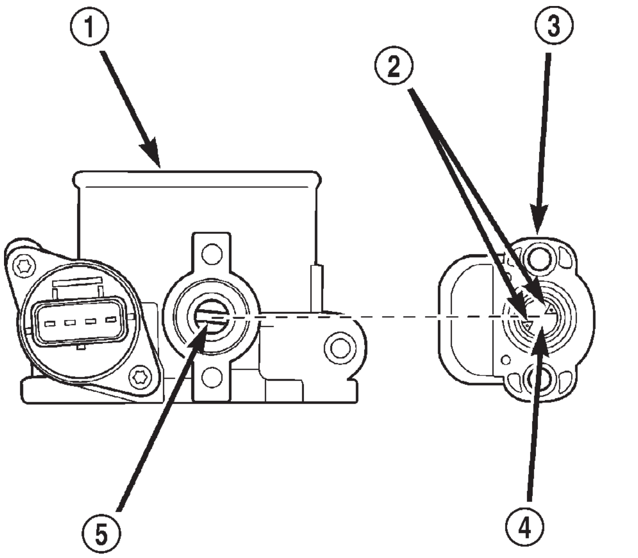


Fig. 64 TPS Installation—4.7L

1 - THROTTLE BODY
2 - LOCATING TANGS
3 - THROTTLE POSITION SENSOR
4 - SOCKET
5 - THROTTLE SHAFT

(1) Install TPS and two retaining bolts.
(2) Tighten bolts to 7 N·m (60 in. lbs.) torque.
(3) Manually operate throttle control lever by hand to check for any binding of TPS.
(4) Connect TPS electrical connector to TPS.
(5) Install air duct/air box to throttle body.

INSTALLATION - 2.5L

The TPS is mounted to the throttle body (Fig. 53).

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 65). The TPS must be installed so that it can be rotated a few degrees. (If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs). The TPS will be under slight tension when rotated.

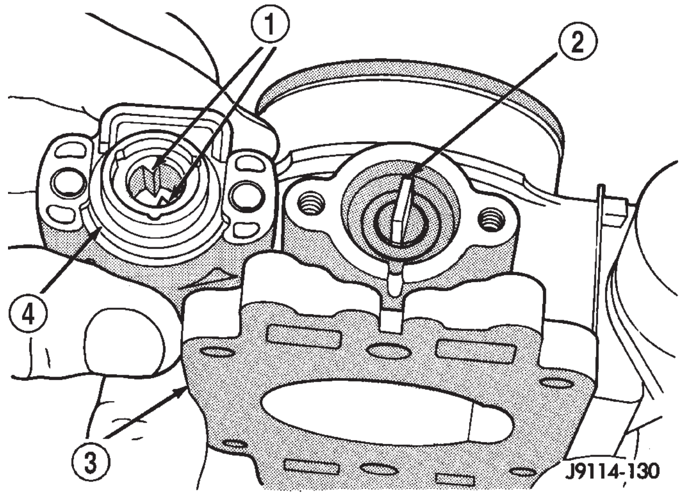


Fig. 65 Throttle Position Sensor Installation—2.5L Engine

1 - TANGS
2 - THROTTLE SHAFT
3 - THROTTLE BODY
4 - TPS

(1) Install the TPS and retaining screws.
(2) Tighten screws to 7 N·m (60 in. lbs.) torque.
(3) Connect TPS electrical connector to TPS.
(4) Manually operate the throttle (by hand) to check for any TPS binding before starting the engine.
(5) Install air duct at throttle body.

STEERING

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STEERING

DESCRIPTION

Power steering systems consist of:

- Steering column
- Rack and pinion steering gear
- Belt driven hydraulic steering pump
- Pump pressure and return hoses
- Oil Cooler

OPERATION

The steering column shaft is attached to the gear pinion. The rotation of the pinion moves the gear rack from side-to-side. This lateral action of the rack pushes and pulls the tie rods to change the direction of the front wheels.

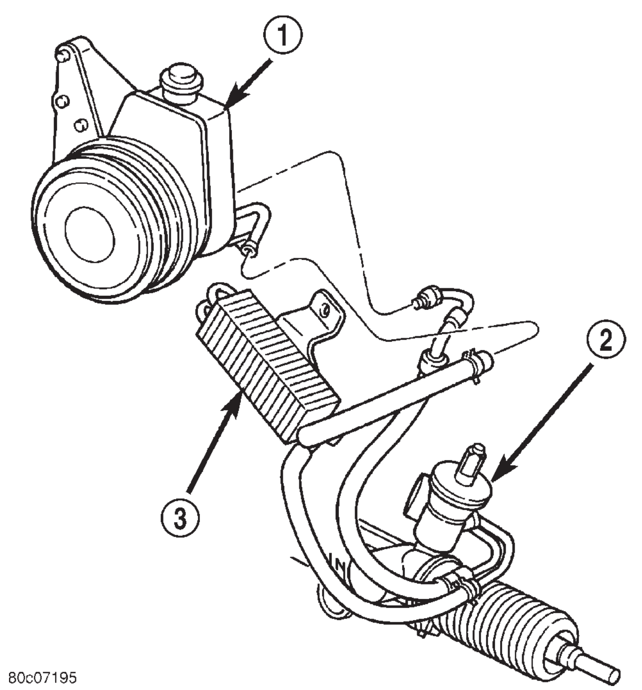

Fig. 1 Steering Pump, Gear And Oil Cooler - 5.2L & 5.9L

1 - HYDRAULIC PUMP
2 - RACK AND PINION GEAR
3 - OIL COOLER

Power assist is provided by an engine mounted hydraulic pump, (Fig. 1) and (Fig. 2) the pump supplies hydraulic fluid pressure to the steering gear. Some vehicles are equipped with an oil cooler.

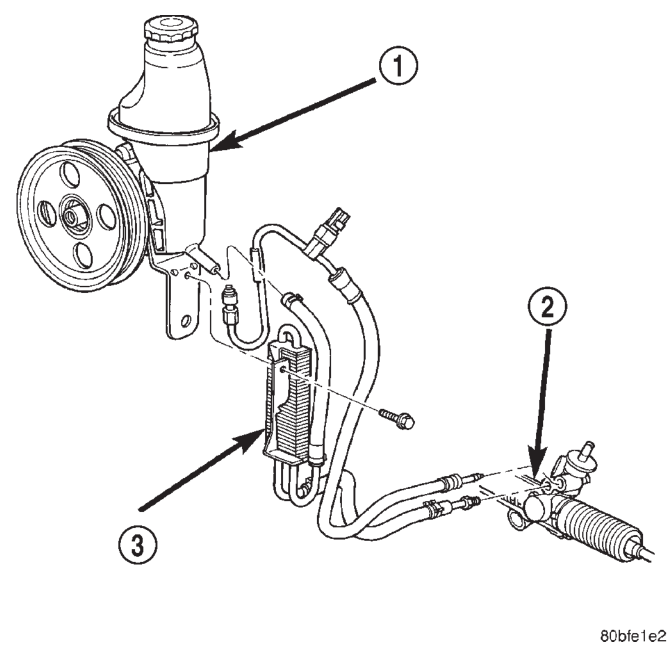

Fig. 2 Steering Pump, Gear And Oil Cooler - 4.7L

1 - HYDRAULIC PUMP
2 - RACK AND PINION GEAR
3 - OIL COOLER

STEERING (Continued)

DIAGNOSIS AND TESTING - POWER STEERING SYSTEM

STEERING NOISE

There is some noise in all power steering systems. One of the most common is a hissing sound evident at a standstill parking. Or when the steering wheel is at the end of it's travel. Hiss is a high frequency noise similar to that of a water tap being closed slowly. The noise is present in all valves that have a high velocity fluid passing through an orifice. There is no relationship between this noise and steering performance.

CONDITION	POSSIBLE CAUSES	CORRECTION
OBJECTIONAL HISS OR WHISTLE	1. Steering intermediate shaft to dash panel seal.	1. Check and repair seal at dash panel.
	2. Noisy valve in power steering gear.	2. Replace steering gear.
RATTLE OR CLUNK	1. Gear mounting bolts loose.	1. Tighten bolts to specification.
	2. Loose or damaged suspension components.	2. Inspect and repair suspension.
	3. Internal gear noise.	3. Replace steering gear.
	4. Pressure hose in contact with other components.	4. Reposition hose.
	5. Loose or damaged intermediate shaft or column.	5. Inspect and repair or replace.
CHIRP OR SQUEAL	1. Loose belt.	1. Adjust or replace.
WHINE OR GROWL	1. Low fluid level.	1. Fill to proper level.
	2. Pressure hose in contact with other components.	2. Reposition hose.
	3. Internal pump noise.	3. Replace pump.
SUCKING AIR SOUND	1. Loose return line clamp.	1. Replace clamp.
	2. O-ring missing or damaged on hose fitting.	2. Replace o-ring.
	3. Low fluid level.	3. Fill to proper level.
	4. Air leak between pump and reservoir.	4. Repair as necessary.
	5. Reservoir cap not installed correctly.	5. Install reservoir cap correctly.
SCRUBBING OR KNOCKING	1. Wrong tire size.	1. Verify tire size.
	2. Wrong gear.	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 components (ball joints/tie rod ends).	3 Inspect and repair as necessary.
	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.	7. Replace gear.

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. Low pump pressure.	4. Pressure test and repair as necessary.
	5. Internal gear leak.	5. Replace gear.
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 suspension compnents.
	4. High friction in steering gear.	4. Replace gear.

LOOSE STEERING AND VEHICLE LEAD

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE PLAY IN STEERING WHEEL	1. Worn or loose suspension or steering components.	1. Inspect and repair as necessary.
	2. Worn or loose wheel bearings.	2. Inspect and repair or adjust bearings.
	3. Steering gear mounting.	3. Tighten gear mounting bolts to specification.
	4. Gear out of adjustment.	4. Replace gear.
	5. Worn or loose steering coupler.	5. Inspect and replace as necessary.
VEHICLE PULLS OR LEADS TO ONE SIDE.	1. Tire Pressure.	1. Adjust tire pressure.
	2. Radial tire lead.	2. Rotate tires.
	3. Brakes dragging.	3. Repair as necessary.
	4. Wheel alignment.	4. Align front end.

STEERING (Continued)

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 kit 6815 (Fig. 3) and (Fig. 4) Adapter Kit 6893.

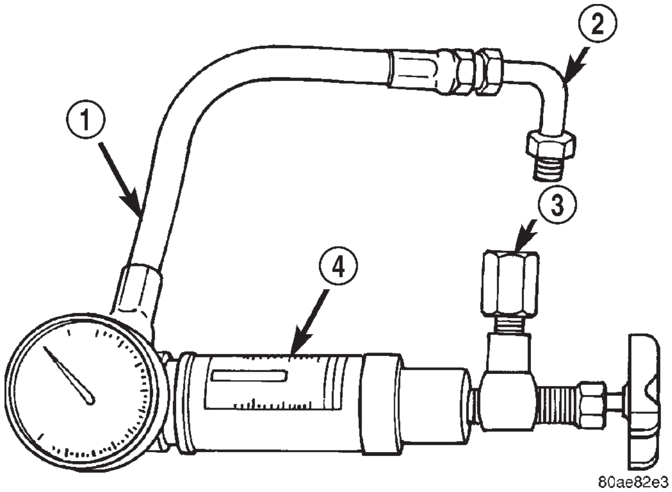

Fig. 3 Analyzer With Tube and Adapter For 5.2L & 5.9L

1 - GAUGE HOSE
2 - TUBE
3 - ADAPTER FITTINGS
4 - ANALYZER

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 6844.

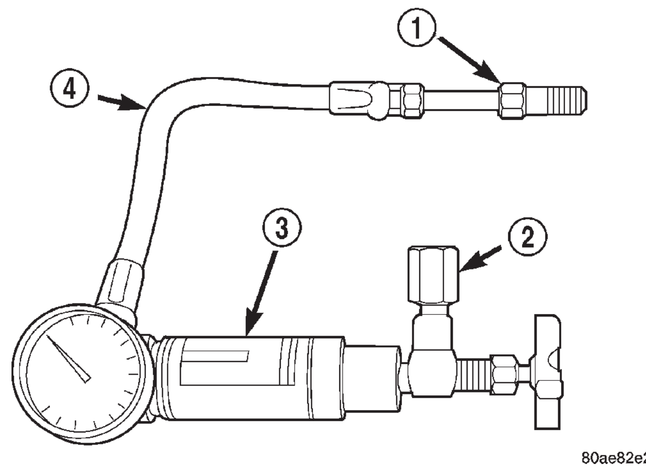

Fig. 4 Analyzer With Tube and Adapter For 4.7L

1 - TUBE
2 - ADAPTER FITTINGS
3 - ANALYZER
4 - GAUGE HOSE

(3) Connect Adapter 6826 to Power Steering Analyzer test valve end.

(4) Disconnect the high pressure hose from the power steering pump.

(5) Connect the tube to the pump hose fitting.

(6) Connect the power steering hose from the steering gear to the adapter.

(7) Open the test valve completely.

(8) Start engine and let idle long enough to circulate power steering fluid through flow/pressure test gauge and to get air out of the fluid. Then shut off engine.

(9) Check fluid level, add fluid as necessary. Start engine again and let idle.

(10) Gauge should read below 862 kPa (125 psi), if above, inspect the hoses for restrictions and repair as necessary. The initial pressure reading should be in the range of 345-552 kPa (50-80 psi).

(11) Increase the engine speed to 1500 RPM and read the flow meter. If the flow rate (GPM) is below specification, (refer to pump specification chart for GPM) the pump should be replaced.

STEERING (Continued)

CAUTION: The following test procedure involves testing maximum pump pressure output and flow control valve operation. Do not leave valve closed for more than three seconds as the pump could be damaged.

(12) Close valve fully three times and record highest pressure indicated each time. **All three readings must be above specifications and within 345 kPa (50 psi) of each other.**

- Pressures above specifications but not within 345 kPa (50 psi) of each other, replace pump.
- Pressures within 345 kPa (50 psi) of each other but below specifications, replace pump.

(13) Open the test valve and turn the steering wheel to the extreme left and right positions three times against the stops. Record the highest pressure reading at each position. Compare readings to the pump specifications chart. If pressures readings are not within 50 psi of each other, the gear is leaking internally and must be replaced.

CAUTION: Do not force the pump to operate against the stops for more than 2 to 3 seconds at a time because, pump damage will result.

PUMP SPECIFICATION

ENGINE	RELIEF PRESSURE ± 50	FLOW RATE (GPM) AT 1500 RPM
5.2L	10342 kPa (1500 psi)	2.4 - 2.8
4.7L	10342 kPa (1450 psi)	2.4 - 2.8
5.9L	10342 kPa (1500 psi)	2.4 - 2.8

COLUMN

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COLUMN

DESCRIPTION

The tilt and standard column (Fig. 1) has been designed to be serviced as an assembly; less wiring, switches, shrouds, steering wheel, etc. Most steering column components can be serviced without removing the steering column from the vehicle.

To service the steering wheel, switches or airbag, refer to Restraints and follow all WARNINGS and CAUTIONS.

NOTE: When servicing the steering wheel after removing the old bolt a new bolt must be used when installing.

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.

CAUTION: Do not hammer on steering column shaft or shift tube. This may cause damage to the shaft, shift tube or bearing.

CAUTION: Do not attempt to remove or modify the park lock slider or link.

CAUTION: Do not attempt to remove the pivot pins to disassemble the tilting mechanism. Do not remove shaft lock plate or plate retainer. This will damage the column.

DIAGNOSIS AND TESTING - STEERING COLUMN

If the vehicle is involved in a front end collision/the air bag has deployed the column must be inspected. This inspection will determine if the Column has collapsed. Inspect the column mounting capsules visually and manually push and pull them to check separation or movement. (Fig. 1)

COLUMN (Continued)

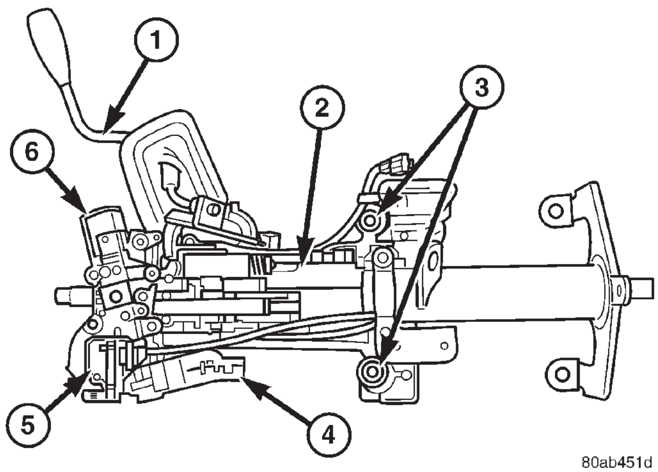

Fig. 1 STEERING COLUMN

1 - Shift Lever
2 - Steering Column
3 - Mounting Crash Capsules
4 - Igntion Switch
5 - Tilt Lever/Cable Assembly
6 - Key Cylinder Housing

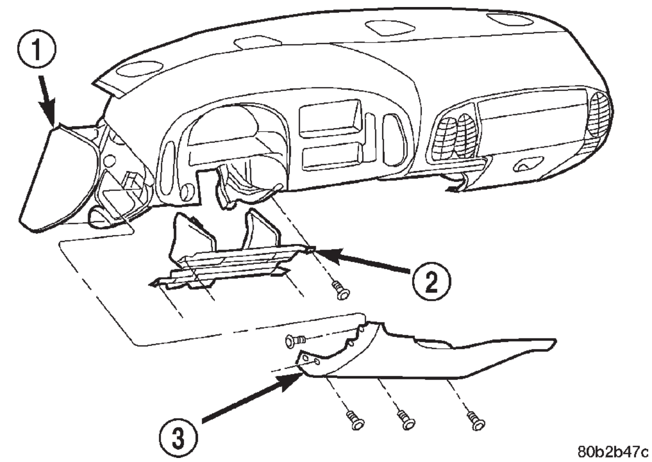

Fig. 2 LOWER COLUMN COVER/KNEE BLOCKER

1 - FUSE ACCESS PANEL
2 - KNEE BLOCKER
3 - LOWER COLUMN COVER

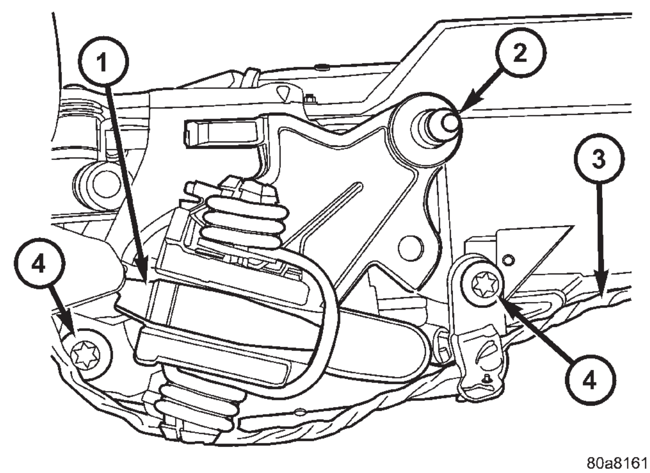

Fig. 3 SHIFT CABLE CONNECTOR

1 - Shift lever
2 - Cable Connection
3 - Overdrive Electrical Wiring
4 - Mounting Screws

REMOVAL

WARNING: BEFORE SERVICING THE STEERING COLUMN THE AIRBAG SYSTEM MUST BE DISARMED. REFER TO ELECTRICAL RESTRAINT SYSTEM FOR SERVICE PROCEDURES. FAILURE TO DO SO MAY RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY.

(1) Position front wheels straight ahead.

(2) Remove the negative (ground) cable from the battery.

(3) Remove the airbag,(Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

(4) Remove the steering wheel with an appropriate puller.

CAUTION: Ensure the puller bolts are fully engaged into the steering wheel and not into the clockspring, before attempting to remove the wheel. Failure to do so may damage the steering wheel/clockspring.

(5) Remove the steering column opening cover and knee blocker. (Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL). (Fig. 2).

(6) Remove tilt lever handle (if equipped) from column.

(7) Remove the lower and upper shrouds.

(8) Disconnect the shift cable by unsnapping the shift cable clip from the shift lever and remove from the cable bracket. (Fig. 3)

(9) Remove the turn signal multi-function switch connector.

(10) Remove remaining electrical connections from the column switches.

(11) Remove upper steering shaft coupler bolt and slide the shaft down (Fig. 4).

(12) Remove steering column mounting nuts (Fig. 5).

(13) Remove column from vehicle.

(14) Remove clockspring, switches and key cylinder, (Fig. 6)(Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL) & (Refer to 19 - STEERING/COLUMN/LOCK CYLINDER HOUSING - REMOVAL).

COLUMN (Continued)

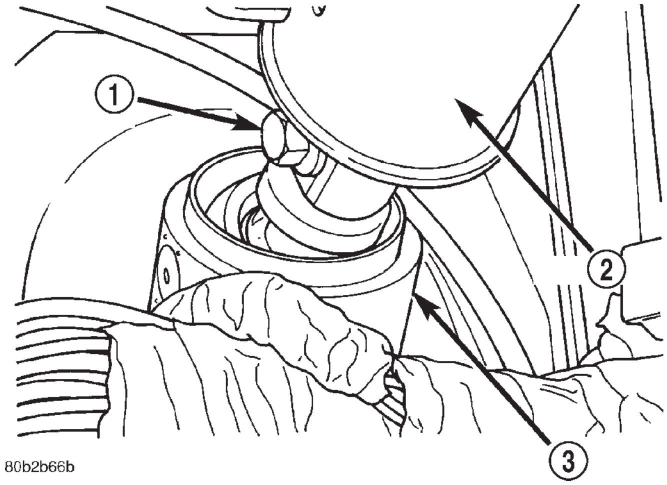

Fig. 4 Steering Coupler

1 - COUPLER BOLT
2 - COLUMN
3 - COUPLER

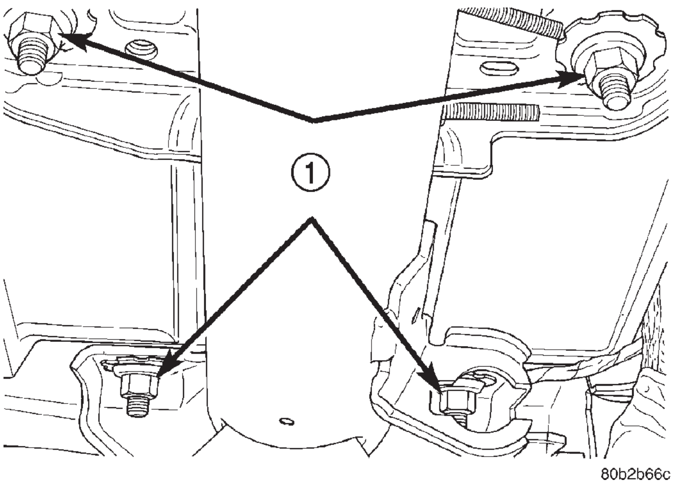

Fig. 5 (TYPICAL) MOUNTING NUTS

1 - COLUMN MOUNTING NUTS

CAUTION: Failure to follow Restraints procedure for clockspring removal, may damage the clockspring plastic latches.

INSTALLATION

WARNING: BEFORE SERVICING THE STEERING COLUMN THE AIRBAG SYSTEM MUST BE DISARMED. REFER TO ELECTRICAL RESTRAINT SYSTEM FOR SERVICE PROCEDURES. FAILURE TO DO SO MAY RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY.

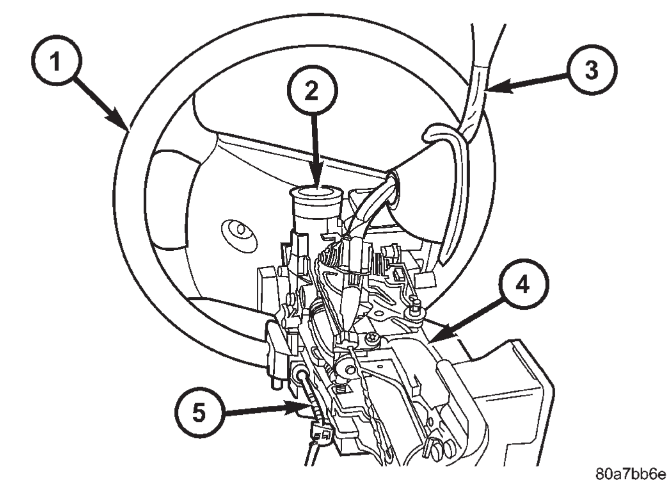

Fig. 6 STEERING COLUMN

1 - Steering Wheel
2 - Key Cylinder
3 - Gear Shift Lever
4 - Steering Column
5 - Tilt Lever Cable

CAUTION: All fasteners must be torqued to specification to ensure proper operation of the steering column.

(1) Install switches, clockspring and key cylinder-,(Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - INSTALLATION) & (Refer to 19 - STEERING/COLUMN/LOCK CYLINDER HOUSING - INSTALLATION).

(2) Position the column to the panel bracket and attaching studs. Install, but **loose assemble** the mounting nuts.

(3) Firmly slide steering column upward against the studs in dash panel and hand tighten the nuts.

(4) Install steering shaft coupler on the steering shaft and install a **new** bolt.

NOTE: Torque the upper left nut first then the lower right nut. Then torque the lower left nut then the upper right nut.

(5) Tighten column mounting nuts to 28 N·m (250 in. lbs.).

CAUTION: Ensure that the shift lever is in the PARK position and snap the shift cable adjustment clip in place.

(6) Install shift cable.

(7) Connect the multi-function switch wiring and tighten to 12 N·m (105 in. lbs.).

(8) Install the wiring connections to the column switches.

(9) Install the lower and upper shrouds.

COLUMN (Continued)

(10) Install the tilt lever handle (if equipped).

(11) Install the knee blocker and steering column opening cover,(Refer to 23 - BODY/INSTRUMENT PANEL - INSTALLATION).

(12) Install steering wheel by aligning the D flat on the wheel to the D flat on the column also use a **new** bolt and tighten the bolt to 61 N·m (45 ft. lbs.).

(13) Install airbag,(Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

(14) Connect the battery ground (negative) cable.

(15) Check operation of the automatic transmission shift linkage and adjust as necessary,(Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 46RE/GEAR SHIFT CABLE - ADJUSTMENTS).

(16) Test the operation of the horn, lights and any other functions that are steering column operated.

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Steering Column Steering Wheel Bolt	61	45	540
Steering Column Mounting Nuts	28	21	250
Steering Column Shaft Coupler Bolt/Nut	49	36	434
Steering Column Multi-function Switch Screws	12	9	105
Steering Column Shifter lever Screws	12	9	105

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.

OPERATION

Vehicles equipped with an automatic transmission and a steering column mounted shifter: an interlock device is located within the steering column. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is in the LOCKED or ACCESSORY position. If it is difficult to rotate the key to or from the LOCK or ACCESSORY position, the interlock device within the steering column may be defective. This device is not serviceable. If repair is necessary, the steering column assembly must be replaced. (Refer to 19 - STEERING/COLUMN - REMOVAL).

Vehicles equipped with a manual transmission and a floor mounted shifter: on certain models, a lever is located on the steering column behind the ignition key lock cylinder. The lever must be manually operated to allow rotation of the ignition key lock cylinder to the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lever mechanism may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. (Refer to 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).

IGNITION SWITCH (Continued)

DIAGNOSIS AND TESTING - IGNITION SWITCH

TEST AND REPAIR

If the key removal effort is excessive on a vehicle with a automatic transmission first adjust the shift linkage, (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 46RE/GEAR SHIFT CABLE - ADJUSTMENTS).

If the ignition switch effort is excessive remove the ignition key cylinder from the steering column. (Refer to 19 - STEERING/COLUMN/LOCK CYLINDER HOUSING - REMOVAL). Check the turning effort of the key cylinder. If the ignition key cylinder effort is excessive replace the key cylinder. If the ignition key cylinder operates properly look for the following conditions.

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 the negative (ground) cable from the battery.

(2) Disable the airbag, (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

(3) Remove the lower and upper shrouds.

(4) Remove key cylinder. (Refer to 19 - STEERING/COLUMN/LOCK CYLINDER HOUSING - REMOVAL).

(5) Disconnect the lower clockspring connectors.

(6) Remove the wire retainer from the tilt lever bracket.

(7) Remove the tilt lever mounting screws to gain access to the ignition switch mounting screws.

(8) For columns without tilt remove the bracket to gain access to the ignition switch mounting screws. (Fig. 7)

(9) Disconnect the electrical connector at rear of ignition switch (Fig. 8).

(10) Remove ignition switch mounting screw.

(11) Using a small screwdriver, push on locking tab and remove switch from steering column.

INSTALLATION

The ignition key must be in the key cylinder for cylinder Installation. The key cylinder must be installed after installing the ignition switch.

(1) Before installing ignition switch, rotate the slot in the switch to the ON position.

(2) Connect the electrical connector to rear of the ignition switch. Make sure that locking tabs are fully seated into wiring connector.

(3) Position switch to column and install tamper proof screw. Tighten screw to 12 N·m (105 in. lbs.).

(4) Install the tilt lever bracket mounting screws. Tighten screw to 4.5 N·m (40 in. lbs.).

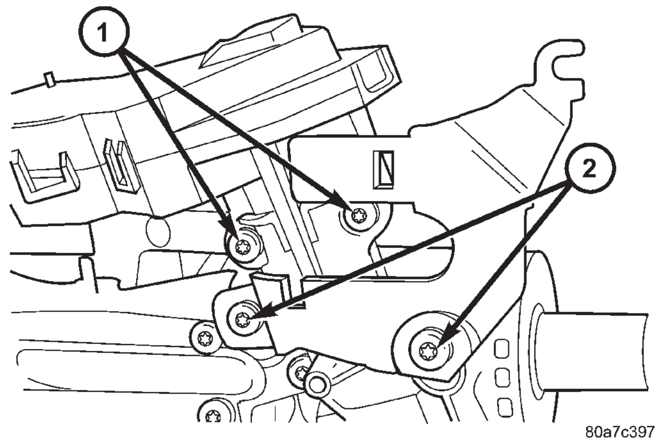

Fig. 7 IGNITION SWITCH WITHOUT TILT

1 - Ignition Switch Mounting Screws
2 - Non-Tilt Mounitng Bracket Screws

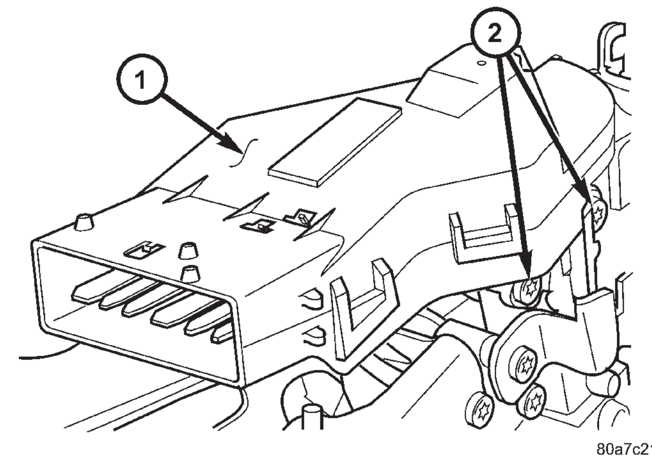

Fig. 8 IGNITION SWITCH

1 - Ignition Switch
2 - Ignition Switch Mounting Screws

(5) If the column is equipped with a non-tilt install the bracket. Tighten screw to 4.5 N·m (40 in. lbs.) (Fig. 7)

(6) Insert the wire retainer to the tilt lever bracket.

(7) Reconnect the lower clockspring connectors.

(8) Install the key cylinder.

(9) Install the Upper and lower shrouds.

(10) Install steering column lower cover.

(11) Enable the airbag system. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

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. It closes a path to ground for the Central Timer Module (CTM) when the ignition key is inserted in the ignition lock cylinder and the driver door ajar switch is closed (driver door is open). The key-in ignition switch opens the ground path when the key is removed from the ignition lock cylinder. The ground path is also opened when the driver door ajar switch is open (driver door is closed).

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).

DIAGNOSIS AND TESTING - IGNITION SWITCH AND KEY LOCK CYLINDER

ELECTRICAL DIAGNOSIS

For ignition switch electrical schematics, refer to the appropriate section in Wiring Diagrams.

MECHANICAL DIAGNOSIS (KEY DIFFICULT TO ROTATE)

Vehicles equipped with an automatic transmission and a steering column mounted shifter: an interlock device is located within the steering column. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is in the LOCKED or ACCESSORY position. If it is difficult to rotate the key to or from the LOCK or ACCESSORY position, the interlock device within the steering column may be defective. This device is not serviceable. If repair is necessary, the steering column assembly must be replaced. (Refer to 19 - STEERING/COLUMN - REMOVAL).

Vehicles equipped with a manual transmission and a floor mounted shifter: on certain models, a lever is located on the steering column behind the ignition key lock cylinder. The lever must be manually operated to allow rotation of the ignition key lock cylinder to the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lever mechanism may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. (Refer to 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).

LOCK CYLINDER HOUSING

REMOVAL

The ignition key must be in the key cylinder for cylinder removal.

(1) Disconnect negative cable from battery.

(2) Remove upper and lower covers (shrouds) from steering column.

(3) Place shifter in PARK position.

(4) A retaining pin (Fig. 9) is located at side of key cylinder assembly.

(a) Rotate key to RUN position.

(b) Press in on retaining pin while pulling key cylinder from ignition switch.

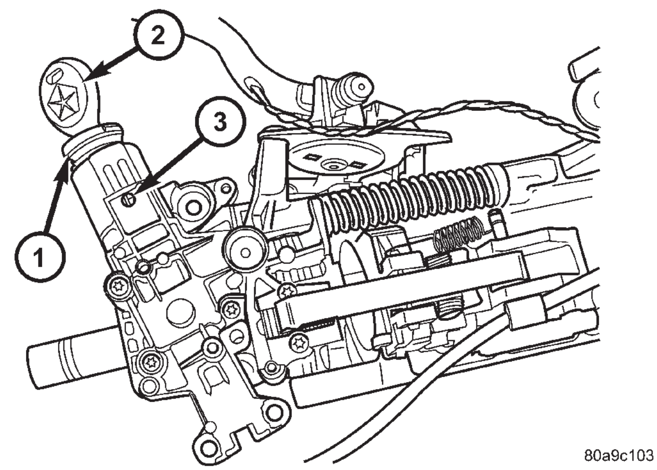

Fig. 9 KEY CYLINDER

1 - Key Lock Cylinder
2 - Key
3 - Reataining Pin Hole

INSTALLATION

The ignition key must be in the key cylinder for cylinder installation.

(1) Install the key cylinder into the housing using care to align the end of the key cylinder with the ignition switch.

(2) Push the key cylinder in until it clicks.

(3) Replace the upper and lower shrouds.

(4) Reconnect the battery.

GEAR SHIFT LEVER

REMOVAL

(1) Remove the kneeblocker. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(2) Loosen the steering column bolts enough to lower the column without removing.

(3) Remove the upper and lower shrouds.

(4) Disconnect over drive switch wiring.

(5) Disconnect the shift cable from the pin and unsnap the cable adjusting clip.

(6) Remove the screws retaining the gear shift lever. (Fig. 10)

(7) Remove the gear shift lever from the steering column assembly.

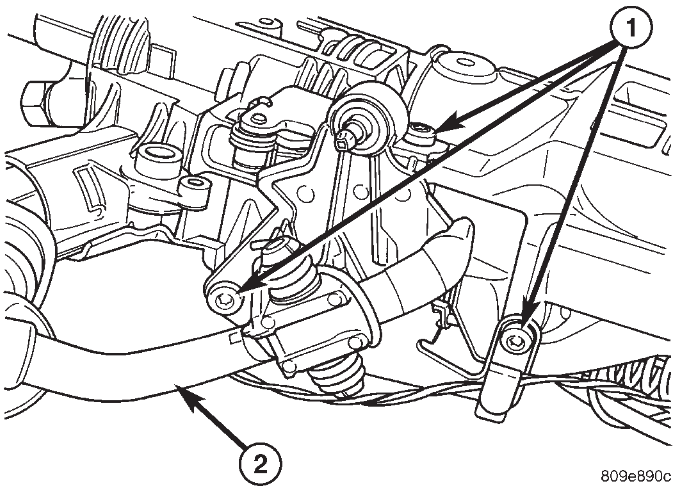

Fig. 10 Gear Shift Lever Removal

1 - SCREWS
2 - GEARSHIFT LEVER

INSTALLATION

(1) Install the gear shift lever onto the steering column assembly (Fig. 10).

(2) Install the shift lever screws. Tighten the screws to 12 N.m (105 In. Lbs).

(3) Connect the shift cable to the pin ensuring the shift lever is in PARK and snap the shift cable adjustment clip in place.

(4) Connect over drive switch wiring.

(5) Install the upper and lower shrouds.

(6) Tighten the steering column mounting nuts to 28 N.m (250 In. Lbs).

(7) Install the kneeblocker. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

GEAR

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GEAR

DESCRIPTION

A rack and pinion steering gears (Fig. 1) is made up of two main components, the pinon shaft and the rack. The gear cannot be adjusted or internally serviced. If a malfunction or a fluid leak occurs, the gear must be replaced as an assembly. If a boot seal becomes damaged, the steering gear must be removed to replace the boot seal.

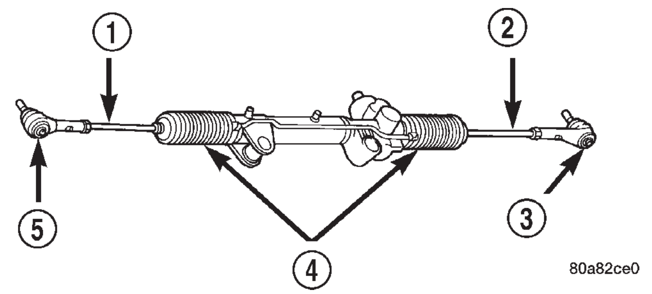


Fig. 1 Rack & Pinion Steering Gear

1 - TIE ROD
2 - TIE ROD
3 - TIE ROD END
4 - BOOTS
5 - TIE ROD END

OPERATION

The steering column shaft is attached to the gear pinion. The rotation of the pinion moves the gear rack from side-to-side. This lateral action of the rack pushes and pulls the tie rods to change the direction of the front wheels.

REMOVAL - 2WD

(1) Raise and support the vehicle.
(2) Remove the nuts from the tie rod ends.
(3) Separate tie rod ends from the knuckles with Puller C-3894-A (Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL) (Fig. 2).

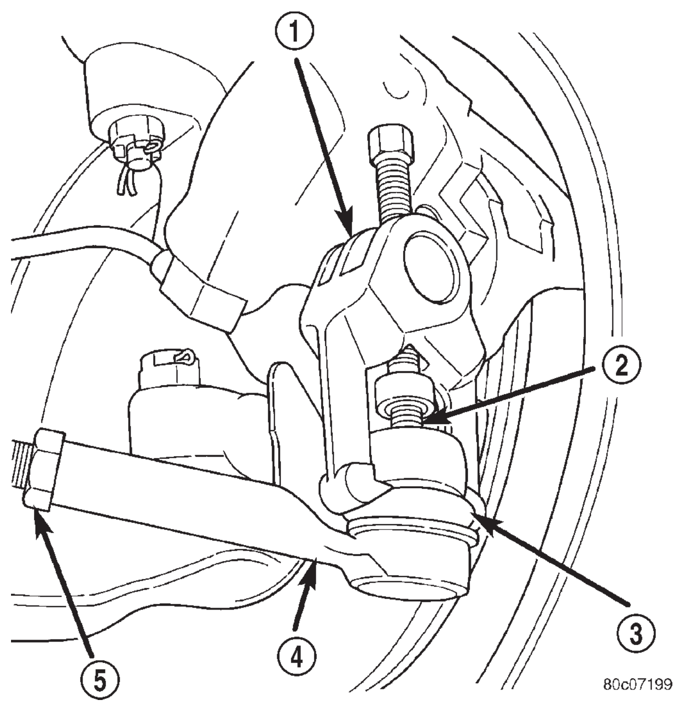


Fig. 2 Tie Rod End Puller

1 - TOOL C-3894-A
2 - BALL STUD
3 - SEAL
4 - TIE-ROD END
5 - LOCKNUT

GEAR (Continued)

(4) Remove the power steering lines from the gear. (Refer to 19 - STEERING/PUMP/HOSES - REMOVAL),(Refer to 19 - STEERING/PUMP/HOSES - REMOVAL).

(5) Remove the lower coupler bolt and slide the coupler off the gear (Fig. 3).

(6) Remove the mounting bolts from the gear to the front crossmember and remove the gear (Fig. 4).

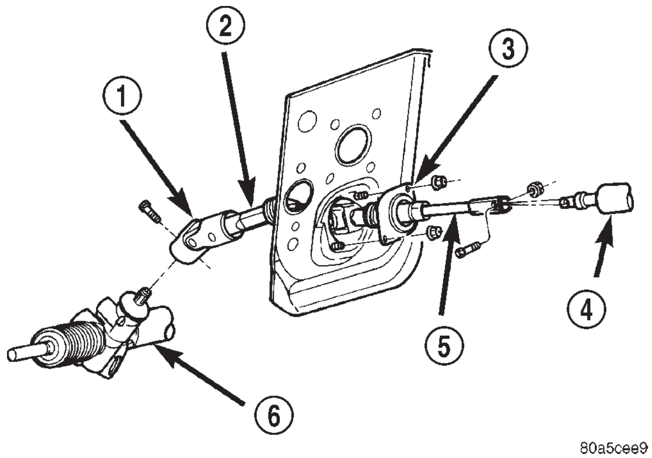


Fig. 3 Gear Coupler

1 - COUPLER
2 - LOWER SHAFT
3 - TOE PLATE
4 - STEERING COLUMN
5 - UPPER SHAFT
6 - RACK AND PINION STEERING GEAR

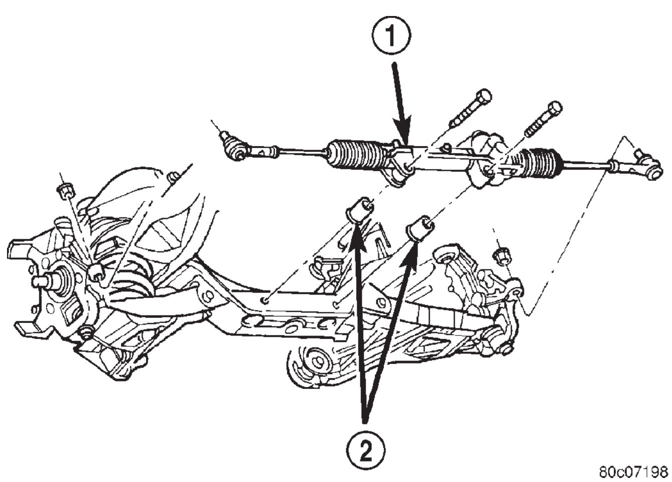


Fig. 4 Rack & Pinion Steering Gear - 4x2

1 - RACK AND PINION STEERING GEAR
2 - BUSHING

REMOVAL - 4WD

(1) Raise and support the vehicle.

(2) Remove the splash shield from under the front end to gain access to the gear.

(3) Remove the nuts from the tie rod ends.

(4) Separate tie rod ends from the knuckles with Puller C-3894-A (Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL) (Fig. 5).

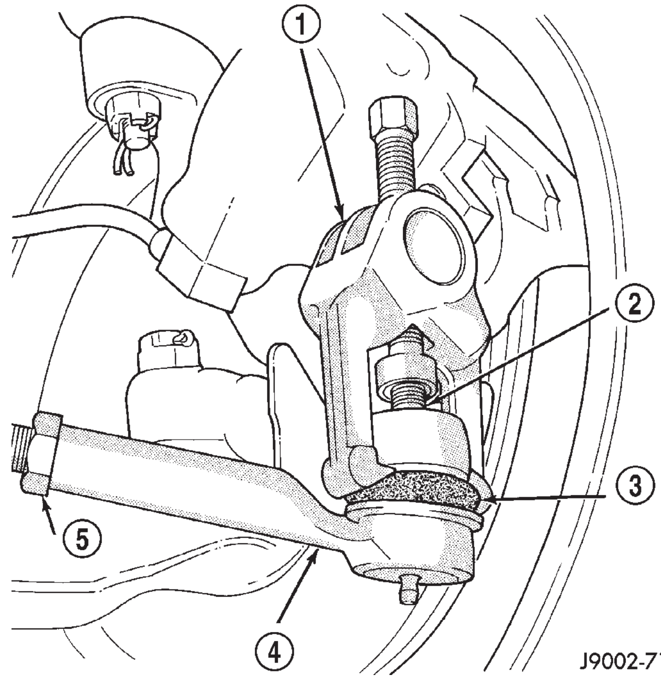


Fig. 5 Tie

1 - TOOL C-3894–A
2 - BALL STUD
3 - SEAL
4 - TIE-ROD END
5 - LOCK NUT

(5) Remove the power steering lines from the gear. (Refer to 19 - STEERING/PUMP/HOSES - REMOVAL),(Refer to 19 - STEERING/PUMP/HOSES - REMOVAL).

GEAR (Continued)

(6) Remove the lower coupler bolt and slide the coupler off the gear (Fig. 6).

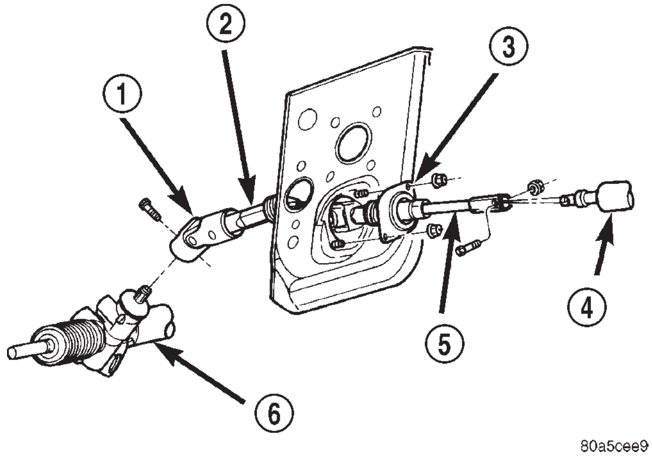


Fig. 6 Gear Coupler

1 - COUPLER
2 - LOWER SHAFT
3 - TOE PLATE
4 - STEERING COLUMN
5 - UPPER SHAFT
6 - RACK AND PINION STEERING GEAR

(7) Remove the mounting bolts (Fig. 7) from the gear to the front crossmember. Slide the gear to the right side of the vehicle. Then tilt the left end of the gear down and remove the gear.

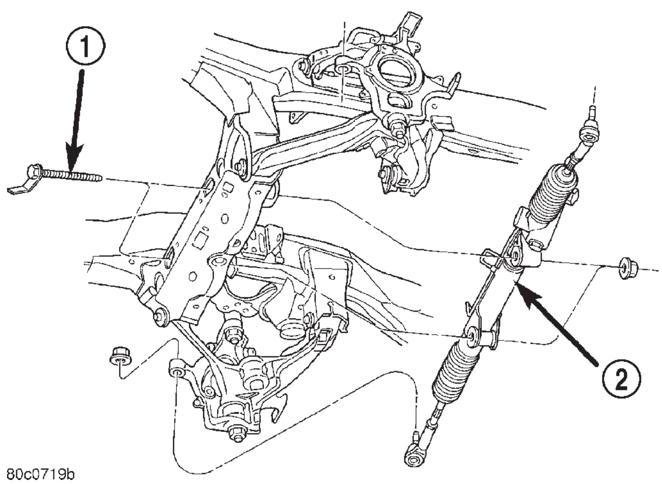


Fig. 7 Rack & Pinion Steering Gear - 4x4

1 - MOUNTING BOLT
2 - RACK AND PINION STEERING GEAR

INSTALLATION - 2WD

NOTE: Before installing gear inspect bushings and replace if worn or damaged.

(1) Install gear on front crossmember and tighten mounting bolts to 258 N·m (190 ft. lbs.).
(2) Slide shaft coupler onto gear. Install **new** bolt and tighten to 49 N·m (36 ft. lbs.).
(3) Clean tie rod end studs and knuckle tapers.
(4) Install tie rod ends into the steering knuckles and tighten the nuts to 108 N·m (80 ft. lbs.). (Refer to 19 - STEERING/LINKAGE/TIE ROD END - INSTALLATION).
(5) Install power steering lines to steering gear. (Refer to 19 - STEERING/PUMP/HOSES - INSTALLATION),(Refer to 19 - STEERING/PUMP/HOSES - INSTALLATION).
(6) Remove support and lower vehicle.
(7) Fill system with fluid, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).
(8) Adjust the toe position. (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

INSTALLATION - 4WD

NOTE: Before installing gear inspect bushings and replace if worn or damaged.

(1) Install gear on front crossmember and tighten mounting bolts to 230 N·m (170 ft. lbs.).
(2) Slide shaft coupler onto gear. Install **new** bolt and tighten to 49 N·m (36 ft. lbs.).
(3) Clean tie rod end studs and knuckle tapers.
(4) Install tie rod ends into the steering knuckles and tighten the nuts to 88 N·m (65 ft. lbs.). (Refer to 19 - STEERING/LINKAGE/TIE ROD END - INSTALLATION).
(5) Install power steering lines to steering gear. (Refer to 19 - STEERING/PUMP/HOSES - INSTALLATION),(Refer to 19 - STEERING/PUMP/HOSES - INSTALLATION).
(6) Install the splash shield.
(7) Remove support and lower vehicle.
(8) Fill system with fluid, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).
(9) Adjust the toe position. (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

SPECIFICATIONS

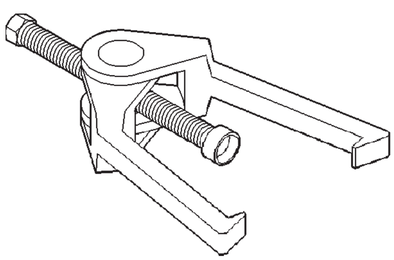
TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Rack and Pinion Steering Gear Gear to Frame Bolts	258	190	—
Rack and Pinion Steering Gear Intermediate Shaft Bolt	49	36	—
Tie Rod End Knuckle Nut	108	80	—
Tie Rod End Jam Nut	75	55	—
Power Steering Line Pressure Line	35	25	—
Power Steering Line Return Line	35	25	—

SPECIAL TOOLS

RACK & PINION STEERING GEAR



Puller C-3894-A

LINKAGE

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TIE ROD END

REMOVAL - INNER TIE ROD END

(1) Raise and support the vehicle.
(2) Remove the tire and wheel assembly.
(3) Remove the outer tie rod end,(Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL).
(4) Remove the inner tie rod end from the rack and pinion (Fig. 1).

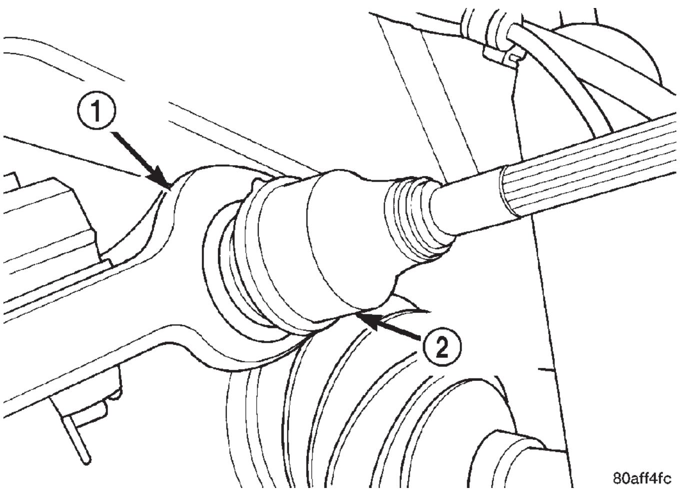


Fig. 1 Inner Tie Rod

1 - WRENCH
2 - INNER TIE ROD

REMOVAL - OUTER TIE ROD END

NOTE: Do not twist the boot at anytime during removal or installation.

(1) Loosen the jam nut.
(2) Remove the outer tie rod end nut at the steering knuckle.
(3) Separate the tie rod ball stud from the knuckle with Remover MB-991113 (Fig. 2).
(4) Unthread the outer tie rod end from the inner tie rod.

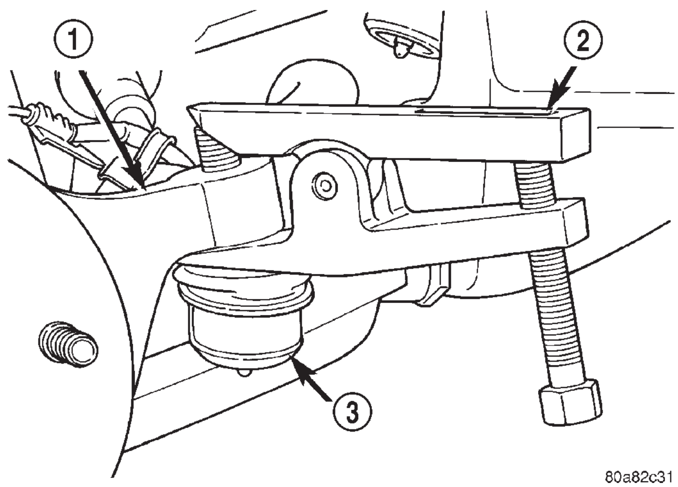


Fig. 2 Tie Rod End

1 - STEERING KNUCKLE
2 - REMOVER
3 - TIE ROD END

INSTALLATION - INNER TIE ROD END

NOTE: Do not twist the boot at anytime during installation.

(1) Thread the inner tie rod end into the rack and pinion (Fig. 3).
(2) Tighten the inner tie to 68 N·m (50 ft. lbs.).
(3) Install the out tie rod end,(Refer to 19 - STEERING/LINKAGE/TIE ROD END - INSTALLATION).
(4) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
(5) Remove the support and lower the vehicle.

TIE ROD END (Continued)

(6) Set wheel toe pattern,(Refer to 2 - SUSPENSION/ WHEEL ALIGNMENT - STANDARD PROCEDURE).

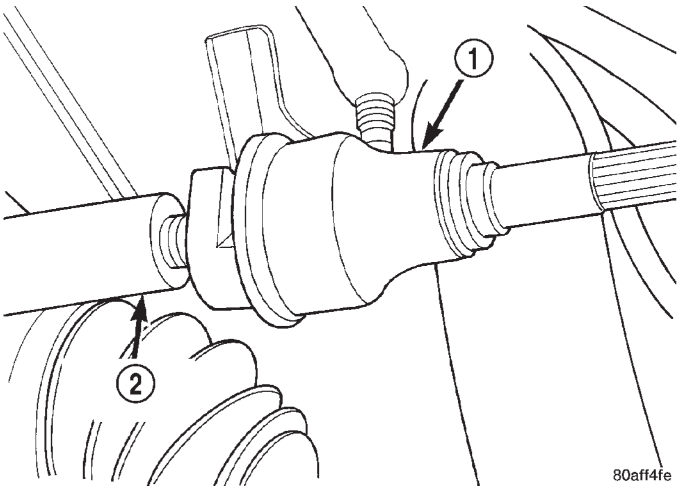


Fig. 3 Inner Tie Rod

1 - INNER TIE ROD
2 - CENTER LINK

INSTALLATION - OUTER TIE ROD END

NOTE: Do not twist the boot at anytime during removal or installation.

(1) Thread the outer tie rod end onto the inner tie rod, to it's original position.
(2) Install the outer tie rod end into the steering knuckle.
(3) Tighten the ball stud nut on the steering knuckle to 88 N·m (65 ft. lbs.).
(4) Tighten jam nut to 75 N·m (55 ft. lbs.).
(5) Set wheel toe pattern,(Refer to 2 - SUSPENSION/ WHEEL ALIGNMENT - STANDARD PROCEDURE).

BOOT SEAL

DESCRIPTION

The boot seal is a bellows type seal the protects dirt and contaminates from entering the open gears of the rack and pinion unit.

OPERATION

The boot seal operates with the inward and outward motions of the rack and pinion, If the seal is worn or ripped in any way it must be replaced.

REMOVAL

(1) Loosen the jam nut to remove the outer tie rod end,(Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL).
(2) Remove the jam nut.
(3) Remove the outer clamp from the rubber boot (Fig. 4).
(4) Remove the boot inner clamp.
(5) On 4x2 vehicles mark the breather tube location on steering gear before removing the rubber boot (Fig. 4).

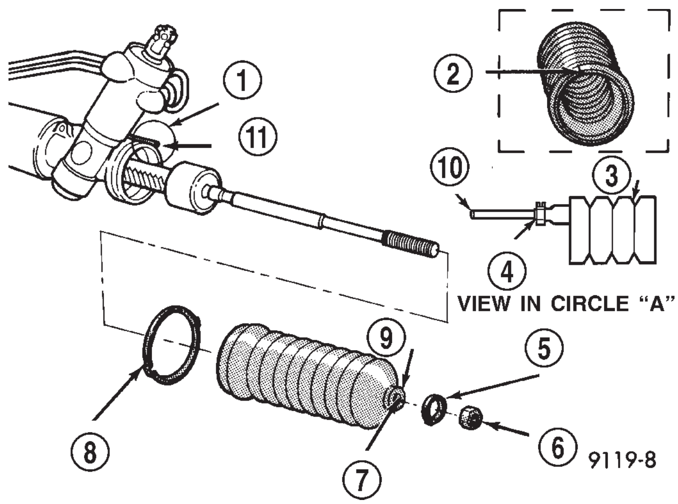


Fig. 4 Boot Seal - 4x2

1 - CIRCLE "A"
2 - MARK BREATHER TUBE LOCATION
3 - BOOT
4 - SNORKEL CLAMP
5 - BOOT CLAMP (OUTER)
6 - JAM NUT
7 - USE LUBE HERE
8 - BOOT CLAMP (INNER)
9 - BOOT SEAL
10 - BREATHER TUBE
11 - BREATHER TUBE

INSTALLATION

(1) Lubricate the boot outer groove (tie rod) with silicone type lubricant. Ensure that the boot is not twisted.
(2) On 4x2 vehicles align the breather tube with the reference mark on the steering gear.
(3) Position and align the new boot over the housing.
(4) Install inner clamp on the rubber boot.
(5) Install the snorkel clamp on 4x2 vehicles.
(6) Install outer clamp on the inner tie rod.
(7) Install the jam nut and the outer tie rod end,(Refer to 19 - STEERING/LINKAGE/TIE ROD END - INSTALLATION).
(8) Perform a wheel alignment,(Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

PUMP

TABLE OF CONTENTS

PUMP

DESCRIPTION

The pump is connected to the steering gear via the pressure hose and the return hose. The pump shaft has a pressed-on pulley that is belt driven by the crankshaft pulley.

Trailer tow option vehicles are equipped with a power steering pump oil cooler. On the 5.2L and 5.9L the oil cooler is mounted to the engine block. On the 4.7L the oil cooler is mounted to the power steering pump.

NOTE: Power steering pumps are not interchangeable with pumps installed on other vehicles.

OPERATION

Hydraulic pressure is provided for the power steering gear by the belt driven power steering pump (Fig. 1) and (Fig. 2). The power steering pumps are constant flow rate and displacement, vane-type pumps.

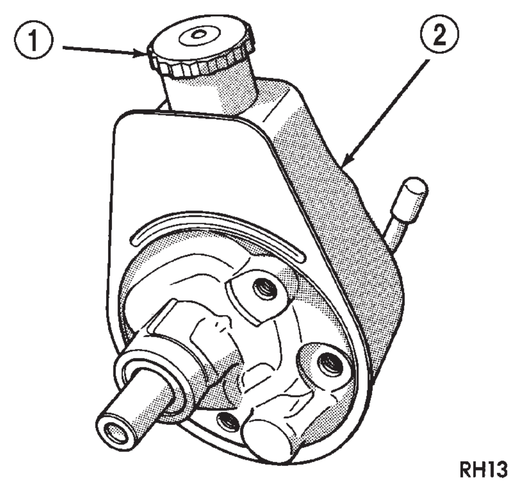


Fig. 1 Power Steering Pump - 5.2L & 5.9L

1 - RESERVOIR CAP AND DIPSTICK
2 - RESERVOIR

DIAGNOSIS AND TESTING - PUMP LEAKAGE

The pump is serviced as an assembly and should not be disassembled. Plastic pump reservoirs can be replace and the reservoir O-ring.

Check for leaks in the following areas:
- Pump shaft seal behind the pulley
- Pump to reservoir O-ring
- Reservoir cap
- Pressure and return lines
- Flow control valve fitting

PUMP (Continued)

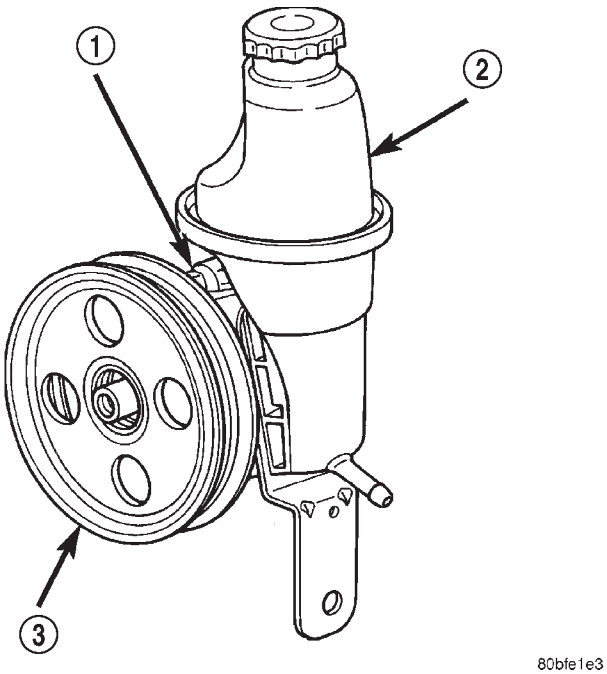


Fig. 2 Power Steering Pump - 4.7L

1 - PUMP
2 - RESERVOIR
3 - PULLEY

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 temperature.

(1) Turn steering wheel all the way to the left

(2) Fill the pump fluid reservoir to the proper level and let the fluid settle for at least two (2) minutes.

(3) Raise the front wheels off the ground.

(4) Slowly turn the steering wheel lock-to-lock 20 times with the engine off while checking the fluid level.

NOTE: Vehicles with long return lines or oil coolers turn wheel 40 times.

(5) Start the engine. With the engine idling maintain the fluid level.

(6) Lower the front wheels and let the engine idle for two minutes.

(7) Turn the steering wheel in both direction and verify power assist and quiet operation of the pump.

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 - POWER STEERING PUMP - 4.7L

(1) Remove the serpentine drive belt, (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Remove return hose from the pump reservoir and drain the pump.

(3) Remove power steering pressure switch connector and remove pressure line from the bottom of the pump.

(4) Remove the oil cooler mounting bolt from the pump bracket if equipped.

(5) Remove 3 pump mounting bolts (Fig. 3) through pulley access holes.

(6) Remove the pump from the left cylinder head.

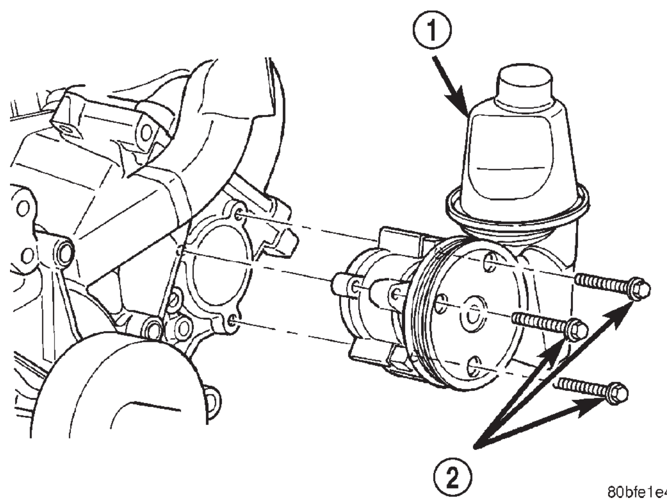


Fig. 3 Power Steering Pump - 4.7L

1 - PUMP
2 - MOUNTING BOLTS

PUMP (Continued)

REMOVAL - POWER STEERING PUMP - 5.2L & 5.9L

(1) Remove the serpentine drive belt, (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Clamp the fluid return hose and disconnect the hoses from the power steering pump. Cap the fittings.

(3) Remove battery ground cable and bracket bolts.

(4) Remove the pump assembly (Fig. 4).

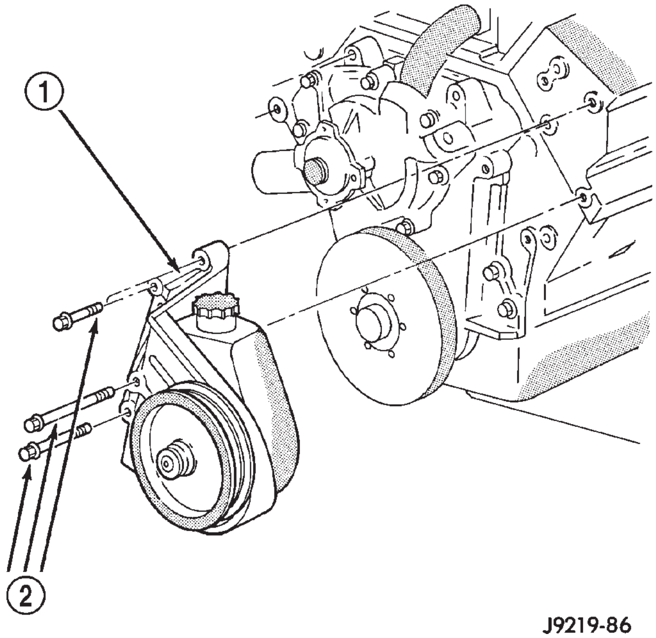


Fig. 4 Pump Assembly

1 - PUMP ASSEMBLY
2 - BOLTS

(5) Remove the pump pulley, (Refer to 19 - STEERING/PUMP/PULLEY - REMOVAL). This will allow access to the pump attaching screws.

(6) Remove the pump bracket bolts (Fig. 5) and remove the bracket.

INSTALLATION - POWER STEERING PUMP - 4.7L

(1) Align the pump with the mounting holes in the left cylinder head.

(2) Install 3 pump mounting bolts through the pulley access holes. Tighten the bolts to 28 N·m (21 ft. lbs.).

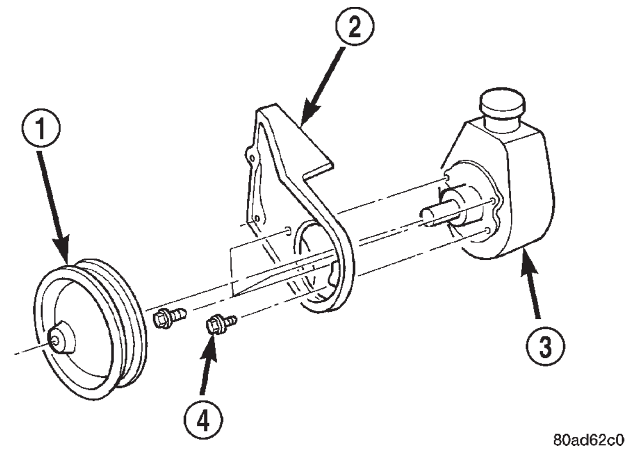


Fig. 5 Pump Mounting Bracket

1 - PULLEY
2 - PUMP BRACKET
3 - STEERING PUMP
4 - BOLT

(3) Install the oil cooler to the pump bracket if equipped. Install the oil cooler mounting bolt.

(4) Install the pressure line and return hose to the pump. Tighten the pressure line to 35 N·m (25 ft. lbs.).

(5) Install power steering pressure switch connector.

(6) Install the serpentine drive belt, (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(7) Fill the power steering pump, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

INSTALLATION - POWER STEERING PUMP - 5.2L & 5.9L

(1) Install the bracket on the pump and tighten bolts to 41 N·m (30 ft. lbs.).

(2) Install the pump pulley, (Refer to 19 - STEERING/PUMP/PULLEY - INSTALLATION).

(3) Install pump assembly on the engine block and tighten the bolts to 41 N·m (30 ft. lbs.).

(4) Install the battery ground wire and tighten nut to 41 N·m (30 ft. lbs.).

(5) Connect the fluid hoses to the pump.

(6) Install the serpentine drive belt, (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(7) Fill the reservoir with power steering fluid, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

SPECIFICATIONS

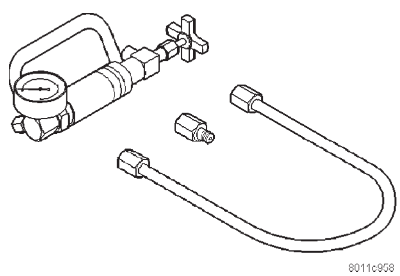
TORQUE CHART

TORQUE SPECIFICATIONS

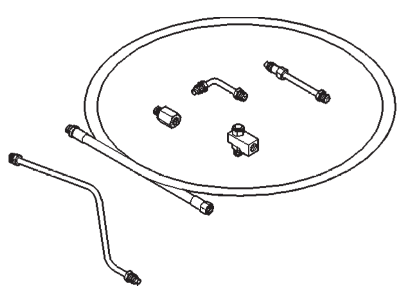
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
5.2L/5.9L Power Steering Pump Pump Bracket Bolts	41	30	—
5.2L/5.9L Power Steering Pump Pump Mounting Bolts	41	30	—
5.2L/5.9L Power Steering Pump Flow Control Valve	75	55	—
5.2L/5.9L Power Steering Pump Pressure Line	35	25	—
4.7L Power Steering Pump Pump Mounting Bolts	28	21	—
4.7L Power Steering Pump Flow Control Valve	81	60	—
4.7L Power Steering Pump Pressure Line	35	25	—

SPECIAL TOOLS

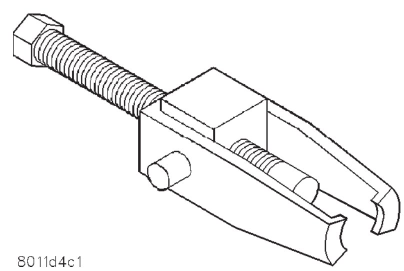
POWER STEERING PUMP



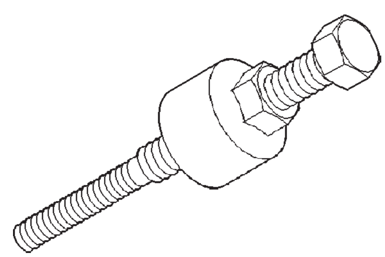
Analyzer Set, Power Steering Flow/Pressure 6815



Adapters, Power Steering Flow/Pressure Tester 6893



Puller C-4333



Installer, Power Steering Pulley C-4063–B

FLUID COOLER

REMOVAL

(1) Siphon the power steering system.
(2) Disconnect the return hose at the pump.
(3) Raise and support the vehicle.
(4) Disconnect the return hose at the cooler.
(5) Remove the cooler mounting nut and bolt.
(6) Remove the cooler.

INSTALLATION

(1) Install the cooler.
(2) Install the cooler mounting nut and bolt.
(3) Reconnect the return hose at the cooler.
(4) Remove the support and lower the vehicle.
(5) Reconnect the return hose at the pump.
(6) Refill the power steering system,(Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

HOSES

REMOVAL - RETURN HOSE

(1) Siphon the power steering system.
(2) Raise and support the vehicle.
(3) Disconnect the return hose at the cooler.
(4) Disconnect the return hose at the gear.
(5) Remove the pressure hose from the vehicle.

REMOVAL - PRESSURE HOSE

(1) Siphon the power steering system.
(2) Raise and support the vehicle.
(3) Disconnect the pressure hose at the pump.
(4) Disconnect the pressure hose at the gear.
(5) Remove the pressure hose from the vehicle.

INSTALLATION - RETURN HOSE

(1) Install the return hose to the vehicle.
(2) Reconnect the return hose at the cooler. Tighten the hose to 34 N·m (25 ft. lbs.).
(3) Reconnect the return hose at the gear. Tighten the hose to 34 N·m (25 ft. lbs.).
(4) Remove the support and lower the vehicle.
(5) Refill the power steering system,(Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

INSTALLATION - PRESSURE HOSE

(1) Install the pressure hose to the vehicle.
(2) Reconnect the pressure hose at the gear. Tighten the hose to 34 N·m (25 ft. lbs.).
(3) Reconnect the pressure hose at the pump. Tighten the hose to 34 N·m (25 ft. lbs.).
(4) Remove the support and lower the vehicle.
(5) Refill the power steering system,(Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

POWER STEERING PRESSURE SWITCH

DESCRIPTION

A pressure sensing switch (Fig. 6) is included in the power steering system (mounted on the high-pressure line). This switch will be used only on vehicles equipped with a 4.7L V–8 engine and power steering.

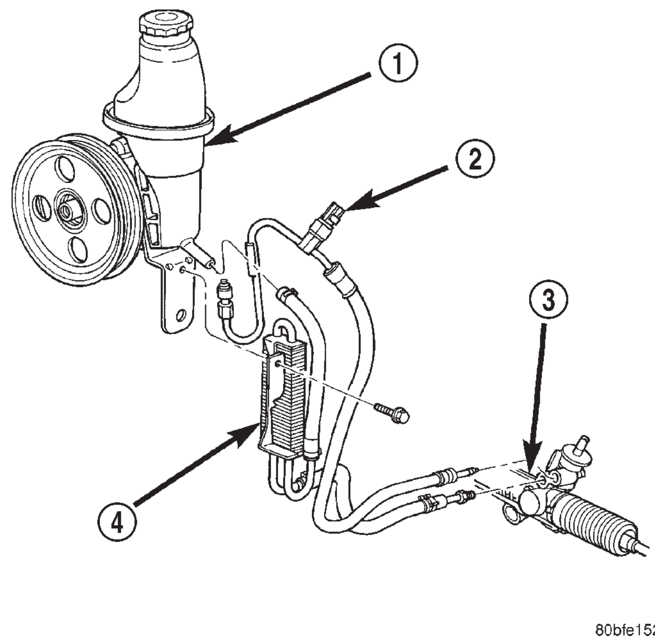


Fig. 6 Power Steering Pump Pressure Switch—4.7L V-8 Engine

1 - HYDRAULIC PUMP
2 - POWER STEERING PRESSURE SWITCH
3 - RACK AND PINION GEAR
4 - OIL COOLER

OPERATION

The power steering pressure switch provides an input to the Powertrain Control Module (PCM). This input is provided during periods of high pump load and low engine rpm; such as during parking maneuvers. The PCM will then increase the idle speed through the Idle Air Control (IAC) motor. This is done to prevent the engine from stalling under the increased load.

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.

POWER STEERING PRESSURE SWITCH (Continued)

REMOVAL

This switch is used only with 4.7L V-8 engine.

The power steering pressure switch is installed in the power steering high-pressure hose (Fig. 6).

(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 used only with 4.7L V-8 engine.

(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 4.7L, 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, (Refer to 19 - STEERING/PUMP 4.7L - REMOVAL) OR (Refer to 19 - STEERING/PUMP 5.2 L & 5.9L - REMOVAL).

(2) Remove pulley from pump with Puller C-4333 (Fig. 7).

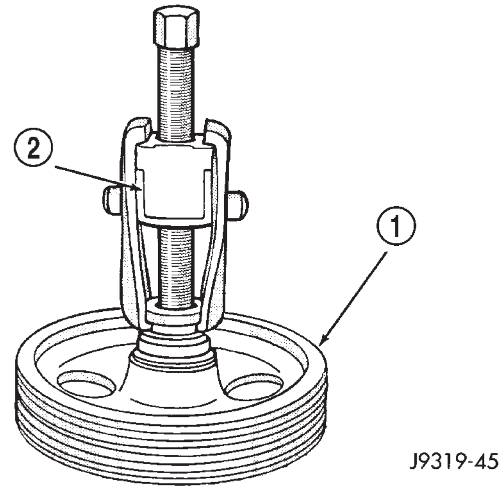


Fig. 7 Pulley Removal

1 - POWER STEERING PUMP DRIVE PULLEY
2 - SPECIAL TOOL C-4333

INSTALLATION

CAUTION: On vehicles equipped with the 4.7L, 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 (Fig. 8) flush with the end of the shaft. Ensure the tool and pulley remain aligned with the pump shaft.

(3) Install pump assembly, (Refer to 19 - STEERING/PUMP 4.7L - INSTALLATION) OR (Refer to 19 - STEERING/PUMP 5.2L & 5.9L - INSTALLATION).

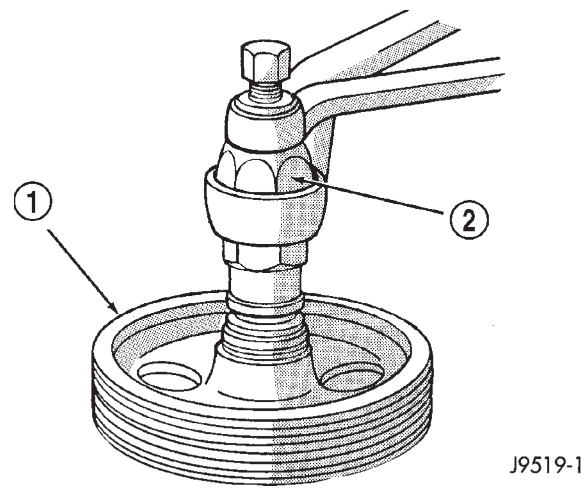


Fig. 8 Pulley Installation

1 - POWER STEERING PUMP DRIVE PULLEY
2 - SPECIAL TOOL C-4063–B

(4) With Serpentine Belts; Run engine until warm (5 min.) and note any belt chirp. If chirp exists, move pulley outward approximately 0.5 mm (0.020 in.). If noise increases, press on 1.0 mm (0.040 in.). **Be careful that pulley does not contact mounting bolts.**

TRANSMISSION AND TRANSFER CASE

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MANUAL - NV1500

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MANUAL - NV1500

DESCRIPTION

The NV1500 is a medium-duty, 5-speed, constant mesh, fully synchronized manual transmission. Fifth gear is an overdrive range with a ratio of 0.80:1. The Transmission is available in 4-cyl. equipped 2WD models.

The transmission gear case consists of two aluminum gear housings and a detachable clutch housing.

The mainshaft is supported by two sealed ball bearings, and the countershaft is supported by two tapered roller bearings. The transmission gears all rotate on caged type needle bearings. A roller bearing is used between the input and output shaft.

The Transmission 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. Internal shift components consist of the forks, shaft, shift lever socket, and detent components.

NV1500 GEAR RATIOS

RANGE	RATIO
FIRST	3.85 :1
SECOND	2.25 :1
THIRD	1.48 :1
FOURTH	1.00 :1
FIFTH	0.80 :1
REVERSE	3.52 :1

Identification bar code tags (Fig. 1) are located on each side of the transmission, below the shift tower. The tag located on the right side has the part number and the tag located on the left side has the build sequence and date information.

MANUAL - NV1500 (Continued)

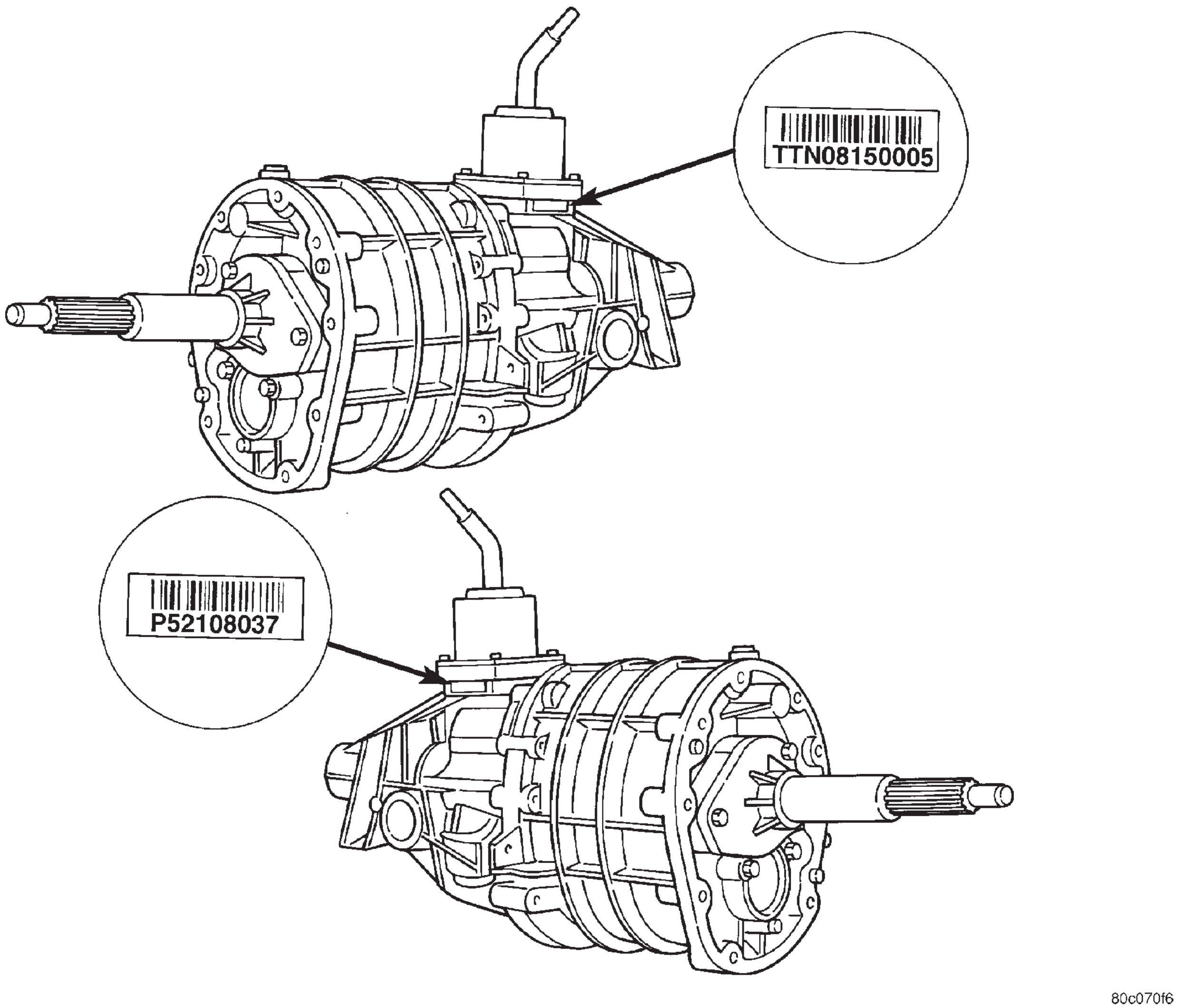


Fig. 1 NV1500 IDENTIFICATION

OPERATION

The manual transmission receives power through the clutch assembly from the engine. The clutch disc is splined to the transmission input shaft and is turned at engine speed at all times that the clutch is engaged. The input shaft is connected to the transmission countershaft through the mesh of fourth speed gear on the input shaft and the fourth countershaft gear. At this point, all the transmission gears are spinning.

The driver selects a particular gear by moving the shift lever to the desired gear position. This movement moves the internal transmission shift components to begin the shift sequence. As the shift lever moves the selected shift rail, the shift fork attached to that rail begins to move. The fork is positioned in a groove in the outer circumference of the synchronizer sleeve. As the shift fork moves the synchronizer sleeve, the synchronizer begins to speed-up or slow down the selected gear (depending on whether we are up-shifting or down-shifting). The synchronizer does this by having the synchronizer hub splined to the mainshaft, or the countershaft in some cases, and moving the blocker ring into contact with the gear's friction cone. As the blocker ring and friction cone come together, the gear speed is brought up or down to the speed of the synchronizer. As the two speeds match, the splines on the inside of the synchronizer sleeve become aligned with the teeth on the blocker ring and the friction cone and eventually will slide over the teeth, locking the gear to the mainshaft, or countershaft, through the synchronizer.

DIAGNOSIS AND TESTING - NV1500 MANUAL TRANSMISSION

LOW LUBRICANT LEVEL

A low transmission lubricant level is generally the result of a leak, inadequate lubricant fill, or an incorrect lubricant level check.

Leaks can occur at the mating surfaces of the gear case, intermediate plate and adaptor or extension

MANUAL - NV1500 (Continued)

housing, or from the front/rear seals. A suspected leak could also be the result of an overfill condition.

Leaks at the rear of the extension or adapter housing will be from the housing oil seals. Leaks at component mating surfaces will probably be the result of inadequate sealer, gaps in the sealer, incorrect bolt tightening, or use of a non–recommended sealer.

A leak at the front of the transmission will be from either the front bearing retainer or retainer seal. Lubricant may be seen dripping from the clutch housing after extended operation. If the leak is severe, it may also contaminate the clutch disc causing the disc to slip, grab, and/or chatter.

A correct lubricant level check can only be made when the vehicle is level. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an underfill or overfill condition. Always check the lubricant level after any addition of fluid to avoid an incorrect lubricant level condition.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper, or contaminated lubricants. The consequence of using non–recommended lubricants is noise, excessive wear, internal bind, and hard shifting. Substantial lubricant leaks can result in gear, shift rail, synchro, and bearing damage. If a leak goes undetected for an extended period, the first indications of component damage are usually hard shifting and noise.

Component damage, incorrect clutch adjustment, or a damaged clutch pressure plate or disc are additional probable causes of increased shift effort. Incorrect adjustment or a worn/damaged pressure plate or disc can cause incorrect release. If the clutch problem is advanced, gear clash during shifts can result. Worn or damaged synchro rings can cause gear clash when shifting into any forward gear. In some new or rebuilt transmissions, new synchro rings may tend to stick slightly causing hard or noisy shifts. In most cases, this condition will decline as the rings wear–in.

TRANSMISSION NOISE

Most manual transmissions make some noise during normal operation. Rotating gears generate a mild whine that is audible, but generally only at extreme speeds.

Severe, highly audible transmission noise is generally the initial indicator of a lubricant problem. Insufficient, improper, or contaminated lubricant will promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

REMOVAL

(1) Disconnect battery negative cable.

(2) Shift transmission into Neutral.

(3) Remove floor console. Refer to 23 Body for procedures.

(4) Remove screws attaching shift boot to floorpan. Then slide boot upward on lever extension.

(5) Remove shift lever extension from the shift tower and lever assembly.

(6) Raise and support vehicle.

(7) Mark propeller shaft and axle companion flange for alignment reference. Use paint, scriber, or chalk to mark flange.

(8) Remove propeller shaft.

(9) Disconnect and remove exhaust system Y-pipe.

(10) Disconnect wires at backup light switch.

(11) Support engine with adjustable safety stand and wood block.

(12) If transmission is to be disassembled for repair, remove drain plug and drain lubricant from transmission.

(13) Remove bolts/nuts attaching transmission to rear mount.

(14) Support transmission with a transmission jack. Secure transmission to jack with safety chains.

(15) Remove rear crossmember.

(16) Remove bolts attaching clutch slave cylinder to clutch housing. Then move cylinder aside for working clearance.

(17) Remove starter.

(18) Remove transmission dust shield.

(19) Remove transmission harness wires from clips on transmission shift cover.

(20) Lower transmission slightly.

(21) Remove the bolts attaching the shift tower and lever assembly to the transmission housing. Then remove the shift tower and lever assembly.

(22) Remove bolts attaching transmission to engine.

(23) Slide transmission and jack rearward until input shaft clears clutch disc.

(24) Lower transmission jack and remove transmission from under vehicle.

DISASSEMBLY

FRONT HOUSING

(1) Shift transmission into Neutral.

(2) Remove drain plug and drain lubricant into a container.

(3) Inspect drain plug magnet for debris.

(4) Remove backup light switch (Fig. 2).

(5) Remove shift tower bolts and remove tower and lever assembly (Fig. 3).

MANUAL - NV1500 (Continued)

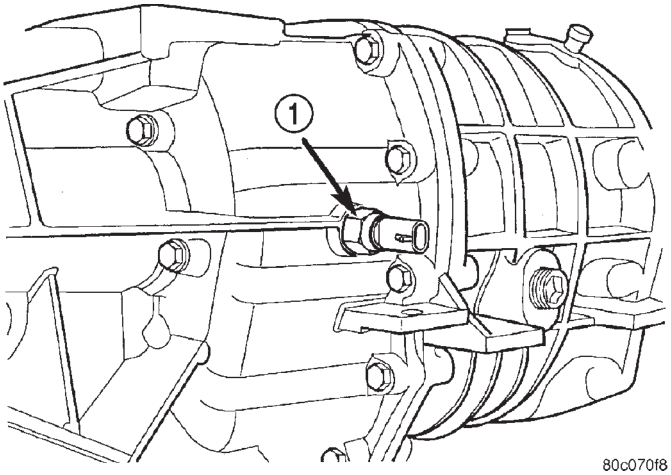


Fig. 2 BACKUP LIGHT SWITCH

1 - BACKUP LAMP SWITCH

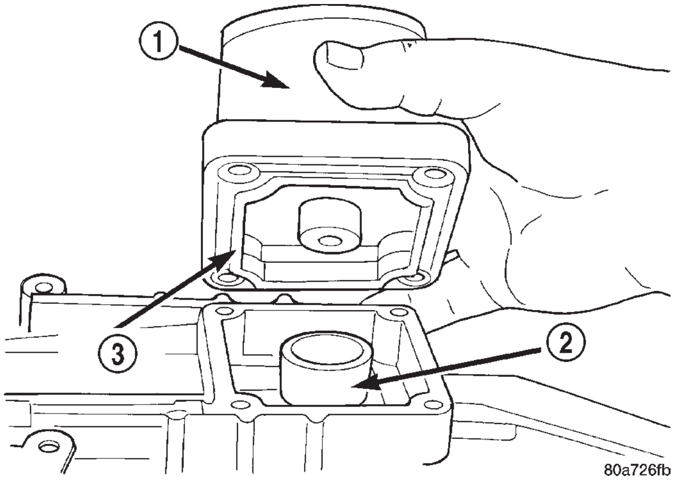


Fig. 3 SHIFT TOWER

1 - SHIFT TOWER AND LEVER ASSEMBLY
2 - SHIFT SOCKET
3 - SEAL

(6) Remove shift shaft lock bolt (Fig. 4). Bolt secures the shift shaft bushing and lever.

(7) Remove shift shaft detent plug with Remover 8117A.

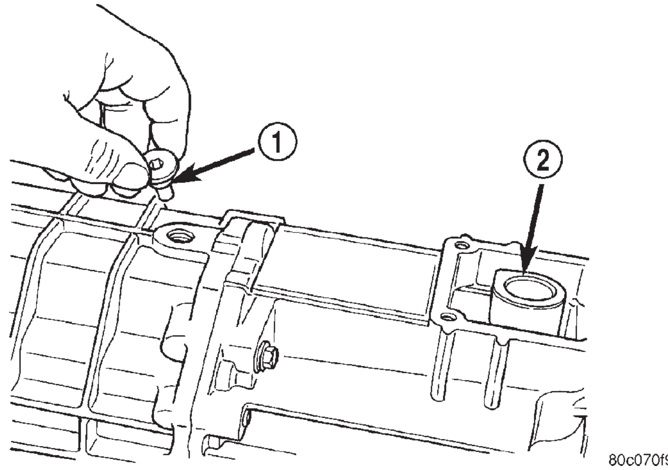


Fig. 4 SHIFT SHAFT BUSHING LOCK BOLT

1 - SHIFT SHAFT LOCK BOLT
2 - SHAFT SOCKET

(8) Remove shift shaft detent plunger and spring with a pencil magnet (Fig. 5).

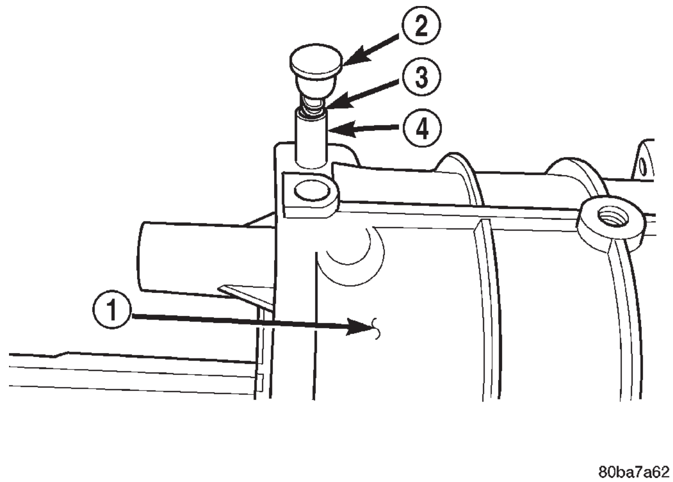


Fig. 5 SHIFT SHAFT DETENT PLUNGER

1 - FRONT HOUSING
2 - PLUG
3 - SPRING
4 - PLUNGER

MANUAL - NV1500 (Continued)

(9) Remove input shaft bearing retainer bolts (Fig. 6).

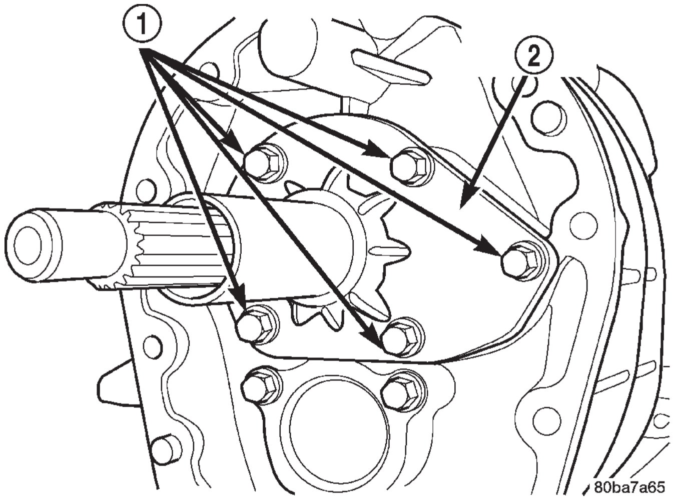


Fig. 6 INPUT SHAFT BEARING RETAINER BOLTS

1 - BOLTS (5)
2 - BEARING RETAINER

(10) Remove bearing retainer from input shaft with a pry tool (Fig. 7).

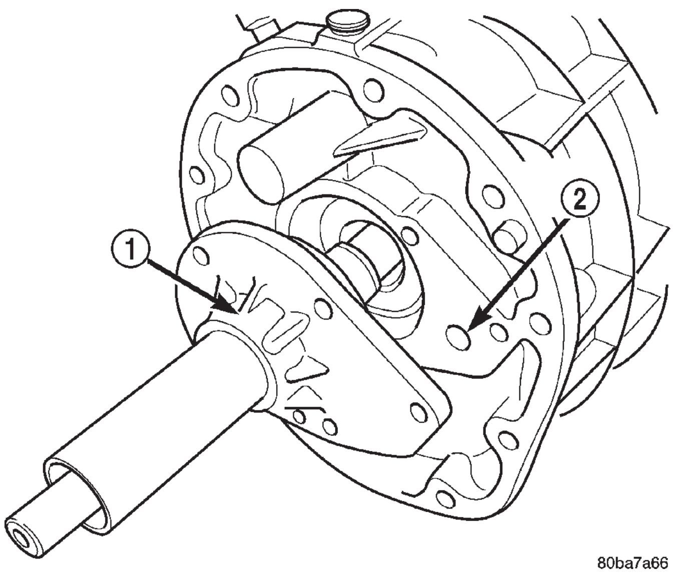


Fig. 7 INPUT SHAFT BEARING RETAINER

1 - BEARING RETAINER
2 - OIL FEED

(11) Remove snap ring securing input shaft in front bearing (Fig. 8).

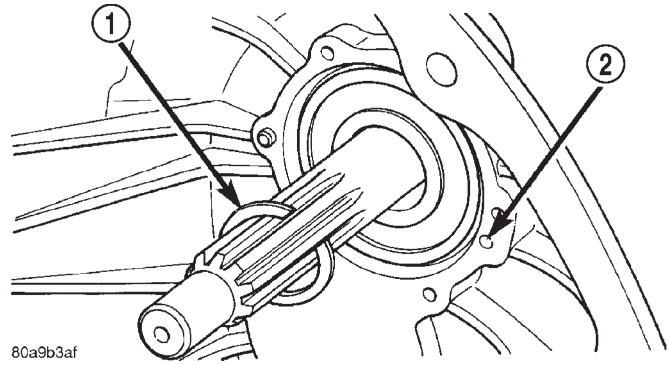


Fig. 8 INPUT SHAFT SNAP RING

1 - INPUT SHAFT SNAP RING
2 - OIL FEED

(12) Remove front housing bolts (Fig. 9). Leave one bolt in place until geartrain is ready to be removed from case. Three bolts at the rear of housing are for the output shaft bearing retainer.

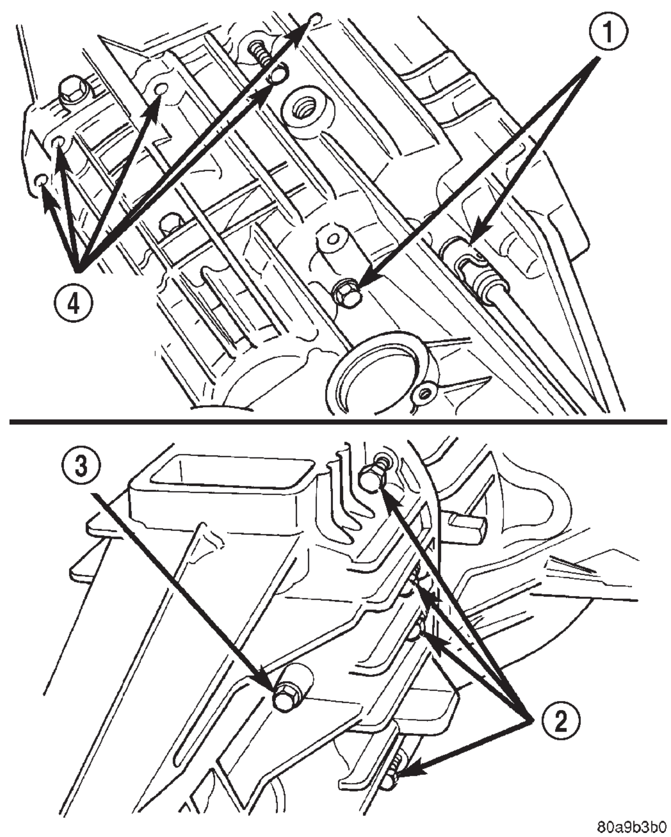


Fig. 9 HOUSING AND BEARING RETAINER BOL

1 - RETAINER BOLTS
2 - HOUSING BOLTS
3 - RETAINER BOLT
4 - HOUSING BOLT LOCATIONS

MANUAL - NV1500 (Continued)

(13) Tap front housing off alignment dowels with a plastic mallet and separate the housing (Fig. 10).

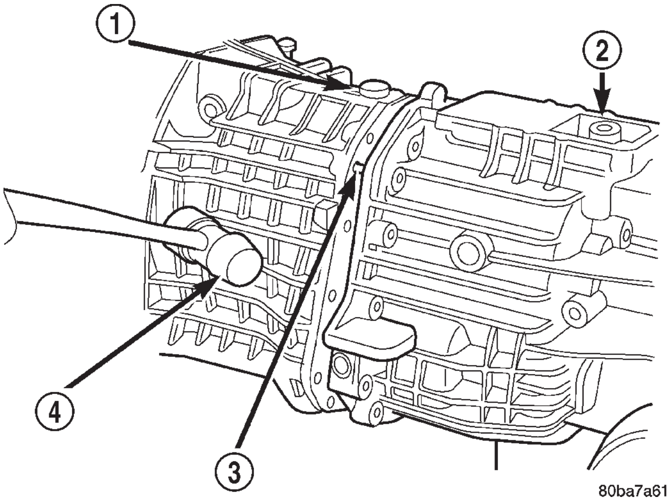


Fig. 10 FRONT HOUSING

1 - FRONT HOUSING
2 - REAR HOUSING
3 - DOWELS (2)
4 - PLASTIC MALLET

(14) Remove input shaft bearing (Fig. 11).

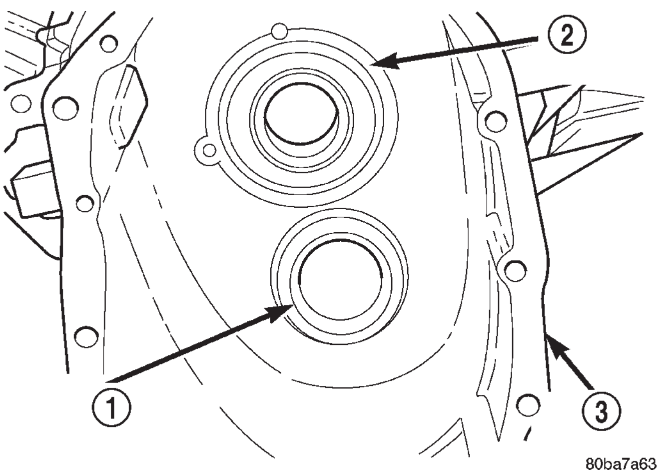


Fig. 11 INPUT SHAFT AND COUNTERSHAFT BEARING

1 - COUNTERSHAFT FRONT BEARING RACE
2 - INPUT SHAFT BEARING
3 - FRONT HOUSING

(15) Note position of input shaft, shift shaft, forks, and geartrain components in housing (Fig. 12).

SHIFT SHAFT, SHIFT FORKS AND REVERSE IDLER

(1) Drive out roll pin that secures shift bushing and lever to shift shaft with a hammer and punch (Fig. 13).

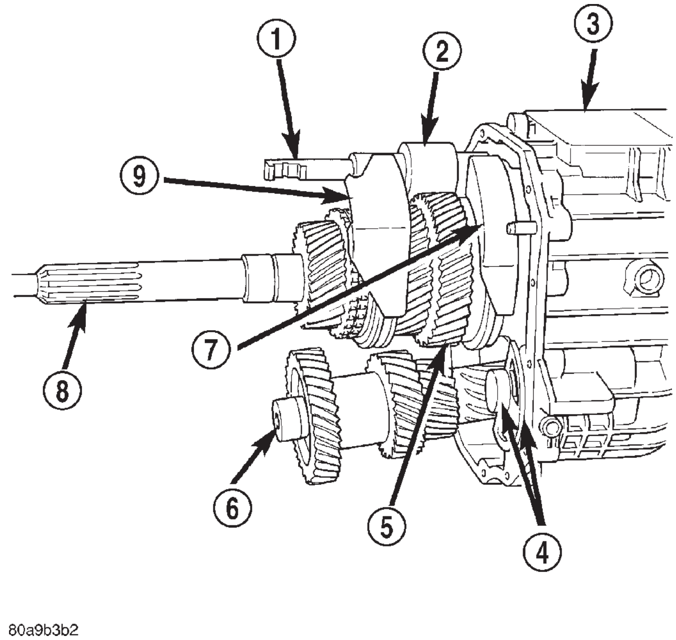


Fig. 12 GEARTRAIN AND SHIFT COMPONENT

1 - SHIFT SHAFT
2 - BUSHING
3 - REAR HOUSING
4 - REVERSE IDLER AND SUPPORT
5 - OUTPUT SHAFT AND GEARS
6 - COUNTERSHAFT
7 - 1-2 FORK
8 - INPUT SHAFT
9 - 3-4 FORK

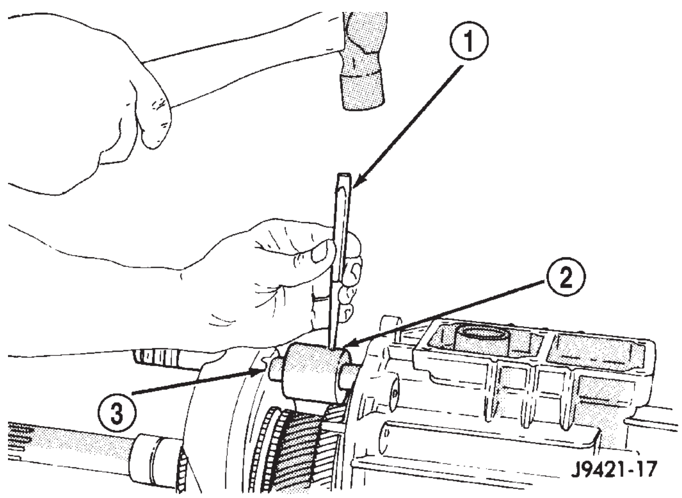


Fig. 13 SHIFT SHAFT LEVER & BUSHING ROLL PIN

1 - PIN PUNCH
2 - BUSHING AND LEVER
3 - SHIFT SHAFT

(2) Position shift socket off to the side so roll pin removal does not interfere with gears.

MANUAL - NV1500 (Continued)

(3) Drive out shift socket roll pin with a hammer and punch.

NOTE: Use proper size punch to prevent damage to the shift shaft.

(4) Pull shift shaft straight out of rear housing, shift socket, fifth-reverse fork and 1-2 fork (Fig. 14).

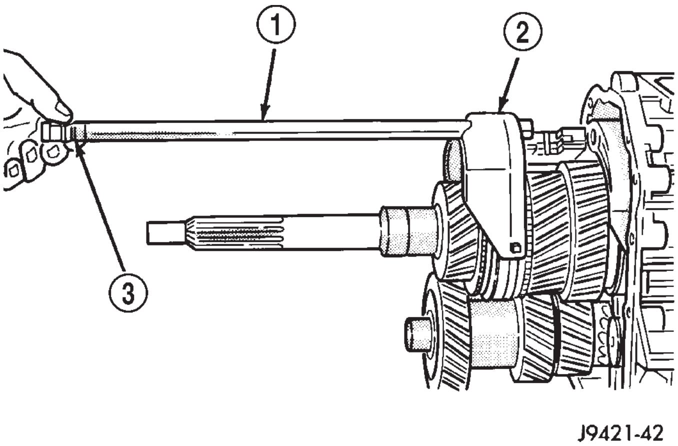


Fig. 14 SHIFT SHAFT

1 - SHIFT SHAFT
2 - 3-4 FORK
3 - SHAFT DETENT NOTCHES

(5) Remove shift socket from rear housing (Fig. 15).

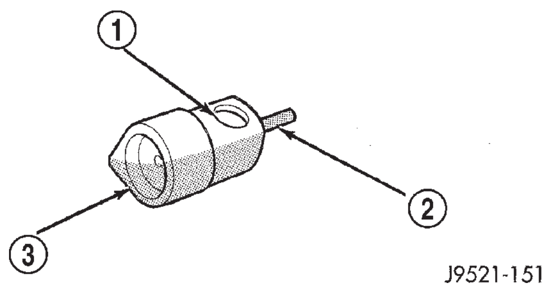


Fig. 15 SHIFT SOCKET AND ROLL PIN

1 - SHAFT BORE
2 - ROLL PIN
3 - SHIFT SOCKET

(6) Remove lever and bushing (Fig. 16).

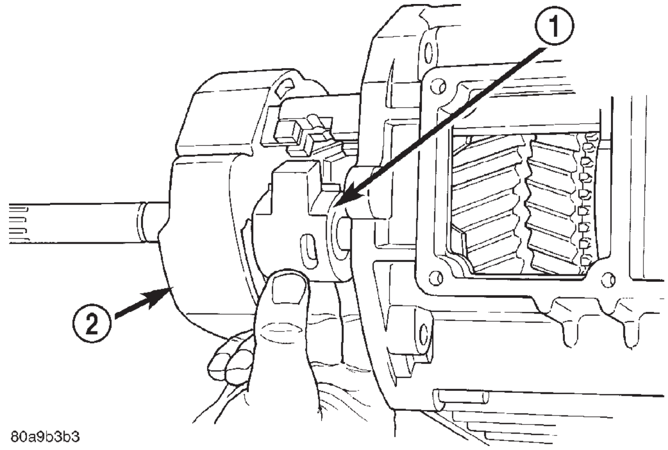


Fig. 16 SHIFT SHAFT LEVER AND BUSHING

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. 17).

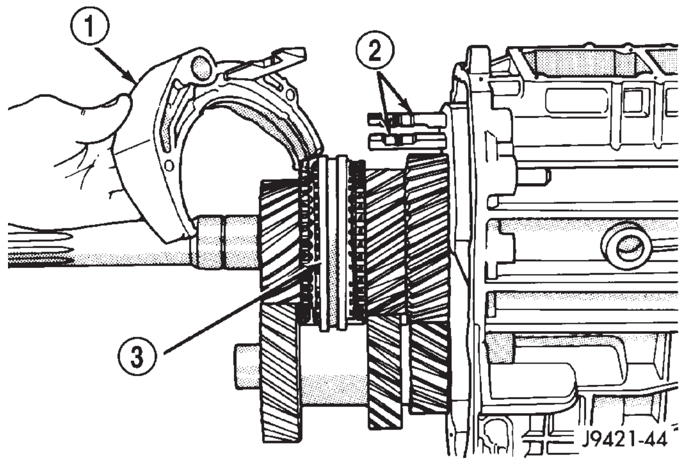


Fig. 17 3-4 SHIFT FORK

1 - 3-4 FORK
2 - 1-2 AND 5TH-REVERSE FORK ARMS
3 - 3-4 SYNCHRO SLEEVE

MANUAL - NV1500 (Continued)

(8) Remove front reverse idler shaft support bolt and loosen rear bolt (Fig. 18).

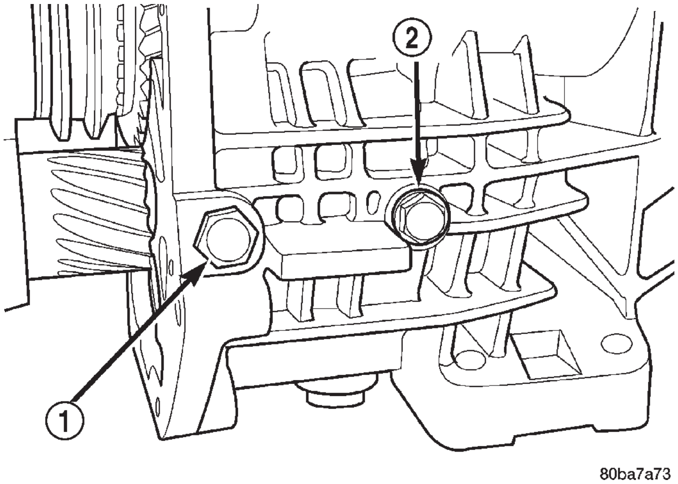


Fig. 18 REVERSE IDLER SHAFT/SUPPORT BOLT

1 - SUPPORT BOLT
2 - SHAFT BOLT

(9) Remove reverse idler shaft support by sliding it straight out of housing.

(10) Remove rear reverse idler shaft bolt.

(11) Remove reverse idler shaft, idler gear, bearing and thrust washer (Fig. 19).

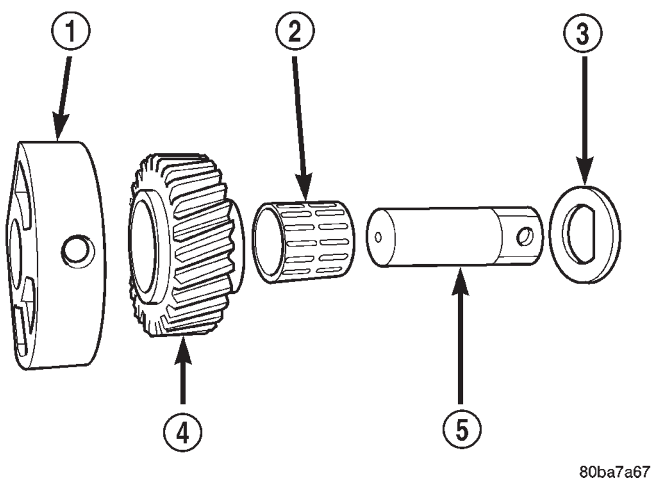


Fig. 19 REVERSE IDLER ASSEMBLY

1 - SUPPORT
2 - BEARING
3 - WASHER
4 - GEAR
5 - SHAFT

GEARTRAIN

(1) Remove output shaft bearing retainer bolts (Fig. 20). Bolts are rear of shift tower opening.

(2) Grab hold of mainshaft and countershaft and remove geartrain from rear housing (Fig. 21).

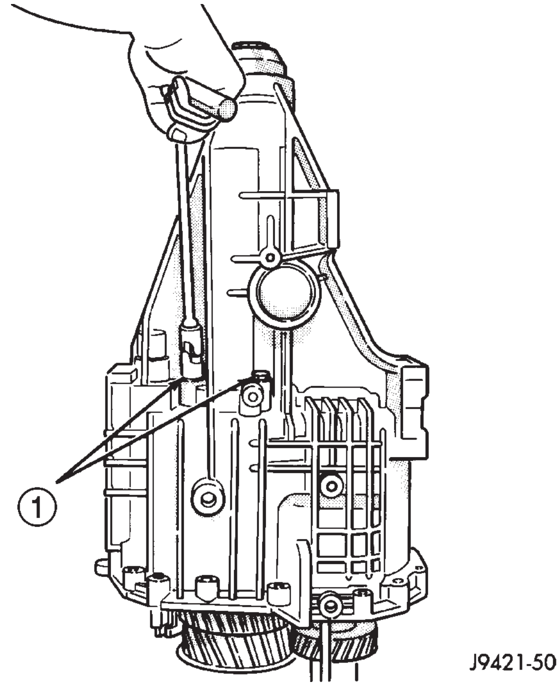


Fig. 20 OUTPUT SHAFT BEARING RETAINER BOLTS

1 - OUTPUT SHAFT BEARING RETAINER BOLTS (THIRD BOLT AT OPPOSITE SIDE OF CASE)

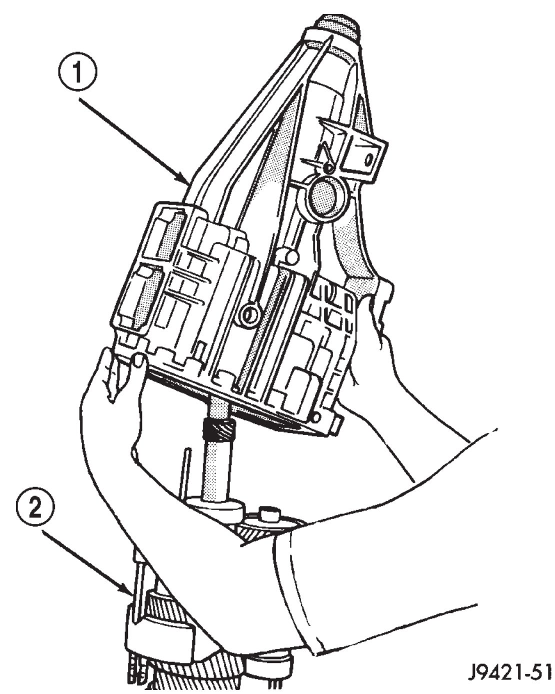


Fig. 21 REAR HOUSING

1 - REAR HOUSING
2 - SHIFT FORKS AND GEARTRAIN

MANUAL - NV1500 (Continued)

GEARTRAIN

(1) Remove 1-2 and fifth-reverse forks from synchro sleeves.

(2) Separate countershaft from mainshaft.

(3) Separate input shaft from output shaft.

COUNTERSHAFT

(1) Remove countershaft front and rear bearing with Puller 8356.

(2) Remove rear bearing race (in rear housing) with Bearing Race Remover L-4454. Install new race with Driver C-4656 and Driver Handle C-4171.

(3) Remove bearing shim cap from front housing (below input shaft bearing retainer). Remove shim. Drive race through and out of housing with Driver C-4656 and Driver Handle C-4171. Install new race into housing from outside. **Do not drive all the way into position. Tightening the shim cap will install the race to the proper position.** Install shim and shim cap and torque cap bolts to 28.5 N·m (21 ft. lbs.).

OUTPUT SHAFT

NOTE: Synchronizer hubs and sleeves are different. Remove synchronizer unit as an assembly to avoid intermixing parts. Mark each synchro hub and sleeve for assembly reference.

(1) Remove snap ring that secures 3-4 synchro hub on output shaft.

(2) Remove 3-4 synchro assembly, third gear synchro ring and third gear with a shop press and Splitter 1130. Position splitter between second and third gears.

(3) Remove third gear needle bearing (Fig. 22).

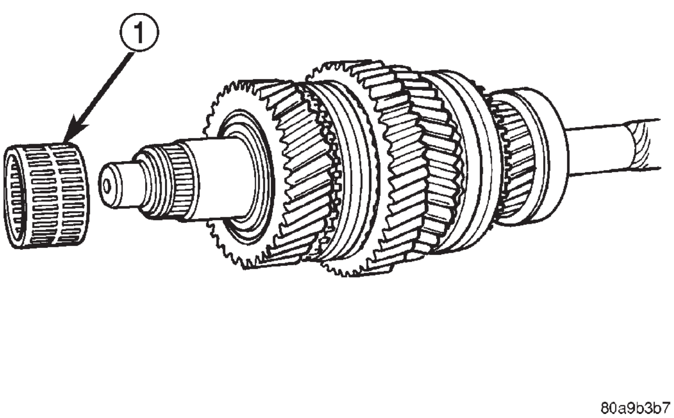


Fig. 22 THIRD GEAR NEEDLE BEARING

1 - THIRD GEAR NEEDLE BEARING

(4) Remove retaining ring that secures two-piece thrust washer on shaft.

(5) Remove two-piece thrust washer (Fig. 23). Note position of washer locating lugs in shaft notches for installation reference.

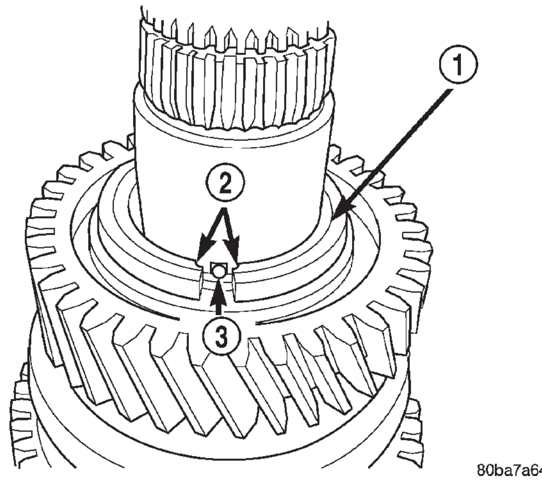


Fig. 23 TWO-PIECE THRUST WASH

1 - WASHER (2 HALVES)
2 - PIN RELIEF
3 - PIN

(6) Remove second gear and needle bearing (Fig. 24).

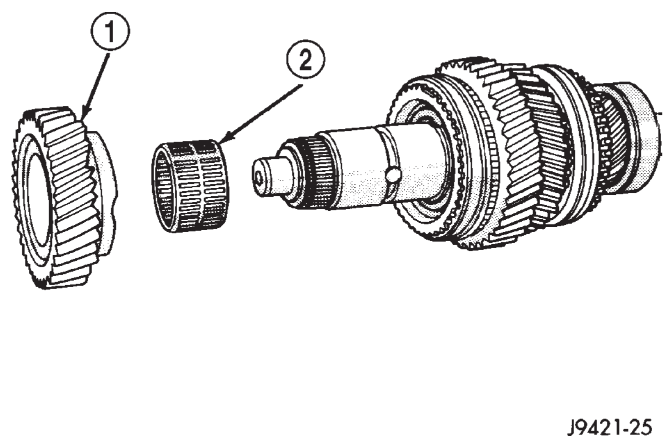


Fig. 24 SECOND GEAR AND NEEDLE BEARING

1 - SECOND GEAR
2 - SECOND GEAR NEEDLE BEARING

(7) Remove 2nd-3rd gear thrust washer locating pin.

(8) Remove second gear synchro ring and synchro cone.

(9) Remove 1-2 synchro hub snap ring.

MANUAL - NV1500 (Continued)

(10) Remove 1-2 synchro hub and sleeve and first gear from output shaft with shop press and Splitter 1130 (Fig. 25). Position splitter between first and reverse gears.

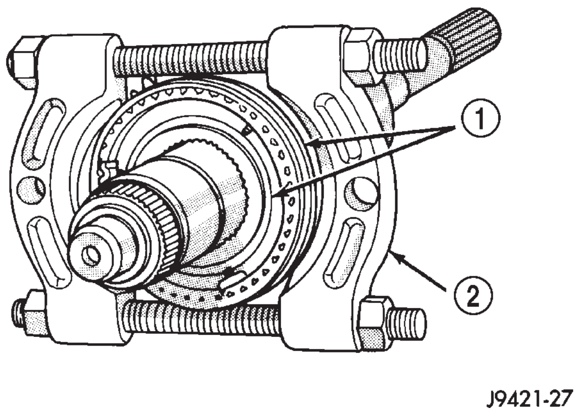


Fig. 25 1-2 SYNCHRO HUB AND SLEEVE

1 - 1-2 SYNCHRO HUB AND SLEEVE
2 - SPECIAL TOOL
1130

(11) Remove first gear needle bearing (Fig. 26).

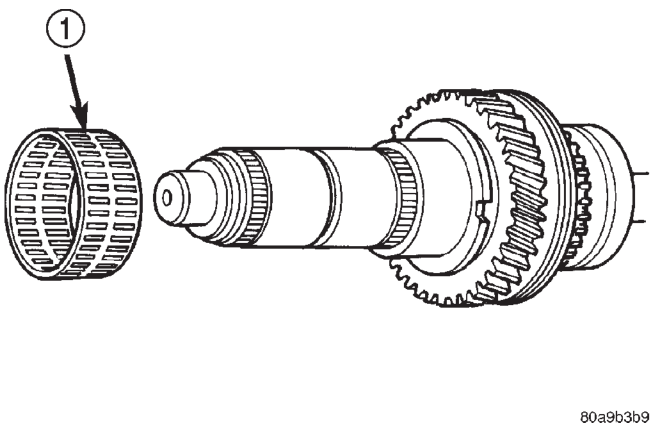


Fig. 26 FIRST GEAR NEEDLE BEARING

1 - FIRST GEAR NEEDLE BEARING

(12) Remove output shaft bearing snap ring (Fig. 27).

(13) Remove output shaft bearing from shaft with shop press and Splitter 1130. Position splitter between bearing and fifth gear.

(14) Remove fifth gear (Fig. 28).

(15) Remove fifth gear needle bearing. Spread bearing apart just enough to clear shoulder on output shaft (Fig. 29).

(16) Remove fifth-reverse synchro hub snap ring (Fig. 30).

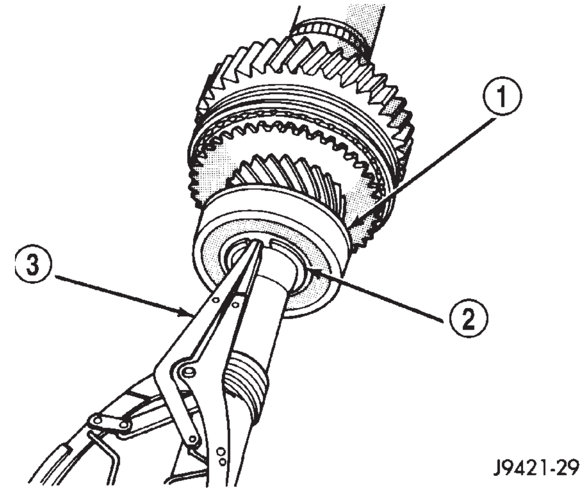


Fig. 27 OUTPUT SHAFT BEARING SNAP RING

1 - OUTPUT SHAFT BEARING
2 - BEARING SNAP RING
3 - SNAP RING PLIERS

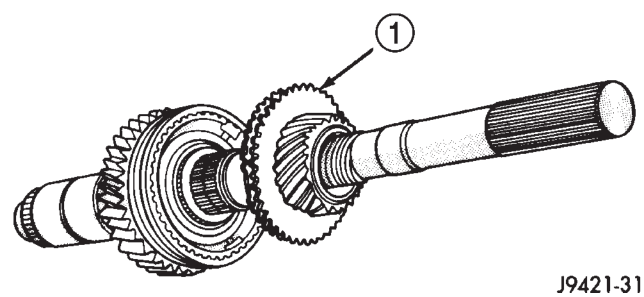


Fig. 28 FIFTH GEAR

1 - FIFTH GEAR AND SYNCHRO RING

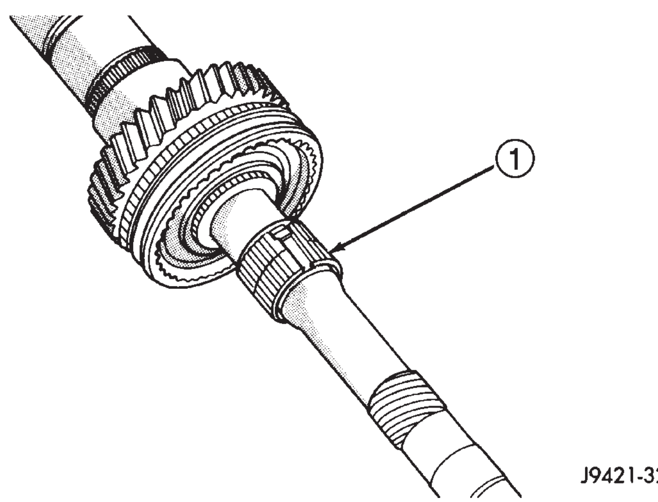


Fig. 29 FIFTH GEAR NEEDLE BEARING

1 - FIFTH GEAR NEEDLE BEARING

MANUAL - NV1500 (Continued)

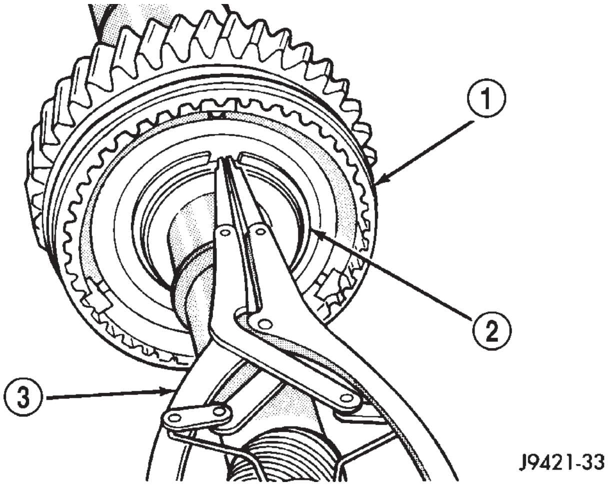


Fig. 30 FIFTH REVERSE SYNCHRO HUB SNAP RING

1 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
2 - SYNCHRO HUB SNAP RING
3 - SNAP RING PLIERS

(17) Remove fifth-reverse synchro hub and sleeve with shop press (Fig. 31).

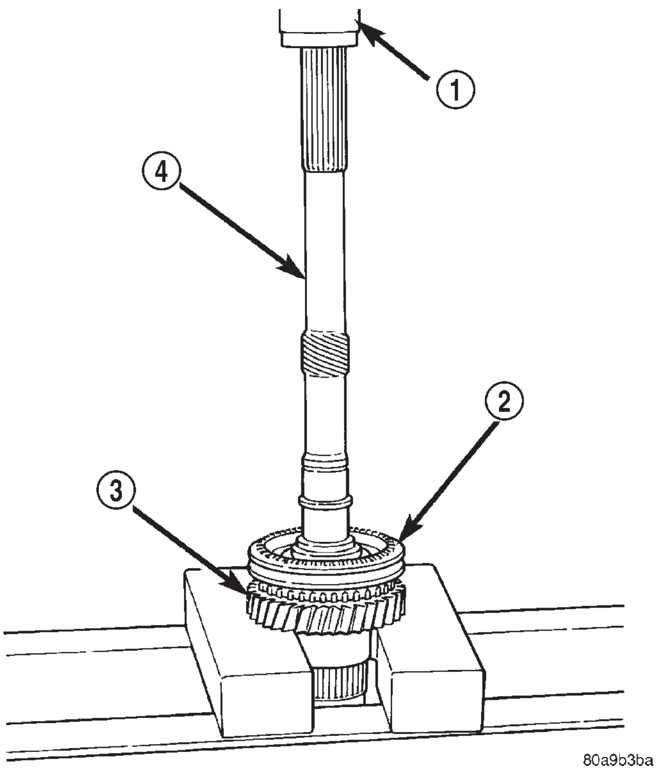


Fig. 31 FIFTH-REVERSE SYNCHRO HUB AND SLEEVE

1 - PRESS
2 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
3 - REVERSE GEAR
4 - OUTPUT SHAFT

(18) Remove reverse gear and needle bearing (Fig. 32).

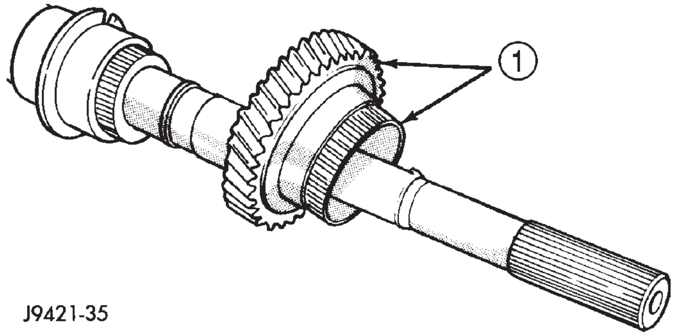


Fig. 32 REVERSE GEAR AND NEEDLE BEARING

1 - REVERSE GEAR AND NEEDLE BEARING

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

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. 33). Replace any fork exhibiting wear or damage in these areas. Do not attempt to salvage shift forks.

Check condition of the shift shaft detent plunger and spring. The plunger should be smooth and free of nicks or scores. The plunger spring should be straight and not collapsed or distorted. Minor scratches or nicks on the plunger can be smoothed with 320/400 grit emery soaked in oil. Replace the plunger and spring if in doubt about condition. Check condition of detent plunger bushings. Replace if damaged.

Inspect the shift shaft, shift shaft bushing and bearing. The shaft lever and the lever bushing that fits over the lever. Replace the shaft if bent, cracked, or severely scored. Minor burrs, nicks or scratches

MANUAL - NV1500 (Continued)

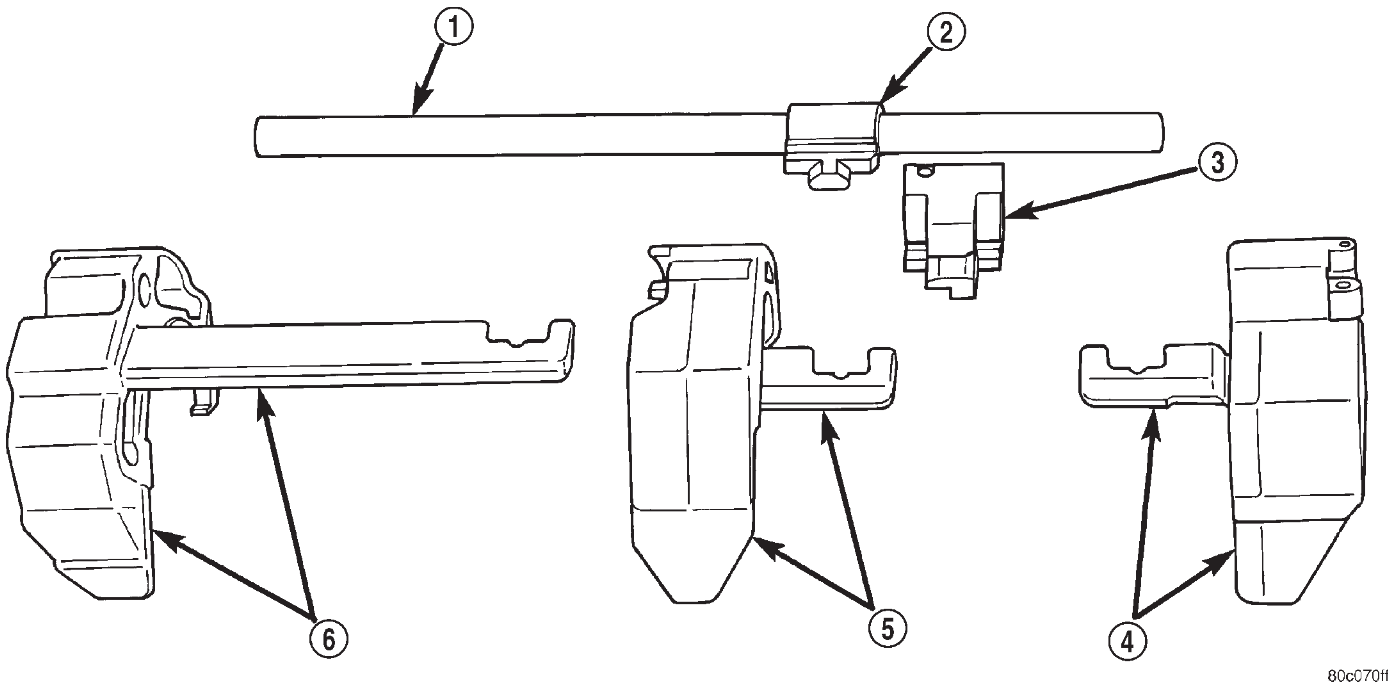


Fig. 33 SHIFT FORKS AND SHAFT

1 - SHIFT SHAFT
2 - SHAFT LEVER
3 - SHAFT LEVER BUSHING
4 - 3-4 SHIFT FORK
5 - 1-2 SHIFT FORK
6 - FIFTH-REVERSE SHIFT FORK

can be smoothed off with 320/400 grit emery cloth followed by polishing with crocus cloth. Replace the shift shaft bushing or bearing if damaged.

Replace the shaft lever and bushing if either part is deformed, or worn. Do not attempt to salvage these parts as shift fork binding will occur. Replace the roll pin that secures the lever to the shaft.

FRONT/REAR HOUSINGS AND BEARING RETAINERS

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.

Inspect the housings carefully. Look for cracks, stripped threads, scored mating surfaces, damaged bearing bores or worn dowel pin holes. Minor nicks on mating surfaces can be dressed off with a fine file or emery cloth. Damaged threads can be renewed by either re-tapping or installing Helicoil inserts.

NOTE: The front housing contains the countershaft front bearing race. The rear housing contains the countershaft rear bearing race. If a countershaft bearing failure results, the bearing races must be replaced also.

Inspect input shaft bearing retainer. Be sure the release bearing slide surface of the retainer is in good condition. Minor nicks on the surface can be smoothed off with 320/420 grit emery cloth and final polished with oil coated crocus cloth. Replace the retainer seal if necessary.

Inspect 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 are standard tapered roller bearings with matching races. The races are pressed into the front and rear housings. Inspect countershaft bearings and races for abnormal wear or damage.

REVERSE IDLER COMPONENTS

Inspect idler gear, bearing, shaft, thrust washer and support for excessive wear or failure (Fig. 34). Replace bearing if any of the needle bearing rollers

MANUAL - NV1500 (Continued)

are worn, chipped, cracked, flat-spotted or brinnelled. Also replace the bearing if the plastic bearing cage is damaged or distorted.

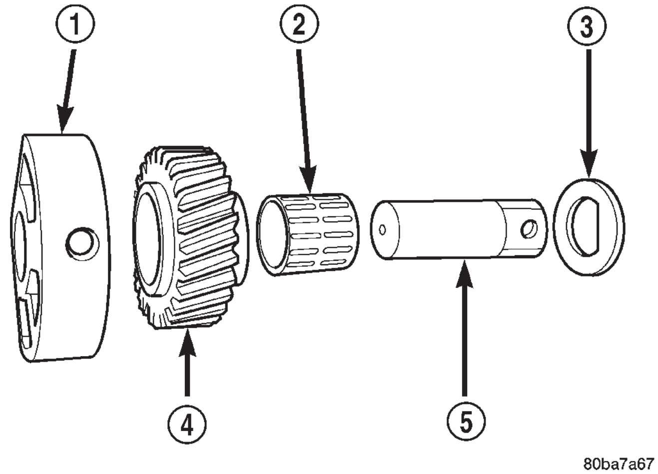


Fig. 34 REVERSE IDLER ASSEMBLY

1 - SUPPORT
2 - BEARING
3 - WASHER
4 - GEAR
5 - SHAFT

Replace thrust washer, if cracked, chipped or worn. Replace idler gear if the teeth are chipped, cracked or worn thin. Replace shaft if worn, scored or the bolt threads are damaged beyond repair. Replace support segment if cracked or chipped and replace the idler attaching bolts if the threads are damaged.

Shift Socket

Inspect shift socket for wear or damage. Replace socket if the roll pin or shift shaft bores are damaged. Minor nicks in the shift lever ball seat in the socket can be smoothed down with 400 grit emery or wet/dry paper. Replace socket if the ball seat is worn, or cracked. Do not reuse the original shift socket roll pin. The socket roll pin is approximately is approximately 33 mm (1-1/4 in.) long.

Output Shaft And Geartrain

Inspect all gears for worn, cracked, chipped or broken teeth. 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 shaft splines and bearings surfaces. Minor nicks on the bearing surfaces can be smoothed with 320/420 grit emery and final polished with crocus cloth. Replace the shaft if the splines are damaged or bearing surfaces are deeply scored, worn or brinnelled.

ASSEMBLY

SYNCHRONIZER

NOTE: The easiest method of assembling each synchro is to install the springs, struts and detent balls one at a time.

(1) Slide the sleeve part way onto the hub. Leave enough room to install the spring in the hub and the strut in the hub groove.

(2) Install first spring in the hub and then install a strut over the spring. Verify spring is seated in the spring bore in the strut.

(3) Slide the sleeve onto the hub just far enough to hold the first strut and spring in place.

(4) Place detent ball in the top of the strut. Then 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.

(5) Repeat procedure for the remaining springs, struts and balls. Tape or rubber band each strut and ball temporarily as they are installed.

(6) Verify the three springs, struts and detent balls are all in place (Fig. 35).

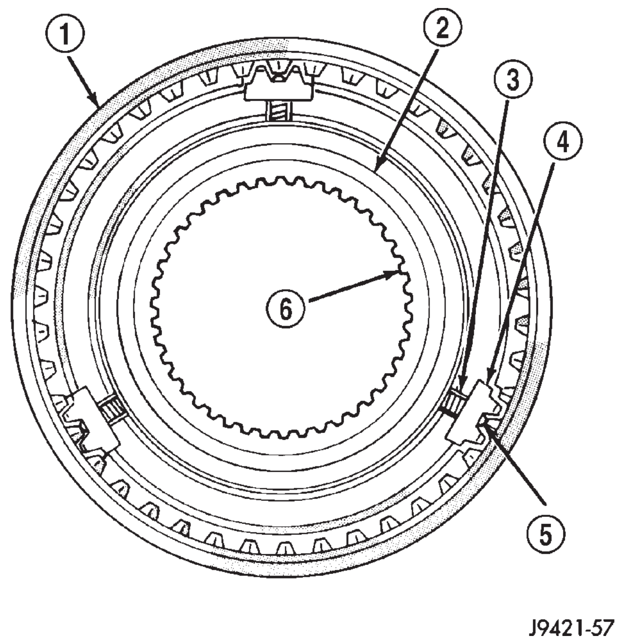


Fig. 35 ASSEMBLED SYNCHRO COMPONENTS

1 - SLEEVE
2 - HUB SHOULDER
3 - SPRING (3)
4 - STRUT (3)
5 - DETENT BALL (3)
6 - HUB

MANUAL - NV1500 (Continued)

OUTPUT SHAFT

NOTE: Lubricate shaft, gears and bearings with recommended lubricant and immerse each synchro ring in lubricant before installation. Petroleum jelly can be used to hold parts in place.

(1) Install reverse gear needle bearing on shaft (Fig. 36). Slide bearing up against shoulder on output shaft.

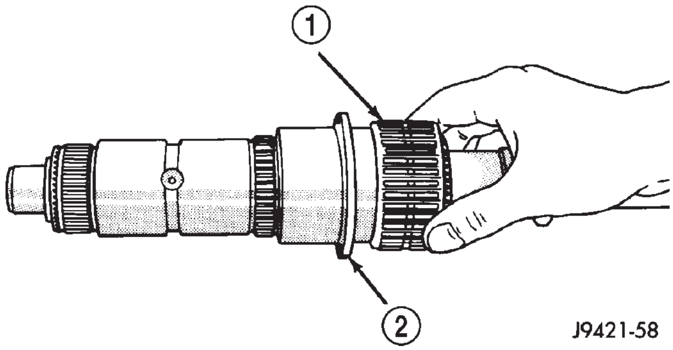


Fig. 36 REVERSE GEAR BEARING

1 - REVERSE GEAR BEARING
2 - SHOULDER

(2) Install reverse gear over needle bearing (Fig. 37).

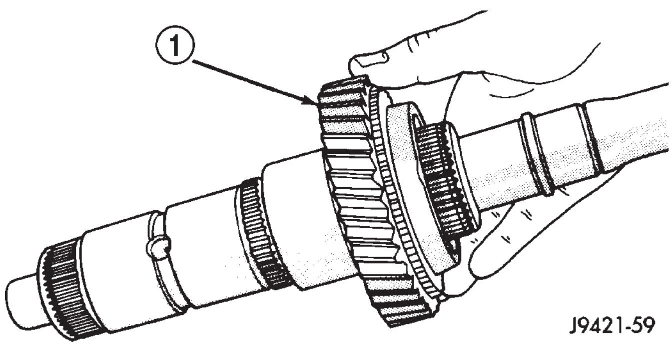


Fig. 37 REVERSE GEAR

1 - REVERSE GEAR

(3) Install solid brass synchro ring on reverse gear (Fig. 38).

NOTE: This synchro ring is different than all the rest. The angle on the friction face is 9° versus the 6.5° of all the other synchro rings.

(4) Start fifth-reverse synchro assembly on output shaft splines by hand. Then seat synchro onto shaft with shop press and Remover 6310-1 (Fig. 39).

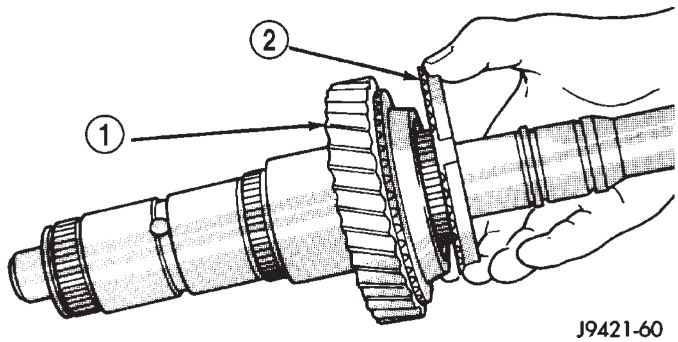


Fig. 38 REVERSE GEAR SYNCHRO RING

1 - REVERSE GEAR
2 - SYNCHRO RING (SOLID BRASS)

CAUTION: Fifth-reverse synchro hub and sleeve can be installed backwards. One side of the sleeve has double grooves and offset teeth. This side must be installed away from reverse gear (towards 5th).

NOTE: The synchro hub is a press fit design. There may be instances where the press is not necessary. As long as there is a snug fit between the hub and the shaft, the hub does not need to be replaced.

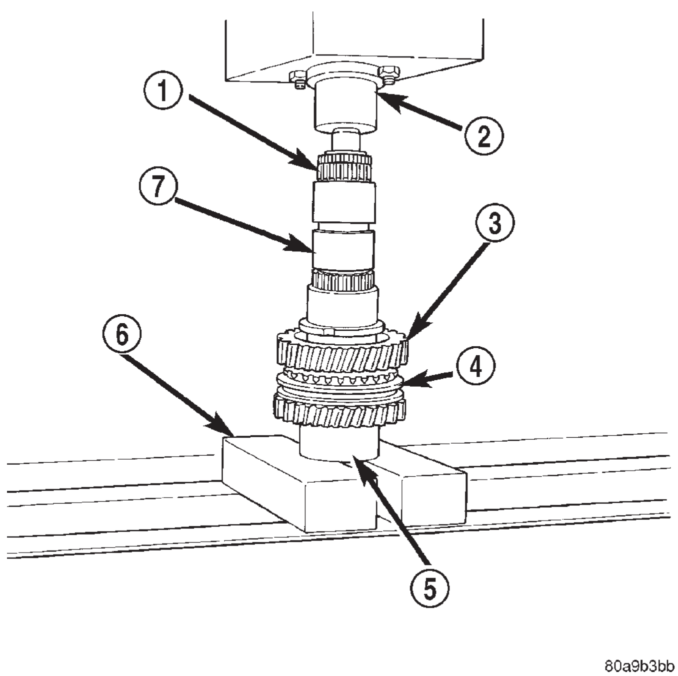


Fig. 39 FIFTH-REVERSE SYNCHRO ASSEMBLY

1 - SPACER
2 - PRESS RAM
3 - REVERSE GEAR
4 - FIFTH-REVERSE SYNCHRO ASSEMBLY
5 - SPECIAL TOOL 6310-1
6 - PRESS BLOCKS
7 - OUTPUT SHAFT

MANUAL - NV1500 (Continued)

(5) Install **new** fifth-reverse hub snap ring (Fig. 40) and verify snap ring is seated in the shaft groove.

NOTE: Install thickest snap ring that will fit in shaft groove.

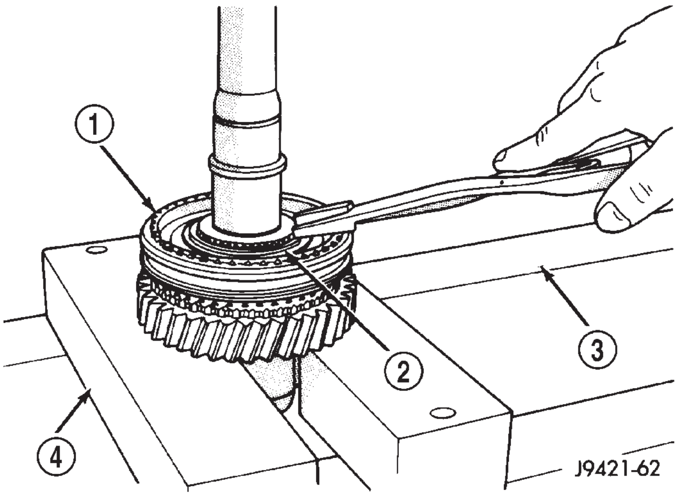


Fig. 40 FIFTH-REVERSE SYNCHRO HUB SNAP RING

1 - FIFTH-REVERSE SYNCHRO ASSEMBLY
2 - SNAP RING
3 - PRESS BED
4 - PRESS BLOCKS

(6) Install fifth gear synchro ring in synchro hub and sleeve (Fig. 41).

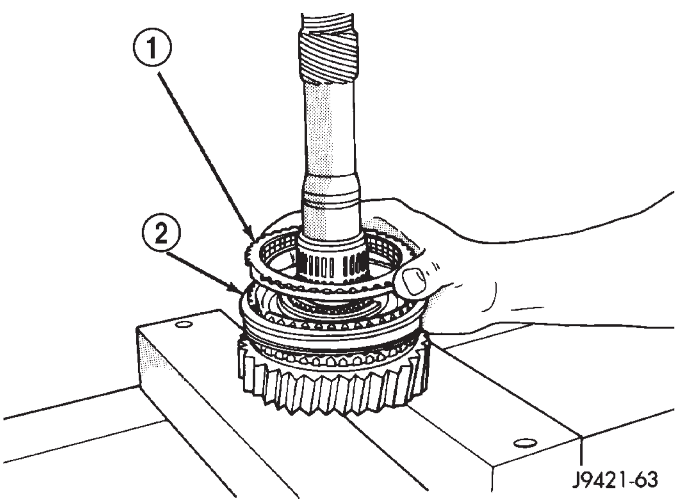


Fig. 41 FIFTH GEAR SYNCHRO RING

1 - FIFTH-SPEED SYNCHRO RING
2 - FIFTH-REVERSE SYNCHRO ASSEMBLY

(7) Install fifth gear bearing, spreading bearing only enough to clear shoulder on output shaft (Fig. 42). Verify bearing is seated.

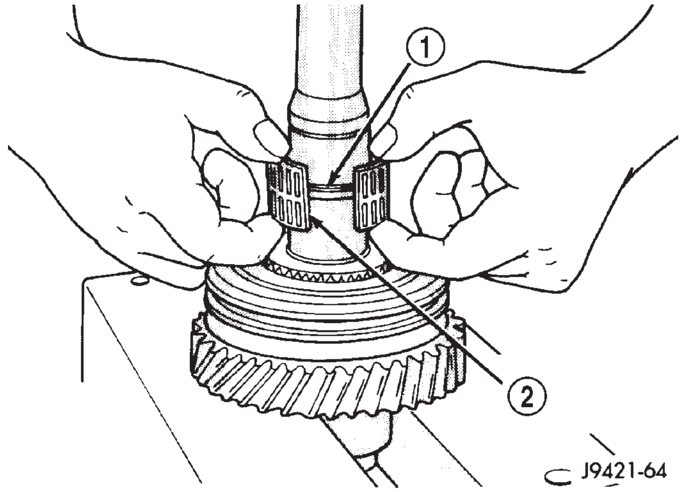


Fig. 42 FIFTH GEAR BEARING

1 - SHAFT SHOULDER
2 - FIFTH GEAR BEARING

(8) Install fifth gear on shaft and onto bearing (Fig. 43).

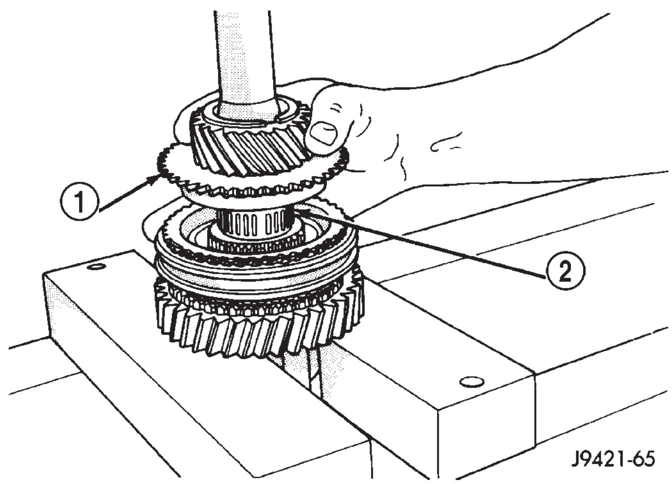


Fig. 43 FIFTH GEAR

1 - FIFTH GEAR
2 - BEARING

(9) Install output shaft bearing.

(10) Install output shaft bearing snap ring, spread snap ring only enough to install it (Fig. 44). Verify snap ring is seated in shaft groove.

MANUAL - NV1500 (Continued)

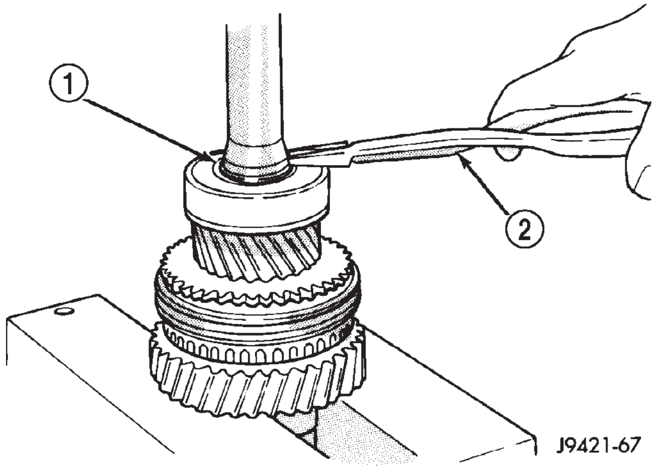


Fig. 44 OUTPUT SHAFT BEARING

1 - BEARING SNAP RING
2 - HEAVY DUTY SNAP RING PLIERS

(11) Invert output shaft and set the shaft in Remover 6310-1 so that fifth gear is seated on the tool (Fig. 45).

(12) Install first gear bearing on output shaft (Fig. 45). Verify bearing is seated on shaft shoulder and is properly joined.

(13) Install synchro cone onto first gear. Verify synchro cone locating tabs are properly located to the recesses in first gear.

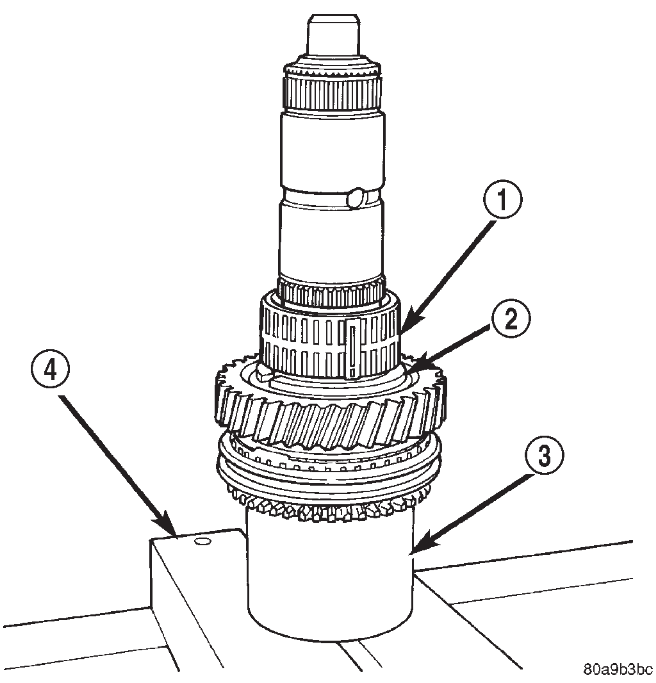


Fig. 45 FIRST GEAR BEARING

1 - FIRST GEAR BEARING
2 - SHAFT SHOULDER
3 - SPECIAL TOOL 6310-1
4 - PRESS BLOCKS

(14) Install first gear on shaft and over bearing with bearing synchro cone facing up (Fig. 46).

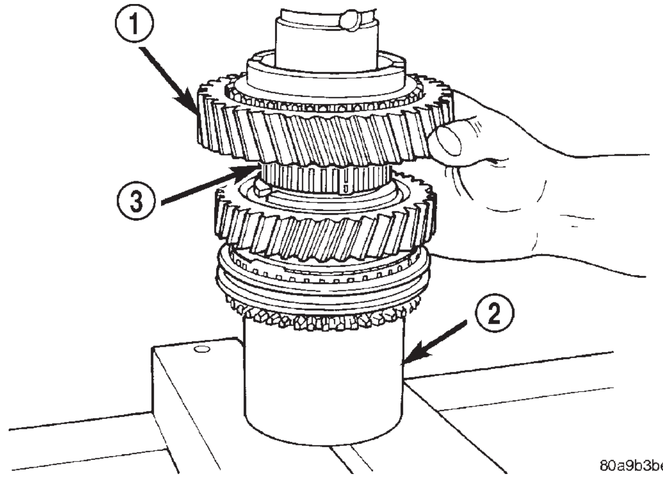


Fig. 46 FIRST GEAR

1 - FIRST GEAR
2 - SPECIAL TOOL 6310-1
3 - BEARING

(15) Install first gear synchro ring (Fig. 47).

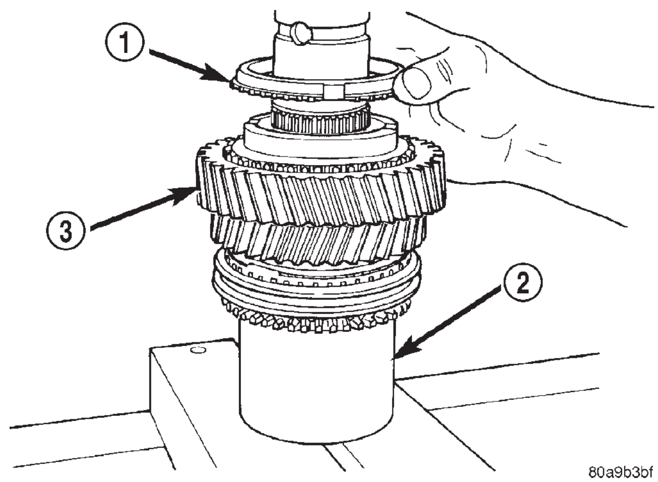


Fig. 47 FIRST GEAR SYNCHRO RING

1 - FIRST GEAR SYNCHRO RING
2 - SPECIAL TOOL 6310-1
3 - FIRST GEAR

(16) Start 1-2 synchro assembly on shaft by hand (Fig. 48). Be sure synchro sleeve is properly positioned.

CAUTION: The 1-2 synchro hub and sleeve can be installed backwards. One side of the sleeve has a groove and offset teeth. This side must be installed towards 1st gear (away from 2nd gear).

MANUAL - NV1500 (Continued)

NOTE: The synchro hub is a press fit design. There may be instances where the press is not necessary. As long as there is a snug fit between the hub and the shaft, the hub does not need to be replaced.

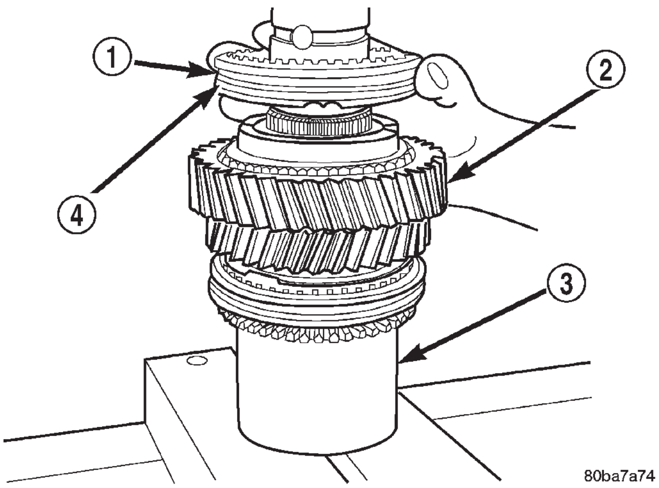


Fig. 48 START 1-2 SYNCHRO ON SHAFT

1 - 1-2 SYNCHRO ASSEMBLY
2 - FIRST GEAR
3 - SPECIAL TOOL 6310-1
4 - BE SURE THIS IS SINGLE GROOVE SIDE OF SYNCHRO SLEEVE

(17) Press 1-2 synchro onto output shaft with suitable size pipe and shop press (Fig. 49).

CAUTION: Align synchro ring and sleeve as hub is being pressed onto the shaft. The synchro ring can be cracked if it becomes misaligned.

(18) Install **new** 1-2 synchro hub snap ring (Fig. 50) with the thickest snap ring that will fit in shaft groove. Verify snap ring is seated in shaft groove.

(19) Install second gear synchro ring in 1-2 synchro hub and sleeve (Fig. 51). Verify synchro ring is seated in sleeve.

(20) Install synchro cone into synchro ring.

(21) Install second gear needle bearing on shaft (Fig. 52).

(22) Install second gear onto shaft and bearing (Fig. 53). Verify second gear is seated on synchro components.

(23) Install thrust washer pin to shaft and install two-piece thrust washer (Fig. 54). Verify washer halves are seated in shaft groove and pin reliefs are positioned at washer locating pin.

(24) Seat retaining ring around two-piece thrust washer.

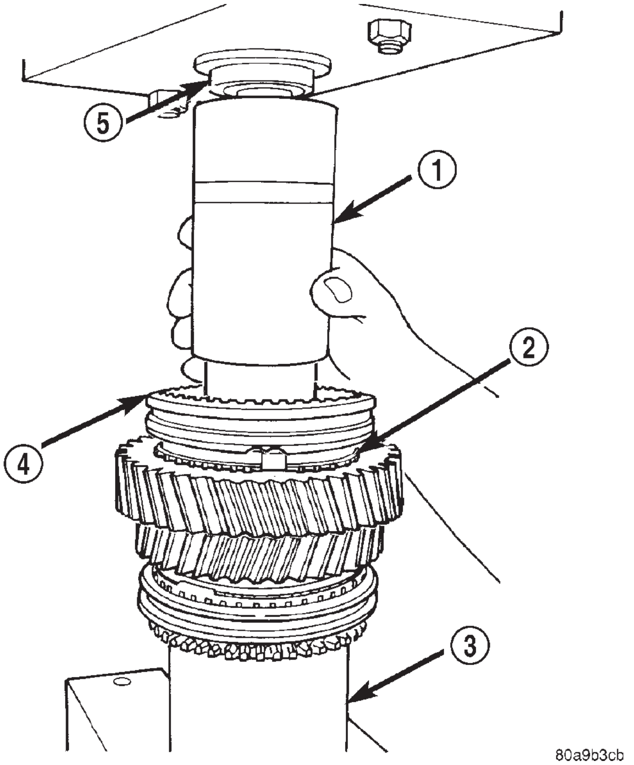


Fig. 49 PRESS 1-2 SYNCHRO ASSEMBLY

1 - SUITABLE SIZE PIPE TOOL
2 - SYNCHRO RING
3 - SPECIAL TOOL 6310-1
4 - 1-2 SYNCHRO ASSEMBLY
5 - PRESS RAM

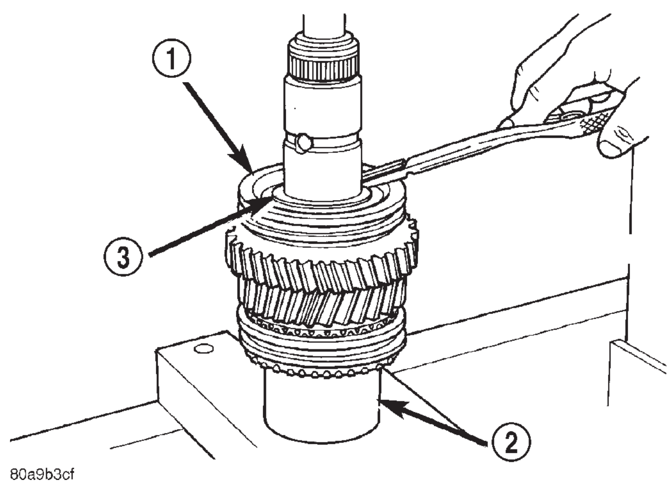


Fig. 50 1-2 SYNCHRO HUB SNAP RING

1 - 1-2 SYNCHRO
2 - SPECIAL TOOL 6310-1
3 - SYNCHRO SNAP RING

MANUAL - NV1500 (Continued)

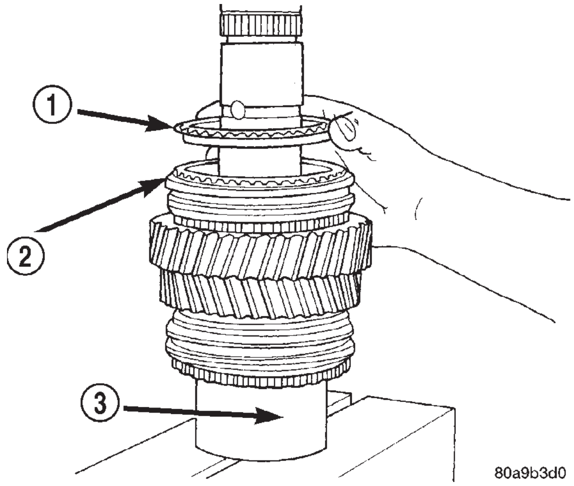


Fig. 51 SECOND GEAR SYNCHRO RING

1 - SECOND GEAR SYNCHRO RING
2 - 1-2 SYNCHRO
3 - SPECIAL TOOL
6310-1

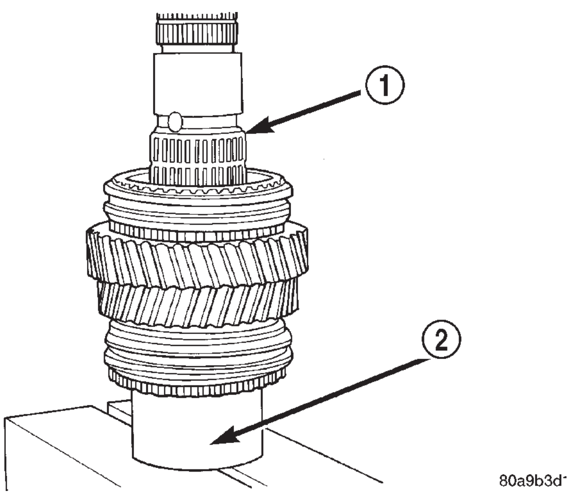


Fig. 52 SECOND GEAR BEARING

1 - SECOND GEAR BEARING
2 - SPECIAL TOOL
6310-1

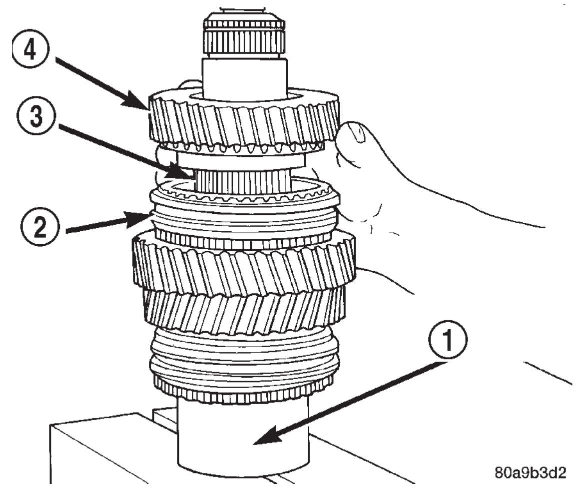


Fig. 53 SECOND GEAR

1 - SPECIAL TOOL
6310-1
2 - 1-2 SYNCHRO ASSEMBLY
3 - BEARING
4 - SECOND GEAR

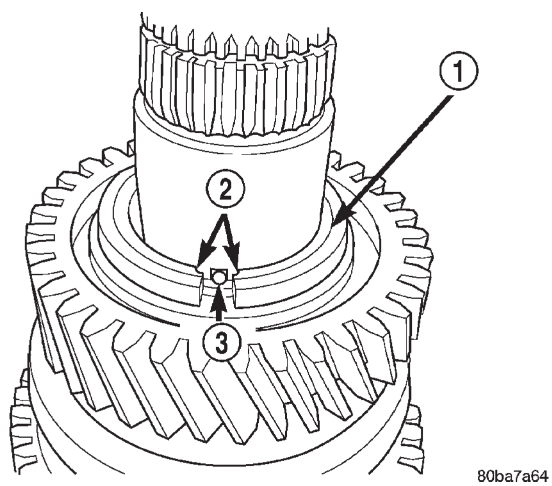


Fig. 54 TWO-PIECE THRUST WASH

1 - WASHER (2 HALVES)
2 - PIN RELIEF
3 - PIN

MANUAL - NV1500 (Continued)

(25) Install third gear needle bearing on shaft (Fig. 55).

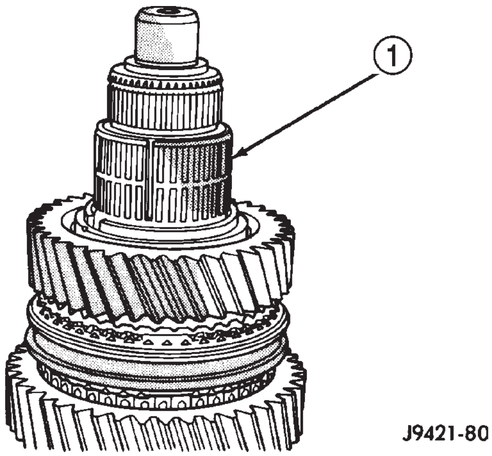


Fig. 55 THIRD GEAR BEARING

1 - THIRD GEAR BEARING

(26) Install third gear on shaft and bearing (Fig. 56).

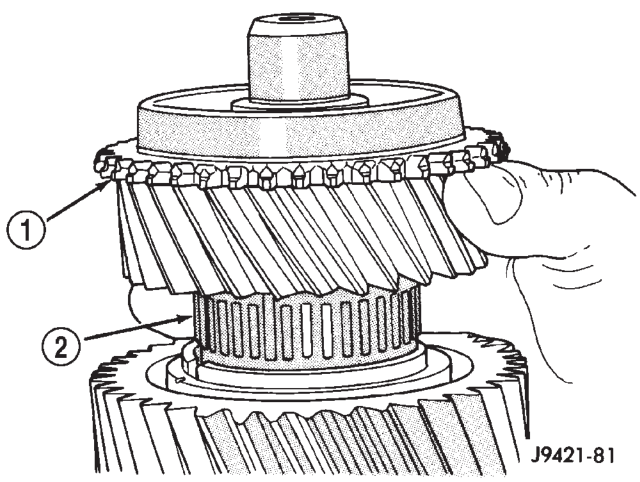


Fig. 56 THIRD GEAR

1 - THIRD GEAR
2 - BEARING

(27) Install third speed synchro ring on third gear (Fig. 57).

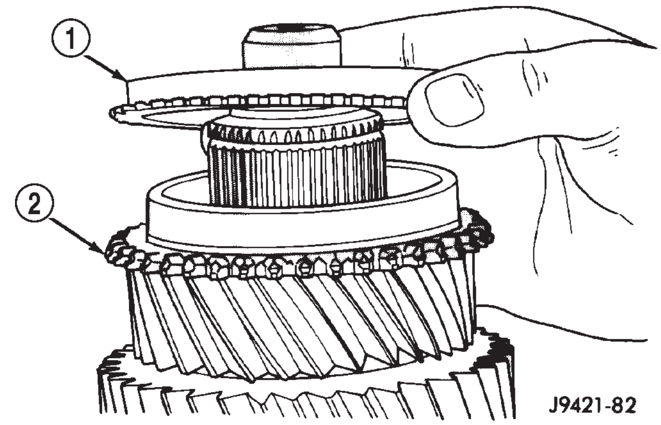


Fig. 57 THIRD SPEED SYNCHRO RING

1 - THIRD SPEED SYNCHRO RING
2 - THIRD GEAR

(28) Start 3-4 synchro hub on output shaft splines by hand (Fig. 58).

CAUTION: The 3-4 synchro hub and sleeve can be installed backwards. One side of the sleeve has two grooves and offset teeth. This side must be installed towards 3rd gear (away from 4th gear).

MANUAL - NV1500 (Continued)

NOTE: The synchro hub is a press fit design. There may be instances where the press is not necessary. As long as there is a snug fit between the hub and the shaft, the hub does not need to be replaced.

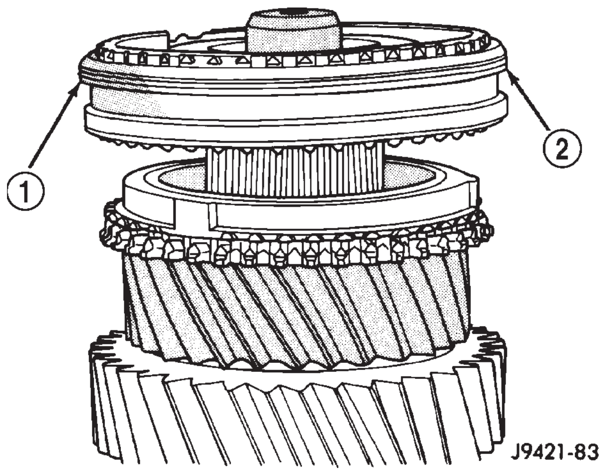


Fig. 58 START 3-4 SYNCHRO HUB ON OUTPUT SHAFT

1 - GROOVED SIDE OF SLEEVE (TO FRONT)
2 - 3-4 SYNCHRO ASSEMBLY

(29) Press 3-4 synchro assembly onto output shaft with shop press and suitable size pipe tool (Fig. 59). Press tool must be as close to the hub center as possible but not contacting the shaft splines.

(30) Install 3-4 synchro hub **new** snap ring (Fig. 60) with thickest snap ring that will fit in shaft groove. Verify snap ring is seated in groove.

(31) Verify position of synchro sleeves before proceeding (Fig. 61).

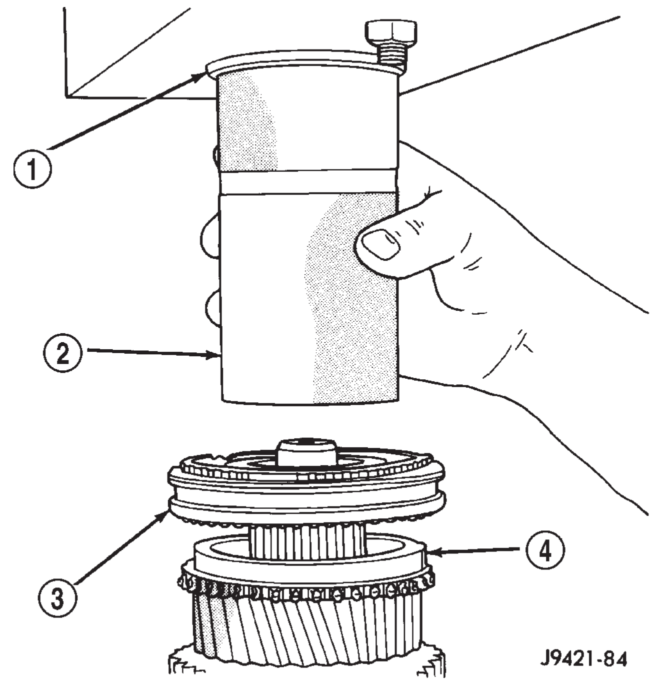


Fig. 59 PRESS 3-4 SYNCHRO ASSEMBLY ON SHAFT

1 - PRESS RAM
2 - PIPE TOOL
3 - 3-4 SYNCHRO
4 - THIRD SPEED SYNCHRO RING

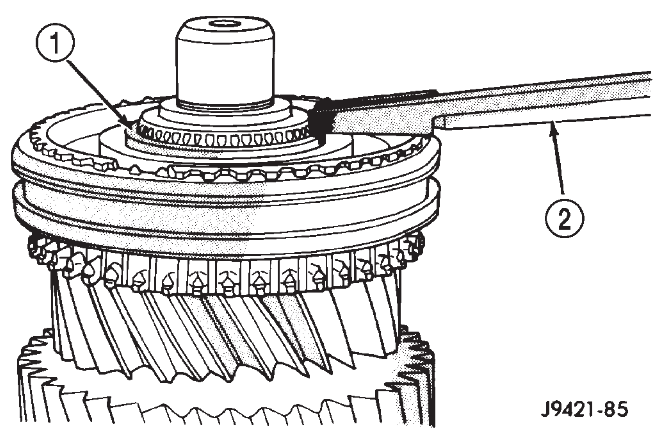


Fig. 60 3-4 SYNCHRO HUB SNAP RING

1 - 3-4 SYNCHRO HUB SNAP RING
2 - HEAVY DUTY SNAP RING PLIERS

MANUAL - NV1500 (Continued)

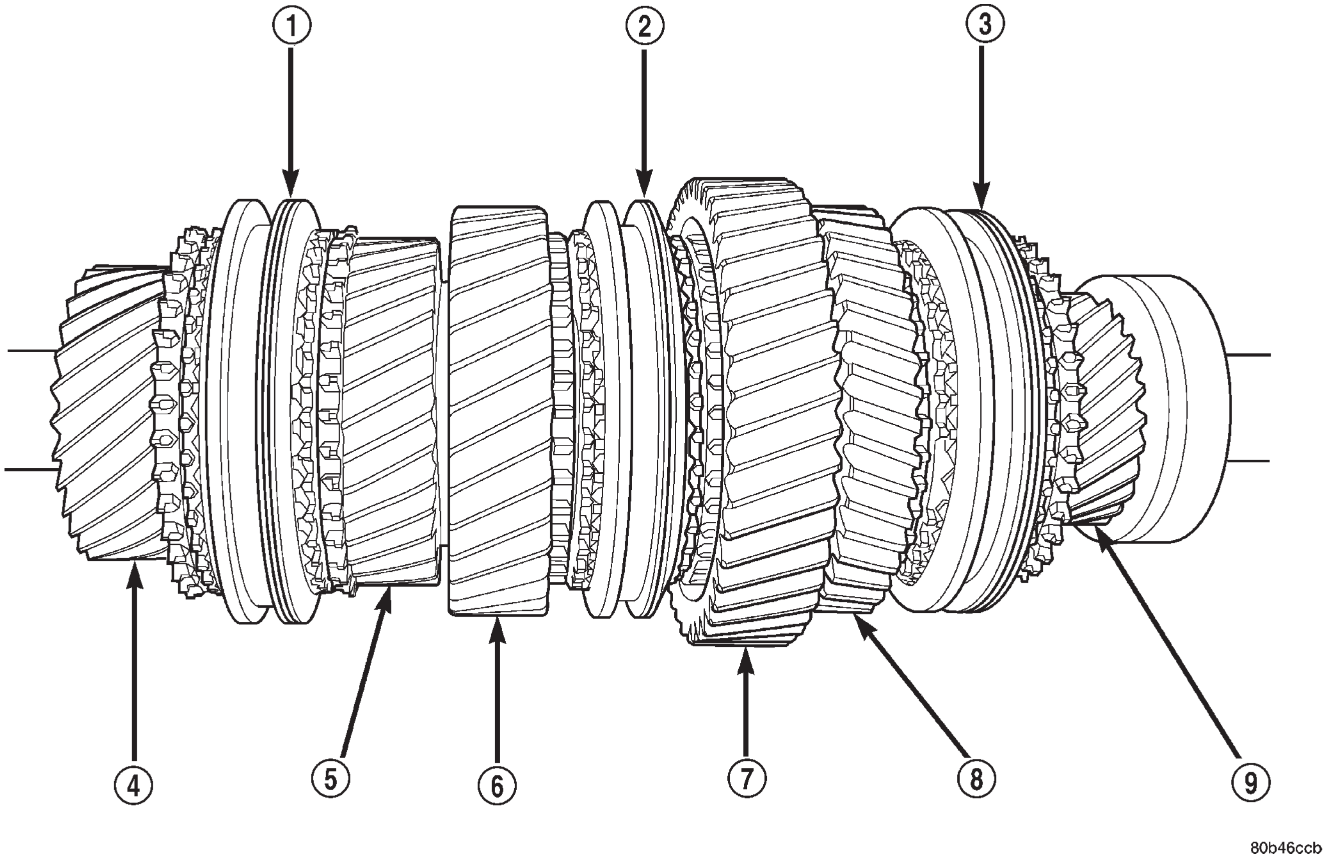


Fig. 61 SYNCHRO SLEEVE POSITION

1 - 2 GROOVES
2 - 1 GROOVE
3 - 2 GROOVES
4 - FOURTH GEAR
5 - THIRD GEAR
6 - SECOND GEAR
7 - FIRST GEAR
8 - REVERSE GEAR
9 - FIFTH GEAR

GEARTRAIN

(1) Install input shaft into Support Stand 8355 (Fig. 62).

(2) Install pilot bearing in input shaft (Fig. 62).

(3) Install fourth gear synchro ring on input shaft (Fig. 63).

(4) Install assembled output shaft and geartrain in input shaft (Fig. 64). Rotate output shaft until the 3-4 synchro ring seats in synchro hub and sleeve.

(5) Slide countershaft into fixture slot. Verify countershaft and output shaft gears are fully meshed with the mainshaft gears (Fig. 65).

(6) Thread one Pilot Stud 8120 in center or passenger side hole of output shaft bearing retainer. Then position retainer on fifth gear.

(7) Assemble 1-2 and fifth reverse-shift forks (Fig. 66). Arm of fifth-reverse fork goes through slot in 1-2 fork.

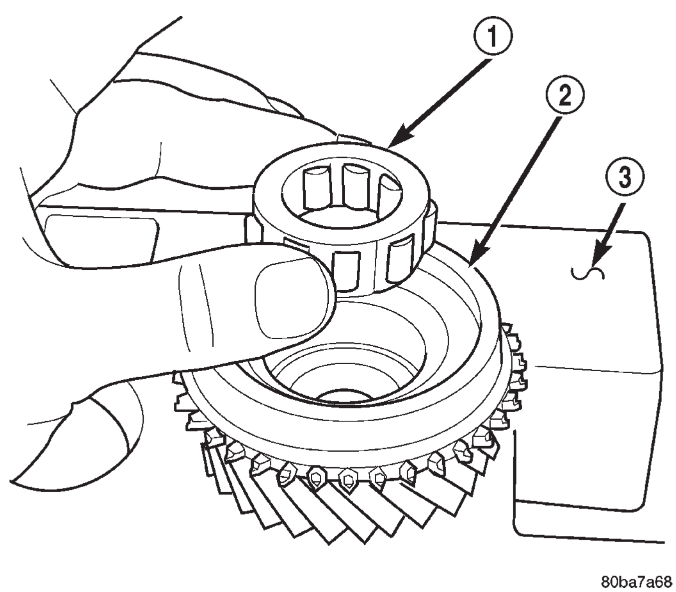


Fig. 62 INPUT SHAFT AND PILOT BEARING

1 - PILOT BEARING
2 - INPUT SHAFT
3 - STAND 8355

MANUAL - NV1500 (Continued)

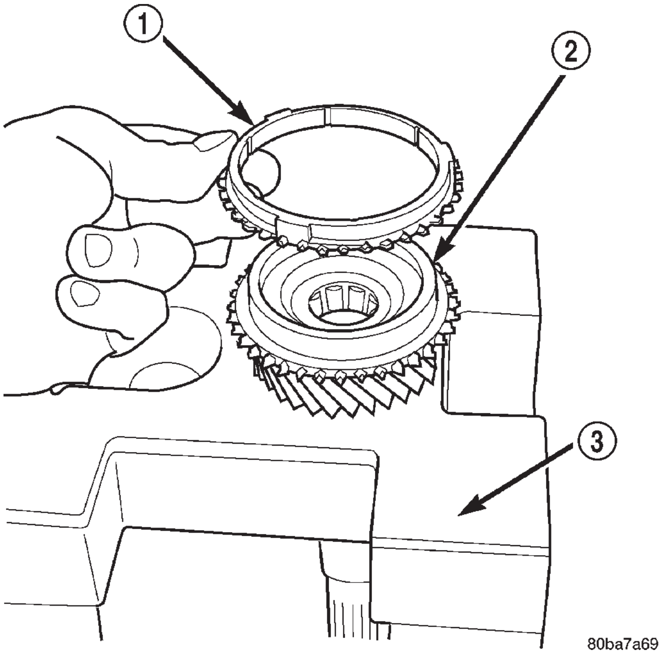


Fig. 63 FOURTH GEAR SYNCHRO RING ON INPUT SHAFT

1 - FOURTH GEAR SYNCHRO RING
2 - INPUT SHAFT
3 - STAND 8355

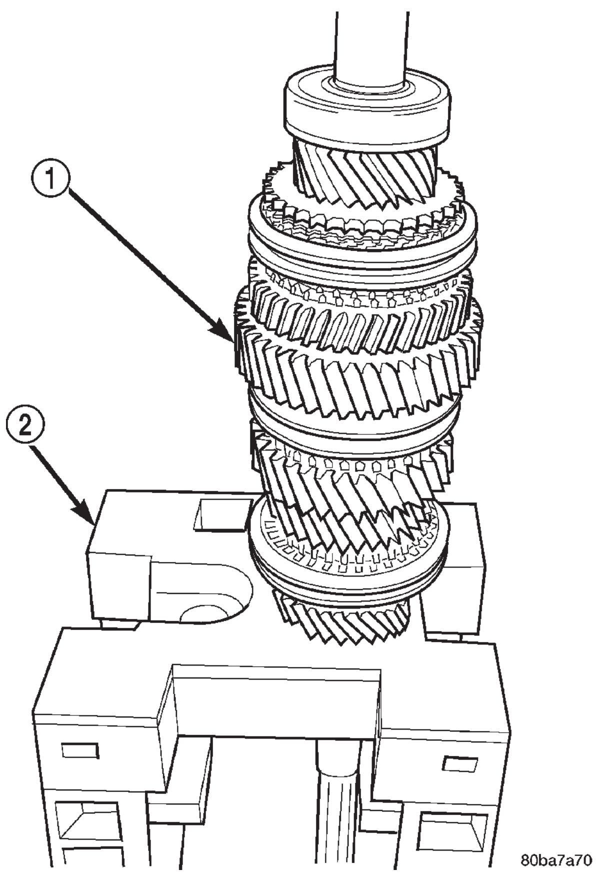


Fig. 64 MAINSHAFT ON SUPPORT STAND

1 - MAIN SHAFT
2 - SUPPORT STAND 8355

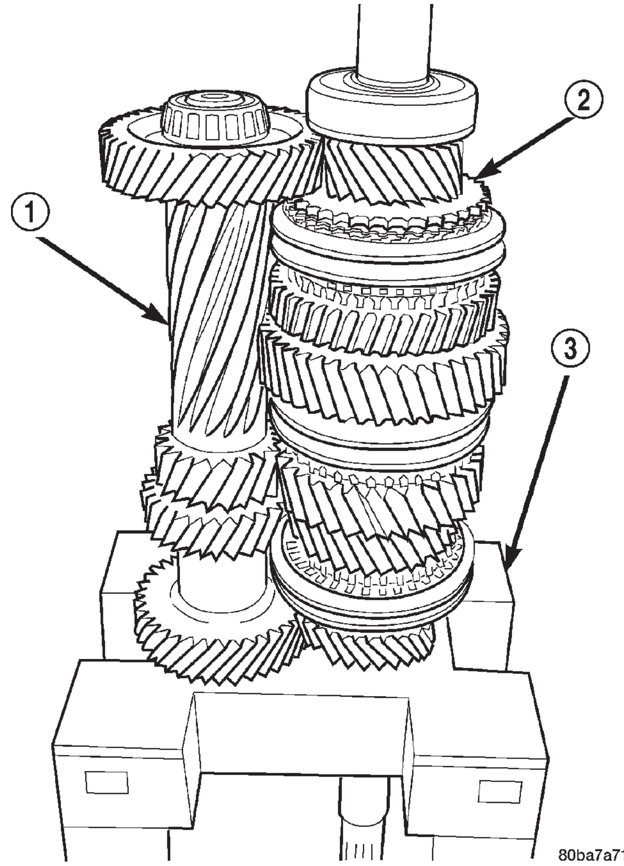


Fig. 65 COUNTERSHAFT ON SUPPORT STAND

1 - COUNTER SHAFT
2 - MAIN SHAFT
3 - SUPPORT STAND 8355

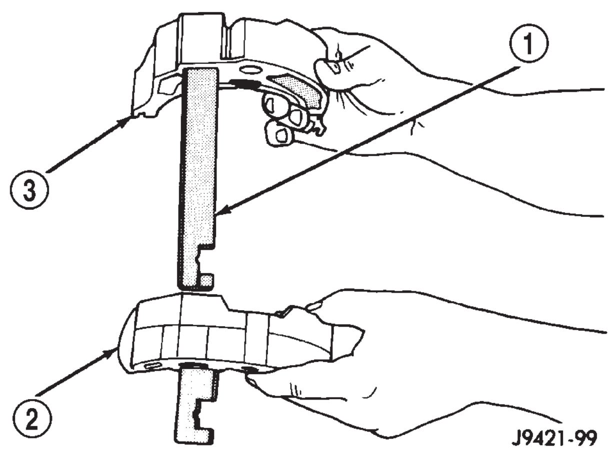


Fig. 66 1-2 AND FIFTH-REVERSE SHIFT FORKS

1 - INSERT ARM THROUGH 1-2 FORK
2 - 1-2 FORK
3 - FIFTH-REVERSE FORK

(8) Install assembled shift forks in synchro sleeves (Fig. 67). Verify forks are seated in sleeves.

MANUAL - NV1500 (Continued)

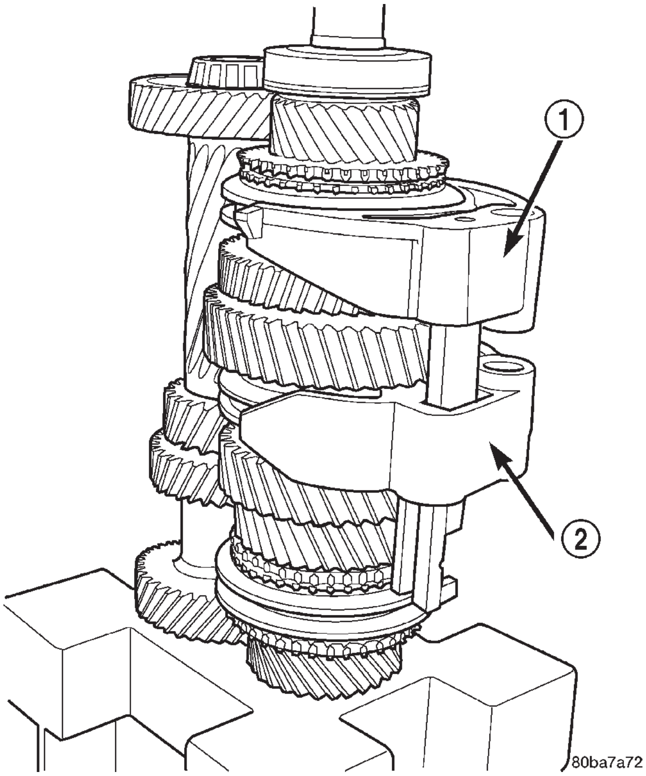


Fig. 67 SHIFT FORKS AND SYNCHROS

1 - FIFTH REVERSE SHIFT FORK
2 - 1-2 SHIFT FORK

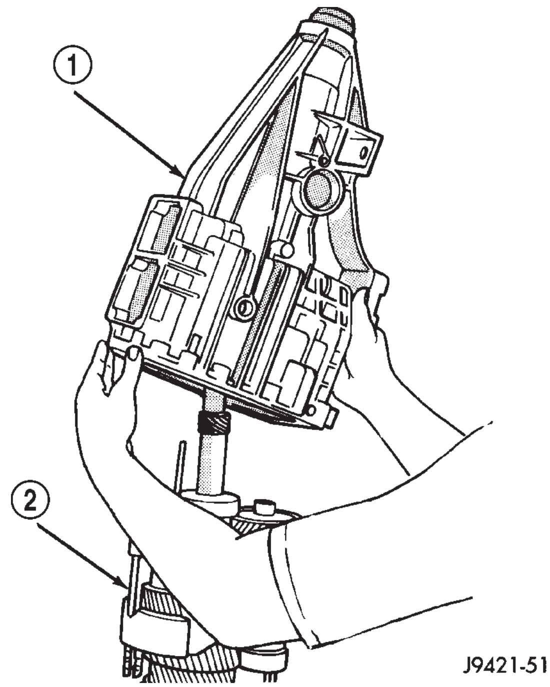


Fig. 68 REAR HOUSING

1 - REAR HOUSING
2 - SHIFT FORKS AND GEARTRAIN

REAR HOUSING

(1) Lubricate countershaft rear bearing race.

(2) Install rear housing onto geartrain (Fig. 68). Verify bearing retainer pilot stud is in correct bolt hole and countershaft and output shaft bearings are aligned in housing and on countershaft.

(3) Seat rear housing on output shaft rear bearing and countershaft. Tap housing into place with plastic or rawhide hammer.

(4) Apply Mopar® Gasket Maker or equivalent to bolt threads, bolt shanks and under bolt heads (Fig. 69).

(5) Start first two bolts in retainer (Fig. 70). It may be necessary to move retainer rearward (with pilot stud) in order to start bolts.

(6) Remove Pilot Stud 8120 and install last retainer bolt (Fig. 70).

(7) Tighten all three retainer bolts to 22 N·m (16 ft. lbs.).

NOTE: All bolts except the reverse idler shaft bolts have o-rings to seal the bolts to the transmission case. Inspect the o-rings to ensure that they are in good condition.

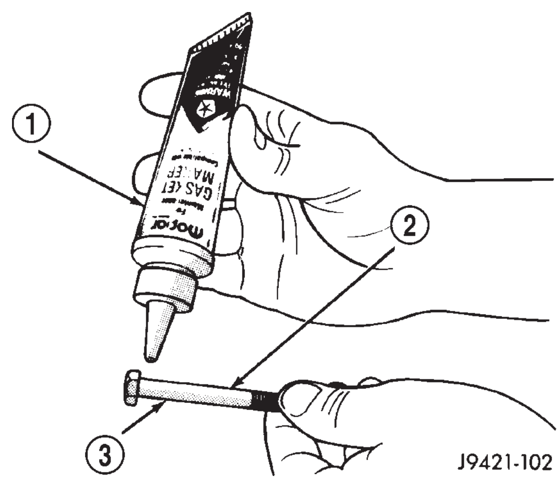


Fig. 69 RETAINER AND HOUSING BOLTS

1 - MOPAR GASKET MAKER
2 - RETAINER AND HOUSING BOLTS
3 - APPLY SEALER TO UNDERSIDE OF BOLT HEAD, SHANK AND THREADS

REVERSE IDLER

(1) Remove geartrain and housing assembly from support stand with aid of helper.

(2) Assemble shaft, gear and washer (without bearing or support) and install into housing (Fig. 71).

MANUAL - NV1500 (Continued)

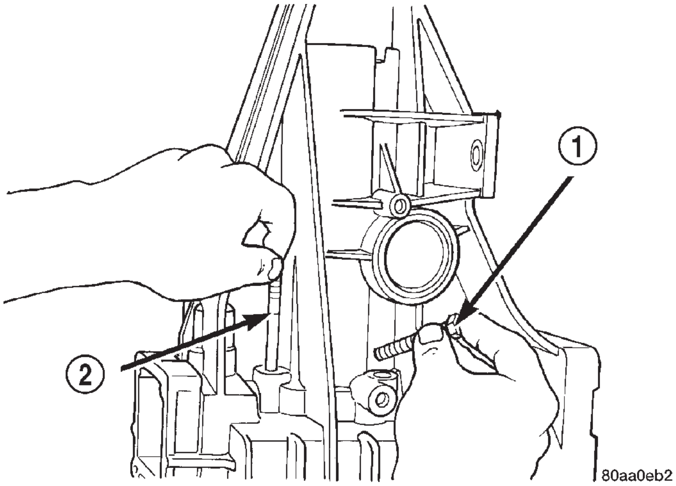


Fig. 70 PILOT STUD AND RETAINER BOLTS

1 - BEARING RETAINER BOLT
2 - SPECIAL TOOL 8120

NOTE: The small shoulder on the reverse idler gear goes toward the front of the transmission.

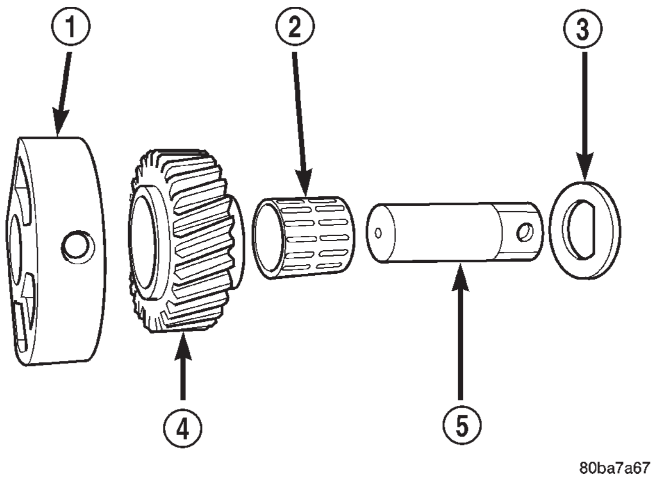


Fig. 71 REVERSE IDLER ASSEMBLY

1 - SUPPORT
2 - BEARING
3 - WASHER
4 - GEAR
5 - SHAFT

(3) Apply Mopar® Gasket Maker or equivalent sealer to underside of idler shaft and support bolt heads, bolt shanks and bolt threads (Fig. 69).

(4) Align hole in housing with threaded hole in shaft and start shaft rear bolt a few threads.

(5) Install bearing into position.

(6) Install segment (Fig. 71), align housing hole with segment threaded hole, and start support bolt a few threads.

(7) Tighten large idler shaft bolt to 43 N·m (31.7 ft. lbs.). Tighten small idler shaft bolt to 22 N·m (16.2 ft. lbs.).

CAUTION: Verify idler shaft and support segment are properly seated and firmly in place while tightening the shaft bolts. The segment, housing or shaft threads can be damaged if the idler shaft is allowed to shift out of position.

SHIFT SHAFT, SHAFT LEVER AND BUSHING AND SHIFT SOCKET

(1) Verify all synchro sleeves are in Neutral position (centered on hub).

CAUTION: Synchros must all be in Neutral position to prevent damage to the housings, shift forks and gears during installation of the two housings.

(2) Install 3-4 shift fork in synchro sleeve (Fig. 72). Verify groove in fork arm is aligned with grooves in 1-2 and fifth-reverse fork arms.

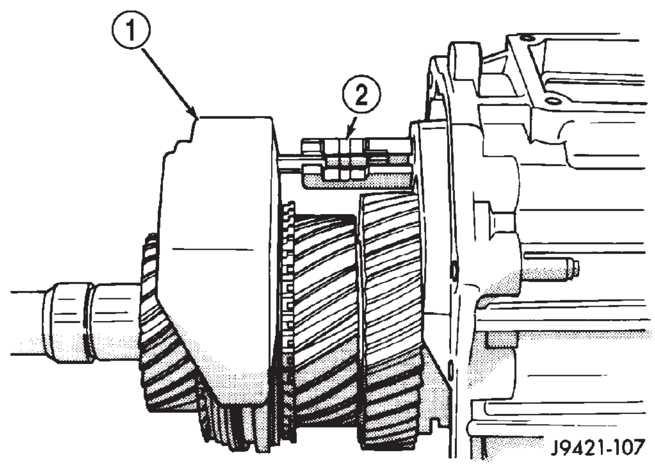


Fig. 72 3-4 SHIFT FORK

1 - 3-4 FORK
2 - ALIGN GROOVES IN FORK ARMS

(3) Slide shift shaft through 3-4 shift fork (Fig. 73). Verify shaft detent notches are to front.

(4) Assemble shift shaft shift lever and bushing (Fig. 74). Slot in bushing must face up and roll pin hole for lever to align with hole in shaft.

(5) Install assembled lever and bushing on shift shaft (Fig. 75).

MANUAL - NV1500 (Continued)

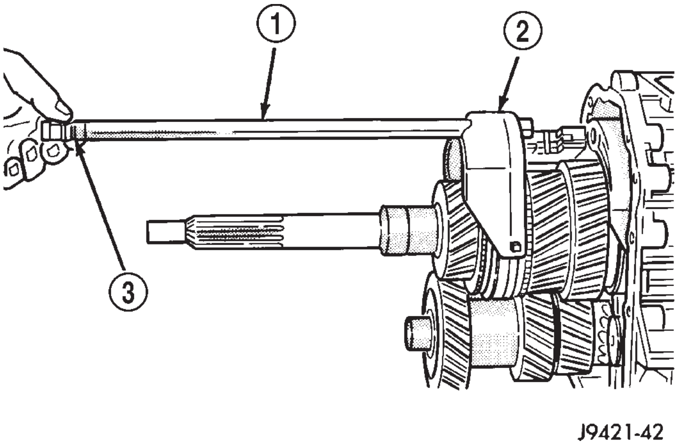


Fig. 73 SHIFT SHAFT

1 - SHIFT SHAFT
2 - 3-4 FORK
3 - SHAFT DETENT NOTCHES

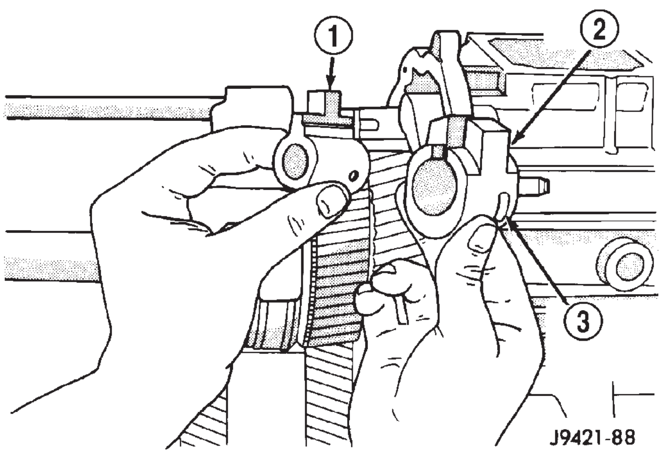


Fig. 74 SHIFT SHAFT LEVER AND BUSHING

1 - SHAFT LEVER
2 - LEVER BUSHING
3 - BUSHING LOCK PIN SLOT

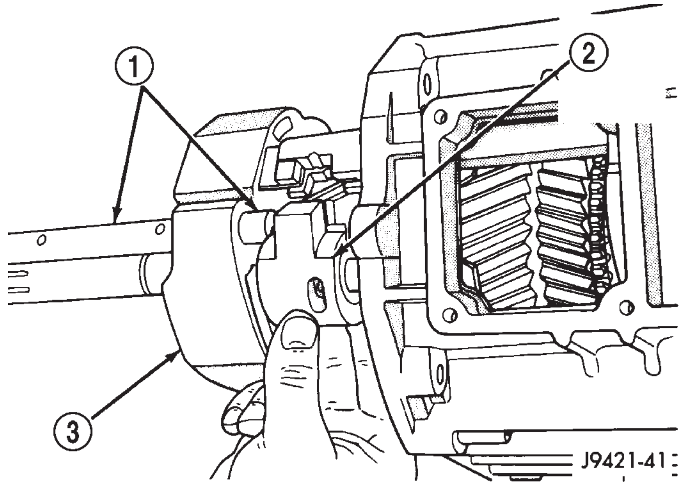


Fig. 75 SHIFT SHAFT LEVER AND BUSHING

1 - SHIFT SHAFT
2 - SHAFT LEVER AND BUSHING
3 - 3–4 FORK

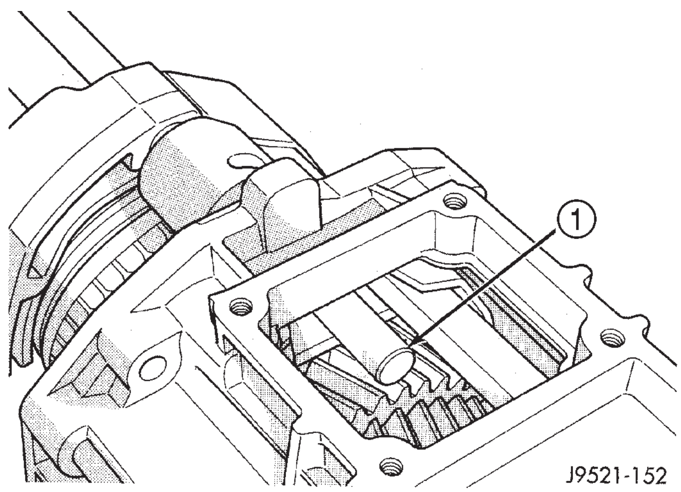


Fig. 76 LEVER OPENING IN HOUSING

1 - SHIFT SHAFT

(6) Slide shift shaft through 1-2 and fifth-reverse fork and into shift lever opening in rear housing (Fig. 76).

(7) Align shift socket with shaft and slide shaft through socket and into shift shaft bearing in rear housing (Fig. 77).

(8) Rotate shift shaft so detent notches in shaft are facing the TOP of the transmission housing.

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, transmission will have to be disassembled to correct shaft alignment.

(9) Select correct new roll pin for shift shaft lever (Fig. 78). Shaft lever roll pin is approximately 22 mm (7/8 in.) long. Shift socket roll pin is approximately 33 mm (1-1/4 in.) long.

(10) Align roll pin holes in shift shaft, lever and bushing, then start roll pin into shaft lever by hand (Fig. 79).

(11) Seat shaft lever roll pin with pin punch (Fig. 80).

CAUTION: 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.

MANUAL - NV1500 (Continued)

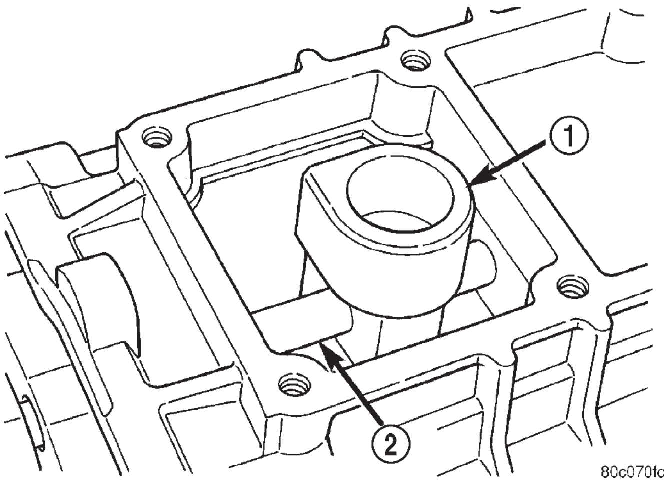


Fig. 77 SHIFT SOCKET AND SHAFT

1 - SHIFT SOCKET
2 - SHIFT SHAFT

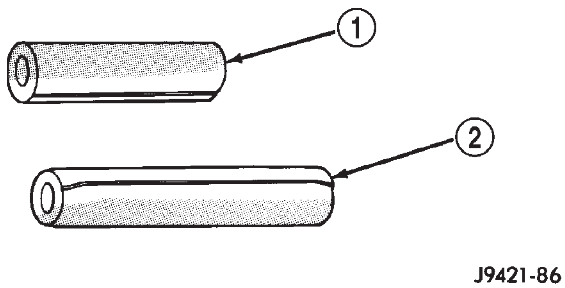


Fig. 78 SHAFT LEVER AND SOCKET ROLL PINS

1 - SHAFT LEVER ROLL PIN
2 - SHIFT SOCKET ROLL PIN

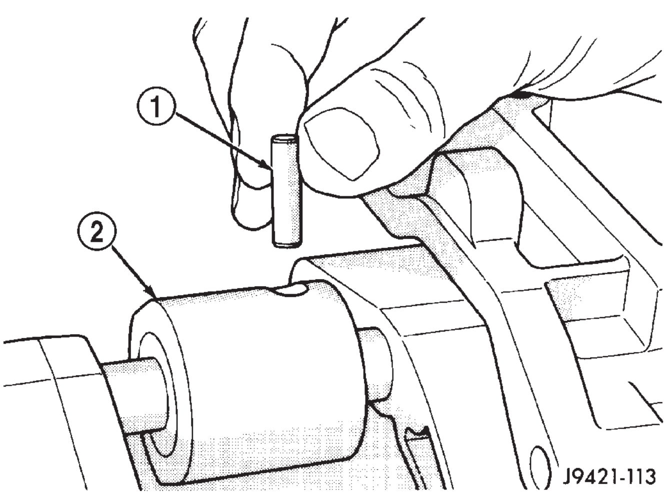


Fig. 79 STARTING ROLL PIN IN SHIFT SHAFT LEVER

1 - SHAFT LEVER ROLL PIN
2 - LEVER AND BUSHING

(12) Verify lock pin slot in lever bushing is positioned as shown (Fig. 80).

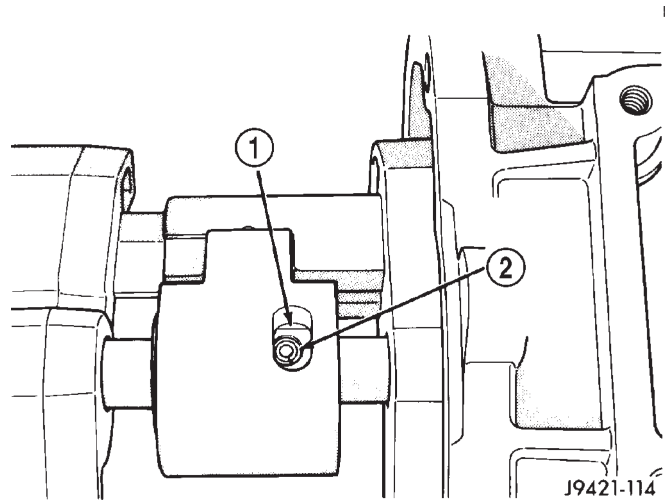


Fig. 80 SEATING SHIFT SHAFT LEVER ROLL PIN

1 - BUSHING LOCK PIN SLOT
2 - SEAT ROLL PIN FLUSH WITH LEVER

(13) Align roll pin holes in shift socket and shift shaft. Then start roll pin into shift shaft by hand (Fig. 81).

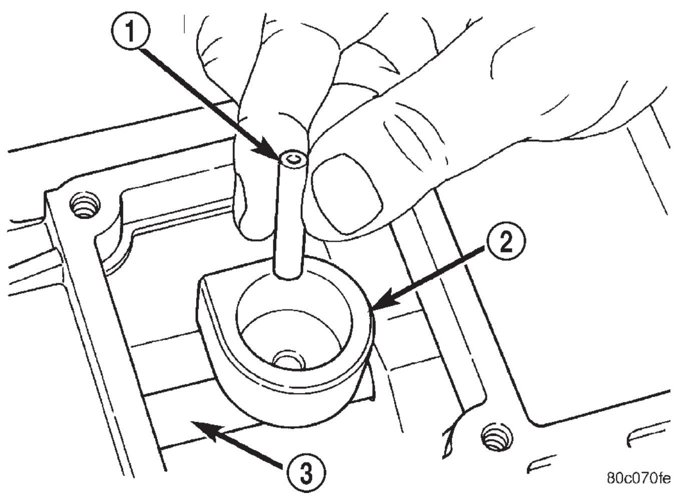


Fig. 81 STARTING ROLL PIN IN SHIFT SOCKET

1 - ROLL PIN
2 - SHIFT SOCKET
3 - SHIFT SHAFT

(14) Seat roll pin in shift socket with pin punch. Roll pin must be instaled flush with socket (Fig. 82).

(15) Verify notches in shift fork arms are aligned.

MANUAL - NV1500 (Continued)

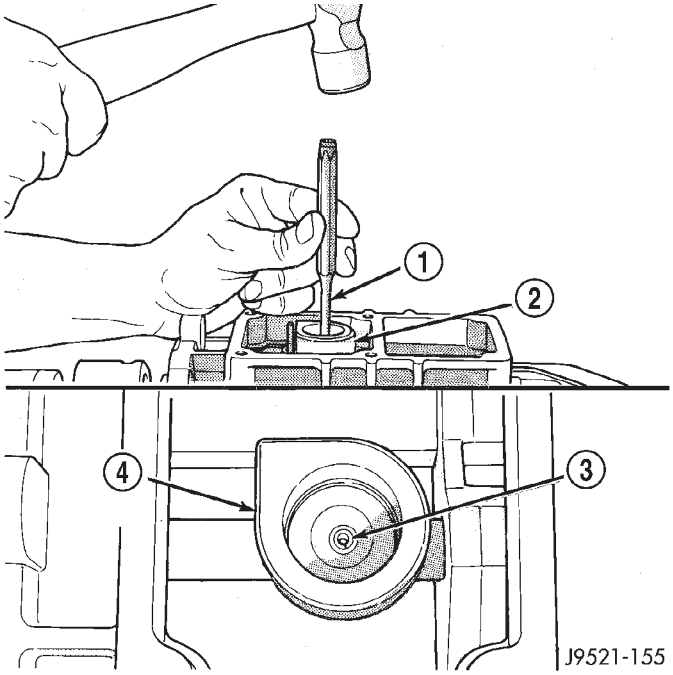


Fig. 82 SEATING SHIFT SOCKET ROLL PIN

1 - PIN PUNCH
2 - SHIFT SOCKET
3 - SEAT ROLL PIN FLUSH
4 - SHIFT SOCKET

FRONT HOUSING AND INPUT SHAFT BEARING RETAINER

(1) If previously removed, install input shaft bearing in front housing bore (Fig. 83). Install snap ring and use plastic mallet to seat bearing. Bearing goes in from front side of housing only.

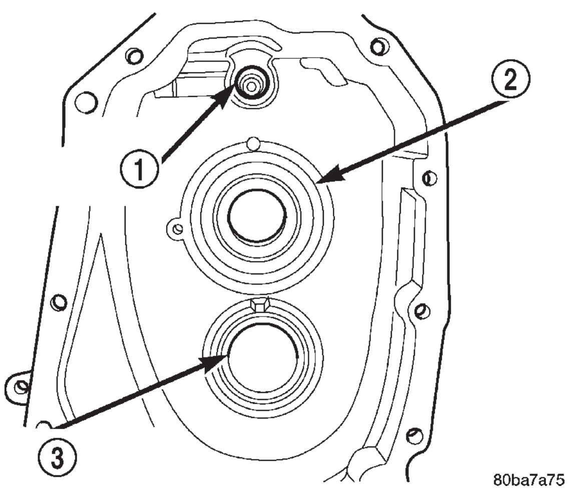


Fig. 83 INPUT SHAFT AND COUNTERSHAFT BEARING

1 - SHIFT SHAFT BUSHING
2 - INPUT SHAFT BEARING
3 - COUNTERSHAFT FRONT BEARING RACE

(2) Apply small amount of petroleum jelly to shift shaft bushing in front housing (Fig. 84).

(3) Apply 1/8 in. wide bead of Mopar® Gasket Maker or equivalent to mating surfaces of front and rear housings (Fig. 84).

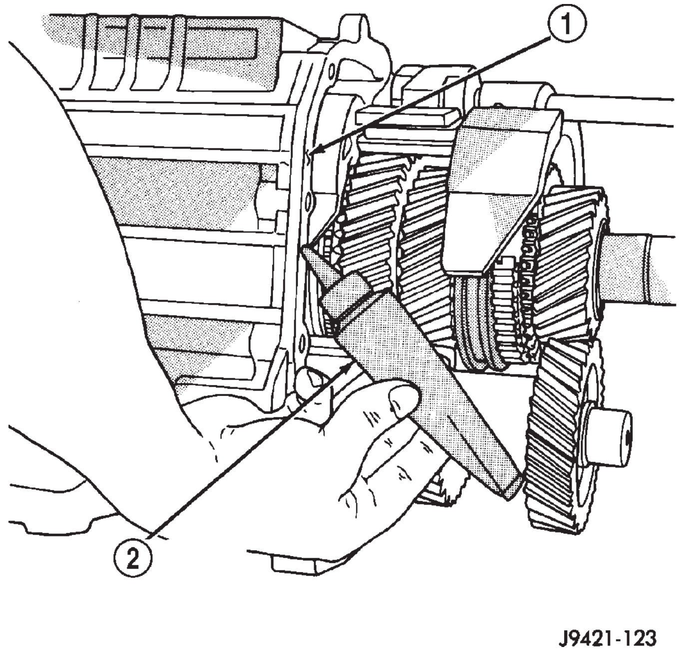


Fig. 84 SEALER TO FRONT/REAR HOUSING

1 - HOUSING FLANGE SURFACE
2 - MOPAR GASKET MAKER (OR LOCTITE 518)

(4) Have helper hold rear housing and geartrain in upright position. Then install front housing on rear housing and geartrain.

(5) Work front housing downward onto geartrain until seated on rear housing.

CAUTION: If the front housing will not seat on the rear housing, the shift components are not in Neutral, or one or more components are misaligned. Do not force the front housing into place.

(6) Place transmission in horizontal position.

(7) 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. 85).

(8) Install and start housing attaching bolts by hand (Fig. 85). Then tighten bolts to 34 N·m (25 ft. lbs.).

(9) Install shift shaft bushing lock bolt (Fig. 86). Apply Mopar® Gasket Maker or equivalent to bolt threads, shank and underside of bolt head before installation.

MANUAL - NV1500 (Continued)

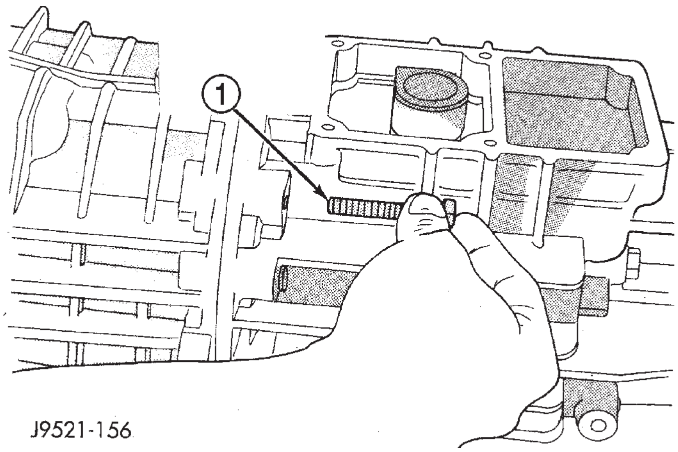


Fig. 85 HOUSING ATTACHING BOLTS

1 - HOUSING ATTACHING BOLTS (APPLY SEALER BEFOREHAND)

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.

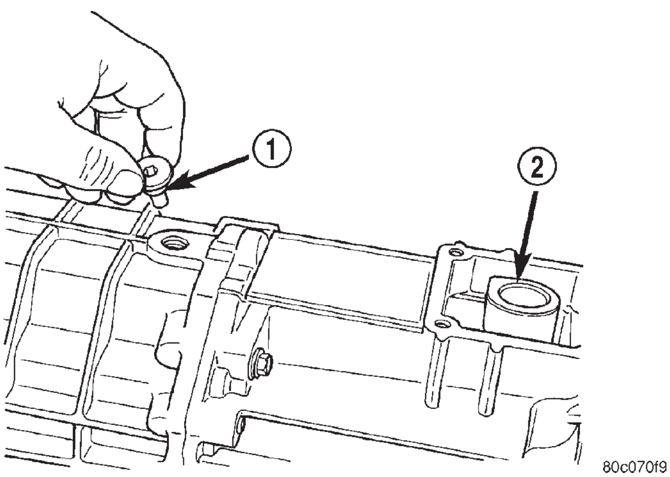


Fig. 86 SHIFT SHAFT BUSHING LOCK BOLT

1 - SHIFT SHAFT LOCK BOLT
2 - SHAFT SOCKET

(10) Remove countershaft bearing shim cap and shim. Attach a dial indicator and move countershaft front and back to measure shaft end play. The required countershaft pre-load 0.001-0.003 inches. Add this amount to the measured amount of countershaft end-play. This gives the amount of shims necessary to correctly pre-load the front and rear countershaft bearings.

(11) Install the selected shims and the shim cap. Tighten shim cap bolts to 29 N·m (21.4 ft. lbs.). Verify the shim selection by rotating the input shaft by hand with the transmission in neutral. The proper torque required to rotate the input shaft and the countershaft is approximately 5-7 in.lbs.. The input shaft should therefore be easily rotated by hand. If the input shaft cannot be rotated by hand or is not smooth through several rotations, re-check the countershaft pre-load.

(12) Lubricate then install shift shaft detent plunger in housing bore (Fig. 87). Lubricate plunger with petroleum jelly or gear lubricant. **Be sure plunger is fully seated in detent notch in shift shaft.**

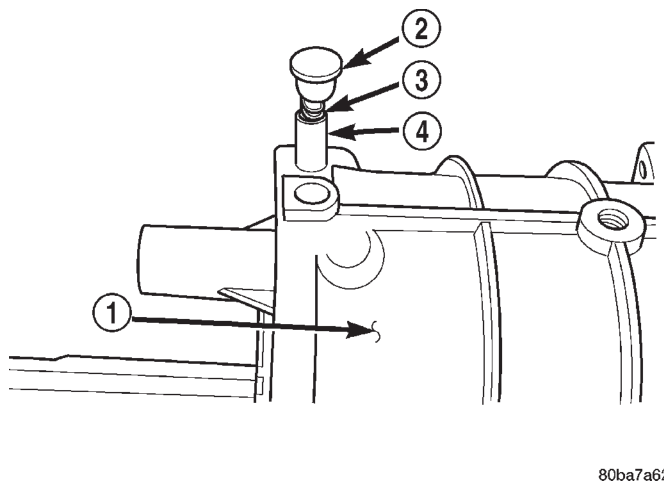


Fig. 87 SHIFT SHAFT DETENT PLUNGER

1 - FRONT HOUSING
2 - PLUG
3 - SPRING
4 - PLUNGER

(13) Install detent spring inside plunger (Fig. 87).

(14) Install detent plug in end of Installer 8123. Position plug on detent spring and compress spring until detent plug pilots in detent plunger bore. Drive detent plug into transmission case until plug seats.

(15) Install backup light switch (Fig. 88).

(16) Install input shaft snap ring (Fig. 89).

(17) Install **new** oil seal in front bearing retainer with Installer 6448 (Fig. 90).

(18) Apply bead of Mopar® Silicone Sealer or equivalent to flange surface of front bearing retainer.

MANUAL - NV1500 (Continued)

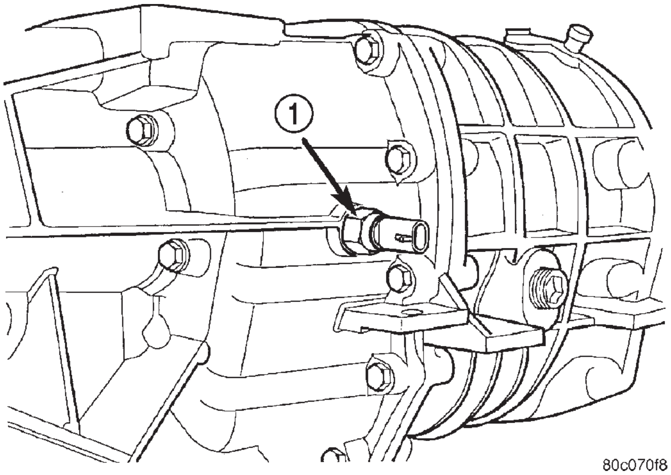


Fig. 88 BACKUP LIGHT SWITCH

1 - BACKUP LAMP SWITCH

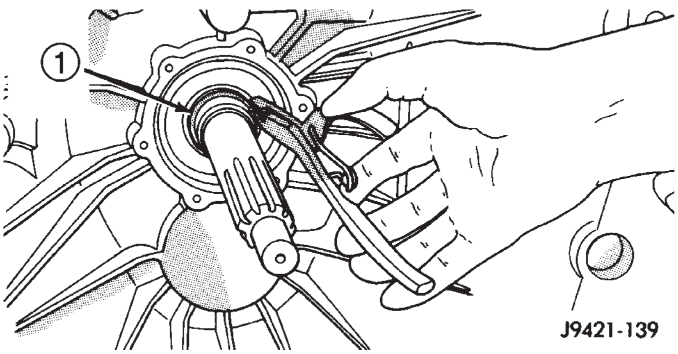


Fig. 89 INPUT SHAFT SNAP RING

1 - INPUT SHAFT SNAP RING

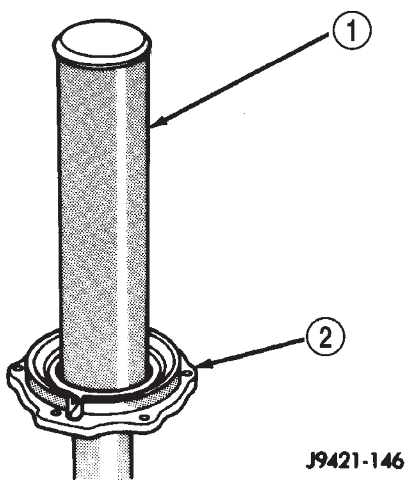


Fig. 90 BEARING RETAINER OIL SEAL

1 - SPECIAL TOOL
6448
2 - FRONT BEARING RETAINER

(19) Align and install front bearing retainer over input shaft and onto housing mounting surface (Fig. 91). Although retainer is one-way fit on housing, be sure bolt holes are aligned before seating retainer.

NOTE: Be sure that no sealer gets into the oil feed hole in the transmission case or bearing retainer.

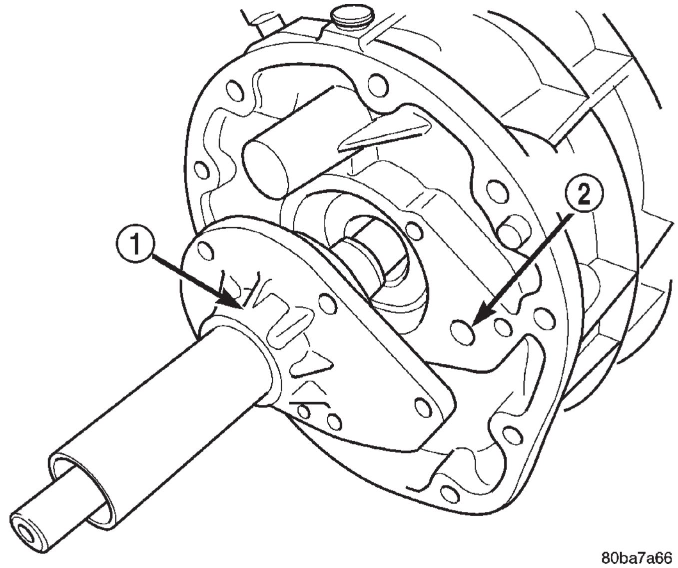


Fig. 91 INPUT SHAFT BEARING RETAINER

1 - BEARING RETAINER
2 - OIL FEED

(20) Install and tighten bearing retainer bolts to 29 N·m (21.4 ft. lbs.) (Fig. 92).

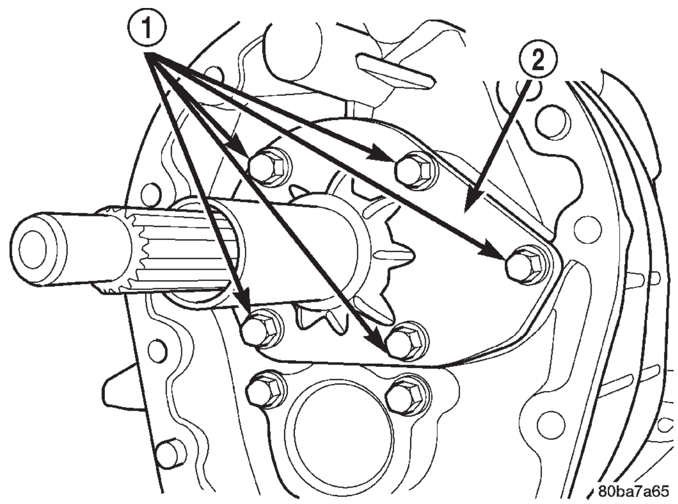


Fig. 92 INPUT SHAFT BEARING RETAINER BOLTS

1 - BOLTS (5)
2 - BEARING RETAINER

MANUAL - NV1500 (Continued)

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. 93). Verify shift ball is seated in socket and offset in the tower is toward the passenger side of the vehicle before installing tower bolts.

(4) Install shift tower bolts (Fig. 94) and tighten bolts to 8.5 N·m (75.2 in. lbs.).

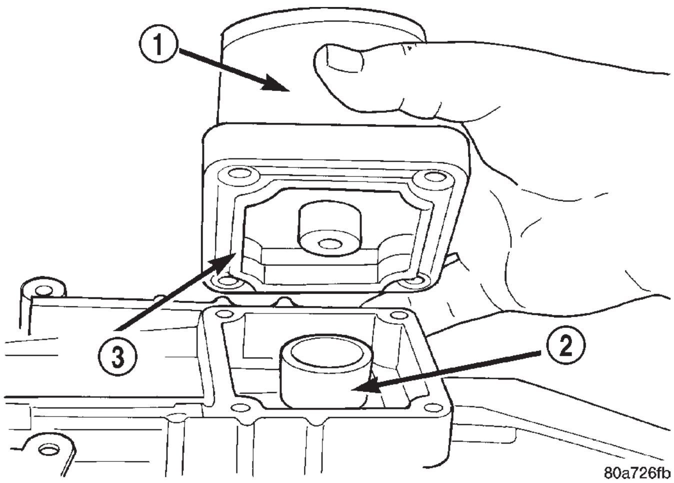


Fig. 93 SHIFT TOWER

1 - SHIFT TOWER AND LEVER ASSEMBLY
2 - SHIFT SOCKET
3 - SEAL

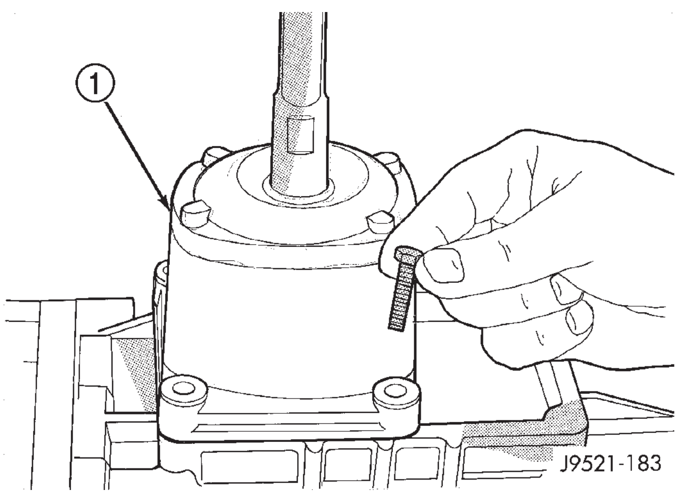


Fig. 94 SHIFT TOWER BOLT

1 - SHIFT TOWER AND LEVER ASSEMBLY

(5) Fill transmission to bottom edge of fill plug hole with Mopar® Transmission.

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

(7) Check transmission vent. Be sure vent is open and not restricted.

INSTALLATION

NOTE: If a new transmission is being installed, be sure to use all components supplied with the new transmission. For example, if a new shift tower is supplied with the new transmission, do not re-use the original shift tower.

(1) Apply light coat of Mopar® high temperature bearing grease to contact surfaces of following components:

- input shaft splines.
- release bearing slide surface of front retainer.
- release bearing bore.
- release fork.
- release fork ball stud.
- propeller shaft slip yoke.

(2) Apply sealer to threads of drain plug and install plug in case.

(3) Mount transmission on jack and position transmission under vehicle.

(4) Raise transmission until input shaft is centered in clutch disc hub.

(5) Move transmission forward and start input shaft in clutch disc and pilot bushing.

(6) Work transmission forward until seated against engine. Do not allow transmission to remain unsupported after input shaft has entered clutch disc.

(7) Install and tighten transmission-to-engine bolts to 108 N·m (80 ft. lbs.).

(8) Install clutch slave cylinder.

(9) Install transmission dust shield.

(10) Install starter.

(11) Connect backup light switch wires.

(12) Fill transmission with recommended lubricant. Correct fill level is bottom edge of fill plug hole.

(13) Install shift tower and lever assembly. Tighten shift tower bolts to 7-10 N·m (5-7 ft. lbs.).

(14) Position transmission harness wires in clips on shift cover.

(15) Install transmission mount on transmission or rear crossmember.

(16) Install rear crossmember.

(17) Remove transmission jack and engine support fixture.

(18) Align and install propeller shaft.

(19) Lower vehicle.

(20) Install the shift lever extension onto the shift tower and lever assembly.

(21) Install shift boot.

(22) Install floor console. Refer to 23 Body for procedures.

(23) Connect battery negative cable.

MANUAL - NV1500 (Continued)

SPECIFICATIONS

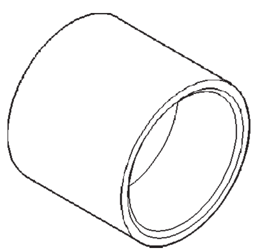
SPECIFICATIONS - NV1500

TORQUE SPECIFICATIONS

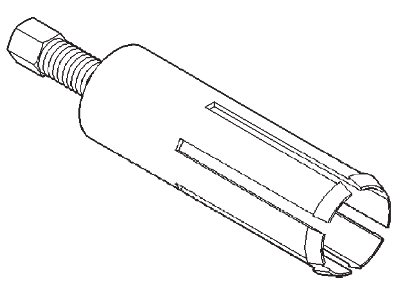
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Back up Lamp Switch	41	30	-
Coutershaft Bearing Shim Cap	41	30	-
Bearing Retainer - Front	41	30	-
Bearing Retainer - Rear	34	25	-
Drain/Fill Plug	34	25	-
Shift Shaft Lock Bolt	27	20	-
Idler Shaft Bolts - M8	27	20	-
Idler Shaft Bolts - M10	52	40	-
Shift Tower Bolts	14	10	120

SPECIAL TOOLS

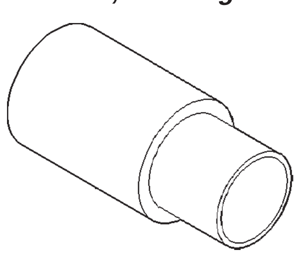
MANUAL - NV1500



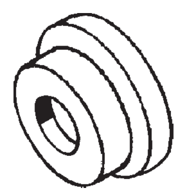
Installer, Seal C-3995-A



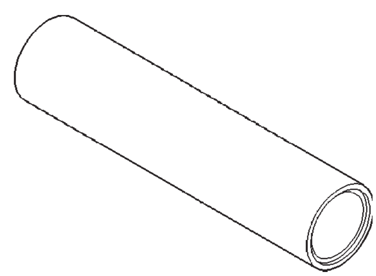
Remover, Bushing 6957



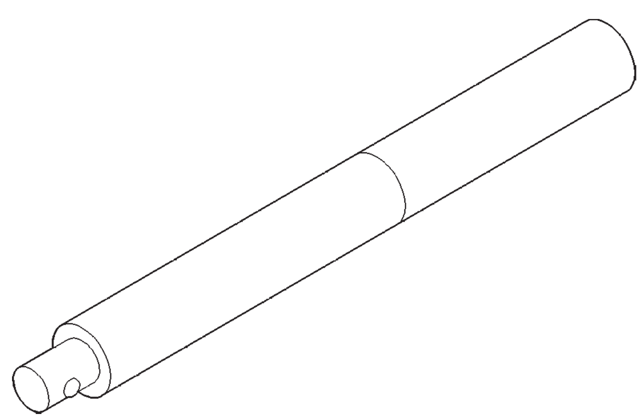
Installer, Bushing 8160



Driver, Bearing Race C-4656

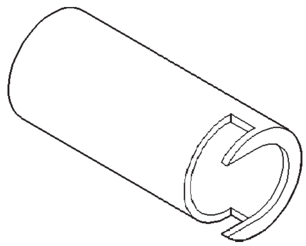


Installer, Seal 6448

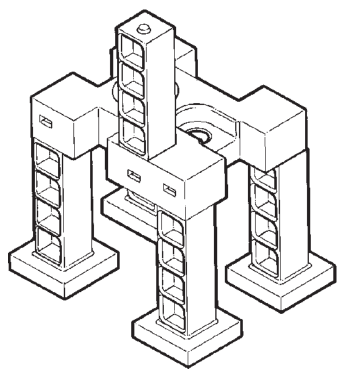


Handle C-4171

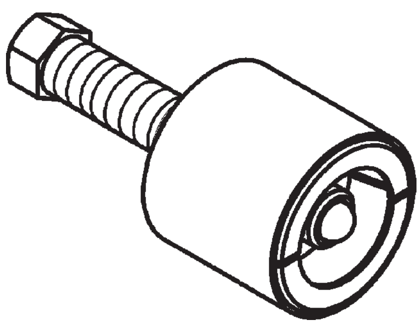
MANUAL - NV1500 (Continued)



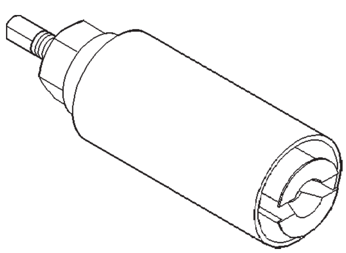
Remover 8117



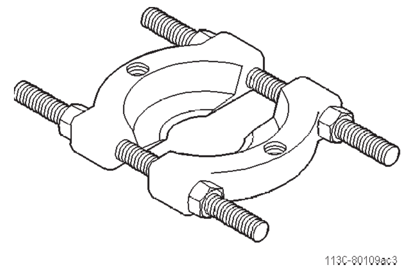
Support Stand 8355



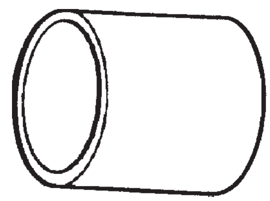
Remover, Bearing 8356



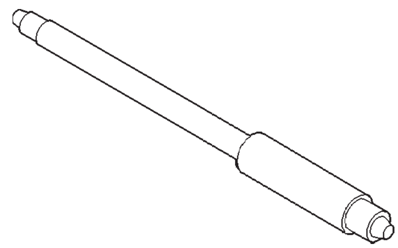
Remover, Bearing Race L-4454



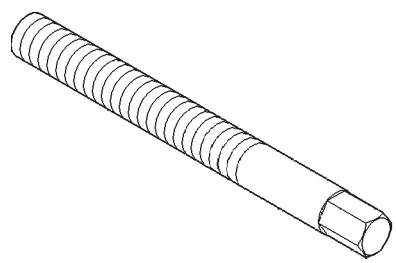
Splitter, Bearing 1130



Tube 6310-1



Remover/Installer 8119



Stud, Alignment 8120

MANUAL - NV3500

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MANUAL - NV3500

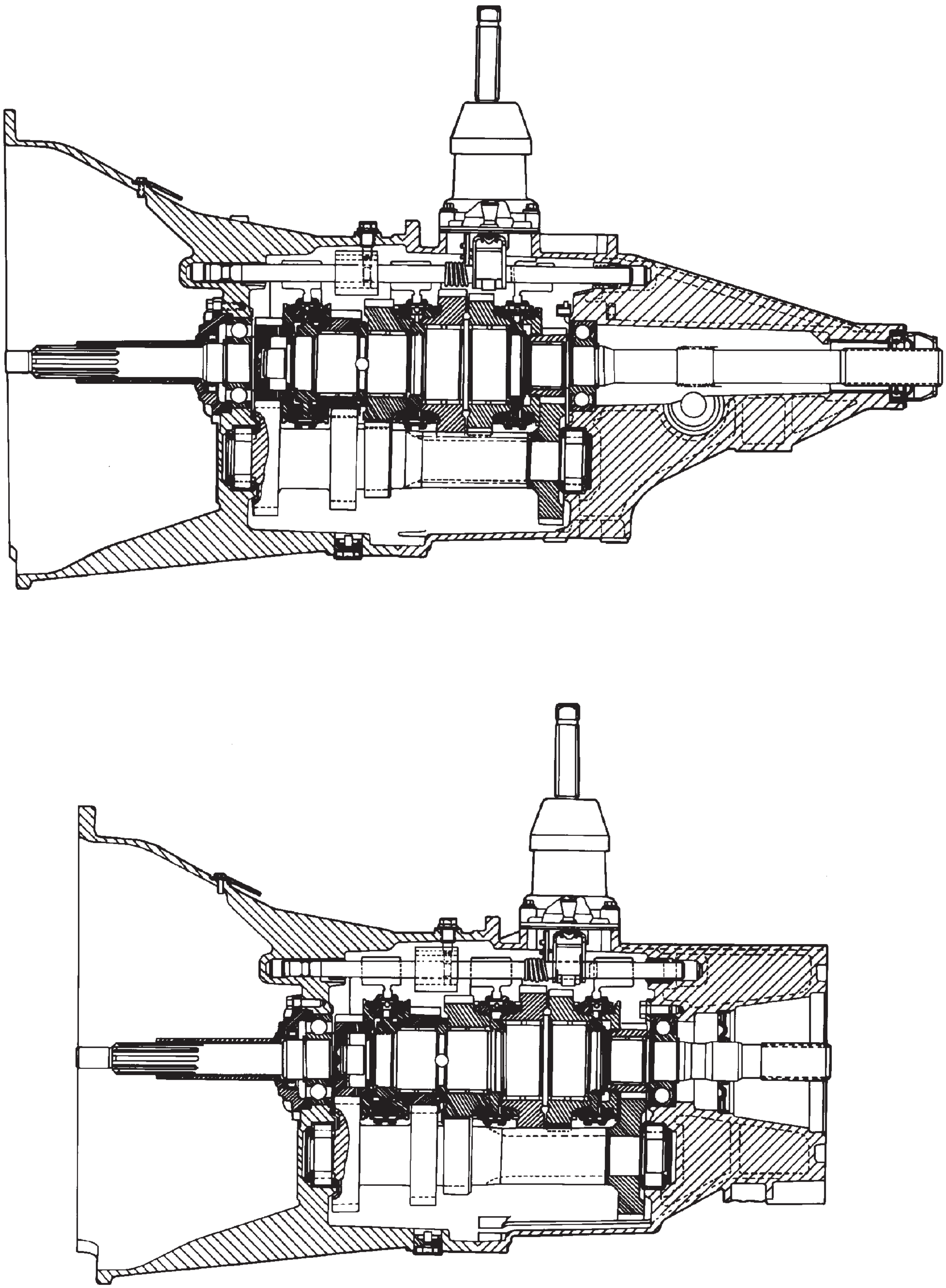
DESCRIPTION

The NV3500 is a medium-duty, 5-speed, constant mesh, fully synchronized manual transmission. Fifth gear is an overdrive range with a ratio of 0.73:1. The NV3500 is available in two and four–wheel drive configurations.

The transmission gear case consists of two aluminum housings (Fig. 1). The clutch housing is not a removable component. It is 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.

MANUAL - NV3500 (Continued)



J9421-1

Fig. 1 NV3500 Manual Transmission

MANUAL - NV3500 (Continued)

The NV3500 has a single shaft shift mechanism with three shift forks all mounted on the shaft. The shaft is supported in the front and rear housings by bushings and one linear ball bearing. Internal shift components consist of the forks, shaft, shift lever socket, and detent components (Fig. 2).

Two versions of the NV3500 are available a wide ratio and a close ratio version.

WIDE RATIO VERSION

GEAR	RATIO
FIRST	4.01:1
SECOND	2.32:1
THIRD	1.40:1
FOURTH	1:1
FIFTH	0.73:1
REVERSE	3.55:1

CLOSE RATIO VERSION

GEAR	RATIO
FIRST	3.48:1
SECOND	2.16:1
THIRD	1.40:1
FOURTH	1:1
FIFTH	0.73:1
REVERSE	3.55:1

OPERATION

The manual transmission receives power through the clutch assembly from the engine. The clutch disc is splined to the transmission input shaft and is turned at engine speed at all times that the clutch is engaged. The input shaft is connected to the transmission countershaft through the mesh of fourth speed gear on the input shaft and the fourth countershaft gear. At this point, all the transmission gears are spinning.

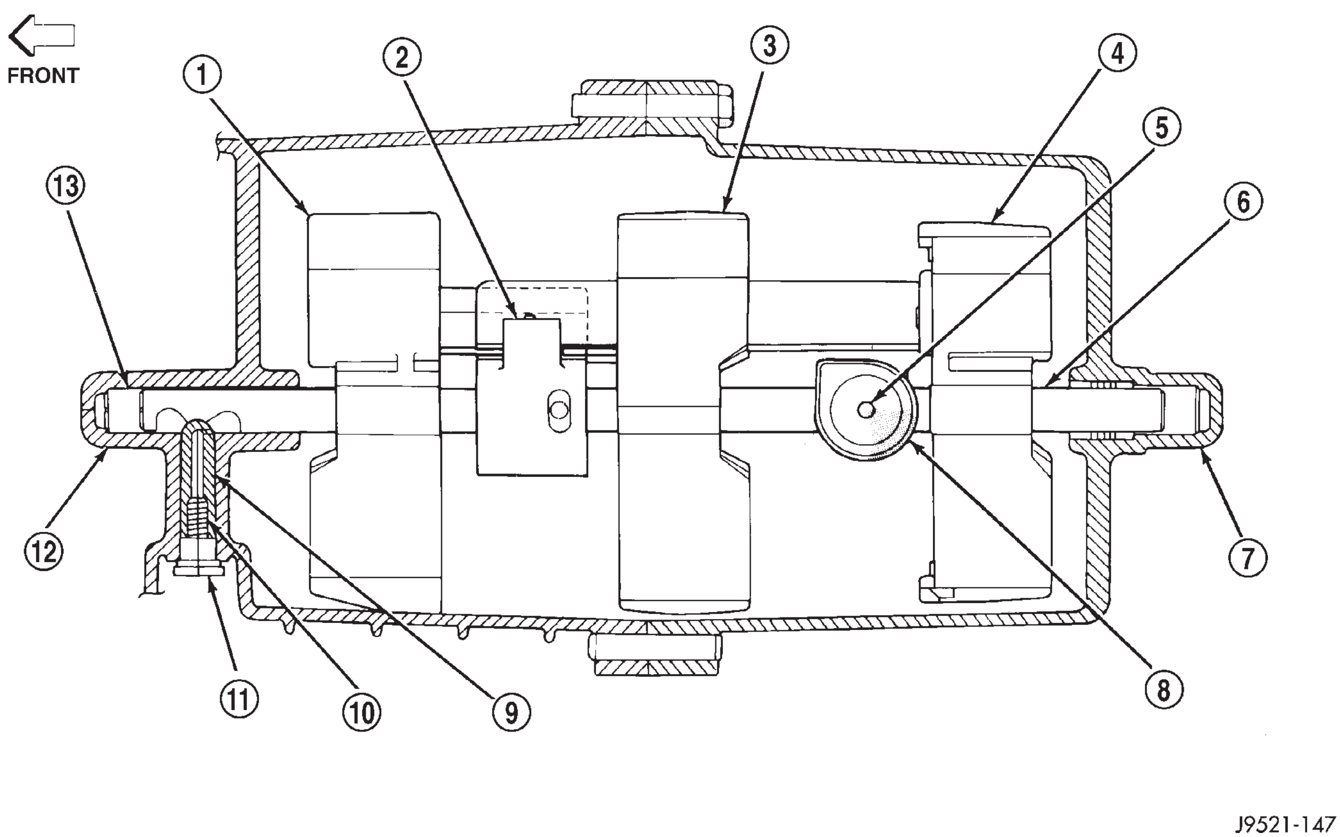


Fig. 2 NV3500 Shift Mechanism

1 - 3–4 FORK
2 - SHIFT SHAFT LEVER AND BUSHING
3 - 1–2 FORK
4 - FIFTH-REVERSE FORK
5 - ROLL PIN
6 - SHIFT SHAFT
7 - REAR HOUSING
8 - SHIFT LEVER SOCKET
9 - DETENT PLUNGER
10 - DETENT SPRING
11 - DETENT PLUG
12 - FRONT HOUSING
13 - SHIFT SHAFT

MANUAL - NV3500 (Continued)

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 - MANUAL TRANSMISSION

LOW LUBRICANT LEVEL

A low transmission lubricant level is generally the result of a leak, inadequate lubricant fill, or an incorrect lubricant level check.

Leaks can occur at the mating surfaces of the gear case, intermediate plate and adaptor or extension housing, or from the front/rear seals. A suspected leak could also be the result of an overfill condition.

Leaks at the rear of the extension or adapter housing will be from the housing oil seals. Leaks at component mating surfaces will probably be the result of inadequate sealer, gaps in the sealer, incorrect bolt tightening, or use of a non–recommended sealer.

A leak at the front of the transmission will be from either the front bearing retainer or retainer seal. Lubricant may be seen dripping from the clutch housing after extended operation. If the leak is severe, it may also contaminate the clutch disc causing the disc to slip, grab, and/or chatter.

A correct lubricant level check can only be made when the vehicle is level. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an underfill or overfill condition. Always check the lubricant level after any addition of fluid to avoid an incorrect lubricant level condition.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper, or contaminated lubricants. The consequence of using non–recommended lubricants is noise, excessive wear, internal bind, and hard shifting. Substantial lubricant leaks can result in gear, shift rail, synchro, and bearing damage. If a leak goes undetected for an extended period, the first indications of component damage are usually hard shifting and noise.

Component damage, incorrect clutch adjustment, or a damaged clutch pressure plate or disc are additional probable causes of increased shift effort. Incorrect adjustment or a worn/damaged pressure plate or disc can cause incorrect release. If the clutch problem is advanced, gear clash during shifts can result. Worn or damaged synchro rings can cause gear clash when shifting into any forward gear. In some new or rebuilt transmissions, new synchro rings may tend to stick slightly causing hard or noisy shifts. In most cases, this condition will decline as the rings wear–in.

TRANSMISSION NOISE

Most manual transmissions make some noise during normal operation. Rotating gears generate a mild whine that is audible, but generally only at extreme speeds.

Severe, highly audible transmission noise is generally the initial indicator of a lubricant problem. Insufficient, improper, or contaminated lubricant will promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

REMOVAL

(1) Disconnect battery negative cable.
(2) Shift transmission into Neutral.
(3) Remove floor console. Refer to Group 23 Body for proper procedures.
(4) Remove shift lever boot.
(5) Remove the shift lever extension from the shift tower and lever assembly.
(6) Raise vehicle.
(7) Remove skid plate, if equipped (4WD).
(8) If transmission will be disassembled for repair, remove drain plug and drain lubricant from transmission.
(9) Mark propeller shafts and companion flange for assembly reference.
(10) Disconnect and remove propeller shafts.
(11) Disconnect and remove exhaust system Y-pipe. Then disconnect and lower remaining exhaust pipes for clearance as necessary.
(12) Disconnect backup light switch wires.

2WD

(1) Remove bolts/nuts attaching transmission to rear mount.
(2) Support transmission with a transmission jack. Secure transmission to jack with safety chains.

MANUAL - NV3500 (Continued)

(3) Remove rear crossmember.

(4) Remove bolts attaching clutch slave cylinder to clutch housing. Then move cylinder aside for working clearance.

(5) Remove starter.

(6) Remove transmission dust shield.

(7) Remove transmission harness wires from clips on transmission shift cover.

(8) Lower transmission slightly.

(9) Remove the bolts attaching the shift tower and lever assembly to the transmission housing. Then remove the shift tower and lever assembly.

(10) Remove bolts attaching transmission to engine.

(11) Slide transmission and jack rearward until input shaft clears clutch disc.

(12) Lower transmission jack and remove transmission from under vehicle.

4WD

(1) Support engine with adjustable safety stand.

(2) Disconnect transfer case shift linkage at transfer case range lever.

(3) Remove transfer case shift lever from transmission.

(4) Remove bolts/nuts attaching transmission to rear support.

(5) Remove crossmember bolts/nuts and remove crossmember.

(6) Support transfer case with transmission jack. Secure transfer case to jack with safety chains.

(7) Remove transfer case attaching nuts.

(8) Move transfer case rearward until input gear clears transmission output shaft.

(9) Lower transfer case assembly and move it from under vehicle.

(10) Support transmission with transmission jack. Secure transmission to jack with safety chains.

(11) Remove transmission harness from retaining clips on transmission shift cover.

(12) Remove clutch slave cylinder splash shield, if equipped.

(13) Remove clutch slave cylinder attaching nuts. Move cylinder aside for working clearance.

(14) Remove starter.

(15) Remove transmission splash shield.

(16) Lower transmission slightly.

(17) Remove bolts attaching shift tower and lever assembly to rear case. Then remove shift tower and lever as an assembly.

(18) Remove bolts attaching transmission to engine.

(19) Move transmission rearward until input shaft clears clutch disc.

(20) Lower transmission and remove it from under vehicle.

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. 3).

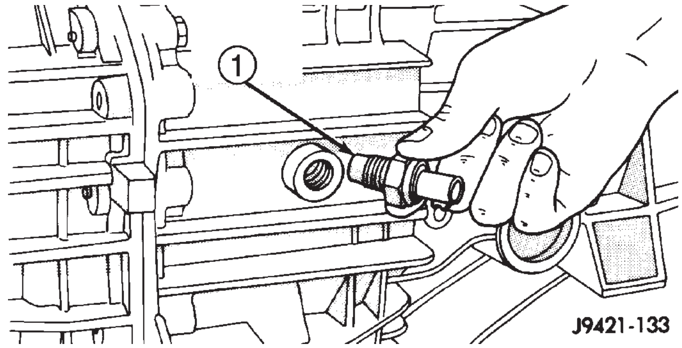


Fig. 3 BACKUP LIGHT SWITCH

1 - BACKUP LIGHT SWITCH

(5) Remove shift tower bolts and remove tower and lever assembly (Fig. 4).

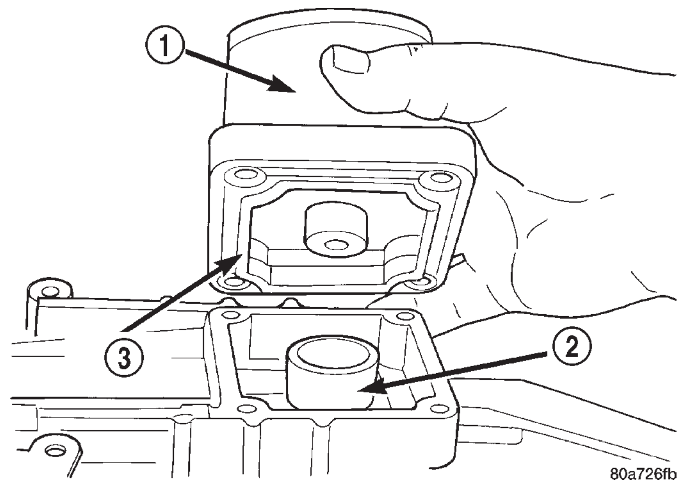


Fig. 4 SHIFT TOWER

1 - SHIFT TOWER AND LEVER ASSEMBLY
2 - SHIFT SOCKET
3 - SEAL

(6) Remove shift shaft lock bolt (Fig. 5) located on top of the housing just forward of shift tower.

(7) Remove shift shaft detent plug with Remover 8117A. Attach the fingers of the remover to the detent plug (Fig. 6). Then push the cup down till it contacts the trans. Tighten the nut (Fig. 7) till it pulls the plug from the trans case.

MANUAL - NV3500 (Continued)

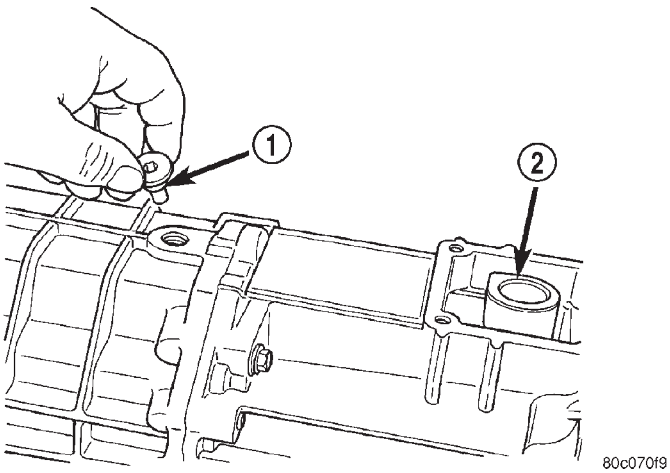


Fig. 5 SHIFT SHAFT LOCK BOLT

1 - SHIFT SHAFT LOCK BOLT
2 - SHAFT SOCKET

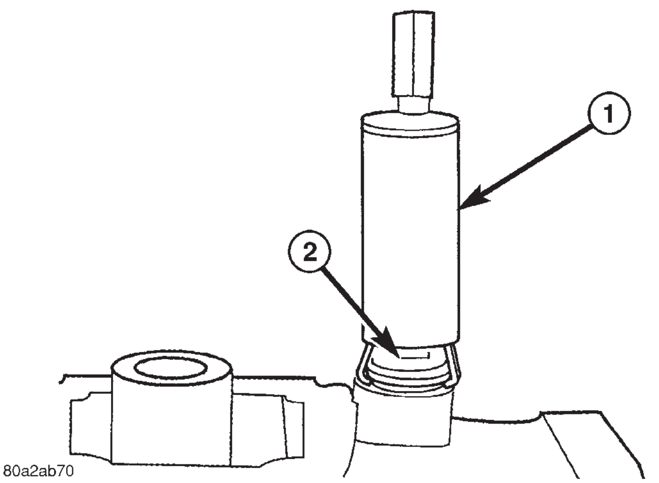


Fig. 6 DETENT PULLER

1 - REMOVER 8117A
2 - DETENT PLUG

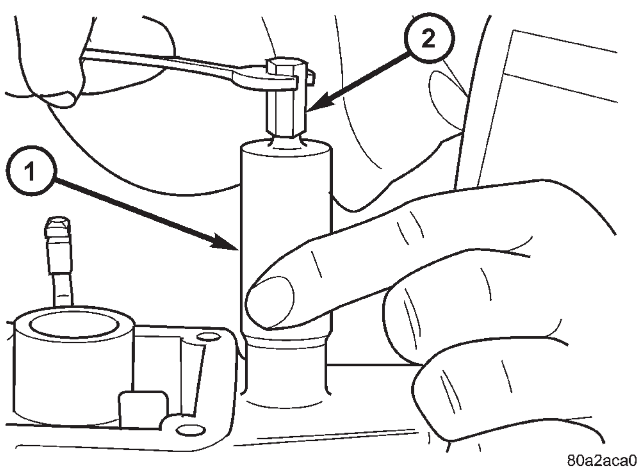


Fig. 7 PULL DETENT PLUG

1 - NUT
2 - REMOVER

(8) Remove shift shaft detent plunger and spring (Fig. 8). Remove spring and plunger with a pencil magnet.

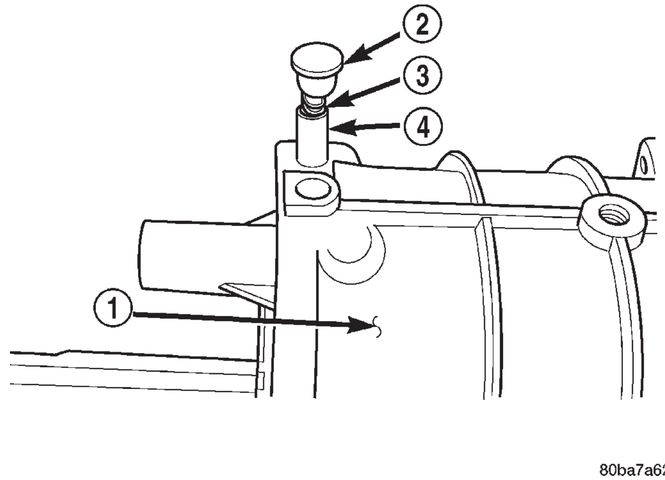


Fig. 8 DETENT PLUNGER

1 - FRONT HOUSING
2 - PLUG
3 - SPRING
4 - PLUNGER

(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. 9).

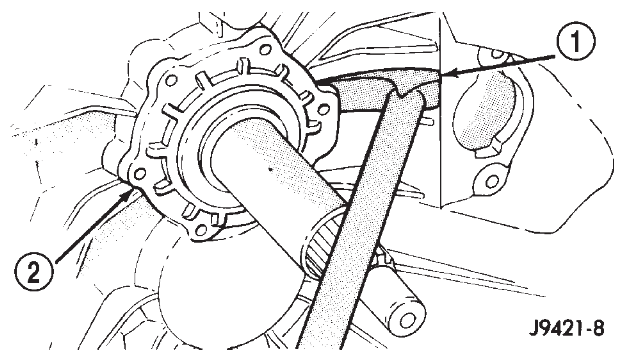


Fig. 9 BEARING RETAINER SEAL

1 - PRY TOOL
2 - INPUT SHAFT BEARING RETAINER

(10) Remove bearing retainer from input shaft (Fig. 10).

(11) Remove snap ring that secures input shaft in front bearing (Fig. 11).

(12) Remove bolts that attach front housing to rear housing (Fig. 12). Three bolts at extreme rear of housing are actually for the output shaft bearing retainer. It is not necessary to remove all three bolts at this time. Leave at least one bolt in place until geartrain is ready to be removed from case.

MANUAL - NV3500 (Continued)

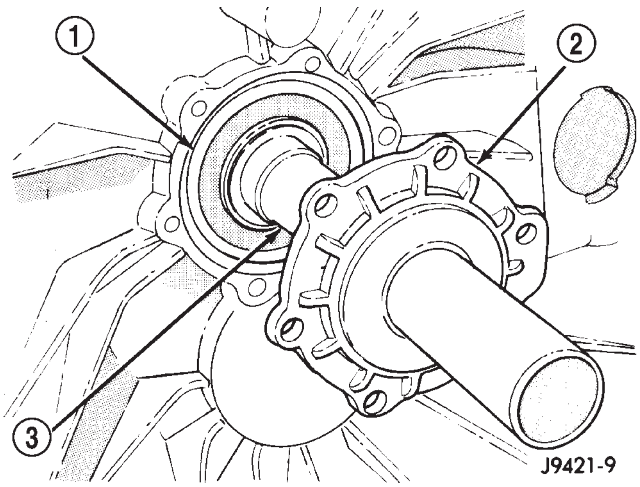


Fig. 10 INPUT SHAFT BEARING RETAINER

1 - SHAFT BEARING
2 - BEARING RETAINER
3 - INPUT SHAFT

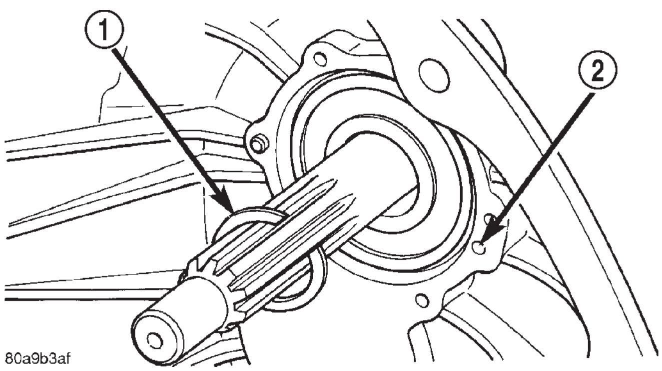


Fig. 11 INPUT SHAFT SNAP RING

1 - INPUT SHAFT SNAP RING
2 - OIL FEED

(13) Separate front housing from rear housing (Fig. 13). With a plastic mallet tap the front housing off the alignment dowels.

(14) Remove and inspect input shaft bearing and countershaft front bearing race (Fig. 14).

(15) Remove screw from reverse blocker and remove blocker (Fig. 15) from case.

(16) Note position of input shaft, shift shaft and forks, and geartrain components in housing (Fig. 16).

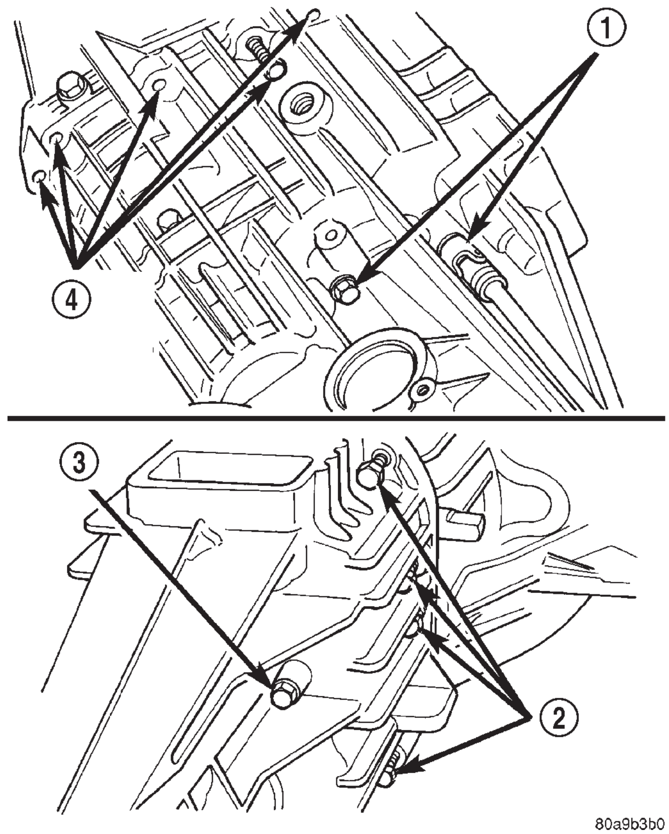


Fig. 12 HOUSING AND BEARING RETAINER BOLTS

1 - RETAINER BOLTS
2 - HOUSING BOLTS
3 - RETAINER BOLT
4 - HOUSING BOLT LOCATIONS

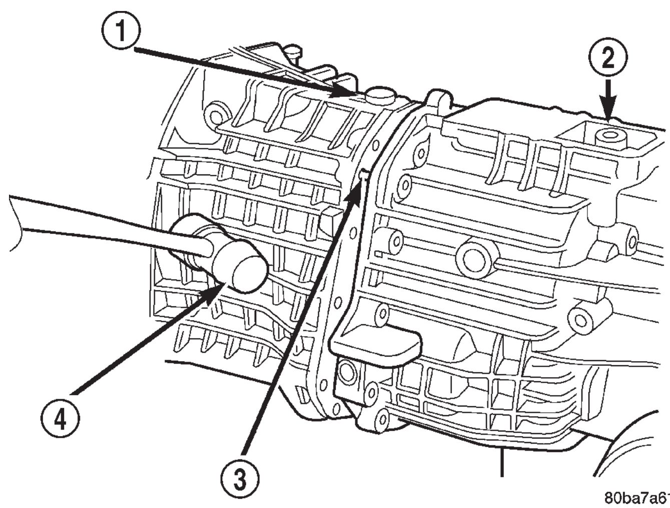


Fig. 13 FRONT HOUSING

1 - FRONT HOUSING
2 - REAR HOUSING
3 - DOWELS (2)
4 - PLASTIC MALLET

MANUAL - NV3500 (Continued)

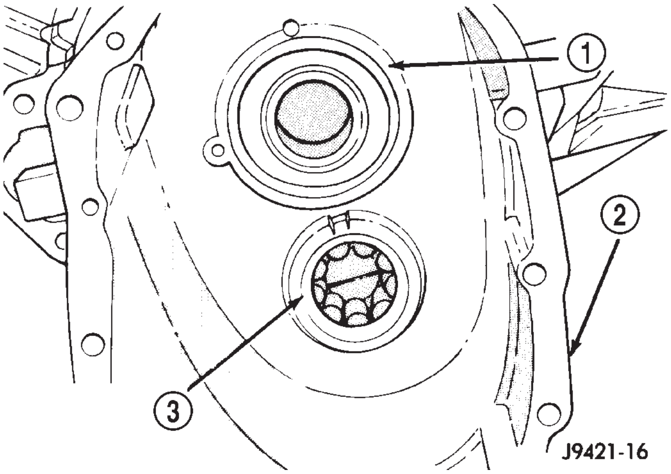


Fig. 14 INPUT SHAFT AND COUNTERSHAFT BEARING RACE

1 - INPUT SHAFT BEARING
2 - FRONT HOUSING
3 - COUNTERSHAFT FRONT BEARING

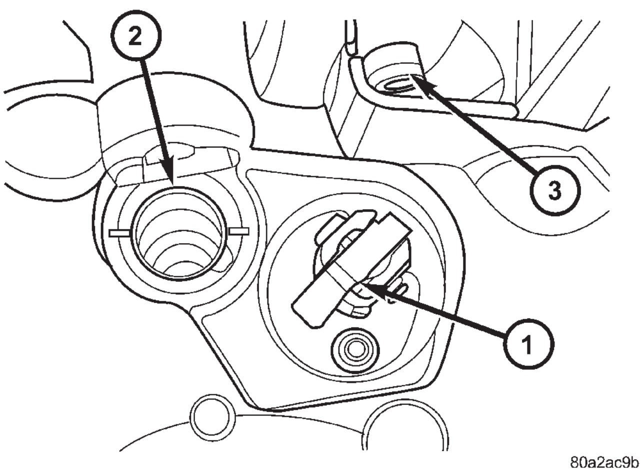


Fig. 15 REVERSE BLOCKER

1 - REVERSE BLOCKER
2 - SHIFTER SHAFT BUSHING
3 - VENT

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).

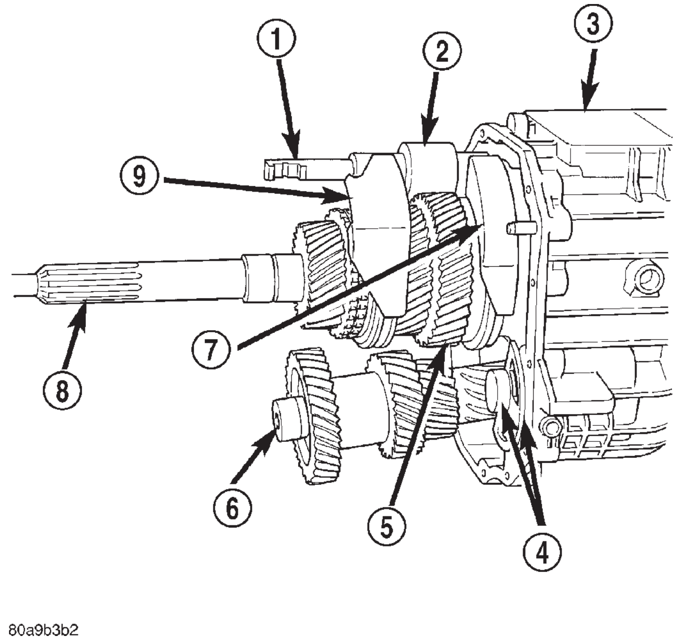


Fig. 16 GEARTRAIN AND SHIFT COMPONENT

1 - SHIFT SHAFT
2 - BUSHING
3 - REAR HOUSING
4 - REVERSE IDLER AND SUPPORT
5 - OUTPUT SHAFT AND GEARS
6 - COUNTERSHAFT
7 - 1-2 FORK
8 - INPUT SHAFT
9 - 3-4 FORK

NOTE: Press the roll pin just enough to clear the shift shaft. Be careful not to push the pin into the geartrain.

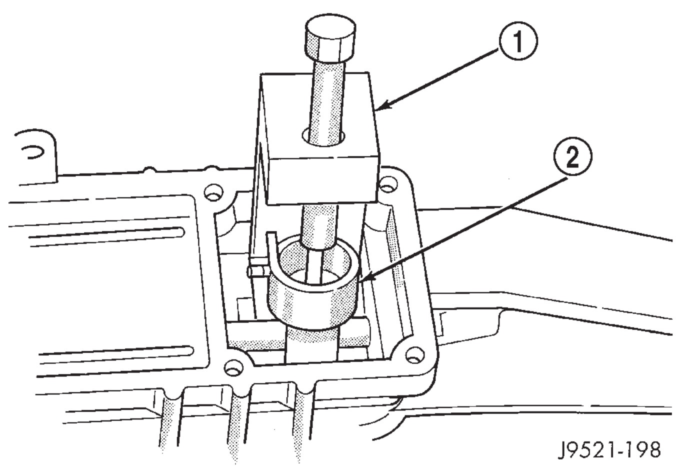


Fig. 17 SHIFT SOCKET ROLL PIN

1 - SPECIAL TOOL 6858
2 - SHIFT SOCKET

MANUAL - NV3500 (Continued)

(2) With a hammer and punch drive out roll pin that secures shift bushing and lever to shift shaft (Fig. 18).

NOTE: Use proper size punch to avoid bending the shift shaft.

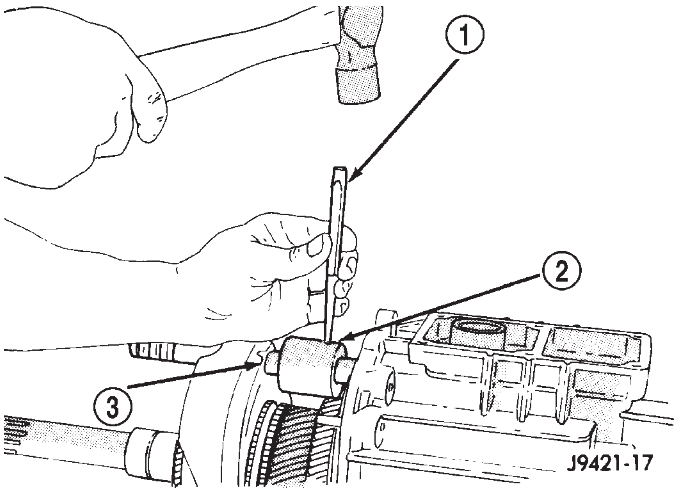


Fig. 18 SHIFT SHAFT LEVER AND BUSHING ROLL PIN

1 - PIN PUNCH
2 - BUSHING AND LEVER
3 - SHIFT SHAFT

(3) Pull shift shaft straight (Fig. 19) out of rear housing.

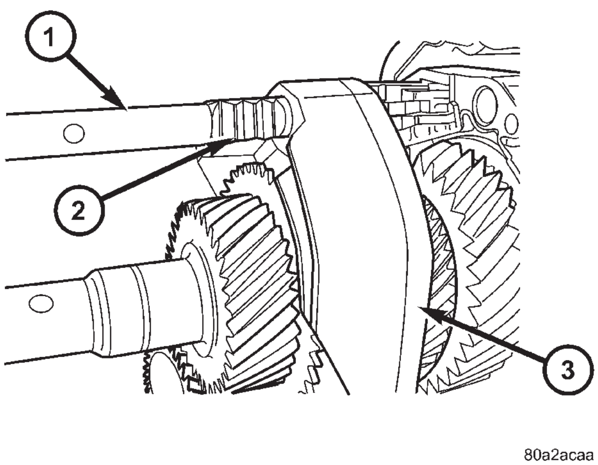


Fig. 19 SHIFT SHAFT

1 - SHIFTER SHAFT
2 - SHIFTER SHAFT DETENT
3 - 3-4 SHIFT FORK

(4) Remove shift socket from rear housing (Fig. 20).

(5) Remove lever and bushing (Fig. 21).

(6) 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. 22).

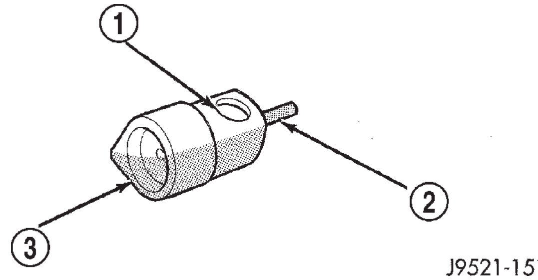


Fig. 20 SHIFT SOCKET AND ROLL PIN

1 - SHAFT BORE
2 - ROLL PIN
3 - SHIFT SOCKET

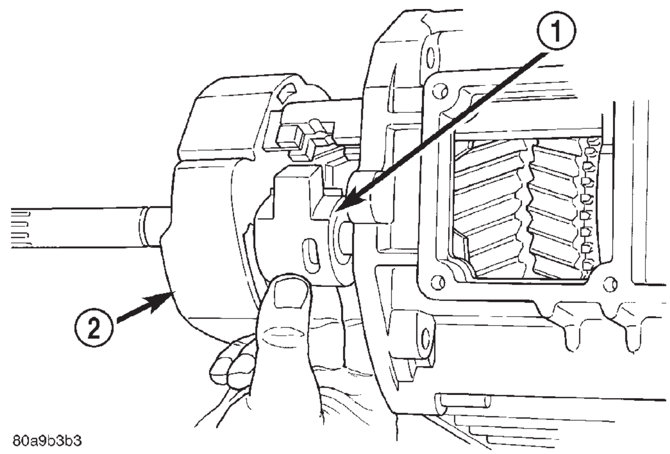


Fig. 21 SHIFT SHAFT LEVER AND BUSHING

1 - SHAFT LEVER AND BUSHING
2 - 3-4 FORK

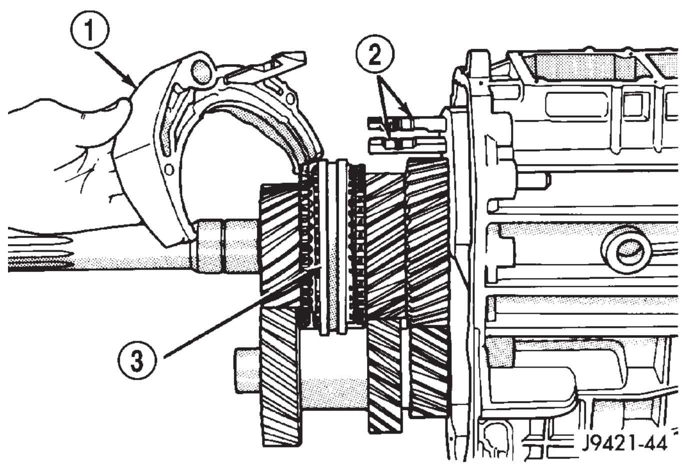


Fig. 22 3-4 SHIFT FORK

1 - 3-4 FORK
2 - 1-2 AND 5TH-REVERSE FORK ARMS
3 - 3-4 SYNCHRO SLEEVE

(7) Remove the reverse idler shaft support bolt (front bolt) (Fig. 23).

MANUAL - NV3500 (Continued)

(8) Loosen rear reverse idler shaft bolt (rear bolt) (Fig. 23).

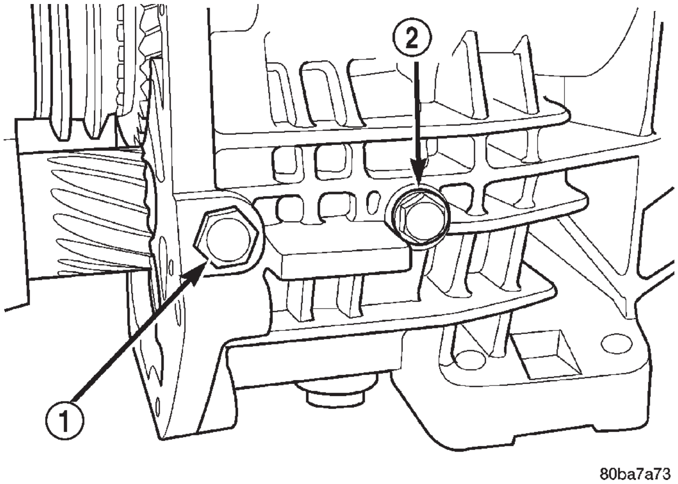


Fig. 23 REVERSE IDLER SHAFT/SUPPORT BOLT

1 - SUPPORT BOLT
2 - SHAFT BOLT

(9) Remove reverse idler shaft support (Fig. 24) segment by sliding it straight out of housing.

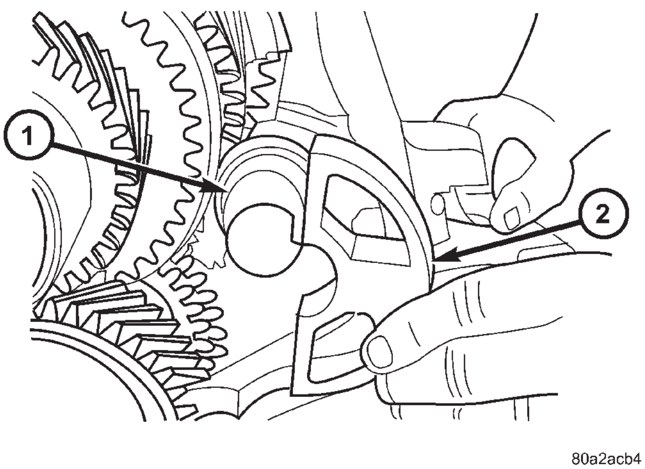


Fig. 24 IDLER SHAFT SUPPORT

1 - IDLER SHAFT
2 - IDLER SHAFT SUPPORT

(10) 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. 25).

(d) Stand geartrain and rear housing upright on fixture (Fig. 26). Have helper hold fixture tool in place while housing and geartrain is being rotated into upright position.

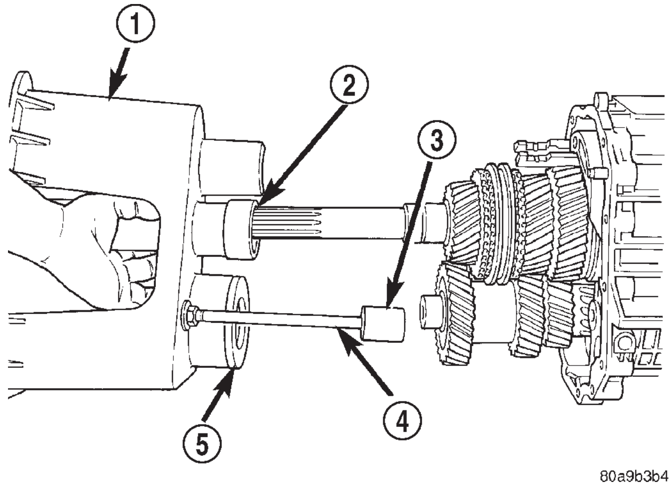


Fig. 25 FIXTURE ASSEMBLY

1 - SPECIAL TOOL 6747
2 - SPECIAL TOOL 6747-1A
3 - SPECIAL TOOL 8115
4 - REVERSE IDLER PEDESTAL
5 - SPECIAL TOOL 6747-2B

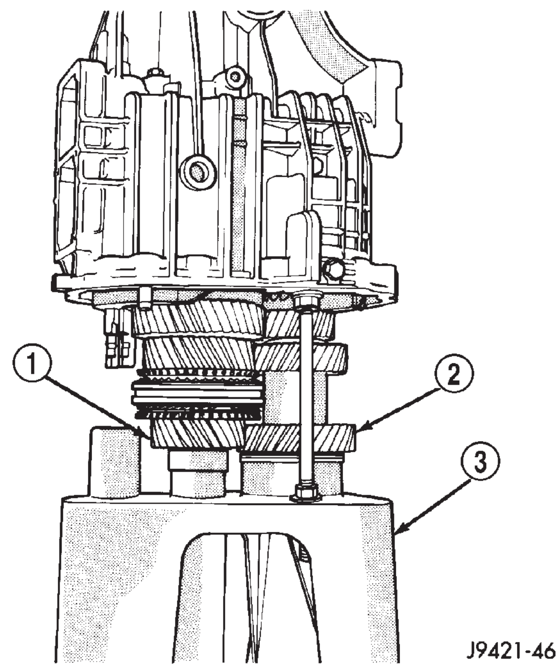


Fig. 26 GEARTRAIN AND HOUSING ON FIXTURE

1 - INPUT SHAFT
2 - COUNTERSHAFT
3 - SPECIAL TOOL 6747

(11) Remove rear bolt holding reverse idler shaft in housing.

MANUAL - NV3500 (Continued)

REAR HOUSING - 2WD

(1) On 2-wheel drive transmission, remove three bolts that attach output shaft bearing retainer to rear case (Fig. 27). Bolts are rear of shift tower opening.

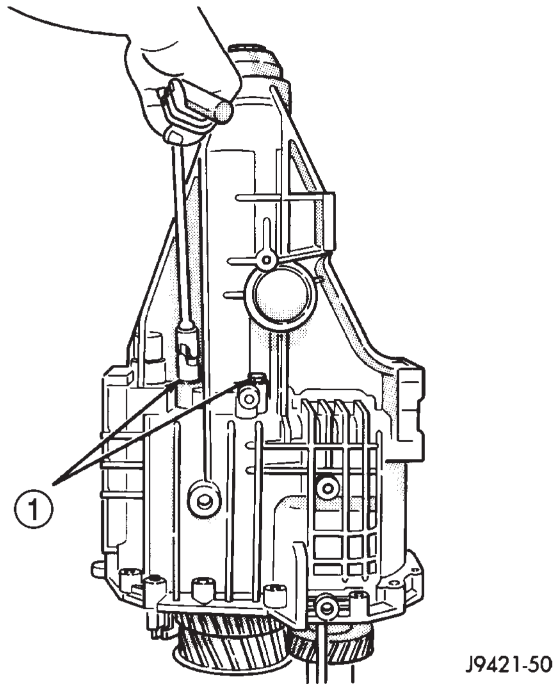


Fig. 27 OUTPUT SHAFT

1 - OUTPUT SHAFT BEARING RETAINER BOLTS (THIRD BOLT IS AT OPPOSITE SIDE OF CASE)

(2) Unseat output shaft bearing from bearing bore in rear housing. Use plastic/rawhide mallet to tap rear housing upward and off output shaft bearing as shown (Fig. 28).

(3) Lift rear housing up and off geartrain (Fig. 29).

(4) Remove countershaft rear bearing from countershaft (Fig. 30).

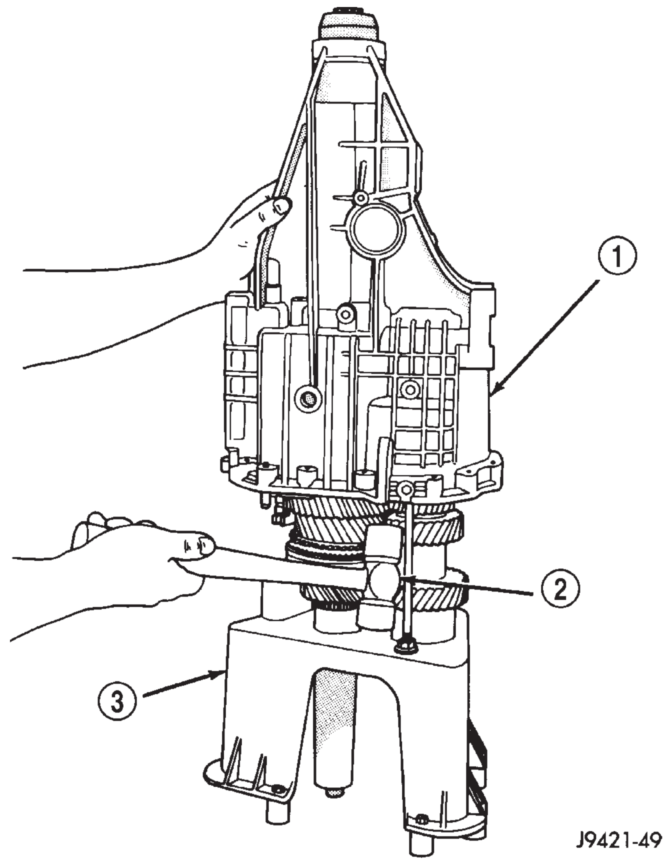


Fig. 28 REAR HOUSING - 2WD

1 - REAR HOUSING
2 - PLASTIC OR RAWHIDE MALLET
3 - FIXTURE TOOL

(5) Examine condition of bearing bore and idler shaft notch in rear housing . Replace housing if any of these components are damaged.

MANUAL - NV3500 (Continued)

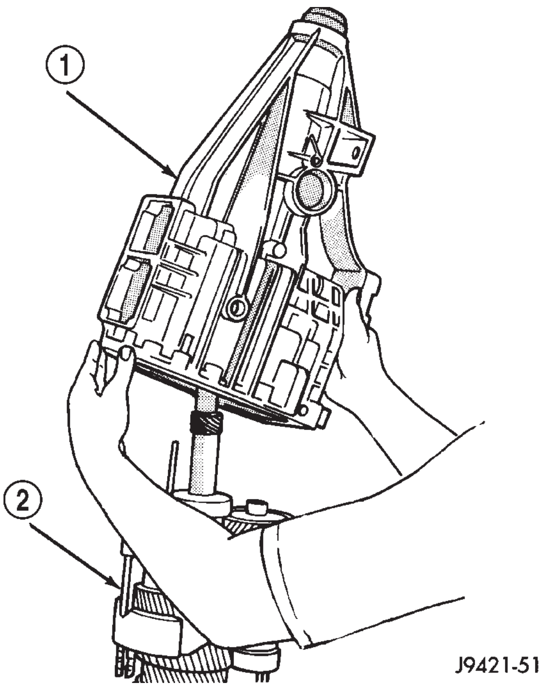


Fig. 29 REAR HOUSING

1 - REAR HOUSING
2 - SHIFT FORKS AND GEARTRAIN

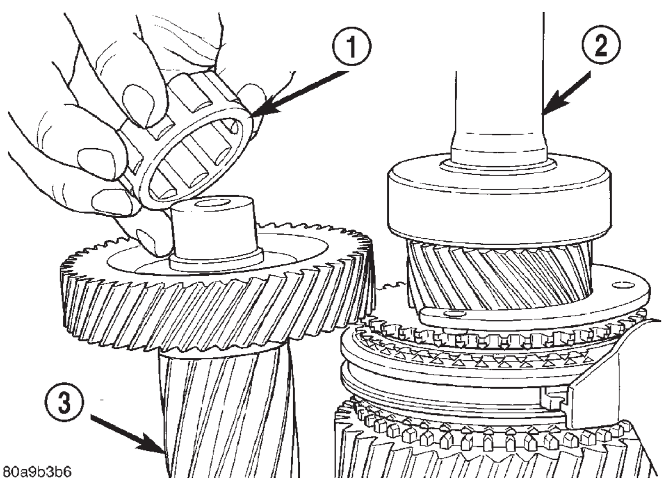


Fig. 30 COUNTERSHAFT REAR BEARING

1 - COUNTERSHAFT REAR BEARING
2 - OUTPUT SHAFT
3 - COUNTER SHAFT

REAR ADAPTER HOUSING - 4WD

(1) Locate rear seal dimples (Fig. 31). With slide hammer mounted screw, remove rear seal by inserting screw into one of the seal dimples (Fig. 32).

(2) Remove rear bearing snap ring from output shaft with snap ring pliers (Fig. 33).

(3) Lift rear adapter housing upward and off geartrain (Fig. 34).

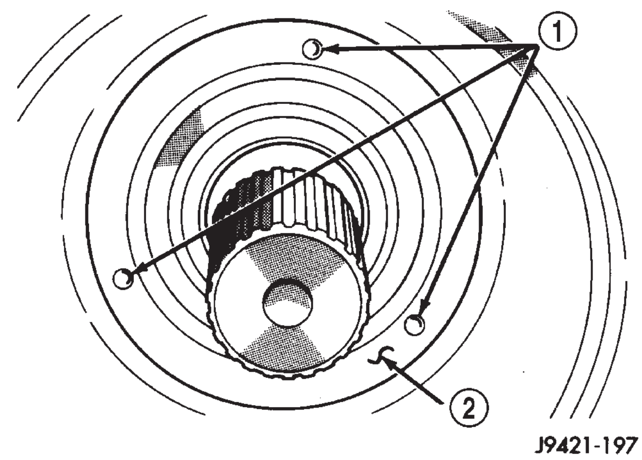


Fig. 31 DIMPLES IN SEAL FACE - 4WD

1 - LOCATION OF DIMPLES
2 - SEAL FACE

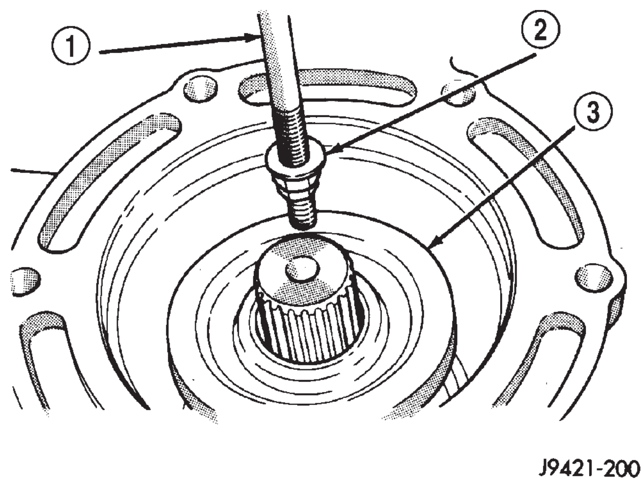


Fig. 32 REAR SEAL - 4WD

1 - SLIDE HAMMER
2 - REMOVER TOOL
3 - REAR SEAL

(4) Remove bearing retainer bolts and remove rear bearing retainer and rear bearing (Fig. 35). 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.

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.

MANUAL - NV3500 (Continued)

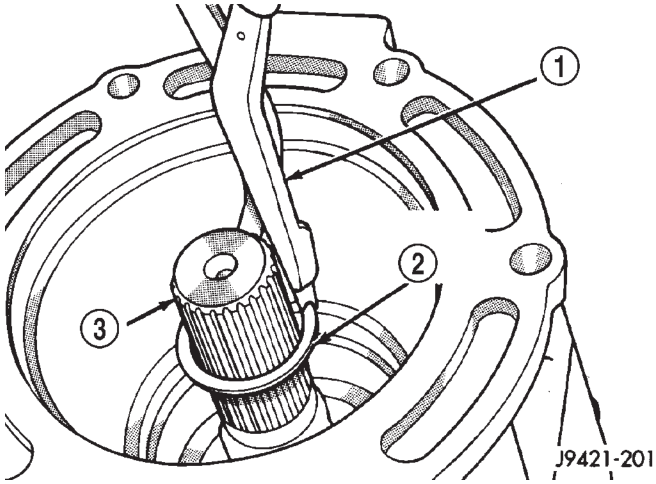


Fig. 33 REAR BEARING SNAP RING - 4WD

1 - HEAVY DUTY SNAP RING PLIERS
2 - REAR BEARING SNAP RING
3 - OUTPUT SHAFT

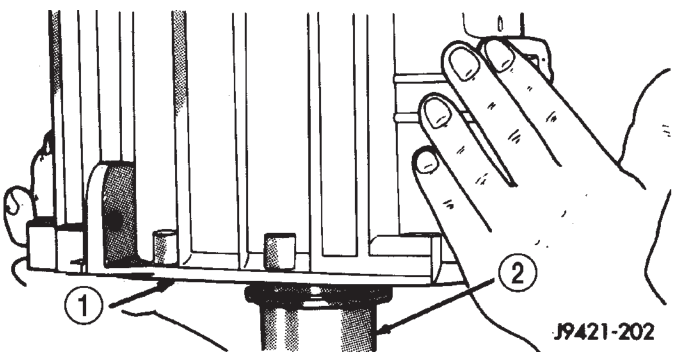


Fig. 34 REAR ADAPTER HOUSING

1 - REAR ADAPTER HOUSING
2 - OUTPUT SHAFT

(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.

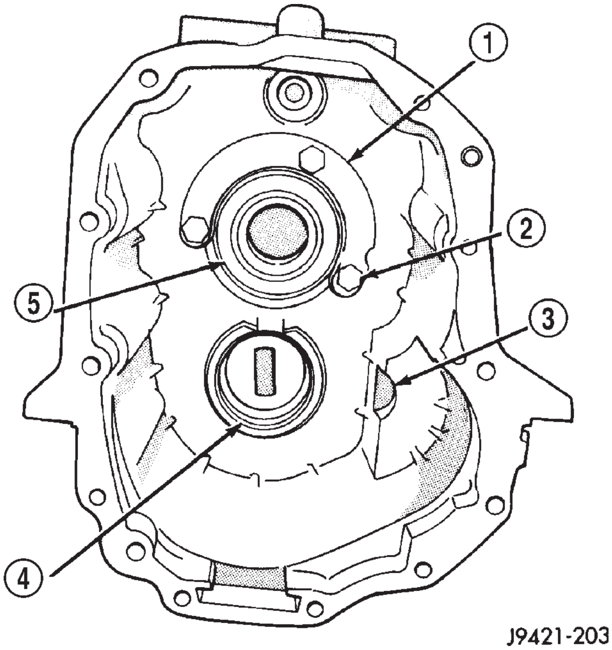


Fig. 35 REAR ADAPTER HOUSING COMPONENTS

1 - BEARING RETAINER
2 - RETAINER BOLTS (3)
3 - IDLER SHAFT NOTCH
4 - COUNTERSHAFT REAR BEARING RACE
5 - REAR BEARING

(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. 36).

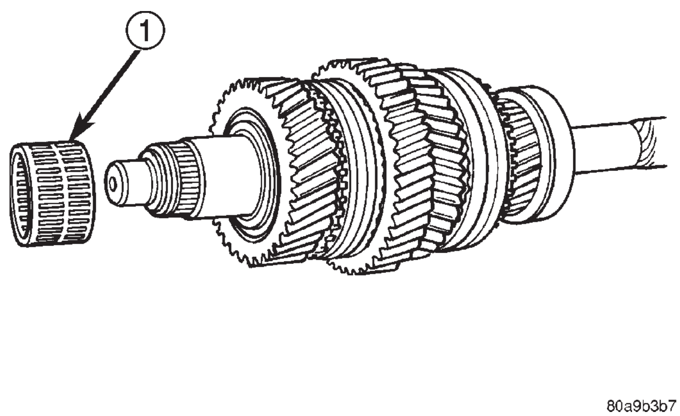


Fig. 36 THIRD GEAR NEEDLE BEARING

1 - THIRD GEAR NEEDLE BEARING

MANUAL - NV3500 (Continued)

(4) Remove retaining ring that secures two-piece thrust washer on shaft (Fig. 37). Use a small pry tool to remove retaining ring.

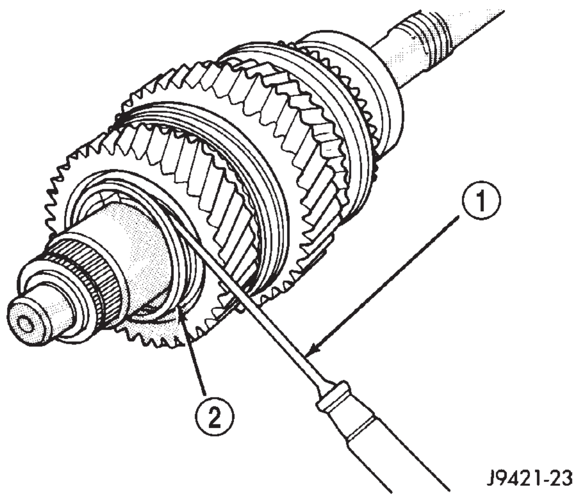


Fig. 37 THRUST WASHER

1 - PRY TOOL
2 - THRUST WASHER RETAINING RING

(5) Remove two-piece thrust washer (Fig. 38). Note position of washer locating lugs in shaft notches for installation reference.

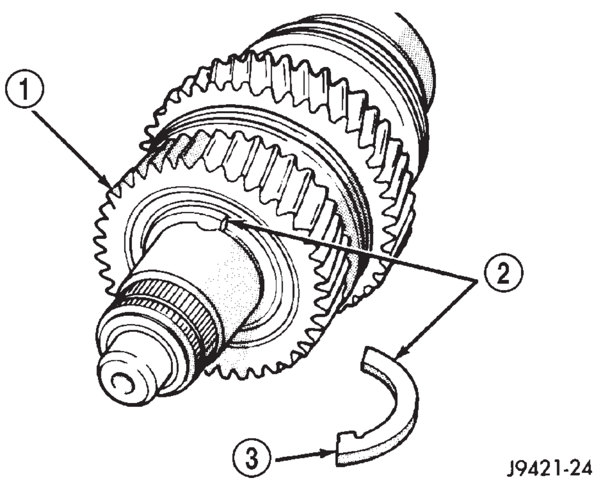


Fig. 38 TWO-PIECE THRUST WASHER

1 - SECOND GEAR
2 - THRUST WASHER (2–PIECE)
3 - WASHER LOCATING LUG

(6) Remove second gear and needle bearing (Fig. 39).

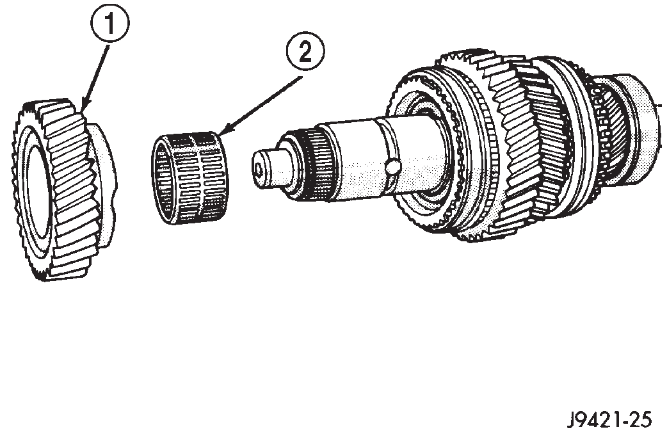


Fig. 39 SECOND GEAR AND NEEDLE BEARING

1 - SECOND GEAR
2 - SECOND GEAR NEEDLE BEARING

(7) Remove second gear synchro ring, synchro friction cone and synchro cone (Fig. 40).
(8) Remove interm ring.
(9) Remove 1-2 synchro hub snap ring.

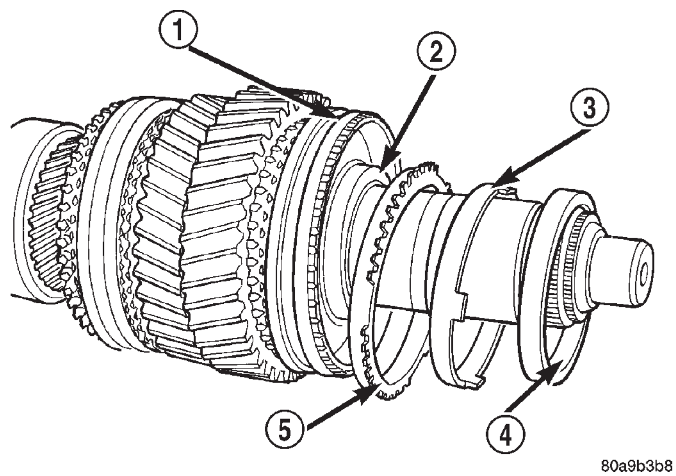


Fig. 40 SECOND GEAR SYNCHRO RING AND CONES

1 - 1-2 SYNCHRO HUB AND SLEEVE
2 - INTERM RING
3 - SYNCHRO FRICTION CONE
4 - SYNCHRO CONE
5 - SYNCHRO RING

MANUAL - NV3500 (Continued)

(10) Remove 1-2 synchro hub and sleeve and first gear from output shaft with press and Bearing Splitter 1130 (Fig. 41). Position splitter between first and reverse gears.

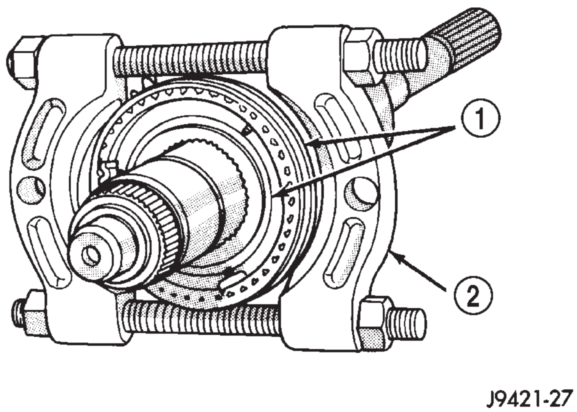


Fig. 41 HUB SLEEVE AND 1-2 SYNCHRO

1 - 1-2 SYNCHRO HUB AND SLEEVE
2 - SPECIAL TOOL
1130

(11) Remove first gear needle bearing (Fig. 42).

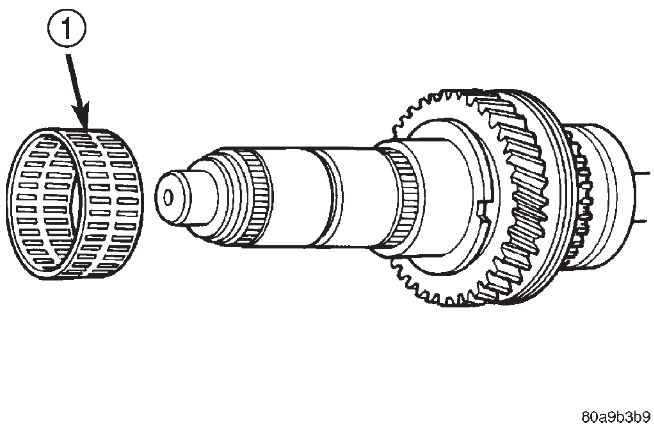


Fig. 42 FIRST GEAR NEEDLE BEARING

1 - FIRST GEAR NEEDLE BEARING

(12) Remove output shaft bearing snap ring (Fig. 43).

(13) On 2-wheel drive models, remove output shaft bearing.

(14) Remove fifth gear (Fig. 44).

(15) Remove fifth gear needle bearing. Spread bearing apart just enough to clear shoulder on output shaft (Fig. 45).

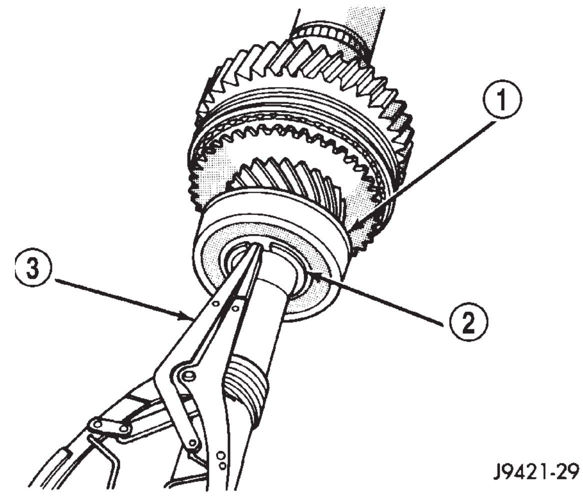


Fig. 43 OUTPUT SHAFT BEARING SNAP RING

1 - OUTPUT SHAFT BEARING
2 - BEARING SNAP RING
3 - SNAP RING PLIERS

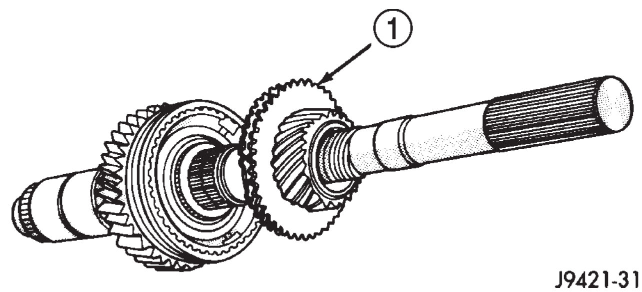


Fig. 44 FIFTH GEAR

1 - FIFTH GEAR AND SYNCHRO RING

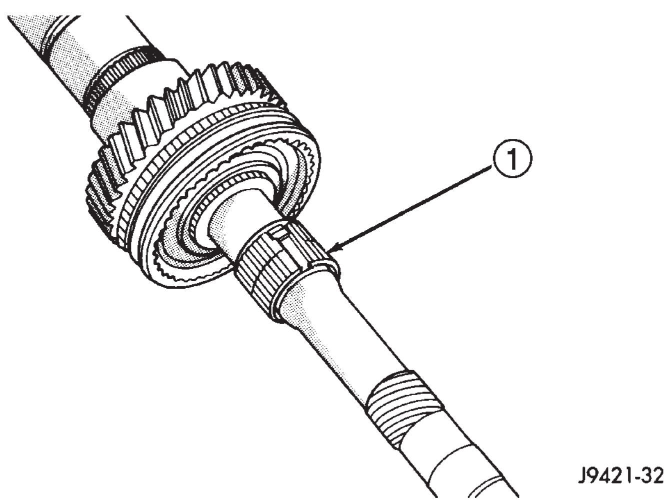


Fig. 45 FIFTH GEAR NEEDLE BEARING

1 - FIFTH GEAR NEEDLE BEARING (SPREAD BEARING TO CLEAR SHOULDER ON SHAFT)

MANUAL - NV3500 (Continued)

(16) Remove fifth-reverse synchro hub snap ring (Fig. 46).

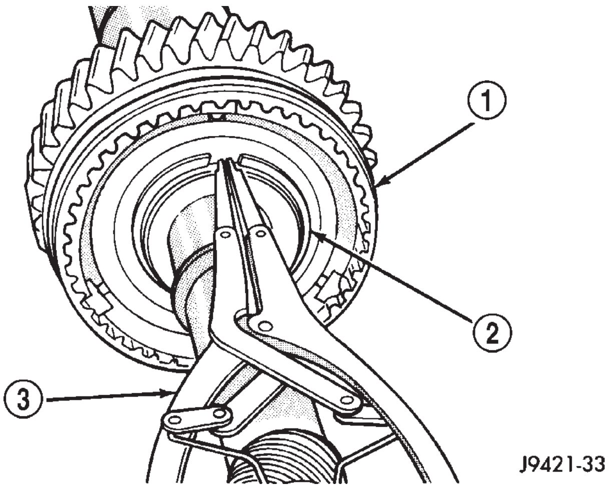


Fig. 46 FIFTH-REVERSE SYNCHRO HUB SNAP RING

1 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
2 - SYNCHRO HUB SNAP RING
3 - SNAP RING PLIERS

(17) Remove fifth-reverse synchro hub and sleeve with a press (Fig. 47).

(18) Remove reverse gear and needle bearing (Fig. 48).

REVERSE IDLER

(1) Remove idler gear snap rings (Fig. 49).

(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.

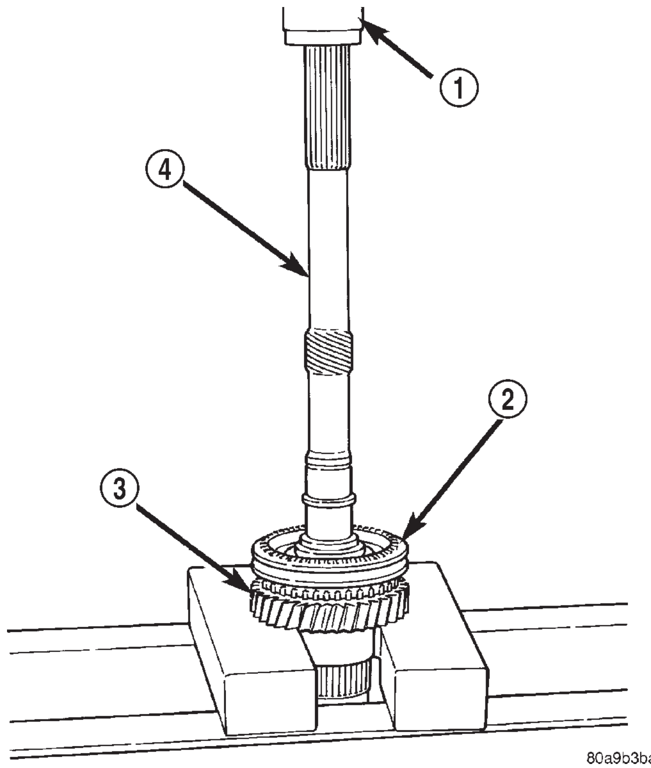


Fig. 47 FIFTH-REVERSE SYNCHRO HUB AND SLEEVE

1 - PRESS
2 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
3 - REVERSE GEAR
4 - OUTPUT SHAFT

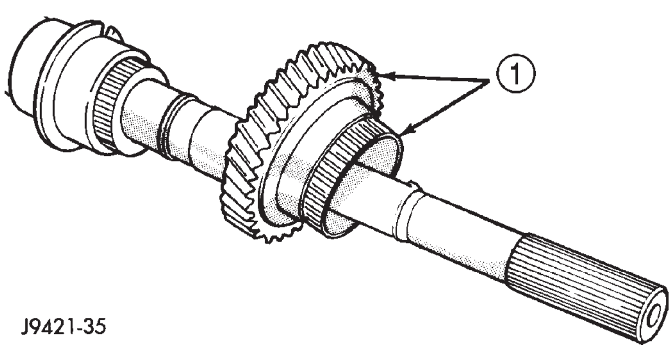


Fig. 48 REVERSE GEAR AND NEEDLE BEARING

1 - REVERSE GEAR AND NEEDLE BEARING

MANUAL - NV3500 (Continued)

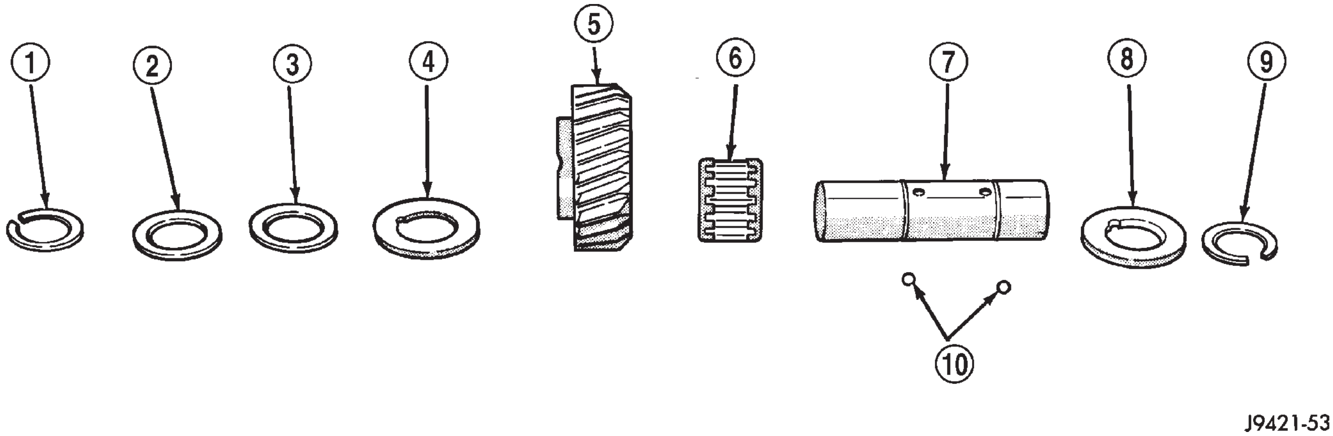


Fig. 49 REVERSE IDLER COMPONENTS

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

INSPECTION

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. 50). Replace any fork exhibiting wear or damage in these areas. Do not attempt to salvage shift forks.

Check condition of the shift shaft detent plunger and spring. The plunger should be smooth and free of nicks, or scores. The plunger spring should be straight and not collapsed, or distorted. Minor scratches, or nicks on the plunger can be smoothed with 320/400 grit emery soaked in oil. Replace the plunger and spring if in doubt about condition. Check condition of detent plunger bushings. Replace if damaged.

Inspect the shift shaft, shift shaft bushing and bearing, the shaft lever, and the lever bushing that fits over the lever. Replace the shaft if bent, cracked, or severely scored. Minor burrs, nicks, or scratches can be smoothed off with 320/400 grit emery cloth followed by polishing with crocus cloth. Replace the shift shaft bushing or bearing if damaged.

Replace the shaft lever and bushing if either part is deformed, or worn. Do not attempt to salvage these parts as shift fork binding will occur. Replace the roll pin that secures the lever to the shaft.

FRONT/REAR HOUSINGS AND BEARING RETAINERS

Inspect the housings carefully. Look for cracks, stripped threads, scored mating surfaces, damaged bearing bores, or worn dowel pin holes. Minor nicks on mating surfaces can be dressed off with a fine file, or emery cloth. Damaged threads can be renewed by either re-tapping or installing Helicoil inserts.

NOTE: The front housing contains the countershaft front bearing race. The rear housing contains the countershaft rear bearing race. Be advised that these components are NOT serviceable items. The front housing will have to be replaced if the countershaft bearing race is loose, worn, or damaged. The rear housing will have to be replaced if the countershaft rear bearing race is loose, worn, or damaged.

Inspect the input shaft bearing retainer. Be sure the release bearing slide surface of the retainer is in good condition. Minor nicks on the surface can be smoothed off with 320/420 grit emery cloth and final polished with oil coated crocus cloth. Replace the retainer seal if necessary.

Inspect the output shaft bearing retainer. Be sure the U-shaped retainer is flat and free of distortion. Replace the retainer if the threads are damaged, or if the retainer is bent, or cracked.

COUNTERSHAFT BEARINGS AND RACES

The countershaft bearings and races are machine lapped during manufacture to form matched sets. The bearings and races should not be interchanged.

MANUAL - NV3500 (Continued)

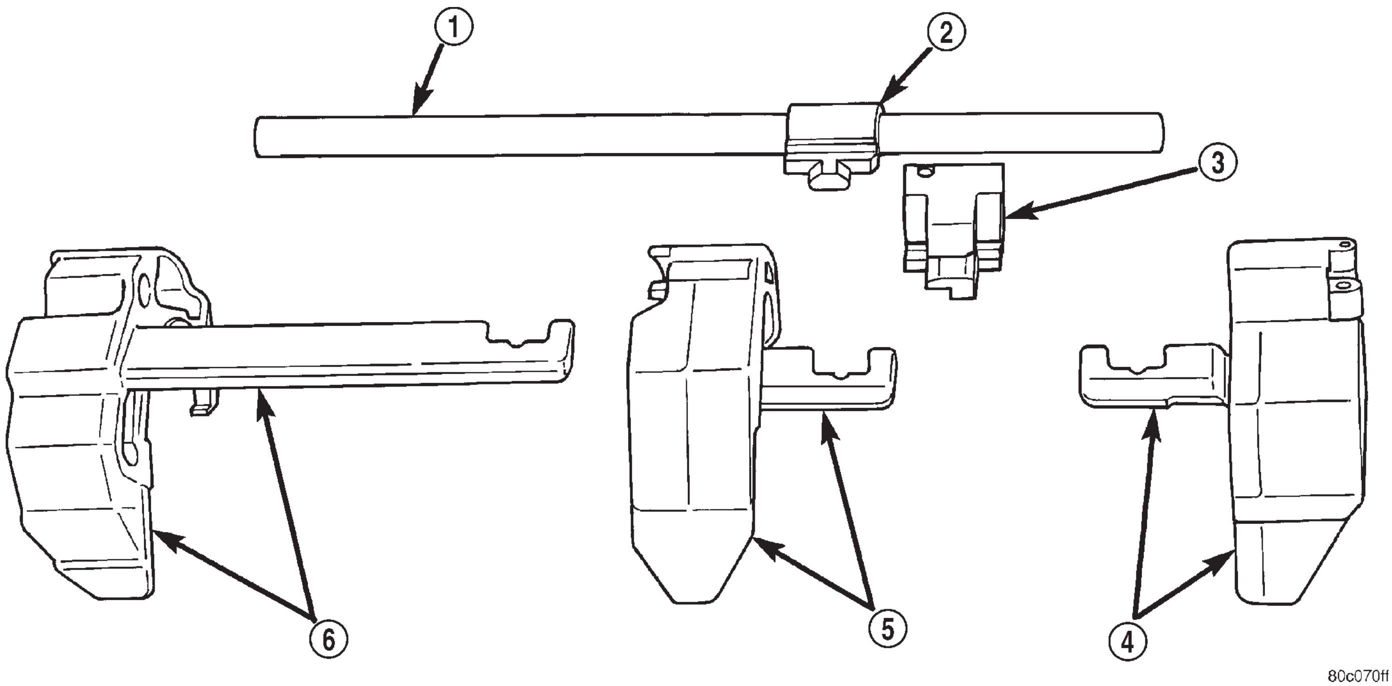


Fig. 50 Shift Forks And Shaft

1 - SHIFT SHAFT
2 - SHAFT LEVER
3 - SHAFT LEVER BUSHING
4 - 3-4 SHIFT FORK
5 - 1-2 SHIFT FORK
6 - FIFTH-REVERSE SHIFT FORK

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. 51). The small diameter side goes in the bearing race.

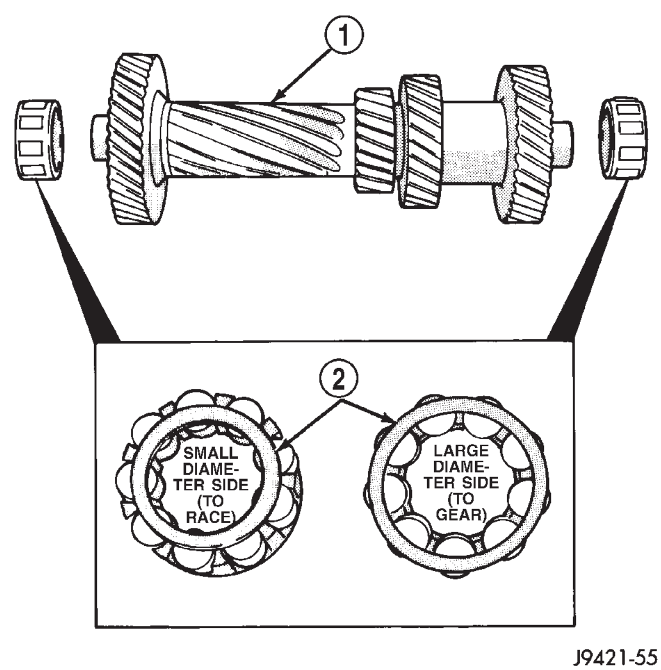


Fig. 51 Countershaft Bearings

1 - COUNTERSHAFT
2 - BEARING CAGE

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.

MANUAL - NV3500 (Continued)

Shift Socket

Inspect the shift socket for wear or damage. replace the socket if the roll pin, or shift shaft bores are damaged. Minor nicks in the shift lever ball seat in the socket can be smoothed down with 400 grit emery or wet/dry paper. Replace the socket if the ball seat is worn, or cracked. Do not reuse the original shift socket roll pin. Install a new pin during reassembly. The socket roll pin is approximately is approximately 33 mm (1-1/4 in.) long.

Output Shaft And Geartrain

Inspect all of the gears for worn, cracked, chipped, or broken teeth. Also check condition of the bearing bore in each gear. The bores should be smooth and free of surface damage. Discoloration of the gear bores is a normal occurrence and is not a reason for replacement. Replace gears only when tooth damage has occurred, or if the bores are brinnelled or severely scored.

Inspect the shaft splines and bearings surfaces. Minor nicks on the bearing surfaces can be smoothed with 320/420 grit emery and final polished with crocus cloth. Replace the shaft if the splines are damaged or bearing surfaces are deeply scored, worn, or brinnelled.

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.

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

To assemble each synchro install the springs, struts and detent balls one at a time as follows:

(1) Slide the sleeve part way onto the hub. Leave enough room to install the spring in the hub and the strut in the hub groove.

(2) Install the first spring in the hub. Then install a strut over the spring. Be sure the spring is seated in the spring bore in the strut.

(3) Slide the sleeve onto the hub just far enough to hold the first strut and spring in place.

(4) Place the detent ball in the top of the strut. Then carefully work the sleeve over the ball to hold it in place. Use a small flat blade screwdriver to press the ball into place while moving the sleeve over it.

(5) Repeat the procedure for the remaining springs, struts and balls. Tape or rubber band each strut and ball to temporarily secure as they are installed.

(6) Verify synchro springs, struts and detent balls are all in place (Fig. 52).

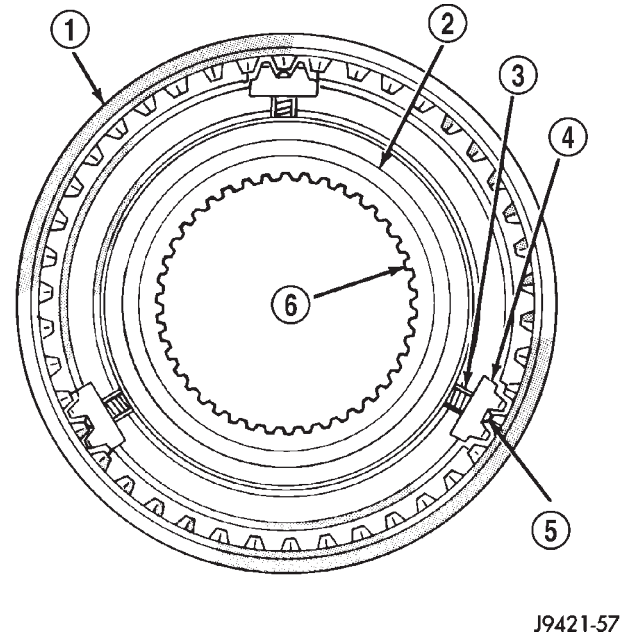


Fig. 52 SYNCHRONIZER COMPONENTS

1 - SLEEVE
2 - HUB SHOULDER
3 - SPRING (3)
4 - STRUT (3)
5 - DETENT BALL (3)
6 - HUB

OUTPUT SHAFT

Lubricate shaft, gears and bearings with recommended lubricant during assembly. Petroleum jelly can be used to hold parts in place. Check bearing surfaces of output shaft for nicks or scratches. Smooth surfaces with 320/400 grit emery cloth if necessary. Apply oil to emery cloth and shaft surface before polishing.

Inspect and replace any synchro ring if worn or damage. Immerse each synchro ring in lubricant before installation.

(1) Lubricate and install reverse gear needle bearing on shaft (Fig. 53). Slide bearing up against shoulder on output shaft.

(2) Install reverse gear over needle bearing (Fig. 54).

(3) Install brass synchro ring on reverse gear (Fig. 55).

(4) Assemble fifth-reverse synchro hub, sleeve, struts, springs and detent balls, if not previously done.

MANUAL - NV3500 (Continued)

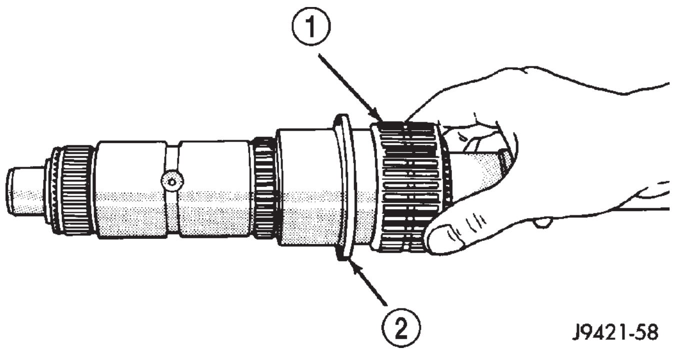


Fig. 53 REVERSE GEAR BEARING

1 - REVERSE GEAR BEARING
2 - SHOULDER

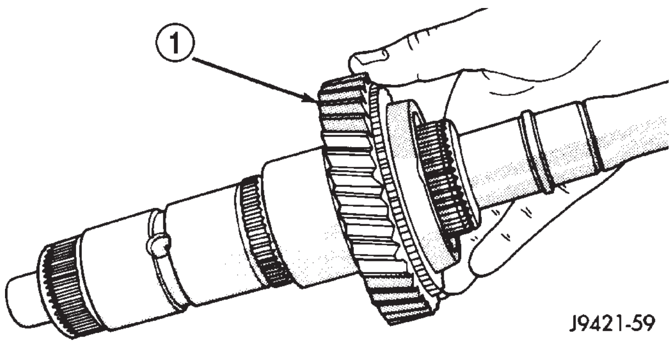


Fig. 54 REVERSE GEAR

1 - REVERSE GEAR

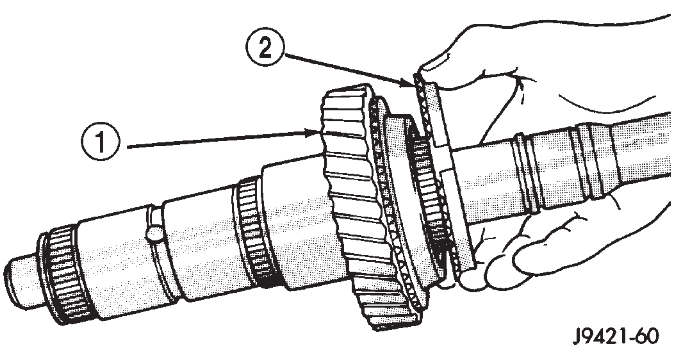


Fig. 55 REVERSE SYNCHRO

1 - REVERSE GEAR
2 - SYNCHRO RING

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. 56).

(6) Install new fifth-reverse hub snap ring (Fig. 57) and verify the snap ring is seated.

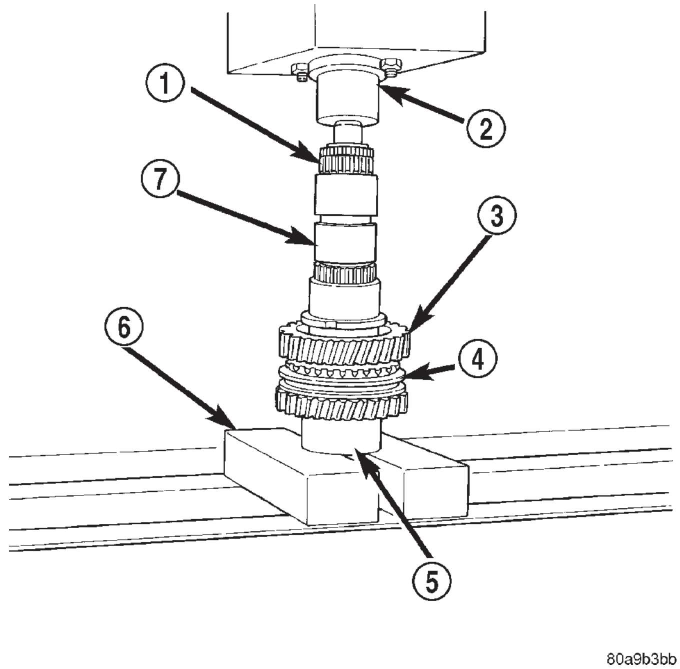


Fig. 56 FIFTH-REVERSE SYNCHRO ASSEMBLY

1 - SPACER
2 - PRESS RAM
3 - REVERSE GEAR
4 - FIFTH-REVERSE SYNCHRO ASSEMBLY
5 - CUP
6 - PRESS BLOCKS
7 - OUTPUT SHAFT

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.

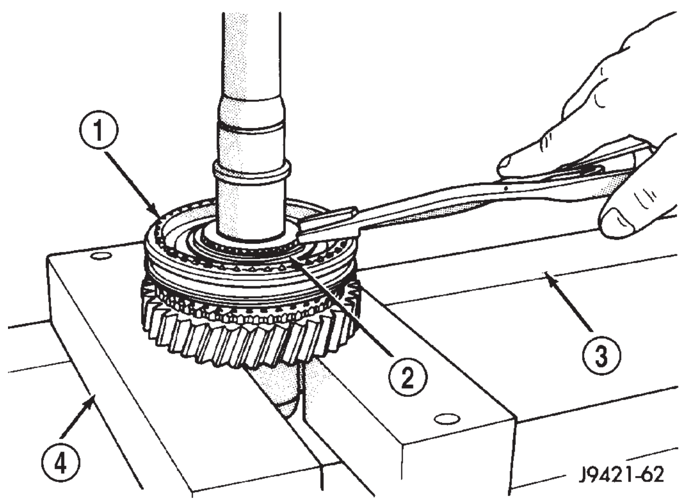


Fig. 57 FIFTH/REVERSE SYNCHRO HUB SNAP RING

1 - FIFTH-REVERSE SYNCHRO ASSEMBLY
2 - SNAP RING
3 - PRESS BED
4 - PRESS BLOCKS

MANUAL - NV3500 (Continued)

(7) Install fifth gear synchro ring in synchro hub and sleeve (Fig. 58).

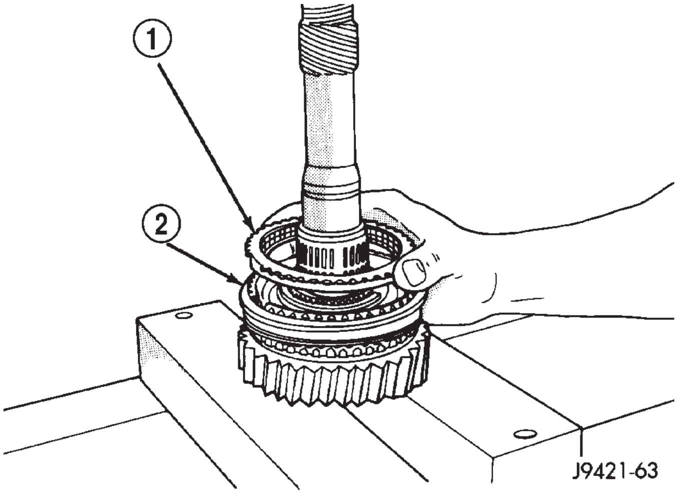


Fig. 58 FIFTH GEAR SYNCHRO RING

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. 59). Verify bearing is properly seated.

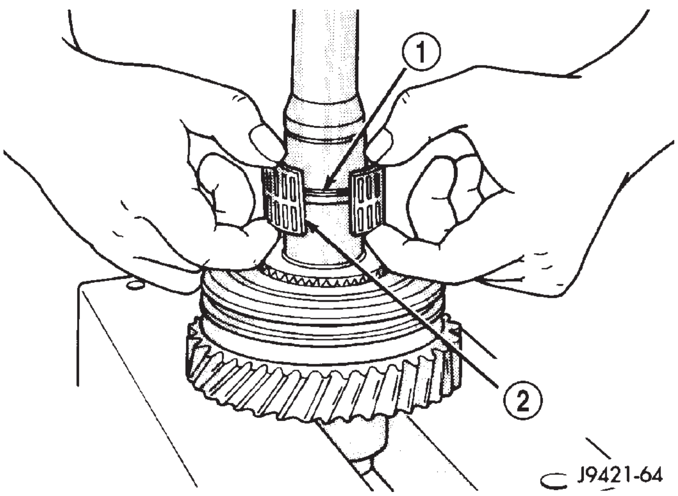


Fig. 59 FIFTH GEAR BEARING

1 - SHAFT SHOULDER
2 - FIFTH GEAR BEARING

(9) Install fifth gear on shaft and onto bearing (Fig. 60).

(10) Invert output shaft and set the shaft in Cup 6310-1 so that fifth gear is seated on the tool (Fig. 61).

(11) Install first gear bearing on output shaft (Fig. 61). Verify bearing is seated on shaft shoulder and is properly joined.

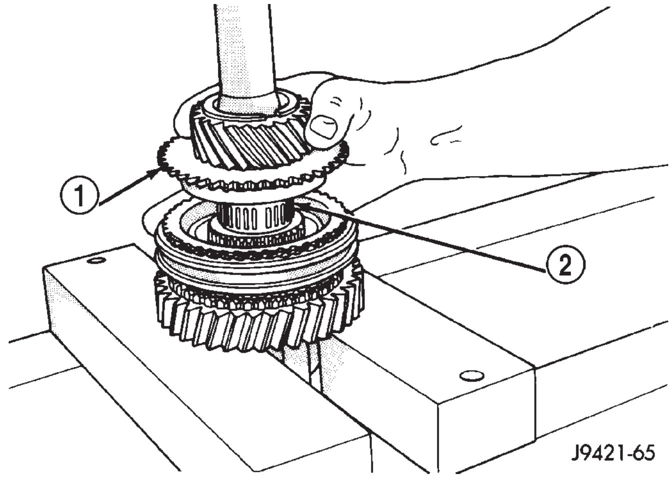


Fig. 60 FIFTH GEAR

1 - FIFTH GEAR
2 - BEARING

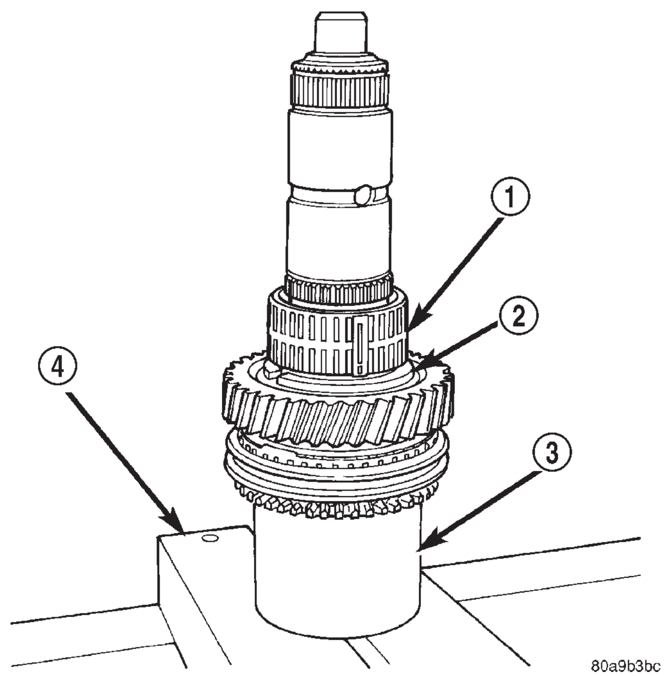


Fig. 61 FIRST GEAR BEARING

1 - FIRST GEAR BEARING
2 - SHAFT SHOULDER
3 - SPECIAL TOOL
4 - PRESS BLOCKS

(12) Install first gear on shaft and over bearing with bearing synchro cone facing up (Fig. 62).

(13) Install first gear synchro ring (Fig. 63).

(14) Assemble 1-2 synchro hub sleeve, springs, struts and detent balls.

MANUAL - NV3500 (Continued)

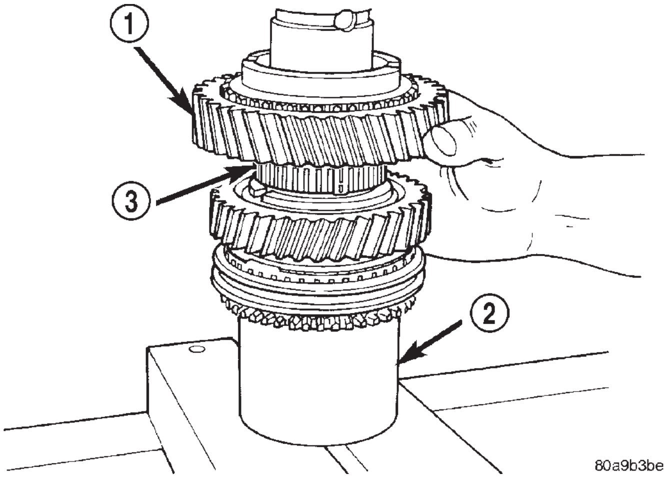


Fig. 62 FIRST GEAR

1 - FIRST GEAR
2 - SPECIAL TOOL
3 - BEARING

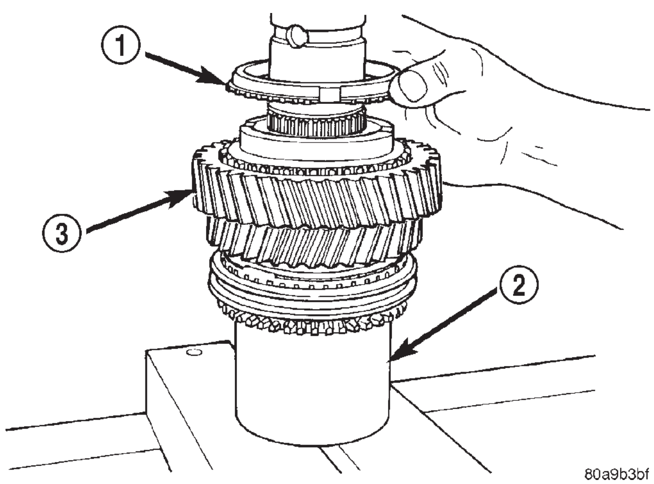


Fig. 63 FIRST GEAR SYNCHRO RING

1 - FIRST GEAR SYNCHRO RING
2 - SPECIAL TOOL
3 - FIRST GEAR

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. 64). Verify synchro sleeve is properly positioned.

(16) Press 1-2 synchro onto output shaft using suitable size pipe tool and shop press (Fig. 65).

CAUTION: Align the synchro ring and sleeve as hub the is being pressed onto the shaft. The synchro ring can crack if not aligned.

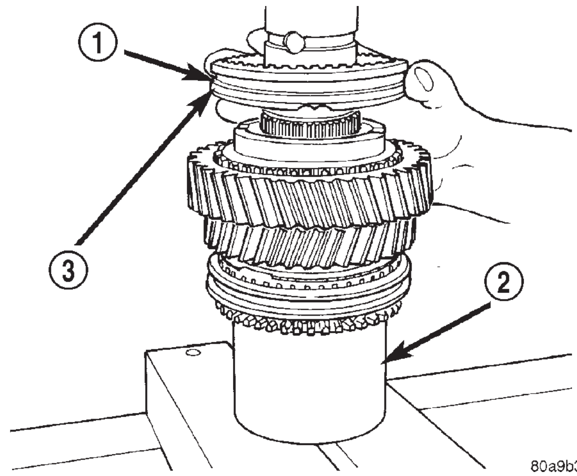


Fig. 64 STARTING 1-2 SYNCHRO ON SHAFT

1 - 1-2 SYNCHRO ASSEMBLY
2 - CUP
3 - FIRST GEAR SIDE OF SYNCHRO SLEEVE

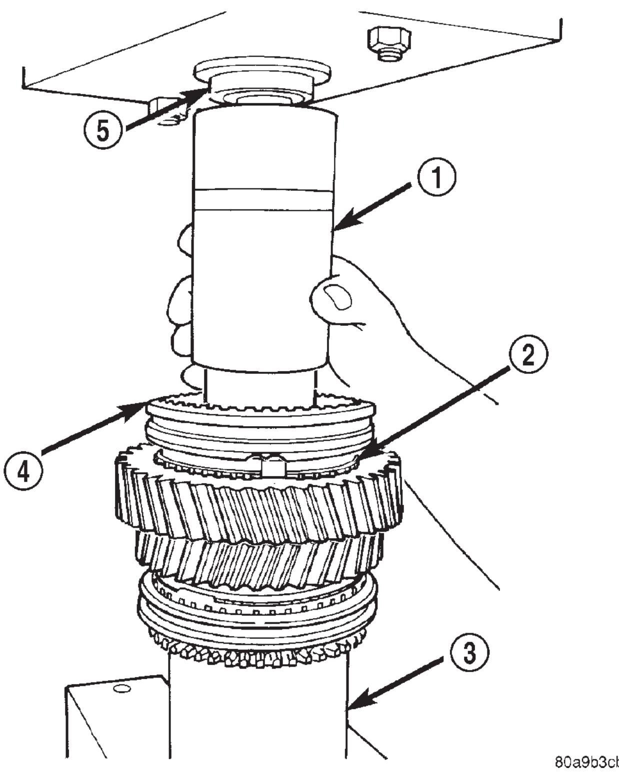


Fig. 65 PRESS 1-2 SYNCHRO

1 - SUITABLE SIZE PIPE
2 - SYNCHRO RING
3 - SPECIAL TOOL
4 - 1-2 SYNCHRO ASSEMBLY
5 - PRESS RAM

MANUAL - NV3500 (Continued)

(17) Install interm ring.

(18) Install new 1-2 synchro hub snap ring (Fig. 66) 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.

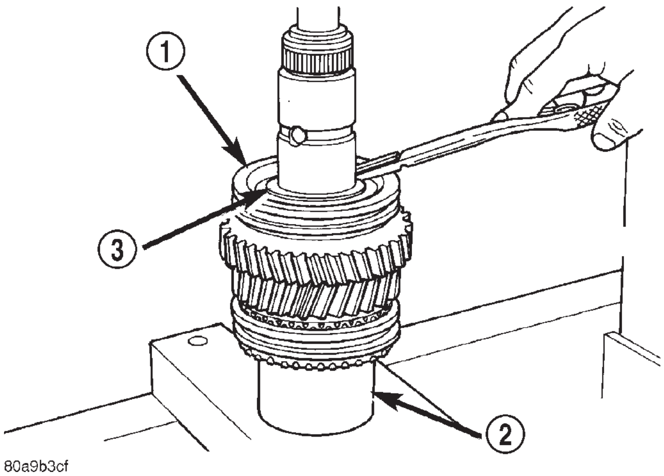


Fig. 66 1-2 SYNCHRO HUB SNAP RING

1 - 1-2 SYNCHRO
2 - CUP
3 - SYNCHRO SNAP RING

(19) Install second gear synchro ring in 1-2 synchro hub and sleeve (Fig. 67). Verify synchro ring is properly seated.

(20) Install synchro friction cone and synchro cone in synchro ring.

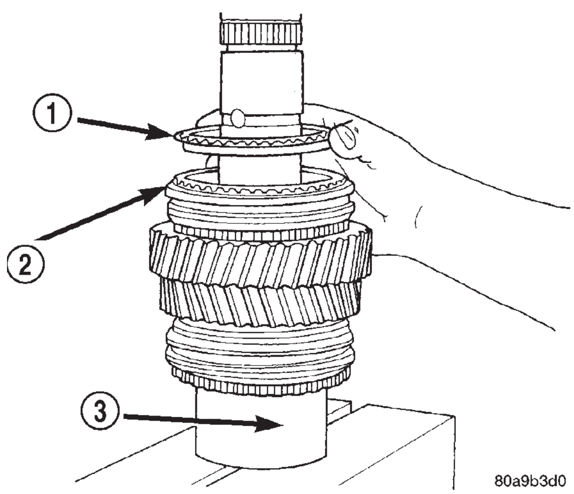


Fig. 67 SECOND GEAR SYNCHRO RING

1 - SECOND GEAR SYNCHRO RING
2 - 1-2 SYNCHRO
3 - SPECIAL TOOL

(21) Install second gear needle bearing on shaft (Fig. 68).

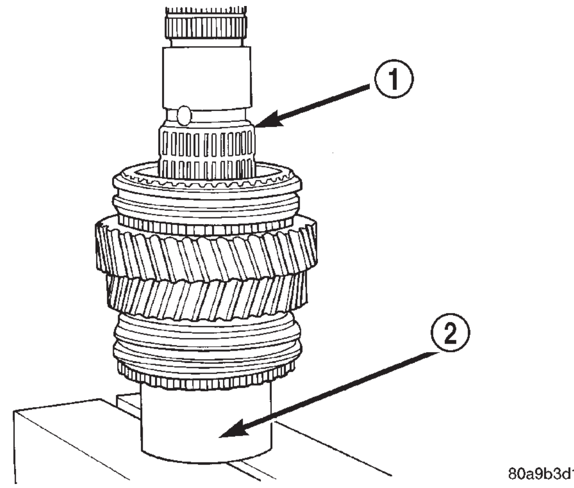


Fig. 68 SECOND GEAR BEARING

1 - SECOND GEAR BEARING
2 - SPECIAL TOOL

(22) Install second gear onto shaft and bearing (Fig. 69). Verify second gear is fully seated on synchro components.

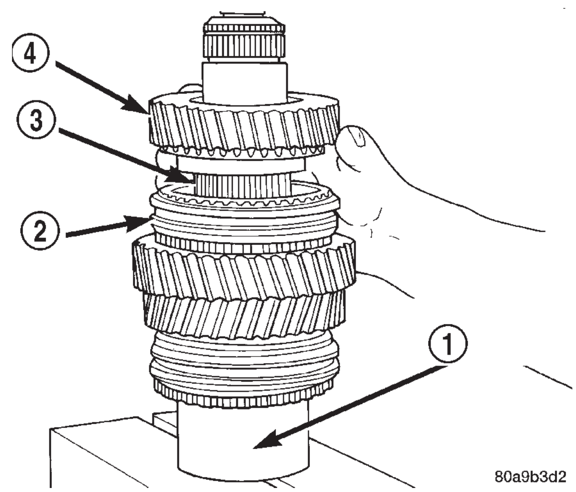


Fig. 69 SECOND GEAR

1 - SPECIAL TOOL
2 - 1-2 SYNCHRO ASSEMBLY
3 - BEARING
4 - SECOND GEAR

(23) Install two-piece thrust washer (Fig. 70). Ensure washer halves are seated in shaft groove and that washer lugs are seated in shaft lug bores. Verify i.d. grooves and markings noted during removal are facing the correct direction.

MANUAL - NV3500 (Continued)

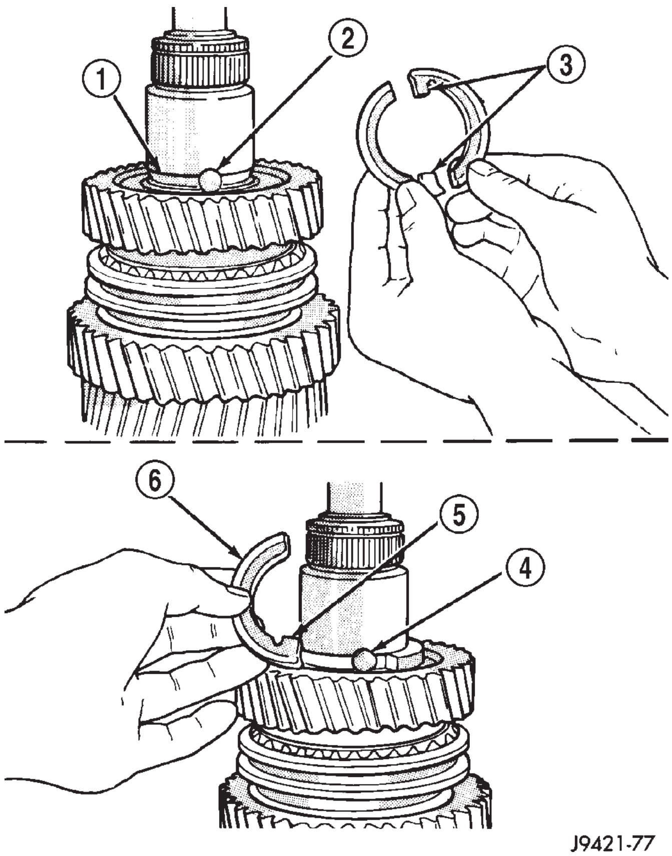


Fig. 70 TWO-PIECE THRUST WASH

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. 71). Ensure locating dimple is between the thrust washer halves.

(25) Seat thrust washer retaining ring with plastic mallet (Fig. 72).

(26) Install third gear needle bearing on shaft (Fig. 73).

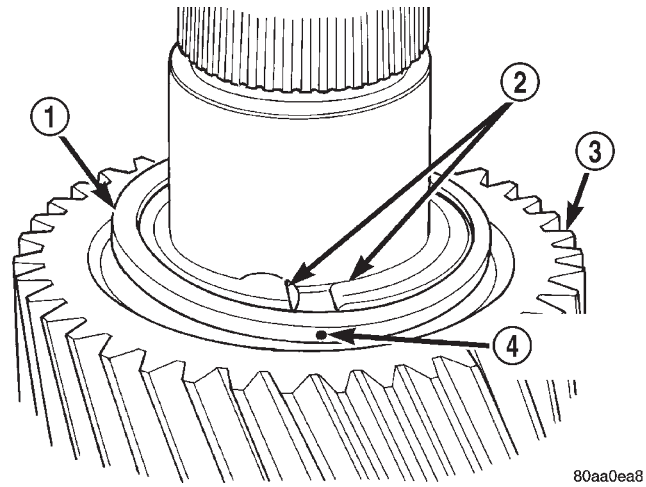


Fig. 71 RETAINING RING

1 - THRUST WASHER RETAINING RING
2 - THRUST WASHER HALVES
3 - SECOND GEAR
4 - LOCATING DIMPLE

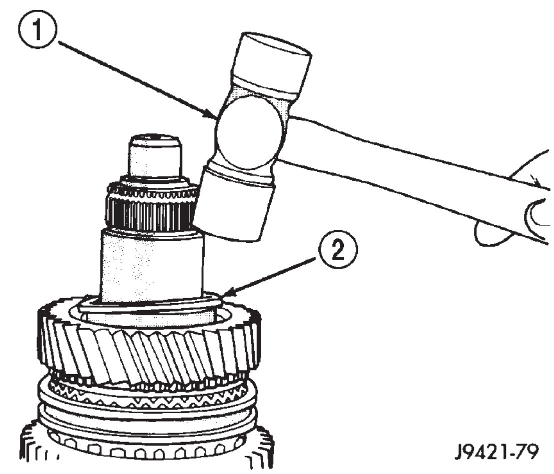


Fig. 72 THRUST WASHER

1 - PLASTIC MALLET
2 - THRUST WASHER RETAINING RING

MANUAL - NV3500 (Continued)

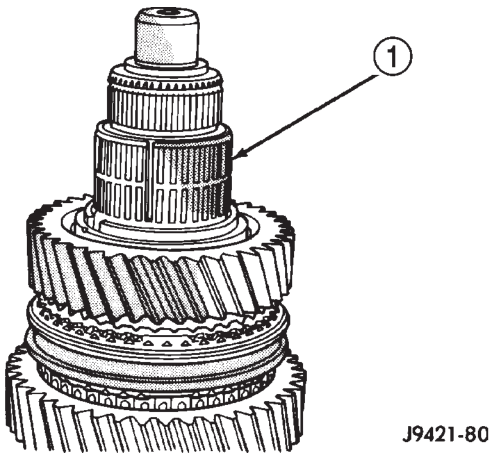


Fig. 73 THIRD GEAR BEARING

1 - THIRD GEAR BEARING

(27) Install third gear on shaft and bearing (Fig. 74).

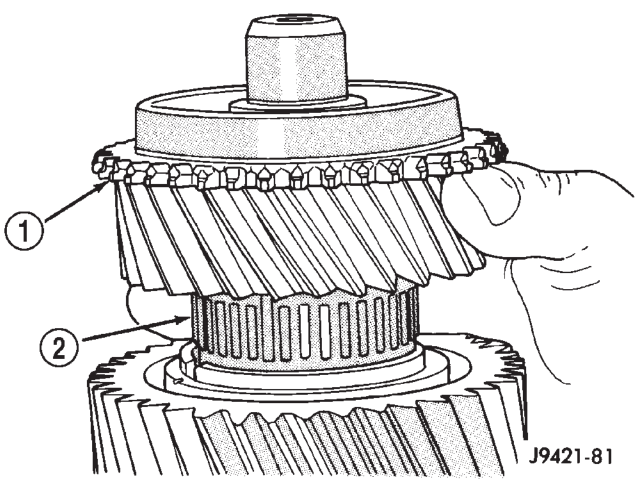


Fig. 74 THIRD GEAR

1 - THIRD GEAR
2 - BEARING

(28) Install third speed synchro ring on third gear (Fig. 75).

(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. 76).

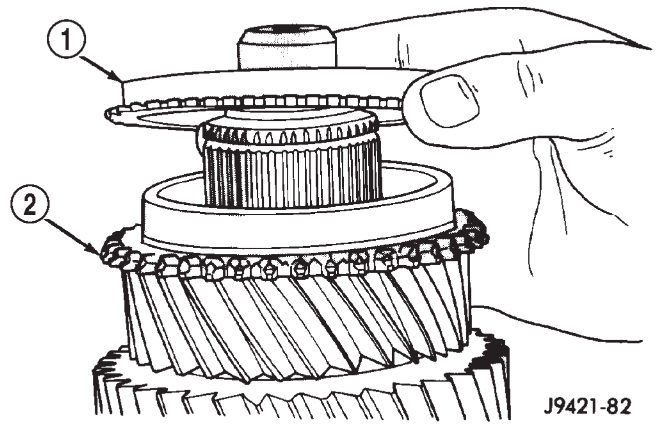


Fig. 75 THIRD SPEED SYNCHRO RING

1 - THIRD SPEED SYNCHRO RING
2 - THIRD GEAR

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.

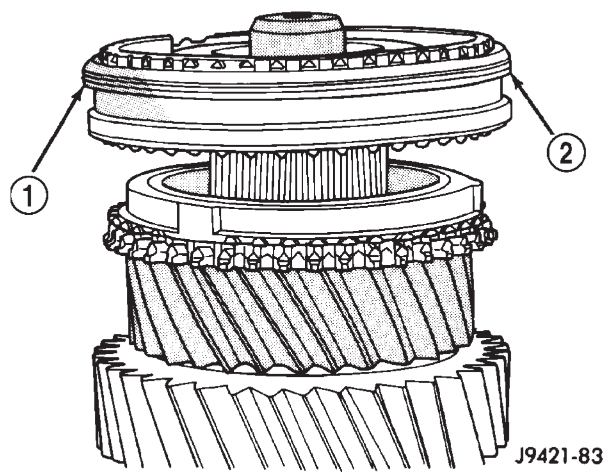


Fig. 76 3-4 SYNCHRO HUB ON OUTPUT SHAFT

1 - GROOVED SIDE OF SLEEVE (TO FRONT)
2 - 3-4 SYNCHRO ASSEMBLY

MANUAL - NV3500 (Continued)

(31) Press 3-4 synchro assembly onto output shaft with shop press and suitable size pipe tool (Fig. 77).

NOTE: Place the pipe on hub as close to output shaft as possible without contacting the shaft splines.

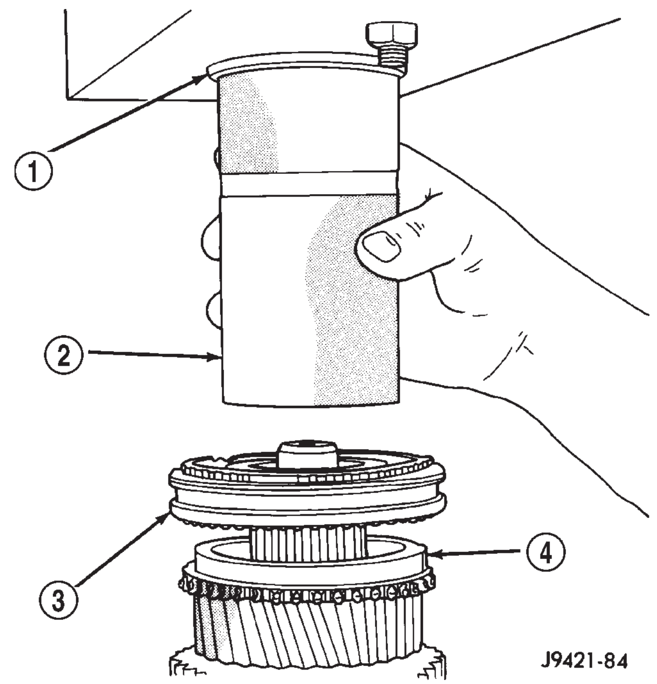


Fig. 77 PRESS 3-4 SYNCHRO ON OUTPUT SHAF

1 - PRESS RAM
2 - PIPE TOOL
3 - 3-4 SYNCHRO
4 - THIRD SPEED SYNCHRO RING

(32) Install 3-4 synchro hub snap ring (Fig. 78)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.

(33) Install output shaft bearing.

(34) Install output shaft bearing snap ring, spreading it just enough to install it (Fig. 79). Verify snap ring is seated in shaft groove.

(35) Verify position of synchro sleeves before proceeding with assembly operations (Fig. 80). 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.

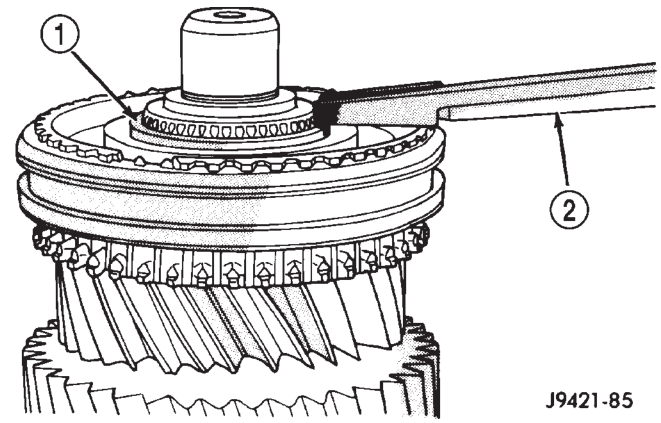


Fig. 78 3-4 SYNCHRO HUB SNAP RING

1 - 3-4 SYNCHRO HUB SNAP RING
2 - SNAP RING PLIERS

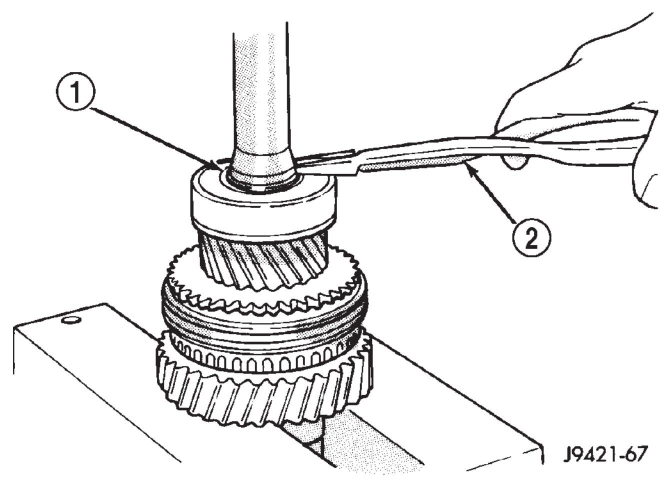


Fig. 79 OUTPUT SHAFT BEARING

1 - BEARING SNAP RING
2 - SNAP RING PLIERS

REVERSE IDLER ASSEMBLY

(1) Lubricate idler components with gear lube.

(2) Slide idler gear bearing on shaft (Fig. 81). Bearing fits either way on shaft.

(3) Slide gear onto shaft. Side of gear with recess goes to rear (Fig. 81).

(4) Place first lock ball in dimple at rear end of idler shaft (Fig. 81). Hold ball in place with petroleum jelly.

(5) Slide thrust rear thrust washer onto shaft and over lock ball (Fig. 82).

(6) Install snap ring in groove at rear of shaft (Fig. 82).

MANUAL - NV3500 (Continued)

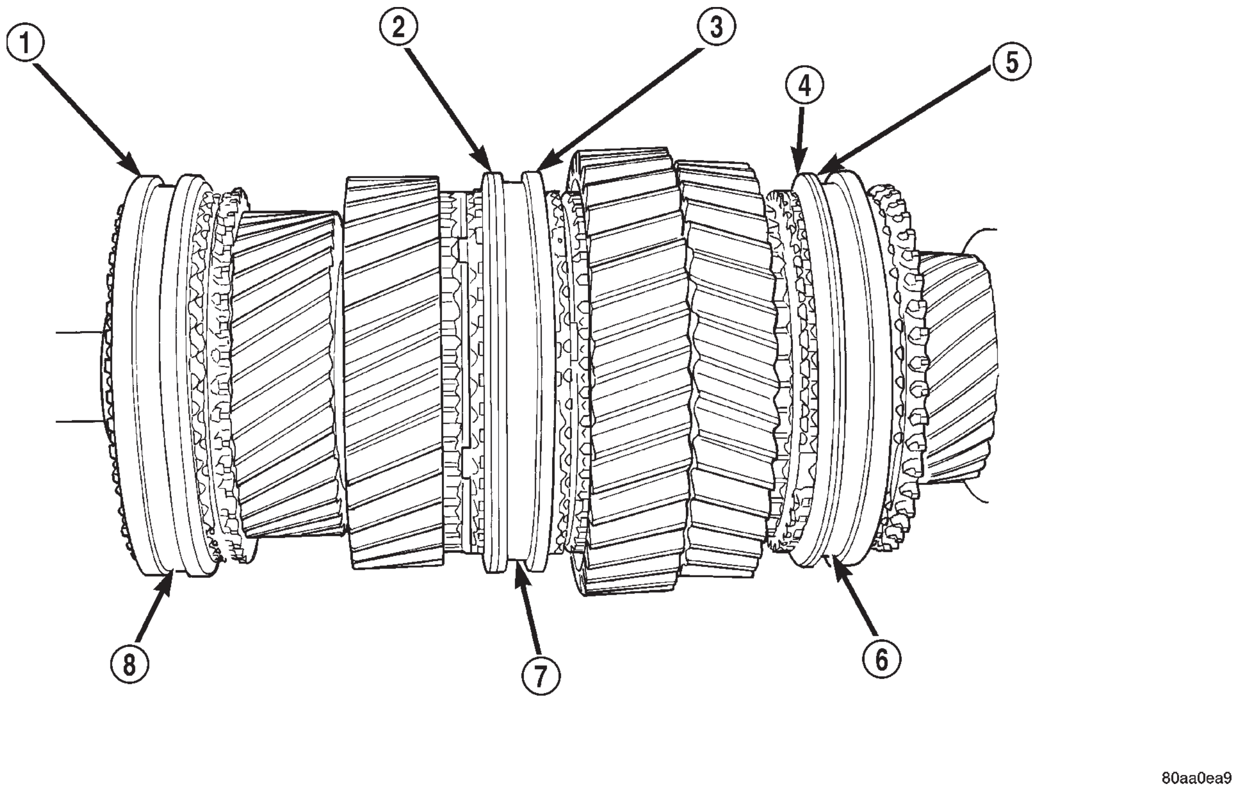


Fig. 80 SYNCHRO SLEEVE LOCATIONS

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

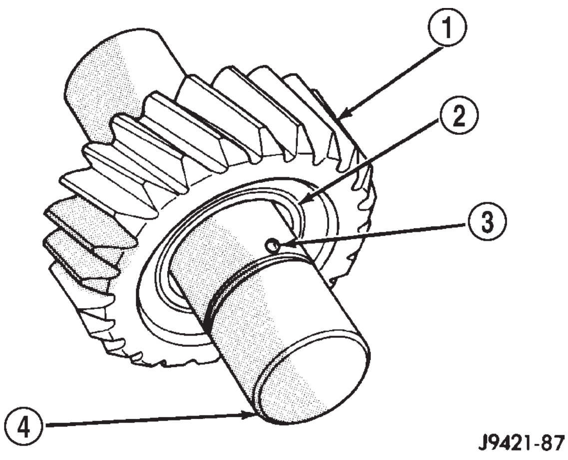


Fig. 81 IDLER GEAR AND BEARING

1 - IDLER GEAR
2 - BEARING
3 - LOCK BALL
4 - REAR OF SHAFT

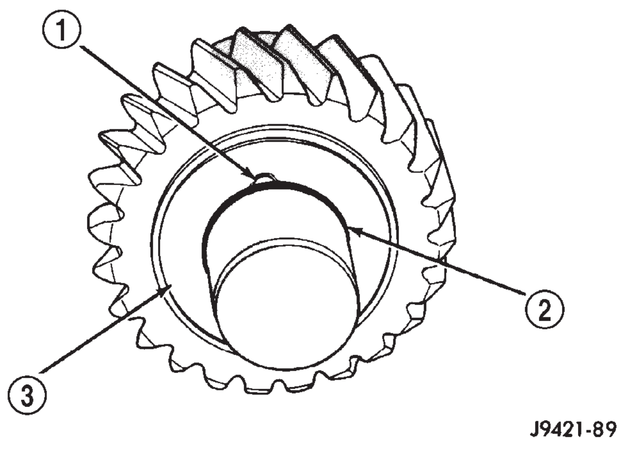


Fig. 82 IDLER GEAR REAR THRUST WASHER

1 - LOCK BALL
2 - SNAP RING GROOVE
3 - THRUST WASHER

MANUAL - NV3500 (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. 83).

(9) Install wave washer, flat washer and remaining snap ring on idler shaft (Fig. 83). Verify snap ring is seated.

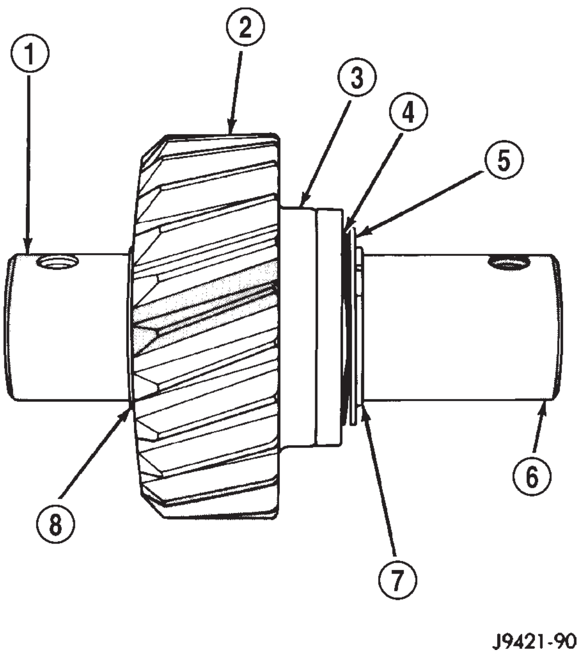


Fig. 83 IDLER GEAR AND SHAFT ASSEMBLY

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.

GEARTRAIN ASSEMBLY

(1) Install Adapter 6747-1A on input shaft hub of Fixture 6747 (Fig. 84).

(2) Install input shaft in fixture tool. Make sure Adapter 6747-1A is positioned under shaft as shown (Fig. 85).

(3) Install pilot bearing in input shaft (Fig. 85).

NOTE: The side of the pilot bearing with the small diameter goes toward the input shaft.

MANUAL - NV3500 (Continued)

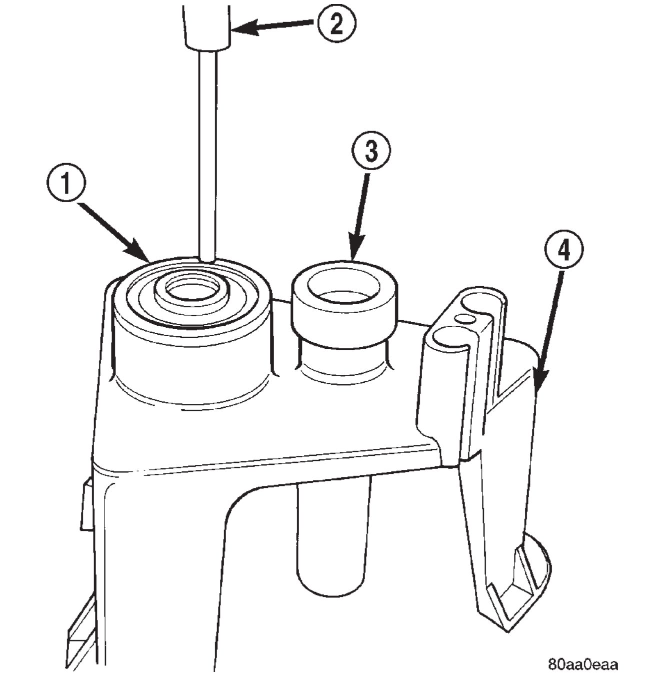


Fig. 84 ASSEMBLY FIXTURE FOR GEARTRAIN

1 - SPECIAL TOOL 6747-2A
2 - SPECIAL TOOL 8115
3 - SPECIAL TOOL 6747-1A
4 - SPECIAL TOOL 6747

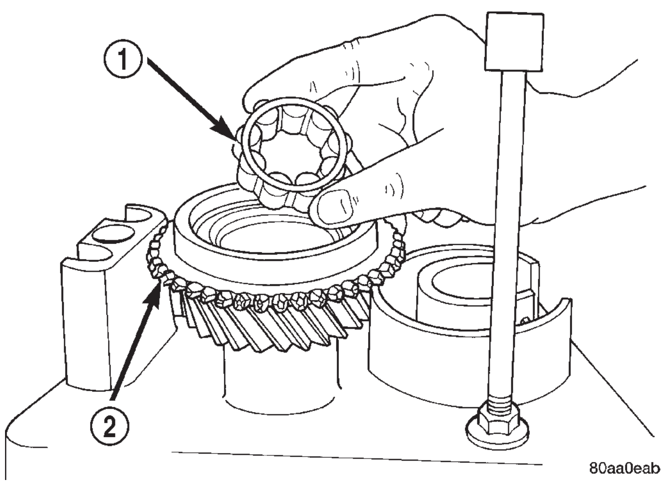


Fig. 85 PILOT BEARING AND INPUT SHAFT

1 - PILOT BEARING
2 - INPUT SHAFT

(4) Install fourth gear synchro ring on input shaft (Fig. 86).

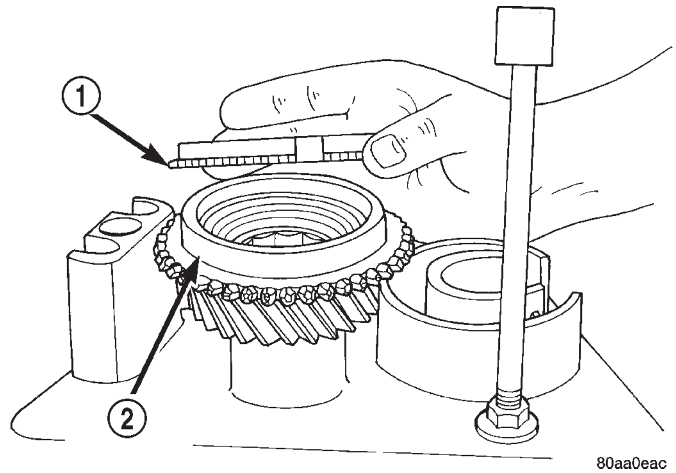


Fig. 86 FOURTH GEAR SYNCHRO

1 - FOURTH GEAR SYNCHRO RING
2 - INPUT SHAFT

(5) Adjust height of idler gear pedestal on assembly fixture (Fig. 87). Start with a basic height of 18.4 cm (7-1/4 in.). Final adjustment can be made after gear is positioned on pedestal.

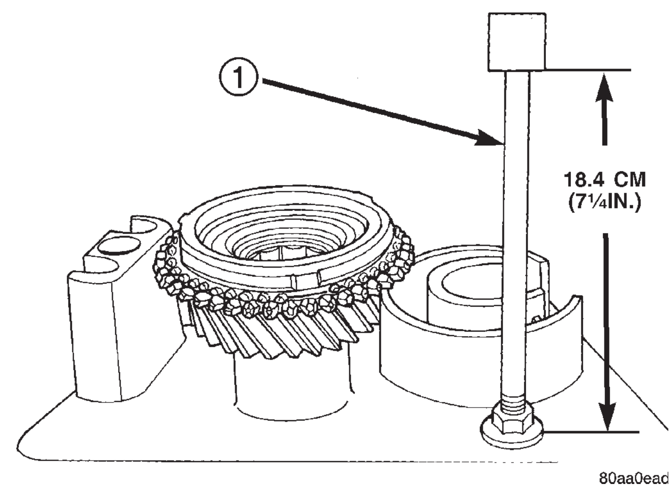


Fig. 87 IDLER PEDESTAL BASIC HEIGHT

1 - REVERSE IDLER PEDESTAL

(6) Install assembled output shaft and geartrain in input shaft (Fig. 88). Carefully rotate output shaft until the 3-4 synchro ring seats in synchro hub and sleeve.

MANUAL - NV3500 (Continued)

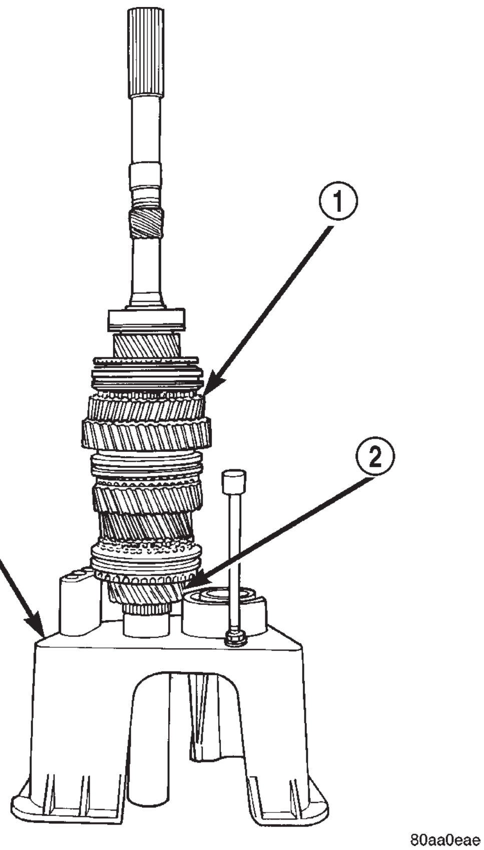


Fig. 88 OUTPUT SHAFT AND GEARTRAIN

1 - OUTPUT SHAFT AND GEARTRAIN
2 - INPUT SHAFT
3 - FIXTURE

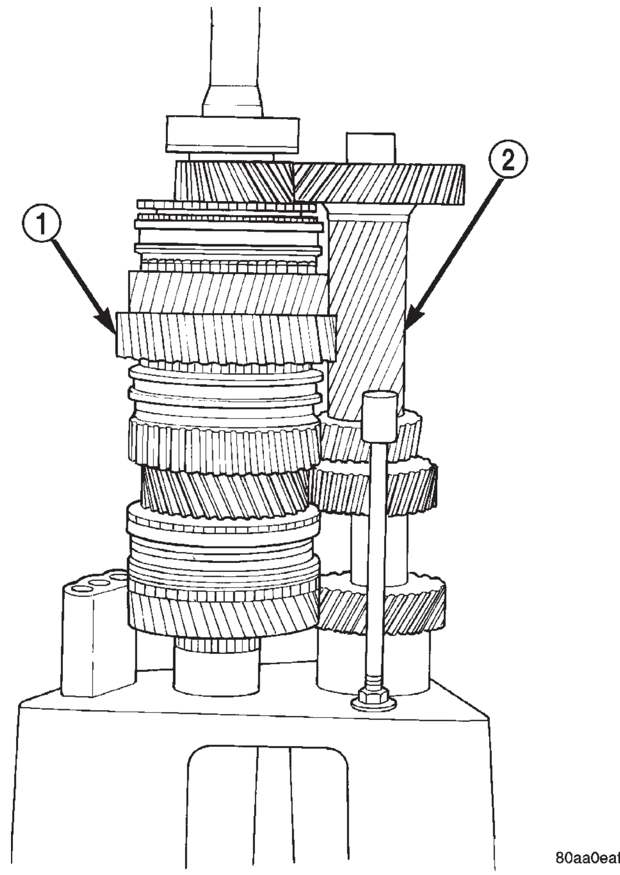


Fig. 89 COUNTERSHAFT ON FIXTURE

1 - OUTPUT SHAFT AND GEARTRAIN
2 - COUNTERSHAFT (SLIDE INTO PLACE ON FIXTURE TOOL)

(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. 89).

(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.

(10) Position reverse idler in support cup of assembly fixture (Fig. 90). 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.

(11) On 2-wheel drive transmission, thread one Alignment Pin 8120 in center or passenger side hole of output shaft bearing retainer. Then position retainer on fifth gear as shown (Fig. 91).

(12) Assemble 1-2 and fifth reverse-shift forks (Fig. 92). Arm of fifth-reverse fork goes through slot in 1-2 fork.

(13) Install assembled shift forks in synchro sleeves (Fig. 93). Verify forks are properly seated in sleeves.

MANUAL - NV3500 (Continued)

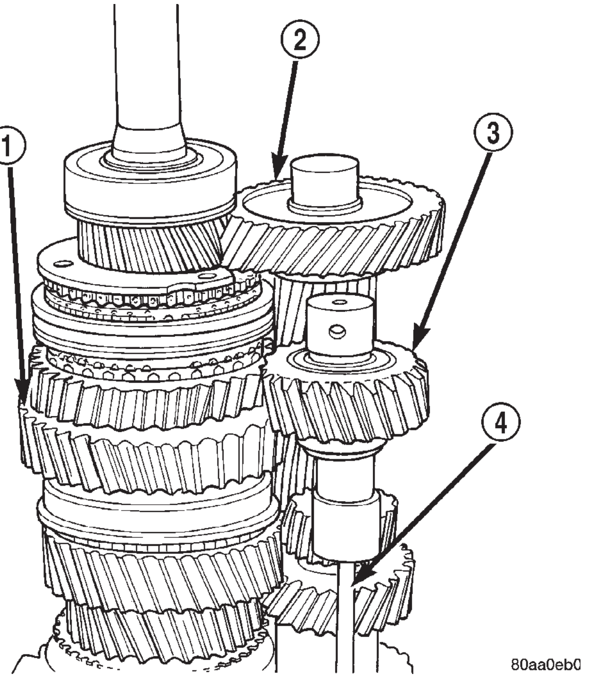


Fig. 90 REVERSE IDLER ASSEMBLY POSITION

1 - OUTPUT SHAFT AND GEARTRAIN
2 - COUNTERSHAFT
3 - REVERSE IDLER ASSEMBLY
4 - PEDESTAL

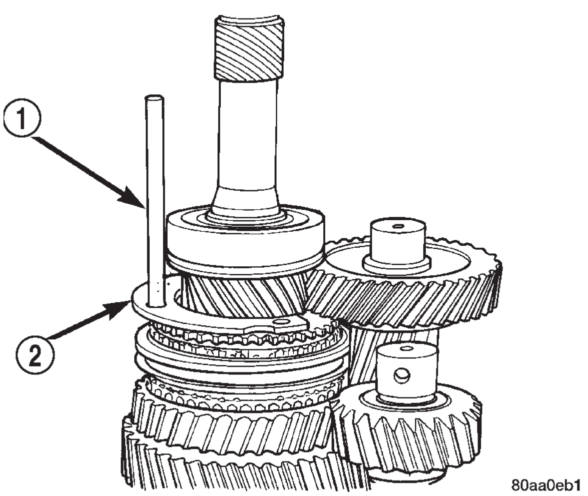


Fig. 91 POSITIONING OUTPUT SHAFT BEARING

1 - ALIGNMENT TOOL
2 - OUTPUT SHAFT BEARING RETAINER

REAR HOUSING - 2WD

(1) Drive adapter housing alignment dowels back into housing until dowels are flush with mounting surface (Fig. 94).

(2) Apply liberal quantity of petroleum jelly to countershaft rear bearing and bearing race.

(3) Install countershaft rear bearing in bearing race (Fig. 95).

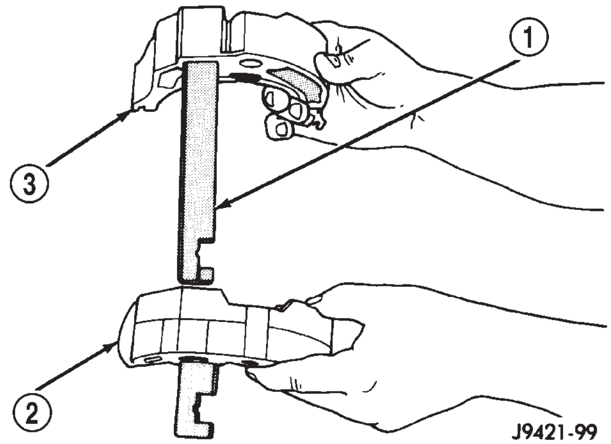


Fig. 92 1-2 AND FIFTH-REVERSE

1 - INSERT ARM THROUGH 1-2 FORK
2 - 1-2 FORK
3 - FIFTH-REVERSE FORK

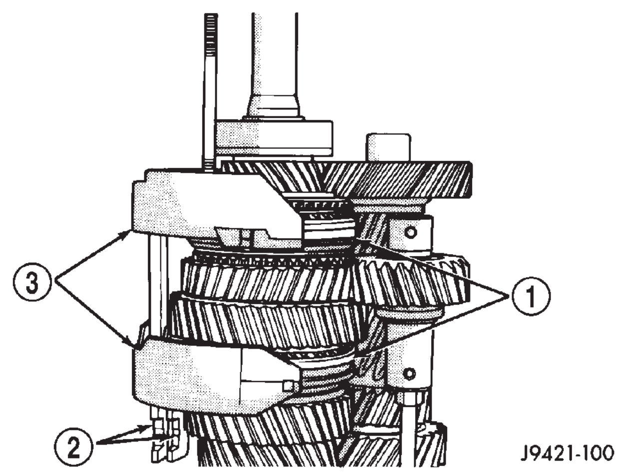


Fig. 93 SHIFT FORKS IN SYNCHRO

1 - SYNCHRO SLEEVES
2 - FORK ARMS
3 - SHIFT FORKS

CAUTION: Be sure the large diameter side of the roller retainer faces the countershaft and the small diameter side faces the race and housing (Fig. 96).

(4) Apply extra petroleum jelly to hold countershaft rear bearing in place when housing is installed.

(5) Apply light coat of petroleum jelly to shift shaft bushing/bearing in rear housing (Fig. 96).

(6) Reach into countershaft rear bearing with finger and push each bearing roller outward against race. Then apply extra petroleum jelly to hold rollers in place. This avoids having rollers becoming displaced during housing installation.

MANUAL - NV3500 (Continued)

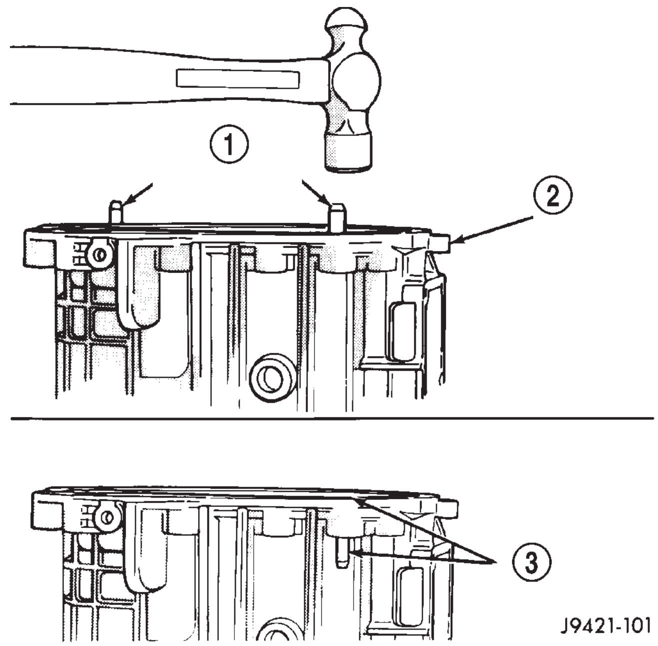


Fig. 94 REAR HOUSING DOWELS

1 - HOUSING ALIGNMENT DOWELS
2 - REAR HOUSING
3 - DOWEL FLUSH WITH SURFACE

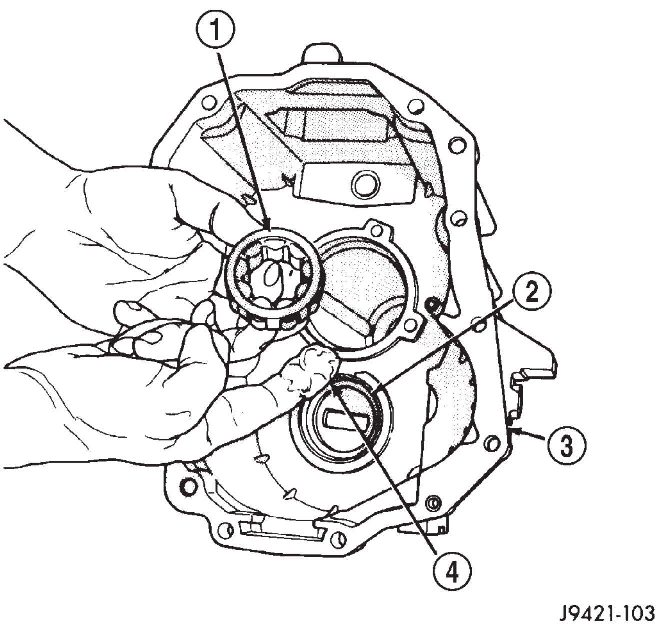


Fig. 95 COUNTERSHAFT REAR BEARING

1 - COUNTERSHAFT REAR BEARING
2 - REAR BEARING RACE
3 - REAR HOUSING
4 - PETROLEUM JELLY

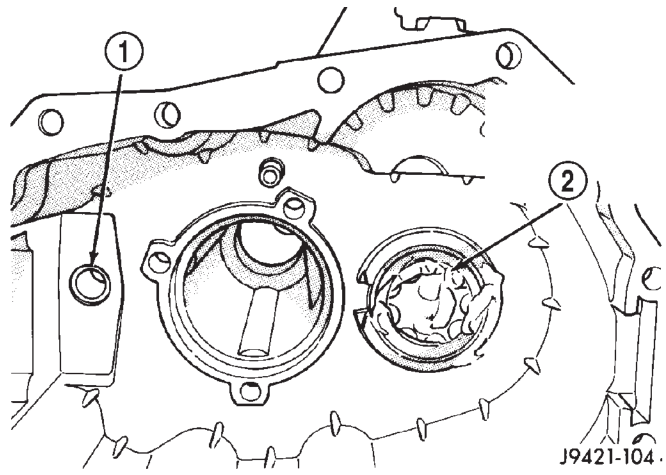


Fig. 96 COUNTERSHAFT REAR BEARING SEATED

1 - SHIFT SHAFT BUSHING/BEARING
2 - COUNTERSHAFT REAR BEARING (SEATED IN RACE)

(7) Install rear housing onto geartrain (Fig. 97). Verify bearing retainer pilot stud is in correct bolt hole in housing. Also be sure countershaft and output shaft bearings are aligned in housing and on countershaft. It may be necessary to lift upward on countershaft slightly to ensure that the countershaft rear bearing engages to the countershaft before the rear output shaft bearing engages the housing.

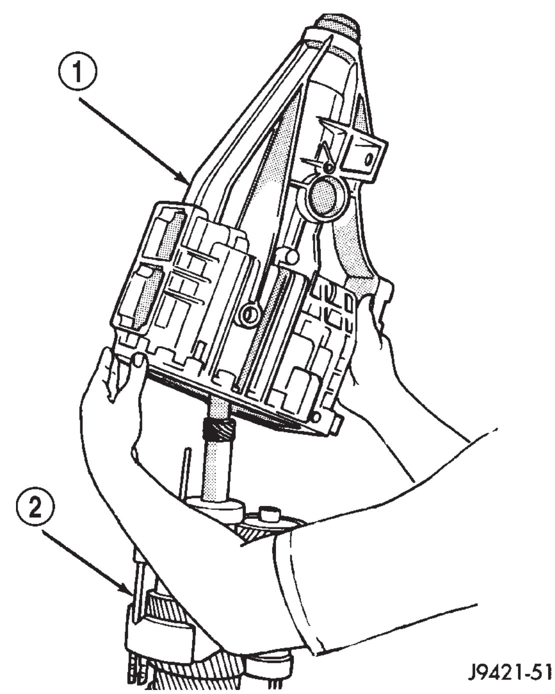


Fig. 97 REAR HOUSING - 2WD

1 - REAR HOUSING
2 - SHIFT FORKS AND GEARTRAIN

MANUAL - NV3500 (Continued)

(8) Seat rear housing on output shaft rear bearing and countershaft. Use plastic or rawhide mallet to tap housing into place.

(9) Apply Mopar Gasket Maker or equivalent, to housing bolt threads, bolt shanks and under bolt heads (Fig. 98).

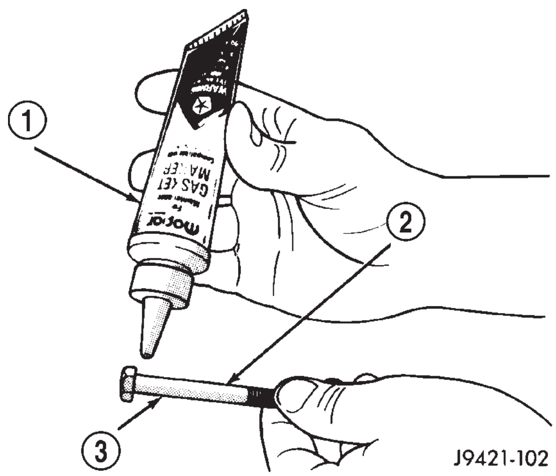


Fig. 98 SEAL RETAING BOLTS

1 - MOPAR GASKET MAKER (OR LOCTITE 518)
2 - RETAINER AND HOUSING BOLTS
3 - APPLY SEALER TO UNDERSIDE OF BOLT HEAD, SHANK AND THREADS

(10) Start first two bolts in retainer (Fig. 99). It may be necessary to move retainer rearward (with pilot stud) in order to start bolts in retainer.

(11) Remove Alignment Pin 8120 and install last retainer bolt (Fig. 99).

(12) Tighten all three retainer bolts to 30-35 N·m (22-26 ft. lbs.).

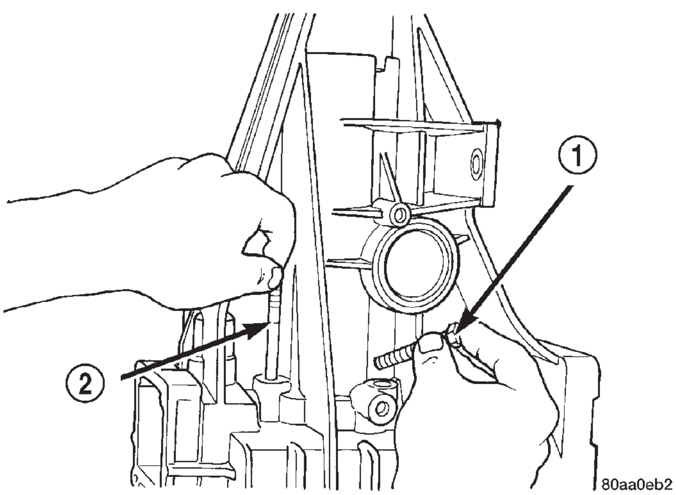


Fig. 99 PILOT STUD AND RETAINER BOLTS - 2WD

1 - BEARING RETAINER BOLT
2 - ALIGNMENT PIN

ADAPTER HOUSING - 4WD

(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. 100).

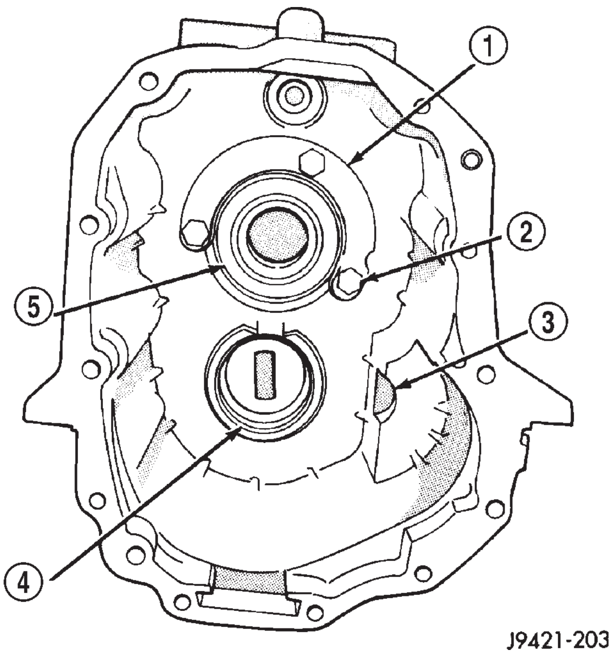


Fig. 100 ADAPTER HOUSING - 4WD

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 (Fig. 98).

(4) Apply liberal quantity of petroleum jelly to countershaft rear bearing and bearing race.

(5) Install countershaft rear bearing in bearing race (Fig. 96).

CAUTION: Be sure the large diameter side of the roller retainer faces the countershaft and the small diameter side faces the race and housing (Fig. 96).

(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 (Fig. 96).

(8) Install adapter housing on geartrain.

(9) Install rear bearing snap ring on output shaft (Fig. 101).

(10) Lubricate lip of new rear seal (Fig. 102) with Mopar Door Ease or transmission fluid.

MANUAL - NV3500 (Continued)

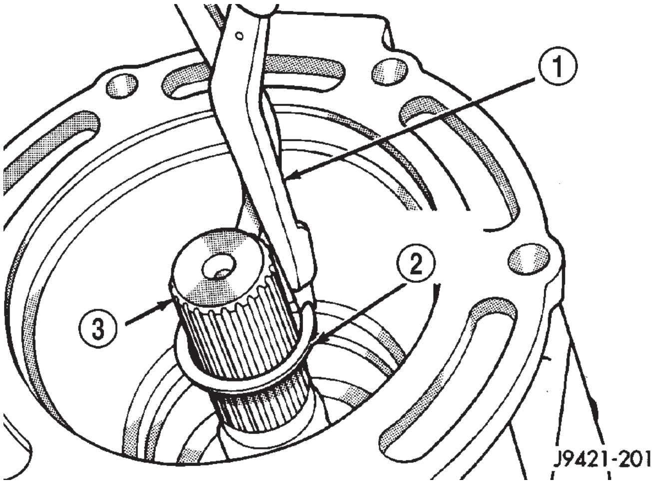


Fig. 101 REAR BEARING SNAP RING - 4WD

1 - SNAP RING PLIERS
2 - SNAP RING
3 - OUTPUT SHAFT

(11) Install new rear seal in adapter housing bore with Installer C-3860-A. Verify seal is seated in housing bore (Fig. 102).

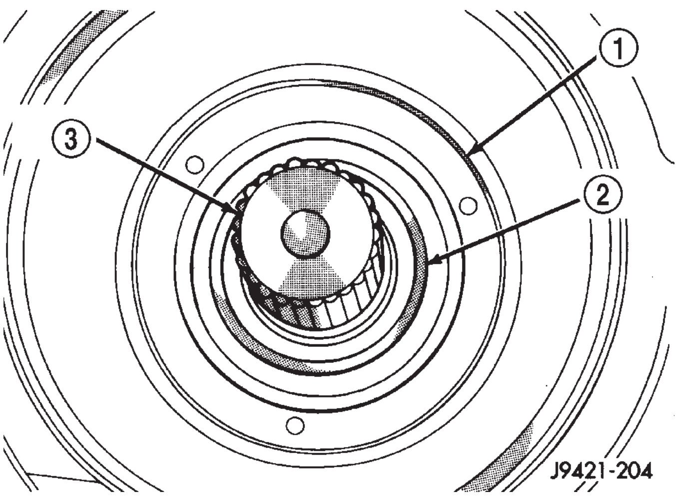


Fig. 102 REAR SEAL

1 - REAR SEAL
2 - SEAL LIP
3 - OUTPUT SHAFT

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. 103). Verify that groove in fork arm is aligned with grooves in 1-2 and fifth-reverse fork arms as shown.

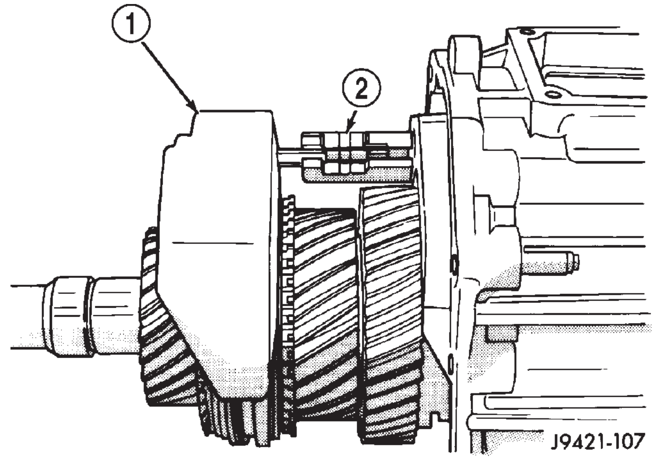


Fig. 103 3-4 SHIFT FORK

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. 104). Be sure slot in bushing is facing up and roll pin hole for lever is aligned with hole in shaft.

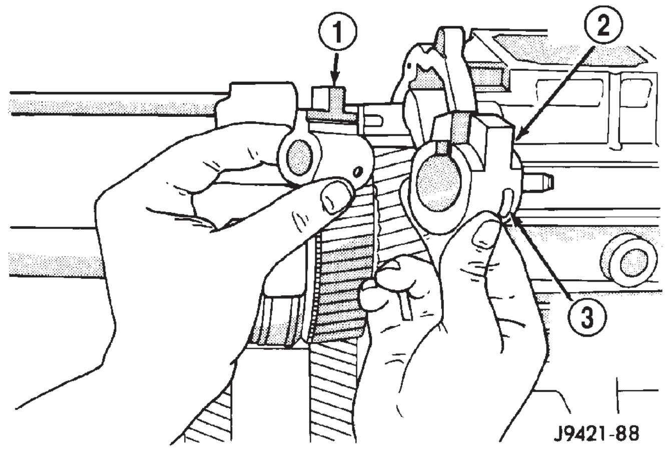


Fig. 104 LEVER AND BUSHING

1 - SHAFT LEVER
2 - LEVER BUSHING
3 - BUSHING LOCK PIN SLOT

(5) Install assembled lever and bushing on shift shaft (Fig. 105).

(6) Slide shift shaft through 1-2 and fifth-reverse fork and into shift lever opening in rear housing (Fig. 106).

MANUAL - NV3500 (Continued)

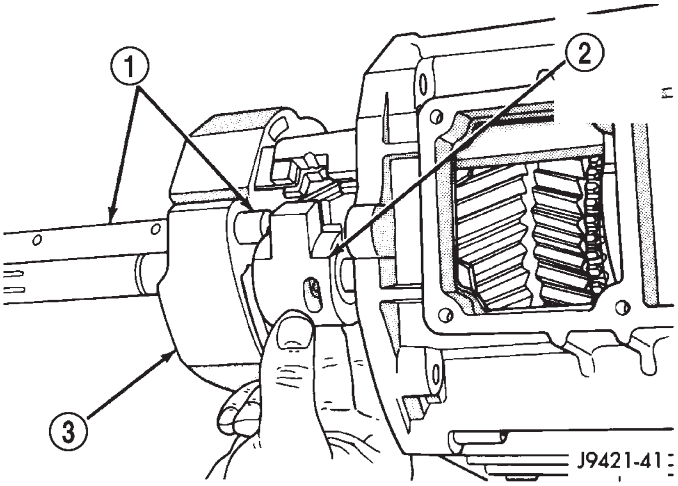


Fig. 105 LEVER AND BUSHING ASSENBLY

1 - SHIFT SHAFT
2 - SHAFT LEVER AND BUSHING
3 - 3-4 FORK

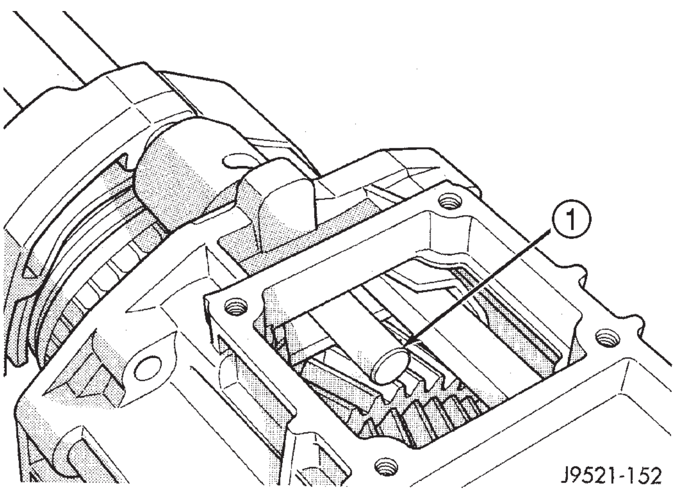


Fig. 106 SHAFT IN LEVER OPENING

1 - SHIFT SHAFT

(7) Align shift socket with shaft and slide shaft through socket and into shift shaft bearing in rear housing (Fig. 107).

(8) Rotate shift shaft so detent notches in shaft are facing the TOP of the transmission housing.

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. 108). 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.

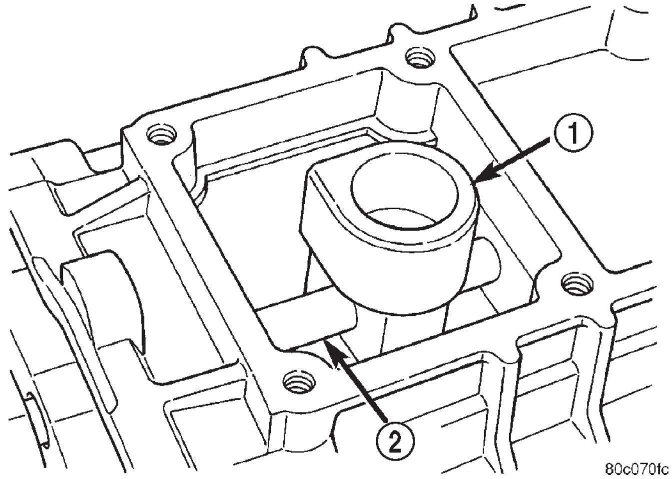


Fig. 107 SHIFT SOCKET

1 - SHIFT SOCKET
2 - SHIFT SHAFT

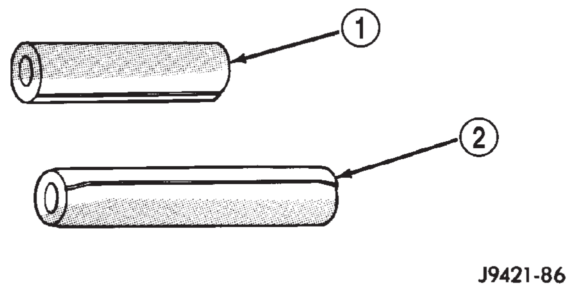


Fig. 108 ROLL PIN IDENTIFICATION

1 - SHAFT LEVER ROLL PIN
2 - SHIFT SOCKET ROLL PIN

(10) Align roll pin holes in shift shaft, lever and bushing. Then start roll pin into shaft lever by hand (Fig. 109).

(11) Seat shaft lever roll pin with pin punch (Fig. 110).

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. 110).

(13) Align roll pin holes in shift socket and shift shaft. Then start roll pin into shift shaft by hand (Fig. 111).

(14) Seat roll pin in shift socket with pin punch. Roll pin must be flush with socket (Fig. 112).

(15) Verify that notches in shift fork arms are aligned. Realign arms if necessary.

MANUAL - NV3500 (Continued)

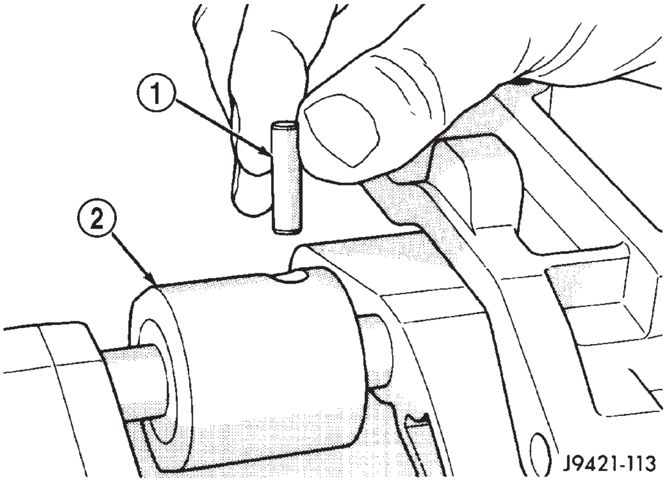


Fig. 109 ROLL PIN IN SHIFT SHAFT

1 - SHAFT LEVER ROLL PIN (" LONG)
2 - LEVER AND BUSHING

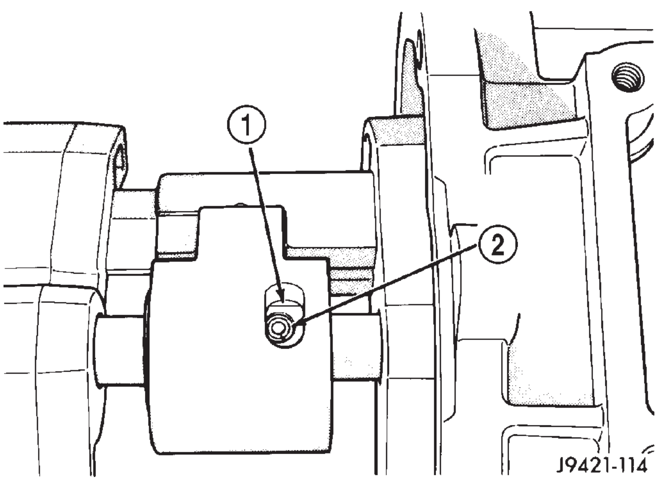


Fig. 110 SHIFT SHAFT LEVER ROLL

1 - BUSHING LOCK PIN SLOT
2 - SEAT ROLL PIN FLUSH WITH LEVER

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. 113). Install snap ring and use plastic mallet to seat bearing. Bearing goes in from front side of housing only.

(3) Apply liberal quantity of petroleum jelly to countershaft front bearing. Then insert bearing in front housing race (Fig. 113). Large diameter side of bearing cage goes toward countershaft (Fig. 114). Small diameter side goes toward bearing race in housing.

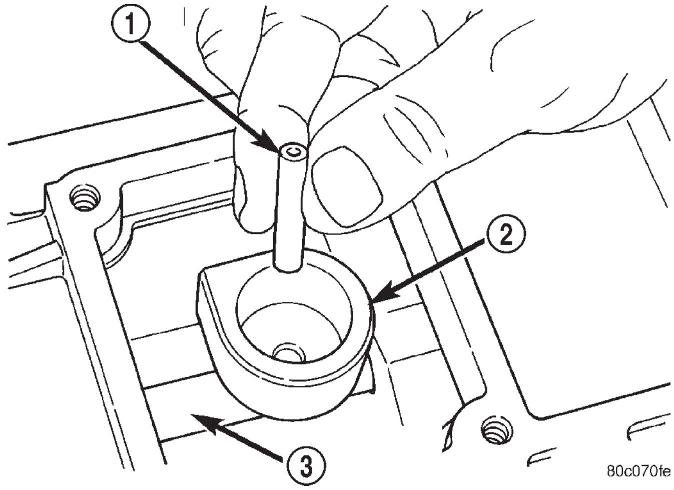


Fig. 111 ROLL PIN IN SHIFT SOCKET

1 - ROLL PIN
2 - SHIFT SOCKET
3 - SHIFT SHAFT

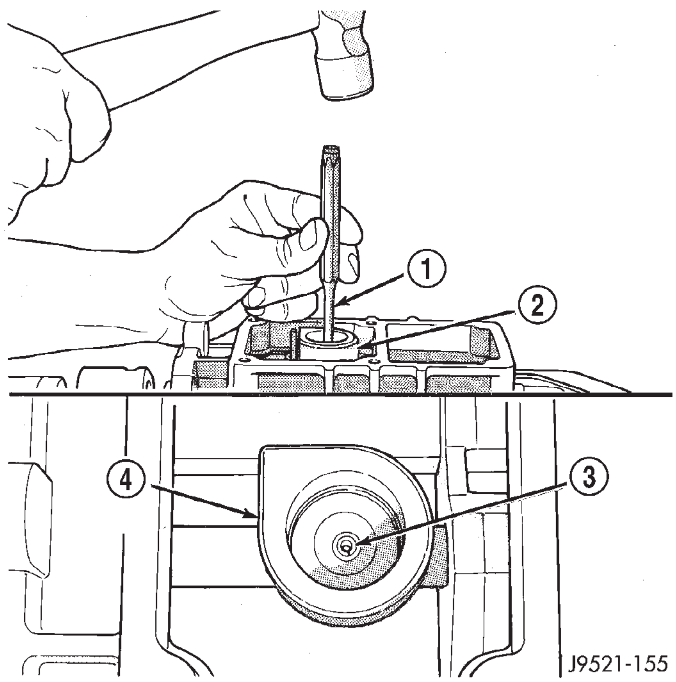


Fig. 112 SEATING SHIFT SOCKET ROLL PIN

1 - PIN PUNCH
2 - SHIFT SOCKET
3 - SEAT ROLL PIN FLUSH
4 - SHIFT SOCKET

(4) Reach into countershaft front bearing with finger, and push each bearing roller outward against race. Then apply extra petroleum jelly to hold rollers in place. This avoids having rollers becoming displaced during housing installation.

MANUAL - NV3500 (Continued)

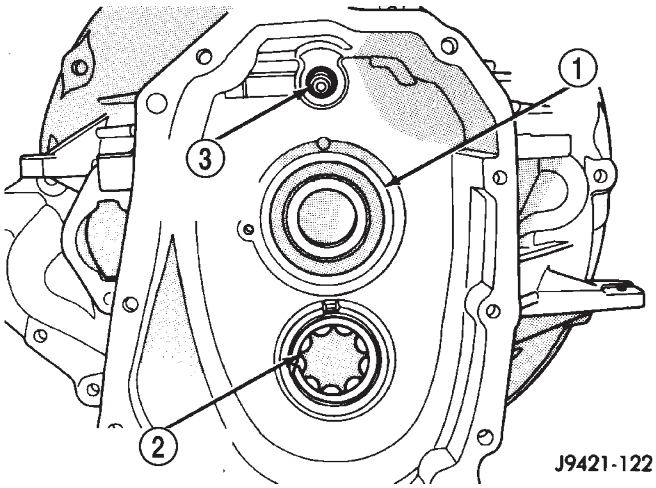


Fig. 113 INPUT SHAFT AND COUNTERSHAFT FRONT BEARING

1 - INPUT SHAFT BEARING
2 - COUNTERSHAFT FRONT BEARING
3 - SHIFT SHAFT BUSHING

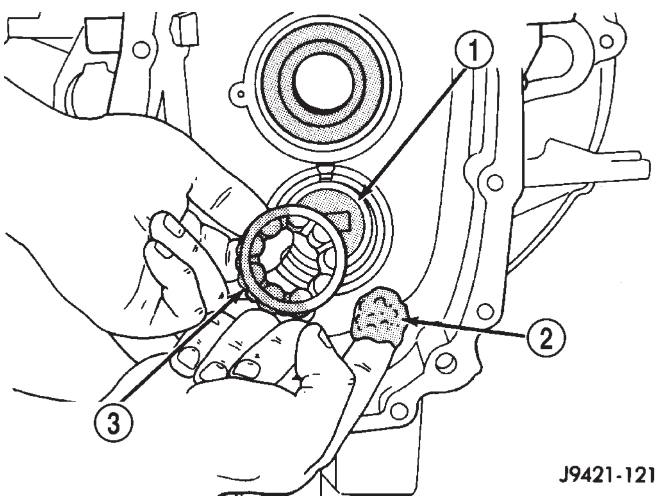


Fig. 114 COUNTERSHAFT FRONT BEARING

1 - BEARING RACE
2 - PETROLEUM JELLY
3 - COUNTERSHAFT FRONT BEARING

(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. 115).

(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.

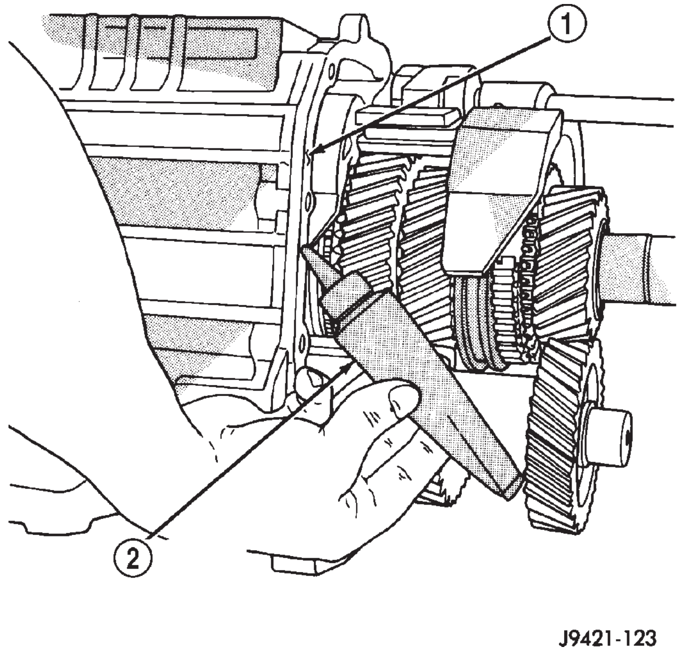


Fig. 115 SEAL FRONT/REAR HOUSINGS

1 - HOUSING FLANGE SURFACE
2 - MOPAR GASKET MAKER

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. 116).

(12) Install and start housing attaching bolts by hand (Fig. 116). Then tighten bolts to 34 N·m (25 ft. lbs.).

(13) Install shift shaft bushing lock bolt (Fig. 117). 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.

MANUAL - NV3500 (Continued)

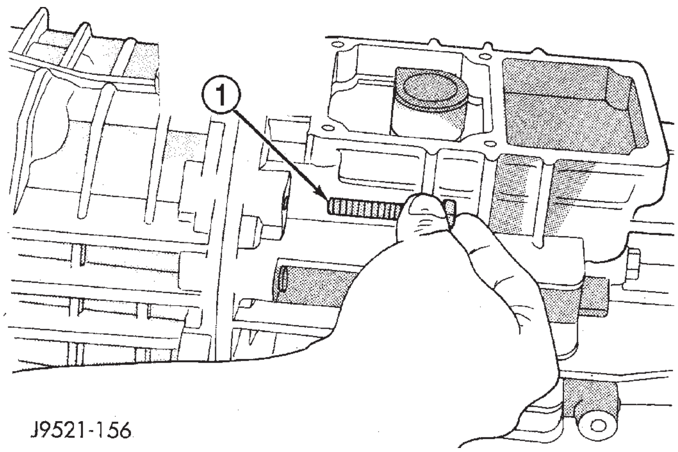


Fig. 116 HOUSING BOLTS

1 - HOUSING ATTACHING BOLTS (APPLY SEALER BEFOREHAND)

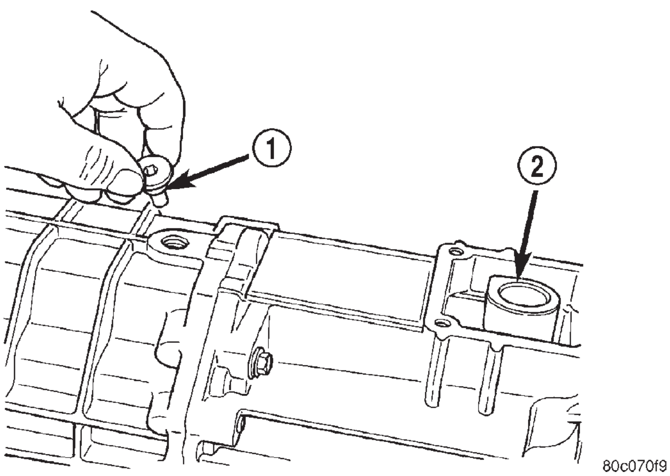


Fig. 117 SHIFT SHAFT BUSHING LOCK BOLT

1 - SHIFT SHAFT LOCK BOLT
2 - SHAFT SOCKET

(14) Lubricate then install shift shaft detent plunger in housing bore (Fig. 118). Lubricate plunger with petroleum jelly or gear lubricant. **Verify plunger is fully seated in detent notch in shift shaft.**

(15) Install detent spring inside plunger (Fig. 118).

(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. 119).

(18) Install input shaft snap ring (Fig. 120).

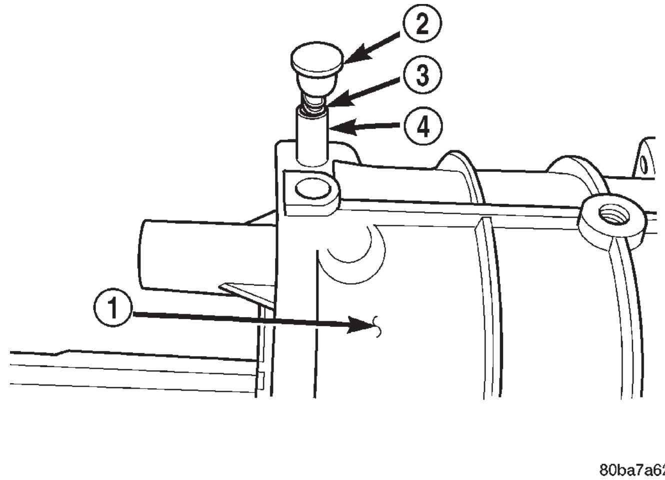


Fig. 118 SHIFT SHAFT DETENT PLUNGER

1 - FRONT HOUSING
2 - PLUG
3 - SPRING
4 - PLUNGER

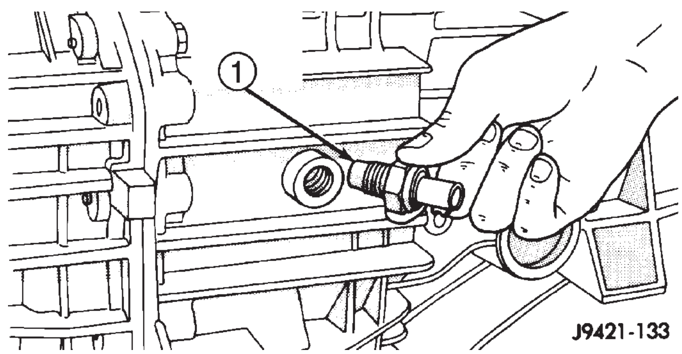


Fig. 119 BACKUP LIGHT SWITCH

1 - BACKUP LIGHT SWITCH

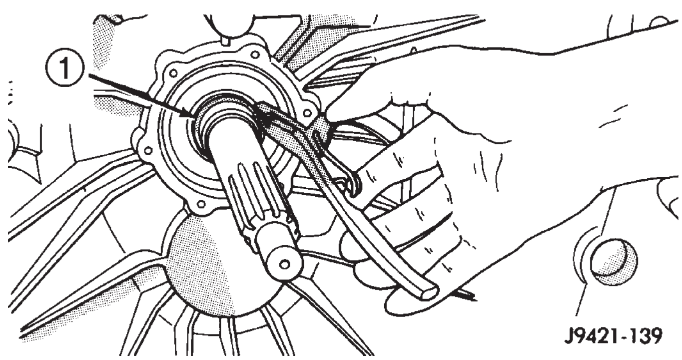


Fig. 120 SHAFT SNAP RING - TYPICAL

1 - INPUT SHAFT SNAP RING

MANUAL - NV3500 (Continued)

(19) Install new oil seal in front bearing retainer with Installer 6448 (Fig. 121).

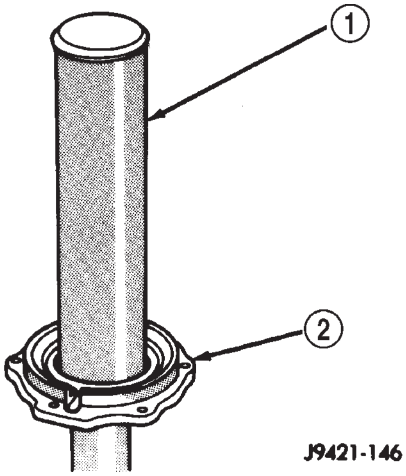


Fig. 121 OIL SEAL IN FRONT BEARING RETAINER

1 - INSTALLER
2 - FRONT BEARING RETAINER

(20) Apply bead of Mopar silicone sealer or equivalent to flange surface of front bearing retainer (Fig. 122).

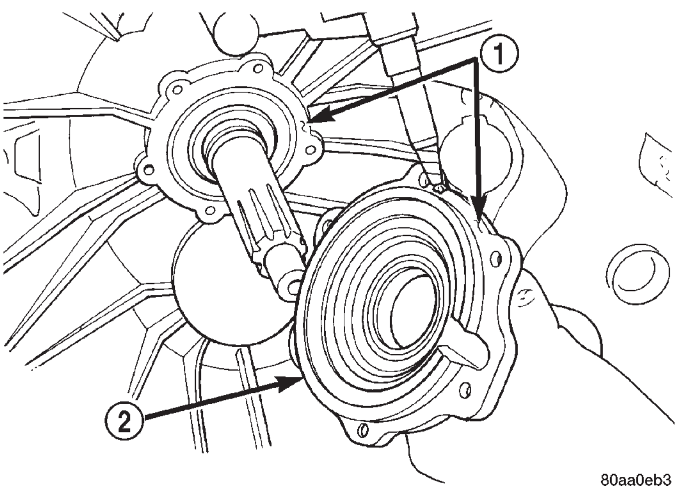


Fig. 122 SEAL BEARING RETAINER AND HOUSING

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. 123). Although retainer is one-way fit on housing, be sure bolt holes are aligned before seating retainer.

NOTE: Ensure no sealer gets into the oil feed hole in the transmission case or bearing retainer.

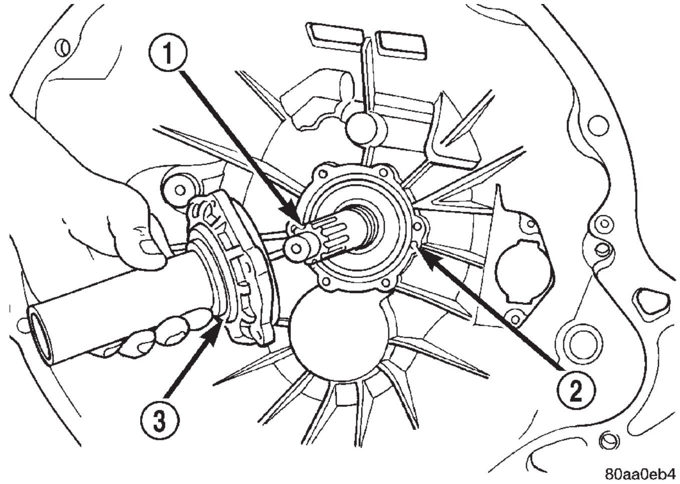


Fig. 123 INPUT SHAFT BEARING RETAINER

1 - INPUT SHAFT
2 - OIL FEED
3 - BEARING RETAINER

(22) Install and tighten bearing retainer bolts to 7-10 N·m (5-7 ft. lbs.) (Fig. 124).

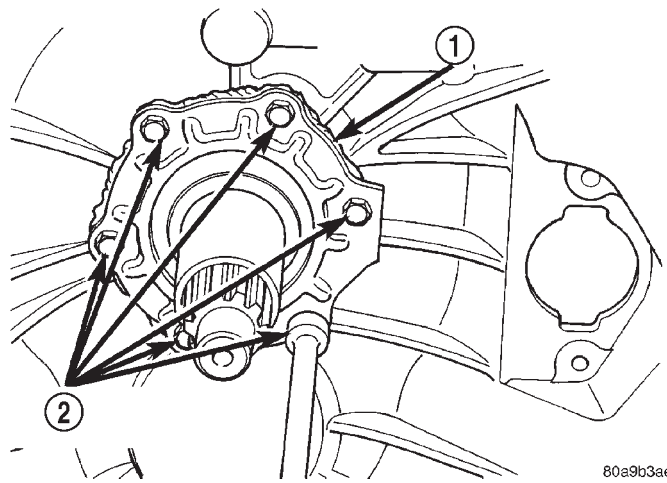


Fig. 124 BEARING RETAINER BOLTS

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. 125). 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. 126). Tighten bolts to 8.5 N·m (75.2 in. lbs.).

MANUAL - NV3500 (Continued)

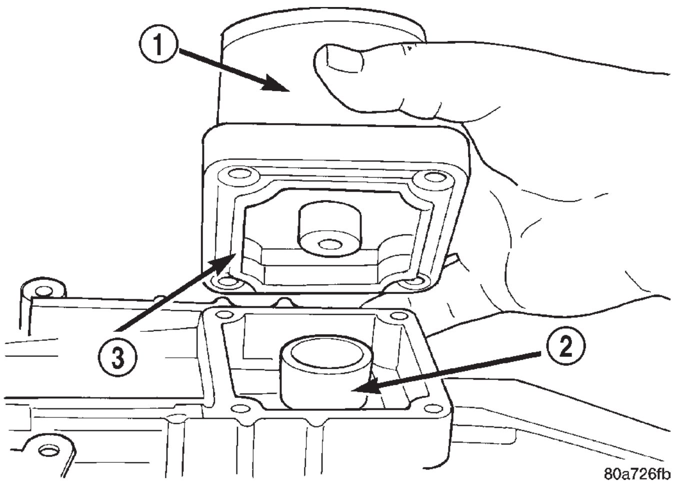


Fig. 125 SHIFT TOWER

1 - SHIFT TOWER

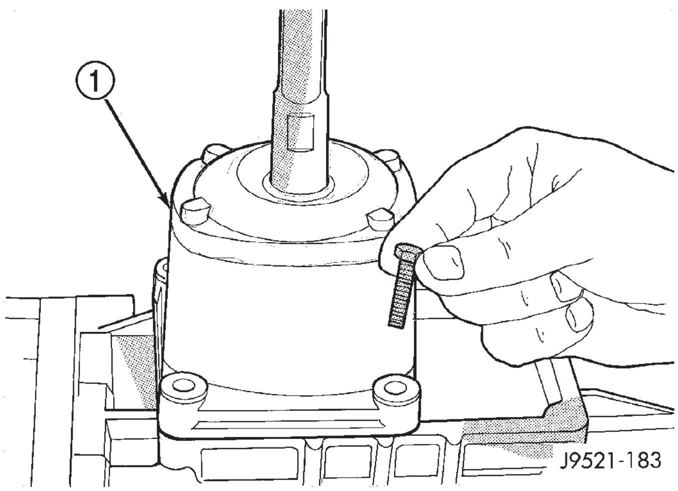


Fig. 126 SHIFT TOWER BOLTS

1 - SHIFT TOWER AND LEVER ASSEMBLY

(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.).

(7) Check transmission vent. Be sure vent is open and not restricted.

INSTALLATION

NOTE: If a new transmission is being installed, be sure to use all components supplied with the new transmission. For example, if a new shift tower is supplied with the new transmission, do not re-use the original shift tower.

(1) Apply light coat of Mopar® high temperature bearing grease to contact surfaces of following components:

- input shaft splines.
- release bearing slide surface of front retainer.
- release bearing bore.
- release fork.
- release fork ball stud.
- propeller shaft slip yoke.

(2) Apply sealer to threads of drain plug, then install plug in case.

(3) Mount transmission on jack and position transmission under vehicle. Secure transmission to jack with safety chains.

(4) Raise transmission until input shaft is centered in clutch disc hub.

(5) Move transmission forward and start input shaft in clutch disc.

(6) Work transmission forward until seated against engine. Do not allow transmission to remain unsupported after input shaft has entered clutch disc.

(7) Install and tighten transmission to engine bolts to 108 N·m (80 ft. lbs.).

(8) Position transmission harness wires in clips on shift cover.

(9) Install slave cylinder and shield, if equipped.

(10) Install transmission mount on transmission or rear crossmember.

2WD

(1) Install rear crossmember.

NOTE: Ensure wiring harness is clear before installing crossmember.

(2) Remove transmission jack and engine support fixture.

(3) Align and install propeller shaft.

(4) Lower vehicle.

(5) Install shift tower and lever assembly. Tighten shift tower bolts to 7-10 N·m (5-7 ft. lbs.).

(6) Install shift boot.

(7) Install floor console. Refer to 23 Body for procedures.

(8) Connect battery negative cable.

4WD

(1) Install transfer case shift lever on transmission.

(2) Install rear crossmember.

NOTE: Ensure wiring harness is clear before installing crossmember.

MANUAL - NV3500 (Continued)

(3) Remove transmission jack and engine support fixture.

(4) Install transfer case on transmission jack. Secure transfer case to jack with safety chains.

(5) Raise jack and align transfer case input gear with transmission output shaft.

(6) Move transfer case forward and seat it on transmission.

(7) Install and tighten transfer case attaching nuts. Tighten nuts to 41-47 N·m (30-35 ft. lbs.) if case has 3/8 studs, or 30-41 N·m (22-30 ft. lbs.) if case has 5/16 studs.

(8) Connect backup light switch wires.

(9) Install transmission dust cover.

(10) Install starter.

(11) Install transfer case shift lever to side of transfer case.

(12) Connect transfer case shift lever to range lever on transfer case.

(13) Align and connect propeller shafts.

(14) Fill transmission with required lubricant. Check lubricant level in transfer case and add lubricant if necessary.

(15) Install transfer case skid plate, if equipped, and crossmember. Tighten attaching bolts/nuts to 41 N·m (30 ft. lbs.).

(16) Install exhaust system components.

(17) Lower vehicle.

(18) Install shift tower and lever assembly. Tighten shift tower bolts to 7-10 N·m (5-7 ft. lbs.).

(19) Install shift lever boot.

(20) Install floor console. Refer to 23 Body for procedures.

(21) Connect battery negative cable.

SPECIFICATIONS

SPECIFICATIONS - NV3500

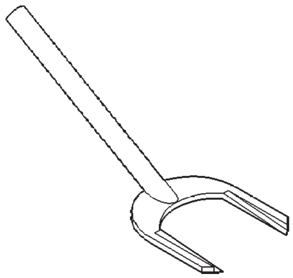
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Clutch Housing Bolts	54-61	40-45	-
Crossmember Bolts	61-75	45-55	-
Crossmember Insulator Nuts	54-61	40-45	-
Drain/Fill Plug	9-27	14-20	-
Front to Rear Housing Bolts	30-35	22-26	-
Front Bearing Bolts	7-10	5-7	62-88
Idler Shaft Bolts	19-25	14-18	-
Rear Bearing Bolts	30-35	22-26	-
Shift Tower Bolts	7-10	5-7	-
Slave Cylinder Nuts	23	17	203
Transfer Case Nuts	47	35	-

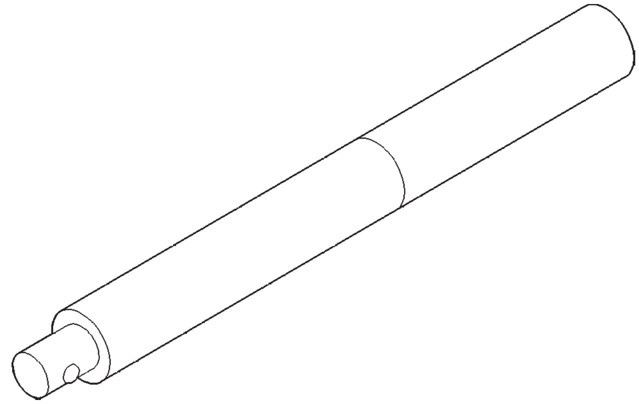
MANUAL - NV3500 (Continued)

SPECIAL TOOLS

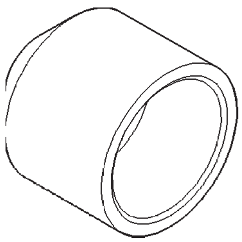
MANUAL - NV3550



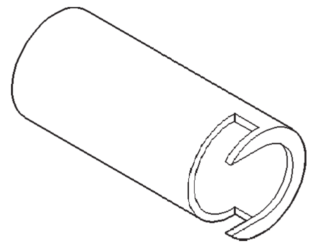
Remover Seal C-3985-B



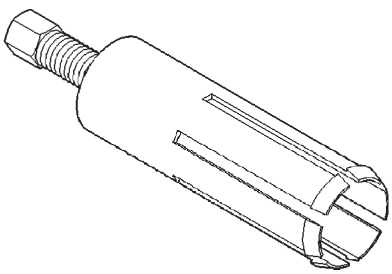
Handle C-4171



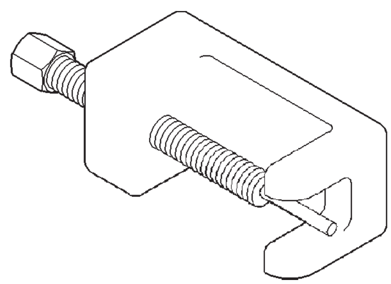
Installer Seal C-3972-A



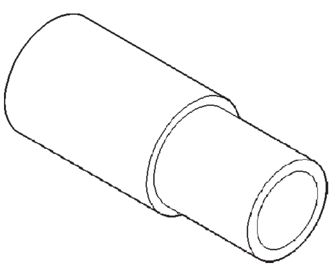
Remover Plug 8117



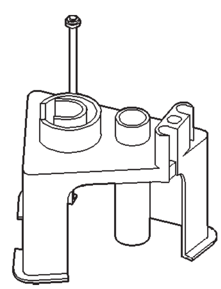
Remover Bushing 6957



Remover/Installer 6858

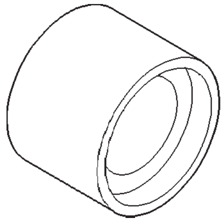


Installer Bushing 6951

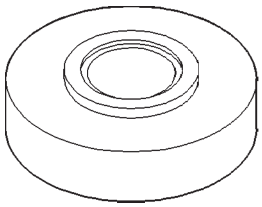


Fixture 6747

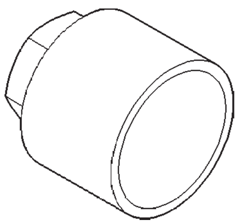
MANUAL - NV3500 (Continued)



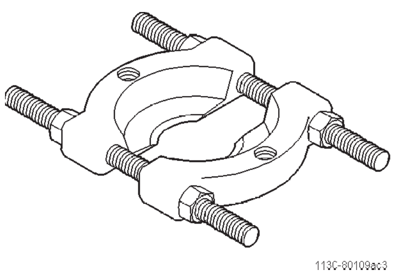
Adapter 6747-1A



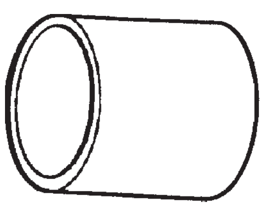
Adapter 6747-2B



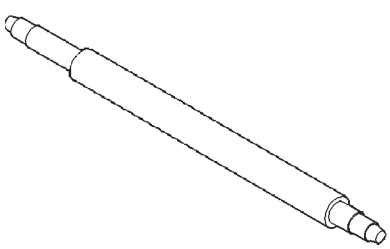
Cup Adapter 8115



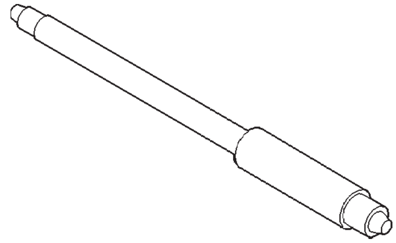
Splitter Bearing 1130



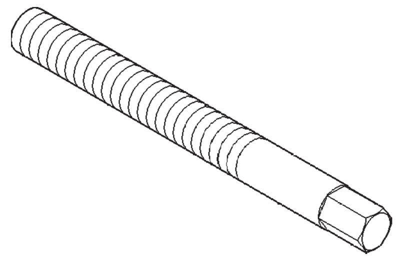
Tube 6310-1



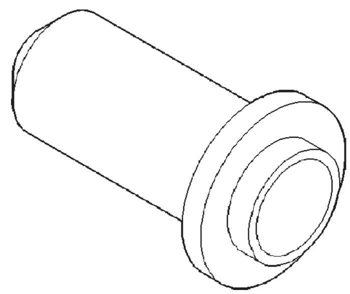
Installer Bushing 8118



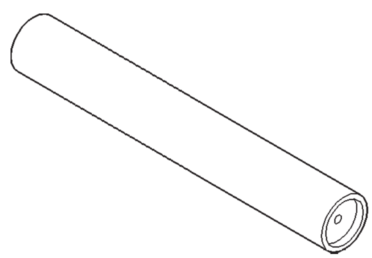
Remover/Installer 8119



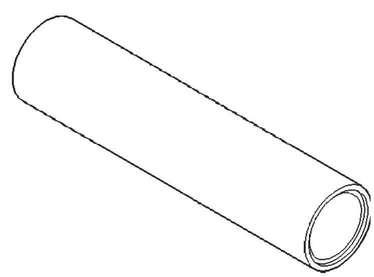
Pin Alignment 8120



Installer Seal C-3860-A



Installer 8123



Installer Cone 6448

EXTENSION HOUSING SEAL

REMOVAL - YOKE SEAL 2WD

(1) Raise raise and support vehicle.

(2) Mark propeller shaft and axle yoke for alignment reference.

(3) Disconnect and remove propeller shaft.

(4) Remove old seal with Remover C-3985-B (Fig. 127) from transmission housing.

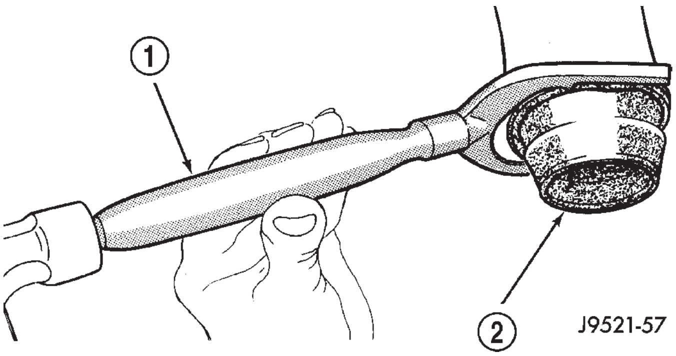


Fig. 127 TRANSMISSION YOKE SEAL

1 - REMOVER
2 - SEAL

REMOVAL - YOKE BUSHING

(1) Raise and support vehicle.

(2) Mark reference lines on the propeller shaft and remove shaft.

(3) Remove housing yoke seal.

(4) Insert Remover 6957 into rear housing and tighten tool to bushing and remove bushing (Fig. 128).

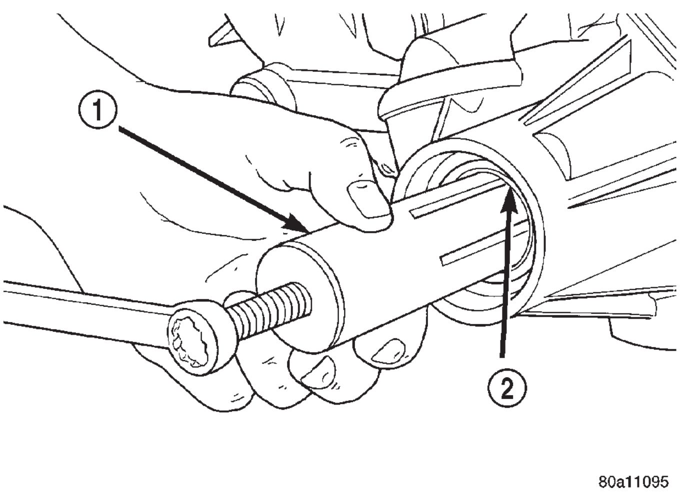


Fig. 128 Bushing Removal - Typical

1 - REMOVER
2 - EXTENSION HOUSING BUSHING

INSTALLATION - YOKE SEAL 2WD

(1) Place seal in position on transmission housing.

(2) Drive new seal into transmission housing with Installer C-3972-A and Handle C-4171 (Fig. 129).

(3) Carefully guide propeller shaft slip yoke into housing and onto output shaft splines.

(4) Install propeller shaft with reference marks aligned.

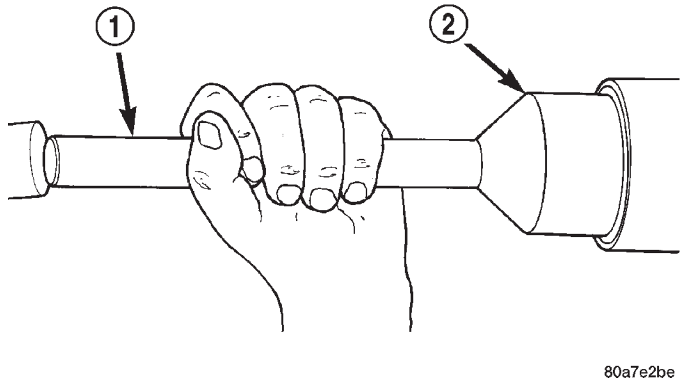


Fig. 129 Transmission Housing Yoke Seal

1 - HANDLE
2 - INSTALLER

(5) Remove support and lower vehicle.

(6) Check transmission fluid level.

INSTALLATION - YOKE BUSHING

(1) Align bushing oil hole with oil slot in rear housing.

(2) Tap bushing into place with Installer 6951 and Handle C-4171.

(3) Install new oil seal in housing using Installer C-3972-A (Fig. 130).

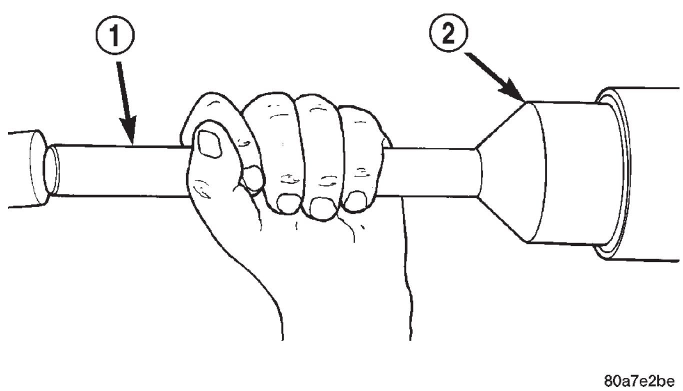


Fig. 130 Rear Housing Seal

1 - HANDLE
2 - INSTALLER

(4) Install propeller shaft with reference marks aligned.

(5) Remove support and lower vehicle.

(6) Check transmission fluid level.

FLUID

DESCRIPTION

The lubricant for the NV3550 is Mopar® Manual Transmission Lubricant, P/N 4761526. This is the **only** lubricant to be used, no other lubricants are acceptable, or recommended.

The correct transmission lubricant level is to the bottom edge of the fill plug hole (Fig. 131).

The transmission must be level to obtain an accurate lubricant level check. A drive–on type of hoist is recommended for this purpose.

The lubricant capacity is approximately 2.28 liters (4.8 pints). This is the approximate quantity needed to refill the transmission after a lubricant change or overhaul.

The fill plug is located in the front housing and the drain plug is on the bottom of the housing (Fig. 131).

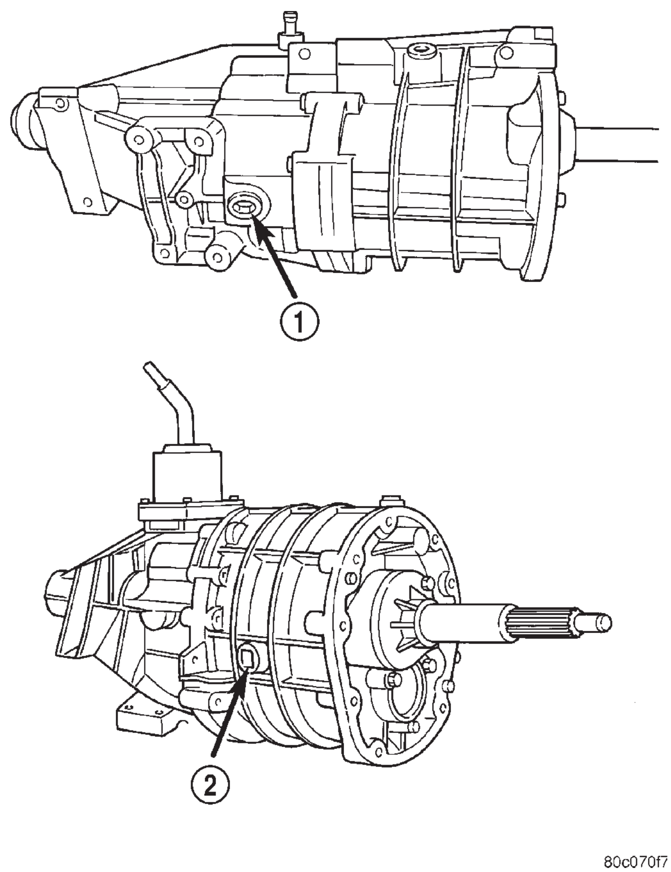


Fig. 131 Drain and Fill Plug Locations

1 - DRAIN PLUG
2 - FILL PLUG

AUTOMATIC TRANSMISSION - 42RE

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AUTOMATIC TRANSMISSION - 42RE

DESCRIPTION

The 42RE is a four speed fully automatic transmission (Fig. 1) with an electronic governor. The 42RE is equipped with a lock-up clutch in the torque converter. First through third gear ranges are provided by the clutches, bands, overrunning clutch, and planetary gear sets in the transmission. Fourth gear range is provided by the overdrive unit that contains an overdrive clutch, direct clutch, planetary gear set, and overrunning clutch.

The transmission contains a front, rear, and direct 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 and overdrive clutch, serve as the holding components. The driving and holding components combine to select the necessary planetary gear components, in the front, rear, or overdrive planetary gear set, transfer the engine power from the input shaft through to the output shaft.

The valve body is mounted to the lower side of the transmission and contains the valves to control pressure regulation, fluid flow control, and clutch/band application. The oil pump is mounted at the front of the transmission and is driven by the torque converter hub. The pump supplies the oil pressure necessary for clutch/band actuation and transmission lubrication.

AUTOMATIC TRANSMISSION - 42RE (Continued)

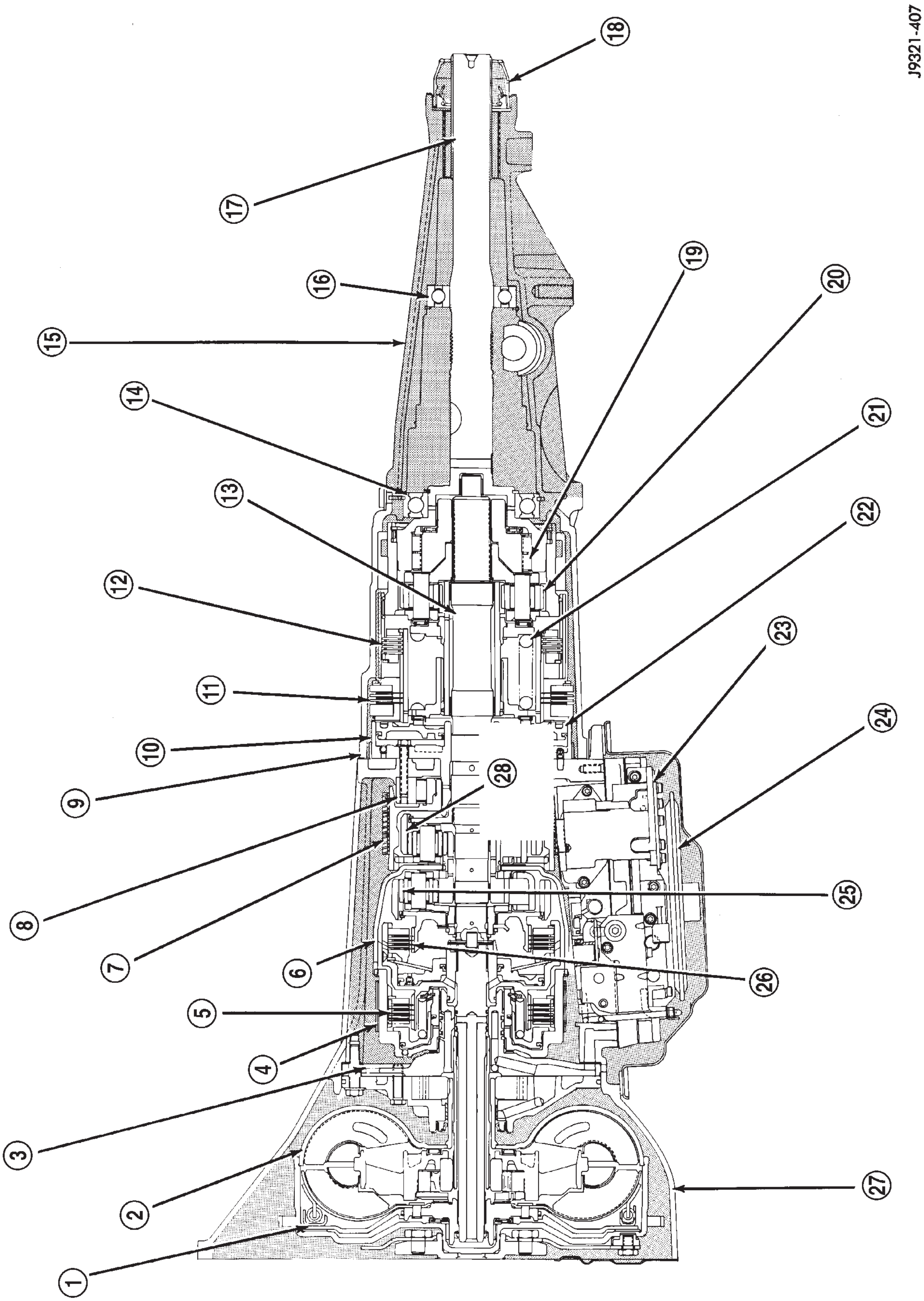


Fig. 1 42RE Transmission

AUTOMATIC TRANSMISSION - 42RE (Continued)

1 - CONVERTER CLUTCH
2 - TORQUE CONVERTER
3 - OIL PUMP AND REACTION SHAFT SUPPORT ASSEMBLY
4 - FRONT BAND
5 - FRONT CLUTCH
6 - DRIVING SHELL
7 - REAR BAND
8 - TRANSMISSION OVERRUNNING CLUTCH
9 - OVERDRIVE UNIT
10 - PISTON RETAINER
11 - OVERDRIVE CLUTCH
12 - DIRECT CLUTCH
13 - INTERMEDIATE SHAFT
14 - FRONT BEARING
15 - HOUSING
16 - REAR BEARING
17 - OUTPUT SHAFT
18 - SEAL
19 - OVERDRIVE OVERRUNNING CLUTCH
20 - OVERDRIVE PLANETARY GEAR
21 - DIRECT CLUTCH SPRING
22 - OVERDRIVE CLUTCH PISTON
23 - VALVE BODY ASSEMBLY
24 - FILTER
25 - FRONT PLANETARY GEAR
26 - REAR CLUTCH
27 - TRANSMISSION
28 - REAR PLANETARY GEAR

IDENTIFICATION

Transmission identification numbers are stamped on the left side of the case just above the oil pan gasket surface (Fig. 2). Refer to this information when ordering replacement parts.

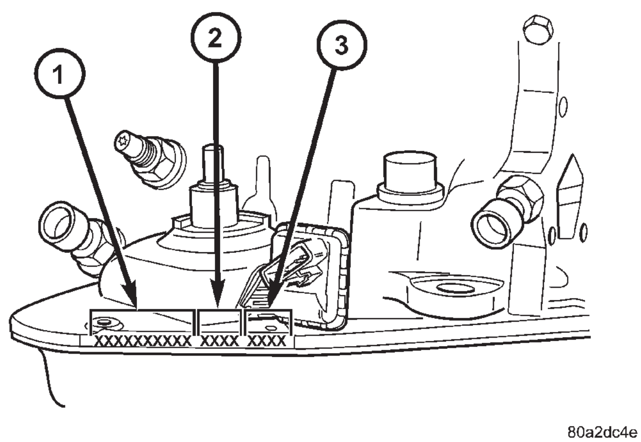


Fig. 2 Transmission Part And Serial Number Location

1 - PART NUMBER
2 - BUILD DATE
3 - SERIAL NUMBER

GEAR RATIOS The 42RE gear ratios are:

1st 2.74:1
2nd 1.54:1
3rd 1.00:1
4th 0.69:1
Rev. 2.21:1

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 fourth 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 assemblies 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 fourth gear, and in third gear under various conditions, such as when the O/D switch is OFF, when the vehicle is cruising on a level surface 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.

Since the overdrive clutch is applied in fourth gear only and the direct clutch is applied in all ranges except fourth gear, the transmission operation for park, neutral, and first through third gear will be described first. Once these powerflows are described, the third to fourth shift sequence will be described.

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.

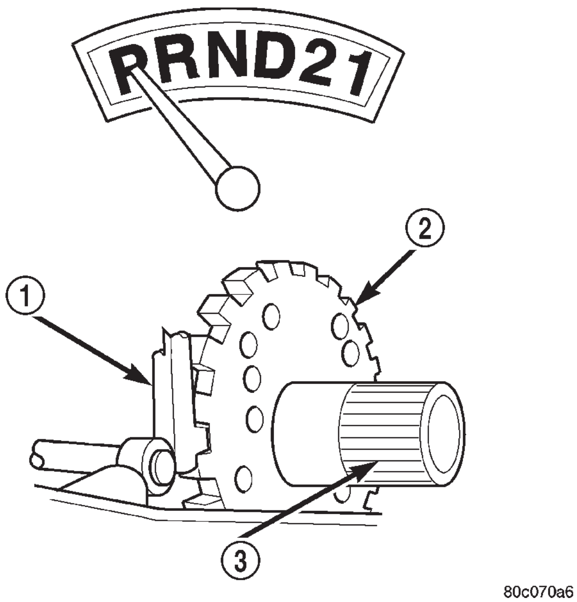


Fig. 3 Park Powerflow

1 - PAWL 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.

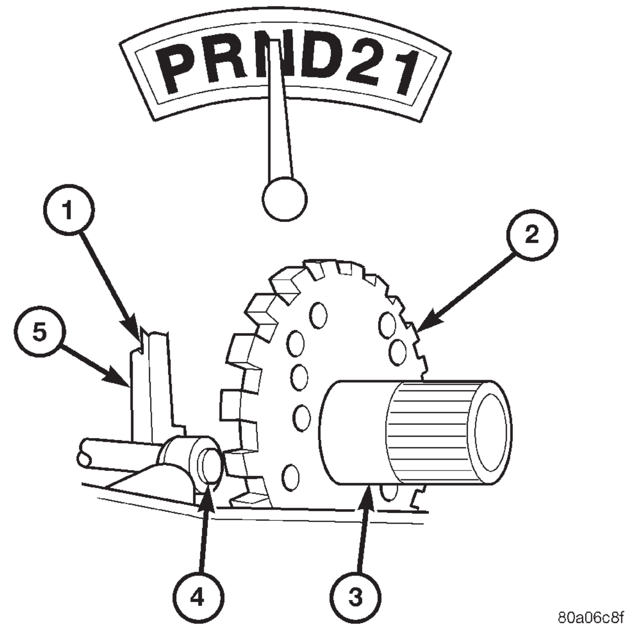


Fig. 4 Neutral Powerflow

1 - PAWL DISENGAGED FOR NEUTRAL
2 - PARK SPRAG
3 - OUTPUT SHAFT
4 - CAM
5 - PAWL

AUTOMATIC TRANSMISSION - 42RE (Continued)

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.

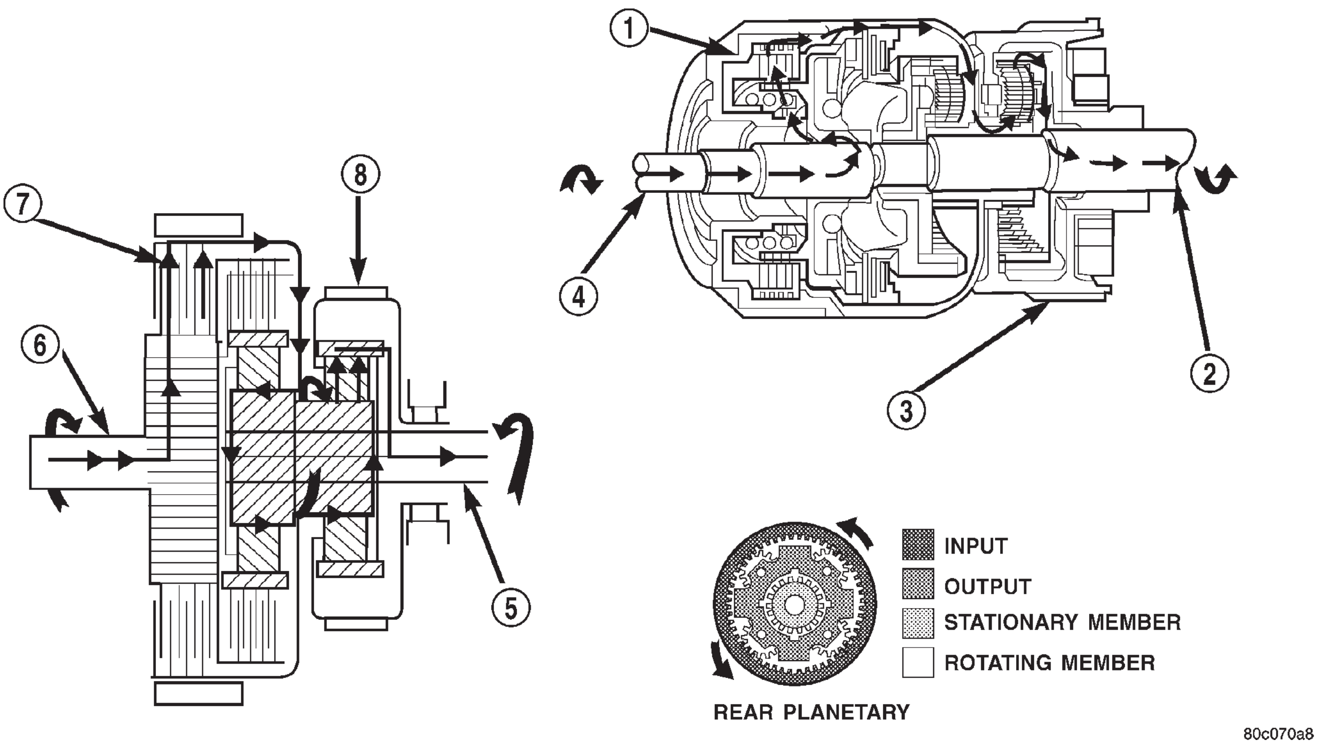


Fig. 5 Reverse Powerflow

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 - 42RE (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.

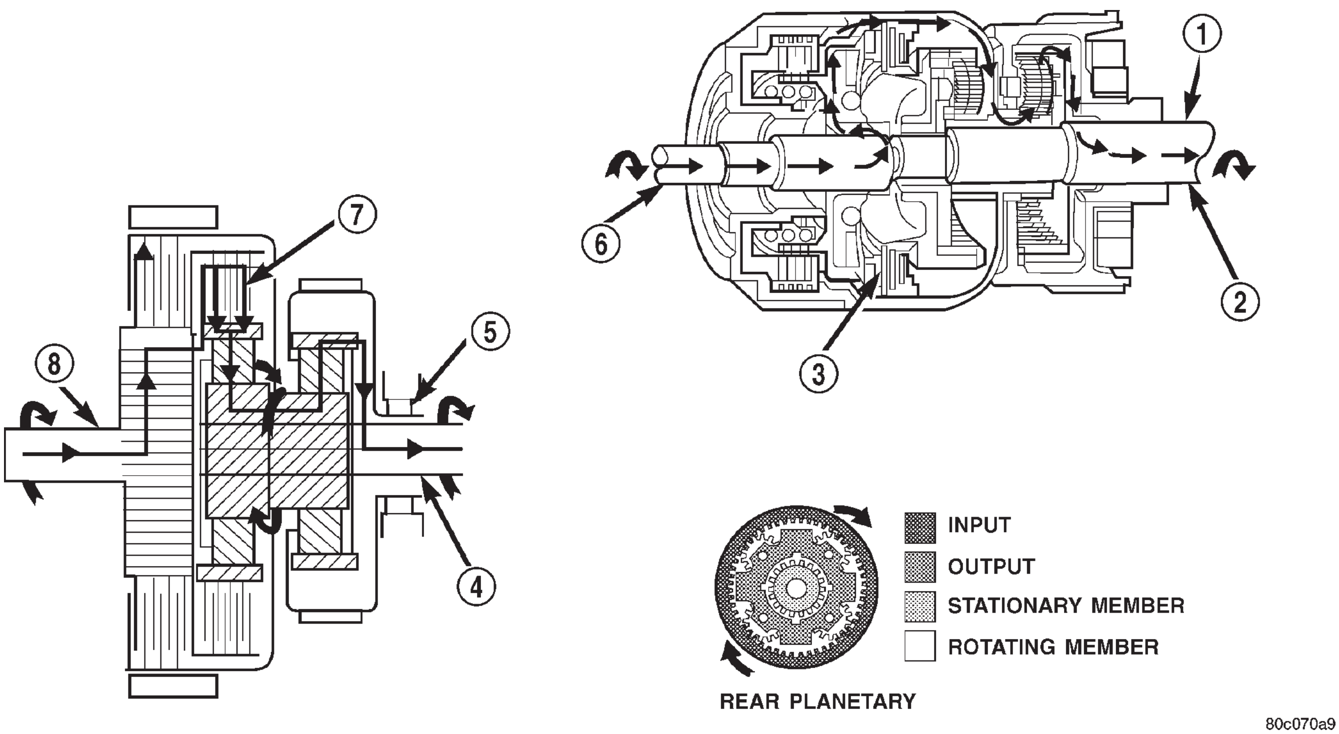


Fig. 6 First Gear Powerflow

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 - 42RE (Continued)

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.

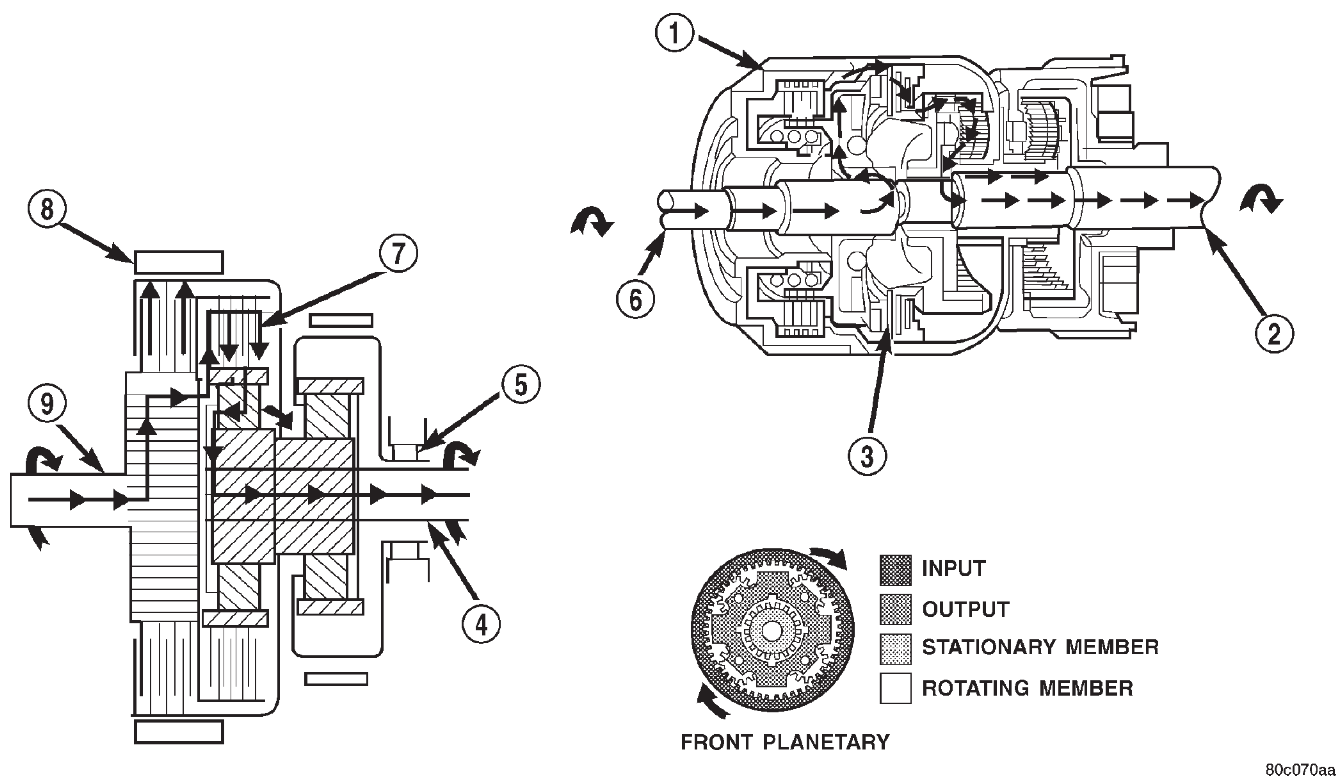


Fig. 7 Second Gear Powerflow

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

AUTOMATIC TRANSMISSION - 42RE (Continued)

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.

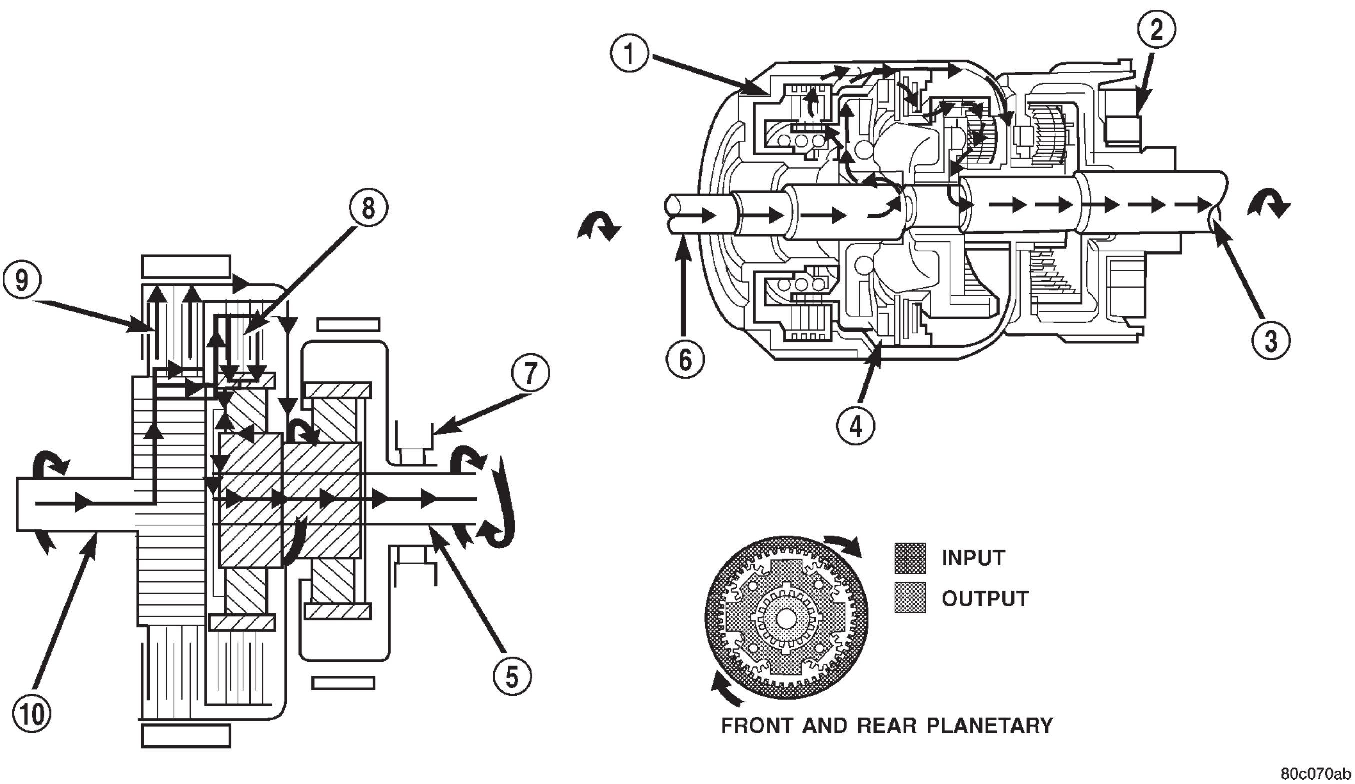


Fig. 8 Direct Drive Powerflow

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

FOURTH GEAR POWERFLOW

Fourth gear overdrive range is electronically controlled and hydraulically activated. Various sensor inputs are supplied to the powertrain control module to operate the overdrive solenoid on the valve body. The solenoid contains a check ball that opens and closes a vent port in the 3-4 shift valve feed passage. The overdrive solenoid (and check ball) are not energized in first, second, third, or reverse gear. The vent port remains open, diverting line pressure from the 2-3 shift valve away from the 3-4 shift valve. The overdrive control switch must be in the ON position to transmit overdrive status to the PCM. A 3-4 upshift occurs only when the overdrive solenoid is energized by the PCM. The PCM energizes the overdrive solenoid during the 3-4 upshift. This causes the solenoid check ball to close the vent port allowing line pressure from the 2-3 shift valve to act directly on the 3-4 upshift valve. Line pressure on the 3-4 shift valve overcomes valve spring pressure moving the valve to the upshift position. This action exposes the feed passages to the 3-4 timing valve, 3-4 quick fill valve, 3-4 accumulator, and ultimately to the overdrive piston. Line pressure through the timing valve moves the overdrive piston into contact with the overdrive clutch. The direct clutch is disengaged before the overdrive clutch is engaged. The boost valve provides increased fluid apply pressure to the overdrive clutch during 3-4 upshifts, and when accelerating in fourth gear. The 3-4 accumulator cushions overdrive clutch engagement to smooth 3-4 upshifts. The accumulator is charged at the same time as apply pressure acts against the overdrive piston.

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 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.

Operate the transmission in all gear ranges. Check for shift variations and engine flare which indicates slippage. Note if shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Slippage indicated by engine flare, usually means clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul will be necessary to restore normal operation.

A slipping clutch or band can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch and Band Application chart provides a basis for analyzing road test results.

AUTOMATIC TRANSMISSION - 42RE (Continued)

CLUTCH AND BAND APPLICATION CHART

SHIFT LEVER POSITION	TRANSMISSION CLUTCHES AND BANDS					OVERDRIVE CLUTCHES		
	FRONT CLUTCH	FRONT BAND	REAR CLUTCH	REAR BAND	OVER-RUNNING CLUTCH	OVER-DRIVE CLUTCH	DIRECT CLUTCH	OVER-RUNNING CLUTCH
Reverse	X			X			X	
Drive - First			X		X		X	X
Drive - Second		X	X				X	X
Drive - Third	X		X				X	X
Drive - Fourth	X		X			X		
Manual Second		X	X		X		X	X
Manual First			X	X	X		X	X

Note that the rear clutch is applied in all forward ranges (D, 2, 1). The transmission overrunning clutch is applied in first gear (D, 2 and 1 ranges) only. The rear band is applied in 1 and R range only.

Note that the overdrive clutch is applied only in fourth gear and the overdrive direct clutch and overrunning clutch are applied in all ranges except fourth gear.

For example: If slippage occurs in first gear in D and 2 range but not in 1 range, the transmission overrunning clutch is faulty. Similarly, if slippage occurs in any two forward gears, the rear clutch is slipping.

Applying the same method of analysis, note that the front and rear clutches are applied simultaneously only in D range third and fourth gear. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping.

If the transmission slips in fourth gear but not in third gear, the overdrive clutch is slipping. By selecting another gear which does not use these clutches, the slipping unit can be determined. For example, if the transmission also slips in Reverse, the front clutch is slipping. If the transmission does not slip in Reverse, the rear clutch is slipping.

If slippage occurs during the 3-4 shift or only in fourth gear, the overdrive clutch is slipping. Similarly, if the direct clutch were to fail, the transmission would lose both reverse gear and overrun braking in 2 position (manual second gear).

If the transmission will not shift to fourth gear, the control switch, overdrive solenoid or related wiring may also be the problem cause.

This process of elimination can be used to identify a slipping unit and check operation. Proper use of the Clutch and Band Application Chart is the key.

Although road test analysis will help determine the slipping unit, the actual cause of a malfunction usually cannot be determined until hydraulic and air pressure tests are performed. Practically any condition can be caused by leaking hydraulic circuits or sticking valves.

Unless a malfunction is obvious, such as no drive in D range first gear, do not disassemble the transmission. Perform the hydraulic and air pressure tests to help 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 pressure test gauges are required. Test Gauge C-3292 has a 100 psi range and is used at the accumulator, governor, and front servo ports. Test Gauge C-3293-SP has a 300 psi range and is used at the rear servo and overdrive ports where pressures exceed 100 psi.

Pressure Test Port Locations

Test ports are located at both sides of the transmission case (Fig. 9).

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.

AUTOMATIC TRANSMISSION - 42RE (Continued)

The rear servo and governor pressure ports are at the right rear of the transmission case. The overdrive clutch pressure port is at the left rear of the case.

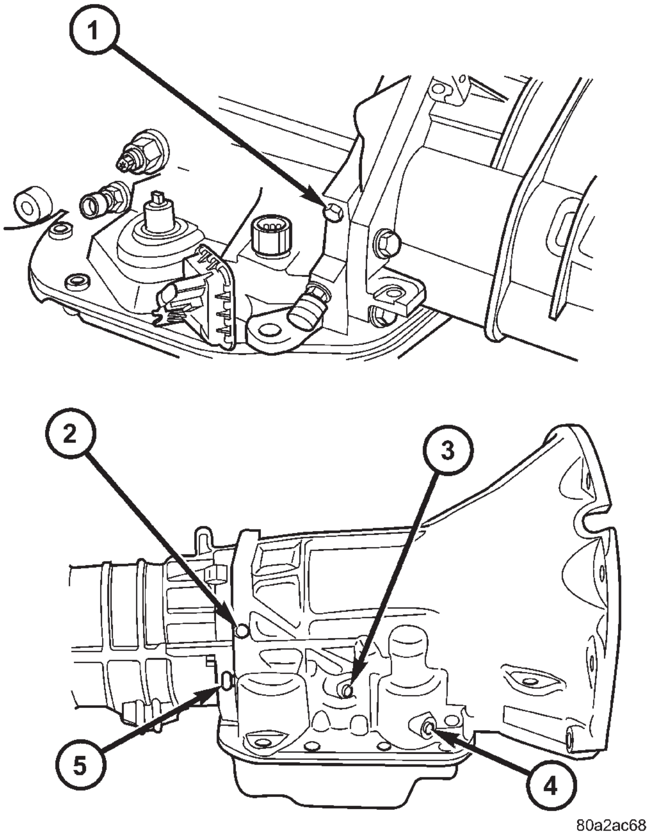


Fig. 9 Pressure Test Port Locations

1 - OVERDRIVE CLUTCH TEST PORT
2 - GOVERNOR TEST PORT
3 - ACCUMULATOR TEST PORT
4 - FRONT SERVO TEST PORT
5 - REAR SERVO TEST PORT

Test One - Transmission In Manual Low

NOTE: This test checks pump output, pressure regulation, and condition of the rear clutch and servo circuit. Both test gauges are required for this test.

(1) Connect tachometer to engine. Position tachometer so it can be observed from driver seat if helper will be operating engine. Raise vehicle on hoist that will allow rear wheels to rotate freely.

(2) Connect 100 psi Gauge C-3292 to accumulator port. Then connect 300 psi Gauge C-3293-SP to rear servo port.

(3) Disconnect throttle and gearshift cables from levers on transmission valve body manual shaft.

(4) Have helper start and run engine at 1000 rpm.

(5) Move transmission shift lever fully forward into 1 range.

(6) Gradually move transmission throttle lever from full forward to full rearward position and note pressures on both gauges:

• 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 throttle lever is moved rearward.

• Rear servo pressure should be same as line pressure within 3 psi (20.68 kPa).

Test Two - Transmission In 2 Range

NOTE: This test checks pump output, line pressure and pressure regulation. Use 100 psi Test Gauge C-3292 for this test.

(1) Leave vehicle in place on hoist and leave Test Gauge C-3292 connected to accumulator port.

(2) Have helper start and run engine at 1000 rpm.

(3) Move transmission shift lever one detent rearward from full forward position. This is 2 range.

(4) Move transmission throttle lever from full forward to full rearward position and read pressure on gauge.

(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 Third Gear

NOTE: This test checks pressure regulation and condition of the clutch circuits. Both test gauges are required for this test.

(1) Turn OD switch off.

(2) Leave vehicle on hoist and leave Gauge C-3292 in place at accumulator port.

(3) Move Gauge C-3293-SP over to front servo port for this test.

(4) Have helper start and run engine at 1600 rpm for this test.

(5) Move transmission shift lever two detents rearward from full forward position. This is D range.

(6) Read pressures on both gauges as transmission throttle lever is gradually moved from full forward to full rearward position:

• Line pressure at accumulator in D range third gear, should be 54-60 psi (372-414 kPa) with throttle lever forward and increase as lever is moved rearward.

• Front servo pressure in D range third gear, should be within 3 psi (21 kPa) of line pressure up to kickdown point.

AUTOMATIC TRANSMISSION - 42RE (Continued)

Test Four - Transmission In Reverse

NOTE: 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) Leave vehicle on hoist and leave gauge C-3292 in place at accumulator port.
(2) Move 300 psi Gauge C-3293-SP back to rear servo port.
(3) Have helper start and run engine at 1600 rpm for test.
(4) Move transmission shift lever four detents rearward from full forward position. This is Reverse range.
(5) Move transmission throttle lever fully forward then fully rearward and note reading at Gauge C-3293-SP.
(6) Pressure should be 145 - 175 psi (1000-1207 kPa) with throttle lever forward and increase to 230 - 280 psi (1586-1931 kPa) as lever is gradually moved rearward.

Test Five - Governor Pressure

NOTE: This test checks governor operation by measuring governor pressure response to changes in vehicle speed. It is usually not necessary to check governor operation unless shift speeds are incorrect or if the transmission will not downshift. The test should be performed on the road or on a hoist that will allow the rear wheels to rotate freely.

(1) Move 100 psi Test Gauge C-3292 to governor pressure port.
(2) Move transmission shift lever two detents rearward from full forward position. This is D range.
(3) Have helper start and run engine at curb idle speed. Then firmly apply service brakes so wheels will not rotate.
(4) Note governor pressure:
- Governor pressure should be no more than 20.6 kPa (3 psi) at curb idle speed and wheels not rotating.
- If pressure exceeds 20.6 kPa (3 psi), a fault exists in governor pressure control system.

(5) Release brakes, slowly increase engine speed, and observe speedometer and pressure test gauge (do not exceed 30 mph on speedometer). Governor pressure should increase in proportion to vehicle speed. Or approximately 6.89 kPa (1 psi) for every 1 mph.
(6) Governor pressure rise should be smooth and drop back to no more than 20.6 kPa (3 psi), after engine returns to curb idle and brakes are applied to prevent wheels from rotating.
(7) Compare results of pressure test with analysis chart.

Test Six - Transmission In Overdrive Fourth Gear

NOTE: This test checks line pressure at the overdrive clutch in fourth gear range. Use 300 psi Test Gauge C-3293-SP for this test. The test should be performed on the road or on a chassis dyno.

(1) Remove tachometer; it is not needed for this test.
(2) Move 300 psi Gauge to overdrive clutch pressure test port. Then remove other gauge and reinstall test port plug.
(3) Lower vehicle.
(4) Turn OD switch on.
(5) Secure test gauge so it can be viewed from drivers seat.
(6) Start engine and shift into D range.
(7) Increase vehicle speed gradually until 3-4 shift occurs and note gauge pressure.
(8) Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-827 kPa (90-120 psi) at 1/2 to 3/4 throttle. Note that pressure can increase to around 896 kPa (130 psi) at full throttle.
(9) Return to shop or move vehicle off chassis dyno.

PRESSURE TEST ANALYSIS CHART

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 (seal rings, clutch seals)
Pressure low in D Fourth Gear Range	Overdrive clutch piston seal, or check ball problem
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area
Pressure OK in 2 but low in R and 1	Leakage in rear servo
Front servo pressure in 2	Leakage in servo; broken servo ring or cracked servo piston
Pressure low in all positions	Clogged filter, stuck regulator valve, worn or faulty pump, low oil level
Governor pressure too high at idle speed	Governor pressure solenoid valve system fault. Refer to diagnostic book.

AUTOMATIC TRANSMISSION - 42RE (Continued)

TEST CONDITION	INDICATION
Governor pressure low at all mph figures	Faulty governor pressure solenoid, transmission control module, or governor pressure sensor
Lubrication pressure low at all throttle positions	Clogged fluid cooler or lines, seal rings leaking, worn pump bushings, pump, clutch retainer, or clogged filter.
Line pressure high	Output shaft plugged, sticky regulator valve
Line pressure low	Sticky regulator valve, clogged filter, worn pump

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. 10).

Front Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Rear Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage. 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.

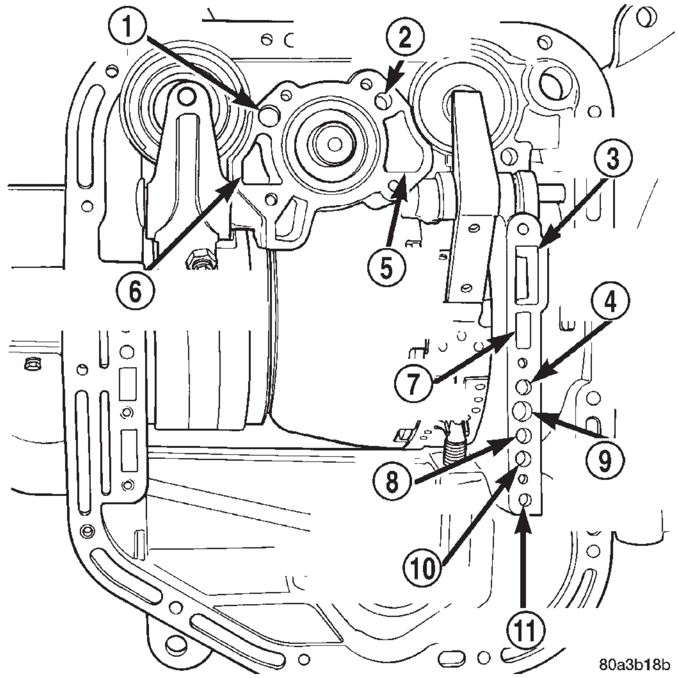


Fig. 10 Air Pressure Test Passages

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

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. 11). Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 11). Pump o-ring or gasket leaks usually travel down the inside of the converter housing. Front band lever pin plug

AUTOMATIC TRANSMISSION - 42RE (Continued)

leaks are generally deposited on the housing and not on the converter.

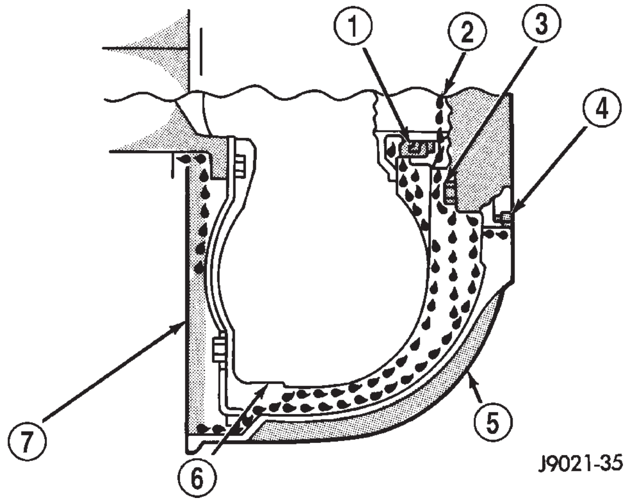


Fig. 11 Converter Housing Leak Paths

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. 12).

(2) Leaks at the converter hub weld (Fig. 12).

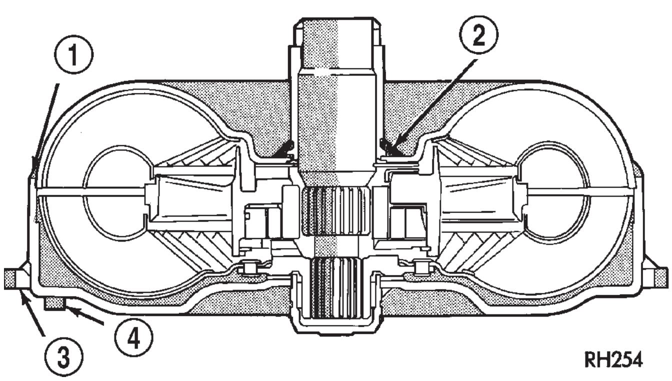


Fig. 12 Converter Leak Points - Typical

1 - OUTSIDE DIAMETER WELD
2 - TORQUE CONVERTER HUB WELD
3 - STARTER RING GEAR
4 - LUG

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

(2) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out when oil pump is removed.

(3) Remove oil pump and remove pump seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter.

(5) Install new pump seal, O-ring, and gasket. Replace oil pump if cracked, porous or damaged in any way. Be sure to loosen the front band before installing the oil pump, damage to the oil pump seal may occur if the band is still tightened to the front clutch retainer.

(6) Loosen kickdown lever pin access plug three turns. Apply Loctite™ 592, or Permatex® No. 2 to plug threads and tighten plug to 17 N·m (150 in. lbs.) torque.

(7) Adjust front band.

(8) Lubricate pump seal and converter hub with transmission fluid or petroleum jelly and install converter.

(9) Install transmission and converter housing dust shield.

(10) Lower vehicle.

DIAGNOSIS AND TESTING - 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 PARK, NEUTRAL, FIRST, SECOND, THIRD, FOURTH, MANUAL FIRST, MANUAL SECOND, and REVERSE gear ranges. Normal working pressures are also supplied for each of the gear ranges.

AUTOMATIC TRANSMISSION - 42RE (Continued)

DIAGNOSIS CHARTS

CONDITION	POSSIBLE CAUSES	CORRECTION
HARSH ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low.	1. Add Fluid
	2. Throttle Linkage Mis-adjusted.	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 Mis-adjusted.	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 Faulty.	11. Replace converter and flush cooler and line before installing new converter.
DELAYED ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low.	1. Correct level and check for leaks.
	2. Filter Clogged.	2. Change filter.
	3. Gearshift Linkage Mis-adjusted.	3. Adjust linkage and repair linkage if worn or damaged.
	4. Torque Converter Drain Back (Oil drains from torque converter into transmission sump).	4. If vehicle moves normally after 5 seconds after shifting into gear, no repair is necessary. If longer, inspect pump bushing for wear. Replace pump house.
	5. Rear Band Mis-adjusted.	5. Adjust band.
	6. Valve Body Filter Plugged.	6. Replace fluid and filter. If oil pan and old fluid were full of clutch disc material and/or metal particles, overhaul will be necessary.
	7. Oil Pump Gears Worn/Damaged.	7. Remove transmission and replace oil pump.
	8. Governor Circuit and Solenoid Valve Electrical Fault.	8. Test with DRB® scan tool and repair as required.
	9. Hydraulic Pressure Incorrect.	9. Perform pressure test, remove transmission and repair as needed.
	10. Reaction Shaft Seal Rings Worn/Broken.	10. Remove transmission, remove oil pump and replace seal rings.
	11. Rear Clutch/Input Shaft, Rear Clutch Seal Rings Damaged.	11. Remove and disassemble transmission and repair as necessary.
	12. Regulator Valve Stuck.	12. Clean.
	13. Cooler Plugged.	13. Transfer case failure can plug cooler.

AUTOMATIC TRANSMISSION - 42RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO DRIVE RANGE (REVERSE OK)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Repair or replace linkage components.
	3. Rear Clutch Burnt.	3. Remove and disassemble transmission and rear clutch and seals. Repair/replace worn or damaged parts as needed.
	4. Valve Body Malfunction.	4. Remove and disassemble valve body. Replace assembly if any valves or bores are damaged.
	5. Transmission Overrunning Clutch Broken.	5. Remove and disassemble transmission. Replace overrunning clutch.
	6. Input Shaft Seal Rings Worn/ Damaged.	6. Remove and disassemble transmission. Replace seal rings and any other worn or damaged parts.
	7. Front Planetary Failed Broken.	7. Remove and repair.
NO DRIVE OR REVERSE (VEHICLE WILL NOT MOVE)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Inspect, adjust and reassemble linkage as needed. Replace worn/damaged parts.
	3. U-Joint/Axle/Transfer Case Broken.	3. Perform preliminary inspection procedure for vehicle that will not move. Refer to procedure in diagnosis section.
	4. Filter Plugged.	4. Remove and disassemble transmission. Repair or replace failed components as needed. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Perform lube flow test. Flush oil. Replace cooler as necessary.
	5. Oil Pump Damaged.	5. Perform pressure test to confirm low pressure. Replace pump body assembly if necessary.
	6. Valve Body Malfunctioned.	6. Check 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.
	8. Park Sprag not Releasing - Check Stall Speed, Worn/Damaged/Stuck.	8. Remove, disassemble, repair.
	9. Torque Converter Damage.	9. Inspect and replace as required.

AUTOMATIC TRANSMISSION - 42RE (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. Fluid Filter Clogged.	2. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Perform lube flow test.
	3. Throttle Linkage Mis-adjusted.	3. Adjust linkage as described in service section.
	4. Throttle Linkage Binding.	4. Check cable for binding. Check for return to closed throttle at transmission.
	5. Gearshift Linkage/Cable Mis-adjusted.	5. Adjust linkage/cable as described in service section.
	6. Clutch or Servo Failure.	6. Remove valve body and air test clutch, and band servo operation. Disassemble and repair transmission as needed.
	7. Governor Circuit Electrical Fault.	7. Test using DRB® scan tool and repair as required.
	8. Front Band Mis-adjusted.	8. Adjust band.
	9. Pump Suction Passage Leak.	9. 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 Mis-adjusted/Damaged.	1. Repair or replace linkage parts as needed.
	2. Park Sprag Sticking.	2. Replace overdrive annulus gear.
	3. Rear Band Mis-adjusted/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. Direct Clutch in Overdrive Worn.	6. Disassemble overdrive. Replace worn or damaged parts.
	7. Front Clutch Burnt.	7. Remove and disassemble transmission. Replace worn, damaged clutch parts as required.
HAS FIRST/REVERSE ONLY (NO 1-2 OR 2-3 UPSHIFT)	1. Governor Circuit Electrical Fault.	1. Test using DRB® scan tool and repair as required.
	2. Valve Body Malfunction.	2. Repair 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.

AUTOMATIC TRANSMISSION - 42RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO LOW GEAR (MOVES IN 2ND OR 3RD GEAR ONLY)	1. Governor Circuit Electrical Fault.	1. Test with DRB® scan tool 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 Mis-adjusted.	1. Adjust linkage.
	2. Accelerator Pedal Travel Restricted.	2. Verify floor mat is not under pedal, repair worn accelerator cable or bent brackets.
	3. Valve Body Hydraulic Pressures Too High or Too Low Due to 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. Governor Circuit Electrical Fault.	4. Test with DRB® scan tool and repair as required.
	5. Valve Body Malfunction.	5. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	6. TPS Malfunction.	6. Replace sensor, check with DRB® scan tool.
	7. PCM Malfunction.	7. Check with DRB® scan tool and replace if required.
	8. Valve Body Malfunction.	8. Repair sticking 1-2, 2-3 shift valves, governor plugs, 3-4 solenoid, 3-4 shift valve, 3-4 timing valve.
STUCK IN LOW GEAR (WILL NOT UPSHIFT)	1. Throttle Linkage Mis-adjusted/ Stuck.	1. Adjust linkage and repair linkage if worn or damaged. Check for binding cable or missing return spring.
	2. Gearshift Linkage Mis-adjusted.	2. Adjust linkage and repair linkage if worn or damaged.
	3. Governor Component Electrical Fault.	3. Check operating pressures and test with DRB® scan tool, repair faulty component.
	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 Mis-adjusted.	1. Adjust linkage.
	2. Rear Clutch Dragging/Warped.	2. Disassemble and repair.
	3. Valve Body Malfunction.	3. Perform hydraulic pressure test to determine cause and repair as required.

AUTOMATIC TRANSMISSION - 42RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
BUZZING NOISE	1. Fluid Level Low	1. Add fluid and check for leaks.
	2. Shift Cable Mis-assembled.	2. Route cable away from engine and bell housing.
	3. Valve Body Mis-assembled.	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 Mis-adjusted.	2. Adjust linkage.
	3. Rear Band Mis-adjusted.	3. Adjust band.
	4. Rear Band Worn.	4. Replace as required.
	5. Overdrive Direct Clutch Worn.	5. Disassemble overdrive. Repair as needed.
	6. Hydraulic Pressure Too Low.	6. Perform hydraulic pressure tests to determine cause.
	7. Rear Servo Leaking.	7. Air pressure check clutch-servo operation and repair as required.
	8. Band Linkage Binding.	8. 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 Mis-adjusted.	3. Adjust linkage.
	4. Gearshift Linkage Mis-adjusted.	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, 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 MANUAL 1 POSITION	Overrunning Clutch Faulty.	Replace overrunning clutch.

AUTOMATIC TRANSMISSION - 42RE (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 Mis-adjusted.	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 Mis-adjusted.	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.
NO 4-3 DOWNSHIFT	1. Circuit Wiring and/or Connectors Shorted.	1. Test wiring and connectors with test lamp and volt/ohmmeter. Repair wiring as necessary. Replace connectors and/or harnesses as required.
	2. PCM Malfunction.	2. Check PCM operation with DRB® scan tool. Replace PCM only if faulty.
	3. TPS Malfunction	3. Check TPS with DRB® scan tool at PCM.
	4. Lockup Solenoid Not Venting.	4. Remove valve body and replace solenoid assembly if plugged or shorted.
	5. Overdrive Solenoid Not Venting.	5. Remove valve body and replace solenoid if plugged or shorted.
	6. Valve Body Valve Sticking.	6. Repair stuck 3-4 shift valve or lockup timing valve.

AUTOMATIC TRANSMISSION - 42RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO 4-3 DOWNSHIFT WHEN CONTROL SWITCH IS TURNED OFF	1. Control Switch Open/Shorted.	1. Test and replace switch if faulty.
	2. Overdrive Solenoid Connector Shorted.	2. Test solenoids and replace if seized or shorted.
	3. PCM Malfunction.	3. Test with DRB® scan tool. Replace PCM if faulty.
	4. Valve Body Stuck Valves.	4. Repair stuck 3-4, lockup or lockup timing valve.
CLUNK NOISE FROM DRIVELINE ON CLOSED THROTTLE 4-3 DOWNSHIFT	1. Transmission Fluid Low.	1. Add Fluid.
	2. Throttle Cable Mis-adjusted.	2. Adjust cable.
	3. Overdrive Clutch Select Spacer Wrong Spacer.	3. Replace overdrive piston thrust plate spacer.
3-4 UPSHIFT OCCURS IMMEDIATELY AFTER 2-3 SHIFT	1. Overdrive Solenoid Connector or Wiring Shorted.	1. Test connector and wiring for loose connections, shorts or ground and repair as needed.
	2. TPS Malfunction.	2. Test TPS and replace as necessary. Check with DRB® scan tool.
	3. PCM Malfunction.	3. Test PCM with DRB® scan tool and replace controller if faulty.
	4. Overdrive Solenoid Malfunction.	4. Replace solenoid.
	5. Valve Body Malfunction.	5. Remove, disassemble, clean and inspect valve body components. Make sure all valves and plugs slide freely in bores. Polish valves with crocus cloth if needed.
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.

AUTOMATIC TRANSMISSION - 42RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO 3-4 UPSHIFT	1. O/D Switch In OFF Position.	1. Turn control switch to ON position.
	2. Overdrive Circuit Fuse Blown.	2. Replace fuse. Determine why fuse failed and repair as necessary (i.e., shorts or grounds in circuit).
	3. O/D Switch Wire Shorted/Open Cut.	3. Check wires/connections with 12V test lamp and voltmeter. Repair damaged or loose wire/connection as necessary.
	4. Distance or Coolant Sensor Malfunction.	4. Check with DRB® scan tool and repair or replace as necessary.
	5. TPS Malfunction.	5. Check with DRB® scan tool and replace if necessary.
	6. Neutral Sense to PCM Wire Shorted/Cut.	6. Test switch/sensor as described in service section and replace if necessary. Engine no start.
	7. PCM Malfunction.	7. Check with DRB® scan tool and replace if necessary.
	8. Overdrive Solenoid Shorted/Open.	8. Replace solenoid if shorted or open and repair loose or damaged wires (DRB® scan tool).
	9. Solenoid Feed Orifice in Valve Body Blocked.	9. Remove, disassemble, and clean valve body thoroughly. Check feed orifice.
	10. Overdrive Clutch Failed.	10. Disassemble overdrive and repair as needed.
	11. Hydraulic Pressure Low.	11. Pressure test transmission to determine cause.
	12. Valve Body Valve Stuck.	12. Repair stuck 3-4 shift valve, 3-4 timing valve.
	13. O/D Piston Incorrect Spacer.	13. Remove unit, check end play and install correct spacer.
	14. Overdrive Piston Seal Failure.	14. Replace both seals.
	15. O/D Check Valve/Orifice Failed.	15. Check for free movement and secure assembly (in piston retainer). Check ball bleed orifice.

AUTOMATIC TRANSMISSION - 42RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SLIPS IN OVERDRIVE FOURTH GEAR	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Overdrive Clutch Pack Worn.	2. Remove overdrive unit and rebuild clutch pack.
	3. Overdrive Piston Retainer Bleed Orifice Blown Out.	3. Disassemble transmission, remove retainer and replace orifice.
	4. Overdrive Piston or Seal Malfunction.	4. Remove overdrive unit. Replace seals if worn. Replace piston if damaged. If piston retainer is damaged, remove and disassemble the transmission.
	5. 3-4 Shift Valve, Timing Valve or Accumulator Malfunction.	5. Remove and overhaul valve body. Replace accumulator seals. Make sure all valves operate freely in bores and do not bind or stick. Make sure valve body screws are correctly tightened and separator plates are properly positioned.
	6. Overdrive Unit Thrust Bearing Failure.	6. Disassemble overdrive unit and replace thrust bearing (NO. 1 thrust bearing is between overdrive piston and clutch hub; NO. 2 thrust bearing is between the planetary gear and the direct clutch spring plate; NO. 3 thrust bearing is between overrunning clutch hub and output shaft).
	7. O/D Check Valve/Bleed Orifice Failure.	7. Check for function/secure orifice insert in O/D piston retainer.
DELAYED 3-4 UPSHIFT (SLOW TO ENGAGE)	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Throttle Valve Cable Mis-adjusted.	2. Adjust throttle valve cable.
	3. Overdrive Clutch Pack Worn/ Burnt.	3. Remove unit and rebuild clutch pack.
	4. TPS Faulty.	4. Test with DRB® scan tool and replace as necessary
	5. Overdrive Clutch Bleed Orifice Plugged.	5. Disassemble transmission and replace orifice.
	6. Overdrive Solenoid or Wiring Shorted/Open.	6. Test solenoid and check wiring for loose/corroded connections or shorts/ grounds. Replace solenoid if faulty and repair wiring if necessary.
	7. Overdrive Excess Clearance.	7. Remove unit. Measure end play and select proper spacer.
	8. O/D Check Valve Missing or Stuck.	8. Check for presence of check valve. Repair or replace as required.
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, 2-3, 3-4 OR 3-2 SHIFTS	Lockup Solenoid Malfunction.	Remove valve body and replace solenoid assembly.

AUTOMATIC TRANSMISSION - 42RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO START IN PARK OR NEUTRAL	1. Gearshift Linkage/Cable Mis-adjusted.	1. Adjust linkage/cable.
	2. Neutral Sense Wire Open/Cut.	2. Check continuity with test lamp. Repair as required.
	3. Park/Neutral Switch, or Transmission Range Sensor Faulty.	3. Refer to service section for test and replacement procedure.
	4. Park/Neutral Switch, or Transmission Range Sensor Connection 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 Mis-adjusted.	2. Adjust band.
	3. Front Clutch Malfunctioned/ Burned.	3. Air-pressure test clutch operation. Remove and rebuild if necessary.
	4. Overdrive Thrust Bearing Failure.	4. Disassemble geartrain and replace bearings.
	5. Direct Clutch Spring Collapsed/ Broken.	5. Remove and disassemble unit. Check clutch position and replace spring.

AUTOMATIC TRANSMISSION - 42RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS.	1. Fluid Lines and Fittings Loose/ Leaks/Damaged.	1. Tighten fittings. If leaks persist, replace fittings and lines if necessary.
	2. Fill Tube (where tube enters case) Leaks/Damaged.	2. Replace tube seal. Inspect tube for cracks in fill tube.
	3. Pressure Port Plug Loose Loose/Damaged.	3. Tighten to correct torque. Replace plug or reseal if leak persists.
	4. Pan Gasket Leaks.	4. Tighten pan screws (150 in. lbs.). If leaks persist, replace gasket.
	5. Valve Body Manual Lever Shaft Seal Leaks/Worn.	5. Replace shaft seal.
	6. Rear Bearing Access Plate Leaks.	6. Replace gasket. Tighten screws.
	7. Gasket Damaged or Bolts are Loose.	7. Replace bolts or gasket or tighten both.
	8. Adapter/Extension Gasket Damaged Leaks/Damaged.	8. Replace gasket.
	9. Park/Neutral Switch, or Transmission Range Sensor Leaks/Damaged.	9. Replace switch and gasket.
	10. Converter Housing Area Leaks.	10. 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.
	11. Pump Seal Leaks/Worn/ Damaged.	11. Replace seal.
	12. Torque Converter Weld Leak/Cracked Hub.	12. Replace converter.
	13. Case Porosity Leaks.	13. Replace case.
NOISY OPERATION IN FOURTH GEAR ONLY	1. Overdrive Clutch Discs, Plates or Snap Rings Damaged.	1. Remove unit and rebuild clutch pack.
	2. Overdrive Piston or Planetary Thrust Bearing Damaged.	2. Remove and disassemble unit. Replace either thrust bearing if damaged.
	3. Output Shaft Bearings Scored/ Damaged.	3. Remove and disassemble unit. Replace either bearing if damaged.
	4. Planetary Gears Worn/Chipped.	4. Remove and overhaul overdrive unit.
	5. Overdrive Unit Overrunning Clutch Rollers Worn/Scored.	5. Remove and overhaul overdrive unit.

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

The overdrive unit can be removed and serviced separately. It is not necessary to remove the entire transmission assembly to perform overdrive unit repairs.

CAUTION: The transmission and torque converter must be removed as an assembly to avoid component damage. The converter driveplate, pump bushing, or oil seal can be damaged if the converter is left attached to the driveplate during removal. Be sure to remove the transmission and converter as an assembly.

(1) Disconnect battery negative cable.
(2) Hoist and support vehicle.
(3) Remove skid plate, if equipped.
(4) Remove skid plate support crossmember, if equipped.
(5) Disconnect and lower or remove necessary exhaust components.
(6) Mark propeller shaft and axle companion flanges for assembly alignment. Then disconnect and remove propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)
(7) Remove starter motor. (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL)
(8) Support engine with suitable support stand and wood block.
(9) Remove bolts attaching engine-to-transmission brackets to transmission.
(10) Remove bolt and nut attaching each engine-to-transmission bracket to the motor mounts.
(11) Remove bolts holding the engine-to-transmission brackets to the front axle, if equipped.
(12) Loosen bolts attaching engine-to-transmission brackets to each side of the engine block.
(13) Raise engine slightly.
(14) Remove torque converter access cover.
(15) Tighten bolts attaching engine-to-transmission brackets to each side of the engine block.
(16) Lower engine.
(17) Disconnect fluid cooler lines at transmission.
(18) If transmission is being removed for overhaul, remove transmission oil pan, drain fluid and reinstall pan.
(19) Remove fill tube bracket bolts and pull tube out of transmission. Retain fill tube seal. On 4x4 models, it will also be necessary to remove bolt attaching transfer case vent tube to converter housing (Fig. 13).
(20) 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.

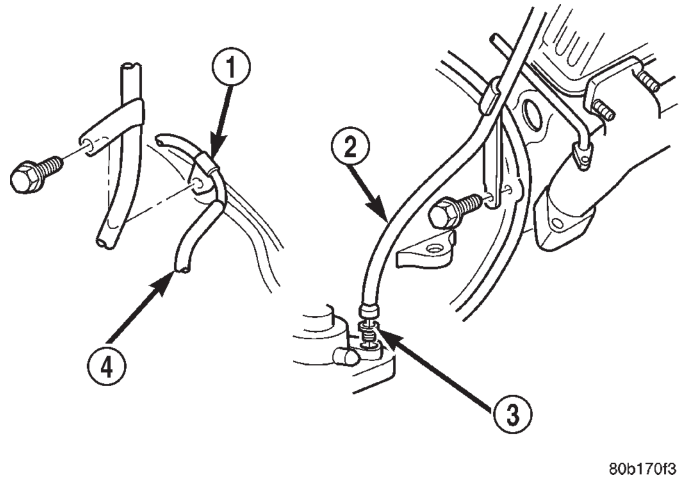


Fig. 13 Fill Tube Attachment

1 - TRANSFER CASE VENT TUBE
2 - FILL TUBE (V8)
3 - TUBE SEAL
4 - FILL TUBE (V6)

(21) Disconnect wires from the transmission range sensor and transmission solenoids connector.
(22) Disconnect throttle valve cable from transmission bracket and throttle valve lever.
(23) On 4x4 models, disconnect shift rod from transfer case shift lever. Or remove shift lever from transfer case and tie rod and lever to chassis component with wire.
(24) Raise transmission slightly with service jack to relieve load on crossmember and supports.
(25) Remove bolts securing rear support and cushion to transmission and crossmember. Raise transmission slightly, slide exhaust hanger arm from bracket (Fig. 14) and remove rear support.
(26) Remove bolts attaching crossmember to frame and remove crossmember.
(27) On 4x4 models, disconnect vent hose from transfer case. Then remove transfer case.
(28) Remove all converter housing bolts.
(29) Carefully work transmission and torque converter assembly rearward off engine block dowels.
(30) Lower transmission and remove assembly from under the vehicle.

DISASSEMBLY

(1) Clean transmission exterior with steam gun or with solvent. Wear eye protection during cleaning operations.
(2) Place transmission in a vertical position.
(3) Measure input shaft end play as follows (Fig. 15).
(a) Attach Adapter 8266-6 to Handle 8266-8.
(b) Attach dial indicator C-3339 to Handle 8266-8.

AUTOMATIC TRANSMISSION - 42RE (Continued)

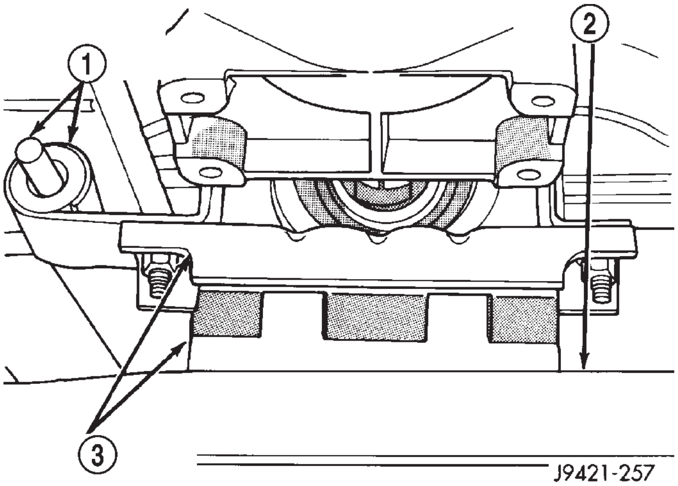


Fig. 14 Rear Support and Cushion

1 - EXHAUST PIPE ARM AND BRACKET
2 - CROSSMEMBER
3 - REAR SUPPORT AND CUSHION

(c) Install the assembled tool onto the input shaft of the transmission and tighten the retaining screw on Adapter 8266-6 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 the input shaft in and out. Record the maximum travel for assembly reference.

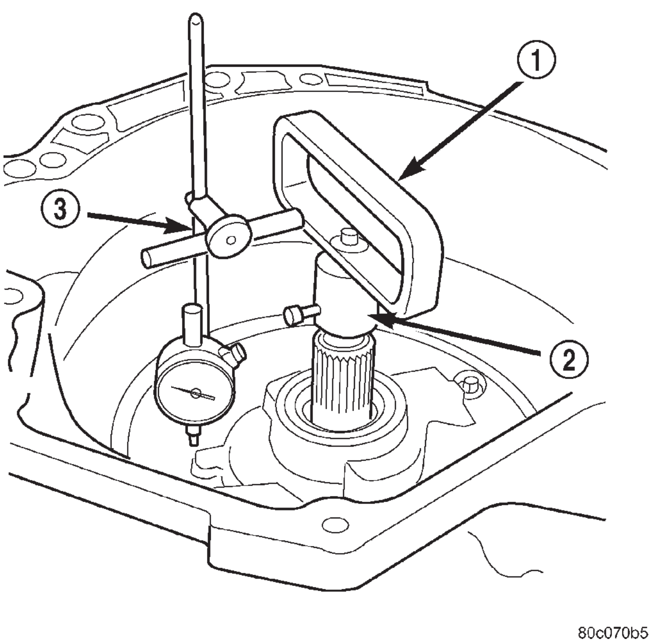


Fig. 15 Checking Input Shaft End Play

1 - TOOL 8266-8
2 - TOOL 8266-6
3 - TOOL C-3339

(4) Remove shift and throttle levers from valve body manual lever shaft.

(5) Place transmission in horizontal position.

(6) Remove transmission oil pan and gasket.

(7) Remove filter from valve body (Fig. 16). Keep filter screws separate from other valve body screws. Filter screws are longer and should be kept with filter.

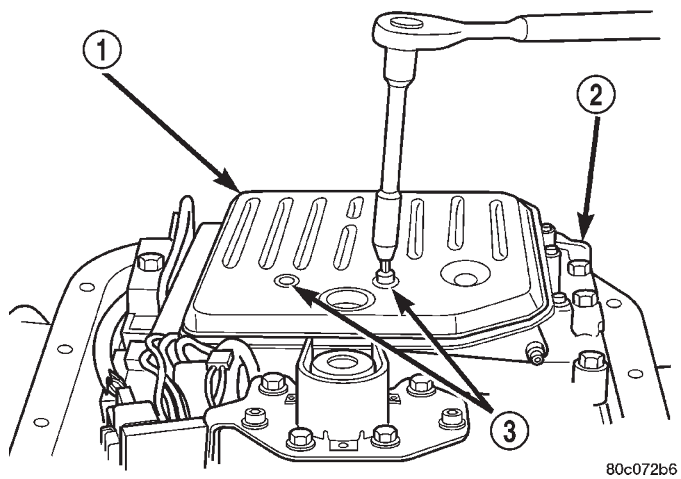


Fig. 16 Oil Filter Removal

1 - OIL FILTER
2 - VALVE BODY
3 - FILTER SCREWS (2)

(8) Remove the transmission range sensor.

(9) Remove hex head bolts attaching valve body to transmission case (Fig. 17). A total of 10 bolts are used. Note different bolt lengths for assembly reference.

(10) Remove valve body assembly. Push valve body harness connector out of case. Then work park rod and valve body out of case (Fig. 18).

(11) Remove accumulator piston and inner and outer springs (Fig. 19).

(12) Remove pump oil seal with suitable pry tool or slide-hammer mounted screw.

(13) Loosen front band adjusting screw locknut 4-5 turns. Then tighten band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out with pump and possibly damaging clutch or pump components.

(14) Remove oil pump bolts.

(15) Thread bolts of Slide Hammer Tools C-3752 into threaded holes in pump body flange (Fig. 20).

(16) Bump slide hammer weights outward to remove pump and reaction shaft support assembly from case (Fig. 20).

AUTOMATIC TRANSMISSION - 42RE (Continued)

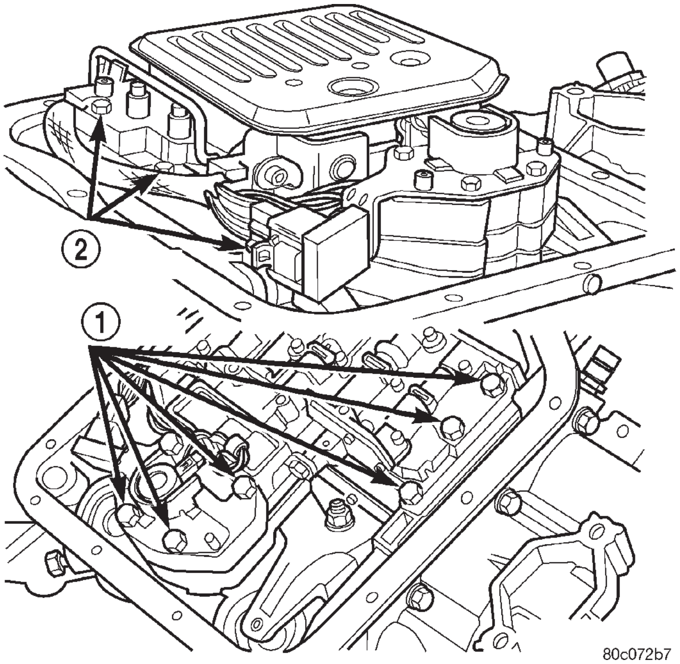


Fig. 17 Valve Body Bolt Locations

1 - VALVE BODY BOLTS
2 - VALVE BODY BOLTS

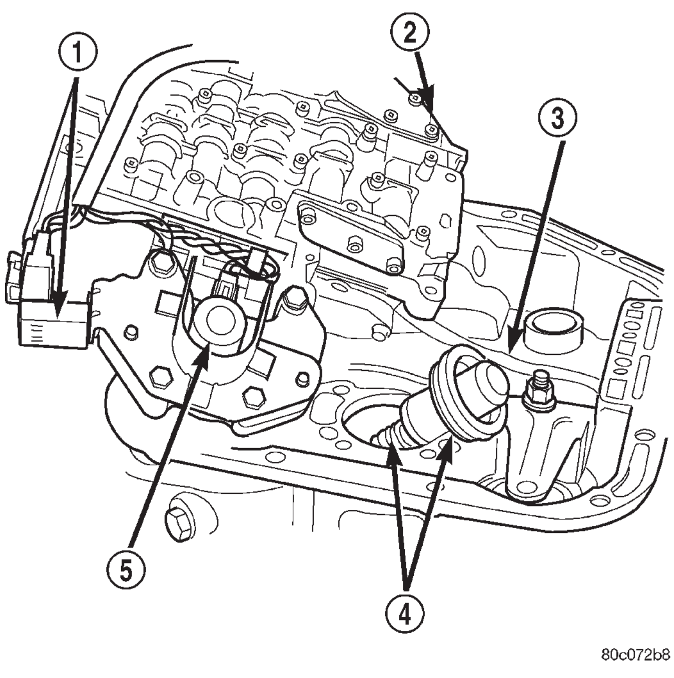


Fig. 18 Valve Body Removal

1 - GOVERNOR PRESSURE SENSOR
2 - VALVE BODY
3 - PARK ROD
4 - ACCUMULATOR PISTON
5 - GOVERNOR PRESSURE SOLENOID

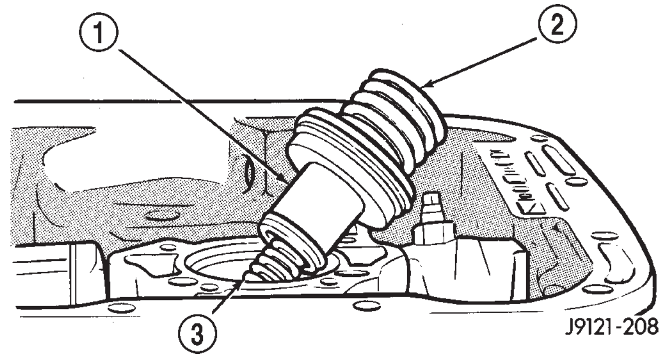


Fig. 19 Accumulator Piston And Springs

1 - ACCUMULATOR PISTON
2 - OUTER SPRING
3 - INNER SPRING

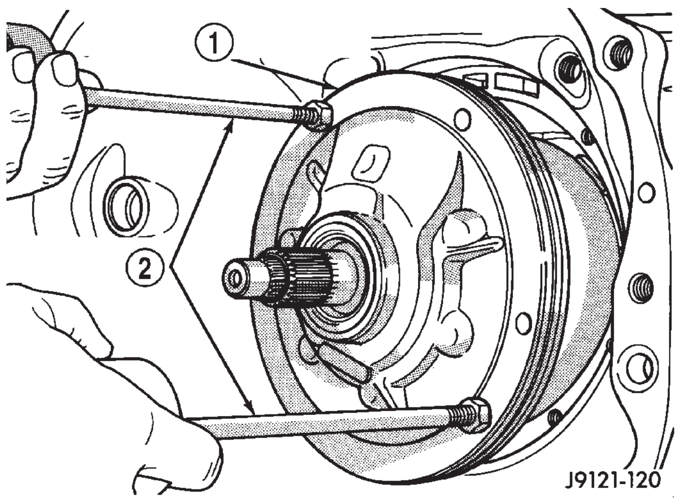


Fig. 20 Removing Oil Pump And Reaction Shaft Support Assembly

1 - OIL PUMP AND REACTION SHAFT SUPPORT ASSEMBLY
2 - SLIDE HAMMER TOOLS C-3752

(17) Loosen front band adjusting screw until band is completely loose.

(18) Squeeze front band together and remove band strut (Fig. 21).

(19) Remove front band lever (Fig. 22).

(20) Remove front band lever shaft plug, if necessary, from converter housing.

(21) Remove front band lever shaft.

AUTOMATIC TRANSMISSION - 42RE (Continued)

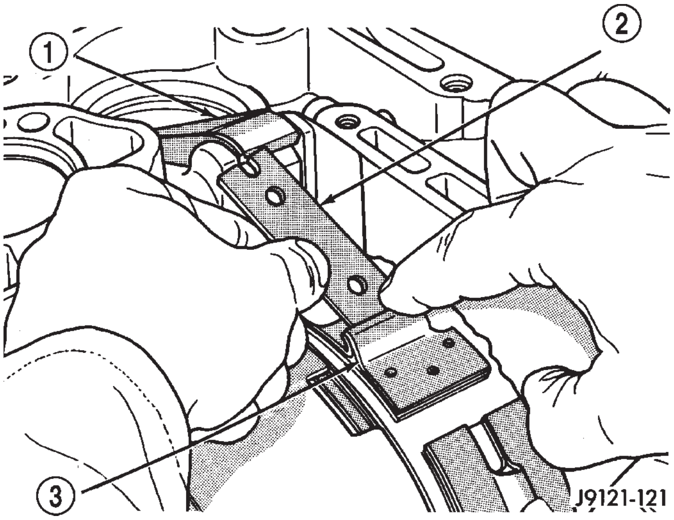


Fig. 21 Removing Front Band Strut

1 - BAND LEVER
2 - BAND STRUT
3 - FRONT BAND

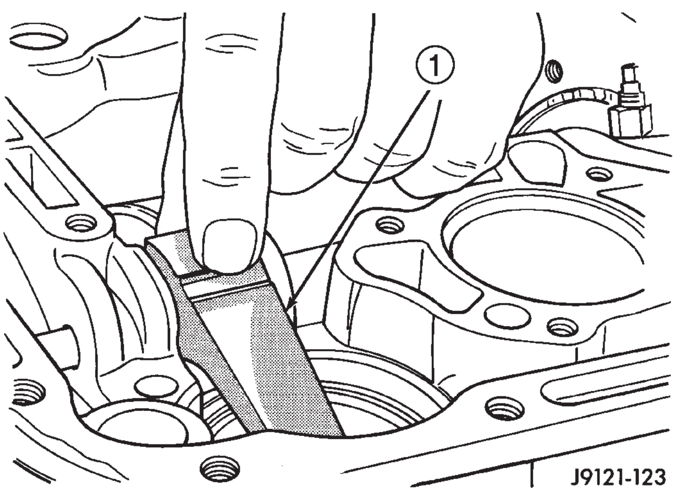


Fig. 22 Removing Front Band Lever

1 - FRONT BAND LEVER

(22) Remove front and rear clutch units as assembly. Grasp input shaft, hold clutch units together and remove them from case (Fig. 23).

(23) Lift front clutch off rear clutch (Fig. 24). Set clutch units aside for overhaul.

(24) Remove intermediate shaft thrust washer from front end of shaft or from rear clutch hub (Fig. 25).

(25) Remove output shaft thrust plate from intermediate shaft hub (Fig. 26).

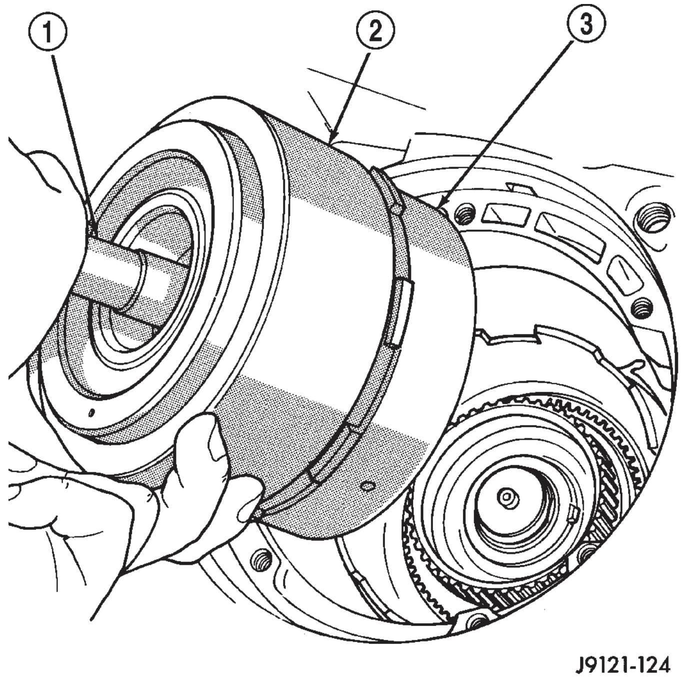


Fig. 23 Removing Front/Rear Clutch Assemblies

1 - INPUT SHAFT
2 - FRONT CLUTCH
3 - REAR CLUTCH

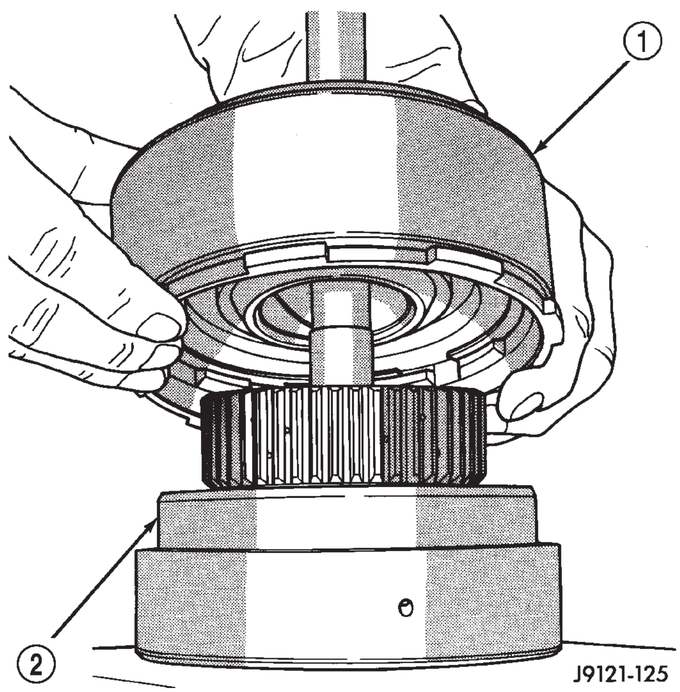


Fig. 24 Separating Front/Rear Clutch Assemblies

1 - FRONT CLUTCH
2 - REAR CLUTCH

AUTOMATIC TRANSMISSION - 42RE (Continued)

(26) Slide front band off driving shell (Fig. 27) and remove band from case.

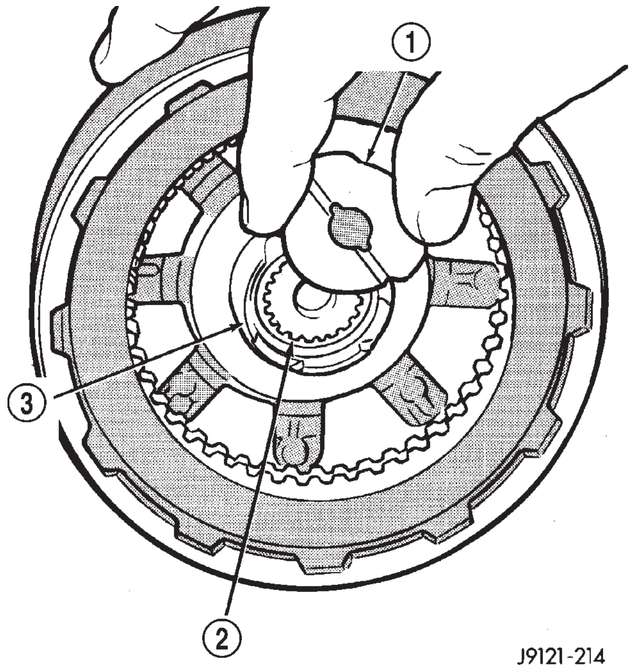


Fig. 25 Removing Intermediate Shaft Thrust Washer

1 - INTERMEDIATE SHAFT THRUST WASHER
2 - INPUT SHAFT
3 - REAR CLUTCH RETAINER HUB

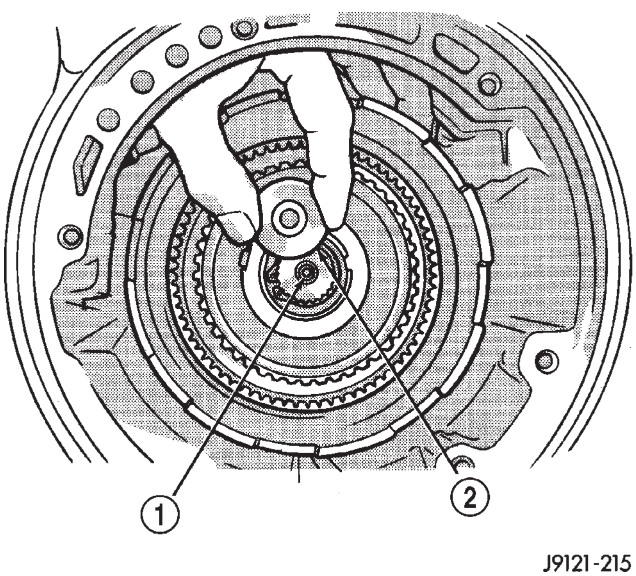


Fig. 26 Removing Intermediate Shaft Thrust Plate

1 - INTERMEDIATE SHAFT HUB
2 - INTERMEDIATE SHAFT THRUST PLATE

(27) Remove planetary geartrain as assembly (Fig. 28). Support geartrain with both hands during removal. Do not allow machined surfaces on intermediate shaft or overdrive piston retainer to become nicked or scratched.

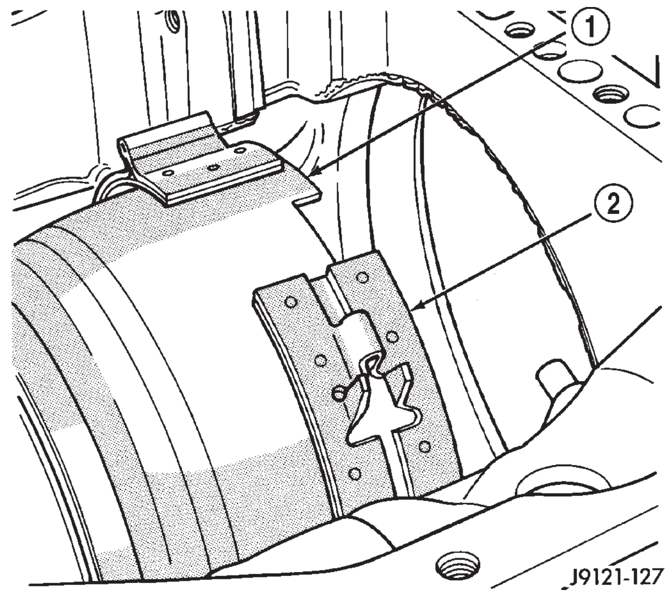


Fig. 27 Front Band Removal

1 - DRIVING SHELL
2 - FRONT BAND

(28) If overdrive unit is not to be serviced, install Alignment Shaft 6227-2 into the overdrive unit to prevent misalignment of the overdrive clutches during service of main transmission components.

(29) Loosen rear band adjusting screw 4-5 turns.

(30) Remove low-reverse drum snap-ring (Fig. 29).

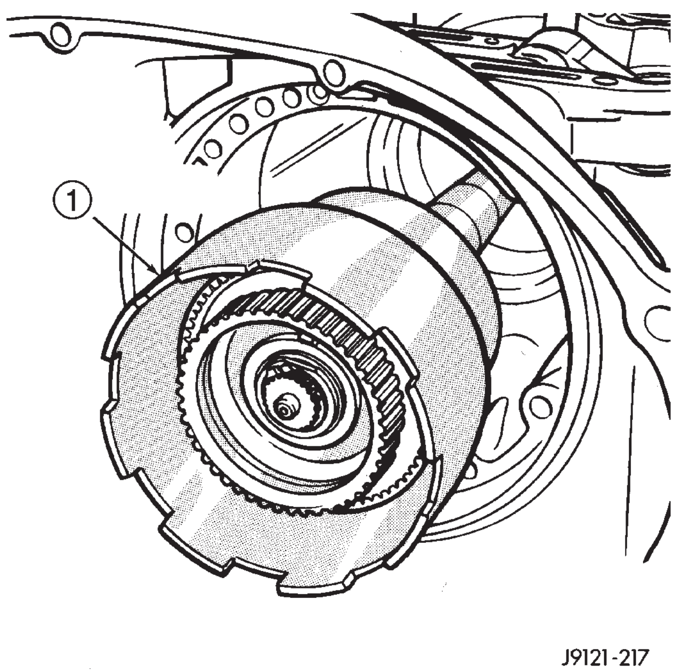


Fig. 28 Removing Planetary Geartrain And Intermediate Shaft Assembly

1 - PLANETARY GEARTRAIN AND INTERMEDIATE SHAFT ASSEMBLY

AUTOMATIC TRANSMISSION - 42RE (Continued)

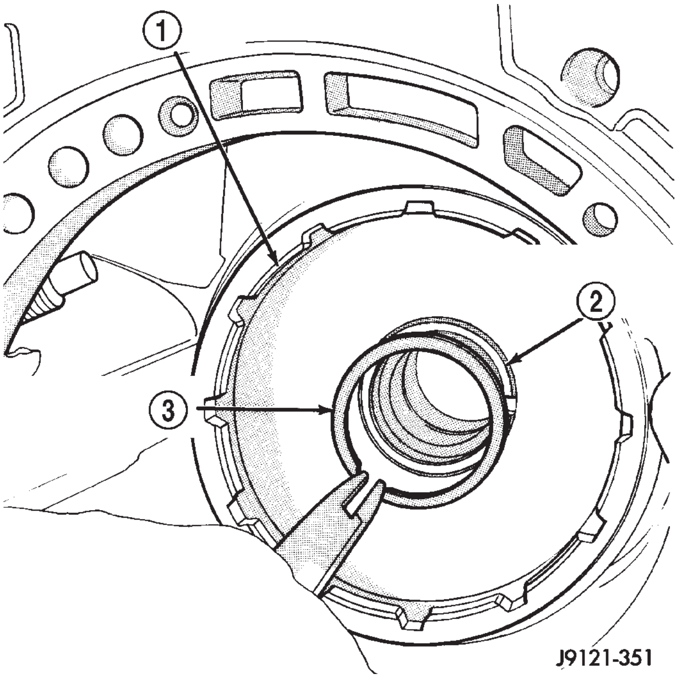


Fig. 29 Removing Low-Reverse Drum Snap-Ring

1 - LOW-REVERSE DRUM
2 - HUB OF OVERDRIVE PISTON RETAINER
3 - LOW-REVERSE DRUM SNAP-RING

(31) Remove low-reverse drum and reverse band.

(32) Remove overrunning clutch roller and spring assembly as a unit (Fig. 30).

(33) Compress front servo rod guide about 1/8 inch with Valve Spring Compressor C-3422-B (Fig. 31).

(34) Remove front servo rod guide snap-ring. Exercise caution when removing snap-ring. Servo bore can be scratched or nicked if care is not exercised.

(35) Remove compressor tools and remove front servo rod guide, spring and servo piston.

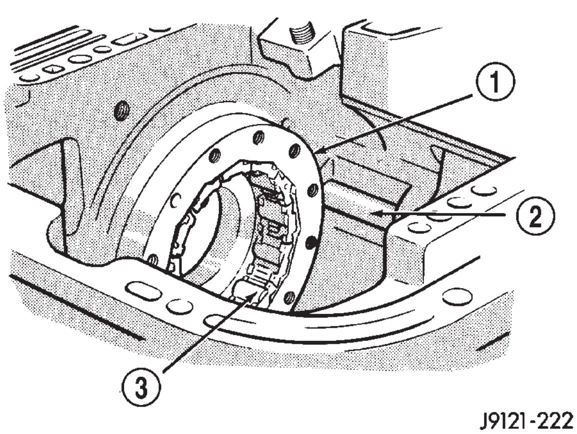


Fig. 30 Overrunning Clutch Assembly Removal

1 - OVERRUNNING CLUTCH CAM
2 - REAR BAND REACTION PIN
3 - OVERRUNNING CLUTCH ASSEMBLY

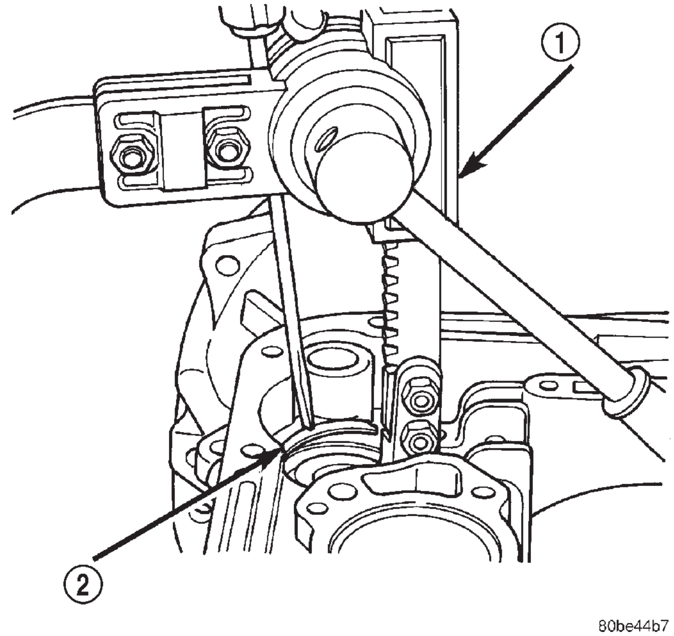


Fig. 31 Compressing Front Servo Rod Guide

1 - SPRING COMPRESSOR TOOL C-3422-B
2 - ROD GUIDE SNAP-RING

(36) Compress rear servo spring retainer about 1/16 inch with Valve Spring Compressor C-3422-B (Fig. 32).

(37) Remove rear servo spring retainer snap-ring. Then remove compressor tools and remove rear servo spring and piston.

(38) Inspect transmission components.

NOTE: To Service the overrunning clutch cam or overdrive piston retainer, refer to the Overrunning Clutch Cam service procedure in this section.

CLEANING

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 stick to case surfaces and transmission components and circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

Lubricate transmission parts with Mopar® ATF +4, type 9602, transmission fluid during overhaul and assembly. Use petroleum jelly, Mopar® Door Ease, or Ru-Glyde™ to prelubricate seals, O-rings, and thrust

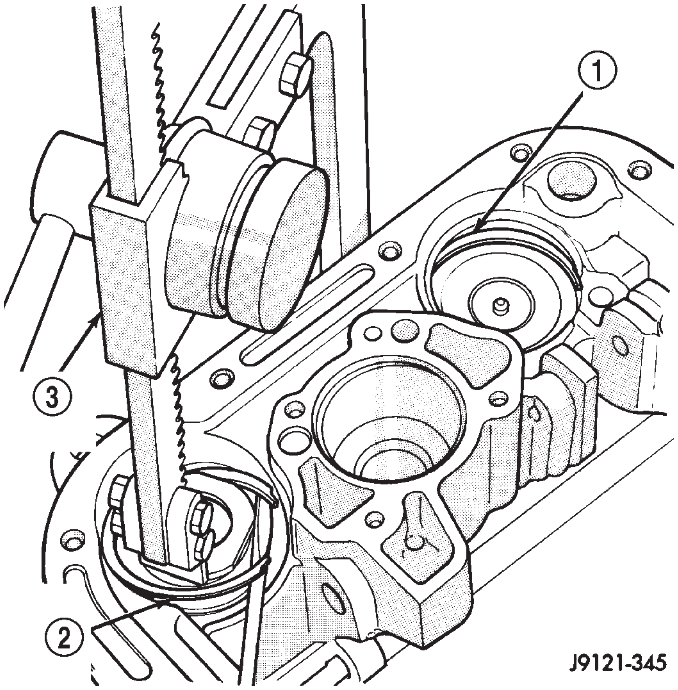


Fig. 32 Compressing Rear Servo Spring

1 - FRONT SERVO SNAP-RING
2 - REAR SERVO SNAP-RING
3 - SPECIAL TOOL

washers. Petroleum jelly can also be used to hold parts in place during reassembly.

INSPECTION

Inspect the case for cracks, porous spots, worn bores, or damaged threads. Damaged threads can be repaired with Helicoil thread inserts. However, the case will have to be replaced if it exhibits any type of damage or wear.

Lubricate the front band adjusting screw threads with petroleum jelly and thread the screw part-way into the case. Be sure the screw turns freely.

Inspect the transmission bushings during overhaul. Bushing condition is important as worn, scored bushings contribute to low pressures, clutch slip and accelerated wear of other components. However, do not replace bushings as a matter of course. Replace bushings only when they are actually worn, or scored.

Use recommended tools to replace bushings. The tools are sized and designed to remove, install, and seat bushings correctly. The bushing replacement tools are included in Bushing Tool Set C-3887-B.

Pre-sized service bushings are available for replacement purposes. Only the sun gear bushings are not serviced.

The use of crocus cloth is permissible where necessary, providing it is used carefully. When used on shafts, or valves, use extreme care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

ASSEMBLY

Do not allow dirt, grease, or foreign material to enter the case or transmission components during assembly. Keep the transmission case and components clean. Also make sure the tools and workbench area used for assembly operations are equally clean.

Shop towels used for wiping off tools and hands must be made from **lint free** material. Lint will stick to transmission parts and could interfere with valve operation, or even restrict fluid passages.

Lubricate the transmission components with Mopar® transmission fluid during reassembly. Use Mopar® Door Ease, or Ru-Glyde™ on seals and O-rings to ease installation.

Petroleum jelly can also be used to hold thrust washers, thrust plates and gaskets in position during assembly. However, **do not** use chassis grease, bearing grease, white grease, or similar lubricants on any transmission part. These types of lubricants can eventually block or restrict fluid passages and interfere with valve operation. Use petroleum jelly only.

Do not force parts into place. The transmission components and subassemblies are easily installed by hand when properly aligned.

If a part seems extremely difficult to install, it is either misaligned or incorrectly assembled. Also verify that thrust washers, thrust plates and seal rings are correctly positioned before assembly. These parts can interfere with proper assembly if mis-positioned.

The planetary geartrain, front/rear clutch assemblies and oil pump are all much easier to install when the transmission case is upright.

(1) Install rear servo piston, spring and retainer (Fig. 33). Install spring on top of servo piston and install retainer on top of spring.

(2) Install front servo piston assembly, servo spring and rod guide (Fig. 34).

(3) Compress front/rear servo springs with Valve Spring Compressor C-3422-B and install each servo snap-ring (Fig. 35).

AUTOMATIC TRANSMISSION - 42RE (Continued)

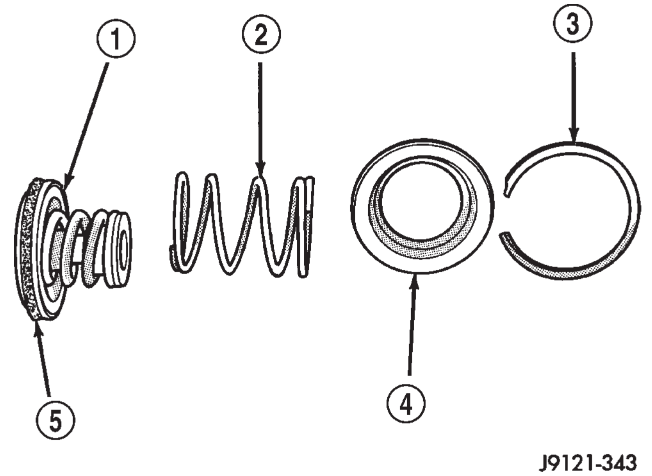


Fig. 33 Rear Servo Components

1 - SERVO PISTON
2 - PISTON SPRING
3 - SNAP-RING
4 - RETAINER
5 - PISTON SEAL

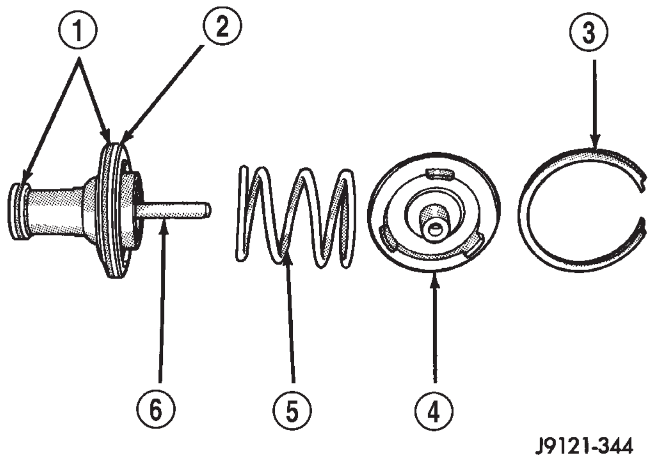


Fig. 34 Front Servo Components

1 - PISTON SEAL RINGS
2 - SERVO PISTON
3 - SNAP-RING
4 - ROD GUIDE
5 - SPRING
6 - ROD

(4) Lubricate clutch cam rollers with transmission fluid.

(5) Install rear band in case (Fig. 36). Be sure twin lugs on band are seated against reaction pin.

(6) Install low-reverse drum and check overrunning clutch operation as follows:

(a) Lubricate overrunning clutch race (on drum hub) with transmission fluid.

(b) Guide drum through rear band.

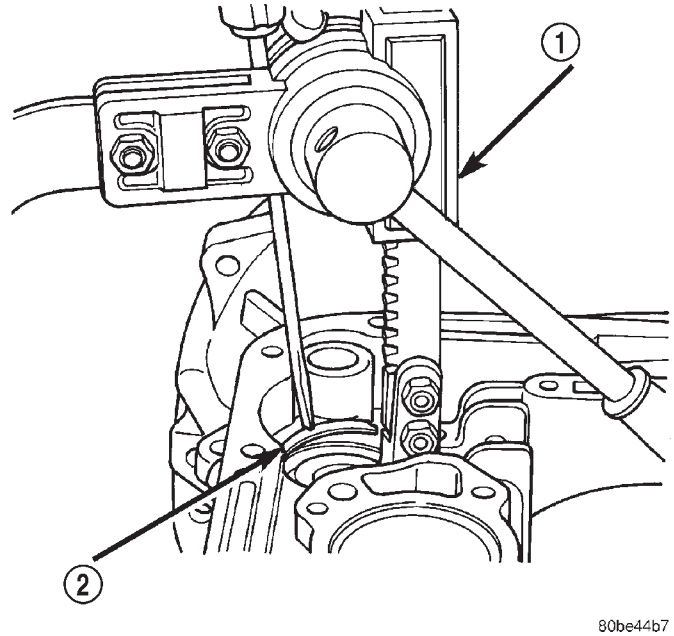


Fig. 35 Compressing Front/Rear Servo Springs

1 - SPRING COMPRESSOR TOOL C-3422-B
2 - ROD GUIDE SNAP-RING

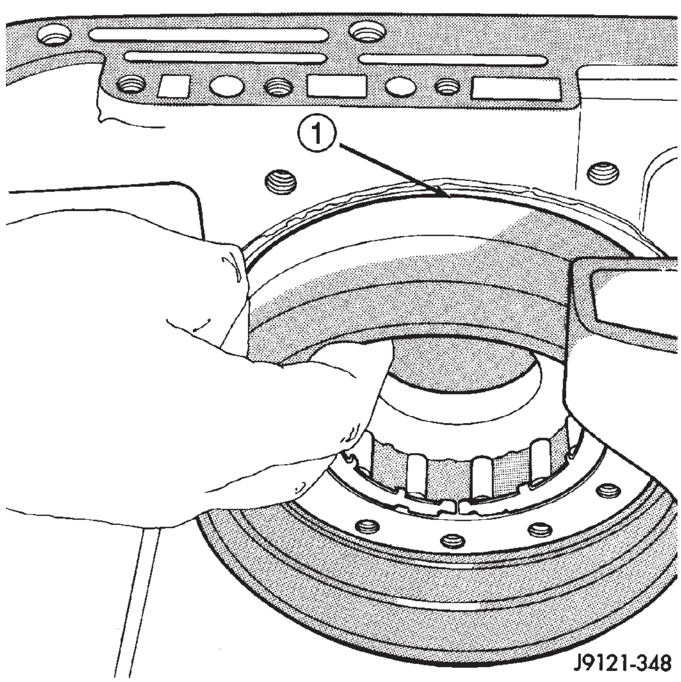


Fig. 36 Rear Band Installation

1 - REAR BAND

(c) Tilt drum slightly and start race (on drum hub) into overrunning clutch rollers.

(d) Press drum rearward and turn it in clockwise direction until drum seats in overrunning clutch (Fig. 37).

AUTOMATIC TRANSMISSION - 42RE (Continued)

(e) Turn drum back and forth. Drum should rotate freely in clockwise direction and lock in counter-clockwise direction (as viewed from front of case).

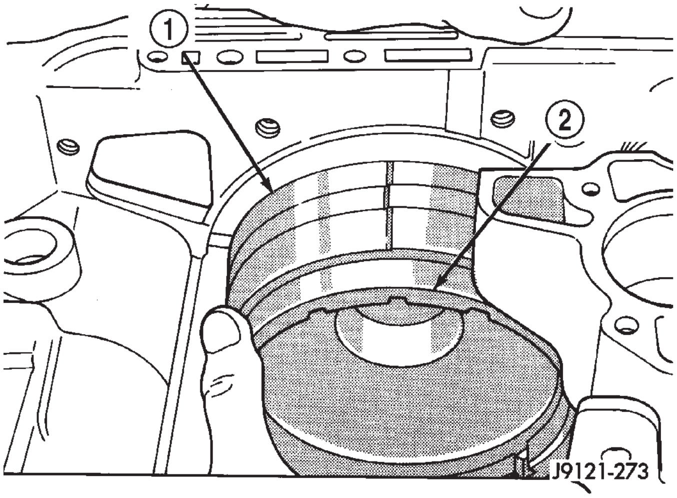


Fig. 37 Installing Low-Reverse Drum

1 - REAR BAND
2 - LOW-REVERSE DRUM

(7) Install snap-ring that secures low-reverse drum to hub of overdrive piston retainer (Fig. 38).

(8) Install rear band lever and pivot pin (Fig. 39). Align lever with pin bores in case and push pivot pin into place.

(9) Install planetary geartrain assembly (Fig. 40).

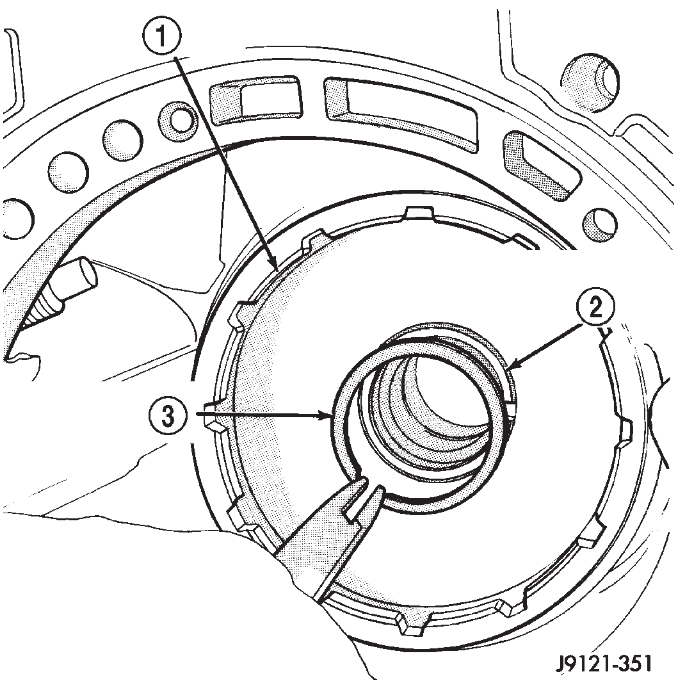


Fig. 38 Installing Low-Reverse Drum Retaining Snap-Ring

1 - LOW-REVERSE DRUM
2 - HUB OF OVERDRIVE PISTON RETAINER
3 - LOW-REVERSE DRUM SNAP-RING

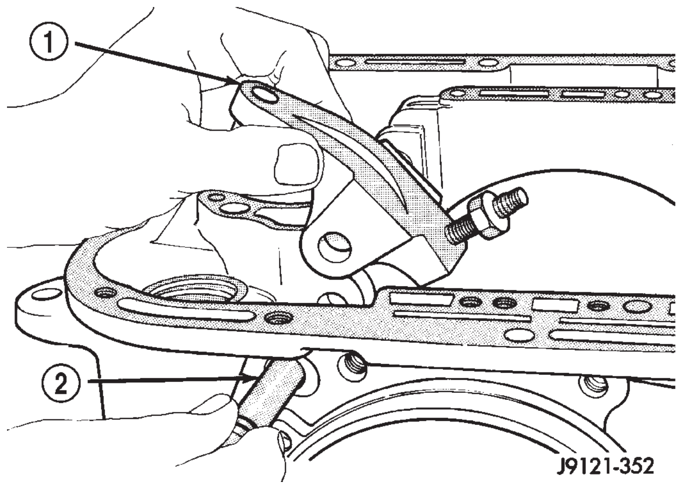


Fig. 39 Rear Band Lever And Pivot Pin Installation

1 - REAR BAND LEVER
2 - LEVER PIVOT PIN

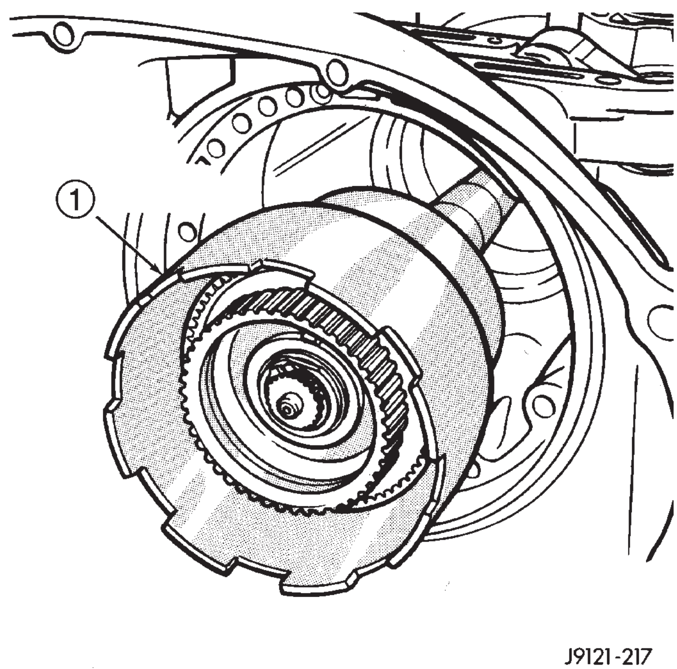


Fig. 40 Installing Planetary Geartrain

1 - PLANETARY GEARTRAIN AND INTERMEDIATE SHAFT ASSEMBLY

(10) Install thrust plate on intermediate shaft hub (Fig. 41). Use petroleum jelly to hold thrust plate in place.

(11) Check seal ring on rear clutch retainer hub and seal rings on input shaft (Fig. 42). Also verify that shaft seal rings are installed in sequence shown.

(12) Install rear clutch thrust washer (Fig. 43). Use additional petroleum jelly to hold washer in place if necessary.

AUTOMATIC TRANSMISSION - 42RE (Continued)

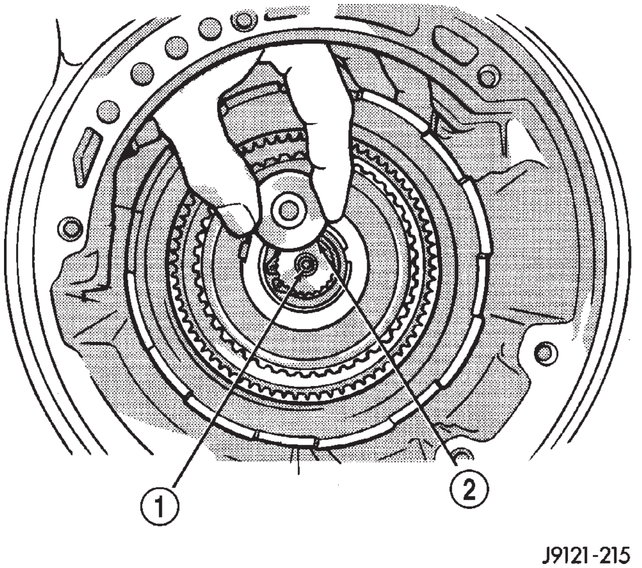


Fig. 41 Installing Intermediate Shaft Thrust Plate

1 - INTERMEDIATE SHAFT HUB
2 - INTERMEDIATE SHAFT THRUST PLATE

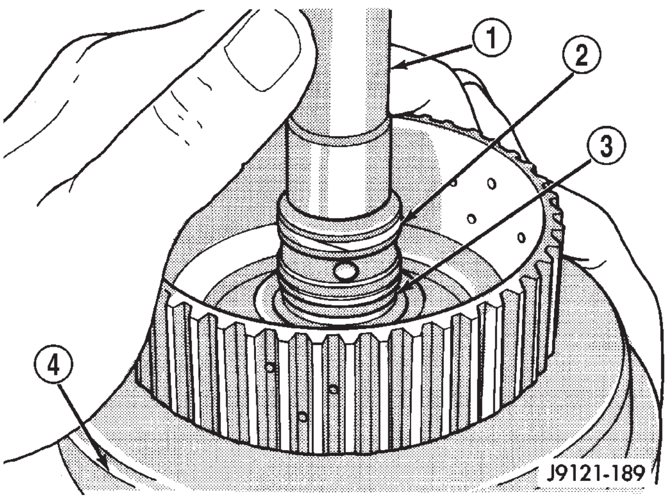


Fig. 42 Input Shaft Seal Ring Location

1 - INPUT SHAFT
2 - TEFLON SEAL RING
3 - PLASTIC SEAL RING
4 - REAR CLUTCH RETAINER

(13) Align clutch discs in front clutch and install front clutch on rear clutch (Fig. 44). Rotate front clutch retainer back and forth until completely seated on rear clutch retainer.

(14) Coat intermediate shaft thrust washer with petroleum jelly. Then install washer in rear clutch hub (Fig. 45). Use enough petroleum jelly to hold washer in place. Be sure grooved side of washer faces rearward (toward output shaft) as shown. Also note that washer only fits one way in clutch hub. Note thickness of this washer. It is a select fit part and is used to control transmission end play.

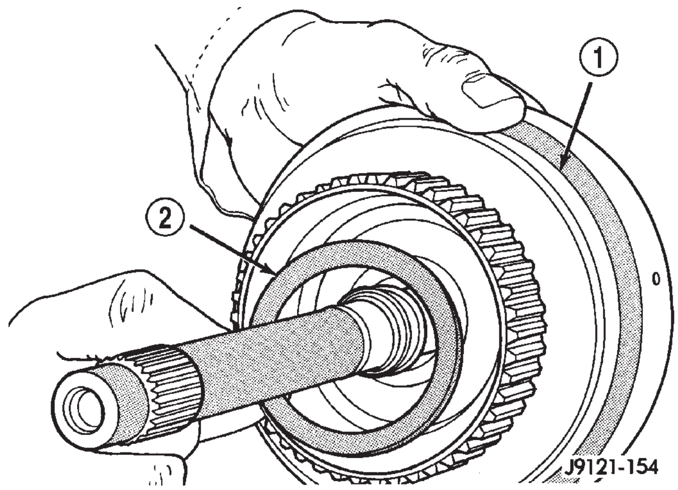


Fig. 43 Installing Rear Clutch Thrust Washer

1 - REAR CLUTCH RETAINER
2 - REAR CLUTCH THRUST WASHER (FIBER)

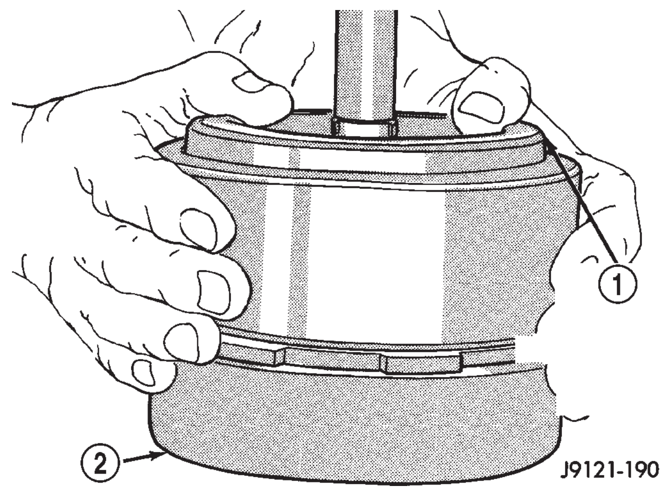


Fig. 44 Assembling Front And Rear Clutch Units

1 - TURN FRONT CLUTCH BACK & FORTH UNTIL SEATED
2 - REAR CLUTCH ASSEMBLY

(15) Align drive teeth on rear clutch discs with small screwdriver (Fig. 46). This makes installation on front planetary easier.

(16) 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.

(17) Slide front band into case.

(18) Install front and rear clutch units as assembly (Fig. 47). 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 - 42RE (Continued)

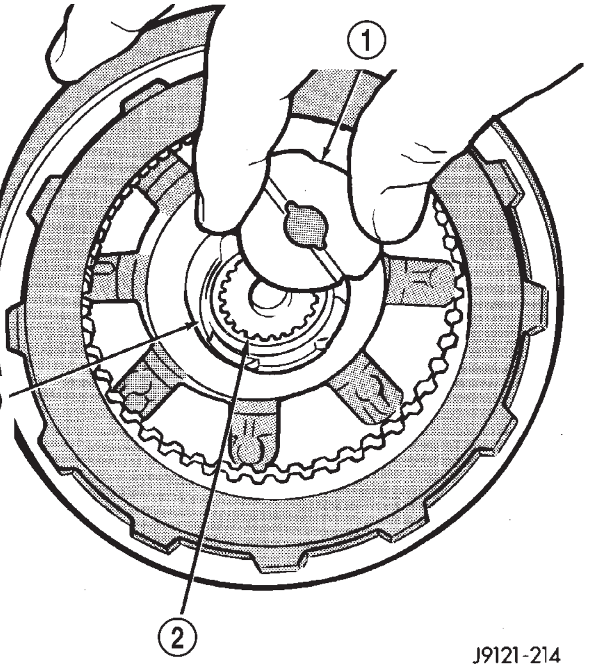


Fig. 45 Installing Intermediate Shaft Thrust Plate

1 - INTERMEDIATE SHAFT THRUST WASHER
2 - INPUT SHAFT
3 - REAR CLUTCH RETAINER HUB

(19) Carefully work assembled clutches back and forth to engage and seat rear clutch discs on front annulus gear. Also be sure front clutch drive lugs are fully engaged in slots of driving shell after installation.

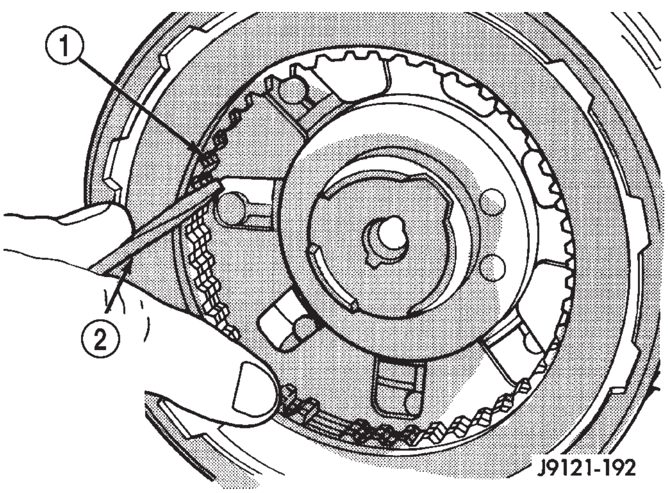


Fig. 46 Aligning Rear Clutch Disc Lugs

1 - REAR CLUTCH DISCS
2 - USE SMALL SCREWDRIVER TO ALIGN CLUTCH DISC TEETH

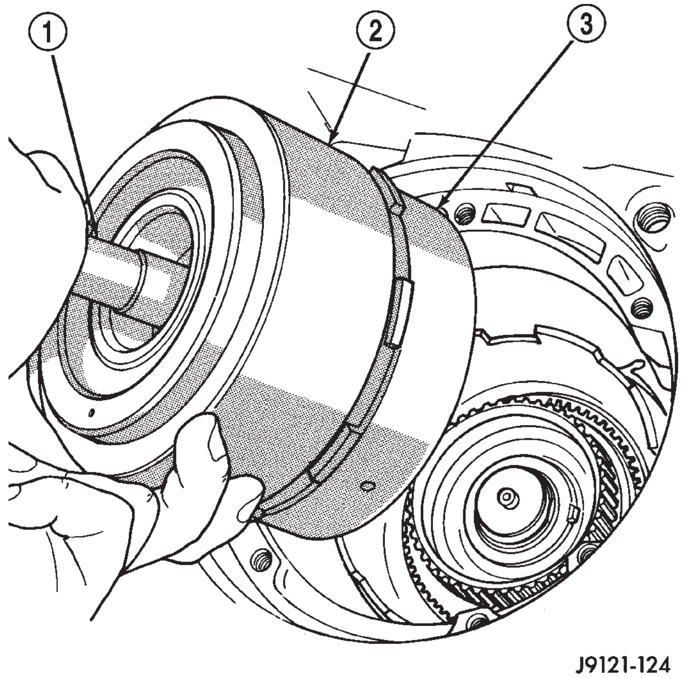


Fig. 47 Installing Front/Rear Clutch Assemblies

1 - INPUT SHAFT
2 - FRONT CLUTCH
3 - REAR CLUTCH

(20) Assemble front band strut.

(21) Install front band adjuster, strut and adjusting screw (Fig. 48).

(22) Tighten band adjusting screw until band just grips clutch retainer. Verify that front/rear clutches are still seated before continuing.

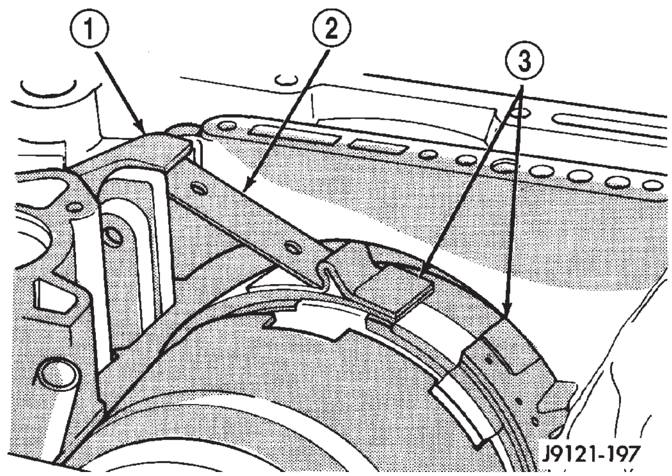


Fig. 48 Front Band Linkage Installation

1 - BAND LEVER
2 - BAND STRUT
3 - FRONT BAND

AUTOMATIC TRANSMISSION - 42RE (Continued)

(23) Check seal rings on reaction shaft support hub. Verify that seal rings are hooked together and that front clutch thrust washer is properly positioned (Fig. 49). Use petroleum jelly to hold thrust washer in place if necessary.

(24) Lubricate oil pump body seal with petroleum jelly. Lubricate pump shaft seal lip with petroleum jelly.

(25) Thread two Pilot Stud Tools C-3288-B into bolt holes in oil pump bore flange (Fig. 50).

(26) Align and install oil pump gasket (Fig. 50).

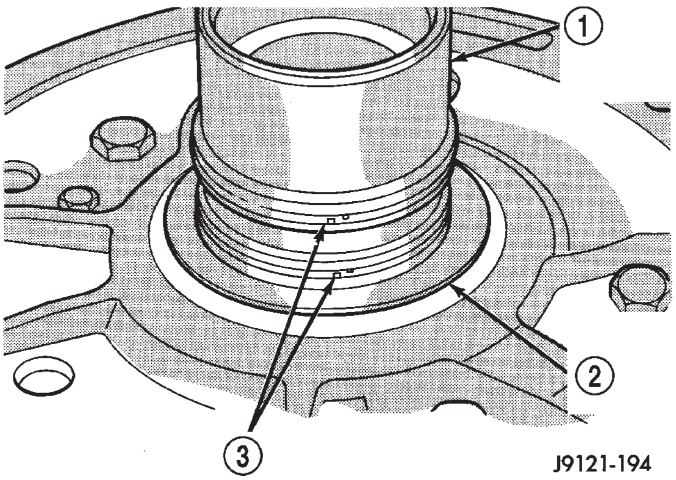


Fig. 49 Reaction Shaft Support Seal Rings And Front Clutch Thrust Washer

1 - REACTION SHAFT SUPPORT HUB
2 - FRONT CLUTCH THRUST WASHER
3 - SEAL RINGS

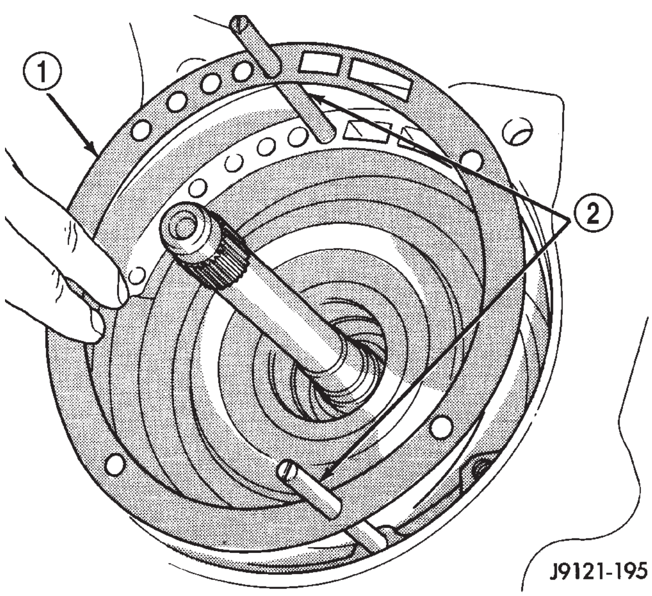


Fig. 50 Installing Pilot Studs And Oil Pump Gasket

1 - OIL PUMP GASKET
2 - PILOT STUD TOOLS C-3288-B

(27) Install oil pump (Fig. 51). Align and position pump on pilot studs. Slide pump down studs and work it into front clutch hub and case by hand. Then install 2 or 3 pump bolts to hold pump in place.

(28) Remove pilot stud tools and install remaining oil pump bolts. Tighten bolts alternately in diagonal pattern to 20 N·m (15 ft. lbs.).

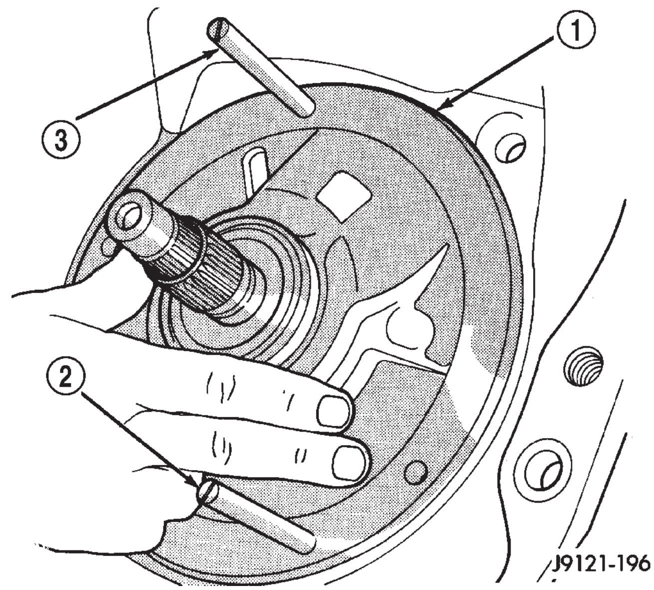


Fig. 51 Installing Oil Pump

1 - OIL PUMP
2 - PILOT STUD TOOL
3 - PILOT STUD TOOL

(29) Measure input shaft end play (Fig. 52).

NOTE: If end play is incorrect, transmission is incorrectly assembled, or the intermediate shaft thrust washer is incorrect. The intermediate shaft thrust washer is selective.

(a) Attach Adapter 8266-6 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 8266-6 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.

(30) Install accumulator piston and inner and outer springs (Fig. 53).

(31) Verify that valve body solenoid harness is secured in 3-4 accumulator housing cover plate.

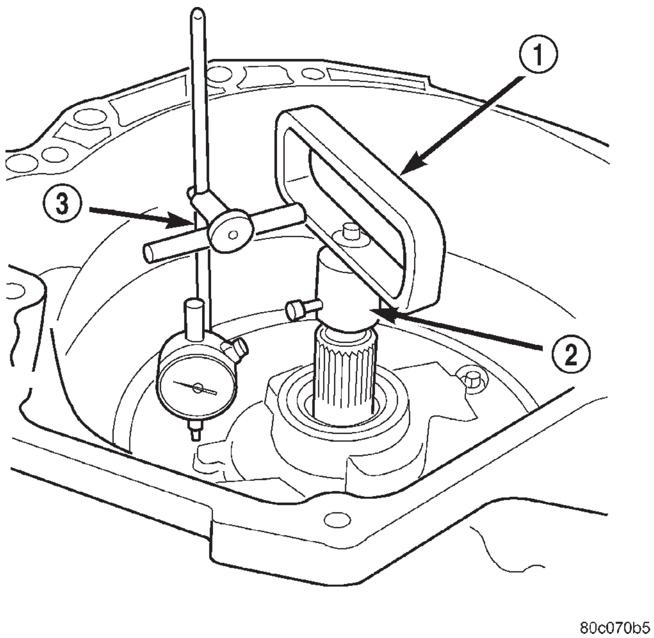


Fig. 52 Checking Input Shaft End Play

1 - TOOL 8266-8
2 - TOOL 8266-6
3 - TOOL C-3339

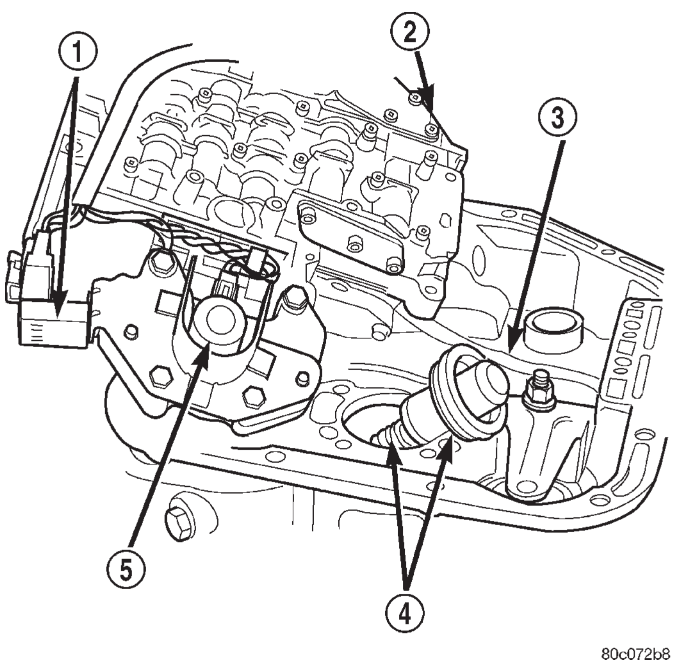


Fig. 53 Accumulator Piston And Springs

1 - GOVERNOR PRESSURE SENSOR
2 - VALVE BODY
3 - PARK ROD
4 - ACCUMULATOR PISTON
5 - GOVERNOR PRESSURE SOLENOID

(32) Install valve body as follows:

(a) Align and carefully insert park rod into pawl. Rod will make click noise as it enters pawl. Move rod slightly to check engagement.

(b) Align and seat valve body on case. Be sure manual lever shaft and overdrive connector are fully seated in case. Also be sure valve body wiring is not pinched or kinked.

(c) Install and start all valve body attaching bolts by hand. Then tighten bolts evenly, in a diagonal pattern to 12 N·m (105 in. lbs.) torque. Do not overtighten valve body bolts. This could result in distortion and cross leakage after installation.

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into the cavity.

(33) Install new filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.).

(34) Adjust front and rear bands.

(35) Install new valve body manual shaft seal in case (Fig. 54). Lubricate seal lip and manual shaft with petroleum jelly. Start seal over shaft and into case. Seat seal with 15/16 inch, deep well socket.

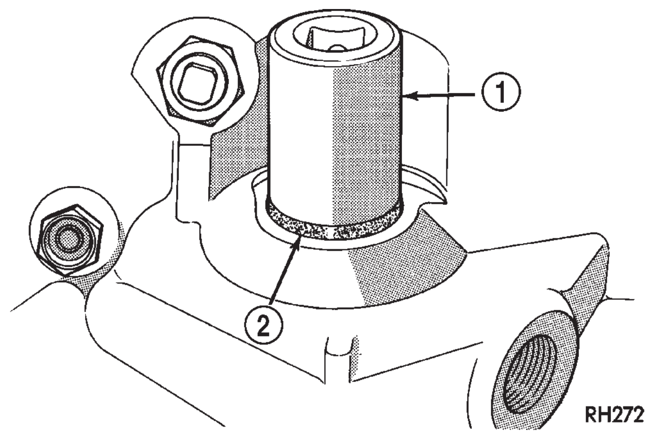


Fig. 54 Installing Manual Lever Shaft Seal

1 - 15/16" SOCKET
2 - SEAL

(36) Thread the transmission range sensor mounting bracket into the transmission case, if necessary. Use Adapter 8581 and an appropriate torque wrench to torque the mounting bracket to 34 N·m (300 in.lbs.) (Fig. 55).

(37) Install the transmission range sensor (Fig. 56) into the mounting bracket with the electrical connector facing the front of the transmission. Install the screws to hold the sensor to the mounting bracket and tighten to 3.4 N·m (30 in.lbs.).

AUTOMATIC TRANSMISSION - 42RE (Continued)

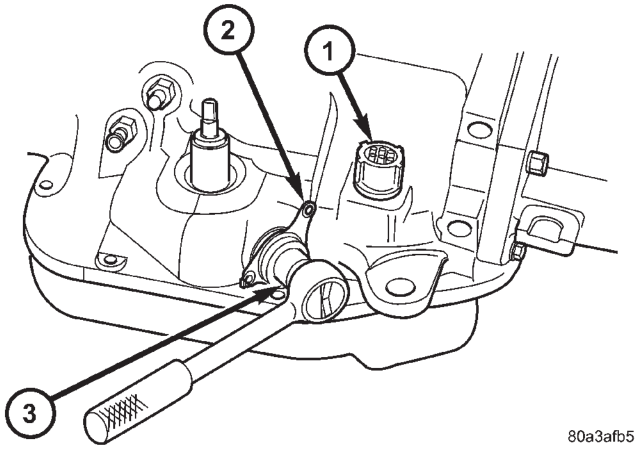


Fig. 55 Tighten the TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - ADAPTER 8581

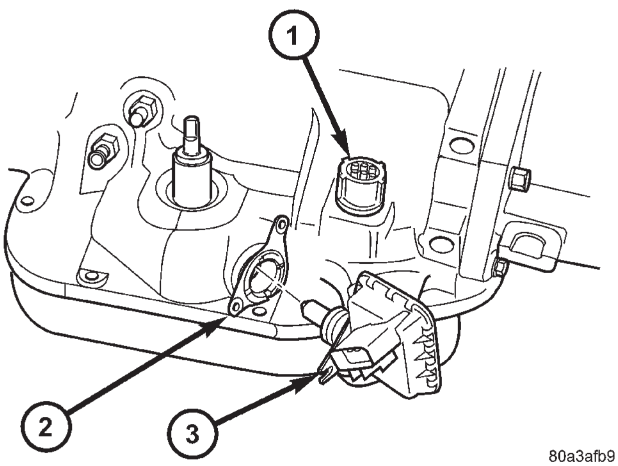


Fig. 56 Install the Transmission Range Sensor

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - TRANSMISSION RANGE SENSOR

(38) Install magnet in oil pan. Magnet goes on small protrusion at corner of pan.

(39) Position new oil pan gasket on case and install oil pan. Tighten pan bolts to 17 N·m (13 ft. lbs.).

(40) Install throttle valve and shift selector levers on valve body manual lever shaft.

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 oil pump seal lip with transmission fluid.

(3) Lubricate converter pilot hub pocket in the rear of the crankshaft with a light coating of Mopar® High Temp Grease.

(4) Align and install converter in oil pump.

(5) Carefully insert converter in oil pump. Then rotate converter back and forth until fully seated in pump gears.

(6) Check converter seating with steel scale and straightedge (Fig. 57). Surface of converter lugs should be 1/2 in. to rear of straightedge when converter is fully seated.

(7) Temporarily secure converter with wedge tool or C-clamp.

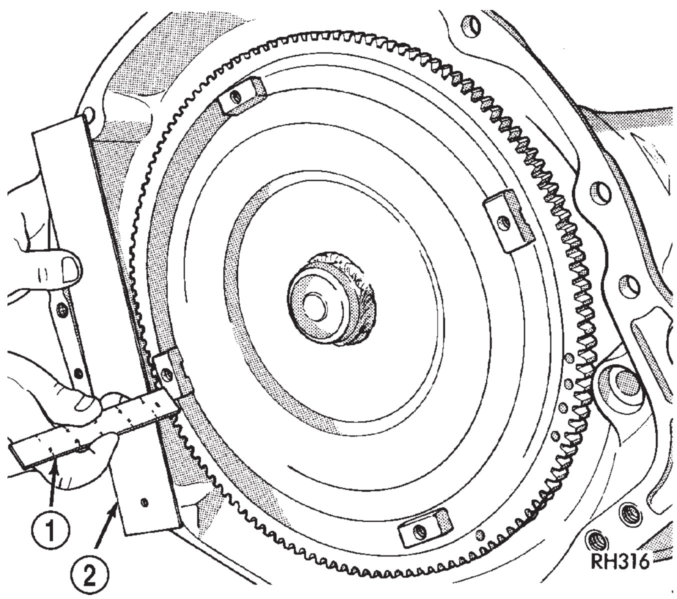


Fig. 57 Checking Converter Seating - Typical

1 - SCALE
2 - STRAIGHTEDGE

AUTOMATIC TRANSMISSION - 42RE (Continued)

(8) Position transmission on jack and secure it with 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 held 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 bolts attaching converter housing to engine.

(14) Install transfer case, if necessary.

(15) Install rear support. Then lower transmission onto crossmember and install bolts attaching transmission mount to crossmember.

(16) Install new plastic retainer grommet on any shift linkage rod or lever that was disconnected. Grommets should not be reused.

(17) Connect gearshift and throttle cable to transmission.

(18) Connect wires to the transmission range sensor, transmission solenoid case connector, and oxygen sensor. Be sure that all transmission harnesses are properly routed.

CAUTION: It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the clutch surface inside the converter.

(19) Install torque converter-to-driveplate bolts. Tighten bolts to 31 N·m (270 in. lbs.).

(20) Raise engine slightly.

(21) Loosen bolts attaching engine-to-transmission brackets to each side of the engine block.

(22) Install converter housing access cover.

(23) Install bolts attaching engine-to-transmission brackets to transmission.

(24) Tighten bolts attaching engine-to-transmission brackets to each side of the engine block.

(25) Lower engine.

(26) Install bolt and nut attaching each engine-to-transmission bracket to the motor mounts.

(27) Remove engine support.

(28) Install bolts to hold engine-to-transmission brackets to the front axle, if equipped.

(29) Install starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION) and cooler line bracket.

(30) Connect cooler lines to transmission.

(31) Install transmission fill tube. Install new seal on tube before installation.

(32) Install exhaust components.

(33) Align and connect propeller shaft(s). (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(34) Install rear skid plate, if equipped.

(35) Adjust gearshift linkage and throttle valve cable if necessary.

(36) Install front skid plate, if equipped.

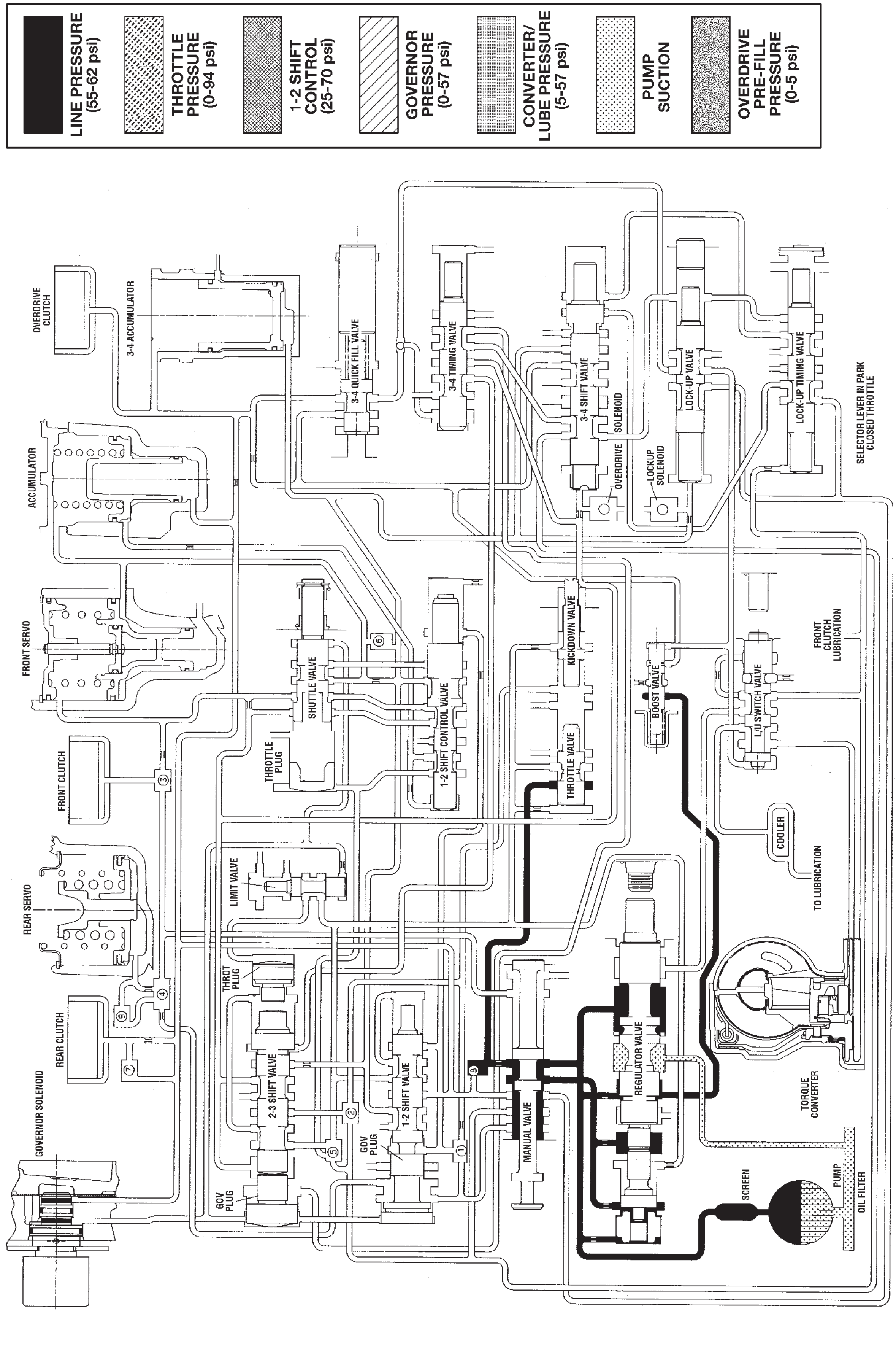
(37) Lower vehicle.

(38) Fill transmission with Mopar® ATF +4, Type 9602 fluid.

AUTOMATIC TRANSMISSION - 42RE (Continued)

SCHEMATICS AND DIAGRAMS

HYDRAULIC SCHEMATICS



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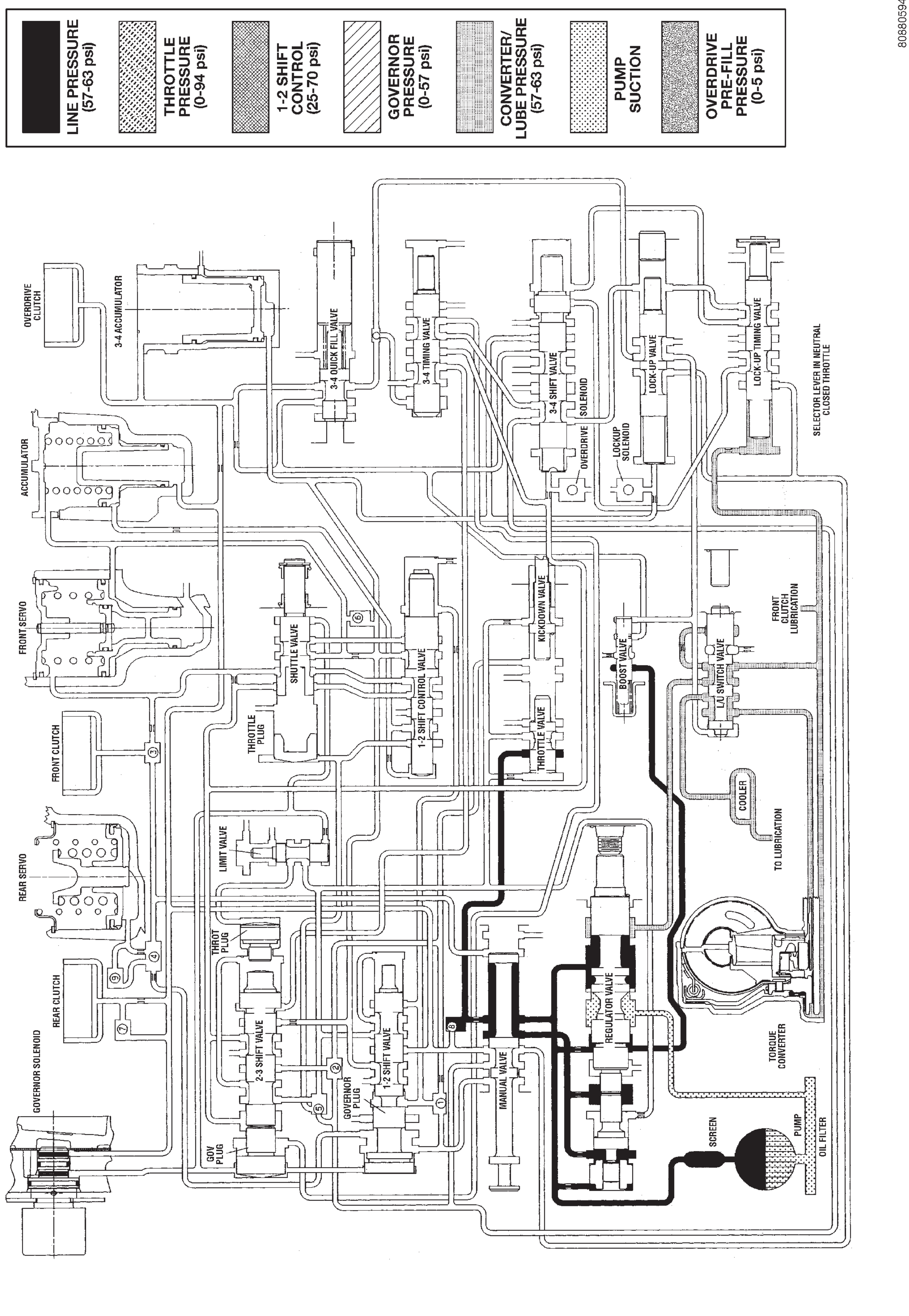
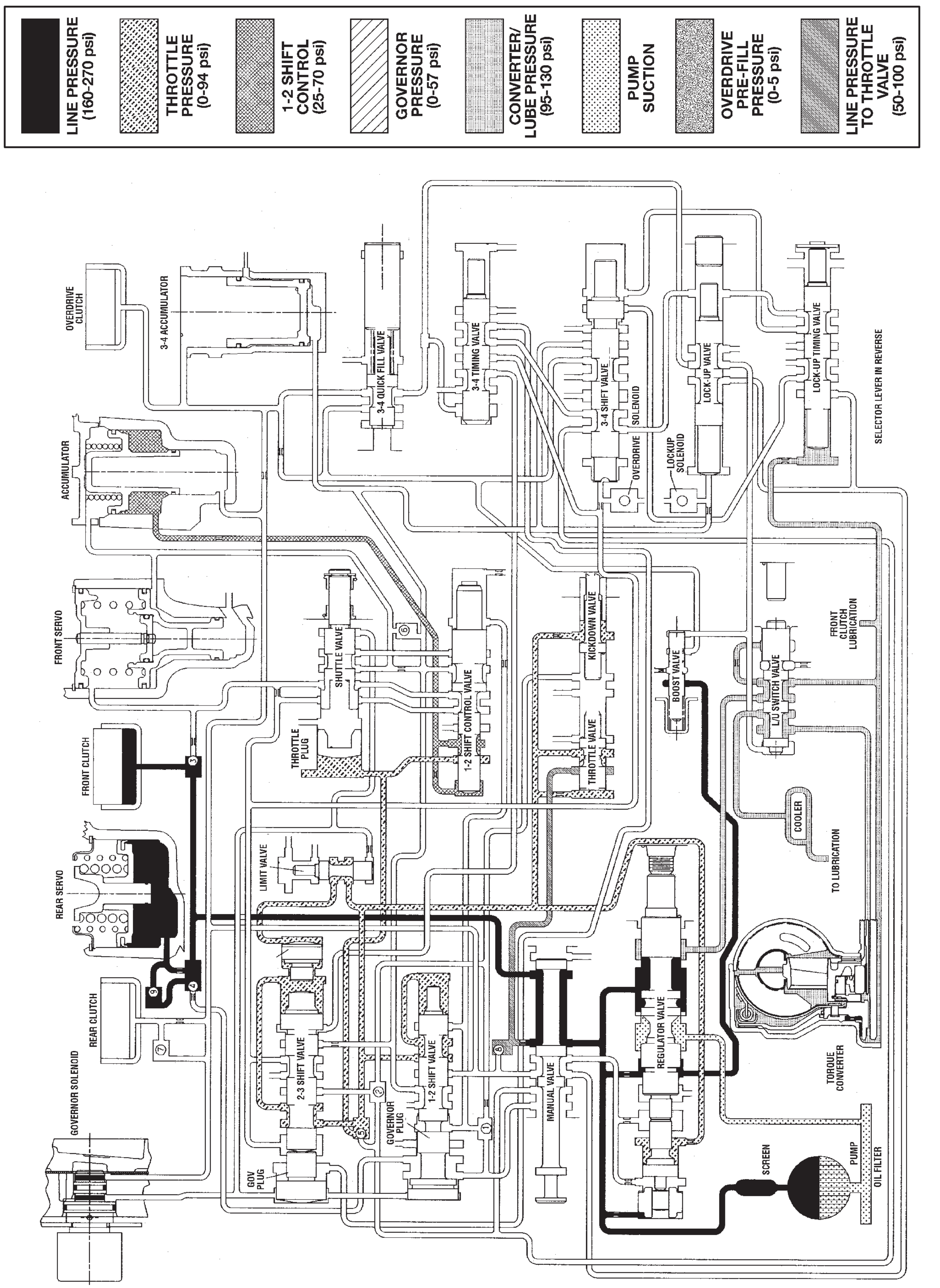
HYDRAULIC FLOW IN PARK

AUTOMATIC TRANSMISSION - 42RE (Continued)



HYDRAULIC FLOW IN NEUTRAL

AUTOMATIC TRANSMISSION - 42RE (Continued)



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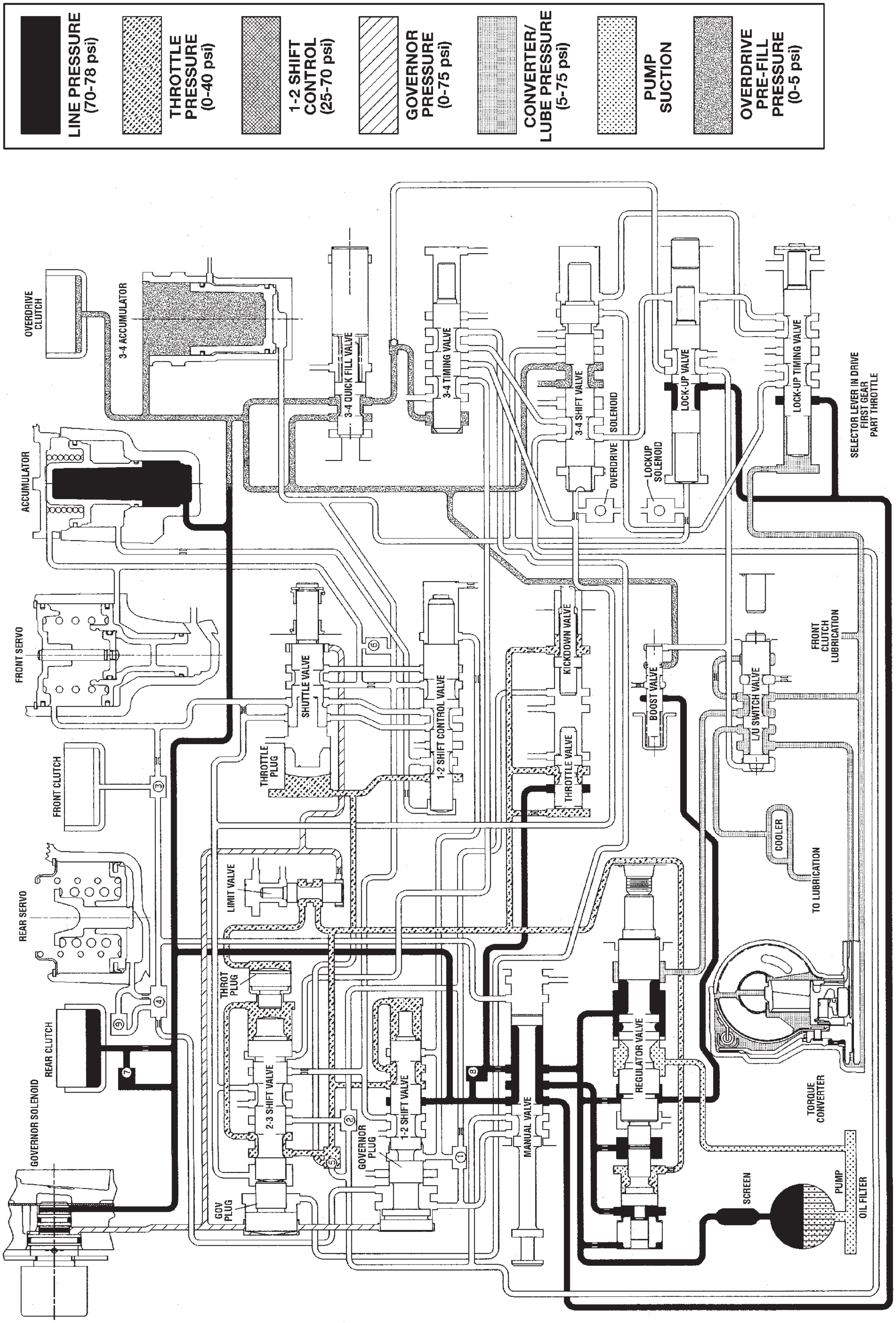
HYDRAULIC FLOW IN REVERSE

AUTOMATIC TRANSMISSION - 42RE (Continued)



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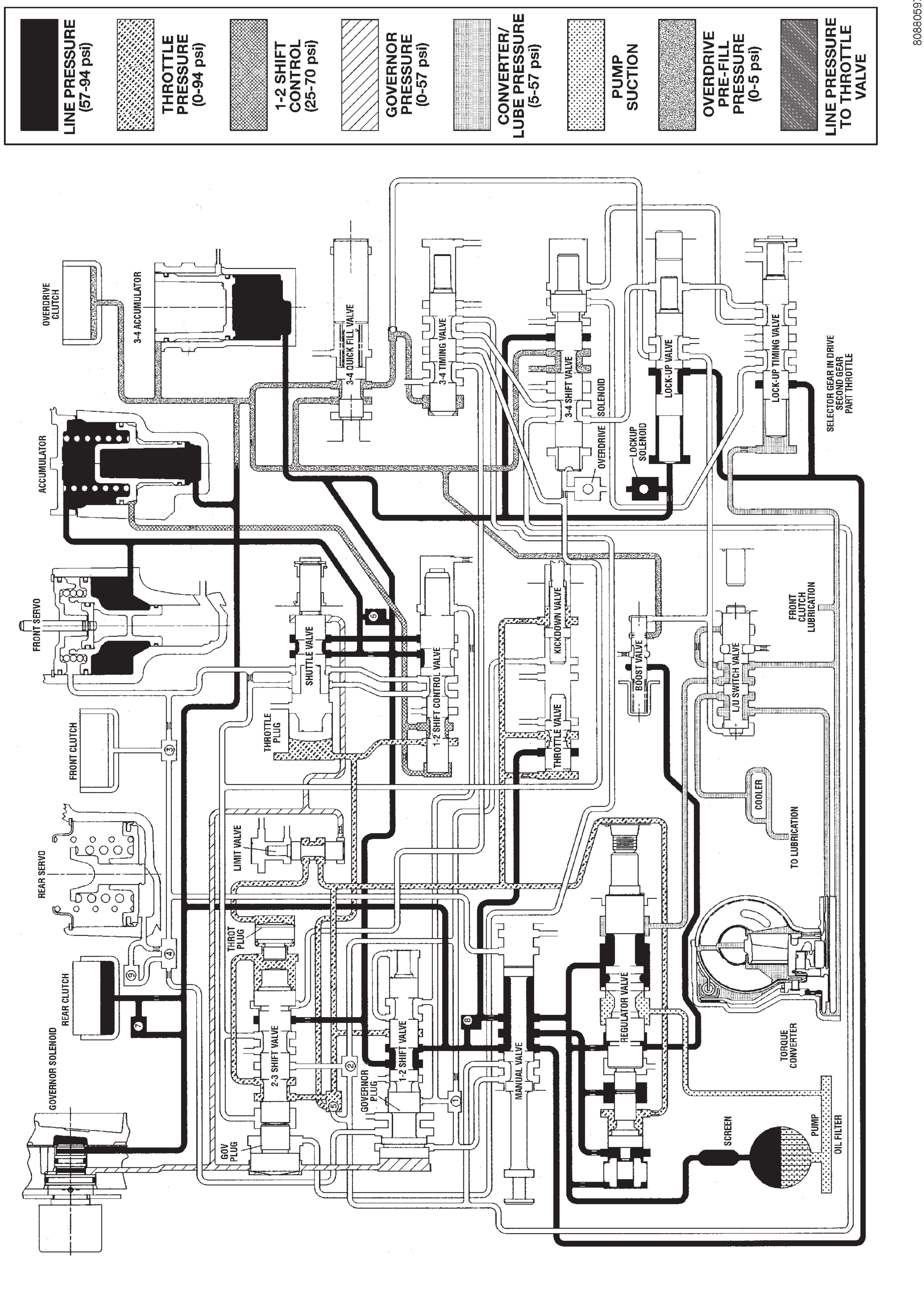
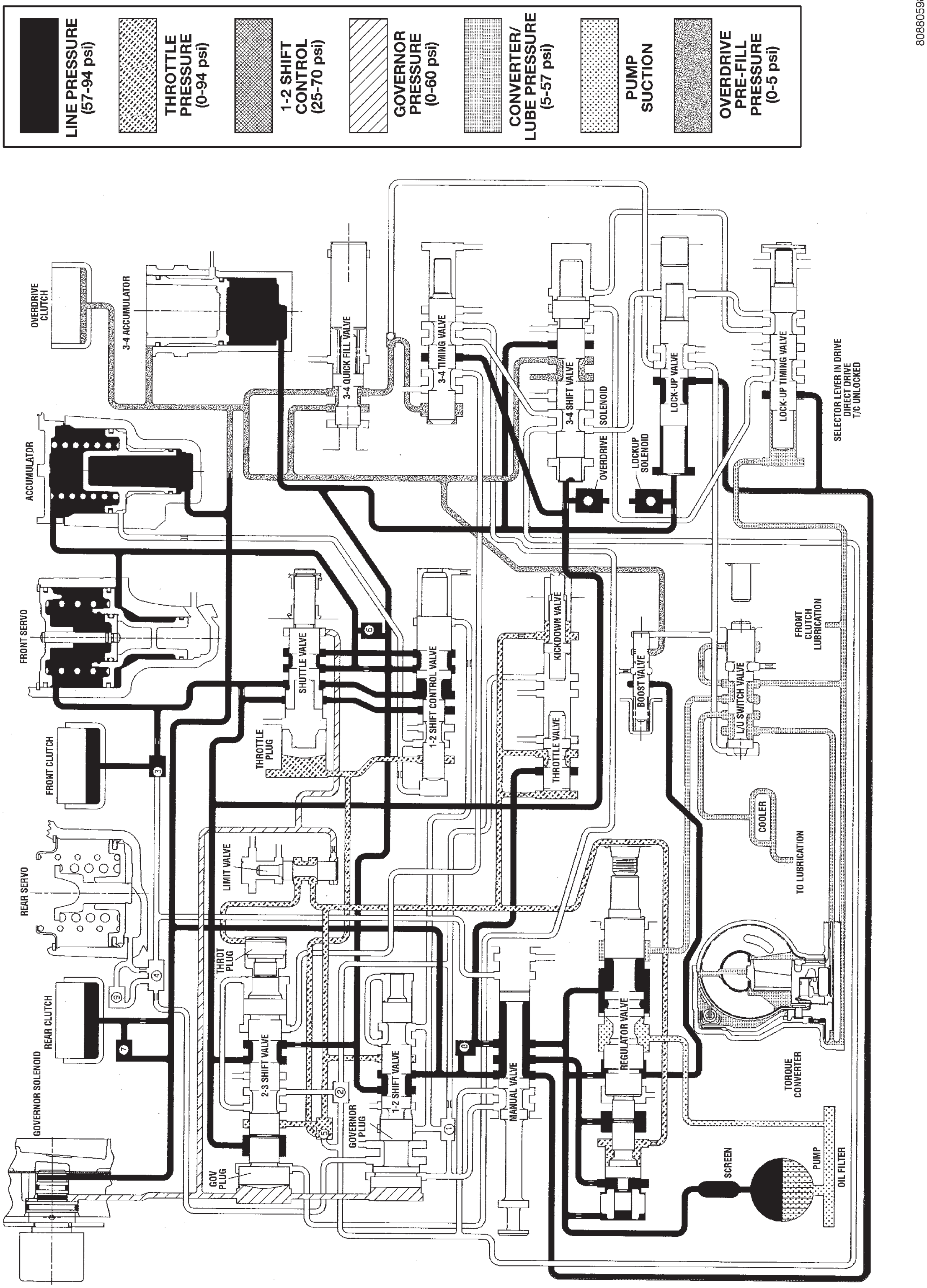
HYDRAULIC FLOW IN DRIVE FIRST GEAR

AUTOMATIC TRANSMISSION - 42RE (Continued)



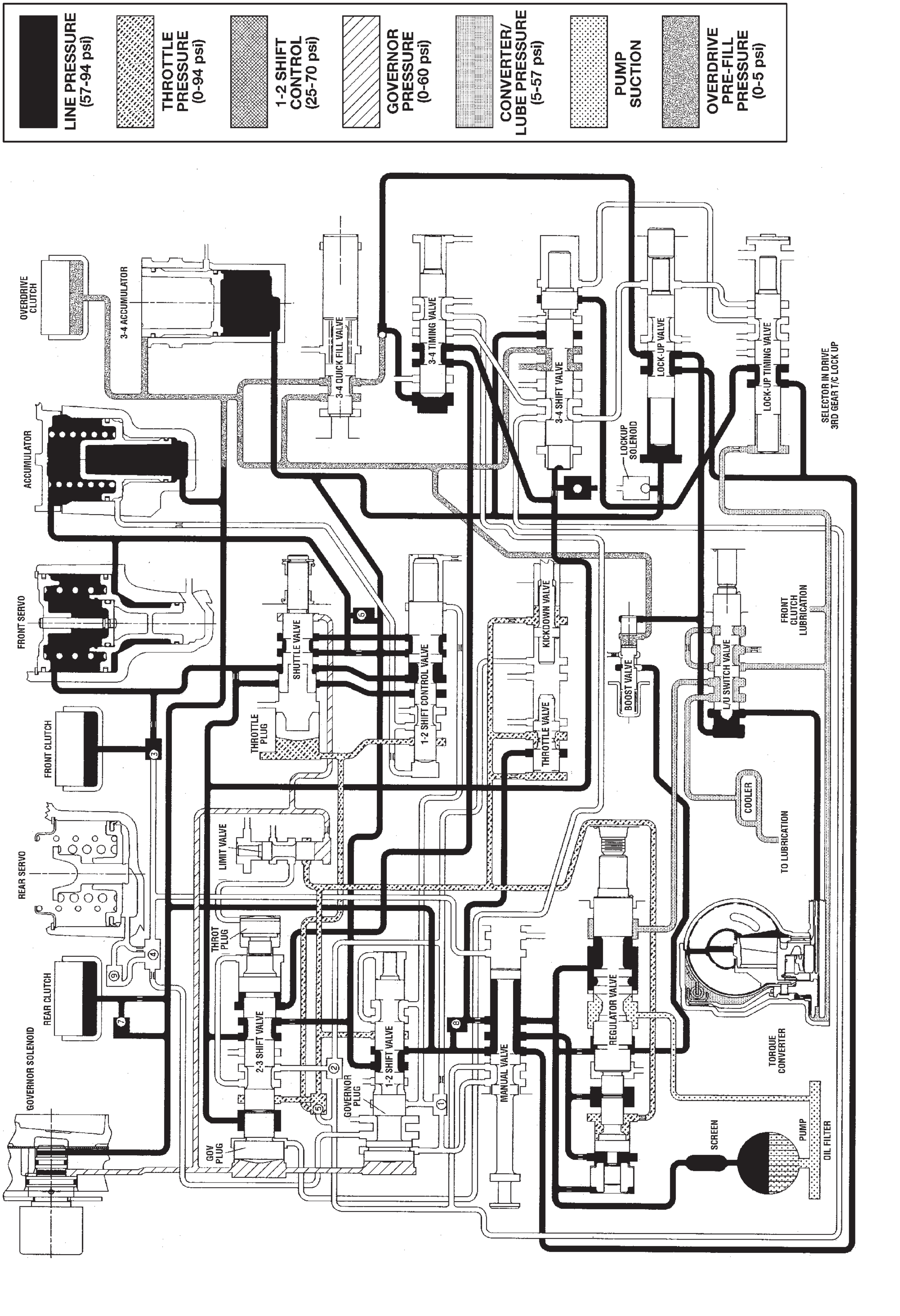
HYDRAULIC FLOW IN DRIVE SECOND GEAR

AUTOMATIC TRANSMISSION - 42RE (Continued)



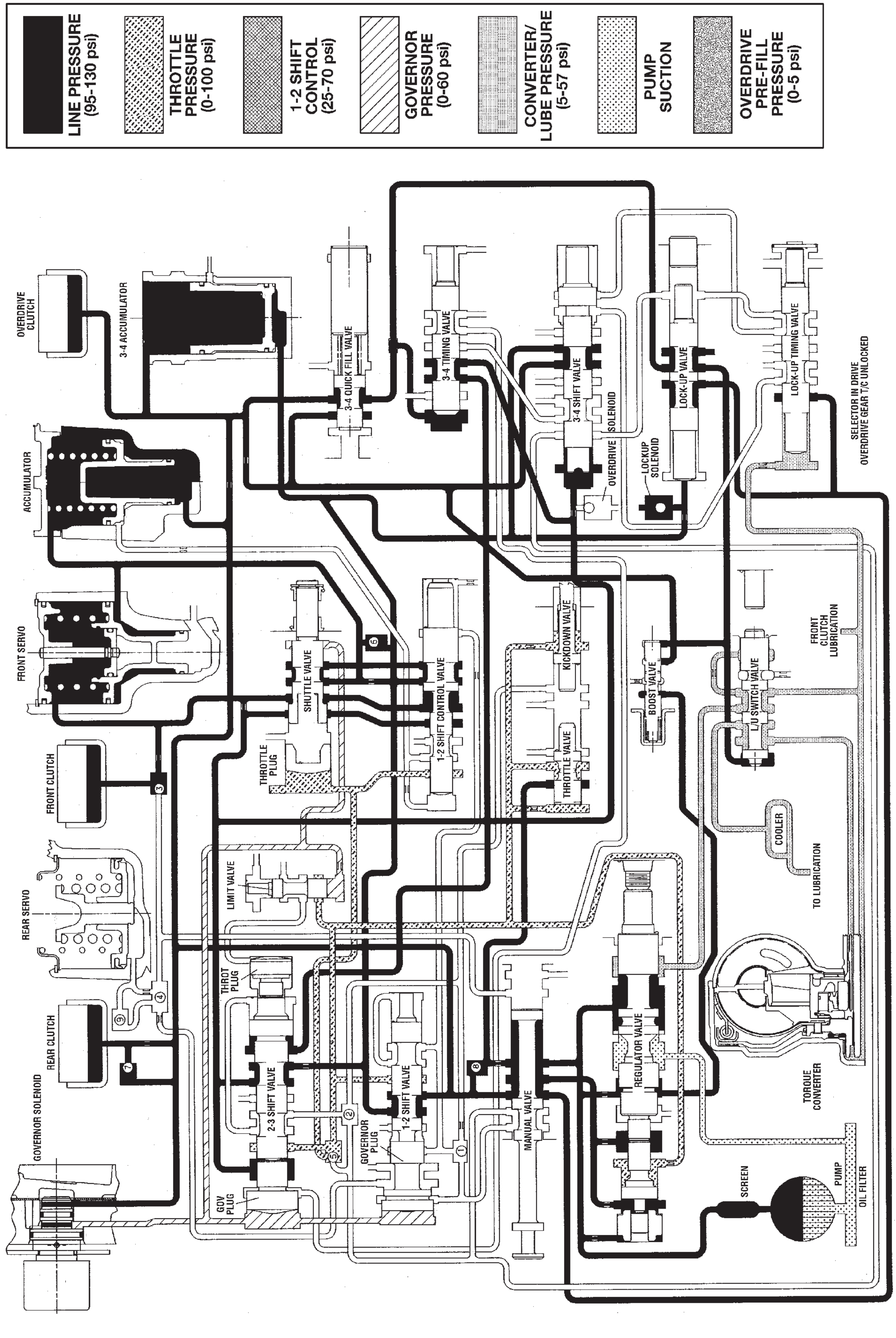
HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH NOT APPLIED)

AUTOMATIC TRANSMISSION - 42RE (Continued)



HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH APPLIED)

AUTOMATIC TRANSMISSION - 42RE (Continued)



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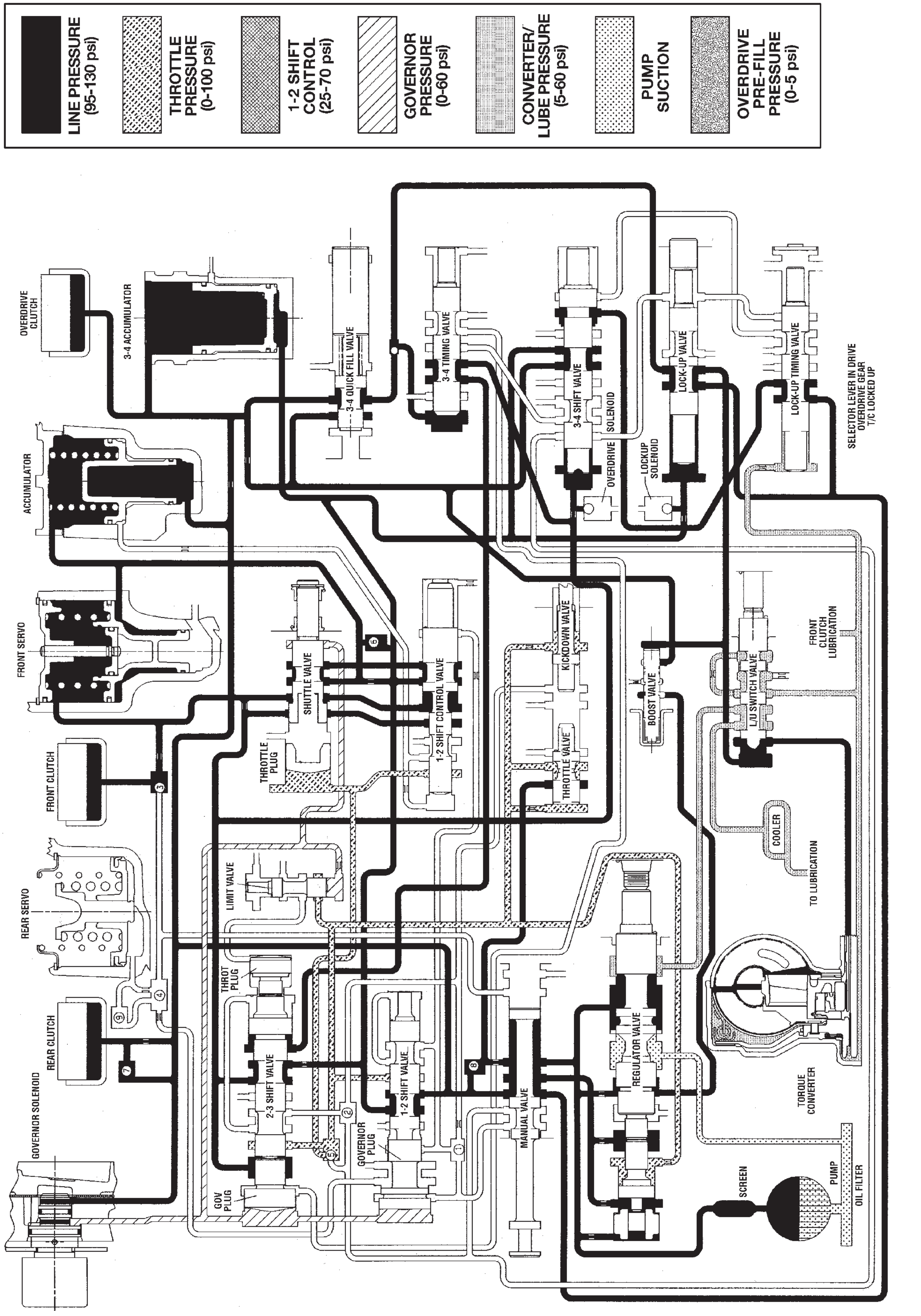
HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH NOT APPLIED)

AUTOMATIC TRANSMISSION - 42RE (Continued)



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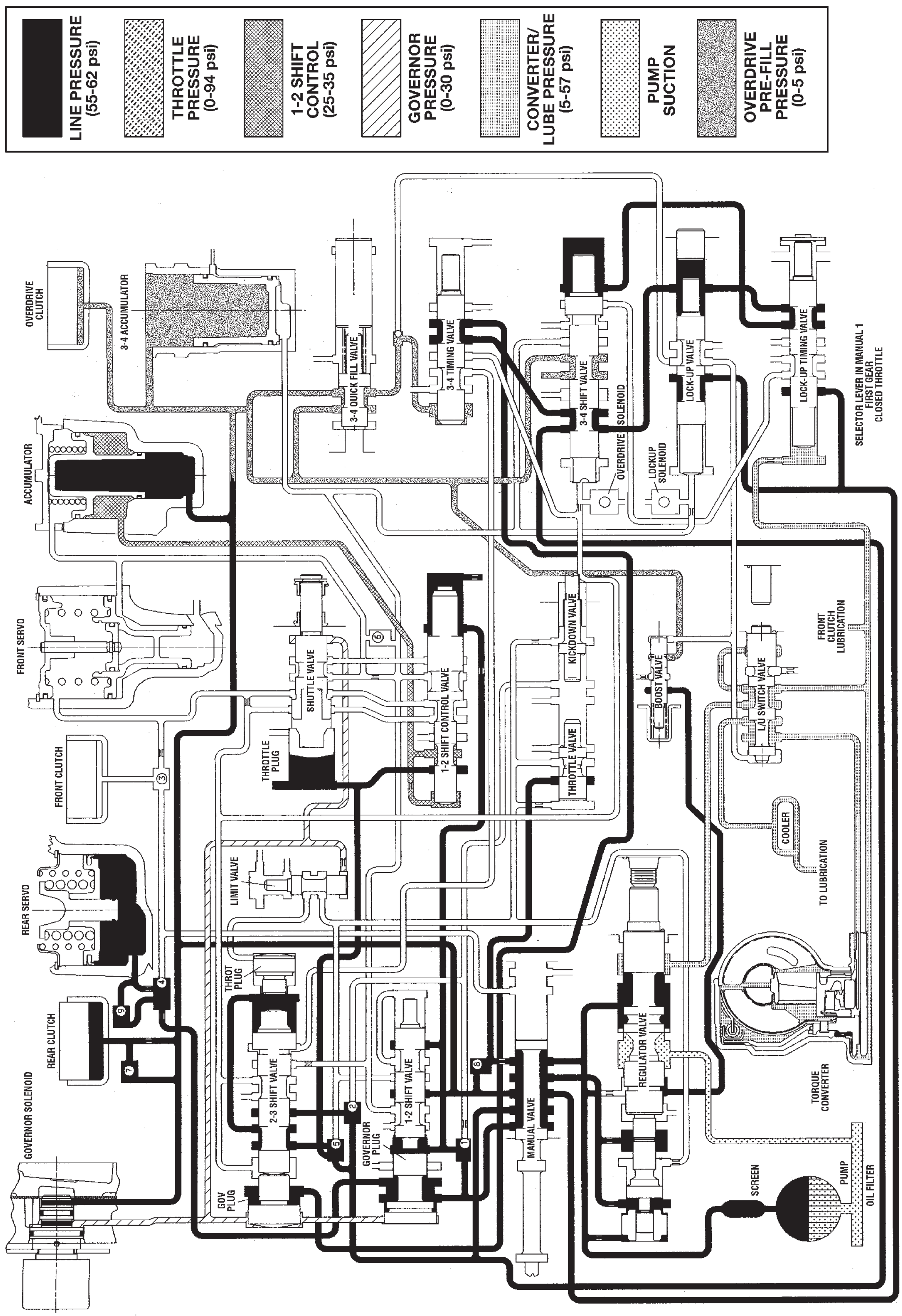
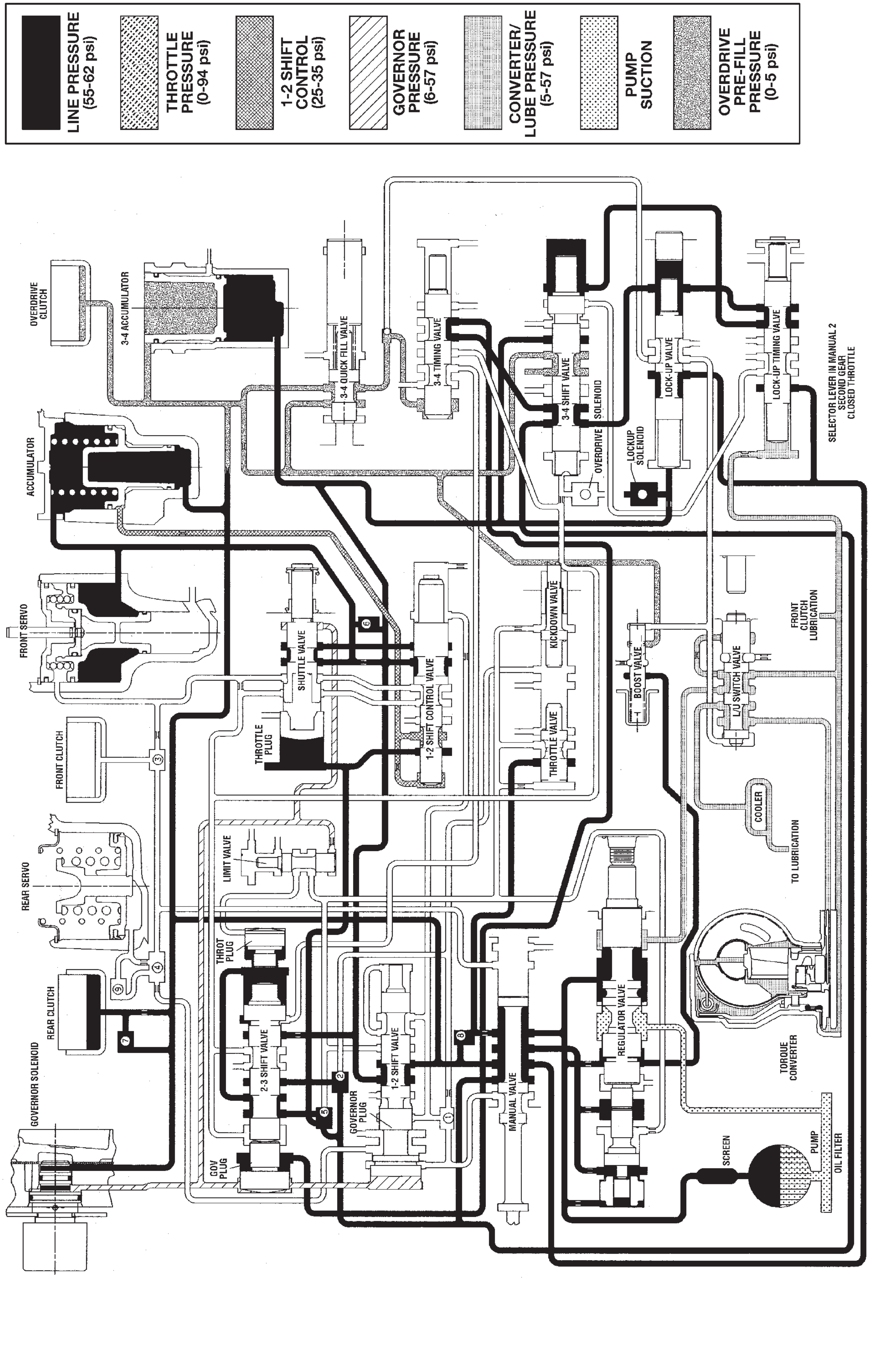
HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH APPLIED)

AUTOMATIC TRANSMISSION - 42RE (Continued)



HYDRAULIC FLOW IN MANUAL LOW (1)

AUTOMATIC TRANSMISSION - 42RE (Continued)



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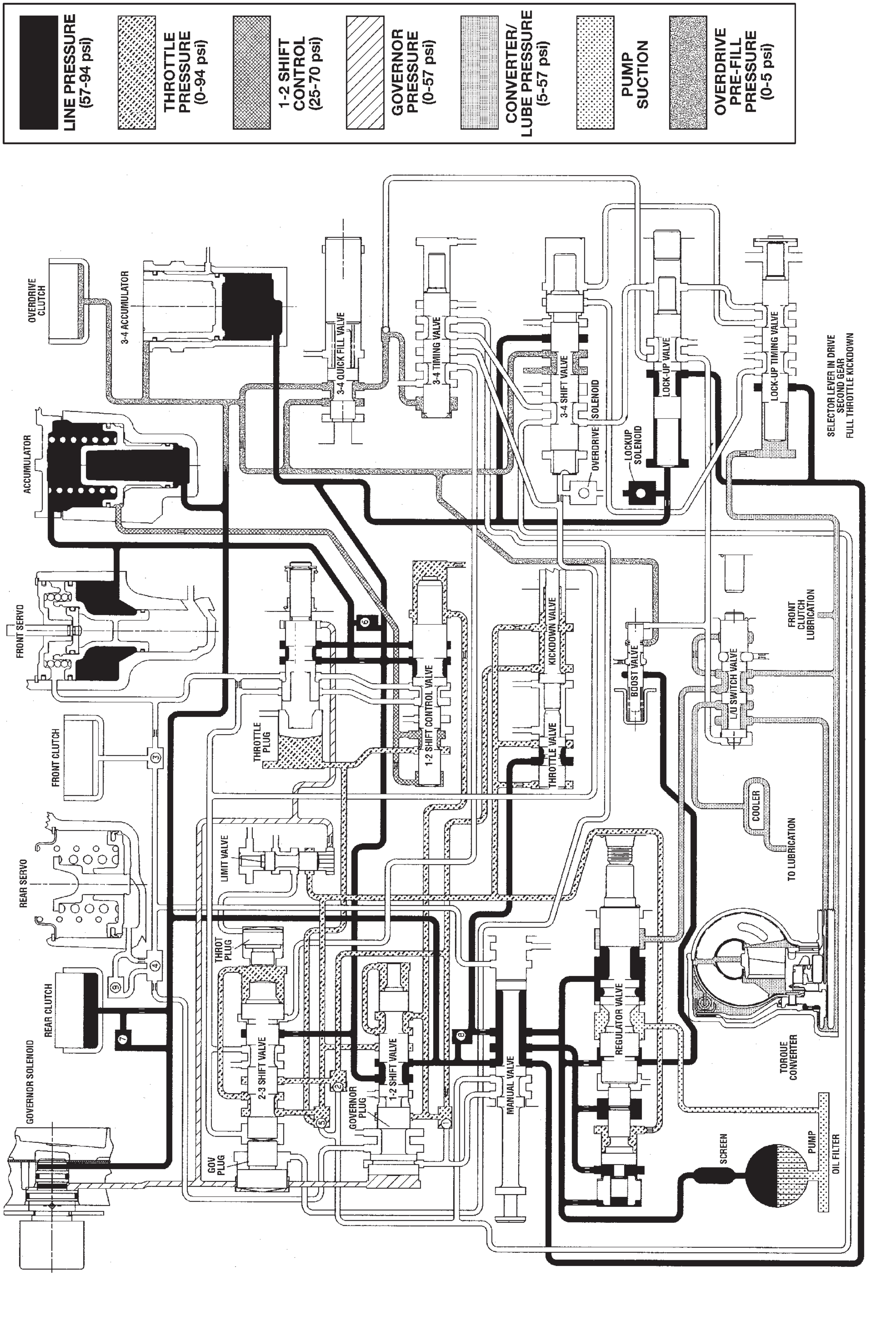
HYDRAULIC FLOW IN MANUAL SECOND (2)

AUTOMATIC TRANSMISSION - 42RE (Continued)



HYDRAULIC FLOW DURING FULL THROTTLE 3-2 DOWNSHIFT (PASSING

AUTOMATIC TRANSMISSION - 42RE (Continued)

SPECIFICATIONS

TRANSMISSION

GENERAL

Component	Metric	Inch
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.	1.70-3.40mm	0.067-0.134 in.
Clutch pack clearance/Rear.	0.559-0.914 mm	0.022-0.036 in.
Front clutch	4 discs	
Rear clutch	4 discs	
Overdrive clutch	3 discs	
Direct clutch	6 discs	
Band adjustment from 72 in. lbs.		
Front band	Back off 3 turns	
Rear band	Back off 4 turns	
Recommended fluid	Mopar® ATF +4, type 9602	

GEAR RATIOS

1ST GEAR	2.74:1
2ND GEAR	1.54:1
3RD GEAR	1.0:1
4TH GEAR	0.69:1
REVERSE	2.21:1

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.
Intermediate shaft thrust plate (shaft hub pilot)	Select fit to set end play	
Output shaft thrust washer (rear clutch hub)	1.5-1.6 mm	0.060-0.063 in.
Rear clutch pack snap-ring	1.5 mm 1.95 mm 2.45 mm	0.060 in. 0.076 in. 0.098 in.
Planetary geartrain snap-ring (at front of output shaft)	Select fit (three thicknesses avalible)	
Overdrive piston thrust plate	Thrust plate and spacer are select fit. Refer to size charts and selection procedures in Overdrive Unit D&A procedures	
Intermiediate shaft spacer		

AUTOMATIC TRANSMISSION - 42RE (Continued)

PRESSURE TEST

Overdrive clutch	Fourth gear only	Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-896 kPa (90-130 psi) at 1/2 to 3/4 throttle.
Line pressure (at accumulator)	Closed throttle	372-414 kPa (54-60 psi).
Front servo	Third or Fourth gear only	No more than 21 kPa (3 psi) lower than line pressure.
Rear servo	1 range R range	No more than 21 kPa (3 psi) lower than line pressure. 1103 kPa (160 psi) at idle, builds to 1862 kPa (270 psi) at 1600 rpm.
Governor	D range closed throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1.5 psi) when stopped with transmission in D, 1, 2. Pressure above 7 kPa (1.5 psi) at stand still will prevent transmission from downshifting.

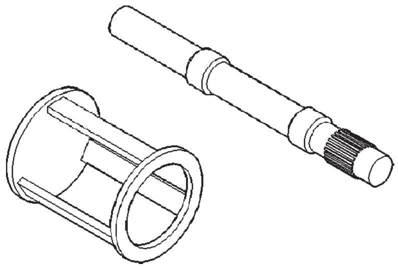
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Fitting, cooler line at trans	18	13	-
Bolt, torque convertor	31	-	270
Bolt, clevis bracket to crossmember	47	35	-
Bolt, clevis bracket to rear support	68	50	-
Bolt, driveplate to crankshaft	75	55	-
Plug, front band reaction	17	13	-
Locknut, front band adj.	34	25	-
Bolt, fluid pan	17	13	-
Screws, fluid filter	4	-	35
Bolt, oil pump	20	15	-
Bolt, overrunning clutch cam	17	13	-
Bolt, O/D to trans.	34	25	-
Bolt, O/D piston retainer	17	13	-
Plug, pressure test port	14	10	-
Bolt, reaction shaft support	20	15	-
Locknut, rear band	41	30	-
Bolt, valve body to case	12	-	100
Sensor, trans speed	27	20	-
Screw, solenoid wiring connector	4	-	35
Screw, solenoid to transfer plate	4	-	35
Bracket, transmission range sensor mounting	34	-	300
Screw, transmission range sensor to mounting bracket	3.4	-	30

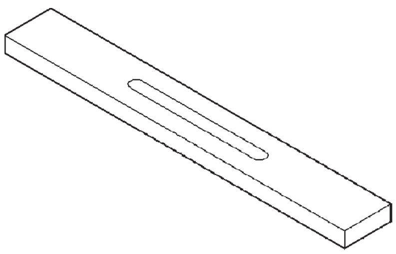
AUTOMATIC TRANSMISSION - 42RE (Continued)

SPECIAL TOOLS

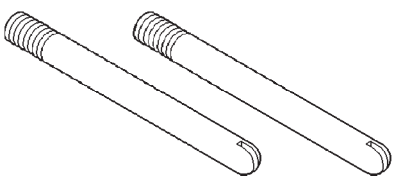
RE TRANSMISSIONS



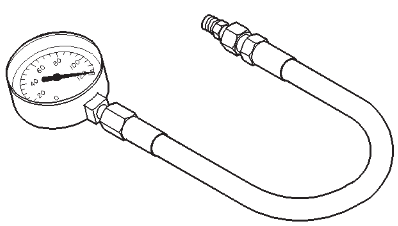
Shaft, Spring Compressor and Alignment - 6227



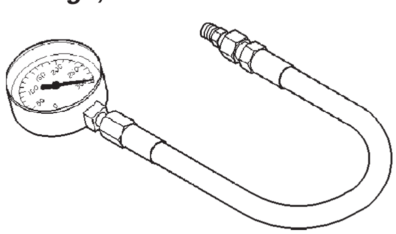
Bar, Gauge - 6311



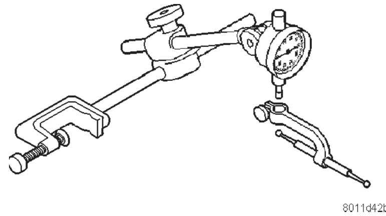
Pilot, Extension Housing - C-3288-B



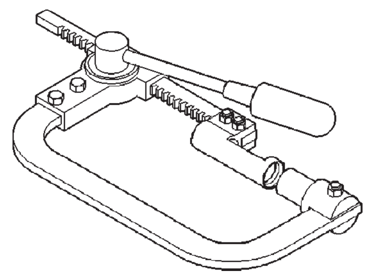
Gauge, Oil Pressure - C-3292



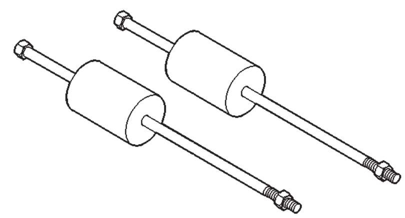
Gauge, Oil Pressure - C-3293SP



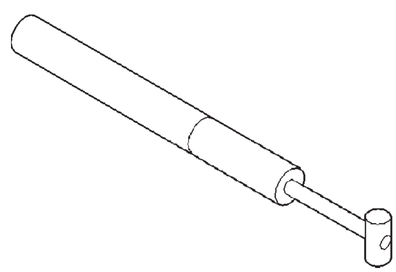
Dial Indicator - C-3339



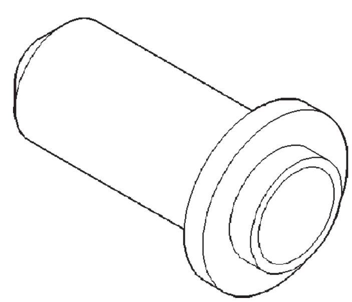
Compressor, Spring - C-3422-C



Puller, Slide Hammer - C-3752

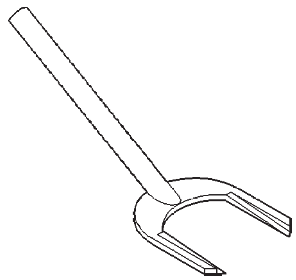


Gauge, Throttle Setting - C-3763

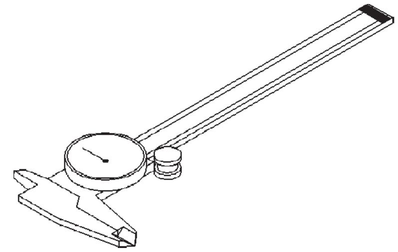


Installer, Seal - C-3860-A

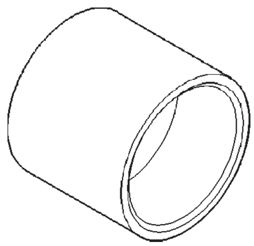
AUTOMATIC TRANSMISSION - 42RE (Continued)



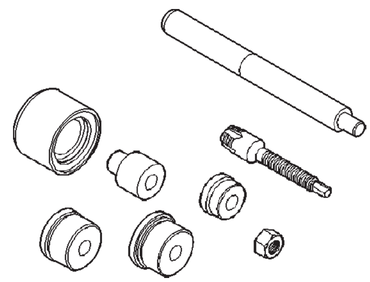
Remover, Seal - C-3985-B



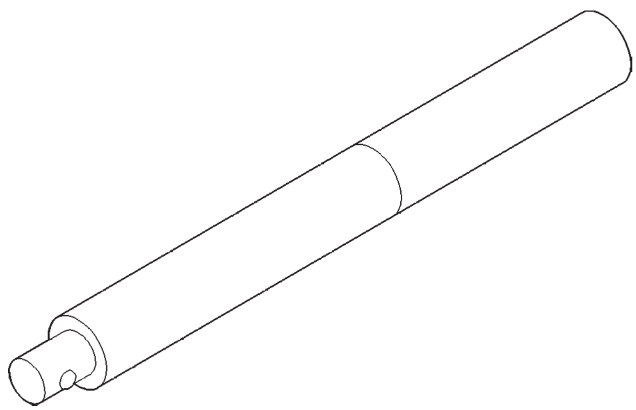
Dial Caliper - C-4962



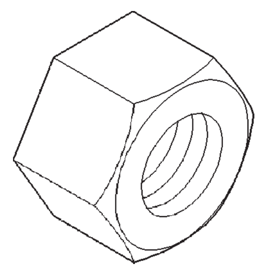
Installer, Seal - C-3995-A



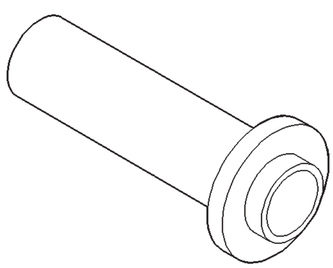
Kit, Bushing Remover/Installer - C-3887-J



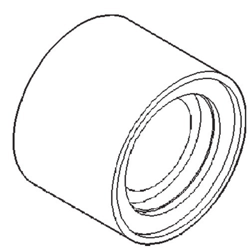
Handle, Universal - C-4171



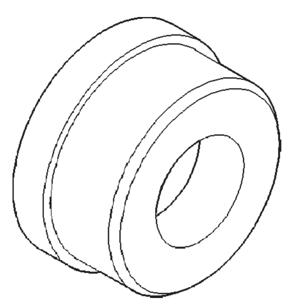
Nut, Bushing Remover - SP-1191, From kit C-3887-J



Installer, Seal - C-4193-A

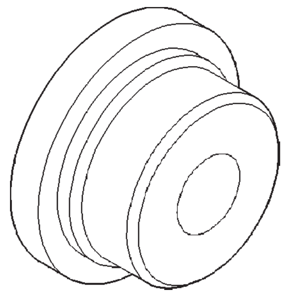


Cup, Bushing Remover - SP-3633, From kit C-3887-J

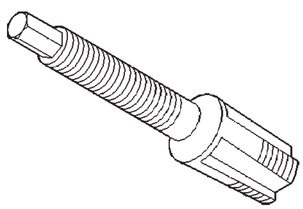


Remover, Bushing - SP-3551

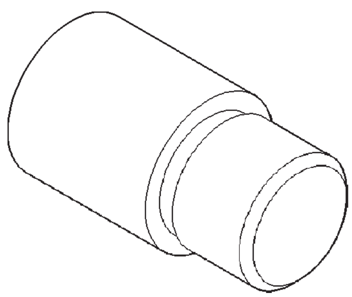
AUTOMATIC TRANSMISSION - 42RE (Continued)



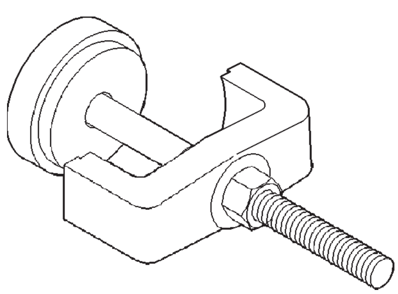
Installer, Bushing - SP-5117



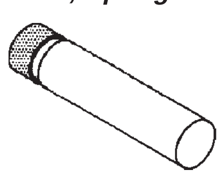
Remover, Bushing - SP-5324



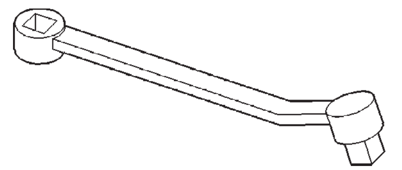
Installer, Bushing - SP-5325



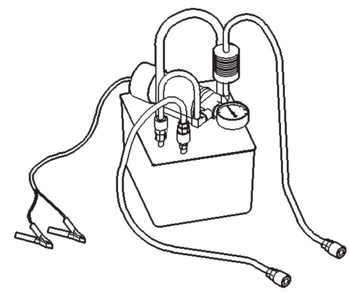
Compressor, Spring - C-3575-A



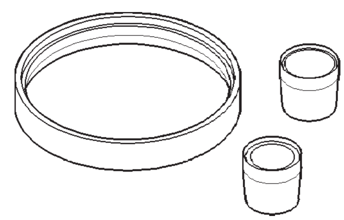
Gauge - 6312



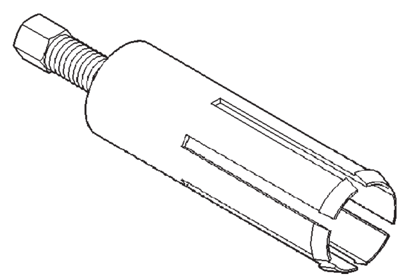
Adapter, Band Adjuster - C-3705



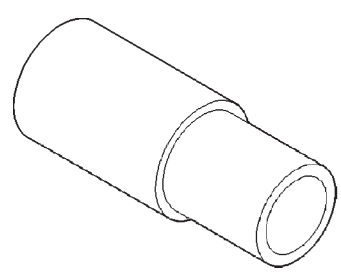
Flusher, Oil Cooler - 6906-B



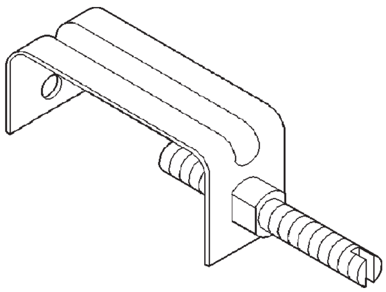
Installer, Piston - 8114



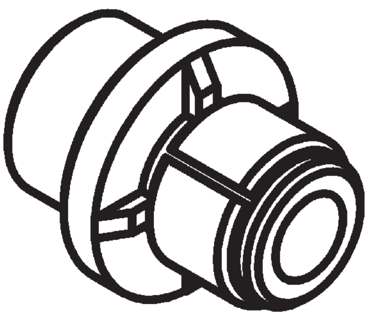
Remover, Bushing - 6957



Installer, Bushing - 6951



Retainer, Detent Ball and Spring - 6583



Socket, TRS Mounting Bracket - 8581

ACCUMULATOR

DESCRIPTION

The accumulator (Fig. 58) 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. The 3-4 accumulator is located in a housing attached to the side of the valve body (Fig. 59).

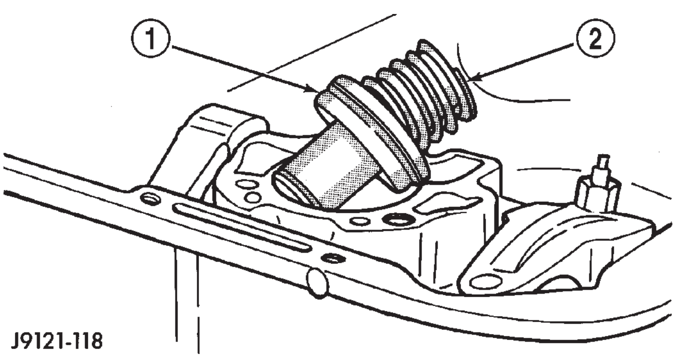


Fig. 58 Accumulator

1 - ACCUMULATOR PISTON
2 - PISTON SPRING

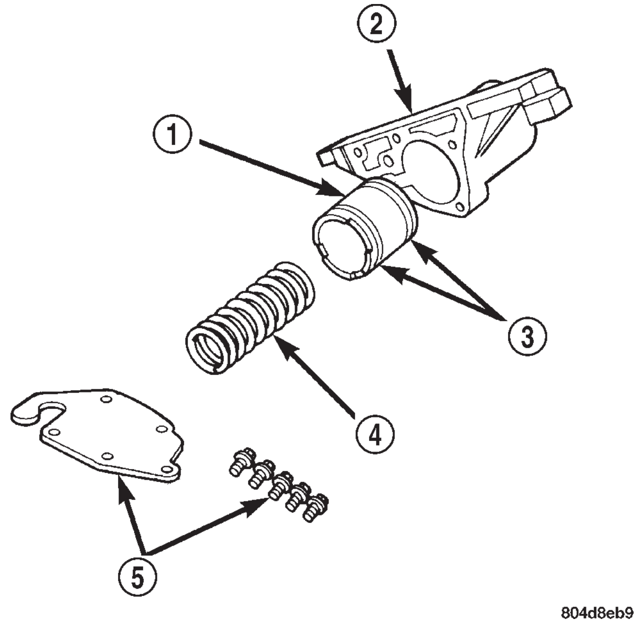


Fig. 59 3-4 Accumulator and Housing

1 - ACCUMULATOR PISTON
2 - 3-4 ACCUMULATOR HOUSING
3 - TEFLON SEALS
4 - PISTON SPRING
5 - COVER PLATE AND SCREWS

OPERATION

Both the accumulator and the 3-4 accumulator function the same. Line pressure is directed to the small end of the piston when the transmission is placed into a DRIVE position (Fig. 60), bottoming it against the accumulator plate. When the 1-2 upshift occurs (Fig. 61), 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.

ACCUMULATOR (Continued)

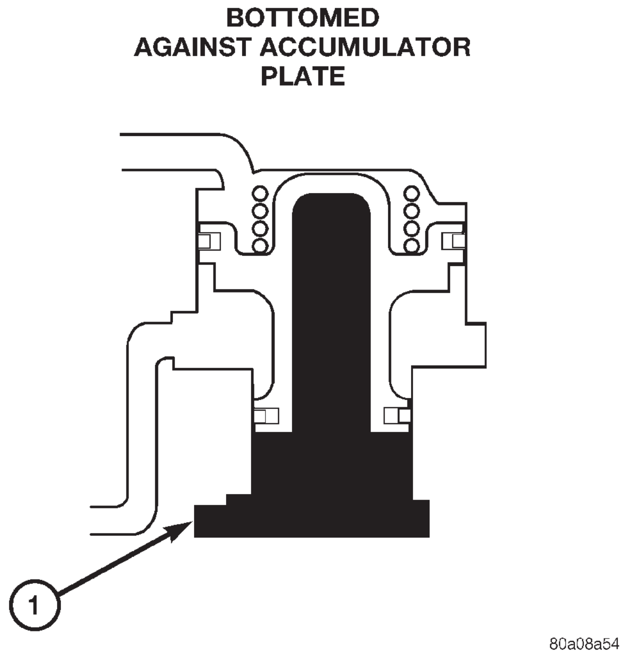


Fig. 60 Accumulator in DRIVE - FIRST GEAR POSITION

1 - LINE PRESSURE

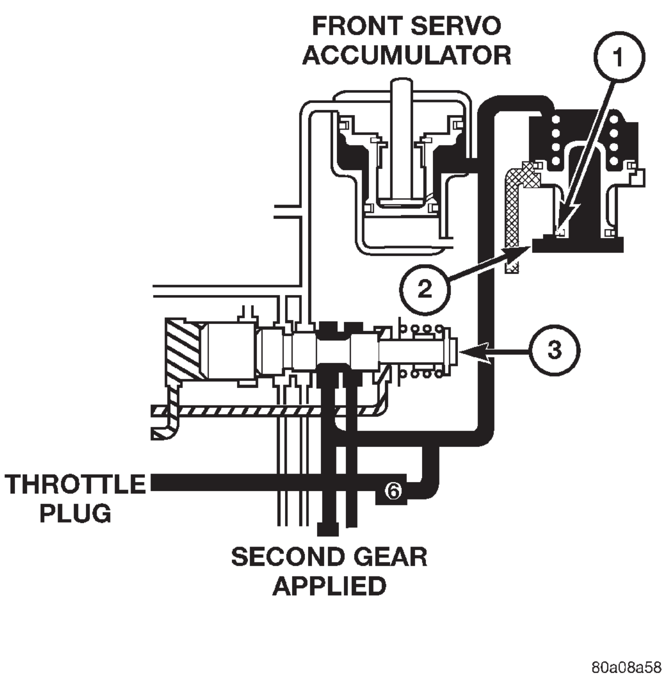


Fig. 61 Accumulator in SECOND Gear Position

1 - BOTTOM OF BORE
2 - LINE PRESSURE
3 - SHUTTLE VALVE

INSPECTION

Inspect the accumulator piston and seal rings (Fig. 62). 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. 62). Replace the springs if the coils are cracked, distorted or collapsed.

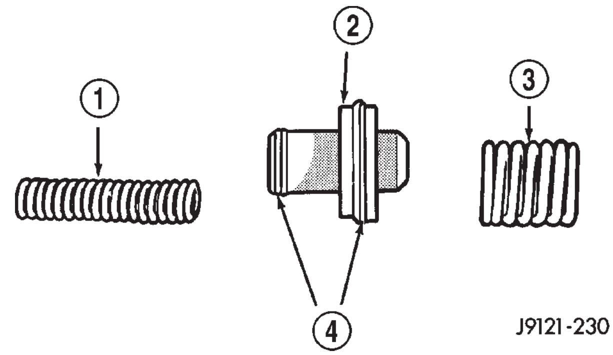


Fig. 62 Accumulator Components

1 - INNER SPRING
2 - ACCUMULATOR PISTON
3 - OUTER SPRING
4 - SEAL RINGS

BANDS

DESCRIPTION

KICKDOWN (FRONT) BAND

The kickdown, or "front", band (Fig. 63) 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).

LOW/REVERSE (REAR) BAND

The low/reverse band, or "rear", band (Fig. 64) is similar in appearance and operation to the front band. The rear band 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.

BANDS (Continued)

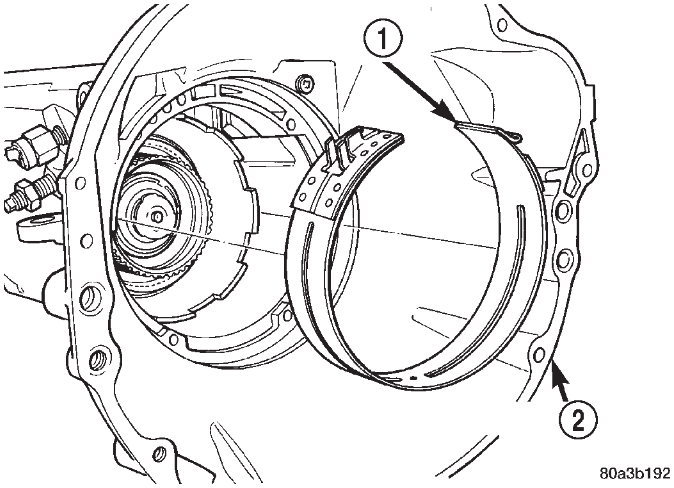


Fig. 63 Front Band

1 - FRONT BAND
2 - TRANSMISSION HOUSING

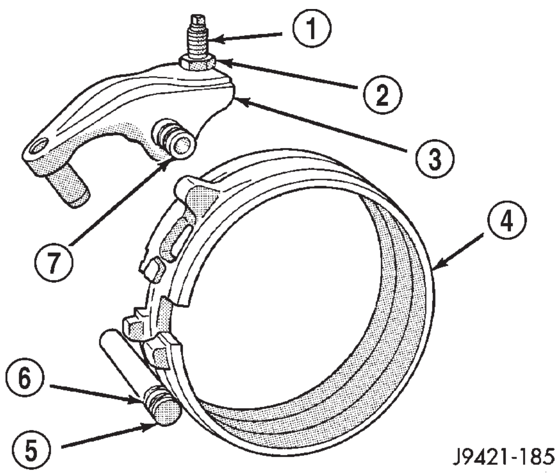


Fig. 64 Rear Band

1 - ADJUSTING SCREW
2 - LOCKNUT
3 - LEVER
4 - REAR BAND
5 - REACTION PIN
6 - O-RINGS
7 - PIVOT PIN

OPERATION

KICKDOWN (FRONT) BAND

The kickdown band holds the common sun gear of the planetary gear sets by applying and holding the front clutch retainer, which is splined to the sun gear driving shell, and in turn splined directly to the sun gear. The application of the band by the servo is typically done by an apply lever and link bar.

LOW/REVERSE (REAR) BAND

The rear band holds the rear planet carrier stationary by being mounted around and applied to the low/reverse drum.

ADJUSTMENT - BANDS

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. 65). Then back locknut off 3-5 turns. Be sure adjusting screw turns freely in case. Apply lubricant to screw threads if necessary.

(3) Tighten band adjusting screw to 8 N·m (72 in. lbs.) torque with Inch Pound Torque Wrench C-3380-A, a 3-in. extension and appropriate Torx™ socket.

CAUTION: If Adapter C-3705 is needed to reach the adjusting screw, tighten the screw to only 5 N·m (47-50 in. lbs.) torque.

(4) Back off front band adjusting screw 3 turns.

(5) Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

(6) Lower vehicle.

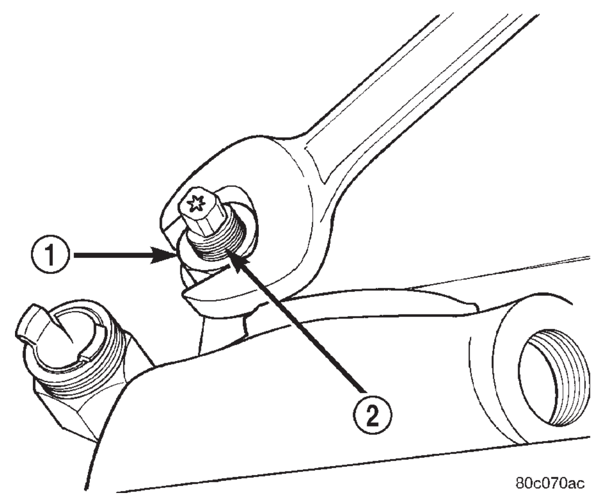


Fig. 65 Front Band Adjustment Screw Location

1 - LOCK-NUT
2 - FRONT BAND ADJUSTER

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.

BANDS (Continued)

(3) Loosen band adjusting screw locknut 5-6 turns (Fig. 66). Be sure adjusting screw turns freely in lever.

(4) Tighten adjusting screw to 8 N·m (72 in. lbs.) torque.

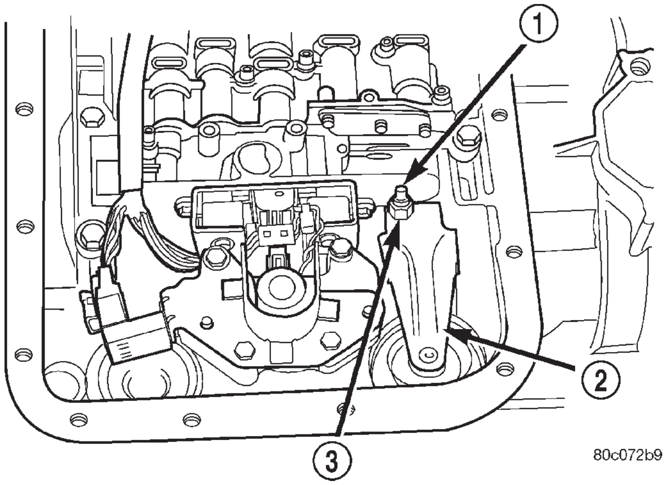


Fig. 66 Rear Band Adjusting Screw Location

1 - ADJUSTING SCREW
2 - REAR BAND LEVER
3 - LOCKNUT

(5) Back off adjusting screw 4 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.

ELECTRONIC GOVERNOR

DESCRIPTION

Governor pressure is controlled electronically. Components used for governor pressure control include:

- Governor body
- Valve body transfer plate
- Governor pressure solenoid valve
- Governor pressure sensor
- Fluid temperature thermistor
- Throttle position sensor (TPS)
- Transmission speed sensor
- Powertrain control module (PCM)

GOVERNOR PRESSURE SOLENOID VALVE

The solenoid valve is a duty-cycle solenoid which regulates the governor pressure needed for upshifts and downshifts. It is an electro-hydraulic device located in the governor body on the valve body transfer plate (Fig. 67).

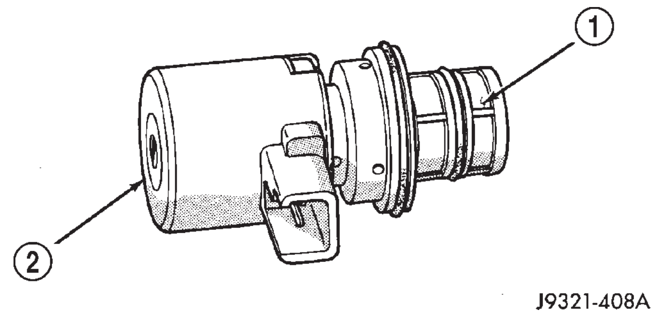


Fig. 67 Governor Pressure Solenoid Valve

1 - SOLENOID FILTER
2 - GOVERNOR PRESSURE SOLENOID

GOVERNOR PRESSURE SENSOR

The governor pressure sensor measures output pressure of the governor pressure solenoid valve (Fig. 68).

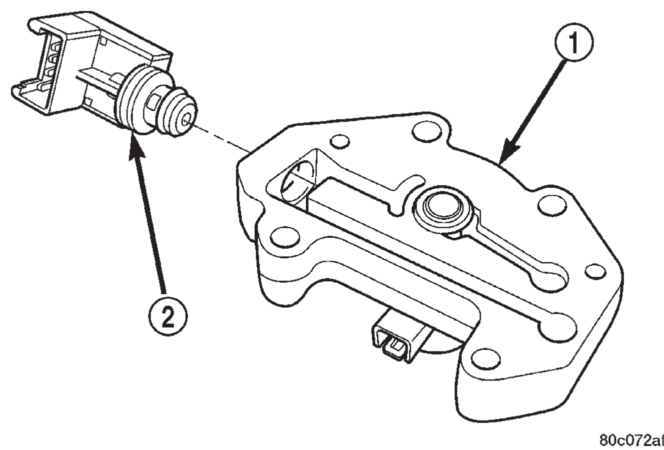


Fig. 68 Governor Pressure Sensor

1 - GOVERNOR BODY
2 - GOVERNOR PRESSURE SENSOR/TRANSMISSION FLUID TEMPERATURE THERMISTOR

GOVERNOR BODY AND TRANSFER PLATE

The transfer plate is designed to supply transmission line pressure to the governor pressure solenoid valve and to return governor pressure.

The governor pressure solenoid valve is mounted in the governor body. The body is bolted to the lower side of the transfer plate (Fig. 68).

GOVERNOR PRESSURE CURVES

There are four governor pressure curves programmed into the transmission control module. The different curves allow the control module to adjust governor pressure for varying conditions. One curve is used for operation when fluid temperature is at, or below, –1°C (30°F). A second curve is used when fluid temperature is at, or above, 10°C (50°F) during normal city or highway driving. A third curve is used during wide-open throttle operation. The fourth curve is used when driving with the transfer case in low range.

ELECTRONIC GOVERNOR (Continued)

OPERATION

Compensation is required for performance variations of two of the input devices. Though the slope of the transfer functions is tightly controlled, offset may vary due to various environmental factors or manufacturing tolerances.

The pressure transducer is affected by barometric pressure as well as temperature. Calibration of the zero pressure offset is required to compensate for shifting output due to these factors.

Normal calibration will be performed when sump temperature is above 50 degrees F, or in the absence of sump temperature data, after the first 10 minutes of vehicle operation. Calibration of the pressure transducer offset occurs each time the output shaft speed falls below 200 RPM. Calibration shall be repeated each 3 seconds the output shaft speed is below 200 RPM. A 0.5 second pulse of 95% duty cycle is applied to the governor pressure solenoid valve and the transducer output is read during this pulse. Averaging of the transducer signal is necessary to reject electrical noise.

Under cold conditions (below 50 degrees F sump), the governor pressure solenoid valve response may be too slow to guarantee 0 psi during the 0.5 second calibration pulse. Calibration pulses are continued during this period, however the transducer output valves are discarded. Transducer offset must be read at key-on, under conditions which promote a stable reading. This value is retained and becomes the offset during the ″cold″ period of operation.

GOVERNOR PRESSURE SOLENOID VALVE

The inlet side of the solenoid valve is exposed to normal transmission line pressure. The outlet side of the valve leads to the valve body governor circuit.

The solenoid valve regulates line pressure to produce governor pressure. The average current supplied to the solenoid controls governor pressure. One amp current produces zero kPa/psi governor pressure. Zero amps sets the maximum governor pressure.

The powertrain control module (PCM) turns on the trans control relay which supplies electrical power to the solenoid valve. Operating voltage is 12 volts (DC). The PCM controls the ground side of the solenoid using the governor pressure solenoid control circuit.

GOVERNOR PRESSURE SENSOR

The sensor output signal provides the necessary feedback to the PCM. This feedback is needed to adequately control governor pressure.

GOVERNOR BODY AND TRANSFER PLATE

The transfer plate channels line pressure to the solenoid valve through the governor body. It also channels governor pressure from the solenoid valve to the governor circuit. It is the solenoid valve that develops the necessary governor pressure.

GOVERNOR PRESSURE CURVES

LOW TRANSMISSION FLUID TEMPERATURE

When the transmission fluid is cold the conventional governor can delay shifts, resulting in higher than normal shift speeds and harsh shifts. The electronically controlled low temperature governor pressure curve is higher than normal to make the transmission shift at normal speeds and sooner. The PCM uses a temperature sensor in the transmission oil sump to determine when low temperature governor pressure is needed.

NORMAL OPERATION

Normal operation is refined through the increased computing power of the PCM and through access to data on engine operating conditions provided by the PCM that were not available with the previous stand-alone electronic module. This facilitated the development of a load adaptive shift strategy - the ability to alter the shift schedule in response to vehicle load condition. One manifestation of this capability is grade ″hunting″ prevention - the ability of the transmission logic to delay an upshift on a grade if the engine does not have sufficient power to maintain speed in the higher gear. The 3-2 downshift and the potential for hunting between gears occurs with a heavily loaded vehicle or on steep grades. When hunting occurs, it is very objectionable because shifts are frequent and accompanied by large changes in noise and acceleration.

WIDE OPEN THROTTLE OPERATION

In wide-open throttle (WOT) mode, adaptive memory in the PCM assures that up-shifts occur at the preprogrammed optimum speed. WOT operation is determined from the throttle position sensor, which is also a part of the emission control system. The initial setting for the WOT upshift is below the optimum engine speed. As WOT shifts are repeated, the PCM learns the time required to complete the shifts by comparing the engine speed when the shifts occur to the optimum speed. After each shift, the PCM adjusts the shift point until the optimum speed is reached. The PCM also considers vehicle loading, grade and engine performance changes due to high altitude in determining when to make WOT shifts. It does this by measuring vehicle and engine acceleration and then factoring in the shift time.

ELECTRONIC GOVERNOR (Continued)

TRANSFER CASE LOW RANGE OPERATION

On four-wheel drive vehicles operating in low range, the engine can accelerate to its peak more rapidly than in Normal range, resulting in delayed shifts and undesirable engine ″flare.″ The low range governor pressure curve is also higher than normal to initiate upshifts sooner. The PCM compares electronic vehicle speed signal used by the speedometer to the transmission output shaft speed signal to determine when the transfer case is in low range.

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove transmission fluid pan and filter.

(3) Disengage wire connectors from pressure sensor and solenoid (Fig. 69).

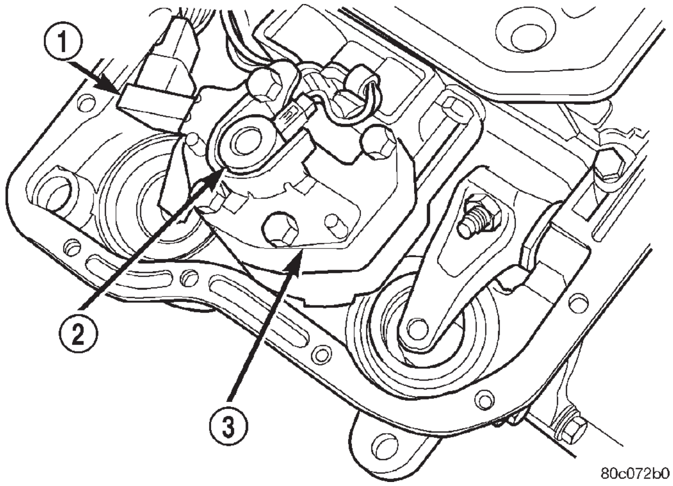


Fig. 69 Governor Solenoid And Pressure Sensor

1 - PRESSURE SENSOR
2 - PRESSURE SOLENOID
3 - GOVERNOR

(4) Remove screws holding pressure solenoid retainer to governor body.

(5) Separate solenoid retainer from governor (Fig. 70).

(6) Pull solenoid from governor body (Fig. 71).

(7) Pull pressure sensor from governor body.

(8) Remove bolts holding governor body to valve body.

(9) Separate governor body from valve body (Fig. 72).

(10) Remove governor body gasket.

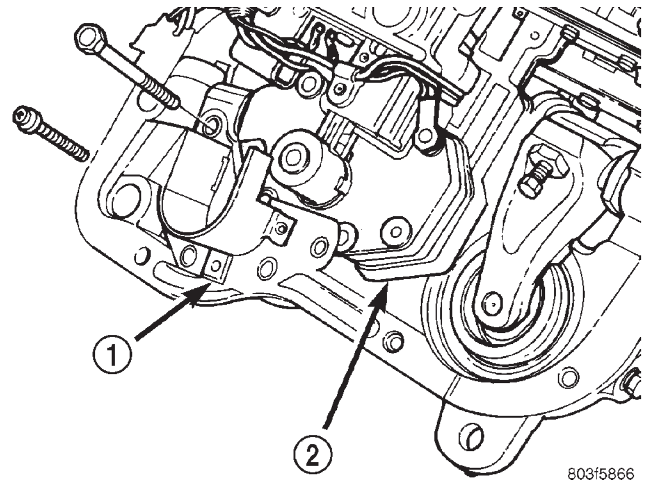


Fig. 70 Pressure Solenoid Retainer

1 - PRESSURE SOLENOID RETAINER
2 - GOVERNOR

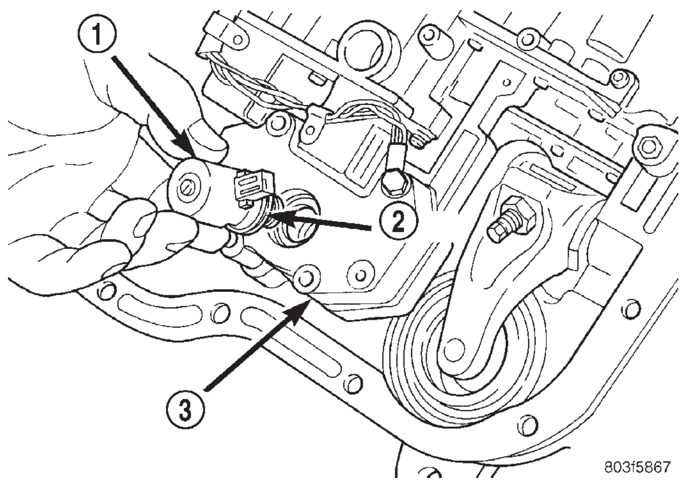


Fig. 71 Pressure Solenoid and O-ring

1 - PRESSURE SOLENOID
2 - O-RING
3 - GOVERNOR

INSTALLATION

Before installing the pressure sensor and solenoid in the governor body, replace o-ring seals, clean the gasket surfaces and replace gasket.

(1) Place gasket in position on back of governor body (Fig. 73).

(2) Place governor body in position on valve body.

ELECTRONIC GOVERNOR (Continued)

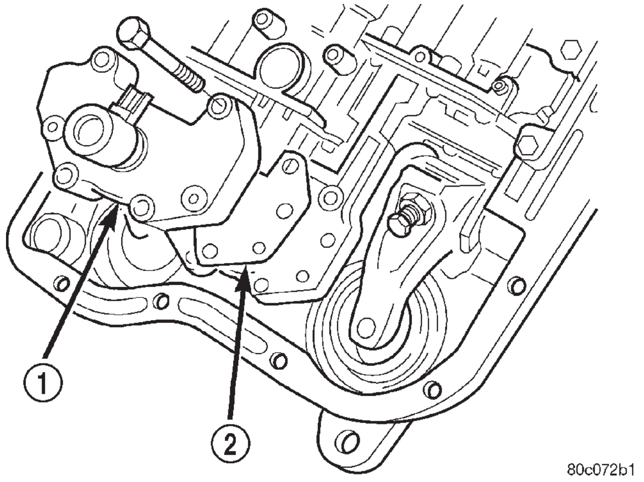


Fig. 72 Governor Body and Gasket

1 - GOVERNOR BODY
2 - GASKET

(3) Install bolts to hold governor body to valve body.

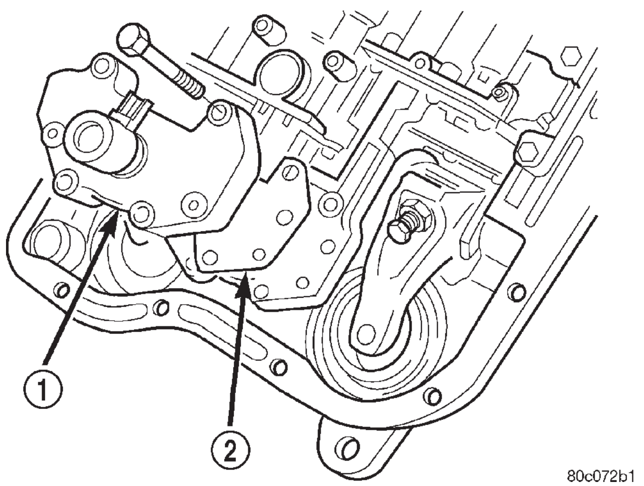


Fig. 73 Governor Body and Gasket

1 - GOVERNOR BODY
2 - GASKET

(4) Lubricate o-ring on pressure sensor with transmission fluid.
(5) Align pressure sensor to bore in governor body.
(6) Push pressure sensor into governor body.
(7) Lubricate o-ring, on pressure solenoid, with transmission fluid.
(8) Align pressure solenoid to bore in governor body (Fig. 74).
(9) Push solenoid into governor body.

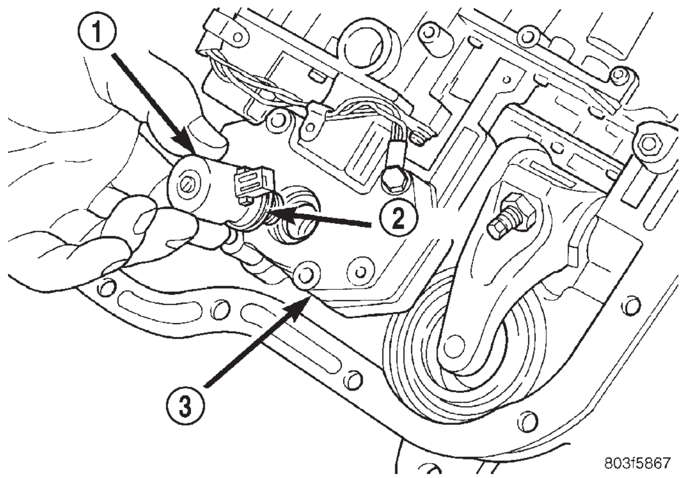


Fig. 74 Pressure Solenoid and O-ring

1 - PRESSURE SOLENOID
2 - O-RING
3 - GOVERNOR

(10) Place solenoid retainer in position on governor (Fig. 75).
(11) Install screws to hold pressure solenoid retainer to governor body.

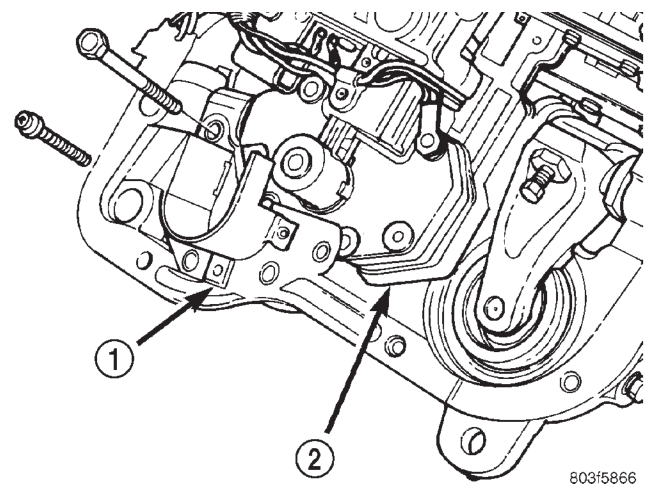


Fig. 75 Pressure Solenoid Retainer

1 - PRESSURE SOLENOID RETAINER
2 - GOVERNOR

(12) Engage wire connectors into pressure sensor and solenoid (Fig. 76).
(13) Install transmission fluid pan and (new) filter.
(14) Lower vehicle and road test to verify repair.

ELECTRONIC GOVERNOR (Continued)

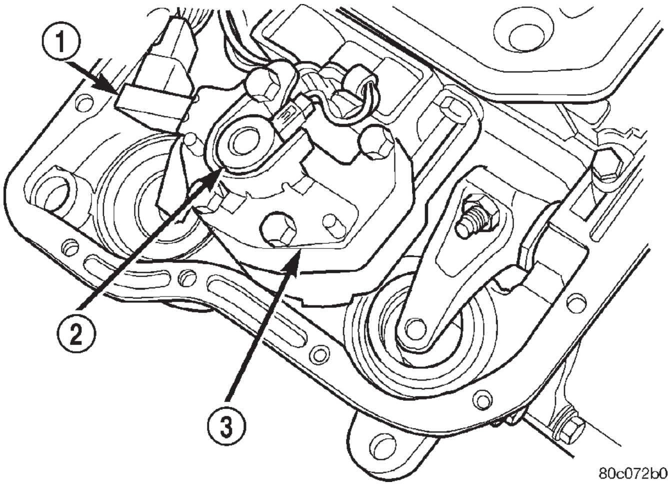


Fig. 76 Governor Solenoid And Pressure Sensor

1 - PRESSURE SENSOR
2 - PRESSURE SOLENOID
3 - GOVERNOR

EXTENSION HOUSING BUSHING

REMOVAL

(1) Remove extension housing yoke seal.

(2) Insert Remover 6957 into the extension housing. Tighten tool to bushing and remove bushing (Fig. 77).

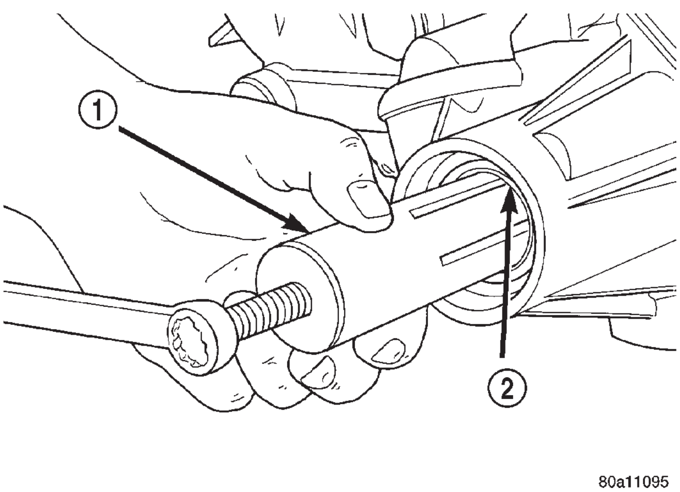


Fig. 77 Bushing Removal - Typical

1 - REMOVER
2 - EXTENSION HOUSING BUSHING

INSTALLATION

(1) Align bushing oil hole with oil slot in extension housing.

(2) Tap bushing into place with Installer 6951 and Handle C-4171.

(3) Install new oil seal in housing using Seal Installer C-3995-A (Fig. 78).

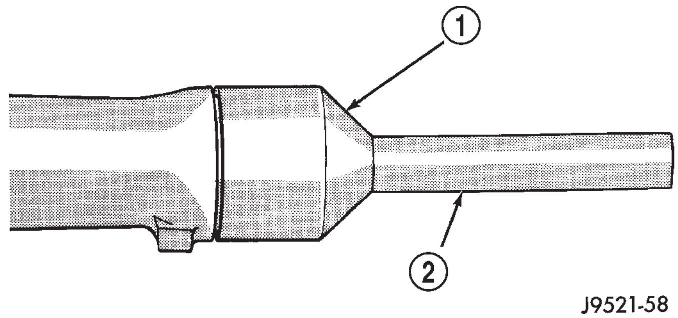


Fig. 78 Extension Housing Seal Installation

1 - SPECIAL TOOL C-3995-A OR C-3972-A
2 - SPECIAL TOOL C-4471

EXTENSION HOUSING SEAL

REMOVAL

(1) Raise vehicle.

(2) Mark propeller shaft and axle yoke, or companion flange, for alignment reference.

(3) Disconnect and remove propeller shaft.

(4) Remove old seal with Seal Remover C-3985-B (Fig. 79) from overdrive extension housing.

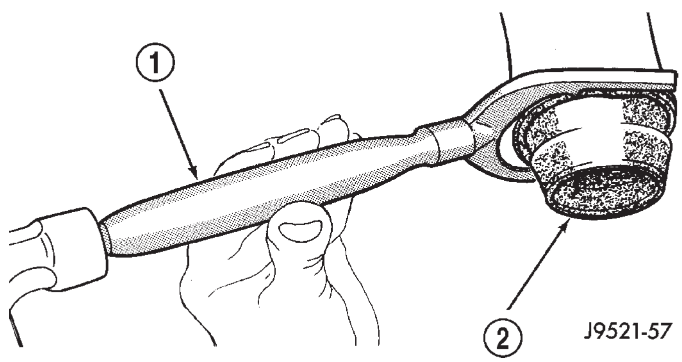


Fig. 79 Removing Transmission Housing Yoke Seal

1 - SPECIAL TOOL C-3985-B
2 - SEAL

EXTENSION HOUSING SEAL (Continued)

INSTALLATION

(1) Place seal in position on overdrive housing.

(2) Drive seal into overdrive housing with Seal Installer C-3995-A (Fig. 80).

(3) Carefully guide propeller shaft slip yoke into housing and onto output shaft splines. Align marks made at removal and connect propeller shaft to rear axle pinion yoke.

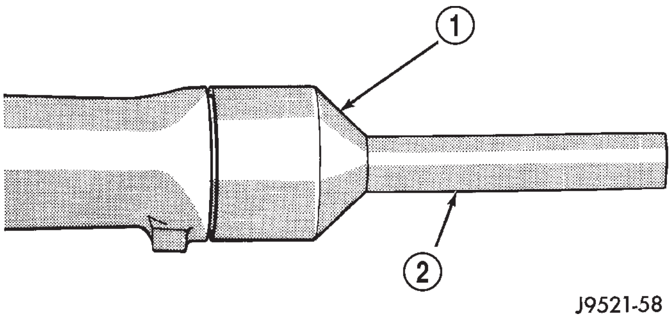


Fig. 80 Installing Overdrive Housing Seal

1 - SPECIAL TOOL C-3995-A OR C-3972-A
2 - SPECIAL TOOL C-4471

FLUID AND FILTER

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 - 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.

FLUID AND FILTER (Continued)

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.

Along with fluid level, it is important to check the condition of the fluid. When the fluid smells burned, and is contaminated with metal or friction material particles, a complete transmission recondition is needed. Be sure to examine the fluid on the dipstick closely. If there is any doubt about its condition, drain out a sample for a double check.

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.**

The transmission fluid level can be checked two ways.

PROCEDURE ONE

(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. 81) 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.

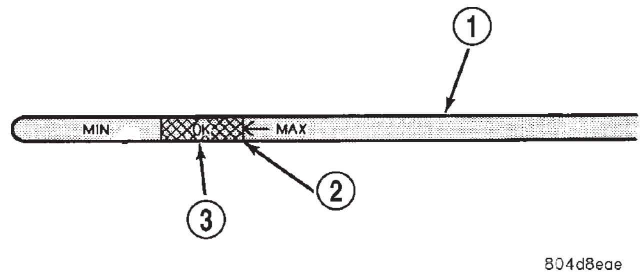


Fig. 81 Dipstick Fluid Level Marks - Typical

1 - DIPSTICK
2 - MAXIMUM CORRECT FLUID LEVEL
3 - ACCEPTABLE FLUID LEVEL

PROCEDURE TWO

(1) Start engine and apply parking brake.

(2) Shift the transmission into DRIVE for approximately 2 seconds.

(3) Shift the transmission into REVERSE for approximately 2 seconds.

(4) Shift the transmission into PARK.

(5) Hook up DRB® scan tool and select engine.

(6) Select sensors.

(7) Read the transmission temperature value.

(8) Compare the fluid temperature value with the figure. (Fig. 82)

(9) Adjust transmission fluid level shown on the dipstick according to the figure.

NOTE: After adding any fluid to the transmission, wait a minimum of 2 minutes for the oil to fully drain from the fill tube into the transmission before rechecking the fluid level.

(10) Check transmission for leaks.

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) Place a large diameter shallow drain pan beneath the transmission pan.

(3) Remove bolts holding front and sides of pan to transmission (Fig. 83).

(4) Loosen bolts holding rear of pan to transmission.

(5) Slowly separate front of pan away from transmission allowing the fluid to drain into drain pan.

(6) Hold up pan and remove remaining bolt holding pan to transmission.

(7) While holding pan level, lower pan away from transmission.

(8) Pour remaining fluid in pan into drain pan.

FLUID AND FILTER (Continued)

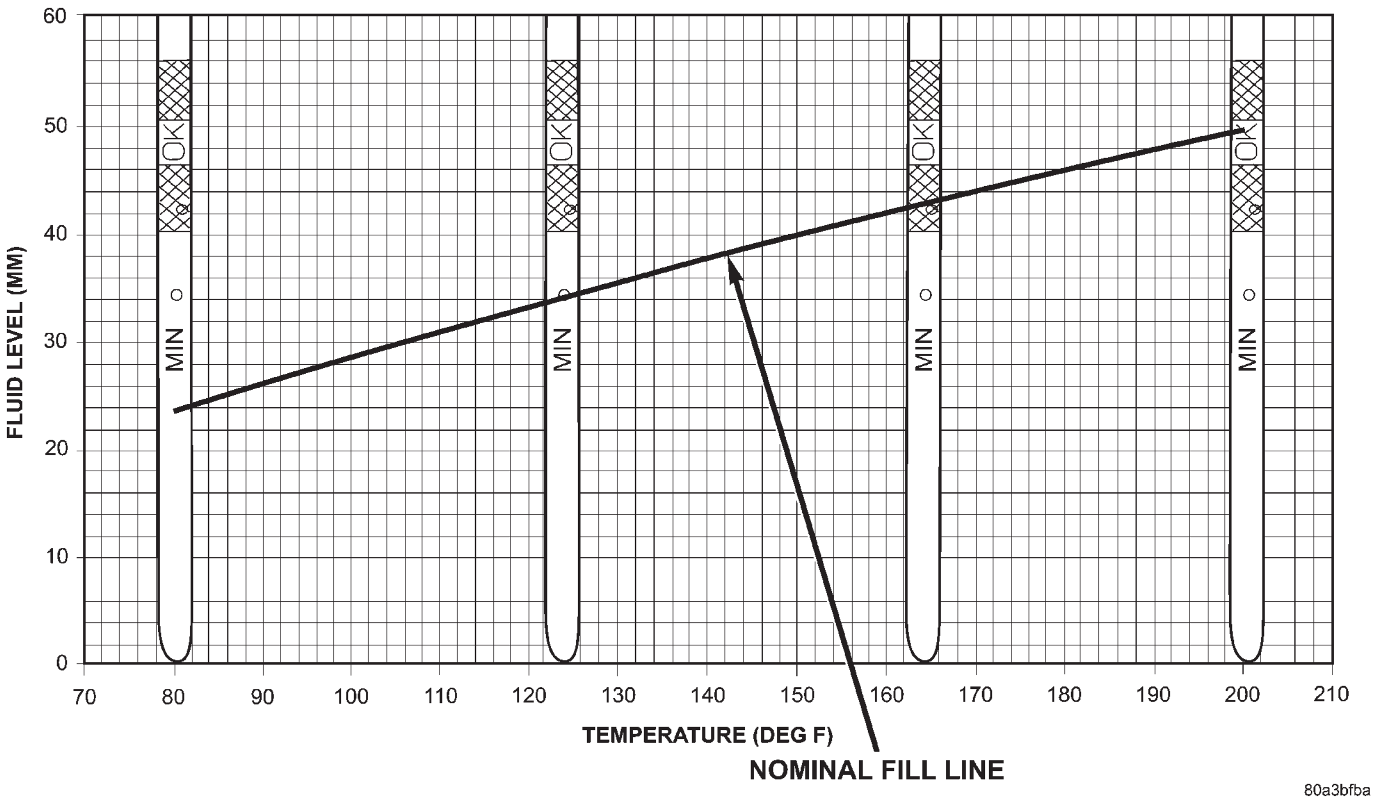


Fig. 82 42/44RE Fluid Fill Graph

(9) Remove screws holding filter to valve body (Fig. 84).

(10) Separate filter from valve body and pour fluid in filter into drain pan.

(11) Dispose of used trans fluid and filter properly.

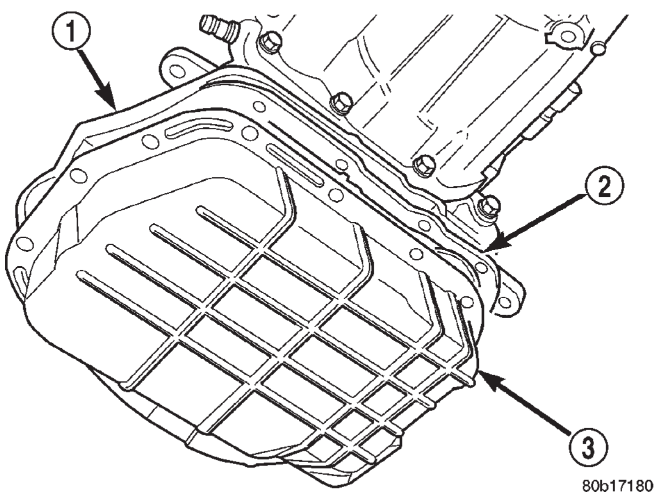


Fig. 83 Transmission Pan

1 - TRANSMISSION
2 - GASKET
3 - PAN

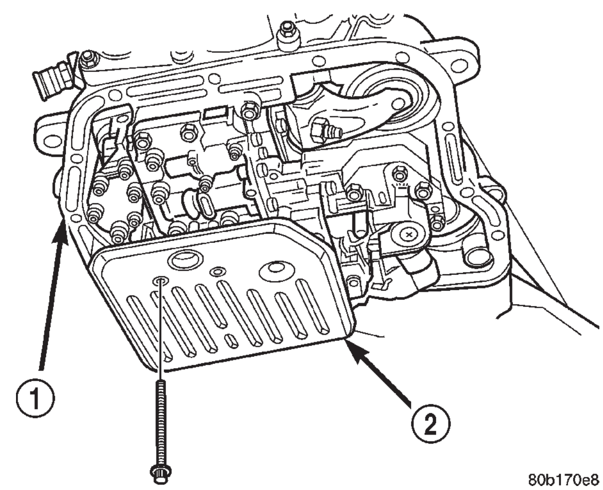


Fig. 84 Transmission Filter

1 - TRANSMISSION
2 - FILTER

FLUID AND FILTER (Continued)

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.

FRONT CLUTCH

DESCRIPTION

The front clutch assembly (Fig. 85) 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.

FRONT CLUTCH (Continued)

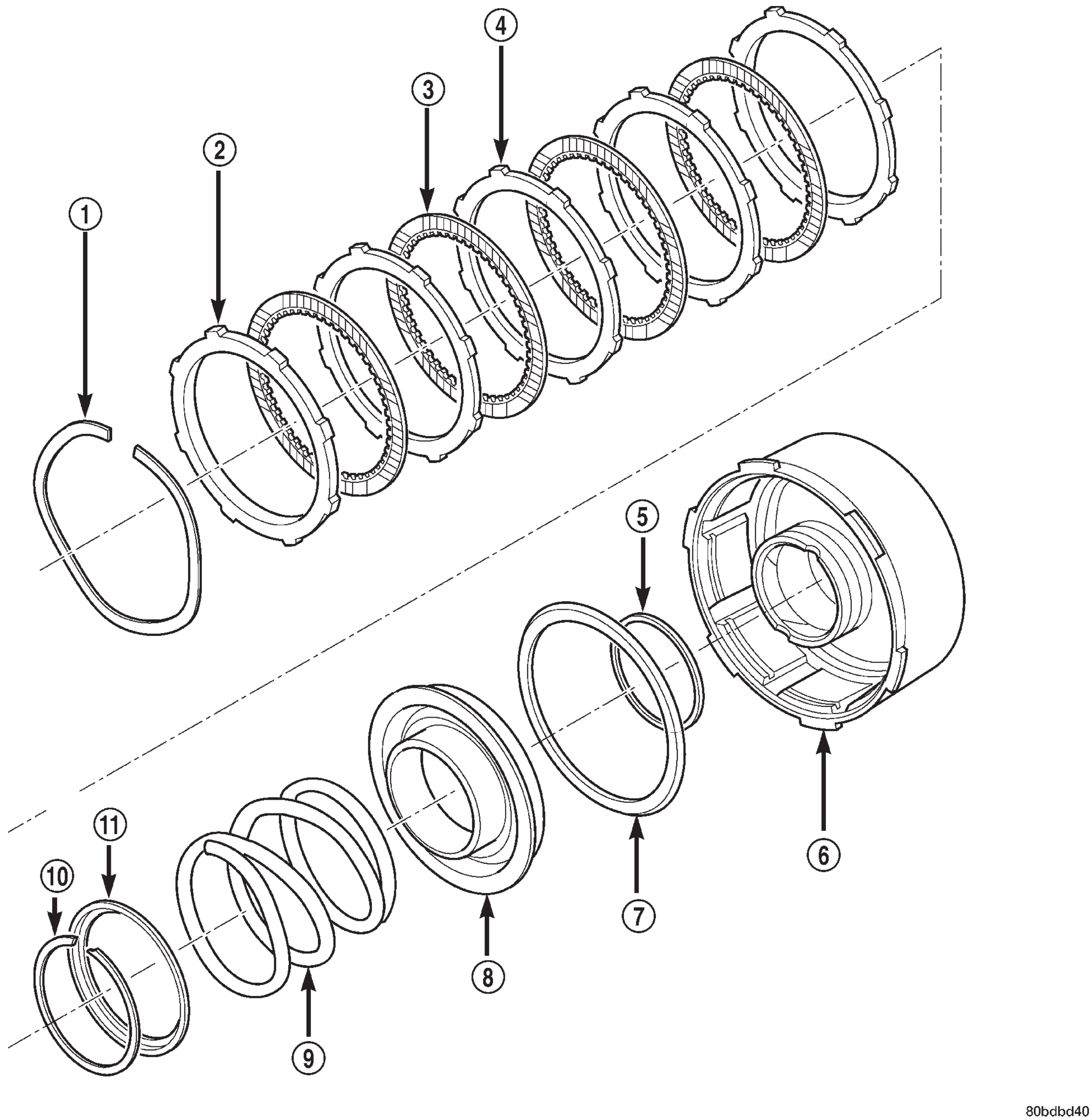


Fig. 85 Front Clutch Components

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

DISASSEMBLY

(1) Remove waved snap-ring and remove pressure plate, clutch plates and clutch discs (Fig. 86).

(2) Compress clutch piston spring with Compressor Tool C-3575-A (Fig. 87). 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.

FRONT CLUTCH (Continued)

(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.

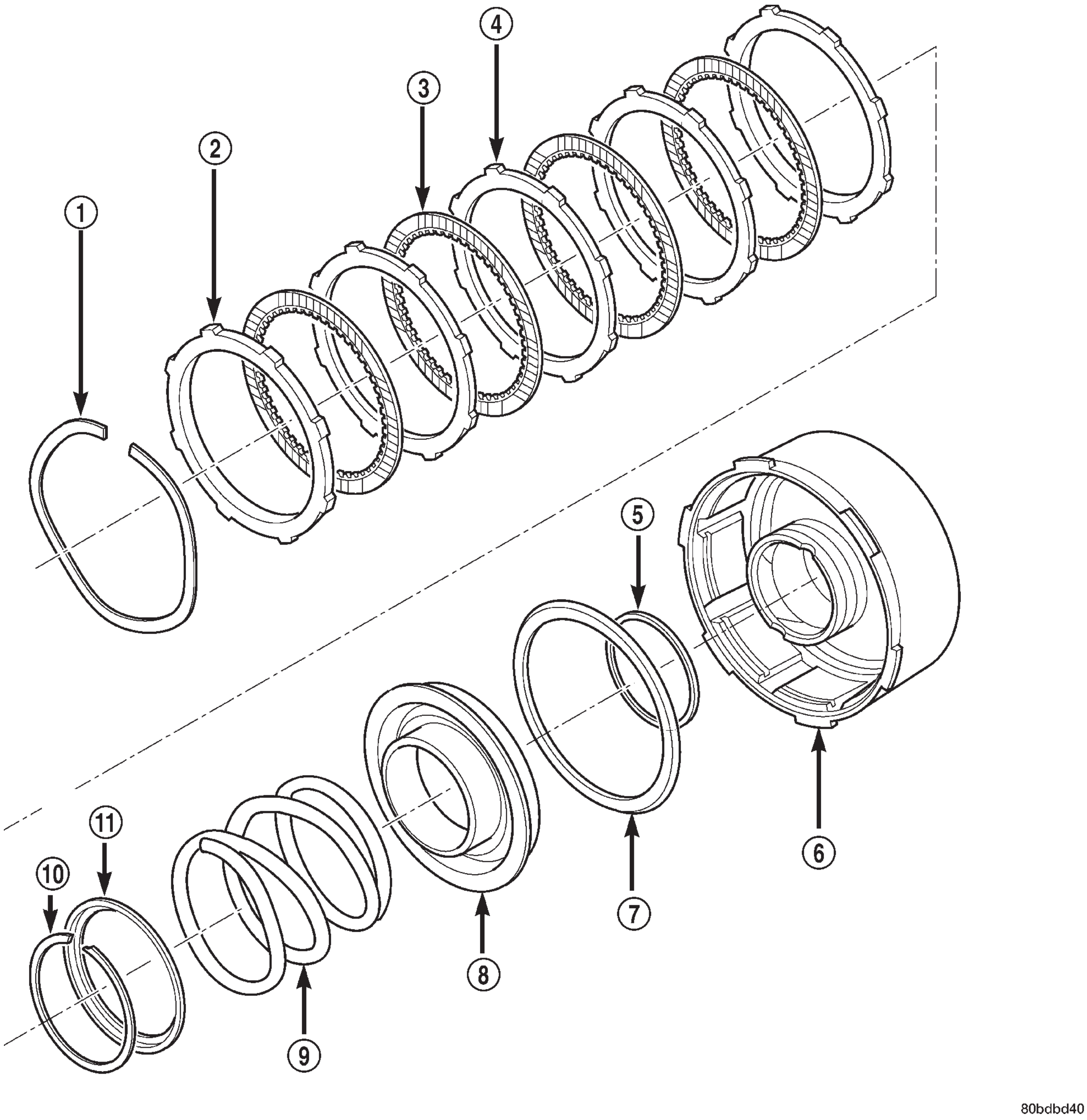


Fig. 86 42RE Front Clutch Components

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)

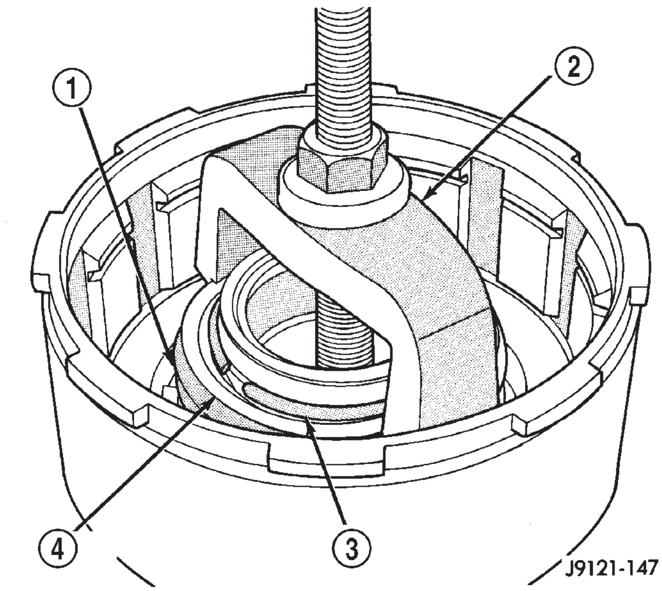


Fig. 87 Compressing Front Clutch Piston Spring

1 - FRONT CLUTCH SPRING
2 - COMPRESSOR TOOL C-3575-A
3 - RETAINER SNAP-RING
4 - SPRING RETAINER

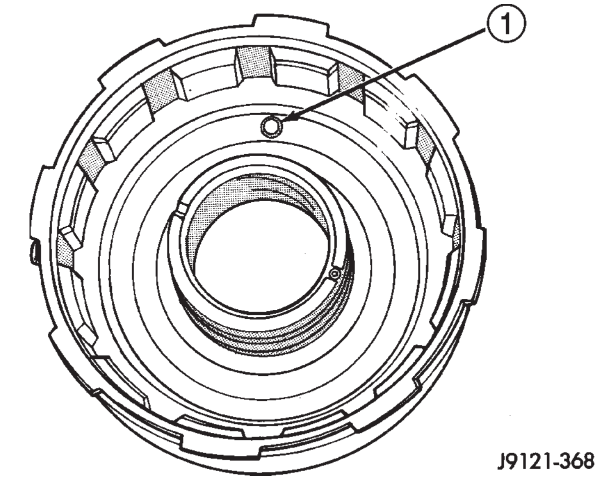


Fig. 88 Front Clutch Piston Retainer Check Ball Location

1 - RETAINER CHECK BALL

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. 88). The ball must move freely and not stick.

NOTE: Inspect the clutch retainer bushings carefully (Fig. 89). 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

NOTE: The 42RE transmission uses four plates and discs for the front clutch.

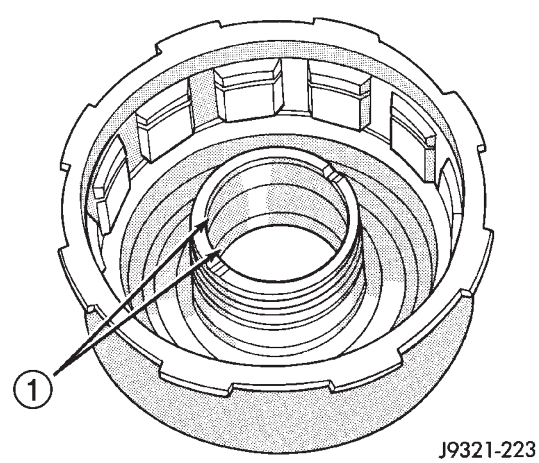


Fig. 89 Retainer Bushing Location/Inspection

1 - FRONT CLUTCH RETAINER BUSHINGS (NON-SERVICEABLE)

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

(2) Install new seals in the clutch retainer lower groove and on 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. 90). 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. 91).

FRONT CLUTCH (Continued)

(6) Position spring retainer on top of piston spring. Make sure retainer is properly installed (Fig. 86).

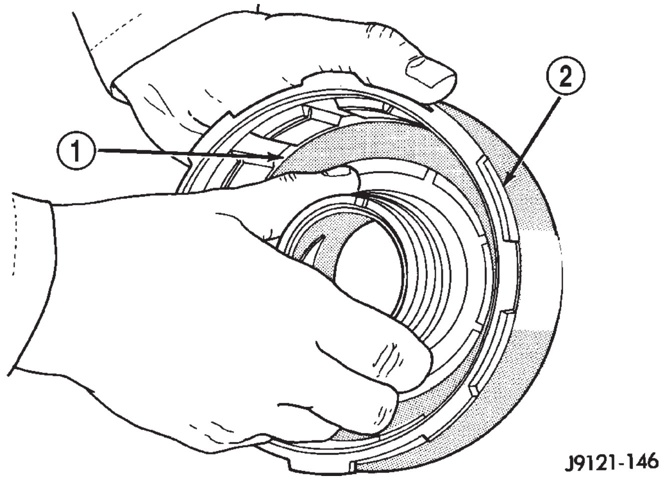


Fig. 90 Front Clutch Piston Installation

1 - CLUTCH PISTON
2 - FRONT CLUTCH RETAINER

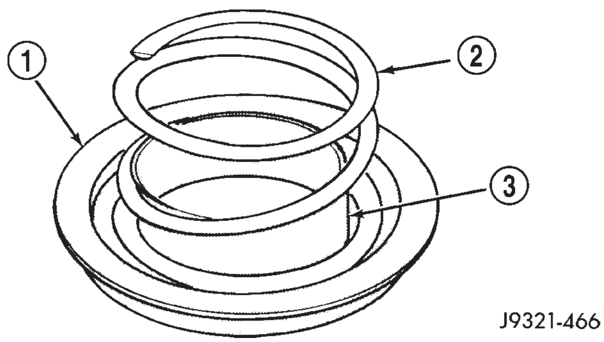


Fig. 91 Clutch Piston Spring Installation

1 - RETAINER
2 - CLUTCH SPRING
3 - PISTON

(7) Compress piston spring and retainer with Compressor Tool C-3575-A (Fig. 87). Then install new snap-ring to secure spring retainer and spring.

(8) Install clutch plates and discs (Fig. 86). Install steel plate then disc until all plates and discs are installed. The front clutch uses 4 clutch discs and plates in a 42RE transmission.

(9) Install pressure plate and waved snap-ring (Fig. 86).

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. 92) 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.

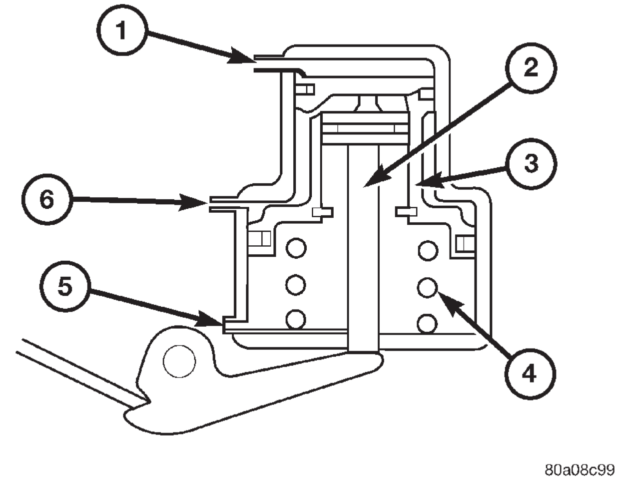


Fig. 92 Front Servo

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.

FRONT SERVO (Continued)

DISASSEMBLY

(1) Remove seal ring from rod guide (Fig. 93).

(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.

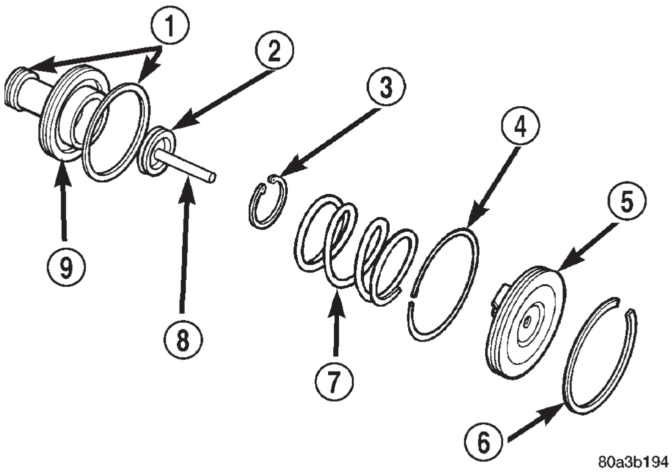


Fig. 93 Front Servo

1 - PISTON RINGS
2 - O-RING
3 - SNAP-RING
4 - SEAL RING
5 - PISTON ROD GUIDE
6 - SNAP-RING
7 - SERVO SPRING
8 - PISTON ROD
9 - SERVO PISTON

CLEANING

Clean the servo piston components (Fig. 94) with solvent and dry them with compressed air.

INSPECTION

Inspect the servo components (Fig. 95). Replace the springs if collapsed, distorted or broken. Replace the guide, rod and piston if cracked, bent, or worn. Discard the servo snap-ring if distorted or warped.

Check the servo piston bore for wear. If the bore is severely scored, or damaged, it will be necessary to replace the case.

Replace any servo component if doubt exists about condition. Do not reuse suspect parts.

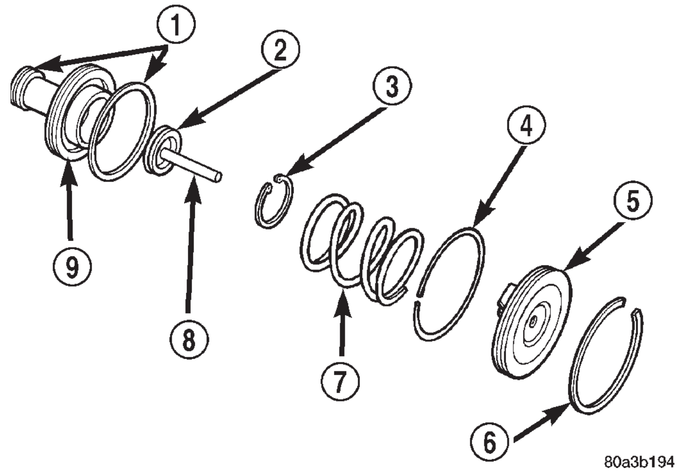


Fig. 94 Front Servo Piston

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

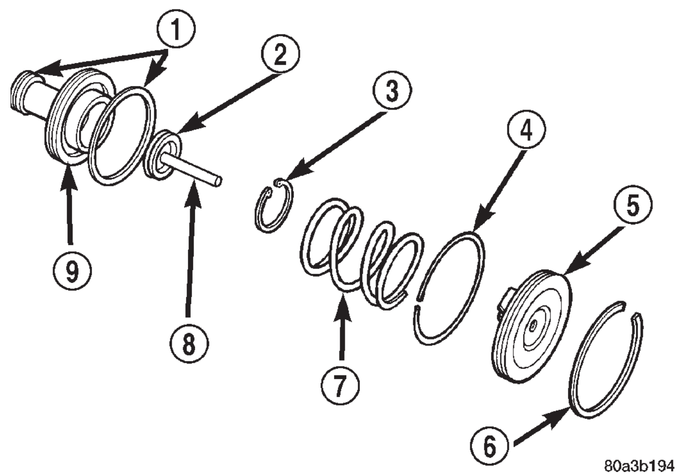


Fig. 95 Front Servo Piston

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

Clean and inspect front servo components.

(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. 96).

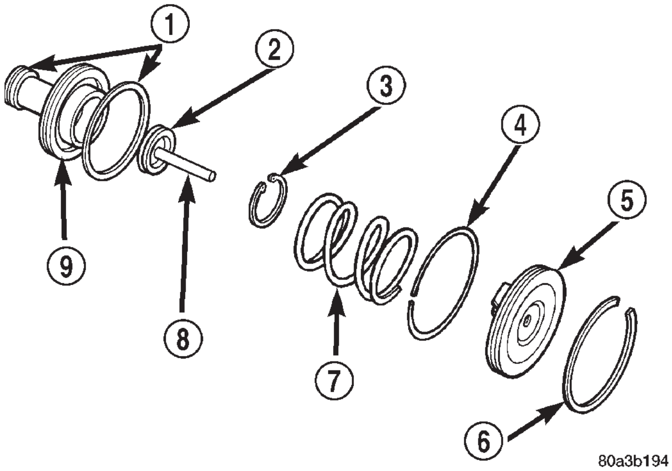


Fig. 96 Front Servo

1 - PISTON RINGS
2 - O-RING
3 - SNAP-RING
4 - SEAL RING
5 - PISTON ROD GUIDE
6 - SNAP-RING
7 - SERVO SPRING
8 - PISTON ROD
9 - SERVO PISTON

GEARSHIFT CABLE

DIAGNOSIS AND TESTING - GEARSHIFT CABLE

(1) The 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 shift lever in PARK or NEUTRAL gate positions only. Engine starts must not be possible in any other gear position.

(3) With shift lever handle in:

(a) PARK position - Apply forward force on center of lever and remove pressure. Engine starts must be possible.

(b) PARK position - Apply rearward force on center of lever 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 lever. Transmission shall not be able to shift from neutral to reverse.

REMOVAL

(1) Shift transmission into PARK.

(2) Remove the dash panel insulation pad as necessary to access the gearshift cable bracket mounting nuts.

(3) Remove nuts retaining the gearshift cable mounting bracket to the dash panel (Fig. 97) or (Fig. 98).

(4) Disconnect cable at lower column lever and feed cable through dash panel opening to underside of vehicle (Fig. 99).

(5) Raise vehicle.

(6) Disengage cable eyelet at transmission shift lever and pull cable adjuster out of mounting bracket (Fig. 100) or (Fig. 101). Remove old cable from vehicle.

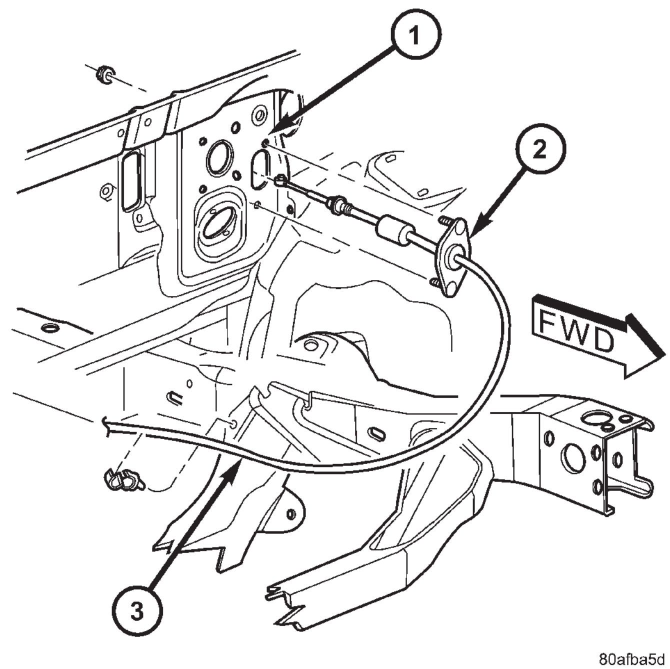


Fig. 97 Cable Mounting at Dash Panel - 4X2

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

GEARSHIFT CABLE (Continued)

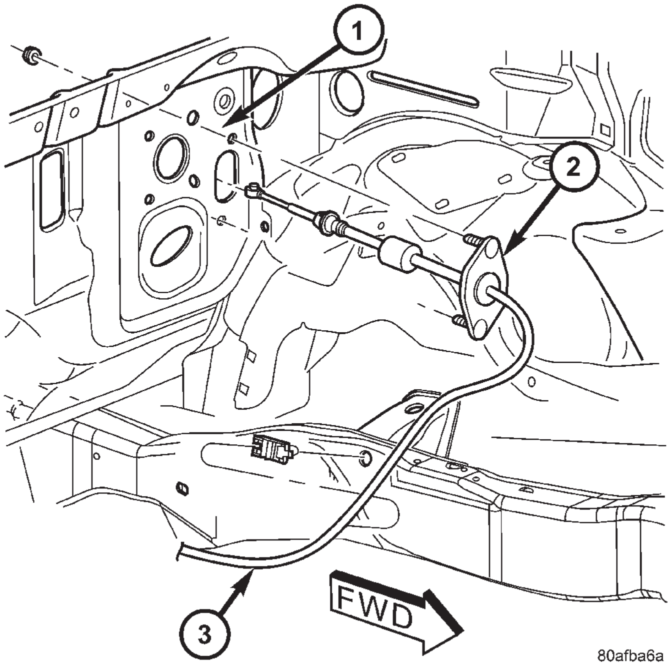


Fig. 98 Cable Mounting at Dash Panel - 4X4

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

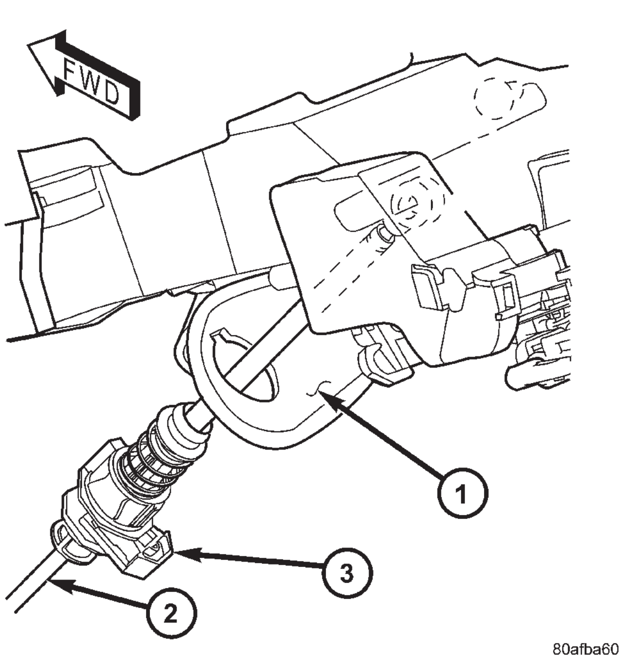


Fig. 99 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB

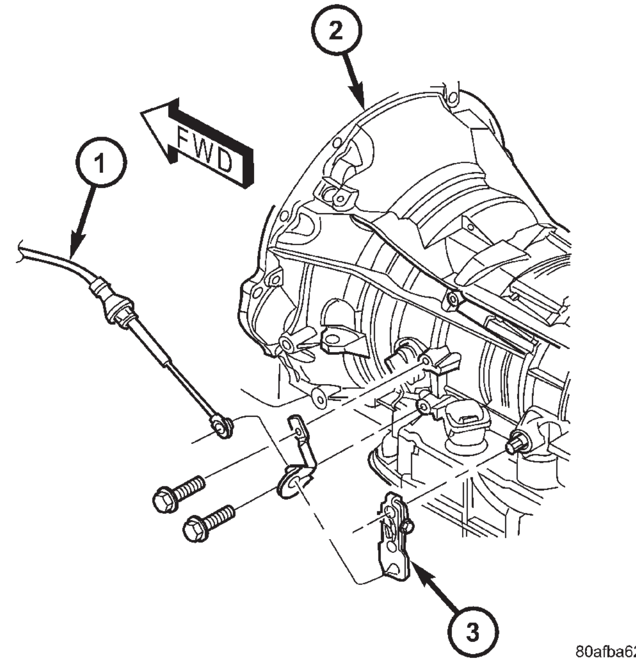


Fig. 100 Gearshift Cable at Transmission - RFE

1 - GEARSHIFT CABLE
2 - RFE TRANSMISSION
3 - MANUAL LEVER

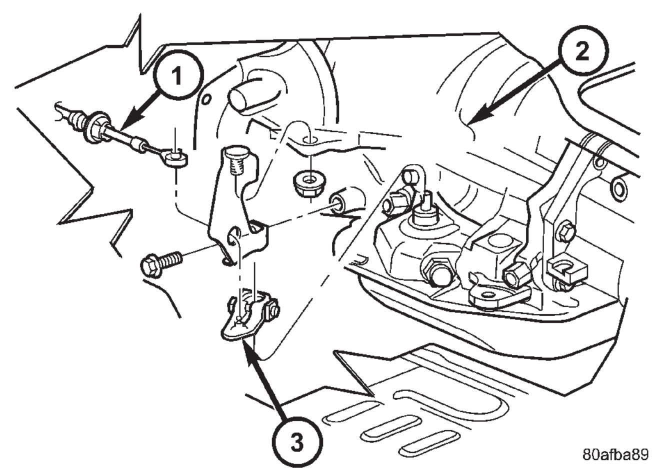


Fig. 101 Gearshift Cable at Transmission - RE

1 - GEARSHIFT CABLE
2 - RE TRANSMISSION
3 - MANUAL LEVER

INSTALLATION

(1) Snap the cable into the transmission bracket so the retaining ears are engaged and snap the cable eyelet onto the manual control lever ball stud.

(2) Lower vehicle.

(3) Route cable through hole in dash panel (Fig. 102) or (Fig. 103).

GEARSHIFT CABLE (Continued)

(4) Seat the cable mounting bracket to dash panel and install retaining nuts to hold the cable housing bracket to the dash panel.

(5) Tighten the nuts to 34 N·m (25 ft.lbs.).

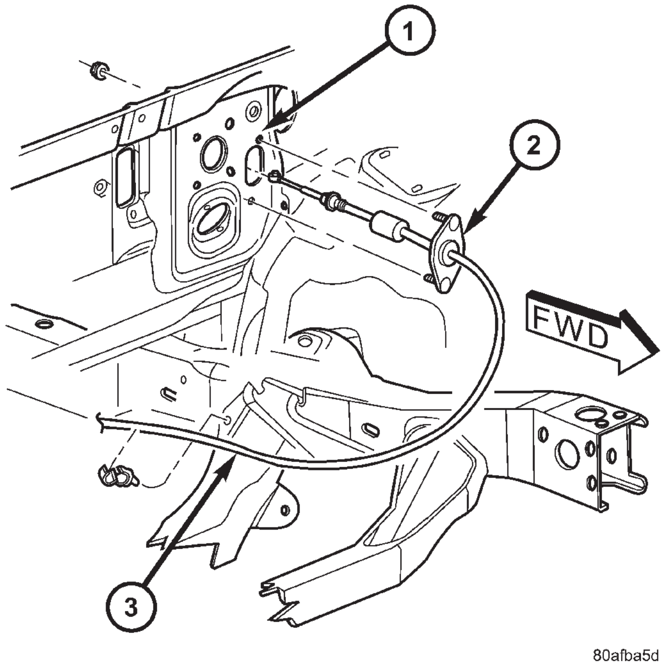


Fig. 102 Cable Mounting at Dash Panel - 4X2

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

(6) Place the transmission manual shift lever in the “PARK” detent (rearmost) position and rotate prop shaft to ensure transmission is in PARK.

(7) Connect shift cable to the steering column shift lever (Fig. 104) by snapping the cable retaining ears into shifter bracket and snapping the cable eyelet on the steering column ball stud.

(8) Lock the shift cable adjustment by pressing the cable adjuster lock upward until it snaps into place.

(9) Check for proper operation of the transmission range sensor.

(10) Adjust the gearshift cable as necessary.

ADJUSTMENTS - GEARSHIFT CABLE

Check adjustment by starting the engine in PARK and NEUTRAL. Adjustment is CORRECT 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.

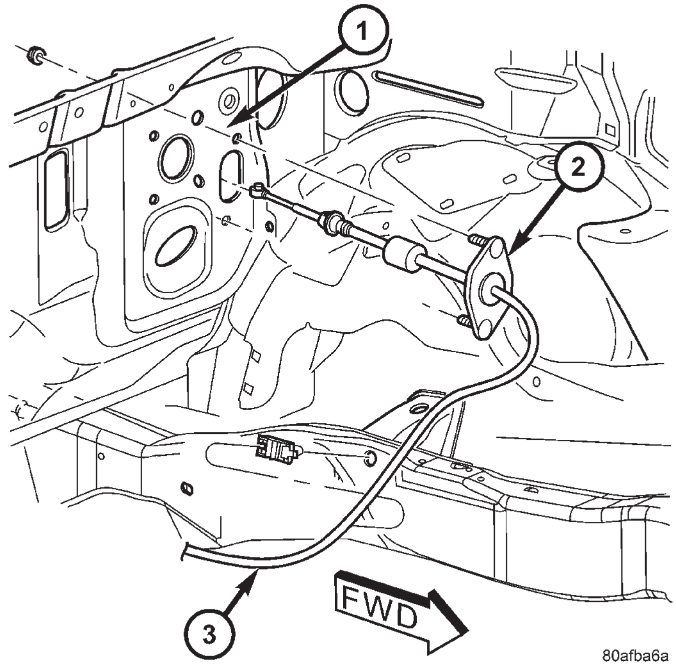


Fig. 103 Cable Mounting at Dash Panel - 4X4

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

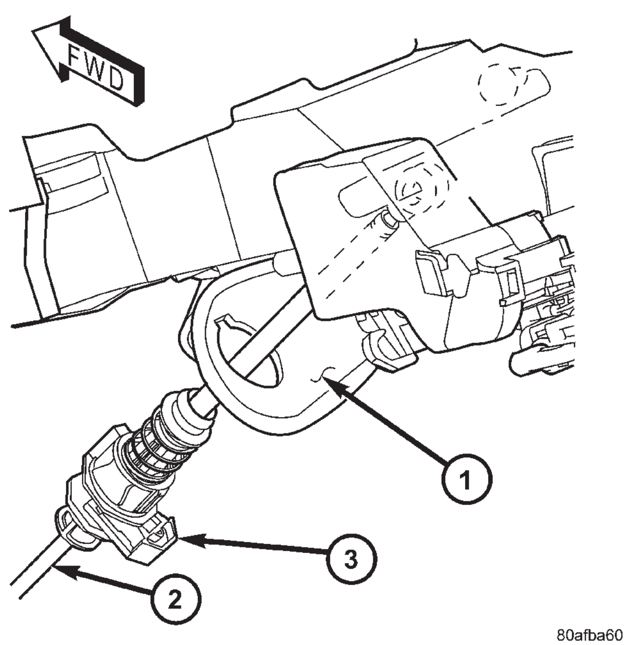


Fig. 104 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB

GEARSHIFT CABLE (Continued)

Gearshift Adjustment Procedure

(1) Shift transmission into PARK.

(2) Release cable adjuster lock tab (underneath the steering column) (Fig. 105) to unlock cable.

(3) Raise vehicle.

(4) Disengage the cable eyelet from the transmission manual shift lever.

(5) Verify transmission shift lever is in PARK detent by moving lever fully rearward. Last rearward detent is PARK position.

(6) Verify positive engagement of transmission park lock by attempting to rotate propeller shaft. Shaft will not rotate when park lock is engaged.

(7) Snap the cable eyelet onto the transmission manual shift lever.

(8) Lower vehicle.

(9) Lock shift cable by pressing cable adjuster lock tab upward until it snaps into place.

(10) Check engine starting. Engine should start only in PARK and NEUTRAL

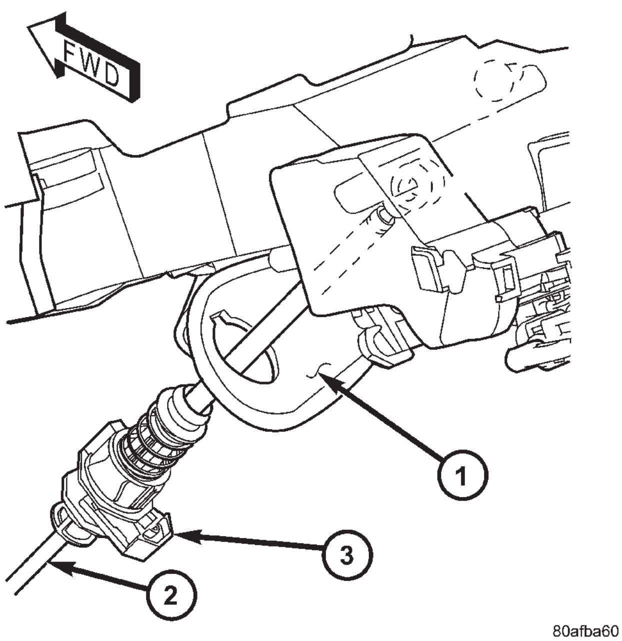


Fig. 105 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB

OIL PUMP

DESCRIPTION

The oil pump (Fig. 106) 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. 107), a housing, and a cover that also serves as the reaction shaft support.

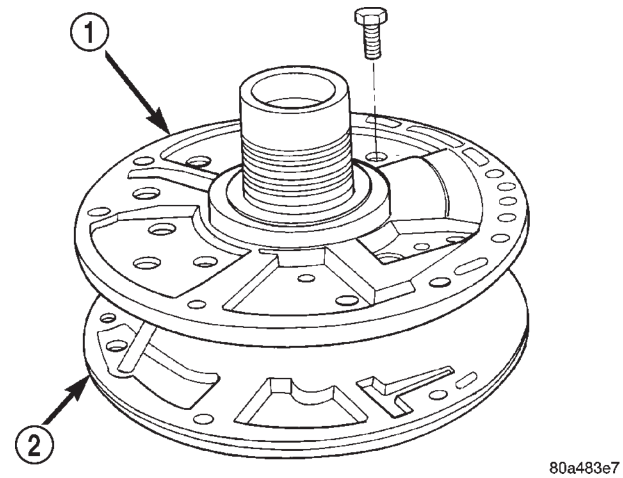


Fig. 106 Oil Pump and Reaction Shaft Support

1 - REACTION SHAFT SUPPORT
2 - PUMP

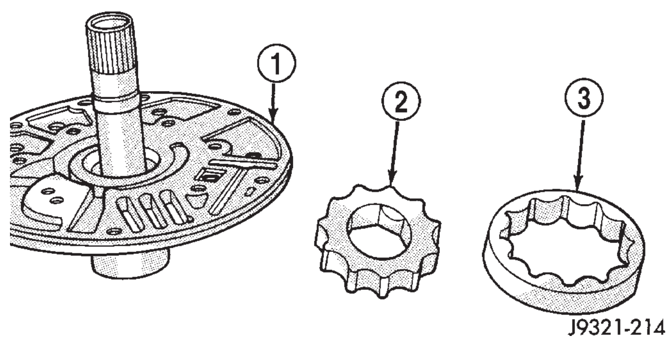


Fig. 107 Pump Gear Removal

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

OIL PUMP (Continued)

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. 108).

(2) Mark pump housing and support assembly for alignment reference.

(3) Remove bolts attaching pump body to support (Fig. 109).

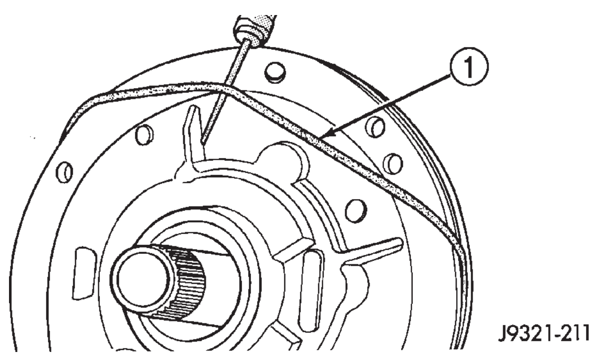


Fig. 108 Removing Pump Seal Ring

1 - PUMP HOUSING SEAL RING

(4) Separate support from pump housing (Fig. 110).

(5) Remove inner and outer gears from reaction shaft support (Fig. 111).

(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. 112).

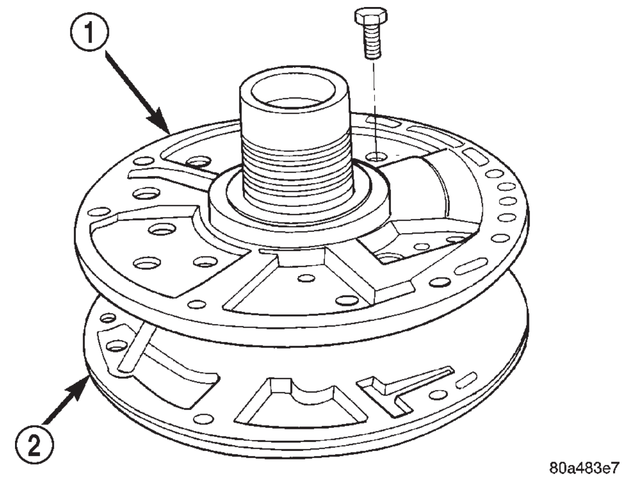


Fig. 109 Pump Support Bolts

1 - REACTION SHAFT SUPPORT
2 - PUMP

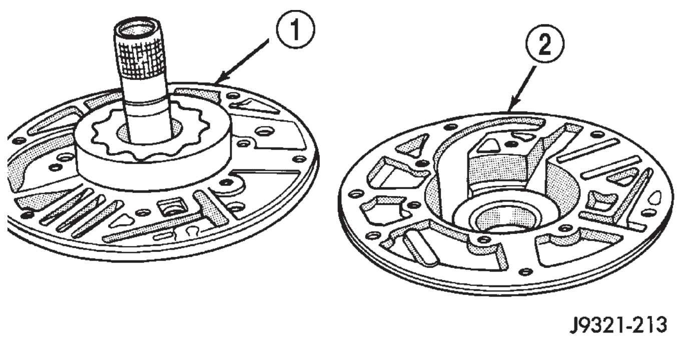


Fig. 110 Separating Pump Housing From Reaction Shaft Support

1 - REACTION SHAFT SUPPORT
2 - PUMP HOUSING

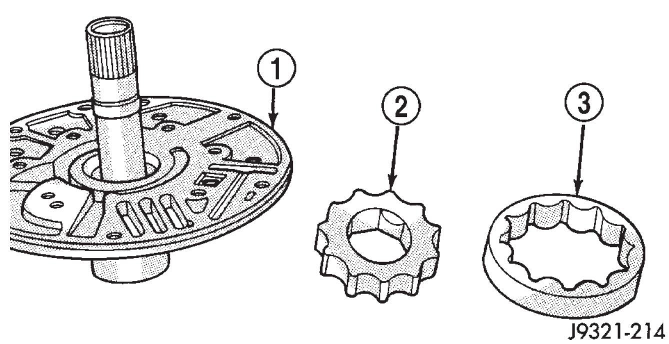


Fig. 111 Pump Gear Removal

1 - REACTION SHAFT SUPPORT
2 - INNER GEAR
3 - OUTER GEAR

OIL PUMP (Continued)

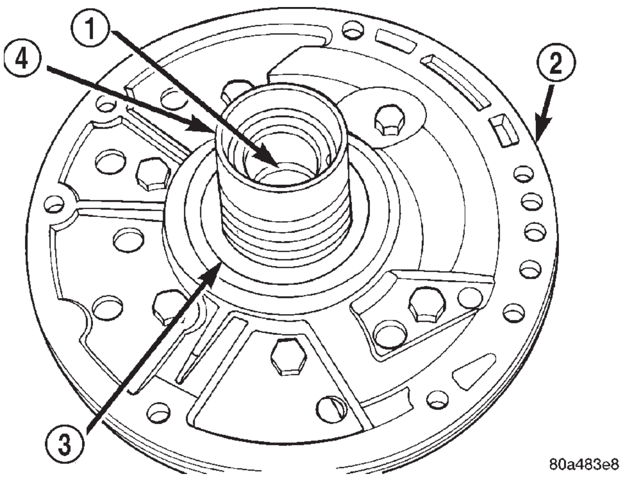


Fig. 112 Support Hub Thrust Washer

1 - BUSHING
2 - REACTION SHAFT SUPPORT
3 - THRUST WASHER
4 - HUB

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. 113).

(2) Install new pump bushing with Tool Handle C-4171 and Bushing Installer SP-5117 (Fig. 113). Bushing should be flush with pump housing bore.

(3) Stake new pump bushing in two places with blunt punch (Fig. 114). 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. 115). 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. 115).

(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.

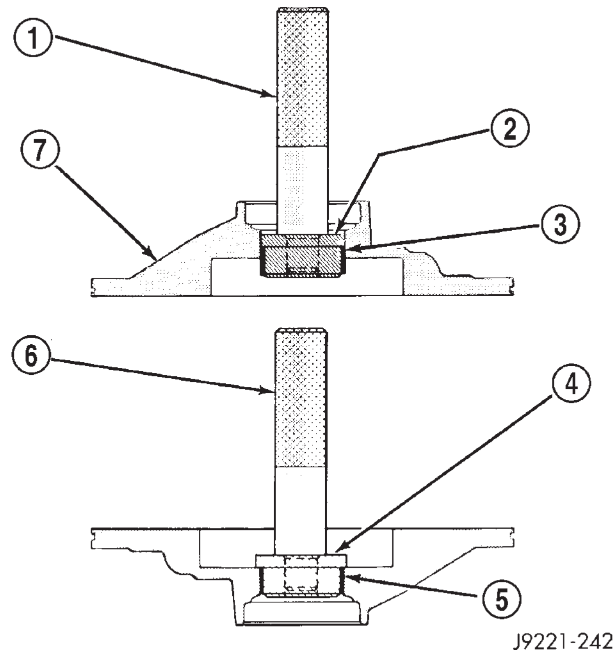


Fig. 113 Removing Oil Pump Bushing

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

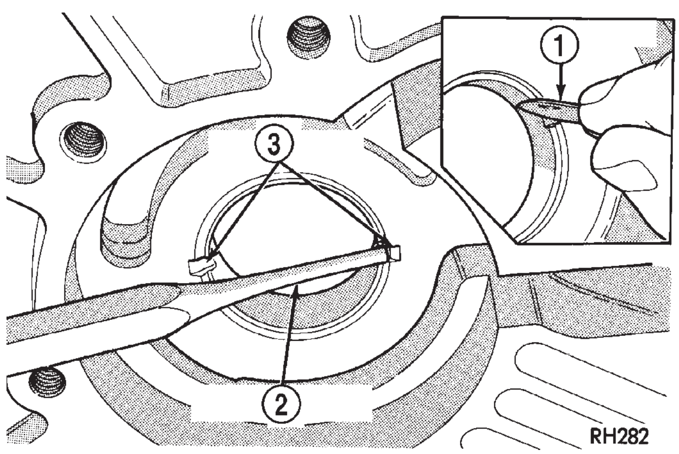


Fig. 114 Staking Oil Pump Bushing

1 - NARROW BLADE
2 - BLUNT PUNCH
3 - TWO STAKES

(9) Clean reaction shaft support thoroughly after installing bushing.

OIL PUMP (Continued)

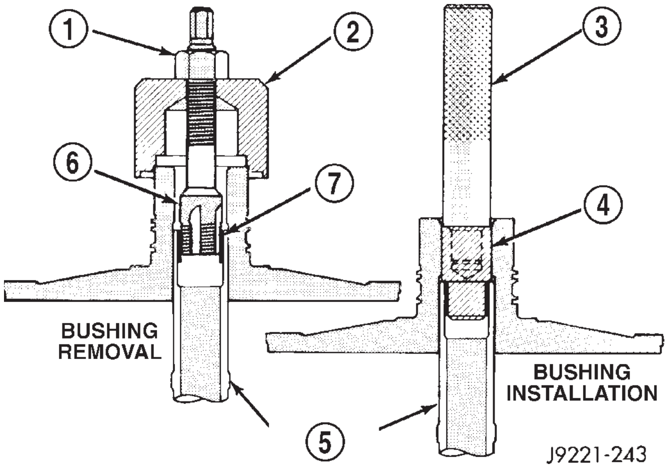


Fig. 115 Replacing Reaction Shaft Support Bushing

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. 116).

(4) Install outer gear in pump housing (Fig. 116). Gear can be installed either way (it is not a one-way fit).

(5) Install pump inner gear (Fig. 117).

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).

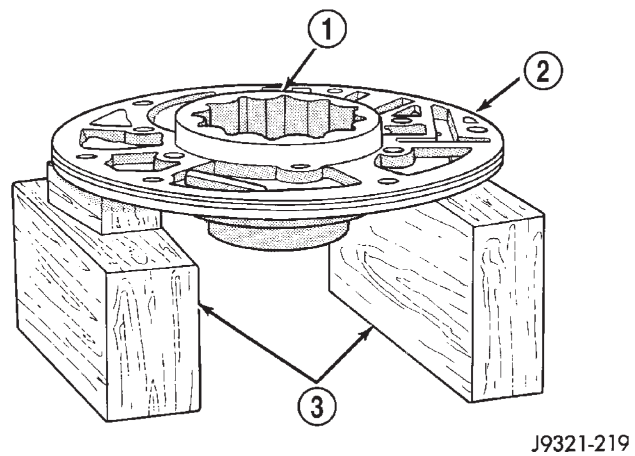


Fig. 116 Supporting Pump And Installing Outer Gear

1 - OUTER GEAR
2 - PUMP HOUSING
3 - WOOD BLOCKS

(6) Install new thrust washer on hub of reaction shaft support. Lubricate washer with transmission fluid or petroleum jelly.

(7) If reaction shaft seal rings are being replaced, install new seal rings on support hub (Fig. 118). Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

OIL PUMP (Continued)

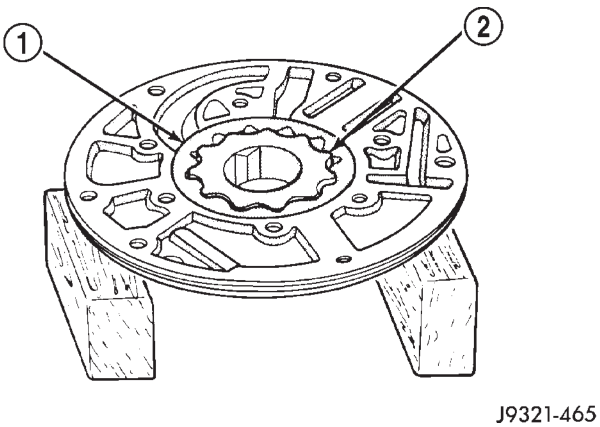


Fig. 117 Pump Inner Gear Installation

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.

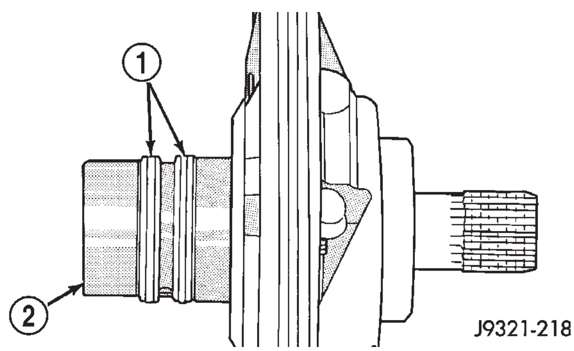


Fig. 118 Hub Seal Ring Position

1 - SEAL RINGS
2 - SUPPORT HUB

(8) Install reaction shaft support on pump housing (Fig. 119).

(9) Align reaction support on pump housing. Use alignment marks made at disassembly. Or, rotate support until bolt holes in support and pump housing are all aligned (holes are offset for one-way fit).

(10) Install all bolts that attach support to pump housing. Then tighten bolts finger tight.

(11) Tighten support-to-pump bolts to required torque as follows:

(a) Reverse pump assembly and install it in transmission case. Position pump so bolts are facing out and are accessible.

(b) Secure pump assembly in case with 2 or 3 bolts, or with pilot studs.

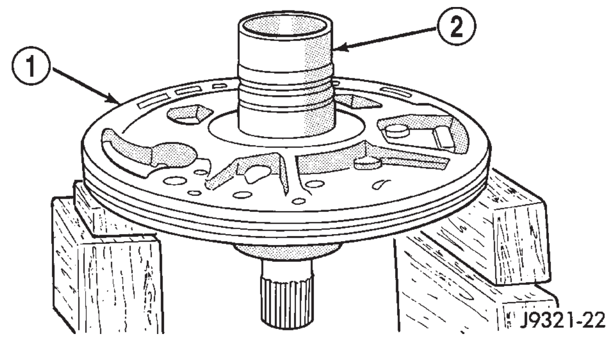


Fig. 119 Assembling Reaction Shaft Support And Pump Housing

1 - PUMP HOUSING
2 - REACTION SHAFT SUPPORT

(c) Tighten support-to-pump bolts to 20 N·m (15 ft. lbs.).

(d) Remove pump assembly from transmission case.

(12) Install new oil seal in pump with Special Tool C-4193 and Tool Handle C-4171 (Fig. 120). 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.

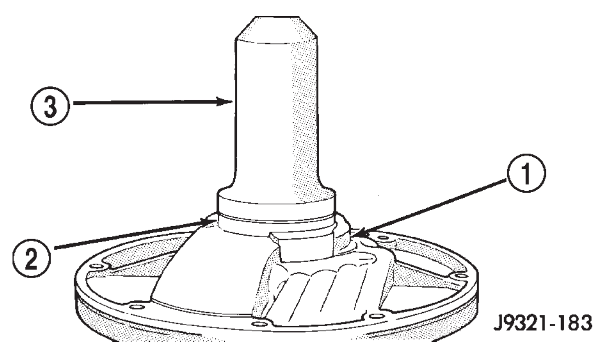


Fig. 120 Pump Oil Seal Installation

1 - PUMP BODY
2 - PUMP SEAL
3 - SPECIAL TOOL C-4193

OUTPUT SHAFT FRONT BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle.

(2) Remove overdrive geartrain from housing.

(3) Remove snap-ring holding output shaft front bearing to overdrive geartrain. (Fig. 121).

(4) Pull bearing from output shaft.

OUTPUT SHAFT FRONT BEARING (Continued)

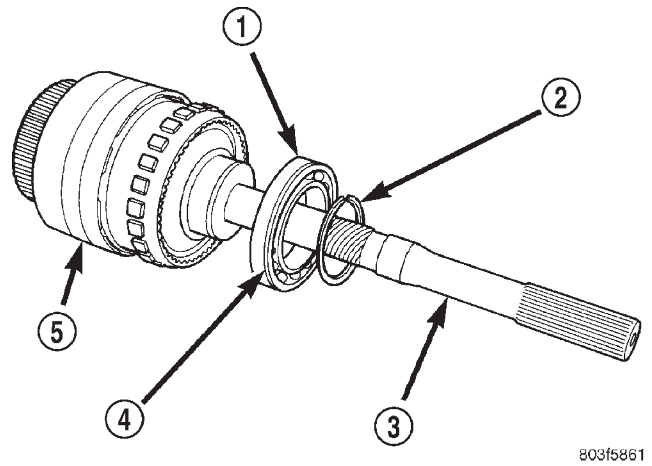


Fig. 121 Output Shaft Front Bearing

1 - OUTPUT SHAFT FRONT BEARING
2 - SNAP-RING
3 - OUTPUT SHAFT
4 - GROOVE TO REAR
5 - OVERDRIVE GEARTRAIN

INSTALLATION

(1) Place replacement bearing in position on geartrain with locating retainer groove toward the rear.

(2) Push bearing onto shaft until the snap-ring groove is visible.

(3) Install snap-ring to hold bearing onto output shaft.

(4) Install overdrive geartrain into housing.

(5) Install overdrive unit in vehicle.

OUTPUT SHAFT REAR BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC/ OVERDRIVE - REMOVAL)

(2) Remove overdrive geartrain from housing.

(3) Remove snap-ring holding output shaft rear bearing into overdrive housing (Fig. 122).

(4) Using a suitable driver inserted through the rear end of housing, drive bearing from housing.

INSTALLATION

(1) Place replacement bearing in position in housing.

(2) Using a suitable driver, drive bearing into housing until the snap-ring groove is visible.

(3) Install snap-ring to hold bearing into housing (Fig. 122).

(4) Install overdrive geartrain into housing.

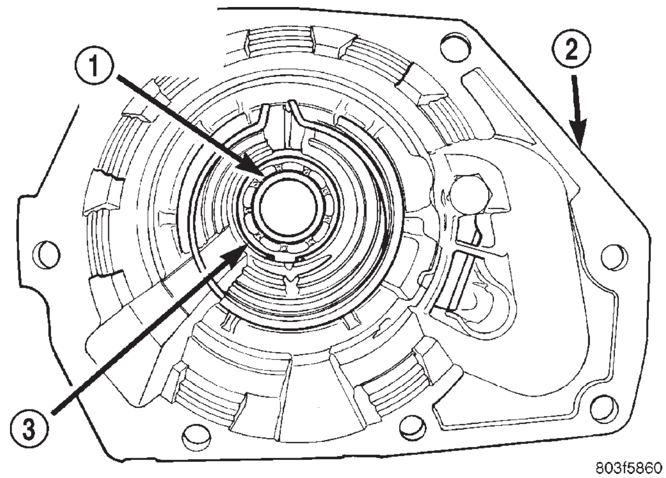


Fig. 122 Output Shaft Rear Bearing

1 - OUTPUT SHAFT REAR BEARING
2 - OVERDRIVE HOUSING
3 - SNAP-RING

(5) Install overdrive unit in vehicle.

OVERDRIVE CLUTCH

DESCRIPTION

The overdrive clutch (Fig. 123) is composed of the pressure plate, clutch plates, holding discs, overdrive piston retainer, piston, piston spacer, and snap-rings. The overdrive clutch is the forwardmost component in the transmission overdrive unit and is considered a holding component. The overdrive piston retainer, piston, and piston spacer are located on the rear of the main transmission case.

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 piston retainer and piston. The fluid pressure is provided by the oil pump, transferred through the control valves and passageways, and enters the clutch through passages at the lower rear portion of the valve body area. With pressure applied between the piston retainer and piston, the piston moves away from the piston retainer and compresses the clutch pack. This action applies the clutch pack, allowing torque to flow through the intermediate shaft into the overdrive planetary gear set. The overdrive clutch discs are attached to the overdrive clutch hub while the overdrive clutch plates, reaction plate, and pressure plate are lugged to the overdrive housing. This allows the intermediate shaft to transfer the engine torque to the planetary gear and overrun-

OVERDRIVE CLUTCH (Continued)

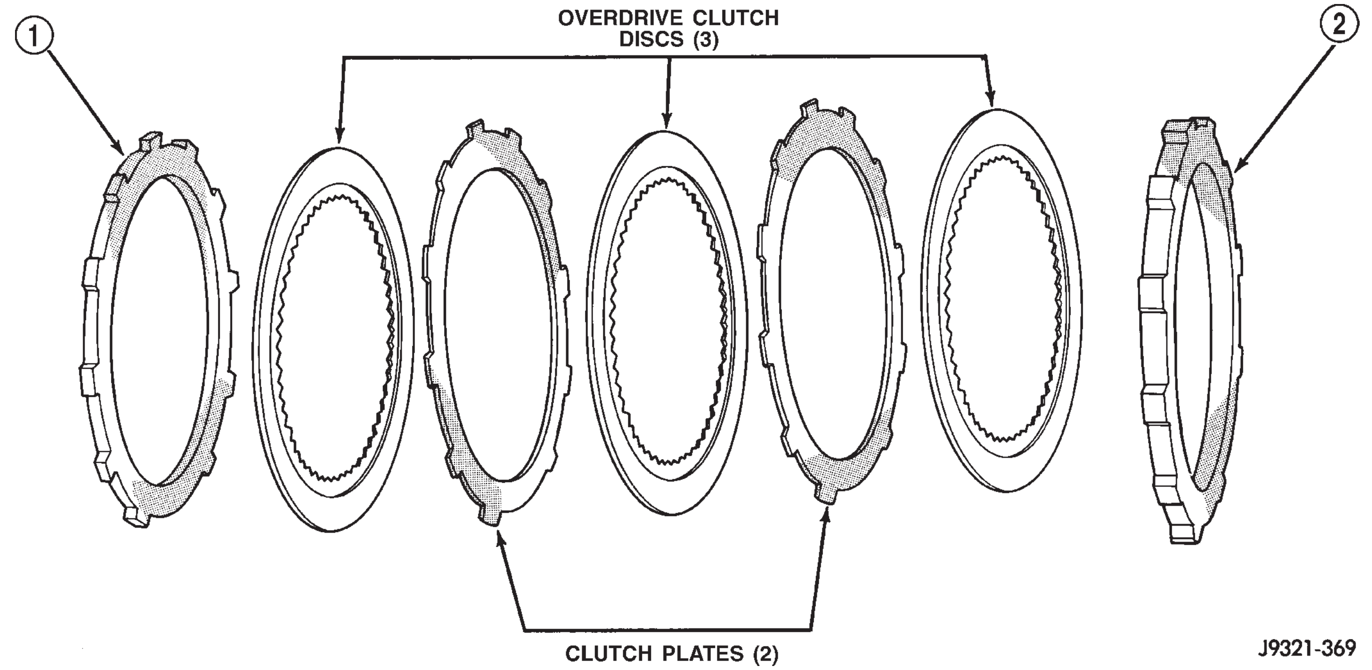


Fig. 123 Overdrive Clutch

1 - REACTION PLATE
2 - PRESSURE PLATE

ning clutch. This drives the planetary gear inside the annulus, which is attached to the overdrive clutch drum and output shaft, creating the desired gear ratio. The waved snap-ring is used to cushion the application of the clutch pack.

OVERDRIVE SWITCH

DESCRIPTION

The overdrive OFF (control) switch is located in the shift lever arm (Fig. 124). The switch is a momentary contact device that signals the PCM to toggle current status of the overdrive function.

OPERATION

At key-on, overdrive operation is allowed. Pressing the switch once causes the overdrive OFF mode to be entered and the overdrive OFF switch lamp to be illuminated. Pressing the switch a second time causes normal overdrive operation to be restored and the overdrive lamp to be turned off. The overdrive OFF mode defaults to ON after the ignition switch is cycled OFF and ON. The normal position for the control switch is the ON position. The switch must be in this position to energize the solenoid and allow a 3-4 upshift. The control switch indicator light illuminates only when the overdrive switch is turned to the OFF position, or when illuminated by the transmission control module.

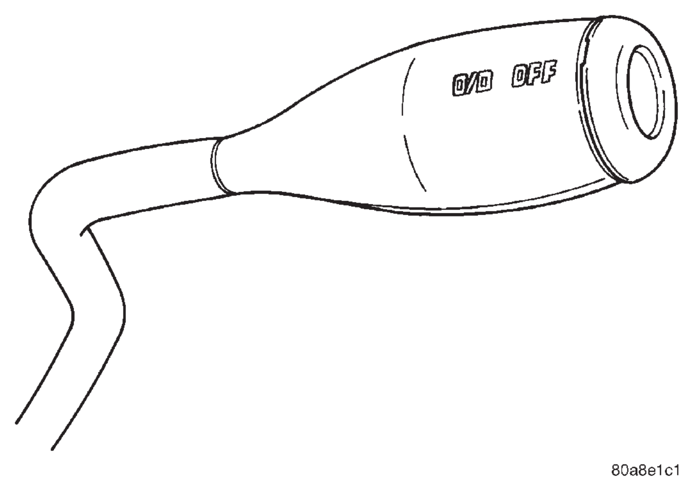


Fig. 124 Overdrive Off Switch

DIAGNOSIS AND TESTING - OVERDRIVE ELECTRICAL CONTROLS

The overdrive off switch, valve body solenoid, case connectors and related wiring can all be tested with a 12 volt test lamp or a volt/ohmmeter. Check continuity of each component when diagnosis indicates this is necessary.

Switch and solenoid continuity should be checked whenever the transmission fails to shift into fourth gear range.

OVERDRIVE SWITCH (Continued)

REMOVAL

(1) Using a plastic trim tool, remove the overdrive off switch retainer from the shift lever (Fig. 125).

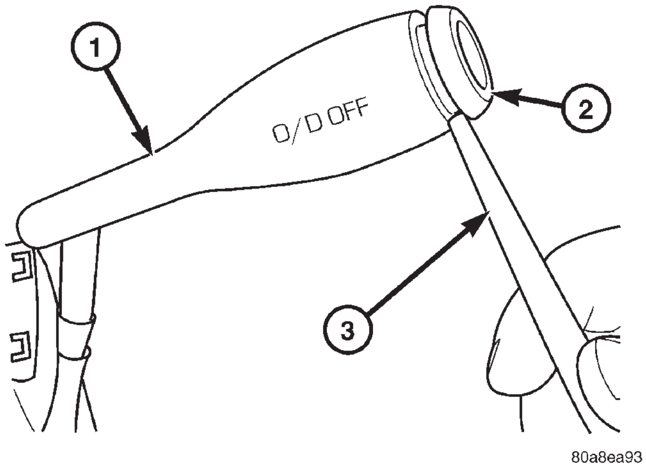


Fig. 125 Overdrive Off Switch Retainer

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH RETAINER
3 - PLASTIC TRIM TOOL

(2) Pull the switch outwards to release it from the connector in the lever (Fig. 126)

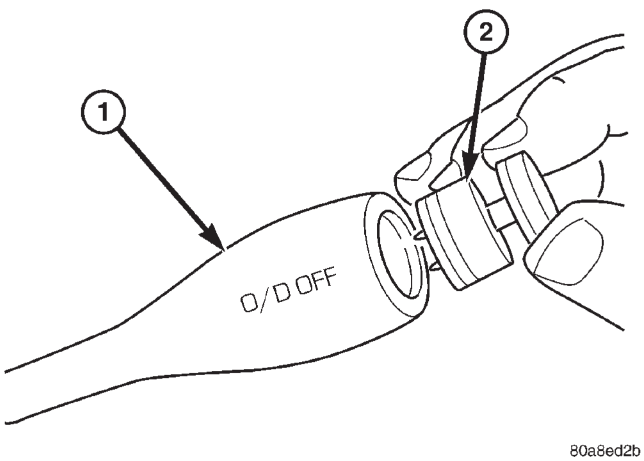


Fig. 126 Remove the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH

INSTALLATION

NOTE: There is enough slack in the wire to pull out the connector from the lever.

(1) Pull the connector out of the lever just enough to grasp it.

CAUTION: Be careful not to bend the pins on the overdrive off switch. Use care when installing the switch, as it is not indexed, and can be accidentally installed incorrectly.

(2) Install the overdrive off switch into the connector (Fig. 127)

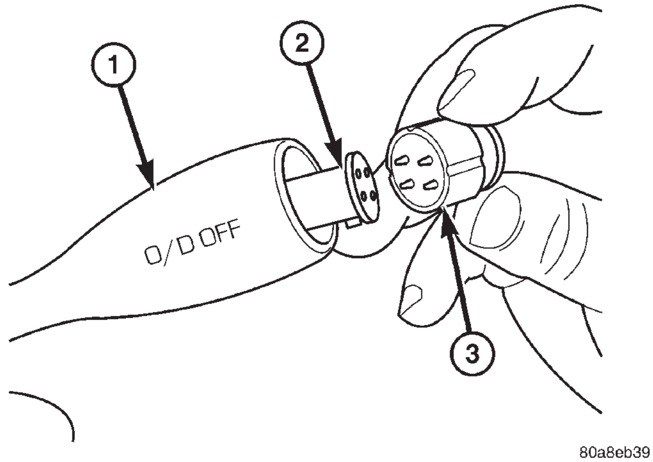


Fig. 127 Install the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH WIRING CONNECTOR
3 - OVERDRIVE OFF SWITCH

(3) Push the overdrive off switch and wiring into the shift lever.
(4) Install the overdrive off switch retainer onto the shift lever.

OVERDRIVE UNIT

REMOVAL

(1) Shift transmission into PARK.
(2) Raise vehicle.
(3) Remove transfer case, if equipped.
(4) Mark propeller shaft universal joint(s) and axle pinion yoke, or the companion flange and flange yoke, for alignment reference at installation, if neccesary.
(5) Disconnect and remove the rear propeller shaft, if necessary. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)
(6) Remove transmission oil pan, remove gasket, drain oil and reinstall pan.
(7) If overdrive unit had malfunctioned, or if fluid is contaminated, remove entire transmission. If diagnosis indicated overdrive problems only, remove just the overdrive unit.
(8) Support transmission with transmission jack.

OVERDRIVE UNIT (Continued)

(9) Remove bolts attaching overdrive unit to transmission (Fig. 128).

CAUTION: Support the overdrive unit with a jack before moving it rearward. This is necessary to prevent damaging the intermediate shaft. Do not allow the shaft to support the entire weight of the overdrive unit.

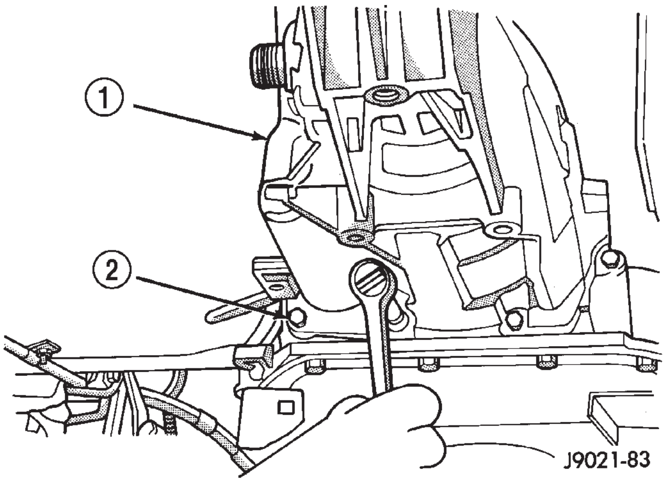


Fig. 128 Overdrive Unit Bolts

1 - OVERDRIVE UNIT
2 - ATTACHING BOLTS (7)

(10) Carefully work overdrive unit off intermediate shaft. Do not tilt unit during removal. Keep it as level as possible.

(11) If overdrive unit does not require service, immediately insert Alignment Tool 6227-2 in splines of planetary gear and overrunning clutch to prevent splines from rotating out of alignment. If misalignment occurs, overdrive unit will have to be disassembled in order to realign splines.

(12) Remove and retain overdrive piston thrust bearing. Bearing may remain on piston or in clutch hub during removal.

(13) Position drain pan on workbench.

(14) Place overdrive unit over drain pan. Tilt unit to drain residual fluid from case.

(15) Examine fluid for clutch material or metal fragments. If fluid contains these items, overhaul will be necessary.

(16) If overdrive unit does not require any service, leave alignment tool in position. Tool will prevent accidental misalignment of planetary gear and overrunning clutch splines.

DISASSEMBLY

(1) Remove transmission speed sensor and O-ring seal from overdrive case (Fig. 129).

(2) Remove overdrive piston thrust bearing (Fig. 130).

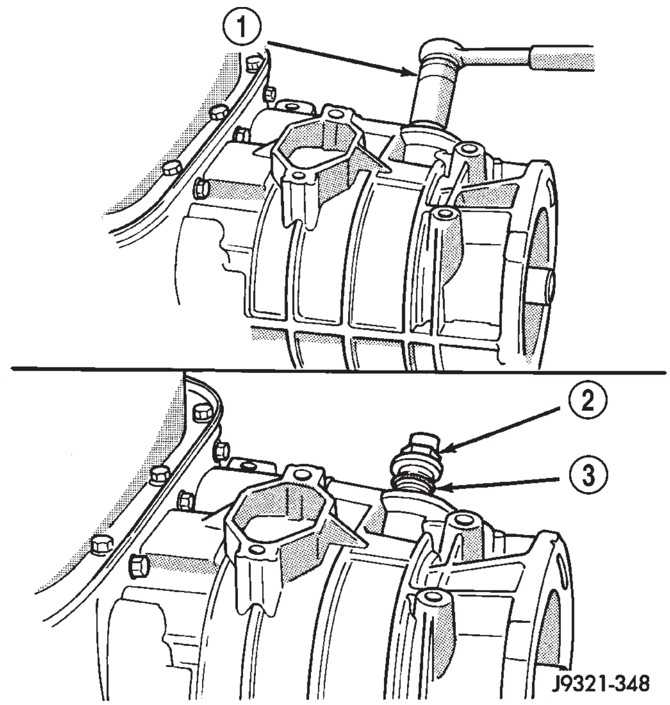


Fig. 129 Transmission Speed Sensor Removal

1 - SOCKET AND WRENCH
2 - SPEED SENSOR
3 - O-RING

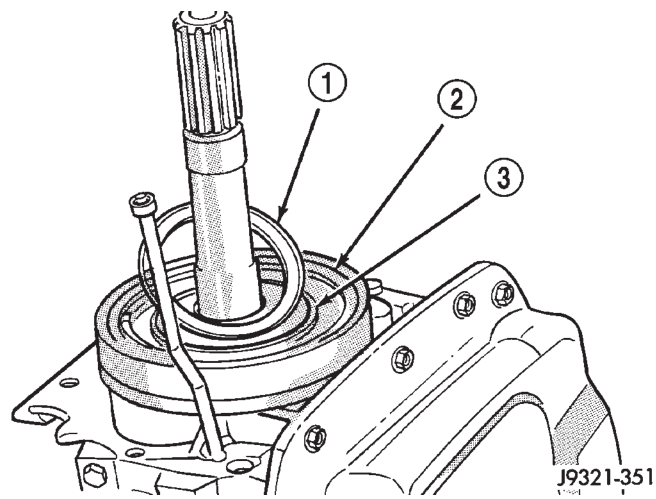


Fig. 130 Overdrive Piston Thrust Bearing Removal

1 - THRUST BEARING
2 - OVERDRIVE PISTON
3 - THRUST PLATE

OVERDRIVE PISTON

(1) Remove overdrive piston thrust plate (Fig. 131). Retain thrust plate. It is a select fit part and may possibly be reused.

(2) Remove intermediate shaft spacer (Fig. 132). Retain spacer. It is a select fit part and may possibly be reused.

OVERDRIVE UNIT (Continued)

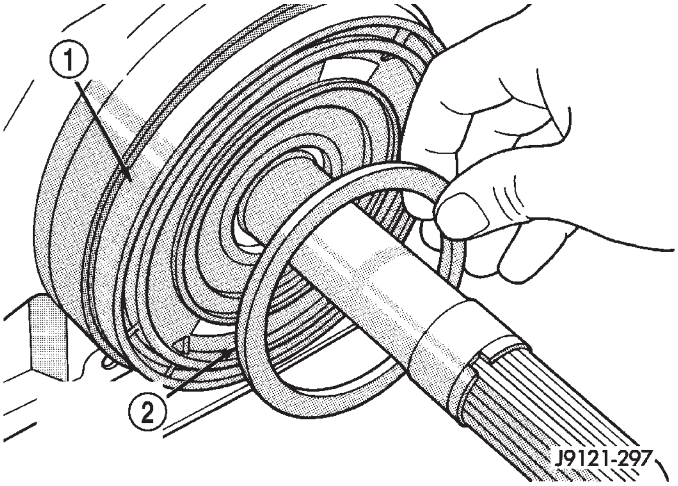


Fig. 131 Overdrive Piston Thrust Plate Removal

1 - OVERDRIVE PISTON
2 - OVERDRIVE PISTON SPACER (SELECT FIT)

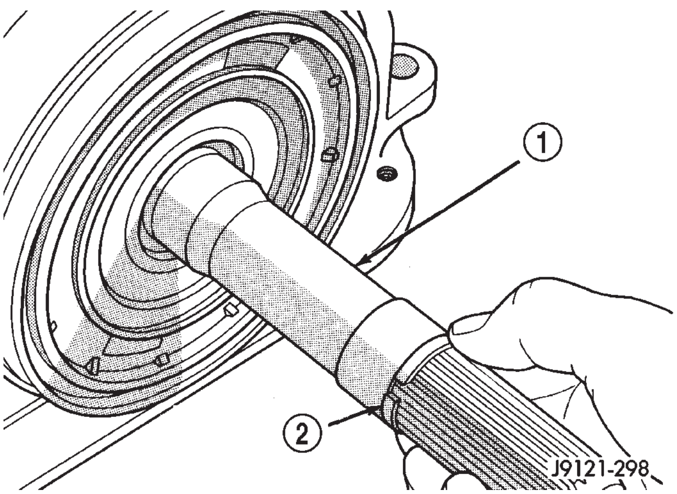


Fig. 132 Intermediate Shaft Spacer Location

1 - INTERMEDIATE SHAFT
2 - INTERMEDIATE SHAFT SPACER (SELECT FIT)

(3) Remove overdrive piston from retainer (Fig. 133).

OVERDRIVE CLUTCH PACK

(1) Remove overdrive clutch pack wire retaining ring (Fig. 134).

(2) Remove overdrive clutch pack (Fig. 135).

NOTE: The 42RE transmission has three clutch discs and two clutch plates.

(3) Note position of clutch pack components for assembly reference (Fig. 136).

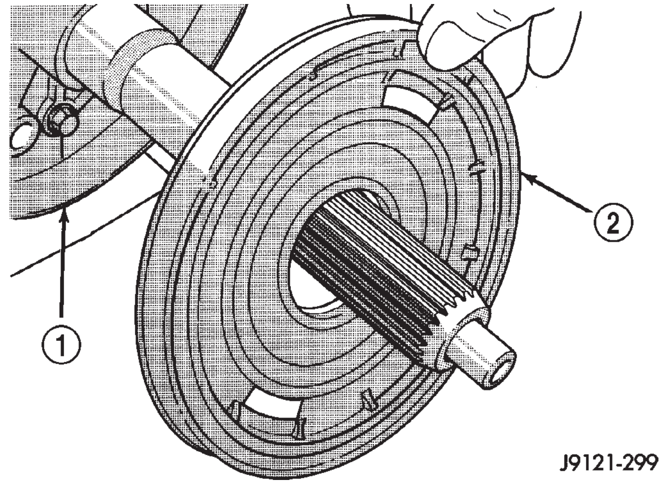


Fig. 133 Overdrive Piston Removal

1 - PISTON RETAINER
2 - OVERDRIVE PISTON

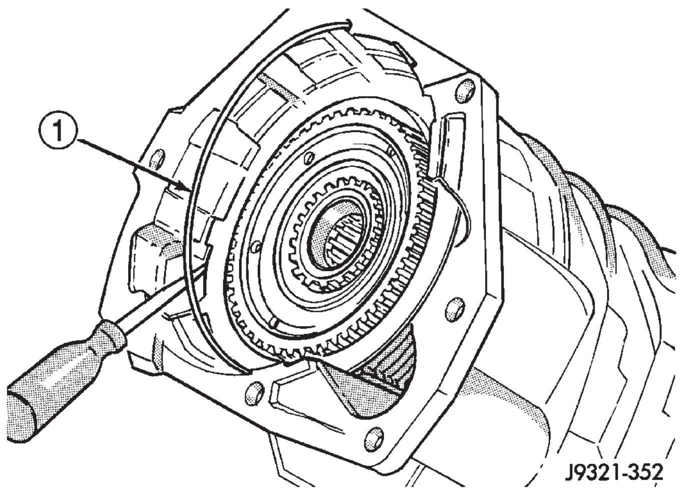


Fig. 134 Removing Overdrive Clutch Pack Retaining Ring

1 - OVERDRIVE CLUTCH PACK RETAINING RING

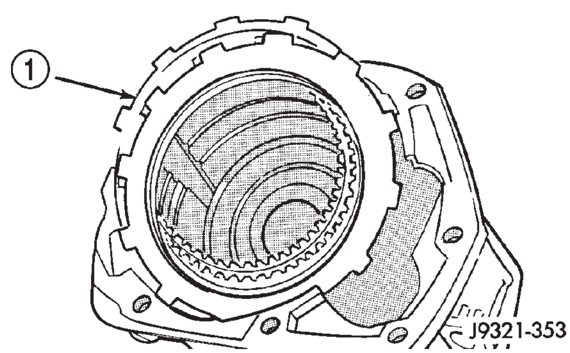


Fig. 135 Overdrive Clutch Pack Removal

1 - OVERDRIVE CLUTCH PACK

OVERDRIVE UNIT (Continued)

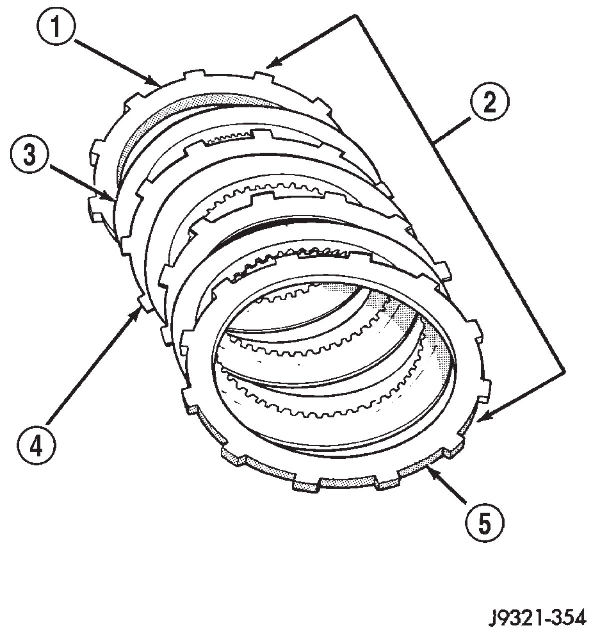


Fig. 136 42RE Overdrive Clutch Component Position

1 - PRESSURE PLATE (TO FRONT)
2 - OVERDRIVE CLUTCH PACK
3 - CLUTCH DISC (3)
4 - CLUTCH PLATE (2)
5 - REACTION PLATE (TO REAR)

OVERDRIVE GEARTRAIN

(1) Remove overdrive clutch wave spring (Fig. 137).

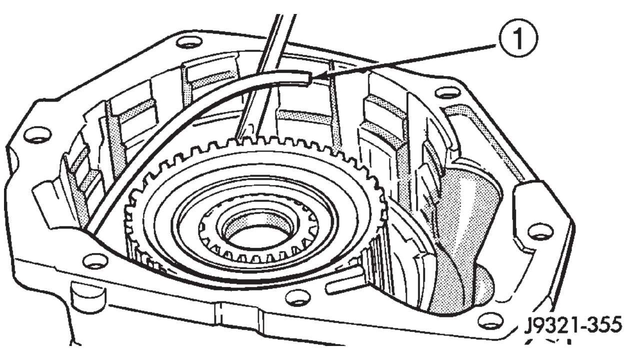


Fig. 137 Overdrive Clutch Wave

1 - WAVE SPRING

(2) Remove overdrive clutch reaction snap-ring (Fig. 138). Note that snap-ring is located in same groove as wave spring.

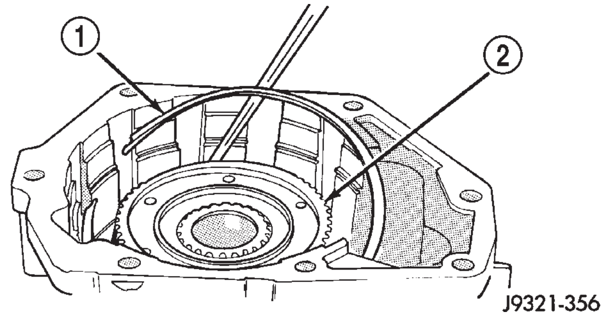


Fig. 138 Overdrive Clutch Reaction Snap-Ring Removal

1 - REACTION RING
2 - CLUTCH HUB

(3) Remove Torx™ head screws that attach access cover and gasket to overdrive case (Fig. 139).

(4) Remove access cover and gasket (Fig. 140).

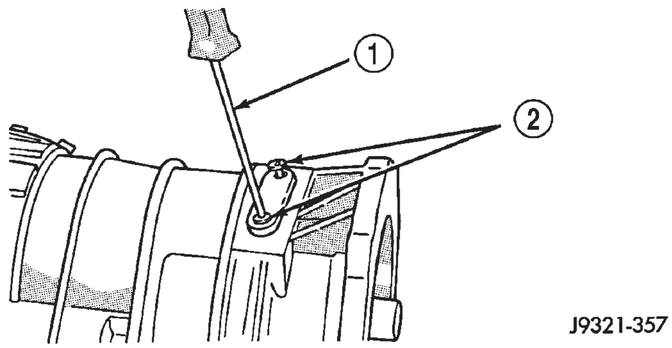


Fig. 139 Access Cover Screw Removal

1 - TORX SCREWDRIVER (T25)
2 - ACCESS COVER SCREWS

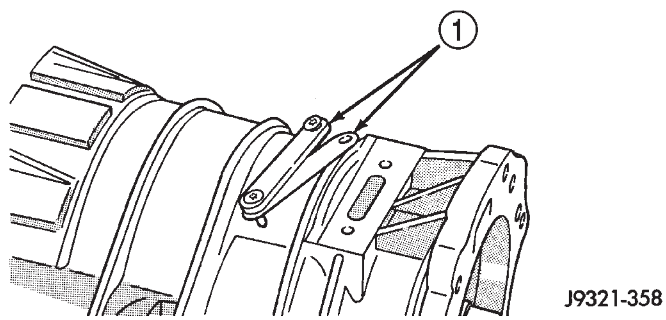


Fig. 140 Access Cover And Gasket Removal

1 - ACCESS COVER AND GASKET

OVERDRIVE UNIT (Continued)

(5) Expand output shaft bearing snap-ring with expanding-type snap-ring pliers. Then push output shaft forward to release shaft bearing from locating ring (Fig. 141).

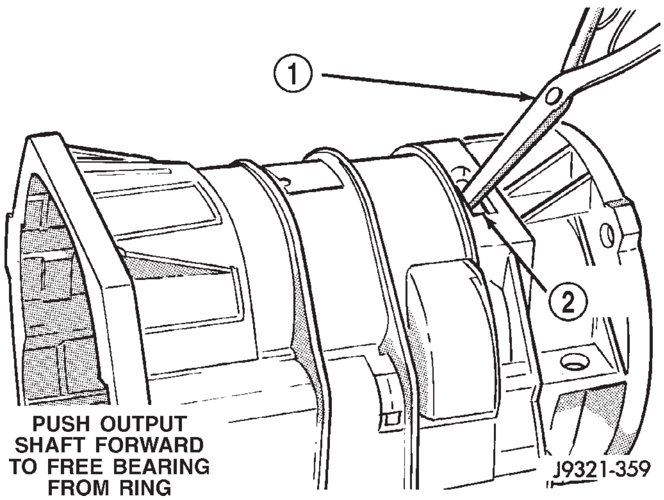


Fig. 141 Releasing Bearing From Locating Ring

1 - EXPAND BEARING LOCATING RING WITH SNAP-RING PLIERS
2 - ACCESS HOLE

(6) Lift gear case up and off geartrain assembly (Fig. 142).

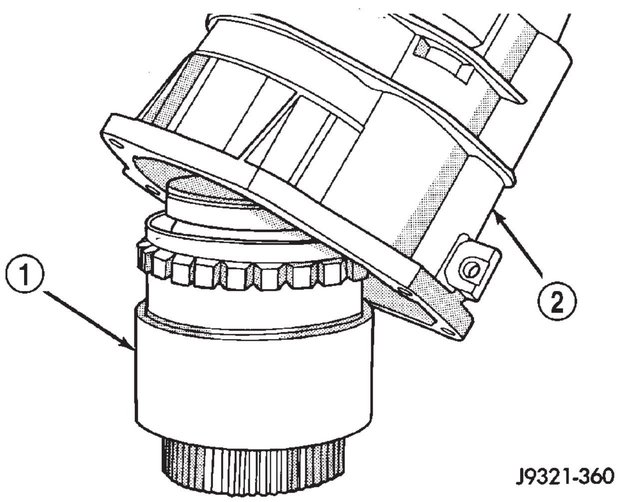


Fig. 142 Removing Gear Case From Geartrain Assembly

1 - GEARTRAIN ASSEMBLY
2 - GEAR CASE

(7) Remove snap-ring that retains rear bearing on output shaft.

(8) Remove rear bearing from output shaft (Fig. 143).

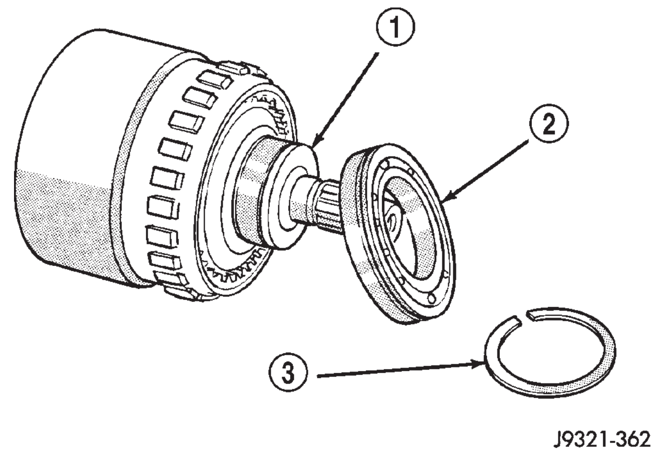


Fig. 143 Rear Bearing Removal

1 - OUTPUT SHAFT
2 - REAR BEARING
3 - SNAP-RING

DIRECT CLUTCH, HUB AND SPRING

WARNING: THE NEXT STEP IN DISASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE SPRING COMPRESSOR TOOL 6227-1 AND A HYDRAULIC SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 5-6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(1) Mount geartrain assembly in shop press (Fig. 144).

(2) Position Compressor Tool 6227-1 on clutch hub (Fig. 144). Support output shaft flange with steel press plates as shown and center assembly under press ram.

(3) Apply press pressure slowly. Compress hub and spring far enough to expose clutch hub retaining ring and relieve spring pressure on clutch pack snap-ring (Fig. 144).

OVERDRIVE UNIT (Continued)

(4) Remove direct clutch pack snap-ring (Fig. 145).

(5) Remove direct clutch hub retaining ring (Fig. 146).

(6) Release press load slowly and completely (Fig. 147).

(7) Remove Special Tool 6227-1. Then remove clutch pack from hub (Fig. 147).

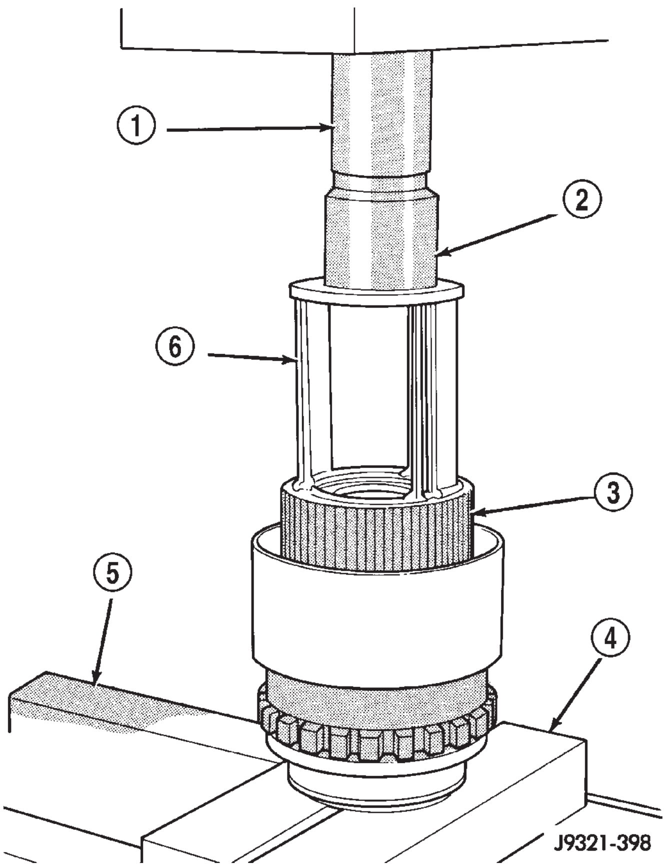


Fig. 144 Geartrain Mounted In Shop Press

1 - PRESS RAM
2 - SPECIAL TOOL C-3995-A (OR SIMILAR TOOL)
3 - CLUTCH HUB
4 - PLATES
5 - PRESS BED
6 - SPECIAL TOOL 6227-1

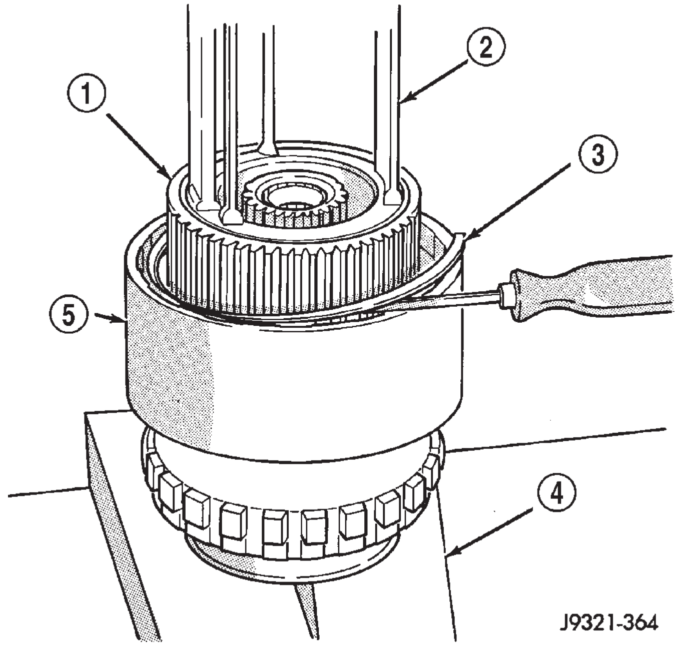


Fig. 145 Direct Clutch Pack Snap-Ring Removal

1 - CLUTCH HUB
2 - SPECIAL TOOL 6227-1
3 - DIRECT CLUTCH PACK SNAP-RING
4 - PRESS PLATES
5 - CLUTCH DRUM

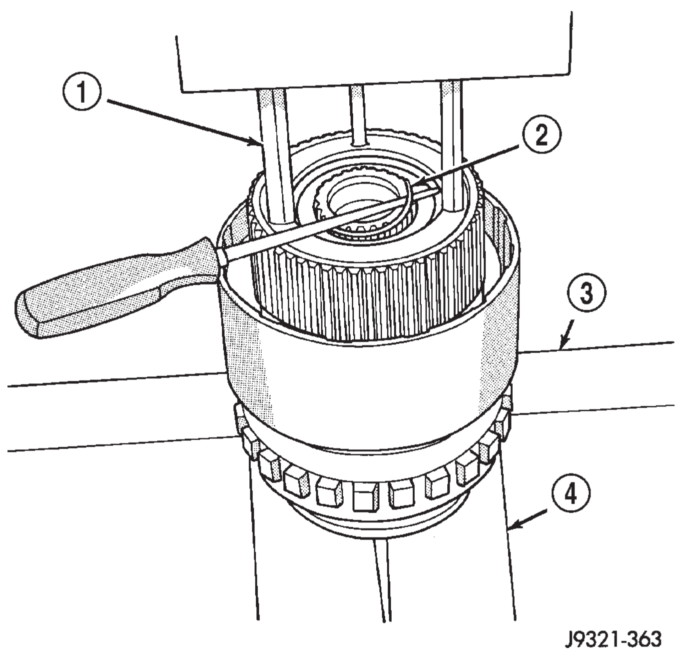


Fig. 146 Direct Clutch Hub Retaining Ring Removal

1 - SPECIAL TOOL 6227-1
2 - CLUTCH HUB RETAINING RING
3 - PRESS BED
4 - PRESS PLATES

OVERDRIVE UNIT (Continued)

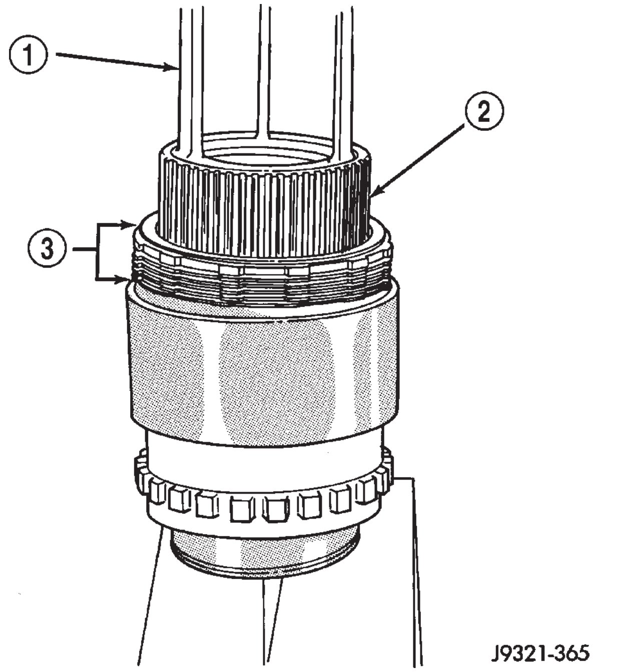


Fig. 147 Direct Clutch Pack Removal

1 - SPECIAL TOOL 6227-1
2 - DIRECT CLUTCH HUB
3 - DIRECT CLUTCH PACK

GEARTRAIN

(1) Remove direct clutch hub and spring (Fig. 148).

(2) Remove sun gear and spring plate. Then remove planetary thrust bearing and planetary gear (Fig. 149).

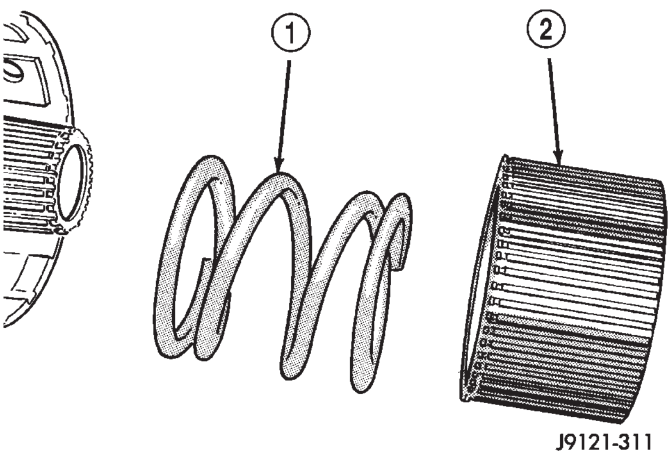


Fig. 148 Direct Clutch Hub And Spring Removal

1 - DIRECT CLUTCH SPRING
2 - DIRECT CLUTCH HUB

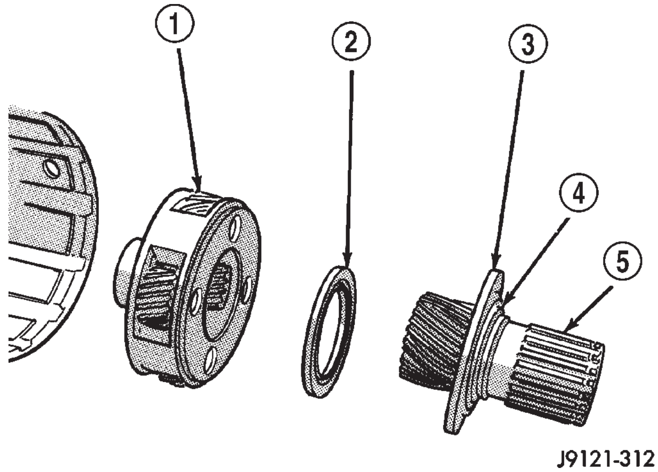


Fig. 149 Removing Sun Gear, Thrust Bearing And Planetary Gear

1 - PLANETARY GEAR
2 - PLANETARY THRUST BEARING
3 - CLUTCH SPRING PLATE
4 - SPRING PLATE SNAP-RING
5 - SUN GEAR

(3) Remove overrunning clutch assembly with expanding type snap-ring pliers (Fig. 150). Insert pliers into clutch hub. Expand pliers to grip hub splines and remove clutch with counterclockwise, twisting motion.

(4) Remove thrust bearing from overrunning clutch hub.

(5) Remove overrunning clutch from hub.

(6) Mark position of annulus gear and direct clutch drum for assembly alignment reference (Fig. 151). Use small center punch or scriber to make alignment marks.

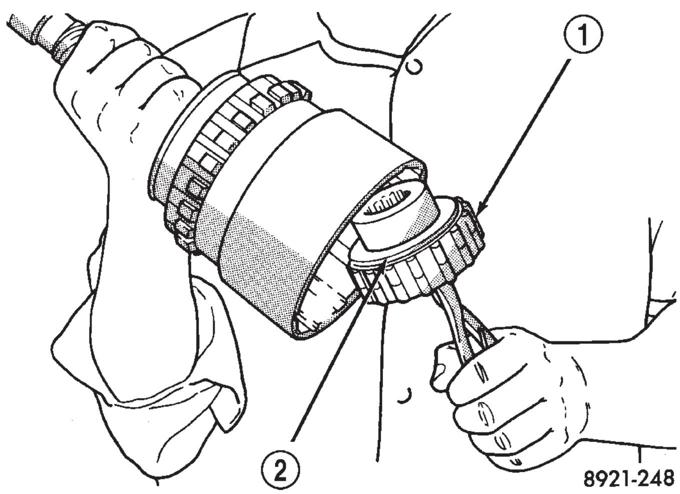


Fig. 150 Overrunning Clutch

1 - OVERRUNNING CLUTCH
2 - NEEDLE BEARING

OVERDRIVE UNIT (Continued)

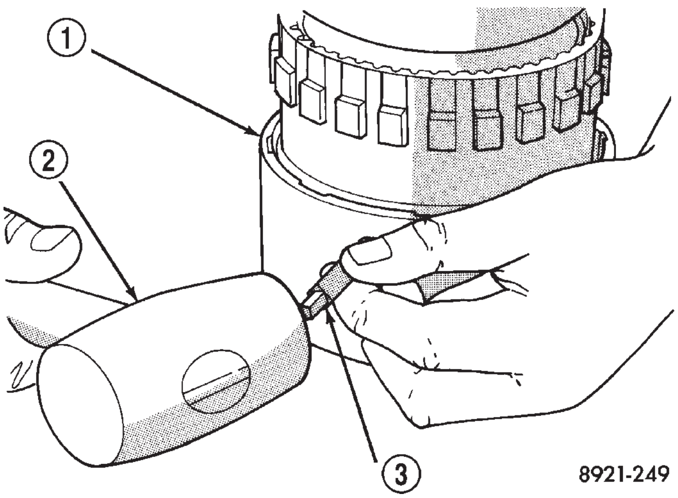


Fig. 151 Marking Direct Clutch Drum And Annulus Gear For Assembly Alignment

1 - DIRECT CLUTCH DRUM
2 - HAMMER
3 - PUNCH

(7) Remove direct clutch drum rear retaining ring (Fig. 152).

(8) Remove direct clutch drum outer retaining ring (Fig. 153).

(9) Mark annulus gear and output shaft for assembly alignment reference (Fig. 154). Use punch or scriber to mark gear and shaft.

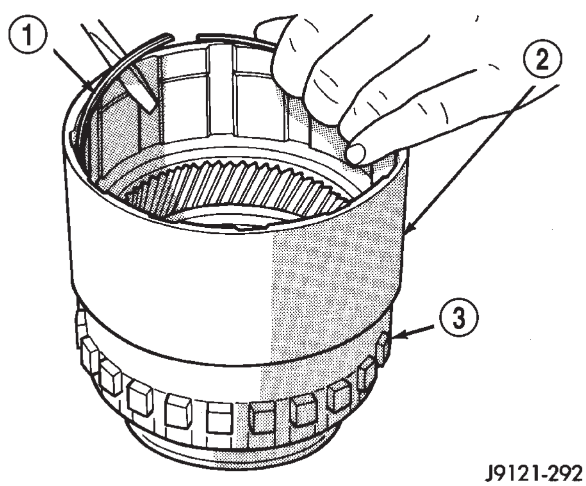


Fig. 152 Clutch Drum Inner Retaining Ring Removal

1 - INNER RETAINING RING
2 - DIRECT CLUTCH DRUM
3 - ANNULUS GEAR

(10) Remove snap-ring that secures annulus gear on output shaft (Fig. 155). Use two screwdrivers to unseat and work snap-ring out of groove as shown.

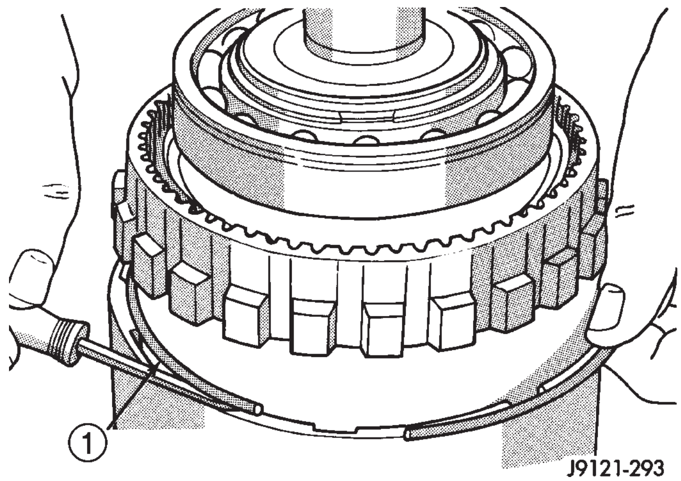


Fig. 153 Clutch Drum Outer Retaining Ring Removal

1 - OUTER RETAINING RING

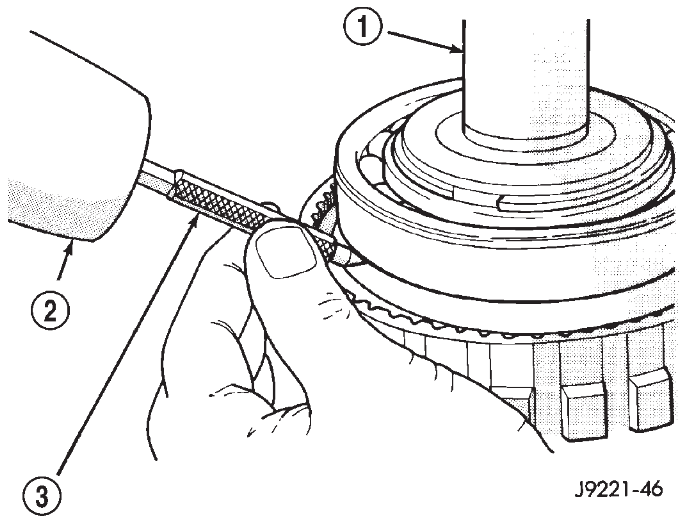


Fig. 154 Marking Annulus Gear And Output Shaft For Assembly Alignment

1 - OUTPUT SHAFT
2 - HAMMER
3 - PUNCH

(11) Remove annulus gear from output shaft (Fig. 156). Use rawhide or plastic mallet to tap gear off shaft.

GEAR CASE AND PARK LOCK

(1) Remove locating ring from gear case.

(2) Remove park pawl shaft retaining bolt and remove shaft, pawl and spring.

(3) Remove reaction plug snap-ring and remove reaction plug.

(4) Remove output shaft seal.

OVERDRIVE UNIT (Continued)

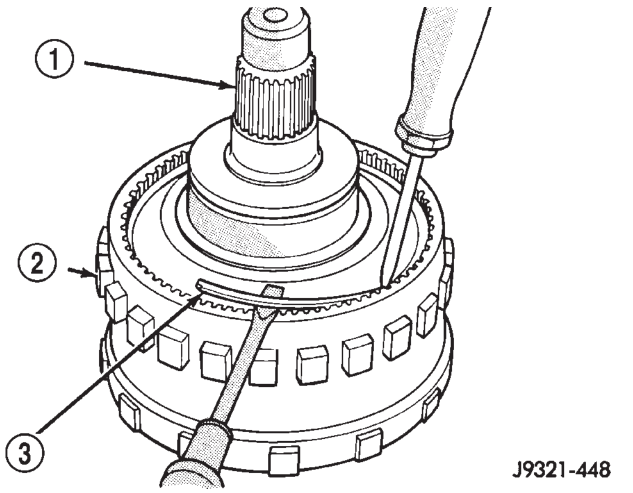


Fig. 155 Annulus Gear Snap-Ring Removal

1 - OUTPUT SHAFT
2 - ANNULUS GEAR
3 - SNAP-RING

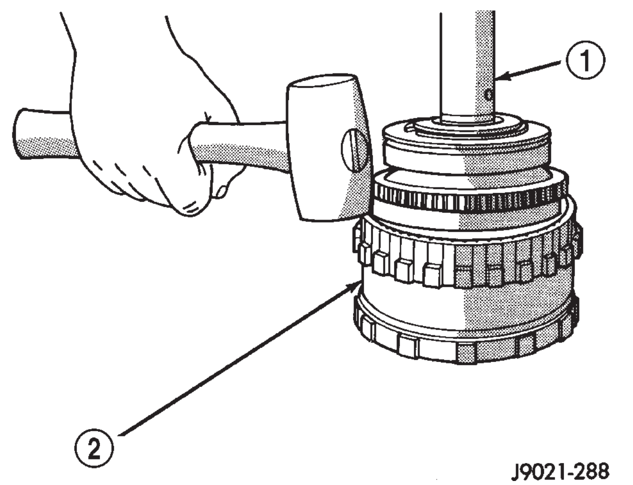


Fig. 156 Annulus Gear Removal

1 - OUTPUT SHAFT
2 - ANNULUS GEAR

CLEANING

Clean the geartrain and case components with solvent. Dry all parts except the bearings with compressed air. Allow bearings to air dry.

Do not use shop towels for wiping parts dry unless the towels are made from a lint-free material. A sufficient quantity of lint (from shop towels, cloths, rags, etc.) could plug the transmission filter and fluid passages.

Discard the old case gasket and seals. Do not attempt to salvage these parts. They are not reusable. Replace any of the overdrive unit snap-rings if distorted or damaged.

Minor nicks or scratches on components can be smoothed with crocus cloth. However, do not attempt to reduce severe scoring on any components with abrasive materials. Replace severely scored components; do not try to salvage them.

INSPECTION

Check condition of the park lock components and the overdrive case.

Check the bushings in the overdrive case. Replace the bushings if severely scored or worn. Also replace the case seal if loose, distorted, or damaged.

Examine the overdrive and direct clutch discs and plates. Replace the discs if the facing is worn, severely scored, or burned and flaking off. Replace the clutch plates if worn, heavily scored, or cracked. Check the lugs on the clutch plates for wear. The plates should slide freely in the drum. Replace the plates or drum if binding occurs.

Check condition of the annulus gear, direct clutch hub, clutch drum and clutch spring. Replace the gear, hub and drum if worn or damaged. Replace the spring if collapsed, distorted, or cracked.

Be sure the splines and lugs on the gear, drum and hub are in good condition. The clutch plates and discs should slide freely in these components.

Inspect the thrust bearings and spring plate. Replace the plate if worn or scored. Replace the bearings if rough, noisy, brinnelled, or worn.

Inspect the planetary gear assembly and the sun gear and bushings. If either the sun gear or the bushings are damaged, replace the gear and bushings as an assembly. The gear and bushings are not serviced separately.

The planetary carrier and pinions must be in good condition. Also be sure the pinion pins are secure and in good condition. Replace the carrier if worn or damaged.

Inspect the overrunning clutch and race. The race surface should be smooth and free of scores. Replace the overrunning clutch assembly or the race if either assembly is worn or damaged in any way.

Replace the shaft pilot bushing and inner bushing if damaged. Replace either shaft bearing if rough or noisy. Replace the bearing snap-rings if distorted or cracked.

Check the machined surfaces on the output shaft. These surfaces should clean and smooth. Very minor nicks or scratches can be smoothed with crocus cloth. Replace the shaft if worn, scored or damaged in any way.

Inspect the output shaft bushings. The small bushing is the intermediate shaft pilot bushing. The large bushing is the overrunning clutch hub bushing. Replace either bushing if scored, pitted, cracked, or worn.

OVERDRIVE UNIT (Continued)

ASSEMBLY

GEARTRAIN AND DIRECT CLUTCH

(1) Soak direct clutch and overdrive clutch discs in Mopar® ATF +4, type 9602, transmission fluid. Allow discs to soak for 10-20 minutes.

(2) Install new pilot bushing and clutch hub bushing in output shaft if necessary (Fig. 157). Lubricate bushings with petroleum jelly, or transmission fluid.

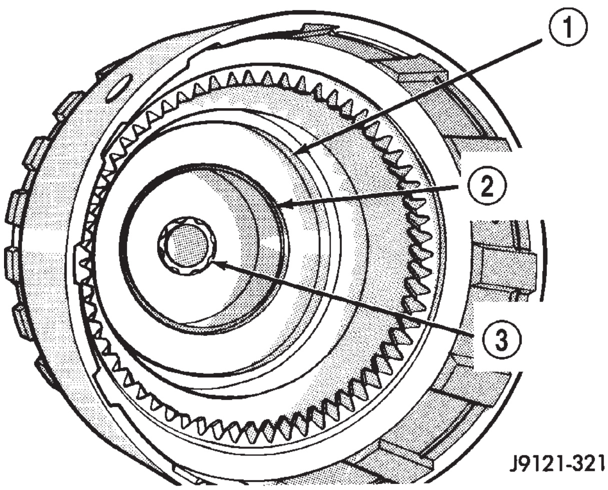


Fig. 157 Output Shaft Pilot Bushing

1 - OUTPUT SHAFT HUB
2 - OVERRUNNING CLUTCH HUB BUSHING
3 - INTERMEDIATE SHAFT PILOT BUSHING

(3) Install annulus gear on output shaft, if removed. Then install annulus gear retaining snap-ring (Fig. 158).

(4) Align and install clutch drum on annulus gear (Fig. 159). Be sure drum is engaged in annulus gear lugs.

(5) Install clutch drum outer retaining ring (Fig. 159).

(6) Slide clutch drum forward and install inner retaining ring (Fig. 160).

(7) Install rear bearing and snap-ring on output shaft (Fig. 161). Be sure locating ring groove in bearing is toward rear.

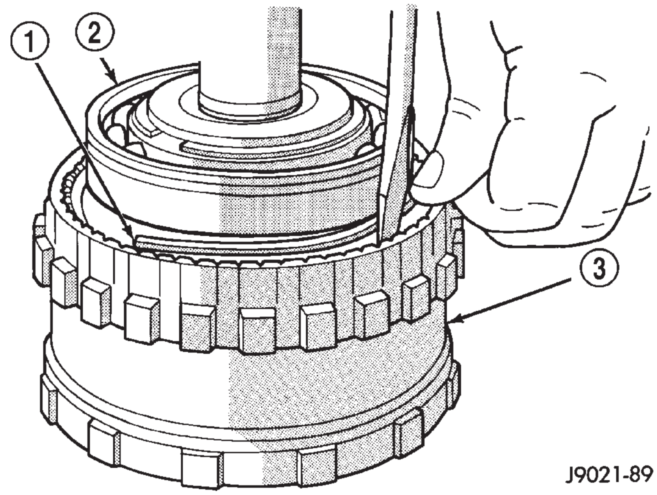


Fig. 158 Annulus Gear Installation

1 - SNAP-RING
2 - OUTPUT SHAFT FRONT BEARING
3 - ANNULUS GEAR

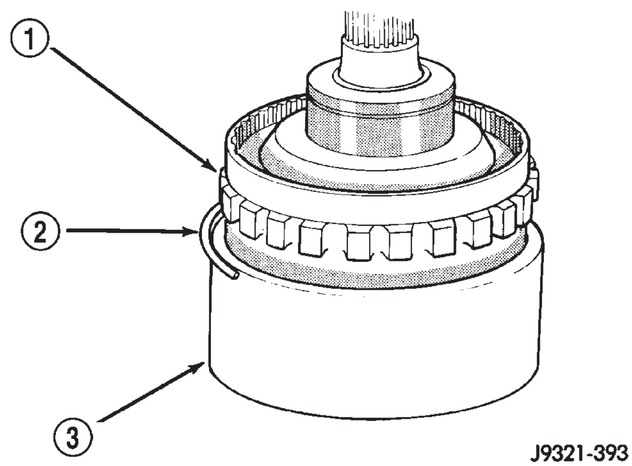


Fig. 159 Clutch Drum And Outer Retaining Ring Installation

1 - ANNULUS GEAR
2 - OUTER SNAP-RING
3 - CLUTCH DRUM

OVERDRIVE UNIT (Continued)

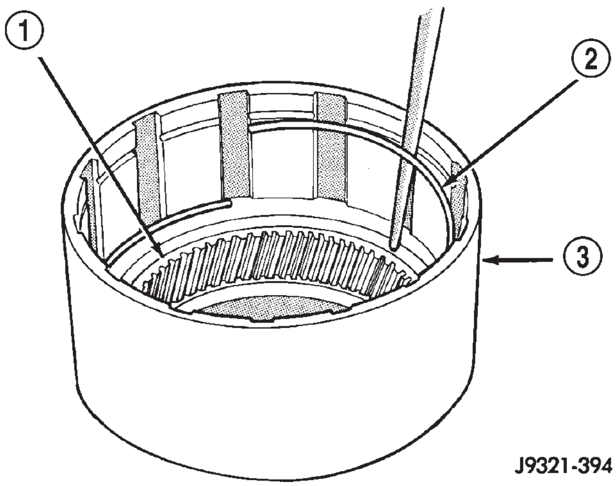


Fig. 160 Clutch Drum Inner Retaining Ring Installation

1 - ANNULUS GEAR
2 - INNER SNAP-RING
3 - CLUTCH DRUM

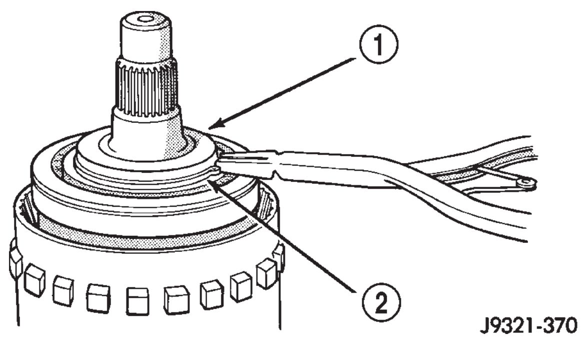


Fig. 161 Rear Bearing And Snap-Ring Installation

1 - REAR BEARING
2 - SNAP-RING

(8) Install overrunning clutch on hub (Fig. 162). Note that clutch only fits one-way. Shoulder on clutch should seat in small recess at edge of hub.

(9) Install thrust bearing on overrunning clutch hub. Use generous amount of petroleum jelly to hold bearing in place for installation. Bearing fits one-way only. Be sure bearing is seated squarely against hub. Reinstall bearing if it does not seat squarely.

(10) Install overrunning clutch in output shaft (Fig. 163). Insert snap-ring pliers in hub splines. Expand pliers to grip hub. Then install assembly with counterclockwise, twisting motion.

(11) Install planetary gear in annulus gear (Fig. 164). Be sure planetary pinions are fully seated in annulus gear before proceeding.

(12) Coat planetary thrust bearing and bearing contact surface of spring plate with generous amount of petroleum jelly. This will help hold bearing in place during installation.

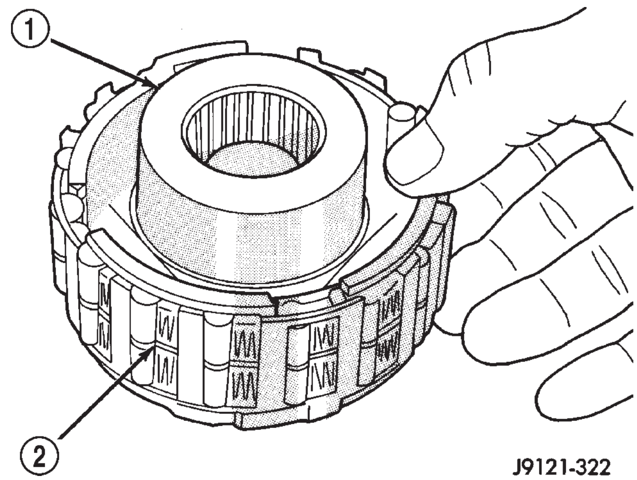


Fig. 162 Assembling Overrunning Clutch And Hub

1 - CLUTCH HUB
2 - OVERRUNNING CLUTCH

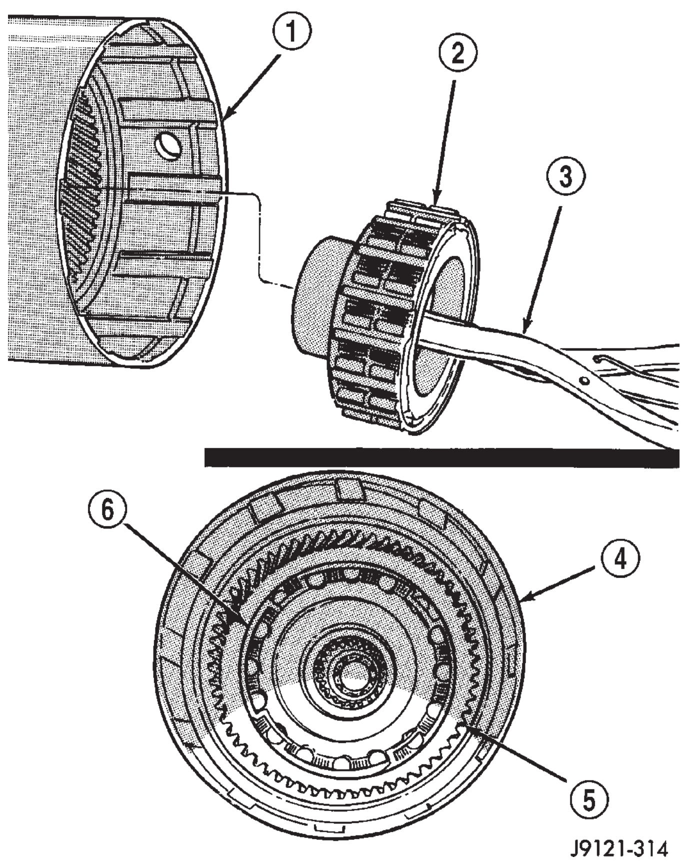


Fig. 163 Overrunning Clutch Installation

1 - CLUTCH DRUM
2 - OVERRUNNING CLUTCH ASSEMBLY
3 - EXPANDING-TYPE SNAP-RING PLIERS
4 - CLUTCH DRUM
5 - ANNULUS GEAR
6 - OVERRUNNING CLUTCH ASSEMBLY SEATED IN OUTPUT SHAFT

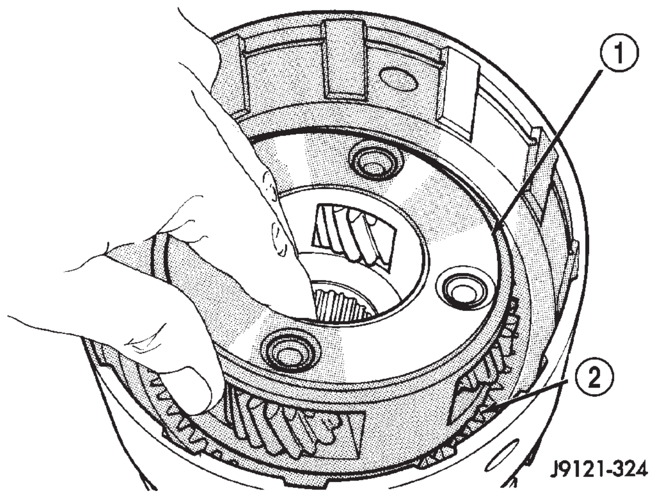


Fig. 164 Planetary Gear Installation

1 - PLANETARY GEAR
2 - ANNULUS GEAR

(13) Install planetary thrust bearing on sun gear (Fig. 165). Slide bearing onto gear and seat it against spring plate as shown. Bearing fits one-way only. If it does not seat squarely against spring plate, remove and reposition bearing.

(14) Install assembled sun gear, spring plate and thrust bearing (Fig. 166). Be sure sun gear and thrust bearing are fully seated before proceeding.

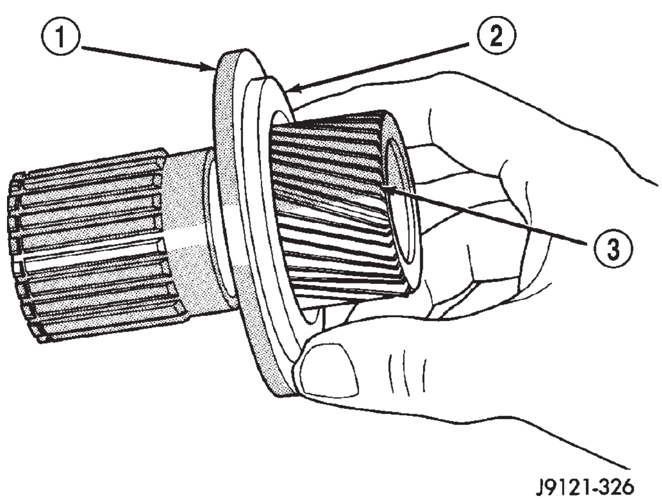


Fig. 165 Planetary Thrust Bearing Installation

1 - SPRING PLATE
2 - PLANETARY THRUST BEARING
3 - SUN GEAR

(15) Mount assembled output shaft, annulus gear, and clutch drum in shop press. Direct clutch spring, hub and clutch pack are easier to install with assembly mounted in press.

(16) Align splines in hubs of planetary gear and overrunning clutch with Alignment tool 6227-2 (Fig. 167). Insert tool through sun gear and into splines of both hubs. Be sure alignment tool is fully seated before proceeding.

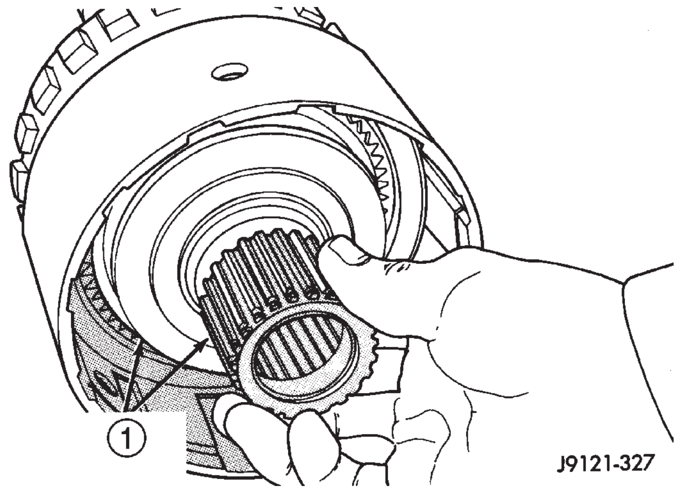


Fig. 166 Sun Gear Installation

1 - SUN GEAR AND SPRING PLATE ASSEMBLY

(17) Install direct clutch spring (Fig. 168). Be sure spring is properly seated on spring plate.

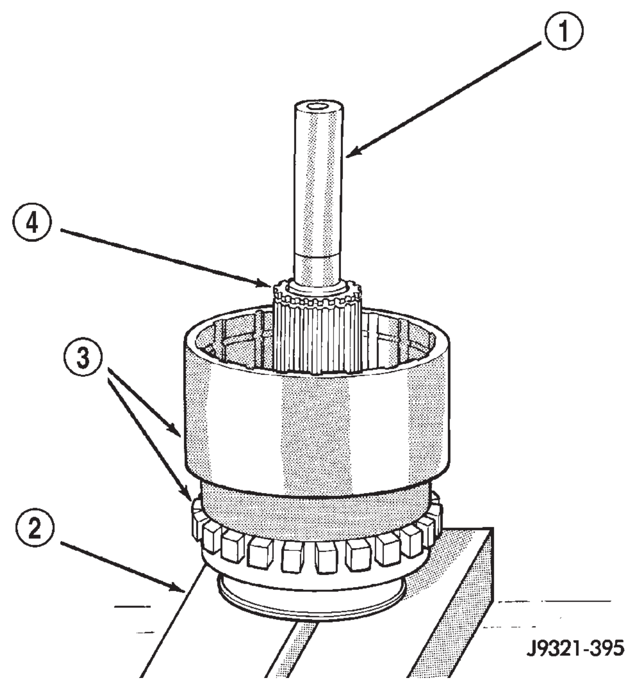


Fig. 167 Alignment Tool Installation

1 - SPECIAL TOOL 6227-2
2 - PRESS PLATES
3 - ASSEMBLED DRUM AND ANNULUS GEAR
4 - SUN GEAR

NOTE: The 42RE transmission has 6 direct clutch discs and 5 clutch plates.

OVERDRIVE UNIT (Continued)

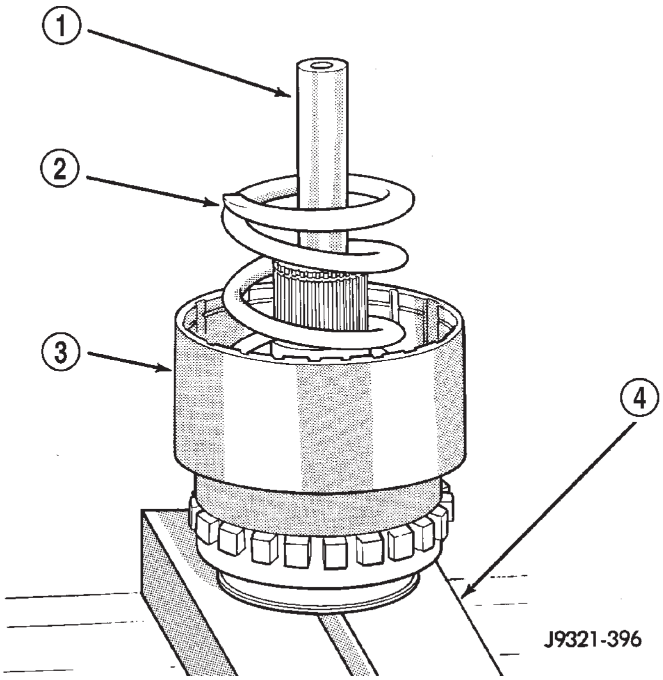


Fig. 168 Direct Clutch Spring Installation

1 - SPECIAL TOOL 6227-2
2 - DIRECT CLUTCH SPRING
3 - CLUTCH HUB
4 - PRESS PLATES

(18) Assemble and install direct clutch pack on hub as follows:

(a) Assemble clutch pack components (Fig. 169).

(b) Install direct clutch reaction plate on clutch hub first. Note that one side of reaction plate is counterbored. Be sure this side faces rearward. Splines at rear of hub are raised slightly. Counterbore in plate fits over raised splines. Plate should be flush with this end of hub (Fig. 170).

(c) Install first clutch disc followed by a steel plate until all discs and plates have been installed.

(d) Install pressure plate. This is last clutch pack item to be installed. Be sure plate is installed with shoulder side facing upward (Fig. 171).

(19) Install clutch hub and clutch pack on direct clutch spring (Fig. 172). Be sure hub is started on sun gear splines before proceeding.

WARNING: THE NEXT STEP IN GEARTRAIN ASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH HUB AND SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE COMPRESSOR TOOL C-6227-1 AND A HYDRAULIC-TYPE SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

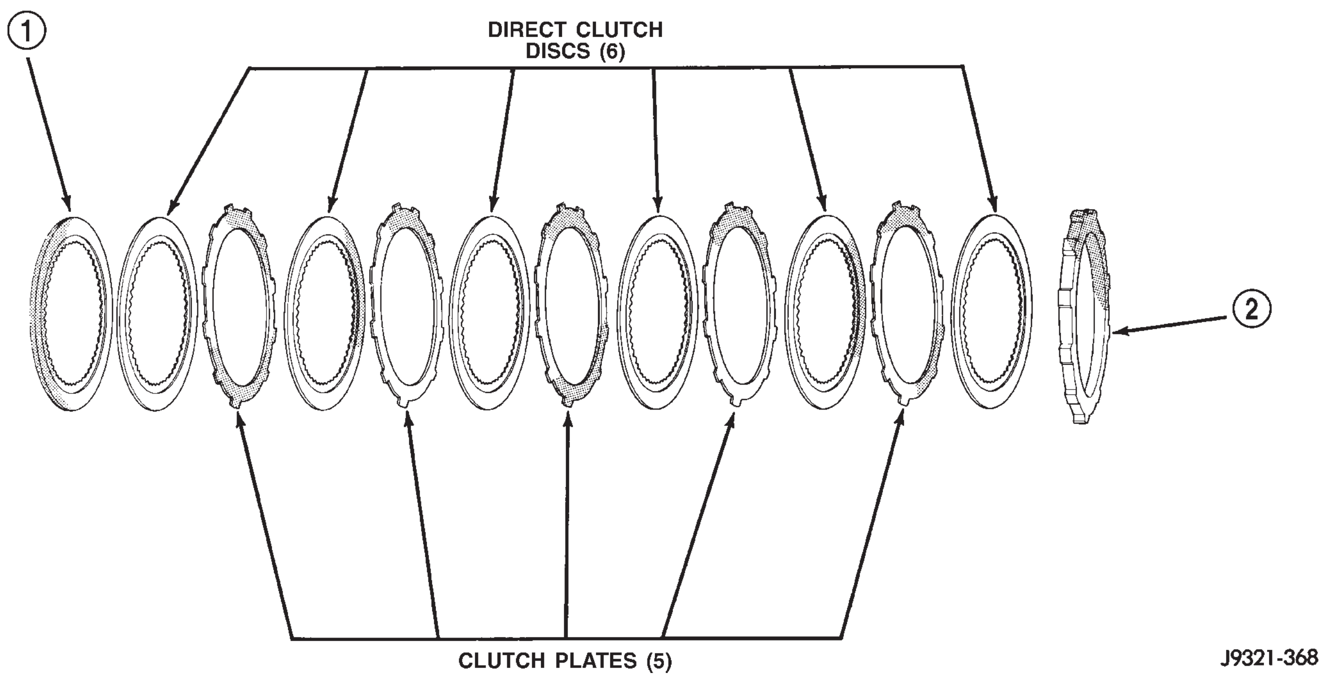


Fig. 169 42RE Direct Clutch Pack Components

1 - REACTION PLATE
2 - PRESSURE PLATE

OVERDRIVE UNIT (Continued)

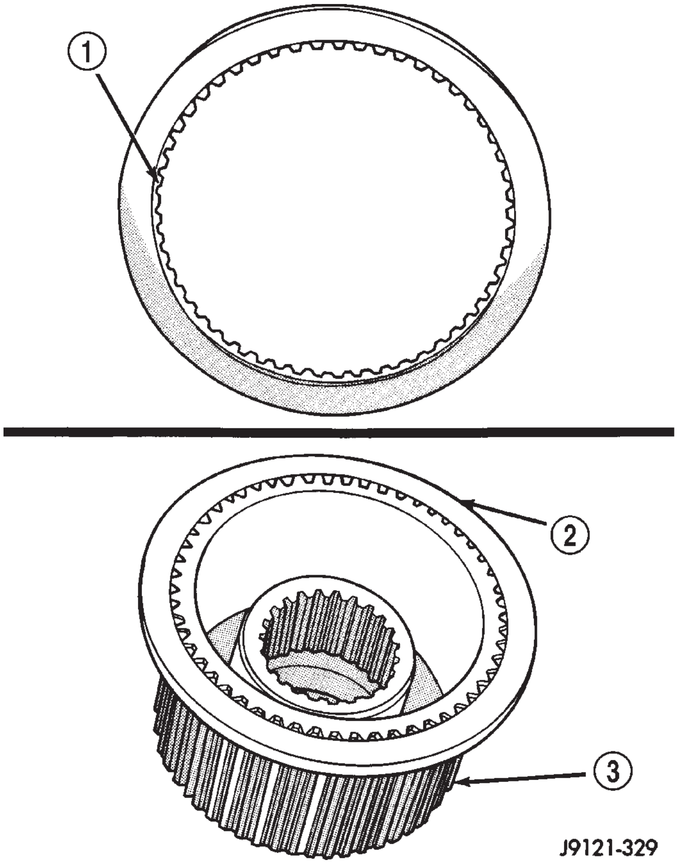


Fig. 170 Correct Position Of Direct Clutch Reaction Plate

1 - REACTION PLATE COUNTERBORE
2 - DIRECT CLUTCH REACTION PLATE (FLUSH WITH END OF HUB)
3 - CLUTCH HUB

(20) Position Compressor Tool 6227-1 on clutch hub.

(21) Compress clutch hub and spring just enough to place tension on hub and hold it in place.

(22) Slowly compress clutch hub and spring. Compress spring and hub only enough to expose ring grooves for clutch pack snap ring and clutch hub retaining ring.

(23) Realign clutch pack on hub and seat clutch discs and plates in clutch drum.

(24) Install direct clutch pack snap-ring (Fig. 173). Be very sure snap-ring is fully seated in clutch drum ring groove.

(25) Install clutch hub retaining ring (Fig. 174). Be very sure retaining ring is fully seated in sun gear ring groove.

(26) Slowly release press ram, remove compressor tools and remove geartrain assembly.

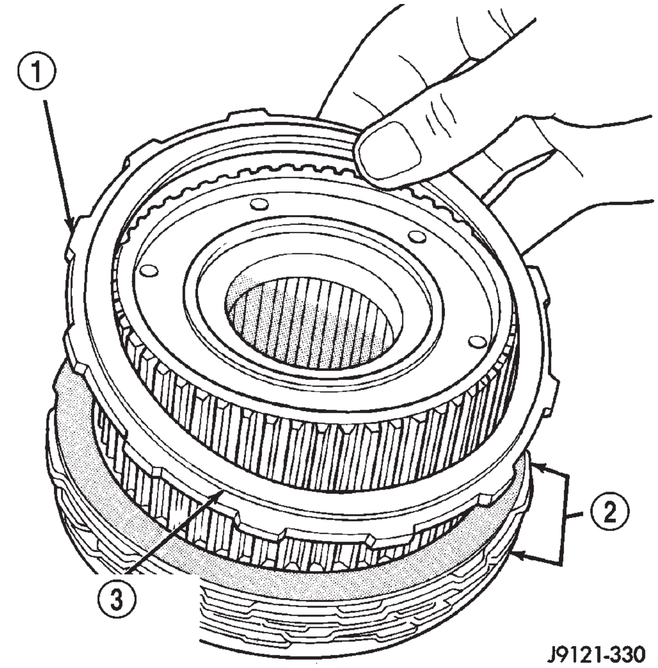


Fig. 171 Correct Position Of Direct Clutch Pressure Plate

1 - DIRECT CLUTCH PRESSURE PLATE
2 - CLUTCH PACK
3 - BE SURE SHOULDER SIDE OF PLATE FACES UPWARD

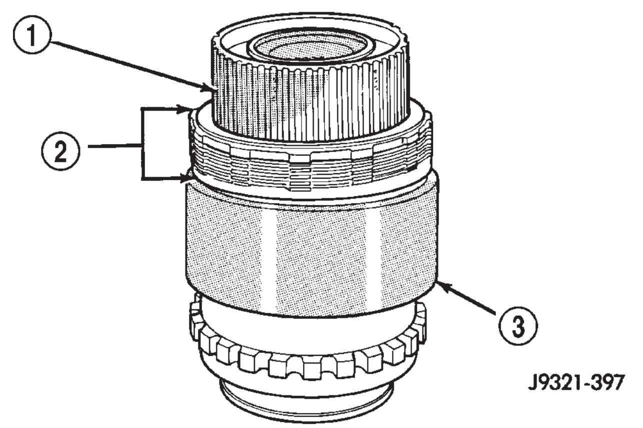


Fig. 172 Direct Clutch

1 - CLUTCH HUB
2 - DIRECT CLUTCH PACK
3 - CLUTCH DRUM

OVERDRIVE UNIT (Continued)

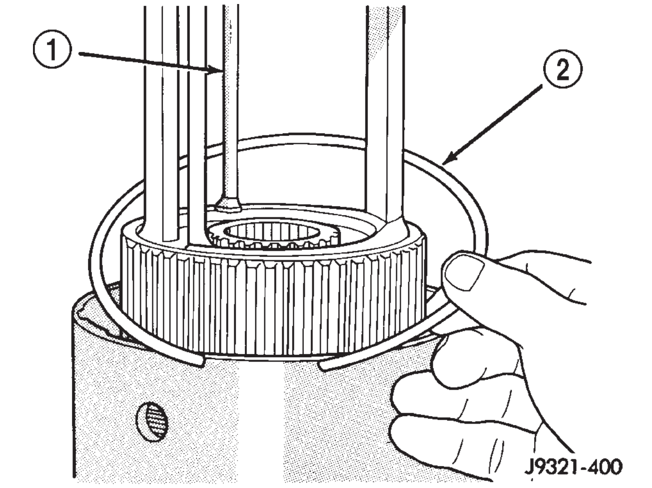


Fig. 173 Direct Clutch Pack Snap-Ring Installation

1 - SPECIAL TOOL 6227-1
2 - DIRECT CLUTCH PACK SNAP-RING

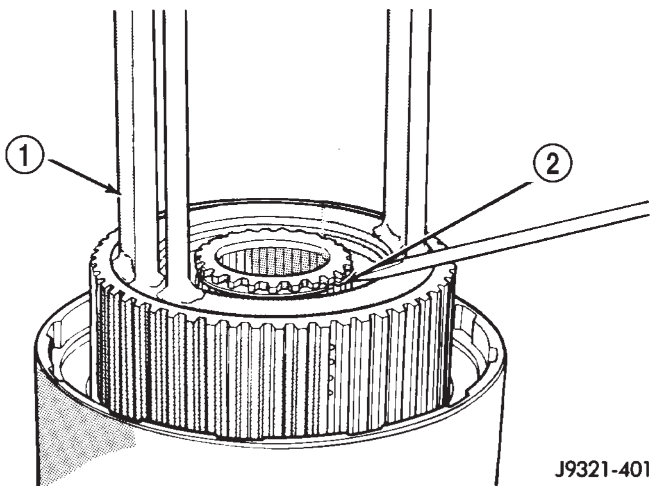


Fig. 174 Clutch Hub Retaining Ring Installation

1 - SPECIAL TOOL 6227-1
2 - CLUTCH HUB RETAINING RING

GEAR CASE

(1) Position park pawl and spring in case and install park pawl shaft. Verify that end of spring with 90° bend is hooked to pawl and straight end of spring is seated against case.

(2) Install pawl shaft retaining bolt. Tighten bolt to 27 N·m (20 ft. lbs.) torque.

(3) Install park lock reaction plug. Note that plug has locating pin at rear (Fig. 175). Be sure pin is seated in hole in case before installing snap-ring.

(4) Install reaction plug snap-ring (Fig. 176). Compress snap ring only enough for installation; do not distort it.

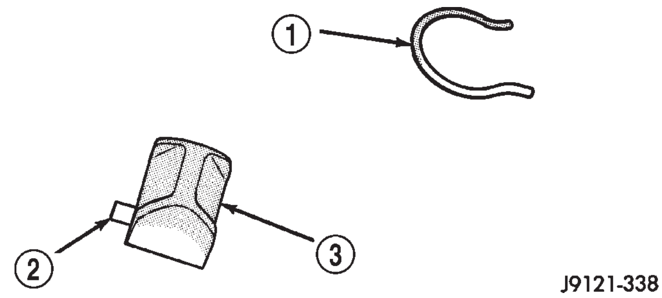


Fig. 175 Reaction Plug Locating Pin And Snap-Ring

1 - REACTION PLUG SNAP-RING (DO NOT OVERCOMPRESS TO INSTALL)
2 - LOCATING PIN
3 - PARK LOCK REACTION PLUG

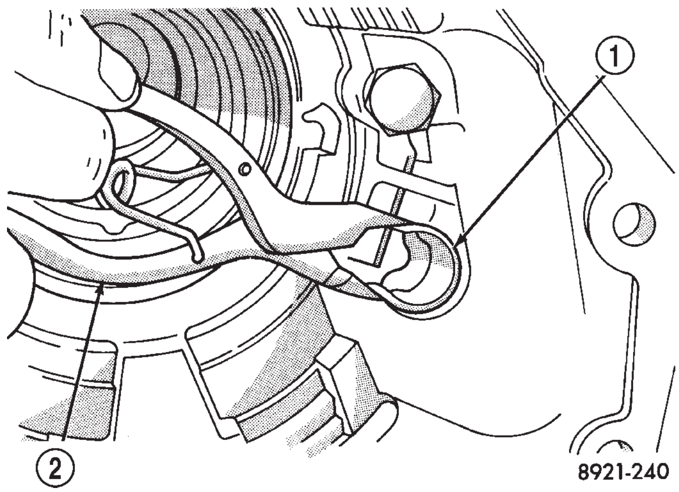


Fig. 176 Reaction Plug And Snap-Ring Installation

1 - REACTION PLUG SNAP-RING
2 - SNAP-RING PLIERS

(5) Install new seal in gear case. On 4x4 gear case, use Tool Handle C-4171 and Installer C-3860-A to seat seal in case. On 4 x 2 gear case, use same Handle C-4171 and Installer C-3995-A to seat seal in case.

(6) Verify that tab ends of rear bearing locating ring extend into access hole in gear case (Fig. 177).

(7) Support geartrain on Tool 6227-1 (Fig. 178). Be sure tool is securely seated in clutch hub.

(8) Install overdrive gear case on geartrain (Fig. 178).

(9) Expand front bearing locating ring with snap-ring pliers (Fig. 179). Then slide case downward until locating ring locks in bearing groove and release snap-ring.

(10) Install locating ring access cover and gasket in overdrive unit case (Fig. 180).

OVERDRIVE UNIT (Continued)

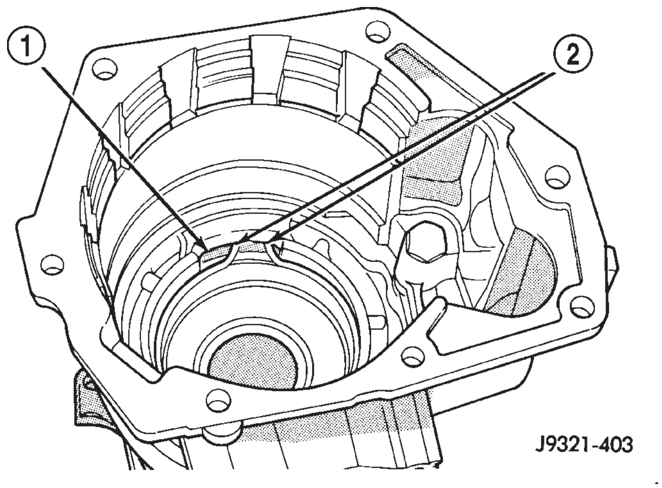


Fig. 177 Correct Rear Bearing Locating Ring Position

1 - CASE ACCESS HOLE
2 - TAB ENDS OF LOCATING RING

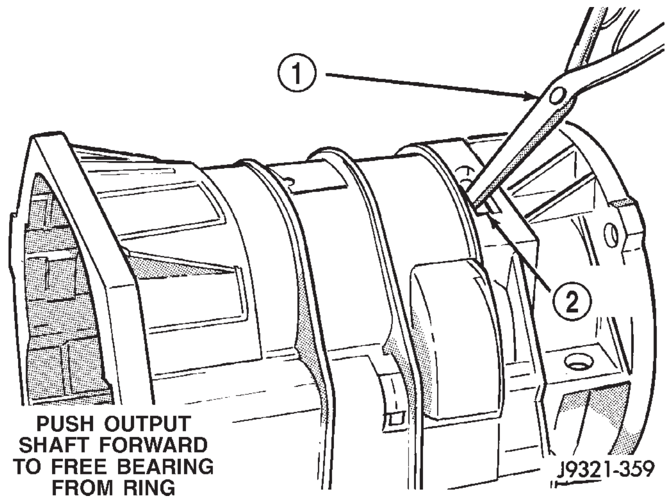


Fig. 179 Seating Locating Ring In Rear Bearing

1 - EXPAND BEARING LOCATING RING WITH SNAP-RING PLIERS
2 - ACCESS HOLE

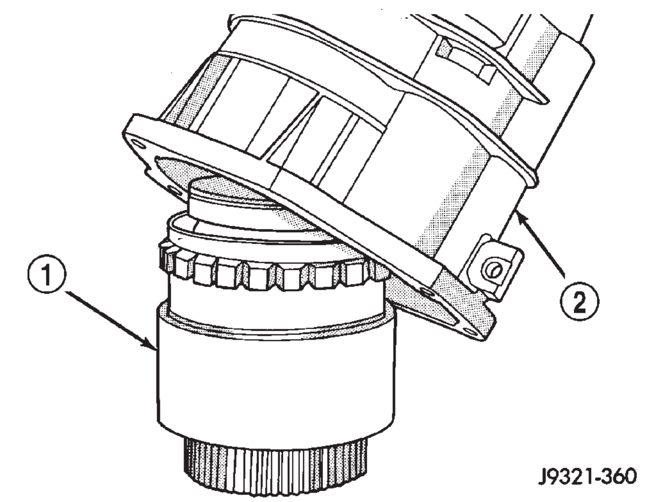


Fig. 178 Overdrive Gear Case Installation

1 - GEARTRAIN ASSEMBLY
2 - GEAR CASE

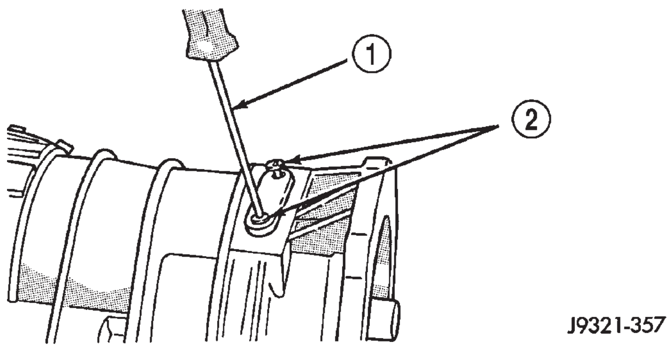


Fig. 180 Locating Ring Access Cover And Gasket Installation

1 - TORX SCREWDRIVER (T25)
2 - ACCESS COVER SCREWS

OVERDRIVE CLUTCH

(1) Install overdrive clutch reaction ring first. Reaction ring is flat with notched ends (Fig. 181).

(2) Install wave spring on top of reaction ring (Fig. 182). Reaction ring and wave ring both fit in same ring groove. Use screwdriver to seat each ring securely in groove. Also ensure that the ends of the two rings are offset from each other.

NOTE: The 42RE transmission has 3 overdrive clutch discs and 2 plates.

(3) Assemble overdrive clutch pack (Fig. 183).

(4) Install overdrive clutch reaction plate first.

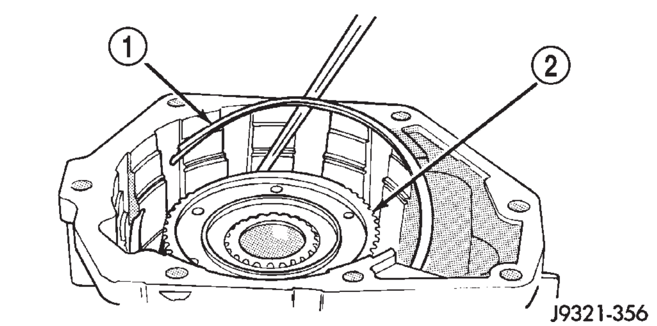


Fig. 181 Overdrive Clutch Reaction Ring Installation

1 - REACTION RING
2 - CLUTCH HUB

NOTE: The reaction plate is thinner than the pressure plate in a 42RE transmission.

OVERDRIVE UNIT (Continued)

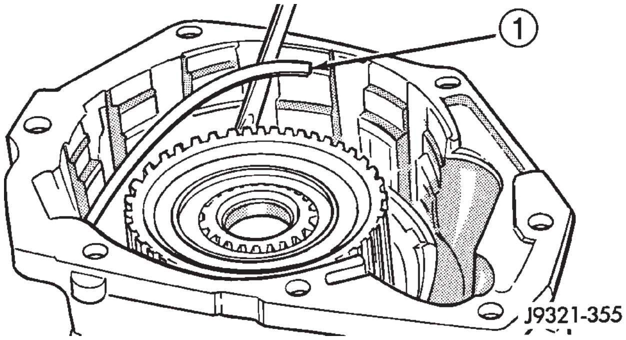


Fig. 182 Overdrive Clutch Wave Spring Installation

1 - WAVE SPRING

(5) Install first clutch disc followed by first clutch plate. Then install remaining clutch discs and plates in same order.

(6) Install clutch pack pressure plate.

(7) Install clutch pack wire-type retaining ring (Fig. 184).

INTERMEDIATE SHAFT SPACER SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

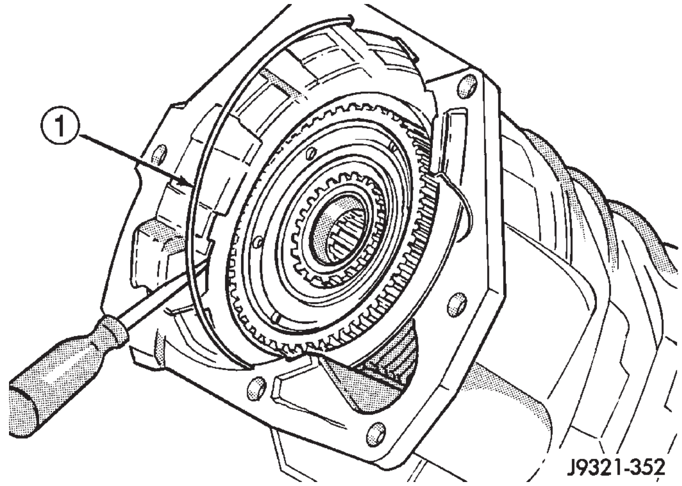


Fig. 184 Overdrive Clutch Pack Retaining Ring Installation

1 - OVERDRIVE CLUTCH PACK RETAINING RING

(2) Determine correct thickness intermediate shaft spacer as follows:

(a) Insert Special Tool 6312 through sun gear, planetary gear and into pilot bushing in output shaft. Be sure tool bottoms against planetary shoulder.

(b) Position Gauge Tool 6311 across face of overdrive case (Fig. 185). Then position Dial Caliper C-4962 over gauge tool.

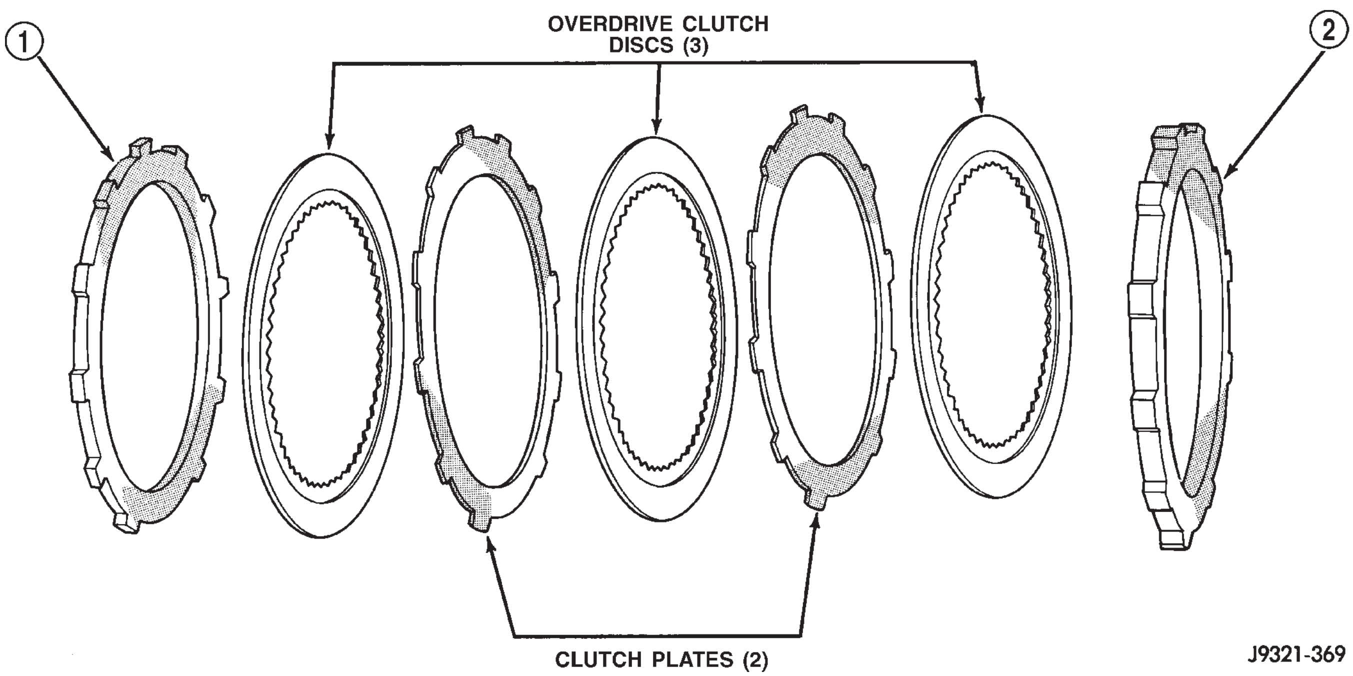


Fig. 183 42RE Overdrive Clutch Components

1 - REACTION PLATE
2 - PRESSURE PLATE

OVERDRIVE UNIT (Continued)

(c) Extend sliding scale of dial caliper downward through gauge tool slot until scale contacts end of Gauge Alignment Tool 6312. Lock scale in place. Remove dial caliper tool and note distance measured (Fig. 185).

(d) Select proper thickness end play spacer from spacer chart based on distance measured (Fig. 186).

(e) Remove Gauge Alignment Tool 6312.

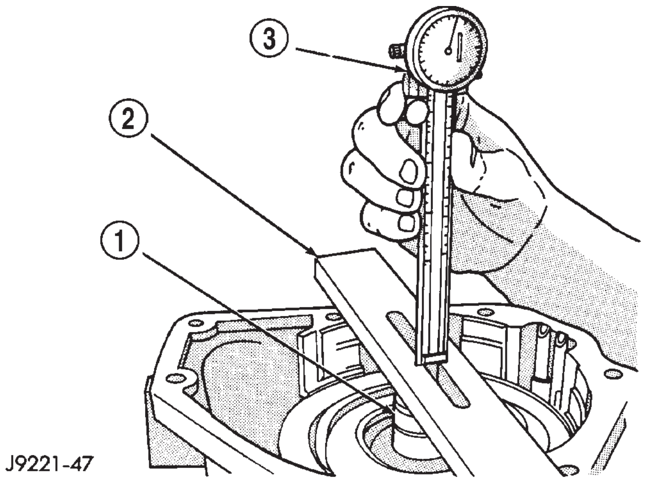


Fig. 185 Shaft End Play Measurement

1 - SPECIAL TOOL 6312
2 - SPECIAL TOOL 6311
3 - SPECIAL TOOL C-4962

End Play Measurement (Inches)	Spacer Thickness (Inches)
.7336 - .7505	.158 - .159
.7506 - .7675	.175 - .176
.7676 - .7855	.193 - .194
.7856 - .8011	.211 - .212

J9121-341

Fig. 186 Intermediate Shaft End Play Spacer Selection

OD THRUST PLATE SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

(2) Determine correct thickness overdrive piston thrust plate as follows:

(a) Position Gauge Tool 6311 across face of overdrive case. Then position Dial Caliper C-4962 over gauge tool (Fig. 187).

(b) Measure distance to clutch hub thrust bearing seat at four points 90° apart. Then average measurements by adding them and dividing by 4.

(c) Select and install required thrust plate from information in thrust plate chart (Fig. 188).

(3) Leave Alignment Tool 6227-2 in place. Tool will keep planetary and clutch hub splines in alignment until overdrive unit is ready for installation on transmission.

(4) Transmission speed sensor can be installed at this time if desired. However, it is recommended that sensor not be installed until after overdrive unit is secured to transmission.

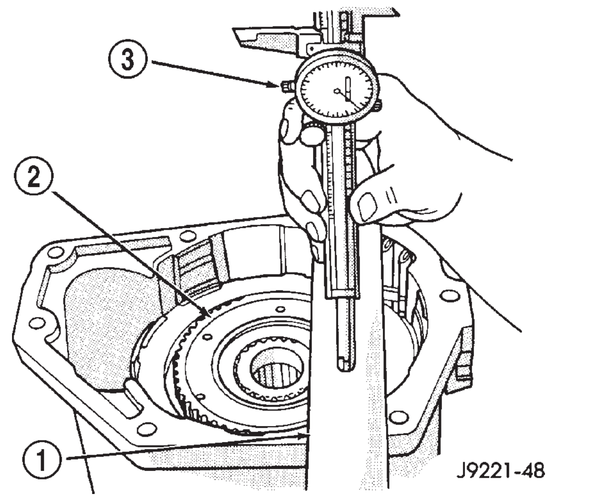


Fig. 187 Overdrive Piston Thrust Plate Measurement

1 - SPECIAL TOOL 6311
2 - DIRECT CLUTCH HUB THRUST BEARING SEAT
3 - SPECIAL TOOL C-4962

End Play Measurement (Inches)	Spacer Thickness (Inches)
1.7500 - 1.7649	.108 - .110
1.7650 - 1.7799	.123 - .125
1.7800 - 1.7949	.138 - .140
1.7950 - 1.8099	.153 - .155
1.8100 - 1.8249	.168 - .170
1.8250 - 1.8399	.183 - .185
1.8400 - 1.8549	.198 - .200
1.8550 - 1.8699	.213 - .215
1.8700 - 1.8849	.228 - .230
1.8850 - 1.8999	.243 - .245

J9121-342

Fig. 188 Overdrive Piston Thrust Plate Selection

OVERDRIVE UNIT (Continued)

OVERDRIVE PISTON

(1) Install new seals on over drive piston.

(2) Stand transmission case upright on bellhousing.

(3) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(4) Position Seal Guide 8114-2 on inner edge of overdrive piston retainer.

(5) Install overdrive piston in overdrive piston retainer by: aligning locating lugs on overdrive piston to the two mating holes in retainer.

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

(b) Lubricate overdrive piston seals with Mopar® Door Ease, or equivalent.

(c) Install piston over Seal Guide 8114-2 and inside Guide Ring 8114-1.

(d) Push overdrive piston into position in retainer.

(e) Verify that the locating lugs entered the lug bores in the retainer.

(6) Install intermediate shaft spacer on intermediate shaft.

(7) Install overdrive piston thrust plate on overdrive piston.

(8) Install overdrive piston thrust bearing on overdrive piston.

(9) Install transmission speed sensor and O-ring seal in overdrive case (Fig. 129).

INSTALLATION

(1) Be sure overdrive unit Alignment Tool 6227-2 is fully seated before moving unit. If tool is not seated and gear splines rotate out of alignment, overdrive unit will have to be disassembled in order to realign splines.

(2) If overdrive piston retainer was not removed during service and original case gasket is no longer reusable, prepare new gasket by trimming it.

(3) Cut out old case gasket around piston retainer with razor knife (Fig. 189).

(4) Use old gasket as template and trim new gasket to fit.

(5) Position new gasket over piston retainer and on transmission case. Use petroleum jelly to hold gasket in place if necessary. Do not use any type of sealer to secure gasket. Use petroleum jelly only.

(6) Install selective spacer on intermediate shaft, if removed. Spacer goes in groove just rearward of shaft rear splines (Fig. 190).

(7) Install thrust bearing in overdrive unit sliding hub. Use petroleum jelly to hold bearing in position.

CAUTION: Be sure the shoulder on the inside diameter of the bearing is facing forward.

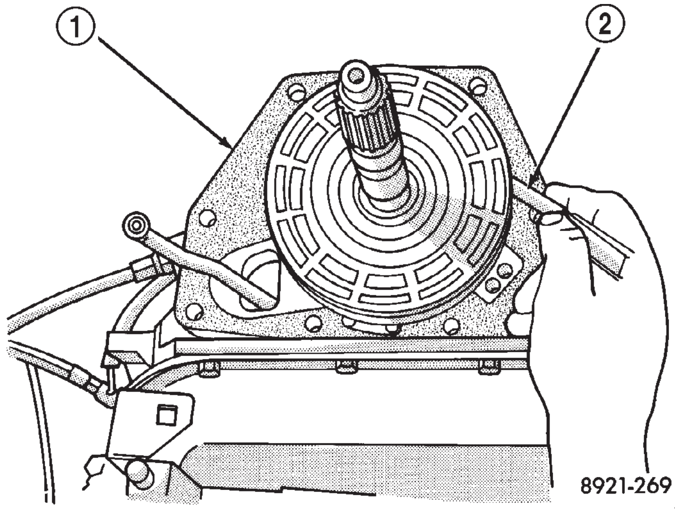


Fig. 189 Trimming Overdrive Case Gasket

1 - GASKET
2 - SHARP KNIFE

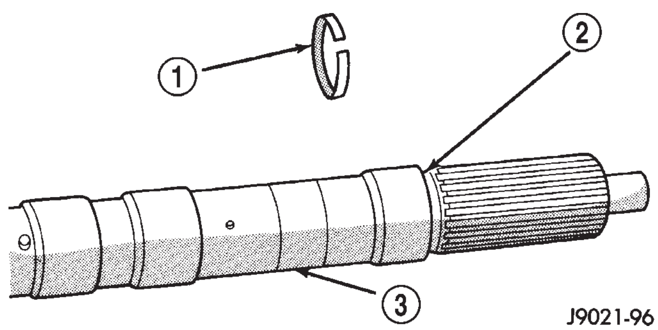


Fig. 190 Intermediate Shaft Selective Spacer Location

1 - SELECTIVE SPACER
2 - SPACER GROOVE
3 - INTERMEDIATE SHAFT

(8) Verify that splines in overdrive planetary gear and overrunning clutch hub are aligned with Alignment Tool 6227-2. Overdrive unit cannot be installed if splines are not aligned. If splines have rotated out of alignment, unit will have to be disassembled to realign splines.

(9) Carefully slide Alignment Tool 6227-2 out of overdrive planetary gear and overrunning clutch splines.

(10) Raise overdrive unit and carefully slide it straight onto intermediate shaft. Insert park rod into park lock reaction plug at same time. Avoid tilting overdrive during installation as this could cause planetary gear and overrunning clutch splines to rotate out of alignment. If this occurs, it will be necessary to remove and disassemble overdrive unit to realign splines.

OVERDRIVE UNIT (Continued)

(11) Work overdrive unit forward on intermediate shaft until seated against transmission case.

(12) Install bolts attaching overdrive unit to transmission unit. Tighten bolts in diagonal pattern to 34 N·m (25 ft-lbs).

(13) Connect the transmission speed sensor and overdrive wiring connectors.

(14) Install the transfer case, if equipped.

(15) Align and install rear propeller shaft, if necessary. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER

DESCRIPTION

The overrunning clutch (Fig. 191) 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.

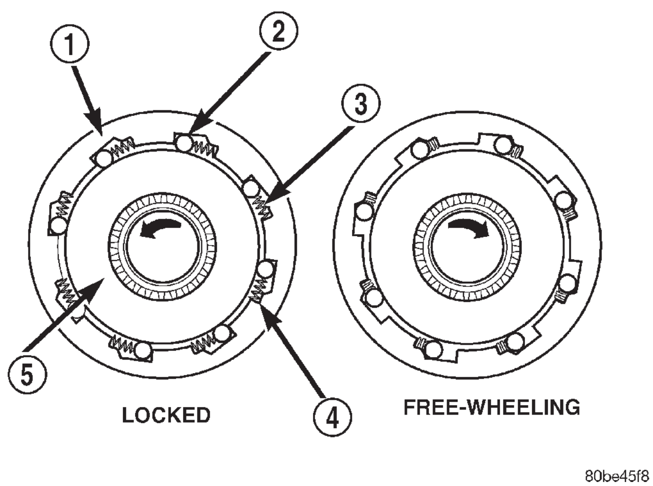


Fig. 191 Overrunning Clutch

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 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.

DISASSEMBLY

NOTE: To service the overrunning clutch cam and the overdrive piston retainer, the transmission geartrain and the overdrive unit must be removed from the transmission.

(1) Remove the overdrive piston (Fig. 192).

(2) Remove the overdrive piston retainer bolts.

(3) Remove overdrive piston retainer.

(4) Remove case gasket.

(5) Mark the position of the overrunning clutch cam in the case (Fig. 193).

(6) Remove the overrunning clutch cam bolts.

(7) Remove the overrunning clutch cam.

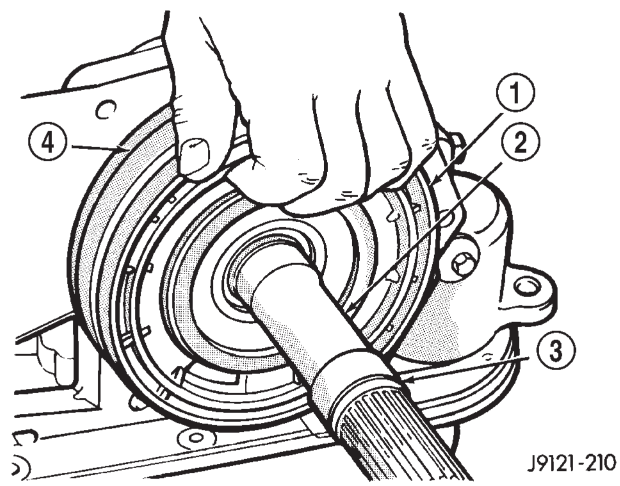


Fig. 192 Overdrive Piston Removal

1 - OVERDRIVE CLUTCH PISTON
2 - INTERMEDIATE SHAFT
3 - SELECTIVE SPACER
4 - PISTON RETAINER

CLEANING

Clean the overrunning clutch assembly, clutch cam, low-reverse drum, and overdrive piston retainer in solvent. Dry them with compressed air after cleaning.

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 dam-

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER (Continued)

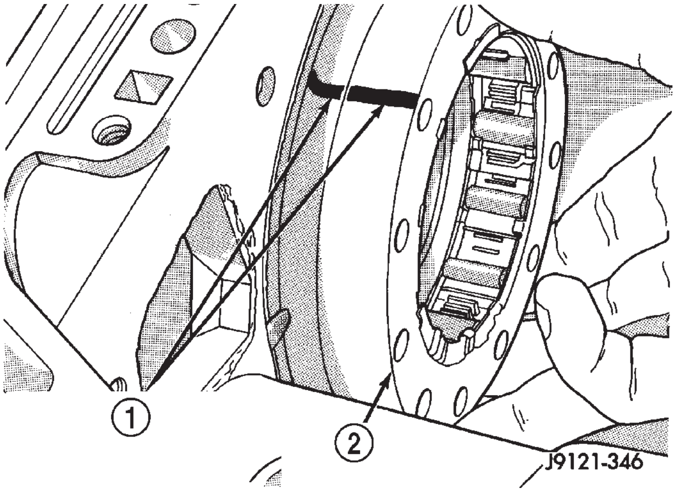


Fig. 193 Overrunning Clutch Cam Removal

1 - ALIGN MARKS IDENTIFYING NON-THREADED HOLE IN CAM AND CASE

2 - OVERRUNNING CLUTCH ASSEMBLY

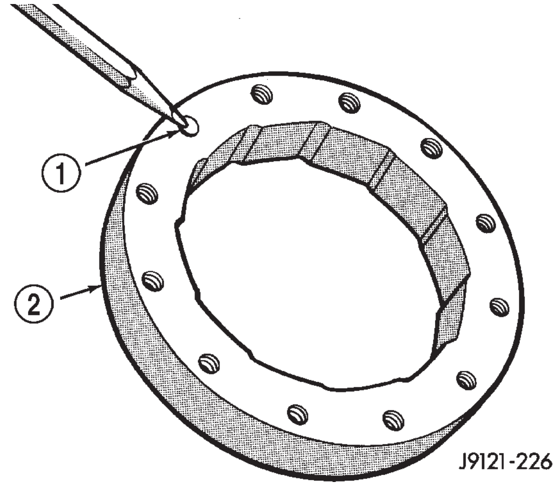


Fig. 194 Location Of Non-Threaded Hole In Clutch Cam

1 - NON-THREADED HOLE

2 - OVERRUNNING CLUTCH CAM

aged, or if the roller cage is distorted, or damaged. Replace the cam if worn, cracked or damaged.

Replace the low-reverse drum if the clutch race, roller surface or inside diameter is scored, worn or damaged. **Do not remove the clutch race from the low-reverse drum under any circumstances. Replace the drum and race as an assembly if either component is damaged.**

Examine the overdrive piston retainer carefully for wear, cracks, scoring or other damage. Be sure the retainer hub is a snug fit in the case and drum. Replace the retainer if worn or damaged.

ASSEMBLY

(1) Examine bolt holes in overrunning clutch cam. Note that one hole is **not threaded** (Fig. 194). This hole must align with blank area in clutch cam bolt circle (Fig. 195). Mark hole location on clutch cam and blank area in case with grease pencil, paint stripe, or scribe mark for assembly reference.

(2) Mark location of non-threaded hole in clutch cam and blank area in bolt circle with grease pencil.

(3) Align and install overrunning clutch and cam in case (Fig. 196). Be sure cam is correctly installed. Bolt holes in cam are slightly countersunk on one side. Be sure this side of cam faces rearward (toward piston retainer).

(4) Verify that non-threaded hole in clutch cam is properly aligned. Check alignment by threading a bolt into each bolt hole. Adjust clutch cam position if necessary.

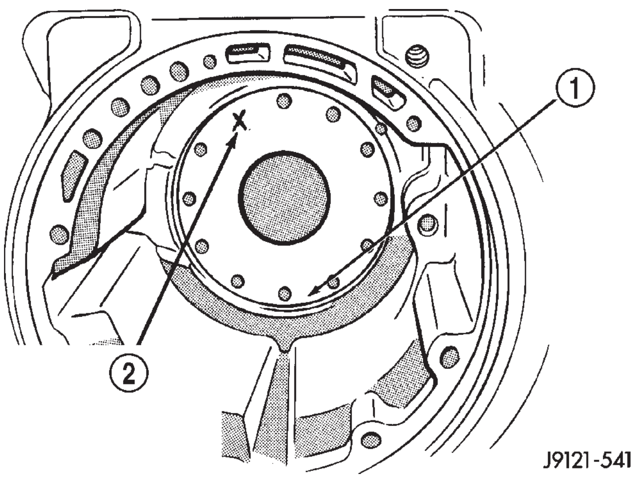


Fig. 195 Location Of Blank Area In Clutch Cam Bolt Circle

1 - OVERRUNNING CLUTCH CAM SEAT IN CASE

2 - NON-THREADED HOLE IN CLUTCH CAM ALIGNS HERE (BLANK AREA) OF SEAT

(5) Install and tighten overrunning clutch cam bolts to 17 N·m (13 ft. lbs.) torque. Note that clutch cam bolts are shorter than piston retainer bolts.

(6) Install new gasket at rear of transmission case. Use petroleum jelly to hold gasket in place. Be sure to align governor feed holes in gasket with feed passages in case (Fig. 197). Also install gasket before overdrive piston retainer. Center hole in gasket is smaller than retainer and cannot be installed over retainer.

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER (Continued)

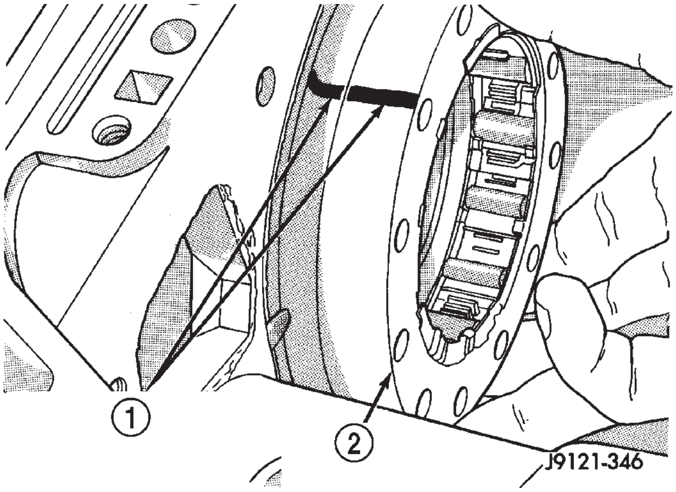


Fig. 196 Overrunning Clutch Installation

1 - ALIGN MARKS IDENTIFYING NON-THREADED HOLE IN CAM AND CASE
2 - OVERRUNNING CLUTCH ASSEMBLY

(7) Position overdrive piston retainer on transmission case and align bolt holes in retainer, gasket and case (Fig. 198). Then install and tighten retainer bolts to 17 N·m (13 ft. lbs.) torque.

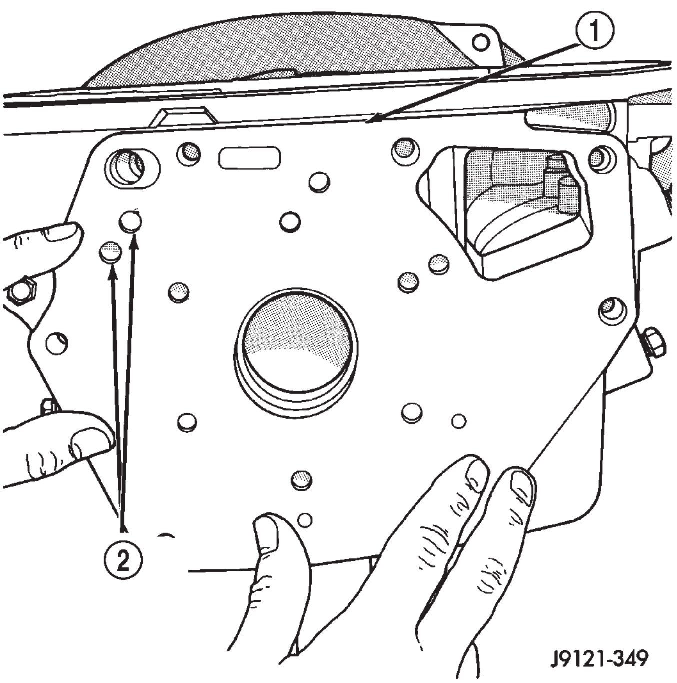


Fig. 197 Installing/Aligning Case Gasket

1 - CASE GASKET
2 - BE SURE GOVERNOR TUBE FEED HOLES IN CASE AND GASKET ARE ALIGNED

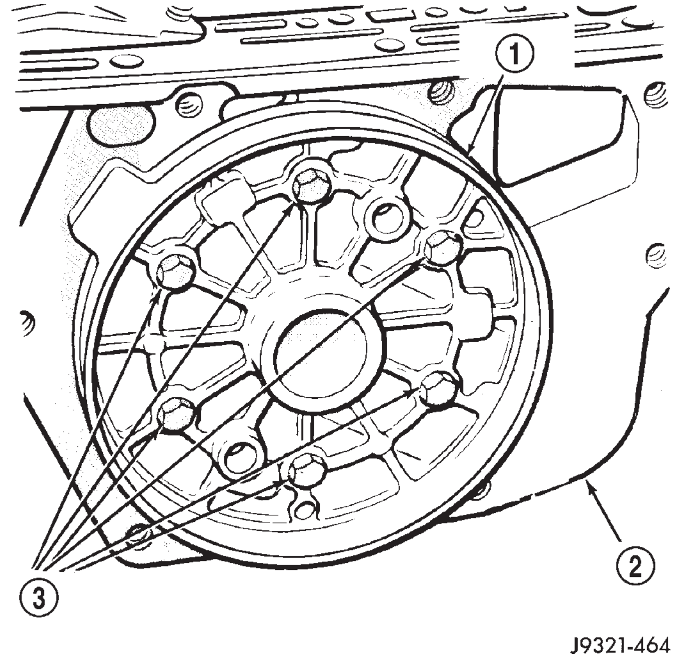


Fig. 198 Aligning Overdrive Piston Retainer

1 - PISTON RETAINER
2 - GASKET
3 - RETAINER BOLTS

(8) Install new seals on over drive piston.

(9) Stand transmission case upright on bellhousing.

(10) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(11) Position Seal Guide 8114-2 on inner edge of overdrive piston retainer.

(12) Install overdrive piston in overdrive piston retainer by: aligning locating lugs on overdrive piston to the two mating holes in retainer.

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

(b) Lubricate overdrive piston seals with Mopar® Door Ease, or equivalent.

(c) Install piston over Seal Guide 8114-2 and inside Guide Ring 8114-1.

(d) Push overdrive piston into position in retainer.

(e) Verify that the locating lugs entered the lug bores in the retainer.

NOTE: Install the remaining transmission components and the overdrive unit.

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. 199) 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.

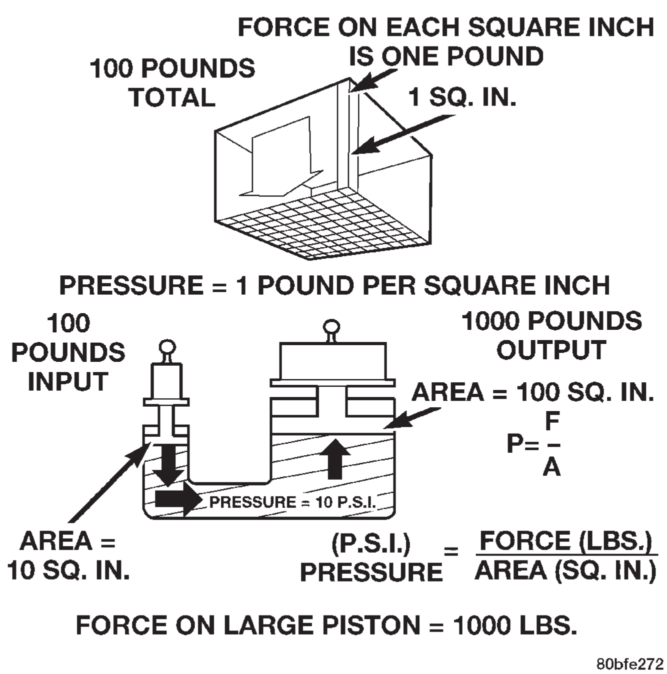


Fig. 199 Force and Pressure Relationship

PRESSURE ON A CONFINED FLUID

Pressure is exerted on a confined fluid (Fig. 200) 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.

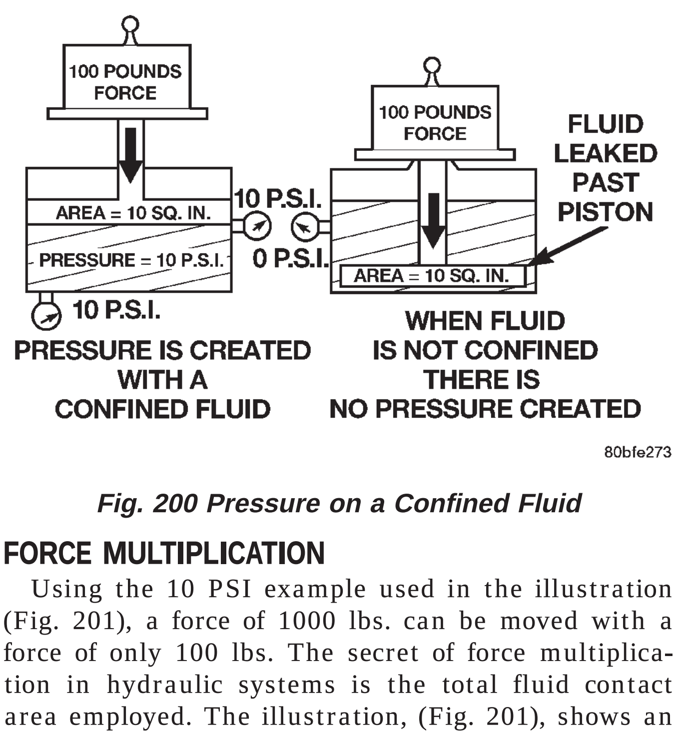


Fig. 200 Pressure on a Confined Fluid

FORCE MULTIPLICATION

Using the 10 PSI example used in the illustration (Fig. 201), 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. 201), 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

PISTONS (Continued)

force applied divided by the contact area. Therefore, by means of simple algebra, the output force may be found. This concept is extremely important, as it is also used in the design and operation of all shift valves and limiting valves in the valve body, as well as the pistons, of the transmission, which activate the clutches and bands. It is nothing more than using a difference of area to create a difference in pressure to move an object.

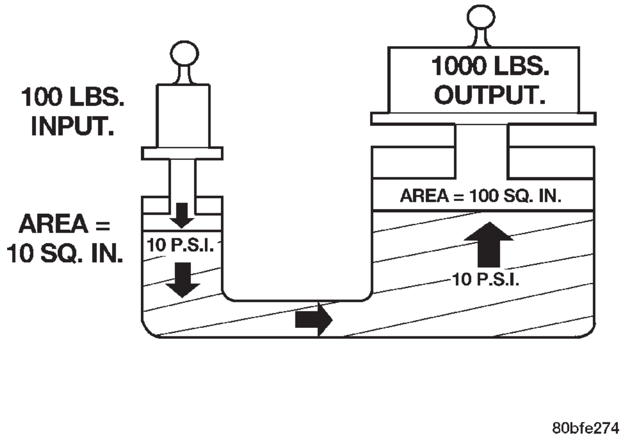


Fig. 201 Force Multiplication

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. 202) 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.

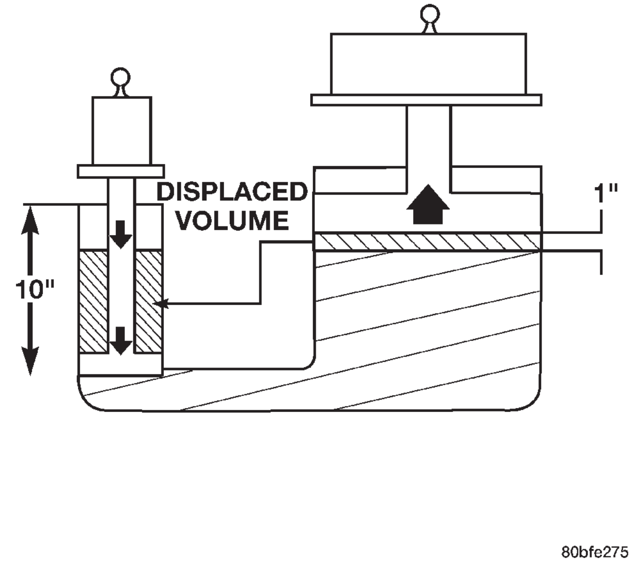


Fig. 202 Piston Travel

PLANETARY GEARTRAIN/ OUTPUT SHAFT

DESCRIPTION

The planetary gearsets (Fig. 203) are designated as the front, rear, and overdrive planetary gear assemblies and located in such order. A simple planetary gearset consists of three main members:

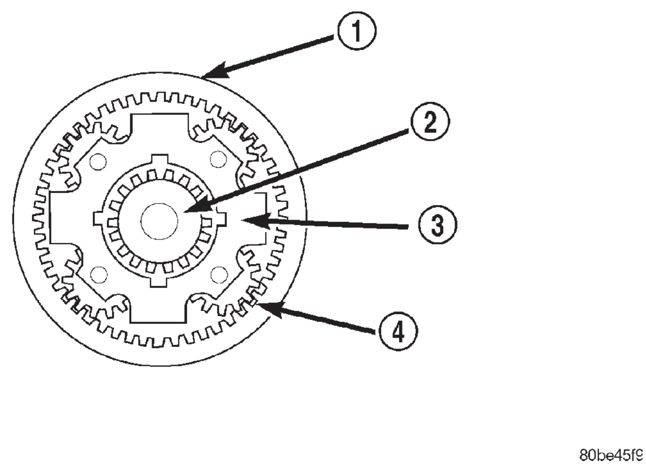


Fig. 203 Planetary Gearset

1 - ANNULUS GEAR
2 - SUN GEAR
3 - PLANET CARRIER
4 - PLANET PINIONS (4)

- The sun gear which is at the center of the system.

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

- The planet carrier with planet pinion gears which are free to rotate on their own shafts and are in mesh with the sun gear.
- The annulus gear, which rotates around and is in mesh with the planet pinion gears.

NOTE: The number of pinion gears does not affect the gear ratio, only the duty rating.

OPERATION

With any given planetary gearset, several conditions must be met for power to be able to flow:

- One member must be held.
- Another member must be driven or used as an input.
- The third member may be used as an output for power flow.
- For direct drive to occur, two gear members in the front planetary gearset must be driven.

NOTE: Gear ratios are dependent on the number of teeth on the annulus and sun gears.

DISASSEMBLY

(1) Remove planetary snap-ring (Fig. 204).

(2) Remove front annulus and planetary assembly from driving shell (Fig. 204).

(3) Remove snap-ring that retains front planetary gear in annulus gear (Fig. 205).

(4) Remove tabbed thrust washer and tabbed thrust plate from hub of front annulus (Fig. 206).

(5) Separate front annulus and planetary gears (Fig. 206).

(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. 207).

(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.

INSPECTION

Check sun gear and driving shell condition. Replace the gear if damaged or if the bushings are scored or worn. The bushings are not serviceable. Replace the driving shell if worn, cracked or damaged.

Replace planetary gear sets if gears, pinion pins, or carrier are damaged in any way. Replace the annulus gears and supports if either component is worn or damaged.

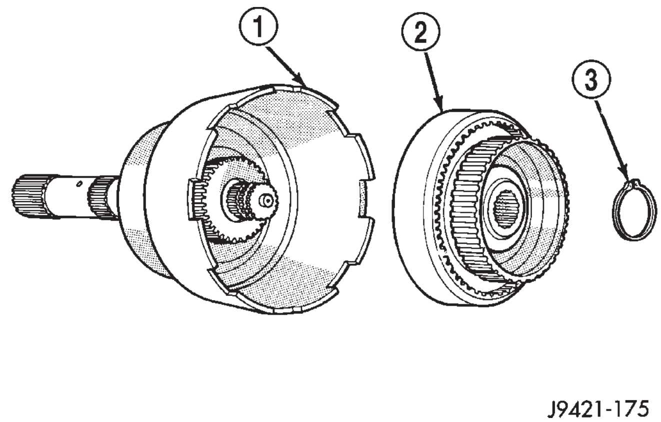


Fig. 204 Front Annulus And Planetary Assembly Removal

1 - DRIVING SHELL
2 - FRONT ANNULUS AND PLANETARY ASSEMBLY
3 - PLANETARY SNAP-RING

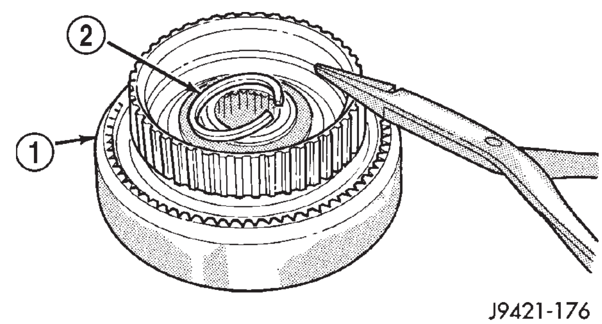


Fig. 205 Front Planetary Snap-Ring Removal

1 - FRONT ANNULUS GEAR
2 - PLANETARY SNAP-RING

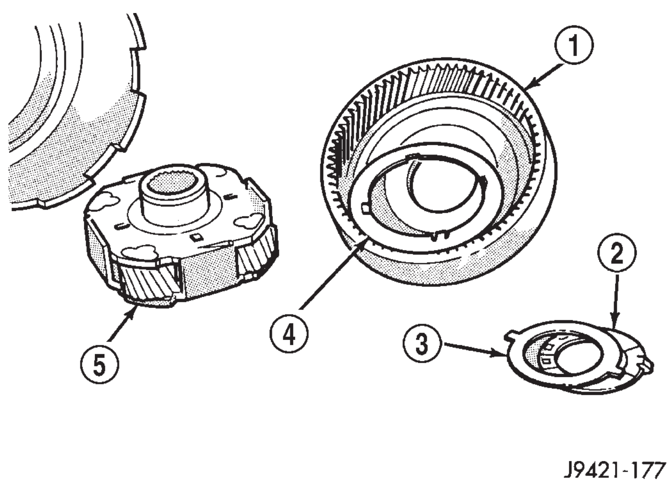


Fig. 206 Front Planetary And Annulus Gear Disassembly

1 - FRONT ANNULUS
2 - THRUST WASHER
3 - THRUST PLATE
4 - FRONT THRUST WASHER
5 - FRONT PLANETARY

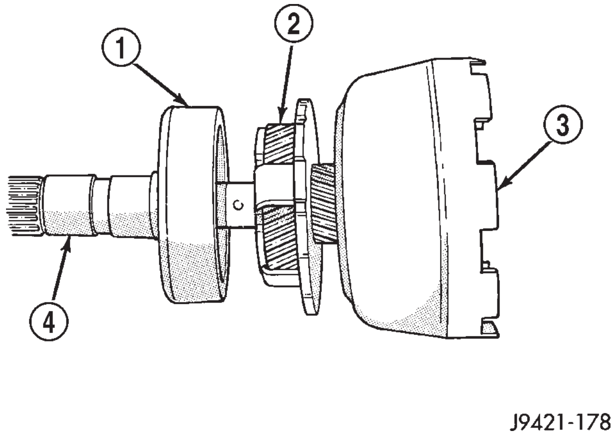


Fig. 207 Removing Driving Shell, Rear Planetary And Rear Annulus

1 - REAR ANNULUS
2 - REAR PLANETARY
3 - DRIVING SHELL
4 - OUTPUT SHAFT

Inspect the geartrain spacers, thrust plates, snap-rings, and thrust washers. Replace any of these parts that are worn, distorted or damaged. Do not attempt to reuse these parts.

The planetary gear thrust washers are different sizes. The large diameter washers go on the front planetary and the smaller washers go on the rear planetary. All the washers have four locating tabs on them. These tabs fit in the holes or slots provided in each planetary gear.

Inspect the output shaft carefully. Pay particular attention to the machined bushing/bearing surfaces on the shaft and the governor valve shaft bore at the shaft rear.

Replace the output shaft if the machined surfaces are scored, pitted, or damaged in any way. Also replace the shaft if the splines are damaged, or exhibits cracks at any location (especially at the governor valve shaft bore).

The annulus gears can be removed from their supports if necessary. Just remove the snap-rings and separate the two parts when replacement is necessary. In addition, the annulus gear bushings can be replaced if severely worn, or scored. However it is not necessary to replace the bushings if they only exhibit normal wear. Check bushing fit on the output shaft to be sure.

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. 208).

(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. 208).

(5) Install assembled rear planetary and annulus gear on output shaft (Fig. 209). Verify that assembly is fully seated on shaft.

(6) Install front thrust washer on rear planetary gear (Fig. 210). 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. 211).

(8) Install thrust plate on sun gear (Fig. 212). Note that driving shell thrust plates are interchangeable. Use either plate on sun gear and at front/rear of shell.

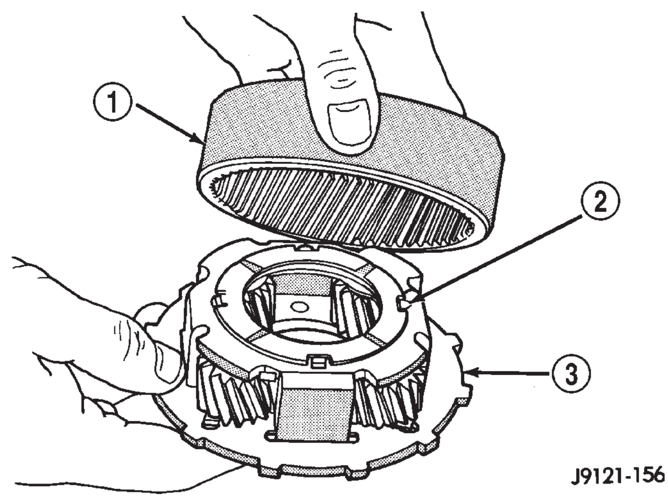


Fig. 208 Assembling Rear Annulus And Planetary Gear

1 - REAR ANNULUS GEAR
2 - TABBED THRUST WASHER
3 - REAR PLANETARY

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

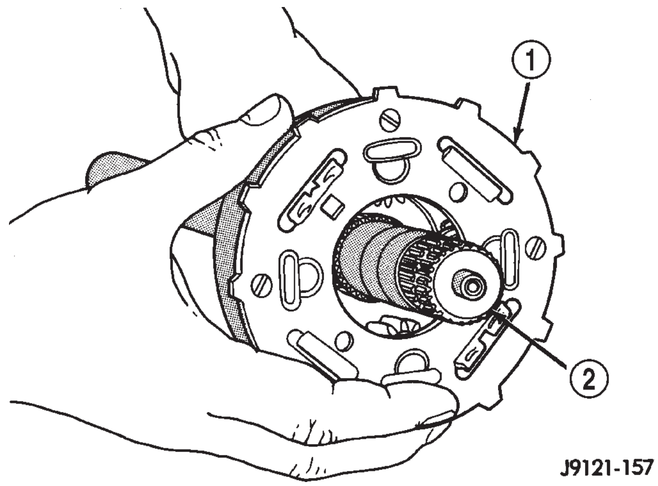


Fig. 209 Installing Rear Annulus And Planetary On Output Shaft

1 - REAR ANNULUS AND PLANETARY GEAR ASSEMBLY
2 - OUTPUT SHAFT

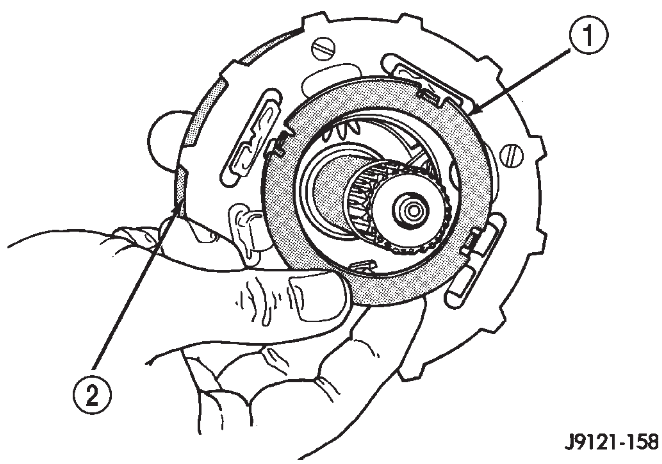


Fig. 210 Installing Rear Planetary Front Thrust Washer

1 - FRONT TABBED THRUST WASHER
2 - REAR PLANETARY GEAR

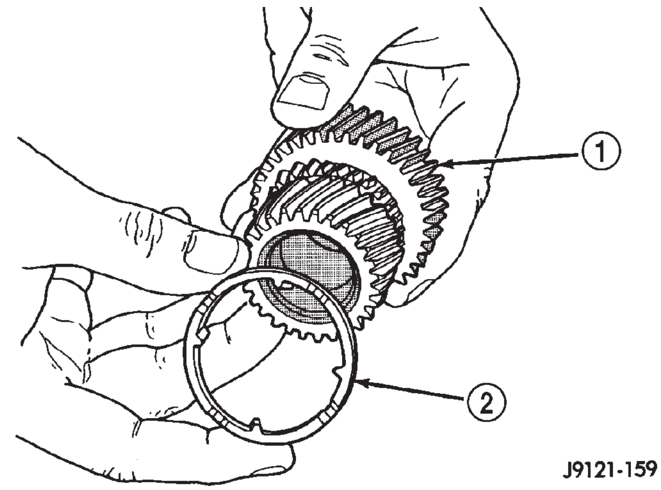


Fig. 211 Installing Spacer On Sun Gear

1 - SUN GEAR
2 - SUN GEAR SPACER

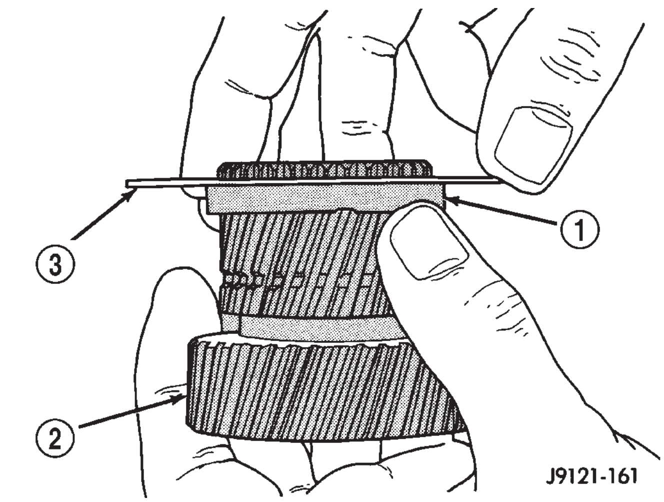


Fig. 212 Installing Driving Shell Front Thrust Plate On Sun Gear

1 - SPACER
2 - SUN GEAR
3 - THRUST PLATE

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

(9) Hold sun gear in place and install thrust plate over sun gear at rear of driving shell (Fig. 213).

(10) Position wood block on bench and support sun gear on block (Fig. 214). This makes it easier to align and install sun gear lock ring. Keep wood block handy as it will also be used for geartrain end play check.

(11) Align rear thrust plate on driving shell and install sun gear lock ring. Be sure ring is fully seated in sun gear ring groove (Fig. 215).

(12) Install assembled driving shell and sun gear on output shaft (Fig. 216).

(13) Install rear thrust washer on front planetary gear (Fig. 217). Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

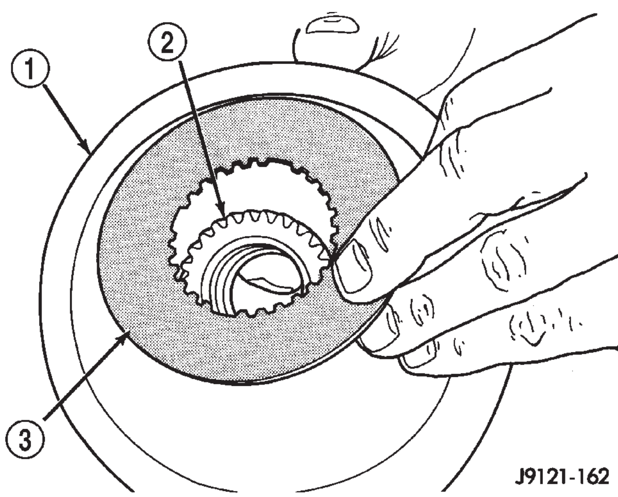


Fig. 213 Installing Driving Shell Rear Thrust Plate

1 - DRIVING SHELL
2 - SUN GEAR
3 - REAR THRUST PLATE

(14) Install front planetary gear on output shaft and in driving shell (Fig. 218).

(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.

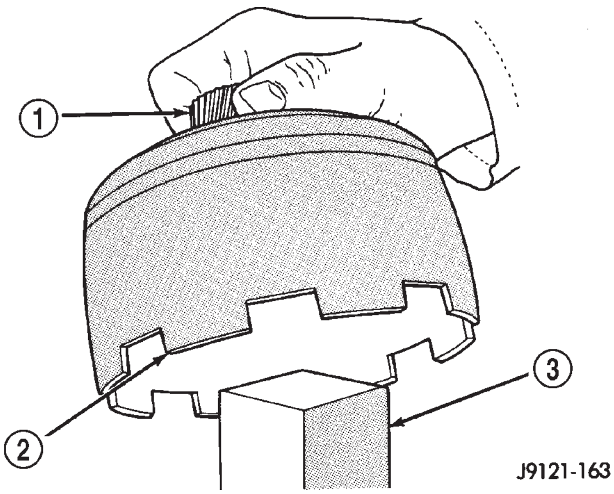


Fig. 214 Supporting Sun Gear On Wood Block

1 - SUN GEAR
2 - DRIVING SHELL
3 - WOOD BLOCK

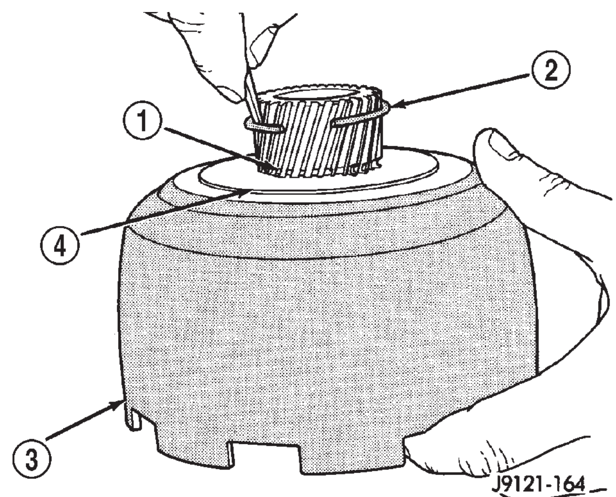


Fig. 215 Installing Sun Gear Lock Ring

1 - LOCK RING GROOVE
2 - SUN GEAR LOCK RING
3 - DRIVING SHELL
4 - REAR THRUST PLATE

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

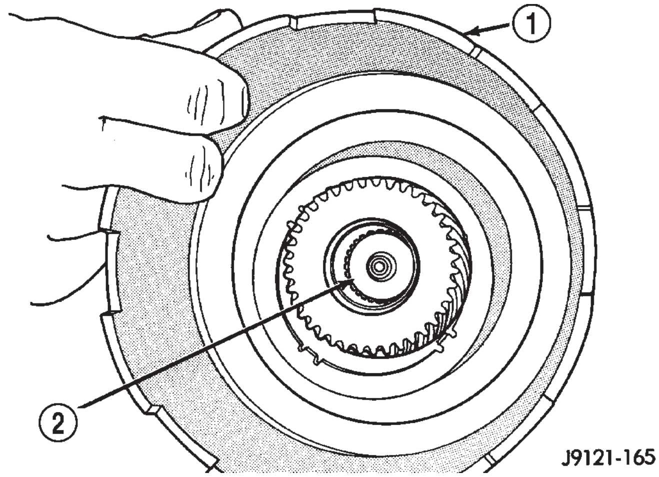


Fig. 216 Installing Assembled Sun Gear And Driving Shell On Output Shaft

1 - SUN GEAR/DRIVING SHELL ASSEMBLY
2 - OUTPUT SHAFT

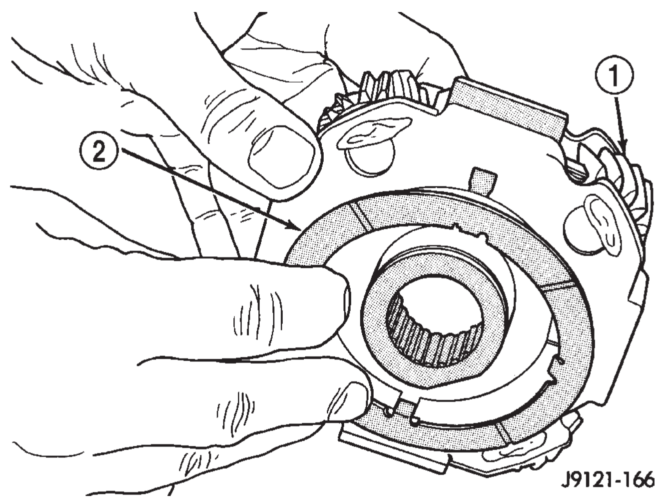


Fig. 217 Installing Rear Thrust Washer On Front Planetary Gear

1 - FRONT PLANETARY GEAR
2 - REAR TABBED THRUST WASHER

(16) Assemble front annulus gear and support, if necessary. Be sure support snap-ring is seated.

(17) Install front annulus on front planetary (Fig. 218).

(18) Position thrust plate on front annulus gear support (Fig. 219). Note that plate has two tabs on it. These tabs fit in notches of annulus hub.

(19) Install thrust washer in front annulus (Fig. 220). Align flat on washer with flat on planetary hub. Also be sure washer tab is facing up.

(20) Install front annulus snap-ring (Fig. 221). 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. 222). 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. 223). 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.

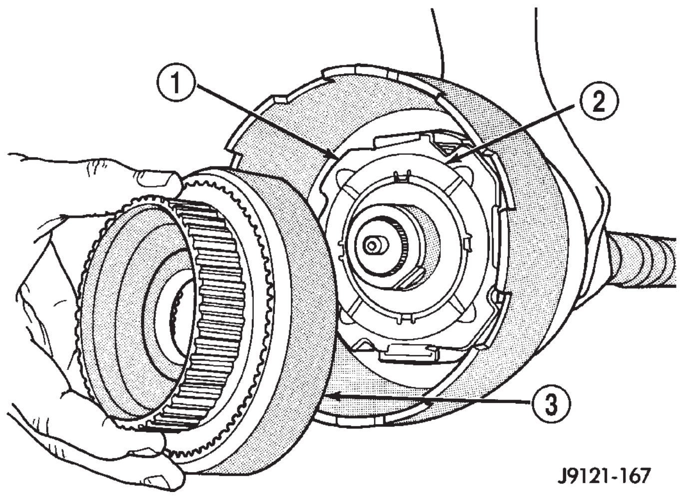


Fig. 218 Installing Front Planetary And Annulus Gears

1 - FRONT PLANETARY GEAR
2 - FRONT THRUST WASHER
3 - FRONT ANNULUS GEAR

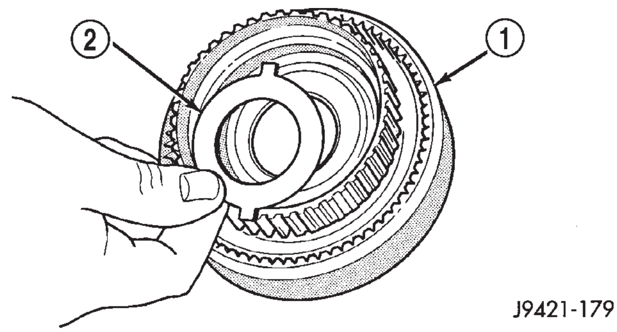


Fig. 219 Positioning Thrust Plate On Front Annulus Support

1 - FRONT ANNULUS
2 - THRUST PLATE

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

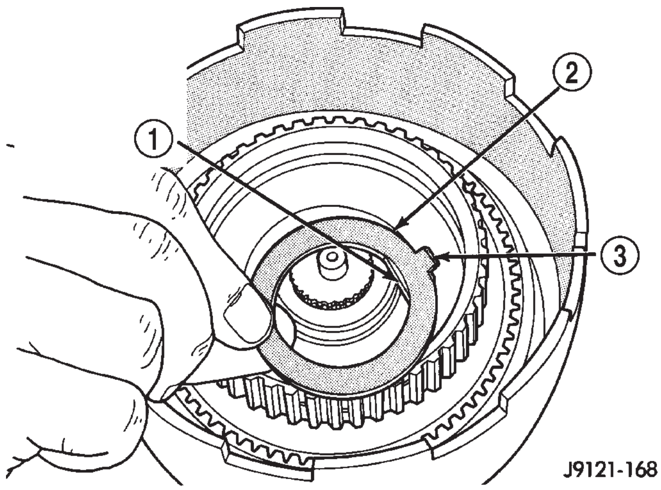


Fig. 220 Installing Front Annulus Thrust Washer

1 - WASHER FLAT ALIGNS WITH FLAT ON PLANETARY HUB
2 - FRONT ANNULUS THRUST WASHER
3 - TAB FACES FRONT

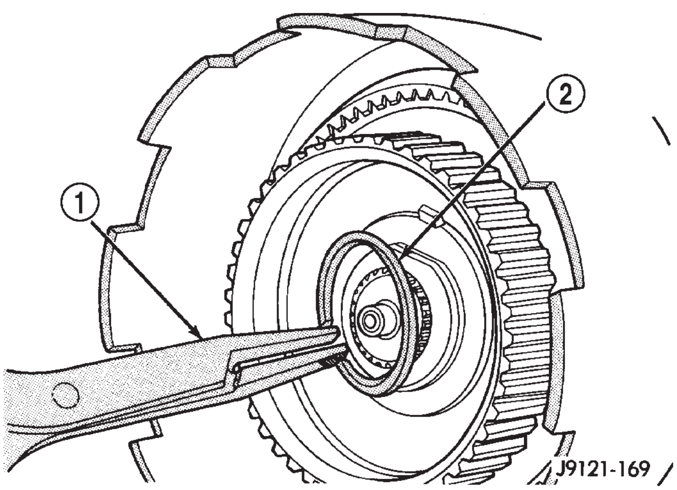


Fig. 221 Installing Front Annulus Snap-Ring

1 - SNAP-RING PLIERS
2 - FRONT ANNULUS SNAP-RING

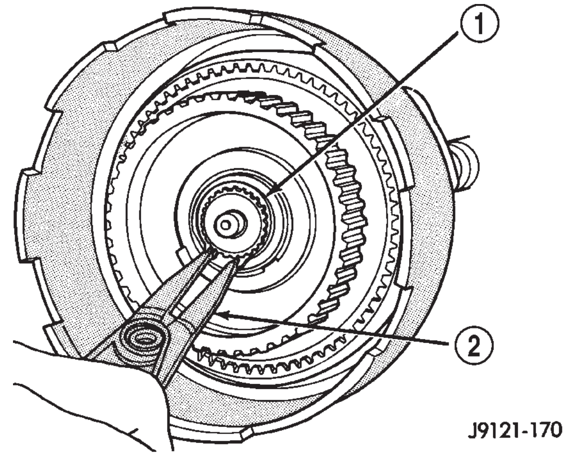


Fig. 222 Installing Planetary Selective Snap-Ring

1 - SELECTIVE SNAP-RING
2 - SNAP-RING PLIERS

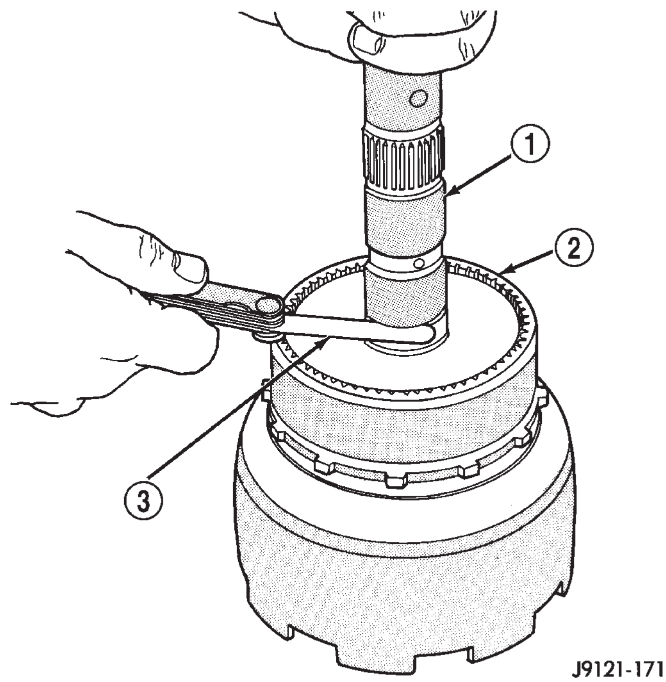


Fig. 223 Checking Planetary Geartrain End Play

1 - OUTPUT SHAFT
2 - REAR ANNULUS GEAR
3 - FEELER GAUGE

REAR CLUTCH

DESCRIPTION

The rear clutch assembly (Fig. 224) 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.

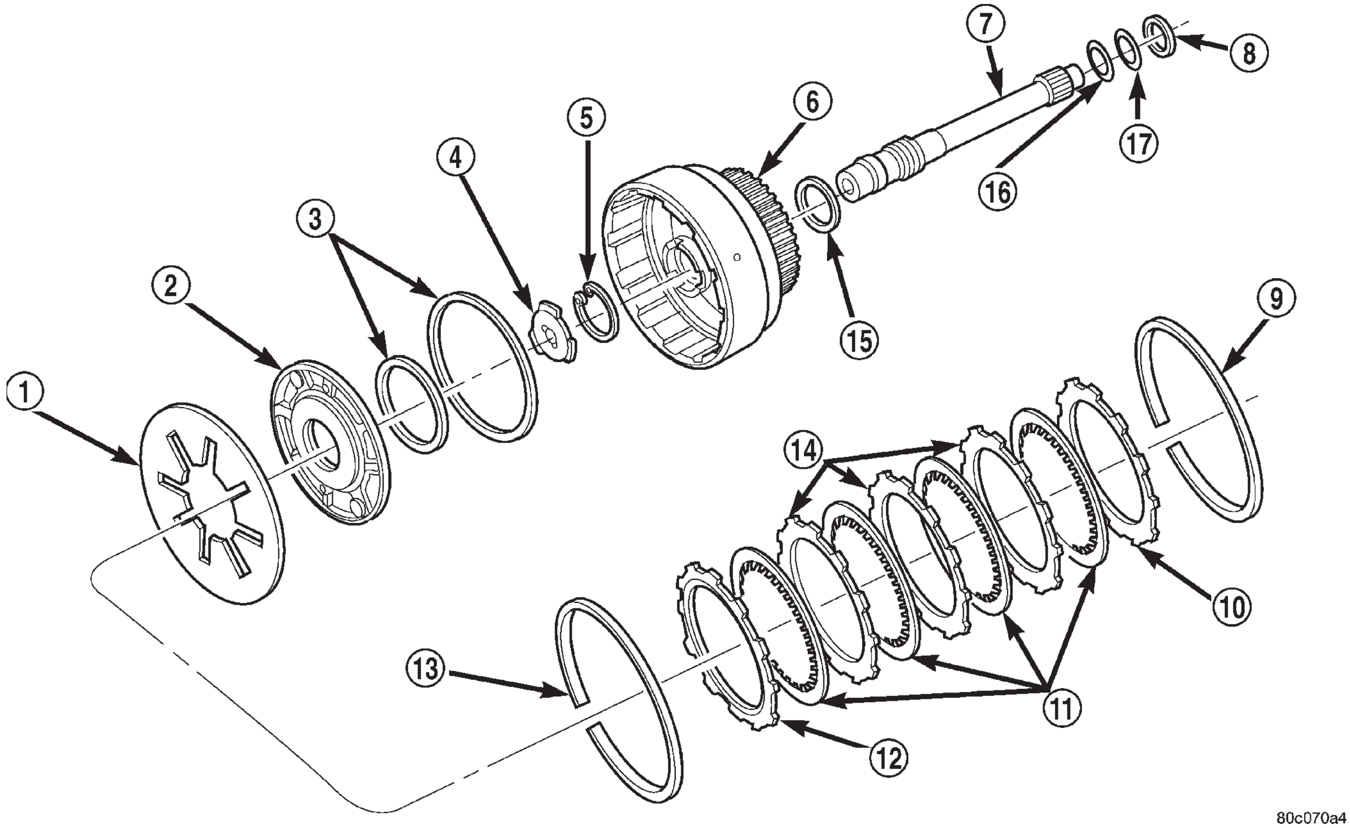


Fig. 224 Rear Clutch

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)

REAR CLUTCH (Continued)

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 fiber thrust washer from forward side of clutch retainer.

(2) Remove input shaft front/rear seal rings.

(3) Remove selective clutch pack snap-ring (Fig. 225).

(4) Remove top pressure plate, clutch discs, steel plates, bottom pressure plate and wave snap-ring and wave spring (Fig. 225).

(5) Remove clutch piston with rotating motion.

(6) Remove and discard piston seals.

(7) Remove input shaft snap-ring (Fig. 226). 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. Do not use rags or shop towels to dry any of the clutch parts. Lint from such materials will adhere to component surfaces and could restrict or block fluid passages after assembly.

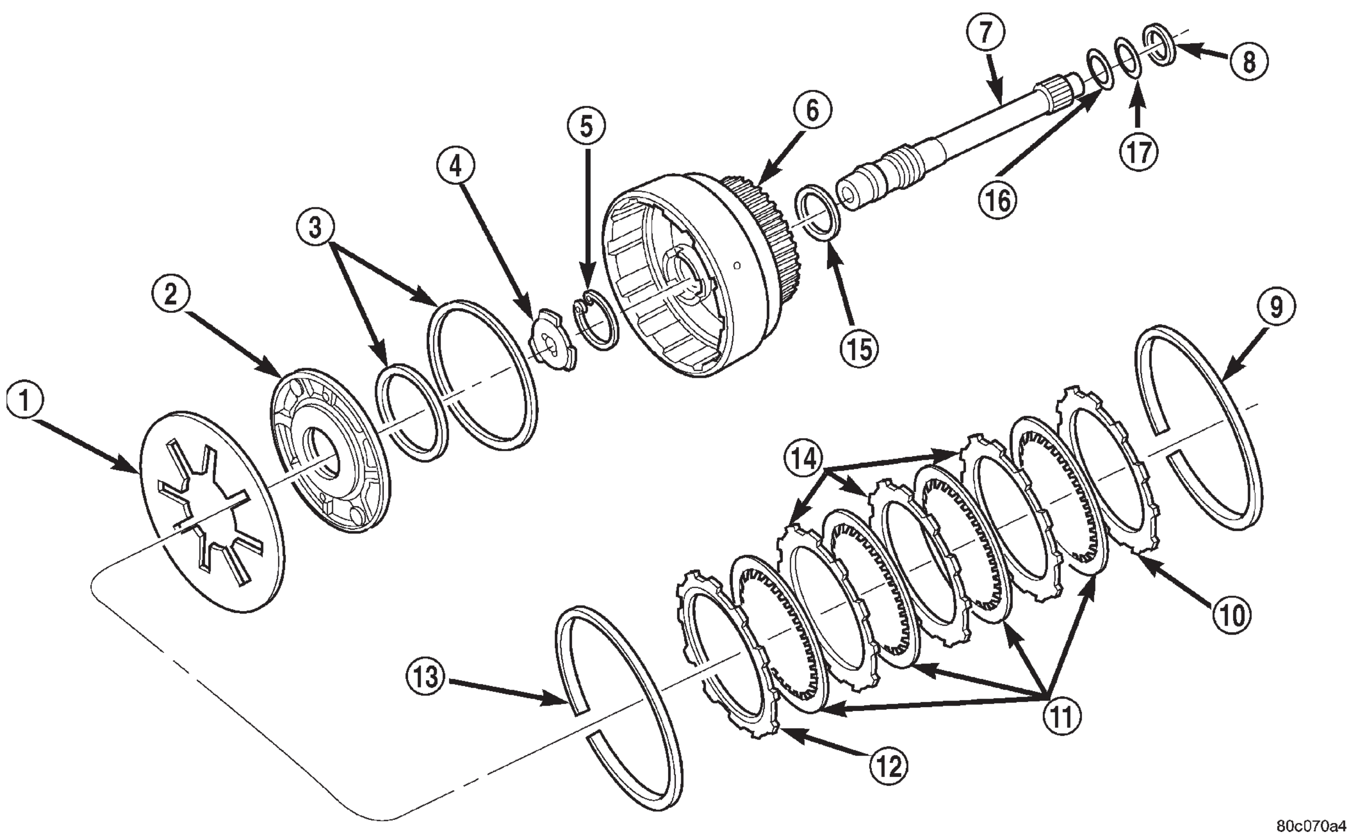


Fig. 225 Rear Clutch Components

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)

REAR CLUTCH (Continued)

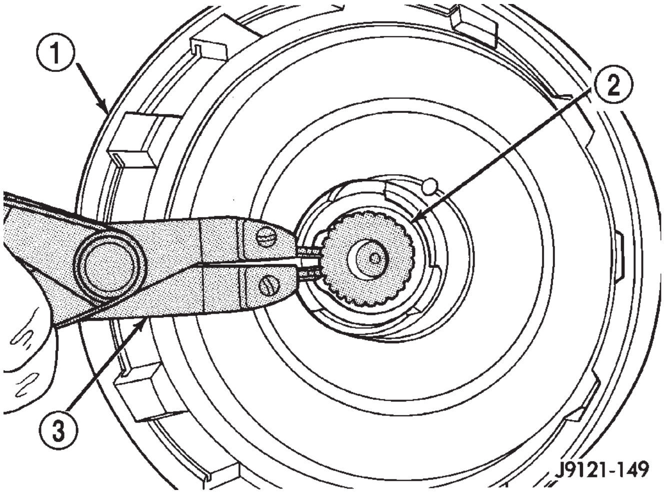


Fig. 226 Removing Input Shaft Snap-Ring

1 - REAR CLUTCH RETAINER
2 - INPUT SHAFT SNAP-RING
3 - SNAP-RING PLIERS

INSPECTION

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off. Replace the top and bottom pressure plates if scored, warped, or cracked. Be sure the driving lugs on the pressure and clutch plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston spring and wave spring if either part is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The clutch and pressure plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged. Also check action of the check balls in the retainer and piston. Each check ball must move freely and not stick.

Replace the retainer bushing if worn, scored, or doubt exists about bushing condition.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check condition of the fiber thrust washer and metal output shaft thrust washer. Replace either washer if worn or damaged.

Check condition of the seal rings on the input shaft and clutch retainer hub. Replace the seal rings only if worn, distorted, or damaged. The input shaft front seal ring is teflon with chamfered ends. The rear ring is metal with interlocking ends.

Check the input shaft for wear, or damage. Replace the shaft if worn, scored or damaged in any way.

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. 227) and (Fig. 228).

(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 (Fig. 229). Use a suitably sized press tool to support retainer as close to input shaft as possible.

(4) Install input shaft snap-ring (Fig. 226).

(5) Invert retainer and press input shaft in opposite direction until snap-ring is seated.

(6) Install new seals on clutch piston. Be sure lip of each seal faces interior of clutch retainer.

(7) Lubricate lip of piston seals with generous quantity of Mopar® Door Ease. Then lubricate retainer hub and bore with light coat of transmission fluid.

(8) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.020″ thick), can be used to guide seals into place if necessary.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip. In addition, never use any type of metal tool to help ease the piston seals into place. Metal tools will cut, shave, or score the seals.

(9) Install piston spring in retainer and on top of piston (Fig. 230). Concave side of spring faces downward (toward piston).

(10) Install wave spring in retainer (Fig. 230). Be sure spring is completely seated in retainer groove.

(11) Install bottom pressure plate (Fig. 225). 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. 225).

(13) Install top pressure plate.

(14) Install selective snap-ring. Be sure snap-ring is fully seated in retainer groove.

REAR CLUTCH (Continued)

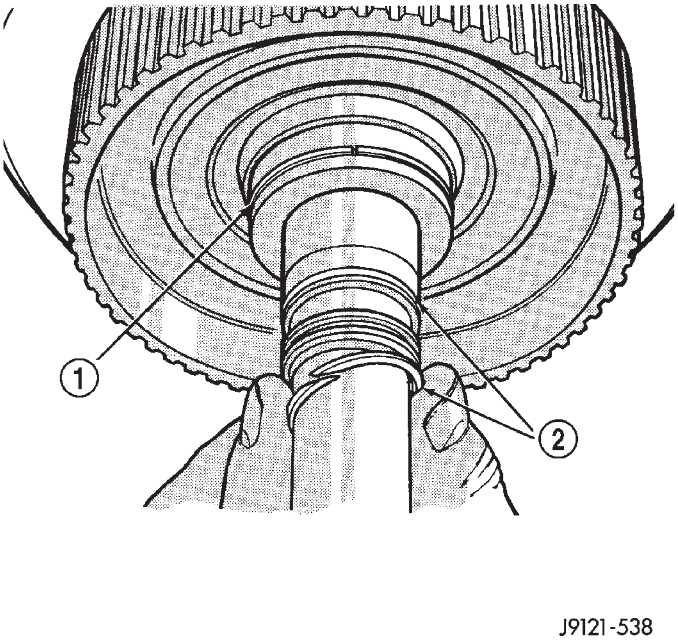


Fig. 227 Rear Clutch Retainer And Input Shaft Seal Ring Installation

1 - REAR CLUTCH RETAINER HUB SEAL RING
2 - INPUT SHAFT SEAL RINGS

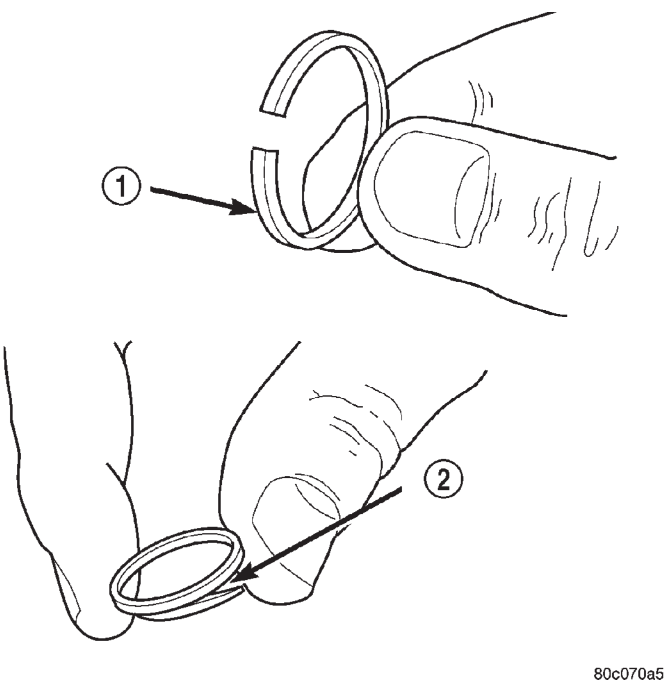


Fig. 228 Input Shaft Seal Ring Identification

1 - PLASTIC REAR SEAL RING
2 - TEFLON FRONT SEAL RING (SQUEEZE RING TOGETHER SLIGHTLY BEFORE INSTALLATION FOR BETTER FIT)

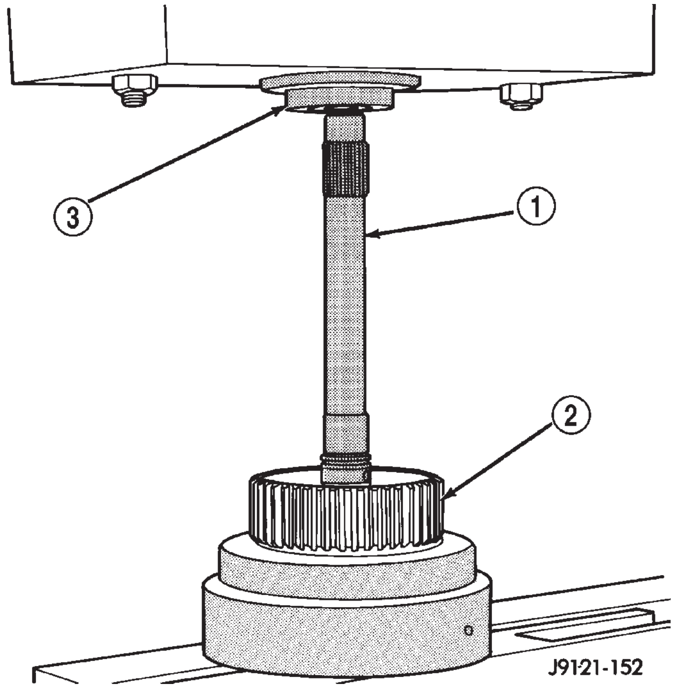


Fig. 229 Pressing Input Shaft Into Rear Clutch Retainer

1 - INPUT SHAFT
2 - REAR CLUTCH RETAINER
3 - PRESS RAM

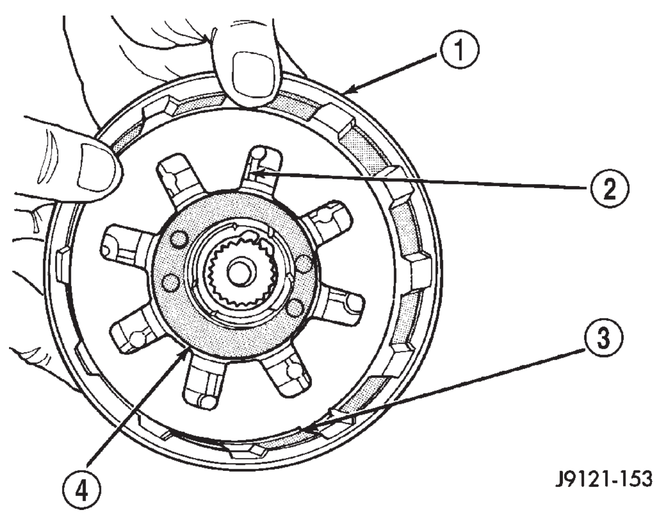


Fig. 230 Piston Spring/Wave Spring Position

1 - REAR CLUTCH RETAINER
2 - PISTON SPRING
3 - WAVE SPRING
4 - CLUTCH PISTON

REAR CLUTCH (Continued)

(15) Using a suitable gauge bar and dial indicator, measure clutch pack clearance (Fig. 231).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 231).

(b) Using two small screw drivers, lift the pressure plate and release it.

(c) Zero the dial indicator.

(d) Lift the pressure plate until it contacts the snap-ring and record the dial indicator reading.

Clearance should be 0.559 - 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.

(16) Coat rear clutch thrust washer with petroleum jelly and install washer over input shaft and into clutch retainer (Fig. 232). Use enough petroleum jelly to hold washer in place.

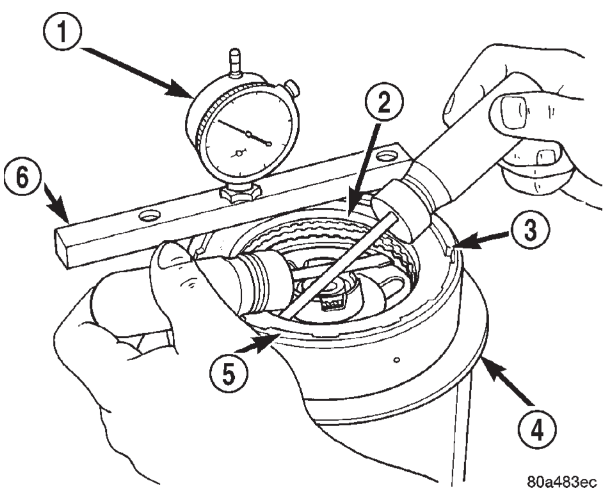


Fig. 231 Checking Rear Clutch Pack Clearance

1 - DIAL INDICATOR
2 - PRESSURE PLATE
3 - SNAP-RING
4 - STAND
5 - REAR CLUTCH
6 - GAUGE BAR

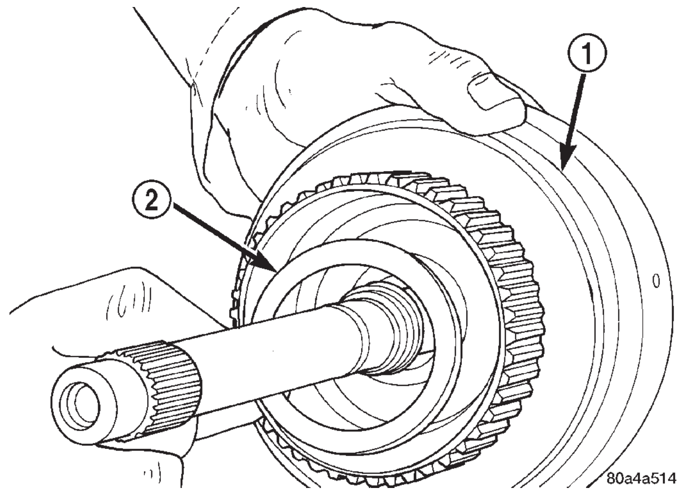


Fig. 232 Installing Rear Clutch Thrust Washer

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. 233).

(2) Remove and discard servo piston seal ring.

REAR SERVO (Continued)

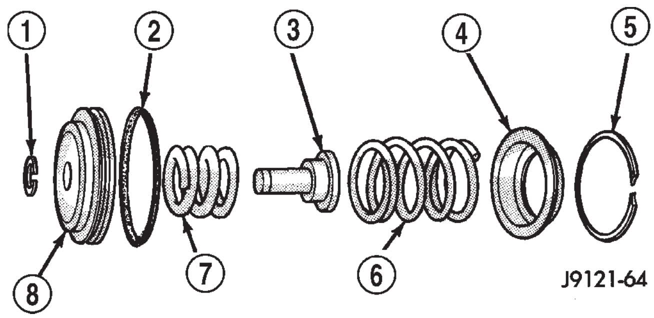


Fig. 233 Rear Servo Components

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. 234). 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.

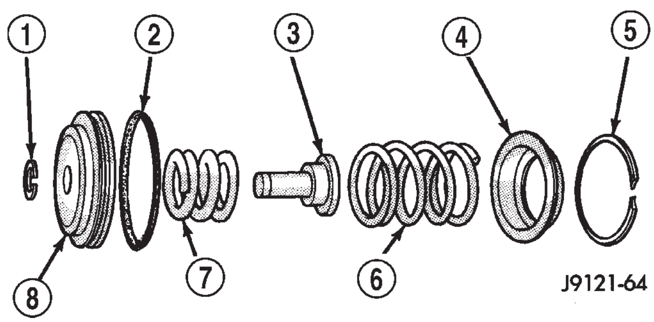


Fig. 234 Rear Servo Components

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. 235) 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.

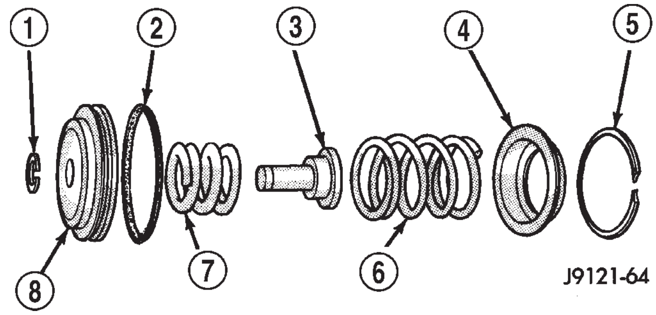


Fig. 235 Rear Servo Components

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 gear shift mechanism provides six shift positions which are:

- PARK (P)
- REVERSE (R)
- NEUTRAL (N)
- DRIVE (D)
- Manual SECOND (2)
- Manual LOW (1)

OPERATION

Manual LOW (1) range provides first gear only. Overrun braking is also provided in this range. Manual SECOND (2) range provides first and second gear only.

DRIVE range provides first, second third and overdrive fourth gear ranges. The shift into overdrive fourth gear range occurs only after the transmission has completed the shift into D third gear range. No further movement of the shift mechanism is required to complete the 3-4 shift.

The fourth gear upshift occurs automatically when the overdrive selector switch is in the ON position. No upshift to fourth gear will occur if any of the following are true:

- The transmission fluid temperature is below 10° C (50° F) or above 121° C (250° F).
- The shift to third is not yet complete.
- Vehicle speed is too low for the 3-4 shift to occur.
- Battery temperature is below -5° C (23° F).

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:

- Increase the amount of current applied to the coil or
- 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.

SPEED SENSOR

DESCRIPTION

The speed sensor (Fig. 236) is located in the overdrive gear case. The sensor is positioned over the park gear and monitors transmission output shaft rotating speed.

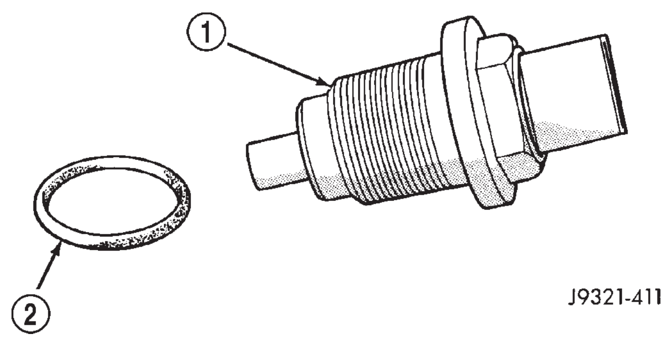


Fig. 236 Transmission Output Speed Sensor

1 - TRANSMISSION OUTPUT SHAFT SPEED SENSOR
2 - SEAL

OPERATION

Speed sensor signals are triggered by the park gear lugs as they rotate past the sensor pickup face. Input signals from the sensor are sent to the transmission control module for processing. Signals from this sensor are shared with the powertrain control module.

THROTTLE VALVE CABLE

DESCRIPTION

Transmission throttle valve cable (Fig. 237) 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.

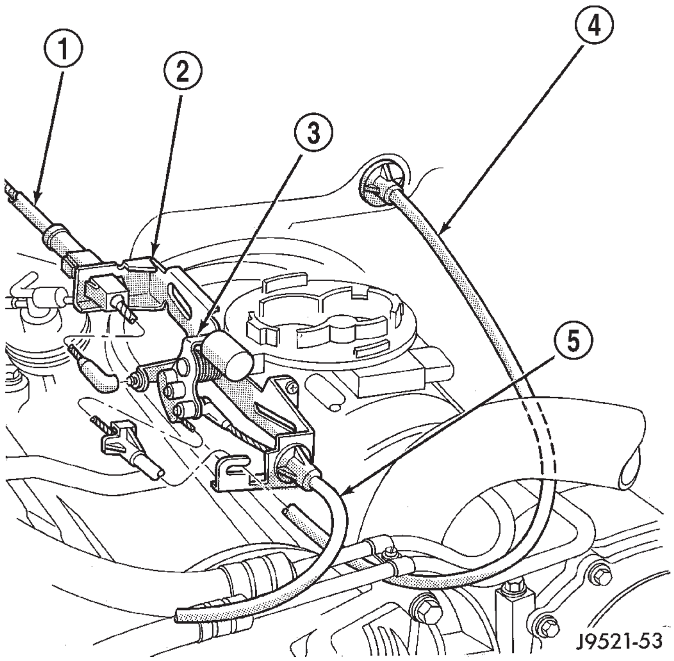


Fig. 237 Throttle Valve Cable Attachment - At Engine

1 - THROTTLE VALVE CABLE
2 - CABLE BRACKET
3 - THROTTLE BODY LEVER
4 - ACCELERATOR CABLE
5 - SPEED CONTROL CABLE

The transmission throttle valve is operated by a cam on the throttle lever. The throttle lever is operated by an adjustable cable (Fig. 238). 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.

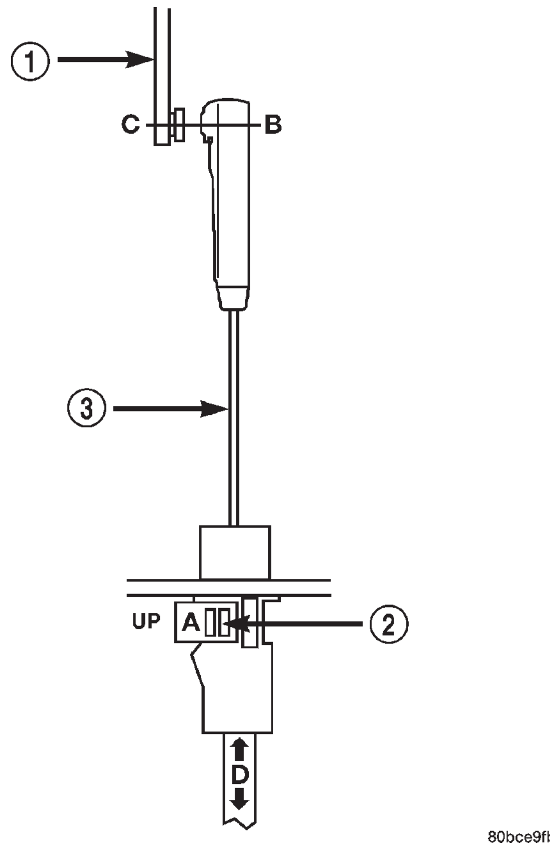


Fig. 238 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - THROTTLE VALVE CABLE

ADJUSTMENTS - TRANSMISSION 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.

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. 239). Then verify that the transmission throttle lever (Fig. 240) is also at idle (fully forward) position.

THROTTLE VALVE CABLE (Continued)

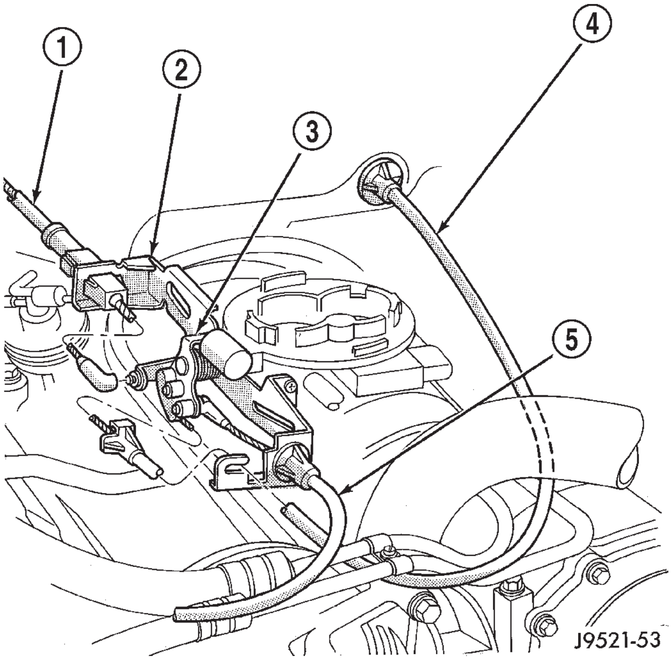


Fig. 239 Throttle Valve Cable Attachment - At Engine

1 - THROTTLE VALVE CABLE
2 - CABLE BRACKET
3 - THROTTLE BODY LEVER
4 - ACCELERATOR CABLE
5 - SPEED CONTROL CABLE

(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. 241).

• 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.

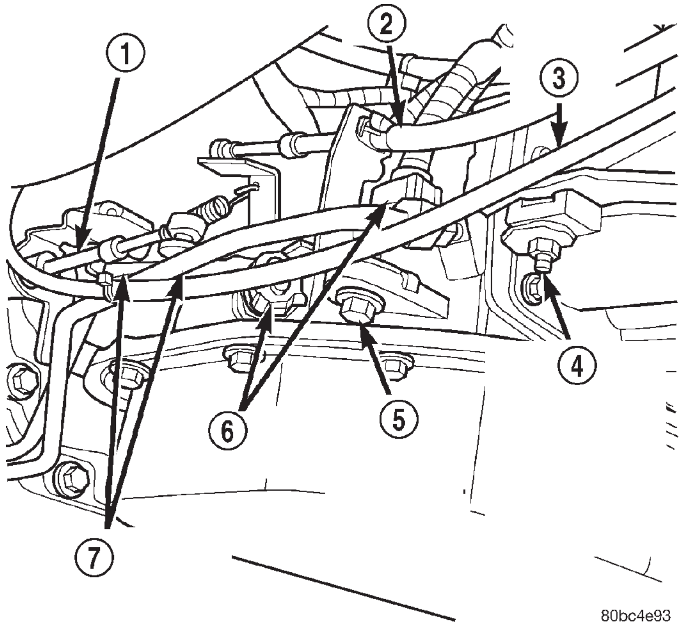


Fig. 240 Throttle Valve Cable at Transmission

1 - TRANSMISSION SHIFTER CABLE
2 - THROTTLE VALVE CABLE
3 - TRANSFER CASE SHIFTER CABLE
4 - TRANSFER CASE SHIFTER CABLE BRACKET RETAINING BOLT (1 OR 2)
5 - THROTTLE VALVE CABLE BRACKET RETAINING BOLT
6 - ELECTRICAL CONNECTORS
7 - TRANSMISSION FLUID LINES

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. 241). 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. 241).

THROTTLE VALVE CABLE (Continued)

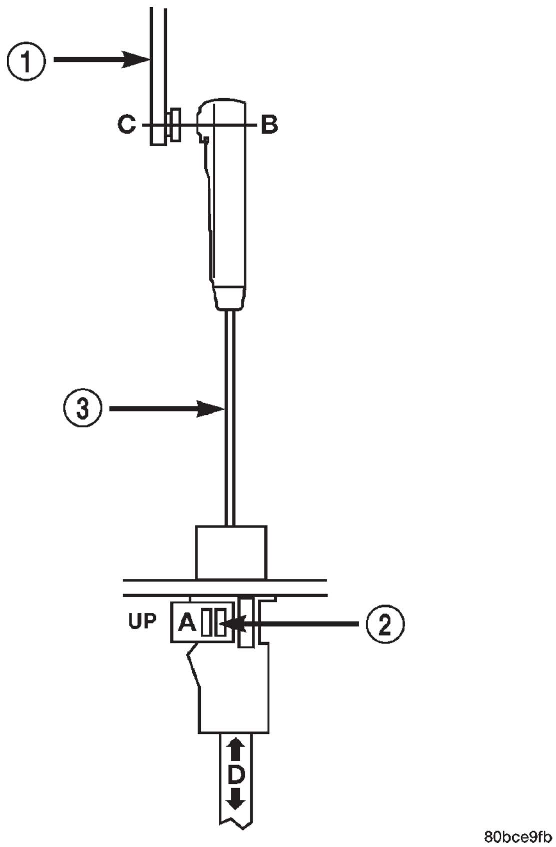


Fig. 241 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - THROTTLE VALVE CABLE

(7) While holding the T.V. cable in the set position push the T.V. cable lock (A) into the down position (Fig. 241). 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. 242) 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 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 all transmission fluid cooler(s) and lines.

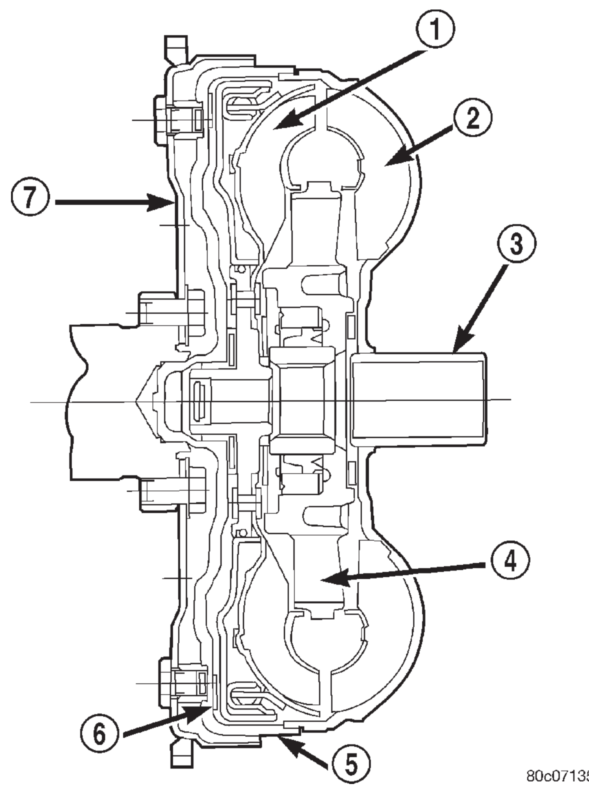


Fig. 242 Torque Converter Assembly

1 - TURBINE
2 - IMPELLER
3 - HUB
4 - STATOR
5 - FRONT COVER
6 - CONVERTER CLUTCH DISC
7 - DRIVE PLATE

TORQUE CONVERTER (Continued)

IMPELLER

The impeller (Fig. 243) 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 members of the system.

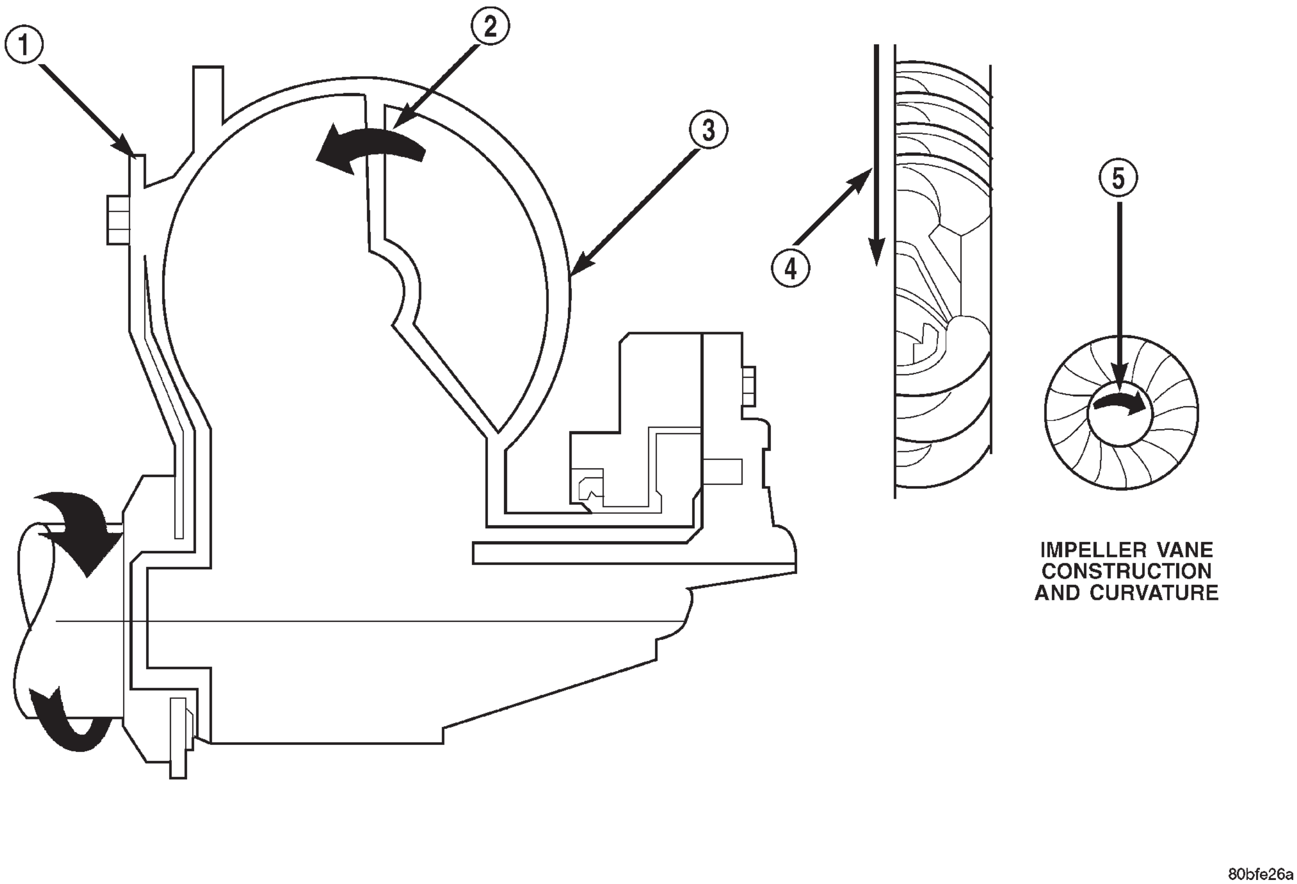


Fig. 243 Impeller

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)

TURBINE

The turbine (Fig. 244) 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.

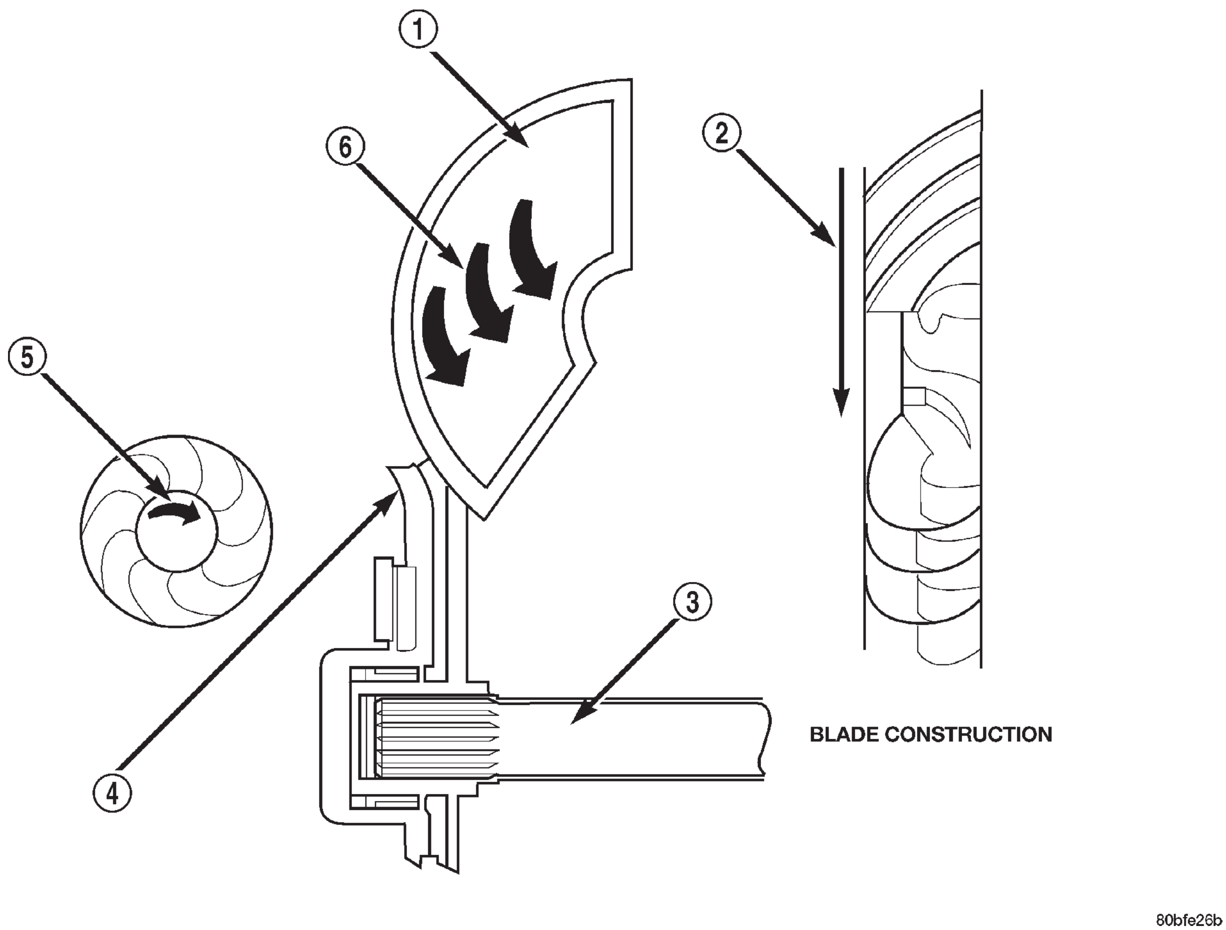


Fig. 244 Turbine

1 - TURBINE VANE
2 - ENGINE ROTATION
3 - INPUT SHAFT
4 - PORTION OF TORQUE CONVERTER COVER
5 - ENGINE ROTATION
6 - OIL FLOW WITHIN TURBINE SECTION

TORQUE CONVERTER (Continued)

STATOR

The stator assembly (Fig. 245) 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. 246). 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.

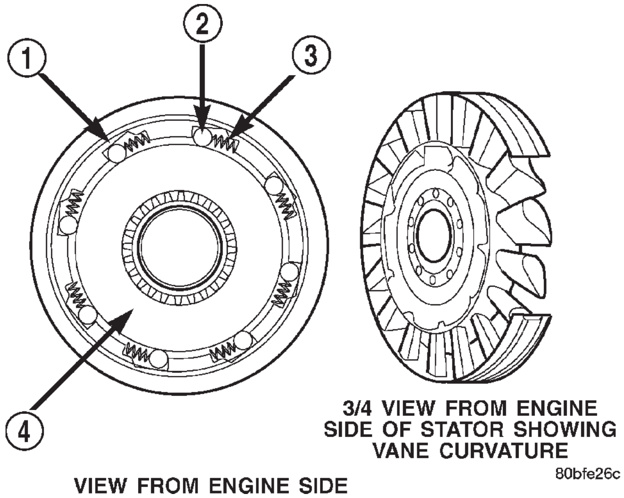


Fig. 245 Stator Components

1 - CAM (OUTER RACE)
2 - ROLLER
3 - SPRING
4 - INNER RACE

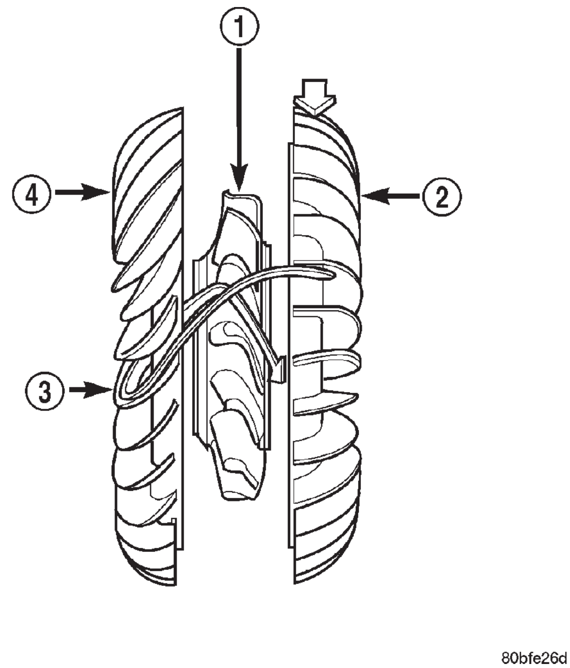


Fig. 246 Stator Location

1 - STATOR
2 - IMPELLER
3 - FLUID FLOW
4 - TURBINE

TORQUE CONVERTER CLUTCH (TCC)

The TCC (Fig. 247) was installed to improve the efficiency of the torque converter that is lost to the slippage of the fluid coupling. Although the fluid coupling provides smooth, shock-free power transfer, it is natural for all fluid couplings to slip. If the impeller and turbine were mechanically locked together, a zero slippage condition could be obtained. A hydraulic piston was added to the turbine, and a friction material was added to the inside of the front cover to provide this mechanical lock-up.

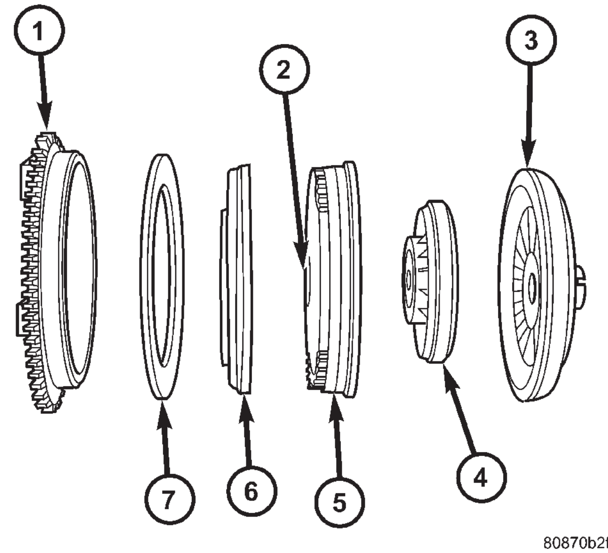


Fig. 247 Torque Converter Clutch (TCC)

1 - IMPELLER FRONT COVER
2 - THRUST WASHER ASSEMBLY
3 - IMPELLER
4 - STATOR
5 - TURBINE
6 - PISTON
7 - FRICTION DISC

OPERATION

The converter impeller (Fig. 248) (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.

TORQUE CONVERTER (Continued)

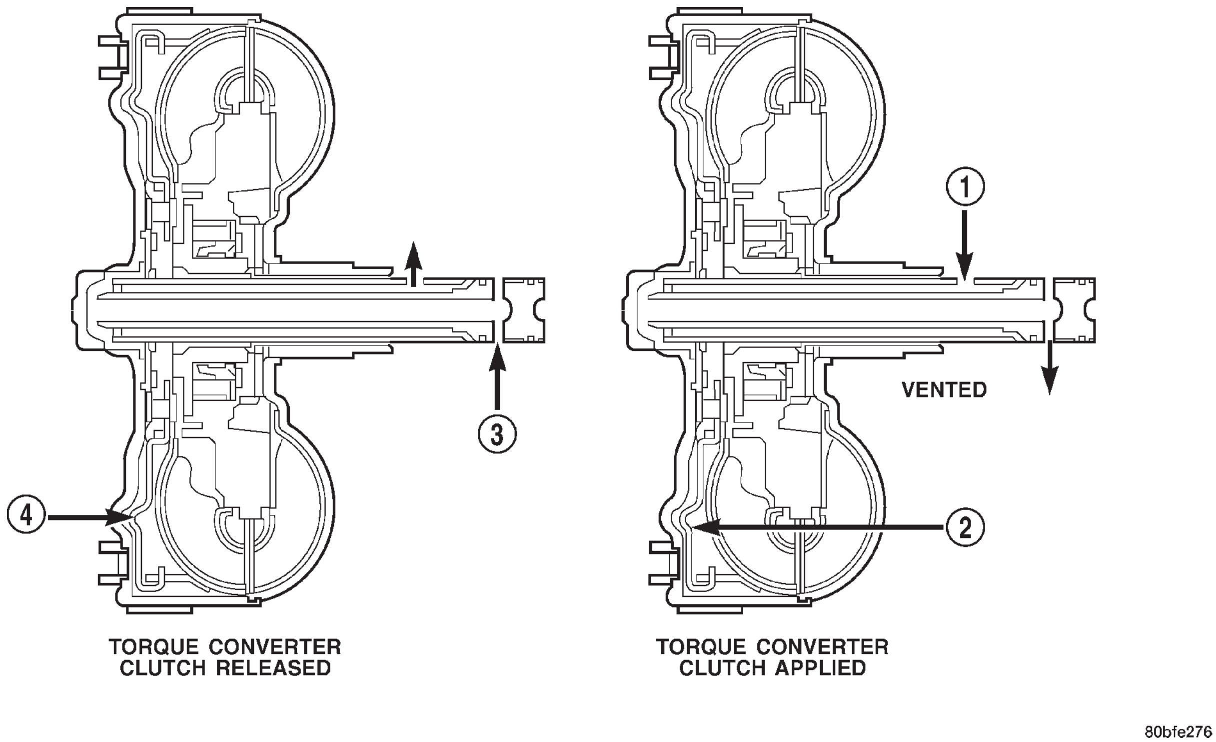


Fig. 248 Torque Converter Fluid Operation

1 - APPLY PRESSURE
2 - THE PISTON MOVES SLIGHTLY FORWARD
3 - RELEASE PRESSURE
4 - THE PISTON MOVES SLIGHTLY REARWARD

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. 249). 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 counterclockwise direction. When this happens the overrunning 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)

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 fourth gear, and in third gear under various conditions, such as when the O/D switch is OFF, when the vehicle is cruising on a level surface 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.

TORQUE CONVERTER (Continued)

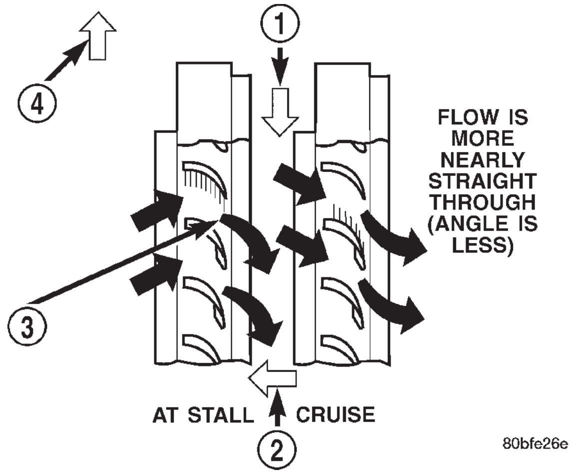


Fig. 249 Stator Operation

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

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 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. 250). 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.

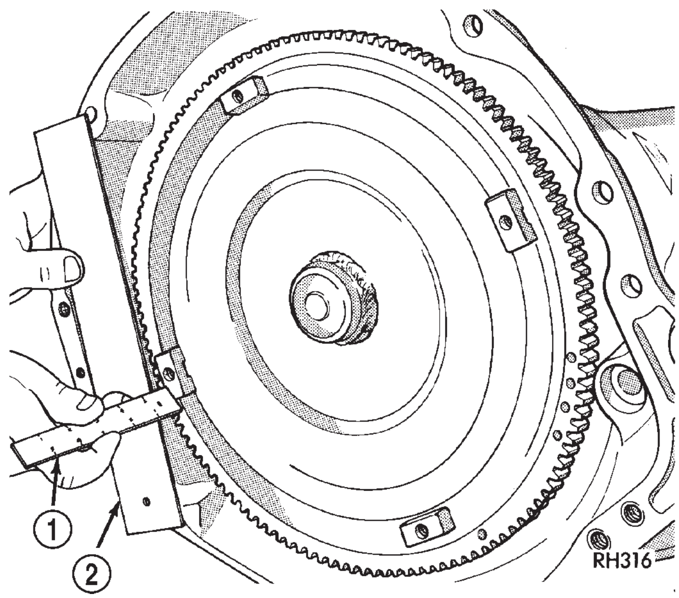


Fig. 250 Checking Torque Converter Seating - Typical

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.

TRANSMISSION RANGE SENSOR

DESCRIPTION

The Transmission Range Sensor (TRS) (Fig. 251) has 3 primary functions:

- Provide a PARK/NEUTRAL start signal to the engine controller and the starter relay.
- Turn the Back-up lamps on when the transmission is in REVERSE and the engine (ignition) is on.
- Provide a transmission range signal to the instrument cluster.

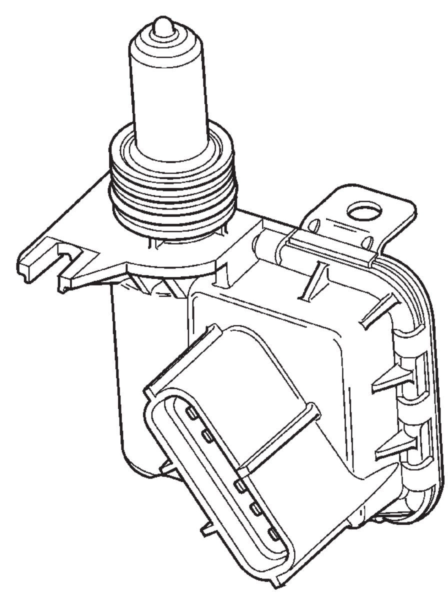


Fig. 251 Transmission Range Sensor

TRANSMISSION RANGE SENSOR (Continued)

The sensor is mounted in the transmission housing near the valve body, just above the pan rail. It's in the same position as the Park/Neutral switch on other transmissions. The TRS contacts a cammed surface on the manual valve lever. The cammed surface translates the rotational motion of the manual lever into the linear motion of the sensor. The cammed surface on the manual lever is comprised of two parts controlling the TRS signal: The insulator portion contacts the switch poppet when the manual lever is not in PARK or NEUTRAL. The manual lever itself contacts the poppet when the lever is in PARK or NEUTRAL; providing a ground for the signal from the starter relay and the JTEC engine controller.

OPERATION

As the switch moves through its linear motion (Fig. 252) contacts slide across a circuit board which changes the resistance between the range sensing pins of the switch. A power supply on the instrument cluster provides a regulated voltage signal to the switch. The return signal is decoded by the cluster, which then controls the PRNDL display to correspond with the correct transmission range. A bus message of transmission range is also sent by the cluster. In REVERSE range a second contact set closes the circuit providing power to the reverse lamps.

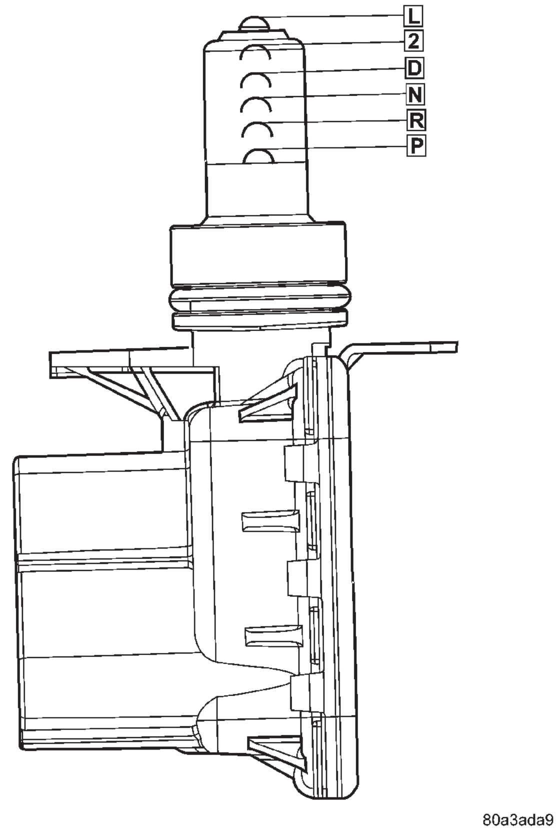


Fig. 252 Transmission Range Sensor Linear Movement

TRANSMISSION RANGE SENSOR (Continued)

Mechanical State	Electronic Display (Ignition Unlocked)	Electronic Display (Ignition On)		
Indicated Gear Position			Transmission Status	Column Shifter Position
P	P	P	Vehicle is in PARK with the pawl engaged.	In the PARK gate.
	R		The PARK pawl is disengaged and the vehicle is free to roll, but REVERSE is not engaged.	Between the PARK and REVERSE gates.
R	R	R	The transmission is hydraulically in REVERSE.	In the REVERSE gate.
	N		The transmission is transitioning between REVERSE and NEUTRAL.	Between the REVERSE and NEUTRAL gates.
N	N	N	The vehicle is in NEUTRAL.	In the NEUTRAL gate.
	N		The transmission is transitioning between NEUTRAL and DRIVE, but is not in DRIVE.	Between the NEUTRAL and DRIVE gates.
D	D	D	The transmission is hydraulically in DRIVE.	In the DRIVE gate,
2	2	2	The transmission is hydraulically in Manual SECOND.	In the SECOND gate.
1	1	1	The transmission is hydraulically in Manual FIRST.	In the FIRST gate.

DIAGNOSIS AND TESTING - TRANSMISSION RANGE SENSOR (TRS)

NOTE: For all circuit identification in the following steps, Refer to the appropriate Wiring Information.

(1) Raise vehicle on suitable hoist.

(2) Disconnect the vehicle's shift cable from the manual lever.

(3) With the manual lever in the PARK position (the PARK position is with the manual lever moved to the full rearward position), measure the resistance between the Park/Neutral Position Sense pin of the TRS and the transmission case. The resistance should be less than 5 ohms.

(4) With the manual lever in the NEUTRAL position (the NEUTRAL position is with the manual lever moved two detents forward of the full rearward position), measure the resistance between the Park/Neutral Position Sense pin of the TRS and the transmission case. The resistance should be less than 5 ohms.

(5) If the resistance is greater than 5 ohms in either of the previous steps, check for a dirty contact between the tip of the TRS rod and the valve body manual lever. If the contact is OK, replace the TRS.

(6) With the manual lever in the REVERSE position (the REVERSE position is with the manual lever moved one detent forward of the full rearward position), measure the resistance between the Fused Ignition Switch Output and the Back-up Lamp feed pins of the TRS. The resistance should be less than 5 ohms. If the resistance is greater than 5 ohms, replace the TRS.

TRANSMISSION RANGE SENSOR (Continued)

(7) With the manual lever in the PARK position (the PARK position is with the manual lever moved to the full rearward position), measure the resistance between the Cluster Resistance Signal and the Cluster Signal Return pins of the TRS. The resistance should be 522.2 ohms. If the resistance is not correct, replace the TRS.

(8) With the manual lever in the REVERSE position (the REVERSE position is with the manual lever moved one detent forward of the full rearward position), measure the resistance between the Cluster Resistance Signal and the Cluster Signal Return pins of the TRS. The resistance should be 206.2 ohms. If the resistance is not correct, replace the TRS.

(9) With the manual lever in the NEUTRAL position (the NEUTRAL position is with the manual lever moved two detents forward of the full rearward position), measure the resistance between the Cluster Resistance Signal and the Cluster Signal Return pins of the TRS. The resistance should be 108.6 ohms. If the resistance is not correct, replace the TRS.

(10) With the manual lever in the DRIVE position (the DRIVE position is with the manual lever moved three detents forward of the full rearward position), measure the resistance between the Cluster Resistance Signal and the Cluster Signal Return pins of the TRS. The resistance should be 59.9 ohms. If the resistance is not correct, replace the TRS.

(11) With the manual lever in the SECOND position (the SECOND position is with the manual lever moved one detent rearward of the full forward position), measure the resistance between the Fused Ignition Switch Output and the Back-up Lamp feed pins of the TRS. The resistance should be 31.9 ohms. If the resistance is not correct, replace the TRS.

(12) With the manual lever in the LOW position (the LOW position is with the manual lever moved to the full forward position), measure the resistance between the Fused Ignition Switch Output and the Back-up Lamp feed pins of the TRS. The resistance should be 13.7 ohms. If the resistance is not correct, replace the TRS.

REMOVAL

(1) Raise vehicle and position drain pan under the transmission range sensor (TRS).

(2) Move the transmission manual lever to the manual LOW position. The manual LOW position is with the manual lever in the forward-most detent.

(3) Disengage the wiring connector from the TRS.

(4) Remove the two screws holding the TRS to the TRS mounting bracket.

(5) Remove the TRS (Fig. 253) from the TRS mounting bracket by pulling it straight out of the bracket.

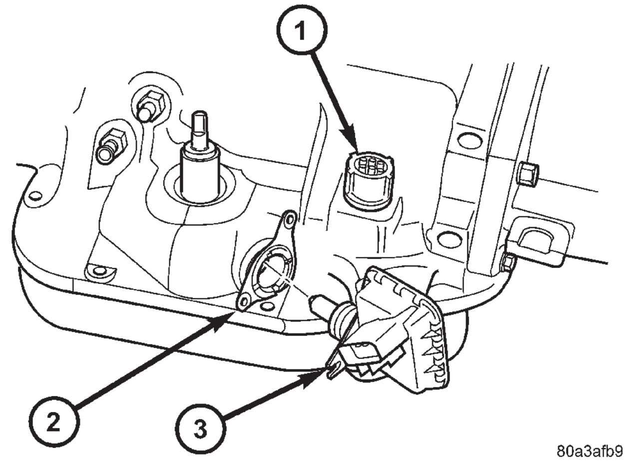


Fig. 253 Remove Transmission Range Sensor

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - TRANSMISSION RANGE SENSOR

(6) Loosen the TRS mounting bracket in the transmission case using Adapter 8581 (Fig. 254).

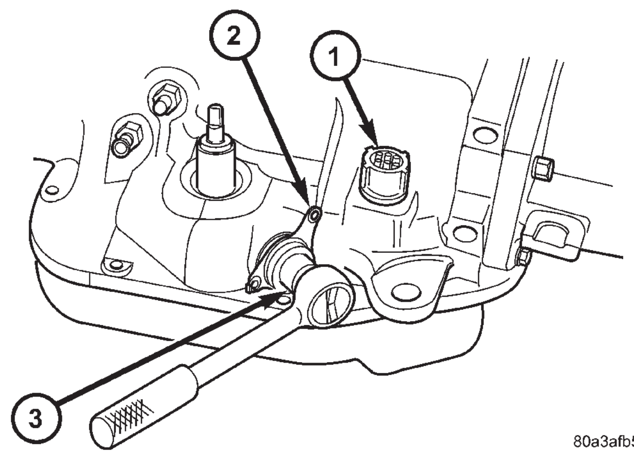


Fig. 254 Loosen the TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - ADAPTER 8581

TRANSMISSION RANGE SENSOR (Continued)

(7) Remove the TRS mounting bracket (Fig. 255) from the transmission case.

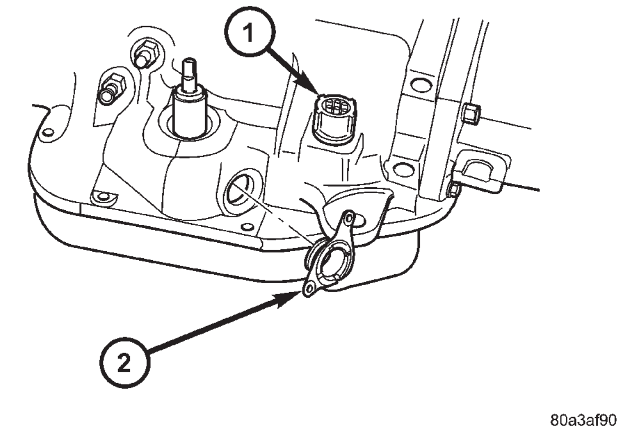


Fig. 255 Remove TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET

INSTALLATION

(1) Move the transmission manual shaft lever to the manual LOW position.

(2) Install the TRS mounting bracket into the transmission case. Using Adapter 8581 (Fig. 256), tighten the mounting bracket to 34 N·m (300 in.lbs.).

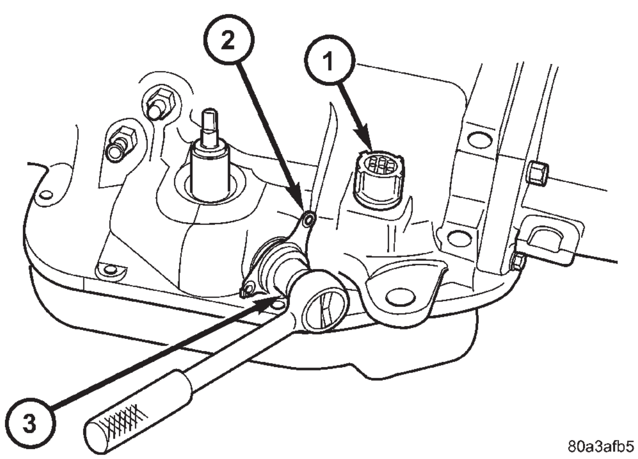


Fig. 256 Tighten the TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - ADAPTER 8581

(3) Install the TRS (Fig. 257) into the mounting bracket with the wiring connector facing the front of the transmission.

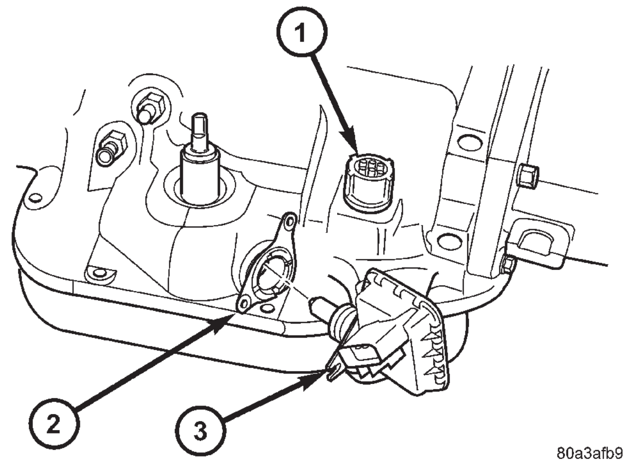


Fig. 257 Remove Transmission Range Sensor

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - TRANSMISSION RANGE SENSOR

(4) Install the two screws to hold the TRS to the mounting bracket. Tighten the screws to 3.4 N·m (30 in.lbs.).

(5) Verify proper sensor operation (Fig. 258).

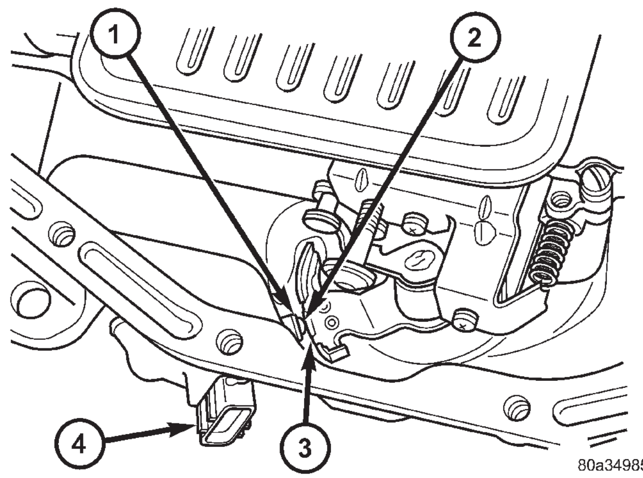


Fig. 258 Transmission Range Sensor Operation

1 - NEUTRAL CONTACT
2 - MANUAL LEVER AND SENSOR PLUNGER IN REVERSE POSITION
3 - PARK CONTACT
4 - TRANSMISSION RANGE SENSOR

(6) Move the transmission manual shaft lever to the PARK position.

(7) Connect TRS wiring connector to the TRS and lower vehicle.

(8) Refill the transmission fluid to the correct level.

TRANSMISSION TEMPERATURE SENSOR

DESCRIPTION

Transmission fluid temperature readings are supplied to the transmission control module by the thermistor (Fig. 259). The temperature readings are used to control engagement of the fourth gear overdrive clutch, the converter clutch, and governor pressure. Normal resistance value for the thermistor at room temperature is approximately 1000 ohms.

The thermistor is part of the governor pressure sensor assembly and is immersed in transmission fluid at all times.

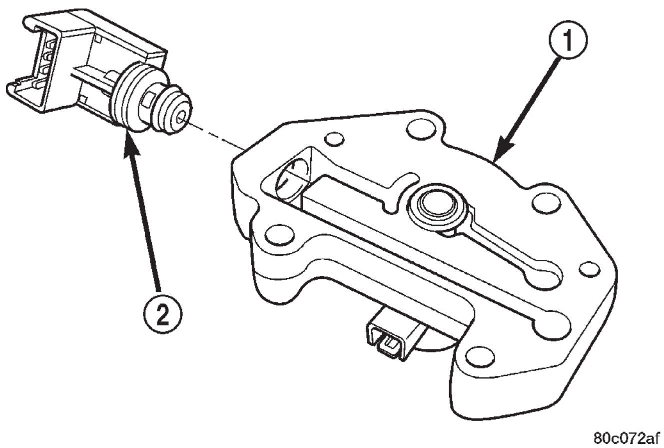


Fig. 259 Governor Pressure Sensor

1 - GOVERNOR BODY

2 - GOVERNOR PRESSURE SENSOR/TRANSMISSION FLUID TEMPERATURE THERMISTOR

OPERATION

The PCM prevents engagement of the converter clutch and overdrive clutch, when fluid temperature is below approximately 10°C (50°F).

If fluid temperature exceeds 126°C (260°F), the PCM causes a 4-3 downshift and engage the converter clutch. Engagement is according to the third gear converter clutch engagement schedule.

The overdrive OFF lamp in the instrument panel illuminates when the shift back to third occurs. The transmission will not allow fourth gear operation until fluid temperature decreases to approximately 110°C (230°F).

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. 260), (Fig. 261), (Fig. 262), and (Fig. 263):

- 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
- 3-4 shift valve
- 3-4 timing valve
- 3-4 quick fill valve
- 3-4 accumulator
- Throttle valve
- Throttle pressure plug
- Switch valve
- Manual valve
- Converter clutch lock-up valve
- Converter clutch lock-up timing Valve
- Shuttle valve
- Shuttle valve throttle plug
- Boost Valve
- 10 check balls

By adjusting the spring pressure acting on the regulator valve, transmission line pressure can be adjusted.

VALVE BODY (Continued)

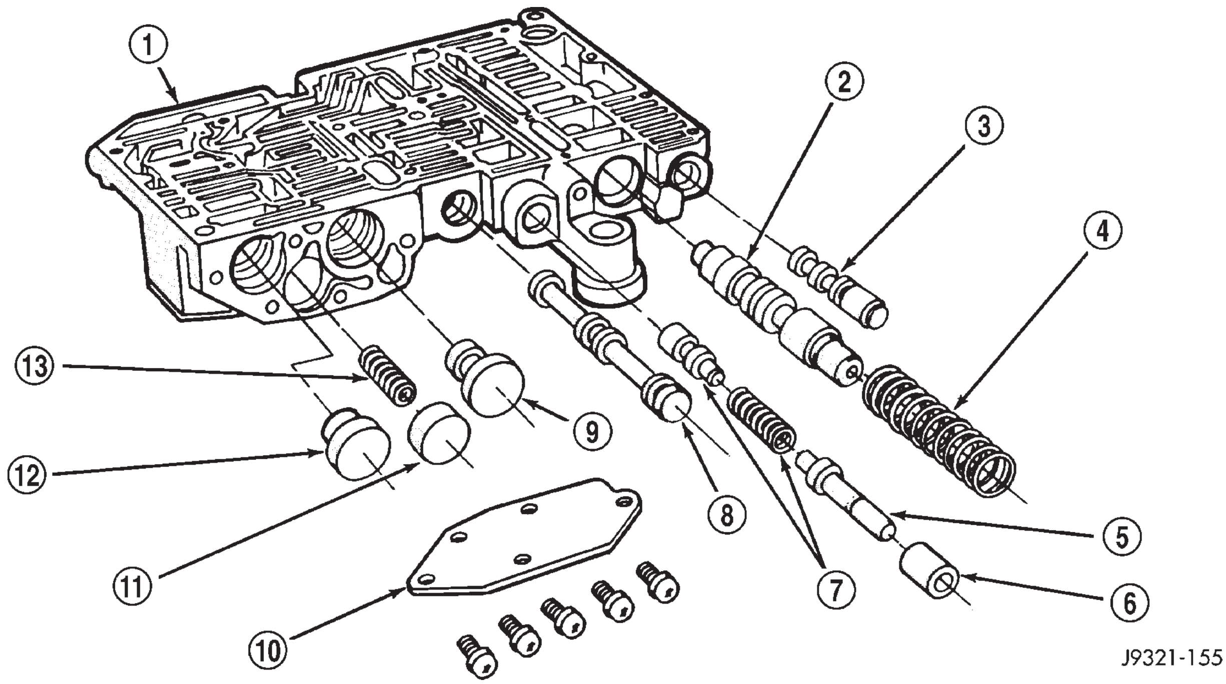


Fig. 260 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

VALVE BODY (Continued)

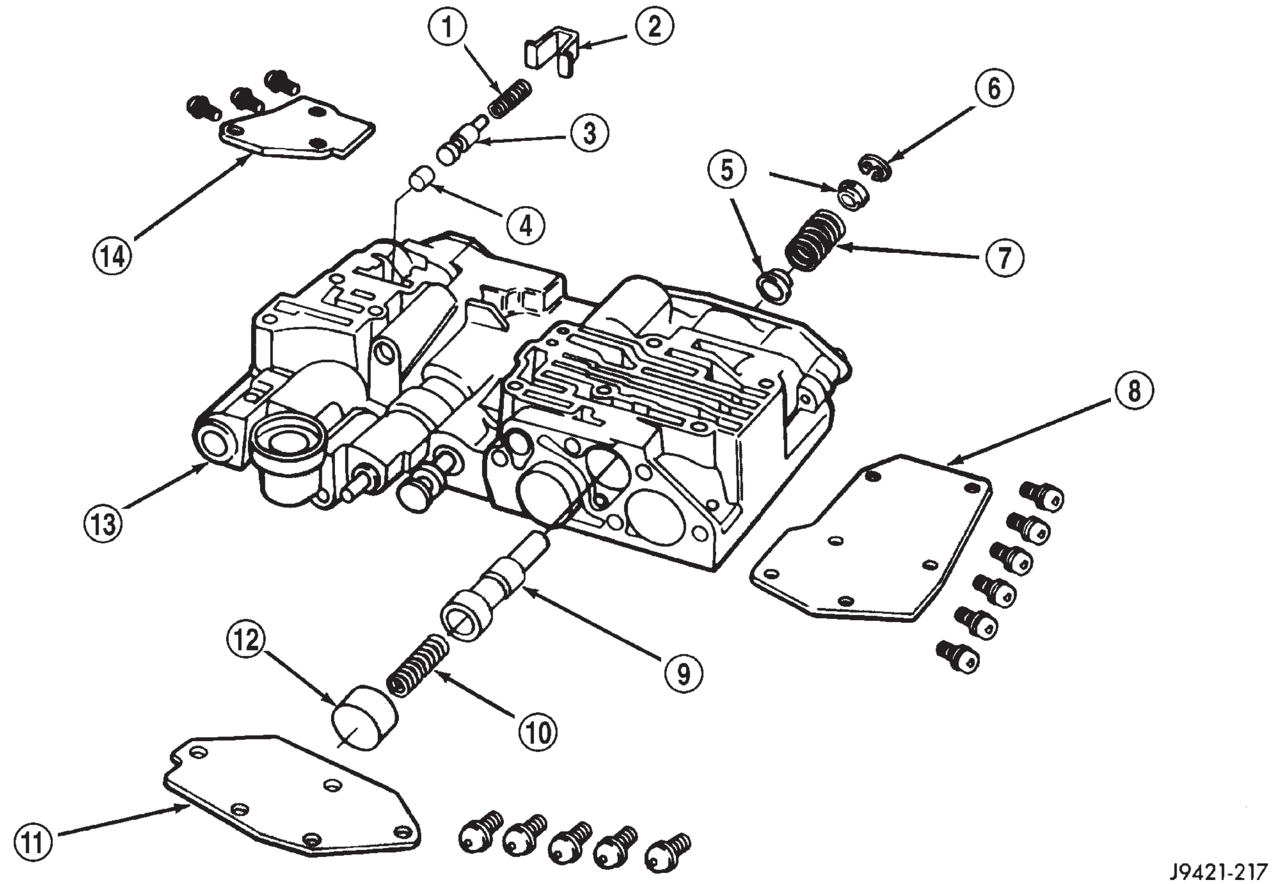


Fig. 261 Shuttle and Boost Valve Locations

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

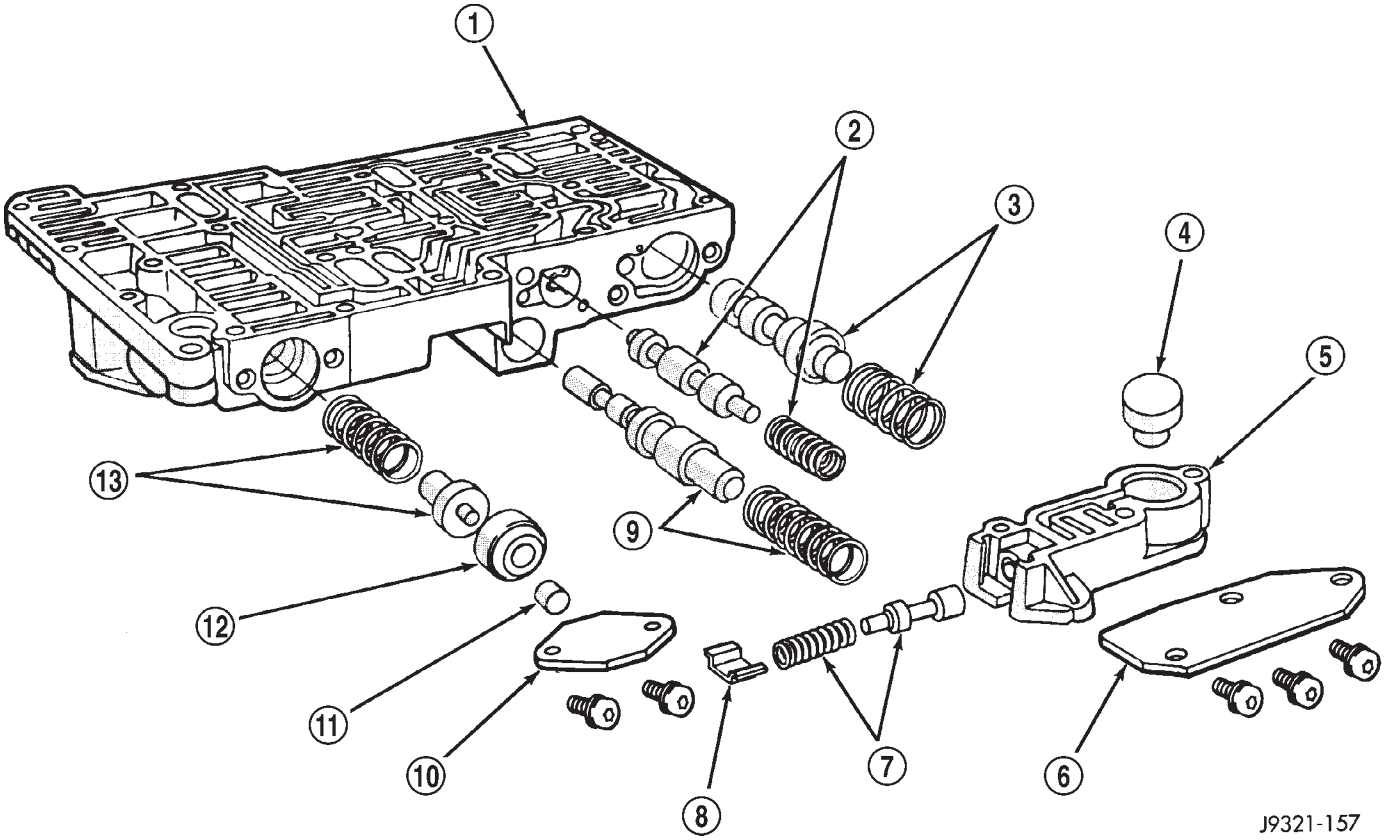


Fig. 262 Upper Housing Shift Valve and Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - LINE PRESSURE PLUG
12 - PLUG SLEEVE
13 - THROTTLE PRESSURE SPRING AND PLUG

VALVE BODY (Continued)

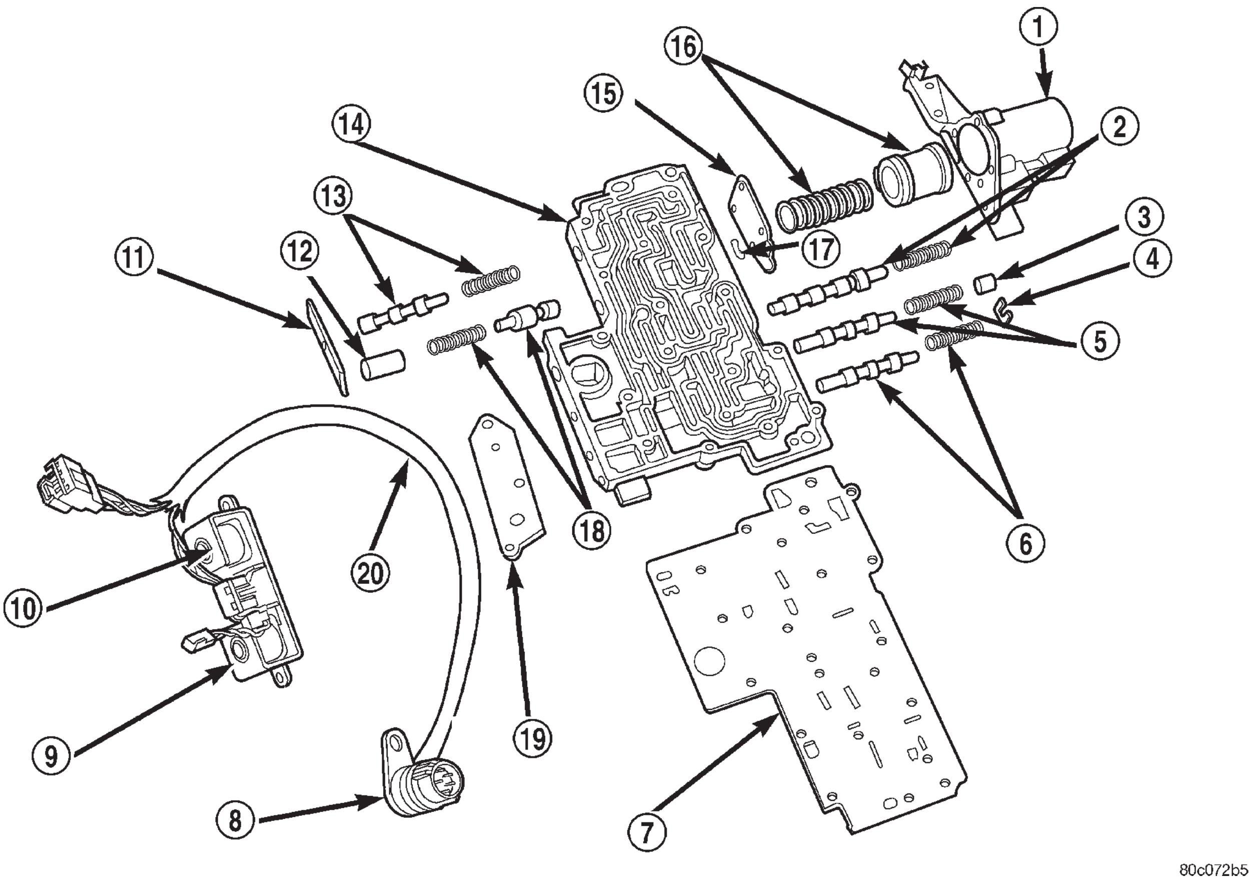


Fig. 263 Lower Housing Shift Valves and Springs

1 - 3-4 ACCUMULATOR HOUSING
2 - 3-4 SHIFT VALVE AND SPRING
3 - PLUG
4 - SPRING RETAINER
5 - CONVERTER CLUTCH VALVE AND SPRING
6 - CONVERTER CLUTCH TIMING VALVE AND SPRING
7 - OVERDRIVE SEPARATOR PLATE
8 - CASE CONNECTOR
9 - CONVERTER CLUTCH SOLENOID
10 - OVERDRIVE SOLENOID
11 - TIMING VALVE COVER
12 - PLUG
13 - 3-4 TIMING VALVE AND SPRING
14 - LOWER HOUSING
15 - ACCUMULATOR END PLATE
16 - 3-4 ACCUMULATOR PISTON AND SPRING
17 - E-CLIP
18 - 3-4 QUICK FILL SPRING AND VALVE
19 - SOLENOID GASKET
20 - HARNESS

VALVE BODY (Continued)

OPERATION

NOTE: Refer to the Hydraulic Schematics for a visual aid in determining valve location, operation and design.

CHECK BALLS

CHECK BALL NUMBER	DESCRIPTION
1	Allows either the manual valve to put line pressure on the 1-2 governor plug or the KD Valve to put WOT line pressure on the 1-2 governor plug.
2	Allows either the manual valve to put line pressure on the 2-3 governor plug or the KD Valve to put WOT line pressure on the 2-3 governor plug.
3	Allows either the Reverse circuit or the 3rd gear circuit to pressurize the front clutch.
4	Allows either the Manual Low circuit from the Manual Valve or the Reverse from the Manual Valve circuit to pressurize the rear servo.
5	Directs line pressure to the spring end of the 2-3 shift valve in either Manual Low or Manual 2nd, forcing the downshift to 2nd gear regardless of governor pressure.
6	Provides a by-pass around the front servo orifice so that the servo can release quickly.
7	Provides a by-pass around the rear clutch orifice so that the clutch can release quickly.
8	Directs reverse line pressure through an orifice to the throttle valve eliminating the extra leakage and insuring that Reverse line pressure pressure will be sufficient.
9	Provides a by-pass around the rear servo orifice so that the servo can release quickly.
ECE (10)	Allows the lockup clutch to used at WOT in 3rd gear by putting line pressure from the 3-4 Timing Valve on the interlock area of the 2-3 shift valve, thereby preventing a 3rd gear Lock-up to 2nd gear kickdown.

VALVE BODY (Continued)

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. 264) 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.

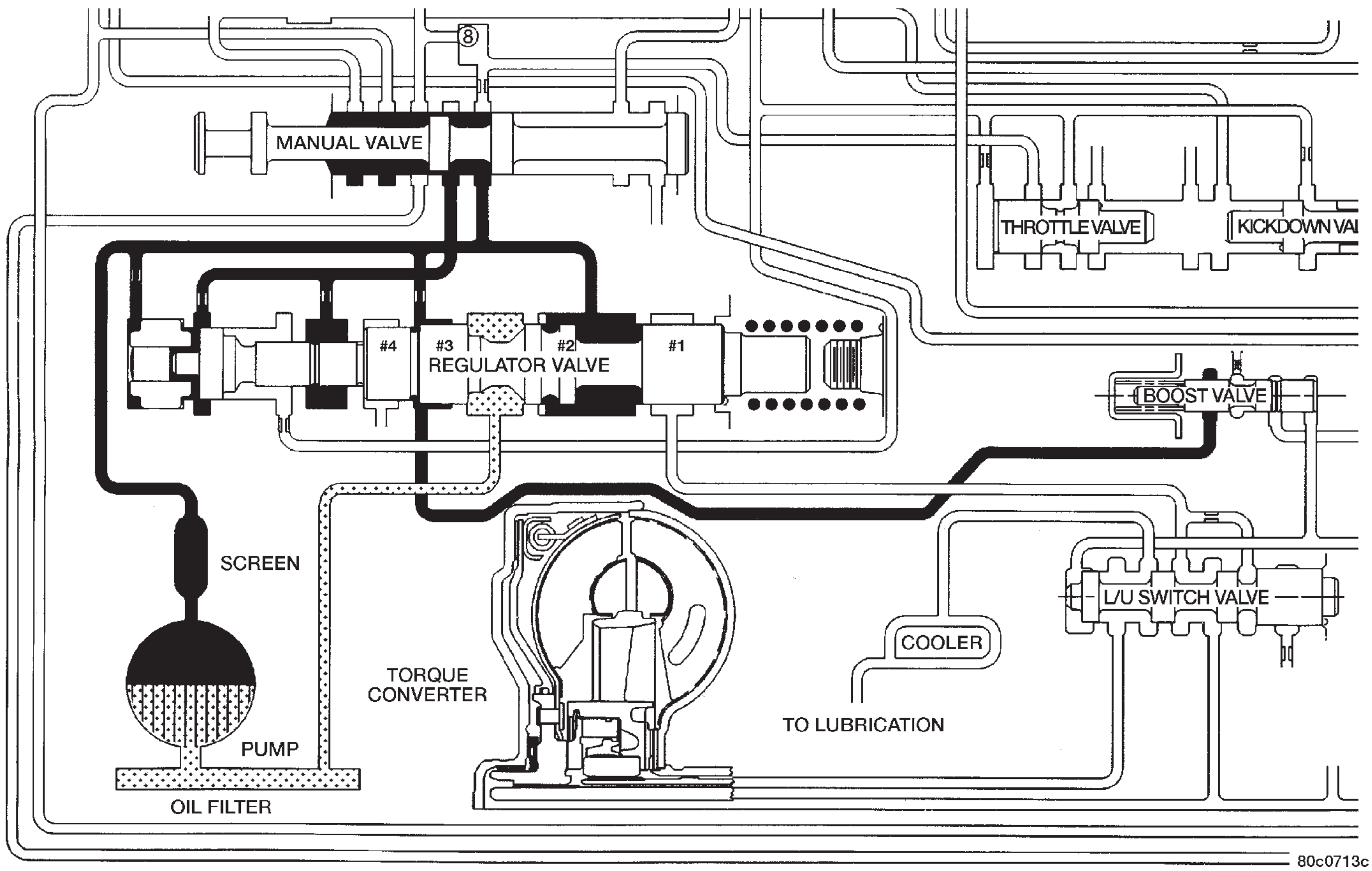


Fig. 264 Regulator Valve in PARK Position

VALVE BODY (Continued)

Meanwhile, the torque converter is filled slowly. In all other gear positions (Fig. 265), 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 and the transmission's internal condition within a range of 57-94 psi (except in REVERSE) (Fig. 266). The regulated line pressure in REVERSE (Fig. 267) 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.

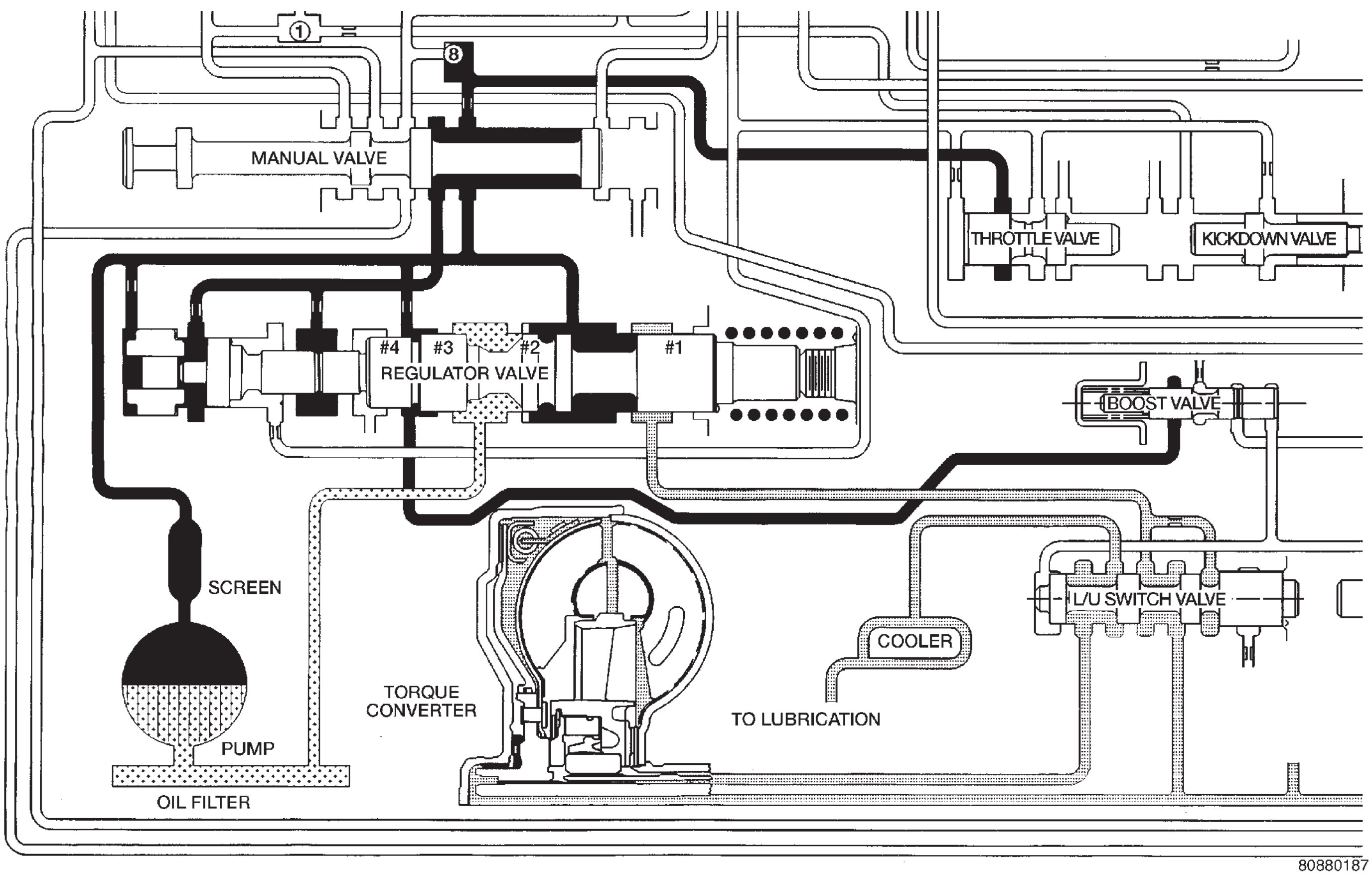


Fig. 265 Regulator Valve in NEUTRAL Position

VALVE BODY (Continued)

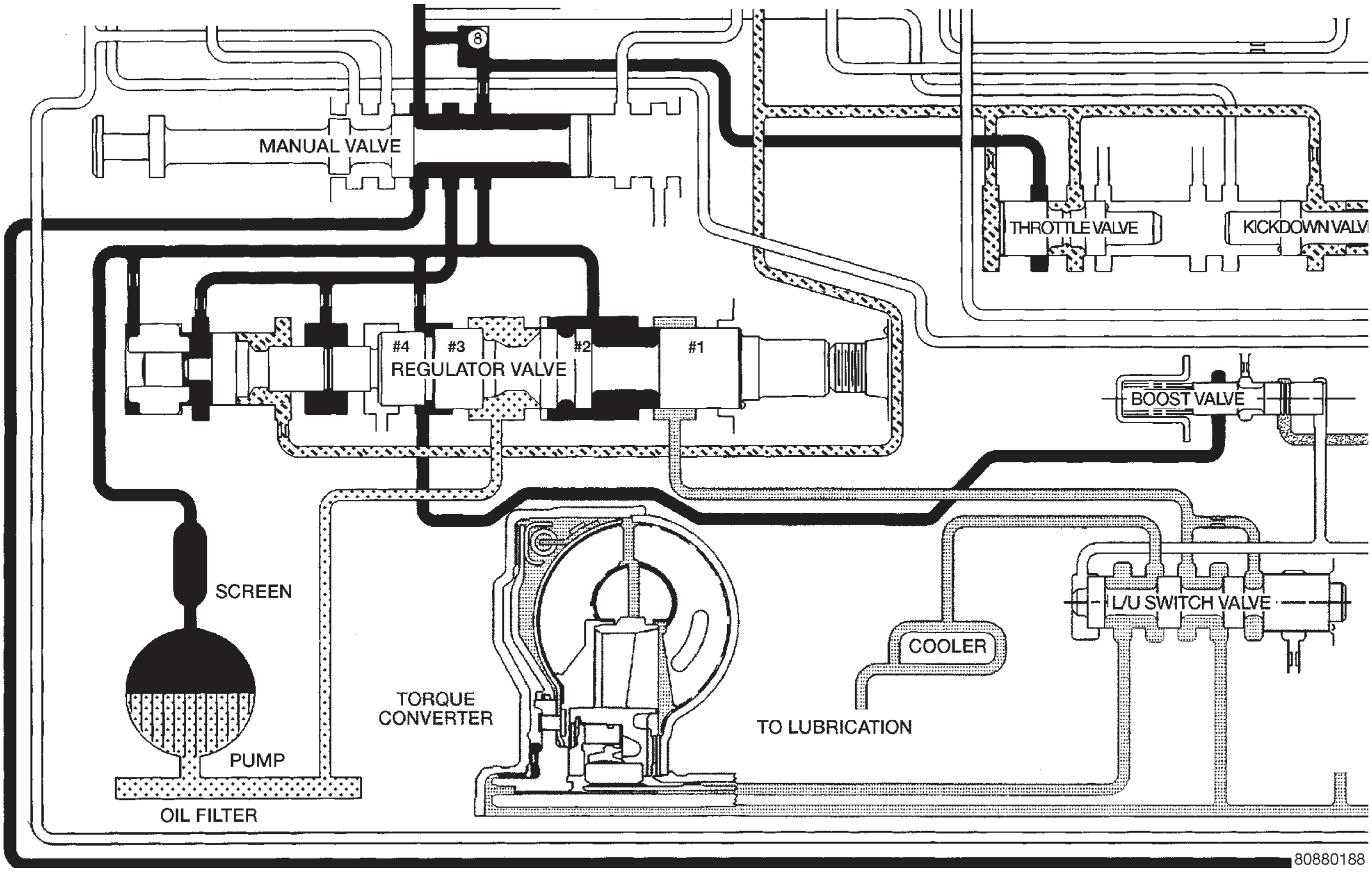


Fig. 266 Regulator Valve in DRIVE Position

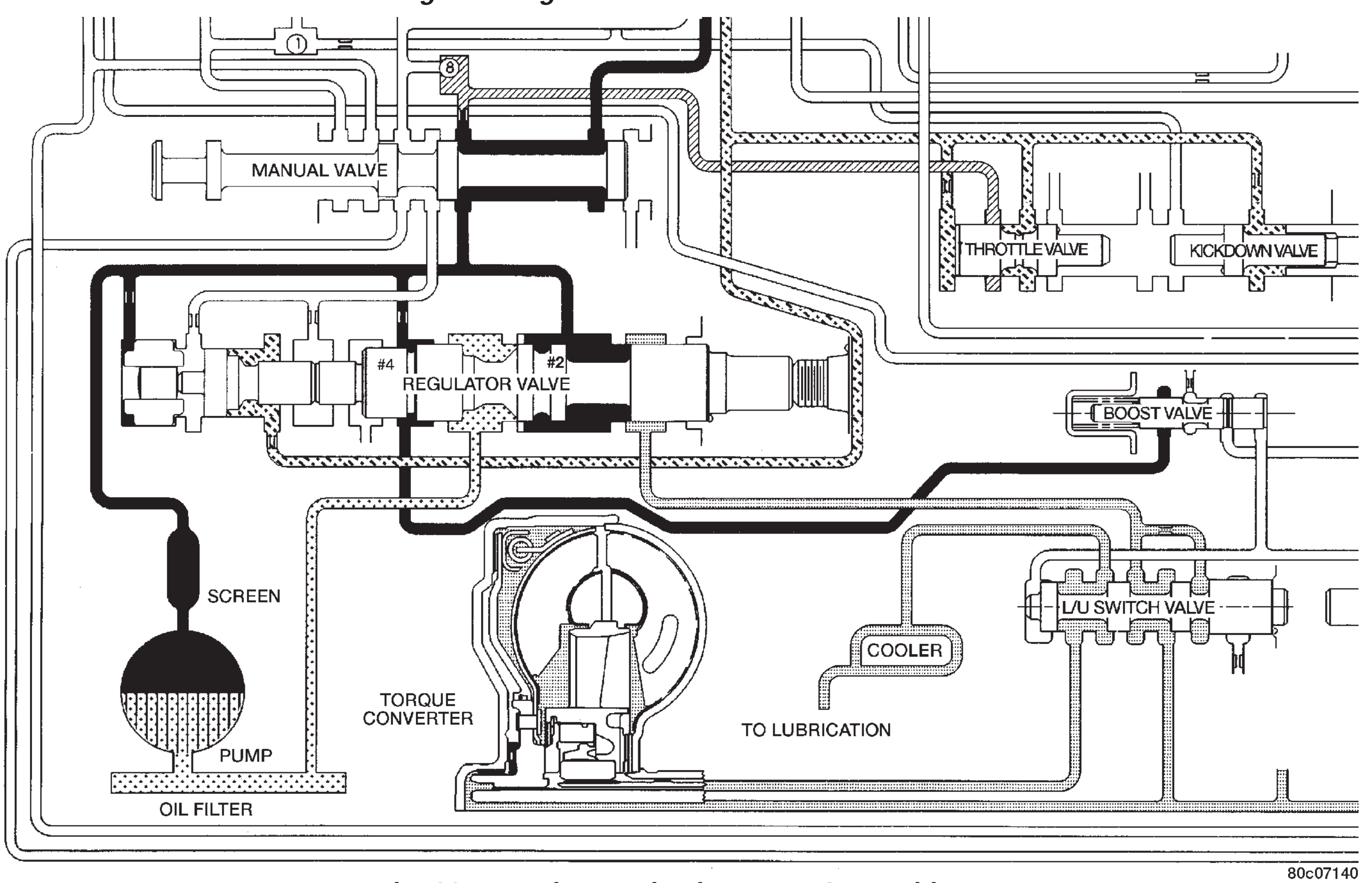


Fig. 267 Regulator Valve in REVERSE Position

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. 268) 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.

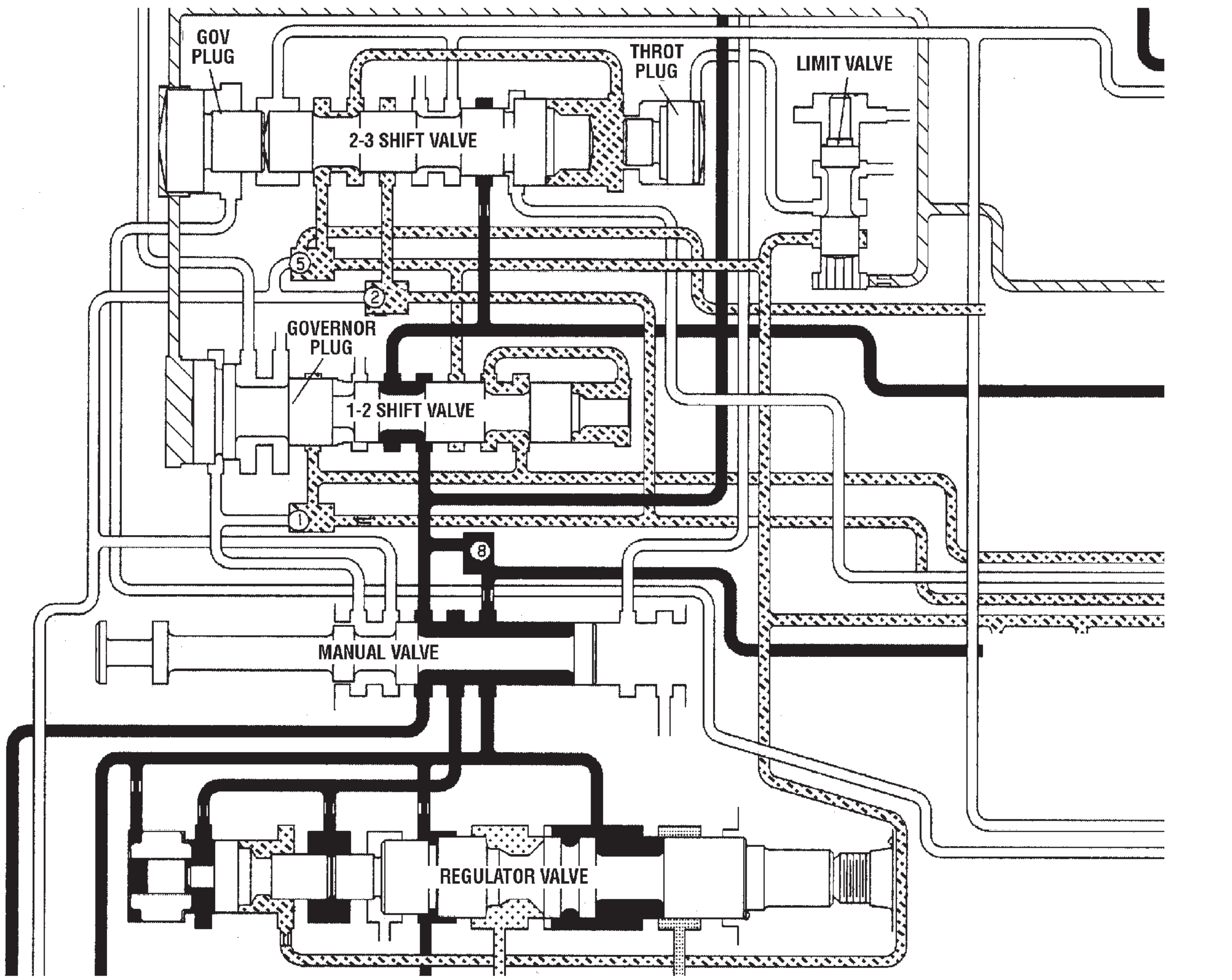


Fig. 268 Kickdown Valve-Wide Open Throttle

VALVE BODY (Continued)

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. 269) the limit valve does not come into play and does not affect the downshifts. As the vehicle's speed increases (Fig. 270), 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.

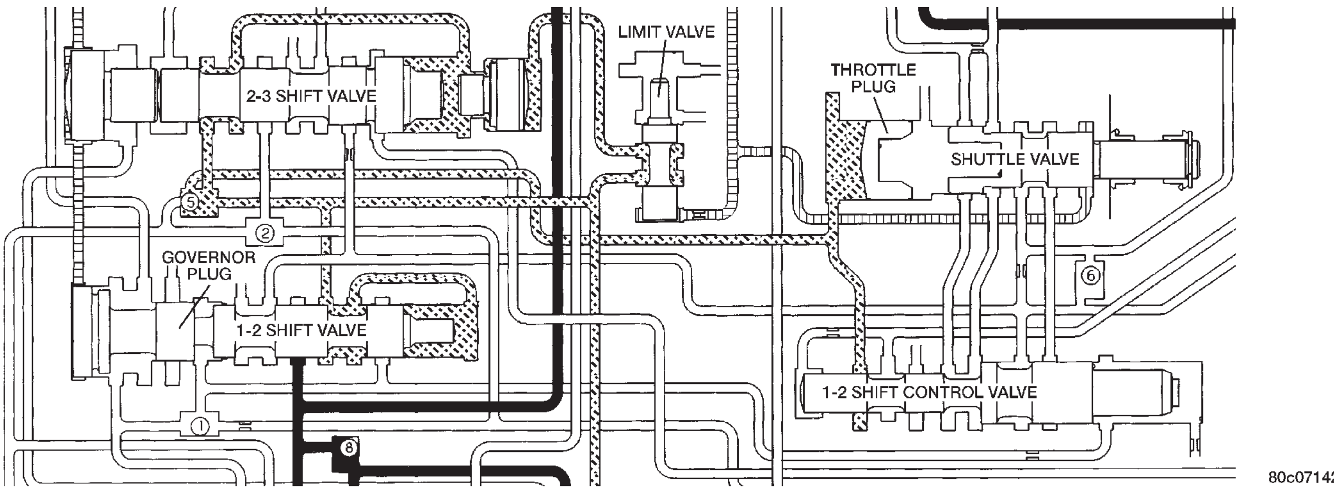


Fig. 269 Kickdown Limit Valve-Low Speeds

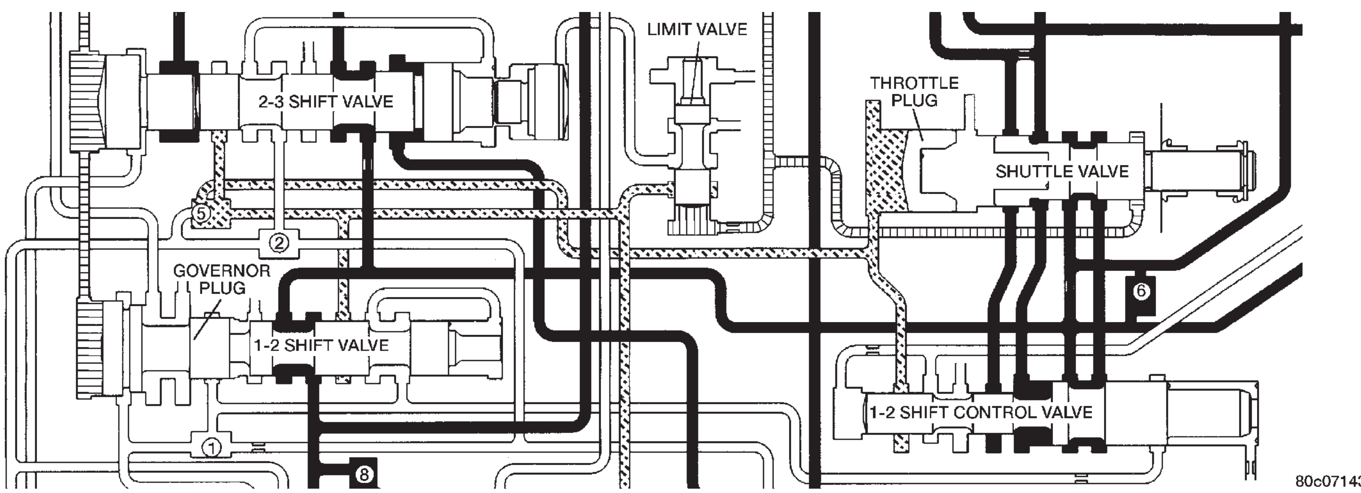


Fig. 270 Kickdown Limit Valve-High Speeds

VALVE BODY (Continued)

1-2 SHIFT VALVE

The 1-2 shift valve assembly (Fig. 271), 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. 272).

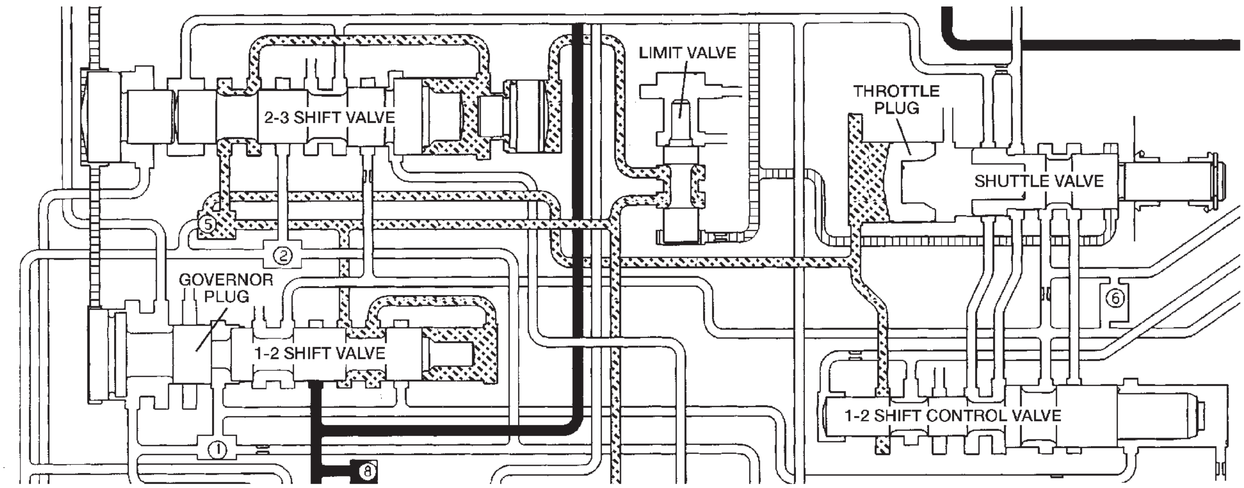


Fig. 271 1-2 Shift Valve-Before Shift

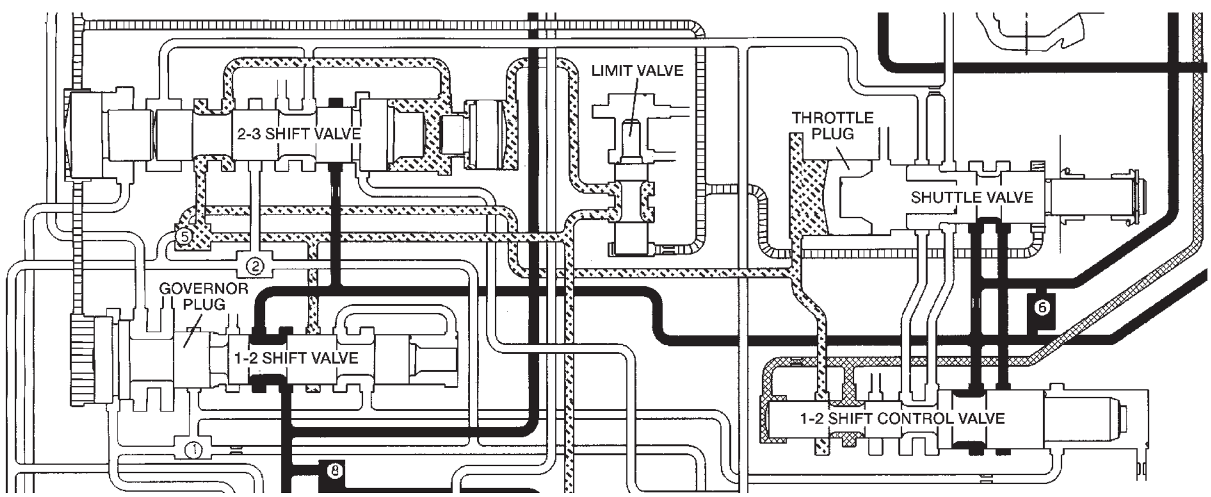


Fig. 272 1-2 Shift Valve-After Shift

VALVE BODY (Continued)

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. 273):

- 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.

2-3 SHIFT VALVE

The 2-3 shift valve mechanism (Fig. 274) consists of the 2-3 shift valve, governor plug and spring, and a throttle plug. After the 1-2 shift valve has completed its operation and applied the front band, line pressure is directed to the 2-3 shift valve through the connecting passages from the 1-2 shift valve. The line pressure will then dead–end at land #2 until the 2-3 valve is ready to make its shift. Now that the vehicle is in motion and under acceleration, there is throttle pressure being applied to the spring side of the valve and between lands #3 and #4.

As vehicle speed increases, governor pressure increases proportionately, until it becomes great enough to overcome the combined throttle and spring pressure on the right side of the valve. Since the throttle pressure end of the 2-3 shift valve is larger in diameter than the 1-2 shift valve, the 2-3 shift will always happen at a greater speed than the 1-2 shift. When this happens, the governor plug is forced against the shift valve moving it to the right. The

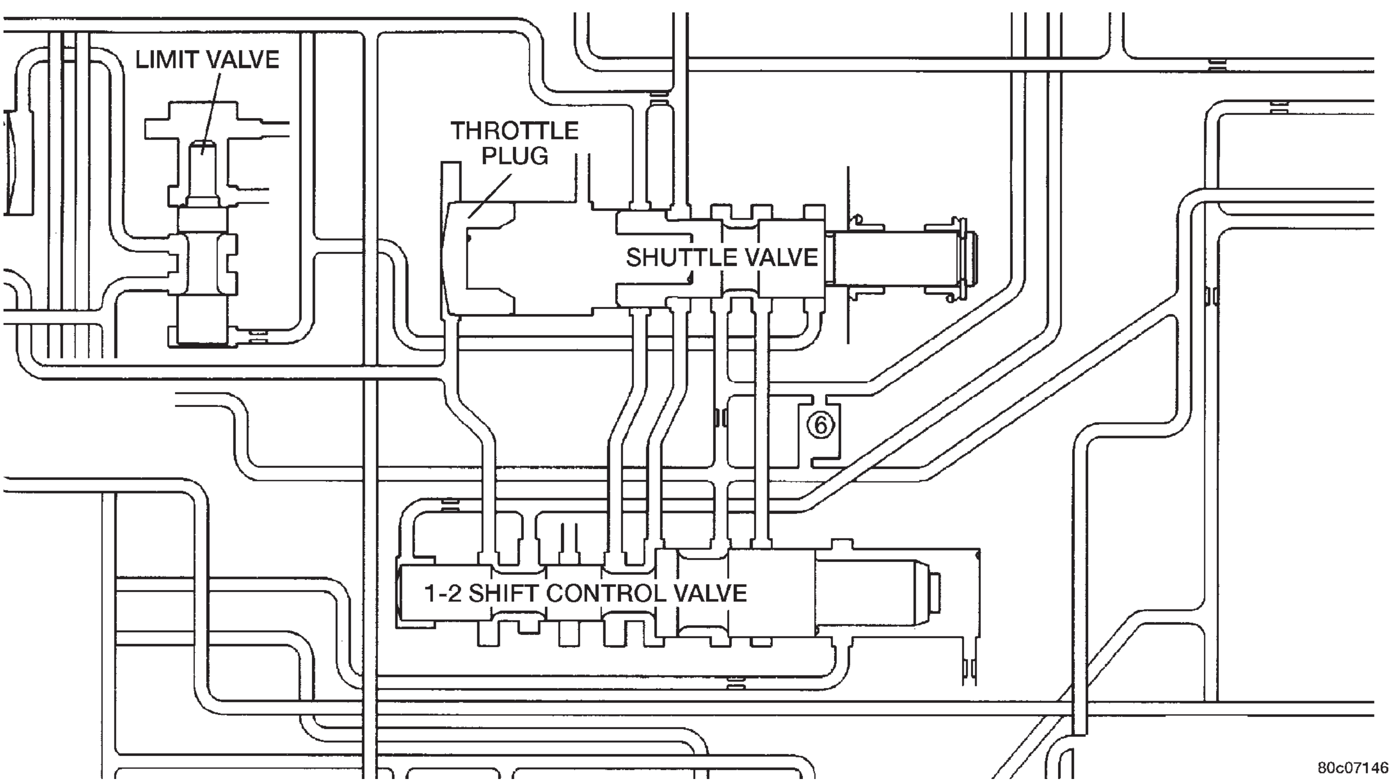


Fig. 273 1-2 Shift Control Valve

VALVE BODY (Continued)

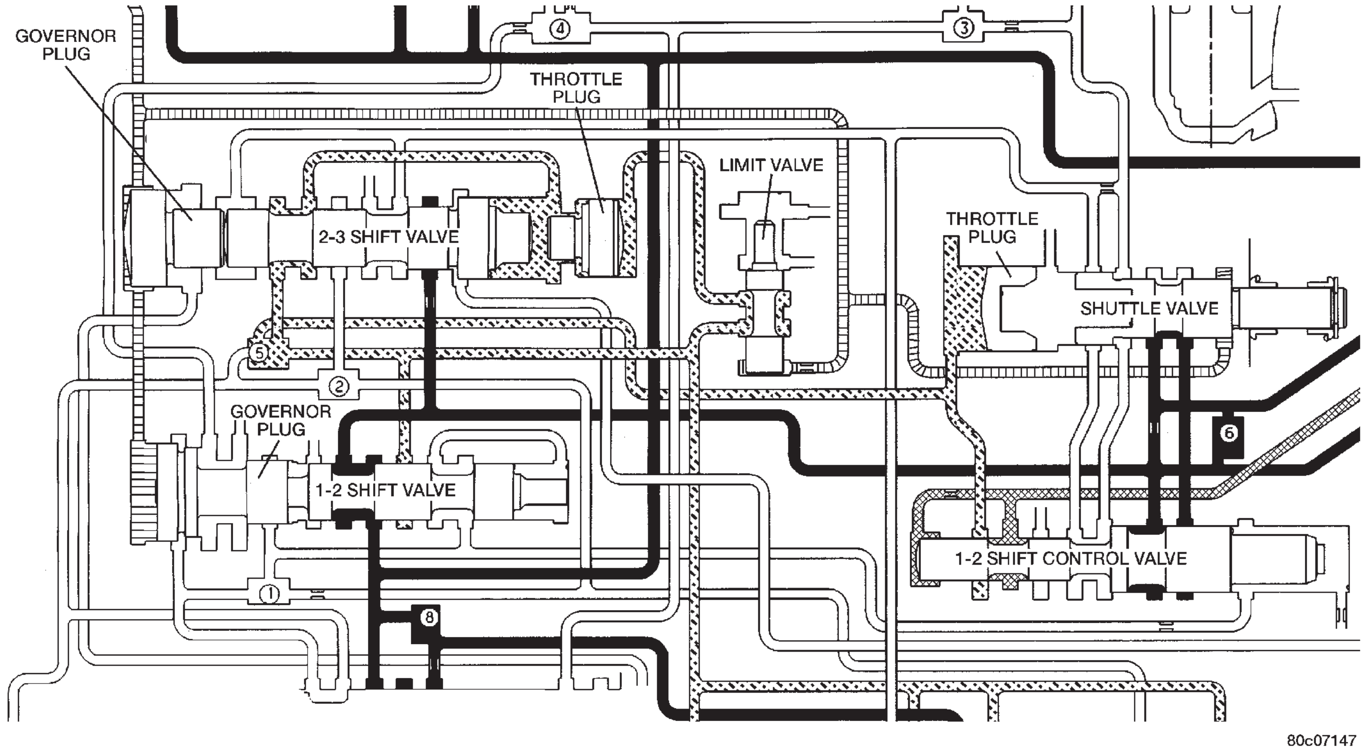


Fig. 274 2-3 Shift Valve-Before Shift

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. 275), 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.

3-4 SHIFT VALVE

The PCM energizes the overdrive solenoid during the 3-4 upshift (Fig. 276). This causes the solenoid check ball to close the vent port allowing line pressure from the 2-3 shift valve to act directly on the 3-4 upshift valve. Line pressure on the 3-4 shift valve overcomes valve spring pressure moving the valve to the upshift position (Fig. 277). This action exposes the feed passages to the 3-4 timing valve, 3-4 quick fill valve, 3-4 accumulator, and ultimately to the overdrive piston.

3-4 TIMING VALVE

The 3-4 timing valve is moved by line pressure coming through the 3-4 shift valve (Fig. 277). After the shift, the timing valve holds the 2-3 shift valve in an upshift position. The purpose is to prevent the 2-3 valve from downshifting before the 3-4 valve (Fig. 276).

3-4 QUICK FILL VALVE

The 3-4 quick fill valve provides faster engagement of the overdrive clutch during 3-4 upshifts. The valve temporarily bypasses the clutch piston feed orifice at the start of a 3-4 upshift (Fig. 276). This exposes a larger passage into the piston retainer resulting in a much faster clutch fill and apply sequence. The quick fill valve does not bypass the regular clutch feed orifice throughout the 3-4 upshift. Instead, once a predetermined pressure develops within the clutch, the valve closes the bypass (Fig. 277). Clutch fill is then completed through the regular feed orifice.

VALVE BODY (Continued)

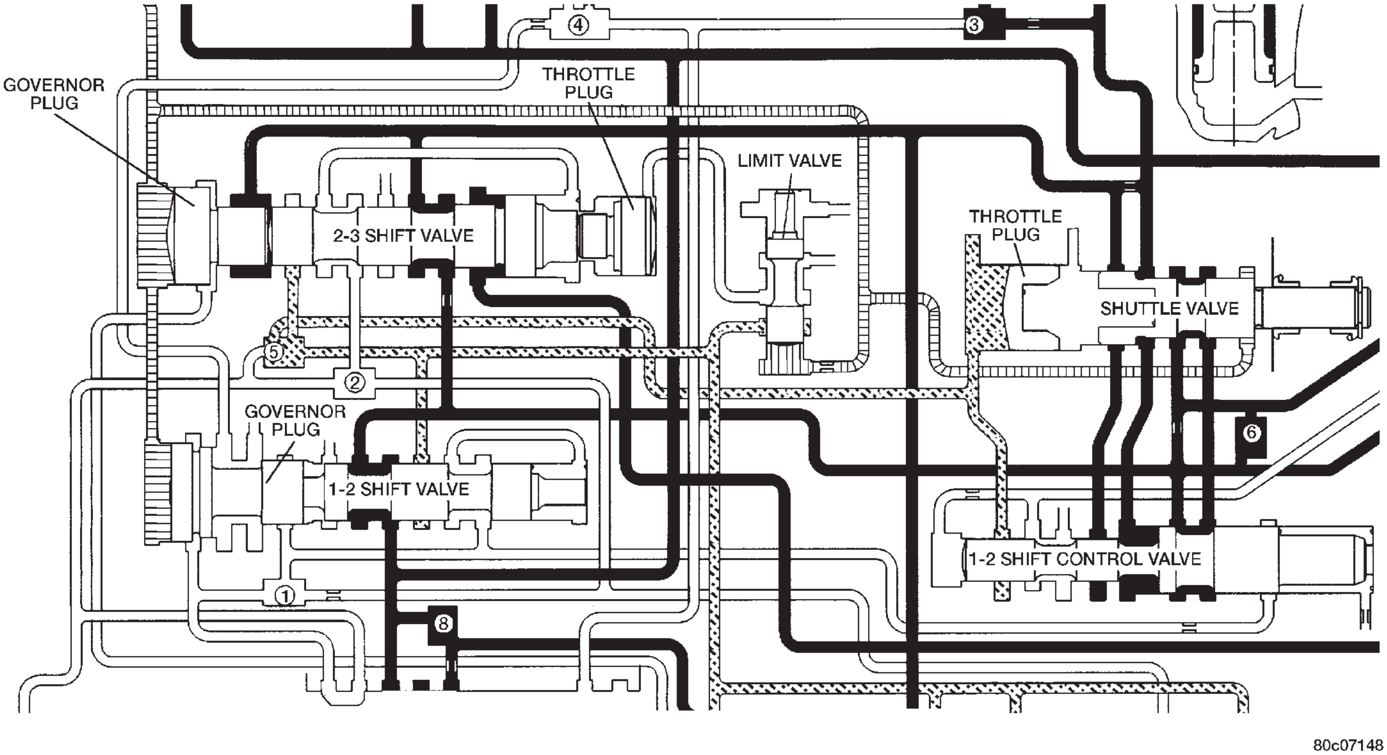


Fig. 275 2-3 Shift Valve-After Shift

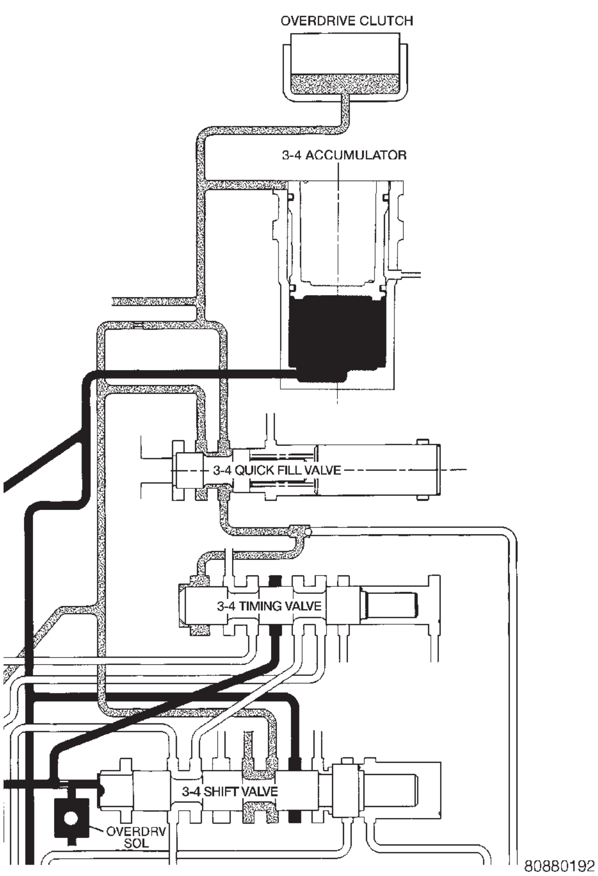


Fig. 276 3-4 Shift Valve Before Shift

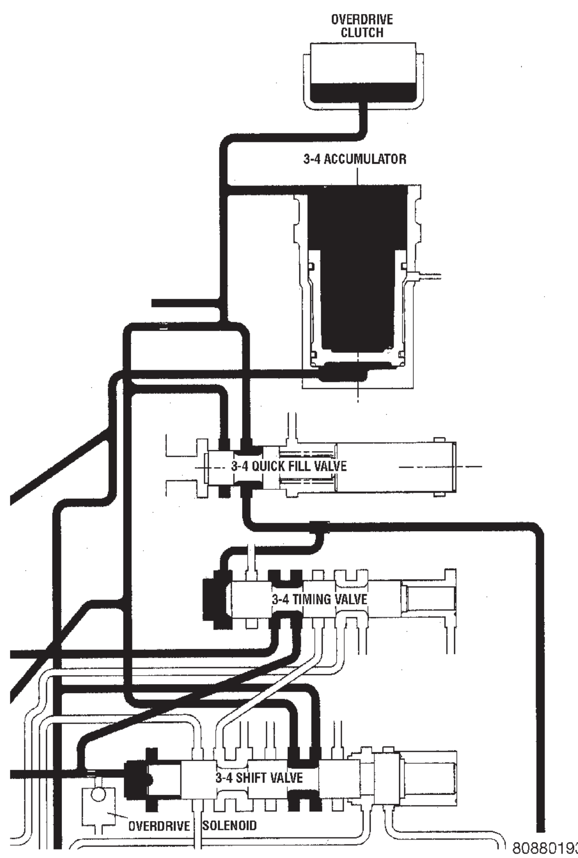


Fig. 277 3-4 Shift Valve After Shift

VALVE BODY (Continued)

THROTTLE VALVE

In all gear positions the throttle valve (Fig. 278) 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 speed has 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.

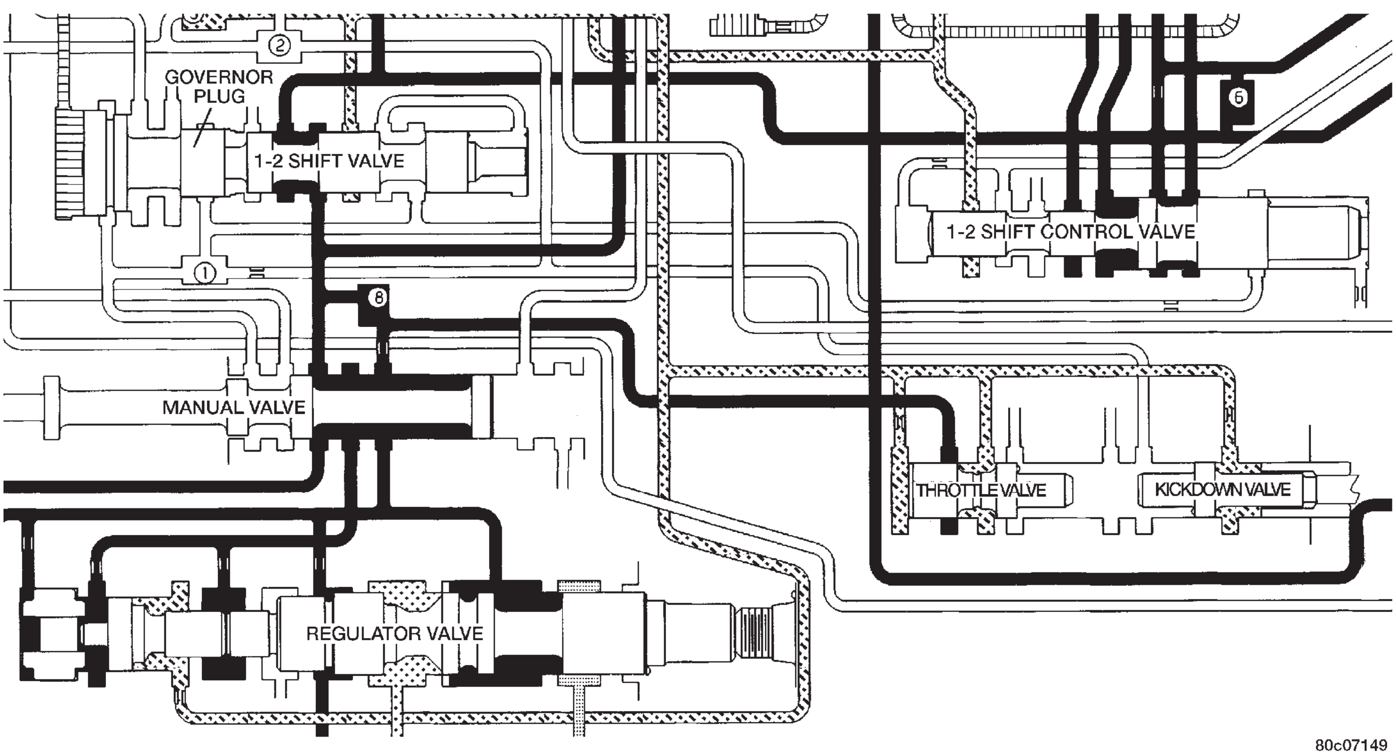


Fig. 278 Throttle Valve

VALVE BODY (Continued)

SWITCH VALVE

When the transmission is in Drive Second before the TCC application occurs (Fig. 279), the pressure regulator valve is supplying torque converter pressure to the switch valve. The switch valve directs this pressure through the transmission input shaft, into the converter, through the converter, back out between the input shaft and the reaction shaft, and back up to the switch valve. From the switch valve, the fluid pressure is directed to the transmission cooler, and lubrication pressure returns from the cooler to lubricate different portions of the transmission.

Once the TCC control valve has moved to the right (Fig. 280), line pressure is directed to the tip of the switch valve, forcing the valve to the right. 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 right allowing line pressure to engage the TCC, torque converter pressure is directed past the switch valve into the transmission cooler and lubrication circuits.

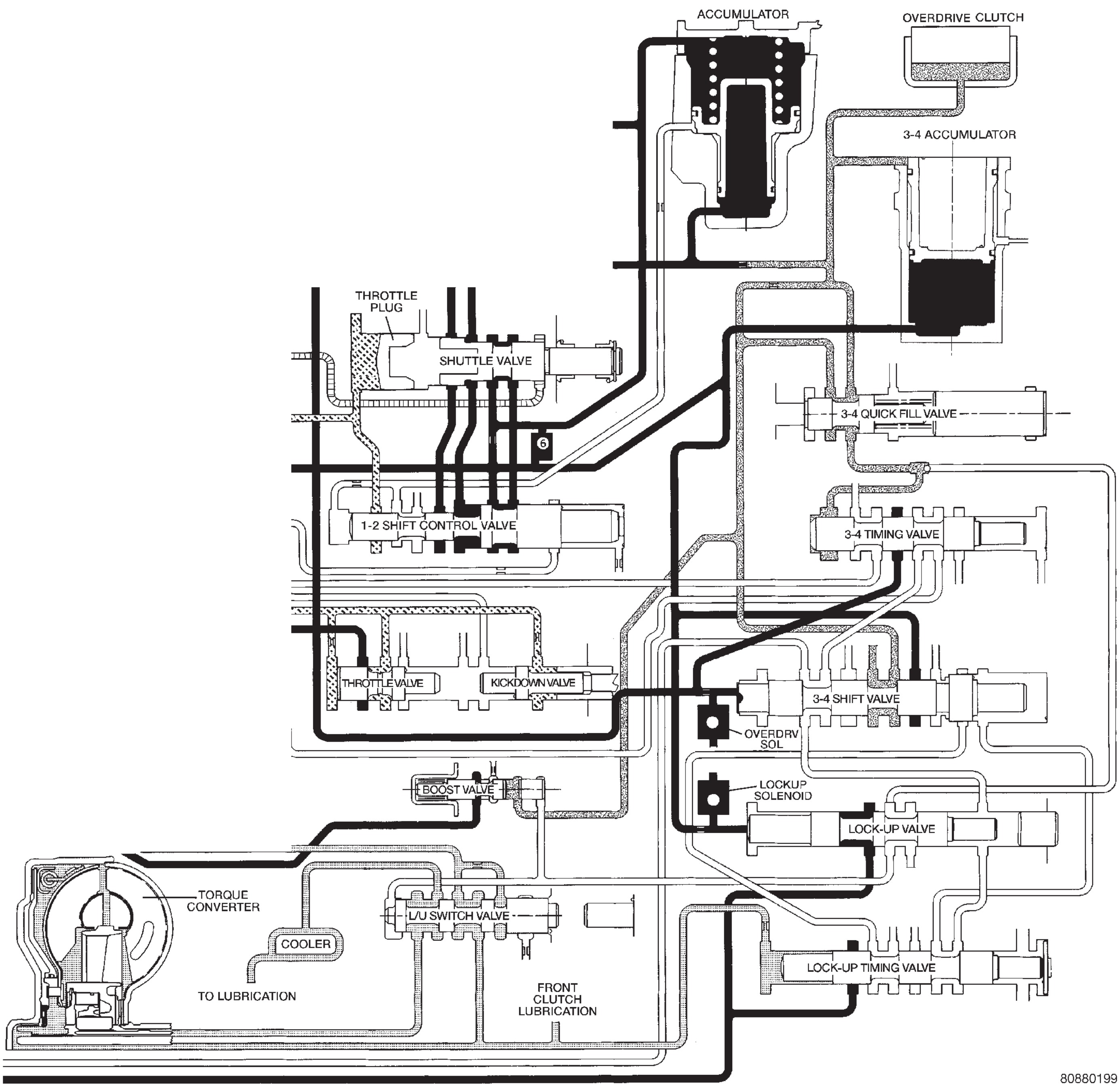


Fig. 279 Switch Valve-Torque Converter Unlocked

VALVE BODY (Continued)

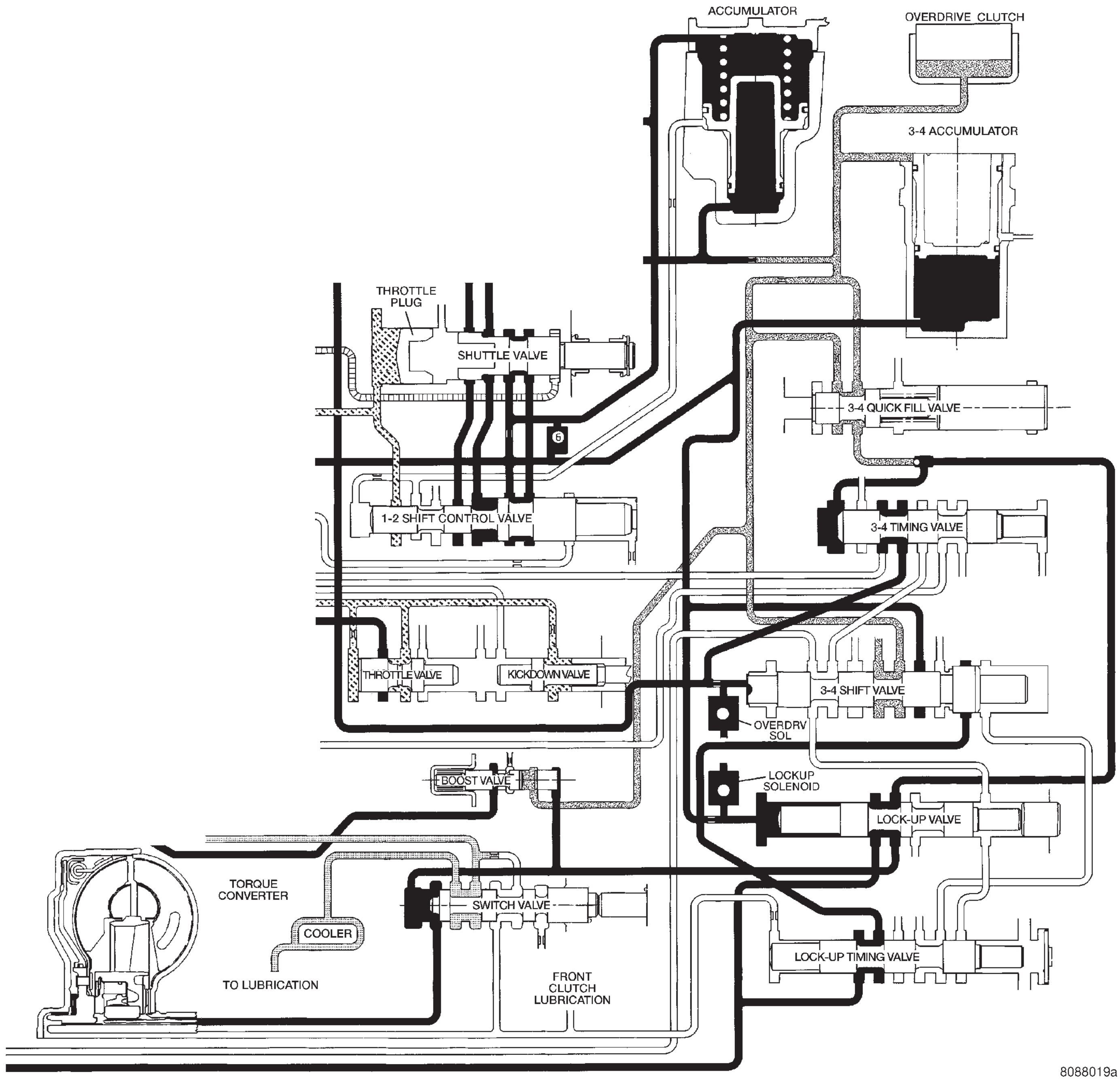


Fig. 280 Switch Valve-Torque Converter Locked

MANUAL VALVE

The manual valve (Fig. 281) 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 gear-shift 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 lever.

CONVERTER CLUTCH LOCK-UP VALVE

The torque converter clutch (TCC) lock-up 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 lock-up valve which moves to the right and applies pressure to the torque converter clutch.

VALVE BODY (Continued)

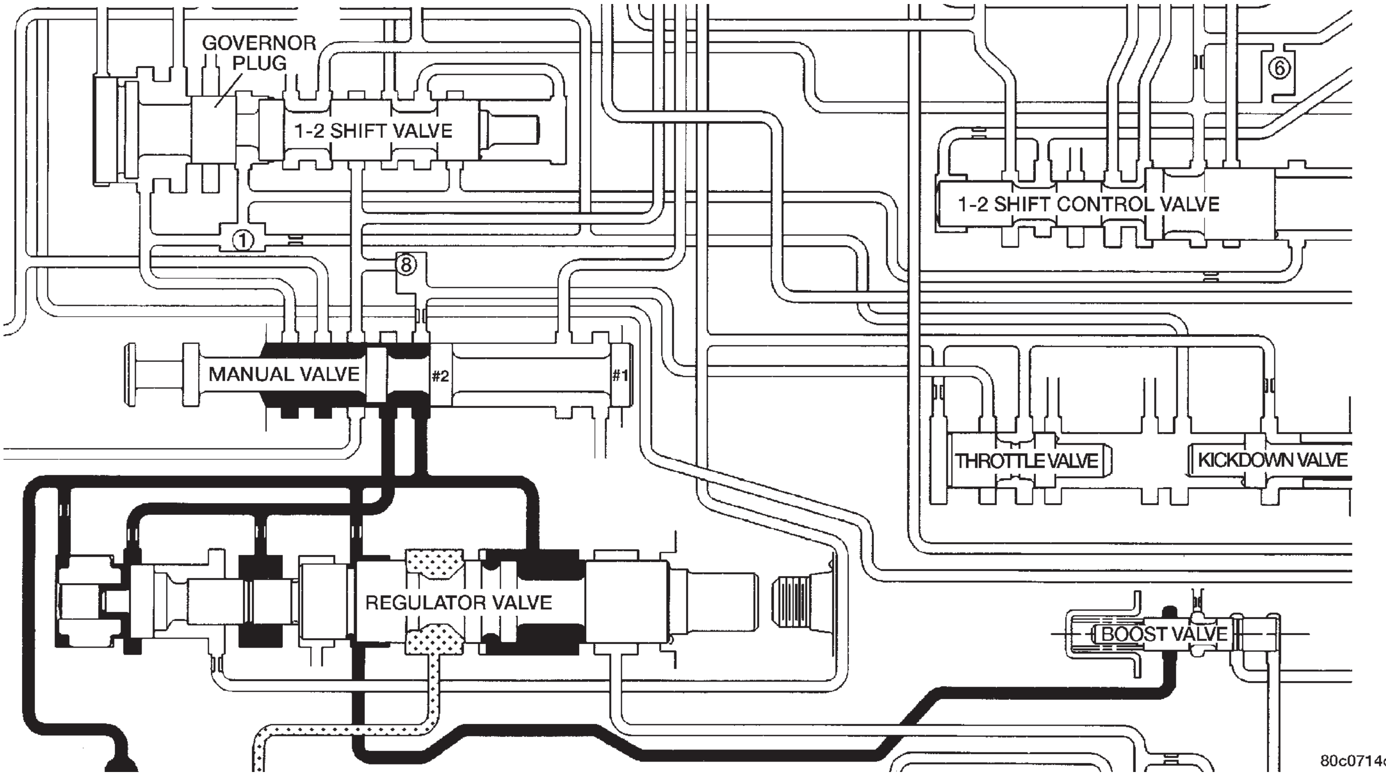


Fig. 281 Manual Valve

CONVERTER CLUTCH LOCK-UP TIMING VALVE

The torque converter clutch (TCC) lock-up timing valve is there to block any 4-3 downshift until the TCC is completely unlocked and the clutch is disengaged.

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. 273) 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.

BOOST VALVE

The boost valve (Fig. 282) provides increased fluid apply pressure to the overdrive clutch during 3-4 upshifts (Fig. 283), and when accelerating in fourth gear. The boost valve also serves to increase line pressure during torque converter lock-up.

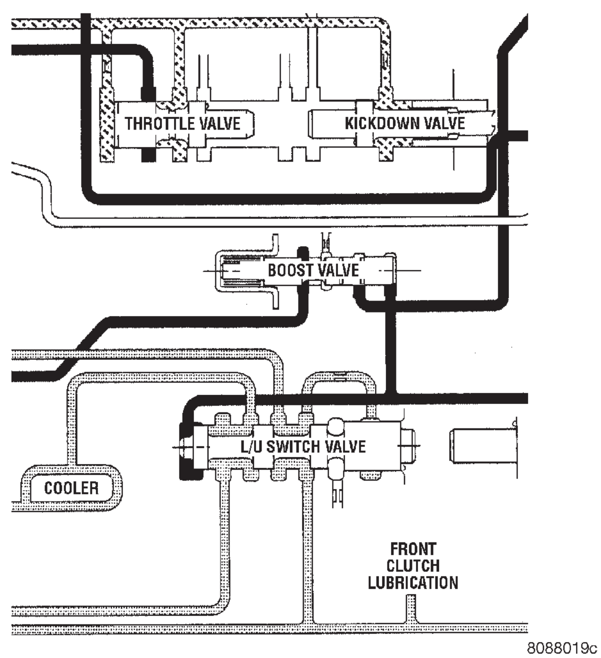


Fig. 282 Boost Valve Before Lock-up

VALVE BODY (Continued)

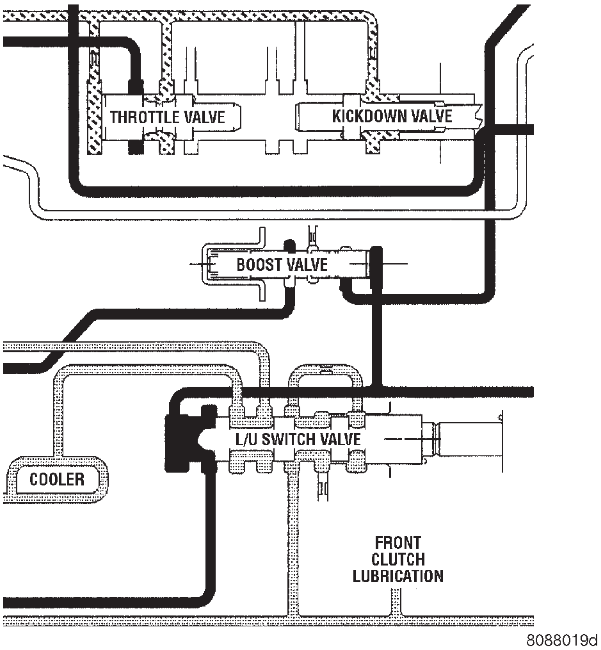


Fig. 283 Boost Valve After Lock-up

REMOVAL

The valve body can be removed for service without having to remove the transmission assembly.

The valve body can be disassembled for cleaning and inspection of the individual components.

The only replaceable valve body components are:

- Manual lever.
- Manual lever washer, seal, E-clip, and shaft seal.
- Manual lever detent ball.
- Throttle lever.
- Fluid filter.
- Pressure adjusting screw bracket.
- Governor pressure solenoid.
- Governor pressure sensor (includes transmission temperature thermistor).
- Converter clutch/overdrive solenoid assembly and harness .
- Governor housing gasket.
- Solenoid case connector O-rings.

(1) Shift transmission into NEUTRAL.

(2) Raise vehicle.

(3) Remove gearshift and throttle levers from shaft of valve body manual lever.

(4) Disconnect wires at solenoid case connector (Fig. 284).

(5) Remove the transmission range sensor.

(6) Position drain pan under transmission oil pan.

(7) Remove transmission oil pan and gasket.

(8) Remove fluid filter from valve body.

(9) Remove bolts attaching valve body to transmission case.

(10) Lower valve body enough to remove accumulator piston and springs.

(11) Work manual lever shaft and electrical connector out of transmission case.

(12) Lower valve body, rotate valve body away from case, pull park rod out of sprag, and remove valve body (Fig. 285).

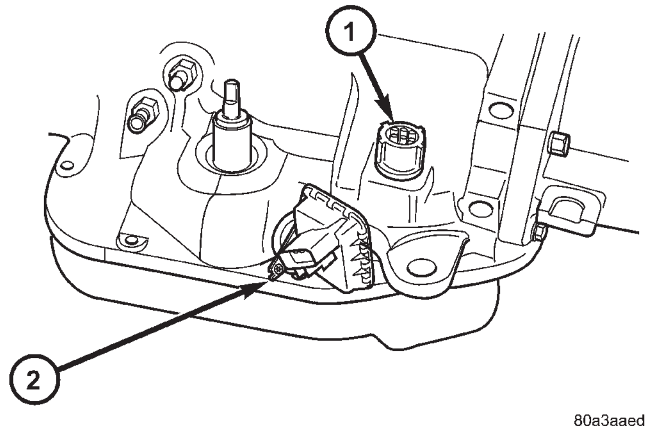


Fig. 284 Transmission Case Connector

1 - SOLENOID CASE CONNECTOR
2 - TRANSMISSION RANGE SENSOR

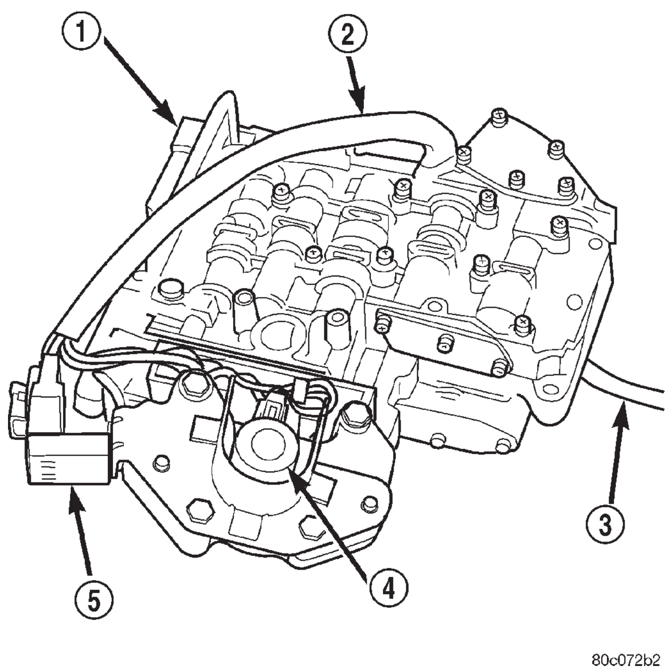


Fig. 285 Valve Body

1 - VALVE BODY
2 - WIRE HARNESS
3 - PARK ROD
4 - GOVERNOR PRESSURE SOLENOID
5 - GOVERNOR PRESSURE SENSOR

VALVE BODY (Continued)

DISASSEMBLY

CAUTION: Do not clamp any valve body component in a vise. This practice can damage the component resulting in unsatisfactory operation after assembly and installation. Do not use pliers to remove any of the valves, plugs or springs and do not force any of the components out or into place. The valves and valve body housings will be damaged if force is used. Tag or mark the valve body springs for reference as they are removed. Do not allow them to become intermixed.

(1) Disconnect wires from governor pressure sensor and solenoid.

(2) Remove screws attaching governor body and retainer plate to transfer plate.

(3) Remove retainer plate, governor body and gasket from transfer plate.

(4) Remove governor pressure sensor from governor body.

(5) Remove governor pressure solenoid by pulling it straight out of bore in governor body. Remove and discard solenoid O-rings if worn, cut, or torn.

(6) Remove small shoulder bolt that secures solenoid harness case connector to 3-4 accumulator housing (Fig. 286). Retain shoulder bolt. Either tape it to harness or thread it back into accumulator housing after connector removal.

(7) Unhook overdrive/converter solenoid harness from 3-4 accumulator cover plate (Fig. 287).

(8) Turn valve body over and remove screws that attach overdrive/converter solenoid assembly to valve body (Fig. 288).

(9) Remove solenoid and harness assembly from valve body (Fig. 289).

(10) Remove boost valve cover (Fig. 290).

(11) Remove boost valve retainer, valve spring and boost valve (Fig. 291).

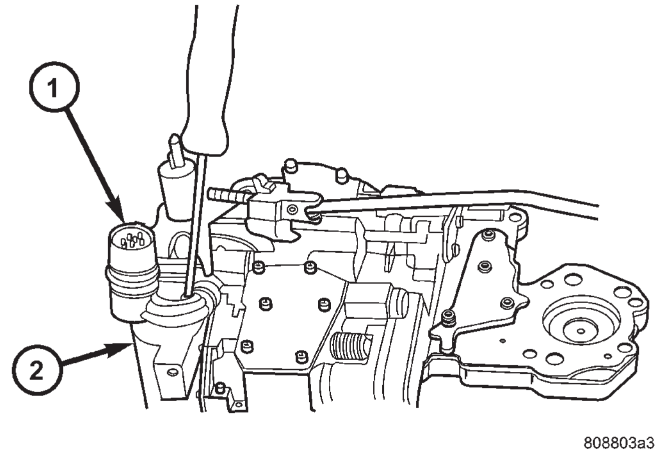


Fig. 286 Solenoid Harness Case Connector Shoulder Bolt

1 - SOLENOID HARNESS CASE CONNECTOR
2 - 3-4 ACCUMULATOR HOUSING

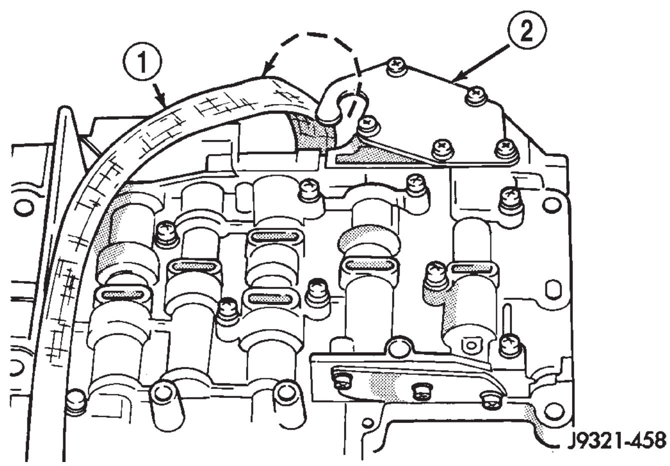


Fig. 287 Unhooking Solenoid Harness From Accumulator Cover Plate

1 - OVERDRIVE/CONVERTER SOLENOID WIRE HARNESS
2 - 3-4 ACCUMULATOR COVER PLATE

VALVE BODY (Continued)

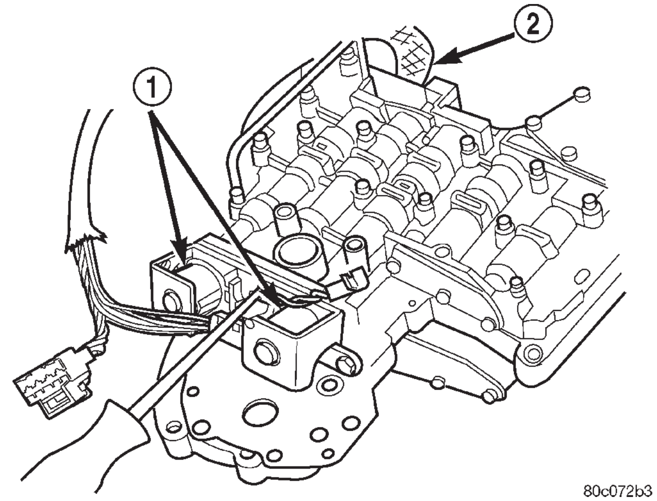


Fig. 288 Solenoid Assembly Screws

1 - OVERDRIVE/CONVERTER CLUTCH SOLENOID ASSEMBLY
2 - HARNESS

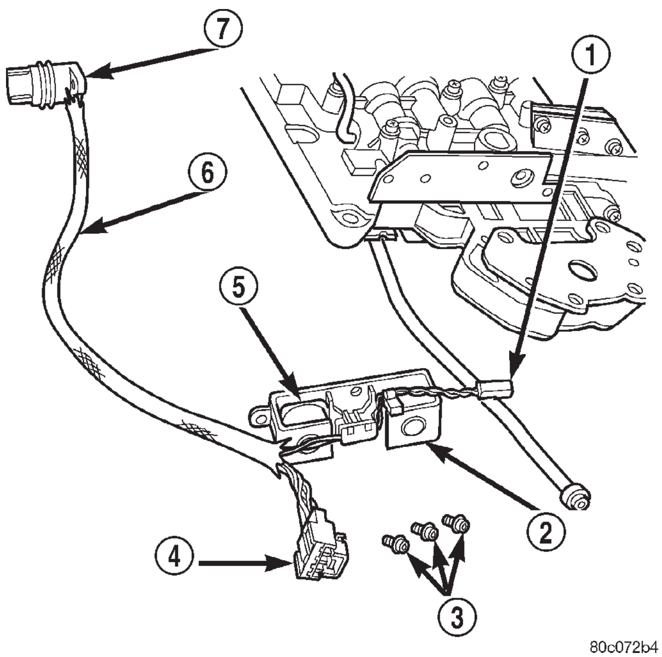


Fig. 289 Solenoid Assembly

1 - GOVERNOR SOLENOID WIRES
2 - CONVERTER CLUTCH SOLENOID
3 - SOLENOID SCREWS
4 - GOVERNOR SENSOR WIRES
5 - OVERDRIVE SOLENOID
6 - HARNESS
7 - CASE CONNECTOR

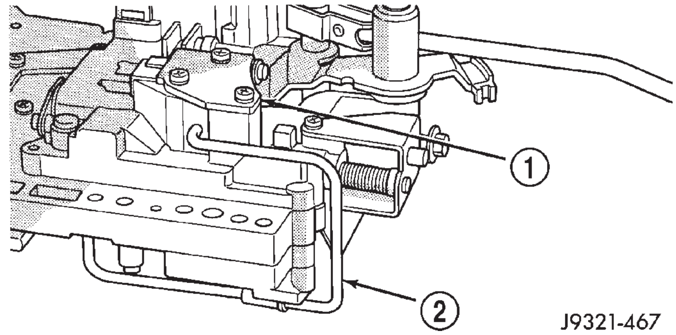


Fig. 290 Boost Valve

1 - BOOST VALVE HOUSING AND COVER
2 - BOOST VALVE TUBE

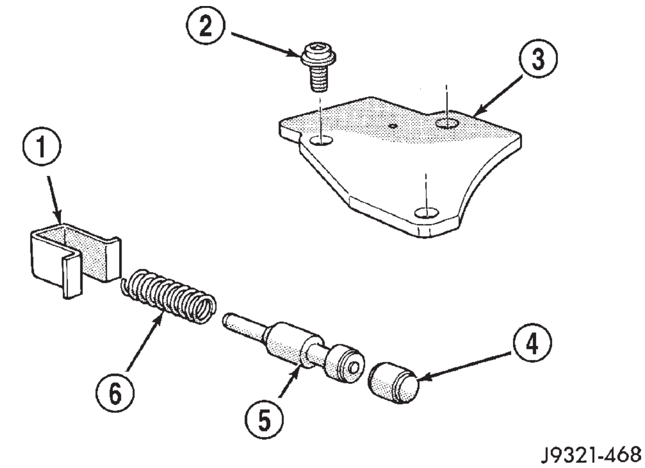


Fig. 291 Boost Valve Components

1 - SPRING AND VALVE RETAINER
2 - COVER SCREWS
3 - BOOST VALVE COVER
4 - BOOST VALVE PLUG
5 - BOOST VALVE
6 - BOOST VALVE SPRING

(12) Secure detent ball and spring with Retainer Tool 6583 (Fig. 292).

(13) Remove park rod E-clip and separate rod from manual lever (Fig. 293).

(14) Remove E-clip and washer that retains throttle lever shaft in manual lever (Fig. 294).

(15) Remove manual lever and throttle lever (Fig. 295). Rotate and lift manual lever off valve body and throttle lever shaft. Then slide throttle lever out of valve body.

VALVE BODY (Continued)

(16) Position pencil magnet next to detent housing to catch detent ball and spring. Then carefully remove Retainer Tool 6583 and remove detent ball and spring (Fig. 296).

(17) Remove screws attaching pressure adjusting screw bracket to valve body and transfer plate (Fig. 297). Hold bracket firmly against spring tension while removing last screw.

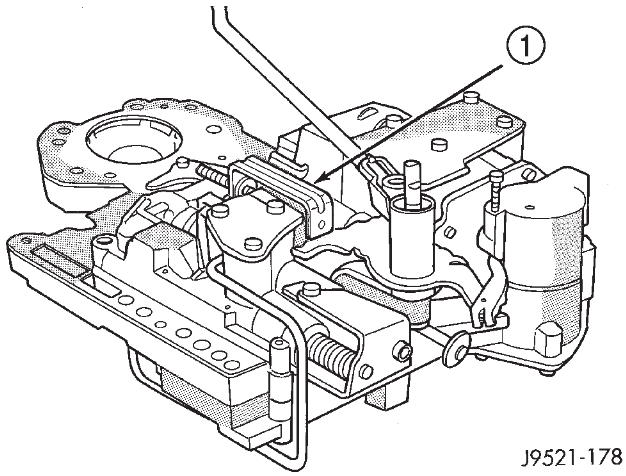


Fig. 292 Detent Ball And Spring

1 - SPECIAL TOOL 6583 POSITIONED ON DETENT HOUSING

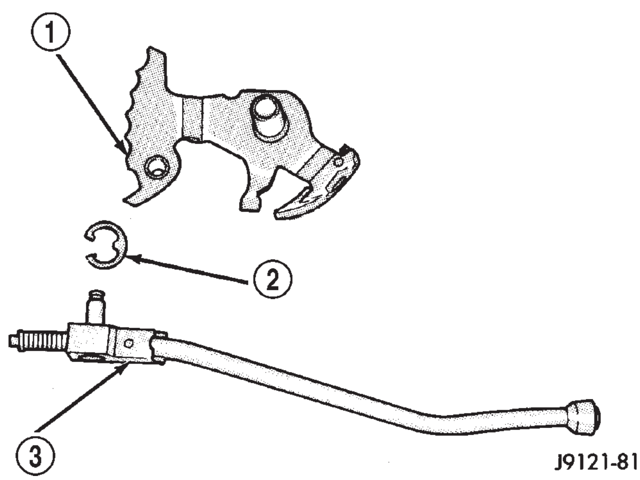


Fig. 293 Park Rod

1 - MANUAL LEVER
2 - E-CLIP
3 - PARK ROD

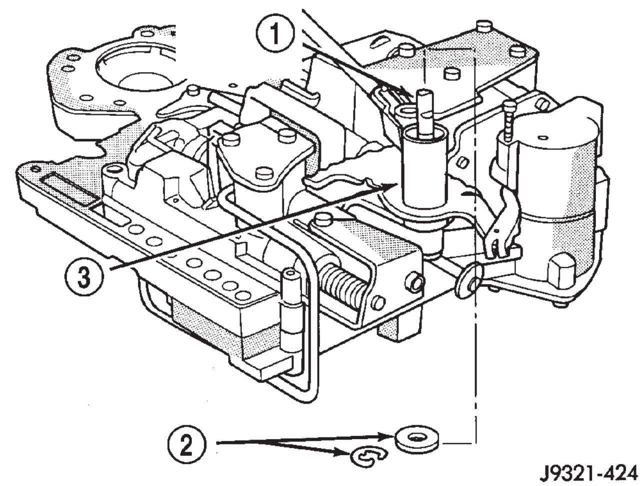


Fig. 294 Throttle Lever E-Clip And Washer

1 - THROTTLE LEVER SHAFT
2 - E-CLIP AND WASHER
3 - MANUAL SHAFT

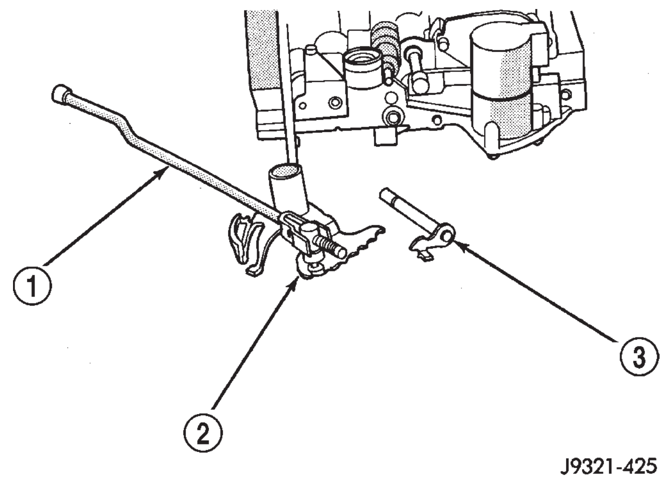


Fig. 295 Manual And Throttle Lever

1 - PARK ROD
2 - MANUAL LEVER ASSEMBLY
3 - THROTTLE LEVER

VALVE BODY (Continued)

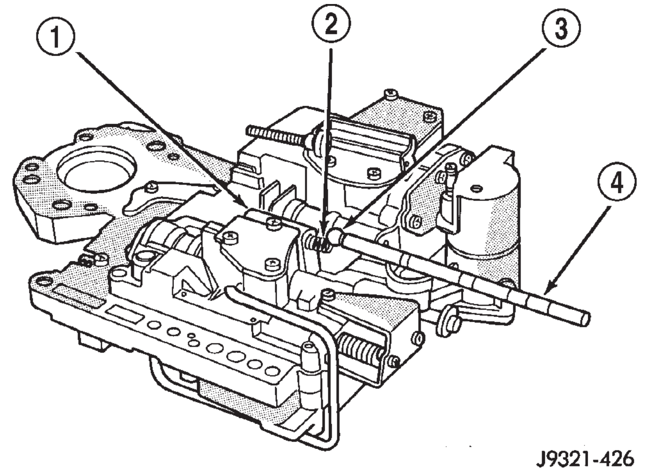


Fig. 296 Detent Ball And Spring

1 - DETENT HOUSING
2 - DETENT SPRING
3 - DETENT BALL
4 - PENCIL MAGNET

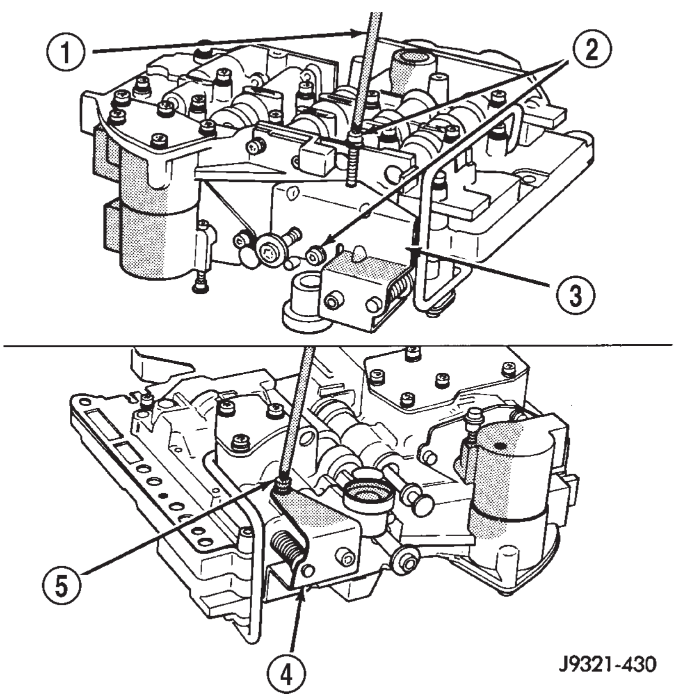


Fig. 297 Adjusting Screw Bracket Fastener

1 - T25 TORX™ BIT
2 - REMOVE THESE SCREWS FIRST
3 - BRACKET
4 - BRACKET
5 - REMOVE THIS SCREW LAST

(18) Remove adjusting screw bracket, line pressure adjusting screw, pressure regulator valve spring and switch valve spring (Fig. 298). Do not remove throttle pressure adjusting screw from bracket and do not disturb setting of either adjusting screw during removal.

(19) Turn upper housing over and remove switch valve, regulator valve and spring, and manual valve (Fig. 299).

(20) Remove kickdown detent, kickdown valve, and throttle valve and spring (Fig. 299).

(21) Loosen left-side 3-4 accumulator housing attaching screw about 2-3 threads. Then remove center and right-side housing attaching screws (Fig. 300).

(22) Carefully rotate 3-4 accumulator housing upward and remove 3-4 shift valve spring and converter clutch valve plug and spring (Fig. 301).

(23) Remove left-side screw and remove 3-4 accumulator housing from valve body (Fig. 302).

(24) Bend back tabs on boost valve tube brace (Fig. 303).

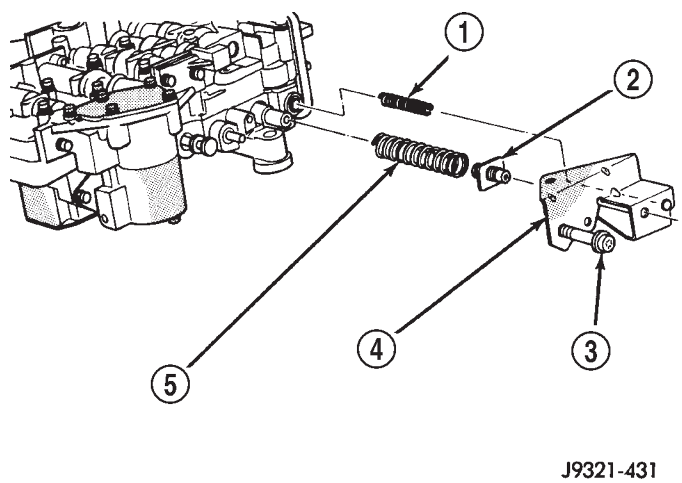


Fig. 298 Adjusting Screw Bracket And Spring

1 - SWITCH VALVE SPRING
2 - LINE PRESSURE SCREW
3 - THROTTLE PRESSURE ADJUSTING SCREW
4 - ADJUSTING SCREW BRACKET
5 - PRESSURE REGULATOR VALVE SPRING

VALVE BODY (Continued)

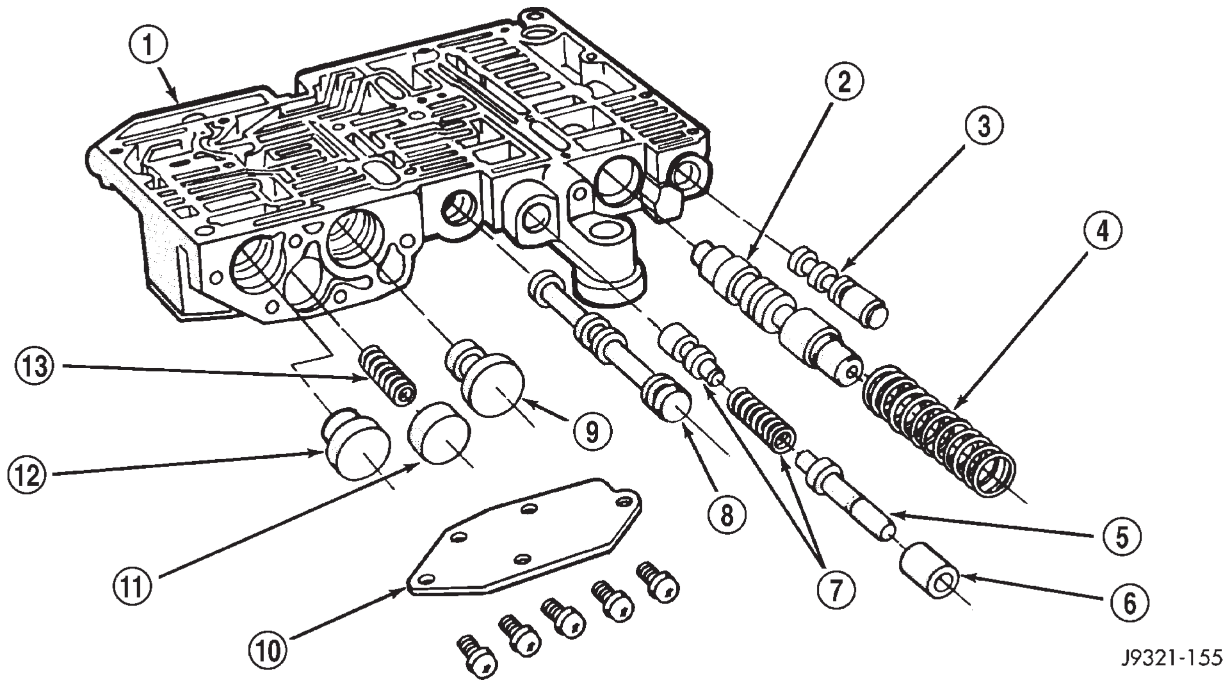


Fig. 299 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

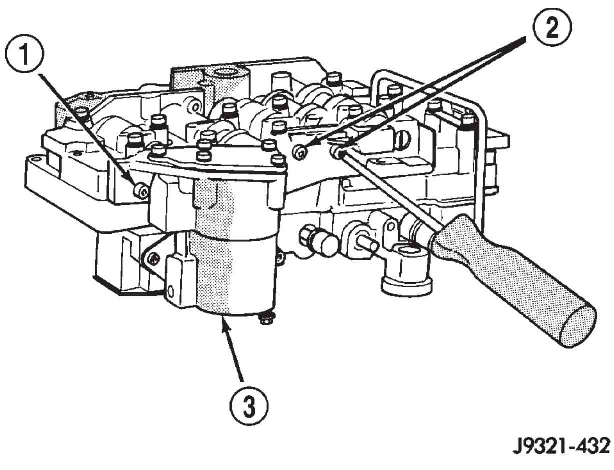


Fig. 300 Accumulator Housing Screw Locations

1 - LOOSEN THIS SCREW
2 - REMOVE THESE SCREWS
3 - 3-4 ACCUMULATOR HOUSING

(25) Remove boost valve connecting tube (Fig. 304). Disengage tube from upper housing port first. Then rock opposite end of tube back and forth to work it out of lower housing.

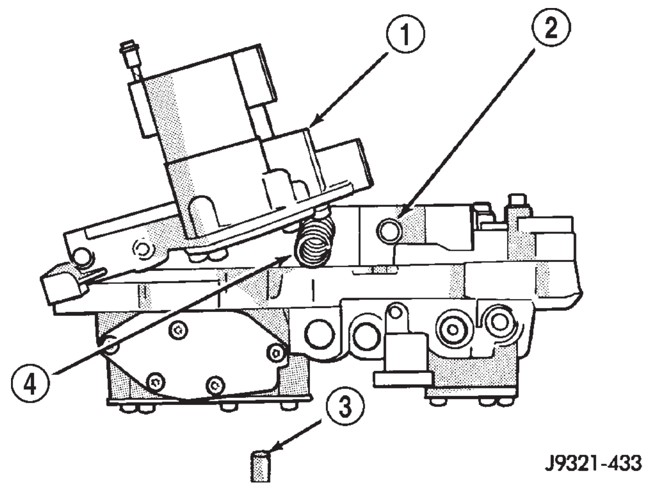


Fig. 301 3-4 Shift And Converter Clutch Valve Springs And Plug

1 - ACCUMULATOR HOUSING
2 - CONVERTER CLUTCH VALVE SPRING
3 - CLUTCH VALVE PLUG
4 - 3-4 SHIFT VALVE SPRING

VALVE BODY (Continued)

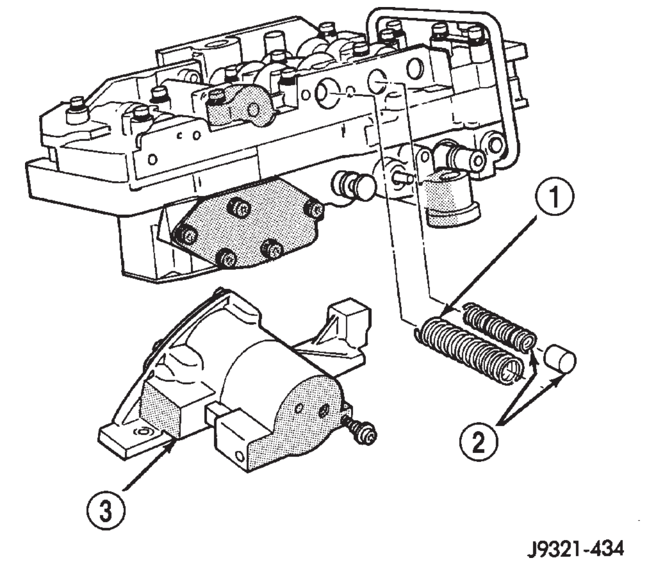


Fig. 302 Accumulator Housing, Valve Springs And Plug

1 - 3-4 SHIFT VALVE SPRING
2 - CONVERTER CLUTCH VALVE SPRING AND PLUG
3 - 3-4 ACCUMULATOR HOUSING

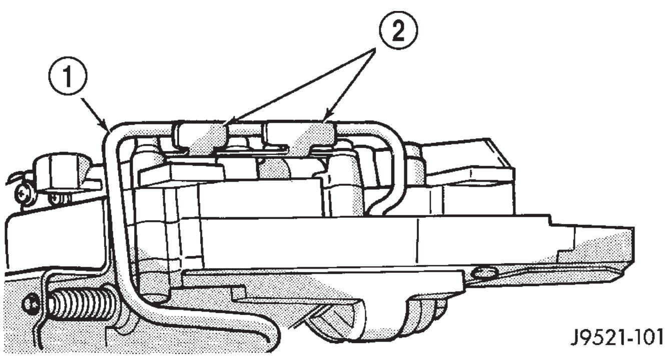


Fig. 303 Boost Valve Tube Brace

1 - BOOST VALVE TUBE
2 - TUBE BRACE (DOUBLE TAB)

CAUTION: Do not use tools to loosen or pry the connecting tube out of the valve body housings. Loosen and remove the tube by hand only.

(26) Turn valve body over so lower housing is facing upward (Fig. 305). In this position, the two check balls in upper housing will remain in place and not fall out when lower housing and separator plate are removed.

(27) Remove screws attaching valve body lower housing to upper housing and transfer plate (Fig. 305). Note position of boost valve tube brace for assembly reference.

(28) Remove lower housing and overdrive separator plate from transfer plate (Fig. 305).

(29) Remove the ECE check ball from the transfer plate (Fig. 306). The ECE check ball is approximately 4.8 mm (3/16 in.) in diameter.

(30) Remove transfer plate from upper housing (Fig. 307).

(31) Turn transfer plate over so upper housing separator plate is facing upward.

(32) Remove upper housing separator plate from transfer plate (Fig. 308). Note position of filter in separator plate for assembly reference.

(33) Remove rear clutch and rear servo check balls from transfer plate. Note check ball location for assembly reference (Fig. 309).

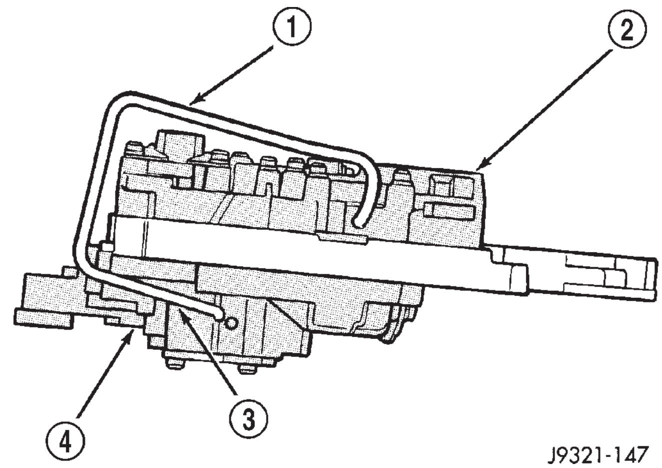


Fig. 304 Boost Valve Tube

1 - BOOST VALVE TUBE
2 - LOWER HOUSING
3 - DISENGAGE THIS END OF TUBE FIRST
4 - UPPER HOUSING

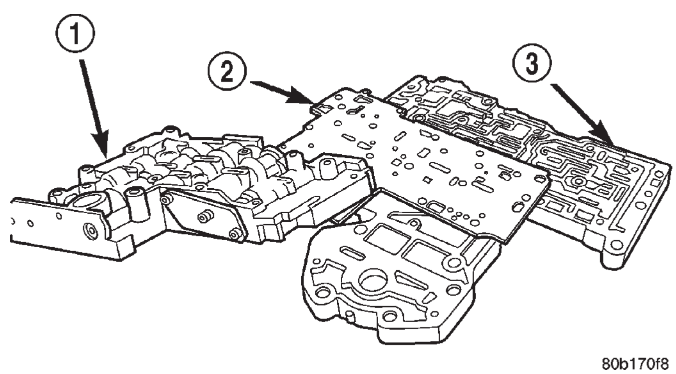


Fig. 305 Lower Housing

1 - LOWER HOUSING
2 - OVERDRIVE SEPARATOR PLATE
3 - TRANSFER PLATE AND UPPER HOUSING

VALVE BODY (Continued)

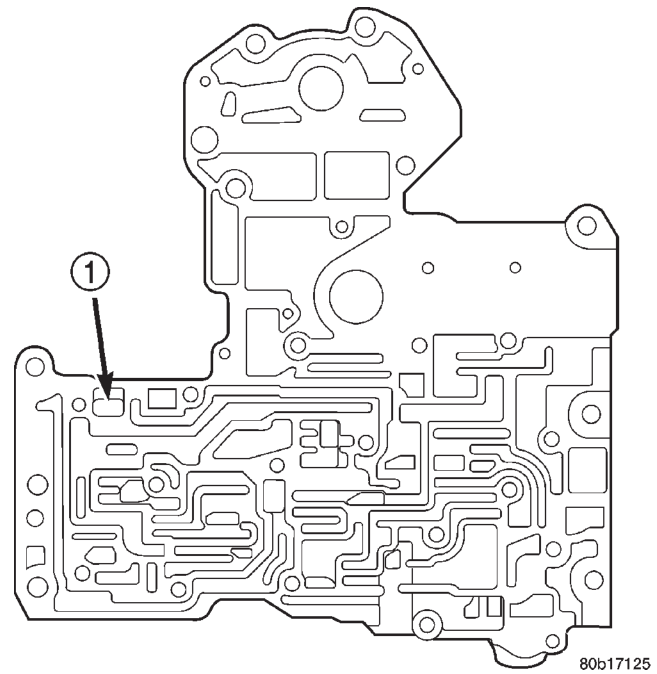


Fig. 306 ECE Check Ball

1 - ECE CHECK BALL (3/16″)

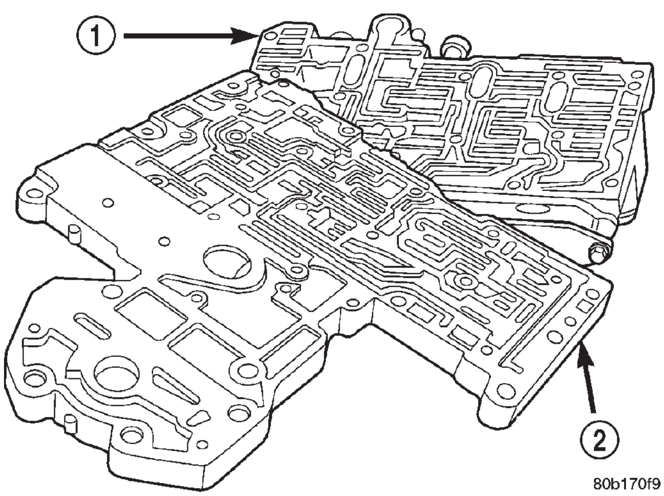


Fig. 307 Transfer Plate

1 - UPPER HOUSING
2 - TRANSFER PLATE

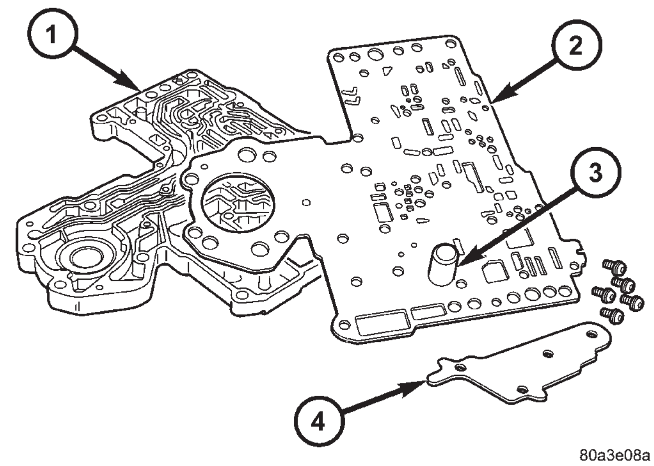


Fig. 308 Upper Housing Separator Plate

1 - TRANSFER PLATE
2 - UPPER HOUSING SEPARATOR PLATE
3 - FILTER SCREEN
4 - BRACE

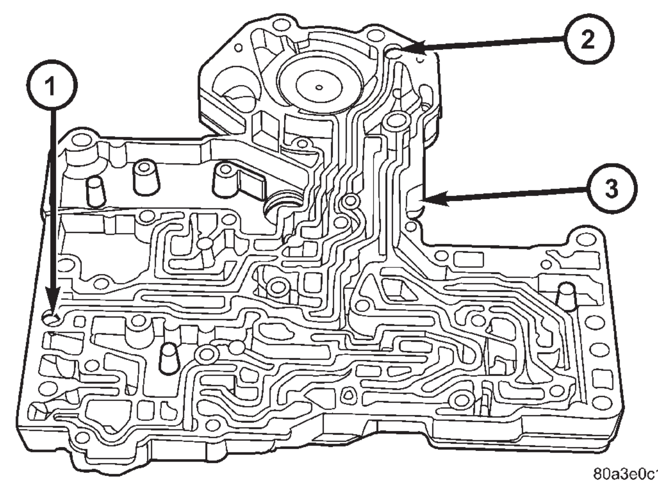


Fig. 309 Rear Clutch And Rear Servo Check Ball

1 - REAR CLUTCH CHECK BALL
2 - REAR SERVO CHECK BALL
3 - TRANSFER PLATE

VALVE BODY (Continued)

VALVE BODY UPPER HOUSING

(1) Note location of check balls in valve body upper housing (Fig. 310). Then remove the one large diameter and the six smaller diameter check balls.

(2) Remove governor plug and shuttle valve covers (Fig. 312).

(3) Remove E-clip that secures shuttle valve secondary spring on valve stem (Fig. 311).

(4) Remove throttle plug, primary spring, shuttle valve, secondary spring, and spring guides (Fig. 312).

(5) Remove boost valve retainer, spring and valve if not previously removed.

(6) Remove throttle plug and 1-2 and 2-3 governor plugs (Fig. 299).

(7) Turn upper housing around and remove limit valve and shift valve covers (Fig. 313).

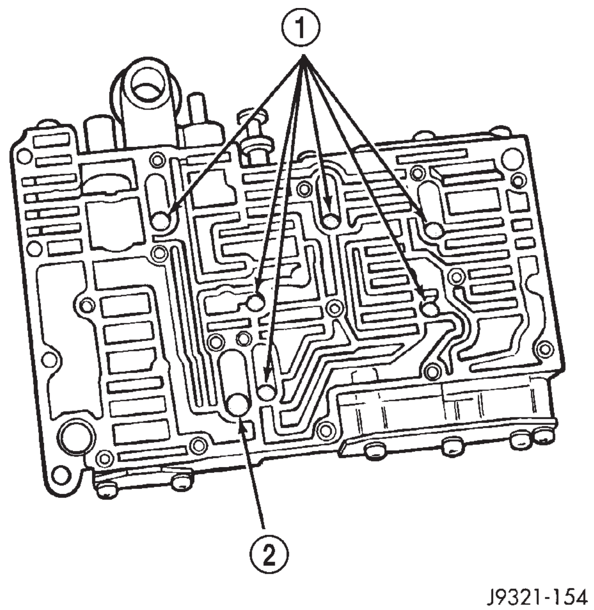


Fig. 310 Check Ball Locations In Upper Housing

1 - SMALL DIAMETER CHECK BALLS (6)
2 - LARGE DIAMETER CHECK BALL (1)

(8) Remove limit valve housing. Then remove retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing (Fig. 313).

(9) Remove 1-2 shift control valve and spring (Fig. 313).

(10) Remove 1-2 shift valve and spring (Fig. 313).

(11) Remove 2-3 shift valve and spring from valve body (Fig. 313).

(12) Remove pressure plug cover (Fig. 313).

(13) Remove line pressure plug, sleeve, throttle pressure plug and spring (Fig. 313).

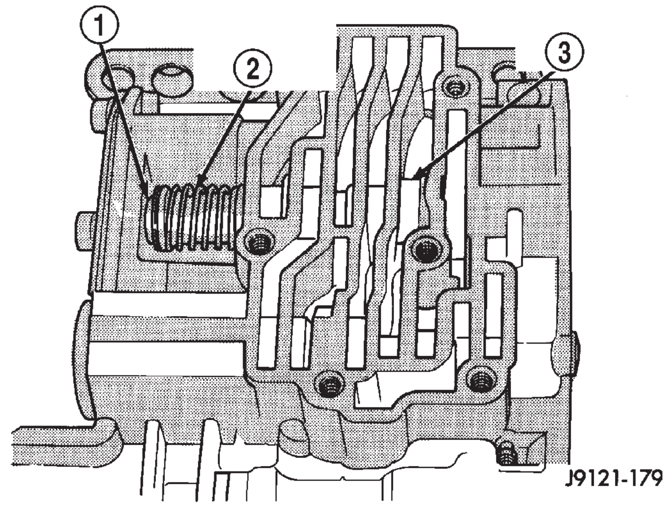


Fig. 311 Shuttle Valve E-Clip And Secondary Spring Location

1 - E-CLIP
2 - SECONDARY SPRING AND GUIDES
3 - SHUTTLE VALVE

VALVE BODY (Continued)

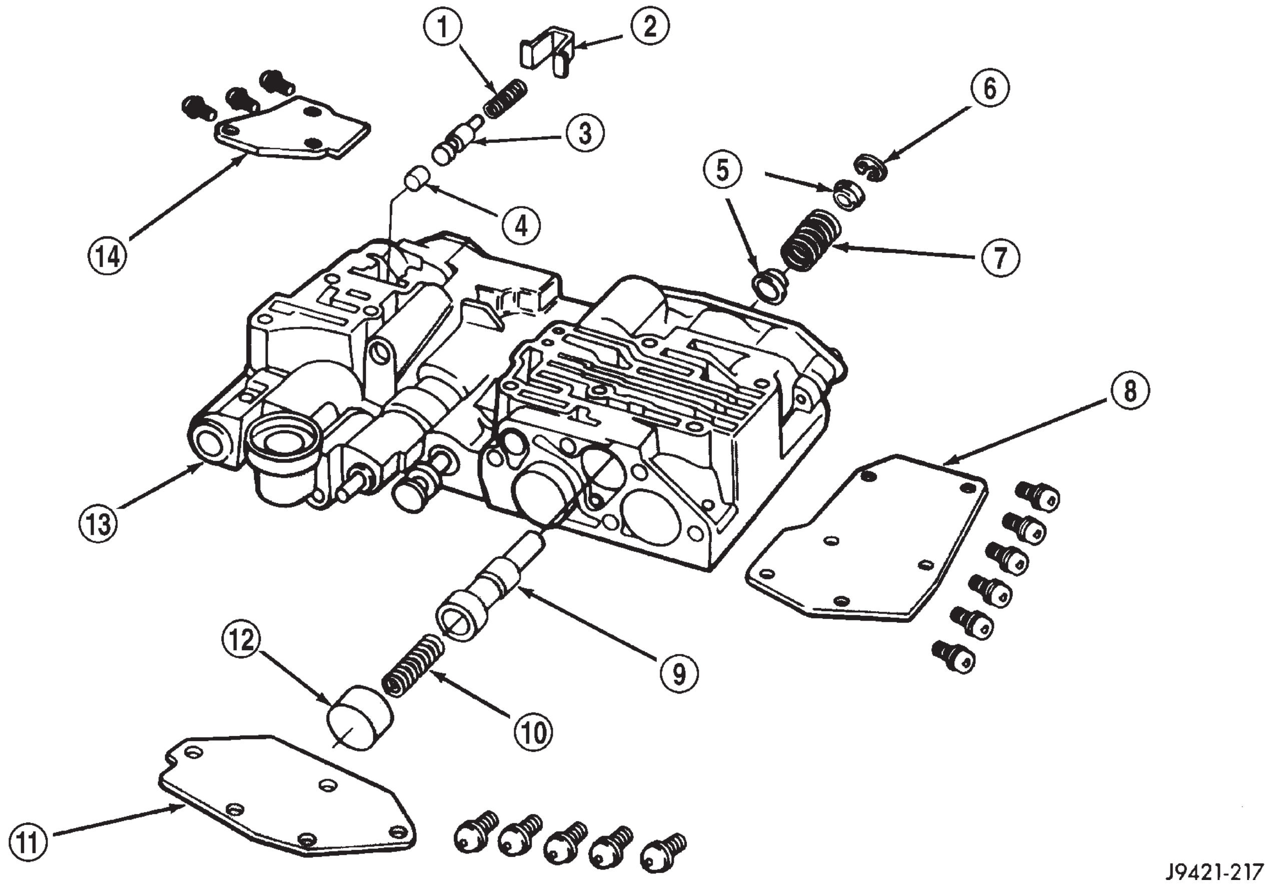


Fig. 312 Shuttle And Boost Valve Components

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

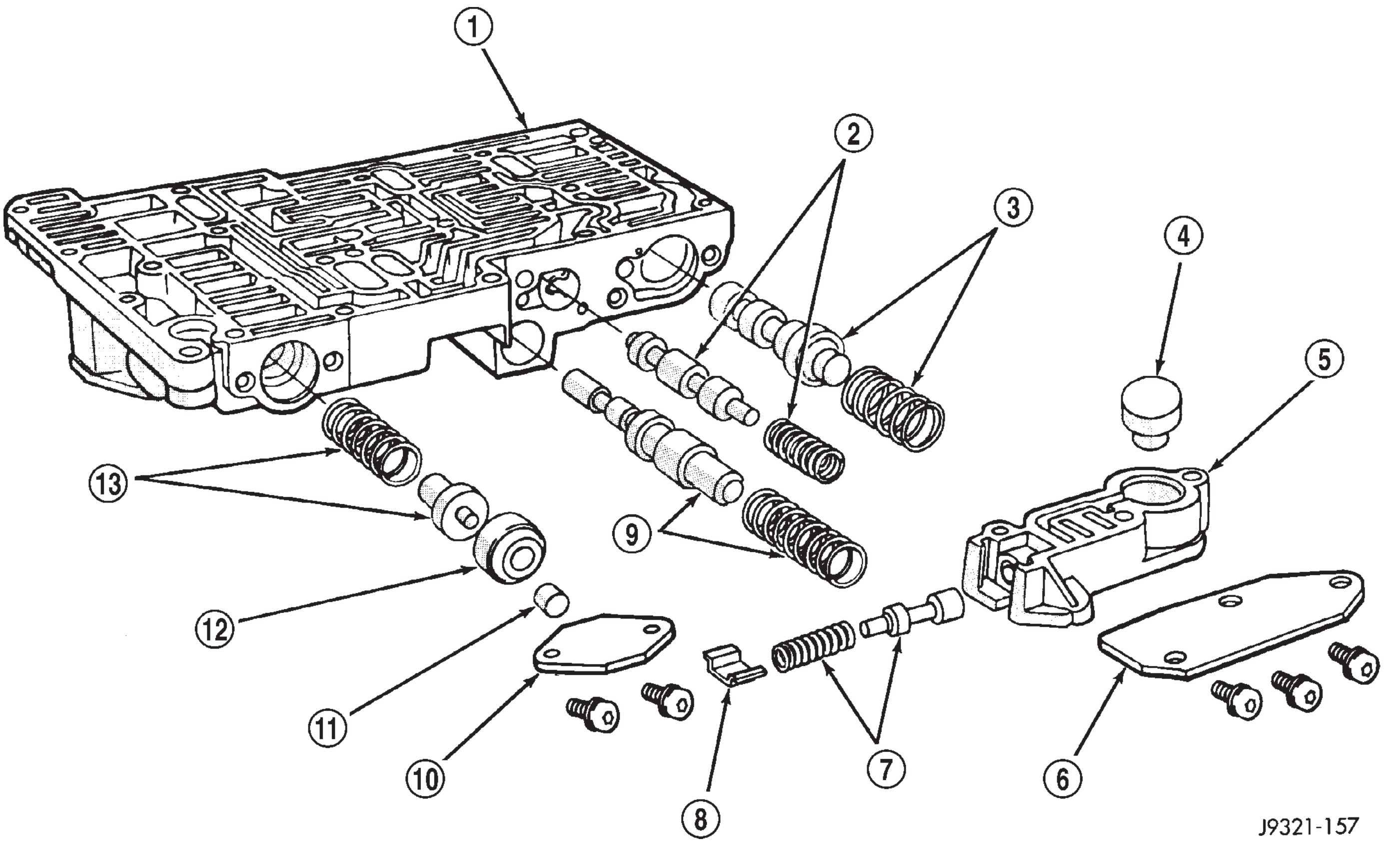


Fig. 313 Upper Housing Shift Valve And Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - LINE PRESSURE PLUG
12 - PLUG SLEEVE
13 - THROTTLE PRESSURE SPRING AND PLUG

VALVE BODY (Continued)

VALVE BODY LOWER HOUSING

(1) Remove timing valve cover.
(2) Remove 3-4 timing valve and spring.
(3) Remove 3-4 quick fill valve, spring and plug.
(4) Remove 3-4 shift valve and spring.
(5) Remove converter clutch valve, spring and plug (Fig. 314).
(6) Remove converter clutch timing valve, retainer and valve spring.

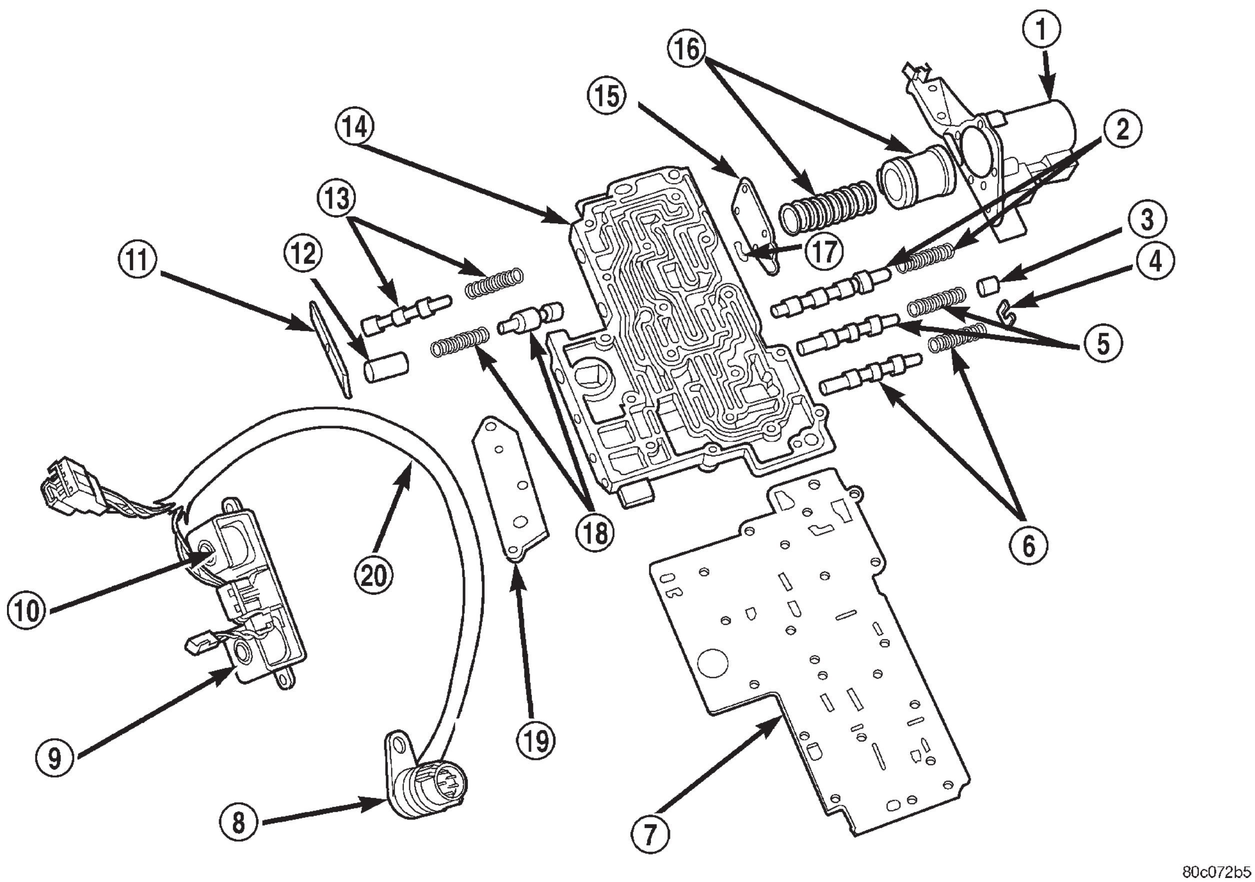


Fig. 314 Lower Housing Shift Valves and Springs

1 - 3-4 ACCUMULATOR HOUSING
2 - 3-4 SHIFT VALVE AND SPRING
3 - PLUG
4 - SPRING RETAINER
5 - CONVERTER CLUTCH VALVE AND SPRING
6 - CONVERTER CLUTCH TIMING VALVE AND SPRING
7 - OVERDRIVE SEPARATOR PLATE
8 - CASE CONNECTOR
9 - CONVERTER CLUTCH SOLENOID
10 - OVERDRIVE SOLENOID
11 - TIMING VALVE COVER
12 - PLUG
13 - 3-4 TIMING VALVE AND SPRING
14 - LOWER HOUSING
15 - ACCUMULATOR END PLATE
16 - 3-4 ACCUMULATOR PISTON AND SPRING
17 - E-CLIP
18 - 3-4 QUICK FILL SPRING AND VALVE
19 - SOLENOID GASKET
20 - HARNESS

VALVE BODY (Continued)

3-4 ACCUMULATOR HOUSING

(1) Remove end plate from housing.

(2) Remove piston spring.

(3) Remove piston. Remove and discard piston seals (Fig. 315).

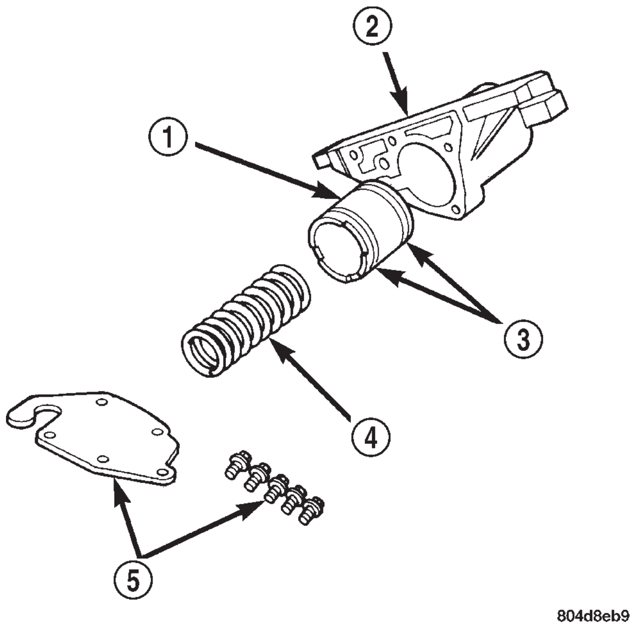


Fig. 315 Accumulator Housing Components

1 - ACCUMULATOR PISTON
2 - 3-4 ACCUMULATOR HOUSING
3 - TEFLON SEALS
4 - PISTON SPRING
5 - COVER PLATE AND SCREWS

CLEANING

Clean the valve housings, valves, plugs, springs, and separator plates with a standard parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution.

Do not immerse any of the electrical components in cleaning solution. Clean the governor solenoid and sensor and the dual solenoid and harness assembly by wiping them off with dry shop towels only.

Dry all except the electrical parts with compressed air. Make sure all passages are clean and free from obstructions. **Do not use rags or shop towels to dry or wipe off valve body components. Lint from these materials can stick to valve body parts, interfere with valve operation, and clog filters and fluid passages.**

Wipe the governor pressure sensor and solenoid valve with dry, lint free shop towels only. The O-rings on the sensor and solenoid valve are the only serviceable components. Be sure the vent ports in the solenoid valve are open and not blocked by dirt or debris. Replace the valve and/or sensor only when DRB scan tool diagnosis indicates this is necessary. Or, if either part has sustained physical damage (dented, deformed, broken, etc.).

CAUTION: Do not turn the small screw at the end of the solenoid valve for any reason. Turning the screw in either direction will ruin solenoid calibration and result in solenoid failure. In addition, the filter on the solenoid valve is NOT serviceable. Do not try to remove the filter as this will damage the valve housing.

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.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with a sheet of crocus cloth. Position the crocus cloth on a surface plate, sheet of plate glass or equally flat surface. If distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: Many of the valves and plugs, such as the throttle valve, shuttle valve plug, 1-2 shift valve and 1-2 governor plug, are made of coated aluminum. Aluminum components are identified by the dark color of the special coating applied to the surface (or by testing with a magnet). Do not sand aluminum valves or plugs under any circumstances. This practice could damage the special coating causing the valves/plugs to stick and bind.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Minor surface scratches on steel valves and plugs can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.** Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

VALVE BODY (Continued)

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

Check the two separator plates for distortion or damage of any kind. Inspect the upper housing, lower housing, 3-4 accumulator housing, and transfer plate carefully. Be sure all fluid passages are clean and clear. Check condition of the upper housing and transfer plate check balls as well. The check balls and ball seats must not be worn or damaged.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores.

Valve body bores do not change dimensionally with use. If the valve body functioned correctly when new, it will continue to operate properly after cleaning and inspection. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

The only serviceable valve body components are listed below. The remaining valve body components are serviced only as part of a complete valve body assembly. Serviceable parts are:

- dual solenoid and harness assembly
- solenoid gasket
- solenoid case connector O-rings and shoulder bolt
- switch valve and spring
- pressure adjusting screw and bracket assembly
- throttle lever
- manual lever and shaft seal
- throttle lever shaft seal, washer, and E-clip
- fluid filter and screws
- detent ball and spring
- valve body screws
- governor pressure solenoid
- governor pressure sensor and retaining clip
- park lock rod and E-clip

ASSEMBLY

CAUTION: Do not force valves or plugs into place during reassembly. If the valve body bores, valves and plugs are free of distortion or burrs, the valve body components should all slide into place easily. In addition, do not overtighten the transfer plate and valve body screws during reassembly. Overtightening can distort the housings resulting in valve sticking, cross leakage and unsatisfactory operation. Tighten valve body screws to recommended torque only.

LOWER HOUSING

(1) Lubricate valves, springs, and the housing valve and plug bores with clean transmission fluid (Fig. 314).

(2) Install 3-4 timing valve spring and valve in lower housing.

(3) Install 3-4 quick fill valve in lower housing.

(4) Install 3-4 quick fill valve spring and plug in housing.

(5) Install timing valve end plate. Tighten end plate screws to 4 N·m (35 in. lbs.) torque.

3-4 ACCUMULATOR

(1) Lubricate accumulator piston, seals and housing piston bore with clean transmission fluid (Fig. 315).

(2) Install new seal rings on accumulator piston.

(3) Install piston and spring in housing.

(4) Install end plate on housing.

TRANSFER PLATE

(1) Install rear clutch and rear servo check balls in transfer plate (Fig. 316).

(2) Install filter screen in upper housing separator plate (Fig. 317).

(3) Align and position upper housing separator plate on transfer plate (Fig. 318).

(4) Install brace plate (Fig. 318). Tighten brace attaching screws to 4 N·m (35 in. lbs.) torque.

(5) Install remaining separator plate attaching screws. Tighten screws to 4 N·m (35 in. lbs.) torque.

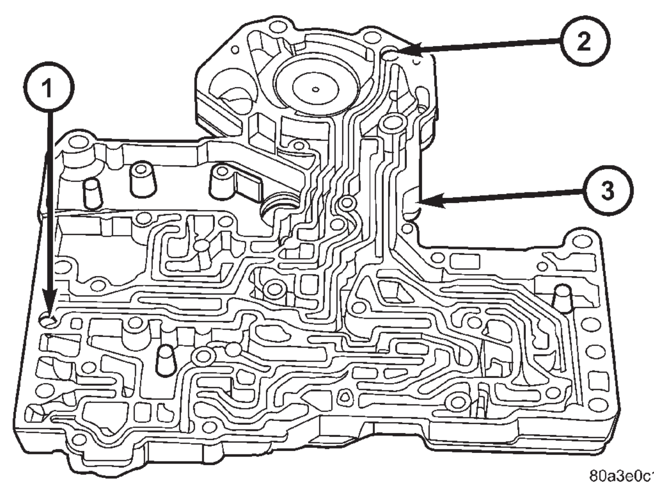


Fig. 316 Rear Clutch And Rear Servo Check Ball Locations

1 - REAR CLUTCH CHECK BALL
2 - REAR SERVO CHECK BALL
3 - TRANSFER PLATE

VALVE BODY (Continued)

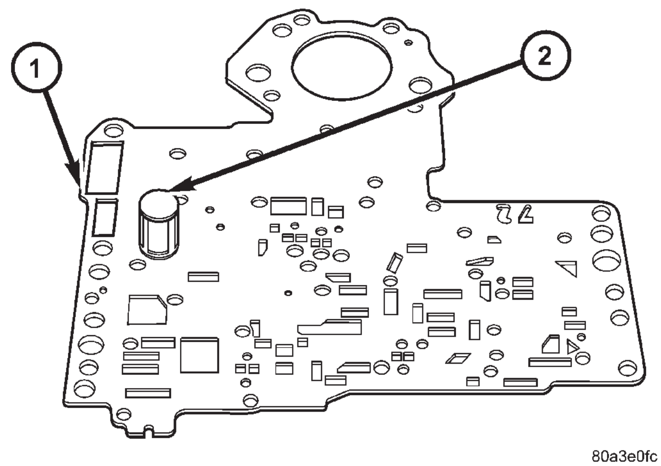


Fig. 317 Separator Plate Filter Screen Installation

1 - UPPER HOUSING SEPARATOR PLATE
2 - FILTER SCREEN

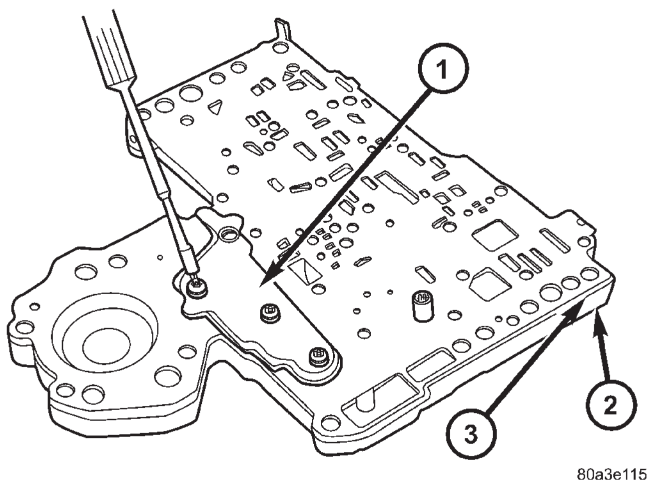


Fig. 318 Brace Plate

1 - BRACE
2 - TRANSFER PLATE
3 - SEPARATOR PLATE

UPPER AND LOWER HOUSING

(1) Position upper housing so internal passages and check ball seats are facing upward. Then install check balls in housing (Fig. 319). Eight check balls are used. The single large check ball is approximately 8.7 mm (11/32 in.) diameter. The single small check ball is approximately 4.8 mm (3/16 in.) in diameter. The remaining 6 check balls are approximately 6.3 mm (1/4 in.) in diameter.

(2) Position assembled transfer plate and upper housing separator plate on upper housing (Fig. 320). Be sure filter screen is seated in proper housing recess.

(3) Install the ECE check ball into the transfer plate (Fig. 306). The ECE check ball is approximately 4.8 mm (3/16 in.) in diameter.

(4) Position lower housing separator plate on transfer plate (Fig. 321).

(5) Install lower housing on assembled transfer plate and upper housing (Fig. 322).

(6) Install and start all valve body screws by hand except for the screws to hold the boost valve tube brace. Save those screws for later installation. Then tighten screws evenly to 4 N·m (35 in. lbs.) torque. Start at center and work out to sides when tightening screws (Fig. 322).

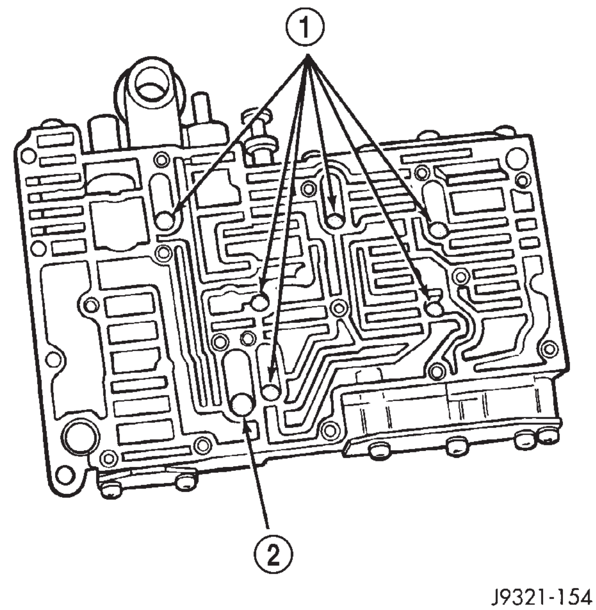


Fig. 319 Check Ball Locations In Upper Housing

1 - SMALL DIAMETER CHECK BALLS (6)
2 - LARGE DIAMETER CHECK BALL (1)

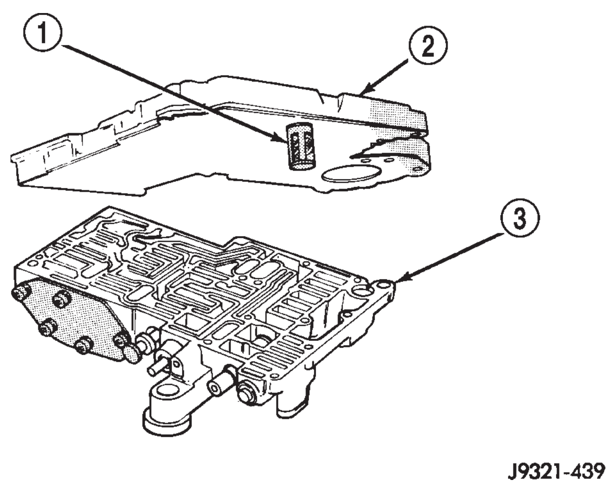


Fig. 320 Installing Transfer Plate On Upper Housing

1 - FILTER SCREEN
2 - TRANSFER PLATE/SEPARATOR PLATE ASSEMBLY
3 - UPPER HOUSING

VALVE BODY (Continued)

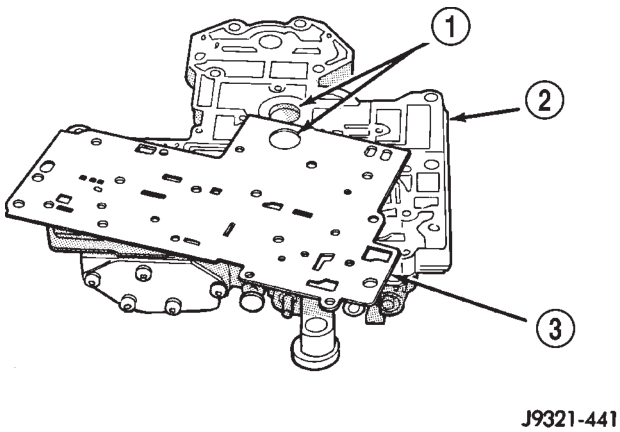


Fig. 321 Lower Housing Separator Plate

1 - BE SURE TO ALIGN BORES
2 - TRANSFER PLATE
3 - LOWER HOUSING (OVERDRIVE) SEPARATOR PLATE

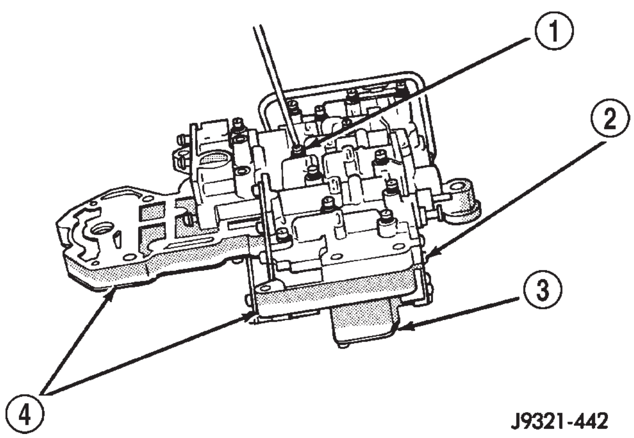


Fig. 322 Installing Lower Housing On Transfer Plate And Upper Housing

1 - VALVE BODY SCREWS (13)
2 - LOWER HOUSING
3 - UPPER HOUSING
4 - TRANSFER PLATE

UPPER HOUSING VALVE AND PLUG

Refer to (Fig. 323), (Fig. 324) and (Fig. 325) to perform the following steps.

(1) Lubricate valves, plugs, springs with clean transmission fluid.

(2) Assemble regulator valve line pressure plug, sleeve, throttle plug and spring. Insert assembly in upper housing and install cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(3) Install 1-2 and 2-3 shift valves and springs.

(4) Install 1-2 shift control valve and spring.

(5) Install retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing.

(6) Install limit valve housing and cover plate. Tighten screws to 4 N·m (35 in. lbs.).

(7) Install shuttle valve as follows:

(a) Insert plastic guides in shuttle valve secondary spring and install spring on end of valve.

(b) Install shuttle valve into housing.

(c) Hold shuttle valve in place.

(d) Compress secondary spring and install E-clip in groove at end of shuttle valve.

(e) Verify that spring and E-clip are properly seated before proceeding.

(8) Install shuttle valve cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(9) Install 1-2 and 2-3 valve governor plugs in valve body.

(10) Install shuttle valve primary spring and throttle plug.

(11) Align and install governor plug cover. Tighten cover screws to 4 N·m (35 in. lbs.) torque.

VALVE BODY (Continued)

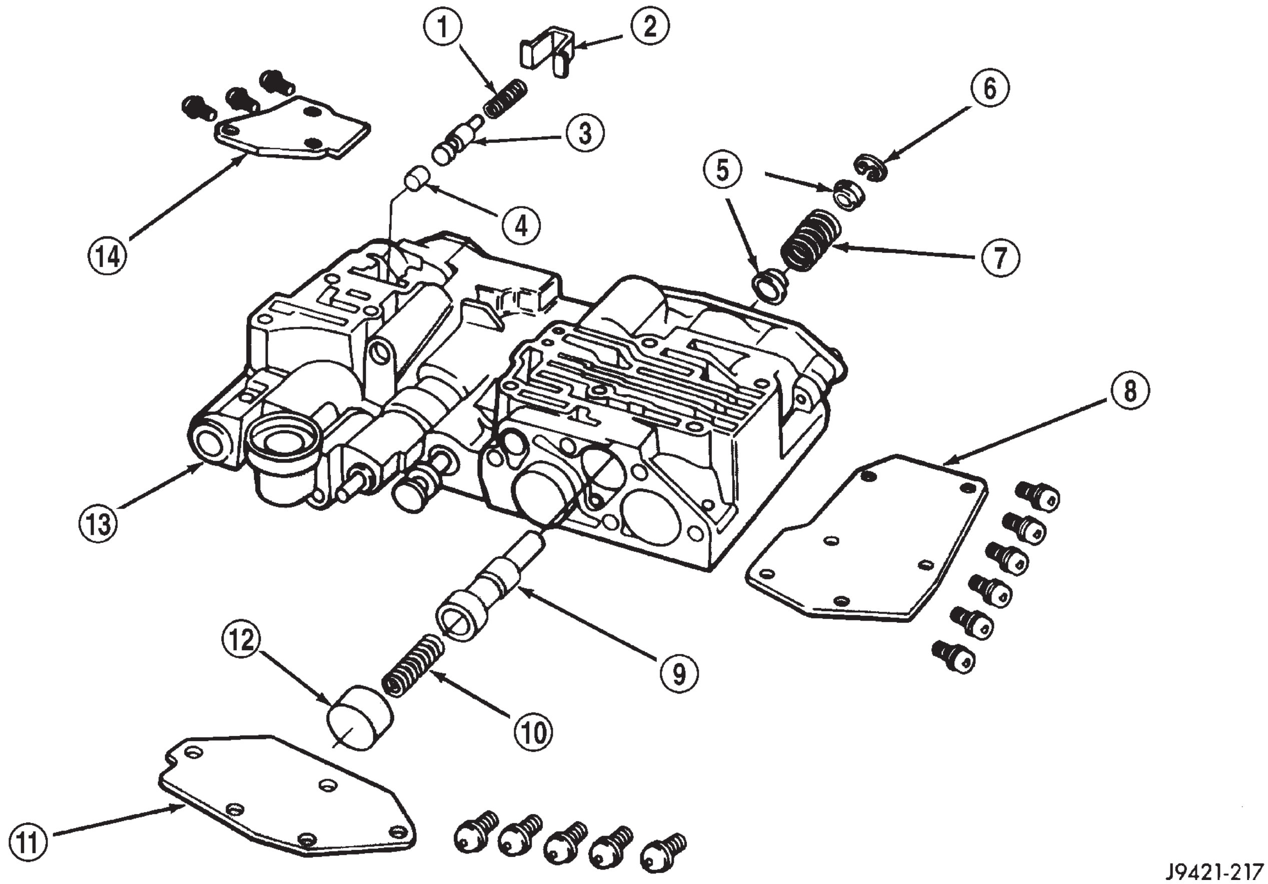


Fig. 323 Shuttle And Boost Valve Components

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

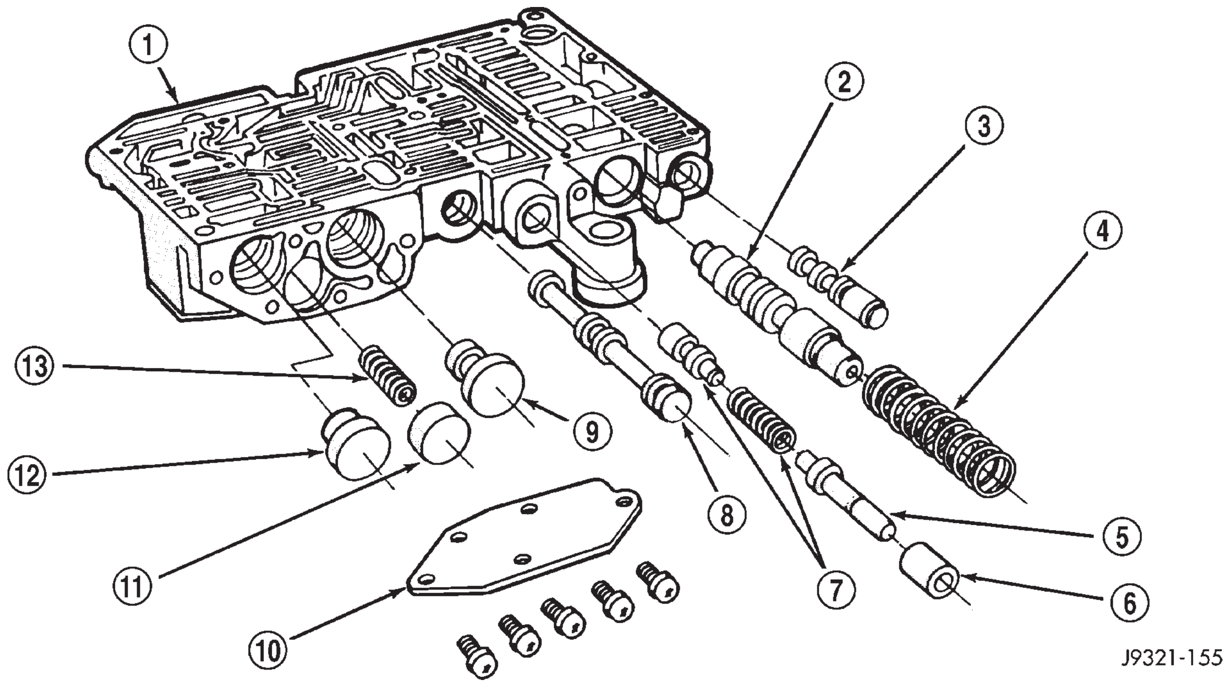


Fig. 324 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

VALVE BODY (Continued)

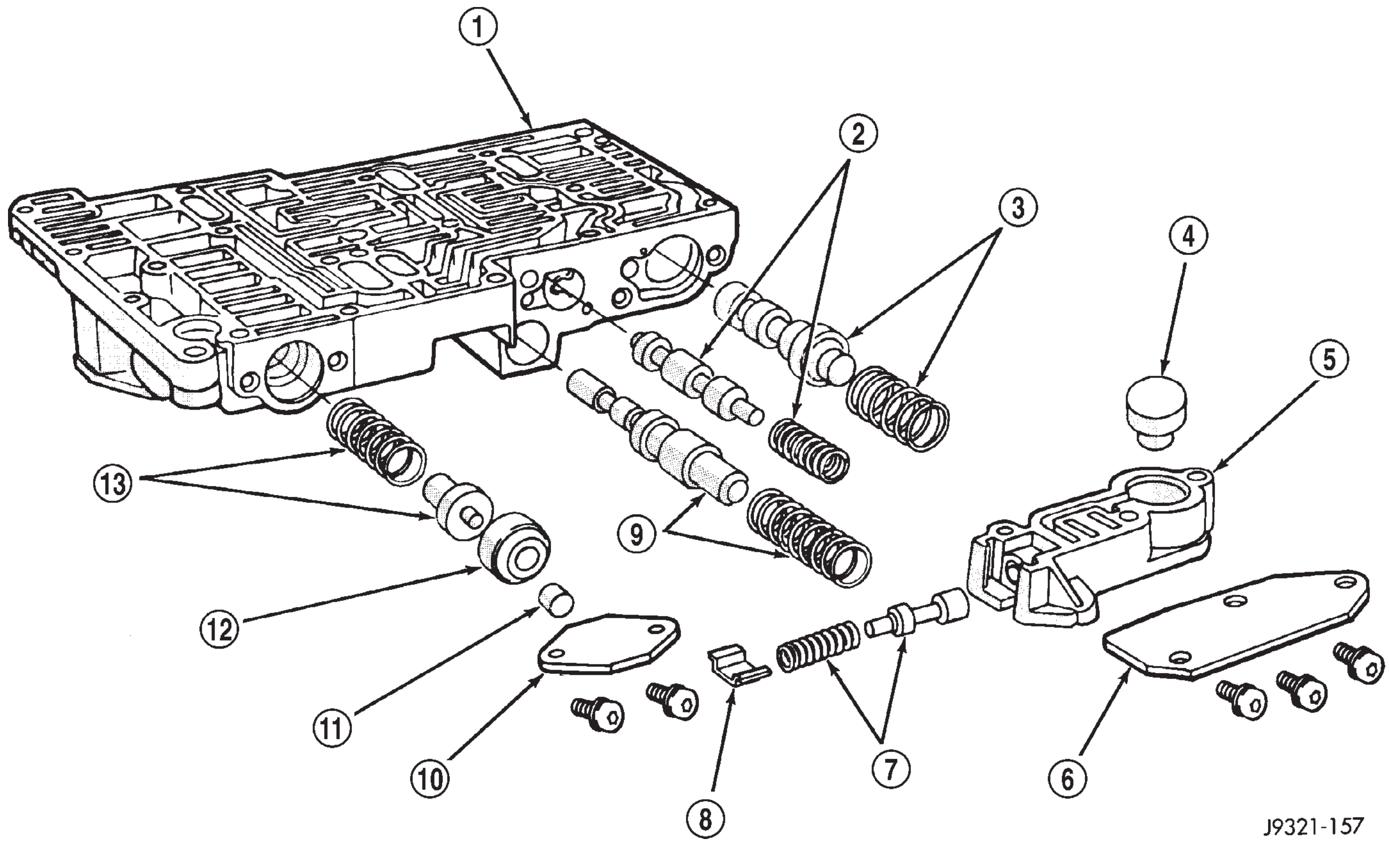


Fig. 325 Upper Housing Shift Valve And Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - LINE PRESSURE PLUG
12 - PLUG SLEEVE
13 - THROTTLE PRESSURE SPRING AND PLUG

BOOST VALVE TUBE AND BRACE

(1) Position valve body assembly so lower housing is facing upward (Fig. 326).

(2) Lubricate tube ends and housing ports with transmission fluid or petroleum jelly.

(3) Start tube in lower housing port first. Then swing tube downward and work opposite end of tube into upper housing port (Fig. 326).

(4) Insert and seat each end of tube in housings.

(5) Slide tube brace under tube and into alignment with valve body screw holes (Fig. 327).

(6) Install and finger tighten three screws that secure tube brace to valve body housings (Fig. 327).

(7) Bend tube brace tabs up and against tube to hold it in position (Fig. 328).

(8) Tighten all valve body housing screws to 4 N·m (35 in. lbs.) torque after tube and brace are installed. Tighten screws in diagonal pattern starting at center and working outward.

VALVE BODY (Continued)

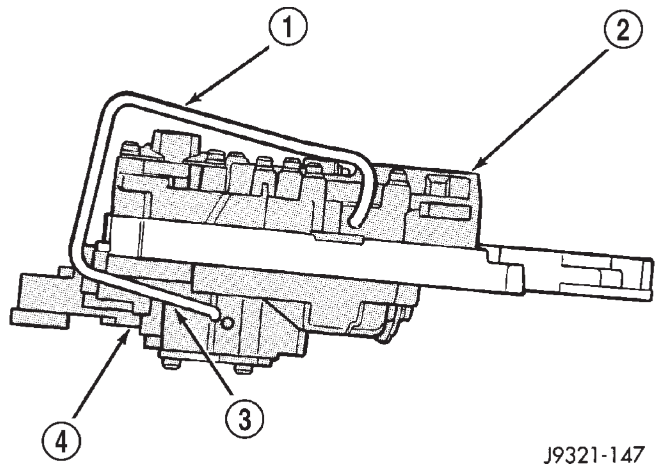


Fig. 326 Boost Valve Tube

1 - BOOST VALVE TUBE
2 - LOWER HOUSING
3 - DISENGAGE THIS END OF TUBE FIRST
4 - UPPER HOUSING

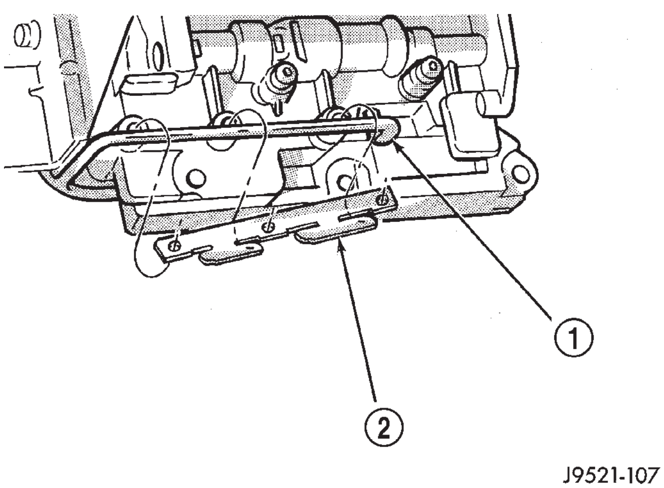


Fig. 327 Boost Valve Tube And Brace

1 - BOOST VALVE TUBE
2 - TUBE BRACE

3-4 ACCUMULATOR

(1) Position converter clutch valve and 3-4 shift valve springs in housing (Fig. 329).

(2) Loosely attach accumulator housing with right-side screw (Fig. 329). Install only one screw at this time as accumulator must be free to pivot upward for ease of installation.

(3) Install 3-4 shift valve and spring.

(4) Install converter clutch timing valve and spring.

(5) Position plug on end of converter clutch valve spring. Then compress and hold springs and plug in place with fingers of one hand.

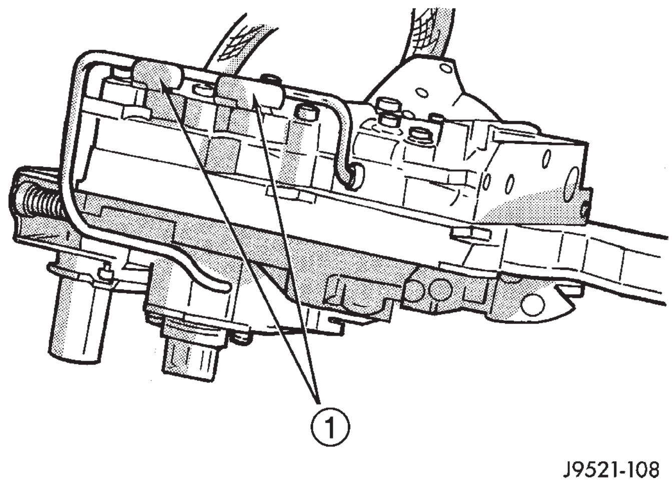


Fig. 328 Securing Boost Valve Tube With Brace Tabs

1 - BEND TABS UP AGAINST TUBE AS SHOWN

(6) Swing accumulator housing upward over valve springs and plug.

(7) Hold accumulator housing firmly in place and install remaining two attaching screws. Be sure springs and clutch valve plug are properly seated (Fig. 330). Tighten screws to 4 N·m (35 in. lbs.).

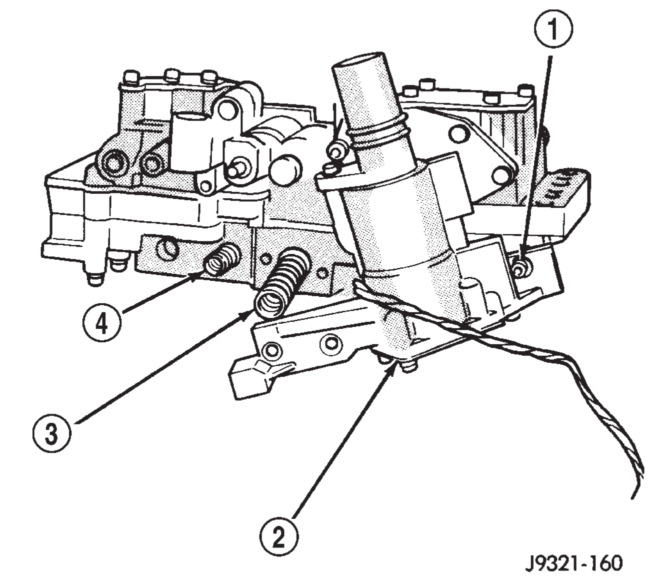


Fig. 329 Converter Clutch And 3-4 Shift Valve Springs

1 - RIGHT-SIDE SCREW
2 - 3-4 ACCUMULATOR
3 - 3-4 SHIFT VALVE SPRING
4 - CONVERTER CLUTCH VALVE SPRING

VALVE BODY (Continued)

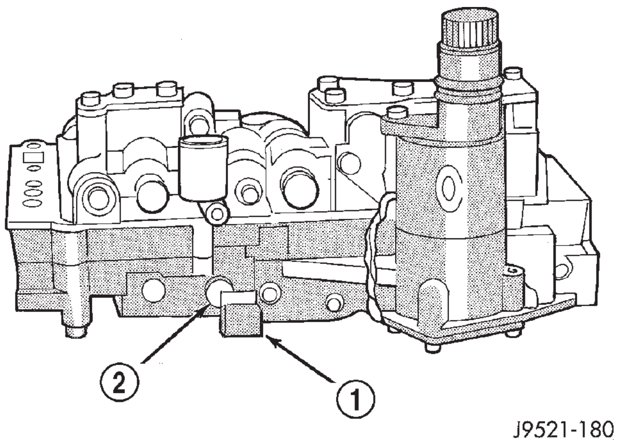


Fig. 330 Seating 3-4 Accumulator On Lower Housing

1 - ACCUMULATOR BOX
2 - CONVERTER CLUTCH VALVE PLUG

VALVE BODY FINAL

(1) Install boost valve, valve spring, retainer and cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(2) Insert manual lever detent spring in upper housing.

(3) Position detent ball on end of spring. Then hold detent ball and spring in detent housing with Retainer Tool 6583 (Fig. 331).

(4) Install throttle lever in upper housing. Then install manual lever over throttle lever and start manual lever into housing.

(5) Align manual lever with detent ball and manual valve. Hold throttle lever upward. Then press down on manual lever until fully seated. Remove detent ball retainer tool after lever is seated.

(6) Then install manual lever seal, washer and E-clip.

(7) Verify that throttle lever is aligned with end of kickdown valve stem and that manual lever arm is engaged in manual valve (Fig. 332).

(8) Position line pressure adjusting screw in adjusting screw bracket.

(9) Install spring on end of line pressure regulator valve.

(10) Install switch valve spring on tang at end of adjusting screw bracket.

(11) Install manual valve.

(12) Install throttle valve and spring.

(13) Install kickdown valve and detent.

(14) Install pressure regulator valve.

(15) Install switch valve.

(16) Position adjusting screw bracket on valve body. Align valve springs and press bracket into place. Install short, upper bracket screws first and long bottom screw last. Verify that valve springs and bracket are properly aligned. Then tighten all three bracket screws to 4 N·m (35 in. lbs.) torque.

(17) Perform Line Pressure and Throttle Pressure adjustments. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC/VALVE BODY - ADJUSTMENTS)

(18) Lubricate solenoid case connector O-rings and shaft of manual lever with light coat of petroleum jelly.

(19) Attach solenoid case connector to 3-4 accumulator with shoulder-type screw. Connector has small locating tang that fits in dimple at top of accumulator housing (Fig. 333). Seat tang in dimple before tightening connector screw.

(20) Install solenoid assembly and gasket. Tighten solenoid attaching screws to 8 N·m (72 in. lbs.) torque.

(21) Verify that solenoid wire harness is properly routed (Fig. 334). Solenoid harness must be clear of manual lever and park rod and not be pinched between accumulator housing and cover.

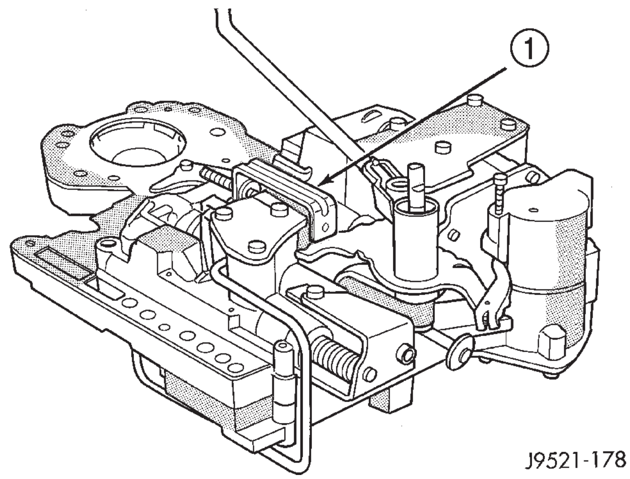


Fig. 331 Detent Ball Spring

1 - SPECIAL TOOL 6583 POSITIONED ON DETENT HOUSING

GOVERNOR BODY, SENSOR AND SOLENOID

(1) Turn valve body assembly over so accumulator side of transfer plate is facing down.

(2) Install new O-rings on governor pressure solenoid and sensor.

(3) Lubricate solenoid and sensor O-rings with clean transmission fluid.

(4) Install governor pressure sensor in governor body.

(5) Install governor pressure solenoid in governor body. Push solenoid in until it snaps into place in body.

(6) Position governor body gasket on transfer plate.

VALVE BODY (Continued)

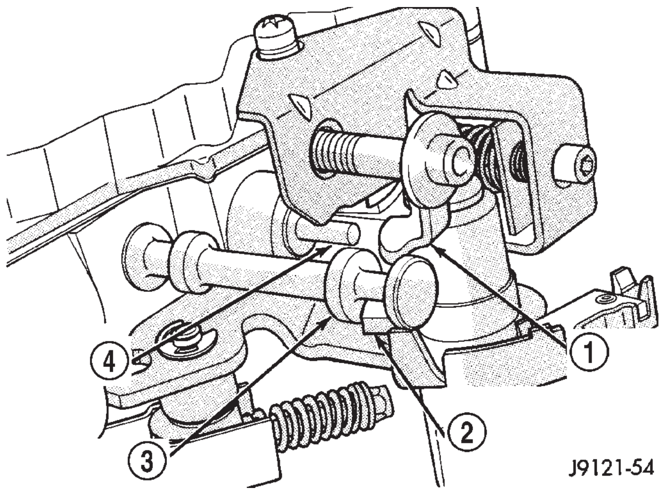


Fig. 332 Manual And Throttle Lever Alignment

1 - THROTTLE LEVER
2 - MANUAL LEVER VALVE ARM
3 - MANUAL VALVE
4 - KICKDOWN VALVE

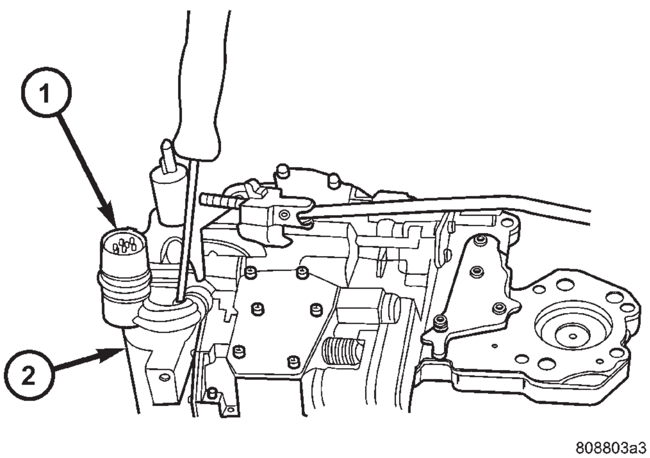


Fig. 333 Solenoid Harness Case Connector Shoulder Bolt

1 - SOLENOID HARNESS CASE CONNECTOR
2 - 3-4 ACCUMULATOR HOUSING

(7) Install retainer plate on governor body and around solenoid. Be sure solenoid connector is positioned in retainer cutout.

(8) Align screw holes in governor body and transfer plate. Then install and tighten governor body screws to 4 N·m (35 in. lbs.) torque.

(9) Connect harness wires to governor pressure solenoid and governor pressure sensor.

(10) Install fluid filter and pan.

(11) Lower vehicle.

(12) Fill transmission with recommended fluid and road test vehicle to verify repair.

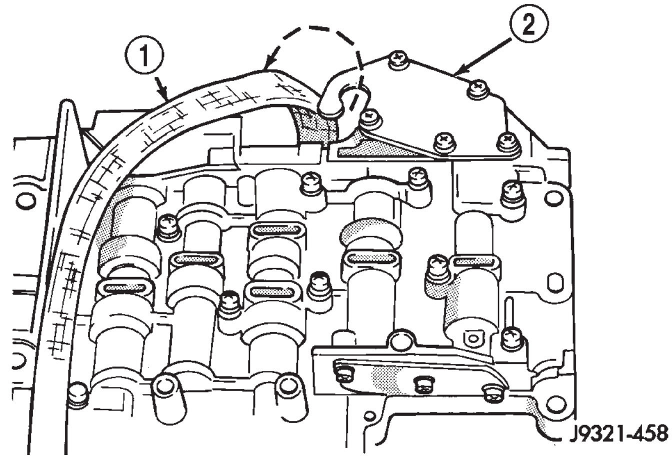


Fig. 334 Solenoid Harness Routing

1 - OVERDRIVE/CONVERTER SOLENOID WIRE HARNESS
2 - 3-4 ACCUMULATOR COVER PLATE

INSTALLATION

(1) Check condition of O-ring seals on valve body harness connector (Fig. 335). Replace seals on connector body if cut or worn.

(2) Check condition of manual lever shaft seal in transmission case. Replace seal if lip is cut or worn. Install new seal with 15/16 deep well socket (Fig. 336).

(3) Check condition of seals on accumulator piston (Fig. 337). Install new piston seals, if necessary.

(4) Place valve body manual lever in low (1 position) so ball on park lock rod will be easier to install in sprag.

(5) Lubricate shaft of manual lever with petroleum jelly. This will ease inserting shaft through seal in case.

(6) Lubricate seal rings on valve body harness connector with petroleum jelly.

(7) Position valve body in case and work end of park lock rod into and through pawl sprag. Turn propeller shaft to align sprag and park lock teeth if necessary. The rod will click as it enters pawl. Move rod to check engagement.

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into this cavity.

(8) Install accumulator springs and piston into case. Then swing valve body over piston and outer spring to hold it in place.

(9) Align accumulator piston and outer spring, manual lever shaft and electrical connector in case.

(10) Then seat valve body in case and install one or two bolts to hold valve body in place.

VALVE BODY (Continued)

(11) Tighten valve body bolts alternately and evenly to 11 N·m (100 in. lbs.) torque.

(12) Install new fluid filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.) torque.

(13) Install throttle and gearshift levers on valve body manual lever shaft.

(14) Check and adjust front and rear bands if necessary.

(15) Connect solenoid case connector wires.

(16) Install the transmission range sensor.

(17) Install oil pan and new gasket. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(18) Lower vehicle and fill transmission with Mopar® ATF +4, type 9602, fluid.

(19) Check and adjust gearshift and throttle valve cables, if necessary.

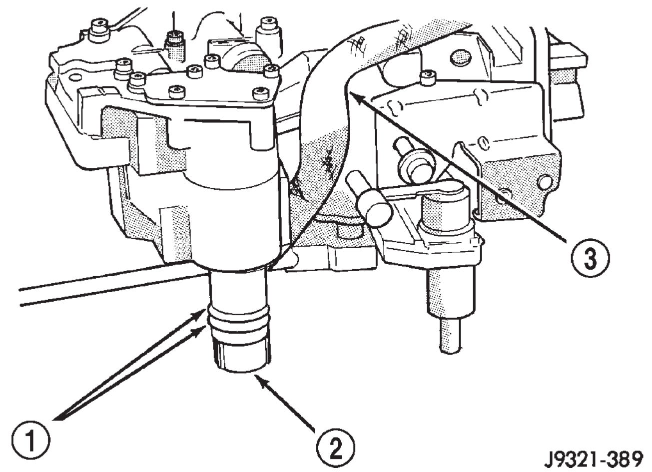


Fig. 335 Valve Body Harness Connector O-Ring Seal

1 - CONNECTOR O-RINGS
2 - VALVE BODY HARNESS CONNECTOR
3 - HARNESS

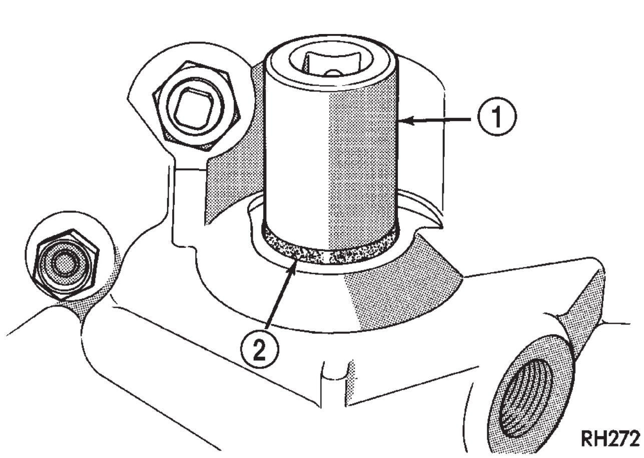


Fig. 336 Manual Lever Shaft Seal

1 - 15/16" SOCKET
2 - SEAL

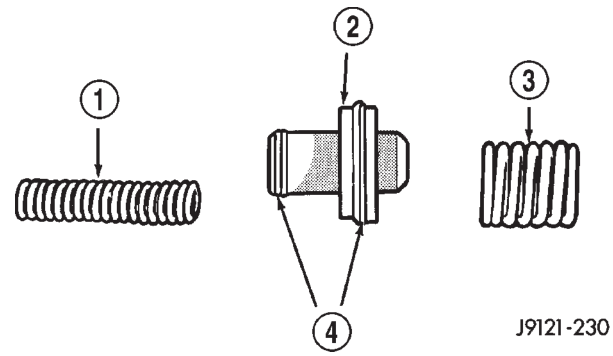


Fig. 337 Accumulator Piston Components

1 - INNER SPRING
2 - ACCUMULATOR PISTON
3 - OUTER SPRING
4 - SEAL RINGS

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. 338).

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.

VALVE BODY (Continued)

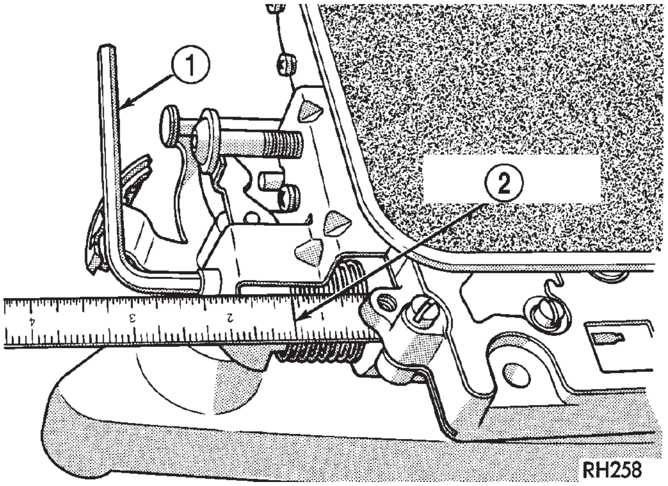


Fig. 338 Line Pressure Adjustment

1 - WRENCH
2 - 1–5/16 INCH

THROTTLE PRESSURE ADJUSTMENT

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 339).

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.

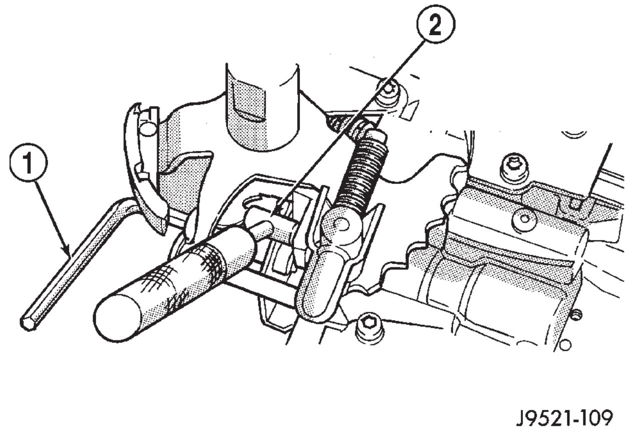


Fig. 339 Throttle Pressure Adjustment

1 - HEX WRENCH (IN THROTTLE LEVER ADJUSTING SCREW)
2 - SPECIAL TOOL C-3763 (POSITIONED BETWEEN THROTTLE LEVER AND KICKDOWN VALVE)

AUTOMATIC TRANSMISSION - 46RE

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AUTOMATIC TRANSMISSION - 46RE

DESCRIPTION

The 46RE (Fig. 1) is a four speed fully automatic transmissions with an electronic governor. The 46RE is equipped with a lock-up clutch in the torque converter. First through third gear ranges are provided by the clutches, bands, overrunning clutch, and planetary gear sets in the transmission. Fourth gear range is provided by the overdrive unit that contains an overdrive clutch, direct clutch, planetary gear set, and overrunning clutch.

The transmission contains a front, rear, and direct 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 and overdrive clutch, serve as the holding components. The driving and holding components combine to select the necessary planetary gear components, in the front, rear, or overdrive planetary gear set, transfer the engine power from the input shaft through to the output shaft.

The valve body is mounted to the lower side of the transmission and contains the valves to control pressure regulation, fluid flow control, and clutch/band application. The oil pump is mounted at the front of the transmission and is driven by the torque converter hub. The pump supplies the oil pressure necessary for clutch/band actuation and transmission lubrication.

AUTOMATIC TRANSMISSION - 46RE (Continued)

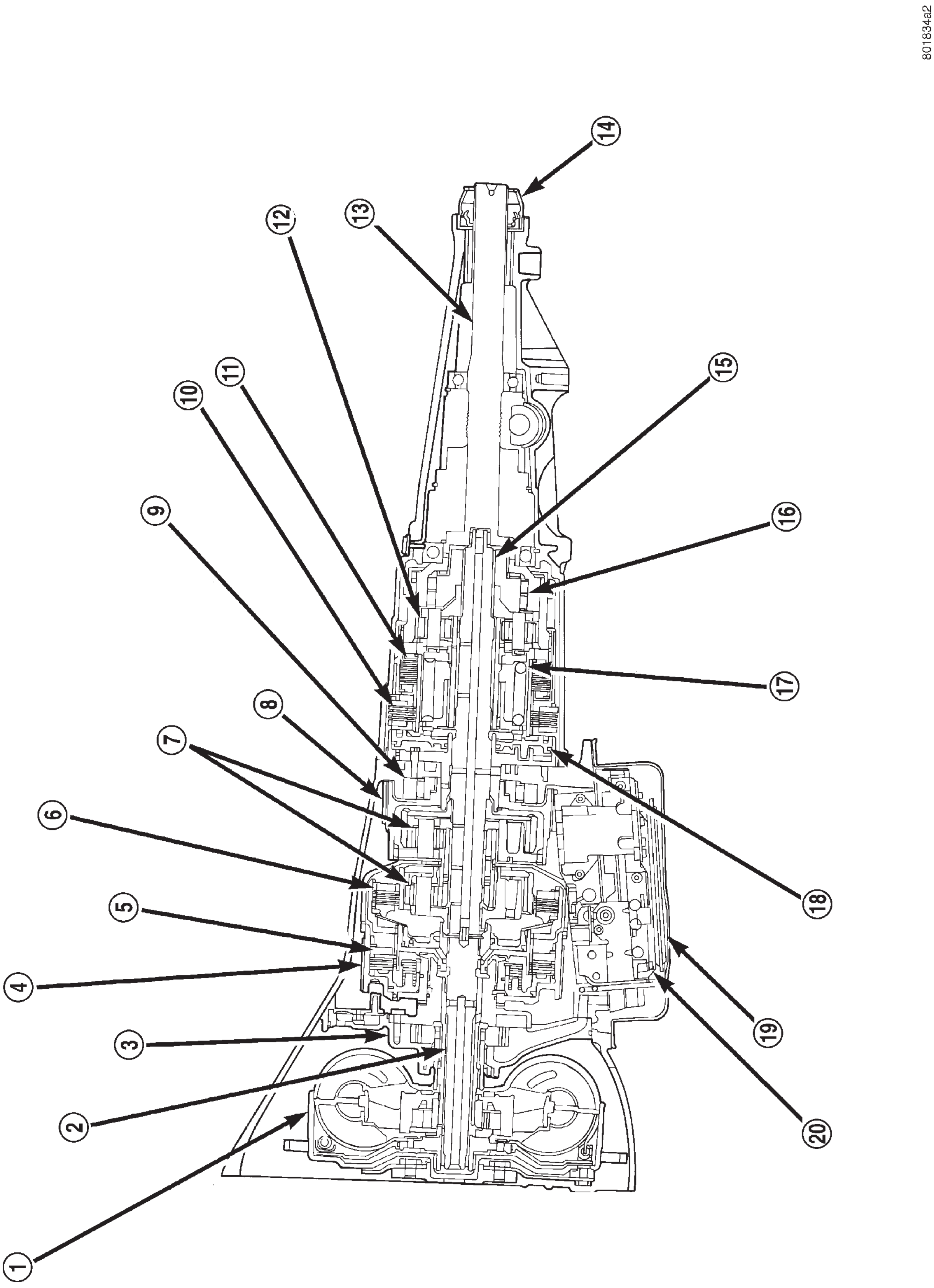


Fig. 1 46RE Transmission

AUTOMATIC TRANSMISSION - 46RE (Continued)

1 - TORQUE CONVERTER
2 - INPUT SHAFT
3 - OIL PUMP
4 - FRONT BAND
5 - FRONT CLUTCH
6 - REAR CLUTCH
7 - PLANETARIES
8 - REAR BAND
9 - OVERRUNNING CLUTCH
10 - OVERDRIVE CLUTCH
11 - DIRECT CLUTCH
12 - PLANETARY GEAR
13 - OUTPUT SHAFT
14 - SEAL
15 - INTERMEDIATE SHAFT
16 - OVERDRIVE OVERRUNNING CLUTCH
17 - DIRECT CLUTCH SPRING
18 - OVERDRIVE PISTON RETAINER
19 - FILTER
20 - VALVE BODY

IDENTIFICATION

Transmission identification numbers are stamped on the left side of the case just above the oil pan gasket surface (Fig. 2). Refer to this information when ordering replacement parts.

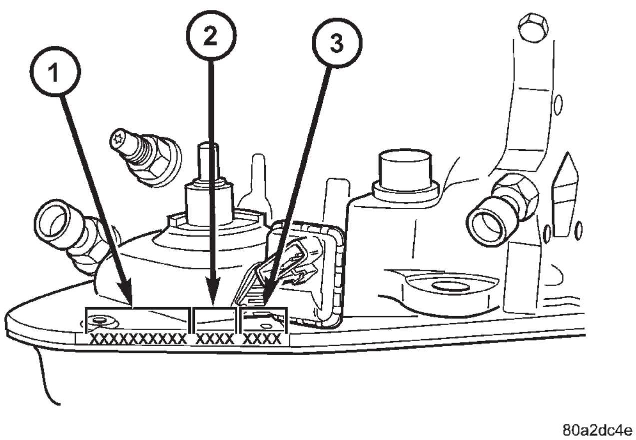


Fig. 2 Transmission Part And Serial Number Location

1 - PART NUMBER
2 - BUILD DATE
3 - SERIAL NUMBER

GEAR RATIOS The 46RE gear ratios are:

1st	2.45:1
2nd	1.45:1
3rd	1.00:1
4th	0.69:1
Rev.	2.21

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 fourth 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 assemblies 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 fourth gear, and in third gear under various conditions, such as when the O/D switch is OFF, when the vehicle is cruising on a level surface 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.

Since the overdrive clutch is applied in fourth gear only and the direct clutch is applied in all ranges except fourth gear, the transmission operation for park, neutral, and first through third gear will be described first. Once these powerflows are described, the third to fourth shift sequence will be described.

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.

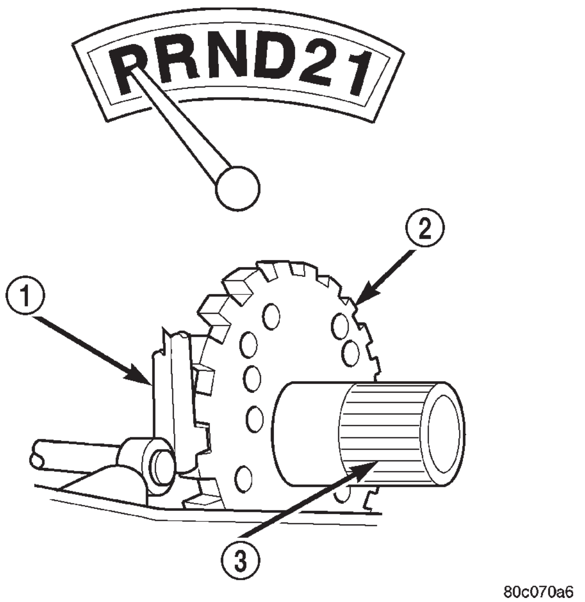


Fig. 3 Park Powerflow

1 - PAWL 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.

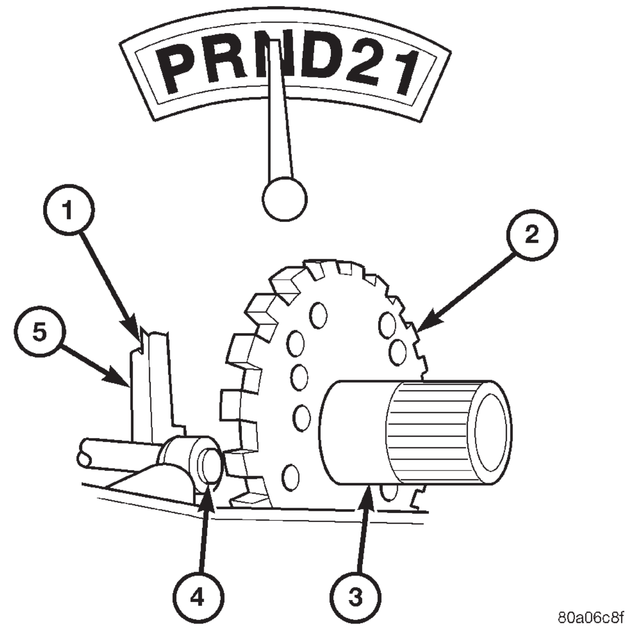


Fig. 4 Neutral Powerflow

1 - PAWL DISENGAGED FOR NEUTRAL
2 - PARK SPRAG
3 - OUTPUT SHAFT
4 - CAM
5 - PAWL

AUTOMATIC TRANSMISSION - 46RE (Continued)

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.

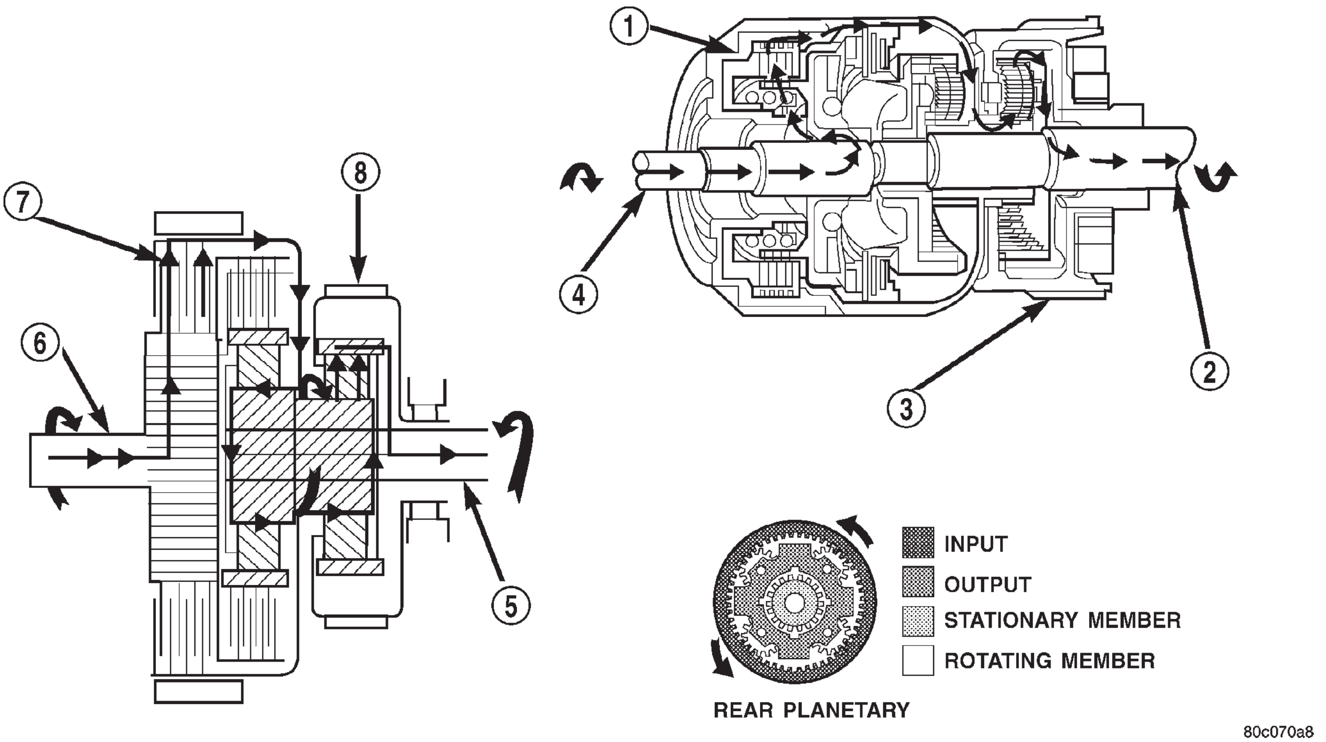


Fig. 5 Reverse Powerflow

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 - 46RE (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.

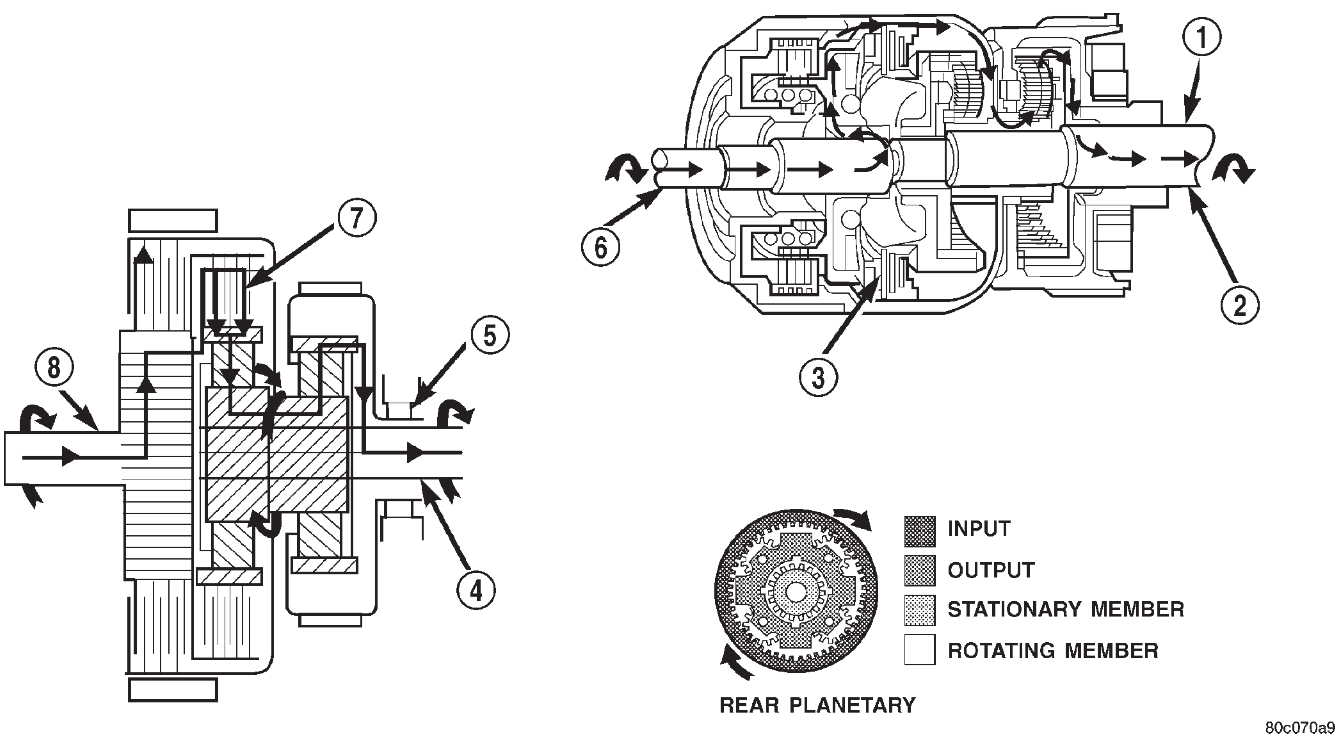


Fig. 6 First Gear Powerflow

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 - 46RE (Continued)

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.

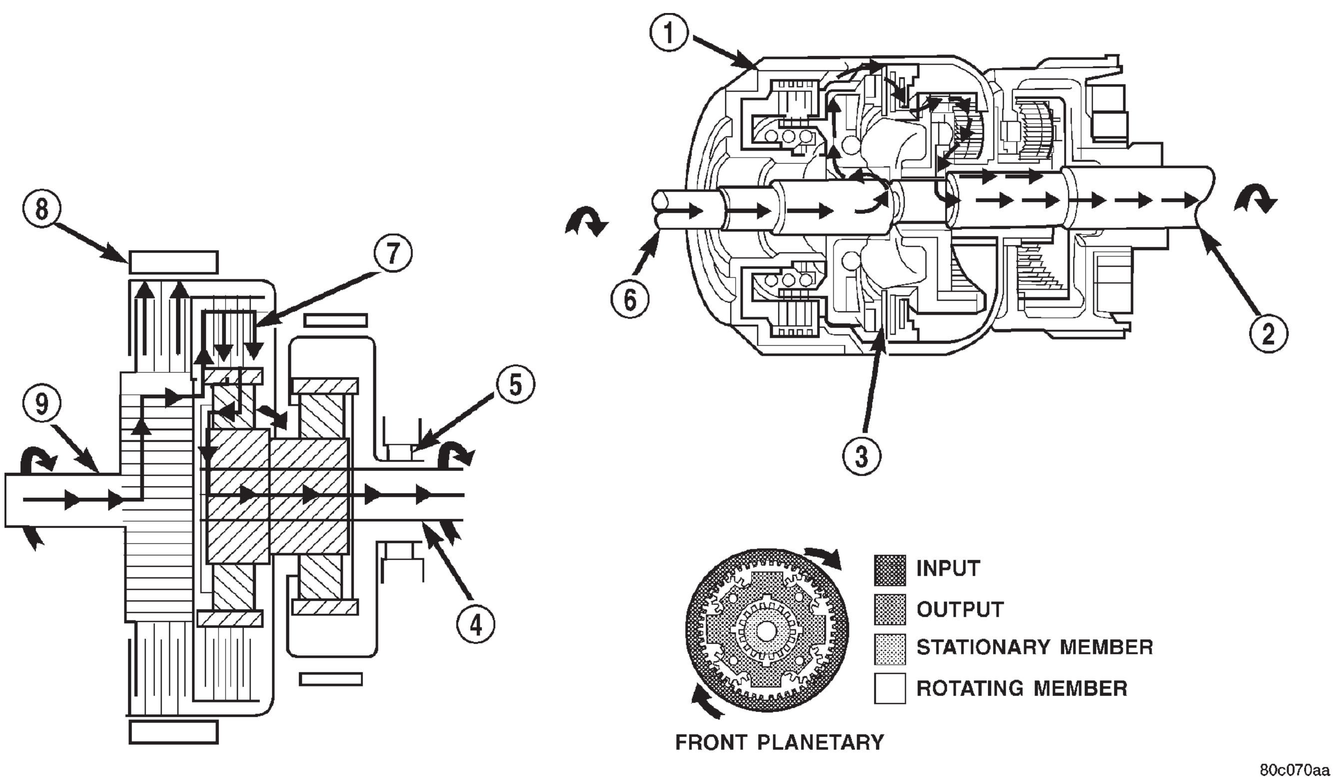


Fig. 7 Second Gear Powerflow

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

AUTOMATIC TRANSMISSION - 46RE (Continued)

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.

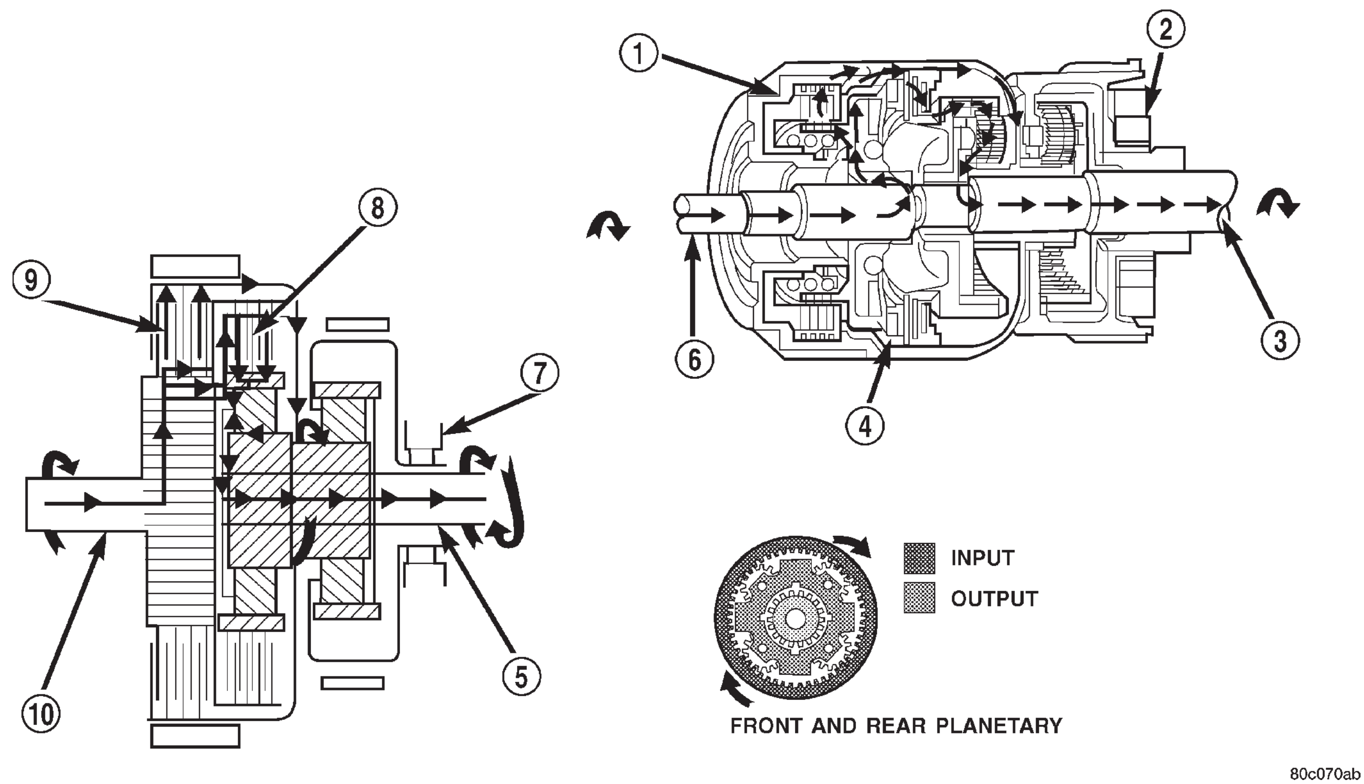


Fig. 8 Direct Drive Powerflow

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

FOURTH GEAR POWERFLOW

Fourth gear overdrive range is electronically controlled and hydraulically activated. Various sensor inputs are supplied to the powertrain control module to operate the overdrive solenoid on the valve body. The solenoid contains a check ball that opens and closes a vent port in the 3-4 shift valve feed passage. The overdrive solenoid (and check ball) are not energized in first, second, third, or reverse gear. The vent port remains open, diverting line pressure from the 2-3 shift valve away from the 3-4 shift valve. The overdrive control switch must be in the ON position to transmit overdrive status to the PCM. A 3-4 upshift occurs only when the overdrive solenoid is energized by the PCM. The PCM energizes the overdrive solenoid during the 3-4 upshift. This causes the solenoid check ball to close the vent port allowing line pressure from the 2-3 shift valve to act directly on the 3-4 upshift valve. Line pressure on the 3-4 shift valve overcomes valve spring pressure moving the valve to the upshift position. This action exposes the feed passages to the 3-4 timing valve, 3-4 quick fill valve, 3-4 accumulator, and ultimately to the overdrive piston. Line pressure through the timing valve moves the overdrive piston into contact with the overdrive clutch. The direct clutch is disengaged before the overdrive clutch is engaged. The boost valve provides increased fluid apply pressure to the overdrive clutch during 3-4 upshifts, and when accelerating in fourth gear. The 3-4 accumulator cushions overdrive clutch engagement to smooth 3-4 upshifts. The accumulator is charged at the same time as apply pressure acts against the overdrive piston.

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 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.

Operate the transmission in all gear ranges. Check for shift variations and engine flare which indicates slippage. Note if shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Slippage indicated by engine flare, usually means clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul will be necessary to restore normal operation.

A slipping clutch or band can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch and Band Application chart provides a basis for analyzing road test results.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CLUTCH AND BAND APPLICATION CHART

SHIFT LEVER POSITION	TRANSMISSION CLUTCHES AND BANDS					OVERDRIVE CLUTCHES		
	FRONT CLUTCH	FRONT BAND	REAR CLUTCH	REAR BAND	OVERRUNNING CLUTCH	OVERDRIVE CLUTCH	DIRECT CLUTCH	OVERRUNNING CLUTCH
Reverse	X			X			X	
Drive - First			X		X		X	X
Drive - Second		X	X				X	X
Drive - Third	X		X				X	X
Drive - Fourth	X		X			X		
Manual Second		X	X		X		X	X
Manual First			X	X	X		X	X

Note that the rear clutch is applied in all forward ranges (D, 2, 1). The transmission overrunning clutch is applied in first gear (D, 2 and 1 ranges) only. The rear band is applied in 1 and R range only.

Note that the overdrive clutch is applied only in fourth gear and the overdrive direct clutch and overrunning clutch are applied in all ranges except fourth gear.

For example: If slippage occurs in first gear in D and 2 range but not in 1 range, the transmission overrunning clutch is faulty. Similarly, if slippage occurs in any two forward gears, the rear clutch is slipping.

Applying the same method of analysis, note that the front and rear clutches are applied simultaneously only in D range third and fourth gear. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping.

If the transmission slips in fourth gear but not in third gear, the overdrive clutch is slipping. By selecting another gear which does not use these clutches, the slipping unit can be determined. For example, if the transmission also slips in Reverse, the front clutch is slipping. If the transmission does not slip in Reverse, the rear clutch is slipping.

If slippage occurs during the 3-4 shift or only in fourth gear, the overdrive clutch is slipping. Similarly, if the direct clutch were to fail, the transmission would lose both reverse gear and overrun braking in 2 position (manual second gear).

If the transmission will not shift to fourth gear, the control switch, overdrive solenoid or related wiring may also be the problem cause.

This process of elimination can be used to identify a slipping unit and check operation. Proper use of the Clutch and Band Application Chart is the key.

Although road test analysis will help determine the slipping unit, the actual cause of a malfunction usually cannot be determined until hydraulic and air pressure tests are performed. Practically any condition can be caused by leaking hydraulic circuits or sticking valves.

Unless a malfunction is obvious, such as no drive in D range first gear, do not disassemble the transmission. Perform the hydraulic and air pressure tests to help 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 pressure test gauges are required. Test Gauge C-3292 has a 100 psi range and is used at the accumulator, governor, and front servo ports. Test Gauge C-3293-SP has a 300 psi range and is used at the rear servo and overdrive ports where pressures exceed 100 psi.

Pressure Test Port Locations

Test ports are located at both sides of the transmission case (Fig. 9).

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.

AUTOMATIC TRANSMISSION - 46RE (Continued)

The rear servo and governor pressure ports are at the right rear of the transmission case. The overdrive clutch pressure port is at the left rear of the case.

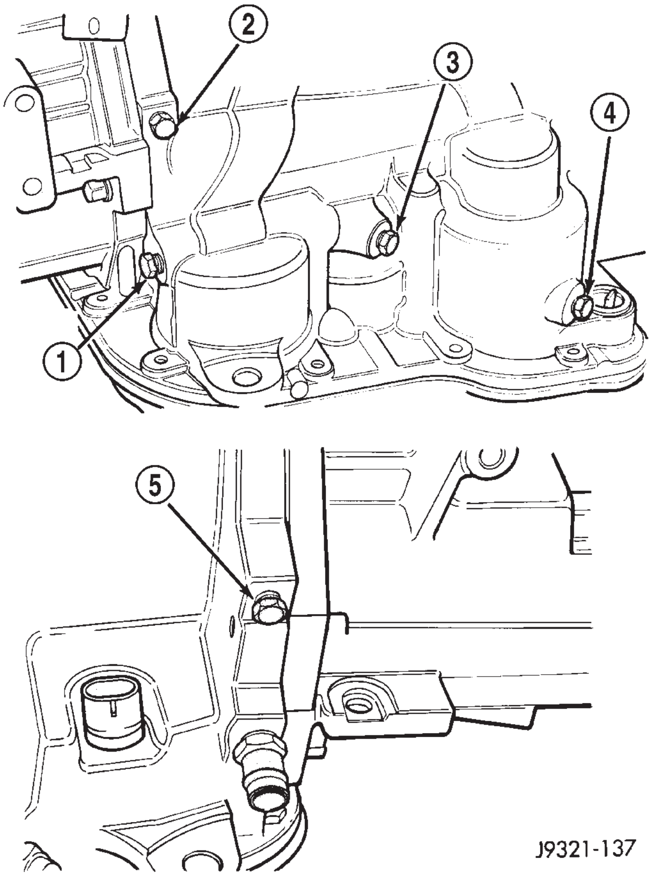


Fig. 9 Pressure Test Port Locations

1 - REAR SERVO TEST PORT
2 - GOVERNOR TEST PORT
3 - ACCUMULATOR TEST PORT
4 - FRONT SERVO TEST PORT
5 - OVERDRIVE CLUTCH TEST PORT

Test One - Transmission In Manual Low

NOTE: This test checks pump output, pressure regulation, and condition of the rear clutch and servo circuit. Both test gauges are required for this test.

(1) Connect tachometer to engine. Position tachometer so it can be observed from driver seat if helper will be operating engine. Raise vehicle on hoist that will allow rear wheels to rotate freely.

(2) Connect 100 psi Gauge C-3292 to accumulator port. Then connect 300 psi Gauge C-3293-SP to rear servo port.

(3) Disconnect throttle and gearshift cables from levers on transmission valve body manual shaft.

(4) Have helper start and run engine at 1000 rpm.

(5) Move transmission shift lever fully forward into 1 range.

(6) Gradually move transmission throttle lever from full forward to full rearward position and note pressures on both gauges:

- 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 throttle lever is moved rearward.
- Rear servo pressure should be same as line pressure within 3 psi (20.68 kPa).

Test Two - Transmission In 2 Range

NOTE: This test checks pump output, line pressure and pressure regulation. Use 100 psi Test Gauge C-3292 for this test.

(1) Leave vehicle in place on hoist and leave Test Gauge C-3292 connected to accumulator port.

(2) Have helper start and run engine at 1000 rpm.

(3) Move transmission shift lever one detent rearward from full forward position. This is 2 range.

(4) Move transmission throttle lever from full forward to full rearward position and read pressure on gauge.

(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 Third Gear

NOTE: This test checks pressure regulation and condition of the clutch circuits. Both test gauges are required for this test.

(1) Turn OD switch off.

(2) Leave vehicle on hoist and leave Gauge C-3292 in place at accumulator port.

(3) Move Gauge C-3293-SP over to front servo port for this test.

(4) Have helper start and run engine at 1600 rpm for this test.

(5) Move transmission shift lever two detents rearward from full forward position. This is D range.

(6) Read pressures on both gauges as transmission throttle lever is gradually moved from full forward to full rearward position:

- Line pressure at accumulator in D range third gear, should be 54-60 psi (372-414 kPa) with throttle lever forward and increase as lever is moved rearward.
- Front servo pressure in D range third gear, should be within 3 psi (21 kPa) of line pressure up to kickdown point.

AUTOMATIC TRANSMISSION - 46RE (Continued)

Test Four - Transmission In Reverse

NOTE: 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) Leave vehicle on hoist and leave gauge C-3292 in place at accumulator port.

(2) Move 300 psi Gauge C-3293-SP back to rear servo port.

(3) Have helper start and run engine at 1600 rpm for test.

(4) Move transmission shift lever four detents rearward from full forward position. This is Reverse range.

(5) Move transmission throttle lever fully forward then fully rearward and note reading at Gauge C-3293-SP.

(6) Pressure should be 145 - 175 psi (1000-1207 kPa) with throttle lever forward and increase to 230 - 280 psi (1586-1931 kPa) as lever is gradually moved rearward.

Test Five - Governor Pressure

NOTE: This test checks governor operation by measuring governor pressure response to changes in vehicle speed. It is usually not necessary to check governor operation unless shift speeds are incorrect or if the transmission will not downshift. The test should be performed on the road or on a hoist that will allow the rear wheels to rotate freely.

(1) Move 100 psi Test Gauge C-3292 to governor pressure port.

(2) Move transmission shift lever two detents rearward from full forward position. This is D range.

(3) Have helper start and run engine at curb idle speed. Then firmly apply service brakes so wheels will not rotate.

(4) Note governor pressure:

- Governor pressure should be no more than 20.6 kPa (3 psi) at curb idle speed and wheels not rotating.
- If pressure exceeds 20.6 kPa (3 psi), a fault exists in governor pressure control system.

(5) Release brakes, slowly increase engine speed, and observe speedometer and pressure test gauge (do not exceed 30 mph on speedometer). Governor pressure should increase in proportion to vehicle speed. Or approximately 6.89 kPa (1 psi) for every 1 mph.

(6) Governor pressure rise should be smooth and drop back to no more than 20.6 kPa (3 psi), after engine returns to curb idle and brakes are applied to prevent wheels from rotating.

(7) Compare results of pressure test with analysis chart.

Test Six - Transmission In Overdrive Fourth Gear

NOTE: This test checks line pressure at the overdrive clutch in fourth gear range. Use 300 psi Test Gauge C-3293-SP for this test. The test should be performed on the road or on a chassis dyno.

(1) Remove tachometer; it is not needed for this test.

(2) Move 300 psi Gauge to overdrive clutch pressure test port. Then remove other gauge and reinstall test port plug.

(3) Lower vehicle.

(4) Turn OD switch on.

(5) Secure test gauge so it can be viewed from drivers seat.

(6) Start engine and shift into D range.

(7) Increase vehicle speed gradually until 3-4 shift occurs and note gauge pressure.

(8) Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-827 kPa (90-120 psi) at 1/2 to 3/4 throttle. Note that pressure can increase to around 896 kPa (130 psi) at full throttle.

(9) Return to shop or move vehicle off chassis dyno.

PRESSURE TEST ANALYSIS CHART

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 (seal rings, clutch seals)
Pressure low in D Fourth Gear Range	Overdrive clutch piston seal, or check ball problem
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area
Pressure OK in 2 but low in R and 1	Leakage in rear servo
Front servo pressure in 2	Leakage in servo; broken servo ring or cracked servo piston
Pressure low in all positions	Clogged filter, stuck regulator valve, worn or faulty pump, low oil level
Governor pressure too high at idle speed	Governor pressure solenoid valve system fault. Refer to diagnostic book.

AUTOMATIC TRANSMISSION - 46RE (Continued)

TEST CONDITION	INDICATION
Governor pressure low at all mph figures	Faulty governor pressure solenoid, transmission control module, or governor pressure sensor
Lubrication pressure low at all throttle positions	Clogged fluid cooler or lines, seal rings leaking, worn pump bushings, pump, clutch retainer, or clogged filter.
Line pressure high	Output shaft plugged, sticky regulator valve
Line pressure low	Sticky regulator valve, clogged filter, worn pump

DIAGNOSIS AND TESTING - AIR TESTING TRANSMISSION CLUTCH AND BAND OPERATION

Air-pressure testing can be used to check transmission front/rear clutch and band operation. The test can be conducted with the transmission either in the vehicle or on the work bench, as a final check, after overhaul.

Air-pressure testing requires that the oil pan and valve body be removed from the transmission. The servo and clutch apply passages are shown (Fig. 10).

Front Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Rear Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Front Servo Air Test

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring 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.

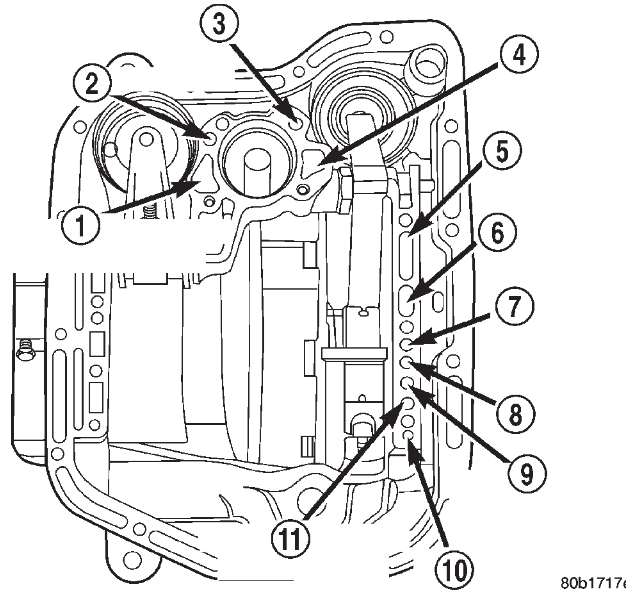


Fig. 10 Air Pressure Test Passages

1 - LINE PRESSURE TO ACCUMULATOR
2 - REAR SERVO APPLY
3 - FRONT SERVO APPLY
4 - FRONT SERVO RELEASE
5 - PUMP SUCTION
6 - PUMP PRESSURE
7 - FRONT CLUTCH APPLY
8 - REAR CLUTCH APPLY
9 - TO TORQUE CONVERTOR
10 - TO COOLER
11 - FROM TORQUE CONVERTER

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. 11). Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 11). Pump 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.

AUTOMATIC TRANSMISSION - 46RE (Continued)

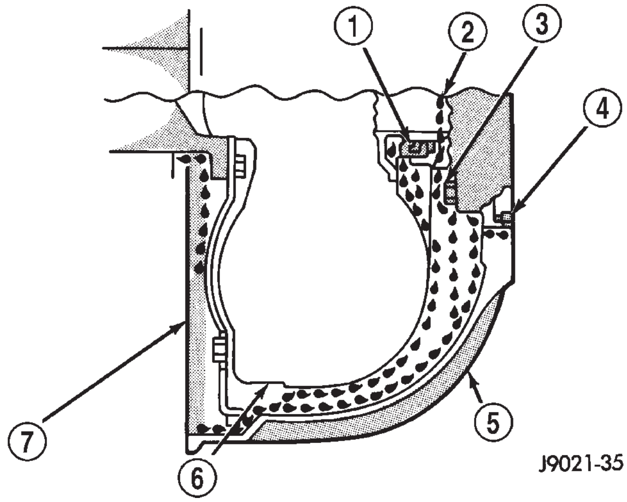


Fig. 11 Converter Housing Leak Paths

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. 12).

(2) Leaks at the converter hub weld (Fig. 12).

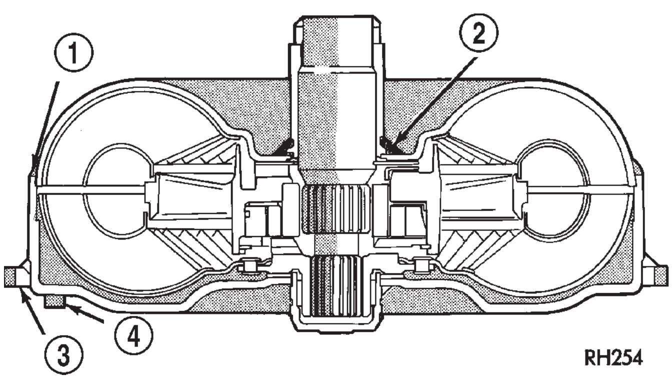


Fig. 12 Converter Leak Points - Typical

1 - OUTSIDE DIAMETER WELD
2 - TORQUE CONVERTER HUB WELD
3 - STARTER RING GEAR
4 - LUG

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

(2) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out when oil pump is removed.

(3) Remove oil pump and remove pump seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter.

(5) Install new pump seal, O-ring, and gasket. Replace oil pump if cracked, porous or damaged in any way. Be sure to loosen the front band before installing the oil pump, damage to the oil pump seal may occur if the band is still tightened to the front clutch retainer.

(6) Loosen kickdown lever pin access plug three turns. Apply Loctite™ 592, or Permatex® No. 2 to plug threads and tighten plug to 17 N·m (150 in. lbs.) torque.

(7) Adjust front band.

(8) Lubricate pump seal and converter hub with transmission fluid or petroleum jelly and install converter.

(9) Install transmission and converter housing dust shield.

(10) Lower vehicle.

DIAGNOSIS AND TESTING - 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 PARK, NEUTRAL, FIRST, SECOND, THIRD, FOURTH, MANUAL FIRST, MANUAL SECOND, and REVERSE gear ranges. Normal working pressures are also supplied for each of the gear ranges.

AUTOMATIC TRANSMISSION - 46RE (Continued)

DIAGNOSIS CHARTS

CONDITION	POSSIBLE CAUSES	CORRECTION
HARSH ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low.	1. Add Fluid
	2. Throttle Linkage Mis-adjusted.	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 Mis-adjusted.	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 Faulty.	11. Replace converter and flush cooler and line before installing new converter.
DELAYED ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low.	1. Correct level and check for leaks.
	2. Filter Clogged.	2. Change filter.
	3. Gearshift Linkage Mis-adjusted.	3. Adjust linkage and repair linkage if worn or damaged.
	4. Torque Converter Drain Back (Oil drains from torque converter into transmission sump).	4. If vehicle moves normally after 5 seconds after shifting into gear, no repair is necessary. If longer, inspect pump bushing for wear. Replace pump house.
	5. Rear Band Mis-adjusted.	5. Adjust band.
	6. Valve Body Filter Plugged.	6. Replace fluid and filter. If oil pan and old fluid were full of clutch disc material and/or metal particles, overhaul will be necessary.
	7. Oil Pump Gears Worn/Damaged.	7. Remove transmission and replace oil pump.
	8. Governor Circuit and Solenoid Valve Electrical Fault.	8. Test with DRB® scan tool and repair as required.
	9. Hydraulic Pressure Incorrect.	9. Perform pressure test, remove transmission and repair as needed.
	10. Reaction Shaft Seal Rings Worn/Broken.	10. Remove transmission, remove oil pump and replace seal rings.
	11. Rear Clutch/Input Shaft, Rear Clutch Seal Rings Damaged.	11. Remove and disassemble transmission and repair as necessary.
	12. Regulator Valve Stuck.	12. Clean.
	13. Cooler Plugged.	13. Transfer case failure can plug cooler.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO DRIVE RANGE (REVERSE OK)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Repair or replace linkage components.
	3. Rear Clutch Burnt.	3. Remove and disassemble transmission and rear clutch and seals. Repair/replace worn or damaged parts as needed.
	4. Valve Body Malfunction.	4. Remove and disassemble valve body. Replace assembly if any valves or bores are damaged.
	5. Transmission Overrunning Clutch Broken.	5. Remove and disassemble transmission. Replace overrunning clutch.
	6. Input Shaft Seal Rings Worn/ Damaged.	6. Remove and disassemble transmission. Replace seal rings and any other worn or damaged parts.
	7. Front Planetary Failed Broken.	7. Remove and repair.
NO DRIVE OR REVERSE (VEHICLE WILL NOT MOVE)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Inspect, adjust and reassemble linkage as needed. Replace worn/damaged parts.
	3. U-Joint/Axle/Transfer Case Broken.	3. Perform preliminary inspection procedure for vehicle that will not move. Refer to procedure in diagnosis section.
	4. Filter Plugged.	4. Remove and disassemble transmission. Repair or replace failed components as needed. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Perform lube flow test. Flush oil. Replace cooler as necessary.
	5. Oil Pump Damaged.	5. Perform pressure test to confirm low pressure. Replace pump body assembly if necessary.
	6. Valve Body Malfunctioned.	6. Check 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.
	8. Park Sprag not Releasing - Check Stall Speed, Worn/Damaged/Stuck.	8. Remove, disassemble, repair.
	9. Torque Converter Damage.	9. Inspect and replace as required.

AUTOMATIC TRANSMISSION - 46RE (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. Fluid Filter Clogged.	2. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Perform lube flow test.
	3. Throttle Linkage Mis-adjusted.	3. Adjust linkage as described in service section.
	4. Throttle Linkage Binding.	4. Check cable for binding. Check for return to closed throttle at transmission.
	5. Gearshift Linkage/Cable Mis-adjusted.	5. Adjust linkage/cable as described in service section.
	6. Clutch or Servo Failure.	6. Remove valve body and air test clutch, and band servo operation. Disassemble and repair transmission as needed.
	7. Governor Circuit Electrical Fault.	7. Test using DRB® scan tool and repair as required.
	8. Front Band Mis-adjusted.	8. Adjust band.
	9. Pump Suction Passage Leak.	9. 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 Mis-adjusted/Damaged.	1. Repair or replace linkage parts as needed.
	2. Park Sprag Sticking.	2. Replace overdrive annulus gear.
	3. Rear Band Mis-adjusted/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. Direct Clutch in Overdrive Worn.	6. Disassemble overdrive. Replace worn or damaged parts.
	7. Front Clutch Burnt.	7. Remove and disassemble transmission. Replace worn, damaged clutch parts as required.
HAS FIRST/REVERSE ONLY (NO 1-2 OR 2-3 UPSHIFT)	1. Governor Circuit Electrical Fault.	1. Test using DRB® scan tool and repair as required.
	2. Valve Body Malfunction.	2. Repair 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.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO LOW GEAR (MOVES IN 2ND OR 3RD GEAR ONLY)	1. Governor Circuit Electrical Fault.	1. Test with DRB® scan tool 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 Mis-adjusted.	1. Adjust linkage.
	2. Accelerator Pedal Travel Restricted.	2. Verify floor mat is not under pedal, repair worn accelerator cable or bent brackets.
	3. Valve Body Hydraulic Pressures Too High or Too Low Due to 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. Governor Circuit Electrical Fault.	4. Test with DRB® scan tool and repair as required.
	5. Valve Body Malfunction.	5. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	6. TPS Malfunction.	6. Replace sensor, check with DRB® scan tool.
	7. PCM Malfunction.	7. Check with DRB® scan tool and replace if required.
	8. Valve Body Malfunction.	8. Repair sticking 1-2, 2-3 shift valves, governor plugs, 3-4 solenoid, 3-4 shift valve, 3-4 timing valve.
STUCK IN LOW GEAR (WILL NOT UPSHIFT)	1. Throttle Linkage Mis-adjusted/ Stuck.	1. Adjust linkage and repair linkage if worn or damaged. Check for binding cable or missing return spring.
	2. Gearshift Linkage Mis-adjusted.	2. Adjust linkage and repair linkage if worn or damaged.
	3. Governor Component Electrical Fault.	3. Check operating pressures and test with DRB® scan tool, repair faulty component.
	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 Mis-adjusted.	1. Adjust linkage.
	2. Rear Clutch Dragging/Warped.	2. Disassemble and repair.
	3. Valve Body Malfunction.	3. Perform hydraulic pressure test to determine cause and repair as required.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
BUZZING NOISE	1. Fluid Level Low	1. Add fluid and check for leaks.
	2. Shift Cable Mis-assembled.	2. Route cable away from engine and bell housing.
	3. Valve Body Mis-assembled.	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 Mis-adjusted.	2. Adjust linkage.
	3. Rear Band Mis-adjusted.	3. Adjust band.
	4. Rear Band Worn.	4. Replace as required.
	5. Overdrive Direct Clutch Worn.	5. Disassemble overdrive. Repair as needed.
	6. Hydraulic Pressure Too Low.	6. Perform hydraulic pressure tests to determine cause.
	7. Rear Servo Leaking.	7. Air pressure check clutch-servo operation and repair as required.
	8. Band Linkage Binding.	8. 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 Mis-adjusted.	3. Adjust linkage.
	4. Gearshift Linkage Mis-adjusted.	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, 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.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SLIPS IN LOW GEAR ″D″ ONLY, BUT NOT IN MANUAL 1 POSITION	Overrunning Clutch Faulty.	Replace overrunning clutch.
GROWLING, GRATING OR SCRAPING NOISES	1. Drive Plate Broken.	1. Replace.
	2. Torque Converter Bolts Hitting Dust Shield.	2. Dust shield bent. Replace or repair.
	3. Planetary Gear Set Broken/ Seized.	3. Check for debris in oil pan and repair as required.
	4. Overrunning Clutch Worn/Broken.	4. Inspect and check for debris in oil pan. Repair as required.
	5. Oil Pump Components Scored/ Binding.	5. Remove, inspect and repair as required.
	6. Output Shaft Bearing or Bushing Damaged.	6. Remove, inspect and repair as required.
	7. Clutch Operation Faulty.	7. Perform air pressure check and repair as required.
	8. Front and Rear Bands Mis-adjusted.	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 Mis-adjusted.	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.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO 4-3 DOWNSHIFT	1. Circuit Wiring and/or Connectors Shorted.	1. Test wiring and connectors with test lamp and volt/ohmmeter. Repair wiring as necessary. Replace connectors and/or harnesses as required.
	2. PCM Malfunction.	2. Check PCM operation with DRB® scan tool. Replace PCM only if faulty.
	3. TPS Malfunction	3. Check TPS with DRB® scan tool at PCM.
	4. Lockup Solenoid Not Venting.	4. Remove valve body and replace solenoid assembly if plugged or shorted.
	5. Overdrive Solenoid Not Venting.	5. Remove valve body and replace solenoid if plugged or shorted.
	6. Valve Body Valve Sticking.	6. Repair stuck 3-4 shift valve or lockup timing valve.
NO 4-3 DOWNSHIFT WHEN CONTROL SWITCH IS TURNED OFF	1. Control Switch Open/Shorted.	1. Test and replace switch if faulty.
	2. Overdrive Solenoid Connector Shorted.	2. Test solenoids and replace if seized or shorted.
	3. PCM Malfunction.	3. Test with DRB® scan tool. Replace PCM if faulty.
	4. Valve Body Stuck Valves.	4. Repair stuck 3-4, lockup or lockup timing valve.
CLUNK NOISE FROM DRIVELINE ON CLOSED THROTTLE 4-3 DOWNSHIFT	1. Transmission Fluid Low.	1. Add Fluid.
	2. Throttle Cable Mis-adjusted.	2. Adjust cable.
	3. Overdrive Clutch Select Spacer Wrong Spacer.	3. Replace overdrive piston thrust plate spacer.
3-4 UPSHIFT OCCURS IMMEDIATELY AFTER 2-3 SHIFT	1. Overdrive Solenoid Connector or Wiring Shorted.	1. Test connector and wiring for loose connections, shorts or ground and repair as needed.
	2. TPS Malfunction.	2. Test TPS and replace as necessary. Check with DRB® scan tool.
	3. PCM Malfunction.	3. Test PCM with DRB® scan tool and replace controller if faulty.
	4. Overdrive Solenoid Malfunction.	4. Replace solenoid.
	5. Valve Body Malfunction.	5. Remove, disassemble, clean and inspect valve body components. Make sure all valves and plugs slide freely in bores. Polish valves with crocus cloth if needed.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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.
NO 3-4 UPSHIFT	1. O/D Switch In OFF Position.	1. Turn control switch to ON position.
	2. Overdrive Circuit Fuse Blown.	2. Replace fuse. Determine why fuse failed and repair as necessary (i.e., shorts or grounds in circuit).
	3. O/D Switch Wire Shorted/Open Cut.	3. Check wires/connections with 12V test lamp and voltmeter. Repair damaged or loose wire/connection as necessary.
	4. Distance or Coolant Sensor Malfunction.	4. Check with DRB® scan tool and repair or replace as necessary.
	5. TPS Malfunction.	5. Check with DRB® scan tool and replace if necessary.
	6. Neutral Sense to PCM Wire Shorted/Cut.	6. Test switch/sensor as described in service section and replace if necessary. Engine no start.
	7. PCM Malfunction.	7. Check with DRB® scan tool and replace if necessary.
	8. Overdrive Solenoid Shorted/Open.	8. Replace solenoid if shorted or open and repair loose or damaged wires (DRB® scan tool).
	9. Solenoid Feed Orifice in Valve Body Blocked.	9. Remove, disassemble, and clean valve body thoroughly. Check feed orifice.
	10. Overdrive Clutch Failed.	10. Disassemble overdrive and repair as needed.
	11. Hydraulic Pressure Low.	11. Pressure test transmission to determine cause.
	12. Valve Body Valve Stuck.	12. Repair stuck 3-4 shift valve, 3-4 timing valve.
	13. O/D Piston Incorrect Spacer.	13. Remove unit, check end play and install correct spacer.
	14. Overdrive Piston Seal Failure.	14. Replace both seals.
	15. O/D Check Valve/Orifice Failed.	15. Check for free movement and secure assembly (in piston retainer). Check ball bleed orifice.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SLIPS IN OVERDRIVE FOURTH GEAR	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Overdrive Clutch Pack Worn.	2. Remove overdrive unit and rebuild clutch pack.
	3. Overdrive Piston Retainer Bleed Orifice Blown Out.	3. Disassemble transmission, remove retainer and replace orifice.
	4. Overdrive Piston or Seal Malfunction.	4. Remove overdrive unit. Replace seals if worn. Replace piston if damaged. If piston retainer is damaged, remove and disassemble the transmission.
	5. 3-4 Shift Valve, Timing Valve or Accumulator Malfunction.	5. Remove and overhaul valve body. Replace accumulator seals. Make sure all valves operate freely in bores and do not bind or stick. Make sure valve body screws are correctly tightened and separator plates are properly positioned.
	6. Overdrive Unit Thrust Bearing Failure.	6. Disassemble overdrive unit and replace thrust bearing (NO. 1 thrust bearing is between overdrive piston and clutch hub; NO. 2 thrust bearing is between the planetary gear and the direct clutch spring plate; NO. 3 thrust bearing is between overrunning clutch hub and output shaft).
	7. O/D Check Valve/Bleed Orifice Failure.	7. Check for function/secure orifice insert in O/D piston retainer.
DELAYED 3-4 UPSHIFT (SLOW TO ENGAGE)	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Throttle Valve Cable Mis-adjusted.	2. Adjust throttle valve cable.
	3. Overdrive Clutch Pack Worn/ Burnt.	3. Remove unit and rebuild clutch pack.
	4. TPS Faulty.	4. Test with DRB® scan tool and replace as necessary
	5. Overdrive Clutch Bleed Orifice Plugged.	5. Disassemble transmission and replace orifice.
	6. Overdrive Solenoid or Wiring Shorted/Open.	6. Test solenoid and check wiring for loose/corroded connections or shorts/ grounds. Replace solenoid if faulty and repair wiring if necessary.
	7. Overdrive Excess Clearance.	7. Remove unit. Measure end play and select proper spacer.
	8. O/D Check Valve Missing or Stuck.	8. Check for presence of check valve. Repair or replace as required.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TORQUE CONVERTER LOCKS UP IN SECOND AND/OR THIRD GEAR	Lockup Solenoid, Relay or Wiring Shorted/Open.	Test solenoid, relay and wiring for continuity, shorts or grounds. Replace solenoid and relay if faulty. Repair wiring and connectors as necessary.
HARSH 1-2, 2-3, 3-4 OR 3-2 SHIFTS	Lockup Solenoid Malfunction.	Remove valve body and replace solenoid assembly.
NO START IN PARK OR NEUTRAL	1. Gearshift Linkage/Cable Mis-adjusted.	1. Adjust linkage/cable.
	2. Neutral Sense Wire Open/Cut.	2. Check continuity with test lamp. Repair as required.
	3. Park/Neutral Switch, or Transmission Range Sensor Faulty.	3. Refer to service section for test and replacement procedure.
	4. Park/Neutral Switch, or Transmission Range Sensor Connection 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 Mis-adjusted.	2. Adjust band.
	3. Front Clutch Malfunctioned/ Burned.	3. Air-pressure test clutch operation. Remove and rebuild if necessary.
	4. Overdrive Thrust Bearing Failure.	4. Disassemble geartrain and replace bearings.
	5. Direct Clutch Spring Collapsed/ Broken.	5. Remove and disassemble unit. Check clutch position and replace spring.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS.	1. Fluid Lines and Fittings Loose/ Leaks/Damaged.	1. Tighten fittings. If leaks persist, replace fittings and lines if necessary.
	2. Fill Tube (where tube enters case) Leaks/Damaged.	2. Replace tube seal. Inspect tube for cracks in fill tube.
	3. Pressure Port Plug Loose Loose/Damaged.	3. Tighten to correct torque. Replace plug or reseal if leak persists.
	4. Pan Gasket Leaks.	4. Tighten pan screws (150 in. lbs.). If leaks persist, replace gasket.
	5. Valve Body Manual Lever Shaft Seal Leaks/Worn.	5. Replace shaft seal.
	6. Rear Bearing Access Plate Leaks.	6. Replace gasket. Tighten screws.
	7. Gasket Damaged or Bolts are Loose.	7. Replace bolts or gasket or tighten both.
	8. Adapter/Extension Gasket Damaged Leaks/Damaged.	8. Replace gasket.
	9. Park/Neutral Switch, or Transmission Range Sensor Leaks/Damaged.	9. Replace switch and gasket.
	10. Converter Housing Area Leaks.	10. 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.
	11. Pump Seal Leaks/Worn/ Damaged.	11. Replace seal.
	12. Torque Converter Weld Leak/Cracked Hub.	12. Replace converter.
	13. Case Porosity Leaks.	13. Replace case.
NOISY OPERATION IN FOURTH GEAR ONLY	1. Overdrive Clutch Discs, Plates or Snap Rings Damaged.	1. Remove unit and rebuild clutch pack.
	2. Overdrive Piston or Planetary Thrust Bearing Damaged.	2. Remove and disassemble unit. Replace either thrust bearing if damaged.
	3. Output Shaft Bearings Scored/ Damaged.	3. Remove and disassemble unit. Replace either bearing if damaged.
	4. Planetary Gears Worn/Chipped.	4. Remove and overhaul overdrive unit.
	5. Overdrive Unit Overrunning Clutch Rollers Worn/Scored.	5. Remove and overhaul overdrive unit.

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

The overdrive unit can be removed and serviced separately. It is not necessary to remove the entire transmission assembly to perform overdrive unit repairs.

CAUTION: The transmission and torque converter must be removed as an assembly to avoid component damage. The converter driveplate, pump bushing, or oil seal can be damaged if the converter is left attached to the driveplate during removal. Be sure to remove the transmission and converter as an assembly.

(1) Disconnect battery negative cable.

(2) Hoist and support vehicle.

(3) Remove skid plate, if equipped.

(4) Remove skid plate support crossmember, if equipped.

(5) Disconnect and lower or remove necessary exhaust components.

(6) Mark propeller shaft and axle companion flanges for assembly alignment. Then disconnect and remove propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(7) Remove starter motor. (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL)

(8) Support engine with suitable support stand and wood block.

(9) Remove bolts attaching engine-to-transmission brackets to transmission.

(10) Remove bolt and nut attaching each engine-to-transmission bracket to the motor mounts.

(11) Remove bolts holding the engine-to-transmission brackets to the front axle, if equipped.

(12) Loosen bolts attaching engine-to-transmission brackets to each side of the engine block.

(13) Raise engine slightly.

(14) Remove torque converter access cover.

(15) Tighten bolts attaching engine-to-transmission brackets to each side of the engine block.

(16) Lower engine.

(17) Disconnect fluid cooler lines at transmission.

(18) If transmission is being removed for overhaul, remove transmission oil pan, drain fluid and reinstall pan.

(19) Remove fill tube bracket bolts and pull tube out of transmission. Retain fill tube seal. On 4x4 models, it will also be necessary to remove bolt attaching transfer case vent tube to converter housing (Fig. 13).

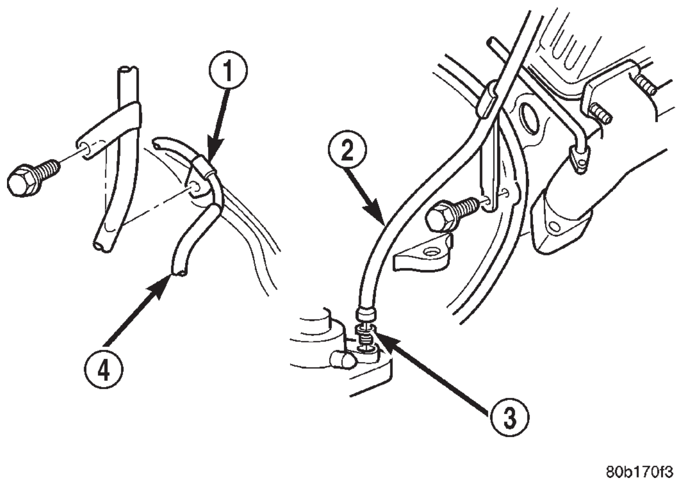


Fig. 13 Fill Tube Attachment

1 - TRANSFER CASE VENT TUBE
2 - FILL TUBE (V8)
3 - TUBE SEAL
4 - FILL TUBE (V6)

(20) 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.

(21) Disconnect wires from the transmission range sensor and transmission solenoids connector.

(22) Disconnect throttle valve cable from transmission bracket and throttle valve lever.

(23) On 4x4 models, disconnect shift rod from transfer case shift lever. Or remove shift lever from transfer case and tie rod and lever to chassis component with wire.

(24) Raise transmission slightly with service jack to relieve load on crossmember and supports.

(25) Remove bolts securing rear support and cushion to transmission and crossmember. Raise transmission slightly, slide exhaust hanger arm from bracket (Fig. 14) and remove rear support.

(26) Remove bolts attaching crossmember to frame and remove crossmember.

(27) On 4x4 models, disconnect vent hose from transfer case. Then remove transfer case.

(28) Remove all converter housing bolts.

AUTOMATIC TRANSMISSION - 46RE (Continued)

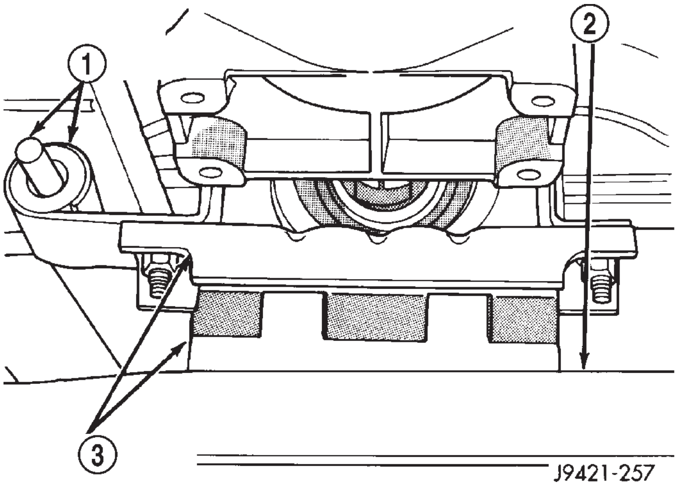


Fig. 14 Rear Support and Cushion

1 - EXHAUST PIPE ARM AND BRACKET
2 - CROSSMEMBER
3 - REAR SUPPORT AND CUSHION

(29) Carefully work transmission and torque converter assembly rearward off engine block dowels.

(30) Lower transmission and remove assembly from under the vehicle.

DISASSEMBLY

(1) Clean exterior of transmission with suitable solvent or pressure washer.

(2) Place transmission in vertical position.

(3) Measure the input shaft end play as follows (Fig. 15).

(a) Attach Adapter 8266-5 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 8266-5 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. Record the maximum travel for assembly reference

(4) Remove throttle and shift levers from valve body manual shaft and throttle lever shaft.

(5) Remove transmission oil pan and gasket.

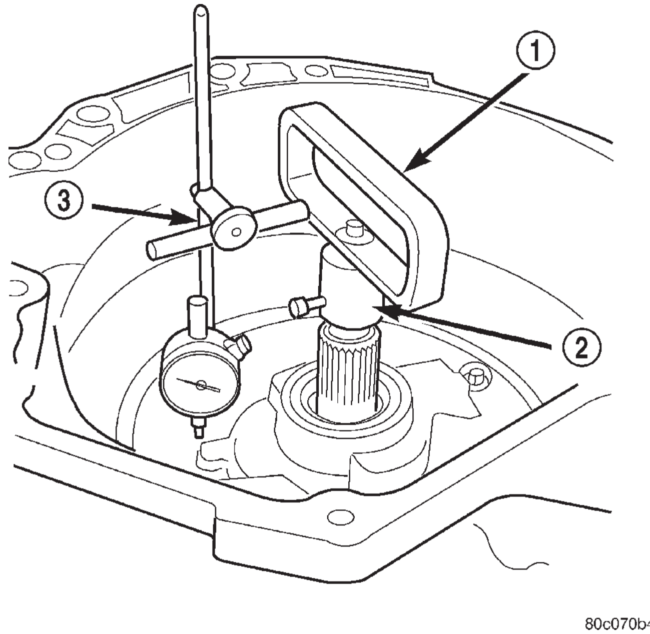


Fig. 15 Checking Input Shaft End Play

1 - TOOL 8266-8
2 - TOOL 8266-5
3 - TOOL C-3339

(6) Remove filter from valve body (Fig. 16). Keep filter screws separate from other valve body screws. Filter screws are longer and should be kept with filter.

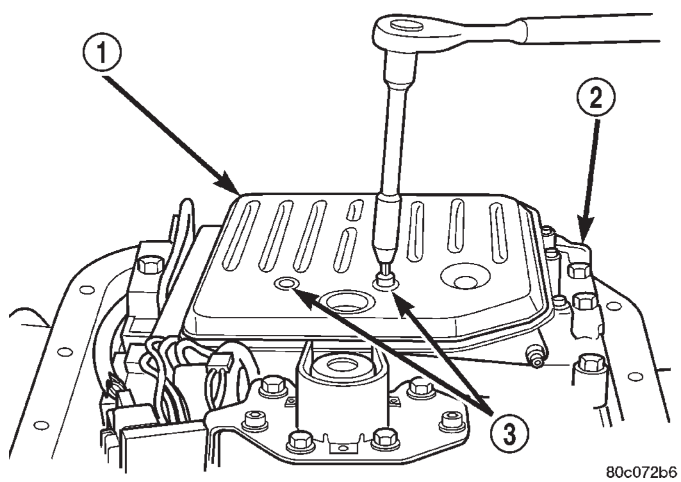


Fig. 16 Oil Filter Removal

1 - OIL FILTER
2 - VALVE BODY
3 - FILTER SCREWS (2)

AUTOMATIC TRANSMISSION - 46RE (Continued)

(7) Remove the transmission range sensor.

(8) Remove hex head bolts attaching valve body to transmission case (Fig. 17). A total of 10 bolts are used. Note different bolt lengths for assembly reference.

(9) Remove valve body assembly. Push valve body harness connector out of case. Then work park rod and valve body out of case (Fig. 18).

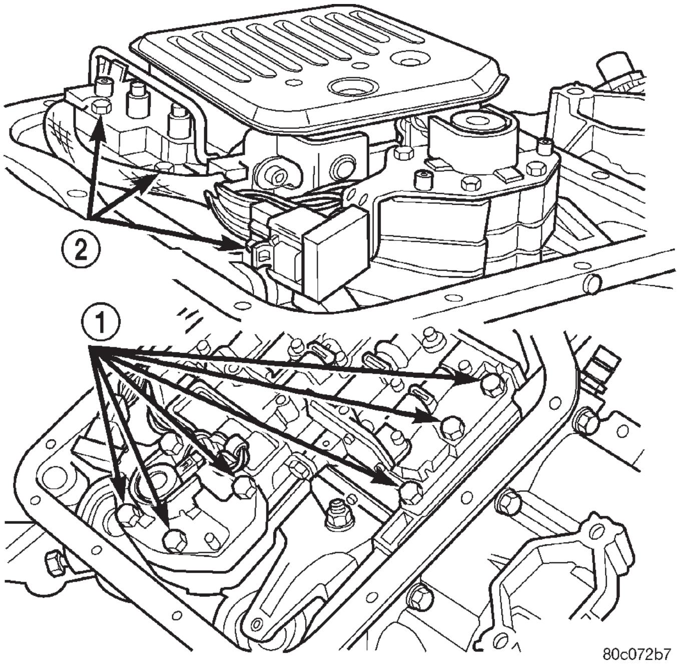


Fig. 17 Valve Body Bolt Locations

1 - VALVE BODY BOLTS
2 - VALVE BODY BOLTS

(10) Remove accumulator outer spring, piston and inner spring (Fig. 19). Note position of piston and springs for assembly reference. Remove and discard piston seals if worn or cut.

(11) Remove pump oil seal with suitable pry tool or slide-hammer mounted screw.

(12) Remove front band lever pin access plug (Fig. 20). Use square end of 1/4 in. drive extension to remove plug as shown.

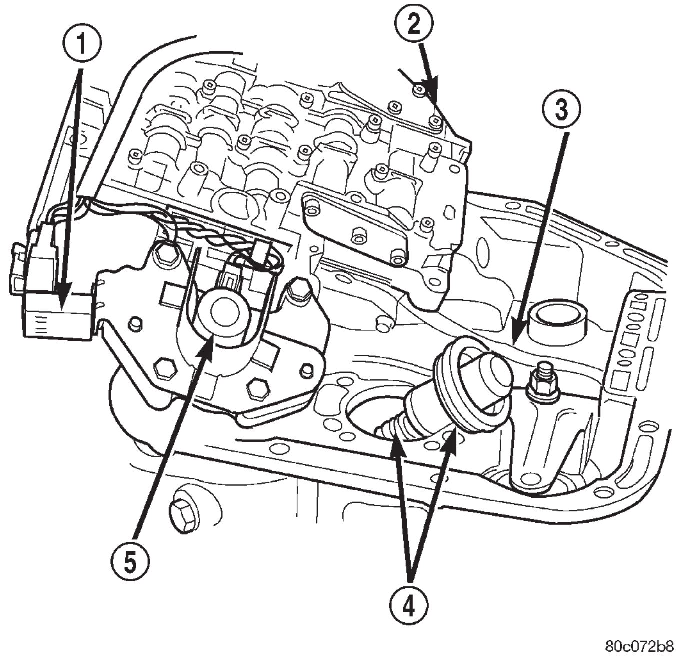


Fig. 18 Valve Body Removal

1 - GOVERNOR PRESSURE SENSOR
2 - VALVE BODY
3 - PARK ROD
4 - ACCUMULATOR PISTON
5 - GOVERNOR PRESSURE SOLENOID

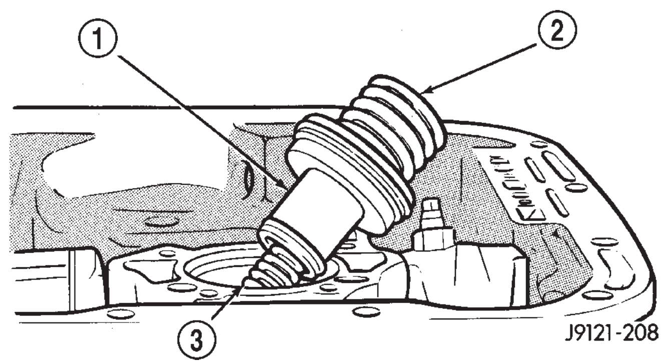


Fig. 19 Accumulator Component Removal

1 - ACCUMULATOR PISTON
2 - OUTER SPRING
3 - INNER SPRING

AUTOMATIC TRANSMISSION - 46RE (Continued)

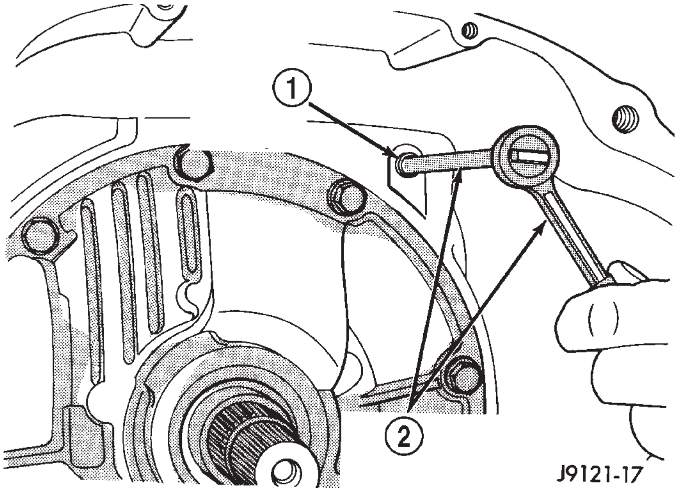


Fig. 20 Front Band Lever Pin Access Plug

1 - FRONT BAND REACTION PIN ACCESS PLUG
2 - 1/4 DRIVE EXTENSION AND RATCHET

(13) Remove oil pump and reaction shaft support assembly as follows:

(a) Tighten front band adjusting screw until band is tight around front clutch retainer (Fig. 21). This will prevent retainer from coming out with pump and possibly damaging clutch or pump components.

(b) Remove oil pump bolts.

(c) Thread Slide Hammer Tools C-3752 into threaded holes in flange of oil pump housing (Fig. 22).

(d) Remove oil pump and reaction shaft support by bumping slide hammers outward alternately to pull pump from case (Fig. 23).

(14) Remove oil pump gasket (Fig. 24). Note gasket position in case for assembly reference.

(15) Loosen front band adjusting screw until band is completely loose.

(16) Remove front band strut and anchor (Fig. 25).

(17) Squeeze front band together slightly and slide band over front clutch retainer and out of case (Fig. 26).

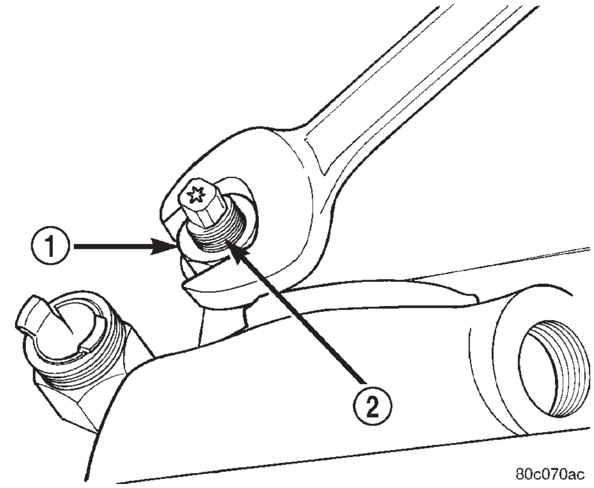


Fig. 21 Tightening Front Band To Hold Front Clutch In Place

1 - LOCK-NUT
2 - FRONT BAND ADJUSTER

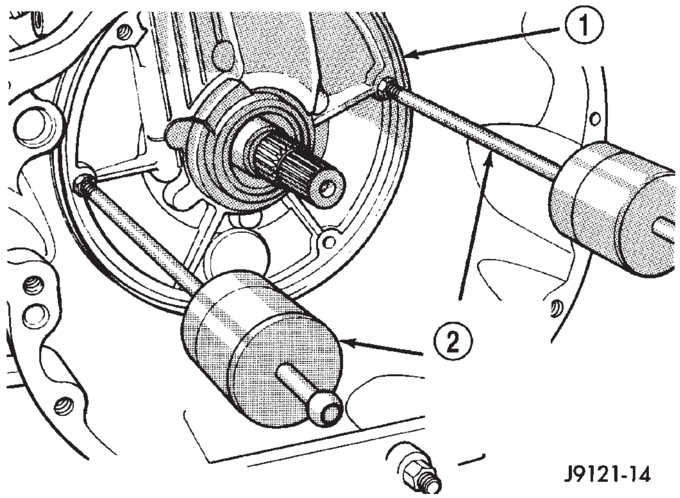


Fig. 22 Oil Pump Removal Tools

1 - PUMP HOUSING
2 - SLIDE HAMMER TOOLS (THREAD INTO PUMP HOUSING)

AUTOMATIC TRANSMISSION - 46RE (Continued)

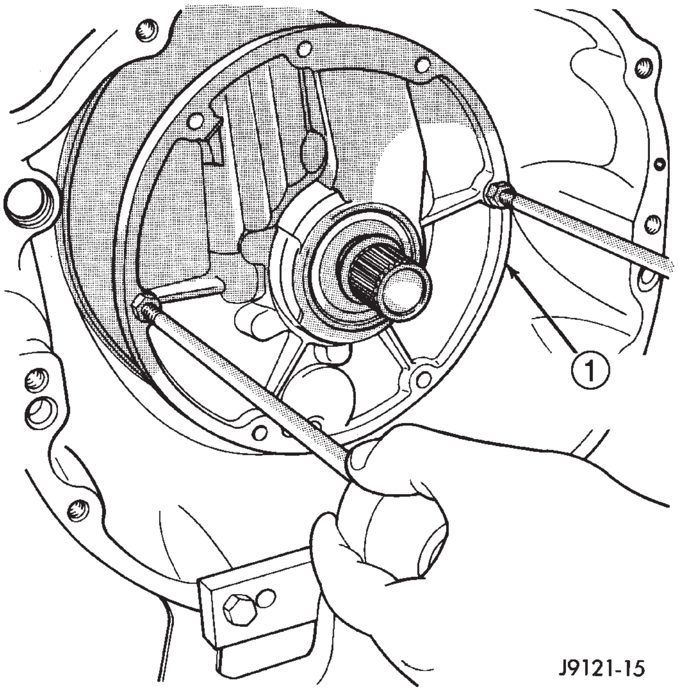


Fig. 23 Oil Pump Removal

1 - OIL PUMP AND REACTION SHAFT SUPPORT

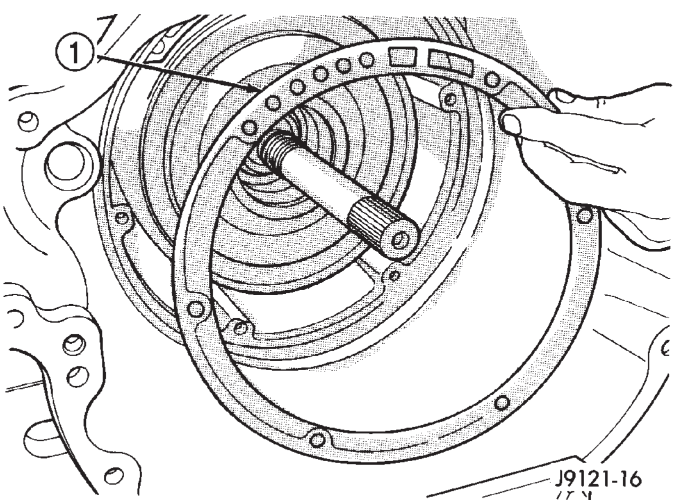


Fig. 24 Oil Pump Gasket

1 - OIL PUMP GASKET

(18) Remove front and rear clutch assemblies as a unit (Fig. 27).

(19) Remove front band reaction pin and lever. Start pin through lever and out of case bore with drift or punch. Then use pencil magnet to withdraw pin completely (Fig. 28).

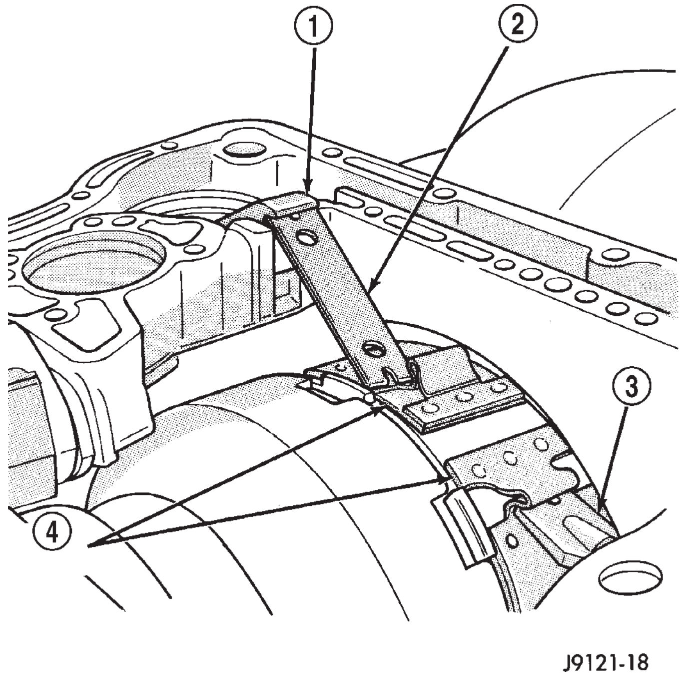


Fig. 25 Front Band Linkage

1 - LEVER
2 - STRUT
3 - ANCHOR
4 - FRONT BAND

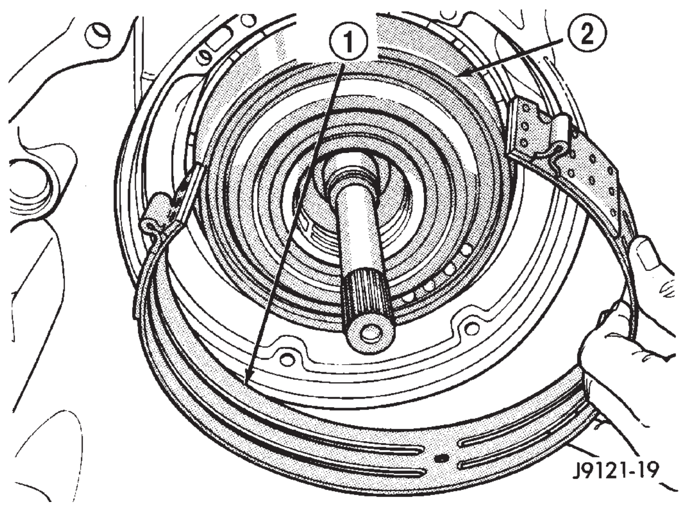


Fig. 26 Front Band Removal

1 - FRONT BAND
2 - FRONT CLUTCH RETAINER

(20) Remove intermediate shaft thrust washer. Triangular shaped washer will either be on shaft pilot hub or in rear clutch retainer (Fig. 29).

AUTOMATIC TRANSMISSION - 46RE (Continued)

(21) Remove thrust plate from intermediate shaft hub (Fig. 30).

(22) Remove intermediate shaft-planetary geartrain assembly (Fig. 31).

(23) If overdrive unit is not to be serviced, install Alignment Shaft 6227-2 into the overdrive unit to prevent misalignment of the overdrive clutches during service of main transmission components.

(24) Loosen rear band locknut and loosen adjusting screw 3-4 turns.

(25) Remove snap-ring that retains low-reverse drum on overdrive piston retainer hub (Fig. 32).

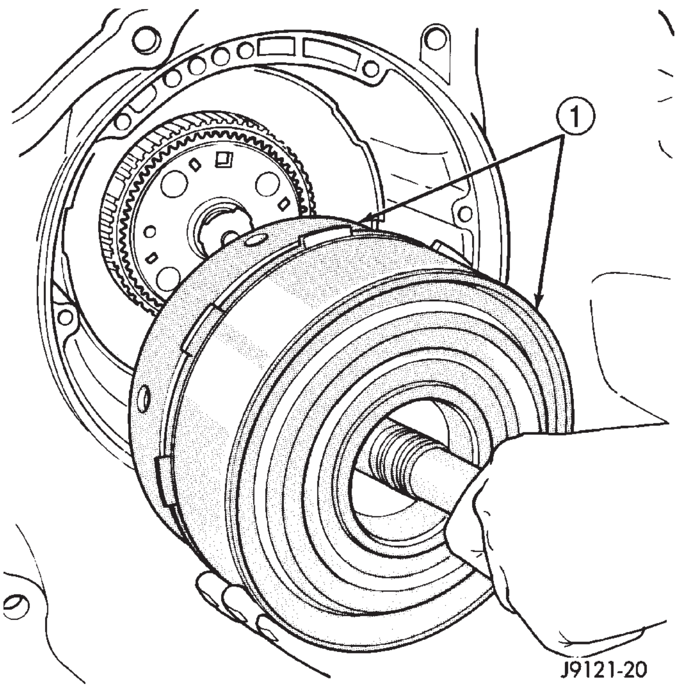


Fig. 27 Removing Front/Rear Clutch Assemblies

1 - FRONT AND REAR CLUTCH ASSEMBLIES

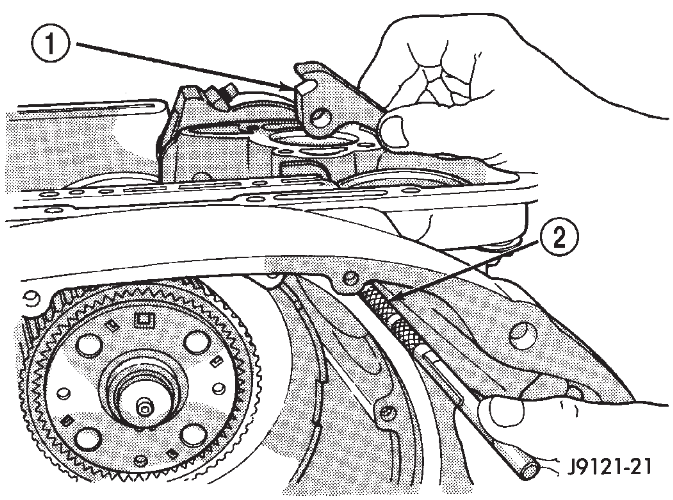


Fig. 28 Front Band Lever And Pin

1 - BAND LEVER
2 - USE PENCIL MAGNET TO REMOVE REACTION PIN

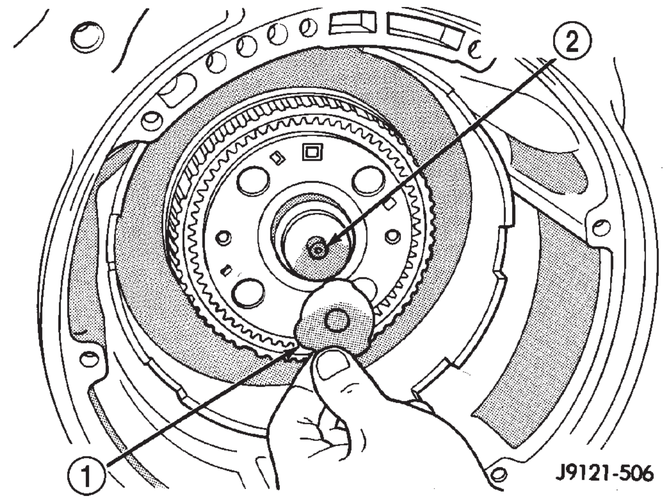


Fig. 29 Intermediate Shaft Thrust Washer

1 - THRUST WASHER
2 - INTERMEDIATE SHAFT PILOT HUB

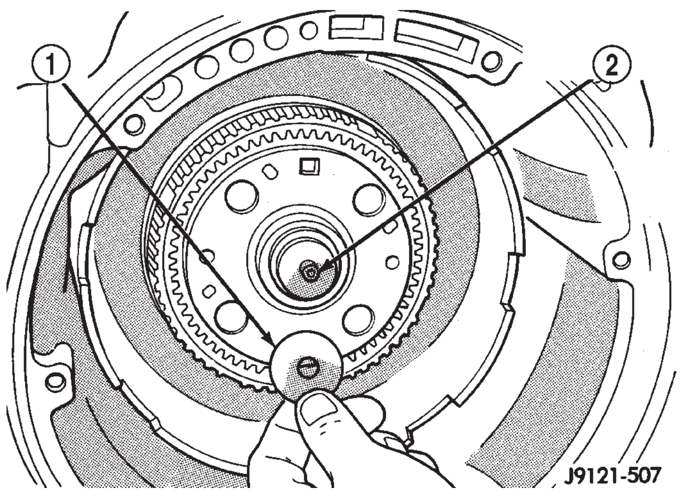


Fig. 30 Intermediate Shaft Thrust Plate

1 - SHAFT THRUST PLATE
2 - INTERMEDIATE SHAFT PILOT HUB

(26) Slide low-reverse drum and thrust washer off piston retainer hub and out of rear band (Fig. 33).

(27) Note that overrunning clutch race will remain on splines of low-reverse drum after removal (Fig. 34). **The race is a permanent press fit on the hub splines. Do not attempt to remove the race.**

AUTOMATIC TRANSMISSION - 46RE (Continued)

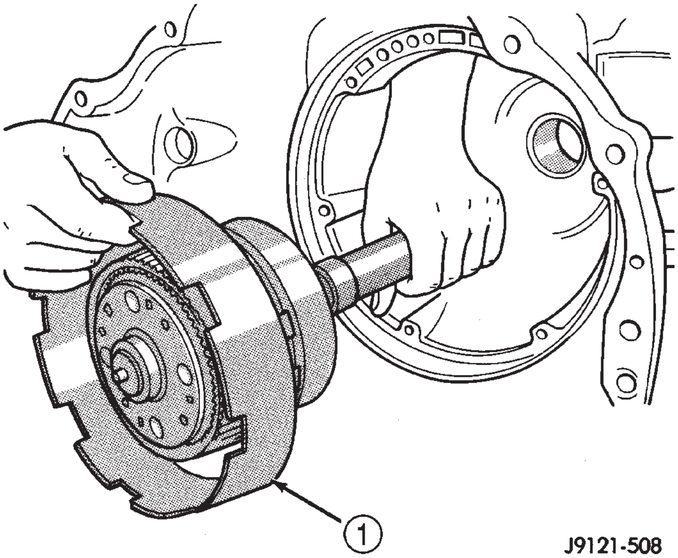


Fig. 31 Intermediate Shaft And Planetary Geartrain

1 - INTERMEDIATE SHAFT AND PLANETARY GEARTRAIN ASSEMBLY

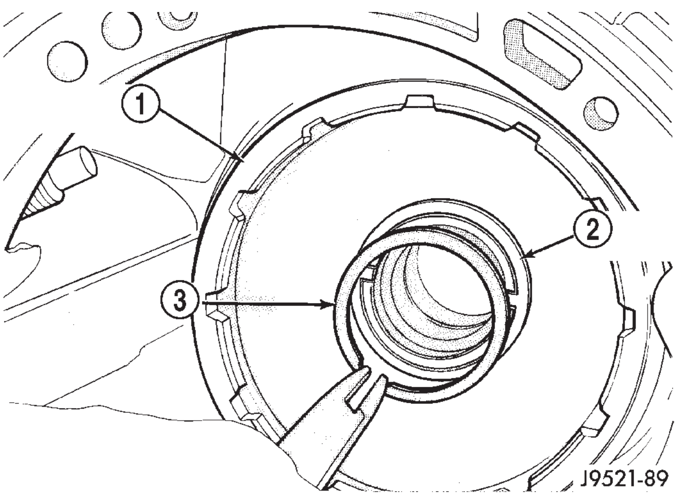


Fig. 32 Low-Reverse Drum Snap-Ring

1 - LOW-REVERSE DRUM
2 - TABBED WASHER
3 - SNAP-RING

(28) Remove overrunning clutch assembly (Fig. 35). Assembly can be removed without displacing rollers and springs if care is exercised. Note position of rollers and springs for assembly reference.

(29) Remove rear band adjusting lever, reaction lever and pin (Fig. 36).

(30) Remove strut from rear band. Keep strut with levers and pin for cleaning, inspection and assembly reference.

(31) Remove rear band and link (Fig. 37).

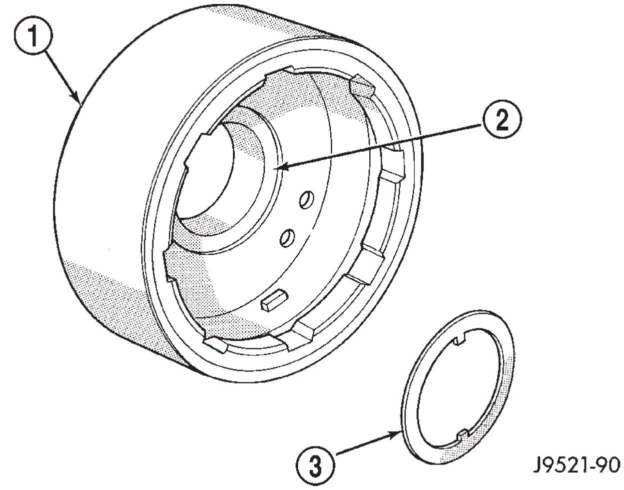


Fig. 33 Low-Reverse Drum And Thrust Washer

1 - LOW-REVERSE DRUM
2 - SPOTFACE FOR WASHER
3 - THRUST WASHER

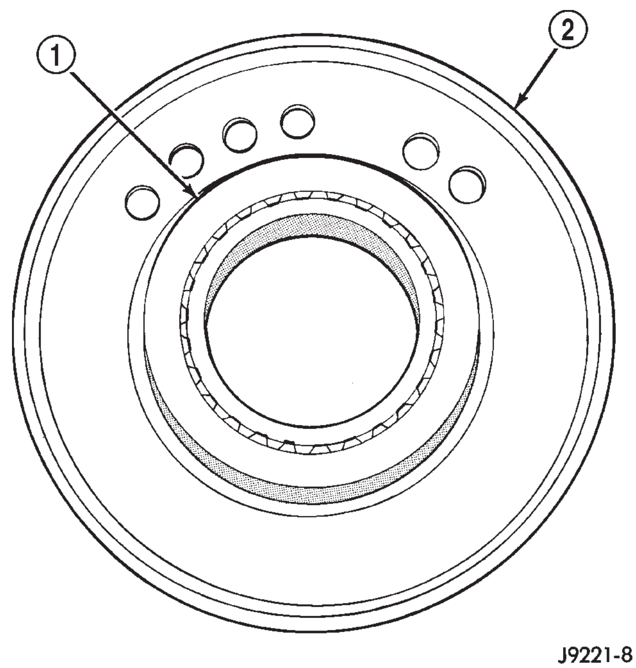


Fig. 34 Overrunning Clutch Race Position On Low-Reverse Drum

1 - OVERRUNNING CLUTCH RACE
2 - LOW-REVERSE DRUM

(32) Compress front servo rod guide with large C-clamp and Tool C-4470, or Compressor Tool C-3422-B (Fig. 38). Compress guide only enough to permit snap-ring removal (about 1/8 in.).

AUTOMATIC TRANSMISSION - 46RE (Continued)

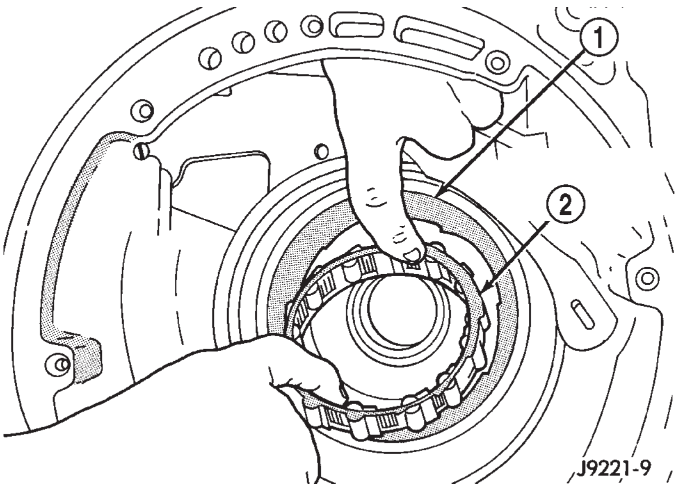


Fig. 35 Overrunning Clutch Removal

1 - CLUTCH CAM
2 - OVERRUNNING CLUTCH ASSEMBLY

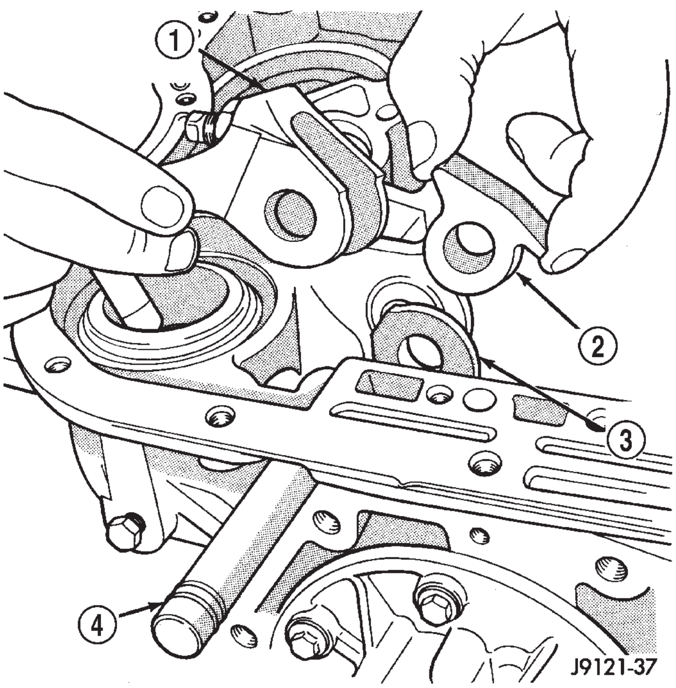


Fig. 36 Rear Band Levers And Pins

1 - REAR BAND ADJUSTING LEVER
2 - REACTION LEVER
3 - BAND LINK
4 - REAR BAND REACTION PIN

(33) Remove servo piston snap-ring (Fig. 38). Unseat one end of ring. Then carefully work removal tool around back of ring until free of ring groove. **Exercise caution when removing snap-ring. Servo bore can be scratched or nicked if care is not exercised.**

(34) Remove tools and remove servo piston and spring.

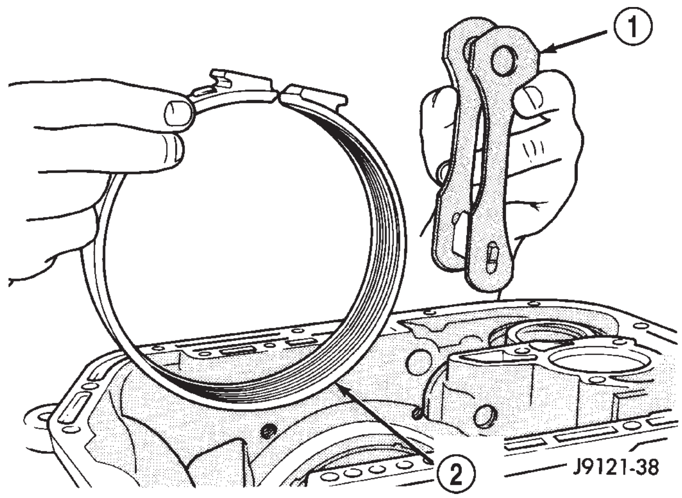


Fig. 37 Rear Band And Link

1 - BAND LINK
2 - REAR BAND

(35) Compress rear servo piston with C-clamp and Tool C-4470, or Valve Spring Compressor C-3422-B (Fig. 39). Compress servo spring retainer only enough to permit snap-ring removal.

(36) Remove servo piston snap-ring (Fig. 39). Start one end of ring out of bore. Then carefully work removal tool around back of snap-ring until free of ring groove. **Exercise caution when removing snap-ring. Servo bore can be scratched or nicked if care is not exercised.**

(37) Remove tools and remove rear servo retainer, spring and piston assembly.

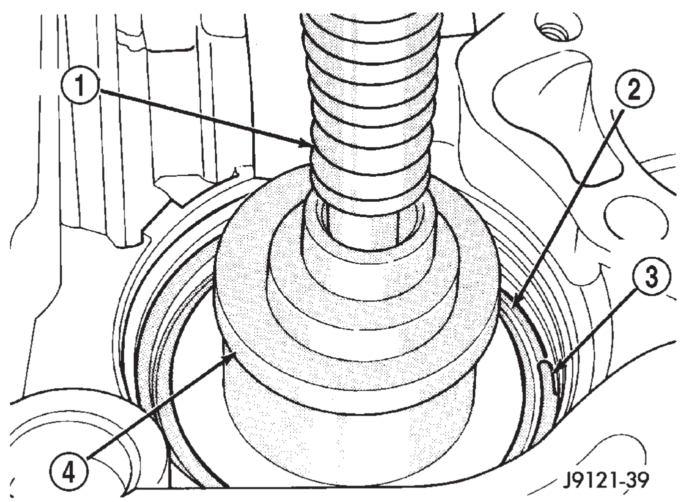


Fig. 38 Front Servo Retaining Snap-Ring

1 - C-CLAMP
2 - FRONT SERVO ROD GUIDE
3 - SNAP-RING
4 - TOOL C-4470

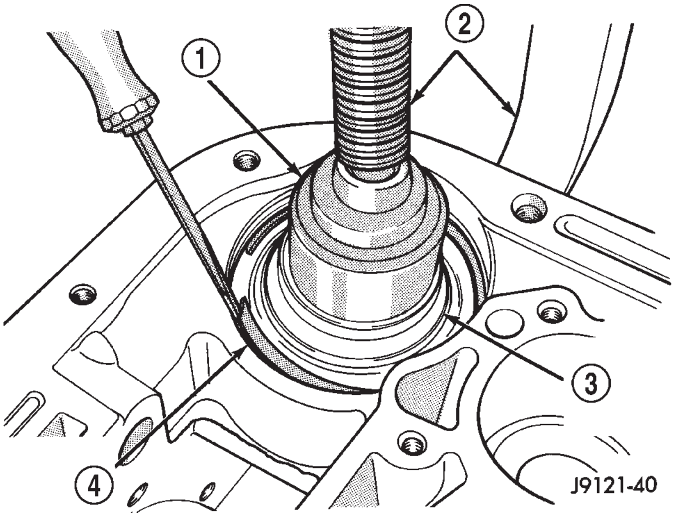


Fig. 39 Rear Servo Retaining Snap-Ring

1 - TOOL C-4470
2 - C-CLAMP
3 - REAR SERVO SPRING RETAINER
4 - RETAINER SNAP-RING

CLEANING

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 stick to case surfaces and transmission components and circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

Lubricate transmission parts with Mopar® ATF +4, type 9602, transmission fluid during overhaul and assembly. Use petroleum jelly, Mopar® Door Ease, or Ru-Glyde™ to prelubricate seals, O-rings, and thrust washers. Petroleum jelly can also be used to hold parts in place during reassembly.

INSPECTION

Inspect the case for cracks, porous spots, worn bores, or damaged threads. Damaged threads can be repaired with Helicoil thread inserts. However, the case will have to be replaced if it exhibits any type of damage or wear.

Lubricate the front band adjusting screw threads with petroleum jelly and thread the screw part-way into the case. Be sure the screw turns freely.

Inspect the transmission bushings during overhaul. Bushing condition is important as worn, scored bushings contribute to low pressures, clutch slip and accelerated wear of other components. However, do not replace bushings as a matter of course. Replace bushings only when they are actually worn, or scored.

Use recommended tools to replace bushings. The tools are sized and designed to remove, install, and seat bushings correctly. The bushing replacement tools are included in Bushing Tool Set C-3887-B.

Pre-sized service bushings are available for replacement purposes. Only the sun gear bushings are not serviced.

The use of crocus cloth is permissible where necessary, providing it is used carefully. When used on shafts, or valves, use extreme care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

ASSEMBLY

Do not allow dirt, grease, or foreign material to enter the case or transmission components during assembly. Keep the transmission case and components clean. Also make sure the tools and workbench area used for reassembly operations are equally clean.

Shop towels used for wiping off tools and your hands must be made from **lint free** materials. Lint will stick to transmission parts and could interfere with valve operation or even restrict fluid passages.

Lubricate transmission clutch and gear components with Mopar® ATF +4, type 9602, during reassembly. Soak clutch discs in transmission fluid before installation.

Use Mopar® Door Ease, or Ru-Glyde™ on piston seals and O-rings to ease installation. Petroleum jelly can also be used to lubricate and hold thrust washers and plates in position during assembly.

Do not use chassis grease, bearing grease, white grease, or similar lubricants on any part. These types of lubricants can eventually block or restrict fluid passages and valve operation. Use petroleum jelly only.

Do not force parts into place. The transmission components and sub-assemblies are easily installed by hand when properly aligned. If a part seems difficult to install, it is either misaligned or incorrectly assembled. Verify that thrust washers, thrust plates and seal rings are correctly positioned.

The planetary geartrain, front/rear clutch assemblies and oil pump are all much easier to install

AUTOMATIC TRANSMISSION - 46RE (Continued)

when the transmission case is upright. Either tilt the case upward with wood blocks, or cut a hole in the bench large enough for the intermediate shaft and rear support. Then lower the shaft and support into the hole and support the rear of the case directly on the bench.

FRONT/REAR SERVO

(1) Lubricate rear servo piston seal with Mopar® Door Ease or ATF +4. Lubricate servo bore in case with ATF +4.

(2) Install rear servo piston in case. Position piston at slight angle to bore and insert piston with twisting motion (Fig. 40).

(3) Install rear servo spring and retainer in case bore (Fig. 41). Be sure spring is seated on piston.

(4) Compress rear servo piston with C-clamp or Valve Spring Compressor C-3422-B and install servo piston snap-ring (Fig. 42).

(5) Lubricate front servo piston components and servo bore in case with transmission fluid.

(6) Install front servo piston in bore. Carefully "run" small, suitable tool around piston ring to press it back into groove and ease installation (Fig. 43). Rotate piston into bore at same time. Rock piston slightly to ease piston ring past snap-ring groove and into bore.

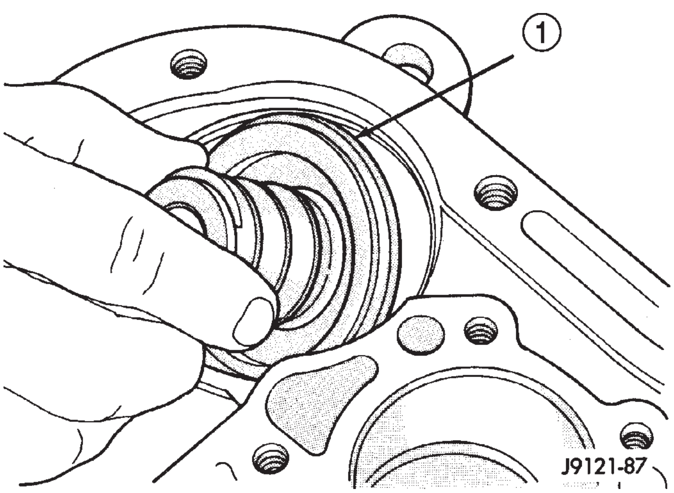


Fig. 40 Rear Servo Piston

1 - REAR SERVO PISTON

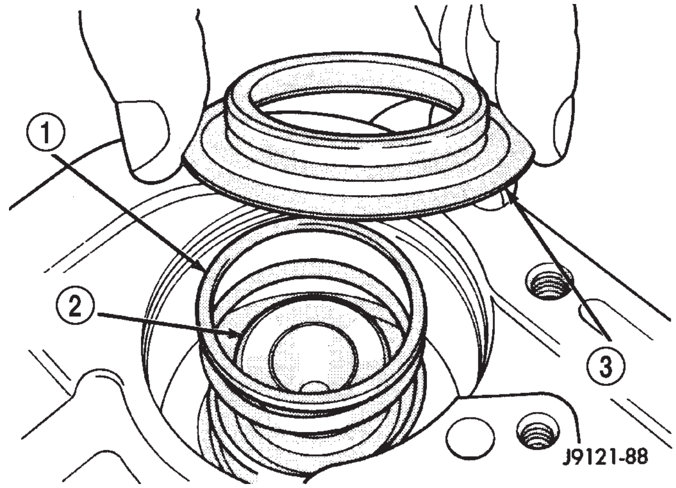


Fig. 41 Rear Servo Piston Spring And Retainer

1 - PISTON SPRING
2 - REAR SERVO PISTON
3 - SPRING RETAINER

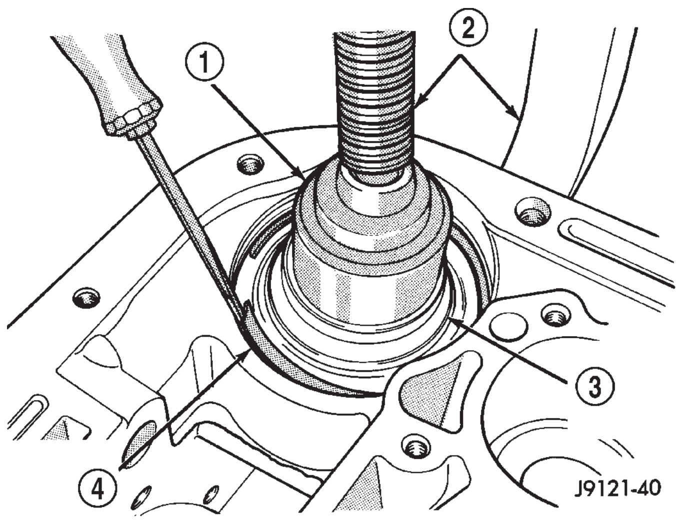


Fig. 42 Rear Servo Snap-Ring

1 - TOOL C-4470
2 - C-CLAMP
3 - REAR SERVO SPRING RETAINER
4 - RETAINER SNAP-RING

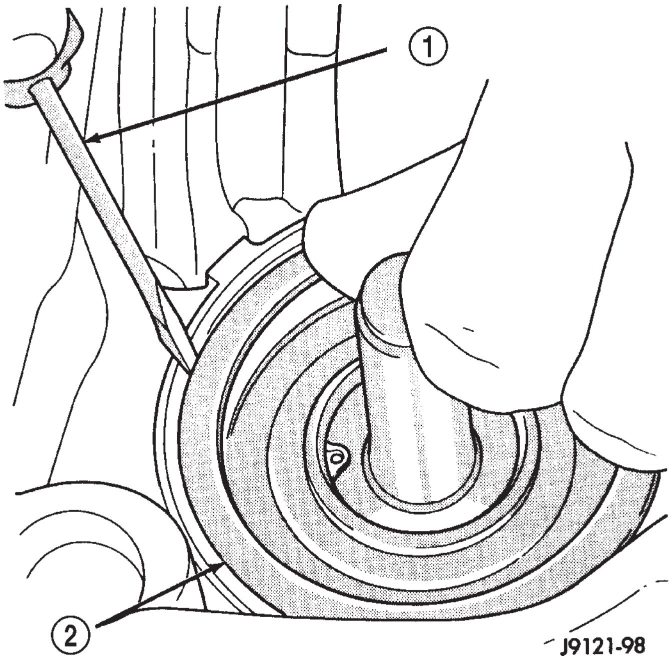


Fig. 43 Front Servo Piston

1 - USE SUITABLE TOOL TO HELP SEAT PISTON RING
2 - FRONT SERVO PISTON

(7) Bottom front servo piston in bore and install servo spring.

(8) Install front servo piston rod guide as follows:

(a) Place Tool SP-5560 (or similar size tool) on guide and position C-clamp on tool and case (Fig. 44).

(b) Slowly compress rod guide while simultaneously easing seal ring into bore with suitable tool.

(9) Install rod guide snap-ring (Fig. 44).

OVERRUNNING CLUTCH, REAR BAND, AND LOW-REVERSE DRUM

(1) Install overrunning clutch components.

(2) Position rear band and link in case (Fig. 45).

(3) Install low-reverse drum (Fig. 46). Slide drum through rear band, onto piston retainer hub and into engagement with overrunning clutch and race.

(4) Install thrust washer in low-reverse drum spotface (Fig. 47). Use petroleum jelly to hold washer in place.

(5) Install snap-ring that secures low-reverse drum to piston retainer hub (Fig. 47).

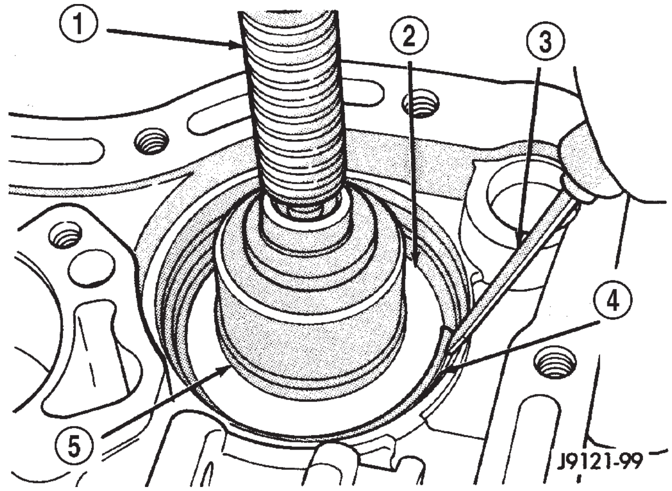


Fig. 44 Front Servo Rod Guide And Snap-Ring

1 - C-CLAMP
2 - ROD GUIDE
3 - SMALL SCREWDRIVER
4 - ROD GUIDE SNAP-RING
5 - TOOL SP-5560

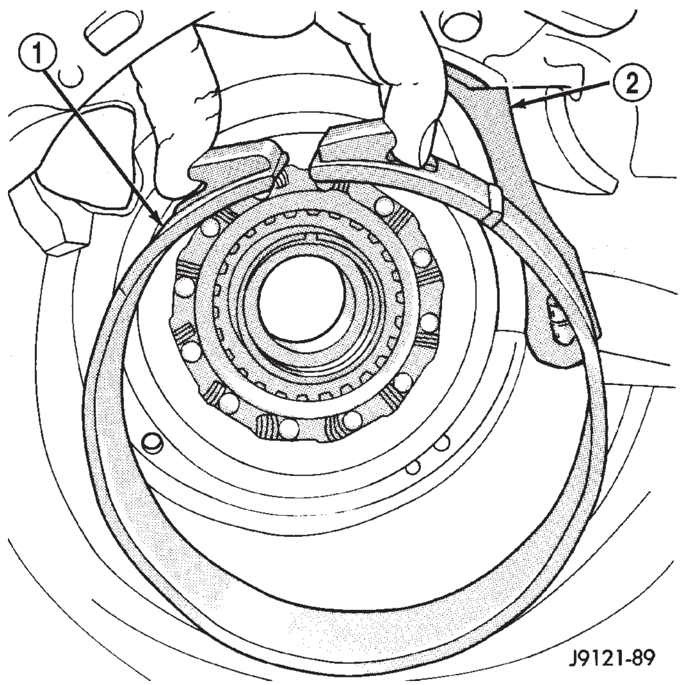


Fig. 45 Rear Band And Link

1 - REAR BAND
2 - BAND LINK

AUTOMATIC TRANSMISSION - 46RE (Continued)

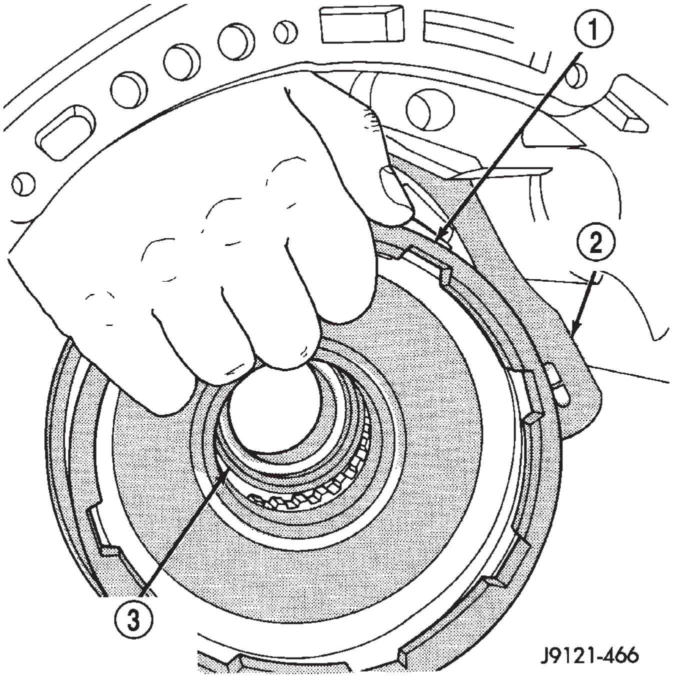


Fig. 46 Low-Reverse Drum

1 - LOW-REVERSE DRUM
2 - REAR BAND LINK
3 - HUB OF OVERDRIVE PISTON RETAINER

(6) Insert band reaction pin part way into case and band link (Fig. 48).

(7) Install rear band adjusting lever, reaction lever, and strut (Fig. 49). Be sure levers and strut are aligned and engaged before seating band reaction pin in case.

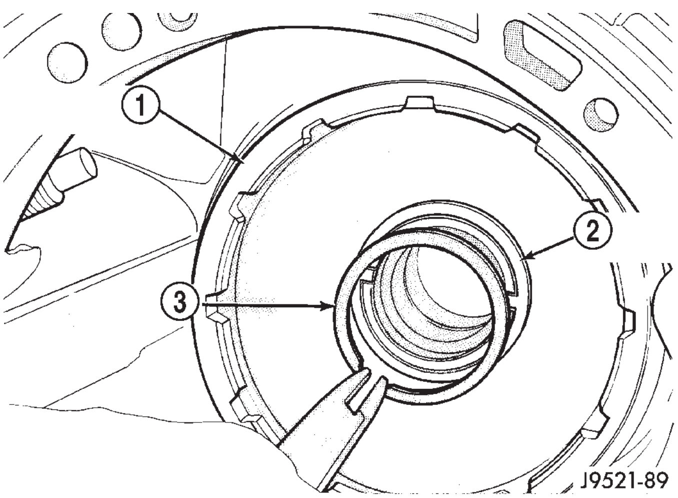


Fig. 47 Low-Reverse Drum Snap-Ring

1 - LOW-REVERSE DRUM
2 - TABBED WASHER
3 - SNAP-RING

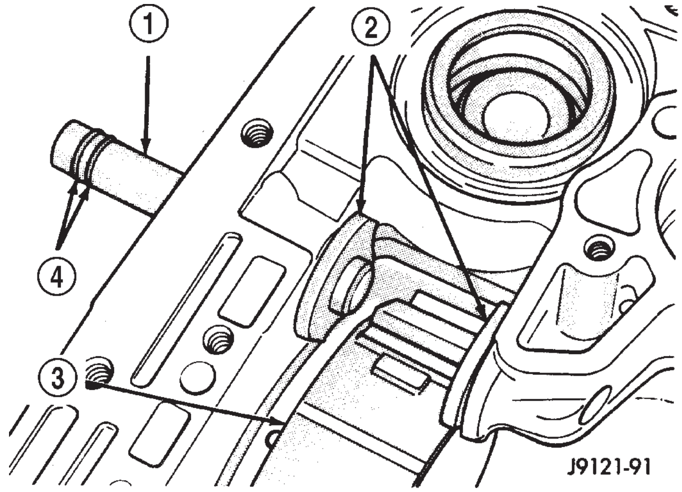


Fig. 48 Rear Band Reaction Pin

1 - REACTION PIN
2 - BAND LINK
3 - REAR BAND
4 - O-RINGS

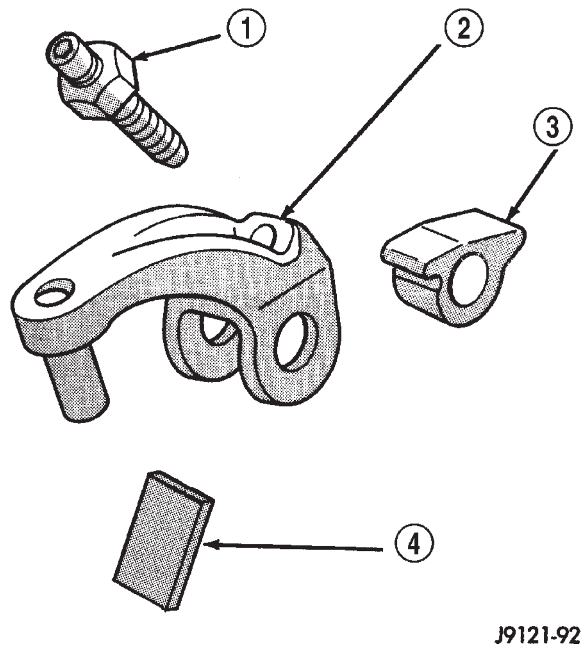


Fig. 49 Rear Band Levers And Strut

1 - ADJUSTING SCREW AND NUT
2 - ADJUSTING LEVER
3 - REACTION LEVER
4 - STRUT

AUTOMATIC TRANSMISSION - 46RE (Continued)

PLANETARY GEARTRAIN, FRONT/REAR CLUTCH, AND FRONT BAND

(1) Remove Alignment Shaft 6227-2, if installed previously.

(2) Install assembled intermediate shaft and planetary geartrain (Fig. 50). Support shaft carefully during installation. Do not allow shaft bearing/bushing surfaces to become nicked or scratched.

(3) Lubricate intermediate shaft thrust plate with petroleum jelly and install plate on shaft pilot hub (Fig. 51).

(4) Check input shaft front seal rings, fiber thrust washer and rear seal ring (Fig. 52). Be ends of rear seal ring are hooked together and the square cut ends of front seal rings are firmly seated against each other. Lubricate seal rings with petroleum jelly after checking them.

(5) Assemble front and rear clutches (Fig. 53). Align lugs on front clutch discs. Mount front clutch on rear clutch. Turn front clutch retainer back and forth until front clutch discs are fully seated on rear clutch splined hub.

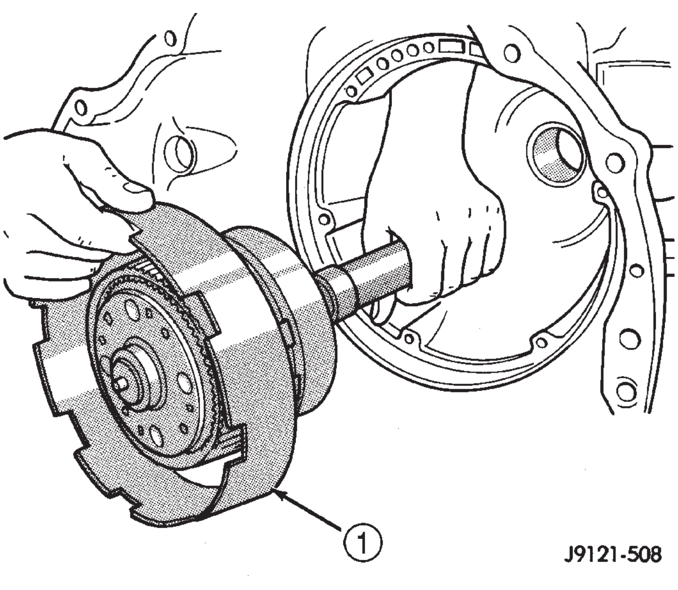


Fig. 50 Intermediate Shaft And Planetary Geartrain

1 - INTERMEDIATE SHAFT AND PLANETARY GEARTRAIN ASSEMBLY

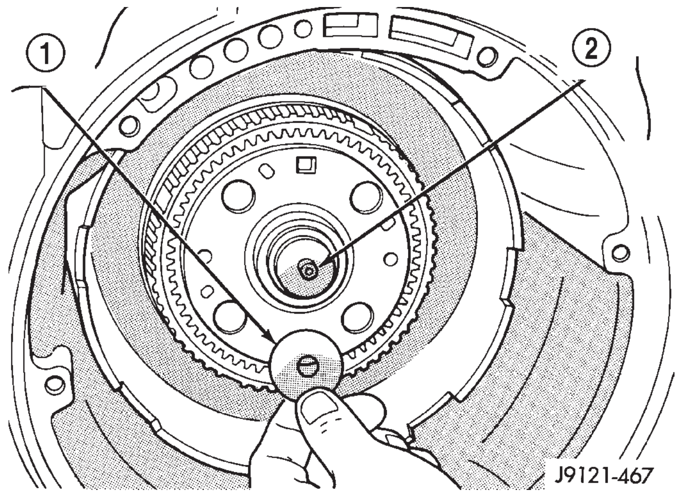


Fig. 51 Intermediate Shaft Thrust Plate

1 - SHAFT THRUST PLATE
2 - INTERMEDIATE SHAFT PILOT HUB

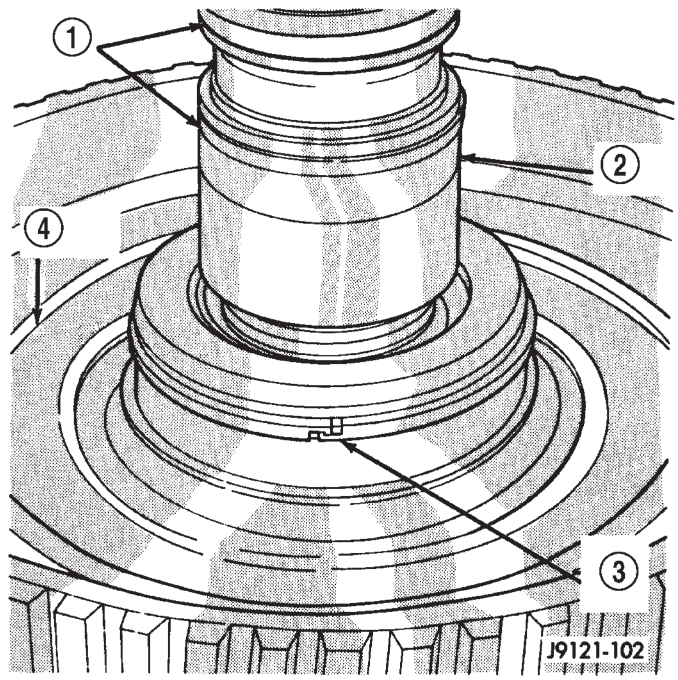


Fig. 52 Input Shaft Seal Rings And Thrust Washer

1 - TORLON® FRONT SEAL RINGS
2 - INPUT SHAFT
3 - REAR SEAL RING
4 - THRUST WASHER

AUTOMATIC TRANSMISSION - 46RE (Continued)

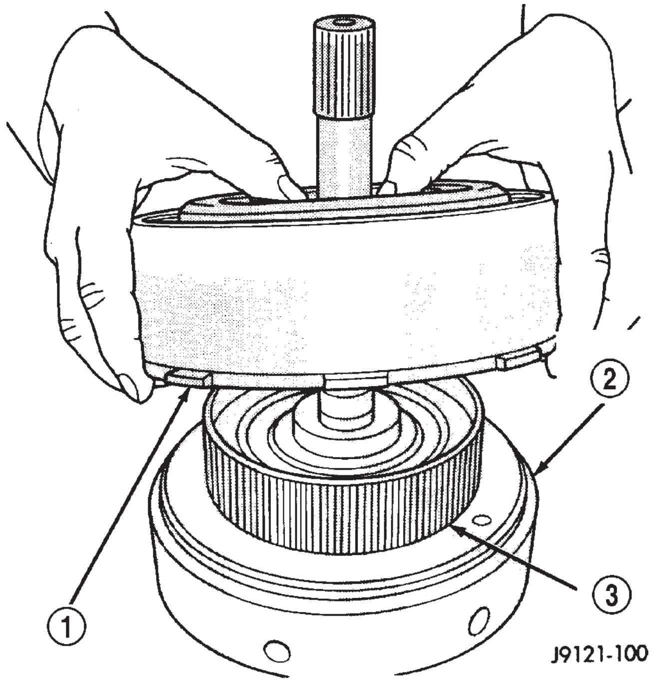


Fig. 53 Assembling Front And Rear Clutches

1 - FRONT CLUTCH ASSEMBLY
2 - REAR CLUTCH ASSEMBLY
3 - REAR CLUTCH SPLINED HUB

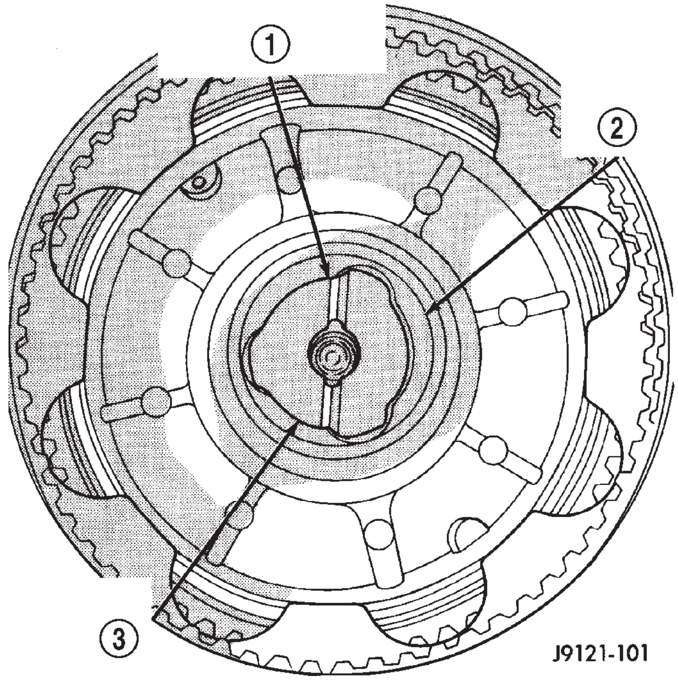


Fig. 54 Intermediate Shaft Thrust Washer

1 - BE SURE WASHER GROOVES FACE OUT AS SHOWN
2 - REAR CLUTCH RETAINER HUB
3 - OUTPUT SHAFT THRUST WASHER

(6) Install intermediate shaft thrust washer in hub of rear clutch retainer (Fig. 54). Use petroleum jelly to hold washer in place. Position washer so grooves are facing outward. Washer only fits one way in clutch retainer hub.

(7) Place transmission case in upright position, or place blocks under front end of transmission repair stand to tilt case rearward. This makes it easier to install front/rear clutch assembly.

(8) Align discs in rear clutch. Then install and engage assembly in front planetary and driving shell (Fig. 55). Turn clutch retainers back and forth until both clutches are seated.

(9) Position front band lever in case and over servo rod guide. Then install front band lever pin in case and slide it through lever.

(10) Coat threads of front band pin access plug with sealer and install it in case. Tighten plug to 17 N·m (13 ft. lbs.) torque.

(11) Slide front band over front clutch retainer and install front band strut and anchor (Fig. 56).

(12) Tighten front band adjusting screw until band is tight on clutch retainer. This will hold clutches in place while oil pump is being installed. Verify that front/rear clutch assembly is still properly seated before tightening band.

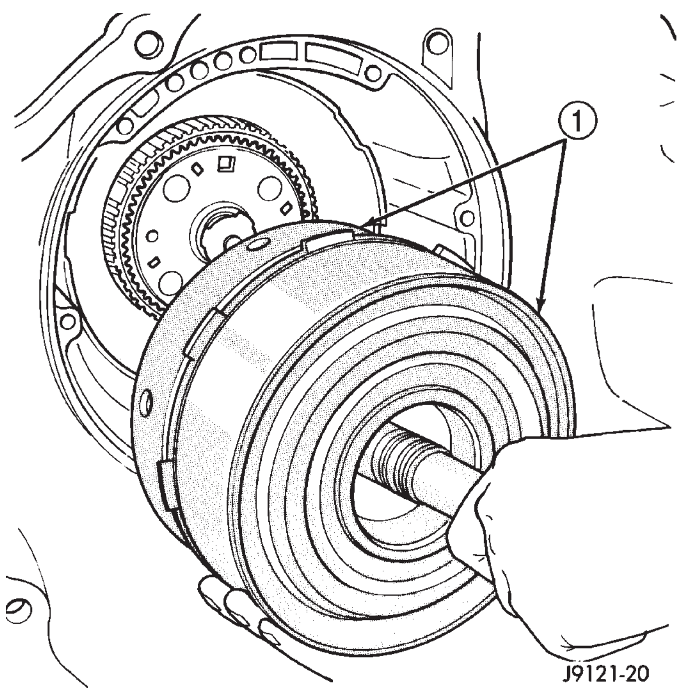


Fig. 55 Front/Rear Clutch Assemblies

1 - FRONT AND REAR CLUTCH ASSEMBLIES

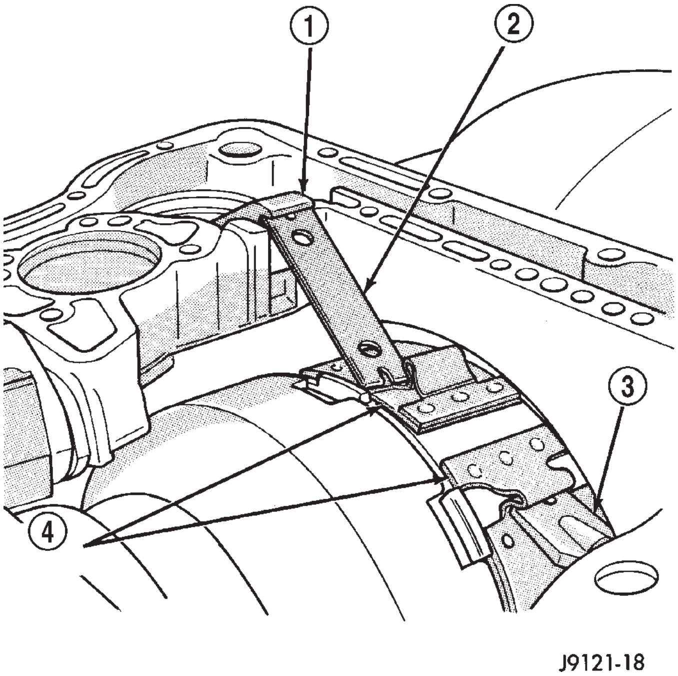


Fig. 56 Front Band And Linkage

1 - LEVER
2 - STRUT
3 - ANCHOR
4 - FRONT BAND

OIL PUMP

(1) Install oil pump Pilot Studs C-3288-B in case (Fig. 57).

(2) Install new oil pump gasket on pilot studs and seat it in case. Be sure gasket is properly aligned with fluid passages in case (Fig. 57).

(3) Coat front clutch fiber thrust washer with petroleum jelly to hold it in place. Then install washer over reaction shaft hub and seat it on pump (Fig. 58).

CAUTION: The thrust washer bore (I.D.), is chamfered on one side. Make sure the chamfered side is installed so it faces the pump.

(4) Check seal rings on reaction shaft support. Be sure rings are hooked together correctly. Also be sure fiber thrust washer is in position (Fig. 59). Use extra petroleum jelly to hold washer in place if necessary.

(5) Lubricate oil pump seals with petroleum Mopar® ATF +4, type 9602.

(6) Mount oil pump on pilot studs and slide pump into case opening (Fig. 60). Work pump into case by hand. Do not use a mallet or similar tools to seat pump.

(7) Remove pilot studs and install oil pump bolts. Tighten pump bolts alternately and evenly to fully seat pump in case. Then final-tighten pump bolts to 20 N·m (15 ft. lbs.) torque.

(8) Verify correct installation. Rotate input and intermediate shafts and check for bind. If bind exists, components are either mis-assembled, or not seated. Disassemble and correct as necessary before proceeding.

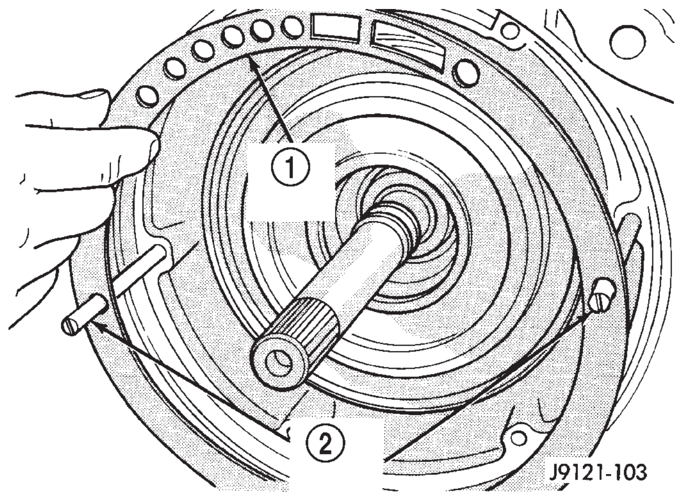


Fig. 57 Oil Pump Gasket And Pilot Studs

1 - OIL PUMP GASKET
2 - PILOT STUDS C-3288-B

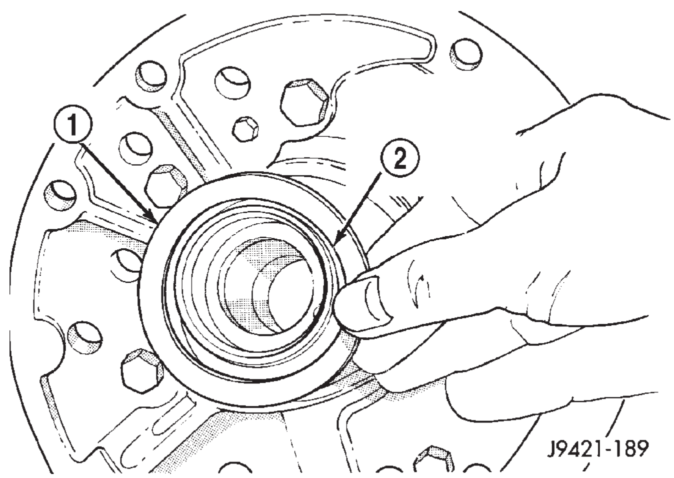


Fig. 58 Front Clutch Thrust Washer

1 - THRUST WASHER
2 - CHAMFERED SIDE OF WASHER BORE GOES TOWARD PUMP

AUTOMATIC TRANSMISSION - 46RE (Continued)

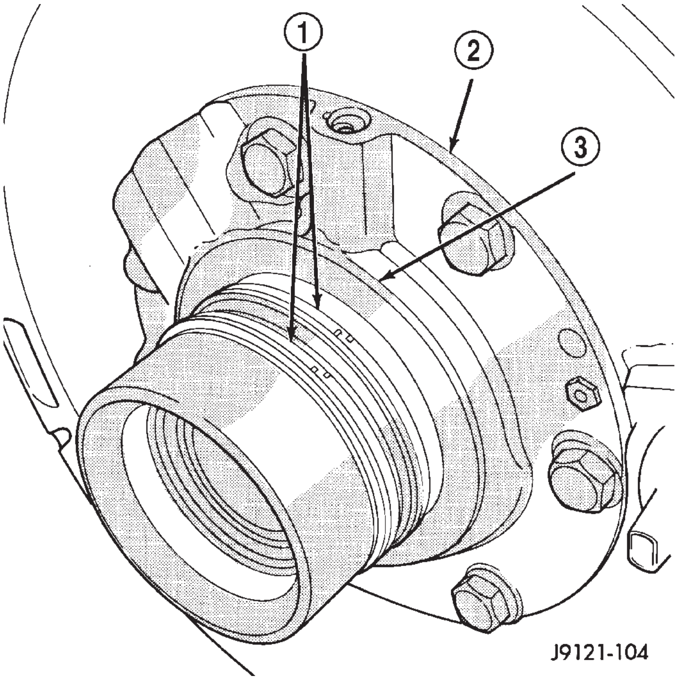


Fig. 59 Reaction Shaft Seal Ring And Thrust Washer

1 - SEAL RINGS
2 - REACTION SHAFT SUPPORT
3 - THRUST WASHER (FIBER)

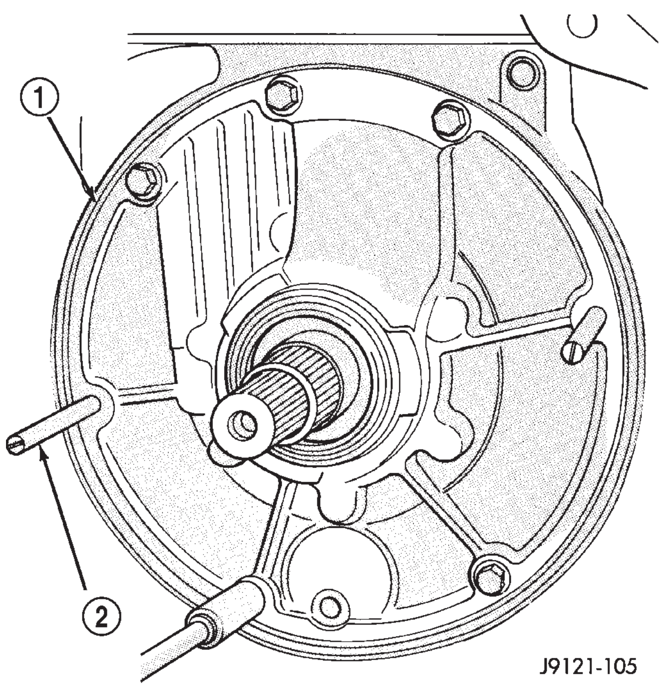


Fig. 60 Oil Pump

1 - SEAT OIL PUMP IN CASE BY HAND
2 - REMOVE PILOT STUDS WHEN PUMP IS SEATED

INPUT SHAFT END PLAY CHECK

NOTE: Overdrive unit must be installed in order to correctly measure the input shaft end-play.

(1) Measure input shaft end play (Fig. 61).

NOTE: If end play is incorrect, transmission is incorrectly assembled, or reaction shaft thrust washer is incorrect. The reaction shaft thrust washer is selective.

(a) Attach Adapter 8266-5 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 8266-5 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 0.86 - 2.13 mm (0.034 - 0.084 in.). Adjust as necessary.

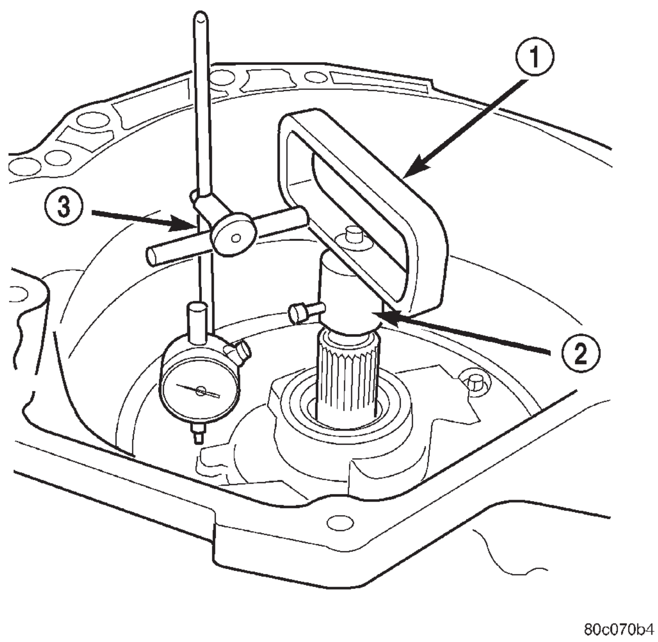


Fig. 61 Checking Input Shaft End Play

1 - TOOL 8266-8
2 - TOOL 8266-5
3 - TOOL C-3339

AUTOMATIC TRANSMISSION - 46RE (Continued)

ACCUMULATOR, VALVE BODY, OIL PAN, AND TORQUE CONVERTER

(1) Install accumulator inner spring, piston and outer spring (Fig. 62).

(2) Install new valve body manual shaft seal in case (Fig. 63). Lubricate seal lip and manual shaft with petroleum jelly. Start seal over shaft and into case. Seat seal with 15/16 inch, deep well socket.

(3) Install valve body as follows:

(a) Start park rod into park pawl. If rod will not slide past park pawl, pawl is engaged in park gear. Rotate overdrive output shaft with suitable size 12 point socket; this will free pawl and allow rod to engage.

(b) Align and seat valve body on case. Be sure manual lever shaft and overdrive connector are fully seated in case.

(c) Install and start all valve body attaching bolts by hand. Then tighten bolts evenly, in a diagonal pattern to 12 N·m (105 in. lbs.) torque. **Do not overtighten valve body bolts. This could result in distortion and cross leakage after installation.**.

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into this cavity.

(4) Install new filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.).

(5) Install the transmission range sensor.

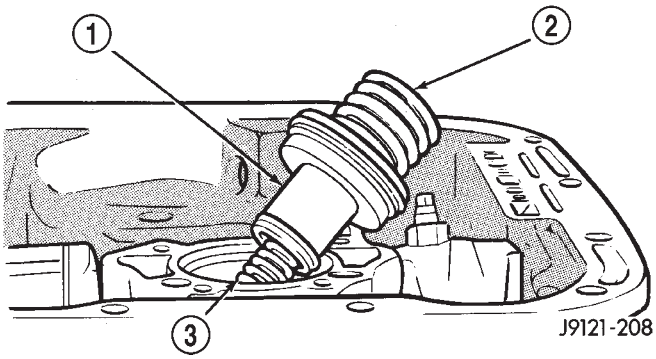


Fig. 62 Accumulator Piston And Springs

1 - ACCUMULATOR PISTON
2 - OUTER SPRING
3 - INNER SPRING

CAUTION: If the condition of the transmission before the overhaul procedure caused excessive metallic or fiber contamination in the fluid, replace the torque converter and reverse flush the cooler(s) and cooler lines. Fluid contamination and transmission failure can result if not done.

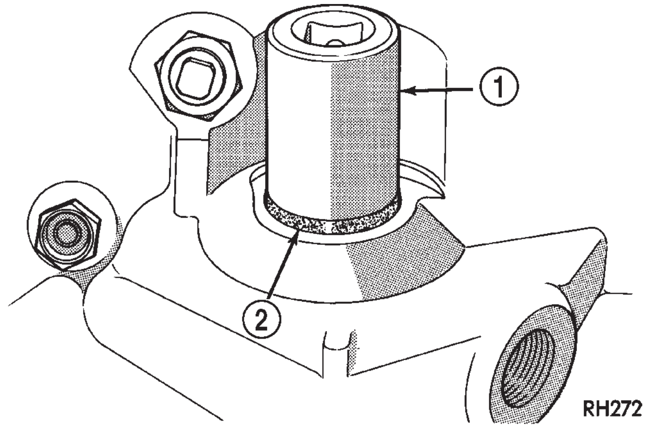


Fig. 63 Manual Lever Shaft Seal

1 - 15/16" SOCKET
2 - SEAL

(6) Install torque converter. Use C-clamp or metal strap to hold converter in place for installation.

BAND ADJUSTMENT AND FINAL

(1) Adjust front and rear bands as follows:

(a) Loosen locknut on each band adjusting screw 4-5 turns.

(b) Tighten both adjusting screws to 8 N·m (72 in. lbs.).

(c) Back off front band adjusting screw 2-7/8 turns.

(d) Back off rear band adjusting screw 2 turns.

(e) Hold each adjusting screw in position and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(2) Install magnet in oil pan. Magnet seats on small protrusion at corner of pan.

(3) Position new oil pan gasket on case and install oil pan. Tighten pan bolts to 17 N·m (13 ft. lbs.).

(4) Install throttle valve and shift selector levers on valve body manual lever shaft.

(5) Apply small quantity of dielectric grease to terminal pins of solenoid case connector and transmission range sensor.

(6) Fill transmission with recommended fluid. Refer to Service Procedures section of this group.

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 oil pump seal lip with transmission fluid.

(3) Lubricate converter pilot hub pocket in the rear of the crankshaft with a light coating of Mopar® High Temp Grease.

(4) Align and install converter in oil pump.

AUTOMATIC TRANSMISSION - 46RE (Continued)

(5) Carefully insert converter in oil pump. Then rotate converter back and forth until fully seated in pump gears.

(6) Check converter seating with steel scale and straightedge (Fig. 64). Surface of converter lugs should be 1/2 in. to rear of straightedge when converter is fully seated.

(7) Temporarily secure converter with wedge tool or C-clamp.

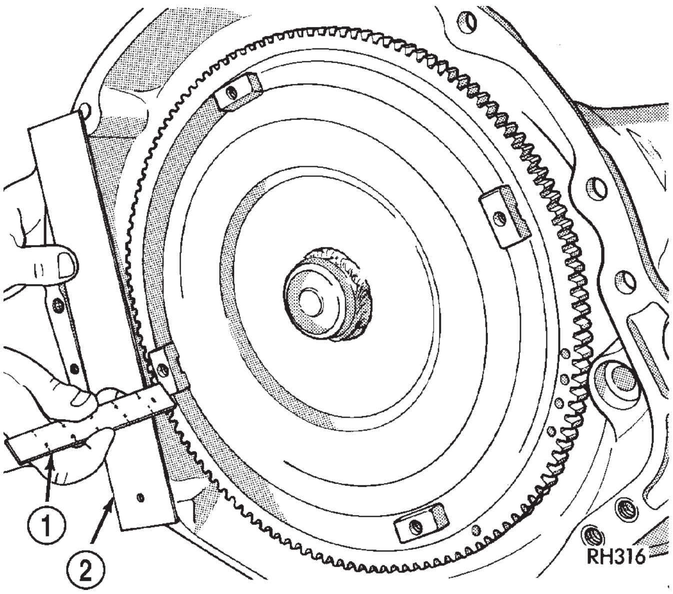


Fig. 64 Checking Converter Seating - Typical

1 - SCALE
2 - STRAIGHTEDGE

(8) Position transmission on jack and secure it with 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 held 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 bolts attaching converter housing to engine.

(14) Install transfer case, if necessary.

(15) Install rear support. Then lower transmission onto crossmember and install bolts attaching transmission mount to crossmember.

(16) Install new plastic retainer grommet on any shift linkage rod or lever that was disconnected. Grommets should not be reused.

(17) Connect gearshift and throttle cable to transmission.

(18) Connect wires to the transmission range sensor, transmission solenoid case connector, and oxygen sensor. Be sure that all transmission harnesses are properly routed.

CAUTION: It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the clutch surface inside the converter.

(19) Install torque converter-to-driveplate bolts. Tighten bolts to 31 N·m (270 in. lbs.).

(20) Raise engine slightly.

(21) Loosen bolts attaching engine-to-transmission brackets to each side of the engine block.

(22) Install converter housing access cover.

(23) Install bolts attaching engine-to-transmission brackets to transmission.

(24) Tighten bolts attaching engine-to-transmission brackets to each side of the engine block.

(25) Lower engine.

(26) Install bolt and nut attaching each engine-to-transmission bracket to the motor mounts.

(27) Remove engine support.

(28) Install bolts to hold engine-to-transmission brackets to the front axle, if equipped.

(29) Install starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION) and cooler line bracket.

(30) Connect cooler lines to transmission.

(31) Install transmission fill tube. Install new seal on tube before installation.

(32) Install exhaust components.

(33) Align and connect propeller shaft(s). (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(34) Install rear skid plate, if equipped.

(35) Adjust gearshift linkage and throttle valve cable if necessary.

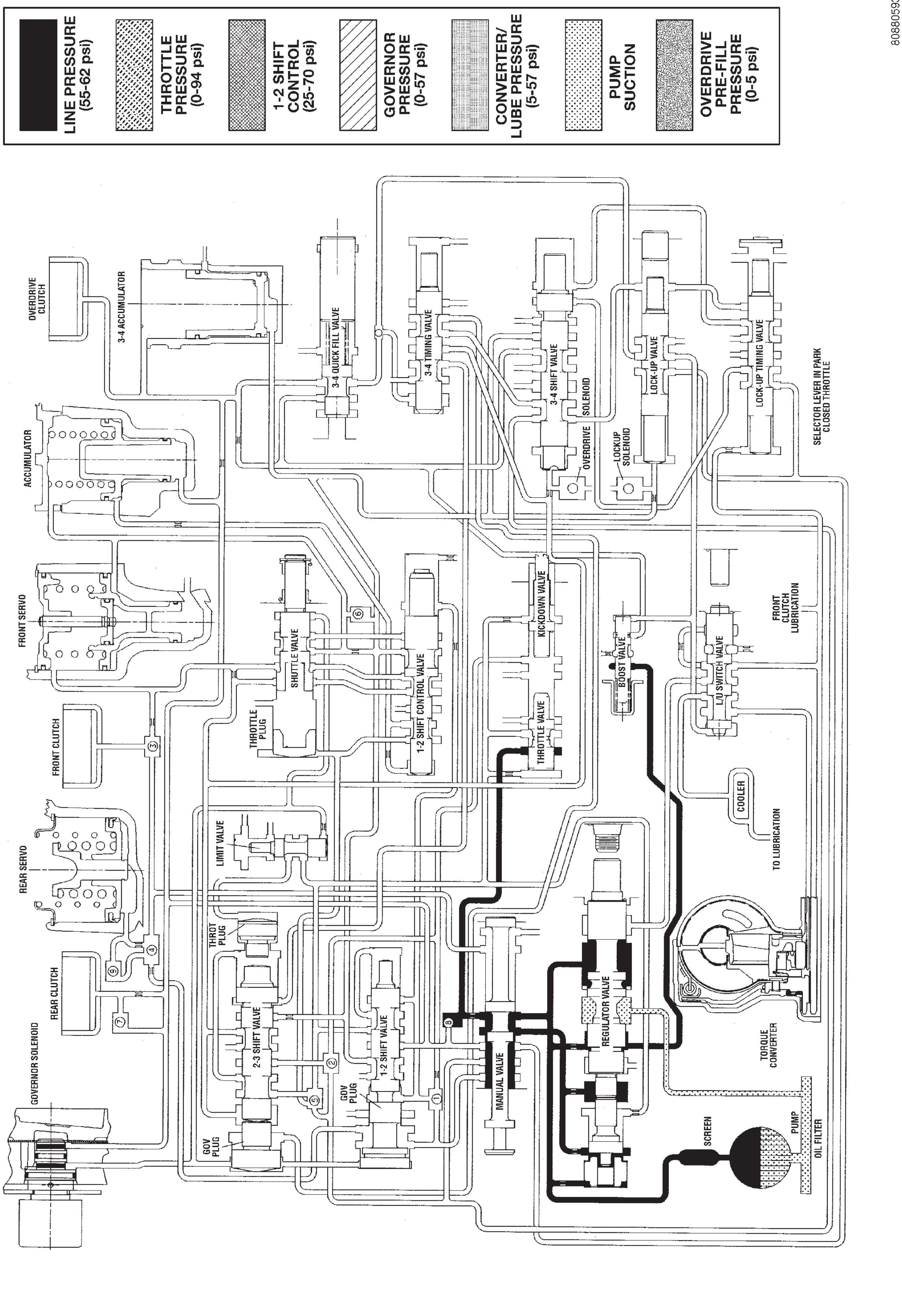
(36) Install front skid plate, if equipped.

(37) Lower vehicle.

(38) Fill transmission with Mopar® ATF +4, Type 9602 fluid.

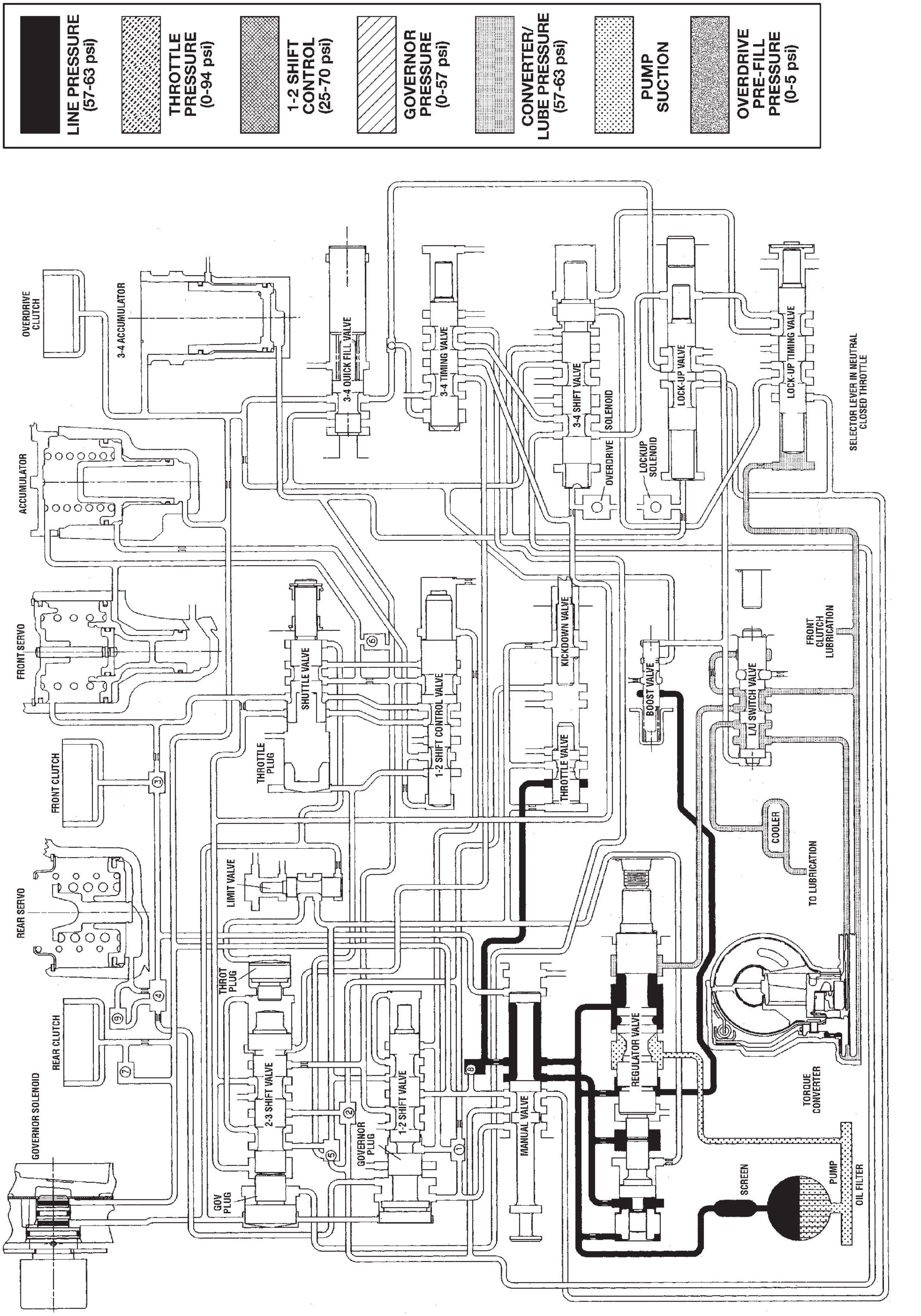
SCHEMATICS AND DIAGRAMS

HYDRAULIC SCHEMATICS



HYDRAULIC FLOW IN PARK

AUTOMATIC TRANSMISSION - 46RE (Continued)



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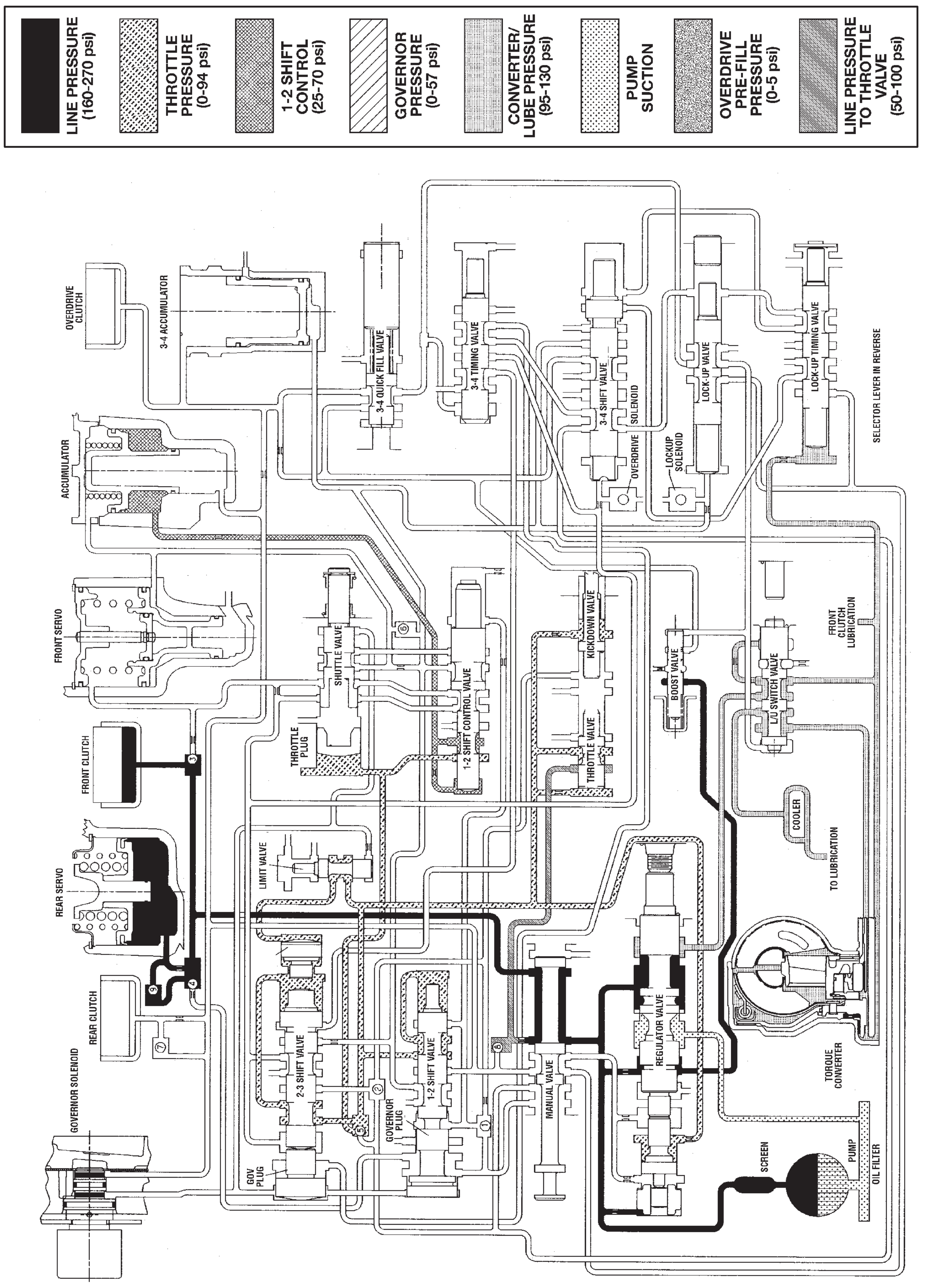
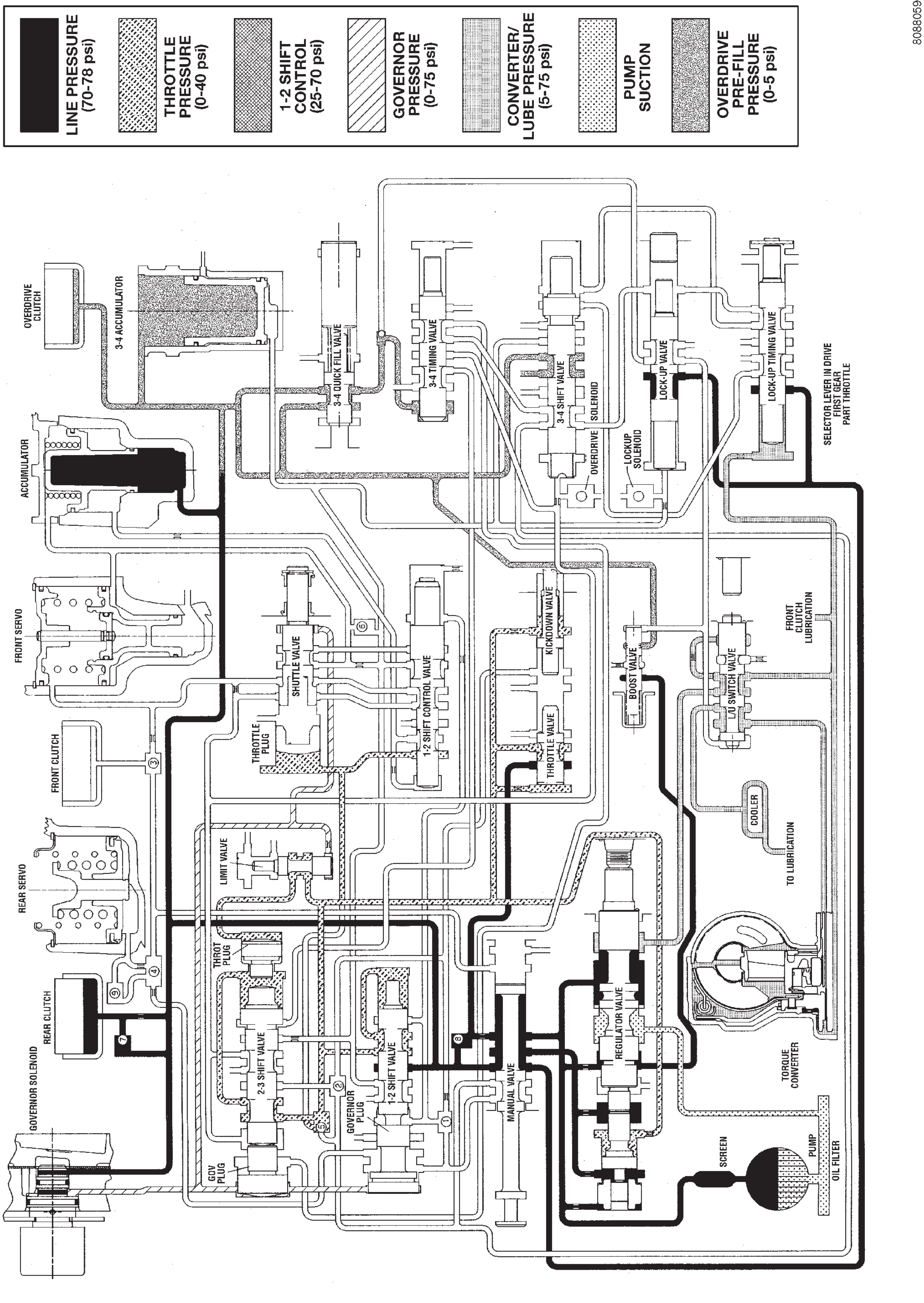
HYDRAULIC FLOW IN NEUTRAL

AUTOMATIC TRANSMISSION - 46RE (Continued)



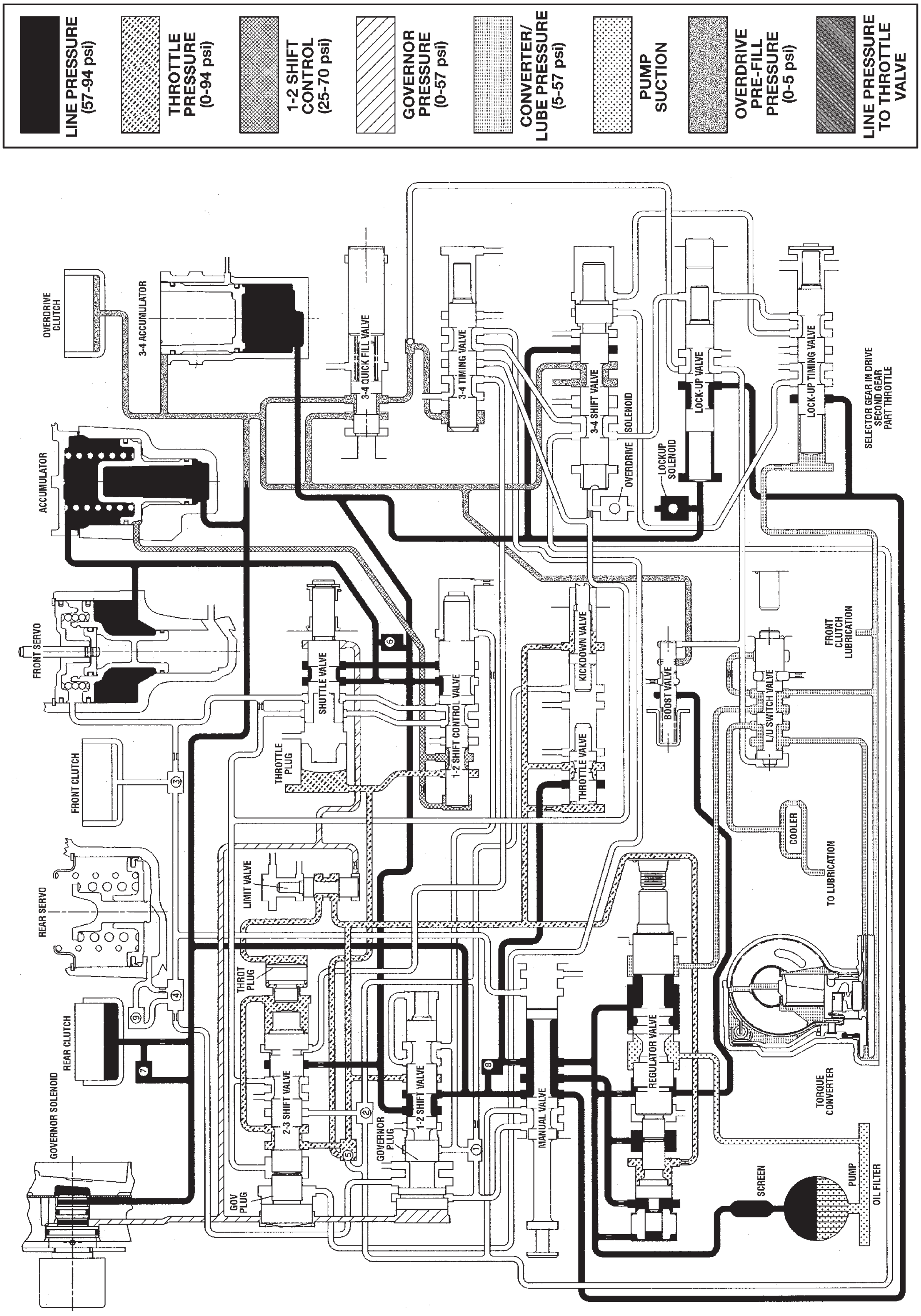
HYDRAULIC FLOW IN REVERSE

AUTOMATIC TRANSMISSION - 46RE (Continued)



HYDRAULIC FLOW IN DRIVE FIRST GEAR

AUTOMATIC TRANSMISSION - 46RE (Continued)



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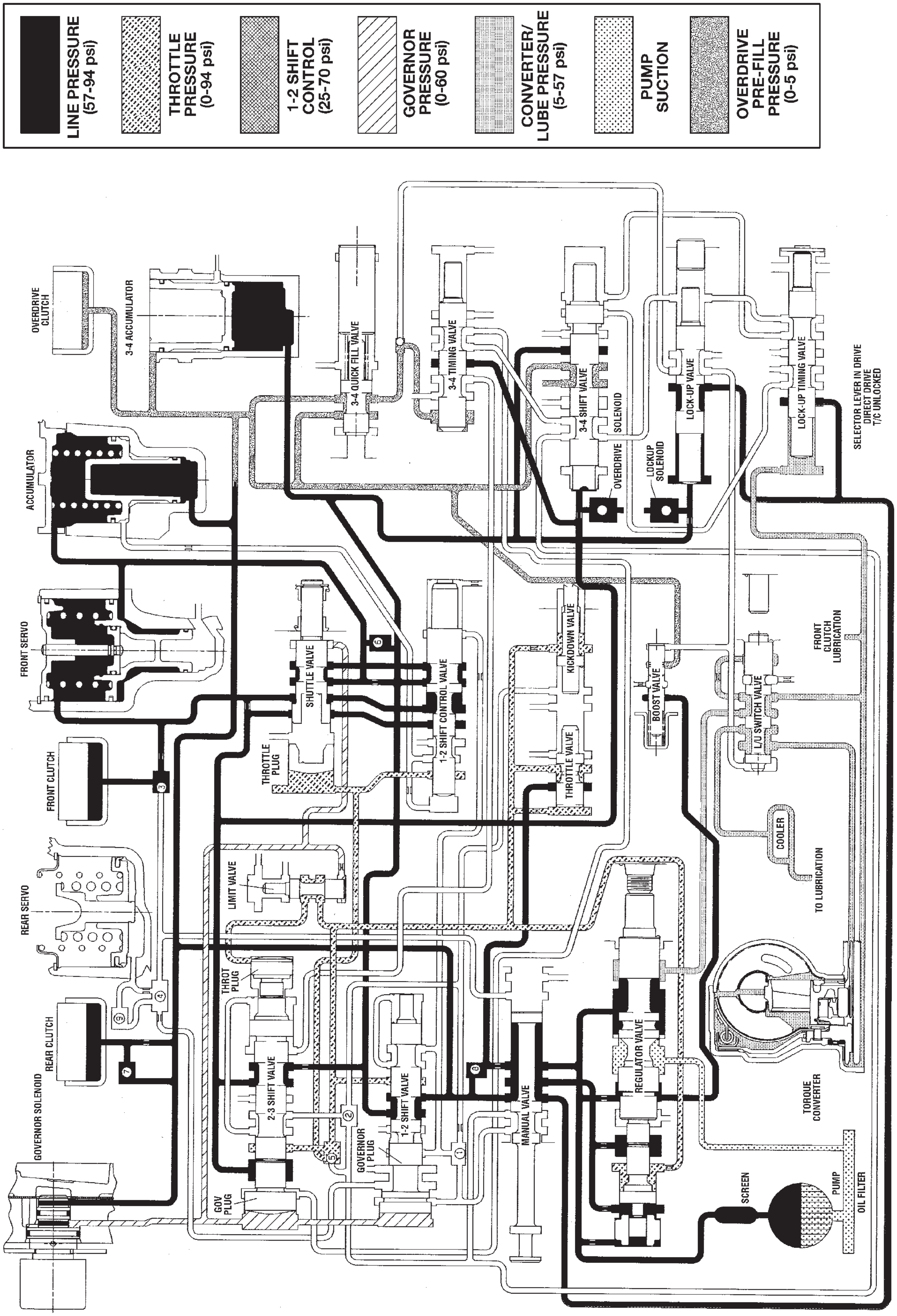
HYDRAULIC FLOW IN DRIVE SECOND GEAR

AUTOMATIC TRANSMISSION - 46RE (Continued)



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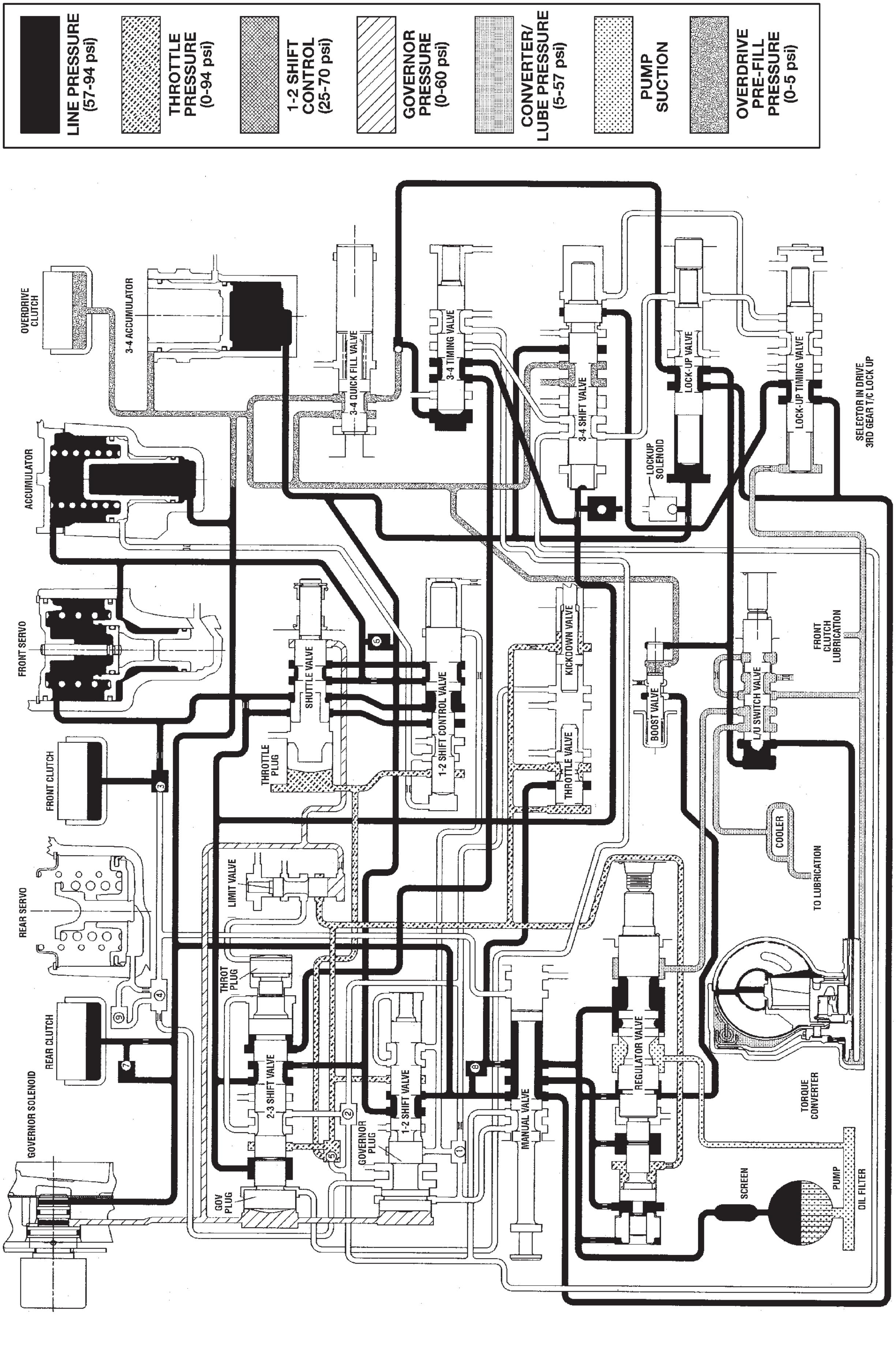
HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH NOT APPLIED)

AUTOMATIC TRANSMISSION - 46RE (Continued)



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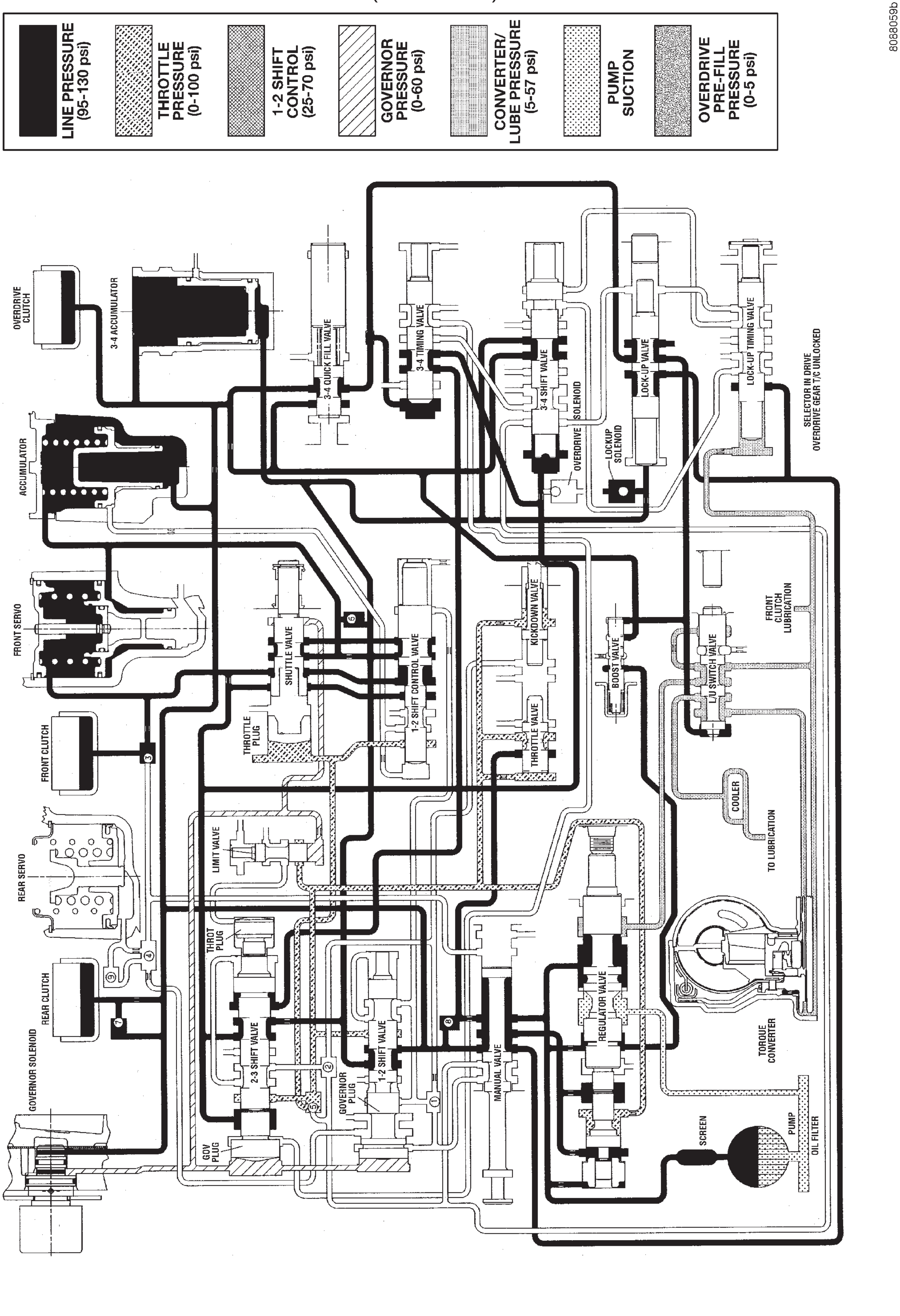
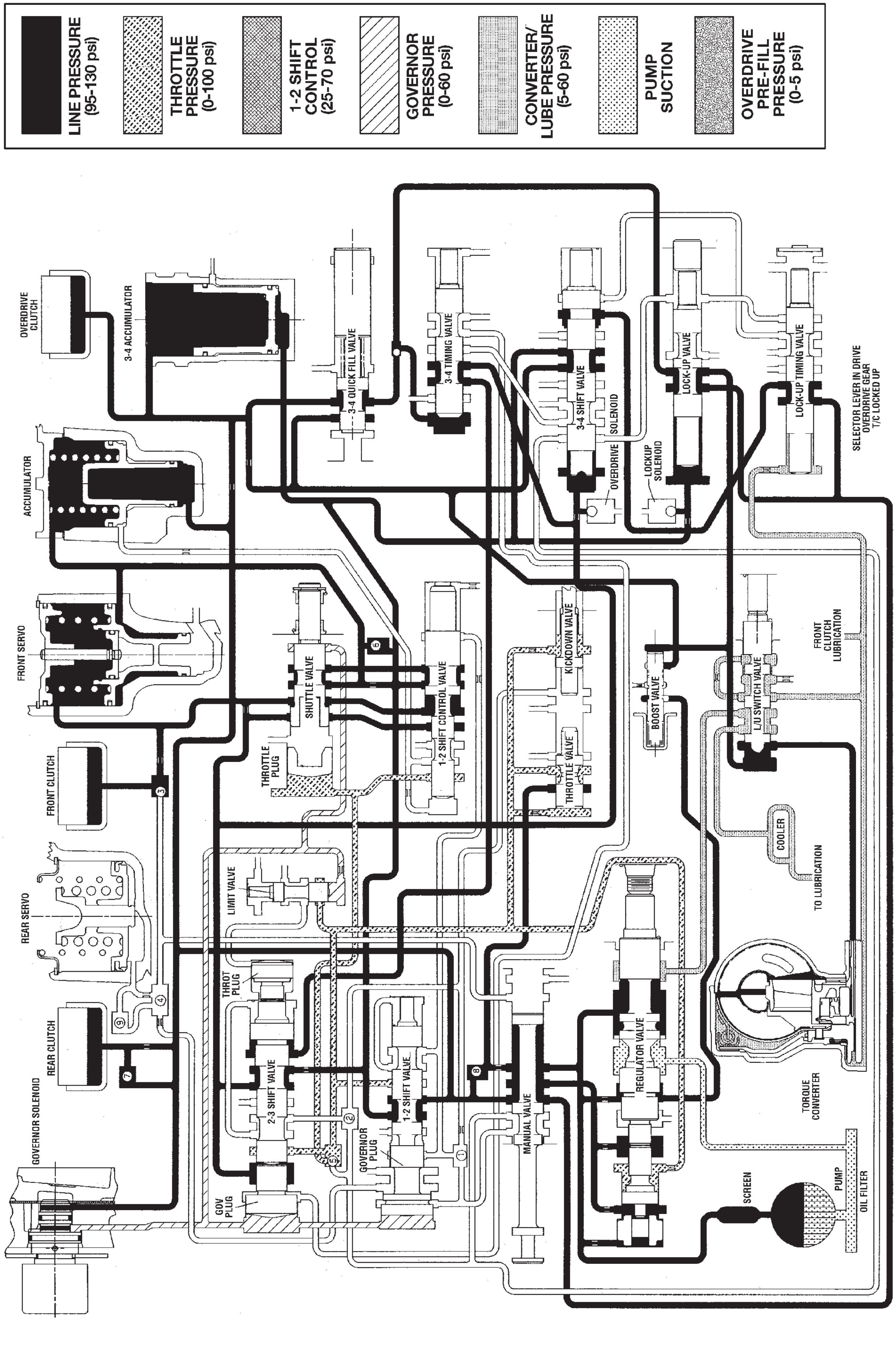
HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH APPLIED)

AUTOMATIC TRANSMISSION - 46RE (Continued)



HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH NOT APPLIED)

AUTOMATIC TRANSMISSION - 46RE (Continued)



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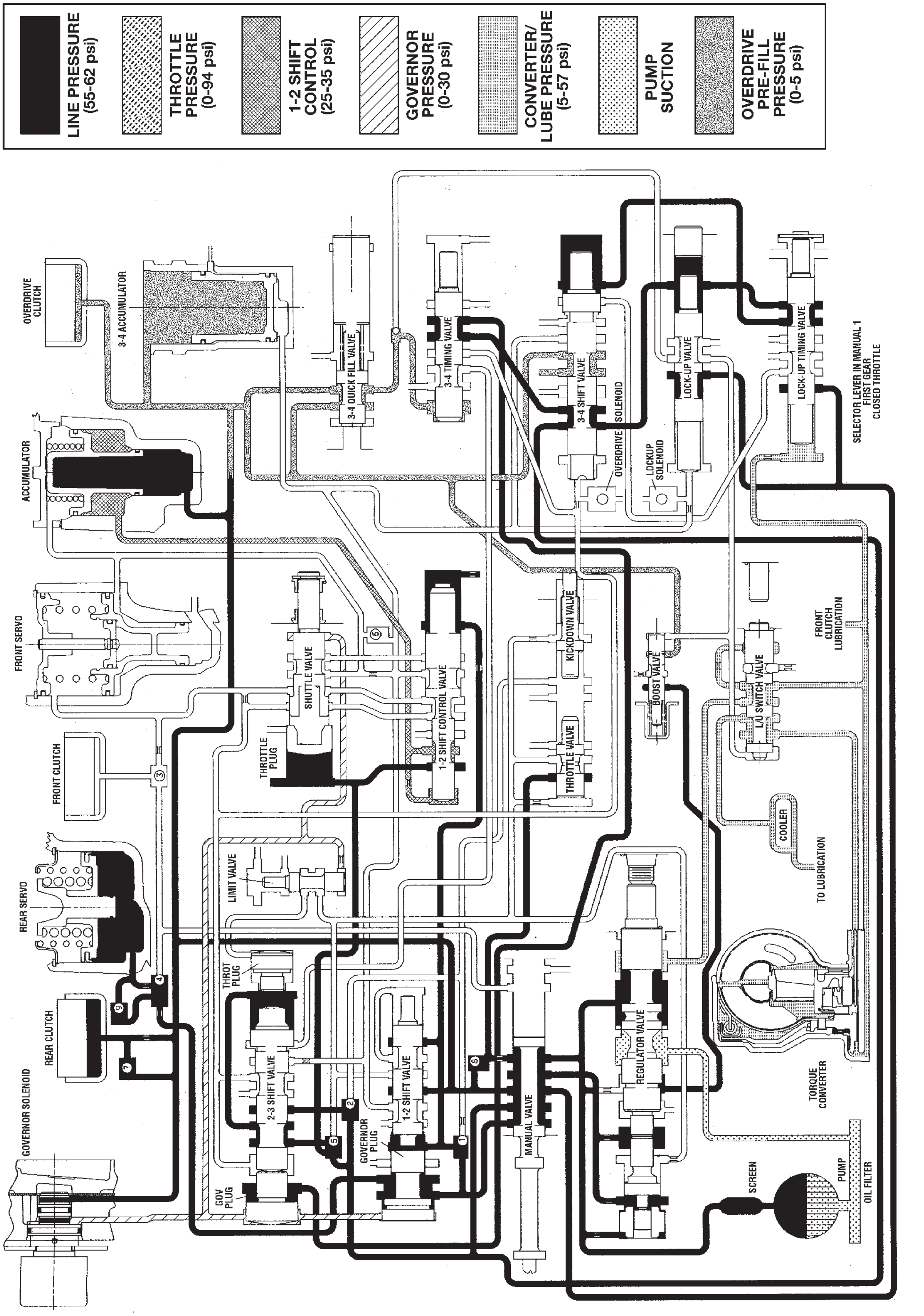
HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH APPLIED)

AUTOMATIC TRANSMISSION - 46RE (Continued)



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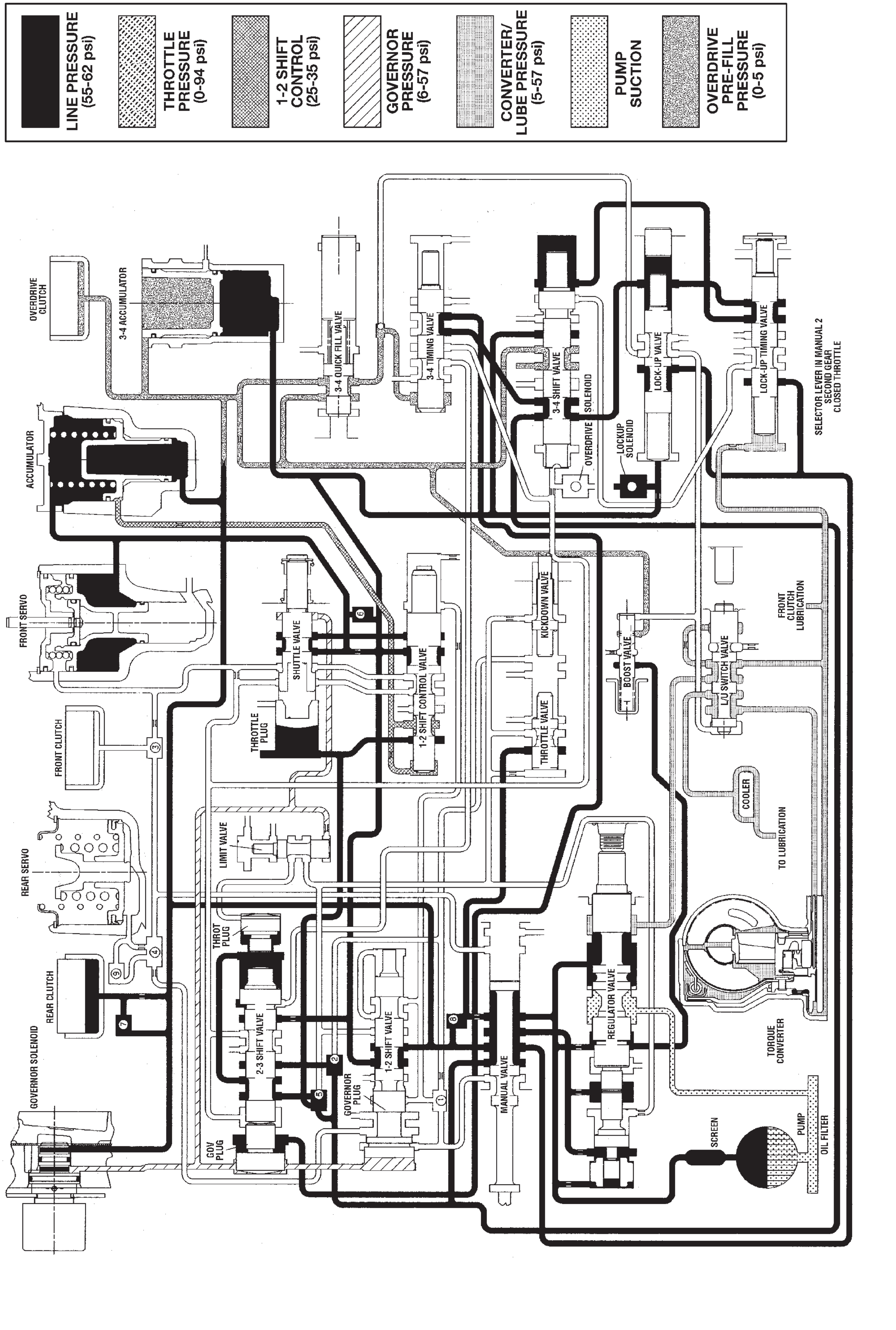
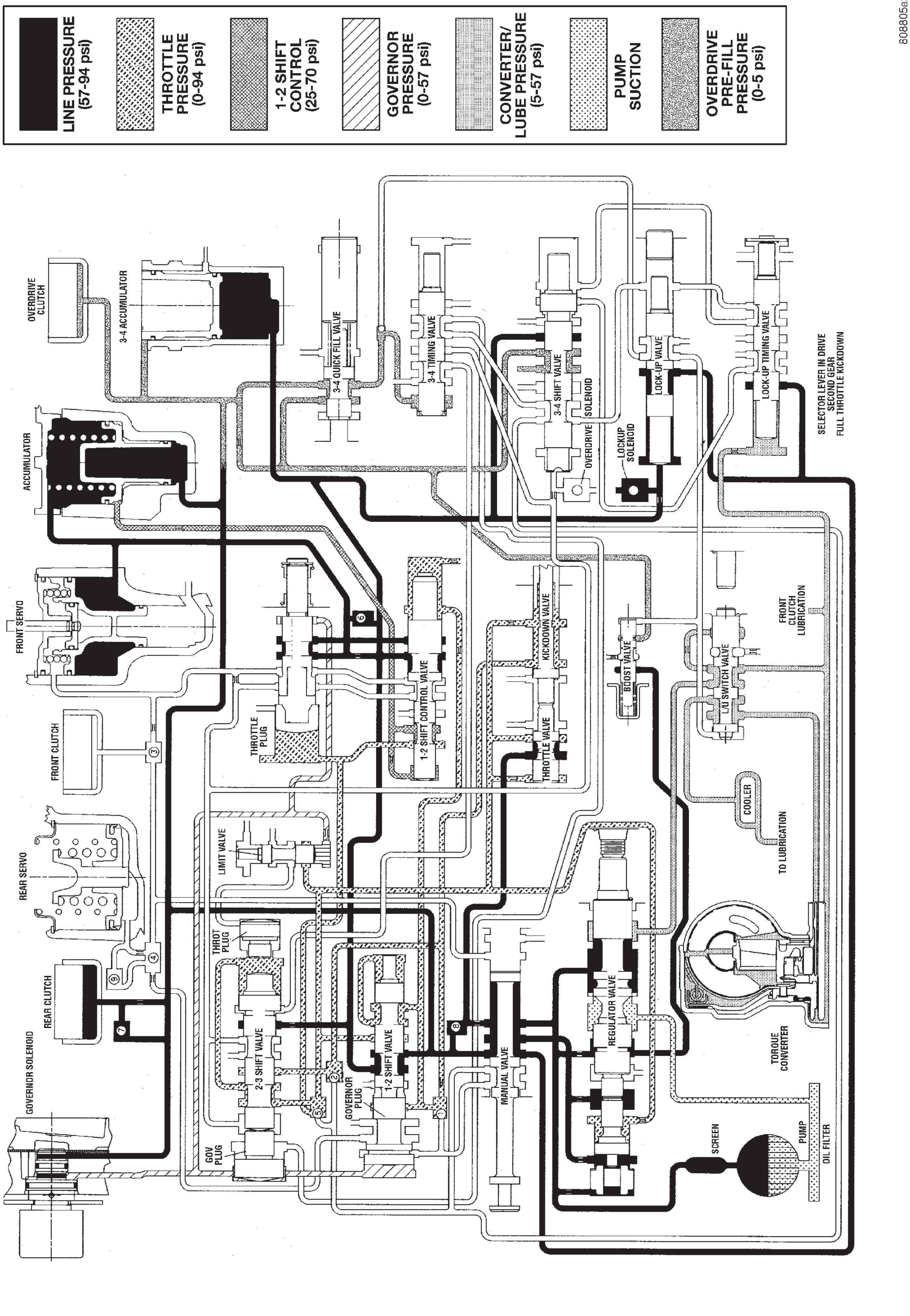
HYDRAULIC FLOW IN MANUAL LOW (1)

AUTOMATIC TRANSMISSION - 46RE (Continued)



HYDRAULIC FLOW IN MANUAL SECOND (2)

AUTOMATIC TRANSMISSION - 46RE (Continued)



HYDRAULIC FLOW DURING FULL THROTTLE 3-2 DOWNSHIFT (PASSING

AUTOMATIC TRANSMISSION - 46RE (Continued)

SPECIFICATIONS

TRANSMISSION

GENERAL

Component	Metric	Inch
Planetary end play	0.150-1.22 mm	0.006-0.048 in.
Input shaft end play	0.86-2.13 mm	0.034-0.084 in.
Clutch pack clearance/Front.	1.78-3.28 mm	0.070-0.129 in.
Clutch pack clearance/Rear.	0.635-0.914 mm	0.025-0.036 in.
Front clutch	3 discs	
Rear clutch	4 discs	
Overdrive clutch	4 discs	
Direct clutch	8 discs	
Band adjustment from 72 in. lbs.		
Front band	Back off 2 7/8 turns	
Rear band	Back off 2 turns	
Recommended fluid	Mopar® ATF +4, type 9602	

GEAR RATIOS

1ST GEAR	2.45:1
2ND GEAR	1.45:1
3RD GEAR	1.0:1
4TH GEAR	0.69:1
REVERSE	2.21:1

THRUST WASHER/SPACER/SNAP-RING DIMENSIONS

Component	Metric	Inch
Front clutch thrust washer (reaction shaft support hub)	1.55 mm	0.061 in.
	2.15 mm	0.084 in.
	2.59 mm	0.102 in.
Rear clutch thrust washer (clutch retainer)	1.55 mm	0.061 in.
Intermediate shaft thrust plate (shaft hub pilot)	1.5-1.6 mm	0.060-0.063 in.
Output shaft thrust washer (rear clutch hub)	1.3-1.4 mm	0.052-0.054 in.
	1.75-1.8 mm	0.068-0.070 in.
	2.1-2.2 mm	0.083-0.085 in.
Rear clutch pack snap-ring	1.5-1.6 mm	0.060-0.062 in.
	1.9-1.95 mm	0.074-0.076 in.
Planetary geartrain snap-ring (at front of output shaft)	1.4-1.5 mm	0.055-0.059 in.
	1.6-1.7 mm	0.062-0.066 in.
Overdrive piston thrust plate	Thrust plate and spacer are select fit. Refer to size charts and selection procedures in Overdrive Unit D&A procedures	
Intermediate shaft spacer		

AUTOMATIC TRANSMISSION - 46RE (Continued)

PRESSURE TEST

Overdrive clutch	Fourth gear only	Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-896 kPa (90-130 psi) at 1/2 to 3/4 throttle.
Line pressure (at accumulator)	Closed throttle	372-414 kPa (54-60 psi).
Front servo	Third or Fourth gear only	No more than 21 kPa (3 psi) lower than line pressure.
Rear servo	1 range R range	No more than 21 kPa (3 psi) lower than line pressure. 1103 kPa (160 psi) at idle, builds to 1862 kPa (270 psi) at 1600 rpm.
Governor	D range closed throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1.5 psi) when stopped with transmission in D, 1, 2. Pressure above 7 kPa (1.5 psi) at stand still will prevent transmission from downshifting.

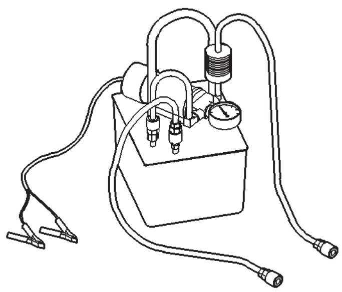
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Fitting, cooler line at trans	18	13	-
Bolt, torque convertor	31	-	270
Bolt, clevis bracket to crossmember	47	35	-
Bolt, clevis bracket to rear support	68	50	-
Bolt, driveplate to crankshaft	75	55	-
Plug, front band reaction	17	13	-
Locknut, front band adj.	34	25	-
Bolt, fluid pan	17	13	-
Screws, fluid filter	4	-	35
Bolt, oil pump	20	15	-
Bolt, overrunning clutch cam	17	13	-
Bolt, O/D to trans.	34	25	-
Bolt, O/D piston retainer	17	13	-
Plug, pressure test port	14	10	-
Bolt, reaction shaft support	20	15	-
Locknut, rear band	41	30	-
Bolt, valve body to case	12	-	100
Sensor, trans speed	27	20	-
Screw, solenoid wiring connector	4	-	35
Screw, solenoid to transfer plate	4	-	35
Bracket, transmission range sensor mounting	34	-	300
Screw, transmission range sensor to mounting bracket	3.4	-	30

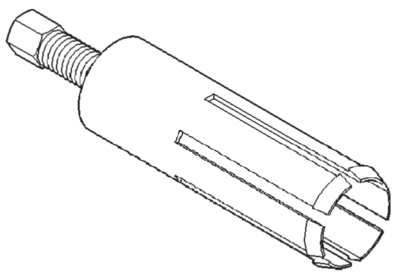
AUTOMATIC TRANSMISSION - 46RE (Continued)

SPECIAL TOOLS

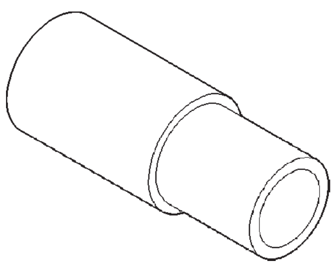
RE TRANSMISSION



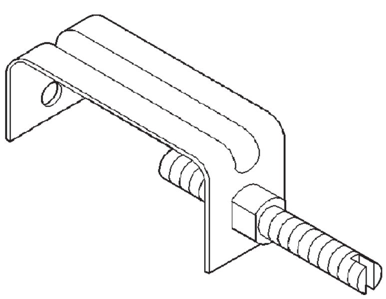
Flusher, Oil Cooler - 6906



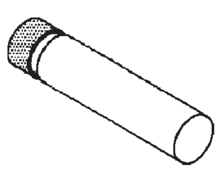
Remover, Bushing - 6957



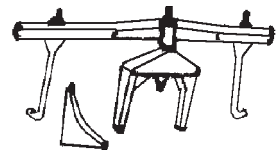
Installer, Bushing - 6951



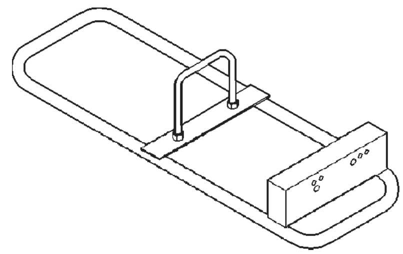
Retainer, Detent Ball and Spring - 6583



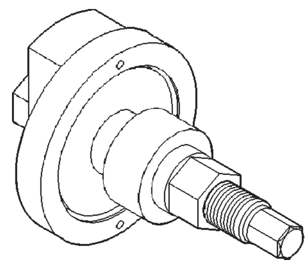
Gauge, Block - 6312



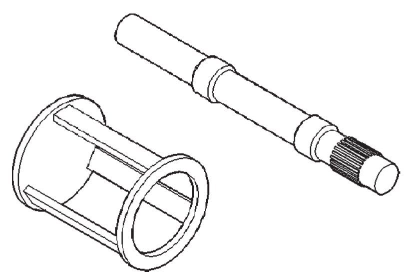
Fixture, Engine Support - C-3487-A



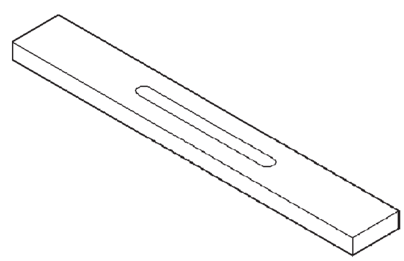
Stand, Transmission Repair - C-3750-B



Compressor, Spring - C-3863-A

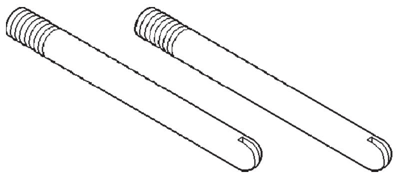


Spring Compressor and Alignment Shaft - 6227

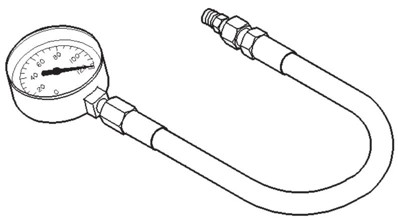


Bar, Gauge - 6311

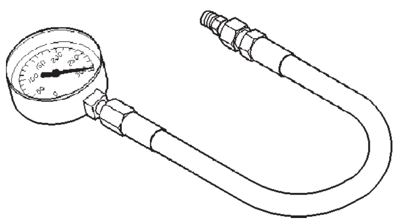
AUTOMATIC TRANSMISSION - 46RE (Continued)



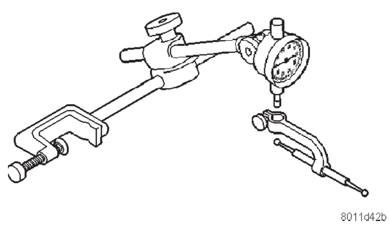
Studs, Oil Pump Pilot - C-3288-B



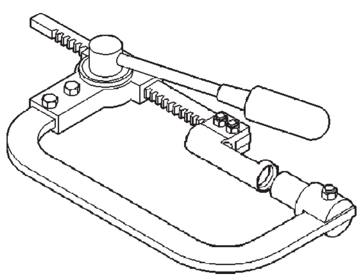
Gauge, Pressure - C-3292



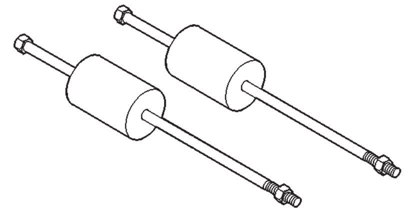
Gauge, Pressure - C-3293SP



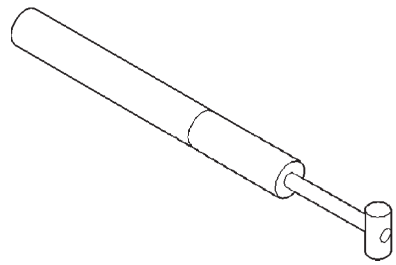
Set, Dial Indicator - C-3339



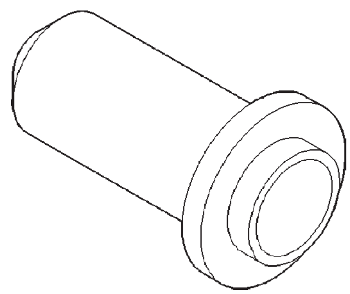
Compressor, Spring - C-3422-B



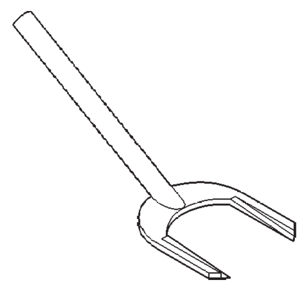
Puller, Slide Hammer - C-3752



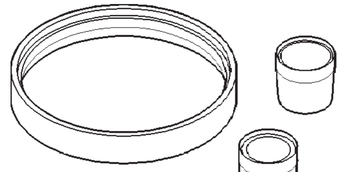
Gauge, Throttle Setting - C-3763



Installer, Seal - C-3860-A

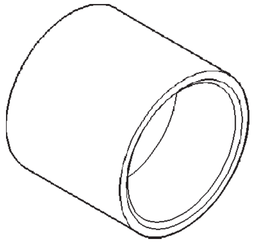


Remover, Seal - C-3985-B

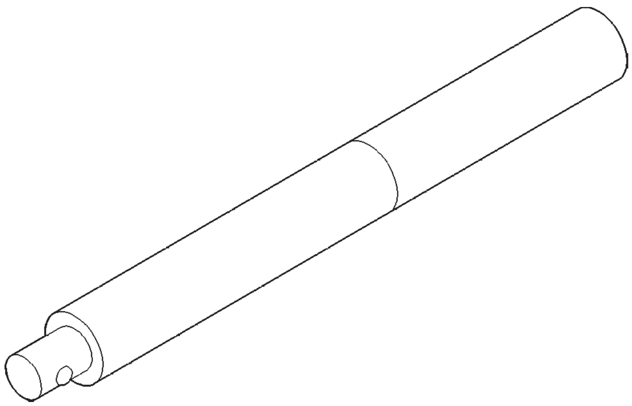


Installer, Overdrive Piston Seal - 8114

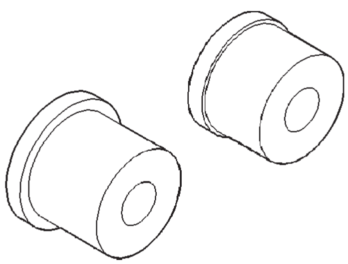
AUTOMATIC TRANSMISSION - 46RE (Continued)



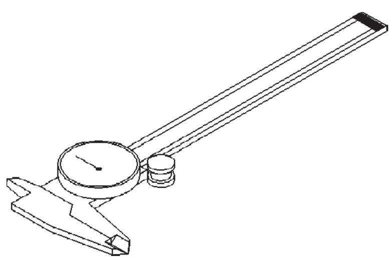
Installer, Seal - C-3995-A



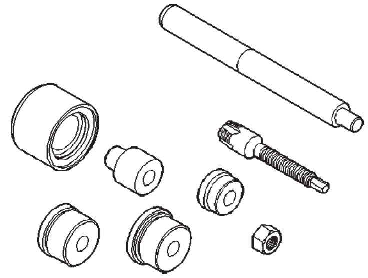
Handle, Universal - C-4171



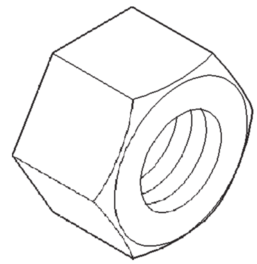
Remover/Installer, Bushing - C-4470



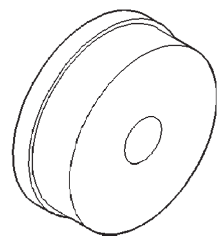
Dial Caliper - C-4962



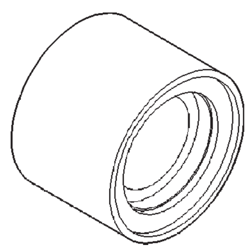
Set, Bushing Remover/Installer - C-3887-J



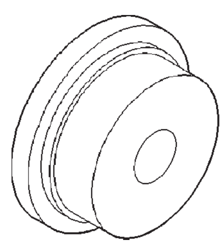
Nut, Bushing Remover - SP-1191, From kit C-3887-J



Remover, Front Clutch Bushing - SP-3629, From kit C-3887-J

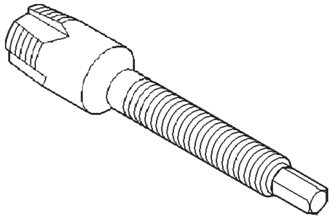


Cup, Bushing Remover - SP-3633, From kit C-3887-J

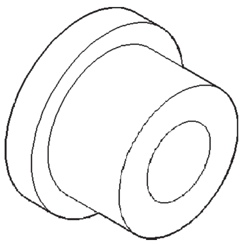


Installer, Oil Pump Bushing - SP-5118, From kit C-3887-J

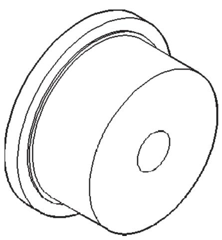
AUTOMATIC TRANSMISSION - 46RE (Continued)



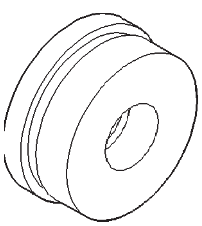
Remover, Reaction Shaft Bushing - SP-5301, From Kit C-3887-J



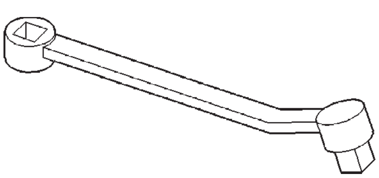
Installer, Reaction Shaft Bushing - SP-5302, From kit C-3887-J



Installer, Front Clutch Bushing - SP-5511, From kit C-3887-J



Remover, Bushing - SP-3550, From kit C-3887-J



Adapter, Band Adjuster - C-3705

ACCUMULATOR

DESCRIPTION

The accumulator (Fig. 65) 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. The 3-4 accumulator is located in a housing attached to the side of the valve body (Fig. 66).

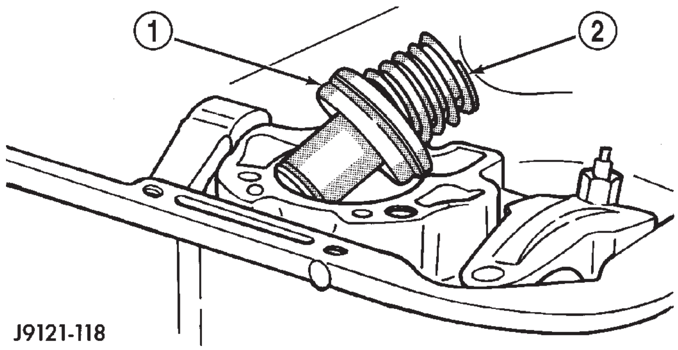


Fig. 65 Accumulator

1 - ACCUMULATOR PISTON
2 - PISTON SPRING

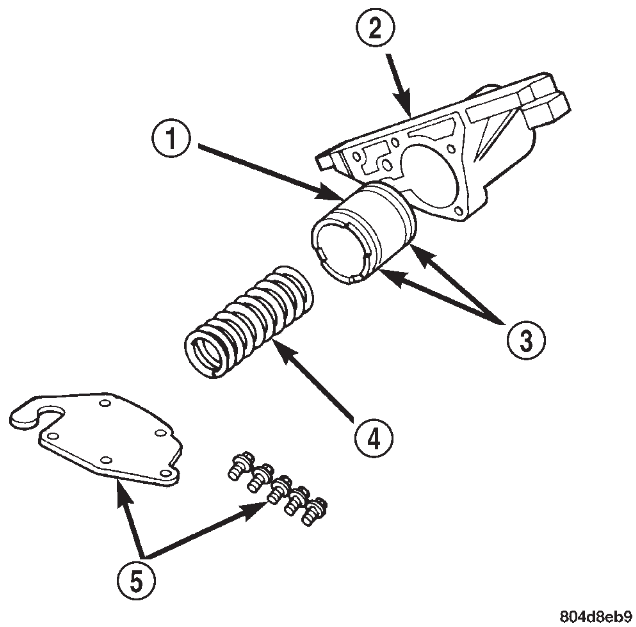


Fig. 66 3-4 Accumulator and Housing

1 - ACCUMULATOR PISTON
2 - 3-4 ACCUMULATOR HOUSING
3 - TEFLON SEALS
4 - PISTON SPRING
5 - COVER PLATE AND SCREWS

ACCUMULATOR (Continued)

OPERATION

Both the accumulator and the 3-4 accumulator function the same. Line pressure is directed to the small end of the piston when the transmission is placed into a DRIVE position (Fig. 67), bottoming it against the accumulator plate. 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. 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.

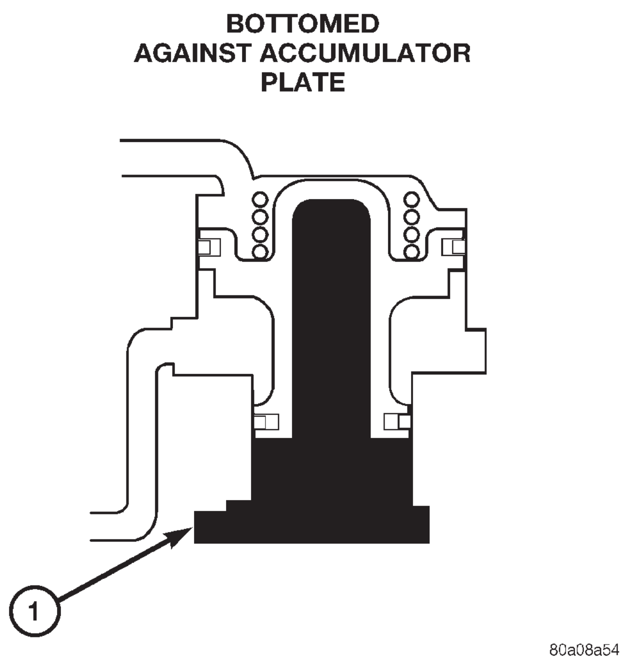


Fig. 67 Accumulator in DRIVE - FIRST GEAR POSITION

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.

Check condition of the accumulator inner and outer springs (Fig. 69). Replace the springs if the coils are cracked, distorted or collapsed.

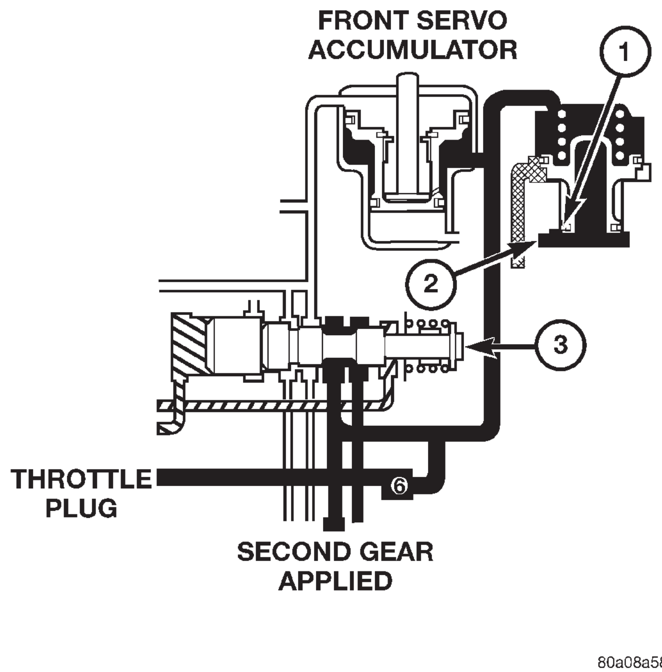


Fig. 68 Accumulator in SECOND Gear Position

1 - BOTTOM OF BORE
2 - LINE PRESSURE
3 - SHUTTLE VALVE

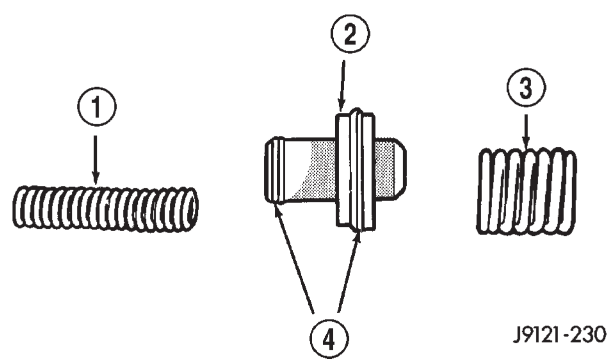


Fig. 69 Accumulator Components

1 - INNER SPRING
2 - ACCUMULATOR PISTON
3 - OUTER SPRING
4 - SEAL RINGS

BANDS

DESCRIPTION

KICKDOWN (FRONT) BAND

The kickdown, or “front”, band (Fig. 70) 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

BANDS (Continued)

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).

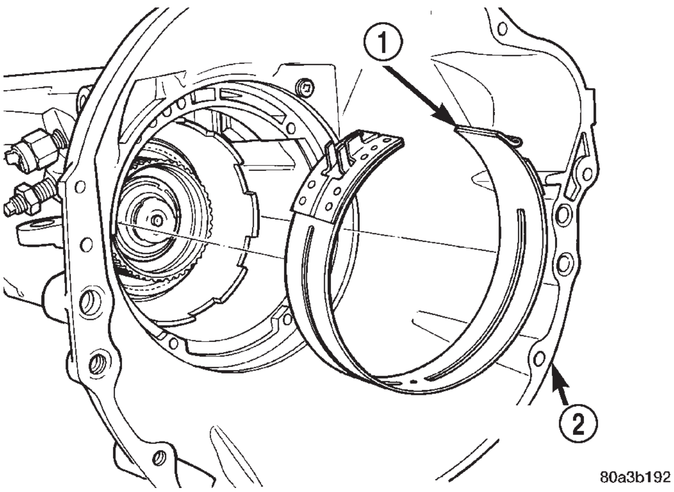


Fig. 70 Front Band

1 - FRONT BAND
2 - TRANSMISSION HOUSING

LOW/REVERSE (REAR) BAND

The low/reverse band, or “rear”, band (Fig. 71) 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).

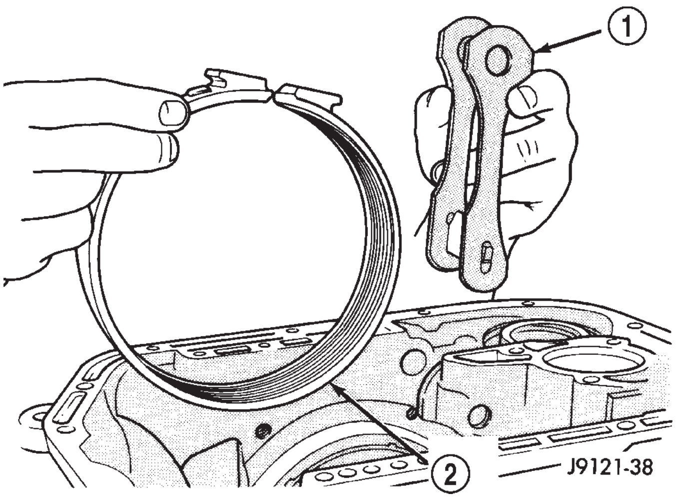


Fig. 71 Rear Band And Link

1 - BAND LINK
2 - REAR BAND

OPERATION

KICKDOWN (FRONT) BAND

The kickdown band holds the common sun gear of the planetary gear sets by applying and holding the front clutch retainer, which is splined to the sun gear driving shell, and in turn splined directly to the sun gear. The application of the band by the servo is typically done by an apply lever and link bar.

LOW/REVERSE (REAR) BAND

The rear band holds the rear planet carrier stationary by being mounted around and applied to the low/reverse drum.

ADJUSTMENT - BANDS

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. 72). 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 an 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 2-7/8 turns.

(5) Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

(6) Lower vehicle.

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 8 N·m (72 in. lbs.) torque (Fig. 73).

(5) Back off adjusting screw 2 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.

BANDS (Continued)

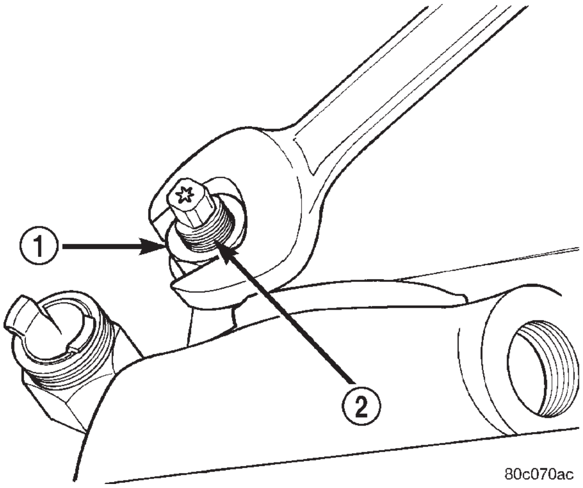


Fig. 72 Front Band Adjustment Screw Location

1 - LOCK-NUT
2 - FRONT BAND ADJUSTER

(8) Lower vehicle and refill transmission with Mopar® ATF +4, Type 9602 fluid.

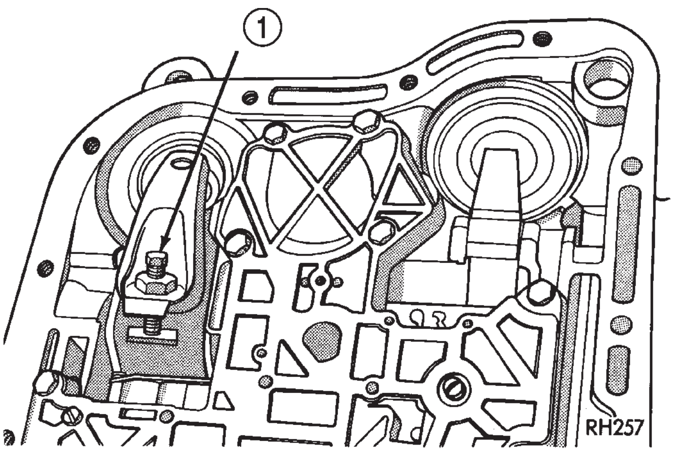


Fig. 73 Rear Band Adjustment Screw Location

1 - LOW-REVERSE BAND ADJUSTMENT

ELECTRONIC GOVERNOR

DESCRIPTION

Governor pressure is controlled electronically. Components used for governor pressure control include:

- Governor body
- Valve body transfer plate
- Governor pressure solenoid valve
- Governor pressure sensor
- Fluid temperature thermistor
- Throttle position sensor (TPS)
- Transmission speed sensor
- Powertrain control module (PCM)

GOVERNOR PRESSURE SOLENOID VALVE

The solenoid valve is a duty-cycle solenoid which regulates the governor pressure needed for upshifts and downshifts. It is an electro-hydraulic device located in the governor body on the valve body transfer plate (Fig. 74).

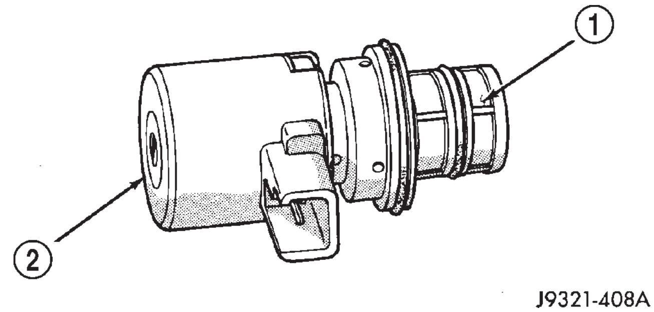


Fig. 74 Governor Pressure Solenoid Valve

1 - SOLENOID FILTER
2 - GOVERNOR PRESSURE SOLENOID

GOVERNOR PRESSURE SENSOR

The governor pressure sensor measures output pressure of the governor pressure solenoid valve (Fig. 75).

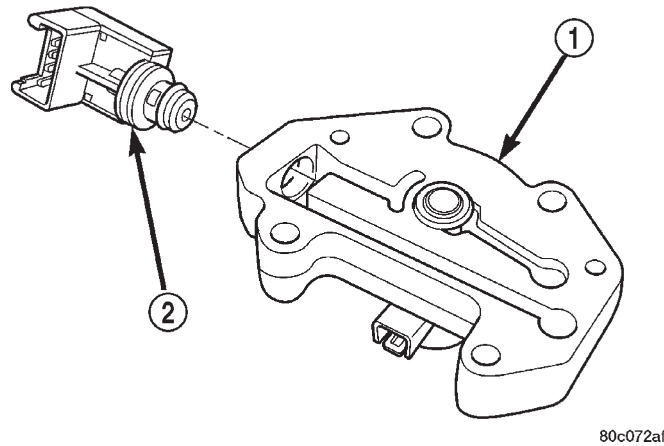


Fig. 75 Governor Pressure Sensor

1 - GOVERNOR BODY
2 - GOVERNOR PRESSURE SENSOR/TRANSMISSION FLUID TEMPERATURE THERMISTOR

GOVERNOR BODY AND TRANSFER PLATE

The transfer plate is designed to supply transmission line pressure to the governor pressure solenoid valve and to return governor pressure.

The governor pressure solenoid valve is mounted in the governor body. The body is bolted to the lower side of the transfer plate (Fig. 75).

ELECTRONIC GOVERNOR (Continued)

GOVERNOR PRESSURE CURVES

There are four governor pressure curves programmed into the transmission control module. The different curves allow the control module to adjust governor pressure for varying conditions. One curve is used for operation when fluid temperature is at, or below, –1°C (30°F). A second curve is used when fluid temperature is at, or above, 10°C (50°F) during normal city or highway driving. A third curve is used during wide-open throttle operation. The fourth curve is used when driving with the transfer case in low range.

OPERATION

Compensation is required for performance variations of two of the input devices. Though the slope of the transfer functions is tightly controlled, offset may vary due to various environmental factors or manufacturing tolerances.

The pressure transducer is affected by barometric pressure as well as temperature. Calibration of the zero pressure offset is required to compensate for shifting output due to these factors.

Normal calibration will be performed when sump temperature is above 50 degrees F, or in the absence of sump temperature data, after the first 10 minutes of vehicle operation. Calibration of the pressure transducer offset occurs each time the output shaft speed falls below 200 RPM. Calibration shall be repeated each 3 seconds the output shaft speed is below 200 RPM. A 0.5 second pulse of 95% duty cycle is applied to the governor pressure solenoid valve and the transducer output is read during this pulse. Averaging of the transducer signal is necessary to reject electrical noise.

Under cold conditions (below 50 degrees F sump), the governor pressure solenoid valve response may be too slow to guarantee 0 psi during the 0.5 second calibration pulse. Calibration pulses are continued during this period, however the transducer output valves are discarded. Transducer offset must be read at key-on, under conditions which promote a stable reading. This value is retained and becomes the offset during the ″cold″ period of operation.

GOVERNOR PRESSURE SOLENOID VALVE

The inlet side of the solenoid valve is exposed to normal transmission line pressure. The outlet side of the valve leads to the valve body governor circuit.

The solenoid valve regulates line pressure to produce governor pressure. The average current supplied to the solenoid controls governor pressure. One amp current produces zero kPa/psi governor pressure. Zero amps sets the maximum governor pressure.

The powertrain control module (PCM) turns on the trans control relay which supplies electrical power to the solenoid valve. Operating voltage is 12 volts (DC). The PCM controls the ground side of the solenoid using the governor pressure solenoid control circuit.

GOVERNOR PRESSURE SENSOR

The sensor output signal provides the necessary feedback to the PCM. This feedback is needed to adequately control governor pressure.

GOVERNOR BODY AND TRANSFER PLATE

The transfer plate channels line pressure to the solenoid valve through the governor body. It also channels governor pressure from the solenoid valve to the governor circuit. It is the solenoid valve that develops the necessary governor pressure.

GOVERNOR PRESSURE CURVES

LOW TRANSMISSION FLUID TEMPERATURE

When the transmission fluid is cold the conventional governor can delay shifts, resulting in higher than normal shift speeds and harsh shifts. The electronically controlled low temperature governor pressure curve is higher than normal to make the transmission shift at normal speeds and sooner. The PCM uses a temperature sensor in the transmission oil sump to determine when low temperature governor pressure is needed.

NORMAL OPERATION

Normal operation is refined through the increased computing power of the PCM and through access to data on engine operating conditions provided by the PCM that were not available with the previous stand-alone electronic module. This facilitated the development of a load adaptive shift strategy - the ability to alter the shift schedule in response to vehicle load condition. One manifestation of this capability is grade ″hunting″ prevention - the ability of the transmission logic to delay an upshift on a grade if the engine does not have sufficient power to maintain speed in the higher gear. The 3-2 downshift and the potential for hunting between gears occurs with a heavily loaded vehicle or on steep grades. When hunting occurs, it is very objectionable because shifts are frequent and accompanied by large changes in noise and acceleration.

WIDE OPEN THROTTLE OPERATION

In wide-open throttle (WOT) mode, adaptive memory in the PCM assures that up-shifts occur at the preprogrammed optimum speed. WOT operation is determined from the throttle position sensor, which is also a part of the emission control system. The ini-

ELECTRONIC GOVERNOR (Continued)

tial setting for the WOT upshift is below the optimum engine speed. As WOT shifts are repeated, the PCM learns the time required to complete the shifts by comparing the engine speed when the shifts occur to the optimum speed. After each shift, the PCM adjusts the shift point until the optimum speed is reached. The PCM also considers vehicle loading, grade and engine performance changes due to high altitude in determining when to make WOT shifts. It does this by measuring vehicle and engine acceleration and then factoring in the shift time.

TRANSFER CASE LOW RANGE OPERATION

On four-wheel drive vehicles operating in low range, the engine can accelerate to its peak more rapidly than in Normal range, resulting in delayed shifts and undesirable engine ″flare.″ The low range governor pressure curve is also higher than normal to initiate upshifts sooner. The PCM compares electronic vehicle speed signal used by the speedometer to the transmission output shaft speed signal to determine when the transfer case is in low range.

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove transmission fluid pan and filter.

(3) Disengage wire connectors from pressure sensor and solenoid (Fig. 76).

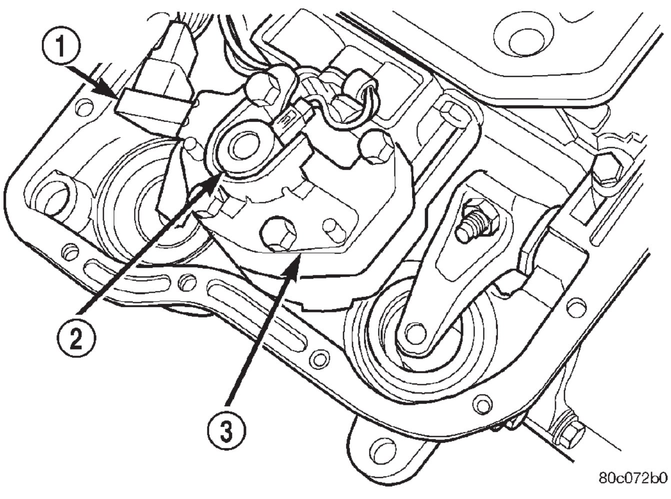


Fig. 76 Governor Solenoid And Pressure Sensor

1 - PRESSURE SENSOR
2 - PRESSURE SOLENOID
3 - GOVERNOR

(4) Remove screws holding pressure solenoid retainer to governor body.

(5) Separate solenoid retainer from governor (Fig. 77).

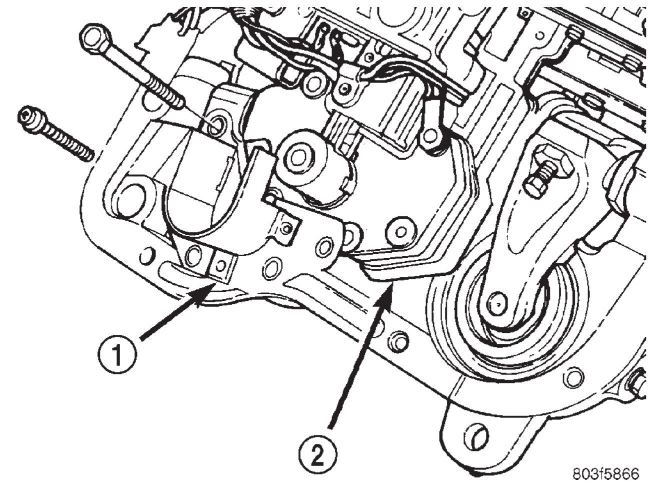


Fig. 77 Pressure Solenoid Retainer

1 - PRESSURE SOLENOID RETAINER
2 - GOVERNOR

(6) Pull solenoid from governor body (Fig. 78).

(7) Pull pressure sensor from governor body.

(8) Remove bolts holding governor body to valve body.

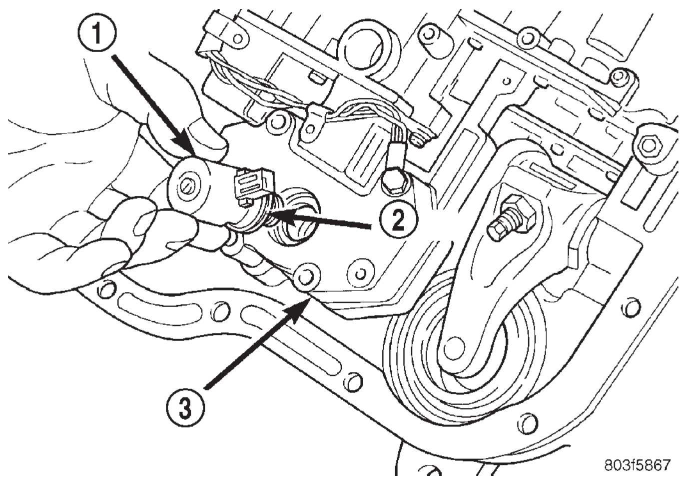


Fig. 78 Pressure Solenoid and O-ring

1 - PRESSURE SOLENOID
2 - O-RING
3 - GOVERNOR

(9) Separate governor body from valve body (Fig. 79).

(10) Remove governor body gasket.

ELECTRONIC GOVERNOR (Continued)

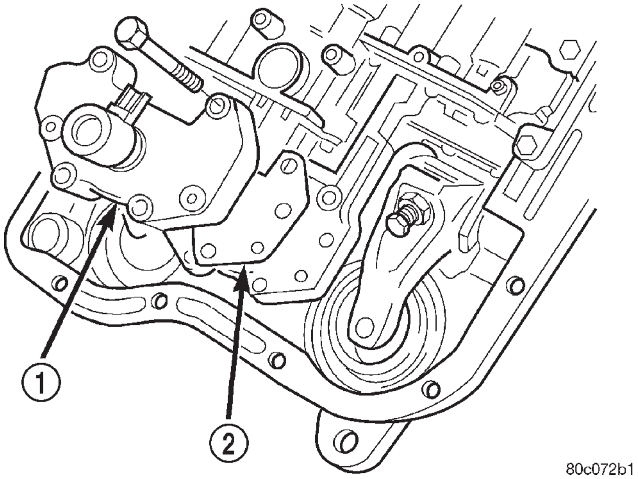


Fig. 79 Governor Body and Gasket

1 - GOVERNOR BODY
2 - GASKET

INSTALLATION

Before installing the pressure sensor and solenoid in the governor body, replace o-ring seals, clean the gasket surfaces and replace gasket.

(1) Place gasket in position on back of governor body (Fig. 80).

(2) Place governor body in position on valve body.

(3) Install bolts to hold governor body to valve body.

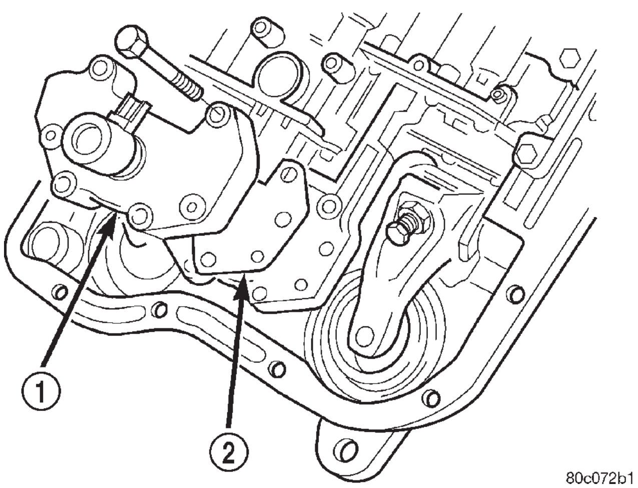


Fig. 80 Governor Body and Gasket

1 - GOVERNOR BODY
2 - GASKET

(4) Lubricate o-ring on pressure sensor with transmission fluid.

(5) Align pressure sensor to bore in governor body.

(6) Push pressure sensor into governor body.

(7) Lubricate o-ring, on pressure solenoid, with transmission fluid.

(8) Align pressure solenoid to bore in governor body (Fig. 81).

(9) Push solenoid into governor body.

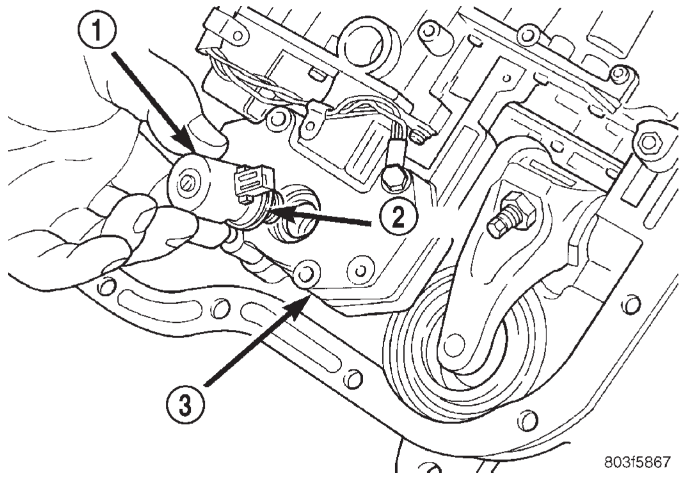


Fig. 81 Pressure Solenoid and O-ring

1 - PRESSURE SOLENOID
2 - O-RING
3 - GOVERNOR

(10) Place solenoid retainer in position on governor (Fig. 82).

(11) Install screws to hold pressure solenoid retainer to governor body.

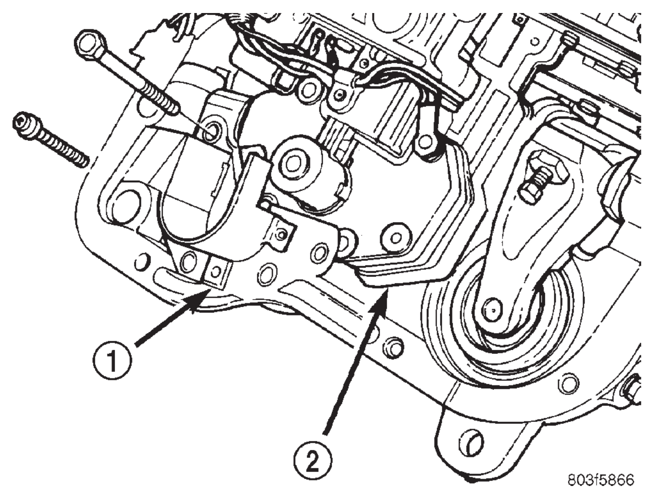


Fig. 82 Pressure Solenoid Retainer

1 - PRESSURE SOLENOID RETAINER
2 - GOVERNOR

ELECTRONIC GOVERNOR (Continued)

(12) Engage wire connectors into pressure sensor and solenoid (Fig. 83).

(13) Install transmission fluid pan and (new) filter.

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

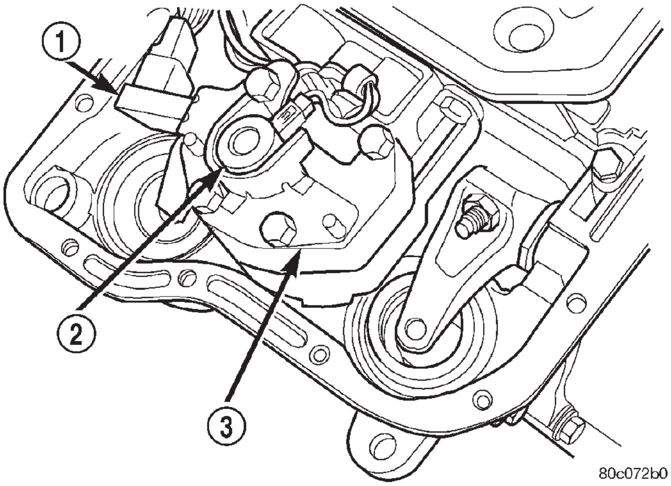


Fig. 83 Governor Solenoid And Pressure Sensor

1 - PRESSURE SENSOR
2 - PRESSURE SOLENOID
3 - GOVERNOR

EXTENSION HOUSING BUSHING

REMOVAL

(1) Remove extension housing yoke seal.

(2) Insert Remover 6957 into the extension housing. Tighten tool to bushing and remove bushing (Fig. 84).

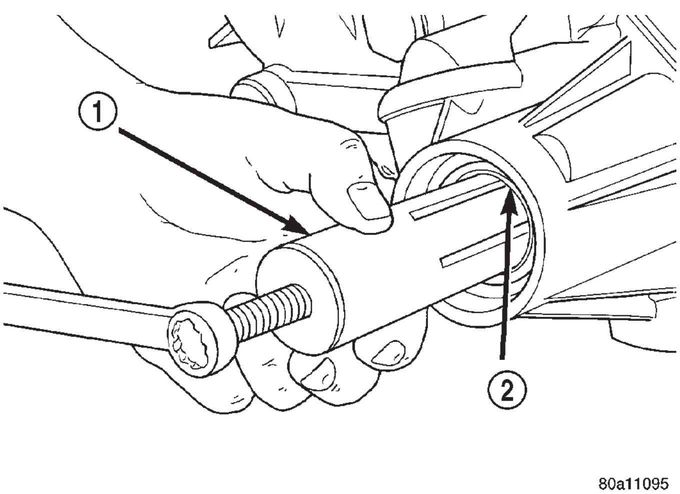


Fig. 84 Bushing Removal - Typical

1 - REMOVER
2 - EXTENSION HOUSING BUSHING

INSTALLATION

(1) Align bushing oil hole with oil slot in extension housing.

(2) Tap bushing into place with Installer 6951 and Handle C-4171.

(3) Install new oil seal in housing using Seal Installer C-3995-A (Fig. 85).

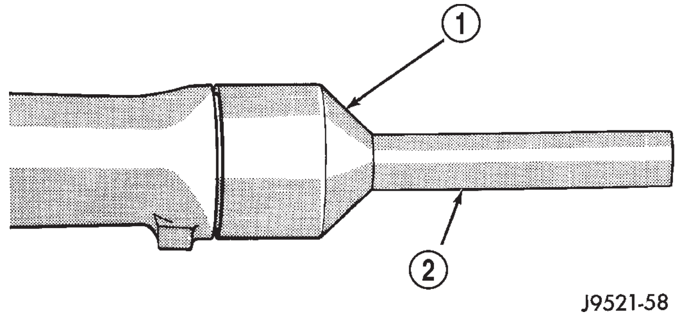


Fig. 85 Extension Housing Seal Installation

1 - SPECIAL TOOL C-3995-A OR C-3972-A
2 - SPECIAL TOOL C-4471

EXTENSION HOUSING SEAL

REMOVAL

(1) Raise vehicle.

(2) Mark propeller shaft and axle yoke for alignment reference.

(3) Disconnect and remove propeller shaft.

(4) Remove old seal with Seal Remover C-3985-B (Fig. 86) from overdrive housing.

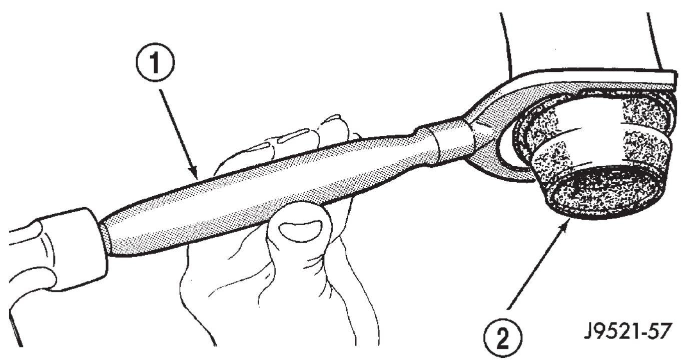


Fig. 86 Removing Transmission Housing Yoke Seal

1 - REMOVER
2 - SEAL

EXTENSION HOUSING SEAL (Continued)

INSTALLATION

(1) Place seal in position on overdrive housing.

(2) Drive seal into overdrive housing with Seal Installer C-3995-A (Fig. 87).

(3) Carefully guide propeller shaft slip yoke into housing and onto output shaft splines. Align marks made at removal and connect propeller shaft to rear axle pinion yoke.

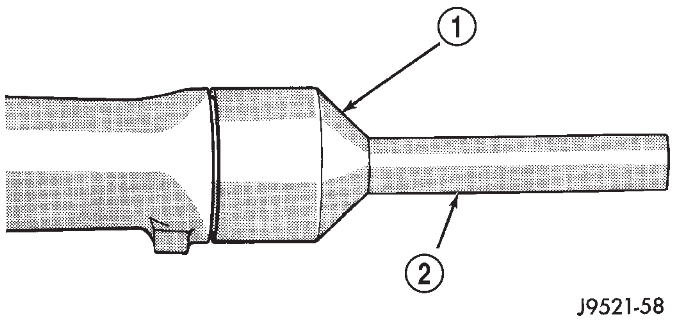


Fig. 87 Installing Overdrive Housing Seal

1 - SPECIAL TOOL C-3995-A OR C-3972-A
2 - SPECIAL TOOL C-4471

FLUID AND FILTER

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.

FLUID AND FILTER (Continued)

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.

Along with fluid level, it is important to check the condition of the fluid. When the fluid smells burned, and is contaminated with metal or friction material particles, a complete transmission recondition is needed. Be sure to examine the fluid on the dipstick closely. If there is any doubt about its condition, drain out a sample for a double check.

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.**

The transmission fluid level can be checked two ways.

PROCEDURE ONE

(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.

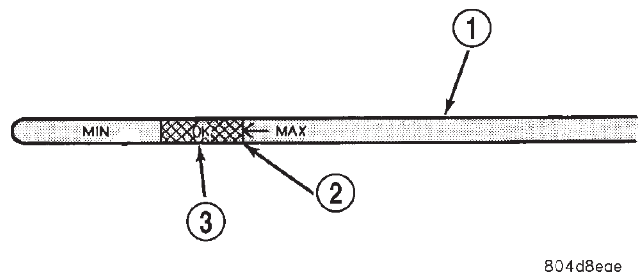


Fig. 88 Dipstick Fluid Level Marks - Typical

1 - DIPSTICK
2 - MAXIMUM CORRECT FLUID LEVEL
3 - ACCEPTABLE FLUID LEVEL

PROCEDURE TWO

(1) Start engine and apply parking brake.

(2) Shift the transmission into DRIVE for approximately 2 seconds.

(3) Shift the transmission into REVERSE for approximately 2 seconds.

(4) Shift the transmission into PARK.

(5) Hook up DRB® scan tool and select engine.

(6) Select sensors.

(7) Read the transmission temperature value.

(8) Compare the fluid temperature value with the figure (Fig. 89).

(9) Adjust transmission fluid level shown on the dipstick according to the figure.

NOTE: After adding any fluid to the transmission, wait a minimum of 2 minutes for the oil to fully drain from the fill tube into the transmission before rechecking the fluid level.

(10) Check transmission for leaks.

FLUID AND FILTER (Continued)

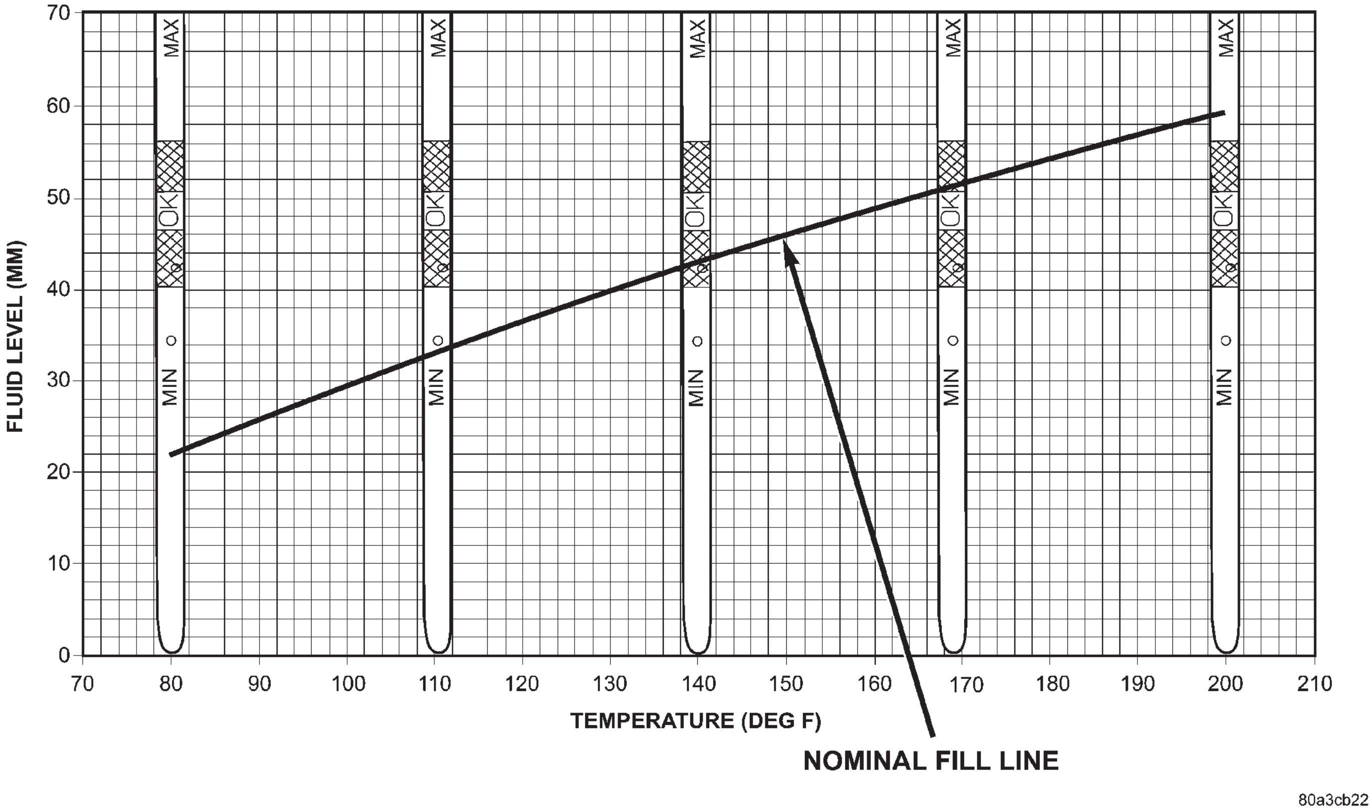


Fig. 89 46RE Fluid Fill Graph

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) Place a large diameter shallow drain pan beneath the transmission pan.

(3) Remove bolts holding front and sides of pan to transmission (Fig. 90).

(4) Loosen bolts holding rear of pan to transmission.

(5) Slowly separate front of pan away from transmission allowing the fluid to drain into drain pan.

(6) Hold up pan and remove remaining bolt holding pan to transmission.

(7) While holding pan level, lower pan away from transmission.

(8) Pour remaining fluid in pan into drain pan.

(9) Remove screws holding filter to valve body (Fig. 91).

(10) Separate filter from valve body and pour fluid in filter into drain pan.

(11) Dispose of used trans fluid and filter properly.

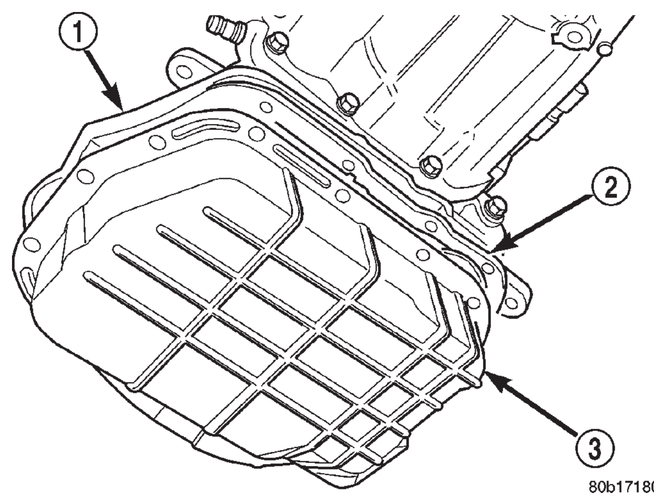


Fig. 90 Transmission Pan

1 - TRANSMISSION
2 - GASKET
3 - PAN

FLUID AND FILTER (Continued)

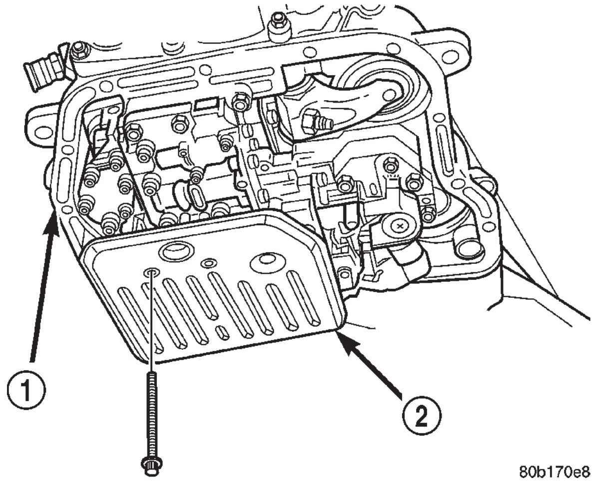


Fig. 91 Transmission Filter

1 - TRANSMISSION
2 - FILTER

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.

FRONT CLUTCH

DESCRIPTION

The front clutch assembly (Fig. 92) 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.

FRONT CLUTCH (Continued)

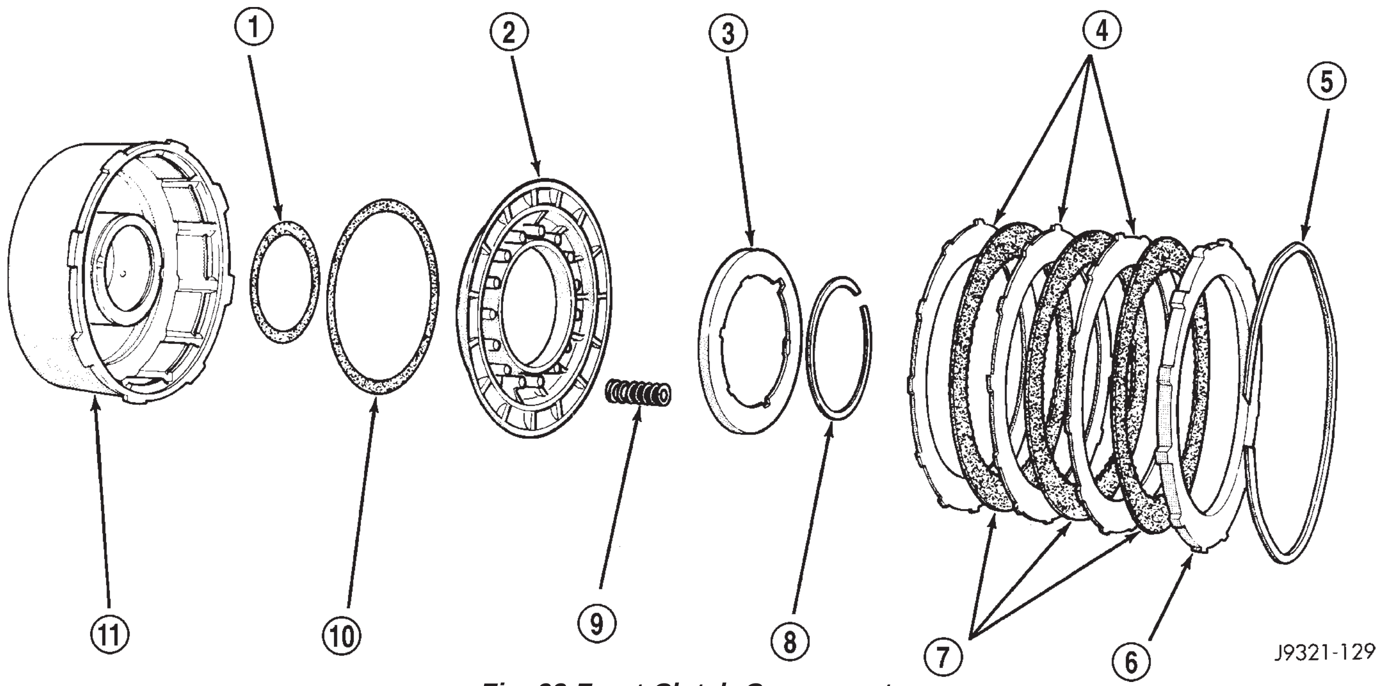


Fig. 92 Front Clutch Components

1 - INNER PISTON SEAL
2 - CLUTCH PISTON
3 - CLUTCH PISTON SPRING RETAINER
4 - CLUTCH PLATES
5 - CLUTCH PACK SNAP-RING (WAVED)
6 - REACTION PLATE
7 - CLUTCH DISCS
8 - RETAINER SNAP-RING
9 - CLUTCH PISTON SPRINGS (9)
10 - OUTER PISTON SEAL
11 - FRONT CLUTCH RETAINER

DISASSEMBLY

(1) Remove the waved snap-ring, reaction plate, clutch plates, and clutch discs.

(2) Compress clutch piston retainer and piston springs with Compressor Tool C-3863-A (Fig. 93).

(3) Remove retainer snap-ring and remove compressor tool.

(4) Remove clutch piston springs (Fig. 94). Note position of piston springs for assembly reference.

(5) Remove clutch piston from retainer with a twisting motion.

(6) Remove and discard clutch piston inner and outer seals.

(7) Assemble Tool Handle C-4171 and Bushing Remover SP-3629 (Fig. 95).

(8) Insert remover tool in bushing and drive bushing straight out of clutch retainer.

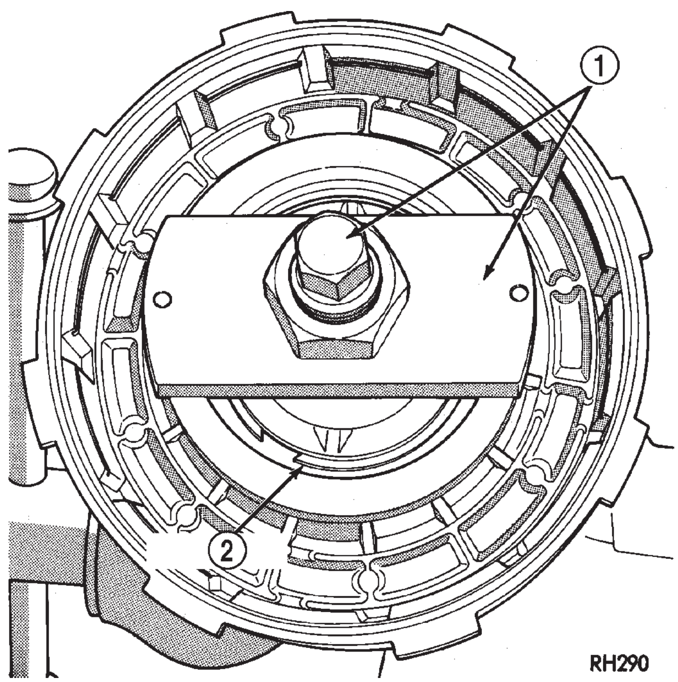


Fig. 93 Removing Front Clutch Spring Retainer Snap-Ring

1 - SPECIAL TOOL C-3863-A
2 - SNAP-RING

FRONT CLUTCH (Continued)

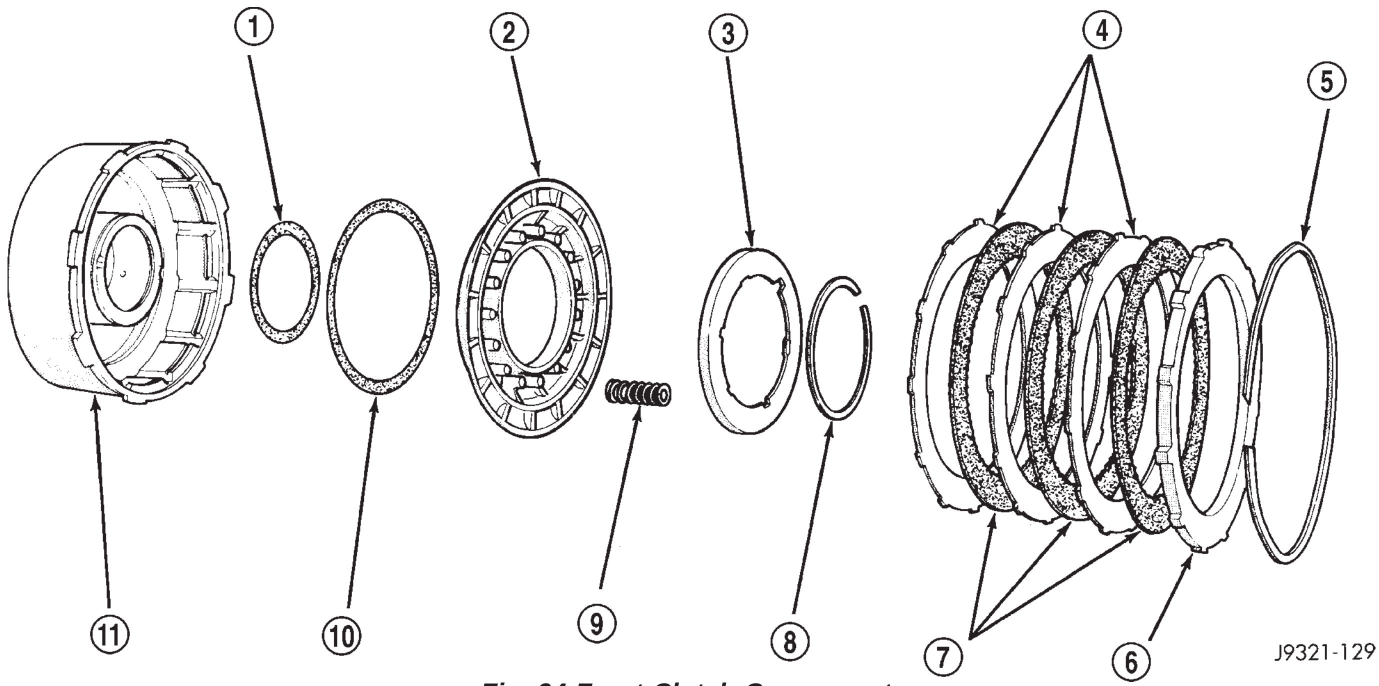


Fig. 94 Front Clutch Components

1 - INNER PISTON SEAL
2 - CLUTCH PISTON
3 - CLUTCH PISTON SPRING RETAINER
4 - CLUTCH PLATES
5 - CLUTCH PACK SNAP-RING (WAVED)
6 - REACTION PLATE
7 - CLUTCH DISCS
8 - RETAINER SNAP-RING
9 - CLUTCH PISTON SPRINGS (9)
10 - OUTER PISTON SEAL
11 - FRONT CLUTCH RETAINER

INSPECTION

Inspect the front clutch components. Replace the clutch discs if warped, worn, scored, burned or charred, the lugs are damaged, or if the facing is flaking off. Replace the steel plates and reaction plate if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plate are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston springs and spring retainer if either are distorted, warped or broken.

Check the lug grooves in the clutch piston retainer. The steel plates should slide freely in the slots. Replace the piston retainer if the grooves are worn or damaged. Also check action of the check ball in the piston retainer. The ball must move freely and not stick.

Replace the retainer bushing if worn, scored, or there is any doubt about bushing condition.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check the clutch piston check ball. The ball should be securely in place. Replace the piston if the ball is missing, or seized in place.

FRONT CLUTCH (Continued)

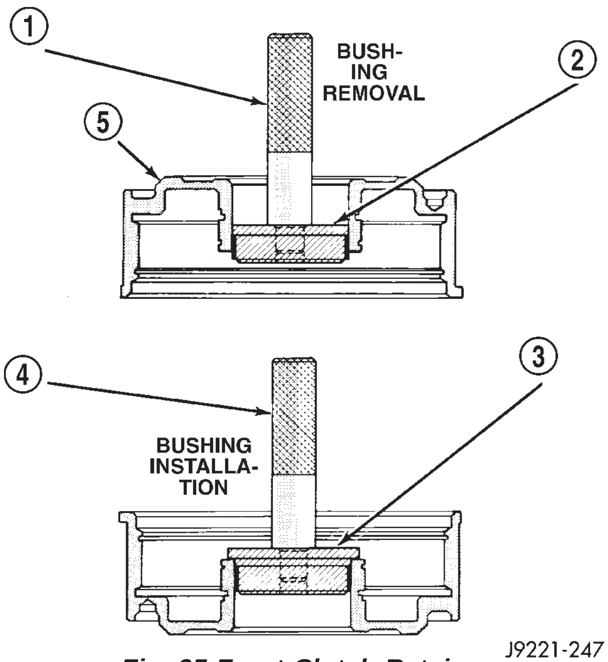


Fig. 95 Front Clutch Retainer Bushing Replacement Tools

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL SP-3629
3 - SPECIAL TOOL SP-5511
4 - SPECIAL TOOL C-4171
5 - FRONT CLUTCH RETAINER

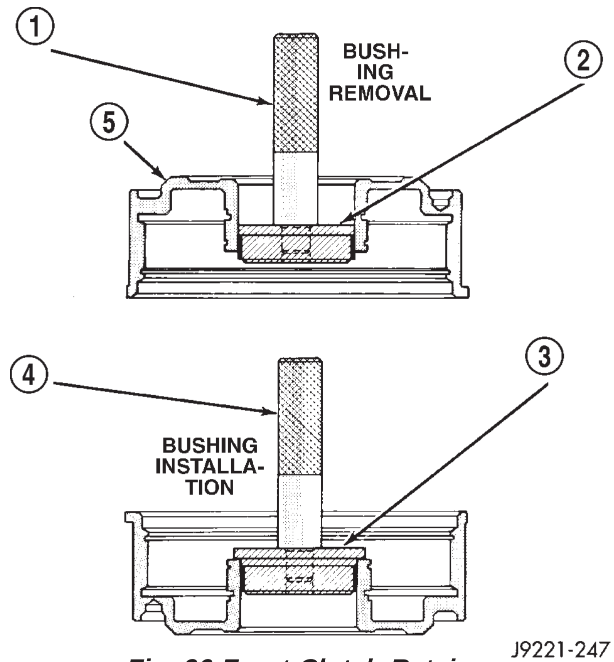


Fig. 96 Front Clutch Retainer Bushing Replacement Tools

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL SP-3629
3 - SPECIAL TOOL SP-5511
4 - SPECIAL TOOL C-4171
5 - FRONT CLUTCH RETAINER

ASSEMBLY

NOTE: The 46RE transmission uses three plates and discs for the front clutch.

(1) Mount Bushing Installer SP-5511 on tool handle (Fig. 96).

(2) Slide new bushing onto installer tool and start bushing into retainer.

(3) Tap new bushing into place until installer tool bottoms against clutch retainer.

(4) Remove installer tools and clean retainer thoroughly.

(5) Soak clutch discs in transmission fluid.

(6) Install new inner piston seal onto the outer diameter of the clutch retainer inner hub.

(7) Install new outer seal onto the clutch piston. Be sure seal lips of both seals face the interior of the retainer.

(8) Lubricate new inner and outer piston seals with Ru-Glyde™, or Mopar® Door Ease.

(9) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.015 - 0.020 in. 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.

(10) Install and position nine clutch piston springs (Fig. 97).

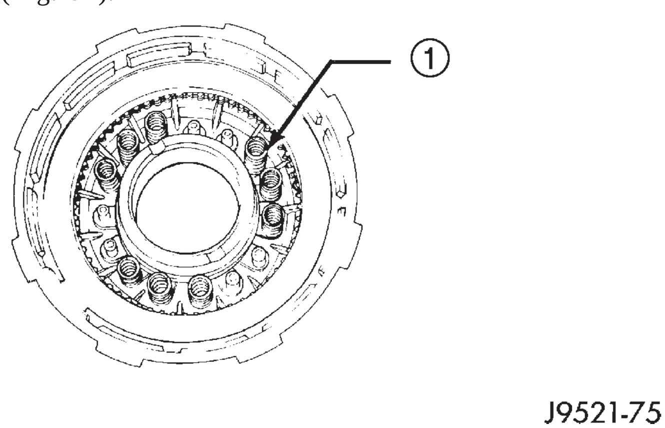


Fig. 97 Front Clutch Spring Position

1 - 9 SPRING CLUTCH

(11) Install spring retainer on top of piston springs.

FRONT CLUTCH (Continued)

(12) Compress spring retainer and piston springs with Tool C-3863-A.

(13) Install spring retainer snap-ring and remove compressor tool.

(14) Install clutch plates and discs (Fig. 94). Three clutch discs, three steel plates and one reaction plate are required.

(15) Install reaction plate followed by waved snap-ring.

(16) Check clutch pack clearance with feeler gauge (Fig. 98). Clearance between waved spring and pressure plate should 1.78 - 3.28 mm (0.070 - 0.129 in.). If clearance is incorrect, clutch plates, clutch discs, snap-ring, or pressure plate may have to be changed.

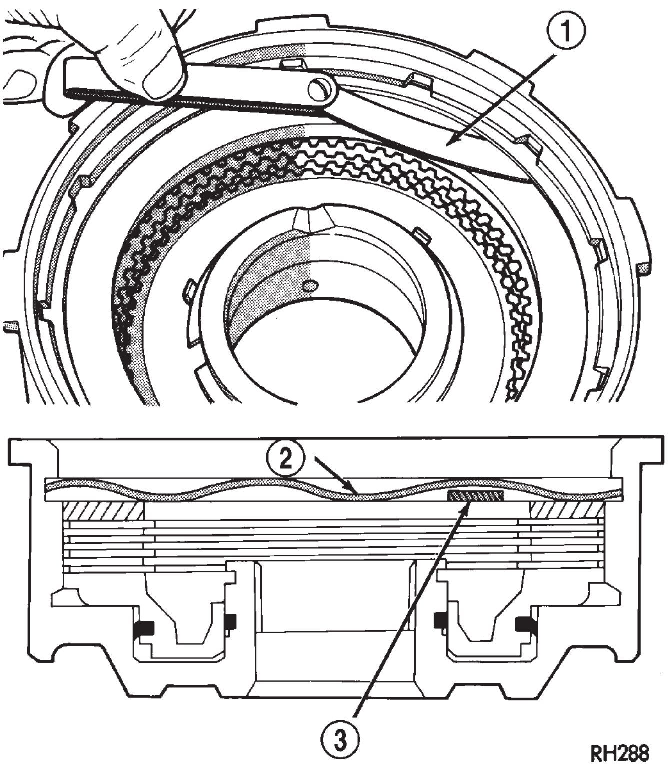


Fig. 98 Typical Method Of Measuring Front Clutch Pack Clearance

1 - FEELER GAUGE
2 - WAVED SNAP-RING
3 - FEELER GAUGE

FRONT SERVO

DESCRIPTION

The kickdown servo (Fig. 99) 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.

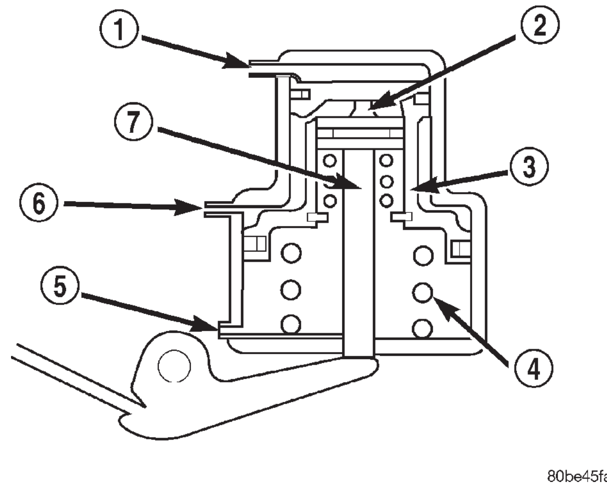


Fig. 99 Front Servo

1 - VENT
2 - INNER PISTON
3 - PISTON
4 - SPRING
5 - RELEASE PRESSURE
6 - APPLY PRESSURE
7 - PISTON ROD

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.

FRONT SERVO (Continued)

DISASSEMBLY

(1) Remove seal ring from rod guide (Fig. 100).

(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.

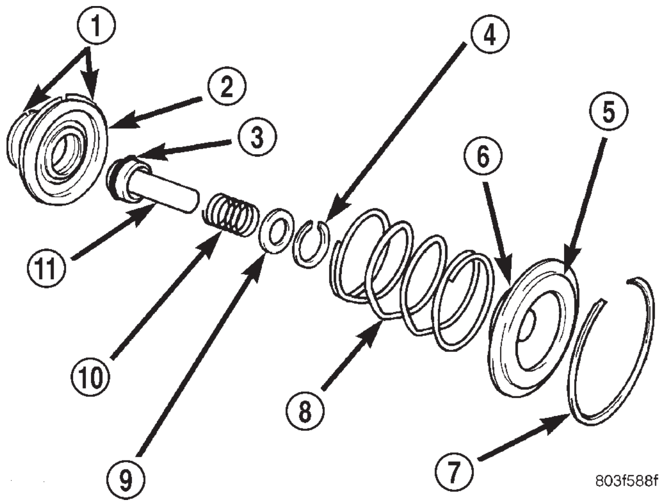


Fig. 100 Front Servo

1 - PISTON RINGS
2 - SERVO PISTON
3 - O-RING
4 - SNAP-RING
5 - PISTON ROD GUIDE
6 - SEAL RING
7 - SNAP-RING
8 - SERVO SPRING
9 - WASHER
10 - SPRING
11 - PISTON ROD

CLEANING

Clean the servo piston components (Fig. 101) with solvent and dry them with compressed air.

INSPECTION

Inspect the servo components (Fig. 102). Replace the springs if collapsed, distorted or broken. Replace the guide, rod and piston if cracked, bent, or worn. Discard the servo snap-ring if distorted or warped.

Check the servo piston bore for wear. If the bore is severely scored, or damaged, it will be necessary to replace the case.

Replace any servo component if doubt exists about condition. Do not reuse suspect parts.

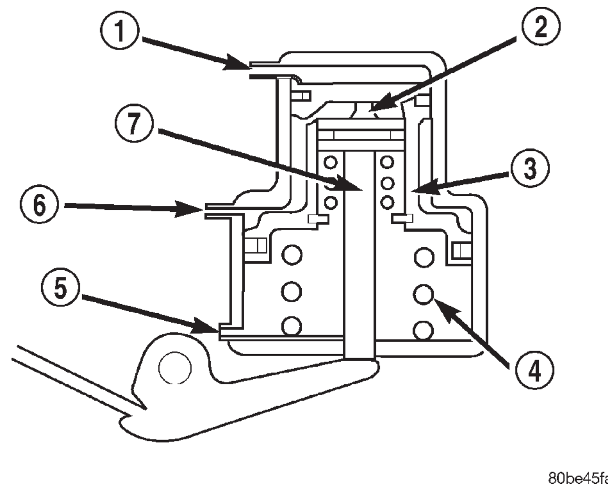


Fig. 101 Front Servo

1 - VENT
2 - INNER PISTON
3 - PISTON
4 - SPRING
5 - RELEASE PRESSURE
6 - APPLY PRESSURE
7 - PISTON ROD

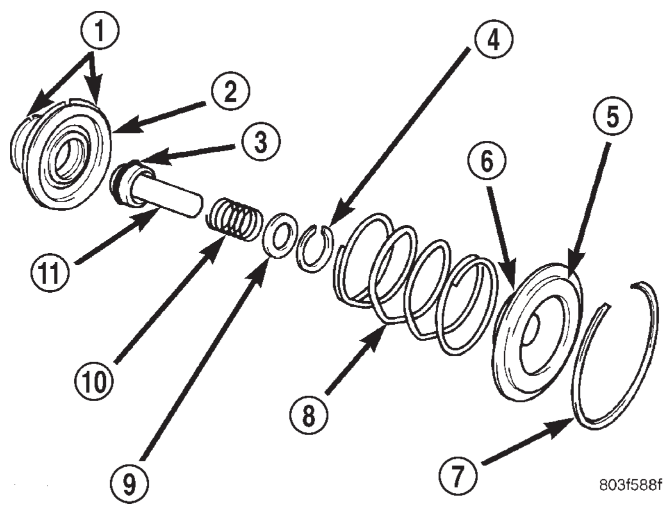


Fig. 102 Front Servo

1 - PISTON RINGS
2 - SERVO PISTON
3 - O-RING
4 - SNAP-RING
5 - PISTON ROD GUIDE
6 - SEAL RING
7 - SNAP-RING
8 - SERVO SPRING
9 - WASHER
10 - SPRING
11 - PISTON ROD

FRONT SERVO (Continued)

ASSEMBLY

Clean and inspect front servo components.

(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. 103).

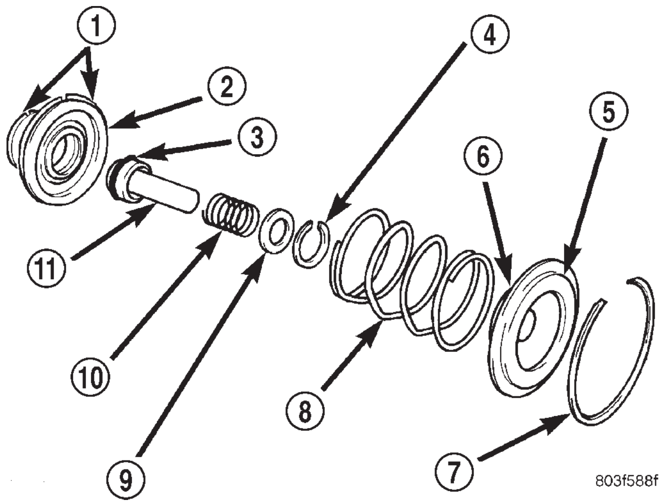


Fig. 103 Front Servo

1 - PISTON RINGS
2 - SERVO PISTON
3 - O-RING
4 - SNAP-RING
5 - PISTON ROD GUIDE
6 - SEAL RING
7 - SNAP-RING
8 - SERVO SPRING
9 - WASHER
10 - SPRING
11 - PISTON ROD

GEARSHIFT CABLE

DIAGNOSIS AND TESTING - GEARSHIFT CABLE

(1) The 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 shift lever in PARK or NEUTRAL gate positions only. Engine starts must not be possible in any other gear position.

(3) With shift lever handle in:

(a) PARK position - Apply forward force on center of lever and remove pressure. Engine starts must be possible.

(b) PARK position - Apply rearward force on center of lever 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 lever. Transmission shall not be able to shift from neutral to reverse.

REMOVAL

(1) Shift transmission into PARK.

(2) Remove the dash panel insulation pad as necessary to access the gearshift cable bracket mounting nuts.

(3) Remove nuts retaining the gearshift cable mounting bracket to the dash panel (Fig. 104) or (Fig. 105).

(4) Disconnect cable at lower column lever and feed cable through dash panel opening to underside of vehicle (Fig. 106).

(5) Raise vehicle.

(6) Disengage cable eyelet at transmission shift lever and pull cable adjuster out of mounting bracket (Fig. 107) or (Fig. 108). Remove old cable from vehicle.

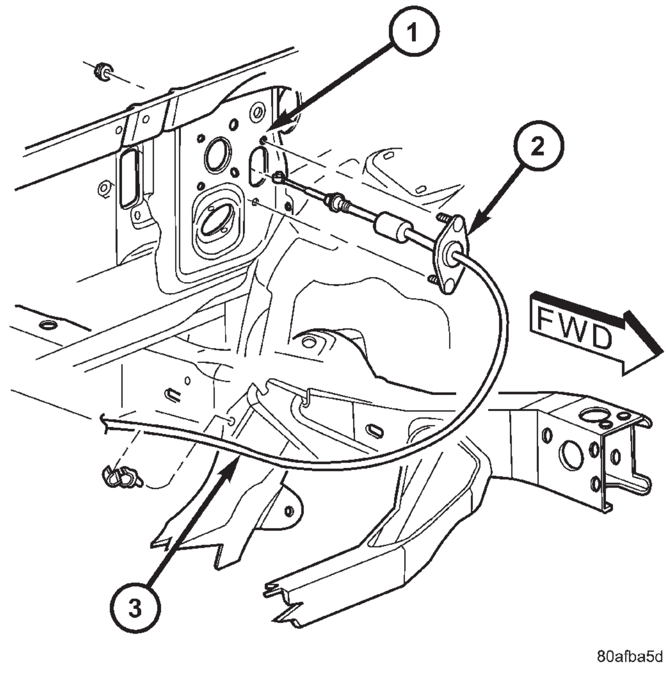


Fig. 104 Cable Mounting at Dash Panel - 4X2

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

GEARSHIFT CABLE (Continued)

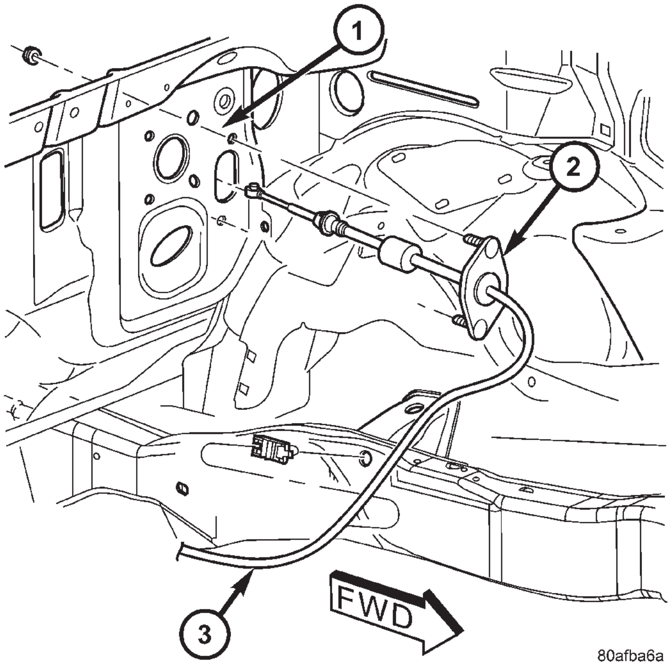


Fig. 105 Cable Mounting at Dash Panel - 4X4

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

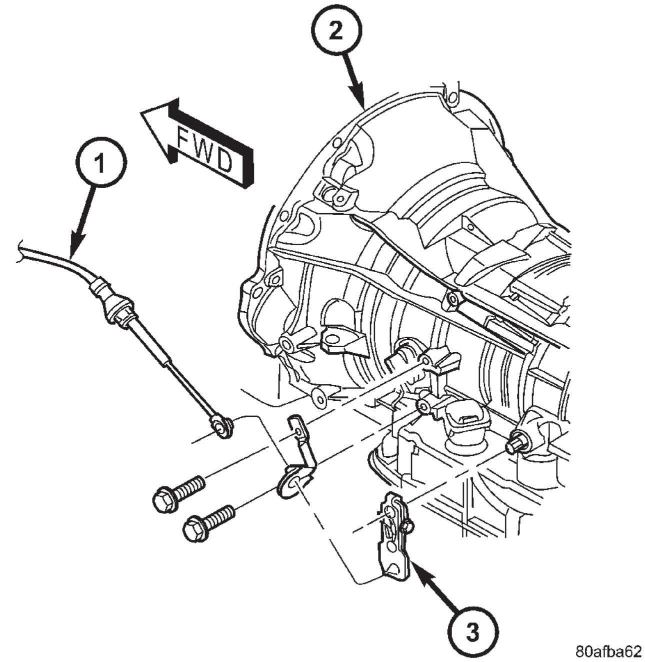


Fig. 107 Gearshift Cable at Transmission - RFE

1 - GEARSHIFT CABLE
2 - RFE TRANSMISSION
3 - MANUAL LEVER

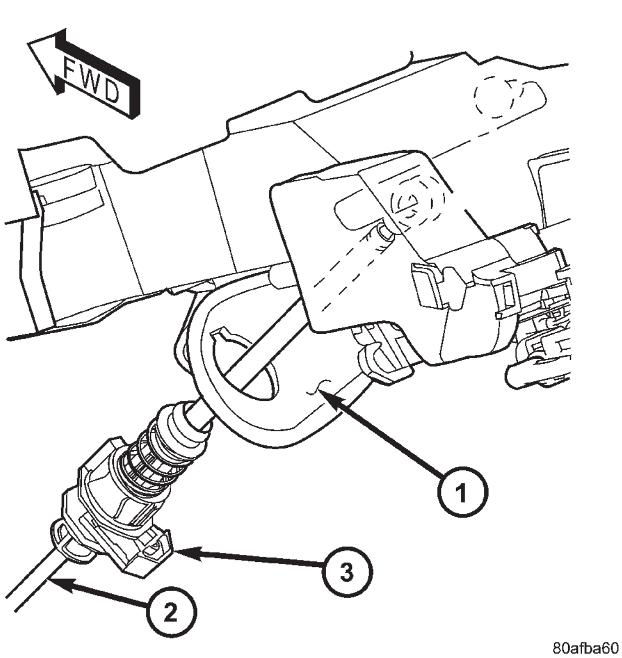


Fig. 106 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB

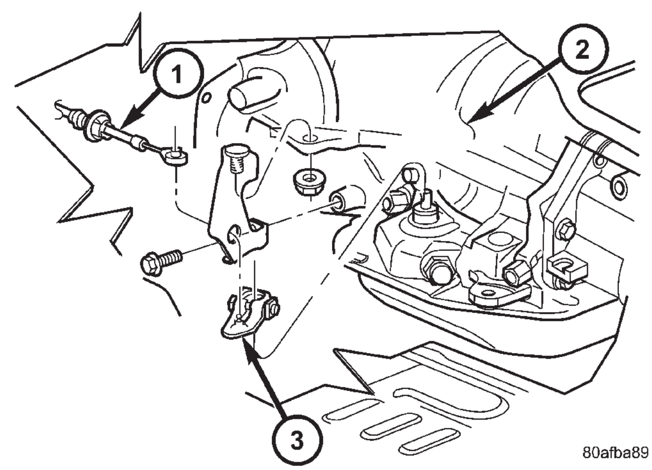


Fig. 108 Gearshift Cable at Transmission - RE

1 - GEARSHIFT CABLE
2 - RE TRANSMISSION
3 - MANUAL LEVER

GEARSHIFT CABLE (Continued)

INSTALLATION

(1) Snap the cable into the transmission bracket so the retaining ears are engaged and snap the cable eyelet onto the manual control lever ball stud.

(2) Lower vehicle.

(3) Route cable through hole in dash panel (Fig. 109) or (Fig. 110).

(4) Seat the cable mounting bracket to dash panel and install retaining nuts to hold the cable housing bracket to the dash panel.

(5) Tighten the nuts to 34 N·m (25 ft.lbs.).

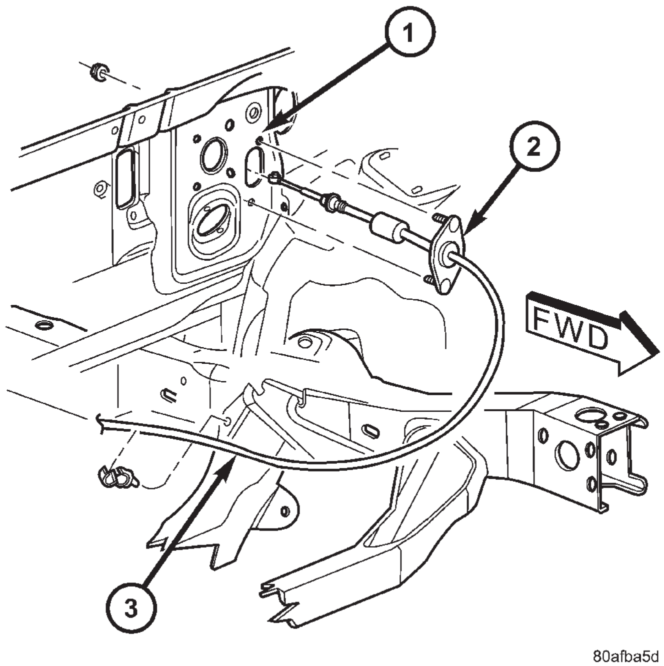


Fig. 109 Cable Mounting at Dash Panel - 4X2

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

(6) Place the transmission manual shift lever in the "PARK" detent (rearmost) position and rotate prop shaft to ensure transmission is in PARK.

(7) Connect shift cable to the steering column shift lever (Fig. 111) by snapping the cable retaining ears into shifter bracket and snapping the cable eyelet on the steering column ball stud.

(8) Lock the shift cable adjustment by pressing the cable adjuster lock upward until it snaps into place.

(9) Check for proper operation of the transmission range sensor.

(10) Adjust the gearshift cable as necessary.

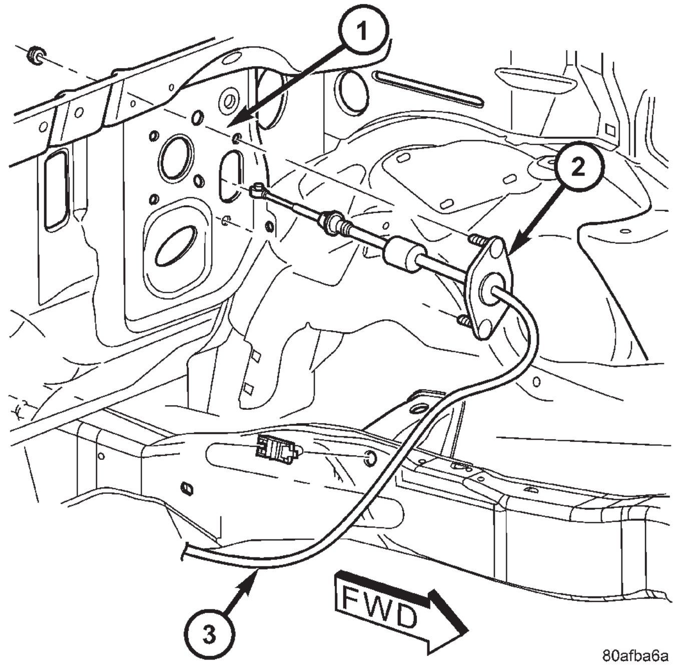


Fig. 110 Cable Mounting at Dash Panel - 4X4

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

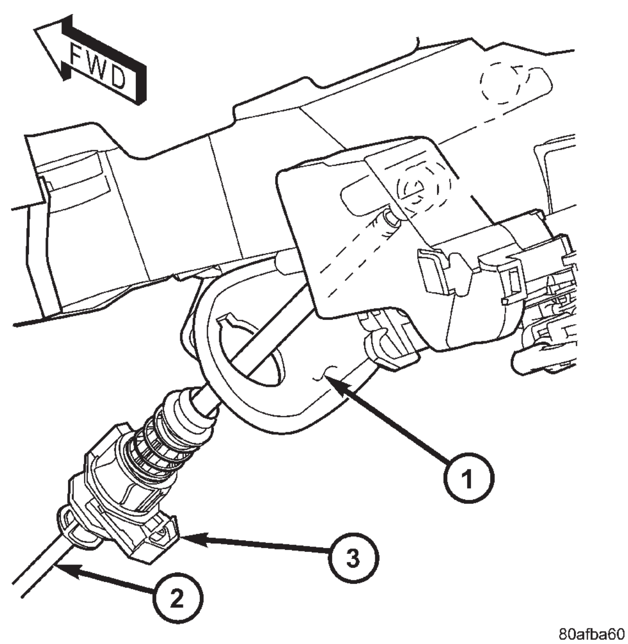


Fig. 111 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB

GEARSHIFT CABLE (Continued)

ADJUSTMENTS - GEARSHIFT CABLE

Check adjustment by starting the engine in PARK and NEUTRAL. Adjustment is CORRECT 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) Release cable adjuster lock tab (underneath the steering column) (Fig. 112) to unlock cable.
(3) Raise vehicle.
(4) Disengage the cable eyelet from the transmission manual shift lever.
(5) Verify transmission shift lever is in PARK detent by moving lever fully rearward. Last rearward detent is PARK position.
(6) Verify positive engagement of transmission park lock by attempting to rotate propeller shaft. Shaft will not rotate when park lock is engaged.
(7) Snap the cable eyelet onto the transmission manual shift lever.
(8) Lower vehicle.
(9) Lock shift cable by pressing cable adjuster lock tab upward until it snaps into place.
(10) Check engine starting. Engine should start only in PARK and NEUTRAL

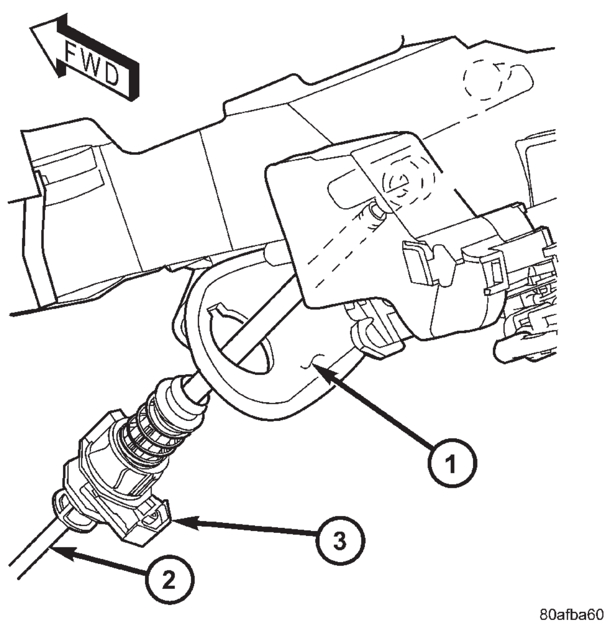


Fig. 112 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB

OIL PUMP

DESCRIPTION

The oil pump (Fig. 113) is located in the pump housing inside the bell housing of the transmission case. The oil pump consists of an inner and outer gear, a housing, and a 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.

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.

OIL PUMP (Continued)

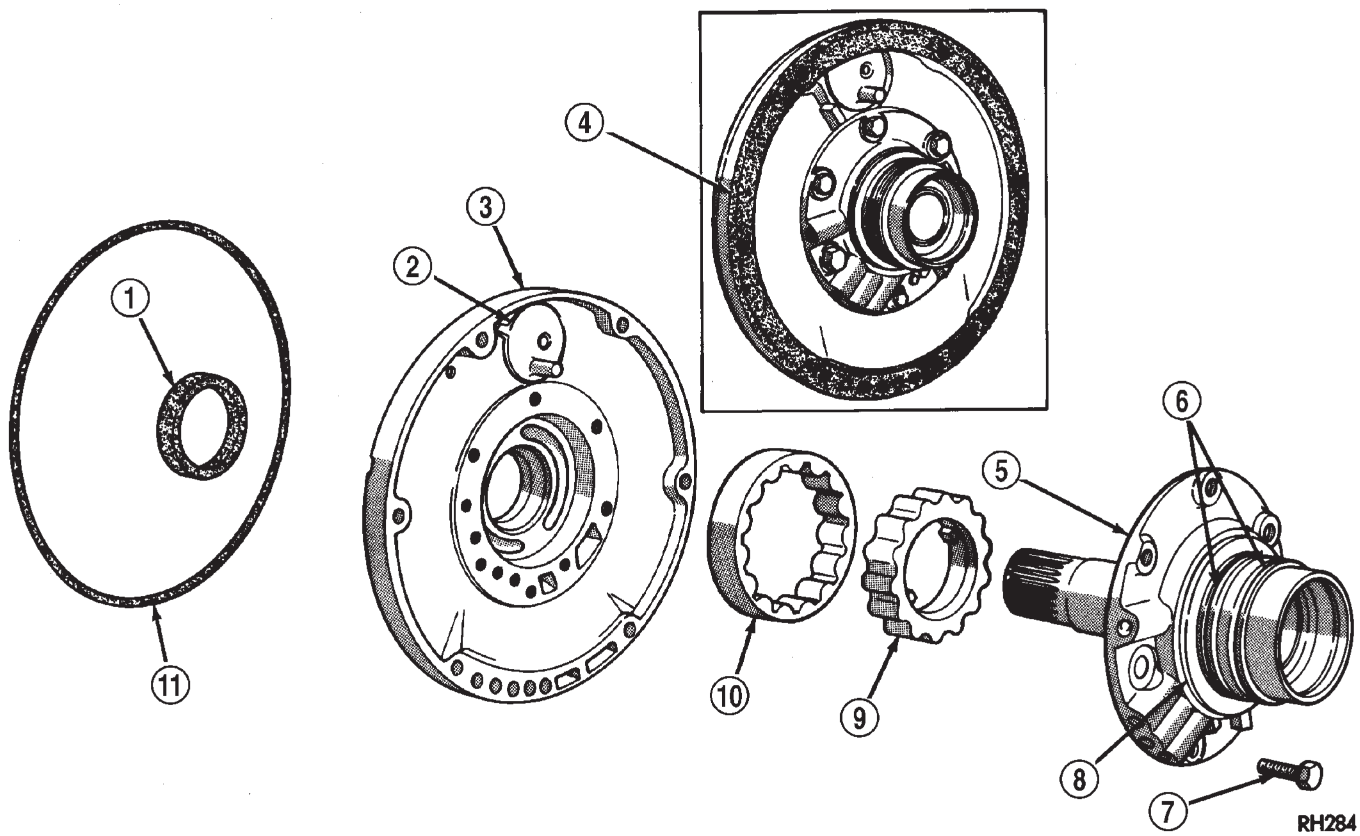


Fig. 113 Oil Pump Assembly

1 - OIL SEAL
2 - VENT BAFFLE
3 - OIL PUMP BODY
4 - GASKET
5 - REACTION SHAFT SUPPORT
6 - SEAL RINGS
7 - BOLTS (6)
8 - #1 THRUST WASHER (SELECTIVE)
9 - INNER GEAR
10 - OUTER GEAR
11 - “O” RING

OIL PUMP (Continued)

DISASSEMBLY

(1) Mark position of support in oil pump body for assembly alignment reference. Use scriber or paint to make alignment marks.

(2) Place pump body on two wood blocks.

(3) Remove reaction shaft support bolts and separate support from pump body (Fig. 114).

(4) Remove pump inner and outer gears (Fig. 115).

(5) Remove o-ring seal from pump body (Fig. 116). Discard seal after removal.

(6) Remove oil pump seal with Remover Tool C-3981. Discard seal after removal.

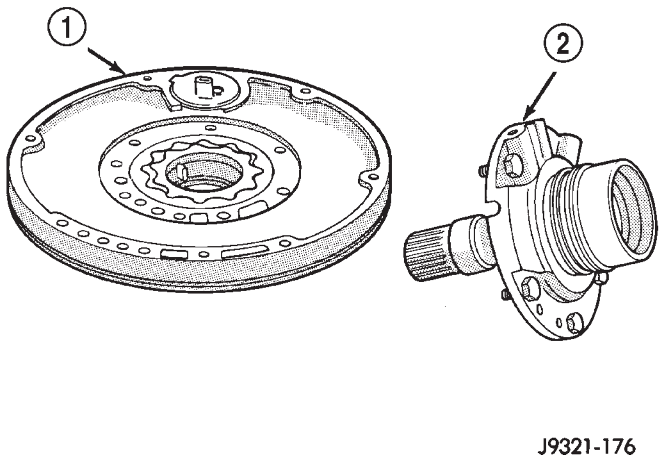


Fig. 114 Reaction Shaft Support

1 - OIL PUMP
2 - REACTION SHAFT SUPPORT

OIL PUMP BUSHING REMOVAL

(1) Position pump housing on clean, smooth surface with gear cavity facing down.

(2) Remove bushing with Tool Handle C-4171 and Bushing Remover SP-3550 (Fig. 117).

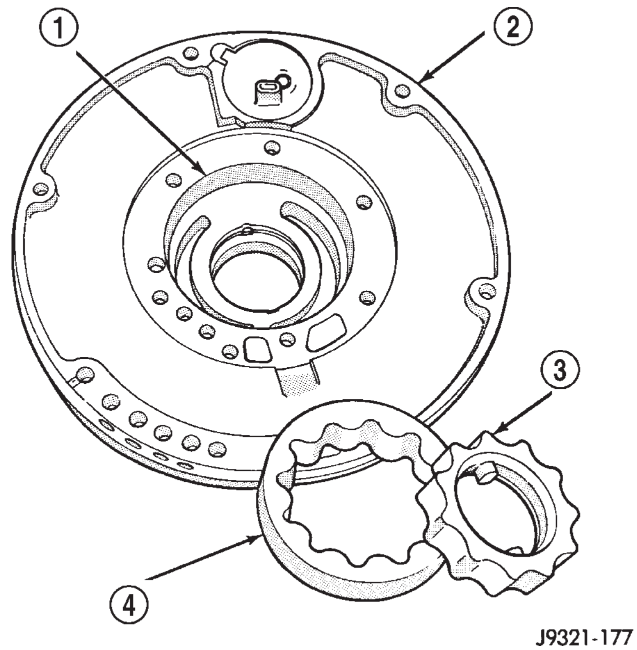


Fig. 115 Pump Gears

1 - GEAR BORE
2 - PUMP BODY
3 - INNER GEAR
4 - OUTER GEAR

REACTION SHAFT SUPPORT BUSHING REMOVAL

(1) Assemble Cup Tool SP-3633, Nut SP-1191 and Bushing Remover SP-5301 (Fig. 118).

(2) Hold cup tool firmly against reaction shaft. Thread remover tool into bushing as far as possible by hand.

(3) Using wrench, thread remover tool an additional 3-4 turns into bushing to firmly engage tool.

(4) Tighten tool hex nut against cup tool to pull bushing from shaft. Clean all chips from shaft and support after bushing removal.

OIL PUMP (Continued)

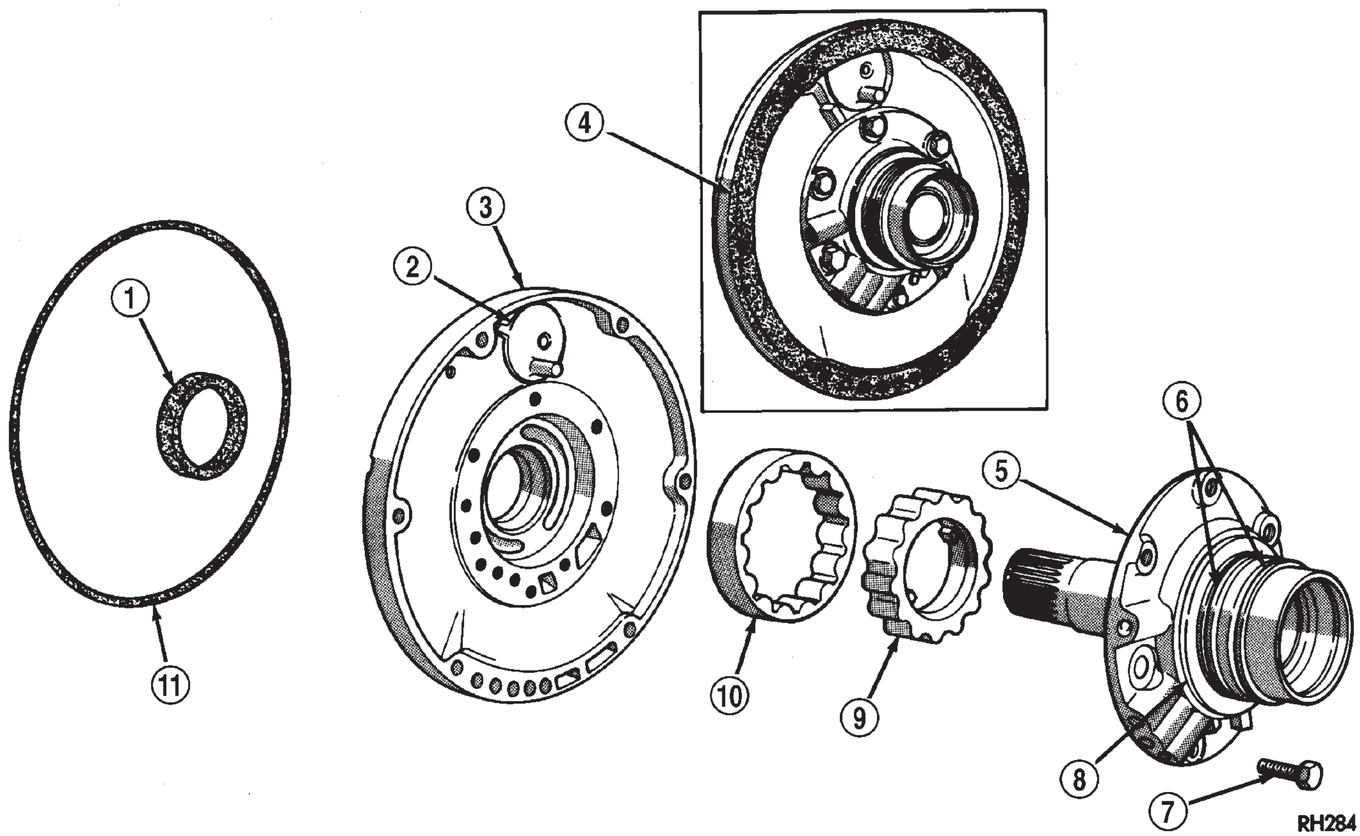


Fig. 116 Oil Pump Assembly

1 - OIL SEAL
2 - VENT BAFFLE
3 - OIL PUMP BODY
4 - GASKET
5 - REACTION SHAFT SUPPORT
6 - SEAL RINGS
7 - BOLTS (6)
8 - #1 THRUST WASHER (SELECTIVE)
9 - INNER GEAR
10 - OUTER GEAR
11 - “O” RING

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.

OIL PUMP (Continued)

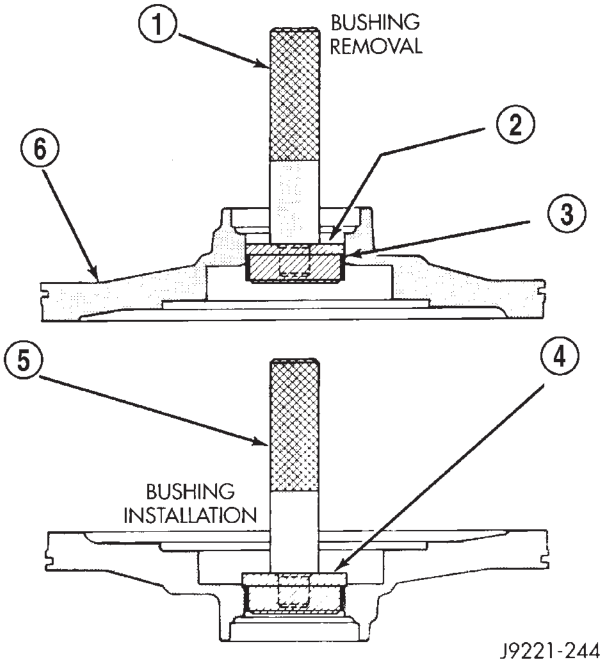


Fig. 117 Oil Pump Bushing

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL SP-3550
3 - BUSHING
4 - SPECIAL TOOL SP-5118
5 - SPECIAL TOOL C-4171
6 - PUMP HOUSING

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 (Fig. 119).

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.

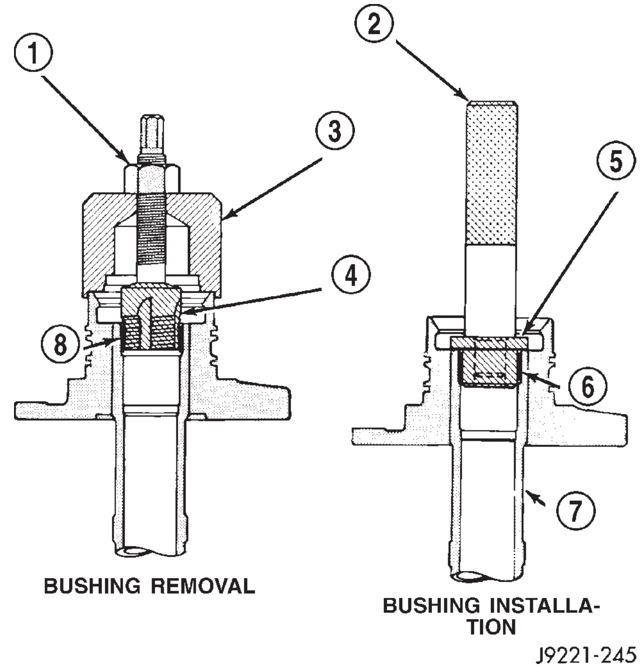


Fig. 118 Reaction Shaft Bushing

1 - SPECIAL TOOL SP-1191
2 - SPECIAL TOOL C-4171
3 - SPECIAL TOOL SP-3633
4 - SPECIAL TOOL SP-5301
5 - SPECIAL TOOL SP-5302
6 - BUSHING
7 - REACTION SHAFT
8 - BUSHING

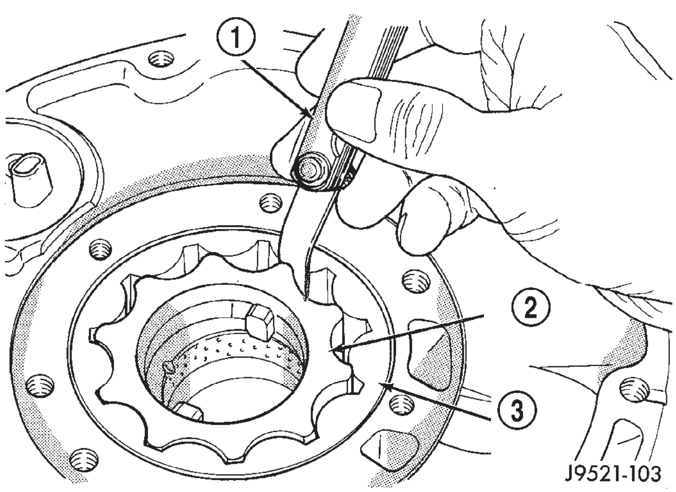


Fig. 119 Checking Pump Gear Tip Clearance

1 - FEELER GAUGE
2 - INNER GEAR
3 - OUTER GEAR

OIL PUMP (Continued)

ASSEMBLY

OIL PUMP BUSHING

(1) Assemble Tool Handle C-4171 and Bushing Installer SP-5118 (Fig. 120).

(2) Place bushing on installer tool and start bushing into shaft.

(3) Tap bushing into place until Installer Tool SP-5118 bottoms in pump cavity. Keep tool and bushing square with bore. Do not allow bushing to become cocked during installation.

(4) Stake pump bushing in two places with blunt punch. Remove burrs from stake points with knife blade (Fig. 121).

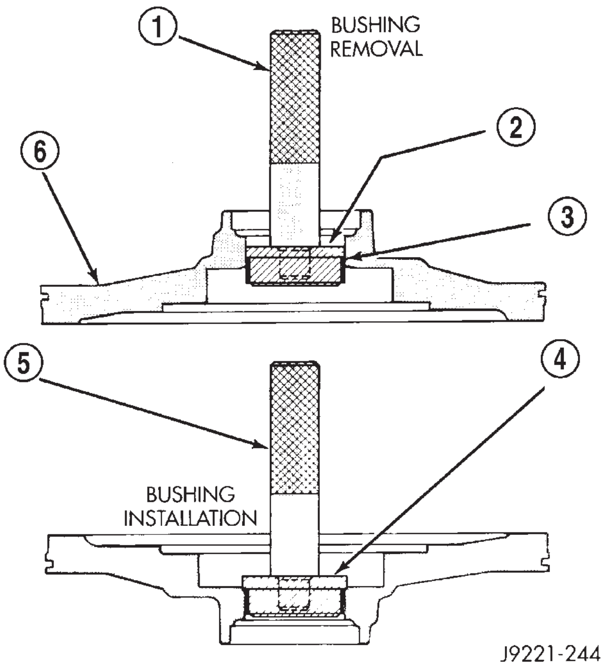


Fig. 120 Oil Pump Bushing

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL SP-3550
3 - BUSHING
4 - SPECIAL TOOL SP-5118
5 - SPECIAL TOOL C-4171
6 - PUMP HOUSING

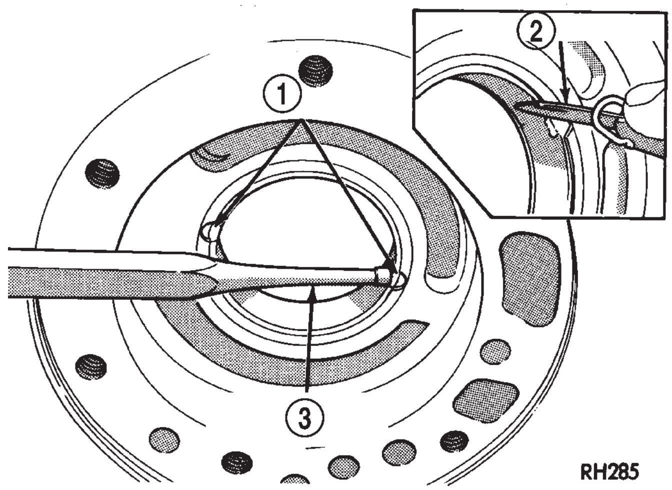


Fig. 121 Staking-Deburring Oil Pump Bushing

1 - TWO STAKES
2 - NARROW BLADE
3 - BLUNT PUNCH

REACTION SHAFT SUPPORT BUSHING

(1) Place reaction shaft support upright on a clean, smooth surface.

(2) Assemble Bushing Installer Tools C-4171 and SP-5302. Then slide new bushing onto installer tool (Fig. 122).

(3) Start bushing in shaft. Tap bushing into shaft until installer tool bottoms against support flange.

(4) Clean reaction shaft support thoroughly after bushing replacement (to remove any chips).

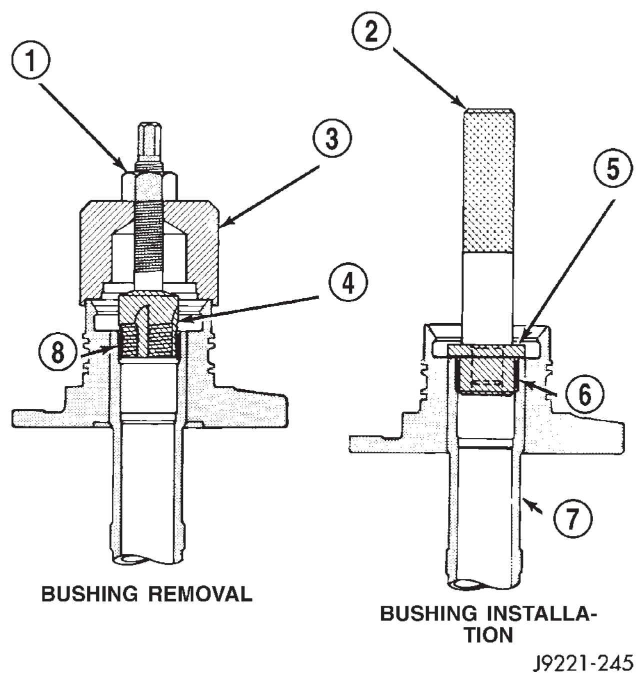


Fig. 122 Reaction Shaft Bushing

1 - SPECIAL TOOL SP-1191
2 - SPECIAL TOOL C-4171
3 - SPECIAL TOOL SP-3633
4 - SPECIAL TOOL SP-5301
5 - SPECIAL TOOL SP-5302
6 - BUSHING
7 - REACTION SHAFT
8 - BUSHING

OIL PUMP (Continued)

OIL PUMP BODY

(1) Lubricate pump gears with transmission fluid and install them in pump body.

(2) Install thrust washer on reaction shaft support hub. Lubricate washer with petroleum jelly or transmission fluid before installation.

(3) If reaction shaft seal rings are being replaced, install new seal rings on support hub. Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

CAUTION: The reaction shaft support seal rings will break if overspread, or twisted. If new rings are being installed, spread them only enough for installation. Also be very sure the ring ends are securely hooked together after installation. Otherwise, the rings will either prevent pump installation, or break during installation.

(4) Align and install reaction shaft support on pump body.

(5) Install bolts attaching reaction shaft support to pump. Tighten bolts to 20 N·m (175 in. lbs.) torque.

(6) Install new pump seal with Installer Tool C-3860-A (Fig. 123). Use hammer or mallet to tap seal into place.

(7) Install new o-ring on pump body. Lubricate oil seal and o-ring with petroleum jelly.

(8) Cover pump assembly to prevent dust entry and set aside for assembly installation.

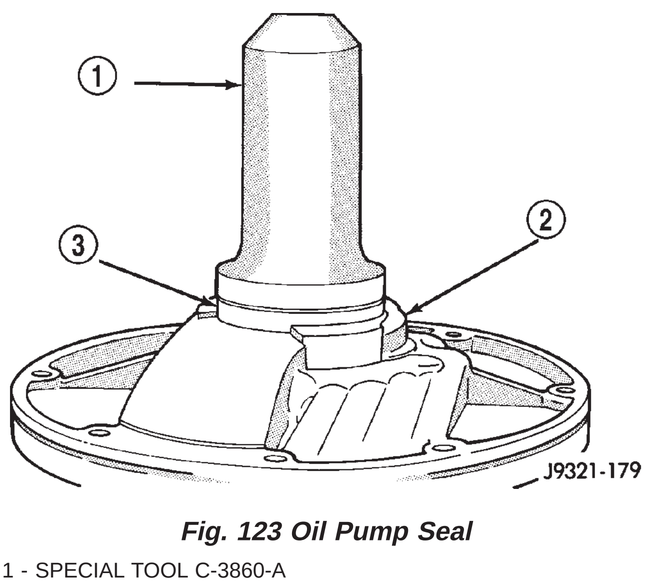


Fig. 123 Oil Pump Seal

1 - SPECIAL TOOL C-3860-A
2 - PUMP BODY
3 - PUMP SEAL

OUTPUT SHAFT FRONT BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle.

(2) Remove overdrive geartrain from housing.

(3) Remove snap-ring holding output shaft front bearing to overdrive geartrain. (Fig. 124).

(4) Pull bearing from output shaft.

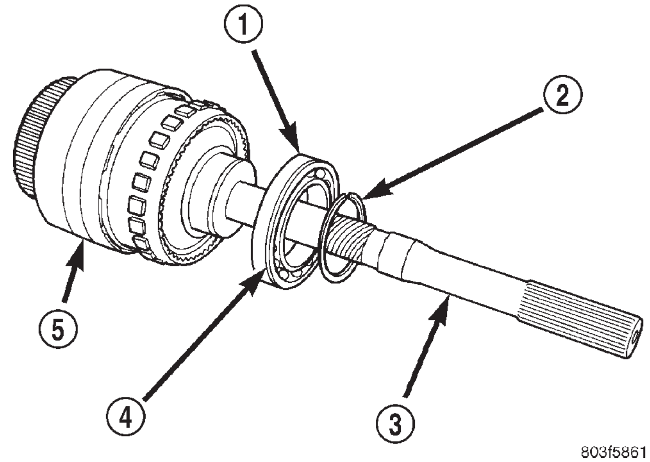


Fig. 124 Output Shaft Front Bearing

1 - OUTPUT SHAFT FRONT BEARING
2 - SNAP-RING
3 - OUTPUT SHAFT
4 - GROOVE TO REAR
5 - OVERDRIVE GEARTRAIN

INSTALLATION

(1) Place replacement bearing in position on geartrain with locating retainer groove toward the rear.

(2) Push bearing onto shaft until the snap-ring groove is visible.

(3) Install snap-ring to hold bearing onto output shaft.

(4) Install overdrive geartrain into housing.

(5) Install overdrive unit in vehicle.

OUTPUT SHAFT REAR BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC/OVERDRIVE - REMOVAL)

(2) Remove overdrive geartrain from housing.

(3) Remove snap-ring holding output shaft rear bearing into overdrive housing (Fig. 125).

(4) Using a suitable driver inserted through the rear end of housing, drive bearing from housing.

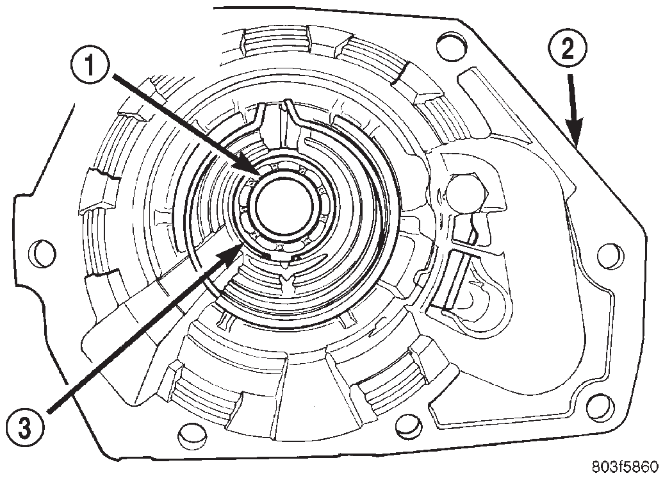


Fig. 125 Output Shaft Rear Bearing

1 - OUTPUT SHAFT REAR BEARING
2 - OVERDRIVE HOUSING
3 - SNAP-RING

INSTALLATION

(1) Place replacement bearing in position in housing.

(2) Using a suitable driver, drive bearing into housing until the snap-ring groove is visible.

(3) Install snap-ring to hold bearing into housing (Fig. 122).

(4) Install overdrive geartrain into housing.

(5) Install overdrive unit in vehicle.

OVERDRIVE CLUTCH

DESCRIPTION

The overdrive clutch (Fig. 126) is composed of the pressure plate, clutch plates, holding discs, overdrive piston retainer, piston, piston spacer, and snap-rings. The overdrive clutch is the forwardmost component in the transmission overdrive unit and is considered a holding component. The overdrive piston retainer, piston, and piston spacer are located on the rear of the main transmission case.

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 piston retainer and piston. The fluid pressure is provided by the oil pump, transferred through the control valves and passageways, and enters the clutch through passages at the lower rear portion of the valve body area. With pressure applied between the piston retainer and piston, the piston moves away from the piston retainer and compresses the clutch pack. This action applies the clutch pack, allowing torque to flow through the intermediate shaft into the overdrive planetary gear set. The overdrive clutch discs are attached to the overdrive clutch hub while the overdrive clutch plates, reaction plate, and pressure plate are lugged to the overdrive housing. This allows the intermediate shaft to transfer the engine torque to the planetary gear and overrunning clutch. This drives the planetary gear inside the annulus, which is attached to the overdrive clutch drum and output shaft, creating the desired gear ratio. The waved snap-ring is used to cushion the application of the clutch pack.

OVERDRIVE CLUTCH (Continued)

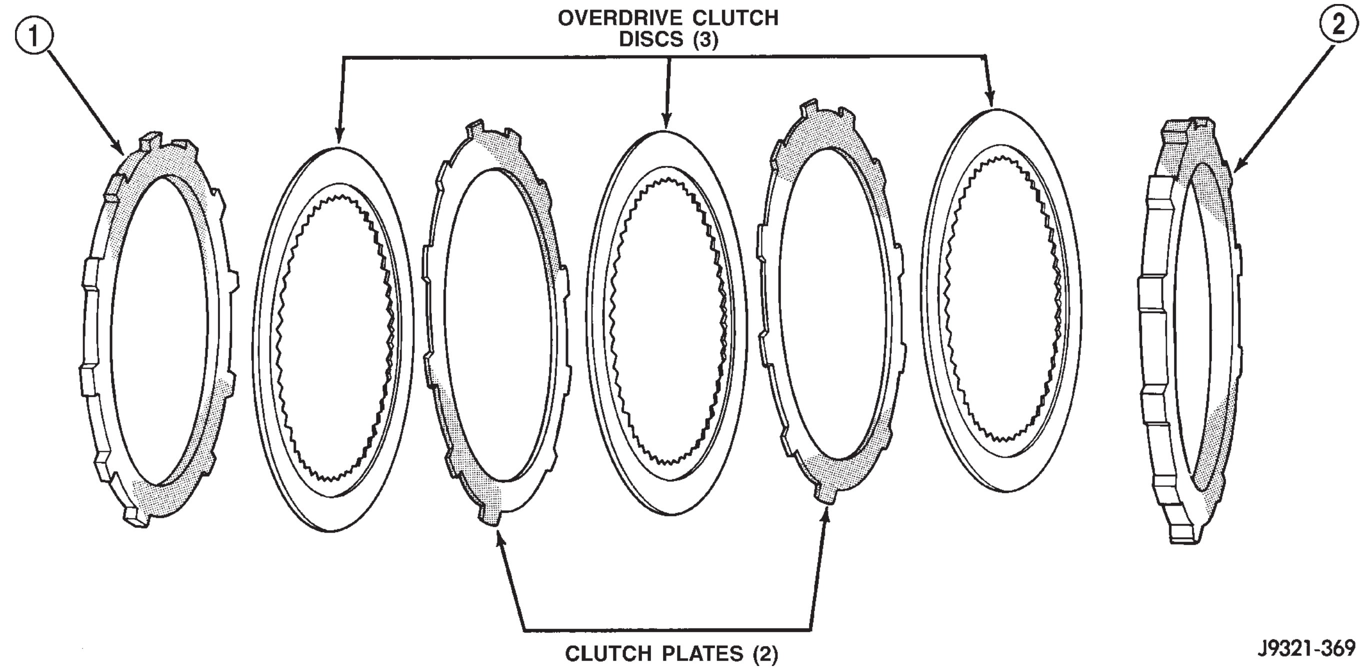


Fig. 126 Overdrive Clutch

1 - REACTION PLATE
2 - PRESSURE PLATE

OVERDRIVE SWITCH

DESCRIPTION

The overdrive OFF (control) switch is located in the shift lever arm (Fig. 127). The switch is a momentary contact device that signals the PCM to toggle current status of the overdrive function.

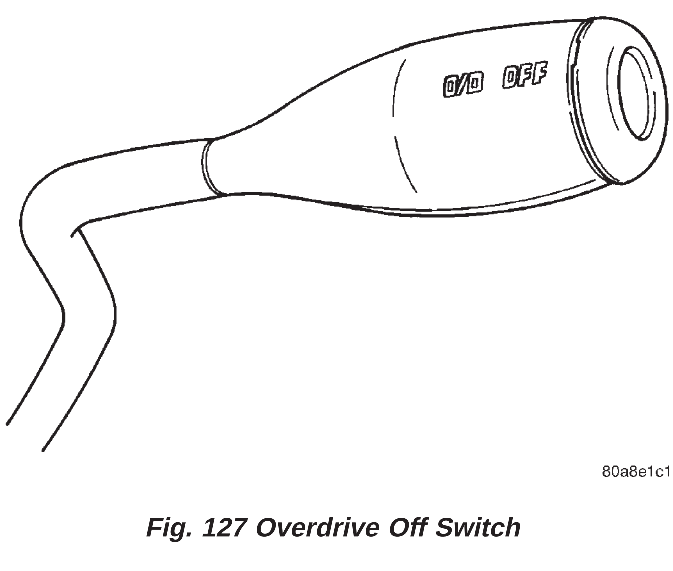


Fig. 127 Overdrive Off Switch

OPERATION

At key-on, overdrive operation is allowed. Pressing the switch once causes the overdrive OFF mode to be entered and the overdrive OFF switch lamp to be illuminated. Pressing the switch a second time causes normal overdrive operation to be restored and the overdrive lamp to be turned off. The overdrive OFF mode defaults to ON after the ignition switch is cycled OFF and ON. The normal position for the control switch is the ON position. The switch must be in this position to energize the solenoid and allow a 3-4 upshift. The control switch indicator light illuminates only when the overdrive switch is turned to the OFF position, or when illuminated by the transmission control module.

DIAGNOSIS AND TESTING - OVERDRIVE ELECTRICAL CONTROLS

The overdrive off switch, valve body solenoid, case connectors and related wiring can all be tested with a 12 volt test lamp or a volt/ohmmeter. Check continuity of each component when diagnosis indicates this is necessary.

Switch and solenoid continuity should be checked whenever the transmission fails to shift into fourth gear range.

REMOVAL

(1) Using a plastic trim tool, remove the overdrive off switch retainer from the shift lever (Fig. 128).

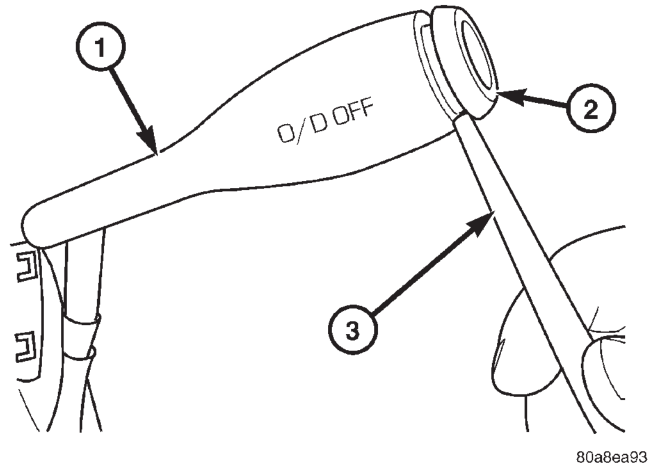


Fig. 128 Overdrive Off Switch Retainer

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH RETAINER
3 - PLASTIC TRIM TOOL

(2) Pull the switch outwards to release it from the connector in the lever (Fig. 129)

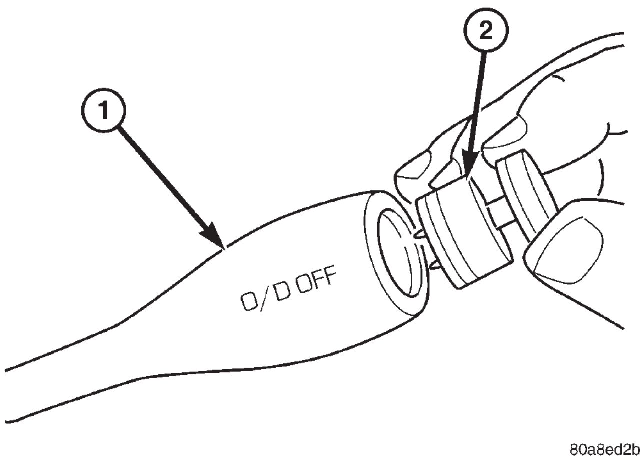


Fig. 129 Remove the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH

INSTALLATION

NOTE: There is enough slack in the wire to pull out the connector from the lever.

(1) Pull the connector out of the lever just enough to grasp it.

CAUTION: Be careful not to bend the pins on the overdrive off switch. Use care when installing the switch, as it is not indexed, and can be accidentally installed incorrectly.

(2) Install the overdrive off switch into the connector (Fig. 130)

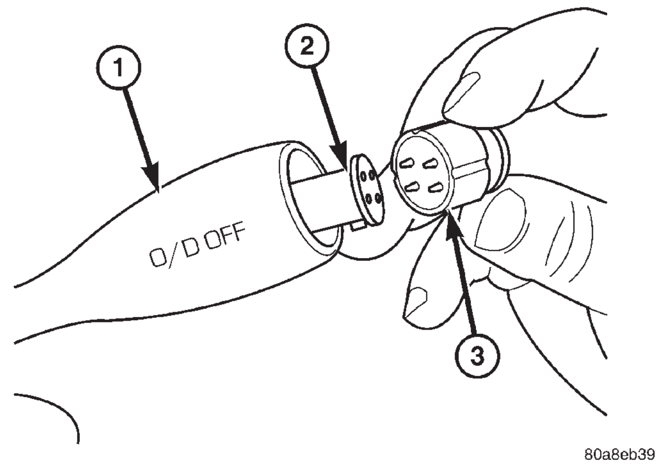


Fig. 130 Install the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH WIRING CONNECTOR
3 - OVERDRIVE OFF SWITCH

(3) Push the overdrive off switch and wiring into the shift lever.
(4) Install the overdrive off switch retainer onto the shift lever.

OVERDRIVE UNIT

REMOVAL

(1) Shift transmission into PARK.
(2) Raise vehicle.
(3) Remove transfer case, if equipped.
(4) Mark propeller shaft universal joint(s) and axle pinion yoke, or the companion flange and flange yoke, for alignment reference at installation, if neccesary.
(5) Disconnect and remove the rear propeller shaft, if necessary. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)
(6) Remove transmission oil pan, remove gasket, drain oil and reinstall pan.
(7) If overdrive unit had malfunctioned, or if fluid is contaminated, remove entire transmission. If diagnosis indicated overdrive problems only, remove just the overdrive unit.
(8) Support transmission with transmission jack.

OVERDRIVE UNIT (Continued)

(9) Remove bolts attaching overdrive unit to transmission (Fig. 131).

CAUTION: Support the overdrive unit with a jack before moving it rearward. This is necessary to prevent damaging the intermediate shaft. Do not allow the shaft to support the entire weight of the overdrive unit.

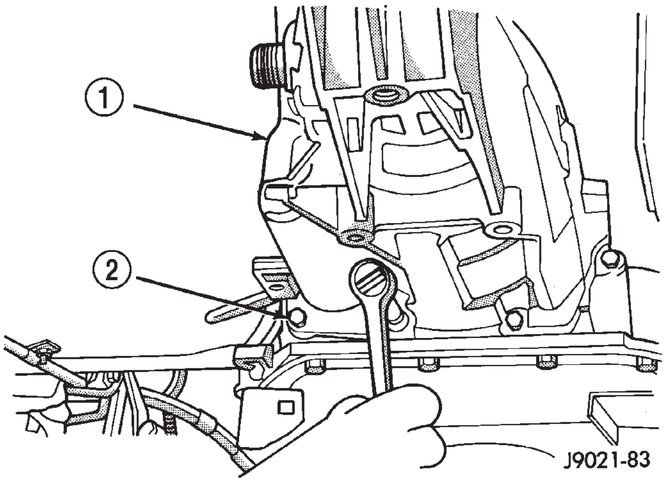


Fig. 131 Overdrive Unit Bolts

1 - OVERDRIVE UNIT
2 - ATTACHING BOLTS (7)

(10) Carefully work overdrive unit off intermediate shaft. Do not tilt unit during removal. Keep it as level as possible.

(11) If overdrive unit does not require service, immediately insert Alignment Tool 6227-2 in splines of planetary gear and overrunning clutch to prevent splines from rotating out of alignment. If misalignment occurs, overdrive unit will have to be disassembled in order to realign splines.

(12) Remove and retain overdrive piston thrust bearing. Bearing may remain on piston or in clutch hub during removal.

(13) Position drain pan on workbench.

(14) Place overdrive unit over drain pan. Tilt unit to drain residual fluid from case.

(15) Examine fluid for clutch material or metal fragments. If fluid contains these items, overhaul will be necessary.

(16) If overdrive unit does not require any service, leave alignment tool in position. Tool will prevent accidental misalignment of planetary gear and overrunning clutch splines.

DISASSEMBLY

(1) Remove transmission speed sensor and o-ring seal from overdrive case (Fig. 132).

(2) Remove overdrive piston thrust bearing (Fig. 133).

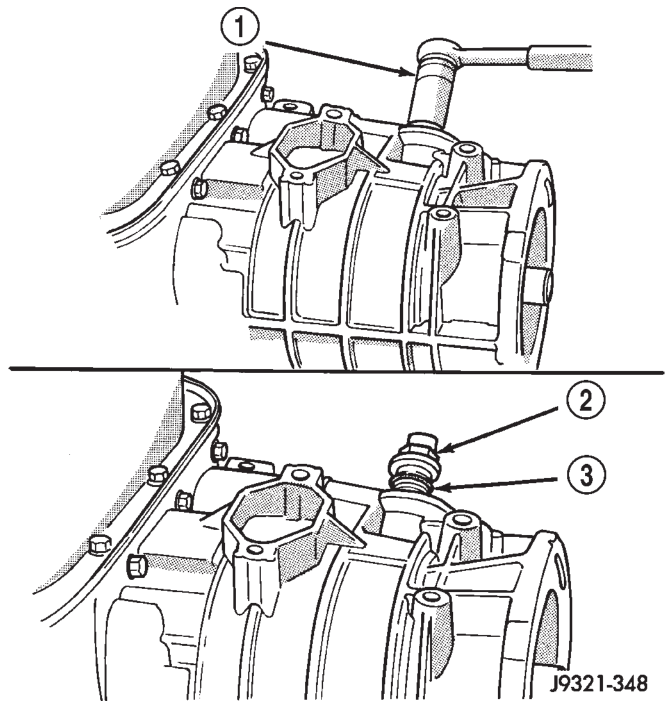


Fig. 132 Transmission Speed Sensor

1 - SOCKET AND WRENCH
2 - SPEED SENSOR
3 - O-RING

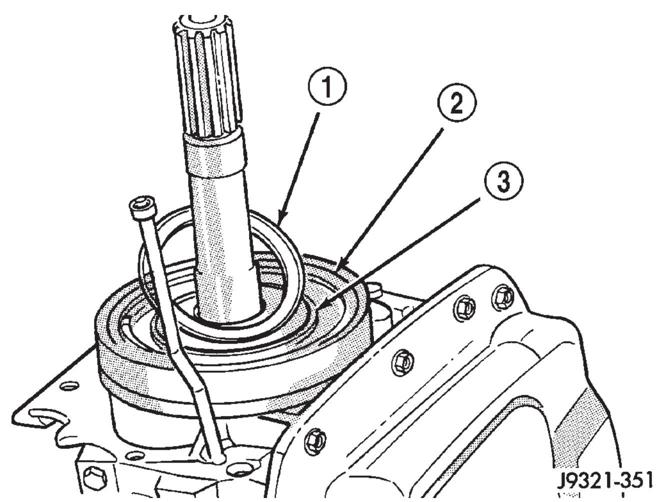


Fig. 133 Overdrive Piston Thrust Bearing Removal/ Installation

1 - THRUST BEARING
2 - OVERDRIVE PISTON
3 - THRUST PLATE

OVERDRIVE PISTON

(1) Remove overdrive piston thrust plate (Fig. 134). Retain thrust plate. It is a select fit part and may possibly be reused.

OVERDRIVE UNIT (Continued)

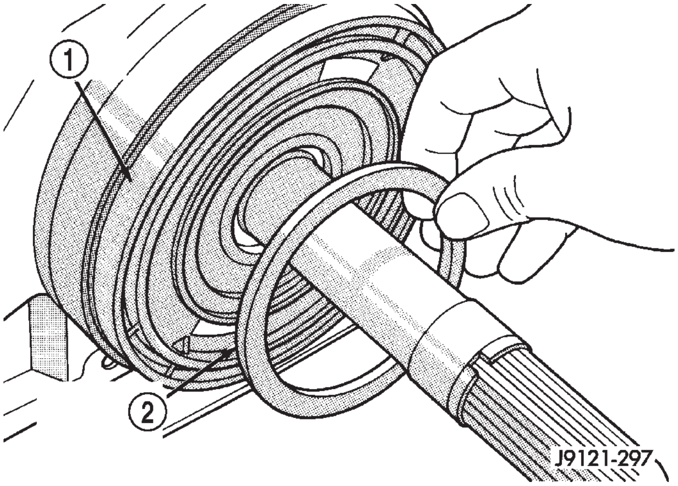


Fig. 134 Overdrive Piston Thrust Plate Removal/ Installation

1 - OVERDRIVE PISTON
2 - OVERDRIVE PISTON SPACER (SELECT FIT)

(2) Remove intermediate shaft spacer (Fig. 135). Retain spacer. It is a select fit part and may possibly be reused.

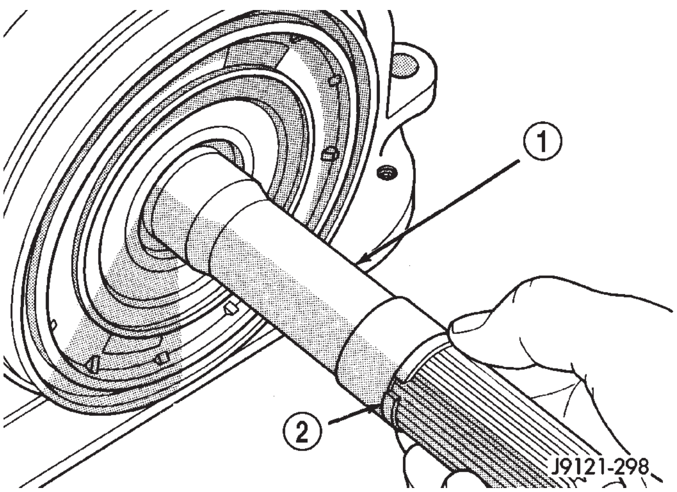


Fig. 135 Intermediate Shaft Spacer Location

1 - INTERMEDIATE SHAFT
2 - INTERMEDIATE SHAFT SPACER (SELECT FIT)

(3) Remove overdrive piston from retainer (Fig. 136).

OVERDRIVE CLUTCH PACK

(1) Remove overdrive clutch pack wire retaining ring (Fig. 137).

(2) Remove overdrive clutch pack (Fig. 138).

(3) Note position of clutch pack components for assembly reference (Fig. 139).

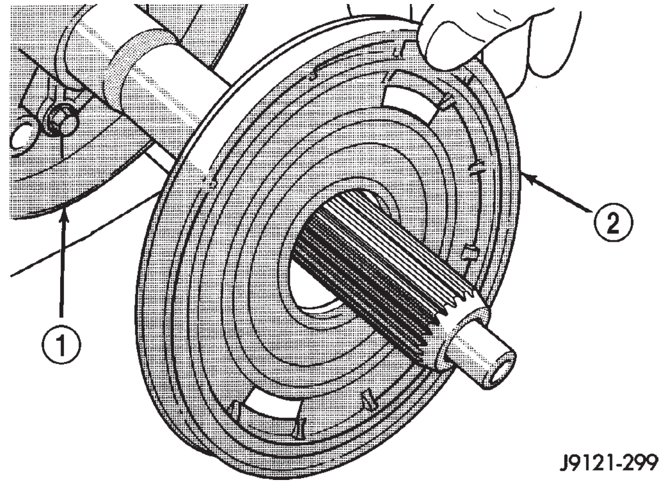


Fig. 136 Overdrive Piston Removal

1 - PISTON RETAINER
2 - OVERDRIVE PISTON

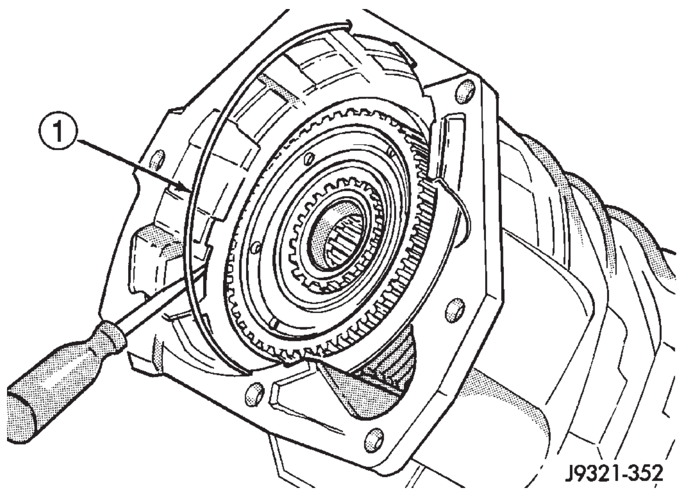


Fig. 137 Removing Overdrive Clutch Pack Retaining Ring

1 - OVERDRIVE CLUTCH PACK RETAINING RING

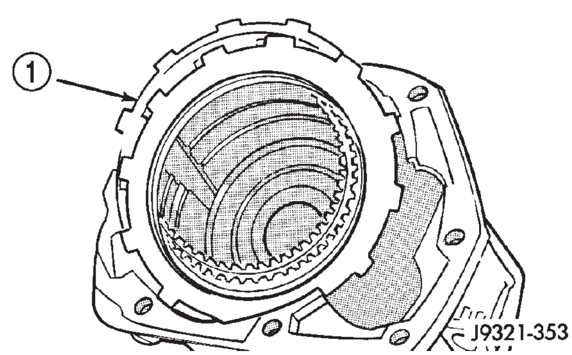


Fig. 138 Overdrive Clutch Pack Removal

1 - OVERDRIVE CLUTCH PACK

OVERDRIVE UNIT (Continued)

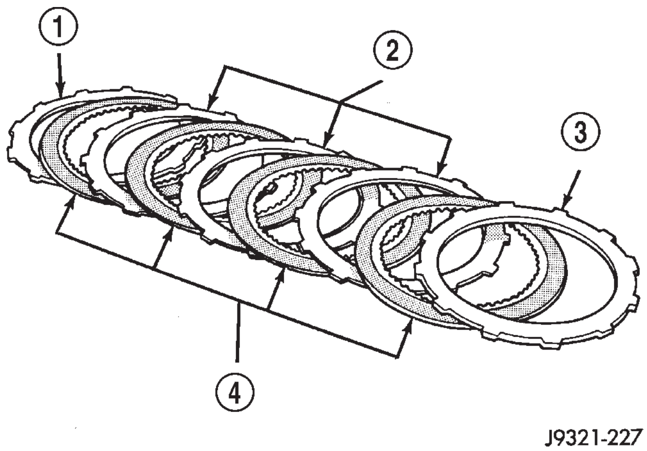


Fig. 139 Overdrive Clutch Component Position - Typical

1 - REACTION PLATE
2 - CLUTCH PLATES (3)
3 - PRESSURE PLATE
4 - CLUTCH DISCS (4)

OVERDRIVE GEARTRAIN

(1) Remove overdrive clutch wave spring (Fig. 140).

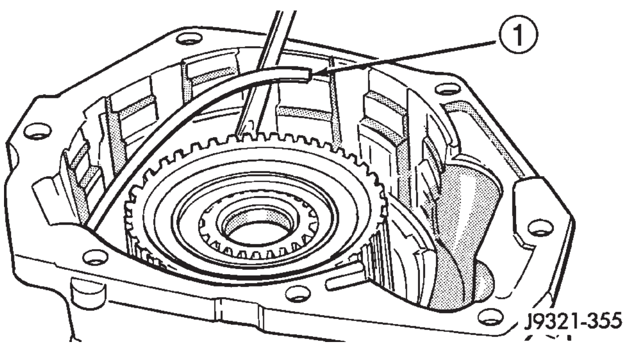


Fig. 140 Overdrive Clutch Wave Spring Removal

1 - WAVE SPRING

(2) Remove overdrive clutch reaction snap-ring (Fig. 141). Note that snap-ring is located in same groove as wave spring.

(3) Remove Torx™ head screws that attach access cover and gasket to overdrive case (Fig. 142).

(4) Remove access cover and gasket (Fig. 143).

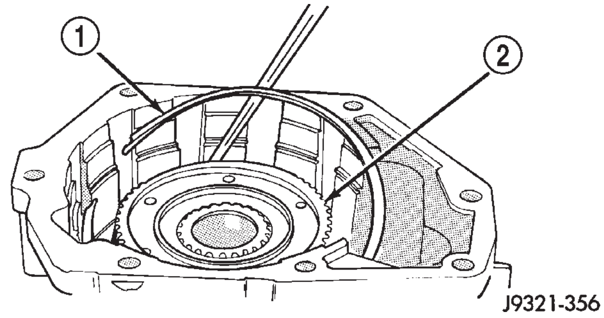


Fig. 141 Overdrive Clutch Reaction Snap-Ring Removal

1 - REACTION RING
2 - CLUTCH HUB

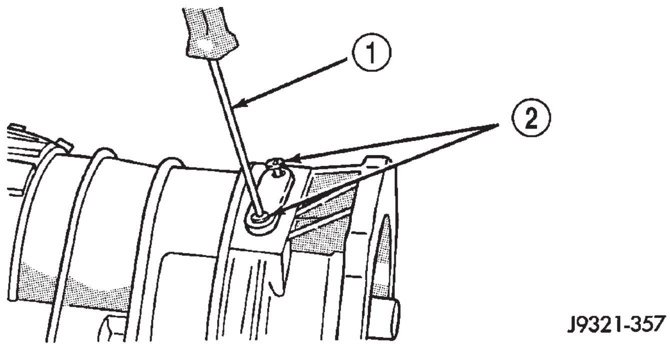


Fig. 142 Access Cover Screw Removal

1 - TORX SCREWDRIVER (T25)
2 - ACCESS COVER SCREWS

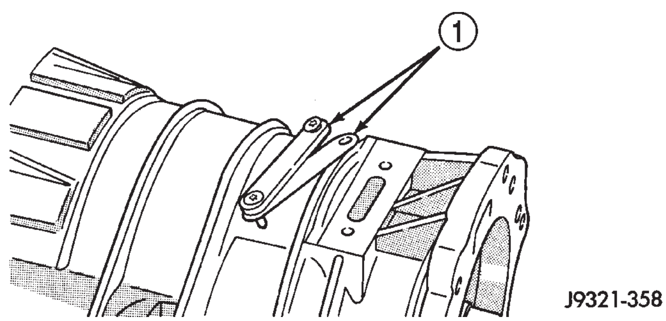


Fig. 143 Access Cover And Gasket Removal

1 - ACCESS COVER AND GASKET

OVERDRIVE UNIT (Continued)

(5) Expand output shaft bearing snap-ring with expanding-type snap-ring pliers. Then push output shaft forward to release shaft bearing from locating ring (Fig. 144).

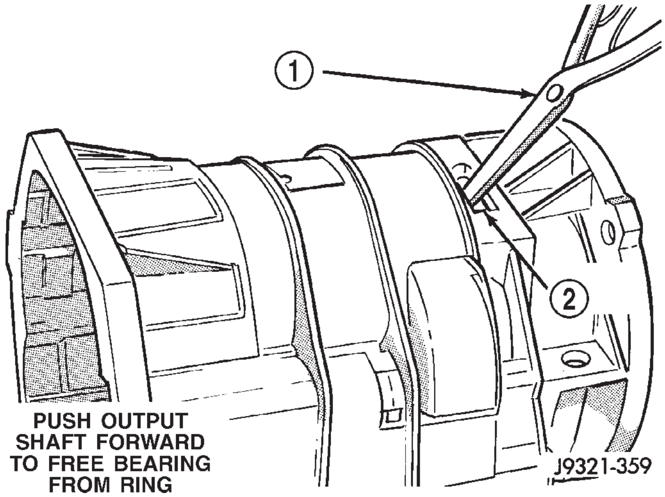


Fig. 144 Releasing Bearing From Locating Ring

1 - EXPAND BEARING LOCATING RING WITH SNAP-RING PLIERS
2 - ACCESS HOLE

(6) Lift gear case up and off geartrain assembly (Fig. 145).

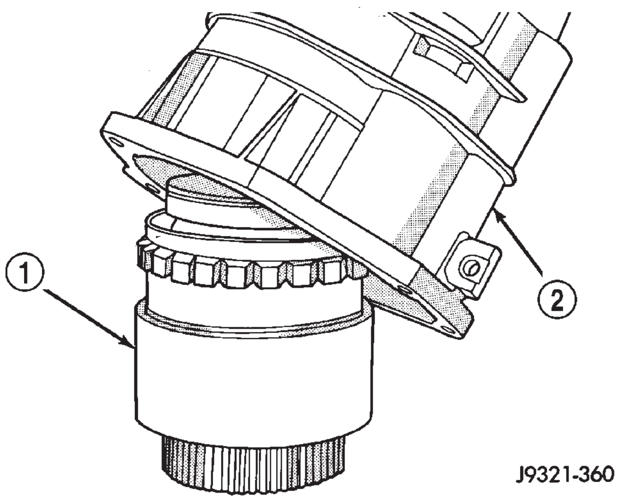


Fig. 145 Removing Geartrain

1 - GEARTRAIN ASSEMBLY
2 - GEAR CASE

(7) Remove snap-ring that retains rear bearing on output shaft.

(8) Remove rear bearing from output shaft (Fig. 146).

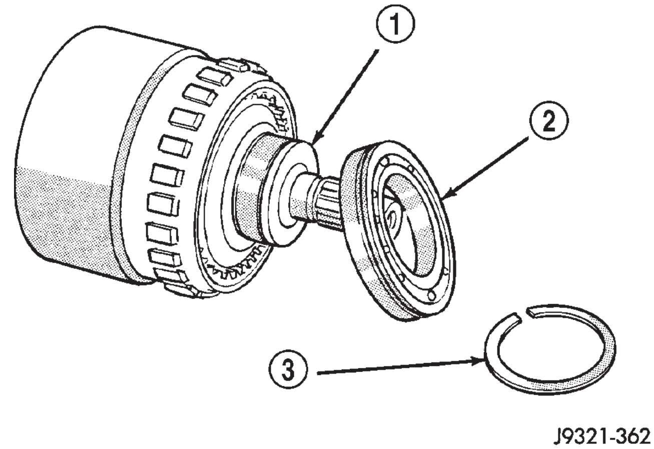


Fig. 146 Rear Bearing Removal

1 - OUTPUT SHAFT
2 - REAR BEARING
3 - SNAP-RING

DIRECT CLUTCH, HUB AND SPRING

WARNING: THE NEXT STEP IN DISASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE SPRING COMPRESSOR TOOL 6227-1 AND A HYDRAULIC SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 5-6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

OVERDRIVE UNIT (Continued)

(1) Mount geartrain assembly in shop press (Fig. 147).

(2) Position Compressor Tool 6227-1 on clutch hub (Fig. 147). Support output shaft flange with steel press plates as shown and center assembly under press ram.

(3) Apply press pressure slowly. Compress hub and spring far enough to expose clutch hub retaining ring and relieve spring pressure on clutch pack snap-ring (Fig. 147).

(4) Remove direct clutch pack snap-ring (Fig. 148).

(5) Remove direct clutch hub retaining ring (Fig. 149).

(6) Release press load slowly and completely (Fig. 150).

(7) Remove Special Tool 6227-1. Then remove clutch pack from hub (Fig. 150).

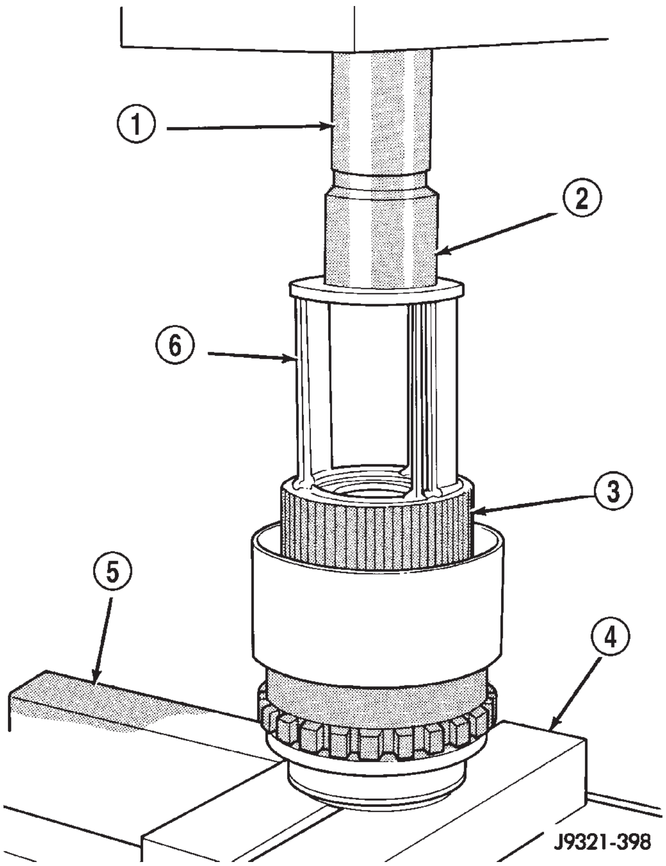


Fig. 147 Geartrain Mounted In Shop Press

1 - PRESS RAM
2 - SPECIAL TOOL C-3995-A (OR SIMILAR TOOL)
3 - CLUTCH HUB
4 - PLATES
5 - PRESS BED
6 - SPECIAL TOOL 6227-1

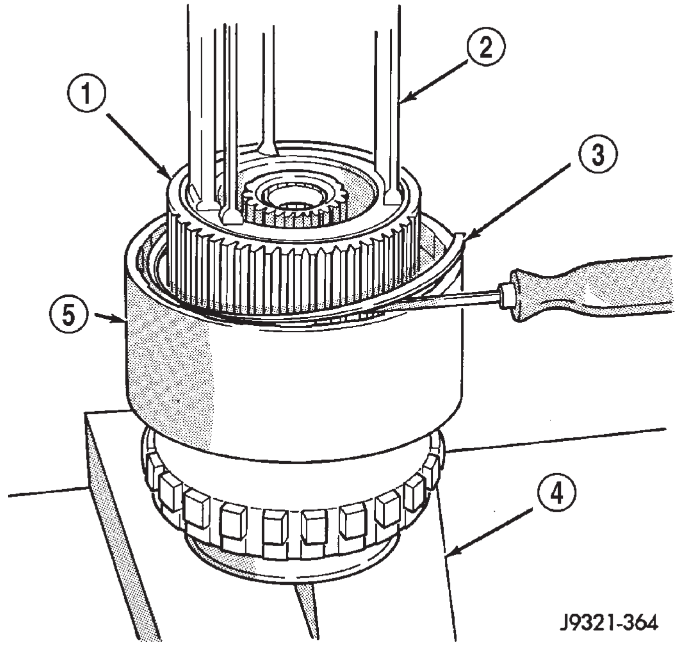


Fig. 148 Direct Clutch Pack Snap-Ring Removal

1 - CLUTCH HUB
2 - SPECIAL TOOL 6227-1
3 - DIRECT CLUTCH PACK SNAP-RING
4 - PRESS PLATES
5 - CLUTCH DRUM

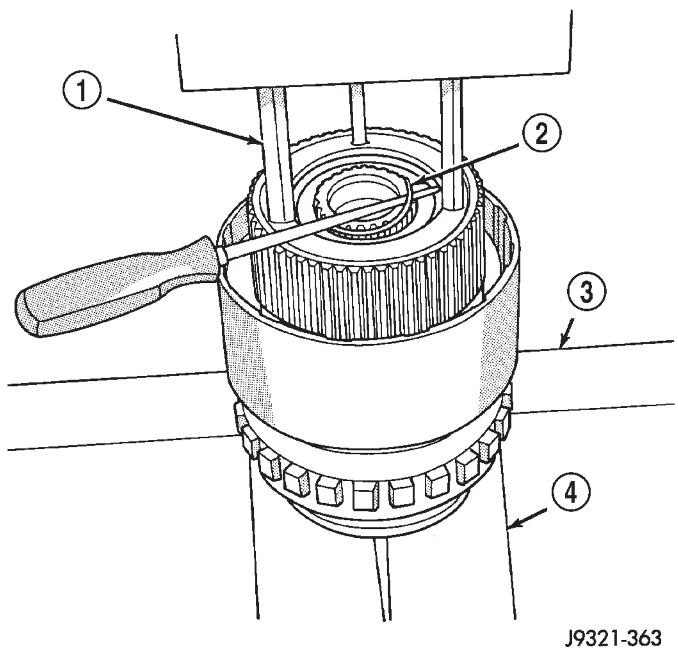


Fig. 149 Direct Clutch Hub Retaining Ring Removal

1 - SPECIAL TOOL 6227-1
2 - CLUTCH HUB RETAINING RING
3 - PRESS BED
4 - PRESS PLATES

OVERDRIVE UNIT (Continued)

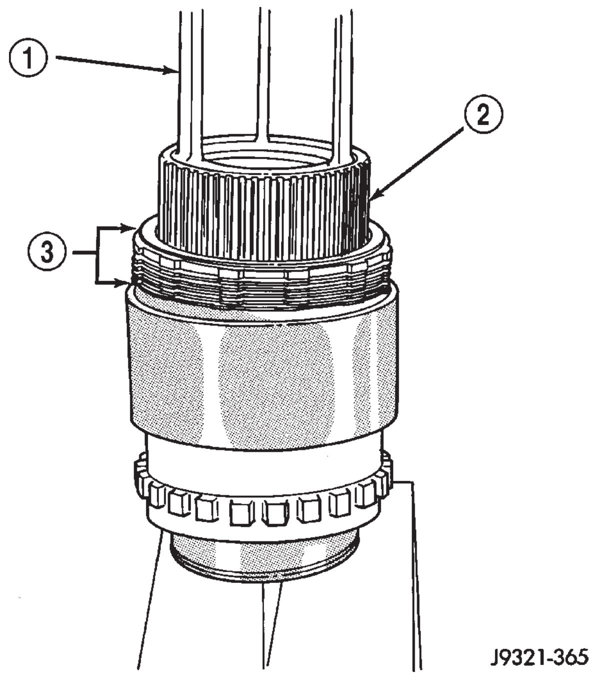


Fig. 150 Direct Clutch Pack Removal

1 - SPECIAL TOOL 6227-1
2 - DIRECT CLUTCH HUB
3 - DIRECT CLUTCH PACK

GEARTRAIN

(1) Remove direct clutch hub and spring (Fig. 151).

(2) Remove sun gear and spring plate. Then remove planetary thrust bearing and planetary gear (Fig. 152).

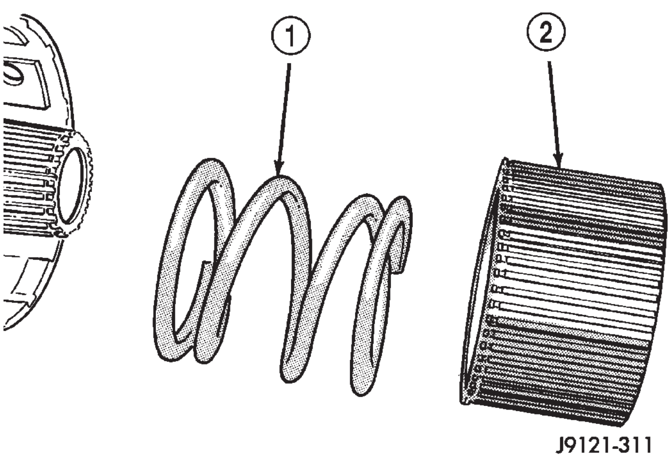


Fig. 151 Direct Clutch Hub And Spring Removal

1 - DIRECT CLUTCH SPRING
2 - DIRECT CLUTCH HUB

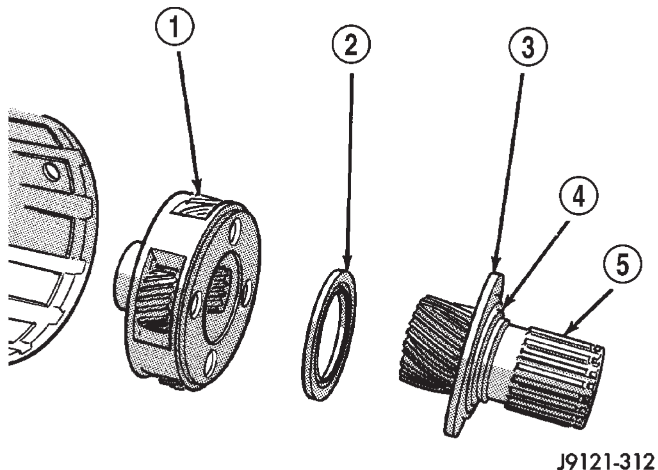


Fig. 152 Removing Sun Gear, Thrust Bearing And Planetary Gear

1 - PLANETARY GEAR
2 - PLANETARY THRUST BEARING
3 - CLUTCH SPRING PLATE
4 - SPRING PLATE SNAP-RING
5 - SUN GEAR

(3) Remove overrunning clutch assembly with expanding type snap-ring pliers (Fig. 153). Insert pliers into clutch hub. Expand pliers to grip hub splines and remove clutch with counterclockwise, twisting motion.

(4) Remove thrust bearing from overrunning clutch hub.

(5) Remove overrunning clutch from hub.

(6) Mark position of annulus gear and direct clutch drum for assembly alignment reference (Fig. 154). Use small center punch or scriber to make alignment marks.

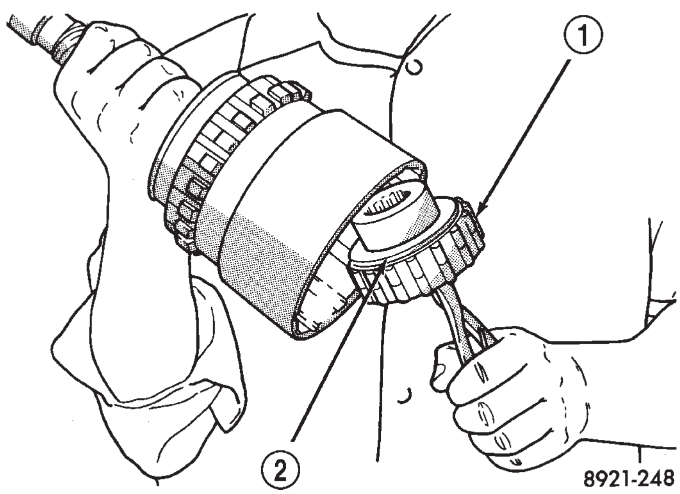


Fig. 153 Overrunning Clutch Assembly Removal/ Installation

1 - OVERRUNNING CLUTCH
2 - NEEDLE BEARING

OVERDRIVE UNIT (Continued)

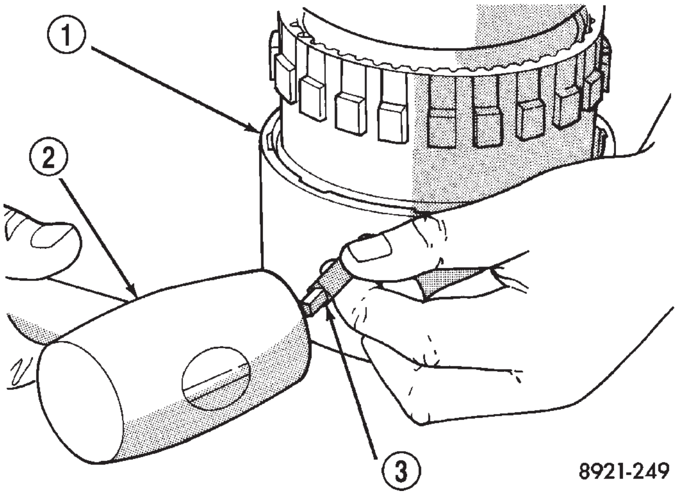


Fig. 154 Marking Direct Clutch Drum And Annulus Gear For Assembly Alignment

1 - DIRECT CLUTCH DRUM
2 - HAMMER
3 - PUNCH

(7) Remove direct clutch drum rear retaining ring (Fig. 155).

(8) Remove direct clutch drum outer retaining ring (Fig. 156).

(9) Mark annulus gear and output shaft for assembly alignment reference (Fig. 157). Use punch or scriber to mark gear and shaft.

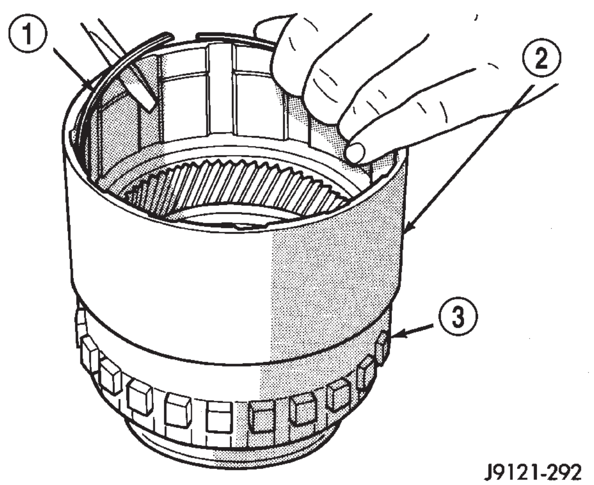


Fig. 155 Clutch Drum Inner Retaining Ring Removal

1 - INNER RETAINING RING
2 - DIRECT CLUTCH DRUM
3 - ANNULUS GEAR

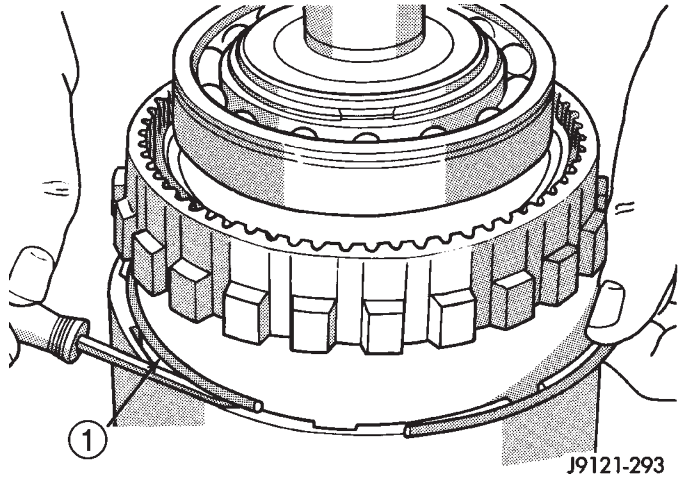


Fig. 156 Clutch Drum Outer Retaining Ring Removal

1 - OUTER RETAINING RING

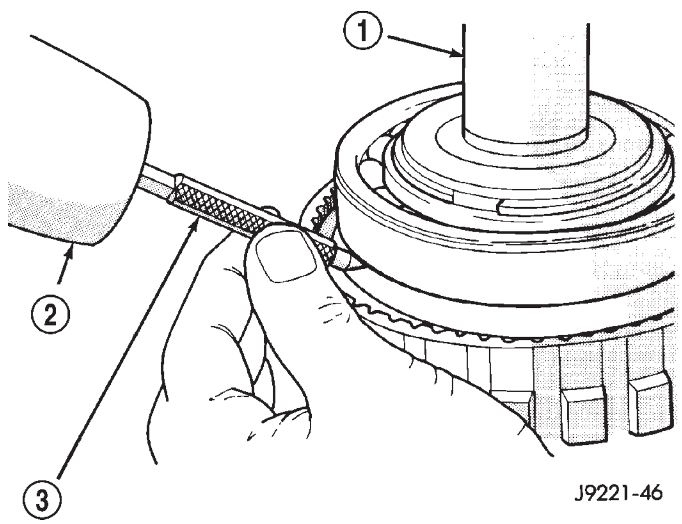


Fig. 157 Marking Annulus Gear And Output Shaft For Assembly Alignment

1 - OUTPUT SHAFT
2 - HAMMER
3 - PUNCH

OVERDRIVE UNIT (Continued)

(10) Remove snap-ring that secures annulus gear on output shaft (Fig. 158). Use two screwdrivers to unseat and work snap-ring out of groove as shown.

(11) Remove annulus gear from output shaft (Fig. 159). Use rawhide or plastic mallet to tap gear off shaft.

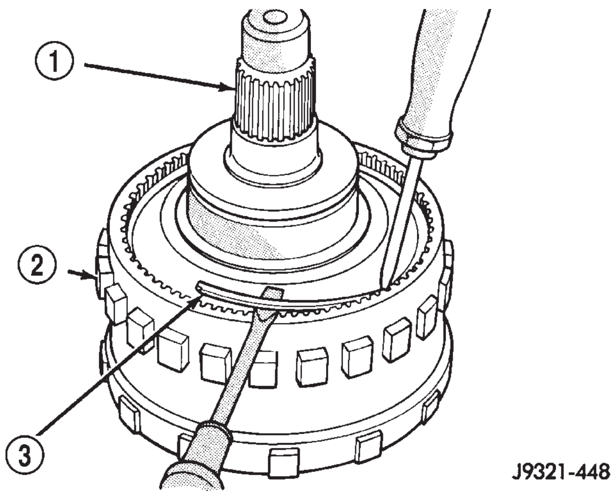


Fig. 158 Annulus Gear Snap-Ring Removal

1 - OUTPUT SHAFT
2 - ANNULUS GEAR
3 - SNAP-RING

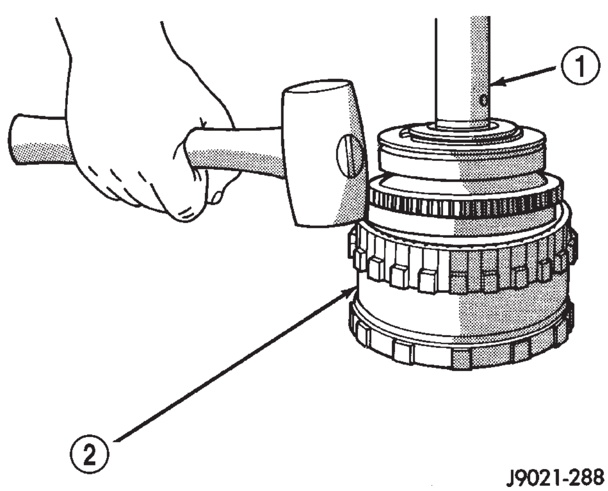


Fig. 159 Annulus Gear Removal

1 - OUTPUT SHAFT
2 - ANNULUS GEAR

GEAR CASE AND PARK LOCK

(1) Remove locating ring from gear case.

(2) Remove park pawl shaft retaining bolt and remove shaft, pawl and spring.

(3) Remove reaction plug snap-ring and remove reaction plug.

(4) Remove output shaft seal.

CLEANING

Clean the geartrain and case components with solvent. Dry all parts except the bearings with compressed air. Allow bearings to air dry.

Do not use shop towels for wiping parts dry unless the towels are made from a lint-free material. A sufficient quantity of lint (from shop towels, cloths, rags, etc.) could plug the transmission filter and fluid passages.

Discard the old case gasket and seals. Do not attempt to salvage these parts. They are not reusable. Replace any of the overdrive unit snap-rings if distorted or damaged.

Minor nicks or scratches on components can be smoothed with crocus cloth. However, do not attempt to reduce severe scoring on any components with abrasive materials. Replace severely scored components; do not try to salvage them.

INSPECTION

Check condition of the park lock components and the overdrive case.

Check the bushings in the overdrive case. Replace the bushings if severely scored or worn. Also replace the case seal if loose, distorted, or damaged.

Examine the overdrive and direct clutch discs and plates. Replace the discs if the facing is worn, severely scored, or burned and flaking off. Replace the clutch plates if worn, heavily scored, or cracked. Check the lugs on the clutch plates for wear. The plates should slide freely in the drum. Replace the plates or drum if binding occurs.

Check condition of the annulus gear, direct clutch hub, clutch drum and clutch spring. Replace the gear, hub and drum if worn or damaged. Replace the spring if collapsed, distorted, or cracked.

Be sure the splines and lugs on the gear, drum and hub are in good condition. The clutch plates and discs should slide freely in these components.

Inspect the thrust bearings and spring plate. Replace the plate if worn or scored. Replace the bearings if rough, noisy, brinnelled, or worn.

Inspect the planetary gear assembly and the sun gear and bushings. If either the sun gear or the bushings are damaged, replace the gear and bushings as an assembly. The gear and bushings are not serviced separately.

OVERDRIVE UNIT (Continued)

The planetary carrier and pinions must be in good condition. Also be sure the pinion pins are secure and in good condition. Replace the carrier if worn or damaged.

Inspect the overrunning clutch and race. The race surface should be smooth and free of scores. Replace the overrunning clutch assembly or the race if either assembly is worn or damaged in any way.

Replace the shaft pilot bushing and inner bushing if damaged. Replace either shaft bearing if rough or noisy. Replace the bearing snap-rings if distorted or cracked.

Check the machined surfaces on the output shaft. These surfaces should clean and smooth. Very minor nicks or scratches can be smoothed with crocus cloth. Replace the shaft if worn, scored or damaged in any way.

Inspect the output shaft bushings. The small bushing is the intermediate shaft pilot bushing. The large bushing is the overrunning clutch hub bushing. Replace either bushing if scored, pitted, cracked, or worn.

ASSEMBLY

GEARTRAIN AND DIRECT CLUTCH

(1) Soak direct clutch and overdrive clutch discs in Mopar® ATF +4, type 9602, transmission fluid. Allow discs to soak for 10-20 minutes.

(2) Install new pilot bushing and clutch hub bushing in output shaft if necessary (Fig. 160). Lubricate bushings with petroleum jelly, or transmission fluid.

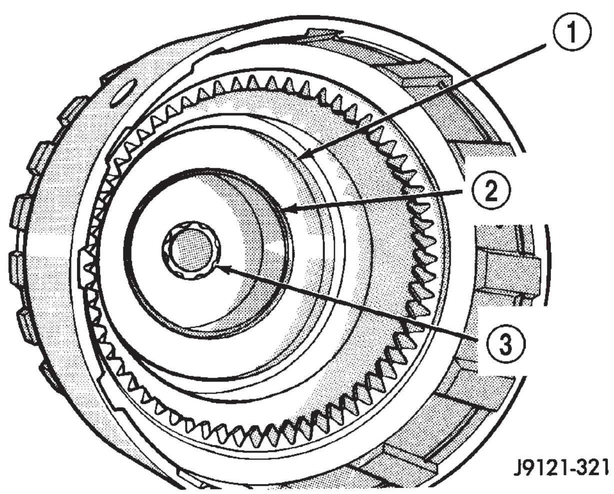


Fig. 160 Output Shaft Pilot Bushing

1 - OUTPUT SHAFT HUB
2 - OVERRUNNING CLUTCH HUB BUSHING
3 - INTERMEDIATE SHAFT PILOT BUSHING

(3) Install annulus gear on output shaft, if removed. Then install annulus gear retaining snap-ring (Fig. 161).

(4) Align and install clutch drum on annulus gear (Fig. 162). Be sure drum is engaged in annulus gear lugs.

(5) Install clutch drum outer retaining ring (Fig. 162).

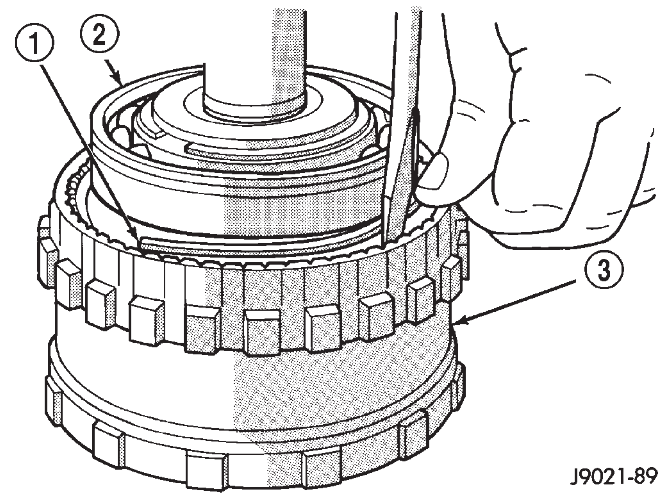


Fig. 161 Annulus Gear Installation

1 - SNAP-RING
2 - OUTPUT SHAFT FRONT BEARING
3 - ANNULUS GEAR

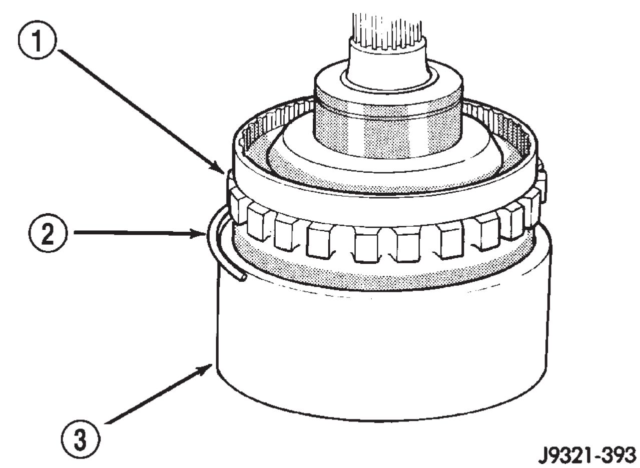


Fig. 162 Clutch Drum And Outer Retaining Ring Installation

1 - ANNULUS GEAR
2 - OUTER SNAP-RING
3 - CLUTCH DRUM

OVERDRIVE UNIT (Continued)

(6) Slide clutch drum forward and install inner retaining ring (Fig. 163).

(7) Install rear bearing and snap ring on output shaft (Fig. 164). Be sure locating ring groove in bearing is toward rear.

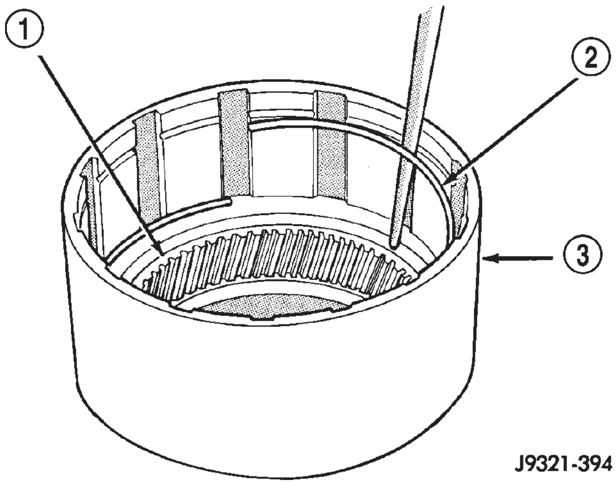


Fig. 163 Clutch Drum Inner Retaining Ring Installation

1 - ANNULUS GEAR
2 - INNER SNAP-RING
3 - CLUTCH DRUM

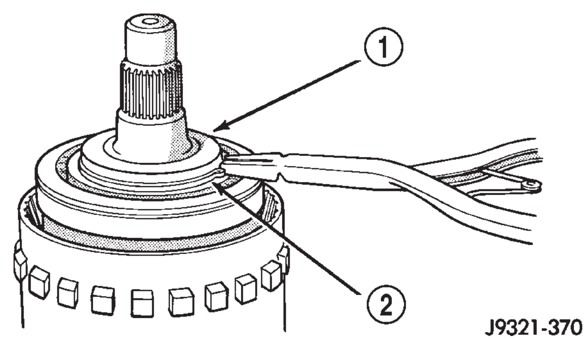


Fig. 164 Rear Bearing And Snap-Ring Installation

1 - REAR BEARING
2 - SNAP-RING

(8) Install overrunning clutch on hub (Fig. 165). Note that clutch only fits one way. Shoulder on clutch should seat in small recess at edge of hub.

(9) Install thrust bearing on overrunning clutch hub. Use generous amount of petroleum jelly to hold bearing in place for installation. Bearing fits one way only. Be sure bearing is seated squarely against hub. Reinstall bearing if it does not seat squarely.

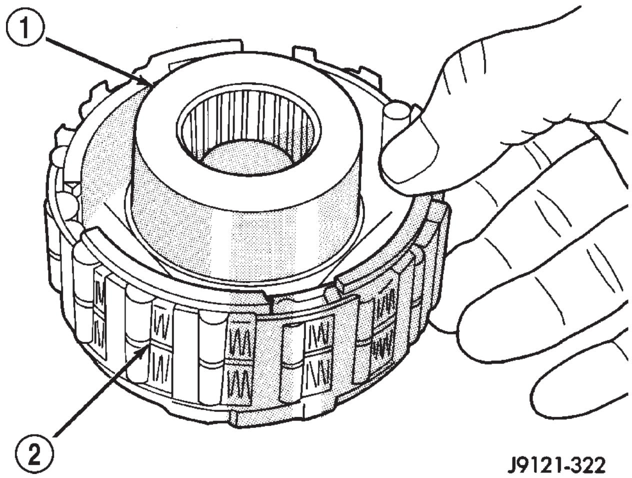


Fig. 165 Assembling Overrunning Clutch And Hub

1 - CLUTCH HUB
2 - OVERRUNNING CLUTCH

(10) Install overrunning clutch in output shaft (Fig. 166). Insert snap ring pliers in hub splines. Expand pliers to grip hub. Then install assembly with counterclockwise, twisting motion.

(11) Install planetary gear in annulus gear (Fig. 167). Be sure planetary pinions are fully seated in annulus gear before proceeding.

(12) Coat planetary thrust bearing and bearing contact surface of spring plate with generous amount of petroleum jelly. This will help hold bearing in place during installation.

(13) Install planetary thrust bearing on sun gear (Fig. 168). Slide bearing onto gear and seat it against spring plate as shown. Bearing fits one way only. If it does not seat squarely against spring plate, remove and reposition bearing.

(14) Install assembled sun gear, spring plate and thrust bearing (Fig. 169). Be sure sun gear and thrust bearing are fully seated before proceeding.

(15) Mount assembled output shaft, annulus gear, and clutch drum in shop press. Direct clutch spring, hub and clutch pack are easier to install with assembly mounted in press.

OVERDRIVE UNIT (Continued)

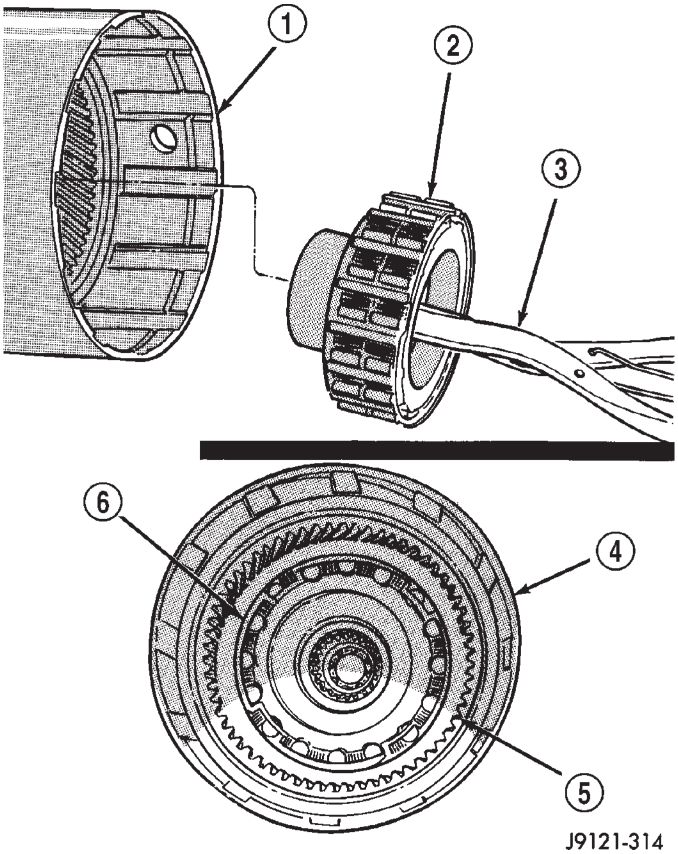


Fig. 166 Overrunning Clutch Installation

1 - CLUTCH DRUM
2 - OVERRUNNING CLUTCH ASSEMBLY
3 - EXPANDING-TYPE SNAP-RING PLIERS
4 - CLUTCH DRUM
5 - ANNULUS GEAR
6 - OVERRUNNING CLUTCH ASSEMBLY SEATED IN OUTPUT SHAFT

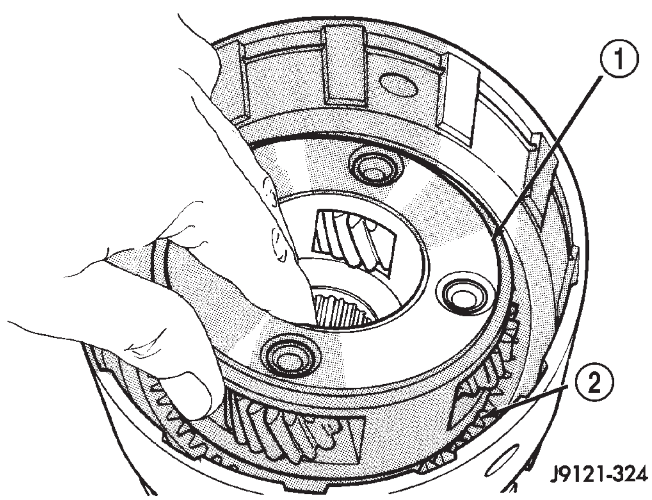


Fig. 167 Planetary Gear Installation

1 - PLANETARY GEAR
2 - ANNULUS GEAR

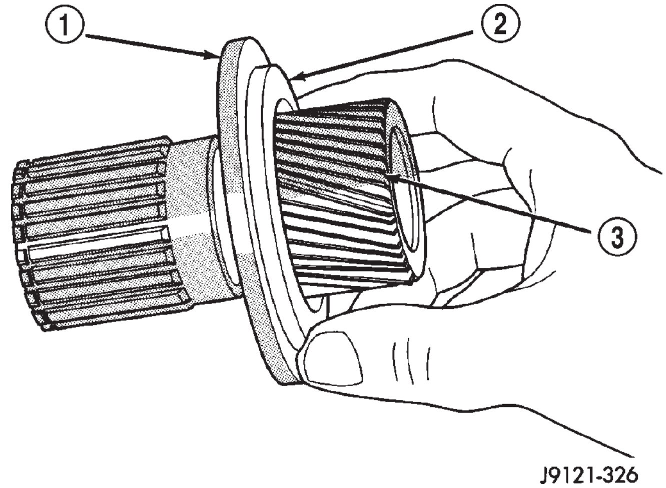


Fig. 168 Planetary Thrust Bearing Installation

1 - SPRING PLATE
2 - PLANETARY THRUST BEARING
3 - SUN GEAR

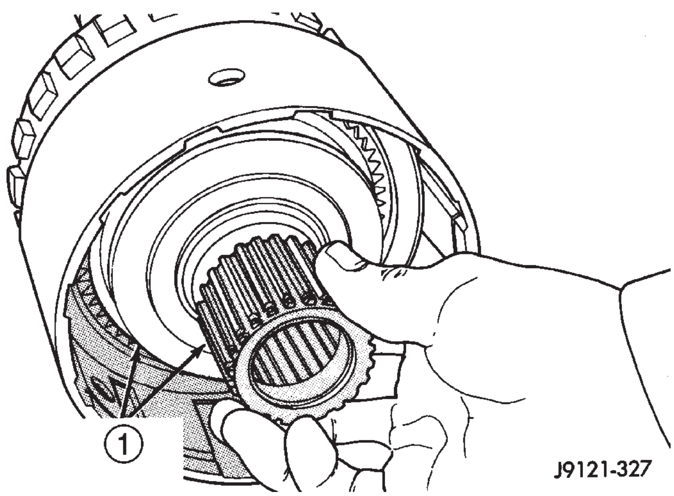


Fig. 169 Sun Gear Installation

1 - SUN GEAR AND SPRING PLATE ASSEMBLY

(16) Align splines in hubs of planetary gear and overrunning clutch with Alignment tool 6227-2 (Fig. 170). Insert tool through sun gear and into splines of both hubs. Be sure alignment tool is fully seated before proceeding.

OVERDRIVE UNIT (Continued)

(17) Install direct clutch spring (Fig. 171). Be sure spring is properly seated on spring plate.

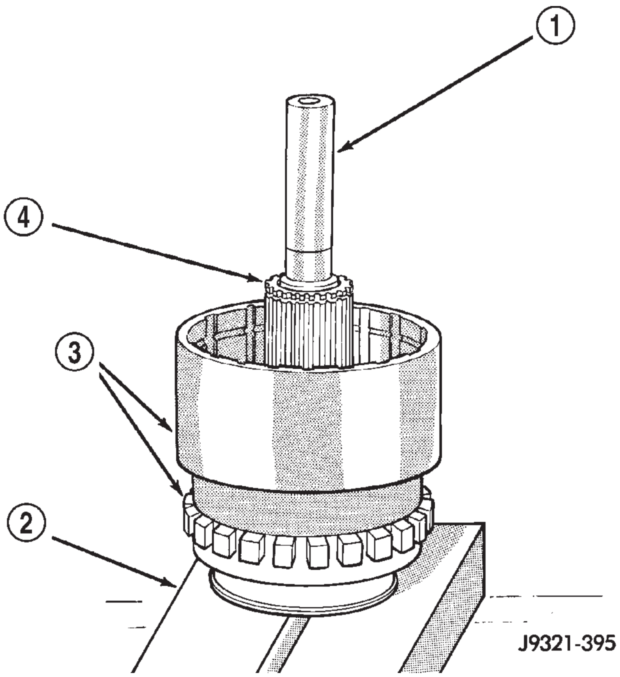


Fig. 170 Alignment Tool Installation

1 - SPECIAL TOOL 6227-2
2 - PRESS PLATES
3 - ASSEMBLED DRUM AND ANNULUS GEAR
4 - SUN GEAR

NOTE: The direct clutch in a 46RE transmission uses 8 clutch discs.

(18) Assemble and install direct clutch pack on hub as follows:

(a) Assemble clutch pack components (Fig. 172).

(b) Install direct clutch reaction plate on clutch hub first. Note that one side of reaction plate is counterbored. Be sure this side faces rearward. Splines at rear of hub are raised slightly. Counterbore in plate fits over raised splines. Plate should be flush with this end of hub (Fig. 173).

(c) Install first clutch disc followed by a steel plate until all discs and plates have been installed.

(d) Install pressure plate. This is last clutch pack item to be installed. Be sure plate is installed with shoulder side facing upward (Fig. 174).

(19) Install clutch hub and clutch pack on direct clutch spring (Fig. 175). Be sure hub is started on sun gear splines before proceeding.

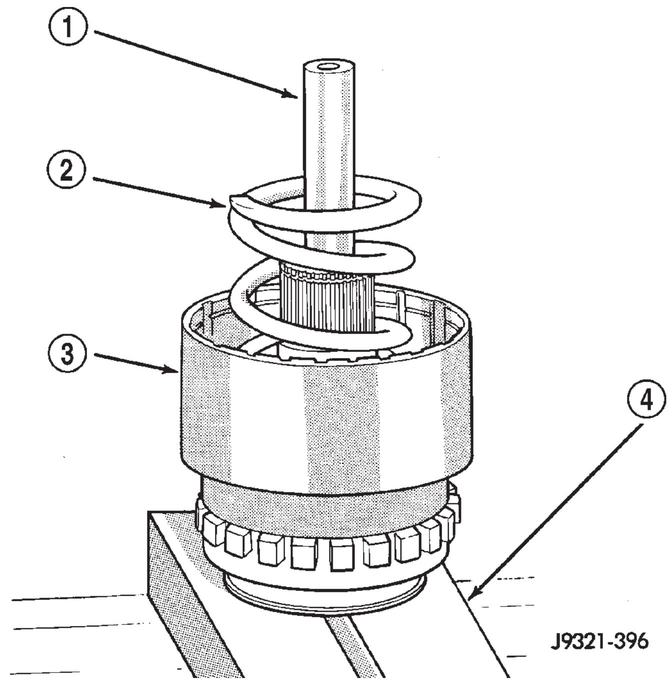


Fig. 171 Direct Clutch Spring Installation

1 - SPECIAL TOOL 6227-2
2 - DIRECT CLUTCH SPRING
3 - CLUTCH HUB
4 - PRESS PLATES

WARNING: THE NEXT STEP IN GEARTRAIN ASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH HUB AND SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE COMPRESSOR TOOL C-6227-1 AND A HYDRAULIC-TYPE SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

OVERDRIVE UNIT (Continued)

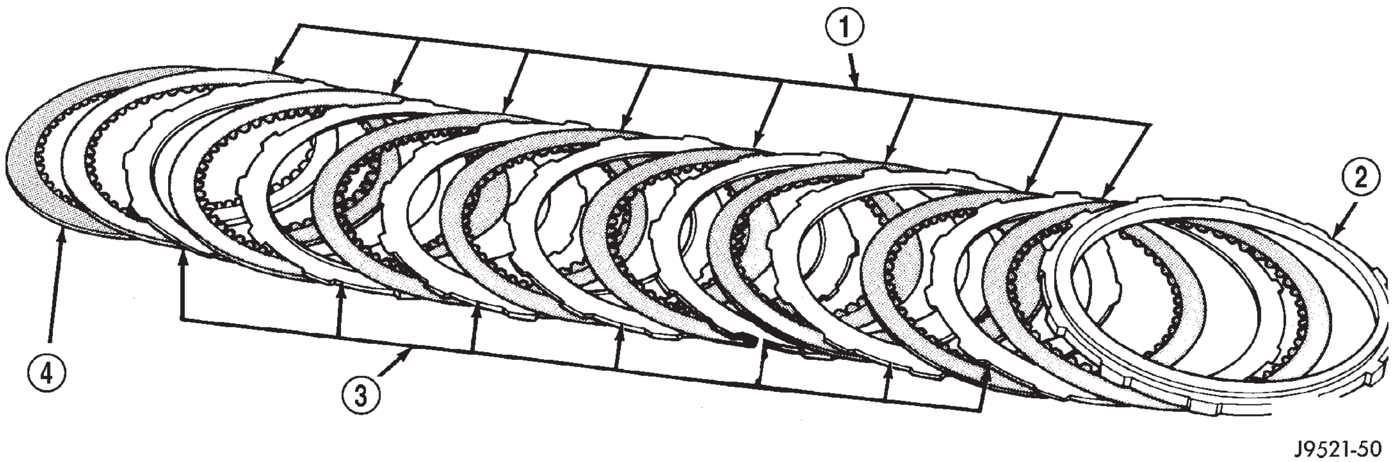


Fig. 172 46RE Direct Clutch Pack Components

1 - CLUTCH DISCS (8)
2 - PRESSURE PLATE
3 - CLUTCH PLATES (7)
4 - REACTION PLATE

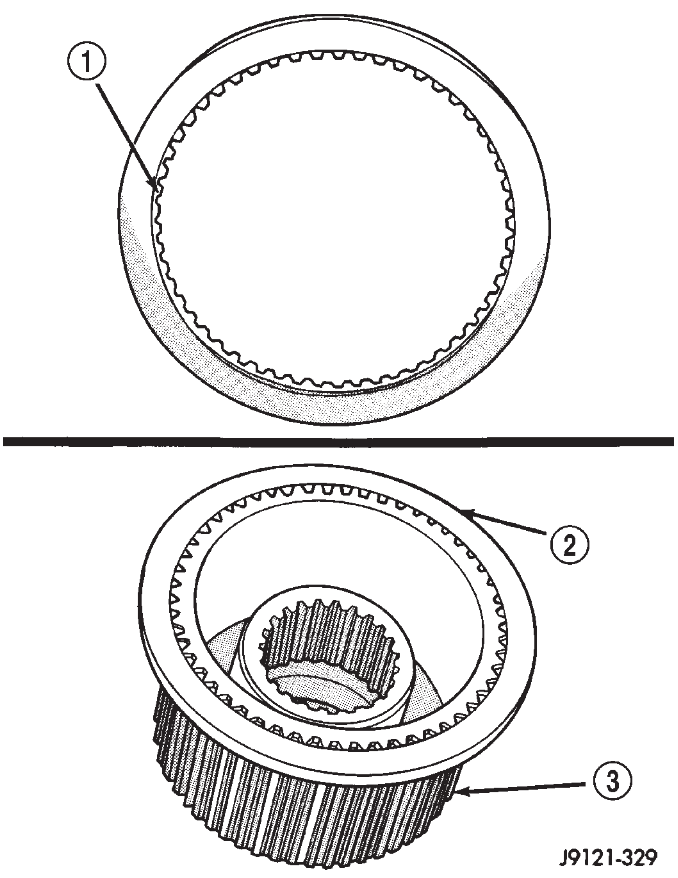


Fig. 173 Correct Position Of Direct Clutch Reaction Plate

1 - REACTION PLATE COUNTERBORE
2 - DIRECT CLUTCH REACTION PLATE (FLUSH WITH END OF HUB)
3 - CLUTCH HUB

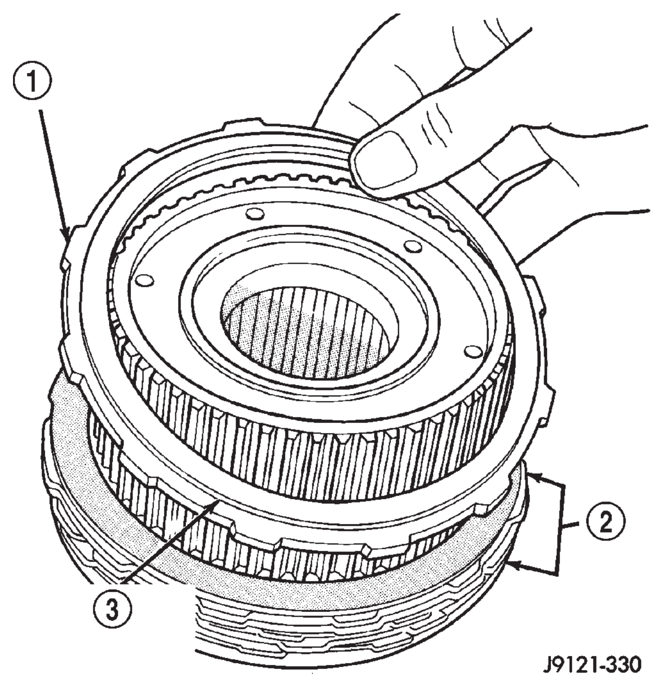


Fig. 174 Correct Position Of Direct Clutch

1 - DIRECT CLUTCH PRESSURE PLATE
2 - CLUTCH PACK
3 - BE SURE SHOULDER SIDE OF PLATE FACES UPWARD

(20) Position Compressor Tool 6227-1 on clutch hub.

(21) Compress clutch hub and spring just enough to place tension on hub and hold it in place.

(22) Slowly compress clutch hub and spring. Compress spring and hub only enough to expose ring grooves for clutch pack snap ring and clutch hub retaining ring.

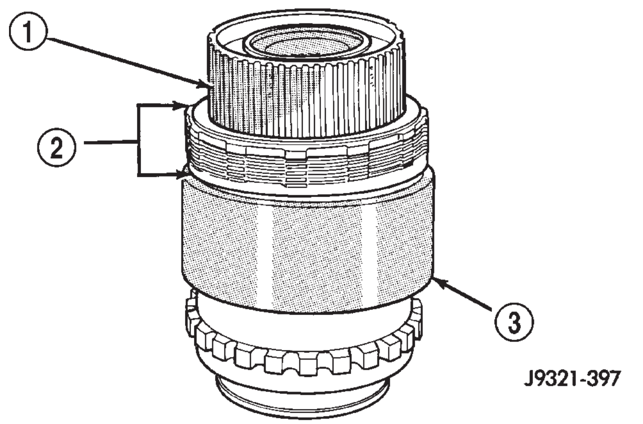


Fig. 175 Direct Clutch Pack And Clutch Hub Installation

1 - CLUTCH HUB
2 - DIRECT CLUTCH PACK
3 - CLUTCH DRUM

(23) Realign clutch pack on hub and seat clutch discs and plates in clutch drum.

(24) Install direct clutch pack snap ring (Fig. 176). Be very sure snap ring is fully seated in clutch drum ring groove.

(25) Install clutch hub retaining ring (Fig. 177). Be very sure retaining ring is fully seated in sun gear ring groove.

(26) Slowly release press ram, remove compressor tools and remove geartrain assembly.

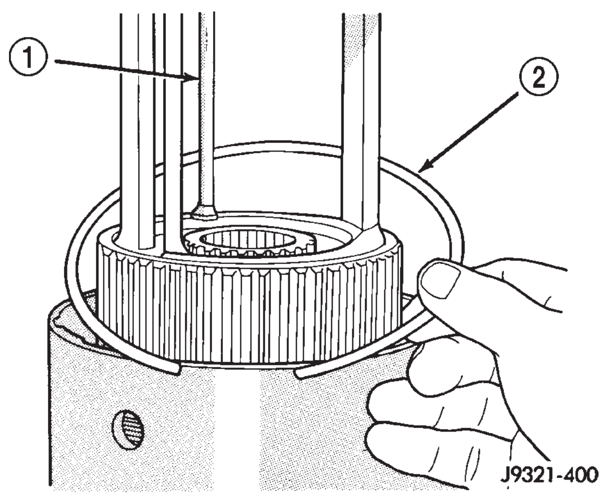


Fig. 176 Direct Clutch Pack Snap-Ring Installation

1 - SPECIAL TOOL 6227-1
2 - DIRECT CLUTCH PACK SNAP-RING

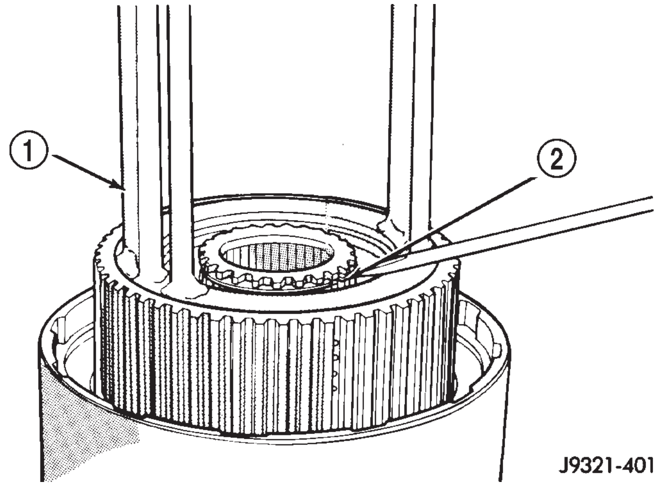


Fig. 177 Clutch Hub Retaining Ring Installation

1 - SPECIAL TOOL 6227-1
2 - CLUTCH HUB RETAINING RING

GEAR CASE

(1) Position park pawl and spring in case and install park pawl shaft. Verify that end of spring with 90° bend is hooked to pawl and straight end of spring is seated against case.

(2) Install pawl shaft retaining bolt. Tighten bolt to 27 N·m (20 ft. lbs.) torque.

(3) Install park lock reaction plug. Note that plug has locating pin at rear (Fig. 178). Be sure pin is seated in hole in case before installing snap ring.

(4) Install reaction plug snap-ring (Fig. 179). Compress snap ring only enough for installation; do not distort it.

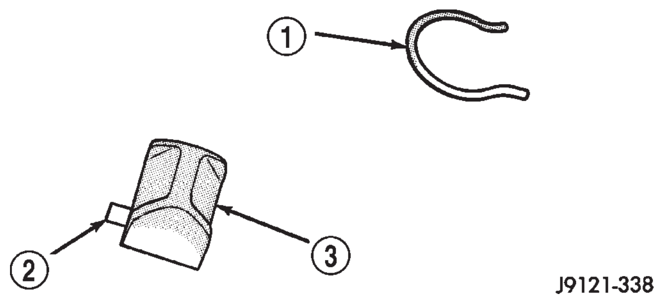


Fig. 178 Reaction Plug Locating Pin And Snap-Ring

1 - REACTION PLUG SNAP-RING (DO NOT OVERCOMPRESS TO INSTALL)
2 - LOCATING PIN
3 - PARK LOCK REACTION PLUG

OVERDRIVE UNIT (Continued)

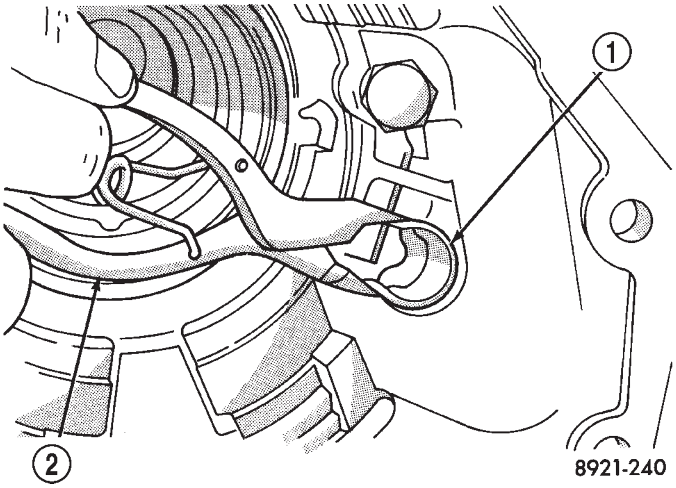


Fig. 179 Reaction Plug And Snap-Ring Installation

1 - REACTION PLUG SNAP-RING
2 - SNAP-RING PLIERS

(5) Install new seal in gear case. Use Handle C-4171 and Installer C-3995-A to seat seal in case.

(6) Verify that tab ends of rear bearing locating ring extend into access hole in gear case (Fig. 180).

(7) Support geartrain on Tool 6227-1 (Fig. 181). Be sure tool is securely seated in clutch hub.

(8) Install overdrive gear case on geartrain (Fig. 181).

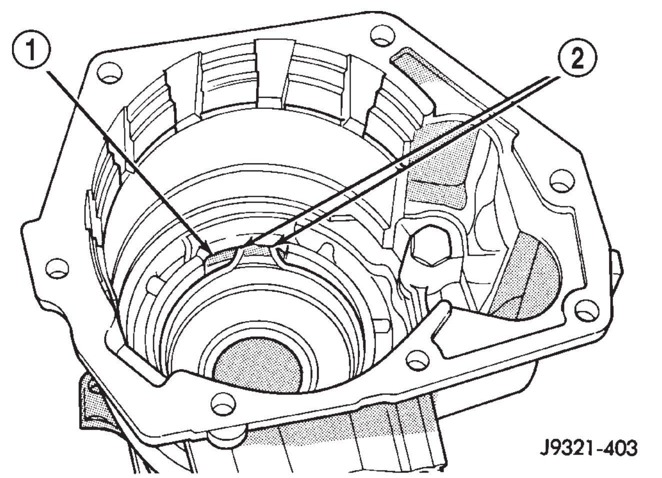


Fig. 180 Correct Rear Bearing Locating Ring Position

1 - CASE ACCESS HOLE
2 - TAB ENDS OF LOCATING RING

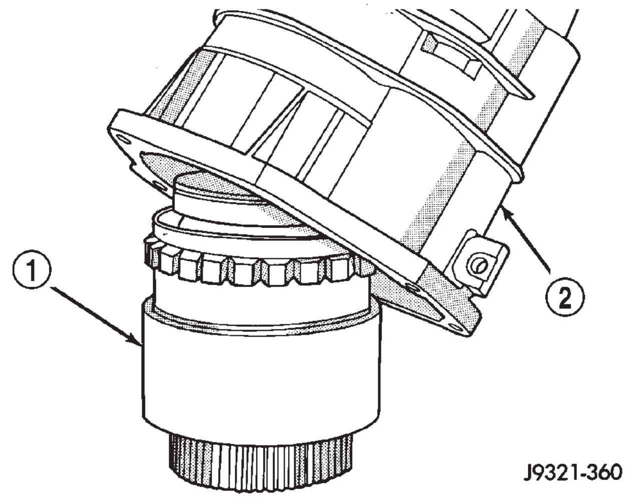


Fig. 181 Overdrive Gear Case Installation

1 - GEARTRAIN ASSEMBLY
2 - GEAR CASE

(9) Expand front bearing locating ring with snap ring pliers (Fig. 182). Then slide case downward until locating ring locks in bearing groove and release snap ring.

(10) Install locating ring access cover and gasket in overdrive unit case (Fig. 183).

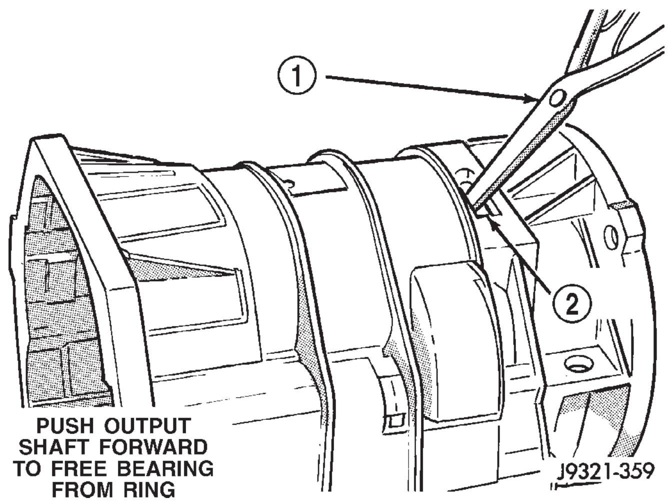


Fig. 182 Seating Locating Ring In Rear Bearing

1 - EXPAND BEARING LOCATING RING WITH SNAP-RING PLIERS
2 - ACCESS HOLE

OVERDRIVE UNIT (Continued)

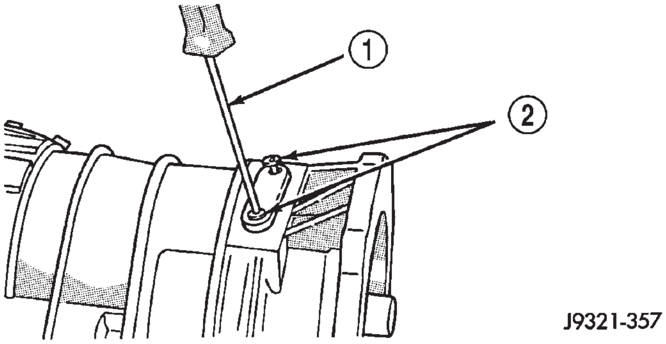


Fig. 183 Locating Ring Access Cover And Gasket Installation

1 - TORX SCREWDRIVER (T25)
2 - ACCESS COVER SCREWS

OVERDRIVE CLUTCH

NOTE: The overdrive clutch in a 46RE transmission uses 4 clutch discs.

(1) Install overdrive clutch reaction ring first. Reaction ring is flat with notched ends (Fig. 184).

(2) Install wave spring on top of reaction ring (Fig. 185). Reaction ring and wave ring both fit in same ring groove. Use screwdriver to seat each ring securely in groove. Also ensure that the ends of the two rings are offset from each other.

(3) Assemble overdrive clutch pack (Fig. 186).

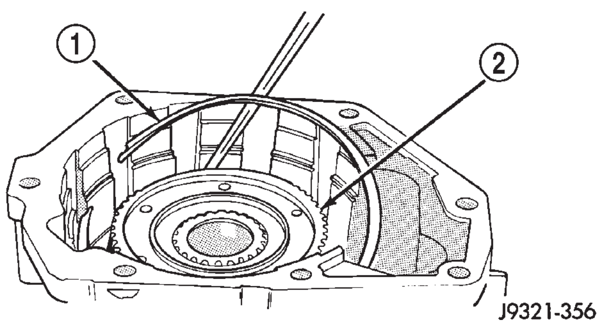


Fig. 184 Overdrive Clutch Reaction Ring Installation

1 - REACTION RING
2 - CLUTCH HUB

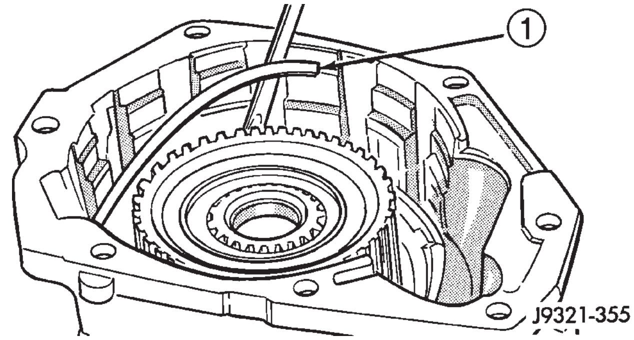


Fig. 185 Overdrive Clutch Wave Spring Installation

1 - WAVE SPRING

(4) Install overdrive clutch reaction plate first.

NOTE: The reaction plate is the same thickness as the pressure plate in a 46RE transmission.

(5) Install first clutch disc followed by first clutch plate. Then install remaining clutch discs and plates in same order.

(6) Install clutch pack pressure plate.

(7) Install clutch pack wire-type retaining ring (Fig. 187).

INTERMEDIATE SHAFT SPACER SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

(2) Determine correct thickness intermediate shaft spacer as follows:

(a) Insert Special Tool 6312 through sun gear, planetary gear and into pilot bushing in output shaft. Be sure tool bottoms against planetary shoulder.

(b) Position Gauge Tool 6311 across face of overdrive case (Fig. 188). Then position Dial Caliper C-4962 over gauge tool.

(c) Extend sliding scale of dial caliper downward through gauge tool slot until scale contacts end of Gauge Alignment Tool 6312. Lock scale in place. Remove dial caliper tool and note distance measured (Fig. 188).

(d) Select proper thickness end play spacer from spacer chart based on distance measured (Fig. 189).

(e) Remove Gauge Alignment Tool 6312.

OVERDRIVE UNIT (Continued)

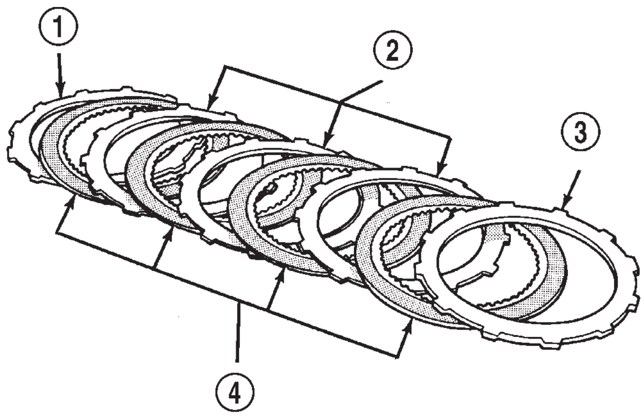


Fig. 186 46RE Overdrive Clutch Components

1 - REACTION PLATE
2 - CLUTCH PLATES (3)
3 - PRESSURE PLATE
4 - CLUTCH DISCS (4)

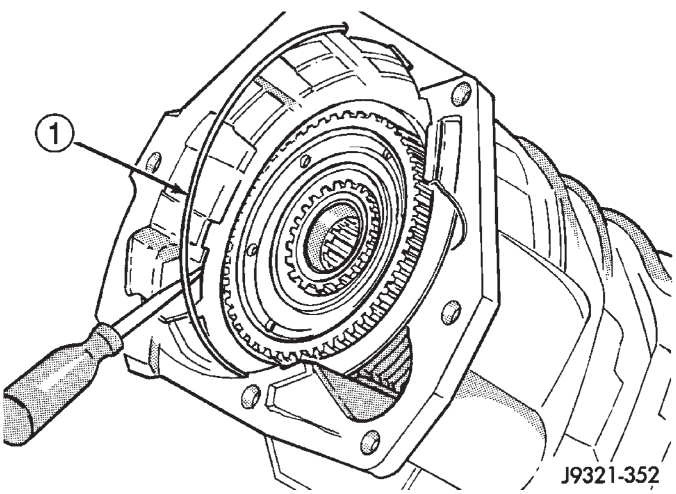


Fig. 187 Overdrive Clutch Pack Retaining Ring Installation

1 - OVERDRIVE CLUTCH PACK RETAINING RING

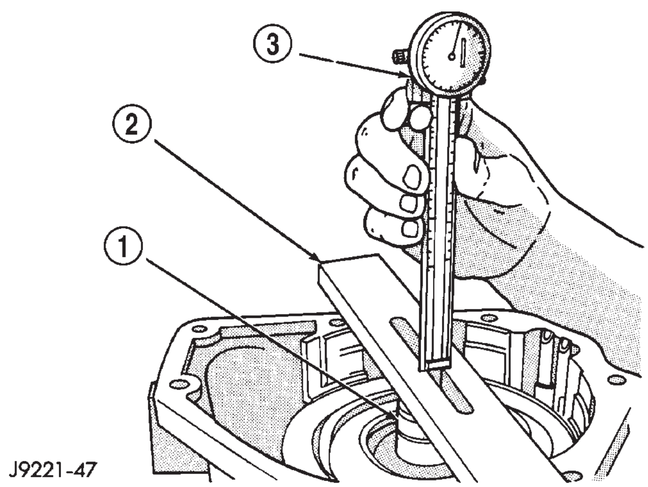


Fig. 188 Shaft End Play Measurement

1 - SPECIAL TOOL 6312
2 - SPECIAL TOOL 6311
3 - SPECIAL TOOL C-4962

End Play Measurement (Inches)	Spacer Thickness (Inches)
.7336 - .7505	.158 - .159
.7506 - .7675	.175 - .176
.7676 - .7855	.193 - .194
.7856 - .8011	.211 - .212

J9121-341

Fig. 189 Intermediate Shaft End Play Spacer Selection

OVERDRIVE UNIT (Continued)

OD THRUST PLATE SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

(2) Determine correct thickness overdrive piston thrust plate as follows:

(a) Position Gauge Tool 6311 across face of overdrive case. Then position Dial Caliper C-4962 over gauge tool (Fig. 190).

(b) Measure distance to clutch hub thrust bearing seat at four points 90° apart. Then average measurements by adding them and dividing by 4.

(c) Select and install required thrust plate from information in thrust plate chart (Fig. 191).

(3) Leave Alignment Tool 6227-2 in place. Tool will keep planetary and clutch hub splines in alignment until overdrive unit is ready for installation on transmission.

(4) Transmission speed sensor can be installed at this time if desired. However, it is recommended that sensor not be installed until after overdrive unit is secured to transmission.

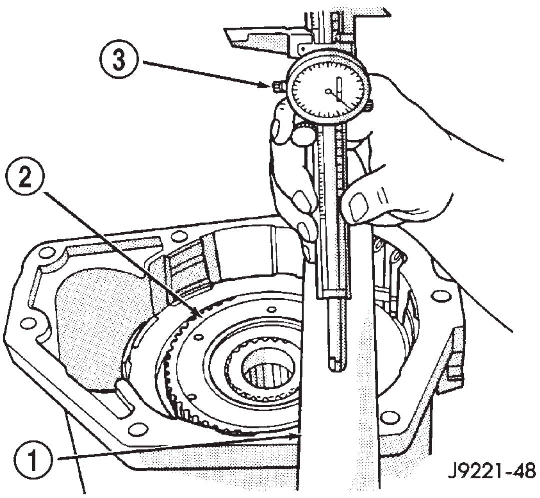


Fig. 190 Overdrive Piston Thrust Plate Measurement

1 - SPECIAL TOOL 6311
2 - DIRECT CLUTCH HUB THRUST BEARING SEAT
3 - SPECIAL TOOL C-4962

OVERDRIVE PISTON

(1) Install new seals on overdrive piston.

(2) Stand transmission case upright on bellhousing.

(3) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(4) Position Seal Guide 8114-3 on inner edge of overdrive piston retainer.

End Play Measurement (Inches)	Spacer Thickness (Inches)
1.7500 - 1.7649	.108 - .110
1.7650 - 1.7799	.123 - .125
1.7800 - 1.7949	.138 - .140
1.7950 - 1.8099	.153 - .155
1.8100 - 1.8249	.168 - .170
1.8250 - 1.8399	.183 - .185
1.8400 - 1.8549	.198 - .200
1.8550 - 1.8699	.213 - .215
1.8700 - 1.8849	.228 - .230
1.8850 - 1.8999	.243 - .245

J9121-342

Fig. 191 Overdrive Piston Thrust Plate Selection

(5) Install overdrive piston in overdrive piston retainer by:

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

(b) Lubricate overdrive piston seals with Mopar® Door Ease, or equivalent.

(c) Install piston over Seal Guide 8114–3 and inside Guide Ring 8114–1.

(d) Push overdrive piston into position in retainer.

(e) Verify that the locating lugs entered the lug bores in the retainer.

(6) Install intermediate shaft spacer on intermediate shaft.

(7) Install overdrive piston thrust plate on overdrive piston.

(8) Install overdrive piston thrust bearing on overdrive piston.

(9) Install transmission speed sensor and O-ring seal in overdrive case.

INSTALLATION

(1) Be sure overdrive unit Alignment Tool 6227-2 is fully seated before moving unit. If tool is not seated and gear splines rotate out of alignment, overdrive unit will have to be disassembled in order to realign splines.

(2) If overdrive piston retainer was not removed during service and original case gasket is no longer reusable, prepare new gasket by trimming it.

(3) Cut out old case gasket around piston retainer with razor knife (Fig. 192).

(4) Use old gasket as template and trim new gasket to fit.

(5) Position new gasket over piston retainer and on transmission case. Use petroleum jelly to hold gasket in place if necessary. Do not use any type of sealer to secure gasket. Use petroleum jelly only.

OVERDRIVE UNIT (Continued)

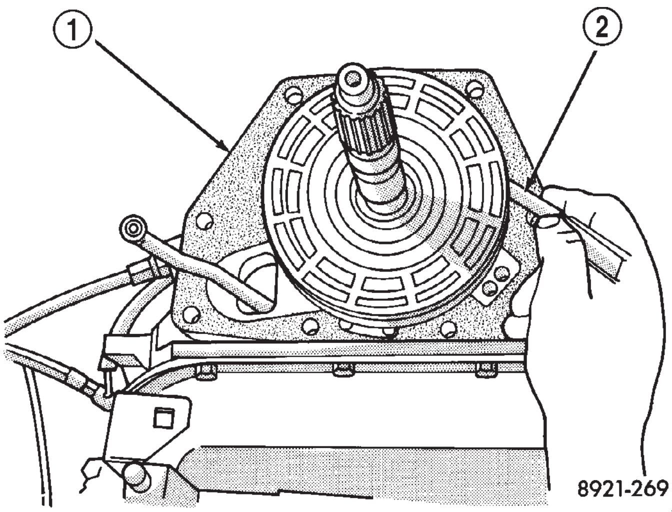


Fig. 192 Trimming Overdrive Case Gasket

1 - GASKET
2 - SHARP KNIFE

(6) Install selective spacer on intermediate shaft, if removed. Spacer goes in groove just rearward of shaft rear splines (Fig. 193).

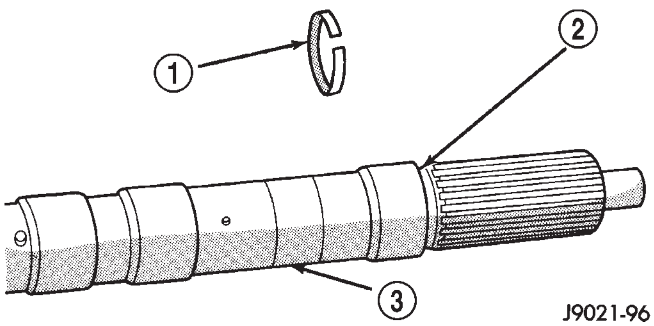


Fig. 193 Intermediate Shaft Selective Spacer Location

1 - SELECTIVE SPACER
2 - SPACER GROOVE
3 - INTERMEDIATE SHAFT

(7) Install thrust bearing in overdrive unit sliding hub. Use petroleum jelly to hold bearing in position.

CAUTION: Be sure the shoulder on the inside diameter of the bearing is facing forward.

(8) Verify that splines in overdrive planetary gear and overrunning clutch hub are aligned with Alignment Tool 6227-2. Overdrive unit cannot be installed if splines are not aligned. If splines have rotated out of alignment, unit will have to be disassembled to realign splines.

(9) Carefully slide Alignment Tool 6227-2 out of overdrive planetary gear and overrunning clutch splines.

(10) Raise overdrive unit and carefully slide it straight onto intermediate shaft. Insert park rod into park lock reaction plug at same time. Avoid tilting overdrive during installation as this could cause planetary gear and overrunning clutch splines to rotate out of alignment. If this occurs, it will be necessary to remove and disassemble overdrive unit to realign splines.

(11) Work overdrive unit forward on intermediate shaft until seated against transmission case.

(12) Install bolts attaching overdrive unit to transmission unit. Tighten bolts in diagonal pattern to 34 N·m (25 ft-lbs).

(13) Connect the transmission speed sensor and overdrive wiring connectors.

(14) Install the transfer case, if equipped.

(15) Align and install rear propeller shaft, if necessary. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER

DESCRIPTION

The overrunning clutch (Fig. 194) 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.

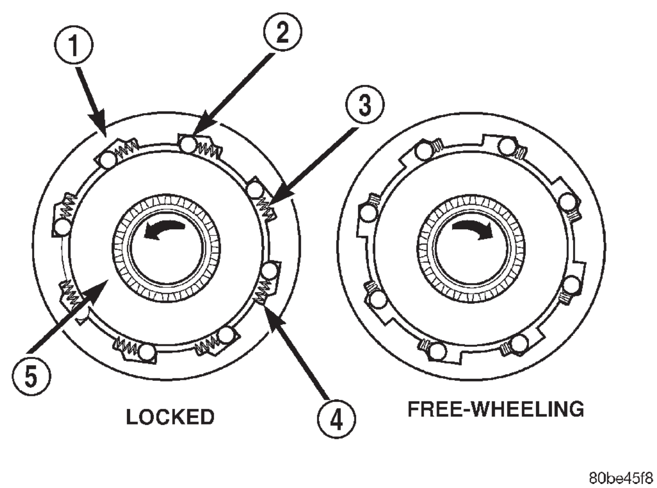


Fig. 194 Overrunning Clutch

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) Remove the overdrive piston (Fig. 195).

(2) Remove the overdrive piston retainer bolts.

(3) Remove overdrive piston retainer.

(4) Remove case gasket.

(5) Tap old cam out of case with pin punch. Insert punch through bolt holes at rear of case (Fig. 196). Alternate position of punch to avoid cocking cam during removal.

(6) Clean clutch cam bore and case. Be sure to remove all chips/shavings generated during cam removal.

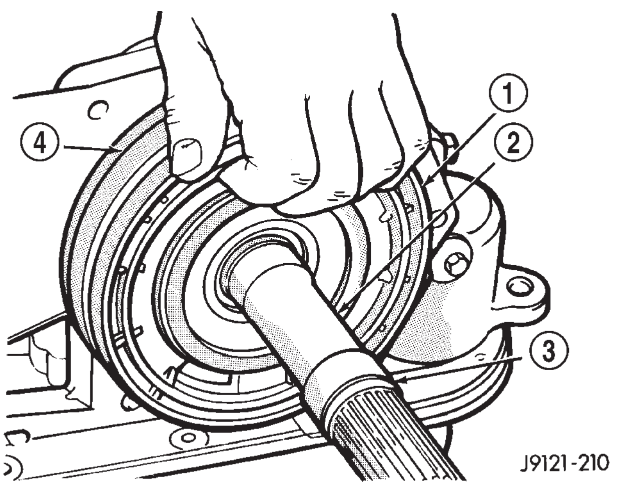


Fig. 195 Overdrive Piston Removal

1 - OVERDRIVE CLUTCH PISTON
2 - INTERMEDIATE SHAFT
3 - SELECTIVE SPACER
4 - PISTON RETAINER

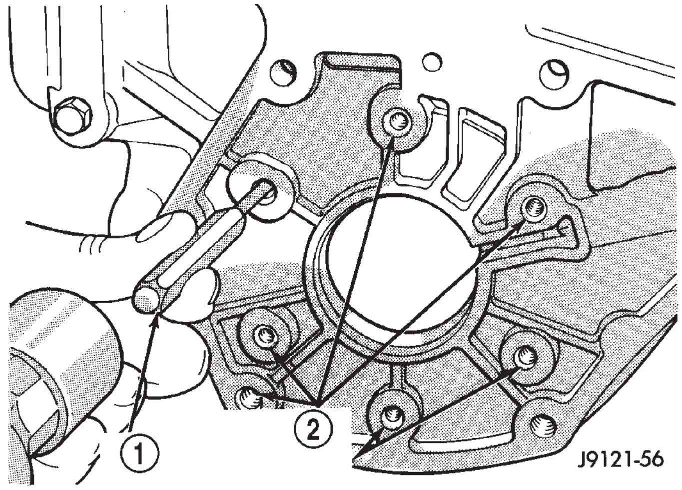


Fig. 196 Overrunning Clutch Cam

1 - PIN PUNCH
2 - REAR SUPPORT BOLT HOLES

CLEANING

Clean the overrunning clutch assembly, clutch cam, low-reverse drum, and overdrive piston retainer in solvent. Dry them with compressed air after cleaning.

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.

Replace the low-reverse drum if the clutch race, roller surface or inside diameter is scored, worn or damaged. **Do not remove the clutch race from the low-reverse drum under any circumstances. Replace the drum and race as an assembly if either component is damaged.**

Examine the overdrive piston retainer carefully for wear, cracks, scoring or other damage. Be sure the retainer hub is a snug fit in the case and drum. Replace the retainer if worn or damaged.

ASSEMBLY

(1) Temporarily install overdrive piston retainer in case. Use 3-4 bolts to secure retainer.

(2) Align and start new clutch cam in the transmission case. Be sure serrations on cam and in case are aligned (Fig. 197). Then tap cam into case just enough to hold it in place.

(3) Verify that cam is correctly positioned before proceeding any further. Narrow ends of cam ramps should be to left when cam is viewed from front end of case (Fig. 197).

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER (Continued)

(4) Insert Adapter Tool SP-5124 into piston retainer (Fig. 198).

(5) Assemble Puller Bolt SP-3701 and Press Plate SP-3583-A (Fig. 199).

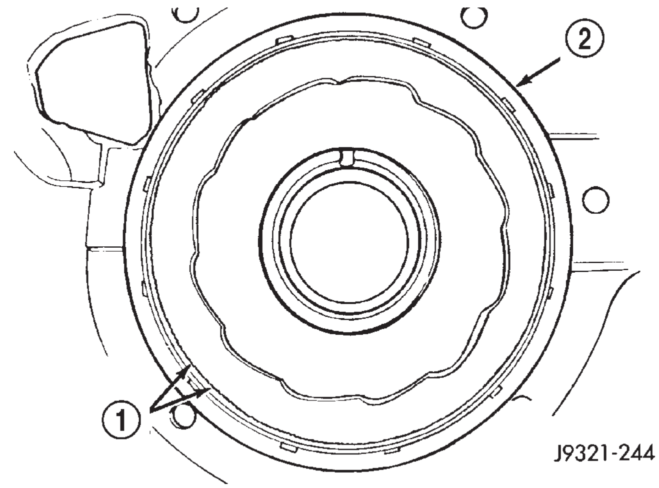


Fig. 197 Positioning Replacement Clutch Cam In Case

1 - ALIGN SERRATIONS ON CAM AND IN CASE
2 - CLUTCH CAM

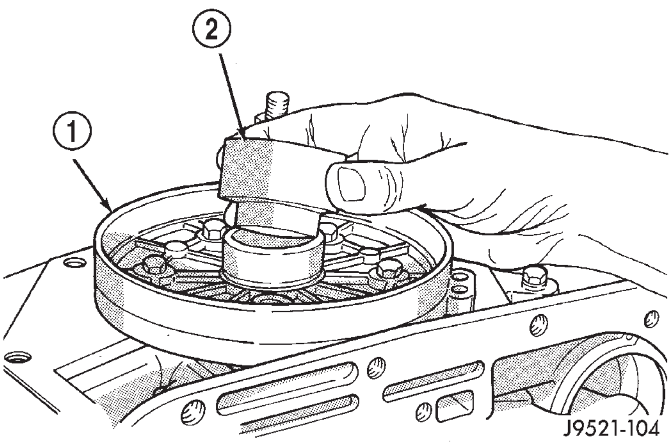


Fig. 198 Positioning Adapter Tool In Overdrive Piston Retainer

1 - PISTON RETAINER
2 - SPECIAL TOOL SP-5124

(6) Install assembled puller plate and bolt (Fig. 200). Insert bolt through cam, case and adapter tool. Be sure plate is seated squarely on cam.

(7) Hold puller plate and bolt in place and install puller nut SP-3701 on puller bolt (Fig. 201).

(8) Tighten puller nut to press clutch cam into case (Fig. 201). Be sure cam is pressed into case evenly and does not become cocked.

(9) Remove clutch cam installer tools.

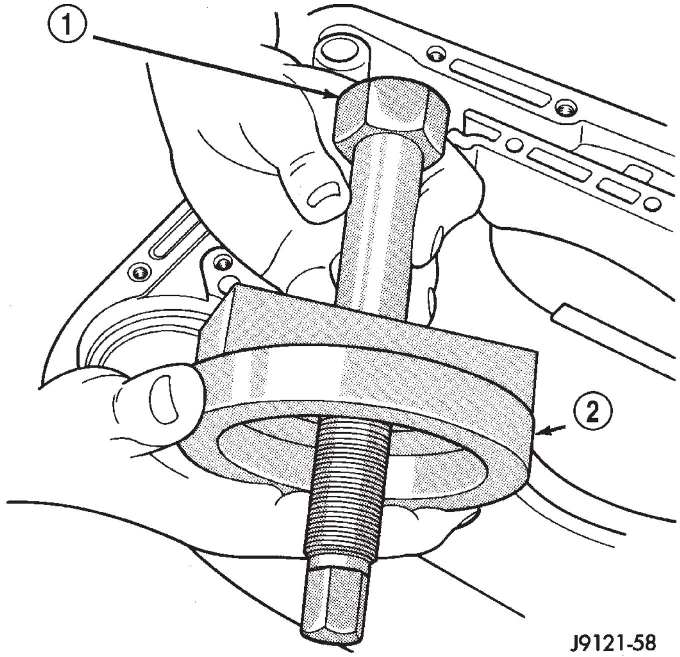


Fig. 199 Assembling Clutch Cam Puller Bolt And Press Plate

1 - PULLER BOLT SP-3701
2 - PRESS PLATE SP-3583-A

(10) Stake case in 14 places around clutch cam to help secure cam in case. Use blunt punch or chisel to stake case.

(11) Remove piston retainer from case. Cover retainer with plastic sheeting, or paper to keep it dust free.

(12) Clean case and cam thoroughly. Be sure any chips/shavings generated during cam installation are removed from case.

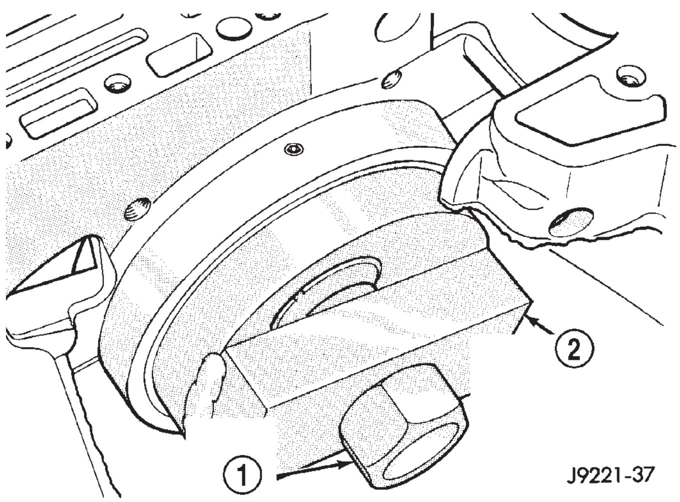


Fig. 200 Positioning Puller Plate On Clutch Cam

1 - SPECIAL TOOL SP-3701
2 - BE SURE PLATE SP-3583-A IS SEATED SQUARELY ON CAM

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER (Continued)

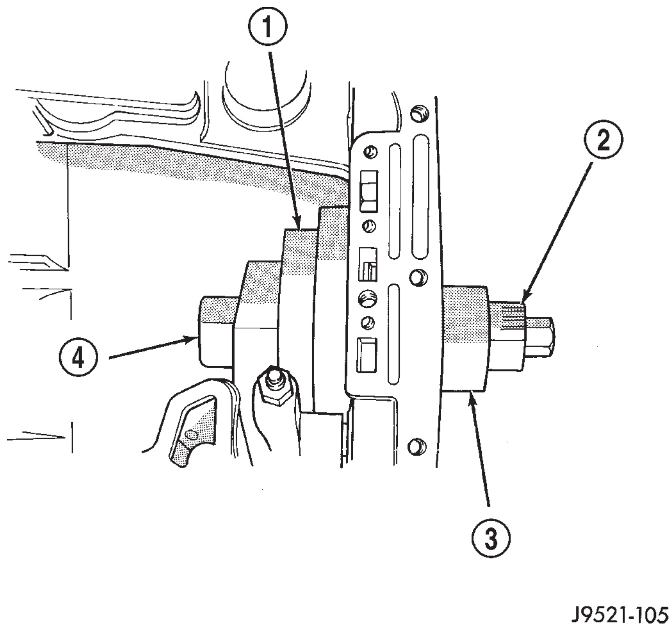


Fig. 201 Pressing Overrunning Clutch Cam Into Case

1 - SPECIAL TOOL SP-3583-A
2 - TIGHTEN NUT TO DRAW CAM INTO CASE (NUT IS PART OF BOLT SP-3701)
3 - SPECIAL TOOL SP-5124
4 - SPECIAL TOOL SP-3701

(13) Install new gasket at rear of transmission case. Use petroleum jelly to hold gasket in place. Be sure to align governor feed holes in gasket with feed passages in case (Fig. 202). Also install gasket before overdrive piston retainer. Center hole in gasket is smaller than retainer and cannot be installed over retainer.

(14) Position overdrive piston retainer on transmission case and align bolt holes in retainer, gasket and case (Fig. 203). Then install and tighten retainer bolts to 17 N·m (13 ft. lbs.) torque.

(15) Install new seals on overdrive piston.

(16) Stand transmission case upright on bellhousing.

(17) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(18) Position Seal Guide 8114-3 on inner edge of overdrive piston retainer.

(19) Install overdrive piston in overdrive piston retainer by: aligning locating lugs on overdrive piston to the two mating holes in retainer.

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

(b) Lubricate overdrive piston seals with Mopar® Door Ease, or equivalent.

(c) Install piston over Seal Guide 8114-3 and inside Guide Ring 8114-1.

(d) Push overdrive piston into position in retainer.

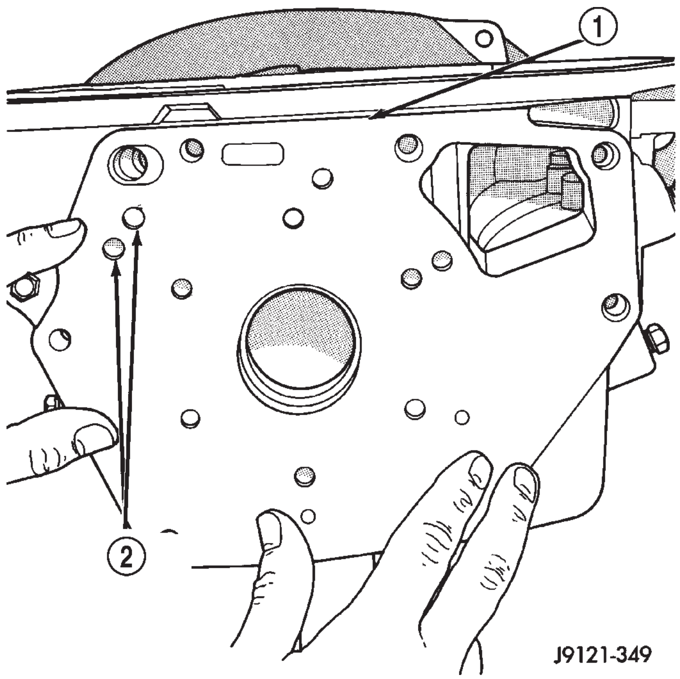


Fig. 202 Installing/Aligning Case Gasket

1 - CASE GASKET
2 - BE SURE GOVERNOR TUBE FEED HOLES IN CASE AND GASKET ARE ALIGNED

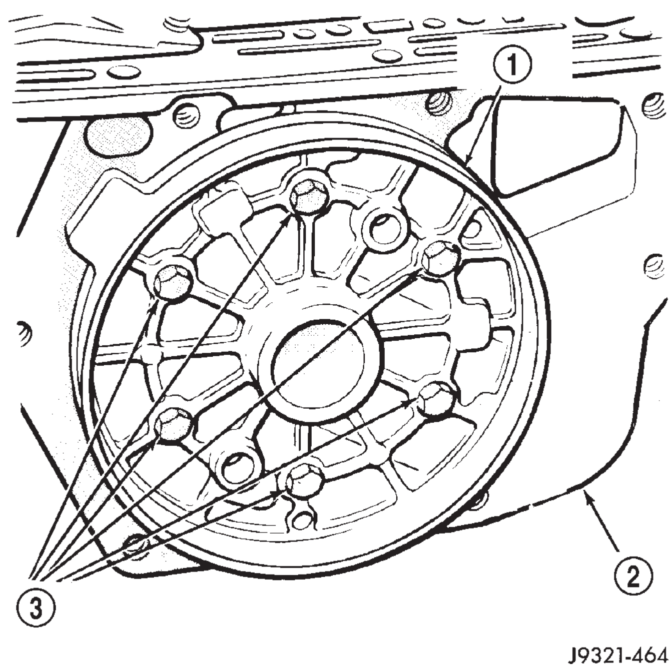


Fig. 203 Aligning Overdrive Piston Retainer

1 - PISTON RETAINER
2 - GASKET
3 - RETAINER BOLTS

(e) Verify that the locating lugs entered the lug bores in the retainer.

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. 204) 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.

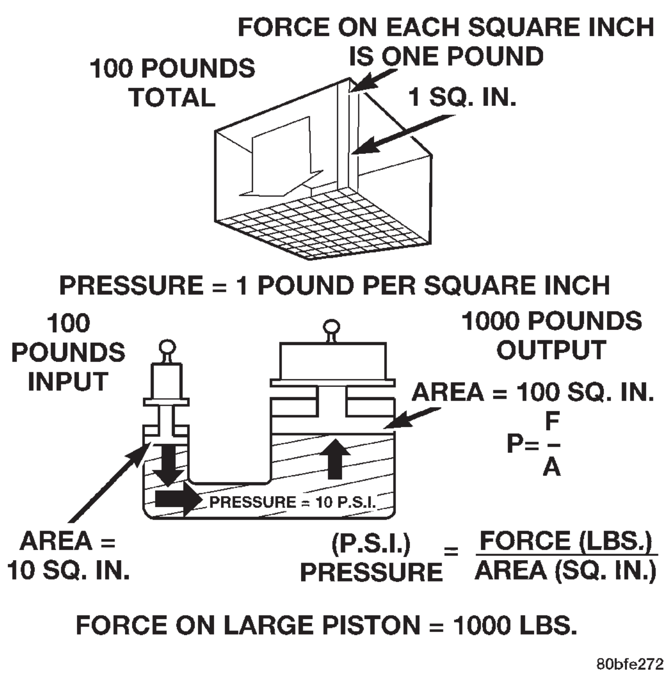


Fig. 204 Force and Pressure Relationship

PRESSURE ON A CONFINED FLUID

Pressure is exerted on a confined fluid (Fig. 205) 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.

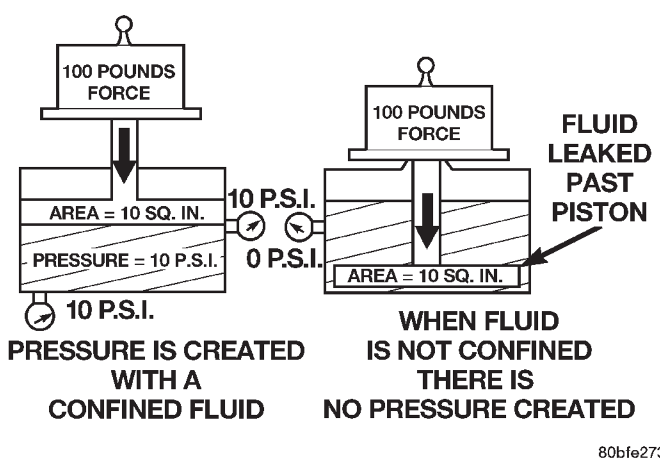


Fig. 205 Pressure on a Confined Fluid

PISTONS (Continued)

FORCE MULTIPLICATION

Using the 10 PSI example used in the illustration (Fig. 206), 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. 206), shows an area that is ten times larger than the original area. The pressure created with the smaller 100 lb. input is 10 PSI. The concept “pressure is the same everywhere” means that the pressure underneath the larger piston is also 10 PSI. Pressure is equal to the force applied divided by the contact area. Therefore, by means of simple algebra, the output force may be found. This concept is extremely important, as it is also used in the design and operation of all shift valves and limiting valves in the valve body, as well as the pistons, of the transmission, which activate the clutches and bands. It is nothing more than using a difference of area to create a difference in pressure to move an object.

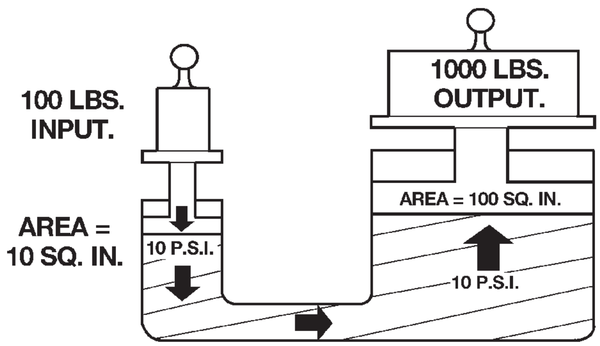


Fig. 206 Force Multiplication

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. 207) 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.

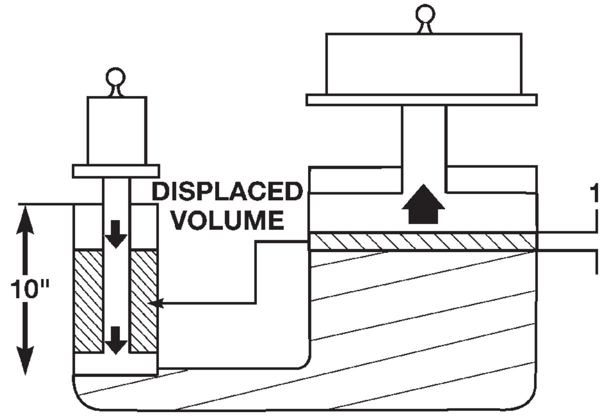


Fig. 207 Piston Travel

PLANETARY GEARTRAIN/ OUTPUT SHAFT

DESCRIPTION

The planetary gearsets (Fig. 208) are designated as the front, rear, and overdrive planetary gear assemblies and located in such order. A simple planetary gearset consists of three main members:

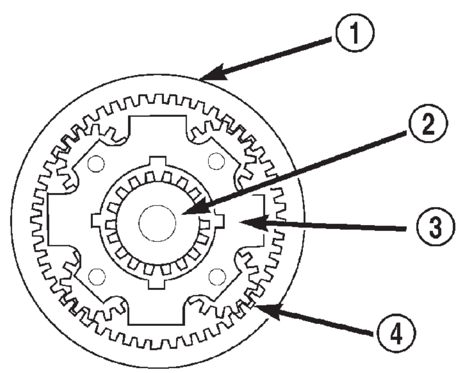


Fig. 208 Planetary Gearset

1 - ANNULUS GEAR
2 - SUN GEAR
3 - PLANET CARRIER
4 - PLANET PINIONS (4)

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

- The sun gear which is at the center of the system.
- The planet carrier with planet pinion gears which are free to rotate on their own shafts and are in mesh with the sun gear.
- The annulus gear, which rotates around and is in mesh with the planet pinion gears.

NOTE: The number of pinion gears does not affect the gear ratio, only the duty rating.

OPERATION

With any given planetary gearset, several conditions must be met for power to be able to flow:

- One member must be held.
- Another member must be driven or used as an input.
- The third member may be used as an output for power flow.
- For direct drive to occur, two gear members in the front planetary gearset must be driven.

NOTE: Gear ratios are dependent on the number of teeth on the annulus and sun gears.

DISASSEMBLY

(1) Remove planetary snap-ring from intermediate shaft (Fig. 209). Discard snap-ring as it is not reusable.

(2) Remove front planetary gear and front annulus gear as assembly (Fig. 210).

(3) Remove front planetary gear and thrust washer from front annulus gear (Fig. 211). Note thrust washer position for assembly reference.

(4) Remove tabbed thrust washer from driving shell (Fig. 212). Note washer position for assembly reference.

(5) Remove sun gear and driving shell as assembly (Fig. 213).

(6) Remove tabbed thrust washer from rear planetary gear (Fig. 214). Note washer position on gear for assembly reference.

(7) Remove rear planetary gear and rear annulus gear from intermediate shaft (Fig. 215).

(8) Remove thrust plate from rear annulus gear (Fig. 216).

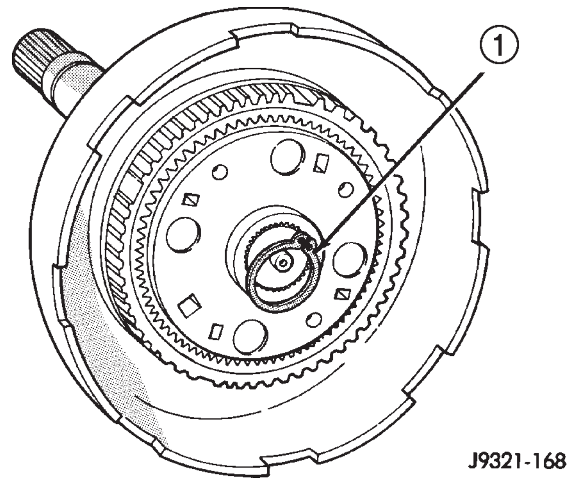


Fig. 209 Removing Planetary Snap-Ring

1 - PLANETARY SNAP-RING

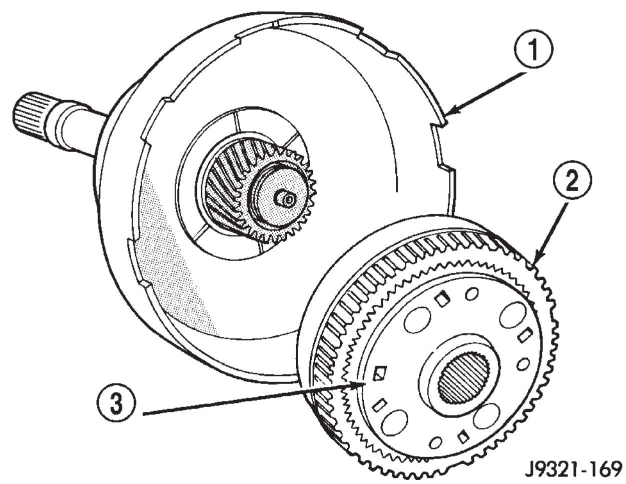


Fig. 210 Removing Front Planetary And Annulus Gears

1 - DRIVING SHELL
2 - FRONT ANNULUS GEAR
3 - FRONT PLANETARY GEAR

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

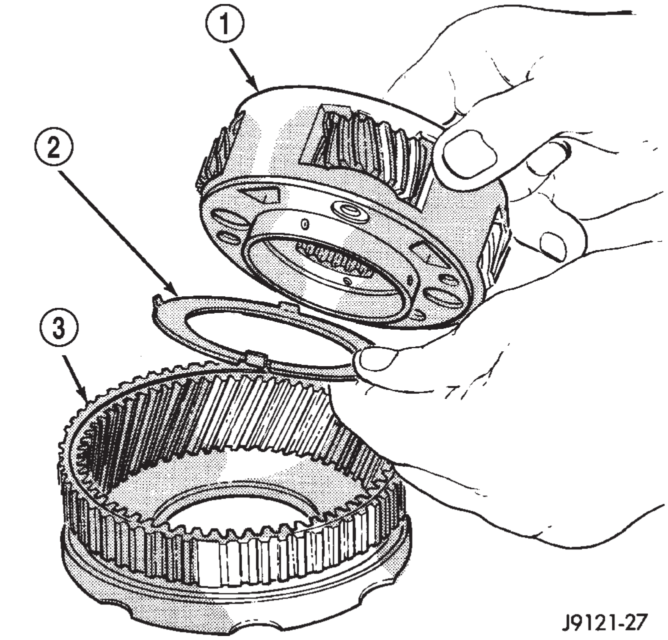


Fig. 211 Disassembling Front Planetary And Annulus Gears

1 - FRONT PLANETARY GEAR
2 - TABBED THRUST WASHER
3 - FRONT ANNULUS GEAR

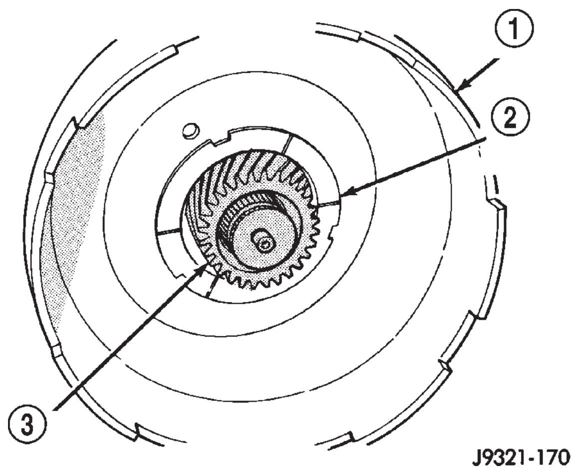


Fig. 212 Driving Shell Thrust Washer Removal

1 - DRIVING SHELL
2 - TABBED THRUST WASHER
3 - SUN GEAR

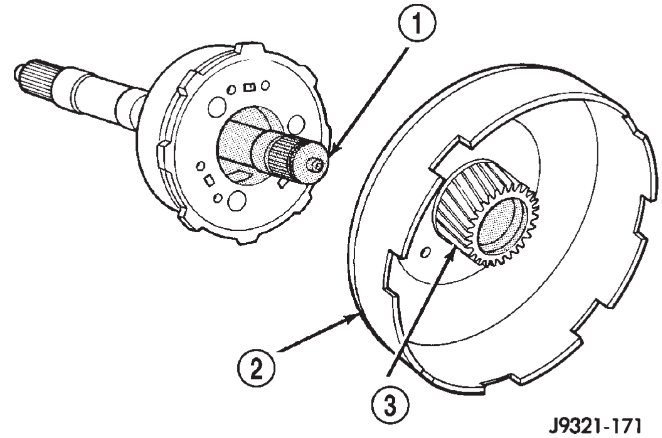


Fig. 213 Sun Gear And Driving Shell Removal

1 - INTERMEDIATE SHAFT
2 - DRIVING SHELL
3 - SUN GEAR

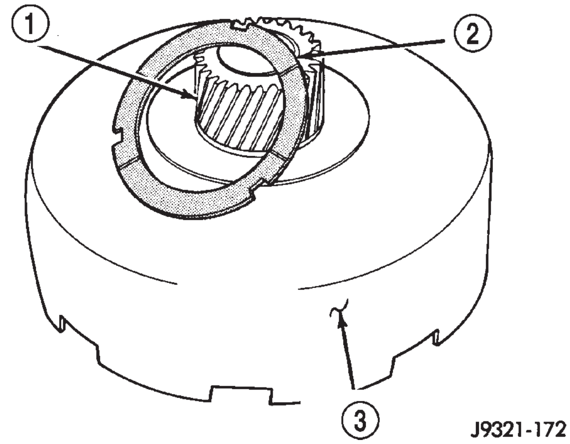


Fig. 214 Rear Planetary Thrust Washer Removal

1 - SUN GEAR
2 - REAR PLANETARY THRUST WASHER
3 - DRIVING SHELL

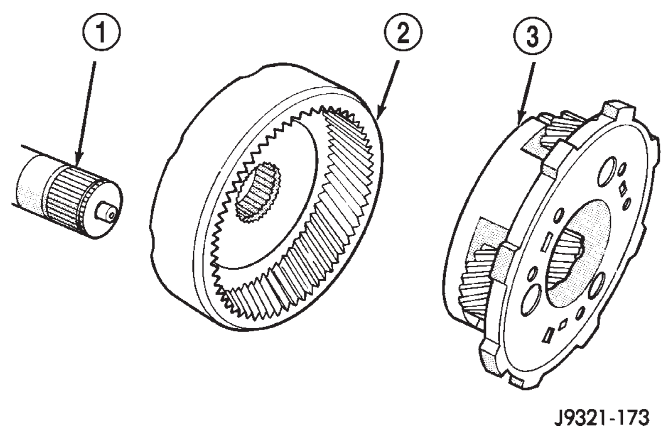


Fig. 215 Rear Planetary And Annulus Gear Removal

1 - INTERMEDIATE SHAFT
2 - REAR ANNULUS GEAR
3 - REAR PLANETARY GEAR

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

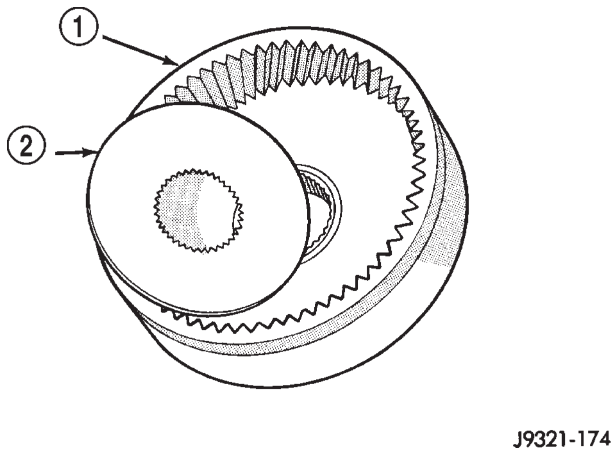


Fig. 216 Rear Annulus Thrust Plate Removal

1 - REAR ANNULUS GEAR
2 - THRUST PLATE

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 intermediate shaft. Be sure the oil passages are open and clear. Replace the shaft if scored, pitted, or damaged.

Inspect the sun gear and driving shell. If either component is worn or damaged, remove the sun gear rear retaining ring and separate the sun gear and thrust plate from the driving shell. Then replace the necessary component.

Replace the sun gear as an assembly if the gear teeth are chipped or worn. Also replace the gear as an assembly if the bushings are scored or worn. The sun gear bushings are not serviceable. Replace the thrust plate if worn, or severely scored. Replace the driving shell if distorted, cracked, or damaged in any way.

Replace all snap-rings during geartrain assembly. Reusing snap-rings is not recommended.

ASSEMBLY

(1) Lubricate sun gear and planetary gears with transmission fluid during assembly. Use petroleum jelly to lubricate intermediate shaft bushing surfaces, thrust washers and thrust plates and to hold these parts in place during assembly.

(2) Install front snap-ring on sun gear and install gear in driving shell. Then install thrust plate over sun gear and against rear side of driving shell (Fig. 217). Install rear snap-ring to secure sun gear and thrust plate in driving shell.

(3) Install rear annulus gear on intermediate shaft (Fig. 218).

(4) Install thrust plate in annulus gear (Fig. 219). Be sure plate is seated on shaft splines and against gear.

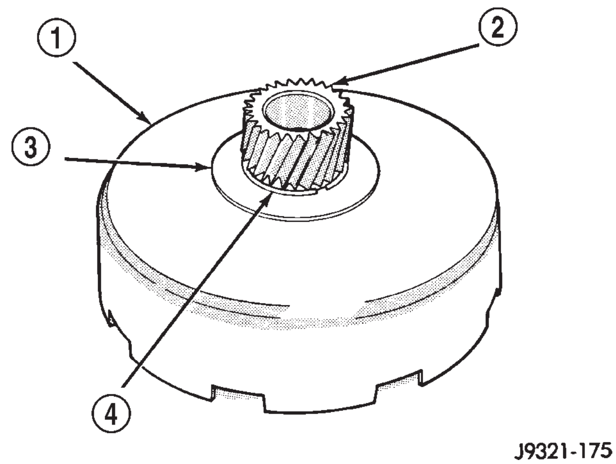


Fig. 217 Sun Gear Installation

1 - DRIVING SHELL
2 - SUN GEAR
3 - THRUST PLATE
4 - SUN GEAR REAR RETAINING RING

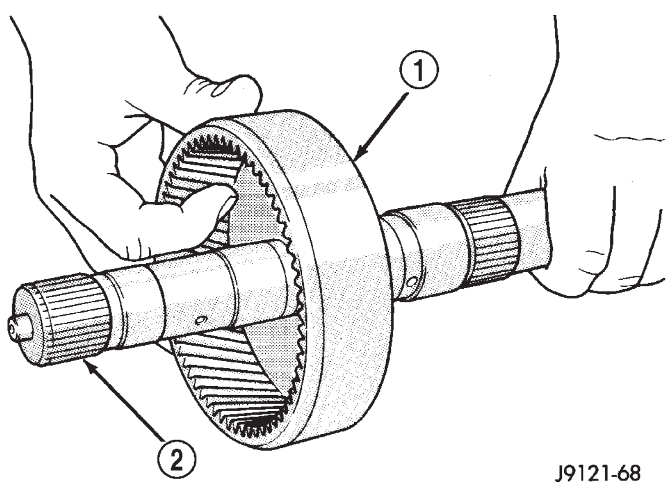


Fig. 218 Installing Rear Annulus Gear On Intermediate Shaft

1 - REAR ANNULUS GEAR
2 - OUTPUT SHAFT

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

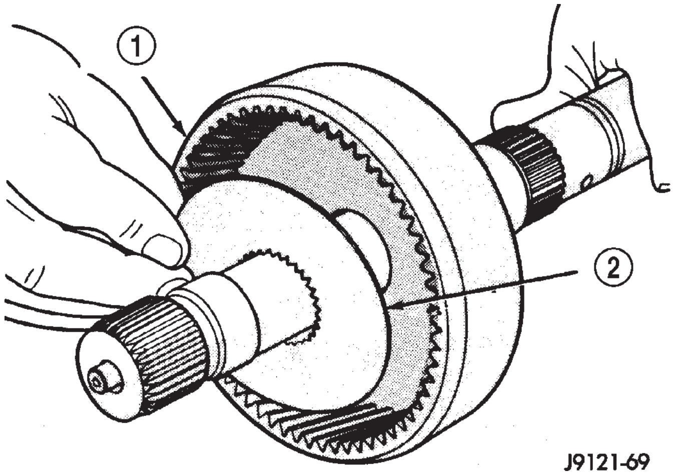


Fig. 219 Installing Rear Annulus Thrust Plate

1 - REAR ANNULUS GEAR
2 - THRUST PLATE

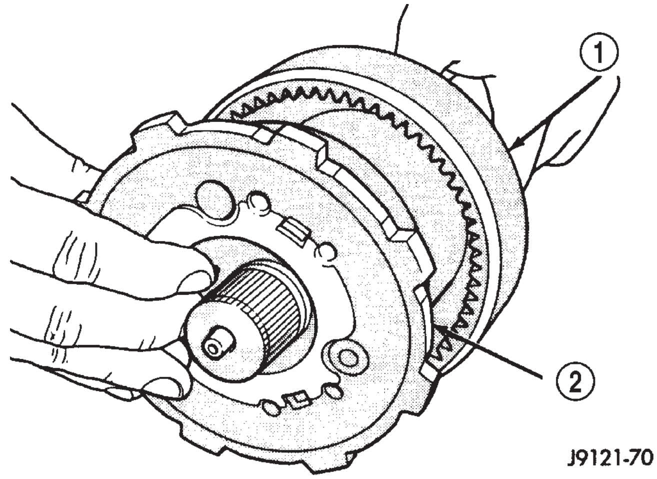


Fig. 220 Installing Rear Planetary Gear

1 - REAR ANNULUS GEAR
2 - REAR PLANETARY GEAR

(5) Install rear planetary gear in rear annulus gear (Fig. 220). Be sure planetary carrier is seated against annulus gear.

(6) Install tabbed thrust washer on front face of rear planetary gear (Fig. 221). Seat washer tabs in matching slots in face of gear carrier. Use extra petroleum jelly to hold washer in place if desired.

(7) Lubricate sun gear bushings with petroleum jelly or transmission fluid.

(8) Install sun gear and driving shell on intermediate shaft (Fig. 222). Seat shell against rear planetary gear. Verify that thrust washer on planetary gear was not displaced during installation.

(9) Install tabbed thrust washer in driving shell (Fig. 223), be sure washer tabs are seated in tab slots of driving shell. Use extra petroleum jelly to hold washer in place if desired.

(10) Install tabbed thrust washer on front planetary gear (Fig. 224). Seat washer tabs in matching slots in face of gear carrier. Use extra petroleum jelly to hold washer in place if desired.

(11) Install front annulus gear over and onto front planetary gear (Fig. 225). Be sure gears are fully meshed and seated.

(12) Install front planetary and annulus gear assembly (Fig. 226). Hold gears together and slide them onto shaft. Be sure planetary pinions are seated on sun gear and that planetary carrier is seated on intermediate shaft.

(13) Place geartrain in upright position. Rotate gears to be sure all components are seated and properly assembled. Snap-ring groove at forward end of intermediate shaft will be completely exposed when components are assembled correctly.

(14) Install new planetary snap-ring in groove at end of intermediate shaft (Fig. 227).

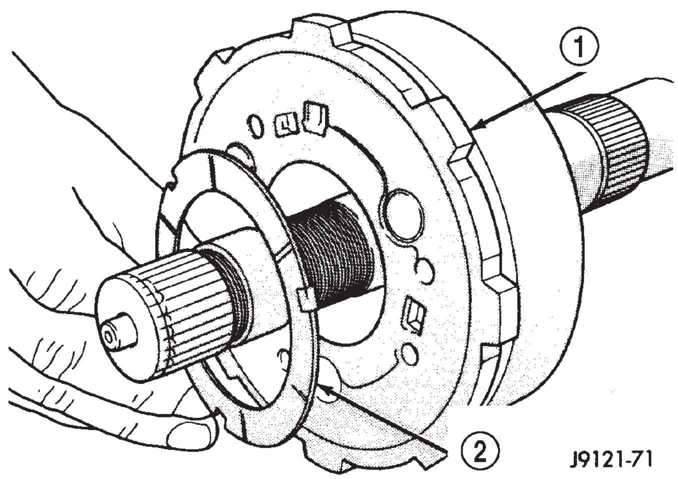


Fig. 221 Installing Rear Planetary Thrust Washer

1 - REAR PLANETARY GEAR
2 - TABBED THRUST WASHER

(15) Turn planetary geartrain over. Position wood block under front end of intermediate shaft and support geartrain on shaft. Be sure all geartrain parts have moved forward against planetary snap-ring. This is important for accurate end play check.

(16) Check planetary geartrain end play with feeler gauge (Fig. 228). Insert gauge between rear annulus gear and shoulder on intermediate shaft as shown. End play should be 0.15 to 1.22 mm (0.006 to 0.048 in.).

(17) If end play is incorrect, install thinner/thicker planetary snap-ring as needed.

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

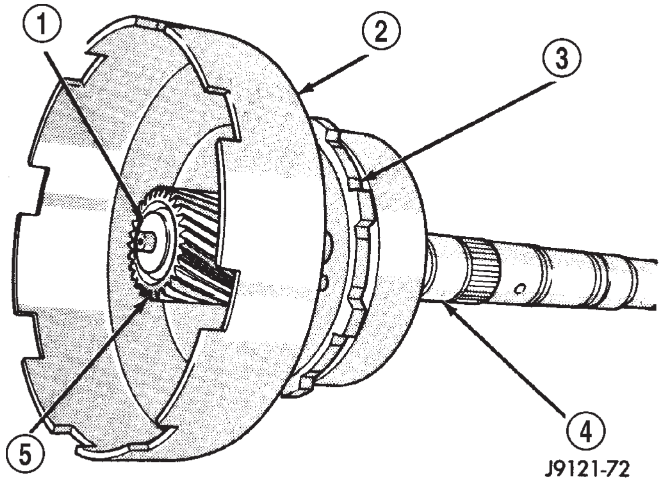


Fig. 222 Installing Sun Gear And Driving Shell

1 - OUTPUT SHAFT
2 - DRIVING SHELL
3 - REAR PLANETARY GEAR
4 - OUTPUT SHAFT
5 - SUN GEAR

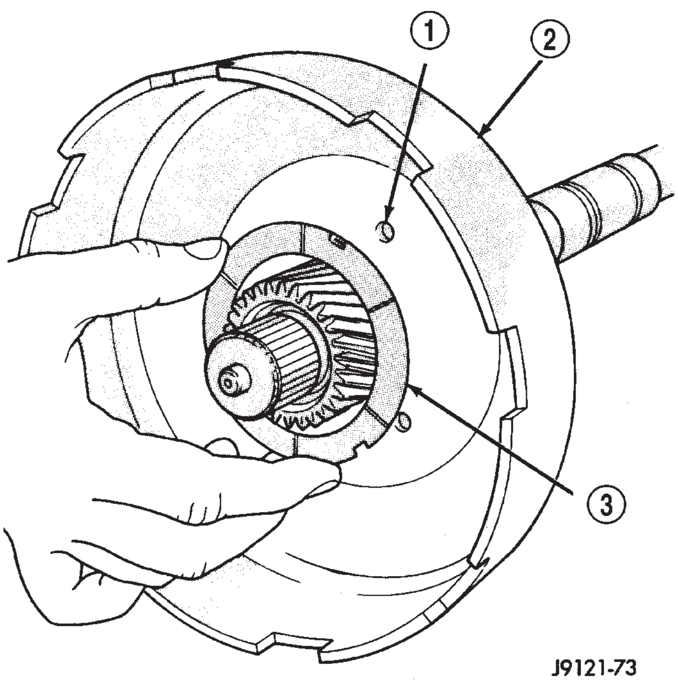


Fig. 223 Installing Driving Shell Thrust Washer

1 - TAB SLOTS (3)
2 - DRIVING SHELL
3 - TABBED THRUST WASHER

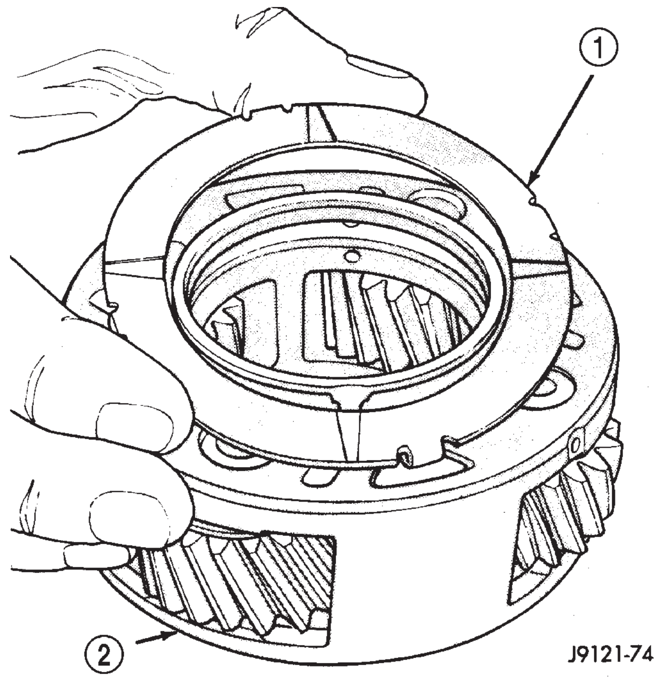


Fig. 224 Installing Thrust Washer On Front Planetary Gear

1 - TABBED THRUST WASHER
2 - FRONT PLANETARY GEAR

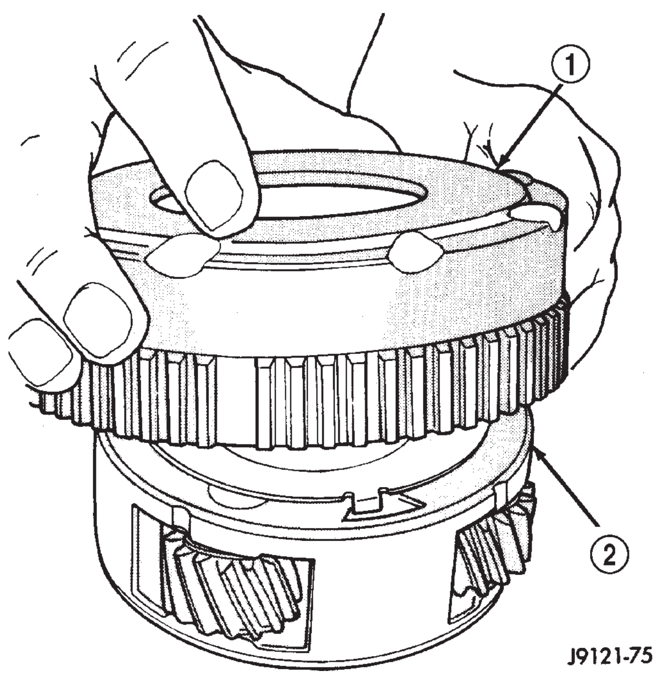


Fig. 225 Assembling Front Planetary And Annulus Gears

1 - FRONT ANNULUS GEAR
2 - FRONT PLANETARY GEAR

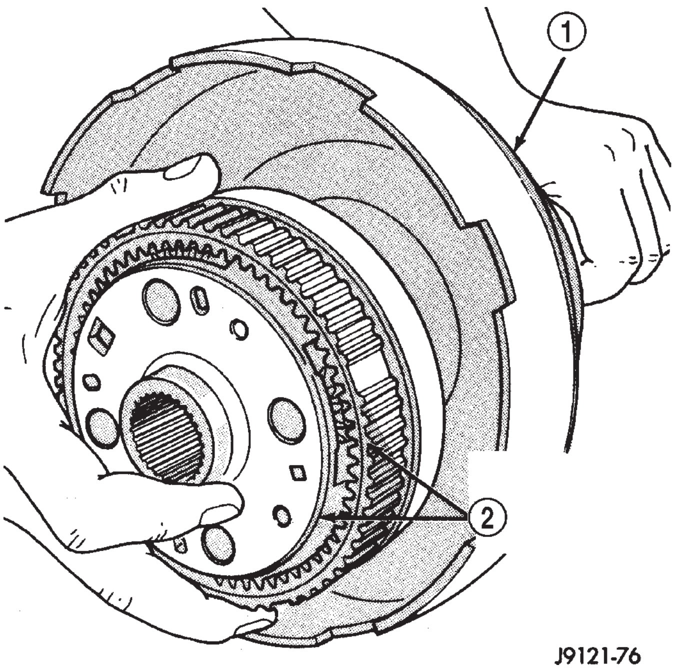


Fig. 226 Installing Front Planetary And Annulus Gear Assembly

1 - DRIVING SHELL
2 - ASSEMBLED FRONT PLANETARY AND ANNULUS GEARS

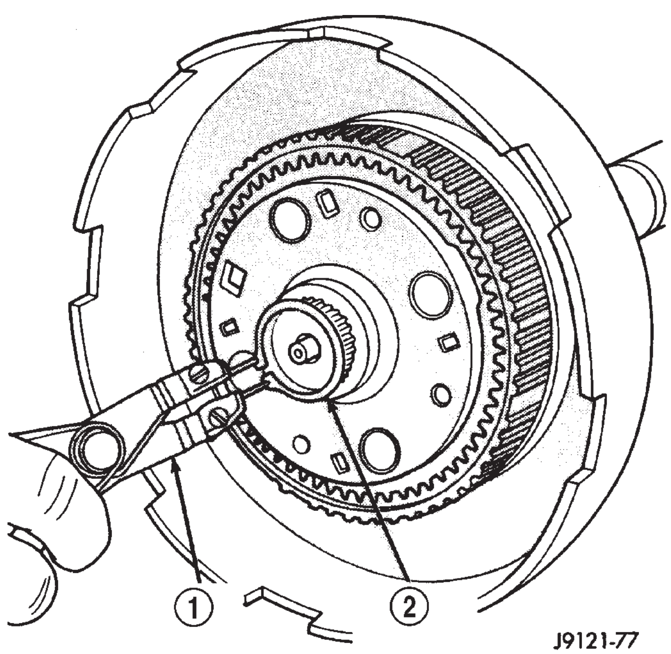


Fig. 227 Installing Planetary Snap-Ring

1 - SNAP-RING PLIERS
2 - PLANETARY SNAP-RING

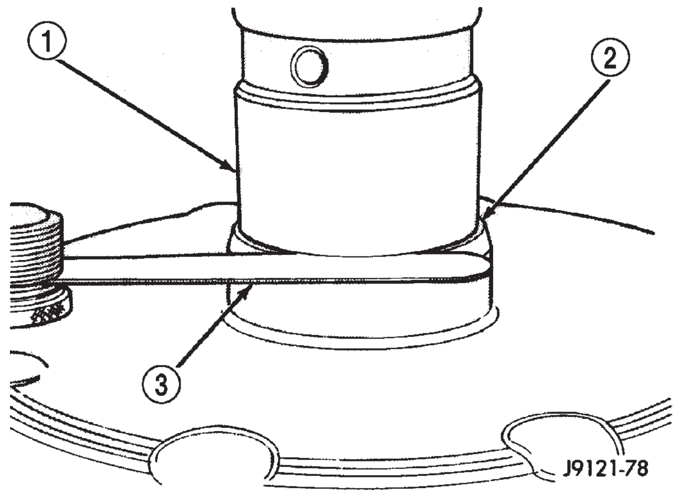


Fig. 228 Checking Planetary Geartrain End Play

1 - OUTPUT SHAFT
2 - REAR ANNULUS GEAR
3 - FEELER GAUGE

REAR CLUTCH

DESCRIPTION

The rear clutch assembly (Fig. 229) 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.

REAR CLUTCH (Continued)

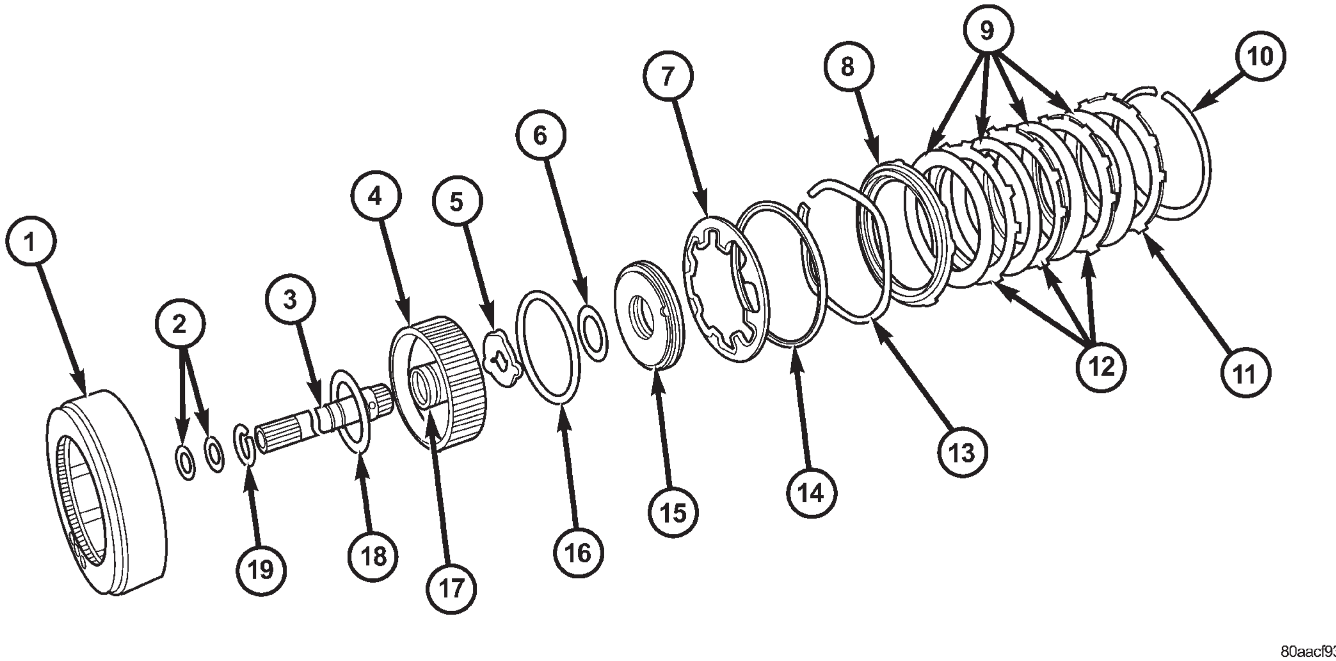


Fig. 229 Rear Clutch Components

1 - REAR CLUTCH RETAINER
2 - TORLON™ SEAL RINGS
3 - INPUT SHAFT
4 - PISTON RETAINER
5 - OUTPUT SHAFT THRUST WASHER
6 - INNER PISTON SEAL
7 - PISTON SPRING
8 - PRESSURE PLATE
9 - CLUTCH DISCS
10 - SNAP-RING (SELECTIVE)
11 - REACTION PLATE
12 - CLUTCH PLATES
13 - WAVE SPRING
14 - SPACER RING
15 - PISTON
16 - OUTER PISTON SEAL
17 - REAR SEAL RING
18 - FIBER THRUST WASHER
19 - RETAINING RING

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 fiber thrust washer from forward side of clutch retainer.

(2) Remove input shaft front and rear seal rings.

(3) Remove selective clutch pack snap-ring (Fig. 230).

(4) Remove the reaction plate, clutch discs, steel plates, pressure plate, wave spring, spacer ring, and piston spring (Fig. 230).

(5) Remove clutch piston with rotating motion.

(6) Remove and discard piston seals.

(7) Remove input shaft retaining ring. It may be necessary to press the input shaft in slightly to relieve tension on the retaining 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. Do not use rags or shop towels to dry any of the clutch parts. Lint from such materials will adhere to component surfaces and could restrict or block fluid passages after assembly.

REAR CLUTCH (Continued)

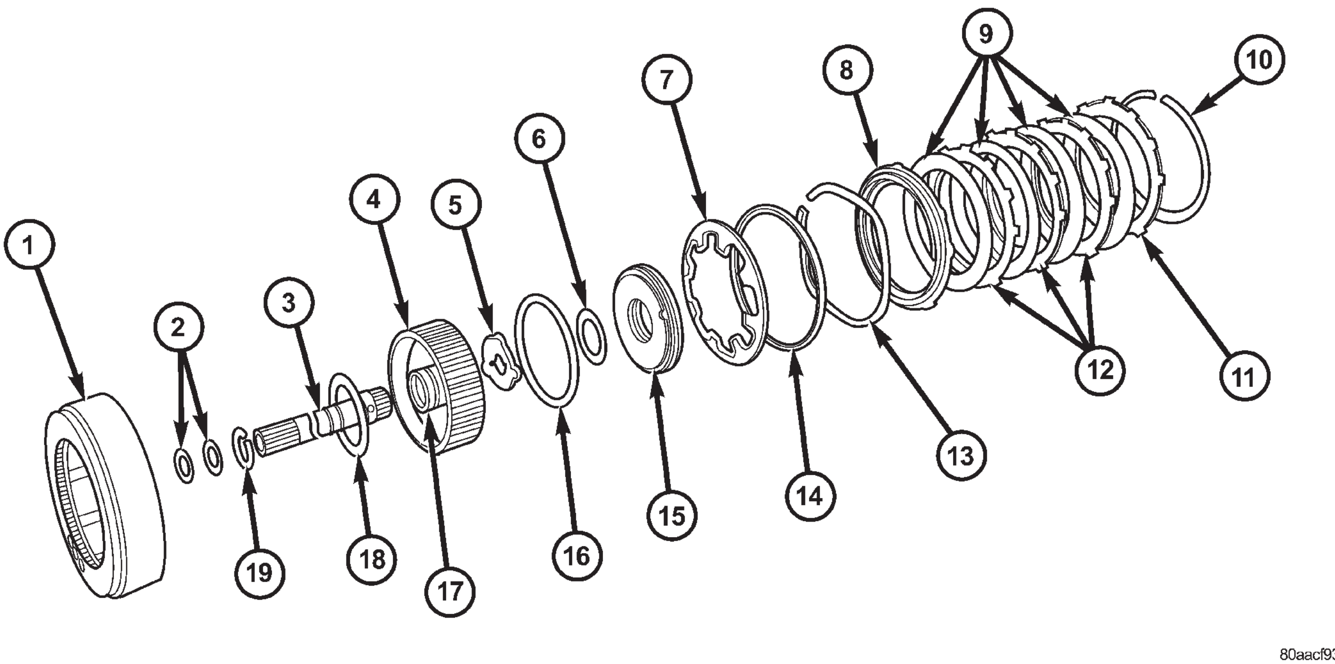


Fig. 230 Rear Clutch Components

1 - REAR CLUTCH RETAINER
2 - TORLON™ SEAL RINGS
3 - INPUT SHAFT
4 - PISTON RETAINER
5 - OUTPUT SHAFT THRUST WASHER
6 - INNER PISTON SEAL
7 - PISTON SPRING
8 - PRESSURE PLATE
9 - CLUTCH DISCS
10 - SNAP-RING (SELECTIVE)
11 - REACTION PLATE
12 - CLUTCH PLATES
13 - WAVE SPRING
14 - SPACER RING
15 - PISTON
16 - OUTER PISTON SEAL
17 - REAR SEAL RING
18 - FIBER THRUST WASHER
19 - RETAINING RING

INSPECTION

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off. Replace the top and bottom pressure plates if scored, warped, or cracked. Be sure the driving lugs on the pressure and clutch plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston spring and wave spring if either part is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The clutch and pressure plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged. Also check action of the check balls in the retainer and piston. Each check ball must move freely and not stick.

Replace the retainer bushing if worn, scored, or doubt exists about bushing condition.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check condition of the fiber thrust washer and metal output shaft thrust washer. Replace either washer if worn or damaged.

Check condition of the seal rings on the input shaft and clutch retainer hub. Replace the seal rings only if worn, distorted, or damaged. The input shaft front seal ring is teflon with chamfered ends. The rear ring is metal with interlocking ends.

Check the input shaft for wear, or damage. Replace the shaft if worn, scored or damaged in any way.

REAR CLUTCH (Continued)

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.

(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 partially press input shaft into retainer (Fig. 231). Use a suitably sized press tool to support retainer as close to input shaft as possible.

(4) Install input shaft retaining ring.

(5) Press the input shaft the remainder of the way into the clutch retainer.

(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. Concave side of spring faces downward (toward piston).

(10) Install the spacer ring and wave spring into the retainer. Be sure spring is completely seated in retainer groove.

(11) Install pressure plate (Fig. 230). Ridged side of plate faces downward (toward piston) and flat side toward clutch pack.

(12) Install first clutch disc in retainer on top of 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. 230).

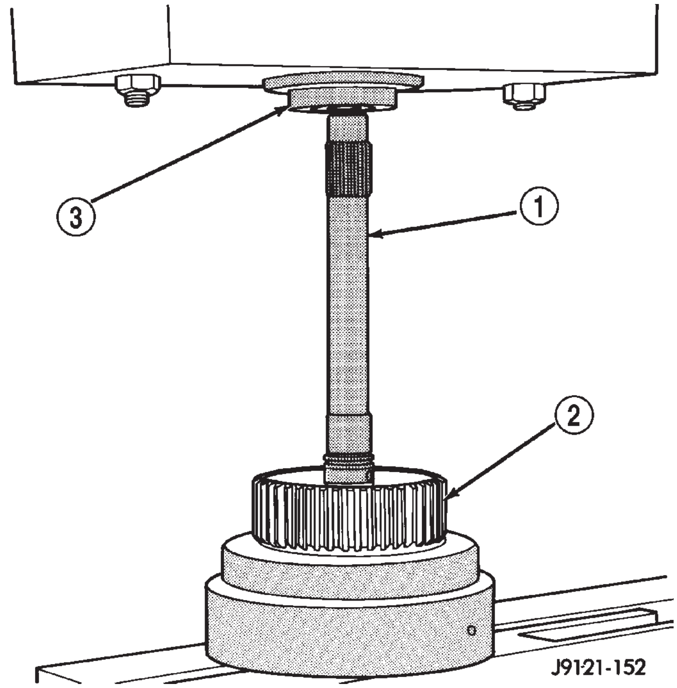


Fig. 231 Pressing Input Shaft Into Rear Clutch Retainer

1 - INPUT SHAFT
2 - REAR CLUTCH RETAINER
3 - PRESS RAM

(13) Install the reaction 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. 232).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 232).

(b) Using two small screw drivers, lift the pressure plate and release it.

(c) Zero the dial indicator.

(d) Lift the pressure plate until it contacts the snap-ring and record the dial indicator reading.

Clearance should be 0.635 - 0.914 mm (0.025 - 0.036 in.). If clearance is incorrect, steel plates, discs, selective snap ring and pressure plates may have to be changed.

REAR CLUTCH (Continued)

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.

(16) Coat rear clutch thrust washer with petroleum jelly and install washer over input shaft and into clutch retainer (Fig. 233). Use enough petroleum jelly to hold washer in place.

(17) Set rear clutch aside for installation during final assembly.

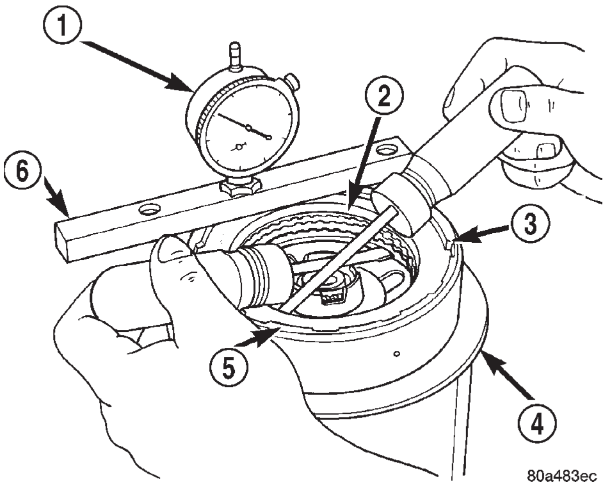


Fig. 232 Checking Rear Clutch Pack Clearance

1 - DIAL INDICATOR
2 - PRESSURE PLATE
3 - SNAP-RING
4 - STAND
5 - REAR CLUTCH
6 - GAUGE BAR

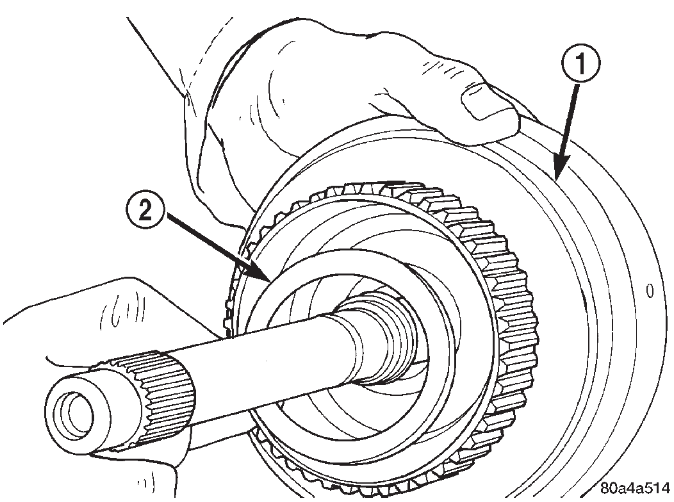


Fig. 233 Installing Rear Clutch Thrust Washer

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. 234).

(2) Remove and discard servo piston seal ring.

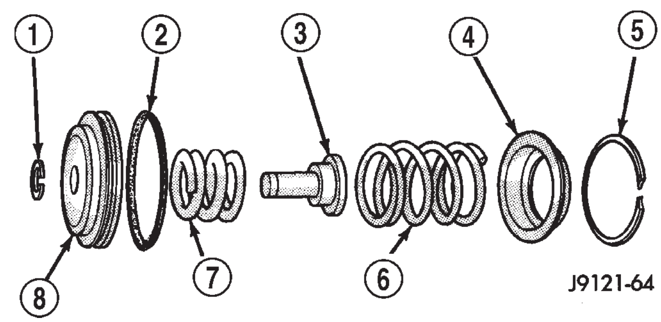


Fig. 234 Rear Servo Components

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. 235). 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.

REAR SERVO (Continued)

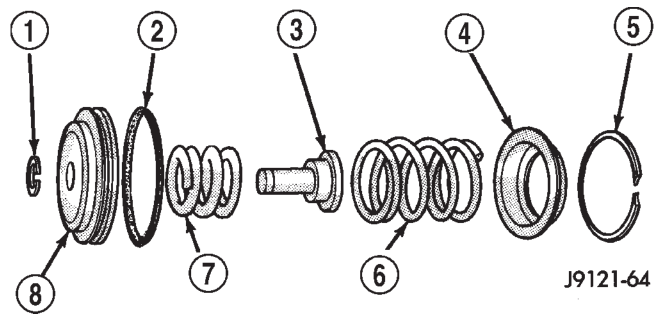


Fig. 235 Rear Servo Components

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. 236) 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.

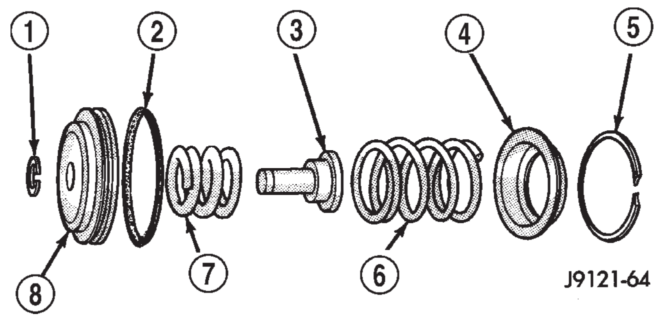


Fig. 236 Rear Servo Components

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 gear shift mechanism provides six shift positions which are:

- PARK (P)
- REVERSE (R)
- NEUTRAL (N)
- DRIVE (D)
- Manual SECOND (2)
- Manual LOW (1)

OPERATION

Manual LOW (1) range provides first gear only. Overrun braking is also provided in this range. Manual SECOND (2) range provides first and second gear only.

DRIVE range provides first, second third and overdrive fourth gear ranges. The shift into overdrive fourth gear range occurs only after the transmission has completed the shift into D third gear range. No further movement of the shift mechanism is required to complete the 3-4 shift.

The fourth gear upshift occurs automatically when the overdrive selector switch is in the ON position. No upshift to fourth gear will occur if any of the following are true:

- The transmission fluid temperature is below 10° C (50° F) or above 121° C (250° F).
- The shift to third is not yet complete.
- Vehicle speed is too low for the 3-4 shift to occur.
- Battery temperature is below -5° C (23° F).

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.

SOLENOID (Continued)

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:

- Increase the amount of current applied to the coil or
- 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.

SPEED SENSOR

DESCRIPTION

The speed sensor (Fig. 237) is located in the overdrive gear case. The sensor is positioned over the park gear and monitors transmission output shaft rotating speed.

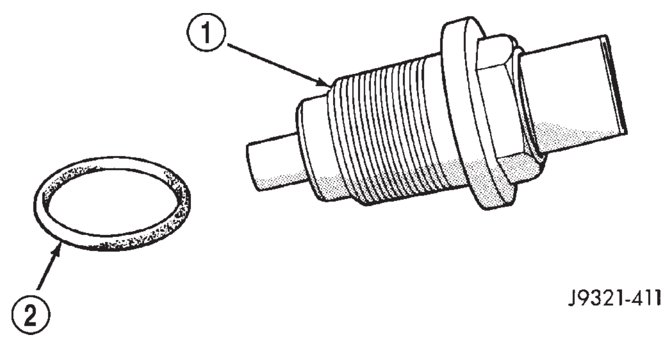


Fig. 237 Transmission Output Speed Sensor

1 - TRANSMISSION OUTPUT SHAFT SPEED SENSOR
2 - SEAL

OPERATION

Speed sensor signals are triggered by the park gear lugs as they rotate past the sensor pickup face. Input signals from the sensor are sent to the transmission control module for processing. Signals from this sensor are shared with the powertrain control module.

THROTTLE VALVE CABLE

DESCRIPTION

Transmission throttle valve cable (Fig. 238) 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.

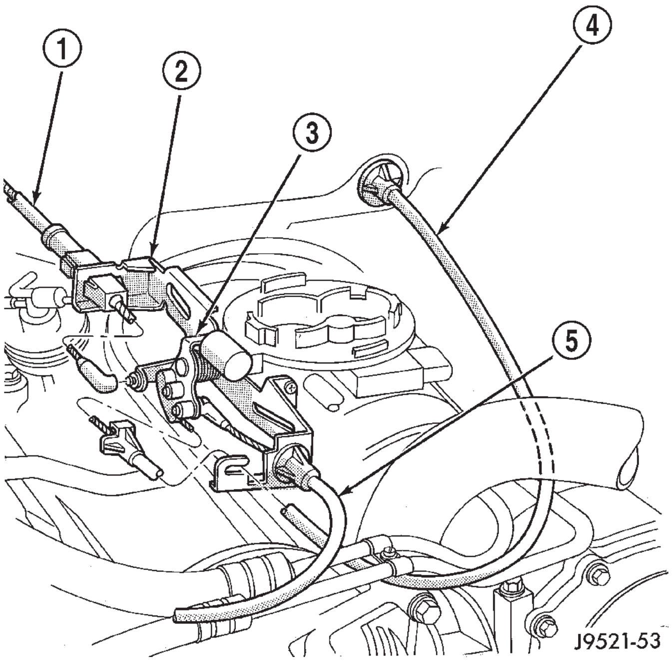


Fig. 238 Throttle Valve Cable Attachment - At Engine

1 - THROTTLE VALVE CABLE
2 - CABLE BRACKET
3 - THROTTLE BODY LEVER
4 - ACCELERATOR CABLE
5 - SPEED CONTROL CABLE

The transmission throttle valve is operated by a cam on the throttle lever. The throttle lever is operated by an adjustable cable (Fig. 239). 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.

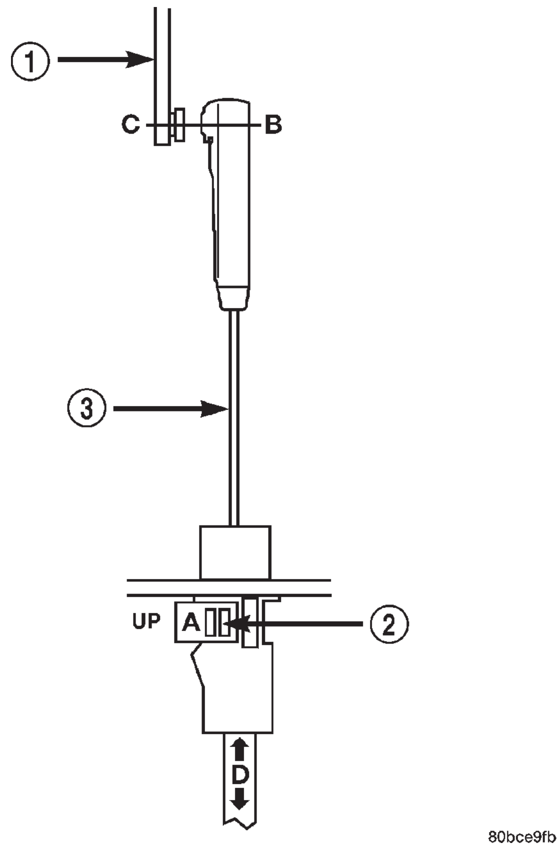


Fig. 239 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - THROTTLE VALVE CABLE

ADJUSTMENTS - TRANSMISSION 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.

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. 240). Then verify that the transmission throttle lever (Fig. 241) is also at idle (fully forward) position.

(4) Slide cable off attachment stud on throttle body lever.

THROTTLE VALVE CABLE (Continued)

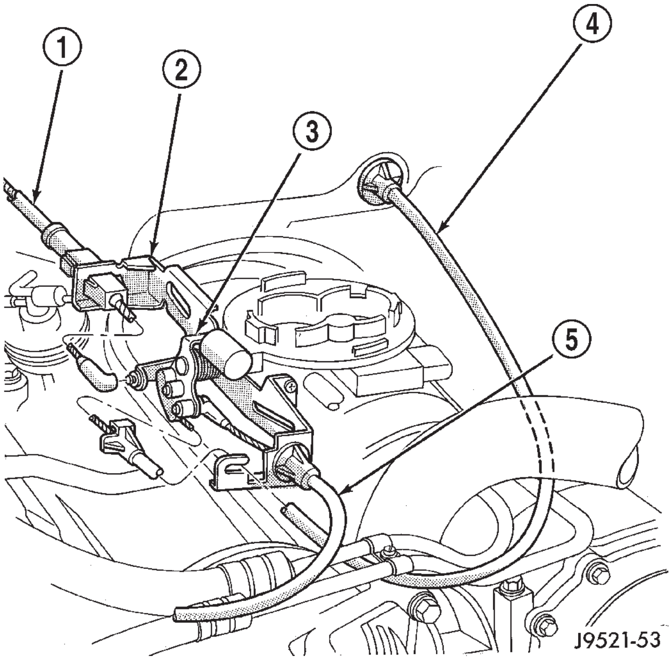


Fig. 240 Throttle Valve Cable Attachment - At Engine

1 - THROTTLE VALVE CABLE
2 - CABLE BRACKET
3 - THROTTLE BODY LEVER
4 - ACCELERATOR CABLE
5 - SPEED CONTROL CABLE

(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. 242).

• 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.

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.**

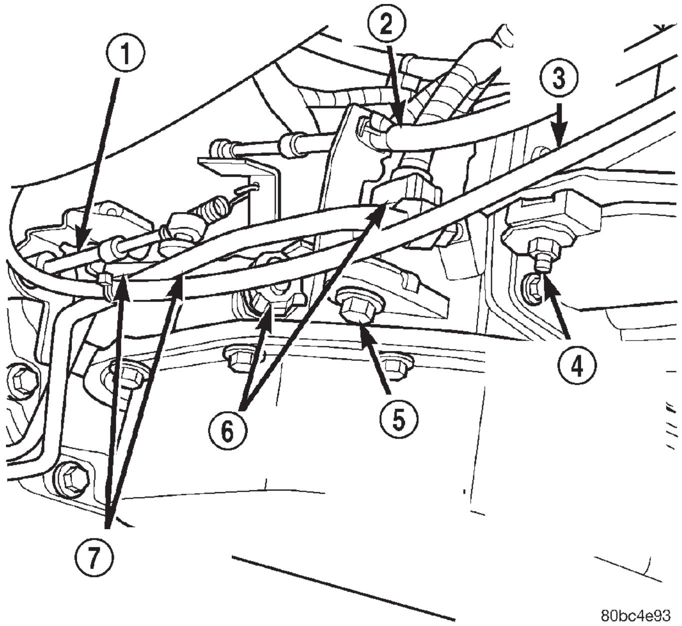


Fig. 241 Throttle Valve Cable at Transmission

1 - TRANSMISSION SHIFTER CABLE
2 - THROTTLE VALVE CABLE
3 - TRANSFER CASE SHIFTER CABLE
4 - TRANSFER CASE SHIFTER CABLE BRACKET RETAINING BOLT (1 OR 2)
5 - THROTTLE VALVE CABLE BRACKET RETAINING BOLT
6 - ELECTRICAL CONNECTORS
7 - TRANSMISSION FLUID LINES

(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. 242). 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. 242).

(7) While holding the T.V. cable in the set position push the T.V. cable lock (A) into the down position (Fig. 242). 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.

THROTTLE VALVE CABLE (Continued)

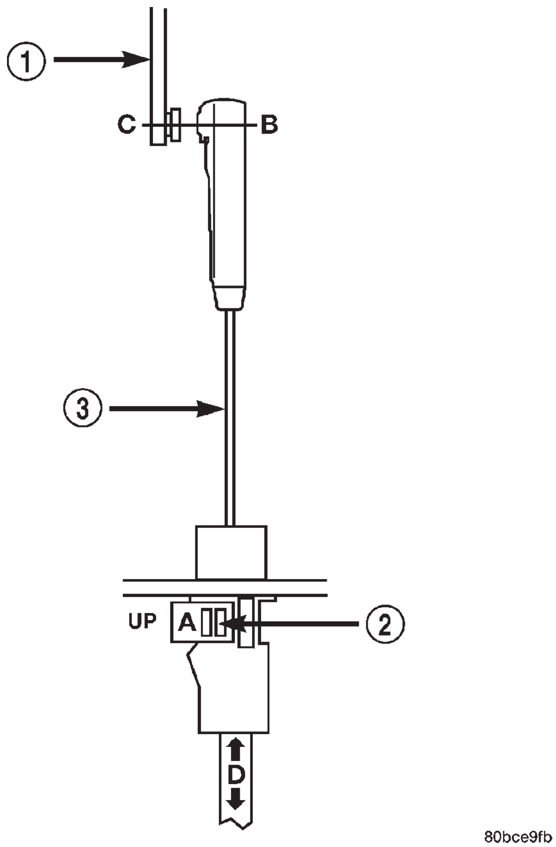


Fig. 242 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - THROTTLE VALVE CABLE

(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. 243) 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 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 all transmission fluid cooler(s) and lines.

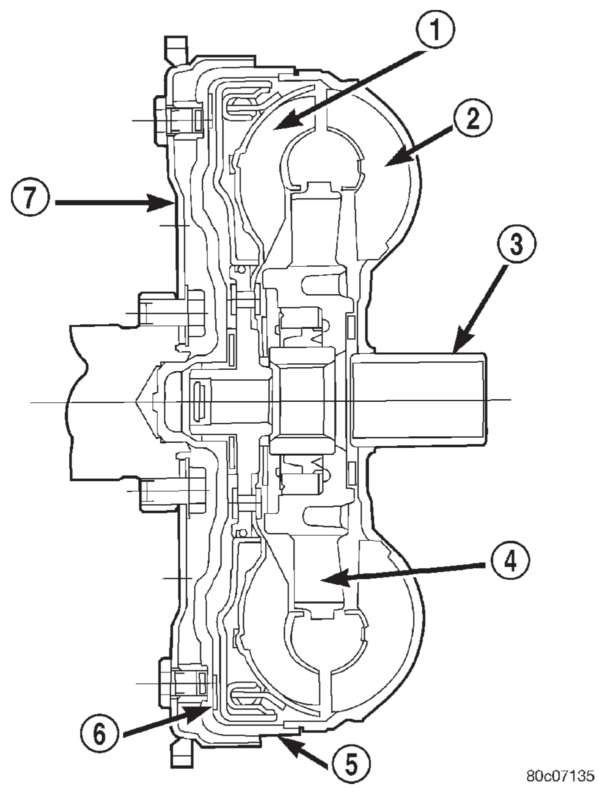


Fig. 243 Torque Converter Assembly

1 - TURBINE
2 - IMPELLER
3 - HUB
4 - STATOR
5 - FRONT COVER
6 - CONVERTER CLUTCH DISC
7 - DRIVE PLATE

IMPELLER

The impeller (Fig. 244) 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 members of the system.

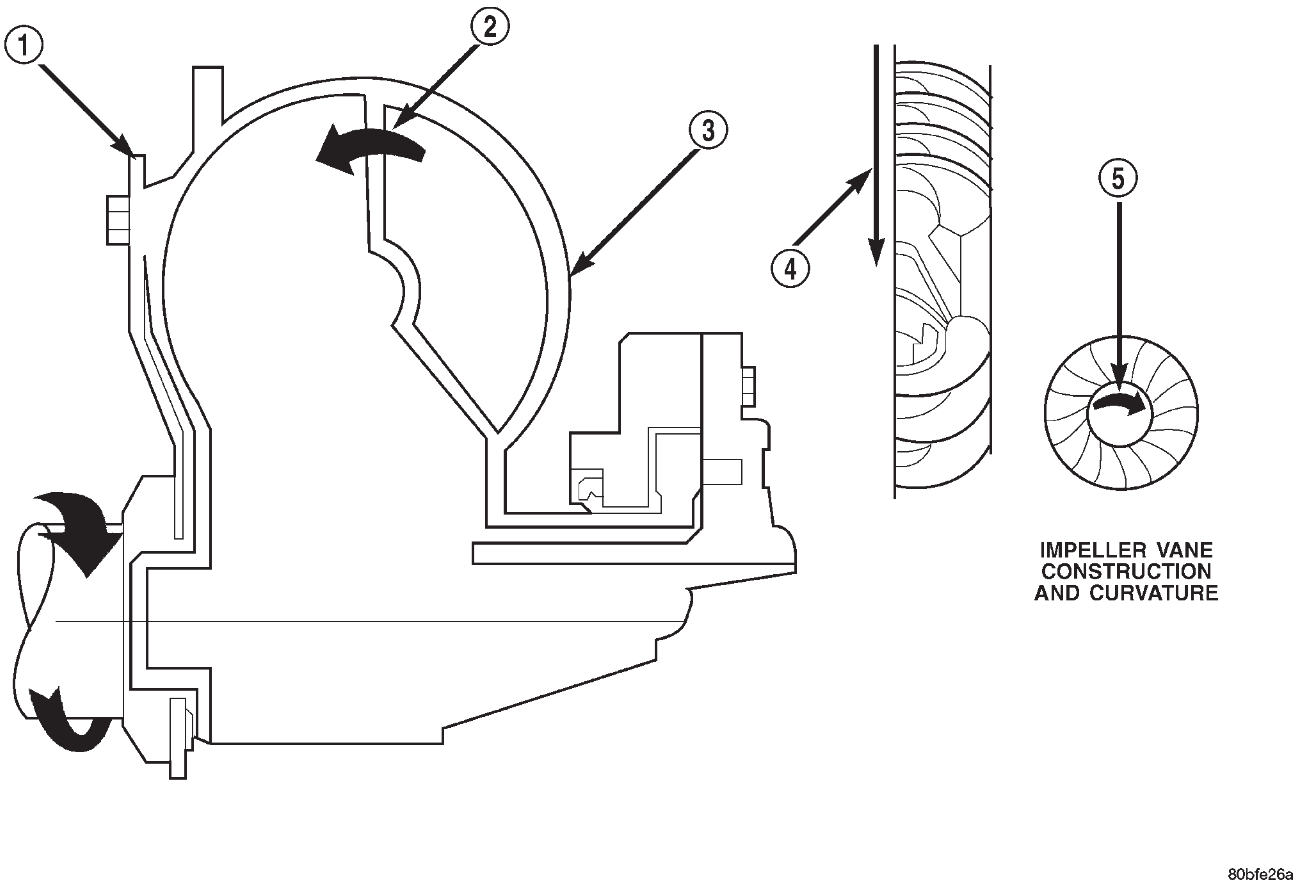


Fig. 244 Impeller

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

TURBINE

The turbine (Fig. 245) 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.

TORQUE CONVERTER (Continued)

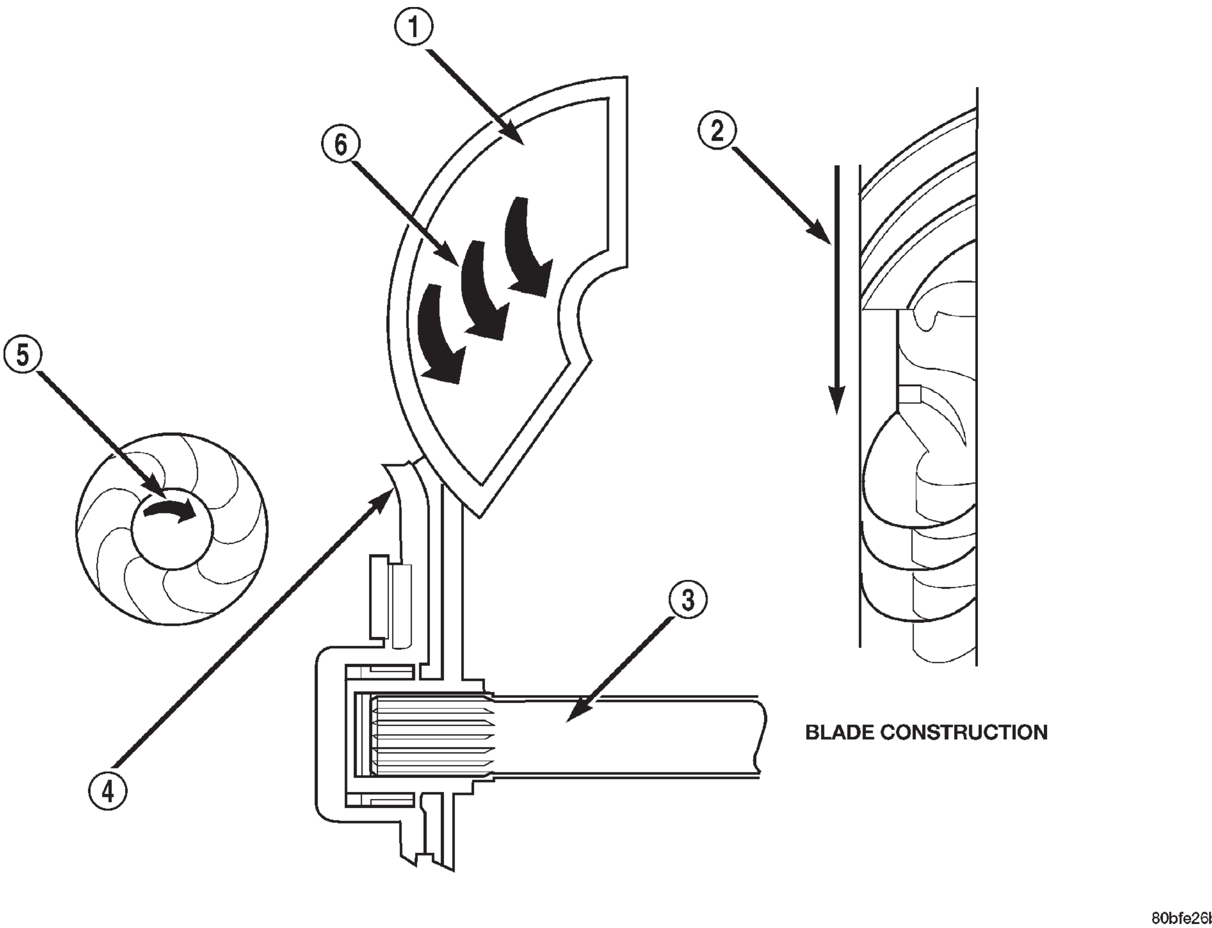


Fig. 245 Turbine

1 - TURBINE VANE
2 - ENGINE ROTATION
3 - INPUT SHAFT
4 - PORTION OF TORQUE CONVERTER COVER
5 - ENGINE ROTATION
6 - OIL FLOW WITHIN TURBINE SECTION

TORQUE CONVERTER (Continued)

STATOR

The stator assembly (Fig. 246) 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. 247). 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.

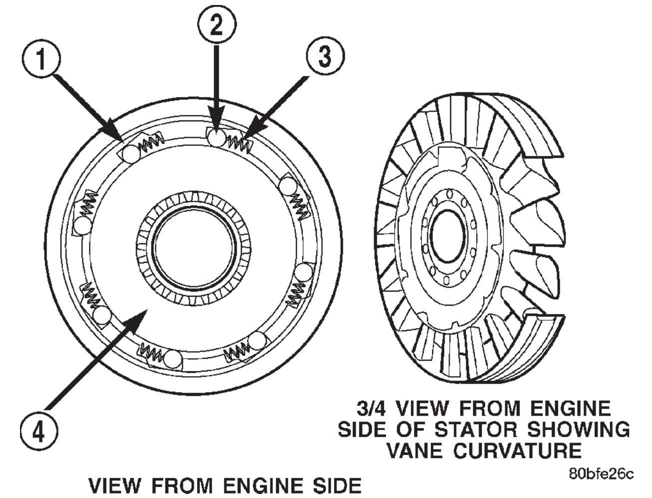


Fig. 246 Stator Components

1 - CAM (OUTER RACE)
2 - ROLLER
3 - SPRING
4 - INNER RACE

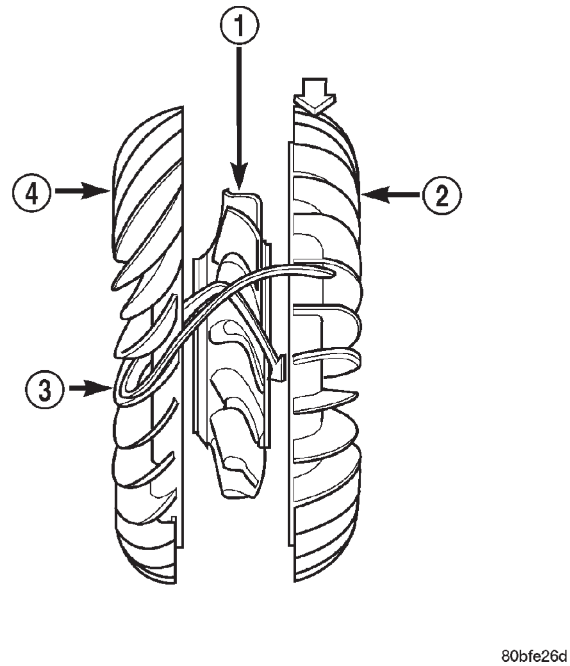


Fig. 247 Stator Location

1 - STATOR
2 - IMPELLER
3 - FLUID FLOW
4 - TURBINE

TORQUE CONVERTER CLUTCH (TCC)

The TCC (Fig. 248) 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. 249) (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.

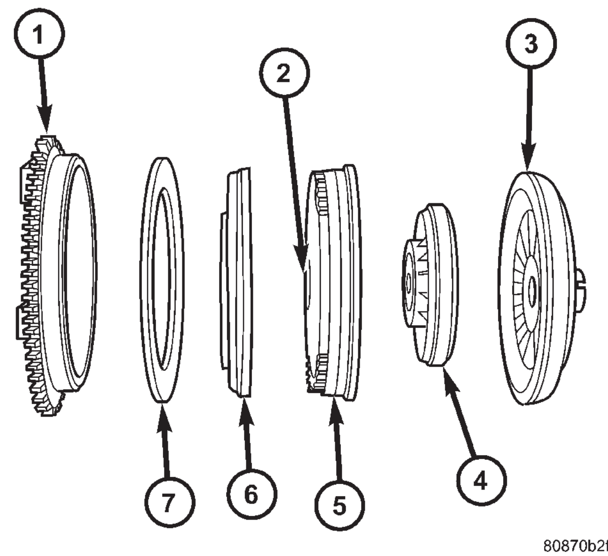


Fig. 248 Torque Converter Clutch (TCC)

1 - IMPELLER FRONT COVER
2 - THRUST WASHER ASSEMBLY
3 - IMPELLER
4 - STATOR
5 - TURBINE
6 - PISTON
7 - FRICTION DISC

TORQUE CONVERTER (Continued)

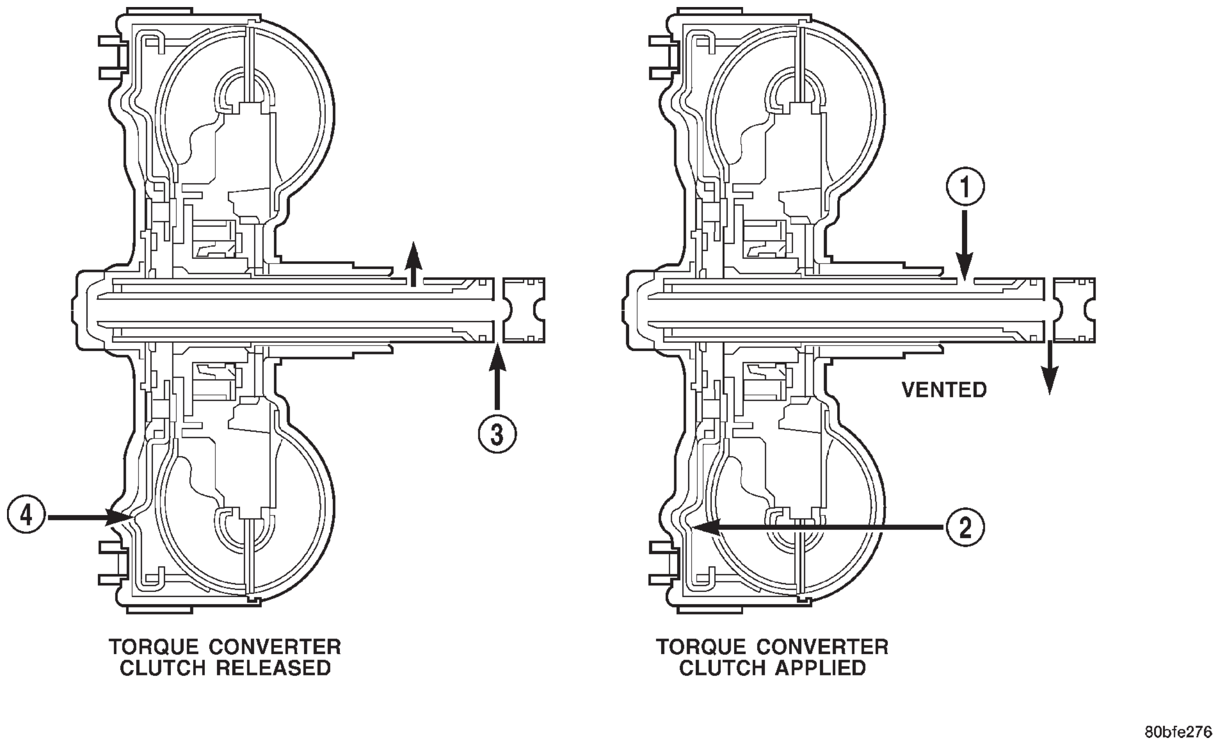


Fig. 249 Torque Converter Fluid Operation

1 - APPLY PRESSURE
2 - THE PISTON MOVES SLIGHTLY FORWARD
3 - RELEASE PRESSURE
4 - THE PISTON MOVES SLIGHTLY REARWARD

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. 250). 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 counterclockwise direction. When this happens the overrunning 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)

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 fourth gear, and in third gear under various conditions, such as when the O/D switch is OFF, when the vehicle is cruising on a level surface 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.

TORQUE CONVERTER (Continued)

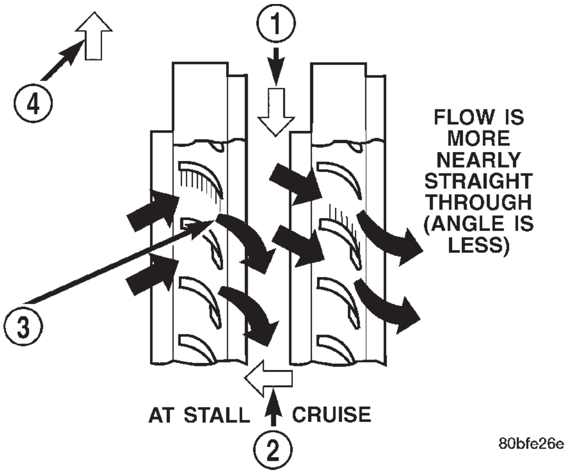


Fig. 250 Stator Operation

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

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 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. 251). 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.

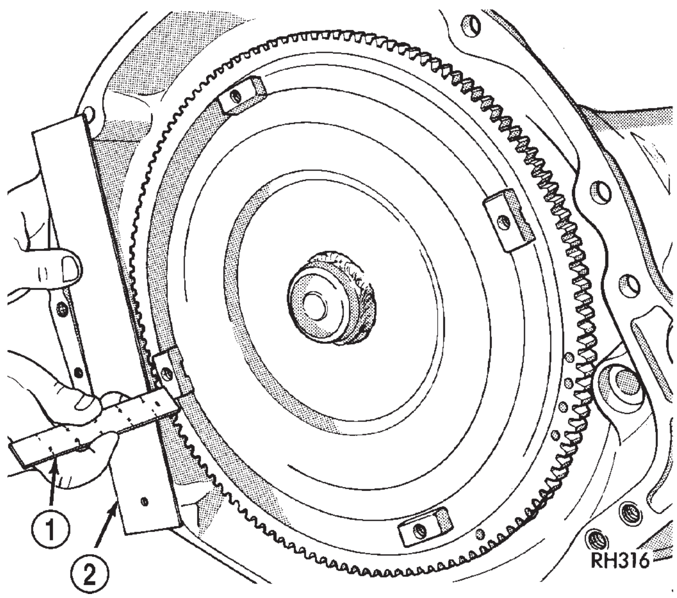


Fig. 251 Checking Torque Converter Seating - Typical

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.

TRANSMISSION RANGE SENSOR

DESCRIPTION

The Transmission Range Sensor (TRS) (Fig. 252) has 3 primary functions:

- Provide a PARK/NEUTRAL start signal to the engine controller and the starter relay.
- Turn the Back-up lamps on when the transmission is in REVERSE and the engine (ignition) is on.
- Provide a transmission range signal to the instrument cluster.

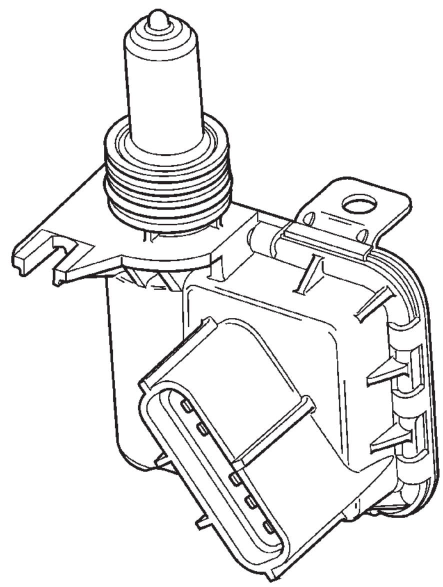


Fig. 252 Transmission Range Sensor

The sensor is mounted in the transmission housing near the valve body, just above the pan rail. It's in the same position as the Park/Neutral switch on other transmissions. The TRS contacts a cammed surface on the manual valve lever. The cammed surface translates the rotational motion of the manual lever into the linear motion of the sensor. The cammed surface on the manual lever is comprised of two parts controlling the TRS signal: The insulator portion contacts the switch poppet when the manual lever is not in PARK or NEUTRAL. The manual lever itself contacts the poppet when the lever is in PARK or NEUTRAL; providing a ground for the signal from the starter relay and the JTEC engine controller.

OPERATION

As the switch moves through its linear motion (Fig. 253) contacts slide across a circuit board which changes the resistance between the range sensing pins of the switch. A power supply on the instrument cluster provides a regulated voltage signal to the switch. The return signal is decoded by the cluster, which then controls the PRNDL display to correspond with the correct transmission range. A bus message of transmission range is also sent by the cluster. In REVERSE range a second contact set closes the circuit providing power to the reverse lamps.

TRANSMISSION RANGE SENSOR (Continued)

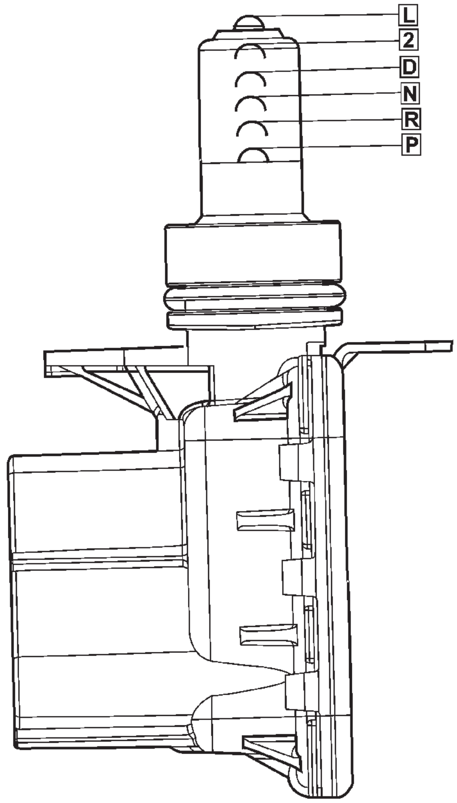


Fig. 253 Transmission Range Sensor Linear Movement

Mechanical State	Electronic Display (Ignition Unlocked)	Electronic Display (Ignition On)		
Indicated Gear Position			**Transmission Status**	**Column Shifter Position**
P	P	P	Vehicle is in PARK with the pawl engaged.	In the PARK gate.
	R		The PARK pawl is disengaged and the vehicle is free to roll, but REVERSE is not engaged.	Between the PARK and REVERSE gates.
R	R	R	The transmission is hydraulically in REVERSE.	In the REVERSE gate.
	N		The transmission is transitioning between REVERSE and NEUTRAL.	Between the REVERSE and NEUTRAL gates.
N	N	N	The vehicle is in NEUTRAL.	In the NEUTRAL gate.
	N		The transmission is transitioning between NEUTRAL and DRIVE, but is not in DRIVE.	Between the NEUTRAL and DRIVE gates.
D	D	D	The transmission is hydraulically in DRIVE.	In the DRIVE gate,

TRANSMISSION RANGE SENSOR (Continued)

Mechanical State	Electronic Display (Ignition Unlocked)	Electronic Display (Ignition On)		
Indicated Gear Position			Transmission Status	Column Shifter Position
2	2	2	The transmission is hydraulically in Manual SECOND.	In the SECOND gate.
1	1	1	The transmission is hydraulically in Manual FIRST.	In the FIRST gate.

DIAGNOSIS AND TESTING - TRANSMISSION RANGE SENSOR (TRS)

NOTE: For all circuit identification in the following steps, Refer to the appropriate Wiring Information.

(1) Raise vehicle on suitable hoist.

(2) Disconnect the vehicle's shift cable from the manual lever.

(3) With the manual lever in the PARK position (the PARK position is with the manual lever moved to the full rearward position), measure the resistance between the Park/Neutral Position Sense pin of the TRS and the transmission case. The resistance should be less than 5 ohms.

(4) With the manual lever in the NEUTRAL position (the NEUTRAL position is with the manual lever moved two detents forward of the full rearward position), measure the resistance between the Park/Neutral Position Sense pin of the TRS and the transmission case. The resistance should be less than 5 ohms.

(5) If the resistance is greater than 5 ohms in either of the previous steps, check for a dirty contact between the tip of the TRS rod and the valve body manual lever. If the contact is OK, replace the TRS.

(6) With the manual lever in the REVERSE position (the REVERSE position is with the manual lever moved one detent forward of the full rearward position), measure the resistance between the Fused Ignition Switch Output and the Back-up Lamp feed pins of the TRS. The resistance should be less than 5 ohms. If the resistance is greater than 5 ohms, replace the TRS.

(7) With the manual lever in the PARK position (the PARK position is with the manual lever moved to the full rearward position), measure the resistance between the Cluster Resistance Signal and the Cluster Signal Return pins of the TRS. The resistance should be 522.2 ohms. If the resistance is not correct, replace the TRS.

(8) With the manual lever in the REVERSE position (the REVERSE position is with the manual lever moved one detent forward of the full rearward position), measure the resistance between the Cluster Resistance Signal and the Cluster Signal Return pins of the TRS. The resistance should be 206.2 ohms. If the resistance is not correct, replace the TRS.

(9) With the manual lever in the NEUTRAL position (the NEUTRAL position is with the manual lever moved two detents forward of the full rearward position), measure the resistance between the Cluster Resistance Signal and the Cluster Signal Return pins of the TRS. The resistance should be 108.6 ohms. If the resistance is not correct, replace the TRS.

(10) With the manual lever in the DRIVE position (the DRIVE position is with the manual lever moved three detents forward of the full rearward position), measure the resistance between the Cluster Resistance Signal and the Cluster Signal Return pins of the TRS. The resistance should be 59.9 ohms. If the resistance is not correct, replace the TRS.

(11) With the manual lever in the SECOND position (the SECOND position is with the manual lever moved one detent rearward of the full forward position), measure the resistance between the Fused Ignition Switch Output and the Back-up Lamp feed pins of the TRS. The resistance should be 31.9 ohms. If the resistance is not correct, replace the TRS.

(12) With the manual lever in the LOW position (the LOW position is with the manual lever moved to the full forward position), measure the resistance between the Fused Ignition Switch Output and the Back-up Lamp feed pins of the TRS. The resistance should be 13.7 ohms. If the resistance is not correct, replace the TRS.

TRANSMISSION RANGE SENSOR (Continued)

REMOVAL

(1) Raise vehicle and position drain pan under the transmission range sensor (TRS).

(2) Move the transmission manual lever to the manual LOW position. The manual LOW position is with the manual lever in the forward-most detent.

(3) Disengage the wiring connector from the TRS.

(4) Remove the two screws holding the TRS to the TRS mounting bracket.

(5) Remove the TRS (Fig. 254) from the TRS mounting bracket by pulling it straight out of the bracket.

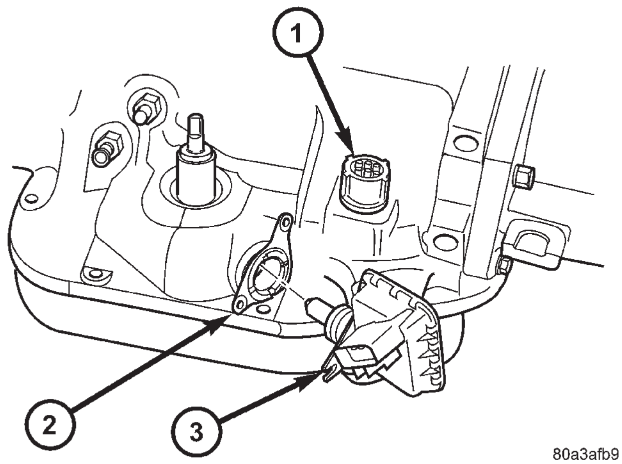


Fig. 254 Remove Transmission Range Sensor

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - TRANSMISSION RANGE SENSOR

(6) Loosen the TRS mounting bracket in the transmission case using Adapter 8581 (Fig. 255).

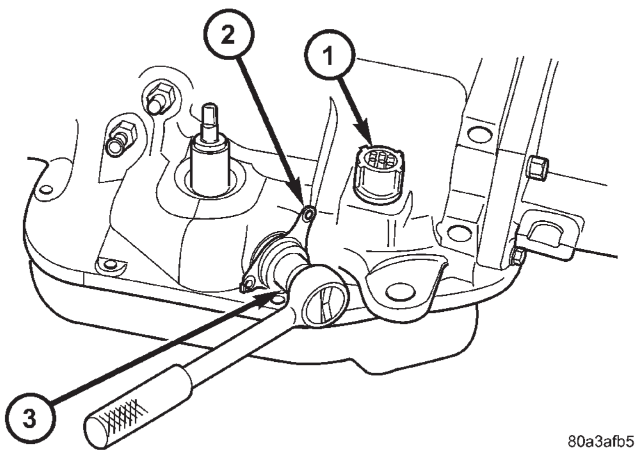


Fig. 255 Loosen the TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - ADAPTER 8581

(7) Remove the TRS mounting bracket (Fig. 256) from the transmission case.

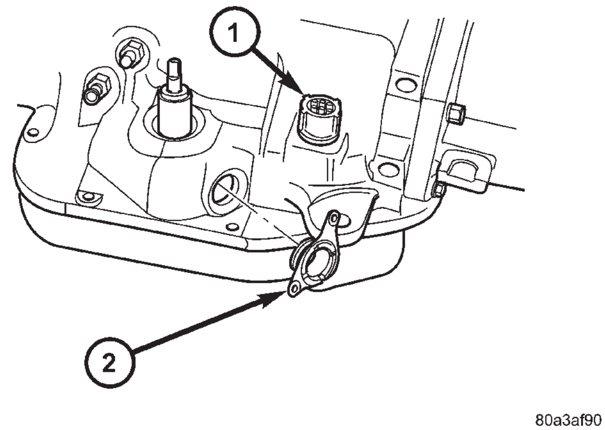


Fig. 256 Remove TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET

INSTALLATION

(1) Move the transmission manual shaft lever to the manual LOW position.

(2) Install the TRS mounting bracket into the transmission case. Using Adapter 8581 (Fig. 257), tighten the mounting bracket to 34 N·m (300 in.lbs.).

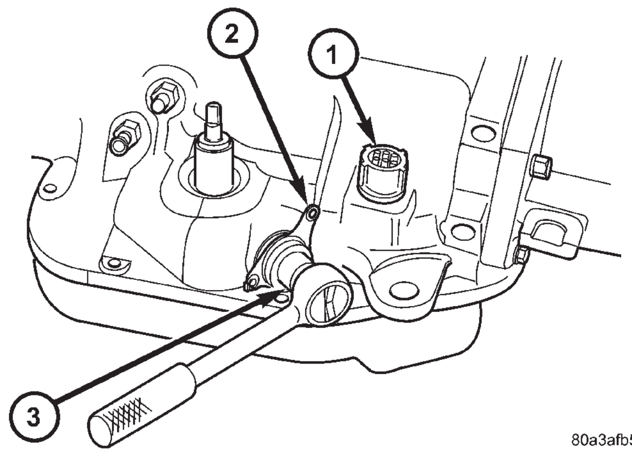


Fig. 257 Tighten the TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - ADAPTER 8581

(3) Install the TRS (Fig. 258) into the mounting bracket with the wiring connector facing the front of the transmission.

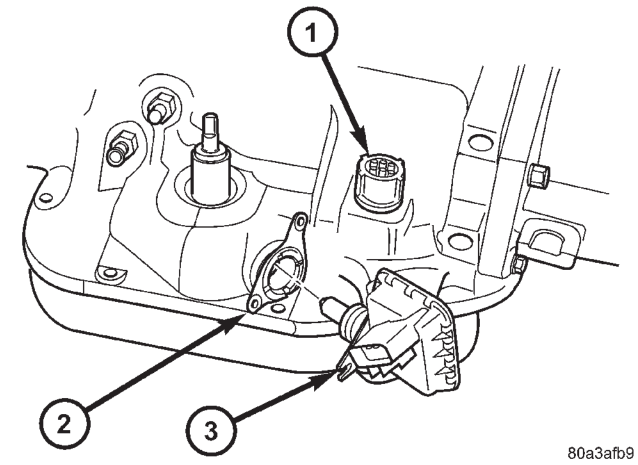


Fig. 258 Remove Transmission Range Sensor

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - TRANSMISSION RANGE SENSOR

(4) Install the two screws to hold the TRS to the mounting bracket. Tighten the screws to 3.4 N·m (30 in.lbs.).

(5) Verify proper sensor operation (Fig. 259).

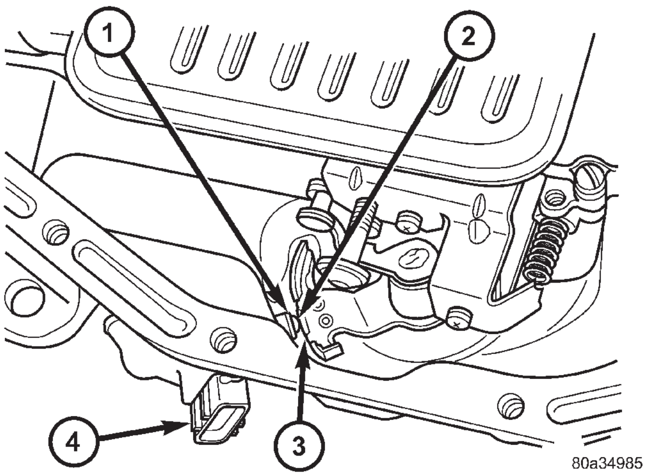


Fig. 259 Transmission Range Sensor Operation

1 - NEUTRAL CONTACT
2 - MANUAL LEVER AND SENSOR PLUNGER IN REVERSE POSITION
3 - PARK CONTACT
4 - TRANSMISSION RANGE SENSOR

(6) Move the transmission manual shaft lever to the PARK position.

(7) Connect TRS wiring connector to the TRS and lower vehicle.

(8) Refill the transmission fluid to the correct level.

TRANSMISSION TEMPERATURE SENSOR

DESCRIPTION

Transmission fluid temperature readings are supplied to the transmission control module by the thermistor (Fig. 260). The temperature readings are used to control engagement of the fourth gear overdrive clutch, the converter clutch, and governor pressure. Normal resistance value for the thermistor at room temperature is approximately 1000 ohms.

The thermistor is part of the governor pressure sensor assembly and is immersed in transmission fluid at all times.

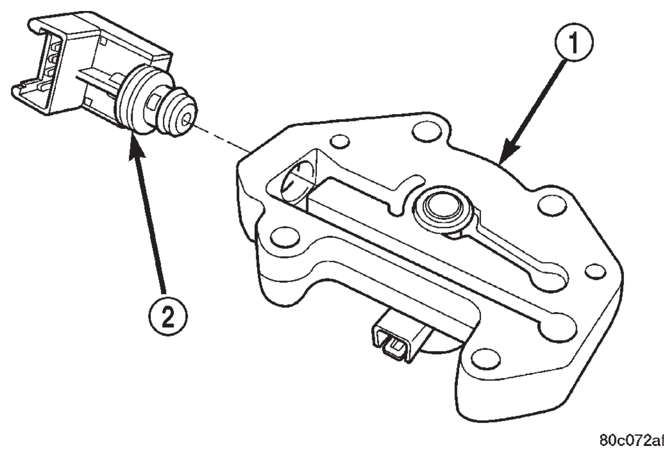


Fig. 260 Governor Pressure Sensor

1 - GOVERNOR BODY
2 - GOVERNOR PRESSURE SENSOR/TRANSMISSION FLUID TEMPERATURE THERMISTOR

OPERATION

The PCM prevents engagement of the converter clutch and overdrive clutch, when fluid temperature is below approximately 10°C (50°F).

If fluid temperature exceeds 126°C (260°F), the PCM causes a 4-3 downshift and engage the converter clutch. Engagement is according to the third gear converter clutch engagement schedule.

The overdrive OFF lamp in the instrument panel illuminates when the shift back to third occurs. The transmission will not allow fourth gear operation until fluid temperature decreases to approximately 110°C (230°F).

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. 261), (Fig. 262), (Fig. 263), and (Fig. 264):

- 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
- 3-4 shift valve
- 3-4 timing valve
- 3-4 quick fill valve
- 3-4 accumulator
- Throttle valve
- Throttle pressure plug
- Switch valve
- Manual valve
- Converter clutch lock-up valve
- Converter clutch lock-up timing Valve
- Shuttle valve
- Shuttle valve throttle plug
- Boost Valve
- 10 check balls

By adjusting the spring pressure acting on the regulator valve, transmission line pressure can be adjusted.

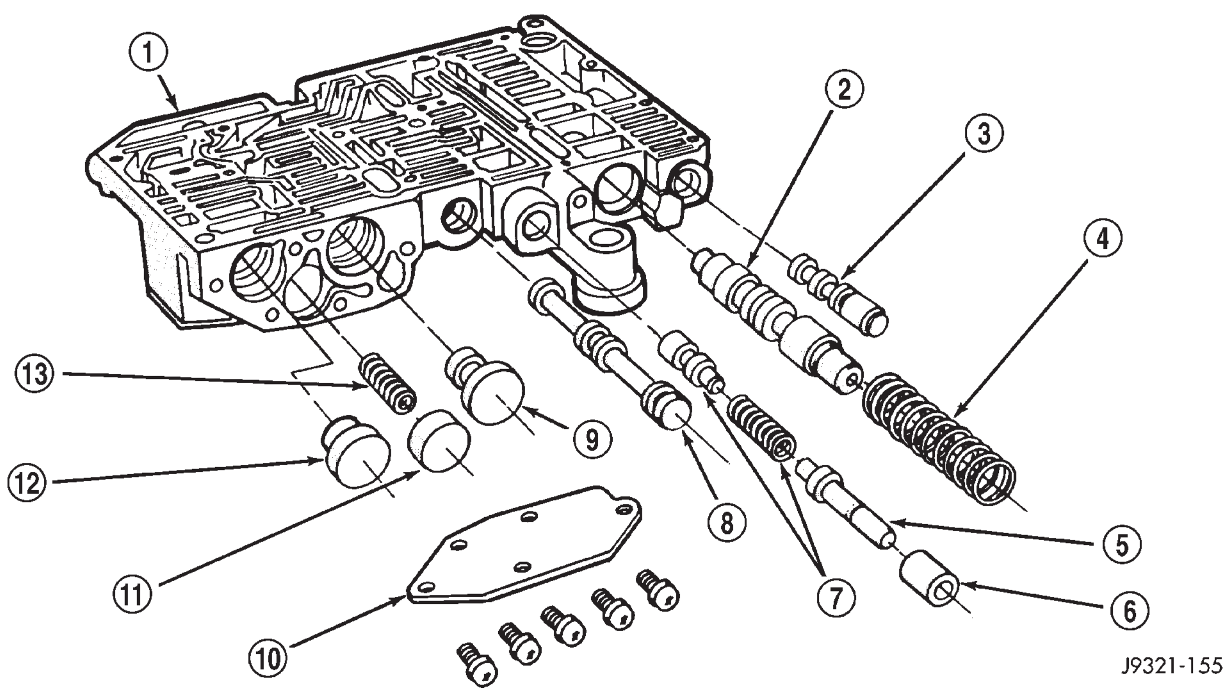


Fig. 261 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

VALVE BODY (Continued)

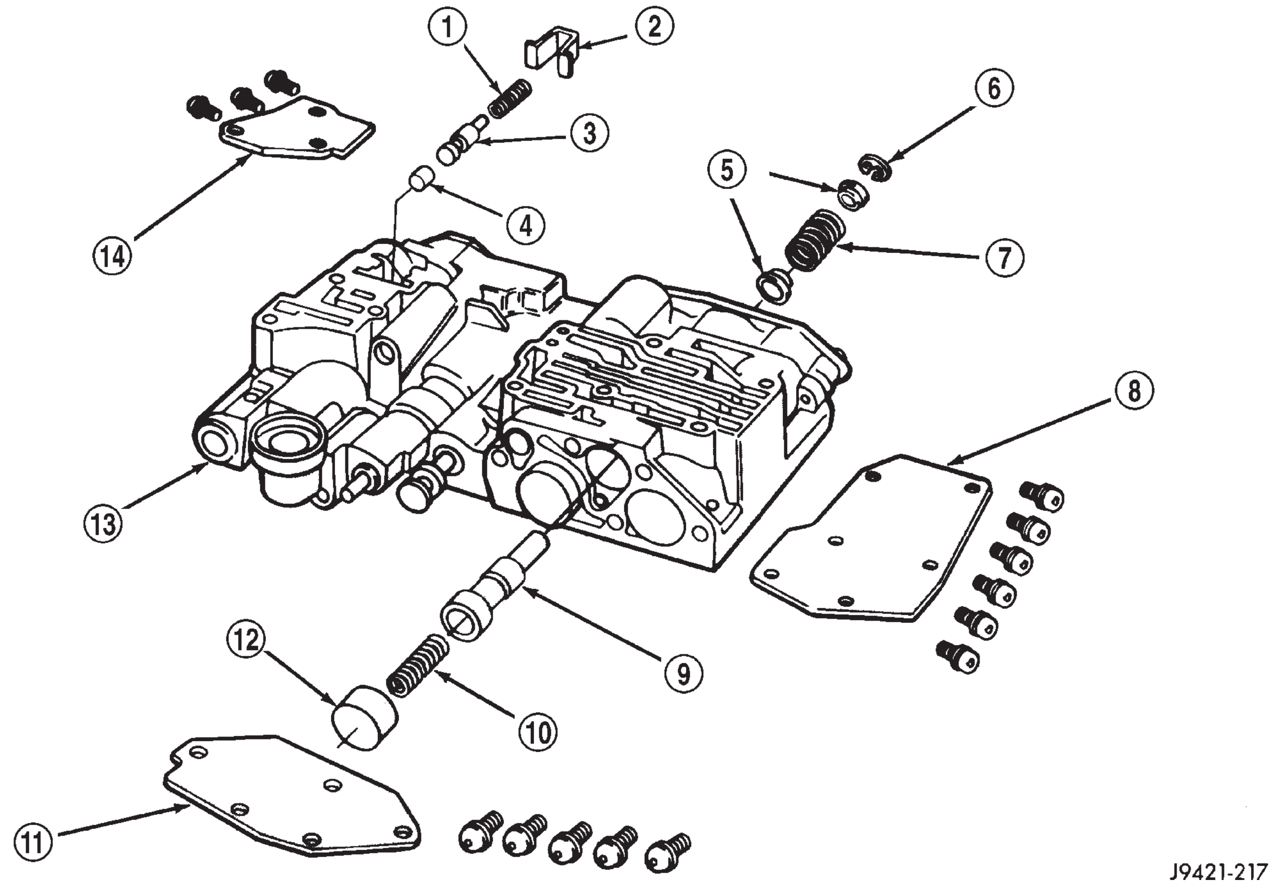


Fig. 262 Shuttle and Boost Valve Locations

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

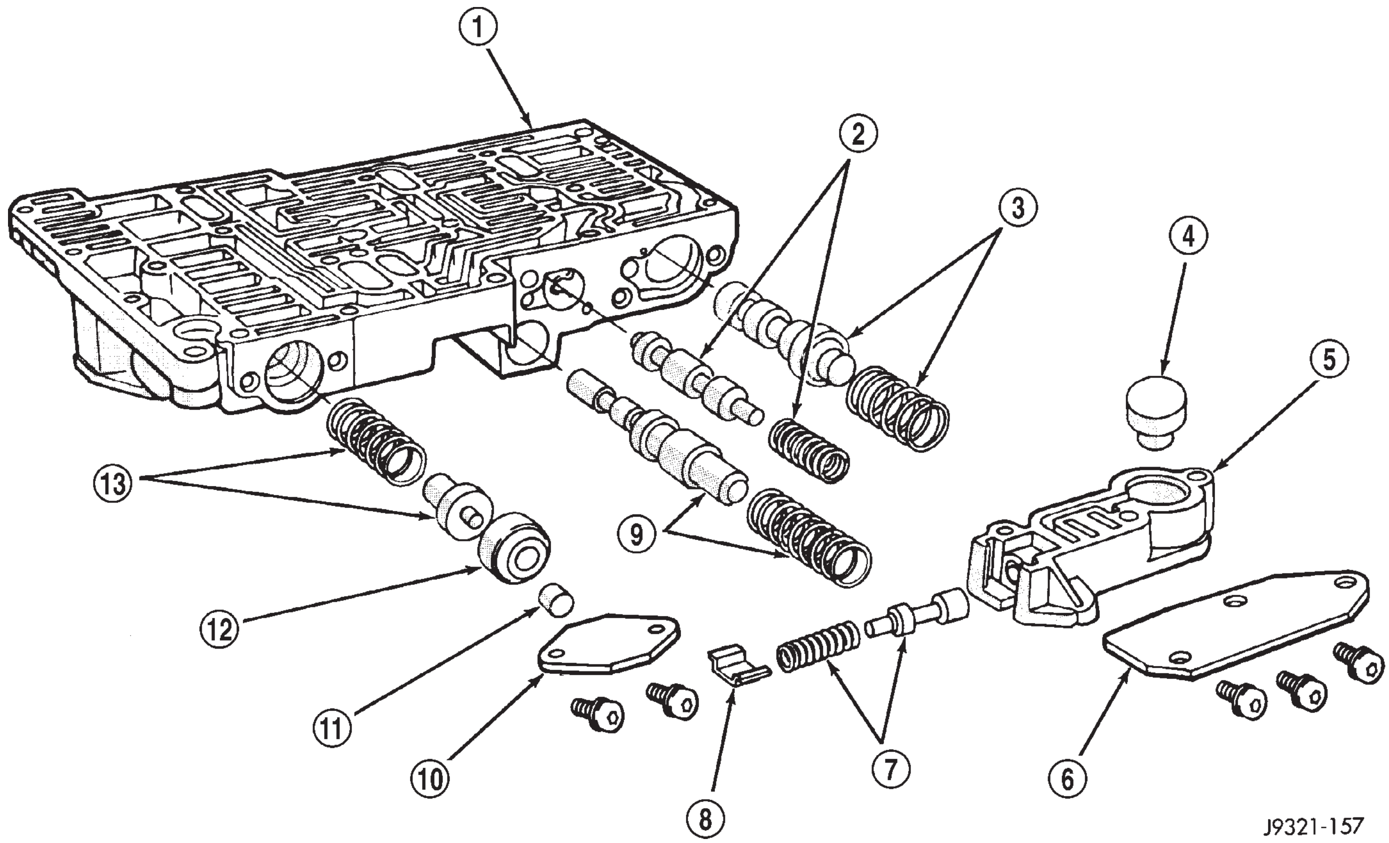


Fig. 263 Upper Housing Shift Valve and Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - LINE PRESSURE PLUG
12 - PLUG SLEEVE
13 - THROTTLE PRESSURE SPRING AND PLUG

VALVE BODY (Continued)

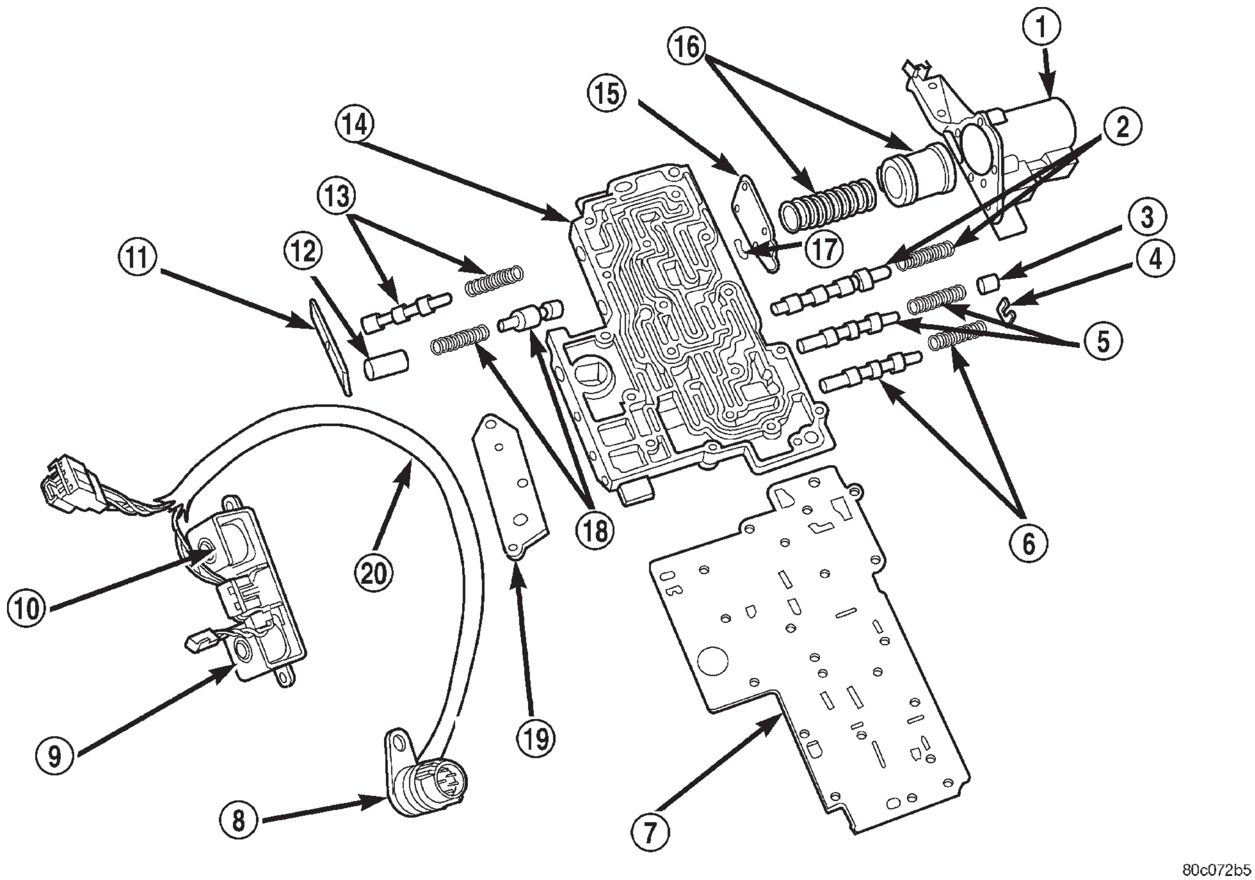


Fig. 264 Lower Housing Shift Valves and Springs

1 - 3-4 ACCUMULATOR HOUSING
2 - 3-4 SHIFT VALVE AND SPRING
3 - PLUG
4 - SPRING RETAINER
5 - CONVERTER CLUTCH VALVE AND SPRING
6 - CONVERTER CLUTCH TIMING VALVE AND SPRING
7 - OVERDRIVE SEPARATOR PLATE
8 - CASE CONNECTOR
9 - CONVERTER CLUTCH SOLENOID
10 - OVERDRIVE SOLENOID
11 - TIMING VALVE COVER
12 - PLUG
13 - 3-4 TIMING VALVE AND SPRING
14 - LOWER HOUSING
15 - ACCUMULATOR END PLATE
16 - 3-4 ACCUMULATOR PISTON AND SPRING
17 - E-CLIP
18 - 3-4 QUICK FILL SPRING AND VALVE
19 - SOLENOID GASKET
20 - HARNESS

VALVE BODY (Continued)

OPERATION

NOTE: Refer to the Hydraulic Schematics for a visual aid in determining valve location, operation and design.

CHECK BALLS

CHECK BALL NUMBER	DESCRIPTION
1	Allows either the manual valve to put line pressure on the 1-2 governor plug or the KD Valve to put WOT line pressure on the 1-2 governor plug.
2	Allows either the manual valve to put line pressure on the 2-3 governor plug or the KD Valve to put WOT line pressure on the 2-3 governor plug.
3	Allows either the Reverse circuit or the 3rd gear circuit to pressurize the front clutch.
4	Allows either the Manual Low circuit from the Manual Valve or the Reverse from the Manual Valve circuit to pressurize the rear servo.
5	Directs line pressure to the spring end of the 2-3 shift valve in either Manual Low or Manual 2nd, forcing the downshift to 2nd gear regardless of governor pressure.
6	Provides a by-pass around the front servo orifice so that the servo can release quickly.
7	Provides a by-pass around the rear clutch orifice so that the clutch can release quickly.
8	Directs reverse line pressure through an orifice to the throttle valve eliminating the extra leakage and insuring that Reverse line pressure pressure will be sufficient.
9	Provides a by-pass around the rear servo orifice so that the servo can release quickly.
ECE (10)	Allows the lockup clutch to used at WOT in 3rd gear by putting line pressure from the 3-4 Timing Valve on the interlock area of the 2-3 shift valve, thereby preventing a 3rd gear Lock-up to 2nd gear kickdown.

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. 265) 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.

Meanwhile, the torque converter is filled slowly. In all other gear positions (Fig. 266), 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 pres-

VALVE BODY (Continued)

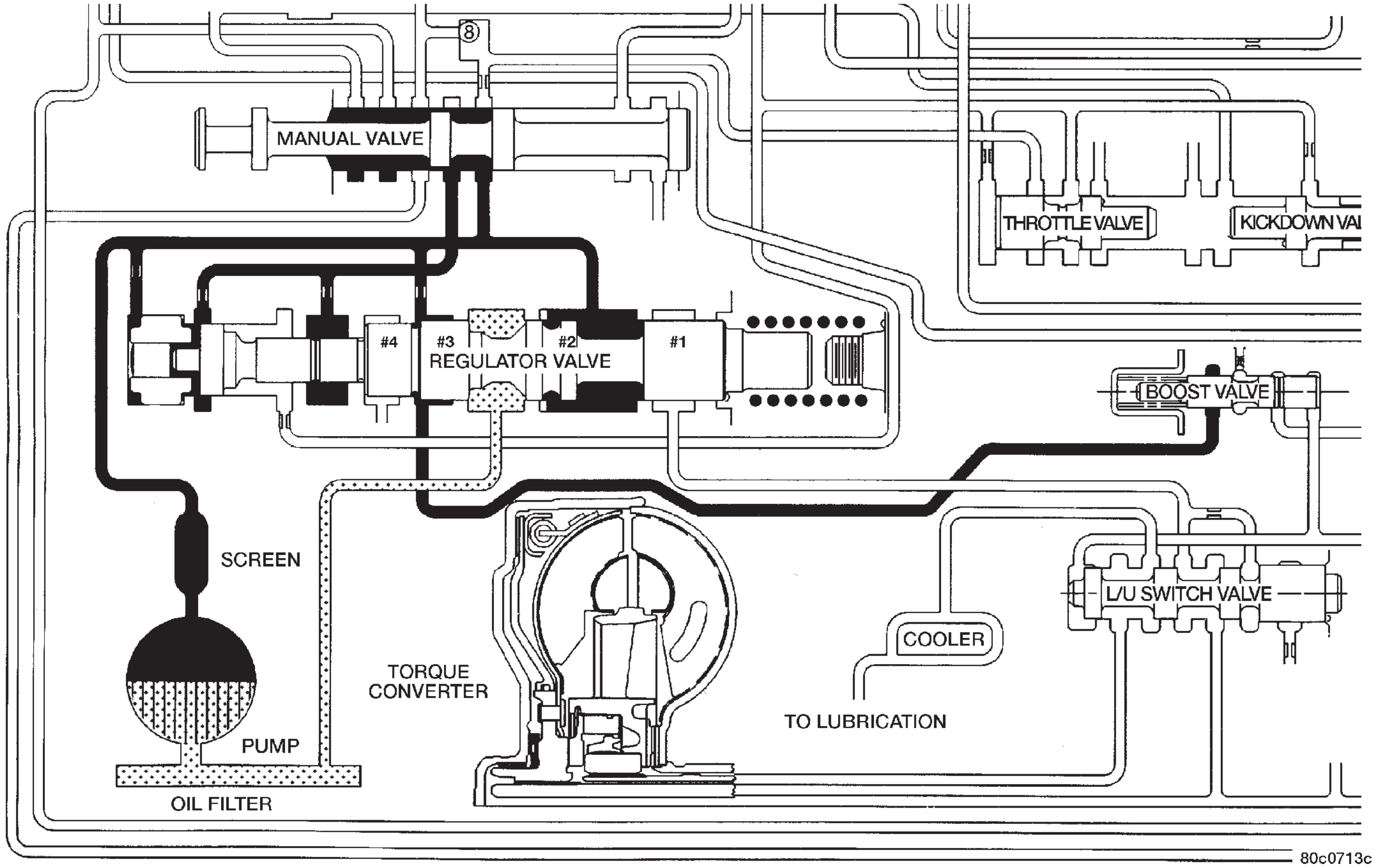


Fig. 265 Regulator Valve in PARK Position

sure 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 and the transmission's internal condition within a range of 57-94 psi (except in REVERSE) (Fig. 267). The regulated line pressure in REVERSE (Fig. 268) 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.

VALVE BODY (Continued)

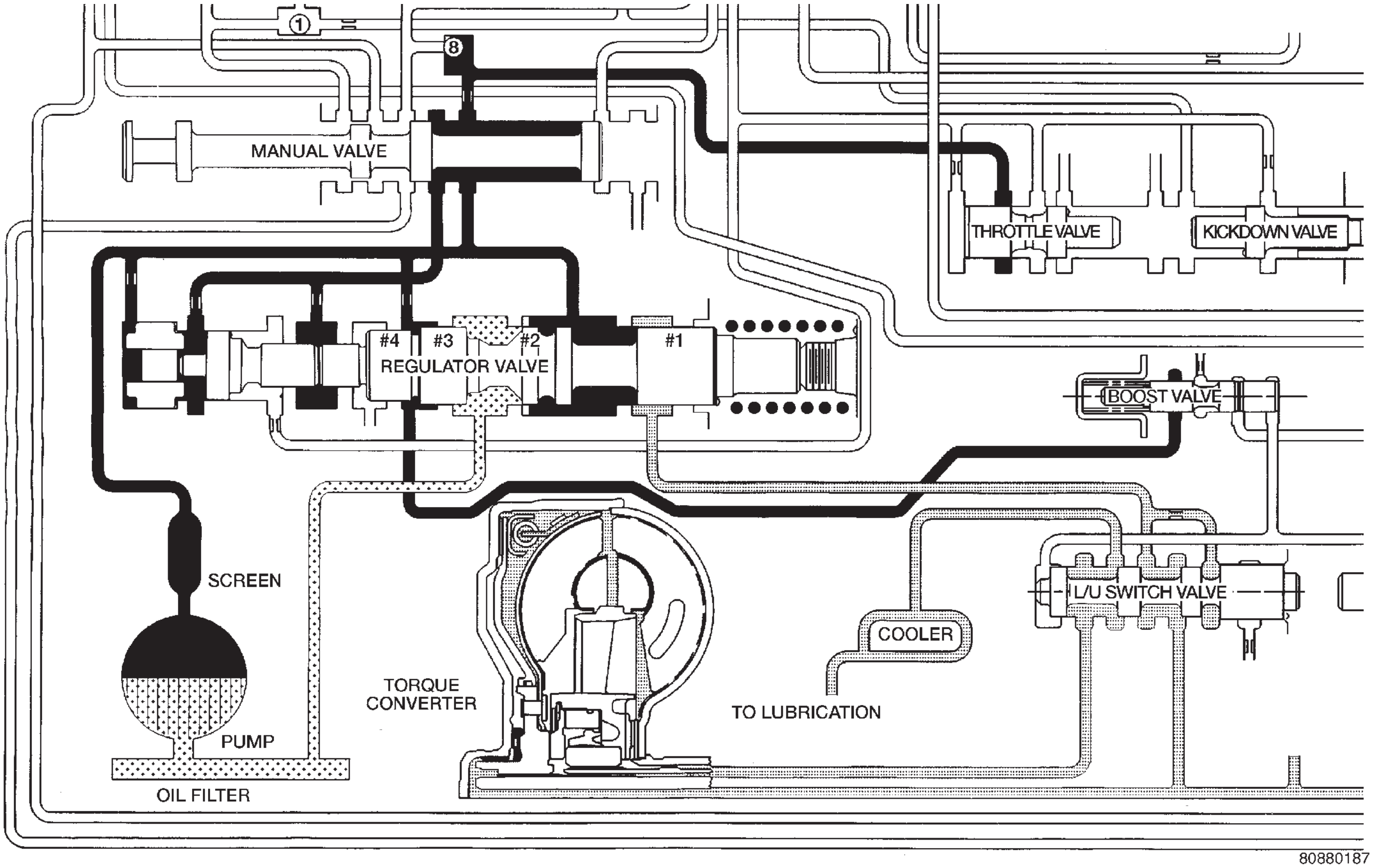


Fig. 266 Regulator Valve in NEUTRAL Position

VALVE BODY (Continued)

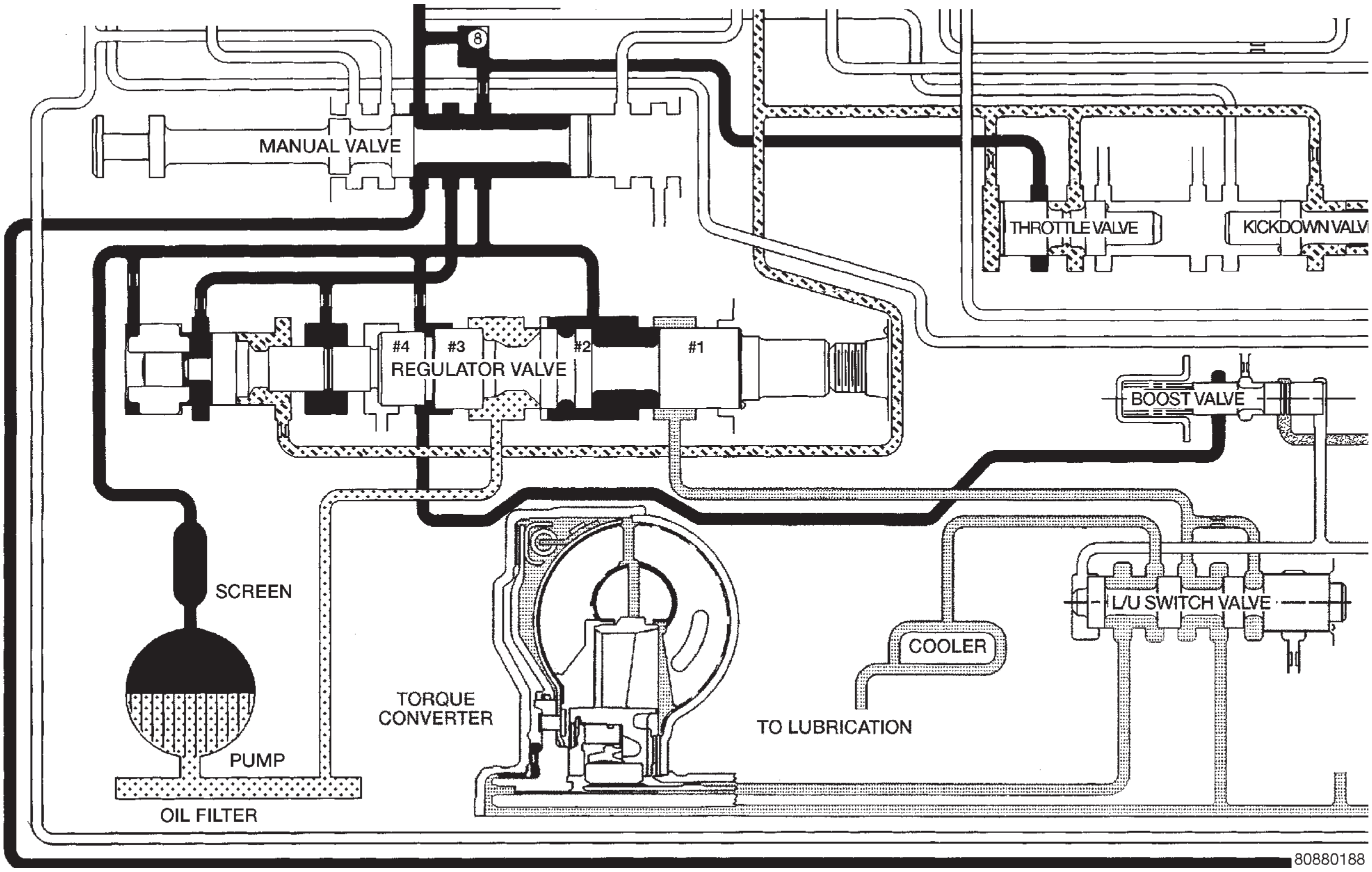


Fig. 267 Regulator Valve in DRIVE Position

VALVE BODY (Continued)

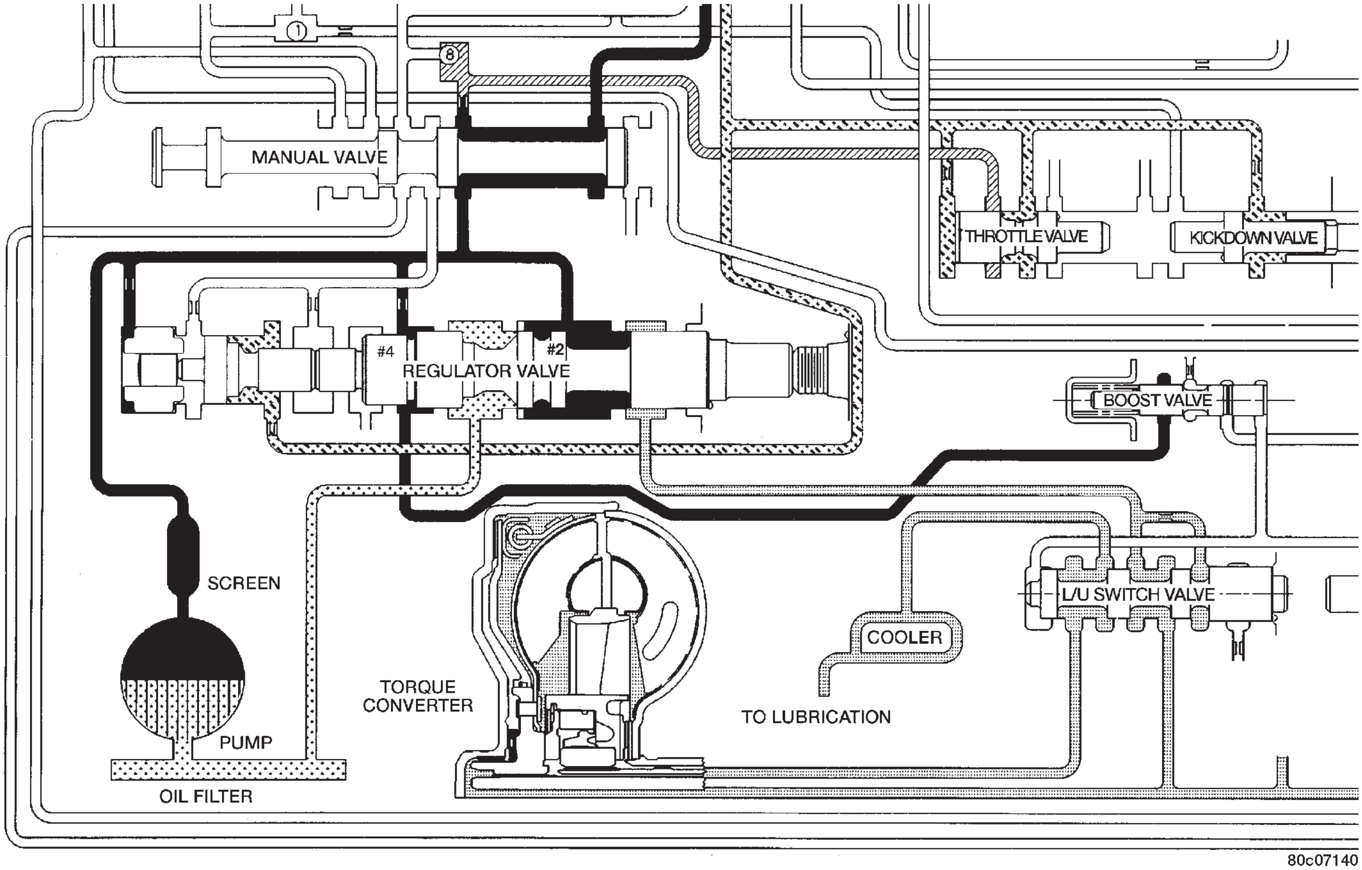


Fig. 268 Regulator Valve in REVERSE Position

KICKDOWN VALVE

When the throttle valve is as far over to the left as it can go, the maximum line pressure possible will enter the throttle pressure circuit. In this case, throttle pressure will equal line pressure. With the kickdown valve (Fig. 269) 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. 270) the limit valve does not come into play and does not affect the downshifts. As the vehicle's speed increases (Fig. 271), 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)

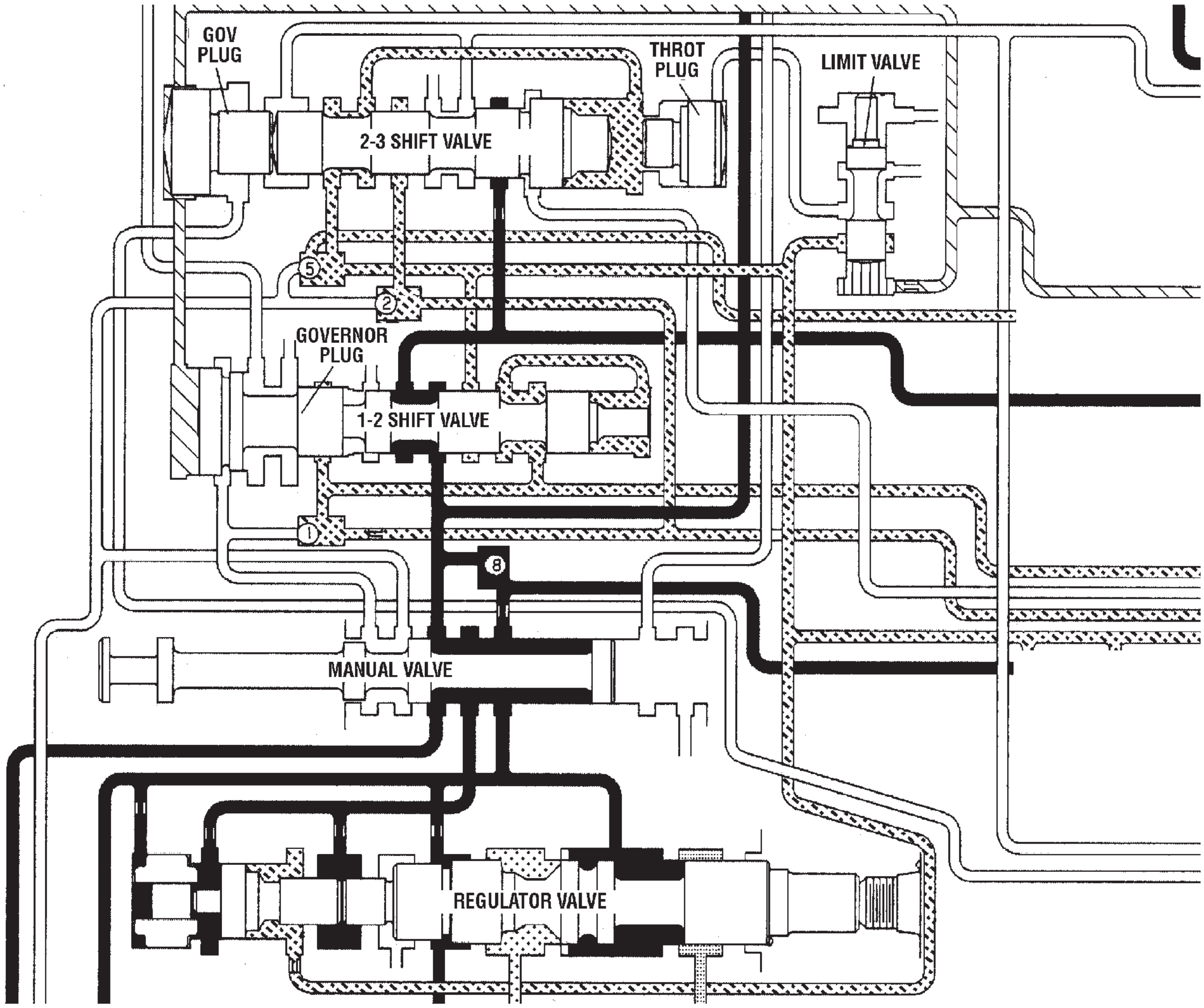


Fig. 269 Kickdown Valve-Wide Open Throttle

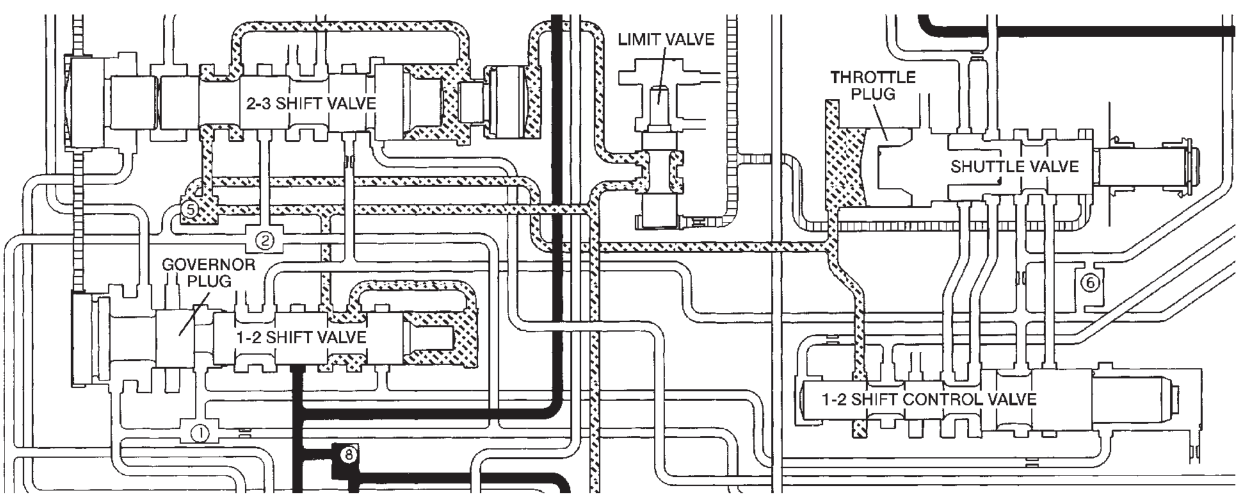


Fig. 270 Kickdown Limit Valve-Low Speeds

VALVE BODY (Continued)

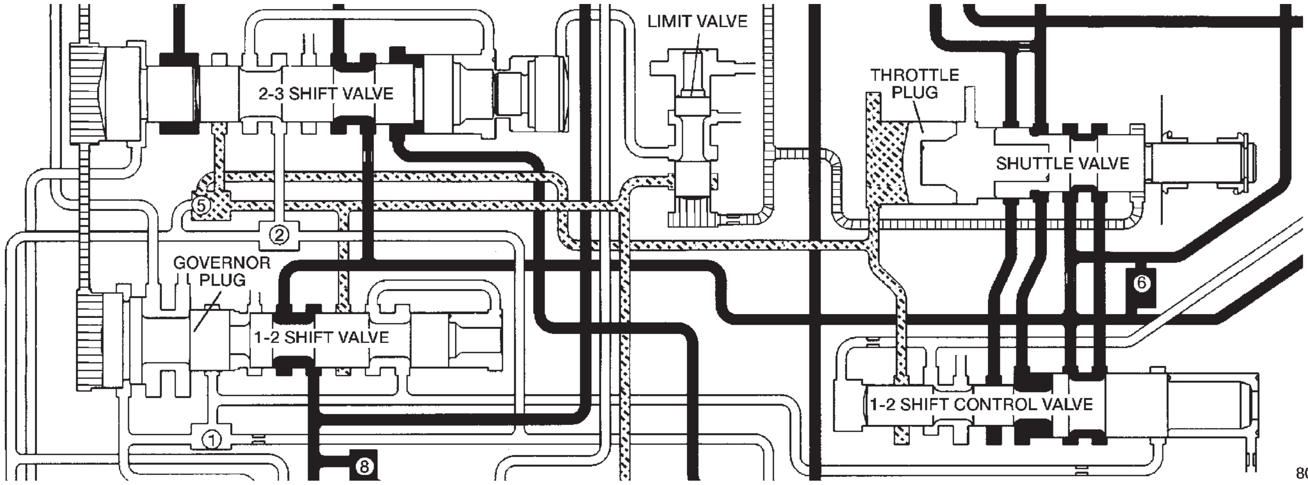


Fig. 271 Kickdown Limit Valve-High Speeds

1-2 SHIFT VALVE

The 1-2 shift valve assembly (Fig. 272), 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. 273).

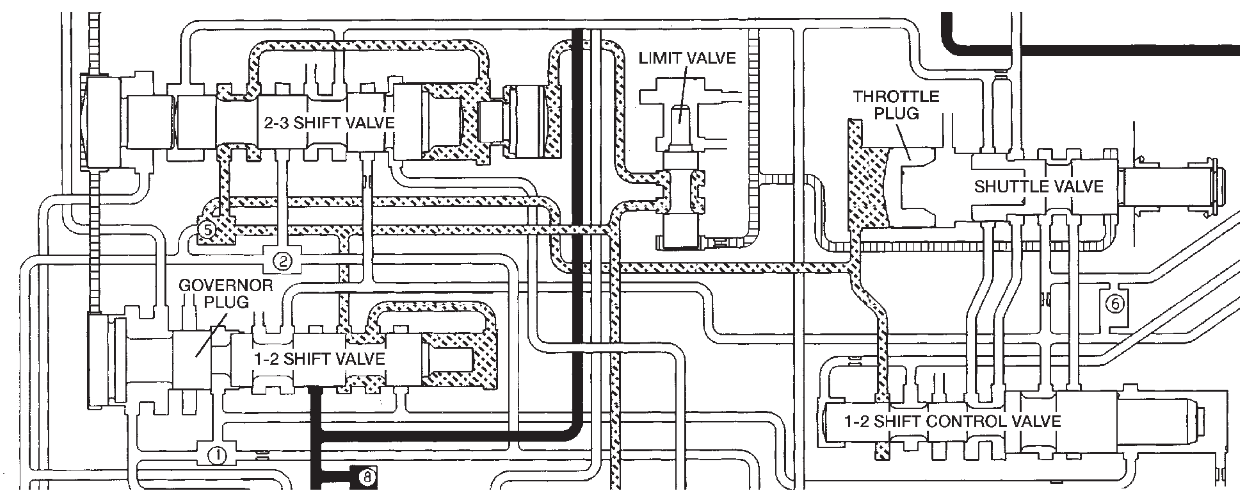


Fig. 272 1-2 Shift Valve-Before Shift

VALVE BODY (Continued)

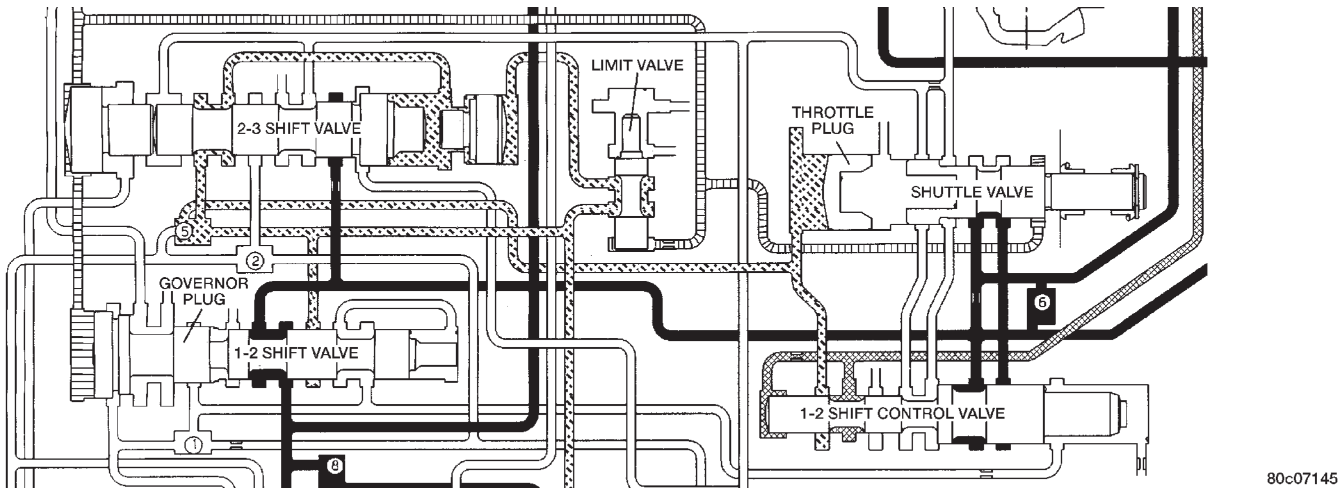


Fig. 273 1-2 Shift Valve-After Shift

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. 274):

• 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.

2-3 SHIFT VALVE

The 2-3 shift valve mechanism (Fig. 275) consists of the 2-3 shift valve, governor plug and spring, and a throttle plug. After the 1-2 shift valve has completed its operation and applied the front band, line pressure is directed to the 2-3 shift valve through the connecting passages from the 1-2 shift valve. The line pressure will then dead–end at land #2 until the 2-3 valve is ready to make its shift. Now that the vehicle is in motion and under acceleration, there is throttle pressure being applied to the spring side of the valve and between lands #3 and #4.

As vehicle speed increases, governor pressure increases proportionately, until it becomes great enough to overcome the combined throttle and spring pressure on the right side of the valve. Since the throttle pressure end of the 2-3 shift valve is larger in diameter than the 1-2 shift valve, the 2-3 shift will always happen at a greater speed than the 1-2 shift. 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. 276), 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)

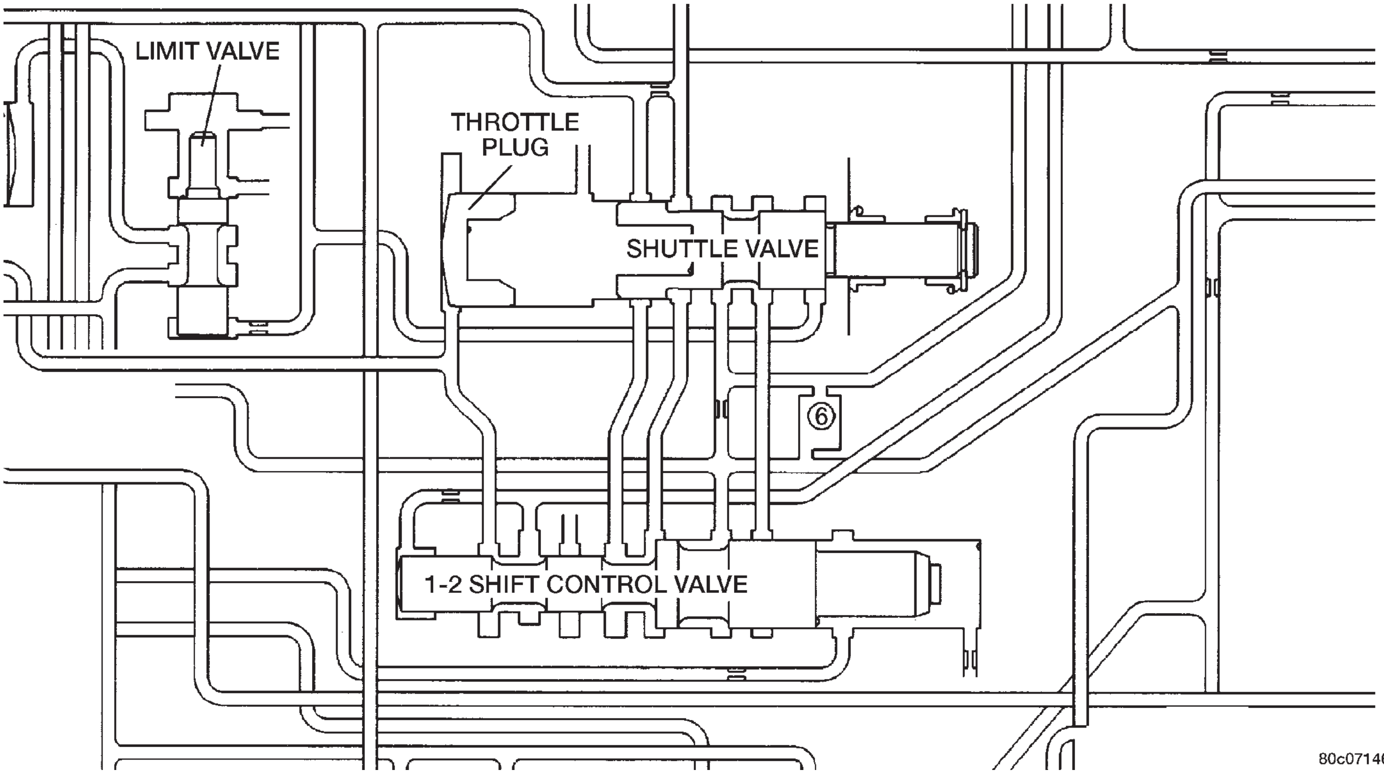


Fig. 274 1-2 Shift Control Valve

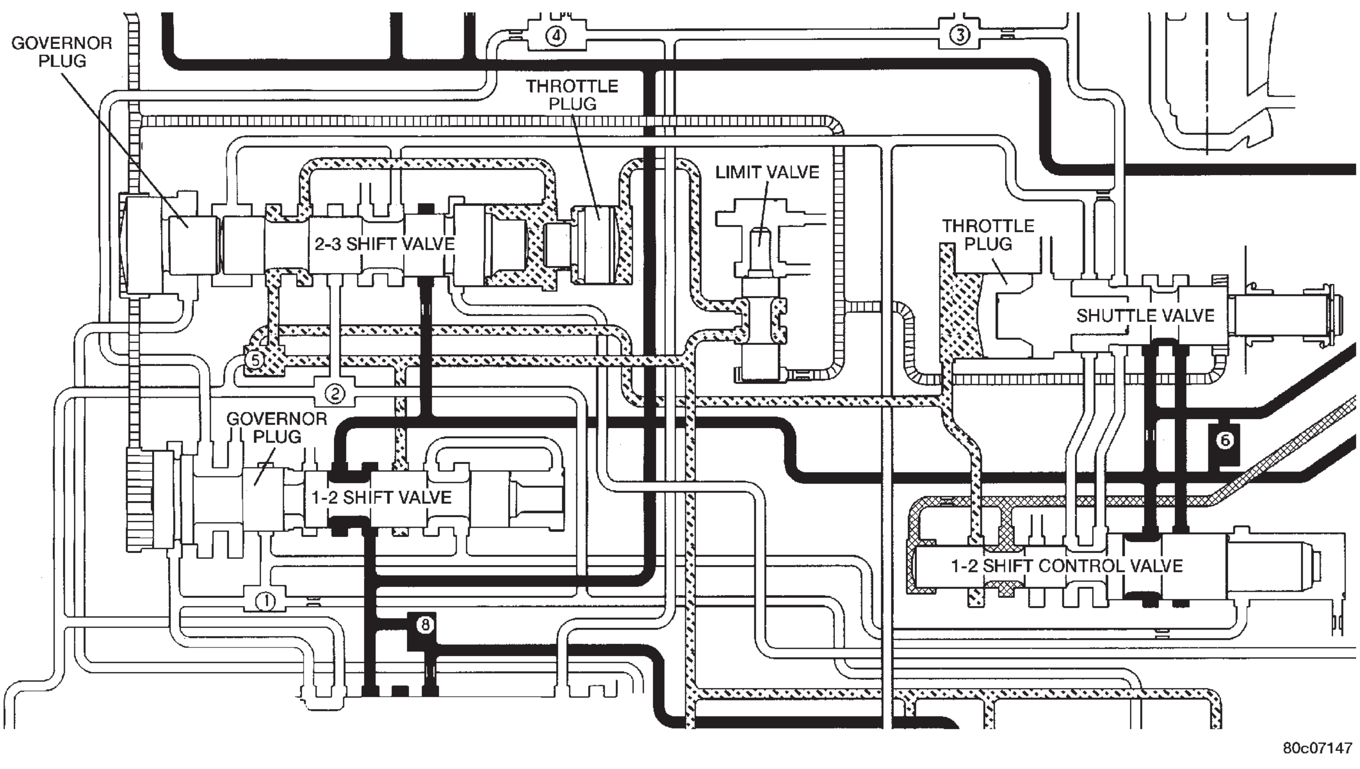


Fig. 275 2-3 Shift Valve-Before Shift

VALVE BODY (Continued)

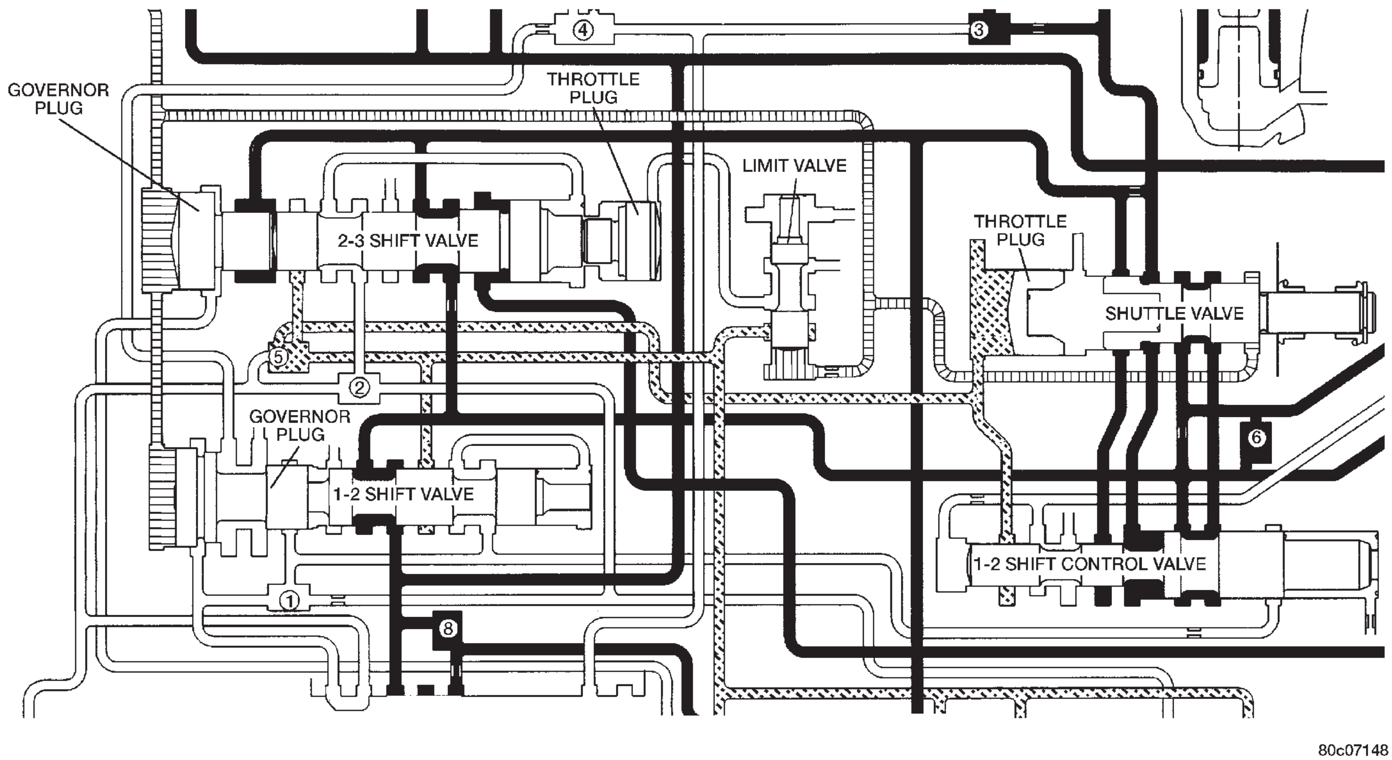


Fig. 276 2-3 Shift Valve-After Shift

3-4 SHIFT VALVE

The PCM energizes the overdrive solenoid during the 3-4 upshift (Fig. 277). This causes the solenoid check ball to close the vent port allowing line pressure from the 2-3 shift valve to act directly on the 3-4 upshift valve. Line pressure on the 3-4 shift valve overcomes valve spring pressure moving the valve to the upshift position (Fig. 278). This action exposes the feed passages to the 3-4 timing valve, 3-4 quick fill valve, 3-4 accumulator, and ultimately to the overdrive piston.

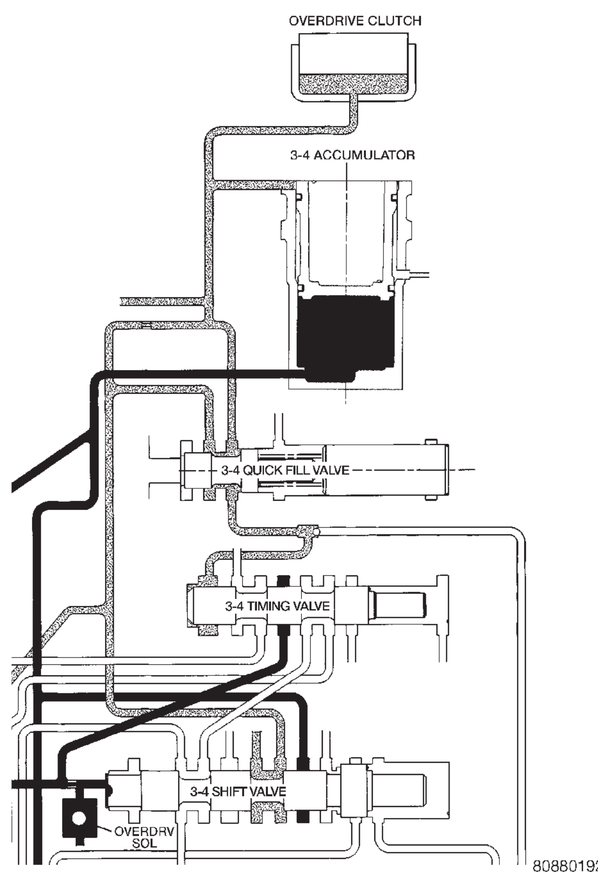


Fig. 277 3-4 Shift Valve Before Shift

VALVE BODY (Continued)

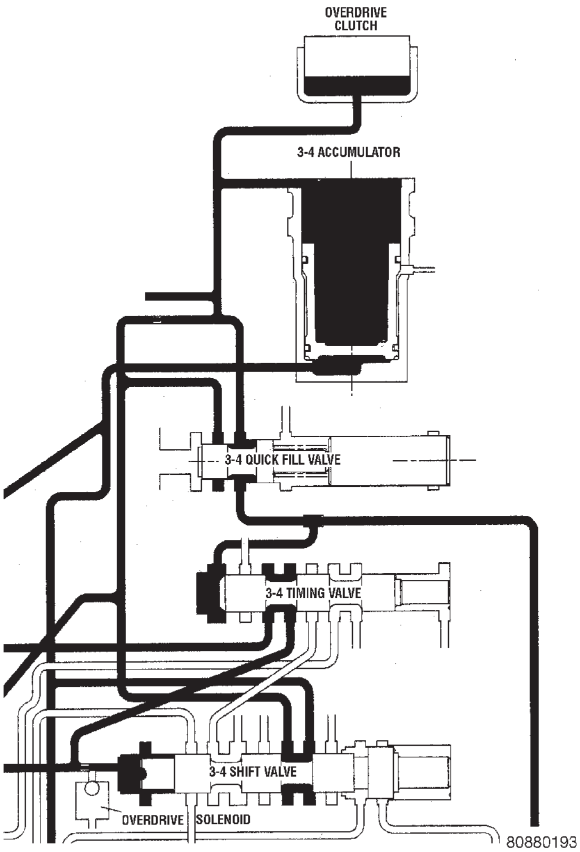


Fig. 278 3-4 Shift Valve After Shift

3-4 TIMING VALVE

The 3-4 timing valve is moved by line pressure coming through the 3-4 shift valve (Fig. 278). After the shift, the timing valve holds the 2-3 shift valve in an upshift position. The purpose is to prevent the 2-3 valve from downshifting before the 3-4 valve (Fig. 277).

3-4 QUICK FILL VALVE

The 3-4 quick fill valve provides faster engagement of the overdrive clutch during 3-4 upshifts. The valve temporarily bypasses the clutch piston feed orifice at the start of a 3-4 upshift (Fig. 277). This exposes a larger passage into the piston retainer resulting in a much faster clutch fill and apply sequence. The quick fill valve does not bypass the regular clutch feed orifice throughout the 3-4 upshift. Instead, once a predetermined pressure develops within the clutch, the valve closes the bypass (Fig. 278). Clutch fill is then completed through the regular feed orifice.

THROTTLE VALVE

In all gear positions the throttle valve (Fig. 279) 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 speed has 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.

VALVE BODY (Continued)

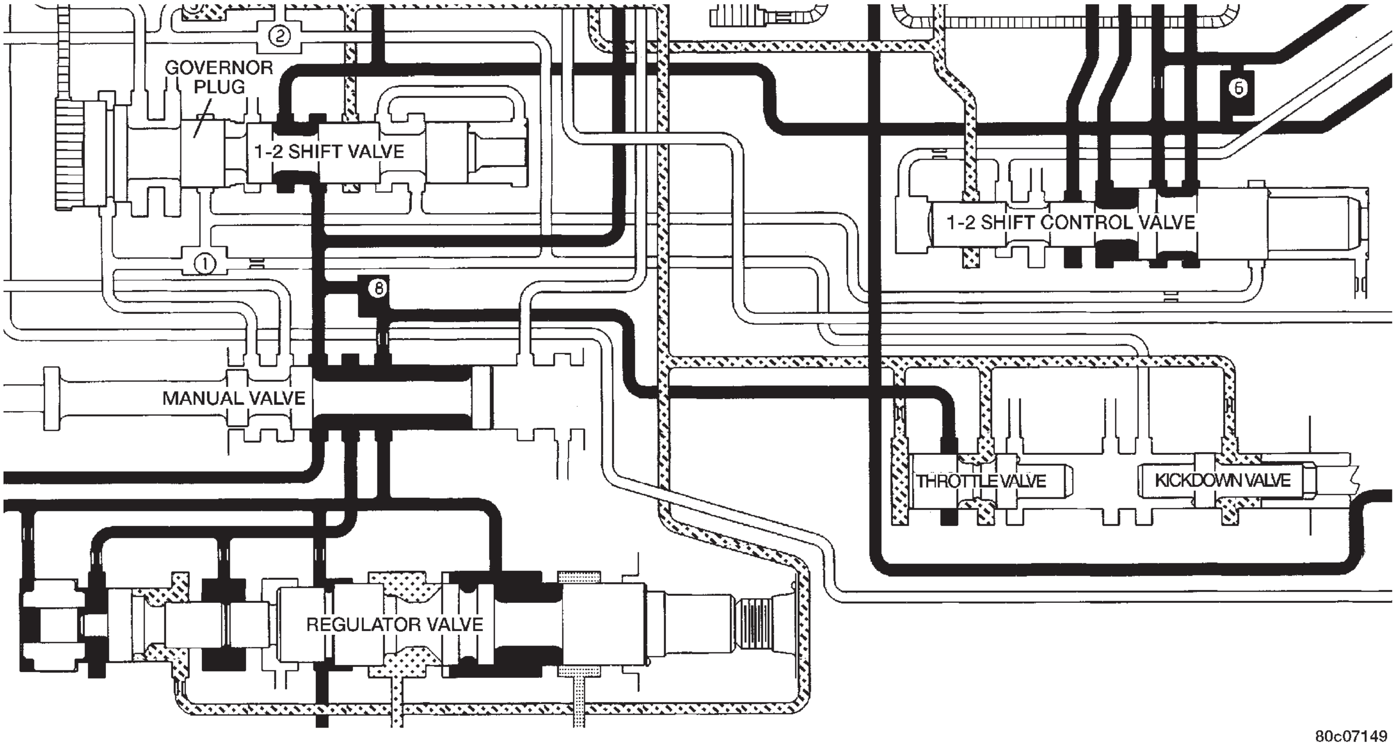


Fig. 279 Throttle Valve

SWITCH VALVE

When the transmission is in Drive Second before the TCC application occurs (Fig. 280), the pressure regulator valve is supplying torque converter pressure to the switch valve. The switch valve directs this pressure through the transmission input shaft, into the converter, through the converter, back out between the input shaft and the reaction shaft, and back up to the switch valve. From the switch valve, the fluid pressure is directed to the transmission cooler, and lubrication pressure returns from the cooler to lubricate different portions of the transmission.

Once the TCC control valve has moved to the right (Fig. 281), line pressure is directed to the tip of the switch valve, forcing the valve to the right. 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 right 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)

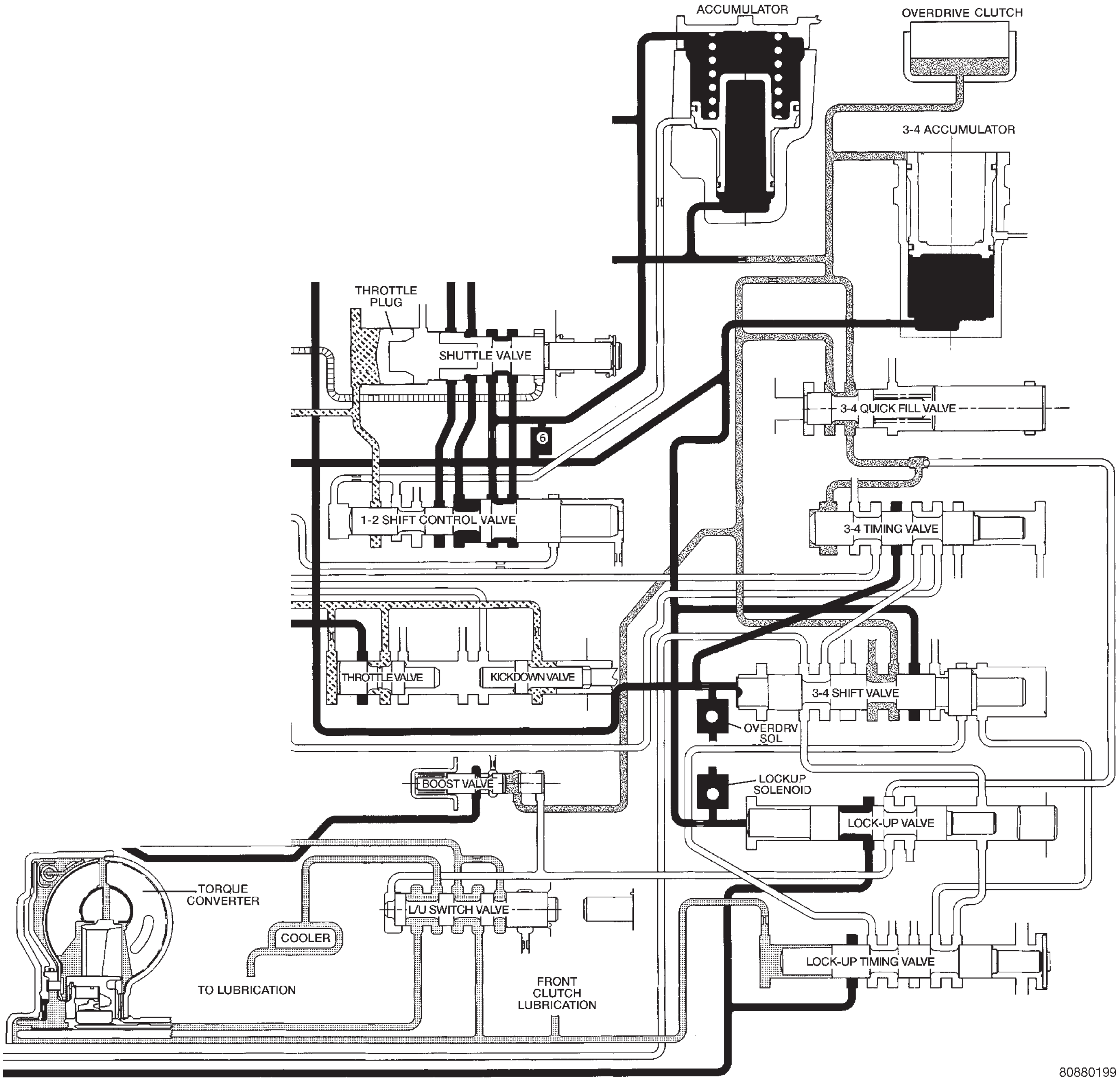


Fig. 280 Switch Valve-Torque Converter Unlocked

VALVE BODY (Continued)

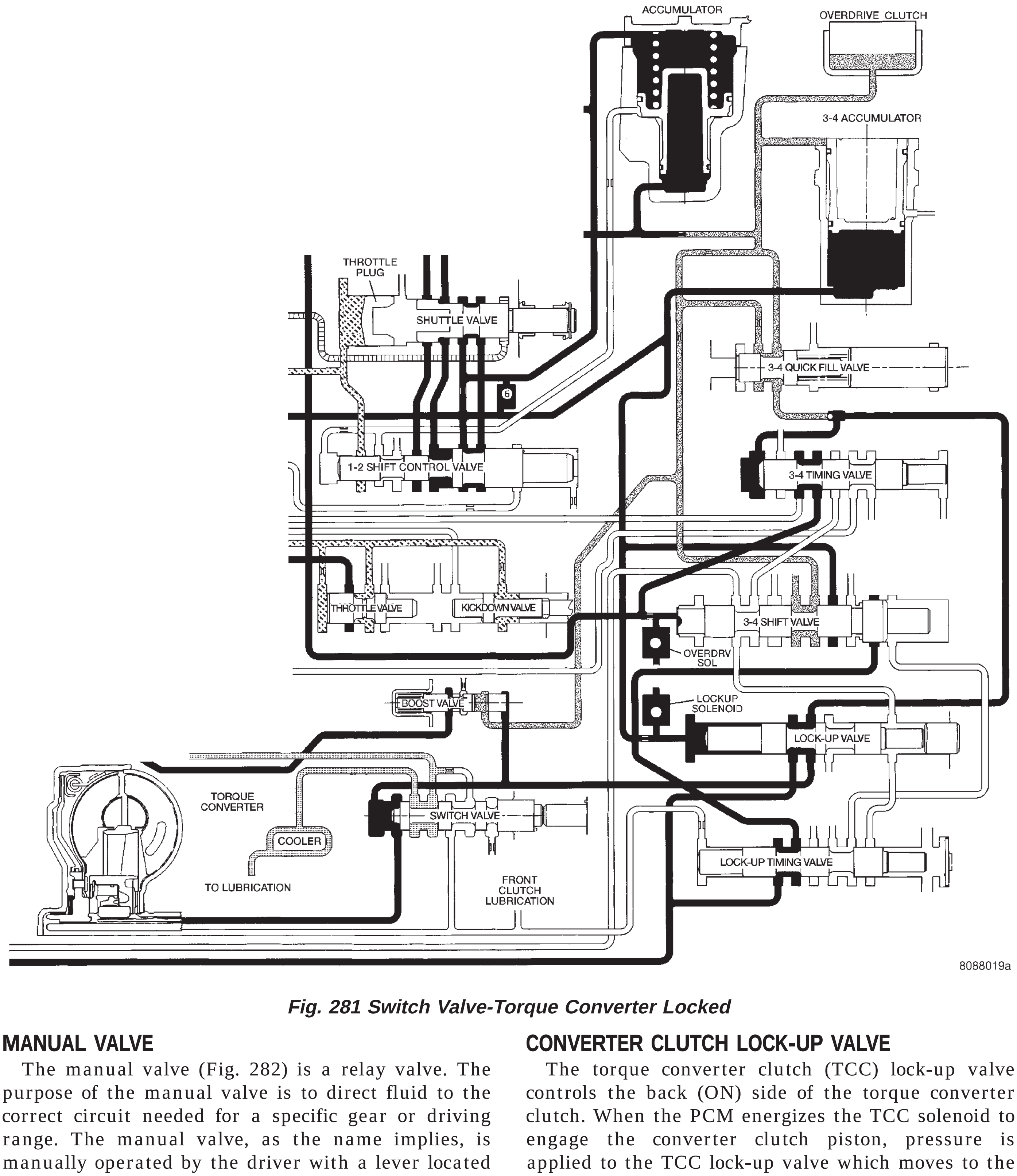


Fig. 281 Switch Valve-Torque Converter Locked

MANUAL VALVE

The manual valve (Fig. 282) 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 gear-shift 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 lever.

CONVERTER CLUTCH LOCK-UP VALVE

The torque converter clutch (TCC) lock-up 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 lock-up valve which moves to the right and applies pressure to the torque converter clutch.

VALVE BODY (Continued)

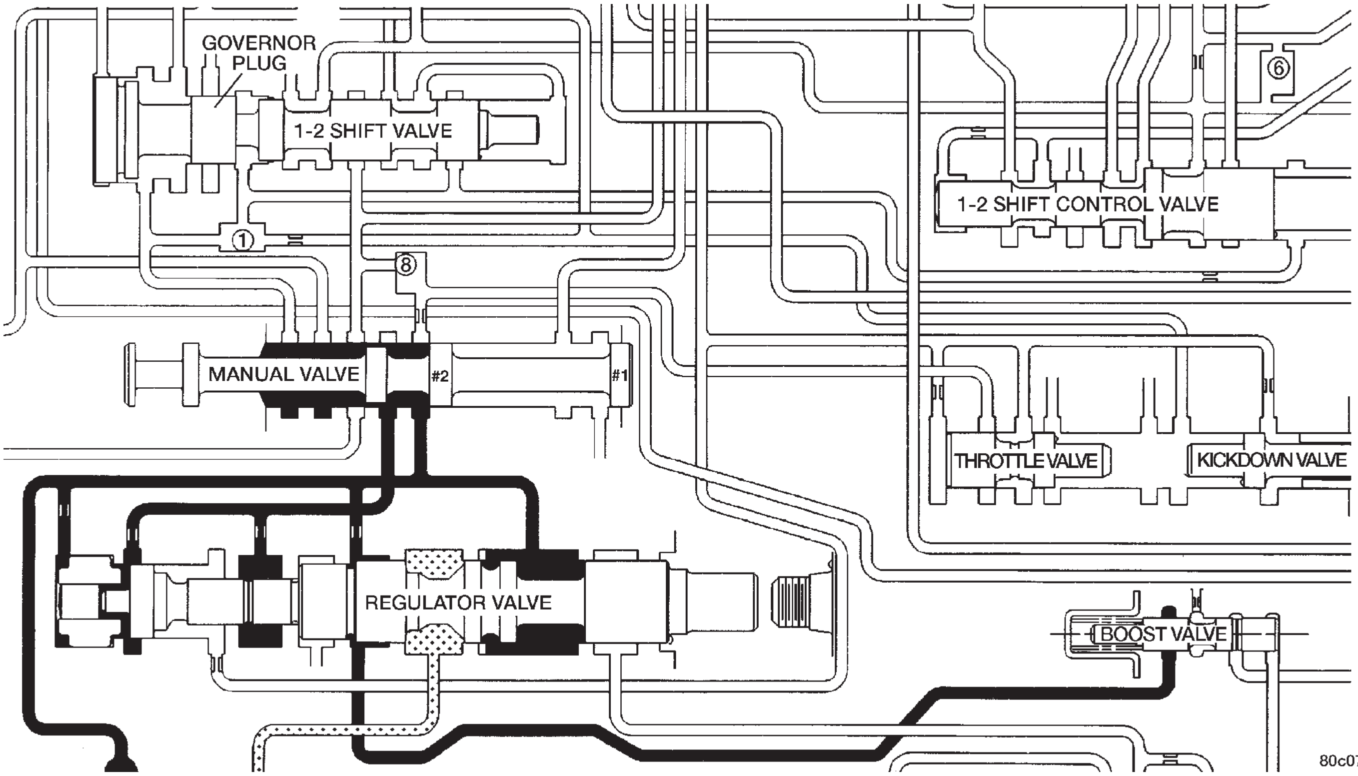


Fig. 282 Manual Valve

CONVERTER CLUTCH LOCK-UP TIMING VALVE

The torque converter clutch (TCC) lock-up timing valve is there to block any 4-3 downshift until the TCC is completely unlocked and the clutch is disengaged.

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. 274) 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.

BOOST VALVE

The boost valve (Fig. 283) provides increased fluid apply pressure to the overdrive clutch during 3-4 upshifts (Fig. 284), and when accelerating in fourth gear. The boost valve also serves to increase line pressure during torque converter lock-up.

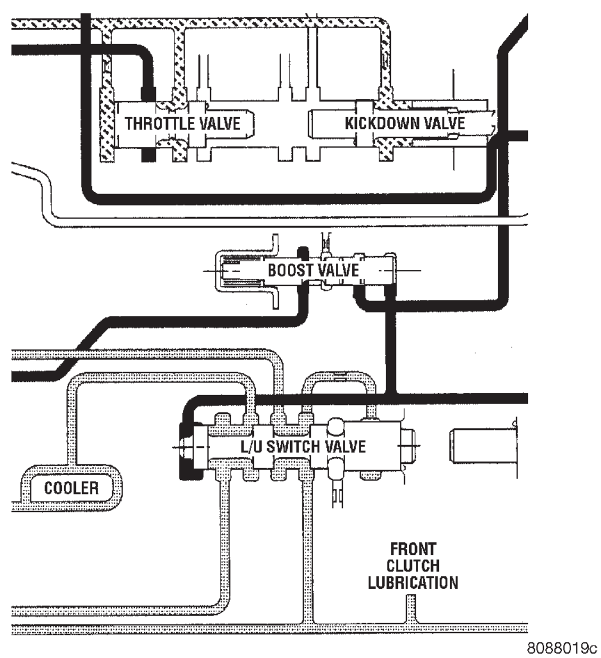


Fig. 283 Boost Valve Before Lock-up

VALVE BODY (Continued)

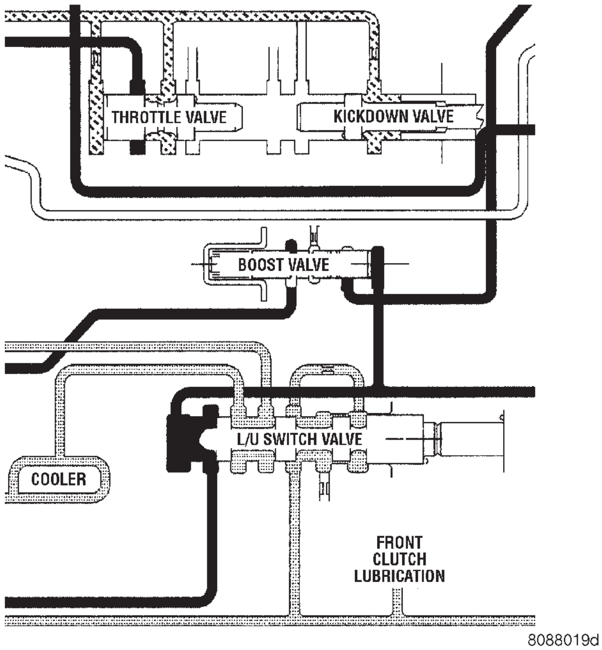


Fig. 284 Boost Valve After Lock-up

REMOVAL

The valve body can be removed for service without having to remove the transmission assembly.

The valve body can be disassembled for cleaning and inspection of the individual components.

The only replaceable valve body components are:

- Manual lever.
- Manual lever washer, seal, E-clip, and shaft seal.
- Manual lever detent ball.
- Throttle lever.
- Fluid filter.
- Pressure adjusting screw bracket.
- Governor pressure solenoid.
- Governor pressure sensor (includes transmission temperature thermistor).
- Converter clutch/overdrive solenoid assembly and harness .
- Governor housing gasket.
- Solenoid case connector O-rings.

(1) Shift transmission into NEUTRAL.

(2) Raise vehicle.

(3) Remove gearshift and throttle levers from shaft of valve body manual lever.

(4) Disconnect wires at solenoid case connector (Fig. 285).

(5) Remove the transmission range sensor.

(6) Position drain pan under transmission oil pan.

(7) Remove transmission oil pan and gasket.

(8) Remove fluid filter from valve body.

(9) Remove bolts attaching valve body to transmission case.

(10) Lower valve body enough to remove accumulator piston and springs.

(11) Work manual lever shaft and electrical connector out of transmission case.

(12) Lower valve body, rotate valve body away from case, pull park rod out of sprag, and remove valve body (Fig. 286).

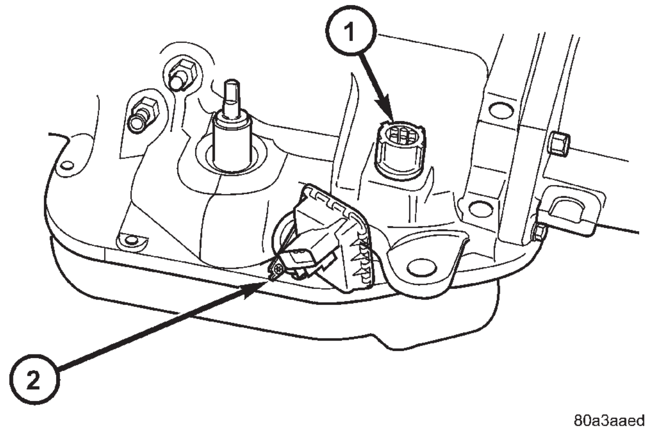


Fig. 285 Transmission Case Connector

1 - SOLENOID CASE CONNECTOR
2 - TRANSMISSION RANGE SENSOR

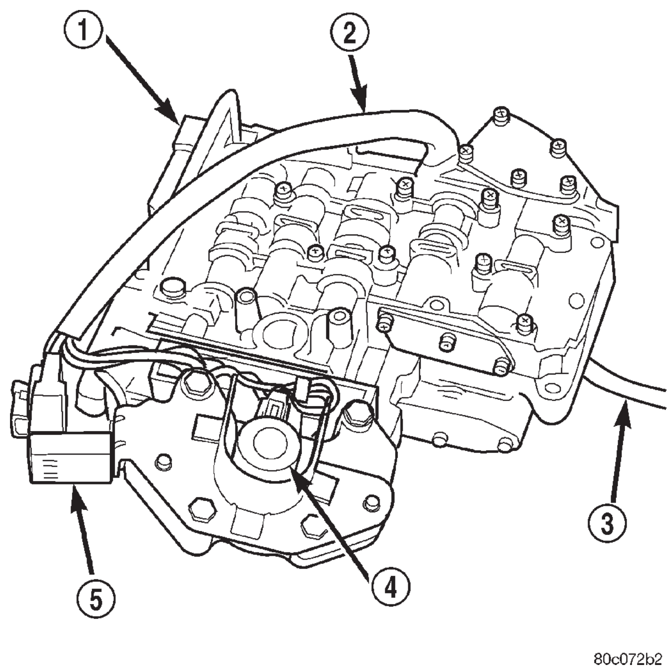


Fig. 286 Valve Body

1 - VALVE BODY
2 - WIRE HARNESS
3 - PARK ROD
4 - GOVERNOR PRESSURE SOLENOID
5 - GOVERNOR PRESSURE SENSOR

VALVE BODY (Continued)

DISASSEMBLY

CAUTION: Do not clamp any valve body component in a vise. This practice can damage the component resulting in unsatisfactory operation after assembly and installation. Do not use pliers to remove any of the valves, plugs or springs and do not force any of the components out or into place. The valves and valve body housings will be damaged if force is used. Tag or mark the valve body springs for reference as they are removed. Do not allow them to become intermixed.

(1) Disconnect wires from governor pressure sensor and solenoid.

(2) Remove screws attaching governor body and retainer plate to transfer plate.

(3) Remove retainer plate, governor body and gasket from transfer plate.

(4) Remove governor pressure sensor from governor body.

(5) Remove governor pressure solenoid by pulling it straight out of bore in governor body. Remove and discard solenoid O-rings if worn, cut, or torn.

(6) Remove small shoulder bolt that secures solenoid harness case connector to 3-4 accumulator housing (Fig. 287). Retain shoulder bolt. Either tape it to harness or thread it back into accumulator housing after connector removal.

(7) Unhook overdrive/converter solenoid harness from 3-4 accumulator cover plate (Fig. 288).

(8) Turn valve body over and remove screws that attach overdrive/converter solenoid assembly to valve body (Fig. 289).

(9) Remove solenoid and harness assembly from valve body (Fig. 290).

(10) Remove boost valve cover (Fig. 291).

(11) Remove boost valve retainer, valve spring and boost valve (Fig. 292).

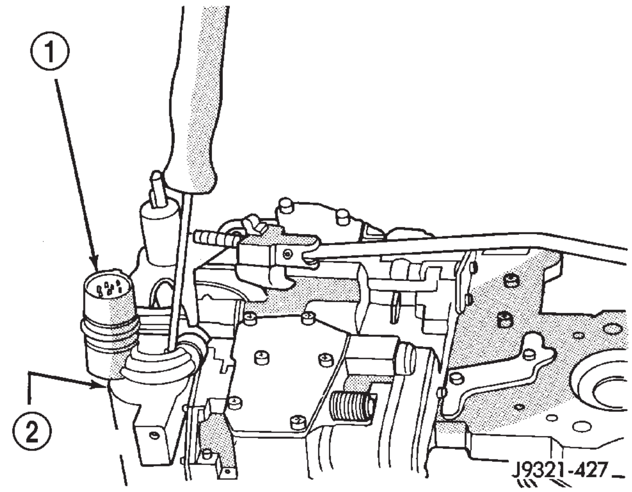


Fig. 287 Solenoid Harness Case Connector Shoulder Bolt

1 - SOLENOID HARNESS CASE CONNECTOR
2 - 3-4 ACCUMULATOR HOUSING

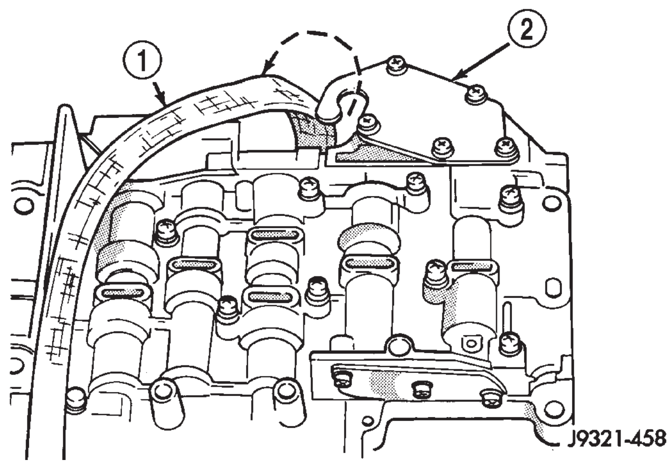


Fig. 288 Solenoid Harness Routing

1 - OVERDRIVE/CONVERTER SOLENOID WIRE HARNESS
2 - 3-4 ACCUMULATOR COVER PLATE

VALVE BODY (Continued)

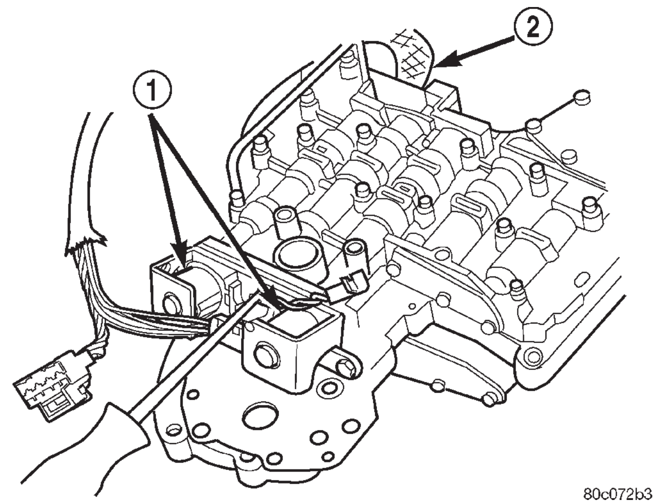


Fig. 289 Solenoid Assembly Screws

1 - OVERDRIVE/CONVERTER CLUTCH SOLENOID ASSEMBLY
2 - HARNESS

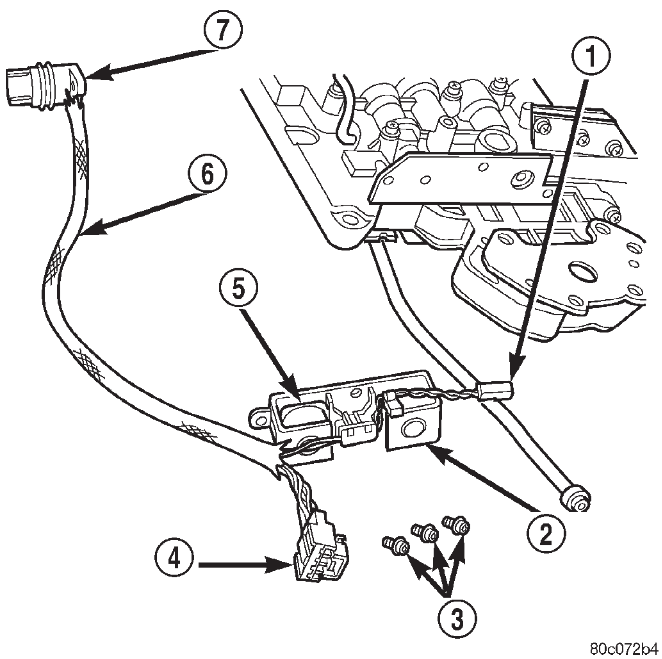


Fig. 290 Solenoid Assembly

1 - GOVERNOR SOLENOID WIRES
2 - CONVERTER CLUTCH SOLENOID
3 - SOLENOID SCREWS
4 - GOVERNOR SENSOR WIRES
5 - OVERDRIVE SOLENOID
6 - HARNESS
7 - CASE CONNECTOR

(12) Secure detent ball and spring with Retainer Tool 6583 (Fig. 293).

(13) Remove park rod E-clip and separate rod from manual lever (Fig. 294).

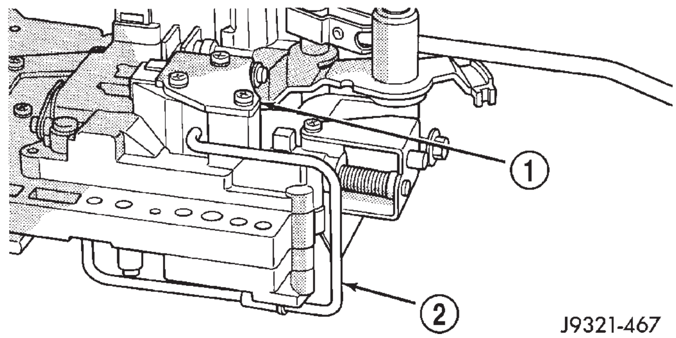


Fig. 291 Boost Valve Cover Location

1 - BOOST VALVE HOUSING AND COVER
2 - BOOST VALVE TUBE

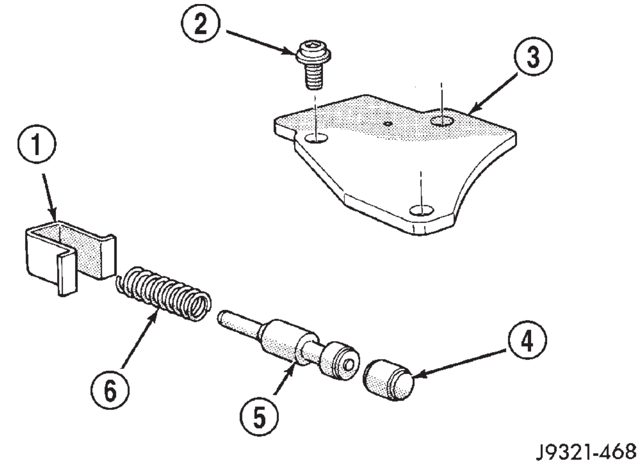


Fig. 292 Boost Valve Components

1 - SPRING AND VALVE RETAINER
2 - COVER SCREWS
3 - BOOST VALVE COVER
4 - BOOST VALVE PLUG
5 - BOOST VALVE
6 - BOOST VALVE SPRING

(14) Remove E-clip and washer that retains throttle lever shaft in manual lever (Fig. 295).

(15) Remove manual lever and throttle lever (Fig. 296). Rotate and lift manual lever off valve body and throttle lever shaft. Then slide throttle lever out of valve body.

(16) Position pencil magnet next to detent housing to catch detent ball and spring. Then carefully remove Retainer Tool 6583 and remove detent ball and spring (Fig. 297).

VALVE BODY (Continued)

(17) Remove screws attaching pressure adjusting screw bracket to valve body and transfer plate (Fig. 298). Hold bracket firmly against spring tension while removing last screw.

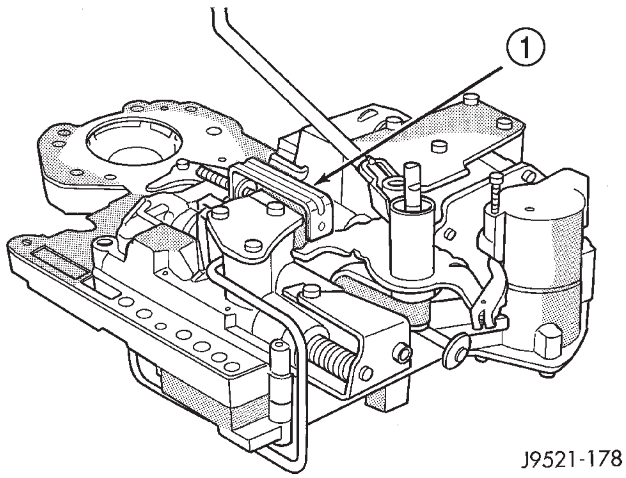


Fig. 293 Detent Ball Spring

1 - SPECIAL TOOL 6583 POSITIONED ON DETENT HOUSING

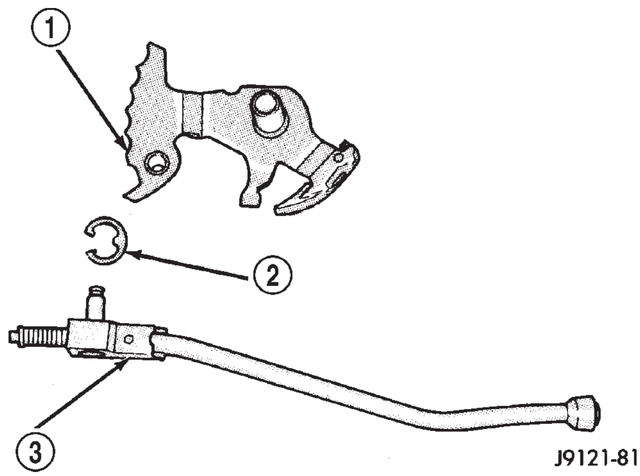


Fig. 294 Park Rod

1 - MANUAL LEVER
2 - E-CLIP
3 - PARK ROD

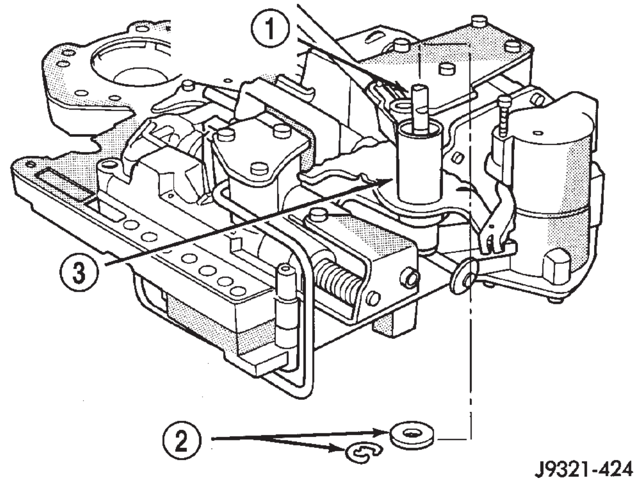


Fig. 295 Throttle Lever E-Clip And Washer

1 - THROTTLE LEVER SHAFT
2 - E-CLIP AND WASHER
3 - MANUAL SHAFT

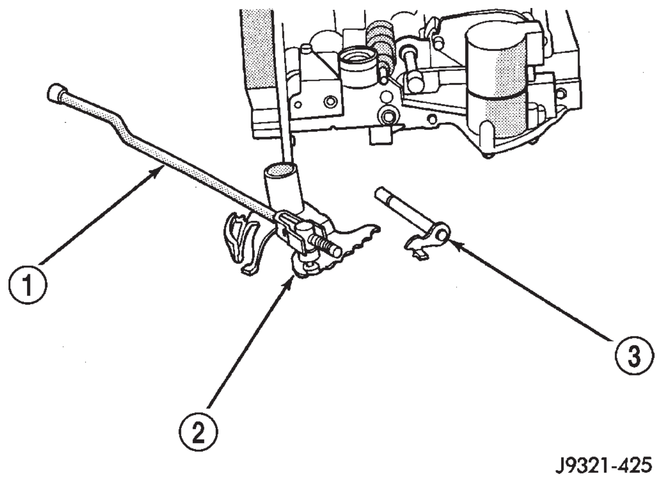


Fig. 296 Manual And Throttle Lever

1 - PARK ROD
2 - MANUAL LEVER ASSEMBLY
3 - THROTTLE LEVER

VALVE BODY (Continued)

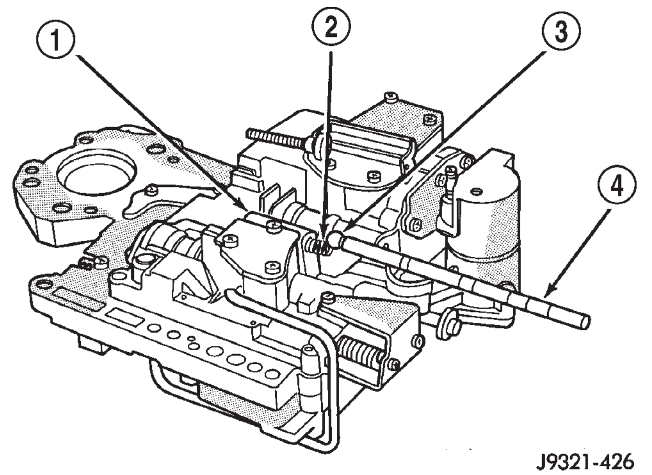


Fig. 297 Detent Ball And Spring

1 - DETENT HOUSING
2 - DETENT SPRING
3 - DETENT BALL
4 - PENCIL MAGNET

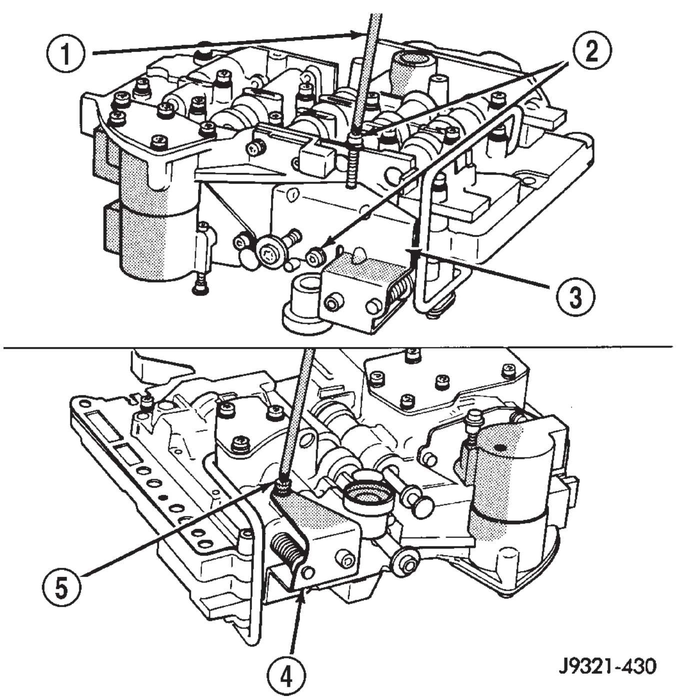


Fig. 298 Adjusting Screw Bracket Fastener

1 - T25 TORX™ BIT
2 - REMOVE THESE SCREWS FIRST
3 - BRACKET
4 - BRACKET
5 - REMOVE THIS SCREW LAST

(18) Remove adjusting screw bracket, line pressure adjusting screw, pressure regulator valve spring and switch valve spring (Fig. 299). Do not remove throttle pressure adjusting screw from bracket and do not disturb setting of either adjusting screw during removal.

(19) Turn upper housing over and remove switch valve, regulator valve and spring, and manual valve (Fig. 300).

(20) Remove kickdown detent, kickdown valve, and throttle valve and spring (Fig. 300).

(21) Loosen left-side 3-4 accumulator housing attaching screw about 2-3 threads. Then remove center and right-side housing attaching screws (Fig. 301).

(22) Carefully rotate 3-4 accumulator housing upward and remove 3-4 shift valve spring and converter clutch valve plug and spring (Fig. 302).

(23) Remove left-side screw and remove 3-4 accumulator housing from valve body (Fig. 303).

(24) Bend back tabs on boost valve tube brace (Fig. 304).

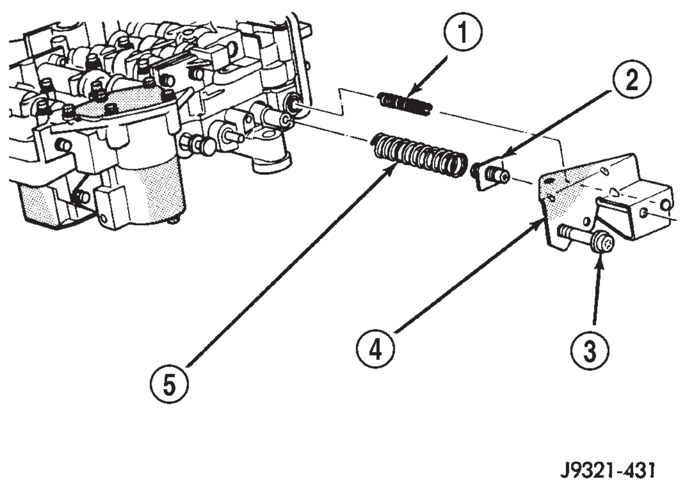


Fig. 299 Adjusting Screw Bracket

1 - SWITCH VALVE SPRING
2 - LINE PRESSURE SCREW
3 - THROTTLE PRESSURE ADJUSTING SCREW
4 - ADJUSTING SCREW BRACKET
5 - PRESSURE REGULATOR VALVE SPRING

VALVE BODY (Continued)

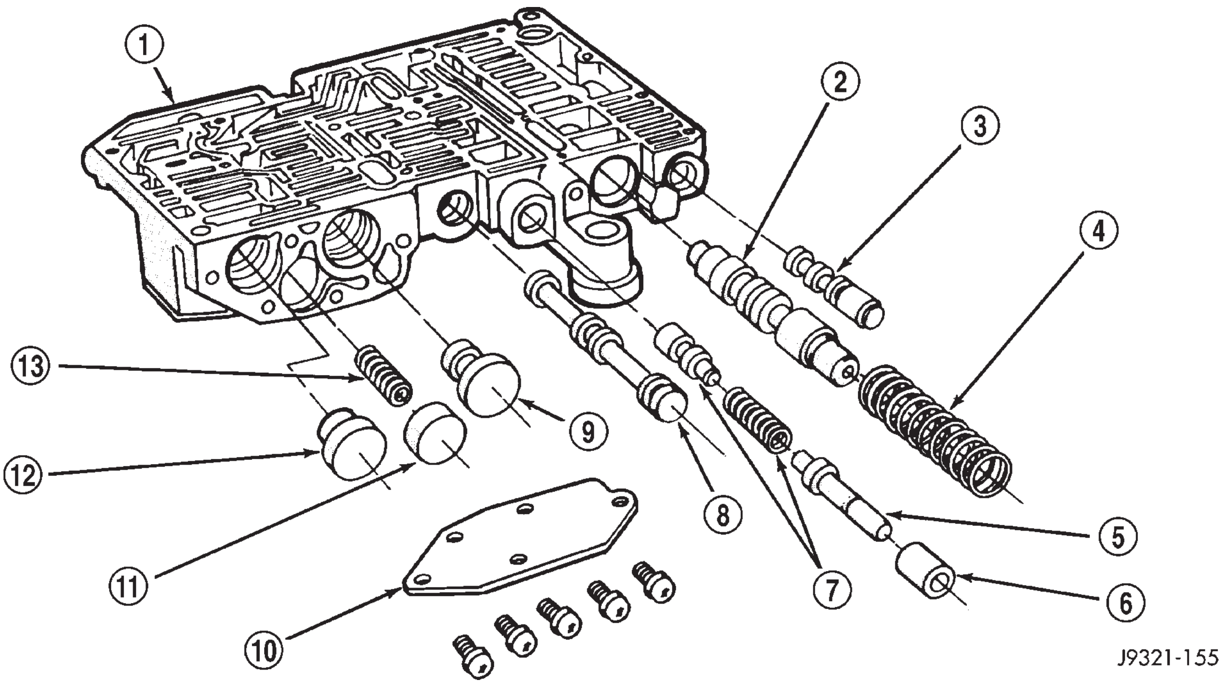


Fig. 300 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

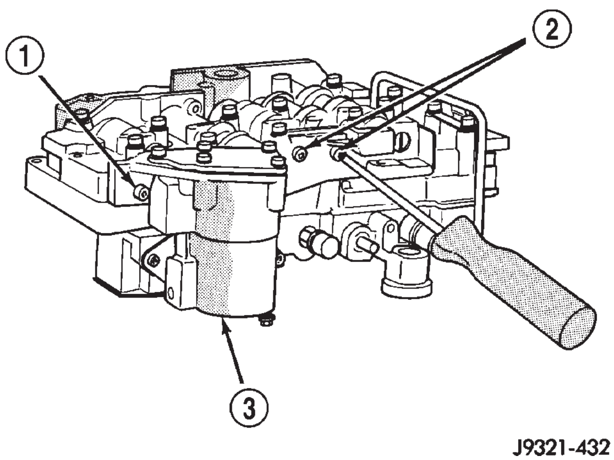


Fig. 301 Accumulator Housing Screw Locations

1 - LOOSEN THIS SCREW
2 - REMOVE THESE SCREWS
3 - 3-4 ACCUMULATOR HOUSING

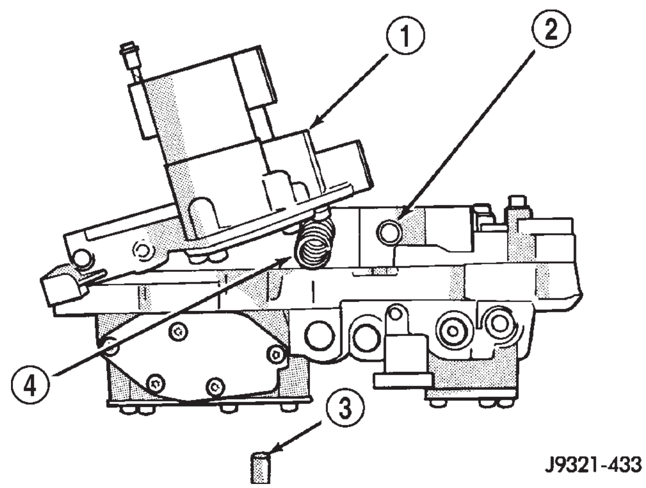


Fig. 302 3-4 Shift And Converter Clutch Valve Springs and Plug

1 - ACCUMULATOR HOUSING
2 - CONVERTER CLUTCH VALVE SPRING
3 - CLUTCH VALVE PLUG
4 - 3-4 SHIFT VALVE SPRING

VALVE BODY (Continued)

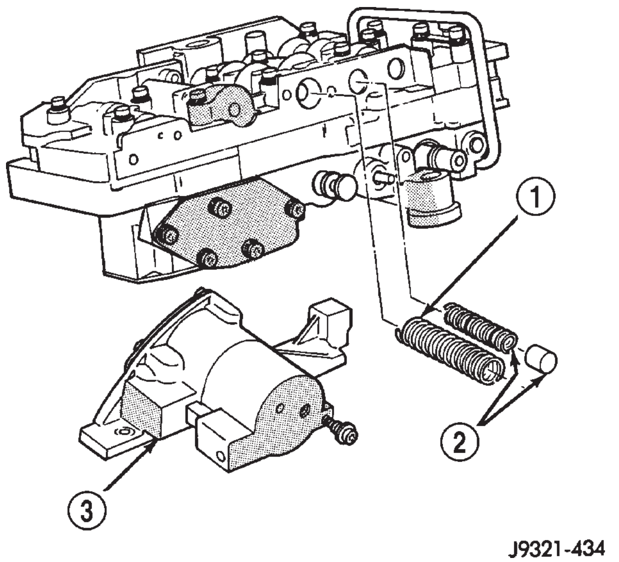


Fig. 303 Accumulator Housing, Valve Springs, and Plug

1 - 3-4 SHIFT VALVE SPRING
2 - CONVERTER CLUTCH VALVE SPRING AND PLUG
3 - 3-4 ACCUMULATOR HOUSING

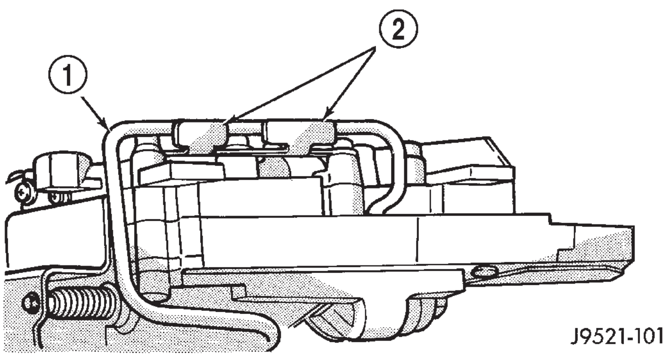


Fig. 304 Boost Valve Tube Brace

1 - BOOST VALVE TUBE
2 - TUBE BRACE (DOUBLE TAB)

(25) Remove boost valve connecting tube (Fig. 305). Disengage tube from upper housing port first. Then rock opposite end of tube back and forth to work it out of lower housing.

CAUTION: Do not use tools to loosen or pry the connecting tube out of the valve body housings. Loosen and remove the tube by hand only.

(26) Turn valve body over so lower housing is facing upward (Fig. 306). In this position, the two check balls in upper housing will remain in place and not fall out when lower housing and separator plate are removed.

(27) Remove screws attaching valve body lower housing to upper housing and transfer plate (Fig. 306). Note position of boost valve tube brace for assembly reference.

(28) Remove lower housing and overdrive separator plate from transfer plate (Fig. 306).

(29) Remove the ECE check ball from the transfer plate (Fig. 307). The ECE check ball is approximately 4.8 mm (3/16 in.) in diameter.

(30) Remove transfer plate from upper housing (Fig. 308).

(31) Turn transfer plate over so upper housing separator plate is facing upward.

(32) Remove upper housing separator plate from transfer plate (Fig. 309). Note position of filter in separator plate for assembly reference.

(33) Remove rear clutch and rear servo check balls from transfer plate. Note check ball location for assembly reference (Fig. 310).

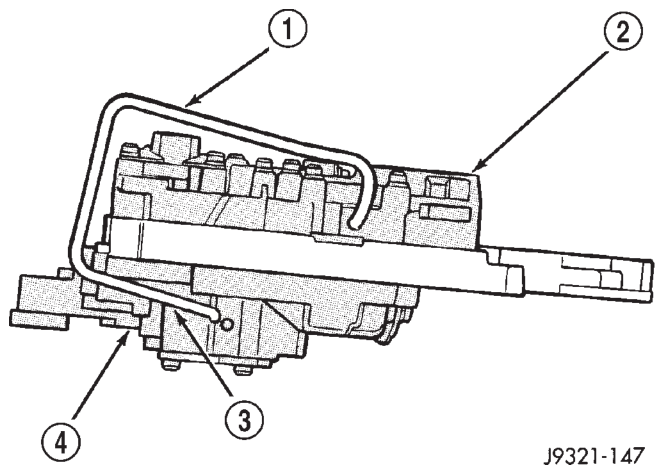


Fig. 305 Boost Valve Tube

1 - BOOST VALVE TUBE
2 - LOWER HOUSING
3 - DISENGAGE THIS END OF TUBE FIRST
4 - UPPER HOUSING

VALVE BODY (Continued)

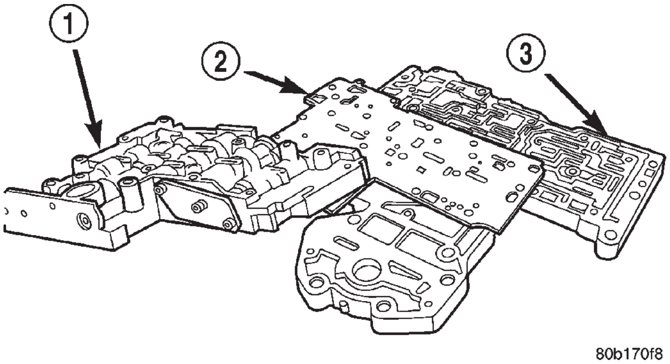


Fig. 306 Lower Housing

1 - LOWER HOUSING
2 - OVERDRIVE SEPARATOR PLATE
3 - TRANSFER PLATE AND UPPER HOUSING

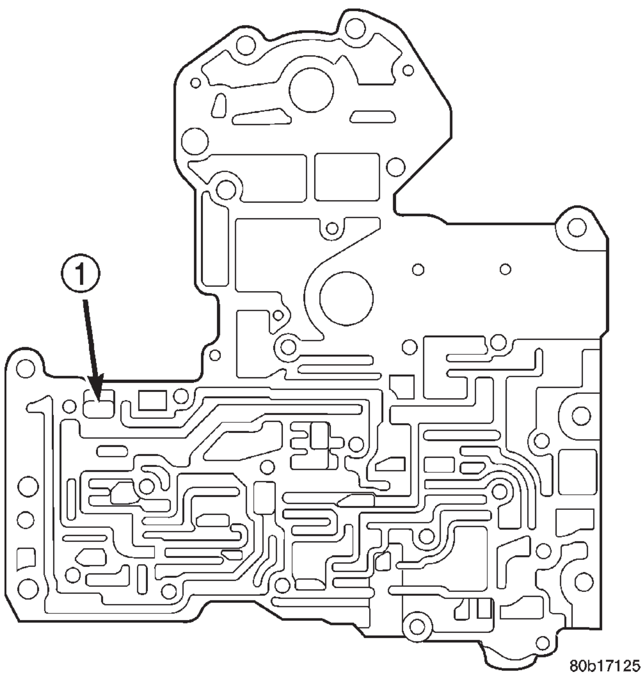


Fig. 307 ECE Check Ball

1 - ECE CHECK BALL (3/16″)

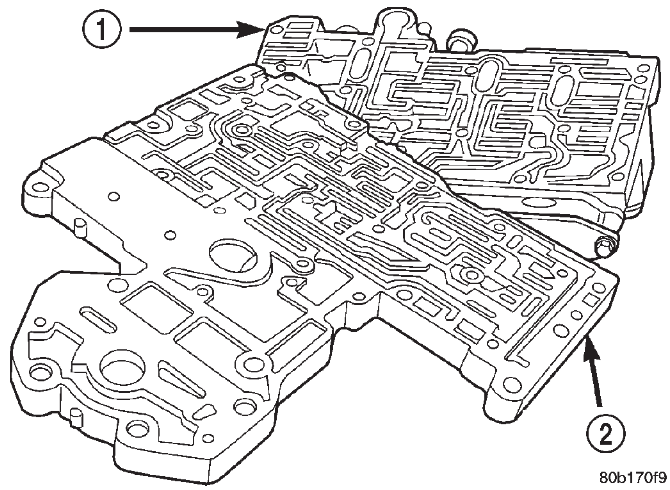


Fig. 308 Transfer Plate

1 - UPPER HOUSING
2 - TRANSFER PLATE

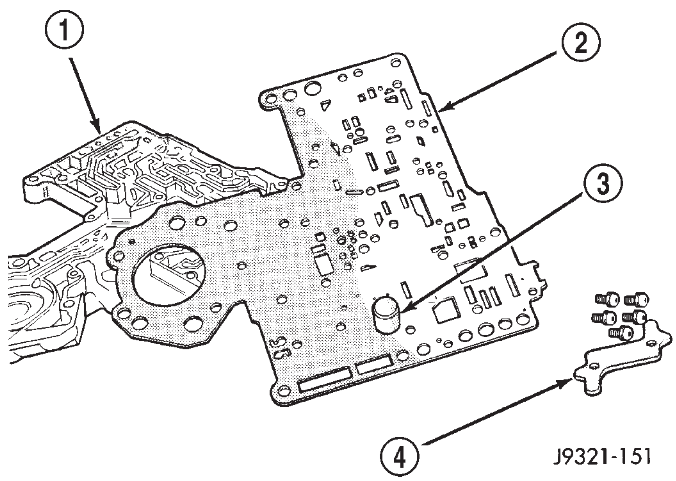


Fig. 309 Upper Housing Separator Plate

1 - TRANSFER PLATE
2 - UPPER HOUSING SEPARATOR PLATE
3 - FILTER SCREEN
4 - BRACE

VALVE BODY (Continued)

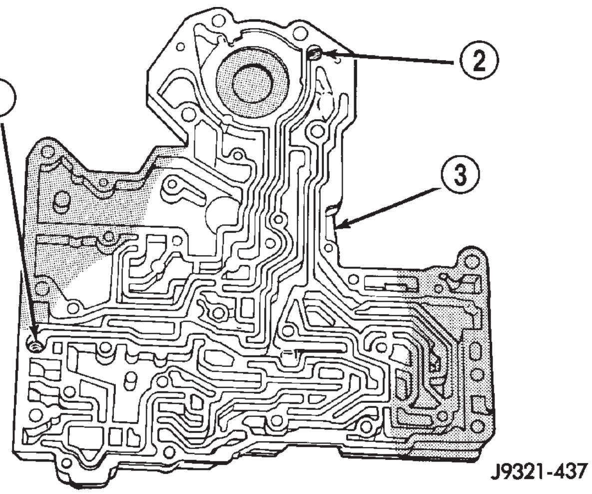


Fig. 310 Rear Clutch and Rear Servo Check Ball Locations

1 - REAR CLUTCH CHECK BALL
2 - REAR SERVO CHECK BALL
3 - TRANSFER PLATE

VALVE BODY UPPER HOUSING

(1) Note location of check balls in valve body upper housing (Fig. 311). Then remove the one large diameter and the six smaller diameter check balls.

(2) Remove governor plug and shuttle valve covers (Fig. 313).

(3) Remove E-clip that secures shuttle valve secondary spring on valve stem (Fig. 312).

(4) Remove throttle plug, primary spring, shuttle valve, secondary spring, and spring guides (Fig. 313).

(5) Remove boost valve retainer, spring and valve if not previously removed.

(6) Remove throttle plug and 1-2 and 2-3 governor plugs (Fig. 300).

(7) Turn upper housing around and remove limit valve and shift valve covers (Fig. 314).

(8) Remove limit valve housing. Then remove retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing (Fig. 314).

(9) Remove 1-2 shift control valve and spring (Fig. 314).

(10) Remove 1-2 shift valve and spring (Fig. 314).

(11) Remove 2-3 shift valve and spring from valve body (Fig. 314).

(12) Remove pressure plug cover (Fig. 314).

(13) Remove line pressure plug, sleeve, throttle pressure plug and spring (Fig. 314).

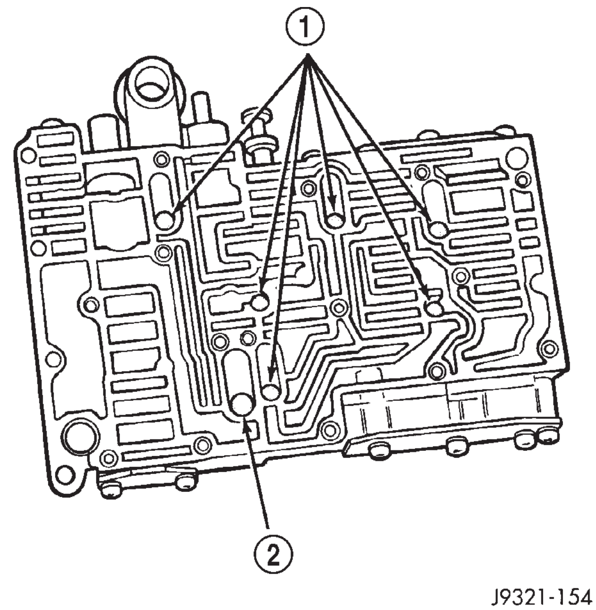


Fig. 311 Check Ball Locations In Upper Housing

1 - SMALL DIAMETER CHECK BALLS (6)
2 - LARGE DIAMETER CHECK BALL (1)

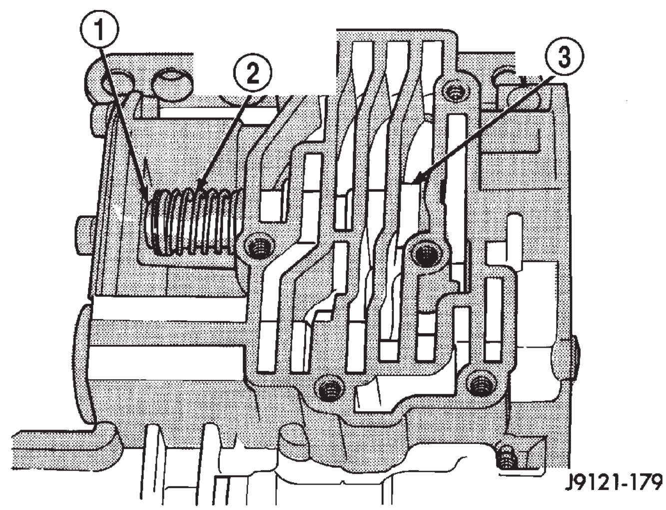


Fig. 312 Shuttle Valve E-Clip And Secondary Spring

1 - E-CLIP
2 - SECONDARY SPRING AND GUIDES
3 - SHUTTLE VALVE

VALVE BODY (Continued)

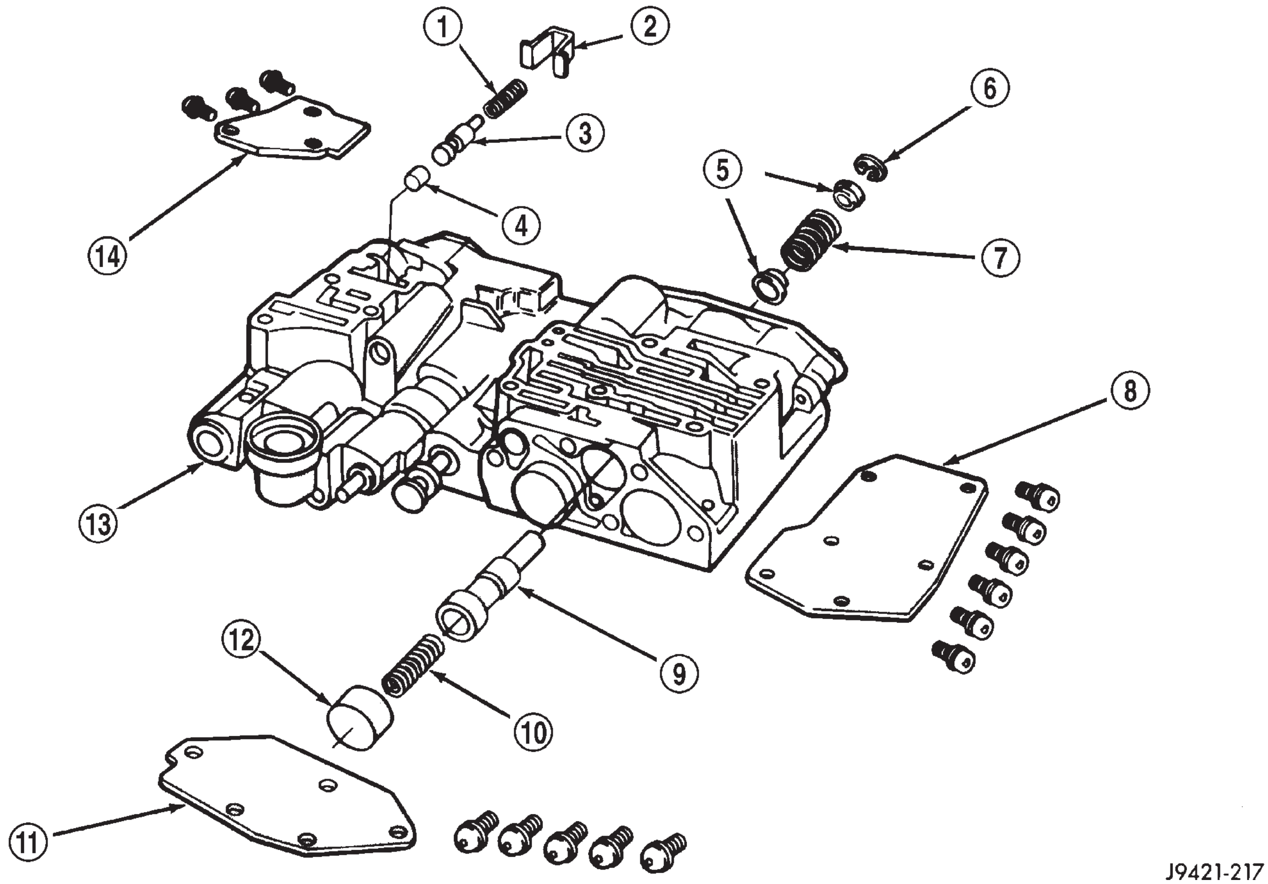


Fig. 313 Shuttle and Boost Valve Location

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

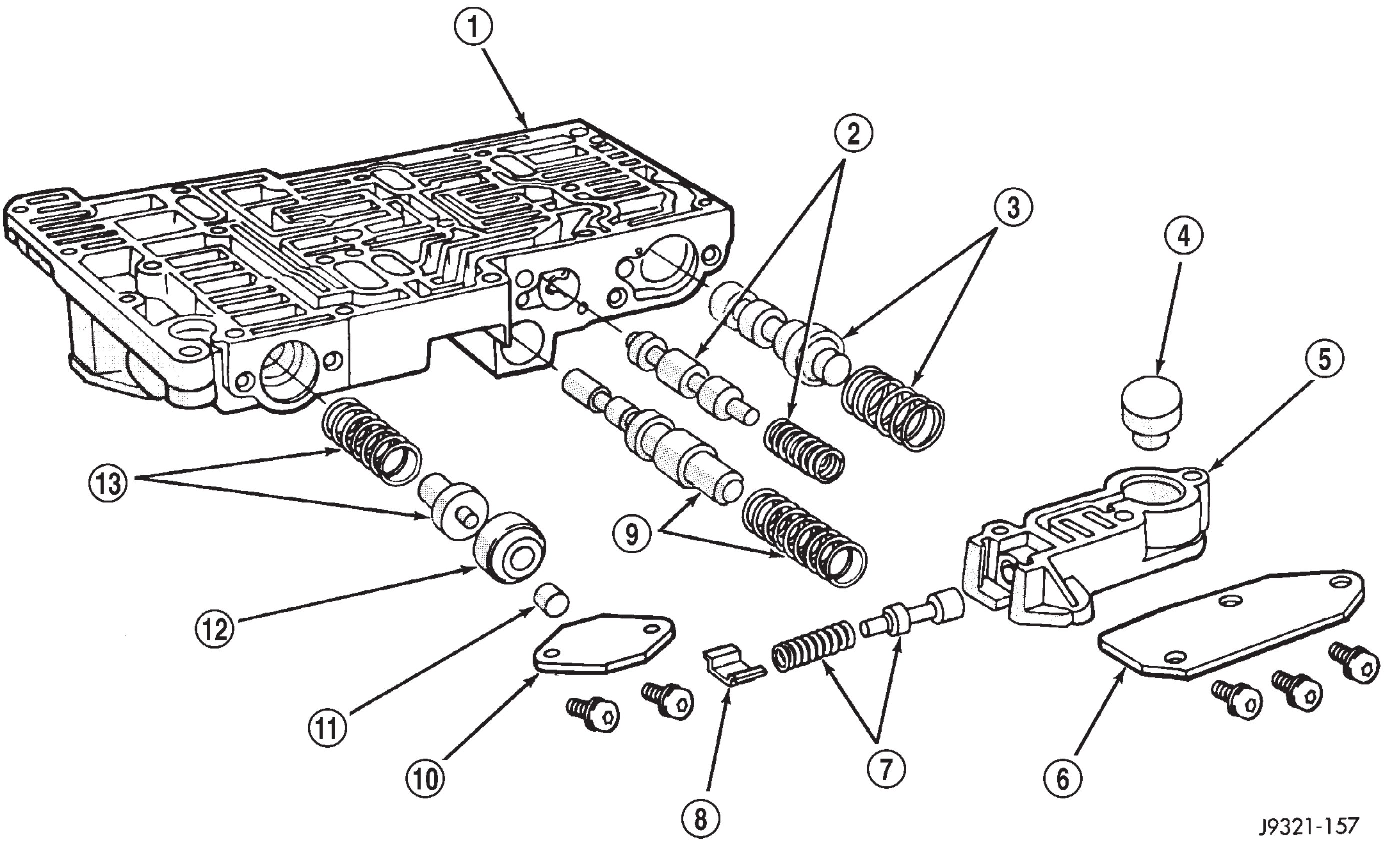


Fig. 314 Upper Housing Shift Valve and Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - LINE PRESSURE PLUG
12 - PLUG SLEEVE
13 - THROTTLE PRESSURE SPRING AND PLUG

VALVE BODY (Continued)

VALVE BODY LOWER HOUSING

(1) Remove timing valve cover.

(2) Remove 3-4 timing valve and spring.

(3) Remove 3-4 quick fill valve, spring and plug.

(4) Remove 3-4 shift valve and spring.

(5) Remove converter clutch valve, spring and plug (Fig. 315).

(6) Remove converter clutch timing valve, retainer and valve spring.

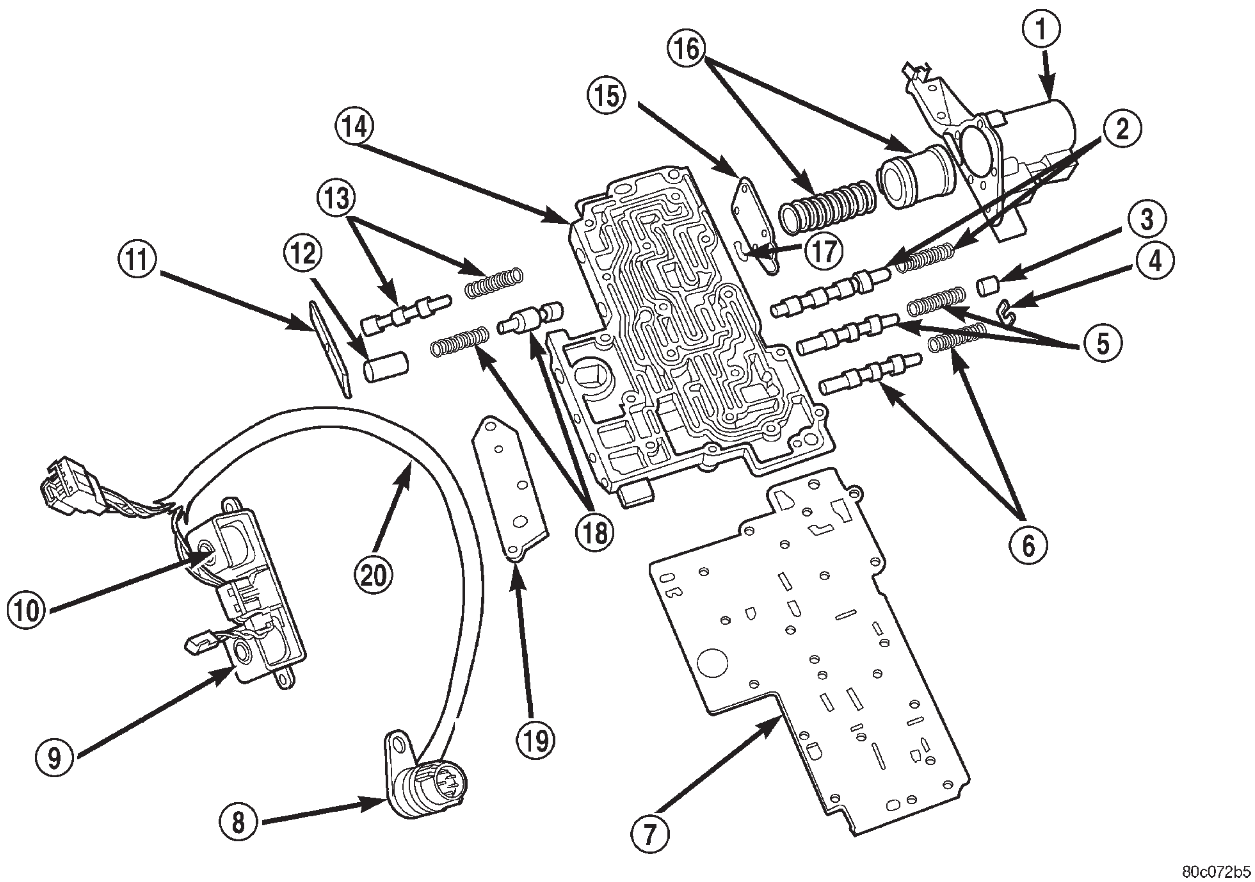


Fig. 315 Lower Housing Shift Valves and Springs

1 - 3-4 ACCUMULATOR HOUSING
2 - 3-4 SHIFT VALVE AND SPRING
3 - PLUG
4 - SPRING RETAINER
5 - CONVERTER CLUTCH VALVE AND SPRING
6 - CONVERTER CLUTCH TIMING VALVE AND SPRING
7 - OVERDRIVE SEPARATOR PLATE
8 - CASE CONNECTOR
9 - CONVERTER CLUTCH SOLENOID
10 - OVERDRIVE SOLENOID
11 - TIMING VALVE COVER
12 - PLUG
13 - 3-4 TIMING VALVE AND SPRING
14 - LOWER HOUSING
15 - ACCUMULATOR END PLATE
16 - 3-4 ACCUMULATOR PISTON AND SPRING
17 - E-CLIP
18 - 3-4 QUICK FILL SPRING AND VALVE
19 - SOLENOID GASKET
20 - HARNESS

VALVE BODY (Continued)

3-4 ACCUMULATOR HOUSING

(1) Remove end plate from housing.

(2) Remove piston spring.

(3) Remove piston. Remove and discard piston seals (Fig. 316).

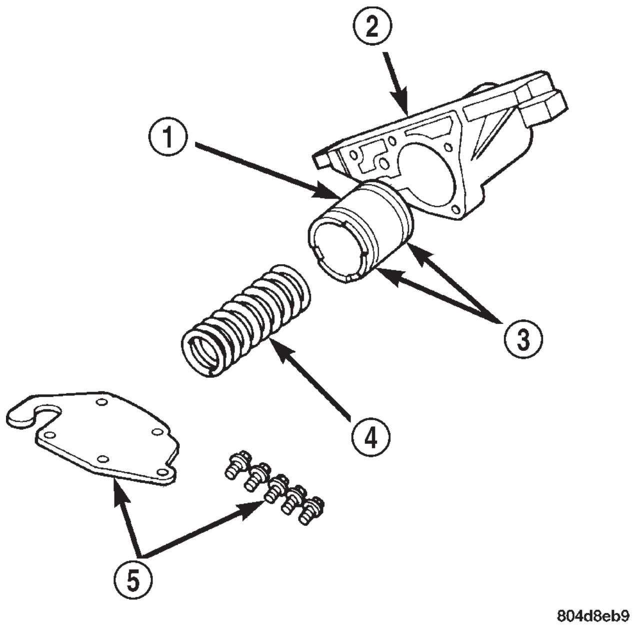


Fig. 316 3-4 Accumulator and Housing

1 - ACCUMULATOR PISTON
2 - 3-4 ACCUMULATOR HOUSING
3 - TEFLON SEALS
4 - PISTON SPRING
5 - COVER PLATE AND SCREWS

CLEANING

Clean the valve housings, valves, plugs, springs, and separator plates with a standard parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution.

Do not immerse any of the electrical components in cleaning solution. Clean the governor solenoid and sensor and the dual solenoid and harness assembly by wiping them off with dry shop towels only.

Dry all except the electrical parts with compressed air. Make sure all passages are clean and free from obstructions. **Do not use rags or shop towels to dry or wipe off valve body components. Lint from these materials can stick to valve body parts, interfere with valve operation, and clog filters and fluid passages.**

Wipe the governor pressure sensor and solenoid valve with dry, lint free shop towels only. The O-rings on the sensor and solenoid valve are the only serviceable components. Be sure the vent ports in the solenoid valve are open and not blocked by dirt or debris. Replace the valve and/or sensor only when DRB scan tool diagnosis indicates this is necessary. Or, if either part has sustained physical damage (dented, deformed, broken, etc.).

CAUTION: Do not turn the small screw at the end of the solenoid valve for any reason. Turning the screw in either direction will ruin solenoid calibration and result in solenoid failure. In addition, the filter on the solenoid valve is NOT serviceable. Do not try to remove the filter as this will damage the valve housing.

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.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with a sheet of crocus cloth. Position the crocus cloth on a surface plate, sheet of plate glass or equally flat surface. If distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: Many of the valves and plugs, such as the throttle valve, shuttle valve plug, 1-2 shift valve and 1-2 governor plug, are made of coated aluminum. Aluminum components are identified by the dark color of the special coating applied to the surface (or by testing with a magnet). Do not sand aluminum valves or plugs under any circumstances. This practice could damage the special coating causing the valves/plugs to stick and bind.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Minor surface scratches on steel valves and plugs can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.**Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

VALVE BODY (Continued)

Check the two separator plates for distortion or damage of any kind. Inspect the upper housing, lower housing, 3-4 accumulator housing, and transfer plate carefully. Be sure all fluid passages are clean and clear. Check condition of the upper housing and transfer plate check balls as well. The check balls and ball seats must not be worn or damaged.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores.

Valve body bores do not change dimensionally with use. If the valve body functioned correctly when new, it will continue to operate properly after cleaning and inspection. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

The only serviceable valve body components are listed below. The remaining valve body components are serviced only as part of a complete valve body assembly. Serviceable parts are:

- dual solenoid and harness assembly
- solenoid gasket
- solenoid case connector O-rings and shoulder bolt
- switch valve and spring
- pressure adjusting screw and bracket assembly
- throttle lever
- manual lever and shaft seal
- throttle lever shaft seal, washer, and E-clip
- fluid filter and screws
- detent ball and spring
- valve body screws
- governor pressure solenoid
- governor pressure sensor and retaining clip
- park lock rod and E-clip

ASSEMBLY

CAUTION: Do not force valves or plugs into place during reassembly. If the valve body bores, valves and plugs are free of distortion or burrs, the valve body components should all slide into place easily. In addition, do not overtighten the transfer plate and valve body screws during reassembly. Overtightening can distort the housings resulting in valve sticking, cross leakage and unsatisfactory operation. Tighten valve body screws to recommended torque only.

LOWER HOUSING

(1) Lubricate valves, springs, and the housing valve and plug bores with clean transmission fluid (Fig. 314).

(2) Install 3-4 timing valve spring and valve in lower housing.

(3) Install 3-4 quick fill valve in lower housing.

(4) Install 3-4 quick fill valve spring and plug in housing.

(5) Install timing valve end plate. Tighten end plate screws to 4 N·m (35 in. lbs.) torque.

3-4 ACCUMULATOR

(1) Lubricate accumulator piston, seals and housing piston bore with clean transmission fluid (Fig. 315).

(2) Install new seal rings on accumulator piston.

(3) Install piston and spring in housing.

(4) Install end plate on housing.

TRANSFER PLATE

(1) Install rear clutch and rear servo check balls in transfer plate (Fig. 317).

(2) Install filter screen in upper housing separator plate (Fig. 318).

(3) Align and position upper housing separator plate on transfer plate (Fig. 319).

(4) Install brace plate (Fig. 319). Tighten brace attaching screws to 4 N·m (35 in. lbs.) torque.

(5) Install remaining separator plate attaching screws. Tighten screws to 4 N·m (35 in. lbs.) torque.

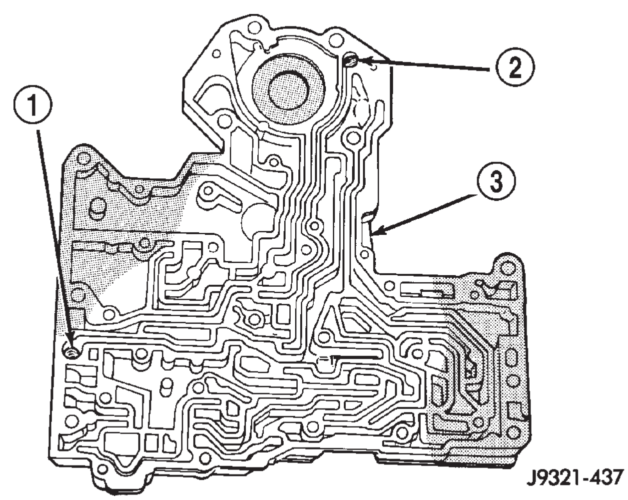


Fig. 317 Rear Clutch And Rear Servo Check Ball Locations

1 - REAR CLUTCH CHECK BALL
2 - REAR SERVO CHECK BALL
3 - TRANSFER PLATE

VALVE BODY (Continued)

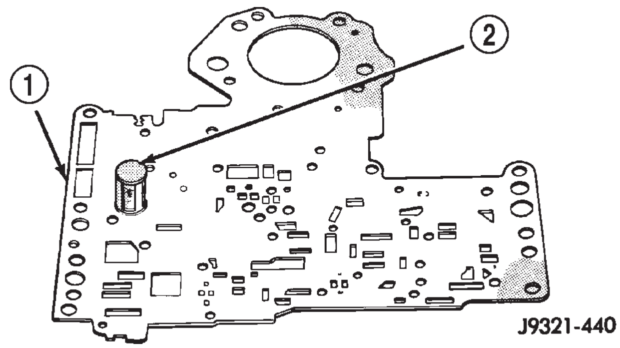


Fig. 318 Separator Plate Filter Screen Installation

1 - UPPER HOUSING SEPARATOR PLATE
2 - FILTER SCREEN

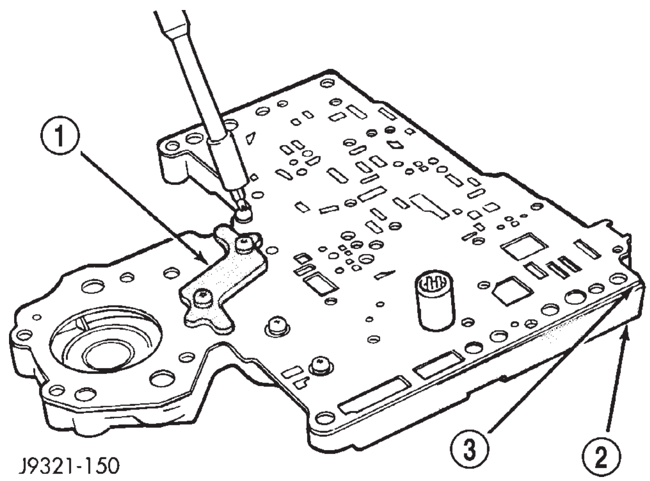


Fig. 319 Brace Plate

1 - BRACE
2 - TRANSFER PLATE
3 - SEPARATOR PLATE

UPPER AND LOWER HOUSING

(1) Position upper housing so internal passages and check ball seats are facing upward. Then install check balls in housing (Fig. 320). Eight check balls are used. The single large check ball is approximately 8.7 mm (11/32 in.) diameter. The single small check ball is approximately 4.8 mm (3/16 in.) in diameter. The remaining 6 check balls are approximately 6.3 mm (1/4 in.) in diameter.

(2) Position assembled transfer plate and upper housing separator plate on upper housing (Fig. 321). Be sure filter screen is seated in proper housing recess.

(3) Install the ECE check ball into the transfer plate (Fig. 306). The ECE check ball is approximately 4.8 mm (3/16 in.) in diameter.

(4) Position lower housing separator plate on transfer plate (Fig. 322).

(5) Install lower housing on assembled transfer plate and upper housing (Fig. 323).

(6) Install and start all valve body screws by hand except for the screws to hold the boost valve tube brace. Save those screws for later installation. Then tighten screws evenly to 4 N·m (35 in. lbs.) torque. Start at center and work out to sides when tightening screws (Fig. 323).

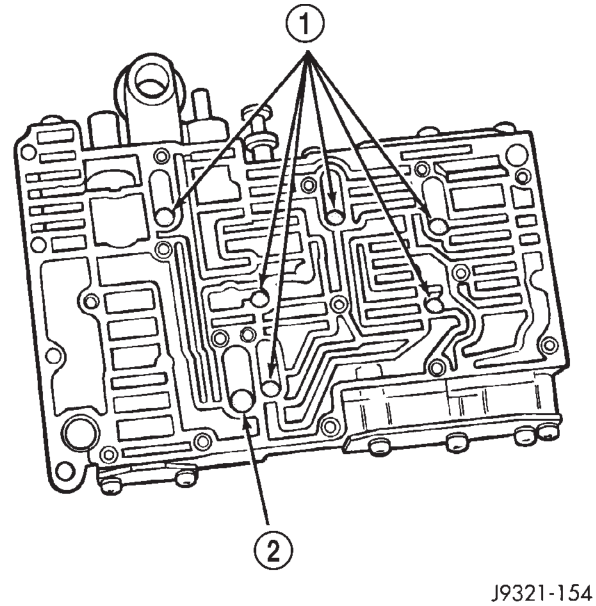


Fig. 320 Check Ball Locations In Upper Housing

1 - SMALL DIAMETER CHECK BALLS (6)
2 - LARGE DIAMETER CHECK BALL (1)

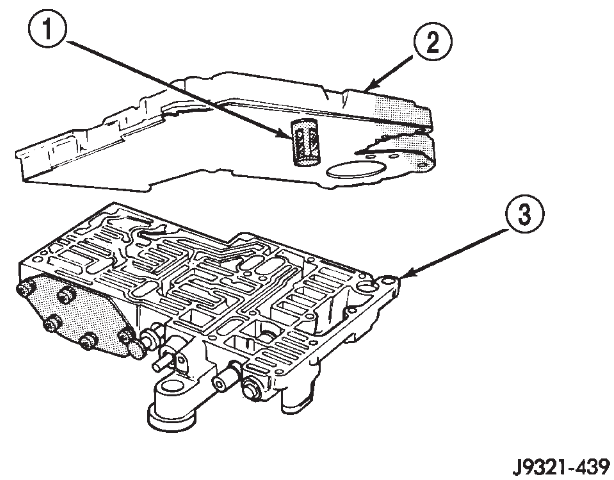


Fig. 321 Installing Transfer Plate On Upper Housing

1 - FILTER SCREEN
2 - TRANSFER PLATE/SEPARATOR PLATE ASSEMBLY
3 - UPPER HOUSING

VALVE BODY (Continued)

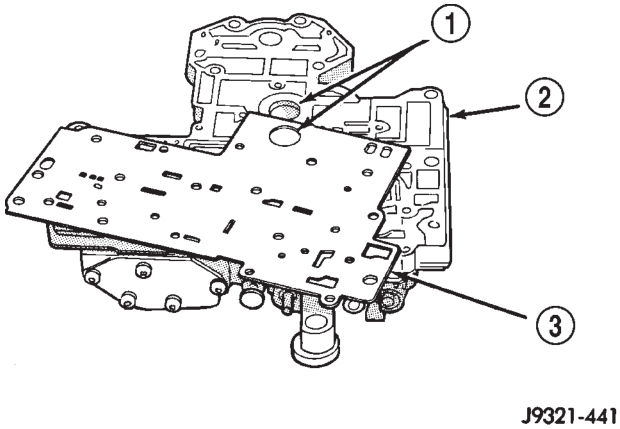


Fig. 322 Lower Housing Separator Plate

1 - BE SURE TO ALIGN BORES
2 - TRANSFER PLATE
3 - LOWER HOUSING (OVERDRIVE) SEPARATOR PLATE

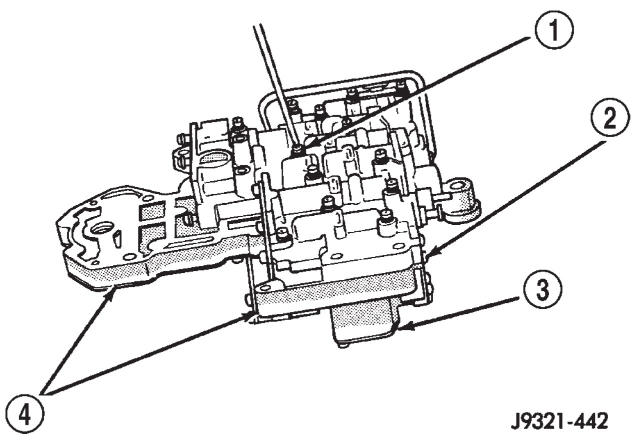


Fig. 323 Installing Lower Housing On Transfer Plate And Upper Housing

1 - VALVE BODY SCREWS (13)
2 - LOWER HOUSING
3 - UPPER HOUSING
4 - TRANSFER PLATE

UPPER HOUSING VALVE AND PLUG

Refer to (Fig. 324), (Fig. 325) and (Fig. 326) to perform the following steps.

(1) Lubricate valves, plugs, springs with clean transmission fluid.

(2) Assemble regulator valve line pressure plug, sleeve, throttle plug and spring. Insert assembly in upper housing and install cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(3) Install 1-2 and 2-3 shift valves and springs.

(4) Install 1-2 shift control valve and spring.

(5) Install retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing.

(6) Install limit valve housing and cover plate. Tighten screws to 4 N·m (35 in. lbs.).

(7) Install shuttle valve as follows:

(a) Insert plastic guides in shuttle valve secondary spring and install spring on end of valve.

(b) Install shuttle valve into housing.

(c) Hold shuttle valve in place.

(d) Compress secondary spring and install E-clip in groove at end of shuttle valve.

(e) Verify that spring and E-clip are properly seated before proceeding.

(8) Install shuttle valve cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(9) Install 1-2 and 2-3 valve governor plugs in valve body.

(10) Install shuttle valve primary spring and throttle plug.

(11) Align and install governor plug cover. Tighten cover screws to 4 N·m (35 in. lbs.) torque.

VALVE BODY (Continued)

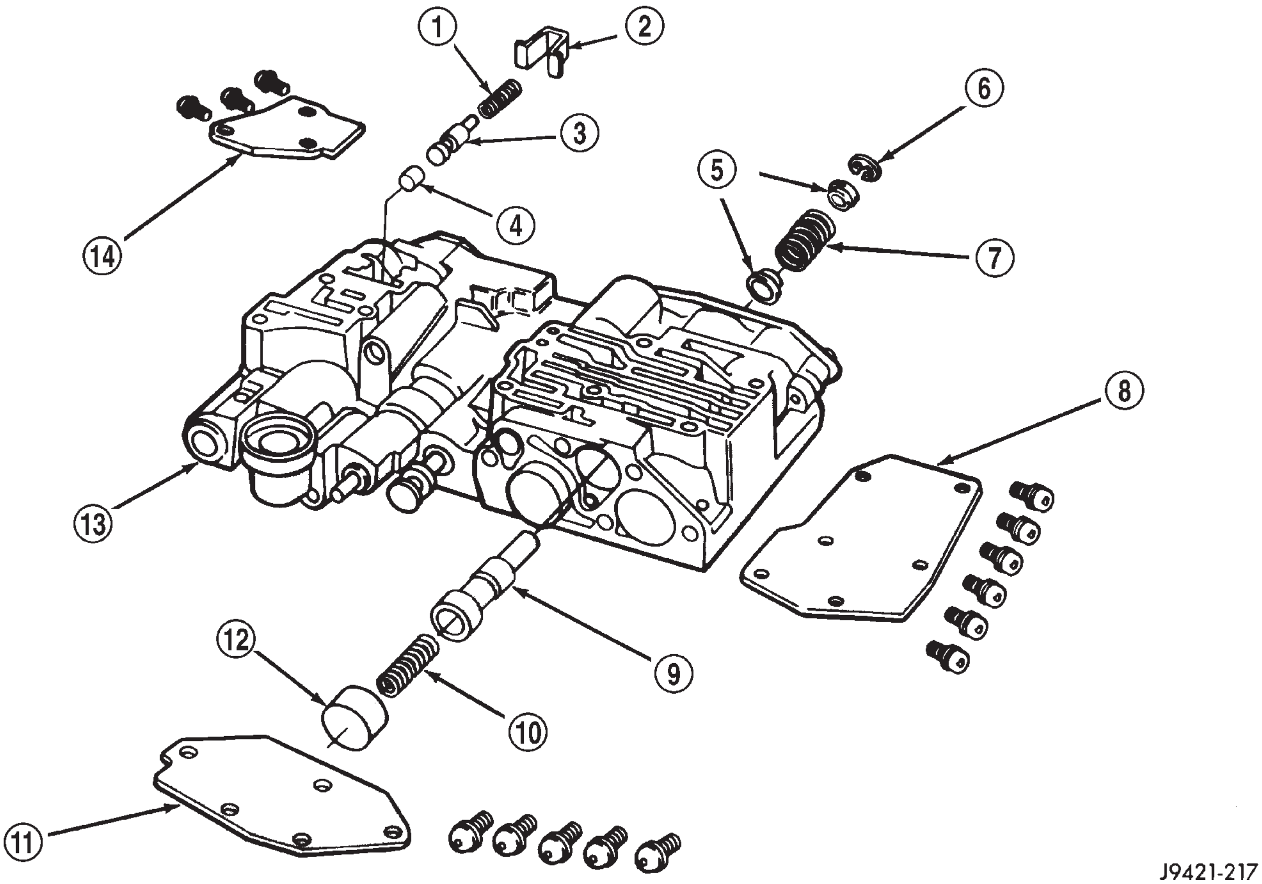


Fig. 324 Shuttle and Boost Valve Locations

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

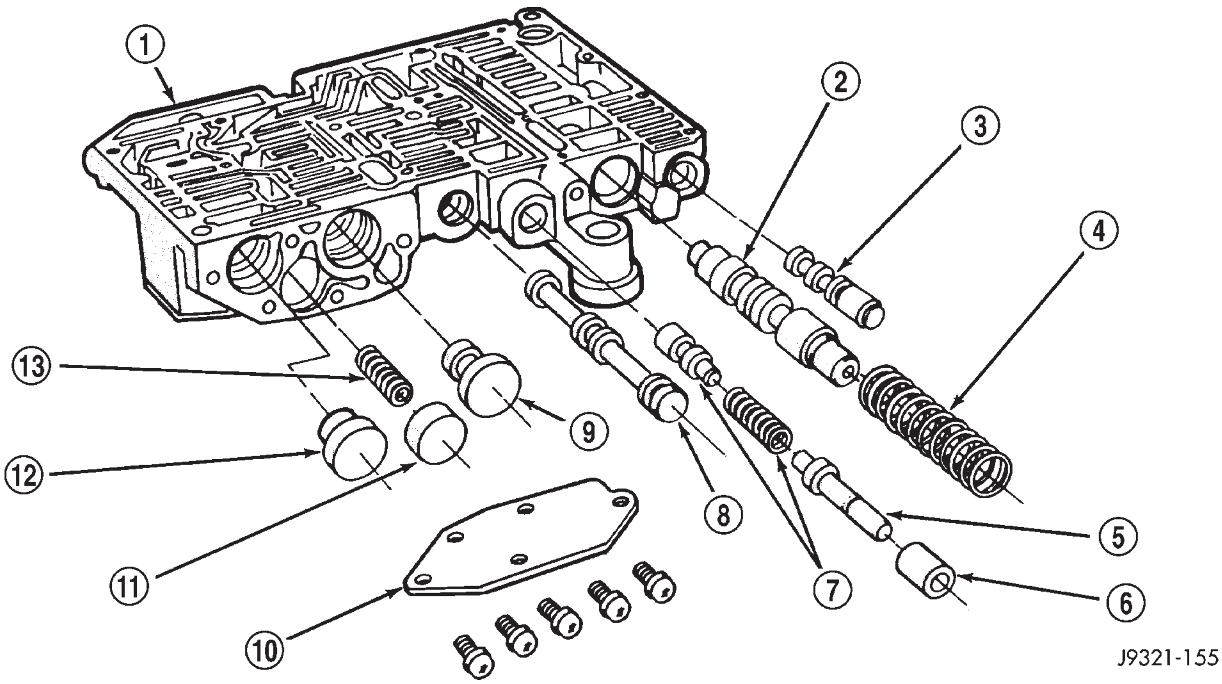


Fig. 325 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

VALVE BODY (Continued)

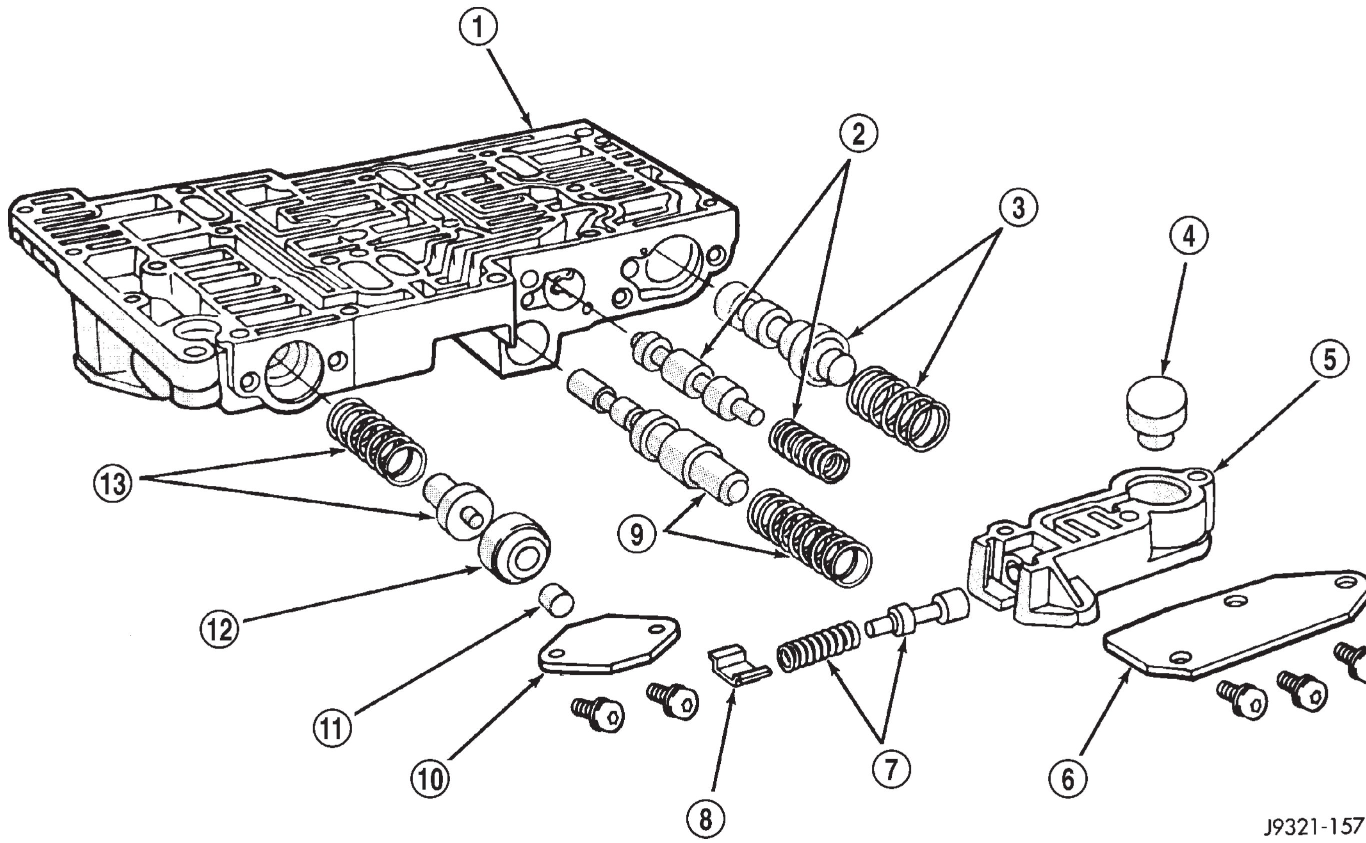


Fig. 326 Upper Housing Shift Valve and Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - LINE PRESSURE PLUG
12 - PLUG SLEEVE
13 - THROTTLE PRESSURE SPRING AND PLUG

VALVE BODY (Continued)

BOOST VALVE TUBE AND BRACE

(1) Position valve body assembly so lower housing is facing upward (Fig. 327).

(2) Lubricate tube ends and housing ports with transmission fluid or petroleum jelly.

(3) Start tube in lower housing port first. Then swing tube downward and work opposite end of tube into upper housing port (Fig. 327).

(4) Insert and seat each end of tube in housings.

(5) Slide tube brace under tube and into alignment with valve body screw holes (Fig. 328).

(6) Install and finger tighten three screws that secure tube brace to valve body housings (Fig. 328).

(7) Bend tube brace tabs up and against tube to hold it in position (Fig. 329).

(8) Tighten all valve body housing screws to 4 N·m (35 in. lbs.) torque after tube and brace are installed. Tighten screws in diagonal pattern starting at center and working outward.

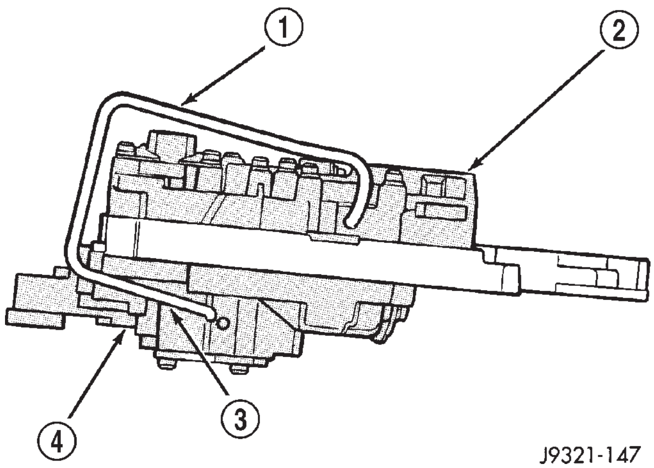


Fig. 327 Boost Valve Tube

1 - BOOST VALVE TUBE
2 - LOWER HOUSING
3 - DISENGAGE THIS END OF TUBE FIRST
4 - UPPER HOUSING

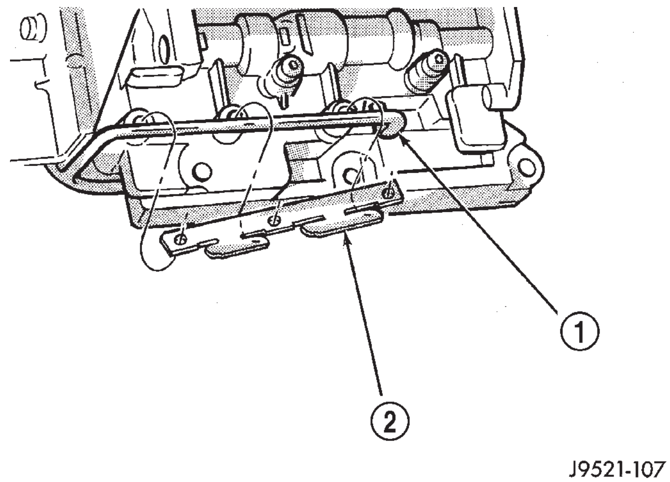


Fig. 328 Boost Valve Tube And Brace

1 - BOOST VALVE TUBE
2 - TUBE BRACE

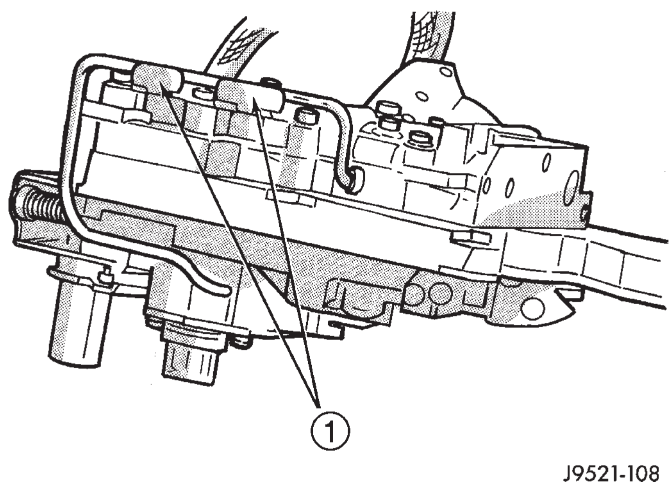


Fig. 329 Securing Boost Valve Tube With Brace Tabs

1 - BEND TABS UP AGAINST TUBE AS SHOWN

3-4 ACCUMULATOR

(1) Position converter clutch valve and 3-4 shift valve springs in housing (Fig. 330).

(2) Loosely attach accumulator housing with right-side screw (Fig. 330). Install only one screw at this time as accumulator must be free to pivot upward for ease of installation.

(3) Install 3-4 shift valve and spring.

(4) Install converter clutch timing valve and spring.

(5) Position plug on end of converter clutch valve spring. Then compress and hold springs and plug in place with fingers of one hand.

(6) Swing accumulator housing upward over valve springs and plug.

(7) Hold accumulator housing firmly in place and install remaining two attaching screws. Be sure springs and clutch valve plug are properly seated (Fig. 331). Tighten screws to 4 N·m (35 in. lbs.).

VALVE BODY (Continued)

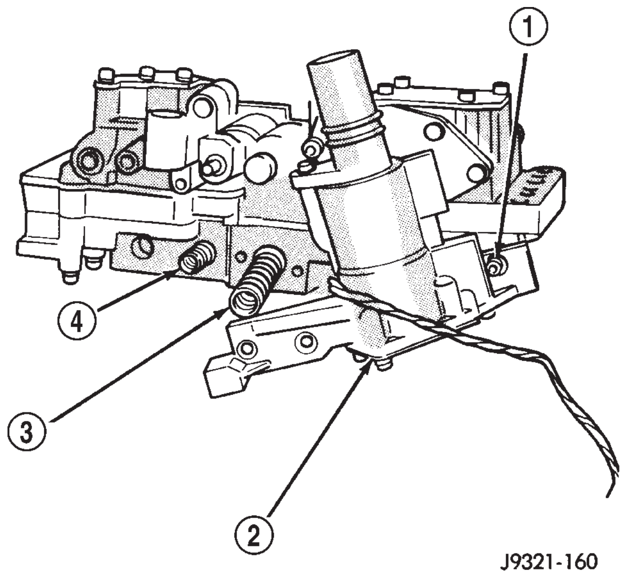


Fig. 330 Converter Clutch And 3-4 Shift Valve Springs

1 - RIGHT-SIDE SCREW
2 - 3-4 ACCUMULATOR
3 - 3-4 SHIFT VALVE SPRING
4 - CONVERTER CLUTCH VALVE SPRING

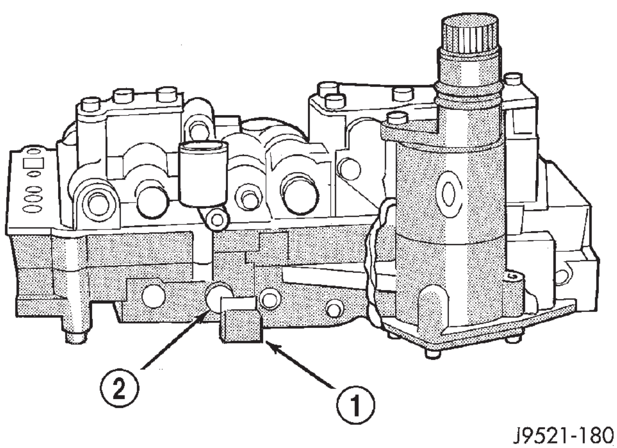


Fig. 331 Seating 3-4 Accumulator On Lower Housing

1 - ACCUMULATOR BOX
2 - CONVERTER CLUTCH VALVE PLUG

VALVE BODY FINAL

(1) Install boost valve, valve spring, retainer and cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(2) Insert manual lever detent spring in upper housing.

(3) Position detent ball on end of spring. Then hold detent ball and spring in detent housing with Retainer Tool 6583 (Fig. 332).

(4) Install throttle lever in upper housing. Then install manual lever over throttle lever and start manual lever into housing.

(5) Align manual lever with detent ball and manual valve. Hold throttle lever upward. Then press down on manual lever until fully seated. Remove detent ball retainer tool after lever is seated.

(6) Then install manual lever seal, washer and E-clip.

(7) Verify that throttle lever is aligned with end of kickdown valve stem and that manual lever arm is engaged in manual valve (Fig. 333).

(8) Position line pressure adjusting screw in adjusting screw bracket.

(9) Install spring on end of line pressure regulator valve.

(10) Install switch valve spring on tang at end of adjusting screw bracket.

(11) Install manual valve.

(12) Install throttle valve and spring.

(13) Install kickdown valve and detent.

(14) Install pressure regulator valve.

(15) Install switch valve.

(16) Position adjusting screw bracket on valve body. Align valve springs and press bracket into place. Install short, upper bracket screws first and long bottom screw last. Verify that valve springs and bracket are properly aligned. Then tighten all three bracket screws to 4 N·m (35 in. lbs.) torque.

(17) Perform Line Pressure and Throttle Pressure adjustments. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC/VALVE BODY - ADJUSTMENTS)

(18) Lubricate solenoid case connector O-rings and shaft of manual lever with light coat of petroleum jelly.

(19) Attach solenoid case connector to 3-4 accumulator with shoulder-type screw. Connector has small locating tang that fits in dimple at top of accumulator housing (Fig. 334). Seat tang in dimple before tightening connector screw.

(20) Install solenoid assembly and gasket. Tighten solenoid attaching screws to 8 N·m (72 in. lbs.) torque.

(21) Verify that solenoid wire harness is properly routed (Fig. 335). Solenoid harness must be clear of manual lever and park rod and not be pinched between accumulator housing and cover.

VALVE BODY (Continued)

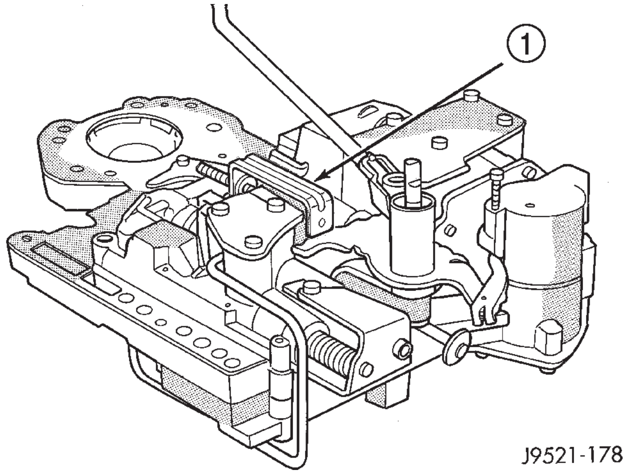


Fig. 332 Detent Ball Spring

1 - SPECIAL TOOL 6583 POSITIONED ON DETENT HOUSING

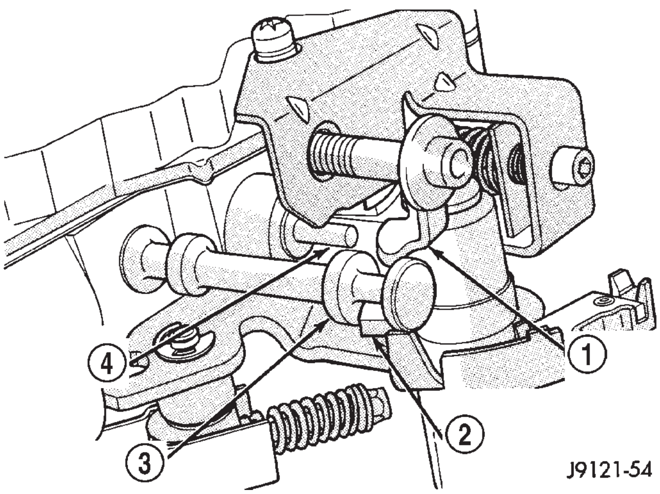


Fig. 333 Manual And Throttle Lever Alignment

1 - THROTTLE LEVER
2 - MANUAL LEVER VALVE ARM
3 - MANUAL VALVE
4 - KICKDOWN VALVE

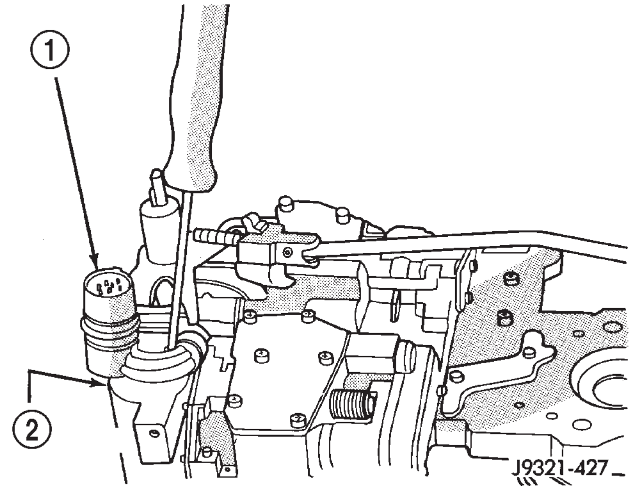


Fig. 334 Solenoid Harness Case Connector Shoulder Bolt

1 - SOLENOID HARNESS CASE CONNECTOR
2 - 3-4 ACCUMULATOR HOUSING

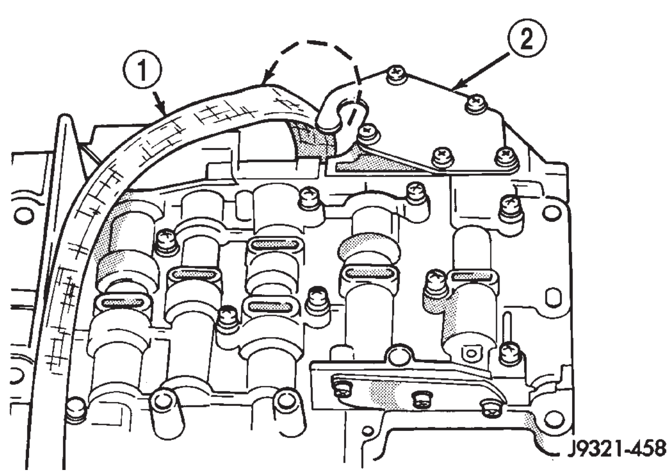


Fig. 335 Solenoid Harness Routing

1 - OVERDRIVE/CONVERTER SOLENOID WIRE HARNESS
2 - 3-4 ACCUMULATOR COVER PLATE

GOVERNOR BODY, SENSOR AND SOLENOID

(1) Turn valve body assembly over so accumulator side of transfer plate is facing down.

(2) Install new O-rings on governor pressure solenoid and sensor.

(3) Lubricate solenoid and sensor O-rings with clean transmission fluid.

(4) Install governor pressure sensor in governor body.

(5) Install governor pressure solenoid in governor body. Push solenoid in until it snaps into place in body.

(6) Position governor body gasket on transfer plate.

(7) Install retainer plate on governor body and around solenoid. Be sure solenoid connector is positioned in retainer cutout.

(8) Align screw holes in governor body and transfer plate. Then install and tighten governor body screws to 4 N·m (35 in. lbs.) torque.

(9) Connect harness wires to governor pressure solenoid and governor pressure sensor.

(10) Install fluid filter and pan.

(11) Lower vehicle.

(12) Fill transmission with recommended fluid and road test vehicle to verify repair.

VALVE BODY (Continued)

INSTALLATION

(1) Check condition of O-ring seals on valve body harness connector (Fig. 336). Replace seals on connector body if cut or worn.

(2) Check condition of manual lever shaft seal in transmission case. Replace seal if lip is cut or worn. Install new seal with 15/16 deep well socket (Fig. 337).

(3) Check condition of seals on accumulator piston (Fig. 338). Install new piston seals, if necessary.

(4) Place valve body manual lever in low (1 position) so ball on park lock rod will be easier to install in sprag.

(5) Lubricate shaft of manual lever with petroleum jelly. This will ease inserting shaft through seal in case.

(6) Lubricate seal rings on valve body harness connector with petroleum jelly.

(7) Position valve body in case and work end of park lock rod into and through pawl sprag. Turn propeller shaft to align sprag and park lock teeth if necessary. The rod will click as it enters pawl. Move rod to check engagement.

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into this cavity.

(8) Install accumulator springs and piston into case. Then swing valve body over piston and outer spring to hold it in place.

(9) Align accumulator piston and outer spring, manual lever shaft and electrical connector in case.

(10) Then seat valve body in case and install one or two bolts to hold valve body in place.

(11) Tighten valve body bolts alternately and evenly to 11 N·m (100 in. lbs.) torque.

(12) Install new fluid filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.) torque.

(13) Install throttle and gearshift levers on valve body manual lever shaft.

(14) Check and adjust front and rear bands if necessary.

(15) Connect solenoid case connector wires.

(16) Install the transmission range sensor.

(17) Install oil pan and new gasket. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(18) Lower vehicle and fill transmission with Mopar® ATF +4, type 9602, fluid.

(19) Check and adjust gearshift and throttle valve cables, if necessary.

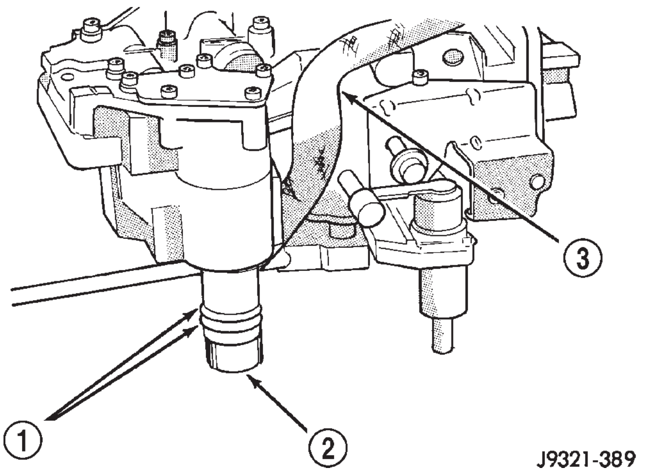


Fig. 336 Valve Body Harness Connector O-Ring Seal

1 - CONNECTOR O-RINGS
2 - VALVE BODY HARNESS CONNECTOR
3 - HARNESS

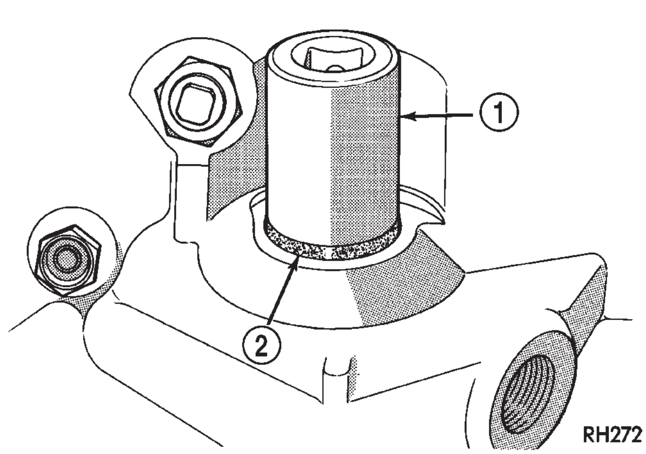


Fig. 337 Manual Lever Shaft Seal

1 - 15/16" SOCKET
2 - SEAL

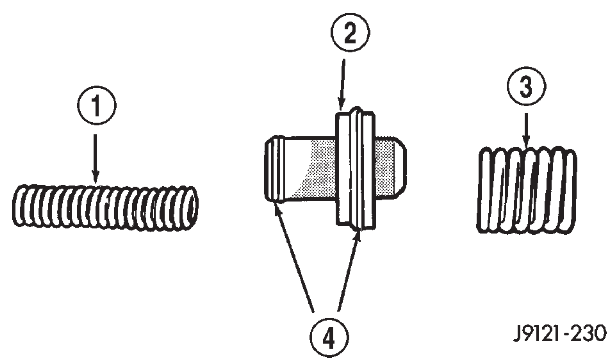


Fig. 338 Accumulator Piston Components

1 - INNER SPRING
2 - ACCUMULATOR PISTON
3 - OUTER SPRING
4 - SEAL RINGS

VALVE BODY (Continued)

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. 339).

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.

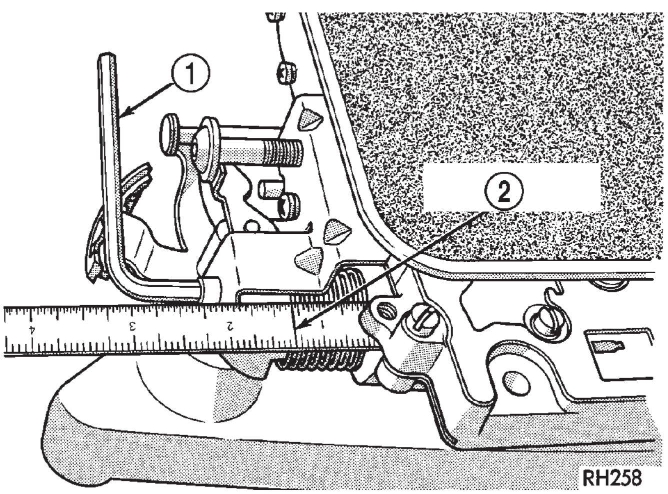


Fig. 339 Line Pressure Adjustment

1 - WRENCH
2 - 1–5/16 INCH

THROTTLE PRESSURE ADJUSTMENT

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 340).

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.

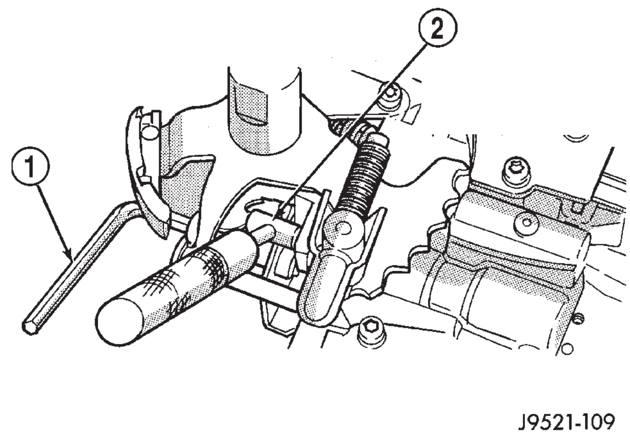


Fig. 340 Throttle Pressure Adjustment

1 - HEX WRENCH (IN THROTTLE LEVER ADJUSTING SCREW)
2 - SPECIAL TOOL C-3763 (POSITIONED BETWEEN THROTTLE LEVER AND KICKDOWN VALVE)

AUTOMATIC TRANSMISSION - 45RFE

TABLE OF CONTENTS

AUTOMATIC TRANSMISSION - 45RFE

DESCRIPTION

The 45RFE automatic transmission is a sophisticated, multi-range, electronically controlled transmission which combines optimized gear ratios for responsive performance, state of the art efficiency features and low NVH. Other features include driver adaptive shifting and three planetary gear sets to provide wide ratio capability with precise ratio steps for optimum driveability. The three planetary gear sets also make available a unique alternate second gear ratio. The primary 2nd gear ratio fits between 1st and 3rd gears for normal through-gear accelerations. The alternate second gear ratio (2prime) allows smoother 4-2 kickdowns at high speeds to provide 2nd gear passing performance over a wider highway cruising range.

The hydraulic portion of the transmission consists of the transmission fluid, fluid passages, hydraulic valves, and various line pressure control components.

The primary mechanical components of the transmission consist of the following:

- Three multiple disc input clutches
- Three multiple disc holding clutches
- Five hydraulic accumulators
- Three planetary gear sets
- Dual Stage Hydraulic oil pump
- Valve body
- Solenoid pack

The TCM is the “heart” or “brain” of the electronic control system and relies on information from various direct and indirect inputs (sensors, switches, etc.) to determine driver demand and vehicle operating conditions. With this information, the TCM can calculate and perform timely and quality shifts through various output or control devices (solenoid pack, transmission control relay, etc.).

TRANSMISSION IDENTIFICATION

Transmission identification numbers are stamped on the left side of the case just above the oil pan sealing surface (Fig. 1). Refer to this information when ordering replacement parts. A label is attached to the transmission case above the stamped numbers. The label gives additional information which may also be necessary for identification purposes.

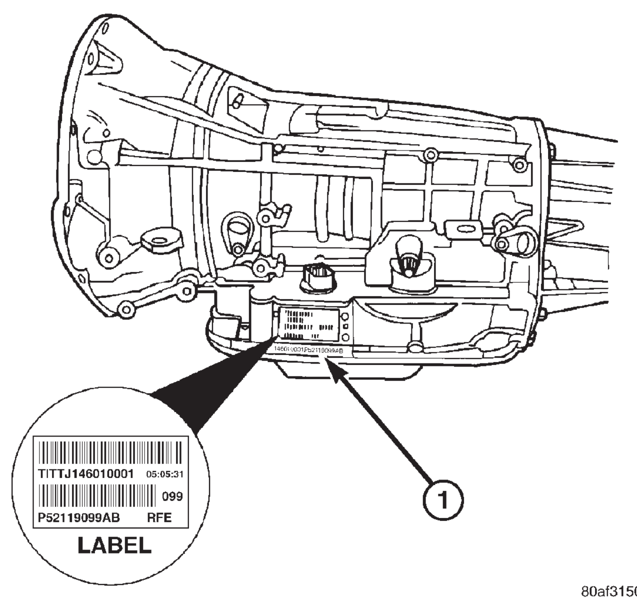


Fig. 1 Transmission Part And Serial Number Location

1 - IDENTIFICATION NUMBERS (STAMPED)

AUTOMATIC TRANSMISSION - 45RFE (Continued)

GEAR RATIOS The 45RFE gear ratios are:

1st	3.00:1
2nd	1.67:1
2nd Prime	1.50:1
3rd	1.00:1
4th	0.75:1
Reverse	3.00:1

OPERATION

The 45RFE offers full electronic control of all automatic up and downshifts, and features real-time adaptive closed-loop shift and pressure control. Electronic shift and torque converter clutch controls help protect the transmission from damage due to high temperatures, which can occur under severe operating conditions. By altering shift schedules, line pressure, and converter clutch control, these controls reduce heat generation and increase transmission cooling.

To help reduce efficiency-robbing parasitic losses, the transmission includes a dual-stage transmission fluid pump with electronic output pressure control. Under most driving conditions, pump output pressure greatly exceeds that which is needed to keep the clutches applied. The 45RFE pump-pressure control system monitors input torque and adjusts the pump pressure accordingly. The primary stage of the pump works continuously; the second stage is bypassed when demand is low. The control system also monitors input and output speed and, if incipient clutch slip is observed, the pressure control solenoid duty cycle is varied, increasing pressure in proportion to demand.

A high-travel torque converter damper assembly allows earlier torque converter clutch engagement to reduce slippage. Needle-type thrust bearings reduce internal friction. The 45RFE is packaged in a one-piece die-cast aluminum case. To reduce NVH, the case has high lateral, vertical and torsional stiffness. It is also designed to maximize the benefit of the structural dust cover that connects the bottom of the bell housing to the engine bedplate, enhancing overall power train stiffness. Dual filters protect the pump and other components. A pump return filter is added to the customary main sump filter. Independent lubrication and cooler circuits assure ample pressure for normal transmission operation even if the cooler is obstructed or the fluid cannot flow due to extremely low temperatures.

The hydraulic control system design (without electronic assist) provides the transmission with PARK, REVERSE, NEUTRAL, SECOND, and THIRD gears, based solely on driver shift lever selection. This design allows the vehicle to be driven (in "limp-in" mode) in the event of a electronic control system failure, or a situation that the Transmission Control Module (TCM) recognizes as potentially damaging to the transmission.

The TCM also performs certain self-diagnostic functions and provides comprehensive information (sensor data, DTC's, etc.) which is helpful in proper diagnosis and repair. This information can be viewed with the DRB scan tool.

DIAGNOSIS AND TESTING - AUTOMATIC TRANSMISSION

CAUTION: Before attempting any repair on a 45RFE automatic transmission, check for Diagnostic Trouble Codes with the DRB® scan tool.

Transmission malfunctions may be caused by these general conditions:
- Poor engine performance
- Improper adjustments
- Hydraulic malfunctions
- Mechanical malfunctions
- Electronic malfunctions

Diagnosis of these problems should always begin by checking the easily accessible variables: fluid level and condition, gearshift cable adjustment. Then perform a road test to determine if the problem has been corrected or if more diagnosis is necessary. If the problem persists after the preliminary tests and corrections are completed, hydraulic pressure checks should be performed.

DIAGNOSIS AND TESTING - PRELIMINARY DIAGNOSIS

Two basic procedures are required. One procedure for vehicles that are drivable and an alternate procedure for disabled vehicles (will not back up or move forward).

VEHICLE IS DRIVABLE

(1) Check for transmission fault codes using DRB® scan tool.

(2) Check fluid level and condition.

(3) Adjust gearshift cable if complaint was based on delayed, erratic, or harsh shifts.

(4) Road test and note how transmission upshifts, downshifts, and engages.

(5) Perform stall test if complaint is based on sluggish acceleration. Or, if abnormal throttle opening is needed to maintain normal speeds with a properly tuned engine.

(6) Perform hydraulic pressure test if shift problems were noted during road test.

(7) Perform air-pressure test to check clutch operation.

AUTOMATIC TRANSMISSION - 45RFE (Continued)

VEHICLE IS DISABLED

(1) Check fluid level and condition.

(2) Check for broken or disconnected gearshift cable.

(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 driveplate, 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 all 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, overrunning clutch, or line pressure problems.

A slipping clutch can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch Application chart provides a basis for analyzing road test results.

CLUTCH APPLICATION CHART

SLP	UD	OD	R	2C	4C	L/R	OVERRUNNING
P–PARK						ON	
R–REVERSE			ON			ON	
N-NEUTRAL						ON	
D–OVERDRIVE FIRST	ON					ON*	ON
SECOND	ON			ON			
SECOND PRIME	ON				ON		
THIRD	ON	ON					
FOURTH		ON			ON		
LIMP-IN	ON	ON					
2–FIRST	ON					ON*	ON
SECOND	ON			ON			
LIMP-IN	ON			ON			
1–LOW	ON					ON	ON

*L/R clutch is on only with the output shaft speed below 150 rpm.

DIAGNOSIS AND TESTING - HYDRAULIC PRESSURE TEST

An accurate tachometer and pressure test gauges are required. Test Gauge C-3293-SP has a 300 psi range and is used at all locations where pressures exceed 100 psi.

Pressure Test Port Locations

Only two pressure ports are supplied on the transmission case. The torque converter clutch apply and release ports are located on the right side of the transmission case (Fig. 2).

To determine the line pressure, there are two available methods. The DRB® scan tool can be used to read line pressure from the line pressure sensor. The second method is to install Line Pressure Adapter 8259 (Fig. 4) into the transmission case and then install the pressure gauge and the original sensor into the adapter. This will allow a comparison of the DRB® readings and the gauge reading to determe the accuracy of the line pressure sensor. The DRB® line pressure reading should match the gauge reading within ±10 psi.

AUTOMATIC TRANSMISSION - 45RFE (Continued)

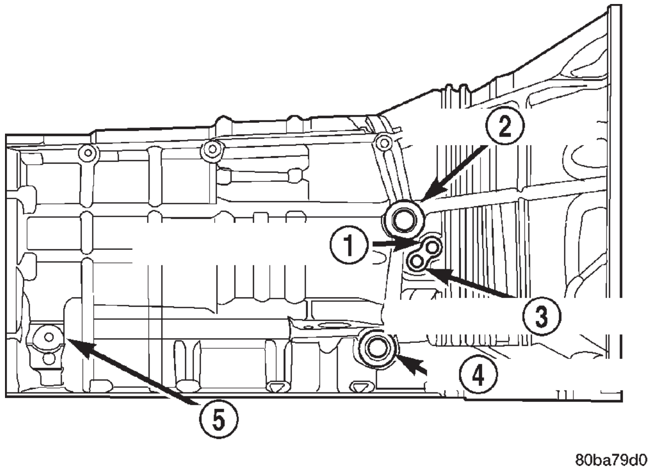


Fig. 2 Torque Converter Pressure Locations

1 - TCC RELEASE
2 - TO COOLER
3 - TCC APPLY
4 - FROM COOLER
5 - LINE PRESSURE SENSOR

In order to access any other pressure tap locations, the transmission oil pan must be removed, the pressure port plugs removed and Valve Body Pressure Tap Adapter 8258-A (Fig. 5) installed. The extensions supplied with Adapter 8258-A will allow the installation of pressure gauges to the valve body. Refer to (Fig. 3) for correct pressure tap location identification.

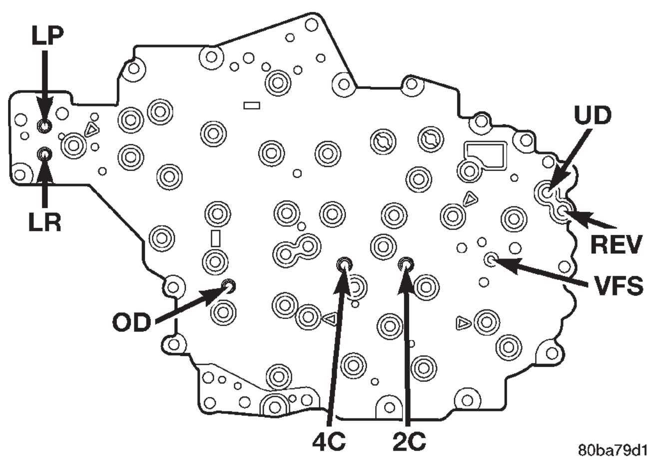


Fig. 3 Pressure Tap Locations

TEST PROCEDURE

All pressure readings should be taken with the transmission fluid level full, transmission oil at the normal operating temperature, and the engine at 1500 rpm. Check the transmission for proper operation in each gear position that is in question or if a specific element is in question, check the pressure readings in at least two gear positions that employ that element. Refer to the Hydraulic Schematics at the rear of this section to determine the correct pressures for each element in a given gear position.

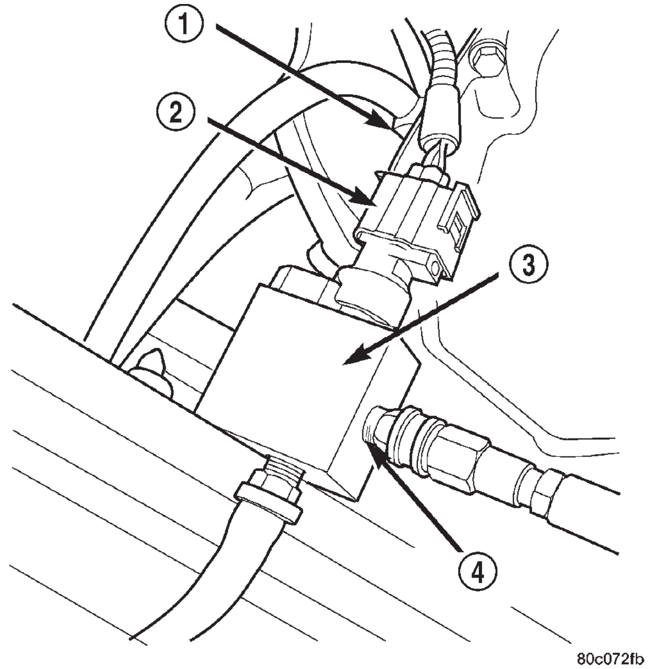


Fig. 4 Line Pressure Adapter 8259

1 - LINE PRESSURE SENSOR PORT
2 - LINE PRESSURE SENSOR
3 - TOOL 8259
4 - PRESSURE TAP

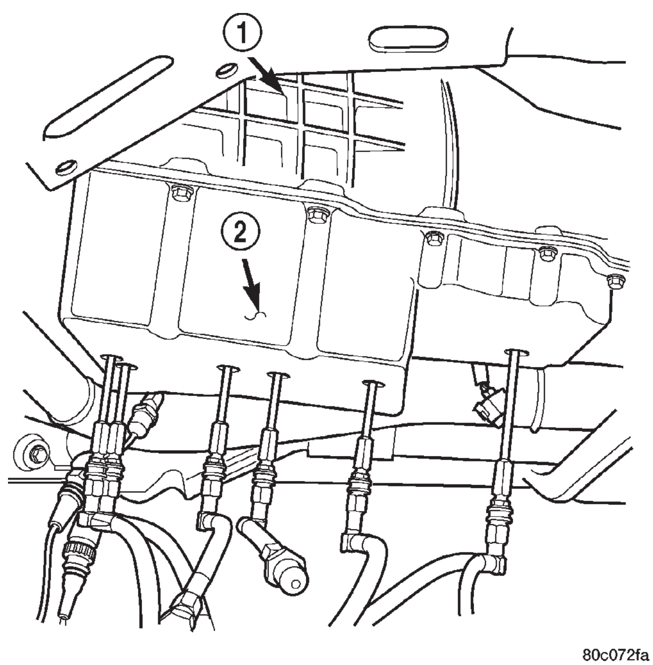


Fig. 5 Valve Body Pressure Tap Adapter 8258-A

1 - 45RFE TRANSMISSION
2 - TOOL 8258-A

AUTOMATIC TRANSMISSION - 45RFE (Continued)

NOTE: The 45RFE utilizes closed loop control of pump line pressure. The pressure readings may therefore vary greatly but should always follow line pressure.

Some common pressures that can be measured to evaluate pump and clutch performance are the upshift/downshift pressures and the garage shift pressures. The upshift/downshift pressure for all shifts is 120 psi. The garage shift pressure when performing a N-R shift is 220 psi. The garage shift pressure for the R-N and N-1 shifts is 120 psi.

DIAGNOSIS AND TESTING - AIR CHECKING TRANSMISSION CLUTCH OPERATION

Air-pressure testing can be used to check transmission clutch operation. The test can be conducted with the transmission either in the vehicle or on the work bench, as a final check.

Air-pressure testing requires that the oil pan and valve body be removed from the transmission. The clutch apply passages are shown (Fig. 6).

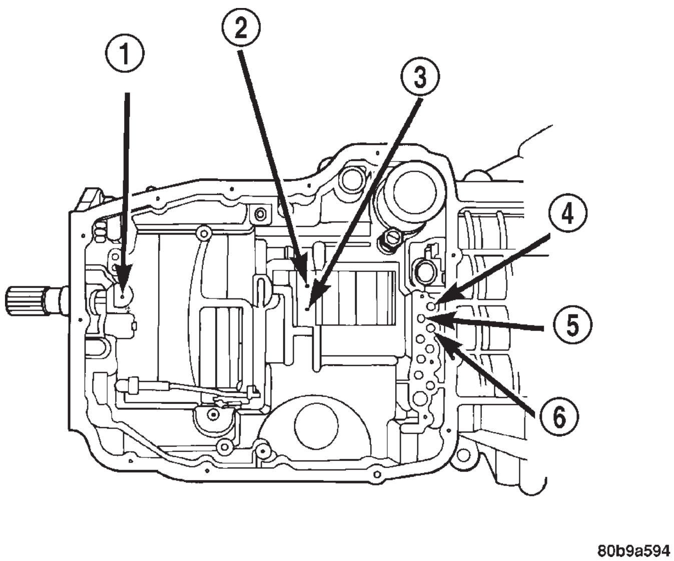


Fig. 6 Air Pressure Test Passages

1 - LOW REVERSE CLUTCH
2 - 4TH CLUTCH
3 - 2ND CLUTCH
4 - OVERDRIVE CLUTCH
5 - UNDERDRIVE CLUTCH
6 - REVERSE CLUTCH

NOTE: The air supply which is used must be free of moisture and dirt. Use a pressure of 30 psi to test clutch operation.

Apply air pressure at each port. If the clutch is functioning, a soft thump will be heard as the clutch is applied. The clutch application can also be felt by touching the appropriate element while applying air pressure. As the air pressure is released, the clutch should also release.

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. Torque converter seal leaks tend to move along the drive hub and onto the rear of the converter. Pump cover seal tend to run down the cover and the inside surface of the bellhousing.

Some leaks, or suspected leaks, may be particularly difficult to locate. If necessary, a Mopar® approved dye may be used to locate a leak.

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are:

(1) Leaks at the weld joint around the outside diameter weld (Fig. 7).

(2) Leaks at the converter hub weld (Fig. 7).

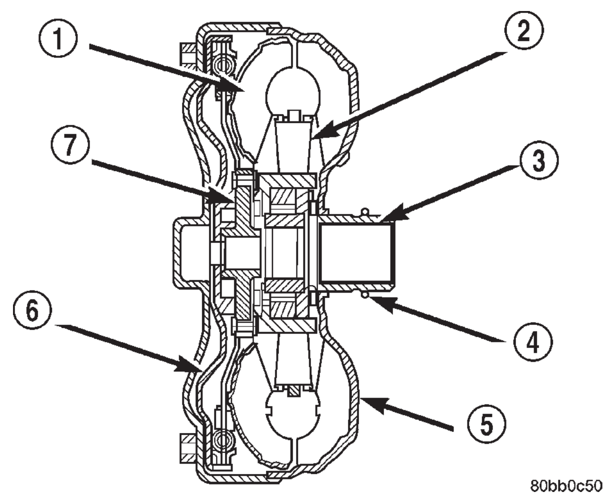


Fig. 7 Torque Converter Assembly

1 - TURBINE ASSEMBLY
2 - STATOR
3 - CONVERTER HUB
4 - O-RING
5 - IMPELLER ASSEMBLY
6 - CONVERTER CLUTCH PISTON
7 - TURBINE HUB

AUTOMATIC TRANSMISSION - 45RFE (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 the negative battery cable.

(2) Raise and support the vehicle

(3) Remove any necessary skid plates. (Refer to 13 - FRAMES & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - REMOVAL)

(4) Mark propeller shaft and axle companion flanges for assembly alignment.

(5) Remove the rear propeller shaft

(6) Remove the front propeller shaft, if necessary.

(7) Remove the engine to transmission collar (Fig. 8).

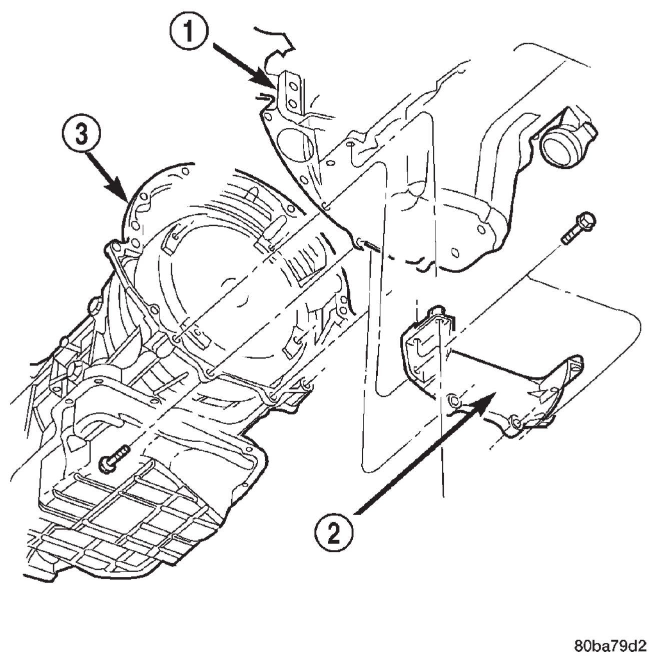


Fig. 8 Transmission Collar

1 - ENGINE
2 - ENGINE TO TRANSMISSION COLLAR
3 - TRANSMISSION

(8) Remove the exhaust support bracket from the rear of the transmission.

(9) Disconnect and lower or remove any necessary exhaust components.

(10) Remove the starter motor.

(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) Disconnect wires from solenoid and pressure switch assembly, input and output speed sensors, and line pressure sensor.

(13) Disconnect gearshift cable from transmission manual valve lever (Fig. 9).

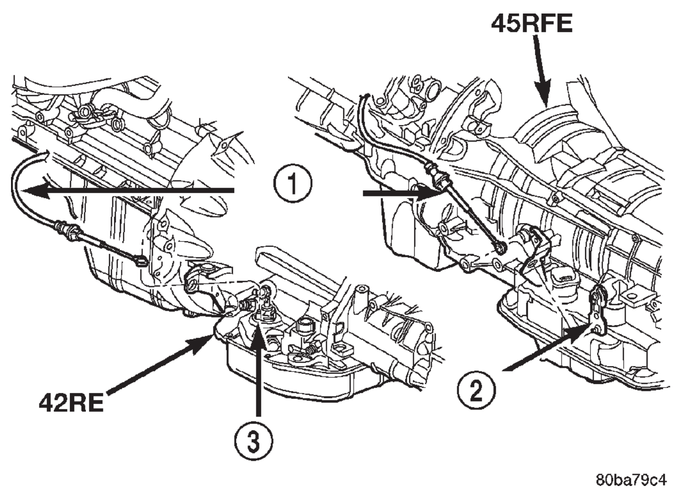


Fig. 9 Transmission Shift Cable

1 - SHIFT CABLE
2 - MANUAL LEVER
3 - MANUAL LEVER

(14) Disconnect transmission fluid cooler lines at transmission fittings and clips.

(15) Disconnect the transmission vent hose from the transmission.

(16) Support rear of engine with safety stand or jack.

(17) Raise transmission slightly with service jack to relieve load on crossmember and supports.

(18) Remove bolts securing rear support and cushion to transmission and crossmember (Fig. 10).

(19) Remove bolts attaching crossmember to frame and remove crossmember.

(20) Remove transfer case.

(21) Remove all remaining converter housing bolts.

(22) Carefully work transmission and torque converter assembly rearward off engine block dowels.

(23) Hold torque converter in place during transmission removal.

(24) Lower transmission and remove assembly from under the vehicle.

(25) To remove torque converter, carefully slide torque converter out of the transmission.

AUTOMATIC TRANSMISSION - 45RFE (Continued)

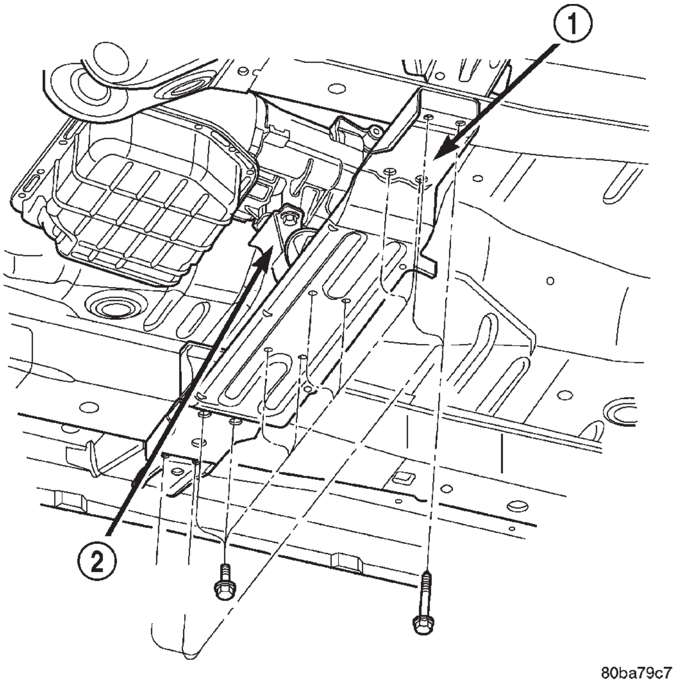


Fig. 10 Rear Transmission Crossmember

1 - CROSSMEMBER
2 - REAR TRANSMISSION MOUNT

DISASSEMBLY

(1) Drain fluid from transmission.

(2) Clean exterior of transmission with suitable solvent or pressure washer.

(3) Remove the torque converter from the transmission.

(4) Remove the manual shift lever from the transmission.

(5) Remove the input, output, and line pressure sensors from the transmission case (Fig. 11).

(6) Inspect the ends of the sensors for debris, which may indicate the nature of the transmission failure.

(7) Install Support Stand 8257 onto the transmission case (Fig. 12).

(8) Using Adapter 8266-1 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the input shaft end-play (Fig. 13).

NOTE: When measuring the input shaft end-play, two ″stops″ will be felt. When the input shaft is pushed inward and the dial indicator zeroed, the first ″stop″ felt when the input shaft is pulled outward is the movement of the input shaft in the input clutch housing hub. This value should not be included in the end-play measured value and therefore must be recorded and subtracted from the dial indicator reading.

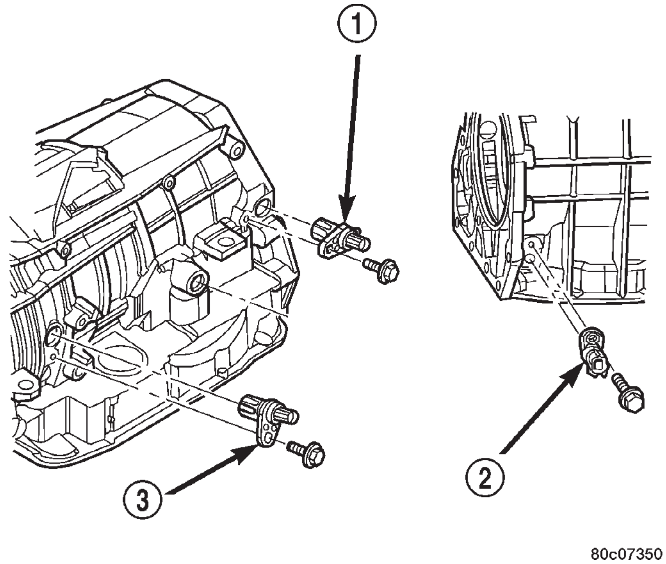


Fig. 11 Remove Input, Output, and Line Pressure Sensors

1 - OUTPUT SPEED SENSOR
2 - LINE PRESSURE SENSOR
3 - INPUT SPEED SENSOR

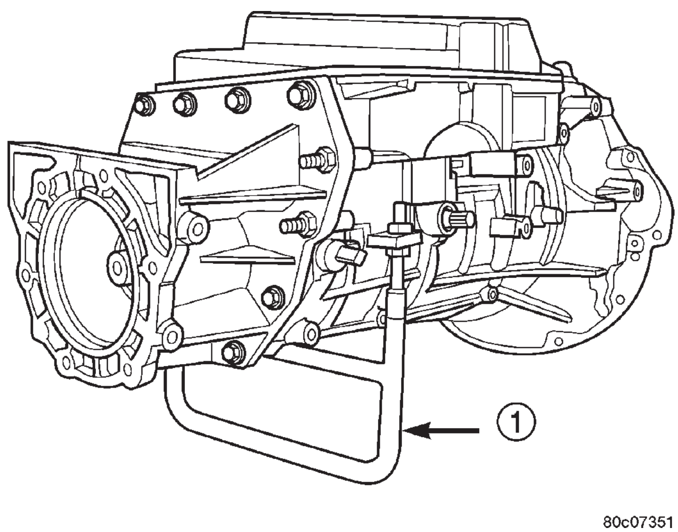


Fig. 12 Install Support Stand - Tool 8257

1 - TOOL 8257

AUTOMATIC TRANSMISSION - 45RFE (Continued)

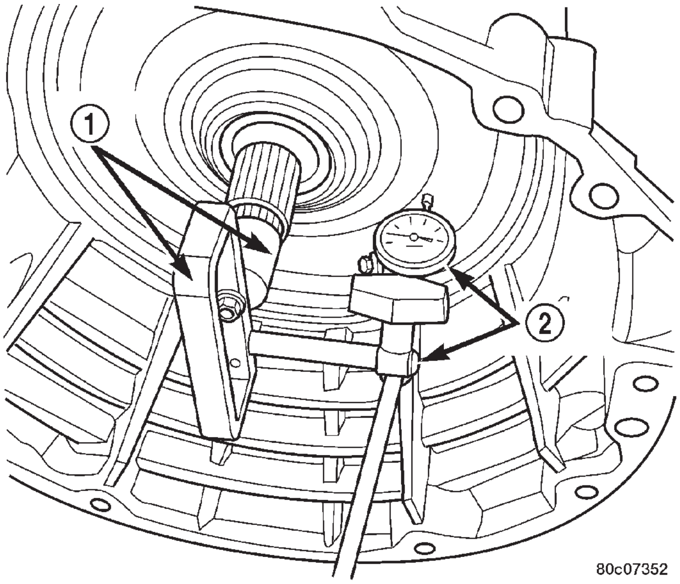


Fig. 13 Measure Input Shaft End Play

1 - TOOL 8266
2 - TOOL C-3339

(9) Remove the bolts holding the transmission extension/adapter housing to the transmission case.

(10) Remove the extension/adapter housing from the transmission case.

(11) Using Alignment Plate 8261, Adapter 8266-17 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the output shaft end-play (Fig. 14).

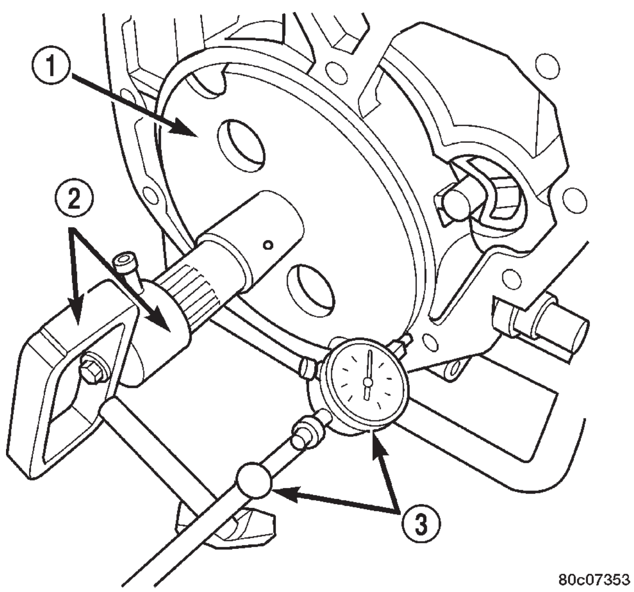


Fig. 14 Measure Output Shaft End Play

1 - TOOL 8261
2 - TOOL 8266
3 - TOOL C-3339

(12) Remove the bolts holding the transmission oil pan to the transmission case.

(13) Remove the transmission oil pan from the transmission case.

(14) Remove the primary oil filter and the oil cooler return filter (Fig. 15).

(15) Remove the cooler return filter bypass valve.

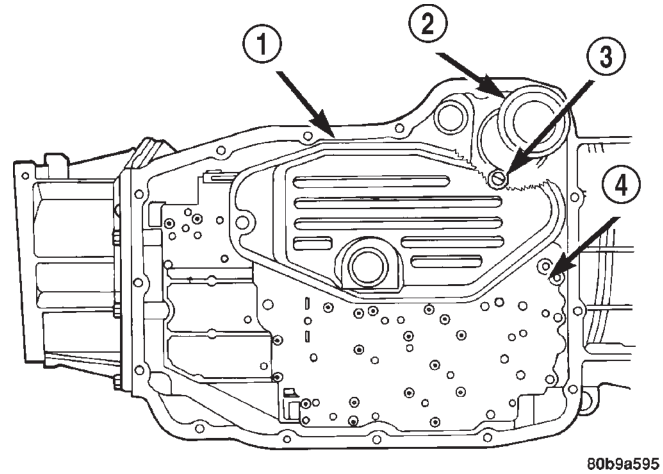


Fig. 15 Remove Primary Oil and Cooler Filters

1 - PRIMARY OIL FILTER
2 - COOLER RETURN FILTER
3 - COOLER RETURN FILTER BYPASS VALVE
4 - VALVE BODY

(16) Remove the bolts holding the valve body to the transmission case (Fig. 16).

(17) Remove the valve body from the transmission case.

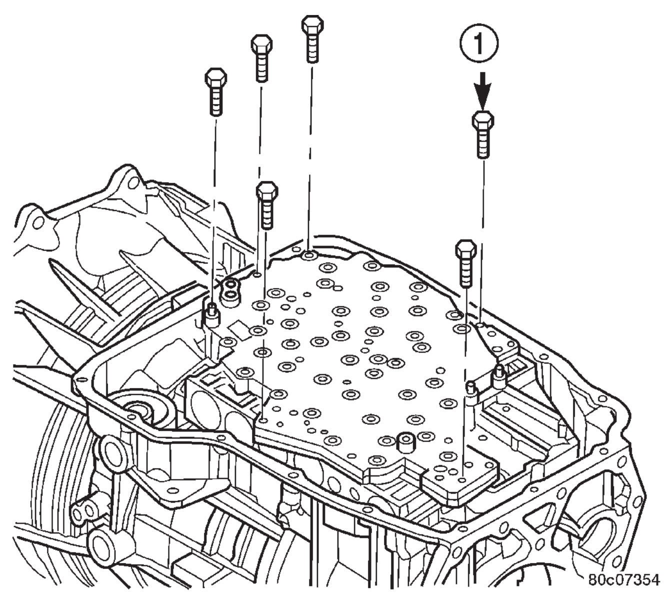


Fig. 16 Remove Valve Body Assembly

1 - VALVE BODY TO CASE BOLT (6)

AUTOMATIC TRANSMISSION - 45RFE (Continued)

(18) Remove the outer snap-ring securing the transmission front cover into the transmission case (Fig. 17).

(19) Remove the inner snap-ring securing the transmission front cover to the oil pump (Fig. 17).

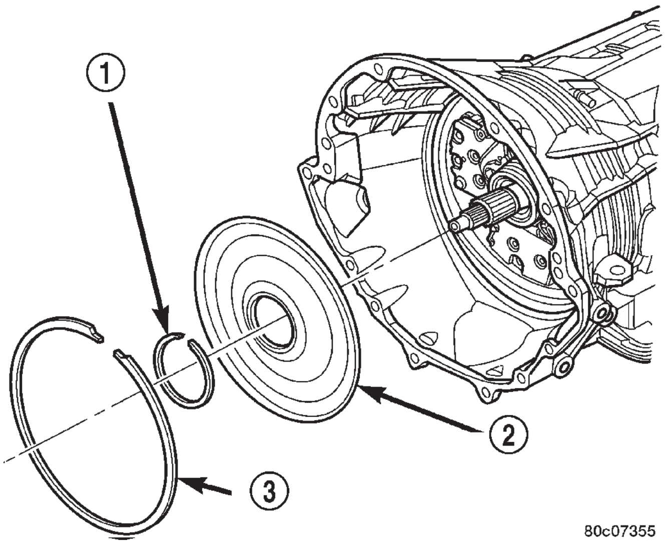


Fig. 17 Remove Transmission Front Cover

1 - INNER SNAP-RING
2 - TRANSMISSION COVER
3 - OUTER SNAP-RING

(20) Reaching through a case opening in the valve body area with a long blunted tool, remove the transmission front cover from the transmission case.

(21) Remove the bolts holding the oil pump into the transmission case (Fig. 18).

(22) Remove the oil pump. Hold inward on the input shaft to prevent pulling the input clutch assembly with the oil pump (Fig. 18).

(23) Remove the number 1 bearing from the input clutch assembly (Fig. 19).

(24) Remove the input clutch assembly from the transmission case (Fig. 19).

(25) Remove the number 5 bearing and selective thrust plate from the input clutch assembly (Fig. 19), or the 4C clutch retainer/bulkhead.

(26) Remove the 4C clutch retainer/bulkhead tapered snap-ring from the transmission case (Fig. 20).

(27) Remove the 4C clutch retainer/bulkhead from the transmission case (Fig. 20).

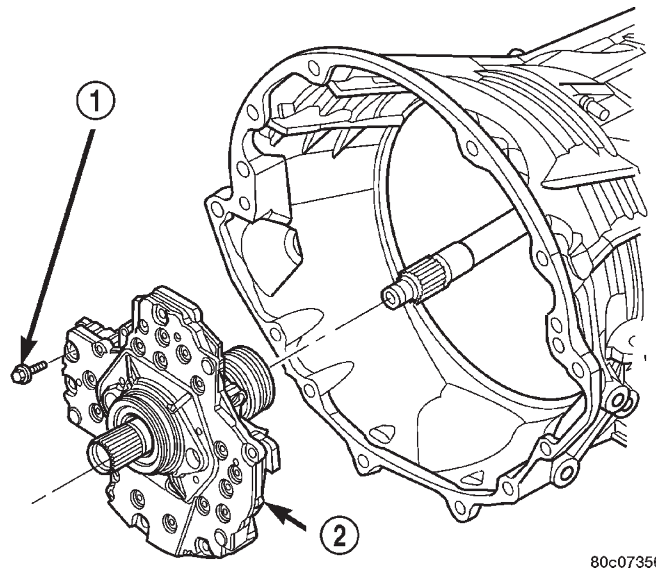


Fig. 18 Remove Oil Pump

1 - OIL PUMP TO CASE BOLT (6)
2 - OIL PUMP

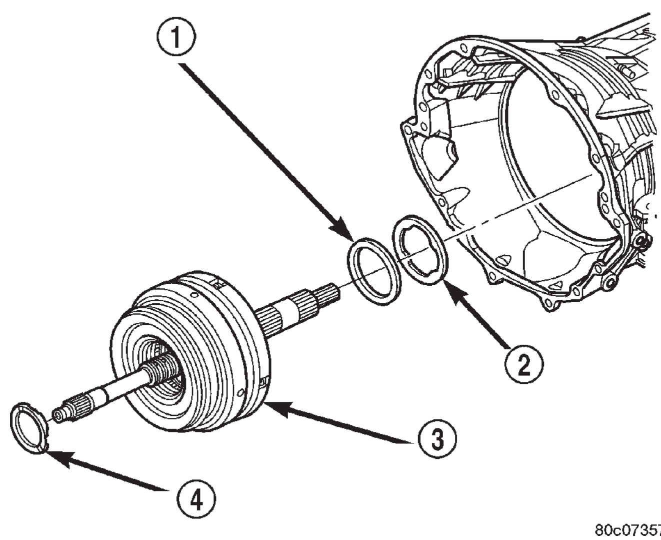


Fig. 19 Remove Input Clutch Assembly

1 - BEARING NUMBER 5
2 - THRUST PLATE (SELECT)
3 - INPUT CLUTCH ASSEMBLY
4 - BEARING NUMBER 1

AUTOMATIC TRANSMISSION - 45RFE (Continued)

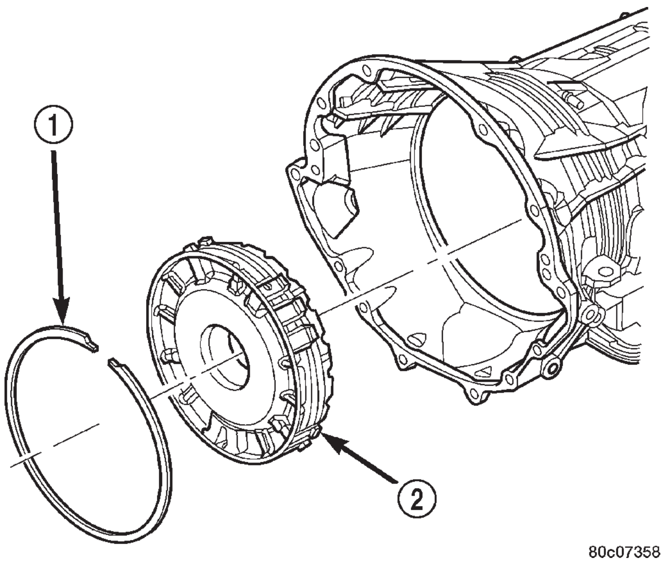


Fig. 20 Remove 4C Clutch Retainer/Bulkhead

1 - SNAP-RING
2 - 4C CLUTCH RETAINER/BULKHEAD

(28) Remove the front 2C clutch pack snap-ring from the transmission case (Fig. 21).

(29) Remove the 2C clutch pack from the transmission case (Fig. 21).

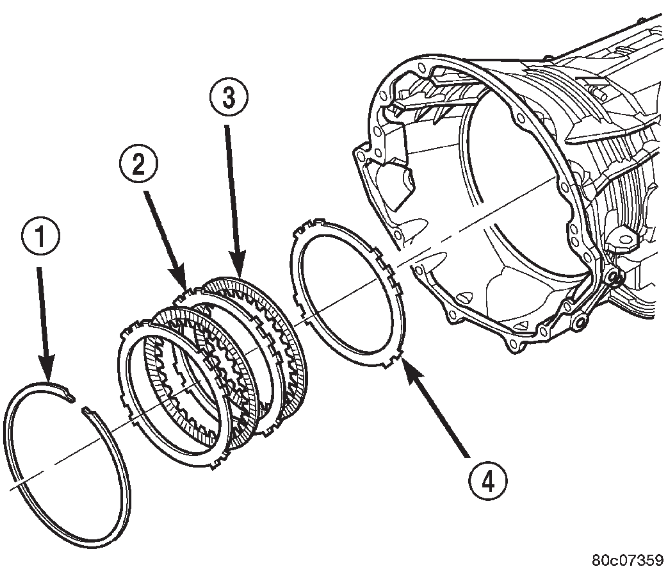


Fig. 21 Remove 2C Clutch Pack

1 - SNAP-RING
2 - PLATE
3 - DISC
4 - REACTION PLATE

(30) Remove the rear selective plate and number 6 bearing from the reaction annulus (Fig. 22).

(31) Remove the reaction annulus from the reaction planetary carrier (Fig. 22).

(32) Remove the number 7 bearing (Fig. 22).

(33) Remove the reaction sun gear (Fig. 22).

(34) Remove the number 8 bearing from the reaction planetary carrier (Fig. 22).

(35) Remove the reaction planetary carrier (Fig. 22). Note that this planetary gear set has three pinion gears.

(36) Remove the number 9 bearing from the reverse planetary gear set (Fig. 22).

(37) Remove the snap-ring holding the park sprag gear onto the output shaft (Fig. 23).

(38) Remove the park sprag gear from the output shaft (Fig. 24).

(39) Remove the input/reverse planetary assembly (Fig. 25).

(40) Remove the number 12 bearing from the input/reverse planetary assembly (Fig. 25).

(41) Remove the snap-ring holding the low/reverse clutch retainer into the transmission case (Fig. 26).

(42) Remove the low/reverse clutch retainer from the transmission case (Fig. 26).

(43) Remove the park pawl rod and e-clip (Fig. 27).

(44) Remove the park pawl rod guide snap-ring (Fig. 27).

(45) Remove the park pawl rod guide (Fig. 27).

(46) Remove the park pawl pivot shaft, park pawl, and spring (Fig. 27).

(47) Remove the manual selector shaft (Fig. 27).

(48) Remove the manual selector shaft seal.

(49) Remove the dipstick tube seal.

AUTOMATIC TRANSMISSION - 45RFE (Continued)

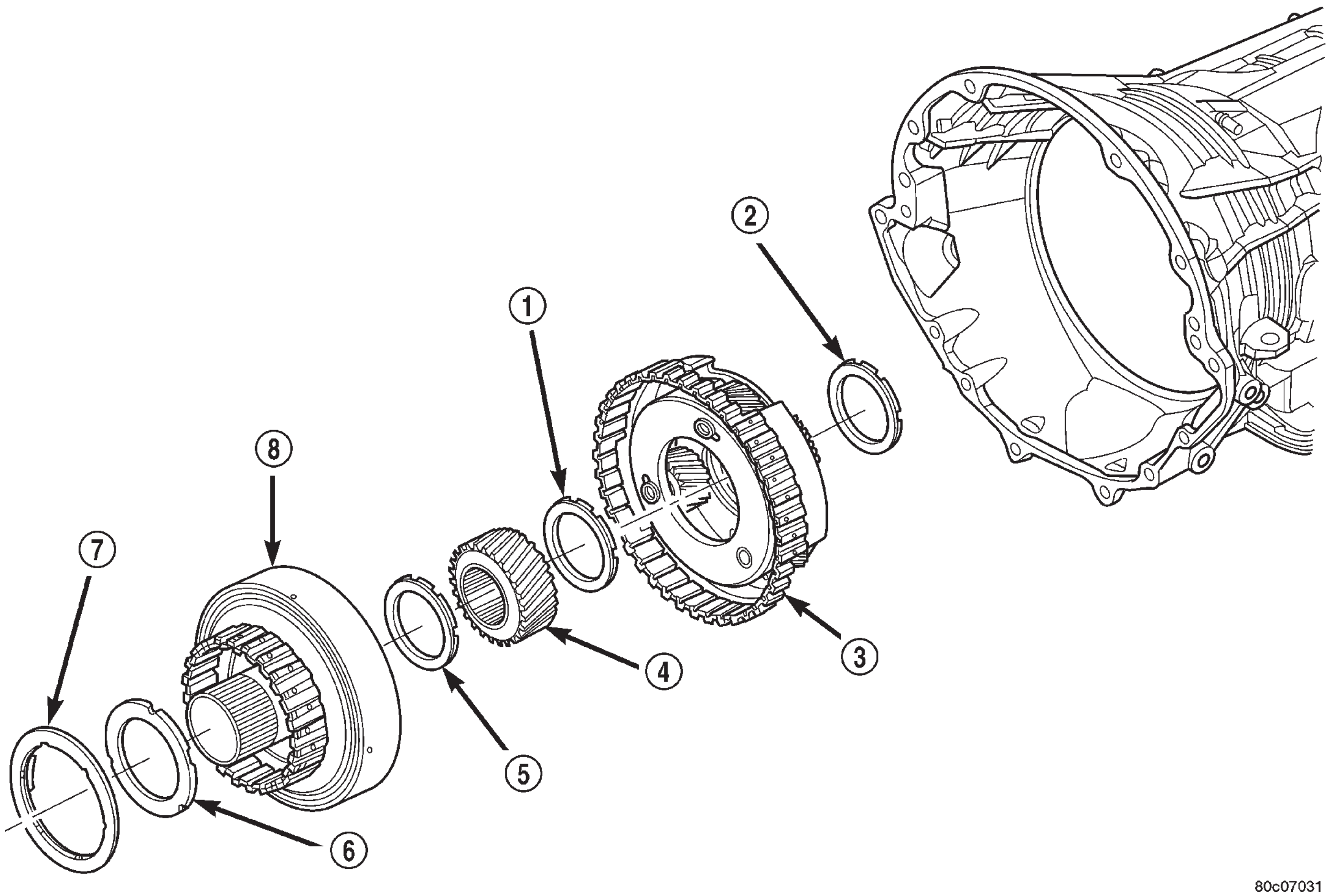


Fig. 22 Remove Reaction Annulus and Carrier

1 - BEARING NUMBER 8
2 - BEARING NUMBER 9
3 - REACTION PLANETARY CARRIER
4 - REACTION SUN GEAR
5 - BEARING NUMBER 7
6 - THRUST PLATE (SELECT)
7 - BEARING NUMBER 6
8 - REACTION ANNULUS

AUTOMATIC TRANSMISSION - 45RFE (Continued)

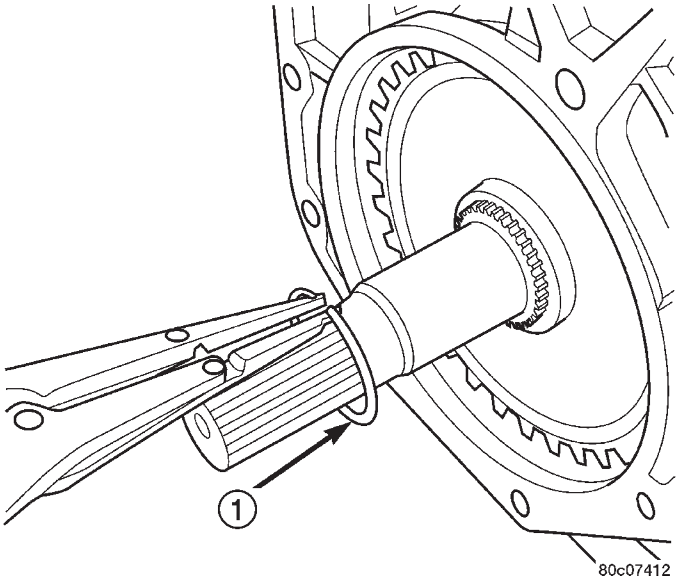


Fig. 23 Remove Park Sprag Snap-Ring

1 - SNAP-RING

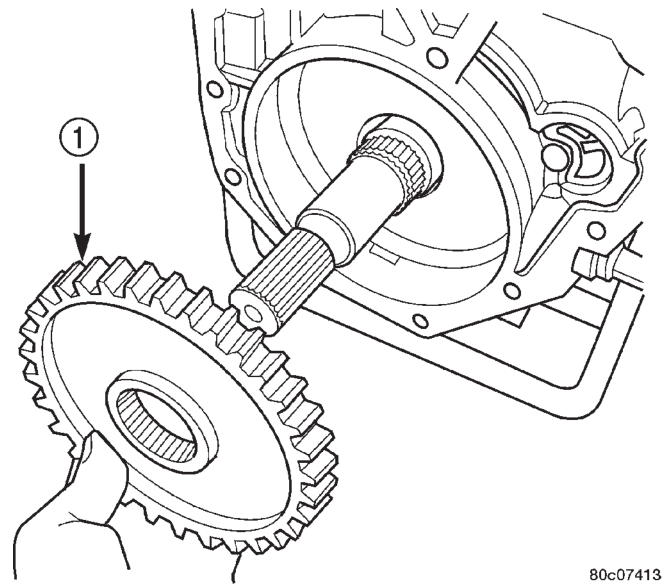


Fig. 24 Remove Park Sprag Gear

1 - PARK SPRAG GEAR

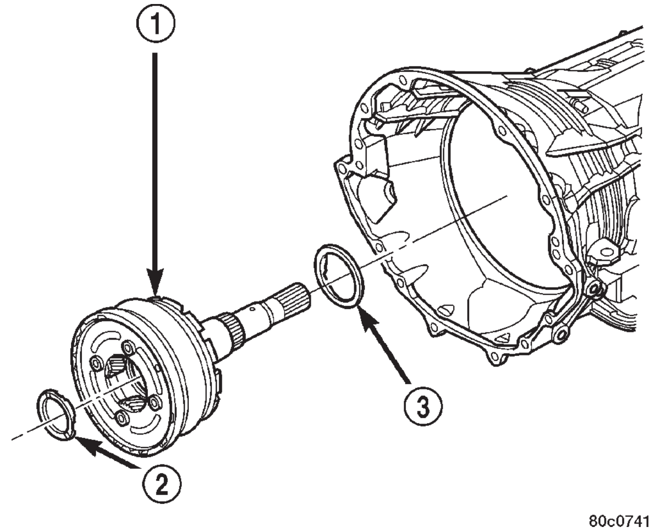


Fig. 25 Remove Input/Reverse Planetary Assembly

1 - INPUT/REVERSE PLANETARY ASSEMBLY
2 - BEARING NUMBER 9
3 - BEARING NUMBER 12

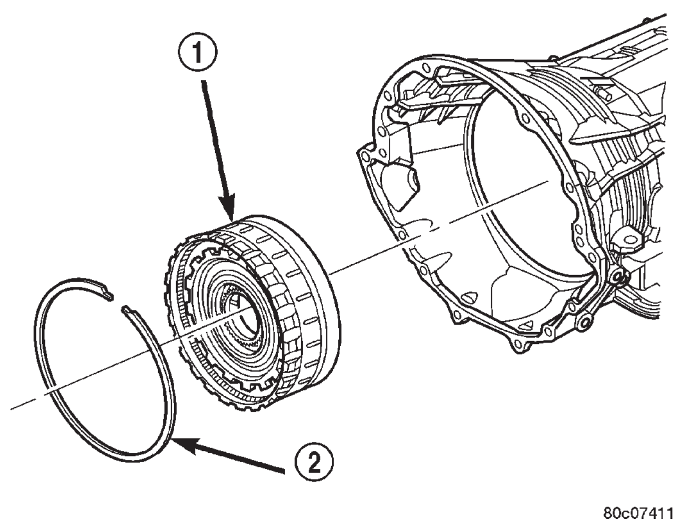


Fig. 26 Remove Low/Reverse Clutch Retainer

1 - LOW/REVERSE OVERRUNNING CLUTCH ASSEMBLY
2 - SNAP-RING

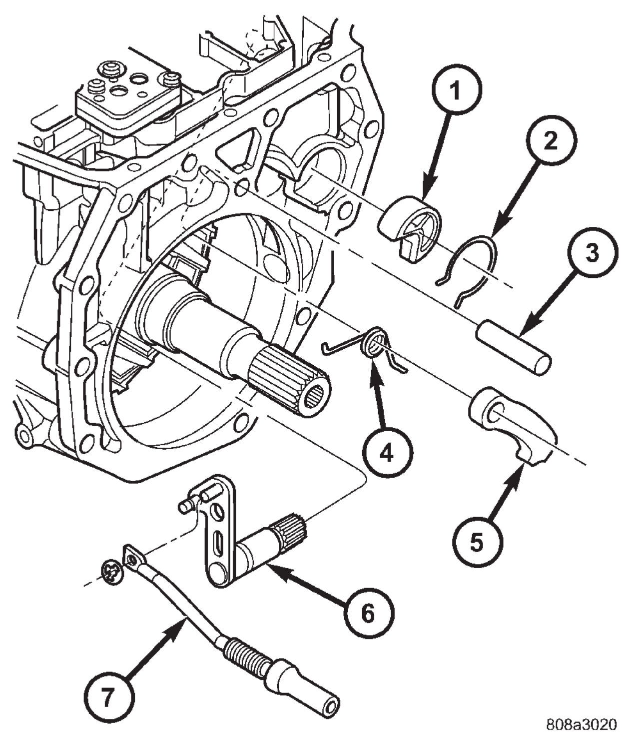


Fig. 27 Manual Shaft/Park Lock Components

1 - GUIDE
2 - SNAP-RING
3 - SHAFT
4 - SPRING
5 - PARK PAWL
6 - MANUAL SHAFT/LEVER
7 - PARK ROD

CLEANING

The use of crocus cloth is permissible where necessary, providing it is used carefully. When used on shafts, or valves, use extreme care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

Lubricate transmission parts with Mopar® ATF +4, Type 9602, transmission fluid during overhaul and assembly. Use petroleum jelly, Mopar® Door Ease, or Ru-Glyde to prelubricate seals, O-rings, and thrust washers. Petroleum jelly can also be used to hold parts in place during reassembly.

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 stick to case surfaces and transmission components and circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

INSPECTION

Inspect the case for cracks, porous spots, worn bores, or damaged threads. Damaged threads can be repaired with Helicoil thread inserts. However, the case will have to be replaced if it exhibits any type of damage or wear.

ASSEMBLY

(1) Clean and inspect all components. Replace any components which show evidence of excessive wear or scoring.

(2) Install the cooler filter bypass valve.

(3) Torque the bypass valve to specification. The valve uses a tapered pipe thread and excessive torque can damage the transmission case. Tighten the cooler filter bypass valve to 4.5 N·m (40 in.lbs.).

(4) Install a new selector shaft seal using Seal Installer 8253 (Fig. 28).

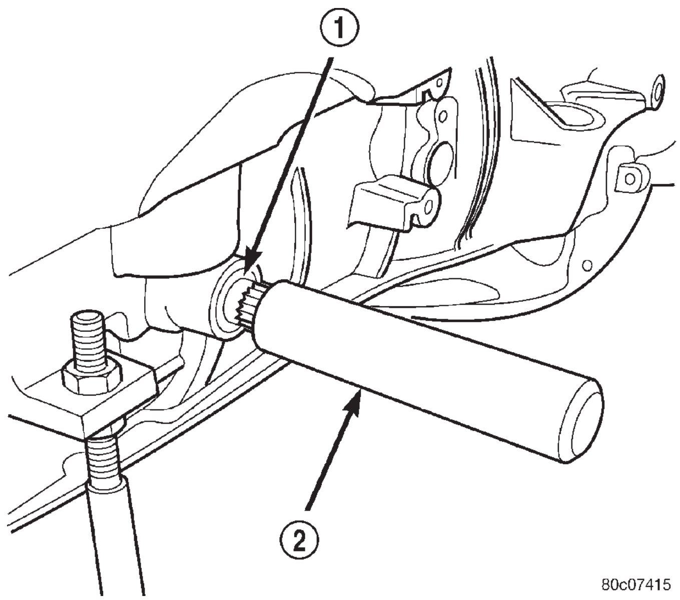


Fig. 28 Install Selector Shaft

1 - SEAL
2 - TOOL 8253

AUTOMATIC TRANSMISSION - 45RFE (Continued)

(5) Install the manual selector shaft and retaining screw. Tighten the manual selector shaft retaining screw to 28 N·m (250 in.lbs.).

(6) Install the park pawl, spring, and shaft (Fig. 29).

(7) Install the park rod and e-clip (Fig. 29).

(8) Install the park rod guide and snap-ring (Fig. 29).

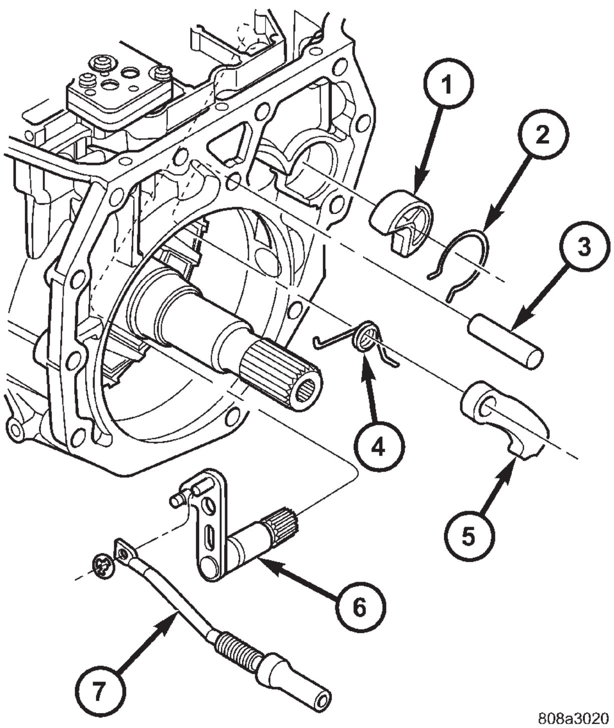


Fig. 29 Manual Shaft/Park Lock Components

1 - GUIDE
2 - SNAP-RING
3 - SHAFT
4 - SPRING
5 - PARK PAWL
6 - MANUAL SHAFT/LEVER
7 - PARK ROD

(9) Install a new dipstick tube seal using Seal Installer 8254 (Fig. 30).

NOTE: Before final assembly of transmission centerline, the 2C/4C clutch components should be installed into position and measured as follows:

(10) Install the 2C reaction plate into the transmission case (Fig. 31). The reaction plate is directional. The plate must be installed with the flat side toward the front of the transmission.

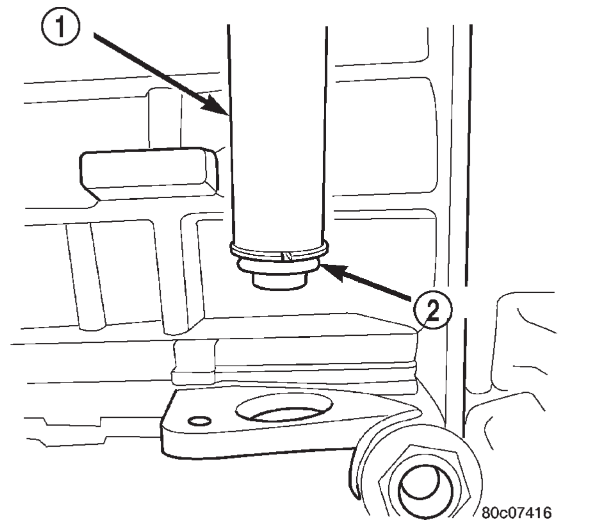


Fig. 30 Install Dipstick Tube Seal Using Tool 8254

1 - TOOL 8254
2 - SEAL

(11) Install the 2C clutch pack into the transmission case (Fig. 31).

(12) Install the flat 2C clutch snap-ring into the transmission case (Fig. 31).

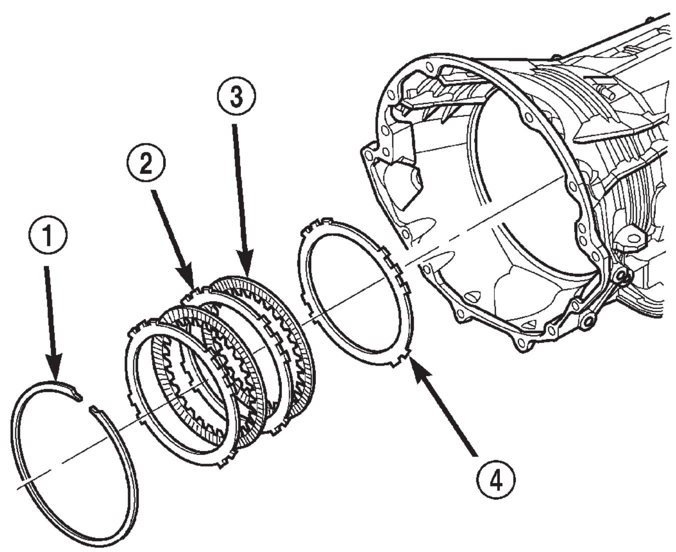


Fig. 31 Install 2C Clutch Pack

1 - SNAP-RING
2 - PLATE
3 - DISC
4 - REACTION PLATE

AUTOMATIC TRANSMISSION - 45RFE (Continued)

(13) Install the 4C retainer/bulkhead into the transmission case. Make sure that the oil feed holes are pointing toward the valve body area.

(14) Install the 4C retainer/bulkhead tapered snap-ring into the transmission case. Make sure that the open ends of the snap-ring are located in the case opening toward the valve body area.

(15) Using a feeler gauge through the opening in the rear of the transmission case, measure the 2C clutch pack clearance between the 2C reaction plate and the transmission case at four different points. The average of these measurements is the 2C clutch pack clearance. The correct clutch clearance is 0.533-1.27 mm (0.021-0.050 in.). The reaction plate is not selective. If the clutch pack clearance is not within specification, the reaction plate, all the friction discs, and steels must be replaced.

(16) Remove the 4C retainer/bulkhead and all of the 2C clutch components from the transmission case.

(17) Install the low/reverse clutch assembly (Fig. 32). Make sure that the oil feed hole points toward the valve body area and that the bleed orifice is aligned with the notch in the rear of the transmission case.

(18) Install the snap-ring to hold the low/reverse clutch retainer into the transmission case (Fig. 32). The snap-ring is tapered and must be installed with the tapered side forward. Once installed, verify that the snap-ring is fully seated in the snap-ring groove.

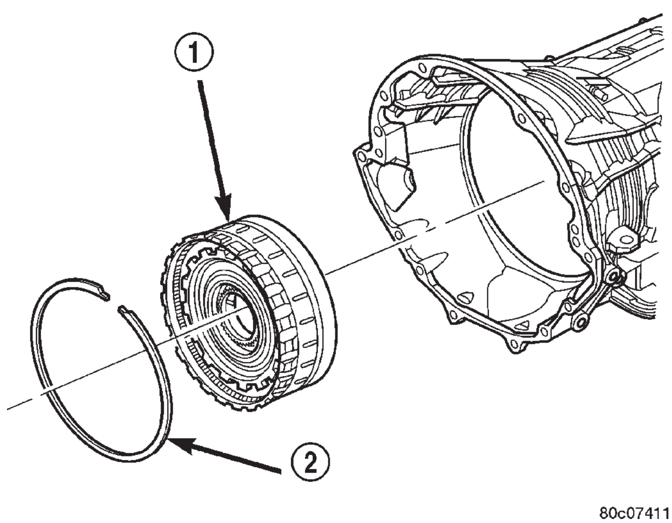


Fig. 32 Install Low/Reverse Clutch Retainer

1 - LOW/REVERSE OVERRUNNING CLUTCH ASSEMBLY
2 - SNAP-RING

(19) Air check the low/reverse clutch and verify correct overrunning clutch operation.

(20) Install the number 12 bearing over the output shaft of the rear planetary gear set and onto the low/reverse clutch assembly. The flat side of the bearing goes toward the clutch assembly.

(21) Install the reverse/input planetary assembly through the low/reverse clutch assembly (Fig. 33).

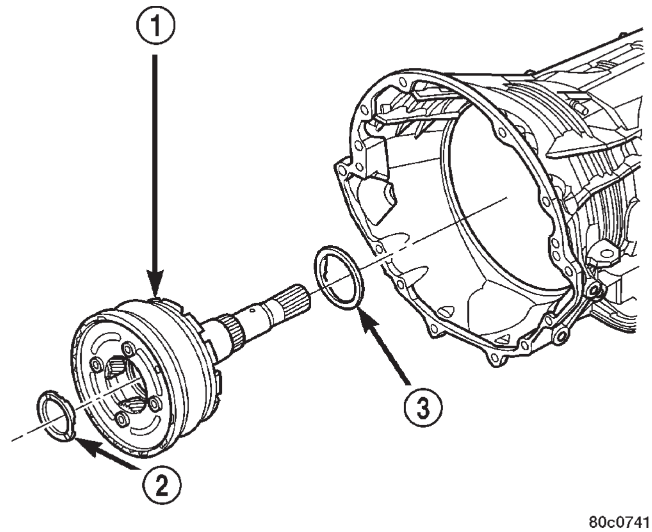


Fig. 33 Install Input/Reverse Planetary Assembly

1 - INPUT/REVERSE PLANETARY ASSEMBLY
2 - BEARING NUMBER 9
3 - BEARING NUMBER 12

(22) Install the park sprag onto the output shaft (Fig. 34).

(23) Install the snap-ring to hold the park sprag onto the output shaft (Fig. 35).

AUTOMATIC TRANSMISSION - 45RFE (Continued)

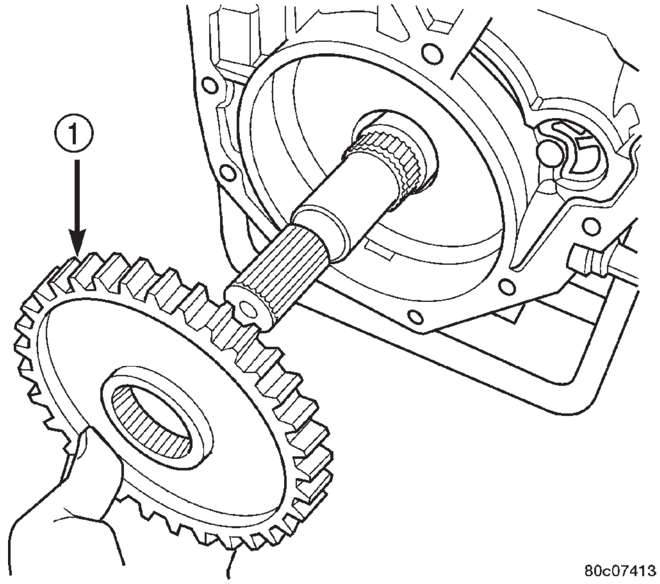


Fig. 34 Install Park Sprag Gear

1 - PARK SPRAG GEAR

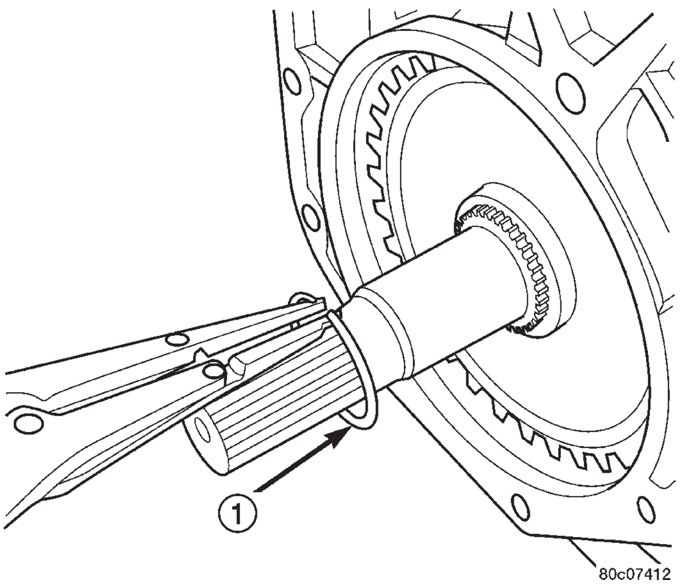


Fig. 35 Install Park Sprag Snap-Ring

1 - SNAP-RING

(24) Install the 2C reaction plate into the transmission case (Fig. 36). The reaction plate is directional. The plate must be installed with the flat side toward the front of the transmission.

(25) Install the 2C clutch pack into the transmission case (Fig. 36).

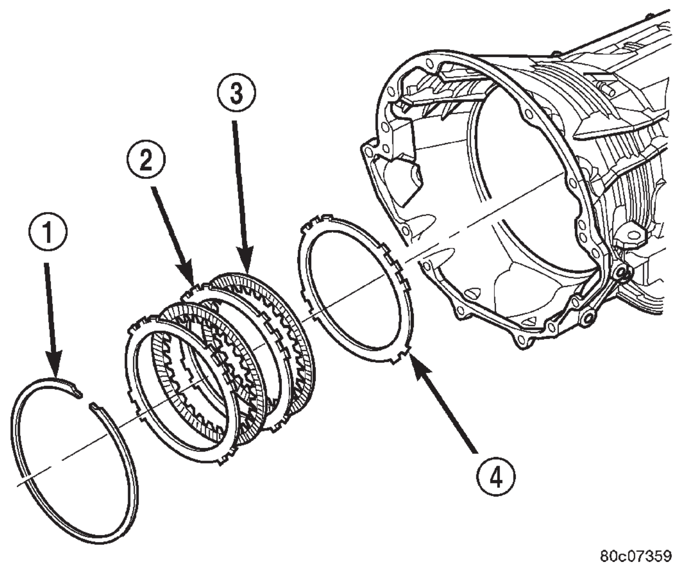


Fig. 36 Install 2C Clutch Pack

1 - SNAP-RING
2 - PLATE
3 - DISC
4 - REACTION PLATE

(26) Install the number 8 bearing inside the reaction carrier with the round side against the planetary carrier.

(27) Install the reaction planetary gear set and the number 9 bearing, with the flat side toward the reaction planetary, into the transmission case (Fig. 37).

(28) Install the flat 2C clutch snap-ring into the transmission case (Fig. 36).

(29) Install the reaction sun gear into the reaction planetary gear set. **Make sure** the small shoulder is facing the front of the transmission (Fig. 37).

(30) Install the number 7 bearing onto the reaction sun gear with the flat side against the sun gear (Fig. 37).

AUTOMATIC TRANSMISSION - 45RFE (Continued)

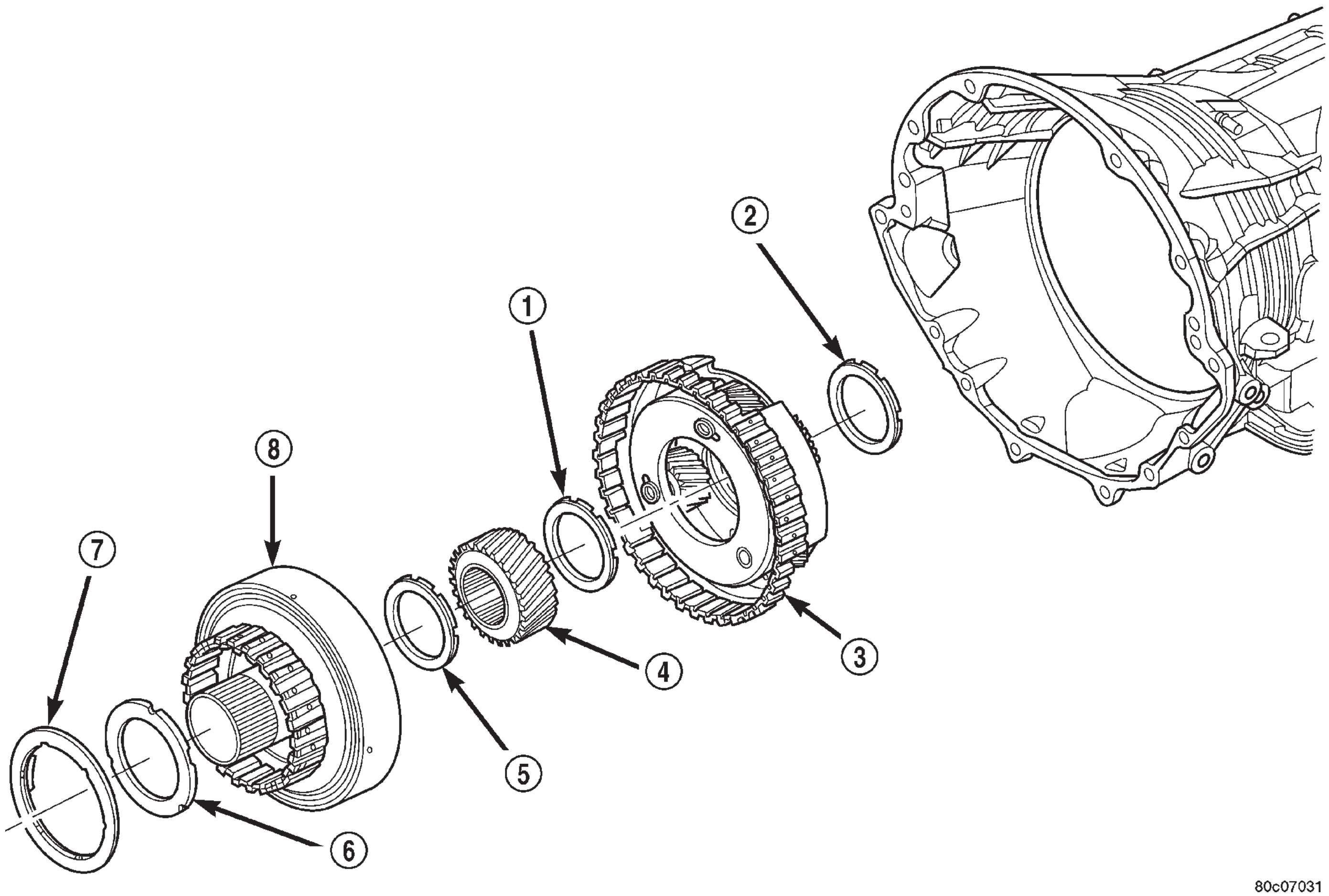


Fig. 37 Install Reaction Annulus and Carrier

1 - BEARING NUMBER 8
2 - BEARING NUMBER 9
3 - REACTION PLANETARY CARRIER
4 - REACTION SUN GEAR
5 - BEARING NUMBER 7
6 - THRUST PLATE (SELECT)
7 - BEARING NUMBER 6
8 - REACTION ANNULUS

(31) Install the output shaft selective thrust plate onto the reaction annulus with the oil grooves facing the annulus gear and the tabs and notches aligned as shown in (Fig. 38).

(32) Install the number 6 bearing against the output shaft selective thrust plate with the flat side against the thrust plate (Fig. 37).

(33) Install the reaction annulus into the reaction planetary gear set (Fig. 37).

(34) Install the 4C retainer/bulkhead into the transmission case. Make sure that the oil feed holes are pointing toward the valve body area. Rotate the reaction annulus during the installation of the 4C retainer/bulkhead to ease installation.

(35) Install the 4C retainer/bulkhead tapered snap-ring into the transmission case (Fig. 39). Make sure that the open ends of the snap-ring are located in the case opening toward the valve body area.

(36) Air check the 2C and 4C clutch operation.

(37) Using Alignment Plate 8261, Adapter 8266-17 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the output shaft end-play (Fig. 40). The correct output shaft end-play is 0.22-0.55 mm (0.009-0.021 in.). Adjust as necessary. Install the chosen output shaft selective thrust plate and re-measure end-play to verify selection.

(38) Apply a bead of RTV silicone and install the extension/adapter housing onto the transmission case.

(39) Install and torque the bolts to hold the extension/adapter housing onto the transmission case. The correct torque is 54 N·m (40 ft.lbs.).

(40) Install the number 5 bearing and selective thrust plate onto the 4C retainer/bulkhead (Fig. 41).

(41) Install the input clutch assembly into the transmission case (Fig. 41). Make sure that the input clutch assembly is fully installed by performing a visual inspection through the input speed sensor

AUTOMATIC TRANSMISSION - 45RFE (Continued)

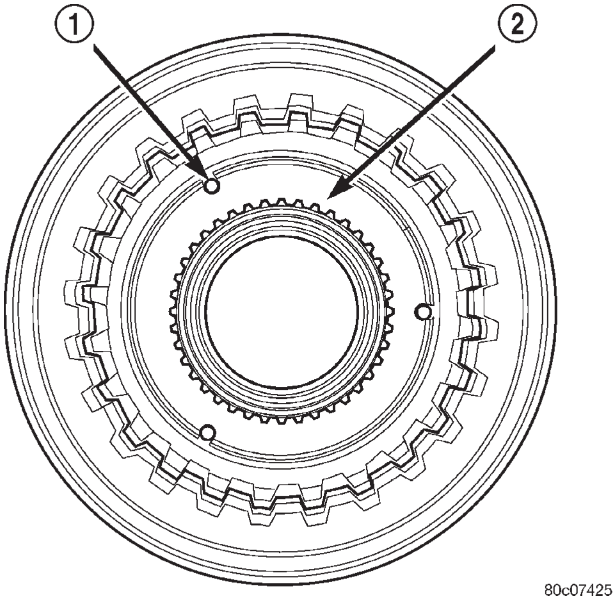


Fig. 38 Thrust Plate Alignment

1 - LOCATING LUG (3)
2 - THRUST PLATE

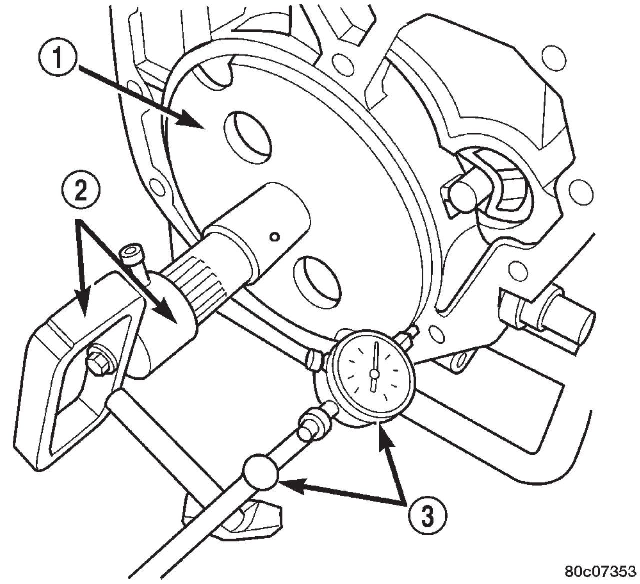


Fig. 40 Measure Output Shaft End Play

1 - TOOL 8261
2 - TOOL 8266
3 - TOOL C-3339

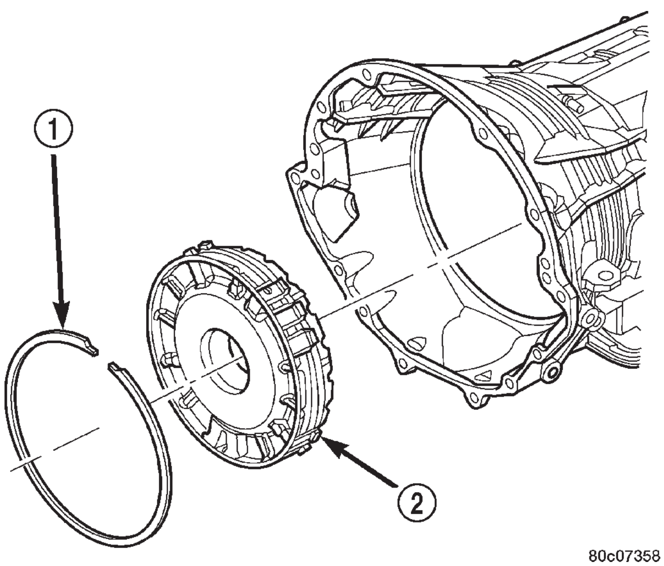


Fig. 39 Install 4C Clutch Retainer/Bulkhead

1 - SNAP-RING
2 - 4C CLUTCH RETAINER/BULKHEAD

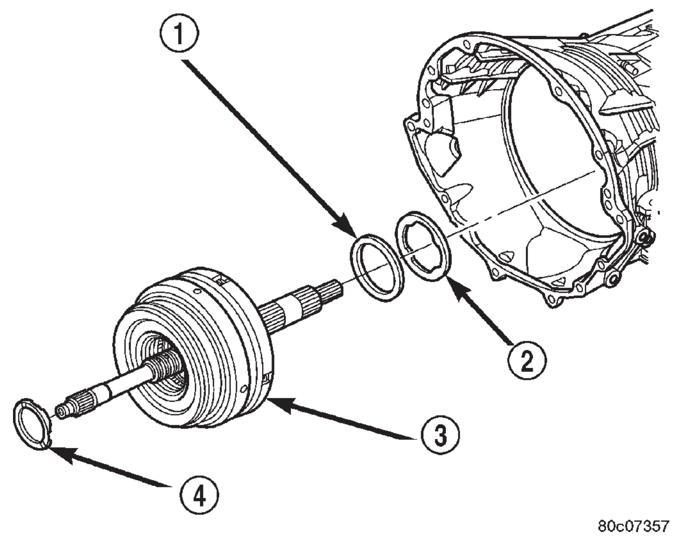


Fig. 41 Install Input Clutch Assembly

1 - BEARING NUMBER 5
2 - THRUST PLATE (SELECT)
3 - INPUT CLUTCH ASSEMBLY
4 - BEARING NUMBER 1

hole. If the tone wheel teeth on the input clutch assembly are visible, the assembly is fully installed.

(42) Install the number 1 bearing with the flat side up in the pocket of the input clutch assembly (Fig. 41).

(43) Install the oil pump into the transmission case (Fig. 42).

(44) Install the bolts to hold the oil pump into the transmission case. Tighten the oil pump bolts to 28 N·m (250 in.lbs.).

(45) Using Adapter 8266-1 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the input shaft end-play (Fig. 43). The correct end-play is 0.46-0.89 mm (0.018-0.035 in.). Adjust as necessary. Install the chosen thrust plater on the number 5 bearing and re-measure end-play to verify selection.

AUTOMATIC TRANSMISSION - 45RFE (Continued)

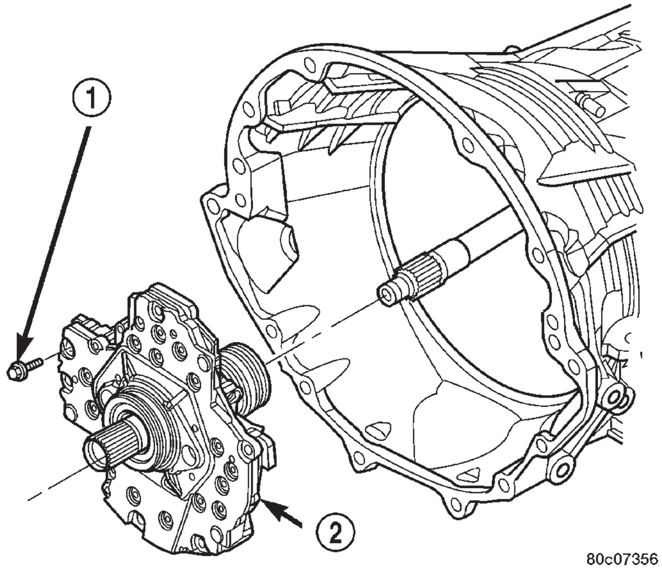


Fig. 42 Install Oil Pump

1 - OIL PUMP TO CASE BOLT (6)
2 - OIL PUMP

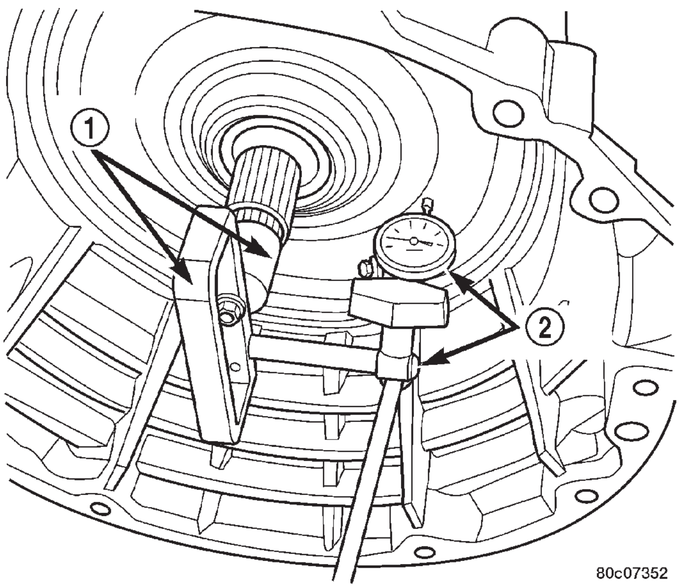


Fig. 43 Measure Input Shaft End Play

1 - TOOL 8266
2 - TOOL C-3339

NOTE: When measuring the input shaft end-play, two ″stops″ will be felt. When the input shaft is pushed inward and the dial indicator zeroed, the first ″stop″ felt when the input shaft is pulled outward is the movement of the input shaft in the input clutch housing hub. This value should not be included in the end-play measured value and therefore must be recorded and subtracted from the dial indicator reading.

(46) Install the transmission front cover into the transmission case (Fig. 44).

(47) Install the outer snap-ring to hold the transmission front cover into the transmission case (Fig. 44).

(48) Partially install the inner transmission front cover snap-ring onto the oil pump (Fig. 44).

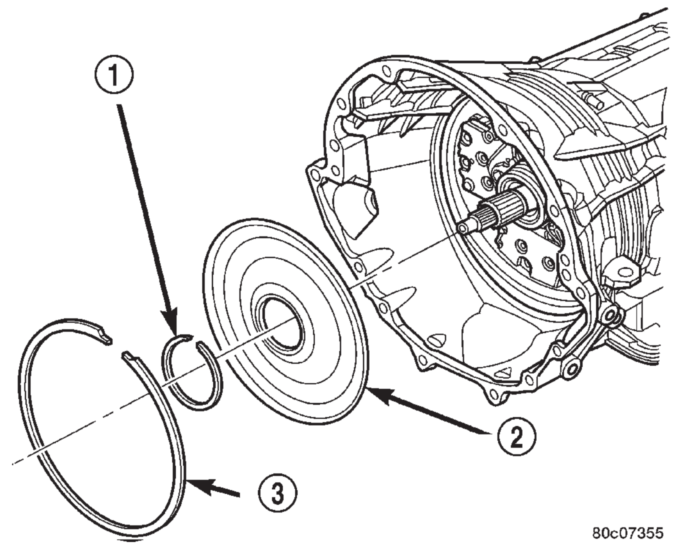


Fig. 44 Install the Transmission Front Cover

1 - INNER SNAP-RING
2 - TRANSMISSION COVER
3 - OUTER SNAP-RING

(49) Using Installer 8255, install the inner transmission front cover snap-ring the remainder of the way onto the oil pump (Fig. 45).

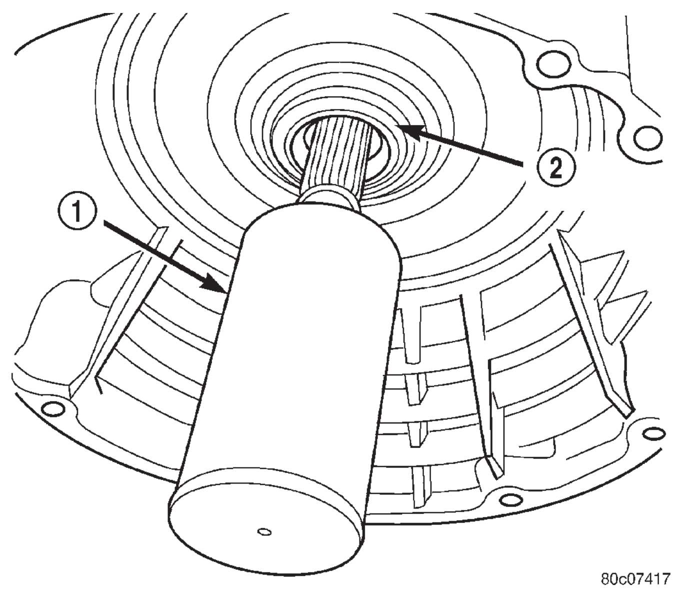


Fig. 45 Seat Snap-Ring Using Tool 8255

1 - TOOL 8255
2 - SNAP-RING

AUTOMATIC TRANSMISSION - 45RFE (Continued)

(50) Install the valve body (Fig. 46). Verify that the pin on the manual lever has properly engaged the TRS selector plate. Tighten the valve body to transmission case bolts to 12 N·m (105 in.lbs.).

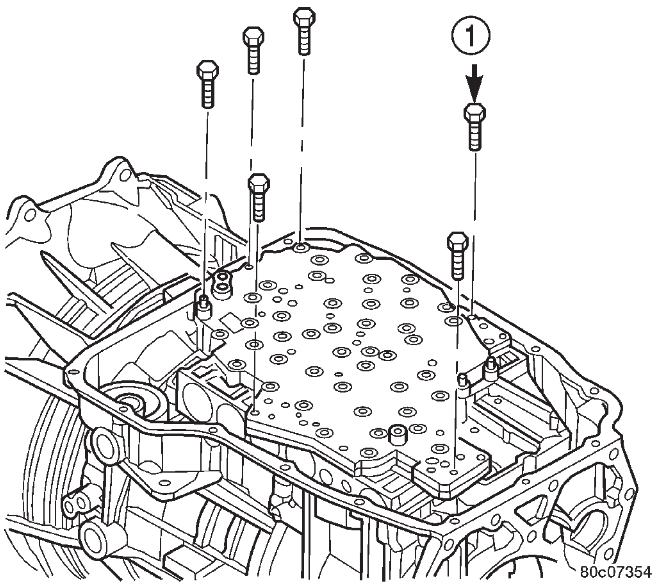


Fig. 46 Install Valve Body Assembly

1 - VALVE BODY TO CASE BOLT (6)

(51) Verify that the primary oil filter seal is properly installed in the oil pump inlet bore.

(52) Install the primary oil filter and the oil cooler return filter (Fig. 47). Tighten the screw to hold the primary oil filter to the valve body to 4.5 N·m (40 in.lbs.). Using Oil Filter Wrench 8321, tighten the cooler return oil filter to the transmission case to 14 N·m (125 in.lbs.).

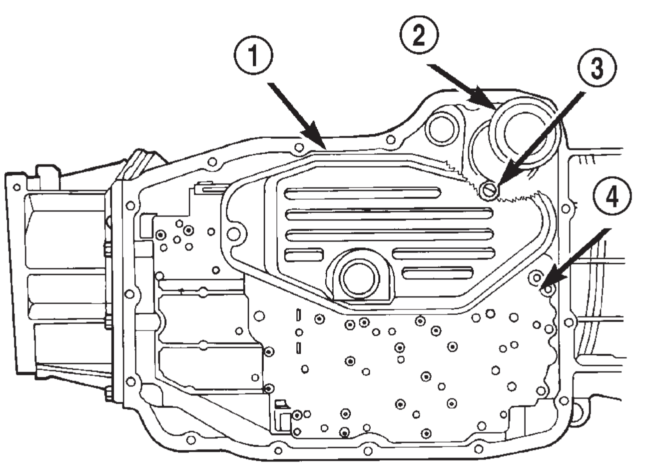


Fig. 47 Install Primary Oil and Cooler Filters

1 - PRIMARY OIL FILTER
2 - COOLER RETURN FILTER
3 - COOLER RETURN FILTER BYPASS VALVE
4 - VALVE BODY

(53) Apply RTV silicone to the oil pan and install the transmission oil pan. Tighten the bolts to 12 N·m (105 in.lbs.).

(54) Install the input, output, and line pressure sensors (Fig. 48). Tighten the bolts to 12 N·m (105 in.lbs.).

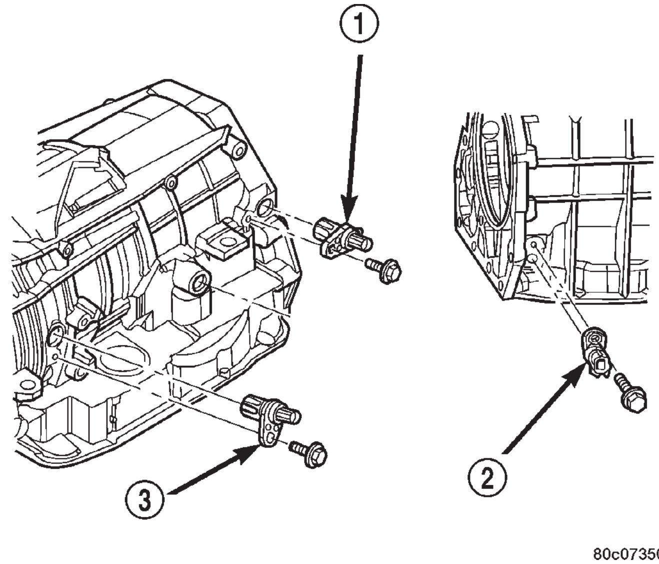


Fig. 48 Install Input, Output, and Line Pressure Sensors

1 - OUTPUT SPEED SENSOR
2 - LINE PRESSURE SENSOR
3 - INPUT SPEED SENSOR

(55) Install the manual shift lever from the transmission. Torque the retaining cross-bolt to 16 N·m (140 in.lbs.).

INSTALLATION

(1) Check torque converter hub and hub drive flats for sharp edges burrs, scratches, or nicks. Polish the hub and flats with 320/400 grit paper and crocus cloth if necessary. Verify that the converter hub o-ring is properly installed and is free of any debris. The hub must be smooth to avoid damaging pump seal at installation.

(2) If a replacement transmission is being installed, transfer any components necessary, such as the manual shift lever and shift cable bracket, from the original transmission onto the replacement transmission.

(3) Lubricate oil pump seal lip with transmission fluid.

AUTOMATIC TRANSMISSION - 45RFE (Continued)

(4) Align converter and oil pump.

(5) Carefully insert converter in oil pump. Then rotate converter back and forth until fully seated in pump gears.

(6) Check converter seating with steel scale and straightedge (Fig. 49). Surface of converter lugs should be at least 13mm (1/2 in.) to rear of straightedge when converter is fully seated.

(7) Temporarily secure converter with C-clamp.

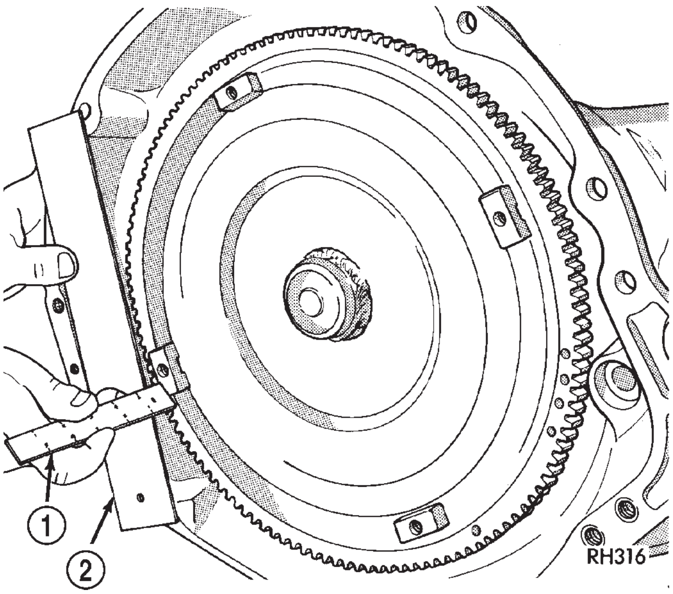


Fig. 49 Checking Torque Converter Seating - Typical

1 - SCALE
2 - STRAIGHTEDGE

(8) Position transmission on jack and secure it with 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) Apply a light coating of Mopar® High Temp Grease to the torque converter hub pocket in the rear pocket of the engine's crankshaft.

(11) Raise transmission and align the torque converter with the drive plate and transmission converter housing with the engine block.

(12) Move transmission forward. Then raise, lower or tilt transmission to align the converter housing with engine block dowels.

(13) Carefully work transmission forward and over engine block dowels until converter hub is seated in crankshaft. Verify that no wires, or the transmission vent hose, have become trapped between the engine block and the transmission.

(14) Install two bolts to attach the transmission to the engine.

(15) Install remaining torque converter housing to engine bolts. Tighten to 68 N·m (50 ft.lbs.).

(16) Install transfer case, if equipped. Tighten transfer case nuts to 35 N·m (26 ft.lbs.).

(17) Install rear transmission crossmember. Tighten crossmember to frame bolts to 68 N·m (50 ft.lbs.).

(18) Install rear support to transmission. Tighten bolts to 47 N·m (35 ft.lbs.).

(19) Lower transmission onto crossmember and install bolts attaching transmission mount to crossmember. Tighten clevis bracket to crossmember bolts to 47 N·m (35 ft.lbs.). Tighten the clevis bracket to rear support bolt to 68 N·m (50 ft.lbs.).

(20) Remove engine support fixture.

(21) Connect gearshift cable to transmission.

(22) Connect wires to solenoid and pressure switch assembly connector, input and output speed sensors, and line pressure sensor. Be sure transmission harnesses are properly routed.

CAUTION: It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the clutch surface inside the converter.

(23) Install torque converter-to-driveplate bolts. Tighten bolts to 31 N·m (270 in. lbs.).

(24) Install starter motor and cooler line bracket.

(25) Connect cooler lines to transmission.

(26) Install transmission fill tube.

(27) Install exhaust components.

(28) Install the engine collar onto the transmission and the engine. Tighten the bolts to 54 N·m (40 ft.lbs.).

(29) Align and connect propeller shaft(s).

(30) Adjust gearshift cable if necessary.

(31) Install any skid plates removed previously. (Refer to 13 - FRAMES & BUMPERS/FRAME/ TRANSFER CASE SKID PLATE - INSTALLATION)

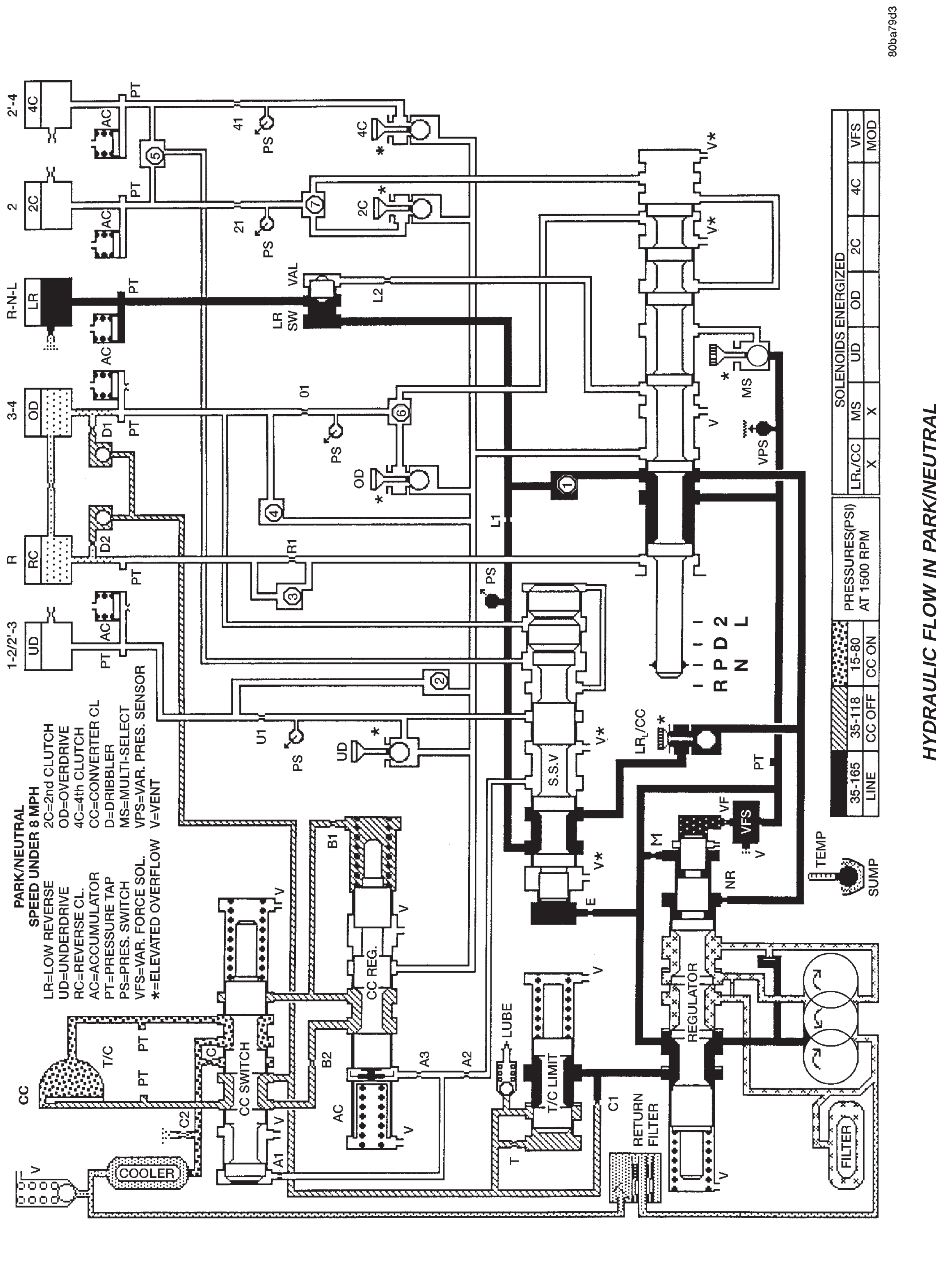
(32) Lower vehicle.

(33) Fill transmission with Mopar® ATF +4, type 9602, Automatic Transmission Fluid.

AUTOMATIC TRANSMISSION - 45RFE (Continued)

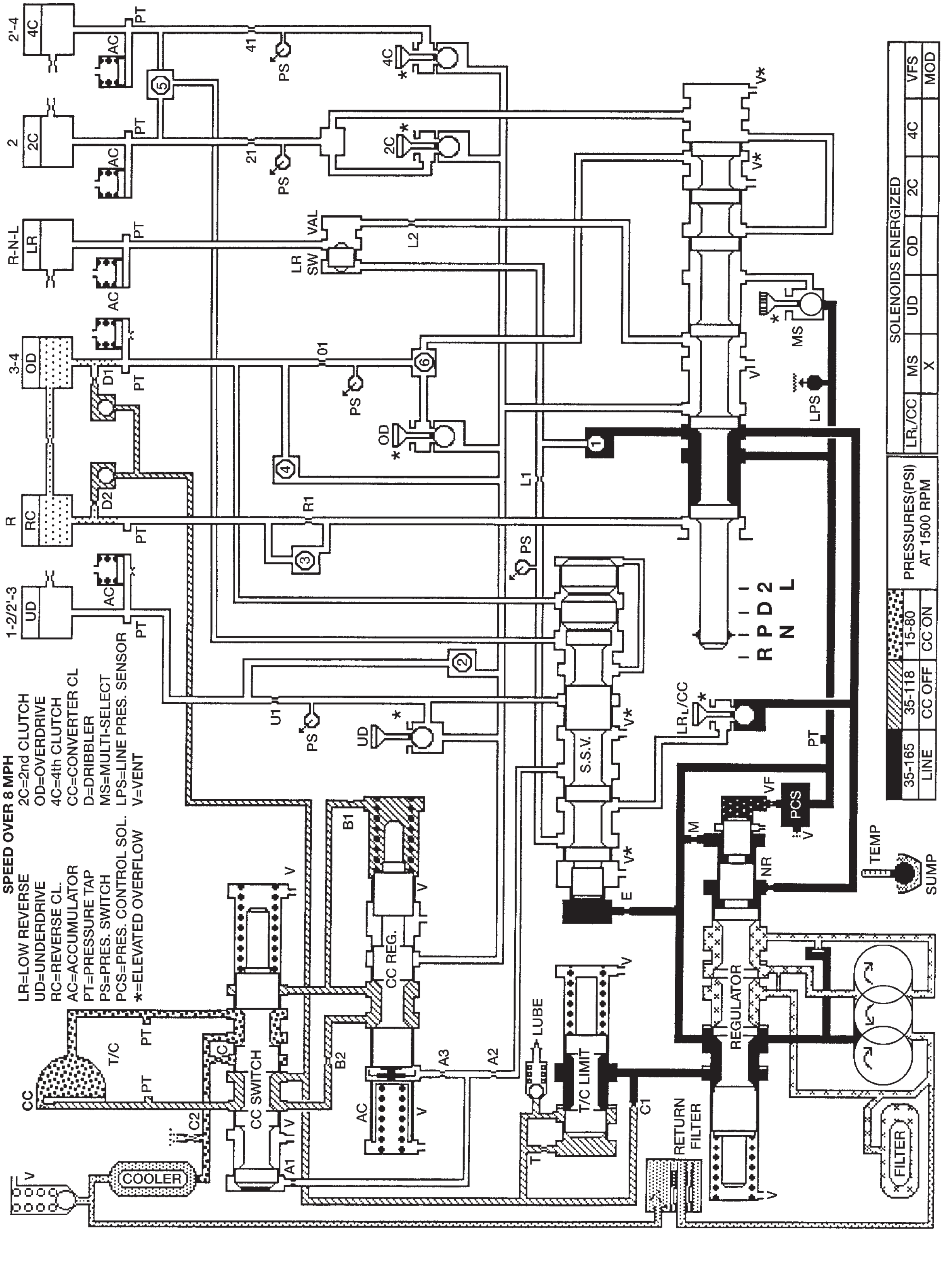
SCHEMATICS AND DIAGRAMS

HYDRAULIC SCHEMATICS



HYDRAULIC FLOW IN PARK/NEUTRAL

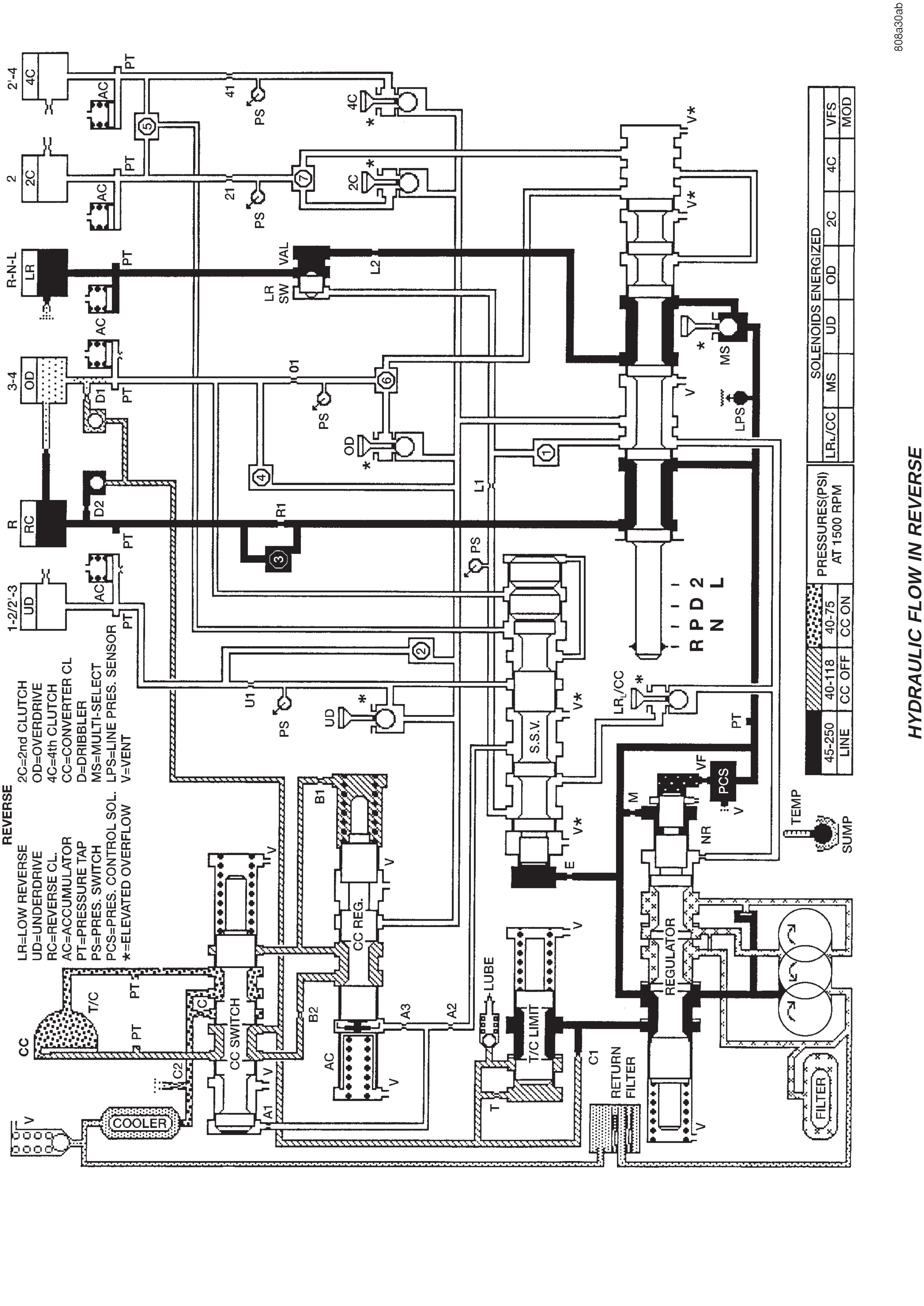
AUTOMATIC TRANSMISSION - 45RFE (Continued)



808a30aa

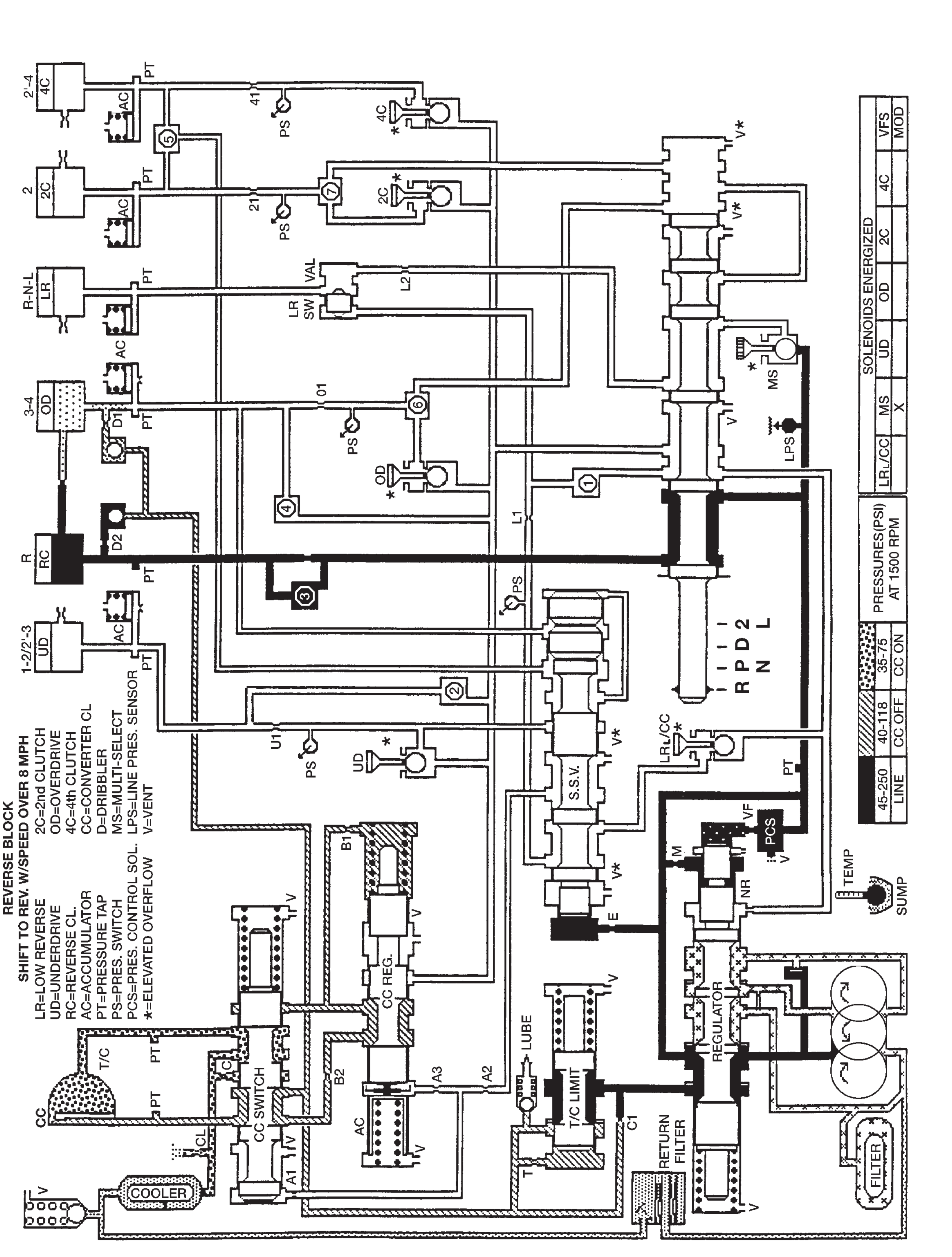
HYDRAULIC FLOW IN NEUTRAL OVER 8MPH

AUTOMATIC TRANSMISSION - 45RFE (Continued)



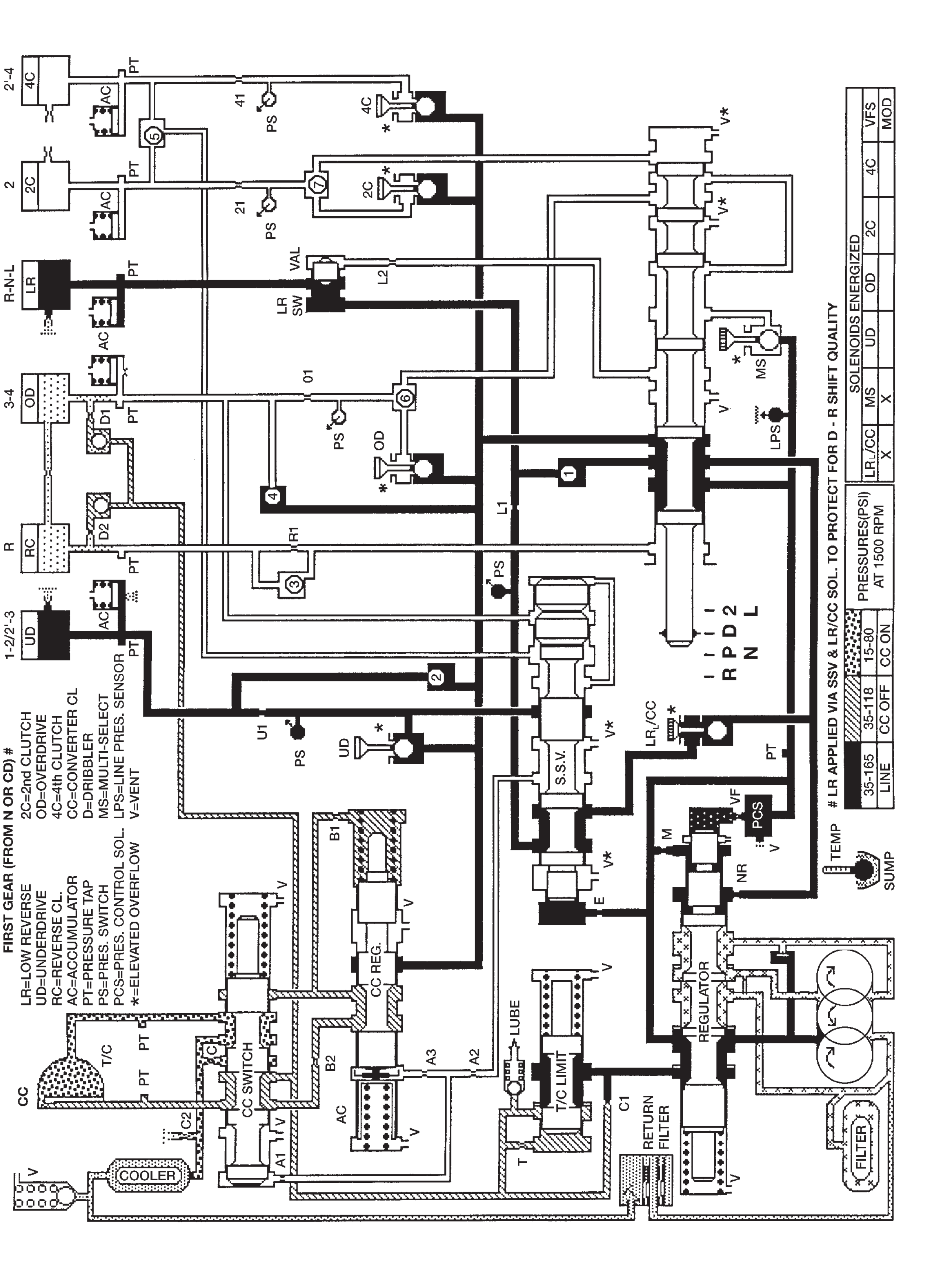
HYDRAULIC FLOW IN REVERSE

AUTOMATIC TRANSMISSION - 45RFE (Continued)



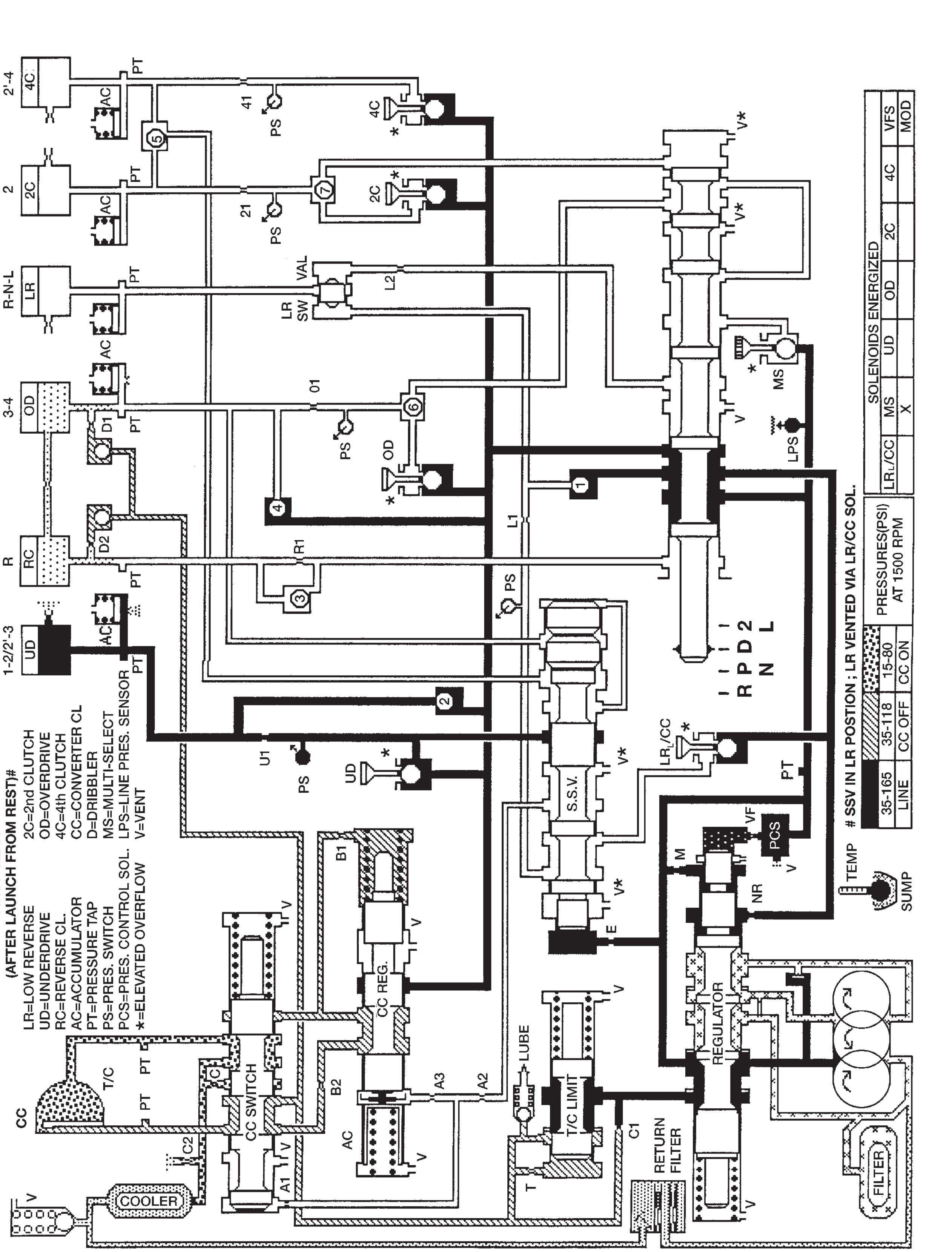
HYDRAULIC FLOW IN REVERSE BLOCK

AUTOMATIC TRANSMISSION - 45RFE (Continued)



HYDRAULIC FLOW IN FIRST GEAR (FROM N OR OD)

AUTOMATIC TRANSMISSION - 45RFE (Continued)

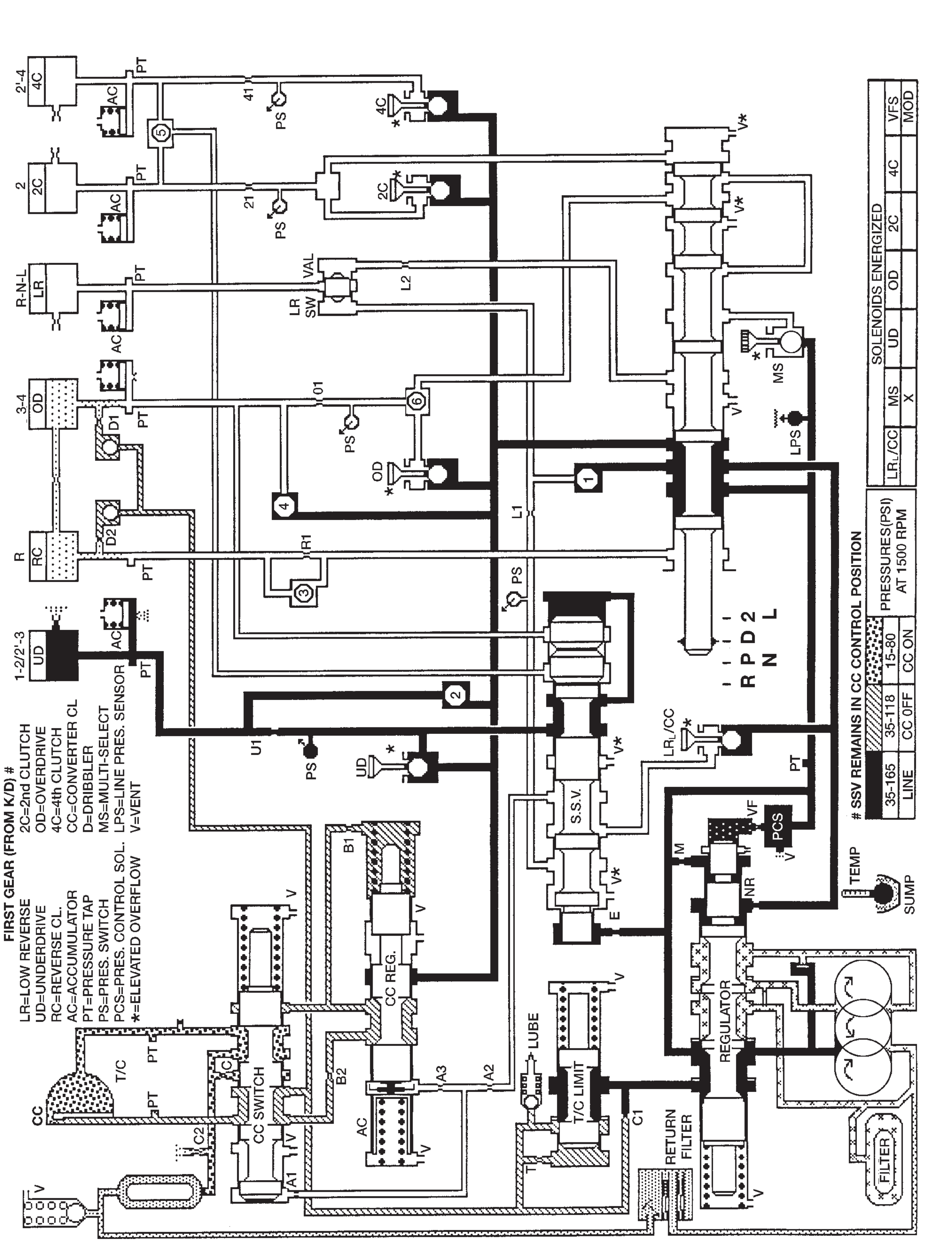


35-165	35-118	15-80	PRESSURES(PSI) AT 1500 RPM
LINE	CC OFF	CC ON	

SOLENOIDS ENERGIZED					
LR/CC	MS	UD	OD	2C	4C	VFS
	X					MOD

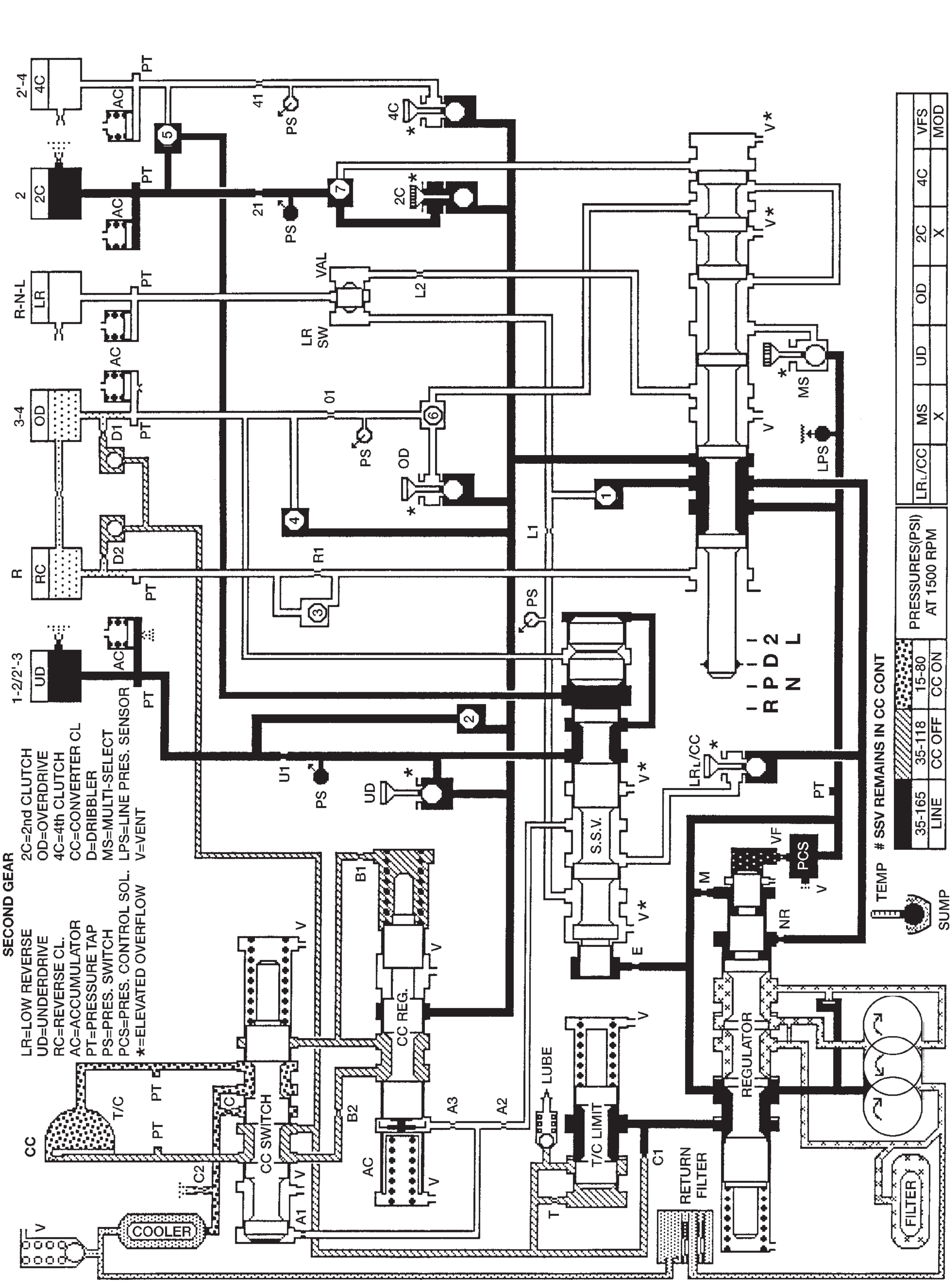
HYDRAULIC FLOW IN FIRST GEAR (AFTER LAUNCH FROM REST)

AUTOMATIC TRANSMISSION - 45RFE (Continued)



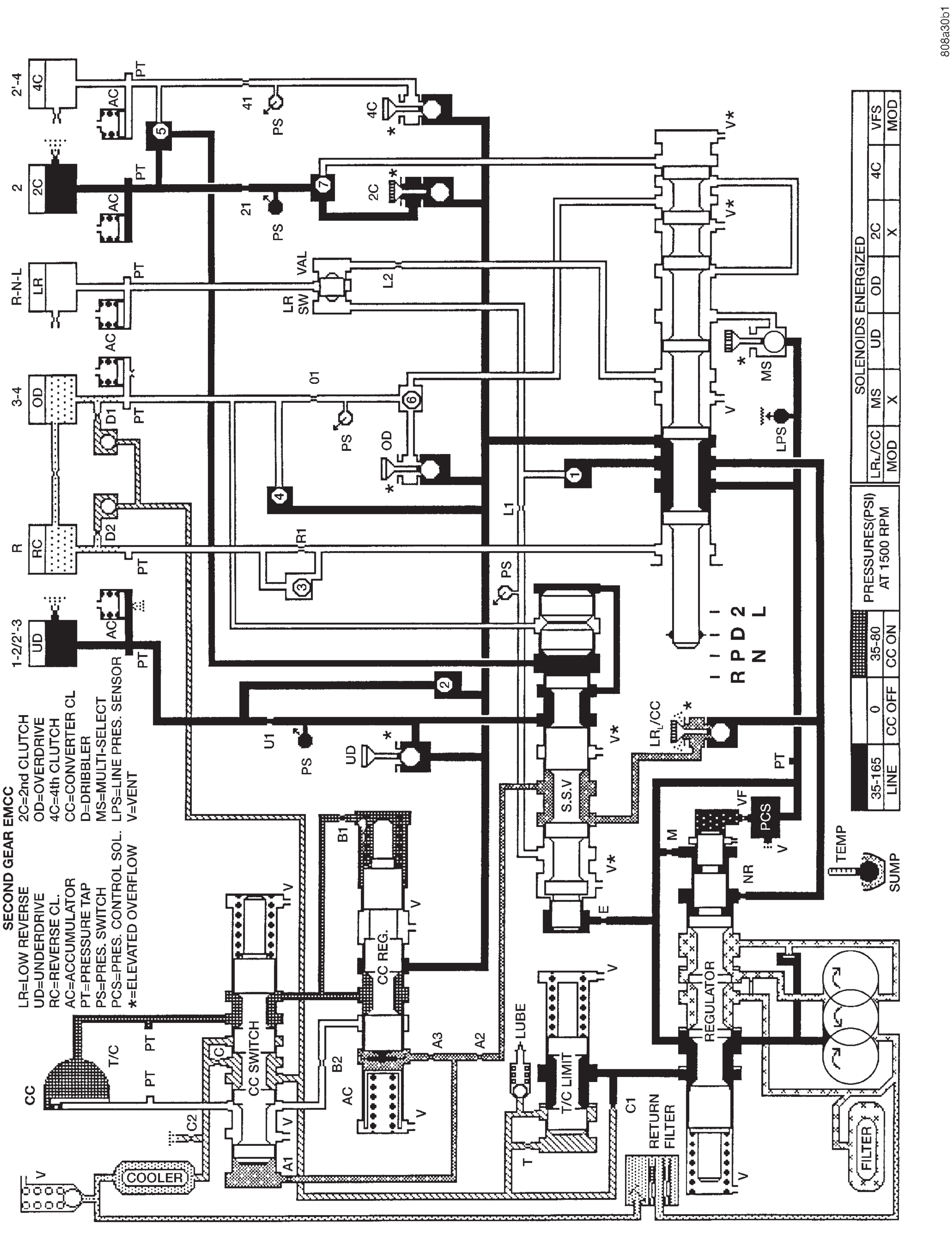
HYDRAULIC FLOW IN FIRST GEAR (FROM K/D)

AUTOMATIC TRANSMISSION - 45RFE (Continued)



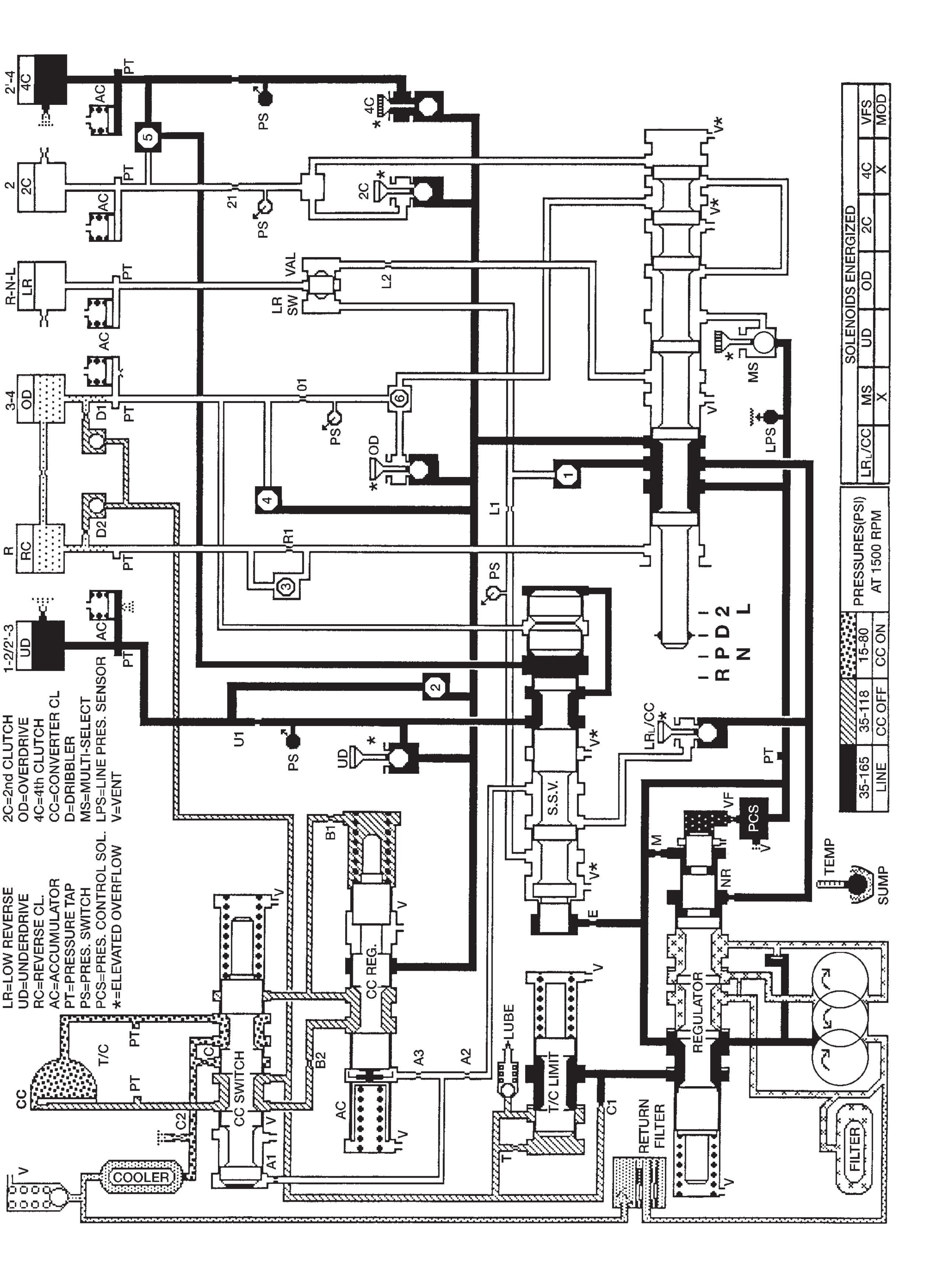
HYDRAULIC FLOW IN SECOND GEAR

AUTOMATIC TRANSMISSION - 45RFE (Continued)



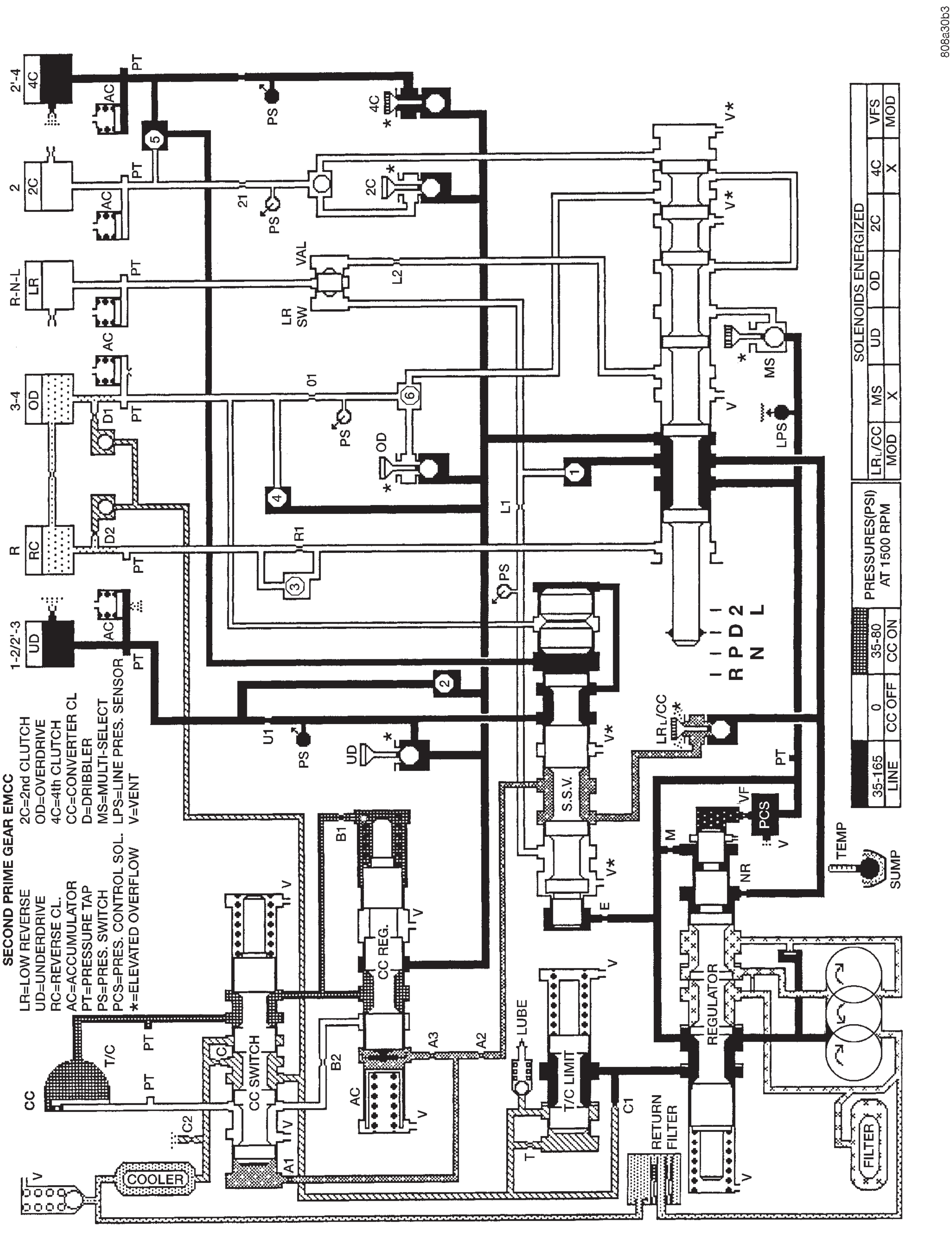
HYDRAULIC FLOW IN SECOND GEAR EMCC

AUTOMATIC TRANSMISSION - 45RFE (Continued)



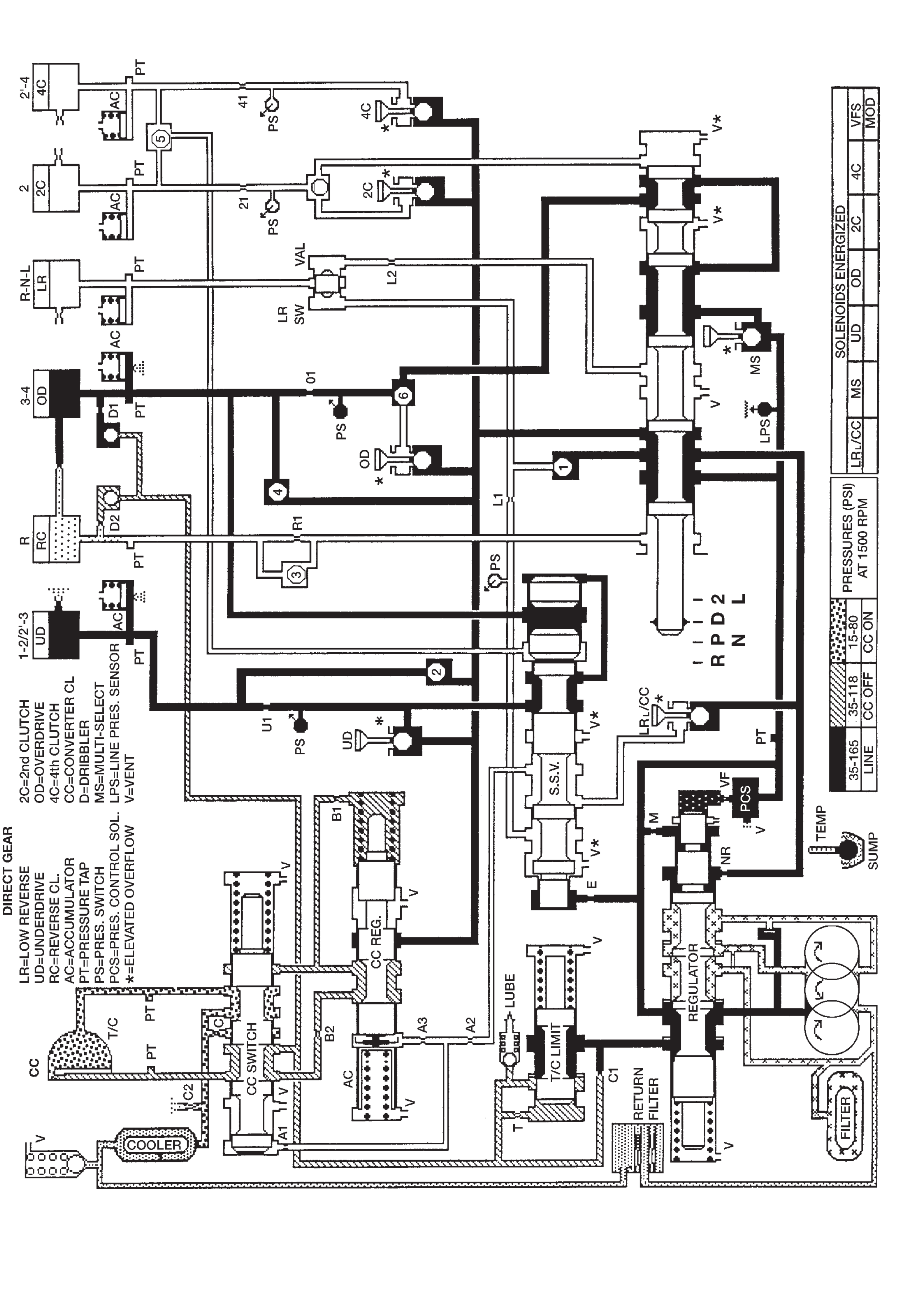
HYDRAULIC FLOW IN SECOND PRIME GEAR

AUTOMATIC TRANSMISSION - 45RFE (Continued)



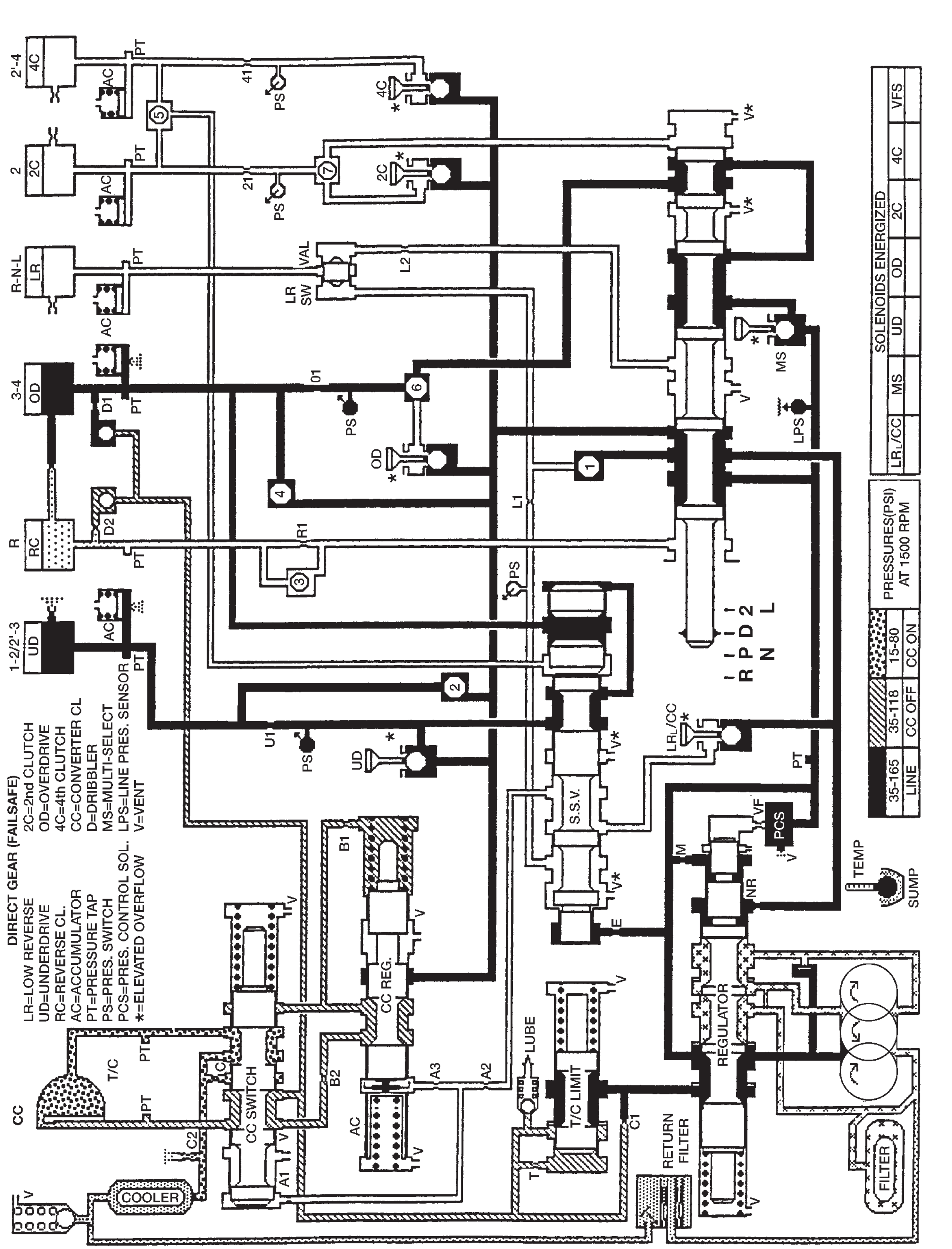
HYDRAULIC FLOW IN SECOND PRIME GEAR EMCC

AUTOMATIC TRANSMISSION - 45RFE (Continued)



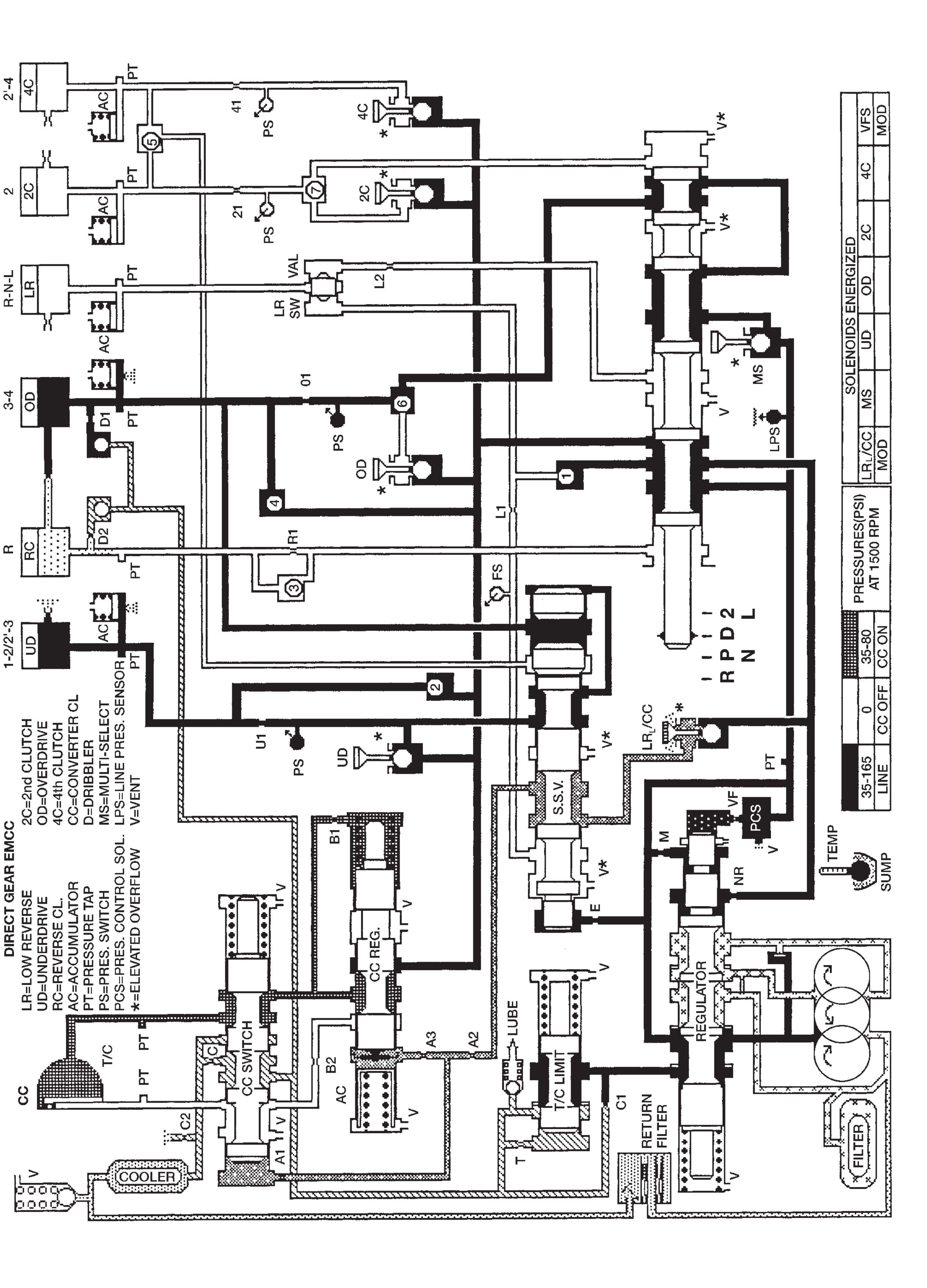
HYDRAULIC FLOW IN DIRECT GEAR

AUTOMATIC TRANSMISSION - 45RFE (Continued)



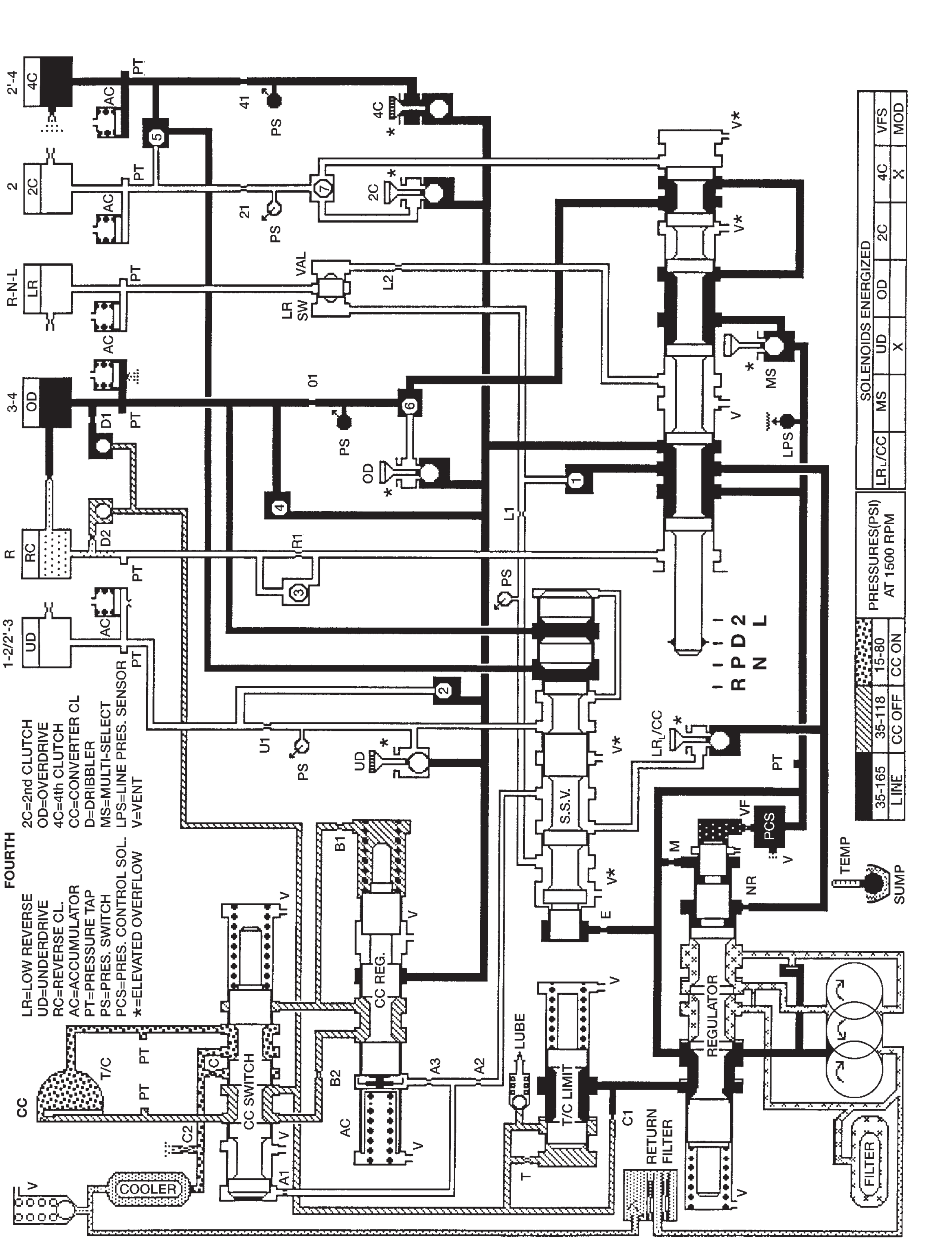
HYDRAULIC FLOW IN DIRECT GEAR (FAILSAFE)

AUTOMATIC TRANSMISSION - 45RFE (Continued)



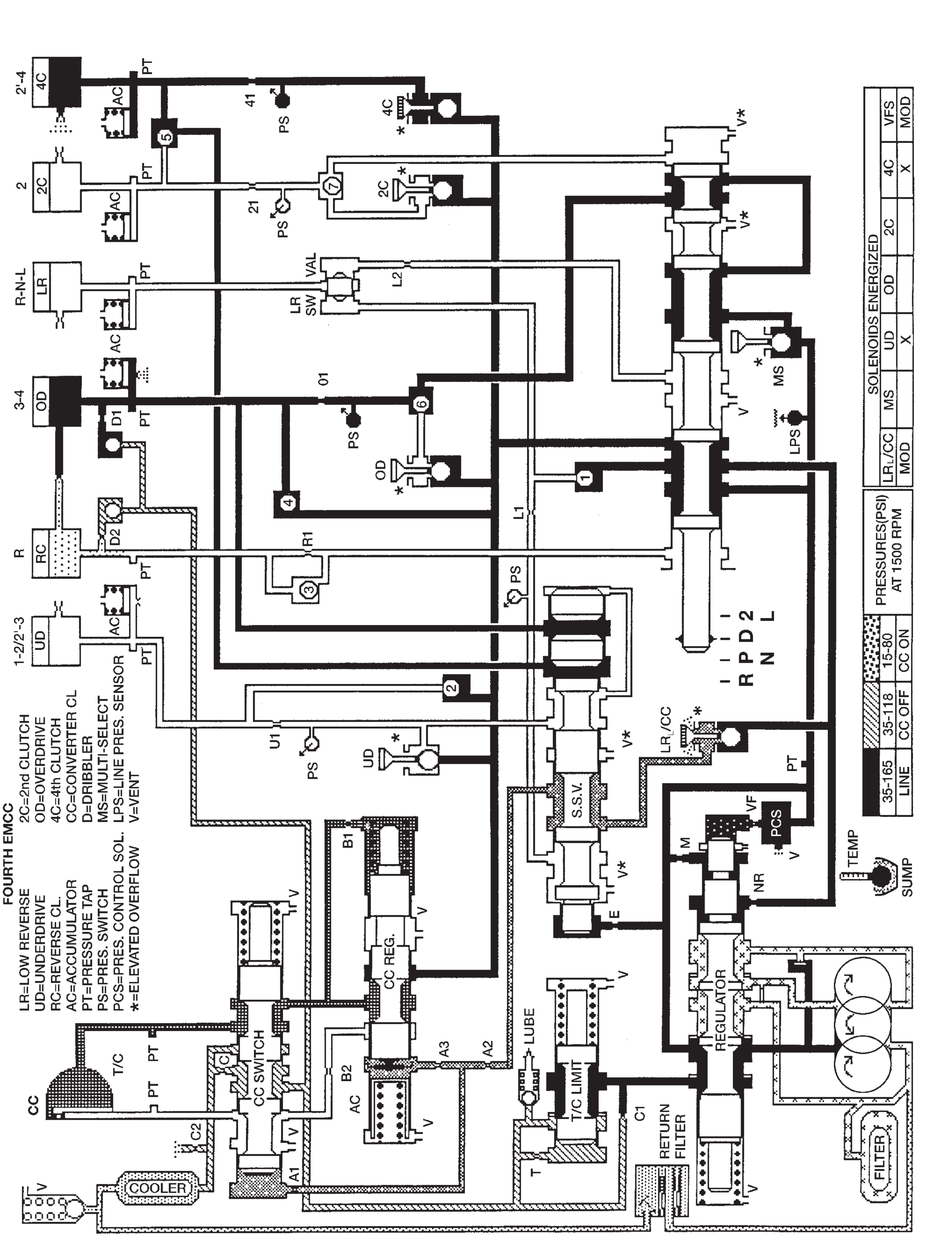
HYDRAULIC FLOW IN DIRECT GEAR EMCC

AUTOMATIC TRANSMISSION - 45RFE (Continued)



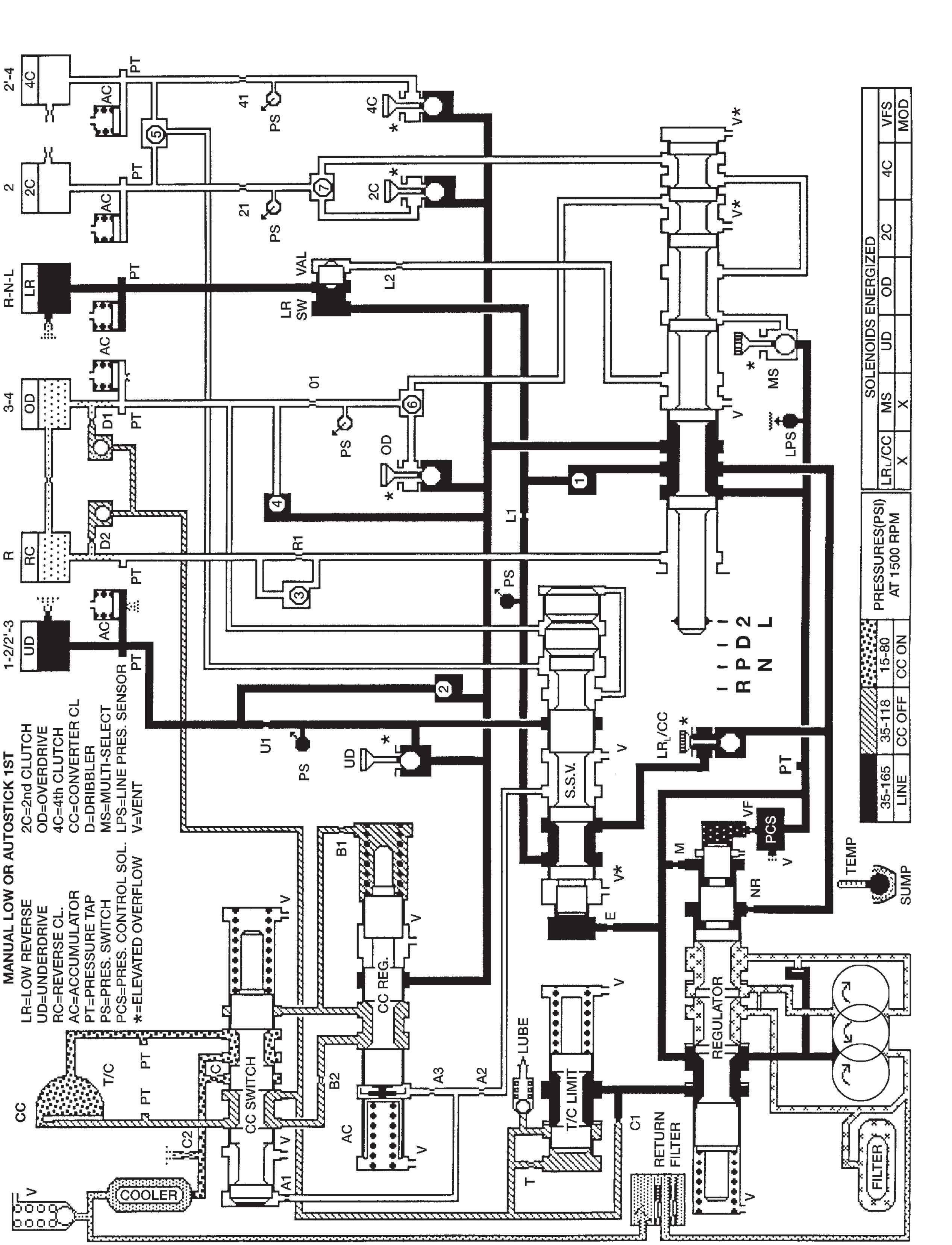
HYDRAULIC FLOW IN FOURTH

AUTOMATIC TRANSMISSION - 45RFE (Continued)



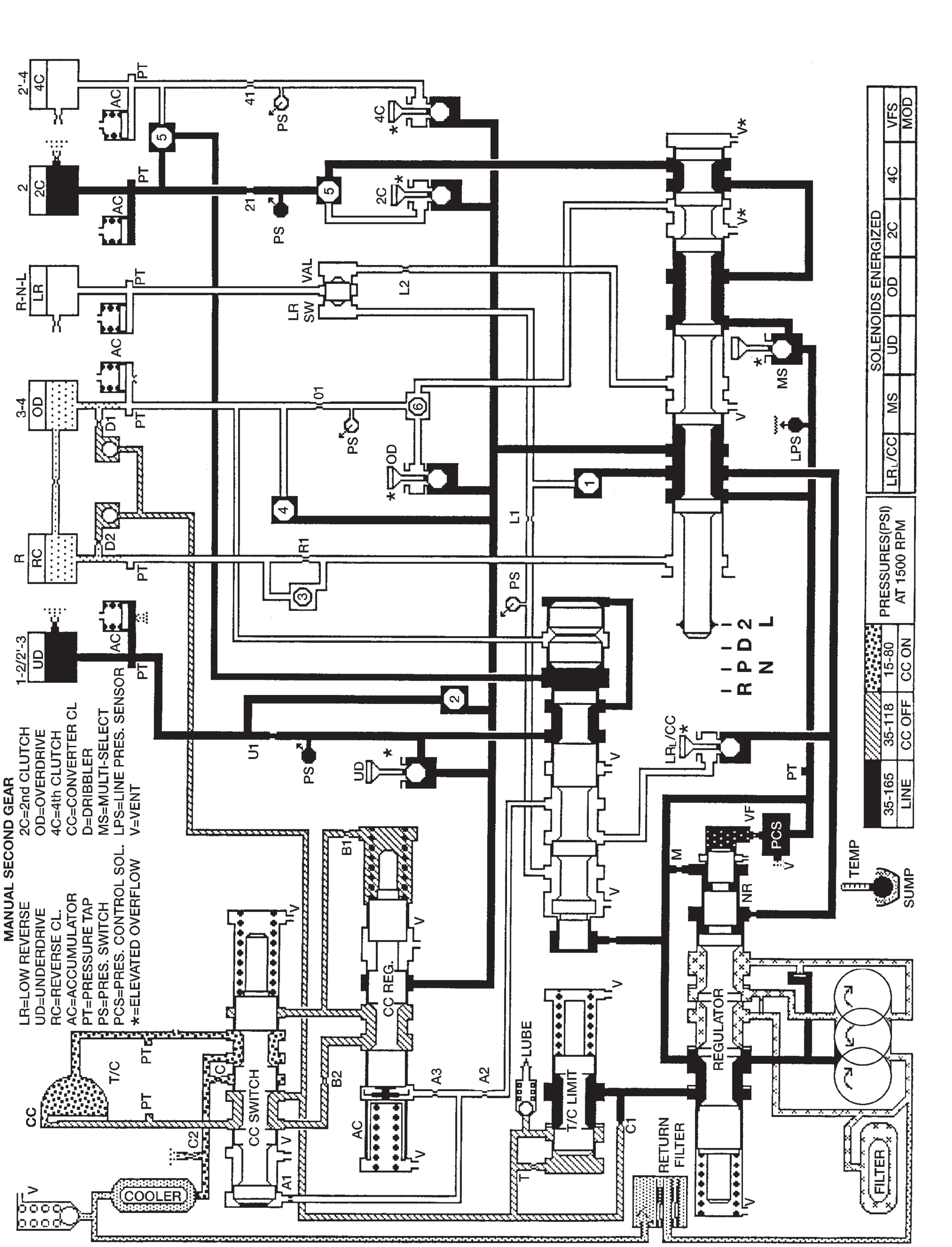
HYDRAULIC FLOW IN FOURTH EMCC

AUTOMATIC TRANSMISSION - 45RFE (Continued)



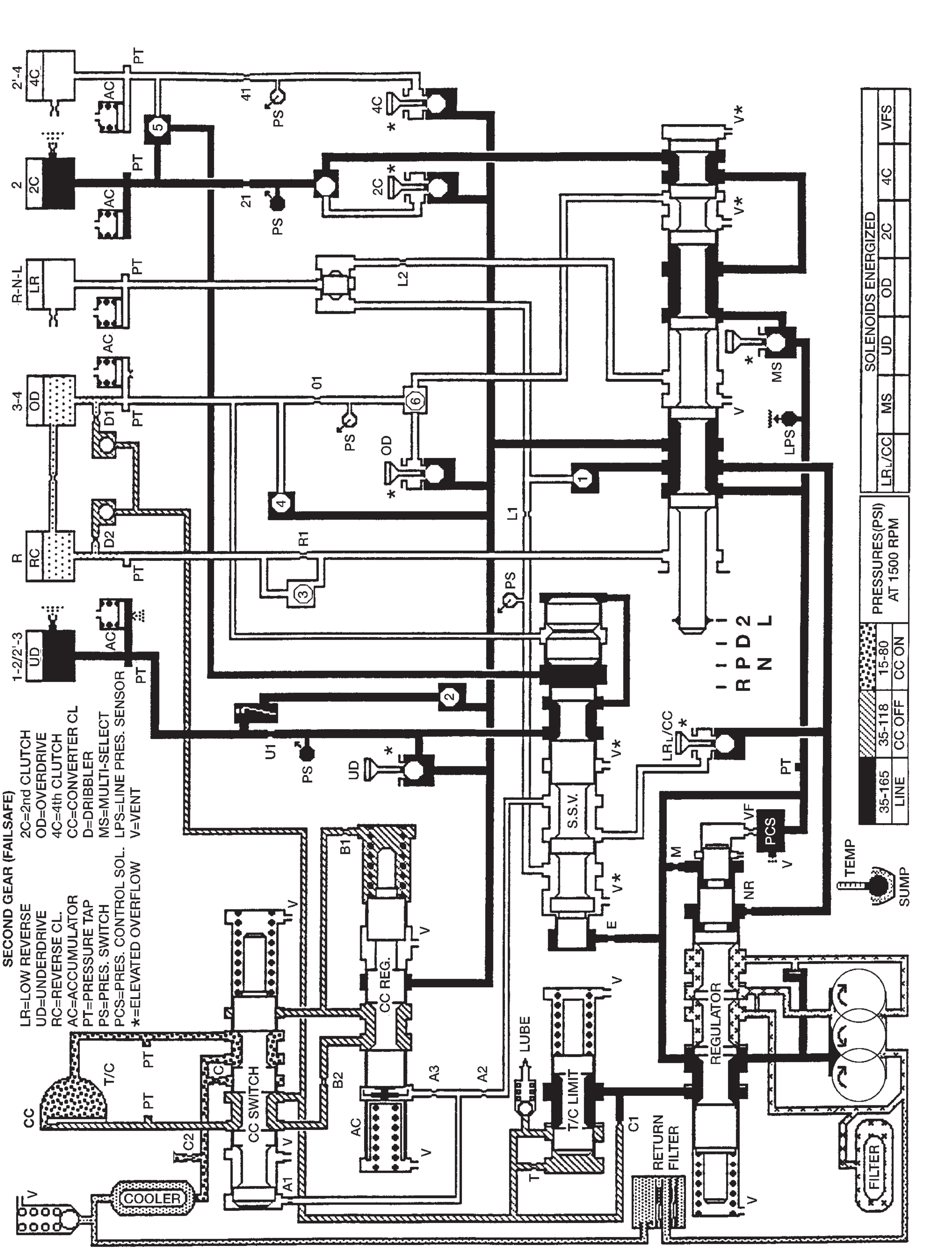
HYDRAULIC FLOW IN MANUAL LOW OR AUTOSTICK 1ST

AUTOMATIC TRANSMISSION - 45RFE (Continued)



HYDRAULIC FLOW IN MANUAL SECOND

AUTOMATIC TRANSMISSION - 45RFE (Continued)



HYDRAULIC FLOW IN MANUAL SECOND (FAILSAFE)

AUTOMATIC TRANSMISSION - 45RFE (Continued)

SPECIFICATIONS

TRANSMISSION

GENERAL

Component	Metric	Inch
Output Shaft End Play	0.22-0.55 mm	0.009-0.021 in.
Input Shaft End Play	0.46-0.89 mm	0.018-0.035 in.
2C Clutch Pack Clearance	0.53-1.27 mm	0.021-0.050 in.
4C Clutch Pack Clearance	0.81-1.35 mm	0.032-0.053 in.
L/R Clutch Pack Clearance	1.14-1.91 mm	0.045-0.075 in.
OD Clutch Pack Clearance	1.016-1.65 mm	0.040-0.065 in.
UD Clutch Pack Clearance	0.76-1.160 mm	0.030-0.063 in.
Reverse Clutch Pack Clearance	0.81-1.24 mm	0.032-0.049 in.
Recommended fluid	Mopar® ATF Plus 4, type 9602	

GEAR RATIOS

1ST	3.00:1
2ND	1.67:1
2ND Prime	1.50:1
3RD	1.0:1
4TH	0.75:1
REVERSE	3.00:1

TORQUE SPECIFICATIONS

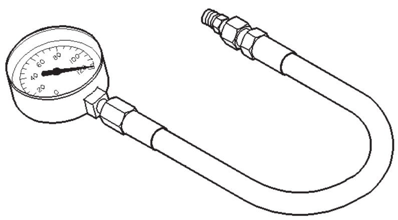
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Fitting, cooler line at trans	17.5	-	155
Bolt, torque convertor	31	23	-
Bolt/nut, crossmember	68	50	-
Bolt, driveplate to crankshaft	75	55	-
Bolt, oil pan	11.8	-	105
Screw, primary fluid filter	4.5	-	40
Bolt, oil pump	28.2	-	250
Bolt, oil pump body to cover	4.5	-	40
Screw, plate to oil pump body	4.5	-	40
Bolt, valve body to case	11.8	-	105
Plug, pressure test port	5.1	-	45
Bolt, reaction shaft support	11.8	-	105
Screw, valve body to transfer plate	5.6	-	50
Screw, solenoid module to transfer plate	5.7	-	50
Screw, accumulator cover	4.5	-	40
Screw, detent spring	4.5	-	40
Bolt, input speed sensor	11.8	-	105
Bolt, output speed sensor	11.8	-	105

AUTOMATIC TRANSMISSION - 45RFE (Continued)

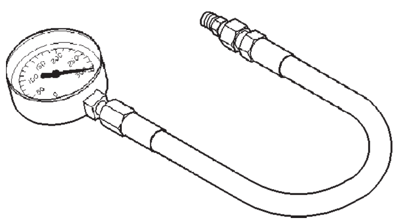
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Bolt, line pressure sensor	11.8	-	105
Bolt, extension housing	54	40	-
Valve, cooler return filter bypass	4.5	-	40
Screw, manual valve cam retaining	4.5	-	40
Bolt, manual lever	28.2	-	250

SPECIAL TOOLS

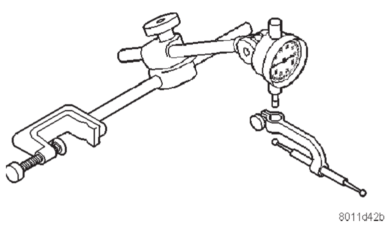
RFE TRANSMISSION



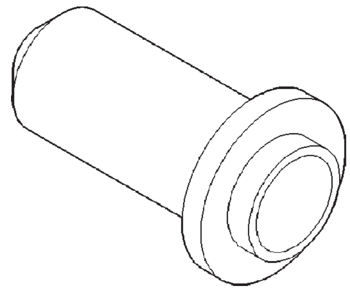
Gauge, Oil Pressure - C-3292



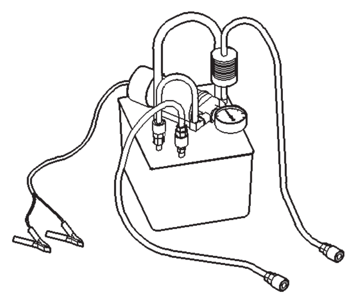
Gauge, Oil Pressure - C-3293SP



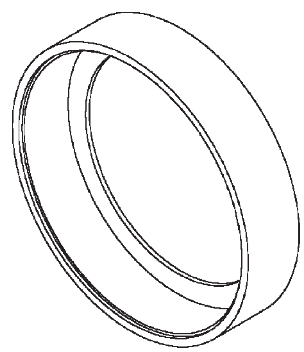
Dial Indicator - C-3339



Installer, Seal - C-3860-A

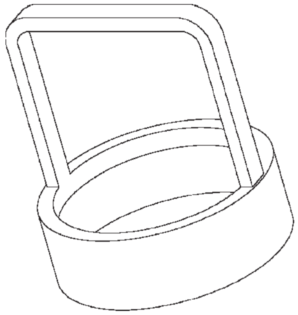


Flusher, Oil Cooler - 6906-C

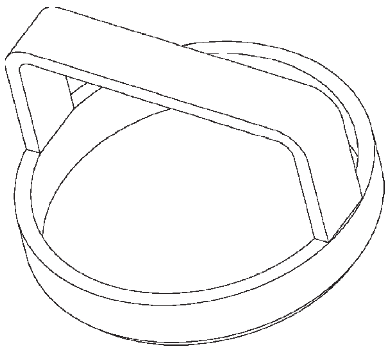


Compressor, Spring - 8249

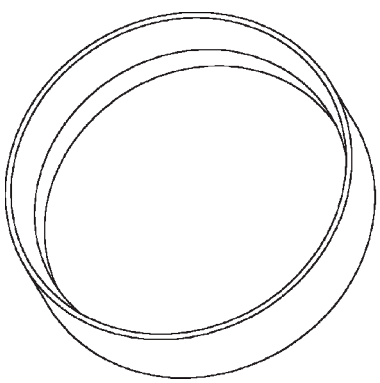
AUTOMATIC TRANSMISSION - 45RFE (Continued)



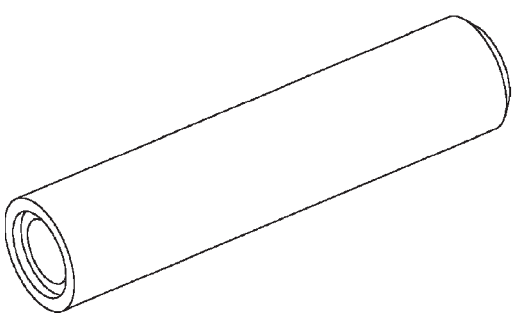
Compressor, Spring - 8250



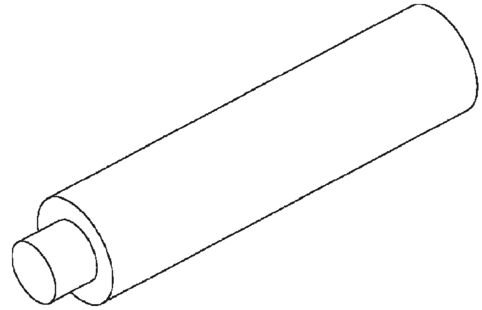
Compressor, Spring - 8251



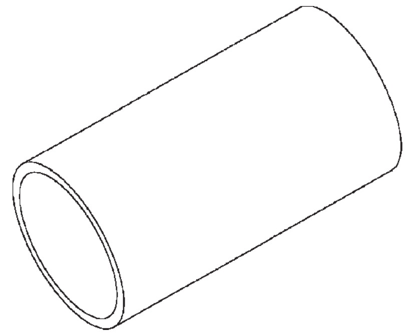
Installer, Piston - 8252



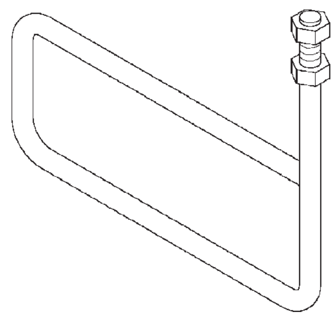
Installer, Seal - 8253



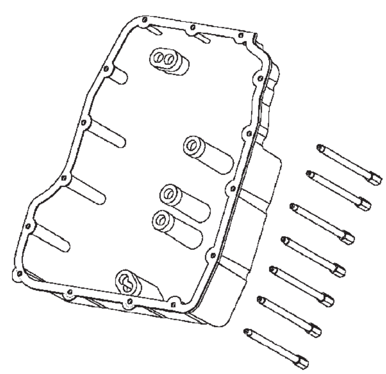
Installer, Seal - 8254



Installer, Snap-ring - 8255

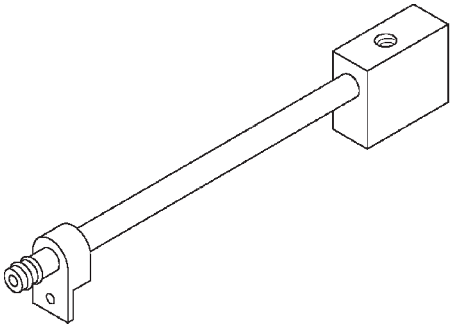


Stand, Support - 8257

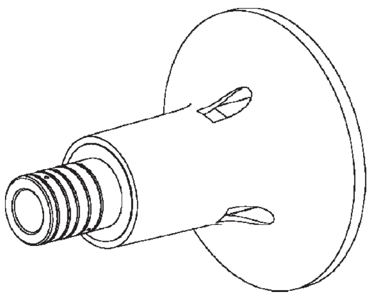


Adapter, Pressure Tap - 8258-A

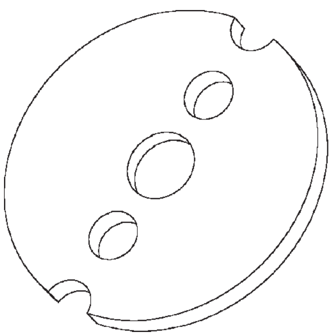
AUTOMATIC TRANSMISSION - 45RFE (Continued)



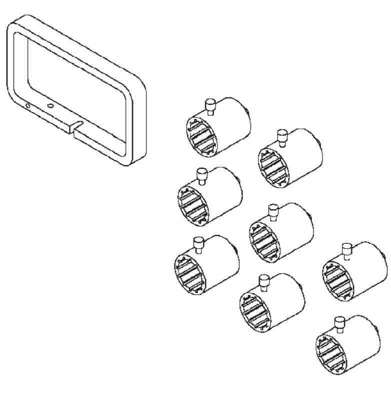
Adapter, Line Pressure - 8259



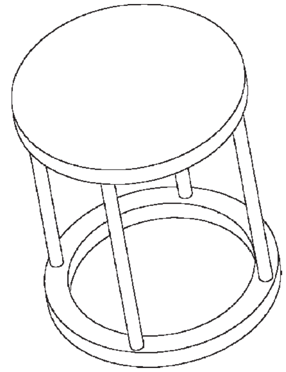
Fixture, Input Clutch Pressure - 8260



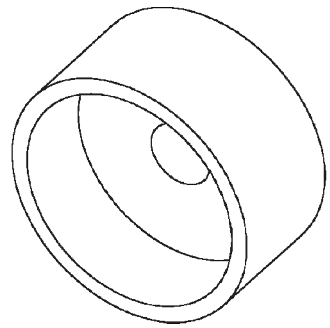
Plate, Alignment - 8261



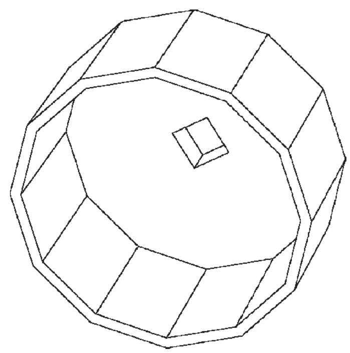
End Play Set - 8266



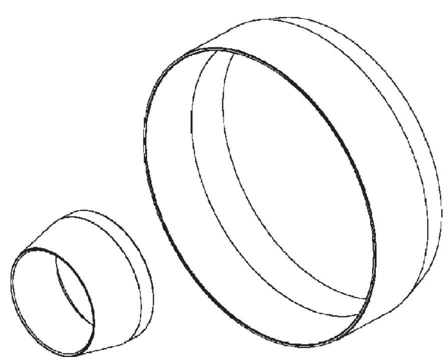
Compressor, Spring - 8285



Installer, Bearing - 8320



Wrench, Filter - 8321



Installer, Piston - 8504

4C RETAINER/BULKHEAD

DISASSEMBLY

(1) Remove the 2C piston belleville spring snap-ring from the 4C retainer /bulkhead (Fig. 50).

(2) Remove the 2C piston Belleville spring from the retainer/bulkhead (Fig. 50).

(3) Remove the 2C piston from the retainer/bulkhead. Use 20 psi of air pressure to remove the piston if necessary.

(4) Remove the 4C clutch snap-ring from the retainer/bulkhead (Fig. 50).

(5) Remove the 4C clutch pack from the retainer/bulkhead (Fig. 50).

(6) Using Spring Compressor 8250 and a suitable shop press, compress the 4C piston return spring and remove the snap-ring (Fig. 50).

(7) Remove the 4C piston return spring and piston from the retainer/bulkhead (Fig. 50). Use 20 psi of air pressure to remove the piston if necessary.

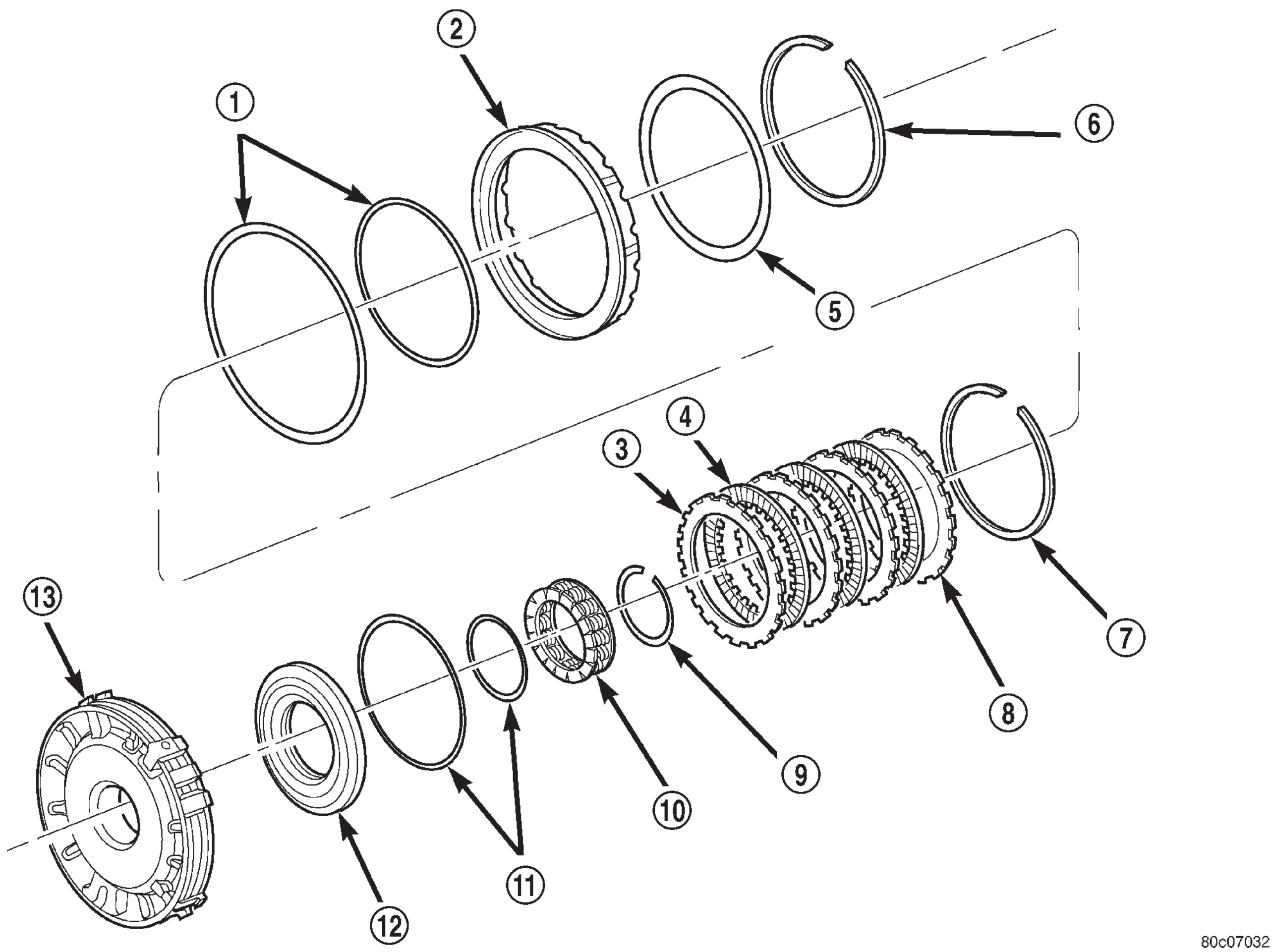


Fig. 50 4C Retainer/Bulkhead Components

1 - SEAL
2 - 2C PISTON
3 - PLATE
4 - DISC
5 - 2C BELLEVILLE SPRING
6 - SNAP-RING
7 - SNAP-RING (SELECT)
8 - REACTION PLATE
9 - SNAP-RING
10 - RETURN SPRING
11 - SEAL
12 - 4C PISTON
13 - 4C RETAINER/BULKHEAD

4C RETAINER/BULKHEAD (Continued)

ASSEMBLY

(1) Clean and inspect all components. Replace any components which show evidence of excessive wear or scoring.

(2) Install new seals on the 2C and 4C pistons (Fig. 50).

(3) Lubricate all seals with Mopar® ATF +4, type 9602 prior to installation.

(4) Install the 4C piston into the 4C retainer/bulkhead (Fig. 50).

(5) Position the 4C piston return spring onto the 4C piston.

(6) Using Spring Compressor 8250 and a suitable shop press, compress the 4C piston return spring and install the snap-ring (Fig. 51).

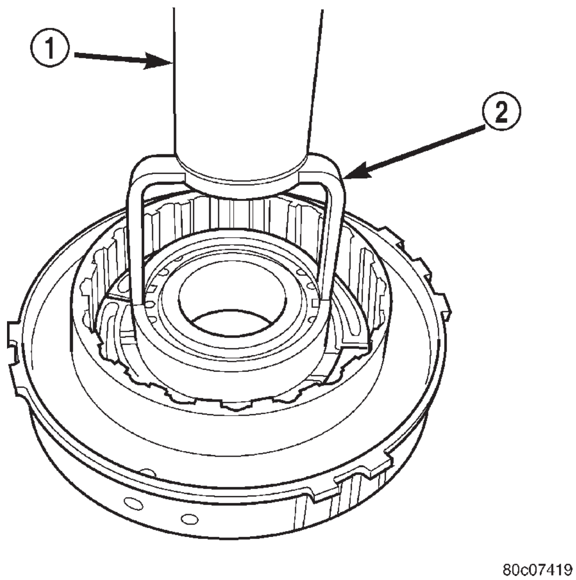


Fig. 51 Compress 4C Piston Return Spring Using Tool 8250

1 - PRESS
2 - TOOL 8250

(7) Assemble and install the 4C clutch pack into the retainer/bulkhead (Fig. 50) with the steel separator plate against the piston.

(8) Install the 4C reaction plate and snap-ring into the retainer/bulkhead (Fig. 50). The 4C reaction plate is non-directional.

(9) Measure the 4C clutch clearance. The correct clutch clearance is 0.81-1.35 mm (0.032-0.053 in.). The snap-ring is selectable. Install the chosen snap-ring and re-measure to verify the selection.

(10) Install the 2C piston into the retainer/bulkhead (Fig. 50).

(11) Position the 2C Belleville spring onto the 2C piston.

(12) Position the 2C Belleville spring snap-ring onto the 2C Belleville spring (Fig. 50).

(13) Using Spring Compressor 8249 and a suitable shop press (Fig. 52), compress the belleville spring until the snap-ring is engaged with the snap-ring groove in the retainer/bulkhead.

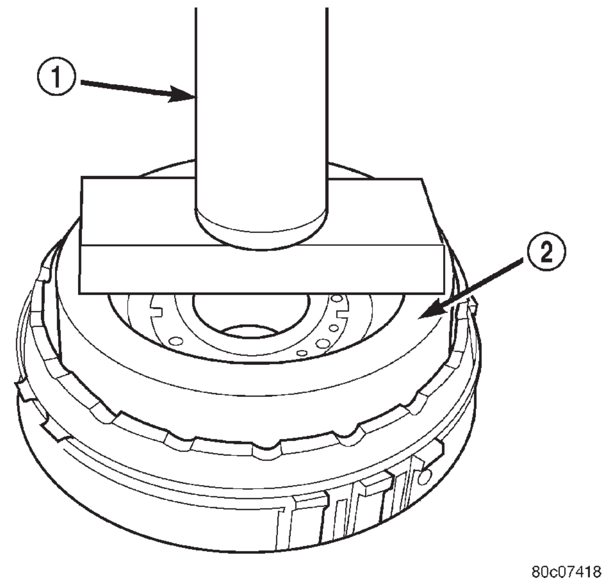


Fig. 52 Compress 2C Belleville Spring Using Tool 8249

1 - PRESS
2 - TOOL 8249

ADAPTER HOUSING SEAL

REMOVAL

(1) Remove the transfer case from the transmission.

(2) Using a screw mounted on a slide hammer, remove the adapter housing seal.

INSTALLATION

(1) Clean the adapter seal bore in the adapter housing of any residue or particles remaining from the original seal.

(2) Install new oil seal in the adapter housing using Seal Installer C-3860-A (Fig. 53). A properly installed seal is flush to the face of the seal bore.

(3) Install the transfer case onto the transmission.

ADAPTER HOUSING SEAL (Continued)

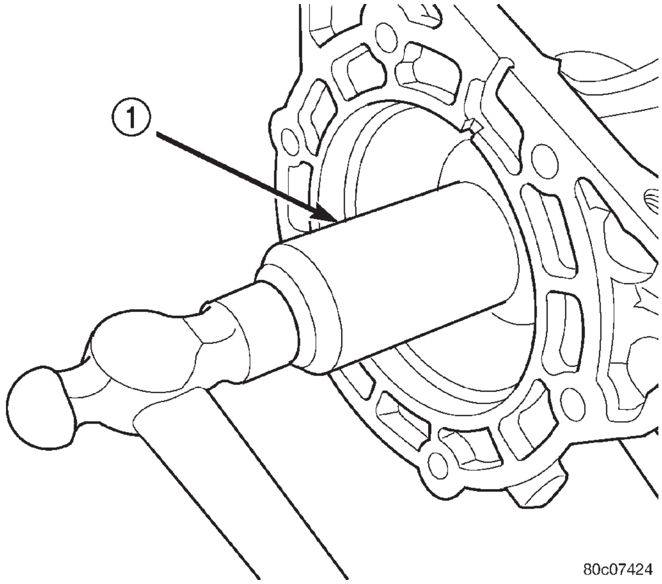


Fig. 53 Adapter Housing Seal Installation

1 - TOOL C-3860-A

FLUID AND FILTER

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 three primary causes.

(1) Internal clutch slippage, usually caused by low line pressure, inadequate clutch apply pressure, or clutch seal failure.

(2) 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.

(3) 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 - 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

FLUID AND FILTER (Continued)

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.

Along with fluid level, it is important to check the condition of the fluid. When the fluid smells burned, and is contaminated with metal or friction material particles, a complete transmission recondition is needed. Be sure to examine the fluid on the dipstick closely. If there is any doubt about its condition, drain out a sample for a double check.

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.

The torque converter fills in both the P (PARK) and N (NEUTRAL) positions. Place the selector lever in P (PARK) to be sure that the fluid level check is accurate. **The engine should be running at idle speed for at least one minute, with the vehicle on level ground.** At normal operating temperature (approximately 82 C. or 180 F.), the fluid level is correct if it is in the HOT region (cross-hatched area) on the oil level indicator. The fluid level will be approximately at the upper COLD hole of the dipstick at 70° F fluid temperature.

NOTE: Engine and Transmission should be at normal operating temperature before performing this procedure.

(1) Start engine and apply parking brake.
(2) Shift the transmission into DRIVE for approximately 2 seconds.
(3) Shift the transmission into REVERSE for approximately 2 seconds.
(4) Shift the transmission into PARK.
(5) Hook up DRB® scan tool and select transmission.
(6) Select sensors.
(7) Read the transmission temperature value.
(8) Compare the fluid temperature value with the chart.
(9) Adjust transmission fluid level shown on the dipstick according to the chart.

NOTE: After adding any fluid to the transmission, wait a minimum of 2 minutes for the oil to fully drain from the fill tube into the transmission before rechecking the fluid level.

(10) Check transmission for leaks.

STANDARD PROCEDURE - FLUID AND FILTER REPLACEMENT

For proper service intervals (Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION).

REMOVAL

(1) Hoist and support vehicle on safety stands.
(2) Place a large diameter shallow drain pan beneath the transmission pan.
(3) Remove bolts holding front and sides of pan to transmission.
(4) Loosen bolts holding rear of pan to transmission.
(5) Slowly separate front of pan away from transmission allowing the fluid to drain into drain pan.
(6) Hold up pan and remove remaining bolts holding pan to transmission.
(7) While holding pan level, lower pan away from transmission.
(8) Pour remaining fluid in pan into drain pan.
(9) Remove screw holding filter to valve body (Fig. 54).
(10) Separate filter from valve body and oil pump and pour fluid in filter into drain pan.
(11) Remove and discard the oil filter seal from the bottom of the oil pump.
(12) If replaceing the cooler return filter, use Oil Filter Wrench 8321 to remove the filter from the transmission.
(13) Dispose of used trans fluid and filter(s) properly.

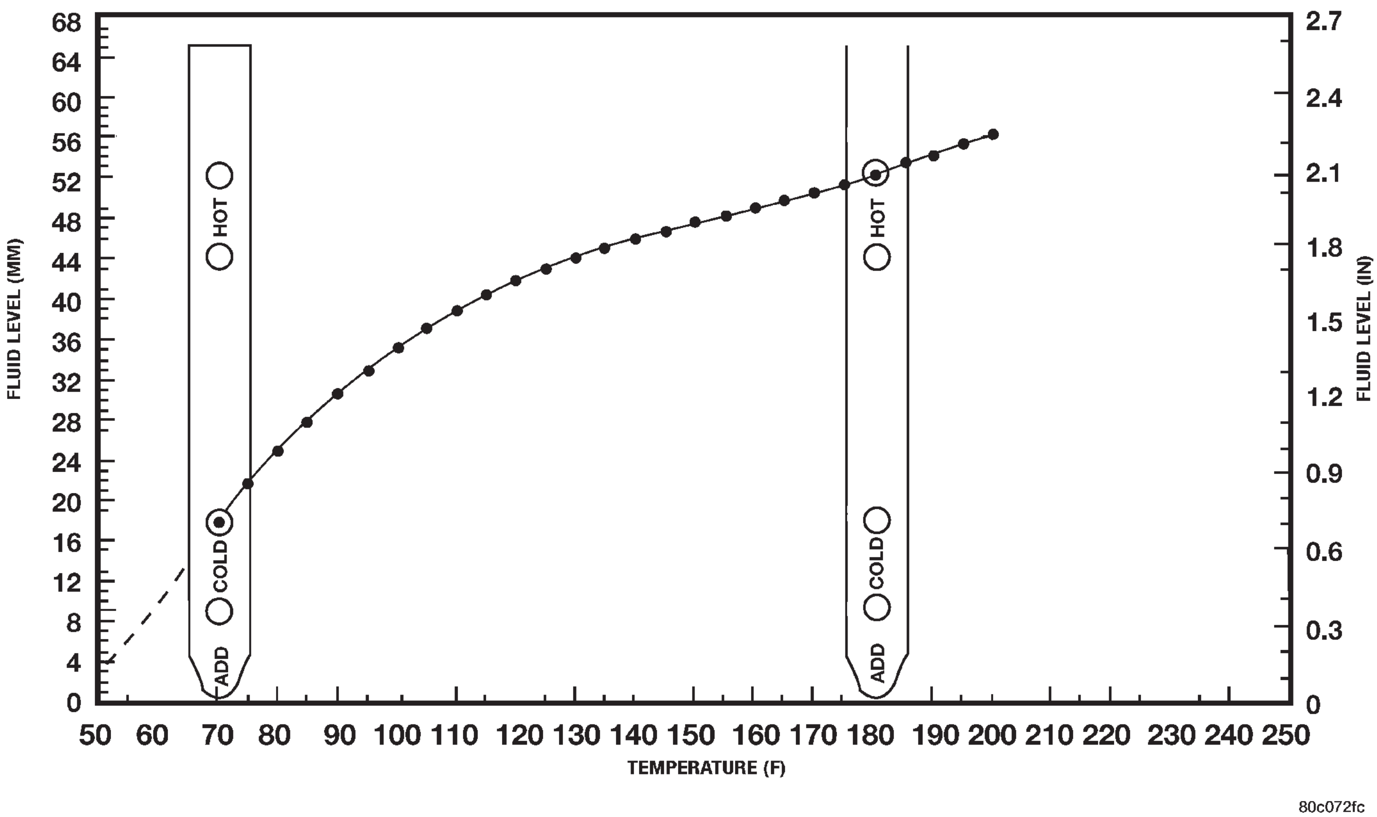
INSPECTION

Inspect bottom of pan and magnet for excessive amounts of metal. A light coating of clutch material on the bottom of the pan does not indicate a problem unless accompanied by a slipping condition or shift lag. If fluid and pan are contaminated with excessive amounts of debris, refer to the diagnosis section of this group.

CLEANING

(1) Using a suitable solvent, clean pan and magnet.
(2) Using a suitable gasket scraper, clean original sealing material from surface of transmission case and the transmission pan.

FLUID AND FILTER (Continued)



Transmission Fluid Temperature Chart

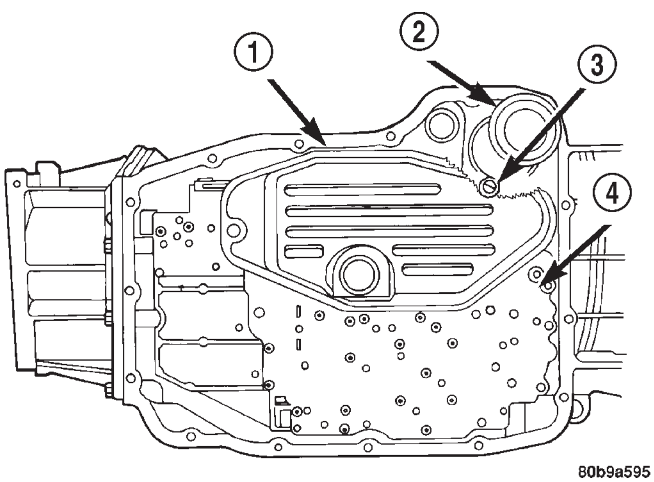


Fig. 54 Transmission Filters - 4X4 Shown

1 - PRIMARY OIL FILTER
2 - COOLER RETURN FILTER
3 - COOLER RETURN FILTER BYPASS VALVE
4 - VALVE BODY

INSTALLATION

(1) Install a new oil filter seal into the bottom of the oil pump.

NOTE: Do not attempt to install the seal onto the oil filter first and then into the oil pump. An unsatisfactory seal between the oil pump and filter will result, allowing air to be drawn into the pump.

(2) Place replacement filter in position on valve body and into the oil pump.

(3) Install screw to hold filter to valve body (Fig. 54). Tighten screw to 4.5 N·m (40 in. lbs.) torque.

(4) Install new cooler return filter onto the transmission, if necessary. Torque the filter to 14.12 N·m (125 in.lbs.).

(5) Place bead of Mopar® RTV sealant onto the transmission case sealing surface.

(6) Place pan in position on transmission.

(7) Install bolts to hold pan to transmission. Tighten bolts to 11.8 N·m (105 in. lbs.) torque.

(8) Lower vehicle and fill transmission with Mopar® ATF +4, type 9602 fluid.

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.

FLUID AND FILTER (Continued)

(2) Add following initial quantity of Mopar® ATF +4 to transmission:

(a) If only fluid and filter were changed, add **10 pints (5 quarts)** of ATF +4 to transmission.

(b) If transmission was completely overhauled, torque converter was replaced or drained, and cooler was flushed, add **24 pints (12 quarts)** of ATF +4 to transmission.

(3) Check the transmission fluid (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 45RFE/FLUID - STANDARD PROCEDURE) and adjust as required.

GEARSHIFT CABLE

DIAGNOSIS AND TESTING - GEARSHIFT CABLE

(1) The 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 shift lever in PARK or NEUTRAL gate positions only. Engine starts must not be possible in any other gear position.

(3) With shift lever handle in:

(a) PARK position - Apply forward force on center of lever and remove pressure. Engine starts must be possible.

(b) PARK position - Apply rearward force on center of lever 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 lever. Transmission shall not be able to shift from neutral to reverse.

REMOVAL

(1) Shift transmission into PARK.

(2) Remove the dash panel insulation pad as necessary to access the gearshift cable bracket mounting nuts.

(3) Remove nuts retaining the gearshift cable mounting bracket to the dash panel (Fig. 55) or (Fig. 56).

(4) Disconnect cable at lower column lever and feed cable through dash panel opening to underside of vehicle (Fig. 57).

(5) Raise vehicle.

(6) Disengage cable eyelet at transmission shift lever and pull cable adjuster out of mounting bracket (Fig. 58) or (Fig. 59). Remove old cable from vehicle.

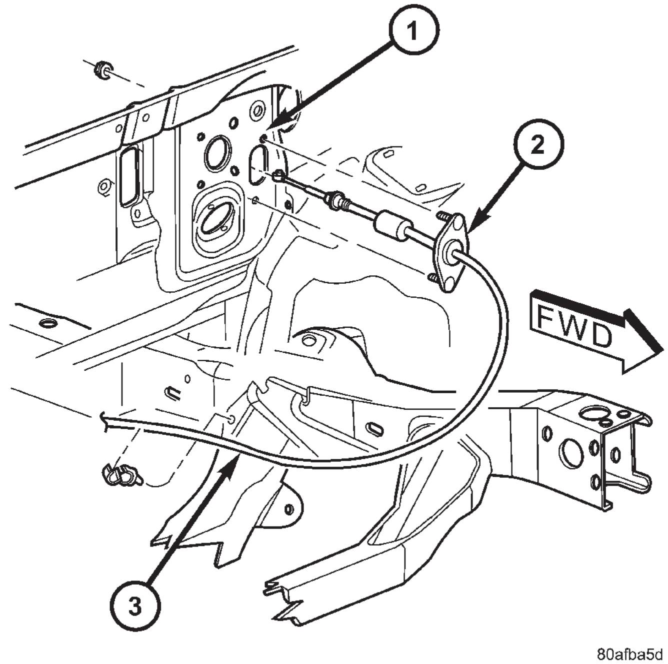


Fig. 55 Cable Mounting at Dash Panel - 4X2

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

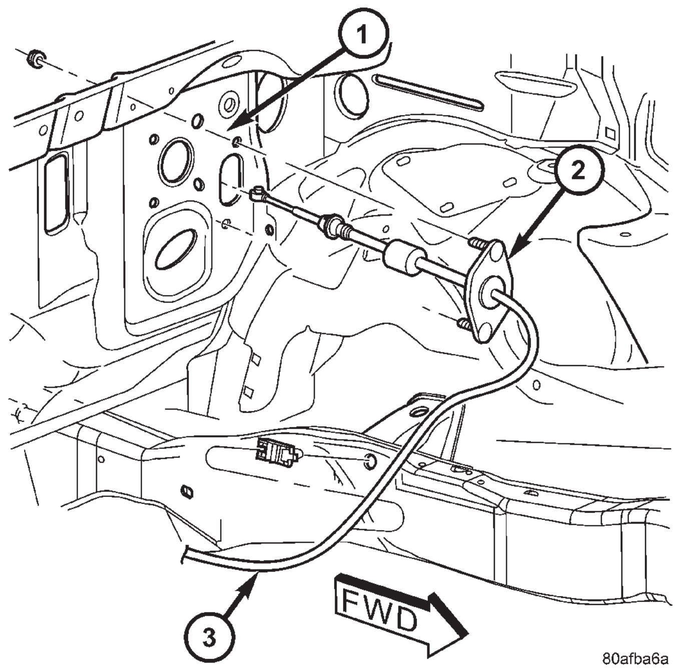


Fig. 56 Cable Mounting at Dash Panel - 4X4

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

GEARSHIFT CABLE (Continued)

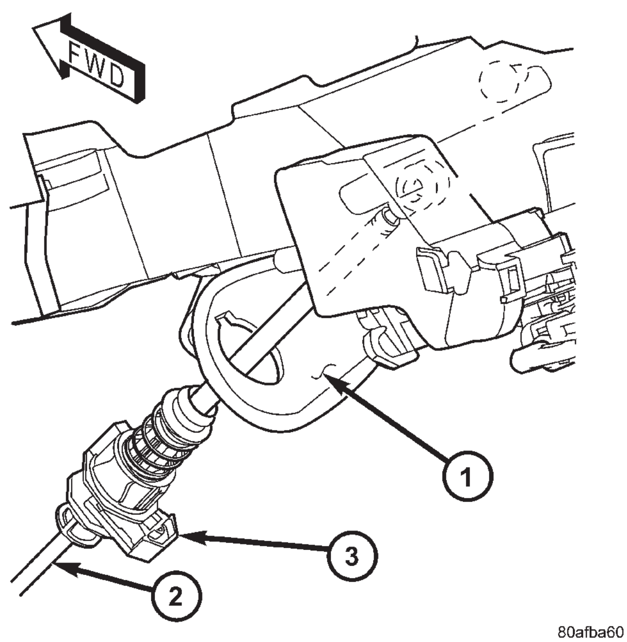


Fig. 57 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB

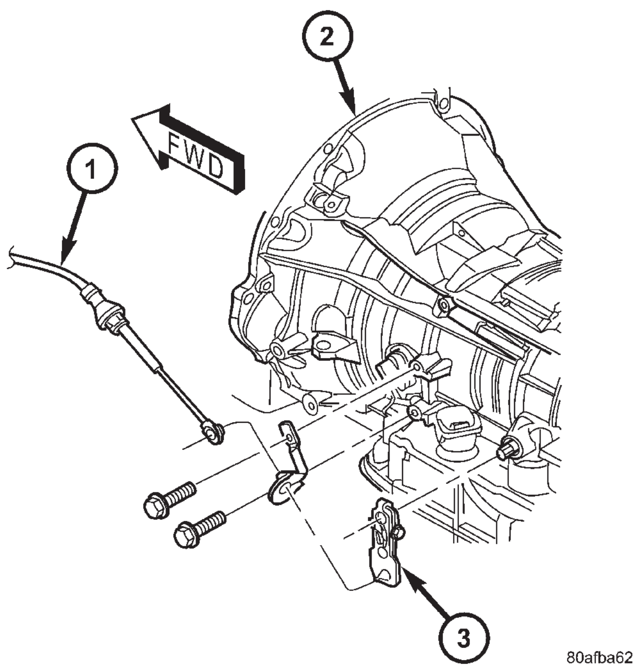


Fig. 58 Gearshift Cable at Transmission - RFE

1 - GEARSHIFT CABLE
2 - RFE TRANSMISSION
3 - MANUAL LEVER

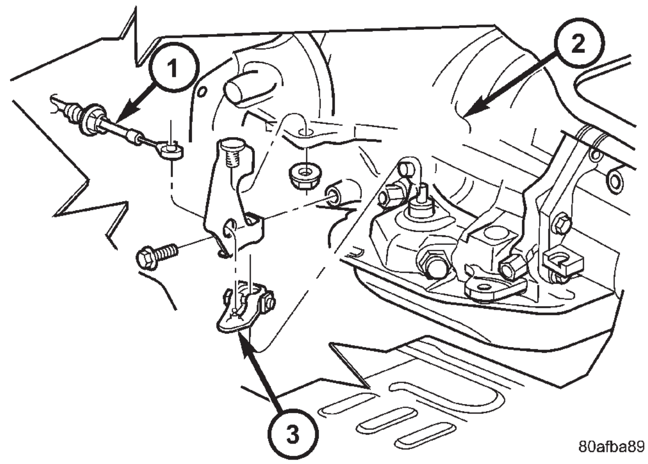


Fig. 59 Gearshift Cable at Transmission - RE

1 - GEARSHIFT CABLE
2 - RE TRANSMISSION
3 - MANUAL LEVER

INSTALLATION

(1) Snap the cable into the transmission bracket so the retaining ears are engaged and snap the cable eyelet onto the manual control lever ball stud.

(2) Lower vehicle.

(3) Route cable through hole in dash panel (Fig. 60) or (Fig. 61).

(4) Seat the cable mounting bracket to dash panel and install retaining nuts to hold the cable housing bracket to the dash panel.

(5) Tighten the nuts to 34 N·m (25 ft.lbs.).

(6) Place the transmission manual shift lever in the “PARK” detent (rearmost) position and rotate prop shaft to ensure transmission is in PARK.

(7) Connect shift cable to the steering column shift lever (Fig. 62) by snapping the cable retaining ears into shifter bracket and snapping the cable eyelet on the steering column ball stud.

(8) Lock the shift cable adjustment by pressing the cable adjuster lock upward until it snaps into place.

(9) Check for proper operation of the transmission range sensor.

(10) Adjust the gearshift cable as necessary.

GEARSHIFT CABLE (Continued)

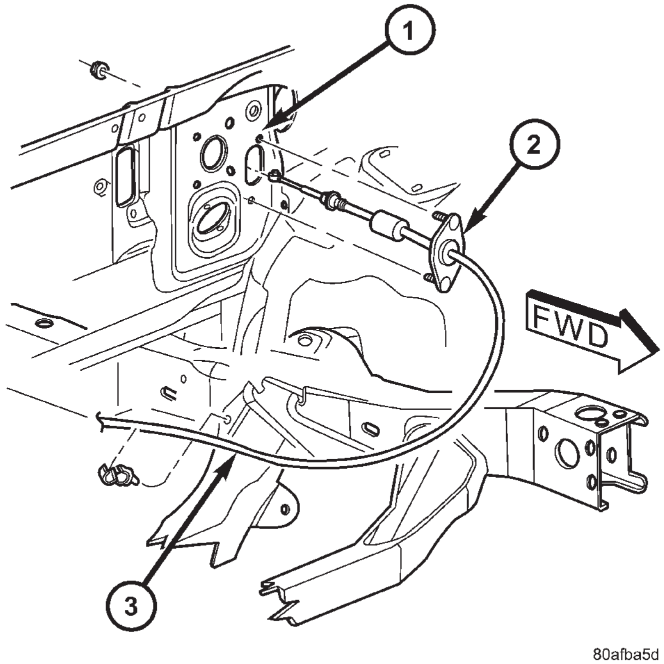


Fig. 60 Cable Mounting at Dash Panel - 4X2

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

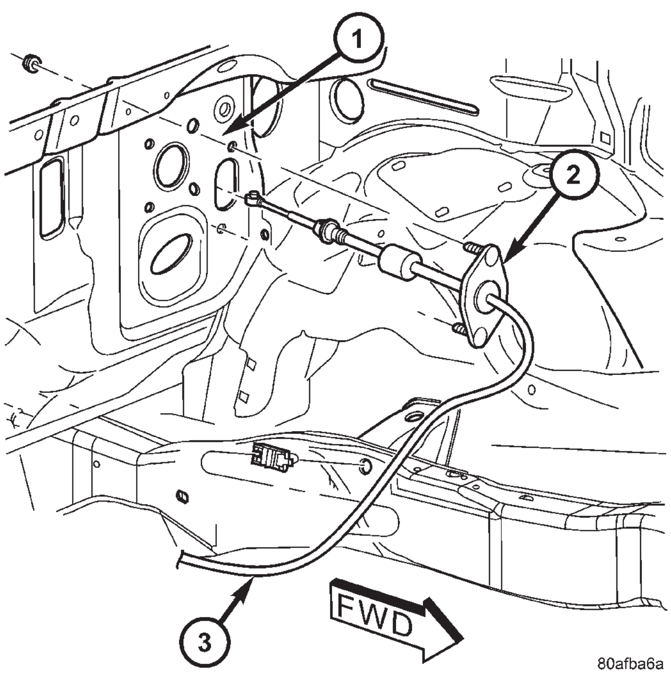


Fig. 61 Cable Mounting at Dash Panel - 4X4

1 - DASH PANEL
2 - GEARSHIFT CABLE MOUNTING BRACKET
3 - GEARSHIFT CABLE

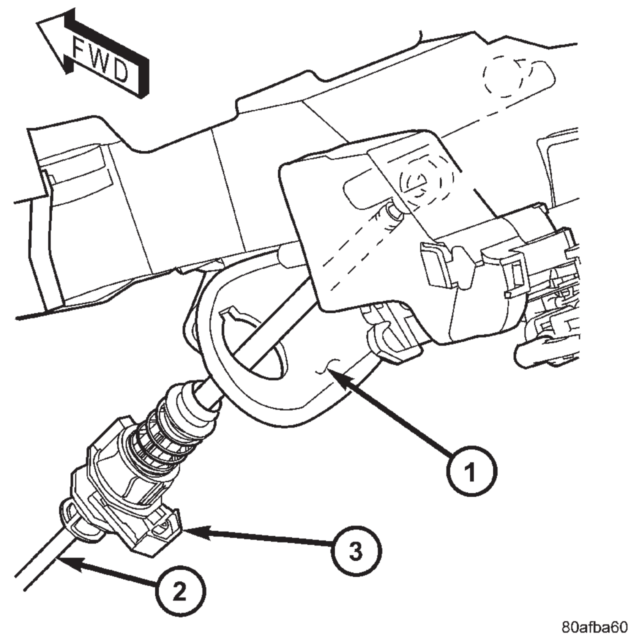


Fig. 62 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB

ADJUSTMENTS - GEARSHIFT CABLE

Check adjustment by starting the engine in PARK and NEUTRAL. Adjustment is CORRECT 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 CABLE (Continued)

Gearshift Adjustment Procedure

(1) Shift transmission into PARK.

(2) Release cable adjuster lock tab (underneath the steering column) (Fig. 63) to unlock cable.

(3) Raise vehicle.

(4) Disengage the cable eyelet from the transmission manual shift lever.

(5) Verify transmission shift lever is in PARK detent by moving lever fully rearward. Last rearward detent is PARK position.

(6) Verify positive engagement of transmission park lock by attempting to rotate propeller shaft. Shaft will not rotate when park lock is engaged.

(7) Snap the cable eyelet onto the transmission manual shift lever.

(8) Lower vehicle.

(9) Lock shift cable by pressing cable adjuster lock tab upward until it snaps into place.

(10) Check engine starting. Engine should start only in PARK and NEUTRAL

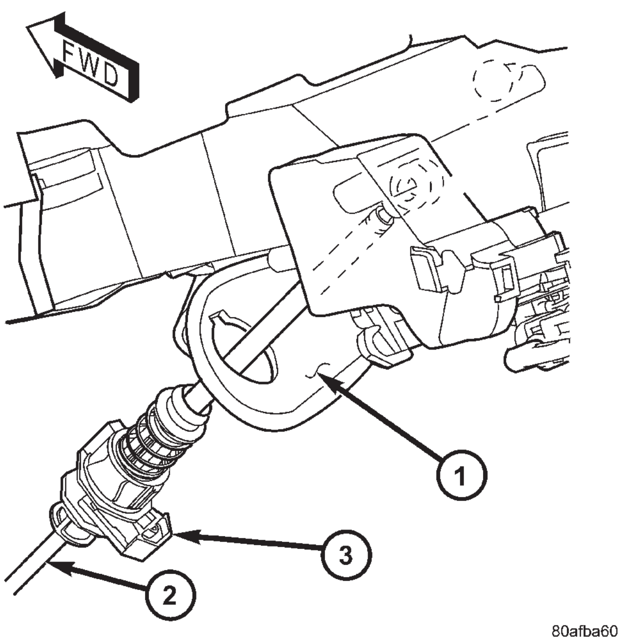


Fig. 63 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB

HOLDING CLUTCHES

DESCRIPTION

Three hydraulically applied multi-disc clutches are used to hold some planetary geartrain components stationary while the input clutches drive others. The 2C, 4C, and Low/Reverse clutches are considered holding clutches. The 2C and 4C clutches are located in the 4C retainer/bulkhead (Fig. 64), while the Low/Reverse clutch is located at the rear of the transmission case (Fig. 65).

OPERATION

2C CLUTCH

The 2C clutch is hydraulically applied in second gear by pressurized fluid against the 2C piston. When the 2C clutch is applied, the reverse sun gear assembly is held or grounded to the transmission case by holding the reaction planetary carrier.

4C CLUTCH

The 4C clutch is hydraulically applied in second prime and fourth gear by pressurized fluid against the 4C clutch piston. When the 4C clutch is applied, the reaction annulus gear is held or grounded to the transmission case.

LOW/REVERSE CLUTCH

The Low/Reverse clutch is hydraulically applied in park, reverse, neutral, and first gear, only at low speeds, by pressurized fluid against the Low/Reverse clutch piston. When the Low/Reverse clutch is applied, the input annulus assembly is held or grounded to the transmission case.

HOLDING CLUTCHES (Continued)

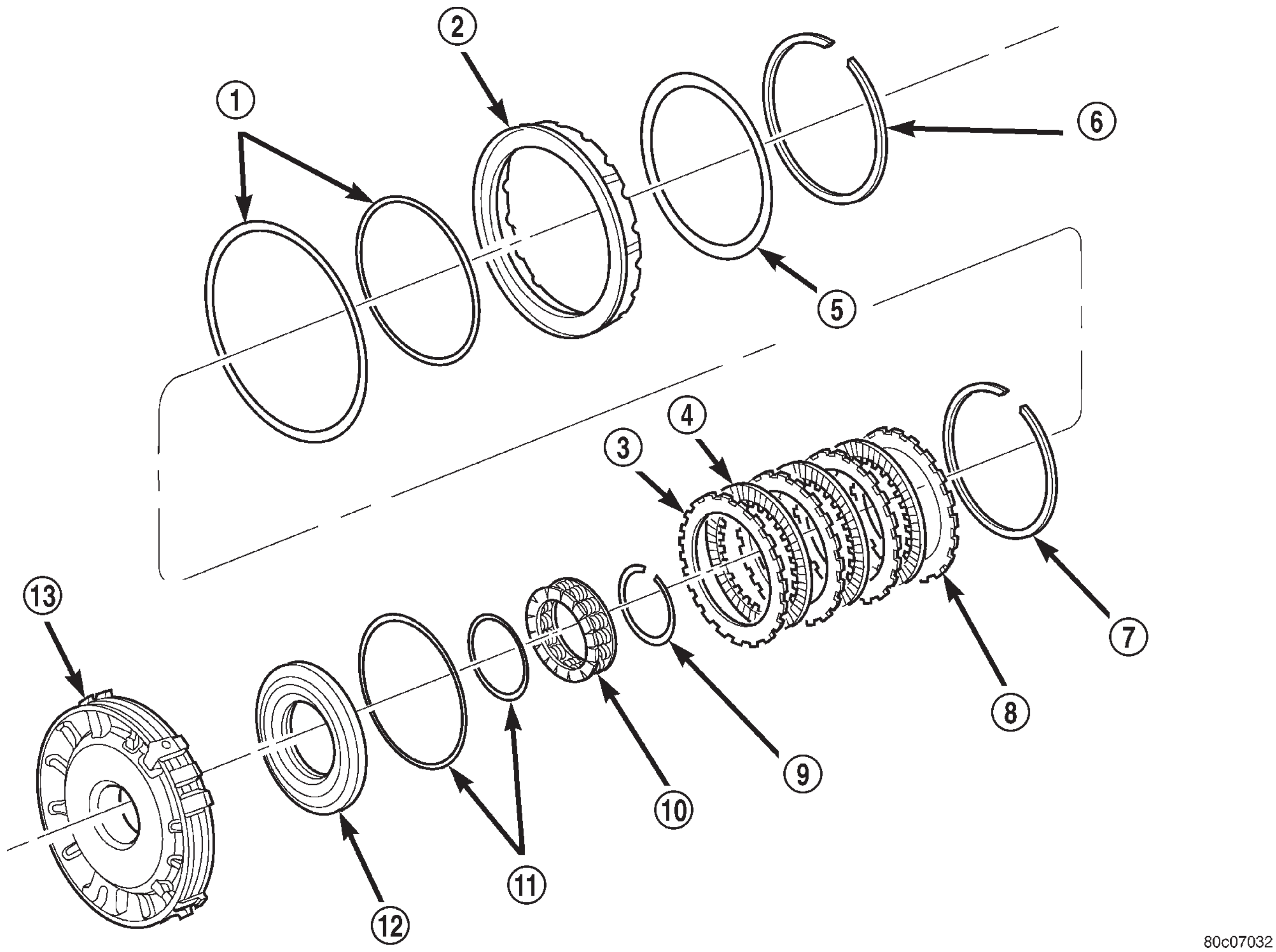


Fig. 64 2C and 4C Clutches

1 - SEAL
2 - 2C PISTON
3 - PLATE
4 - DISC
5 - 2C BELLEVILLE SPRING
6 - SNAP-RING
7 - SNAP-RING (SELECT)
8 - REACTION PLATE
9 - SNAP-RING
10 - RETURN SPRING
11 - SEAL
12 - 4C PISTON
13 - 4C RETAINER/BULKHEAD

HOLDING CLUTCHES (Continued)

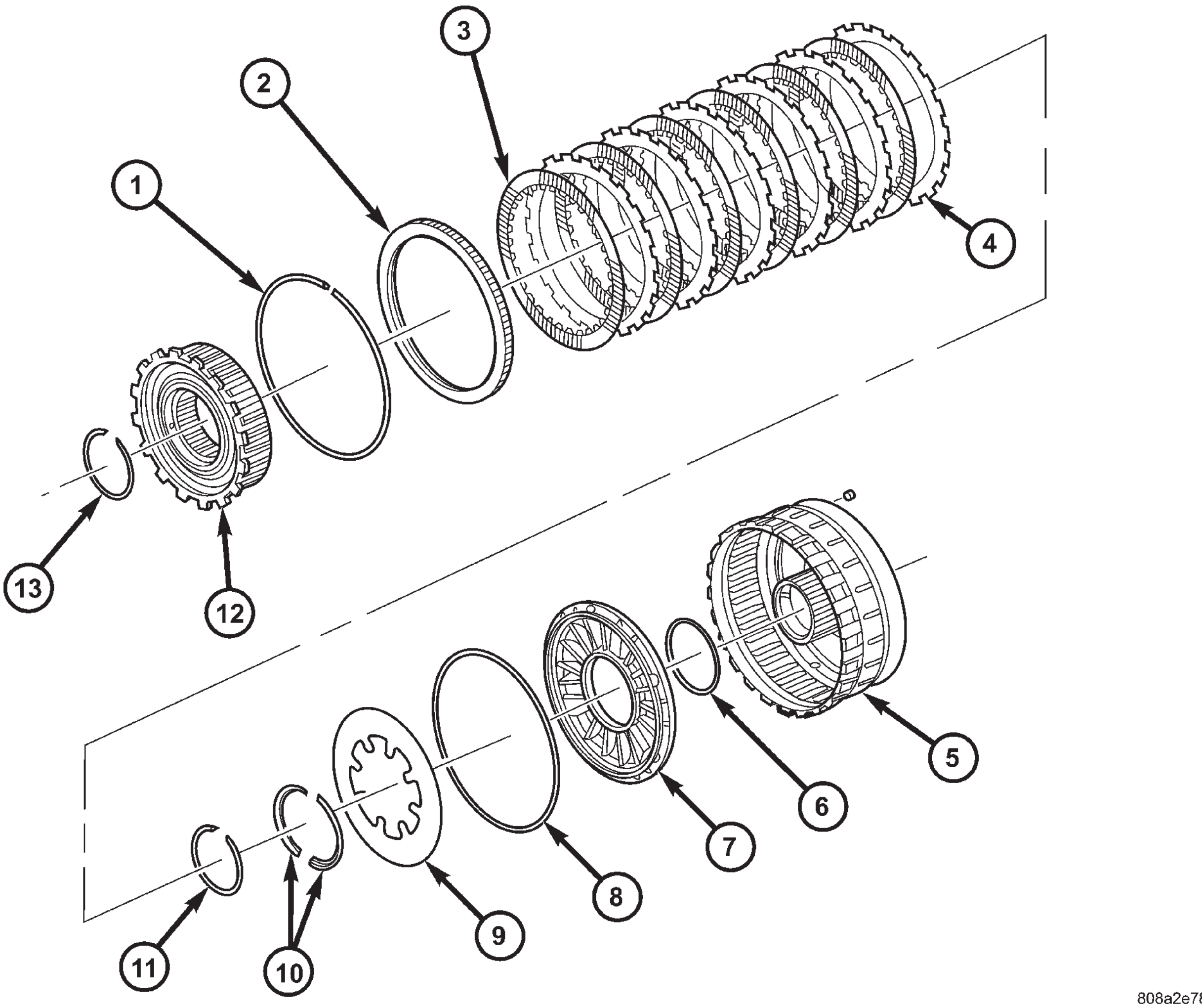


Fig. 65 Low/Reverse Clutch

1 - SNAP-RING (SELECT)
2 - REACTION PLATE
3 - DISC
4 - PLATE
5 - L/R CLUTCH RETAINER
6 - SEAL
7 - PISTON
8 - SEAL
9 - BELLEVILLE SPRING
10 - RETAINER
11 - SNAP-RING
12 - OVERRUNNING CLUTCH
13 - SNAP-RING

INPUT CLUTCH ASSEMBLY

DESCRIPTION

Three hydraulically applied input clutches are used to drive planetary components. The underdrive, overdrive, and reverse clutches are considered input clutches and are contained within the input clutch assembly (Fig. 66) and (Fig. 67). The input clutch assembly also contains:

- Input shaft
- Input hub
- Clutch retainer
- Underdrive piston
- Overdrive/reverse piston
- Overdrive hub
- Underdrive hub

OPERATION

The three input clutches are responsible for driving different components of the planetary geartrain.

UNDERDRIVE CLUTCH

The underdrive clutch is hydraulically applied in first, second, second prime, and third (direct) gears by pressurized fluid against the underdrive piston. When the underdrive clutch is applied, the underdrive hub drives the input sun gear.

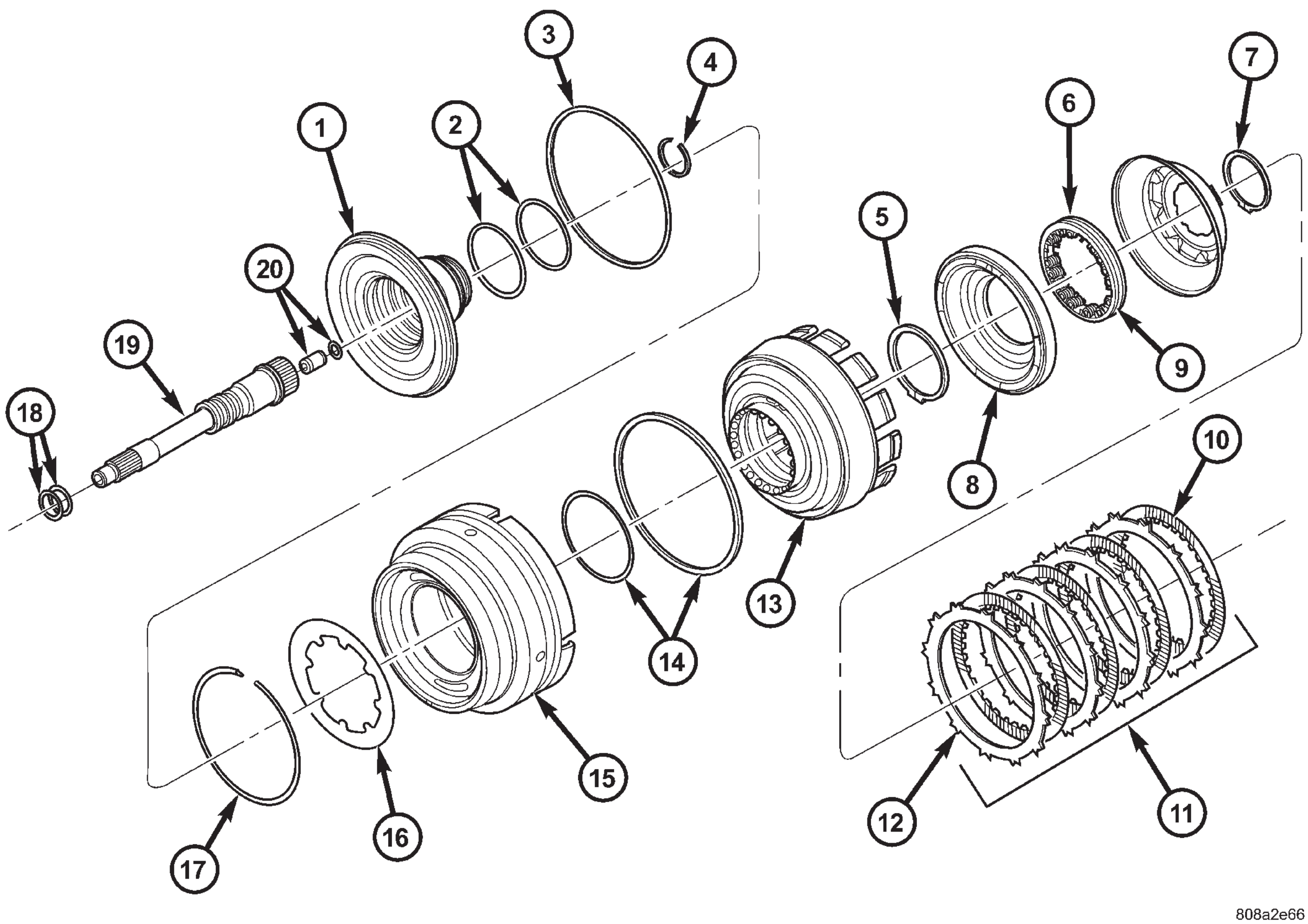


Fig. 66 Input Clutch Assembly - Part 1

1 - INPUT CLUTCH HUB
2 - O-RING SEALS
3 - SEAL
4 - SNAP-RING
5 - SNAP-RING
6 - UD BALANCE PISTON
7 - SNAP-RING
8 - UD PISTON
9 - SPRING
10 - DISC
11 - UD CLUTCH
12 - PLATE
13 - CLUTCH RETAINER
14 - SEAL
15 - OD/REV PISTON
16 - BELLEVILLE SPRING
17 - SNAP-RING
18 - SEAL RINGS
19 - INPUT SHAFT
20 - LUBRICATION CHECK VALVE AND SNAP-RING

INPUT CLUTCH ASSEMBLY (Continued)

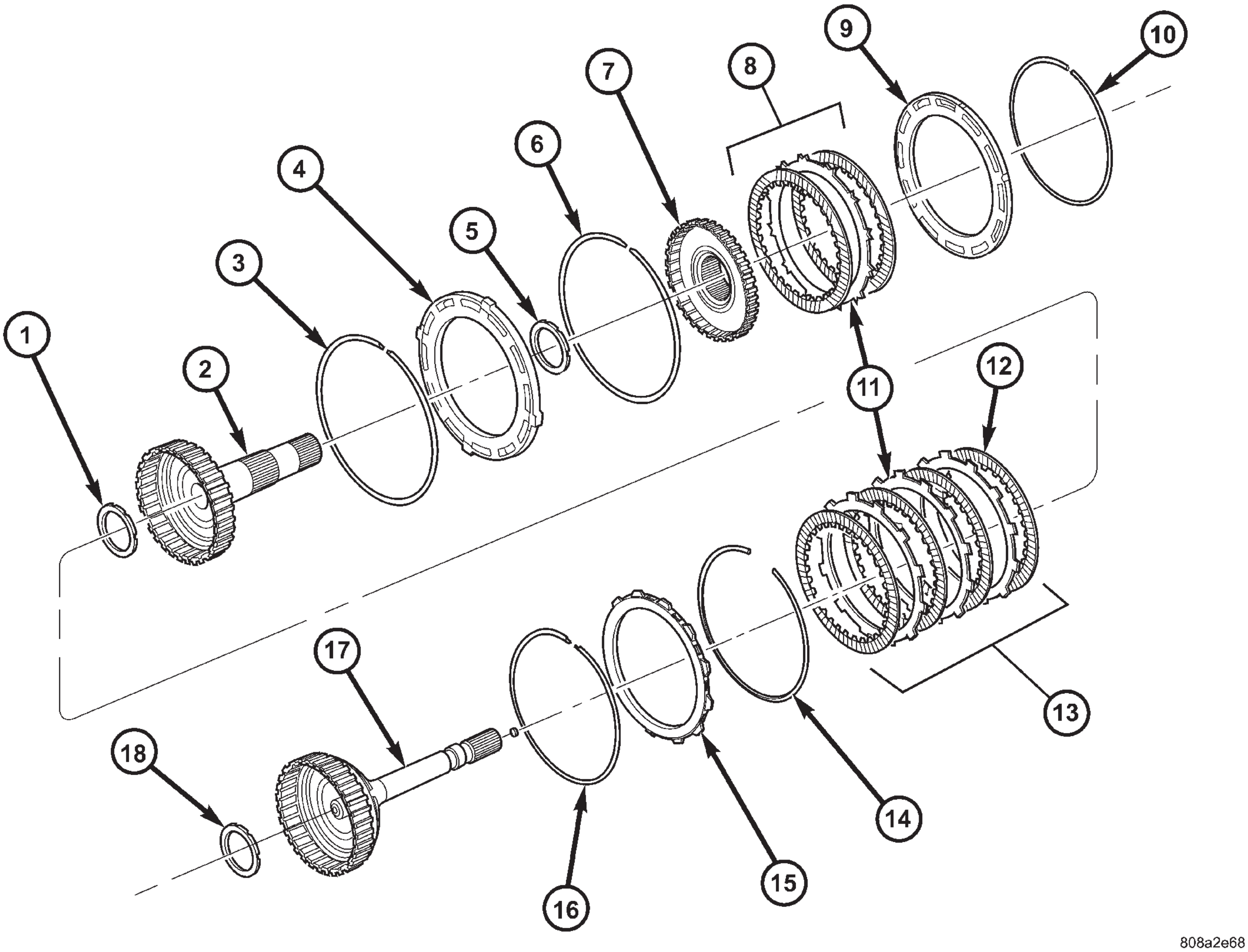


Fig. 67 Input Clutch Assembly - Part 2

1 - BEARING NUMBER 3
2 - OD HUB/SHAFT
3 - SNAP-RING (WAVE)
4 - REV/OD REACTION PLATE
5 - BEARING NUMBER 4
6 - SNAP-RING (FLAT)
7 - REVERSE HUB/SHAFT
8 - REVERSE CLUTCH
9 - REVERSE REACTION PLATE
10 - SNAP-RING (SELECT)
11 - PLATE
12 - DISC
13 - OD CLUTCH
14 - SNAP-RING (TAPERED)
15 - UD/OD REACTION PLATE
16 - SNAP-RING (FLAT)
17 - UD HUB/SHAFT
18 - BEARING NUMBER 2

OVERDRIVE CLUTCH

The overdrive clutch is hydraulically applied in third (direct) and fourth gears by pressurized fluid against the overdrive/reverse piston. When the overdrive clutch is applied, the overdrive hub drives the reverse carrier/input annulus assembly.

REVERSE CLUTCH

The reverse clutch is hydraulically applied in reverse gear by pressurized fluid against the overdrive/reverse piston. When the reverse clutch is applied, the reaction annulus gear is driven.

DISASSEMBLY

(1) Remove the reverse reaction plate selective snap-ring from the input clutch retainer (Fig. 68).

(2) Remove the reverse reaction plate from the input clutch retainer.

(3) Remove the reverse hub and reverse clutch pack from the input clutch retainer.

(4) Remove the number 4 bearing from the overdrive hub.

(5) Remove the overdrive hub from the input clutch retainer (Fig. 68).

INPUT CLUTCH ASSEMBLY (Continued)

(6) Remove the number 3 bearing from the underdrive hub.

(7) Remove the OD/reverse reaction plate snap-ring from the input clutch retainer.

(8) Remove the underdrive hub, overdrive clutch, and overdrive reaction plate from the input clutch retainer (Fig. 68).

NOTE: The overdrive friction discs and steel discs are thicker than the matching components in the underdrive and reverse clutches.

(9) Remove the number 2 bearing from the input clutch hub.

(10) Remove the overdrive clutch wave snap-ring from the input clutch retainer.

(11) Remove the UD/OD reaction plate tapered snap-ring from the input clutch retainer.2

(12) Remove the UD/OD reaction plate from the input clutch retainer.

(13) Remove the UD/OD reaction plate flat snap-ring from the input clutch retainer (Fig. 68).

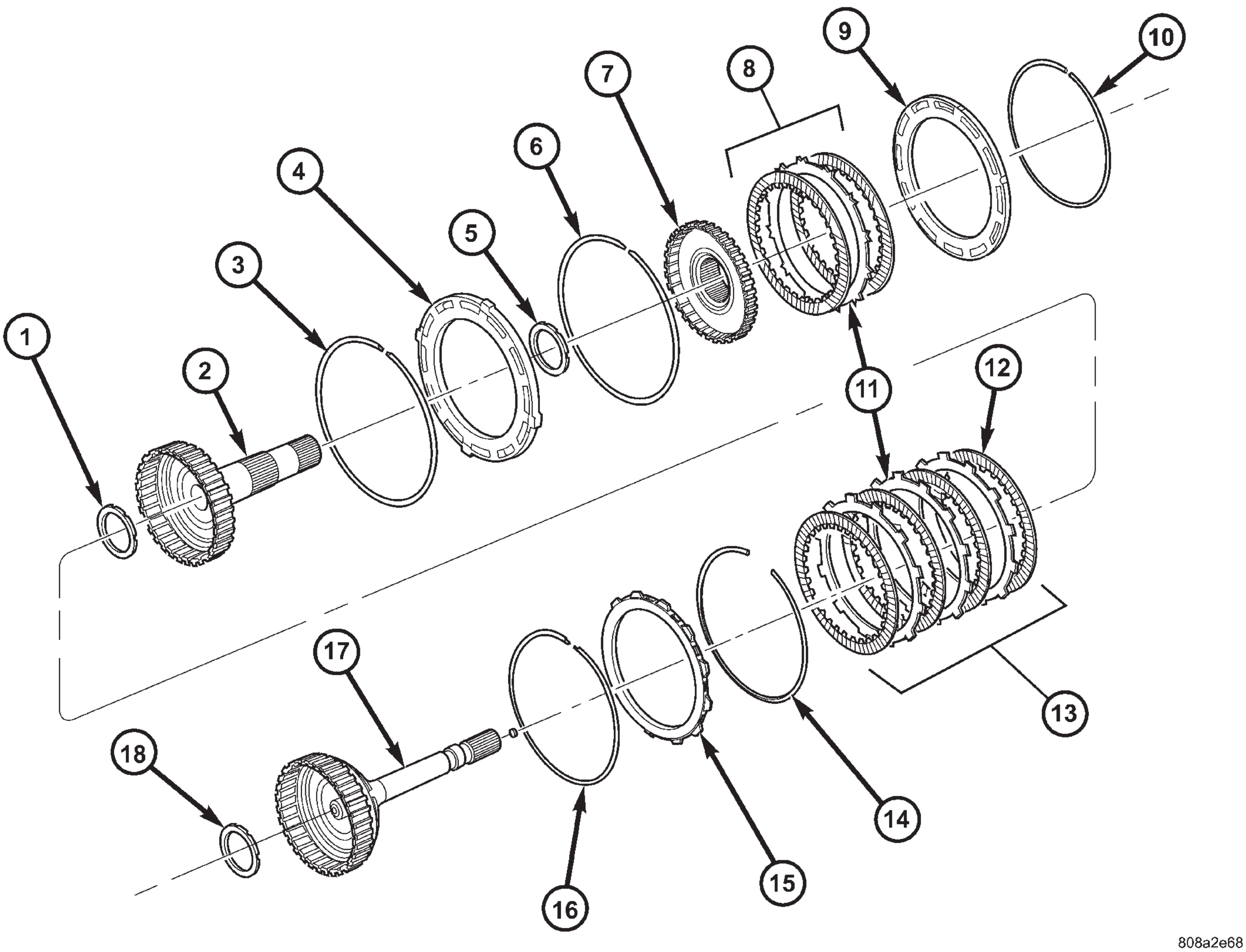


Fig. 68 Input Clutch Assembly - Part 2

1 - BEARING NUMBER 3
2 - OD HUB/SHAFT
3 - SNAP-RING (WAVE)
4 - REV/OD REACTION PLATE
5 - BEARING NUMBER 4
6 - SNAP-RING (FLAT)
7 - REVERSE HUB/SHAFT
8 - REVERSE CLUTCH
9 - REVERSE REACTION PLATE
10 - SNAP-RING (SELECT)
11 - PLATE
12 - DISC
13 - OD CLUTCH
14 - SNAP-RING (TAPERED)
15 - UD/OD REACTION PLATE
16 - SNAP-RING (FLAT)
17 - UD HUB/SHAFT
18 - BEARING NUMBER 2

INPUT CLUTCH ASSEMBLY (Continued)

(14) Remove the underdrive clutch pack from the input clutch retainer (Fig. 70).

(15) Using Spring Compressor 8251, compress the UD/OD balance piston and remove the snap-ring from the input clutch hub (Fig. 69).

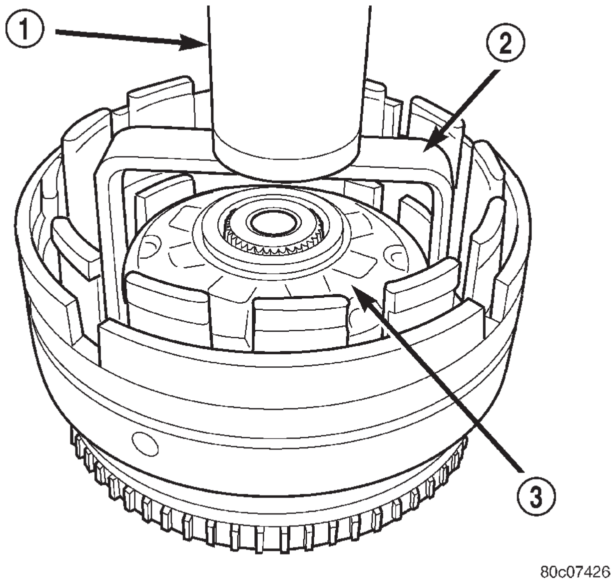


Fig. 69 Compressing UD/OD Balance Piston Using Tool 8251

1 - PRESS
2 - TOOL 8251
3 - BALANCE PISTON

(16) Remove the UD/OD balance piston and piston return spring from the input clutch retainer (Fig. 70).

(17) Remove the underdrive piston from the input clutch retainer (Fig. 70).

NOTE: Both the UD/OD balance piston and the underdrive piston have seals molded onto them. If the seal is damaged, do not attempt to install a new seal onto the piston. The piston/seal must be replaced as an assembly.

(18) Remove the input clutch retainer tapered snap-ring.

(19) Separate input clutch retainer from input clutch hub.

(20) Separate OD/reverse piston from input clutch hub retainer (Fig. 70).

(21) Remove all seals and o-rings from the input shaft and input hub. The o-rings on the input hub are color coded. Be sure to make note of which o-ring belongs in which location.

ASSEMBLY

(1) Install all new seals and o-rings onto the input shaft and input hub. The o-rings on the input hub are color coded. Be sure to install the correct o-ring in the correct location.

(2) Check the transmission lubrication check valve located in the input shaft using shop air. The valve should only allow air flow in one direction. If the valve allows no air flow, or air flow in both directions, the valve will need to be replaced.

(3) Lubricate all seals with Mopar® ATF +4, type 9602, prior to installation.

(4) Assemble the OD/reverse piston onto the input clutch hub (Fig. 71).

(5) Assemble the input clutch retainer onto the input clutch hub.

(6) Install the input clutch retainer tapered snap-ring with tapered side up onto the input clutch hub.

INPUT CLUTCH ASSEMBLY (Continued)

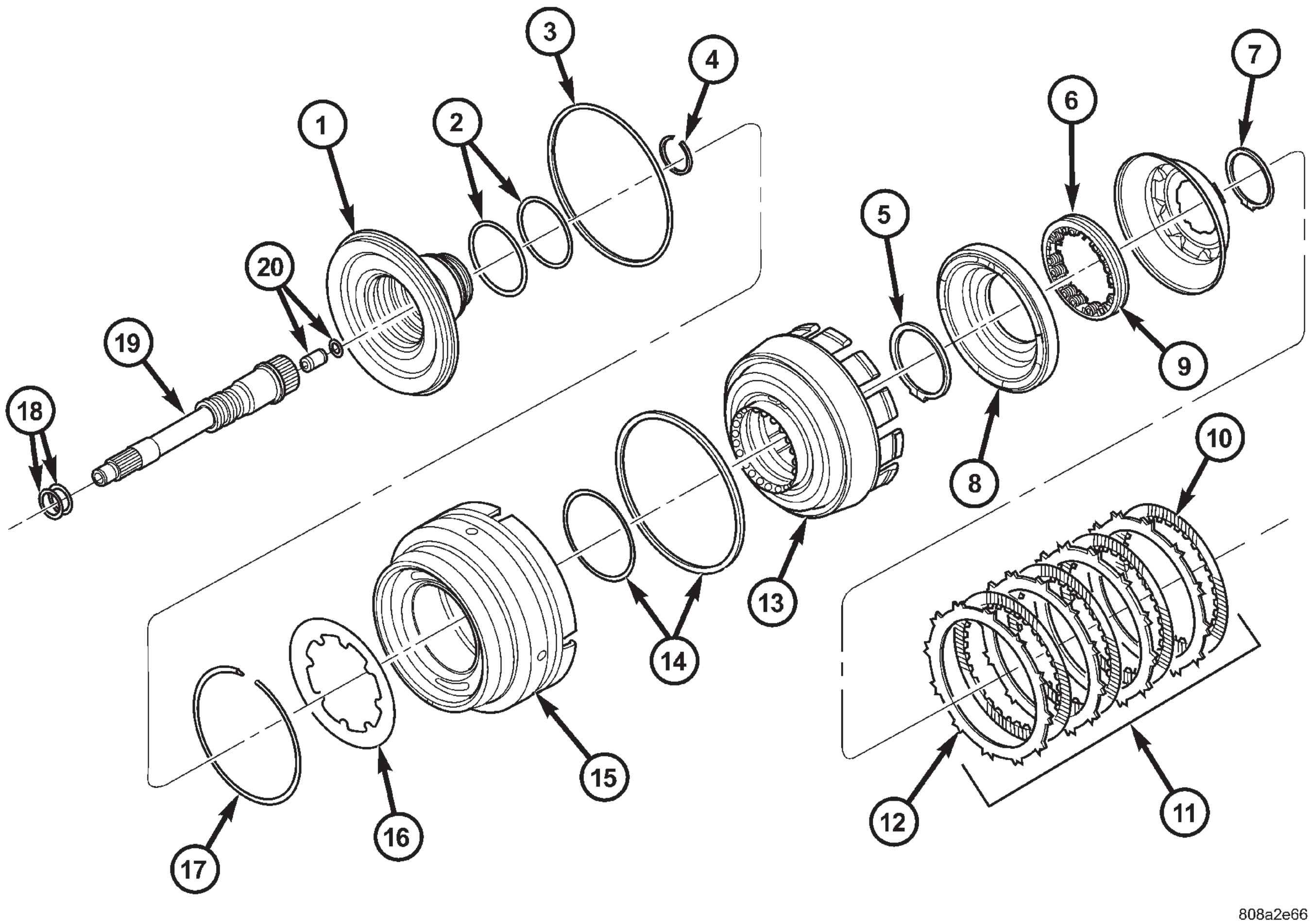


Fig. 70 Input Clutch Assembly - Part 1

1 - INPUT CLUTCH HUB
2 - O-RING SEALS
3 - SEAL
4 - SNAP-RING
5 - SNAP-RING
6 - UD BALANCE PISTON
7 - SNAP-RING
8 - UD PISTON
9 - SPRING
10 - DISC
11 - UD CLUTCH
12 - PLATE
13 - CLUTCH RETAINER
14 - SEAL
15 - OD/REV PISTON
16 - BELLEVILLE SPRING
17 - SNAP-RING
18 - SEAL RINGS
19 - INPUT SHAFT
20 - LUBRICATION CHECK VALVE AND SNAP-RING

INPUT CLUTCH ASSEMBLY (Continued)

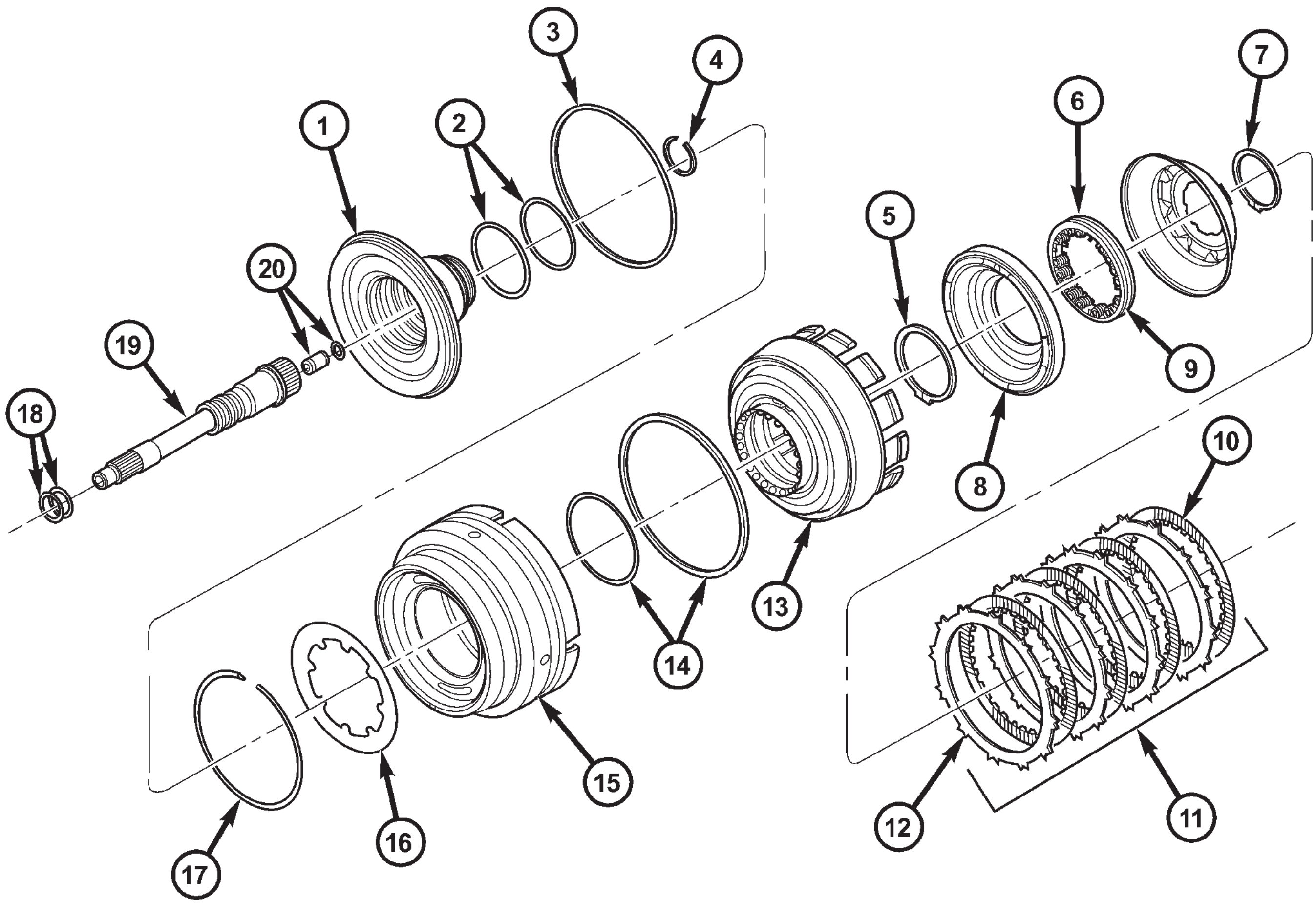


Fig. 71 Input Clutch Assembly - Part II

1 - INPUT CLUTCH HUB
2 - O-RING SEALS
3 - SEAL
4 - SNAP-RING
5 - SNAP-RING
6 - UD BALANCE PISTON
7 - SNAP-RING
8 - UD PISTON
9 - SPRING
10 - DISC
11 - UD CLUTCH
12 - PLATE
13 - CLUTCH RETAINER
14 - SEAL
15 - OD/REV PISTON
16 - BELLEVILLE SPRING
17 - SNAP-RING
18 - SEAL RINGS
19 - INPUT SHAFT
20 - LUBRICATION CHECK VALVE AND SNAP-RING

INPUT CLUTCH ASSEMBLY (Continued)

(7) Install Piston Guides 8504 into the input clutch retainer (Fig. 72) and onto the input clutch hub to guide the inner and outer underdrive piston seals into position.

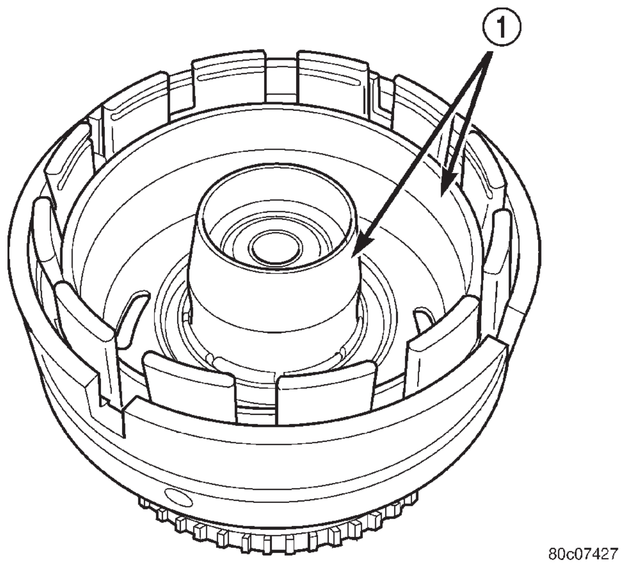


Fig. 72 Install Underdrive Piston Using Tool 8504

1 - TOOL 8504

(8) Install the underdrive piston into the input clutch retainer and over the input clutch hub (Fig. 71).

(9) Install the UD/OD balance piston return spring pack into the input clutch retainer.

(10) Install Piston Guide 8252 into the input clutch retainer (Fig. 73) to guide the UD/OD balance piston seal into position inside the underdrive piston.

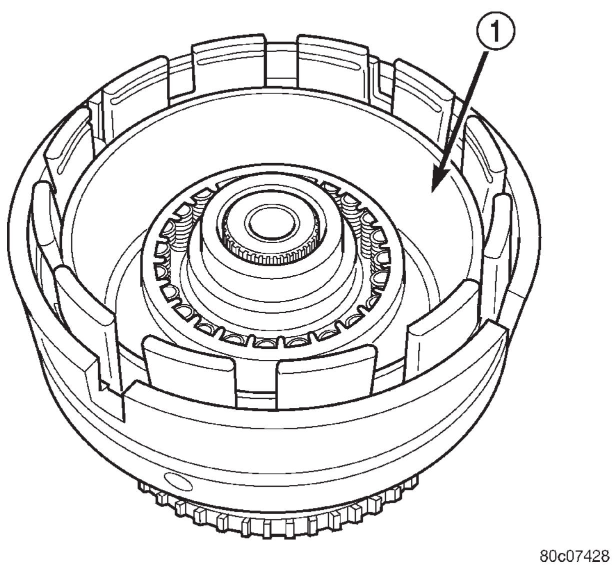


Fig. 73 Install Balance Piston Using Tool 8252

1 - TOOL 8252

(11) Install the UD/OD balance piston into the input clutch retainer and the underdrive piston.

(12) Using Spring Compressor 8251, compress the UD/OD return spring pack and secure the piston in place with the snap-ring (Fig. 74).

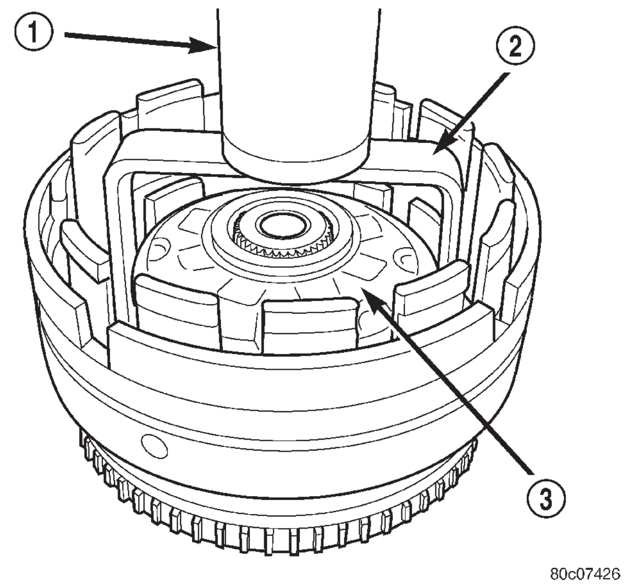


Fig. 74 Compressing UD/OD Balance Piston Using Tool 8251

1 - PRESS
2 - TOOL 8251
3 - BALANCE PISTON

(13) Install the underdrive clutch pack into the input clutch retainer (Fig. 71).

(14) Install the UD/OD reaction plate lower flat snap-ring (Fig. 75). The correct snap-ring can be identified by the two tabbed ears.

(15) Install the UD/OD reaction plate into the input clutch retainer. The reaction plate is to be installed with the big step down.

(16) Install the UD/OD reaction plate upper tapered snap-ring with tapered side up.

INPUT CLUTCH ASSEMBLY (Continued)

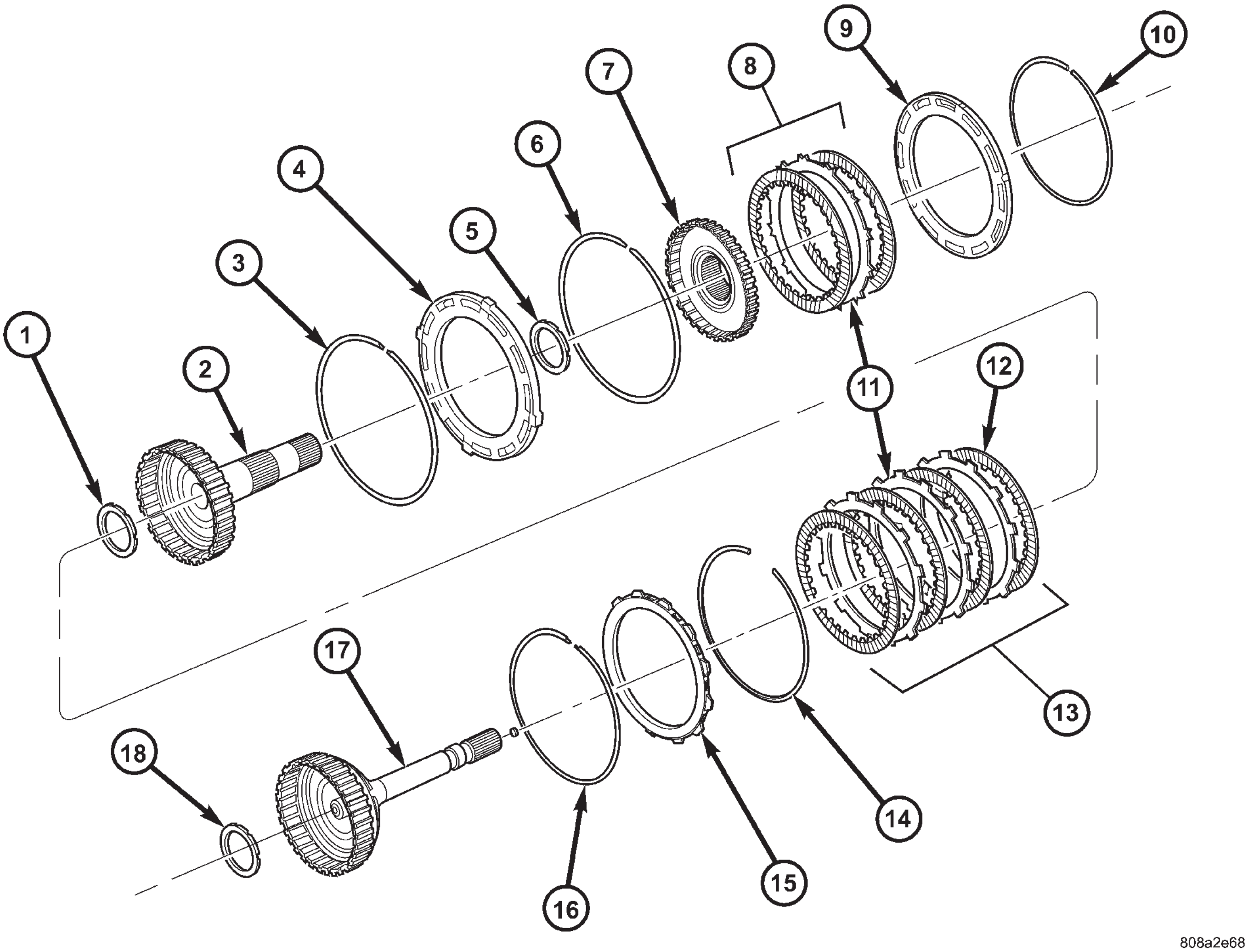


Fig. 75 Input Clutch Assembly - Part I

1 - BEARING NUMBER 3
2 - OD HUB/SHAFT
3 - SNAP-RING (WAVE)
4 - REV/OD REACTION PLATE
5 - BEARING NUMBER 4
6 - SNAP-RING (FLAT)
7 - REVERSE HUB/SHAFT
8 - REVERSE CLUTCH
9 - REVERSE REACTION PLATE
10 - SNAP-RING (SELECT)
11 - PLATE
12 - DISC
13 - OD CLUTCH
14 - SNAP-RING (TAPERED)
15 - UD/OD REACTION PLATE
16 - SNAP-RING (FLAT)
17 - UD HUB/SHAFT
18 - BEARING NUMBER 2

INPUT CLUTCH ASSEMBLY (Continued)

(17) Install the input clutch assembly into Input Clutch Pressure Fixture 8260 (Fig. 76). Mount a dial indicator to the assembly, push down on the clutch discs and zero the indicator against the underdrive clutch discs (Fig. 77). Apply 20 psi of air pressure to the underdrive clutch and record the dial indicator reading. Measure and record UD clutch pack measurement in four (4) places, 90° apart. Take average of four measurements and compare with UD clutch pack clearance specification. The correct clutch clearance is 0.76-1.16 mm (0.030-0.063 in.). The reaction plate is not selective. If the clutch clearance is not within specification, replace the reaction plate along with all the friction and steel discs.

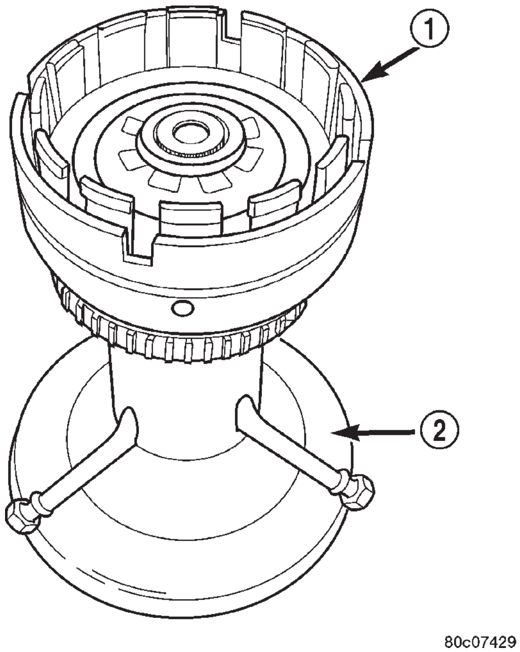


Fig. 76 Input Clutch Assembly Mounted on Tool 8260

1 - INPUT CLUTCH ASSEMBLY
2 - TOOL 8260

(18) Install the overdrive clutch pack into the input clutch retainer (Fig. 75). The overdrive steel separator plates can be identified by the lack of the half-moon cuts in the locating tabs.

(19) Install the overdrive clutch wavy snap-ring with the two tabbed ears into the input clutch retainer.

(20) Install the OD/reverse reaction plate into the input clutch retainer. The reaction plate is non-directional (Fig. 75).

(21) Install the OD/reverse reaction plate flat snap-ring into the input clutch retainer.

(22) Mount a dial indicator to the assembly and zero the indicator against the OD/reverse reaction plate (Fig. 78). Apply 20 psi of air pressure to the

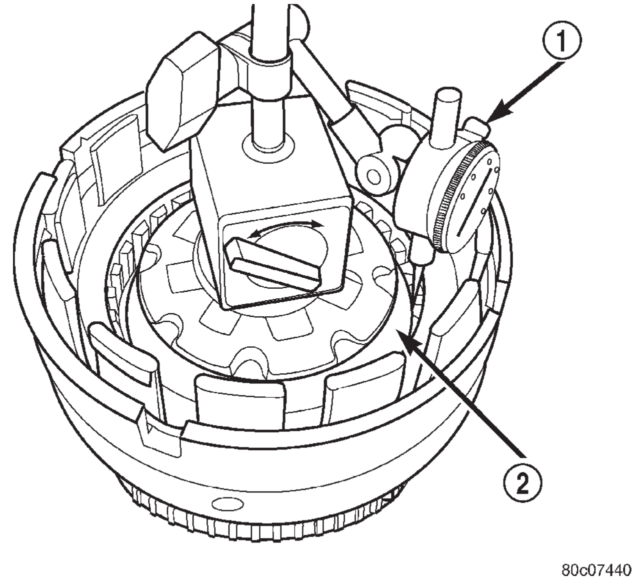


Fig. 77 Measuring UD Clutch Clearance

1 - TOOL C-3339
2 - UNDERDRIVE CLUTCH PACK

overdrive clutch and record the dial indicator reading. Measure and record OD clutch pack measurement in four (4) places, 90° apart. Take average of four measurements and compare with OD clutch pack clearance specification.Verify that the clutch clearance is 1.016-1.65 mm (0.040-0.065 in.). The reaction plate is not selective. If the clutch clearance is not within specification, replace the reaction plate along with all the friction and steel discs.

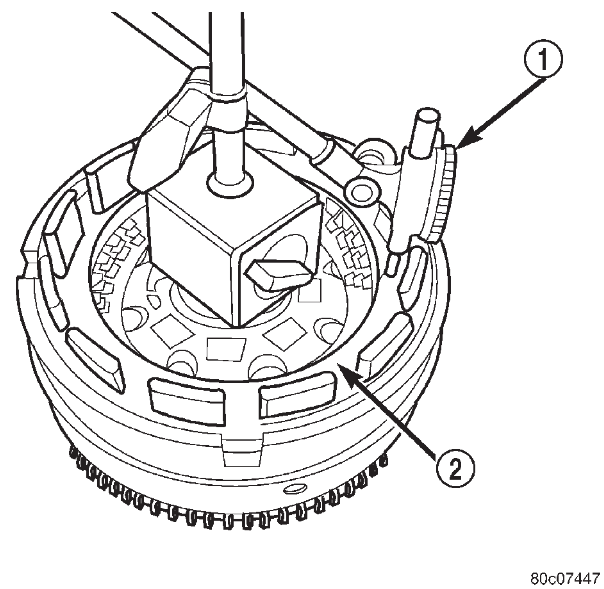


Fig. 78 Measuring OD Clutch Clearance

1 - TOOL C-3339
2 - OD/REV REACTION PLATE

INPUT CLUTCH ASSEMBLY (Continued)

(23) Install the reverse clutch pack into the input clutch retainer (Fig. 75).

(24) Install the reverse reaction plate into the input clutch retainer.

(25) Install the reverse reaction plate selective snap-ring into the input clutch retainer.

(26) Mount a dial indicator to the assembly, push down on the clutch discs, pull up on the reaction plate to ensure the plate is properly seated and zero the indicator against the reverse clutch discs (Fig. 79). Apply 20 psi of air pressure to the reverse clutch and record the dial indicator reading. Measure and record Reverse clutch pack measurement in four (4) places, 90° apart. Take average of four measurements and compare with Reverse clutch pack clearance specification. The correct clutch clearance is 0.81-1.24 mm (0.032-0.049 in.). Adjust as necessary. Install the chosen snap-ring and re-measure to verify selection.

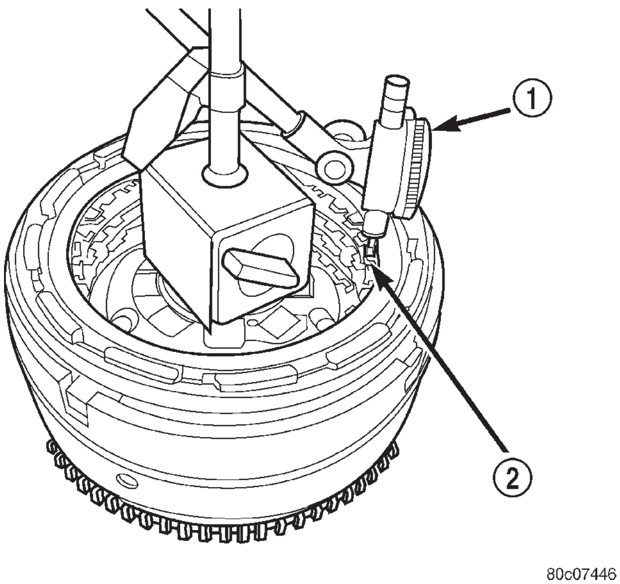


Fig. 79 Measuring Reverse Clutch Clearance

1 - TOOL C-3339
2 - REVERSE CLUTCH PACK

(27) Remove the reverse clutch pack from the input clutch retainer.

(28) Install the number 2 bearing onto the underdrive hub with flat side up/forward with petroleum jelly.

(29) Install the underdrive hub into the input clutch retainer.

(30) Install the number 3 bearing into the overdrive hub with the flat side up/forward with petroleum jelly.

(31) Install the overdrive hub into the input clutch retainer.

(32) Install the number 4 bearing into the reverse hub with flat side up/forward with petroleum jelly.

(33) Install the reverse hub into the input clutch retainer.

(34) Install the complete reverse clutch pack.

(35) Install the reverse reaction plate and snap-ring.

(36) Push up on reaction plate to allow reverse clutch to move freely.

INPUT SPEED SENSOR

DESCRIPTION

The Input and Output Speed Sensors are two-wire magnetic pickup devices that generate AC signals as rotation occurs. They are mounted in the left side of the transmission case and are considered primary inputs to the Transmission Control Module (TCM).

OPERATION

The Input Speed Sensor provides information on how fast the input shaft is rotating. As the teeth of the input clutch hub pass by the sensor coil, an AC voltage is generated and sent to the TCM. The TCM interprets this information as input shaft rpm.

The Output Speed Sensor generates an AC signal in a similar fashion, though its coil is excited by rotation of the rear planetary carrier lugs. The TCM interprets this information as output shaft rpm.

The TCM compares the input and output speed signals to determine the following:

- Transmission gear ratio
- Speed ratio error detection
- CVI calculation

The TCM also compares the input speed signal and the engine speed signal to determine the following:

- Torque converter clutch slippage
- Torque converter element speed ratio

REMOVAL

(1) Raise vehicle.

(2) Place a suitable fluid catch pan under the transmission.

(3) Remove the wiring connector from the input speed sensor (Fig. 80).

(4) Remove the bolt holding the input speed sensor to the transmission case.

(5) Remove the input speed sensor from the transmission case.

INSTALLATION

(1) Install the input speed sensor into the transmission case.

(2) Install the bolt to hold the input speed sensor into the transmission case. Tighten the bolt to 11.9 N·m (105 in.lbs.).

INPUT SPEED SENSOR (Continued)

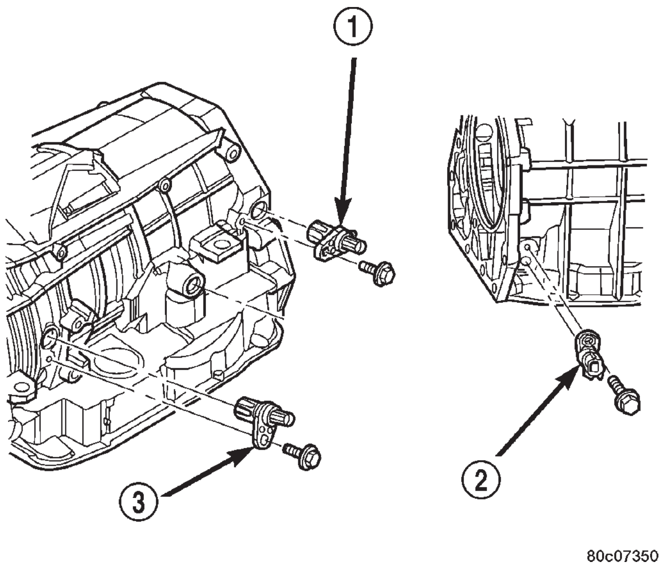


Fig. 80 Input Speed Sensor

1 - OUTPUT SPEED SENSOR
2 - LINE PRESSURE SENSOR
3 - INPUT SPEED SENSOR

(3) Install the wiring connector onto the input speed sensor

(4) Verify the transmission fluid level. Add fluid as necessary.

(5) Lower vehicle.

LINE PRESSURE (LP) SENSOR

DESCRIPTION

The TCM utilizes a closed-loop system to control transmission line pressure. The system contains a variable force style solenoid, the Pressure Control Solenoid, mounted on the side of the solenoid and pressure switch assembly. The solenoid is duty cycle controlled by the TCM to vent the unnecessary line pressure supplied by the oil pump back to the sump. The system also contains a variable pressure style sensor, the Line Pressure Sensor, which is a direct input to the TCM. The line pressure solenoid monitors the transmission line pressure and completes the feedback loop to the TCM. The TCM uses this information to adjust its control of the pressure control solenoid to achieve the desired line pressure.

OPERATION

The TCM calculates the desired line pressure based upon inputs from the transmission and engine. The TCM calculates the torque input to the transmission and uses that information as the primary input to the calculation. The line pressure is set to a predetermined value during shifts and when the transmission is in the PARK and NEUTRAL positions. This is done to ensure consistent shift quality. During all other operation, the actual line pressure is compared to the desired line pressure and adjustments are made to the pressure control solenoid duty cycle.

REMOVAL

(1) Raise vehicle.

(2) Place a suitable fluid catch pan under the transmission.

(3) Remove the wiring connector from the line pressure sensor (Fig. 81).

(4) Remove the bolt holding the line pressure sensor to the transmission case.

(5) Remove the line pressure sensor from the transmission case.

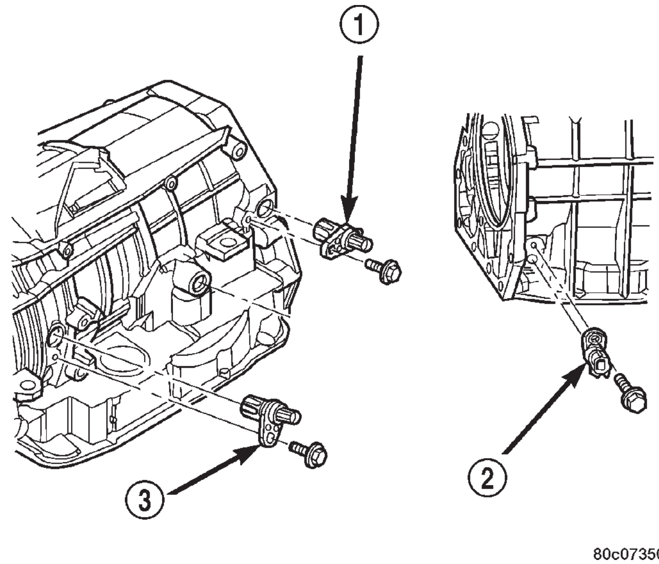


Fig. 81 Line Pressure Sensor

1 - OUTPUT SPEED SENSOR
2 - LINE PRESSURE SENSOR
3 - INPUT SPEED SENSOR

INSTALLATION

(1) Install the line pressure sensor into the transmission case.

(2) Install the bolt to hold the line pressure sensor into the transmission case. Tighten the bolt to 11.9 N·m (105 in.lbs.).

(3) Install the wiring connector onto the line pressure sensor

(4) Verify the transmission fluid level. Add fluid as necessary.

(5) Lower vehicle.

LOW/REVERSE CLUTCH

DISASSEMBLY

(1) Remove the inner overrunning clutch snap-ring from the low/reverse clutch retainer (Fig. 82).

(2) Remove the outer low/reverse reaction plate flat snap-ring (Fig. 82).

(3) Remove the low/reverse clutch and the overrunning clutch from the low/reverse clutch retainer as an assembly (Fig. 82).

(4) Separate the low/reverse clutch from the overrunning clutch.

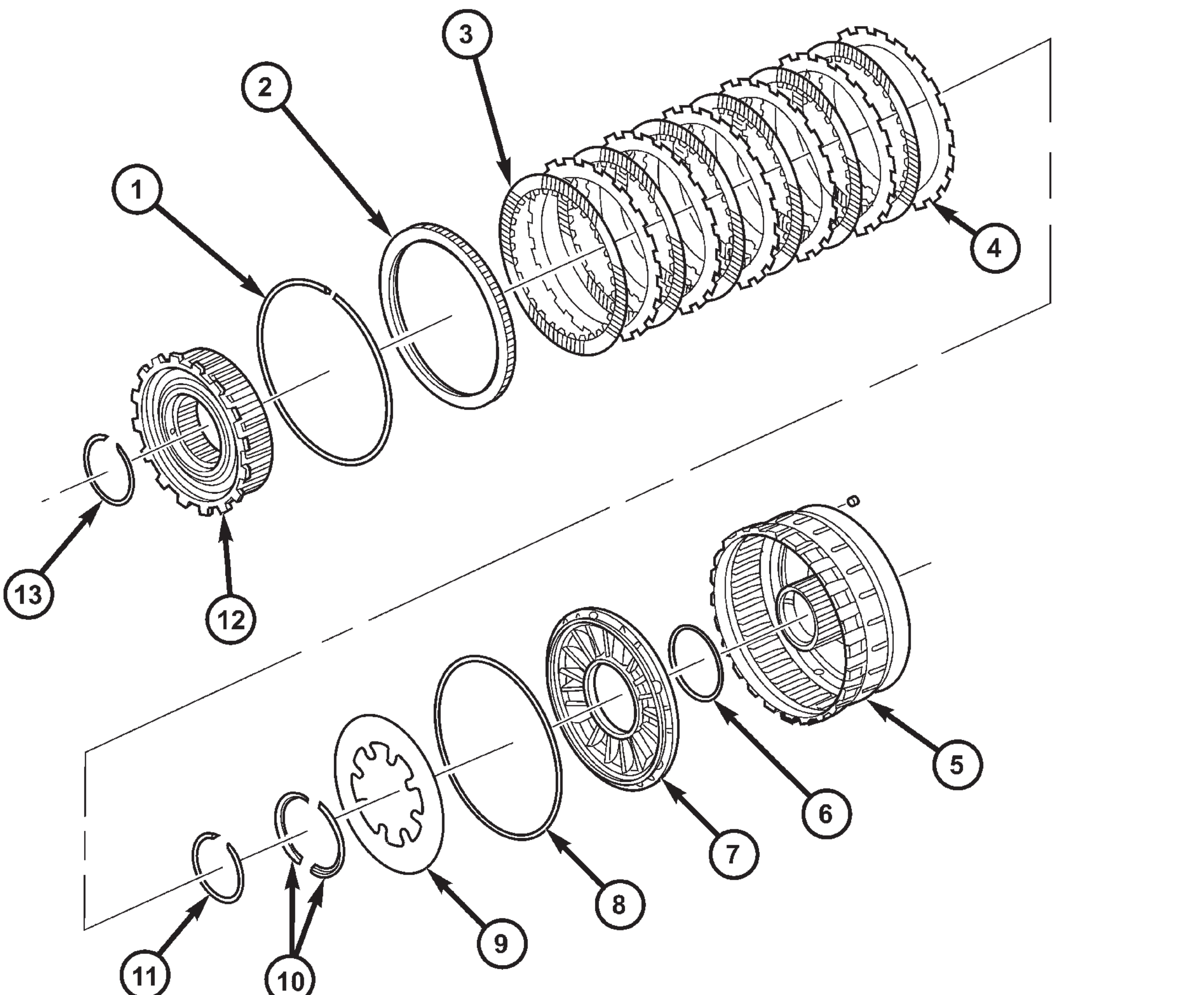


Fig. 82 Low/Reverse Clutch Assembly

1 - SNAP-RING (SELECT)
2 - REACTION PLATE
3 - DISC
4 - PLATE
5 - L/R CLUTCH RETAINER
6 - SEAL
7 - PISTON
8 - SEAL
9 - BELLEVILLE SPRING
10 - RETAINER
11 - SNAP-RING
12 - OVERRUNNING CLUTCH
13 - SNAP-RING

LOW/REVERSE CLUTCH (Continued)

(5) Remove the overrunning clutch snap-ring (Fig. 83).

(6) Remove the spacer from the overrunning clutch (Fig. 83).

(7) Separate the inner and outer races of the overrunning clutch (Fig. 83).

(8) Remove the overrunning clutch lower snap-ring (Fig. 83).

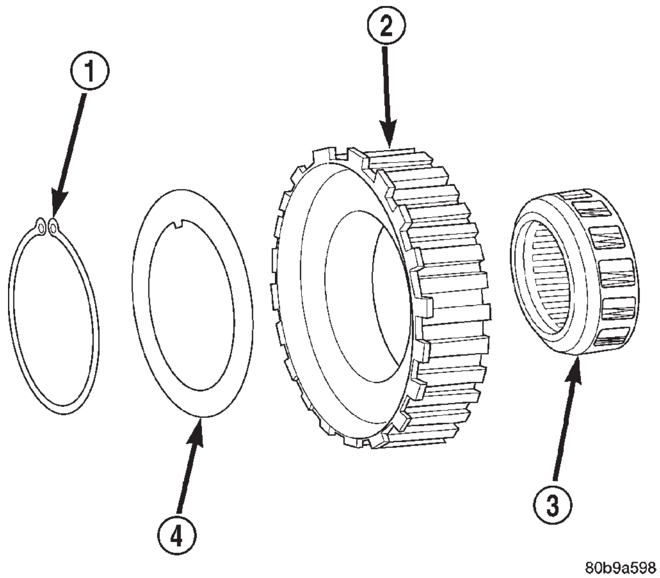


Fig. 83 Overrunning Clutch

1 - SNAP-RING
2 - OUTER RACE
3 - OVERRUNNING CLUTCH
4 - SPACER

(9) Using Spring Compressor 8285 and a suitable shop press (Fig. 84), compress the low/reverse piston Belleville spring and remove the split retaining ring holding the Belleville spring into the low/reverse clutch retainer.

(10) Remove the low/reverse clutch Belleville spring and piston from the low/reverse clutch retainer. Use 20 psi of air pressure to remove the piston if necessary.

CLEANING

Clean the overrunning clutch assembly, clutch cam, and low-reverse clutch retainer. Dry them with compressed air after cleaning.

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.

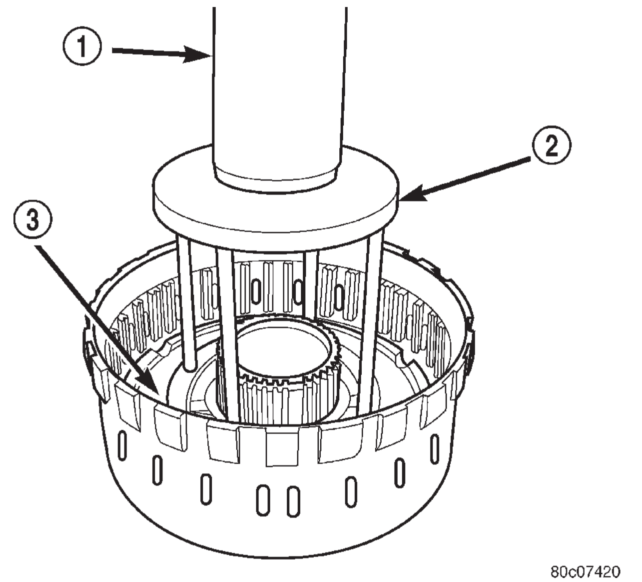


Fig. 84 Compress Low/Reverse Belleville Spring Using Tool 8285

1 - PRESS
2 - TOOL 8285
3 - BELLEVILLE SPRING

Replace the low-reverse clutch retainer if the clutch race, roller surface or inside diameter is scored, worn or damaged.

ASSEMBLY

(1) Check the bleed orifice to ensure that it is not plugged or restricted.

(2) Install a new seal on the low/reverse piston. Lubricate the seal with Mopar® ATF +4, type 9602, prior to installation.

(3) Install the low/reverse piston into the low/reverse clutch retainer.

(4) Position the low/reverse piston Belleville spring on the low/reverse piston.

(5) Using Spring Compressor 8285 and a suitable shop press (Fig. 84), compress the low/reverse piston Belleville spring and install the split retaining ring to hold the Belleville spring into the low/reverse clutch retainer.

(6) Install the lower overrunning clutch snap-ring (Fig. 83).

(7) Assemble the inner and outer races of the overrunning clutch (Fig. 83).

(8) Position the overrunning clutch spacer on the overrunning clutch.

(9) Install the upper overrunning clutch snap-ring (Fig. 83).

(10) Assemble and install the low/reverse clutch pack into the low/reverse clutch retainer (Fig. 82).

(11) Install the low/reverse reaction plate into the low/reverse clutch retainer (Fig. 82). The reaction

LOW/REVERSE CLUTCH (Continued)

plate is directional and must be installed with the flat side down.

(12) Install the low/reverse clutch pack snap-ring (Fig. 82). The snap-ring is selectable and should be chosen to give the correct clutch pack clearance.

(13) Measure the low/reverse clutch pack clearance and adjust as necessary. The correct clutch clearance is 1.14-1.91 mm (0.045-0.075 in.).

(14) Install the overrunning clutch into the low/reverse clutch retainer making sure that the index splines are aligned with the retainer.

(15) Install the overrunning clutch inner snap-ring.

OIL PUMP

DESCRIPTION

The oil pump (Fig. 85) is located at the front of the transmission inside the bell housing and behind the transmission front cover. The oil pump consists of two independent pumps (Fig. 86), a number of valves (Fig. 87), a front seal (Fig. 88), and a bolt on reaction shaft. The converter clutch switch and regulator valves, pressure regulator valve, and converter pressure limit valve are all located in the oil pump housing.

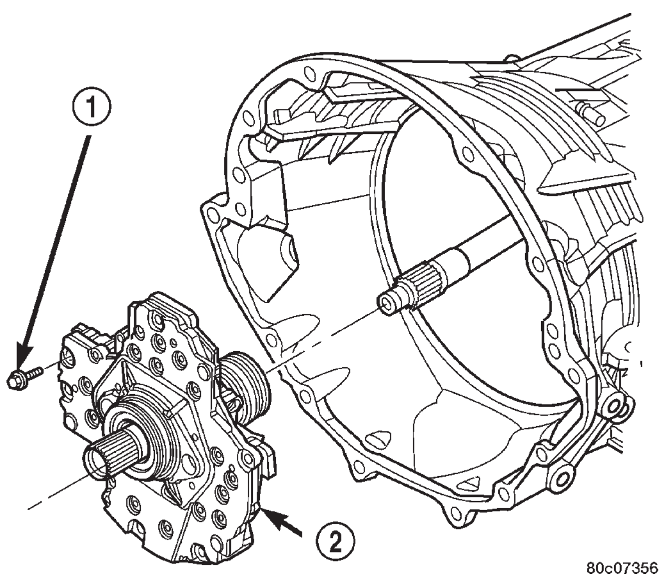


Fig. 85 Oil Pump

1 - OIL PUMP TO CASE BOLT (6)
2 - OIL PUMP

OPERATION

As the torque converter rotates, the converter hub rotates the oil pump drive gear. As the drive gear rotates both driven gears, 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 oil pump valves.

At low speeds, both pumps supply fluid to the transmission. As the speed of the torque converter increases, the pressure output of both pumps increases until the primary pump pressure reaches the point where it can close off the check valve located between the two pumps. When the check valve is closed, the secondary pump is shut down and the primary pump supplies all the fluid to the transmission.

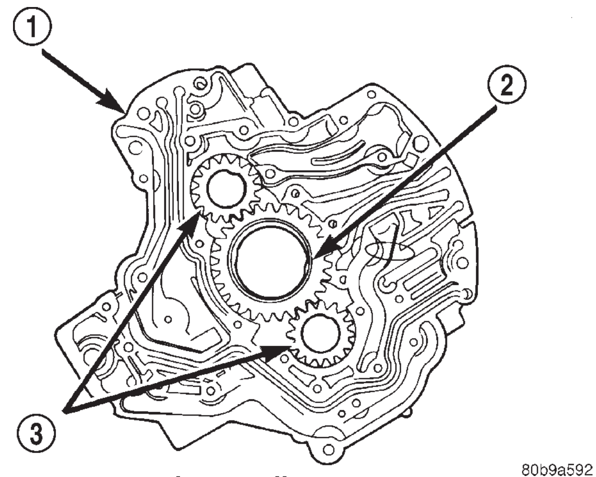


Fig. 86 Oil Pump Gears

1 - PUMP BODY
2 - DRIVE GEAR
3 - DRIVEN GEARS

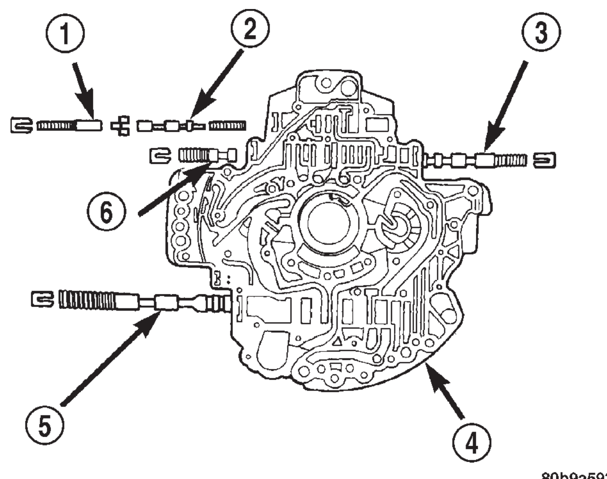


Fig. 87 Oil Pump Valves

1 - TORQUE CONVERTER CLUTCH ACCUMULATOR VALVE
2 - TORQUE CONVERTER CLUTCH CONTROL VALVE
3 - TORQUE CONVERTER CLUTCH SWITCH VALVE
4 - PUMP COVER
5 - PRESSURE REGULATOR VALVE
6 - TORQUE CONVERTER CLUTCH LIMIT VALVE

OIL PUMP (Continued)

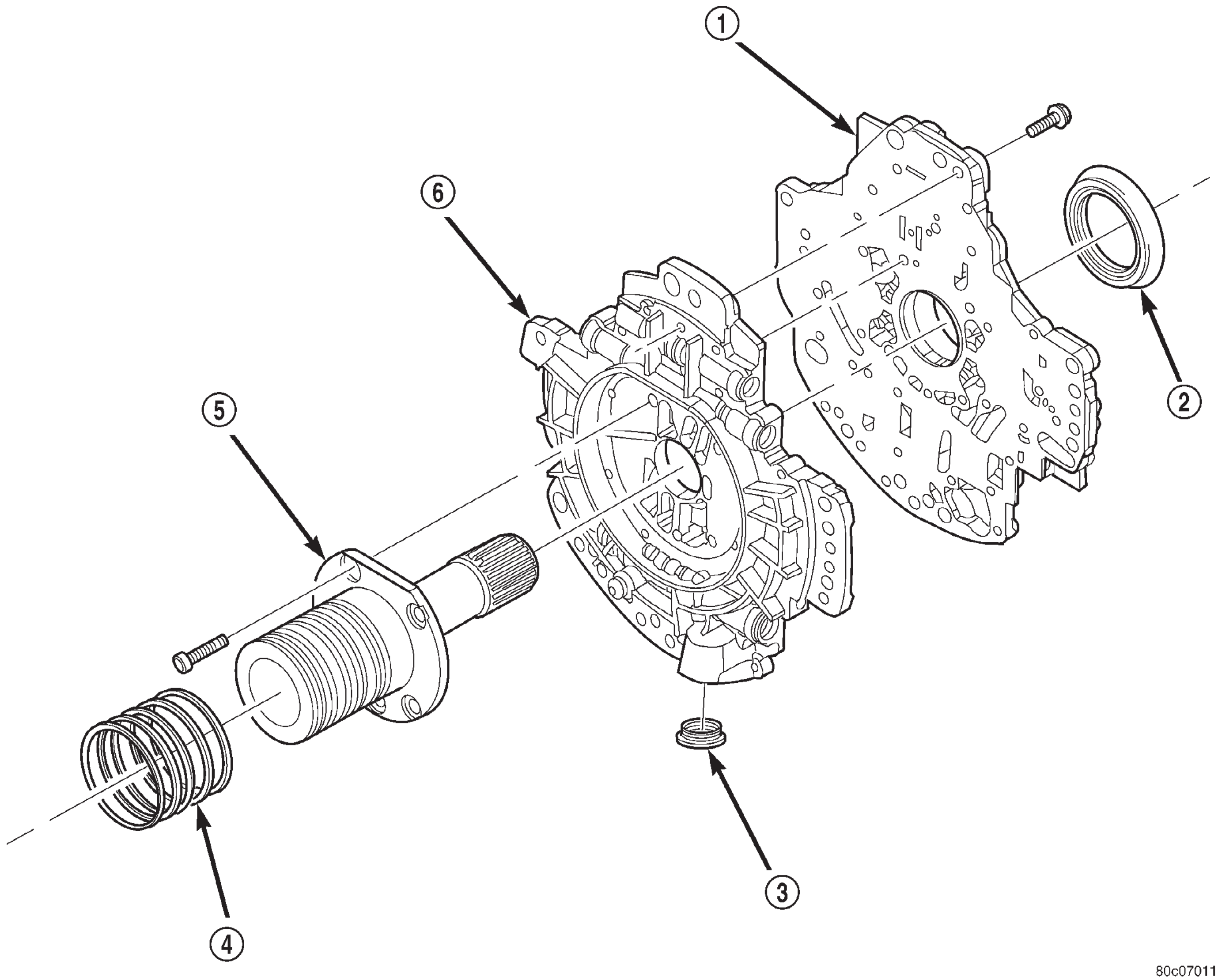


Fig. 88 Oil Pump Reaction Shaft

1 - PUMP HOUSING
2 - SEAL
3 - OIL FILTER SEAL
4 - SEAL RING (5)
5 - REACTION SHAFT SUPPORT
6 - VALVE BODY

CONVERTER CLUTCH SWITCH VALVE

The converter clutch switch valve is used to control the hydraulic pressure supplied to the front (OFF) side of the torque converter clutch.

CONVERTER CLUTCH REGULATOR VALVE

The converter clutch regulator valve is used to control the hydraulic pressure supplied to the back (ON) side of the torque converter clutch.

TORQUE CONVERTER LIMIT VALVE

The torque converter limit valve serves to limit the available line pressure to the torque converter clutch to approximately 120 psi.

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.

OIL PUMP (Continued)

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 1800 rpm**, with the shift selector in neutral. Verify that the transmission fluid temperature is below 104.5° C (220° F) for this test.

(3) If one quart of transmission fluid is collected in the container in 30 seconds or less, oil pump flow volume is within acceptable limits. If fluid flow is intermittent, or it takes more than 30 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 the bolts holding the reaction shaft support to the oil pump (Fig. 89).

(2) Remove the reaction shaft support from the oil pump (Fig. 89).

(3) Remove all bolts holding the oil pump halves together (Fig. 89).

(4) Using suitable prying tools, separate the oil pump sections by inserting the tools in the supplied areas and prying the halves apart.

NOTE: The oil pump halves are aligned to each other through the use of two dowels. Be sure to pry upward evenly to prevent damage to the oil pump components.

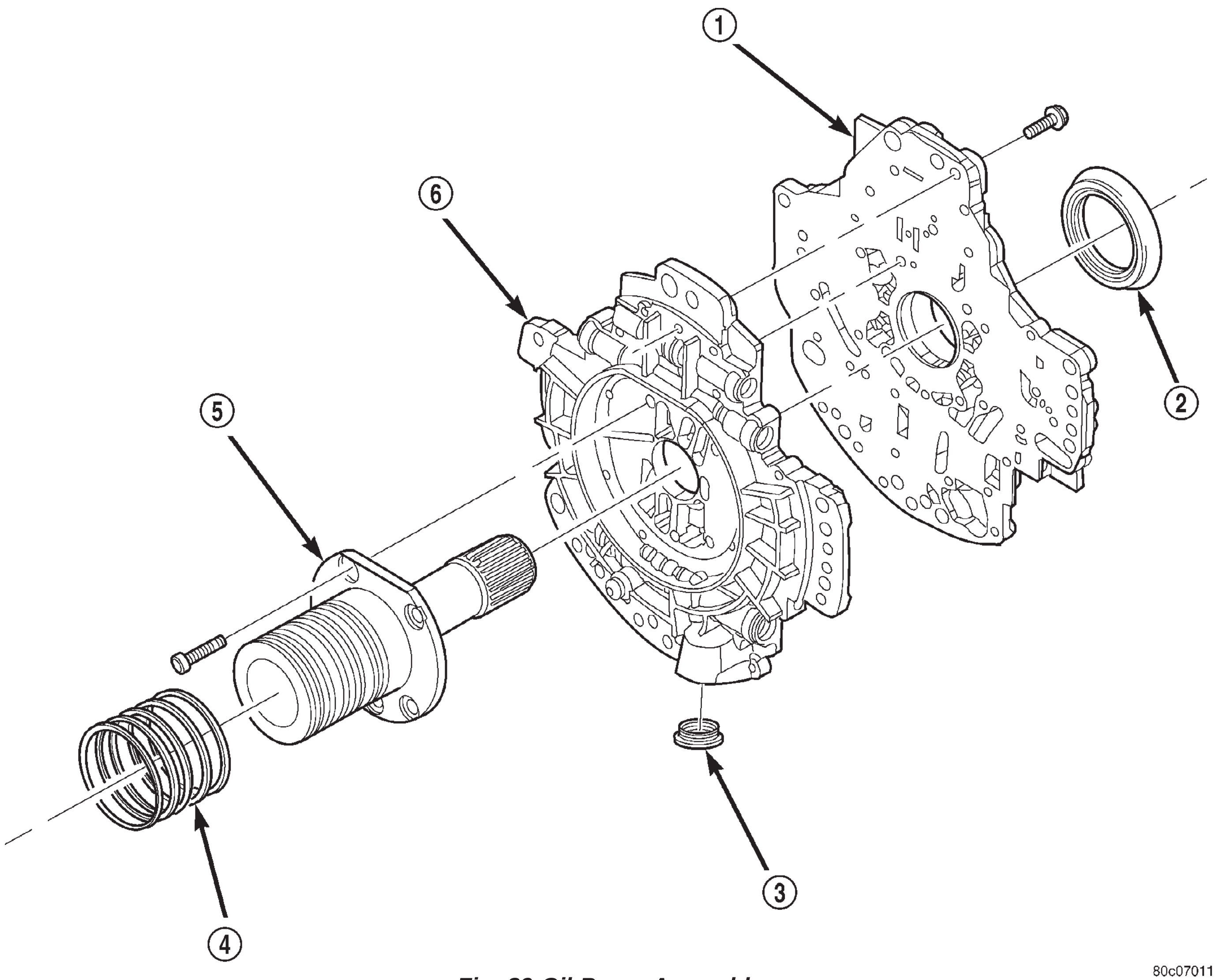


Fig. 89 Oil Pump Assembly

1 - PUMP HOUSING
2 - SEAL
3 - OIL FILTER SEAL
4 - SEAL RING (5)
5 - REACTION SHAFT SUPPORT
6 - VALVE BODY

OIL PUMP (Continued)

(5) Remove the screws holding the separator plate onto the oil pump body (Fig. 90).

(6) Remove the separator plate from the oil pump body (Fig. 90).

(7) Mark all gears for location. The gears are select fit and if the oil pump is to be reused, the gears must be returned to their original locations.

(8) Remove the oil pump gears from the oil pump case (Fig. 90).

(9) Remove the oil pump valve retainers and associated valve and spring one at a time (Fig. 91) (Fig. 92). Mark the combination of components as a group and tag them as to the location from which they were removed.

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.

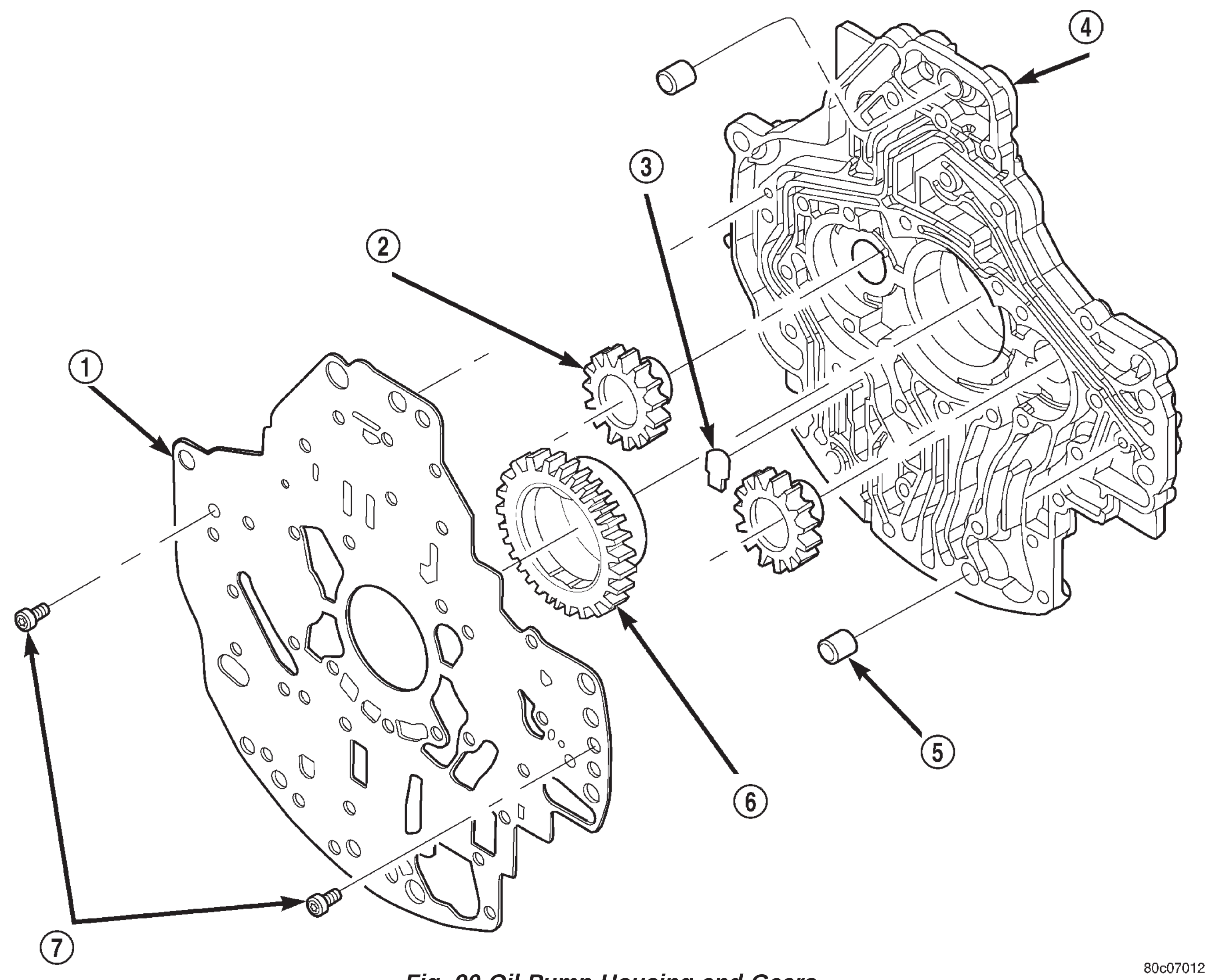


Fig. 90 Oil Pump Housing and Gears

1 - SEPARATOR PLATE
2 - DRIVEN GEAR (2)
3 - CHECK VALVE
4 - PUMP HOUSING
5 - DOWEL (2)
6 - DRIVE GEAR
7 - SCREW

OIL PUMP (Continued)

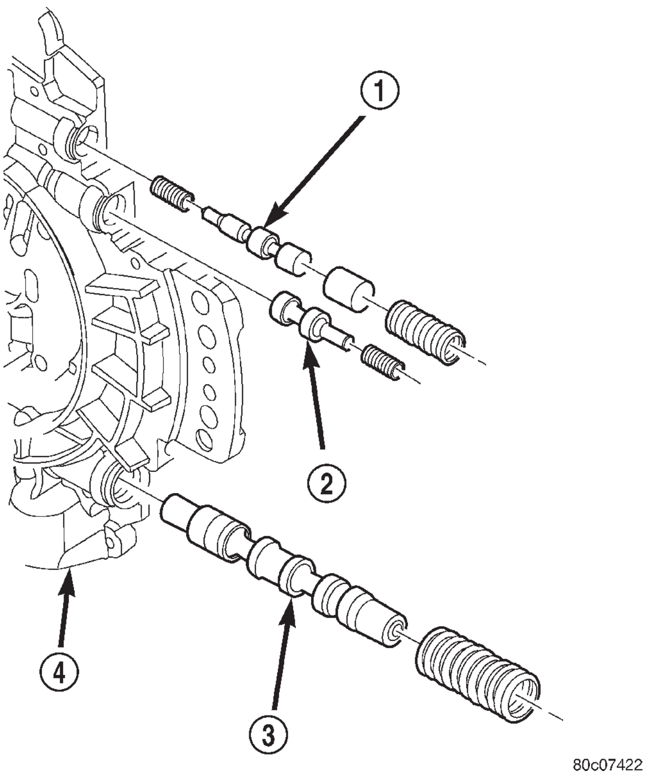


Fig. 91 Oil Pump Valve Body

1 - T/C REGULATOR VALVE
2 - T/C LIMIT VALVE
3 - REGULATOR VALVE
4 - OIL PUMP VALVE BODY

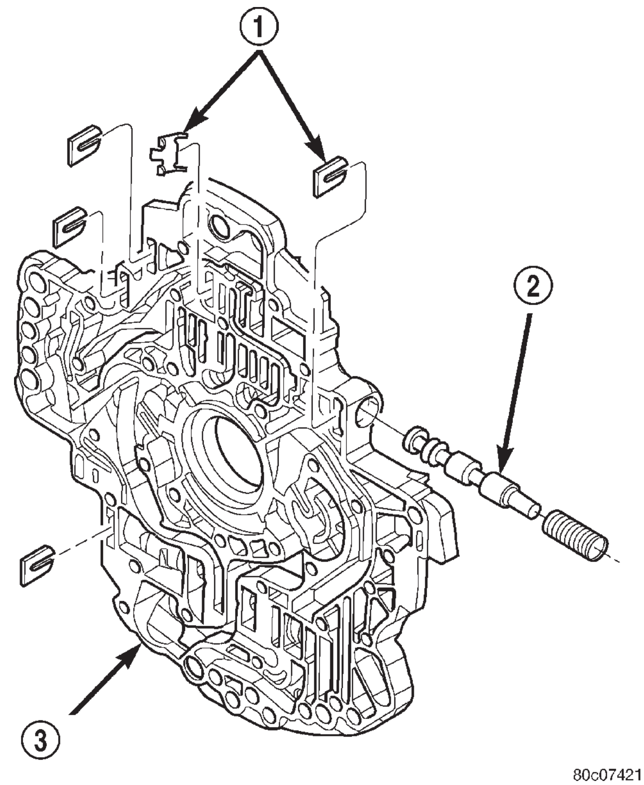


Fig. 92 T/C Switch Valve

1 - RETAINER
2 - T/C SWITCH VALVE
3 - OIL PUMP VALVE BODY

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.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Minor surface scratches on steel valves and plugs can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.** Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

Inspect all the valve and plug bores in the oil pump cover. Use a penlight to view the bore interiors. Replace the oil pump if any bores are distorted or scored. Inspect all of the valve 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.

ASSEMBLY

(1) Clean and inspect all components. Make sure that all passages are thoroughly cleaned and are free from dirt or debris. Make sure that all valves move freely in their proper bore. Make sure that all gear pockets and bushings are free from excessive wear and scoring. Replace the oil pump if any excessive wear or scoring is found.

(2) Coat the gears with Mopar® ATF +4, type 9602, and install into their original locations.

(3) Lubricate the oil pump valves with Mopar® ATF +4, type 9602, and install the valve, spring and retainer into the appropriate oil pump valve body bore (Fig. 91) (Fig. 92).

(4) Place the separator plate onto the oil pump body (Fig. 90).

(5) Install the screws to hold the separator plate onto the oil pump body (Fig. 90). Tighten the screws to 4.5 N·m (40 in.lbs.).

(6) Position the oil pump cover onto the locating dowels (Fig. 89).

(7) Seat the two oil pump halves together and install all bolts finger tight.

(8) Torque all bolts down slowly starting in the center and working outward. The correct torque is 4.5 N·m (40 in.lbs.).

(9) Verify that the oil pump gears rotate freely and smoothly.

(10) Position the reaction shaft support into the oil pump (Fig. 89).

OIL PUMP (Continued)

(11) Install and torque the bolts to hold the reaction shaft support to the oil pump (Fig. 89). The correct torque is 12 N·m (105 in.lbs.).

OIL PUMP FRONT SEAL

REMOVAL

(1) Remove transmission from the vehicle.

(2) Remove the torque converter from the transmission.

(3) Using a screw mounted in a slide hammer, remove the oil pump front seal.

INSTALLATION

(1) Clean seal bore of the oil pump of any residue or particles from the original seal.

(2) Install new oil seal in the oil pump housing using Seal Installer C-3860-A (Fig. 93).

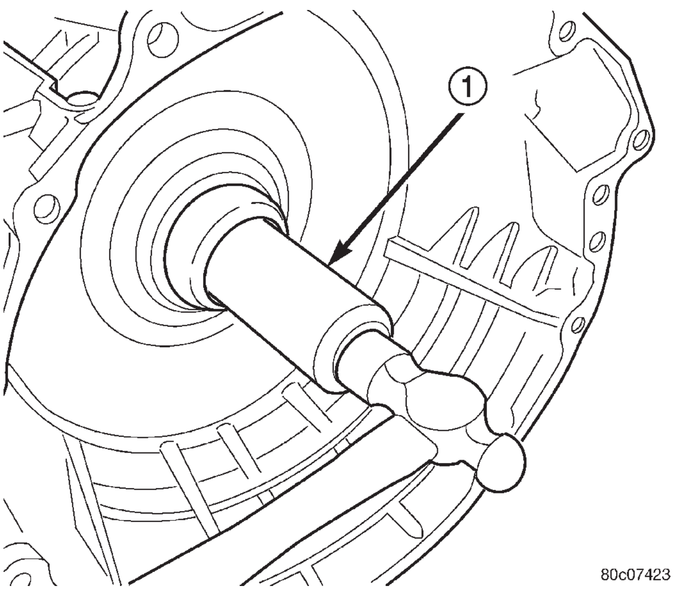


Fig. 93 Install Oil Pump Front Seal

1 - TOOL C-3860-A

OUTPUT SPEED SENSOR

DESCRIPTION

The Input and Output Speed Sensors are two-wire magnetic pickup devices that generate AC signals as rotation occurs. They are mounted in the left side of the transmission case and are considered primary inputs to the Transmission Control Module (TCM).

OPERATION

The Input Speed Sensor provides information on how fast the input shaft is rotating. As the teeth of the input clutch hub pass by the sensor coil, an AC voltage is generated and sent to the TCM. The TCM interprets this information as input shaft rpm.

The Output Speed Sensor generates an AC signal in a similar fashion, though its coil is excited by rotation of the rear planetary carrier lugs. The TCM interprets this information as output shaft rpm.

The TCM compares the input and output speed signals to determine the following:

- Transmission gear ratio
- Speed ratio error detection
- CVI calculation

The TCM also compares the input speed signal and the engine speed signal to determine the following:

- Torque converter clutch slippage
- Torque converter element speed ratio

REMOVAL

(1) Raise vehicle.

(2) Place a suitable fluid catch pan under the transmission.

(3) Remove the wiring connector from the output speed sensor (Fig. 94).

(4) Remove the bolt holding the output speed sensor to the transmission case.

(5) Remove the output speed sensor from the transmission case.

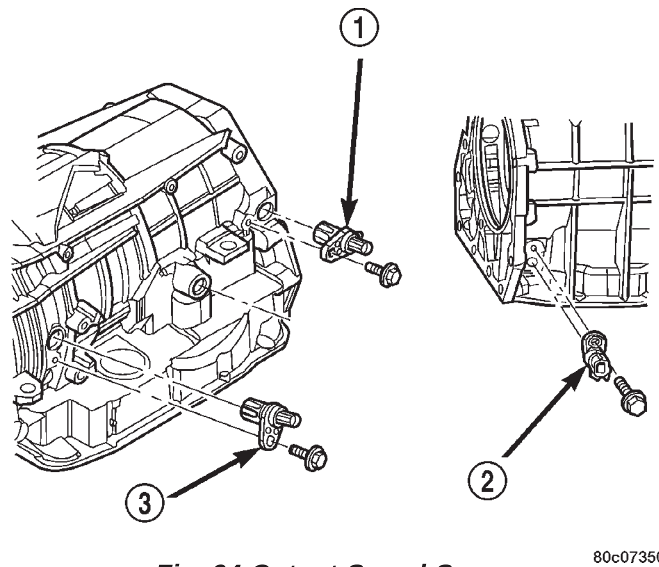


Fig. 94 Output Speed Sensor

1 - OUTPUT SPEED SENSOR
2 - LINE PRESSURE SENSOR
3 - INPUT SPEED SENSOR

INSTALLATION

(1) Install the output speed sensor into the transmission case.

(2) Install the bolt to hold the output speed sensor into the transmission case. Tighten the bolt to 11.9 N·m (105 in.lbs.).

OUTPUT SPEED SENSOR (Continued)

(3) Install the wiring connector onto the output speed sensor

(4) Verify the transmission fluid level. Add fluid as necessary.

(5) Lower vehicle.

OVERDRIVE SWITCH

DESCRIPTION

The overdrive OFF (control) switch is located in the shift lever arm (Fig. 95). The switch is a momentary contact device that signals the PCM to toggle current status of the overdrive function.

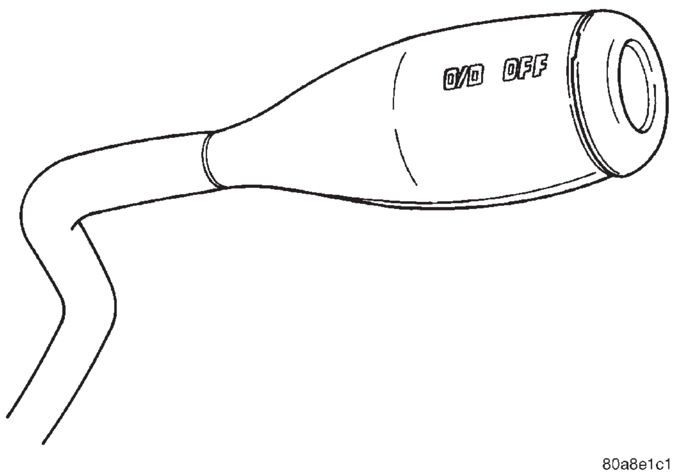


Fig. 95 Overdrive Off Switch

OPERATION

At key-on, overdrive operation is allowed. Pressing the switch once causes the overdrive OFF mode to be entered and the overdrive OFF switch lamp to be illuminated. Pressing the switch a second time causes normal overdrive operation to be restored and the overdrive lamp to be turned off. The overdrive OFF mode defaults to ON after the ignition switch is cycled OFF and ON. The normal position for the control switch is the ON position. The switch must be in this position to energize the solenoid and allow a 3-4 upshift. The control switch indicator light illuminates only when the overdrive switch is turned to the OFF position, or when illuminated by the transmission control module.

REMOVAL

(1) Using a plastic trim tool, remove the overdrive off switch retainer from the shift lever (Fig. 96).

(2) Pull the switch outwards to release it from the connector in the lever (Fig. 97)

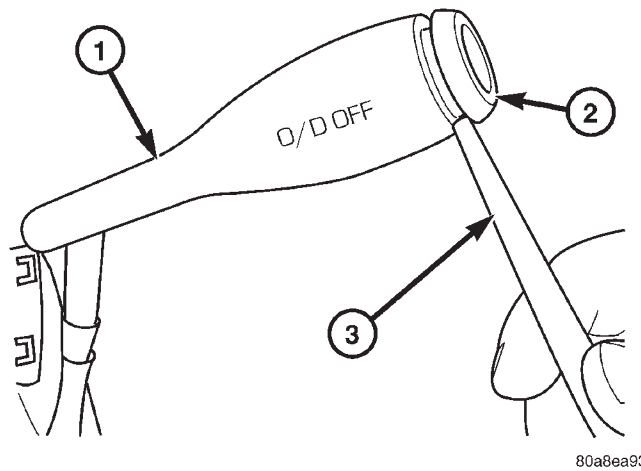


Fig. 96 Overdrive Off Switch Retainer

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH RETAINER
3 - PLASTIC TRIM TOOL

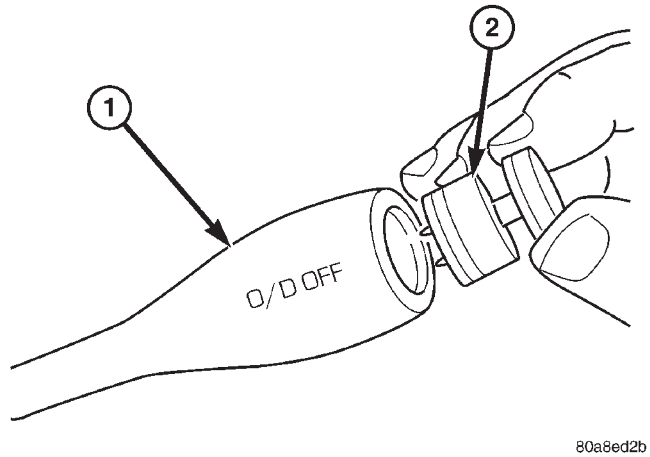


Fig. 97 Remove the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH

OVERDRIVE SWITCH (Continued)

INSTALLATION

NOTE: There is enough slack in the wire to pull out the connector from the lever.

(1) Pull the connector out of the lever just enough to grasp it.

CAUTION: Be careful not to bend the pins on the overdrive off switch. Use care when installing the switch, as it is not indexed, and can be accidentally installed incorrectly.

(2) Install the overdrive off switch into the connector (Fig. 98)

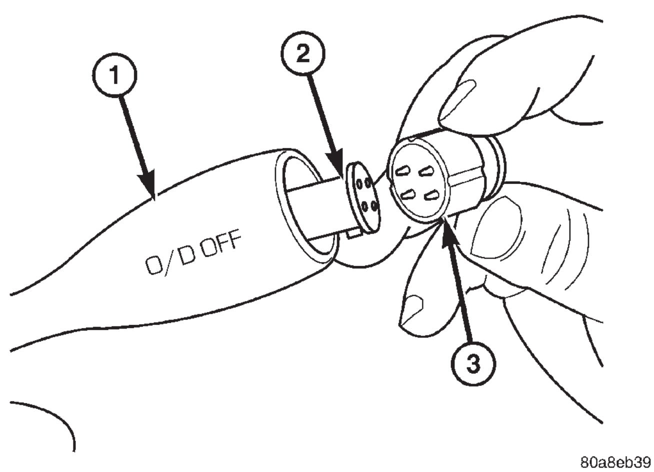


Fig. 98 Install the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH WIRING CONNECTOR
3 - OVERDRIVE OFF SWITCH

(3) Push the overdrive off switch and wiring into the shift lever.

(4) Install the overdrive off switch retainer onto the shift lever.

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. 99) 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.

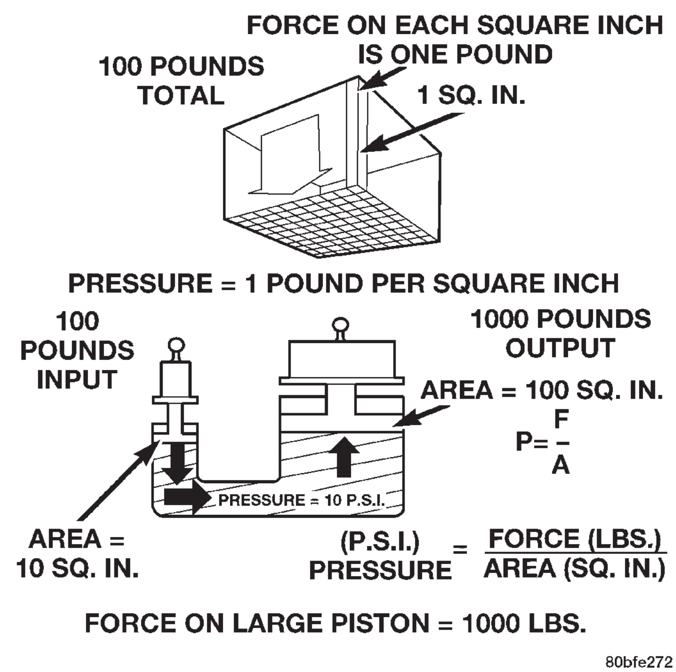


Fig. 99 Force and Pressure Relationship

PRESSURE ON A CONFINED FLUID

Pressure is exerted on a confined fluid (Fig. 100) 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.

PISTONS (Continued)

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.

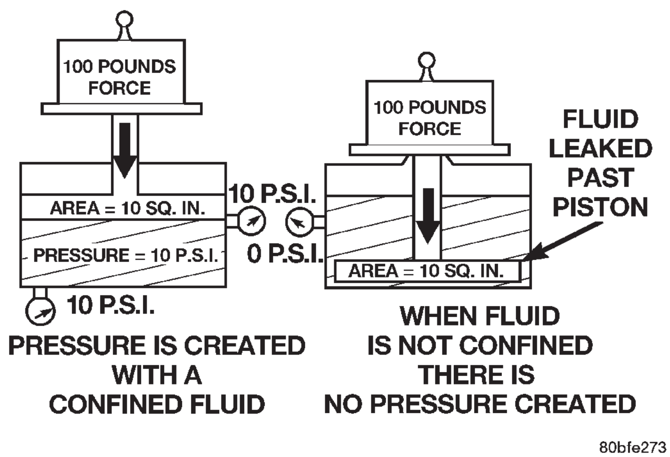


Fig. 100 Pressure on a Confined Fluid

FORCE MULTIPLICATION

Using the 10 PSI example used in the illustration (Fig. 101), 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. 101), shows an area that is ten times larger than the original area. The pressure created with the smaller 100 lb. input is 10 PSI. The concept "pressure is the same everywhere" means that the pressure underneath the larger piston is also 10 PSI. Pressure is equal to the force applied divided by the contact area. Therefore, by means of simple algebra, the output force may be found. This concept is extremely important, as it is also used in the design and operation of all shift valves and limiting valves in the valve body, as well as the pistons, of the transmission, which activate the clutches and bands. It is nothing more than using a difference of area to create a difference in pressure to move an object.

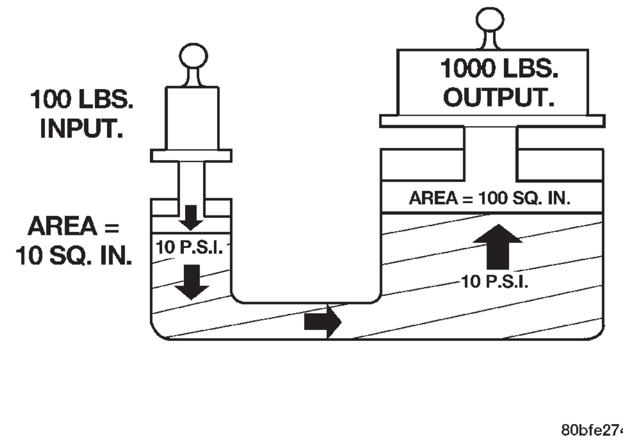


Fig. 101 Force Multiplication

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. 102) 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.

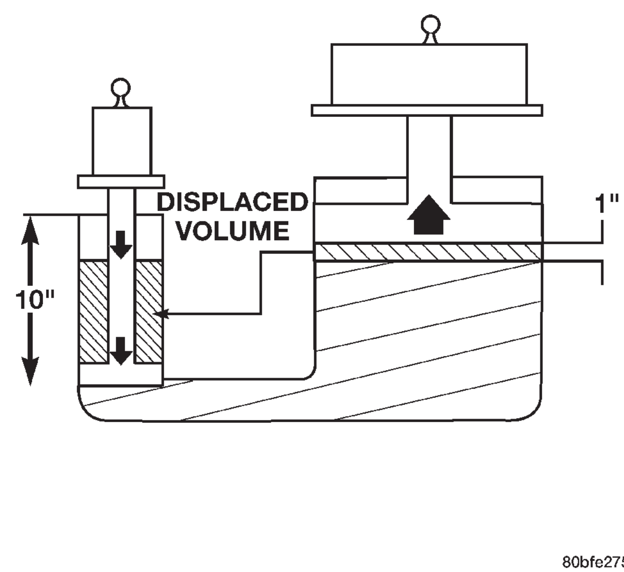


Fig. 102 Piston Travel

PLANETARY GEARTRAIN

DESCRIPTION

The planetary geartrain is located behind the 4C retainer/bulkhead, toward the rear of the transmission. The planetary geartrain consists of three primary assemblies:

- Reaction (Fig. 103).
- Reverse (Fig. 104).
- Input (Fig. 104).

OPERATION

REACTION PLANETARY GEARTRAIN

The reaction planetary carrier and reverse sun gear of the reaction planetary geartrain are a single component which is held by the 2C clutch when required. The reaction annulus gear is a stand alone component that can be driven by the reverse clutch or held by the 4C clutch. The reaction sun gear is driven by the overdrive clutch.

REVERSE PLANETARY GEARTRAIN

The reverse planetary geartrain is the middle of the three planetary sets. The reverse planetary carrier can be driven by the overdrive clutch as required. The reverse planetary carrier is also splined to the input annulus gear, which can be held by the low/reverse clutch. The reverse planetary annulus, input planetary carrier, and output shaft are all one piece.

INPUT PLANETARY GEARTRAIN

The input sun gear of the input planetary geartrain is driven by the underdrive clutch.

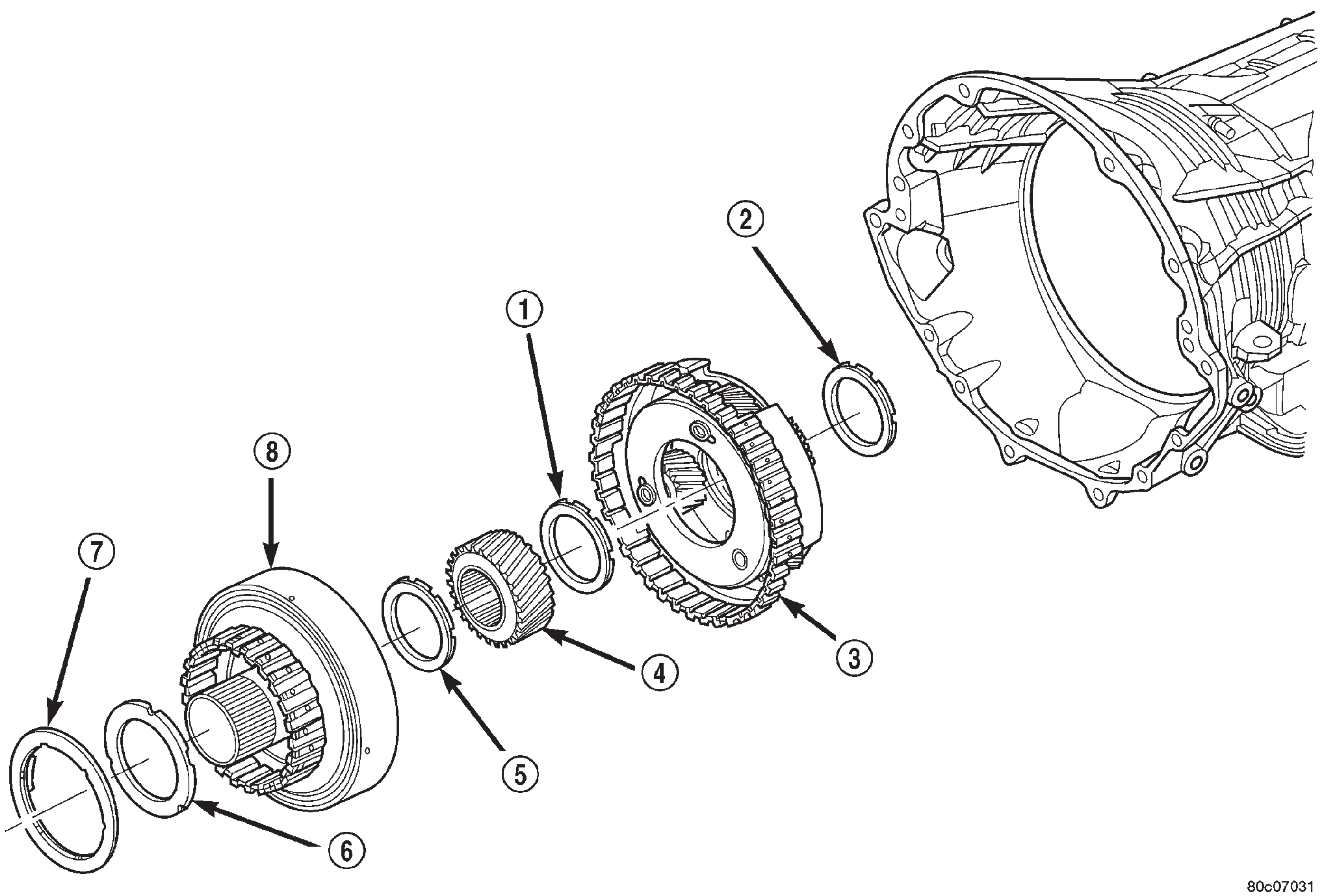


Fig. 103 Reaction Planetary Geartrain

1 - BEARING NUMBER 8
2 - BEARING NUMBER 9
3 - REACTION PLANETARY CARRIER
4 - REACTION SUN GEAR
5 - BEARING NUMBER 7
6 - THRUST PLATE (SELECT)
7 - BEARING NUMBER 6
8 - REACTION ANNULUS

PLANETARY GEARTRAIN (Continued)

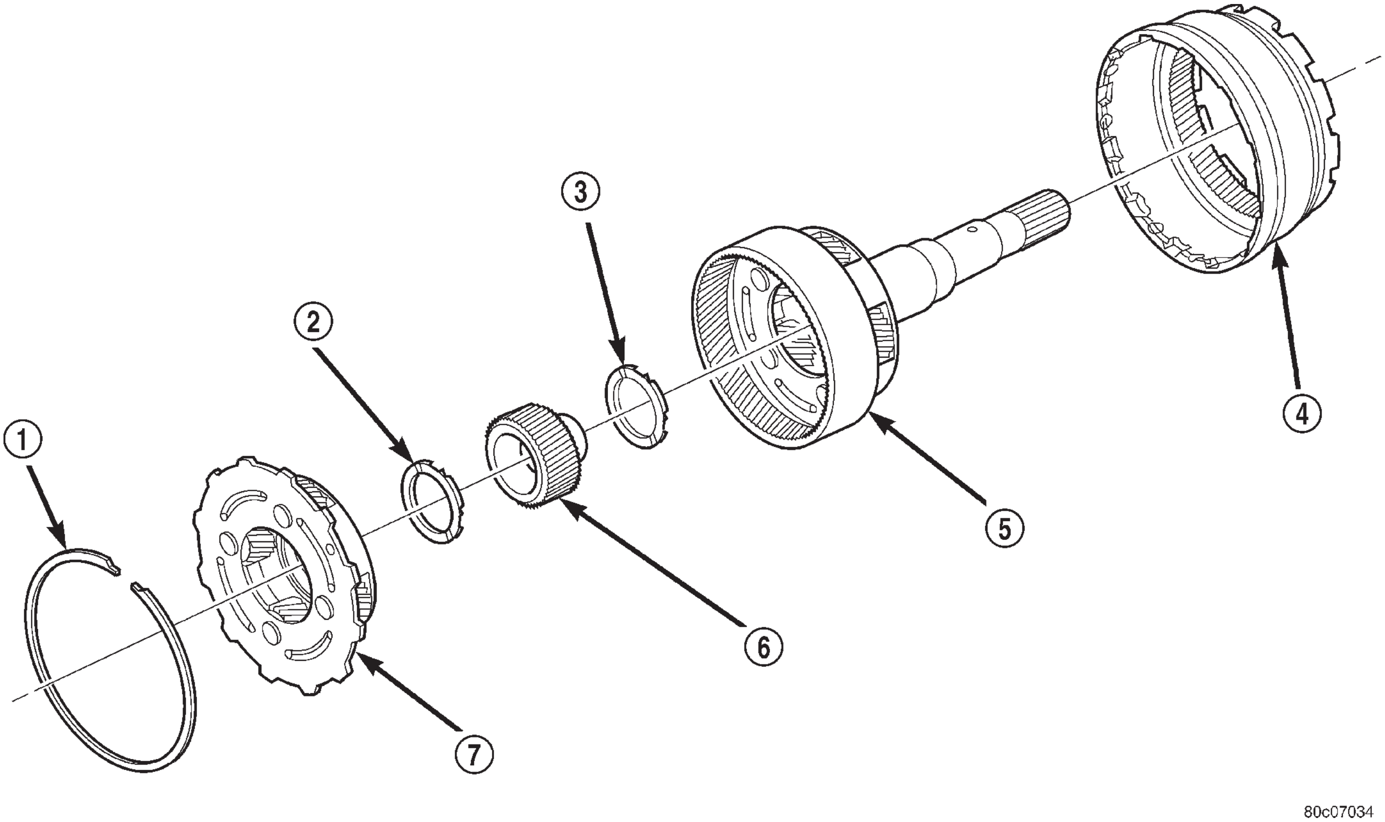


Fig. 104 Reverse/Input Planetary Geartrain

1 - SNAP-RING
2 - BEARING NUMBER 10
3 - BEARING NUMBER 11
4 - INPUT ANNULUS
5 - INPUT PLANETARY CARRIER
6 - INPUT SUN GEAR
7 - REVERSE PLANETARY CARRIER

DISASSEMBLY

(1) Remove the snap-ring holding the input annulus into the input carrier (Fig. 105).

(2) Remove the input annulus from the input carrier (Fig. 105).

(3) Remove the number 9 bearing from the reverse planetary carrier. Note that this planetary carrier has four pinion gears.

(4) Remove the reverse planetary gear carrier (Fig. 105).

(5) Remove the number 10 bearing from the input sun gear (Fig. 105).

(6) Remove the input sun gear from the input carrier (Fig. 105).

(7) Remove the number 11 bearing from the input carrier (Fig. 105).

CLEANING

Clean the planetary components in solvent and dry them with compressed air.

INSPECTION

Check sun gear and driving shell condition. Replace the gear if damaged or if the bushings are scored or worn. The bushings are not serviceable. Replace the driving shell if worn, cracked or damaged.

Replace planetary gear sets if gears, pinion pins, or carrier are damaged in any way. Replace the annulus gears and supports if either component is worn or damaged.

Replace the output shaft if the machined surfaces are scored, pitted, or damaged in any way. Also replace the shaft if the splines are damaged, or exhibits cracks at any location.

ASSEMBLY

(1) Clean and inspect all components. Replace any components which show evidence of excessive wear or scoring.

(2) Install the number 11 bearing into the input planetary carrier with the flat side up and facing forward (Fig. 105).

PLANETARY GEARTRAIN (Continued)

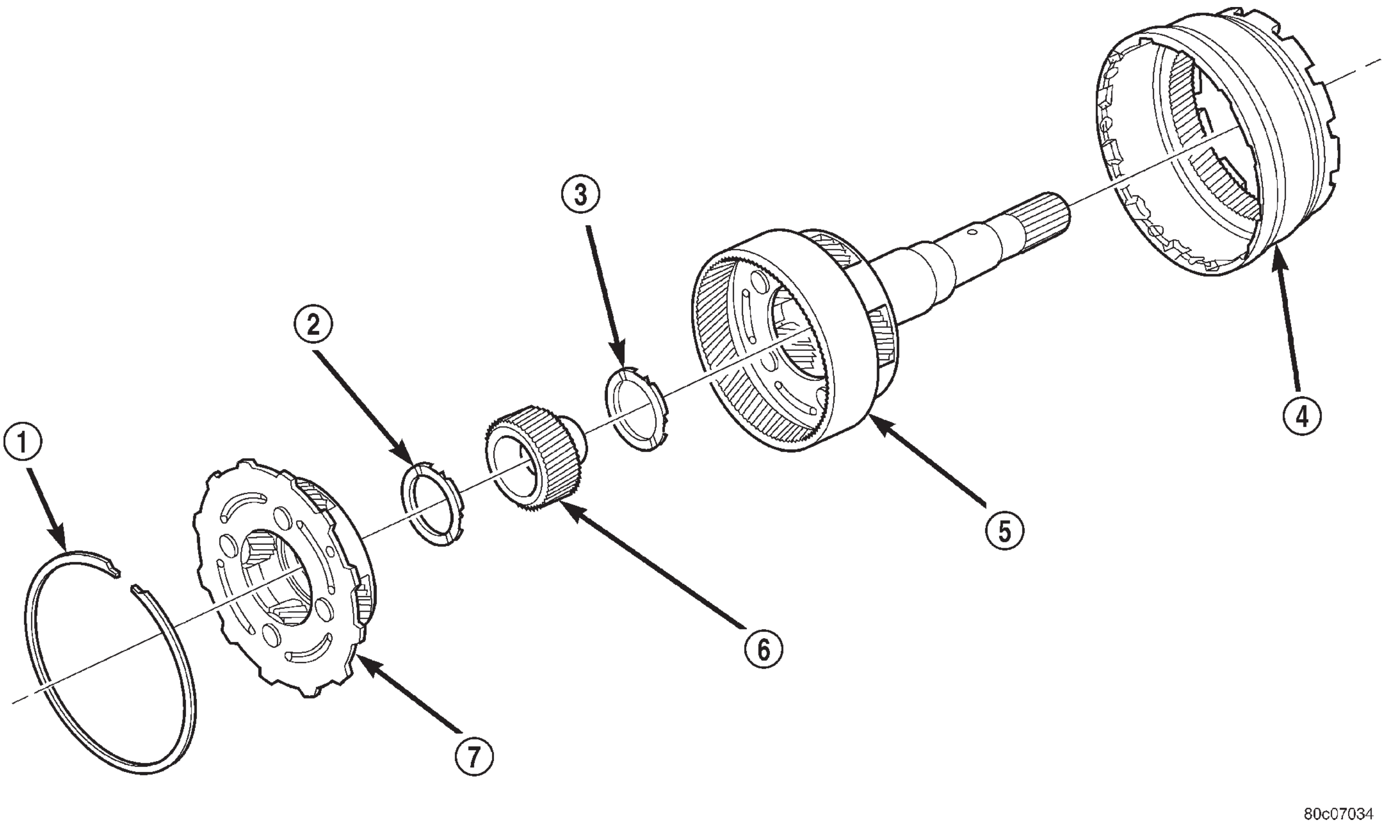


Fig. 105 Reverse/Input Planetary Carrier Assembly

1 - SNAP-RING
2 - BEARING NUMBER 10
3 - BEARING NUMBER 11
4 - INPUT ANNULUS
5 - INPUT PLANETARY CARRIER
6 - INPUT SUN GEAR
7 - REVERSE PLANETARY CARRIER

(3) Install the input sun gear into the input carrier (Fig. 105).

(4) Install the number 10 bearing onto the rear of the reverse planetary carrier with the flat side toward the carrier (Fig. 105).

(5) Install the number 9 bearing onto the front of the reverse planetary carrier with the rounded side toward the carrier and the flat side facing upward (Fig. 105).

(6) Install the reverse planetary gear carrier into the input carrier (Fig. 105).

(7) Install the input annulus gear into the input carrier (Fig. 105).

(8) Install the snap-ring to hold the input annulus gear into the input carrier (Fig. 105).

SHIFT MECHANISM

DESCRIPTION

The gear shift mechanism provides six shift positions which are:

- Park (P)
- Reverse (R)
- Neutral (N)
- Drive (D)
- Manual second (2)
- Manual low (1)

OPERATION

MANUAL LOW (1) range provides first gear only. Overrun braking is also provided in this range. MANUAL SECOND (2) range provides first and second gear only.

DRIVE range provides FIRST, SECOND THIRD and OVERDRIVE FOURTH gear ranges. The shift into OVERDRIVE FOURTH gear range occurs only after the transmission has completed the shift into D THIRD gear range. No further movement of the shift mechanism is required to complete the 3-4 shift.

The FOURTH gear upshift occurs automatically when the overdrive selector switch is in the ON position. No upshift to FOURTH gear will occur if any of the following are true:

SHIFT MECHANISM (Continued)

- The transmission fluid temperature is below 10° C (50° F) or above 121° C (250° F).
- The shift to THIRD is not yet complete.
- Vehicle speed is too low for the 3-4 shift to occur.
- Battery temperature is below -5° C (23° F).

SOLENOID SWITCH VALVE

DESCRIPTION

The Solenoid Switch Valve (SSV) is located in the valve body and controls the direction of the transmission fluid when the L/R-TCC solenoid is energized.

OPERATION

The Solenoid Switch Valve controls line pressure from the LR-TCC solenoid. In 1st gear, the SSV will be in the downshifted position, thus directing fluid to the L/R clutch circuit. In 2nd, 3rd, and 4th, the solenoid switch valve will be in the upshifted position and directs the fluid into the torque converter clutch (TCC) circuit.

When shifting into 1st gear, a special hydraulic sequence is performed to ensure SSV movement into the downshifted position. The L/R pressure switch is monitored to confirm SSV movement. If the movement is not confirmed (the L/R pressure switch does not close), 2nd gear is substituted for 1st. A DTC will be set after three unsuccessful attempts are made to get into 1st gear in one given key start.

SOLENOIDS

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:

- Increase the amount of current applied to the coil or
- 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.

TORQUE CONVERTER

DESCRIPTION

The torque converter (Fig. 106) 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 and contains an o-ring seal to better control oil flow.

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.

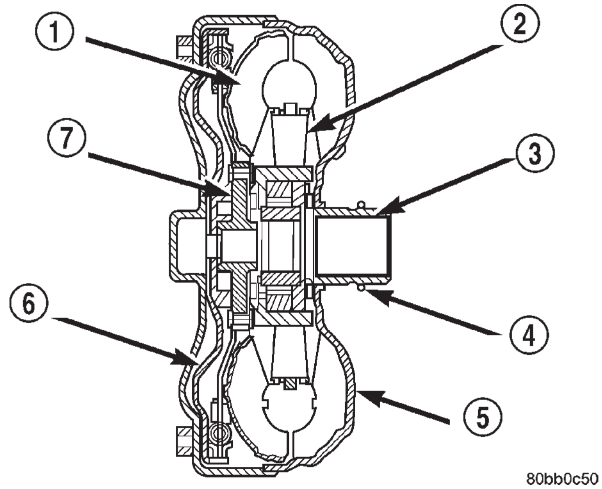


Fig. 106 Torque Converter Assembly

1 - TURBINE ASSEMBLY
2 - STATOR
3 - CONVERTER HUB
4 - O-RING
5 - IMPELLER ASSEMBLY
6 - CONVERTER CLUTCH PISTON
7 - TURBINE HUB

TORQUE CONVERTER (Continued)

IMPELLER

The impeller (Fig. 107) 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 members of the system.

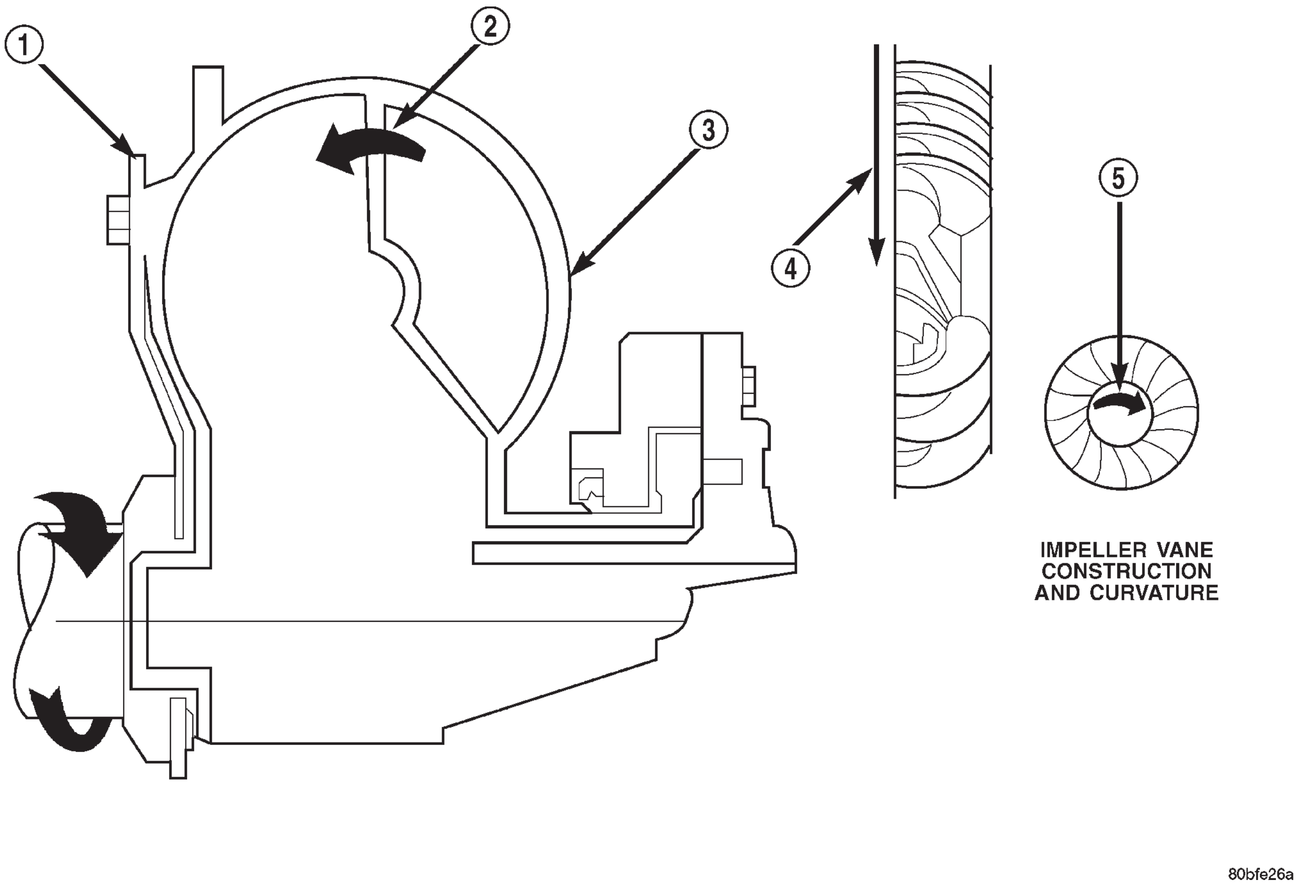


Fig. 107 Impeller

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)

TURBINE

The turbine (Fig. 108) 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.

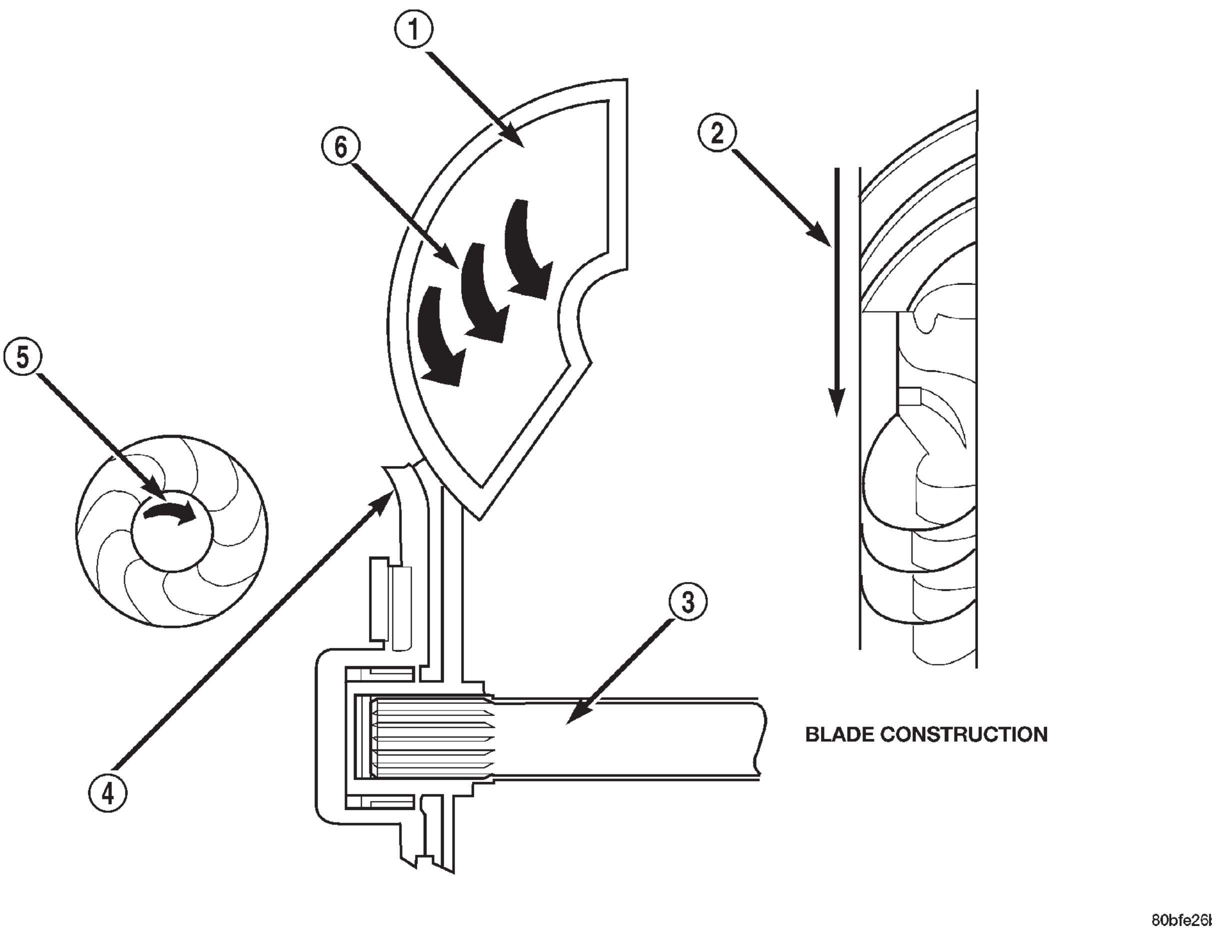


Fig. 108 Turbine

1 - TURBINE VANE
2 - ENGINE ROTATION
3 - INPUT SHAFT
4 - PORTION OF TORQUE CONVERTER COVER
5 - ENGINE ROTATION
6 - OIL FLOW WITHIN TURBINE SECTION

TORQUE CONVERTER (Continued)

STATOR

The stator assembly (Fig. 109) 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. 110). 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.

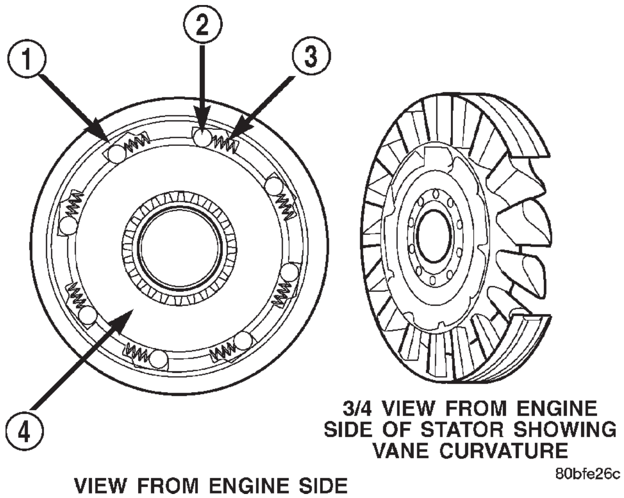


Fig. 109 Stator Components

1 - CAM (OUTER RACE)
2 - ROLLER
3 - SPRING
4 - INNER RACE

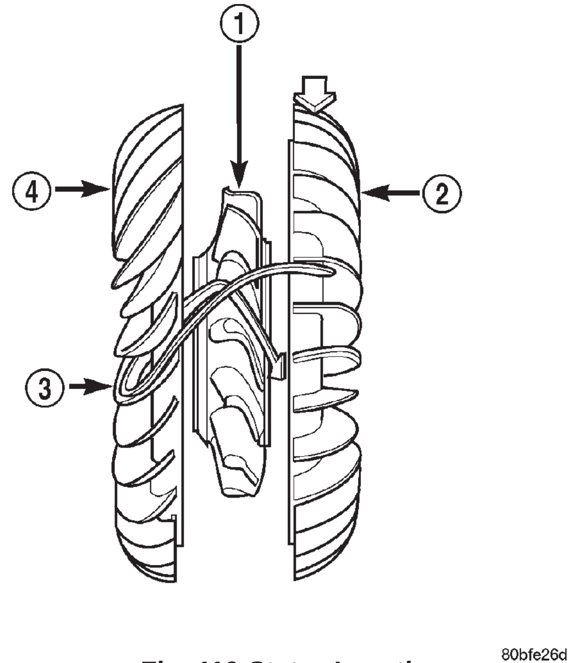


Fig. 110 Stator Location

1 - STATOR
2 - IMPELLER
3 - FLUID FLOW
4 - TURBINE

TORQUE CONVERTER CLUTCH (TCC)

The TCC (Fig. 111) 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 with friction material was added to the turbine assembly to provide this mechanical lock-up.

In order to reduce heat build-up in the transmission and buffer the powertrain against torsional vibrations, the TCM can duty cycle the L/R-CC Solenoid to achieve a smooth application of the torque converter clutch. This function, referred to as Electronically Modulated Converter Clutch (EMCC) can occur at various times depending on the following variables:

- Shift lever position
- Current gear range
- Transmission fluid temperature
- Engine coolant temperature
- Input speed

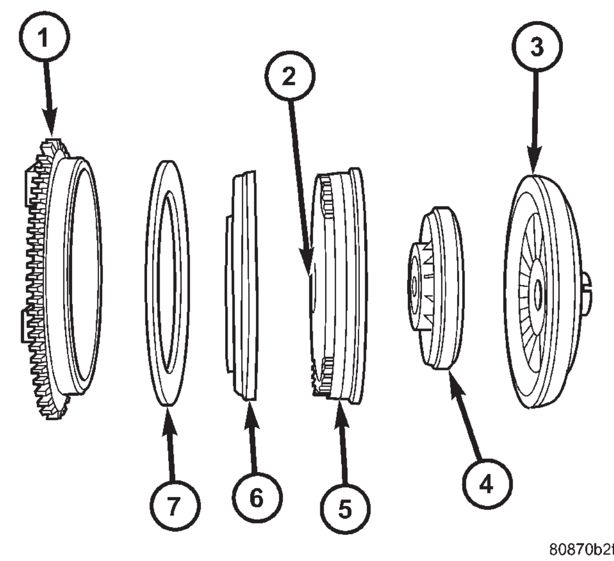


Fig. 111 Torque Converter Clutch (TCC)

1 - IMPELLER FRONT COVER
2 - THRUST WASHER ASSEMBLY
3 - IMPELLER
4 - STATOR
5 - TURBINE
6 - PISTON
7 - FRICTION DISC

- Throttle angle
- Engine speed

OPERATION

The converter impeller (Fig. 112) (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. 113). 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 and friction material to the front cover, 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 clutch can be engaged in second, third, and fourth gear ranges depending on overdrive control switch position. If the overdrive control switch is in the normal ON position, the clutch will engage after

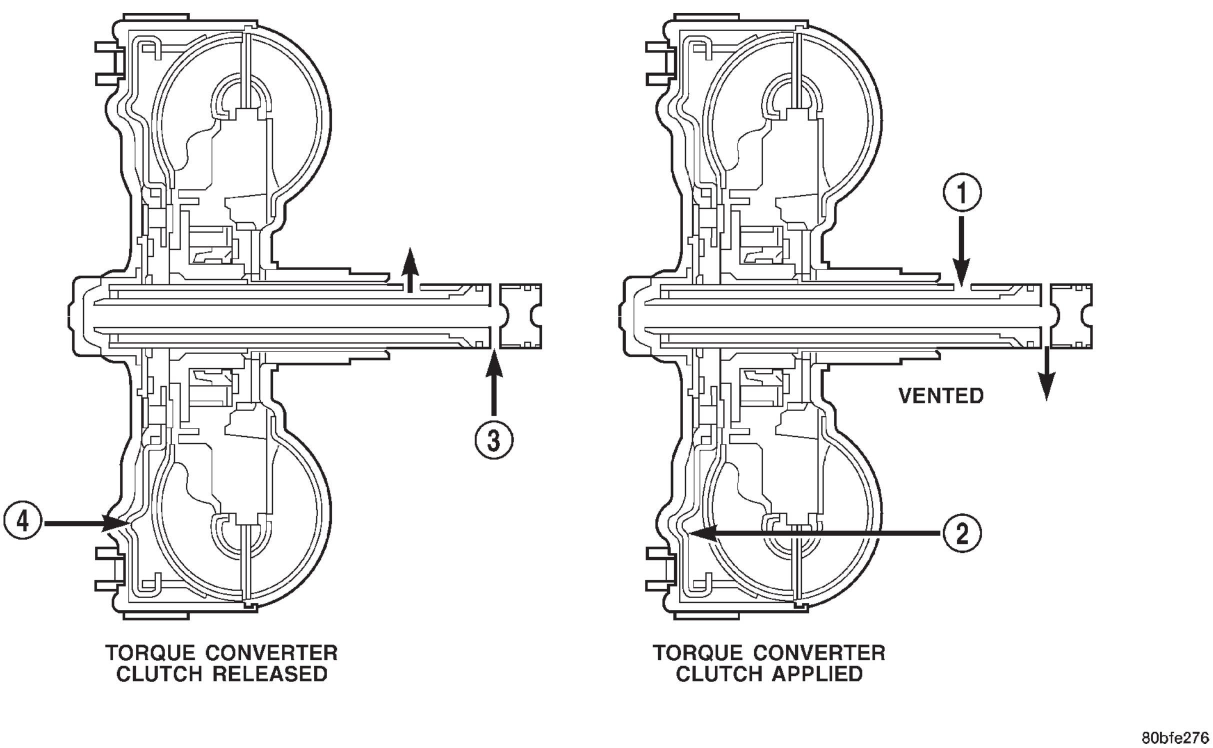


Fig. 112 Torque Converter Fluid Operation - Typical

1 - APPLY PRESSURE
2 - THE PISTON MOVES SLIGHTLY FORWARD
3 - RELEASE PRESSURE
4 - THE PISTON MOVES SLIGHTLY REARWARD

TORQUE CONVERTER (Continued)

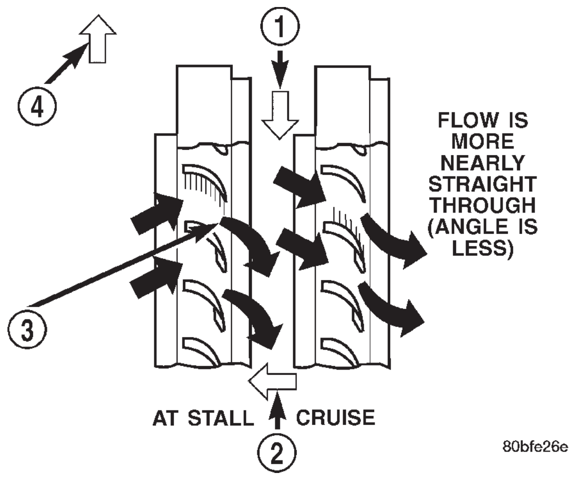


Fig. 113 Stator Operation

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

the shift to fourth gear, and above approximately 72 km/h (45 mph). If the control switch is in the OFF position, the clutch will engage after the shift to third gear, at approximately 56 km/h (35 mph) at light throttle.

The TCM controls the torque converter by way of internal logic software. The programming of the software provides the TCM with control over the L/R-CC Solenoid. There are four output logic states that can be applied as follows:

- No EMCC
- Partial EMCC
- Full EMCC
- Gradual-to-no EMCC

NO EMCC

Under No EMCC conditions, the L/R Solenoid is OFF. There are several conditions that can result in NO EMCC operations. No EMCC can be initiated due to a fault in the transmission or because the TCM does not see the need for EMCC under current driving conditions.

PARTIAL EMCC

Partial EMCC operation modulates the L/R Solenoid (duty cycle) to obtain partial torque converter clutch application. Partial EMCC operation is maintained until Full EMCC is called for and actuated. During Partial EMCC some slip does occur. Partial EMCC will usually occur at low speeds, low load and light throttle situations.

FULL EMCC

During Full EMCC operation, the TCM increases the L/R Solenoid duty cycle to full ON after Partial EMCC control brings the engine speed within the desired slip range of transmission input speed relative to engine rpm.

GRADUAL-TO-NO EMCC

This operation is to soften the change from Full or Partial EMCC to No EMCC. This is done at mid-throttle by decreasing the L/R Solenoid duty cycle.

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 flats for sharp edges, burrs, scratches, or nicks. Polish the hub and flats with 320/400 grit paper or crocus cloth if necessary. Verify that the converter hub o-ring is properly installed and is free from debris. The hub must be smooth to avoid damaging the pump seal at installation.

(1) Lubricate oil pump seal lip with transmission fluid.

(2) Place torque converter in position on transmission.

CAUTION: Do not damage oil pump seal or converter hub o-ring 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.

TORQUE CONVERTER (Continued)

(6) Check converter seating with a scale and straightedge (Fig. 114). Surface of converter lugs should be at least 13 mm (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.

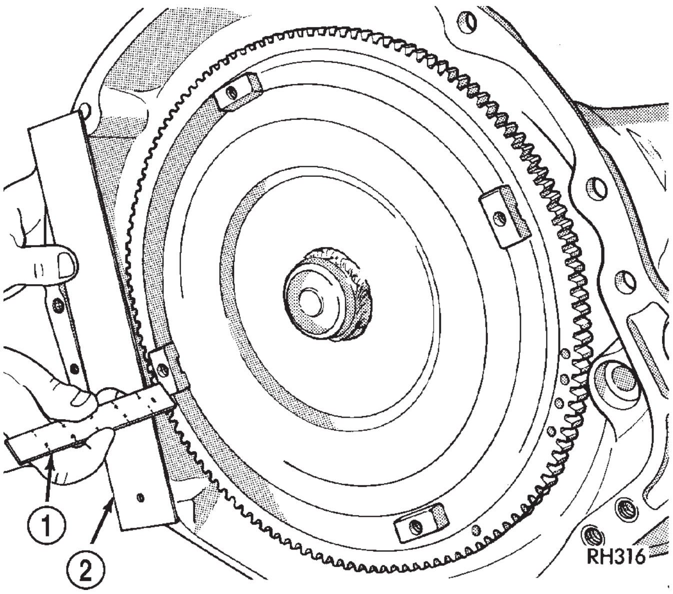


Fig. 114 Checking Torque Converter Seating-Typical

1 - SCALE
2 - STRAIGHTEDGE

TRANSMISSION CONTROL RELAY

DESCRIPTION

The relay is supplied fused B+ voltage, energized by the TCM, and is used to supply power to the solenoid pack when the transmission is in normal operating mode.

OPERATION

When the relay is "off", no power is supplied to the solenoid pack and the transmission is in "limp-in" mode. After a controller reset, the TCM energizes the relay. Prior to this, the TCM verifies that the contacts are open by checking for no voltage at the switched battery terminals. After this is verified, the voltage at the solenoid pack pressure switches is checked. After the relay is energized, the TCM monitors the terminals to verify that the voltage is greater than 3 volts.

TRANSMISSION RANGE SENSOR

DESCRIPTION

The Transmission Range Sensor (TRS) is mounted to the top of the valve body inside the transmission.

The Transmission Range Sensor (TRS) has six switch contacts that:

- Determine shift lever position
- Supply ground to the Starter Relay in Park and Neutral only.
- Supply ground to the TCM for backup lamp control in Reverse only.

The TRS also has an integrated temperature sensor (thermistor) that communicates transmission temperature to the TCM and PCM.

OPERATION

The Transmission Range Sensor (TRS) communicates shift lever position to the TCM as a combination of open and closed switches. Each shift lever position has an assigned combination of switch states (open/closed) that the TCM receives from four sense circuits. The TCM interprets this information and determines the appropriate transmission gear position and shift schedule.

There are many possible combinations of open and closed switches (codes). Seven of these possible codes are related to gear position and five are recognized as "between gear" codes. This results in many codes which should **never occur**. These are called "invalid" codes. An invalid code will result in a DTC, and the TCM will then determine the shift lever position based on pressure switch data. This allows reasonably normal transmission operation with a TRS failure.

GEAR	C5	C4	C3	C2	C1
Park	CL	OP	OP	CL	CL
Temp 1	CL	OP	OP	CL	OP
Reverse	OP	OP	OP	CL	OP
Temp 2	OP	OP	CL	CL	OP
Neutral 1	OP	OP	CL	CL	CL
Neutral 2	OP	CL	CL	CL	CL
Temp 3	OP	CL	CL	CL	OP
Drive	OP	CL	CL	OP	OP
Temp 4	OP	CL	OP	OP	OP
Manual 2	CL	CL	OP	OP	OP
Temp 5	CL	OP	OP	OP	OP
Manual 1	CL	OP	CL	OP	OP

TRANSMISSION SOLENOID/ TRS ASSEMBLY

DESCRIPTION

The transmission solenoid/TRS assembly is internal to the transmission and mounted on the valve body assembly (Fig. 115). The assembly consists of six solenoids that control hydraulic pressure to the six friction elements (transmission clutches), and the torque converter clutch. The pressure control solenoid is located on the side of the solenoid/TRS assembly. The solenoid/TRS assembly also contains five pressure switches that feed information to the TCM.

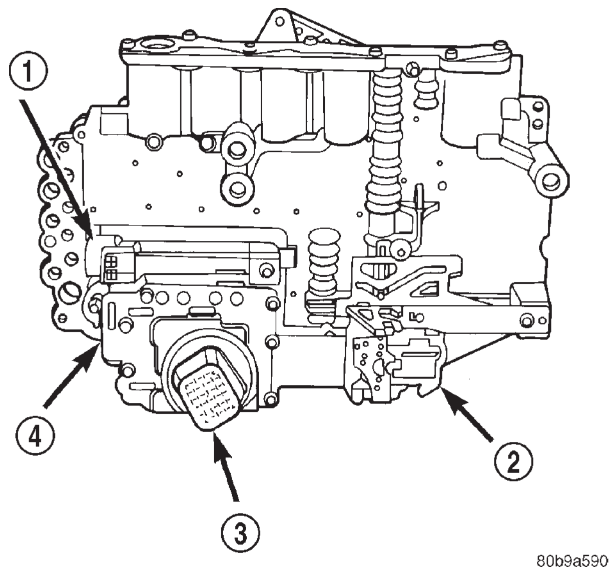


Fig. 115 Transmission Solenoid/TRS Assembly

1 - PRESSURE CONTROL SOLENOID
2 - TRANSMISSION RANGE SENSOR
3 - 23-WAY CONNECTOR
4 - SOLENOID PACK

OPERATION

SOLENOIDS

Solenoids are used to control the L/R, 2C, 4C, OD, and UD friction elements. The reverse clutch is controlled by line pressure and the position of the manual valve in the valve body. All the solenoids are contained within the Solenoid and Pressure Switch Assembly. The solenoid and pressure switch assembly contains one additional solenoid, Multi-Select (MS), which serves primarily to provide 2nd and 3rd gear limp-in operation.

The solenoids receive electrical power from the Transmission Control Relay through a single wire. The TCM energizes or operates the solenoids individually by grounding the return wire of the solenoid as necessary. When a solenoid is energized, the solenoid valve shifts, and a fluid passage is opened or closed (vented or applied), depending on its default operating state. The result is an apply or release of a frictional element.

The MS and UD solenoids are normally applied to allow transmission limp-in in the event of an electrical failure.

The continuity of the solenoids and circuits are periodically tested. Each solenoid is turned on or off depending on its current state. An inductive spike should be detected by the TCM during this test. If no spike is detected, the circuit is tested again to verify the failure. In addition to the periodic testing, the solenoid circuits are tested if a speed ratio or pressure switch error occurs.

PRESSURE SWITCHES

The TCM relies on five pressure switches to monitor fluid pressure in the L/R, 2C, 4C, UD, and OD hydraulic circuits. The primary purpose of these switches is to help the TCM detect when clutch circuit hydraulic failures occur. The switches close at 23 psi and open at 11 psi, and simply indicate whether or not pressure exists. The switches are continuously monitored by the TCM for the correct states (open or closed) in each gear as shown in the following chart:

GEAR	L/R	2C	4C	UD	OD
R	OP	OP	OP	OP	OP
P/N	CL	OP	OP	OP	OP
1ST	CL*	OP	OP	CL	OP
2ND	OP	CL	OP	CL	OP
2ND PRIME	OP	OP	CL	CL	OP
D	OP	OP	OP	CL	CL
FOURTH	OP	OP	CL	OP	CL

*L/R is closed if output speed is below 100 rpm in Drive and Manual 2. L/R is open in Manual 1.

A Diagnostic Trouble Code (DTC) will set if the TCM senses any switch open or closed at the wrong time in a given gear.

TRANSMISSION SOLENOID/TRS ASSEMBLY (Continued)

REMOVAL

(1) Remove the valve body from the transmission (Fig. 116).

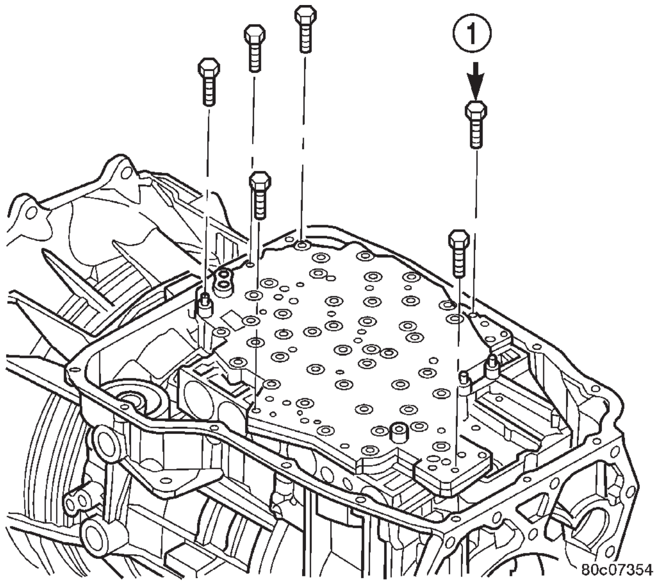


Fig. 116 Valve Body Bolts

1 - VALVE BODY TO CASE BOLT (6)

(2) Remove the screws holding the transmission solenoid/TRS assembly onto the valve body (Fig. 117).

(3) Separate the transmission solenoid/TRS assembly from the valve body.

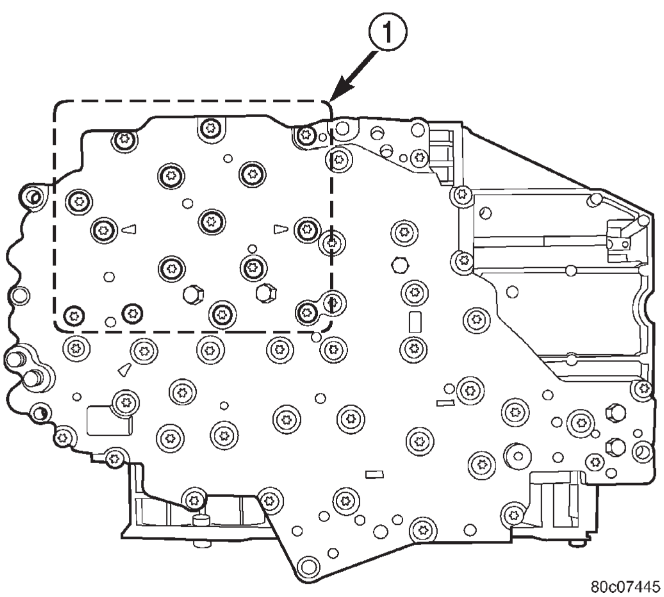


Fig. 117 Ttransmission Solenoid/TRS Assembly Screws

1 - SOLENOID PACK BOLTS (15)

INSTALLATION

(1) Place TRS selector plate in the PARK position.

(2) Position the transmission solenoid/TRS assembly onto the valve body. Be sure that both alignment dowels are fully seated in the valve body and that the TRS switch contacts are properly positioned in the selector plate

(3) Install the screws to hold the transmission solenoid/TRS assembly onto the valve body.

(4) Tighten the solenoid assembly screws adjacent to the arrows cast into the bottom of the valve body first. Tighten the screws to 5.7 N·m (50 in.lbs.).

(5) Tighten the remainder of the solenoid assembly screws to 5.7 N·m (50 in.lbs.).

(6) Install the valve body into the transmission.

TRANSMISSION TEMPERATURE SENSOR

DESCRIPTION

The transmission temperature sensor is a thermistor that is integral to the Transmission Range Sensor (TRS).

OPERATION

The transmission temperature sensor is used by the TCM to sense the temperature of the fluid in the sump. Since fluid temperature can affect transmission shift quality and convertor lock up, the TCM requires this information to determine which shift schedule to operate in.

Calculated Temperature

A failure in the temperature sensor or circuit will result in calculated temperature being substituted for actual temperature. Calculated temperature is a predicted fluid temperature which is calculated from a combination of inputs:

- Battery (ambient) temperature
- Engine coolant temperature
- In-gear run time since start-up

VALVE BODY

DESCRIPTION

The valve body consists of a cast aluminum valve body, a separator plate, and a 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. 118) and (Fig. 119):

- Solenoid switch valve
- Manual valve
- Low/reverse switch valve
- 5 Accumulators
- 7 check balls

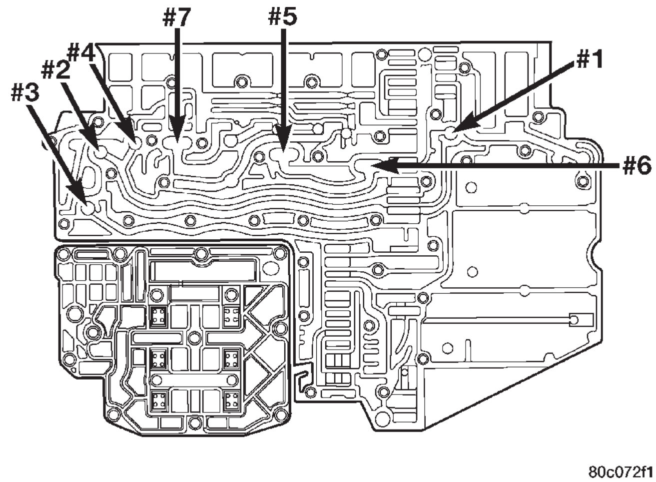


Fig. 119 Check Ball Locations

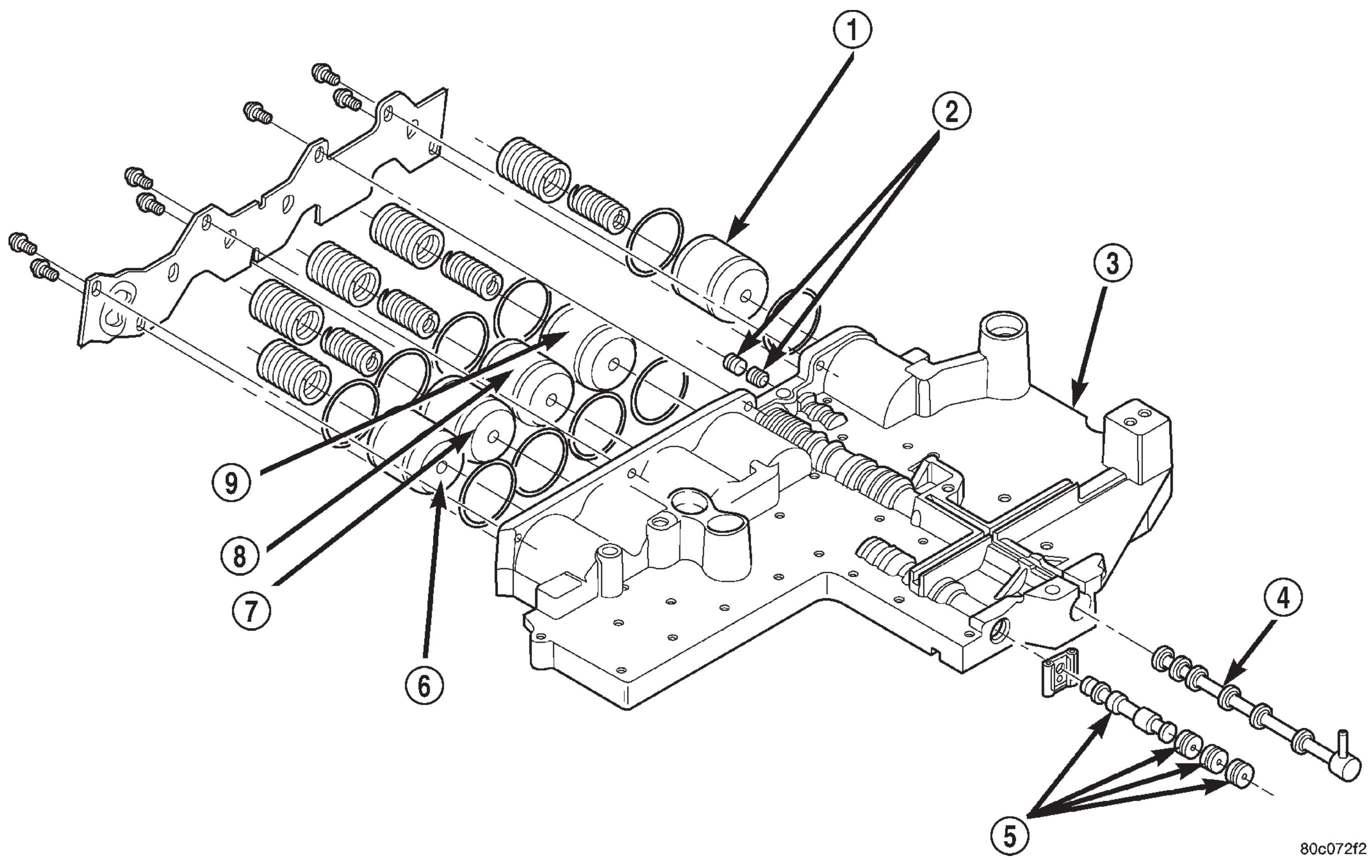


Fig. 118 Valve Body Components

1 - LOW/REVERSE ACCUMULATOR
2 - LOW/REVERSE SWITCH VALVE
3 - UPPER VALVE BODY
4 - MANUAL VALVE
5 - SOLENOID SWITCH VALVE
6 - OVERDRIVE ACCUMULATOR
7 - UNDERDRIVE ACCUMULATOR
8 - 4C ACCUMULATOR
9 - 2C ACCUMULATOR

VALVE BODY (Continued)

OPERATION

NOTE: Refer to the Hydraulic Schematics for a visual aid in determining valve location, operation and design.

SOLENOID SWITCH VALVE

The Solenoid Switch Valve (SSV) controls the direction of the transmission fluid when the L/R-TCC solenoid is energized.

The Solenoid Switch Valve controls line pressure from the LR-TCC solenoid. In 1st gear, the SSV will be in the downshifted position, thus directing fluid to the L/R clutch circuit. In 2nd, 3rd, and 4th gears, the solenoid switch valve will be in the upshifted position and directs the fluid into the torque converter clutch (TCC) circuit.

When shifting into 1st gear, a special hydraulic sequence is performed to ensure SSV movement into the downshifted position. The L/R pressure switch is monitored to confirm SSV movement. If the movement is not confirmed (the L/R pressure switch does not close), 2nd gear is substituted for 1st. A DTC will be set after three unsuccessful attempts are made to get into 1st gear in one given key start.

MANUAL VALVE

The manual valve 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 top of the valve body. The valve is connected mechanically by a cable to the gearshift mechanism. The valve is held in each of its positions by a roller detent spring (Fig. 120) that engages the “roostercomb” of the TRS selector plate.

LOW/REVERSE SWITCH VALVE

The low/reverse switch valve allows the low/reverse clutch to be operated by either the LR/CC solenoid or the MS solenoid.

REMOVAL

The valve body can be removed for service without having to remove the transmission assembly.

The valve body can be disassembled for cleaning and inspection of the individual components. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 45RFE/VALVE BODY - DISASSEMBLY)

(1) Shift transmission into PARK.

(2) Raise vehicle.

(3) Disconnect wires at the solenoid and pressure switch assembly connector.

(4) Position drain pan under transmission oil pan.

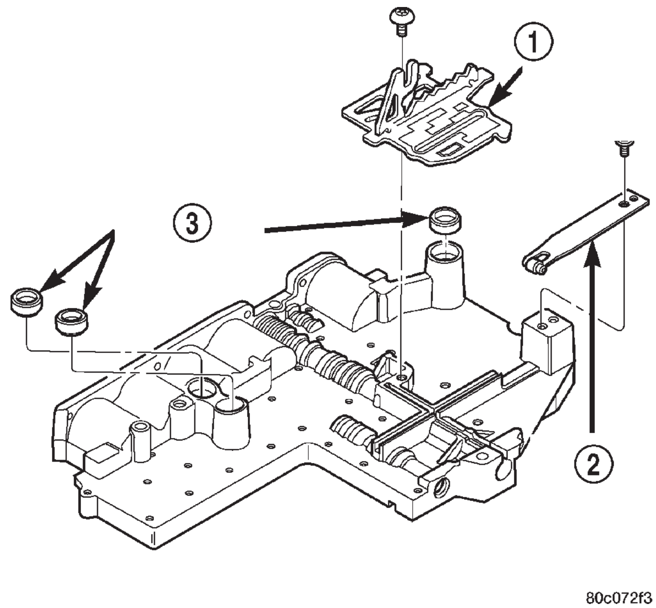


Fig. 120 TRS Selector Plate and Detent Spring

1 - TRS SELECTOR PLATE
2 - DETENT SPRING
3 - CLUTCH PASSAGE SEALS

(5) Remove transmission oil pan.

(6) Remove the primary oil filter from valve body. (Fig. 121)

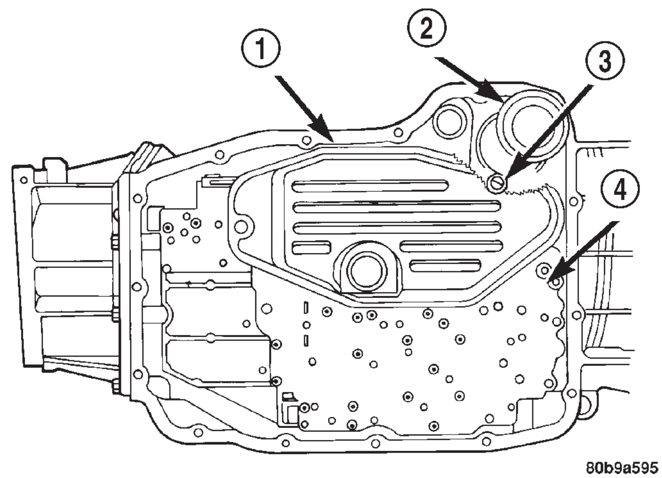


Fig. 121 Remove Primary Oil Filter

1 - PRIMARY OIL FILTER
2 - COOLER RETURN FILTER
3 - COOLER RETURN FILTER BYPASS VALVE
4 - VALVE BODY

VALVE BODY (Continued)

(7) Remove bolts attaching valve body to transmission case (Fig. 122).

(8) Lower the valve body and work the electrical connector out of transmission case.

(9) Separate the valve body from the transmission.

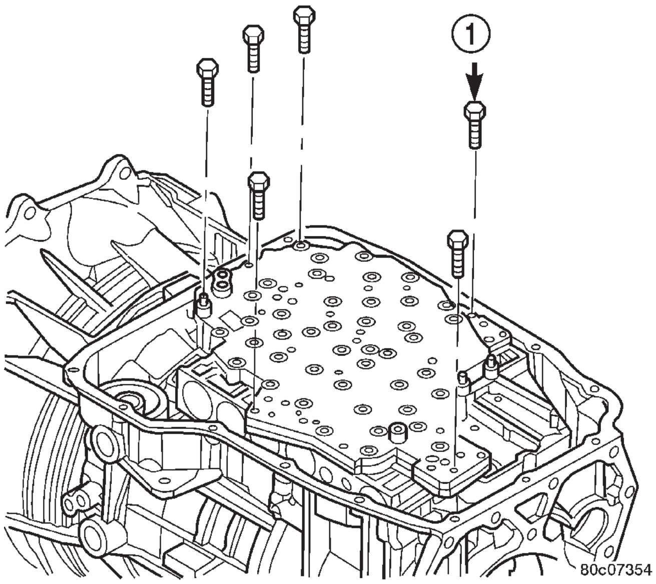


Fig. 122 Valve Body Bolts

1 - VALVE BODY TO CASE BOLT (6)

DISASSEMBLY

(1) Remove the screws holding the solenoid and pressure switch assembly to the valve body (Fig. 123). Do not remove the screws on the top of the solenoid and pressure switch assembly.

(2) Separate the solenoid and pressure switch assembly from the valve body.

(3) Remove the screw holding the detent spring (Fig. 124) onto the valve body.

(4) Remove the detent spring from the valve body.

(5) Remove the TRS selector plate from the valve body and the manual valve.

(6) Remove the clutch passage seals from the valve body, if necessary.

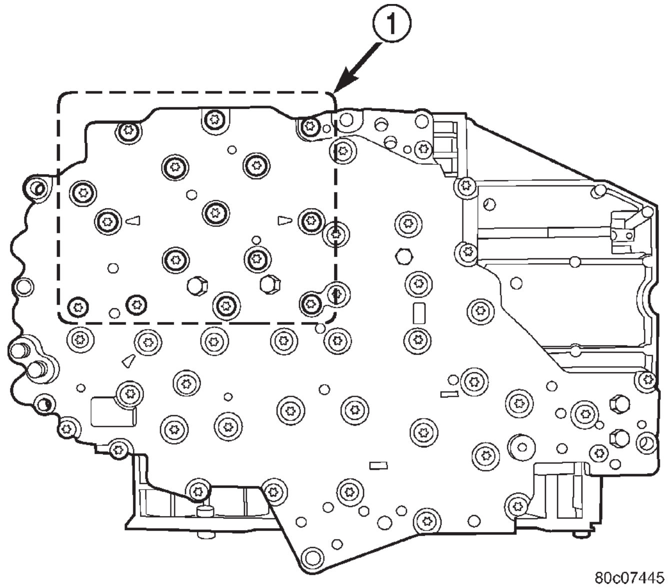


Fig. 123 Solenoid and Pressure Switch Assembly Screws

1 - SOLENOID PACK BOLTS (15)

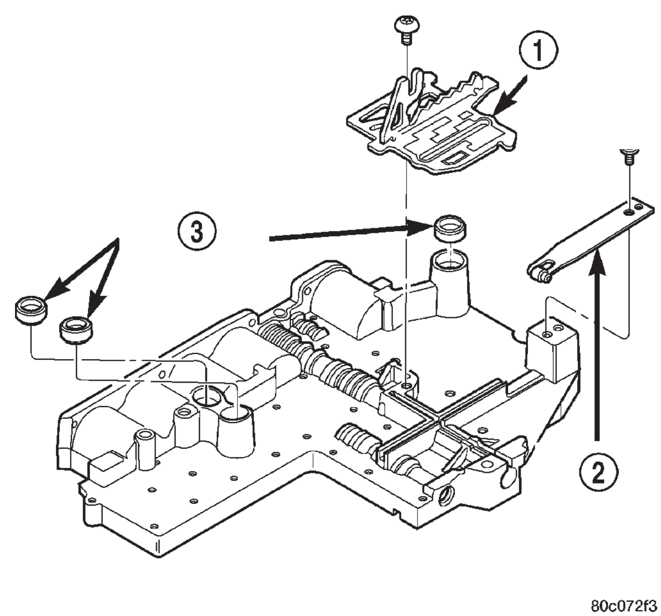


Fig. 124 Valve Body External Components

1 - TRS SELECTOR PLATE
2 - DETENT SPRING
3 - CLUTCH PASSAGE SEALS

VALVE BODY (Continued)

(7) Remove the screws holding the accumulator cover onto the valve body (Fig. 125).

(8) Remove the accumulator springs and pistons from the valve body. Note which accumulator piston and spring belong in each location.

(9) Place the valve body on the bench with the transfer plate upward.

NOTE: The valve body contains seven check balls. The transfer plate must be placed upward to prevent losing the check balls when the transfer plate is removed from the valve body.

(10) Remove the screws holding the valve body to the valve body transfer plate.

(11) Remove the transfer plate from the valve body. Note the location of all check balls (Fig. 126).

(12) Remove the check balls from the valve body.

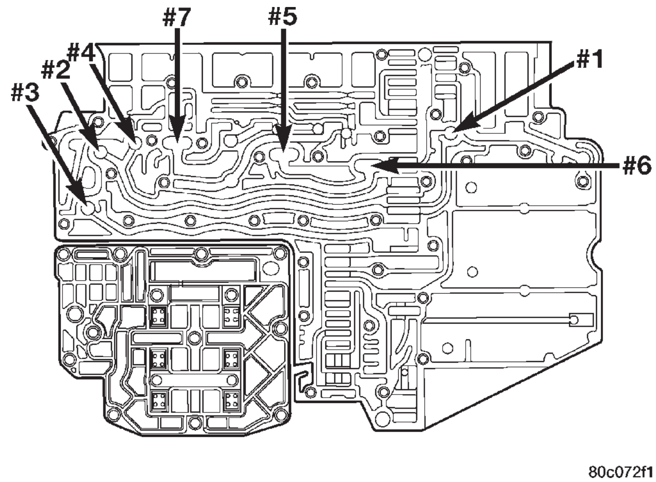


Fig. 126 Check Ball Locations

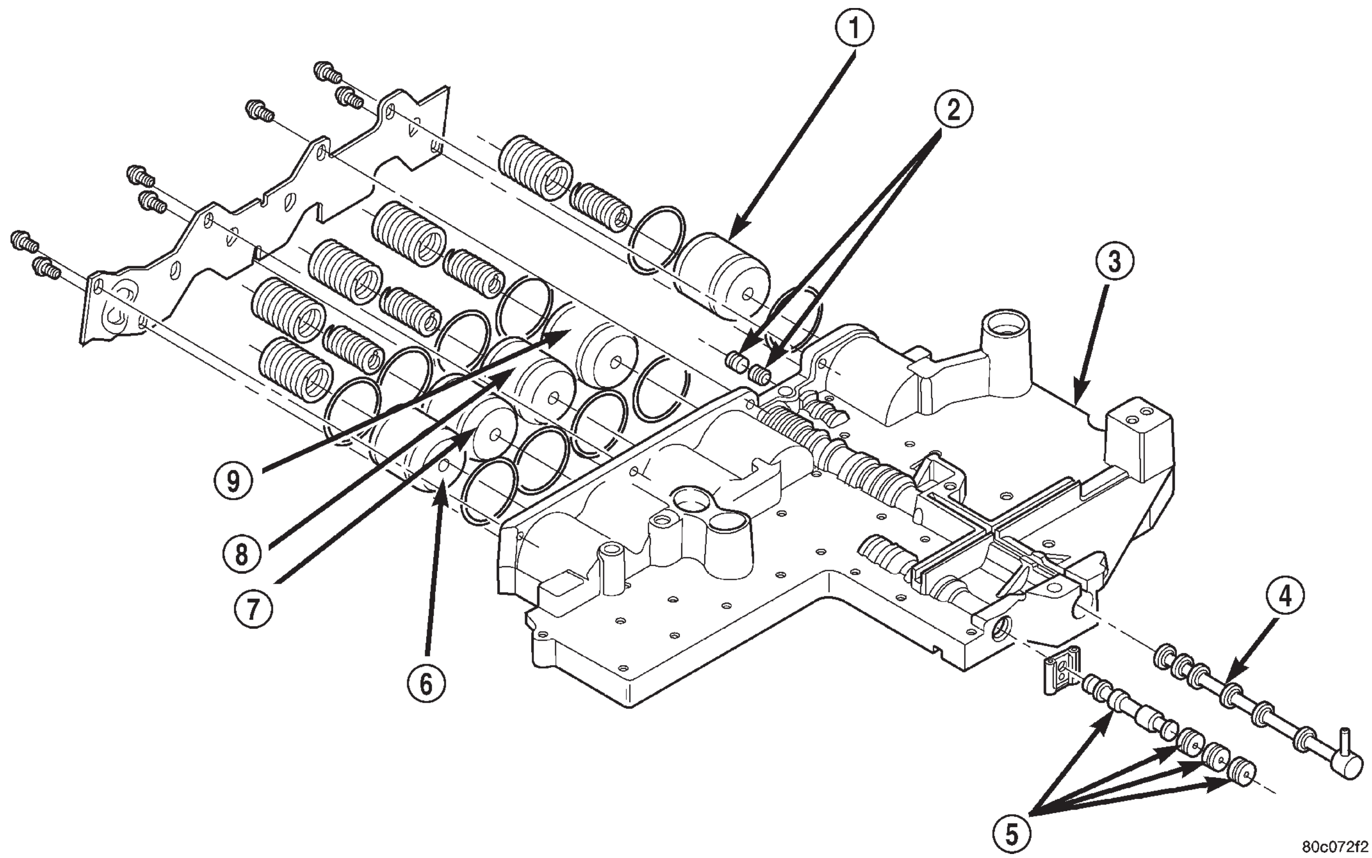


Fig. 125 Valve Body Components

1 - LOW/REVERSE ACCUMULATOR
2 - LOW/REVERSE SWITCH VALVE
3 - UPPER VALVE BODY
4 - MANUAL VALVE
5 - SOLENOID SWITCH VALVE
6 - OVERDRIVE ACCUMULATOR
7 - UNDERDRIVE ACCUMULATOR
8 - 4C ACCUMULATOR
9 - 2C ACCUMULATOR

VALVE BODY (Continued)

(13) Remove the retainers securing the solenoid switch valve, manual valve, and the low/reverse switch valve into the valve body and remove the associated valve and spring. Tag each valve and spring combination with location information to aid in assembly. (Fig. 127)

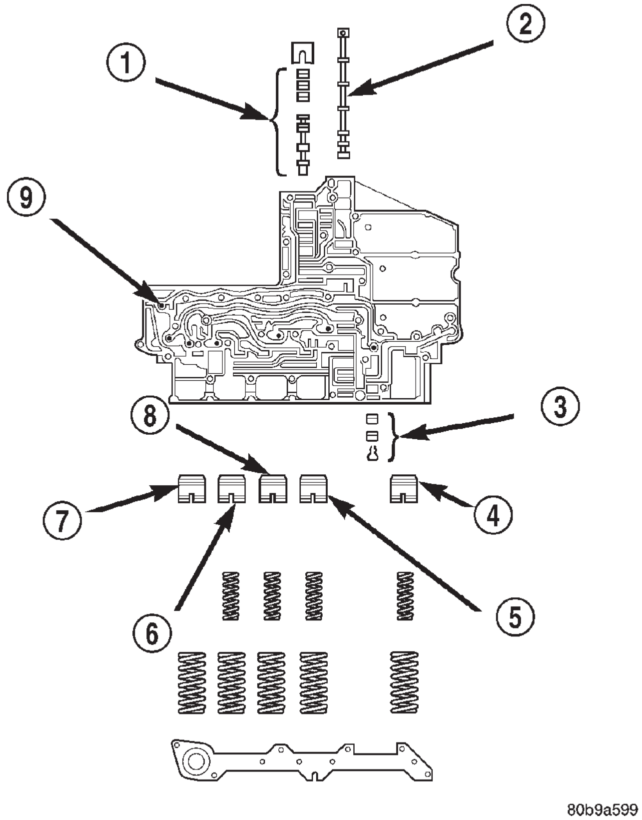


Fig. 127 Valve Body Components

1 - SOLENOID SWITCH VALVE
2 - MANUAL VALVE
3 - LOW REVERSE SWITCH VALVE
4 - LOW REVERSE ACCUMULATOR
5 - 2ND CLUTCH ACCUMULATOR
6 - UNDERDRIVE ACCUMULATOR
7 - OVERDRIVE ACCUMULATOR
8 - 4TH CLUTCH ACCUMULATOR
9 - CHECK BALLS (7)

CLEANING

Clean the valve housings, valves, plugs, springs, and separator plates with a standard parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution. (Fig. 128)

Do not immerse any of the electrical components in cleaning solution. Clean the electrical components by wiping them off with dry shop towels only.

Dry all except the electrical parts with compressed air. Make sure all passages are clean and free from obstructions. **Do not use rags or shop towels to dry or wipe off valve body components. Lint from these materials can stick to valve body parts, interfere with valve operation, and clog filters and fluid passages.**

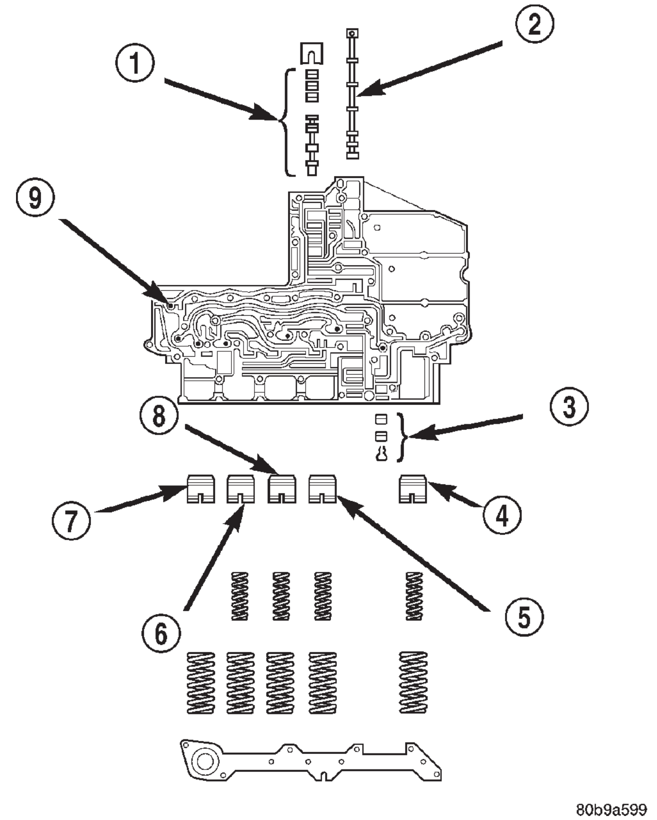


Fig. 128 Valve Body Components

1 - SOLENOID SWITCH VALVE
2 - MANUAL VALVE
3 - LOW REVERSE SWITCH VALVE
4 - LOW REVERSE ACCUMULATOR
5 - 2ND CLUTCH ACCUMULATOR
6 - UNDERDRIVE ACCUMULATOR
7 - OVERDRIVE ACCUMULATOR
8 - 4TH CLUTCH ACCUMULATOR
9 - CHECK BALLS (7)

INSPECTION

Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straight-edge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with a sheet of crocus cloth. Position the crocus cloth on a surface plate, sheet of plate glass or equally flat surface. If distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

VALVE BODY (Continued)

Inspect the valves and plugs (Fig. 129) for scratches, burrs, nicks, or scores. Minor surface scratches on steel valves and plugs can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.** Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

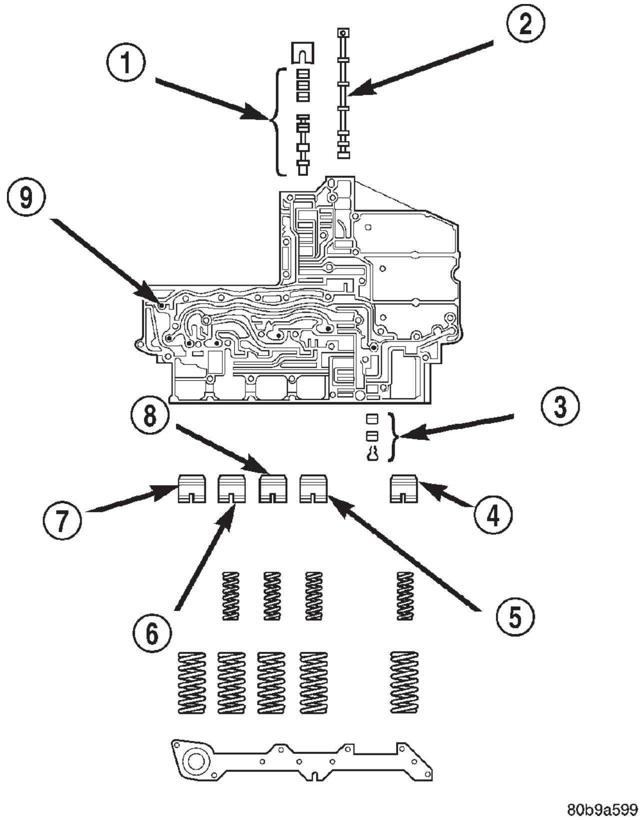


Fig. 129 Valve Body Components

1 - SOLENOID SWITCH VALVE
2 - MANUAL VALVE
3 - LOW REVERSE SWITCH VALVE
4 - LOW REVERSE ACCUMULATOR
5 - 2ND CLUTCH ACCUMULATOR
6 - UNDERDRIVE ACCUMULATOR
7 - OVERDRIVE ACCUMULATOR
8 - 4TH CLUTCH ACCUMULATOR
9 - CHECK BALLS (7)

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.

Inspect all the accumulator 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 accumulator springs. The springs must be free of distortion, warpage or broken coils.

Inspect all the fluid seals on the valve body (Fig. 130). Replace any seals that are cracked, distorted, or damaged in any way. These seals pass fluid pressure directly to the clutches. Any pressure leak at these points, may cause transmission performance problems.

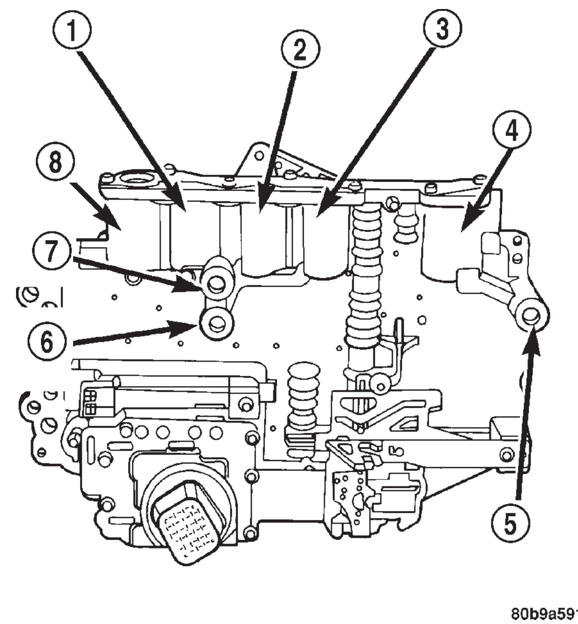


Fig. 130 Valve Body Seals

1 - UNDERDRIVE ACCUMULATOR (2 SPRINGS)
2 - 4TH CLUTCH ACCUMULATOR (2 SPRINGS)
3 - 2ND CLUTCH ACCUMULATOR (2 SPRINGS)
4 - LOW REVERSE ACCUMULATOR (2 SPRINGS)
5 - LOW/REVERSE PASSAGE SEAL
6 - 2ND CLUTCH PASSAGE SEAL
7 - 4TH CLUTCH PASSAGE SEAL
8 - OVERDRIVE ACCUMULATOR (1 SPRING)

ASSEMBLY

(1) Lubricate valves, springs, and the housing valve bores with clean transmission fluid.

(2) Install solenoid switch valve, manual valve, and the low/reverse switch valve into the valve body.

(3) Install the retainers to hold each valve into the valve body.

(4) Install the valve body check balls into their proper locations.

(5) Position the transfer plate onto the valve body.

VALVE BODY (Continued)

(6) Install the screws to hold the transfer plate to the valve body. Tighten the screws to 5.6 N·m (50 in. lbs.).

(7) Install the accumulator pistons and springs into the valve body in the location from which they were removed. Note that all accumulators except the overdrive have two springs. The overdrive accumulator piston has only one spring.

(8) Position the accumulator cover onto the valve body.

(9) Install the screws to hold the accumulator cover onto the valve body. Tighten the screws to 4.5 N·m (40 in. lbs.).

(10) Install the TRS selector plate onto the valve body and the manual valve.

(11) Install the solenoid and pressure switch assembly onto the valve body.

(12) Install the screws to hold the solenoid and pressure switch assembly onto the valve body. Tighten the screws to 5.7 N·m (50 in. lbs.). Tighten the screws adjacent to the arrows cast into the bottom of the transfer plate first.

(13) Position the detent spring onto the valve body.

(14) Install the screw to hold the detent spring onto the valve body. Tighten the screw to 4.5 N·m (40 in. lbs.).

(15) Install new clutch passage seals onto the valve body, if necessary

INSTALLATION

(1) Check condition of seals on valve body and the solenoid and pressure switch assembly. Replace seals if cut or worn.

(2) Place TRS selector plate in the PARK position.

(3) Place the transmission in the PARK position.

(4) Lubricate seal on the solenoid and pressure switch assembly connector with petroleum jelly.

(5) Position valve body in transmission and align the manual lever on the valve body to the pin on the transmission manual shift lever.

(6) Seat valve body in case and install one or two bolts to hold valve body in place.

(7) Tighten valve body bolts alternately and evenly to 12 N·m (105 in. lbs.) torque.

(8) Install new fluid filter on valve body. Tighten filter screws to 4.5 N·m (40 in. lbs.) torque.

(9) Connect the solenoid and pressure switch assembly connector.

(10) Install oil pan. Tighten pan bolts to 12 N·m (105 in. lbs.) torque.

(11) Lower vehicle and fill transmission with Mopar® ATF +4, type 9602, fluid.

(12) Check and adjust gearshift cable, if necessary.

TRANSFER CASE - NV233

TABLE OF CONTENTS

TRANSFER CASE - NV233

DESCRIPTION

The NV233 is an electronically controlled part-time transfer case with a low range gear reduction system. The NV233 has three operating ranges plus a NEUTRAL position. The low range system provides a gear 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)
- 4HI (4-wheel drive)
- 4LO (4-wheel drive low range)
- NEUTRAL

The 2WD range is for use on any road surface at any time.

The 4HI and 4LO 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 4LO 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 dash mounted shift selector switch. The shift selector switch provides a input to the Transfer Case Control Module (TCCM) to indicate the driver's desire to change operating ranges. The TCCM uses this input, along with input from the transfer case mounted mode sensor and information from the vehicle's bus, to determine if a shift is permitted. If the TCCM decides the shift is permitted, the TCCM controls the shift motor, mounted to the exterior of the transfer case, to perform the shift.

TRANSFER CASE - NV233 (Continued)

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.

OPERATION

The input gear is splined to the transmission output shaft. The input gear drives the mainshaft through the planetary assembly and range sleeve. 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.

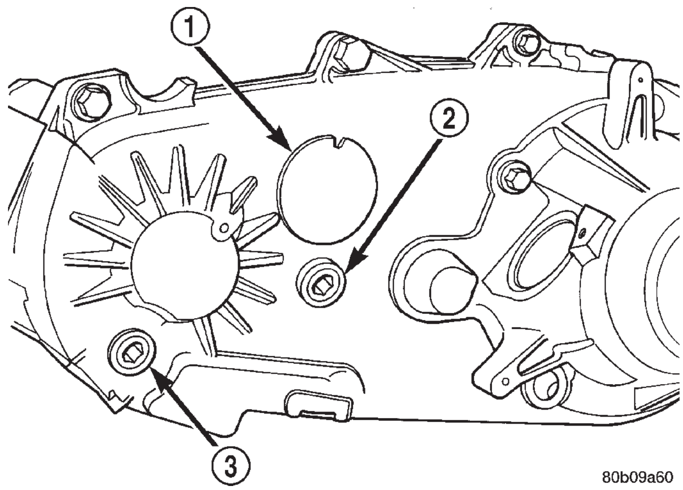


Fig. 1 Fill/Drain Plug And I.D. Tag Locations - Typical

1 - I.D. TAG
2 - FILL PLUG
3 - DRAIN PLUG

DIAGNOSIS AND TESTING - TRANSFER CASE - NV233

DIAGNOSIS CHART

Condition	Possible Cause	Correction
Transfer case difficult to shift or will not shift into desired range.	1) Transfer case electronically controlled shift system malfunction.	1) Verify proper operation per the appropriate diagnostic manual.
	2) If vehicle was operated for an extended period in 4HI mode on dry surface, driveline torque load may cause difficulty.	2) Drive the vehicle in a straight line and momentarily release the accelerator. The transfer case can then be shifted to the desired mode.
	3) Insufficient or incorrect lubricant.	3) Drain and refill transfer case with the correct quantity of Mopar® ATF +4, type 9602, Automatic Transmission Fluid.
	4) Internal transfer case components binding, worn, or damaged.	4) 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 quantity of Mopar® ATF +4, type 9602, Automatic Transmission Fluid.
	2) Internal transfer case components binding, worn, or damaged.	2) Repair or replace components as necessary.

TRANSFER CASE - NV233 (Continued)

Condition	Possible Cause	Correction
Transfer case noisy while in, or jumps out of, 4LO mode.	1) Transfer case not completely engaged in 4LO position.	1) While rolling 2-3 MPH and the transmission in NEUTRAL, or clutch depressed on vehicles equipped with a manual transmission, shift transfer case to the 2WD or 4HI position, and then back into the 4LO position.
	2) Range fork damaged, inserts worn, or fork is binding on the shift rail.	2) Repair or replace components as necessary.
	3) Low range gear worn or damaged.	3) 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 4HI mode on dry surfaces,	1) Operate vehicle in 2WD mode on dry surfaces.

REMOVAL

(1) Shift transfer case into 2WD.
(2) Raise vehicle.
(3) Drain transfer case lubricant.
(4) Mark front and rear propeller shafts for alignment reference.
(5) Support transmission with jack stand.
(6) Remove rear crossmember and skid plate, if equipped.
(7) Disconnect front and rear propeller shafts at transfer case.
(8) Disconnect transfer case shift motor and mode sensor wire connectors.
(9) Disconnect transfer case vent hose.
(10) Support transfer case with transmission jack.
(11) Secure transfer case to jack with chains.
(12) Remove nuts attaching transfer case to transmission (Fig. 2).
(13) Pull transfer case and jack rearward to disengage transfer case.
(14) Remove transfer case from under vehicle.

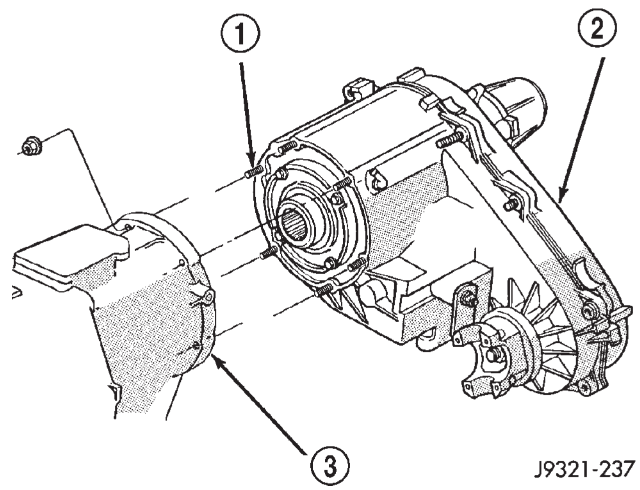


Fig. 2 Transfer Case Mounting - Typical

1 - MOUNTING STUDS
2 - TRANSFER CASE
3 - TRANSMISSION

DISASSEMBLY

Position transfer case on shallow drain pan. Remove drain plug and drain lubricant remaining in case.

REAR RETAINER AND OIL PUMP

(1) Remove extension housing bolts.

(2) Tap extension housing with plastic or rawhide mallet to loosen sealer (Fig. 3).

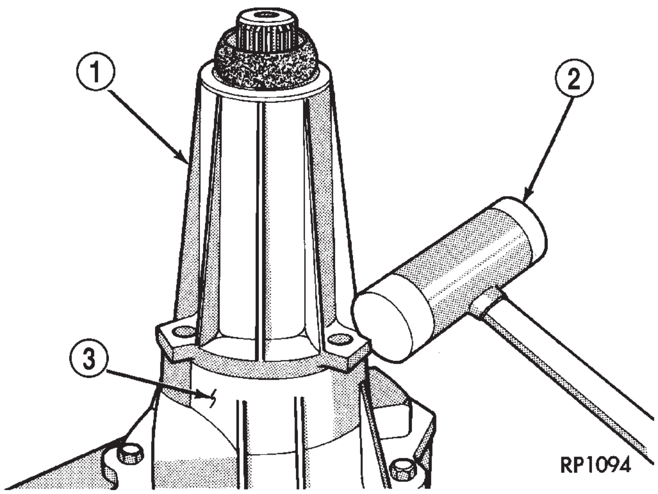


Fig. 3 Remove Extension Housing

1 - EXTENSION HOUSING
2 - PLASTIC HAMMER
3 - REAR RETAINER

(3) Separate extension housing from rear retainer.

(4) Remove rear bearing snap-ring (Fig. 4).

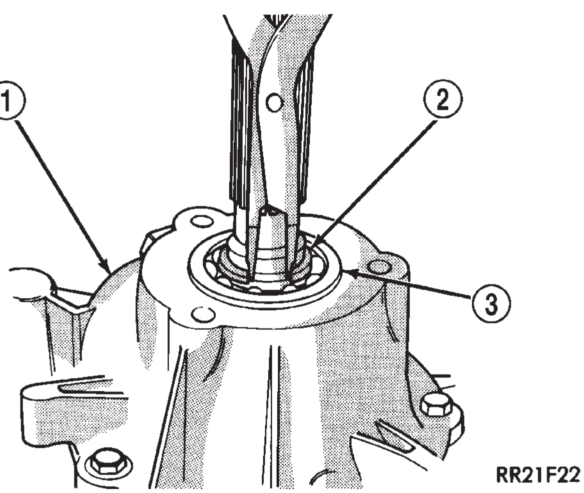


Fig. 4 Remove Rear Bearing Snap-Ring

1 - REAR RETAINER
2 - SNAP-RING
3 - REAR BEARING

(5) Remove bolts holding rear retainer to rear case half.

(6) Loosen rear retainer with pry tool to break sealer bead. Pry only against retainer boss as shown (Fig. 5).

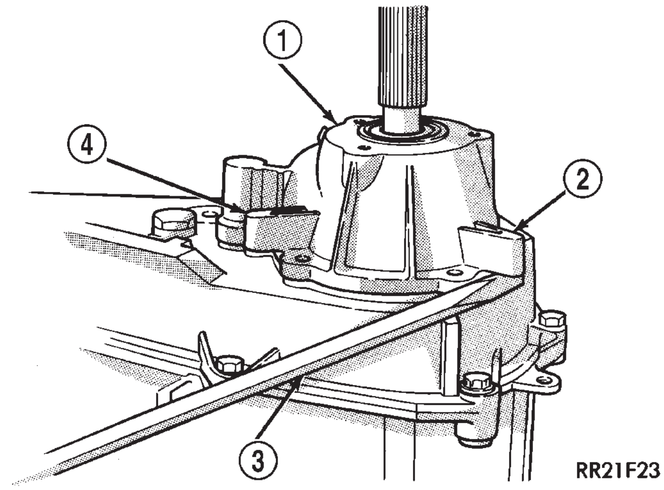


Fig. 5 Loosening Rear Retainer

1 - REAR RETAINER
2 - TAB (2)
3 - SCREWDRIVER
4 - TAB

(7) Disengage oil pickup tube from oil pump and remove oil pump assembly (Fig. 6).

(8) Remove pick-up tube o-ring from oil pump (Fig. 7), if necessary. Do not disassemble the oil pump, it is not serviceable.

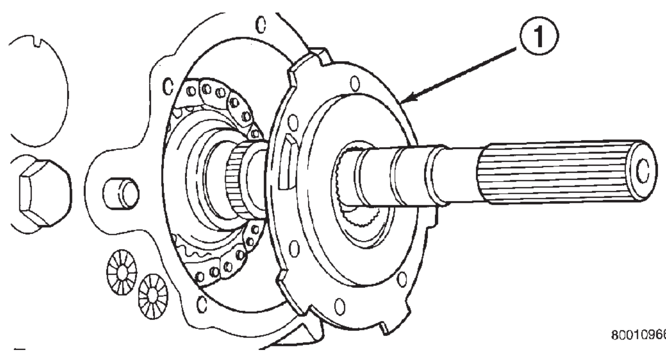


Fig. 6 Oil Pump Removal

1 - OIL PUMP

TRANSFER CASE - NV233 (Continued)

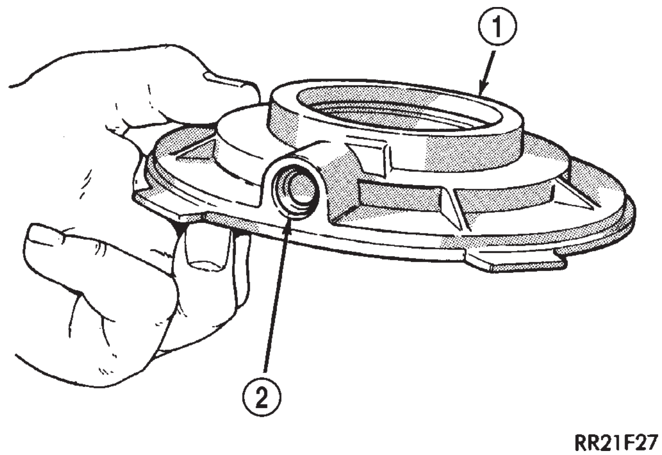


Fig. 7 Pick-up Tube O-ring Location

1 - OIL PUMP
2 - O-RING

COMPANION FLANGE AND SHIFT MOTOR ASSEMBLY

(1) Remove front companion flange nut with a socket and impact wrench

(2) Remove the front companion flange. If the flange is difficult to remove by hand, remove it with bearing splitter, or with standard two jaw puller. Be sure puller tool is positioned on the flange and not on the slinger, as slinger will be damaged.

(3) Remove seal washer from front output shaft. Discard washer as it should not be reused.

(4) Remove the bolts (Fig. 8) which hold the shift motor and mode sensor assembly to the transfer case.

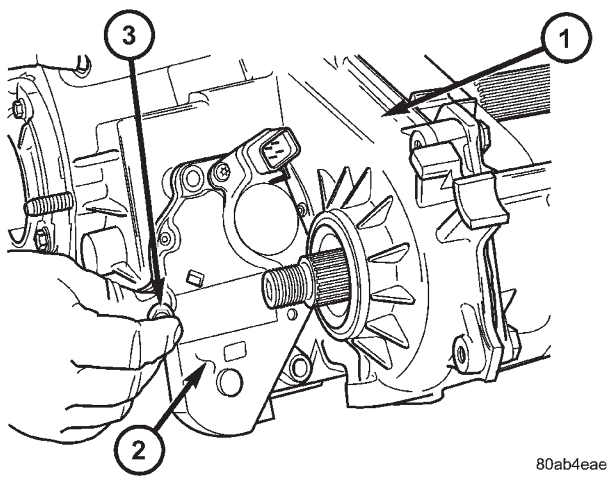


Fig. 8 Remove the Shift Motor and Mode Sensor Assembly Bolts

1 - TRANSFER CASE
2 - SHIFT MOTOR AND MODE SENSOR ASSEMBLY
3 - BOLT

(5) Remove the shift motor and mode sensor assembly from the transfer case.

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. 9).

(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. 10).

(4) Remove rear case from front case.

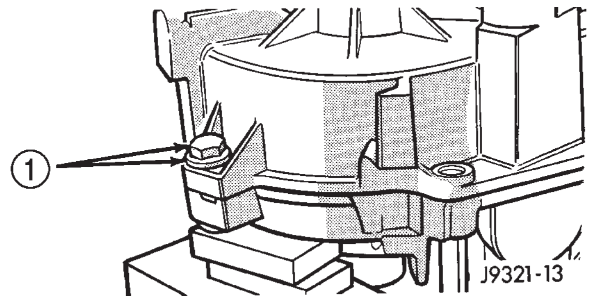


Fig. 9 Rear Case Alignment Bolt Locations

1 - ALIGNMENT BOLT AND WASHER (AT EACH END OF CASE)

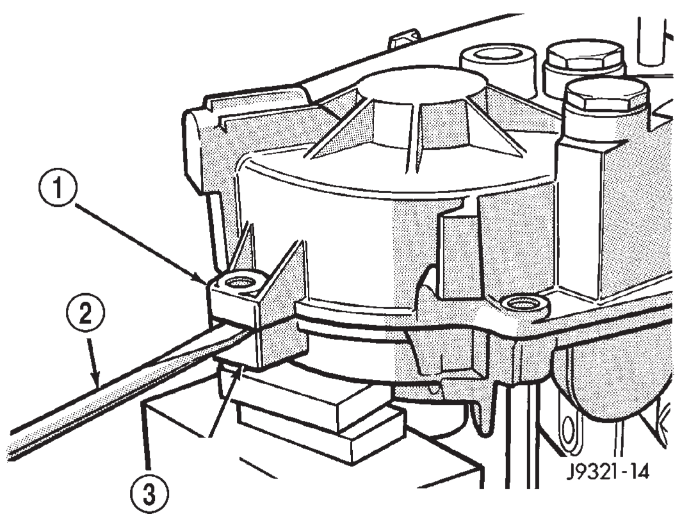


Fig. 10 Loosening Rear Case

1 - REAR CASE
2 - PRY TOOL (IN CASE SLOT)
3 - FRONT CASE

TRANSFER CASE - NV233 (Continued)

(5) Remove oil pickup tube from rear case (Fig. 11).

(6) Remove mode fork spring (Fig. 12).

(7) Pull front output shaft upward and out of front output shaft bearing (Fig. 13).

(8) Remove front output shaft and chain.

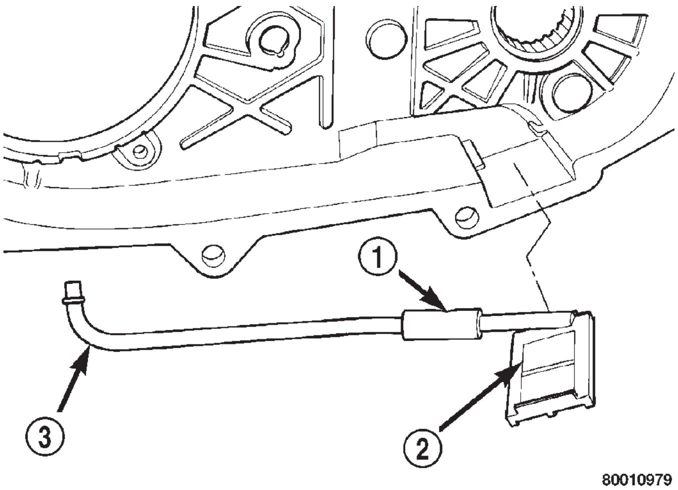


Fig. 11 Oil Pickup Tube Removal

1 - CONNECTING HOSE
2 - PICKUP SCREEN
3 - PICKUP TUBE

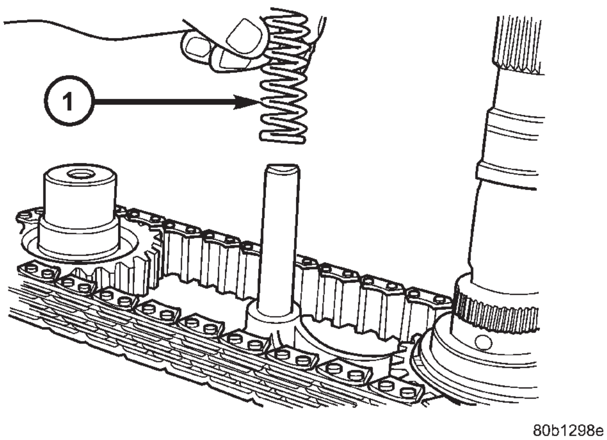


Fig. 12 Mode Fork Spring Removal

1 - MODE SPRING

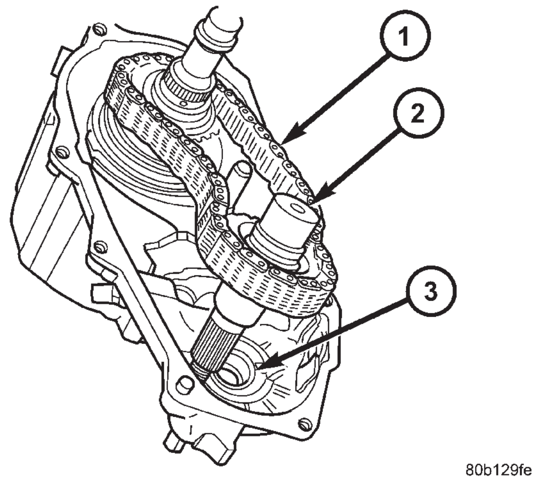


Fig. 13 Remove Front Output Shaft And Drive Chain

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. 14).

(2) Remove mainshaft from mode sleeve and input gear pilot bearing.

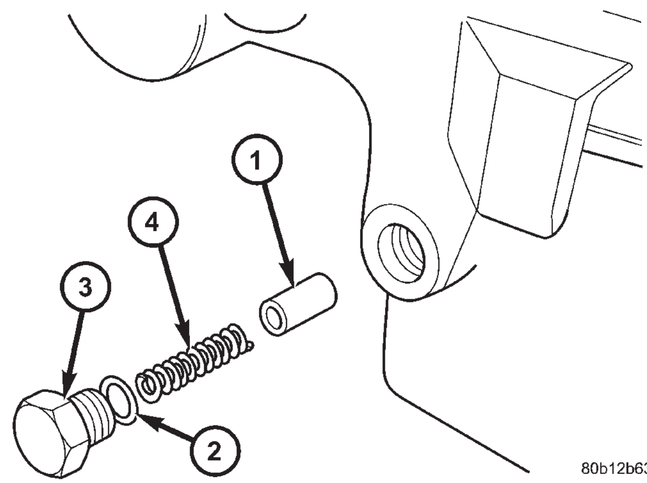


Fig. 14 Detent Plug, Spring, And Plunger Removal

1 - PLUNGER
2 - O-RING
3 - PLUG
4 - SPRING

TRANSFER CASE - NV233 (Continued)

(3) Remove mode fork and sleeve as an assembly (Fig. 15). 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. 16). Note fork position for installation reference.

(5) Remove shift sector from front case (Fig. 17).

(6) Remove shift sector o-ring (Fig. 18).

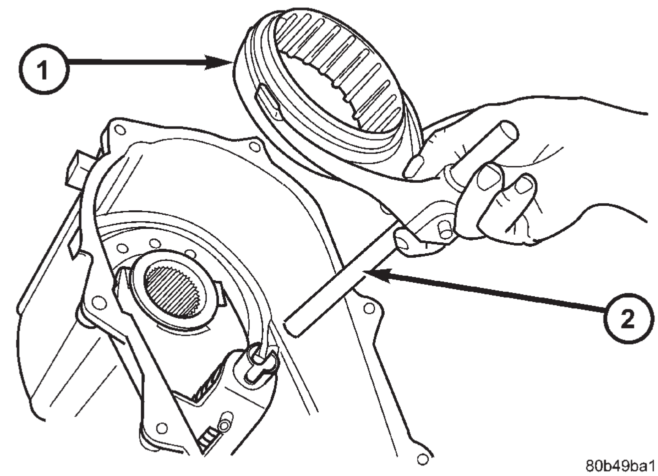


Fig. 15 Mode Fork And Sleeve Removal

1 - MODE SLEEVE
2 - MODE FORK AND RAIL

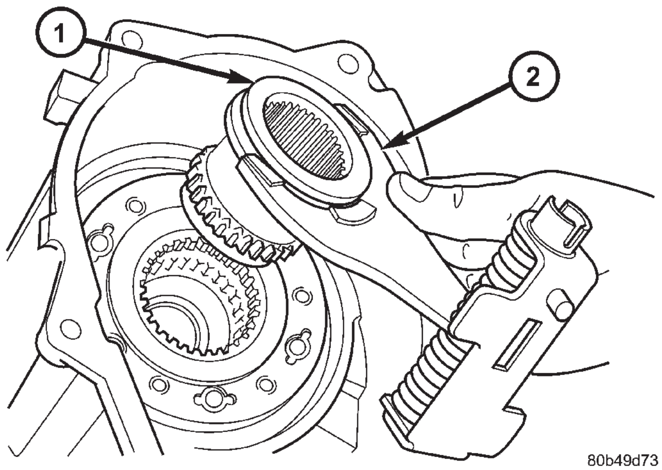


Fig. 16 Range Fork And Hub Removal

1 - RANGE HUB
2 - RANGE FORK

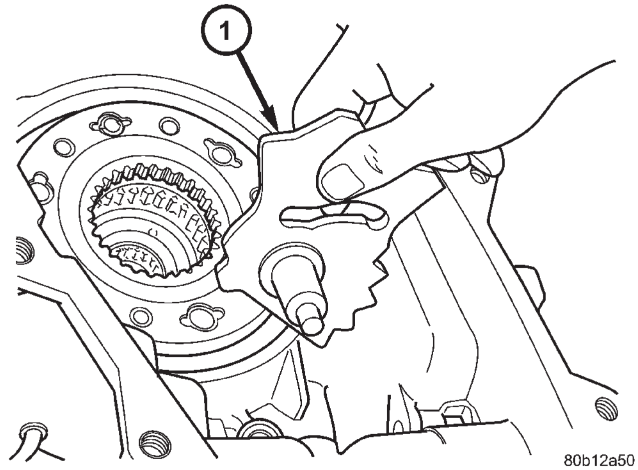


Fig. 17 Shift Sector Removal

1 - SHIFT SECTOR

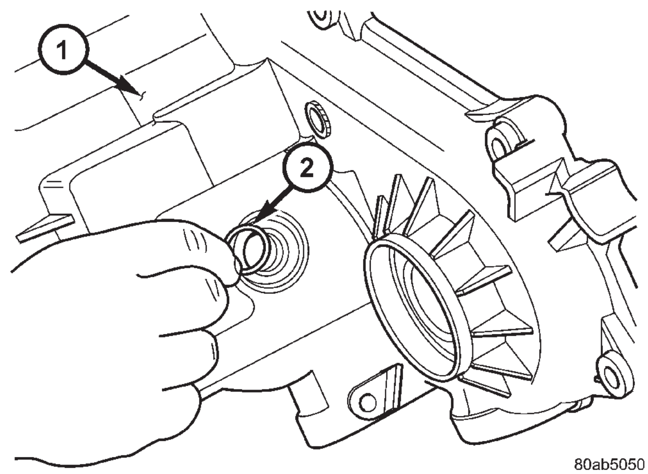


Fig. 18 Remove the Shift Sector O-Ring

1 - TRANSFER CASE FRONT HOUSING
2 - SHIFT SECTOR O-RING

TRANSFER CASE - NV233 (Continued)

MAINSHAFT

(1) Remove mode hub retaining ring with heavy duty snap-ring pliers (Fig. 19).

(2) Slide mode hub off mainshaft (Fig. 20).

(3) Slide drive sprocket off mainshaft (Fig. 21).

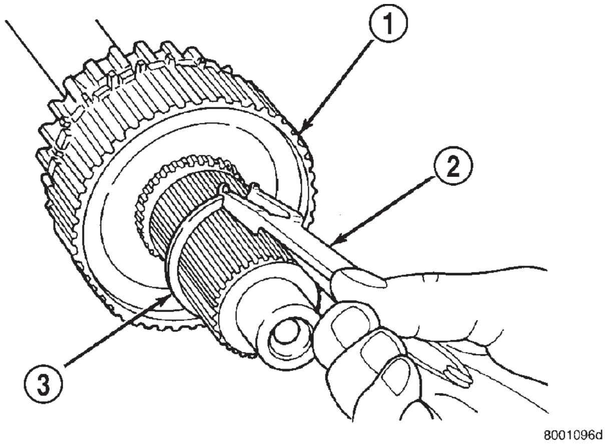


Fig. 19 Mode Hub Retaining Ring Removal

1 - MODE HUB
2 - SNAP-RING PLIERS (HEAVY DUTY)
3 - MODE HUB RETAINING RING

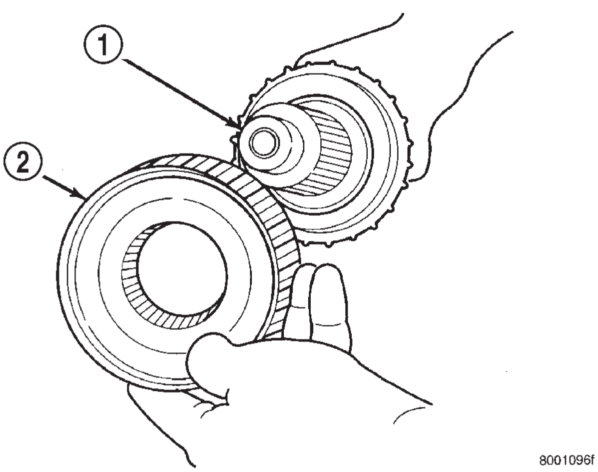


Fig. 20 Mode Hub Removal

1 - MAINSHAFT
2 - MODE HUB

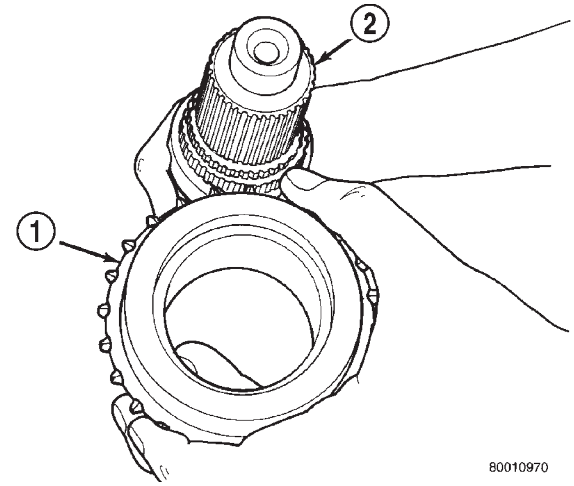


Fig. 21 Drive Sprocket Removal

1 - DRIVE SPROCKET
2 - MAINSHAFT

INPUT GEAR AND LOW RANGE GEAR

(1) Remove front bearing retainer attaching bolts (Fig. 22).

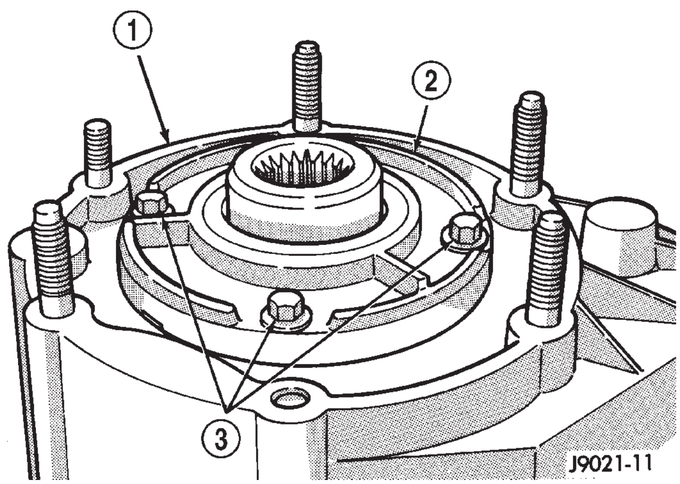


Fig. 22 Front Bearing Retainer Bolts

1 - FRONT CASE
2 - FRONT BEARING RETAINER
3 - RETAINER BOLTS

TRANSFER CASE - NV233 (Continued)

(2) Remove front bearing retainer. Pry retainer loose with pry tool positioned in slots at each end of retainer (Fig. 23).

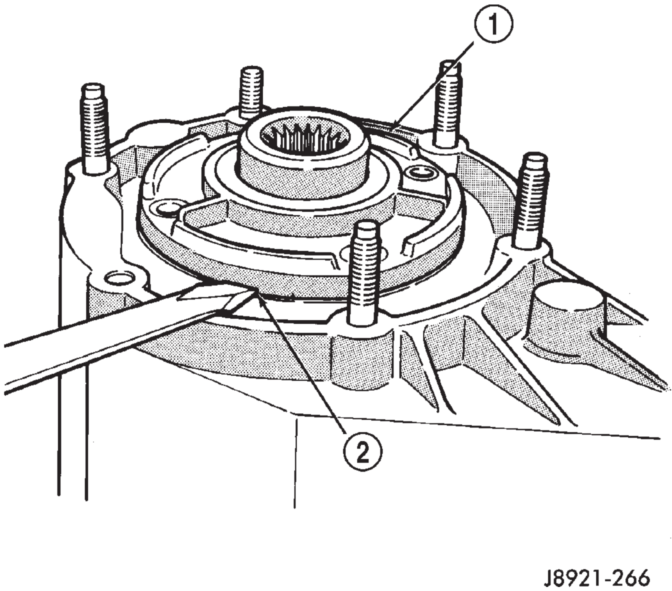


Fig. 23 Front Bearing Retainer Removal

1 - FRONT BEARING RETAINER
2 - RETAINER SLOT

(3) Remove front bearing retainer seal. Tap seal out with drift and hammer.

(4) Remove input gear retaining ring with heavy duty snap-ring pliers (Fig. 24)

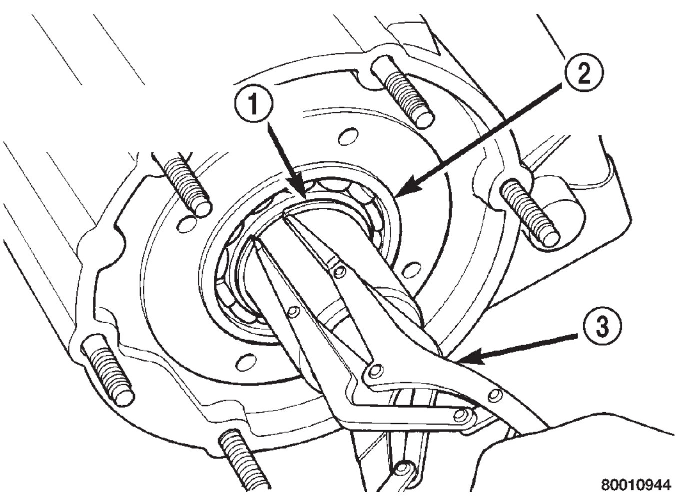


Fig. 24 Removing Input Gear Retaining Ring

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. 25). Tap gear out of bearing with plastic mallet if necessary.

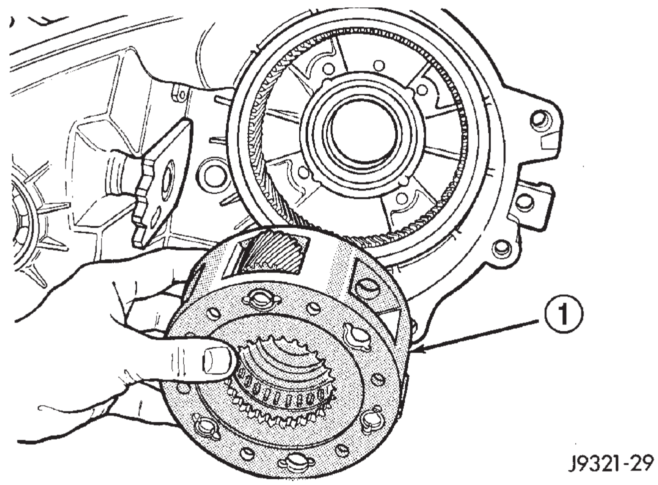


Fig. 25 Input Gear And Planetary Carrier Removal

1 - INPUT AND LOW RANGE GEAR ASSEMBLY

INPUT AND LOW RANGE GEAR

(1) Remove snap-ring that retains input gear in low range gear (Fig. 26).

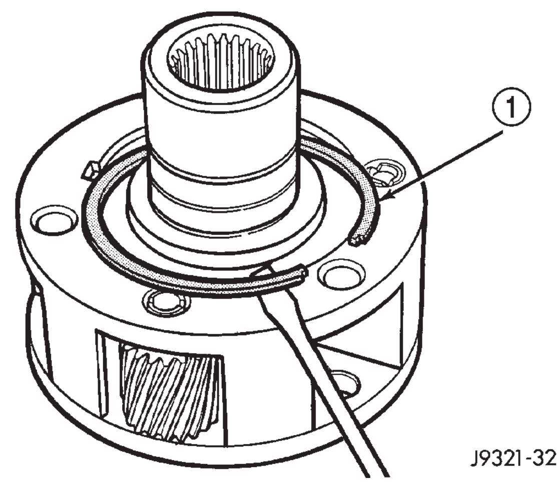


Fig. 26 Input Gear Snap-Ring Removal

1 - INPUT GEAR SNAP-RING

TRANSFER CASE - NV233 (Continued)

(2) Remove retainer (Fig. 27).

(3) Remove front tabbed thrust washer (Fig. 28).

(4) Remove input gear (Fig. 29).

(5) Remove rear tabbed thrust washer from low range gear (Fig. 30).

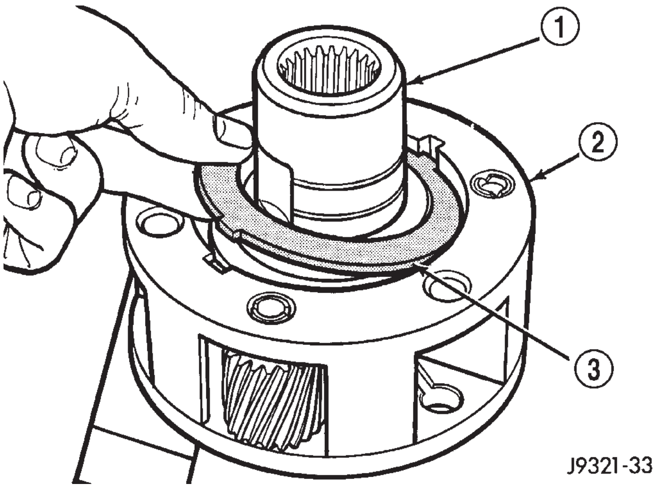


Fig. 27 Input Gear Retainer Removal

1 - INPUT GEAR
2 - LOW RANGE GEAR
3 - RETAINER

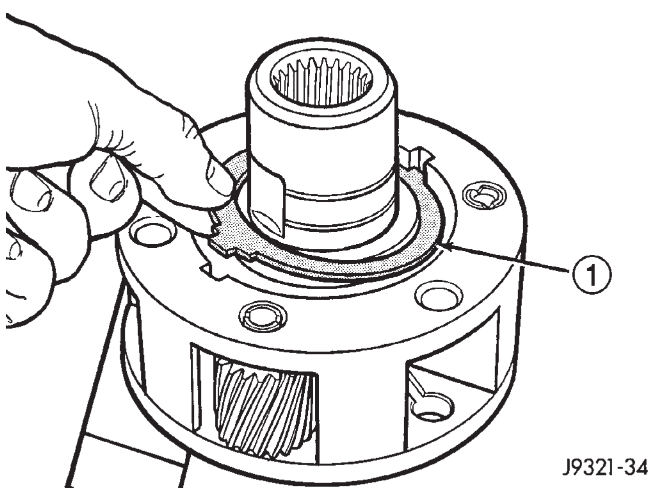


Fig. 28 Front Tabbed Thrust Washer Removal

1 - FRONT 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.

The oil pickup screen can be cleaned with solvent. Shake excess solvent from the screen after cleaning and allow it to air dry. Do not use compressed air.

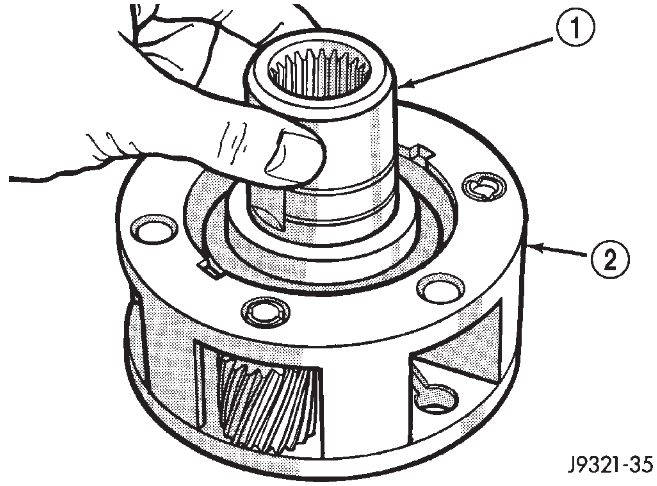


Fig. 29 Input Gear Removal

1 - INPUT GEAR
2 - LOW RANGE GEAR

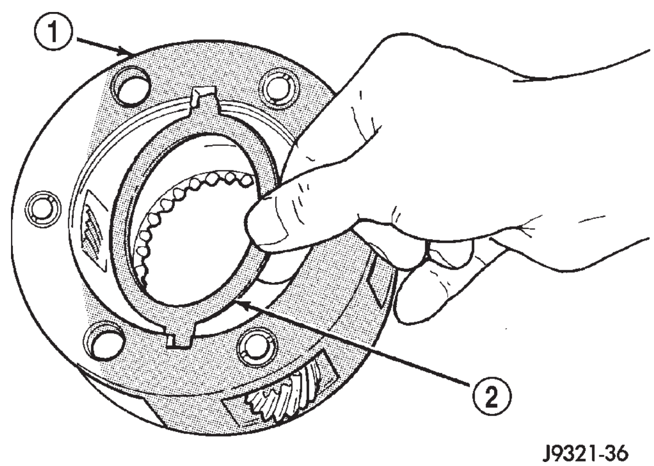


Fig. 30 Rear Tabbed Thrust Washer

1 - LOW RANGE GEAR
2 - REAR TABBED THRUST WASHER

INSPECTION

MAINSHAFT/SPROCKET/HUB INSPECTION

Inspect the splines on the hub and shaft and the teeth on the sprocket (Fig. 31). 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. 32). Minor nicks can be dressed off with an oilstone but replace the gear if any teeth are broken, cracked, or chipped. The

TRANSFER CASE - NV233 (Continued)

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.

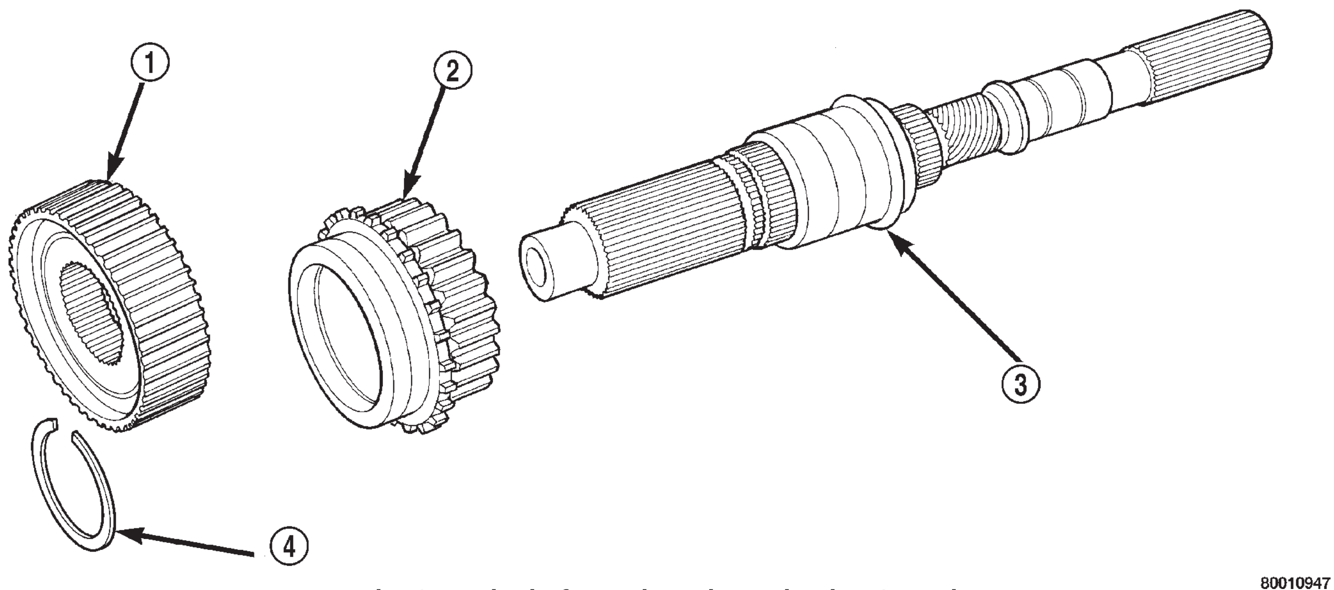


Fig. 31 Mainshaft, Mode Hub, And Drive Sprocket

1 - MODE HUB
2 - DRIVE SPROCKET
3 - MAINSHAFT
4 - MODE HUB RETAINING RING

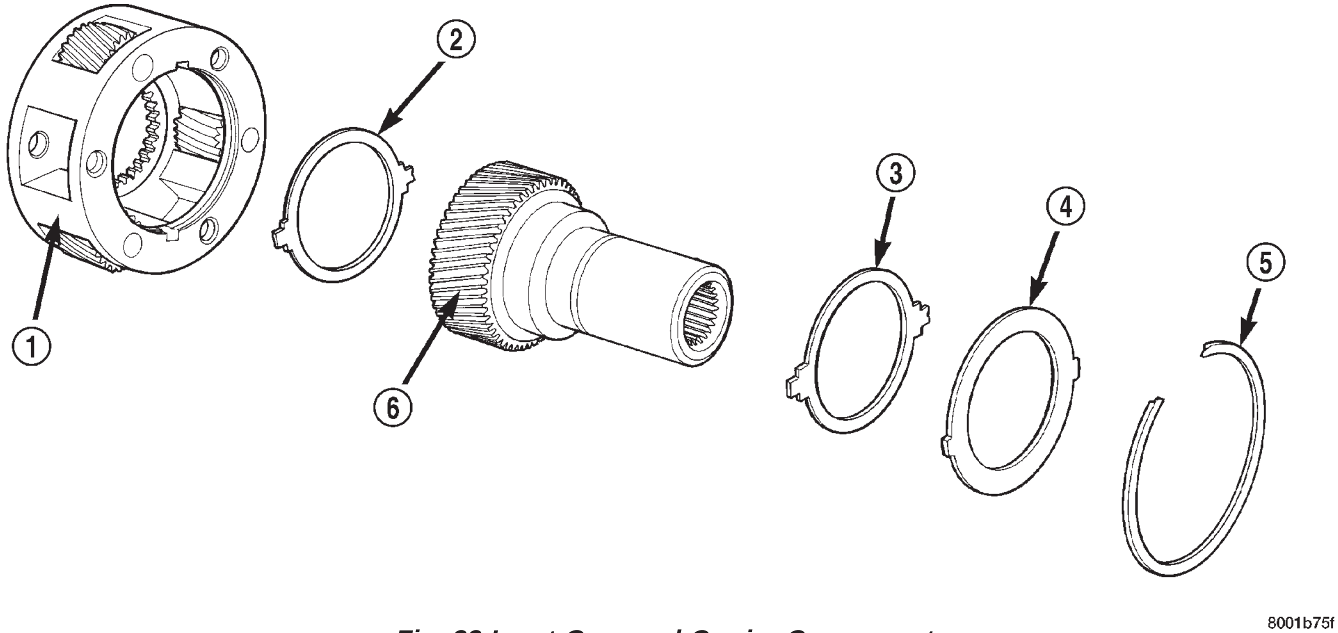


Fig. 32 Input Gear and Carrier Components

1 - PLANETARY CARRIER
2 - REAR THRUST WASHER
3 - FRONT THRUST WASHER
4 - CARRIER LOCK RING
5 - CARRIER LOCK RETAINING RING
6 - INPUT GEAR

TRANSFER CASE - NV233 (Continued)

SHIFT FORKS/HUBS/SLEEVES

Check condition of the shift forks and mode fork shift rail (Fig. 33). Minor nicks on the shift rail can be smoothed with 320-400 grit emery cloth.

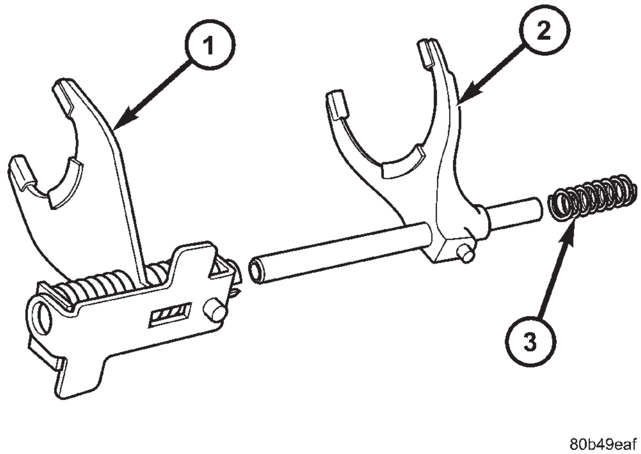


Fig. 33 Shift Forks

1 - RANGE FORK
2 - MODE FORK AND RAIL
3 - MODE SPRING

Inspect the shift fork wear pads (Fig. 34). The mode and range fork pads are serviceable and can be replaced if necessary.

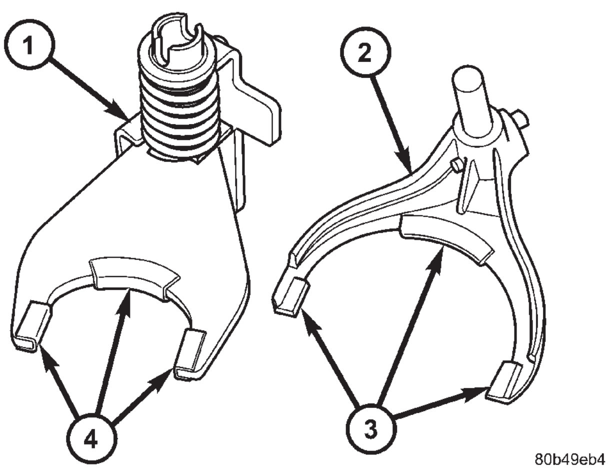


Fig. 34 Shift Fork And Wear Pad Locations

1 - RANGE FORK
2 - MODE FORK
3 - WEAR PADS (SERVICEABLE)
4 - WEAR PADS (SERVICEABLE)

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

REAR RETAINER AND EXTENSION HOUSING

Inspect the retainer components. 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.

Inspect the retaining rings and washers. Replace any part if distorted, bent, or broken. Reuse is not recommended.

Inspect the extension housing seal and bushing. Replace both components if either show any sign of wear or damage.

FRONT OUTPUT SHAFT/FLANGE/DRIVE CHAIN

Check condition of the seal contact surfaces on the companion flange slinger. This surface must be clean and smooth to ensure proper seal life. Replace the flange 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. 35)

FRONT/REAR CASES AND FRONT RETAINER

Inspect the cases and retainer for wear and damage. 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.

TRANSFER CASE - NV233 (Continued)

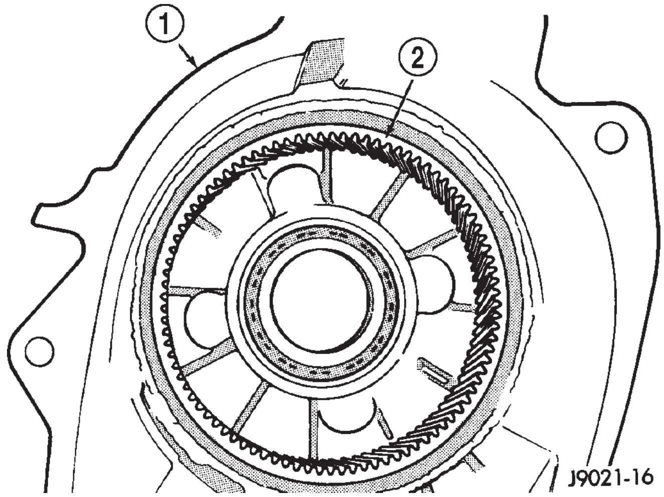


Fig. 35 Low Range Annulus Gear

1 - FRONT CASE
2 - LOW RANGE ANNULUS GEAR

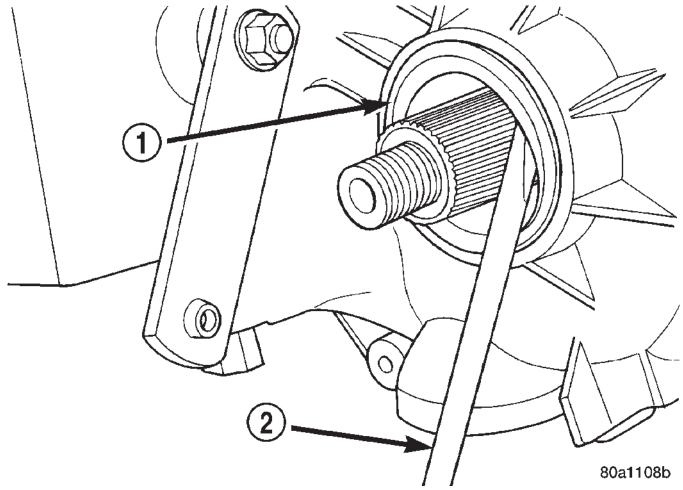


Fig. 36 Front Output Seal Removal - Typical

1 - OUTPUT SHAFT SEAL
2 - PRY TOOL

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.

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. 36).

(2) Remove bearing retaining ring with screw-driver (Fig. 37).

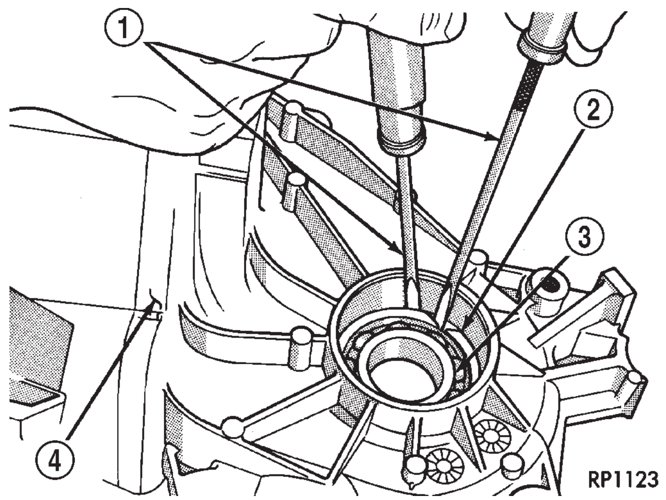


Fig. 37 Front Output Shaft Bearing Retaining Ring Removal

1 - SCREWDRIVERS
2 - SNAP-RING
3 - FRONT OUTPUT SHAFT BEARING
4 - FRONT CASE

TRANSFER CASE - NV233 (Continued)

(3) Remove bearing with Tool Handle C-4171 and Tool 5065 (Fig. 38).

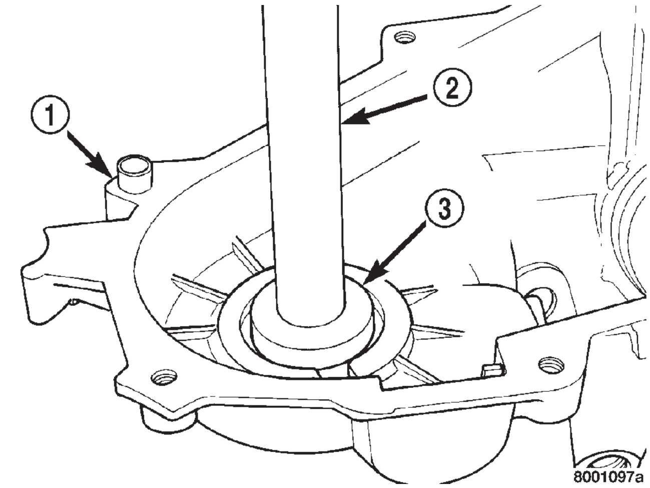


Fig. 38 Front Output Shaft Bearing Removal

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. 39).

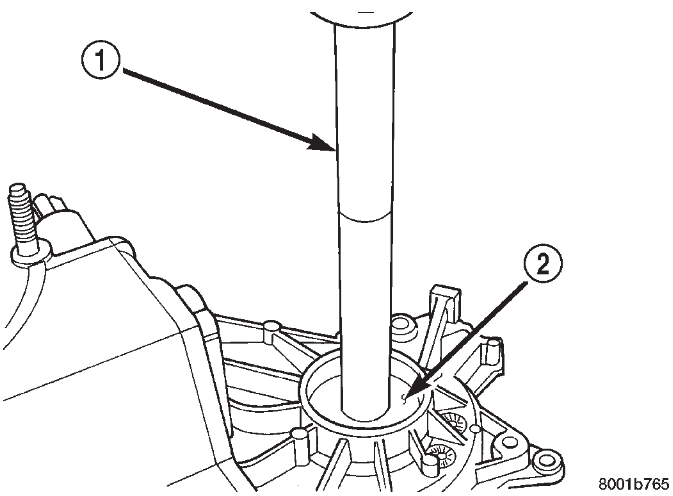


Fig. 39 Front Output Shaft Bearing Installation

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL 5064

(5) Install output shaft front bearing retaining ring (Fig. 40). Start ring into place by hand. Then use small screwdriver to work ring into case groove. Be sure ring is fully seated before proceeding.

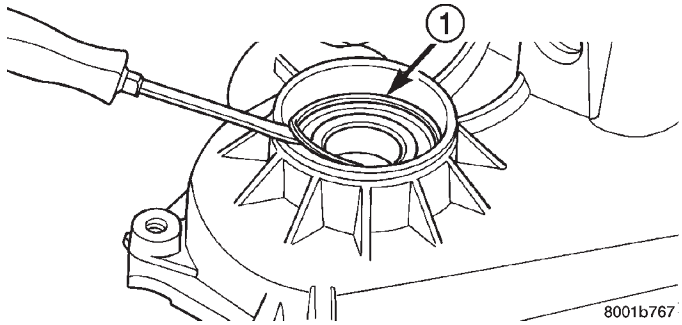


Fig. 40 Installing Front Output Shaft Bearing Retaining Ring

1 - WORK RETAINING RING INTO BORE GROOVE WITH SMALL SCREWDRIVER

(6) Install new front output seal in front case with Installer Tool 8143-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. 41). Once seal is started, continue tapping seal into bore until installer tool bottoms against case.

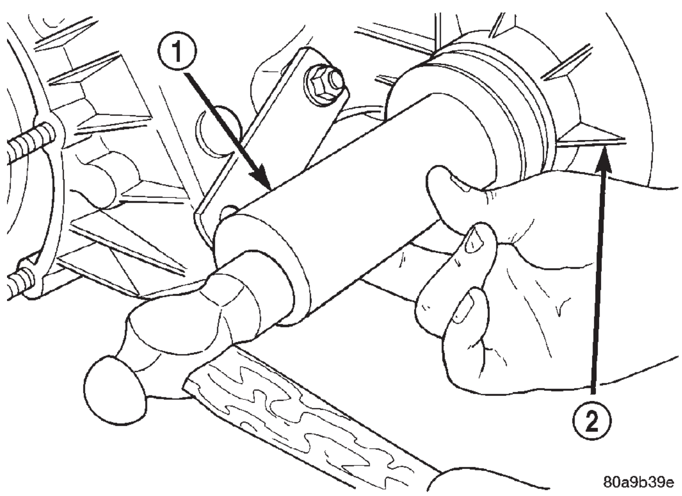


Fig. 41 Front Output Seal Installation - Typical

1 - INSTALLER 8143-A
2 - TRANSFER CASE

TRANSFER CASE - NV233 (Continued)

(7) Remove the output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 42).

(8) Install new bearing with Tool Handle C-4171 and Installer 5066 (Fig. 43). The bearing bore is chamfered at the top. Install the bearing so it is flush with the lower edge of this chamfer (Fig. 44).

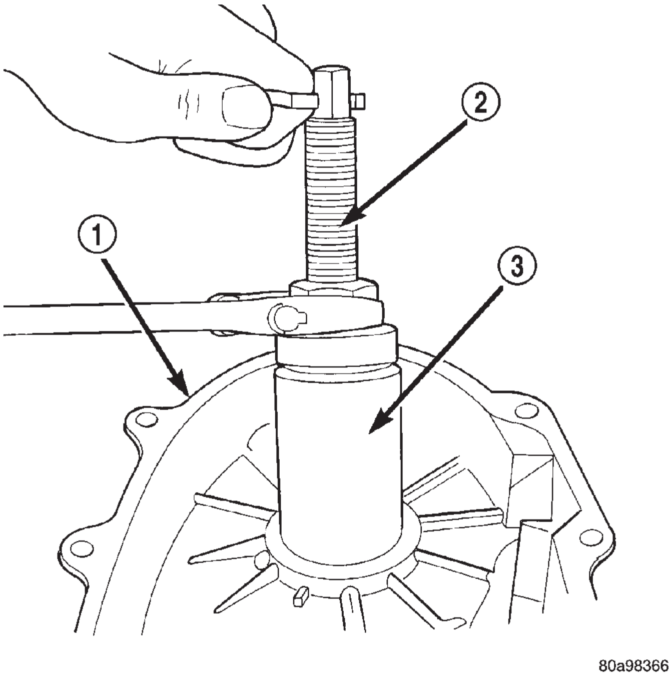


Fig. 42 Output Shaft Rear Bearing Removal

1 - REAR CASE
2 - SPECIAL TOOL L-4454-1 AND L-4454-3
3 - SPECIAL TOOL 8148

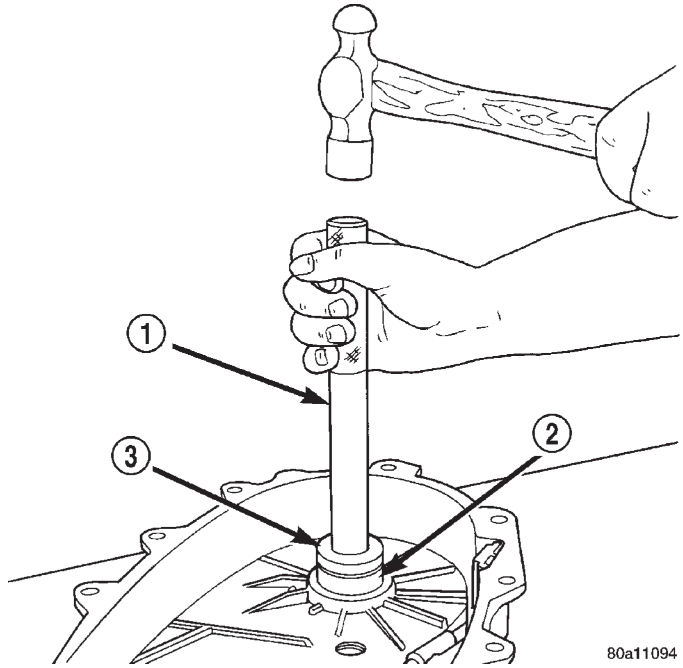


Fig. 43 Output Shaft Rear Bearing Installation

1 - HANDLE C-4171
2 - OUTPUT SHAFT INNER BEARING
3 - INSTALLER 5066

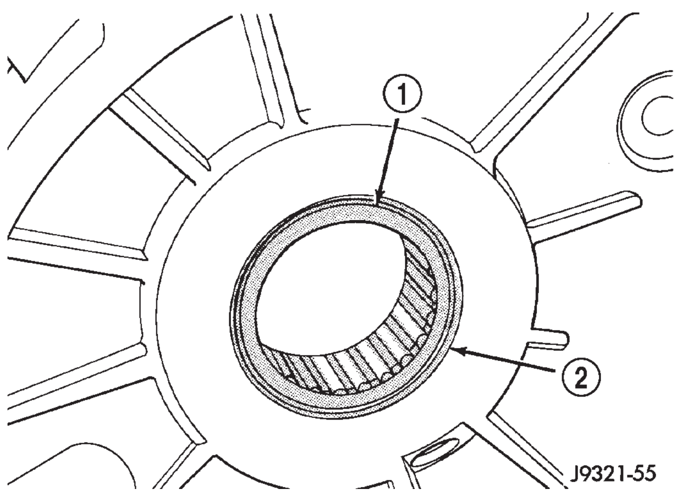


Fig. 44 Output Shaft Rear Bearing Installation Depth

1 - BEARING (SEATED) AT LOWER EDGE OF CHAMFER
2 - CHAMFER

TRANSFER CASE - NV233 (Continued)

(9) Using Remover C-4210 and Handle C-4171, drive input shaft bearing from inside the annulus gear opening in the case (Fig. 45).

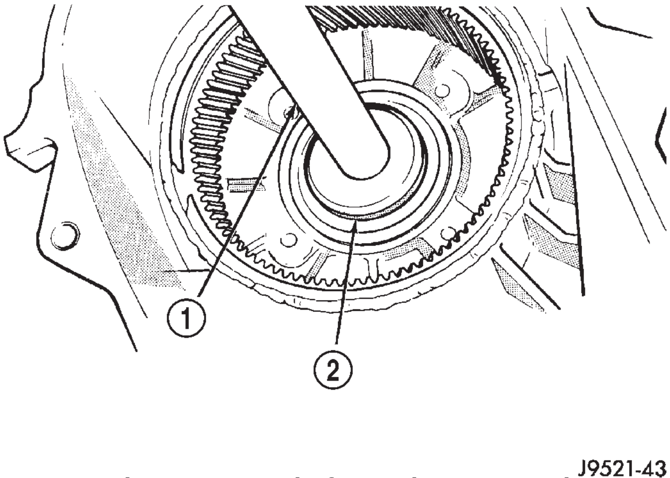


Fig. 45 Input Shaft Bearing Removal

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL C-4210

(10) Install locating ring on new bearing.

(11) Position case so forward end is facing upward.

(12) Using Remover C-4210 and Handle C-4171, drive input shaft bearing into case. The bearing locating ring must be fully seated against case surface (Fig. 46).

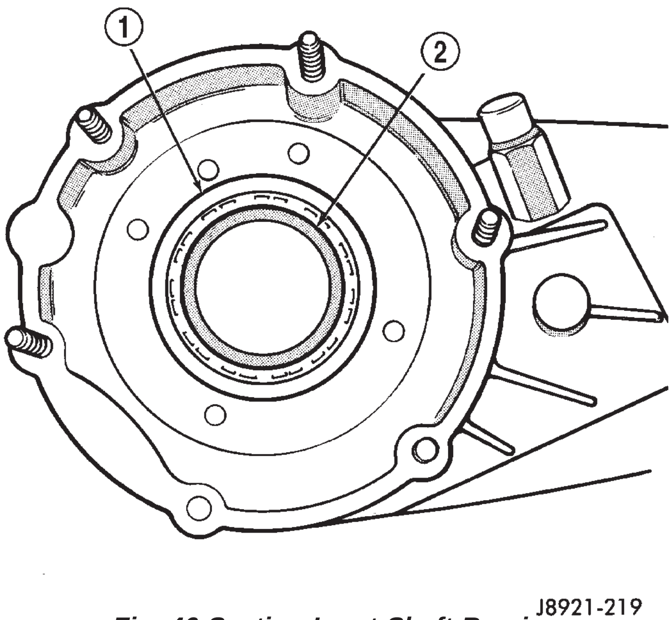


Fig. 46 Seating Input Shaft Bearing

1 - SNAP-RING
2 - INPUT SHAFT BEARING

(13) Remove input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 47).

(14) Install new pilot bearing with Installer 5065 and Handle C-4171 (Fig. 48).

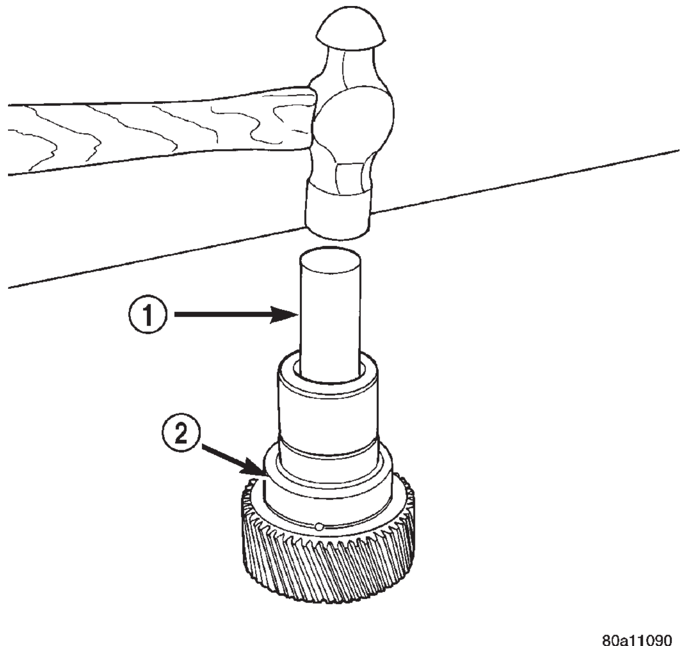


Fig. 47 Remove Input Gear Pilot Bearing

1 - DRIFT
2 - INPUT GEAR

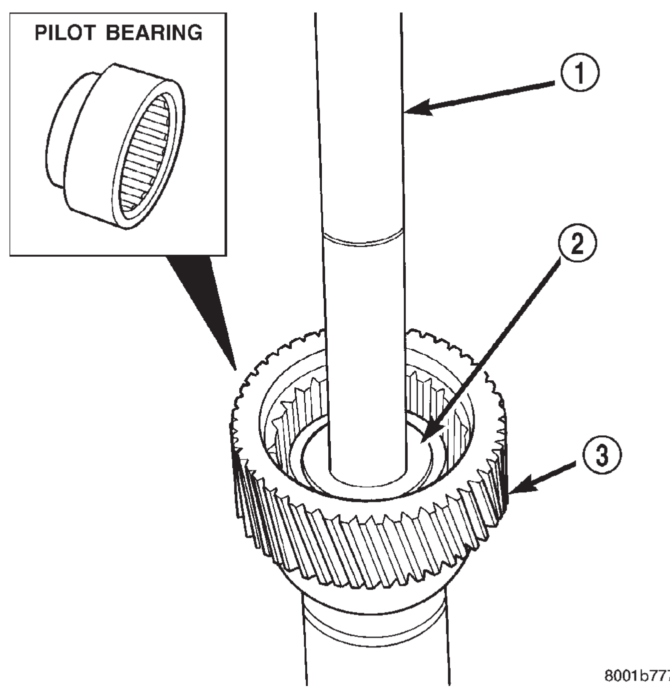


Fig. 48 Install Input Gear Pilot Bearing

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL 5065
3 - INPUT GEAR

TRANSFER CASE - NV233 (Continued)

(15) Remove front bearing retainer seal with suitable pry tool.

(16) Install new front bearing retainer with Installer 7884 (Fig. 49).

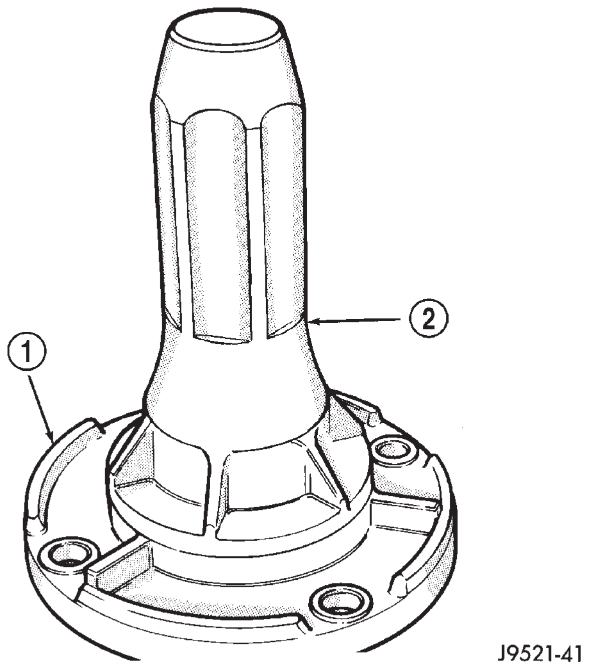


Fig. 49 Install Front Bearing Retainer Seal

1 - FRONT BEARING RETAINER
2 - SPECIAL TOOL 7884

(17) Remove seal from oil pump housing with a suitable pry tool

(18) Install new seal in oil pump housing with Installer 7888 (Fig. 50).

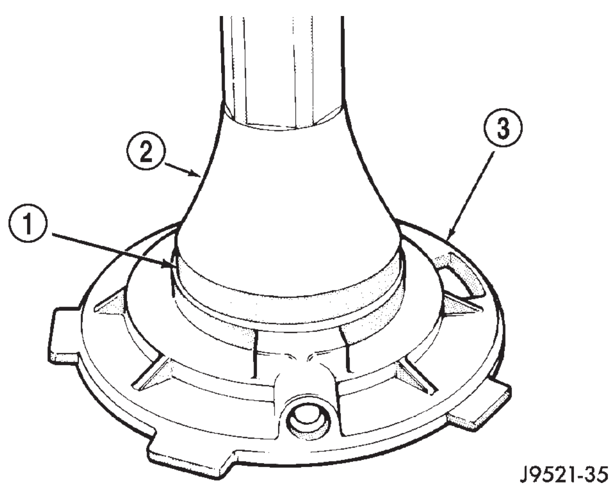


Fig. 50 Oil Pump Seal Installation

1 - HOUSING SEAL
2 - SPECIAL TOOL 7888
3 - OIL PUMP FEED HOUSING

(19) Remove rear retainer bearing with Installer 5065 and Handle C-4171.

(20) Install rear bearing in retainer with Handle C-4171 and Installer 5064 (Fig. 51).

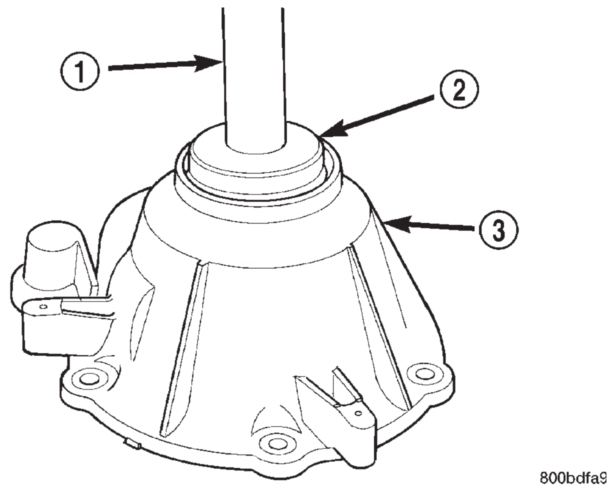


Fig. 51 Installing Rear Bearing In Retainer

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL 5064
3 - REAR RETAINER

INPUT AND LOW RANGE GEAR

(1) Lubricate gears and thrust washers (Fig. 52) with recommended transmission fluid.

(2) Install first thrust washer in low range gear (Fig. 52). Be sure washer tabs are properly aligned in gear notches.

(3) Install input gear in low range gear. Be sure input gear is fully seated.

(4) Install remaining thrust washer in low range gear and on top of input gear. Be sure washer tabs are properly aligned in gear notches.

(5) Install retainer on input gear and install snap-ring.

TRANSFER CASE - NV233 (Continued)

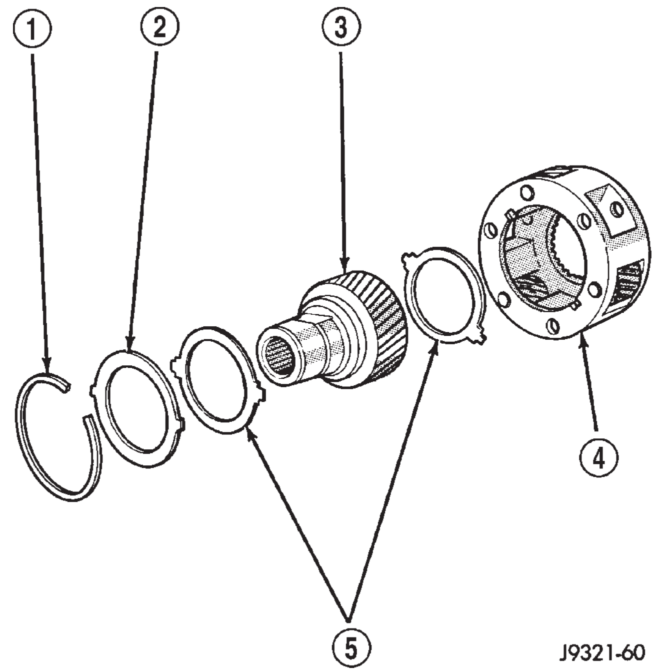


Fig. 52 Input/Low Range Gear Components

1 - SNAP-RING
2 - RETAINER PLATE
3 - INPUT GEAR
4 - LOW RANGE GEAR
5 - THRUST WASHERS

INPUT GEAR AND LOW RANGE GEAR

(1) Align and install low range/input gear assembly in front case (Fig. 53). 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. 54).

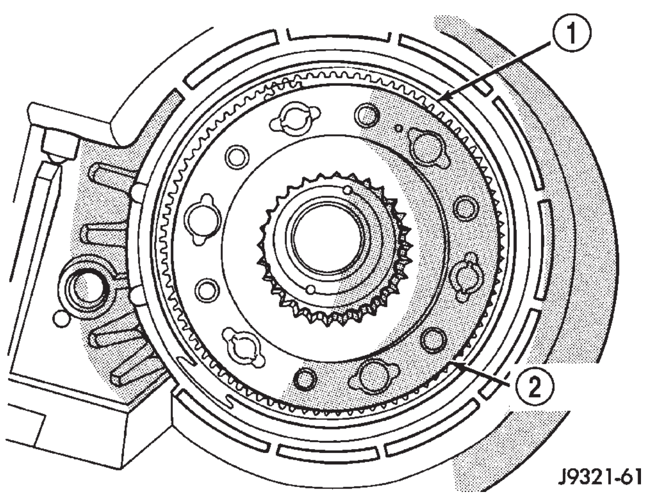


Fig. 53 Input/Low Range Gear Installation

1 - ANNULUS GEAR
2 - INPUT/LOW RANGE GEAR

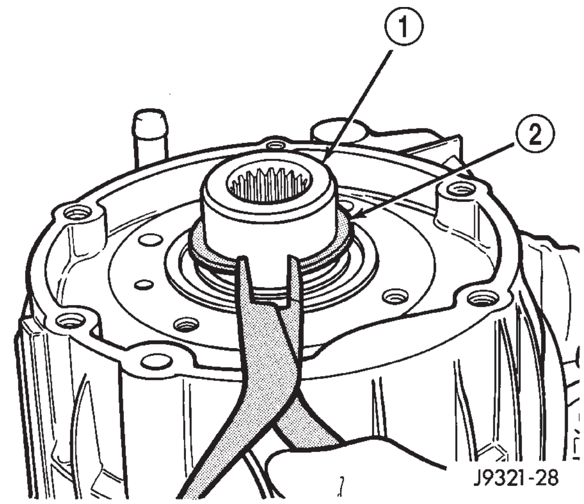


Fig. 54 Install Input Gear Snap-Ring

1 - INPUT GEAR
2 - SNAP-RING

(3) Clean gasket sealer residue from retainer and inspect retainer for cracks or other damage.

(4) Apply a 3 mm (1/8 in.) bead of Mopar® Gasket Maker, or equivalent silicone adhesive, to sealing surface of retainer.

(5) Align cavity in seal retainer with fluid return hole in front of case.

CAUTION: Do not block fluid return cavity on sealing surface of retainer when applying Mopar® Gasket Maker, or equivalent silicone adhesive sealer. Seal failure and fluid leak can result.

(6) Install bolts to hold retainer to transfer case (Fig. 55). Tighten to 16-25 N·m (12-18 ft. lbs.) of torque.

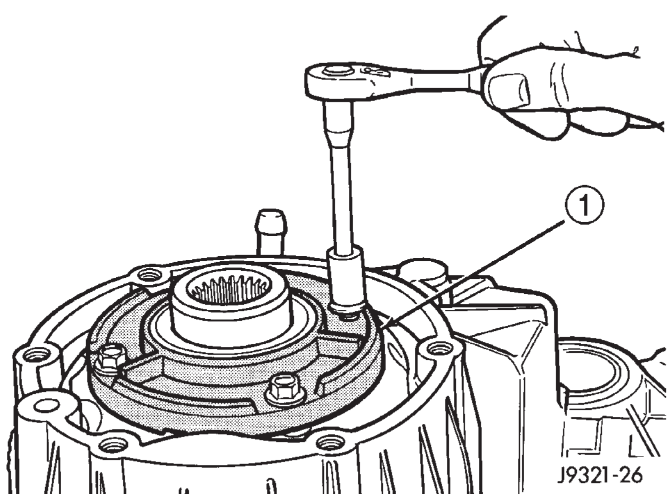


Fig. 55 Install Front Bearing Retainer

1 - FRONT BEARING RETAINER

TRANSFER CASE - NV233 (Continued)

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.

SHIFT FORKS AND MAINSHAFT

(1) Install new sector shaft O-ring.

(2) Install shift sector in case (Fig. 56). Lubricate sector shaft with transmission fluid before installation.

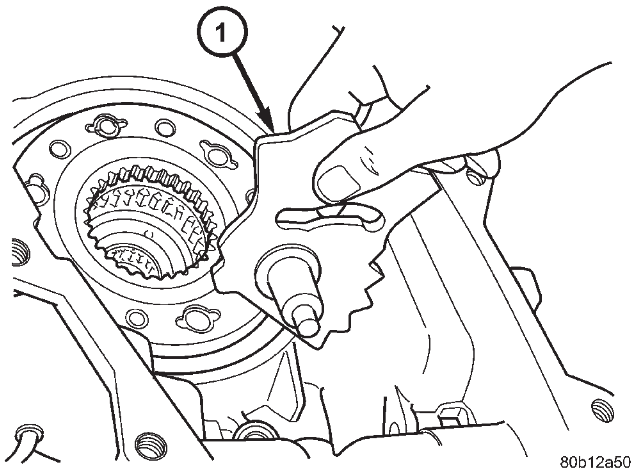


Fig. 56 Shift Sector Installation

1 - SHIFT SECTOR

(3) Assemble and install range fork and hub (Fig. 57). Be sure hub is properly seated in low range gear and engaged to the input gear.

(4) Align and insert range fork pin in shift sector slot.

(5) Install assembled mainshaft (Fig. 58). Be sure shaft is seated in pilot bearing and input gear.

(6) Install new pads on mode fork if necessary.

(7) Insert mode sleeve in mode fork mode fork. Be sure long side of sleeve is toward long end of shift rail (Fig. 59).

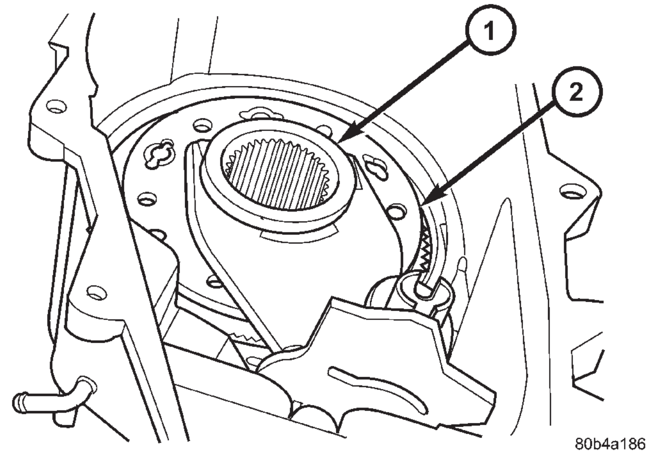


Fig. 57 Install Range Fork And Hub Assembly

1 - RANGE HUB
2 - RANGE FORK

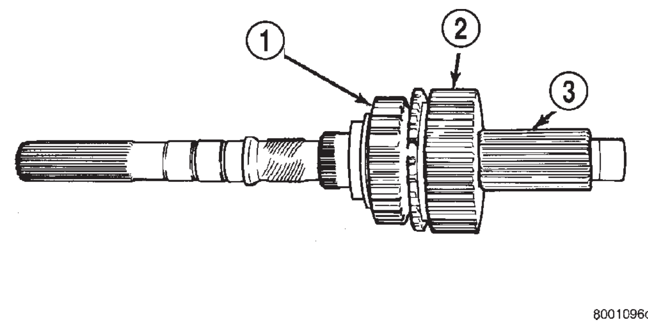


Fig. 58 Mainshaft Assembly Installation

1 - DRIVE SPROCKET
2 - MODE HUB
3 - MAINSHAFT

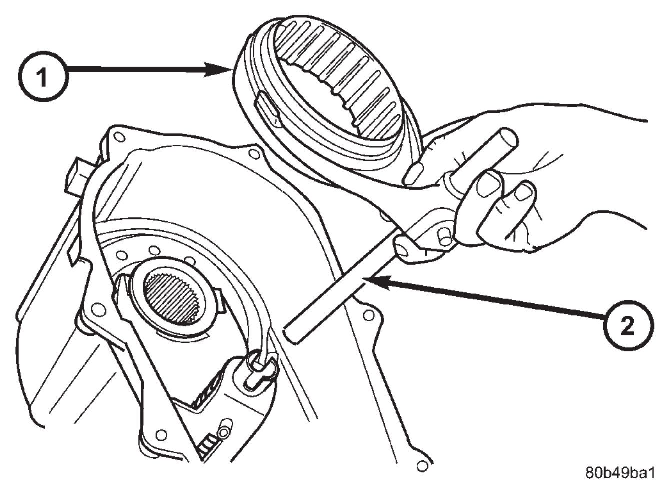


Fig. 59 Mode Fork And Sleeve Installation

1 - MODE SLEEVE
2 - MODE FORK AND RAIL

TRANSFER CASE - NV233 (Continued)

(8) Install assembled mode fork and sleeve (Fig. 60). Be sure fork rail goes through range fork and into case bore. Also be sure sleeve is aligned and seated on mainshaft hub.

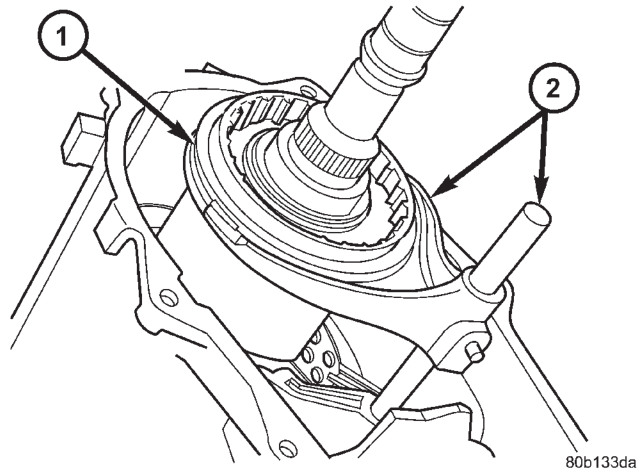


Fig. 60 Mode Fork And Sleeve Installation

1 - MODE SLEEVE
2 - MODE FORK AND RAIL

(9) Rotate sector to NEUTRAL position.
(10) Install new O-ring on detent plug (Fig. 61).
(11) Lubricate detent plunger with transmission fluid or light coat of petroleum jelly.
(12) Install detent plunger, spring and plug (Fig. 61).
(13) Verify that plunger is properly engaged in sector.

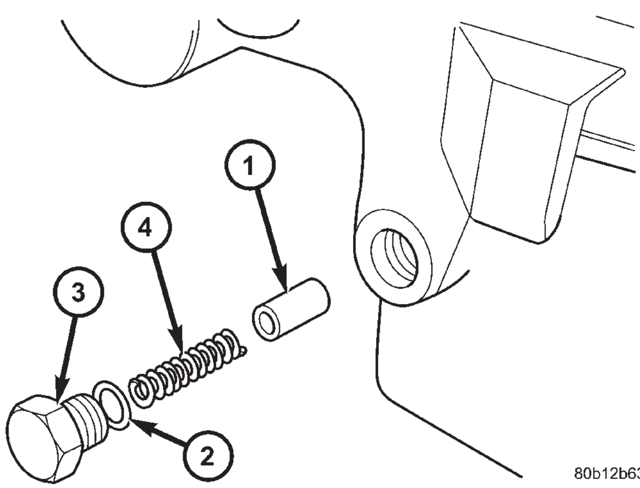


Fig. 61 Shift Detent Components

1 - PLUNGER
2 - O-RING
3 - PLUG
4 - SPRING

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. 62).
(3) Start chain on mainshaft drive sprocket.
(4) Guide front shaft into bearing and drive sprocket onto mainshaft drive gear (Fig. 62).
(5) Install mode spring on upper end of mode fork shift rail (Fig. 63).

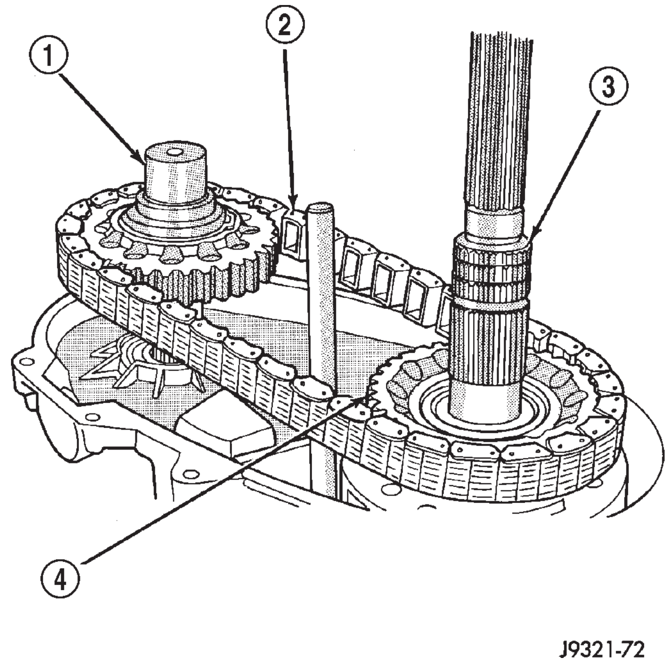


Fig. 62 Installing Drive Chain And Front Output Shaft

1 - FRONT OUTPUT SHAFT
2 - DRIVE CHAIN
3 - MAINSHAFT
4 - DRIVE SPROCKET

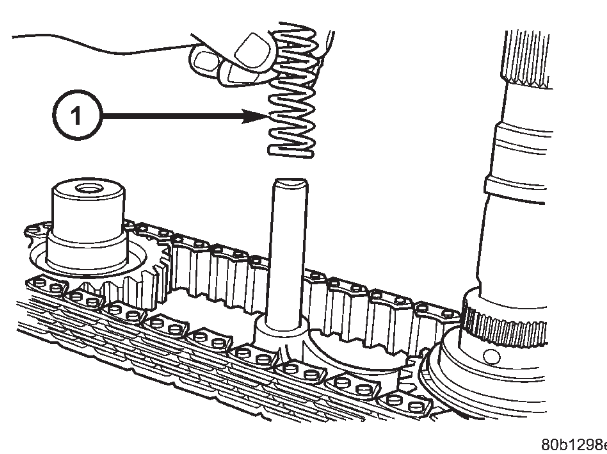


Fig. 63 Install Mode Fork Spring

1 - MODE SPRING

TRANSFER CASE - NV233 (Continued)

OIL PUMP AND REAR CASE

(1) Install magnet in front case pocket (Fig. 64).

(2) Assemble oil pickup screen, connecting hose, and tube.

(3) Install new pickup tube O-ring in oil pump (Fig. 65).

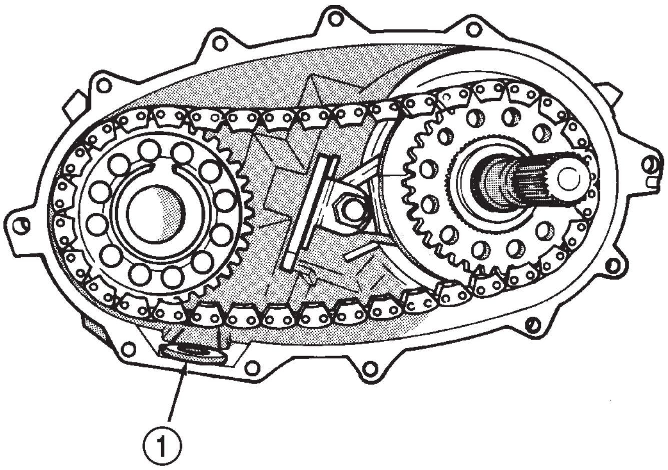


Fig. 64 Installing Case Magnet

1 - MAGNET

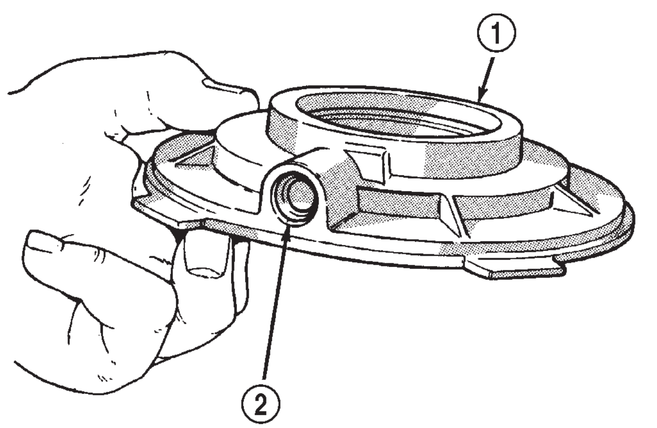


Fig. 65 Pickup Tube O-Ring Position

1 - OIL PUMP
2 - O-RING

(4) Insert oil pickup tube in oil pump inlet.

(5) Position assembled oil pump and pickup tube in rear case. Be sure pickup screen is securely seated in case slot. Also be sure oil pump locating tabs are outside rear case (Fig. 66).

(6) Apply 3 mm (1/8 in.) wide bead of Mopar® Gasket Maker, or equivalent silicone adhesive sealer, to mounting flange of front case. Work sealer bead around bolt holes.

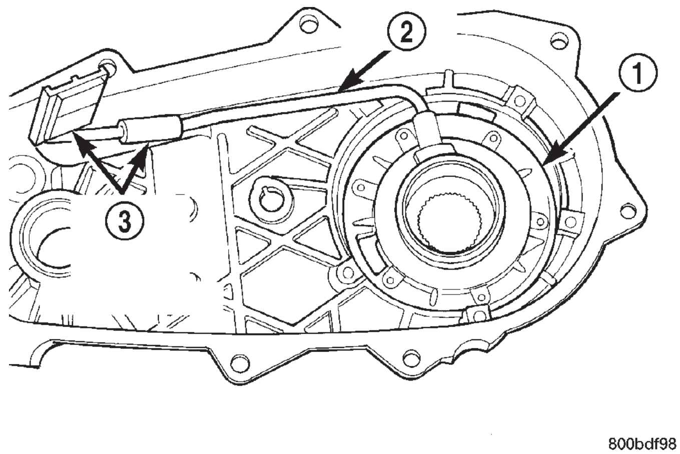


Fig. 66 Oil Pump And Pickup Tube Installation

1 - OIL PUMP
2 - PICKUP TUBE
3 - PICKUP SCREEN AND CONNECTOR

(7) Lift rear case and oil pump and carefully position assembly on front case. Be sure case dowels are aligned and that mode fork rail extends through rear case before seating rear case on front case.

(8) Install case attaching bolts. Alignment bolts at each end of case are only ones requiring washers (Fig. 67).

(9) Tighten case bolts to 27-34 N·m (20-25 ft. lbs.) torque.

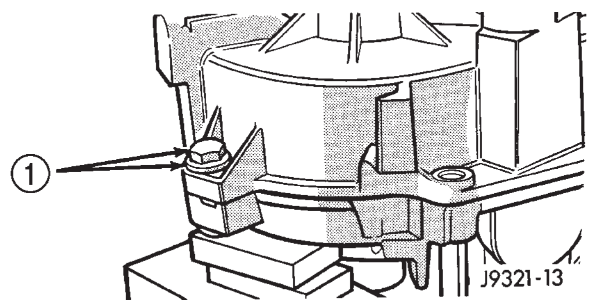


Fig. 67 Alignment Bolt Location

1 - ALIGNMENT BOLT AND WASHER (AT EACH END OF CASE)

COMPANION FLANGE AND SHIFT MOTOR AND MODE SENSOR ASSEMBLY

(1) Position the shift motor and mode sensor assembly onto the transfer case.

(2) Install the bolts to hold the shift motor and mode sensor assembly to the transfer case. Tighten the bolts to 16-25 N·m (12-18 ft. lbs.) torque.

TRANSFER CASE - NV233 (Continued)

CAUTION: If the original shift motor and mode sensor assembly bolts are reused, be sure to use Mopar® Lock & Seal or Loctite™ 242 to replenish the lock patch material originally found on the bolts

(3) Install new seal washer onto the front output shaft (Fig. 68).

(4) Lubricate the companion flange hub with transmission fluid and install the flange onto the front output shaft.

(5) Install a new companion flange nut onto the front output shaft.

(6) Tighten the flange nut to 122-176 N·m (90-130 ft. lbs.) torque. Use Tool 6958, or similar tool to hold flange while tightening nut.

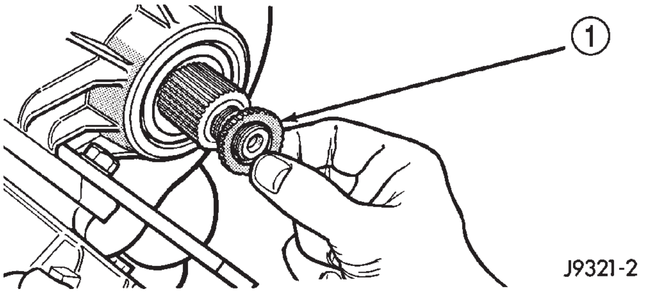


Fig. 68 Yoke Seal Washer Installation

1 - YOKE SEAL WASHER

REAR RETAINER

(1) Apply 3 mm (1/8 in.) wide bead of Mopar® Gasket Maker, or equivalent silicone adhesive sealer, to mounting surface of rear retainer. Allow sealer to set-up slightly before proceeding.

(2) Install rear retainer on rear case. Tighten retainer bolts to 27-34 N·m (20-25 ft. lbs.).

(3) Install new output shaft bearing snap-ring (Fig. 69). Lift mainshaft slightly to seat snap-ring in shaft groove, if necessary.

(4) Apply 3 mm (1/8 in.) wide bead of Mopar® Gasket Maker, or equivalent silicone adhesive sealer, to mounting surface of extension housing. Allow sealer to set-up slightly before proceeding.

(5) Install extension housing on rear retainer.

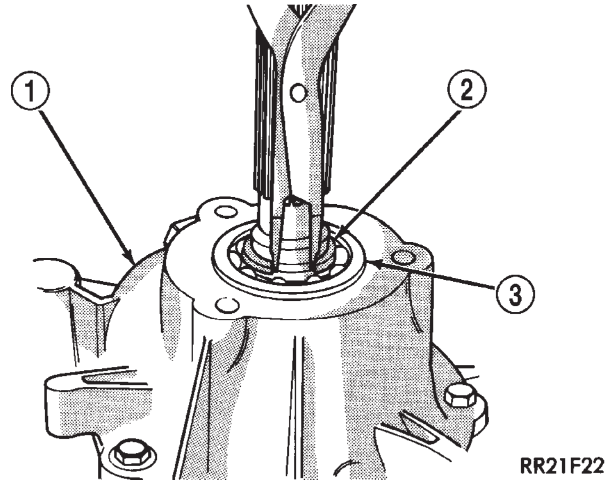


Fig. 69 Install Output Bearing Snap-Ring

1 - REAR RETAINER
2 - SNAP-RING
3 - REAR BEARING

(6) Install extension housing bolts and tighten to 27-34 N·m (20-25 ft. lbs.).

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 onto the transmission.

(5) Install and tighten transfer case attaching nuts to 27-34 N·m (20-25 ft. lbs.) torque.

(6) Connect the vent hose.

(7) Connect the shift motor and mode sensor wiring connectors. Secure wire harness to clips on transfer case.

(8) Align and connect the propeller shafts.

(9) Fill transfer case with correct fluid. (Refer to 21 - TRANSMISSION/TRANSAXLE/TRANSFER CASE/FLUID - STANDARD PROCEDURE)

(10) Install rear crossmember and skid plate, if equipped. Tighten crossmember bolts to 41 N·m (30 ft. lbs.) torque.

(11) Remove transmission jack and support stand.

(12) Lower vehicle and verify transfer case shift operation.

TRANSFER CASE - NV233 (Continued)

SPECIFICATIONS

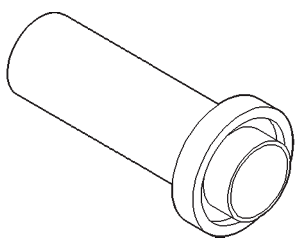
SPECIFICATIONS - TRANSFER CASE - NV233

TORQUE SPECIFICATIONS

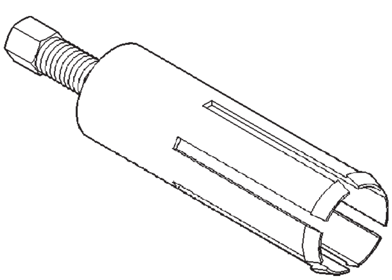
DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Plug, Detent	16-24	12-18	-
Plug, Drain/Fill	20-34	15-25	-
Bolt, Front Brg. Retainer	16-25	12-18	-
Bolt, Case Half	27-34	20-25	-
Nut, Companion Flange	122-176	90-130	-
Bolt, Shift motor and Mode Sensor Assembly	16-25	12-18	-
Bolt, Rear Retainer	27-34	20-25	-
Bolt, Extension Housing	27-34	20-25	-
Nut, Mounting	27-34	20-25	-

SPECIAL TOOLS

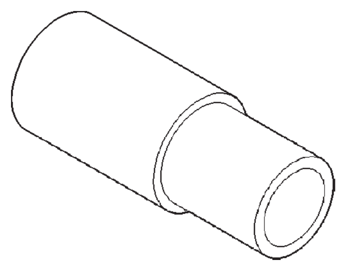
TRANSFER CASE - NV233



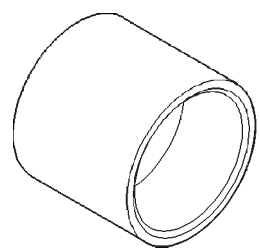
Installer, Seal - 8143-A



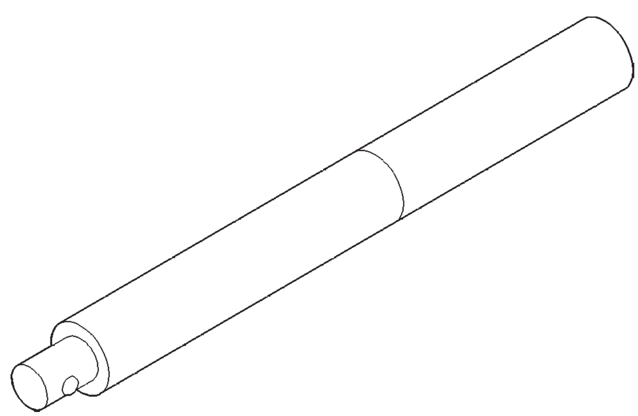
Remover, Bushing - 8158



Installer, Bushing - 8157

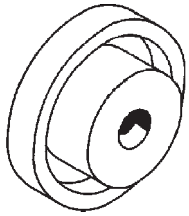


Installer, Seal - D-163

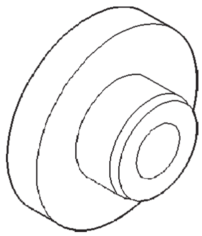


Handle, Universal - C-4171

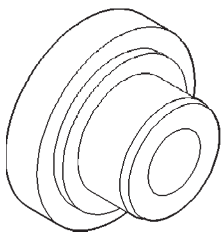
TRANSFER CASE - NV233 (Continued)



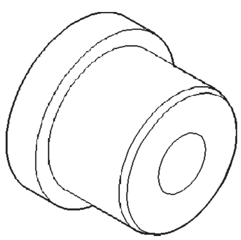
Installer, Seal - C-4210



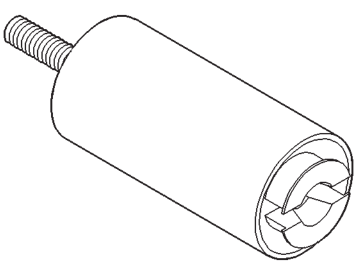
Installer, Bearing - 5064



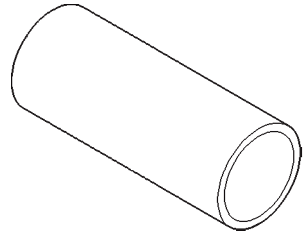
Installer, Bearing - 5065



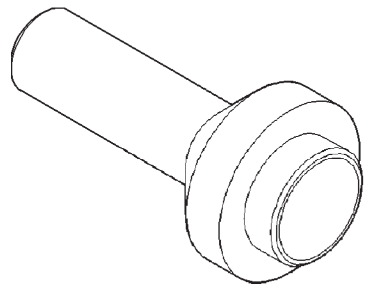
Installer, Bushing—5066



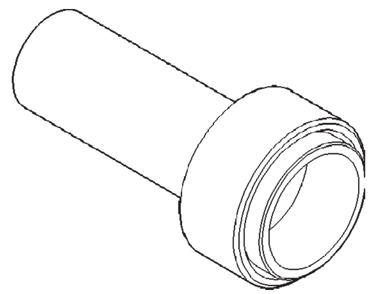
Remover - L-4454



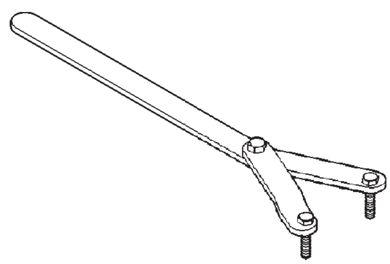
Cup - 8148



Installer, Seal - 7884



Installer, Pump Housing Seal - 7888



Wrench, Spanner - 6958

FLUID

STANDARD PROCEDURE - FLUID DRAIN AND REFILL

The fill and drain plugs are both in the rear case (Fig. 70).

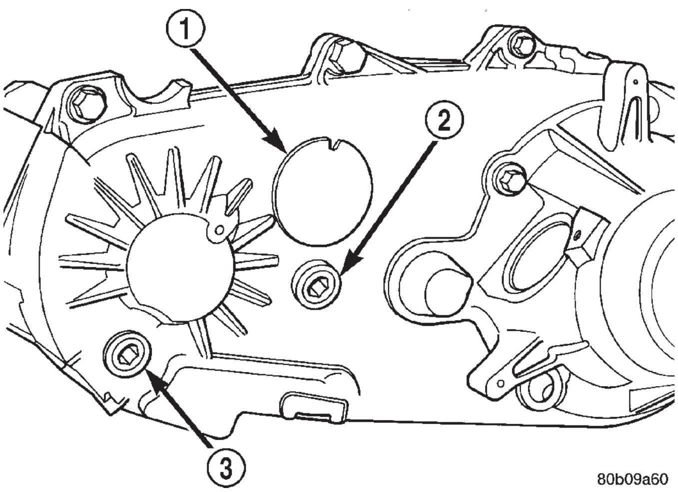


Fig. 70 Fill/Drain Plug and I.D. Tag Location - Typical

1 - I.D. TAG
2 - FILL PLUG
3 - DRAIN PLUG

(1) Raise vehicle.
(2) Position drain pan under transfer case.
(3) Remove drain and fill plugs and drain lubricant completely.
(4) Install drain plug. Tighten plug to 41-54 N·m (30-40 ft. lbs.).
(5) Remove drain pan.
(6) Fill transfer case to bottom edge of fill plug opening with Mopar® ATF +4, type 9602, Automatic Transmission fluid.
(7) Install and tighten fill plug to 41-54 N·m (30-40 ft. lbs.).
(8) Lower vehicle.

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 companion flange.
(4) Remove seal from front case with suitable pry tool (Fig. 71).

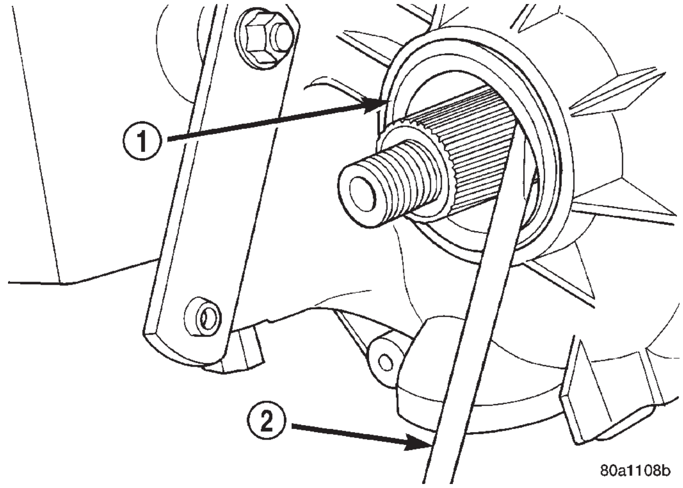


Fig. 71 Remove Front Output Shaft Seal - Typical

1 - OUTPUT SHAFT SEAL
2 - PRY TOOL

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. 72). Once seal is started, continue tapping seal into bore until installer tool seats against case.

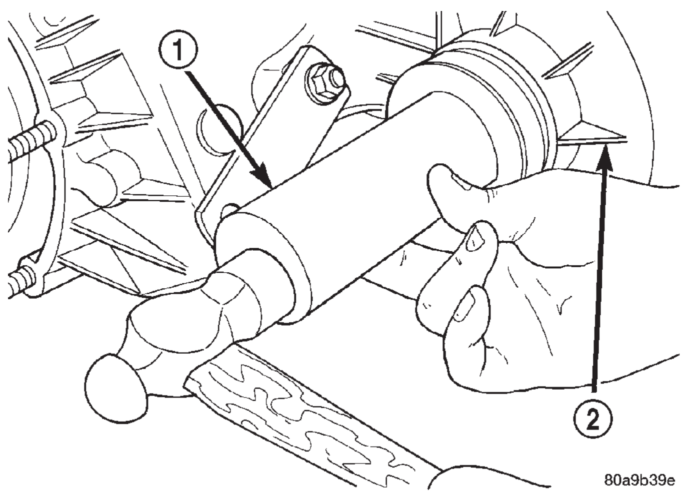


Fig. 72 Front Output Shaft Seal Installation - Typical

1 - INSTALLER 8143-A
2 - TRANSFER CASE

(2) Install the front output shaft companion flange. Tighten the flange nut to 122-176 N·m (90-130 ft.lbs.).
(3) Install the front propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

MODE SENSOR

DESCRIPTION

The transfer case mode sensor (Fig. 73) is an electronic device whose output can be interpreted to indicate the shift motor shaft's rotary position. The sensor consists of a magnetic ring and four Hall Effect Transistors to create a 4 channel digital device (non-contacting) whose output converts the motor shaft position into a coded signal. The TCCM must supply 5VDC (+/- 0.5v) to the sensor and monitor the shift motor position. The four channels are denoted A, B, C, and D. The sensor is mechanically linked to the shaft of the cam which causes the transfer case shifting. The mode sensor draws less than 53 mA.

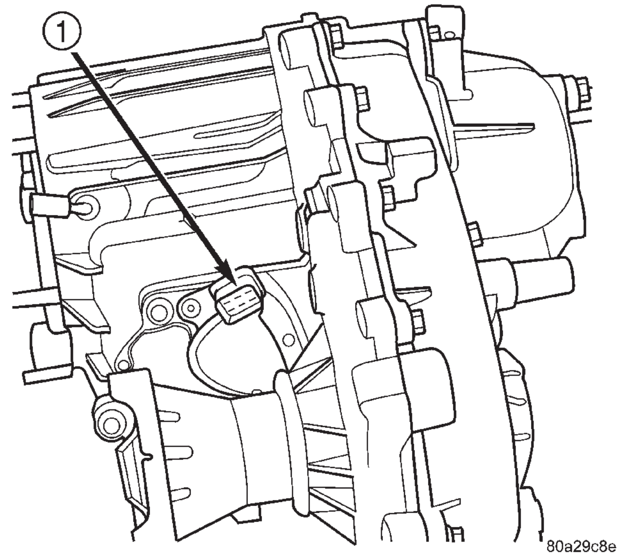


Fig. 73 Mode Sensor

1 - TRANSFER CASE MODE SENSOR

OPERATION

During normal vehicle operation, the Transfer Case Control Module (TCCM) monitors the mode sensor outputs at least every 250 (+/-50) milliseconds when the shift motor is stationary and 400 microseconds when the shift motor is active. A mode sensor signal between 3.8 Volts and 0.8 Volts is considered to be undefined.

Refer to for the relative angles of the transfer case shift sector versus the interpreted transfer case gear operating mode. Refer to for the sensor codes returned to the TCCM for each transfer case mode sensor position. The various between gears positions can also be referred as the transfer case's coarse position. These coarse positions come into play during shift attempts.

SECTOR ANGLES VS. TRANSFER CASE POSITION

Shaft Angle (Degrees)	Transfer Case Position
+40	4LO
+20	N
0	2WD/AWD
-20	4HI

MODE SENSOR CODES

Transfer Case Angle (degrees)	Sensor Channel A	Sensor Channel B	Sensor Channel C	Sensor Channel D
Between Gears	H	H	L	H
+40 (4LO)	H	H	L	L
Between Gears	H	H	L	H
Between Gears	H	L	L	H
+20 (NEUTRAL)	H	L	L	L
Between Gears	H	L	L	H
Between Gears	H	L	H	H
0 (2WD/AWD)	H	L	H	L
Between Gears	H	L	H	H
Between Gears	L	L	H	H
-20 (4HI)	L	L	H	L
Between Gears	L	L	H	H
Between Gears	L	H	H	H

REAR RETAINER BUSHING AND SEAL

REMOVAL

(1) Raise vehicle.

(2) Remove rear propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(3) Using a suitable pry tool or slide-hammer mounted screw, remove the rear retainer seal.

(4) Using Remover 8158, remove the bushing from rear retainer (Fig. 74).

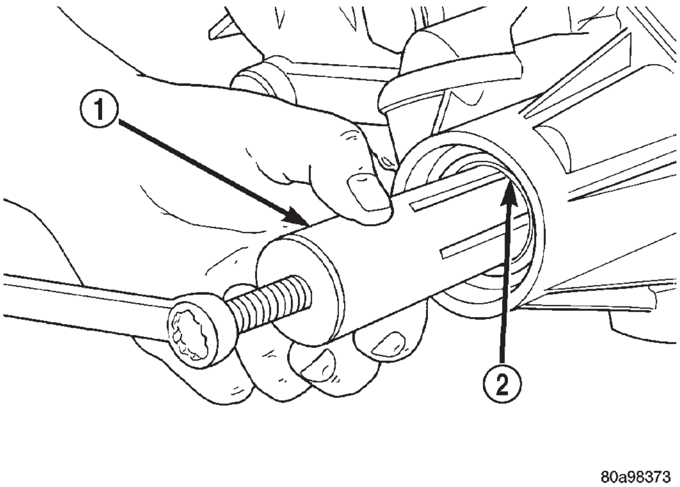


Fig. 74 Rear Retainer Bushing Removal

1 - REMOVER 8158
2 - REAR RETAINER BUSHING

INSTALLATION

(1) Clean fluid residue from sealing surface and inspect for defects.

(2) Position replacement bushing in rear retainer with fluid port in bushing aligned with slot in retainer.

(3) Using Installer 8157, drive bushing into retainer until installer seats against case (Fig. 75).

(4) Using Installer D-163, install seal in rear retainer (Fig. 76).

(5) Install the rear propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(6) Verify proper fluid level.

(7) Lower vehicle.

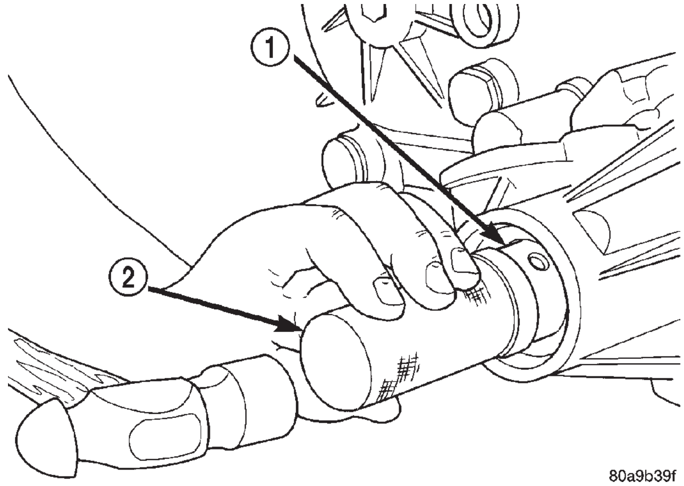


Fig. 75 Rear Retainer Bushing Installation

1 - REAR RETAINER BUSHING
2 - INSTALLER 8157

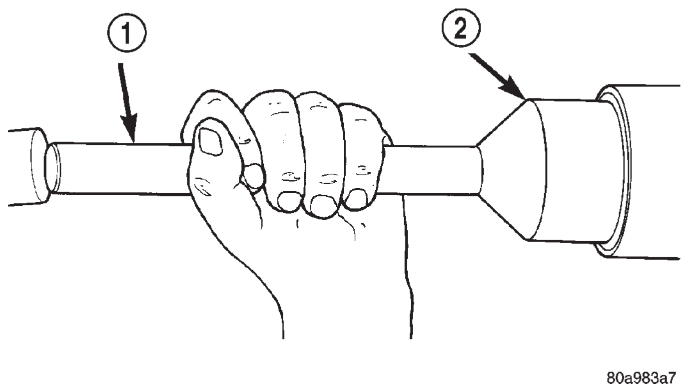


Fig. 76 Install Rear Retainer Seal

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL D-163

SELECTOR SWITCH

DESCRIPTION

The selector switch assembly (Fig. 77) is mounted in the vehicle Instrument Panel (IP) and consists of a rotary knob connected to a resistive network for the mode and range shift selections. Also located in this assembly is a recessed, normally open momentary switch for making shifts into and out of transfer case NEUTRAL. A pen, or similar instrument, is used to make a NEUTRAL shift selection, thus reducing the likelihood of an inadvertent shift request.

The selector switch also contains four light emitting diode's (LED's) to indicate the transfer case position and whether a shift is in progress.

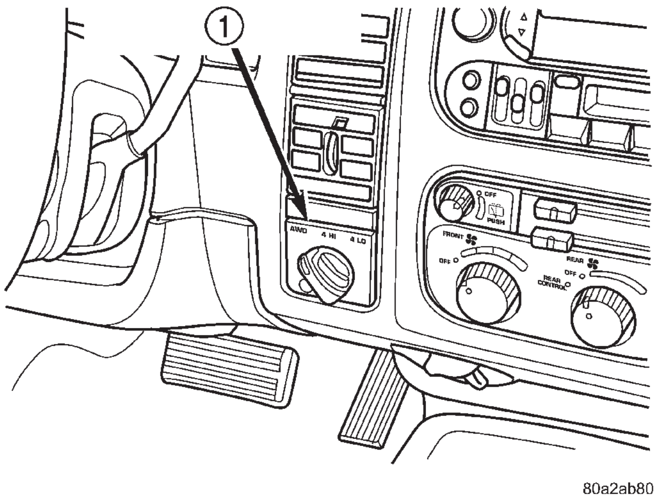


Fig. 77 Selector Switch

1 - TRANSFER CASE MODE SELECTOR SWITCH

OPERATION

As the position of the selector switch varies, the resistance between the Mode Sensor supply voltage pin and the Mode Sensor output will vary. Hardware, software, and calibrations within the Transfer Case Control Module (TCCM) are provided that interpret the selector switch resistance as given in the table below:

SELECTOR SWITCH INTERPRETATION

Step	Resistance Range (ohms)	Required Interpretation
A	<200	Shorted
B	400-700	NEUTRAL
C	1050-1450	4LO
D	1850-2300	4H
E	3050-5950	2WD/AWD (Default)
F	9.5-12.5K	In between positions
G	>15.5K	Open

For resistances between the ranges B-E shown for each valid position (T-Case NEUTRAL, 4LO, 4HI, 2WD/AWD), the TCCM may interpret the resistance as:

- either of the neighboring valid positions.
- as an invalid fault position.

For resistances between the ranges E and F shown for AWD/2WD and in-between positions, the TCCM may interpret the resistance as:

- the AWD/2WD position.
- an invalid fault position.
- a valid in-between position.

For resistances between the ranges F and G shown for in-between positions and fault condition (open), the TCCM may interpret the resistance as:

- a valid in-between position.
- an invalid fault position.

For resistances between the ranges A and B shown for the fault condition (short) and , T-Case NEUTRAL, the TCCM may interpret the resistance as:

- the T-Case NEUTRAL position.
- an invalid fault position.

The LED's in the selector assembly are illuminated/flashed in the following manner to indicate a particular condition or state.

- A solidly illuminated LED indicates a successfully completed shift and the current operating mode of the transfer case. While a shift has been requested but not yet completed, the LED for the source transfer case position remains solidly illuminated.
- A flashing operating mode LED for the desired gear indicates that a shift to that position has been requested, but all of the driver controllable conditions have not been met. This is in an attempt to notify the driver that the transmission needs to be put into NEUTRAL, the vehicle speed is too great, or some other condition outlined (other than a diagnostic failure that would prevent this shift) above is not met. Note that this flashing will continue indefinitely until the conditions are eventually met, or the selec-

SELECTOR SWITCH (Continued)

tor switch position is changed, or if diagnostic routines no longer allow the requested shift.

• If the driver attempts to make a shift into transfer case NEUTRAL, and any of the driver controllable conditions are not met, the request will be ignored until all of the conditions are met or until the NEUTRAL select button is released. Additionally the neutral lamp will flash, or begin to flash while the button is depressed and operator controllable conditions are not being met. All of the LED's except the Neutral will flash if any of the operator controllable conditions for shifting are not met while the Neutral button is depressed. This ″toggle″ type of feature is necessary because the TCCM would interpret another request immediately after the shift into transfer case NEUTRAL has completed.

• No LED's illuminated indicate a fault in the transfer case control system.

SHIFT MOTOR

DESCRIPTION

The shift motor (Fig. 78) consists of a permanent magnet D.C. motor with gear reduction to convert a high speed-low torque device into a low speed-high torque device. The output of the device is coupled to a shaft which internally moves the mode and range forks that change the transfer case operating ranges. The motor is rated at 25 amps maximum at 72° F with 10 volts at the motor leads.

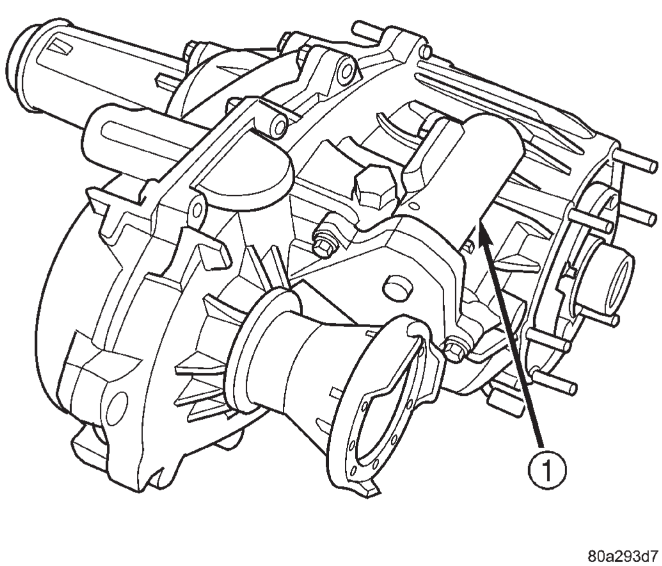


Fig. 78 Shift Motor - Shown Inverted

1 - TRANSFER CASE SHIFT MOTOR

OPERATION

The transfer case shift motor responds to the Transfer Case Control Module (TCCM) commands to move the transfer case shift sector bi-directionally, as required, to obtain the transfer case operating mode indicated by the instrument panel mounted selector switch.

REMOVAL

(1) Raise the vehicle on a suitable hoist.

(2) Remove the front propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(3) Disengage the wiring connectors from the shift motor and mode sensor.

(4) Remove the front output shaft companion flange from the transfer case.

(5) Remove the bolts (Fig. 79) holding the shift motor and mode sensor assembly onto the transfer case.

(6) Separate the shift motor and mode sensor assembly from the transfer case.

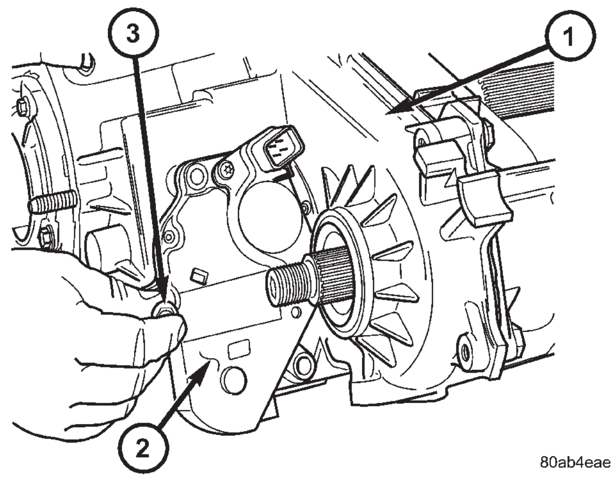


Fig. 79 Remove the Shift Motor and Mode Sensor Assembly Bolts

1 - TRANSFER CASE
2 - SHIFT MOTOR AND MODE SENSOR ASSEMBLY
3 - BOLT

SHIFT MOTOR (Continued)

INSTALLATION

(1) Verify that the shift sector o-ring is clean and properly positioned over the shift sector and against the transfer case.

(2) Position the shift motor and mode sensor assembly onto the transfer case.

(3) Install the bolts (Fig. 80) to hold the assembly onto the transfer case. Tighten the bolts to 16-24 N·m (12-18 ft.lbs.).

CAUTION: If the original shift motor and mode sensor assembly bolts are reused, be sure to use Mopar® Lock & Seal or Loctite™ 242 to replenish the lock patch material originally found on the bolts

(4) Engage the wiring connectors to the shift motor and mode sensor.

(5) Install the transfer case front output shaft companion flange onto the transfer case. Tighten the flange nut to 122-176 N·m (90-130 ft.lbs.).

(6) Install the front propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(7) Refill the transfer case as necessary.

(8) Lower vehicle and verify transfer case operation.

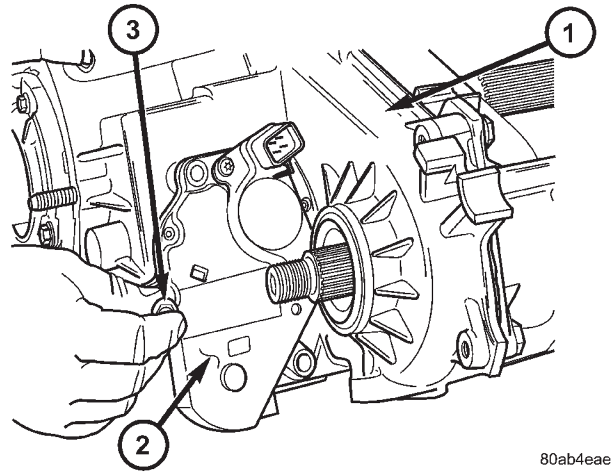


Fig. 80 Install the Shift Motor and Mode Sensor Assembly Bolts

1 - TRANSFER CASE
2 - SHIFT MOTOR AND MODE SENSOR ASSEMBLY
3 - BOLT

TRANSFER CASE - NV244

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TRANSFER CASE - NV244

DESCRIPTION

The NV244 is an electronically controlled full and part-time transfer case with no two wheel drive operation.

A differential in the transfer case is used to control torque transfer to the front and rear axles. A low range gear reduction system provides increased low speed torque capability for off road operation. The low range provides a 2.72:1 reduction ratio.

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

NV244 operating ranges are:

- AWD(All-Wheel Drive)
- 4HI (Part-time)
- 4LO
- NEUTRAL

The AWD mode can be used at any time and on any road surface.

The 4HI (Part-time) and 4LO ranges are for off road use only. The only time these ranges can be used is when the road surface is covered with snow, ice, or other loose slippery material.

SHIFT MECHANISM

Operating ranges are selected with a dash mounted shift selector switch. The shift selector switch provides a input to the Transfer Case Control Module (TCCM) to indicate the driver's desire to change operating ranges. The TCCM uses this input, along with the input from the transfer case mounted mode sensor and information from the vehicle's bus, to determine if a shift is permitted. If the TCCM decides the shift is permitted, the TCCM controls the shift motor, mounted to the exterior of the transfer case, to perform the shift.

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.

OPERATION

The input gear is splined to the transmission output shaft. The input gear drives the mainshaft through the planetary assembly and range sleeve. 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.

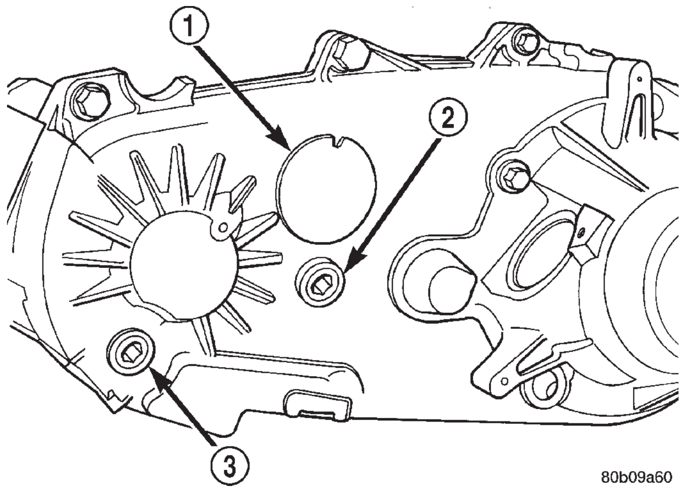


Fig. 1 Fill/Drain Plug And I.D. Tag Locations - Typical

1 - I.D. TAG
2 - FILL PLUG
3 - DRAIN PLUG

DIAGNOSIS AND TESTING - TRANSFER CASE - NV244

DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Transfer case difficult to shift or will not shift into desired range.	1) Transfer case electronically controlled shift system malfunction.	1) Verify proper operation per the appropriate diagnostic manual.
	2) Insufficient or incorrect lubricant.	2) Drain and refill transfer case with the correct quantity of Mopar® ATF +4, type 9602, Automatic Transmission Fluid.
	3) Internal transfer case components binding, worn, or damaged.	3) Repair or replace components as necessary.
Transfer case noisy in all drive modes.	1) Insufficient or incorrect lubricant.	1) Drain and refill transfer case with the correct quantity of Mopar® ATF +4, type 9602, Automatic Transmission Fluid.
	2) Internal transfer case components binding, worn, or damaged.	2) Repair or replace components as necessary.

TRANSFER CASE - NV244 (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
Transfer case noisy while in, or jumps out of, 4LO.	1) Transfer case not completely engaged in 4LO position.	1) While rolling 2-3 MPH and the transmission in NEUTRAL, or the clutch depressed on vehicles equipped with a manual transmission, shift the transfer case to the AWD or 4HI position, and then back into the 4LO position.
	2) Range fork damaged, inserts worn, or fork is binding on the shift rail.	2) Repair or replace components as necessary.
	3) Low range gear worn or damaged.	3) 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.
Transfer case will not shift through 4HI (Part-time) range.	1) Incomplete shift due to drivetrain torque load.	1) Drive in a straight line and momentarily release the accelerator pedal to complete the shift.
	2) Incorrect tire pressure.	2) Correct tire pressure as necessary.
	3) Excessive tire wear.	3) Correct tire condition as necessary.
	4) Excessive vehicle loading.	4) Correct as necessary.

REMOVAL

(1) Shift transfer case into AWD.
(2) Raise vehicle.
(3) Drain transfer case lubricant.
(4) Mark front and rear propeller shafts for alignment reference.
(5) Disconnect front and rear propeller shafts at transfer case.
(6) Support transmission with jack stand.
(7) Remove rear crossmember and skid plate, if equipped.
(8) Disconnect transfer case shift motor and mode sensor wire connectors.
(9) Disconnect transfer case vent hose.
(10) Support transfer case with transmission jack.
(11) Secure transfer case to jack with chains.
(12) Remove nuts attaching transfer case to transmission (Fig. 2).
(13) Pull transfer case and jack rearward to disengage transfer case from the transmission adapter housing and output shaft.
(14) Remove transfer case from under vehicle.

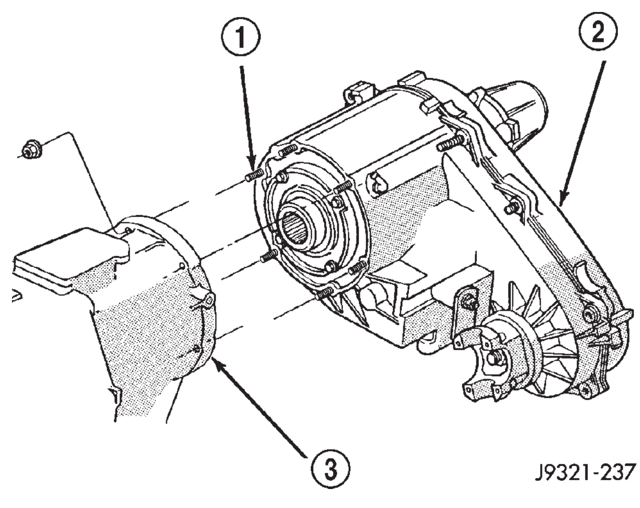


Fig. 2 Transfer Case Mounting - Typical

1 - MOUNTING STUDS
2 - TRANSFER CASE
3 - TRANSMISSION

TRANSFER CASE - NV244 (Continued)

DISASSEMBLY

COMPANION FLANGE AND SHIFT MOTOR ASSEMBLY

(1) Remove front companion flange nut with a socket and impact wrench

(2) Remove the front companion flange. If the flange is difficult to remove by hand, remove it with bearing splitter, or with standard two jaw puller. Be sure puller tool is positioned on the flange and not on the slinger, as slinger will be damaged.

(3) Remove seal washer from front output shaft. Discard washer as it should not be reused.

(4) Remove the bolts (Fig. 3) which hold the shift motor and mode sensor assembly to the transfer case.

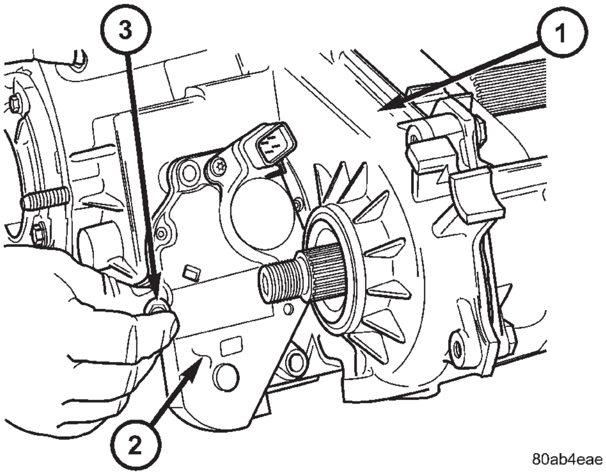


Fig. 3 Remove the Shift Motor and Mode Sensor Assembly Bolts

1 - TRANSFER CASE
2 - SHIFT MOTOR AND MODE SENSOR ASSEMBLY
3 - BOLT

(5) Remove the shift motor and mode sensor assembly from the transfer case.

REAR RETAINER

(1) Remove extension housing bolts.

(2) Tap extension housing with plastic or rawhide mallet to loosen sealer (Fig. 4).

(3) Separate extension housing from rear retainer.

(4) Remove rear bearing snap-ring (Fig. 5).

(5) Remove bolts holding rear retainer to rear case half.

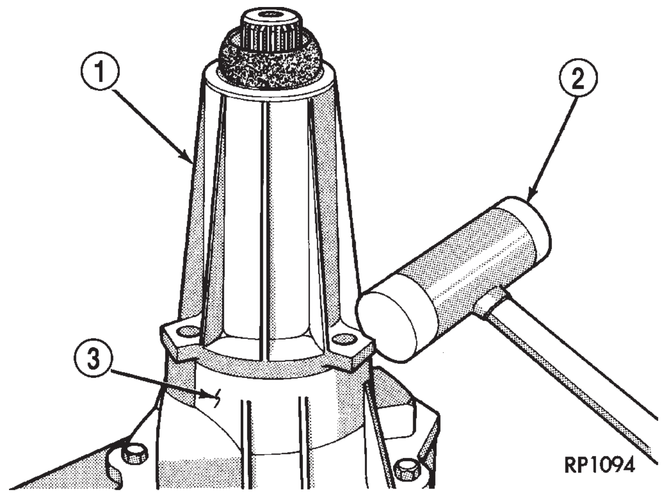


Fig. 4 Remove Extension Housing

1 - EXTENSION HOUSING
2 - PLASTIC HAMMER
3 - REAR RETAINER

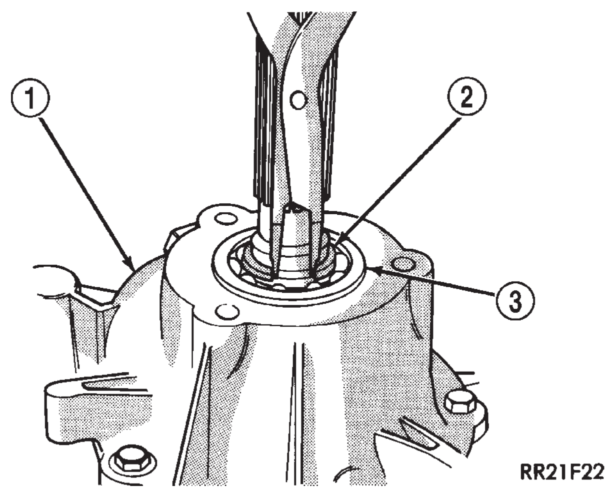


Fig. 5 Remove the Output Bearing Snap-Ring

1 - REAR RETAINER
2 - SNAP-RING
3 - REAR BEARING

TRANSFER CASE - NV244 (Continued)

(6) Loosen rear retainer with pry tool to break sealer bead. Pry only against retainer boss as shown (Fig. 6).

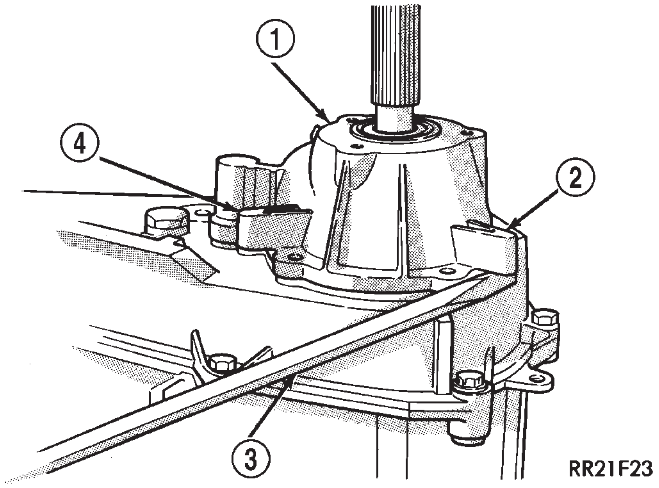


Fig. 6 Loosening Rear Retainer

1 - REAR RETAINER
2 - TAB (2)
3 - SCREWDRIVER
4 - TAB

(7) Remove rear bearing O.D. retaining ring with snap-ring pliers. Then tilt pump and slide it off output shaft (Fig. 7)

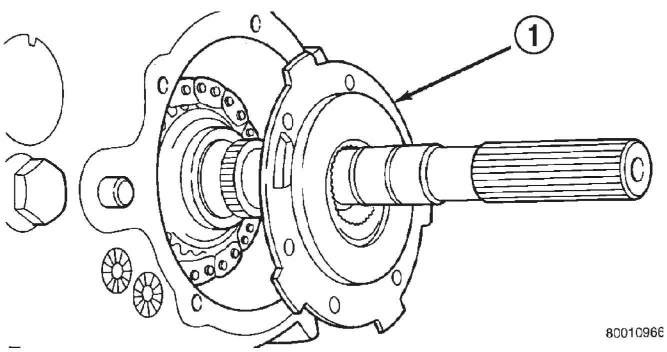


Fig. 7 Oil Pump Removal

1 - OIL PUMP

(8) Remove pickup tube o-ring from pump (Fig. 8) but do not disassemble pump; it is not a repairable part.

(9) Remove seal from oil pump with pry tool.

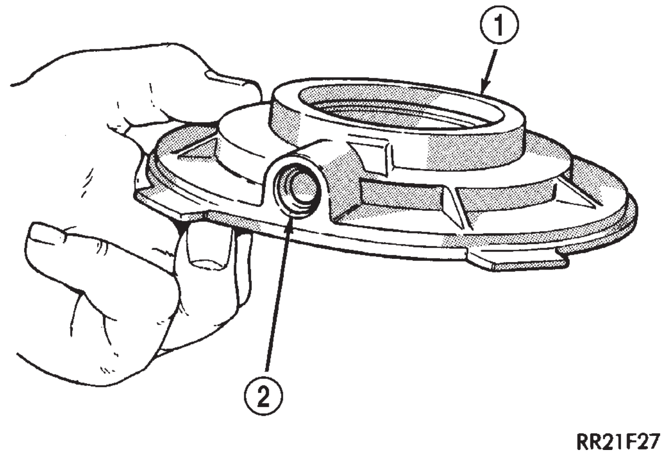


Fig. 8 Pickup Tube O-Ring Location

1 - OIL PUMP
2 - O-RING

(10) Remove bolts attaching rear case to front case (Fig. 9). Note position of the two black finish bolts at each end of the case. These bolts go through the case dowels and require a washer under the bolt head.

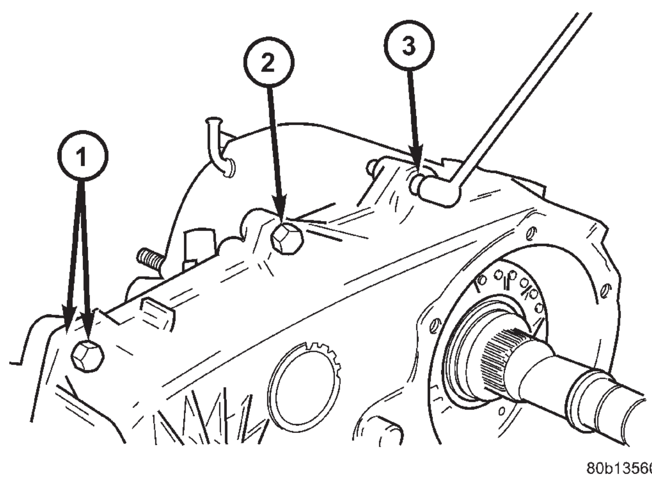


Fig. 9 Spline And Dowel Bolt Locations

1 - DOWEL BOLT AND WASHER (2)
2 - CASE BOLT (5)
3 - SPLINE HEAD BOLT (1)

TRANSFER CASE - NV244 (Continued)

(11) Remove rear case from front case (Fig. 10). Insert screwdrivers into slots cast into each end of case. Then pry upward to break sealer bead and remove rear case.

CAUTION: Do not pry on the sealing surface of either case half as the surfaces will become damaged.

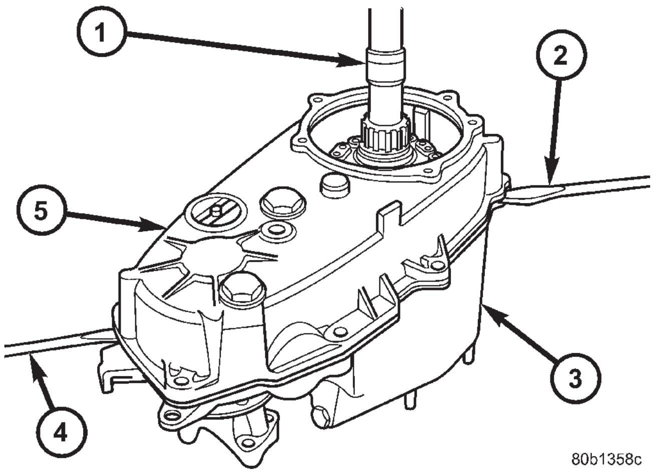


Fig. 10 Loosening/Removing Rear Case

1 - MAINSHAFT
2 - SCREWDRIVER
3 - FRONT CASE
4 - SCREWDRIVER
5 - REAR CASE

(12) Remove oil pickup tube and screen from rear case (Fig. 11).

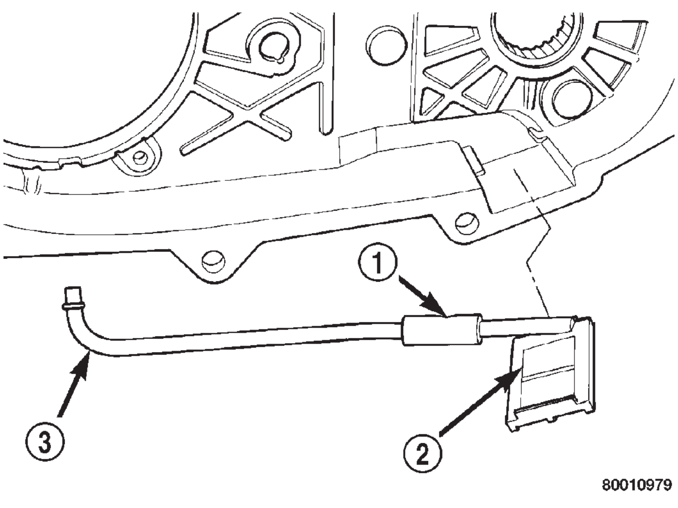


Fig. 11 Oil Pickup Screen, Hose And Tube Removal

1 - CONNECTING HOSE
2 - PICKUP SCREEN
3 - PICKUP TUBE

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(1) Remove drive sprocket snap-ring (Fig. 12).

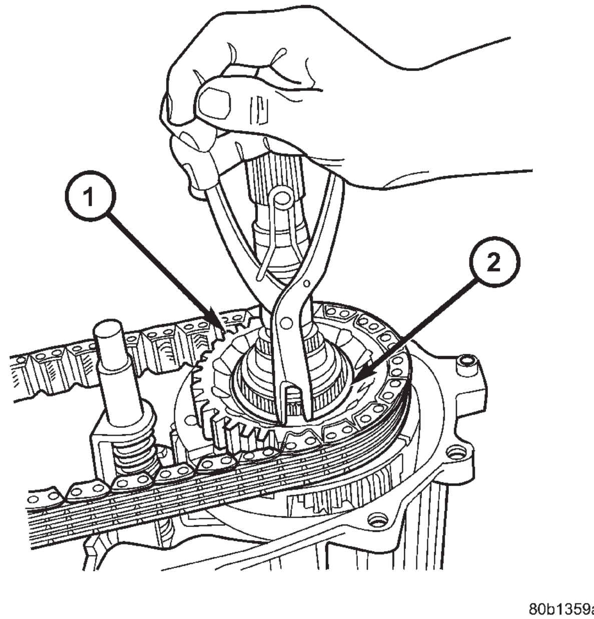


Fig. 12 Drive Sprocket Snap-Ring Removal

1 - DRIVE SPROCKET
2 - DRIVE SPROCKET SNAP-RING

(2) Remove drive sprocket and chain (Fig. 13).
(3) Remove front output shaft (Fig. 14).

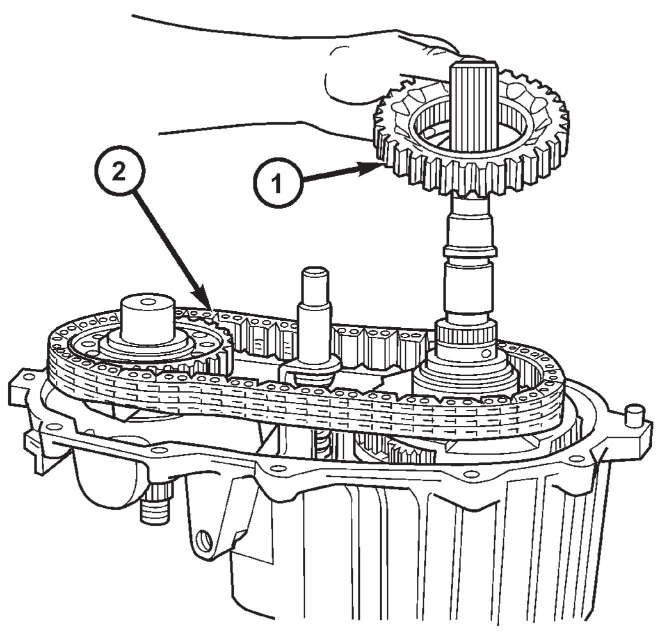


Fig. 13 Drive Sprocket And Chain Removal

1 - FRONT OUTPUT SHAFT
2 - DRIVE CHAIN
3 - DRIVE SPROCKET

TRANSFER CASE - NV244 (Continued)

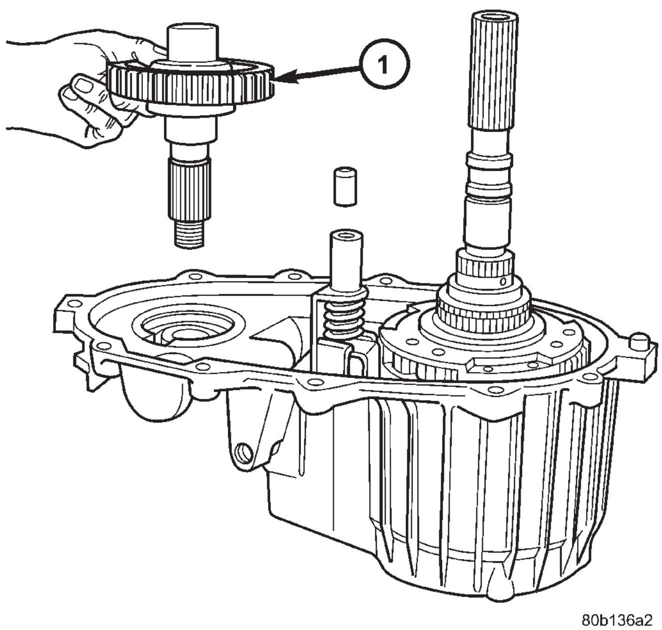


Fig. 14 Removing Front Output Shaft

1 - FRONT OUTPUT SHAFT

SHIFT FORKS AND MAINSHAFT

(1) Remove shift detent plug, spring and pin (Fig. 15).

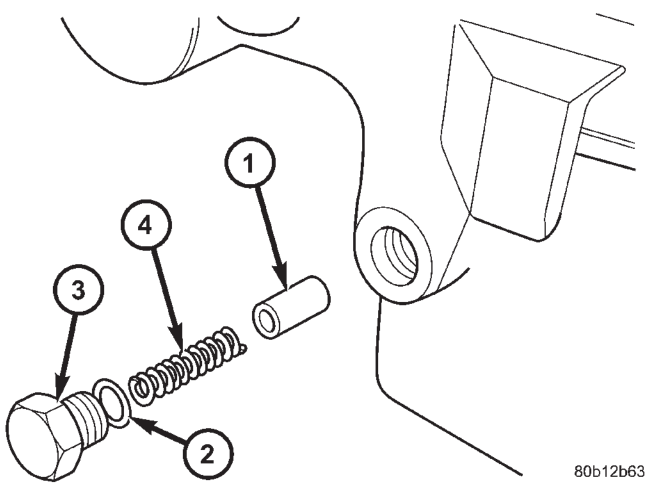


Fig. 15 Detent Pin, Spring, And Plug Removal

1 - PLUNGER
2 - O-RING
3 - PLUG
4 - SPRING

(2) Remove shift rail by pulling it straight up and out of fork (Fig. 16).

(3) Remove mode fork and mainshaft as assembly (Fig. 17).

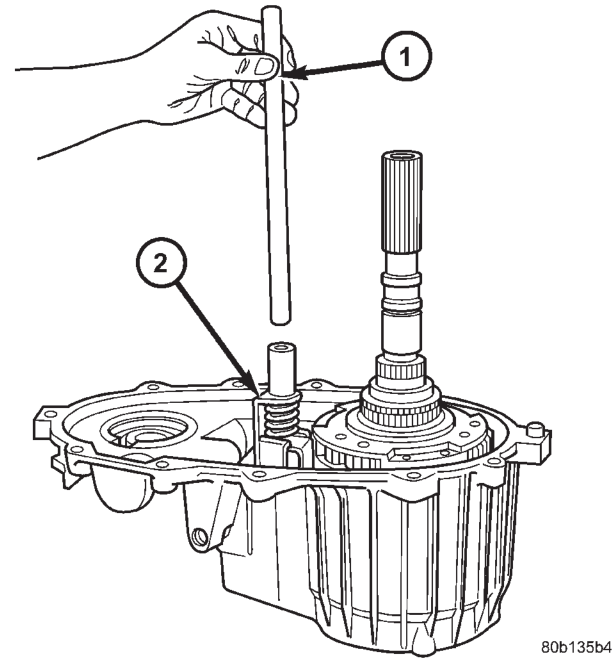


Fig. 16 Shift Rail Removal

1 - SHIFT RAIL
2 - MODE FORK

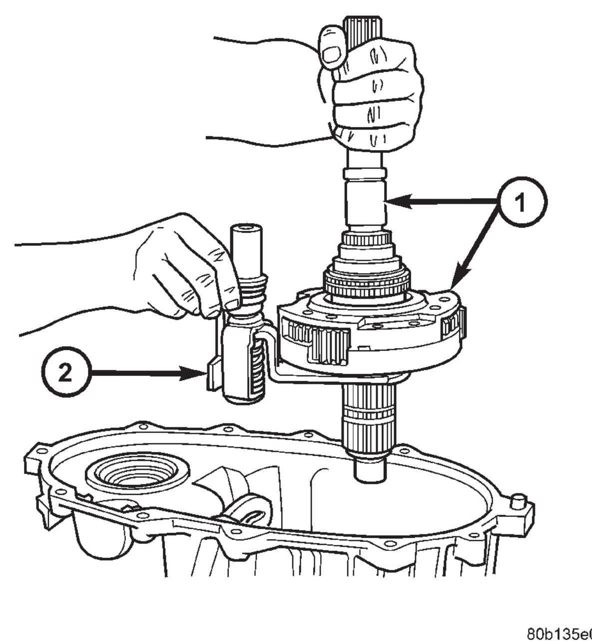


Fig. 17 Mainshaft And Mode Fork Removal

1 - MAINSHAFT ASSEMBLY
2 - MODE FORK

TRANSFER CASE - NV244 (Continued)

(4) Remove mode shift sleeve and mode fork assembly from mainshaft (Fig. 18). Note position of mode sleeve in fork and remove sleeve.

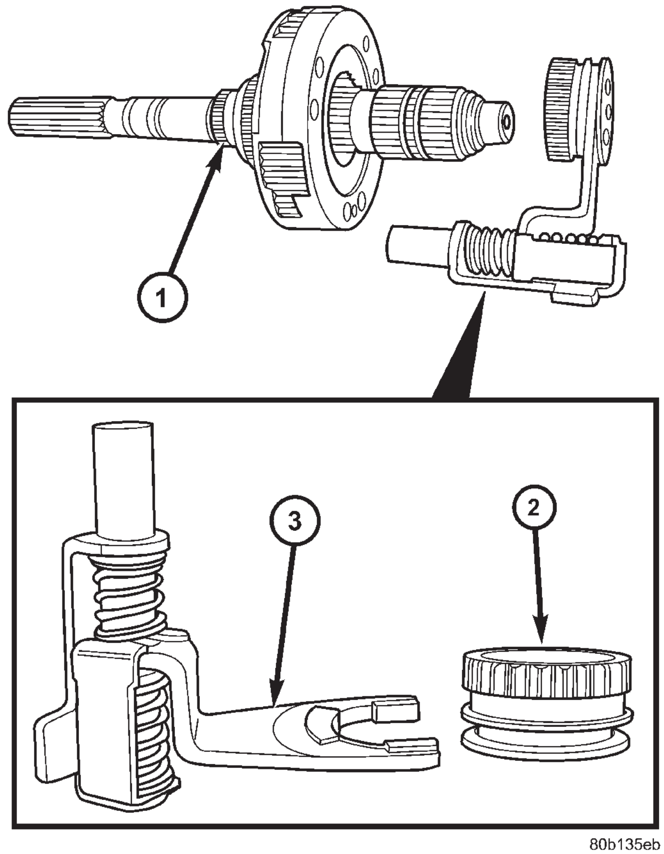


Fig. 18 Separate Mode Fork And Sleeve

1 - MAINSHAFT
2 - SLEEVE
3 - MODE FORK ASSEMBLY

(5) Remove intermediate clutch shaft snap-ring (Fig. 19).

(6) Remove clutch shaft thrust ring (Fig. 20).

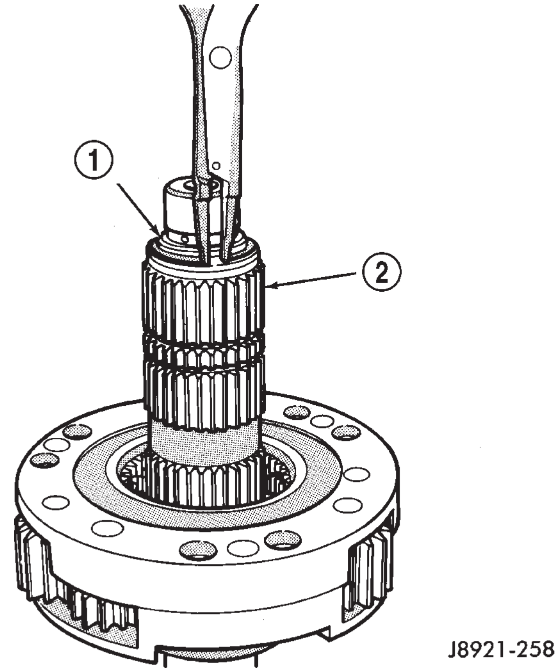


Fig. 19 Remove the Intermediate Clutch Shaft Snap-Ring

1 - SNAP-RING
2 - INTERMEDIATE CLUTCH SHAFT

Fig. 20 Remove the Intermediate Clutch Shaft Thrust Ring

1 - CLUTCH SHAFT THRUST RING

TRANSFER CASE - NV244 (Continued)

(7) Remove intermediate clutch shaft (Fig. 21).

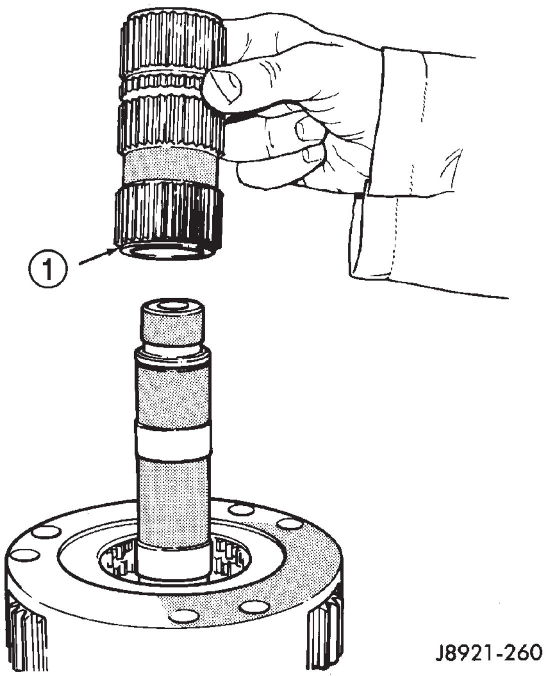


Fig. 21 Remove the Intermediate Clutch Shaft

1 - INTERMEDIATE CLUTCH SHAFT

(8) Remove differential snap-ring (Fig. 22).

(9) Remove differential (Fig. 23).

(10) Remove differential needle bearings and both needle bearing thrust washers from mainshaft.

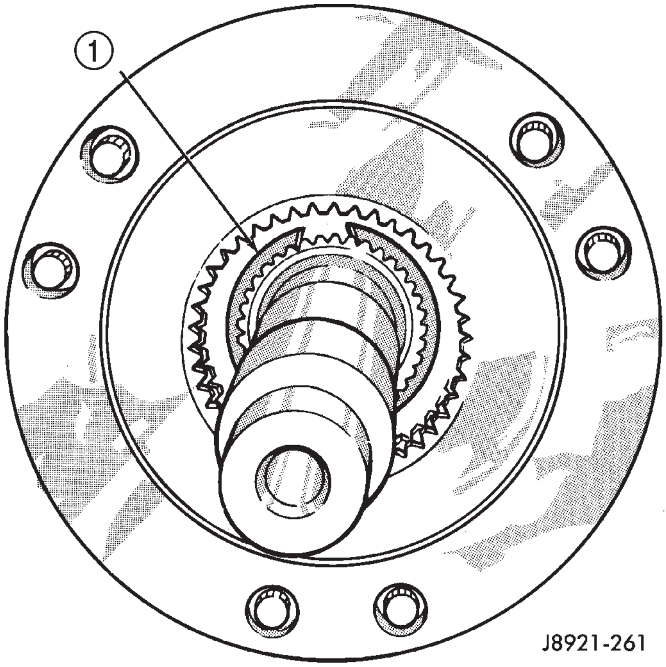


Fig. 22 Remove the Differential Snap-Ring

1 - DIFFERENTIAL SNAP-RING

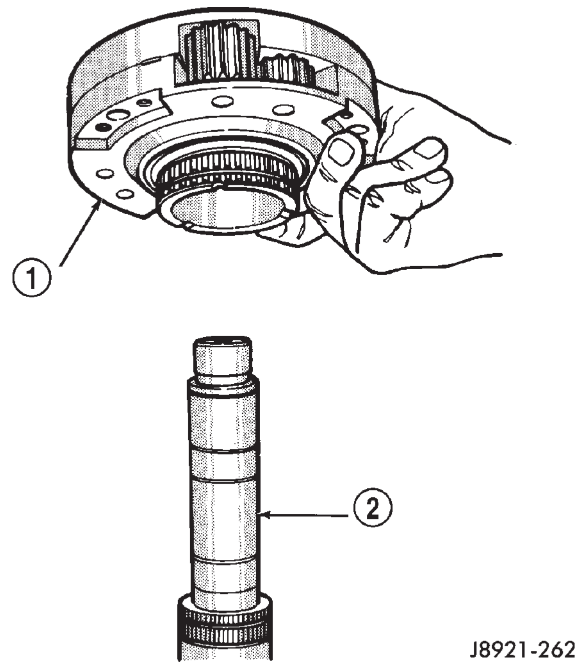


Fig. 23 Remove the Differential

1 - DIFFERENTIAL

2 - MAINSHAFT

(11) Slide low range fork pin out of shift sector slot (Fig. 24).

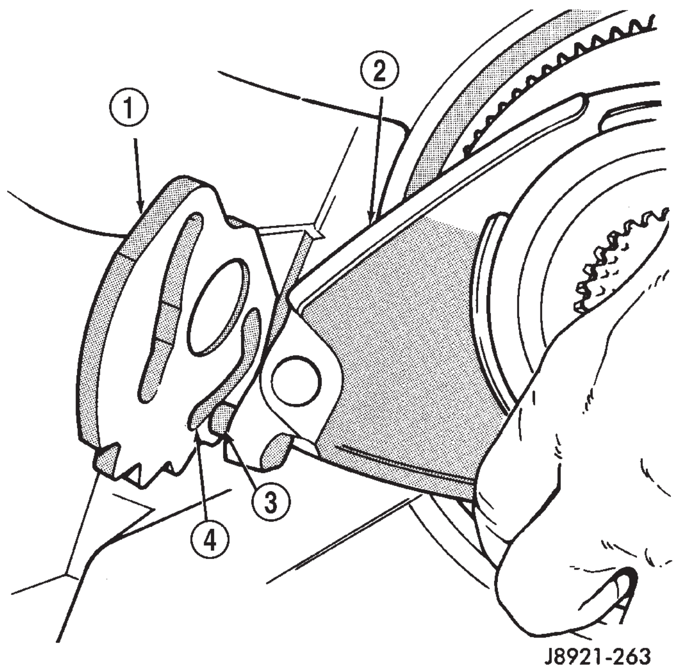


Fig. 24 Disengaging the Low Range Fork

1 - SHIFT SECTOR

2 - LOW RANGE FORK

3 - PIN

4 - SLOT

TRANSFER CASE - NV244 (Continued)

(12) Remove low range fork and hub (Fig. 25).
(13) Remove shift sector.

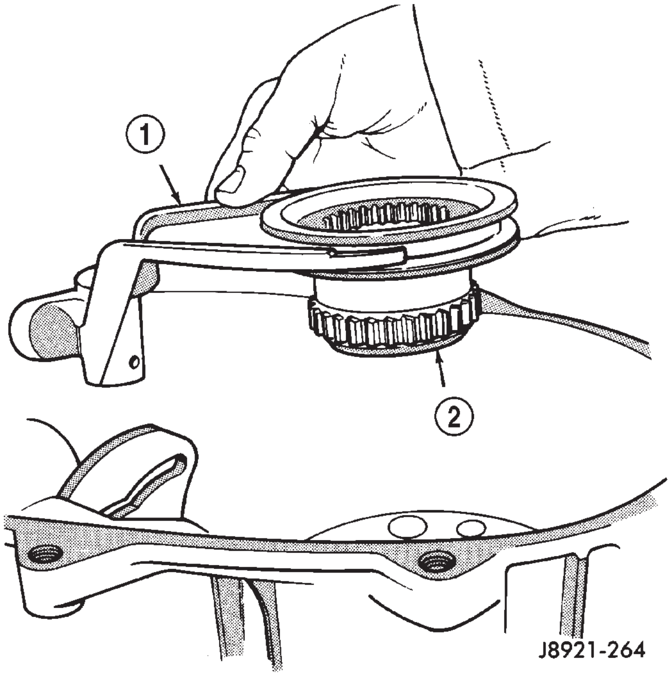


Fig. 25 Low Range Fork And Hub Removal

1 - LOW RANGE FORK
2 - FORK HUB

(14) Remove shift sector o-ring (Fig. 26).

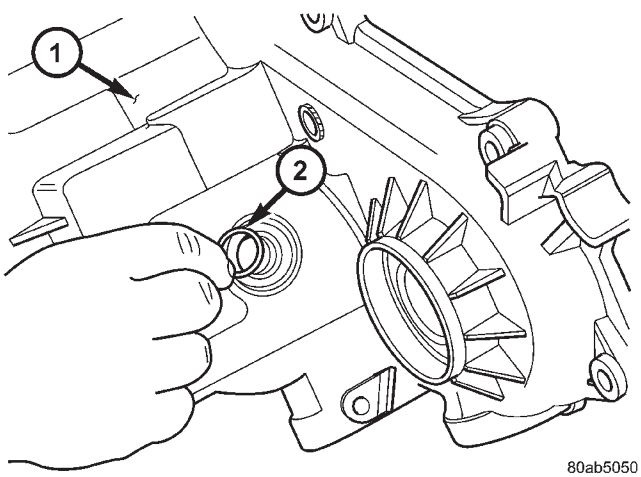


Fig. 26 Remove the Shift Sector O-Ring

1 - TRANSFER CASE FRONT HOUSING
2 - SHIFT SECTOR O-RING

INPUT GEAR/LOW RANGE ASSEMBLY

(1) Remove front bearing retainer bolts.
(2) Remove front bearing retainer. Carefully pry retainer loose with screwdriver (Fig. 27). Position screwdriver in slots cast into retainer.
(3) Remove input gear snap-ring (Fig. 28).

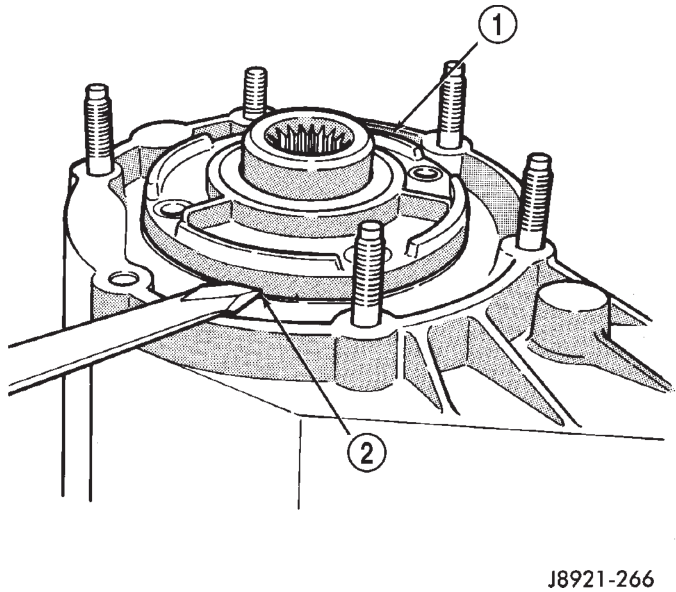


Fig. 27 Front Bearing Retainer Removal

1 - FRONT BEARING RETAINER
2 - RETAINER SLOT

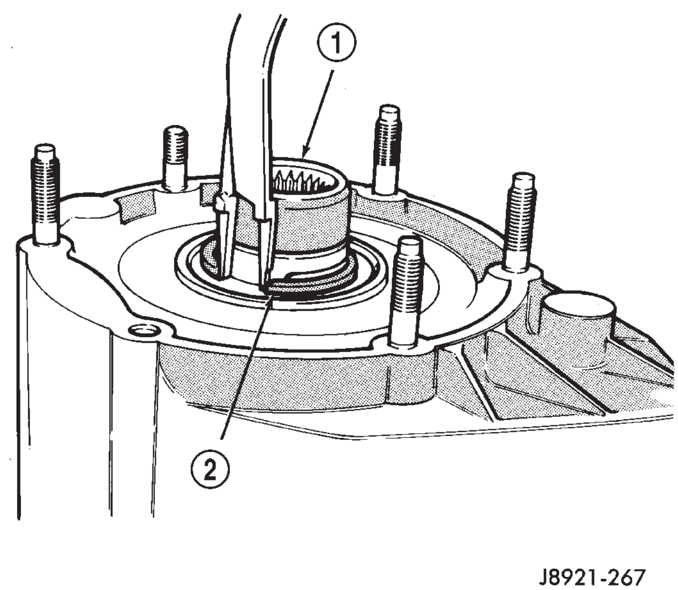


Fig. 28 Remove the Input Gear Snap-Ring

1 - INPUT GEAR
2 - SNAP-RING

TRANSFER CASE - NV244 (Continued)

(4) Remove input/low range gear assembly from bearing with Tool Handle C-4171 and Tool 7829-A (Fig. 29).

(5) Remove low range gear snap-ring (Fig. 30).

(6) Remove input gear retainer, thrust washers, and input gear from low range gear (Fig. 31).

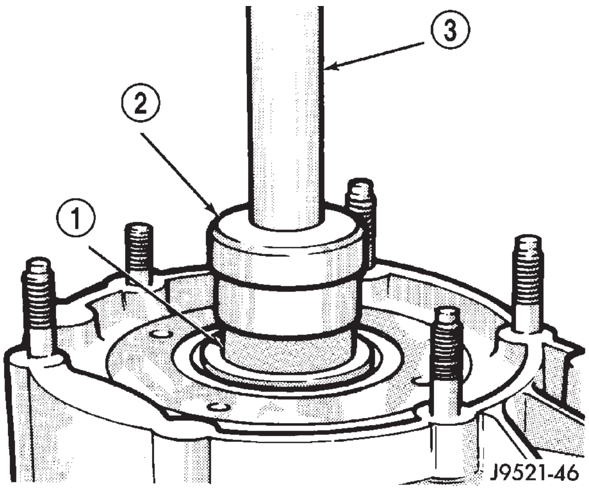


Fig. 29 Input And Low Range Gear Assembly Removal

1 - INPUT-LOW RANGE GEARS
2 - SPECIAL TOOL 7829-A
3 - SPECIAL TOOL C-4171

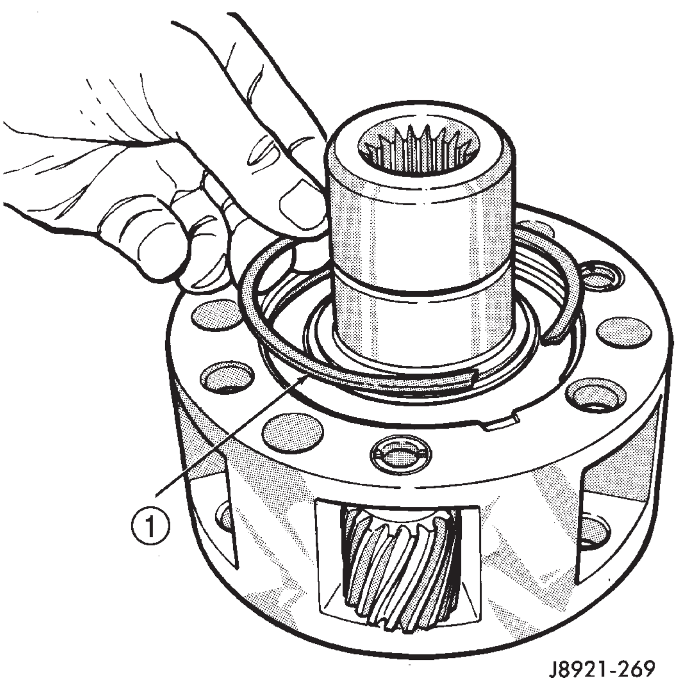


Fig. 30 Remove the Low Range Gear Snap-Ring

1 - LOW RANGE GEAR SNAP-RING

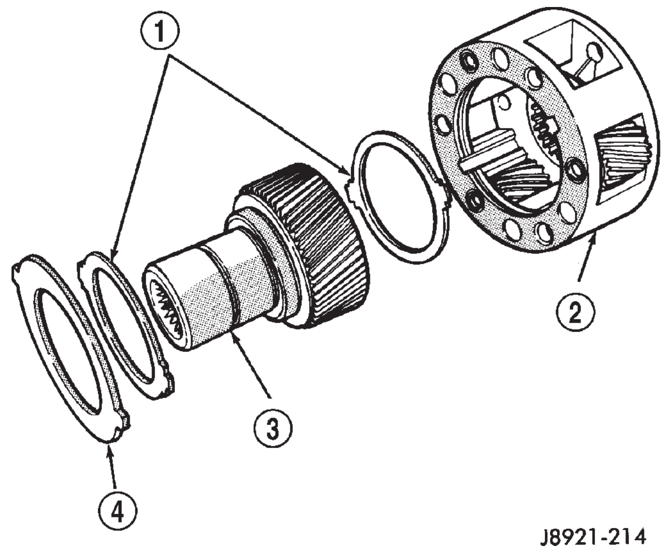


Fig. 31 Low Range And Input Gear Assembly

1 - THRUST WASHERS
2 - LOW RANGE GEAR
3 - INPUT GEAR
4 - RETAINER

(7) Inspect low range annulus gear (Fig. 32). **Gear is not a serviceable component. If damaged, replace gear and front case as an assembly.**

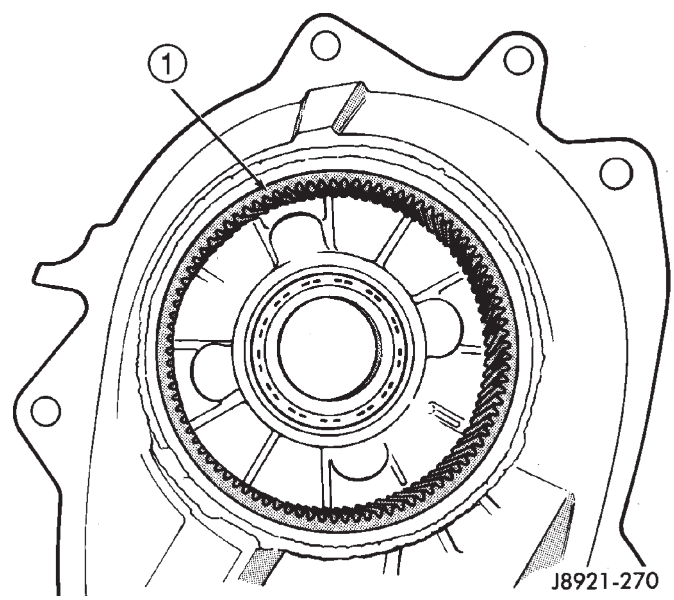


Fig. 32 Inspecting Low Range Annulus Gear

1 - LOW RANGE ANNULUS GEAR

TRANSFER CASE - NV244 (Continued)

(8) Remove oil seals from the following components:
- front bearing retainer.
- rear retainer.
- oil pump.
- case halves.

DIFFERENTIAL

(1) Mark differential case halves for reference.
(2) Remove differential case bolts.
(3) Invert differential on workbench.
(4) Separate top case from bottom case. Use slots in case halves to pry them apart (Fig. 33).
(5) Remove thrust washers and planet gears from case pins (Fig. 34).
(6) Remove mainshaft and sprocket gears from bottom case (Fig. 35). Note gear position for reference before separating them.

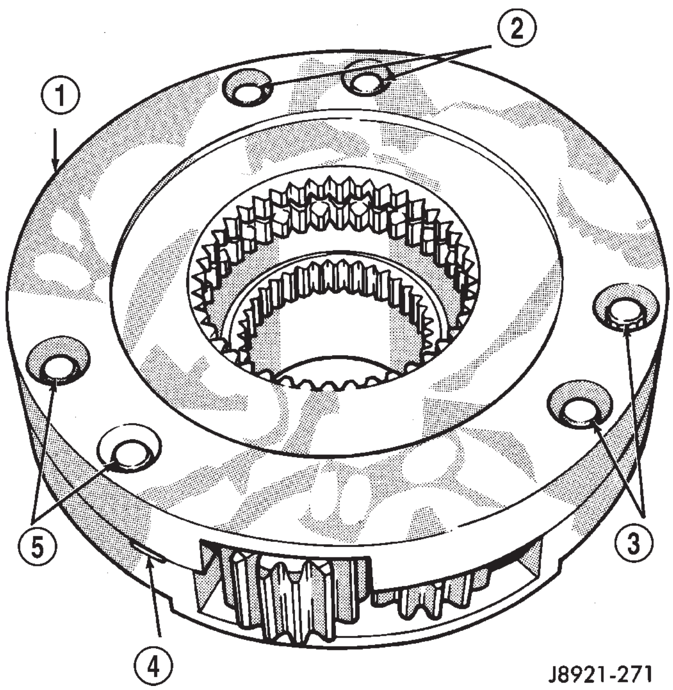


Fig. 33 Separating Differential Case Halves

1 - TOP CASE
2 - CASE BOLTS
3 - CASE BOLTS
4 - CASE SLOTS
5 - CASE BOLTS

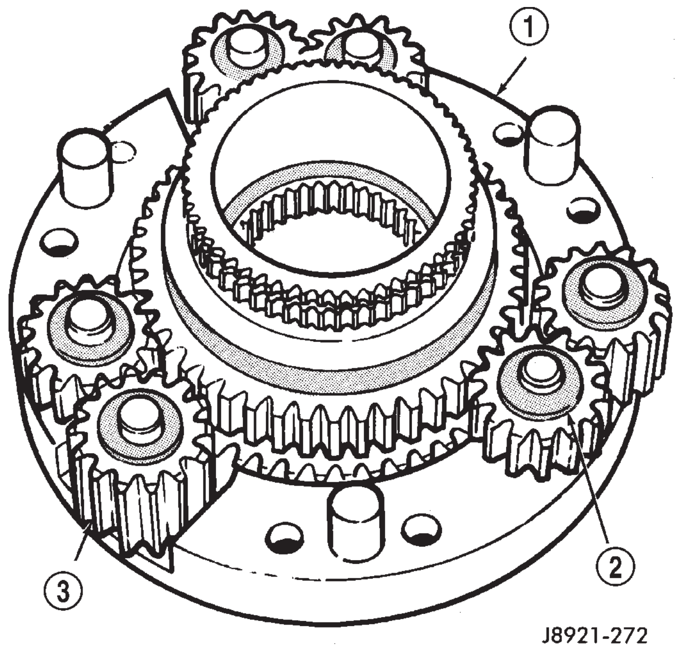


Fig. 34 Planet Gears And Thrust Washer Removal

1 - BOTTOM CASE
2 - THRUST WASHERS (12)
3 - PLANET GEARS (6)

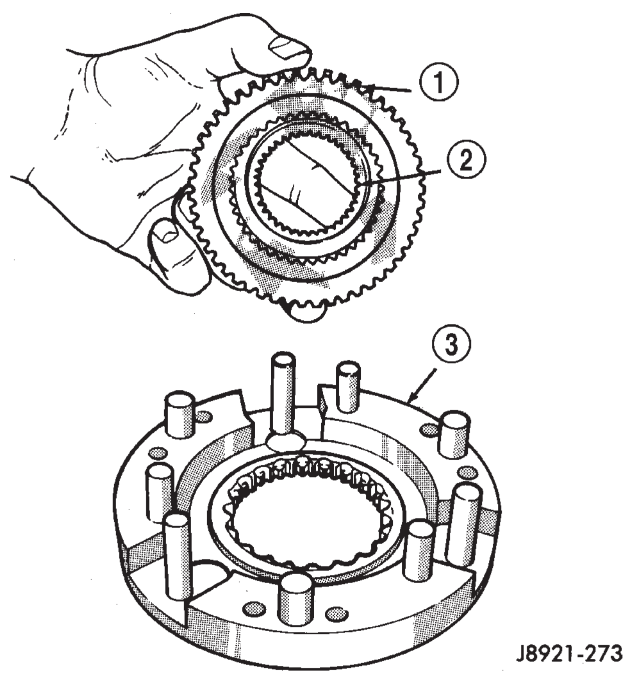


Fig. 35 Mainshaft And Sprocket Gear Removal

1 - MAINSHAFT GEAR
2 - SPROCKET GEAR
3 - BOTTOM CASE

TRANSFER CASE - NV244 (Continued)

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.

The oil pickup screen can be cleaned with solvent. Shake excess solvent from the screen after cleaning and allow it to air dry. Do not use compressed air.

INSPECTION

MAINSHAFT/SPROCKET/HUB INSPECTION

Inspect the splines on the hub and shaft and the teeth on the sprocket. Minor nicks and scratches can be smoothed with an oilstone. However, replace any part 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. 36). 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.

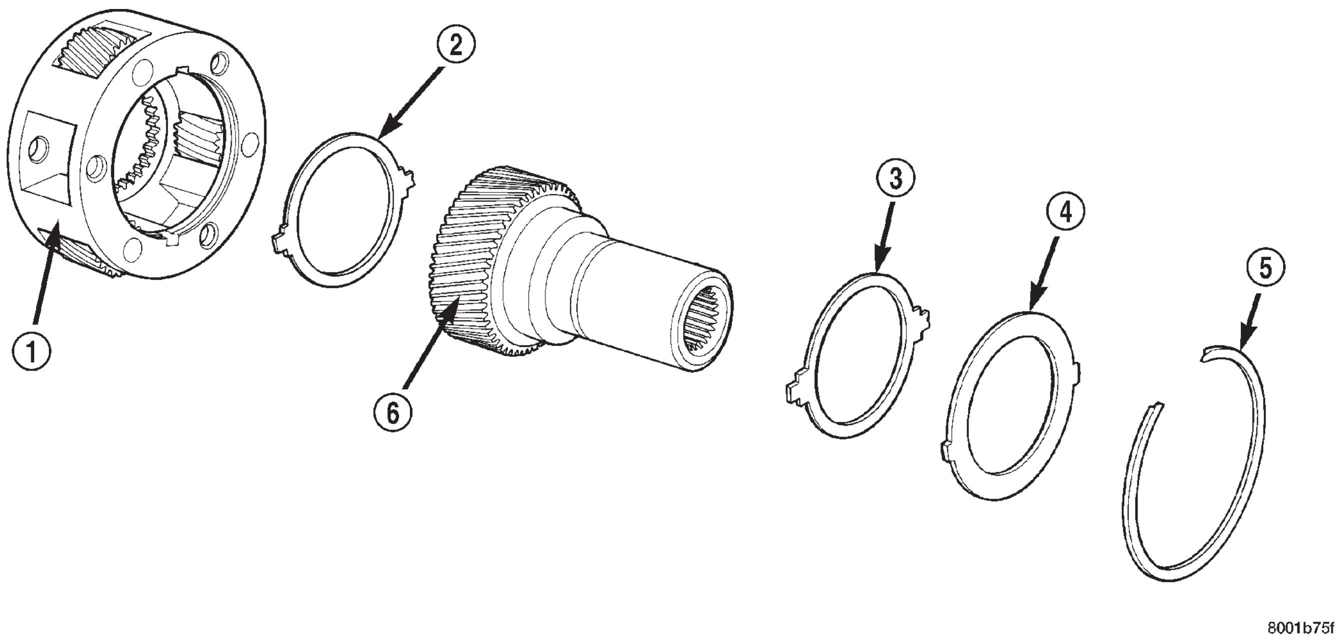


Fig. 36 Input Gear And Carrier Components

1 - PLANETARY CARRIER
2 - REAR THRUST WASHER
3 - FRONT THRUST WASHER
4 - CARRIER LOCK RING
5 - CARRIER LOCK RETAINING RING
6 - INPUT GEAR

TRANSFER CASE - NV244 (Continued)

SHIFT FORKS/HUBS/SLEEVES

Check condition of the shift forks and mode fork shift rail (Fig. 37). Minor nicks on the shift rail can be smoothed with 320-400 grit emery cloth.

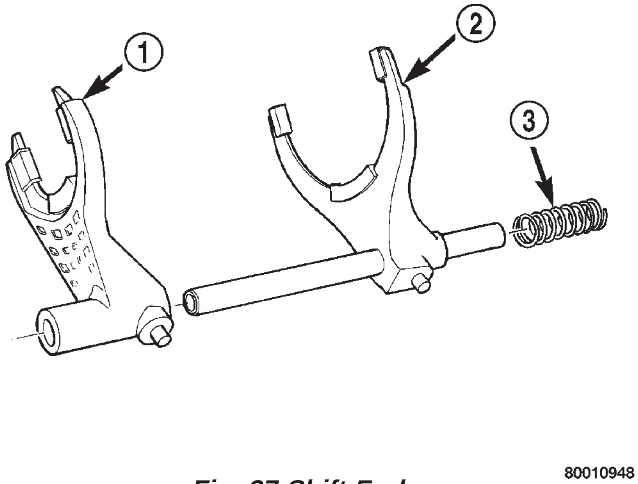


Fig. 37 Shift Forks

1 - RANGE FORK
2 - MODE FORK AND RAIL
3 - MODE SPRING

Inspect the shift fork wear pads (Fig. 38). The mode and range fork pads are serviceable and can be replaced if necessary.

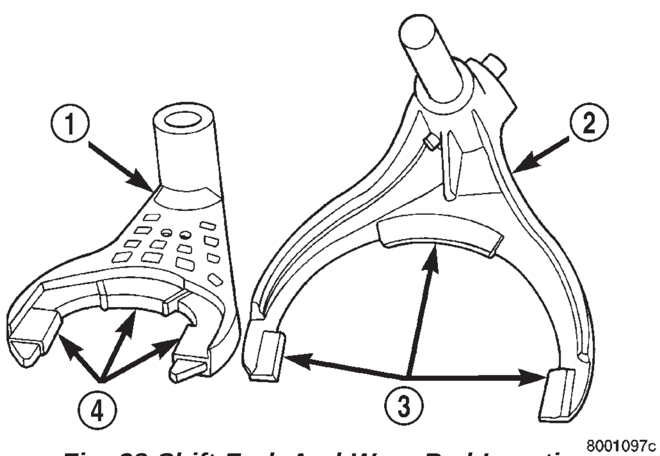


Fig. 38 Shift Fork And Wear Pad Locations

1 - RANGE FORK
2 - MODE FORK
3 - WEAR PADS (SERVICEABLE)
4 - WEAR PADS (SERVICEABLE)

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

REAR RETAINER AND EXTENSION HOUSING

Inspect the retainer components. 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.

Inspect the retaining rings and washers. Replace any part if distorted, bent, or broken. Reuse is not recommended.

Inspect the extension housing seal and bushing. Replace both components if either show any sign of wear or damage.

FRONT OUTPUT SHAFT/FLANGE/DRIVE CHAIN

Check condition of the seal contact surfaces on the companion flange slinger. This surface must be clean and smooth to ensure proper seal life. Replace the flange 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. 39)

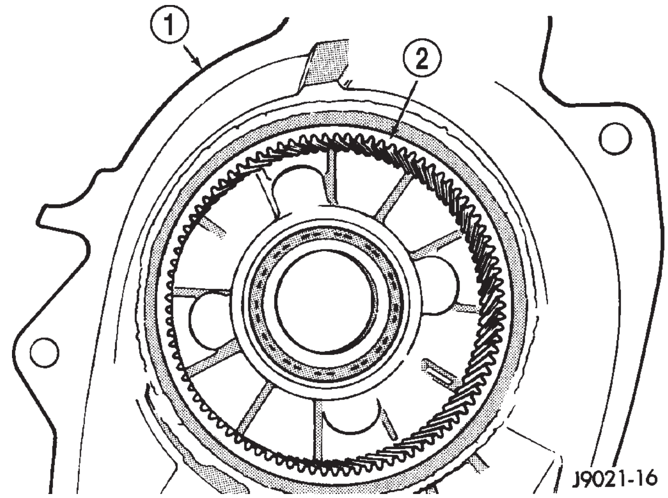


Fig. 39 Low Range Annulus Gear

1 - FRONT CASE
2 - LOW RANGE ANNULUS GEAR

TRANSFER CASE - NV244 (Continued)

FRONT/REAR CASES AND FRONT RETAINER

Inspect the cases and retainer for wear and damage. 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 automatic transmission fluid or petroleum jelly (where indicated) during assembly.

CAUTION: The bearing bores in various transfer case components contain oil feed holes. Make sure replacement bearings do not block the holes.

BEARINGS AND SEALS

(1) Remove snap-ring that retains front output shaft front bearing in case (Fig. 40). Then remove bearing. Use hammer handle, or hammer and brass punch to tap bearing out of case.

(2) Install new front output shaft front bearing with Tool Handle C-4171 and Installer 8033-A with the tapered cone upward (Fig. 41).

(3) Install front bearing snap-ring (Fig. 40).

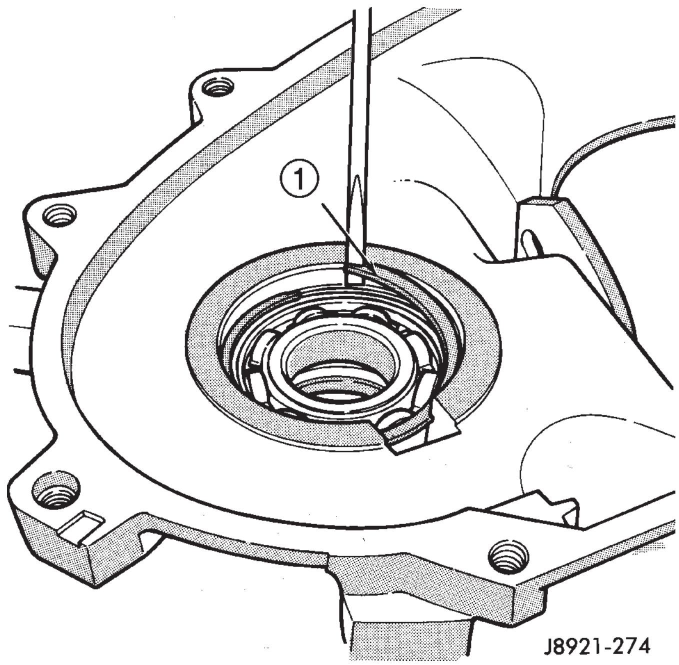


Fig. 40 Front Output Shaft Front Bearing Snap-Ring Removal

1 - FRONT BEARING SNAP-RING

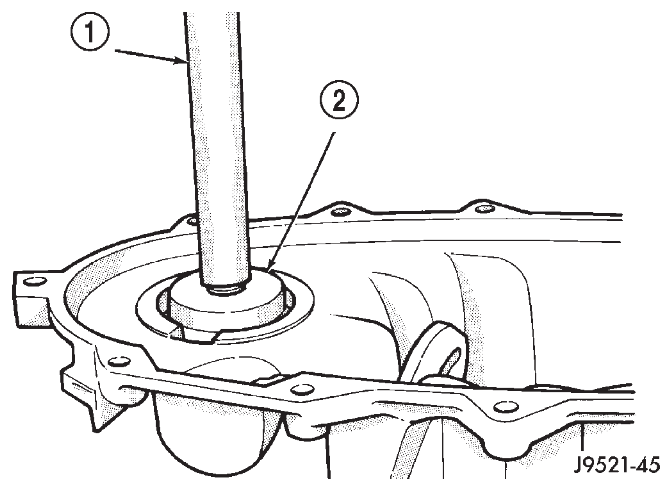


Fig. 41 Install the Front Output Shaft Front Bearing

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL 8033-A

TRANSFER CASE - NV244 (Continued)

(4) Install new front output shaft oil seal with Installer 6952-A (Fig. 42).

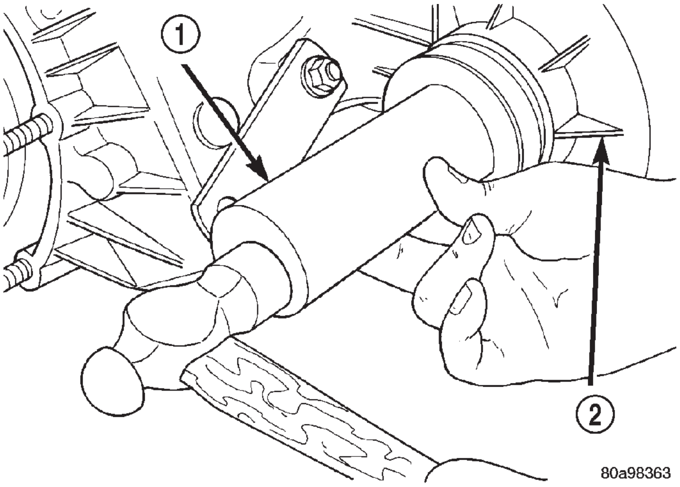


Fig. 42 Install Front Output Shaft Seal - Typical

1 - INSTALLER 6952-A
2 - TRANSFER CASE

(5) Remove input shaft bearing with Tool Handle C-4171 and Remover C-4210 (Fig. 43).

(6) Install snap-ring on new input shaft bearing.

(7) Install new input shaft bearing with Tool Handle C-4171 and Remover C-4210. Install bearing far enough to seat snap-ring against case (Fig. 44).

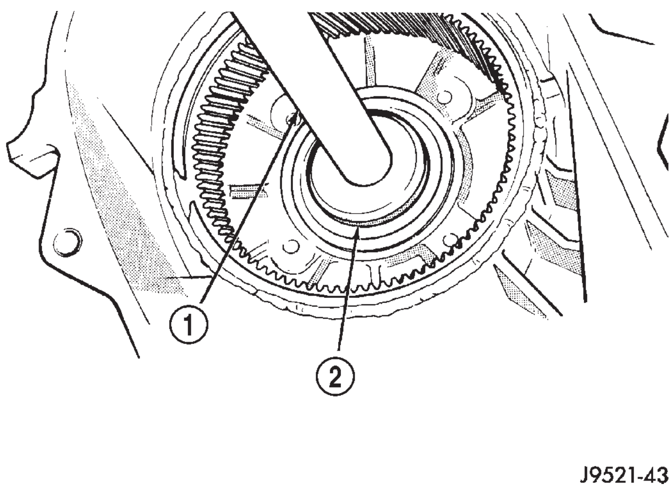


Fig. 43 Input Shaft Bearing Removal

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL C-4210

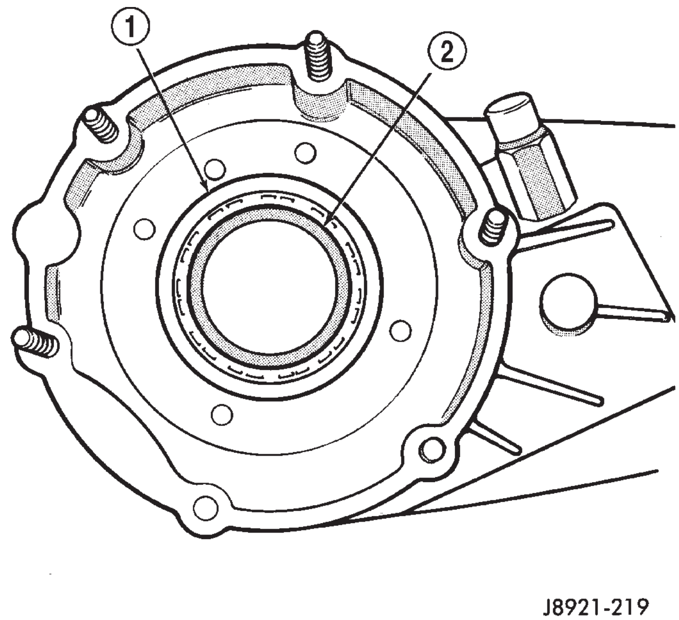


Fig. 44 Seating Input Shaft Bearing

1 - SNAP-RING
2 - INPUT SHAFT BEARING

(8) Remove the input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 45).

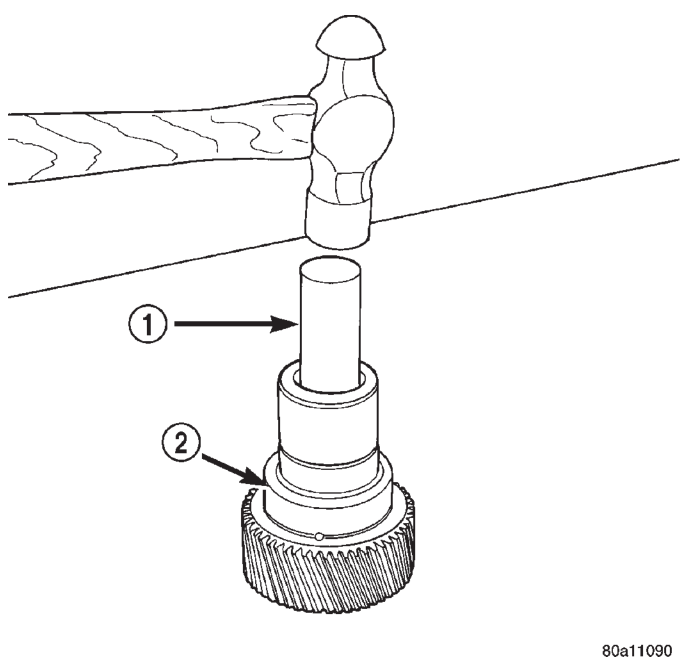


Fig. 45 Remove Input Gear Pilot Bearing

1 - DRIFT
2 - INPUT GEAR

TRANSFER CASE - NV244 (Continued)

(9) Install new pilot bearing with Installer 8128 and Handle C-4171 (Fig. 46).

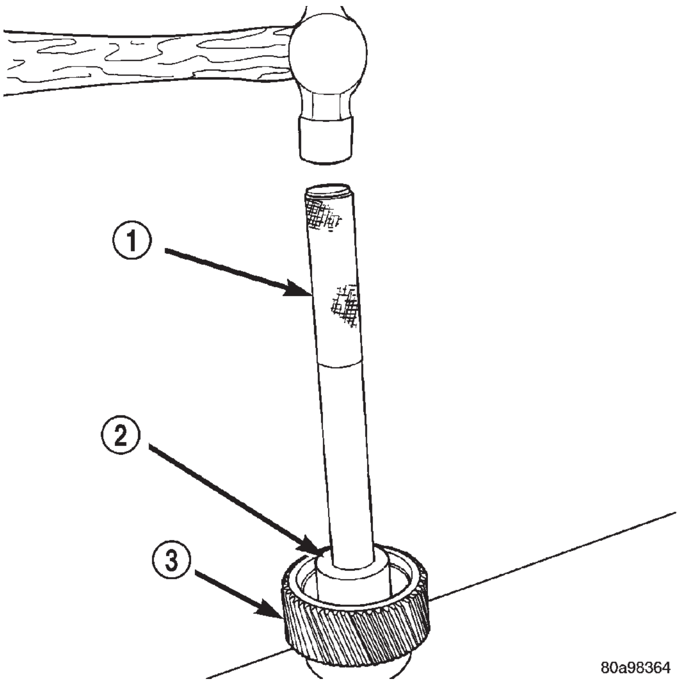


Fig. 46 Install Input Gear Pilot Bearing

1 - HANDLE C-4171
2 - INSTALLER 8128
3 - INPUT GEAR

(10) Install new seal in front bearing retainer with Installer 7884 (Fig. 47).

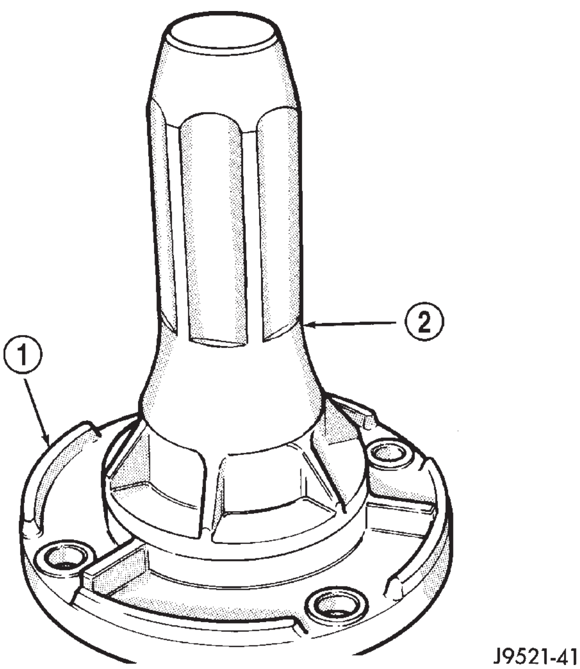


Fig. 47 Front Bearing Retainer Seal Installation

1 - FRONT BEARING RETAINER
2 - SPECIAL TOOL 7884

(11) Remove front output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 48).

(12) Install new bearing with Tool Handle C-4171 and Installer 5066 (Fig. 49). Lubricate bearing after installation.

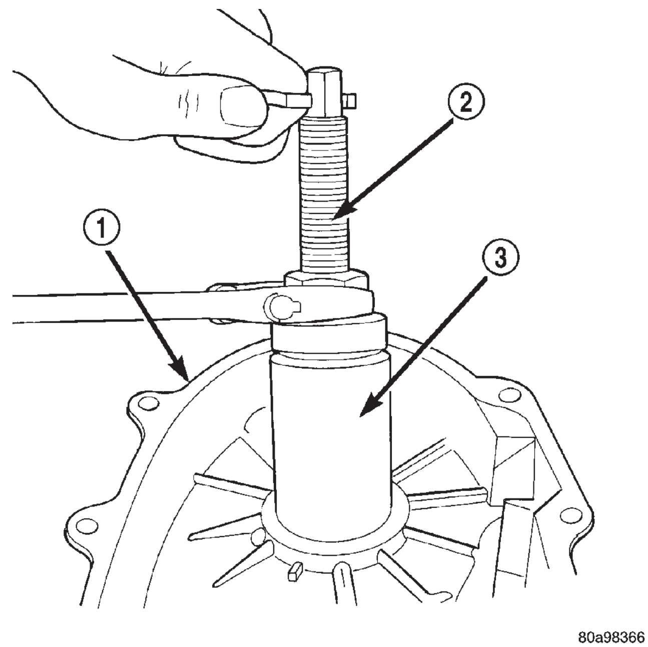


Fig. 48 Remove Front Output Shaft Rear Bearing

1 - REAR CASE
2 - SPECIAL TOOL L-4454-1 AND L-4454-3
3 - SPECIAL TOOL 8148

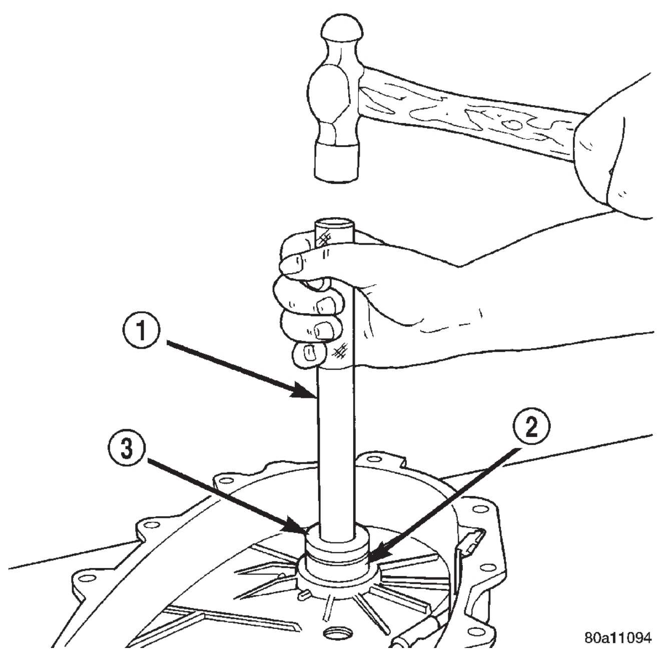


Fig. 49 Install Front Output Shaft Rear Bearing

1 - HANDLE C-4171
2 - OUTPUT SHAFT INNER BEARING
3 - INSTALLER 5066

TRANSFER CASE - NV244 (Continued)

(13) Install new seal in oil pump feed housing with Special Tool 7888 (Fig. 50).

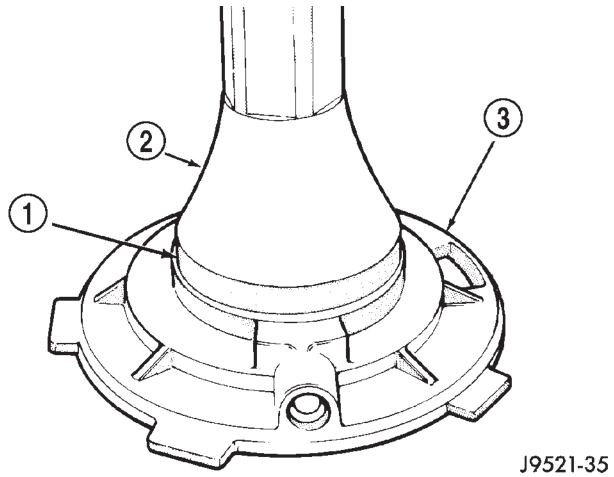


Fig. 50 Oil Pump Seal Installation

1 - HOUSING SEAL
2 - SPECIAL TOOL 7888
3 - OIL PUMP FEED HOUSING

(14) Install new pickup tube o-ring in oil pump (Fig. 51).

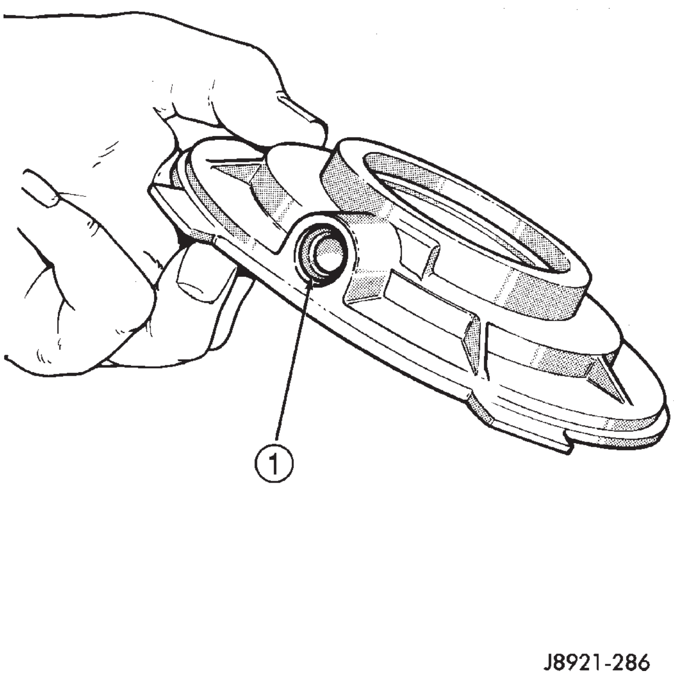


Fig. 51 Pickup Tube O-Ring Installation

1 - PICKUP TUBE O-RING

(15) Remove rear retainer bearing with Remover 5065 and Handle C-4171.

(16) Install rear bearing in retainer with Handle C-4171 and Installer 5064 (Fig. 52).

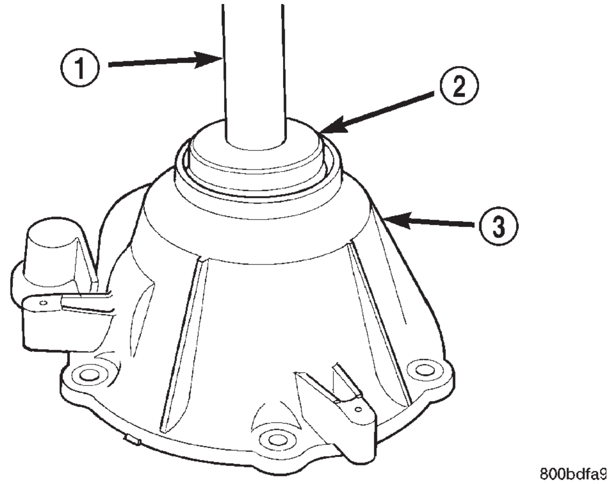


Fig. 52 Installing Rear Output Shaft Bearing In Retainer

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL 5064
3 - REAR RETAINER

DIFFERENTIAL

(1) Lubricate differential components with automatic transmission fluid.

(2) Install sprocket gear in differential bottom case (Fig. 53).

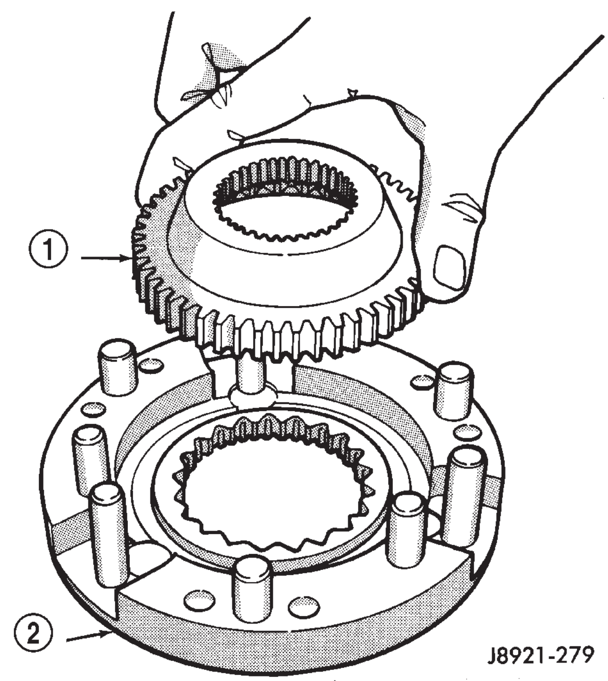


Fig. 53 Installing Differential Sprocket Gear

1 - SPROCKET GEAR
2 - BOTTOM CASE

TRANSFER CASE - NV244 (Continued)

(3) Install differential planet gears and new thrust washers (Fig. 54). **Be sure thrust washers are installed at top and bottom of each planet gear.**

(4) Install differential mainshaft gear (Fig. 54).

(5) Align and position differential top case on bottom case (Fig. 55). Align using scribe marks made at disassembly.

(6) While holding differential case halves together, invert the differential and start the differential case bolts.

(7) Tighten differential case bolts to specified torque.

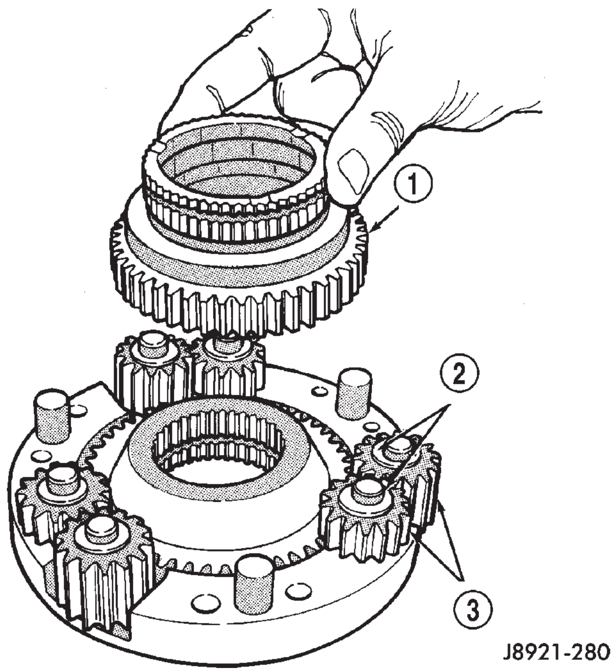


Fig. 54 Installing Mainshaft And Planet Gears

1 - MAINSHAFT GEAR
2 - THRUST WASHERS (12)
3 - PLANET GEARS (6)

INPUT GEAR/LOW RANGE

(1) Assemble low range gear, input gear thrust washers, input gear and input gear retainer (Fig. 56).

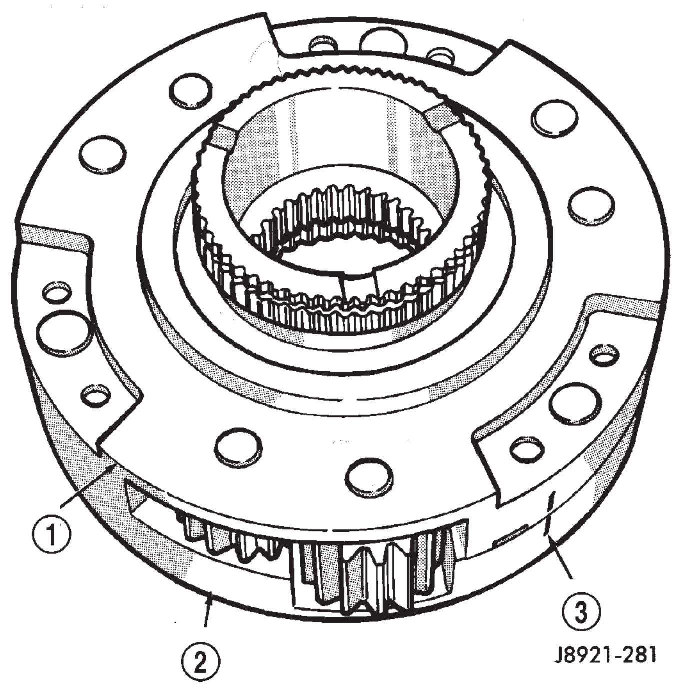


Fig. 55 Differential Case Assembly

1 - TOP CASE
2 - BOTTOM CASE
3 - CASE ALIGNMENT MARKS

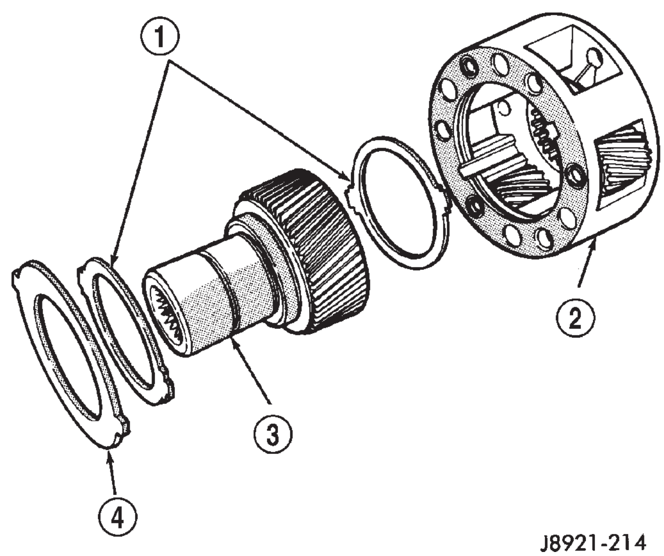


Fig. 56 Low Range And Input Gear Assembly

1 - THRUST WASHERS
2 - LOW RANGE GEAR
3 - INPUT GEAR
4 - RETAINER

TRANSFER CASE - NV244 (Continued)

(2) Install low range gear snap-ring (Fig. 57).

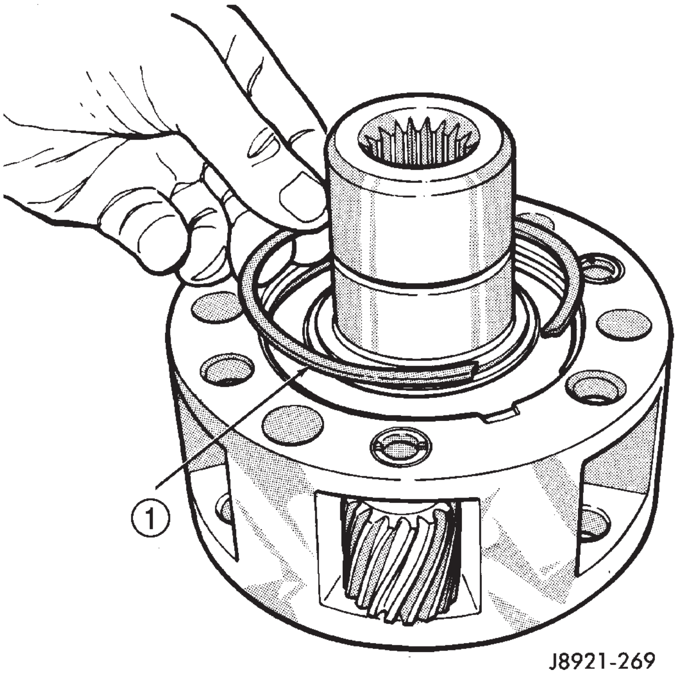


Fig. 57 Install the Low Range Gear Snap-Ring

1 - LOW RANGE GEAR SNAP-RING

(3) Lubricate input gear and low range gears with automatic transmission fluid.

(4) Start input gear shaft into front case bearing.

(5) Press input gear shaft into front bearing.

(6) Install new input gear snap-ring (Fig. 58).

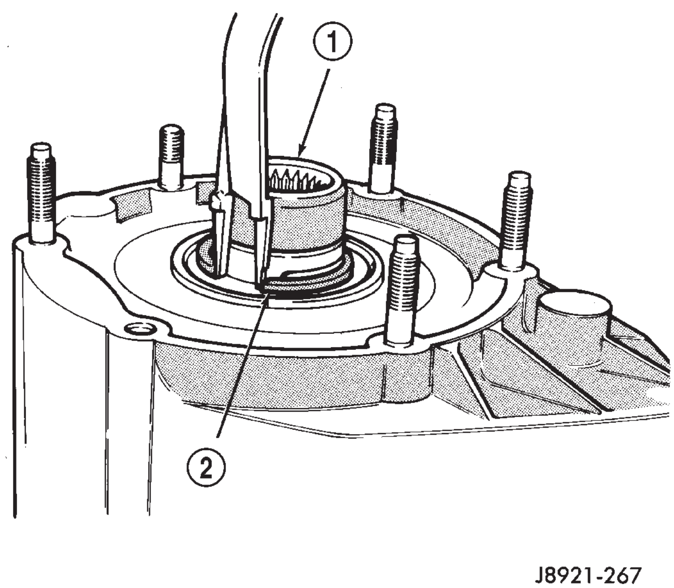


Fig. 58 Install the Input Gear Snap-Ring

1 - INPUT GEAR
2 - SNAP-RING

(7) Apply 3 mm (1/8 in.) wide bead of Mopar® Gasket Maker, or equivalent silicone adhesive sealer, to seal surface of front bearing retainer.

(8) Install front bearing retainer (Fig. 59). Tighten retainer bolts to 16-25 N·m (12-18 ft. lbs.) torque.

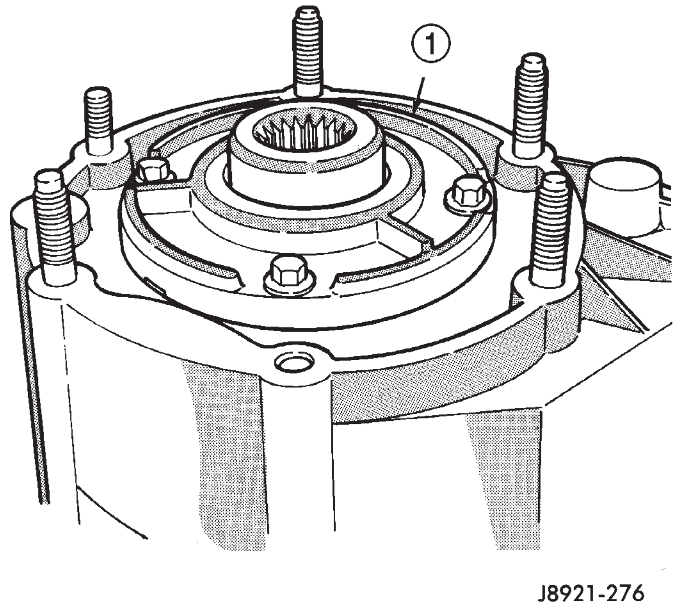


Fig. 59 Installing Front Bearing Retainer

1 - FRONT BEARING RETAINER

SHIFT FORKS AND MAINSHAFT

(1) Install new sector shaft o-ring (Fig. 60).

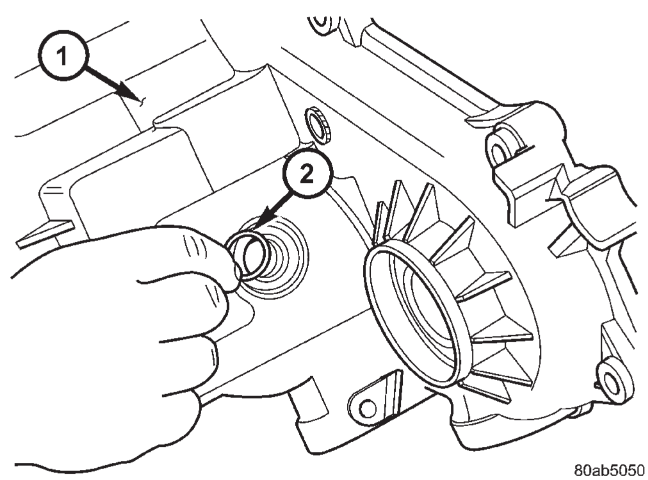


Fig. 60 Install the Shift Sector O-ring

1 - TRANSFER CASE FRONT HOUSING
2 - SHIFT SECTOR O-RING

TRANSFER CASE - NV244 (Continued)

(2) Install shift sector.

(3) Install new pads on low range fork, if necessary, (Fig. 61).

(4) Assemble low range fork and hub (Fig. 61).

(5) Position low range fork and hub in case. Be sure low range fork pin is engaged in shift sector slot (Fig. 62).

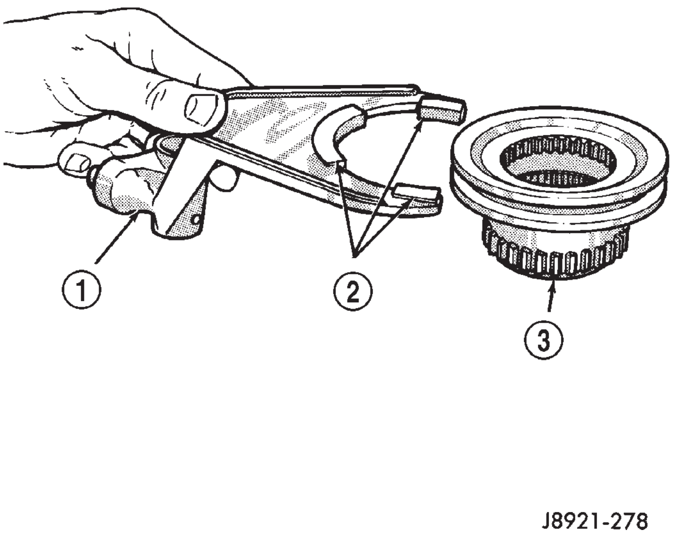


Fig. 61 Assembling Low Range Fork And Hub

1 - LOW RANGE FORK
2 - PADS
3 - HUB

(6) Install first mainshaft bearing spacer on mainshaft (Fig. 63).

(7) Install bearing rollers on mainshaft (Fig. 63). **Coat bearing rollers with generous quantity of petroleum jelly to hold them in place.**

(8) Install remaining bearing spacer on mainshaft (Fig. 63). Do not displace any bearings while installing spacer.

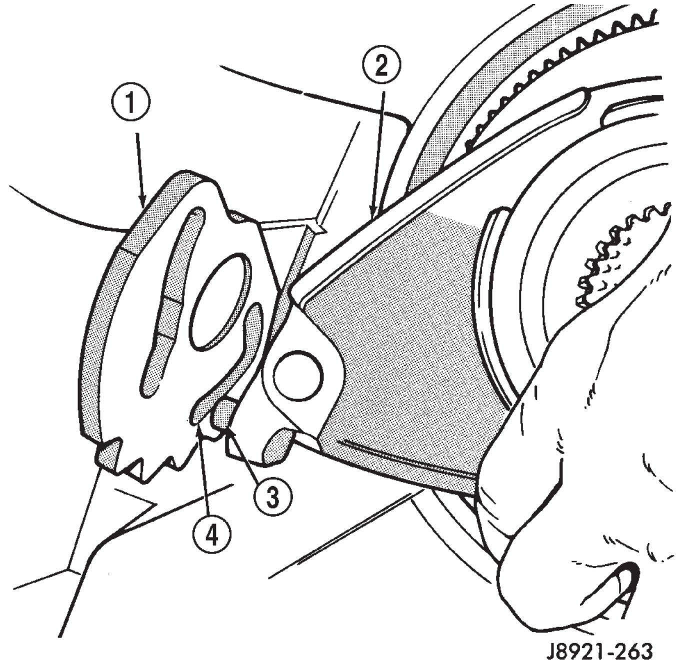


Fig. 62 Positioning Low Range Fork

1 - SHIFT SECTOR
2 - LOW RANGE FORK
3 - PIN
4 - SLOT

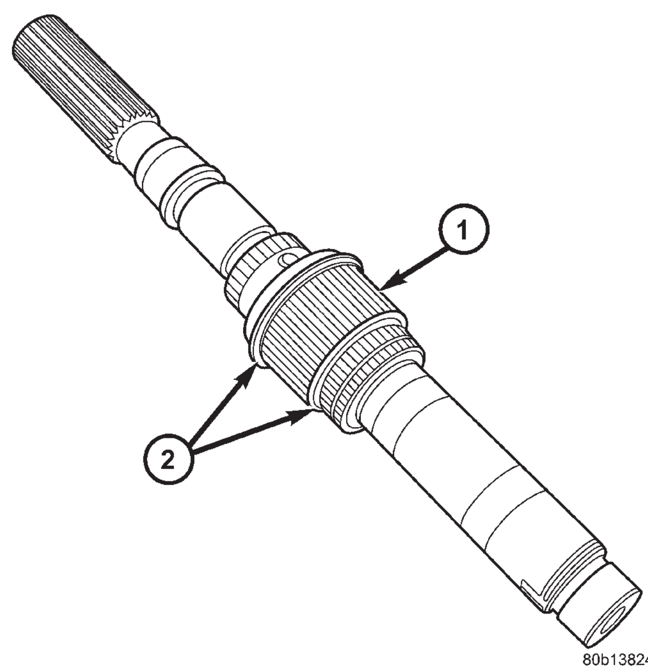


Fig. 63 Installing Mainshaft Bearing Rollers and Spacers

1 - MAINSHAFT BEARING ROLLERS
2 - BEARING SPACERS

TRANSFER CASE - NV244 (Continued)

(9) Install differential (Fig. 64). **Do not displace mainshaft bearings when installing differential.**

(10) Install differential snap-ring (Fig. 65).

(11) Install intermediate clutch shaft (Fig. 66).

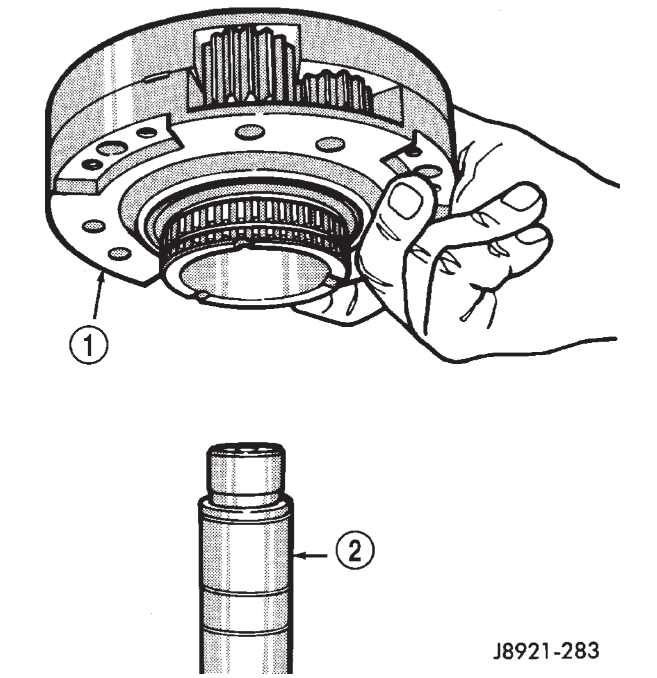


Fig. 64 Differential Installation

1 - DIFFERENTIAL
2 - MAINSHAFT

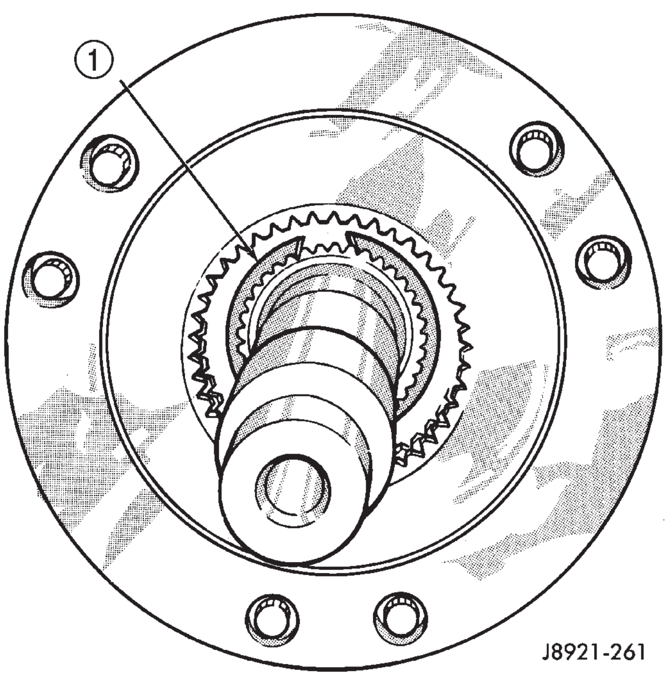


Fig. 65 Installing Differential Snap-Ring

1 - DIFFERENTIAL SNAP-RING

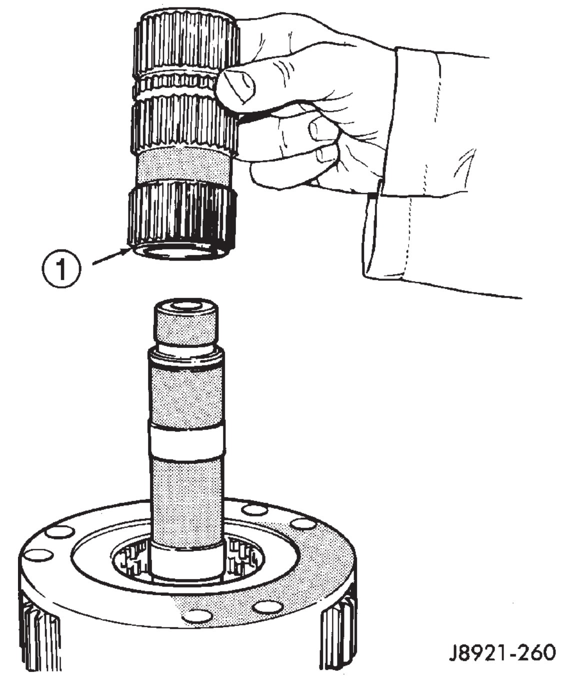


Fig. 66 Installing Intermediate Clutch Shaft

1 - INTERMEDIATE CLUTCH SHAFT

(12) Install clutch shaft thrust ring (Fig. 67).

Fig. 67 Installing Clutch Shaft Thrust Ring

1 - CLUTCH SHAFT THRUST RING

TRANSFER CASE - NV244 (Continued)

(13) Install clutch shaft snap-ring (Fig. 68).

(14) Inspect mode fork assembly (Fig. 69). Replace pads and bushing if necessary. Replace fork tube if bushings inside tube are worn or damaged. Also check springs and slider bracket (Fig. 69). Replace worn or damaged components.

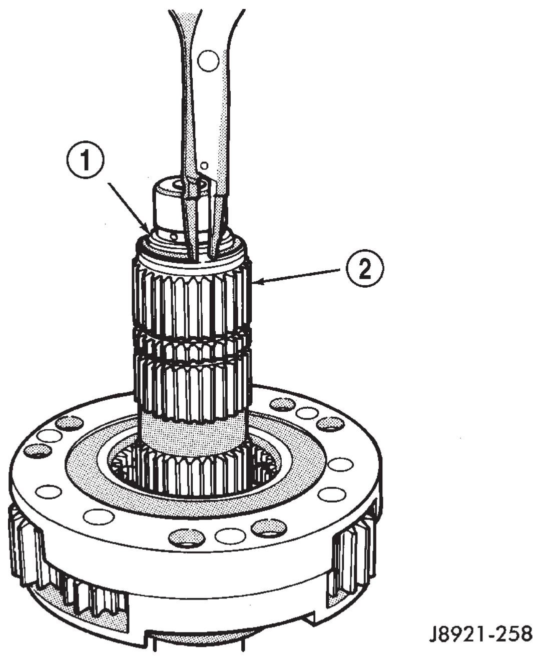


Fig. 68 Installing Clutch Shaft Snap-Ring

1 - SNAP-RING
2 - INTERMEDIATE CLUTCH SHAFT

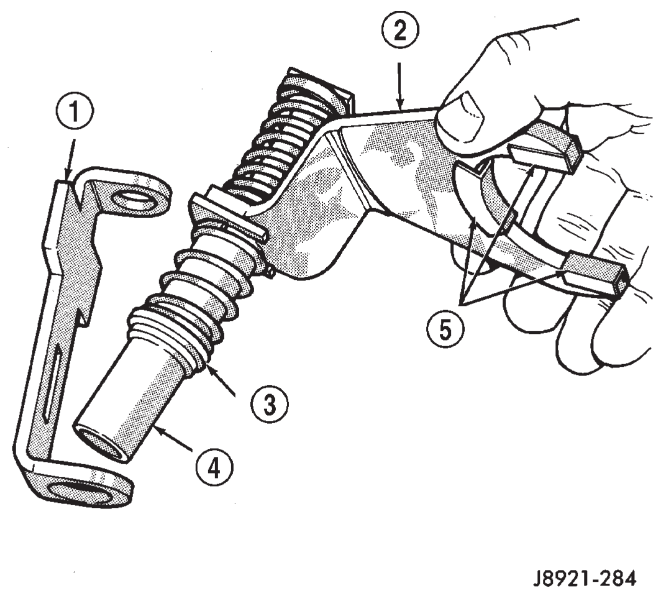


Fig. 69 Mode Fork Assembly Inspection

1 - SLIDER
2 - MODE FORK
3 - BUSHING/SPRING
4 - TUBE
5 - PADS

(15) Install mode sleeve in mode fork (Fig. 70). Then install assembled sleeve and fork on mainshaft. Be sure mode sleeve splines are engaged in differential splines.

(16) Install mode fork and mainshaft assembly in case (Fig. 71). Rotate mainshaft slightly to engage shaft with low range gears.

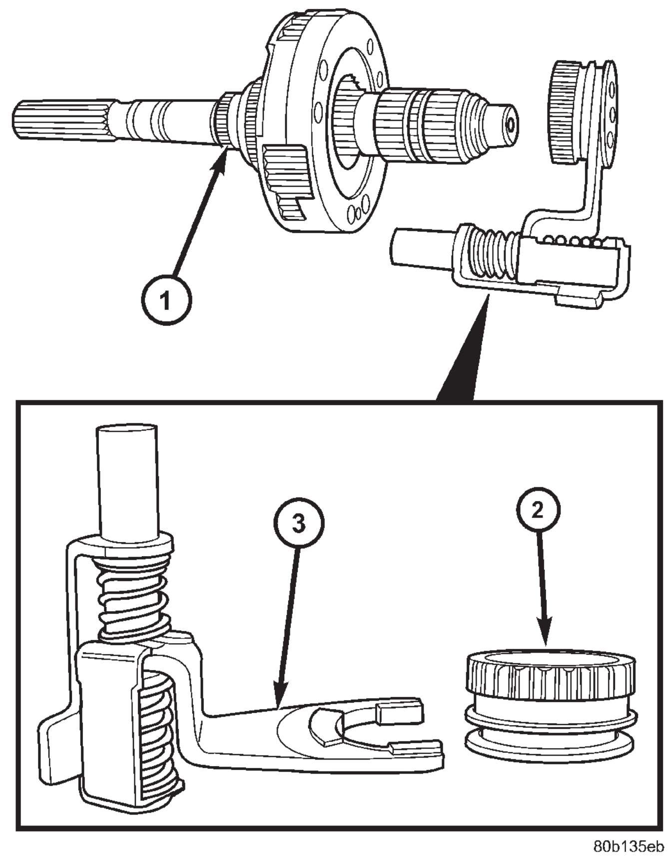


Fig. 70 Installing Mode Fork And Sleeve

1 - MAINSHAFT
2 - SLEEVE
3 - MODE FORK ASSEMBLY

TRANSFER CASE - NV244 (Continued)

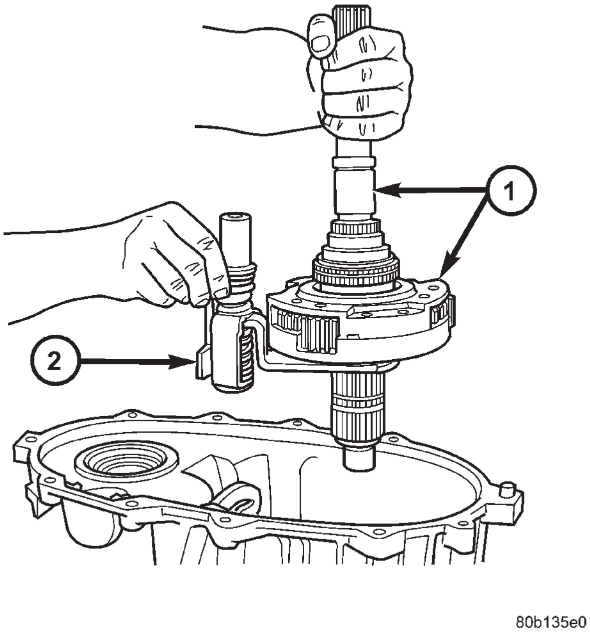


Fig. 71 Assembled Mainshaft And Mode Fork Installation

1 - MAINSHAFT ASSEMBLY
2 - MODE FORK

(17) Rotate mode fork pin into shift sector slot.

(18) Install shift rail (Fig. 72). **Be sure rail is seated in both shift forks.**

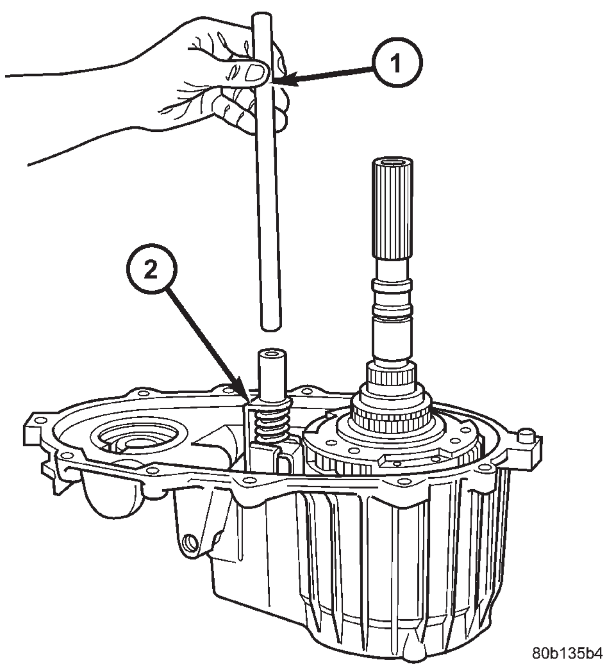


Fig. 72 Shift Rail Installation

1 - SHIFT RAIL
2 - MODE FORK

(19) Install detent plunger, detent spring, and detent plug in case (Fig. 73).

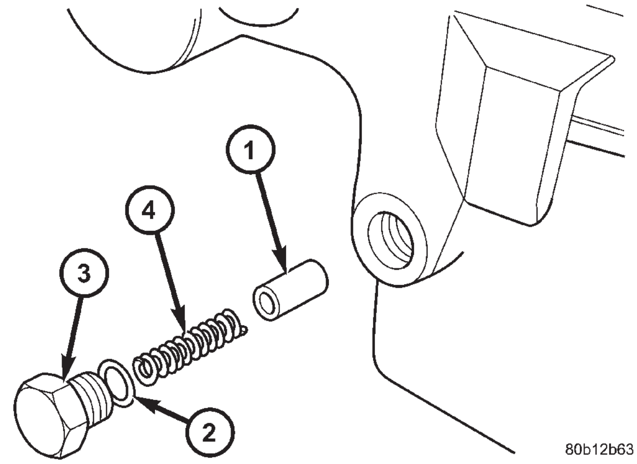


Fig. 73 Detent Pin, Spring And Plug Installation

1 - PLUNGER
2 - O-RING
3 - PLUG
4 - SPRING

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(1) Install front output shaft (Fig. 74).

(2) Install drive chain (Fig. 74). Engage chain with front output shaft sprocket teeth.

(3) Install drive sprocket (Fig. 74). Engage drive sprocket teeth with chain. Then engage sprocket splines with mainshaft splines.

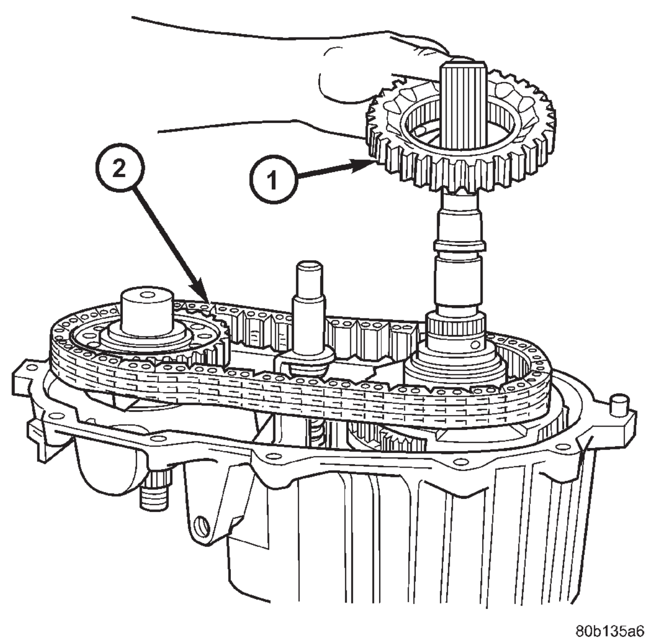


Fig. 74 Drive Chain And Sprocket Installation

1 - FRONT OUTPUT SHAFT
2 - DRIVE CHAIN
3 - DRIVE SPROCKET

TRANSFER CASE - NV244 (Continued)

(4) Install drive sprocket snap-ring (Fig. 75).

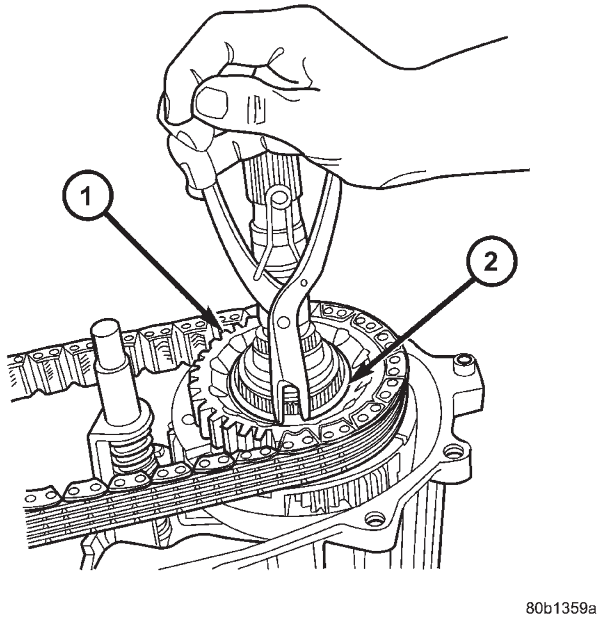


Fig. 75 Drive Sprocket Snap-Ring Installation

1 - DRIVE SPROCKET
2 - DRIVE SPROCKET SNAP-RING

OIL PUMP AND REAR CASE

(1) Insert oil pickup tube in oil pump and attach oil screen and connector hose to pickup tube. Then install assembled pump, tube and screen in rear case (Fig. 76). Be sure screen is seated in case slot as shown.

(2) Clean the transfer case magnet.

(3) Install magnet in front case pocket (Fig. 77).

(4) Apply 3 mm (1/8 in.) wide bead of Mopar® Gasket Maker, or equivalent silicone adhesive sealer, to seal surface of front case.

(5) Align and install rear case on front case. Be sure case locating dowels are in place and that mainshaft splines are engaged in oil pump inner gear.

(6) Install and tighten front case to rear case bolts to 27-34 N·m (20-25 ft. lbs.) torque. **Be sure to install a washer under each bolt used at case dowel locations.**

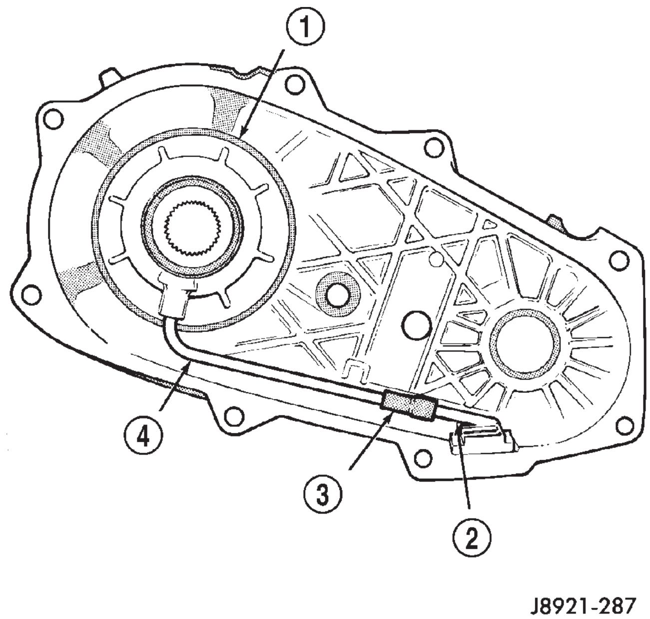


Fig. 76 Oil Screen And Pickup Tube Installation

1 - OIL PUMP
2 - OIL SCREEN
3 - CONNECTOR
4 - PICKUP TUBE

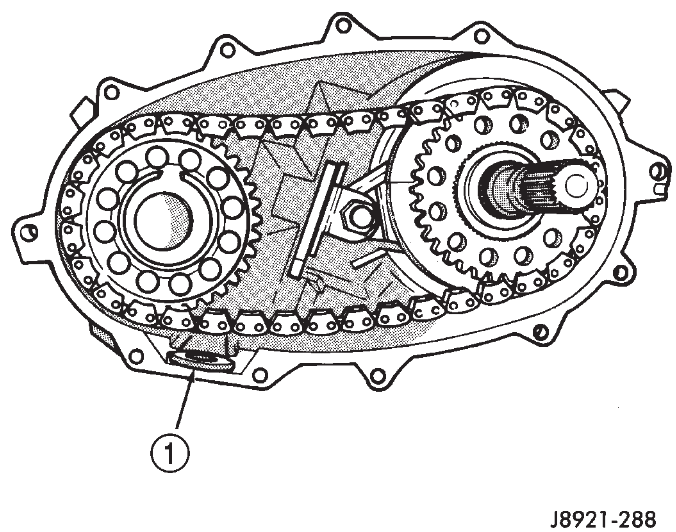


Fig. 77 Installing Case Magnet

1 - MAGNET

REAR RETAINER

(1) Install rear bearing O.D. retaining ring with snap-ring pliers (Fig. 78). Be sure retaining ring is fully seated in retainer groove.

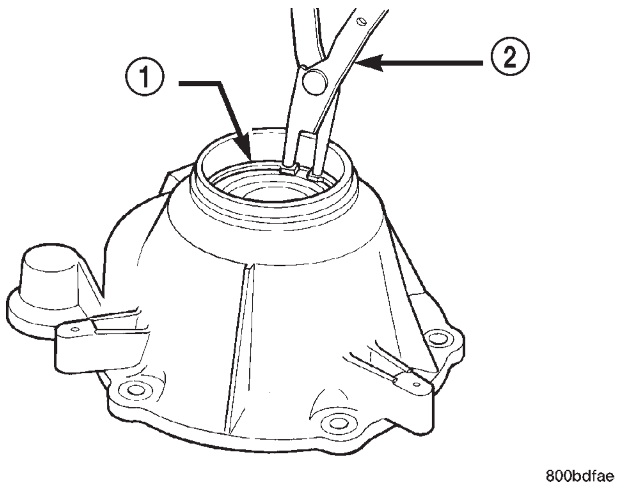


Fig. 78 Rear Bearing Retaining Ring Installation

1 - REAR BEARING O.D. RETAINING RING
2 - SNAP-RING PLIERS

(2) Apply bead of Mopar® Sealer, or Loctite™ Ultra Gray, to mating surface of rear retainer. Sealer bead should be a maximum of 3/16 in.

(3) Install rear retainer on rear case. Tighten retainer bolts to 27-34 N·m (20-25 ft. lbs.) torque.

(4) Install new output shaft bearing snap-ring (Fig. 79). Lift mainshaft slightly to seat snap-ring in shaft groove, if necessary.

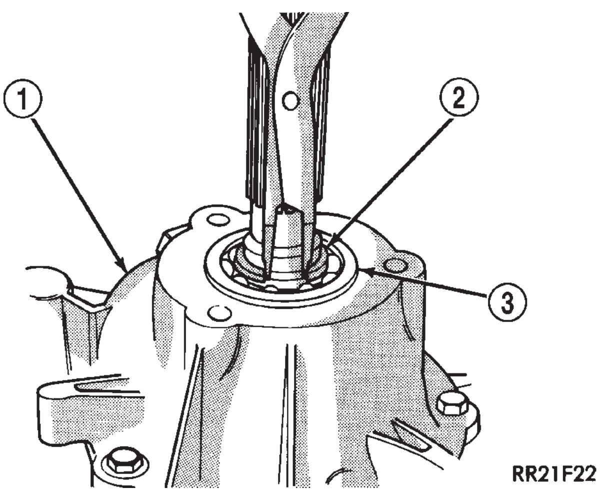


Fig. 79 Install Output Bearing Snap-Ring

1 - REAR RETAINER
2 - SNAP-RING
3 - REAR BEARING

(5) Apply 3 mm (1/8 in.) wide bead of Mopar® Gasket Maker, or equivalent silicone adhesive sealer, to mounting surface of extension housing. Allow sealer to set-up slightly before proceeding.

(6) Install extension housing on rear retainer.

(7) Install extension housing bolts and tighten to 27-34 N·m (20-25 ft. lbs.).

COMPANION FLANGE AND SHIFT MOTOR AND MODE SENSOR ASSEMBLY

(1) Position the shift motor and mode sensor assembly onto the transfer case.

(2) Install the bolts (Fig. 80) to hold the shift motor and mode sensor assembly to the transfer case. Tighten the bolts to 16-24 N·m (12-18 ft. lbs.) torque.

CAUTION: If the original shift motor and mode sensor assembly bolts are reused, be sure to use Mopar® Lock & Seal or Loctite™ 242 to replenish the lock patch material originally found on the bolts

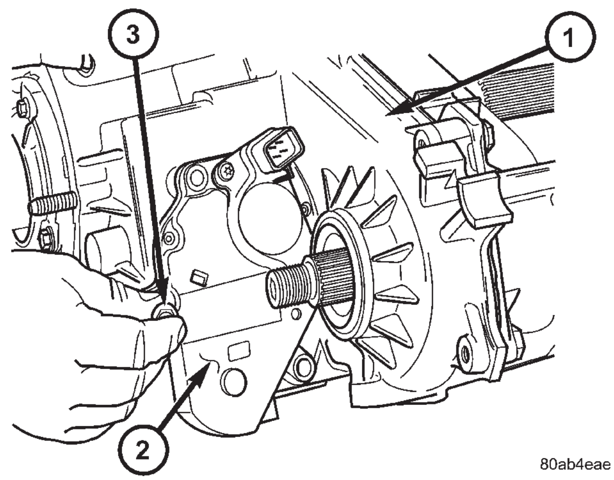


Fig. 80 Install the Shift Motor and Mode Sensor Assembly Bolts

1 - TRANSFER CASE
2 - SHIFT MOTOR AND MODE SENSOR ASSEMBLY
3 - BOLT

TRANSFER CASE - NV244 (Continued)

(3) Install new seal washer onto the front output shaft (Fig. 81).

(4) Lubricate the companion flange hub with transmission fluid and install the flange onto the front output shaft.

(5) Install a new companion flange nut onto the front output shaft.

(6) Tighten the flange nut to 122-176 N·m (90-130 ft. lbs.) torque. Use Tool 6958, or similar tool to hold flange while tightening nut.

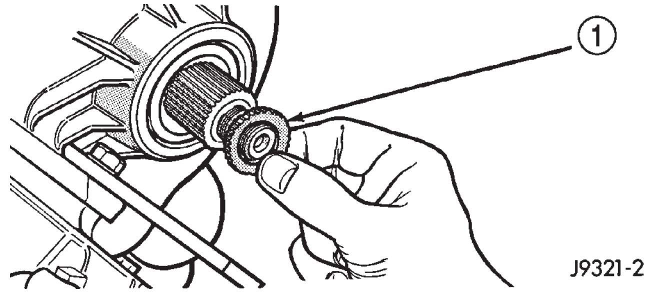


Fig. 81 Yoke Seal Washer Installation

1 - YOKE SEAL WASHER

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 onto the transmission.

(5) Install and tighten transfer case attaching nuts to 27-34 N·m (20-25 ft. lbs.) torque.

(6) Connect the vent hose.

(7) Connect the shift motor and mode sensor wiring connectors. Secure wire harness to clips on transfer case.

(8) Align and connect the propeller shafts.

(9) Fill transfer case with correct fluid. (Refer to 21 - TRANSMISSION/TRANSAXLE/TRANSFER CASE/FLUID - STANDARD PROCEDURE)

(10) Install rear crossmember and skid plate, if equipped. Tighten crossmember bolts to 41 N·m (30 ft. lbs.) torque.

(11) Remove transmission jack and support stand.

(12) Lower vehicle and verify transfer case shift operation.

SPECIFICATIONS

SPECIFICATIONS - TRANSFER CASE - NV244

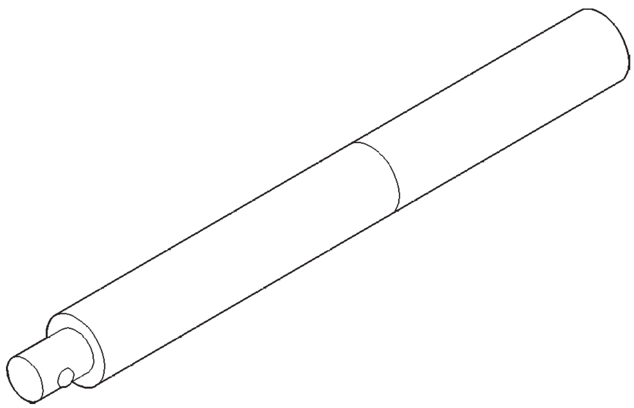
TORQUE SPECIFICATIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Plug, Detent	16-24	12-18	-
Bolt, Differential Case	17-27	15-24	-
Plug, Drain/Fill	20-34	15-25	-
Bolt, Front Brg. Retainer	16-25	12-18	-
Bolt, Case Half	27-34	20-25	-
Nut, Companion Flange	122-176	90-130	-
Bolt, Shift Motor and Mode Sensor Assembly	16-25	12-18	-
Bolt, Rear Retainer	27-34	20-25	-
Bolt, Extension Housing	27-34	20-25	-
Nut, Mounting	27-34	20-25	-

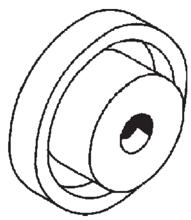
TRANSFER CASE - NV244 (Continued)

SPECIAL TOOLS

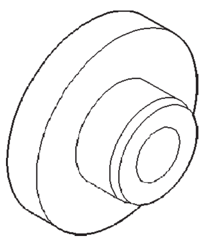
TRANSFER CASE - NV244



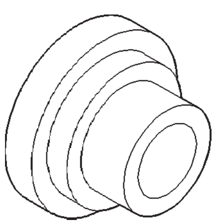
Handle, Universal - C-4171



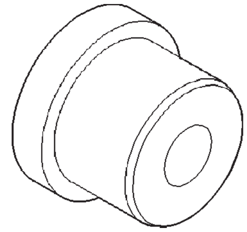
Remover, Bearing - C-4210



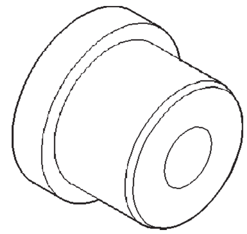
Installer, Bearing - 5064



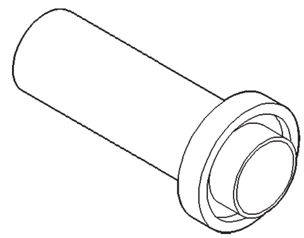
Installer, Bearing - 8128



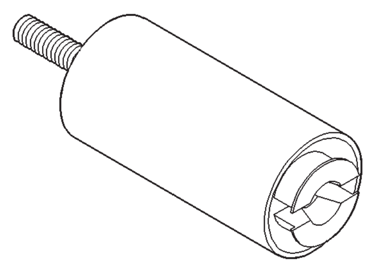
Installer, Bearing - 5066



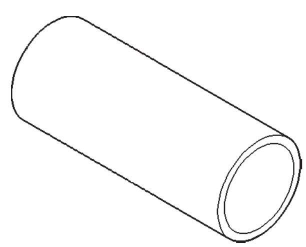
Installer, Bearing - 5066



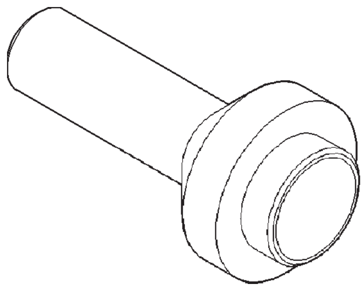
Installer, Seal - 6952-A



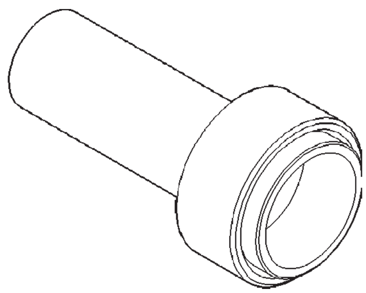
Remover, Bearing - L-4454



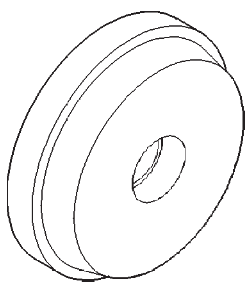
Cup - 8148



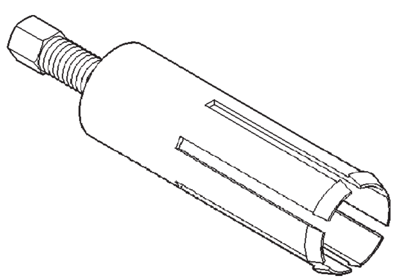
Installer, Seal - 7884



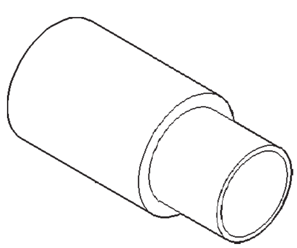
Installer, Pump Housing Seal - 7888



Installer, Bearing - 8033-A



Remover, Bushing - 8158



Installer, Bushing - 8157

FLUID

STANDARD PROCEDURE - FLUID DRAIN AND REFILL

The fill and drain plugs are both in the rear case (Fig. 82).

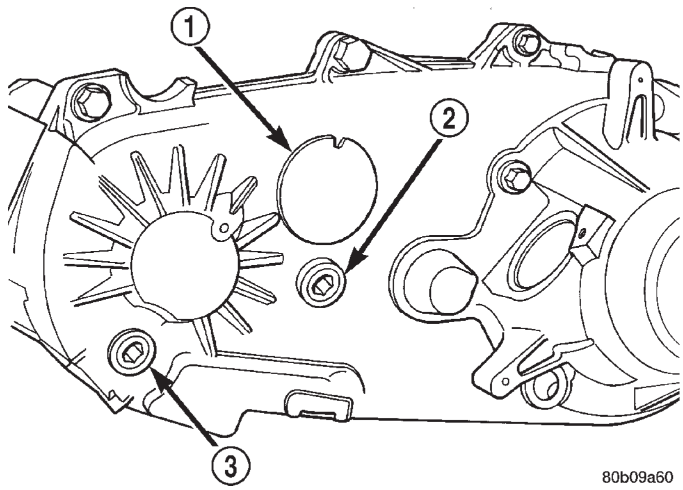


Fig. 82 Fill/Drain Plug and I.D. Tag Location - Typical

1 - I.D. TAG
2 - FILL PLUG
3 - DRAIN PLUG

(1) Raise vehicle.
(2) Position drain pan under transfer case.
(3) Remove drain and fill plugs and drain lubricant completely.
(4) Install drain plug. Tighten plug to 41-54 N·m (30-40 ft. lbs.).
(5) Remove drain pan.
(6) Fill transfer case to bottom edge of fill plug opening with Mopar® ATF +4, type 9602, Automatic Transmission fluid.
(7) Install and tighten fill plug to 41-54 N·m (30-40 ft. lbs.).
(8) Lower vehicle.

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 companion flange.

(4) Remove seal from front case with suitable pry tool (Fig. 83).

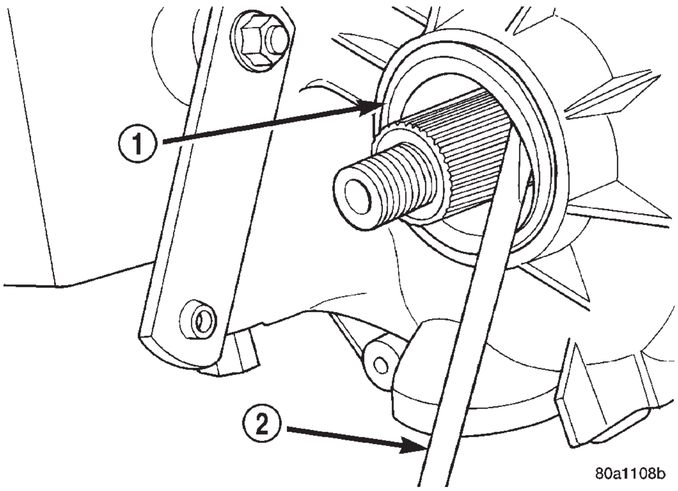


Fig. 83 Remove Front Output Shaft Seal - Typical

1 - OUTPUT SHAFT SEAL
2 - PRY TOOL

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. 84). Once seal is started, continue tapping seal into bore until installer tool seats against case.

(2) Install the front output shaft companion flange. Tighten the flange nut to 122-176 N·m (90-130 ft.lbs.).

(3) Install the front propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

MODE SENSOR

DESCRIPTION

The transfer case mode sensor (Fig. 85) is an electronic device whose output can be interpreted to indicate the shift motor shaft's rotary position. The sensor consists of a magnetic ring and four Hall Effect Transistors to create a 4 channel digital device

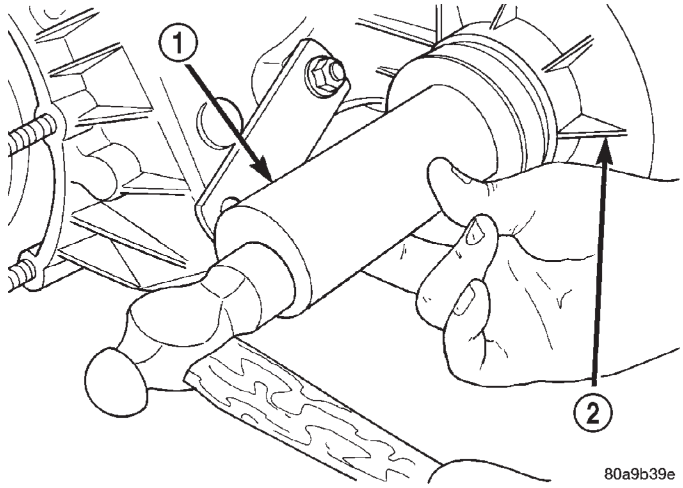


Fig. 84 Front Output Shaft Seal Installation - Typical

1 - INSTALLER 8143-A
2 - TRANSFER CASE

(non-contacting) whose output converts the motor shaft position into a coded signal. The TCCM must supply 5VDC (+/- 0.5v) to the sensor and monitor the shift motor position. The four channels are denoted A, B, C, and D. The sensor is mechanically linked to the shaft of the cam which causes the transfer case shifting. The mode sensor draws less than 53 mA.

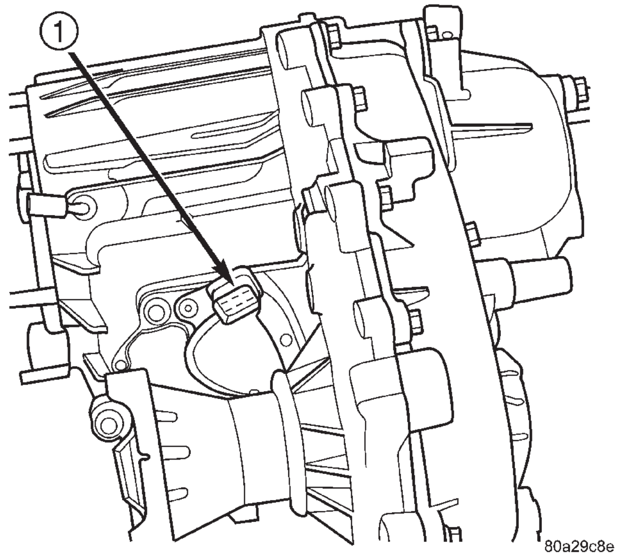


Fig. 85 Mode Sensor

1 - TRANSFER CASE MODE SENSOR

MODE SENSOR (Continued)

OPERATION

During normal vehicle operation, the Transfer Case Control Module (TCCM) monitors the mode sensor outputs at least every 250 (+/-50) milliseconds when the shift motor is stationary and 400 microseconds when the shift motor is active. A mode sensor signal between 3.8 Volts and 0.8 Volts is considered to be undefined.

Refer to for the relative angles of the transfer case shift sector versus the interpreted transfer case gear operating mode. Refer to for the sensor codes returned to the TCCM for each transfer case mode sensor position. The various between gears positions can also be referred as the transfer case's coarse position. These coarse positions come into play during shift attempts.

SECTOR ANGLES VS. TRANSFER CASE POSITION

Shaft Angle (Degrees)	Transfer Case Position
+40	4LO
+20	N
0	2WD/AWD
-20	4HI

MODE SENSOR CODES

Transfer Case Angle (degrees)	Sensor Channel A	Sensor Channel B	Sensor Channel C	Sensor Channel D
Between Gears	H	H	L	H
+40 (4LO)	H	H	L	L
Between Gears	H	H	L	H
Between Gears	H	L	L	H
+20 (NEUTRAL)	H	L	L	L
Between Gears	H	L	L	H
Between Gears	H	L	H	H
0 (2WD/AWD)	H	L	H	L
Between Gears	H	L	H	H
Between Gears	L	L	H	H
-20 (4HI)	L	L	H	L
Between Gears	L	L	H	H
Between Gears	L	H	H	H

REAR RETAINER BUSHING AND SEAL

REMOVAL

(1) Raise vehicle.

(2) Remove rear propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(3) Using a suitable pry tool or slide-hammer mounted screw, remove the rear retainer seal.

(4) Using Remover 8158, remove the bushing from rear retainer (Fig. 86).

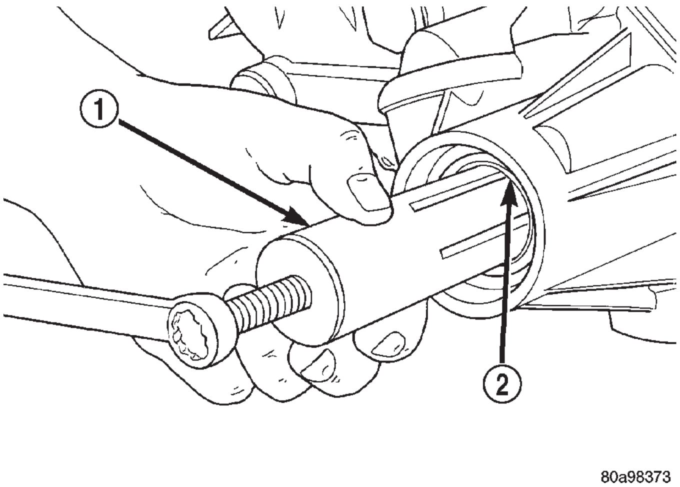


Fig. 86 Rear Retainer Bushing Removal

1 - REMOVER 8158
2 - REAR RETAINER BUSHING

INSTALLATION

(1) Clean fluid residue from sealing surface and inspect for defects.

(2) Position replacement bushing in rear retainer with fluid port in bushing aligned with slot in retainer.

(3) Using Installer 8157, drive bushing into retainer until installer seats against case (Fig. 87).

(4) Using Installer D-163, install seal in rear retainer (Fig. 88).

(5) Install the rear propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(6) Verify proper fluid level.

(7) Lower vehicle.

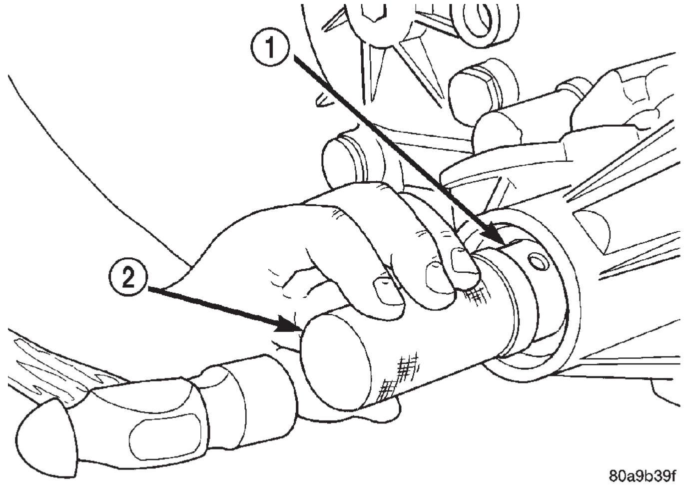


Fig. 87 Rear Retainer Bushing Installation

1 - REAR RETAINER BUSHING
2 - INSTALLER 8157

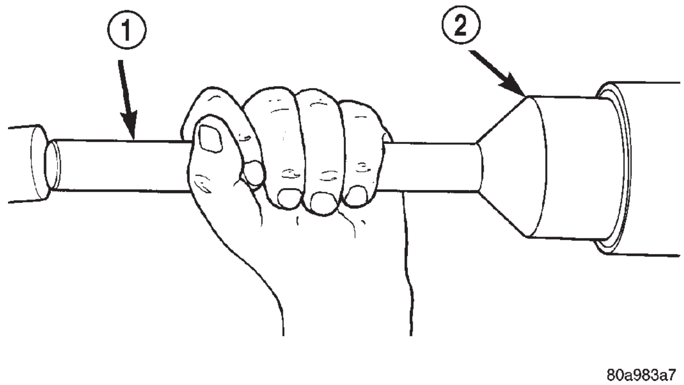


Fig. 88 Install Rear Retainer Seal

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL D-163

SELECTOR SWITCH

DESCRIPTION

The selector switch assembly (Fig. 89) is mounted in the vehicle Instrument Panel (IP) and consists of a rotary knob connected to a resistive network for the mode and range shift selections. Also located in this assembly is a recessed, normally open momentary switch for making shifts into and out of transfer case NEUTRAL. A pen, or similar instrument, is used to make a NEUTRAL shift selection, thus reducing the likelihood of an inadvertent shift request.

The selector switch also contains four light emitting diode's (LED's) to indicate the transfer case position and whether a shift is in progress.

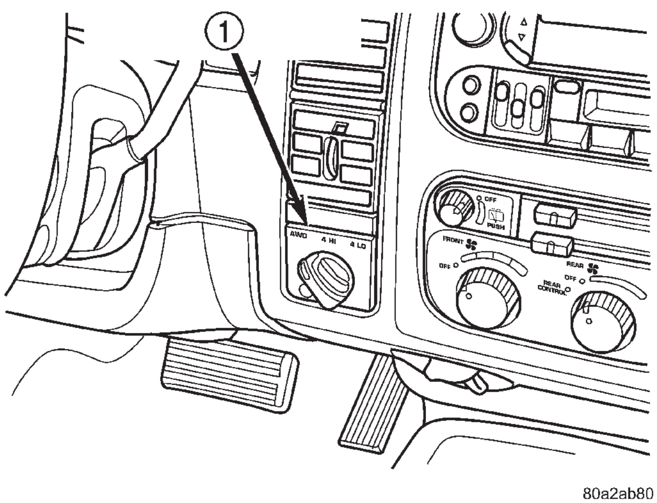


Fig. 89 Selector Switch

1 - TRANSFER CASE MODE SELECTOR SWITCH

OPERATION

As the position of the selector switch varies, the resistance between the Mode Sensor supply voltage pin and the Mode Sensor output will vary. Hardware, software, and calibrations within the Transfer Case Control Module (TCCM) are provided that interpret the selector switch resistance as given in the table below:

SELECTOR SWITCH INTERPRETATION

Step	Resistance Range (ohms)	Required Interpretation
A	<200	Shorted
B	400-700	NEUTRAL
C	1050-1450	4LO
D	1850-2300	4H
E	3050-5950	2WD/AWD (Default)
F	9.5-12.5K	In between positions
G	>15.5K	Open

For resistances between the ranges B-E shown for each valid position (T-Case NEUTRAL, 4LO, 4HI, 2WD/AWD), the TCCM may interpret the resistance as:

- either of the neighboring valid positions.
- as an invalid fault position.

For resistances between the ranges E and F shown for AWD/2WD and in-between positions, the TCCM may interpret the resistance as:

- the AWD/2WD position.
- an invalid fault position.
- a valid in-between position.

For resistances between the ranges F and G shown for in-between positions and fault condition (open), the TCCM may interpret the resistance as:

- a valid in-between position.
- an invalid fault position.

For resistances between the ranges A and B shown for the fault condition (short) and , T-Case NEUTRAL, the TCCM may interpret the resistance as:

- the T-Case NEUTRAL position.
- an invalid fault position.

The LED's in the selector assembly are illuminated/flashed in the following manner to indicate a particular condition or state.

- A solidly illuminated LED indicates a successfully completed shift and the current operating mode of the transfer case. While a shift has been requested but not yet completed, the LED for the source transfer case position remains solidly illuminated.
- A flashing operating mode LED for the desired gear indicates that a shift to that position has been requested, but all of the driver controllable conditions have not been met. This is in an attempt to notify the driver that the transmission needs to be put into NEUTRAL, the vehicle speed is too great, or some other condition outlined (other than a diagnostic failure that would prevent this shift) above is not met. Note that this flashing will continue indefinitely until the conditions are eventually met, or the selec-

SELECTOR SWITCH (Continued)

tor switch position is changed, or if diagnostic routines no longer allow the requested shift.

- If the driver attempts to make a shift into transfer case NEUTRAL, and any of the driver controllable conditions are not met, the request will be ignored until all of the conditions are met or until the NEUTRAL select button is released. Additionally the neutral lamp will flash, or begin to flash while the button is depressed and operator controllable conditions are not being met. All of the LED's except the Neutral will flash if any of the operator controllable conditions for shifting are not met while the Neutral button is depressed. This ″toggle″ type of feature is necessary because the TCCM would interpret another request immediately after the shift into transfer case NEUTRAL has completed.
- No LED's illuminated indicate a fault in the transfer case control system.

SHIFT MOTOR

DESCRIPTION

The shift motor (Fig. 90) consists of a permanent magnet D.C. motor with gear reduction to convert a high speed-low torque device into a low speed-high torque device. The output of the device is coupled to a shaft which internally moves the mode and range forks that change the transfer case operating ranges. The motor is rated at 25 amps maximum at 72° F with 10 volts at the motor leads.

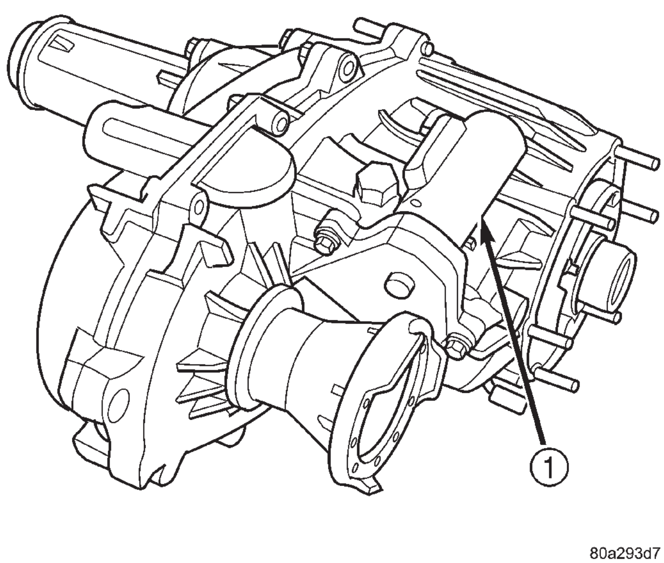


Fig. 90 Shift Motor - Shown Inverted

1 - TRANSFER CASE SHIFT MOTOR

OPERATION

The transfer case shift motor responds to the Transfer Case Control Module (TCCM) commands to move the transfer case shift sector bi-directionally, as required, to obtain the transfer case operating mode indicated by the instrument panel mounted selector switch.

REMOVAL

(1) Raise the vehicle on a suitable hoist.

(2) Remove the front propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(3) Disengage the wiring connectors from the shift motor and mode sensor.

(4) Remove the front output shaft companion flange from the transfer case.

(5) Remove the bolts (Fig. 91) holding the shift motor and mode sensor assembly onto the transfer case.

(6) Separate the shift motor and mode sensor assembly from the transfer case.

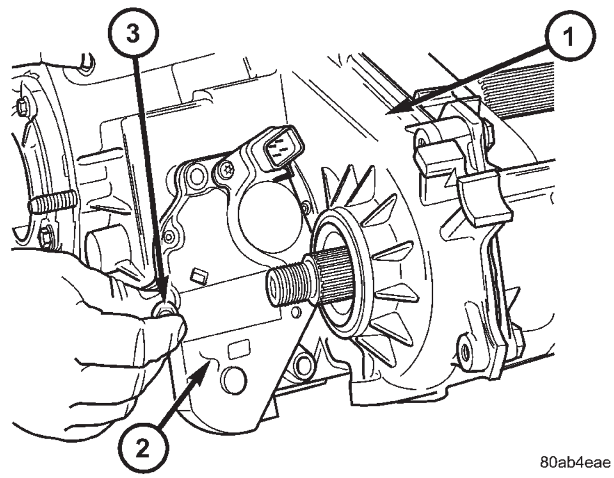


Fig. 91 Remove the Shift Motor and Mode Sensor Assembly Bolts

1 - TRANSFER CASE
2 - SHIFT MOTOR AND MODE SENSOR ASSEMBLY
3 - BOLT

SHIFT MOTOR (Continued)

INSTALLATION

(1) Verify that the shift sector o-ring is clean and properly positioned over the shift sector and against the transfer case.

(2) Position the shift motor and mode sensor assembly onto the transfer case.

(3) Install the bolts (Fig. 92) to hold the assembly onto the transfer case. Tighten the bolts to 16-24 N·m (12-18 ft.lbs.).

CAUTION: If the original shift motor and mode sensor assembly bolts are reused, be sure to use Mopar® Lock & Seal or Loctite™ 242 to replenish the lock patch material originally found on the bolts

(4) Engage the wiring connectors to the shift motor and mode sensor.

(5) Install the transfer case front output shaft companion flange onto the transfer case. Tighten the flange nut to 122-176 N·m (90-130 ft.lbs.).

(6) Install the front propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(7) Refill the transfer case as necessary.

(8) Lower vehicle and verify transfer case operation.

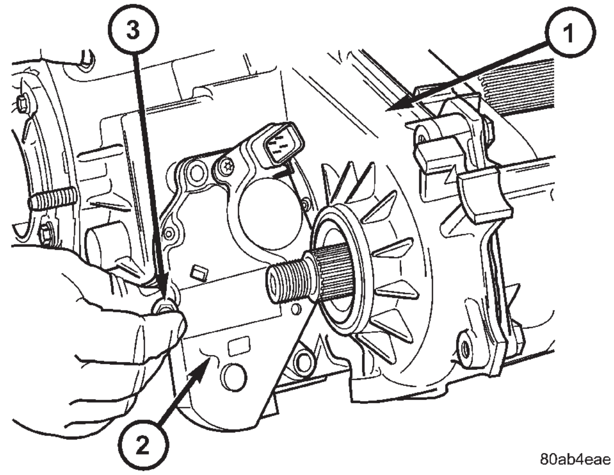


Fig. 92 Install the Shift Motor and Mode Sensor Assembly Bolts

1 - TRANSFER CASE
2 - SHIFT MOTOR AND MODE SENSOR ASSEMBLY
3 - BOLT

TIRES/WHEELS

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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.

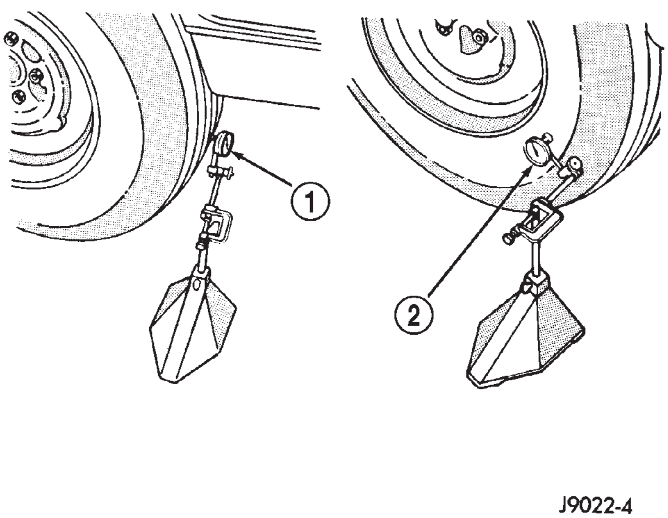

Fig. 1 Checking Tire/Wheel/Hub Runout

1 - RADIAL RUNOUT
2 - LATERAL RUNOUT

Radial runout of more than 1.5 mm (.060 inch) measured at the center line of the tread may cause the vehicle to shake.

Lateral runout of more than 2.0 mm (.080 inch) measured near the shoulder of the tire may cause the vehicle to shake.

Sometimes radial runout can be reduced. Relocate the wheel and tire assembly on the mounting studs (See Method 1). If this does not reduce runout to an acceptable level, the tire can be rotated on the wheel. (See Method 2).

METHOD 1 (RELOCATE WHEEL ON HUB)

(1) Drive vehicle a short distance to eliminate tire flat spotting from a parked position.

(2) Check wheel bearings and adjust if adjustable or replace if necessary.

(3) Check the wheel mounting surface.

(4) Relocate wheel on the mounting, two studs over from the original position.

(5) Tighten wheel nuts until all are properly torqued, to eliminate brake distortion.

(6) Check radial runout. If still excessive, mark tire sidewall, wheel, and stud at point of maximum runout and proceed to Method 2.

METHOD 2 (RELOCATE TIRE ON WHEEL)

NOTE: Rotating the tire on wheel is particularly effective when there is runout in both tire and wheel.

TIRES/WHEELS (Continued)

(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, Refer to match mounting procedure.

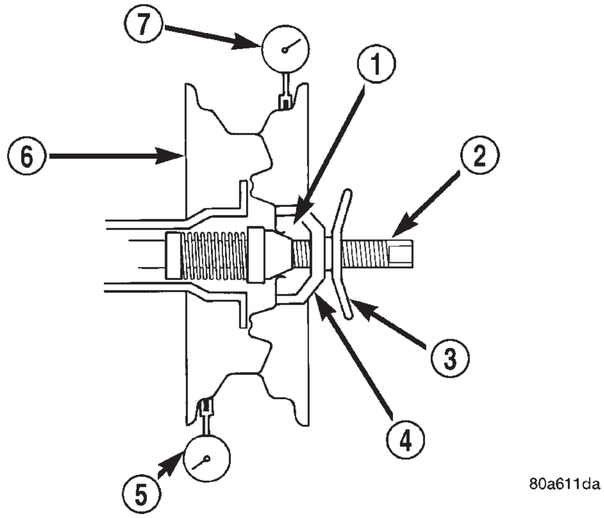

Fig. 2 Radial Runout

1 - MOUNTING CONE
2 - SPINDLE SHAFT
3 - WING NUT
4 - PLASTIC CUP
5 - DIAL INDICATOR
6 - WHEEL
7 - DIAL INDICATOR

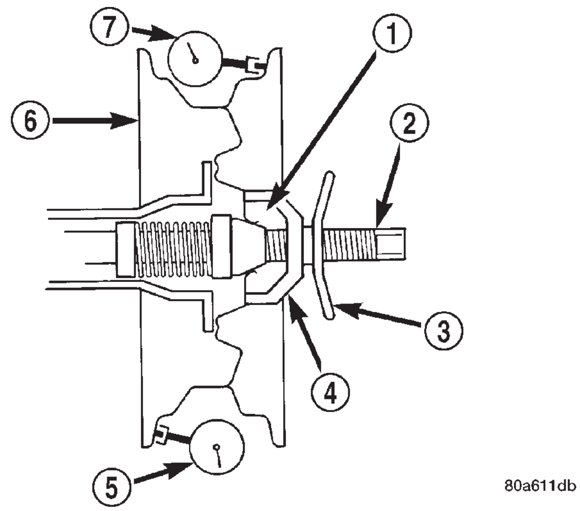

Fig. 3 Lateral Runout

1 - MOUNTING CONE
2 - SPINDLE SHAFT
3 - WING NUT
4 - PLASTIC CUP
5 - DIAL INDICATOR
6 - WHEEL
7 - DIAL INDICATOR

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.

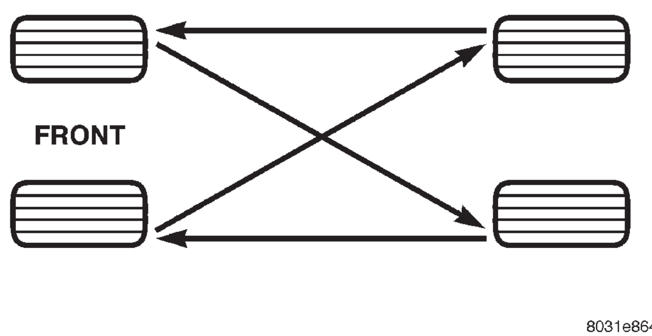

Fig. 4 Tire Rotation Pattern

STANDARD PROCEDURE - MATCH MOUNTING

Wheels and tires are match mounted at the factory. This means that the high spot of the tire is matched to the low spot on the wheel rim. Each are marked with a bright colored temporary label on the outboard surface for alignment. The wheel is also marked permanently on the inside of the rim in the tire well. This permanent mark may be a paint dot or line, a permanent label or a stamped impression such as an X. An optional location mark is a small spherical indentation on the vertical face of the outboard flange on some non styled base steel wheels. The tire must be removed to locate the permanent mark on the inside of the wheel.

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.

TIRES/WHEELS (Continued)

(1) Remove the tire and wheel assembly from the vehicle and mount on a service dynamic balance machine.

(2) Measure the total runout on the center of the tire tread rib with a dial indicator. Record the indicator reading. Mark the tire to indicate the high spot. Place a mark on the tire at the valve stem location (Fig. 5).

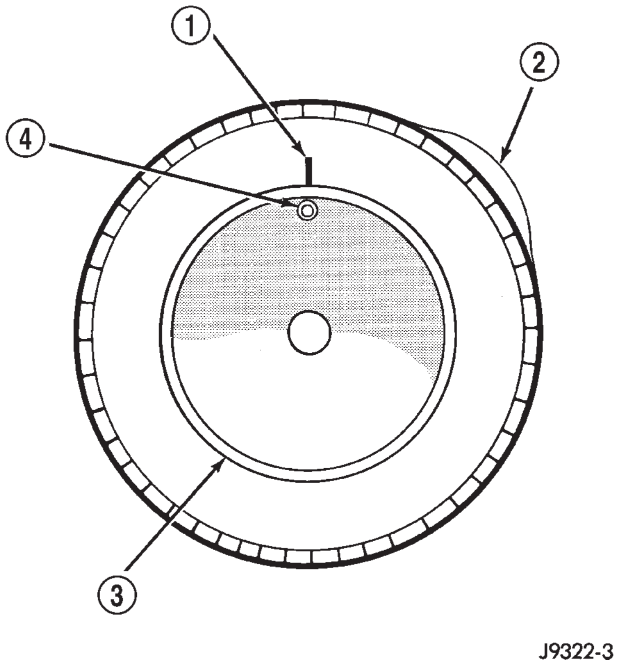

Fig. 5 First Measurement On Tire

1 - REFERENCE MARK
2 - **1ST MEASUREMENT HIGH SPOT MARK TIRE AND RIM**
3 - WHEEL
4 - VALVE STEM

(3) Break down the tire and remount it 180 degrees on the rim (Fig. 6).

(4) Measure the total indicator runout again. Mark the tire to indicate the high spot.

(5) If runout is still excessive, the following procedures must be done.

- If the high spot is within 101.6 mm (4.0 in.) of the first spot and is still excessive, replace the tire.
- If the high spot is within 101.6 mm (4.0 in.) of the first spot on the wheel, the wheel may be out of specifications. (Refer to 22 - TIRES/WHEELS - DIAGNOSIS AND TESTING).
- 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. 7). This procedure will normally reduce the runout to an acceptable amount, if not replace the rim.

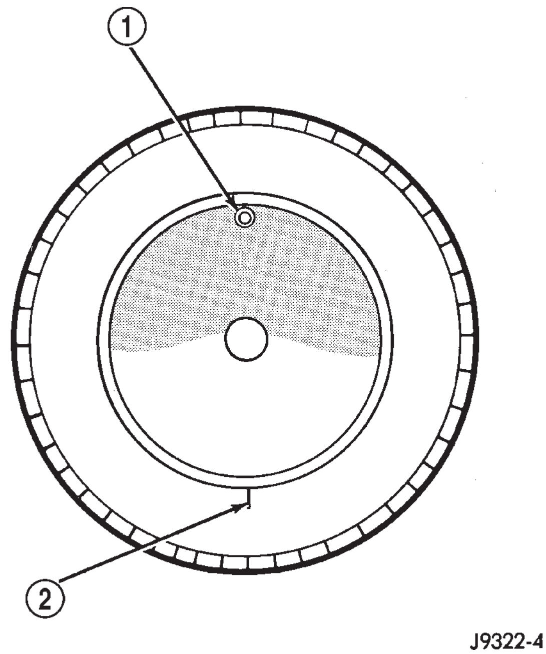

Fig. 6 Remount Tire 180 Degrees

1 - VALVE STEM
2 - REFERENCE MARK

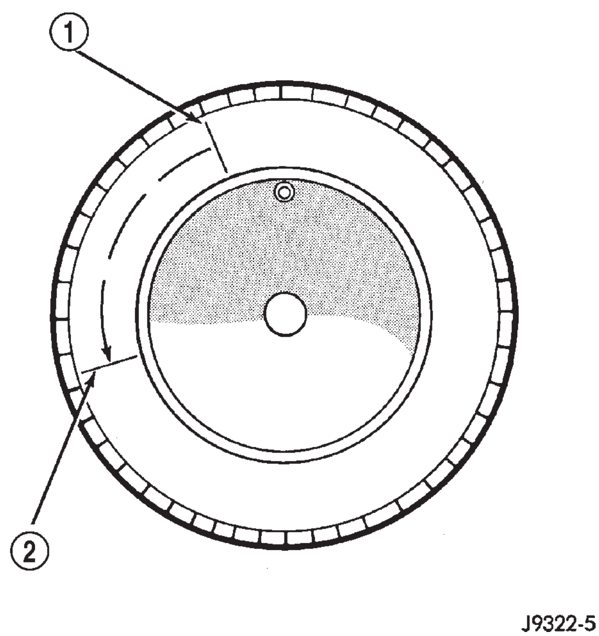

Fig. 7 Remount Tire 90 Degrees In Direction of Arrow

1 - 2ND HIGH SPOT ON TIRE
2 - 1ST HIGH SPOT ON TIRE

TIRES/WHEELS (Continued)

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 the location of the 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. 8).

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. 9).

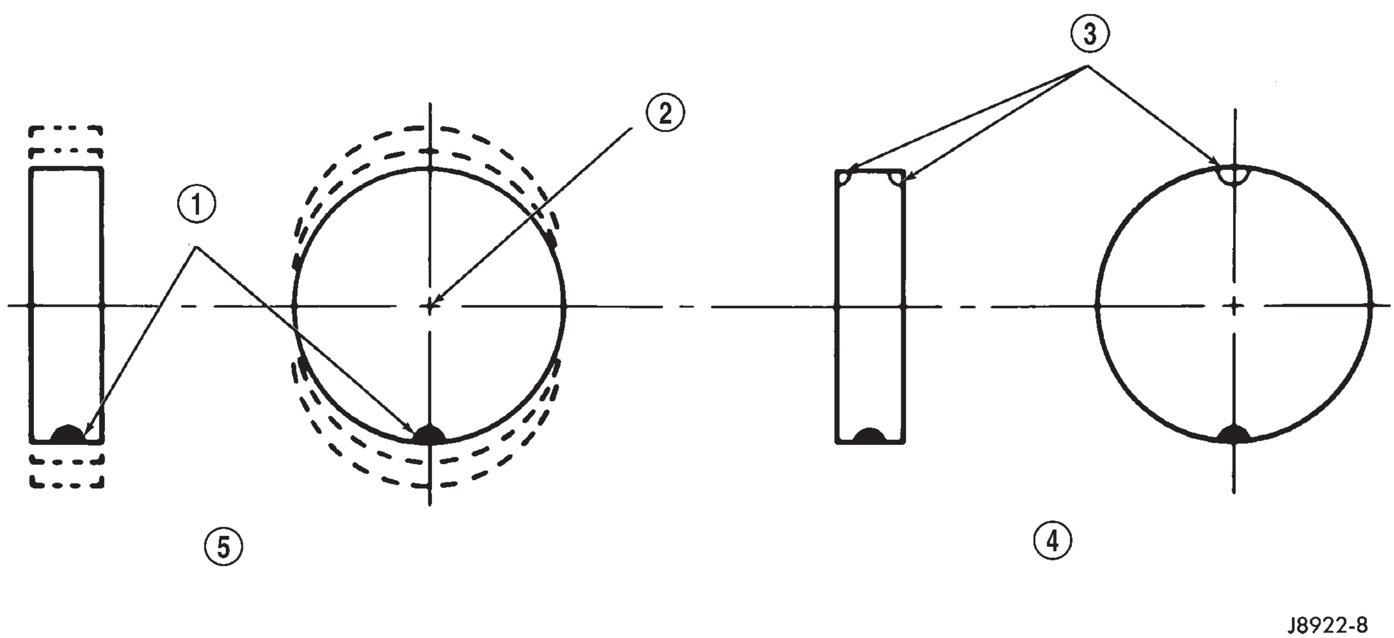

Fig. 8 Static Unbalance & Balance

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

TIRES/WHEELS (Continued)

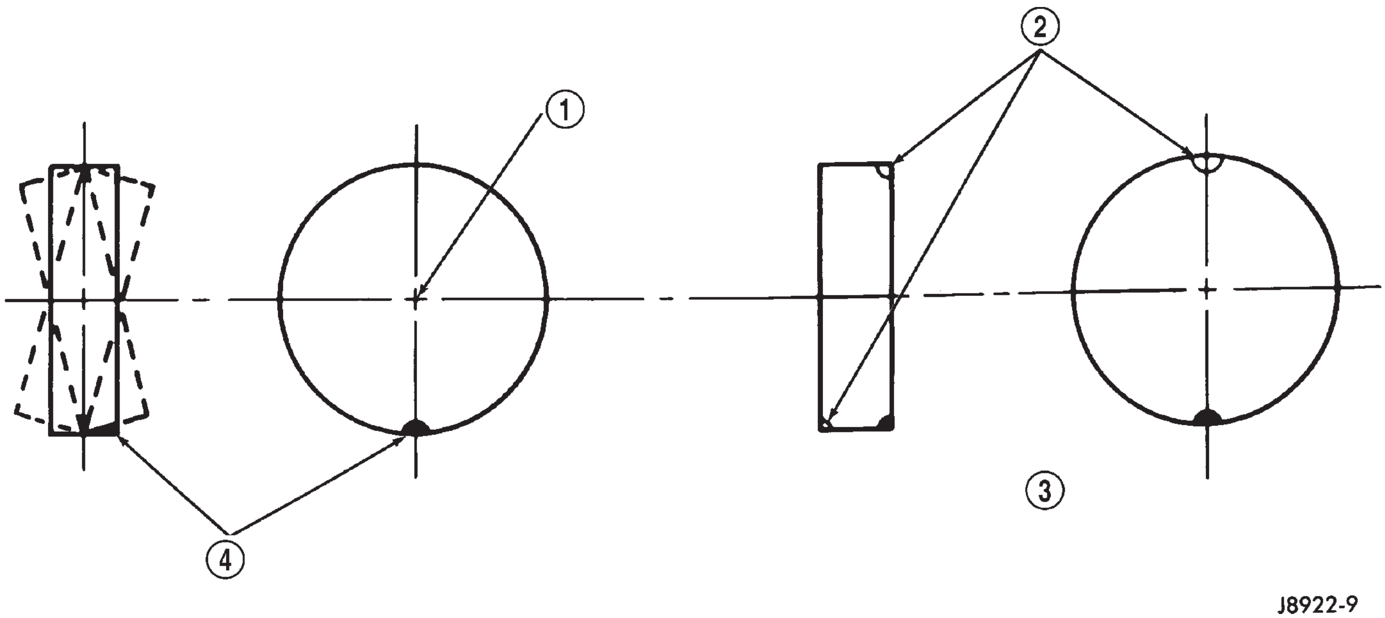

Fig. 9 Dynamic Unbalance & Balance

1 - CENTER LINE OF SPINDLE
2 - ADD BALANCE WEIGHTS HERE
3 - CORRECTIVE WEIGHT LOCATION
4 - HEAVY SPOT WHEEL SHIMMY AND VIBRATION

TIRES

DESCRIPTION - 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. 10).

Performance tires have a speed rating letter after the aspect ratio number. The speed rating is not always printed on the tire sidewall. These ratings are:

- **Q** up to 100 mph
- **S** up to 112 mph
- **T** up to 118 mph
- **U** up to 124 mph
- **H** up to 130 mph
- **V** up to 149 mph
- **Z** more than 149 mph (consult the tire manufacturer for the specific speed rating)

An All Season type tire will have either **M + S, M & S or M–S** (indicating mud and snow traction) imprinted on the side wall.

TIRE CHAINS

Tire snow chains may be used on **certain** models. Refer to the Owner's Manual for more information.

DESCRIPTION - RADIAL – PLY TIRES

Radial-ply tires improve handling, tread life and ride quality, and decrease rolling resistance.

TIRES (Continued)

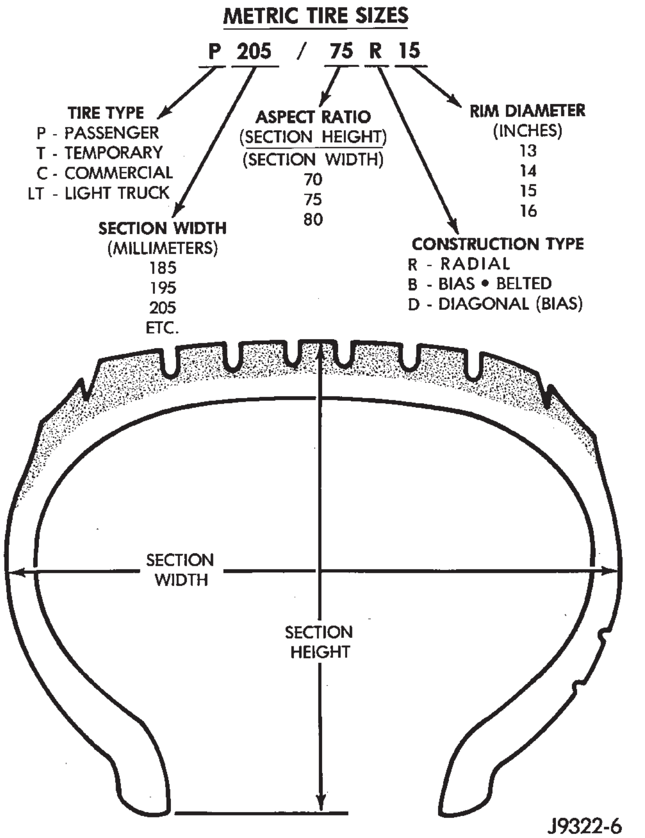

Fig. 10 Tire Identification

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.

DESCRIPTION - TIRE INFLATION PRESSURES

Under inflation will cause rapid shoulder wear, tire flexing, and possible tire failure (Fig. 11).

Over inflation will cause rapid center wear and loss of the tire's ability to cushion shocks (Fig. 12).

Improper inflation can cause:

- Uneven wear patterns
- Reduced tread life
- Reduced fuel economy

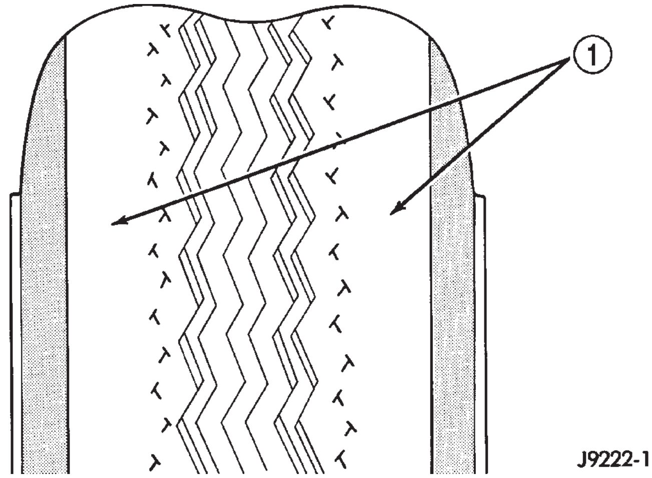

Fig. 11 Under Inflation Wear

1 - THIN TIRE THREAD AREAS

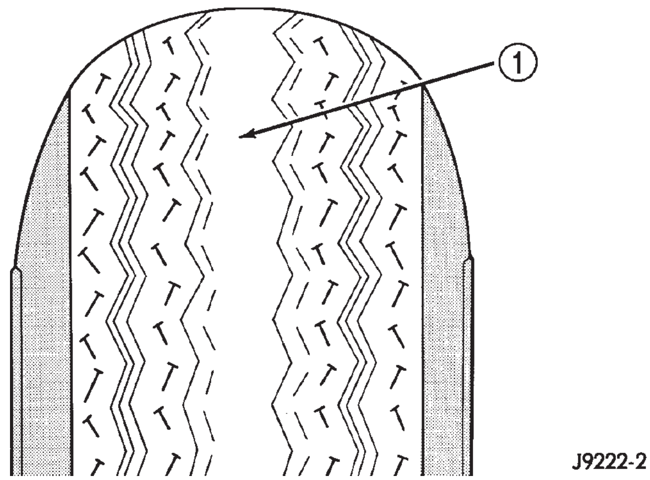

Fig. 12 Over Inflation Wear

1 - THIN TIRE THREAD AREA

- 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

TIRES (Continued)

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.

Failure to use equivalent replacement tires may adversely affect the safety and handling of the vehicle.

The use of oversize tires may cause interference with vehicle components. Under extremes of suspension and steering travel, interference with vehicle components may cause tire damage.

WARNING: FAILURE TO EQUIP THE VEHICLE WITH TIRES HAVING ADEQUATE SPEED CAPABILITY CAN RESULT IN SUDDEN TIRE FAILURE.

DIAGNOSIS AND TESTING - PRESSURE GAUGES

A quality air pressure gauge is recommended to check tire pressure. After checking the air pressure, replace valve cap finger tight.

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. 13).

Tire replacement is necessary when indicators appear in two or more grooves or if localized balding occurs.

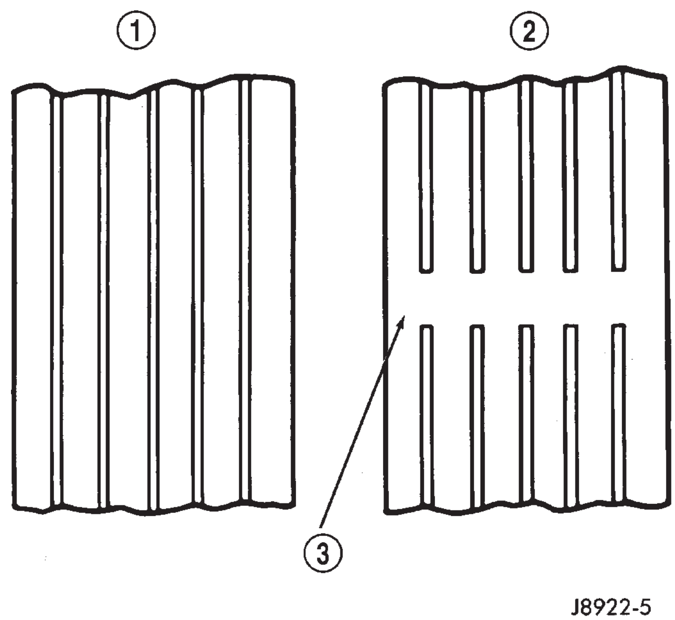

Fig. 13 Tread Wear Indicators

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. 14).

Excessive toe-in or toe-out causes wear on the tread edges and a feathered effect across the tread (Fig. 14).

TIRES (Continued)

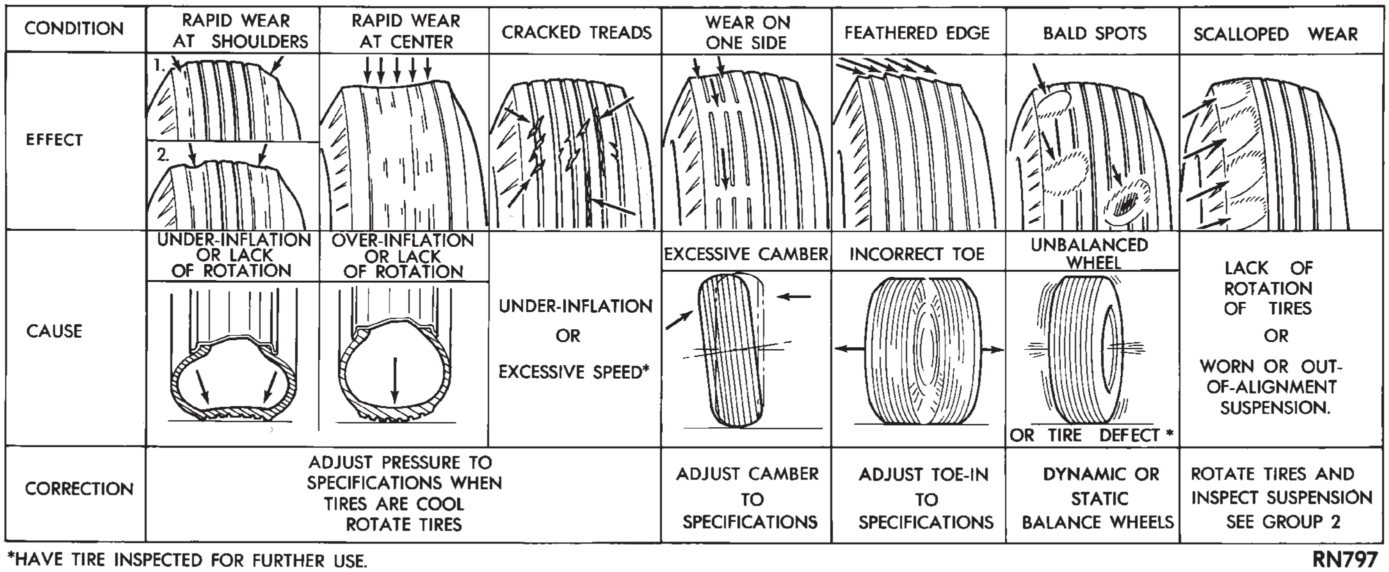

Fig. 14 Tire Wear Patterns

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. 15). The tire should be replaced if the puncture is located in the sidewall.

Deflate tire completely before removing the tire from the wheel. Use lubrication such as a mild soap solution when dismounting or mounting tire. Use tools free of burrs or sharp edges which could damage the tire or wheel rim.

Before mounting tire on wheel, make sure all rust is removed from the rim bead and repaint if necessary.

Install wheel on vehicle, and tighten to proper torque specification.

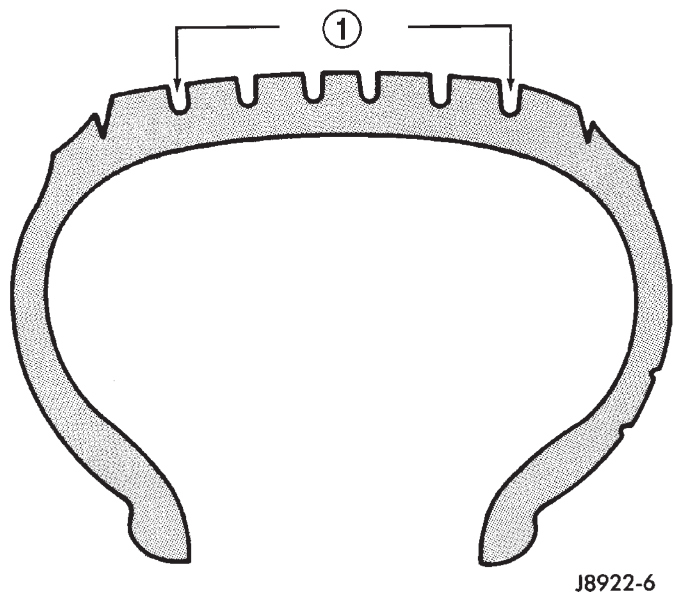

Fig. 15 Tire Repair Area

1 - REPAIRABLE AREA

CLEANING - TIRES

Remove the protective coating on the tires before delivery of a vehicle. This coating may cause deterioration of the tires.

To remove the protective coating, apply warm water and let it soak for a few minutes. Afterwards, scrub the coating away with a soft bristle brush. Steam cleaning may also be used to remove the coating.

NOTE: DO NOT use gasoline, mineral oil, oil-based solvent or a wire brush for cleaning.

SPECIFICATIONS

TIRE SPECIFICATION

SPECIFICATIONS

DESCRIPTION	SPECIFICATION
TIRE	P215/75R15
TIRE	P235/75R15 XL
TIRE	P255/65R16
TIRE	P255/55R17
TIRE	P265/70R16

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.

WHEELS

DESCRIPTION

The rim size is on the vehicle safety certification label located on the drivers door shut face. The size of the rim is determined by the drivetrain package. Original equipment wheels/rims are designed for operation up to the specified maximum vehicle capacity.

All models use stamped steel, cast aluminum or forged aluminum wheels. Every wheel has raised sections between the rim flanges and rim drop well called safety humps (Fig. 16) .

Initial inflation of the tire forces the bead over these raised sections. In case of rapid loss of air pressure, the raised sections help hold the tire on the wheel.

The wheel studs and nuts are designed for specific applications. All aluminum and some steel wheels have wheel stud nuts with an enlarged nose. This enlarged nose is necessary to ensure proper retention of the wheels. Do not use replacement studs or nuts with a different design or lesser quality.

DIAGNOSIS AND TESTING - WHEEL INSPECTION

Inspect wheels for:

- Excessive run out
- Dents or cracks
- Damaged wheel lug nut holes
- Air Leaks from any area or surface of the rim

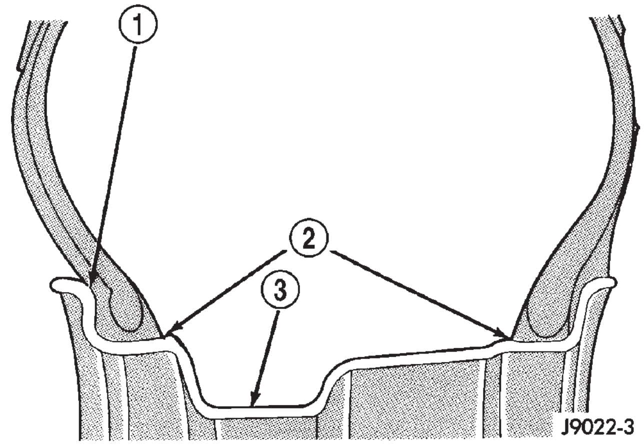

Fig. 16 Safety Rim

1 - FLANGE
2 - RIDGE
3 - WELL

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.

WHEEL INSTALLATION

The wheel studs and nuts are designed for specific applications. They must be replaced with equivalent parts. Do not use replacement parts of lesser quality or a substitute design. All aluminum and some steel wheels have wheel stud nuts which feature an enlarged nose. This enlarged nose is necessary to ensure proper retention of the aluminum wheels.

NOTE: Do not use chrome plated lug nuts with chrome plated wheels.

WHEELS (Continued)

Before installing the wheel, be sure to remove any build up of corrosion on the wheel mounting surfaces. Ensure wheels are installed with good metal-to-metal contact. Improper installation could cause loosening of wheel nuts. This could affect the safety and handling of your vehicle.

To install the wheel, first position it properly on the mounting surface. All wheel nuts should then be tightened just snug. Gradually tighten them in sequence to the proper torque specification (Fig. 17). **Never use oil or grease on studs or nuts.**

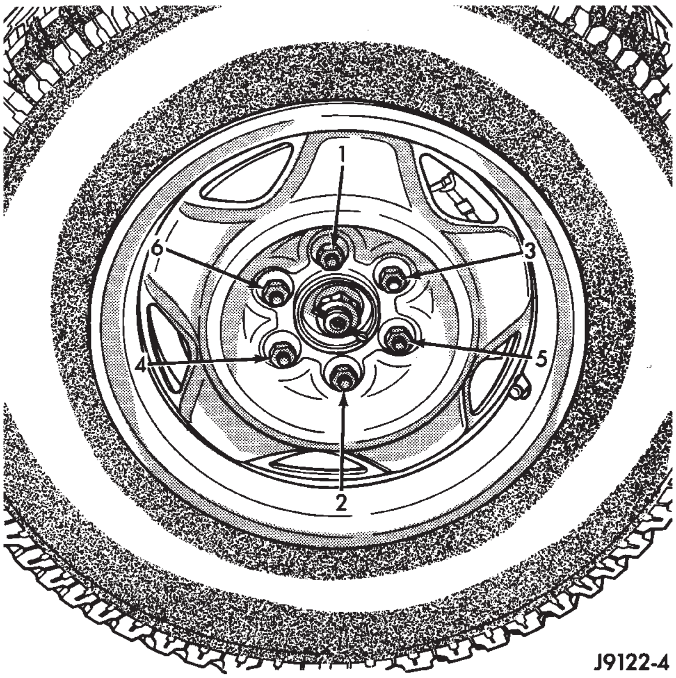

Fig. 17 Lug Nut Tightening Pattern

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.

NOTE: Do not use chrome plated lug nuts with chrome plated wheels.

Before installing the wheel, be sure to remove any build up of corrosion on the wheel mounting surfaces. Ensure wheels are installed with good metal-to-metal contact. Improper installation could cause loosening of wheel nuts. This could affect the safety and handling of your vehicle.

To install the wheel, first position it properly on the mounting surface. All wheel nuts should then be tightened just snug. Gradually tighten them in sequence to the proper torque specification (Fig. 17). **Never use oil or grease on studs or nuts.**

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.

SPECIFICATIONS

TORQUE CHART

CAUTION: DO NOT USE CHROME PLATED LUG NUTS WITH CHROME PLATED WHEELS.

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Wheel Lug Nut	115 to 157	85 to 115	—

STUDS

REMOVAL

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

(1) Raise and support the vehicle.
(2) Remove the wheel and tire assembly.
(3) Remove the brake caliper, caliper adapter and rotor, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).
(4) Remove the stud from the hub with Remover C-4150A (Fig. 18).

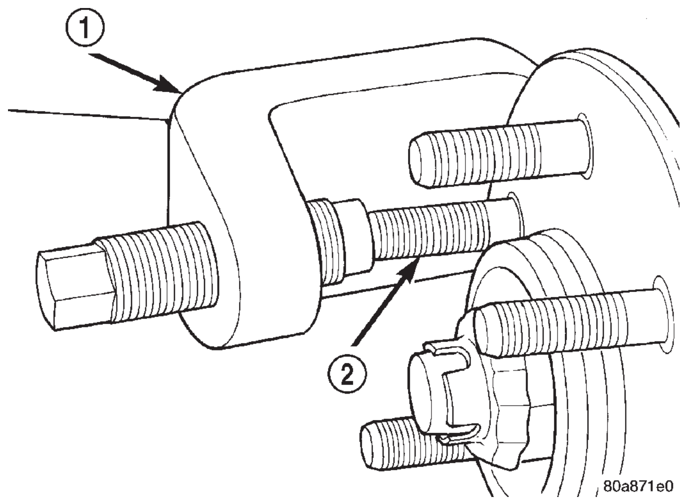

Fig. 18 Wheel Stud Removal

1 - REMOVER
2 - WHEEL STUD

INSTALLATION

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

(1) Install the new stud into the hub flange.
(2) Install three washers onto the 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) refer to Brakes for procedure.
(6) Install the wheel and tire assembly, (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE) use a new lug nut on the stud or studs that were replaced.
(7) Remove the support and lower vehicle.

BODY

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BODY

DIAGNOSIS AND TESTING - WATER LEAKS

Water leaks can be caused by poor sealing, improper body component alignment, body seam porosity, missing plugs, or blocked drain holes. Centrifugal and gravitational force can cause water to drip from a location away from the actual leak point, making leak detection difficult. All body sealing points should be water tight in normal wet-driving conditions. Water flowing downward from the front of the vehicle should not enter the passenger or luggage compartment. Moving sealing surfaces will not always seal water tight under all conditions. At times, side glass or door seals will allow water to enter the passenger compartment during high pressure washing or hard driving rain (severe) conditions. Overcompensating on door or glass adjustments to stop a water leak that occurs under severe conditions can cause premature seal wear and excessive closing or latching effort. After completing a repair, water test vehicle to verify leak has stopped before returning vehicle to use.

VISUAL INSPECTION BEFORE WATER LEAK TESTS

Verify that floor and body plugs are in place, body drains are clear, and body components are properly aligned and sealed. If component alignment or sealing is necessary, refer to the appropriate section of this group for proper procedures.

WATER LEAK TESTS

WARNING: DO NOT USE ELECTRIC SHOP LIGHTS OR TOOLS IN WATER TEST AREA. PERSONAL INJURY CAN RESULT.

When the conditions causing a water leak have been determined, simulate the conditions as closely as possible.

- If a leak occurs with the vehicle parked in a steady light rain, flood the leak area with an open-ended garden hose.
- If a leak occurs while driving at highway speeds in a steady rain, test the leak area with a reasonable velocity stream or fan spray of water. Direct the spray in a direction comparable to actual conditions.
- If a leak occurs when the vehicle is parked on an incline, hoist the end or side of the vehicle to simulate this condition. This method can be used when the leak occurs when the vehicle accelerates, stops or turns. If the leak occurs on acceleration, hoist the front of the vehicle. If the leak occurs when braking, hoist the back of the vehicle. If the leak occurs on left turns, hoist the left side of the vehicle. If the leak occurs on right turns, hoist the right side of the vehicle. For hoisting recommendations refer to Group 0, Lubrication and Maintenance, General Information section.

WATER LEAK DETECTION

To detect a water leak point-of-entry, do a water test and watch for water tracks or droplets forming on the inside of the vehicle. If necessary, remove interior trim covers or panels to gain visual access to the leak area. If the hose cannot be positioned without being held, have someone help do the water test.

Some water leaks must be tested for a considerable length of time to become apparent. When a leak appears, find the highest point of the water track or drop. The highest point usually will show the point of entry. After leak point has been found, repair the leak and water test to verify that the leak has stopped.

BODY (Continued)

Locating the entry point of water that is leaking into a cavity between panels can be difficult. The trapped water may splash or run from the cavity, often at a distance from the entry point. Most water leaks of this type become apparent after accelerating, stopping, turning, or when on an incline.

MIRROR INSPECTION METHOD

When a leak point area is visually obstructed, use a suitable mirror to gain visual access. A mirror can also be used to deflect light to a limited-access area to assist in locating a leak point.

BRIGHT LIGHT LEAK TEST METHOD

Some water leaks in the luggage compartment can be detected without water testing. Position the vehicle in a brightly lit area. From inside the darkened luggage compartment inspect around seals and body seams. If necessary, have a helper direct a drop light over the suspected leak areas around the luggage compartment. If light is visible through a normally sealed location, water could enter through the opening.

PRESSURIZED LEAK TEST METHOD

When a water leak into the passenger compartment cannot be detected by water testing, pressurize the passenger compartment and soap test exterior of the vehicle. To pressurize the passenger compartment, close all doors and windows, start engine, and set heater control to high blower in HEAT position. If engine can not be started, connect a charger to the battery to ensure adequate voltage to the blower. With interior pressurized, apply dish detergent solution to suspected leak area on the exterior of the vehicle. Apply detergent solution with spray device or soft bristle brush. If soap bubbles occur at a body seam, joint, seal or gasket, the leak entry point could be at that location.

DIAGNOSIS AND TESTING - WIND NOISE

Wind noise is the result of most air leaks. Air leaks can be caused by poor sealing, improper body component alignment, body seam porosity, or missing plugs in the engine compartment or door hinge pillar areas. All body sealing points should be airtight in normal driving conditions. Moving sealing surfaces will not always seal airtight under all conditions. At times, side glass or door seals will allow wind noise to be noticed in the passenger compartment during high cross winds. Over compensating on door or glass adjustments to stop wind noise that occurs under severe conditions can cause premature seal wear and excessive closing or latching effort. After a repair procedure has been performed, test vehicle to verify noise has stopped before returning vehicle to use.

Wind noise can also be caused by improperly fitted exterior moldings or body ornamentation. Loose moldings can flutter, creating a buzzing or chattering noise. An open cavity or protruding edge can create a whistling or howling noise. Inspect the exterior of the vehicle to verify that these conditions do not exist.

VISUAL INSPECTION BEFORE TESTS

Verify that floor and body plugs are in place and body components are aligned and sealed. If component alignment or sealing is necessary, refer to the appropriate section of this group for proper procedures.

ROAD TESTING WIND NOISE

(1) Drive the vehicle to verify the general location of the wind noise.

(2) Apply 50 mm (2 in.) masking tape in 150 mm (6 in.) lengths along weatherstrips, weld seams or moldings. After each length is applied, drive the vehicle. If noise goes away after a piece of tape is applied, remove tape, locate, and repair defect.

POSSIBLE CAUSE OF WIND NOISE

- Moldings standing away from body surface can catch wind and whistle.
- Gaps in sealed areas behind overhanging body flanges can cause wind-rushing sounds.
- Misaligned movable components.
- Missing or improperly installed plugs in pillars.
- Weld burn through holes.

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).

BODY (Continued)

- 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.

STANDARD PROCEDURE - HEAT STAKING

(1) Remove trim panel.

(2) Bend or move the trim panel components at the heat staked joints. Observe the heat staked locations and/or component seams for looseness.

(3) Heat stake the components.

(a) If the heat staked or component seam location is loose, hold the two components tightly together and using a soldering gun with a flat tip, melt the material securing the components together. Do not over heat the affected area, damage to the exterior of the trim panel may occur.

(b) If the heat staked material is broken or missing, use a hot glue gun to apply new material to the area to be repaired. The panels that are being heat staked must be held together while the applying the glue. Once the new material is in place, it may be necessary to use a soldering gun to melt the newly applied material. Do not over heat the affected area, damage to the exterior of the trim panel may occur.

(4) Allow the repaired area to cool and verify the repair.

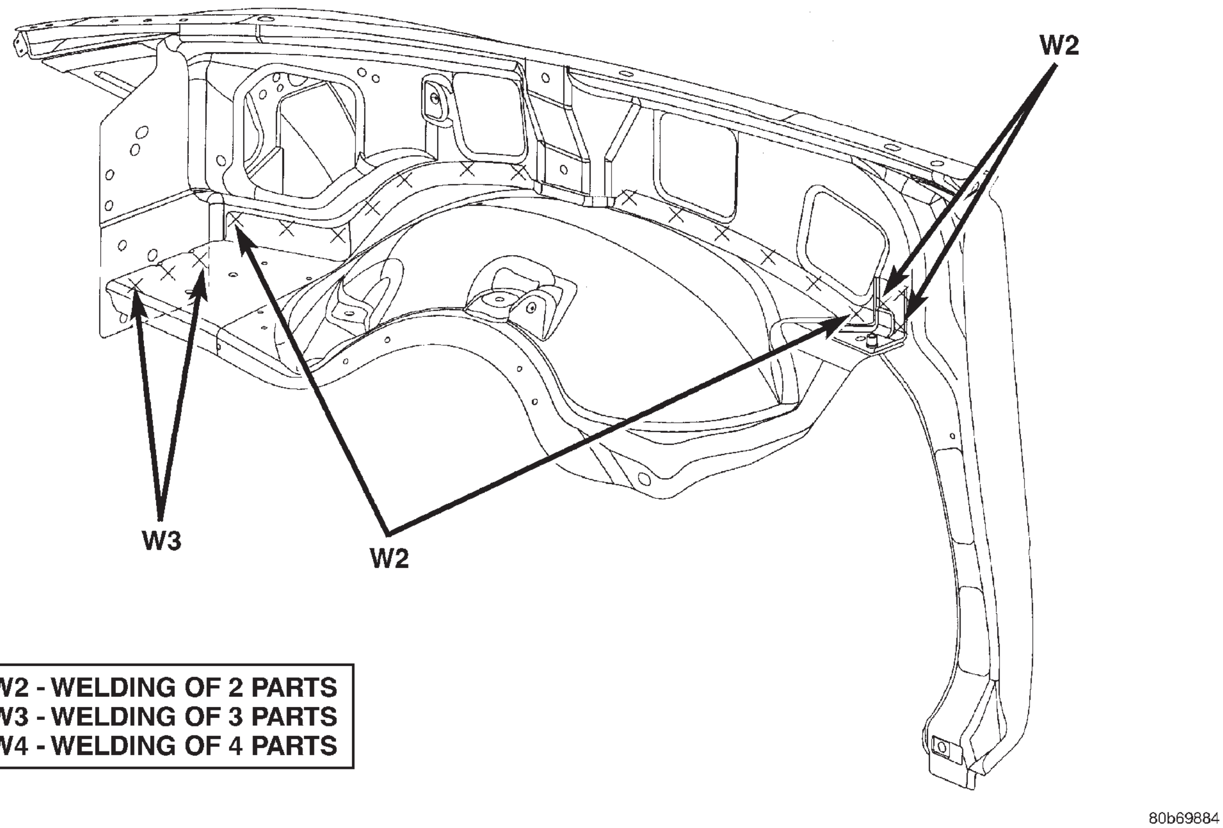
(5) Install trim panel.

BODY (Continued)

SPECIFICATIONS

WELD LOCATIONS

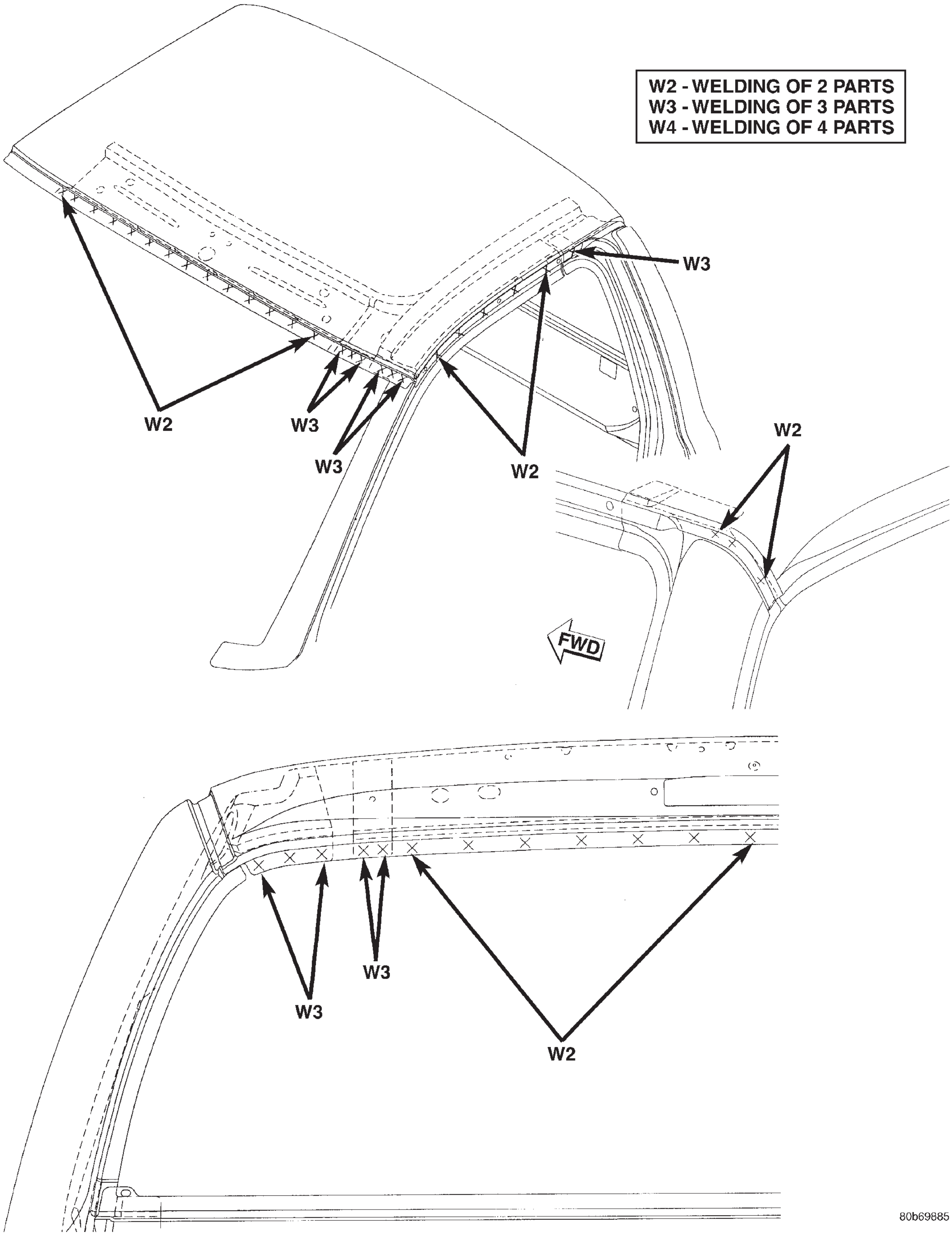
FRONT FENDER AND INNER WHEELHOUSE



W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

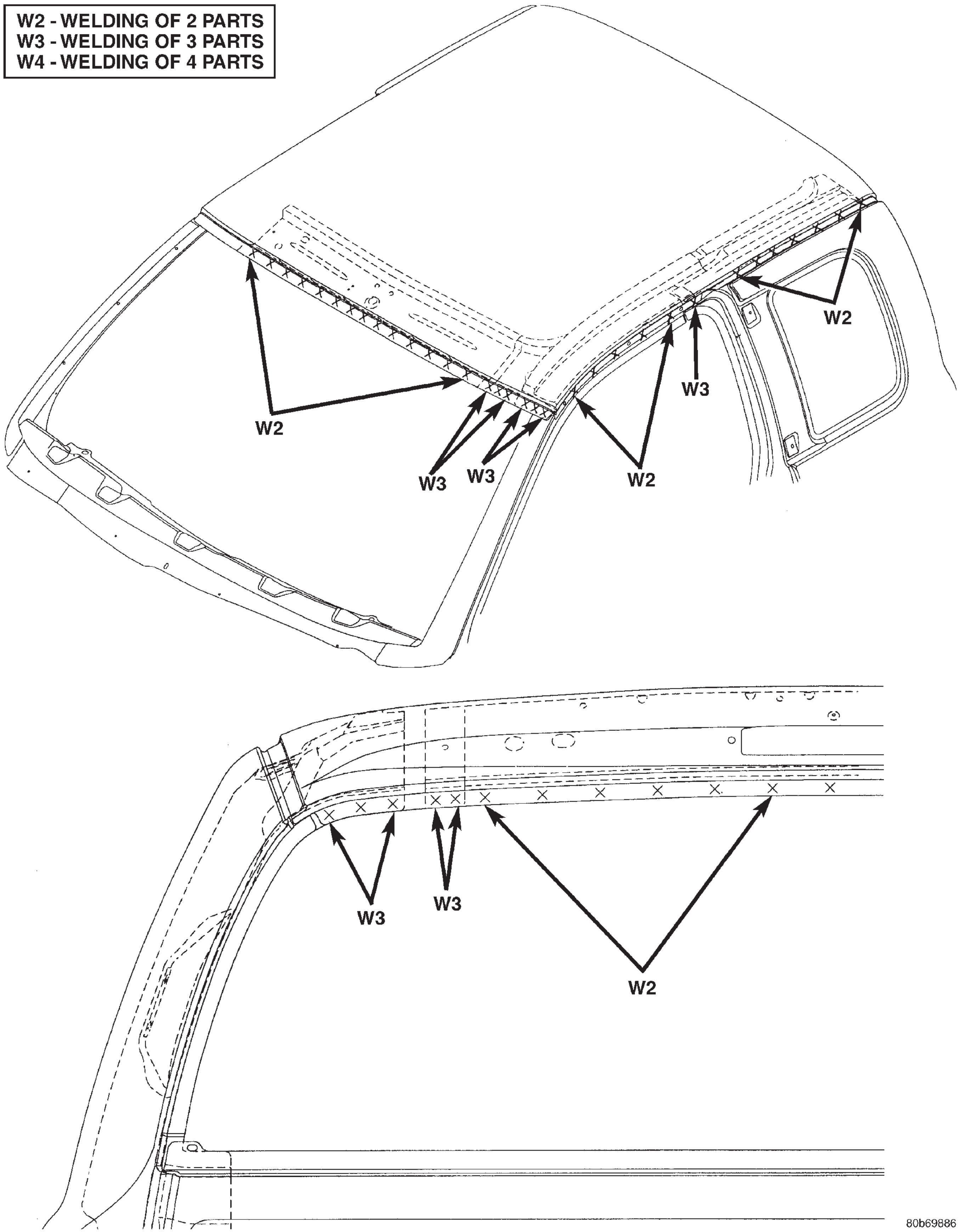
BODY (Continued)

ROOF PANEL—REGULAR CAB



BODY (Continued)

ROOF PANEL—CLUB CAB



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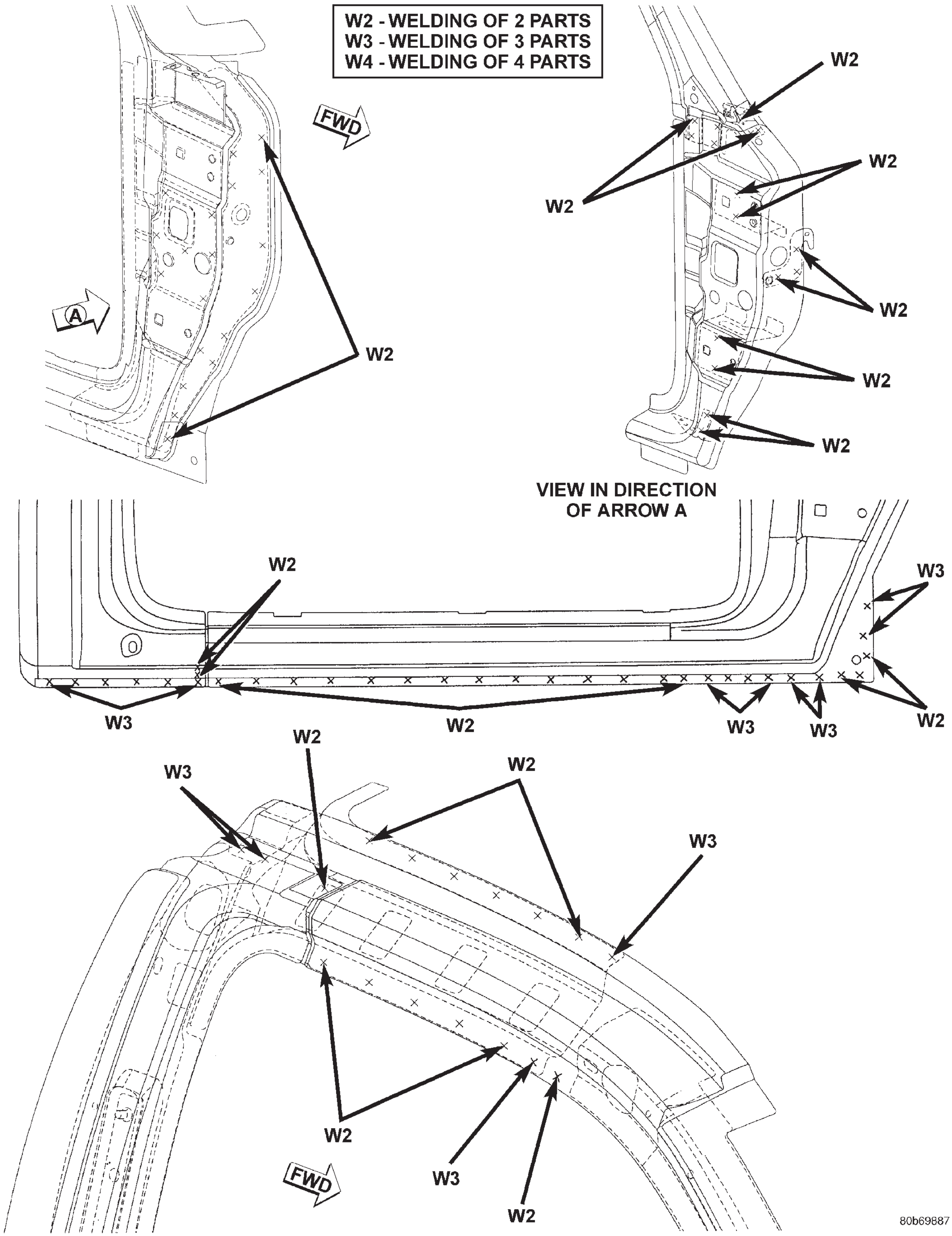
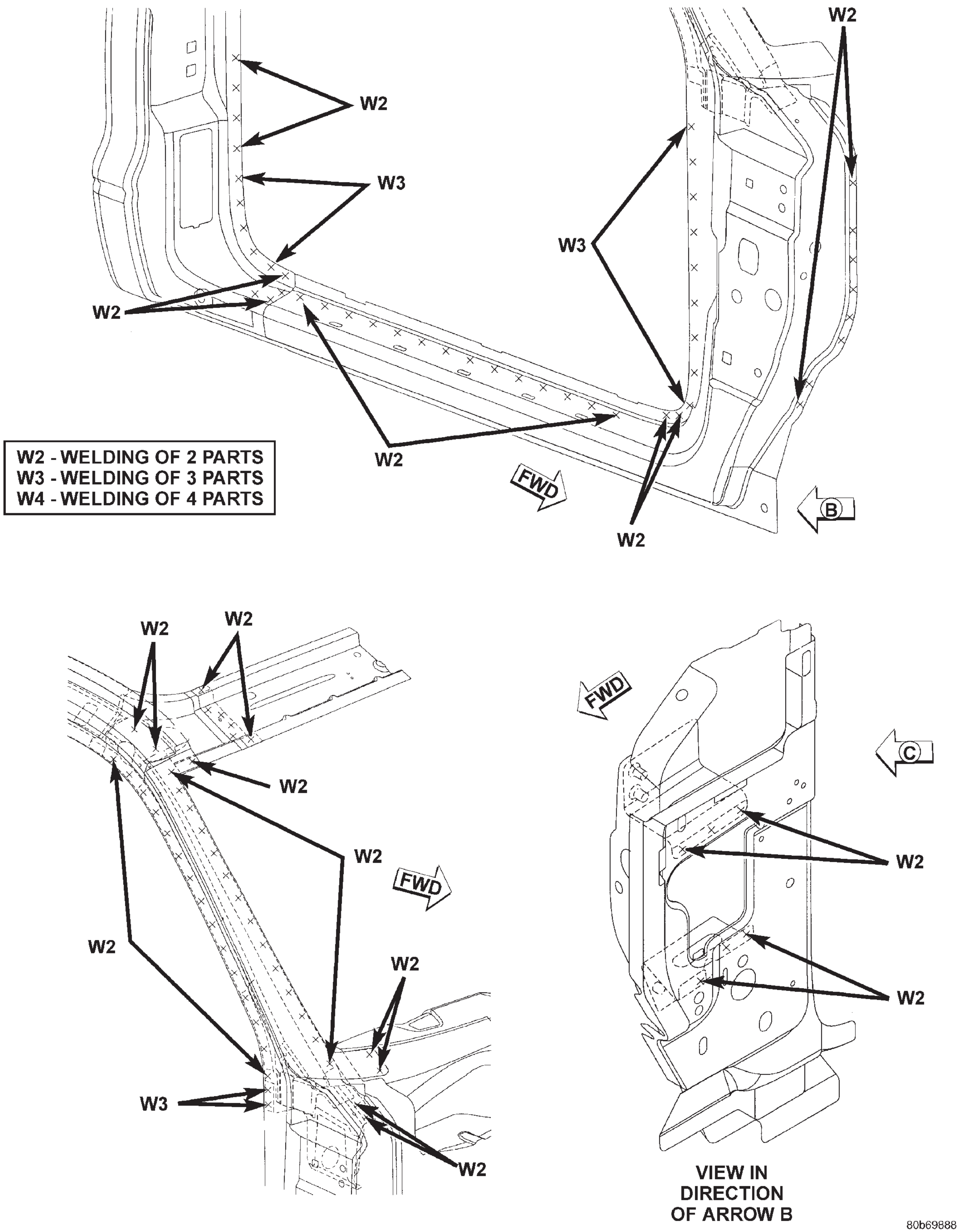
BODY SIDE APERTURE—REGULAR CAB



BODY (Continued)

BODY SIDE APERTURE—REGULAR CAB



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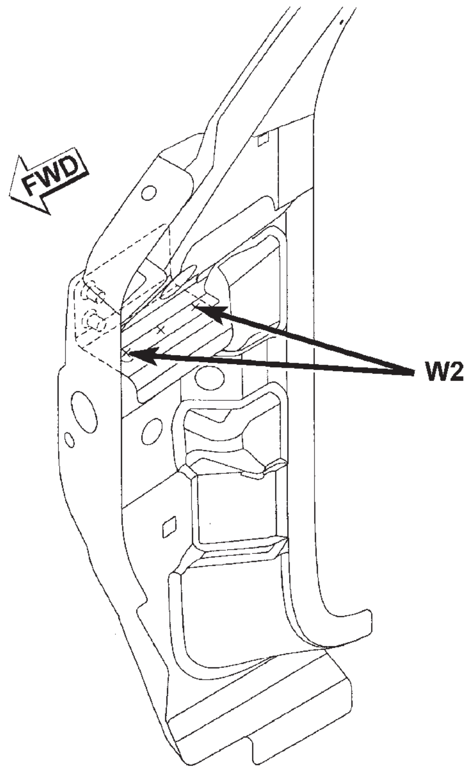
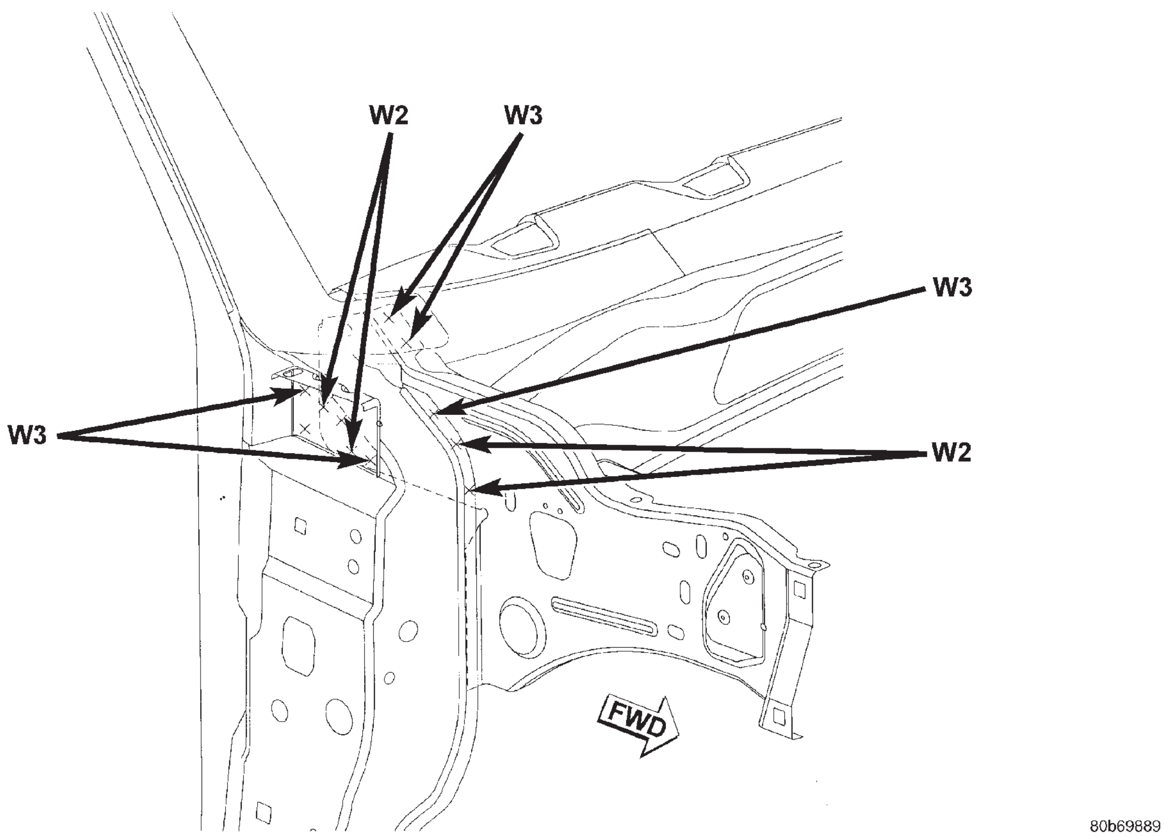
BODY SIDE APERTURE—REGULAR CAB



W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

VIEW IN
DIRECTION
OF ARROW C



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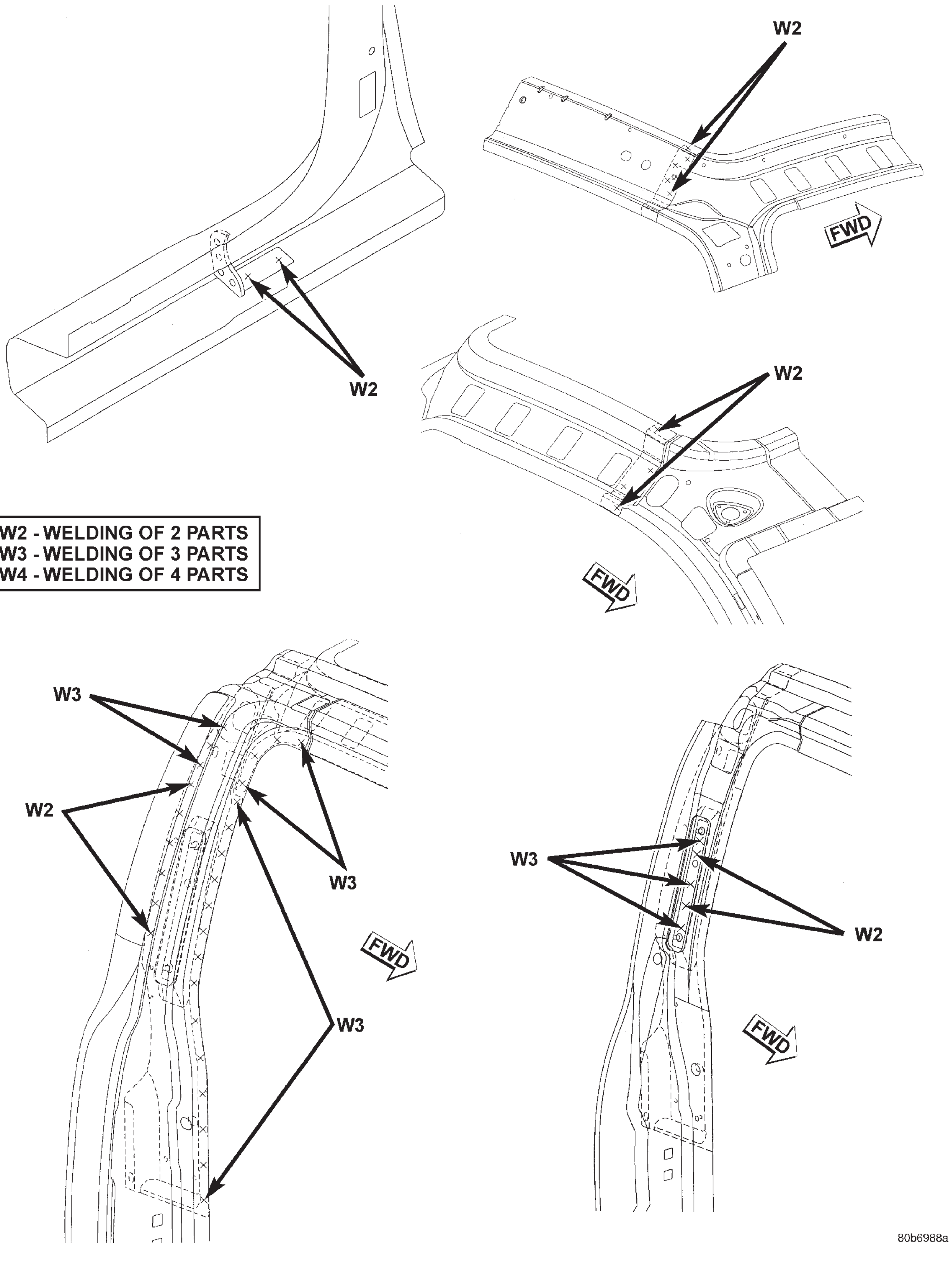
BODY SIDE APERTURE—REGULAR CAB



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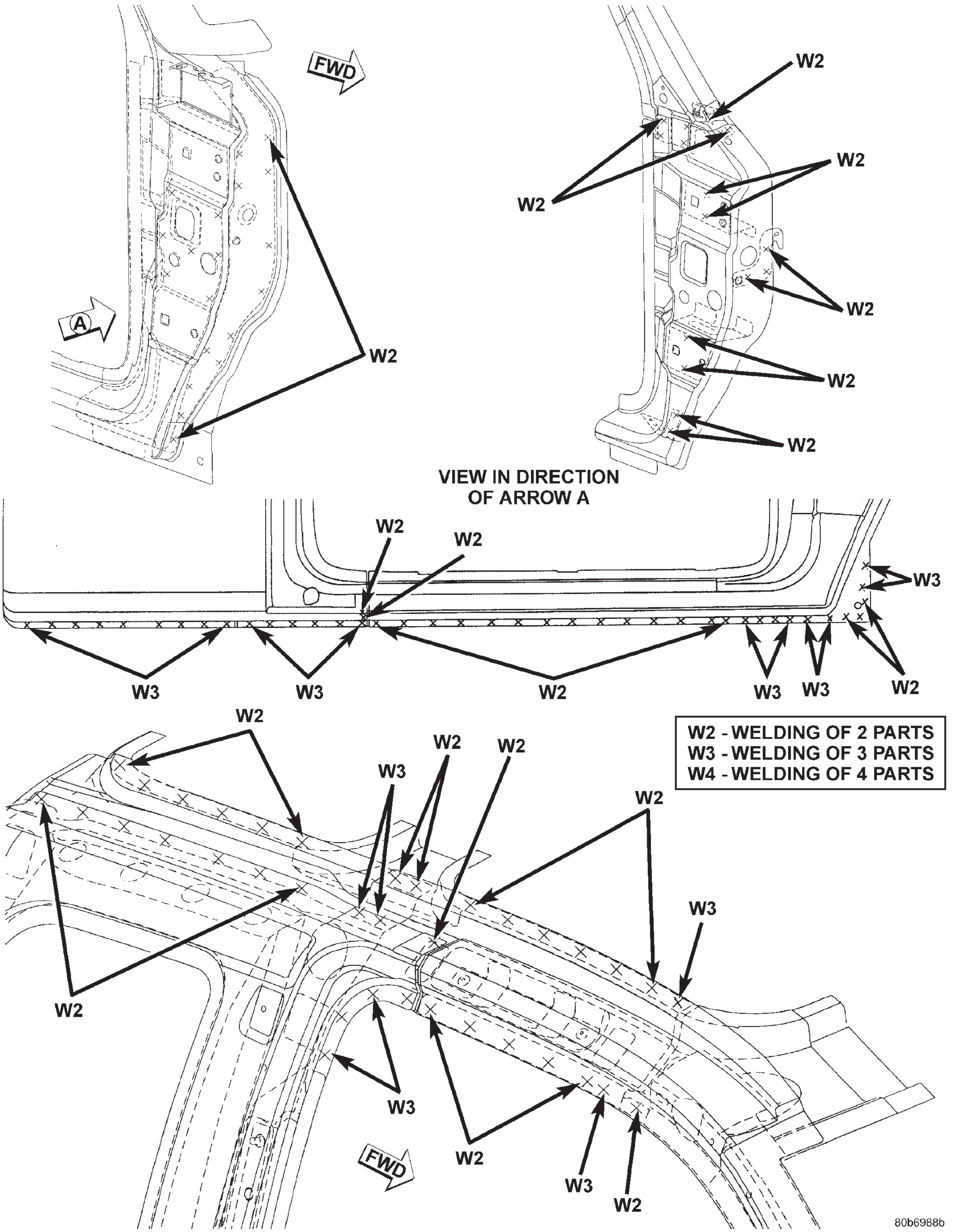
BODY (Continued)

BODY SIDE APERTURE—CLUB CAB



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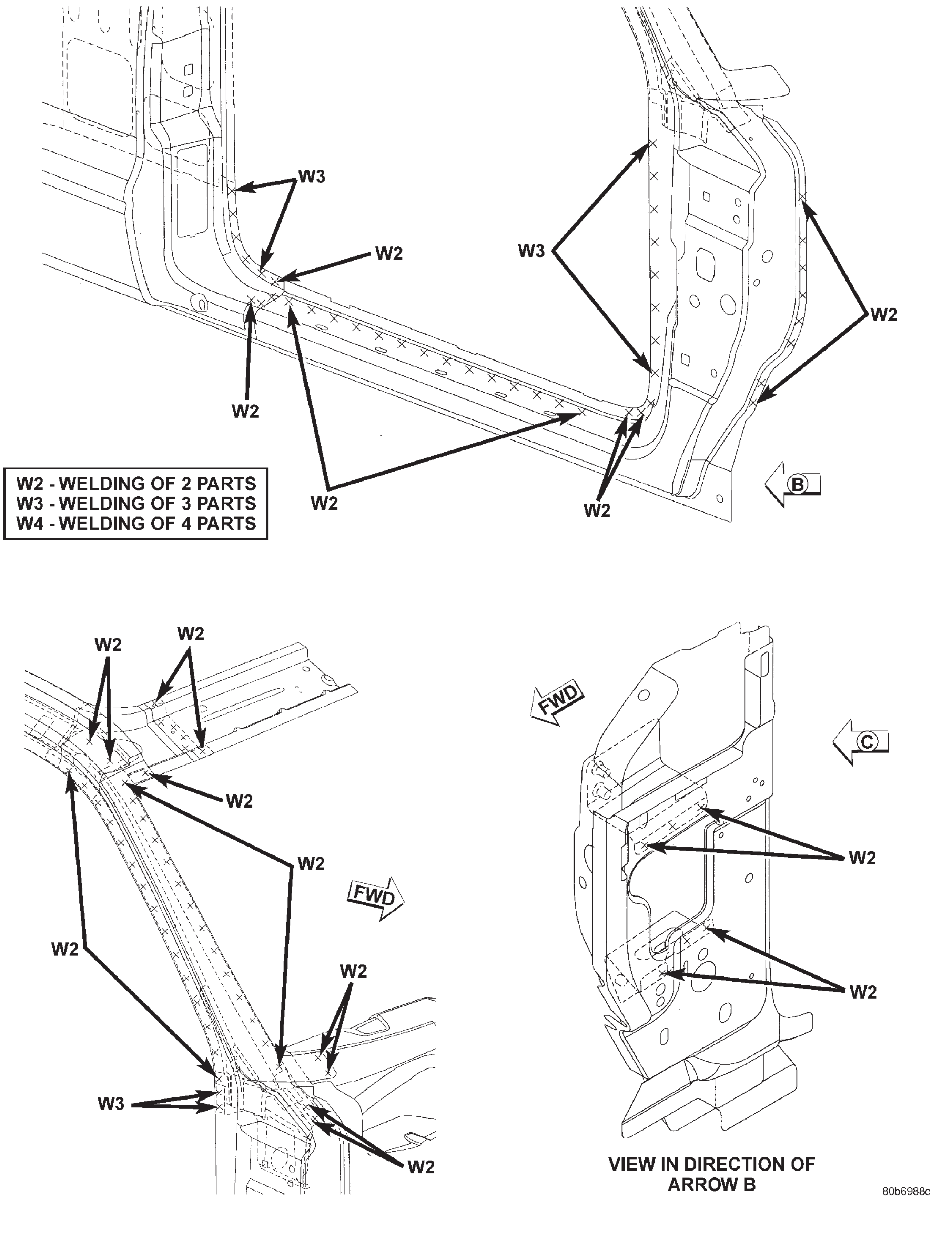
BODY SIDE APERTURE—CLUB CAB



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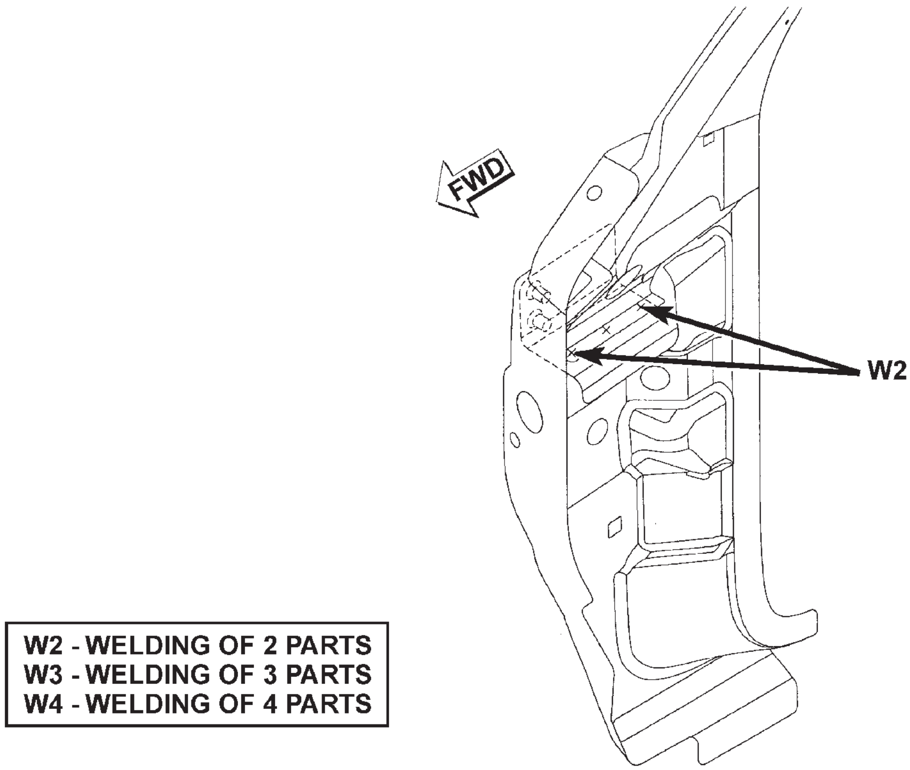
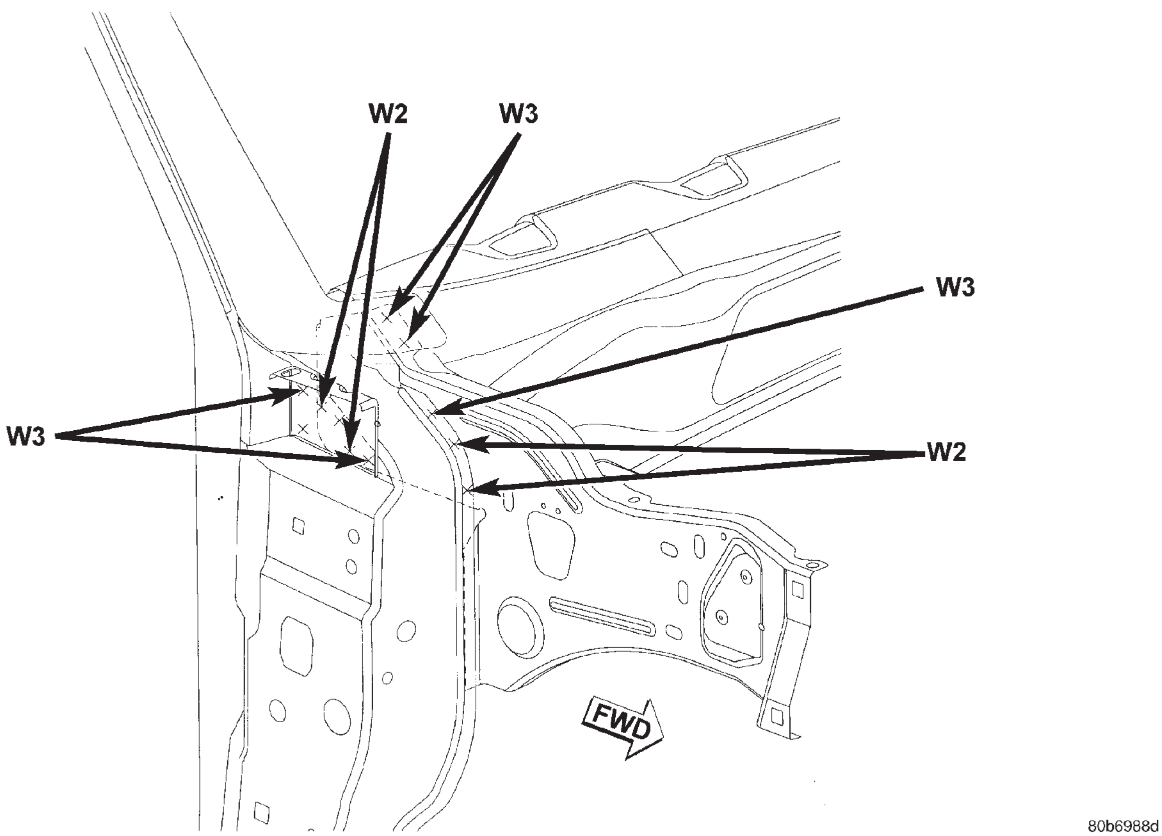
BODY SIDE APERTURE—CLUB CAB



VIEW IN DIRECTION OF ARROW C



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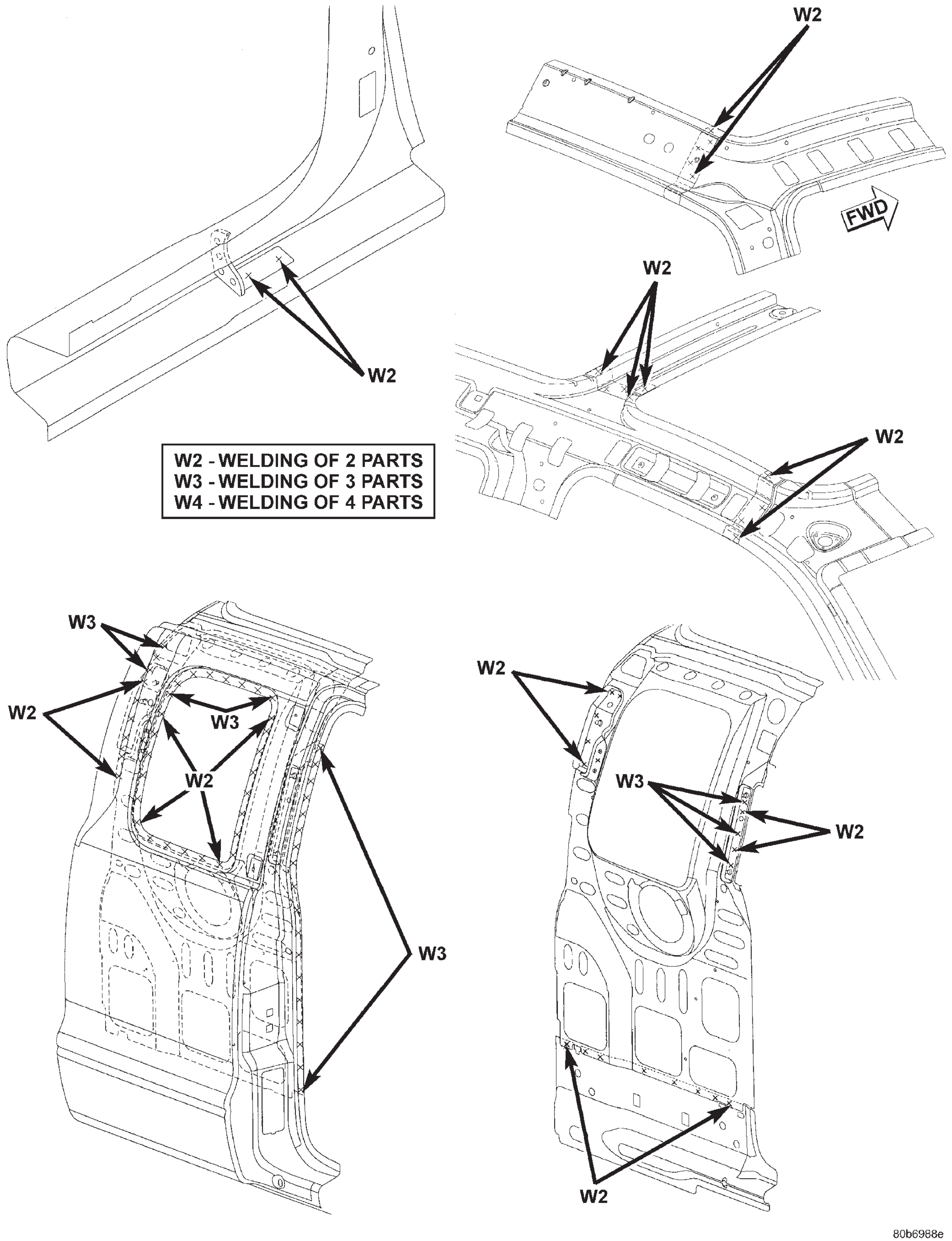
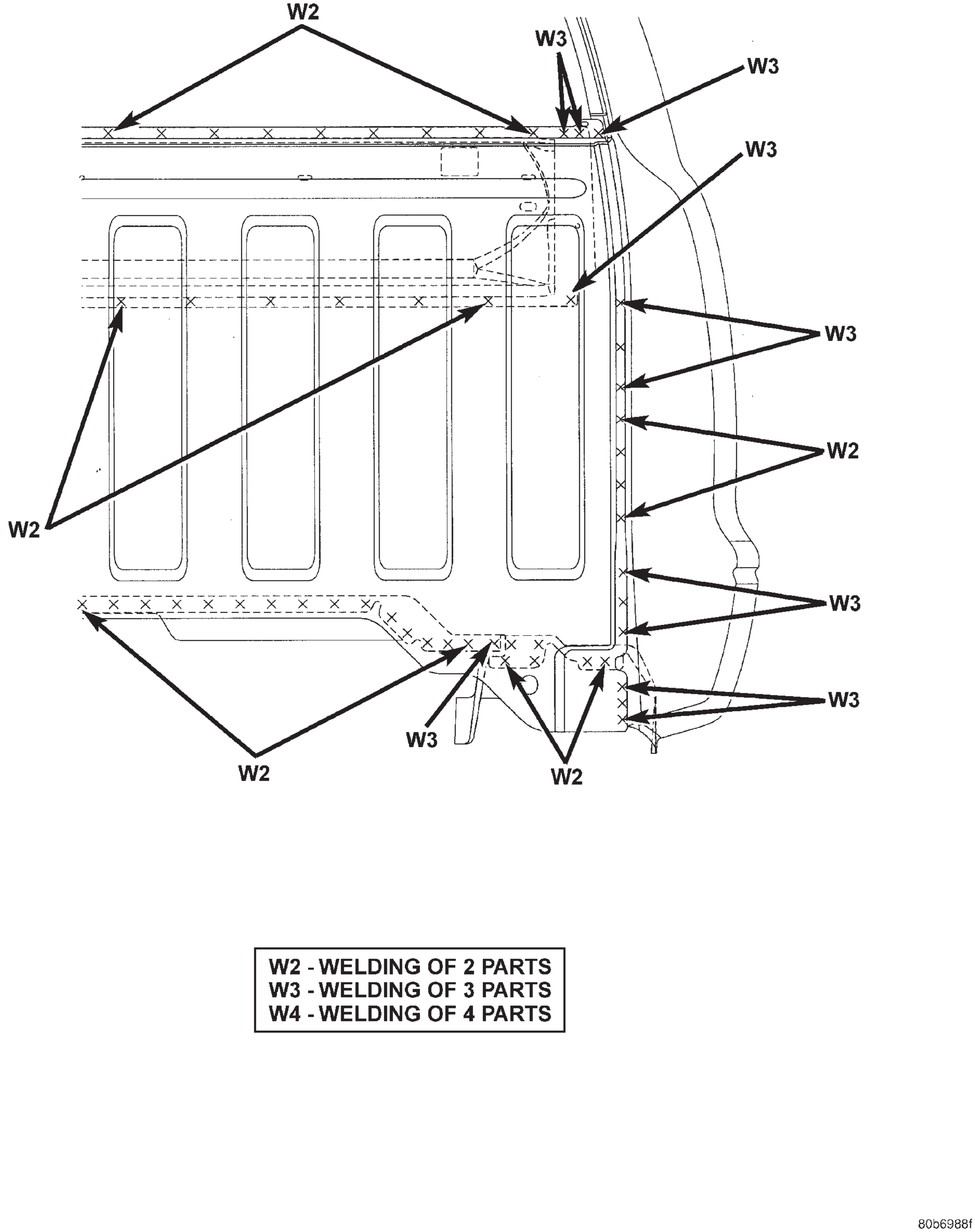
BODY SIDE APERTURE—CLUB CAB



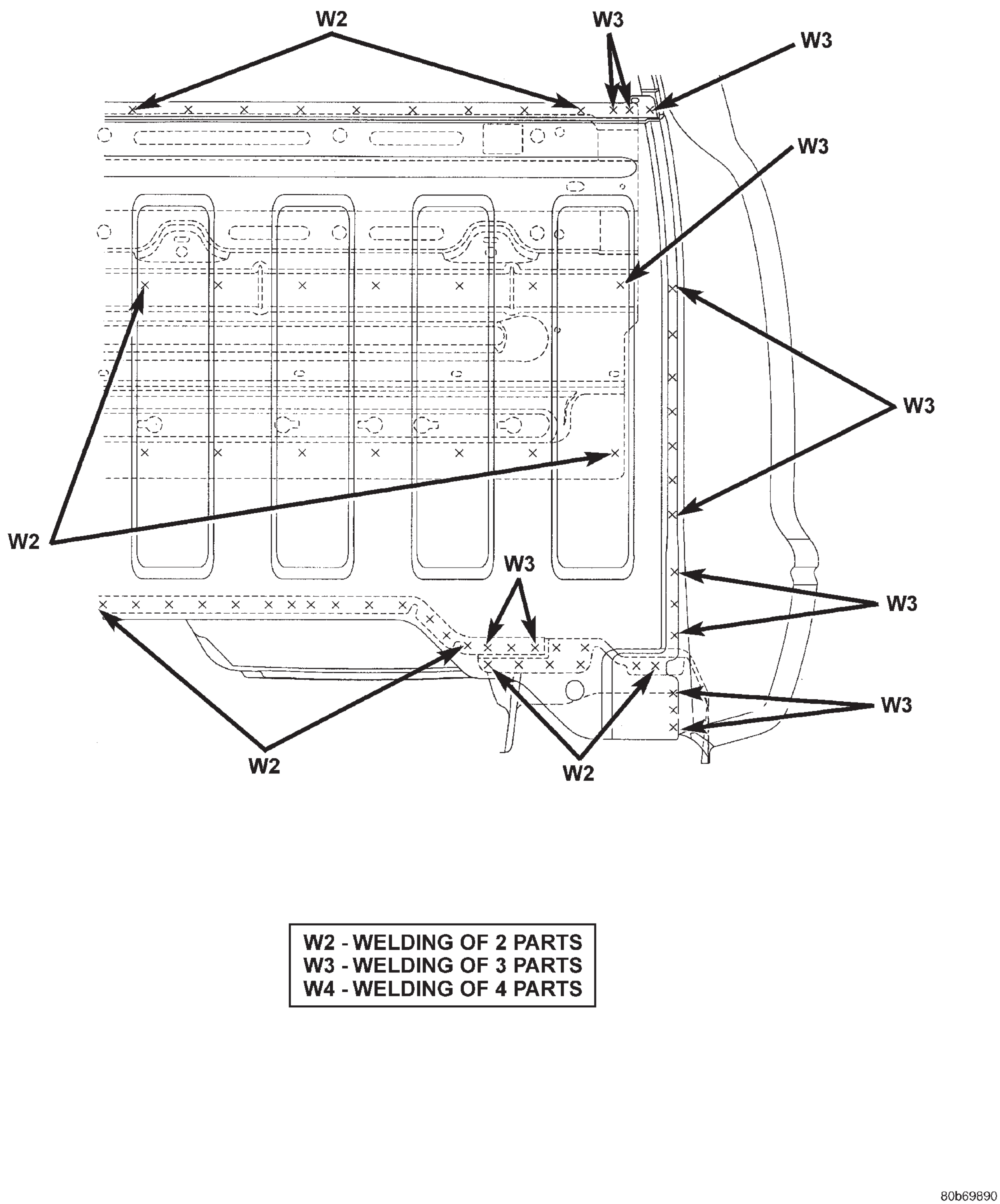
BODY (Continued)

CAB BACK PANEL—REGULAR CAB



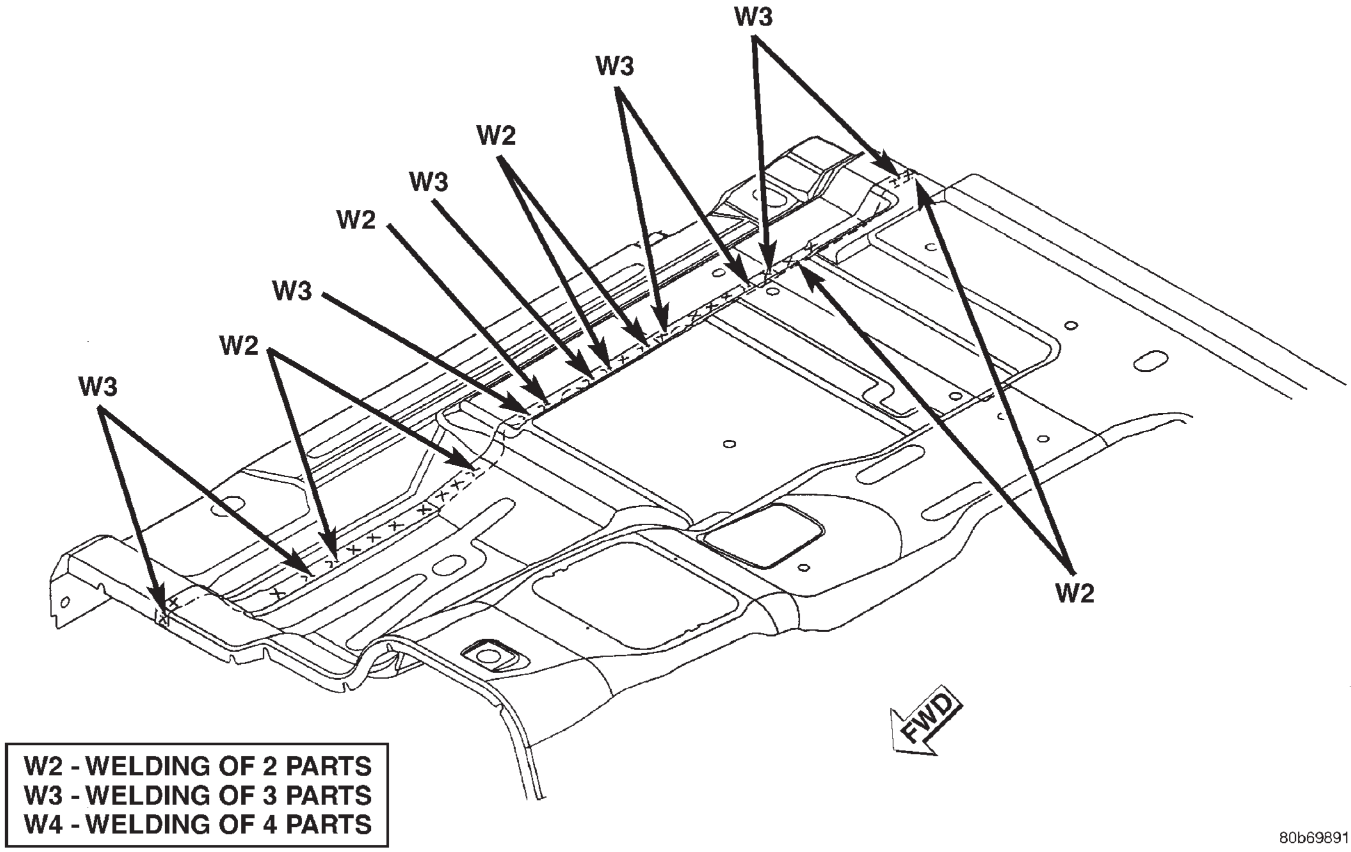
BODY (Continued)

CAB BACK PANEL—CLUB CAB



BODY (Continued)

FLOOR PAN—REGULAR CAB



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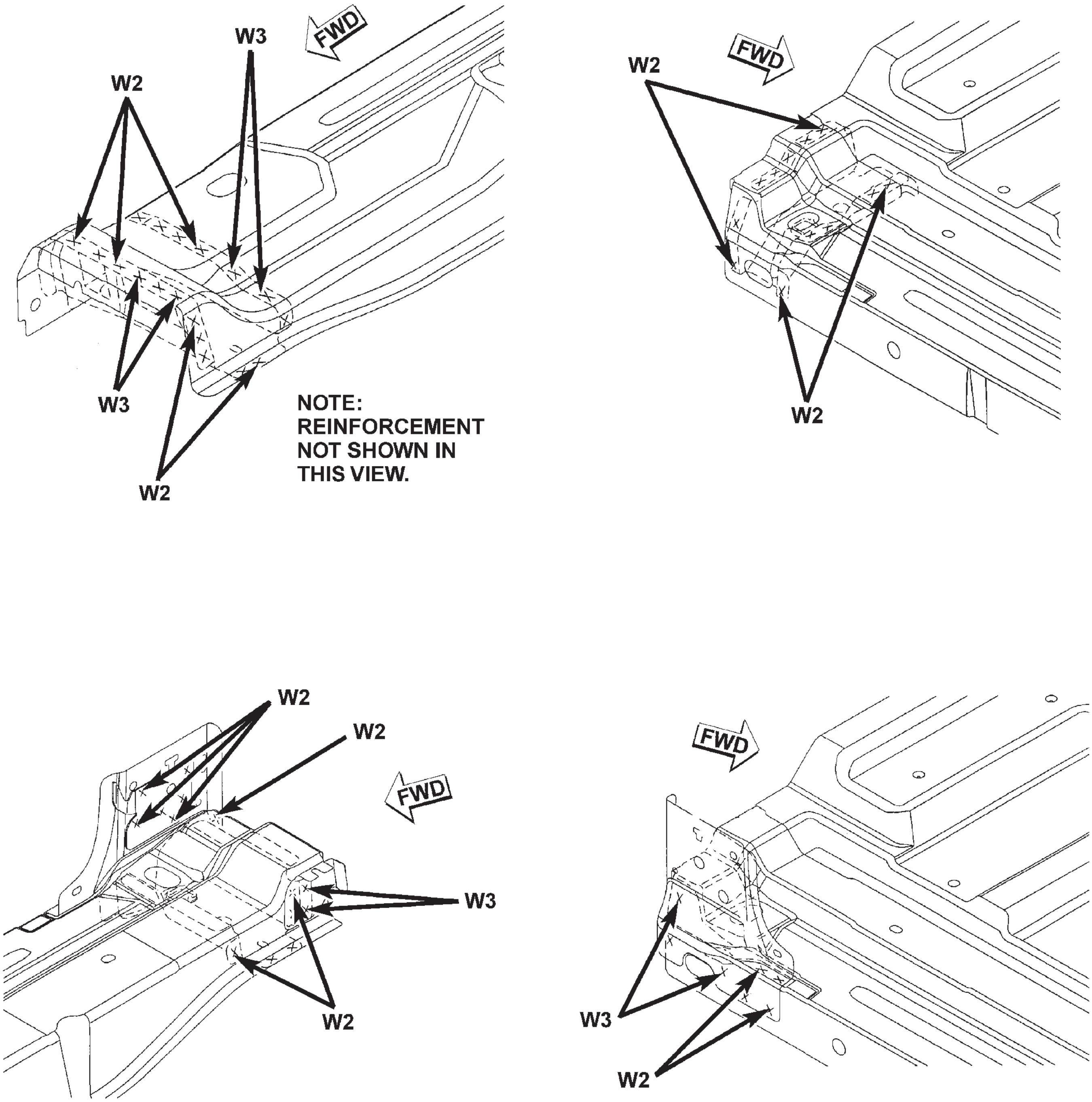
FLOOR PAN—REGULAR CAB



W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS
W4 - WELDING OF 4 PARTS

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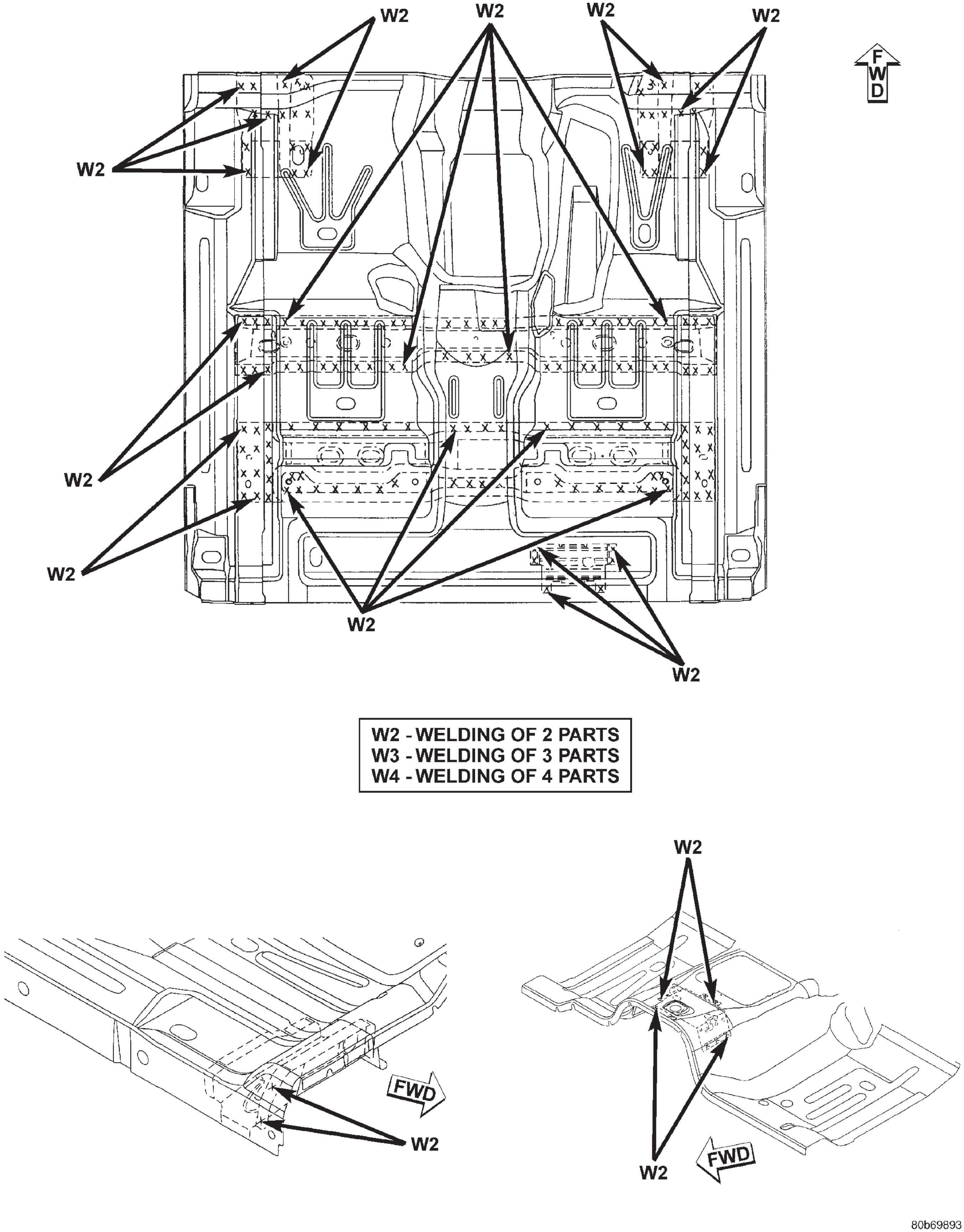
BODY (Continued)

FLOOR PAN—CLUB CAB



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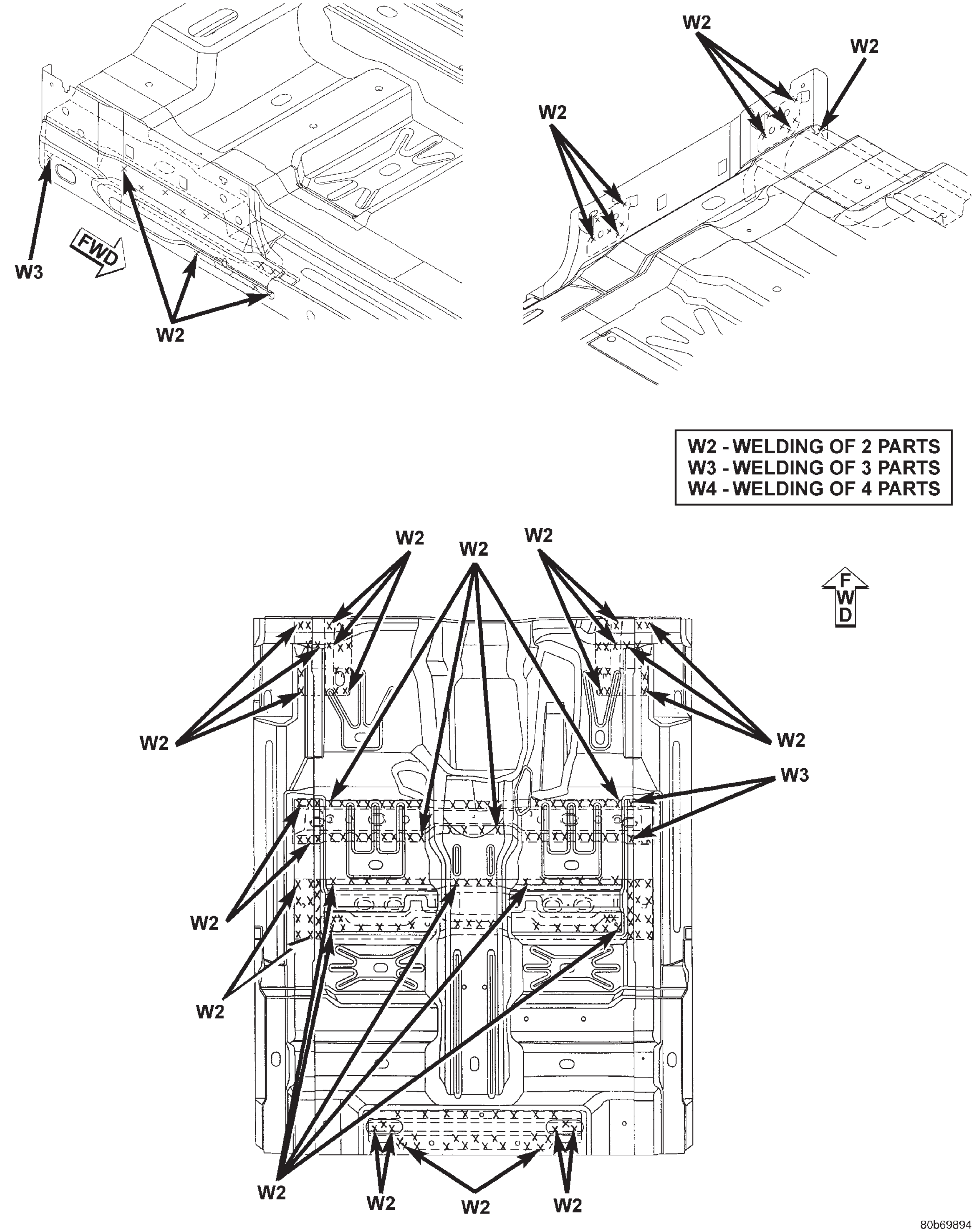
FLOOR PAN—CLUB CAB



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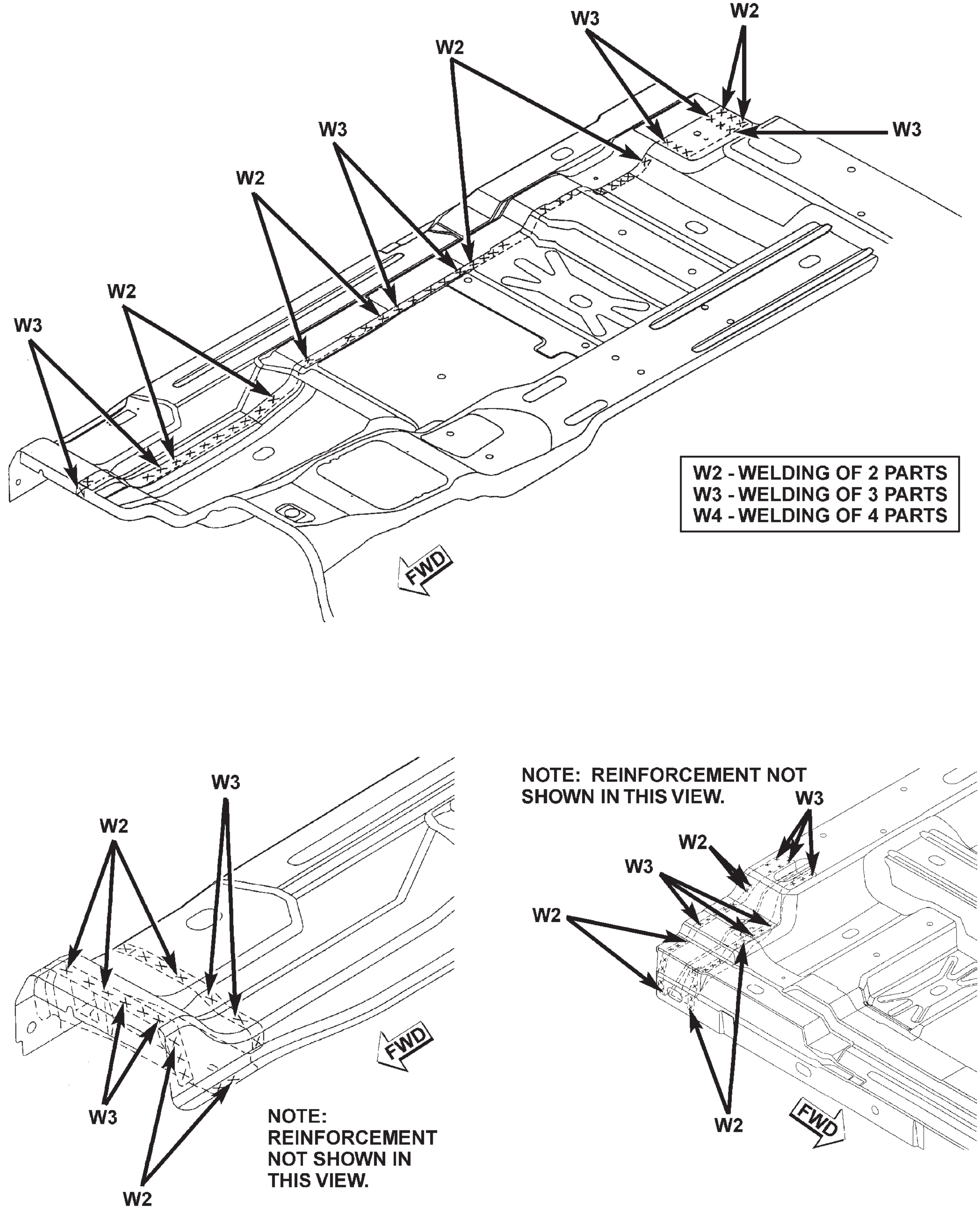
FLOOR PAN—CLUB CAB



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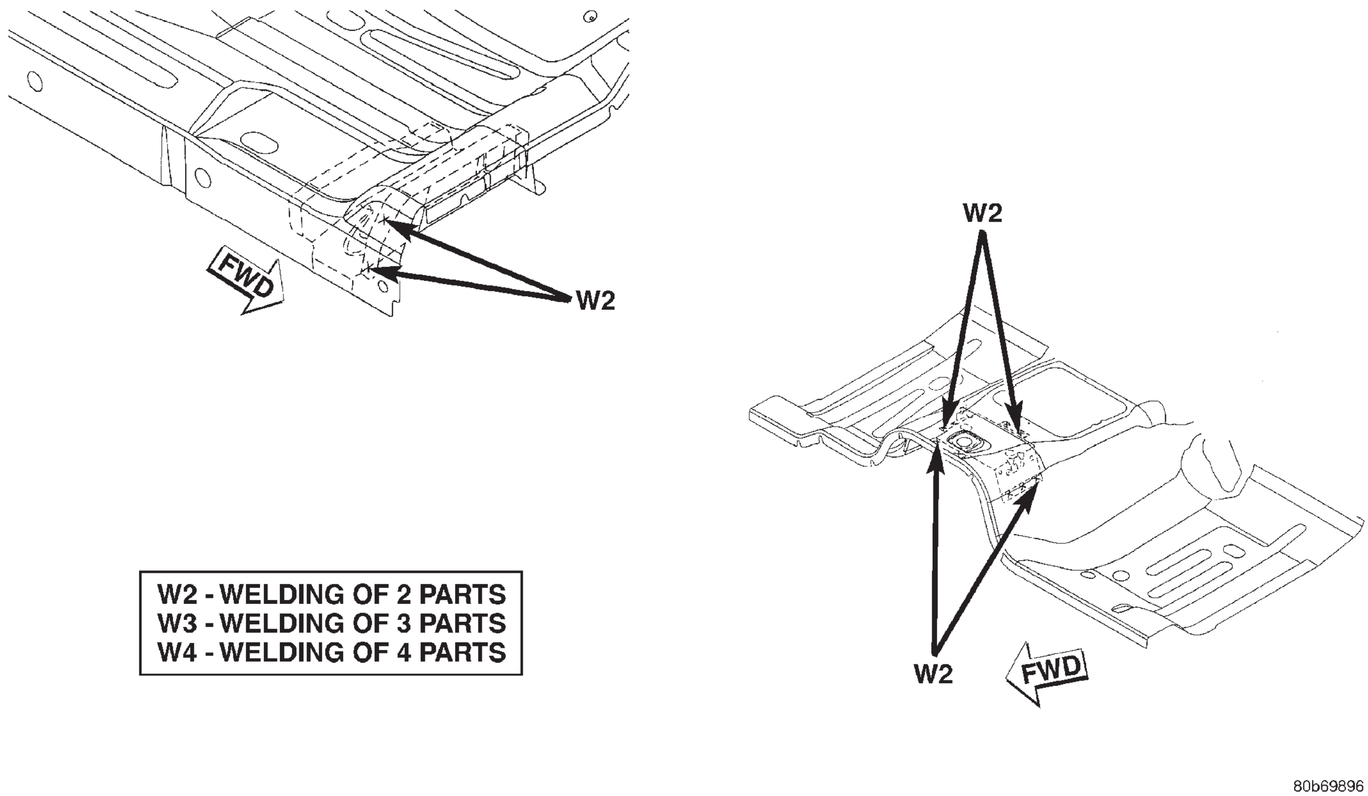
COWL AND DASH PANEL



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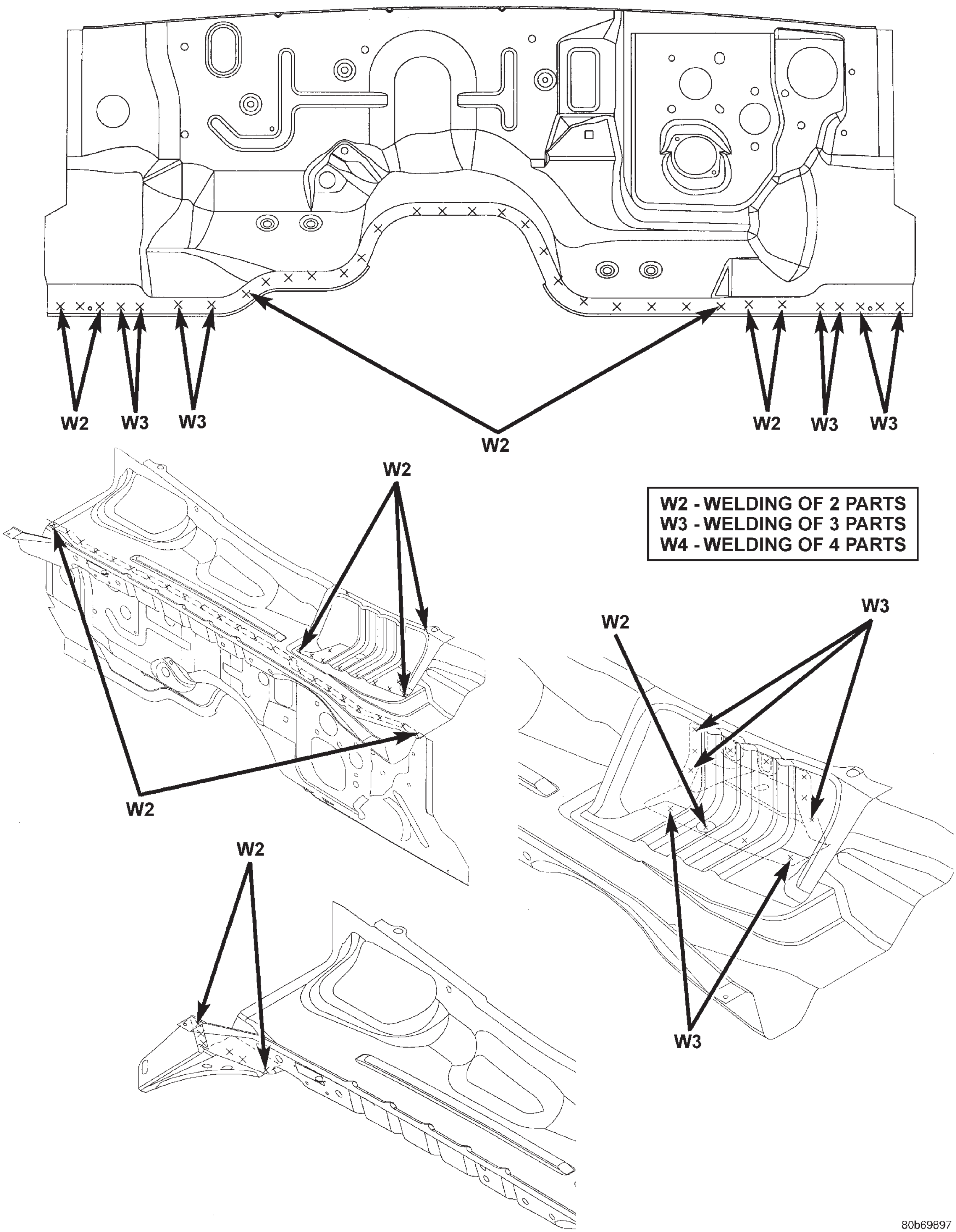
COWL AND DASH PANEL



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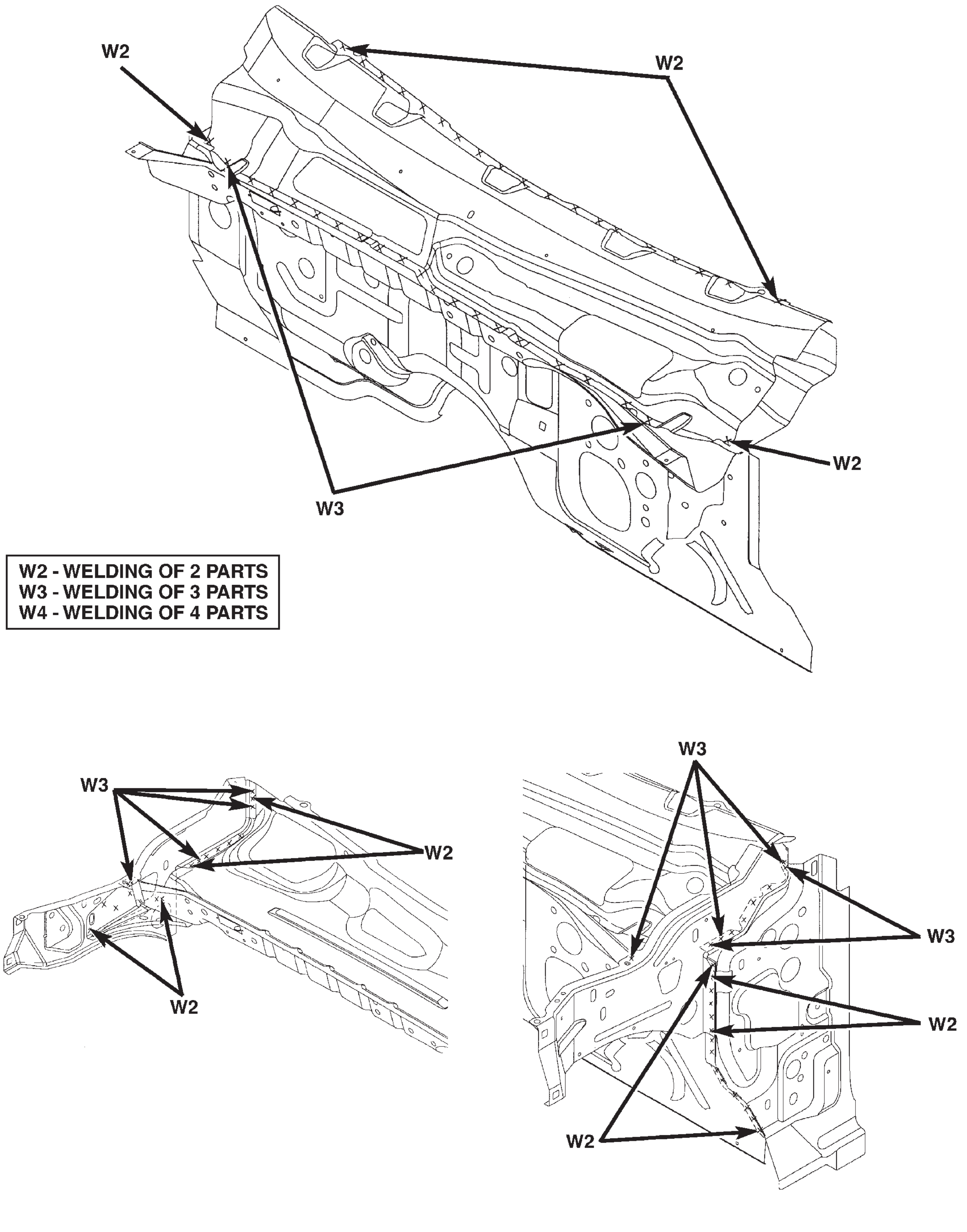
COWL AND DASH



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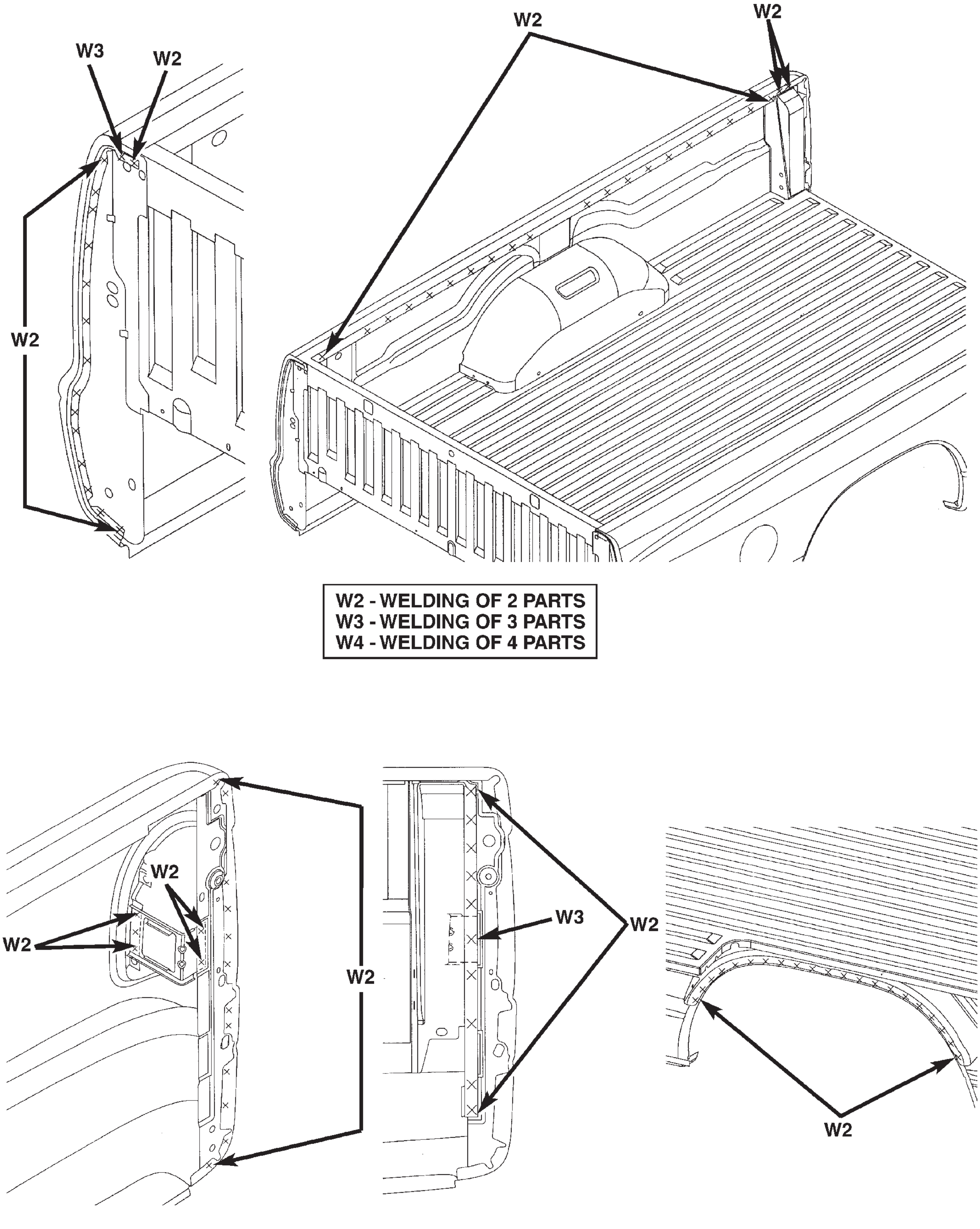
CARGO BOX INNER SIDE PANEL



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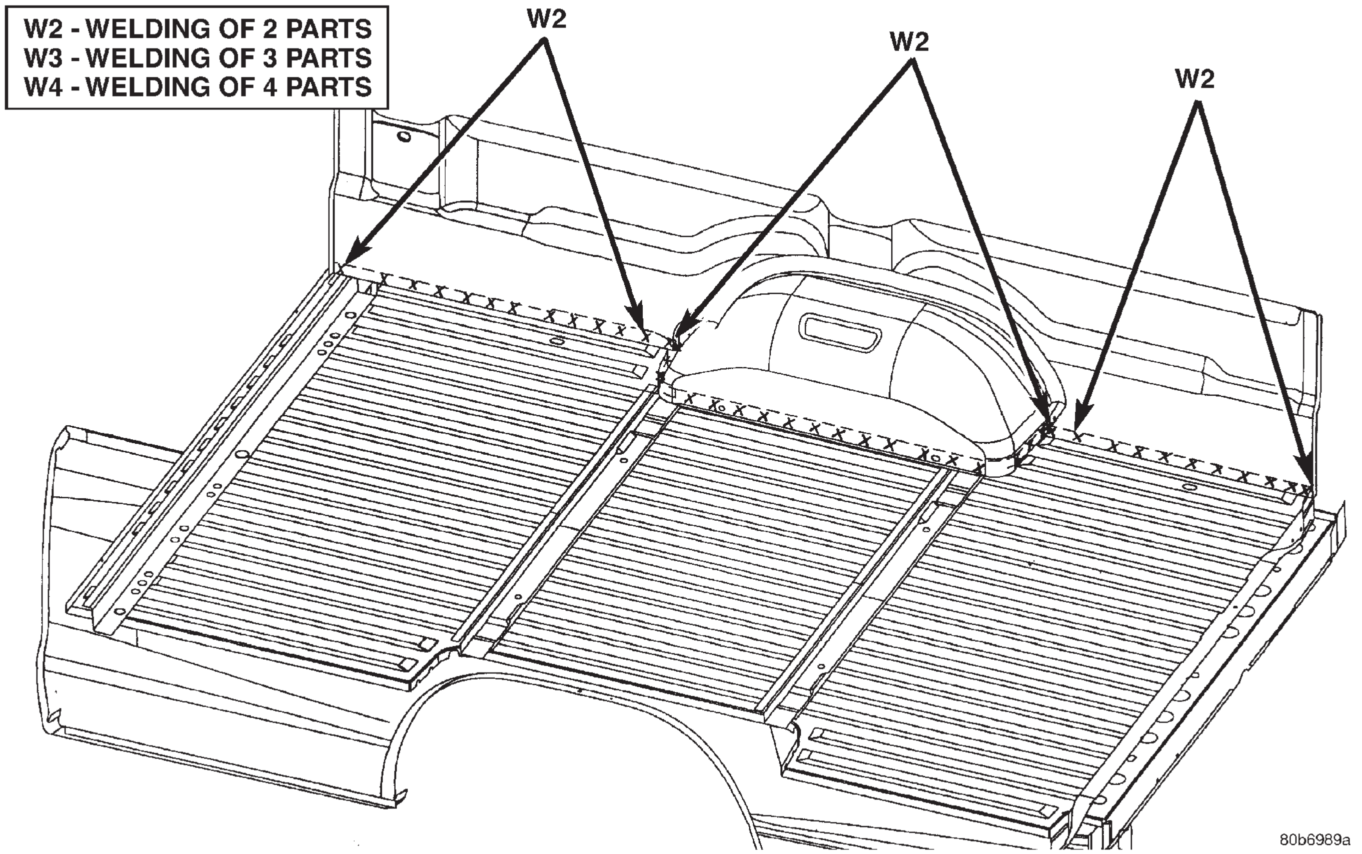
CARGO BOX INNER SIDE PANEL



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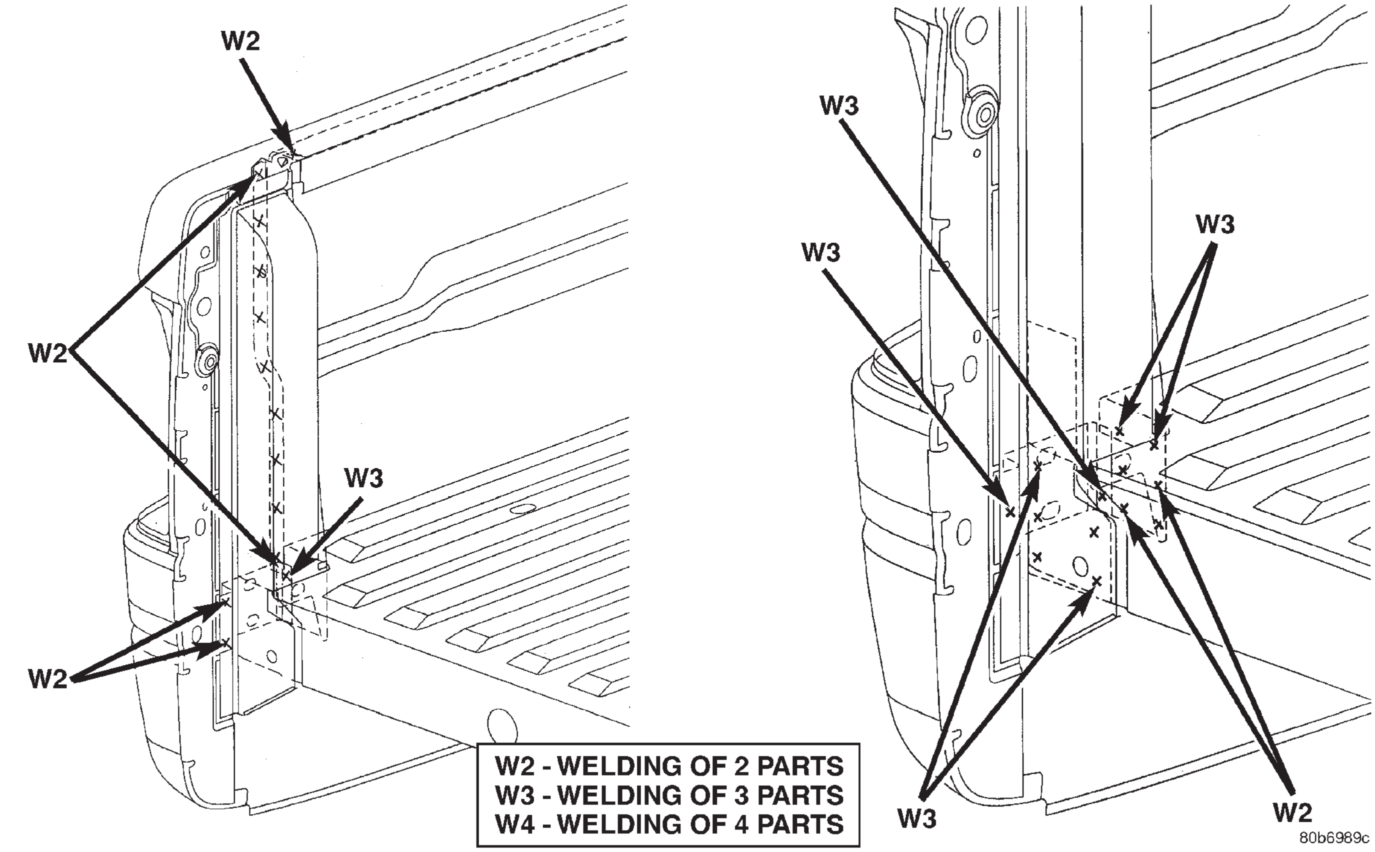

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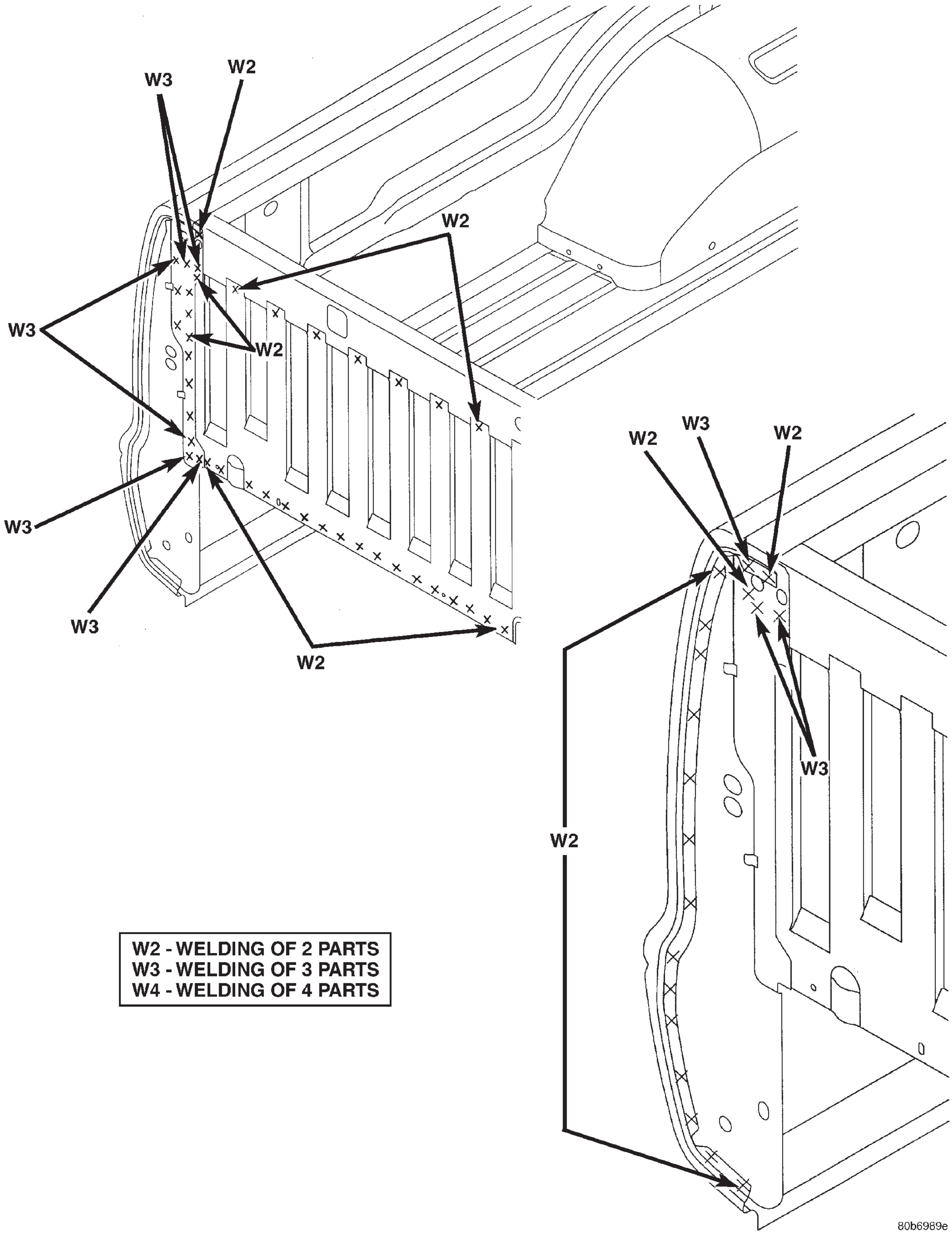
CARGO BOX FRONT PANELS



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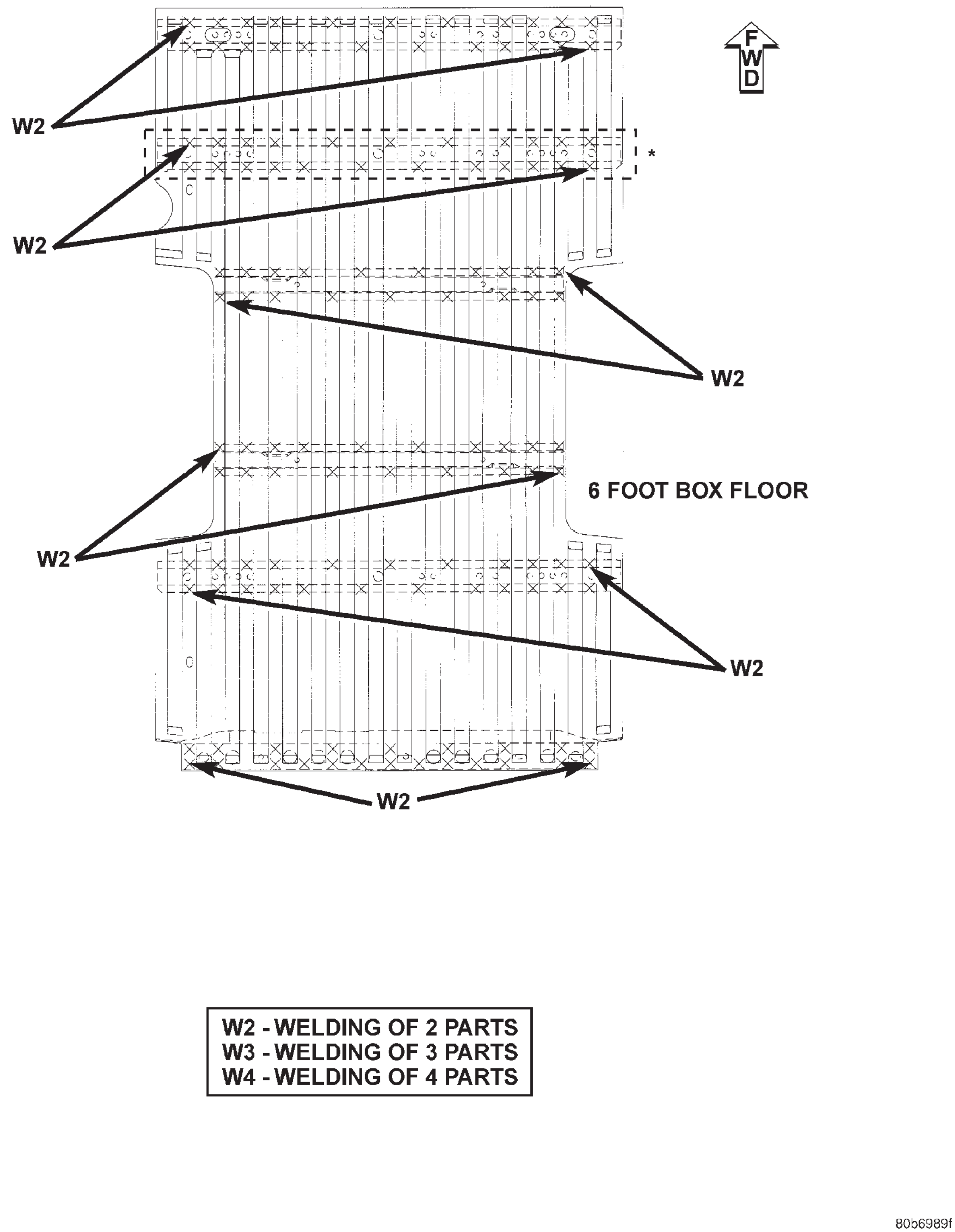
CARGO BOX FLOOR



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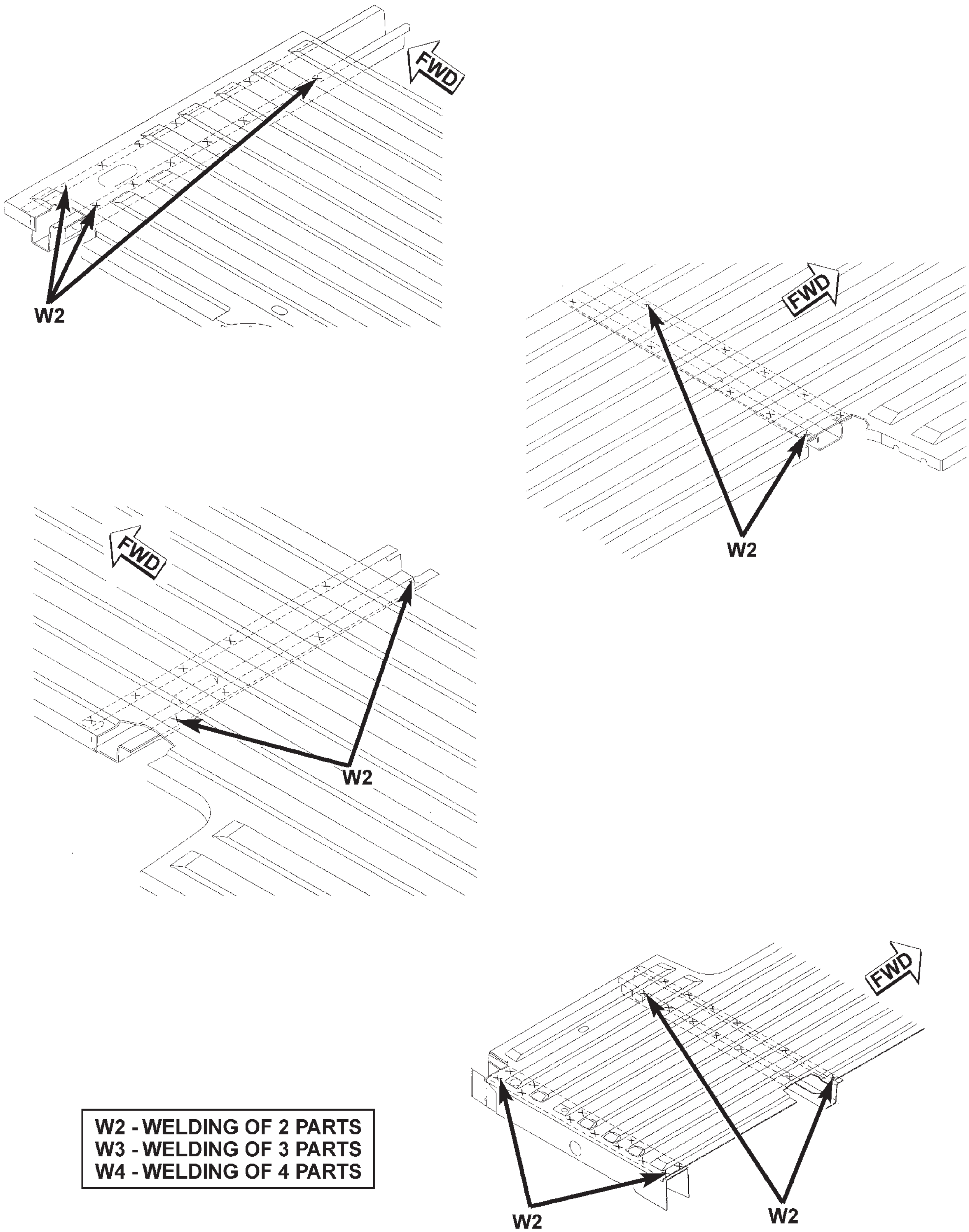
CARGO BOX FLOOR



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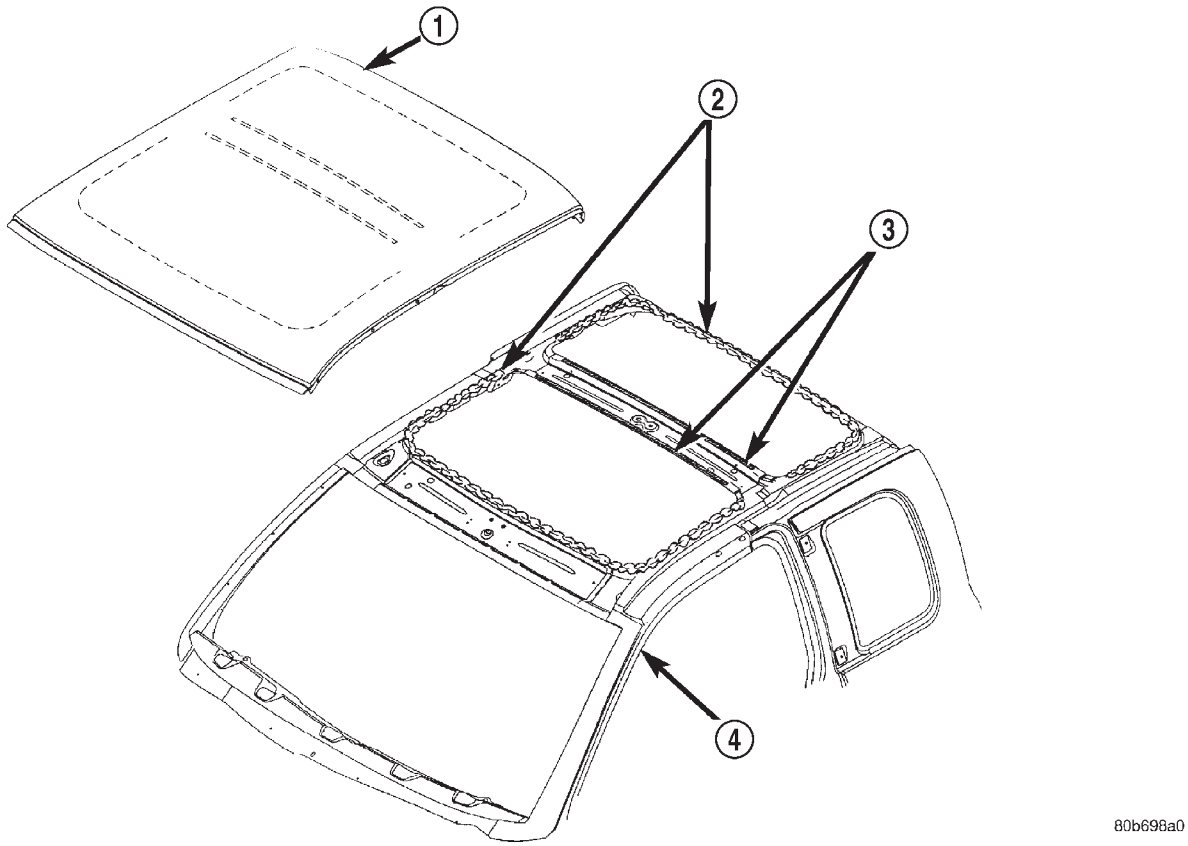
STRUCTURAL ADHESIVE LOCATIONS

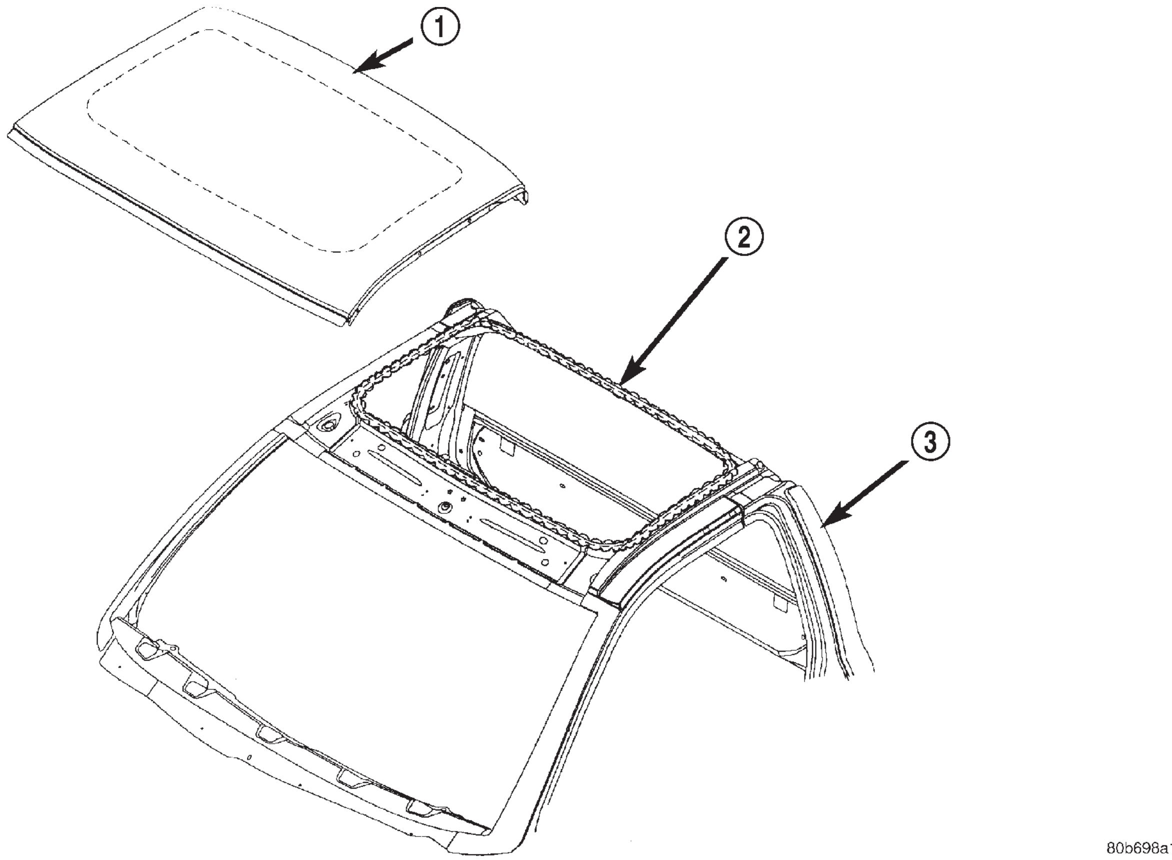
ROOF—EXTENDED CAB



1 - OUTER ROOF PANEL
2 - STRUCTURAL ADHESIVE
3 - ADHESIVE RIBBON
4 - EXTENDED CAB FRAMING

BODY (Continued)

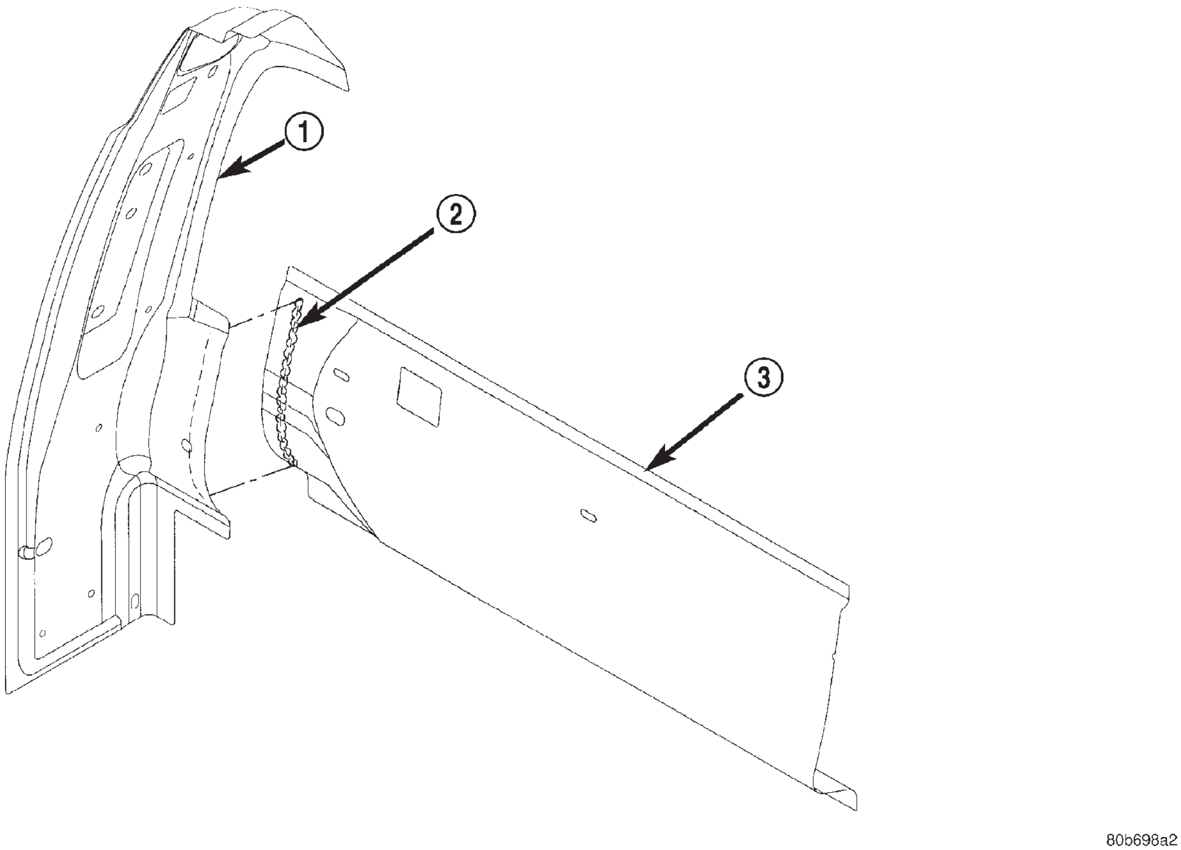
ROOF—REGULAR CAB



1 - OUTER ROOF PANEL
2 - STRUCTURAL ADHESIVE
3 - REGULAR CAB FRAMING

BODY (Continued)

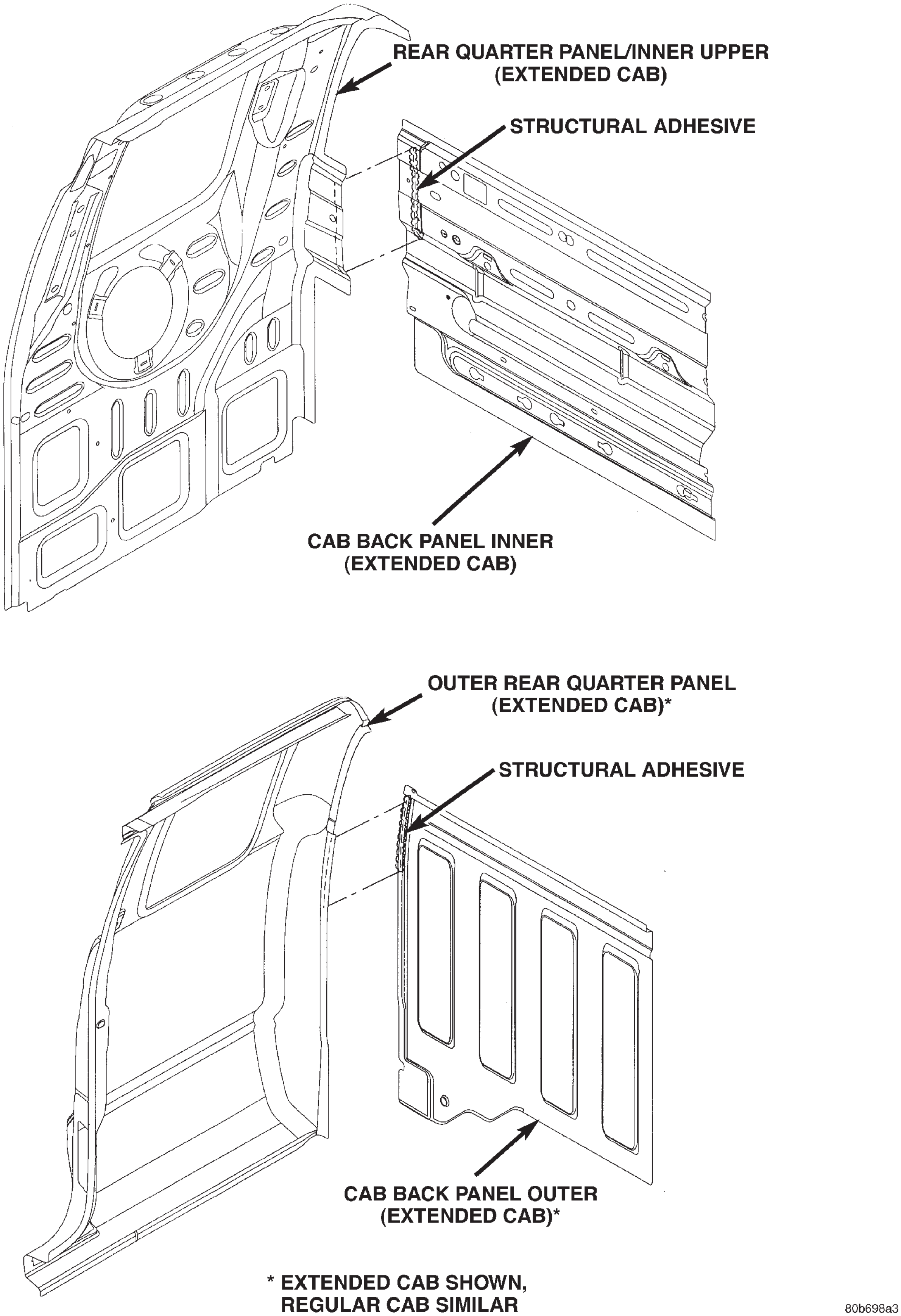
REAR QUARTER PANEL—REGULAR CAB



1 - REAR QUARTER PANEL/INNER UPPER (REGULAR CAB)
2 - STRUCTURAL ADHESIVE
3 - CAB BACK REINFORCEMENT (REGULAR CAB)

BODY (Continued)

REAR QUARTER PANEL—EXTENDED CAB



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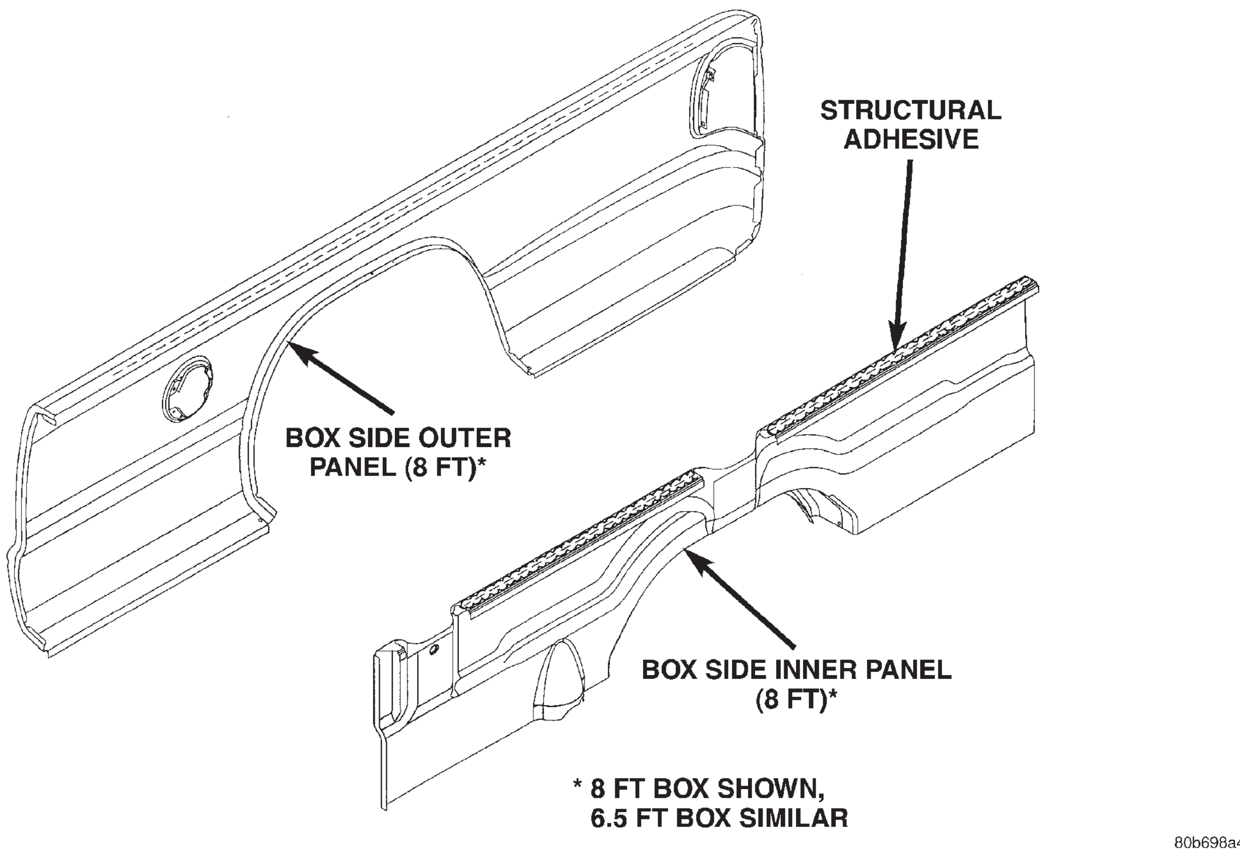
CARGO BOX INNER AND OUTER PANEL



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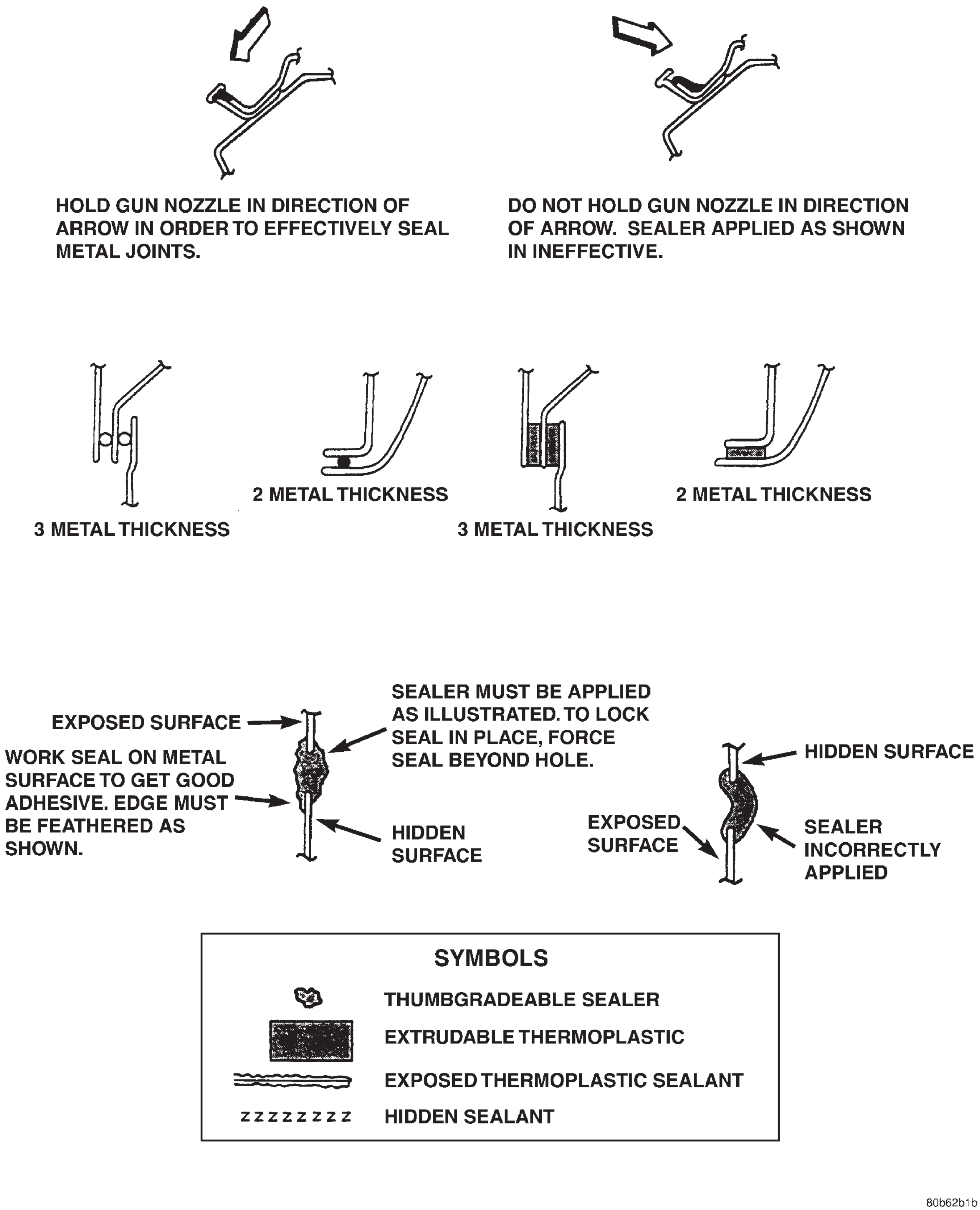
SEALER LOCATIONS

APPLICATION METHODS



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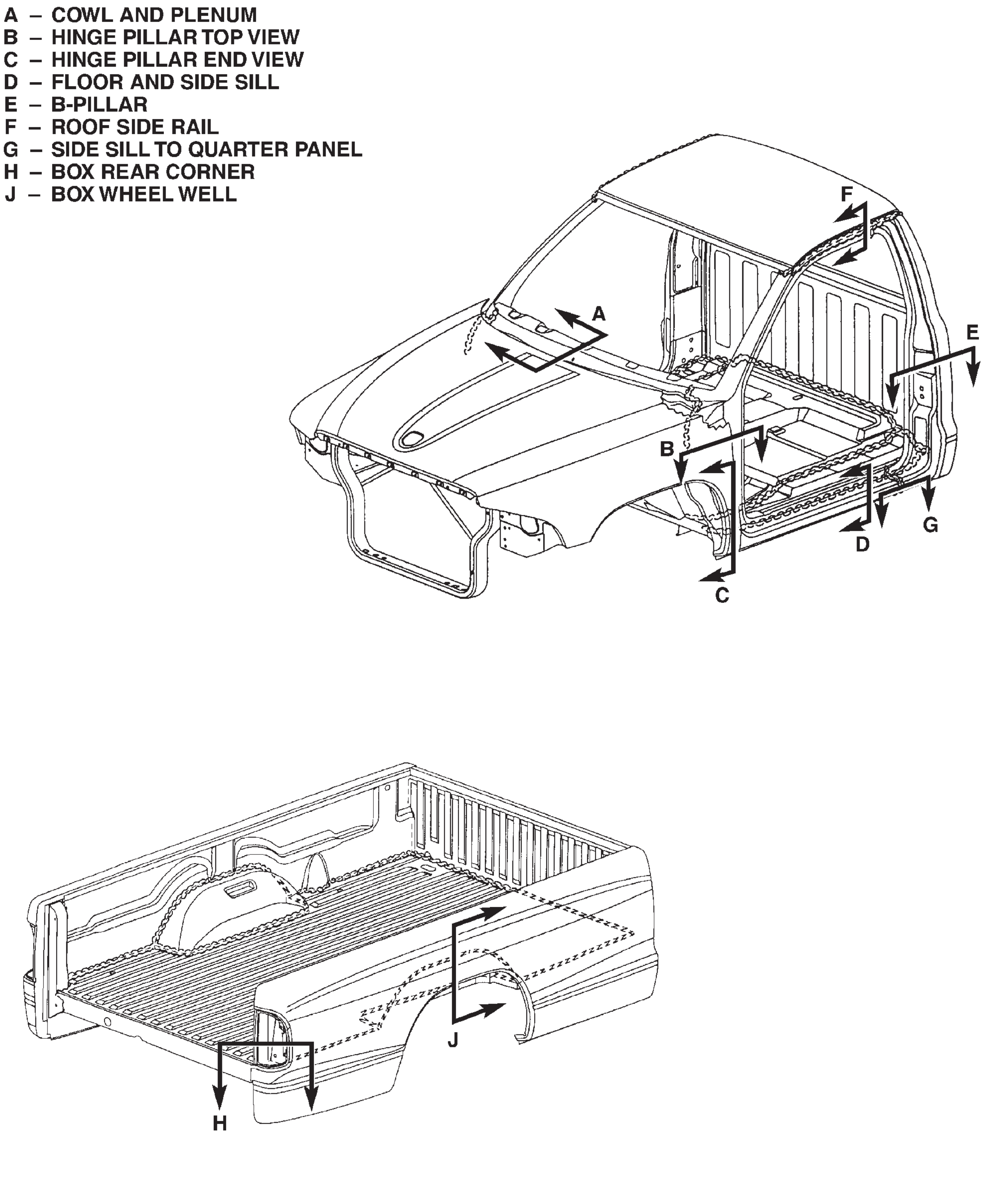
SEALER LOCATION



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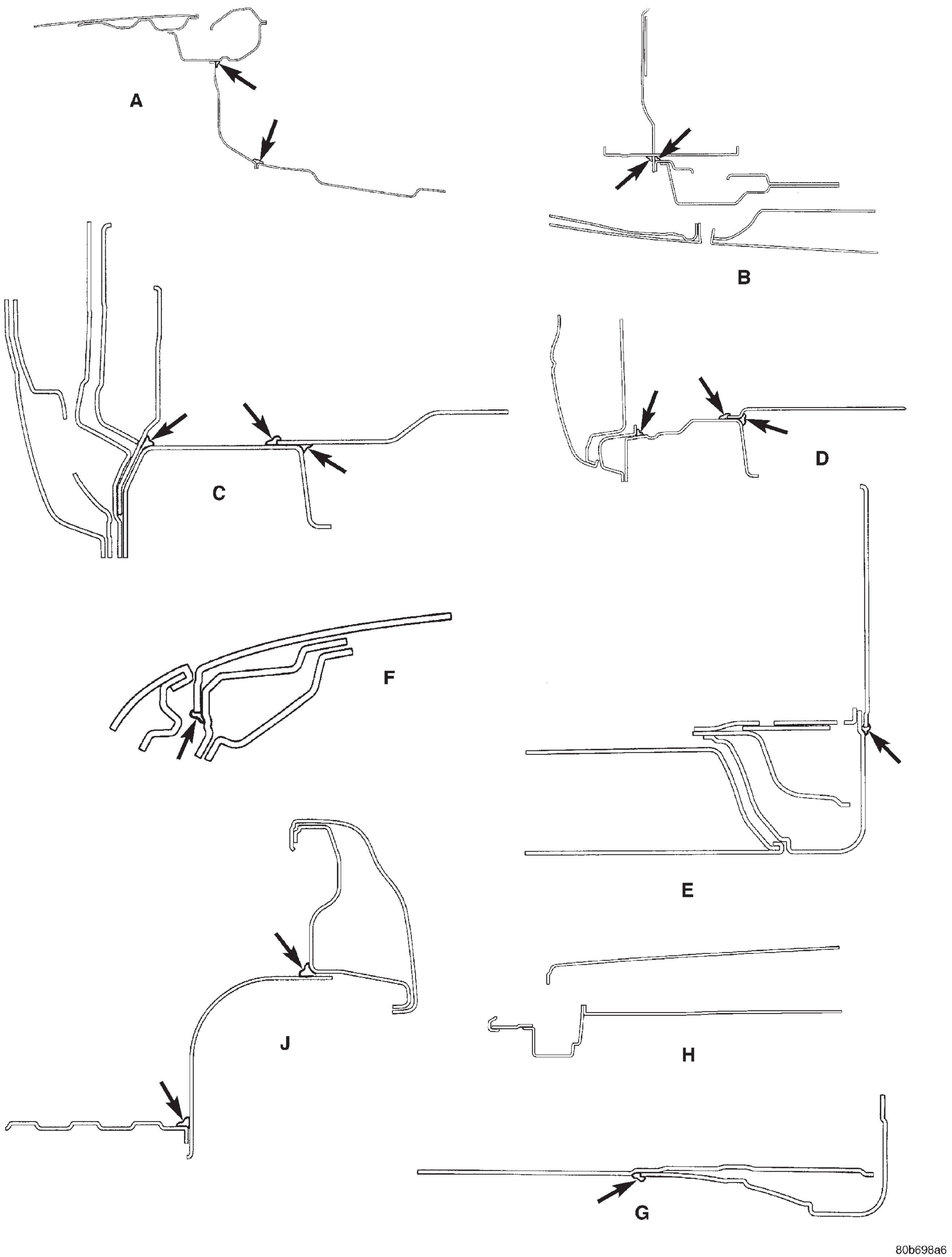
APPLICATION CUT-AWAY



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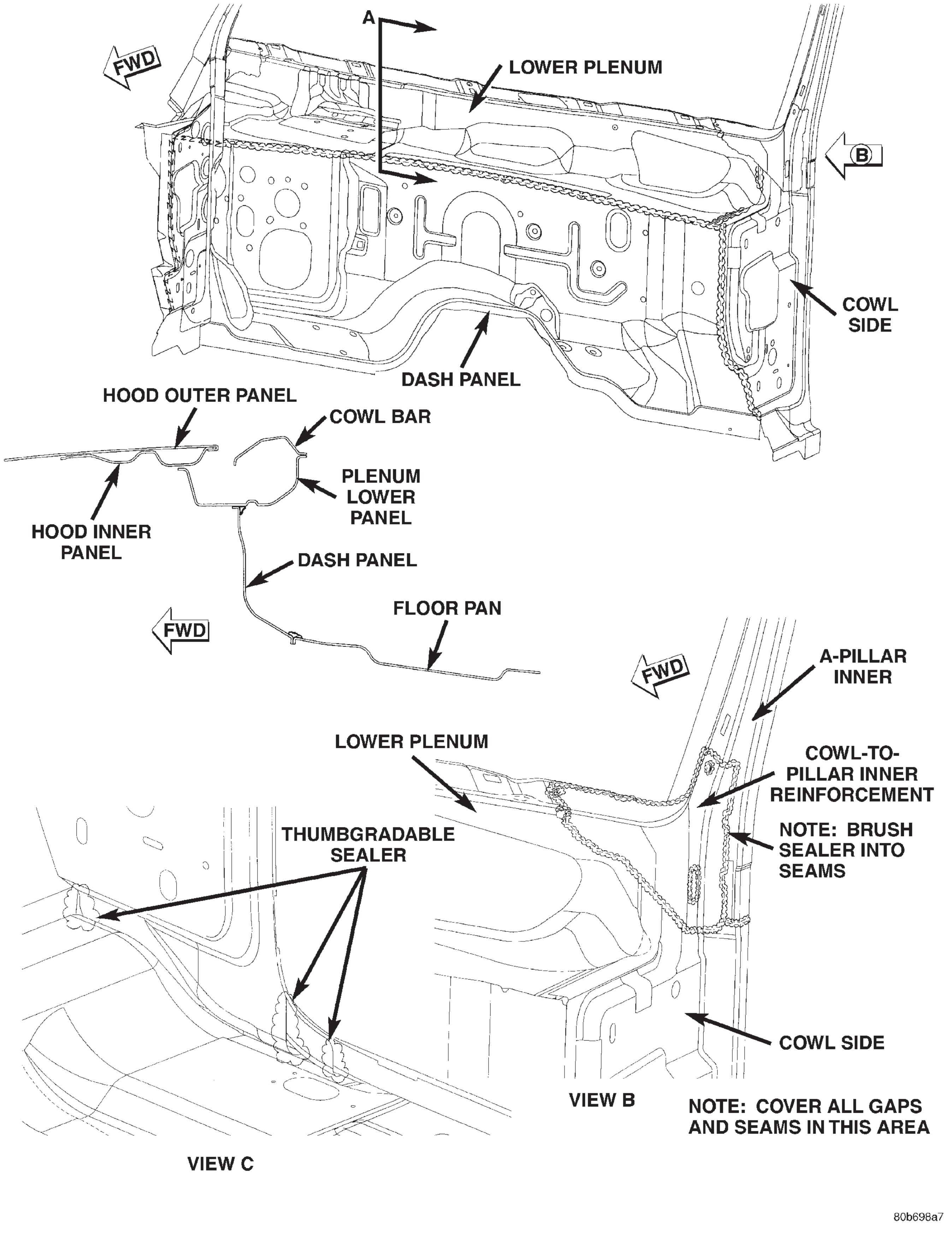
COWL AND DASH PANEL



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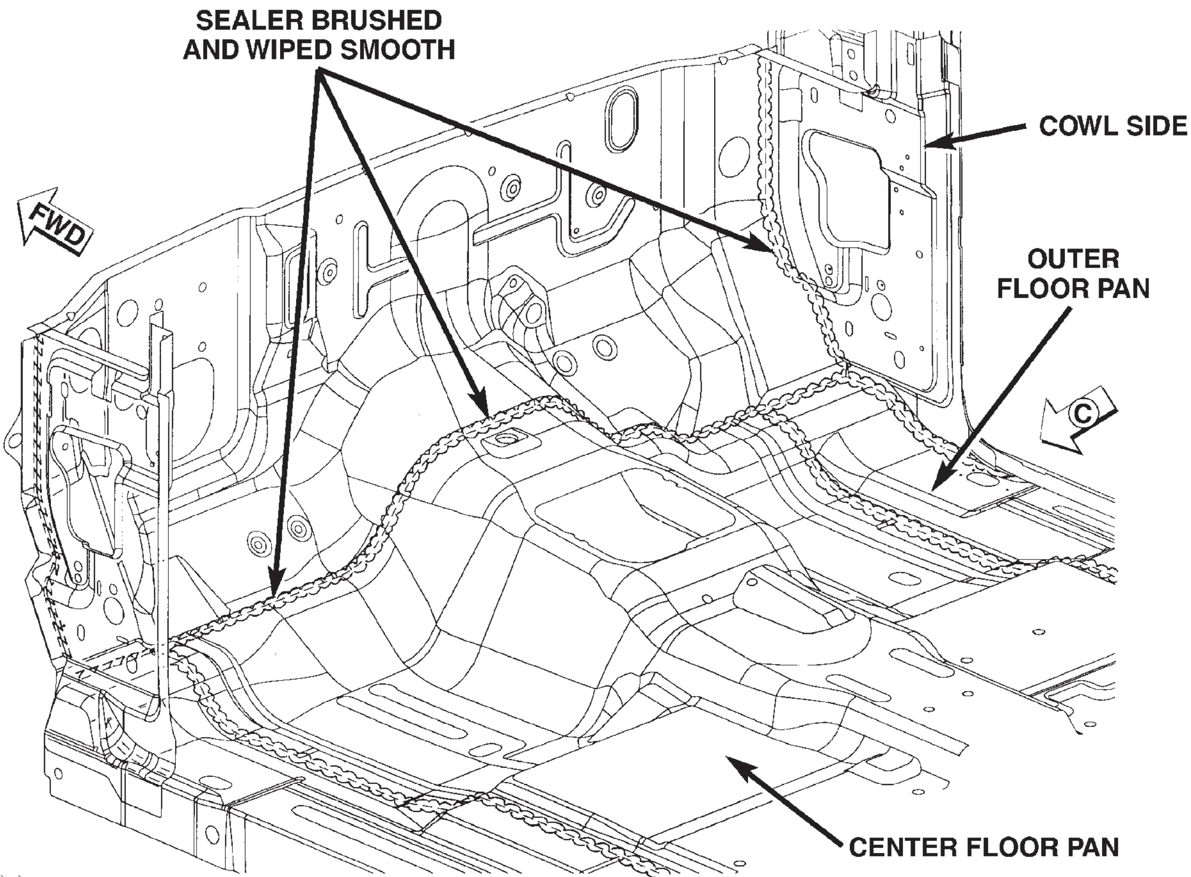
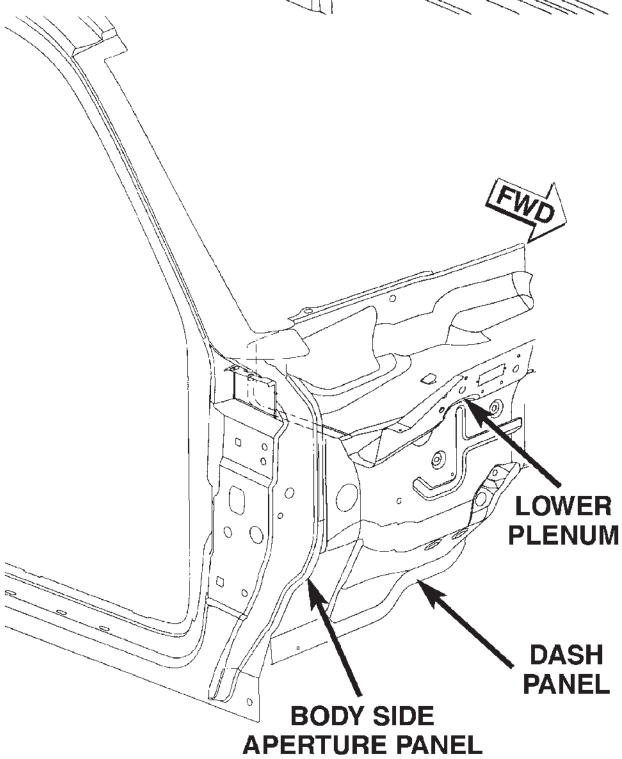
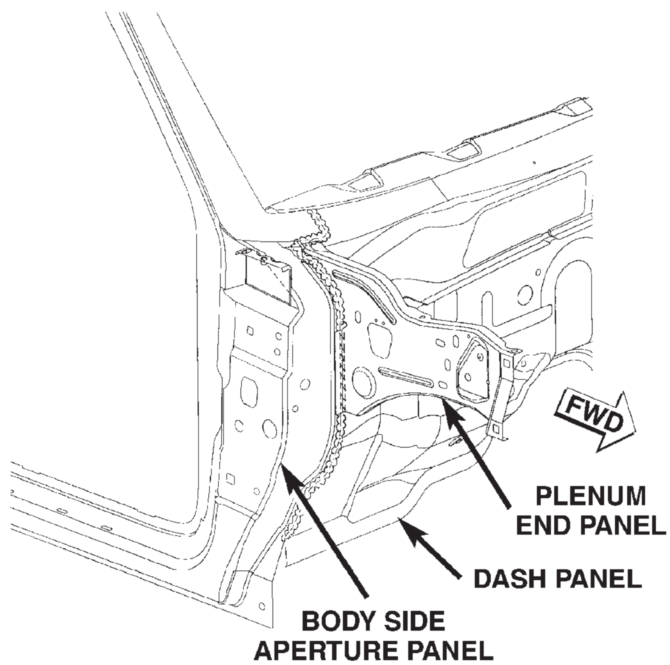
COWL AND DASH PANEL







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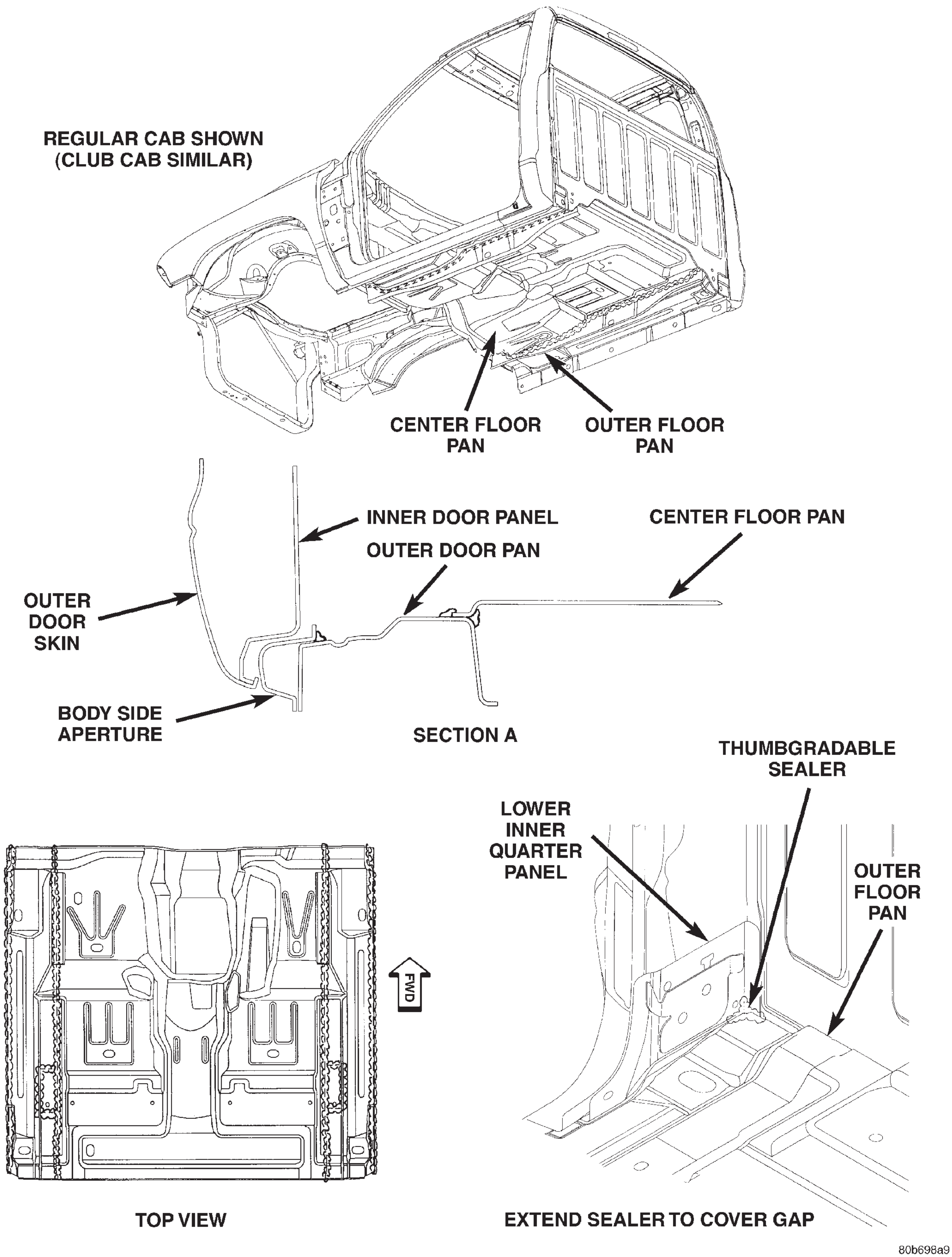
BODY (Continued)

FLOOR PAN



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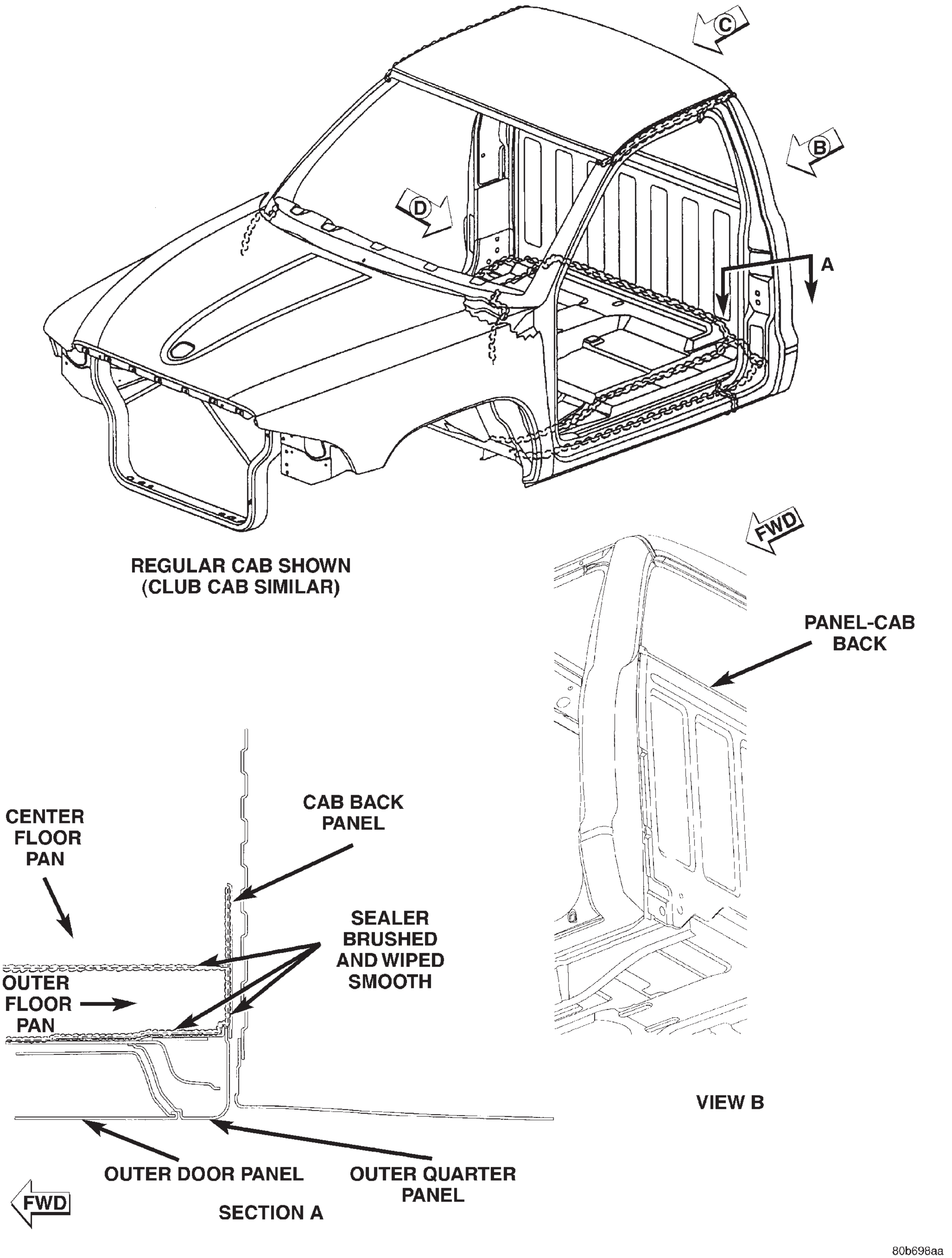
CAB REAR PANEL



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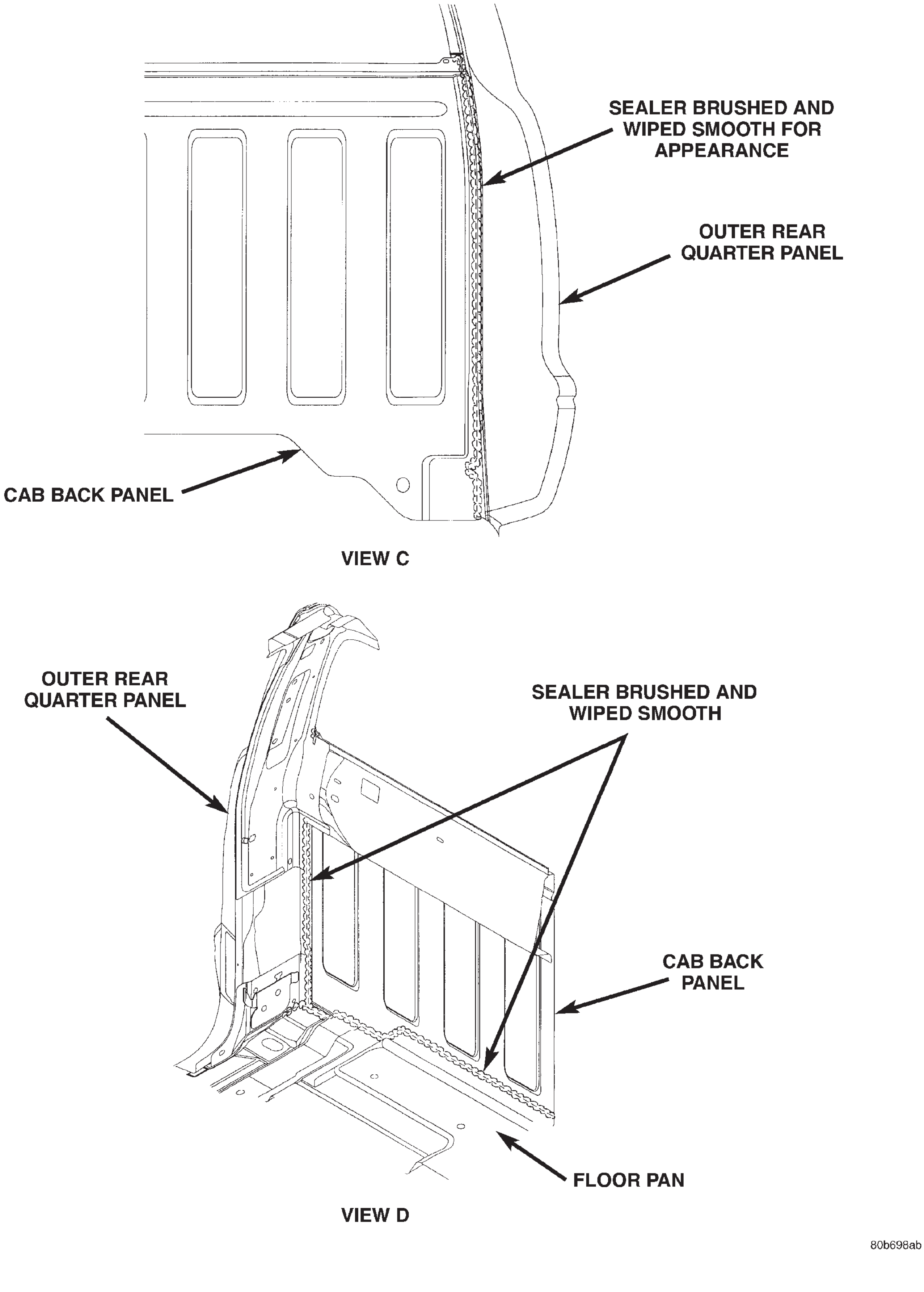
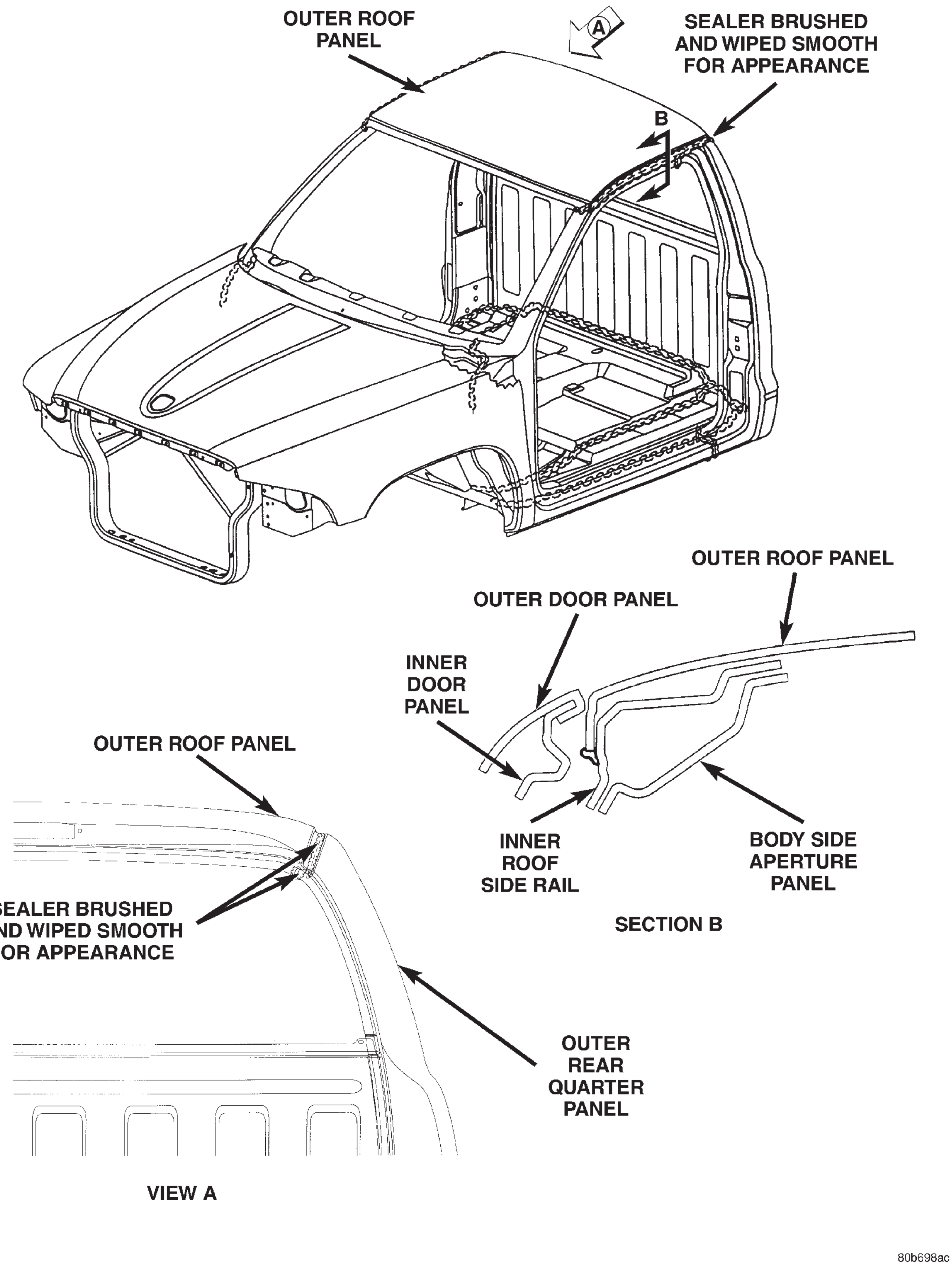
CAB REAR PANEL



BODY (Continued)

ROOF PANEL



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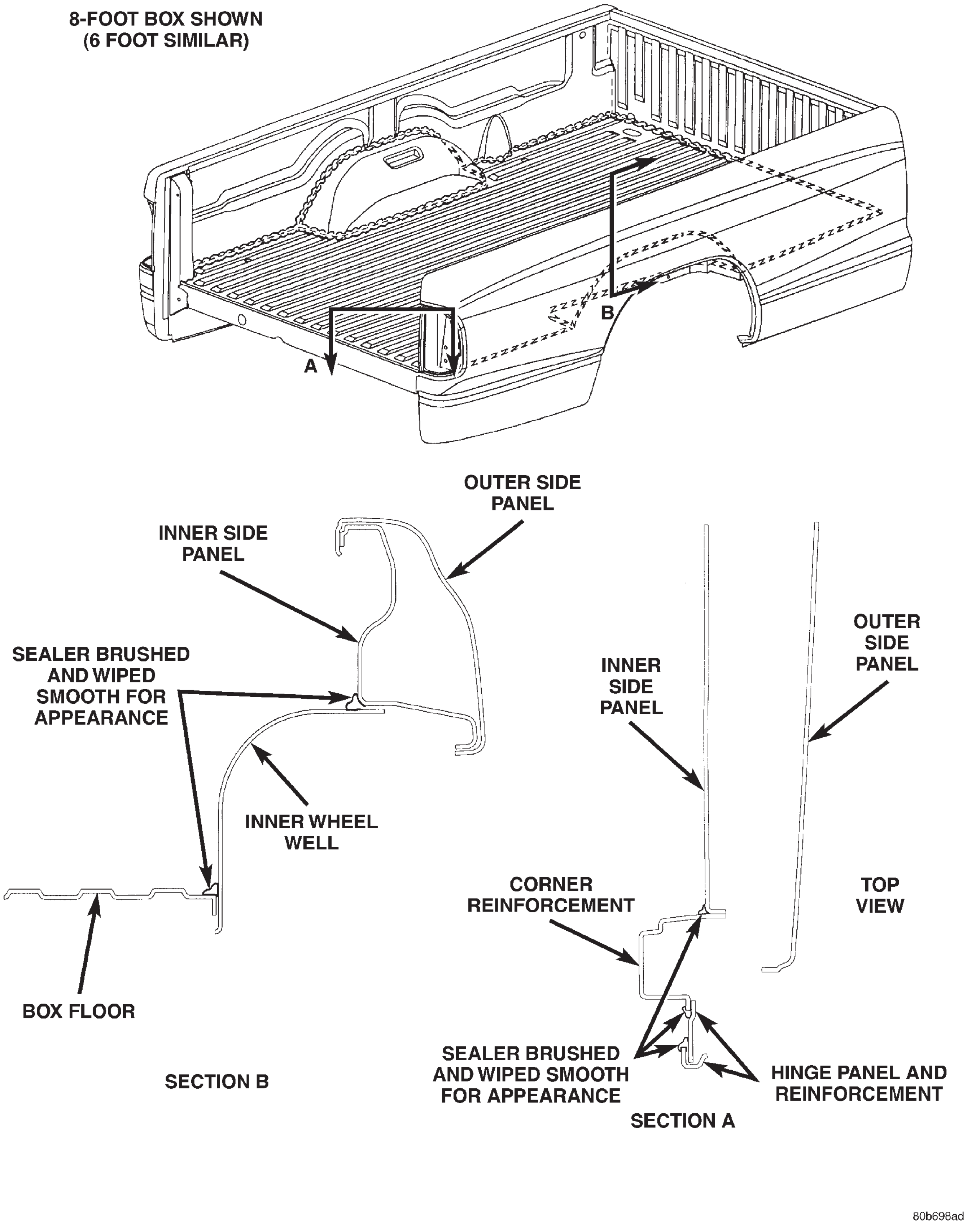
CARGO BOX



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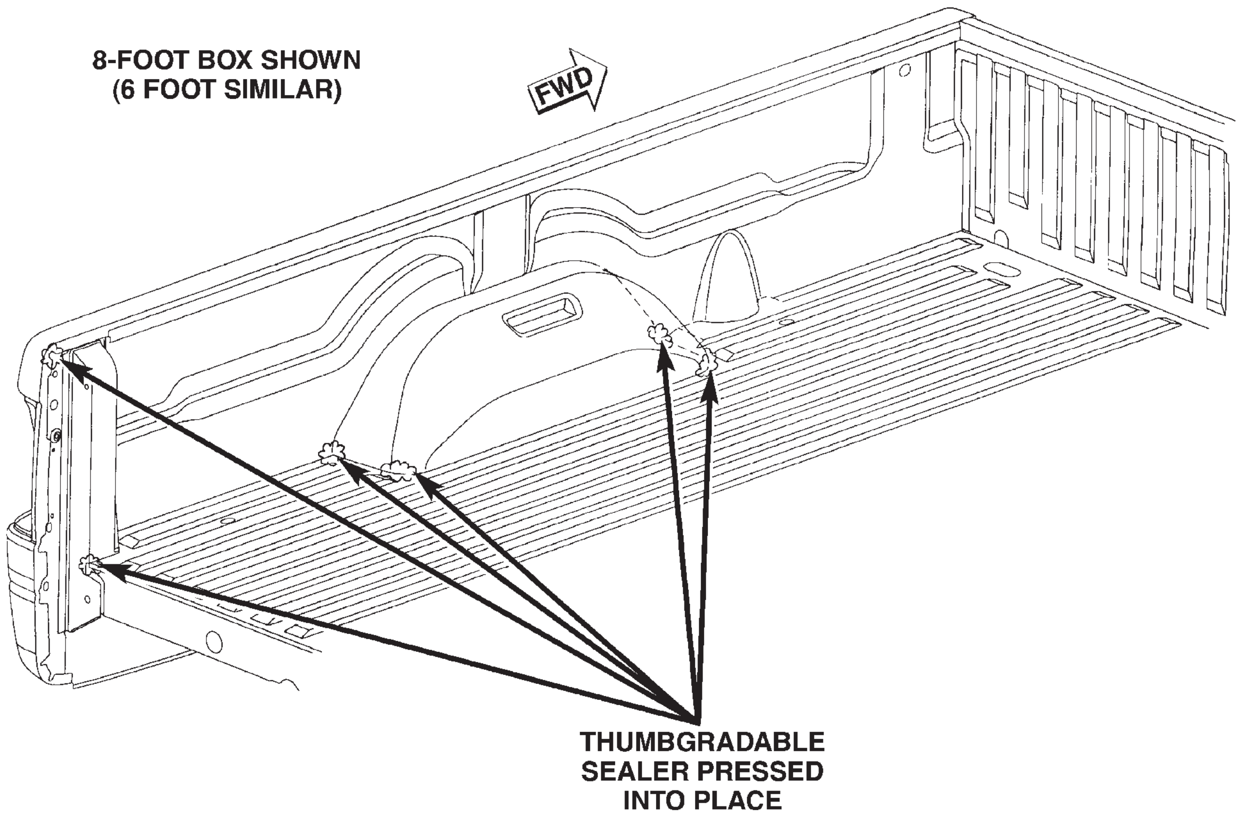
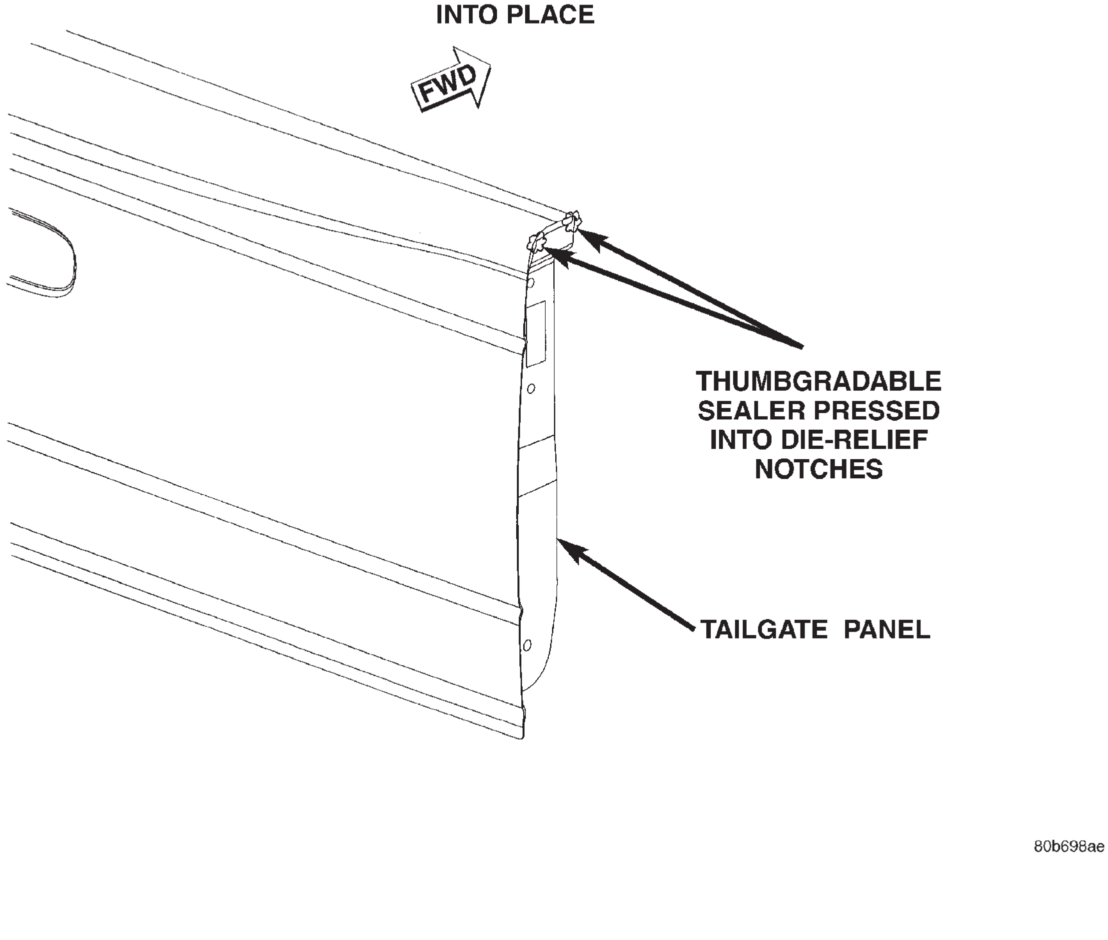
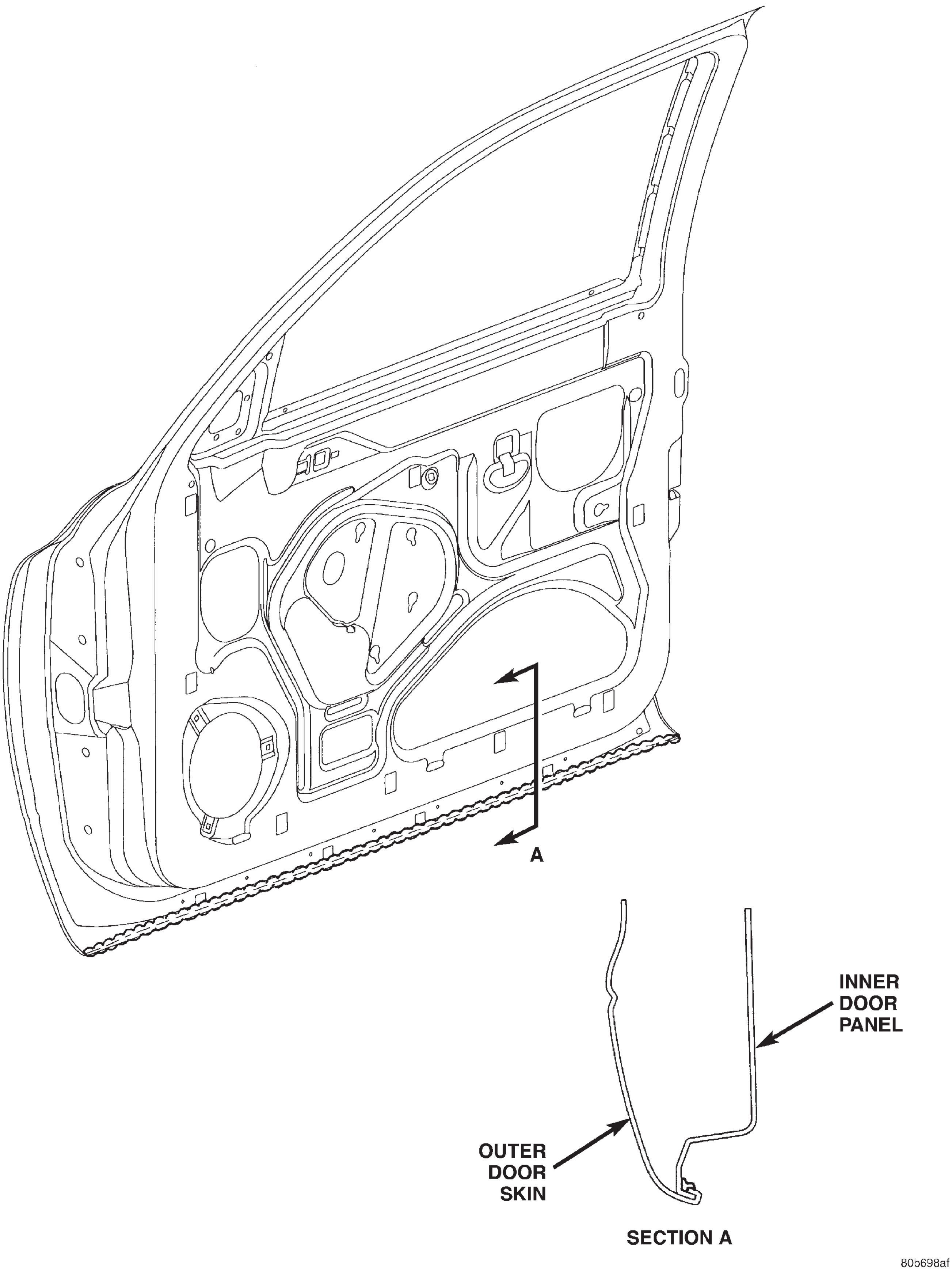
CARGO BOX





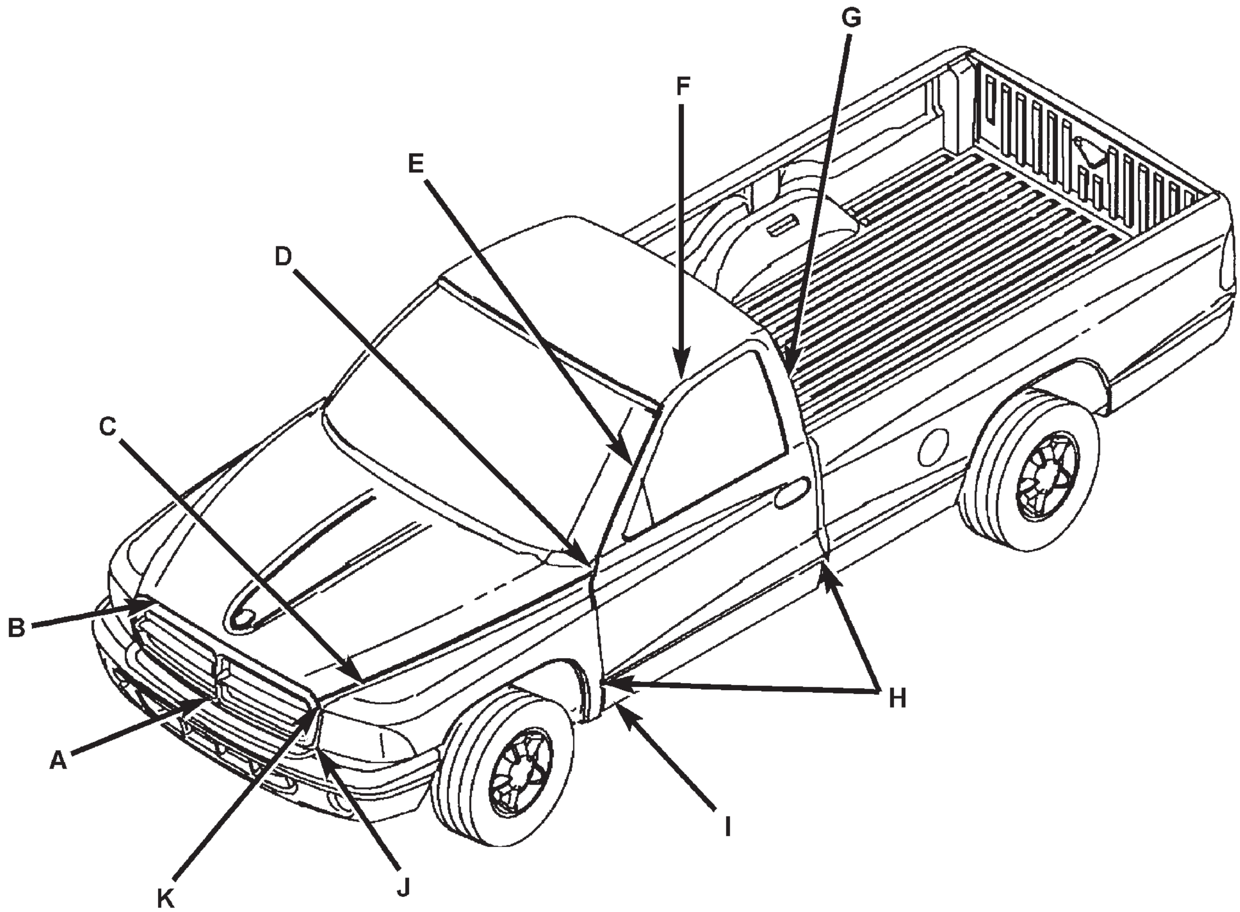
BODY (Continued)

DOORS



BODY (Continued)

BODY GAP AND FLUSH MEASUREMENTS



	DESCRIPTION	GAP	FLUSH
A	Grille to Fascia	17.1 +/- 3.0	N/A
B	Hood to Grille	1.5 +/- 0.8	0.7 +/- 0.5
C	Hood to Fender	2.8 +/- 1.5	0.3 +/- 1.5
D	Door to Hood / Fender	5.0 +/- 1.0	0.0 +/- 0.5
E	Door to Windshield Molding	5.1 +/- 1.5	N/A
F	Door to Roof	6.0 +/- 1.5	2.0 +/- 1.0
G	Door to Quarter	4.5 +/- 1.5	0.0 +/- 1.5
H	Fender / Door / Quarter Char Line U/D	4.5 +/- 1.5	0.0 +/- 1.5
I	Door to Sill	7.0 +/- 2.0	0.0 +/- 1.5
J	Grille to Headlamp	8.3 +/- 3.0	N/A
K	Grille to Fender	6.0 +/- 1.5	N/A

NOTE: ALL MEASUREMENTS ARE IN MM.

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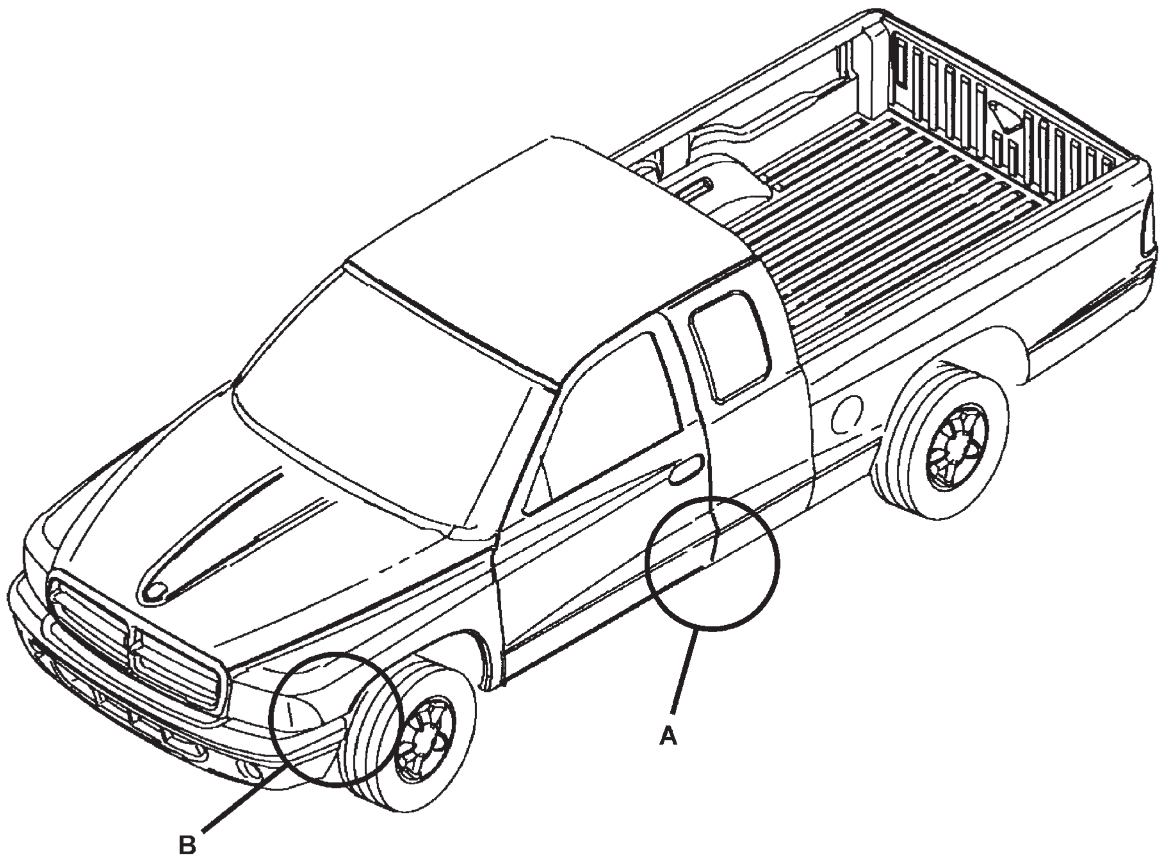
BODY (Continued)

BODY GAP AND FLUSH



	DESCRIPTION	ALIGNMENT
A	Door to Quarter	0 +/- 2.5
B	Bumper to Fender	0 +/- 3.0

NOTE: ALL MEASUREMENTS ARE IN MM.

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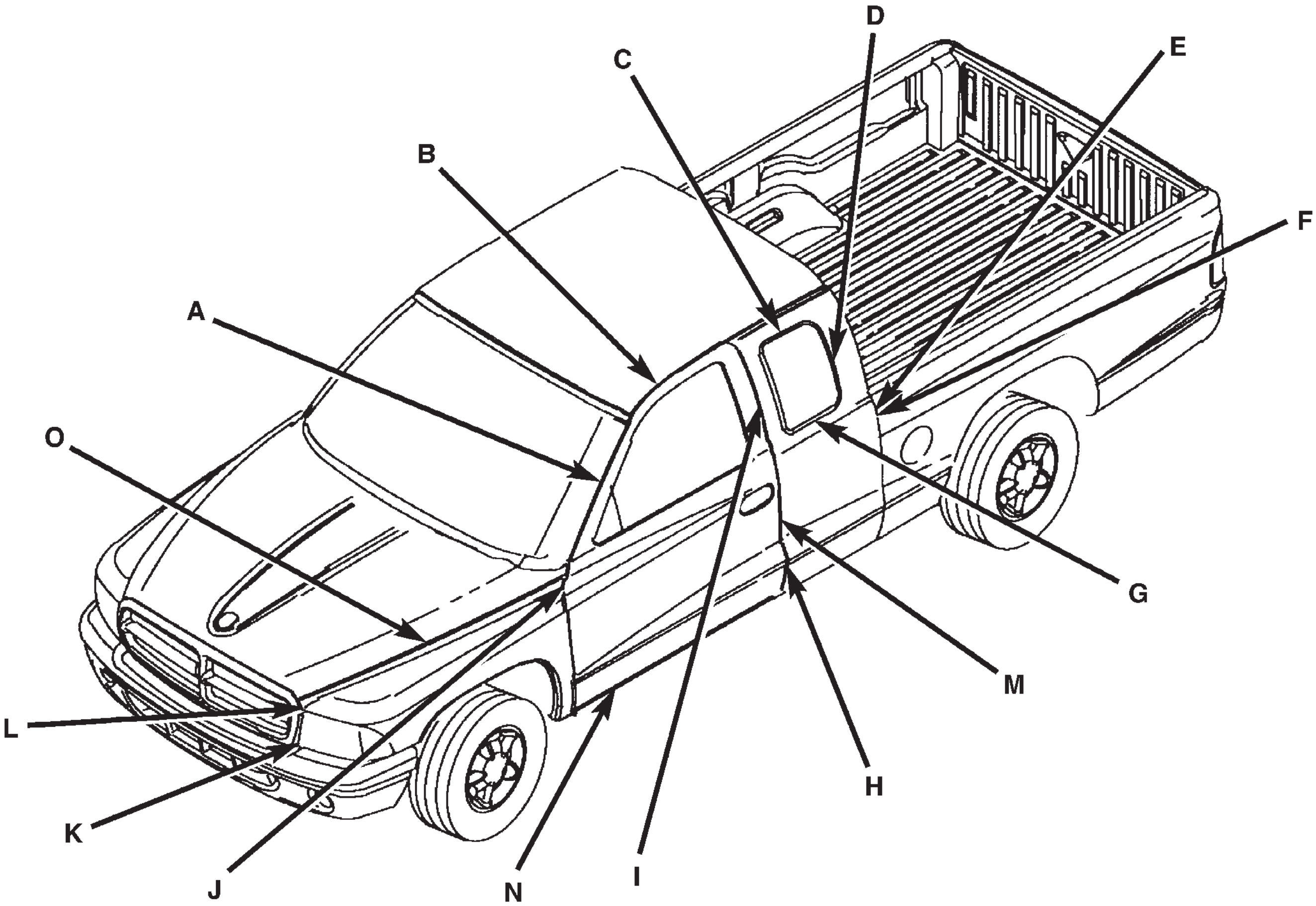
BODY (Continued)

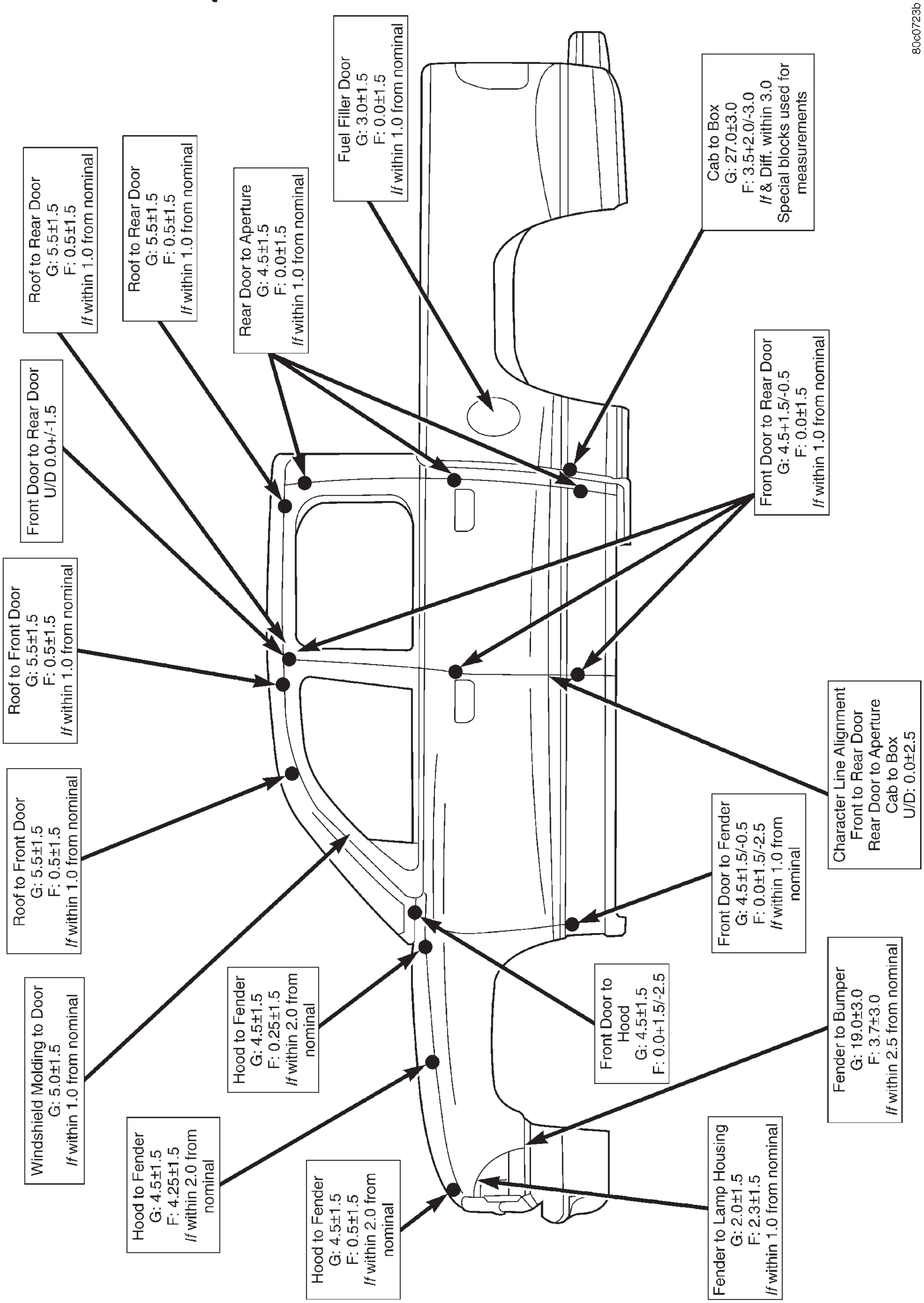
BODY GAP AND FLUSH — EXTENDED CAB



	DESCRIPTION	GAP	FLUSH
A	Door to Window Molding	5.1 +/- 1.5	N/A
B	Door to Roof	6.0 +/- 1.5	2.0 +/- 1.0
C	Quarter Glass to Quarter (Top)	5.0 +/- 1.5	3.6 +/- 1.5
D	Quarter Glass to Quarter (Rear)	5.0 +/- 1.5	3.6 +/- 1.5
E	Cab to Standard Box	18.7 +/- 3.0	0.0 +/- 1.5
F	Cab to Extended Box	18.7 +/- 3.0	0.0 +/- 1.5
G	Quarter Glass to Quarter (Bottom)	5.0 +/- 1.5	N/A
H	Door to Quarter	0.0 +/- 2.5	N/A
I	Quarter Glass to Door	5.0 +/- 1.5	3.6 +/- 1.5
J	Door to Hood/Fender	5.0 +/- 1.0	0.0 +/- 0.5
K	Grille to Headlamp	8.3 +/- 3.0	N/A
L	Grille to Fender	6.0 +/- 1.5	N/A
M	Door to Aperture	5.0 +/- 1.0	0.0 +/- 0.5
N	Door to Sill	7.0 +/- 2.0	0.0 +/- 1.5
O	Hood to Fender	6.0 +/- 1.0	1.5 +/- 1.0

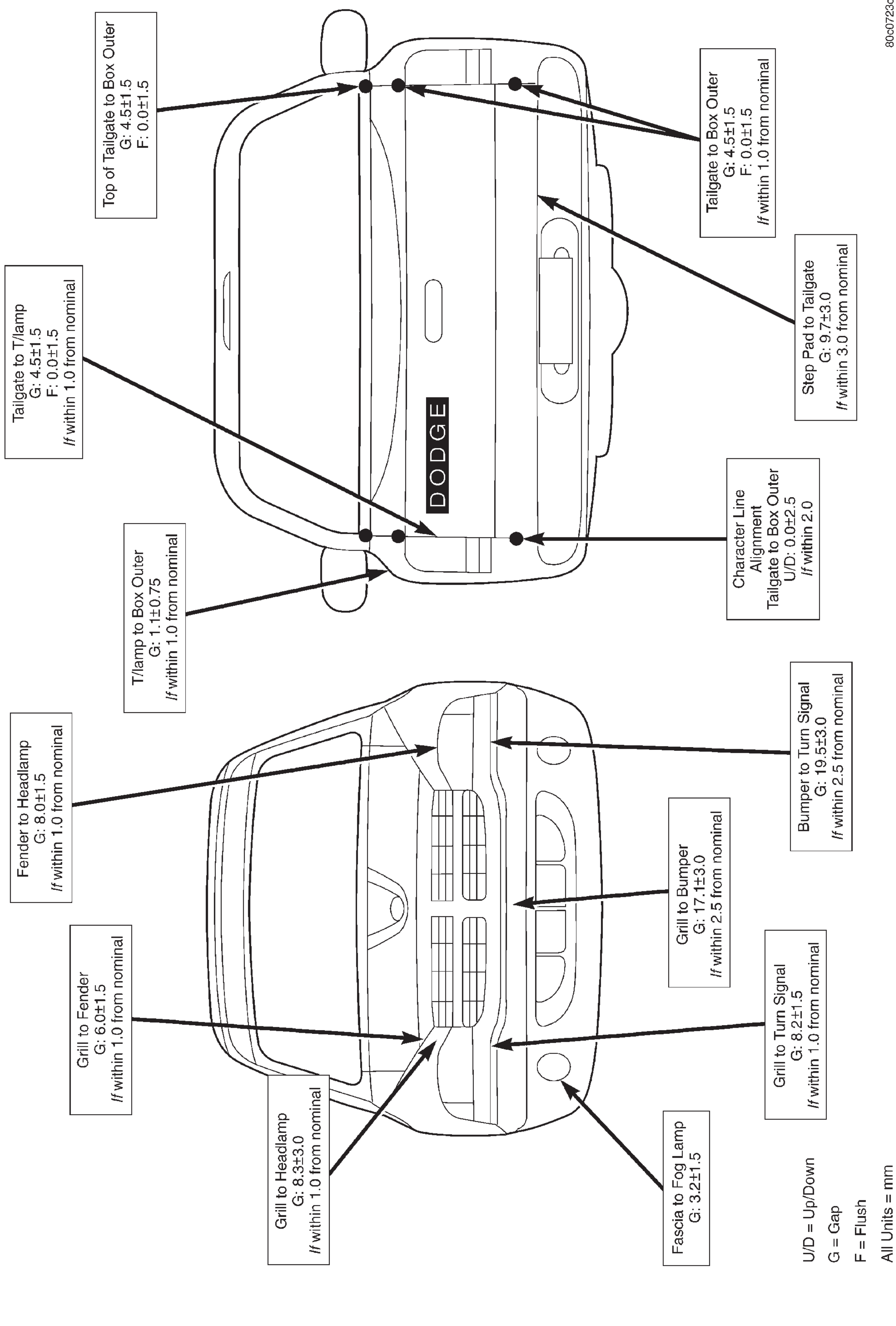
BODY (Continued)

BODY GAP AND FLUSH— QUAD CAB



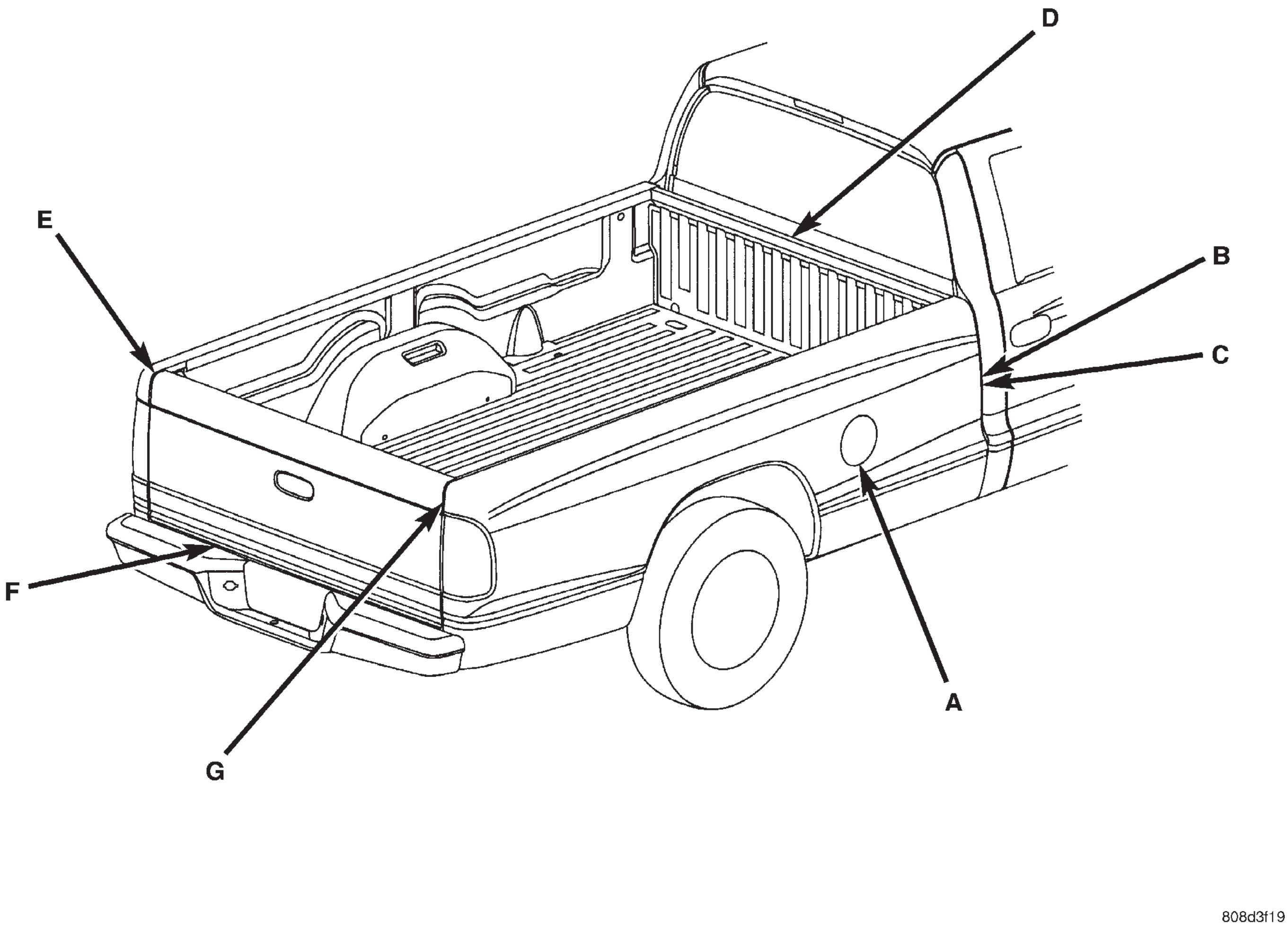
BODY (Continued)

BODY GAP AND FLUSH— QUAD CAB



BODY (Continued)

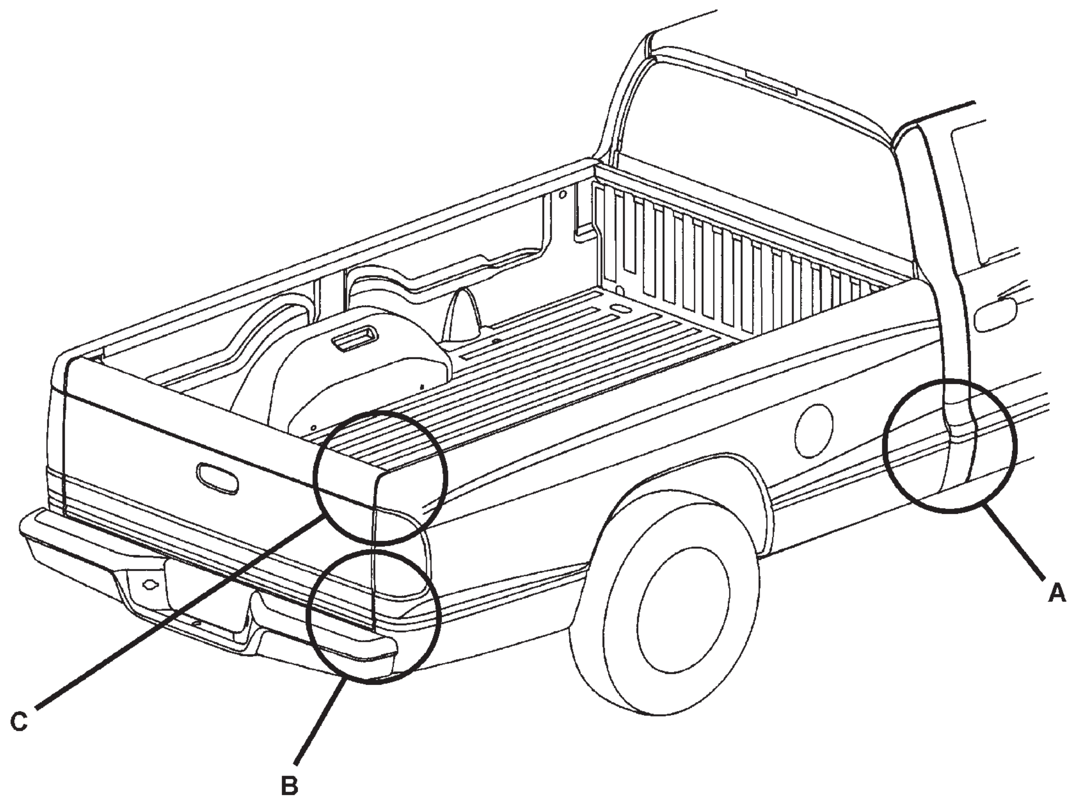
BODY GAP AND FLUSH — CARGO BOX



	DESCRIPTION	GAP	FLUSH
A	Fuel Filler Door to Box	3.0 +/- 1.5	0.0 +/- 1.5
B	Cargo to Standard Box	18.7 +/- 3.0	0.0 +/- 1.5
C	Cargo to Extended Box	18.7 +/- 3.0	0.0 +/- 1.5
E	Box to Tailgate U/D	N/A	0.0 +/- 1.5
F	Tailgate to Bumper	9.7 +/- 3.0	N/A
G	Box to Tailgate	6.0 +/- 1.0	0.0 +/- 0.5

BODY (Continued)

BODY GAP AND FLUSH — CARGO BOX



	DESCRIPTION	ALIGNMENT
A	Cab to Box Character Line	0 +/- 2.5
B	Box to Tailgate	0 +/- 2.5
C	Box to Tailgate	0 +/- 2.5

NOTE: ALL MEASUREMENTS ARE IN MM.

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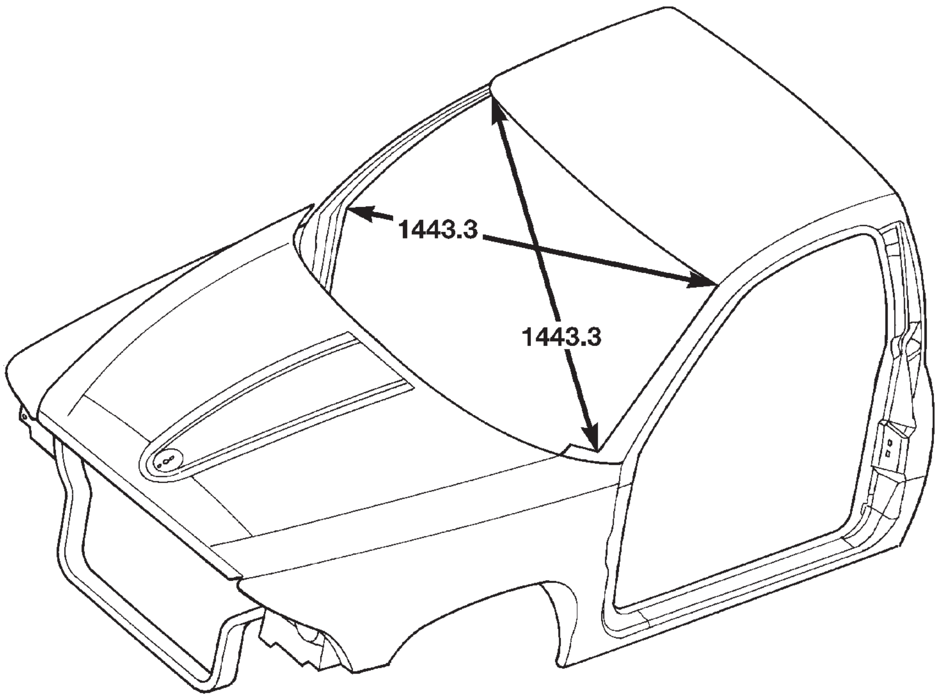
BODY (Continued)

BODY OPENING DIMENSIONS

WINDSHIELD OPENING



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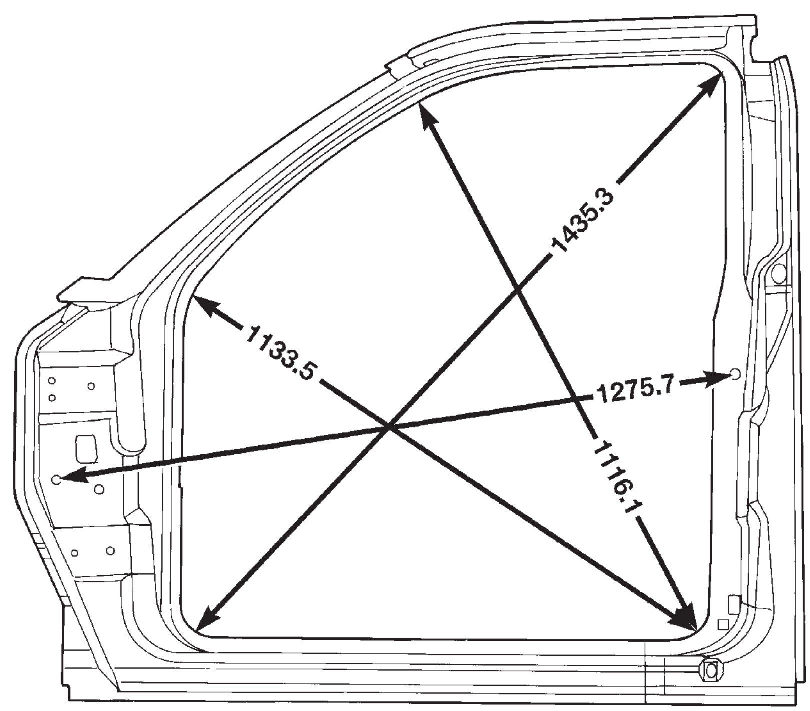
DOOR OPENING



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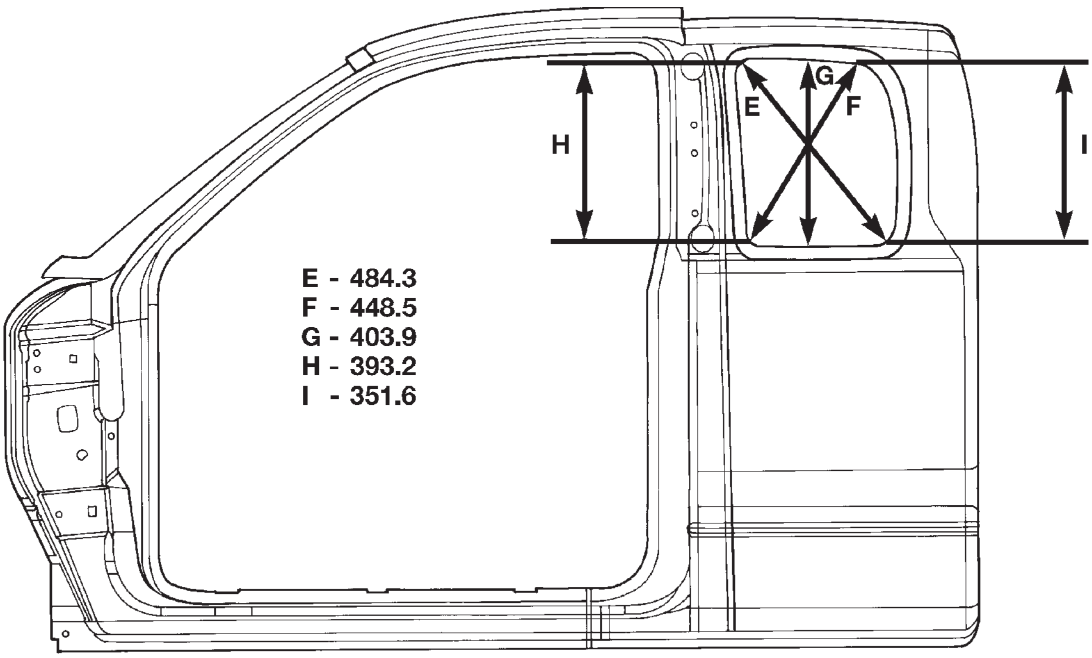
BODY (Continued)

QUARTER WINDOW OPENING



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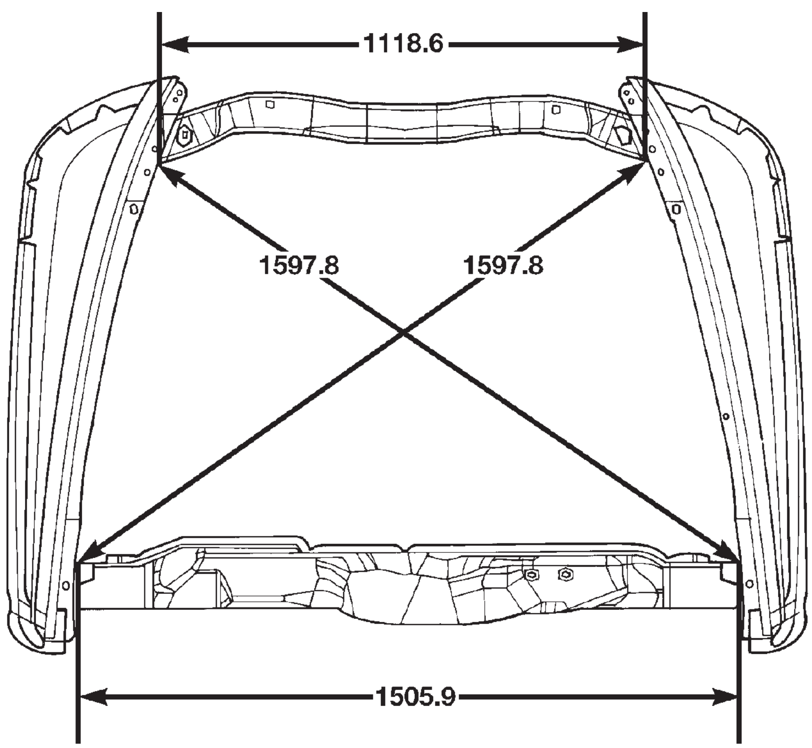
ENGINE COMPARTMENT OPENING



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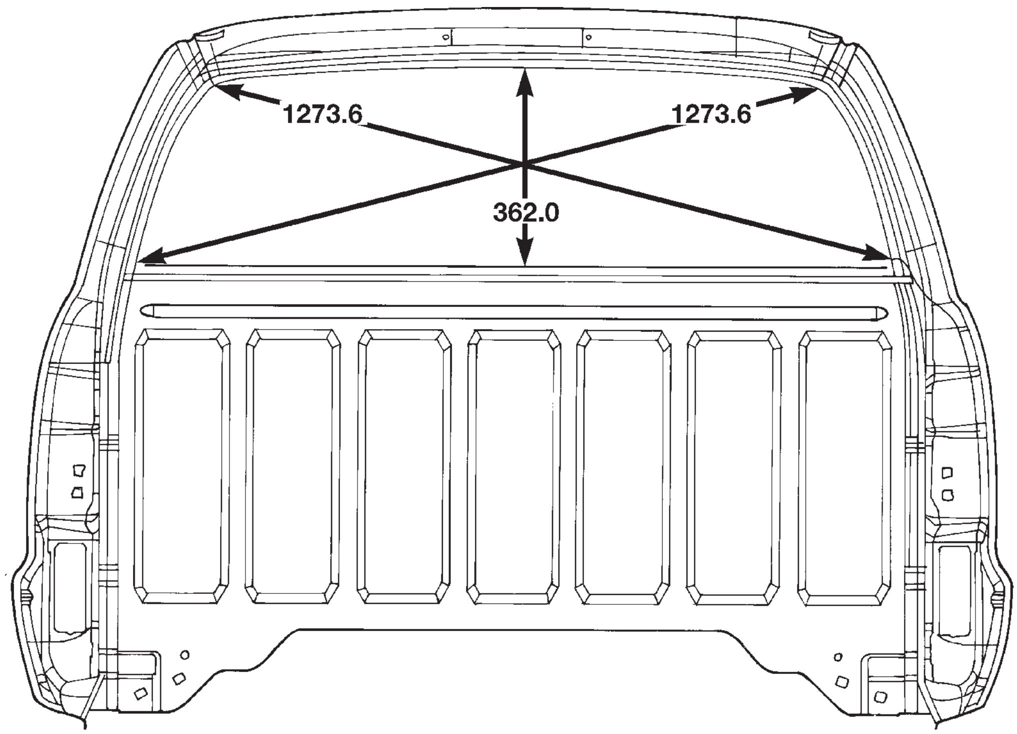
BODY (Continued)

BACKLITE OPENING



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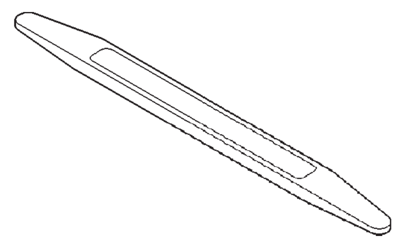
BODY (Continued)

TORQUE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Bench seat track to seat frame bolt	24 N·m (17 ft. lbs.)
Bench seat outer track to seat frame bolt	24 N·m (17 ft. lbs.)
Bench seat to floor pan front bolt	40 N·m (30 ft. lbs.)
Bench seat to floor pan rear bolt	28 N·m (20 ft. lbs.)
Bucket seat track to seat frame bolt	24 N·m (17 ft. lbs.)
Bucket seat track to floor pan front bolt	28 N·m (20 ft. lbs.)
Bucket seat track to floor pan rear inboard bolt	40 N·m (30 ft. lbs.)
Bucket seat track to floor pan rear outboard bolt	28 N·m (20 ft. lbs.)
Cab mounting bolt	81 N·m (60 ft. lbs.)
Cargo box bolt	27 N·m (20 ft. lbs.)
Center seat to bucket seat inboard track bolts	24 N·m (17 ft. lbs.)
Console lid/seat back pivot bolt	24 N·m (17 ft. lbs.)
Console lid/seat back to left hinge bracket torx screws	24 N·m (17 ft. lbs.)
Front bucket seat belt buckle anchor bolt	40 N·m (29 ft. lbs.)
Front door hinge to hinge pillar bolts	28 N·m (21 ft. lbs.)
Front door hinge to door nuts and bolts	28 N·m (21 ft. lbs.)
Front seat belt retractor bolt	44 N·m (32 ft. lbs.)
Front turning loop anchor bolt	44 N·m (32 ft. lbs.)
Front lower belt anchor bolt	44 N·m (32 ft. lbs.)
Front seat rear inboard seat track to floor pan bolts	40 N·m (30 ft. lbs.) torque.
Front seat rear outboard seat track to floor pan bolts	16 N·m (11 ft. lbs.)
Front seat front seat track to floor pan bolts	16 N·m (11 ft. lbs.)
Rear seat belt retractor bolt	44 N·m (32 ft. lbs.)
Rear turning loop anchor bolt	44 N·m (32 ft. lbs.)
Rear lower belt anchor bolt	44 N·m (32 ft. lbs.)
Rearview mirror set screw	1 N·m (9 in. lbs.)
Side view mirror nut	7 N·m (65 in. lbs.)
Rear seat belt/buckle anchor bolt	44 N·m (32 ft. lbs.)

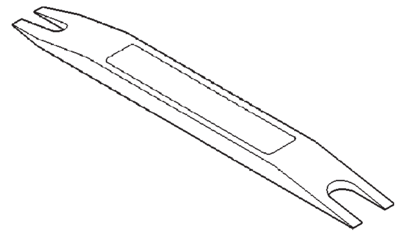
SPECIAL TOOLS

BODY



Trim Stick C-4755

Torx Bit Set C-4794-B



Molding Remover C-4829

DECKLID/HATCH/LIFTGATE/TAILGATE

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TAILGATE CHECK CABLE

REMOVAL

(1) Release tailgate latch and open tailgate.
(2) Pry lock tab outward to clear stud head on cargo box (Fig. 1).
(3) Push cable end forward until stud head is in clearance hole portion of cable end.
(4) Separate cable end from stud.
(5) Remove screw holding cable to tailgate.
(6) Separate check cable from tailgate.

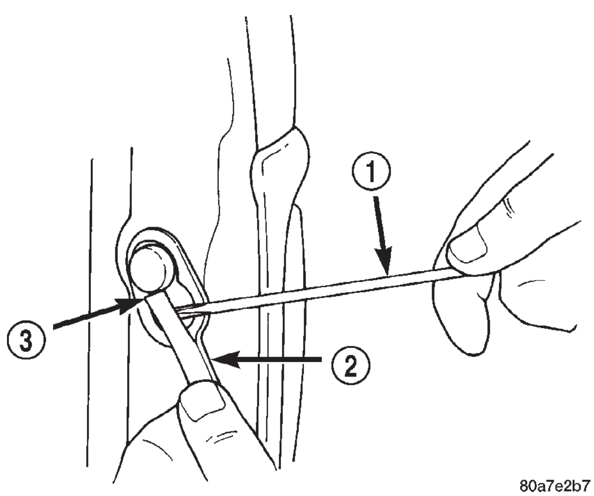

Fig. 1 Tailgate Check

1 - SCREW DRIVER
2 - TAILGATE CHECK CABLE
3 - LOCK TAB

INSTALLATION

Reverse the preceding operation.

TAILGATE LATCH

REMOVAL

(1) Remove bolts attaching tailgate latch to tailgate (Fig. 2).
(2) Remove bezel for tailgate latch release handle.
(3) Remove bolts attaching tailgate latch release handle to tailgate.
(4) Disengage latch rods at tailgate latch release handle.
(5) Separate latch from tailgate and disengage latch rod from latch.

INSTALLATION

(1) Engage latch rods to tailgate latch release handle.
(2) Install tailgate latch release handle.
(3) Attach latch release rod to latch.
(4) Position latch in tailgate.
(5) Install bolts attaching tailgate latch to tailgate.
(6) Install bezel for tailgate latch release handle.

TAILGATE LATCH RELEASE HANDLE

REMOVAL

(1) Using a trim stick and starting at the bottom of the latch release handle, disengage the bottom clips attaching the bezel to the tailgate.
(2) Slide the bezel downward to remove it from the tailgate.
(3) Remove screws attaching latch release handle to tailgate (Fig. 2).
(4) Disengage latch release rods (Fig. 3).
(5) Separate latch release from tailgate.

TAILGATE LATCH RELEASE HANDLE (Continued)

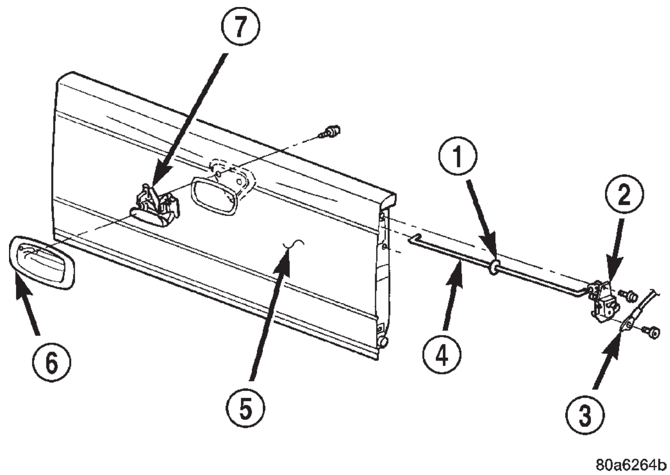

Fig. 2 Tailgate

1 - SILENCER DISC
2 - LATCH
3 - CABLE
4 - LATCH RELEASE ROD
5 - TAILGATE
6 - BEZEL
7 - LATCH RELEASE

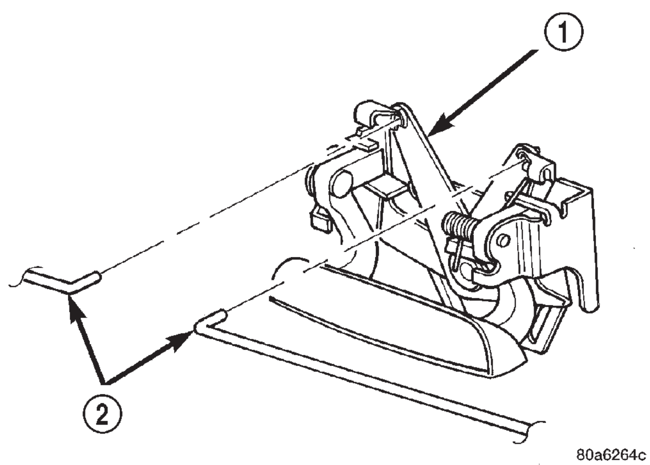

Fig. 3 Latch Release Rods

1 - TAILGATE LATCH RELEASE
2 - TAILGATE LATCH RELEASE RODS

INSTALLATION

(1) Position latch release in tailgate.
(2) Engage latch release rods.
(3) Install screws attaching latch release handle to tailgate.
(4) Position the top of the bezel in tailgate and slide the bezel upward and snap into place.

TAILGATE LATCH STRIKER

REMOVAL

(1) Release tailgate latch and open tailgate.
(2) Remove tailgate check cable.
(3) Using a grease pencil, mark the location of the striker.
(4) Remove striker from cargo box (Fig. 4).

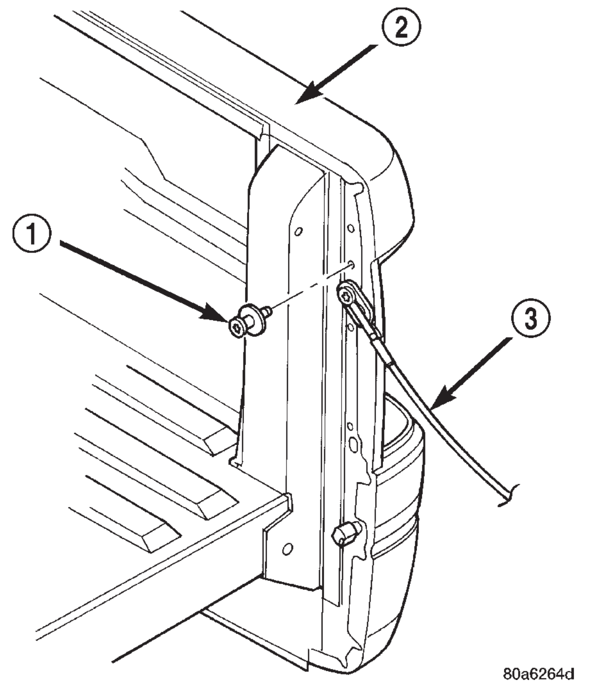

Fig. 4 Tailgate Latch Striker

1 - STRIKER
2 - BODY
3 - CABLE

INSTALLATION

(1) Align the striker using the reference marks.
(2) Install striker.
(3) Install tailgate check cable.

TAILGATE

REMOVAL

(1) Release tailgate latch and open tailgate.
(2) Disconnect tailgate check cable.
(3) Close tailgate until the notch in the right hand collar aligns with the pivot pin.
(4) Slip tailgate hinge collar from hinge pins.
(5) Slide tailgate to the right and separate left hand collar from the pivot pin.
(6) Separate tailgate from vehicle.

INSTALLATION

Reverse the preceding operation.

DOOR - CARGO

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AIR EXHAUSTER

REMOVAL

(1) Release door latch and open door.

(2) Using a small flat blade, depress the clips under the top of the exhauster frame.

(3) Separate air exhauster from vehicle.

INSTALLATION

(1) Position air exhauster on door shut face (Fig. 1).

(2) Engage clips and press into place.

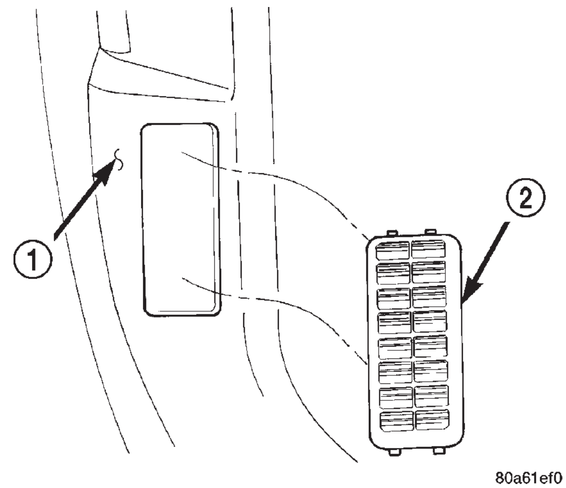

Fig. 1 Air Exhauster

1 - DOOR SHUT FACE
2 - AIR EXHAUSTER

DOOR - FRONT

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FRONT DOOR

REMOVAL

(1) Release door latch and open door.

(2) Using a suitable marker, mark the outline of the door hinges on the door end to aid installation.

(3) Remove protective boot from door wire harness connector.

(4) Disengage door wire harness connector.

(5) Support door on a suitable lifting device.

(6) While holding the door steady on lift, remove bolts and nuts attaching upper and lower door hinge to door end (Fig. 1).

(7) Separate door from vehicle.

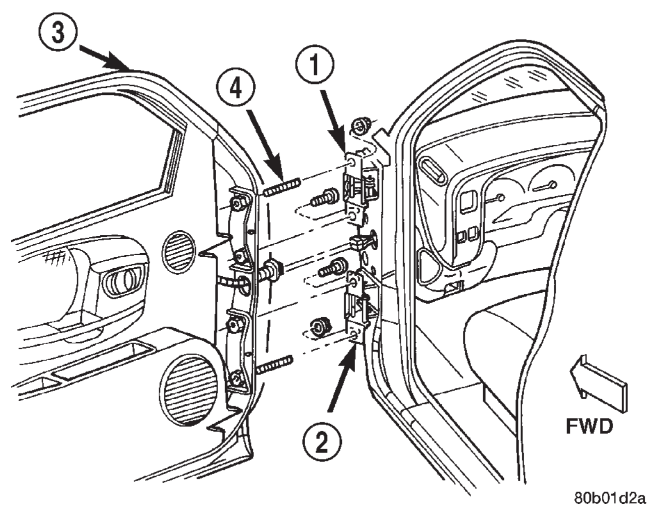

Fig. 1 Door Hinge

1 - UPPER HINGE
2 - LOWER HINGE
3 - DOOR
4 - STUD

INSTALLATION

(1) Support door on a suitable lifting device.

(2) Position door on vehicle and align with marks.

(3) Install bolts and nuts attaching upper and lower door hinge to door end. Tighten fasteners to 28 N·m (21 ft. lbs.) torque.

(4) Engage door wire harness connector.

(5) Install protective boot on door wire harness connector.

FRONT DOOR (Continued)

ADJUSTMENTS - UP/DOWN

Up/down door adjustment is done by loosening the hinge to cowl fasteners at both hinges. Then move the door to the correct position.

(1) Support the door with a padded floor jack.

(2) Loosen hinge to cowl fasteners at both hinges. Move the door to the correct up/down position.

(3) Tighten the hinge to cowl fasteners.

(4) Remove the floor jack from the door.

ADJUSTMENTS - IN/OUT

In/out door adjustment is done by loosening the hinge to door fasteners. Then move the door to the correct position.

(1) Support the door with a padded floor jack.

(2) Loosen the applicable hinge to door fasteners. Move the door to the correct in/out position.

(3) If necessary, loosen the other hinge to door fasteners and move the door to the correct in/out position.

(4) Tighten the hinge to door fasteners.

(5) Remove the floor jack from the door.

FRONT DOOR GLASS

REMOVAL

(1) Remove door trim panel.

(2) Remove water dam as necessary to gain access to glass regulator arm.

(3) Remove inner door belt weatherstrip.

(4) Remove outer door belt weatherstrip.

(5) Lower glass to full down position and align glass regulator arm with access holes in inner door panel.

(6) Remove front glass run channel.

(7) Remove nuts attaching glass channel to regulator arm (Fig. 2).

(8) Separate glass from regulator arm.

(9) Lift glass upward and out of opening at top of door.

INSTALLATION

(1) Slowly lower glass into door.

(2) Position glass in regulator arm.

(3) Install front glass run channel.

(4) Install nuts attaching glass channel to regulator arm.

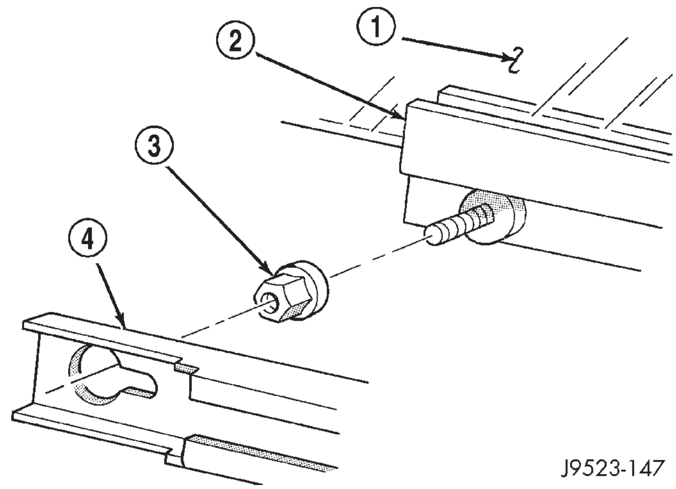

Fig. 2 Door Glass

1 - GLASS
2 - GLASS CHANNEL
3 - NUT
4 - REGULATOR ARM

(5) Ensure glass is aligned in run channels and tighten run channel bolts.

(6) Install outer door belt weatherstrip.

(7) Install inner door belt weatherstrip.

(8) Install water dam.

(9) Install door trim panel.

FRONT DOOR OUTSIDE HANDLE

REMOVAL

(1) Remove door trim panel.

(2) Remove water dam as necessary to gain access to door handle.

(3) Roll glass up.

(4) Remove fastener access plug from door end panel (Fig. 3).

(5) Disengage lock cylinder to latch rod from the latch (Fig. 4).

(6) Disengage outside handle to latch rod from the latch.

(7) Remove nuts attaching outside door handle to door.

(8) Separate outside handle from the door.

FRONT DOOR OUTSIDE HANDLE (Continued)

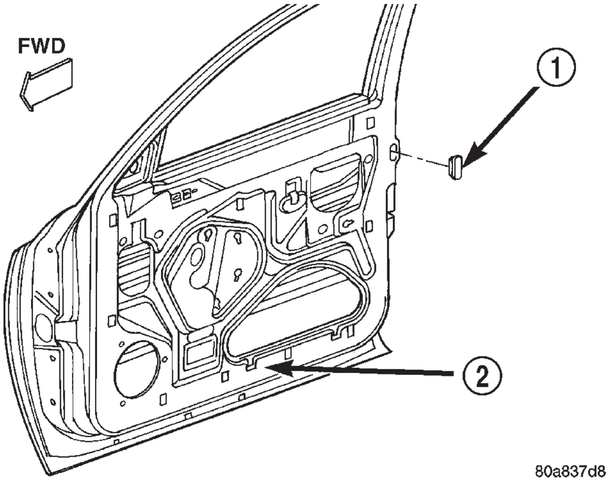

Fig. 3 Access Plug

1 - ACCESS PLUG
2 - DOOR

INSTALLATION

(1) Position outside handle in the door.

(2) Install nuts attaching outside door handle to door. Tighten the nuts to 5.0 N·m (45 in. lbs) torque.

(3) Engage outside handle to latch rod to the latch.

(4) Engage lock cylinder to latch rod to the latch.

(5) Install fastener access plug in the door end panel.

(6) Install water dam.

(7) Install door trim panel.

FDR LOWER GLASS RUN CHANNELS

REMOVAL

(1) Remove trim panel.

(2) Remove water dam as necessary to access lower run channels.

(3) Remove bolts attaching lower glass run channels to door panel (Fig. 5).

(4) Remove glass.

(5) Slide lower run channels downward to disengage from upper run channels.

(6) Remove lower run channels from door.

INSTALLATION

(1) Position lower run channels in door.

(2) Slide lower run channels upward to engage into upper run channels.

(3) Install glass.

(4) Install bolts attaching lower glass run channels to door panel.

(5) Install water dam.

(6) Install trim panel.

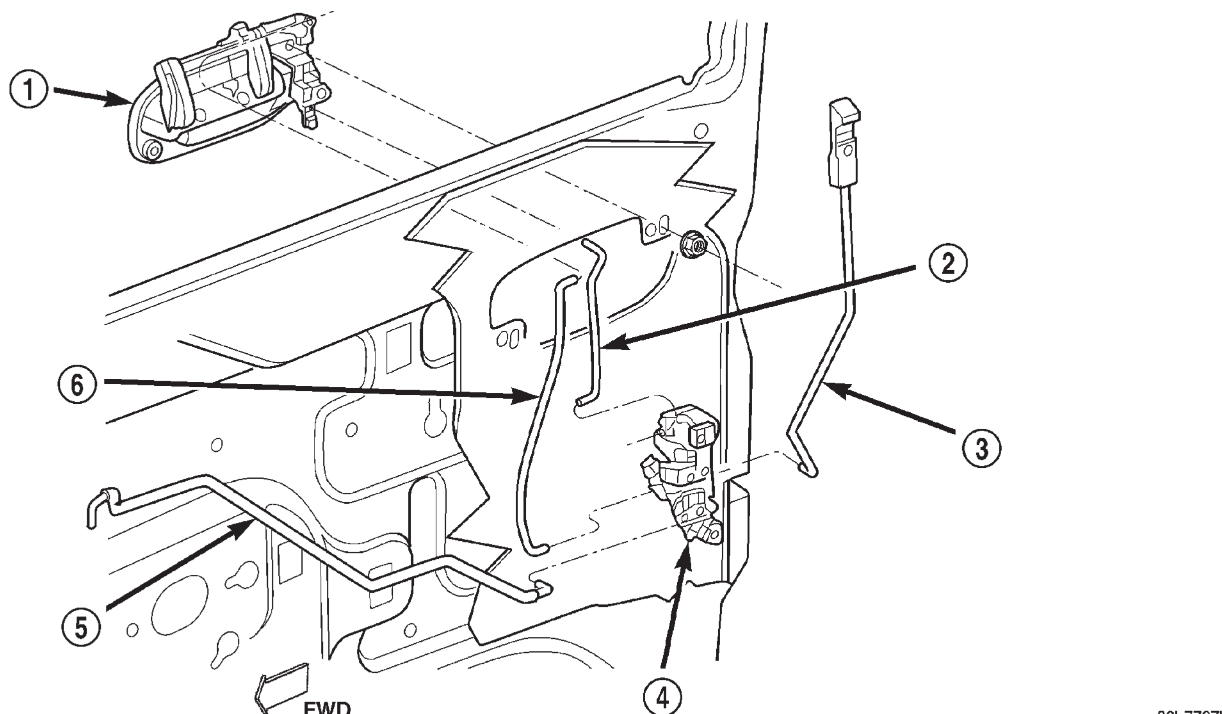

Fig. 4 Outside Door Handle

1 - OUTSIDE HANDLE
2 - LOCK CYLINDER TO LATCH ROD
3 - LOCK BUTTON TO LATCH ROD
4 - LATCH
5 - INSIDE HANDLE TO LATCH ROD
6 - OUTSIDE HANDLE TO LATCH ROD

FDR LOWER GLASS RUN CHANNELS (Continued)

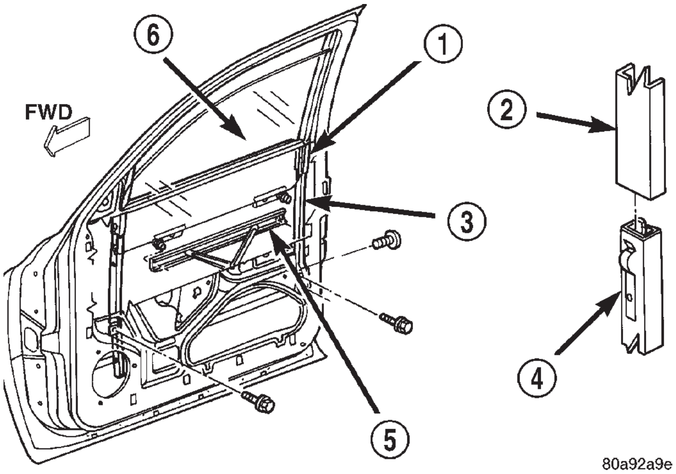

Fig. 5 Lower Glass Run

1 - UPPER GLASS RUN CHANNEL
2 - UPPER CHANNEL
3 - LOWER GLASS RUN CHANNEL
4 - LOWER CHANNEL
5 - REGULATOR
6 - DOOR GLASS

FRONT DOOR HINGE

DESCRIPTION

The hinge pin is not serviceable. Replace the hinge if the hinge pin is damaged.

REMOVAL

(1) Release door latch and open door.
(2) Support door on a suitable lifting device.
(3) Using a suitable marker, mark the outline of the door hinge on the hinge pillar and door end frame to aid installation.
(4) Remove bolts attaching hinge to door (Fig. 6).
(5) Remove bolts attaching door hinge to hinge pillar.
(6) Separate door hinge from vehicle.

INSTALLATION

(1) If necessary, paint replacement door hinge before installation.
(2) Position door hinge on hinge pillar using alignment marks.
(3) Install bolts attaching door hinge to hinge pillar. Tighten bolts to 28 N·m (21 ft. lbs.) torque.
(4) Install bolts attaching hinge to door. Tighten bolts to 28 N·m (21 ft. lbs.) torque.

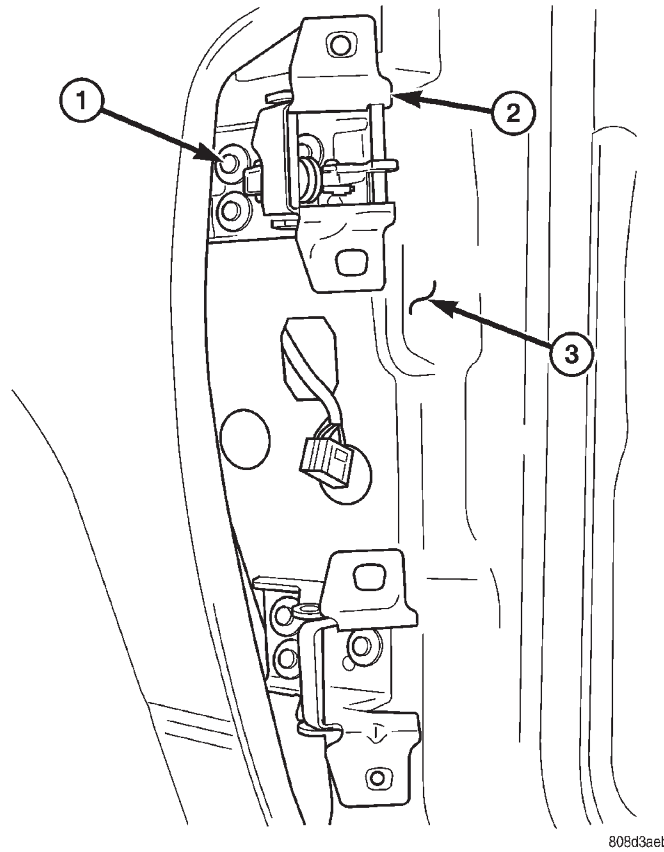

Fig. 6 Door Hinge

1 - BOLT
2 - HINGE
3 - HINGE PILLAR

FRONT DOOR INSIDE HANDLE ACTUATOR

DESCRIPTION

The front door inside handle actuator is heat staked to the trim panel. If the handle needs servicing, refer to the heat staking procedure located in this section.

FRONT DOOR LATCH

REMOVAL

(1) Remove door trim panel.
(2) Peel back water dam as necessary.
(3) For access to latch, roll up glass and remove bolts attaching rearward glass run channel to door. Move and secure glass run channel.

FRONT DOOR LATCH (Continued)

(4) Remove screws attaching latch to door shut face (Fig. 7).

(5) Disengage wire harness connector for power door locks, if equipped.

(6) Disengage lock button to latch rod from the latch.

(7) Disengage lock cylinder to latch rod from the latch (Fig. 4).

(8) Disengage inside handle to latch rod from the latch.

(9) Disengage outside handle to latch rod from the latch.

(10) Separate latch from door.

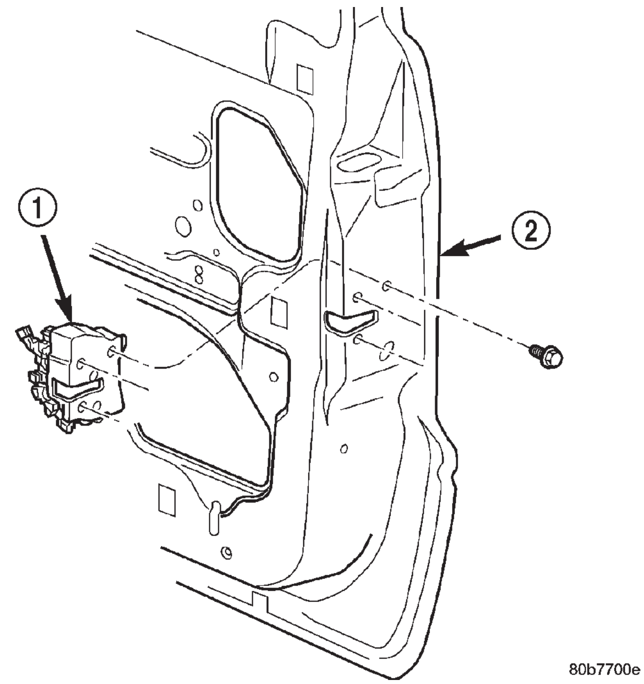

Fig. 7 Latch

1 - LATCH
2 - DOOR

INSTALLATION

(1) Engage latch rod to outside handle.

(2) Engage inside handle to latch rod to the latch.

(3) Engage lock cylinder to latch rod to the latch.

(4) Engage lock button to latch rod to the latch.

(5) Position latch in door.

(6) Install screws attaching latch to door shut face. Tighten the screws to 9.6 N·m (85 in. lbs.) torque.

(7) Engage outside handle to latch rod to the latch.

(8) Engage wire harness connector for power door locks, if equipped.

(9) Install rearward glass run channel.

(10) Install water dam.

(11) Install door trim panel.

(12) Using the access hole in the door shut face, loosen the latch adjustment screw and ensure the outside door handle is flush with door outer panel. Tighten the adjustment screw.

ADJUSTMENTS

(1) Insert a torx driver through the round hole in the door end frame near the latch striker opening (Fig. 8).

(2) Loosen torx head screw on the side of the latch linkage.

(3) Lift upward on outside door handle and release it.

(4) Tighten torx head screw on latch.

(5) Verify latch operation.

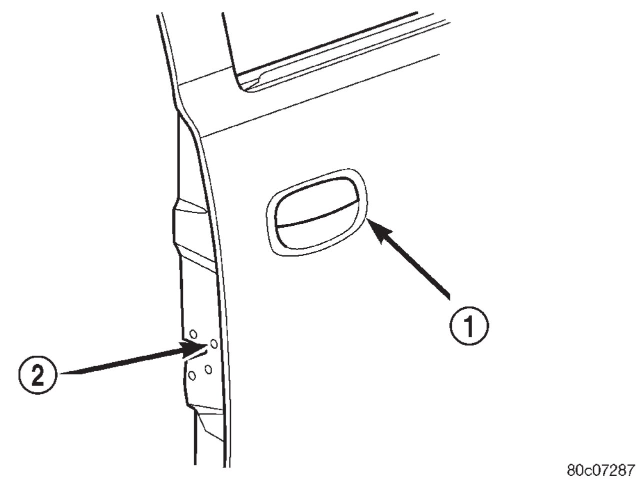

Fig. 8 Door Latch Adjustment

1 - OUTSIDE DOOR HANDLE
2 - DOOR LATCH ADJUSTMENT ACCESS

FRONT DOOR LATCH STRIKER

REMOVAL

(1) Use a wax crayon or equivalent and mark the position of the striker on the B-pillar.

(2) Remove the screws attaching the striker and spacer to the B-pillar (Fig. 9).

(3) Separate the striker from the B-pillar.

INSTALLATION

(1) Using the alignment marks, position the spacer and striker on the B-Pillar.

(2) Install the screws. Tighten the screw to 28.2 N·m (250 in. lbs.) torque.

FRONT DOOR LATCH STRIKER (Continued)

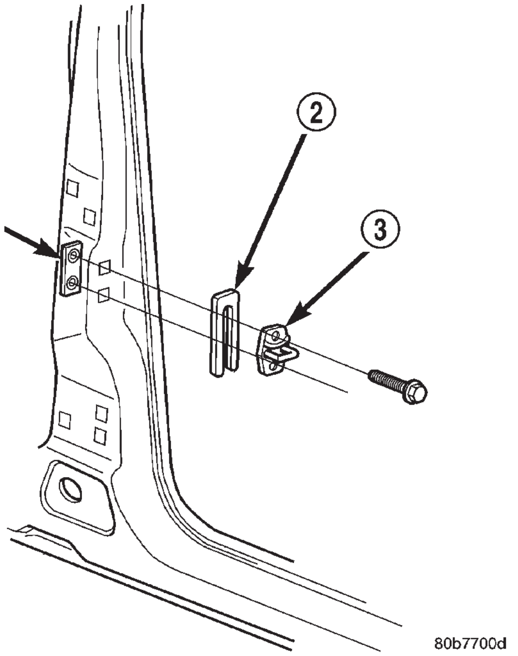

Fig. 9 Front Door Latch Striker

1 - TAPPING PLATE
2 - SPACER
3 - STRIKER

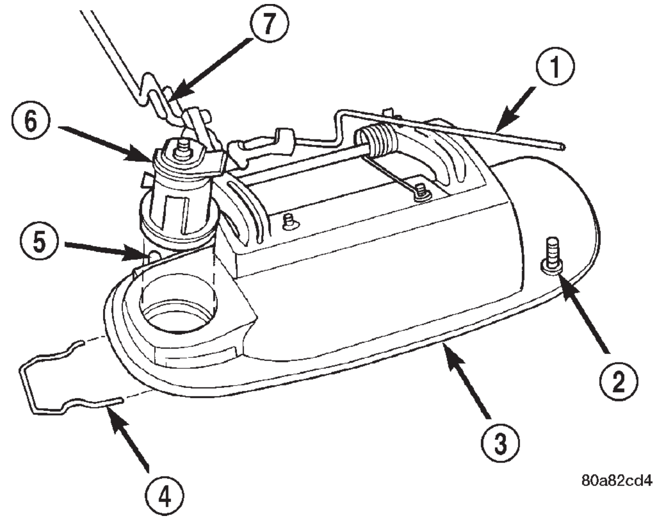

Fig. 10 Lock Cylinder

1 - LOCK CYLINDER TO LATCH ROD
2 - STUD
3 - OUTSIDE HANDLE
4 - RETAINING CLIP
5 - STUD
6 - LOCK CYLINDER
7 - LOCK BUTTON ROD

FRONT DOOR LOCK CYLINDER

LOCK CYLINDERS

Ignition, door, deck lid, and rear hatch lock cylinders are all codable to the key. Lock barrels, tumblers, and tumbler springs are available to allow the technician to change replacement locks cylinders to match the customer's original key set. See the appropriate section in this manual for lock cylinder removal. See the Mopar® catalogue for part numbers and lock coding procedures.

REMOVAL

(1) Remove door trim panel.
(2) Remove outside handle.
(3) Disengage lock cylinder to latch rod from the lock cylinder.
(4) Using a small flat blade, pry lock cylinder retaining clip from lock cylinder housing/outside handle (Fig. 10).
(5) Push lock cylinder out of lock cylinder housing/ outside handle.

INSTALLATION

(1) Push lock cylinder into lock cylinder housing/ outside handle. Ensure the lock cylinder is fully seated in the handle.
(2) Install lock cylinder retaining clip. Ensure the clip is fully seated.
(3) Engage lock cylinder to latch rod to the lock cylinder.
(4) Install outside handle.
(5) Install door trim panel.

TRIM PANEL

REMOVAL

(1) Release door latch and open door.
(2) Roll window down.
(3) Remove window crank (Fig. 11), if equipped.
(4) Remove screws attaching trim panel to door (Fig. 12) and (Fig. 13).

CAUTION: Do not forcibly pull trim panel from door, damage to trim panel may occur.

TRIM PANEL (Continued)

(5) Simultaneously lift upward and outward to release retainer steps from inner door panel (Fig. 14).

(6) Disengage inside handle linkage rod from inside handle.

(7) Disconnect speaker harness wire connector (Fig. 15).

(8) Disengage clips attaching power window/lock switch panel to door trim panel. Disengage wire connector from switch panel, if equipped (Fig. 16).

(9) Separate door trim panel from vehicle.

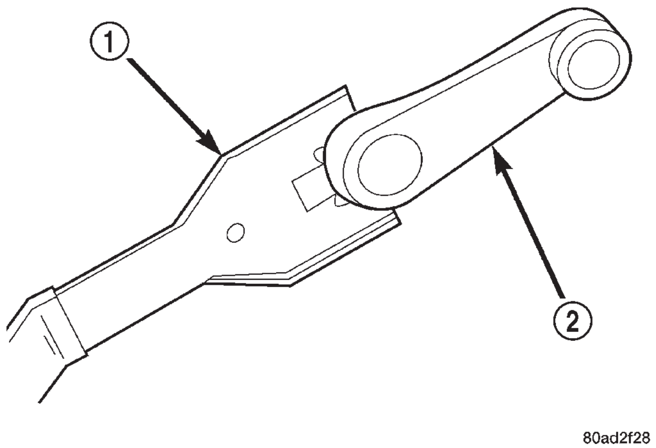

Fig. 11 Window Crank—Typical

1 - WINDOW CRANK REMOVAL TOOL
2 - WINDOW CRANK

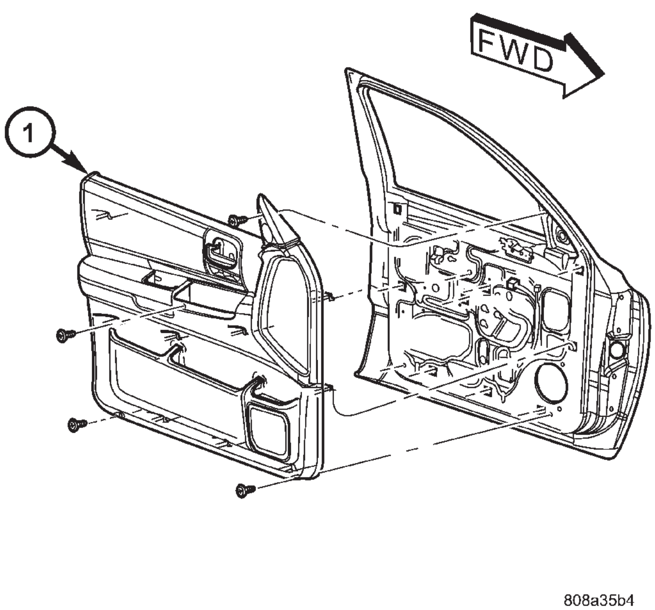

Fig. 12 Door Trim Panel

1 - TRIM PANEL

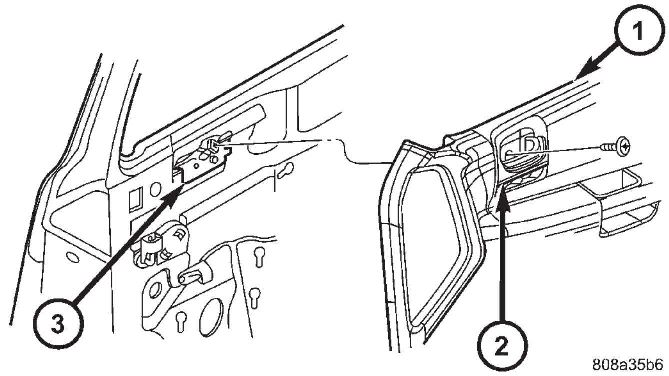

Fig. 13 Trim Panel Screw

1 - TRIM PANEL
2 - INSIDE DOOR HANDLE
3 - INSIDE DOOR HANDLE BRACKET

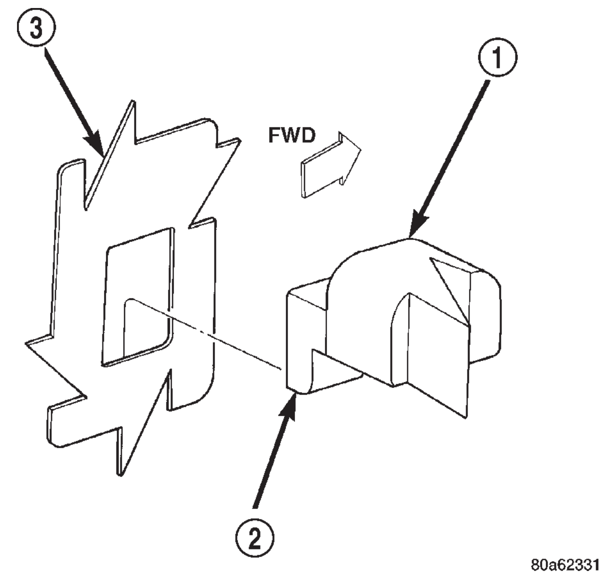

Fig. 14 Trim Panel Retainer

1 - TRIM PANEL
2 - RETAINER STEP
3 - INNER DOOR PANEL

INSTALLATION

(1) Position trim panel at door.

(2) Engage wire connector for window/lock switch panel, if equipped. Engage clips attaching power window/lock switch panel to door trim panel.

(3) Engage power mirror wire connector, if equipped.

(4) Connect speaker harness wire connector.

(5) Engage inside handle linkage rod to inside handle.

(6) Align trim panel retainer steps with inner door panel and slide trim panel into place.

TRIM PANEL (Continued)

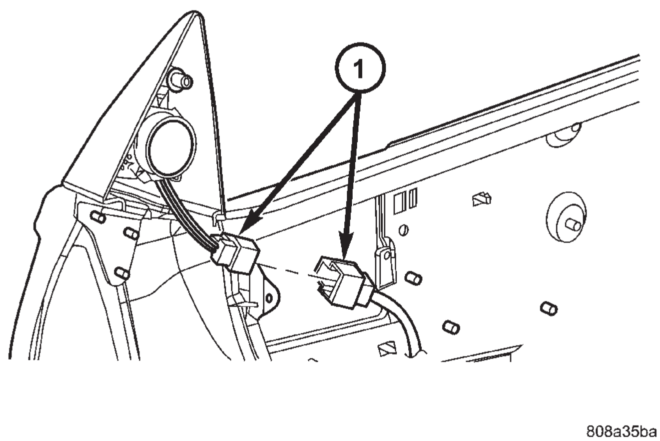

Fig. 15 Speaker And Power Mirror Connector

1 - SPEAKER CONNECTOR

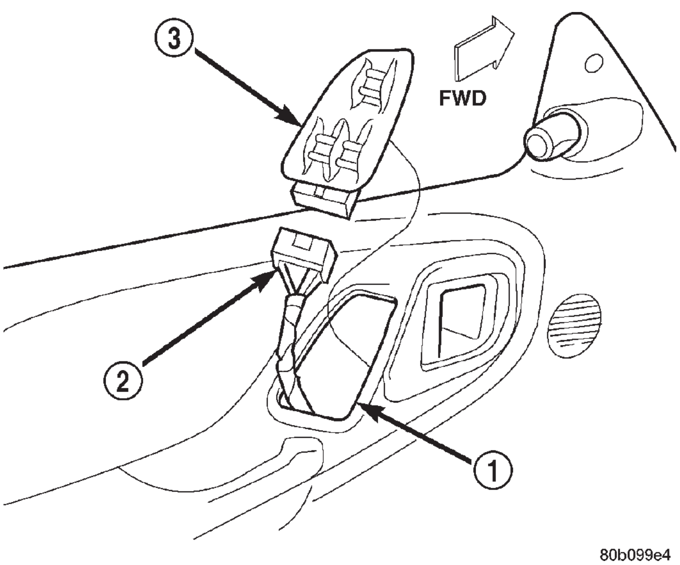

Fig. 16 Power Door Lock/Window Connector

1 - TRIM PANEL SWITCH BEZEL OPENING
2 - WIRE HARNESS CONNECTOR
3 - SWITCH AND BEZEL UNIT

(7) Install screws attaching trim panel to door.
(8) Install window crank, if equipped.

FRONT DOOR WATERDAM

REMOVAL

(1) Remove the trim panel from the door.

(2) Carefully separate the waterdam from the door inner panel at the areas with adhesive (Fig. 17). Remove the waterdam from the door inner panel.

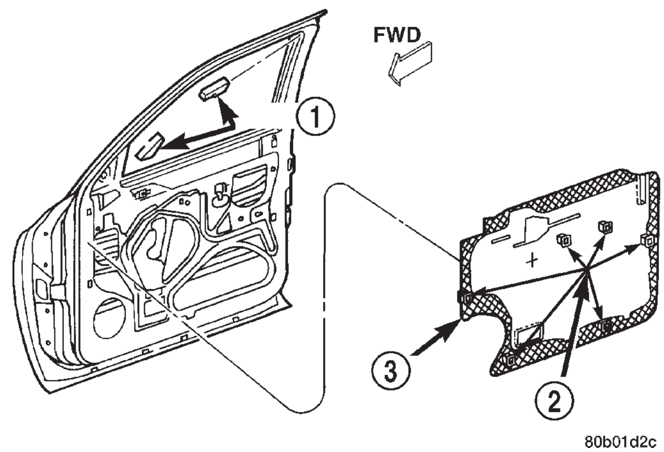

Fig. 17 Water Dam

1 - STUFFERS
2 - RETAINER STEP POCKETS
3 - WATER DAM

INSTALLATION

(1) Apply an appropriate adhesive/sealant to the waterdam edges before installing it.

(2) Position the waterdam on the door inner panel and press it inward at the areas with the adhesive to attach it to the inner panel.

(3) Ensure that the retainer step pockets are position correctly in the door inner panel.

(4) Install the door trim panel.

FRONT DOOR WINDOW REGULATOR

REMOVAL

(1) Remove door trim panel.

(2) Remove water dam as necessary to access window regulator.

(3) Remove glass from door.

(4) Disengage power window motor wire connector from door harness, if equipped (Fig. 18).

(5) Loosen bolts in slotted holes attaching regulator to door inner panel (Fig. 19).

(6) Remove bolts attaching window regulator to inner door panel.

(7) Extract window regulator through access hole in inner door panel.

(8) Separate window regulator from door panel.

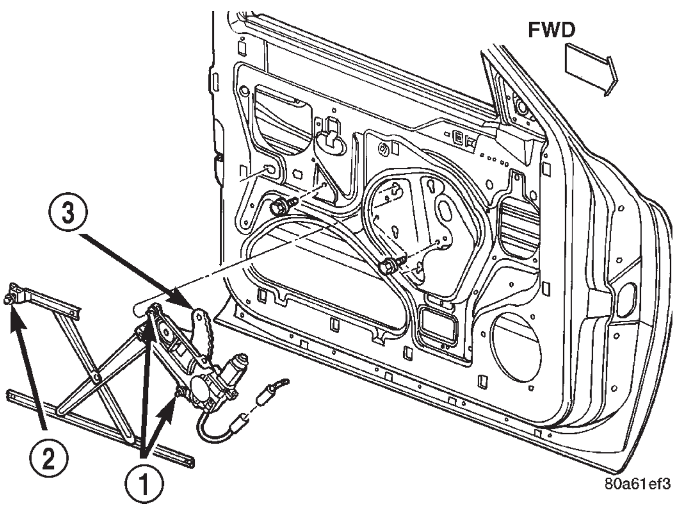

Fig. 18 Power Regulator

1 - SCREW
2 - SCREW
3 - POWER WINDOW REGULATOR

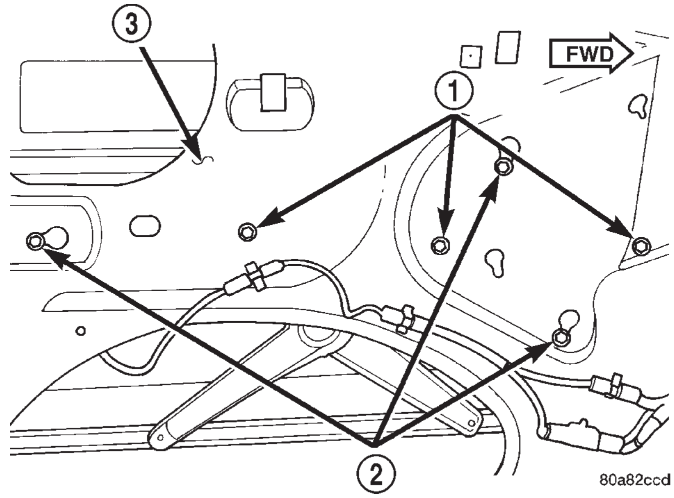

Fig. 19 Power Regulator Bolts

1 - REMOVE BOLTS
2 - LOOSEN BOLTS
3 - DOOR INNER PANEL

INSTALLATION

(1) Position regulator in door and align bolts with slotted holes in door inner panel.

(2) Install bolts attaching window regulator to inner door panel.

(3) Engage power window motor wire connector to door harness, if equipped.

(4) Install glass in door.

(5) Install outer belt weatherstrip.

(6) Install inner belt weatherstrip.

(7) Install water dam.

(8) Install door trim panel.

(9) Verify operation.

DOORS - REAR

TABLE OF CONTENTS

DOORS - REAR

REMOVAL

(1) Remove B-pillar trim.
(2) Disconnect door wire harness connector.
(3) Support door on suitable stand.
(4) Using a wax crayon or equivalent, mark hinge position on B-pillar.
(5) Remove bolts attaching hinge to B-pillar (Fig. 1).

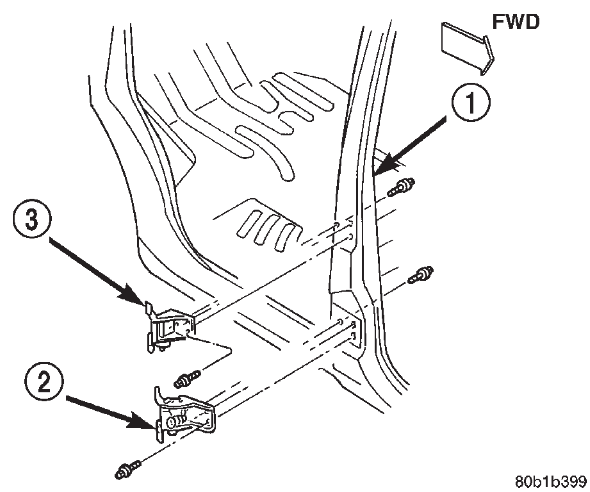

Fig. 1 Rear Door Hinge

1 - B-PILLAR
2 - LOWER HINGE
3 - UPPER HINGE

INSTALLATION

(1) Align and position door on vehicle.
(2) Install bolts attaching hinge to B-pillar (Fig. 1). Tighten bolts to 28 N·m (20 ft. lbs.) torque.
(3) Connect door wire harness connector.
(4) Install B-pillar trim.

ADJUSTMENTS

Minor adjustment for alignment of the door is made by moving the latch striker

IN AND OUT

(1) Loosen the latch striker.
(2) Tap the latch striker inward if the door character line is outboard of the body character line or tap the latch striker outward if the door character line is inboard of the body character line.
(3) Inspect alignment. If correct, tighten striker to 28 N·m (20 ft. lbs.) torque.

UP AND DOWN

(1) Loosen the latch striker.
(2) Tap the latch striker downward if the door character line is higher than the body character line

DOORS - REAR (Continued)

or tap the latch striker upward if the door character line is lower than the body character line.

(3) Inspect alignment. If correct, tighten striker to 28 N·m (20 ft. lbs.) torque.

DOOR GLASS

REMOVAL - REAR DOOR GLASS

(1) Remove the door outer trim panel.
(2) Remove inner and outer beltline weatherstrip.
(3) Remove the door waterdam. Remove the radio speaker, if equipped.
(4) Lower the window glass enough to access the regulator bolt (Fig. 2).
(5) Remove the window glass to regulator bolts.
(6) Raise the window glass manually.
(7) Remove the front lower glass run channel.
(8) Lower the glass.
(9) Using a trim stick or other suitable device, pry up the inside edge of the quarter glass trim (Fig. 3).
(10) Partially remove front upper window weatherstrip.
(11) Raise the glass and remove.

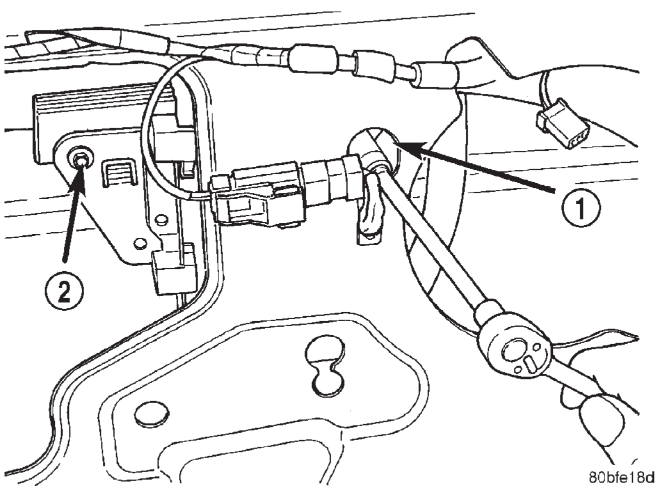

Fig. 2 Window Regulator Bolt Access

1 - GLASS TO REGULATOR BOLT ACCESS
2 - GLASS TO REGULATOR BOLT

REMOVAL - REAR DOOR QUARTER GLASS

CAUTION: The quarter glass trim panel will be difficult to remove without damage. Check availability of replacement before removal.

(1) Remove the rear door trim panel.
(2) Remove the door waterdam.
(3) Remover inner and outer beltline weatherstrip.
(4) Remove the door glass from the door. Refer to door glass procedure in this section.

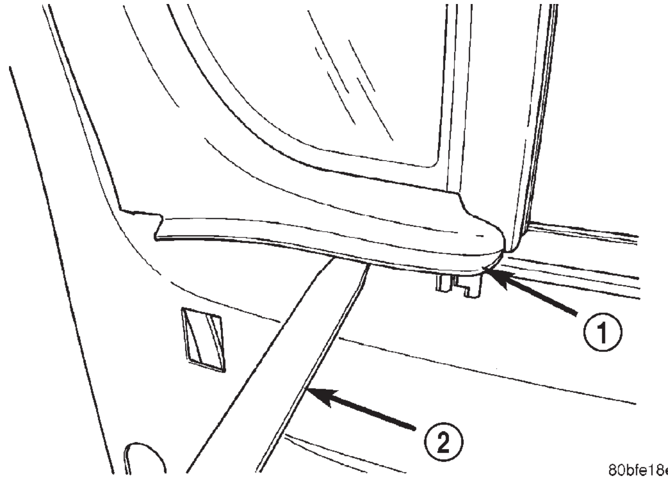

Fig. 3 Quarter Window Trim

1 - QUARTER GLASS TRIM
2 - TRIM STICK

(5) Remove the bolts attaching bottom of rearward run channel to door inner panel.
(6) Remove nuts attaching stationary glass to door frame.
(7) Separate the reward run channel/stationary glass from door.

INSTALLATION - REAR DOOR GLASS

(1) Lower the glass into the door.
(2) Install the front glass weatherstrip and the quarter glass trim.
(3) Raise the glass manually and secure in the door frame.
(4) Install the front lower glass channel.
(5) Lower the glass and install the regulator bolts.
(6) Cycle the glass to ensure proper operation.
(7) Install the waterdam and radio speaker, if equipped.
(8) Install the door trim panel.

INSTALLATION - REAR DOOR QUARTER GLASS

(1) Position the rearward run channel/stationary glass in the door.
(2) Install the nuts attaching stationary glass to door frame.
(3) Install the bolts attaching rearward run channel to door inner panel.
(4) Install the rear door glass. Refer to door glass procedure in this section.
(5) Install inner and outer belt weatherstrip.
(6) Install the door waterdam.
(7) Install the rear door trim panel.

REAR DOOR OUTSIDE HANDLE

REMOVAL

(1) Remove trim panel.
(2) Peel back waterdam to access outside handle.
(3) Remove glass run channel.
(4) Disconnect latch rod (Fig. 4).
(5) Remove nuts attaching handle to outer door panel (Fig. 5).
(6) Separate outside handle from rear door.

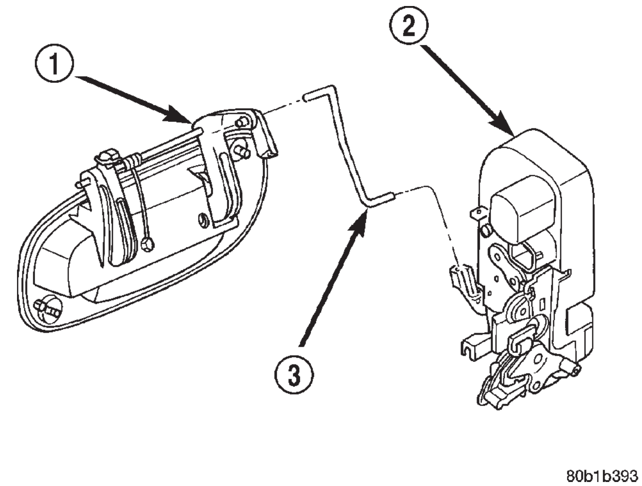

Fig. 4 Latch Rod

1 - OUTSIDE HANDLE
2 - LATCH
3 - LATCH ROD

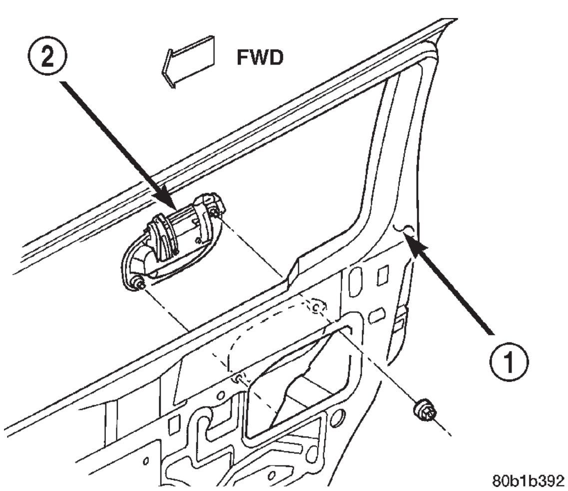

Fig. 5 Rear Door Outside Handle

1 - REAR DOOR
2 - HANDLE

INSTALLATION

(1) Position outside handle in rear door.
(2) Install nuts attaching handle to outer door panel (Fig. 5).
(3) Connect latch rod (Fig. 4).
(4) Install glass run channel.
(5) Install waterdam.
(6) Install trim panel.

REAR DOOR GLASS RUN CHANNELS

REMOVAL

(1) Remove trim panel.
(2) Remove waterdam.
(3) Ensure glass is in full up position and supported. Remove bolts attaching the run channels to door inner panel (Fig. 6).
(4) Remove speaker, if necessary.
(5) Separate run channels from door.

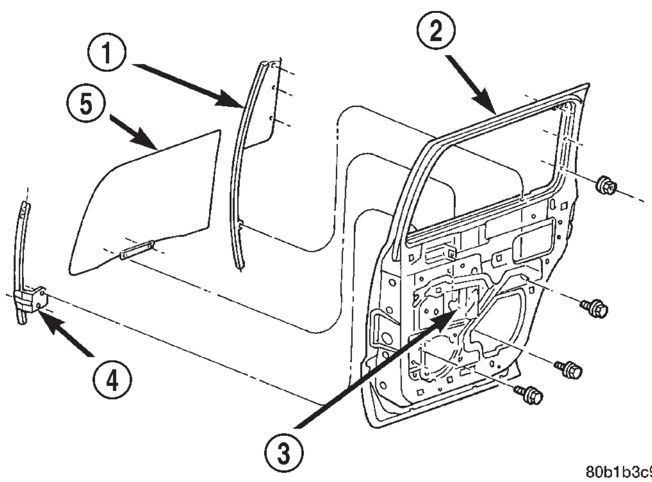

Fig. 6 Rear Door Glass Run Channels

1 - RUN CHANNEL WITH STATIONARY GLASS
2 - REAR DOOR
3 - REGULATOR
4 - RUN CHANNEL
5 - DOOR GLASS

INSTALLATION

(1) Position run channels in door.
(2) Install bolts attaching the run channels to door inner panel (Fig. 6).
(3) Install speaker, if necessary.
(4) Install waterdam.
(5) Install trim panel.

REAR DOOR HINGE

REMOVAL

(1) Remove B-pillar trim.
(2) Disconnect door wire harness connector.
(3) Support door on suitable stand.
(4) Using a wax crayon or equivalent, mark hinge position on B-pillar.
(5) Remove bolts attaching hinge to B-pillar (Fig. 1).
(6) Separate door from vehicle.
(7) Using a wax crayon or equivalent, mark hinge position on door.
(8) Remove bolts attaching hinge to door.

INSTALLATION

(1) Align and position hinge on door.
(2) Install bolts attaching hinge to door. Tighten bolts to 28 N·m (20 ft. lbs.) torque.
(3) Align and position door on vehicle.
(4) Install bolts attaching hinge to B-pillar (Fig. 1). Tighten bolts to 28 N·m (20 ft. lbs.) torque.
(5) Connect door wire harness connector.
(6) Install B-pillar trim.

REAR DOOR INSIDE HANDLE ACTUATOR

DESCRIPTION

The rear door inside handle actuator is heat staked to the trim panel. If the handle needs servicing, refer to the heat staking procedure located in this section.

REAR DOOR LATCH

REMOVAL

(1) Remove trim panel.
(2) Peel waterdam back to access latch.
(3) Disconnect latch rods from latch (Fig. 7).
(4) Disconnect the latch harness connector.
(5) Remove screws attaching latch to rear door (Fig. 8).

INSTALLATION

(1) Connect the latch harness connector.
(2) Install screws attaching latch to rear door.
(3) Connect latch rods to latch.
(4) Install waterdam.
(5) Install trim panel.

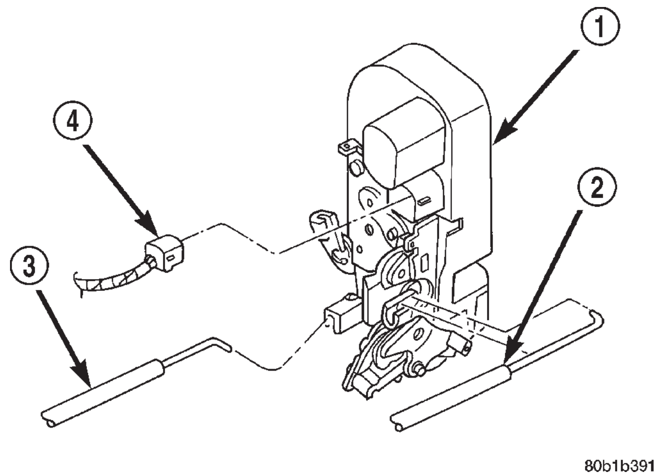

Fig. 7 Rear Door Latch Rods

1 - LATCH
2 - LATCH ROD
3 - LATCH ROD
4 - CONNECTOR

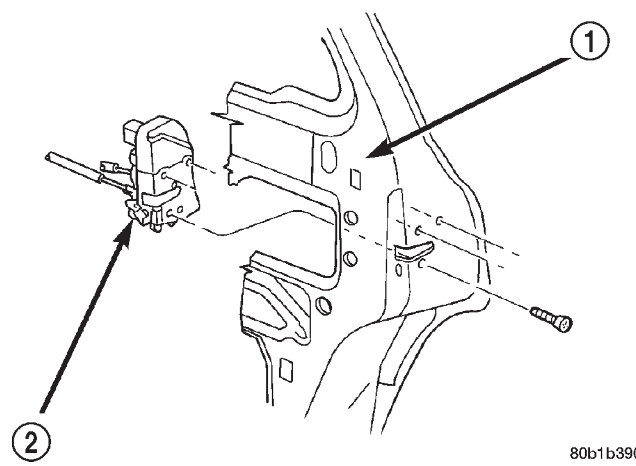

Fig. 8 Rear Door Latch

1 - REAR DOOR
2 - LATCH

REAR DOOR LATCH STRIKER

REMOVAL

(1) Use a wax crayon or equivalent and mark position of striker on C-pillar.
(2) Remove bolts attaching striker and shim to C-pillar.
(3) Separate striker from C-pillar.

INSTALLATION

(1) Using alignment marks, position shim and striker on C-Pillar.
(2) Install bolts. Tighten bolts to 28 N·m (20 ft. lbs.) torque.

REAR DOOR TRIM PANEL

REMOVAL

(1) Release door latch and open door.
(2) Roll window down.
(3) Remove window crank (Fig. 9), if equipped.
(4) Remove screws attaching trim panel to door.

CAUTION: Do not forcibly pull trim panel from door, damage to trim panel may occur.

(5) Simultaneously lift upward and outward to release retainer steps from inner door panel (Fig. 10).
(6) Disengage inside handle linkage rod from inside handle.
(7) Disconnect power widow/lock harness connector, if equipped (Fig. 11).
(8) Separate door trim panel from vehicle.
(9) If necessary, pull upper trim extension outward to disengage from rear door.

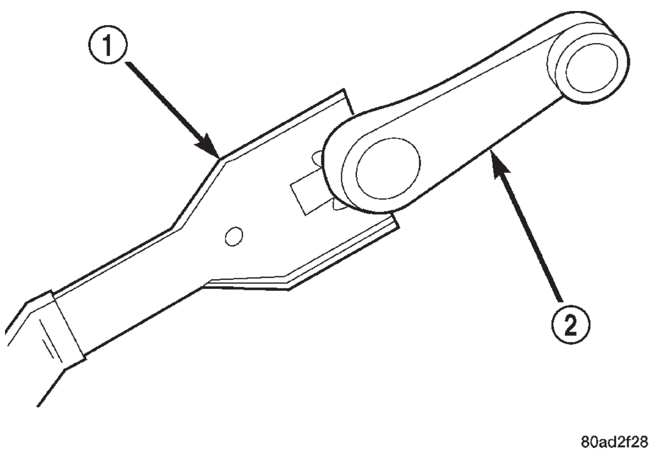

Fig. 9 Window Crank—Typical

1 - WINDOW CRANK REMOVAL TOOL
2 - WINDOW CRANK

INSTALLATION

(1) If removed, install upper trim extension on rear door.
(2) Position trim panel at door.
(3) Engage harness connector for power window/lock, if equipped.
(4) Engage inside handle linkage rod to inside handle.
(5) Align trim panel retainer steps with inner door panel and slide trim panel into place.
(6) Install screws attaching trim panel to door.
(7) Install window crank, if equipped.

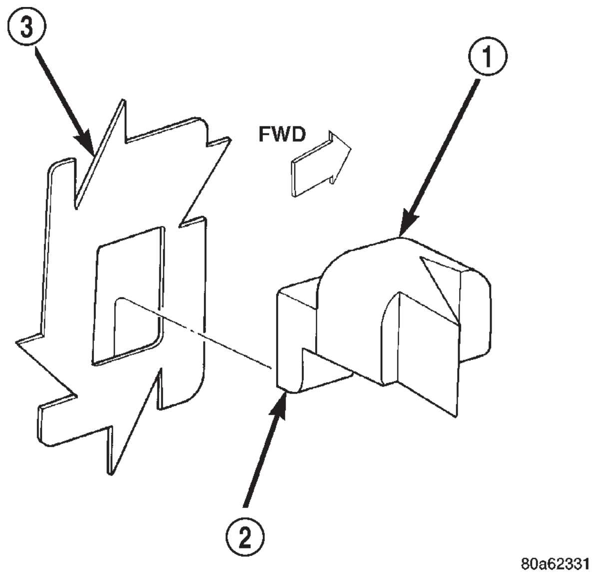

Fig. 10 Trim Panel Retainer

1 - TRIM PANEL
2 - RETAINER STEP
3 - INNER DOOR PANEL

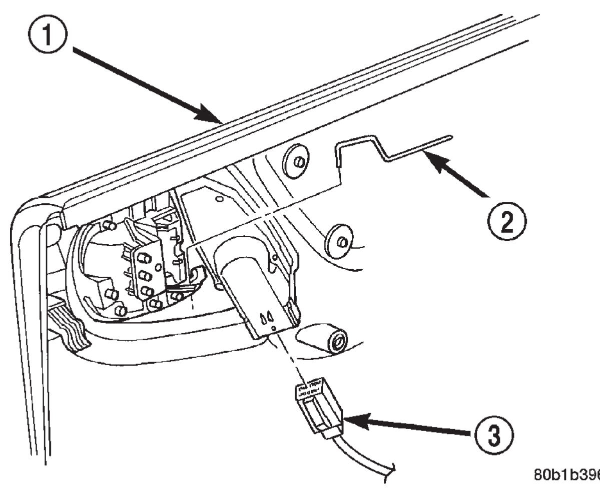

Fig. 11 Power Window/Lock Connector

1 - TRIM PANEL
2 - INSIDE HANDLE LATCH ROD
3 - POWER WINDOW/LOCK CONNECTOR

REAR DOOR WATERDAM

REMOVAL

(1) Remove door trim panel.
(2) Peel the waterdam from the door.
(3) Route the latch rods and wire harnesses through the waterdam.
(4) Separate the waterdam from the door inner panel (Fig. 12).

REAR DOOR WATERDAM (Continued)

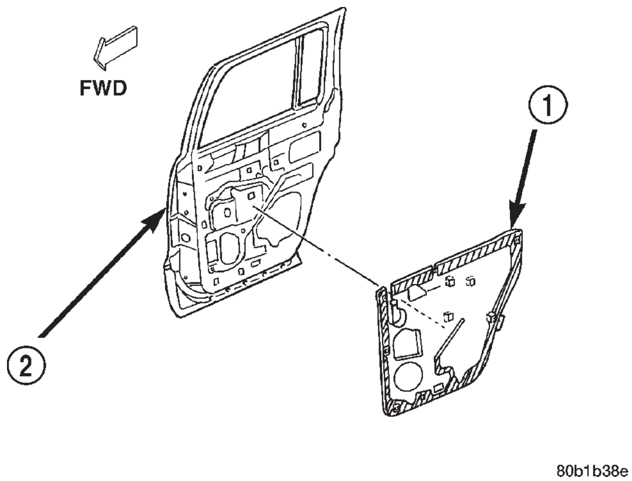

Fig. 12 Rear Door Waterdam

1 - WATER DAM
2 - REAR DOOR

INSTALLATION

(1) Route the latch rods and wire harnesses through the waterdam.

(2) Position the waterdam on the door, apply adhesive as necessary and press into place.

(3) Install door trim panel.

REAR DOOR WINDOW REGULATOR

REMOVAL

(1) Remove the door inner trim panel.

(2) Remove the door waterdam and speaker, if equipped.

(3) Remove the inner and outer beltline weatherstrip.

(4) Lower the door glass.

(5) Remove the bolts attaching the regulator to the glass.

(6) Raise the glass manually and secure in the door frame.

(7) Loosen the regulator attachment nuts and remove the regulator attachment bolts.

(8) Disengage regulator wire harness.

(9) Remove the regulator (Fig. 13).

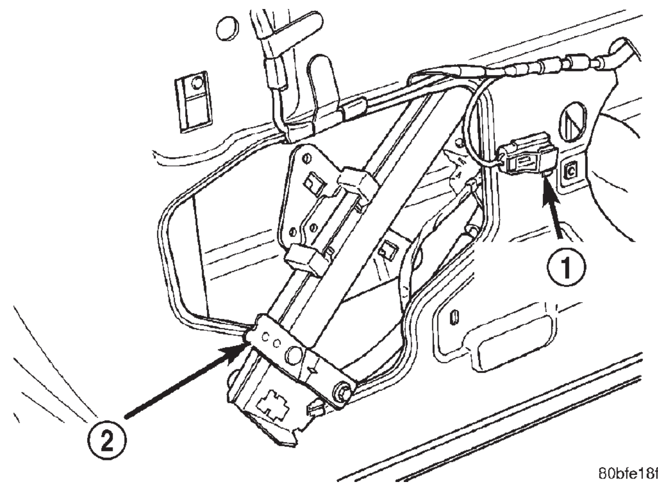

Fig. 13 Rear Door Window Regulator

1 - HARNESS CONNECTOR
2 - POWER WINDOW REGULATOR

INSTALLATION

(1) Position the window regulator in the door.

(2) Install the fasteners attaching the regulator to the inner door panel.

(3) Engage the regulator wire harness.

(4) Lower the glass manually and install the bolts attaching the regulator to the glass.

(5) Cycle the glass to ensure correct operation.

(6) Install the inner and outer beltline weatherstrip.

(7) Install the door waterdam and radio speaker, if equipped.

(8) Install the door trim panel.

EXTERIOR

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EXTERIOR

DESCRIPTION

Exterior sheet metal components make up the exterior of the vehicle. Some exterior metal systems are welded assemblies, such as doors and hoods. Some exterior trim items are made of composite.

OPERATION

The exterior is finished in various metal stampings and composite moldings. These assemblies give the vehicle a finished appearance and protect the occupants from the elements. Some components are part of the energy absorbing system used to protect the occupants in collisions. The exterior sheet metal is repairable and adjustable for fit and finish. Welded and bonded component systems are adjustable as a system. Trim components made of composite are stamped with the type of material used. DaimlerChrysler uses various fasteners to retain trim items. At times, it is not possible to remove trim items without damaging the fastener. If it is not possible to remove an item without damaging a component, cut or break the fasteners and use new ones when installing the component.

BODY SIDE MOLDINGS

REMOVAL

(1) Apply a length of masking tape on the body, parallel to the top edge of the molding to use as a guide, if necessary.

(2) Warm the effected stick-on molding and body metal to approximately 38°C (100°F) using a suitable heat lamp or heat gun.

(3) Pull stick-on molding from painted surface (Fig. 1).

INSTALLATION

(1) Clean body surface with MOPAR Super Kleen solvent or equivalent. Wipe surface dry with lint free cloth.

(2) Remove protective cover from tape on back of molding. Apply molding to body below the masking tape guide.

(3) Remove masking tape guide and heat body and molding. Firmly press molding to body surface to assure adhesion (Fig. 1).

BODY SIDE MOLDINGS (Continued)

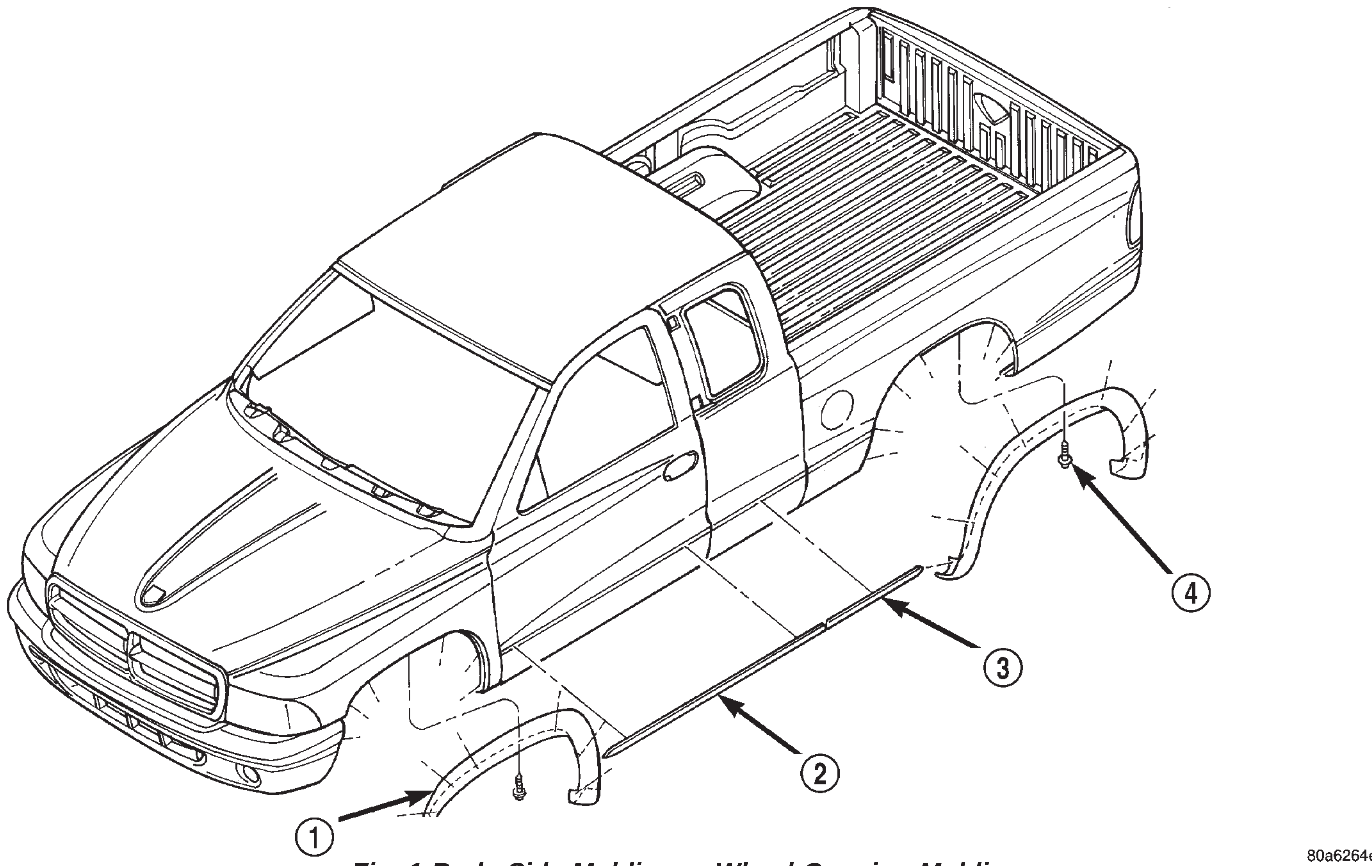

Fig. 1 Body Side Moldings—Wheel Opening Moldings

1 - FRONT WHEEL OPENING MOLDING
2 - DOOR MOLDING
3 - CAB MOLDING
4 - REAR WHEEL OPENING MOLDING

CARGO BOX

REMOVAL

CAUTION: The bolts attaching the cargo box to the frame are specially coated to provide a locking action. These bolts are not reusable and must be replaced each time the cargo box is removed or replaced.

(1) Open fuel fill door.
(2) Remove screws attaching fuel fill neck adaptor to cargo box side wall.
(3) Separate fuel fill neck from cargo box.
(4) Disengage tail lamp wire connector from main body harness.
(5) Remove bolts attaching cargo box to frame rails (Fig. 2).
(6) Using a suitable lifting device, separate cargo box from vehicle.

INSTALLATION

(1) Position cargo box on frame rails.
(2) Install bolts attaching cargo box to frame rails. Tighten bolts to 27 N·m (20 ft. lbs.) torque.
(3) Engage tail lamp wire connector for main body harness.
(4) Install screws attaching fuel fill neck adaptor to cargo box side wall.

CARGO BOX (Continued)

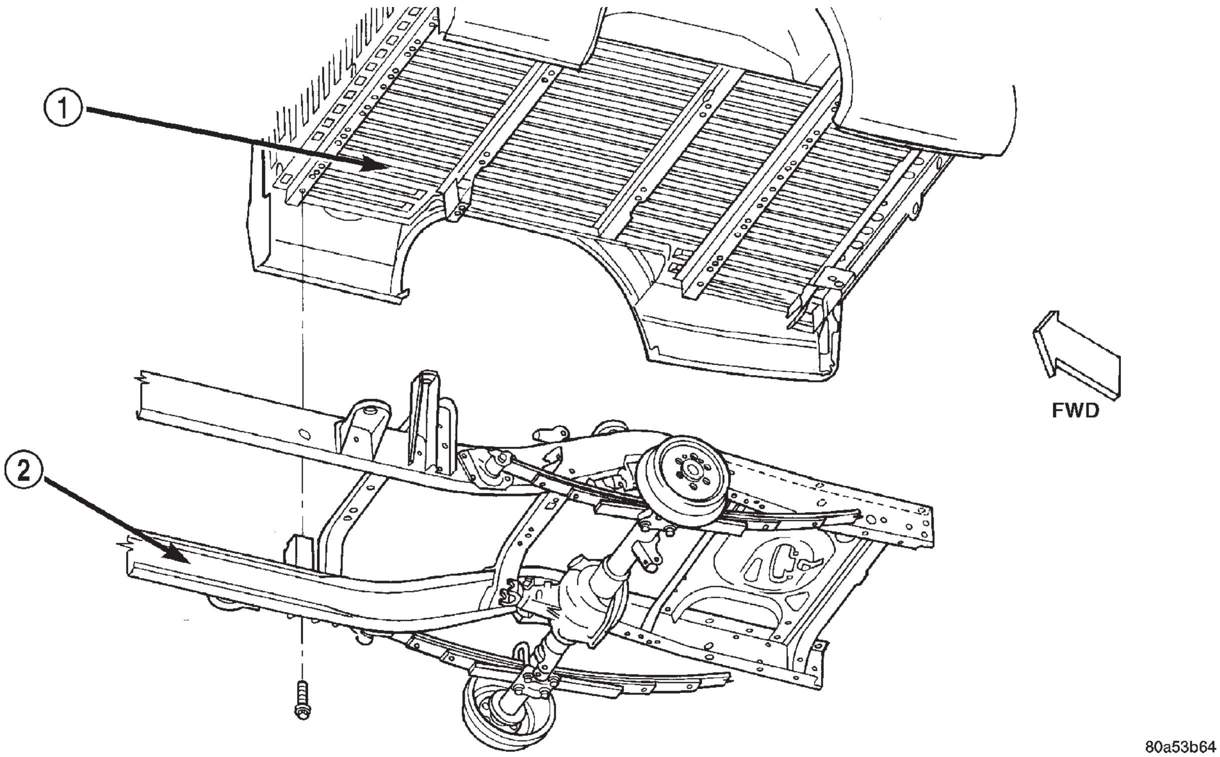

Fig. 2 Cargo Box

1 - CARGO BOX
2 - FRAME RAIL

COWL GRILLE

REMOVAL

(1) Open hood.
(2) Mark wiper arm locations on windshield with grease pencil.
(3) Lift cover for wiper arms and remove nuts attaching wiper arms to cowl.
(4) Remove upper plastic nuts attaching cowl grille to cowl (Fig. 3).
(5) Insert a small flat blade into the slots of the plastic rivet anchors in each cowl grille corner. Lift up on the flat blade to release the rivet anchors.
(6) Remove cowl weatherstrip.
(7) Disconnect and plug windshield washer feed line from cowl.
(8) Disconnect vacuum line from cowl.
(9) Separate cowl grille from cowl.

INSTALLATION

(1) Position cowl grille on cowl.
(2) Connect vacuum line to cowl.
(3) Remove the plug and connect windshield washer feed line to cowl.
(4) Install cowl weatherstrip.

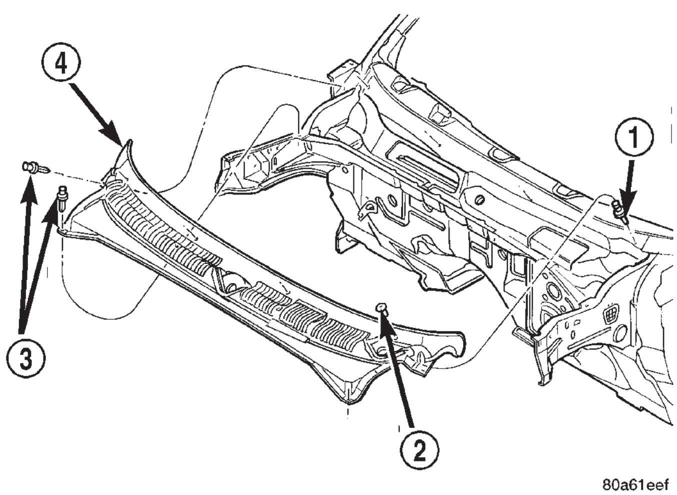

Fig. 3 Cowl Grille

1 - STUD
2 - PLASTIC NUT
3 - PLASTIC RIVET
4 - COWL GRILLE

(5) Position rivet anchors in place and press down to engage.
(6) Install upper plastic nuts attaching cowl grille to cowl.
(7) Align wiper arms and install the nuts.

EXTERIOR NAME PLATES

REMOVAL

NOTE: Exterior nameplates are attached to body panels with adhesive tape.

(1) Apply a length of masking tape on the body, parallel to the top edge of the nameplate to use as a guide, if necessary.
(2) If temperature is below 21°C (70°F) warm emblem with a heat lamp or gun. Do not exceed 52°C (120°F) when heating emblem.
(3) Insert a plastic trim stick or a hard wood wedge behind the emblem to separate the adhesive backing from the body.
(4) Clean adhesive residue from body with MOPAR Super Clean solvent or equivalent.

INSTALLATION

(1) Remove carrier from back of emblem.
(2) Position emblem properly on body (Fig. 4).
(3) Press emblem firmly to body with palm of hand.
(4) If temperature is below 21°C (70°F) warm emblem with a heat lamp or gun to assure adhesion. Do not exceed 52°C (120°F) when heating emblem.

FRONT END SPLASH SHIELDS

REMOVAL

(1) Raise and support the front wheel.
(2) Remove the front wheel.
(3) Remove wheel opening molding.
(4) Remove plastic rivets attaching wheelhouse liner to wheelhouse (Fig. 5).
(5) Separate liner from vehicle.

INSTALLATION

(1) Position liner in wheelhouse.
(2) Install plastic rivets attaching wheelhouse liner to wheelhouse.
(3) Install wheel opening molding.
(4) Install the front wheel.
(5) Remove the support and lower the vehicle.

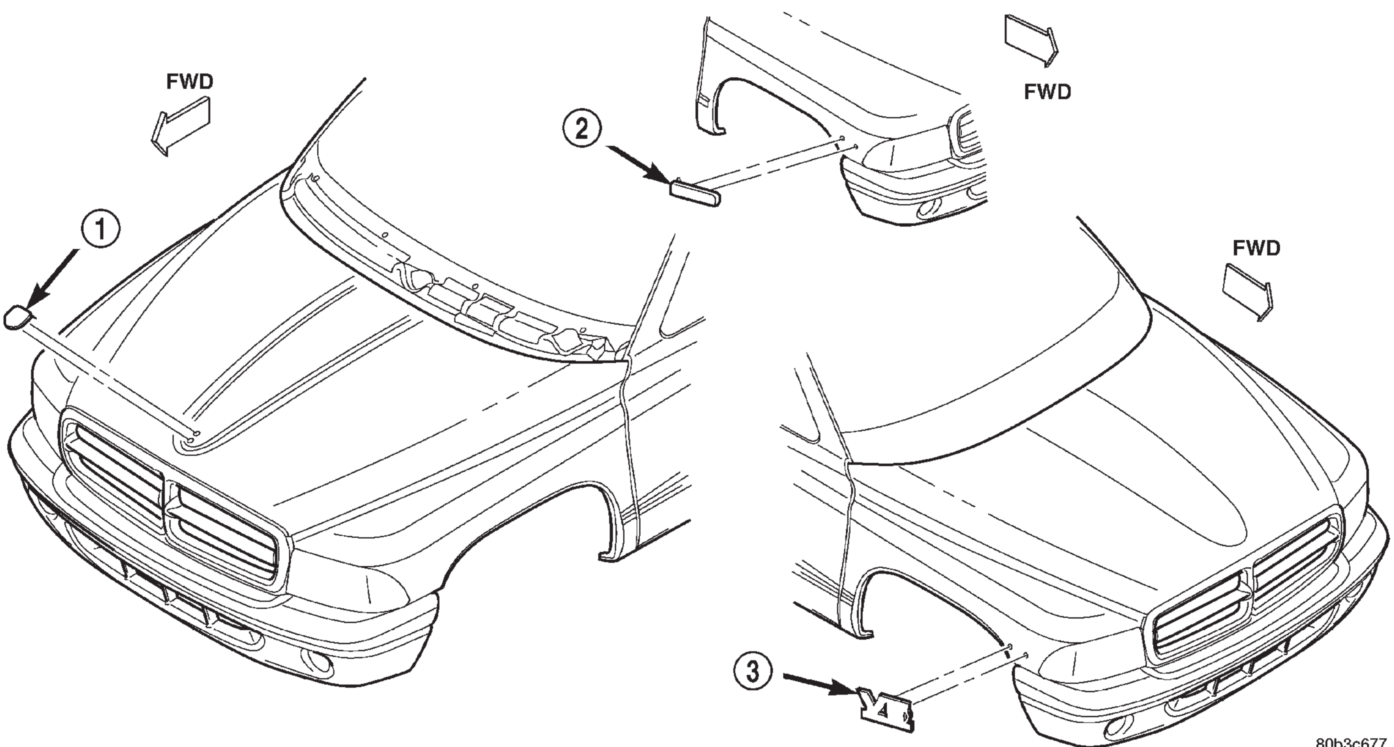

Fig. 4 Exterior Nameplates

1 - HOOD NAME PLATE
2 - MAGNUM POWER NAME PLATE
3 - ENGINE NAME PLATE

FRONT END SPLASH SHIELDS (Continued)

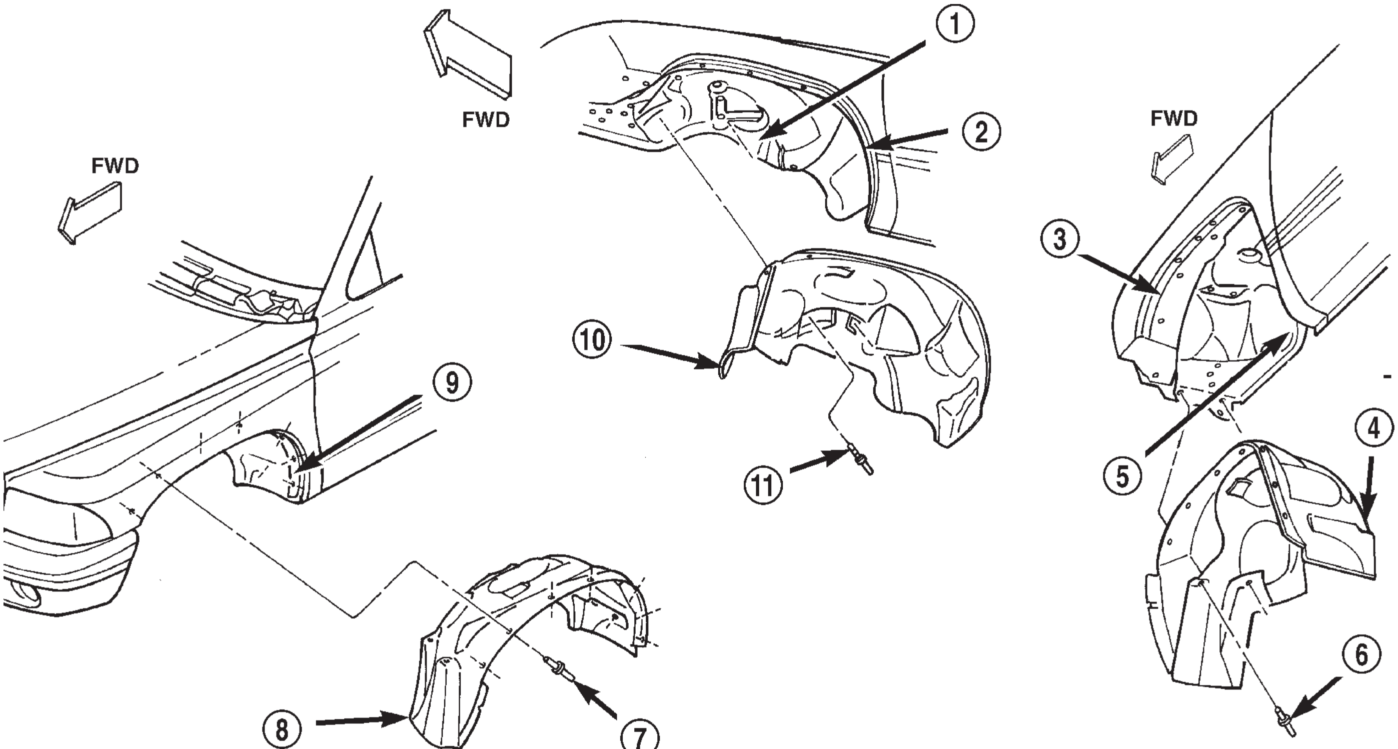

Fig. 5 Front Wheelhouse Liner

1 - FENDER SPLASH SHIELD
2 - INNER FENDER
3 - INNER FENDER
4 - WHEELHOUSE LINER
5 - FENDER SPLASH SHIELD
6 - PLASTIC RIVET
7 - PLASTIC RIVET
8 - WHEELHOUSE LINER
9 - INNER FENDER
10 - WHEELHOUSE LINER
11 - PLASTIC RIVET

FUEL FILL DOOR

REMOVAL

(1) Open the fuel filler door.
(2) Remove the screws attaching the door to the cargo box outer panel (Fig. 6).
(3) Remove the door from the panel.

INSTALLATION

(1) Position the fuel filler door on the cargo box outer panel with the screw holes aligned.
(2) Install the screws attaching the fuel filler door to the cargo box outer panel.

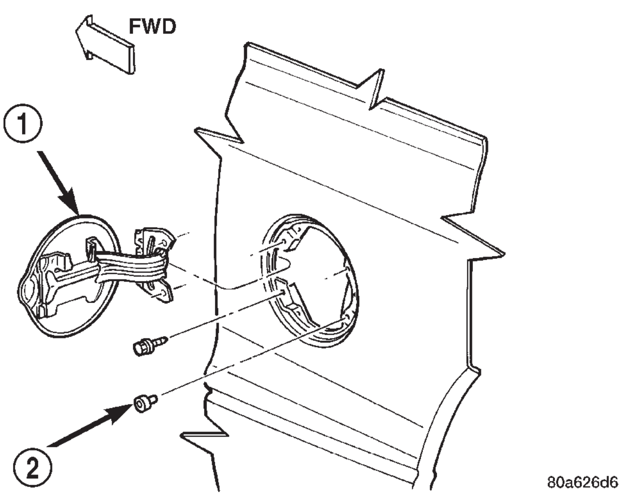

Fig. 6 Fuel Filler Door

1 - FUEL DOOR
2 - BUMPER

GRILLE

REMOVAL

(1) Release primary hood latch.
(2) Release hood safety catch and open hood.
(3) Remove screws attaching bottom of grille to grille mounting bracket.
(4) Remove nuts attaching grille to hood (Fig. 7).
(5) Separate grille from vehicle.

GRILLE (Continued)

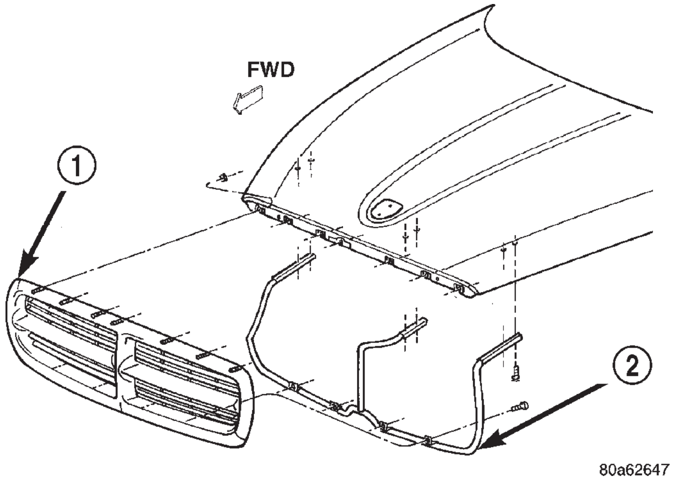

Fig. 7 Grille

1 - GRILLE
2 - GRILLE MOUNTING BRACKET

INSTALLATION

(1) Position grille on hood.
(2) Install nuts attaching grille to hood.
(3) Install screws attaching bottom of grille to grille mounting bracket.
(4) Close hood.

LEFT FRONT FENDER

REMOVAL

(1) Remove battery.
(2) Raise and support the vehicle.
(3) Remove left front wheel.
(4) Remove wheel opening molding.
(5) Remove wheelhouse liner.
(6) Remove left headlamp module.
(7) Remove PDC (power distribution center).
(8) Remove battery tray and battery support bracket (Fig. 8).
(9) Remove HCU (hydraulic control unit) if equipped. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/HCU (HYDRAULIC CONTROL UNIT) - REMOVAL)
(10) Disengage clips attaching hood release cable to inner fender.
(11) Disengage clips attaching wire harness to inner fender and wheelhouse.
(12) Remove bolt attaching fender to lower rocker panel.
(13) Remove bolts attaching fender to lower radiator closure panel (Fig. 8).
(14) Remove bolts attaching fender to hood hinge support bracket.
(15) Remove bolts attaching fender to upper cowl (Fig. 9).
(16) Remove bolts attaching fender to upper radiator closure panel.
(17) Separate fender and wheelhouse from vehicle.

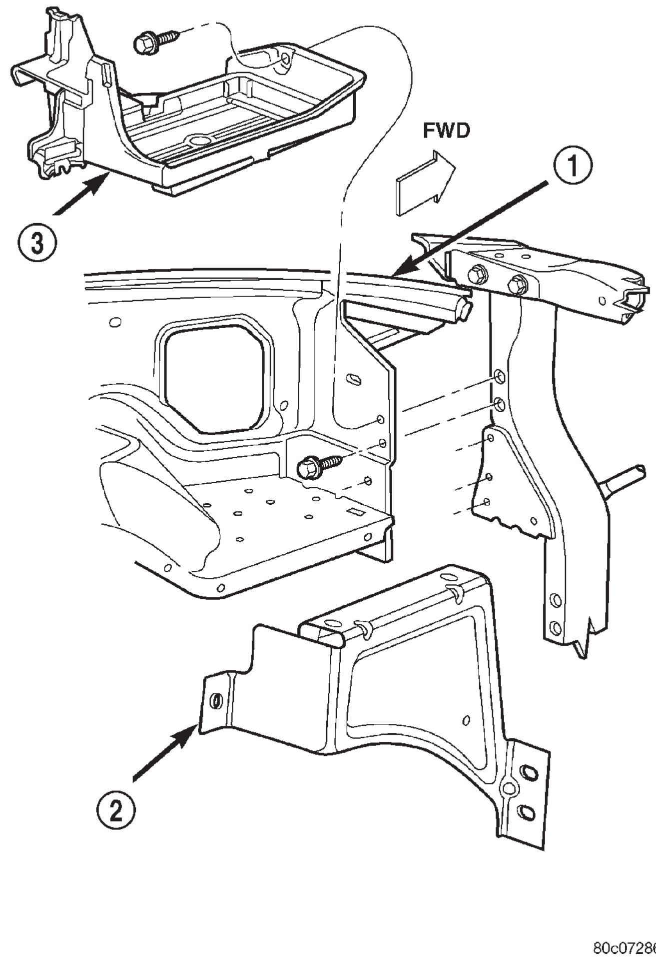

Fig. 8 Battery Tray and Support Bracket

1 - FRONT FENDER
2 - BATTERY TRAY SUPPORT BRACKET
3 - BATTERY TRAY

INSTALLATION

(1) Position fender and wheelhouse from vehicle.
(2) Install bolts attaching fender to upper radiator closure panel.
(3) Install bolts attaching fender to upper cowl.
(4) Install bolts attaching fender to hood hinge support bracket.
(5) Install bolts attaching fender to lower radiator closure panel.
(6) Install bolt attaching fender to lower rocker panel.
(7) Position the hood release cable to inner fender and engage clips.
(8) Position the wire harnesses on the inner fender and wheelhouse and engage clips.

LEFT FRONT FENDER (Continued)

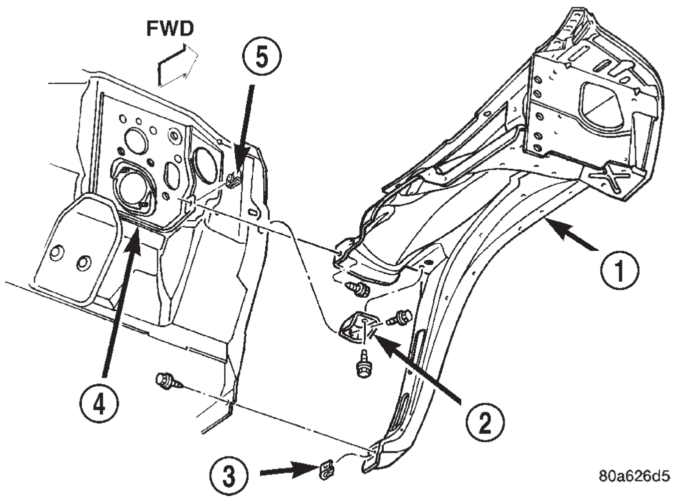

Fig. 9 Front Fender

1 - FRONT FENDER
2 - BRACKET
3 - U-NUT
4 - DASH PANEL
5 - U-NUT

(9) Install HCU if equipped. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/HCU (HYDRAULIC CONTROL UNIT) - INSTALLATION)
(10) Install battery support bracket and battery tray.
(11) Install PDC (power distribution center).
(12) Install left headlamp module.
(13) Install battery.
(14) Install wheelhouse liner.
(15) Install wheel opening molding.
(16) Install left front wheel.
(17) Remove the support and lower the vehicle.

REAR WHEELHOUSE SPLASH SHIELD

REMOVAL

(1) Remove bottom screw attaching wheel opening molding to cargo box.
(2) Remove screws attaching splash shield to inner wheel house (Fig. 10).
(3) Separate splash shield from vehicle.

INSTALLATION

(1) Position splash shield in wheel house.
(2) Install screws attaching splash shield to inner wheel house.
(3) Install bottom screw attaching wheel opening molding to cargo box.

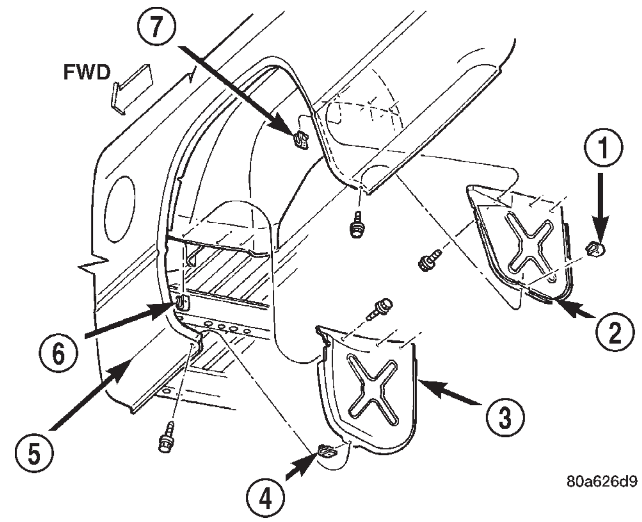

Fig. 10 Rear Splash Shield

1 - U-NUT
2 - REAR SPLASH SHIELD
3 - FRONT SPLASH SHIELD
4 - U-NUT
5 - CARGO BOX
6 - U-NUT
7 - U-NUT

RIGHT FRONT FENDER

REMOVAL

(1) Disconnect battery negative cable.
(2) Raise and support the vehicle.
(3) Remove right front wheel.
(4) Remove wheel opening molding.
(5) Remove wheelhouse liner.
(6) Remove right headlamp module.
(7) Remove air cleaner element housing.
(8) Remove powertrain control module.
(9) Disengage clips attaching wire harnesses to inner fender and wheelhouse.
(10) Remove bolt attaching fender to lower rocker panel.
(11) Remove bolts attaching fender to lower radiator closure panel (Fig. 11).
(12) Remove bolts attaching fender to hood hinge support bracket.
(13) Remove bolts attaching fender to upper cowl.
(14) Remove bolts attaching fender to upper radiator closure panel.
(15) Separate fender and wheelhouse from vehicle.

INSTALLATION

(1) Position fender and wheelhouse from vehicle.
(2) Install bolts attaching fender to upper radiator closure panel.
(3) Install bolts attaching fender to upper cowl.

RIGHT FRONT FENDER (Continued)

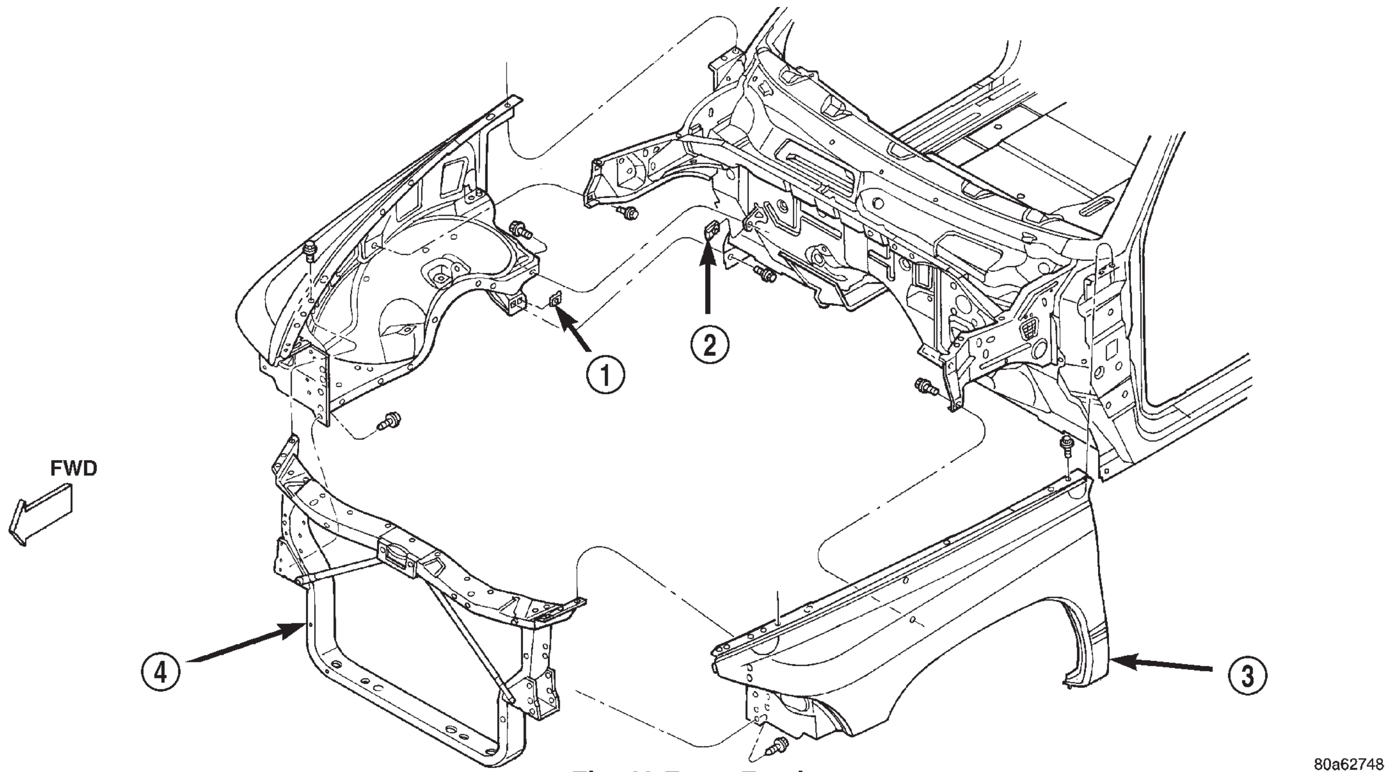

Fig. 11 Front Fender

1 - U-NUT
2 - U-NUT
3 - FRONT FENDER
4 - RADIATOR CLOSURE PANEL

(4) Install bolts attaching fender to hood hinge support bracket.
(5) Install bolts attaching fender to lower radiator closure panel.
(6) Install bolt attaching fender to lower rocker panel.
(7) Position the wire harnesses on the inner fender and wheelhouse and engage clips.
(8) Install powertrain control module.
(9) Install air cleaner element housing.
(10) Install right headlamp module.
(11) Install wheelhouse liner.
(12) Install wheel opening molding.
(13) Install right front wheel.
(14) Remove the support and lower the vehicle.
(15) Connect battery negative cable.

ROOF JOINT MOLDING

REMOVAL

(1) Warm the roof joint molding and roof panel to approximately 38°C (100°F) using a suitable heat lamp or heat gun.
(2) Pull molding from roof joint.

INSTALLATION

(1) Remove adhesive tape residue from roof joint.
(2) If molding is to be reused, remove tape residue from back of molding. Clean molding with MOPAR, Super Kleen solvent or equivalent. Wipe molding dry with lint free cloth. Apply new body side molding (two sided adhesive) tape to back of molding.
(3) Clean roof joint with MOPAR, Super Kleen solvent or equivalent. Wipe dry with lint free cloth.
(4) Remove protective cover from tape on back of molding and apply molding to roof joint.
(5) Heat roof and molding, see step one. Firmly press molding into roof joint to assure adhesion.

SIDE VIEW MIRROR

REMOVAL

(1) Remove door trim panel.
(2) Remove mirror flag seal (Fig. 12).
(3) Disengage power mirror wire connector from door harness, if equipped (Fig. 13).
(4) Remove nuts attaching side view mirror to door frame.
(5) Separate harness grommet form door frame, if equipped.

SIDE VIEW MIRROR (Continued)

(6) Separate side view mirror from vehicle.

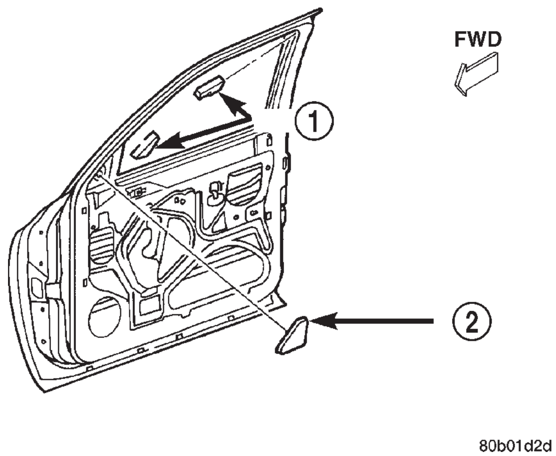

Fig. 12 Mirror Flag Door Seal

1 - STUFFERS
2 - MIRROR FLAG SEAL

INSTALLATION

(1) Position side view mirror on vehicle.
(2) Install harness grommet in door frame, if equipped.
(3) Install nuts attaching side view mirror to door frame. Tighten nuts to 7 N·m (65 in. lbs.) torque.
(4) Engage power mirror wire connector from door harness, if equipped.
(5) Install mirror flag seal.
(6) Install door trim panel.

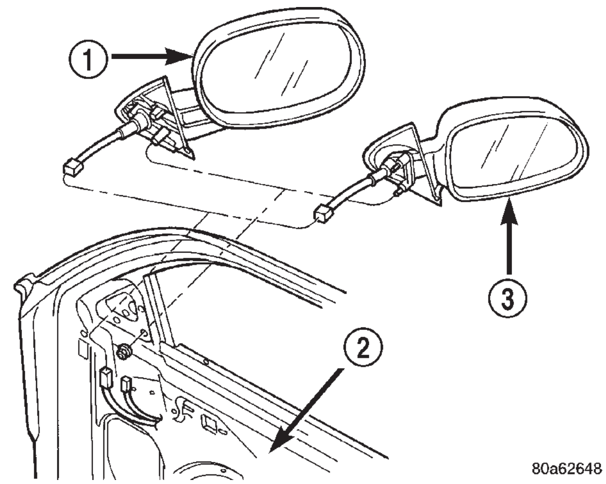

Fig. 13 Side View Mirror Connectors

1 - ELECTRIC FOLD AWAY SIDEVIEW MIRROR
2 - DOOR
3 - ELECTRIC SIDEVIEW MIRROR

WHEEL OPENING MOLDING

REMOVAL

(1) Remove the screws attaching the wheel opening molding to the fender (Fig. 1).
(2) Separate the molding from the wheel opening.

INSTALLATION

(1) Clean body surface with MOPAR Super Kleen solvent or equivalent. Wipe surface dry with lint free cloth.
(2) Position the molding in the wheel opening.
(3) Remove the backing and press to secure molding.
(4) Install the screws attaching the wheel opening molding to the fender.

HOOD

TABLE OF CONTENTS

HOOD HINGE

REMOVAL

(1) Open hood and support the side that requires hinge replacement.

(2) Remove cowl grille.

(3) Mark all bolt and hinge attachment locations with a grease pencil or other suitable device to provide reference marks for installation.

(4) Remove the nuts attaching the hinge to the hood (Fig. 1).

(5) Remove the bolts attaching the hinge to the inner fender (Fig. 1).

(6) Separate hinge from vehicle.

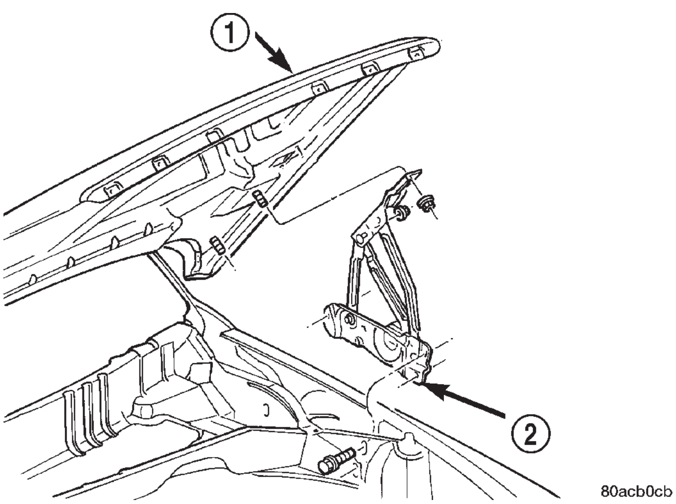

Fig. 1 Hood Hinge

1 - HOOD
2 - HOOD HINGE

INSTALLATION

(1) If necessary, paint new hinge before installation.

(2) Position the hinge on the vehicle and align all marks.

(3) Install the bolts attaching the hinge to the inner fender. Tighten the bolts to 28.2 N·m (250 in. lbs.) torque.

(4) Install the nuts attaching the hinge to the hood. Tighten the nuts to 22.6 N·m (200 in. lbs) torque.

(5) Install cowl grille.

(6) Remove support and verify hood operation. The hood should be aligned to 5 mm (0.2 in.) gap to the front fenders.

HOOD

REMOVAL

(1) Release primary hood latch.

(2) Release hood safety catch and open hood.

(3) Disconnect the under hood lamp wire connector.

(4) Mark all nut and hinge attachment locations with a grease pencil or other suitable device to provide reference marks for installation.

(5) Remove the top nuts attaching hood to hinge and loosen the bottom nuts until they can be removed by hand (Fig. 2).

(6) With assistance of a helper, support the hood at the opposite side of the vehicle.

(7) Remove the bottom nuts and separate the hood from the vehicle.

HOOD (Continued)

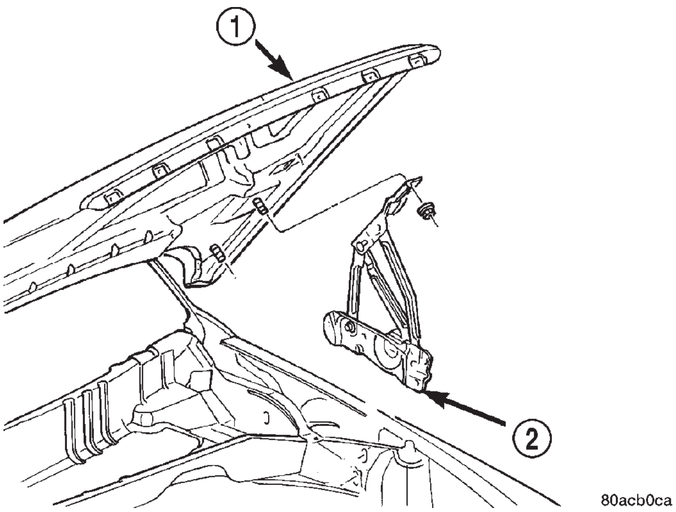

Fig. 2 Hood

1 - HOOD
2 - HOOD HINGE

INSTALLATION

(1) With assistance of a helper, position the hood on hinges.

(2) Align all marks and install the nuts. The hood should be aligned to 5 mm (0.2 in.) gap to the front fenders and flush across the top surfaces along fenders.

(3) Connect the under hood lamp wire connector.

(4) Close hood and adjust as necessary.

ADJUSTMENTS

(1) Loosen the hinge arm-to-hood panel bolts at each side of the vehicle.

(2) Loosen the hood latch screws.

(3) Close the hood. Adjust the fore/aft position.

(4) Raise the hood. Tighten the hinge arm-to-hood panel bolts.

(5) Tighten the latch screws.

(6) Lower the hood. Inspect clearance between the hood and the cowl cover.

HOOD SILENCER PAD

REMOVAL

(1) Raise the hood.

(2) Remove the retainers attaching the silencer pad to the hood (Fig. 3).

(3) Remove the silencer pad from the hood.

INSTALLATION

(1) Position the silencer pad on the hood.

(2) Install the retainers attaching the silencer pad to the hood.

(3) Close the hood.

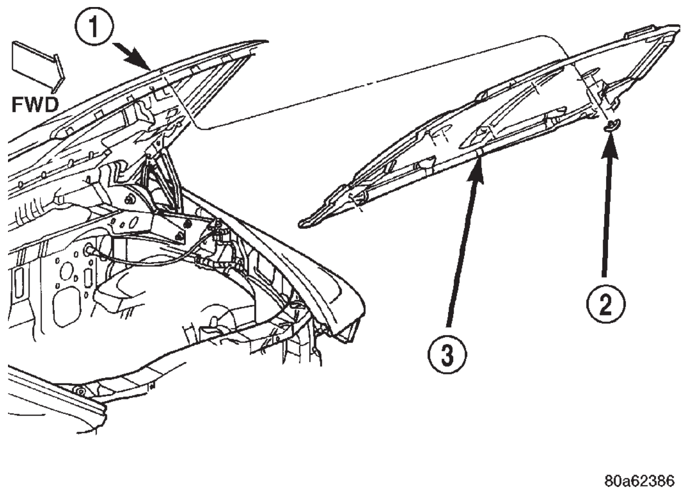

Fig. 3 Hood Silencer Pad

1 - HOOD
2 - RETAINER
3 - HOOD SILENCER PAD

HOOD LATCH

REMOVAL

(1) Release primary hood latch.

(2) Release hood safety catch and open hood.

(3) Using a grease pencil, mark latch position for installation alignment.

(4) Remove bolts attaching hood latch to radiator closure panel crossmember (Fig. 4).

(5) Separate hood latch from crossmember.

(6) Disconnect release cable from hood latch (Fig. 5).

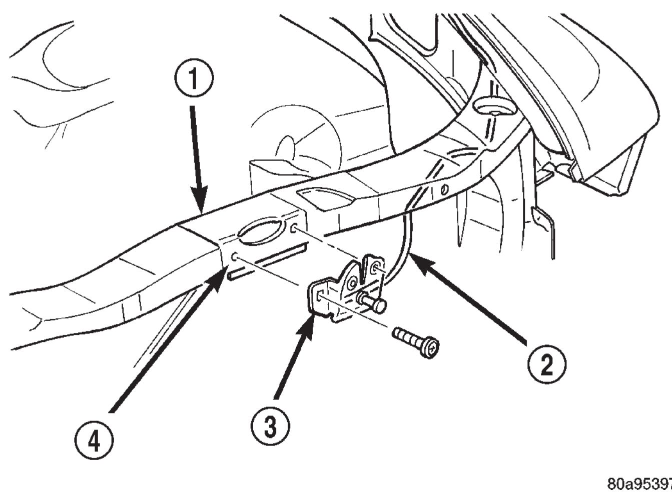

Fig. 4 Hood Latch

1 - RADIATOR CLOSURE PANEL
2 - HOOD RELEASE CABLE
3 - HOOD LATCH
4 - LATCH BRACKET

HOOD LATCH (Continued)

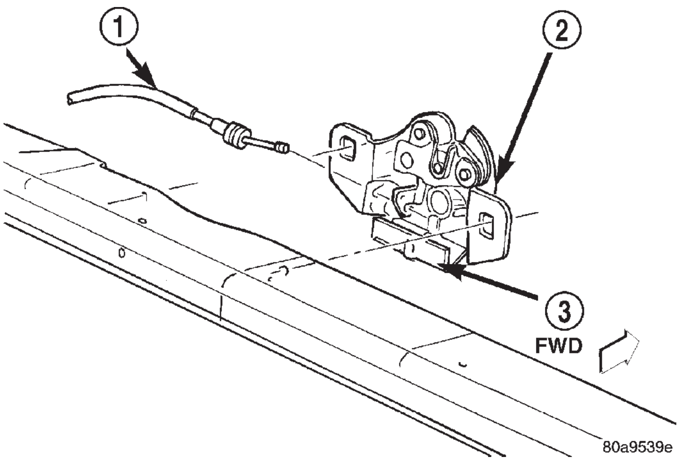

Fig. 5 Hood Release Cable

1 - HOOD RELEASE CABLE
2 - HOOD LATCH
3 - BOTTOM FLANGE

INSTALLATION

(1) Connect release cable to hood latch.

(2) Position hood latch on crossmember. Ensure the bottom flange of hood latch (Fig. 5) is secured around the latch bracket (Fig. 4).

(3) Install the bolts attaching hood latch to radiator closure panel crossmember. Tighten the bolts to 10.7 N·m (80 in. lbs.) torque.

(4) Close hood.

(5) Adjust latch as necessary.

ADJUSTMENTS

(1) Open the hood.

(2) Loosen the hood latch screws.

(3) Move the latch to the correct location and lightly tighten the screws.

(4) Close the hood slowly and observe the latching operation.

(5) As necessary, adjust the latch position and tighten the screws.

HOOD RELEASE CABLE

REMOVAL

(1) Release primary hood latch.

(2) Release hood safety catch and open hood.

(3) Remove hood latch.

(4) Disconnect release cable from hood latch (Fig. 5).

(5) Detach the release cable and the retainer clips in the engine compartment.

(6) Separate the release cable grommet from the dash panel hole.

(7) From the inside of the vehicle, remove the screws attaching the hood release handle to the bottom of the instrument panel (Fig. 6).

(8) Pull/route the hood release cable through the dash panel hole and remove it via the inside of the vehicle.

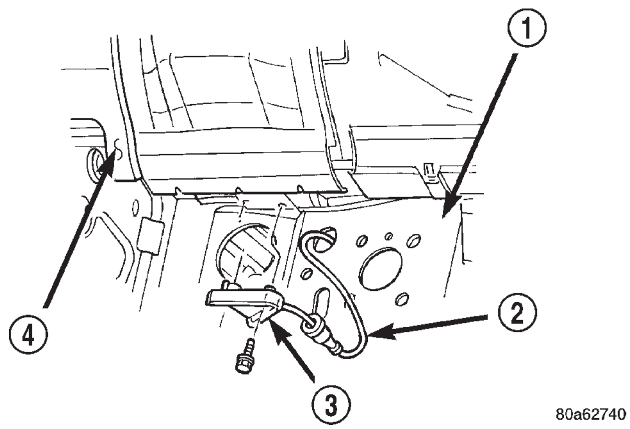

Fig. 6 Hood Release Cable

1 - DASH PANEL
2 - HOOD RELEASE CABLE
3 - HOOD RELEASE HANDLE
4 - INSTRUMENT PANEL

INSTALLATION

NOTE: If replacement hood latch is also being installed, ensure that it is thoroughly lubricated.

(1) From inside the vehicle, pull/route the hood release cable through the dash panel hole and into the engine compartment.

(2) Install the hood release handle.

(3) Install the cable grommet in the dash panel hole.

(4) Attach the retainer clips to the release cable and install them into the holes in the engine compartment.

(5) Attach release cable to hood latch.

(6) Install hood latch.

(7) Test the hood latch release cable for proper operation.

LATCH STRIKER

ADJUSTMENTS

(1) Open the hood.

(2) Loosen the latch striker screws.

(3) Slowly close the hood and observe the latching operation.As necessary, adjust the striker position. Tighten the screws.

HOOD SAFETY LATCH

REMOVAL

(1) Release primary hood latch.

(2) Release hood safety catch and open hood.

(3) Remove bolts attaching hood safety latch to hood (Fig. 7).

(4) Separate safety latch from hood.

INSTALLATION

(1) Position safety latch on hood.

(2) Install bolts attaching safety latch to hood. Tighten the bolts to 9.6 N·m (85 in. lbs.) torque.

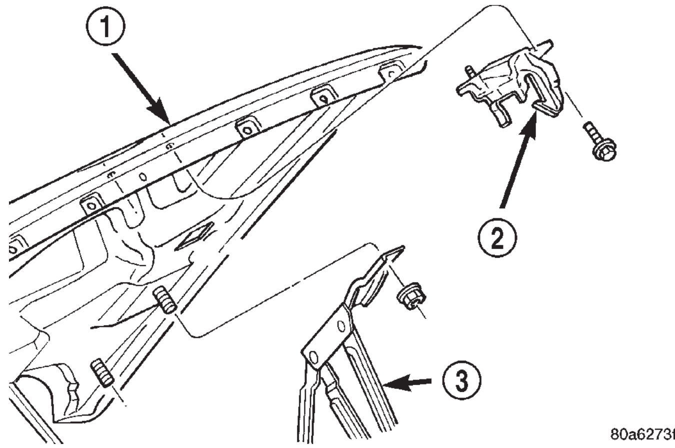

Fig. 7 Hood Safety Latch

1 - HOOD
2 - SAFETY LATCH
3 - HINGE

(3) Close hood and verify operation. Adjust as necessary.

INSTRUMENT PANEL SYSTEM

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INSTRUMENT PANEL SYSTEM

DESCRIPTION

The instrument panel is located at the front of the passenger compartment (Fig. 1). This instrument panel is molded from a blend of various plastics that are mechanically attached to the vehicle. Colors are molded into the plastic components to minimize appearance degradation from scratches or abrasions. The panel components are internally ribbed and riveted to steel reinforcements for additional structural integrity and dimensional stability. The instrument panel surface components are designed to deform upon impact without breaking. This type of construction provides improved energy absorption which, in conjunction with the dual airbags and seat belts, helps to improve occupant protection.

The instrument panel for this vehicle includes the following major features:

- **Cluster Bezel -** This molded plastic bezel is secured with two screws and snap clips to the instrument panel supporting structure. It trims out the edges of the headlamp switch, instrument cluster, radio, heater-air conditioner controls, the passenger airbag on-off switch or rear window defogger switch on vehicles so equipped, and the 4WD transfer case switch on vehicles so equipped. On vehicles without the passenger airbag on-off switch or rear window defogger switch, a small storage cubby bin is provided in the cluster bezel. Likewise, on vehicles without the optional four-wheel drive system, a small storage cubby bin is provided in the cluster bezel. This bezel also incorporates five completely adjustable panel outlets for the climate control system, and fills the opening between the instrument cluster and the top of the steering column where it passes through the instrument panel.
- **End Caps -** A molded plastic end cap is secured with snap clips to each outboard end of the instrument panel. The end cap on the right end of the instrument panel is primarily cosmetic. The end cap on the left end of the instrument panel doubles as a fuse access panel for the Junction Block (JB) and features an integral pull cup on its outer surface to ease removal, while a fuse layout map, a fuse puller and spare fuses are conveniently concealed on its inner surface.

INSTRUMENT PANEL SYSTEM (Continued)

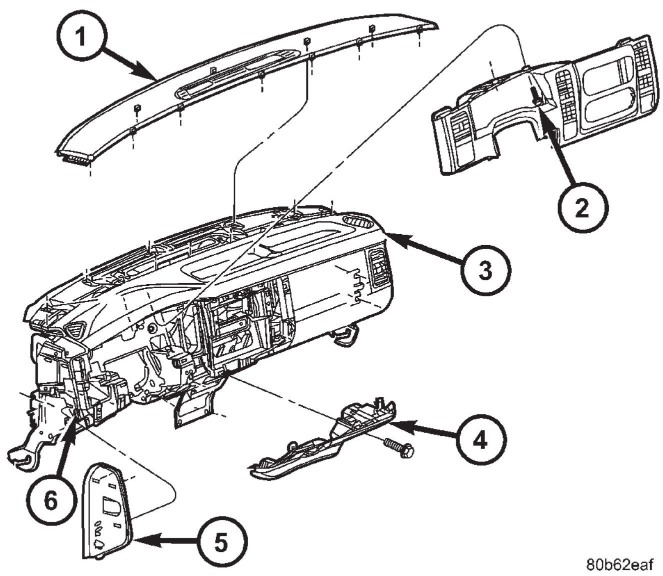

Fig. 1 Instrument Panel

1 - DEFROSTER GRILLE
2 - CLUSTER BEZEL
3 - TOP COVER
4 - LOWER BEZEL
5 - END CAP
6 - INSTRUMENT PANEL

• **Glove Box -** The modular glove box in the passenger side of the instrument panel features a recessed paddle-operated latch handle, a storage bin-type glove box, and a fixed owner's manual shelf at the top of the glove box opening. A metal hinge on the lower edge of the glove box door is riveted to the module and secured with screws to the lower edge of the instrument panel support structure. The glove box door also serves as the passenger side knee blocker. A honeycomb structure between the inner and outer glove box door panels helps to absorb the impact load and distribute it to the instrument panel structure.

• **Lower Bezel -** The instrument panel lower bezel is located on the lower edge of the instrument panel, near the center. This bezel features an ash receiver with a hinged door that is secured with a push/push-type latch and an integral cigar lighter, an accessory power outlet, and a center stack light that illuminates the storage tray at the front of the center floor console on the floor panel transmission tunnel below.

• **Steering Column Opening Cover -** The steering column opening cover serves as the driver side knee blocker. This molded plastic cover has an integral ribbed plastic liner concealed behind it, for increased strength and integrity. The steering column opening cover transfers impact loads to the instrument panel structural support. A paddle-type parking brake release handle is also incorporated in the lower left corner of the steering column opening cover.

• **Top Cover -** The instrument panel top cover is the molded, grained, and color impregnated plastic panel that forms the top of the instrument panel. This panel features an integral hood formation over the instrument cluster on the left side and two integral storage tray formations over the right side. A removable side window demister outlet is incorporated near each outboard end of the top cover.

Hard wired circuitry connects the electrical components on the instrument panel 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 instrument panel 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 complete circuit 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 instrument panel serves as the command center of the vehicle, which necessarily makes it a very complex unit. The instrument panel is designed to house the controls and monitors for standard and optional powertrains, climate control systems, audio systems, safety systems, and many other comfort or convenience items. When the components of the instrument panel structural support are properly assembled and secured in the vehicle they provide superior instrument panel stiffness and integrity to help reduce buzzes, squeaks, and rattles. This type of construction also provides improved energy absorption which, in conjunction with the dual airbags and seat belts, helps to improve occupant protection.

The instrument panel is also designed so that all of the various controls can be safely reached and the monitors can be easily viewed by the vehicle operator when driving, while still allowing relative ease of access to each of these items for service. Modular instrument panel construction allows all of the gauges and controls to be serviced from the front of the panel. In addition, most of the instrument panel electrical components can be accessed without complete instrument panel removal. However, if necessary, the instrument panel can be removed from the vehicle as an assembly.

INSTRUMENT PANEL SYSTEM (Continued)

The steering column opening cover with its integral knee blocker located on the driver side of the instrument panel works in conjunction with the airbag system in a frontal vehicle impact to keep the driver properly positioned for an airbag deployment. In addition, removal of this component provides access to the steering column mounts, the steering column wiring, the Junction Block (JB) (removal of a snap-fit end cap on the left outboard end of the instrument panel allows access to the fuses and circuit breakers), and much of the instrument panel wiring.

In a frontal collision, the glove box door on the passenger side of the instrument panel provides the same function for the front seat passenger as the knee blocker does for the driver. The glove box door also incorporates a recessed latch handle. Removal of the glove box provides access to the passenger airbag, the glove box lamp and switch, the radio antenna coaxial cable, and additional instrument panel wiring.

Removal of the instrument panel cluster bezel allows access to the headlamp switch, the instrument cluster, the radio, the passenger airbag on-off switch (if equipped), the rear window defogger switch (if equipped), the four-wheel drive transfer case switch (if equipped), and the heating and air conditioning control. Removal of the instrument cluster allows access to the cluster illumination and indicator bulbs, and more of the instrument panel wiring. Complete instrument panel removal is required for service of most components internal to the heating and air conditioning system housing, including the heater core and the evaporator.

See the owner's manual in the vehicle glove box for more information on the features, use and operation of all of the components and systems mounted on or in the instrument panel.

REMOVAL

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.

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.

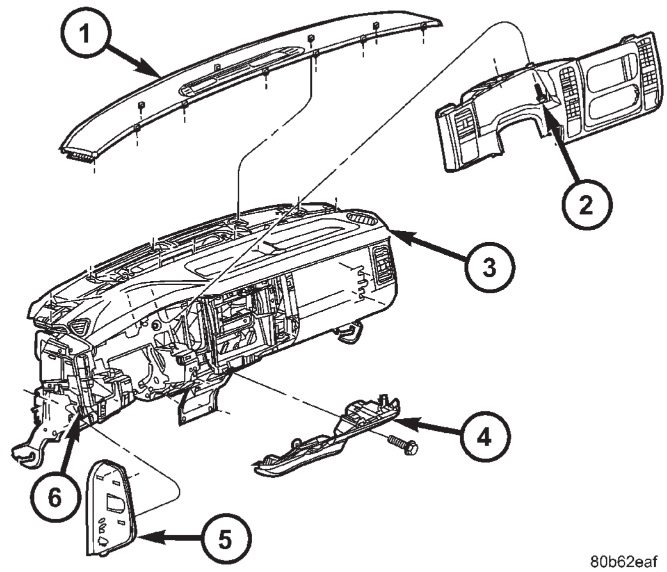

Fig. 2 Instrument Panel

1 - DEFROSTER GRILLE
2 - CLUSTER BEZEL
3 - TOP COVER
4 - LOWER BEZEL
5 - END CAP
6 - INSTRUMENT PANEL

(2) Remove the defroster grille from the instrument panel (Fig. 2). (Refer to 23 - BODY/INSTRUMENT PANEL/DEFROSTER GRILLE - REMOVAL).

(3) Remove the end caps from the left and right outboard ends of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - REMOVAL).

(4) Remove the trim from the left and right cowl side inner panels. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - REMOVAL).

(5) Remove the cluster bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - REMOVAL).

(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 lower bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/IP LOWER RIGHT CENTER BEZEL - REMOVAL).

INSTRUMENT PANEL SYSTEM (Continued)

(8) If the vehicle is so equipped, remove the console from the floor panel transmission tunnel. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL).

(9) From under the passenger side end of the instrument panel, perform the following:

(a) Disconnect the two halves of the radio antenna coaxial cable connector.

(b) If the vehicle is equipped with the Infinity sound system option, disconnect the two instrument panel wire harness connectors for the amplifier from the connector receptacles on the bottom of the amplifier on the right cowl side inner panel.

(c) Remove the nut that secures the instrument panel wire harness ground take out eyelet terminal connector to the ground stud on the right cowl side inner panel, and remove the eyelet terminal from the stud.

(10) From under the driver side end of the instrument panel, perform the following:

(a) Remove the two screws that secure the inside hood release bracket to the instrument panel.

(b) Disengage the 16-way data link connector from the inside hood release bracket and lower the release handle and bracket to the floor.

(c) Disconnect the instrument panel wire harness connector for the Airbag Control Module (ACM) on the floor panel transmission tunnel from the ACM connector receptacle.

(d) Remove the two screws that secure the instrument panel wire harness ground take out eyelet terminal connectors to the left side of the ACM mounting bracket on the floor panel transmission tunnel.

(e) Disconnect the two instrument panel wire harness connectors for the Central Timer Module (CTM) on the left cowl side inner panel from the two outboard connector receptacles on the CTM.

(f) Remove the nut that secures the instrument panel wire harness ground take out eyelet terminal connector to the ground stud on the left cowl side inner panel, and remove the eyelet terminal from the stud.

(g) Disconnect the instrument panel wire harness connector for the park brake switch from the switch terminal on the park brake mechanism.

(h) Disconnect the instrument panel wire harness connector for the brake lamp switch from the switch connector receptacle.

(i) Remove the screw that secures the center of the instrument panel wire harness bulkhead connector to the headlamp and dash wire harness bulkhead connector and disconnect the connector.

(j) Disconnect the two body wire harness connectors from the two instrument panel wire harness connectors that are piggybacked on the bulkhead connector.

(k) Disconnect the body wire harness connector from the connector receptacle on the back of the Junction Block (JB).

(l) Disconnect the two headlamp and dash wire harness connectors from the connector receptacles on the back of the JB.

(11) Remove the steering column from the vehicle. (Refer to 19 - STEERING/COLUMN - REMOVAL).

(12) Loosen the right and left instrument panel cowl side roll-down bracket screws about 13 mm (0.50 inch).

(13) Remove the two screws that secure the instrument panel end brackets to each A-pillar.

(14) Remove the two screws that secure the instrument panel center bracket to the ACM mounting bracket on the floor panel transmission tunnel.

(15) Remove the five screws that secure the top of the instrument panel to the top of the dash panel, removing the center screw last.

(16) Roll down the instrument panel and install a temporary hook in the center hole on top of the instrument panel. Secure the other end of the hook to the center hole in the top of the dash panel. The hook should support the instrument panel in its rolled down position about 46 cm (18 inches) from the dash panel.

(17) With the instrument panel supported in the roll-down position, disconnect the instrument panel wire harness connector from the heater-A/C housing wire harness connector.

(18) With the aid of an assistant, remove the temporary hook and lift the instrument panel assembly off of the roll-down bracket screws and remove it from the vehicle.

INSTALLATION

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INSTRUMENT PANEL SYSTEM (Continued)

(1) With the aid of an assistant, load the instrument panel assembly onto the roll-down bracket screws on the cowl side inner panels in the vehicle. Install a temporary hook in the center hole on top of the instrument panel. Secure the other end of the hook to the center hole in the top of the dash panel. The hook should support the instrument panel in its rolled down position about 46 cm (18 inches) from the dash panel.

(2) With the instrument panel supported in the roll-down position, reconnect the instrument panel wire harness connector to the heater-A/C housing wire harness connector.

(3) Remove the temporary hook from the instrument panel and roll the instrument panel up to its installed position against the dash panel.

(4) Install and tighten the five screws that secure the top of the instrument panel to the top of the dash panel (Fig. 2). Tighten the screws to 2 N·m (17 in. lbs.).

(5) Install and tighten the two screws that secure the instrument panel center bracket to the Airbag Control Module (ACM) mounting bracket on the floor panel transmission tunnel. Tighten the screws to 11 N·m (95 in. lbs.).

(6) Install and tighten the two screws that secure the instrument panel end brackets to each A-pillar. Tighten the screws to 11 N·m (95 in. lbs.).

(7) Tighten the right and left instrument panel cowl side roll-down bracket screws. Tighten the screws to 28 N·m (21 ft. lbs.).

(8) Reinstall the steering column into the vehicle. (Refer to 19 - STEERING/COLUMN - INSTALLATION).

(9) From under the driver side end of the instrument panel, perform the following:

(a) Reconnect the two headlamp and dash wire harness connectors to the connector receptacles on the back of the Junction Block (JB).

(b) Reconnect the body wire harness connector to the connector receptacle on the back of the JB.

(c) Reconnect the two body wire harness connectors to the two instrument panel wire harness connectors that are piggybacked on the bulkhead connector.

(d) Reconnect the instrument panel wire harness bulkhead connector to the headlamp and dash wire harness bulkhead connector and tighten the screw that secures the center of the connector. Tighten the screw to 4 N·m (31 in. lbs.).

(e) Reconnect the instrument panel wire harness connector for the brake lamp switch to the switch connector receptacle.

(f) Reconnect the instrument panel wire harness connector for the park brake switch to the switch terminal on the park brake mechanism.

(g) Reinstall the instrument panel wire harness ground take out eyelet terminal connector to the ground stud on the left cowl side inner panel, and install and tighten the nut that secures the eyelet terminal to the stud. Tighten the nut to 12 N·m (105 in. lbs.).

(h) Reconnect the two instrument panel wire harness connectors for the Central Timer Module (CTM) on the left cowl side inner panel to the two outboard connector receptacles on the CTM.

(i) Install and tighten the two screws that secure the instrument panel wire harness ground take out eyelet terminal connectors to the left side of the ACM mounting bracket on the floor panel transmission tunnel. Tighten the screws to 12 N·m (105 in. lbs.).

(j) Reconnect the instrument panel wire harness connector for the ACM on the floor panel transmission tunnel to the ACM connector receptacle.

(k) Engage the 16-way data link connector into the inside hood release bracket and position the release handle and bracket to the instrument panel.

(l) Install and tighten the two screws that secure the inside hood release bracket to the instrument panel. Tighten the screws to 2 N·m (17 in. lbs.).

(10) From under the passenger side end of the instrument panel, perform the following:

(a) Reconnect the two halves of the radio antenna coaxial cable connector.

(b) If the vehicle is equipped with the Infinity sound system option, reconnect the two instrument panel wire harness connectors for the amplifier to the connector receptacles on the bottom of the amplifier on the right cowl side inner panel.

(c) Reinstall the instrument panel wire harness ground take out eyelet terminal connector to the ground stud on the right cowl side inner panel, and install and tighten the nut. Tighten the nut to 12 N·m (105 in. lbs.).

(11) If the vehicle is so equipped, reinstall the console onto the floor panel transmission tunnel. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION).

(12) Reinstall the lower bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/IP LOWER BEZEL - INSTALLATION).

(13) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(14) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - INSTALLATION).

INSTRUMENT PANEL SYSTEM (Continued)

(15) Reinstall the trim onto the left and right cowl side inner panels. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - INSTALLATION).

(16) Reinstall the end caps onto the left and right outboard ends of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - INSTALLATION).

(17) Reinstall the defroster grille onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/DEFROSTER GRILLE - INSTALLATION)

(18) Reconnect the battery negative cable.

ASH RECEIVER

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) Open the instrument panel ash receiver on the instrument panel lower bezel (Fig. 3).

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry between the upper edge of the ash receiver housing and the instrument panel lower bezel to disengage the two integral snap features of the housing from the their receptacles in the bezel.

(5) Pull the ash receiver and housing unit rearward far enough to access and the instrument panel wire harness connector for the cigar lighter.

(6) Disconnect the instrument panel wire harness connector for the cigar lighter from the receptacle on the back of the lighter.

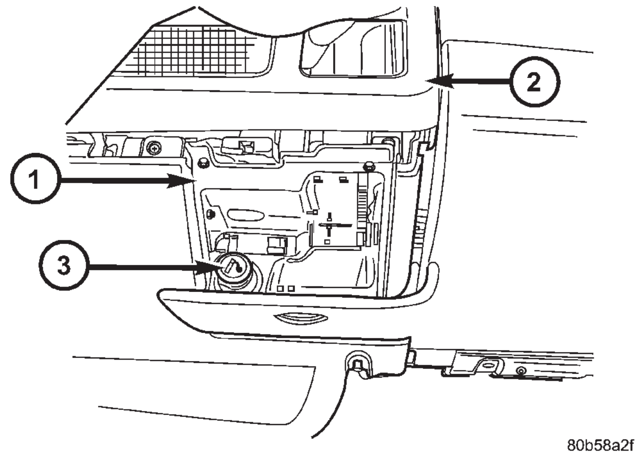

Fig. 3 Ash Receiver

1 - ASH RECEIVER HOUSING
2 - CLUSTER BEZEL
3 - CIGAR LIGHTER

(7) Remove the ash receiver and housing unit from the instrument panel lower bezel.

DISASSEMBLY

The push/push latch lever of the ash receiver and housing unit used in this vehicle is serviced individually. Following are the procedures for disassembling this component from the ash receiver and housing unit.

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(1) Remove the ash receiver and housing unit from the instrument panel lower bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/ASH RECEIVER - REMOVAL).

ASH RECEIVER (Continued)

(2) Using hand pressure, spread the ash receiver housing far enough to disengage the guide/stop pins on the ash receiver door from the slot on each side of the housing (Fig. 4).

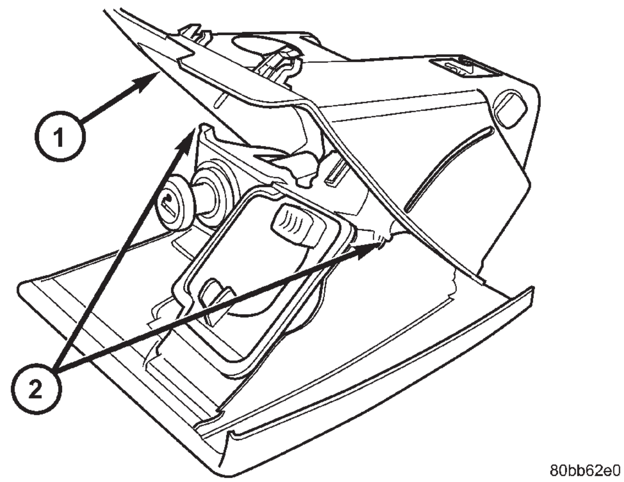

Fig. 4 Ash Receiver Guide/Stop Pins

1 - ASH RECEIVER HOUSING
2 - GUIDE/STOP PINS

(3) Unsnap the two hinges on the bottom of the ash receiver door from the hinge pins on the bottom of the ash receiver housing (Fig. 5).

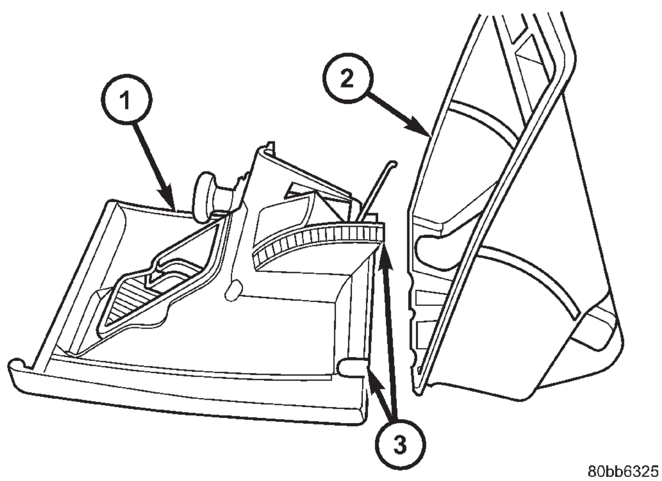

Fig. 5 Ash Receiver Disassembly/Assembly

1 - ASH RECEIVER DOOR
2 - ASH RECEIVER HOUSING
3 - HINGE (2)

(4) From the top of the ash receiver housing, use a blunt tool to push downward on the pivot of the push/push latch lever to disengage it from the housing (Fig. 6).

(5) From the inside of the ash receiver housing, disengage the push/push latch lever guide tang from the keyed end of the guide slot in the top of the housing.

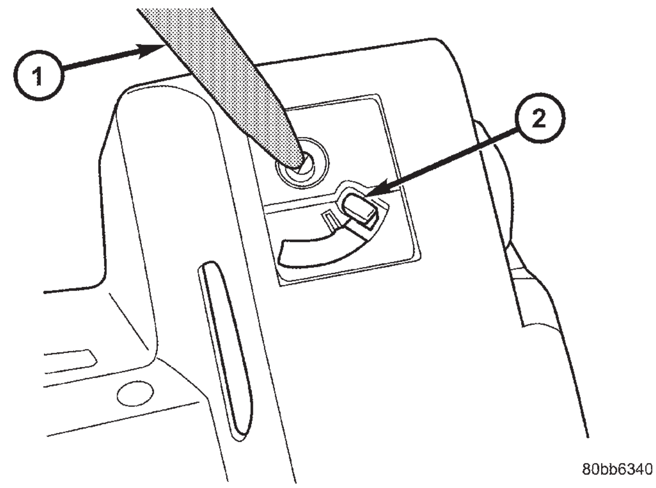

Fig. 6 Push/Push Latch Lever

1 - BLUNT TOOL
2 - PUSH/PUSH LATCH LEVER

ASSEMBLY

The push/push latch lever of the ash receiver and housing unit used in this vehicle is serviced individually. Following are the procedures for assembling this component to the ash receiver and housing unit.

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(1) From the inside of the ash receiver housing, engage the push/push latch lever guide tang into the keyed end of the guide slot in the top of the housing.

(2) From the inside of the ash receiver housing, align the push/push latch lever pivot pin with the pivot hole in the top of the ash receiver housing.

(3) Using hand pressure, push firmly over the pivot pin until it snaps into the pivot hole in the top of the ash receiver housing.

(4) Align the hinges on the bottom of the ash receiver door with the hinge pins on the bottom of the housing (Fig. 7).

ASH RECEIVER (Continued)

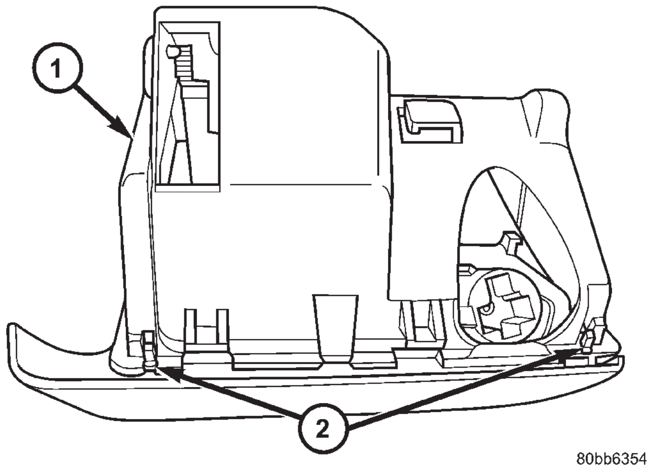

Fig. 7 Ash Receiver Hinge

1 - HOUSING
2 - HINGE (2)

(5) Using hand pressure, snap the hinges of the ash receiver door onto the hinge pins of the housing.

CAUTION: Be certain that the free end of the push/push latch spring on the ash receiver door is inserted into the slotted hole in the ash receiver housing to the left of the push/push latch lever before completing the following step or the spring may be damaged.

(6) Using hand pressure, spread the ash receiver housing far enough to engage the guide/stop pins on the ash receiver door into the slot on each side of the housing (Fig. 4).

(7) Check the operation of the push/push latch of the ash receiver.

(8) Reinstall the ash receiver into the instrument panel lower bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/ASH RECEIVER - INSTALLATION).

INSTALLATION

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(1) Position the ash receiver and housing unit to the instrument panel (Fig. 3).

(2) Reconnect the instrument panel wire harness connector for the cigar lighter to the receptacle on the back of the lighter.

(3) Insert the two tabs on the bottom of the ash receiver housing into their receptacles in the instrument panel lower bezel.

(4) Align the snap features on the top of the ash receiver housing with their receptacles in the instrument panel lower bezel.

(5) Using hand pressure, push firmly upward on the ash receiver housing over each of the two snap feature locations until they are fully engaged in their receptacles.

(6) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - INSTALLATION).

(7) Reconnect the battery negative cable.

BASE TRIM

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel from 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 instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(5) Remove the radio from the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - REMOVAL).

BASE TRIM (Continued)

(6) Remove the top cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/ TOP COVER - REMOVAL).

NOTE: Four of the screws secure the lower instrument panel duct to the base trim.

(7) Remove the screws around the perimeter of the instrument panel that secure the base trim to the instrument panel structural support.

(8) Remove the base trim from the instrument panel structural support.

INSTALLATION

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(1) Position the base trim onto the instrument panel structural support.

(2) Install and tighten the screws around the perimeter of the instrument panel that secure the base trim to the instrument panel structural support. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Reinstall the top cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/ TOP COVER - INSTALLATION).

(4) Reinstall the radio into the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - INSTALLATION).

(5) Install the instrument cluster into the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(6) Reinstall the instrument panel into the vehicle. (Refer to 23 - BODY/INSTRUMENT PANEL - INSTALLATION).

(7) Reconnect the battery negative cable.

CLUSTER BEZEL

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) If the vehicle is equipped with an automatic transmission, turn the ignition switch to the Unlock position, set the park brake, and place the automatic transmission gear selector lever in the Low position.

(3) If the vehicle is equipped with a tilt column, set the tilt steering column in its lowest position.

(4) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(5) Remove the two screws in the hooded area above the instrument cluster that secure the cluster bezel to the instrument panel base trim (Fig. 8).

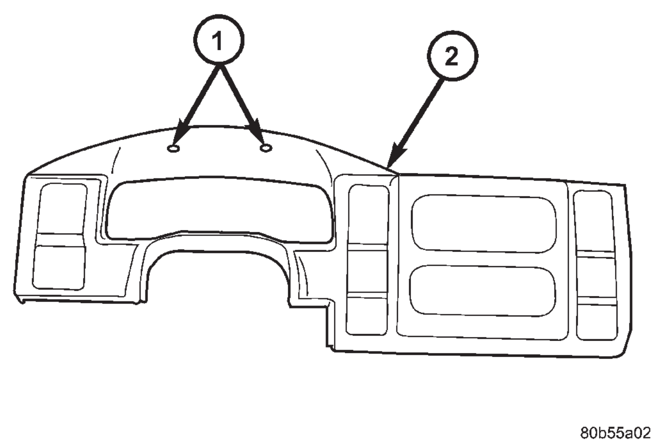

Fig. 8 Cluster Bezel

1 - SCREW (2)
2 - CLUSTER BEZEL

(6) Using a trim stick or another suitable wide flat-bladed tool, gently pry around the perimeter of the cluster bezel to disengage each of the snap clips from their receptacles in the instrument panel base trim.

(7) Pull the right side of the cluster bezel away from the instrument panel far enough to access and disconnect the instrument panel wire harness con-

CLUSTER BEZEL (Continued)

nector for the headlamp switch from the switch connector receptacle.

(8) Pull the left side of the cluster bezel away from the instrument panel far enough to access and disconnect the instrument panel wire harness connectors from the receptacles for the passenger airbag on/off switch (if equipped), the rear window defogger switch (if equipped), the heater-air conditioner control, and the transfer case switch (if equipped).

(9) Remove the cluster bezel from the instrument panel.

INSTALLATION

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(1) Position the cluster bezel to the instrument panel.

(2) Pull the left side of the cluster bezel away from the instrument panel far enough to access and reconnect the instrument panel wire harness connectors to the receptacles for the passenger airbag on/off switch (if equipped), the rear window defogger switch (if equipped), the heater-air conditioner control, and the transfer case switch (if equipped).

(3) Pull the right side of the cluster bezel away from the instrument panel far enough to access and reconnect the instrument panel wire harness connector for the headlamp switch to the switch connector receptacle.

(4) Align the snap clips on the cluster bezel with the receptacles in the instrument panel base trim.

(5) Using hand pressure, press firmly on the cluster bezel over each of the snap clip locations until each of the snap clips is fully engaged in its receptacle in the instrument panel base trim.

(6) Install and tighten the two screws in the hooded area above the instrument cluster that secure the cluster bezel to the instrument panel base trim (Fig. 8). Tighten the screws to 2 N·m (20 in. lbs.).

(7) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(8) Reconnect the battery negative cable.

DEFROSTER GRILLE

REMOVAL

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) Disconnect and isolate the battery negative cable.

(2) Remove the trim from both A-pillars. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM - REMOVAL).

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry around the perimeter of the defroster grille to disengage each of the snap clips from their receptacles in the instrument panel base trim (Fig. 9).

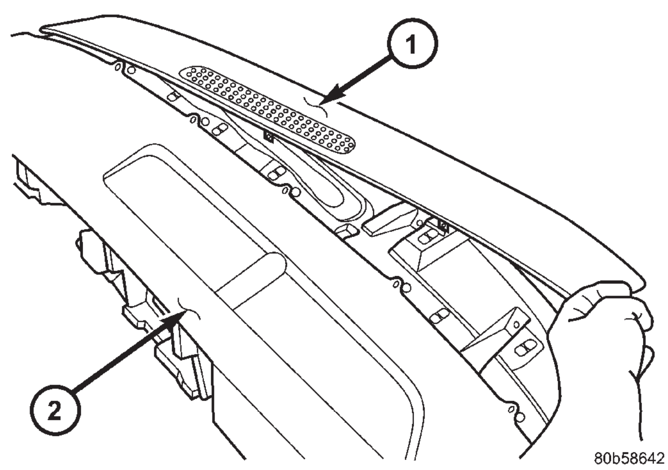

Fig. 9 Defroster Grille

1 - DEFROSTER GRILLE
2 - TOP COVER

(4) Remove the defroster grille from the top of the instrument panel structural support.

DEFROSTER GRILLE (Continued)

INSTALLATION

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NOTE: Be certain that the rubber defroster grille-to-windshield seal is in place on the forward edge of the defroster grille before it is installed to the instrument panel.

(1) Position the defroster grille onto the top of the instrument panel (Fig. 9).

(2) Align the snap clips on the defroster grille with the receptacles in the instrument panel base trim.

(3) Using hand pressure, press firmly on the defroster grille over each of the snap clip locations until each of the snap clips is fully engaged in its receptacle.

(4) Reinstall the trim onto both A-pillars. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM - INSTALLATION).

(5) Reconnect the battery negative cable.

END CAP

REMOVAL - DRIVER SIDE

(1) Insert a finger into the pull cup formation molded into the end cap and pull firmly and sharply outward to disengage each of the snap clips that secure the end cap from their receptacles in the instrument panel base trim (Fig. 10)

(2) Remove the end cap from the end of the instrument panel.

REMOVAL - PASSENGER SIDE

(1) Using a trim stick or another suitable wide flat-bladed tool, gently pry around the perimeter of the passenger side end cap to disengage each of the snap clips from their receptacles in the instrument panel base trim (Fig. 11).

(2) Remove the end cap from the end of the instrument panel.

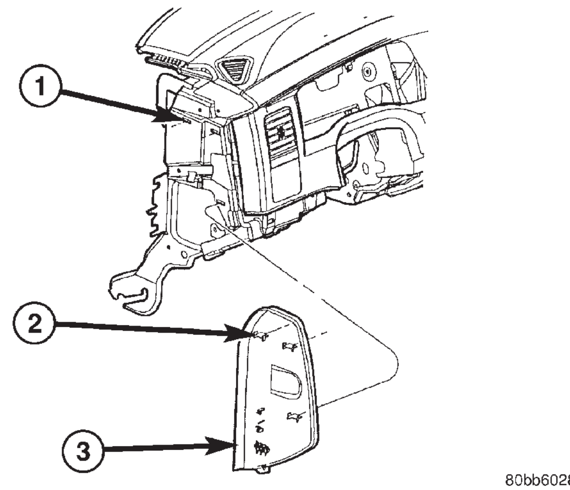

Fig. 10 End Cap Remove/Install

1 - RECEPTACLES
2 - SNAP CLIPS
3 - END CAP

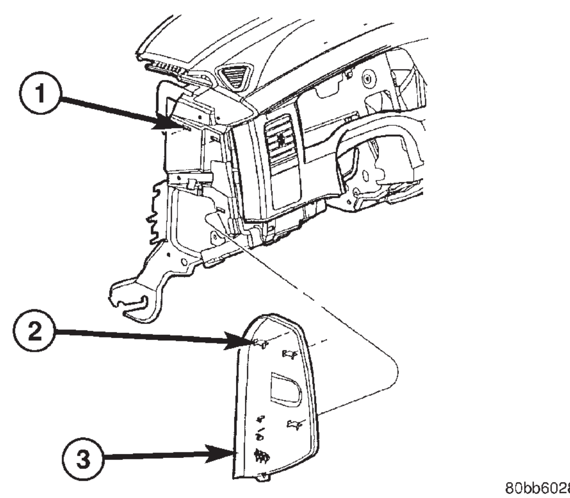

Fig. 11 End Cap Remove/Install - Typical

1 - RECEPTACLES
2 - SNAP CLIPS
3 - END CAP

INSTALLATION

(1) Position the end cap to the outboard end of the instrument panel.

(2) Align the snap clips on the end cap with the receptacles in the instrument panel base trim (Fig. 10).

(3) Using hand pressure, press firmly on the end cap 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.

GLOVE BOX

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 lower bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/LOWER BEZEL - REMOVAL).

(4) Remove the screw that secures the inboard side of the glove box module to the instrument panel behind the lower bezel.

(5) Remove the passenger side end cap from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/END CAP - REMOVAL - PASSENGER SIDE).

(6) Remove the screw that secures the outboard end of the glove box module to the right end of the instrument panel behind the passenger side end cap.

(7) Remove the four screws that secure the bottom of the glove box module to the instrument panel (Fig. 12).

(8) Unlatch and open the glove box.

(9) Remove the latch striker from the upper glove box opening reinforcement. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX LATCH STRIKER - REMOVAL).

(10) Remove the two remaining screws that secure the top of the glove box module to the upper glove box opening reinforcement.

(11) If the vehicle is equipped with a glove box lamp, pull the glove box module away from the instrument panel far enough to access and disconnect the instrument panel wire harness connector from the glove box lamp and switch connector receptacle (Fig. 13).

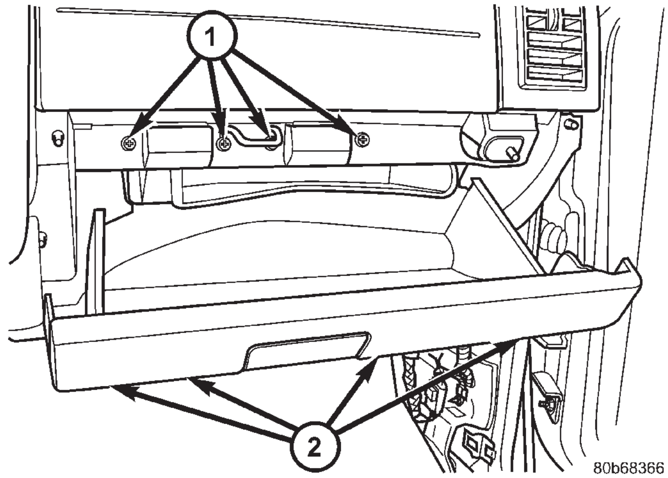

Fig. 12 Glove Box Remove Install

1 - SCREW (4)
2 - SCREW (4)

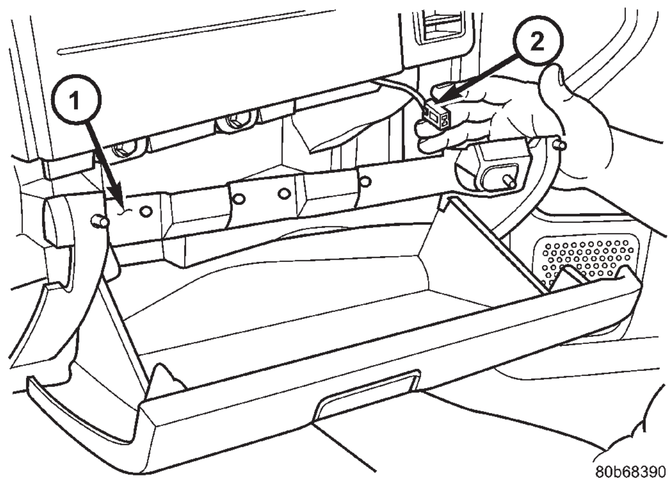

Fig. 13 Glove Box Lamp & Switch Connector

1 - GLOVE BOX MODULE
2 - WIRE HARNESS CONNECTOR

(12) Remove the glove box module from the instrument panel.

DISASSEMBLY

The glove box latch and handle unit of the glove box used in this vehicle is serviced individually. Following are the procedures for disassembling this component from the glove box module.

GLOVE BOX (Continued)

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(1) Remove the glove box module from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(2) Remove the nine screws that secure the flanges around the perimeter of the glove box bin to the inside of the glove box door.

(3) Remove the glove box bin from the inside of the glove box door (Fig. 14).

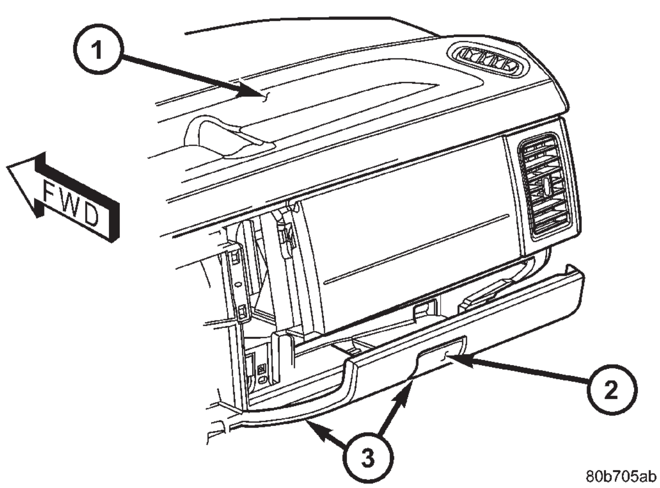

Fig. 14 Glove Box Latch & Handle

1 - TOP COVER
2 - GLOVE BOX LATCH & HANDLE
3 - GLOVE BOX DOOR

(4) Remove the two screws that secure the glove box latch and handle to the inside of the glove box door.

(5) Remove the glove box latch and handle from the inside of the glove box door.

ASSEMBLY

The glove box latch and handle unit of the glove box used in this vehicle is serviced individually. Following are the procedures for assembling this component to the glove box module.

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(1) Position the glove box latch and handle to the inside of the glove box door.

(2) Install and tighten the two screws that secure the glove box latch and handle to the inside of the glove box door. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Position the glove box bin to the inside of the glove box door (Fig. 14).

(4) Install and tighten the nine screws that secure the flanges around the perimeter of the glove box bin to the inside of the glove box door. Tighten the screws to 2 N·m (20 in. lbs.).

(5) Reinstall the glove box module onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION).

INSTALLATION

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(1) Position the glove box module to the instrument panel.

(2) If the vehicle is equipped with a glov box lamp, reconnect the instrument panel wire harness connector to the glove box lamp and switch connector receptacle (Fig. 13).

(3) Position the top of the glove box module to the upper glove box opening reinforcement.

GLOVE BOX (Continued)

(4) Install and tighten the two outboard screws that secure the top of the glove box module to the upper glove box opening reinforcement (Fig. 12). Tighten the screws to 2 N·m (20 in. lbs.).

(5) Reinstall the glove box latch striker to the upper glove box opening reinforcement. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX LATCH STRIKER - INSTALLATION).

(6) Close and latch the glove box.

(7) Install and tighten the four screws that secure the bottom of the glove box module to the instrument panel (Fig. 12). Tighten the screws to 2 N·m (20 in. lbs.).

(8) Install and tighten the screw that secures the outboard end of the glove box module to the right end of the instrument panel behind the passenger side end cap. Tighten the screw to 2 N·m (20 in. lbs.).

(9) Reinstall the passenger side end cap onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - INSTALLATION).

(10) Install and tighten the screw that secures the inboard side of the glove box module to the instrument panel behind the lower bezel. Tighten the screw to 2 N·m (20 in. lbs.).

(11) Open and close the glove box to check for proper hinge operation and alignment (Fig. 15).

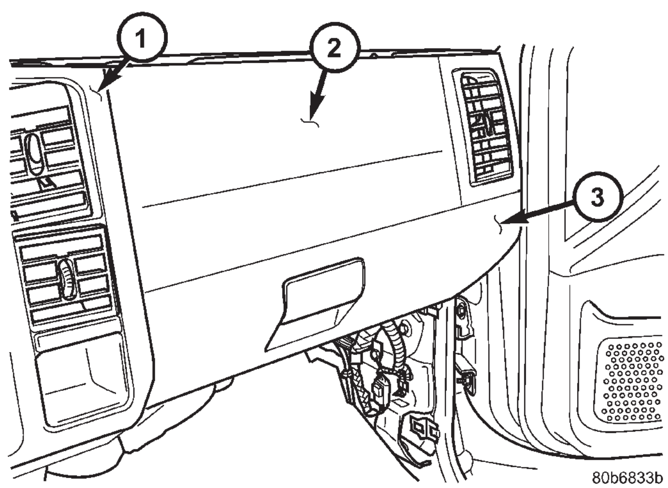

Fig. 15 Glove Box Alignment

1 - CLUSTER BEZEL
2 - PASSENGER AIR BAG DOOR
3 - GLOVE BOX DOOR

(12) Reinstall the lower bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/LOWER BEZEL - INSTALLATION).

(13) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - INSTALLATION).

(14) Reconnect the battery negative cable.

GLOVE BOX LATCH STRIKER

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Unlatch and open the glove box.

(3) Remove the two screws that secure the latch striker to the upper glove box opening reinforcement (Fig. 16).

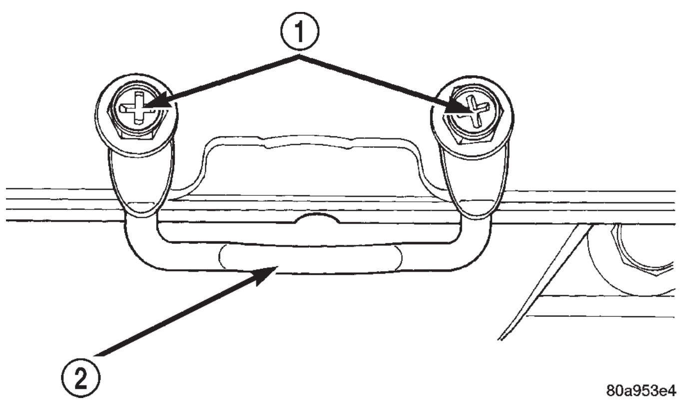

Fig. 16 Glove Box Latch Striker Remove/Install

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. 16).

(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) Close and latch the glove box.

(4) Reconnect the battery negative cable.

INSIDE HOOD RELEASE BRACKET

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 inside hood release handle to the inside hood release bracket and lower the release handle to the floor (Fig. 17).

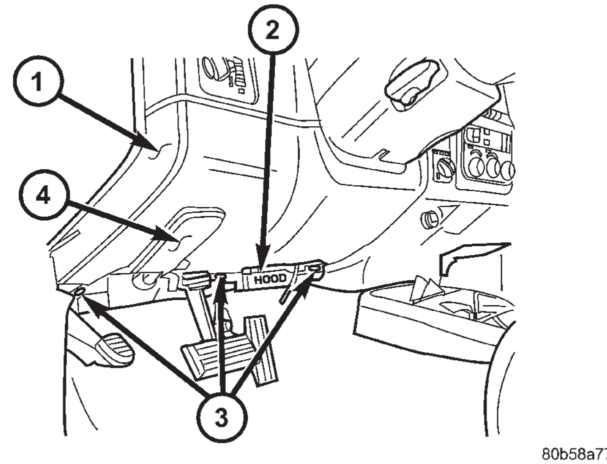

Fig. 17 Steering Column Opening Cover

1 - STEERING COLUMN OPENING COVER
2 - INSIDE HOOD RELEASE
3 - SCREW (3)
4 - PARK BRAKE RELEASE HANDLE

(4) Depress the latch tabs that secure the 16-way data link connector to the inside hood release bracket, and push the connector out of its mounting hole.

(5) Remove the two screws that secure the inside hood release bracket to the instrument panel structural support (Fig. 18).

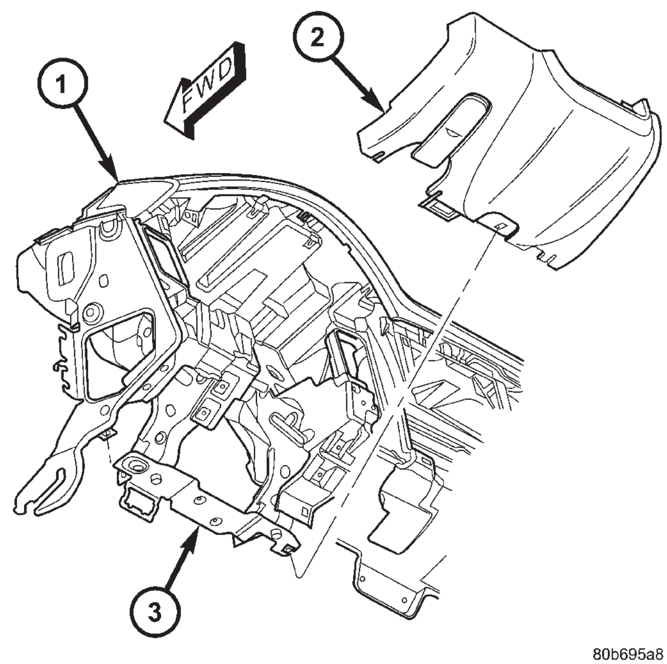

Fig. 18 Inside Hood Release Bracket

1 - TOP COVER
2 - STEERING COLUMN OPENING COVER
3 - INSIDE HOOD RELEASE BRACKET

INSIDE HOOD RELEASE BRACKET (Continued)

(6) Remove the inside hood release bracket from the instrument panel structural support.

INSTALLATION

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(1) Position the inside hood release bracket onto the instrument panel structural support (Fig. 18).
(2) Install and tighten the two screws that secure the inside hood release bracket to the instrument panel structural support. Tighten the screws to 2 N·m (17 in. lbs.).
(3) Install the 16-way data link connector into the mounting hole on the inside hood release bracket.
(4) Position the inside hood release handle to the instrument panel lower reinforcement.
(5) Install and tighten the two screws that secure the inside hood release handle to the inside hood release bracket. Tighten the screws to 3 N·m (25 in. lbs.).
(6) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).
(7) Reconnect the battery negative cable.

LOWER BEZEL

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 steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).
(4) Remove the two screws that secure the bottom of the lower bezel to the instrument panel structural support (Fig. 19).

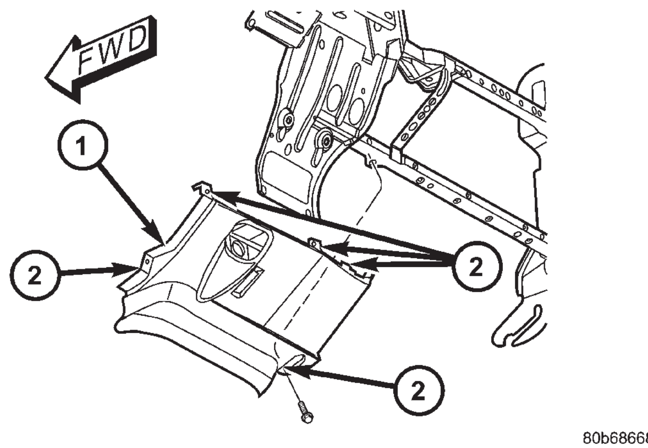

Fig. 19 Lower Bezel Remove/Install

1 - LOWER BEZEL
2 - SCREW (5)

(5) Remove the three screws that secure the top of the lower bezel to the instrument panel structural support.
(6) If the vehicle is so equipped, pull the lower bezel away from the instrument panel far enough to access and disconnect the instrument panel wire harness connectors from the receptacles for the accessory power outlet, the lower bezel console lamp, and the cigar lighter.
(7) Remove the lower bezel from the instrument panel.

INSTALLATION

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(1) Position the lower bezel to the instrument panel.

(2) If the vehicle is so equipped, reconnect the instrument panel wire harness connectors to the receptacles for the accessory power outlet, the lower bezel console lamp, and the cigar lighter.

(3) Position the lower bezel onto the instrument panel (Fig. 19).

(4) Install and tighten the three screws that secure the top of the lower bezel to the instrument panel structural support. Tighten the screws to 2 N·m (20 in. lbs.).

(5) Install and tighten the two screws that secure the bottom of the lower bezel to the instrument panel structural support. Tighten the screws to 2 N·m (20 in. lbs.).

(6) Close and latch the glove box.

(7) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - INSTALLATION).

(8) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(9) Reconnect the battery negative cable.

STEERING COLUMN OPENING COVER

REMOVAL

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(1) Disconnect and isolate the battery negative cable.

(2) Reach under the left end of the instrument panel to access and unsnap the rod end clip on the park brake release link and disengage the link from the back of the handle (Fig. 20).

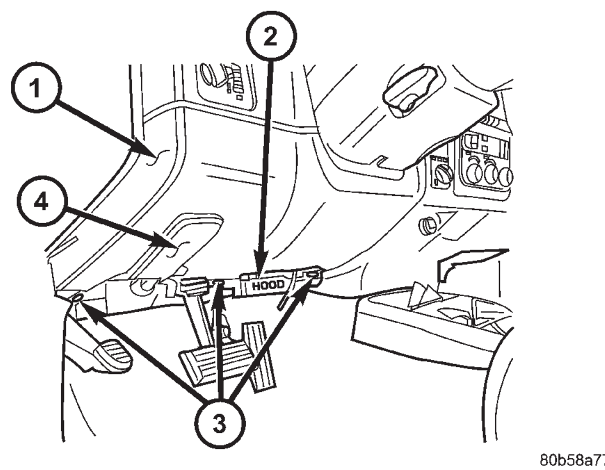

Fig. 20 Steering Column Opening Cover

1 - STEERING COLUMN OPENING COVER
2 - INSIDE HOOD RELEASE
3 - SCREW (3)
4 - PARK BRAKE RELEASE HANDLE

STEERING COLUMN OPENING COVER (Continued)

(3) Remove the three screws that secure the lower edge of the steering column opening cover to the instrument panel structural support.

(4) Using a trim stick or another suitable wide flat-bladed tool, gently pry the upper edge of the steering column opening cover just below the cluster bezel on each side of the steering column away from the instrument panel far enough to disengage each of the snap clip retainers from their receptacles in the instrument panel base trim (Fig. 21).

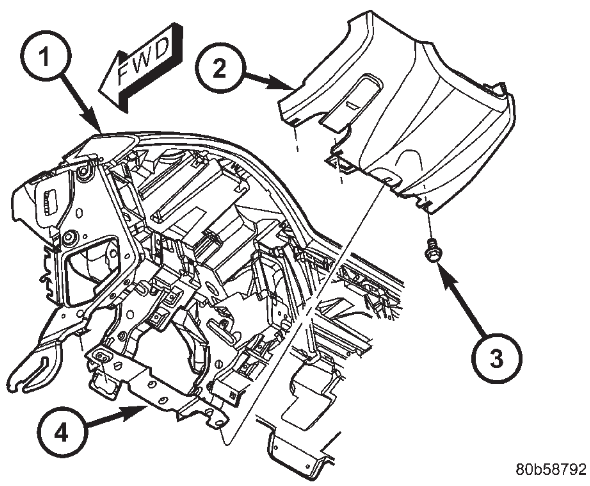

Fig. 21 Steering Column Opening Cover Remove/Install

1 - INSTRUMENT PANEL TOP COVER
2 - STEERING COLUMN OPENING COVER
3 - SCREW (3)
4 - HOOD RELEASE BRACKET

(5) Remove the steering column opening cover from the instrument panel.

INSTALLATION

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(1) Position the steering column opening cover to the instrument panel (Fig. 21).

(2) Align the snap clip retainers on the steering column opening cover with the receptacles in the instrument panel base trim.

(3) Using hand pressure, press firmly on the steering column opening cover over the snap clip locations until each of the snap clips is fully engaged in its receptacle.

(4) Install and tighten the three screws that secure the lower edge of the steering column opening cover to the instrument structural support (Fig. 20). Tighten the screws to 2 N·m (20 in. lbs.).

(5) Reach under the left end of the instrument panel to access and engage the park brake release link to the back of the handle. Then snap the rod end clip over the park brake release link to secure the connection.

(6) Reconnect the battery negative cable.

STORAGE BIN

REMOVAL

A cluster bezel may have one, two, or no storage bins installed on it, depending upon the vehicle equipment. A storage bin is used in place of the optional four-wheel drive transfer case switch, the optional passenger airbag on/off switch, and/or the optional rear window defogger switch. If the vehicle is equipped with both of these switches, it will not have a storage bin installed in the cluster bezel.

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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).

STORAGE BIN (Continued)

(3) Remove the three screws that secure the storage bin to the back of the cluster bezel (Fig. 22).

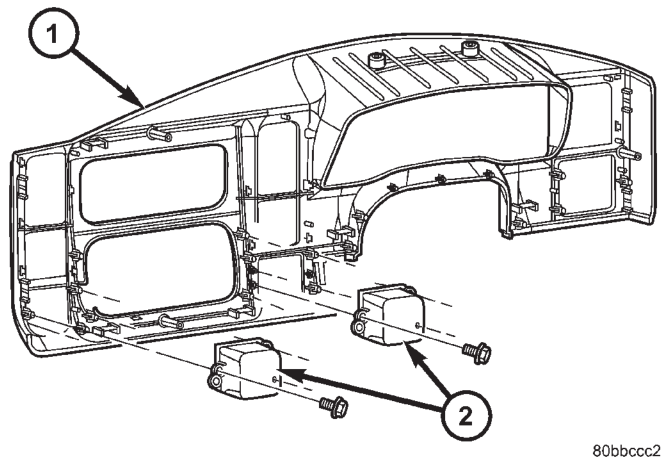

Fig. 22 Storage Bin Remove/Install

1 - CLUSTER BEZEL
2 - STORAGE BIN (2)

(4) Remove the storage bin from the back of the cluster bezel.

INSTALLATION

A cluster bezel may have one, two, or no storage bins installed on it, depending upon the vehicle equipment. A storage bin is used in place of the optional four-wheel drive transfer case switch and the optional passenger airbag on/off switch. If the vehicle is equipped with both of these switches, it will not have a storage bin installed in the cluster bezel.

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) Position the storage bin onto the back of the cluster bezel (Fig. 22).

(2) Install and tighten the three screws that secure the storage bin to the back of the cluster bezel. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - INSTALLATION).

(4) 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, 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) Disconnect and isolate the battery negative cable.

(2) Remove the end caps from each end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/END CAP - REMOVAL - DRIVER SIDE) and (Refer to 23 - BODY/INSTRUMENT PANEL/END CAP - REMOVAL - PASSENGER SIDE).

(3) Remove the cluster bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - REMOVAL).

(4) Remove the passenger airbag from the instrument panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG - REMOVAL).

(5) Remove the defroster grille from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/DEFROSTER GRILLE - REMOVAL).

(6) Remove the six screws that secure the forward edge (nearest the windshield) of the top cover to the instrument panel structural support (Fig. 23).

(7) Remove the screw that secures each outboard end of the top cover to the instrument panel structural support beneath the end caps.

(8) Remove the six screws that secure the rearward edge (nearest the passenger compartment) of the top cover to the instrument panel structural support.

(9) Remove the top cover from the top of the instrument panel structural support.

TOP COVER (Continued)

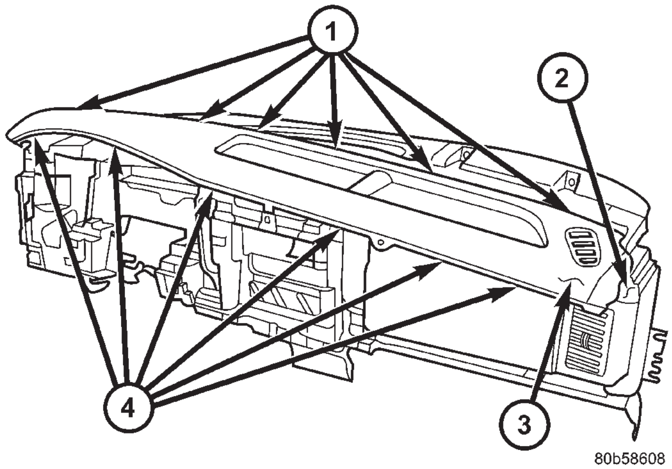

Fig. 23 Top Cover Remove/Install

1 - SCREW (6)
2 - SCREW (2)
3 - TOP COVER
4 - SCREW (6)

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) Position the top cover onto the top of the instrument panel structural support (Fig. 23).

(2) Install and tighten the six screws that secure the rearward edge (nearest the passenger compartment) of the top cover to the instrument panel structural support. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Install and tighten the screw that secures each outboard end of the top cover to the instrument panel structural support beneath the end caps. Tighten the screws to 2 N·m (20 in. lbs.).

(4) Install and tighten the six screws that secure the forward edge (nearest the windshield) of the top cover to the instrument panel structural support. Tighten the screws to 2 N·m (20 in. lbs.).

(5) Reinstall the defroster grille onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/DEFROSTER GRILLE - INSTALLATION).

(6) Reinstall the passenger airbag into the instrument panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG - INSTALLATION).

(7) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - INSTALLATION).

(8) Reinstall the end caps onto each end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/END CAP - INSTALLATION).

(9) Reconnect the battery negative cable.

INTERIOR

TABLE OF CONTENTS

INTERIOR

DESCRIPTION

CAUTION: Do not attempt to remove interior trim panels/moldings without first removing the necessary adjacent panels.

To avoid damaging the panels, ensure that all the screws and clips are removed before attempting to remove an interior trim panel/molding. **Trim panels are somewhat flexible but can be damaged if handled improperly.**

FLOOR SHIFT BOOT

REMOVAL

(1) Using a small flat blade, pry out insert from shift knob (Fig. 1).

(2) Remove nut attaching shift knob to gear shift.

(3) Pull knob off gear shift.

(4) Using a small flat bladed screwdriver pry up one corner of the bezel/boot assembly. Do not separate the boot from the bezel.

FLOOR SHIFT BOOT (Continued)

(5) Lift the boot/bezel assembly off of the floor panel and over the gear shift (Fig. 2) and (Fig. 3).

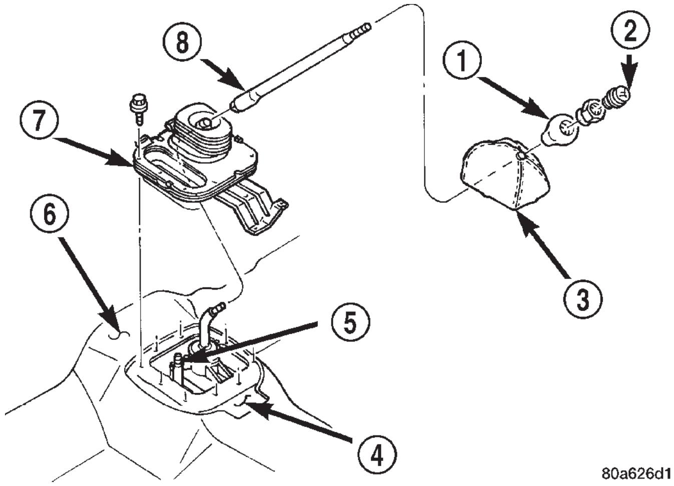

Fig. 1 Shift Knob Insert

1 - KNOB
2 - KNOB INSERT
3 - SHIFT BOOT
4 - FLOOR PAN
5 - TRANSFER CASE LEVER
6 - CARPET
7 - PLATE
8 - GEAR SHIFT

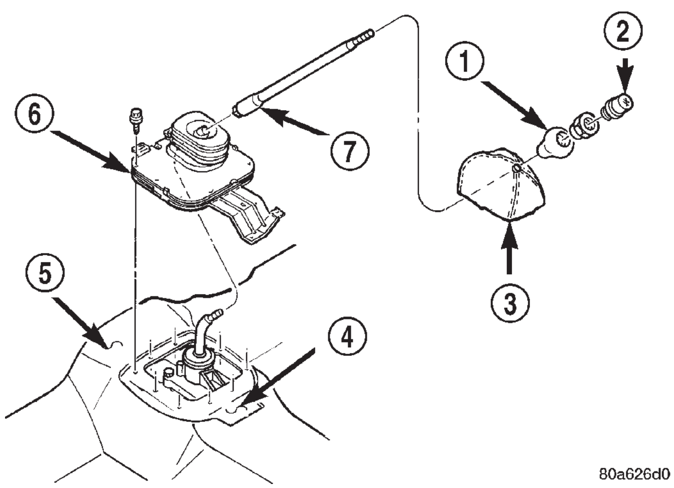

Fig. 2 Shift Boot—Manual Transmission

1 - KNOB
2 - KNOB INSERT
3 - SHIFT BOOT
4 - FLOOR PAN
5 - CARPET
6 - PLATE
7 - GEAR SHIFT

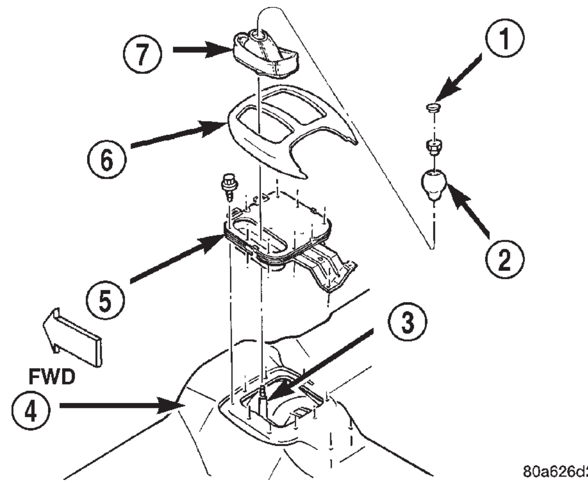

Fig. 3 Shift Boot—Transfer Case

1 - KNOB INSERT
2 - KNOB
3 - TRANSFER CASE SHIFT LEVER
4 - FLOOR PAN
5 - PLATE
6 - BEZEL
7 - TRANSFER CASE SHIFT BOOT

INSTALLATION - FLOOR SHIFT BOOT

(1) Position shift boot/bezel assembly on gear shift.
(2) Press shift boot/bezel onto the floor panel.
(3) Push knob onto gear shift.
(4) Install nut attaching shift knob to gear shift.
(5) Press insert into shift knob.

A-PILLAR TRIM

REMOVAL

(1) Remove A-pillar grab handle, if equipped.
(2) Remove screws from cowl trim cover.
(3) Remove cowl trim cover.
(4) Grasp A-pillar trim and pull outward to disengage clips attaching A-pillar trim to A-pillar (Fig. 4).
(5) Separate A-pillar trim from vehicle.

INSTALLATION

(1) Position A-pillar trim at A-pillar, align clips and press into place.
(2) Install cowl trim cover.
(3) Install A-pillar grab handle, if equipped.

A-PILLAR TRIM (Continued)

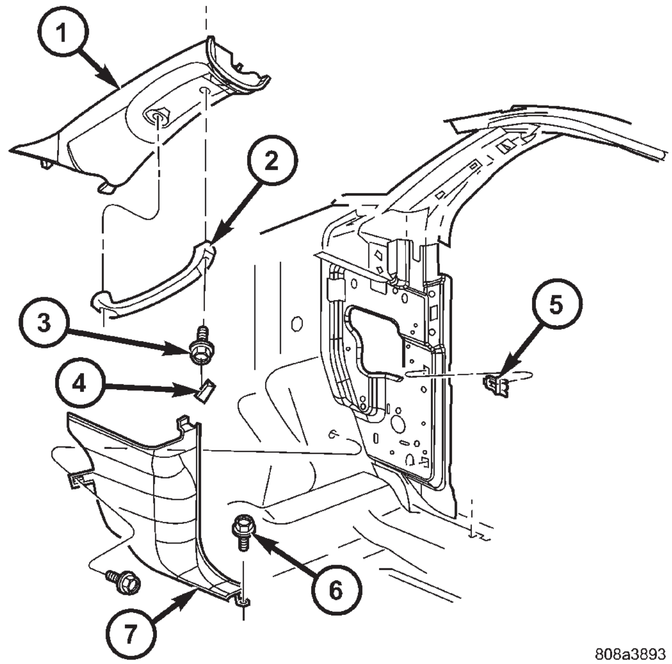

Fig. 4 A-Pillar Trim

1 - A-PILLAR TRIM
2 - ASSIST HANDLE
3 - ASSIST HANDLE BOLTS
4 - PUSH IN COVER
5 - COWL TRIM CLIP
6 - COWL TRIM PANEL BOLT
7 - COWL TRIM PANEL

ASSIST HANDLE

REMOVAL

(1) Using a trim stick, remove the trim covering the assist handle attachment screws (Fig. 5).
(2) Remove the screw attaching the assist handle to the roof structure.
(3) Remove the assist handle.

INSTALLATION

(1) Position the assist handle on the roof structure and headliner.
(2) Install the screws attaching the assist handle to the headliner and roof structure.
(3) Snap in the trim covers.

B-PILLAR TRIM

REMOVAL

The B-pillar trim panel is attached to the B-pillar with push-in fasteners.
(1) Remove door sill cover as necessary to clear B-pillar trim.

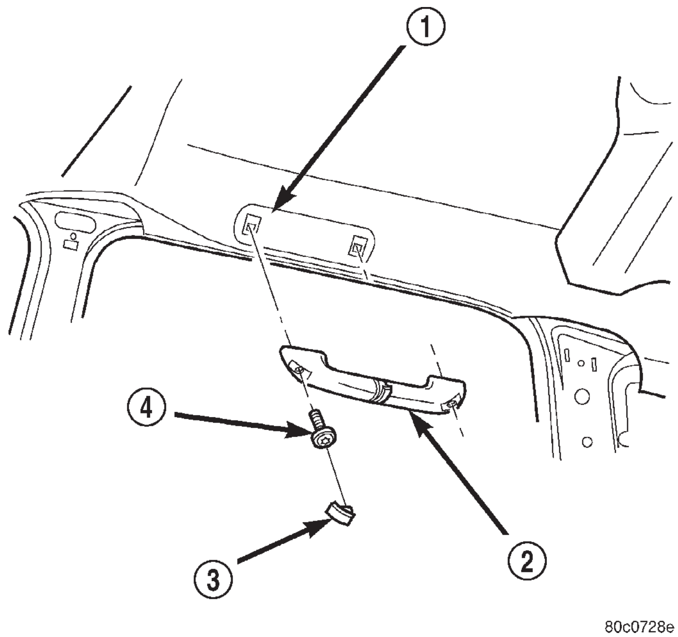

Fig. 5 Assist Handle

1 - HEADLINER
2 - GRAB HANDLE
3 - PUSH IN COVER
4 - SCREW

(2) Remove shoulder belt turning loop.
(3) Grasp B-pillar trim panel and firmly pull outward.
(4) Disconnect speaker harness connector, if equipped.
(5) Route shoulder belt through access slots in B-pillar trim panel.
(6) Separate B-pillar trim panel from B-pillar (Fig. 6).

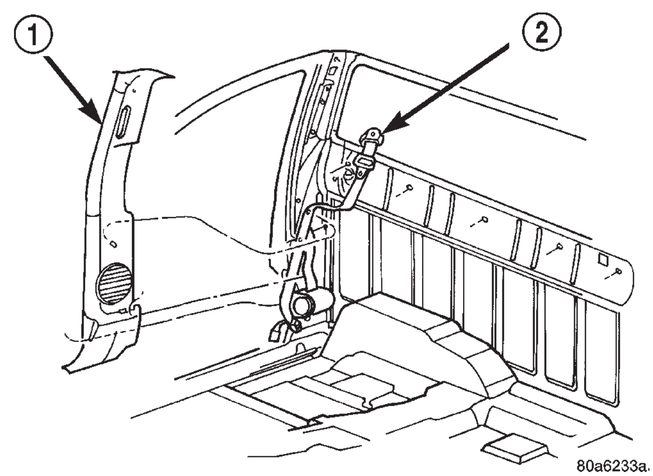

Fig. 6 B-Pillar Trim

1 - B-PILLAR TRIM
2 - TURNING LOOP

B-PILLAR TRIM (Continued)

INSTALLATION

(1) Position trim panel in vehicle.

(2) Route shoulder belt through access slots in B-pillar trim panel.

(3) Connect speaker harness connector, if equipped.

(4) Position B-pillar trim panel on B-pillar and press to seat push-in fasteners.

(5) Install shoulder belt turning loop.

(6) Install door sill cover as necessary.

C-PILLAR TRIM

REMOVAL

(1) Remove the seat belt turning loop. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - REMOVAL)

(2) Using a trim stick C-4755 or equivalent, remove the upper c-pillar trim panel (Fig. 7).

(3) Remove the screws and remove position the lower c-pillar aside.

(4) Remove the seat belt anchor and route seat belt though the lower c-pillar trim panel.

(5) Remove the lower c-pillar trim.

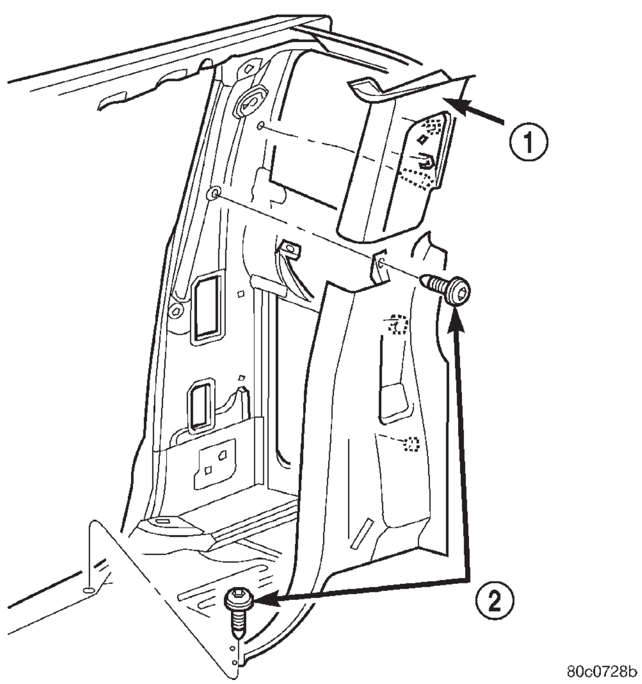

Fig. 7 Upper C Pillar Trim

1 - UPPER C PILLAR TRAY
2 - LOWER C PILLAR TRIM SCREWS

INSTALLATION

(1) Place the lower c-pillar trim into the vehicle and route the seat belt through the trim.

(2) Install the seat belt anchor. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - INSTALLATION)

(3) Install the lower c-pillar trim and install the screws.

(4) Install the upper c-pillar trim.

(5) Install the seat belt turning loop.

CARPETS AND FLOOR MATS

REMOVAL

(1) Remove seat.

(2) Remove door sill and cowl trim covers.

(3) Remove seat belt anchors.

(4) Remove floor shift boot/floor console, if equipped.

(5) Remove rear stowage tray/storage box.

(6) Pull carpet out from under quarter panel trim and cab back panel trim.

(7) Fold carpet or mat toward center of cab.

(8) Remove carpet or mat through door opening (Fig. 8).

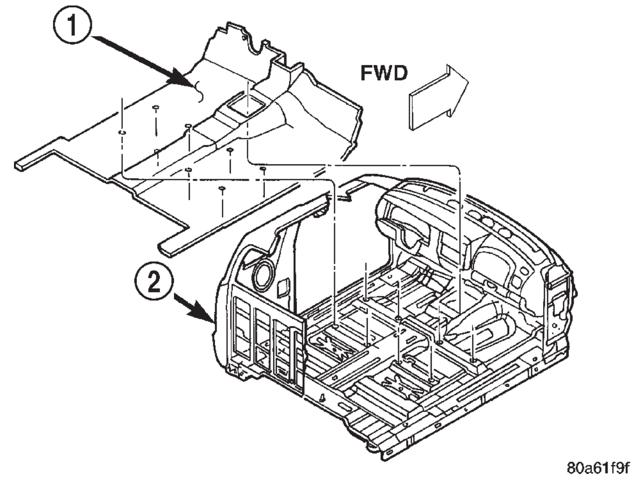

Fig. 8 Floor Carpet or Mat

1 - CARPET
2 - CAB

INSTALLATION

(1) Position the carpet in the cab and align all holes.

(2) Slide carpet under quarter panel trim and cab back panel trim.

(3) Install rear stowage tray/storage box.

(4) Install floor shift boot/floor console, if equipped.

(5) Install seat belt anchors.

(6) Install door sill and cowl trim covers.

(7) Install seat.

COAT HOOK

REMOVAL

(1) Grasp both sides of the coat hook base and firmly pull outward to disengage the coat hook cover from the base (Fig. 9) and (Fig. 10).

(2) Lift/rock the coat hook upward to disengage it from the roof panel.

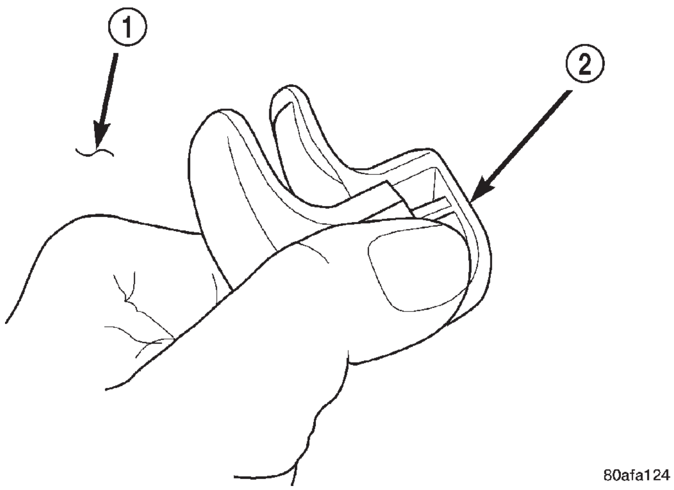

Fig. 9 Coat Hook Removal

1 - HEADLINER
2 - COAT HOOK

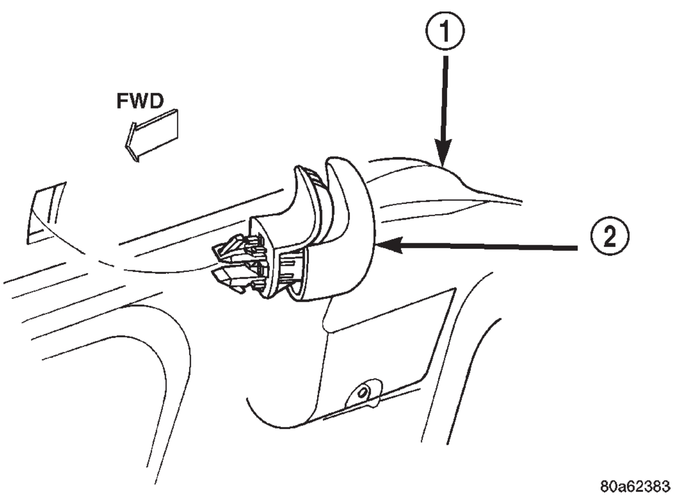

Fig. 10 Coat Hook

1 - CAB
2 - COAT HOOK

INSTALLATION

(1) Position coat hook in roof panel.

(2) Push the coat hook cover inward and secure the coat hook to the roof panel.

COWL TRIM COVER

REMOVAL

(1) Using a trim stick, pry cowl trim cover from cowl to disengage clips.

(2) Separate cowl trim cover from vehicle.

INSTALLATION

(1) Position cowl trim cover on cowl.

(2) Press cowl trim cover into place to engage clips.

DOOR SILL TRIM

REMOVAL

(1) Using a trim stick, pry up sill trim cover from door sill.

(2) Separate sill trim cover from vehicle (Fig. 11).

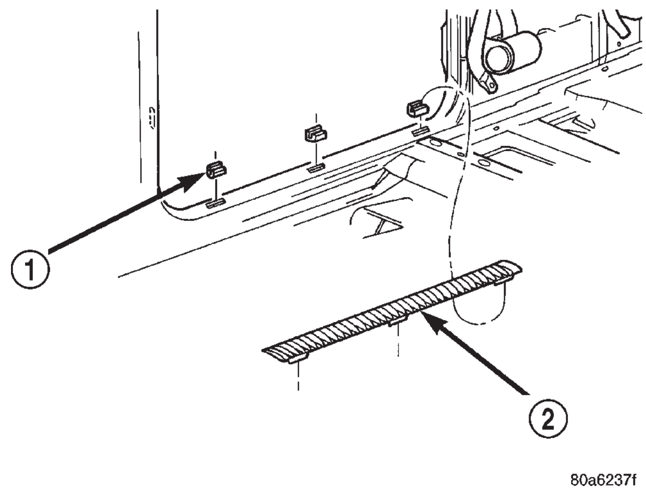

Fig. 11 Sill Trim Cover

1 - CLIP
2 - SILL TRIM COVER

INSTALLATION

(1) Position front edge of sill cover over cowl trim cover and align tab.

(2) Align sill cover and press into place.

FLOOR CONSOLE

REMOVAL

(1) Open console lid and remove bolts attaching console to floor pan (Fig. 12).

(2) Lift the cup holder bin mat and remove bolt attaching the console to the floor pan.

(3) Lift the cup holder mat and remove the bolts attaching the console to the floor pan.

(4) Lift the rear of the console and pull the console rearward to separate from the shift bezel.

(5) Remove the console from the vehicle.

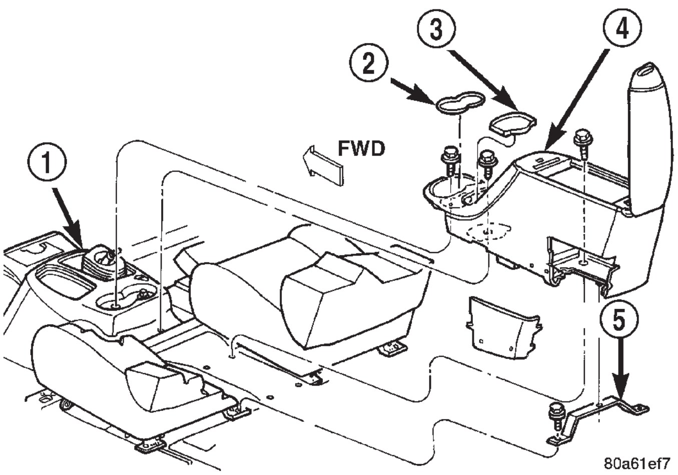

Fig. 12 Floor Console

1 - SHIFT BEZEL
2 - CUP HOLDER MAT
3 - ACCESSORY BIN MAT
4 - FLOOR CONSOLE
5 - BRACKET

INSTALLATION

(1) Position the console in the vehicle.

(2) While holding the console with the front of the console pointing downward, position the front of the console on top of the shift bezel.

(3) Align rear of console with the mounting bracket.

(4) Install bolts attaching console to floor pan.

HEADLINER

REMOVAL

(1) Remove sun visors and visor hooks.

(2) Remove coat hooks.

(3) Remove overhead console, if equipped. Refer to Group 8V, Overhead Console for removal procedure.

(4) Remove A-pillar trim.

(5) Remove quarter trim/B-pillar trim panels.

(6) Remove dome lamp. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/DOME LAMP - REMOVAL).

(7) Separate headliner from roof panel (Fig. 13) and (Fig. 14).

(8) Extract headliner through door opening.

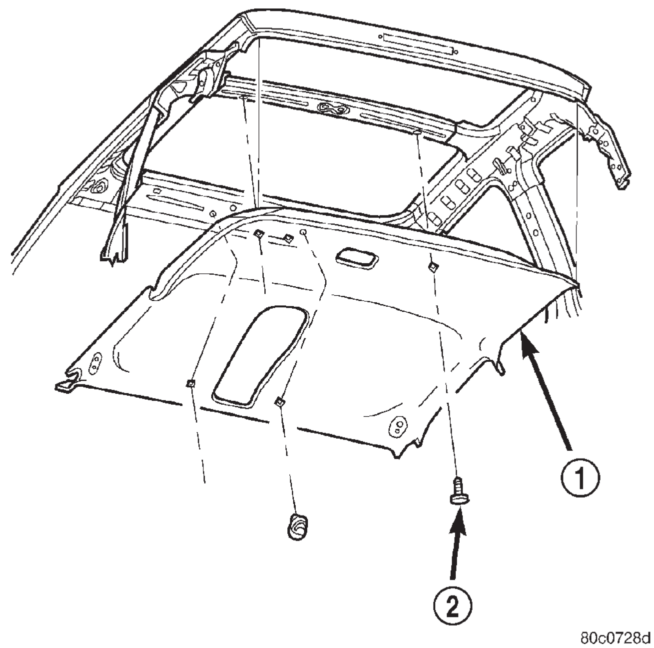

Fig. 13 Quad Cab Headliner

1 - HEADLINER
2 - PUSH IN FASTENER

INSTALLATION

(1) Position headliner in vehicle.

(2) Install quarter/B-pillar trim panels.

(3) Install A-pillar trim.

(4) Install overhead console, if equipped.

(5) Install dome lamp. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/DOME LAMP - INSTALLATION).

(6) Install coat hooks.

(7) Install sun visors and visor hooks.

HEADLINER (Continued)

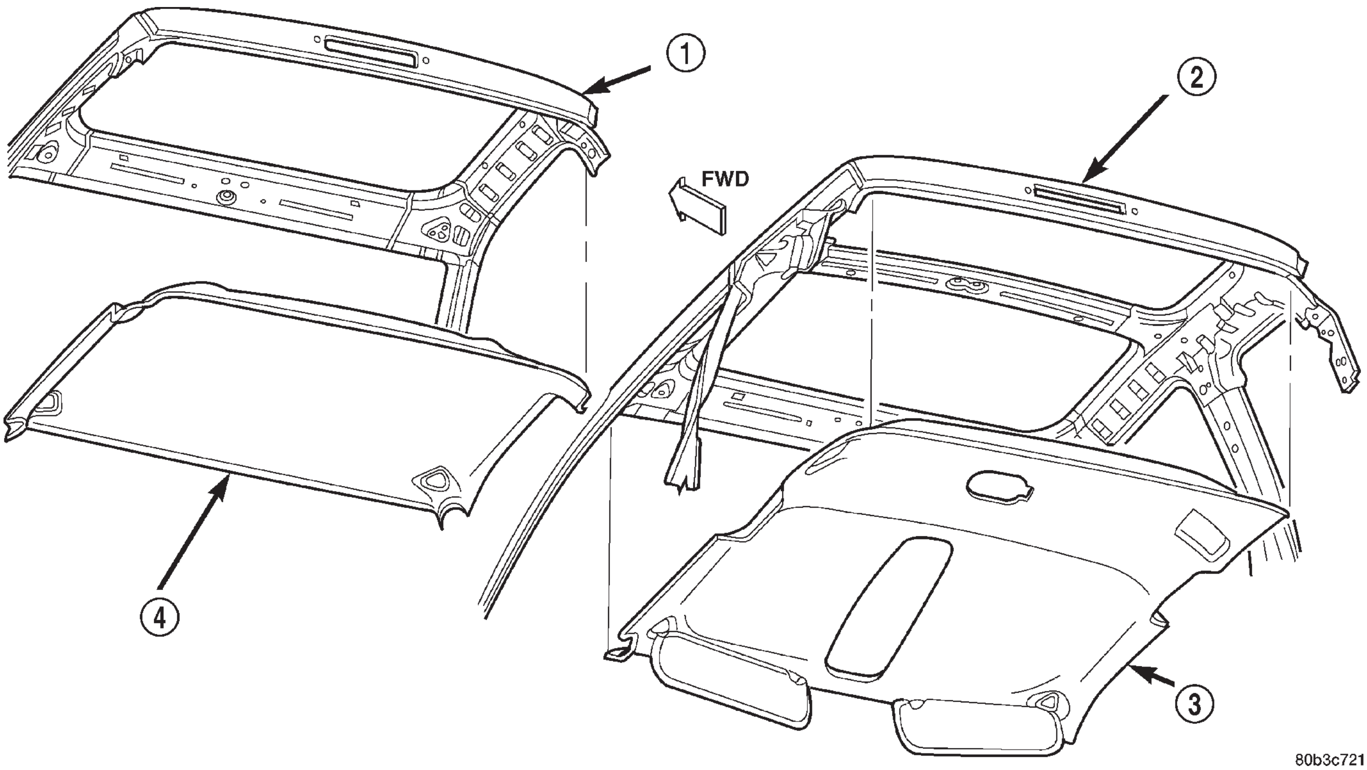

Fig. 14 Headliner

1 - STANDARD CAB
2 - EXTENDED CAB
3 - HEADLINER
4 - HEADLINER

QUARTER TRIM PANEL

REMOVAL

(1) Remove door sill cover as necessary to clear quarter trim.
(2) Remove cab back panel trim.
(3) Remove front and rear shoulder belt turning loops.
(4) Remove the screws attaching the quarter trim panel to the cab back panel.
(5) Grasp quarter trim panel and firmly pull outward to disengage the push-in fasteners.
(6) Route front and rear shoulder belts through access slots in quarter trim panel.
(7) Separate club cab quarter trim panel from quarter panel (Fig. 15).

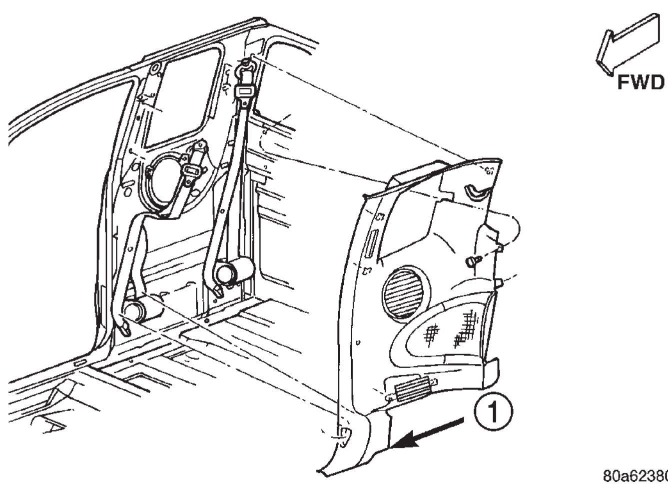

Fig. 15 Quarter Trim Panel

1 - QUARTER TRIM PANEL

INSTALLATION

(1) Position trim panel in vehicle.
(2) Route belt webbing through access slots in quarter trim panel.
(3) Position quarter trim panel on quarter panel and engage hooks at base of quarter trim panel.
(4) Press quarter trim panel inward to seat push-in fasteners.
(5) Install screws attaching quarter trim panel to cab back panel.
(6) Install cab back panel trim.
(7) Install door sill cover as necessary.

REAR CAB BACK PANEL TRIM

REMOVAL

The rear cab back panel trim is attached to the cab with push-in fasteners.

(1) Grasp rear cab back panel trim and firmly pull to release from cab (Fig. 16) and (Fig. 17).

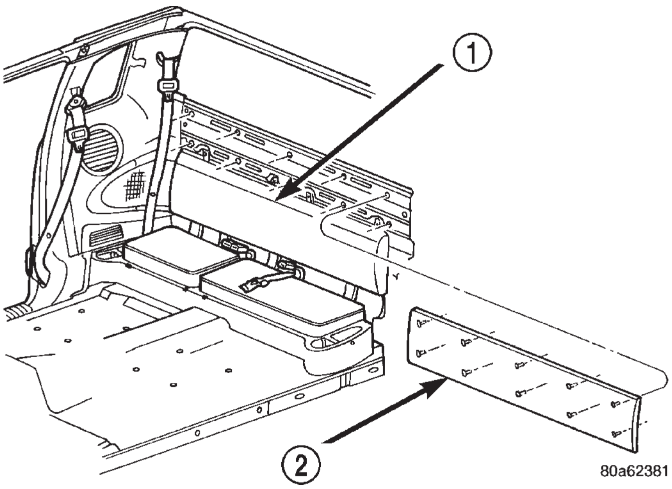

Fig. 16 Rear Cab Back Panel Trim

1 - REAR SEAT BACK
2 - REAR CAB PANEL TRIM

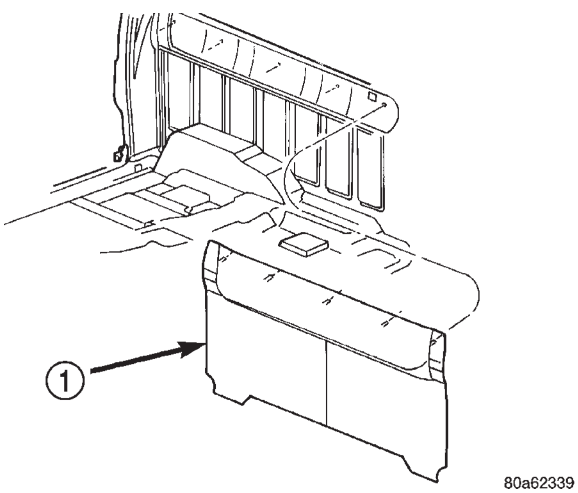

Fig. 17 Rear Cab Back Panel Trim With Carpet

1 - CAB BACK PANEL CARPET

INSTALLATION

(1) Position rear cab back panel trim on cab, align holes and press into place.

REAR STORAGE BOX

REMOVAL

(1) Lift rear seat.

(2) Remove bolts attaching storage box to floor pan (Fig. 18).

(3) Remove rear seat belt/buckle anchor bolts.

(4) Route rear seat belt/buckle through slots in rear of storage box.

(5) Separate storage box from vehicle.

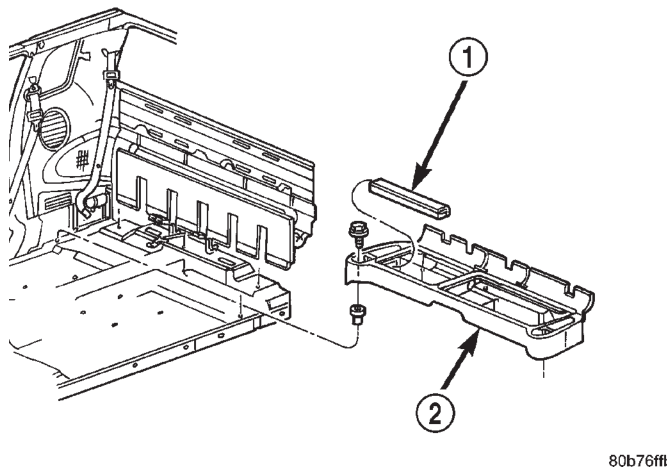

Fig. 18 Storage Box

1 - JACK STORAGE POUCH
2 - STORAGE BOX

INSTALLATION

(1) Position storage box in vehicle.

(2) Route rear seat belt/buckle through slots in rear of storage box.

(3) Install rear seat belt/buckle anchor bolts.

(4) Install bolts attaching storage box to floor pan.

(5) Lower seat.

REAR VIEW MIRROR

REMOVAL

(1) Loosen the mirror base setscrew (Fig. 19).

(2) Slide the mirror base upward and off the bracket.

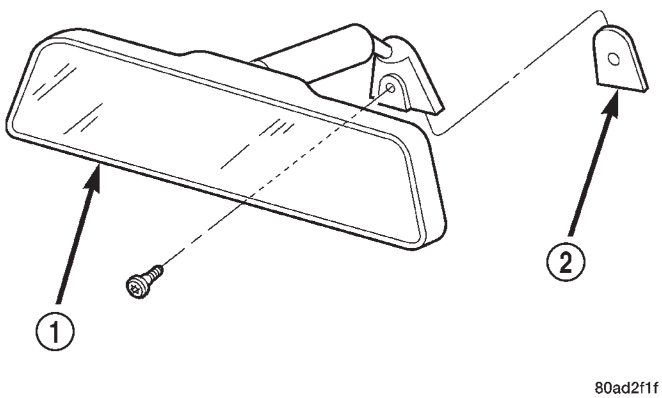

Fig. 19 Rearview Mirror

1 - MIRROR
2 - SUPPORT BUTTON

INSTALLATION

(1) Position the mirror base at the bracket and slide it downward onto the support bracket.

(2) Tighten setscrew to1 N·m (9 in. lbs.) torque.

SHIFT BEZEL

REMOVAL

(1) Remove shift boot/s.

(2) Lift bin cup holder and remove bolts attaching shift bezel to floor pan (Fig. 20).

(3) Remove screw under shift boot attaching patch plate to floor pan.

(4) Disengage 4WD shift indicator lamp connector, if equipped (Fig. 21) and (Fig. 22).

(5) Separate shift bezel from vehicle.

INSTALLATION

(1) Position shift bezel in vehicle.

(2) Engage 4WD shift indicator lamp connector, if equipped.

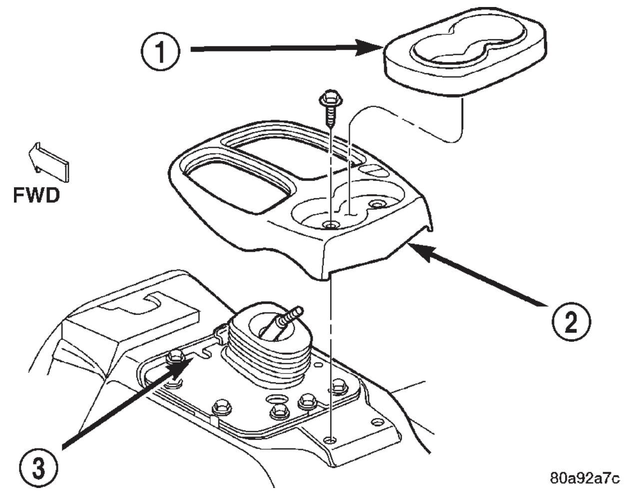

Fig. 20 Shift Bezel 4x2

1 - SHIFT BEZEL CUP HOLDER
2 - SHIFT BEZEL 4 x 2
3 - PATCH PLATE

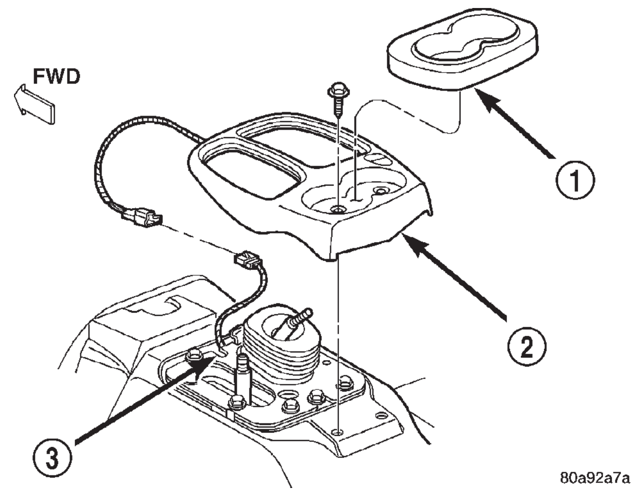

Fig. 21 Shift Bezel 4X4 Manual Trans

1 - SHIFT BEZEL CUP HOLDER
2 - SHIFT BEZEL 4 x 4
3 - PATCH PLATE

(3) Install screw under shift boot attaching patch plate to floor pan.

(4) Install bolts in cup holder attaching shift bezel to floor pan.

(5) Install shift boot/s.

SHIFT BEZEL (Continued)

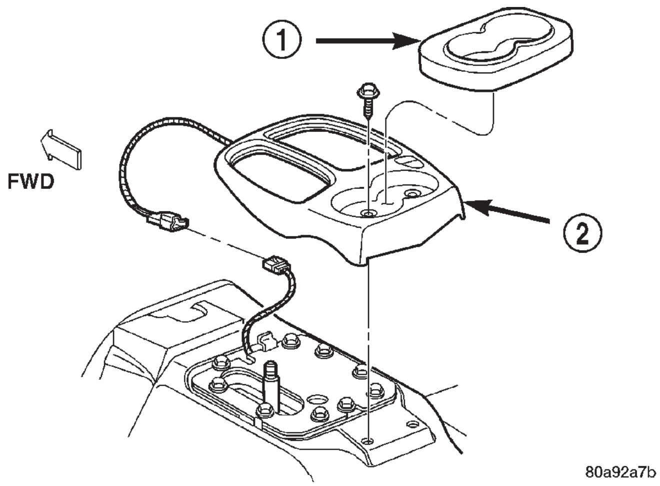

Fig. 22 Shift Bezel 4X4 Automatic Trans

1 - SHIFT BEZEL CUP HOLDER
2 - SHIFT BEZEL 4 x 4

SUN VISORS

REMOVAL

NOTE: All vehicles with driver and passenger side airbags must have a colored-coded, 5-bullet point airbag warning label applied to the sunvisor face surface (in the stored position). When replacing the sunvisor, verify label availability and ensure the label is installed.

(1) Remove the screws that attach the sunvisor arm support bracket to the headliner and the roof panel (Fig. 23).

(2) Detach the sunvisor from the visor supports.

(3) Remove the sunvisor from the headliner and roof panel.

(4) If necessary, remove the screw attaching the visor supports to the headliner and roof panel.

INSTALLATION

NOTE: All vehicles with driver and passenger side airbags must have a colored-coded, 5-bullet point airbag warning label applied to the sunvisor face surface (in the stored position). When replacing the sunvisor, verify label availability and ensure the label is installed.

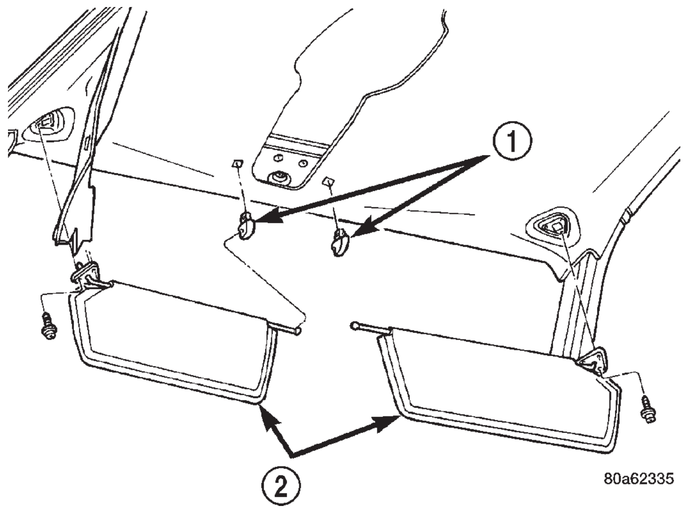

Fig. 23 Sunvisors

1 - VISOR SUPPORT
2 - SUNVISOR

(1) If removed, install the visor supports.

(2) Position the sunvisor in the visor supports and align the arm support bracket holes with the headliner holes.

(3) Install the screws that attach the sunvisor arm support bracket to the headliner and the roof panel.

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.

REAR VIEW MIRROR SUPPORT BRACKET (Continued)

- Allow the accelerator to dry for five minutes.
- Do not touch the bracket contact surface after the accelerator has been applied.

(5) Apply adhesive accelerator to the bracket contact surface on the windshield glass. Allow the accelerator to dry for one minute. Do not touch the glass contact surface after the accelerator has been applied.

(6) Install the bracket according to the following instructions:

- Apply one drop of adhesive at the center of the bracket contact-surface on the windshield glass.
- Apply an even coat of adhesive to the contact surface on the bracket.
- Align the bracket with the marked position on the windshield glass.
- Press and hold the bracket in place for at least one minute.

NOTE: Verify that the mirror support bracket is correctly aligned, because the adhesive will cure rapidly.

(7) Allow the adhesive to cure for 8-10 minutes. Remove any excess adhesive with an alcohol-dampened cloth.

(8) Allow the adhesive to cure for an additional 8-10 minutes before installing the mirror.

AIR EXHAUSTER - CAB

REMOVAL

(1) Remove cab back panel carpet/trim.

(2) Position a long flat blade between cab and cargo box and depress air exhauster upper retaining tabs and disengage from cab back panel.

(3) From inside the vehicle separate air exhauster from cab back panel (Fig. 24).

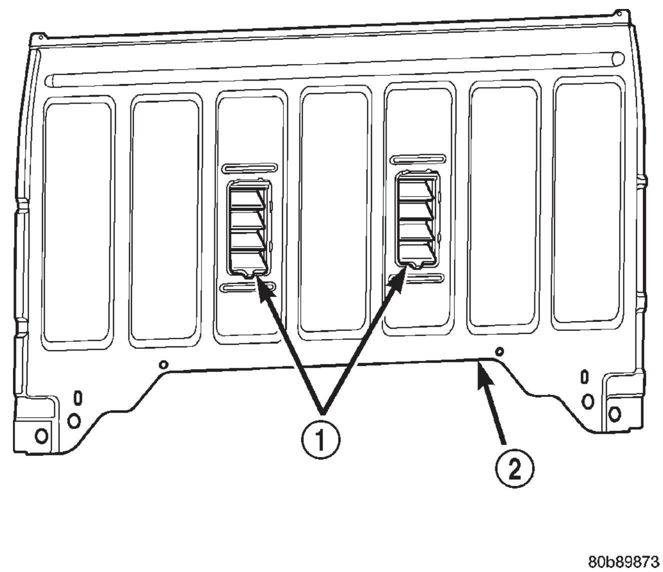

Fig. 24 In Cab Air Exhausters

1 - AIR EXHAUSTERS
2 - CAB BACK PANEL

INSTALLATION

(1) From inside the vehicle position air exhauster in cab back panel.

(2) Press air exhauster inward to engage retaining tabs.

PAINT

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PAINT

SPECIFICATIONS

2001 AN PAINT COLOR CODES

EXTERIOR COLORS

DC CODE	EXTERIOR COLOR	DC CODE	EXTERIOR COLOR
XRV	Dark Garnet Red	PR4	Flame Red Pearl Coat
XV3	Amber Fire Pearl Coat	WSB	Bright Silver Metalic
SG8	Forest Green Pearl Coat	XTL	Medium Bronze Pearl Coat
WBT	Patriot Blue Pearl Coat	VB3	Intense Blue Pearl Coat
DX8	BLack Clear Coat	GW7	Bright White Clear Coat

INTERIOR COLORS

DC CODE	INTERIOR COLOR	DC CODE	INTERIOR COLOR
S	Dark Slate Gray	T	Taupe

BASE COAT/CLEAR COAT FINISH

DESCRIPTION

The original equipment finish is a multi-step process that involves cleaning, electrodeposition (e-coat), base coat, and clear coat steps. Additionally, selected areas of the vehicle may be coated with an anti-chip finish.

OPERATION

On most vehicles a two-part paint application (base coat/clear coat) is used. Color paint that is applied to primer is called base coat. The clear coat protects the base coat from ultraviolet light and provides a durable high-gloss finish.

CAUTION: Do not use abrasive chemicals or compounds on painted surfaces. Damage to finish can result. Do not use harsh alkaline based cleaning solvents on painted surfaces. Damage to finish or color can result.

PAINT CODE

DESCRIPTION

Exterior vehicle body colors are identified on the Body Code plate. The plate is located on the cab back panel. Refer to the Introduction section for body code plate decoding. The paint code is also identified on the Vehicle Safety Certification Label. The label is located on the drivers door shut face.

The color names provided in the Aftermarket Repair Product charts are the color names used on most repair product containers.

PAINT TOUCH-UP

DESCRIPTION

When a painted metal surface has been scratched or chipped, it should be touched-up as soon as possible to avoid corrosion. For best results, use Mopar® Scratch Filler/Primer, Touch-Up Paints and Clear Top Coat. Refer to Introduction group of this manual for Body Code Plate information.

PAINT TOUCH-UP (Continued)

WARNING: USE A OSHA APPROVED BREATHING FILTER WHEN SPRAYING PAINT OR SOLVENTS IN A CONFINED AREA. PERSONAL INJURY CAN RESULT.

STANDARD PROCEDURE - PAINT TOUCH-UP

(1) Scrape loose paint and corrosion from inside scratch or chip.

(2) Clean affected area with Mopar® Tar/Road Oil Remover, and allow to dry.

(3) Fill the inside of the scratch or chip with a coat of filler/primer. Do not overlap primer onto good surface finish. The applicator brush should be wet enough to puddle-fill the defect without running. Do not stroke brush applicator on body surface. Allow the filler/primer to dry hard.

(4) Cover the filler/primer with color touch-up paint. Do not overlap touch-up color onto the original color coat around the scratch or chip. Butt the new color to the original color, if possible. Do not stroke applicator brush on body surface. Allow touch-up paint to dry hard.

(5) On vehicles without clear coat, the touch-up color can be lightly finesse sanded (1500 grit) and polished with rubbing compound.

(6) On vehicles with clear coat, apply clear top coat to touch-up paint with the same technique as described in Step 4. Allow clear top coat to dry hard. If desired, Step 5 can be performed on clear top coat.

WARNING: AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL – BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT.AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL – BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT.

WET SANDING/BUFFING & POLISHING

DESCRIPTION

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.

SEATS

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SEATS

DESCRIPTION

Seat modules are made up of a seat frame, seat cushion, seat back cushion, a covering material, and the electrical components used for power operation, if equipped. Some seat systems also contain seat belt components and supplemental restraint systems.

OPERATION

Seat assemblies transport the occupants in comfort and safety. Seat assemblies also help position occupants correctly in the event of airbag deployment. Seat cushions, coverings, and electrical components are serviceable. Refer to the appropriate group in this manual.

CENTER CONSOLE LID

REMOVAL

(1) Remove the hinge pivot bolt.

(2) Remove the left upper hinge bracket cover.

(3) Remove the torx screws attaching the left hinge bracket to the console lid/seat back (Fig. 1).

(4) Peel back the right pivot bracket cover and carefully pry the pivot from the pivot bracket (Fig. 2).

(5) Separate the console lid/seat back from the seat cushion.

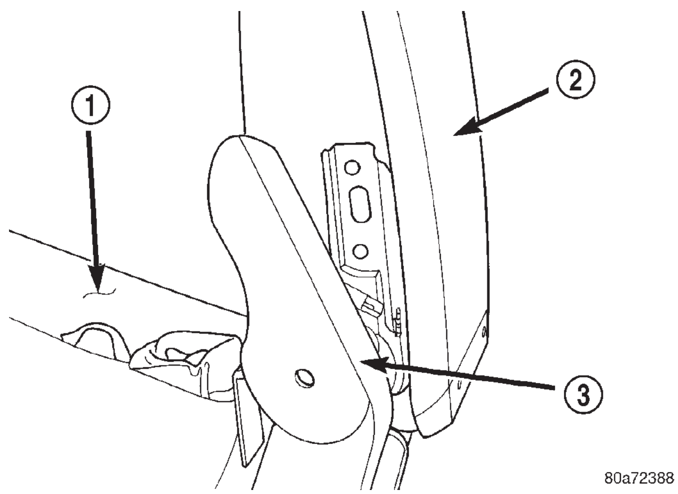

Fig. 1 Hinge Bracket

1 - SEAT CUSHION
2 - SEAT BACK/CONSOLE LID
3 - HINGE COVER

INSTALLATION

(1) Position the console lid/seat back on the seat cushion.

(2) Align the pivot in the pivot bracket.

(3) Install the torx screws attaching the left hinge bracket to the console lid/seat back. Tighten the torx screws to 24 N·m (17 ft. lbs.) torque.

CENTER CONSOLE LID (Continued)

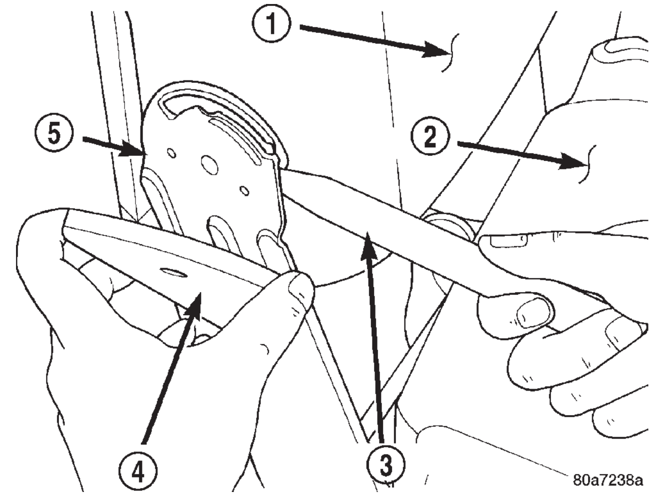

Fig. 2 Pivot Bracket

1 - SEAT BACK
2 - CUSHION
3 - TRIM STICK
4 - COVER
5 - PIVOT BRACKET

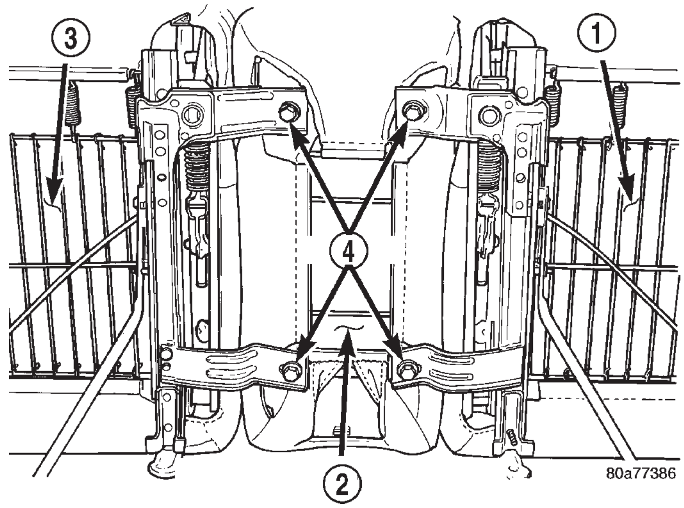

Fig. 3 Center Seat/Console

1 - PASSENGER SEAT
2 - CENTER SEAT/CONSOLE
3 - DRIVERS SEAT
4 - BOLTS

(4) Align the left upper hinge bracket cover and install the bolt.

(5) Install the hinge pivot bolt. Tighten the bolt to 24 N·m (17 ft. lbs.) torque.

CENTER SEAT ARMREST / CONSOLE

REMOVAL - CENTER SEAT/CONSOLE

(1) Remove bucket seats

(2) Remove the bolts attaching the center seat to the bucket seat inboard seat tracks (Fig. 3).

(3) Route the seat belt buckles through the elastic retaining straps.

(4) Separate the center seat/console from the bucket seats.

REMOVAL - CENTER ARMREST/CONSOLE LATCH

(1) Place the armrest/console in the down position.

(2) Open the armrest/console lid and remove the two screws attaching the latch bezel cover and remove the latch cover bezel and the latch button (Fig. 4).

(3) Using a drill stop, and protecting the surrounding trim and upholstery, drill the heads off the two rivets holding the latch to the armrest/console. Do not penetrate the latch bracket.

(4) Remove the latch assembly.

(5) Using the correct size drill bit, remove the remaining portion of the rivet.

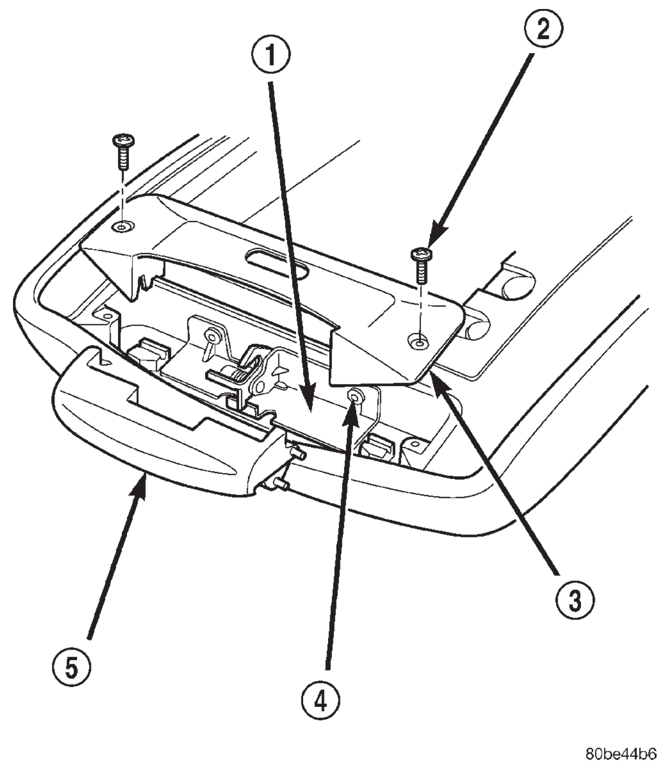

Fig. 4 Center Armrest/Console

1 - LATCH ASSEMBLY
2 - SCREW
3 - LATCH COVER BEZEL
4 - RIVET
5 - BUTTON

CENTER SEAT ARMREST / CONSOLE (Continued)

REMOVAL - CENTER ARMREST UPPER INERTIA LATCH COVER

(1) Move the drivers seat position to full forward with seat back full forward.

(2) Place center arm rest in the down position.

(3) Remove the screw securing the cover to the inertia latch (Fig. 5).

(4) Remove the upper and lower inertia latch covers.

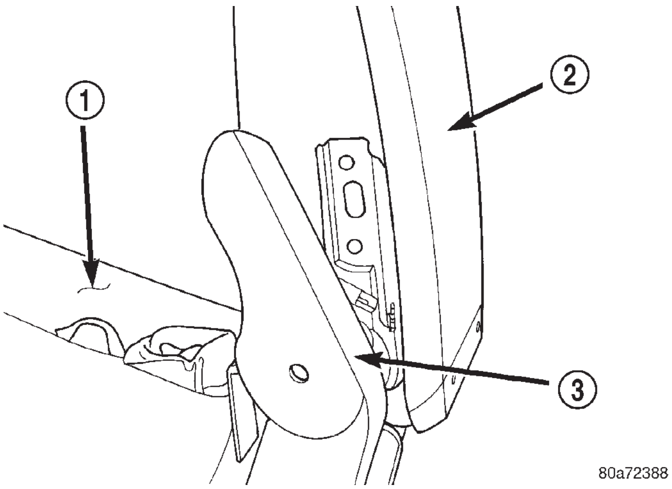

Fig. 5 Armrest/Console Inertia Latch Hinge Cover

1 - SEAT CUSHION
2 - SEAT BACK/CONSOLE LID
3 - HINGE COVER

INSTALLATION - CENTER SEAT/CONSOLE

(1) Position the center seat/console onto the bucket seat inboard seat tracks.

(2) Route the seat belt buckles through the elastic retaining straps.

(3) Install the bolts attaching the center seat to the bucket seat inboard tracks. Tighten the bolts to 24 N·m (17 ft. lbs.) torque.

(4) Install bucket seats

INSTALLATION - CENTER ARMREST/COSOLE LATCH

(1) Before installing the latch assembly, clean the area of any debris.

(2) Align the latch with the hole openings in the bin.

(3) Secure the latch assembly with new rivets.

(4) Place the button in position and retain with the latch cover bezel.

(5) Attach the latch cover bezel with the screws.

(6) Inspect the latch assembly by cycling through a full range of lid motions.

INSTALLATION - CENTER ARMREST UPPER INERTIA LATCH COVER

(1) Install the upper latch cover onto the upper latch inertia arm. Ensure the check strap loops under the stud on the side of the lower stanchion/post.

(2) Install the lower latch cover onto the inertia latch upper arm working it around the latch bracket.

(3) Align the lower latch cover, the upper latch cover, and the latch bracket to the screw hole on the arm.

(4) Secure the cover with the screw and tighten to 4.15 N·m (37 in. lbs.).

(5) Cycle the armrest through a full range of travel and check for freedom of movement. Adjust the latch covers as necessary.

CENTER SEAT CUSHION COVER

REMOVAL

(1) Remove the bucket seats.

(2) Separate the center seat from the bucket seats.

(3) Remove the seat back/console lid.

(4) Disengage the J-straps from the cushion frame (Fig. 6).

(5) Separate the cushion/cover from the frame.

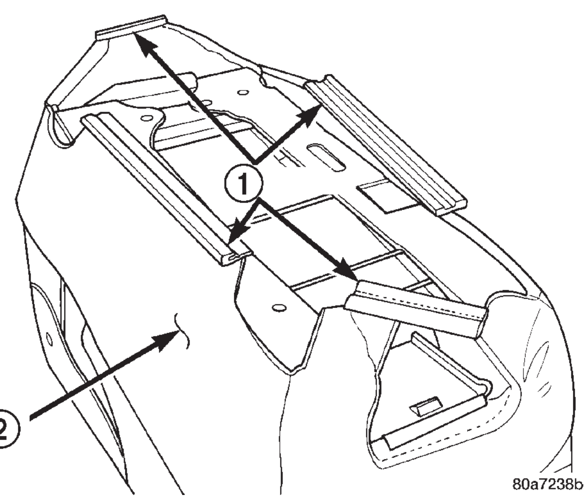

Fig. 6 Center Seat Cushion/Cover

1 - J-STRAPS
2 - CENTER SEAT CUSHION COVER

INSTALLATION

(1) Position the cushion/cover on the frame.

(2) Engage the J-straps from the cushion frame.

(3) Install the seat back/console lid.

(4) Attach the center seat to the bucket seats.

(5) Install the bucket seats.

SEAT

REMOVAL - BENCH SEAT

(1) Move seat to full forward position.
(2) Remove bolts attaching seat track to floor pan.
(3) Move seat to full rearward position.
(4) Remove bolts attaching seat track to floor pan (Fig. 7).
(5) Tilt setback forward and lift seat out through door.

NOTE: Do not activate seat track adjusters once bolts are removed.

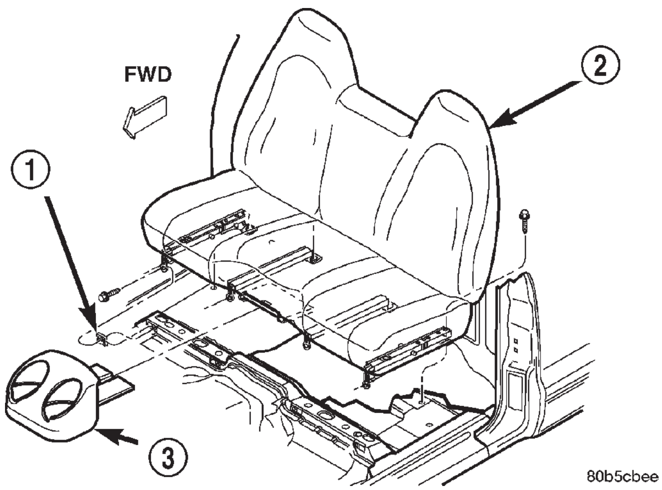

Fig. 7 Bench Seat

1 - U-NUT
2 - BENCH SEAT
3 - CUP HOLDER

REMOVAL - BUCKET SEAT

(1) If equipped, remove side shield and disengage power seat switch connector.

If the vehicle is equipped with a 40/20/40 seat, remove bucket seats and console as one assembly (Fig. 8).

(2) Move seat to full forward position.
(3) Remove rear screws attaching trim cover to seat track (Fig. 9).
(4) Remove rear bolts attaching rear seat track to floor pan.
(5) Move seat to full rearward position.
(6) Remove front screws attaching trim cover to seat track (Fig. 9).
(7) Remove front bolts attaching front seat track to floor pan.

NOTE: Do not actuate recliner or track adjuster once bolts are removed.

(8) Tilt setback forward and lift seat out through door.

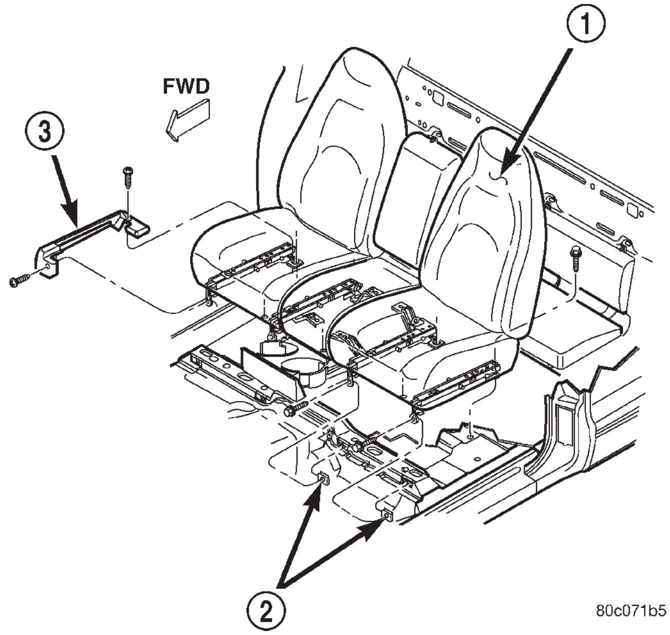

Fig. 8 40/20/40/ Front Seat

1 - 40/20/40 FRONT SEAT
2 - U—NUT
3 - TRIM COVER

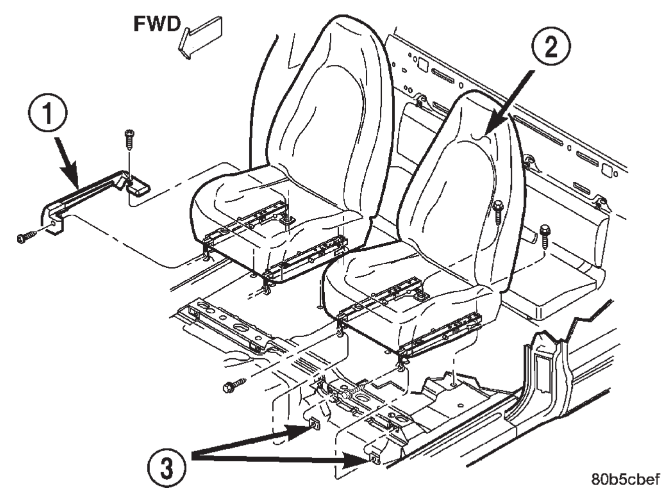

Fig. 9 Bucket Seat & Seat Track Trim Cover

1 - TRIM COVER
2 - BUCKET SEAT
3 - U-NUT

REMOVAL - REAR SEAT QUAD CAB

The quad cab rear seat is a 60/40 seat. Each seat is serviceable separately.

(1) Fold the seating cushion up.
(2) Remove the fasteners retaining the seat to the cab floor.

SEAT (Continued)

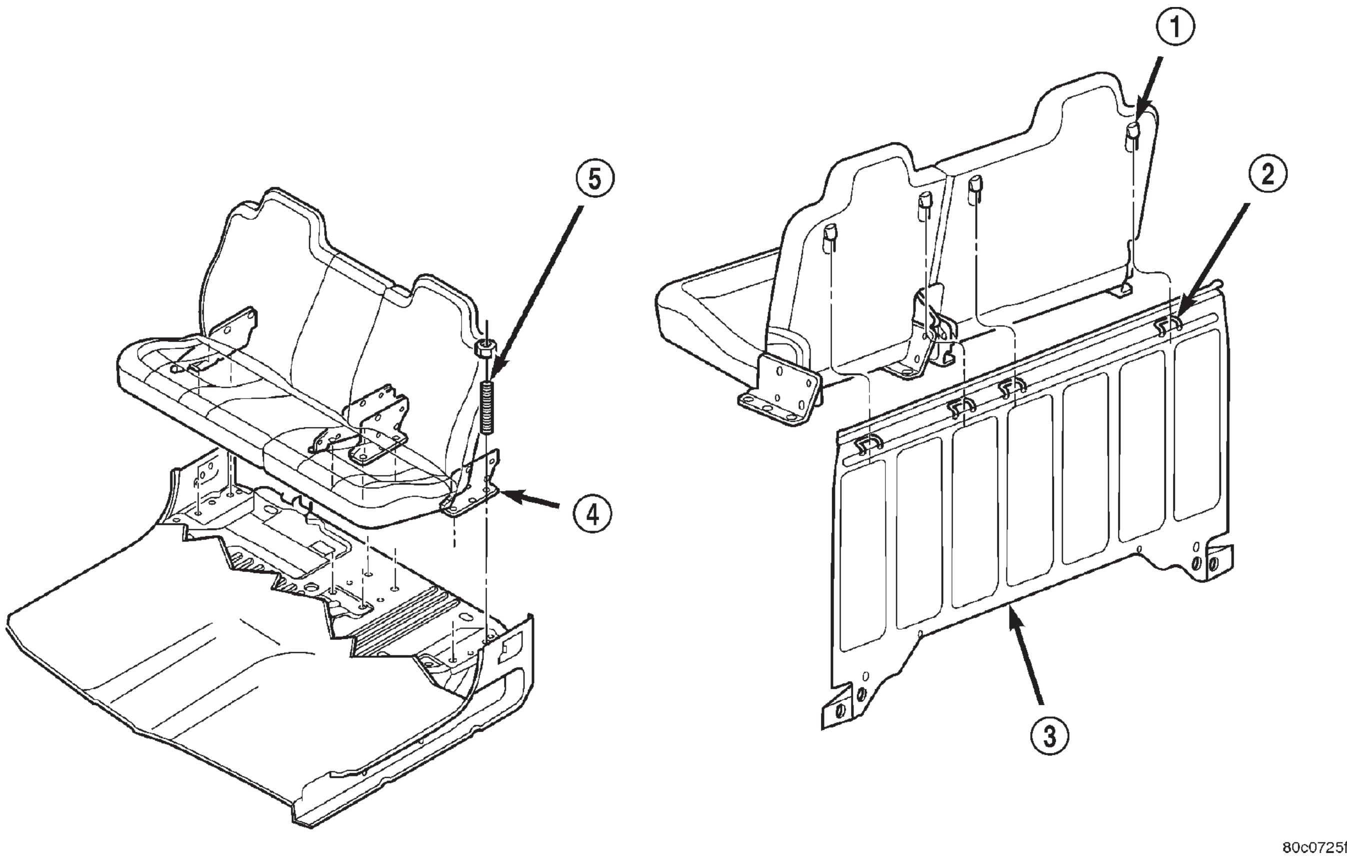

Fig. 10 Rear Seat Quad Cab

1 - HOOK
2 - RETAINER
3 - CAB BACK
4 - SEAT BRACKET
5 - CAB FLOOR STUD

(3) Lift the seat assembly off the retaining studs and the cab back hooks (Fig. 10).

(4) Feed the seat belt between the seat cushion and seat back.

(5) Remove the seat through the rear door.

INSTALLATION - BENCH SEAT

(1) Position seat in vehicle.

NOTE: Ensure each seat track is equally positioned in the full rearward position.

(2) Install the front bolts attaching seat track to floor pan. Tighten bolts to 28 N·m (20 ft. lbs.) torque.

(3) Move seat to full forward position.

(4) Install rear bolts attaching seat track to floor pan. Tighten bolts to 40 N·m (30 ft. lbs.) torque.

INSTALLATION - BUCKET SEAT

(1) Position seat in vehicle.

NOTE: Ensure each seat track is equally positioned in the full rearward position.

(2) Install bolts attaching front seat track to floor pan. Tighten to 28 N·m (20 ft. lbs.) torque.

(3) Install front screws attaching trim cover to seat track.

(4) Move seat to full forward position.

(5) Install bolts attaching rear inboard seat track to floor pan. Tighten to 40 N·m (30 ft. lbs.) torque.

(6) Install bolts attaching rear outboard seat track to floor pan. Tighten to 28 N·m (20 ft. lbs.) torque.

(7) Install rear screws attaching trim cover to seat track.

(8) If equipped, engage power seat switch connector and install side shield.

INSTALLATION - REAR SEAT QUAD CAB

(1) Position the seat on the cab back hooks and the floor studs.

(2) Feed the seat belt between the seat cushion and the seat back.

(3) Ensure the seat back is firmly hooked to the cab back retainers.

(4) Tighten the cab floor fasteners.

SEAT BACK

REMOVAL - REAR SEAT BACK–CLUB CAB

(1) Unsnap upper bolster assembly by pulling forward, and remove rear panel (Fig. 11).

(2) Push seat back firmly downward to disengage retaining tabs on seat back lower edge.

(3) Disengage seat belt/buckle retaining loops (Fig. 12).

(4) Remove cab back bolster assembly.

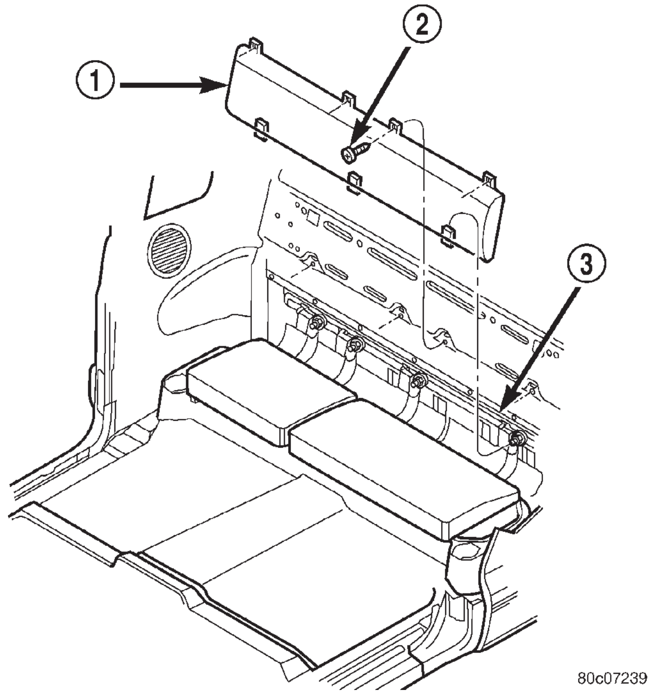

Fig. 11 Rear Seat

1 - SEAT BACK
2 - SCREW
3 - SEAT PIVOT BRACKET

REMOVAL - BENCH SEAT BACK

(1) Move seat to full forward position.

(2) Disengage outer, lower J-strap at base of seat back.

(3) Disengage hook and loop fastener on rear of seat back cover (Fig. 13).

(4) Peel back lower corners of seat back cover to expose hinge bolts (Fig. 14).

(5) Remove the bolts attaching the hinge bracket to the seat back frame.

(6) Remove seat back from vehicle.

INSTALLATION - REAR SEAT BACK–CLUB CAB

(1) Position rear seat back in vehicle.

(2) Position rear seat belt/buckle in the retaining loops.

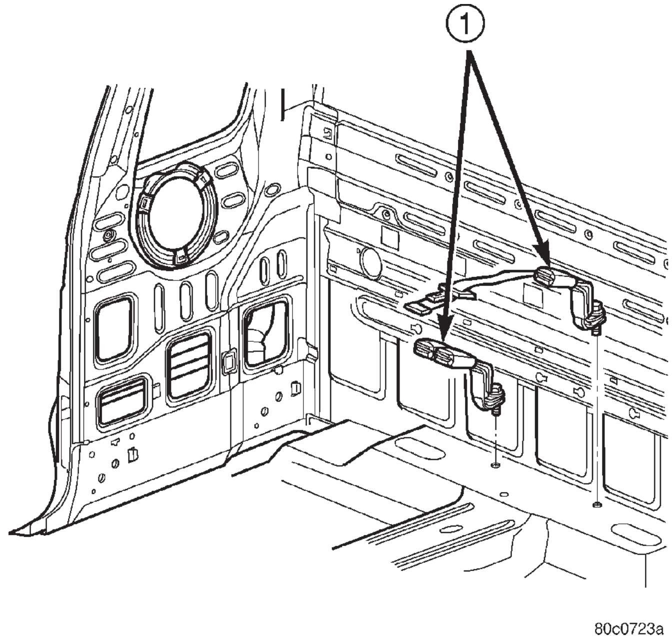

Fig. 12 Rear Seat Belt Buckles

1 - REAR SEAT LAP BELT/BUCKLE

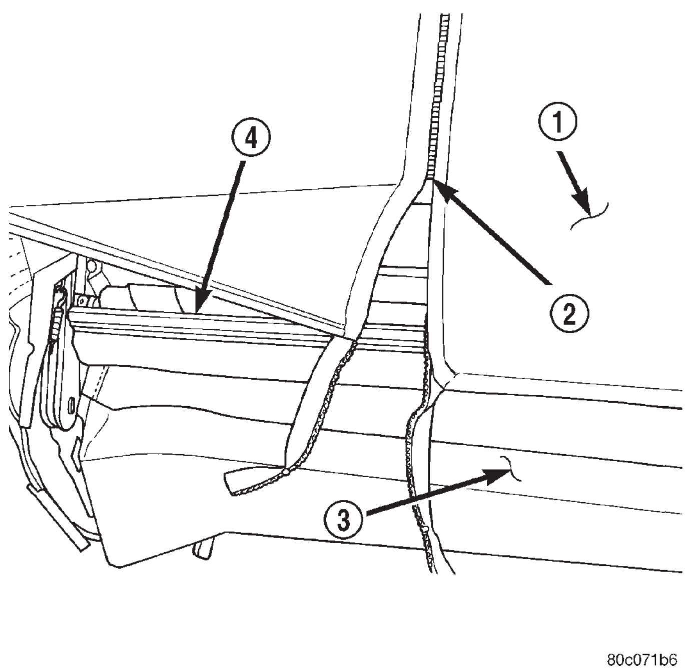

Fig. 13 Seat Back Hook and Loop Fastener

1 - SEAT BACK COVER
2 - HOOK AND LOOP FASTENER
3 - SEAT CUSHION
4 - J—STRAP

(3) Position seat back at cab back panel, align retaining tabs and lift seat back upward to secure seat back.

SEAT BACK (Continued)

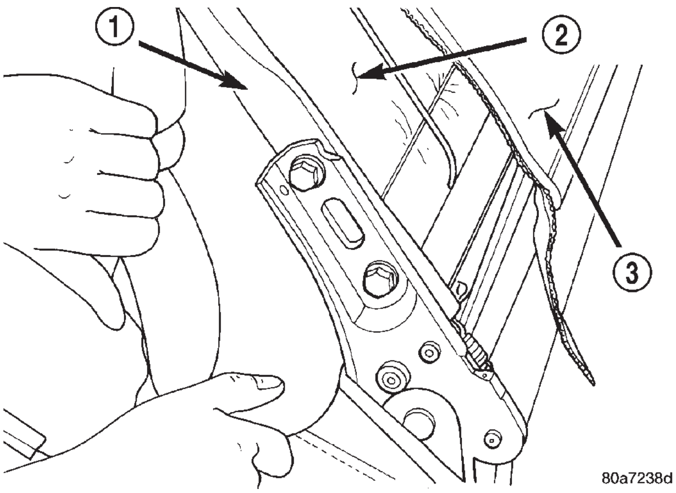

Fig. 14 Hinge Bolts

1 - SEAT BACK FRAME
2 - SEAT BACK CUSHION
3 - SEAT BACK COVER

(4) Secure cab back bolster assembly by aligning upper bolster assembly push pins with holes in cab back sheetmetal and pushing rearward.

INSTALLATION - BENCH SEAT BACK

(1) Position seat back in the vehicle.
(2) Install the bolts attaching the seat back frame to the hinge bracket.
(3) Roll the lower corners of seat back cover over the hinge bolts.
(4) Engage hook and loop fastener on rear of seat back cover.
(5) Engage outer, lower J-strap at base of seat back.
(6) Return seat to normal position.

SEAT BACK CUSHION / COVER

REMOVAL - BENCH SEAT BACK PAD/COVER

(1) Move seat to full forward position.
(2) Disengage outer, lower J-strap at base of seat back.
(3) Pull seat back pad/cover upward and separate from seat back frame.

REMOVAL - BUCKET SEAT BACK PAD/COVER

(1) Position seat in full forward position.
(2) If equipped, remove seat release handle on rear of seat back.
(3) Disengage J-strap at base of seat back.
(4) Disengage hook and loop fastener on rear of seat back (Fig. 15).
(5) Using a trim stick, carefully pry off lumbar handle.
(6) Separate pad/cover from seat back frame.

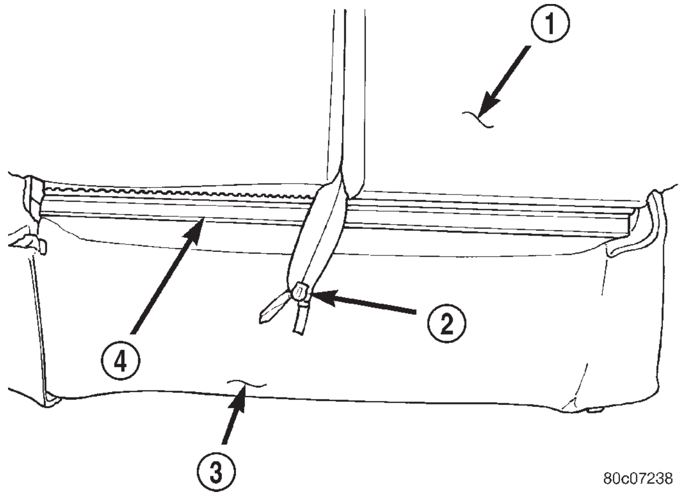

Fig. 15 Seat Back Cover

1 - SEAT BACK COVER
2 - HOOK AND LOOP FASTENER
3 - SEAT CUSHION
4 - J—STRAP

INSTALLATION - BENCH SEAT BACK PAD/COVER

(1) Position seat back pad/cover on the seat back frame.
(2) Engage outer, lower J-strap at base of seat back.
(3) Return seat to normal position.

INSTALLATION - BUCKET SEAT BACK PAD/COVER

(1) Position pad/cover on seat back frame.
(2) Position lumbar handle on lumbar adjuster and press into place.
(3) Engage hook and loop fastener on rear of seat back.
(4) Engage J-straps at base of seat back.
(5) If removed, install seat release handle on rear of seat back.
(6) Return seat to normal position.

SEAT CUSHION

REMOVAL

(1) Remove rear seat back
(2) Remove nuts attaching rear seat cushion hinge to cab back panel.
(3) Separate rear seat cushion from vehicle.

INSTALLATION

(1) Position rear seat cushion in vehicle.

SEAT CUSHION (Continued)

(2) Install nuts attaching rear seat cushion hinge to cab back panel.

(3) Install rear seat back.

SEAT CUSHION COVER

REMOVAL - BENCH SEAT CUSHION/COVER

(1) Remove seat from vehicle.

(2) Remove the bolts attaching the outer seat tracks to the cushion frame (Fig. 17).

(3) Remove push nuts from seat adjuster lever.

(4) Disengage the J-straps around the perimeter of the cushion.

(5) Route the seat belt/buckles through the access hole in the cushion cover.

(6) Remove the cushion/cover from the frame.

REMOVAL - BUCKET SEAT CUSHION/COVER

(1) Remove seat.

(2) Remove the anchor bolt attaching the buckle to the seat track (Fig. 16).

(3) Remove the screw attaching the recliner handle to the recliner mechanism.

(4) Disengage the rearward corner J-straps.

(5) Disengage the side J-straps.

(6) Disengage the front J-strap.

(7) Disengage the rear J-strap.

(8) Separate the cushion/cover from the frame.

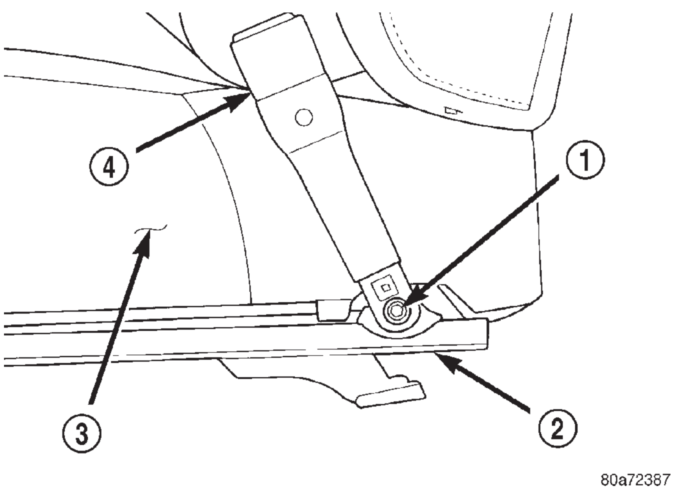

Fig. 16 Buckle Anchor Bolt

1 - ANCHOR BOLT
2 - SEAT TRACK
3 - SEAT CUSHION
4 - BUCKLE

REMOVAL - QUAD CAB REAR SEAT CUSHION COVER

(1) Remove rear seat.

(2) Disengage J strap from seat cushion.

(3) Remove cup holder, if equipped.

(4) Disengage hook and loop fasteners.

(5) Roll seat cushion cover off seat cushion.

INSTALLATION - BENCH SEAT CUSHION/ COVER

(1) Position the cushion/cover on the frame.

(2) Route the seat belt/buckles through the access hole in the cushion cover.

(3) Engage the J-straps around the perimeter of the cushion.

(4) Install the push nuts on the seat adjuster lever.

(5) Install the bolts attaching the outer seat tracks to the cushion frame. Tighten the bolts to 24 N·m (17 ft. lbs.).

(6) Install the seat.

INSTALLATION - BUCKET SEAT CUSHION/ COVER

(1) Position the cushion/cover on the frame.

(2) Engage the rear J-strap.

(3) Engage the front J-strap.

(4) Engage the side J-straps.

(5) Engage the rearward corner J-straps.

(6) Install the recliner handle.

(7) Install seat. Tighten the front seat track bolts to 22–34 N·m (16–25 ft. lbs.). Tighten the rear seat track bolts to 89–140 N·m (66–103 ft. lbs.).

(8) Install the anchor bolt attaching the buckle to the seat track. Tighten the bolt to 40 N·m (29 ft. lbs.).

INSTALLATION - QUAD CAB REAR SEAT CUSHION COVER

(1) Position cover on seat cushion.

(2) Roll cover onto cushion.

(3) Engage the hook and loop fasteners.

(4) Install the cup holder, if equipped.

(5) Engage the J strap.

(6) Install rear seat.

SEAT TRACK

REMOVAL - BENCH SEAT TRACK

(1) Remove seat from vehicle.

(2) Adjust the tracks as necessary to remove the bolts attaching the seat tracks to the cushion frame (Fig. 17).

(3) Remove the push nut from the seat adjuster lever.

(4) Separate the seat track from the frame.

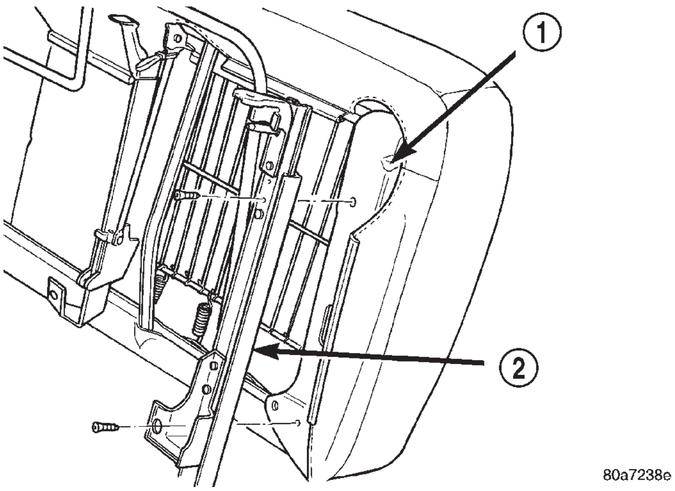

Fig. 17 Seat Track

1 - SEAT CUSHION FRAME
2 - SEAT TRACK

REMOVAL - BUCKET SEAT TRACK

(1) Remove seat.

(2) Adjust the seat track to gain access to the torx bolts attaching the seat track to the cushion frame.

(3) Remove the torx bolts (Fig. 18).

(4) Remove the push nuts from the seat lever adjuster.

(5) Separate the seat track from the frame.

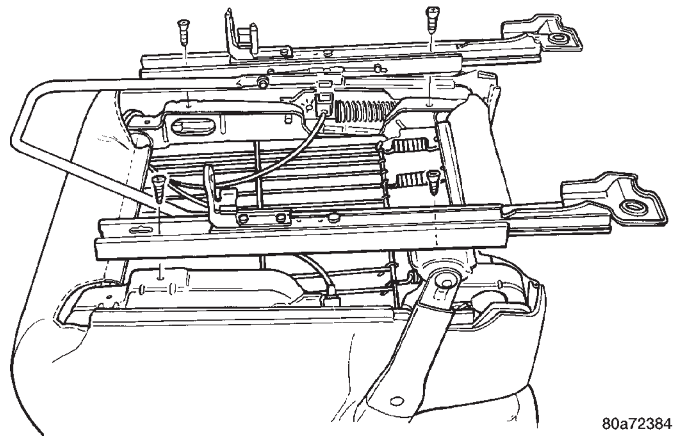

Fig. 18 Bucket Seat Track

INSTALLATION - BENCH SEAT TRACK

(1) Position the seat track on the frame.

(2) Install the push nut on the seat adjuster lever.

(3) Install the bolts attaching the seat tracks to the cushion frame. Tighten bolts to 24 N·m (17 ft. lbs.) torque.

(4) Install the seat.

INSTALLATION - BUCKET SEAT TRACK

(1) Position the seat track on the frame.

(2) Install the push nuts on the seat lever adjuster.

(3) Install the torx bolts attaching the seat track to the cushion frame. Tighten the bolts to 24 N·m (17 ft. lbs.) torque.

(4) Install seat.

STATIONARY GLASS

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STATIONARY GLASS

DESCRIPTION

Windshields are made of two pieces of glass with a plastic inner layer. Windshields and selected stationary glass are structural members of the vehicle. The windshield glass is bonded to the windshield frame with urethane adhesive.

OPERATION

Windshields and other stationary glass protect the occupants from the effects of the elements. Windshields are also used to retain some airbags in position during deployment. Urethane bonded glass is difficult to salvage during removal. The urethane bonding is difficult to cut or clean from any surface. Before removing the glass, check the availability of replacement components.

WINDSHIELD SAFETY PRECAUTIONS

WARNING: DO NOT OPERATE THE VEHICLE WITHIN 24 HOURS OF WINDSHIELD INSTALLATION. IT TAKES AT LEAST 24 HOURS FOR URETHANE ADHESIVE TO CURE. IF IT IS NOT CURED, THE WINDSHIELD MAY NOT PERFORM PROPERLY IN AN ACCIDENT.

- **URETHANE ADHESIVES ARE APPLIED AS A SYSTEM. USE GLASS CLEANER, GLASS PREP SOLVENT, GLASS PRIMER, PVC (VINYL) PRIMER AND PINCH WELD (FENCE) PRIMER PROVIDED BY THE ADHESIVE MANUFACTURER. IF NOT, STRUCTURAL INTEGRITY COULD BE COMPROMISED.**
- **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.

BACKLITE

REMOVAL

Review Safety Precautions and Warnings paragraph at the front of this section before removing glass.

(1) Remove B-pillar/quarter trim panels.
(2) Remove cab back panel trim.
(3) Bend backlite retaining tabs (Fig. 1) inward against glass.
(4) Using a long knife from inside the vehicle, cut urethane holding backlite frame to opening fence.
(5) Separate glass from vehicle.

BACKLITE (Continued)

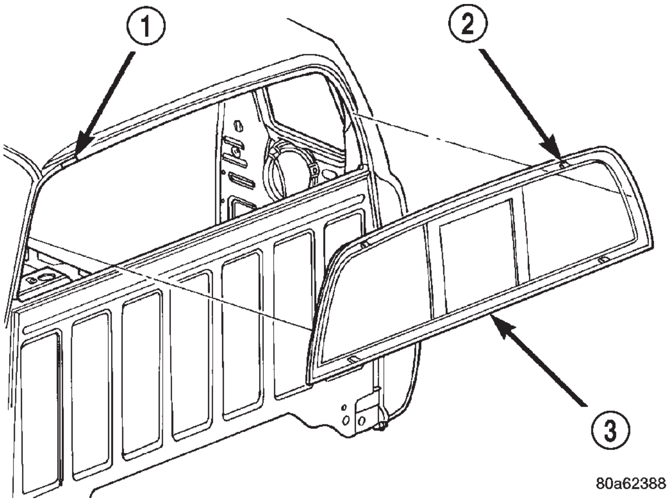

Fig. 1 Backlite

1 - URETHANE
2 - TAB
3 - BACKLITE

INSTALLATION—SLIDING BACKLITE

Review Safety Precautions and Warnings paragraph at the front of this section before removing glass.

(1) Trim urethane adhesive from around rear glass opening fence leaving 1–2 mm of urethane on fence.

(2) Apply RIM primer 25 mm (1 in.) wide to the mating surface of the backlite encapsulation.

(3) Apply Gurit-Essex® Betawipe 4000 25 mm (1 in.) wide to the mating surface of the backlite encapsulation.

(4) Apply blackout primer 25 mm (1 in.) wide to the mating surface of the backlite encapsulation.

(5) Apply pinchweld primer 25 mm (1 in.) wide to the backlite opening fence.

(6) Apply a 10 mm (0.4 in.) bead of urethane around perimeter of backlite along the inside of the encapsulation.

(7) Position backlite into backlite opening using alignment pins in lower corners.

(8) Firmly push glass against rear window glass opening fence.

(9) Bend tabs around edges of backlite opening fence to retain glass.

(10) Clean excess urethane from exterior with Mopar, Super Clean or equivalent.

(11) Install interior trim.

BACKLITE VENT GLASS

REMOVAL

(1) Open vent glass to full open position.

(2) Slide the upper run channel out of the window frame.

(3) Slide the vent glass upward to remove from the window frame.

INSTALLATION

(1) Slide the vent glass downward into window frame.

(2) Position the upper run channel into the window frame and slide it into place.

(3) Verify vent glass operation.

QUARTER WINDOW

REMOVAL

(1) Remove quarter trim panel.

(2) Remove the bolts attaching the latch to the cab side panel (Fig. 2).

(3) Remove the nuts attaching the frame/hinge to the B-pillar (Fig. 3).

(4) Remove the glass from the cab.

(5) If necessary, remove the latch from the glass.

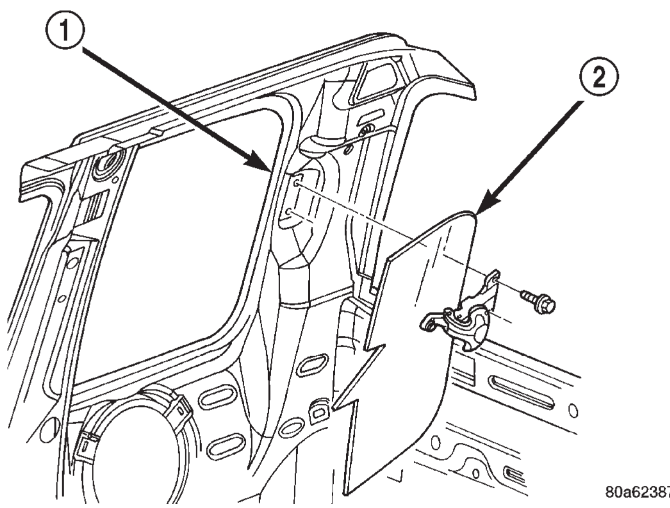

Fig. 2 Quarter

1 - CAB
2 - QUARTER GLASS

QUARTER WINDOW (Continued)

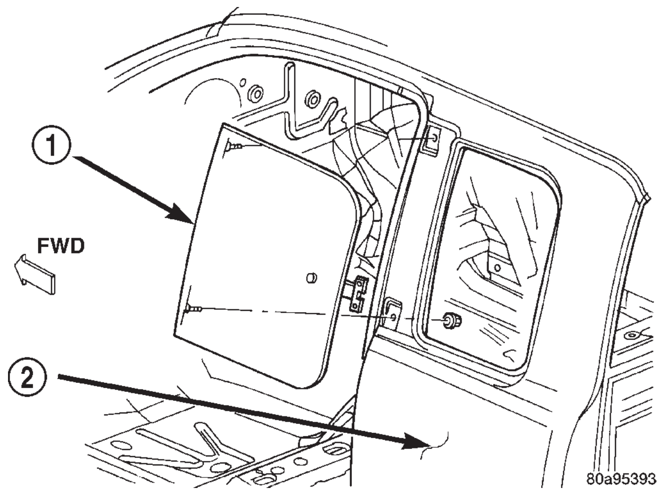

Fig. 3 Quarter Glass

1 - QUARTER GLASS
2 - QUARTER PANEL

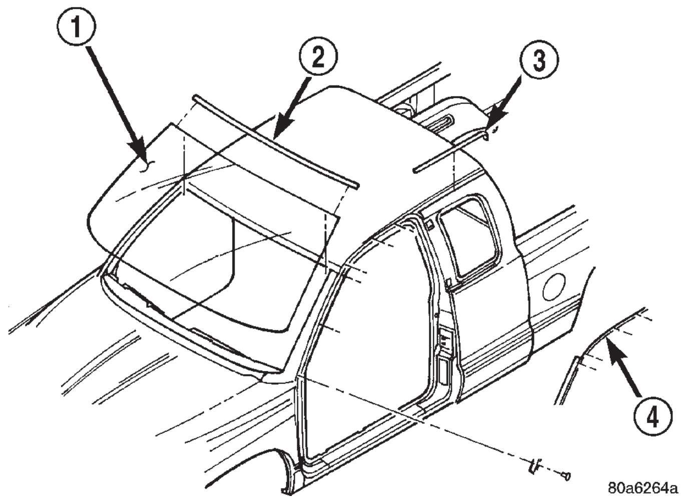

Fig. 4 Windshield Moldings

1 - WINDSHIELD
2 - WINDSHIELD MOLDING
3 - ROOF JOINT MOLDING
4 - WINDSHIELD MOLDING

INSTALLATION

(1) If removed, install the latch to the glass.

(2) Center the window glass at the opening, insert the hinge studs in the B-pillar holes, and install the nuts.

(3) Attach the latch to the rear side panel with the bolts. Tighten the bolts with the latch in the lock position and pushing rearward on the latch.

(4) Test the vent window for water leaks.

(5) Install quarter trim panel.

WINDSHIELD

REMOVAL

(1) Remove rear view mirror.

(2) Remove wipers and cowl grille.

(3) With doors open, remove the weatherstrip from the side windshield moldings.

(4) Remove the screws attaching the side windshield molding to the A-pillars (Fig. 4).

(5) Cut urethane bonding from around windshield using a suitable sharp cold knife (Fig. 5).

(6) Using a long knife, cut urethane bonding from inside the cab at the base of the windshield.

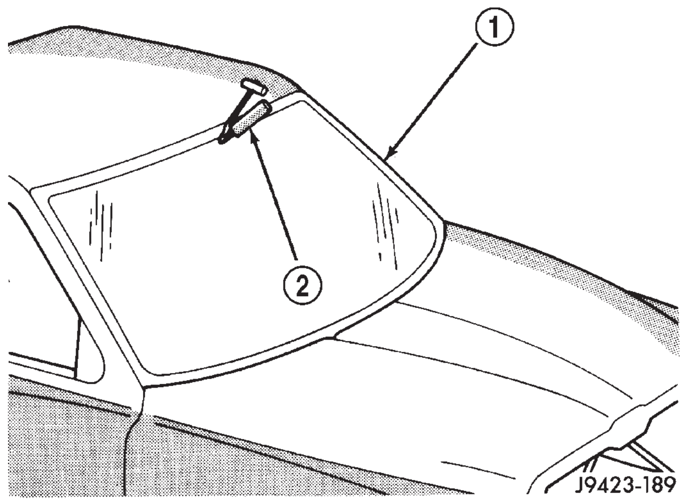

Fig. 5 Cut Urethane Around Windshield

1 - WINDSHIELD
2 - COLD KNIFE

WINDSHIELD (Continued)

INSTALLATION

WARNING: Allow the urethane at least 24 hours to cure before returning the vehicle to use.

CAUTION: Roll down the left and right front door glass and open the rear glass slider (if available) before installing windshield to avoid pressurizing the passenger compartment if a door is slammed before urethane is cured. Water leaks can result.

The windshield fence should be cleaned of most of its old urethane bonding material. A small amount of old urethane, approximately 1-2 mm in height, should remain on the fence. Do not grind off or completely remove all old urethane from the fence, the paint finish and bonding strength will be adversely affected. Support spacers located on the cowl at the bottom of the windshield opening (Fig. 6) should be replaced with new parts. Replace any missing or damaged spacers around the perimeter of the windshield opening.

(1) Place replacement windshield into windshield opening and position glass in the center of the opening against the support spacers. Mark the glass at the support spacers with a grease pencil or pieces of masking tape and ink pen to use as a reference for installation. Remove replacement windshield from windshield opening (Fig. 7).

(2) Position the windshield inside up on a suitable work surface with two padded, wood 10 cm by 10 cm by 50 cm (4 in. by 4 in. by 20 in.) blocks, placed parallel 75 cm (2.5 ft.) apart (Fig. 8).

(3) Clean inside of windshield with MOPAR Glass Cleaner and lint-free cloth.

(4) Apply clear glass primer 25 mm (1 in.) wide around perimeter of windshield and wipe with a new clean and dry lint- free cloth.

(5) Apply the header molding to the windshield.

(6) Apply pinchweld primer 15 mm (.75 in.) wide around the windshield fence. Allow at least three minutes drying time.

(7) Apply a 13mm (1/2 in.) high and 10mm (3/8 in.) wide bead of urethane around the perimeter of windshield. At the bottom, apply the bead 7 mm (1/4 in.) inboard from the glass edge. On the three sides where the molding is on the glass, follow the edge of molding. The urethane bead should be shaped in a triangular cross-section, this can be achieved by notching the tip of the applicator (Fig. 9).

(8) With the aid of a helper, position the windshield over the windshield opening. Align the reference marks at the bottom of the windshield to the support spacers.

(9) Slowly lower windshield glass to the fence opening guiding the lower corners into proper position. Beginning at the bottom and continuing to the top, push glass onto fence along the A-Pillars. Push windshield inward to the fence at the bottom corners.

(10) Clean excess urethane from exterior with MOPAR Super Clean or equivalent.

(11) Apply 150 mm (6 in.) lengths of 50 mm (2 in.) masking tape spaced 250 mm (10 in.) apart to hold molding in place until urethane cures.

(12) Install **new** screws attaching the side windshield moldings to the A-pillars.

(13) Install the weatherstrip onto side windshield moldings.

WINDSHIELD (Continued)

(14) Install cowl grille and wipers.

(15) Install rear view mirror.

(16) After urethane has cured, remove tape strips and water test windshield to verify repair.

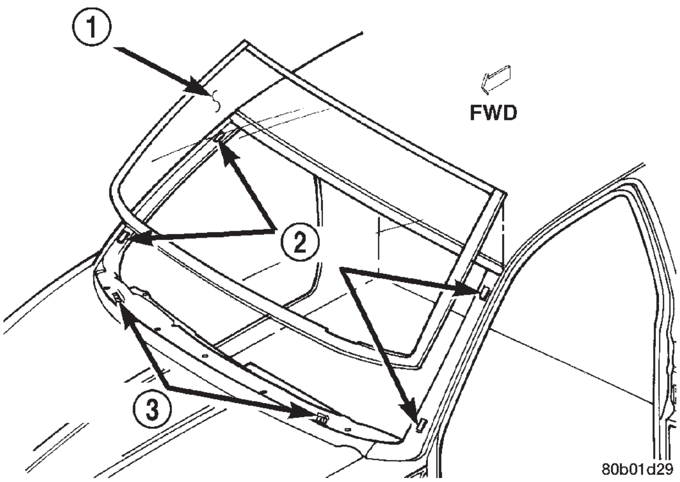

Fig. 6 Support Spacers

1 - WINDSHIELD
2 - SPACERS
3 - SUPPORTS

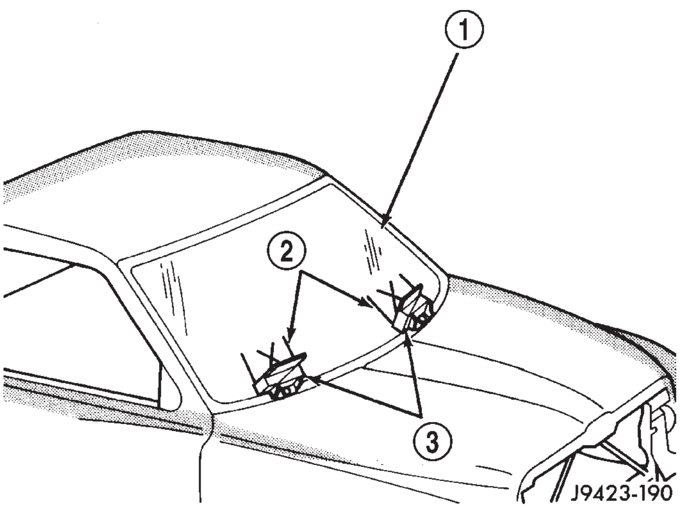

Fig. 7 Center Windshield and Mark at Support Spacers

1 - WINDSHIELD
2 - INDEX MARKS
3 - SUPPORT SPACERS

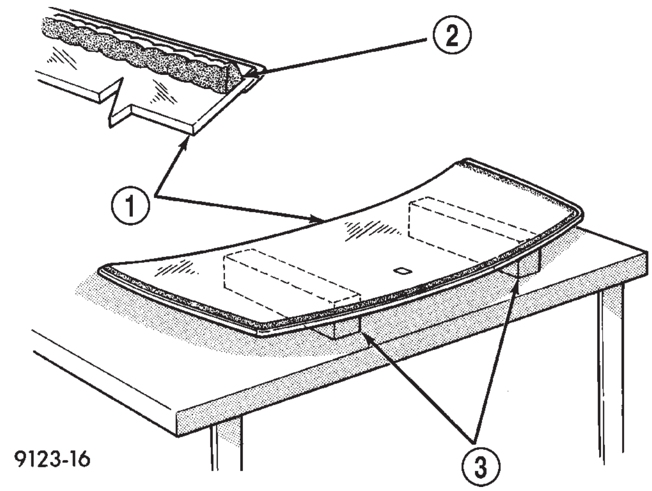

Fig. 8 Work Surface Set up and Molding Installation

1 - WINDSHIELD AND MOULDINGS
2 - URETHANE BEAD AROUND GLASS 7mm (.3 in.) FROM EDGE
3 - BLOCKS

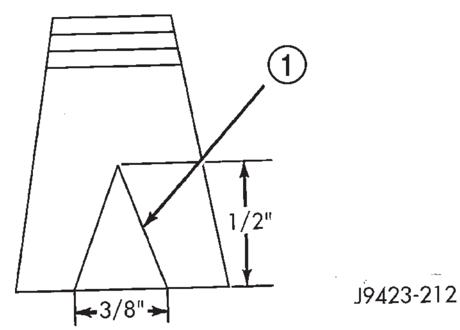

Fig. 9 Applicator Tip

1 - APPLICATOR TIP

WEATHERSTRIP/SEALS

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WEATHERSTRIP/SEALS

REMOVAL

(1) Remove push-in fasteners attaching hood seal to inner hood panel (Fig. 1).

(2) Separate hood seal from vehicle.

INSTALLATION

(1) Position hood seal on inner hood panel.

(2) Install push-in fasteners attaching hood seal to inner hood panel.

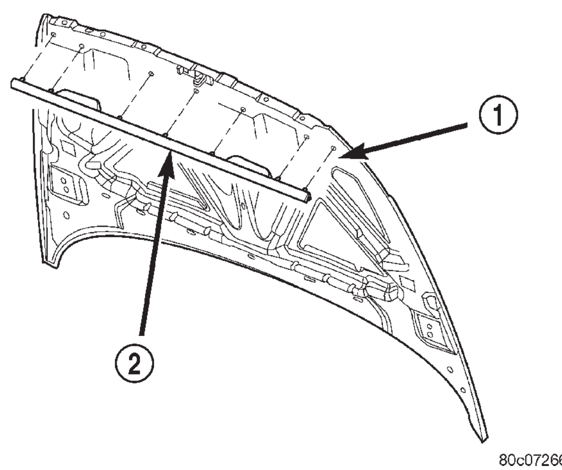

Fig. 1 Hood Seal

1 - INNER HOOD PANEL
2 - HOOD PANEL

CARGO BOX SEAL

REMOVAL

(1) From under the vehicle, use a trim panel removal tool and remove the push-in fasteners attaching the cargo box seal to the cargo box (Fig. 2).

(2) Separate the seal from the cargo box.

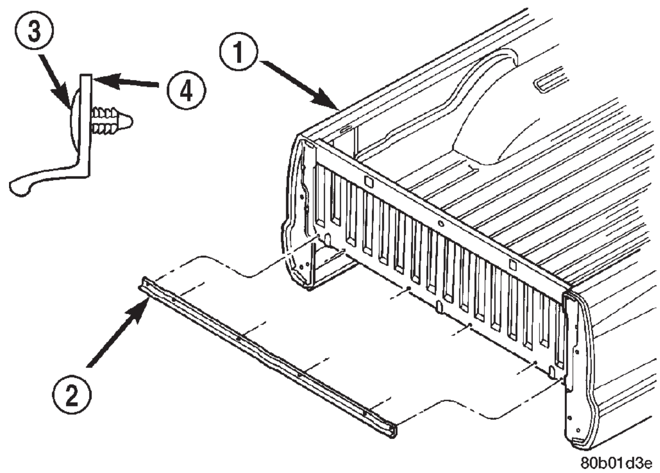

Fig. 2 Cargo Box Seal

1 - CARGO BOX
2 - BOX SEAL
3 - PUSH-IN FASTENER
4 - CARGO BOX SEAL

INSTALLATION

(1) Position the seal on the cargo box

(2) Install the push-in fasteners attaching the cargo box seal to the cargo box (Fig. 2).

COWL WEATHERSTRIP

REMOVAL

(1) Grasp cowl seal and pull seal from flange (Fig. 3).

(2) Separate cowl seal from vehicle.

INSTALLATION

(1) Position cowl seal on flange and press into place.

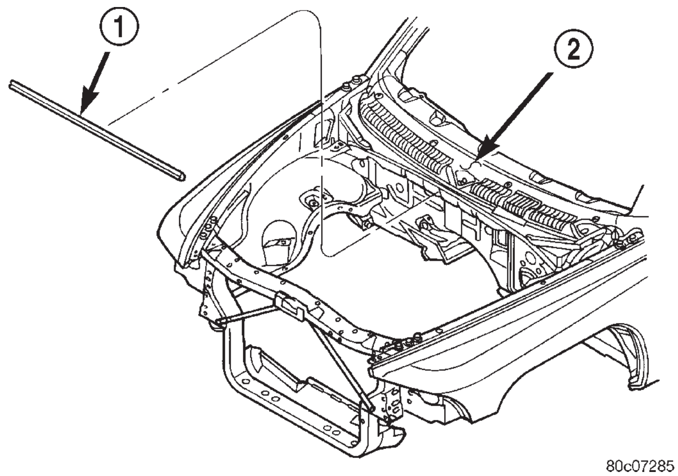

Fig. 3 Cowl Seal

1 - COWL TO HOOD SEAL
2 - COWL

FRONT DOOR GLASS RUN WEATHERSTRIP

REMOVAL

(1) Remove door trim panel.

(2) Remove water dam as necessary to access lower glass run channels.

(3) Remove the bolts attaching the glass run channels.

(4) Remove glass.

(5) Pull the glass run weatherstrip and run channels from the window opening (Fig. 4).

(6) Pull the glass run weatherstrip from the run channels.

INSTALLATION

(1) Install the glass run weatherstrip in the run channels.

(2) Install the glass run weatherstrip in the window opening.

(3) Position the run channels in the door.

(4) Install glass.

(5) Install the glass run channels.

(6) Install inner belt weatherstrip.

(7) Install outer belt weatherstrip.

(8) Install door trim panel.

FRONT DOOR INNER BELT WEATHERSTRIP

REMOVAL

(1) Remove screws attaching trim panel to door.
(2) Lift trim panel up and over inner belt seal.
(3) Peel seal from door (Fig. 4).

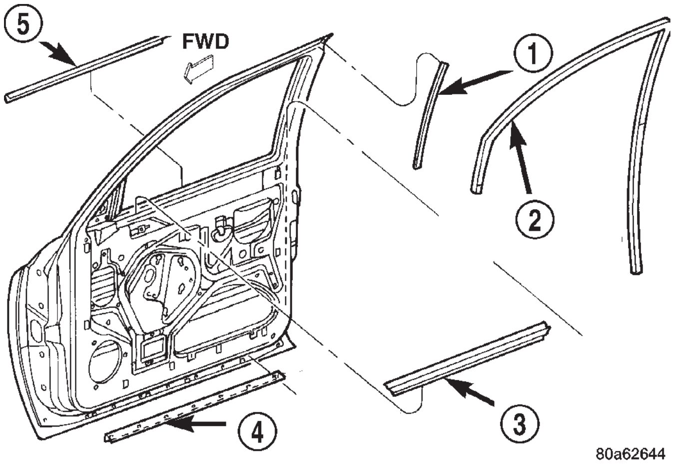

Fig. 4 Front Door Weatherstrip/Seals

1 - B-PILLAR SECONDARY SEAL
2 - GLASS RUN WEATHERSTRIP
3 - INNER BELT WEATHERSTRIP
4 - SECONDARY SEAL
5 - OUTER BELT WEATHERSTRIP

INSTALLATION

(1) Slide seal into position on door.
(2) Position trim panel over inner belt seal and install screws.

FRONT DOOR OUTER BELT WEATHERSTRIP

REMOVAL

(1) Lower glass.
(2) Lift rearward corner of weatherstrip and slide weatherstrip rearward (Fig. 4).

INSTALLATION

(1) Lightly lubricate weatherstrip with silicone and slide weatherstrip behind mirror.
(2) Push weatherstrip down to seat onto door.

FRONT DOOR 2ND WEATHERSTRIP

REMOVAL

The secondary seal is attached with two sided adhesive tape.
(1) Separate the secondary seal and the tape from the inner door panel (Fig. 4).

FRONT DOOR WEATHERSTRIP

REMOVAL

(1) Remove A-pillar trim.
(2) Remove cowl panel and sill cover.
(3) Remove upper turning loop anchor bolt.
(4) Pull B-pillar trim/quarter panel trim outward to access weatherstrip.
(5) Pull weatherstrip from pinch flange around door opening (Fig. 5).

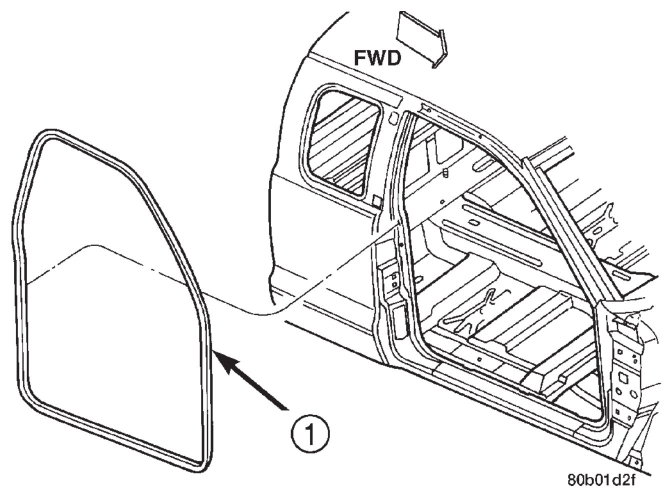

Fig. 5 Door Seal

1 - DOOR SEAL

INSTALLATION

(1) Position the weatherstrip on the pinch flange around door opening and press into place.
(2) Press into place B-pillar trim/quarter panel trim.
(3) Install upper turning loop anchor bolt.
(4) Install cowl panel and sill cover. Ensure the clips attaching the sill cover to the door sill are fully seated.
(5) Install A-pillar trim.

QUARTER VENT GLASS WEATHERSTRIP

REMOVAL

(1) Remove the quarter window. If necessary, refer to the removal procedure.

(2) Pull the seal away from the flange around the perimeter of the window opening (Fig. 6).

(3) Clean the flange as necessary.

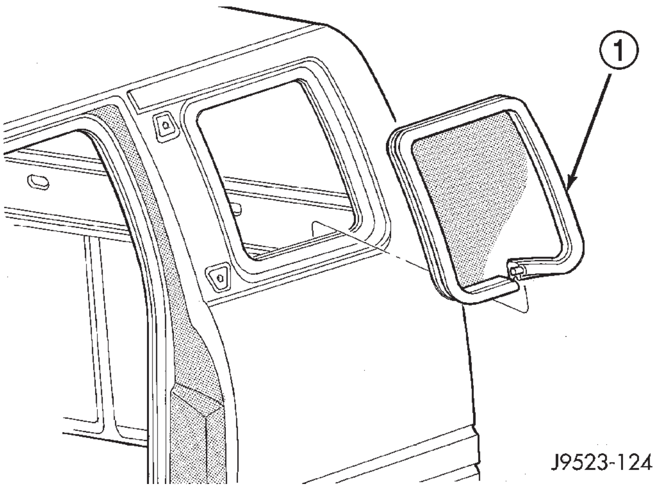

Fig. 6 Quarter Vent Weatherstrip

1 - QUARTER GLASS SEAL

INSTALLATION

(1) Center and butt the seal ends together at the bottom, centerline of the opening.

(2) Mate the seal with the bottom flange.

(3) Mate the seal with the front, vertical flange.

(4) Move upward and mate the seal with the top flange.

(5) Mate the seal with the rear, vertical flange.

(6) Install the quarter window.

REAR DOOR GLASS RUN WEATHERSTRIP

REMOVAL

(1) Remove trim panel.

(2) Remove inner beltline weatherstrip.

(3) Remove outer beltline weatherstrip.

(4) Pull weatherstrip from door frame and divider bar channel (Fig. 7).

INSTALLATION

(1) Position weatherstrip in door frame and divider bar channel.

(2) Install outer beltline weatherstrip.

(3) Install inner beltline weatherstrip.

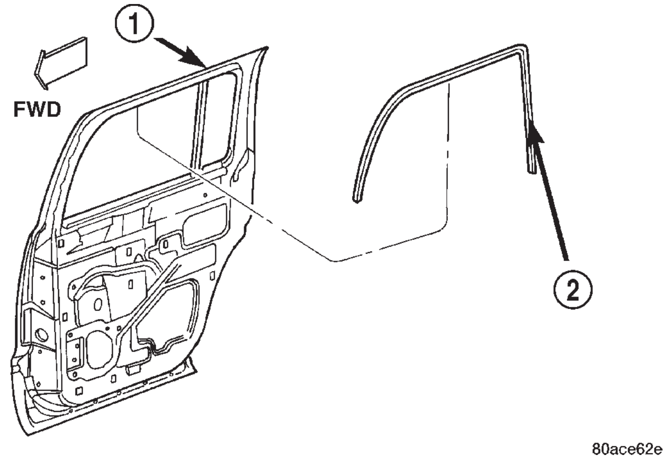

Fig. 7 Glass Run Weatherstrip

1 - REAR DOOR
2 - GLASS RUN WEATHERSTRIP

(4) Install trim panel.

REAR DOOR INNER BELT WEATHERSTRIP

REMOVAL

(1) Remove trim panel.

(2) Pull weatherstrip from inner door panel (Fig. 8).

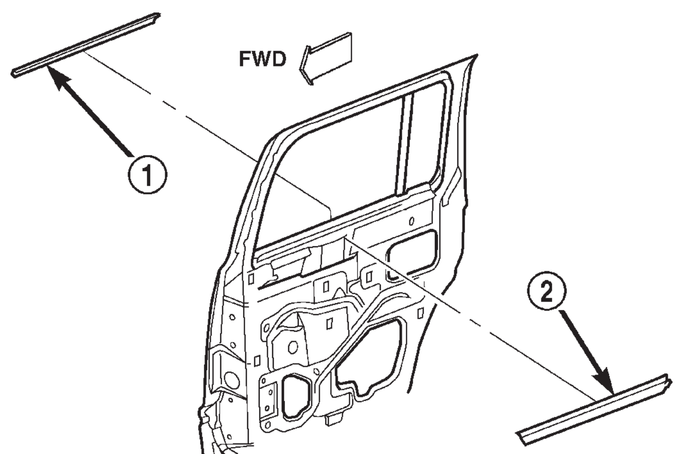

Fig. 8 Inner/Outer Belt Weatherstrip

1 - OUTER BELT WEATHERSTRIP
2 - INNER BELT WEATHERSTRIP

INSTALLATION

(1) Position weatherstrip on inner door panel (Fig. 8).

(2) Press into place.

(3) Install trim panel.

REAR DOOR OUTER BELT WEATHERSTRIP

REMOVAL

(1) Lower glass.

(2) Lift corner of weatherstrip upward and remove weatherstrip from outer door panel.

INSTALLATION

(1) Position weatherstrip on outer door panel.

(2) Press into place.

(3) Raise glass.

REAR DOOR SECONDARY WEATHERSTRIP

REMOVAL

(1) Separate the secondary seal from the inner door panel (Fig. 9).

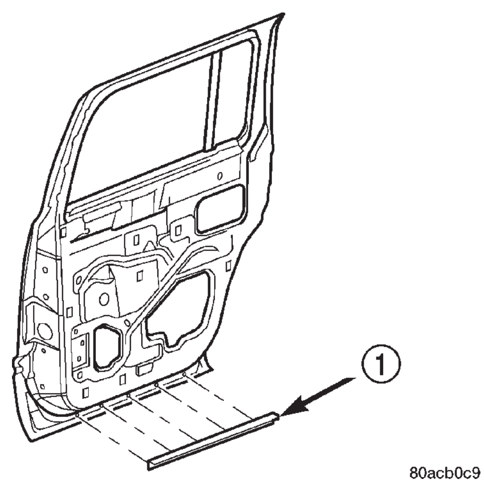

Fig. 9 Rear Door Secondary Seal

1 - REAR DOOR SILL SECONDARY SEAL

INSTALLATION

(1) Thoroughly clean the area of old adhesive. Use Mopar Super Kleen or equivalent.

(2) Position the secondary seal on the inner door panel.

REAR DOOR WEATHERSTRIP

REMOVAL

(1) Remove door sill trim.

(2) Loosen upper and lower B-pillar trim to access weatherstrip.

(3) Remove C-pillar trim.

(4) Pull quarter panel trim outward to access weatherstrip.

(5) Pull weatherstrip from pinch flange around door opening.

INSTALLATION

(1) Clean pinch flange

(2) Position the weatherstrip on the pinch flange around door opening and press into place.

(3) Install quarter panel trim.

(4) Install C-pillar trim.

(5) Install B-pillar trim.

(6) Install door sill trim. Ensure the clips attaching the sill trim to the door sill are fully seated.

(7) Install A-pillar trim.

ROOF RAIL WEATHERSTRIP/ RETAINER

REMOVAL

(1) Release door latch and open door.

(2) The rearward corner of the weatherstip is adhesively attached to the body. Peel back the corner of the weatherstrip to release it from the body.

(3) Pull weatherstrip from retainer.

(4) Remove screws attaching retainer to roof rail (Fig. 10).

(5) Separate retainer from vehicle.

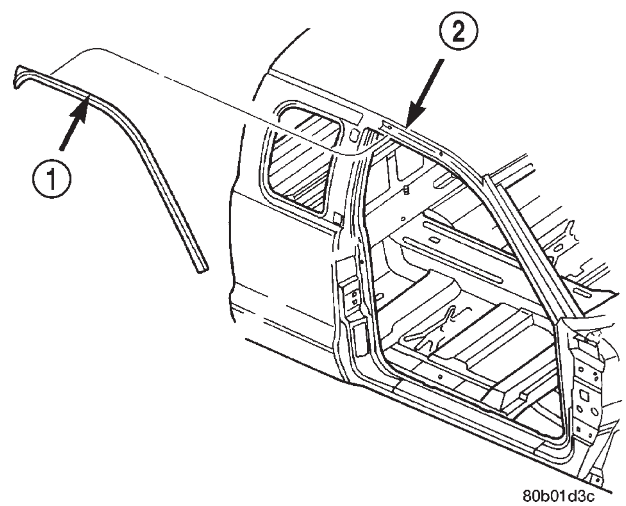

Fig. 10 Roof Rail Weatherstrip/Retainer

1 - ROOF RAIL WEATHERSTRIP

2 - RETAINER

INSTALLATION

NOTE: The screws attaching the retainer to the roof are coated with wax to prevent water leakage. If the retainer has been removed from the roof, replace the screws.

(1) Ensure the area where tape secures the weatherstrip is clean. Use Mopar Super Clean or equivalent.

(2) Position retainer on vehicle.

(3) Install screws attaching retainer to roof rail.

(4) Starting at the forward end of retainer, push weatherstrip on until seated.

(5) Peel the backing from the rearward end of the weatherstrip and press to secure.

HEATING & AIR CONDITIONING

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HEATING & AIR CONDITIONING

DESCRIPTION - COOLING SYSTEM REQUIREMENTS

To maintain the performance level of the HVAC 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 Cooling for more information before the opening of, or attempting any service to the engine cooling system.

DESCRIPTION - REFRIGERANT SYSTEM SERVICE PORTS

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.

OPERATION - REFRIGERANT SYSTEM SERVICE PORTS

The high pressure service port is located on the liquid line between the condenser and the evaporator, near the front of the engine compartment. The low pressure service port is located on the compressor manifold, directly over the suction port of the compressor, for 5.9L Engine. It is on the suction line between the compressor and the evaporator for the 4.7L engine.

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.

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 HVAC 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 tubes 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 (Max-A/C). 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

HEATING & AIR CONDITIONING (Continued)

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.

Before proceeding, (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) and (Refer to 24 - HEATING & AIR CONDITIONING/ PLUMBING - CAUTION). The air temperature in the test room and in the vehicle must be a minimum of 21° C (70° F) for this test. Also the fin probe (located in the evaporator of the HVAC unit) must be a minimum of 65° for this test as well.

(1) Connect a tachometer and a manifold gauge set.

(2) Set the a/c heater control to the recirculation mode (Max-A/C) position, the temperature control knob in the full cool position, and the blower motor switch knob in the highest speed position.

(3) Start the engine and hold the idle at 1,000 rpm with the compressor clutch engaged. If the compressor does not engage, see the A/C Diagnosis chart in the Diagnosis and Testing section of this group.

(4) The engine should be at operating temperature. The doors and windows must be closed.

(5) Insert a thermometer in the driver side center A/C (panel) outlet. Operate the a/c system until it stabslizes.

(6) With the compressor clutch engaged, record the discharge air temperature, the condenser out pressure (high side), and the compressor inlet pressure (low side). The compressor clutch may cycle, depending upon the ambient temperature and humidity. If the clutch cycles, use the readings obtained before the clutch disengaged.

(7) Compare the discharge air temperature reading to the Performance Temperature and Pressure chart. If the temperature reading is high, clamp off both heater hoses (inlet and outlet), wait five minutes and record the temperature again. Compare the second reading to the Performance Temperature and Pressure chart. If the temperature reading is now OK, see A/C Diagnosis chart for normal pressures. Or see A/C Performance Test if air temperatures are too high,

(8) Compare the discharge (high side) and suction (low side) pressure readings to the Performance Temperature and Pressure chart. If the pressures are abnormal, see (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - DIAGNOSIS AND TESTING - REFRIGERANT SYSTEM LEAKS) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE).

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)
Maximum Allowable Air Temperature at Center Panel Outlet	7°C (45°F)	7°C (45°F)	13°C (55°F)	13°C (55°F)	18°C (64°F)
Compressor Inlet Pressure at Service Port (Low Side)	138 to 207 kPa (20 to 30 psi)	172 to 241 kPa (25 to 35 psi)	207 to 276 kPa (30 to 40 psi)	241 to 310 kPa (35 to 45 psi)	276 to 345 kPa (40 to 50 psi)
Condensor Out Pressure at Service Port (High Side)	1034 to 1724 kPa (150 to 250 psi)	1379 to 2068 kPa (200 to 300 psi)	1724 to 2413 kPa (250 to 350 psi)	1999 to 2689 kPa (290 to 390 psi)	2413 to 2965 kPa (350 to 430 psi)

(9) Compare the compressor discharge and suction (evaporator inlet) pressure readings to the Performance Temperature and Pressure chart. If the compressor discharge pressure or suction pressure is not normal, see the Pressure Diagnosis chart.

HEATING & AIR CONDITIONING (Continued)

A/C 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 the Diagnosis and Testing section of this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required.
	2. Faulty Evaporator.	2. See Evaporator Temperature Sensor in the Diagnosis and Testing section of this group. Test the Evaporator Temperature Sensor.
	3. Faulty Powertrain Control Module (PCM)	3. Refer to the proper Diagnosis Procedurers manual for testing of the PCM. Test the PCM and replace, if required.
	4. Faulty Pressure Transducer	4. See Pressure Transducer Diagnosis and Testing in this section.
	5. Faulty Loss of Charge Pressure Switch	5. See Loss of Charge Pressure Switch Diagnosis and Testing in this section
Equal pressures, but the compressor clutch does not engage.	1. No refrigerant in the refrigerant system.	1. (Refer to Plumbing/Diagnosis and Testing - 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 junction block. Repair the shorted circuit or component and replace the fuses, if required.
	3. Faulty a/c compressor clutch coil.	3. (Refer to Controls/A/C Compressor Clutch Coil/Diagnosis and Testing) in this group. Test the compressor clutch coil and replace, if required.
	4. Faulty a/c compressor clutch relay.	4. (Refer to Controls/A/C Compressor Clutch Relay/Diagnosis and Testing) in this group. Test the compressor clutch relay and relay circuits. Repair the circuits or replace the relay, if required.
	5. Faulty evaporator temperature sensor.	5. (Refer to Controls/A/C Low Pressure Switch/Diagnosis and Testing) in this group. Test the a/c low pressure switch and tighten or replace, if required.
	6. Faulty loss of charge pressure switch.	6. (Refer to Controls/A/C Pressure Transducer/ Diagnosis and Testing) in this group. Test the a/c pressure transducer and replace, if required.
	7. Faulty Power Train Control Module.	7. (Refer to Appropriate Diagnostic Information) for testing of the PCM. Test the PCM and replace, if required.
	8. Faulty pressure transducer.	8. Refer to Diagnosis and Testing Faulty Pressure Transducer in the section.
	9. Faulty heater-A/C control.	9. Refer to Faulty heater-A/C Control in this section.

HEATING & AIR CONDITIONING (Continued)

A/C Diagnosis		
Condition	Possible Causes	Correction
Normal pressures, but A/C Performance Test air temperatures at center panel outlet are too high.	1. Excessive refrigerant oil in system.	1. (Refer to Plumbing/Refrigerant Oil/Standard Procedure/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. Blend door actuator inoperative or faulty.	2. Check the Blend Door Actuator operation. Replace as required.
	3. Blend door inoperative or sealing improperly.	3. (Refer to Distribution/Blend Door/Removal/ Installation) in this group. Inspect the blend door for proper operation and sealing and correct, if required.
	4. Faulty evaporator.	4. Refer to evaporator section.
The low side pressure is normal or slightly low, and the high side pressure is too low.	1. Low refrigerant system charge.	1. (Refer to Plumbing/Diagnosis and Testing - 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. (Refer to Plumbing/Accumulator/Removal/ Installation in this group. Replace the restricted accumulator, if required.
	3. Refrigerant flow through the a/c evaporator is restricted.	3. (Refer to Plumbing/A/C Evaporator/Removal/ Installation in this group. Replace the restricted a/c orator, if required.
	4. Faulty a/c compressor.	4. (Refer to Plumbing/A/C Compressor/Removal/ Installation in this group. Replace the a/c compressor, if required.
The low side pressure is normal or slightly high, and the high side pressure is too high.	1. A/C condenser air flow restricted.	1. Check the a/c condenser for damaged fins, foreign objects obstructing air flow through the condenser fins, and missing or improperly installed air seals. Refer to Cooling for more information on air seals. Clean, repair, or replace components as required.
	2. Inoperative cooling fan.	2. Refer to Cooling for more information. Test the cooling fan and replace, if required.
	3. Refrigerant system overcharged.	3. (Refer to Plumbing/Standard Procedure - igerant 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. (Refer to Plumbing/Diagnosis and Testing - 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. Refer to Cooling for more information. Test the cooling system and repair, if required.
	6. Faulty orifice tube.	6. Refer to orifice tube section.

HEATING & AIR CONDITIONING (Continued)

A/C Diagnosis		
Condition	Possible Causes	Correction
The low side pressure is too high, and the high side pressure is too low.	1. Accessory drive belt slipping.	1. Refer to Cooling for more information. Inspect the accessory drive belt condition and tension. Tighten or replace the accessory drive belt, if required.
	2. A/C orifice tube not installed.	2. (Refer to Plumbing/A/C Orifice Tube) in this group. Install the missing fixed orifice tube, if required.
	3. Faulty a/c compressor.	3. (Refer to Plumbing/A/C Compressor/Removal/ Installation 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. (Refer to Plumbing/Caution - Refrigerant Hoses/Lines/Tubes Precaution) 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 a/c orifice tube.	2. (Refer to Plumbing/A/C Orifice Tube) in this group. Replace the restricted fixed orifice tube, if required.
	3. Restricted refrigerant flow through the a/c condenser.	3. (Refer to Plumbing/A/C Condenser) in this group. Replace the restricted a/c condenser, if required.
	4. Restricted Filter Drier.	4. See Filter-Drier in the Removal and Installation section of the group. Replace the restricted Filter-Drier, if required.

DIAGNOSIS AND TESTING - HEATER PERFORMANCE

Before performing the following tests, refer to Group 7 – Cooling System for the procedures to check the engine coolant level and flow, engine coolant reserve/recovery system operation, accessory drive belt condition and tension, radiator air flow and the fan drive operation.

MAXIMUM HEATER OUTPUT

Engine coolant is delivered to the heater core through two heater hoses. With the engine idling at normal operating temperature, set the temperature control knob in the full hot position, the mode control switch knob in the floor position, and the blower motor switch knob in the highest speed position. Using a test thermometer, check the temperature of the air being discharged at the HVAC 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	52.2° C (126° F)	56.1° C (133° F)	59.4° C (139° F)	62.2° C (144° F)

HEATING & AIR CONDITIONING (Continued)

If the floor outlet air temperature is too low, refer to Cooling to check the engine coolant temperature specifications. Both of the heater hoses should be hot to the touch. The coolant return heater hose should be slightly cooler than the coolant supply heater hose. If the return hose is much cooler than the supply hose, locate and repair the engine coolant flow obstruction in the cooling system. Refer to Cooling for the procedures.

OBSTRUCTED COOLANT FLOW

Possible locations or causes of obstructed coolant flow:

- Faulty water pump.
- Faulty thermostat.
- 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:

- A faulty blower system.
- A faulty heater-A/C control.
- An obstructed cowl air intake.
- Obstructed heater system outlets.
- A faulty, obstructed or improperly installed blend-air door or actuator.

TEMPERATURE CONTROL

If the heater outlet air temperature cannot be adjusted with the temperature control knob on the a/c heater control panel, the following could require service:

- The a/c heater control.
- A faulty blend door actuator.
- The blend door.
- Improper engine coolant temperature.
- Obstructed cowl air intake.

Heater Diagnosis

CONDITION	POSSIBLE CAUSE	CORRECTION
INSUFFICIENT HEATER OUTPUT.	1. Incorrect engine coolant level.	1. Check the engine coolant level. Refer to Group 7 - Cooling System for the procedures.
	2. Air trapped in engine cooling system.	2. Check the operation of the coolant reserve/recovery system. Refer to Group 7 - Cooling System for the procedures.
	3. Incorrect engine coolant temperature.	3. Check the performance and operation of the engine cooling system including: thermostat, water pump, fan drive, accessory drive belt, coolant flow (plugged radiator or heater core, plugged or kinked coolant hoses), air flow (missing or improperly installed radiator air seals or fan shroud). Refer to Group 7 - Cooling System for the procedures.
	4. Blend air door actuator not operating properly.	4. See Blend Door Actuator in the Removal and Installation and in the Adjustments sections of this group.
	5. Blend-air door not operating properly.	5. Check for a damaged, obstructed or improperly installed blend-air door or seals. See Heater-A/C Housing Door in the Removal and Installation section of this group.
	6. Insufficient air flow through heater housing.	6. Remove foreign material or obstructions from cowl air intake.
	7. Improper blower motor operation.	7. See Blower Motor in the Diagnosis and Testing section of this group.
	8. Improper electric coolant pump operation.	8. See electric coolant pump section of this group.

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 PSE or an automotive service equipment supplier for refrigerant recovery/recycling/charging equipment. Refer to the operating instructions supplied by the equipment manufacturer for the proper care and use of this equipment.

A manifold gauge set may be needed with some recovery/recycling/charging equipment (Fig. 1). 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.

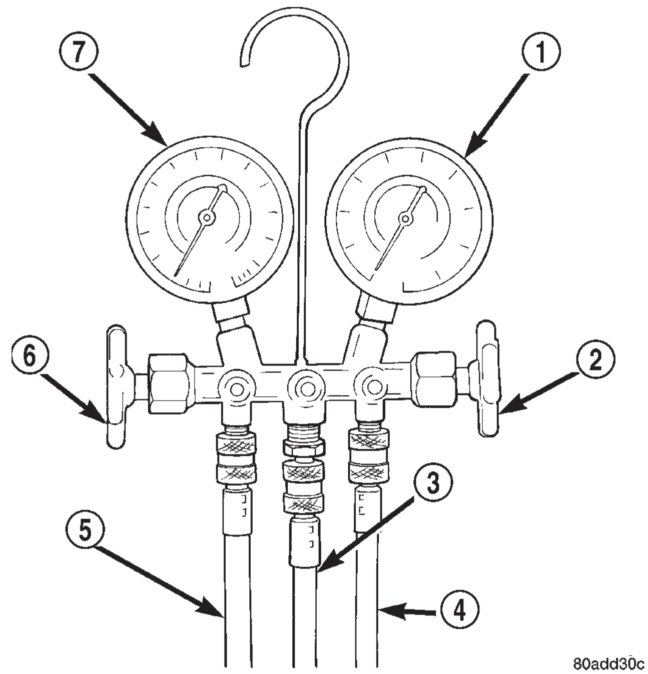

Fig. 1 Manifold Gauge Set - Typical

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 compressor manifold, directly over the suction port of the compressor.

HIGH PRESSURE GAUGE HOSE

The high pressure hose (Red with Black stripe) attaches to the discharge service port. This port is located on the liquid line between the condenser and the evaporator, near the front of the engine compartment.

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.

HEATING & AIR CONDITIONING (Continued)

SPECIFICATIONS

A/C APPLICATION TABLE

Item	Description	Notes
VEHICLE	AN Dakota	
SYSTEM	R134a w/ fixed orifice tube	0.057″orifice tube
COMPRESSOR	Sanden SD7H15	SP-20 PAG oil
Freeze–up Control	2-wire evaporator temperature sensor	
Loss of refrigerent charge	a/c low pressure switch opens < 7-13 psi - resets > 15-25 psi	accumulator mounted
Pressure transducer	450 psi (cut-out) 290 psi (cut-in)	Liquid line mounted
CONTROL HEAD	manual type and electric	
Mode Door	electric	
Blend Door	electric	
Recirculation Door	electric	

Item	Description	Notes
Blower Motor	hardwired to control head	″credit card″ resistor block
COOLING FAN	V-6 & V-8 electrical/ mechanical cooling fan module, I-4 (2.5) electric fan	Relay
CLUTCH	Electro-magnetic	
Control	relay	PCM
Draw	2.0 - 3.9 amps @ 12 V	± 0.5V @ 70° F
Gap	0.016″ - 0.031″	
DRB III®		
Reads	TPS, RPM, A/C stransducer pressure	
Actuators	clutch relay (fan relay 2.5 only), actuator doors	

SPECIFICATIONS

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Compressor Mounting Bolts	41	30	363
Intermediate Shaft Coupler Pinch Bolt	13.5	10	120
H-block Retaining Bolts	18	13	159
Refrigerant Lines at Compressor	23	17	200 ±30
Condenser Mounting Bolts	10.7	8	95
Low Pressure Cycling Switch: Hand Tighten Only	n/a	n/a	n/a

CONTROLS

TABLE OF CONTENTS

A/C COMPRESSOR HIGH PRESSURE RELIEF VALVE

DESCRIPTION

A high pressure relief valve is located on the compressor cylinder head, which is at the rear of the compressor. This mechanical valve is designed to vent refrigerant from the system to protect against damage to the compressor and other system components, caused by condenser air flow restriction or an overcharge of refrigerant.

A/C COMPRESSOR HIGH PRESSURE RELIEF VALVE (Continued)

OPERATION

The high pressure relief valve vents the system when a discharge pressure of 3445 to 4135 kPa (500 to 600 psi) or above is reached. The valve closes with 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 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.

A/C COMPRESSOR CLUTCH

DESCRIPTION

The compressor clutch assembly consists of a stationary electromagnetic coil, a hub bearing and pulley assembly, and a clutch plate (Fig. 1). 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 mounted to the compressor shaft and secured with a nut.

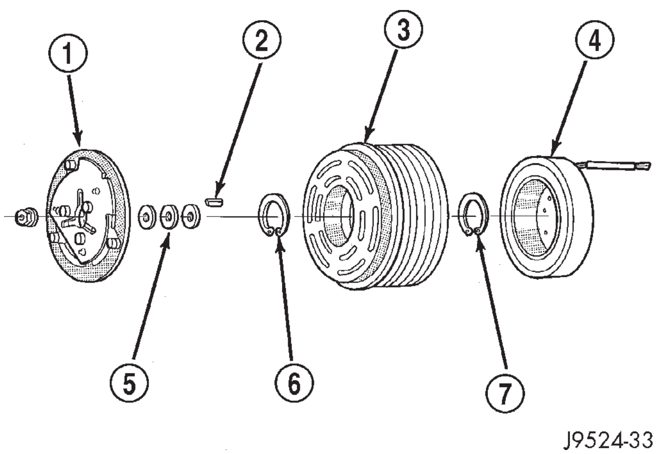

Fig. 1 COMPRESSOR CLUTCH - TYPICAL

1 - CLUTCH PLATE
2 - SHAFT KEY
3 - PULLEY
4 - COIL
5 - CLUTCH SHIMS
6 - SNAP RING
7 - SNAP RING

OPERATION

The compressor clutch assembly provides the means to engage and disengage the compressor from the engine serpentine accessory drive belt. When the clutch coil is energized, it magnetically draws the clutch into contact with the pulley and drives the compressor shaft. When the coil is not energized, the pulley freewheels on the clutch hub bearing, which is part of the pulley. The compressor clutch and coil are the only serviced parts on the compressor.

The compressor clutch engagement is controlled by several components: the a/c heater mode control switch, the a/c loss of charge switch, the a/c pressure transducer, the compressor clutch relay, the evaporator temperature sensor and the Powertrain Control Module (PCM). The PCM may delay compressor clutch engagement for up to thirty seconds (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/POWERTRAIN CONTROL MODULE - DESCRIPTION).

DIAGNOSIS AND TESTING - A/C COMPRESSOR CLUTCH COIL

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information). The battery must be fully-charged before performing the following tests (Refer to 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING).

(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 a/c select button depressed, 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 0.2 volts of the battery voltage. If there is voltage at the clutch coil, but the reading is not within 0.2 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 III® scan tool and (Refer to Appropriate Diagnostic Information) for testing of the compressor clutch circuit. The following components must be checked and repaired as required before you can complete testing of the clutch coil:

- Fuses in the junction block and the Power Distribution Center (PDC)
- A/C Heater Control
- Compressor Clutch Relay
- A/C Pressure Transducer
- A/C Loss of Charge Pressure Switch
- Evaporator Temperature Sensor
- 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

A/C COMPRESSOR CLUTCH (Continued)

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.

STANDARD PROCEDURE - A/C COMPRESSOR 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 a/c heater control to the recirculation mode (Max-A/C), the blower motor switch to 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.

REMOVAL

The refrigerant system can remain fully-charged during compressor clutch, pulley, or coil replacement. The compressor clutch can be serviced in the vehicle.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the serpentine drive belt. Refer to Cooling for the procedures.

(3) Unplug the compressor clutch coil wire harness connector.

(4) Insert the two pins of the spanner wrench (Special Tool 6462 in Kit 6460) into the holes of the clutch plate. Hold the clutch plate stationary and remove the hex nut (Fig. 2).

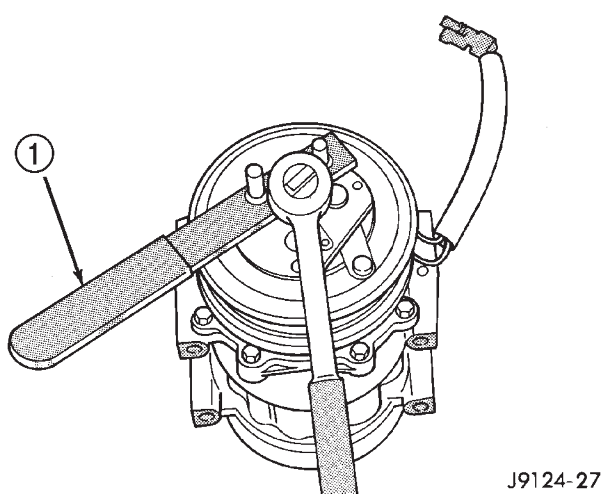

Fig. 2 CLUTCH NUT REMOVE

1 - FRONT PLATE SPANNER

(5) Remove the clutch plate and the clutch shims.

(6) Remove the external front housing snap ring with snap ring pliers (Fig. 3).

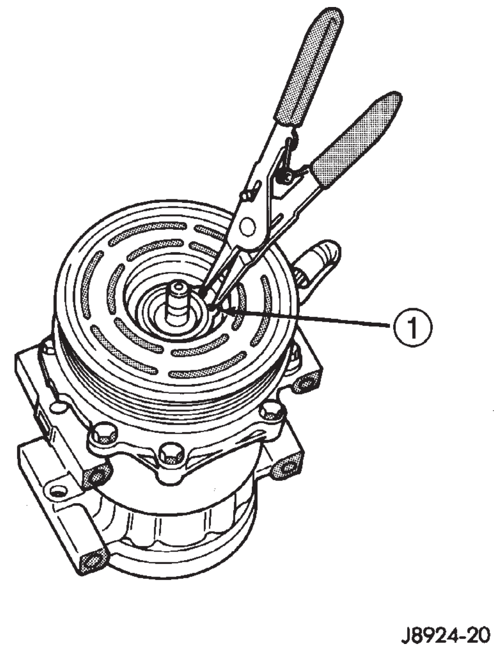

Fig. 3 EXTERNAL SNAP RING REMOVE

1 - EXTERNAL SNAP RING

(7) Install the lip of the rotor puller (Special Tool C-6141-1 in Kit 6460) into the snap ring groove exposed in Step 6, and install the shaft protector (Special Tool C-6141-2 in Kit 6460) (Fig. 4).

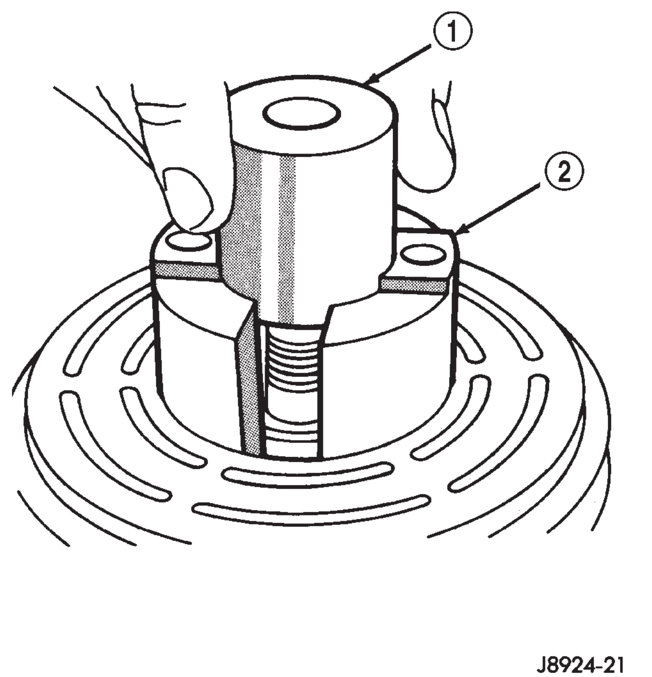

Fig. 4 SHAFT PROTECTOR AND PULLER

1 - PULLER SHAFT PROTECTOR

2 - JAWS

A/C COMPRESSOR CLUTCH (Continued)

(8) Install the puller through-bolts (Special Tool C-6461) through the puller flange and into the jaws of the rotor puller and tighten (Fig. 5). Turn the puller center bolt clockwise until the rotor pulley is free.

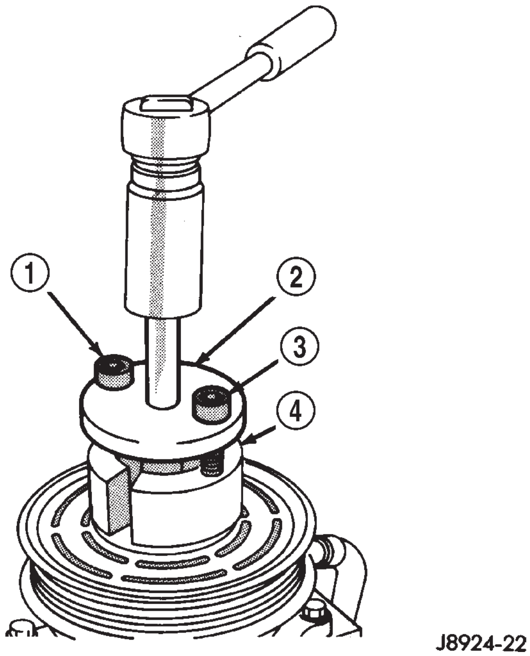

Fig. 5 INSTALL PULLER PLATE

1 - BOLT
2 - PULLER PLATE AND BOLT
3 - BOLT
4 - JAWS

(9) Remove the screw and retainer from the clutch coil lead wire harness on the compressor front housing (Fig. 6).

(10) Remove the snap ring from the compressor hub and remove the clutch field coil (Fig. 7). Slide the clutch field coil off of the compressor hub.

INSPECTION

Examine the friction surfaces of the clutch pulley and the front plate for wear. The pulley and front plate should be replaced if there is excessive wear or scoring.

If the friction surfaces are oily, inspect the shaft and nose area of the compressor for oil. Remove the felt from the front cover. If the felt is saturated with oil, the shaft seal is leaking and the compressor must be replaced.

Check the clutch pulley bearing for roughness or excessive leakage of grease. Replace the bearing, if required.

INSTALLATION

(1) Install the clutch field coil and snap ring.

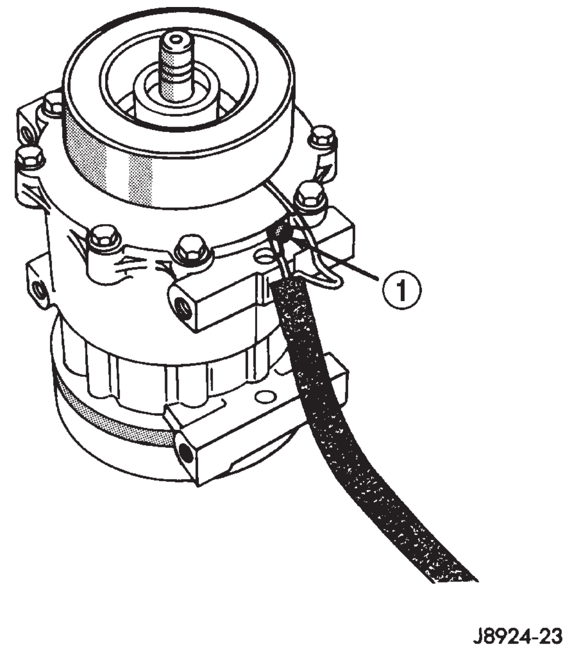

Fig. 6 CLUTCH COIL LEAD WIRE HARNESS

1 - CLIP

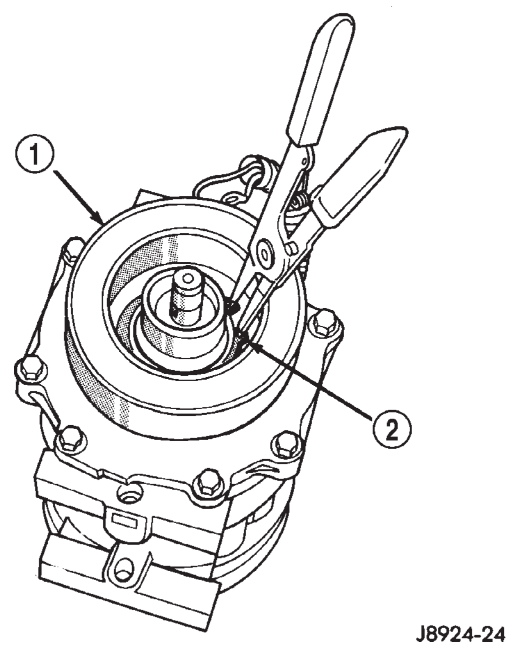

Fig. 7 CLUTCH FIELD COIL SNAP RING REMOVE

1 - FIELD COIL
2 - SNAP RING

(2) Install the clutch coil lead wire harness retaining clip on the compressor front housing and tighten the retaining screw.

A/C COMPRESSOR CLUTCH (Continued)

(3) Align the rotor assembly squarely on the front compressor housing hub.

(4) Thread the handle (Special Tool 6464 in Kit 6460) into the driver (Special Tool 6143 in Kit 6460) (Fig. 8).

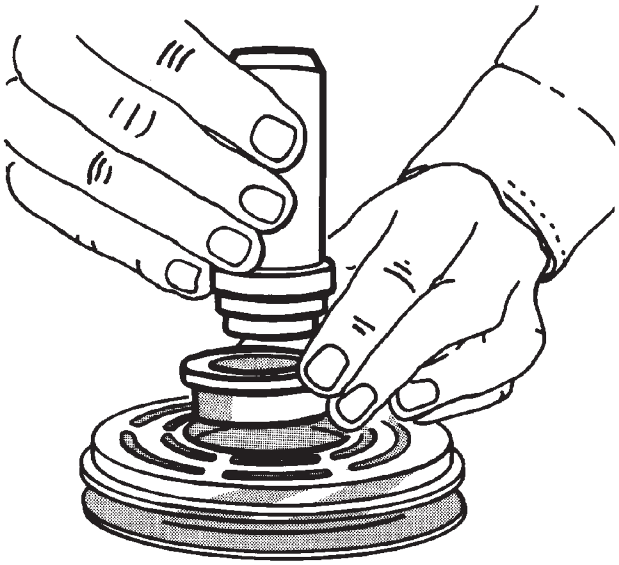

Fig. 8 ROTOR INSTALLER SET

(5) Place the driver tool assembly into the bearing cavity on the rotor. Make certain the outer edge of the tool rests firmly on the rotor bearing inner race (Fig. 9).

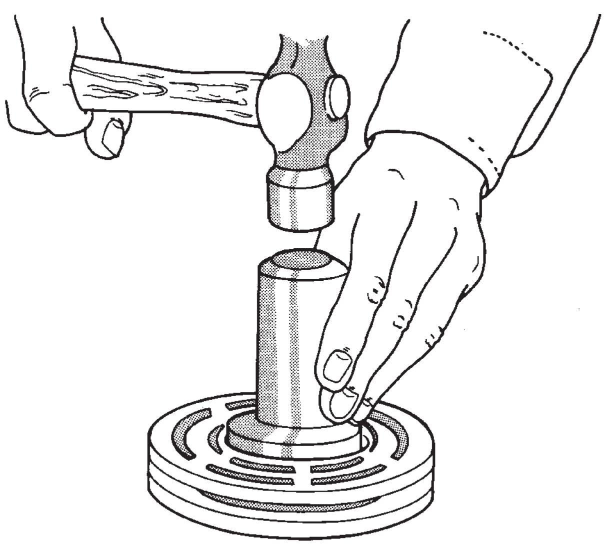

Fig. 9 ROTOR INSTALL

(6) Tap the end of the driver while guiding the rotor to prevent binding. Tap until the rotor bottoms against the compressor front housing hub. Listen for a distinct change of sound during the tapping process, to indicate the bottoming of the rotor.

(7) Install the external front rotor snap ring with snap ring pliers. The bevel side of the snap ring must be facing outward. Press the snap ring to make sure it is properly seated in the groove.

CAUTION: If the snap ring is not fully seated in the groove it will vibrate out, resulting in a clutch failure and severe damage to the front housing of the compressor.

(8) Install the original clutch shims on the compressor shaft.

(9) Install the clutch plate. Use the shaft protector (Special Tool 6141-2 in Kit 6460) to install the clutch plate on the compressor shaft (Fig. 10). Tap the clutch plate over the compressor shaft until it has bottomed against the clutch shims. Listen for a distinct change of sound during the tapping process, to indicate the bottoming of the clutch plate.

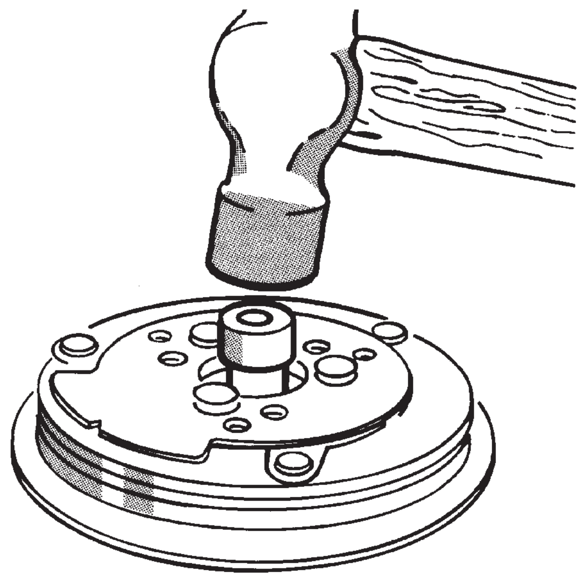

Fig. 10 CLUTCH PLATE INSTALL

(10) Replace the compressor shaft hex nut. Tighten the nut to 14.4 N·m (10.5 ft. lbs.).

(11) Check the clutch air gap with a feeler gauge (Fig. 11). If the air gap does not meet the specification, add or subtract shims as required. The air gap specification is 0.41 to 0.79 millimeter (0.016 to 0.031 inch). If the air gap is not consistent around the circumference of the clutch, lightly pry up at the minimum variations. Lightly tap down at the points of maximum variation.

A/C COMPRESSOR CLUTCH (Continued)

NOTE: The air gap is determined by the spacer shims. When installing an original, or a new clutch assembly, try the original shims first. When installing a new clutch onto a compressor that previously did not have a clutch, use 1.0, 0.50, and 0.13 millimeter (0.040, 0.020, and 0.005 inch) shims from the clutch hardware package that is provided with the new clutch.

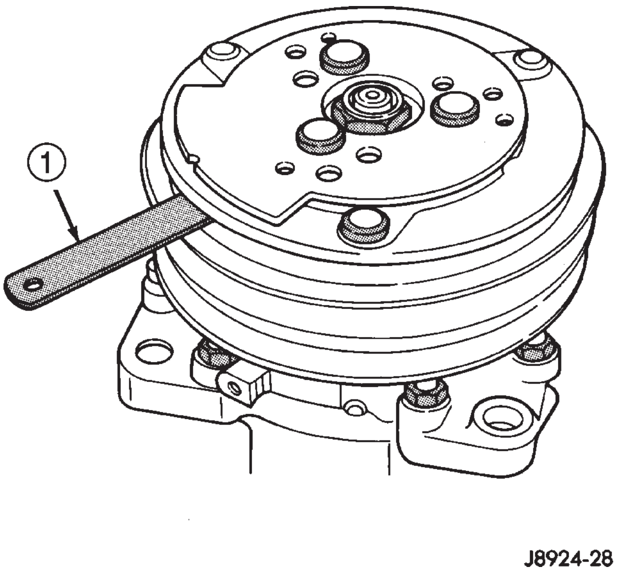

Fig. 11 CHECK CLUTCH AIR GAP

1 - FEELER GAUGE

(12) To complete the procedure, (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

A/C COMPRESSOR CLUTCH RELAY

DESCRIPTION

The a/c 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.

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 a/c heater control, the a/c loss of charge switch, the a/c pressure transducer and the evaporator fin probe.

The compressor clutch relay is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for relay identification and location.

The compressor clutch relay cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING - A/C COMPRESSOR CLUTCH RELAY

RELAY TEST

The compressor clutch relay (Fig. 12) 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 below. If not OK, replace the faulty relay.

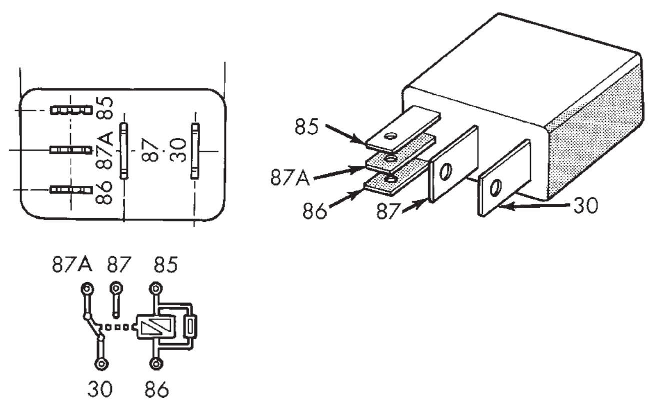

Fig. 12 COMPRESSOR CLUTCH RELAY

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 Appropriate Wiring Information).

(1) The relay common feed terminal cavity (30) is connected to fused battery feed. There should be bat-

A/C COMPRESSOR CLUTCH RELAY (Continued)

tery voltage at the cavity for relay terminal 30 at all times. If OK, go to Step 2. If not OK, repair the open circuit to the fuse in the PDC as required.

(2) The relay normally closed terminal (87A) is not used in this application. Go to Step 3.

(3) The relay normally open terminal cavity (87) is connected to the compressor clutch coil. There should be continuity between this cavity and the A/C compressor clutch relay output circuit cavity of the compressor clutch coil wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) The relay coil battery terminal (86) is connected to the fused ignition switch output (run/start) circuit. There should be battery voltage at the cavity for relay terminal 86 with the ignition switch in the On position. If OK, go to Step 5. If not OK, repair the open circuit to the fuse in the junction block as required.

(5) The coil ground terminal cavity (85) is switched to ground through the Powertrain Control Module (PCM). There should be continuity between this cavity and the A/C compressor clutch relay control circuit cavity of the PCM wire harness connector C (gray) at all times. If not OK, repair the open circuit as required.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 13).

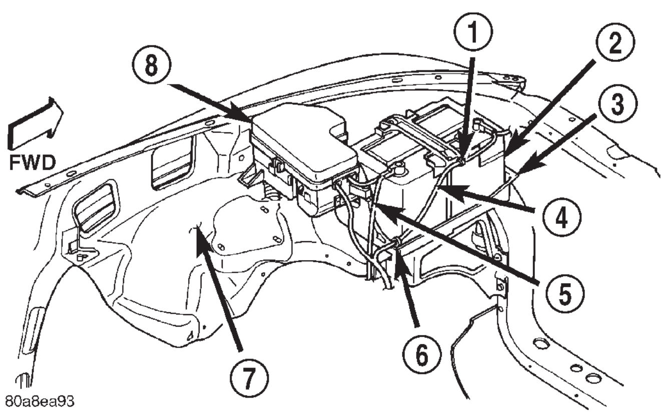

Fig. 13 POWER DISTRIBUTION CENTER LOCATION

1 - CLIP
2 - BATTERY
3 - TRAY
4 - NEGATIVE CABLE
5 - POSITIVE CABLE
6 - CLIP
7 - FENDER INNER SHIELD
8 - POWER DISTRIBUTION CENTER

(3) Refer to the label on the PDC for compressor clutch relay identification and location.

(4) Unplug the compressor clutch relay from the PDC.

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

The a/c heater control is a completely electronic control head (Fig. 14). The a/c heater system uses all electrical controls. These controls provide the vehicle operator with a number of setting options to help control the climate and comfort within the vehicle. Refer to the owner's manual in the vehicle glove box for more information on the features, use, and suggested operation of these controls.

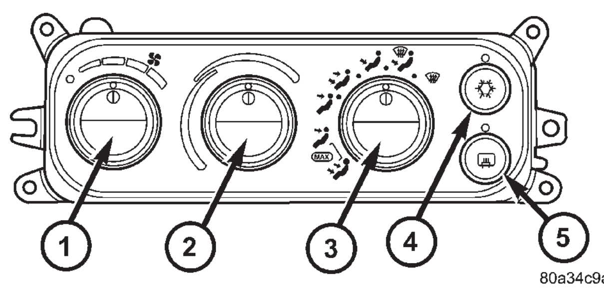

Fig. 14 A/C HEATER CONTROL

1 - BLOWER SPEED CONTROL KNOB
2 - TEMPERATURE CONTROL KNOB
3 - MODE CONTROL KNOB
4 - A/C SELECT BUTTON
5 - REAR WINDOW DEFOGGER/HEATED MIRROR SELECT BUTTON (optional)

OPERATION

The a/c heater control is located to the right of the instrument cluster on the instrument panel. The a/c heater control contains a rotary-type temperature control knob, a rotary-type mode control knob, a rotary-type blower motor speed knob, and push buttons for a/c compressor and rear window defogger/heated mirror operation (Fig. 14).

The a/c heater control is fully electronic, contains the logic and control circuits for the HVAC system, and is on the J1850 data bus.

The a/c heater control cannot be repaired. If faulty or damaged, the entire unit must be replaced. The

A/C HEATER CONTROL (Continued)

illumination lamps are available for service replacement.

DIAGNOSIS AND TESTING- HEATER-A/C CONTROL

Satisfactory heater and air conditioner performance depends upon proper operation and adjustment of all operating controls and refrigeration system components. For circuit descriptions and diagrams, refer to Air Conditioning/Heater in Group 8W - Wiring Diagrams. Use of the DRBIII® is required for diagnosis and testing, follow instructions on DRBIII®.

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 AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) Remove the screws that secure the a/c heater control to the cluster bezel (Fig. 15).

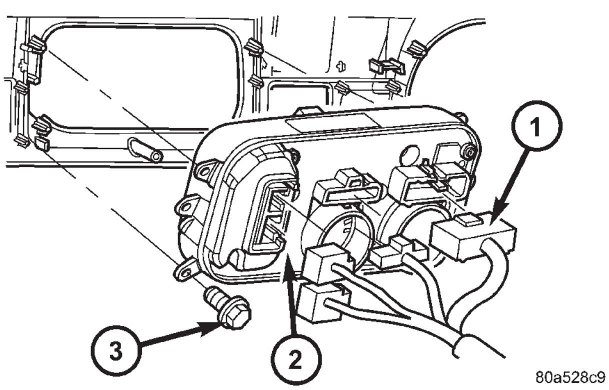

Fig. 15 A/C HEATER CONTROL REMOVE/INSTAL

1 - HEATER A/C CONTROL ELECTRICAL CONNECTOR
2 - HEATER A/C CONTROL
3 - HEATER A/C CONTROL MOUNTING SCREW

(4) Remove the a/c heater control from the cluster bezel.

(5) Unplug the wire harness connectors from the back of the heater-A/C control.

INSTALLATION

(1) Plug the wire harness connector into the back of the heater-A/C control.

(2) Position the a/c heater control in the instrument panel cluster bezel.

(3) Install the fastener screws and tighten to 2.2 N·m (17 ±3 in. lbs.).

(4) Install the cluster bezel in the instrument panel (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL AND INSTALLATION).

(5) Connect the battery negative cable.

(6) Perform A/C cool down test with DRB III.

A/C LOSS OF CHARGE SWITCH

DESCRIPTION

The a/c loss of charge switch is located on the top of the accumulator. The switch is used to measure if refrigerant system pressure goes too low. It is not responsible for cycling the a/c compressor clutch. The switch is screwed onto an accumulator fitting that contains a Schrader-type valve, which allows the switch to be serviced without discharging the refrigerant system. The accumulator fitting is equipped with an O-ring to seal the switch connection.

OPERATION

The loss of charge switch is connected in series electrically with the Heater-A/C controls 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 system charge is low and prevents damage to the compressor. The switch opens with a pressure of 7 to 13 psi and closes when the pressure rises to 15 to 25 psi.

DIAGNOSIS AND TESTING - LOSS OF CHARGE SWITCH

Before performing diagnosis of the loss of charge switch, be certain that the switch is properly installed on the accumulator fitting. If the switch is too loose it may not open the Schrader-type valve in the accumulator fitting, which will prevent the switch from correctly monitoring the refrigerant system pressure. Remember that lower ambient temperatures during cold weather will open the switch contacts and prevent compressor operation due to the pressure/temperature relationship of the refrigerant.

A/C LOSS OF CHARGE SWITCH (Continued)

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 Air Conditioning/Heater in Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the loss of charge switch wire harness connector from the switch on the accumulator fitting.

(3) Install a jumper wire between the two cavities of the loss of charge switch wire harness connector.

(4) Connect a manifold gauge set to the refrigerant system service ports (Refer to 24 - HEATING & AIR CONDITIONING - DESCRIPTION).

(5) Connect the battery negative cable.

(6) Place the heater-A/C mode control switch knob in any A/C position and start the engine.

(7) Check for continuity between the two terminals of the low pressure cycling clutch switch. There should be continuity with a suction pressure reading of 48–89 kPa (7–13 psi) or above, and no continuity with a suction pressure reading of 48–89 kPa (7–13 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 loss of charge switch on the top of the accumulator.

(3) Unscrew the loss of charge 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 loss of charge switch on the accumulator fitting. The switch should be hand-tightened onto the accumulator fitting.

(3) Plug the wire harness connector into the loss of charge switch.

(4) Connect the battery negative cable.

A/C PRESSURE TRANSDUCER

DESCRIPTION

This vehicle is equipped with an a/c pressure transducer. This transducer is screwed onto a fitting on the liquid line between the condenser and the high side refrigerant system service port (Fig. 16).

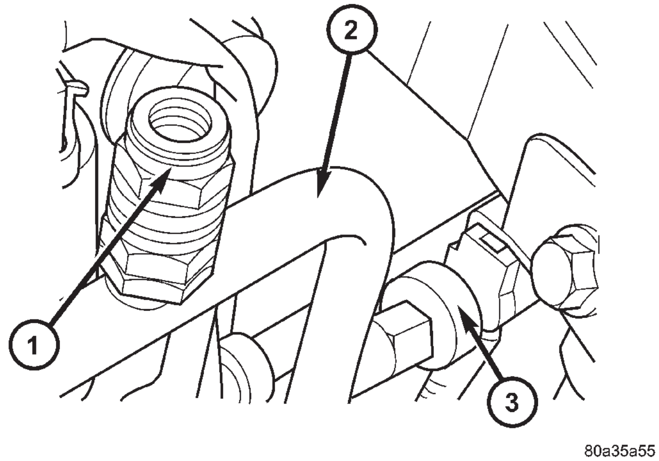

Fig. 16 A/C PRESSURE TRANSDUCER

1 - HIGH SIDE REFRIGERANT SYSTEM SERVICE PORT
2 - LIQUID LINE
3 - A/C PRESSURE TRANSDUCER

OPERATION

The main function of the a/c pressure transducer is to disengage the compressor clutch when the refrigerant system high pressures are too high. The PCM senses a voltage from the transducer and converts it to a pressure. Based on this pressure, the PCM will disengage the clutch at 460 psi and re-engage the clutch at 290 psi. The a/c heater control also uses the pressure value to operate the auto-recirculation function for improved a/c performance under extreme conditions.

DIAGNOSIS AND TESTING - A/C PRESSURE TRANSDUCER

Before performing diagnosis of the a/c pressure transducer switch, verify that the refrigerant system has the correct refrigerant charge. (Refer to 24 - HEATING & AIR CONDITIONING - DIAGNOSIS AND TESTING)

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information in Group 8W).

(1) Turn on engine and have a/c selected.

(2) Using the DRBIII® monitor and record the pressure value as it is sent out from the PCM.

A/C PRESSURE TRANSDUCER (Continued)

(3) Connect the high side manifold gauge set to the fitting on the liquid line high side refrigerant system service port.

(4) Compare the DRBIII® pressure value to the manifold gauge set reading. The pressure reading from the DRBIII® should be similar to the reading of the manifold gauge set value.

(5) If not, replace the a/c pressure transducer.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the A/C pressure transducer, which is mounted to a fitting on the liquid line between the condenser and the high side service port.

(3) Unscrew the A/C pressure transducer from the discharge line fitting.

(4) Remove the A/C pressure transducer 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 A/C pressure transducer on the discharge line fitting.

(3) Plug the wire harness connector into the A/C pressure transducer.

(4) Connect the battery negative cable.

AMBIENT TEMP SENSOR

DESCRIPTION

Ambient air temperature is monitored by the compass mini-trip computer module through the ambient temperature sensor. The ambient temperature sensor is a variable resistor mounted to a bracket that is secured with a screw to the right side of the radiator yoke, behind the radiator grille and in front of the engine compartment.

For complete circuit diagrams (Refer to 8 - ELECTRICAL/WIRING DIAGRAM INFORMATION - DIAGNOSIS AND TESTING). The ambient temperature sensor cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

OPERATION

The ambient temperature sensor is a variable resistor that operates on a five-volt reference signal sent to it by the HVAC control head unit. The resistance in the sensor changes as temperature changes, changing the temperature sensor signal circuit voltage to the HVAC control head unit. Based upon the resistance in the sensor, the HVAC control head unit senses a specific voltage on the temperature sensor signal circuit, which it is programmed to correspond to a specific temperature.

DIAGNOSIS AND TESTING - AMBIENT TEMPERATURE SENSOR

The thermometer function is supported by the ambient temperature sensor, a wiring circuit, and a portion of the HVAC control. If any portion of the ambient temperature sensor circuit fails or if PCI Bus information is missing, a (– –) will appear in the display in place of the temperature, when the sensor is exposed to temperatures above 55° C (140° F), or if the sensor circuit is shorted. A (– –) will appear in the display in place of the temperature, when the sensor is exposed to temperatures below - 40° C (- 40° F), or if the sensor circuit is open.

The ambient temperature sensor circuit can also be diagnosed using the following Sensor Test, and Sensor Circuit Test. If the temperature sensor and circuit are confirmed to be OK, but the temperature display is inoperative or incorrect, refer to Diagnosis and Testing the **Compass Mini-Trip Computer** in this section. For complete circuit diagrams, refer to **Wiring Diagrams**.

SENSOR TEST

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the ambient temperature sensor harness connector.

(2) Measure the resistance of the ambient temperature sensor. At - 40° C (- 40° F), the sensor resistance is 336 kilohms. At 55° C (140° F), the sensor resistance is 2.488 kilohms. The sensor resistance should read between these two values. If OK, refer to **Sensor Circuit Test** in the Diagnosis and Testing section of this group. If not OK, replace the faulty ambient temperature sensor.

SENSOR CIRCUIT TEST

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the ambient temperature sensor wire harness connector and the HVAC control harness connector.

(2) Connect a jumper wire between the two terminals in the body half of the ambient temperature sensor harness connector.

(3) Check for continuity between the sensor return circuit and the ambient temperature sensor signal

AMBIENT TEMP SENSOR (Continued)

circuit cavities of the HVAC control harness connector. There should be continuity. If OK, go to Step 4. If not OK, repair the open sensor return circuit or ambient temperature sensor signal circuit to the ambient temperature sensor as required.

(4) Check for continuity between the ambient temperature sensor signal circuit cavity of the HVAC control harness connector and a good ground. There should be no continuity. If OK, refer to Diagnosis and Testing of the **Compass Mini-Trip Computer** in this section. If not OK, repair the shorted ambient temperature sensor signal circuit as required.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Locate the ambient temperature sensor, on the right side of the radiator yoke behind the grille (Fig. 17).

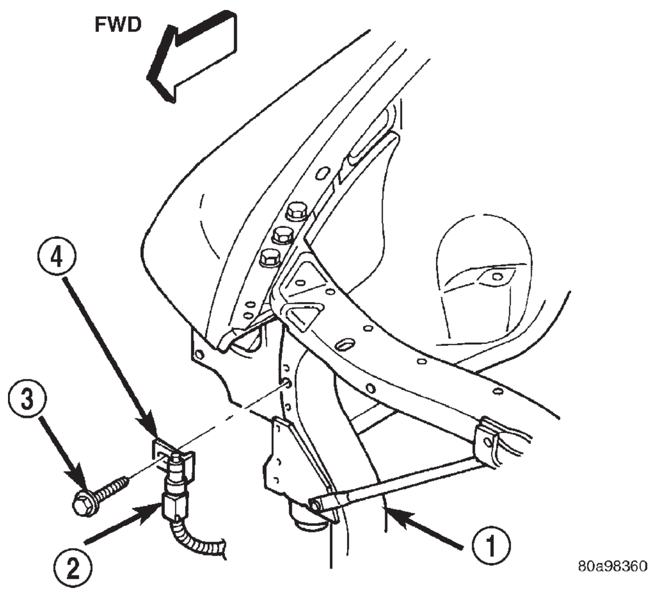

Fig. 17 Ambient Temperature Sensor Remove/Install

1 - YOKE
2 - CONNECTOR
3 - SCREW
4 - SENSOR

(3) Disconnect the wire harness connector from the ambient temperature sensor connector receptacle.

(4) Remove the one screw that secures the ambient temperature sensor bracket to the radiator yoke.

(5) Remove the ambient temperature sensor from the radiator yoke.

INSTALLATION

(1) Position the ambient temperature sensor onto the radiator yoke.

(2) Install and tighten the one screw that secures the ambient temperature sensor bracket to the radiator yoke. Tighten the screw to 5.6 N·m (50 in. lbs.).

(3) Reconnect the wire harness connector to the ambient temperature sensor connector receptacle.

(4) Reconnect the battery negative cable.

BLEND DOOR ACTUATOR

DESCRIPTION

The blend door actuators are reversible, 12-volt Direct Current (DC), servo motors. Models with the single zone heater and air conditioner system have a single blend air door, which is controlled by a single blend door actuator. Models with the optional dual zone front heater and air conditioner system have dual blend air doors, which are controlled by two blend door actuators. The single zone blend door actuator is located on the driver side end of the heater-A/C housing unit, close to the dash panel. In the dual zone system, the same blend door actuator used for the single zone system becomes the passenger blend door actuator, and is mechanically connected to only the passenger side blend air door. In the dual zone system, a second separate blend door actuator is also located on the driver side end of the heater-A/C housing unit close to the instrument panel, and is mechanically connected to only the driver side blend air door.

The blend door actuators are interchangeable with each other, as well as with the actuators for the mode door and the recirculation air door. Each actuator is contained within an identical black molded plastic housing with an integral wire connector receptacle. Two integral mounting tabs allow the actuator to be secured with two screws to the heater-A/C unit housing. Each actuator also has an identical output shaft with splines that connects it to the linkage that drives the proper blend air door. The blend door actuators do not require mechanical indexing to the blend door linkage, as they are electronically calibrated by the heater-A/C control module. The blend door actuators cannot be adjusted or repaired and, if damaged or faulty, they must be replaced.

OPERATION

Each blend door actuator is connected to the heater-A/C control module through the vehicle electrical system by a dedicated two-wire take out and connector of the HVAC wire harness. The blend door actuator can move the blend air door in two directions. When the heater-A/C control module pulls the voltage on one side of the motor connection high and the other connection low, the blend air door will move in one direction. When the module reverses the polarity

BLEND DOOR ACTUATOR (Continued)

of the voltage to the motor, the blend air door moves in the opposite direction. When the module makes the voltage to both connections high or both connections low, the blend air door stops and will not move. These same motor connections also provide a feedback signal to the heater-A/C control module. This feedback signal allows the module to monitor the operation and relative positions of the blend door actuator and the blend air door. The heater-A/C control module learns the blend air door stop positions during the calibration procedure and will store a Diagnostic Trouble Code (DTC) for any problems it detects in the blend door actuator circuits. The blend door actuator can be diagnosed using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

REMOVAL

The single zone heating and air conditioning system is equipped with a single blend door actuator. The dual zone system has two blend door actuators, one for the driver side blend air door and one for the passenger side blend air door. The same service procedures can be used for each of these actuators.

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 silencer from beneath the driver side end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL SILENCER - REMOVAL).

(3) Remove the three screws that secure the heater core shield to the left end of the HVAC distribution housing.

(4) Pull the heater core shield rearward far enough to disengage the two location tabs that position the front of the shield to the receptacles in the two lower finger formations of the heater/ air conditioner housing near the dash panel.

(5) Remove the heater core shield from the distribution housing.

(6) Disconnect the HVAC wire harness connector for the blend door actuator from the actuator connector receptacle.

(7) Remove the two screws that secure the blend door actuator to the distribution housing.

(8) Remove the blend door actuator from the distribution housing.

INSTALLATION

(1) Position the blend door actuator onto the heater/air conditioner housing. If necessary, rotate the actuator slightly to align the splines on the actuator output shaft with those in the blend air door linkage.

(2) Install and tighten the two screws that secure the blend door actuator to the distribution housing. Tighten the screws to 2 N·m (17 in. lbs.).

(3) Reconnect the HVAC wire harness connector for the blend door actuator to the actuator connector receptacle.

(4) Position the heater core shield onto the distribution housing. Be certain that the two location tabs on the front of the shield are engaged in the receptacles in the two lower finger formations of the evaporator housing near the dash panel.

(5) Install and tighten the three screws that secure the heater core shield to the left end of the heater/air conditioner housing. Tighten the screws to 2 N·m (17 in. lbs.).

(6) Reinstall the silencer under the driver side end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL SILENCER - INSTALLATION).

(7) Reconnect the battery negative cable.

(8) Perform the heater-A/C control calibration procedure. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS - FRONT/A/C-HEATER CONTROL - STANDARD PROCEDURE - HEATER-A/C CONTROL CALIBRATION).

BLOWER MOTOR RESISTOR BLOCK

DESCRIPTION

During vehicle assembly, the blower motor resistor is mounted to the HVAC unit inside the passenger compartment. It can be accessed from the passenger foot well area. See Blower Motor Resistor in the Removal and Installation section of this group for more information.

OPERATION

The resistor has multiple resistor circuits each of which will change the resistance in the blower motor ground path to change the blower motor speed. The blower motor switch directs the ground path through

BLOWER MOTOR RESISTOR BLOCK (Continued)

the correct resistor circuit to obtain the selected blower motor speed.

With the blower motor switch in the lowest speed position, the ground path for the motor is applied through all of the resistor circuits. Each higher speed selected with the blower motor switch applies the blower motor ground path through fewer of the resistor circuits, increasing the blower motor speed.

The blower motor resistor cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING - BLOWER MOTOR RESISTOR BLOCK

For circuit descriptions and diagrams, (Refer to 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 AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the blower motor resistor.

(3) Check for continuity between each of the blower motor switch input terminals of the resistor and the resistor output terminal. In each case there should be continuity. If OK, repair the wire harness circuits between the blower motor switch and the blower motor resistor or blower motor as required. If not OK, replace the faulty blower motor resistor.

REMOVAL - BLOWER MOTOR RESISTOR

BLOWER MOTOR RESISTOR

(1) Disconnect and isolate the battery negative cable.

(2) From the passenger foot well area, remove the two hex screws used to secure the blower motor resistor.

(3) Unplug the front blower motor resistor from the wire harness connector.

(4) Pull the front blower motor resistor and its wire harness out of the plenum panel and through the cowl plenum access hole far enough to access the wire harness connector.

(5) Remove the front blower motor resistor from the cowl plenum.

INSTALLATION

(1) Plug the blower motor resistor into the wire harness connector.

(2) Install the blower motor resistor to the cowl plenum panel by feeding the resistor and wire harness back through the cowl plenum access hole.

(3) Install and tighten the two screws that secure the resistor to the HVAC unit. Tighten the screws to 2.2 N·m (20 in. lbs.).

(4) Connect the battery negative cable.

BLOWER MOTOR SWITCH

DESCRIPTION

The heater-A/C blower motor is controlled by a four position rotary-type blower motor switch, mounted in the heater-A/C control panel. The switch allows the selection of one of four blower motor speeds, but can only be turned off by selecting the Off position with the heater-A/C mode control switch knob.

OPERATION

The blower motor switch directs the blower motor ground path through the mode control switch to the blower motor resistor, or directly to ground, as required to achieve the selected blower motor speed.

The blower motor switch cannot be repaired and, if faulty or damaged, the entire heater-A/C control unit must be replaced. The blower motor switch knob is serviced separately.

DIAGNOSIS AND TESTING - BLOWER MOTOR SWITCH

For circuit descriptions and diagrams, (Refer to 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 AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

BLOWER MOTOR SWITCH (Continued)

(1) Check for battery voltage at the fuse in the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the a/c heater control from the instrument panel. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C HEATER CONTROL - REMOVAL) Check for continuity between the ground circuit cavity of the a/c heater control wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) With the a/c heater control wire harness connector unplugged, place the a/c heater mode control switch knob in any position except the Off position. Check for continuity between the ground circuit terminal and each of the blower motor driver circuit terminals of the a/c heater control as you move the blower motor switch knob to each of the four speed positions. There should be continuity at each driver circuit terminal in only one blower motor switch speed position. If OK, test and repair the blower driver circuits between the a/c heater control connector and the blower motor resistor as required. If not OK, replace the faulty a/c heater control unit.

MODE DOOR ACTUATOR

DESCRIPTION

The mode door actuator is a reversible, 12-volt Direct Current (DC), servo motor. The single mode door actuator is located on the driver side end of the heater-A/C housing unit, close to the top of the distribution housing. The mode door actuator is mechanically connected to the mode door. The mode door actuator is interchangeable with the actuators for the blend air door(s) and the recirculation air door. Each actuator is contained within an identical black molded plastic housing with an integral wire connector receptacle. Two integral mounting tabs allow the actuator to be secured with two screws to the heater-A/C unit housing. Each actuator also has an identical output shaft with splines that connects it to the linkage that drives the mode door. The mode door actuator does not require mechanical indexing to the mode door linkage, as it is electronically calibrated by the heater-A/C control module. The mode door actuator cannot be adjusted or repaired and, if damaged or faulty, it must be replaced.

OPERATION

The mode door actuator is connected to the heater-A/C control module through the vehicle electrical system by a dedicated two-wire take out and connector of the HVAC wire harness. The mode door actuator can move the mode door in two directions. When the heater-A/C control module pulls the voltage on one side of the motor connection high and the other connection low, the mode door will move in one direction. When the module reverses the polarity of the voltage to the motor, the mode door moves in the opposite direction. When the module makes the voltage to both connections high or both connections low, the mode door stops and will not move. These same motor connections also provide a feedback signal to the heater-A/C control module. This feedback signal allows the module to monitor the operation and relative position of the mode door actuator and the mode door. The heater-A/C control module learns the mode door stop positions during the calibration procedure and will store a Diagnostic Trouble Code (DTC) for any problems it detects in the mode door actuator circuits. The mode door actuator can be diagnosed 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.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the silencer from beneath the driver side end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL SILENCER - REMOVAL).

(3) Disconnect the HVAC wire harness connector for the mode door actuator from the actuator connector receptacle.

(4) Remove the two screws that secure the mode door actuator to the distribution housing.

(5) Remove the mode door actuator from the distribution housing.

MODE DOOR ACTUATOR (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 mode door actuator onto the heater/AC housing. If necessary, rotate the actuator slightly to align the splines on the actuator output shaft with those in the mode door linkage.

(2) Install and tighten the two screws that secure the mode door actuator to the distribution housing. Tighten the screws to 2 N·m (17 in. lbs.).

(3) Reconnect the HVAC wire harness connector for the mode door actuator to the actuator connector receptacle.

(4) Reinstall the silencer under the driver side end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL SILENCER - INSTALLATION).

(5) Reconnect the battery negative cable.

(6) Perform the heater-A/C control calibration procedure. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS - FRONT/A/C-HEATER CONTROL - STANDARD PROCEDURE - HEATER-A/C CONTROL CALIBRATION).

RECIRCULATION DOOR ACTUATOR

DESCRIPTION

The recirculation door actuator is a reversible, 12-volt Direct Current (DC), servo motor. The single recirculation door actuator is located on the passenger side end of the heater-A/C housing unit, on the bottom of the lower intake air housing. The recirculation door actuator is mechanically connected to the recirculation air door. The recirculation door actuator is interchangeable with the actuators for the blend air door(s) and the mode door. Each actuator is contained within an identical black molded plastic housing with an integral wire connector receptacle. Two integral mounting tabs allow the actuator to be secured with two screws to the lower intake air housing. Each actuator also has an identical output shaft with splines that connects it to the linkage that drives the recirculation air door. The recirculation door actuator does not require mechanical indexing to the recirculation air door, as it is electronically calibrated by the heater-A/C control module. The recirculation door actuator cannot be adjusted or repaired and, if damaged or faulty, it must be replaced.

OPERATION

The recirculation door actuator is connected to the heater-A/C control module through the vehicle electrical system by a dedicated two-wire take out and connector of the HVAC wire harness. The recirculation door actuator can move the recirculation door in two directions. When the heater-A/C control module pulls the voltage on one side of the motor connection high and the other connection low, the recirculation air door will move in one direction. When the module reverses the polarity of the voltage to the motor, the recirculation air door moves in the opposite direction. When the module makes the voltage to both connections high or both connections low, the recirculation air door stops and will not move. These same motor connections also provide a feedback signal to the heater-A/C control module. This feedback signal allows the module to monitor the operation and relative position of the recirculation door actuator and the recirculation air door. The heater-A/C control module learns the recirculation air door stop positions during the calibration procedure and will store a Diagnostic Trouble Code (DTC) for any problems it detects in the recirculation door actuator circuits. The recirculation door actuator can be diagnosed 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.

(1) Disconnect and isolate the battery negative cable.

RECIRCULATION DOOR ACTUATOR (Continued)

(2) Pull the carpet on the passenger side front floor away from the dash panel far enough to access the recirculation door actuator.

(3) Disconnect the HVAC wire harness connector for the recirculation door actuator from the actuator connector receptacle.

(4) Remove the two screws that secure the recirculation door actuator to the lower intake air housing.

(5) Remove the recirculation door actuator from the lower intake air 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 recirculation door actuator onto the lower intake air housing. If necessary, rotate the actuator slightly to align the splines on the actuator output shaft with those in the recirculation air door.

(2) Install and tighten the two screws that secure the recirculation door actuator to the lower intake air housing. Tighten the screws to 2 N·m (17 in. lbs.).

(3) Reconnect the HVAC wire harness connector for the recirculation door actuator to the actuator connector receptacle.

(4) Reposition the carpet on the passenger side front floor back up to the dash panel.

(5) Reconnect the battery negative cable.

(6) Perform the heater-A/C control calibration procedure. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS - FRONT/A/C-HEATER CONTROL - STANDARD PROCEDURE - HEATER-A/C CONTROL CALIBRATION).

DISTRIBUTION

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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 blower wheel can only be serviced with the heater-A/C housing removed from the passenger compartment.

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 fused battery feed through the blower motor relay whenever the ignition switch is in the On position.

The blower motor battery feed circuit is protected by a fuse in the Power Distribution Center (PDC). The blower motor relay control circuit is protected by a fuse in the junction block. Blower motor speed is controlled by regulating the ground path through the heater-A/C mode control switch, the blower motor switch, the blower motor resistor, and the voltage reduction 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 each serviced separately.

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. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

For circuit descriptions and diagrams, refer to Air Conditioning/Heater in Wiring Diagrams. Possible causes of an inoperative blower motor include:
- Faulty fuse
- Faulty blower motor circuit wiring or wire harness connectors
- Faulty blower motor resistor
- Faulty blower motor relay
- Faulty voltage reduction 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.

BLOWER MOTOR (Continued)

VIBRATION

Possible causes of blower motor vibration include:
- Improper blower motor mounting
- Improper blower wheel mounting
- Blower wheel out of balance or deformed
- 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

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) Remove and disassemble the heater-A/C housing (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL) and (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY).

(2) Remove the three screws that secure the blower motor and blower wheel assembly to the heater-A/C housing.

(3) Pull the blower motor and wheel assembly out of the passenger compartment side of the heater-A/C housing while feeding the blower motor wire harness, grommet and connector through the hole on the dash panel side of the housing.

(4) Remove the blower wheel retainer clip and remove the wheel from the blower motor shaft.

INSTALLATION

(1) Place the blower motor, air spoiler, and wheel assembly inside the heater-A/C housing and feed the blower motor wire harness connector through the grommet hole in the dash panel side of the housing.

(2) Pull the blower motor wiring through the hole from the dash panel side of the heater-A/C housing until the grommet is seated, while positioning the blower motor and blower wheel assembly inside the housing.

(3) Install the three screws that secure the blower motor, air spoiler, and wheel assembly to the heater-A/C housing. Tighten the screws to 2.2 N·m (20 in. lbs.).

(4) Plug blower motor connections together.

(5) Carefully install passenger side carpet.

(6) Install lower right kick panel (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - INSTALLATION)

DEFROSTER 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) 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) Place the instrument panel face down on a suitable work surface. Be certain to take the proper precautions to protect the face of the instrument panel from cosmetic damage.

(4) Remove the fasteners that secure the defroster duct to the instrument panel armature.

(5) Remove the defroster duct from the instrument panel.

DEFROSTER DUCTS (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 defroster duct to the instrument panel.

(2) Install the fasteners that secure the defroster duct to the instrument panel armature.

(3) Reinstall the instrument panel in the vehicle. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(4) Reconnect the battery negative cable.

FLOOR DISTRIBUTION DUCTS

REMOVAL

(1) Roll back the carpet on the front floor from under the instrument panel toward the rear of the vehicle. (Refer to 23 - BODY/INTERIOR/CARPETS AND FLOOR MATS - REMOVAL).

(2) Lift the center floor distribution duct upward far enough to disengage its locator hole from the weld stud on the front floor panel.

(3) Pull the floor distribution duct assembly rearward far enough to disengage the center floor distribution duct from the outlet on the bottom of the heater-A/C housing unit.

INSTALLATION

(1) Assemble the right and/or left floor distribution ducts onto the center floor distribution duct as required.

(2) Slide the floor distribution duct assembly under the instrument panel center stack far enough to engage the center floor distribution duct with the outlet on the bottom of the heater-A/C housing unit.

(3) Align the locator hole on the center floor distribution duct with the weld stud on the front floor panel.

(4) Using hand pressure, push the locator hole of the center floor distribution duct down over the weld stud on the front floor panel.

(5) Reinstall the carpet onto the front floor panel and under the instrument panel. (Refer to 23 - BODY/INTERIOR/CARPETS AND FLOOR MATS - INSTALLATION).

HVAC HOUSING

DESCRIPTION

All vehicles are equipped with a common heater-A/C housing assembly. 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 recirculation air door are omitted from the housing.

OPERATION

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 are small enough to pass through the cowl plenum screen can accumulate within the heater-A/C housing. The closed, warm, damp and dark environment created within the heater-A/C housing is ideal for the growth of certain molds, mildews and other fungi. Any accumulation of decaying plant matter provides an additional food source for fungal spores, which enter the housing with the fresh air. Excess debris, as well as objectionable odors created by decaying plant matter and growing fungi can be discharged into the passenger compartment during heater-A/C system operation.

The heater and optional air conditioner are blend-air type systems. In a blend-air system, a blend-air door controls the amount of unconditioned air (or cooled air from the evaporator on models with air conditioning) that is allowed to flow through, or around, the heater core. A temperature control knob on the heater-A/C control panel determines the discharge air temperature. By moving a electric actuator which operates the blend-air door. This allows an almost immediate manual control of the output air temperature of the system.

HVAC HOUSING (Continued)

The mode control knob on the heater-only or heater-A/C control panel is used to direct the conditioned air to the selected system outlets. The mode control switches use an electric actuator to control the mode doors.

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 between the condenser and the evaporator coil to meter refrigerant flow to the evaporator coil.

REMOVAL- HVAC HOUSING PLENUM ADAPTER

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) Remove the heater-A/C housing from the vehicle. See Heater-A/C Housing in the Removal and Installation section of this group for the procedures.

(2) Slide the heater-A/C housing plenum adapter all the way to one side of the plenum opening.

(3) Pull downwards sharply and firmly on the opposite side of the plenum adapter to disengage the snap feature from the plenum opening.

(4) Remove the plenum adapter from the plenum panel.

(5) When reinstalling the heater-A/C housing plenum adapter to the plenum panel opening, be certain that the snap features on each side of the adapter are fully engaged with the sides of the plenum panel opening. This must be a water tight connection to prevent leaks.

REMOVAL- HVAC HOUSING

The heater-A/C housing assembly must be removed from the vehicle and disassembled for service access of the blower motor, blower motor wheel, heater core, evaporator coil, blend-air door, and each of the various mode control doors.

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 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/REFRIGERANT - STANDARD PROCEDURE).

(4) Disconnect the liquid line refrigerant line fitting from the evaporator inlet tube (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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 - 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. Refer to Group 7 - Cooling System for the procedures. Install plugs in, or tape over the opened heater core tubes.

(8) Remove the two screws that retain the hanger strap and air inlet to the plenum.

(9) Remove the nut that secures the heater-A/C housing mounting brace to the stud on the passenger compartment side of the dash panel.

(10) Pull the heater-A/C housing rearward far enough for the mounting studs and the evaporator condensate drain tube to clear the dash panel holes.

(11) Remove the heater-A/C housing from the vehicle.

INSTALLATION- HVAC HOUSING PLENUM ADAPTER

(1) Install the heater-A/C housing plenum adapter to the plenum panel opening, be certain that the snap features on each side of the adapter are fully engaged with the sides of the plenum panel opening. This must be a water tight connection to prevent leaks.

HVAC HOUSING (Continued)

(2) Install the plenum adapter to the plenum panel.

(3) Push upwards sharply and firmly on the opposite side of the plenum adapter to disengage the snap feature to the plenum opening.

(4) Slide the heater-A/C housing plenum adapter onto the plenum opening.

(5) Install the heater-A/C housing to the vehicle. See Heater-A/C housing in the Removal and Installation section of this group for the procedures.

INSTALLATION- HVAC HOUSING

(1) Position the heater-A/C housing to the dash panel. Be certain that the evaporator condensate drain tube and the housing mounting studs are inserted into their correct mounting holes.

(2) Install the screw that secures the air inlet to the plenum.

(3) Install and tighten the four nuts onto the heater-A/C housing mounting studs on the engine compartment side of the dash panel. Tighten the nuts to 7 N·m (60 in. lbs.).

(4) Install the screw that secures the hanger strap to the plenum.

(5) Unplug or remove the tape from the heater core tubes. Connect the heater hoses to the heater core tubes and fill the engine cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(6) If the vehicle is not equipped with air conditioning, go to Step 10. If the vehicle is equipped with air conditioning, unplug or remove the tape from the accumulator inlet tube and the evaporator outlet tube fittings. Connect the accumulator inlet tube coupler to the evaporator outlet tube (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - INSTALLATION).

(7) Unplug or remove the tape from the liquid line and the evaporator inlet tube fittings. Connect the liquid line coupler to the evaporator inlet tube (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - INSTALLATION).

(8) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(9) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(10) Reinstall the instrument panel in the vehicle (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(11) Connect the battery negative cable.

(12) Start the engine and check for proper operation of the heating and air conditioning systems.

INSTRUMENT PANEL DEMISTER 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) 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) Place the instrument panel face down on a suitable work surface. Be certain to take the proper precautions to protect the face of the instrument panel from cosmetic damage.

(4) Remove the fasteners that secure the demister ducts to the instrument panel armature.

(5) Disengage the demister ducts from the demister outlets.

(6) Remove the demister ducts 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 demister ducts to the instrument panel.

INSTRUMENT PANEL DEMISTER DUCTS (Continued)

(2) Engage the demister ducts to the demister outlets.

(3) Install the fasteners that secure the demister ducts to the instrument panel armature.

(4) Reinstall the instrument panel into the vehicle. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(5) Reconnect the battery negative cable.

INSTRUMENT PANEL 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) 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) Place the instrument panel face down on a suitable work surface. Be certain to take the proper precautions to protect the face of the instrument panel from cosmetic damage.

(4) Remove the fasteners that secure the panel ducts to the instrument panel armature.

(5) Disengage the panel ducts from the panel outlets.

(6) Remove the panel ducts from the instrument panel.

INSTALLATION

(1) Position the panel ducts to the instrument panel.

(2) Engage the panel ducts to the panel outlets.

(3) Install the fasteners that secure the panel ducts to the instrument panel armature.

(4) Reinstall the instrument panel into the vehicle. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(5) Reconnect the battery negative cable.

PLUMBING

TABLE OF CONTENTS

PLUMBING

DESCRIPTION- REFRIGERANT LINES

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, which is sandwiched between rubber layers, is used for the R-134a air conditioning system on this vehicle. This nylon tube 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 commonly 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.

PLUMBING (Continued)

OPERATION- REFRIGERANT LINES

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.

SERVICE WARNINGS

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.

PLUMBING (Continued)

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.

CAUTION - 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

PLUMBING (Continued)

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.

DIAGNOSIS AND TESTING - REFRIGERANT SYSTEM LEAKS

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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 - A/C PERFORMANCE) 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 - REFRIGERANT SYSTEM EVACUATE)

(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 - REFRIGERANT SYSTEM CHARGE)

(3) Position the vehicle in a wind-free work area. This will aid in detecting small leaks.

(4) With the engine not running, use a electronic R-134a leak detector and search for leaks. Because R-134a refrigerant is heavier than air, the leak detector probe should be moved slowly along the bottom side of all refrigerant lines, connector fittings and components.

(5) To inspect the evaporator coil for leaks, insert the electronic leak detector probe into the center instrument panel outlet. Set the blower motor switch to the lowest speed position, and the mode control switch in the recirculation mode.

SYSTEM LOW

(1) Position the vehicle in a wind-free work area. This will aid in detecting small leaks.

(2) Bring the refrigerant system up to operating temperature and pressure. This is done by allowing the engine to run with the air conditioning system turned on for five minutes.

(3) With the engine not running, use a electronic R-134a leak detector and search for leaks. Because R-134a refrigerant is heavier than air, the leak detector probe should be moved slowly along the bottom side of all refrigerant lines, connector fittings and components.

(4) To inspect the evaporator coil for leaks, insert the electronic leak detector probe into the center instrument panel outlet. Set the blower motor switch to the lowest speed position, and the mode control switch in the recirculation mode.

STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

After the refrigerant system has been tested for leaks and evacuated, a refrigerant charge can be injected into the system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - SPECIFICATIONS - CHARGE CAPACITY)

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be

PLUMBING (Continued)

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.

A/C COMPRESSOR

DESCRIPTION - A/C COMPRESSOR

The air conditioning system uses a Sanden SD7H15 seven cylinder, reciprocating wobble plate-type compressor on all models. This compressor has a fixed displacement of 150 cubic centimeters (9.375 cubic inches), and has both the suction and discharge ports located on the cylinder head. A label identifying the use of R-134a refrigerant is located on the compressor.

DESCRIPTION - HIGH PRESSURE RELIEF VALVE

A high pressure relief valve is located on the compressor cylinder head, which is at the rear of the compressor. This mechanical valve is designed to vent refrigerant from the system to protect against damage to the compressor and other system components, caused by condenser air flow restriction or an overcharge of refrigerant.

OPERATION - A/C COMPRESSOR

The compressor is driven by the engine through an electric clutch, drive pulley and belt arrangement. The compressor is lubricated by refrigerant oil that is circulated throughout the refrigerant system with the refrigerant.

The compressor draws in low-pressure refrigerant vapor from the evaporator through its suction port. It then compresses the refrigerant into a high-pressure, high-temperature refrigerant vapor, which is then pumped to the condenser through the compressor discharge port.

The compressor cannot be repaired. If faulty or damaged, the entire compressor assembly must be replaced. The compressor clutch, pulley and clutch coil are available for service.

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 with 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 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 operating 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 before beginning this procedure (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - DIAGNOSIS AND TESTING).

(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 - CAUTION)

(5) If the noise is from opening and closing of the high pressure relief valve, recover, evacuate, and recharge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE) 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 - REFRIGERANT OIL LEVEL) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - SPECIFICATIONS - CHARGE CAPACITY) 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

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/PLUMBING - WARNING) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(1) Recover the refrigerant from the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(2) Disconnect and isolate the battery negative cable.

(3) Remove the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Unplug the compressor clutch coil wire harness connector.

(5) Remove the suction and discharge refrigerant line manifold from the compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/SUCTION LINE - REMOVAL) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/LIQUID LINE - REMOVAL). Install plugs in, or tape over all of the opened refrigerant fittings.

(6) Remove the four screws that secure the compressor to the mounting bracket (Fig. 1) or (Fig. 2).

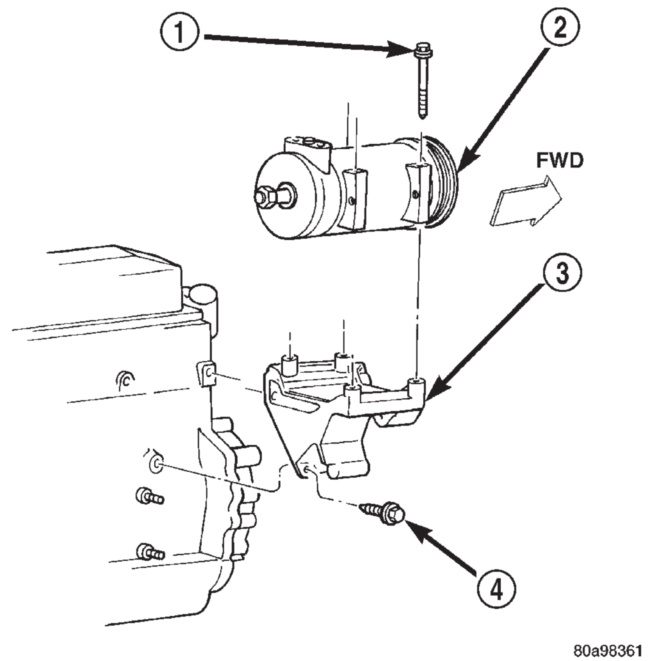

Fig. 1 Compressor Remove/Install - 2.5L Engine

1 - SCREW AND WASHER
2 - COMPRESSOR
3 - BRACKET
4 - SCREW AND WASHER

(7) Remove the compressor from the mounting bracket.

INSTALLATION

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

NOTE: If a replacement compressor is being installed, be certain to check the refrigerant oil level. See Refrigerant Oil Level in the Service Procedures section of this group. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(1) Install the compressor to the mounting bracket. Tighten the four mounting screws to 27 N·m (20 ft. lbs.).

(2) Remove the tape or plugs from all of the opened refrigerant line fittings. Install the suction and discharge line manifold to the compressor (Refer

A/C COMPRESSOR (Continued)

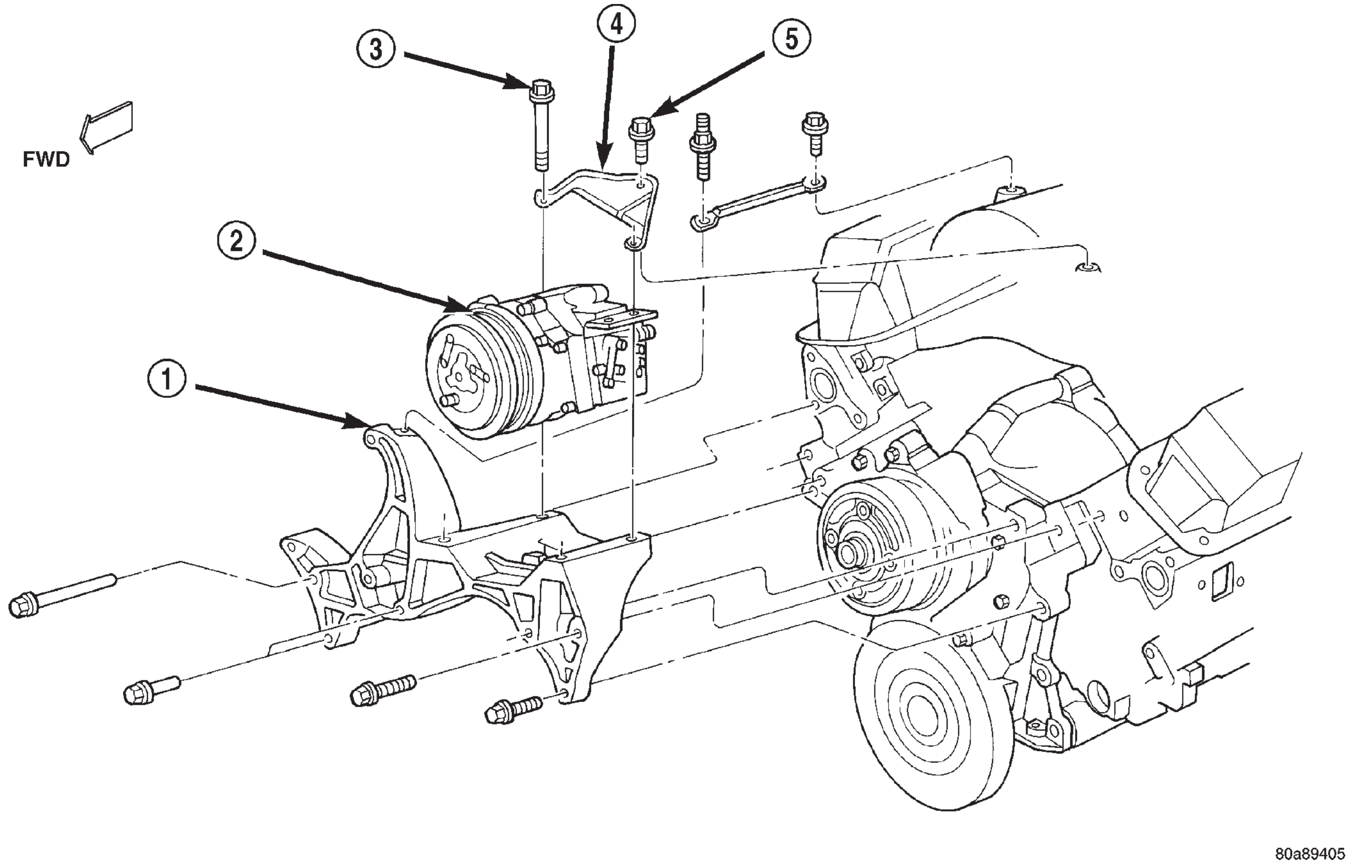

Fig. 2 Compressor Remove/Install - 3.9L and 5.2L

1 - BRACKET
2 - COMPRESSOR
3 - SCREW & WASHER
4 - BRACE
5 - BOLT

to 24 - HEATING & AIR CONDITIONING/PLUMBING/LIQUID LINE - INSTALLATION) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/SUCTION LINE - INSTALLATION).

(3) Install the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(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/REFRIGERANT - STANDARD PROCEDURE).

(7) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - 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, thus causing the refrigerant to change to a liquid state.

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

A/C CONDENSER (Continued)

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/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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/REFRIGERANT - STANDARD PROCEDURE).

(3) Disconnect the refrigerant line fitting that secures the discharge line to the condenser inlet (Fig. 3). Install plugs in, or tape over all of the opened refrigerant line fittings.

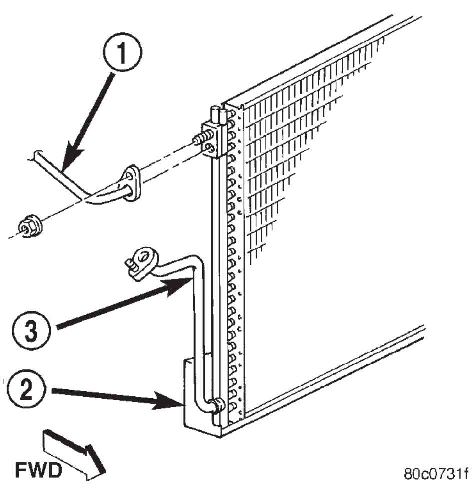

Fig. 3 Condenser Line Fittings

1 - DISCHARGE LINE
2 - CONDENSOR
3 - LIQUID LINE

(4) Disconnect the refrigerant line fitting that secures the liquid line to the condenser outlet. Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the two screws that secure the radiator and fan shroud module to the inside of the upper radiator crossmember.

(6) Remove the condenser cooling module from the vehicle.

INSTALLATION

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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) Remove the plugs or tape from the refrigerant line fittings on the liquid line and the condenser outlet. Connect the liquid line to the condenser outlet. Tighten the fitting to 22.59 ±3.39 N·m (200 ±30 in. lbs.).

(2) Remove the plugs or tape from the refrigerant line fittings on the discharge line and the condenser inlet. Connect the discharge line to the condenser inlet. Tighten the fitting to 22.59 ±3.39 N·m (200 ±30 in. lbs.).

(3) Check that all of the condenser and radiator air seals are in their proper locations.

(4) Connect the battery negative cable.

(5) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(6) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - 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 DISCHARGE LINE

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.

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/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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/REFRIGERANT - STANDARD PROCEDURE).

(3) Unplug the wire harness connector from the a/c pressure transducer switch.

(4) Remove the fasteners and disconnect the refrigerant line couplers at the condenser and the accumulator (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - REMOVAL). Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the fastener that secures the refrigerant line support bracket near the compressor.

(6) Remove the screw that secures the refrigerant line manifold to the compressor. Install plugs in, or tape over all of the opened refrigerant line fittings.

(7) Remove the suction and discharge line assembly from the vehicle.

INSTALLATION

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/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(1) Remove the tape or plugs from all of the refrigerant line fittings. Install the refrigerant line couplers to the condenser and the accumulator (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - INSTALLATION). Tighten the fasteners to 22 ±3.38 N·m (200 ±30 in. lbs.).

(2) Install the refrigerant line manifold to the compressor. Tighten the mounting screw to 22 N·m (200 in. lbs.).

(3) Install the fastener that secures the refrigerant line support bracket near the compressor. Tighten the mounting screw to 6.77 ±1.7 N·m (60 ±15 in. lbs.).

(4) Plug in the wire harness connector to the pressure transducer switch.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(7) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

A/C EVAPORATOR

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.

A/C EVAPORATOR (Continued)

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 high-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. 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 (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL).

(2) Remove the upper housing cover (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY).

(3) Lift the evaporator coil out 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. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

NOTE: If the evaporator is replaced, add 60 milliliters (2 fluid ounces) of refrigerant oil to the refrigerant system.

(1) Insert the evaporator coil into the bottom of the heater-A/C housing.

(2) Reassemble 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 ORIFICE TUBE

DESCRIPTION

The fixed orifice tube is installed in the liquid line between the outlet of the condenser and the inlet of the evaporator. The fixed orifice tube is located near the front end of the rear half of the two-piece liquid line. It is accessed for service by separating the tube fitting that joins the two halves of the liquid line.

OPERATION

The inlet end of the fixed orifice tube has a nylon mesh filter screen, which filters the refrigerant and helps to reduce the potential for blockage of the metering orifice by refrigerant system contaminants (Fig. 4). The outlet end of the tube has a nylon mesh diffuser screen. The O-rings on the plastic body of the fixed orifice tube seal the tube to the inside of the liquid line and prevent the refrigerant from bypassing the fixed metering orifice.

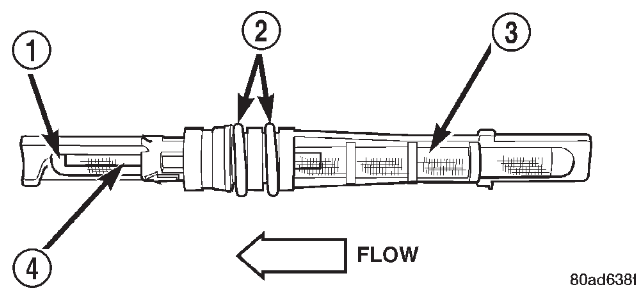

Fig. 4 Fixed Orifice Tube - Typical

1 - DIFFUSER SCREEN
2 - “O” RINGS
3 - INLET FILTER SCREEN
4 - ORIFICE

The fixed orifice tube is used to meter the flow of liquid refrigerant into the evaporator coil. The high-pressure liquid refrigerant from the condenser expands into a low-pressure liquid as it passes through the metering orifice and diffuser screen of the fixed orifice tube.

The fixed orifice tube cannot be repaired and, if faulty or plugged, it must be replaced.

A/C ORIFICE TUBE (Continued)

REMOVAL

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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/REFRIGERANT - STANDARD PROCEDURE).
(3) Disconnect the liquid line refrigerant line fastener at the condenser outlet tube (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - REMOVAL). Install plugs in, or tape over all of the opened refrigerant line fittings.

CAUTION: 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.

(4) Remove the front half of the liquid line from the rear half by disconnecting it at the tube fitting. Install plugs in, or tape over all of the opened refrigerant line tube fittings.
(5) Remove the fixed orifice tube from the rear half of the liquid line using a pair of needle nose pliers. Note the orientation of the fixed orifice tube for correct reinstallation.

INSTALLATION

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(1) Insert the fixed orifice tube into the rear half of the liquid line. Be certain that it is properly oriented (Fig. 5).
(2) Remove the tape or plugs from all of the refrigerant line tube fittings. Install a new O-ring on the liquid line tube fitting. Connect and tighten the tube fitting on the front half of the liquid line to the tube fitting on the rear half of the liquid line (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - INSTALLATION).
(3) Remove the tape or plugs from all of the refrigerant line fittings. Install the front half of the liquid line to the condenser outlet tube. Tighten the fastener to 22.6 ±3.39 N·m (200 ±30 in. lbs.).

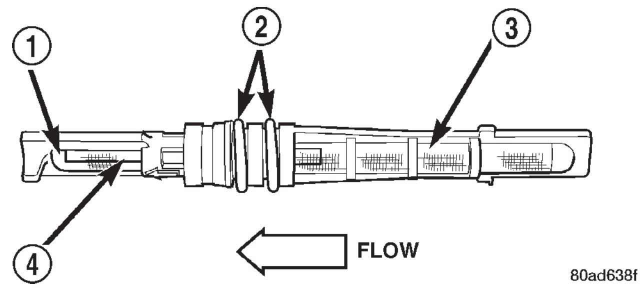

Fig. 5 Fixed Orifice Tube - Typical

1 - DIFFUSER SCREEN
2 - “O” RINGS
3 - INLET FILTER SCREEN
4 - ORIFICE

(4) Connect the battery negative cable.
(5) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).
(6) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

ACCUMULATOR

DESCRIPTION

The accumulator is mounted in the engine compartment between the a/c evaporator outlet tube and the compressor inlet.

OPERATION

Refrigerant enters the accumulator canister as a low pressure vapor through the inlet tube. Any liquid, oil-laden refrigerant falls to the bottom of the canister, which acts as a separator. A desiccant bag is mounted inside the accumulator canister to absorb any moisture which may have entered and become trapped within the refrigerant system (Fig. 6).

REMOVAL

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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/REFRIGERANT - STANDARD PROCEDURE).
(3) Unplug the wire harness connector from the loss of pressure switch.

ACCUMULATOR (Continued)

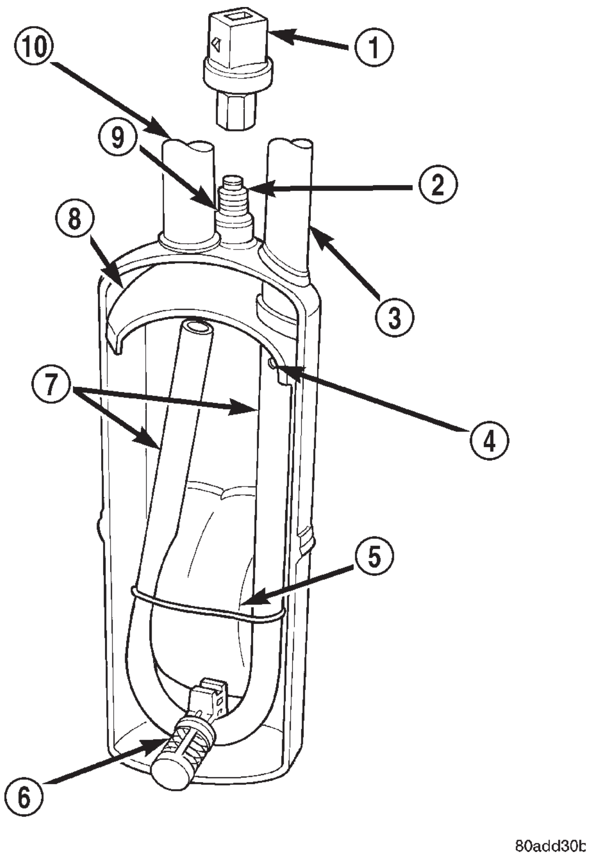

Fig. 6 ACCUMULATOR - TYPICAL

1 - A/C LOSS OF CHARGE SWITCH
2 - LOSS OF CHARGE 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

(4) If the vehicle is so equipped, remove the nuts that secure the vehicle speed control servo mounting bracket to the studs on the cowl plenum panel and move the servo far enough to access the accumulator refrigerant line couplers (Refer to 8 - ELECTRICAL/ SPEED CONTROL/SERVO - REMOVAL).

(5) Loosen the screw that secures the accumulator retaining band to the support bracket on the dash panel.

(6) Disconnect the suction line refrigerant line fastener from the accumulator. Install plugs in, or tape over all of the opened refrigerant line fittings.

(7) Disconnect the accumulator inlet tube refrigerant line secondary clip from the accumulator. 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/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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 both refrigerant lines to the accumulator. Tighten the fasteners to 25.99 ±3.39 N·m (230 ±30 in. lbs.).

(3) Tighten the accumulator retaining band screw to 4.5 N·m (40 in. lbs.).

(4) Plug the wire harness connector into the low pressure cycling clutch switch.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. See Refrigerant System Evacuate in the Service Procedures section of this group.

(7) Charge the refrigerant system. See Refrigerant System Charge in the Service Procedures section of this group.

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 HVAC housing, under the instrument panel. It is a heat exchanger made of rows of tubes and fins.

The heater core is not repairable and if damaged it must be replaced.

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 door

HEATER CORE (Continued)

allows control of the heater output air temperature by controlling how much of the air flowing through the HVAC housing is directed through the heater core. The blower motor speed controls the volume of air flowing through the HVAC 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. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the passenger side rear trim panel (Refer to 23 - BODY/INTERIOR/QUARTER PANEL TRIM - REMOVAL).

(2) Drain to cooling systems (Refer to 7 - COOLING - STANDARD PROCEDURE) or (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the three blend door actuator screws.

(4) Remove the blend door actuator and place aside.

(5) Remove the two screws from the heater/evaporator tubes plastic retainer.

(6) Using spring clamp type pliers remove the clamps from the heater hoses,

(7) Using a twisting motion remove the heater hoses from the heater core.

(8) Lift the heater core out of the heater-A/C housing.

INSTALLATION

(1) Insert the heater core into the bottom of the heater-A/C housing.

(2) Using a twisting motion install the heater hoses to the heater core.

(3) Using spring clamp type pliers install the clamps to the heater hoses.

(4) Install the two screws to the heater/evaporator tubes plastic retainer.

(5) Install blend door actuator.

(6) Install the three blend door actuator screws.

(7) Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE) or (Refer to 7 - COOLING - STANDARD PROCEDURE).

(8) Install the passenger side rear trim panel (Refer to 23 - BODY/INTERIOR/QUARTER PANEL TRIM - INSTALLATION).

LIQUID LINE

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. 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.

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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/REFRIGERANT - STANDARD PROCEDURE).

(3) Remove the engine air filter housing (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - REMOVAL).

(4) If the vehicle is so equipped, remove the nuts that secure the vehicle speed control servo mounting bracket to the studs on the cowl plenum panel and move the servo far enough to access the liquid line to evaporator coupler (Refer to 8 - ELECTRICAL/SPEED CONTROL/SERVO - REMOVAL).

(5) Disconnect the liquid line fastener at the condenser, and refrigerant line coupler at the evaporator (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - REMOVAL).

(6) Disengage the two clips that secure the liquid line to the inner fender shield.

(7) Remove the liquid line from the vehicle.

INSTALLATION

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.

LIQUID LINE (Continued)

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(1) Install the liquid line in the two clips on the inner fender shield.

(2) Remove the tape or plugs from the refrigerant line fittings on the liquid line, the condenser outlet, and the evaporator inlet. Connect the liquid line to the condenser and the evaporator and install the secondary clip (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - INSTALLATION). Tighten the fastener at the condenser to 22.6 ±3.38 N·m (200 ±30 in. lbs.).

(3) If the vehicle is so equipped, reinstall the vehicle speed control servo mounting bracket to the studs on the cowl plenum panel (Refer to 8 - ELECTRICAL/SPEED CONTROL/SERVO - INSTALLATION).

(4) Reinstall the engine air filter housing (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - INSTALLATION).

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(7) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - 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: REVIEW THE WARNINGS AND CAUTIONS IN THE GENERAL INFORMATION SECTION NEAR THE FRONT OF THIS GROUP BEFORE LEAK TESTING THE SYSTEM.

If the air conditioning system does not cool properly, the A/C system performance should be tested. See A/C Performance in the Diagnosis and Testing section of this group for the procedures. If the A/C system refrigerant fill is found to be low or if the system is 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 the 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/REFRIGERANT - 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/REFRIGERANT - 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 and the floor duct outlet. Set the blower motor switch to the lowest speed position, and the mode control switch in the recirculation mode (Max-A/C).

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 and the floor duct outlet. Set the blower motor switch to the lowest speed position, and the mode control switch in the recirculation mode (Max-A/C).

STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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. See Refrigerant System Leaks in the Diagnosis and Testing section of this group for the procedures.

(b) If the refrigerant system maintains the specified vacuum for five minutes, restart the vacuum pump, open the suction and discharge valves and evacuate the system for an additional ten minutes.

(3) Close all of the valves, and turn off the charging station vacuum pump.

(4) The refrigerant system is now ready to be charged with R-134a refrigerant. See Refrigerant System Charge in the Service Procedures section of this group.

STANDARD PROCEDURE- REFRIGERANT RECOVERY

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING 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.

STANDARD PROCEDURE- REFRIGERANT SYSTEM CHARGE

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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 in the Service Procedures section of this group 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 the proper care and use of this equipment.

REFRIGERANT (Continued)

The R-134a refrigerant system charge capacity for this vehicle is: 0.907 kilograms (32 ounces).

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 SD7H15 compressor used in this vehicle is designed to use an SP-20 PAG refrigerant oil. Use only refrigerant oil of this same type to service the refrigerant system.

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 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	210	7.1
Accumulator	90	3
Condenser	30	1
Evaporator	60	2
Compressor	drain and measure the oil from the old compressor as noted	

SUCTION LINE

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.

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/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - 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/REFRIGERANT - STANDARD PROCEDURE).

SUCTION LINE (Continued)

(3) Unplug the wire harness connector from the a/c pressure transducer switch.

(4) Remove the fasteners and disconnect the refrigerant line couplers at the condenser and the accumulator (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - REMOVAL). Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the fastener that secures the refrigerant line support bracket near the compressor.

(6) Remove the screw that secures the refrigerant line manifold to the compressor. Install plugs in, or tape over all of the opened refrigerant line fittings.

(7) Remove the suction and discharge line assembly from the vehicle.

INSTALLATION

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/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(1) Remove the tape or plugs from all of the refrigerant line fittings. Install the refrigerant line couplers to the condenser and the accumulator (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - INSTALLATION). Tighten the fasteners to 22 ±3.38 N·m (200 ±30 in. lbs.).

(2) Install the refrigerant line manifold to the compressor. Tighten the mounting screw to 22 N·m (200 in. lbs.).

(3) Install the fastener that secures the refrigerant line support bracket near the compressor. Tighten the mounting screw to 6.77 ±1.7 N·m (60 ±15 in. lbs.).

(4) Plug in the wire harness connector to the pressure transducer switch.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(7) Charge the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

REFRIGERANT LINE COUPLER

DESCRIPTION- REFRIGERANT LINE COUPLERS

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- REFRIGERANT LINE COUPLERS

The spring-lock coupler is held together by a garter spring inside a circular cage on the male half of the fitting (Fig. 7). When the two coupler halves are connected, the flared end of the female fitting slips behind the garter spring inside the cage on the male fitting. The garter spring and cage prevent the flared end of the female fitting from pulling out of the cage.

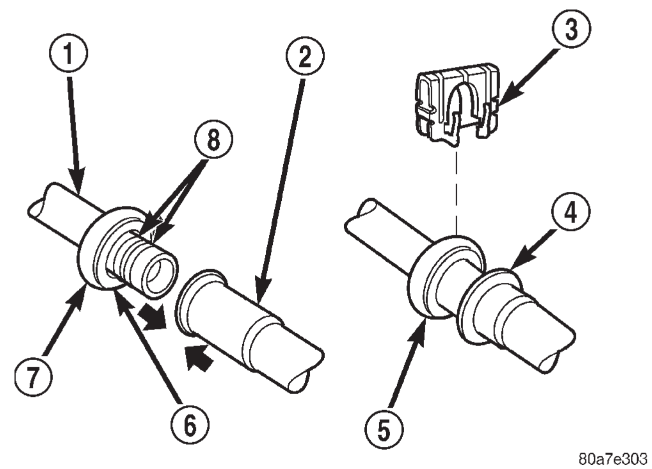

Fig. 7 Spring-Lock Coupler - Typical

1 - MALE HALF SPRING-LOCK COUPLER
2 - FEMALE HALF SPRING-LOCK COUPLER
3 - SECONDARY CLIP
4 - CONNECTION INDICATOR RING
5 - COUPLER CAGE
6 - GARTER SPRING
7 - COUPLER CAGE
8 - "O" RINGS

Two O-rings on the male half of the fitting are used to seal the connection. These O-rings are compatible with R-134a refrigerant and must be replaced with O-rings made of the same material.

REFRIGERANT LINE COUPLER (Continued)

Secondary clips are installed over the two connected coupler halves at the factory for added blowoff protection.

REMOVAL

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(1) Recover the refrigerant from the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - 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. 8).

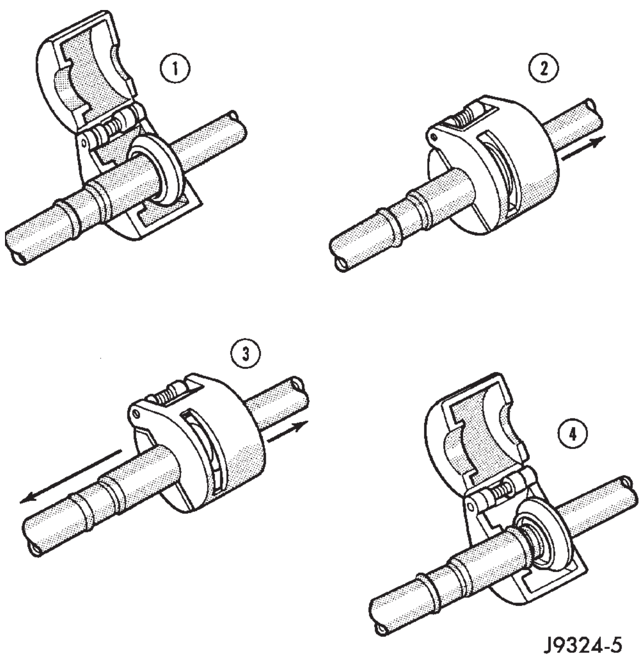

Fig. 8 Refrigerant Line Spring-Lock Coupler Disconnect

(4) Close the two halves of the A/C line disconnect tool around the spring-lock coupler.

(5) Push the A/C line disconnect tool into the open side of the coupler cage to expand the garter spring. Once the garter spring is expanded and while still pushing the disconnect tool into the open side of the coupler cage, pull on the refrigerant line attached to the female half of the coupler fitting until the flange on the female fitting is separated from the garter spring and cage on the male fitting within the disconnect tool.

NOTE: The garter spring may not release if the A/C line disconnect tool is cocked while pushing it into the coupler cage opening.

(6) Open and remove the A/C line disconnect tool from the disconnected spring-lock coupler.

(7) Complete the separation of the two halves of the coupler fitting.

INSTALLATION

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(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.

EMISSIONS CONTROL

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EMISSIONS CONTROL

DESCRIPTION

The Powertrain Control Module (PCM) monitors many different circuits in the fuel injection, ignition, emission and engine systems. If the PCM senses a problem with a monitored circuit often enough to indicate an actual problem, it stores a Diagnostic Trouble Code (DTC) in the PCM's memory. If the code applies to a non-emissions related component or system, and the problem is repaired or ceases to exist, the PCM cancels the code after 40 warm-up cycles. Diagnostic trouble codes that affect vehicle emissions illuminate the Malfunction Indicator (check engine) Lamp. Refer to Malfunction Indicator Lamp in this section.

Certain criteria must be met before the PCM stores a DTC in memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the PCM.

The PCM might not store a DTC for a monitored circuit even though a malfunction has occurred. This may happen because one of the DTC criteria for the circuit has not been met. **For example**, assume the diagnostic trouble code criteria requires the PCM to monitor the circuit only when the engine operates between 750 and 2000 RPM. Suppose the sensor's output circuit shorts to ground when engine operates above 2400 RPM (resulting in 0 volt input to the PCM). Because the condition happens at an engine speed above the maximum threshold (2000 rpm), the PCM will not store a DTC.

There are several operating conditions for which the PCM monitors and sets DTC's. Refer to Monitored Systems, Components, and Non-Monitored Circuits in this section.

Technicians must retrieve stored DTC's by connecting the DRB scan tool (or an equivalent scan tool) to the 16–way data link connector (Fig. 1).

NOTE: Various diagnostic procedures may actually cause a diagnostic monitor to set a DTC. For instance, pulling a spark plug wire to perform a spark test may set the misfire code. When a repair is completed and verified, connect the DRB scan tool to the 16–way data link connector to erase all DTC's and extinguish the MIL (check engine lamp).

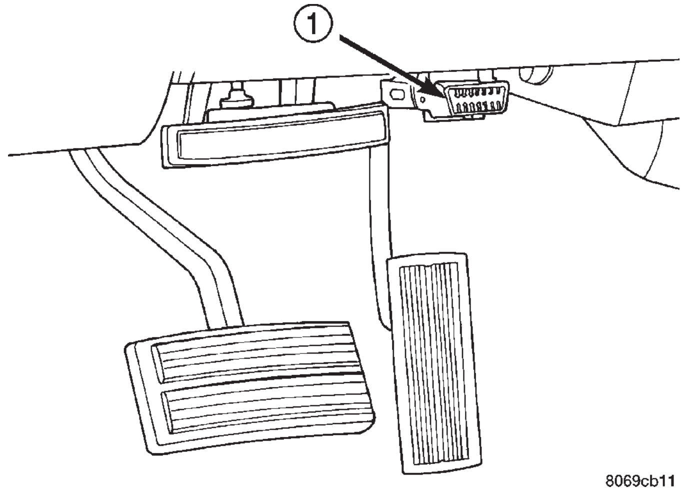

Fig. 1 Data Link (Diagnostic) Connector Location

1 - 16–WAY DATA LINK CONNECTOR

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,

EMISSIONS CONTROL (Continued)

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 Relay Circuit	Problem detected in oxygen sensor heater relay circuit.
P0036 (M)	1/2 O2 Sensor Heater Relay Circuit	Problem detected in oxygen sensor heater relay circuit.
P0106	Barometric Pressure Out of Range	MAP sensor input voltage out of an acceptable range detected during reading of barometric pressure at key-on.
P0107 (M)	Map Sensor Voltage Too Low	MAP sensor input below minimum acceptable voltage.
P0108 (M)	Map Sensor Voltage Too High	MAP sensor input above maximum acceptable voltage.
P0112 (M)	Intake Air Temp Sensor Voltage Low	Intake air (charge) temperature sensor input below the minimum acceptable voltage.
P0113 (M)	Intake Air Temp Sensor Voltage High	Intake air (charge) temperature sensor input above the maximum acceptable voltage.
P0116		A rationatilty error has been detected in the coolant temp sensor.
P0117 (M)	ECT Sensor Voltage Too Low	Engine coolant temperature sensor input below the minimum acceptable voltage.
P0118 (M)	ECT Sensor Voltage Too High	Engine coolant temperature sensor input above the maximum acceptable voltage.
P0121 (M)	TPS Voltage Does Not Agree With MAP	TPS signal does not correlate to MAP sensor signal.
P0121 (M)	Accelerator Position Sensor (APPS) Signal Voltage Too Low	APPS voltage input below the minimum acceptable voltage.
P0122 (M)	Throttle Position Sensor Voltage Low	Throttle position sensor input below the acceptable voltage range.
P0122 (M)	Accelerator Position Sensor (APPS) Signal Voltage Too Low	APPS voltage input below the minimum acceptable voltage.

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
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.
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.

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
P0154 (M)	2/1 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0155 (M)	2/1 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0157 (M)	2/2 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0158 (M)	2/2 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0159	2/2 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0160 (M)	2/2 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0161 (M)	2/2 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0168	Decreased Engine Performance Due To High Injection Pump Fuel Temp	Fuel temperature is above the engine protection limit. Engine power will be derated.
P0171 (M)	1/1 Fuel System Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.
P0172 (M)	1/1 Fuel System Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
P0174 (M)	2/1 Fuel System Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.
P0175 (M)	2/1 Fuel System Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
P0176	Loss of Flex Fuel Calibration Signal	No calibration voltage present from flex fuel sensor.
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.

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
P0205 (M)	Injector #5 Control Circuit	Injector #5 output driver stage does not respond properly to the control signal.
P0206 (M)	Injector #6 Control Circuit	Injector #6 output driver stage does not respond properly to the control signal.
P0207 (M)	Injector #7 Control Circuit	Injector #7 output driver stage does not respond properly to the control signal.
P0208 (M)	Injector #8 Control Circuit	Injector #8 output driver stage does not respond properly to the control signal.
P0209 (M)	Injector #9 Control Circuit	Injector #9 output driver stage does not respond properly to the control signal.
P0210 (M)	Injector #10 Control Circuit	Injector #10 output driver stage does not respond properly to the control signal.
P0215	Fuel Injection Pump Control Circuit	Failure in fuel pump relay control circuit.
P0216 (M)	Fuel Injection Pump Timing Failure	High fuel supply restriction, low fuel pressure or possible wrong or incorrectly installed pump keyway.
P0217	Decreased Engine Performance Due To Engine Overheat Condition	Engine overheating. ECM will derate engine performance.
P0219	Crankshaft Position Sensor Overspeed Signal	Engine has exceeded rpm limits.
P0222 (M)	Idle Validation Signals Both Low	Problem detected with idle validation circuits within APPS.
P0223 (M)	Idle Validation Signals Both High (Above 5 Volts)	Problem detected with idle validation circuits within APPS.
P0230	Transfer Pump (Lift Pump) Circuit Out of Range	Problem detected in fuel transfer pump circuits.
P0232	Fuel Shutoff Signal Voltage Too High	Fuel shut-off signal voltage too high from ECM to fuel injection pump.
P0234 (M)	Turbo Boost Limit Exceeded	Problem detected in turbocharger wastegate.
P0236 (M)	Map Sensor Too High Too Long	Problem detected in turbocharger wastegate.
P0237 (M)	Map Sensor Voltage Too Low	MAP sensor voltage input below the minimum acceptable voltage.
P0238 (M)	Map Sensor Voltage Too High	MAP sensor voltage input above the maximum acceptable voltage.
P0251 (M)	Fuel Inj. Pump Mech. Failure Fuel Valve Feedback Circuit	Problem sensed with fuel circuit internal to fuel injection pump.
P0253 (M)	Fuel Injection Pump Fuel Valve Open Circuit	Problem sensed with fuel circuit internal to fuel injection pump.
P0254	Fuel Injection Pump Fuel Valve Current Too High	Problem caused by internal fuel injection pump failure.
P0300 (M)	Multiple Cylinder Mis-fire	Misfire detected in multiple cylinders.
P0301 (M)	CYLINDER #1 MISFIRE	Misfire detected in cylinder #1.
P0302 (M)	CYLINDER #2 MISFIRE	Misfire detected in cylinder #2.
P0303 (M)	CYLINDER #3 MISFIRE	Misfire detected in cylinder #3.

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
P0304 (M)	CYLINDER #4 MISFIRE	Misfire detected in cylinder #4.
P0305 (M)	CYLINDER #5 MISFIRE	Misfire detected in cylinder #5.
P0306 (M)	CYLINDER #6 MISFIRE	Misfire detected in cylinder #6.
P0307 (M)	CYLINDER #7 MISFIRE	Misfire detected in cylinder #7
P0308 (M)	CYLINDER #8 MISFIRE	Misfire detected in cylinder #8.
P0309 (M)	CYLINDER #9 MISFIRE	Misfire detected in cylinder #9.
P0310 (M)	CYLINDER #10 MISFIRE	Misfire detected in cylinder #10.
P0320 (M)	No Crank Referance Signal at PCM	No reference signal (crankshaft position sensor) detected during engine cranking.
P0320 (M)	No RPM Signal to PCM (Crankshaft Position Sensor Signal to JTEC)	A CKP signal has not been detected at the PCM.
P0325	Knock Sensor #1 Circuit	Knock sensor (#1) signal above or below minimum acceptable threshold voltage at particular engine speeds.
P0330	Knock Sensor #2 Circuit	Knock sensor (#2) signal above or below minimum acceptable threshold voltage at particular engine speeds.
P0336 (M)	Crankshaft Position (CKP) Sensor Signal	Problem with voltage signal from CKP.
P0340 (M)	No Cam Signal At PCM	No fuel sync
P0341 (M)	Camshaft Position (CMP) Sensor Signal	Problem with voltage signal from CMP.
P0350	Ignition Coil Draws Too Much Current	A coil (1-5) is drawing too much current.
P0351 (M)	Ignition Coil # 1 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0352 (M)	Ignition Coil # 2 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0353 (M)	Ignition Coil # 3 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0354 (M)	Ignition Coil # 4 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (High Impedance).
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)

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
P0381 (M)	Wait To Start Lamp Inoperative	Problem detected in wait-to-start bulb circuit.
P0382 (M)	Intake Air Heater Relay #2 Control Circuit	Problem detected in #2 air heater solenoid/relay circuit (not heater element)
P0387	Crankshaft Position Sensor Supply Voltage Too Low	CKP sensor voltage input below the minimum acceptable voltage.
P0388	Crankshaft Position Sensor Supply Voltage Too High	CKP sensor voltage input above the maximum acceptable voltage.
P0401	EGR System Failure	Required change in air/fuel ration not detected during diagnostic test.
P0403	EGR Solenoid Circuit	An open or shorted condition detected in the EGR solenoid control circuit.
P0404	EGR Position Sensor Rationality	EGR position sensor signal does not correlate to EGR duty cycle.
P0405	EGR Position Sensor Volts Too Low	EGR position sensor input below the acceptable voltage range.
P0406	EGR Position Sensor Volts Too High	EGR position sensor input above the acceptable voltage range.
P0412	Secondary Air Solenoid Circuit	An open or shorted condition detected in the secondary air (air switching/aspirator) solenoid control circuit.
P0420 (M)	1/1 Catalytic Converter Efficiency	Catalyst 1/1 efficiency below required level.
P0432 (M)	1/2 Catalytic Converter Efficiency	Catalyst 2/1 efficiency below required level.
P0441 (M)	Evap Purge Flow Monitor	Insufficient or excessive vapor flow detected during evaporative emission system operation.
P0442 (M)	Evap Leak Monitor Medium Leak Detected	A small leak has been detected in the evaporative system.
P0443 (M)	Evap Purge Solenoid Circuit	An open or shorted condition detected in the EVAP purge solenoid control circuit.
P0455 (M)	Evap Leak Monitor Large Leak Detected	A large leak has been detected in the evaporative system.
P0456 (M)	Evap Leak Monitor Small Leak Detected	Leak has been detected in the evaporative system.
P0460	Fuel Level Unit No Change Over Miles	During low fuel
P0460	Fuel Level Unit No Change Over Miles	Fuel level sending unit voltage does not change for more than 40 miles.
P0462	Fuel Level Sending Unit Volts Too Low	Fuel level sensor input below acceptable voltage.
P0462 (M)	Fuel Level Sending Unit Volts Too Low	Open circuit between PCM and fuel gauge sending unit.
P0463	Fuel Level Sending Unit Volts Too High	Fuel level sensor input above acceptable voltage.
P0463 (M)	Fuel Level Sending Unit Volts Too High	Circuit shorted to voltage between PCM and fuel gauge sending unit.

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
P0500 (M)	No Vehicle Speed Sensor Signal	No vehicle speed sensor signal detected during road load conditions.
P0500 (M)	No Vehicle Speed Sensor Signal	A vehicle speed signal was not detected.
P0505 (M)	Idle Air Control Motor Circuits	SBEC II
P0522	Oil Pressure Voltage Too Low	Oil pressure sending unit (sensor) voltage input below the minimum acceptable voltage.
P0523	Oil Pressure Voltage Too High	Oil pressure sending unit (sensor) voltage input above the maximum acceptable voltage.
P0524	Oil Pressure Too Low	Engine oil pressure is low. Engine power derated.
P0545	A/C Clutch Relay Circuit	Problem detected in air conditioning clutch relay control circuit.
P0551	Power Steering Switch Failure	Incorrect input state detected for the power steering switch circuit. PL: High pressure seen at high speed.
P0562	Charging System Voltage Too Low	Supply voltage sensed at ECM too low.
P0563	Charging System Voltage Too High	Supply voltage sensed at ECM too high.
P0600	PCM Failure SPI Communications	No communication detected between co-processors in the control module.
P0601 (M)	Internal Controller Failure	Internal control module fault condition (check sum) detected.
P0602 (M)	ECM Fueling Calibration Error	ECM Internal fault condition detected.
P0604	RAM Check Failure	Transmission control module RAM self test fault detected. -Aisin transmission
P0605	ROM Check Falure	Transmission control module ROM self test fault detected -Aisin transmission
P0606 (M)	ECM Failure	ECM Internal fault condition detected.
P0615	Starter Relay Control Circuit	An open or shorted condition detected in the starter relay control circuit.
P0622 (G)	Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
P0645	A/C Clutch Relay Circuit	An open or shorted condition detected in the A/C clutch relay control circuit.
P0700	EATX Controller DTC Present	This SBEC III or JTEC DTC indicates that the EATX or Aisin controller has an active fault and has illuminated the MIL via a CCD (EATX) or SCI (Aisin) message. The specific fault must be acquired from the EATX via CCD or from the Aisin via ISO-9141.
P0703	Brake Switch Stuck Pressed or Released	Incorrect input state detected in the brake switch circuit. (Changed from P1595)
P0711 (M)	Trans Temp Sensor, No Temp Rise After Start	Relationship between the transmission temperature and overdrive operation and/or TCC operation indicates a failure of the Transmission Temperature Sensor. OBD II Rationality. Was MIL code 37.

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	Trans Temp Sensor Voltage Too Low	Transmission fluid temperature sensor input below acceptable voltage. Was MIL code 37.
P0712 (M)	Trans Temp Sensor Voltage Too Low	Voltage less than 1.55 volts (4-speed auto. trans. only).
P0713	Trans Temp Sensor Voltage Too High	Transmission fluid temperature sensor input above acceptable voltage. Was MIL code 37.
P0713 (M)	Trans Temp Sensor Voltage Too High	Voltage greater than 3.76 volts (4-speed auto. trans. only).
P0720 (M)	Low Output SPD Sensor RPM, Above 15 MPH	The relationship between the Output Shaft Speed Sensor and vehicle speed is not within acceptable limits.
P0720 (M)	Low Output Spd Sensor RPM Above 15 mph	Output shaft speed is less than 60 rpm with vehicle speed above 15 mph (4-speed auto. trans. only).
P0740 (M)	Torq Con Clu, No RPM Drop at Lockup	Relationship between engine and vehicle speeds indicated failure of torque convertor clutch lock-up system (TCC/PTU solenoid)
P0743 (M)	Torque Converter Clutch Solenoid/ Trans Relay Circuits	An open or shorted condition detected in the torque converter clutch (part throttle unlock) solenoid control circuit. Shift solenoid C electrical fault - Aisin transmission
P0743 (M)	Torque Converter Clutch Solenoid/ Trans Relay Circuits	An open or shorted condition detected in the torque converter part throttle unlock solenoid control circuit (3 or 4-speed auto. trans. only).
P0748 (M)	Governor Pressur Sol Control/Trans Relay Circuits	An open or shorted condition detected in the Governor Pressure Solenoid circuit or Trans Relay Circuit in JTEC RE transmissions.
P0748 (M)	Governor Pressure Sol Control/Trans Relay Circuits	An open or shorted condition detected in the governor pressure solenoid or relay circuits (4-speed auto. trans. only).
P0751 (M)	O/D Switch Pressed (Lo) More Than 5 Minutes	Overdrive override switch input is in a prolonged depressed state.
P0751 (M)	O/D Switch Pressed (LO) More Than 5 Min	Overdrive Off switch input too low for more than 5 minutes (4-speed auto. trans. only).
P0753 (M)	Trans 3-4 Shift Sol/Trans Relay Circuits	An open or shorted condition detected in the overdrive solenoid control circuit or Trans Relay Circuit in JTEC RE transmissions. Was MIL code 45.
P0753 (M)	Trans 3-4 Shift Sol/Trans Relay Circuits	An open or shorted condition detected in the transmission 2-4 shift solenoid circuit (4-speed auto. trans. only).
P0756	AW4 Shift Sol B (2-3) Functional Failure	Shift solenoid B (2-3) functional fault - Aisin transmission
P0783 (M)	3-4 Shift Sol, No RPM Drop at Lockup	The overdrive solenoid is unable to engage the gear change from 3rd gear to the overdrive gear.
P0801	Reverse Gear Lockout Circuit Open or Short	An open or shorted condition detected in the transmission reverse gear lock-out solenoid control circuit.
P0830	Clutch Depressed Switch Circuit	Problem detected in clutch switch circuit.
P0833	Clutch Released Switch Circuit	Problem detected in clutch switch circuit.

EMISSIONS CONTROL (Continued)

Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
(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		
P1110	Decrease Engine Performance Due To High Intake Air Temperature	Intake manifold air temperature is above the engine protection limit. Engine power will be derated.
P1180	Decreased Engine Performance Due To High Injection Pump Fuel Temp	Fuel temperature is above the engine protection limit. Engine power will be derated.
P1195 (M)	1/1 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 1/1 during catalyst monitor test. (Also see SCI DTC $66) (was P0133)
P1196 (M)	2/1 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 2/1 during catalyst monitor test. (Also see SCI DTC $7A) (was P0153)
P1197	1/2 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 1/2 during catalyst monitor test. (Also see SCI DTC $68) (was P0139)
P1198	Radiator Temperature Sensor Volts Too High	Radiator coolant temperature sensor input above the maximum acceptable voltage.
P1199	Radiator Temperature Sensor Volts Too Low	Radiator coolant temperature sensor input below the minimum acceptable voltage.
P1281	Engine is Cold Too Long	Engine coolant temperature remains below normal operating temperatures during vehicle travel (Thermostat).
P1282	Fuel Pump Relay Control Circuit	An open or shorted condition detected in the fuel pump relay control circuit.
P1283	Idle Select Signal Invalid	ECM or fuel injection pump module internal fault condition detected.
P1284 (M)	Fuel Injection Pump Battery Voltage Out-Of-Range	Fuel injection pump module internal fault condition detected. Engine power will be derated.
P1285 (M)	Fuel Injection Pump Controller Always On	Fuel injection pump module relay circuit failure detected. Engine power will be derated.
P1286	Accelerator Position Sensor (APPS) Supply Voltage Too High	High voltage detected at APPS.
P1287	Fuel Injection Pump Controller Supply Voltage Low	ECM or fuel injection pump module internal fault condition detected. Engine power will be derated.
P1288	Intake Manifold Short Runner Solenoid Circuit	An open or shorted condition detected in the short runner tuning valve circuit.
P1289	Manifold Tune Valve Solenoid Circuit	An open or shorted condition detected in the manifold tuning valve solenoid control circuit.
P1290	CNG Fuel System Pressure Too High	Compressed natural gas system pressure above normal operating range.
P1291	No Temp Rise Seen From Intake Heaters	Energizing Heated Air Intake does not change intake air temperature sensor an acceptable amount.
P1291 (M)	No Temperature Rise Seen From Intake Air Heaters	Problem detected in intake manifold air heating system.
P1292	CNG Pressure Sensor Voltage Too High	Compressed natural gas pressure sensor reading above acceptable voltage.

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
P1293	CNG Pressure Sensor Voltage Too Low	Compressed natural gas pressure sensor reading below acceptable voltage.
P1294 (M)	Target Idle Not Reached	Target RPM not achieved during drive idle condition. Possible vacuum leak or IAC (AIS) lost steps.
P1295 (M)	No 5 Volts to TP Sensor	Loss of a 5 volt feed to the Throttle Position Sensor has been detected.
P1295 (M)	Accelerator Position Sensor (APPS) Supply Voltage Too Low	APPS supply voltage input below the minimum acceptable voltage.
P1296	No 5 Volts to MAP Sensor	Loss of a 5 volt feed to the MAP Sensor has been detected.
P1297 (M)	No Change in MAP From Start To Run	No difference is recognized between the MAP reading at engine idle and the stored barometric pressure reading.
P1298	Lean Operation at Wide Open Throttle	A prolonged lean condition is detected during Wide Open Throttle
P1299	Vacuum Leak Found (IAC Fully Seated)	MAP Sensor signal does not correlate to Throttle Position Sensor signal. Possible vacuum leak.
P1388	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the ASD or CNG shutoff relay control ckt.
P1388	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the auto shutdown relay circuit.
P1389	No ASD Relay Output Voltage At PCM	No Z1 or Z2 voltage sensed when the auto shutdown relay is energized.
P1389 (M)	No ASD Relay Output Voltage at PCM	An open condition detected In the ASD relay output circuit.
P1390	Timing Belt Skipped 1 Tooth or More	Relationship between Cam and Crank signals not correct
P1391 (M)	Intermittent Loss of CMP or CKP	Loss of the Cam Position Sensor or Crank Position sensor has occurred. For PL 2.0L
P1398 (M)	Mis-Fire Adaptive Numerator at Limit	PCM is unable to learn the Crank Sensor's signal in preparation for Misfire Diagnostics. Probable defective Crank Sensor
P1399	Wait To Start Lamp Cicuit	An open or shorted condition detected in the Wait to Start Lamp circuit.
P1403	No 5V to EGR Sens	Loss of 5v feed to the EGR position sensor.
P01475	Aux 5 Volt Supply Voltage High	Sensor supply voltage for ECM sensors is too high.
P1476	Too Little Secondary Air	Insufficient flow of secondary air injection detected during aspirator test (was P0411)
P1477	Too Much Secondary Air	Excessive flow of secondary air injection detected during aspirator test (was P0411).
P1478	Battery Temp Sensor Volts Out of Limit	Internal temperature sensor input voltage out of an acceptable range.
P1479	Transmission Fan Relay Circuit	An open or shorted condition detected in the transmission fan relay circuit.

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
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)
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.

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
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.
P1680	Clutch Released Switch Circuit	Problem detected in clutch switch electrical circuit.
P1681	No I/P Cluster CCD/J1850 Messages Received	No CCD/J1850 messages received from the cluster control module.
P1682 (G)	Charging System Voltage Too Low	Battery voltage sense input below target charging voltage during engine operation and no significant change in voltage detected during active test of generator output circuit.
P1682	Charging System Voltage Too Low	Charging system output voltage low.
P1683	SPD CTRL PWR Relay; or S/C 12v Driver CKT	An open or shorted condition detected in the speed control servo power control circuit.
P1683	Spd ctrl pwr rly, or s/c 12v driver circuit	An open or shorted condition detected in the speed control servo power control circuit.
P1684	Batt Loss in 50 Star	The battery has been disconnected within the last 50 starts
P1685	SKIM Invalid Key	The engine controler has received an invalid key from the SKIM.
P1686	No SKIM BUS Messages Received	No CCD/J1850 messages received from the Smart Key Immobilizer Module (SKIM).
P1687	No MIC BUS Message	No CCD/J1850 messages received from the Mechanical Instrument Cluster (MIC) module.
P1688 (M)	Internal Fuel Injection Pump Controller Failure	Internal problem within the fuel injection pump. Low power, engine derated, or engine stops.

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
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 CCD Messages received from ECM	Bus communication failure to PCM.
P1695	No CCD/J1850 Message From Body Control Module	No CCD/J1850 messages received from the body control module.
P1696	PCM Failure EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the control module.
P1697	PCM Failure SRI Mile Not Stored	Unsuccessful attempt to update Service Reminder Indicator (SRI or EMR) mileage in the control module EEPROM.
P1698	No CCD/J1850 Message From TCM	No CCD/J1850 messages received from the electronic transmission control module (EATX) or the Aisin transmission controller.
P1698	No CCD Messages received from PCM	Bus communication failure to PCM. A ″Companion DTC″ was set in both the ECM and PCM.
P1719	Skip Shift Solenoid Circuit	An open or shorted condition detected in the transmission 2-3 gear lock-out solenoid control circuit.
P1740	TCC or OD Sol Perf	A rationality error has been detected in either the TCC solenoid or overdrive solenoid systems.
P1740 (M)	TCC OR O/D Solenoid Performance	Problem detected in transmission convertor clutch and/or overdrive circuits (diesel engine with 4-speed auto. trans. only).
P1756 (M)	GOV Press Not Equal to Target @ 15-20 PSI	The requested pressure and the actual pressure are not within a tolerance band for the Governor Control System which is used to regulate governor pressure to control shifts for 1st, 2nd, and 3rd gear. (Mid Pressure Malfunction)
P1756 (M)	Governor Pressure Not Equal to Target @ 15-20 PSI	Governor sensor input not between 10 and 25 psi when requested (4-speed auto. trans. only).

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
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).
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).

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 call 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

EMISSIONS CONTROL (Continued)

- 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 evaporative system and seal the evaporative system so the leak detection test can be run.

The primary components within the assembly are: A three port solenoid that activates both of the functions listed above; a pump which contains a switch, two check valves and a spring/diaphragm, a canister vent valve (CVV) seal which contains a spring loaded vent seal valve.

Immediately after a cold start, between predetermined temperature thresholds limits, the three port solenoid is briefly energized. This initializes the pump by drawing air into the pump cavity and also closes the vent seal. During non test conditions the vent seal is held open by the pump diaphragm assembly which pushes it open at the full travel position. The vent seal will remain closed while the pump is cycling due to the reed switch triggering of the three port solenoid that prevents the diaphragm assembly from reaching full travel. After the brief initialization period, the solenoid is de-energized allowing atmospheric pressure to enter the pump cavity, thus permitting the spring to drive the diaphragm which forces air out of the pump cavity and into the vent system. When the solenoid is energized and de energized, the cycle is repeated creating flow in typical diaphragm pump fashion. The pump is controlled in 2 modes:

Pump Mode: The pump is cycled at a fixed rate to achieve a rapid pressure build in order to shorten the overall test length.

EMISSIONS CONTROL (Continued)

Test Mode: The solenoid is energized with a fixed duration pulse. Subsequent fixed pulses occur when the diaphragm reaches the Switch closure point.

The spring in the pump is set so that the system will achieve an equalized pressure of about 7.5” H20. The cycle rate of pump strokes is quite rapid as the system begins to pump up to this pressure. As the pressure increases, the cycle rate starts to drop off. If there is no leak in the system, the pump would eventually stop pumping at the equalized pressure. If there is a leak, it will continue to pump at a rate representative of the flow characteristic of the size of the leak. From this information we can determine if the leak is larger than the required detection limit (currently set at .040” orifice by CARB). If a leak is revealed during the leak test portion of the test, the test is terminated at the end of the test mode and no further system checks will be performed.

After passing the leak detection phase of the test, system pressure is maintained by turning on the LDP’s solenoid until the purge system is activated. Purge activation in effect creates a leak. The cycle rate is again interrogated and when it increases due to the flow through the purge system, the leak check portion of the diagnostic is complete.

The canister vent valve will unseal the system after completion of the test sequence as the pump diaphragm assembly moves to the full travel position.

Evaporative system functionality will be verified by using the stricter evap purge flow monitor. At an appropriate warm idle the LDP will be energized to seal the canister vent. The purge flow will be clocked up from some small value in an attempt to see a shift in the 02 control system. If fuel vapor, indicated by a shift in the 02 control, is present the test is passed. If not, it is assumed that the purge system is not functioning in some respect. The LDP is again turned off and the test is ended.

MISFIRE MONITOR

Excessive engine misfire results in increased catalyst temperature and causes an increase in HC emissions. Severe misfires could cause catalyst damage. To prevent catalytic convertor damage, the PCM monitors engine misfire.

The Powertrain Control Module (PCM) monitors for misfire during most engine operating conditions (positive torque) by looking at changes in the crankshaft speed. If a misfire occurs the speed of the crankshaft will vary more than normal.

FUEL SYSTEM MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide. The catalyst works best when the Air Fuel (A/F) ratio is at or near the optimum of 14.7 to 1.

The PCM is programmed to maintain the optimum air/fuel ratio of 14.7 to 1. This is done by making short term corrections in the fuel injector pulse width based on the O2S sensor output. The programmed memory acts as a self calibration tool that the engine controller uses to compensate for variations in engine specifications, sensor tolerances and engine fatigue over the life span of the engine. By monitoring the actual fuel-air ratio with the O2S sensor (short term) and multiplying that with the program long-term (adaptive) memory and comparing that to the limit, it can be determined whether it will pass an emissions test. If a malfunction occurs such that the PCM cannot maintain the optimum A/F ratio, then the MIL will be illuminated.

CATALYST MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide.

Normal vehicle miles or engine misfire can cause a catalyst to decay. A meltdown of the ceramic core can cause a reduction of the exhaust passage. This can increase vehicle emissions and deteriorate engine performance, driveability and fuel economy.

The catalyst monitor uses dual oxygen sensors (O2S’s) to monitor the efficiency of the converter. The dual O2S’s sensor strategy is based on the fact that as a catalyst deteriorates, its oxygen storage capacity and its efficiency are both reduced. By monitoring the oxygen storage capacity of a catalyst, its efficiency can be indirectly calculated. The upstream O2S is used to detect the amount of oxygen in the exhaust gas before the gas enters the catalytic converter. The PCM calculates the A/F mixture from the output of the O2S. A low voltage indicates high oxygen content (lean mixture). A high voltage indicates a low content of oxygen (rich mixture).

When the upstream O2S detects a lean condition, there is an abundance of oxygen in the exhaust gas. A functioning converter would store this oxygen so it can use it for the oxidation of HC and CO. As the converter absorbs the oxygen, there will be a lack of oxygen downstream of the converter. The output of the downstream O2S will indicate limited activity in this condition.

As the converter loses the ability to store oxygen, the condition can be detected from the behavior of the downstream O2S. When the efficiency drops, no chemical reaction takes place. This means the concentration of oxygen will be the same downstream as upstream. The output voltage of the downstream O2S copies the voltage of the upstream sensor. The only difference is a time lag (seen by the PCM) between the switching of the O2S's.

To monitor the system, the number of lean-to-rich switches of upstream and downstream O2S's is counted. The ratio of downstream switches to upstream switches is used to determine whether the catalyst is operating properly. An effective catalyst will have fewer downstream switches than it has upstream switches i.e., a ratio closer to zero. For a totally ineffective catalyst, this ratio will be one-to-one, indicating that no oxidation occurs in the device.

The system must be monitored so that when catalyst efficiency deteriorates and exhaust emissions increase to over the legal limit, the MIL will be illuminated.

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 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.

EMISSIONS CONTROL (Continued)

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

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** resolu-

EMISSIONS CONTROL (Continued)

tion 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 MILL state is ON. After the next key cycle, the MIL is not illuminated and both MIL states read OFF.

Diagnostic Trouble Codes (DTCs)

With OBD II, different DTC faults have different priorities according to regulations. As a result, the priorities determine MIL illumination and DTC erasure. DTCs are entered according to individual priority. DTCs with a higher priority overwrite lower priority DTCs.

Priorities

- Priority 0 —Non-emissions related trouble codes
- Priority 1 — One trip failure of a two trip fault for non-fuel system and non-misfire.
- Priority 2 — One trip failure of a two trip fault for fuel system (rich/lean) or misfire.
- Priority 3 — Two trip failure for a non-fuel system and non-misfire or matured one trip comprehensive component fault.
- Priority 4 — Two trip failure or matured fault for fuel system (rich/lean) and misfire or one trip catalyst damaging misfire.

Non-emissions related failures have no priority. One trip failures of two trip faults have low priority. Two trip failures or matured faults have higher priority. One and two trip failures of fuel system and misfire monitor take precedence over non-fuel system and non-misfire failures.

DTC Self Erasure

With one trip components or systems, the MIL is illuminated upon test failure and DTCs are stored.

Two trip monitors are components requiring failure in two consecutive trips for MIL illumination. Upon failure of the first test, the Task Manager enters a maturing code. If the component fails the test for a second time the code matures and a DTC is set.

After three good trips the MIL is extinguished and the Task Manager automatically switches the trip counter to a warm-up cycle counter. DTCs are automatically erased following 40 warm-up cycles if the component does not fail again.

For misfire and fuel system monitors, the component must pass the test under a Similar Conditions Window in order to record a good trip. A Similar Conditions Window is when engine RPM is within ±375 RPM and load is within ±10% of when the fault occurred.

NOTE: It is important to understand that a component does not have to fail under a similar window of operation to mature. It must pass the test under a Similar Conditions Window when it failed to record a Good Trip for DTC erasure for misfire and fuel system monitors.

DTCs can be erased anytime with a DRB III. Erasing the DTC with the DRB III erases all OBD II information. The DRB III automatically displays a

EMISSIONS CONTROL (Continued)

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

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.

EMISSIONS CONTROL (Continued)

• **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 - 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)

SPECIFICATIONS

SPECIFICATIONS - TORQUE - EVAP SYSTEM

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
EVAP Canister Mounting Nut	17-24		150-210
EVAP Canister Purge Solenoid Mounting Bolt – Except 2.5L Engine	11		95
EVAP Canister Purge Solenoid Mounting Nuts – 2.5L Engine	8		75
Leak Detection Pump (LDP) Mounting Screws	1		11

CCV HOSE

DESCRIPTION - 2.5L

2.5L 4–cylinder engines are equipped with a Crankcase Ventilation (CCV) system. The CCV system performs the same function as a conventional PCV system, but does not use a vacuum controlled valve.

A molded vacuum tube connects a fitting on the intake manifold to a fixed orifice fitting of a calibrated size. This fitting meters the amount of crankcase vapors drawn out of the engine. The fixed orifice fitting is located on the side of cylinder head (valve) cover (Fig. 1).

A fresh air supply hose from the air cleaner housing is connected to a fitting at the top/rear of cylinder head cover (Fig. 1).

When the engine is operating, fresh air enters the engine and mixes with crankcase vapors. Engine vacuum draws the vapor/air mixture through the fixed orifice and into the intake manifold. The vapors are then consumed during engine combustion.

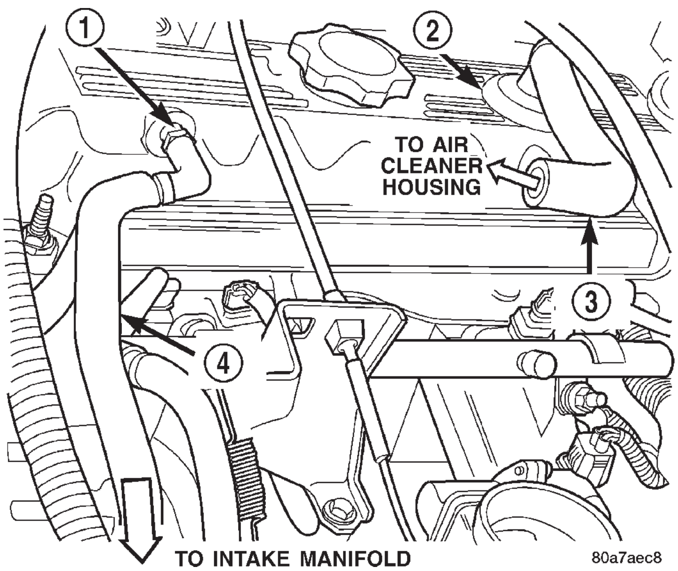

Fig. 1 CCV System—2.5L Engine

1 - FIXED ORIFICE FITTING
2 - AIR INLET FITTING
3 - CCV TUBE
4 - CCV TUBE

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.

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

3.9/5.2/5.9L Engines: The duty cycle EVAP canister purge solenoid is located at left-rear side of engine compartment near power brake vacuum unit (Fig. 2).

2.5L Engine: The solenoid is located at right-rear side of engine compartment (Fig. 3).

(1) Disconnect electrical wiring connector at solenoid

(2) Disconnect vacuum harness at solenoid.

(3) Remove 2 support bracket mounting nuts.

(4) Remove solenoid and its support bracket from vehicle.

EVAP/PURGE SOLENOID (Continued)

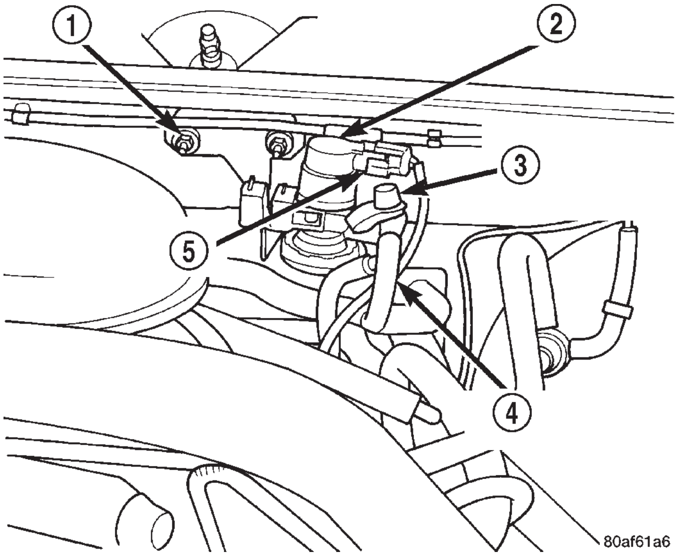

Fig. 2 Duty Cycle EVAP Canister Purge Solenoid

1 - BRACKET NUTS (2)
2 - EVAP CANISTER PURGE SOLENOID
3 - EVAP SYSTEM TEST PORT (IF EQUIPPED)
4 - VACUUM LINES
5 - ELECTRICAL CONNECTOR

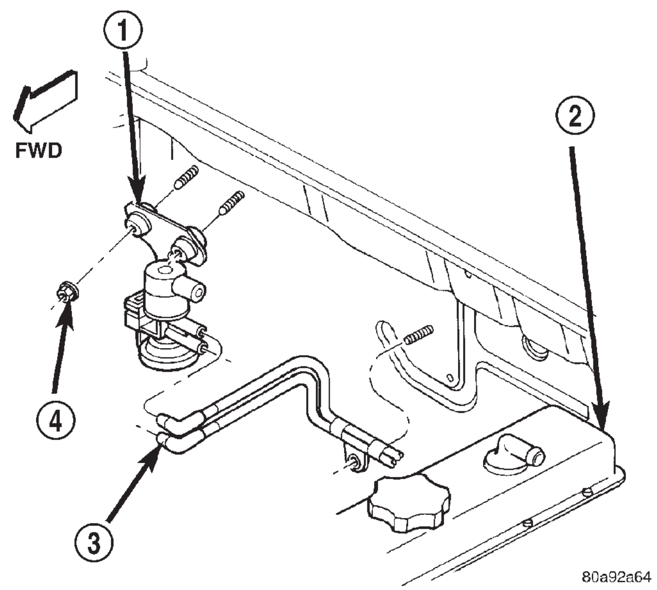

Fig. 3 Duty Cycle EVAP Canister Purge Solenoid—2.5L Engine

1 - DUTY CYCLE SOLENOID
2 - CYLINDER HEAD COVER
3 - VACUUM HOSES
4 - BRACKET NUTS (2)

INSTALLATION

3.9/5.2/5.9L Engines: The duty cycle EVAP canister purge solenoid is located at left-rear side of engine compartment near power brake vacuum unit (Fig. 2).

2.5L Engine: The solenoid is located at right-rear side of engine compartment (Fig. 3).

(1) Position EVAP canister purge solenoid and its mounting bracket.

(2) Install mounting nuts and tighten to 8 N·m (75 in. lbs.) torque.

(3) 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/INSTALLATION

If replacement of the 1/4 turn fuel tank filler tube cap is necessary, it must be replaced with an identical cap to be sure of correct system operation.

CAUTION: Remove the fuel tank filler tube cap to relieve fuel tank pressure. The cap must be removed prior to disconnecting any fuel system component or before draining the fuel tank.

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.

LEAK DETECTION PUMP (Continued)

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.

A typical system schematic is shown in (Fig. 4).

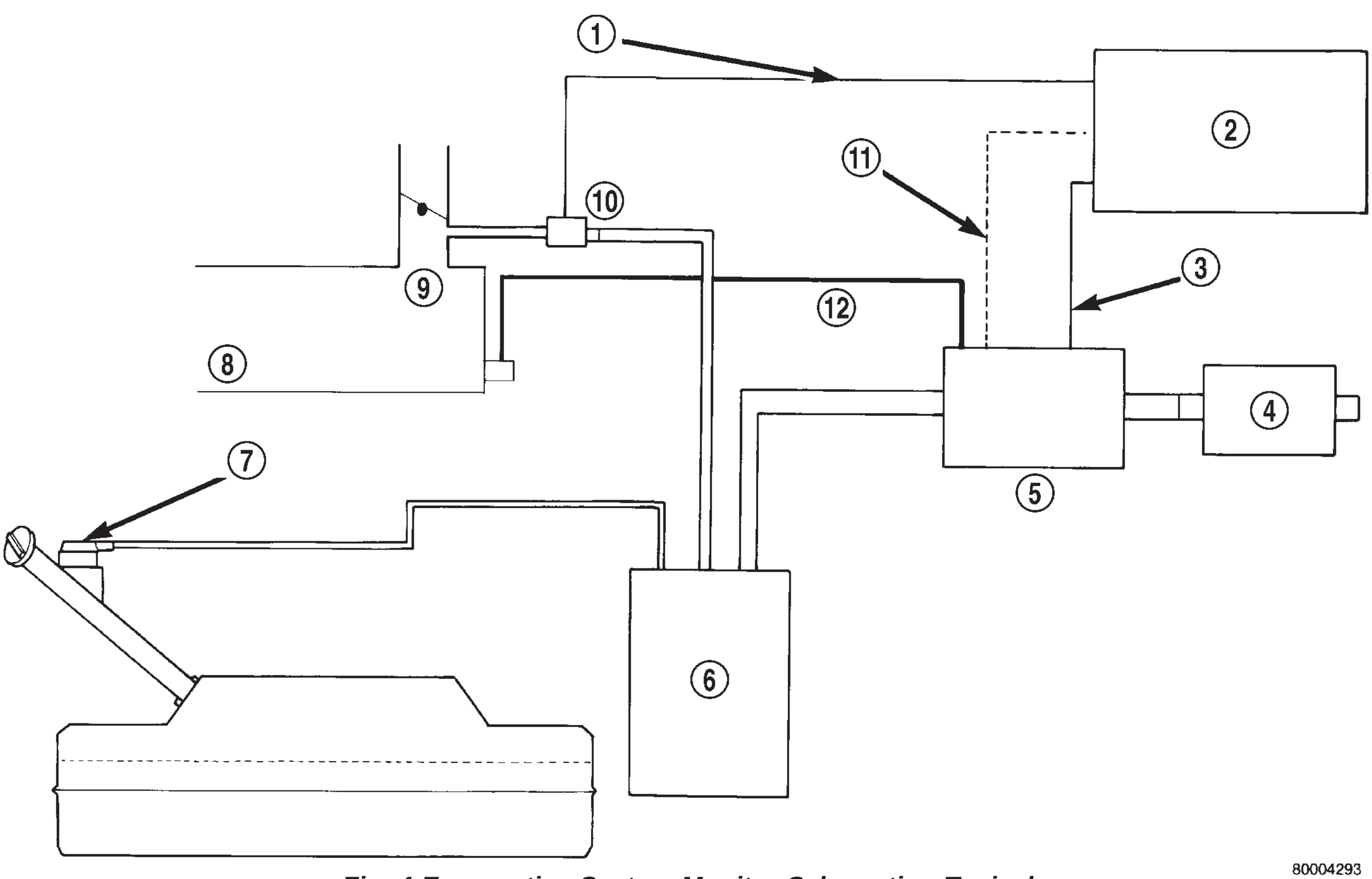

Fig. 4 Evaporative System Monitor Schematic—Typical

1 - DUTY CYCLE PURGE SOLENOID (DCPS) DRIVER
2 - POWERTRAIN CONTROL MODULE (PCM)
3 - 3-PORT SOLENOID DRIVER
4 - REMOTE FILTER
5 - COMBINED CANISTER VENT VALVE & LEAK DETECTION PUMP
6 - CANISTER
7 - TANK ROLLOVER VALVE & VAPOR FLOW CONTROL ORIFICE
8 - INTAKE MANIFOLD
9 - THROTTLE BODY
10 - DCPS
11 - SWITCH SIGNAL INPUT TO THE PCM
12 - ENGINE VACUUM LINE

LEAK DETECTION PUMP (Continued)

REMOVAL

The LDP is located in the engine compartment under the battery tray and Power Distribution Center (PDC) (Fig. 5). The LDP filter is attached to the outside of battery tray (Fig. 6). The LDP and LDP filter are replaced (serviced) as one unit.

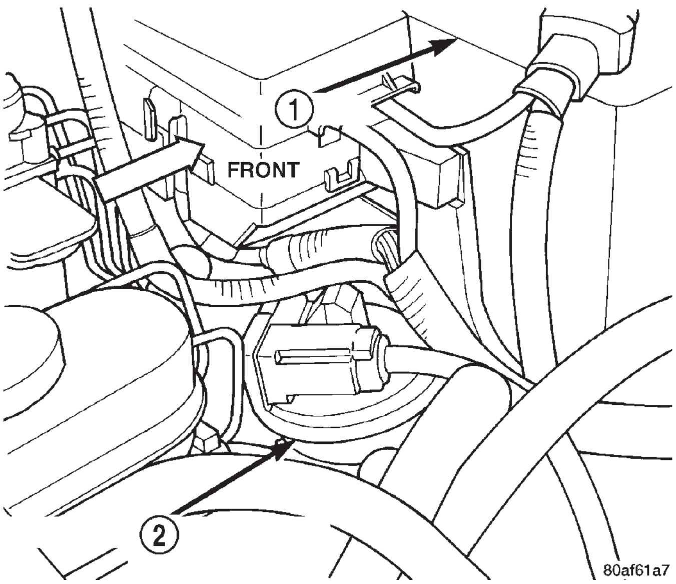

Fig. 5 Leak Detection Pump (LDP) Location

1 - BATTERY
2 - LEAK DETECTION PUMP (LDP)

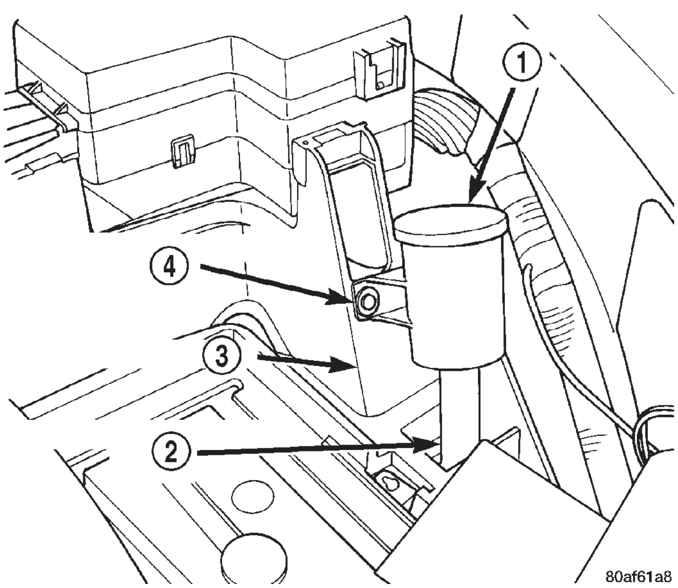

Fig. 6 LDP Filter Location

1 - LDP FILTER
2 - LDP FILTER-TO-LDP HOSE
3 - BATTERY TRAY
4 - LDP MOUNTING CLIP

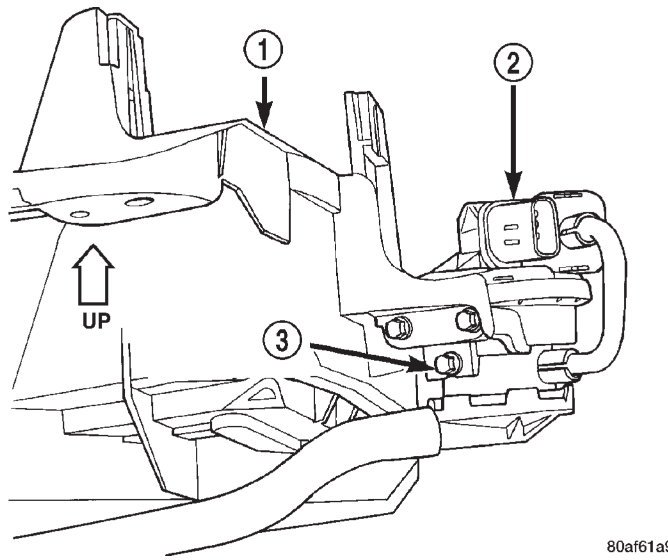

Fig. 7 Leak Detection Pump (LDP) Mounting Screws

1 - BATTERY TRAY
2 - LDP
3 - LDP MOUNTING SCREWS (3)

(1) Disconnect negative battery cable at battery.

(2) Remove battery. Refer to 8, Battery for procedures.

(3) Carefully disconnect rubber hose from bottom of LDP filter (Fig. 6).

(4) Remove clip retaining LDP filter to battery tray (Fig. 6)and remove filter from tray.

(5) Disconnect battery temperature sensor pigtail wiring harness at bottom of battery tray.

(6) To gain access to LDP, the PDC must be partially removed. Remove PDC-to-fender mounting screw at rear of PDC. Unsnap PDC from battery tray. To prevent damage to PDC wiring, carefully position PDC to gain access to LDP.

(7) Remove battery tray. Refer to 8, Battery for procedures.

(8) Carefully remove vapor/vacuum lines at LDP.

(9) Disconnect electrical connector at LDP.

(10) Remove 3 LDP mounting screws (Fig. 7) and remove LDP from vehicle.

INSTALLATION

The LDP is located in the engine compartment under the battery tray and Power Distribution Center (PDC) (Fig. 5). The LDP filter is attached to the outside of battery tray (Fig. 6). The LDP and LDP filter are replaced (serviced) as one unit.

(1) Install LDP to bottom of battery tray. Tighten screws to 1 N·m (11 in. lbs.) torque.

(2) 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**

LEAK DETECTION PUMP (Continued)

purge solenoid for damage or leaks. If a leak is present, a Diagnostic Trouble Code (DTC) may be set.

(3) Connect electrical connector to LDP.

(4) Install battery tray. Refer to 8, Battery for procedures.

(5) Install PDC to fender and battery tray (snaps on to battery tray).

(6) Install LDP filter to battery tray (one clip).

(7) Install connecting hose to bottom of LDP filter.

(8) Connect battery temperature sensor pigtail wiring harness.

(9) Install battery. Refer to 8, Battery for procedures.

(10) Connect negative battery cable to battery.

PCV VALVE

DESCRIPTION - 3.9L/5.2L/5.9L

All 3.9L V-6 and 5.2/5.9L V-8 are equipped with a closed crankcase ventilation system and a positive crankcase ventilation (PCV) valve. The 2.5L 4–cylinder engine is not equipped with a PCV valve. Refer to Crankcase Ventilation System—2.5L Engine for information.

This system consists of a PCV valve mounted on the cylinder head (valve) cover with a hose extending from the valve to the intake manifold (Fig. 8). Another hose connects the opposite cylinder head (valve) cover to the air cleaner housing to provide a source of clean air for the system. A separate crankcase breather/filter is not used.

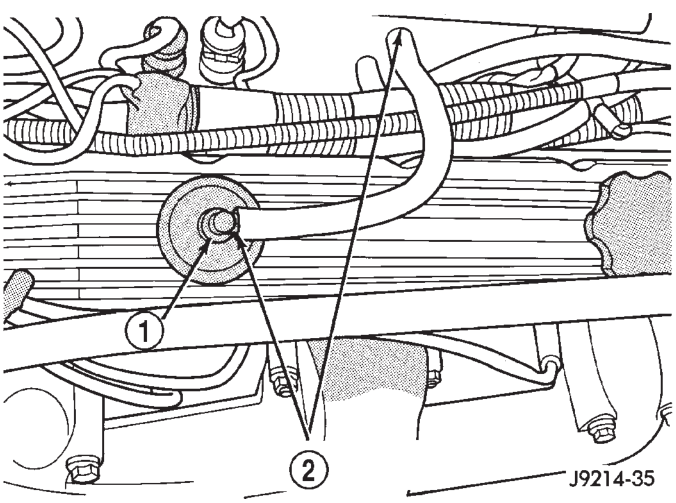

Fig. 8 PCV Valve/Hose—Typical

1 - PCV VALVE
2 - PCV VALVE HOSE CONNECTIONS

DESCRIPTION - 4.7L

The 4.7L V-8 engine is equipped with a closed crankcase ventilation system and a Positive Crankcase Ventilation (PCV) valve.

This system consists of:

- a PCV valve mounted to the oil filler housing (Fig. 9). The PCV valve is sealed to the oil filler housing with an o-ring.
- the air cleaner housing
- two interconnected breathers threaded into the rear of each cylinder head (Fig. 10).
- tubes and hose to connect the system components.

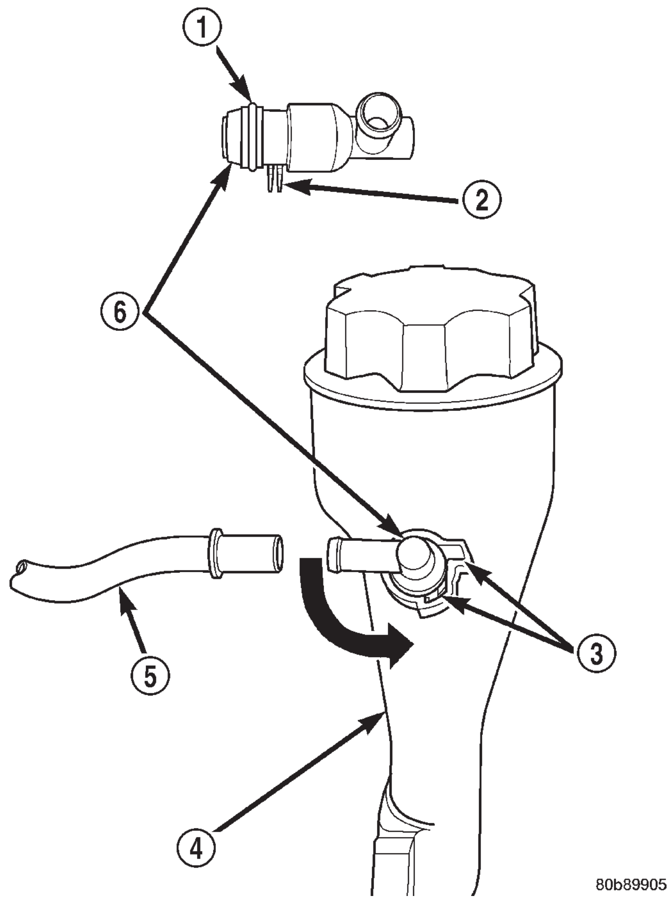

Fig. 9 PCV Valve/Oil Filler Tube (Housing)—4.7L Engine

1 - O-RING
2 - LOCATING TABS
3 - CAM LOCK
4 - OIL FILLER TUBE
5 - PCV LINE/HOSE
6 - PCV VALVE

PCV VALVE (Continued)

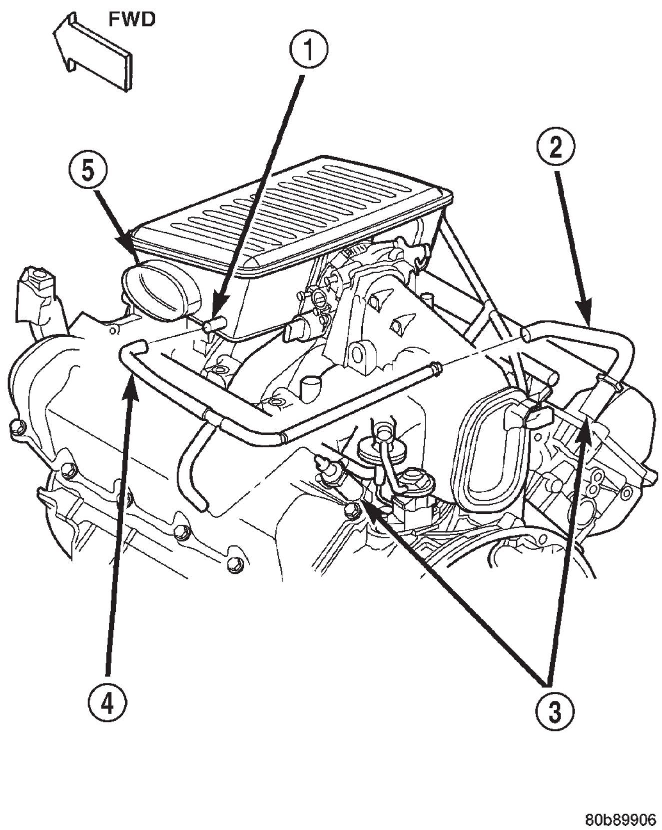

Fig. 10 PCV System Hoses/Tubes—4.7L Engine

1 - FRESH AIR FITTING
2 - CONNECTING TUBES/HOSES
3 - CRANKCASE BREATHERS (2)
4 - RUBBER HOSE
5 - AIR CLEANER RESONATOR

OPERATION - 3.9L/5.2L/5.9L

The PCV system operates by engine intake manifold vacuum (Fig. 11). Filtered air is routed into the crankcase through the air cleaner hose. The metered air, along with crankcase vapors, are drawn through the PCV valve and into a passage in the intake manifold. The PCV system manages crankcase pressure and meters blow by gases to the intake system, reducing engine sludge formation.

The PCV valve contains a spring loaded plunger. This plunger meters the amount of crankcase vapors routed into the combustion chamber based on intake manifold vacuum.

When the engine is not operating or during an engine pop-back, the spring forces the plunger back against the seat (Fig. 12). This will prevent vapors from flowing through the valve.

During periods of high manifold vacuum, such as idle or cruising speeds, vacuum is sufficient to completely compress spring. It will then pull the plunger to the top of the valve (Fig. 13). In this position there is minimal vapor flow through the valve.

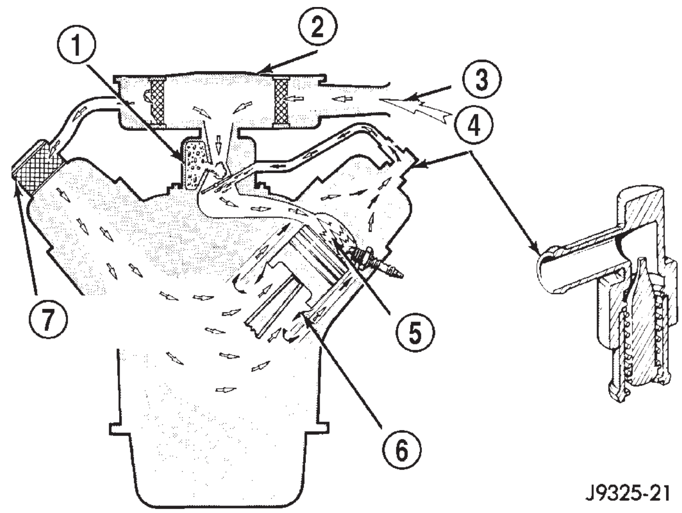

Fig. 11 Typical Closed Crankcase Ventilation System

1 - THROTTLE BODY
2 - AIR CLEANER
3 - AIR INTAKE
4 - PCV VALVE
5 - COMBUSTION CHAMBER
6 - BLOW-BY GASES
7 - CRANKCASE BREATHER/FILTER

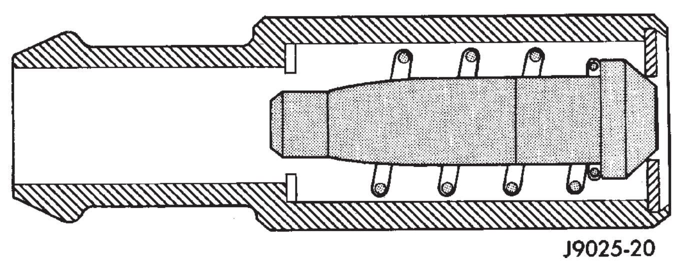

Fig. 12 Engine Off/Engine Pop Back—No Vapor Flow

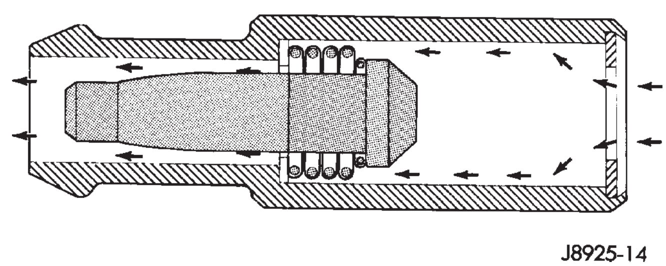

Fig. 13 High Intake Manifold Vacuum—Minimal Vapor Flow

PCV VALVE (Continued)

During periods of moderate manifold vacuum, the plunger is only pulled part way back from inlet. This results in maximum vapor flow through the valve (Fig. 14).

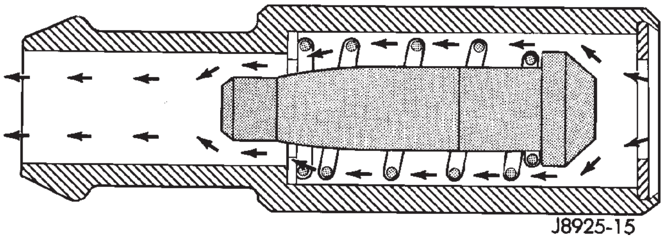

Fig. 14 Moderate Intake Manifold Vacuum—Maximum Vapor Flow

OPERATION - 4.7L

The PCV system operates by engine intake manifold vacuum. Filtered air is routed into the crankcase through the air cleaner hose and crankcase breathers. The metered air, along with crankcase vapors, are drawn through the PCV valve and into a passage in the intake manifold. The PCV system manages crankcase pressure and meters blow-by gases to the intake system, reducing engine sludge formation.

The PCV valve contains a spring loaded plunger. This plunger meters the amount of crankcase vapors routed into the combustion chamber based on intake manifold vacuum.

TYPICAL PCV valves are shown in (Fig. 15), (Fig. 16) and (Fig. 17).

When the engine is not operating, or during an engine pop-back, the spring forces the plunger back against the seat (Fig. 15). This will prevent vapors from flowing through the valve.

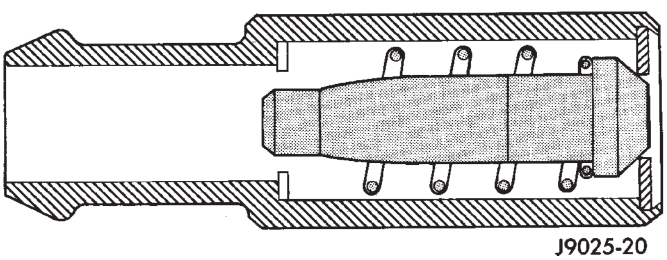

Fig. 15 Engine Off or Engine Pop-Back—No Vapor Flow

During periods of high manifold vacuum, such as idle or cruising speeds, vacuum is sufficient to completely compress spring. It will then pull the plunger to the top of the valve (Fig. 16). In this position there is minimal vapor flow through the valve.

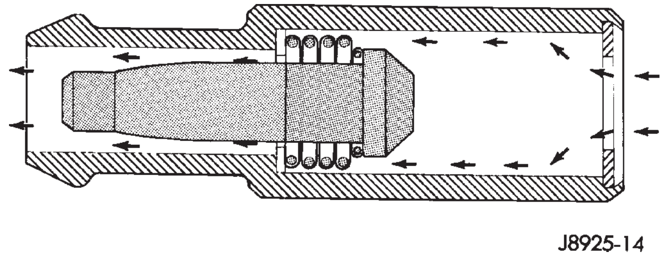

Fig. 16 High Intake Manifold Vacuum—Minimal Vapor Flow

During periods of moderate manifold vacuum, the plunger is only pulled part way back from inlet. This results in maximum vapor flow through the valve (Fig. 17).

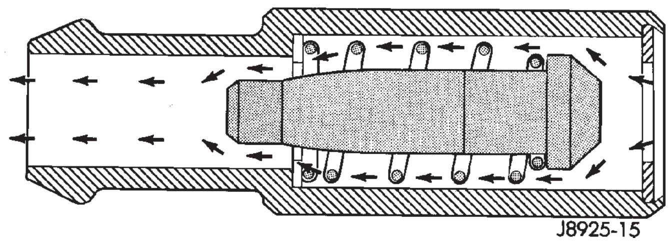

Fig. 17 Moderate Intake Manifold Vacuum—Maximum Vapor Flow

DIAGNOSIS AND TESTING - PCV VALVE TEST—3.9/5.2/5.9L ENGINE

(1) With engine idling, remove the PCV valve from cylinder head (valve) cover. If the valve is not plugged, a hissing noise will be heard as air passes through the valve. Also, a strong vacuum should be felt at the valve inlet (Fig. 18).

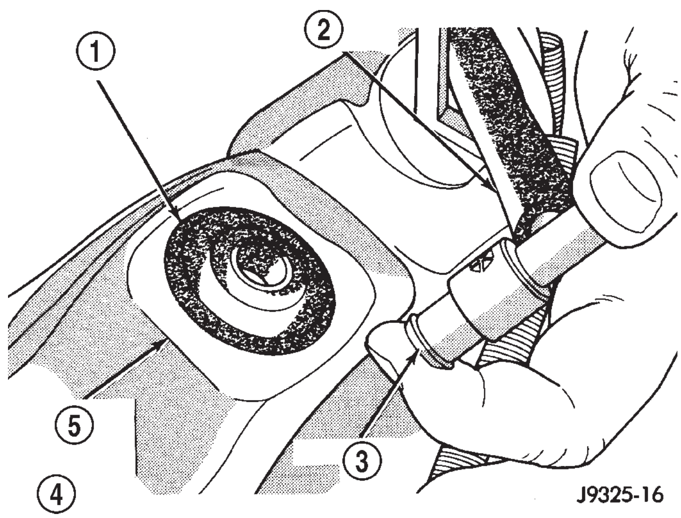

Fig. 18 Vacuum Check at PCV

1 - PCV VALVE GROMMET
2 - PCV HOSE
3 - PCV VALVE
4 - VACUUM MUST BE FELT AGAINST FINGER
5 - ENGINE VALVE COVER

PCV VALVE (Continued)

(2) Return the PCV valve into the valve cover. Remove the fitting and air hose at the opposite valve cover. Loosely hold a piece of stiff paper, such as a parts tag, over the opening (rubber grommet) at the valve cover (Fig. 19).

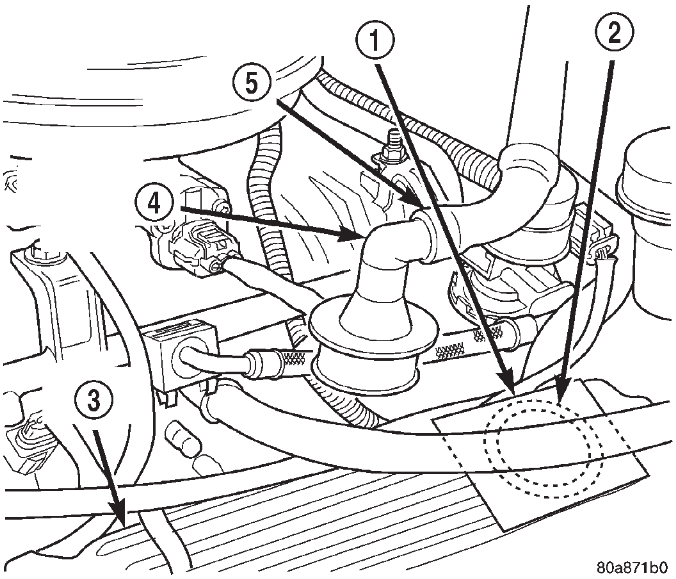

Fig. 19 Vacuum Check at Valve Cover Opening

1 - STIFF PAPER PLACED OVER RUBBER GROMMET
2 - RUBBER GROMMET
3 - VALVE COVER
4 - FITTING REMOVED FROM VALVE COVER
5 - AIR TUBE

(3) The paper should be drawn against the opening in the valve cover with noticeable force. This will be after allowing approximately one minute for crankcase pressure to reduce.

(4) Turn engine off and remove PCV valve from valve cover. The valve should rattle when shaken (Fig. 20).

(5) Replace the PCV valve and retest the system if it does not operate as described in the preceding tests. **Do not attempt to clean the old PCV valve.**

(6) If the paper is not held against the opening in valve cover after new valve is installed, the PCV valve hose may be restricted and must be replaced. The passage in the intake manifold must also be checked and cleaned.

(7) To clean the intake manifold fitting, turn a 1/4 inch drill (by hand) through the fitting to dislodge any solid particles. Blow out the fitting with shop air. If necessary, use a smaller drill to avoid removing any metal from the fitting.

DIAGNOSIS AND TESTING - PCV VALVE/PCV SYSTEM TEST—4.7L V-8 ENGINE

(1) Disconnect PCV line/hose (Fig. 21) by disconnecting rubber connecting hose at PCV valve fitting.

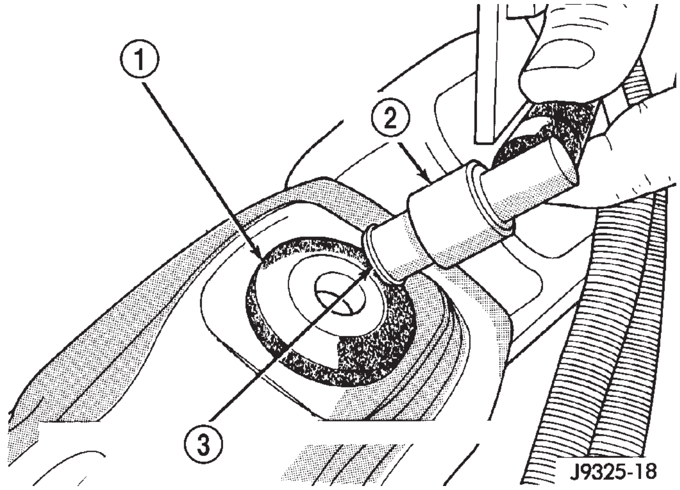

Fig. 20 Shake

1 - PCV VALVE GROMMET
2 - PCV VALVE
3 - PCV VALVE MUST RATTLE WHEN SHAKEN

(2) Remove PCV valve at oil filler tube by rotating PCV valve downward until locating tabs have been freed at cam lock (Fig. 21). After tabs have cleared, pull valve straight out from filler tube. **To prevent damage to PCV valve locating tabs, valve must be pointed downward for removal. Do not force valve from oil filler tube.**

(3) After valve is removed, check condition of valve o-ring (Fig. 21). Also, PCV valve should rattle when shaken.

(4) Reconnect PCV valve to its connecting line/hose.

(5) Start engine and bring to idle speed.

(6) If valve is not plugged, a hissing noise will be heard as air passes through valve. Also, a strong vacuum should be felt with a finger placed at valve inlet.

(7) If vacuum is not felt at valve inlet, check line/hose for kinks or for obstruction. If necessary, clean out intake manifold fitting at rear of manifold. Do this by turning a 1/4 inch drill (by hand) through the fitting to dislodge any solid particles. Blow out the fitting with shop air. If necessary, use a smaller drill to avoid removing any metal from the fitting.

(8) **Do not attempt to clean the old PCV valve.**

(9) Return PCV valve back to oil filler tube by placing valve locating tabs (Fig. 21) into cam lock. Press PCV valve in and rotate valve upward. A slight click will be felt when tabs have engaged cam lock. Valve should be pointed towards rear of vehicle.

(10) Connect PCV line/hose and connecting rubber hose to PCV valve.

(11) Disconnect rubber hose from fresh air fitting at left side of air cleaner resonator box (Fig. 22). Start engine and bring to idle speed. Hold a piece of

PCV VALVE (Continued)

stiff paper (such as a parts tag) loosely over the opening of the disconnected rubber hose.

(12) The paper should be drawn against the hose opening with noticeable force. This will be after allowing approximately one minute for crankcase pressure to reduce.

(13) If vacuum is not present, disconnect each PCV system hose at top of each breather (Fig. 22). Check for obstructions or restrictions.

(14) If vacuum is still not present, remove each PCV system breather (Fig. 22) from each cylinder head. Check for obstructions or restrictions. If plugged, replace breather. Tighten breather to 12 N·m (106 in. lbs.) torque. Do not attempt to clean breather

(15) If vacuum is still not present, disconnect each PCV system hose at each fitting and check for obstructions or restrictions.

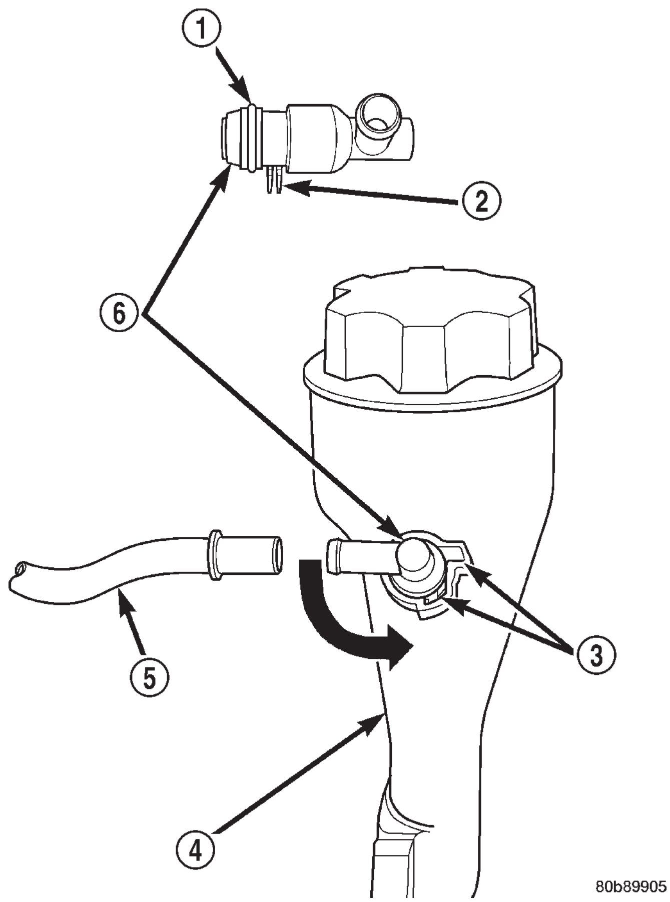

Fig. 21 PCV Valve/Oil Filler Tube—4.7L V-8 Engine

1 - O-RING
2 - LOCATING TABS
3 - CAM LOCK
4 - OIL FILLER TUBE
5 - PCV LINE/HOSE
6 - PCV VALVE

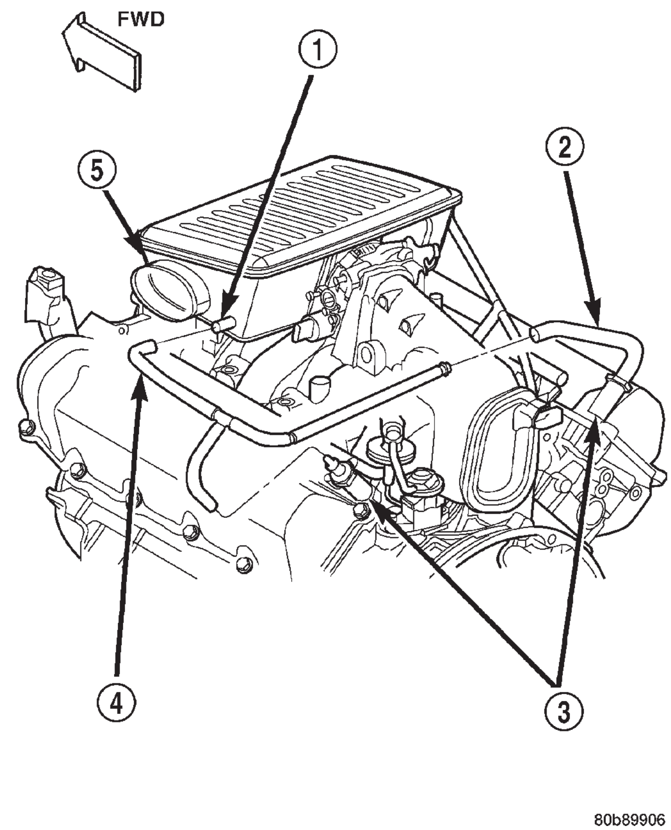

Fig. 22 PCV Breathers/Tubes/Hoses—4.7L V-8 Engine

1 - FRESH AIR FITTING
2 - CONNECTING TUBES/HOSES
3 - CRANKCASE BREATHERS (2)
4 - RUBBER HOSE
5 - AIR CLEANER RESONATOR

REMOVAL - 4.7L

The PCV valve is located on the oil filler tube (Fig. 23). Two locating tabs are located on the side of the valve (Fig. 23). These 2 tabs fit into a cam lock in the oil filler tube. An o-ring seals the valve to the filler tube.

(1) Disconnect PCV line/hose (Fig. 23) by disconnecting rubber hose at PCV valve fitting.

(2) Remove PCV valve at oil filler tube by rotating PCV valve downward (counter-clockwise) until locating tabs have been freed at cam lock (Fig. 23). After tabs have cleared, pull valve straight out from filler tube. **To prevent damage to PCV valve locating tabs, valve must be pointed downward for removal. Do not force valve from oil filler tube.**

(3) After valve is removed, check condition of valve o-ring (Fig. 23).

PCV VALVE (Continued)

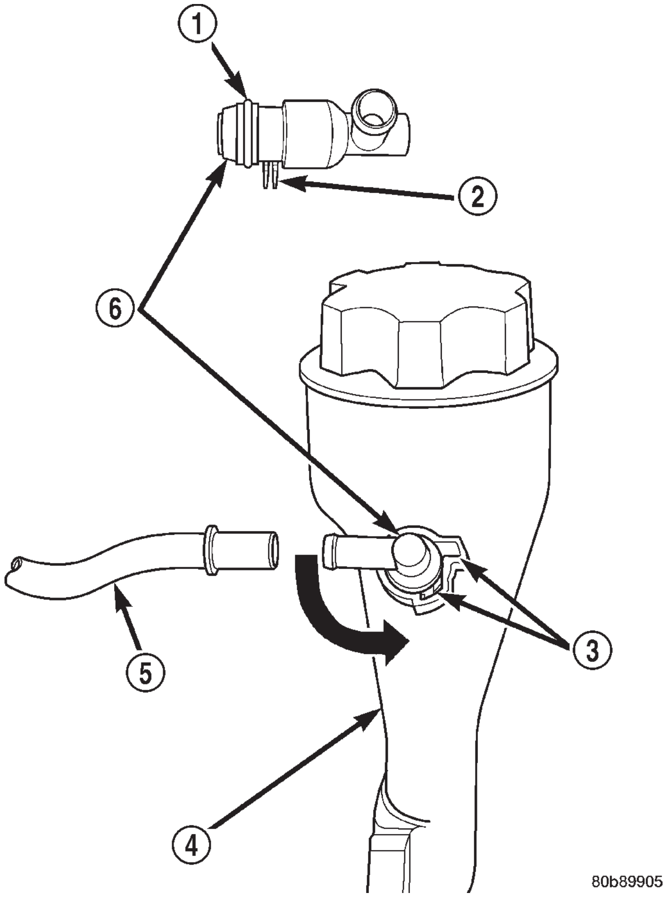

Fig. 23 PCV Valve/Oil Filler Tube Location

1 - O-RING
2 - LOCATING TABS
3 - CAM LOCK
4 - OIL FILLER TUBE
5 - PCV LINE/HOSE
6 - PCV VALVE

INSTALLATION - 4.7L

The PCV valve is located on the oil filler tube (Fig. 23). Two locating tabs are located on the side of the valve (Fig. 23). These 2 tabs fit into a cam lock in the oil filler tube. An o-ring seals the valve to the filler tube.

(1) Return PCV valve back to oil filler tube by placing valve locating tabs (Fig. 23) into cam lock. Press PCV valve in and rotate valve upward. A slight click will be felt when tabs have engaged cam lock. Valve should be pointed towards rear of vehicle.

(2) Connect PCV line/hose and rubber hose to PCV valve.

VACUUM LINES

DESCRIPTION

A vacuum line schematic for emission related items can be found on the Vehicle Emission Control Information (VECI) label. For label location, refer to Vehicle Emission Control Information (VECI) Label.

VAPOR CANISTER

DESCRIPTION

A maintenance free, EVAP canister is used on all vehicles. The EVAP canister is located under the vehicle, inside the left frame rail, in front of the fuel tank (Fig. 24).

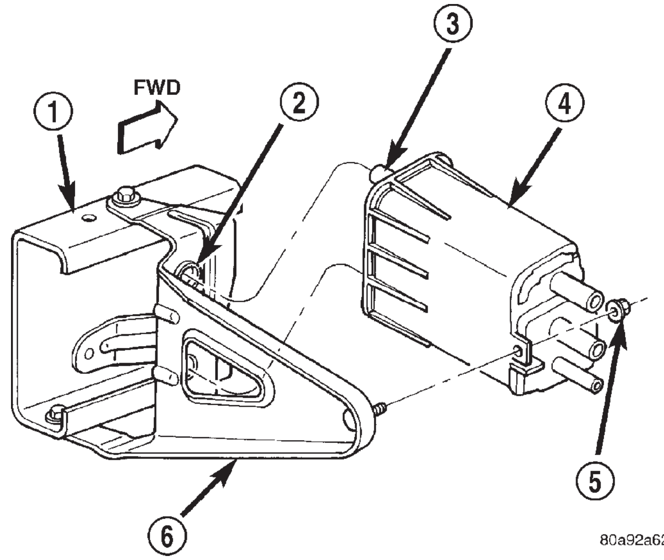

Fig. 24 EVAP Canister Location

1 - LEFT FRAME RAIL
2 - RUBBER GROMMETS (2)
3 - LOCATING PINS (2)
4 - EVAP CANISTER
5 - MOUNTING NUT
6 - MOUNTING BRACKET

OPERATION

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.

VAPOR CANISTER (Continued)

REMOVAL

The EVAP canister is located below the vehicle, inside the left frame rail, in front of the fuel tank (Fig. 25).

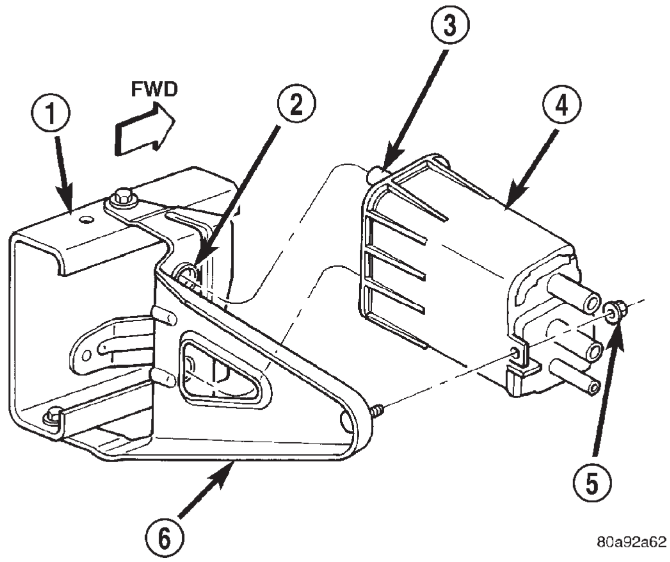

Fig. 25 EVAP Canister Location

1 - LEFT FRAME RAIL
2 - RUBBER GROMMETS (2)
3 - LOCATING PINS (2)
4 - EVAP CANISTER
5 - MOUNTING NUT
6 - MOUNTING BRACKET

(1) Raise vehicle.

(2) Disconnect vacuum lines at EVAP canister. Note location of lines before removal.

(3) Remove canister mounting nut.

(4) Remove canister from mounting bracket.

INSTALLATION

The EVAP canister is located below the vehicle, inside the left frame rail, in front of the fuel tank (Fig. 25).

(1) Position canister locating pins into mounting bracket grommets (Fig. 25) and install mounting nut.

(2) Tighten mounting nut to 17–24 N·m (150–210 in. lbs.) torque.

(3) Connect vacuum lines at canister.

(4) Lower vehicle.

NEW VEHICLE PREPARATION

TABLE OF CONTENTS

INTRODUCTION

DESCRIPTION - THE IMPORTANCE OF CAREFUL NEW VEHICLE PREPARATION

Today, the automobile industry is more competitive than it has been for decades. Automakers around the world, including DaimlerChrysler, have made tremendous improvements in the quality of their vehicles.

As a result, customer expectations have also risen. Today's customers are more particular about their vehicles than ever before. The result is that problems once regarded as insignificant (such as a squeak or rattle) can now make the difference between a repeat customer and one who never purchases another vehicle from you dealership or another DaimlerChrysler Corporation product.

As a technician preparing a new car or truck for delivery, you are the final step in the entire quality process. Your inspection is the final opportunity to detect any flaws that would disappoint the customer. Your efforts will reflect upon the thousands of men and women who design, engineer and build DaimlerChrysler products as well as upon your dealership and on yourself as a competent, conscientious technician.

As manufacturing quality has improved, prep procedures have come to serve as additional quality checks. However, there are several compelling reasons for careful new vehicle preparation.

- Safety-You assure the customer that his or her new vehicle meets all federal safety standards.
- Emissions Controls-When your customers are assured that their new cars meet emissions standards, they will know that they are contributing to cleaner air and helping control pollution.
- Customer Satisfaction-First impressions are very important on a new vehicle. Careful new vehicle preparation will impress your customer.
- Competition-It is common knowledge in the industry that the availability of efficient service is one of the decisive factors in determining which cars will sell. A vehicle delivered to your customers in first class condition, inside and out, will bring them back to the dealership for the kind of service you have led them to expect and for their next new car.

This information outlines service procedures which will ensure that DaimlerChrysler Corporation vehicles are ready for delivery to the customer when they are complete. These procedures follow a logical order, from a careful underhood inspection, to the moment when you complete the warranty certificate and turn the keys over to your customer.

When you have completed the procedures described in this information, both you and your customer will be assured that his or her new vehicle will perform as expected.

USING THE MANUAL

This guide to new vehicle preparation covers all items on the New Vehicle Preparation Form (Fig. 1).

INTRODUCTION (Continued)

DAIMLERCHRYSLER

NEW VEHICLE PREPARATION

Inspection and Road Test ■ Passenger Cars and Trucks

REPAIR ORDER NUMBER	DEALER STOCK NUMBER	KEY CODES	MAKE & YEAR	MODEL	DATE PERFORMED	TECHNICIAN NUMBER

VEHICLE IDENTIFICATION NUMBER	MILEAGE (EXCLUDING 10THS)	CUSTOMER NAME	
			XXXXX

PERFORM THE INSPECTION AND ADJUSTMENTS AS LISTED BELOW

NOTE: Refer To The New Vehicle Preparation Manual For Proper Preparation Procedures. Refer To The Appropriate Service Manual For Specifications And Service Procedures. Conditions Which Can Be Corrected By The Minor Adjustments Specified Below Are Considered Part Of Normal New Vehicle Preparation. Items That Require Correction Beyond The Minor Adjustments Specified Are Eligible For Warranty Reimbursement.

A. UNDER HOOD

1. **Hood Latch/Safety Catch (Adjust As Required)**
☐ Check For Proper Operation

2. **Fluid Levels (Check For Proper Level And Top Off As Required)**
☐ Engine Oil
☐ Automatic Transmission
☐ Clutch Master Cylinder
☐ Brake Master Cylinder
☐ Power Steering
☐ Windshield Washer
☐ Rear Washer
☐ Cooling System

3. **Lines/Hoses (Check Clearance From Moving And Hot Objects; Reroute And Tighten As Required)**
☐ Brake Lines
☐ Fuel Lines
☐ Power Steering Hoses
☐ Vacuum Hoses
☐ Coolant Hoses
☐ Clutch Lines
☐ Refrigerant Lines

4. **Battery (Check State Of Charge)**
☐ Inspect Battery Test Indicator When Easily Visible (Recharge To Assure "Green Dot"); Use Voltmeter When Indicator Is Not Visible (Min. 12.4V)

5. **Wiring (Check Routing And Connections; Reroute And Connect As Required)**
☐ Starter, Generator, A/C Clutch And Ignition, Secondary Wires Installed Correctly
☐ Connect Ignition Off Draw (I.O.D.), Or Install Fuse On Applicable Vehicles
☐ Other ____________

B. UNDER VEHICLE

1. **Visually Inspect For Loose Attachments, Proper Keying, Leakage, Clearance & Routing**
☐ Engine
☐ Oil Cooler
☐ Cooling System
☐ Transmission
☐ Driveshaft Boots
☐ Differential
☐ Transmission Cooler
☐ Brake System
☐ Fuel System
☐ Exhaust System
☐ Steering And Suspension Components
☐ Other ____________

2. **Tire Pressures (Adjust To Specifications)**
☐ Check All Tire Pressures, Including Spare Tire

3. **Tie-Down Brackets**
☐ Remove Where Applicable

C. BODY - EXTERIOR

1. **Operation Of Doors & Locks (Adjust Strikers & Latches As Required)**
☐ All Exterior Door Locks Work Easily With All Keys
☐ All Doors Open/Close Easily (With All Windows Up)
☐ Keyless Entry System Works Properly (Both Transmitters)
☐ Security Alarm Works Properly
☐ Deck Lid/Tailgate/Liftgate Operates Easily

2. **Fit & Finish (Visually Inspect; Touch Up As Required)**
☐ Remove Protective Coatings/Covers
☐ Free From Paint Chips, Scratches, Sags, Runs, Dirt Or Corrosion
☐ Paint Colors Match On All Panels
☐ Moldings/Stripes Are Aligned Properly
☐ Moldings/Stripes Are All Present And Securely Fastened
☐ Door Panels Have Even Gaps And Fit Well With Adjacent Panels
☐ Deck Lid/Liftgate/Tailgate Has Even Gaps And Fit Well With Adjacent Panels
☐ Hood Panel Has Even Gaps And Fits Well With Adjacent Panels
☐ Body Free From Dents And Dings
☐ Other ____________

3. **Body Sealing (Visually Inspect)**
☐ Door And Window Seals
☐ Windshield
☐ Backlight
☐ Deck Lid/Liftgate/Tailgate
☐ Sunroof/Convertible Top
☐ Check For Water Leaks During Normal Recommended Wash
☐ Other ______

4. **Convertible Top (Cycle Top)**
☐ Check And Adjust Alignment Pins As Required

D. BODY - INTERIOR

1. **Windows, Doors & Locks (Check Operation)**
☐ All Manual Windows Open/Close Easily
☐ All Power Windows Operate Correctly
☐ All Power/Manual Door Locks Operate Correctly
☐ All Doors Open/Close Easily
☐ Remote Deck Lid/Liftgate/Tailgate Release (If Equipped)
☐ Glove Box Door Opens/Closes Easily
☐ Console Door Opens/Closes Easily
☐ Sunroof Opens/Closes Easily
☐ Other ____________

2. **Seats (Check Operation)**
☐ Manual/Power Seat Adjustments Work Properly For All Seats
☐ Securely Located In Track
☐ Check Heated Seat Operation

3. **Seat And Shoulder Belts, Retractors And Head Restraints (Check Operation)**
☐ Check All Seat And Shoulder Belts, Including Retractors, For Proper Latching And Ease Of Operation
☐ Check All Head Restraints For Ease Of Operation
☐ Child Seats

4. **Lights/Switches (Check Operation)**
☐ Check All Interior Lights And Switches (Visually Inspect And Operate)
☐ Check All Exterior Lights And Switches (Visually Inspect And Operate)
☐ Check Ignition Switch For Proper Operation

5. **Fit & Finish (Visually Inspect)**
☐ Remove Interior Covers
☐ Instrument Panel, Glove Box Door And Interior Moldings Have Even Gaps
☐ Door Panel Material Is Clean, Free From Wrinkles And Installed Correctly
☐ Seat Material Is Clean, Secure And Free Of Wrinkles
☐ Carpet Is Clean, Secure And Free Of Wrinkles
☐ Other ____________

6. **Compass**
☐ Calibrate & Set Variance

7. **"Shipped Loose"**
☐ Install Any Items

E. ROAD TEST

1. **Neutral Safety Switch**
☐ Check For Proper Operation

2. **Shift/Clutch Interlock System**
☐ Check For Proper Operation

3. **Gauges/Warning Lights**
☐ Check Operation Of All Gauges
☐ Check Operation Of All Warning Lights

4. **Horn (Check Operation)**
☐ Check For Proper Sound Quality

5. **Turn & Emergency Signals (Check Operation)**
☐ Ease Of Operation And Proper Cancelling

6. **Mirrors (Check Operation)**
☐ Check Day/Night Function (If Equipped)
☐ Ease Of Adjustment (Power Or Manual)

7. **Windshield Wipers & Washers (Check Operation)**
☐ Check Washer Pattern (Adjust As Necessary)
☐ Check Intermittent Wipe Feature
☐ Check For Proper Wiping Pattern

8. **Heater/Air Conditioner (Check Operation)**
☐ Heater/Defroster Works Properly
☐ Turn On Rear Defroster During Drive, Then Feel Window For Warmth After Drive
☐ A/C Cools Properly
☐ Fan Operation Is Quiet

9. **Radio (Check Operation)**
☐ Good AM/FM Reception
☐ Cassette/CD Works Properly
☐ Good Sound Quality
☐ Displays Correct Time

10. **Trip Computer/Maintenance Reminder (Check Operation)**
☐ Check That All Modes Operate

11. **Speed Control (Check Operation)**
☐ Check On/Off Switch
☐ Check "Set" Operation
☐ Check "Resume"
☐ Check "Accel/Decel"
☐ Check Brake Release

12. **Service Brakes (Check Operation)**
☐ Vehicle Stops In A Straight Line - No Pulling To One Side
☐ Quiet Operation - Free From Noise
☐ Free From Shudder Or Vibration
☐ Check Brake Warning Light

13. **Parking Brake (Check Operation)**
☐ Easy To Operate
☐ Free From Drag
☐ Able To Hold
☐ Check Warning Light

14. **Engine Performance**
☐ Starts Promptly
☐ Free From Stalling
☐ Idles Smoothly And At Proper Speed
☐ Free From Stumbling Or Hesitation
☐ Produces Sufficient Power
☐ Free From Unusual Noises
☐ Operates Within Proper Temperature Range
☐ Stops When Key Is Shut Off

15. **Transmission/Transfer Case Performance**
☐ Park Lock Holds Vehicle (Automatic)
☐ Shifter (Manual) Or Shift Lever (Automatic) Operates Easily
☐ Shifts Smoothly (Automatic)
☐ Upshifts And Downshifts Properly (Automatic)
☐ Proper Synchronization - Gears Do Not Grind (Manual)
☐ Clutch Operates Smoothly (Manual)
☐ Transfer Case Shifts Easily Among Ranges (4x4 Vehicles)

16. **Steering & Handling**
☐ Power Assist Works Properly - Steering Does Not Require Excessive Effort
☐ Steering Wheel Does Not Vibrate At Idle Or Road Speed
☐ Steering Wheel Centered When Traveling Straight Ahead
☐ Does Not Pull To One Side
☐ Vehicle Does Not Vibrate

17. **Squeaks, Rattles And Wind Noise**
☐ Instrument Panel, Glove Box, Seats, Steering Wheel And Column Are Free From Squeaks And Rattles
☐ Windows And Doors Are Free From Squeaks, Rattles And Wind Noise
☐ Vehicle Exterior Free From Squeaks, Rattles And Noise, Front And Rear
☐ Interior Panels Free From Squeaks And Rattles

18. **Other** ____________

19. **Fuel**
☐ Fill Fuel Tank (Use Specified Grade)

F. PREDELIVERY STORAGE

☐ Always Unplug I.O.D. Connector, Or Pull Fuse That Activates Accessories.

G. PROGRAMMABLE ELECTRONIC FEATURES

Program Per Customer Request (If Equipped)
☐ Rolling Power Door Locks
☐ Horn Chirp When Doors Locked With RKE
☐ Low Fuel Chime
☐ RKE Door Unlock Sequence (One Push Unlocks All Doors)
☐ Headlights On Automatically With Wipers
☐ Remote Key Fobs Linked To Memory
☐ Headlamp Delay Variable Interval
☐ Easy Exit Driver's Seat
☐ Service Interval Reminder

FOLD HERE FOLD HERE

EPA CERTIFICATION OF CONFORMITY

The selling Dealer hereby certifies that (1) this vehicle is covered by an EPA Certificate of Conformity indicating that it conforms to all applicable emission standards of the U.S. Environmental Protection Agency; (2) a visual inspection of this vehicle and engine has been conducted to assure that all emission-related components have been properly installed; (3) all emission-related preparation required by the manufacturer prior to the sale of this vehicle has been properly performed.

If this vehicle has been maintained and used in accordance with the applicable DaimlerChrysler Corporation instructions, and if the vehicle fails an EPA-approved emission test prior to the expiration of 3 months or 4,000 miles (whichever comes first), DaimlerChrysler Corporation through its authorized dealers, will remedy the nonconformity under the emission warranty.

DEALER CERTIFICATION

I CERTIFY THAT THIS VEHICLE HAS BEEN INSPECTED AND ROAD TESTED, AND THAT ADJUSTMENTS WERE PERFORMED, AS INDICATED BY THE CHECK MARKS IN THE BOXES.

____
DEALER, SERVICE MANAGER OR TECHNICIAN SIGNATURE

☐☐ ZONE ☐☐☐☐☐ DEALER CODE

Form No. 84-320-4740 (Rev. 1/98)
00PM1702

1. CUSTOMER COPY

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Fig. 1 NEW VEHICLE PREPARATION FORM

INTRODUCTION (Continued)

Items found requiring adjustment and/or repair should be corrected before delivery of the vehicle.

NOTE: It is the dealer's responsibility to protect new vehicles from damage and deterioration prior to retail delivery both before and after new vehicle preparation.

The information includes the following features:

Inspection points are cross-referenced to the New Vehicle Preparation Form as follows:

- Titles indicate the general area being inspected or the types of checks being made (i.e., underhood, body-exterior, road test, etc.).
- Sub-Titles identify the types of items to be inspected in that area (i.e., lines/hoses, wiring, etc.).

Procedures follow a logical order to prevent duplication and wasted effort.

Tips to help you do a better job are found as **NOTES**.

RECEIVING

INSPECTION

The following procedures are recommended for your own protection upon receipt of new vehicles. When a new car is delivered by the carrier, it should be inspected to ensure that it is in good condition and to determine if there is any shortage or transportation damage.

EXTERIOR

Upon receipt of a new vehicle, check immediately for:

- Under carriage damage
- Chipped or cracked windshield, broken windows, and loose or missing moldings and name-plates
- Dents, scrapes, scratches, chips, dirt in paints or other damage to the body exterior
- Damaged or missing side view mirror(s)
- Missing wheel nuts
- Broken or missing lenses
- Chafing, bruises, cuts, or scrapes on tire sidewalls or tread
- Missing underhood items
- Missing fuel filler cap
- Shipped loose items-license plate bracket, spare tire, jack and tire wrench, radio antenna, floor mats, wheel covers, cargo nets, fuses and other items
- Ensure that IOD fuse is removed
- Check battery test indicator when easily visible, or use voltmeter (battery must be at 12.4 volts or greater). Charge to ensure green dot-visibility, permanent damage may occur if battery remains in a discharged state for any length of time.

INTERIOR

Check interior items such as:

- Rearview mirror
- Accessory control knobs
- Smokers package items
- Keys
- Radio
- Special equipment items listed on shipper
- Owner's Manual and Consumer information Brochures (normally stored in the glove box).
- Cuts, abrasions or stains on interior trim.

NOTE: Remember a careful look at new vehicles when they are received may prevent problems when preparing vehicles for delivery to your customers.

MAJOR INSPECTION POINTS

(1) Check operation of hood latch and safety catch-adjust as required.

(2) Check all fluids for proper level and top off with the proper fluid as required-engine oil, automatic transmission fluid, brake master cylinder, clutch master cylinder, power steering, windshield washer, and cooling system. (Vehicle must be at normal operating temperature for some of these checks.)

(3) Check brake, clutch, fuel, and power steering lines and hoses for leaks and clearance from moving and hot objects-reroute to the proper location and tighten as required.

(4) Check battery state of charge-recharge if necessary, to ensure green dot is visible or instrument panel voltmeter indicates 12.4 volts or greater.

(5) Check routing and connections of underhood wiring, vacuum hoses, refrigerant lines and coolant hoses for leaks, loose connections and clearance from moving objects reroute and tighten connections as required. Install IOD fuse on applicable vehicles.

NOTE: Reset radio, clock, compass, etc., after installing, if vehicle is being delivered.

UNDER HOOD

INSPECTION - HOOD LATCH/SAFETY CATCH

(1) Check operation of hood latch and safety catch-adjust as required (Fig. 2).

NOTE: The safety catch prevents the hood from going to full open position until it is manually released. To test the safety catch, unlock the hood with the interior release, then try to raise the hood without operating the safety catch.

INSPECTION—FLUID LEVELS

ENGINE OIL

CAUTION: Use only oil that meets the specified requirements.

NOTE: If oil level is low, inspect for oil leaks.

(1) Check engine oil level. The oil should be in the safe range or between the minimum and maximum marks.

- If the oil level is at the minimum mark, add oil that meets specifications, Refer to the service information.
- The best time to check the oil is about 5 minutes after a fully warmed-up engine is turned off, or before starting the engine after it has been off overnight.
- For the most accurate readings, the vehicle should be on level ground.
- Wipe up any excess oil that may have spilled, or the customer could mistakenly perceive this as the result of a leak.

AUTOMATIC TRANSMISSION/TRANSAXLE

CAUTION: Only use fluid that meets the vehicle's specific requirement. Consult the service manual for information.

NOTE: Mopar® ATF+4 contains special additives not found in Mercon and Dexron II fLuids. Use of fluid other than Mopar® ATF+4 (when specified) could result in an upshift shudder in some applications.

Transmission and transaxle fluid check procedures are specific to each vehicle line. (Refer to LUBRICATION & MAINTENANCE/FLUID CAPACITIES - SPECIFICATIONS).

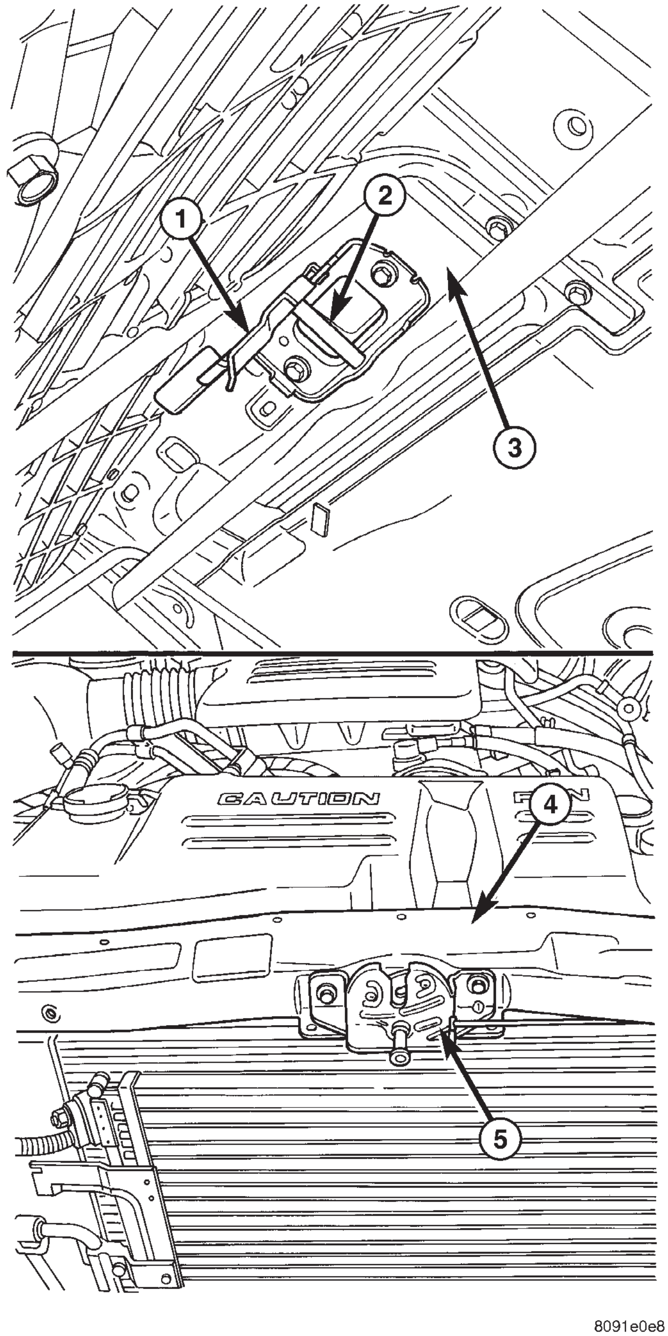

Fig. 2 HOOD LATCH, STRIKER AND SAFETY CATCH

1 - SAFETY CATCH
2 - HOOD LATCH STRIKER
3 - HOOD
4 - RADIATOR UPPER SUPPORT
5 - HOOD LATCH

UNDER HOOD (Continued)

CLUTCH MASTER CYLINDER

CAUTION: only use brake fluid that meets specified requirements (DOT 3 and MVSS 116).

Check the clutch master cylinder fluid level (Fig. 3). Add fluid to the proper level if necessary.

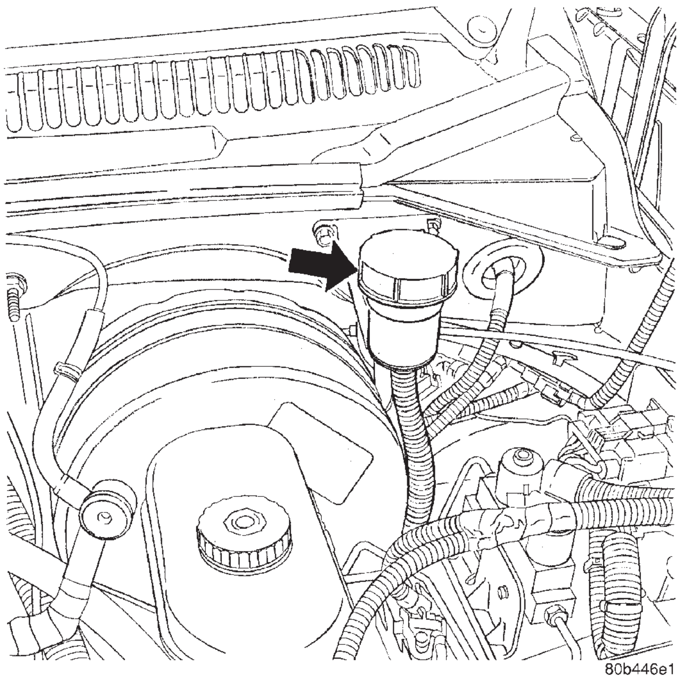

Fig. 3 CLUTCH MASTER CYLINDER RESERVOIR

BRAKE MASTER CYLINDER

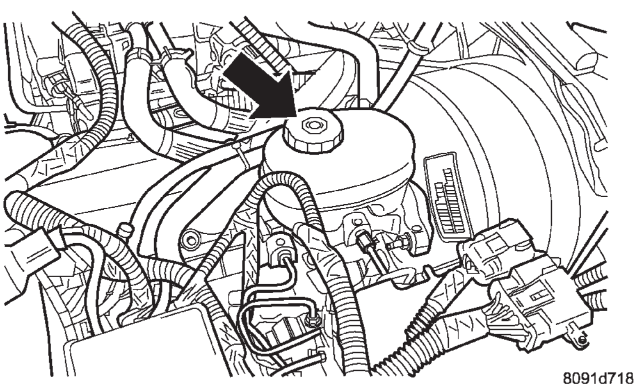

Fig. 4 BRAKE MASTER CYLINDER FLUID RESERVOIR

CAUTION: Only use fluid that meets specified requirements (DOT 3).

NOTE: Wipe the master cylinder cover to remove any dirt.

NOTE: On vehicles equipped with remote antilock brakes, the fluid level check is the same as for a normal system.

Check the brake master cylinder fluid level (Fig. 4). Add fluid to bring the level to the full line on the side of the reservoir (or above the bottom of the split ring in the primary filler hole). Be sure both primary and secondary cavities are full to the maximum level as indicated.

POWER STEERING RESERVOIR

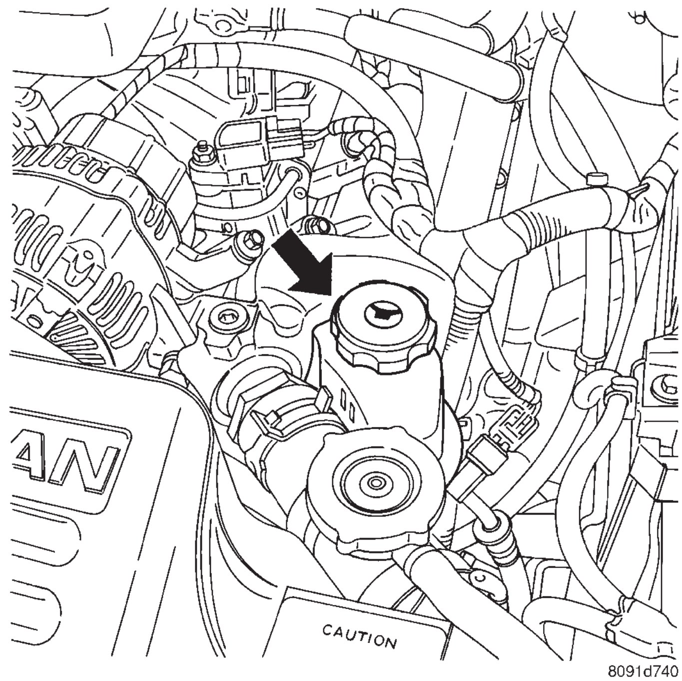

Fig. 5 POWER STEERING FLUID RESERVOIR 4.7L ENGINE

CAUTION: Only use fluid that meets specified requirements. Petroleum fluids, such as Mopar® Power Steering Fluid, are specially formulated for use with power steering hoses and seals.

Check the fluid level; it should be maintained at the proper level indicated on the dipstick, or as viewed through the translucent reservoir. If fluid is required, fill to the proper level. With the engine running at normal operating temperature, turn the steering wheel from stop to stop to expel air from within the system Stop the engine, remove the cap, and recheck the fluid level, making sure that foaming is not present (Fig. 5).

UNDER HOOD (Continued)

WINDSHIELD WASHER RESERVOIR

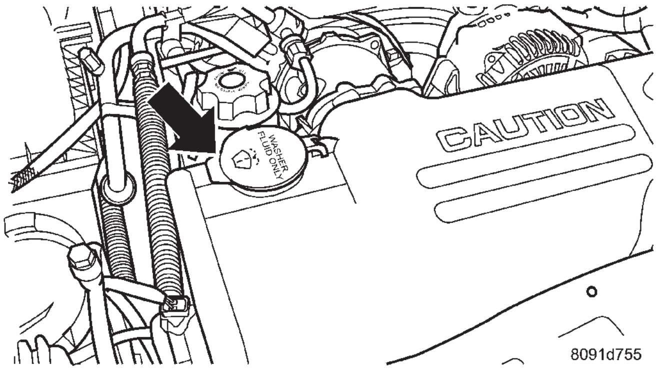

Fig. 6 WINDSHIELD WASHER FLUID RESERVOIR

CAUTION: Do not add engine coolant (antifreeze) to this reservoir.

CAUTION: Avoid spilling washer solvent on the vehicles paint; it could harm the finish.

Check windshield washer solvent reservoir (Fig. 6) and fill as necessary.

NOTE: When using concentrated solvent such as Mopar® All-Weather Windshield Washer Solution, dilute per container directions.

COOLING SYSTEM RESERVOIR

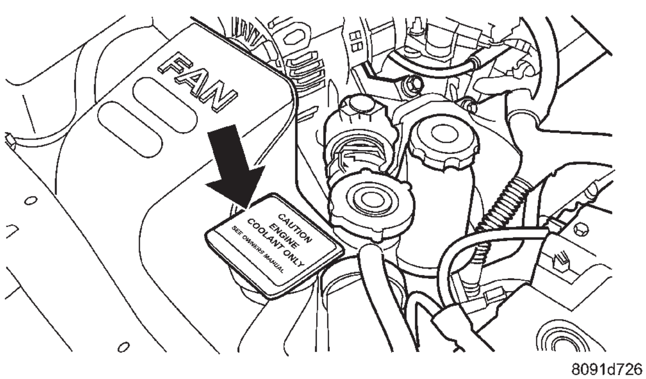

Fig. 7 ENGINE COOLANT RESERVOIR

WARNING: Do not remove radiator cap while cooling system is under pressure.

NOTE: Add coolant only to plastic reserve tank if it is required. Engine must be at normal operating temperature before adding coolant to reserve tank. In cold climates, coolant in reserve tank may appear low; do not add coolant until normal temperature is reached.

Check coolant level with engine idling at normal operating temperature. Coolant level in plastic reserve tank must be between the minimum and maximun marks (Fig. 7).

If coolant is added, use a 50/50 (-30°F protection) concentration of the recommended (Refer to the Service Information for specificate Mopar® antifreeze recommendation) antifreeze and distilled water. Use a higher concentration (up to 65%) if a lower freeze point is required. Do not use recycled coolant in new vehicles.

INSPECTION - LINES/HOSES

Inspect the following for line and hose leaks. Also inspect routing and connections and reroute and tighten as required.

- Brake Lines
- Fuel Lines
- Power Steering Hoses
- Vacuum Hoses
- Heating/Coolant Hoses
- Clutch Lines
- Refrigerant Lines

INSPECTION - BATTERY

When battery is easily accessible, check the test indicator (green dot), terminal tightness and felt (grease) washer on battery posts. Recharge battery as required to assure that the green dot is visible.

When battery is not easily accessible check battery condition with a voltmeter at the jump start locations, or check the voltmeter on the instrument panel (Fig. 8). The reading should be at least 12.4 volts. Recharge battery as required.

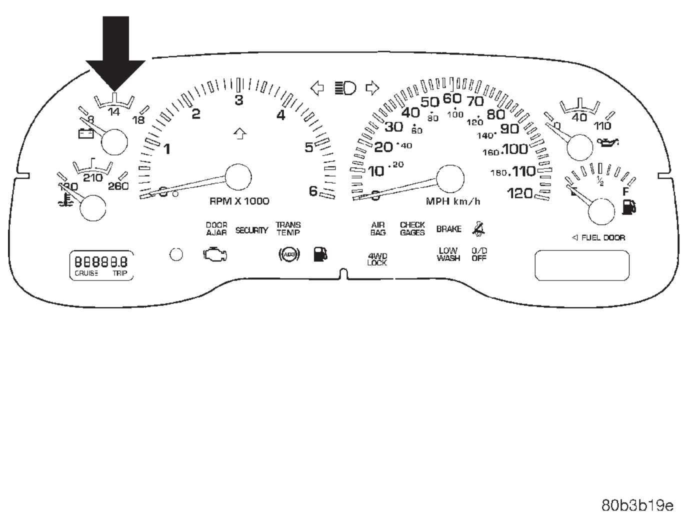

Fig. 8 BATTERY VOLTAGE GAUGE

NOTE: Refer to service information for proper battery charging rates and times.

UNDER HOOD (Continued)

INSPECTION - WIRING

The assembly plant has shipped all vehicles with the interior lights and most electronic memories non-functional by way of an Ignition Off Draw (IOD) fuse removed. The purpose is to reduce the possibility of battery run-down during shipping and storage.

Vehicles stored after prep should have the IOD fuse that activates the accessories pulled to prevent battery drain.

NOTE: Ensure that the IOD fuse is removed to prevent battery drain and possible damage. Vehicles stored for extended periods after prep should be washed frequently, to prevent environmental damage, and reinspected for storage-related problems before delivery.

(1) Install the IOD fuse as equipped. (ON vehicles being delivered, remember to reset radio, clock, compass, etc., as required.)

(2) Check routing and connections of all underhood wiring-reroute and connect as required.

(3) Make sure the starter, generator and air conditioning clutch wiring are correctly installed, routed, and in the clips where provided.

(4) For predelivery storage, always pull the IOD fuse that activates accessories.

UNDER VEHICLE

INSPECTION - TIRE PRESSURES

(1) Using the tire placard or the Safety Certification Label, check that the correct tires are mounted on the vehicle (Fig. 9).

(2) Install valve stem extensions as required.

(3) Using the tire placard or the Safety Certification Label, check tire pressure (including spare) and adjust as required to recommended pressure.

NOTE: Tire pressure may have been set above normal during manufacturing in order to properly seat the tire bead. Be sure to adjust to proper specification.

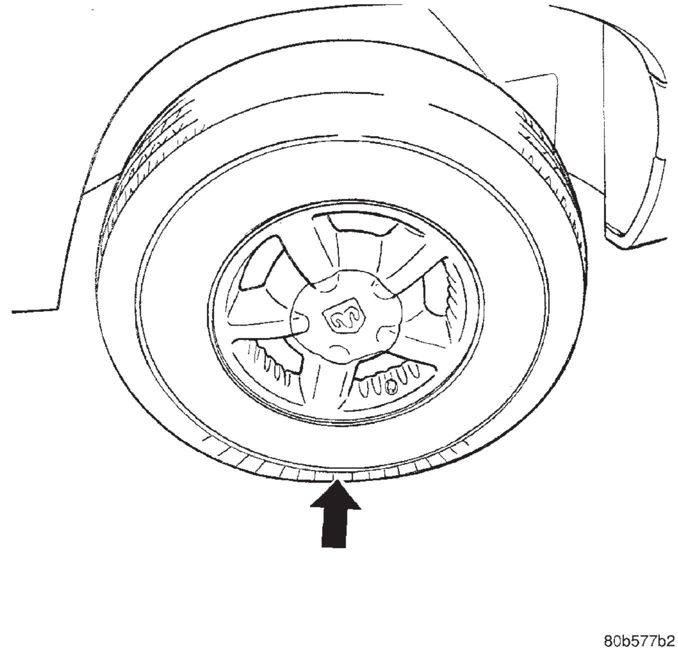

Fig. 9 WHEEL AND TIRE ASSEMBLY

INSPECTION - VISUAL

CAUTION: Before raising the vehicle on a hoist, (Refer to LUBRICATION & MAINTENANCE/HOISTING - STANDARD PROCEDURE).

(1) Visually inspect the following for loose attachment, leakage, clearance and routing, and tighten connections and clamps as required:

- Engine
- Oil Cooler
- Cooling System
- Transaxle
- Driveshaft Boots
- Transmission Cooler
- Brake System
- Fuel System
- Exhaust System
- Steering and Suspension Components

INSTALLATION - WHEEL COVERS

(1) Install cover on wheel by hand only (Fig. 10).

(2) Install and torque wheel nuts to 135 N·m (100 lb. ft.).

(3) Install nut caps, if equipped using lug wrench, do not over tighten.

(4) Remove release liner from removal instructions label and install label next to jacking instructions label. Surface must be clean and flat for proper adhesion of label.

UNDER VEHICLE (Continued)

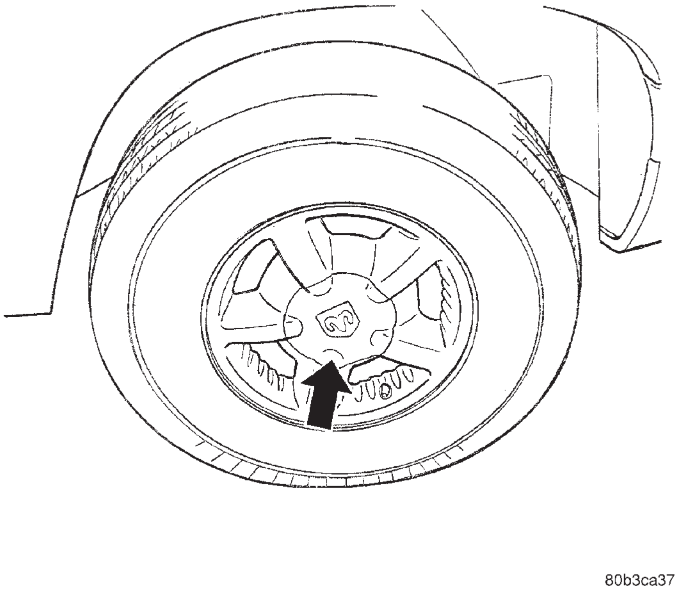

Fig. 10 WHEEL COVER INSTALLATION

EXTERIOR

INSPECTION—BODY SEALING

Visually inspect the following seals during the normal recommended wash. Look for areas where water may have entered the vehicle.

- Door and window seals (Fig. 12)
- Windshield
- Cargo Light (Fig. 11)

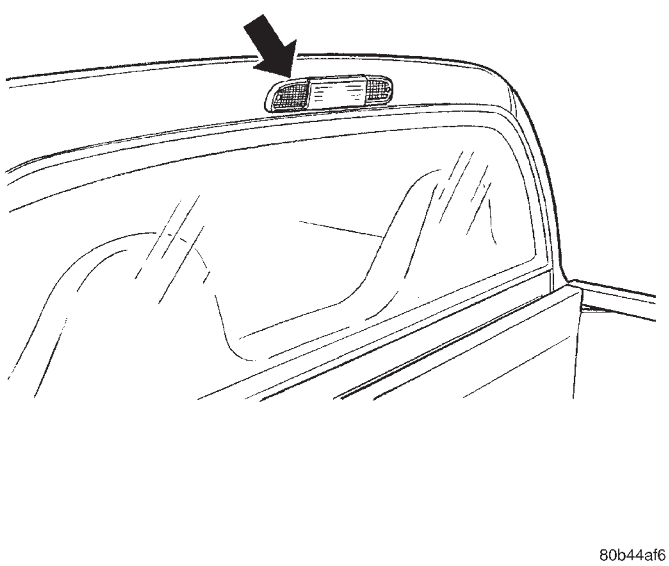

Fig. 11 CARGO LIGHT

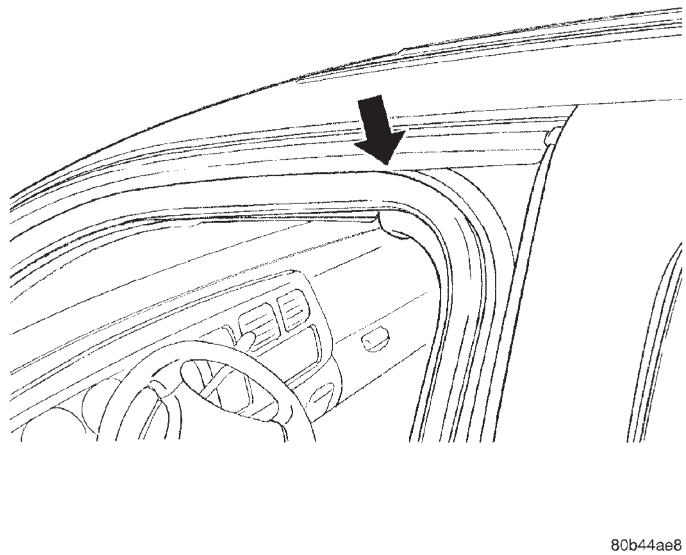

Fig. 12 DOOR AND WINDOW SEALS

INSPECTION - FIT AND FINISH

(1) Remove all protective coatings/covers.

(2) Make sure body is free from paint chips, scratches, sags, run, dirt or corrosion. Touch up any minor paint chips and scratches as required.

(3) Ensure that moldings and stripes are aligned properly.

NOTE: Painted-on accent strips require a unique paint for touch-ups.

(4) Check that the door panels have even gaps and fit well with adjacent body panels (Fig. 13).

(5) Check that the tailgate has even gaps and fits well with adjacent panels (Fig. 14).

(6) Check that the hood panel has even gaps and fits well with adjacent panels (Fig. 15).

(7) Ensure that the body is free from dents and dings.

INSPECTION - KEYLESS ENTRY

Check operation of keyless entry system and program the transmitter/ receiver if necessary (Fig. 16).

EXTERIOR (Continued)

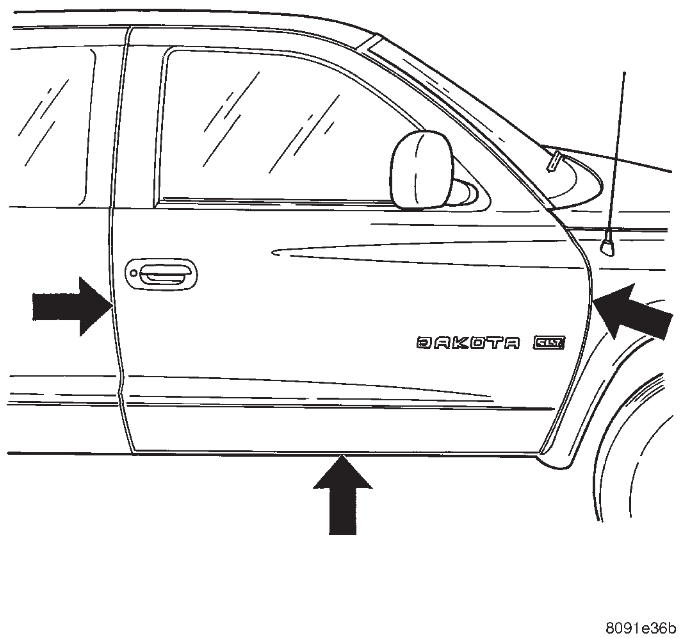

Fig. 13 Door Panel and Fender Fit

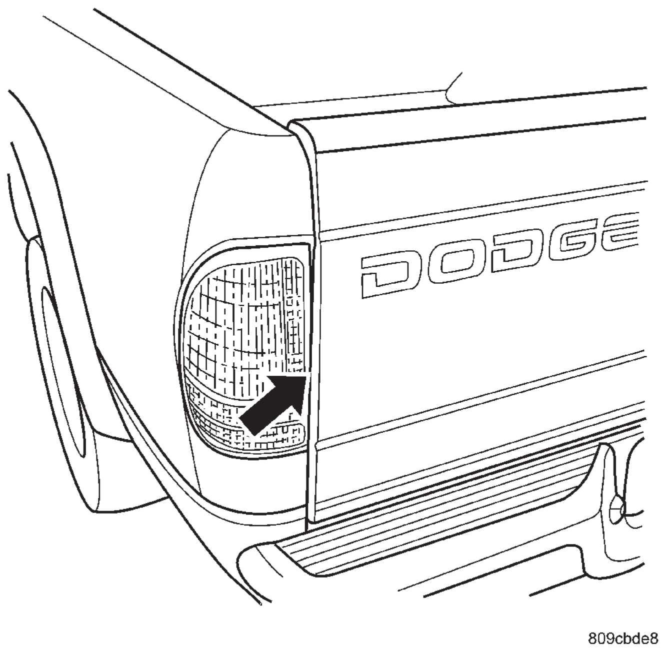

Fig. 14 Tailgate Fit and Alignment

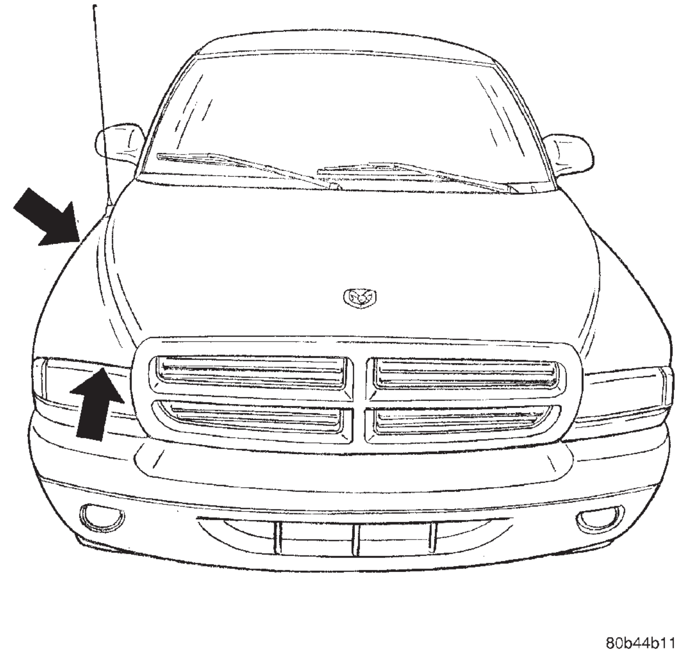

Fig. 15 Hood Fit and Alignment

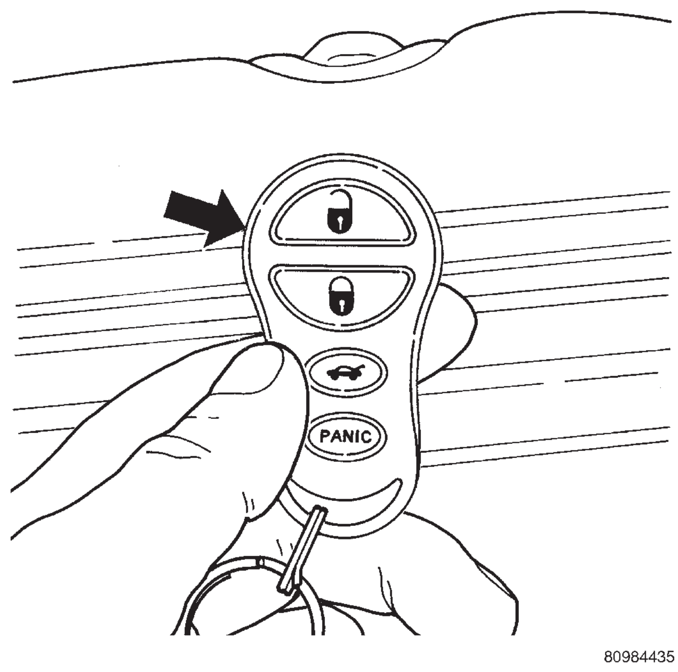

Fig. 16 Keyless Entry Transmitter

EXTERIOR (Continued)

INSPECTION - DOORS AND DOOR LOCKS

(1) Check operation of doors and locks, keyless entry, security alarm and tailgate (Fig. 20). Adjust strikers (Fig. 18) and latches (Fig. 17) as required.

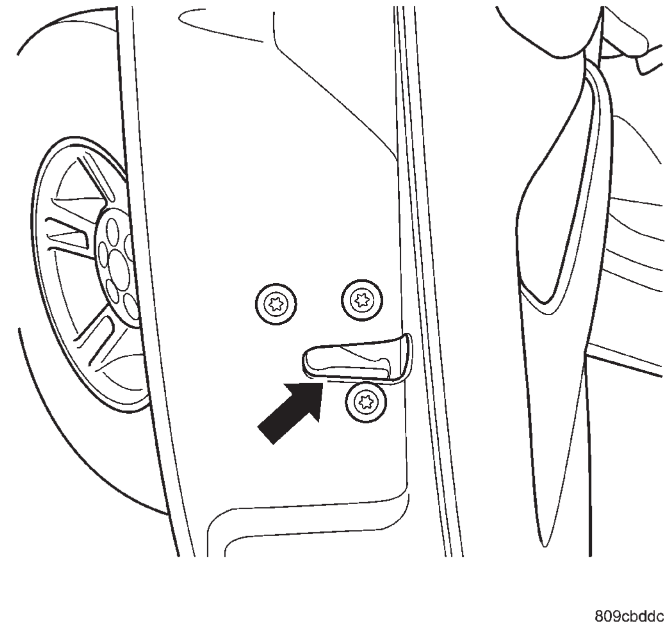

Fig. 17 DOOR LATCH

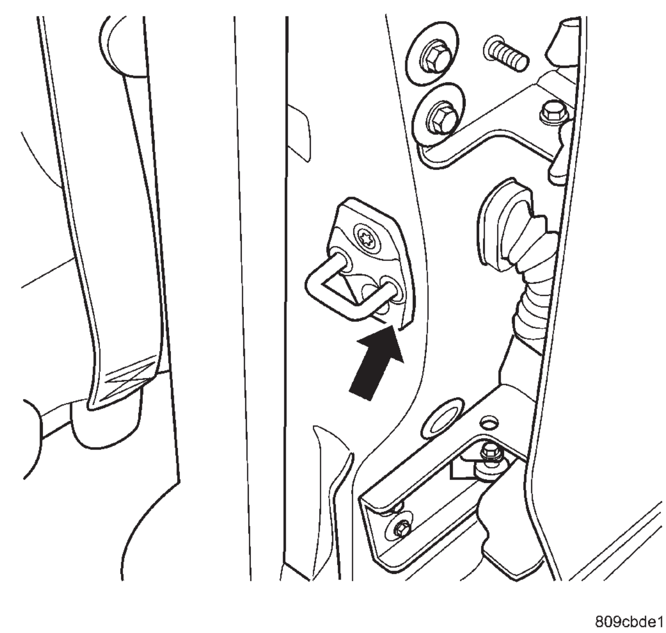

Fig. 18 DOOR STRIKER

(2) Check operation of childproof door locks, if so equipped (Fig. 19).

(3) Remove any protective covers from the door sills.

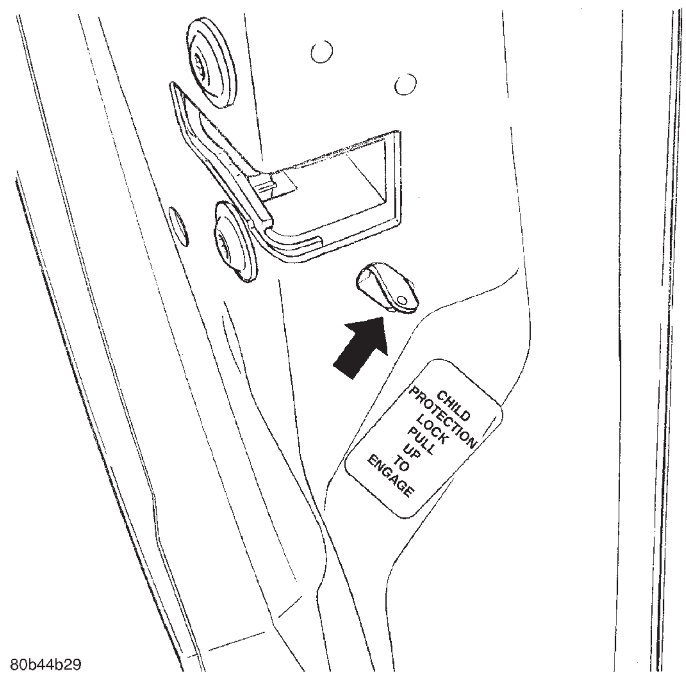

Fig. 19 CHILDPROOF DOOR LOCK SWITCH

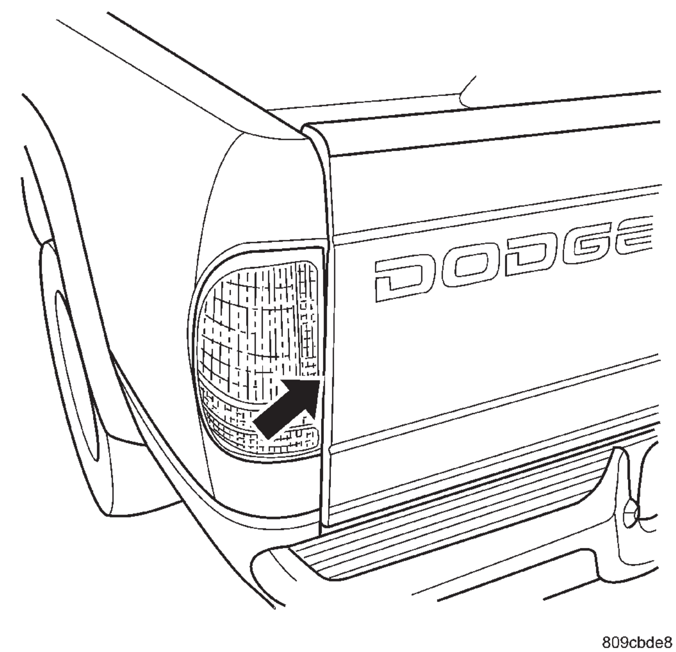

Fig. 20 Tailgate Operation

NOTE: Windows should be in the full up position during these tests (except for the lock tests).

- Open each door (inside and out) to check the release mechanism and ease of operation.
- Partially close the door to check the open-door detent.
- Close the door to check the latches and striker.
- Open the door, lower the window depress the lock plunger and close the door to check the lock.

EXTERIOR (Continued)

• Unlock each door (using both keys) to check lock and key operation.

NOTE: Child proof door locks should be disabled when delivered to the customer.

BODY INTERIOR

INSPECTION - COMPASS

NOTE: Set variance after calibration.

(1) Calibrate and set compass variance, if so equipped (use appropriate procedures in service information) (Fig. 21).

(2) Remove protective film from overhead console, if equipped.

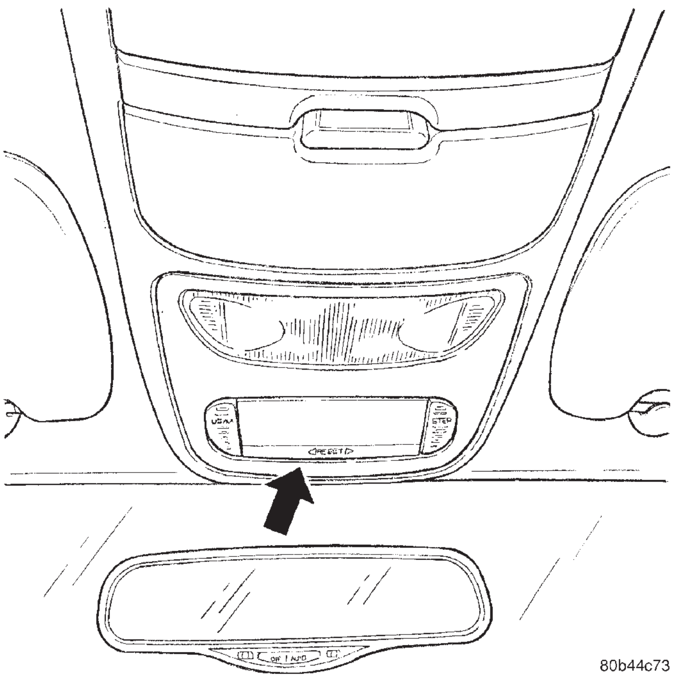

Fig. 21 COMPASS OPERATION

INSPECTION - FIT AND FINISH

(1) Remove any interior covers.

(2) Inspect the instrument panel, glove box door (Fig. 22) and interior moldings for even gaps and alignments.

(3) Check that the door panel material is clean, free from wrinkles and installed correctly.

(4) Check that the seat material is clean, secure and free of wrinkles.

(5) Check that the carpet is clean, secure and free of wrinkles.

(6) Check that the headliner is clean, free of lint and dirt smudges.

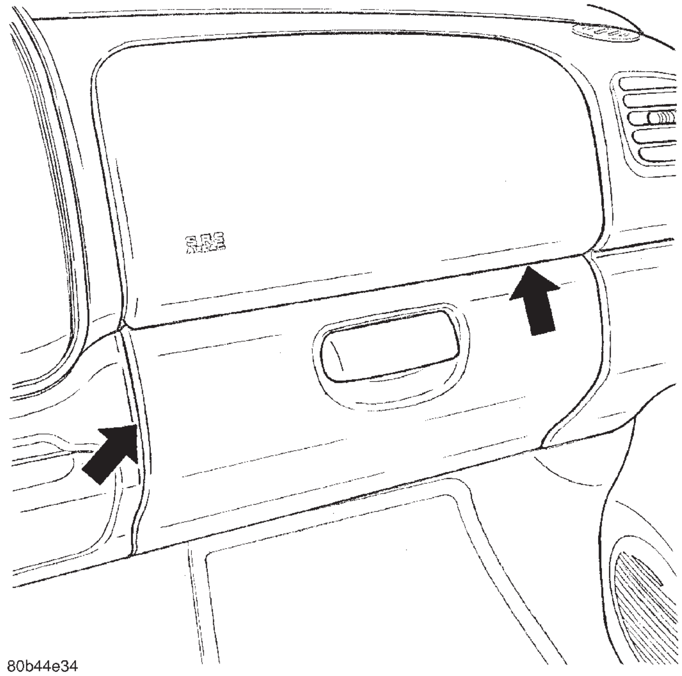

Fig. 22 GLOVE BOX DOOR FIT AND ALIGNMENT

INSPECTION - LIGHTS AND SWITCHES

(1) Remove protective film from all switch bezels.

(2) Operate and visually inspect all interior lights and switches, including:

- Dome/map lamps
- Vanity mirror lamps
- Glove box light
- Ashtray light
- Cigar lighter light
- All gauge lights
- Radio display
- Door-mounted lights, if equipped
- Illuminated entry system, if equipped

(3) Visually inspect and operate all exterior lights and their switches, including:

NOTE: Headlamp aim is preset during vehicle assembly.

- Headlights, including high beam, optical horn (“flash to pass”) and daylight running lamps (DRL’s) (Fig. 23)
- Tail/stop lamps (including center high-mounted stop lamp)
- Parking lights Turn signals Brake lights (including center high mounted stop lamp)
- Emergency flashers
- Fog/driving lights, if equipped
- Off-road or other lights, if equipped
- Cargo bed lights, if equipped (Fig. 24)

(4) Check ignition switch for proper operation in all positions (accessory, lock, on, start and off) (Fig. 25).

BODY INTERIOR (Continued)

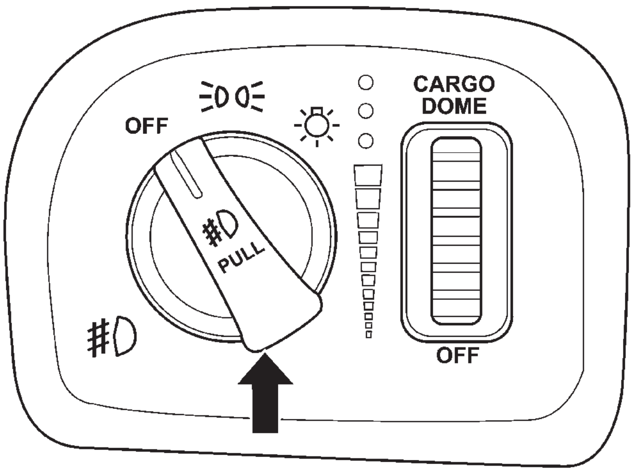

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Fig. 23 HEADLAMP SWITCH

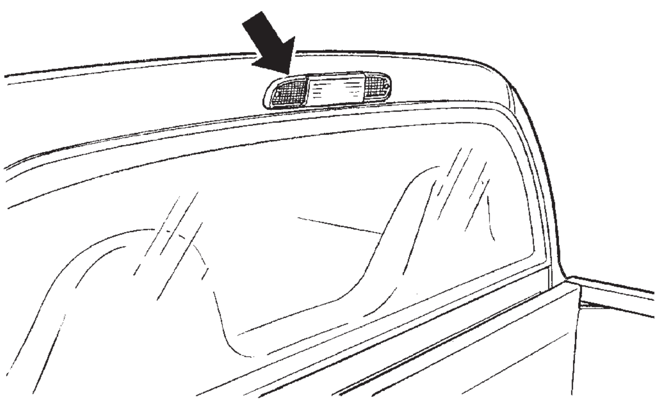

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Fig. 24 CARGO LIGHT

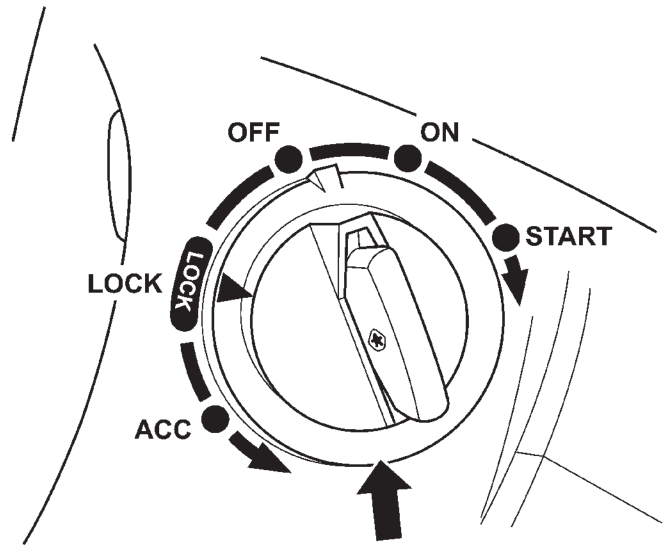

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Fig. 25 IGNITION SWITCH OPERATION

INSPECTION - SEAT BELTS, SHOULDER BELTS, RETRACTORS AND HEAD RESTRAINTS

(1) Inspect all seat belts and harnesses to ensure that they connect and hold properly.

(2) Inspect the condition of the belts and anchors.

(3) Inspect for proper seat belt retraction.

(4) Check that safety labels regarding the use of seat belts and air bags are in place (such as on the sun visors) (Fig. 26).

(5) Ensure head restraints are properly installed. Inspect the height adjustment for ease of operation.

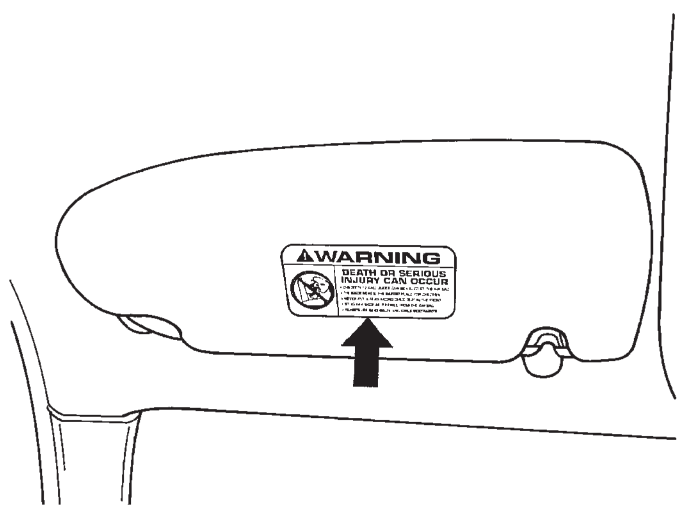

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Fig. 26 SEAT BELT / AIR BAG WARNING LABEL

BODY INTERIOR (Continued)

INSPECTION - SEATS

(1) Remove protective seat, carpet and door covers (if being delivered) where applicable.

(2) Check that manual/power seat adjustments work properly for all seats.

- Inspect the operation of front seat mechanical slides and power adjusters
- Check the seatback recliner for ease of release and operation
- Check the rear seatback latches for ease of release
- On fold-down rear seats, latch the rear seats and pull forward on the seats to check that the latches hold

(3) Check the seat heaters on vehicles equipped with heated seats.

(4) Check all seat headrests.

(5) Check that all seats are securely located in their adjustable tracks.

INSPECTION - WINDOWS, DOORS AND LOCKS

(1) Check all power window switches for proper operation (Fig. 27).

(2) Run all power or manually operated door, quarter and vent windows to the fully closed position to check operation and sealing.

(3) Check all power/manual door locks for correct operation (Fig. 27).

(4) Ensure that all doors open/close easily.

(5) Test the remote fuel door, if so equipped.

(6) Check that the glove box door opens/closes easily (Fig. 28).

(7) Check that the console door opens/closes easily (Fig. 29).

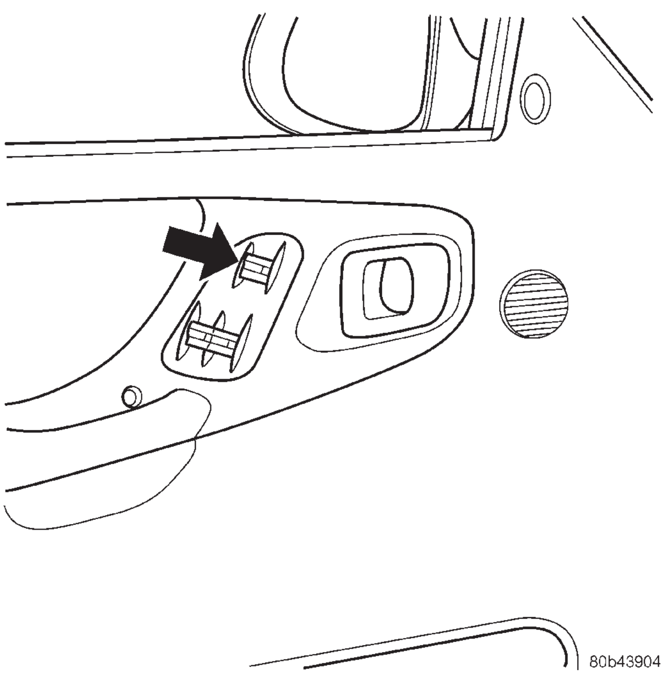

Fig. 27 POWER WINDOW AND LOCK SWITCHES

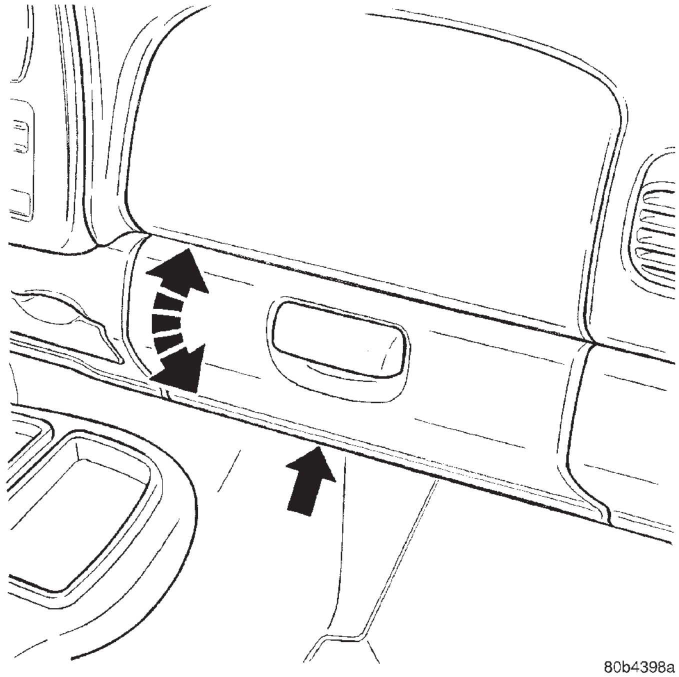

Fig. 28 GLOVE BOX DOOR OPERATION

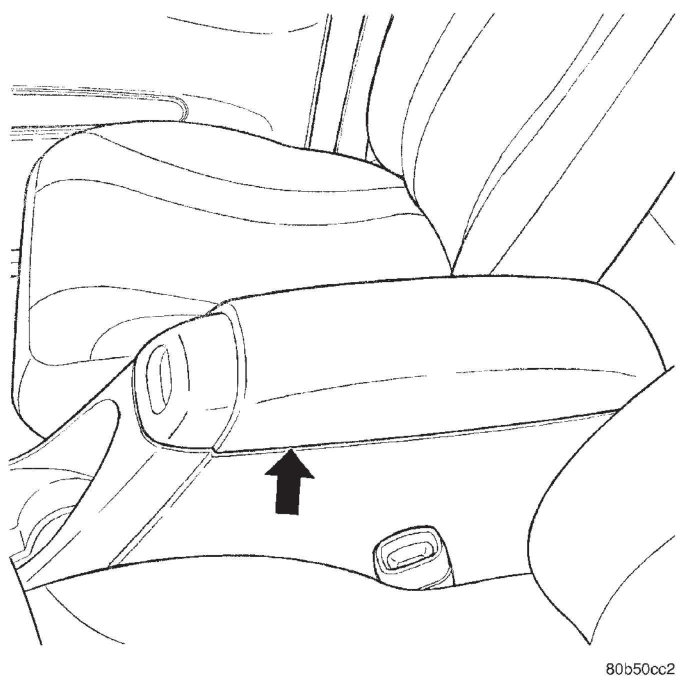

Fig. 29 CONSOLE DOOR OPERATION

BODY INTERIOR (Continued)

INSTALLATION - SHIPPED LOOSE ITEMS

(1) Install the antenna mast (Fig. 30).

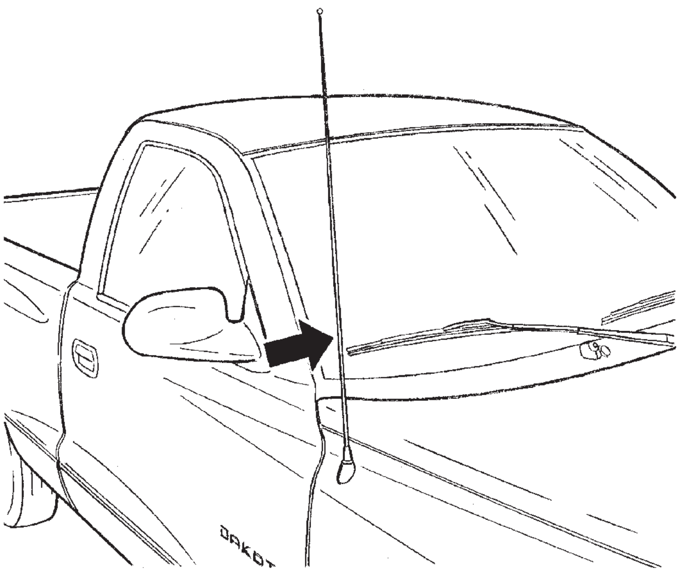

Fig. 30 ANTENNA MAST

(2) Install rear license plate holder and front license plate holder (if required).

(3) Install wheel covers (if required).

ROAD TEST

DESCRIPTION - ROAD TEST INSPECTION

The following items must be inspected during the road test portion of the new vehicle inspection.

- Check neutral safety switch operation
- Check operation of shift/clutch interlock system
- Check operation of gauges and warning lights
- Check horn operation
- Check operation of turn signals and emergency flashers
- Check all mirror adjustments, including day/night function
- Check windshield wipers for proper wipe pattern and intermittent mode (if equipped)
- Check washer spray pattern
- Check heater, defroster and air conditioning for proper operation
- Check that the fan operates quietly
- Check the rear window defroster (if equipped)
- Leave air selection lever in the fresh air position
- Check the rear heater and air conditioning for proper operation
- Check the rear air register locations
- Check that the indicator lamps operate properly
- Check the operation of the radio, cassette and/or compact disc player, and that sound quality is good
- Ensure that the clock displays the correct time
- Check that the trip computer/maintenance reminder operates in all modes
- Check all speed control functions
- Check the service brakes to ensure that they stop the vehicle in a straight line, without noise, shudder or vibration
- Check the brake warning light
- Check the parking brake operation
- Check the engine's performance
- Check the transmission's performance for smooth, quiet operation. If the vehicle is a 4x4, check that the transfer case shifts easily among all ranges
- Check Autostick function (if equipped)
- Check the vehicle's steering and handling
- The steering wheel should be centered when traveling in a straight line
- The vehicle should not pull or vibrate
- Check for squeaks, rattles and wind noise
- Check any other vehicle aspects you believe are important, but that may not be included on the New Vehicle Preparation Form
- Fill fuel tank with specified grade of fuel

INSPECTION - FUEL

Fill fuel tank with specified grade of gasoline (regular, midgrade or premium).

INSPECTION - OTHER

As part of DaimlerChrysler's Customer One philosophy, the "Other" blank is provided on the New Vehicle Preparation Form. This is designed to encourage you to check any aspects of vehicle operation that you believe are important to your customers, but that do not appear elsewhere on the form.

INSPECTION - SQUEAKS, RATTLES AND WIND NOISE

(1) Make sure that the instrument panel, glove box, seats, steering wheel and column are free from squeaks and rattles. Tighten any obvious loose fasteners.

(2) Check that the windows and doors are free from squeaks, rattles and wind noise.

(3) Check that the vehicle exterior is free from squeaks, rattles and noise, front and rear.

(4) Make sure that all interior panels are free from squeaks and rattles.

INSPECTION - STEERING AND HANDLING

(1) Check that the power assist works properly (if equipped). Steering should not require excessive effort.

ROAD TEST (Continued)

(2) Make sure the steering wheel does not vibrate at idle or road speed.

(3) Ensure that the steering wheel is centered when traveling straight ahead.

(4) Check that the vehicle does not drift to one side.

(5) Make sure that the vehicle does not vibrate/ shake.

INSPECTION - TRANSMISSION/TRANSFER CASE

AUTOMATIC TRANSMISSION

(1) Make sure that the park lock holds the vehicle With the vehicle on a grade, put automatic transmission in PARK and slowly release the service brake to see if park lock holds. If it does not hold, the transmission requires further service.

(2) Make sure shift lever operates easily/smoothly (Fig. 31).

Check for smooth shifting. Check for proper upshifting and downshifting.

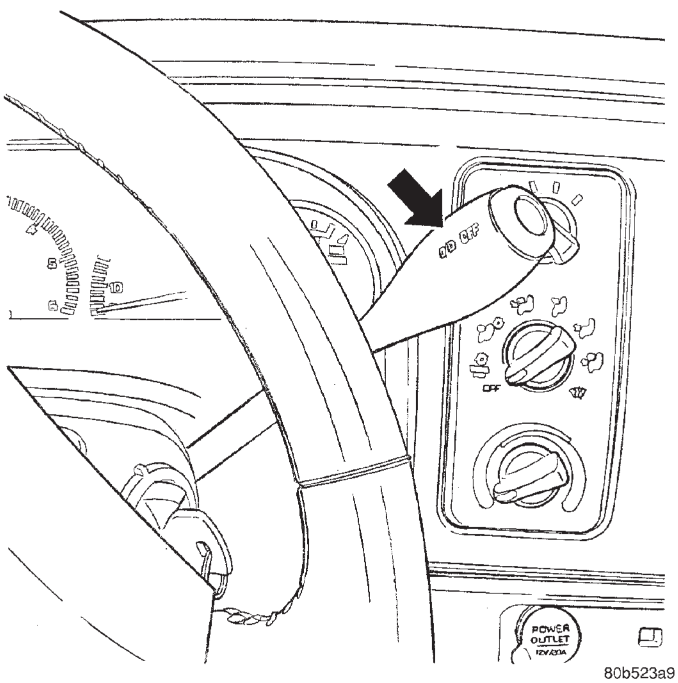

Fig. 31 AUTOMATIC TRANSMISSION RANGE SLECTOR

MANUAL TRANSMISSION

(1) Check that the shifter operates easily (Fig. 32).

(2) Make sure that the clutch operates smoothly.

(3) Look for proper synchronization.

The gears should not grind.

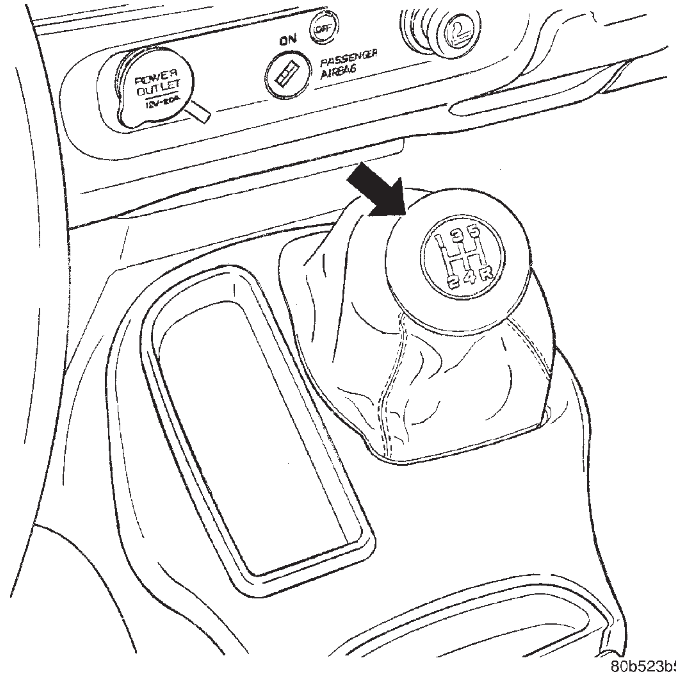

Fig. 32 MANUAL TRANSMISSION RANGE SLECTOR

4X4 TRANSFER CASE

(1) Shift the transfer case (Fig. 33) through all ranges to make sure shifting is smooth and all gear positions respond accordingly.

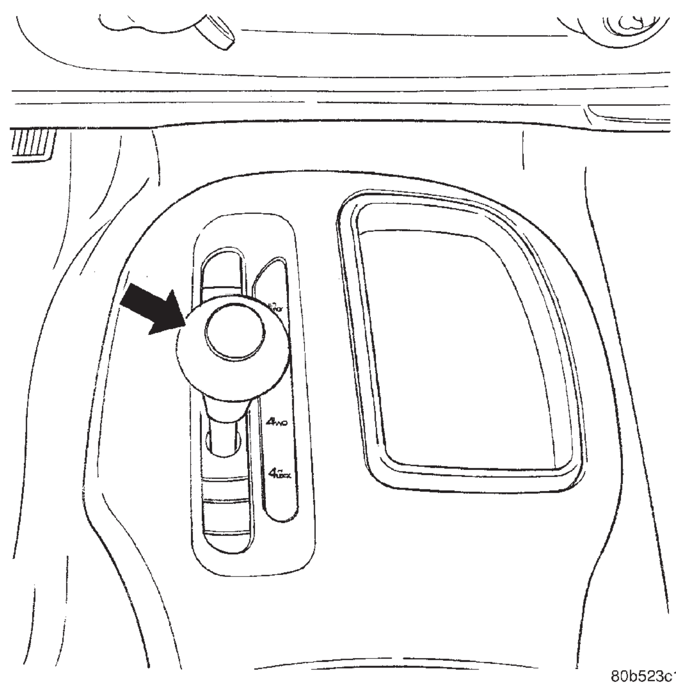

Fig. 33 TRANSFER CASE SLECTOR

ROAD TEST (Continued)

INSPECTION - ENGINE PERFORMANCE

Check the engine for proper performance. It should:

- Start promptly
- Be free from stalling
- Idle smoothly and at proper speed
- Be free from stumbling or hesitation
- Produce sufficient power
- Be free from unusual noises
- Operate within the proper temperature range
- Stop when the ignition key is shut off

INSPECTION - PARKING BRAKE

(1) Ensure that the parking brake is easy to operate (Fig. 34).

(2) Make sure the parking brake does not drag.

(3) With the vehicle stopped on a grade, firmly apply the service brakes, place the transmission in NEUTRAL and set the parking brake. Slowly release the service brakes to see if the parking brake will hold.

(4) Check that the parking brake warning light comes on when the parking brake is applied, and is off when the brake is released.

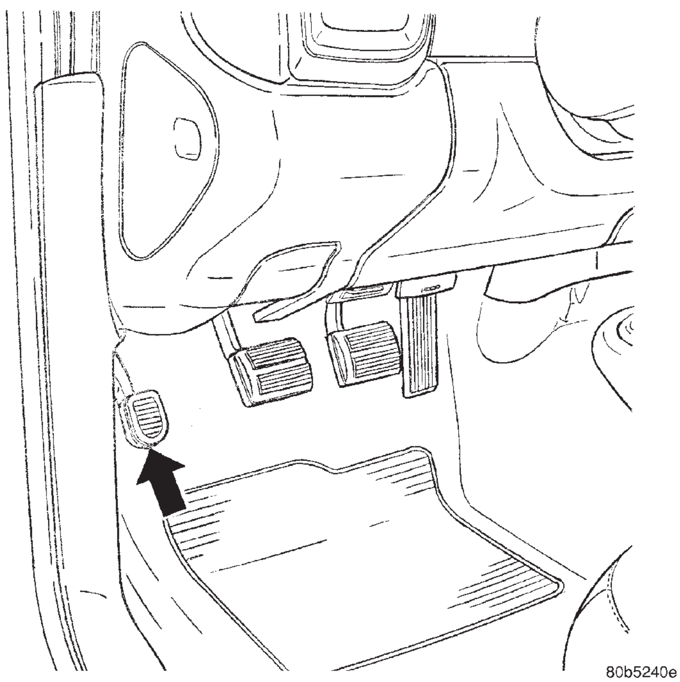

Fig. 34 PARKING BRAKE

INSPECTION - SERVICE BRAKES

(1) Check brake warning light operation at vehicle startup.

(2) Check ABS warning light operation at vehicle startup.

(3) Inspect service brake pedal travel and feel (Fig. 35).

(4) Put the vehicle in gear and apply the brakes while the car is in motion. Be sure brake operation is smooth and positive.

(5) Make sure that the vehicle stops in a straight line, without pulling to one side.

(6) Check that the brakes operate quietly, without noise.

(7) Ensure there is no shudder or vibration when braking.

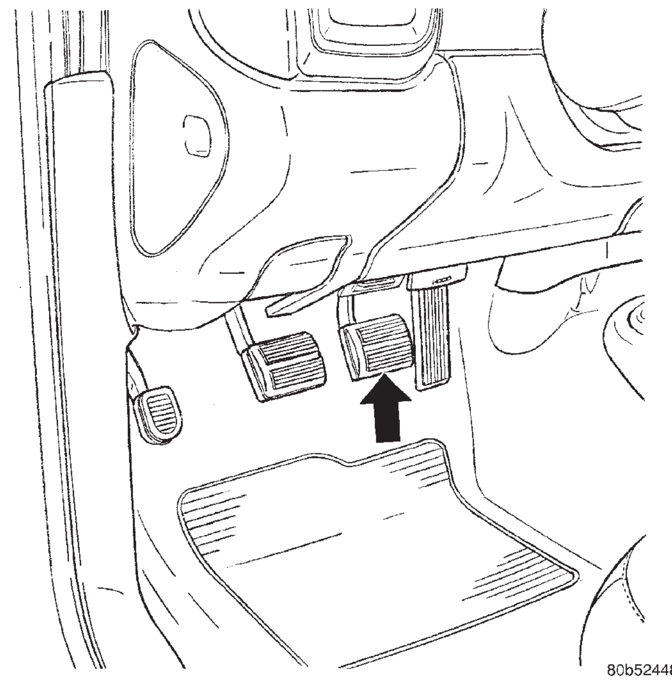

Fig. 35 SERVICE BRAKE

INSPECTION - SPEED CONTROL

Check the following speed control functions (Fig. 36):

- Check on/off switch
- Check “set” operation
- Check “resume” function
- Check “accelerate” and “decelerate” functions
- Check brake release function
- Check “cancel” function

ROAD TEST (Continued)

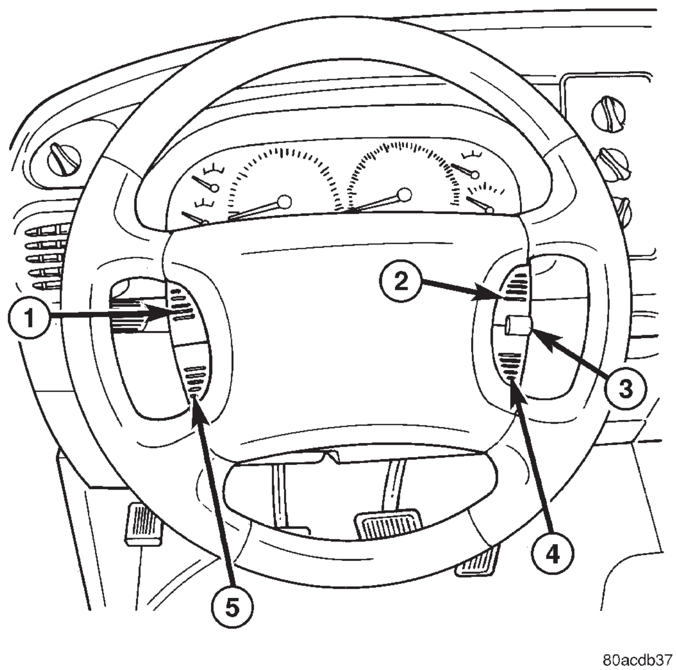

Fig. 36 SPEED CONTROL SWITCHES

1 - ON/OFF SWITCH
2 - ACCELERATE/RESUME SWITCH
3 - CANCEL SWITCH
4 - COAST SWITCH
5 - SET SWITCH

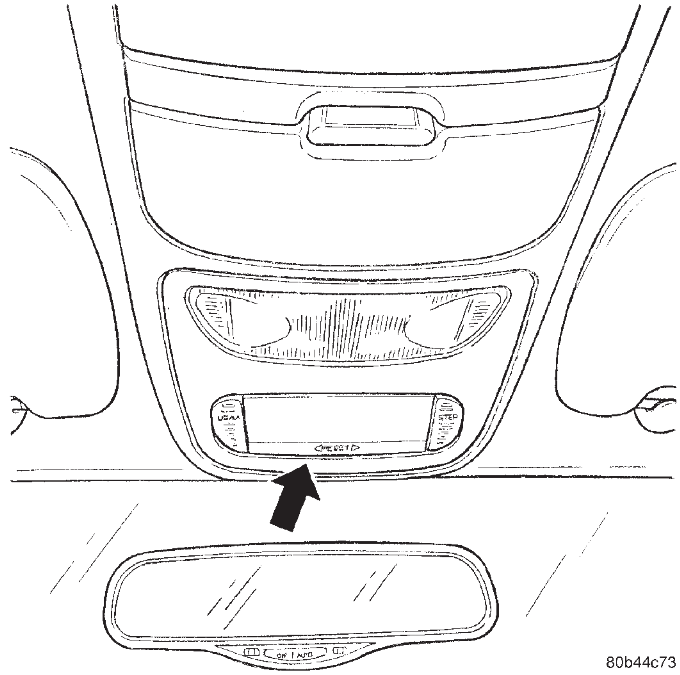

Fig. 37 TRIP COMPUTER OPERATION

INSPECTION - TRIP COMPUTER/ MAINTENANCE REMINDER

NOTE: Reset the average fuel economy when the road test is complete.

Check that all modes operate correctly (Fig. 37).

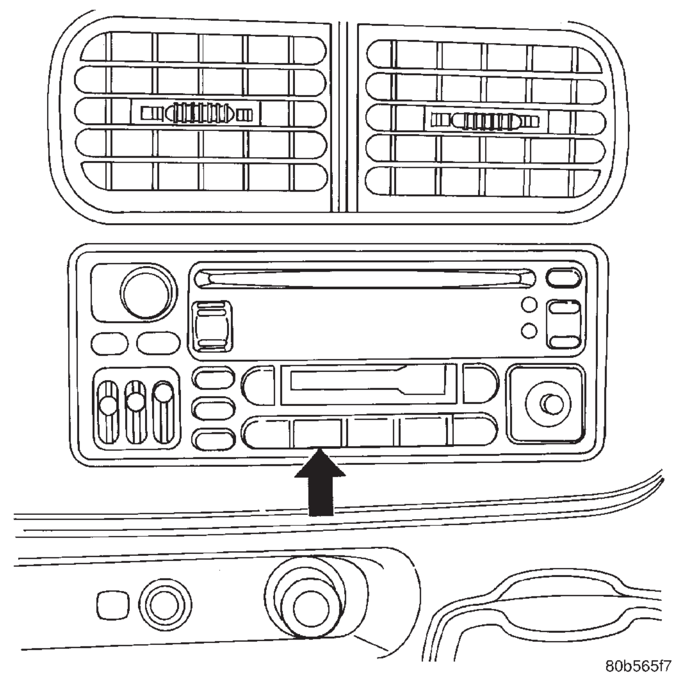

Fig. 38 RADIO OPERATION

INSPECTION - RADIO

(1) Check for good AM/FM reception (Fig. 38).
(2) Check for good AM/FM reception.
(3) Ensure that the cassette and/or compact disc (CD) player works properly.
(4) Check for good sound quality from all speakers.
(5) Ensure that the radio displays the correct time.
(6) Check the steering wheel controls (if equipped).

INSPECTION - HEATER/AIR CONDITIONER

(1) Check that heater/defroster works properly (Fig. 39).
(2) Turn on the heater when the engine reaches operating temperature.
(3) Operate the blower motor in all speeds (Fig. 39).
(4) Operate system in all modes (heat, defrost, etc.).
(5) Operate the rear heater (if equipped).
(6) Check for hot air output at all outlets.
(7) Operate temperature switch (Fig. 39).
(8) Ensure that rear defroster works.
(9) Turn on rear defroster during drive, then feel window for warmth after drive.
(10) Check that the air conditioner cools properly.
(11) Turn on air conditioning system.
(12) Activate the A/C in all modes. (Make sure all modes work properly including rear unit if equipped.).
(13) Operate blower motor switch at all speeds (Fig. 39).
(14) Check for cold output at outlets.
(15) Check that fan operation is quiet.

ROAD TEST (Continued)

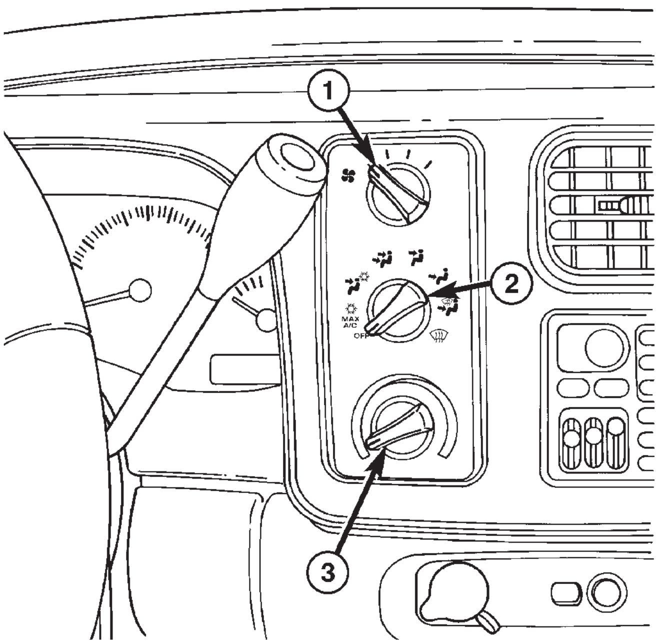

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Fig. 39 HEATER AND A/C CONTROLS

1 - FAN SPEED CONTROL SWITCH
2 - MODE CONTROL SWITCH
3 - TEMPERATURE CONTROL SWITCH

INSPECTION WINDSHIELD WIPERS/WASHERS

(1) Check washer spray pattern for proper operation and aim.

(2) Check intermittent wipe feature for proper operation.

(3) Inspect wiper blades, check for proper wiping pattern-no streaking or missed areas (Fig. 40).

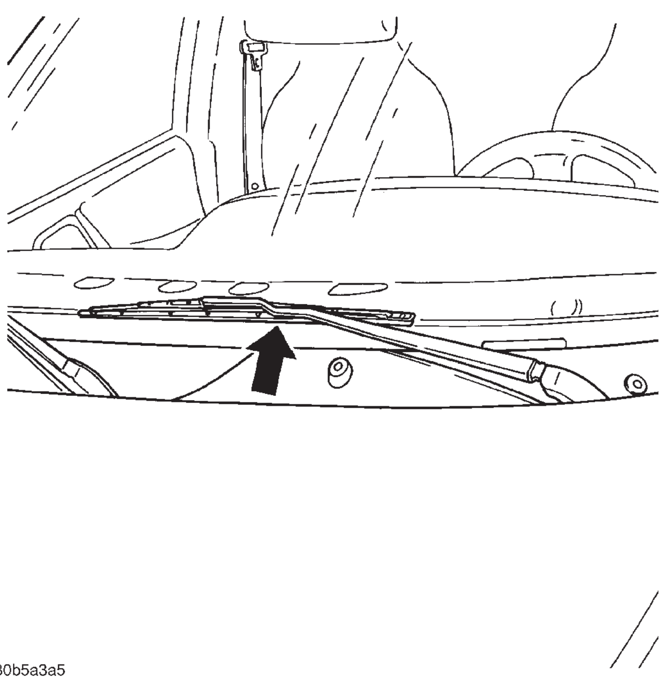

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Fig. 40 WINDSHIELD WIPER AND ARM

INSPECTION - MIRROR

(1) Check operation of rearview mirror's day/night function (if equipped).

(2) Check ease of adjustment for all mirrors (power or manual) (Fig. 41) and (Fig. 42).

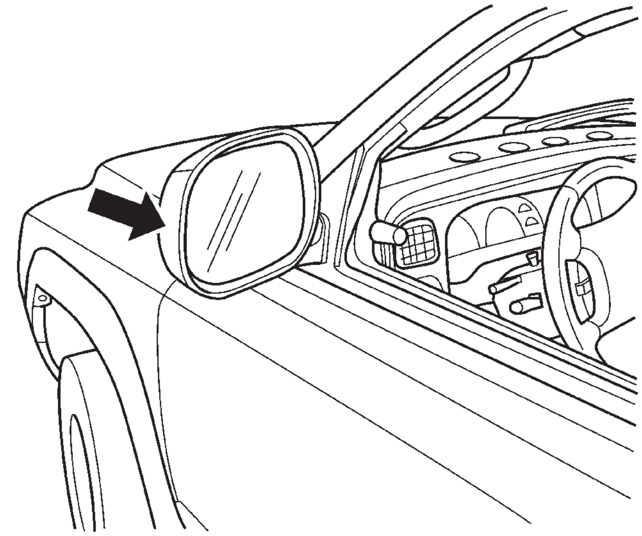

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Fig. 41 DOOR MOUNTED REAR VIEW MIRROR

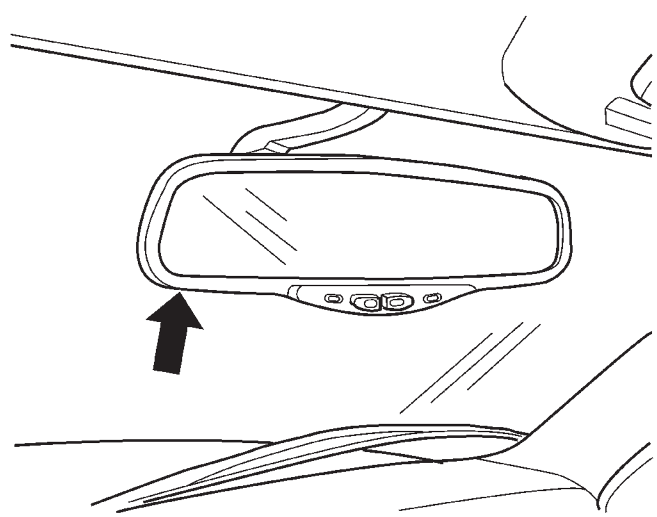

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Fig. 42 INTERIOR REAR VIEW MIRROR

ROAD TEST (Continued)

INSPECTION - TURN AND EMERGENCY SIGNALS

(1) Ensure that the turn signals work properly (including canceling after completing a turn) (Fig. 43).

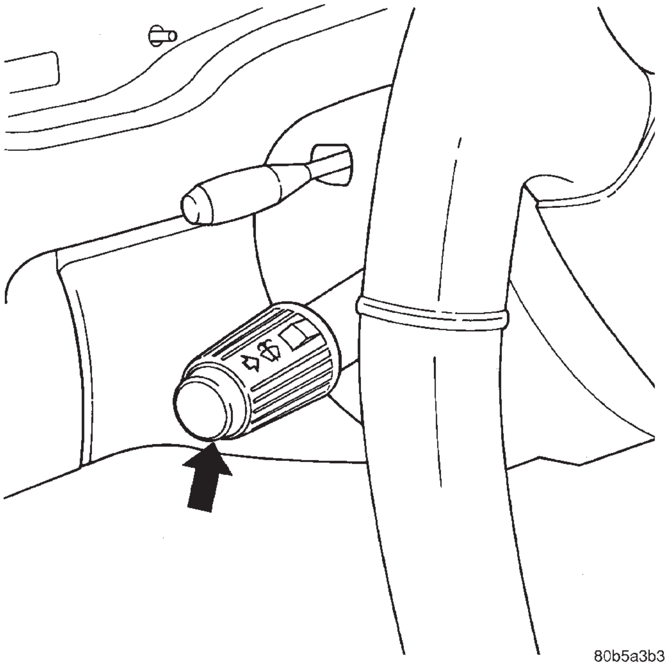

Fig. 43 TURN SIGNAL SWITCH

(2) Ensure that the emergency flashers work properly (Fig. 44).

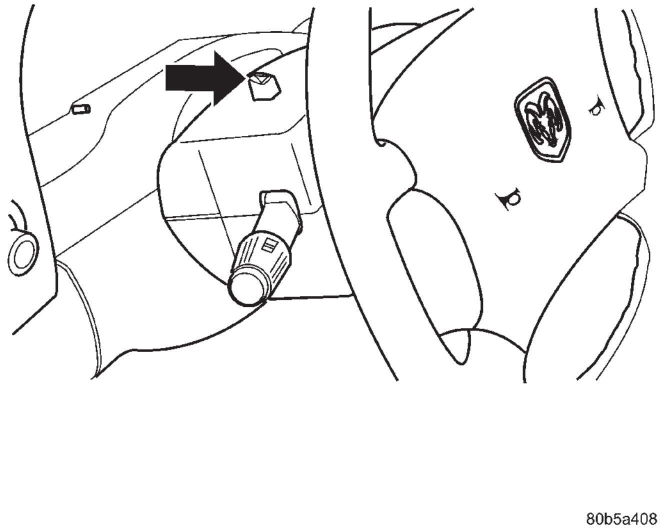

Fig. 44 EMERGENCY LAMP SWITCH

INSPECTION - HORN

Ensure that the horn works properly.

INSPECTION - GAUGES/WARNING LIGHTS

(1) Ensure that all gauges, instrument indicator lights, warning lights and instrument panel lights are functioning properly (Fig. 45).

(2) Inspect operation of message center (if equipped).

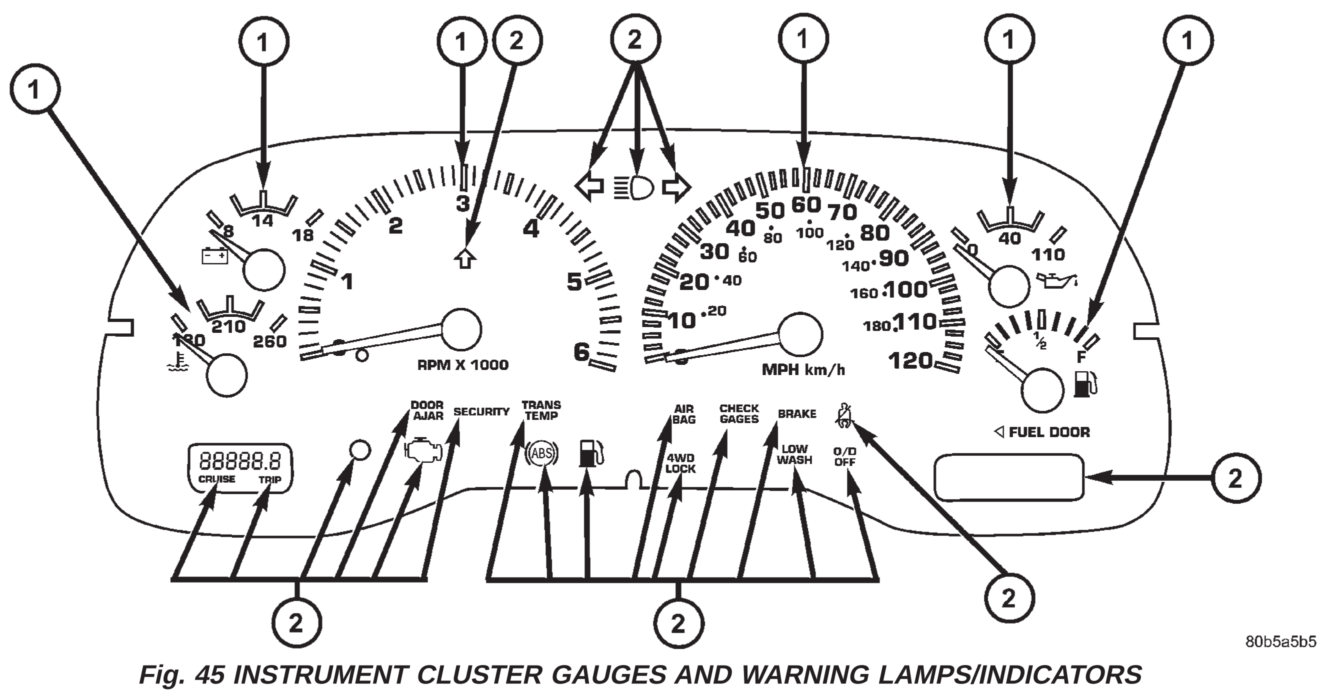

Fig. 45 INSTRUMENT CLUSTER GAUGES AND WARNING LAMPS/INDICATORS

1 - GAUGES
2 - WARNING / INDICATOR LAMPS

ROAD TEST (Continued)

INSPECTION - SHIFT/CLUTCH INTERLOCK SYSTEM

(1) On vehicles with a manual transmission or transaxle, be sure engine starts only when clutch is depressed.

(2) Some vehicles equipped with an automatic transaxle also have a brake interlock system. On these vehicles, be sure that you cannot shift out of PARK without pressing the brake pedal.

INSPECTION - NEUTRAL SAFETY SWITCH

(1) On vehicles with an automatic transmission or transaxle, check shift indicator alignment in all ranges.

(2) Be sure the engine starts in both PARK and NEUTRAL.

(3) Verify that the engine does not start in any REVERSE/DRIVE positions.

PRE-DELIVERY STORAGE

DESCRIPTION

Pre Delivery Storage information is provided to recommend practices to use when storing new vehicles prior to delivery to the customer.

If you have prepared a vehicle that will not be immediately delivered to the customer, store the vehicle according to guidelines outlined in (Refer to 30 - NEW VEHICLE PREP/PREDELIVERY STORAGE - STANDARD PROCEDURE) to prevent unnecessary wear and tear on the vehicles electrical systems, paint and finish and damage due to pilferage and vandalism.

STANDARD PROCEDURE - PRE-DELIVERY STORAGE

(1) If possible, store vehicles indoors, in clean, dry places. If vehicles must be stored outdoors:

- Try to avoid storage locations that are near any obvious sources of industrial or environmental contamination (e.g., trees, factories, steam or vapor vents, railroad tracks, etc.)
- Maintain tight security to help prevent pilferage and vandalism, and inspect each vehicle regularly to check for such damage
- If the vehicle must be parked on an incline, park it with the front end higher than the rear; this will prevent “hydrostatic lock” caused by fuel draining into the engine
- Rinse the vehicle at least once a week. Snow should be washed away more often, since it can trap harmful contaminants. Dry all horizontal surfaces

(2) The IOD fuse should be removed in order to prevent battery drain and possible damage.

(3) Check the vehicle’s coolant and anti-freeze protection.

(4) Check the vehicle’s battery at least once a month for a proper charge (at least 12.4 volts). Charge the battery if necessary. This will help prevent freezing and deterioration.

(5) Check the vehicle’s tires and inflate them to their maximum recommended levels. Move the vehicles periodically to avoid “flatspotting” the tires.

(6) Do not engage the parking brake; keep it in the OFF position.

(7) Keep all windows closed, all doors locked, and all trim covers intact and in place.

(8) Do not use chalks, crayons or any marker containing abrasives on painted, plated or glass surfaces.

(9) Always use seat covers when moving a vehicle.

PROGRAMMABLE ELECTRONIC FEATURES

DESCRIPTION

The programming of electronic features applies to specific DaimlerChrysler Corporation vehicles. Not all vehicles are equipped with these electronic features, and not all vehicles equipped with electronic features have all the available features. Programmable electronic features are subject to change and may be added or deleted from specific vehicle models.

(1) The programmable electronic features that may be provided on the vehicle are:

- Rolling Power Door Locks
- Horn Chirp (When Doors Locked With Remote Keyless Entry)
- Headlamp Flash (When Doors Locked or Unlocked With Remote Keyless Entry)
- Low Fuel Chime
- Remote Keyless Entry Door Unlock Sequence
- Headlights On Automatically With Wipers
- Turn Signal Chime
- 12V Power Outlet
- Remote Unlock
- Remote Linked To Memory
- Headlamp Delay
- Service Interval
- Easy Exit Seat

(2) Programming any of the above features is to be performed prior to vehicle delivery to the customer, depending on customer preference.

PROGRAMMABLE ELECTRONIC FEATURES (Continued)

NOTE: For all vehicles except Caravan/Town and Country, the programming must be performed using the DRB III® scan tool. On Caravan/Town and Country vehicles the features can be programmed using the DRB III® scan tool or by button pushing sequences. The customer can perform programming, if desired, by following the instructions outlined in the owner manual.

OPERATION

NOTE: The programmable features provided on vehicles need to be explained to the customer at the time of sale. The customer's preferences concerning the features should be noted and programmed accordingly during predelivery.

NOTE: When using the DRB III® scan tool to enable/disable any programmable electronic features, go to the main menu item #9 on the DRB III® scan tool. This is "Customer Preferences". You must choose "Customer Preferences" on the main menu to program the desired features.

ROLLING POWER DOOR LOCKS

With this feature enabled, the vehicle's door locking mechanisms automatically lock when the vehicle reaches approximately 24 Km/h (15 mph).

HORN CHIRP

NOTE: This feature can be enabled with or without the headlamp flash feature.

The horn chirp function is a feature that can be enabled or disabled on vehicles equipped with Remote Keyless Entry (RKE). The horn chirps when the vehicle is locked with the RKE transmitter.

HEADLAMP FLASH

NOTE: This feature can be enabled with or without the horn chirp feature.

The headlamp flash function is a feature that can be enabled or disabled on vehicles equipped with Remote Keyless Entry (RKE). The headlamps flash once when the vehicle is locked with the RKE transmitter, and flash twice when the vehicle is unlocked with the RKE transmitter.

LOW FUEL CHIME

All vehicles equipped with the audible low fuel chime are shipped with this feature enabled.

REMOTE KEYLESS ENTRY (RKE) DOOR UNLOCK SEQUENCE

Two door unlock sequences are provided on vehicles equipped with this feature. When using the RKE transmitter to unlock the doors, pressing the unlock button once when the feature is enabled unlocks only the driver's door. Pushing the RKE transmitter unlock button a second time unlocks the remaining doors. When the RKE door unlock feature is disabled, all doors unlock with one press of the RKE transmitter unlock button.

HEADLIGHTS ON AUTOMATICALLY WITH WIPERS

This feature appears on vehicles that have, as an option, automatic headlights. When the windshield wipers are turned on, the headlights automatically turn on.

12V POWER OUTLET

This feature currently appears on Caravan/Voyager/Town and Country vehicles. The vehicles are shipped with the 12V power outlets turned off with the ignition key. The relay can be changed to make the outlets powered at all times. This feature may be of interest to customers with cell phones.

TURN SIGNAL CHIME

This feature is an audible turn signal warning chime. The chime sounds if the turn signal is on, the vehicle has traveled one mile and vehicle speed has exceeded 40 Km/h (25 mph).

REMOTE UNLOCK

The remote unlock function is a feature that can be enabled or disabled on vehicles equipped with Remote Keyless Entry (RKE). With the first press of the RKE transmitter to unlock the doors, the driver's door only unlocks. With the second press of the RKE transmitter, the remaining doors and the liftgate unlock. With the remote unlock feature enabled, the first press of the RKE transmitter unlocks all doors.

REMOTE LINKED TO MEMORY

The remote linked to memory function is currently only available only on Jeep Grand Cherokee Limited vehicles. When enabled, this feature recalls a memory of seats, mirror and radio presets and positions when unlocking the vehicle with the RKE transmitter.

HEADLAMP DELAY

Currently available only on Jeep Grand Cherokee vehicles, the headlamp delay timeout can be set to 30, 60 or 90 seconds. This timeout only occurs when the ignition is turned off prior to turning the head-

PROGRAMMABLE ELECTRONIC FEATURES (Continued)

lamps off, or when leaving the headlamps in AUTO mode.

SERVICE INTERVAL

Currently available only on Jeep Grand Cherokee vehicles, the interval for the service reminder message can be set from 3,219 kilometers to 12,070 kilometers (2,000 miles to 7,500 miles).

EASY EXIT SEAT

Currently available only on Jeep Grand Cherokee Limited vehicles, the driver's seat will reposition 55mm (2.1 inches) rearward, or the end of travel if less than 55mm (2.1 inches) and full downward when the key is removed from the ignition. This feature allows ease of exiting the vehicle. The seat will reposition itself to the memory location when the vehicle is unlocked using the RKE transmitter or by pressing the memory buttons on the door panel.

APPEARANCE TIPS

CLEANING

(1) Before delivering the new vehicle to the customer, the following checks on appearance details are recommended:

- Wash the vehicle to remove all traces of road grime and other dirt on the car from new vehicle preparation operations
- Clean the tire sidewalls
- Clean exterior and interior glass surfaces
- Remove all protective covers
- Remove undercoat overspray, excess window sealer, and excess weatherstrip adhesive
- Inspect interior trim, seats, carpeting, and moldings. Clean as necessary
- Remove shipping and inspection stickers
- After the vehicle is clean, inspect the paint again

(2) Mopar® offers a wide variety of car care products, developed to meet your dealership's requirements. All are specifically formulated for DaimlerChrysler vehicles

FINAL STEPS

STANDARD PROCEDURE - NEW VEHICLE PREPARATION FORM

Complete the Emission Certification Of Conformity Statement on the bottom of the New Vehicle Preparation Form (Fig. 1) in the glove box or storage box after it has been completed and signed by the designated individual.

STANDARD PROCEDURE - OWNER CHECK OUT

The last step in the new vehicle preparation procedure is to help the customer become familiar with the features on their new vehicle. Show the new owner where the controls and gauges are and explain how they operate.

INSPECTION - INFORMATION LABELS

Verify that the following labels are installed and legible.

- Emission control labels
- Monroney label
- Tire pressure label
- Vehicle certification label

Description	Group-Page

Description	Group-Page

Description	Group-Page

SERVICE MANUAL COMMENTS

What features do you find most useful? ____________________

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What errors have you found? Please include page number. ____________________

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What topics are hard to locate, confusing, or not covered completely? ____________________

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What comments or suggestions do you have? ____________________

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Your Name: ____________________ Dealership: ____________________

Address: ____________________

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Manual Name, Year and Number: ____________________

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NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED
STATES

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 124 CENTER LINE, MI

POSTAGE WILL BE PAID BY ADDRESSEE

DaimlerChrysler Corporation
Dealer Technical Operations
800 Chrysler Drive
CIMS 486-02-76
Auburn Hills, MI 48326-2757

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